SERVICE MANUAL

Exhaust Aftertreatment System with DPF and SCR

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Navistar, Inc.

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Summary of Changes

Section	Change
Section 2.5	Added DPF general inspection procedure.
Section 2.6	Added DOC general inspection procedure.
Section 2.7	Added DPF / DOC sensor thread repair procedure.
Section 2.11	Added DEF supply module filter inspection procedure.
Section 2.12	Added DEF system contamination identification procedure.
Section 2.13	Added DEF system decontamination procedure.
Section 2.15	Added reuse guidelines for DEF dosing system components.
Section 3.1	Added operating instructions for DEF refractometer tool.

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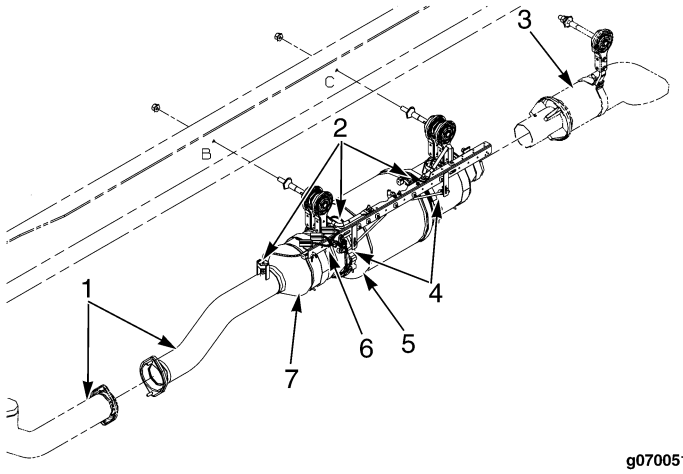
1. DESCRIPTION

NOTE – This manual is intended to be used for general instructions on exhaust aftertreatment systems and removal / installation procedures for diesel particulate filters (DPF), selective catalyst reduction (SCR) systems, and diesel exhaust fluid (DEF) systems. Refer to the applicable engine diagnostic service manual for specific system inspection and diagnostic procedures.

For 2010 vehicles, the Environmental Protection Agency requires a 50% reduction in emissions of nitrogen oxides and a 90% reduction in particulate matter. Oxides of nitrogen are created by the high temperature and speed of combustion. Once in the atmosphere, nitrogen oxide emissions result in ground-level ozone formation and smog. Emission particulates include unburned fuel and lube oil (liquid hydrocarbons), carbon soot from incomplete combustion (main contributor to smoke), water from combustion, and sulfur compounds from the fuel and lubrication oil.

To comply with these new regulations, many changes were made to truck specifications, including ultra-low sulfur diesel fuel, the engine, engine oil, vehicle design, and the exhaust system. The new exhaust system treats the engine exhaust and is referred to as an exhaust aftertreatment system. Stainless-steel tubing, used for heat and corrosion resistance, must be used throughout the system.



1. Turbo pipe
2. Temperature sensor (3)
3. Tailpipe / temperature control device
4. Pressure sensor port (2)
5. Diesel Particulate Filter (DPF)
6. Sensor junction box
7. Diesel Oxidation Catalyst (DOC)

Figure 1 Typical 2010 Exhaust System.

The main components of the exhaust aftertreatment system consist of the turbo pipe, Diesel Oxidation Catalyst (DOC), Diesel Particulate Filter (DPF), temperature control device, temperature sensors, pressure sensors, sensor junction box, and wiring.

Exhaust aftertreatment system configurations are categorized by engine type and the horizontal or vertical orientation of the DPF and tailpipe. For example, when the DPF is mounted horizontally and the tailpipe is mounted vertically, it is referred to as a Horizontal / Vertical system.

Diesel Oxidation Catalyst (DOC): The DOC oxidizes carbon monoxide and hydrocarbons and converts nitrogen oxide to nitrogen dioxide for regeneration.

DESCRIPTION

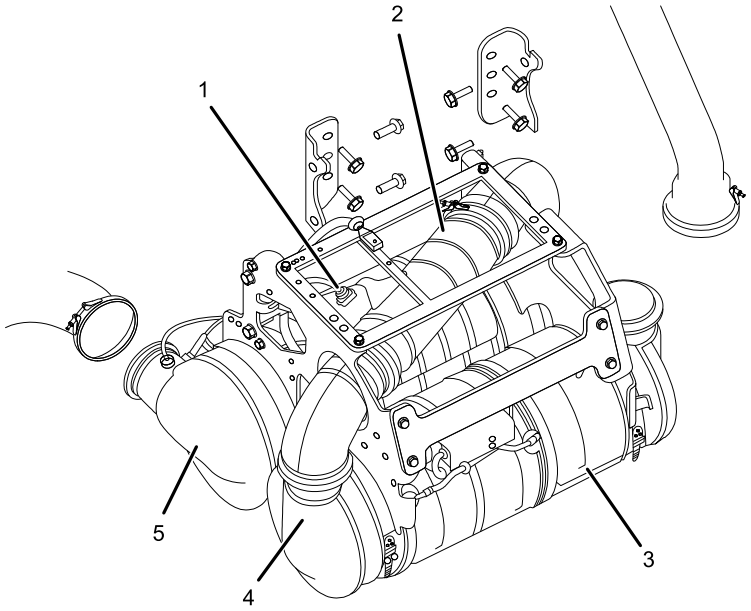
Diesel Particulate Filter (DPF): The DPF is a porous ceramic filter, housed in stainless – steel, that replaces the muffler. Alternate channels of the filter are plugged, forcing the exhaust gas to flow through the porous wall, capturing the soot particles. The DPF burns soot with oxygen and nitrogen dioxide and catches the ash from burnt oil. The exhaust aftertreatment system monitors the efficiency of the DPF. A self-cleaning function (called regeneration) is used to keep the DPF functioning properly between regular ash clean-out maintenance intervals, which must be performed by Service Technicians. An optimal DPF size was chosen for low back-pressure and to maximize ash storage capacity between periodic cleaning.

Tailpipe: Every exhaust system does not have a tailpipe because, in horizontal exit configurations, a new temperature control device replaces the actual tailpipe. However, some vertical exit systems will have a tailpipe only. For all horizontal exit configurations, a horizontal temperature control device is included.

Temperature Control Device (Tailpipe): This device reduces exhaust gas temperatures as they exit the system. Not all vehicles have a temperature control device, as it is not in vertical tailpipe applications. The temperature control device is the last component of the exhaust system and is mounted at the end of the exhaust system. The temperature control device works on a venturi principal, mixing the exhaust gases with external air to reduce the overall exit temperature. The temperature control device is standard on all horizontal exit exhaust systems.

Sensors: Three temperature sensors are located on the exhaust aftertreatment system to monitor temperature levels at different points of the system. One pressure sensor, fed by two pressure lines to the pressure sensor ports, is used to monitor pressure levels at both ends of the DPF and to determine soot buildup.

Aftertreatment Control Module (ACM): Exhaust aftertreatment systems used with the MaxxForce® DT, 9, and 10 engines are controlled by an additional electronic module, the ACM monitors sensors on the exhaust system and communicates with the Engine Interface Module and the Engine Control Module. When conditions are met, or a manual regeneration is requested, the ACM initiates a regeneration cycle. The regeneration cycle causes the ACM to send voltage to the Aftertreatment Fuel Injector solenoid valve to open and inject fuel into the turbo exhaust pipe. See the applicable engine diagnostic manual for diagnostics on the ACM.



1. Diesel Exhaust Fluid (DEF) dosing valve
2. Decomposition reactor tube
3. Diesel Oxidation Catalyst (DOC)
4. Diesel Particulate Filter (DPF)
5. Selective catalyst Reduction (SCR)

Figure 2 Typical 2013 Exhaust System Including Selective Catalyst Reduction (SCR).

Selective catalyst Reduction (SCR): This is a technology that uses a urea-based diesel exhaust fluid (DEF) and a catalyst to significantly reduce nitrogen oxide (NOx) emissions. The purpose of the SCR system is to reduce levels of NOx that are emitted from engines and are harmful to the environment. SCR is aftertreatment technology that treats exhaust gas downstream of the engine. Small quantities of DEF are injected into the exhaust upstream of a catalyst, where it vaporizes and decomposes to form ammonia and carbon dioxide. Ammonia is the desired product, which, in conjunction with the catalyst, converts NOx to harmless nitrogen and water.

Aftertreatment Control Module (ACM): The ACM controls the SCR diesel exhaust fluid dosing system. This device handles the dosing activity, controls the diesel exhaust fluid (DEF) tank heater valve, and monitors DEF tank level and ambient temperature. In this configuration, the ACM will also initiate the regeneration cycle when necessary. If the vehicle is not equipped with an ACM, these functions are performed by the Engine Control Module (ECM).

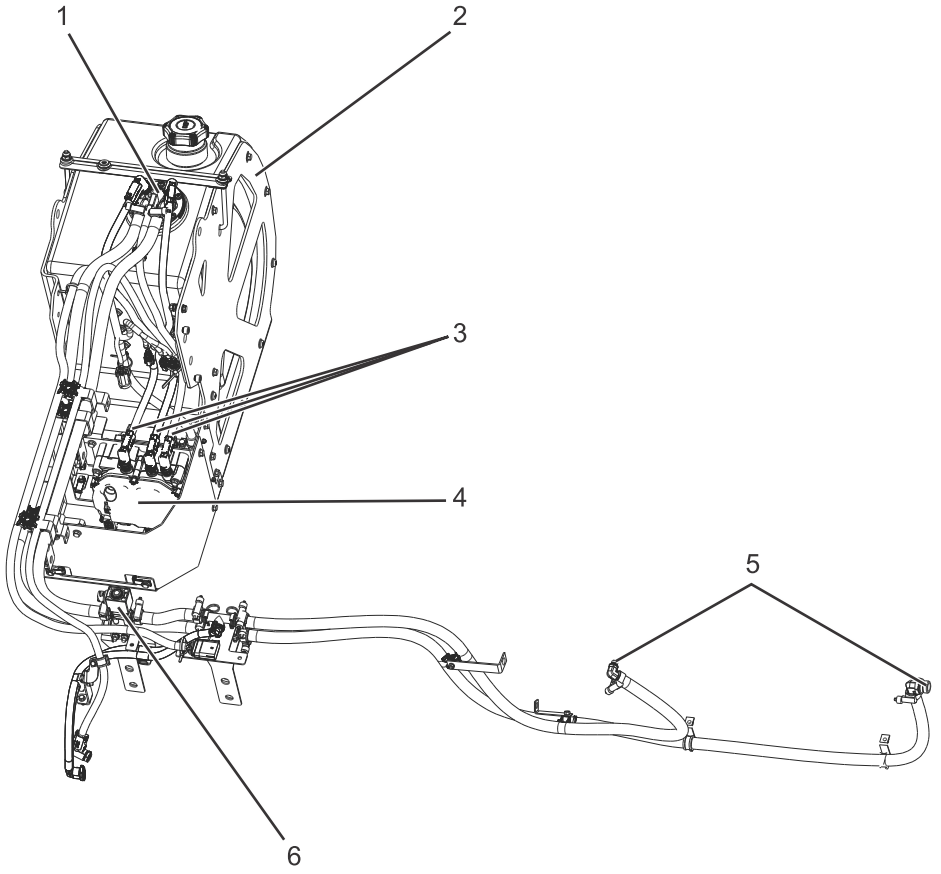
Decomposition Reactor Tube: The decomposition reactor tube is the section of exhaust pipe between the aftertreatment diesel particulate filter and aftertreatment SCR catalyst. The aftertreatment decomposition reactor tube is designed to help atomize and mix diesel exhaust fluid (DEF) that is sprayed into the exhaust stream for complete NOx conversion.

Dosing Valve: The aftertreatment diesel exhaust fluid (DEF) dosing valve is used to spray DEF into the exhaust stream prior to the SCR catalyst inlet. The aftertreatment DEF dosing valve is located on the decomposition reactor tube.

Temperature Sensors: The temperature sensors feed information to the Aftertreatment Control Module (ACM) or Electronic Control Module (ECM) depending on the configuration, allowing the system to calculate the necessary dosing rate.

Nitrogen Oxide (NOx) Sensors: There are two NOx sensors used by this system, an aftertreatment intake NOx sensor and an aftertreatment outlet NOx sensor. The aftertreatment intake NOx sensor monitors emissions of nitrogen oxides entering the aftertreatment SCR system. The aftertreatment outlet NOx sensor monitors the emissions of nitrogen oxides exiting the aftertreatment SCR system. Should the system fail, the nitrogen oxide (NOx) sensors will indicate high emissions and that the vehicle needs servicing.

Ammonia (NH3) Sensor: The ammonia (NH3) sensor is used to detect ammonia in the SCR catalyst. This information is used by the ECM or ACM depending on the application, to determine dosing rates and monitor SCR system efficiency.



1. Diesel Exhaust Fluid (DEF) tank pickup assembly
2. DEF tank assembly
3. DEF line (3)
4. DEF supply module
5. DEF coolant line (2)
6. DEF tank heater valve

Figure 3 Typical Diesel Exhaust Fluid (DEF) System.

Diesel Exhaust Fluid (DEF): The DEF is the reactant necessary for functionality of the Selective Catalyst Reduction (SCR) system. It is a clear, nontoxic fluid, which is used to deliver ammonia to the SCR catalyst and is a 32.5% strength urea/water solution with high purity requirements.

Diesel Exhaust Fluid (DEF) Tank: The diesel exhaust fluid (DEF) tank is filled with DEF. The DEF tank houses the DEF tank pickup assembly.

Diesel Exhaust Fluid (DEF) Supply Module: The DEF fluid is provided to the entire Selective Catalyst Reduction (SCR) system by the Diesel Exhaust Fluid (DEF) supply module. The DEF supply module directly controls flow or dosing rate of DEF.

Diesel Exhaust Fluid (DEF) Power Distribution Module (PDM): Contains relays and fuses for the aftertreatment system.

Diesel Exhaust Fluid (DEF) Tank Pickup Assembly: The DEF tank pickup assembly is mounted in the DEF tank. The assembly includes the DEF level sensor, urea quality sensor, pickup screen, and heating loop used to circulate coolant to heat and defrost DEF. These components are serviced as a complete assembly.

Diesel Exhaust Fluid (DEF) Lines: DEF lines supply DEF from the DEF tank to the DEF supply module and dosing valve.

Diesel Exhaust Fluid (DEF) Coolant Lines: DEF coolant lines supply coolant to the DEF tank and dosing valve to heat or defrost DEF.

Diesel Exhaust Fluid (DEF) Tank Heater Valve: An electronically controlled check valve that controls coolant flow to the DEF tank during temperatures below 23°F (-5°C). The valve is controlled by the ACM or ECM depending on the application.

Diesel Exhaust Fluid (DEF) Line Heater: The DEF line heater is used to heat the DEF lines when the ambient temperature is below 23°F (-5°C). The dosing system will not prime until the DEF lines are completely defrosted.

Delta Pressure Sensor: The Delta pressure sensor is used to monitor pressure levels at both ends of the DPF and to determine engine back pressure. The system is composed of one pressure sensor module, fed by two pressure lines routed to the pressure sensor ports.

1.1. THEORY OF OPERATION

The exhaust aftertreatment system, part of the larger exhaust system, processes engine exhaust to meet emissions requirements. The exhaust aftertreatment system traps particulate matter (soot) and prevents it from leaving the tailpipe. The soot buildup is monitored, and when required, can be burnt to ash through the regeneration process.

The regeneration process is accomplished in different ways, and is determined by manufacturers and / or engine type. Refer to the Vehicle Operator's Manual and Engine Operator's Manual for specific regeneration procedures. The DPF will continue to burn soot to ash until it is full. At this point, the DPF needs to be removed and cleaned, or exchanged for a clean DPF.

1.1.1. MaxxForce® DT, 9, 10, 11, 13, and 15

MaxxForce® DT, 9, 10, 11, 13, and 15 engine exhaust aftertreatment systems inject fuel into the exhaust gas to increase the temperature necessary for DPF regeneration. The Aftertreatment Control Module (ACM) receives data from the exhaust aftertreatment system temperature and pressure sensors to monitor soot buildup. When regeneration is required, the ACM activates the exhaust aftertreatment system fuel injector. Fuel is injected into the exhaust aftertreatment system to increase the temperature and burn the soot to ash. See the applicable engine diagnostic manual for diagnostics.

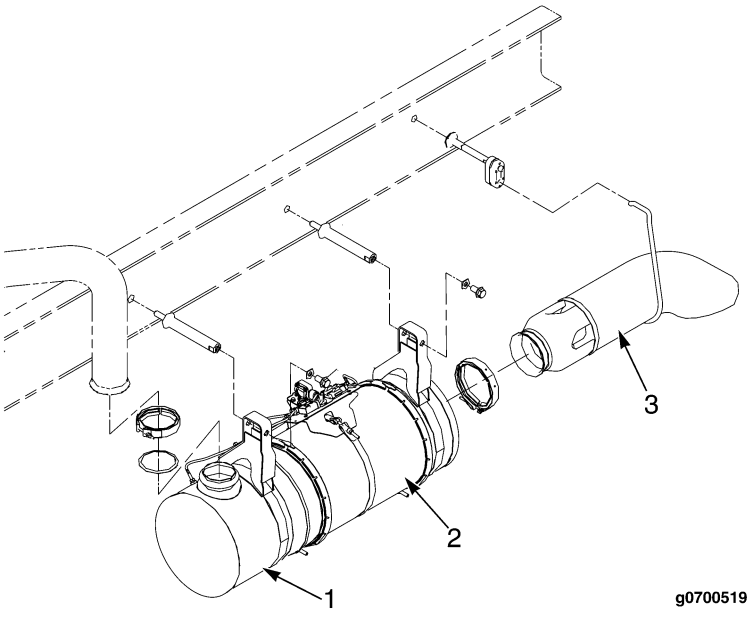
1.1.2. MaxxForce® 7

MaxxForce® 7 engines use an in cylinder dosing system to regenerate the DPF. Regeneration is controlled by the Engine Control Module. See the applicable engine diagnostic manual for diagnostics.

1.1.3. Cummins ISX15, ISB and Navistar® N9, N10, and N13

Cummins ISX15, ISB and Navistar® N9, N10, and N13 engines use a combination of Diesel Particulate Filter (DPF) and Selective Catalyst Reduction (SCR). The aftertreatment DPF system is used to reduce particulate emissions. If exhaust temperatures are naturally high enough to oxidize soot in the particulate filter, regeneration will occur during highway driving or heavy load conditions. This is called passive regeneration. If exhaust temperature is not high enough for passive regeneration, active regeneration will occur, and a small amount of fuel is injected into the exhaust stream. oxidizes and creates heat necessary to regenerate the DPF. Under some operating conditions, the engine may not have the opportunity to regenerate the DPF and stationary (parked) regeneration would be required. Stationary (parked) regeneration requires operator interaction. Refer to the Vehicle Operator’s manual for specific regenerations procedures. For regeneration to occur, the ECM must detect DPF restriction by monitoring temperature and pressure sensors. SCR uses Diesel Exhaust Fluid (DEF) in order to convert nitrogen oxides (NOx) in the exhaust stream to nitrogen and water. A dosing valve is used to inject DEF into the exhaust stream. DEF mixes with exhaust gas and converts into ammonia, which neutralizes the NOx. Once ammonia reacts with NOx, it passes over the SCR catalyst and produces harmless nitrogen and water vapor.

1.2. SINGLE HORIZONTAL / HORIZONTAL

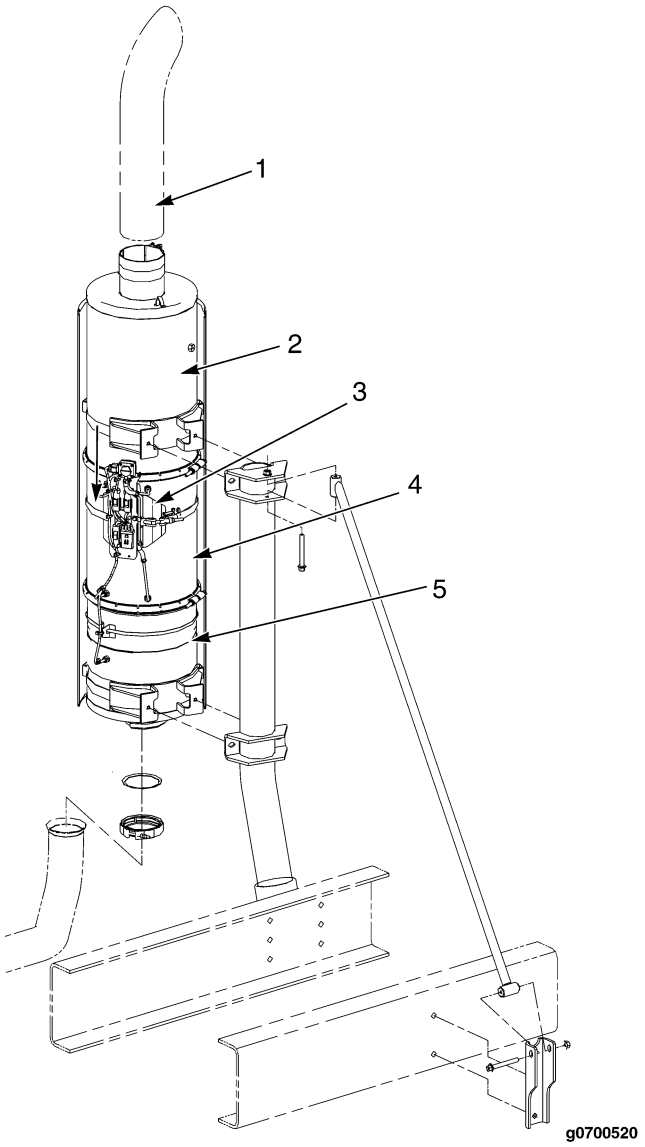


1. Diesel Oxidation (DOC)
2. Diesel Particulate Filter (DPF)
3. Tailpipe / temperature control device

Figure 4 Single Horizontal / Horizontal One-Can System.

The single horizontal / horizontal exhaust system consists of a horizontal DPF and a horizontal tailpipe. There are several variations of single horizontal / horizontal exhaust systems depending on specific truck series. All the variations have the same components and similar removal / installation procedures.

1.3. SINGLE VERTICAL / VERTICAL

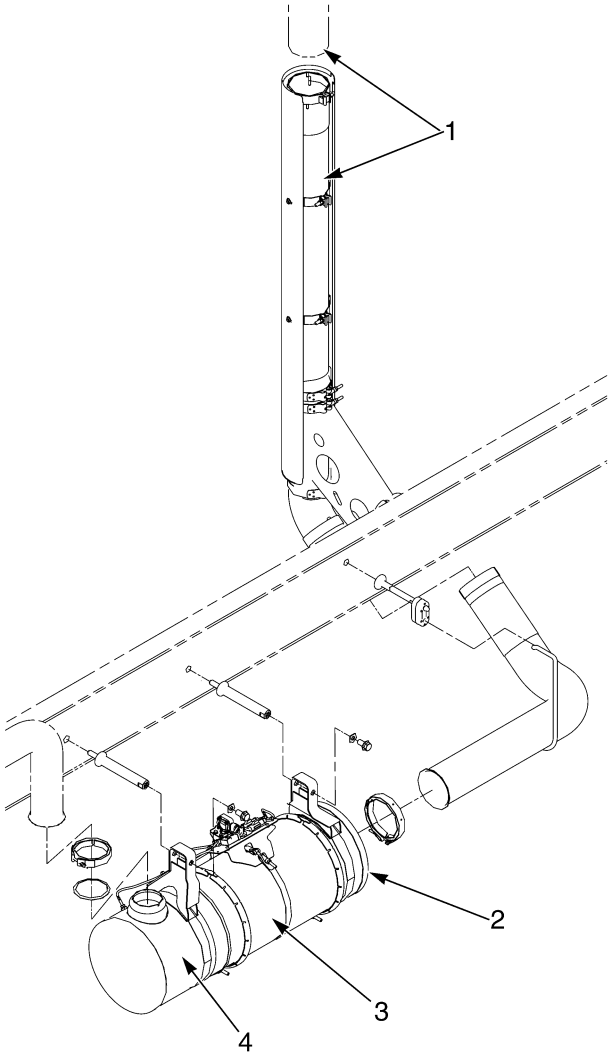


1. Tailpipe
2. Output exhaust can
3. Sensor junction box
4. Diesel Particulate Filter (DPF)
5. Diesel Oxidation Catalyst (DOC)

Figure 5 Single Vertical / Vertical Exhaust System.

The single vertical / vertical exhaust system consists of a vertical DPF and a vertical tailpipe. There are several variations of single vertical / vertical exhaust systems depending on specific truck series. All of the variations have the same components and the removal / installation procedures are similar for the different variations.

1.4. SINGLE HORIZONTAL / VERTICAL

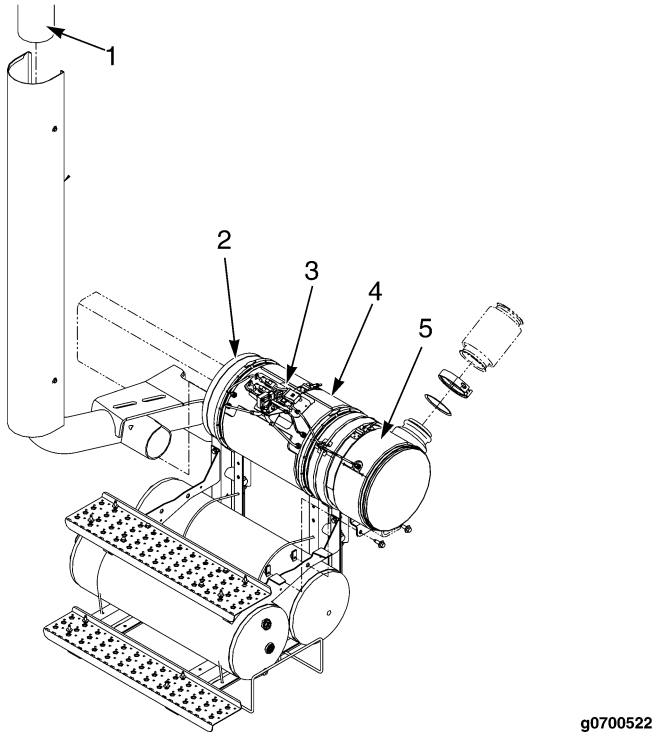


1. Tailpipe
2. Output exhaust can
3. Diesel Particulate Filter (DPF)
4. Diesel Oxidation Catalyst (DOC)

Figure 6 Single Horizontal / Vertical Exhaust System.

The single horizontal / vertical exhaust system consists of a horizontal DPF and a vertical tailpipe. There are several variations of single horizontal / vertical exhaust systems depending on specific truck series. All of the variations have the same components, and the removal / installation procedures are similar for the different variations.

1.5. SINGLE UNDER-CAB HORIZONTAL / VERTICAL



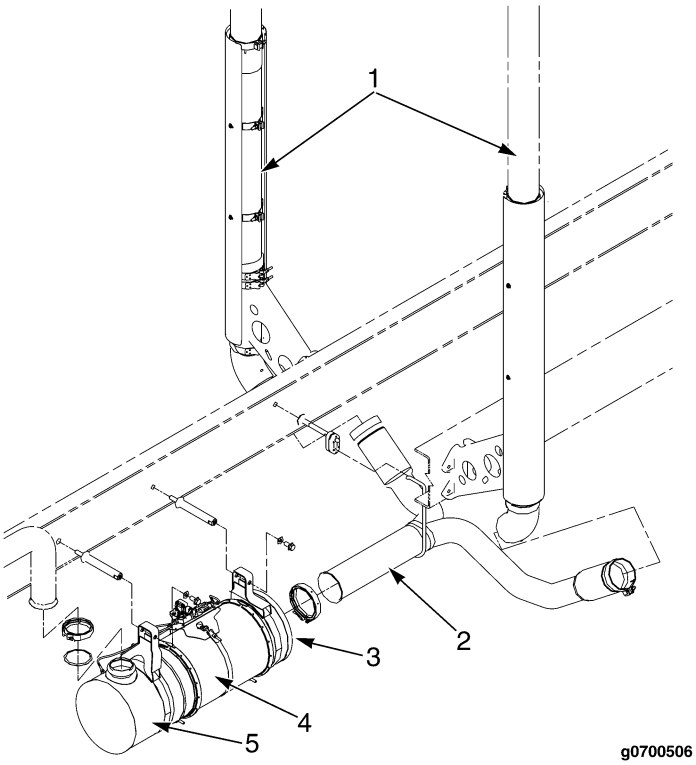
1. Tailpipe
2. Output exhaust can
3. Sensor junction box
4. Diesel Particulate Filter (DPF)
5. Diesel Oxidation Catalyst (DOC)

Figure 7 Single Under-Cab Horizontal / Vertical Exhaust System.

The single under-cab horizontal / vertical exhaust system consists of a horizontal DPF and a vertical tailpipe. There are several variations of single under-cab horizontal / vertical exhaust systems depending on specific truck series. All of the variations have the same components and the removal / installation procedures are similar for the different variations.

These systems are similar to the single horizontal / vertical exhaust system with the main difference being that the DPF is mounted under the cab.

1.6. SINGLE HORIZONTAL / DUAL VERTICAL



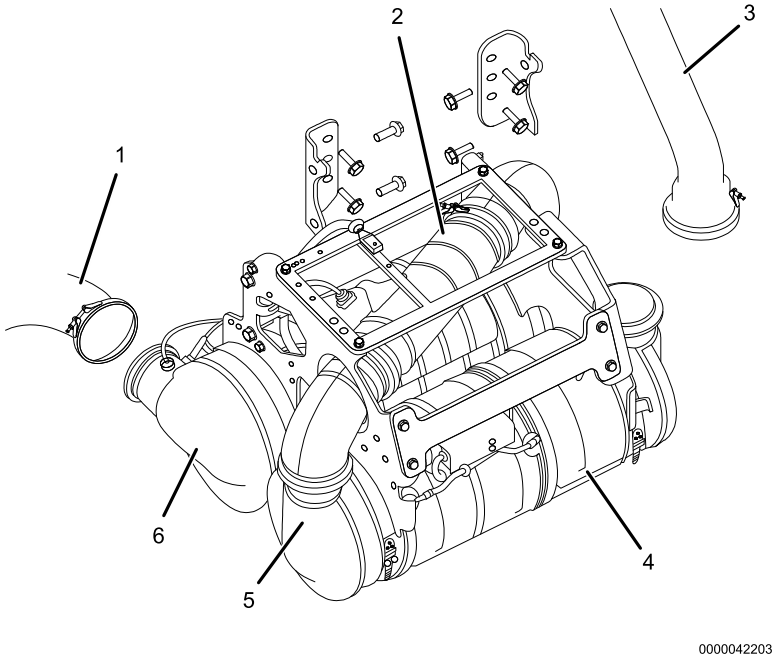
1. Tailpipe
2. Y-pipe
3. Output exhaust can
4. Diesel Particulate Filter (DPF)
5. Diesel Oxidation Catalyst (DOC)

Figure 8 Single Horizontal / Dual Vertical Exhaust System.

The single horizontal / dual vertical exhaust system consists of a horizontal DPF and dual vertical tailpipes. There are several variations of single horizontal / dual vertical exhaust systems depending on specific truck series. All of the variations have the same components and the removal / installation procedures are similar for the different variations.

These systems are similar to the single horizontal / vertical exhaust system. One main difference is that the exhaust is split into two tailpipes utilizing a y-pipe behind the DPF.

1.7. SWITCHBACK / HORIZONTAL

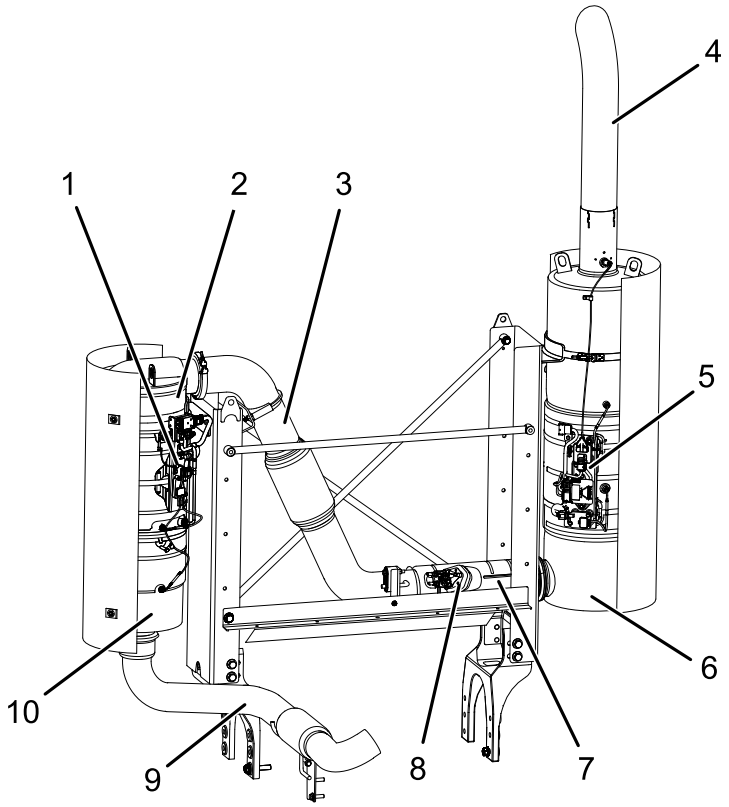


1. Tailpipe
2. Decomposition tube
3. Turbo pipe
4. Diesel Oxidation Catalyst (DOC)
5. Diesel Particulate Filter (DPF)
6. Selective Catalyst Reduction (SCR)

Figure 9 Switchback / Horizontal Exhaust System.

The switchback / horizontal exhaust system consists of a horizontal DPF and DOC, horizontal SCR, and a single horizontal tailpipe. There are several variations of switchback / horizontal exhaust systems with SCR depending on specific truck series. All of the variations have the same components and the removal / installation procedures are similar for each variation.

1.8. VERTICAL / VERTICAL



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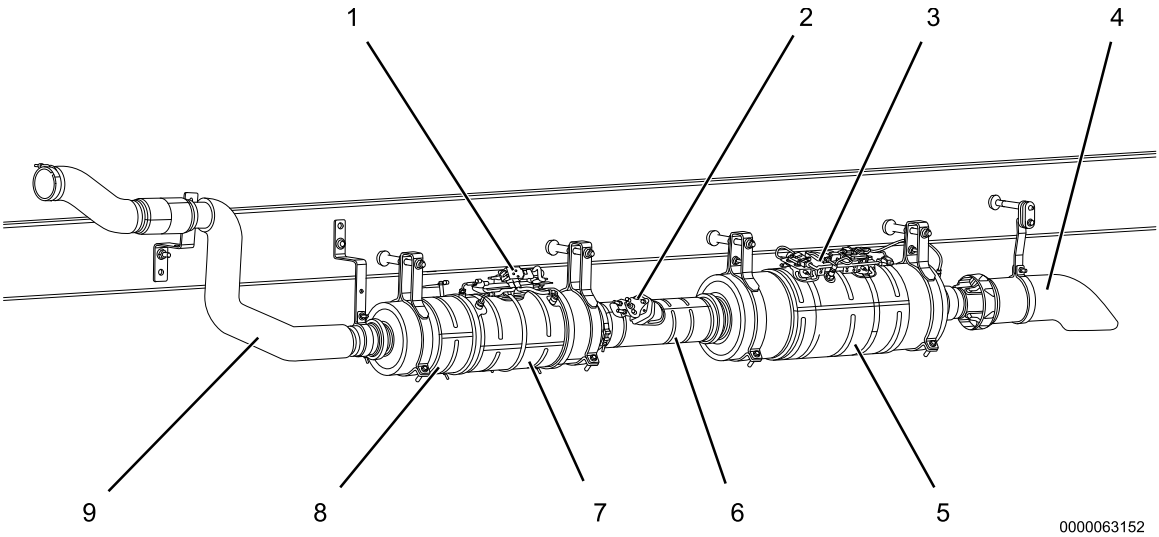
1. Diesel particulate filter (DPF) interface module
2. Diesel Particulate Filter (DPF)
3. Decomposition reactor tube
4. Tailpipe
5. Selective catalyst reduction (SCR) interface module
6. SCR canister
7. Decomposition reactor tube
8. Diesel exhaust fluid (DEF) dosing valve
9. Turbo pipe
10. Diesel Oxidation Catalyst (DOC)

Figure 10 Vertical / Vertical Exhaust System.

The vertical / vertical exhaust system consists of a vertical DPF and DOC, vertical SCR, and a single vertical tailpipe. There are several variations of vertical / vertical exhaust systems with SCR depending on specific truck series. All of the variations have the same components and the removal / installation procedures are similar for each variation.

1.9. IN-LINE



1. Diesel particulate filter (DPF) interface module
2. Diesel exhaust fluid (DEF) dosing valve
3. Selective catalyst reduction (SCR) interface module
4. Tailpipe
5. Selective catalyst reduction (SCR) canister
6. Decomposition reactor tube
7. Diesel Particulate Filter (DPF)
8. Diesel Oxidation Catalyst (DOC)
9. Turbo pipe

Figure 11 In-Line Exhaust System.

The In-Line exhaust system consists of a horizontal DPF and DOC, horizontal SCR, and a single horizontal tailpipe. There are several variations of In-Line exhaust systems with SCR depending on specific truck series. All of the variations have the same components and the removal / installation procedures are similar for each variation.

2. GENERAL SERVICE INFORMATION

WARNING

To prevent property damage, personal injury, and / or death, when servicing the vehicle, park on a flat level service, set the parking brake, turn the engine off, and chock the wheels.

To prevent personal injury or death, disconnect the main negative battery terminal before removing or installing any electrical components.

WARNING

To prevent property damage, personal injury, and / or death, before working on the exhaust system, allow sufficient time for cool down. During regeneration, exhaust gas temperature could reach 1500°F (800°C), and exhaust system surface temperature could exceed 1300°F (700°C), which is hot enough to ignite or melt common materials, and to burn skin. The exhaust and exhaust components can remain hot after the vehicle has stopped moving.

WARNING

To prevent property damage, personal injury, and / or death, use a suitable device for support and removal of the DPF. The DPF is heavy and contains a ceramic "brick" that is sensitive to shocks and impacts.

CAUTION

To prevent damage to sensors and other components of the system, care must be taken when removing any DPF.

NOTE – It may be necessary to disconnect exhaust pipes from the output exhaust can prior to removing the DPF.

NOTE – Before performing any work on the exhaust components, be sure to perform following basic procedures:

1. **Park the vehicle on a flat, level surface.**
2. **Place transmission in neutral (or park, if automatic transmission).**
3. **Set the parking brake.**
4. **Turn off ignition.**
5. **Install wheel chocks.**
6. **Disconnect the batteries.**

2.1. EXHAUST AFTERTREATMENT SYSTEM MODIFICATIONS

Proper long-term operation of the exhaust aftertreatment emissions control devices requires controlling exhaust stream temperatures and the exhaust flow pattern throughout the system. This determines the required location of the components, as well as the insulation of the various parts of the system. Navistar, Inc. will ensure correct factory installation of exhaust aftertreatment systems for compliance with the certification requirements.

Modified systems could void the warranty coverage and violate emissions requirements, as well as damage the engine, exhaust aftertreatment system, and other truck systems. For this reason, application guidelines for exhaust aftertreatment installations are much more complex and restrictive for vehicles incorporating these systems. Modifications to any part of the exhaust aftertreatment system must be approved by Navistar, Inc.

In comparison to vehicles produced prior to 2007, exhaust component surface temperatures and exhaust gas temperatures are considerably higher. As a result of the increased temperatures, clearances to exhaust components need to be increased by typically 40% to ensure that body and / or chassis parts are not damaged by heat.

- No equipment should be mounted within 8 inches (200 mm) of the exhaust pipe outlet to avoid damage from hot exhaust gases.
- Maintain other clearances as shown in the table below.

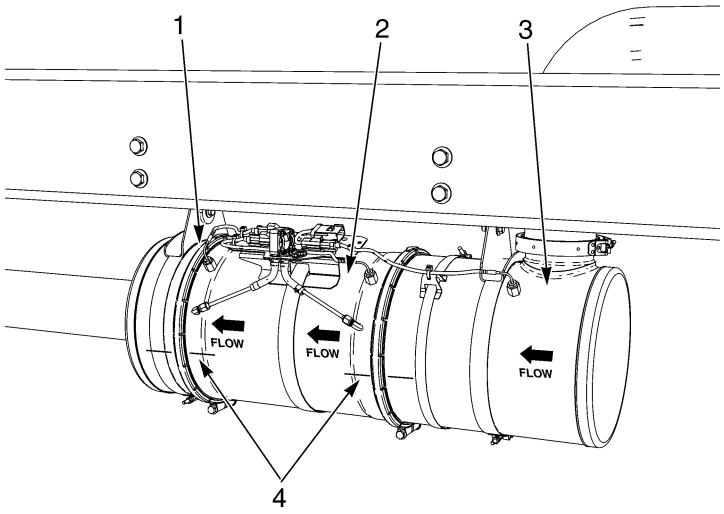
Table 2 Minimum Clearance Between Exhaust System Components and Other Chassis Components.

Component	Minimum Clearance, in. (mm)
Electric Harness	6 (150)
Electric Harness (with heat guard)	4 (100)
Mechanical Cable	2 (50)
Fuel Tube, Metal	6 (150)
Fuel Tube, Rubber or Plastic	6 (150)
Brake Tube, Metal	4 (100)
Brake Tube, Rubber or Plastic	4 (100)
Tire	4 (100)
Fuel Tank	4 (100)

2.2. GASKETS AND FASTENERS

Always use new gaskets and thoroughly clean the mating surfaces when replacing exhaust aftertreatment system components. The bolts and nuts used in these systems are special, and it is recommended that they also be replaced when reinstalling exhaust aftertreatment components.

2.3. DIESEL PARTICULATE FILTER (DPF) INDEXING



1. Output exhaust can
2. Diesel Particulate Filter (DPF)
3. Diesel Oxidation Catalyst (DOC)
4. Index mark (2)

Figure 12 Indexing.

NOTE – Before removing a DPF that will be cleaned and reinstalled, the components must be indexed and marked to show the direction of exhaust flow. This ensures proper installation after the filter has been cleaned.

To index and mark direction of flow on the DPF, place a permanent index mark on all components to show how they should line up and draw an arrow showing flow direction. This important function will ensure that the diesel particular filter is properly installed during the installation procedures.

2.4. DPF AND DOC CLEANING

At some point in time, the DPF or DOC may fill and become plugged with ash. When this occurs, the component must be removed and cleaned, or exchanged. This requires special handling techniques and cleaning equipment that may not be available at the service site. If available, follow the instructions for the specific cleaning equipment.

CAUTION

To prevent damage to DPF and / or DOC, do not attempt to clean the DPF or DOC with a pressure washer or compressed air.

CAUTION

The ash contained within the DPF or DOC is considered a hazardous waste. Disposal should be in accordance with all local laws and regulations. Refer to http://www.epa.gov for more information.

For dealers that wish to purchase their own cleaning equipment, FSX (TrapBlaster, TrapBurner, TrapTester, and SootSucker) systems are the recommended DPF and DOC cleaning systems. Dealers that already purchased the generation 1 Donaldson (Pulse Cleaner and Thermal Regeneration) system may continue using that system. Dealers wishing to purchase cleaning equipment should purchase all equipment for the machine purchased:

- FSX: TrapBlaster, TrapBurner, TrapTester, and SootSucker.
- Donaldson: Pulse Cleaner and Thermal Regeneration

NOTE – All DPFs are tracked and identified with a specific serial number. If a replacement DPF is installed, you must record the serial numbers of both the original and the replacement on the warranty report and in the Service Portal network.

NOTE – Navistar® does not recommend or authorize cleaning of the DOC utilizing the "Air Knife" function, as this will cause the fins to bend.

2.5. DPF GENERAL INSPECTION

This section outlines the inspection guidelines for the Diesel Particulate Filter (DPF). General inspection should be performed when the aftertreatment system is being serviced.

WARNING

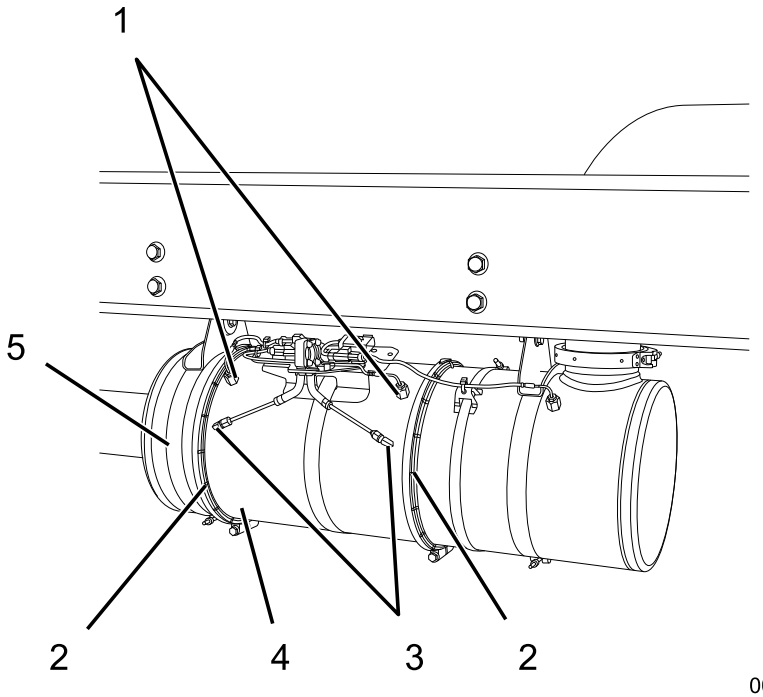
To prevent property damage, personal injury, and / or death, before working on the exhaust system, allow sufficient time for cool down. During regeneration, exhaust gas temperature could reach 1500°F (800°C), and exhaust system surface temperature could exceed 1300°F (700°C), which is hot enough to ignite or melt common materials, and to burn skin. The exhaust and exhaust components can remain hot after the vehicle has stopped moving.

Once the DPF has been removed, clean any residual gasket material from the flanges with a scraping tool.

CAUTION

To prevent property damage, during cleaning or inspection, do not use a grinder or abrasive air tool to remove residual gasket material.

2.5.1. DPF Inspection Points



1. DPF temperature sensor threads (2)
2. DPF V-band clamp (2)
3. DPF pressure sensor threads (2)
4. Diesel particulate filter (DPF)
5. DPF mounting strap

Figure 13 DPF Inspection Points.

Step	Action	Decision
1	Inspect DPF V-band clamps (Figure 13) (Item 2) and mounting straps (Figure 13) (Item 5) for signs of overextension or damage. Are DPF V-band clamps and mounting straps free of overextension and damage?	Yes: Go to Step 2
		No: Replace DPF V-band clamp or mounting strap. After repairs are complete, go to Step 2.

Step	Action	Decision
2	Inspect DPF housing (Figure 13) (Item 4) for dents. Is DPF housing free of dents?	Yes: Go to Step 3.
		No: Replace damaged DPF.

Step	Action	Decision
3	Inspect DPF inlet and outlet (Figure 13)mounting flange for dents, cracks or gouges. Are DPF mounting flanges free of dents, cracks and gouges?	Yes: Go to Step 4.
		No: Replace damaged DPF.

Step	Action	Decision
4	Inspect DPF pressure and temperature sensor threads (Figure 13) (Items 1 and 3) in DPF for damage. Are DPF pressure and temperature threads in the DPF free of damage?	Yes: Go to Step 5.
		No: Refer to DPF/ DOC thread repair procedure page 27and repair damaged threads in DPF. After repairs are complete, go to Step 6.

Figure 14 DPF Inlet / Outlet Face Excessive Oil or Fuel.

Step	Action	Decision
5	Inspect DPF inlet and outlet face (Figure 14) for evidence of excessive coolant, oil, or fuel. Are DPF inlet and outlet face free of excessive coolant, oil, or fuel?	Yes: Go to Step 6.
		No: Replace oil / fuel soaked DPF. After repairs are complete, go to DOC Inspection page 23.

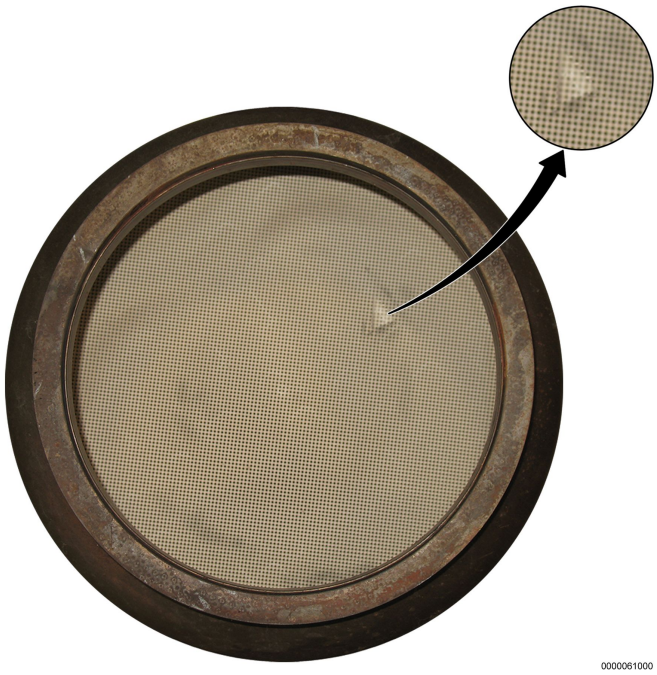


Figure 15 DPF Inlet / Outlet Face Gouge.

Step	Action	Decision
6	Inspect DPF for gouges (Figure 15) on inlet and outlet face. Are DPF inlet and outlet face free of gouges 1/8 in (3 mm) or more deep?	Yes: DPF inspection is complete, go to DOC Inspection page 23.
		No: Replace damaged DPF.

NOTE – If a malfunction resulted in oil, coolant, excessive fuel, or excessive black smoke exiting the exhaust system, refer to the DOC and DPF Reuse Guidelines (page 35) immediately after performing the general inspection. The DOC and DPF reuse guidelines will provide instructions on how to determine if the DPF and DOC can be recovered, reused, or replaced.

2.6. DOC GENERAL INSPECTION

This section outlines the inspection guidelines for the Diesel Oxidation Catalyst (DOC). General inspection should be performed when the aftertreatment system is being serviced.

WARNING

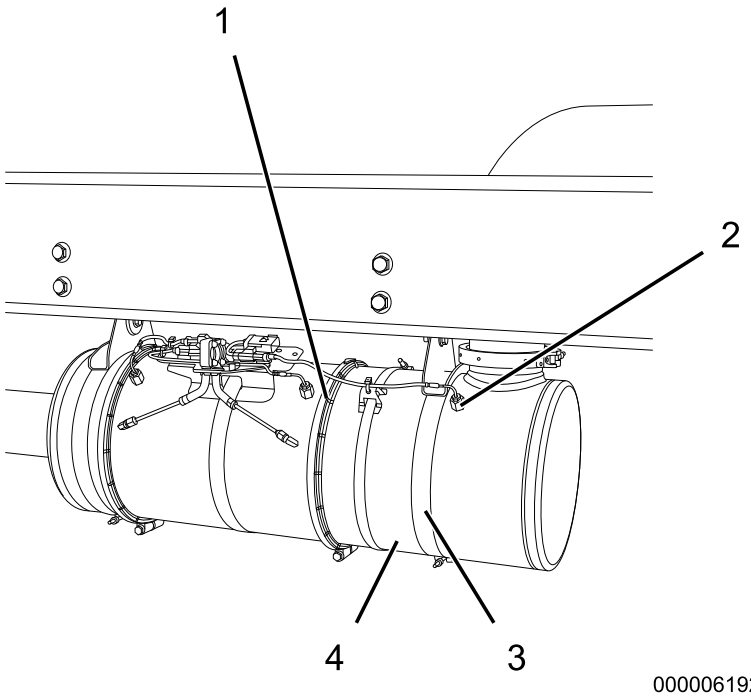
To prevent property damage, personal injury, and / or death, before working on the exhaust system, allow sufficient time for cool down. During regeneration, exhaust gas temperature could reach 1500°F (800°C), and exhaust system surface temperature could exceed 1300°F (700°C), which is hot enough to ignite or melt common materials, and to burn skin. The exhaust and exhaust components can remain hot after the vehicle has stopped moving.

Once the DOC has been removed, clean any residual gasket material from the flanges with a scraping tool

CAUTION

To prevent property damage, during cleaning or inspection, do not use a grinder or abrasive air tool to remove residual gasket material.

2.6.1. DOC Inspection Points



1. DOC V-band clamp
2. DOC temperature sensor thread
3. DOC mounting strap
4. Diesel Oxidation Catalyst (DOC)

Figure 16 DOC Inspection Points.

Step	Action	Decision
1	Inspect DOC V-band clamp (Figure 16) (Item 1) and DOC mounting strap (Figure 16) (Item 3) for signs of overextension or damage. Are DOC V-band clamp and mounting strap free of overextension and damage?	Yes: Go to Step 2. No: Replace DOC V-band clamp or mounting strap. After repairs are complete, go to Step 2.

Step	Action	Decision
2	Inspect DOC (Figure 16) (Item 4) housing for dents. Is DOC housing free of dents?	Yes: Go to Step 3. No: Replace damaged DOC.

Step	Action	Decision
3	Inspect DOC mounting flanges (Figure 16) for dents, cracks or gouges. Are DOC mounting flanges free of dents, cracks and gouges?	Yes: Go to Step 4. No: Replace damaged DOC.

Step	Action	Decision
4	Inspect DOC temperature sensor threads (Figure 16) (Item 2) in DOC for damage. Are DOC temperature sensor threads in DOC free of damage?	Yes: Go to Step 5. No: Refer to DPF / DOC thread repair procedure page 27and repair the damaged threads in the DOC . After repairs are complete, go to Step 5.

Figure 17 DOC Inlet / Outlet Face Excessive Oil or Fuel.

Step	Action	Decision
5	Inspect DOC inlet and outlet (Figure 17) face for evidence of excessive coolant, oil, or fuel. Are DOC inlet and outlet face free of excessive coolant, oil, or fuel?	Yes: Go to Step 6.
		No: Replace oil / fuel soaked DOC.

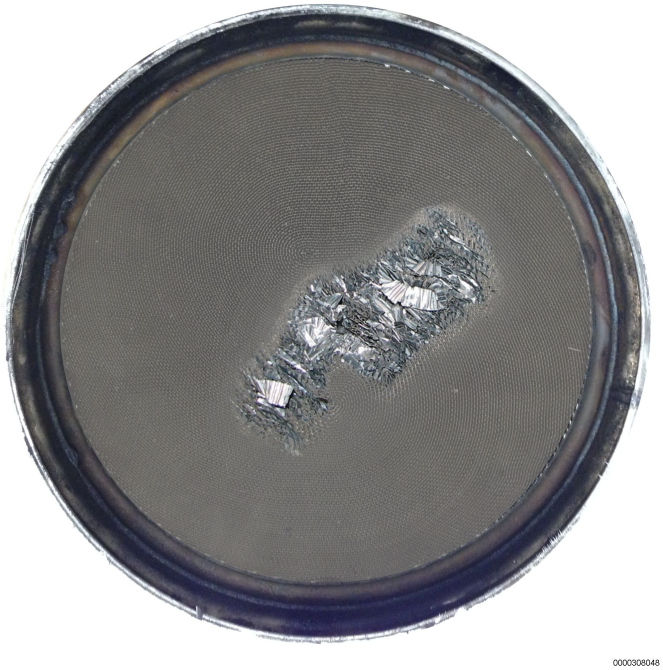


Figure 18 DOC Inlet / Outlet Face Gouge.

Step	Action	Decision
6	Inspect DOC inlet and outlet face (Figure 18) for gouges. Are DOC inlet and outlet face free of gouges 1/8 in (3 mm) or more deep?	Yes: Go to Step 7. No: Replace damaged DOC.

Step	Action	Decision
7	Inspect DOC (Figure 18) by looking through inlet face while shining a light through outlet face. If DOC has a side inlet configuration, insert a shop light and inspection mirror into inlet of DOC. Is it possible to see straight through more than 50% of the DOC cells?	Yes: DOC inspection is complete. No: Clean DOC. Refer to DPF and DOC Cleaning section, (page 18).

NOTE – If a malfunction resulted in oil, coolant, excessive fuel, excessive black smoke exiting the exhaust system, refer to the DOC and DPF Reuse Guidelines (page 35) immediately after performing the general inspection. The DOC and DPF reuse guidelines will provide instructions on how to determine if the DPF and DOC can be recovered, reused, or replaced.

2.7. DPF / DOC THREAD REPAIR

This section outlines the procedure to repair damaged threads in the diesel particulate filter (DPF) and diesel oxidation catalyst (DOC) sensor fittings.

NOTE – Prior to performing this procedure, determine size of fitting needed and obtain the 12 mm thread repair kit (P/N 12-235-02) or the 14 mm thread repair kit (P/N 12-235-03).

CAUTION

To prevent damage to tools and parts, this procedure should be performed by hand. If a drill must be used, it should only be used in steps for reaming / removing old threads. Drill should not exceed 70 RPM drill speed.

CAUTION

To prevent damage to tools and parts, keep tools parallel to surface of bung when performing procedures.

2.7.1. 12 MM Thread Replacement

0000292624

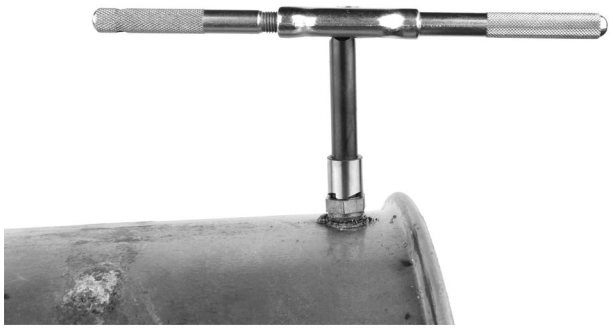
Figure 19 Thread Removal.

NOTE – Use cutting oil for drilling and tapping.

NOTE – Do not exceed 70 RPM drill speed.

1. Remove DPF / DOC from vehicle and secure to a bench. Refer to appropriate DPF or DOC removal and installation procedure later in this manual.

2. Drill out old threads until stop collar touches top of fitting, keeping drill square to surface.



0000292627

Figure 20 Counterbore.

NOTE – Use cutting oil for counterbore.

3. Counterbore hole to full depth of tool (built-in stops limit depth) (Figure 20). This operation is best performed by hand.

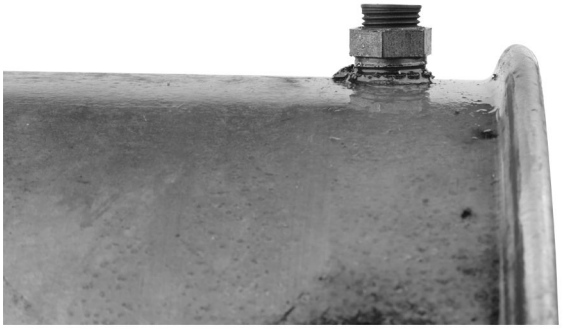
0000292625

Figure 21 Tap Guide.

NOTE – Use cutting oil for drilling and tapping.

4. Holding tap guide (Figure 21) against surface of fitting, slowly tap hole. This operation is best performed by hand.

5. Clean new threads with compressed air.

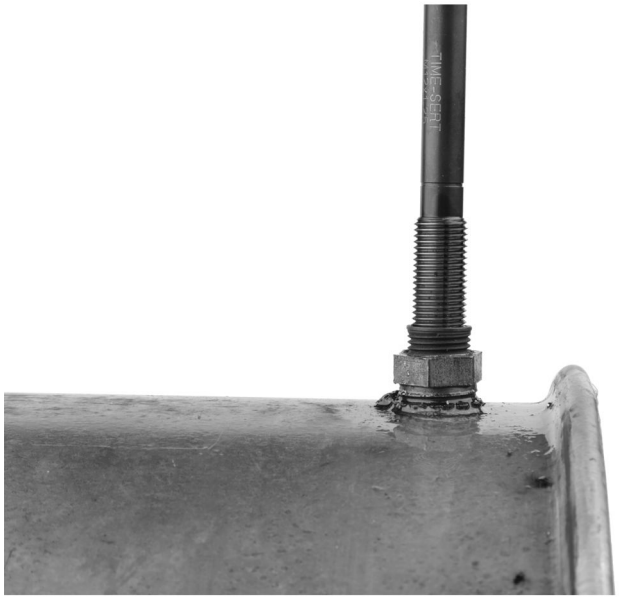


0000292628

Figure 22 Thread Insert.

6. Carefully screw thread insert (Figure 22) a few turns into tapped hole.

7. Apply oil to threads of driver tool.



0000292623

Figure 23 Driver Tool.

NOTE – When flange of insert seats in counterbore, increased resistance will be felt. Continue turning driver until a loosening sensation is felt (which indicates that bottom few threads have expanded), locking insert in place.

8. Thread driver tool into insert (Figure 23), then carefully drive insert using tap wrench. Use slightly more force to continue rotating driver until resistance decreases (or driver bottoms in hole).

9. Remove driver tool and carefully examine new threads to ensure a quality repair.

10. Install DOC / DPF into vehicle. Refer to appropriate Exhaust System Service Manual for specific procedure.

2.7.2. 14 MM Thread Replacement

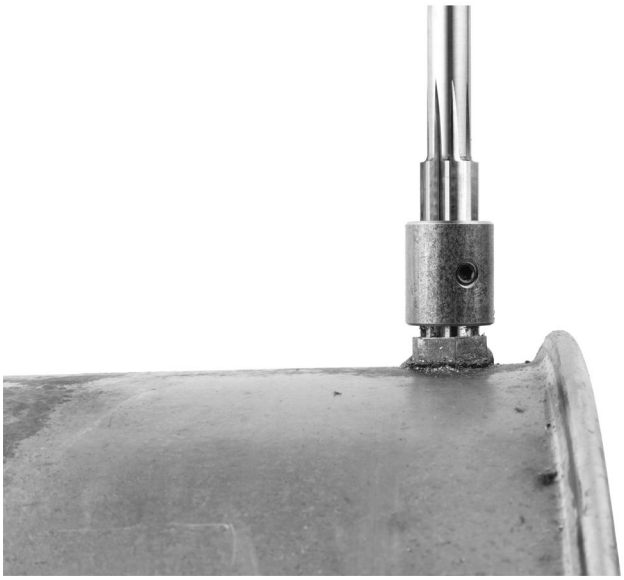
NOTE – Prior to performing this procedure, determine size of fitting needed and obtain the 12 mm thread repair kit (P/N 12-235-02) or the 14 mm thread repair kit (P/N 12-235-03).

CAUTION

To prevent damage to tools and parts, this procedure should be performed by hand. If a drill must be used, it should only be used in steps for reaming / removing old threads. Drill should not exceed 70 RPM drill speed.

CAUTION

To prevent damage to tools and parts, keep tools parallel to surface of bung when performing procedures.



0000292626

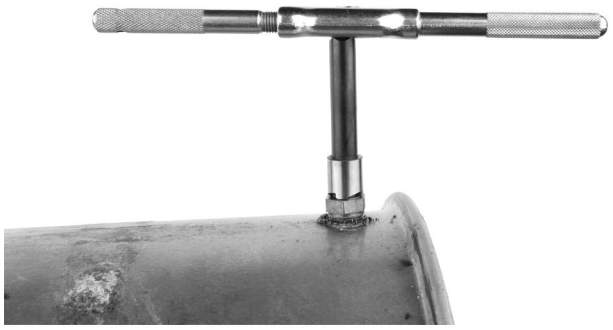
Figure 24 Thread Reamer.

NOTE – Use cutting oil for reaming and tapping.

NOTE – Do not exceed 70 RPM drill speed.

1. Remove DPF/ DOC from vehicle and secure to a bench. Refer to appropriate DPF or DOC removal and installation procedure later in this manual.

2. Ream out old threads until stop collar touches top of fitting, keep reamer square to surface (Figure 24).



0000292627

Figure 25 Counterbore.

NOTE – Use cutting oil for counterbore.

3. Counterbore hole to full depth of tool (built-in stops limit depth) (Figure 25). This operation is best performed by hand.

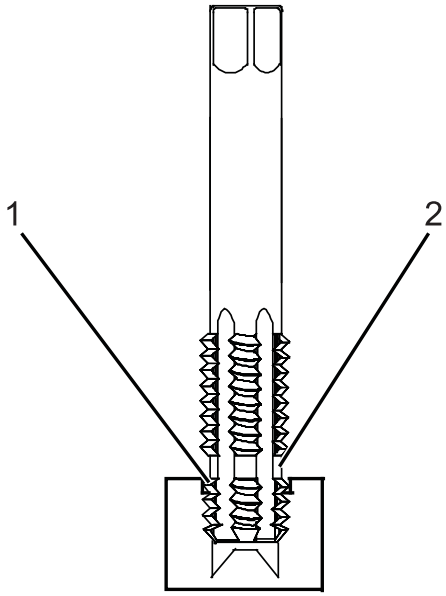
0000292625

Figure 26 Tap Guide

NOTE – Use cutting oil for drilling and tapping.

NOTE – Tap guide must remain flush during tapping.

4. Holding tap guide (Figure 26) against surface of fitting, slowly start to tap hole. This operation is best performed by hand.



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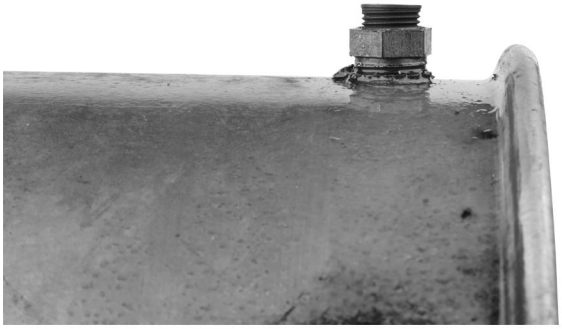
1. Last tap thread before gap
2. Gap

Figure 27 Tap Measurement

NOTE – After starting tap into hole, 2 to 3 turns should be sufficient to achieve required measurement.

5. Apply down pressure while tapping hole. After 2 to 3 turns, remove tap guide and STOP tap when last tap thread BEFORE GAP is level with top of fitting (Figure 27).
6. Slowly remove tap.
7. Clean new threads with compressed air.

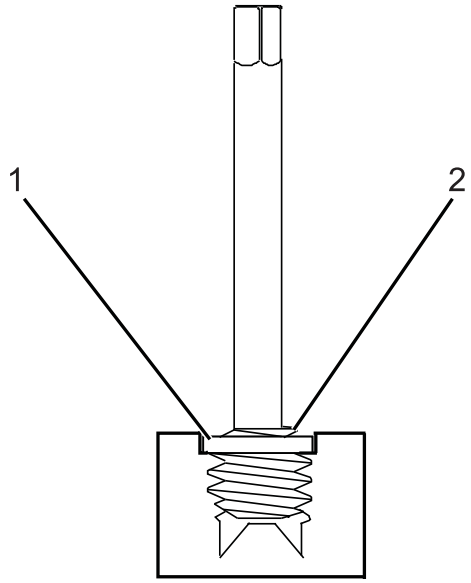


0000292628

Figure 28 Thread Insert.

8. Carefully screw thread insert (Figure 28) a few turns into tapped hole.

9. Apply oil to threads of driver tool.



0000293856

1. Insert
2. Last thread level with surface

Figure 29 Drive Insert.

NOTE – When flange of insert seats in counterbore, increased resistance will be felt. Continue turning driver until a loosening sensation is felt (which indicates that bottom few threads have expanded), locking insert in place.

10. Thread driver tool into insert, then carefully drive insert using tap wrench until last thread on driver tool is level with surface (Figure 29) (Items 1 and 2). Use slightly more force to continue rotating driver until resistance decreases or driver bottoms in hole.

11. Remove driver tool and carefully examine new threads to ensure a quality repair.

12. Install DPF / DOC into vehicle. Refer to appropriate DPF or DOC removal and installation procedure later in this manual.

2.8. DOC AND DPF REUSE GUIDELINES

2.8.1. General Information

This section will provide reuse guidelines for the diesel oxidation catalyst (DOC) and diesel particulate filter (DPF). These guidelines apply to vehicles equipped with Selective Catalyst Reduction (SCR) aftertreatment systems. When inspecting non-SCR aftertreatment systems, refer to the Aftertreatment Symptom-Based Diagnostic and Inspection Manual 0000003081.

An internally cracked or melted DPF can show damage in three ways:

1. The filter outlet channels can have soot stains. These stains will typically not show on the face of the filter, but can be seen in the non-plugged channel walls of the outlet. See “Aftertreatment Diesel Particulate Filter (DPF) Outlet - Soot Stains” ((Figure 39) for an example illustration. Other staining or marks that are on the face of the filter are not indications of a cracked or melted filter. See “Aftertreatment Diesel Particulate Filter (DPF) Outlet - Melted” ((Figure 44) for an example illustration.

2. The tail pipe outlet has excessive soot buildup. Normal operation of the vehicle over its life will cause a very small amount of soot staining in the tail pipe. If excessive soot is found in the tail pipe, it must be cleaned.

3. When black smoke is seen during operation. This should be verified by performing the diesel particulate filter (DPF) snap acceleration test.

Of the three indications of a damaged filter, the first (1) one is the most conclusive. If the first (1) indication of damage is not visibly present, but the second (2) and third (3) can be confirmed together, the filter must be replaced due to cracking or melting. The source of the excessive soot that caused the cracking or melting must be investigated. Refer to the appropriate engine diagnostic manual for diagnostic procedures.

2.8.2. Diesel Oxidation Catalyst (DOC) Inlet / Outlet – Melted

0000329421

Figure 30 Diesel Oxidation Catalyst (DOC) Inlet / Outlet – Melted.

Appearance	The DOC inlet shows melted or deformed cells.
Cause	Excessive fuel or oil has entered the exhaust.
Action	Determine the cause of excessive fuel or oil in the exhaust system. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the source of the excessive fuel or oil has been repaired, replace the DOC.

2.8.3. Diesel Oxidation Catalyst (DOC) Inlet – Face Plugged

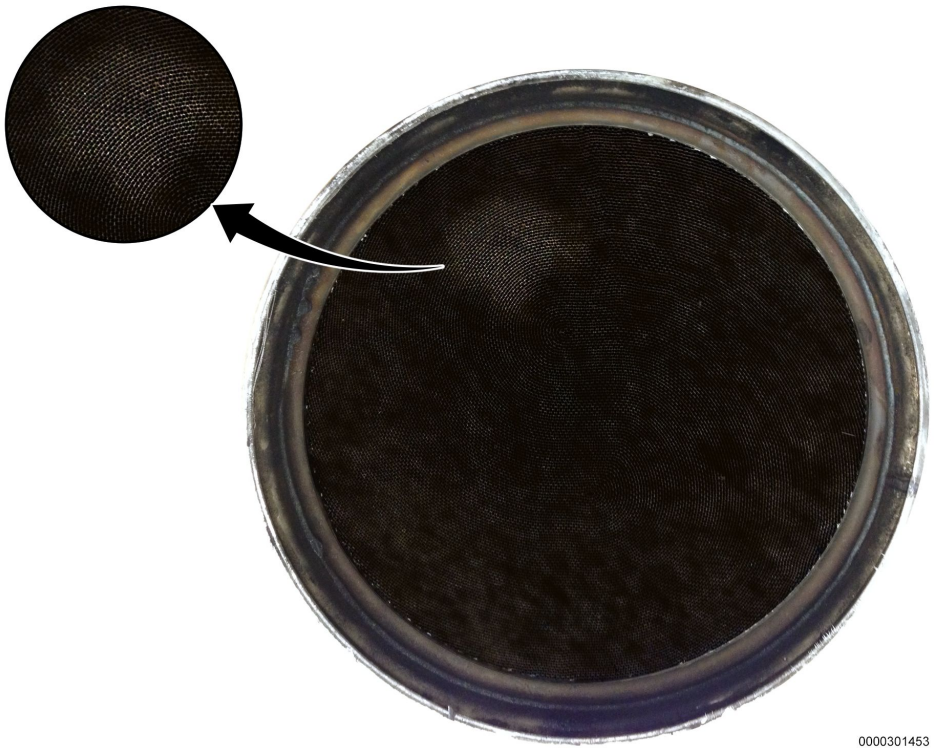


Figure 31 Diesel Oxidation Catalyst (DOC) Inlet – Face Plugged.

Appearance	The DOC inlet face is plugged and light colored areas show signs of coolant flowing through the exhaust system.
Cause	Light engine duty cycles, low exhaust temperatures, excessive engine smoke, or coolant entering the exhaust system.
Action	Determine the cause of the face plugging. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the source of the face plugging has been repaired, the DOC can be cleaned if it is not saturated with coolant. Refer to the DPF and DOC Cleaning section, (page 18).

2.8.4. Diesel Particulate Filter (DPF) Inlet / Outlet – New

0000060996

Figure 32 Diesel Particulate Filter (DPF) Inlet – New.

Appearance	The DPF face is completely clear and all channels are visible.
Action	This is a new filter and is ready to use.

2.8.5. Diesel Particulate Filter (DPF) Inlet – Good but Dirty (1)

0000061002

Figure 33 Diesel Particulate Filter (DPF) Inlet – Dirty and Usable (1).

Appearance	Black soot and gray ash can be seen on the face of the DPF and within the channels.
Cause	The system is working properly.
Action	No action should be taken. The filter can be reused.

2.8.6. Diesel Particulate Filter (DPF) Inlet – Good but Dirty (2)

0000060997

Figure 34 Diesel Particulate Filter (DPF) Inlet – Dirty and Usable (2).

Appearance	Black soot and gray ash can be seen on the face of the DPF and within the channels.
Cause	The system is working properly.
Action	No action should be taken, the filter can be reused.

2.8.7. Diesel Particulate Filter (DPF) Inlet – Clean

Figure 35 Diesel Particulate Filter (DPF) Inlet – Clean.

Appearance	Very little black soot or gray ash can be seen on the face of the DPF and within the channels.
Cause	The system is working properly.
Action	No action should be taken, the filter can be reused.

2.8.8. Diesel Particulate Filter (DPF) Inlet – Gouged

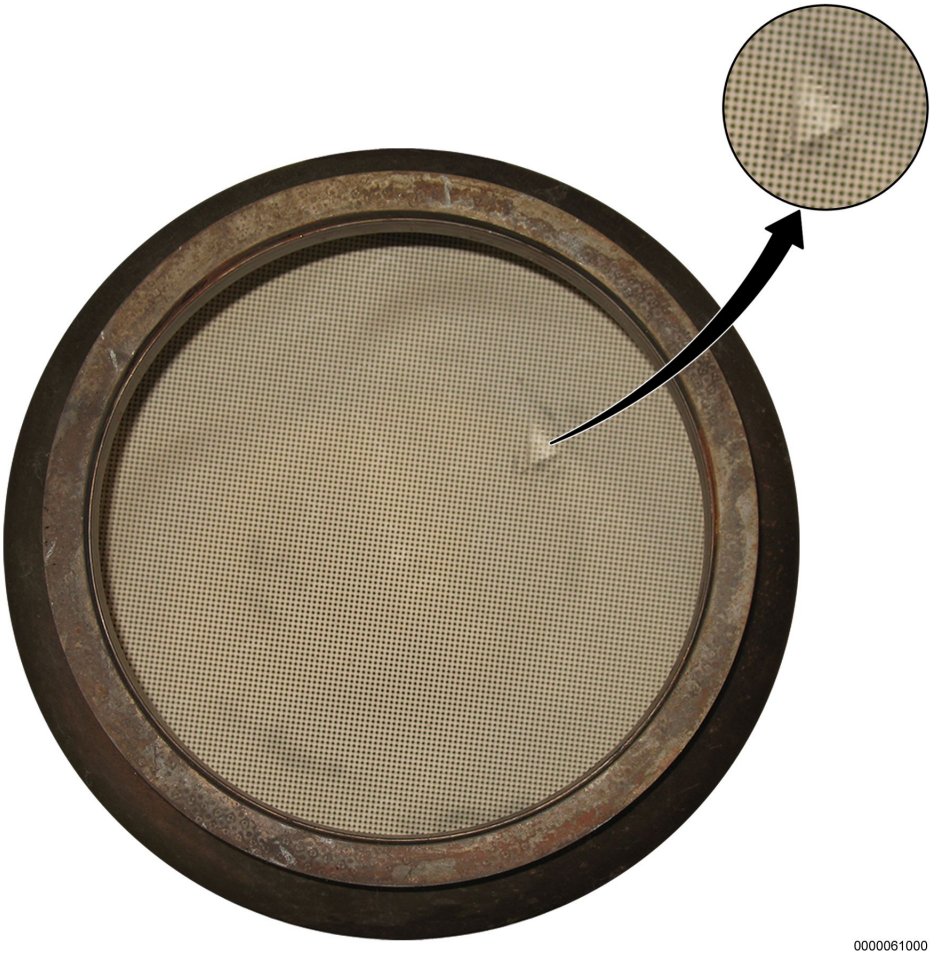
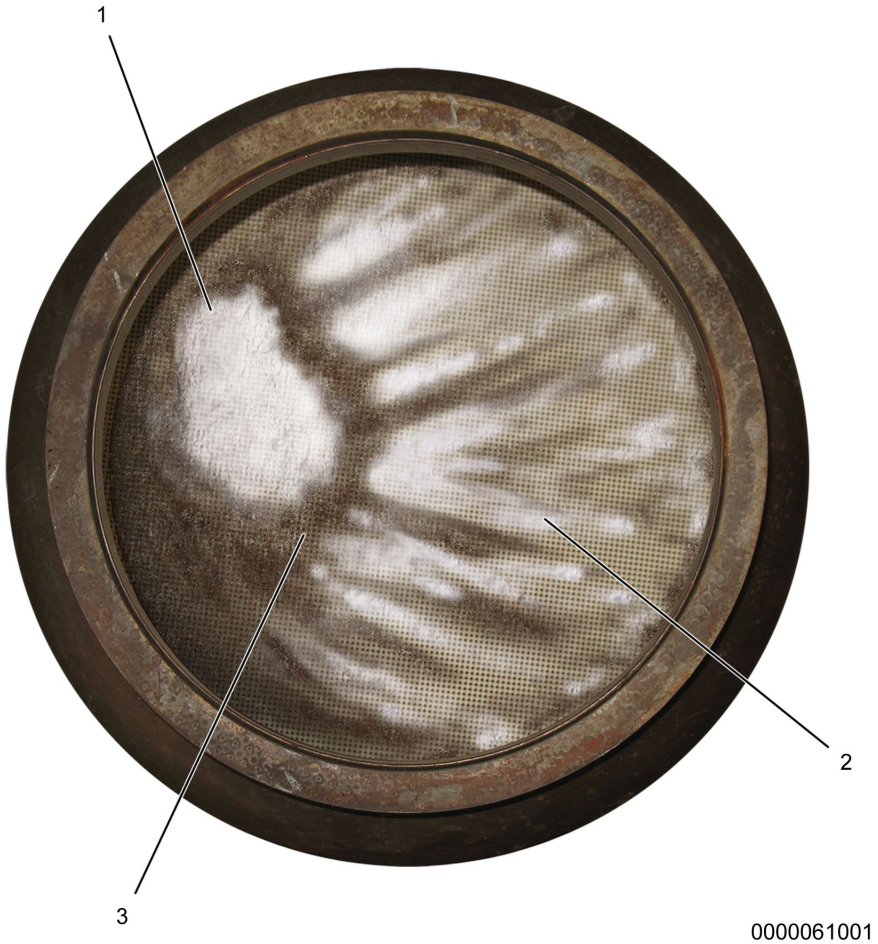


Figure 36 Diesel Particulate Filter (DPF) Inlet – Gouged.

Appearance	The face of the DPF is physically gouged.
Cause	The DPF face was struck with an object or gouged during the manufacturing process.
Action	Check if the gouge(s) in the substrate material is more than 1/8 in (3 mm) deep. If the gouge(s) is deeper than 1/8 in (3 mm), and there are more than 20 cell plugs missing or damaged due to the gouge(s), replace the DPF.

2.8.9. Diesel Particulate Filter (DPF) Inlet – Ash



1. Concentrated ash
2. Dark wet surrounding soot ring
3. Uneven soot streaks

Figure 37 Diesel Particulate Filter (DPF) Inlet – Ash.

Appearance	Concentrated white ash with a dark wet surrounding ring and uneven soot streaks.
Cause	Excessive oil concentration in exhaust gases.
Action	Determine the cause of excessive oil in the exhaust gases. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the source of the oil contamination has been repaired, replace the DPF.

2.8.10. Diesel Particulate Filter (DPF) Inlet – Dark Soot Rings

1. Dark soot rings

Figure 38 Diesel Particulate Filter (DPF) Inlet – Dark Soot Rings.

Appearance	Dark soot rings are visible on the face of the DPF.
Cause	Excessive coolant concentration in exhaust gases.
Action	Determine the cause of coolant contamination in the exhaust system. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the cause of the coolant contamination has been repaired, the DPF can be recovered. Refer to the DPF and DOC Cleaning section, (page 18).

2.8.11. Diesel Particulate Filter (DPF) Outlet – Soot Stains

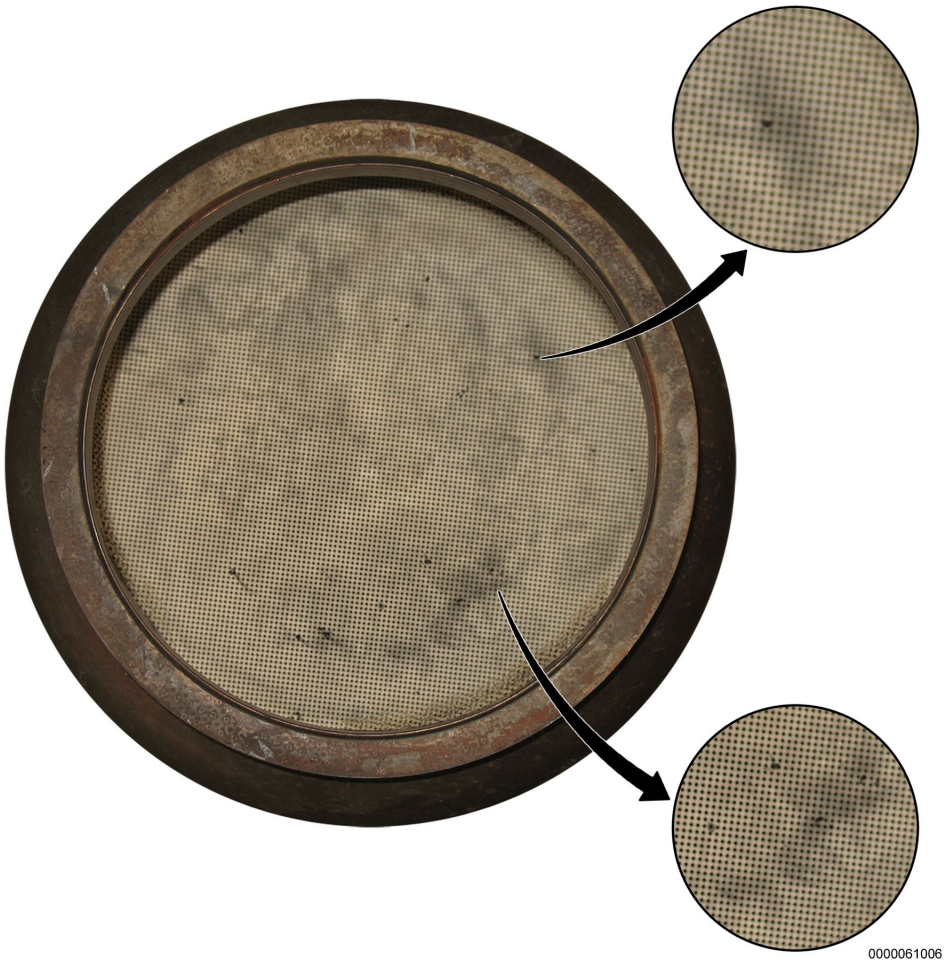


Figure 39 Diesel Particulate Filter (DPF) Outlet – Soot Stains.

Appearance	Black soot stains on the outlet of the DPF.
Cause	Excessive fuel or oil concentration in exhaust.
Action	Determine the cause of excessive fuel or oil in the exhaust system. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the cause of the excessive fuel or oil has been repaired, replace the DPF.

2.8.12. Diesel Particulate Filter (DPF) Outlet – Burn Marks from Welding Process

1. Brown staining

Figure 40 Diesel Particulate Filter (DPF) Outlet – Burn Marks from Welding Process.

Appearance	Brown staining on the edges of the DPF outlet.
Cause	Created by the welding process during manufacturing.
Action	Inspect the filter for black soot stains in the outlet cell walls. If only brown burn marks are visible, the filter can be reused.

2.8.13. Diesel Particulate Filter (DPF) Outlet – Excessive Soot Stains

0000060994

Figure 41 Diesel Particulate Filter (DPF) Outlet – Excessive Soot Stains.

Appearance	Black soot stains on the DPF outlet.
Cause	Excessive fuel or oil concentration in exhaust.
Action	Determine the cause of excessive fuel or oil in the exhaust system. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the cause of the excessive fuel or oil has been repaired, replace the DPF.

2.8.14. Diesel Particulate Filter (DPF) Outlet – Face Cracked

Figure 42 Diesel Particulate Filter (DPF) Outlet – Face Cracked.

Appearance	Crack across the face of the DPF.
Cause	High soot load in the DPF reacted rapidly with the engine exhaust gases, creating a high temperature and cracking the substrate.
Action	Determine the cause of high soot load in the DPF. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the cause of the high soot load has been repaired, replace the DPF.

2.8.15. Diesel Particulate Filter (DPF) Outlet – Coolant Staining

Figure 43 Diesel Particulate Filter (DPF) Outlet – Coolant Staining.

Appearance	Dark streak on the face of the DPF.
Cause	Excessive coolant concentration in exhaust gases.
Action	Determine the cause of coolant contamination in the exhaust system. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the cause of the coolant contamination has been repaired, the DPF can be recovered. Refer to the DPF and DOC Cleaning section, (page 18).

2.8.16. Diesel Particulate Filter (DPF) Outlet – Melted

0000060992

Figure 44 Diesel Particulate Filter (DPF) Outlet – Melted.

Appearance	The DPF shows melted or deformed cells.
Cause	Excessive fuel in the exhaust.
Action	Determine the cause of excessive fuel in the exhaust system. Refer to the appropriate engine diagnostic manual for diagnostic procedures. Once the cause of the excessive fuel has been repaired, replace the DPF.

2.9. DECOMPOSITION REACTOR TUBE CLEANING

The decomposition reactor tube may become blocked by diesel exhaust fluid (DEF) deposits. If the DEF deposits in the mixer area are blocking more than 50% of the decomposition reactor tube, the decomposition reactor tube must be cleaned.

CAUTION

To prevent property damage, do not use a metallic object to clean the decomposition reactor tube. This will scratch the surface of the decomposition reactor tube, which may cause excessive DEF deposits in the future.

If DEF deposits are present, carefully scrape with a nonmetallic object to remove the majority of the DEF deposits. Use a pressure washer to dissolve the remaining DEF deposits. Use **only** water to remove deposits.

CAUTION

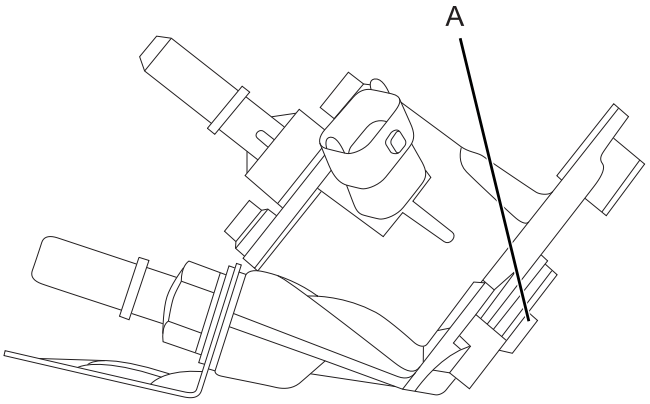
To prevent property damage, do not submerge the decomposition reactor tube in water or solvents, which can saturate and damage the insulation.

Inspect the exhaust flanges for corrosion or other damage. Use a nonmetallic abrasive pad to remove any residual gasket material from the flanges on the decomposition reactor tube.

CAUTION

To prevent property damage, do not grind on the flange surface. This can damage the flange and cause the connection to leak.

2.10. DIESEL EXHAUST FLUID (DEF) DOSING VALVE CLEANING



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1. DEF dosing valve tip

Figure 45 DEF Dosing Valve Tip.

If DEF deposits are found at the DEF dosing valve tip during inspection, the DEF dosing valve must be cleaned.

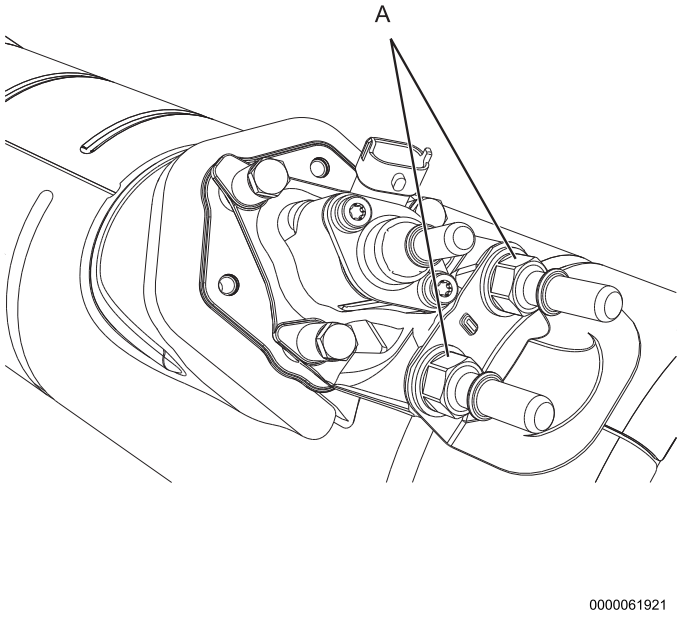
CAUTION

To prevent property damage, do not submerge the DEF dosing valve in solvent or water.

Use a brass brush and warm distilled water to clean the bottom and the tip of the aftertreatment DEF dosing valve. Wipe any debris away with a clean shop towel soaked in distilled water.

CAUTION

To prevent property damage, only use a brass brush to clean the tip of the DEF dosing valve. The use of a wire wheel will cause permanent damage to the DEF dosing valve.



1. DEF dosing coolant fittings

Figure 46 DEF Dosing Valve Coolant Passages.

The DEF dosing valve coolant passages can be cleaned with a safety solvent and pipe cleaner. Once cleaning is complete, perform the following:

1. Position the DEF dosing valve so that the coolant passages are pointing upward.
2. Pour safety solvent in one coolant port until the safety solvent begins to flow out of the opposite port.
3. Dry the DEF dosing valve with compressed air.

NOTE – If safety solvent does not flow as one continuous stream, the coolant passage may still be restricted or blocked. Repeat the pipe cleaner and safety solvent cleaning process again and inspect. If safety solvent does not flow after multiple cleaning attempts, replace the DEF dosing valve.

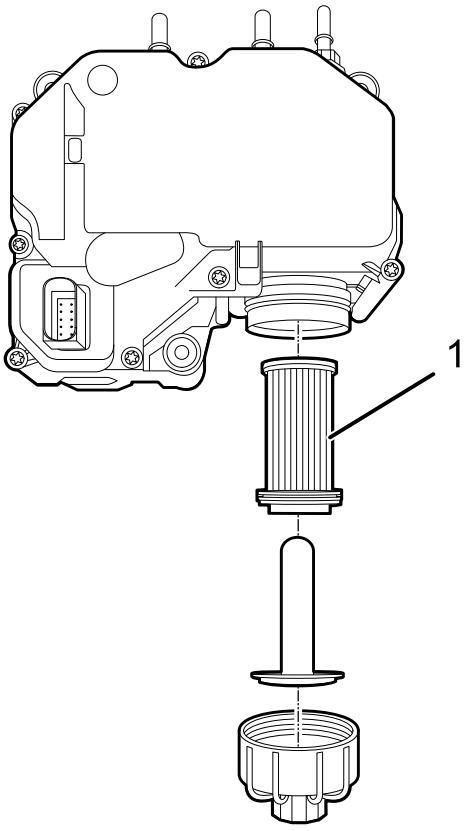
2.11. DEF SUPPLY MODULE FILTER INSPECTION

This section outlines the inspection guidelines for the DEF supply module filter. General inspection should be performed when the DEF supply module is being serviced.

NOTE – Do not disconnect the vehicle batteries until the DEF dosing system has completed the purge cycle. Before beginning to remove and / or disconnect any components, wait at least 5 minutes after the key is turned OFF for the DEF dosing system to purge the DEF from the system. The purge cycle is an automatic process and does not require operator intervention. The DEF supply module will issue an audible pumping noise during the purging process.

CAUTION

To prevent property damage, the DEF line connecting the DEF supply module to the DEF dosing valve is under low pressure and should not be disconnected while the engine is running or before the system has completed the purge process after engine shutdown. Disconnecting the DEF line while under low pressure could disperse DEF.



0000061959

1. DEF supply module filter

Figure 47 Diesel Exhaust Fluid (DEF) Supply Module Filter.

If it is suspected that contaminated DEF has gone through the DEF dosing system, inspect the DEF supply module filter for contamination or an abnormal aroma prior to discarding.

NOTE – When DEF supply module filter is removed from the DEF supply module, it must be discarded and replaced; regardless of condition.

Refer to Diesel Exhaust Fluid (DEF) System Contamination (page 53) for further information regarding contaminated DEF.

2.12. DIESEL EXHAUST FLUID (DEF) SYSTEM CONTAMINATION

This section of the procedure provides information for testing the concentration of diesel exhaust fluid (DEF). The correct concentration of DEF is critical to proper engine and aftertreatment system operation.

CAUTION

It is unlawful to tamper with or remove any component of the aftertreatment system. It is also unlawful to use a DEF that does not meet the specifications provided or to operate the vehicle / equipment without DEF.

The acceptable DEF concentration specification is 32.5 ± 1.5%. Refer to the Diesel Exhaust Fluid (DEF) Refractometer Tool, (page 56) section for instructions on checking DEF concentration. DEF concentration should be checked when:

- The vehicle has been stored for an extended period of time.
- It is suspected that water has been added to the DEF tank.

DEF can become contaminated by the following situations:

- The DEF tank coolant heating system malfunctions, allowing coolant to mix with the DEF.
- The DEF tank cap is missing or damaged, or the tank vent malfunctions.
- The DEF tank is filled with the incorrect fluid.

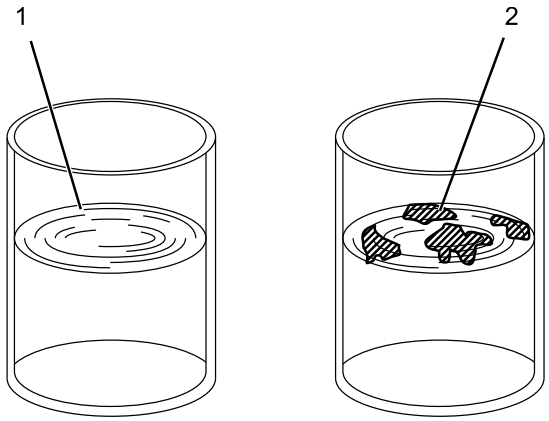
In the event that the DEF becomes contaminated, inspect the DEF to determine the most likely source. Obtain a sample of DEF from the highest fluid point in the DEF tank.

WARNING

To prevent personal injury and / or death, do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. The DEF contains urea. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the Material Safety Data Sheet (MSDS) for additional information.

NOTE – If the DEF system is contaminated, also inspect the DEF tank pickup screen. Refer to Diesel Exhaust Fluid (DEF) Tank Pickup Assembly (See Diesel Exhaust Fluid (DEF) Tank Pickup Assembly – Removal, page 148)) for location.

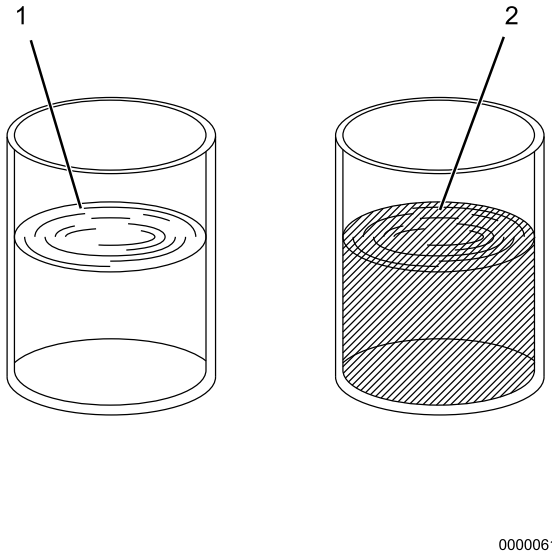
Types of DEF Contamination	
Petroleum based liquids	**Non-petroleum based liquids**
• Diesel fuel • Hydraulic fluid • Brake fluid	• Water • Coolant • Brake fluid



1. Clean uncontaminated DEF
2. DEF contaminated by petroleum based substance

Figure 48 Petroleum Based Contamination.

Since DEF is largely composed of water, petroleum based liquids will separate from the DEF and rise to the top. Look for separation of the fluids, as well as characteristic smells.



1. Clean uncontaminated DEF
2. DEF contaminated by non-petroleum based substance

Figure 49 Non-Petroleum Based Contamination.

If water has been added, the DEF will remain clear. As a result, the DEF will become diluted, reducing the concentration level. Other non-petroleum based liquids typically have coloring and will mix with DEF giving, it a tint. Look for other fluids used on the vehicle that may match, such as coolant or windshield washer fluid.

NOTE – If only water has been added to the DEF tank, drain the DEF tank, flush with distilled water, and fill the tank with new and / or known good DEF. Check the DEF concentration after completing the refill.

2.13. DEF SYSTEM DECONTAMINATION PROCEDURE

If contamination has traveled through the DEF dosing system, perform the following:

1. Drain the DEF tank, flush with distilled water, and replace the DEF tank pickup assembly filter.
2. Remove all of the DEF lines and flush with distilled water.
3. Remove the DEF supply module filter cap.
4. Fill DEF supply module cleaner bottle 18-200-01-01 with water and connect to supply module inlet connector.
5. Using Electronic Service Tool (EST) with ServiceMaxx™ software, go to Tests > KOEO Aftertreatment Tests > DEF Doser Pump Override Test.
6. Select Begin Test. Squeeze DEF supply module cleaner bottle to push water into DEF supply module, until supply module draws water on its own. Repeat flushing procedure until water runs clear.
7. Drain any remaining distilled water from DEF tank and refill with new and / or known good DEF. Check DEF concentration.
8. Replace the DEF supply module filter.
9. Perform a stationary regeneration. Refer to the applicable vehicle operator's manual.
10. Road test the vehicle for 30 minutes to verify system operation.

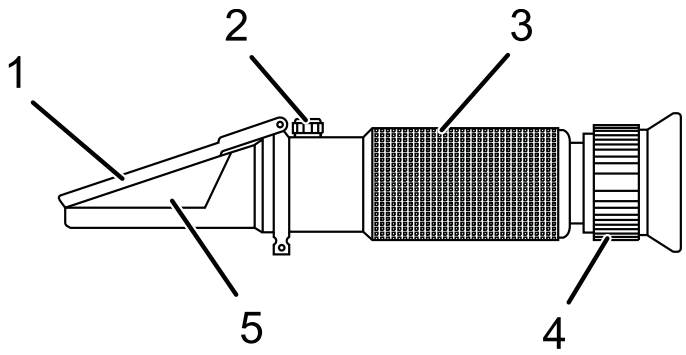
2.14. DIESEL EXHAUST FLUID (DEF) REFRACTOMETER TOOL

The DEF refractometer is a portable instrument used for measuring DEF concentration. This section will outline how the DEF refractometer is used.

WARNING

To prevent personal injury and / or death, do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. The DEF contains urea. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the Material Safety Data Sheet (MSDS) for additional information.

NOTE – The acceptable DEF concentration specification is 32.5 ± 1.5%. If a reading is outside of this specification, the DEF system must be decontaminated and inspected.



0000061545

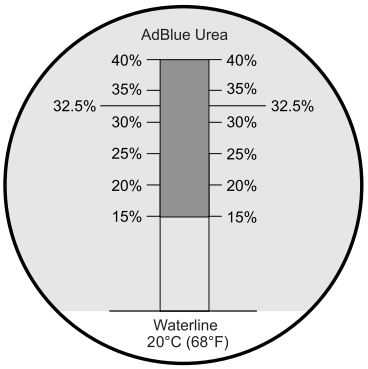
1. Cover plate
2. Correction screw
3. Mirror tube
4. Eyepiece
5. Prism

Figure 50 DEF Refractometer.

Using the DEF Refractometer

1. Aim the prism and cover plate toward a bright light. Adjust the focusing ring of the diopter until the scale within the mirror tube can be seen clearly.

2. To set the refractometer to a null or zero point:
   a. Open the cover plate.
   b. Place one or two drops of pure distilled water on the surface of the prism.
   c. Close the cover plate and press it lightly.
   d. Through the eyepiece, observe where the shadow line falls.
   e. If necessary, adjust the correction screw and make the shadow line coincide with the water line.



0000061544

The refractometer should now have a null point and can be used to measure DEF concentration.

3. Open the cover plate and use a soft cloth provided to wipe the water off the surfaces of the prism and cover plate.

4. Using the plastic dropper, place one or two drops of the DEF on the surface of the prism.

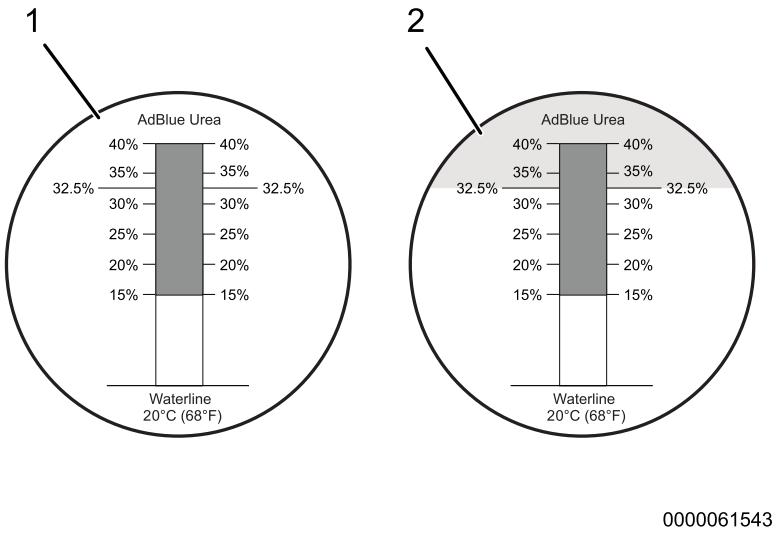
5. Close the cover plate and press it lightly.

6. After measurements are taken, use a soft cloth to wipe the DEF completely from the prism surface and let the surface dry.

CAUTION

To prevent damage to the refractometer, do not use water to wash the instrument.

7. Replace the refractometer in its case and store it in a clean, dry area.



1. DEF refractometer scale without any liquid on the prism
2. DEF refractometer scale with liquid on the prism

Figure 52 DEF Refractometer Scale Examples.

DEF Refractometer Maintenance

- The distilled water and the liquid being measured should be at the same temperature.
- The null point should be adjusted once every 30 minutes (during use).
- Clean the prism completely to prevent residual impurities, which could cause error during measuring.
- The refractometer is a precision optical instrument; handle with care. Do not touch the optical surfaces.
- Avoid strong shock during transportation.

2.15. DIESEL EXHAUST FLUID (DEF) DOSING SYSTEM REUSE GUIDELINES

This section outlines visual examples of DEF system contamination. If contamination is detected, the DEF tank, DEF tank pickup screen, DEF supply module, and all DEF lines must be drained, removed, disassembled, and cleaned thoroughly. Refer to the DEF system decontamination procedure, (page 56).

0000061008

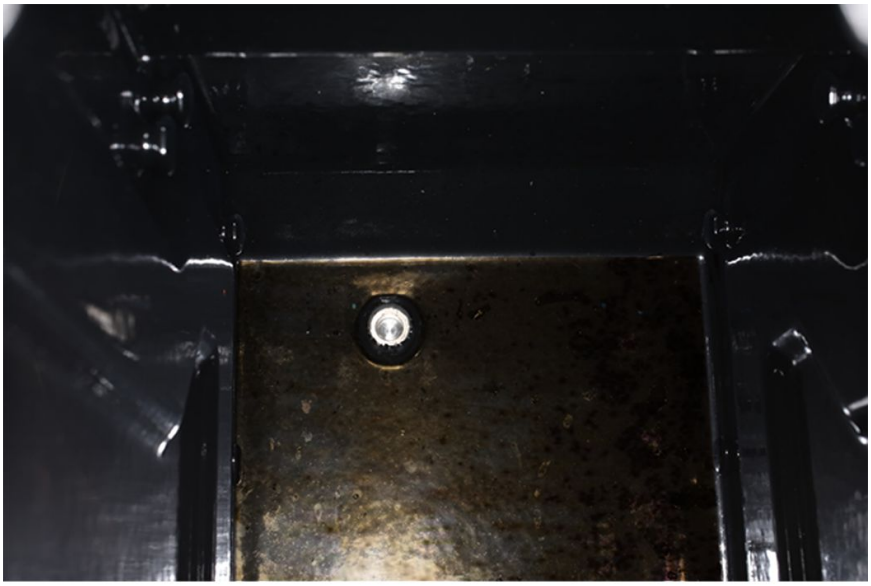
Figure 53 Contamination on Inside Edges of DEF Tank.

Oily substance on the inside edges of the DEF tank indicates that the DEF has been contaminated.

0000061007

Figure 54 Oily Substance On The Def Tank Pickup Assembly.

Oily substance in the bottom the DEF tank pickup assembly indicates the DEF has been contaminated.



0000061009

Figure 55 Debris on Bottom of DEF Tank.

Heavy debris on the bottom the DEF tank pickup assembly indicates the DEF has been contaminated.

0000299083

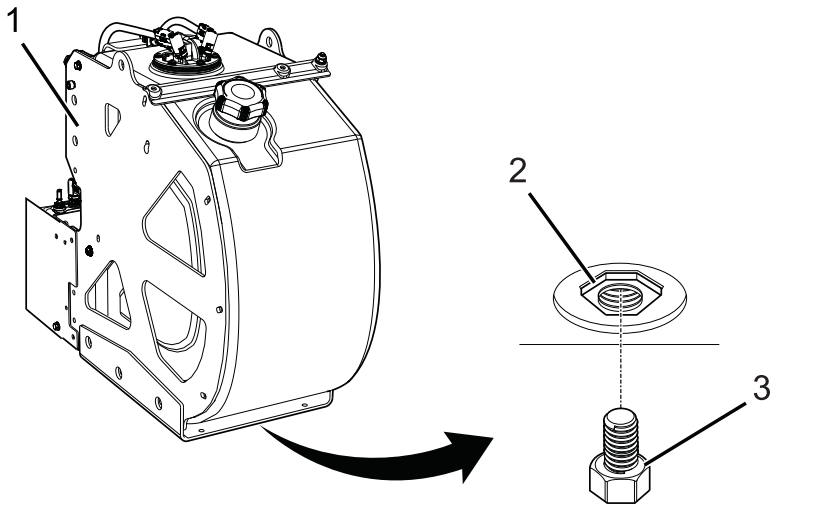
Figure 56 Heavily Contaminated DEF.

A sample of DEF showing evidence of heavy contamination.

2.16. DIESEL EXHAUST FLUID (DEF) TANK DRAINING

WARNING

To prevent personal injury and / or death, do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. The DEF contains urea. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the Material Safety Data Sheet (MSDS) for additional information.



1. DEF tank
2. DEF tank drain plug bung
3. DEF tank drain plug

Figure 57 DEF Tank and Drain Plug (if equipped).

If it is necessary to drain the DEF tank during service, the drain plug (if equipped) is located on the bottom of the DEF tank.

CAUTION

While removing or installing the DEF tank drain plug, the DEF tank drain plug bung must be held in place with a wrench. If the DEF tank drain plug bung is not held in place, it may cause a leak.

CAUTION

Disposing of Diesel Exhaust Fluid (DEF) should always be in accordance with all local laws and regulations. Refer to http://www.epa.gov for more information.

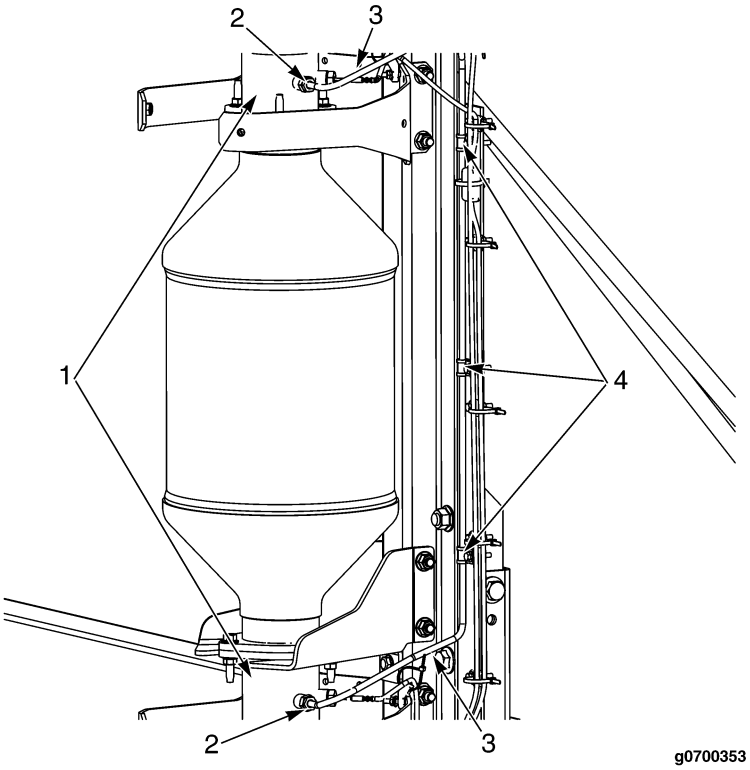
3. COMPONENT REPLACEMENT

NOTE – It may be necessary to remove the heat shield from the exhaust aftertreatment system prior to removing any components. Refer to the applicable diesel particulate filter (DPF) removal procedures for the configuration on which you are working to remove the heat shield.

3.1. MAXXFORCE® 7, DT, 9, OR 10 SYSTEMS

These removal and installation procedures show a typical exhaust aftertreatment system for the MaxxForce® 7, DT, 9, and 10 engines. Although some configurations may vary, the removal and installation of these components will be similar.

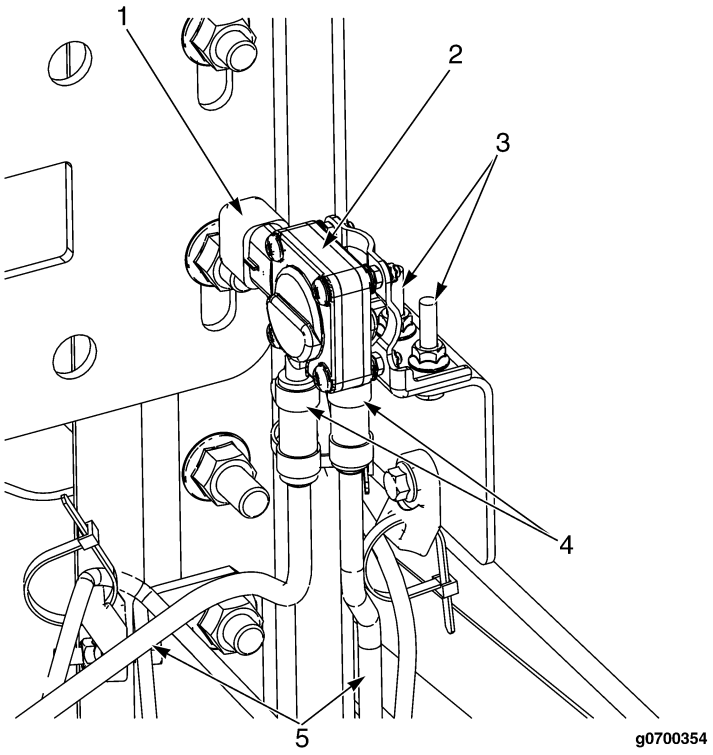
3.1.1. Tubes and Diesel Particulate Filter Differential Pressure (DPFDP) Sensor – Removal



1. DPF pipe (2)
2. Tube nut (2)
3. Tube (2)
4. Nut, bolt, and P-clamp (3)

Figure 58 Tubes.

1. Remove three bolts, nuts, and P-clamps (Figure 58) (Item 4) from tube (Figure 58) (Item 3).
2. Remove two tube nuts (Figure 58) (Item 2) from DPF pipes, (Figure 58) (Item 1).



1. Electrical connector
2. DPFDP sensor
3. Nut and bolt (2)
4. Hose clamp and hose (2)
5. Tube (2)

Figure 59 DPFDP Sensor.

3. Disconnect electrical connector (Figure 59) (Item 1) from DPFDP sensor (Figure 59) (Item 2).

4. Remove two hose clamps and hoses (Figure 59) (Item 4) from DPFDP sensor (Figure 59) (Item 2) and remove tubes (Figure 59) (Item 5).

5. Remove two nuts and bolts (Figure 59) (Item 3) from DPFDP sensor (Figure 59) (Item 2).

6. Remove DPFDP sensor (Figure 59) (Item 2) from vehicle.

3.1.2. Tubes and DPFDP Sensor – Installation

1. Install DPFDP sensor (Figure 59) (Item 2) on vehicle with two nuts and bolts (Figure 59) (Item 3) . Torque bolts to 84 - 96 lb-in (9 - 11 N•m).

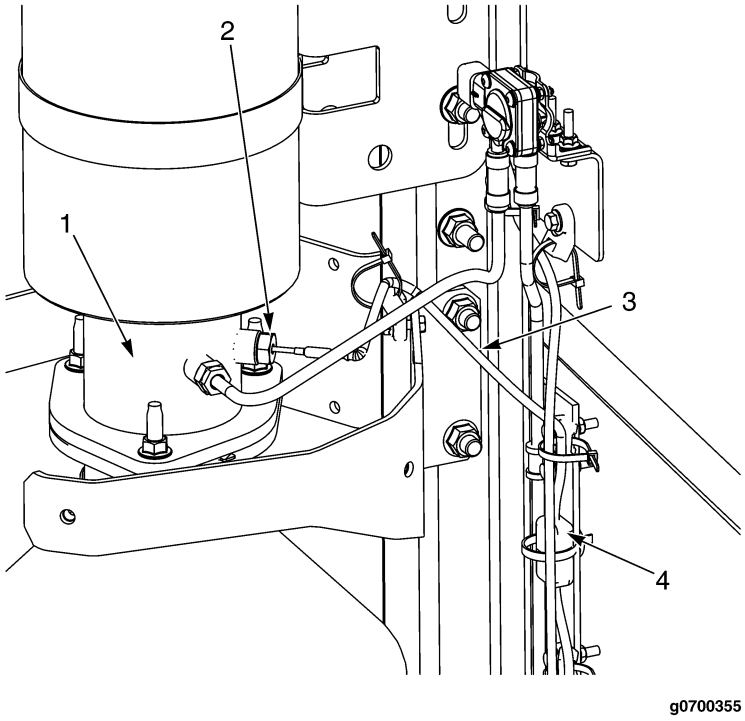
2. Align tubes (Figure 59) (Item 5) and secure to DPFDP sensor (Figure 59) (Item 2) with two hoses and hose clamps (Figure 59) (Item 4).

3. Connect electrical connector (Figure 59) (Item 1) to DPFDP sensor (Figure 59) (Item 2).

4. Install two tubes (Figure 58) (Item 3) on exhaust pipes (Figure 58) (Item 1) with two nuts (Figure 58) (Item 2). Torque pressure nuts to 9 - 15 lb-ft (12 - 20 N•m).

5. Secure longest tube (Figure 58) (Item 3) with three bolts, nuts, and P-clamps (Figure 58) (Item 4). Torque bolts to 84 - 96 lb-in (9 - 11 N•m).

3.1.3. Temperature Sensor – Removal



1. Exhaust pipe
2. Temperature sensor
3. Wiring
4. Electrical connector

Figure 60 Temperature Sensor.

1. Disconnect electrical connector (Figure 60) (Item 4).
2. Remove tie straps as needed from wiring. Discard tie straps.
3. Remove temperature sensor (Figure 60) (Item 2) from exhaust pipe (Figure 60) (Item 1).

3.1.4. Temperature Sensor – Installation

1. Apply antiseize compound to bottom three threads of temperature sensor (Figure 60) (Item 2).
2. Install temperature sensor (Figure 60) (Item 2) on exhaust pipe (Figure 60) (Item 1). Torque temperature sensor to 18 - 30 lb-ft (25 - 40 N•m).

CAUTION

To prevent damage to temperature sensor or wiring, when securing the temperature sensor wiring, ensure that the wiring is not pulled tight or has excessive slack at the temperature sensor.

3. Connect electrical connector (Figure 60) (Item 4).

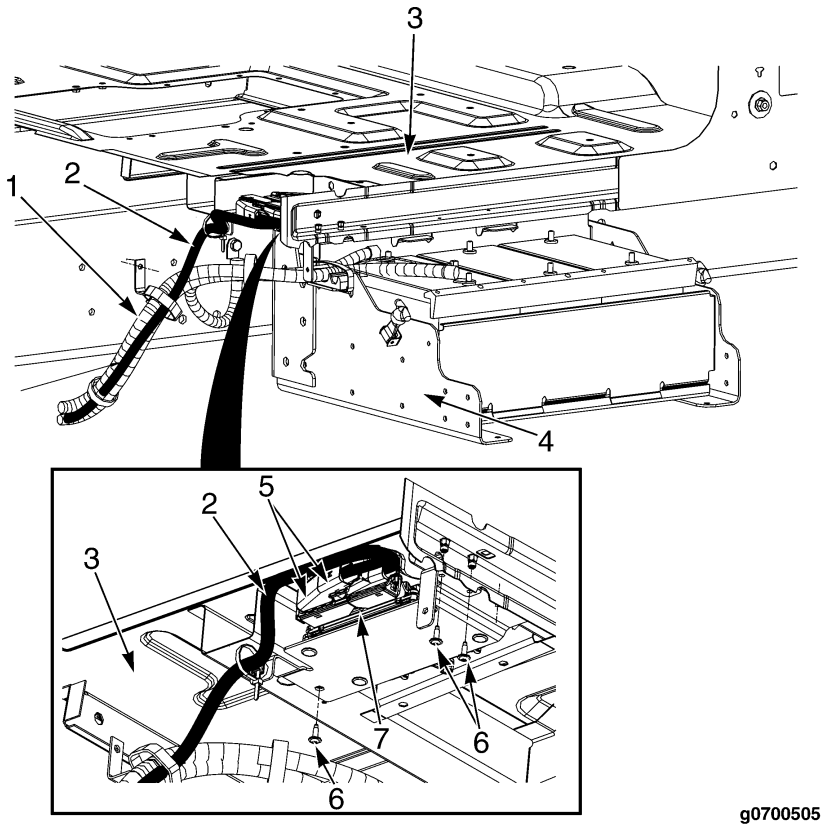
4. Secure wiring (Figure 60) (Item 3) as needed with new tie straps.

3.1.5. Aftertreatment Control Module (ACM) – Removal

NOTE – The ACM is part of the MaxxForce® DT, 9, and 10 exhaust aftertreatment system only (the Maxxforce® 7 is not equipped with one). The ACM is located on the left underside of the cab to the left of the battery box.

NOTE – Refer to the applicable Engine Diagnostic Manual for ACM diagnostic and troubleshooting information.

1. Remove tie straps as necessary. Discard tie straps.



1. Battery cable
2. ACM harness
3. Left underside of cab
4. Battery box
5. Electrical connector (2)
6. Torx screw (3)
7. Aftertreatment Control Module (ACM)

Figure 61 Aftertreatment Control Module (ACM).

2. Disconnect two electrical connectors (Figure 61) (Item 5) from ACM (Figure 61) (Item 7).

3. Remove three torx screws (Figure 61) (Item 6) and ACM (Figure 61) (Item 7) from left underside of cab (Figure 61) (Item 3).

3.1.6. Aftertreatment Control Module (ACM) – Installation

NOTE – If a new ACM is being installed, programming is required after replacement. Refer to applicable Engine Diagnostic Manual for ACM programming instructions.

1. Install ACM (Figure 61) (Item 7) to left underside of cab with three torx screws (Figure 61) (Item 6). Torque torx screws to 48 - 72 lb-in (5 - 8 N•m).

NOTE – Attach 53-way electrical connector first, then 86-way electrical connector.

2. Connect two electrical connectors (Figure 61) (Item 5) to ACM (Figure 61) (Item 7).

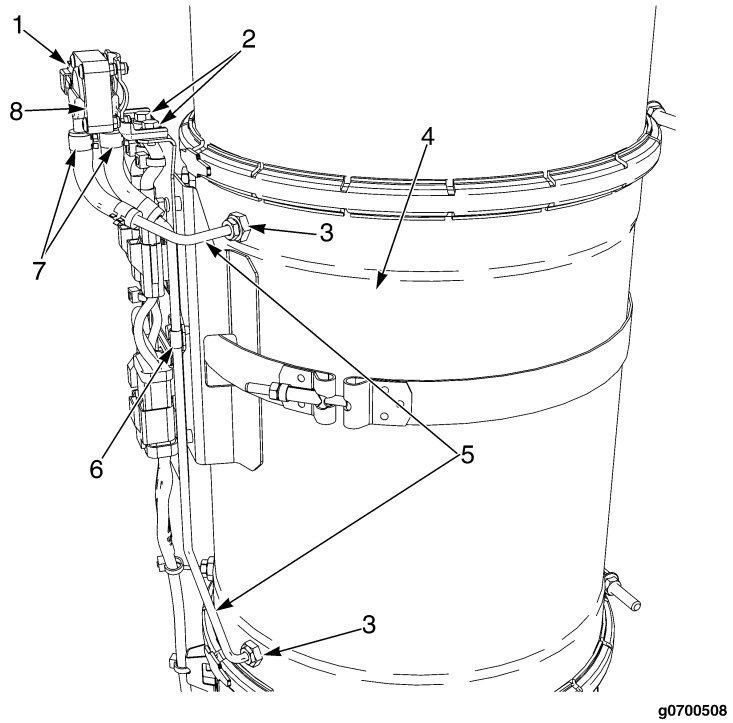
NOTE – If ACM harness was disconnected, route ACM harness along with battery cables to left-side undercab battery box using existing mounting hardware.

3. Secure all wiring and cables with new tie straps as necessary.

3.2. MAXXFORCE® 11, 13, OR 15 SYSTEM

These removal and installation procedures show a typical exhaust system for the MaxxForce® 11, 13, and 15 engines. Although some configurations may vary, the removal and installation of these components will be similar.

3.2.1. Tubes and DPFDP Sensor – Removal



1. Electrical connector
2. Nut and bolt (2)
3. Pressure nut (2)
4. Diesel Particulate Filter (DPF)
5. Tube (2)
6. Bolt, nut, and P-clamp
7. Hose clamp and hose (2)
8. DPFDP sensor

Figure 62 DPFDP Sensor and Tubes.

1. Disconnect electrical connector (Figure 62) (Item 1) from DPFDP sensor (Figure 62) (Item 8).
2. Remove nuts and P-clamps (Figure 62) (Item 6) from tubes (Figure 62) (Item 5) as needed.
3. Remove tie straps from tubes (Figure 62) (Item 5) as needed. Discard tie straps.
4. Remove two nuts (Figure 62) (Item 3) and disconnect tubes (Figure 62) (Item 5).
5. Remove hose clamps and hoses (Figure 62) (Item 7) from DPFDP sensor (Figure 62) (Item 8) and remove tubes (Figure 62) (Item 5).
6. Remove two nuts, bolts (Figure 62) (Item 2) , and DPFDP sensor (Figure 62) (Item 7) from vehicle.

3.2.2. Tubes and DPFDP Sensor – Installation

1. Install DPFDP sensor (Figure 62) (Item 8) on vehicle with two nuts and bolts (Figure 62) (Item 2). Torque bolts to 84 - 96 lb-in (9 - 11 N•m).

2. Align tubes (Figure 62) (Item 5) and install DPFDP sensor (Figure 62) (Item 8) with hoses and hose clamps (Figure 62) (Item 7).

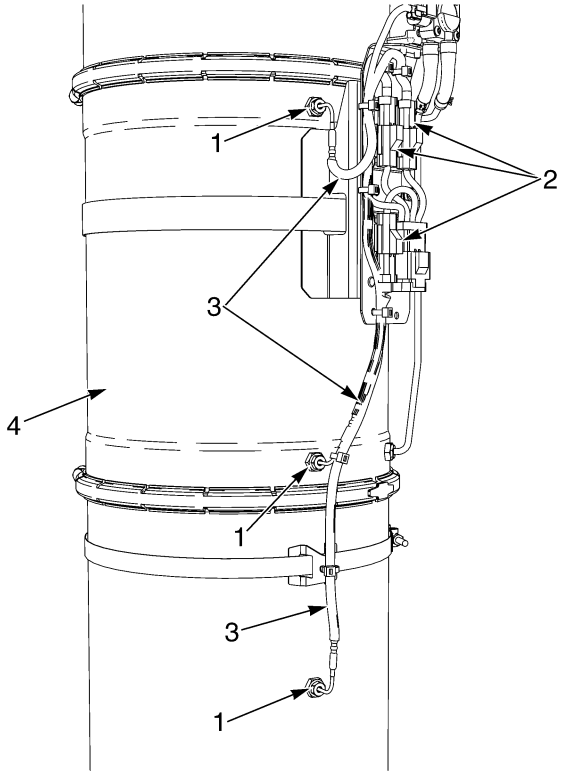
3. Secure two tubes (Figure 62) (Item 5) with two nuts (Figure 62) (Item 3). Torque nuts to 11 - 13 lb-ft (15 - 17 N•m).

4. Secure tube (Figure 62) (Item 5) as needed with bolts, nuts, and P-clamps, (Figure 62) (Item 6). Torque bolts to 84 - 96 lb-in (9 - 11 N•m).

5. Connect electrical connector (Figure 62) (Item 1) to DPFDP sensor (Figure 62) (Item 8).

6. Install new tie straps, as needed, to pressure tubes and wiring.

3.2.3. Temperature Sensor – Removal



1. Temperature sensor (3)
2. Electrical connector (3)
3. Wiring
4. Diesel Particulate Filter (DPF)

Figure 63 Temperature Sensor.

1. Disconnect electrical connector (Figure 63) (Item 2).

2. Remove tie straps, as needed, from wiring (Figure 63) (Item 3). Discard tie straps.

3. Remove temperature sensor (Figure 63) (Item 1) from DPF (Figure 63) (Item 4).

3.2.4. Temperature Sensor – Installation

1. Apply antiseize compound to the bottom three threads of temperature sensor (Figure 63) (Item 1).

2. Install temperature sensor (Figure 63) (Item 1) on DPF (Figure 63) (Item 4). Torque temperature sensor to 18 - 26 lb-ft (25 - 35 N•m).

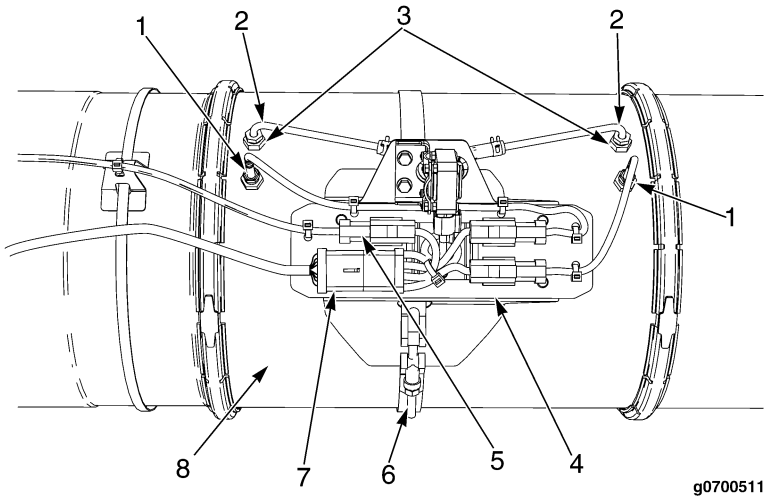
CAUTION

To prevent damage to temperature sensor or wiring, when securing the temperature sensor wiring, ensure that the wiring is not pulled tight or has excessive slack at the temperature sensor.

3. Connect electrical connector (Figure 63) (Item 2).

4. Secure wiring (Figure 63) (Item 3) as needed, with new tie straps.

3.2.5. Sensor Junction Box – Removal



1. Temperature sensor
2. Pressure tube
3. Pressure nut
4. Sensor junction box
5. Output temperature sensor electrical connector
6. Band strap
7. Sensor junction box electrical connector
8. Diesel Particulate Filter (DPF)

Figure 64 Sensor Junction Box.

1. Disconnect output temperature sensor electrical connector (Figure 64), Item 5) from sensor junction box (Figure 64) (Item 4).

2. Disconnect sensor junction box electrical connector (Figure 64) (Item 7) from sensor junction box (Figure 64) (Item 4).

3. Remove two pressure nuts (Figure 64) (Item 3) and disconnect two pressure tubes (Figure 64) (Item 2).

4. Remove two temperature sensors (Figure 64) (Item 1) from DPF (Figure 64) (Item 8).

5. Loosen band strap (Figure 64) (Item 6) securing sensor junction box (Figure 64) (Item 4) to DPF (Figure 64) (Item 8).

6. Remove sensor junction box (Figure 64) (Item 4) from DPF (Figure 64) (Item 8).

3.2.6. Sensor Junction Box – Installation

1. Install sensor junction box (Figure 64) (Item 4) onto DPF (Figure 64) (Item 8) with band strap (Figure 64) (Item 6). Torque band strap to 15 lb-ft (20 N•m).

2. Apply antiseize compound to the bottom three threads of temperature sensors (Figure 64) (Item 1).

3. Install temperature sensors (Figure 64) (Item 1) on DPF (Figure 64) (Item 8). Torque temperature sensor to 18 - 26 lb-ft (25 - 35 N•m).

4. Secure two pressure tubes (Figure 64) (Item 2) with two pressure nuts (Figure 64) (Item 3). Torque pressure nuts to 11 - 13 lb-ft (15 - 17 N•m).

5. Connect sensor junction box electrical connector (Figure 64) (Item 7) to sensor junction box (Figure 64) (Item 4).

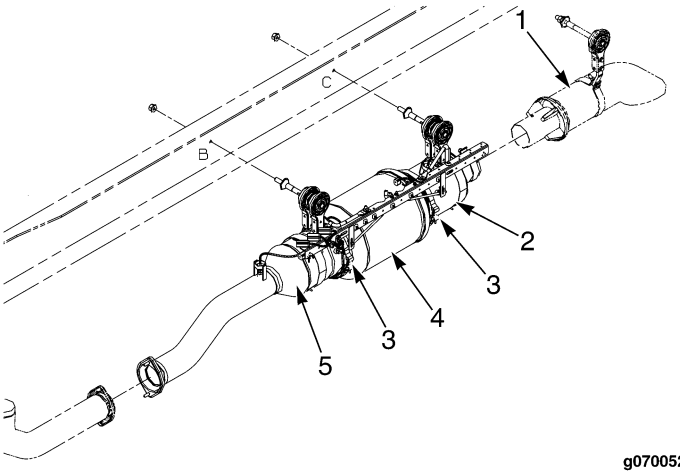
6. Connect output temperature sensor electrical connector (Figure 64) (Item 5) to sensor junction box (Figure 64) (Item 4).

4. SINGLE HORIZONTAL / HORIZONTAL

4.1. MAXXFORCE® 7, DT, 9, OR 10 ENGINE

4.1.1. Diesel Particulate Filter (DPF) (One-Can System) (Except TerraStar®) – Removal

1. Remove heat shields from DPF (if applicable).



1. Tailpipe / temperature control device
2. Output exhaust can
3. V-clamp (2)
4. Diesel Particulate Filter (DPF)
5. Diesel Oxidation Catalyst (DOC)

Figure 65 Diesel Particulate Filter (DPF) (One-Can).

2. Support DPF (Figure 65) (Item 4) with an appropriate floor jack.

3. Disconnect pressure sensor from DPF (See Tubes and Diesel Particulate Filter Differential Pressure (DPFDP) Sensor – Removal, page 63).

CAUTION

To prevent damage to sensor connections, use caution when removing pressure line clamps.

4. Loosen pressure line clamps.

NOTE – Place an index mark along the DPF, output exhaust can and the DOC to help align the components during installation procedures.

5. Loosen V-clamp (Figure 65) (Item 3) securing DPF (Figure 65) (Item 4) to output exhaust can (Figure 65) (Item 2).

6. Loosen V-clamp (Figure 65) (Item 3) securing DPF (Figure 65) (Item 4) to DOC (Figure 65) (Item 5).

7. Remove DPF (Figure 65) (Item 4) from vehicle.

8. Remove two gaskets, one from each end of DPF (Figure 65) (Item 4). Discard gaskets.

4.1.2. Diesel Particulate Filter (DPF) (One-Can System) (Except TerraStar®) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC and DPF during installation. Ensure mating surfaces of DPF are clean prior to installation.

1. Install a new gasket on front and rear of DPF (Figure 65) (Item 4).

2. Using an appropriate floor jack, align DPF (Figure 65) (Item 4) with DOC (Figure 65) (Item 5) and output exhaust can (Figure 65) (Item 2).

3. Install V-clamp (Figure 65) (Item 3) on DPF (Figure 65) (Item 4) and DOC (Figure 65) (Item 5). Torque V-clamp to 13 - 16 lb-ft (18 - 22 N•m).

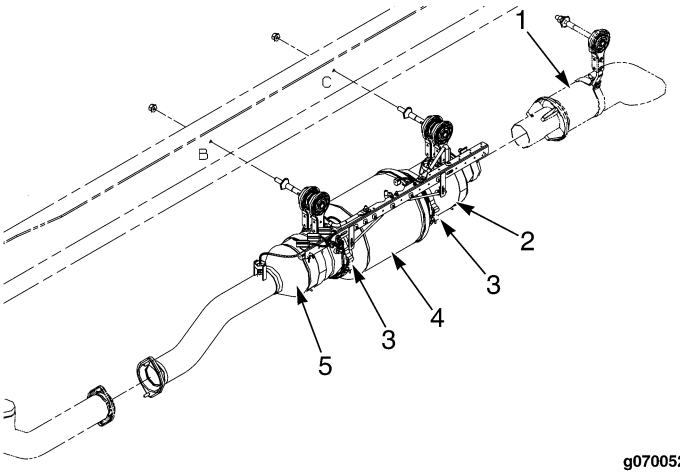
4. Install V-clamp (Figure 65) (Item 3) on DPF (Figure 65) (Item 4) and output exhaust can (Figure 65) (Item 2). Torque V-clamp to 13 - 16 lb-ft (18 - 22 N•m).

5. Install pressure sensor connections and P-clamps (See Tubes and DPFDP Sensor – Installation, page 64).

6. Install heat shields that were removed (if applicable).

4.1.3. Diesel Particulate Filter (DPF) (One-Can System) (TerraStar®) – Removal

1. Remove heat shields from DPF (Figure 66) (Item 4) (if applicable).
2. Support the DPF (Figure 66) (Item 4) with an appropriate floor jack.
3. Disconnect pressure sensor from DPF (See Tubes and Diesel Particulate Filter Differential Pressure (DPFDP) Sensor – Removal, page 63).
4. Remove tailpipe / temperature control device (Figure 66) (Item 1).



1. Tailpipe / temperature control device
2. Output exhaust can
3. V-clamp (2)
4. Diesel Particulate Filter (DPF)
5. Diesel Oxidation Catalyst (DOC)

Figure 66 Diesel Particulate Filter (DPF) (One-Can).

NOTE – Place an index mark along the DPF, output exhaust can and the DOC to help align the components during installation procedures.

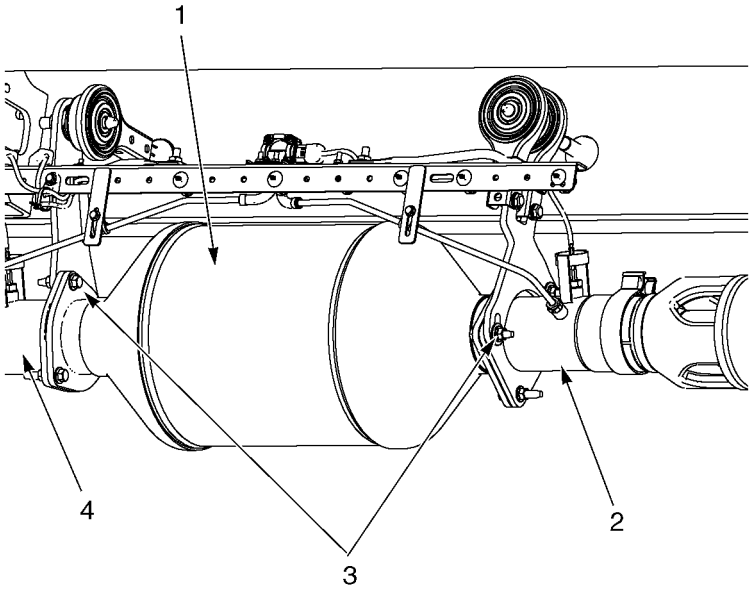
5. Loosen pressure line clamps.
6. Loosen V-clamp (Figure 66) (Item 3) securing DPF (Figure 66) (Item 4) to output exhaust can (Figure 66) (Item 2).
7. Loosen V-clamp (Figure 66) (Item 3) securing DPF (Figure 66) (Item 4) to DOC (Figure 66) (Item 5).
8. Remove DPF (Figure 66) (Item 4).
9. Remove two gaskets, one from each end of DPF (Figure 66) (Item 4). Discard gaskets.

4.1.4. Diesel Particulate Filter (DPF) (One-Can System) (TerraStar®) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC and DPF during installation. Ensure mating surfaces of DPF are clean prior to installation.

1. Install a new gasket on front and rear of DPF (Figure 66) (Item 4).
2. Using an appropriate floor jack, align DPF (Figure 66) (Item 4) with DOC (Figure 66) (Item 5) and output exhaust can (Figure 66) (Item 2).
3. Secure V-clamp (Figure 66) (Item 3) on DPF (Figure 66) (Item 4) and DOC (Figure 66) (Item 5). Torque V-clamp to 13 - 16 lb-ft (18 - 22 N•m).
4. Secure V-clamp (Figure 66) (Item 3) on DPF (Figure 66) (Item 4) and output exhaust can (Figure 66) (Item 2). Torque V-clamp to 13 - 16 lb-ft (18 - 22 N•m).
5. Install pressure sensor connections and P -clamps (See Tubes and DPFDP Sensor – Installation, page 64).
6. Install tailpipe / temperature control device (Figure 66) (Item 1).
7. Install heat shields that were removed (if applicable).

4.1.5. Diesel Particulate Filter (DPF) (Two-Can System) – Removal



1. Diesel Particulate Filter (DPF)
2. Tailpipe
3. Bolts and nuts (6)
4. Inlet pipe

Figure 67 Diesel Particulate Filter (DPF) (Two-Can).

1. Support DPF (Figure 67) (Item 1) with an appropriate floor jack.

NOTE – Some units will have the pressure sensor mounted to the DPF with a band clamp. If necessary, remove band clamp, sensor mounting bracket and pressure sensor. Support pressure sensor or disconnect (See Tubes and Diesel Particulate Filter Differential Pressure (DPFDP) Sensor – Removal, page 63).

2. Remove three bolts and nuts (Figure 67) (Item 3) from rear of DPF (Figure 67) (Item 1) and tailpipe (Figure 67) (Item 2).

3. Remove three bolts and nuts (Figure 67) (Item 3) from front of the DPF (Figure 67) (Item 1) and inlet pipe (Figure 67) (Item 4).

4. Carefully remove DPF (Figure 67) (Item 1) from vehicle.

5. Remove two gaskets, one from each end of DPF (Figure 67) (Item 1). Discard gaskets.

4.1.6. Diesel Particulate Filter (DPF) (Two-Can System) – Installation

1. Using an appropriate floor jack, align DPF (Figure 67) (Item 1) on inlet pipe DPF (Figure 67) (Item 1).

2. Install a new gasket on front of DPF (Figure 67) (Item 1).

NOTE – Some units will have the pressure sensor mounted to the DPF with a band clamp. If necessary, install band clamp, sensor mounting bracket and pressure sensor. Secure pressure sensor or install (See Tubes and DPFDP Sensor – Installation, page 64).

3. Secure DPF (Figure 67) (Item 1) to DPF (Figure 67) (Item 1) with three bolts and nuts (Figure 67) (Item 3). Torque bolts to 35 - 37 lb-ft (47 - 50 N•m).

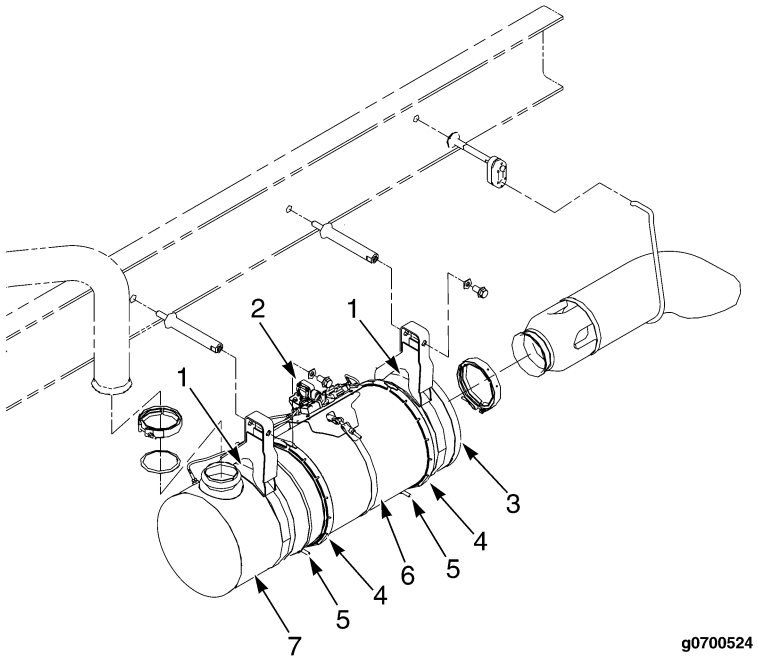
4. Install a new gasket on the rear of DPF (Figure 67) (Item 1).

5. Align tailpipe (Figure 67) (Item 2) on DPF (Figure 67) (Item 1) and secure with three bolts and nuts (Figure 67) (Item 3). Torque bolts to 35 - 37 lb-ft (47 - 50 N•m).

4.2. MAXXFORCE® 11, 13, OR 15 ENGINE

4.2.1. Diesel Particulate Filter (DPF) – Removal

1. Remove sensor junction box (Figure 68) (Item 2) from DPF (Figure 68) (Item 6) .



1. Mount band (2)
2. Sensor junction box
3. Output exhaust can
4. V-clamp (2)
5. Nut (2)
6. Diesel Particulate Filter (DPF)
7. Diesel Oxidation Catalyst (DOC)

Figure 68 Diesel Particulate Filter (DPF).

NOTE – Place an index mark along the DOC, DPF, and the output exhaust can to help align the components during installation procedures.

2. Support DPF (Figure 68) (Item 6) with an appropriate floor jack.

3. Loosen mount band (Figure 68) (Item 1) on output exhaust can (Figure 68) (Item 3).

4. Loosen two nuts (Figure 68) (Item 5) and remove V-clamp (Figure 68) (Item 4) on each end of the DPF (Figure 68) (Item 6).

5. Slide output exhaust can (Figure 68) (Item 3) rearward, approximately 1 in (25 mm), to allow clearance for removal of the DPF (Figure 68) (Item 6).

6. Remove the DPF (Figure 68) (Item 6).

7. Remove two gaskets, one from each end of DPF (Figure 68) (Item 6). Discard gaskets.

4.2.2. Diesel Particulate Filter (DPF) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and the output exhaust can during installation.

1. Using an appropriate floor jack, align DPF, (Figure 68) (Item 6) on DOC (Figure 68) (Item 7).

2. Install two new gaskets, one on each end of DPF, (Figure 68) (Item 6).

3. Secure V-clamp (Figure 68) (Item 4) on DPF, (Figure 68) (Item 6) and DOC, (Figure 68) (Item 7) and secure nuts (Figure 68) (Item 5). Torque V-clamp to 28 - 30 lb-ft (38 - 40 N•m).

4. Align output exhaust can (Figure 68) (Item 3) on DPF, (Figure 68) (Item 6) and secure with V-clamp (Figure 68) (Item 4) and nuts (Figure 68) (Item 5). Torque nut to 28 - 30 lb-ft (38 - 40 N•m).

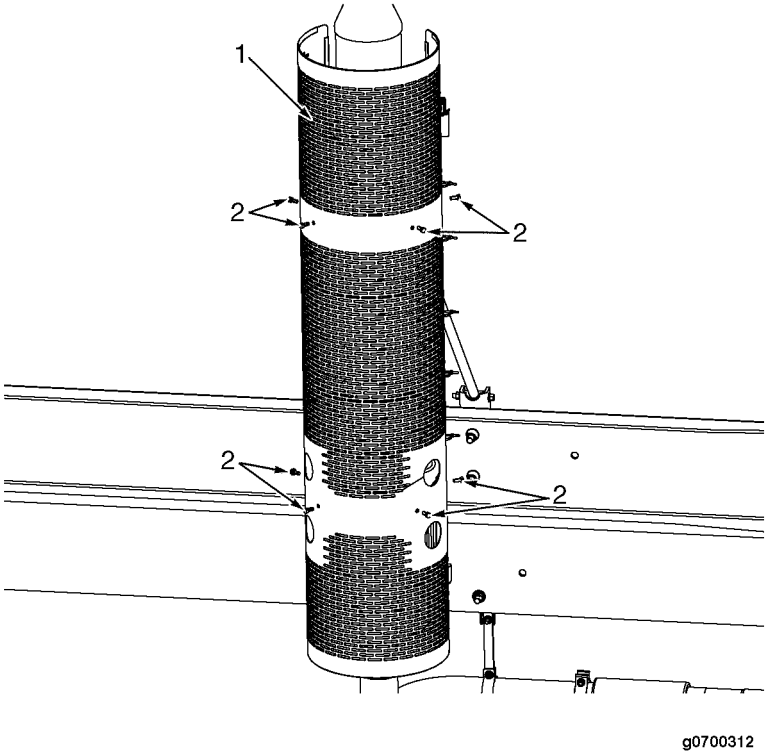
5. Tighten mount band (Figure 68) (Item 1) on output exhaust can (Figure 68) (Item 3). Torque mount band to 97 lb-in (11 N•m).

6. Install sensor junction box (Figure 68) (Item 2) onto DPF (Figure 68) (Item 6).

5. SINGLE VERTICAL / VERTICAL

5.1. MAXXFORCE® 7, DT, 9, OR 10 ENGINE

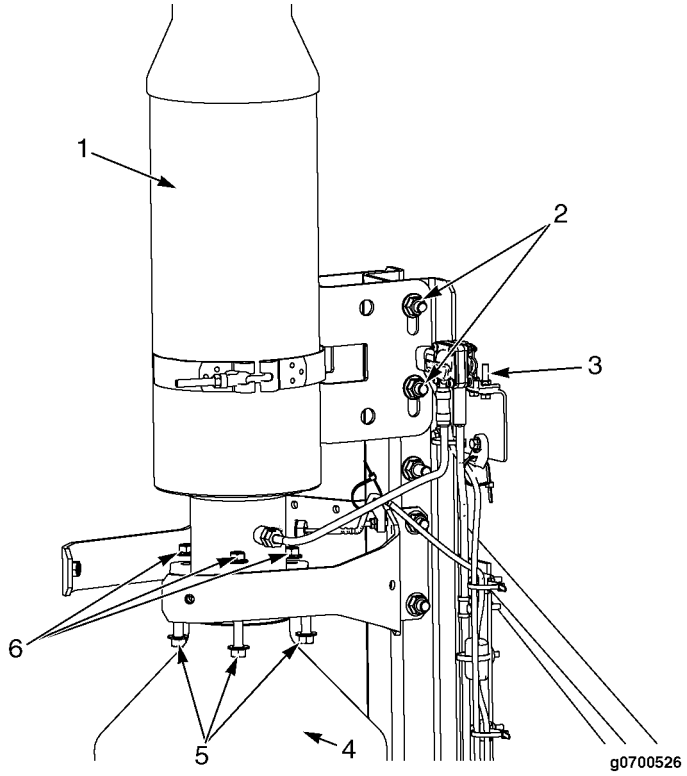
5.1.1. Diesel Particulate Filter (DPF) – Removal



1. Heat shield
2. Bolts and washer (8)

Figure 69 Heat Shield.

1. Remove eight bolts, washers (Figure 69) (Item 2) , and heat shield (Figure 69) (Item 1) from exhaust system.



1. Raintrap / tailpipe assembly
2. Bolt and nut (2)
3. Pressure sensor
4. Diesel Particulate Filter (DPF)
5. Mount bolt (3)
6. Nut (3)

Figure 70 Temperature Control Device.

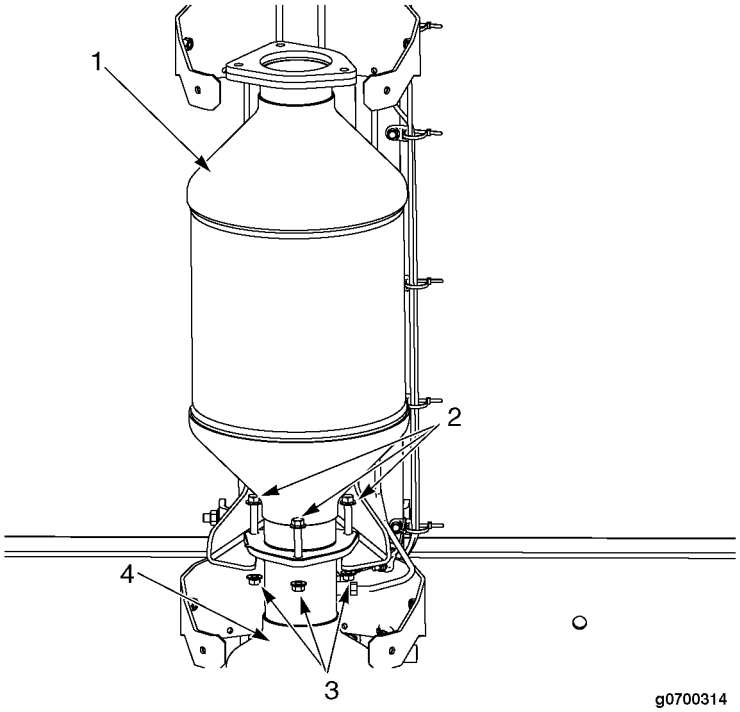
2. Remove three mount bolts (Figure 70) (Item 5) and nuts (Figure 70) (Item 6) from tailpipe (Figure 70) (Item 1) and the DPF (Figure 70) (Item 4).

3. Loosen bolts and nuts (Figure 70) (Item 2) on temperature control device, raise raintrap / tailpipe assembly (Figure 70) (Item 1) to separate joint.

CAUTION

To prevent damage to pressure sensor connections, use caution when raising raintrap / tailpipe assembly.

4. Install bolts and nuts (Figure 70) (Item 2) after raising raintrap / tailpipe assembly (Figure 70) (Item 1). Tighten to hold assembly away from DPF (Figure 70) (Item 4).



1. Diesel particulate filter (DPF)
2. Mount bolt (3)
3. Nut (3)
4. Diesel Oxidation Catalyst (DOC)

Figure 71 Diesel Particulate Filter (DPF).

5. Support DPF (Figure 71) (Item 1) with an appropriate lifting device.
6. Remove three mount bolts and nuts from DPF (Figure 71) (Item 1) and DOC (Figure 71) (Item 4).
7. Carefully remove DPF (Figure 71) (Item 1).
8. Remove two gaskets, one from each end of DPF (Figure 71) (Item 1). Discard gaskets.

5.1.2. Diesel Particulate Filter (DPF) – Installation

1. Install a new gasket on bottom of DPF (Figure 71) (Item 1).

2. Using an appropriate lifting device, install DPF (Figure 71) (Item 1) on DOC (Figure 71) (Item 4).

3. Secure DPF (Figure 71) (Item 1) to DOC (Figure 71) (Item 4). with three mount bolts (Figure 71) (Item 2) and nuts (Figure 71) (Item 3). Torque mount bolts to 35 - 37 lb-ft (47 - 50 N•m).

4. Install a new gasket on the top of DPF (Figure 71) (Item 1).

5. Loosen bolts and nuts (Figure 70) (Item 2) on raintrap / tailpipe assembly (Figure 70) (Item 1), align on DPF (Figure 70) (Item 4), and secure with mount bolts (Figure 70) (Item 5) and nuts (Figure 70) (Item 6). Torque bolts to 35 - 37 lb-ft (47 - 50 N•m).

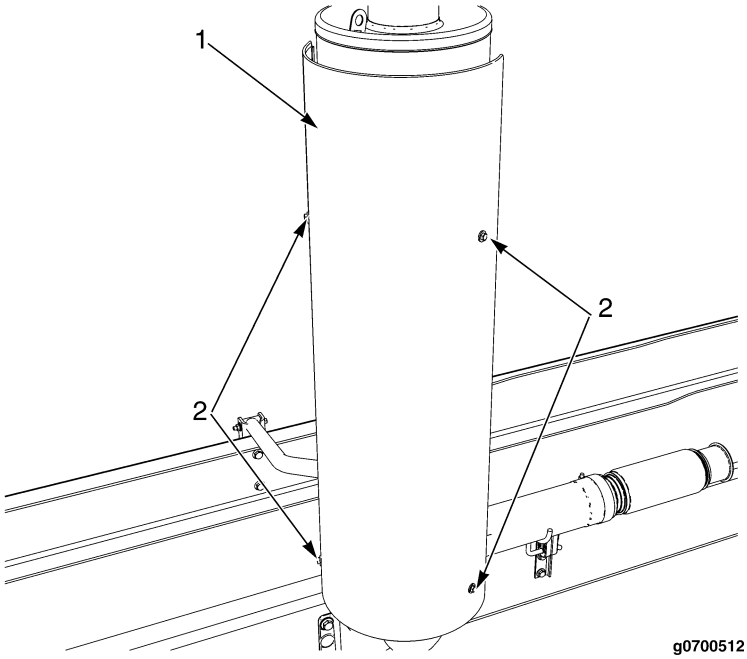
6. Tighten bolts and nuts (Figure 70) (Item 2) on raintrap / tailpipe assembly (Figure 70) (Item 1). Torque bolts and nuts to 35 - 37 lb-ft (47 - 50 N•m).

7. Install heat shield (Figure 69) (Item 1) on exhaust system and with eight bolts, washers (Figure 69) (Item 2).

5.2. MAXXFORCE® 11, 13, OR 15 ENGINE

5.2.1. Diesel Particulate Filter (DPF) – Removal

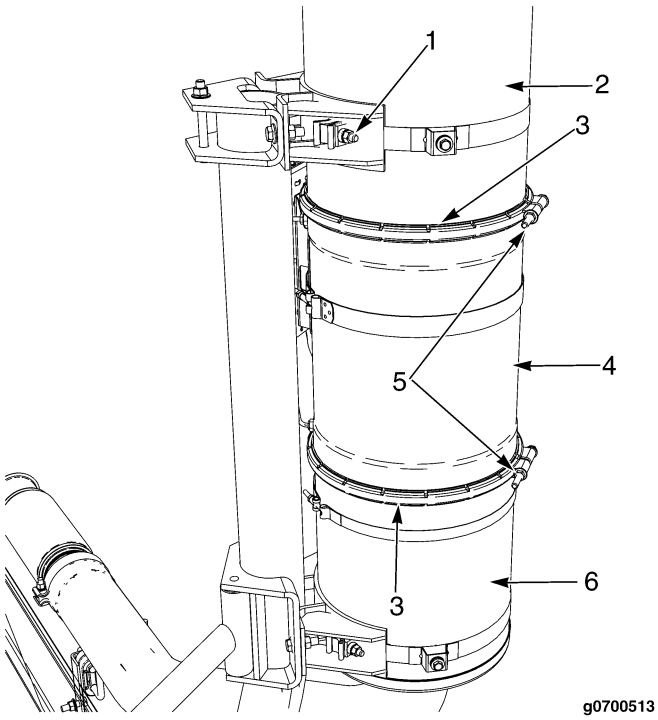
1. Remove sensor junction box from DPF (See Sensor Junction Box – Removal, page 70).



1. Heat shield
2. Bolt and washer (4)

Figure 72 Heat Shield.

2. Remove four bolts, washers (Figure 72) (Item 2), and heat shield (Figure 72) (Item 1) from exhaust system.



1. Mount band nut
2. Output exhaust can
3. V-clamp (2)
4. Diesel Particulate Filter (DPF)
5. Nut (2)
6. Diesel Oxidation Catalyst (DOC)

Figure 73 Output Exhaust Can.

NOTE – Place an index mark along the DOC, DPF, and the output exhaust can to help align the components during installation procedures.

3. Remove nut (Figure 73) (Item 5) and V-clamp (Figure 73) (Item 3) from DPF (Figure 73) (Item 4) and output exhaust can (Figure 73) (Item 2).

4. Loosen mount band nut (Figure 73) (Item 1) on output exhaust can (Figure 73) (Item 2), raise output exhaust can (Figure 73) (Item 2) to separate from DPF (Figure 73) (Item 4) and tighten mount band nut (Figure 73) (Item 1) to hold output exhaust can (Figure 73) (Item 2) in raised position.

5. Remove nut (Figure 73) (Item 5) and V-clamp (Figure 73) (Item 3) from DPF (Figure 73) (Item 4) and DOC(Figure 73) (Item 6).

6. Using an appropriate lifting device, carefully remove DPF (Figure 73) (Item 4) from DOC (Figure 73) (Item 6).

7. Remove two gaskets, one from each end of the DPF (Figure 73) (Item 4). Discard gaskets.

5.2.2. Diesel Particulate Filter (DPF) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and the output exhaust can during installation.

1. Install two new gaskets, one on each end of the DPF (Figure 73) (Item 4).

2. Using an appropriate lifting device, carefully align DPF (Figure 73) (Item 4) on DOC (Figure 73) (Item 6).

3. Install V-clamp (Figure 73) (Item 3) on DPF (Figure 73) (Item 4) and DOC(Figure 73) (Item 6) and secure with nut (Figure 73) (Item 5). Torque nut to 28 - 30 lb-ft (38 - 40 N•m).

4. Loosen mount band nut (Figure 73) (Item 1) securing raised output exhaust can (Figure 73) (Item 2) and align output exhaust can (Figure 73) (Item 2) on DPF (Figure 73) (Item 4). Torque mount band nut to 26 - 33 lb-ft (35 - 45 N•m).

5. Secure V-clamp (Figure 73) (Item 3) to output exhaust can (Figure 73) (Item 2) and DPF (Figure 73) (Item 4).Torque V-clamp to 28 - 30 lb-ft (38 - 40 N•m).

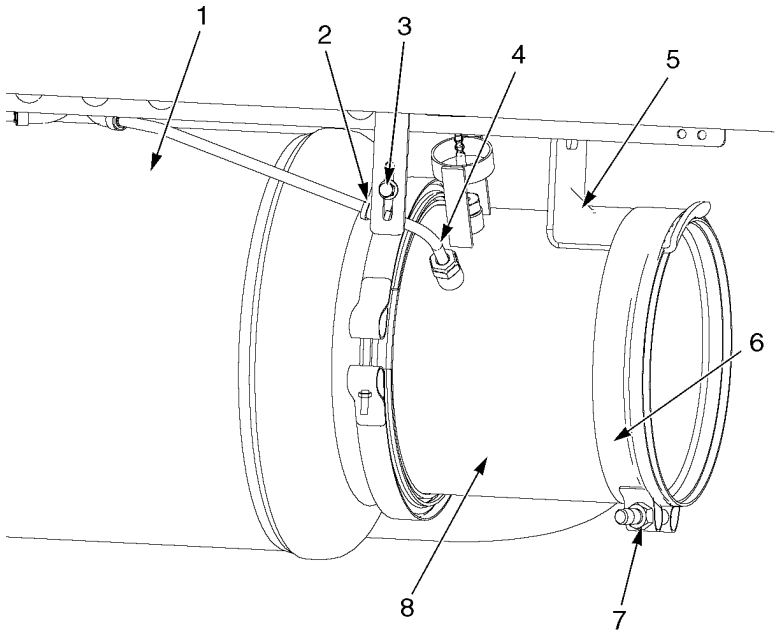
6. Install heat shield (Figure 72) (Item 1) on exhaust system and secure with four bolts, washers (Figure 72) (Item 2).

7. Install sensor junction box onto DPF (See Sensor Junction Box – Installation, page 71).

6. SINGLE HORIZONTAL / VERTICAL

6.1. MAXXFORCE® 7, DT, 9, OR 10 ENGINE

6.1.1. Diesel Particulate Filter (DPF) – Removal



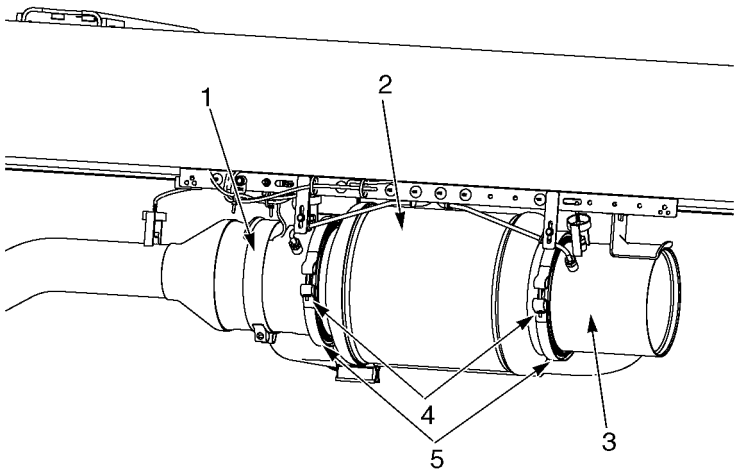
1. Diesel Particulate Filter (DPF)
2. P-clamp
3. Bolt and nut
4. Pressure tube
5. Hanger bracket
6. Mount band
7. Nut
8. Output exhaust can

Figure 74 Output Exhaust Can.

1. Support DPF (Figure 74) (Item 1) with an appropriate floor jack.

2. Remove bolt, nut (Figure 74) (Item 3) and P-clamp (Figure 74) (Item 2) from pressure tube (Figure 74)(Item 4).

3. Loosen nut (Figure 74) (Item 7) and mount band (Figure 74) (Item 6) from hanger bracket (Figure 74) (Item 5) and output exhaust can (Figure 74) (Item 8).



1. Diesel Oxidation Catalyst (DOC)
2. Diesel Particulate Filter (DPF)
3. Output exhaust can
4. Nut (2)
5. V-clamp (2)

Figure 75 Diesel Particulate Filter (DPF).

NOTE – Place an index mark along the DOC, DPF, and the output exhaust can to help align the components during installation procedures.

4. Support DPF (Figure 75) (Item 2) with an appropriate floor jack.

5. Remove two nuts (Figure 75) (Item 4) and V-clamps (Figure 75) (Item 5) from DPF (Figure 75) (Item 2).

6. Slide output exhaust can (Figure 75) (Item 3) rearward, approximately one inch (25 mm), to allow clearance for removal of DPF (Figure 75) (Item 2).

7. Remove DPF (Figure 75) (Item 2) from DOC (Figure 75) (Item 1).

8. Remove two gaskets, one from each end of DPF (Figure 75) (Item 2). Discard gaskets.

6.1.2. Diesel Particulate Filter (DPF) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and output exhaust can during installation.

1. Install a new gasket on front of DPF (Figure 75) (Item 2).

2. Using an appropriate floor jack, align DPF (Figure 75) (Item 2) with DOC (Figure 75) (Item 1).

3. Install V-clamps (Figure 75) (Item 5) on DPF (Figure 75) (Item 2) and DOC (Figure 75) (Item 1) and secure nut (Figure 75) (Item 4). Torque nut to 44 - 89 lb-in (5 - 10 N•m).

4. Install a new gasket on rear of DPF (Figure 75) (Item 2) and align output exhaust can (Figure 75) (Item 3) with DPF (Figure 75) (Item 2).

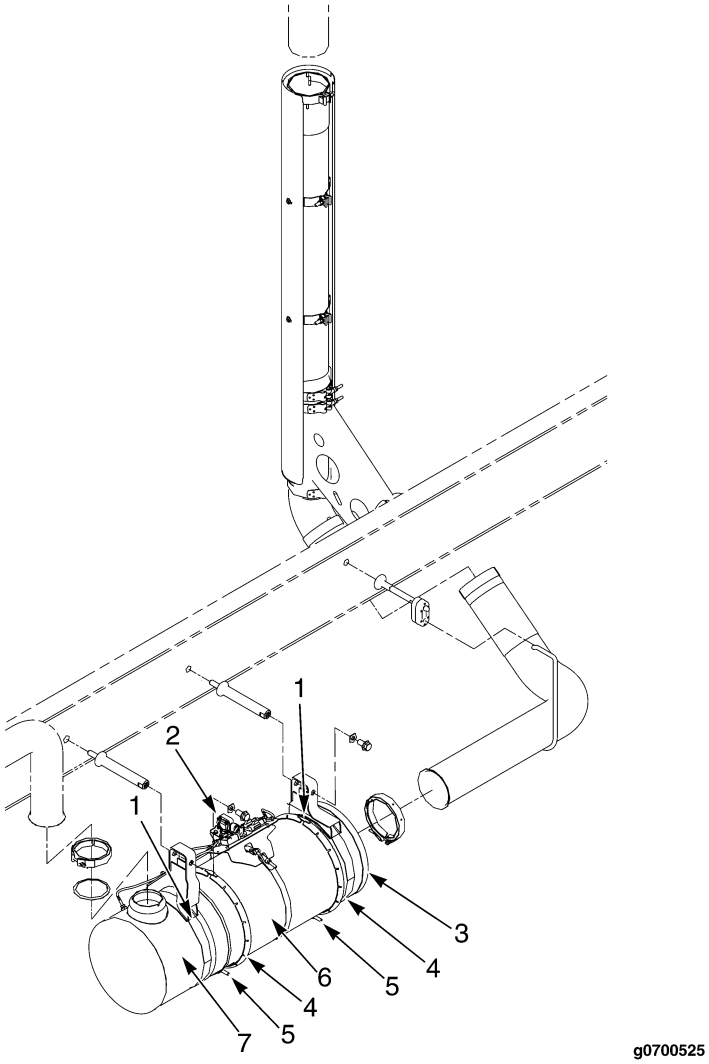
5. Install V-clamps (Figure 75) (Item 5) on the DPF (Figure 75) (Item 2) and output exhaust can (Figure 75) (Item 3) and secure with nut (Figure 75) (Item 4). Torque nut to 44 - 89 lb-in (5 - 10 N•m).

6. Secure hanger bracket to output exhaust can (Figure 75) (Item 3) with mount band and tighten nut (Figure 75) (Item 4). Torque nut to 35 - 46 lb-in (4 - 5 N•m).

7. Install bolt, nut (Figure 74) (Item 3), and P-clamp (Figure 74) (Item 2) on pressure tube (Figure 74) (Item 4). Torque bolt to 84 - 96 lb-in (9 - 11 N•m).

6.2. MAXXFORCE® 11, 13, OR 15 ENGINE

6.2.1. Diesel Particulate Filter (DPF) – Removal



1. Mount band (2)
2. Sensor junction box
3. Output exhaust can
4. V-clamp (2)
5. Nut (2)
6. Diesel Particulate Filter (DPF)
7. Diesel Oxidation Catalyst (DOC)

Figure 76 Diesel Particulate Filter (DPF).

NOTE – Place an index mark along the DPF, output exhaust can, and the DOC to help align the components during installation procedures.

1. Remove sensor junction box (See Sensor Junction Box – Removal, page 70) from DPF (Figure 76) (Item 6).
2. Support DPF (Figure 76) (Item 6) with an appropriate floor jack.
3. Loosen mount band (Figure 76) (Item 1) on output exhaust can (Figure 76) (Item 3).

4. Loosen two nuts (Figure 76) (Item 5) and remove V-clamp (Figure 76) (Item 4) on each end of DPF (Figure 76) (Item 6).

5. Slide output exhaust can (Figure 76) (Item 3) rearward, approximately one inch (25 mm), to allow clearance for removal of DPF (Figure 76) (Item 6).

6. Remove the DPF (Figure 76) (Item 6) from the DOC (Figure 76) (Item 7).

7. Remove two gaskets, one from each end of DPF (Figure 76) (Item 6). Discard gaskets.

6.2.2. Diesel Particulate Filter (DPF) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and the output exhaust can during installation.

1. Install two new gaskets, one on each end of DPF (Figure 76) (Item 6).

2. Using an appropriate floor jack, align DPF (Figure 76) (Item 6) on DOC (Figure 76) (Item 7).

3. Slide output exhaust can (Figure 76) (Item 3) forward onto DPF (Figure 76) (Item 6).

4. Secure V-clamp (Figure 76) (Item 4) at each end of DPF (Figure 76) (Item 6) and tighten two nuts (Figure 76) (Item 5). Torque nuts to 28 - 30 lb-ft (38 - 40 N•m).

5. Secure mount band (Figure 76) (Item 1) on output exhaust can (Figure 76) (Item 3). Torque nut to 97 lb-in (11 N•m).

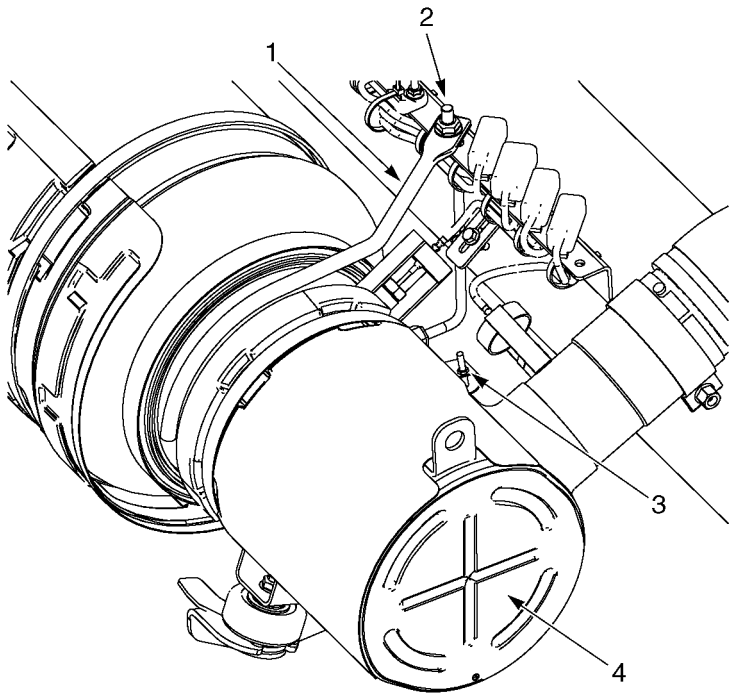
6. Install sensor junction box (See Sensor Junction Box – Installation, page 71) onto DPF (Figure 76) (Item 6).

7. UNDER – CAB HORIZONTAL / VERTICAL

NOTE – There are several configurations for the single under-cab horizontal / vertical exhaust system. The different configurations have different access panels and steps that must be removed prior to beginning this procedure and reinstalled upon completion of these procedures.

7.1. MAXXFORCE® 7, DT, 9, OR 10 ENGINE

7.1.1. Diesel Particulate Filter (DPF) – Removal

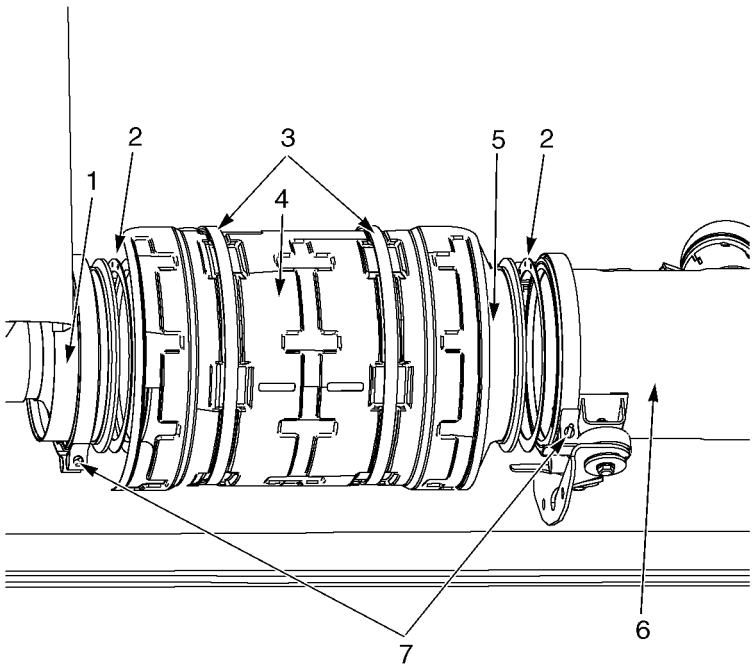


1. Support bracket
2. Bolt and nut
3. Mount band
4. Diesel Oxidation Catalyst (DOC)

Figure 77 Diesel Oxidation Catalyst (DOC).

1. Loosen mount bolt, nut (Figure 77) (Item 2), and support bracket (Figure 77) (Item 1) from DOC (Figure 77) (Item 4).

2. Loosen mount band (Figure 77) (Item 3) from DOC (Figure 77) (Item 4).



1. Output exhaust can
2. Gasket (2)
3. Band strap (2)
4. Heat shield
5. Diesel Particulate Filter (DPF)
6. Diesel Oxidation Catalyst (DOC)
7. V-clamp (2)

Figure 78 Diesel Particulate Filter (DPF).

NOTE – Place an index mark along the DPF, output exhaust can, and the DOC to help align the components during installation procedures.

3. Support DPF (Figure 78) (Item 5) with an appropriate lifting device.

4. Remove V-clamp (Figure 78) (Item 7) at DPF (Figure 78) (Item 5) and DOC (Figure 78) (Item 6). Reposition V-clamp (Figure 78) (Item 7) forward on DOC (Figure 78) Item 6).

5. Remove V-clamp (Figure 78) (Item 7) at DPF (Figure 78) (Item 5) and output exhaust can (Figure 78) (Item 1). Reposition V-clamp (Figure 78) (Item 7) rearward on output exhaust can (Figure 78) (Item 1).

6. Slide DOC (Figure 78) (Item 6) forward, approximately 1 in (25 mm) from DPF (Figure 78) (Item 5).

7. Remove DPF (Figure 78) (Item 5) from output exhaust can (Figure 78) (Item 1).

8. Remove two gaskets, one from each end of DPF (Figure 78) (Item 5). Discard gaskets.

9. Remove two band straps (Figure 78) (Item 3) and heat shield (Figure 78) (Item 4) from DPF (Figure 78) (Item 5).

7.1.2. Diesel Particulate Filter (DPF) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and the output exhaust can during installation.

1. Install heat shield (Figure 78) (Item 4) and two band straps (Figure 78) (Item 3) on DPF (Figure 78) (Item 5).

2. Install two new gaskets, one on each end, of DPF (Figure 78) (Item 5).

3. Using an appropriate lifting device, align DPF (Figure 78) (Item 5) with output exhaust can (Figure 78) (Item 1).

4. Secure V-clamp (Figure 78) (Item 7) on output exhaust can (Figure 78) (Item 1) and DPF (Figure 78) (Item 5). Torque V-clamp to 44 - 89 lb-in (5 - 10 N•m).

5. Align DOC (Figure 78) (Item 6) with DPF (Figure 78) (Item 5).

6. Secure V-clamp (Figure 78) (Item 7) on DOC (Figure 78) (Item 6) and the DPF (Figure 78) (Item 5). Torque V-clamp to 44 - 89 lb-in (5 - 10 N•m).

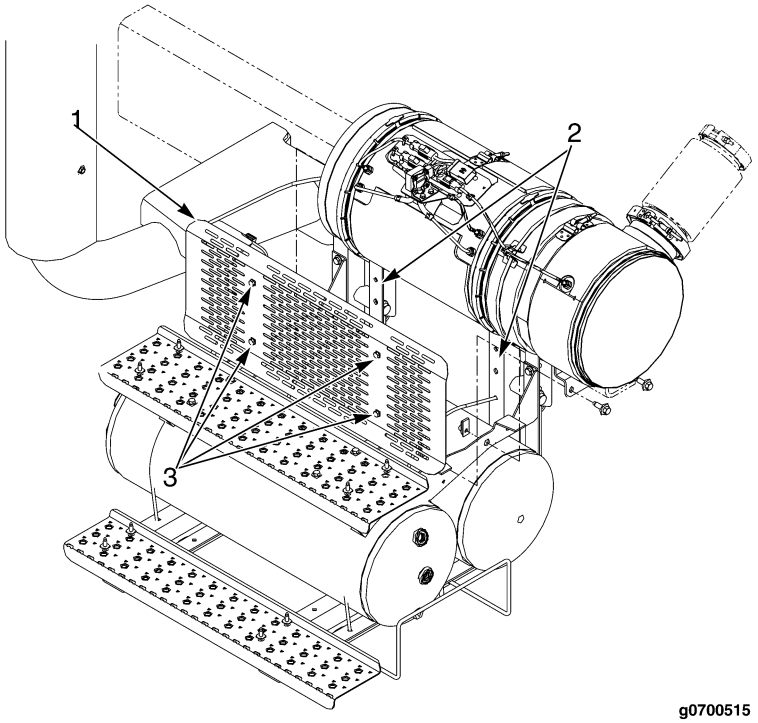
7. Tighten mount band (Figure 77) (Item 3) on DOC (Figure 77) (Item 6). Torque mount band to 35 - 46 lb-ft (47 - 62 N•m).

8. Tighten support bracket (Figure 77) (Item 1), bolt and nut (Figure 77) (Item 2) on DOC (Figure 77) (Item 6).

7.2. MAXXFORCE® 11, 13, OR 15 ENGINE

NOTE – There are several configurations for the single under-cab horizontal / vertical exhaust system. The different configurations have different access panels and steps that must be removed prior to beginning this procedure and reinstalled upon completion of these procedures.

7.2.1. Diesel Particulate Filter (DPF) – Removal



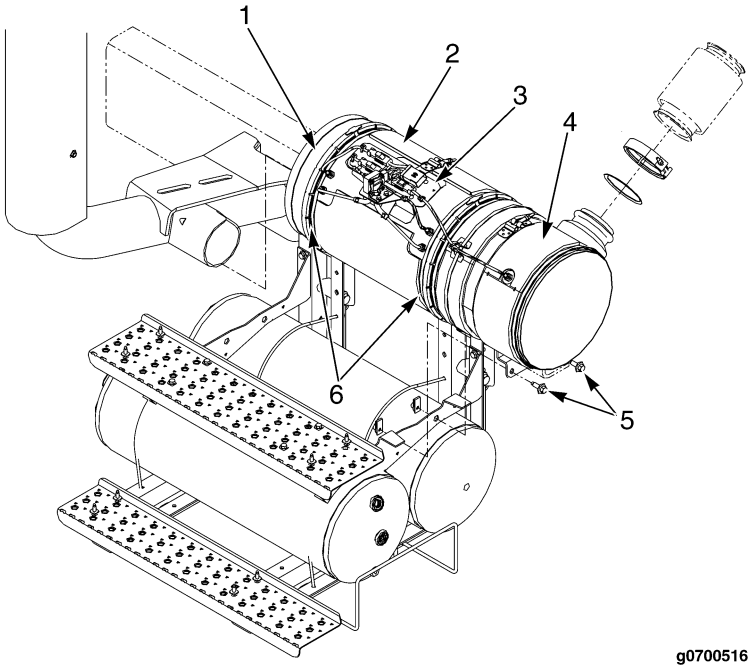
1. Access panel
2. Mount bracket (2)
3. Bolt, nut, and washer (4)

Figure 79 Access Panel.

1. Remove four bolts, nuts and washers (Figure 79) (Item 3) from access panel (Figure 79) (Item 1) and mount brackets (Figure 79) (Item 2).

2. Remove access panel (Figure 79) (Item 1) from the mount brackets (Figure 79) (Item 2).

NOTE – Any heat shields that are mounted on the exhaust components will need to be removed before continuing.



1. Output exhaust can
2. Diesel Particulate Filter (DPF)
3. Sensor junction box
4. Diesel Oxidation Catalyst (DOC)
5. Mount bolts
6. V-clamps

Figure 80 Diesel Particulate Filter (DPF).

3. Remove sensor junction box from DPF (See Sensor Junction Box – Removal, page 70).

NOTE – Place an index mark along the DPF, output exhaust can, and the DOC to help align the components during installation procedures.

4. Support DPF (Figure 80) (Item 2) with an appropriate lifting device.

5. Loosen two mount bolts (Figure 80) (Item 5) from bottom of DOC (Figure 80) (Item 4).

6. Remove V-clamp (Figure 80) (Item 6) from DPF (Figure 80) Item 2) and DOC (Figure 80) (Item 4).

7. Slide DOC (Figure 80) (Item 4) forward, approximately one inch (25 mm), to allow clearance for removal of DPF (Figure 80) (Item 2).

8. Remove V-clamp (Figure 80) (Item 6) from DPF (Figure 80) (Item 2) and output exhaust can (Figure 80) (Item 1).

9. Remove DPF (Figure 80) (Item 2) from output exhaust can (Figure 80) (Item 1).

10. Remove two gaskets, one from each end of DPF (Figure 80) (Item 2). Discard gaskets.

7.2.2. Diesel Particulate Filter (DPF) – Installation

NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and the output exhaust can during installation.

1. Install two new gaskets, one on each end of DPF (Figure 80) (Item 2).

2. Using an appropriate lifting device, align DPF (Figure 80) (Item 2) on output exhaust can (Figure 80) (Item 1).

3. Secure V-clamp (Figure 80) (Item 6) on output exhaust can (Figure 80) (Item 1) and DPF (Figure 80) (Item 2). Torque V-clamp to 28 - 30 lb-ft (38 - 40 N•m).

4. Align DOC (Figure 80) (Item 4) on DPF (Figure 80) (Item 2).

5. Secure V-clamp (Figure 80) (Item 6) to DOC (Figure 80) (Item 4) and DPF (Figure 80) (Item 2). Torque V-clamp to 28 - 30 lb-ft (38 - 40 N•m).

6. Tighten two mount bolts (Figure 80) (Item 5) on bottom of DOC (Figure 80) (Item 4).

7. Install sensor junction box onto DPF (See Sensor Junction Box – Installation, page 71).

8. Align access panel (Figure 79) (Item 1) on mount brackets (Figure 79) (Item 2) and secure with four bolts, nuts and washers (Figure 79) (Item 3).

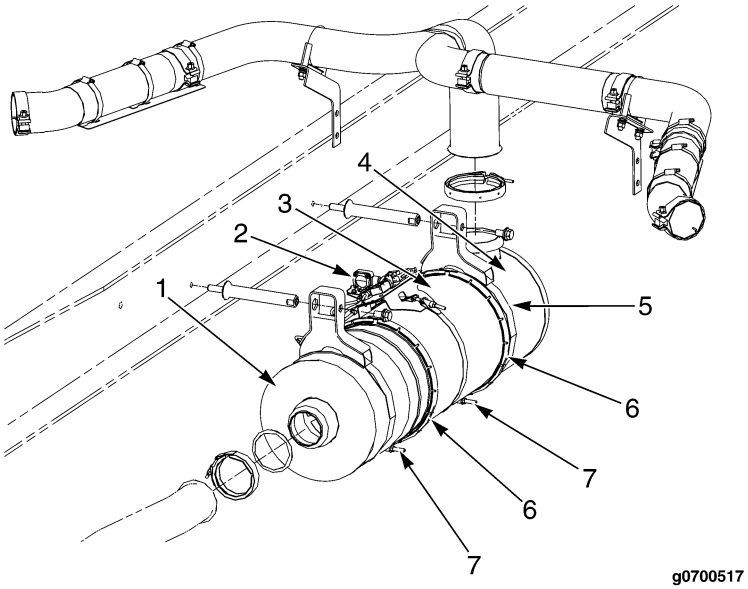
8. SINGLE HORIZONTAL / DUAL VERTICAL

8.1. MAXXFORCE® 11, 13, OR 15 ENGINE

8.1.1. Diesel Particulate Filter (DPF) – Removal

1. Remove sensor junction box (See Sensor Junction Box – Removal, page 70) from DPF (Figure 81) (Item 3) .

2. Support DPF (Figure 81) (Item 3) with an appropriate floor jack.



1. Diesel Oxidation Catalyst (DOC)
2. Sensor junction box
3. Diesel Particulate Filter (DPF)
4. Output exhaust can
5. Mount band
6. V-clamp (2)
7. Nut (2)

Figure 81 Single Horizontal / Dual Vertical.

NOTE – Place an index mark along the DPF, output exhaust can, and the DOC to help align the components during installation procedures.

3. Loosen mount band (Figure 81) (Item 5) on output exhaust can (Figure 81) (Item 4).

4. Loosen two nuts (Figure 81) (Item 7) and remove V-clamp (Figure 81) (Item 6) on each end of DPF (Figure 81) (Item 3).

5. Slide output exhaust can (Figure 81) (Item 4) rearward, approximately one inch (25 mm), to allow clearance for removal of DPF (Figure 81) (Item 3).

6. Remove DPF (Figure 81) (Item 3) from DOC (Figure 81) (Item 1).

7. Remove two gaskets, one from each end of DPF (Figure 81) (Item 3). Discard gaskets.

8.1.2. Diesel Particulate Filter (DPF) – Installation

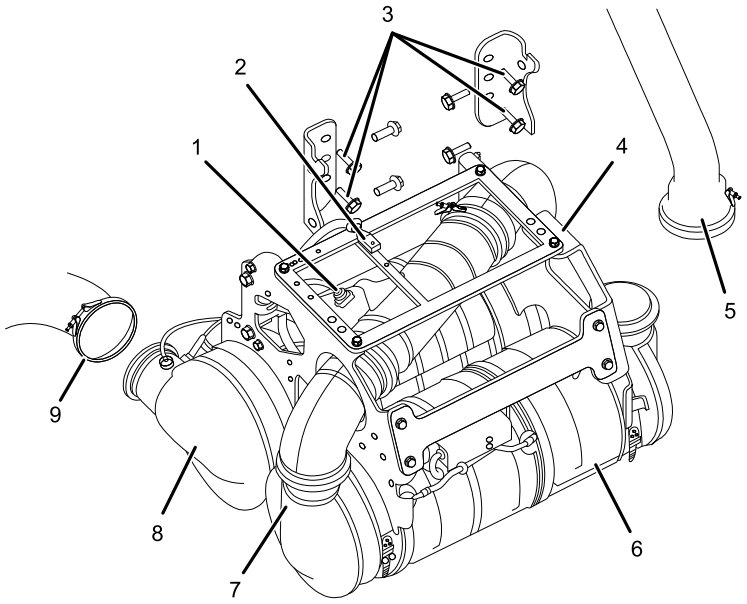
NOTE – Use the index marks that were made during the removal procedures to align the DOC, DPF, and the output exhaust can during installation.

1. Install two new gaskets, one on each end, of DPF (Figure 81) (Item 3).
2. Using an appropriate floor jack, align DPF (Figure 81) (Item 3) on DOC (Figure 81) (Item 1).
3. Slide output exhaust can (Figure 81) (Item 4) forward onto DPF (Figure 81) (Item 3).
4. Secure V-clamps at each end of DPF (Figure 81) (Item 3) and tighten two nuts (Figure 81) (Item 7). Torque nuts to 28 - 30 lb-ft (38 - 40 N•m).
5. Secure mount band (Figure 81) (Item 5) on output exhaust can (Figure 81) (Item 4). Torque mount band nut to 97 lb-in (11 N•m).
6. Install sensor junction box (See Sensor Junction Box – Installation, page 71) onto DPF (Figure 81) (Item 3).

9. SWITCHBACK / HORIZONTAL

9.1. CUMMINS ISX15 OR NAVISTAR® N13 ENGINE

9.1.1. Switchback / Horizontal – Removal



1. Diesel Exhaust Fluid (DEF) dosing valve
2. DEF tank assembly electrical connector
3. Aftertreatment assembly mounting bracket bolt (4)
4. Aftertreatment assembly mounting bracket
5. Turbo Pipe V-clamp
6. DOC
7. DPF
8. SCR canister
9. Tailpipe V-clamp

Figure 82 Switchback / Horizontal.

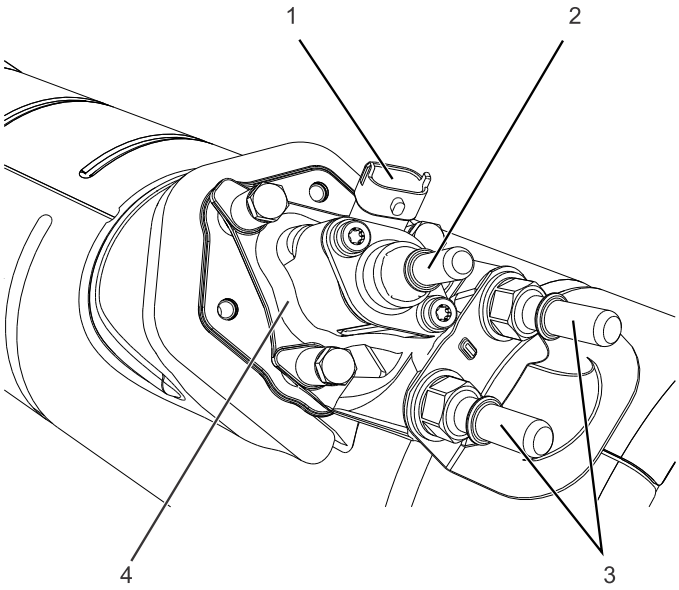
NOTE – There are several configurations of the aftertreatment system for Cummins ISX15 and Navistar® N13. All variations have similar removal / installation procedures.

NOTE – Depending on vehicle configuration, it may be necessary to remove the side skirts and side skirt mounting brackets prior to removing the Switchback / Horizontal exhaust system assembly.

1. Loosen V-clamp (Figure 82) (Item 5) securing turbo pipe to DOC (Figure 82) (Item 6) inlet.

2. Loosen V-clamp (Figure 82) (Item 9) securing tailpipe to SCR canister (Figure 82)Item 8) outlet.

3. Disconnect DEF tank assembly electrical connector (Figure 82) (Item 2) from aftertreatment assembly mounting bracket (Figure 82) (Item 4).



1. Diesel Exhaust Fluid (DEF) dosing valve electrical connector
2. DEF dosing valve pressure line
3. DEF dosing valve coolant line (2)
4. DEF dosing valve

Figure 83 Diesel Exhaust Fluid (DEF) Dosing Valve.

NOTE – To disconnect DEF lines from fittings, push inward on white quick-release clip.

4. Disconnect DEF pressure line (Figure 83) (Item 2) from DEF dosing valve (Figure 83) (Item 4).

5. Disconnect two DEF coolant lines (Figure 83) (Item 3) from DEF dosing valve (Figure 83) (Item 4).

6. Disconnect DEF dosing valve electrical connector (Figure 83) (Item 1) from DEF dosing valve (Figure 83) (Item 4).

7. Support DPF, DOC, SCR canister (Figure 82) (Items 6, 7, and 8) and aftertreatment assembly mounting bracket (Figure 82) (Item 4) with a suitable lifting device.

8. Remove four bracket mounting bolts (Figure 82) (Item 3) from aftertreatment assembly mounting bracket (Figure 82) (Item 4).

9. Lower DPF, DOC, SCR canister (Figure 82) (Items 6, 7, and 8) and aftertreatment assembly mounting bracket (Figure 82) (Item 4).

9.1.2. Switchback / Horizontal – Installation

1. Raise DPF, DOC, SCR canister (Figure 82) (Items 6, 7, and 8) and aftertreatment assembly mounting bracket (Figure 82) (Item 4) with a suitable lifting device.

2. Align DOC inlet (Figure 82) (Item 6) with turbo pipe (Figure 82) (Item 5).

3. Align SCR canister (Figure 82) (Item 8) outlet with tailpipe (Figure 82) (Item 9).

4. Install four aftertreatment assembly mounting bracket bolts (Figure 82) (Item 3) to vehicle frame.

5. Secure turbo pipe to DOC (Figure 82) (Item 6) with V-Clamp (Figure 82) (Item 5). Torque V-clamp nut to 106 lb-in (12 N•m).

6. Secure tailpipe to SCR canister (Figure 82) (Item 8) outlet with V-clamp (Figure 82) (Item 9) Torque V-clamp nut to 106 lb-in (12 N•m).

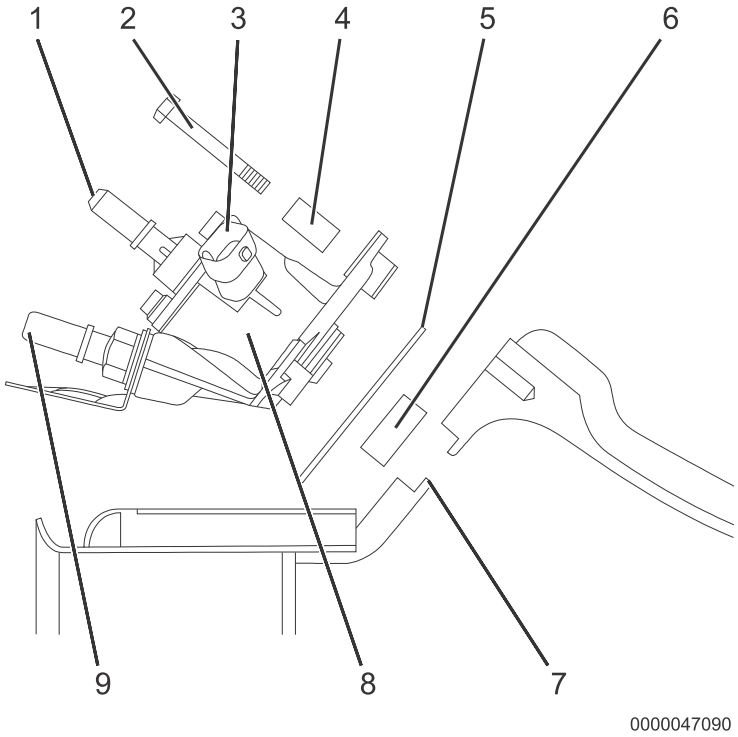
7. Connect DEF dosing valve electrical connector (Figure 83) (Item 1) to DEF dosing valve (Figure 83) (Item 4).

8. Connect two DEF coolant lines (Figure 83) (Item 3) to DEF dosing valve (Figure 83) (Item 4).

9. Connect DEF pressure line (Figure 83) (Item 2) to DEF dosing valve (Figure 83) (Item 4).

10. Connect DEF tank assembly electrical connector (Figure 82) (Item 2) to aftertreatment assembly mounting bracket (Figure 82) (Item 4).

9.1.3. Diesel Exhaust Fluid (DEF) Dosing Valve – Removal



1. DEF dosing valve pressure line
2. DEF dosing valve mounting bolt (3)
3. DEF dosing valve electrical connector
4. DEF dosing valve mounting bolt spacer (3)
5. DEF dosing valve gasket
6. DEF dosing valve thermal isolator
7. DEF dosing valve spray port
8. DEF dosing valve
9. DEF dosing valve coolant line (2)

Figure 84 Diesel Exhaust Fluid (DEF) Dosing Valve.

1. Disconnect DEF pressure line (Figure 84) (Item 1) from DEF dosing valve (Figure 84) (Item 8).

2. Disconnect two DEF coolant lines (Figure 84) (Item 9) from DEF dosing valve (Figure 84) (Item 8).

3. Disconnect DEF dosing valve electrical connector (Figure 84) (Item 3) from DEF dosing valve (Figure 84) (Item 8).

4. Remove three DEF dosing valve mounting bolts (Figure 84) (Item 2) and spacers (Figure 84) (Item 4) from DEF dosing valve (Figure 84) (Item 8).

5. Remove DEF dosing valve (Figure 84) (Item 8) and gasket (Figure 84) (Item 5) from DEF dosing valve spray port (Figure 84) (Item 7). Discard gasket.

6. Remove DEF dosing valve thermal isolator (Figure 84) (Item 6) from DEF dosing valve spray port (Figure 84) (Item 7). Discard isolator.

9.1.4. Diesel Exhaust Fluid (DEF) Dosing Valve – Installation

1. Install new DEF dosing valve thermal isolator (Figure 84) (Item 6) into DEF dosing valve spray port (Figure 84) (Item 7) with tapered end facing DEF dosing valve (Figure 84) (Item 8).

2. Install new DEF dosing valve gasket (Figure 84) (Item 5) onto bottom of DEF dosing valve (Figure 84) (Item 8) with metallic side facing DEF dosing valve.

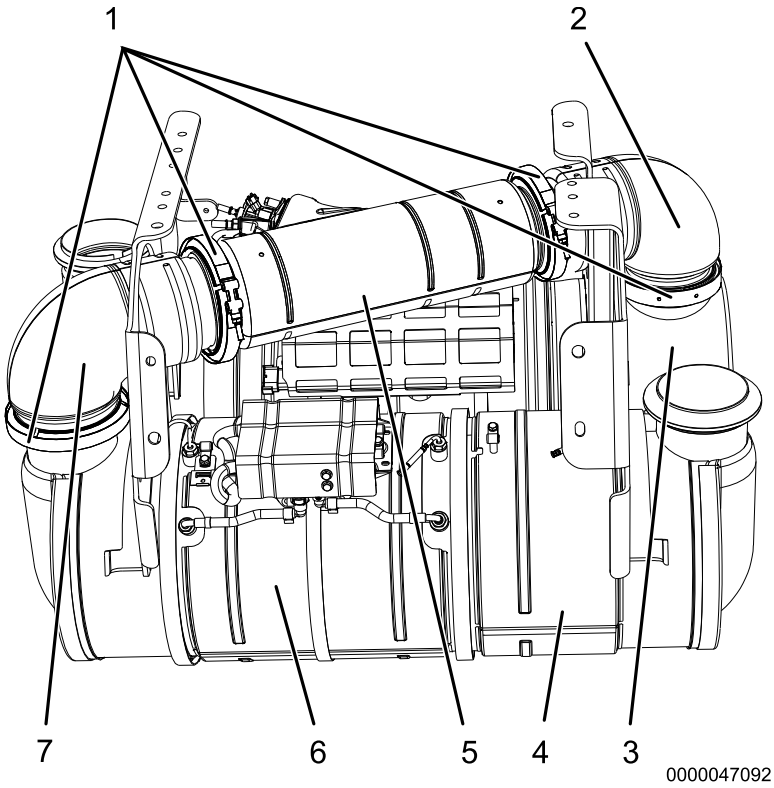
3. Install DEF dosing valve (Figure 84) (Item 8) and gasket (Figure 84) (Item 5) to DEF dosing valve spray port (Figure 84) (Item 7) using three DEF dosing valve mounting bolts (Figure 84) (Item 2).

4. Connect DEF pressure line (Figure 84) (Item 1) to DEF dosing valve (Figure 84) (Item 8).

5. Connect two DEF coolant lines (Figure 84) (Item 9) to DEF dosing valve (Figure 84) (Item 8).

6. Connect DEF dosing valve electrical connector (Figure 84) (Item 3) to DEF dosing valve (Figure 84) (Item 8).

9.1.5. Decomposition Reactor Tube – Removal



1. V-clamp (4)
2. Decomposition reactor tube outlet
3. Selective catalyst Reduction (SCR) canister
4. Diesel Oxidation Catalyst (DOC)
5. Decomposition reactor tube
6. Diesel Particulate Filter (DPF)
7. Decomposition reactor tube inlet

Figure 85 Decomposition Reactor Tube.

1. Loosen V-clamp (Figure 85) (Item 1) securing decomposition reactor tube outlet (Figure 85) (Item 2) to SCR canister (Figure 85) (Item 3) inlet.

2. Loosen V-clamp (Figure 85) (Item 1) securing decomposition reactor tube outlet (Figure 85) (Item 2) to decomposition reactor tube (Figure 85) (Item 5).

3. Remove decomposition reactor tube outlet (Figure 85) (Item 2).

4. Loosen V-clamp (Figure 85) (Item 1) securing decomposition reactor tube (Figure 85) (Item 5) to decomposition reactor tube inlet. (Figure 85) (Item 7).

5. Remove decomposition reactor tube (Figure 85) (Item 5).

6. Loosen V-clamp (Figure 85) (Item 1) securing decomposition reactor tube inlet (Figure 85) (Item 7) to DPF (Figure 85) (Item 6) outlet.

7. Remove decomposition reactor tube inlet (Figure 85) (Item 7).

9.1.6. Decomposition Reactor Tube – Installation

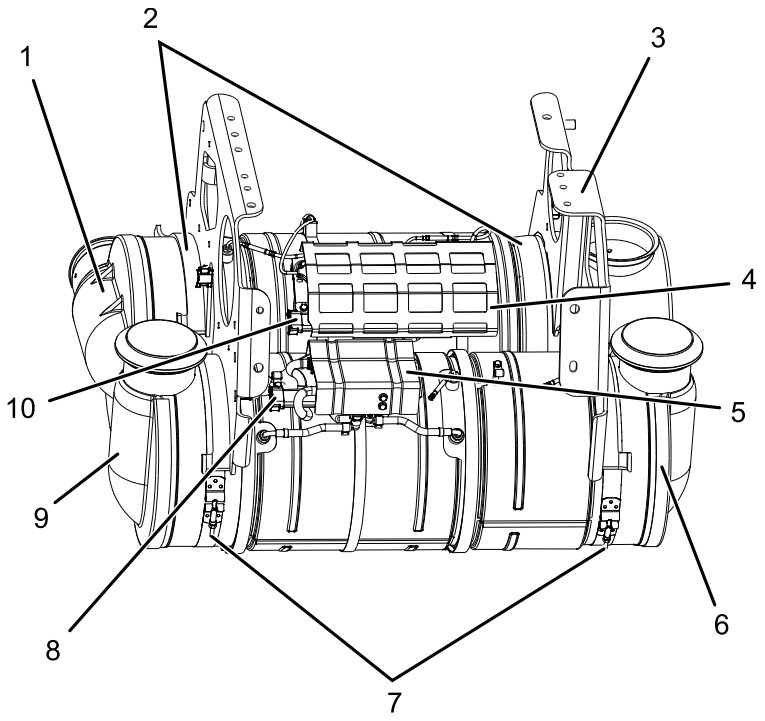
1. Secure decomposition reactor tube inlet (Figure 85) (Item 7) to DPF (Figure 85) (Item 6) outlet with V-clamp (Figure 85) (Item 1).

2. Secure decomposition reactor tube (Figure 85) (Item 5) to decomposition reactor tube inlet (Figure 85) (Item 7) with V-clamp (Figure 85) (Item 1).

3. Secure decomposition reactor tube outlet (Figure 85) (Item 2) to decomposition reactor tube (Figure 85) (Item 5) with V-clamp (Figure 85) (Item 1).

4. Secure decomposition reactor tube outlet (Figure 85) (Item 2) to SCR canister (Figure 85) (Item 3) inlet using V-clamp (Figure 85) (Item 1).

9.1.7. Aftertreatment Assembly Mounting Bracket – Removal



0000042170

1. Selective catalyst Reduction (SCR) canister
2. SCR canister mount band (2)
3. Aftertreatment assembly mounting bracket
4. SCR interface module
5. DPF interface module
6. DOC
7. DPF / DOC mount band (2)
8. DPF interface module junction connector
9. DPF
10. SCR interface junction module connector

Figure 86 Aftertreatment Assembly Mounting Bracket.

NOTE – It may be necessary to remove steps prior to removing the DPF or SCR canister from the mounting bracket.

1. Disconnect DPF interface module junction connector (Figure 86) (Item 8) from DPF interface module (Figure 86) (Item 5).

2. Disconnect SCR interface module junction connector (Figure 86) (Item 10) from SCR interface module (Figure 86) (Item 4).

3. Loosen two mount bands (Figure 86) (Item 7) securing DPF (Figure 86) (Item 9) and DOC (Figure 86) (Item 6) to aftertreatment assembly mounting bracket (Figure 86) (Item 3).

4. Remove DPF (Figure 86) (Item 9) from aftertreatment assembly mounting bracket (Figure 86) (Item 3).

5. Loosen two mount bands (Figure 86) (Item 2) securing SCR canister (Figure 86) (Item 1) to aftertreatment assembly mounting bracket (Figure 86) (Item 3).

6. Remove SCR canister (Figure 86) (Item 1) from aftertreatment assembly mounting bracket (Figure 86) (Item 3).

9.1.8. Diesel Particulate Filter (DPF) and Selective Catalyst Reduction (SCR) Assembly Mounting Bracket – Installation

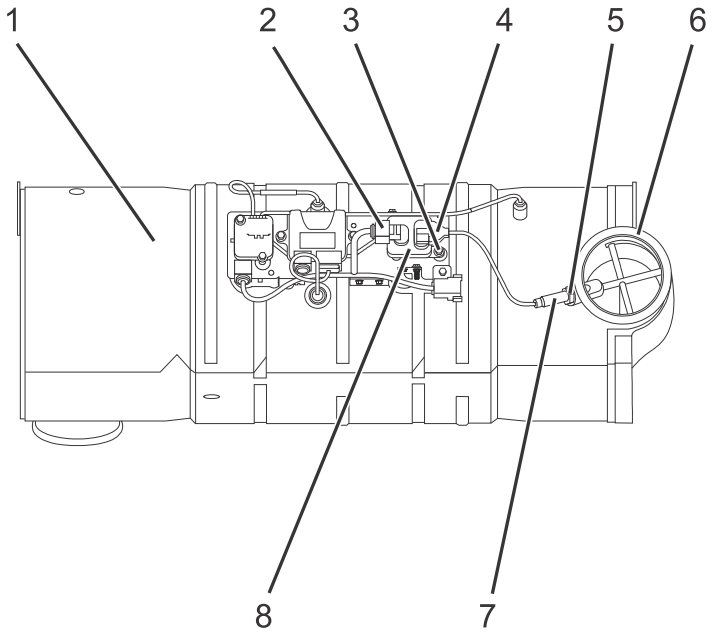
1. Secure SCR canister (Figure 86) (Item 1) to aftertreatment assembly mounting bracket (Figure 86) (Item 3) using two mount bands (Figure 86) (Item 2). Torque nut to 97 lb-in (11 N•m).

2. Secure DPF (Figure 86) (Item 9) and DOC (Figure 86) (Item 6) to aftertreatment assembly mounting bracket (Figure 86) (Item 3) using two mount bands (Figure 86) (Item 7).Torque nut to 97 lb-in (11 N•m).

3. Connect SCR interface module junction connector (Figure 86) (Item 10) to SCR interface module (Figure 86) (Item 4).

4. Connect DPF interface module junction connector (Figure 86) (Item 8) to DPF interface module (Figure 86) (Item 5).

9.1.9. Selective Catalyst Reduction (SCR) NOx Out Sensor Module – Removal



1. SCR canister
2. NOx out sensor harness electrical connector
3. NOx out sensor mounting bolt (2)
4. NOx out sensor electrical connector
5. NOx out sensor mounting nut
6. SCR canister outlet
7. NOx out sensor
8. NOx out sensor module

Figure 87 Selective Catalyst Reduction (SCR) NOx Out Sensor Module.

1. Disconnect NOx out sensor harness electrical connector (Figure 87) (Item 2) from NOx out sensor module (Figure 87) (Item 8).

2. Disconnect NOx out sensor electrical connector (Figure 87) (Item 4) from NOx out sensor module (Figure 87) (Item 8).

3. Remove two NOx out sensor module mounting bolts (Figure 87) (Item 3) from NOx out sensor module (Figure 87) (Item 8).

4. Remove NOx out sensor module (Figure 87) (Item 8) from SCR canister (Figure 87) (Item 1).

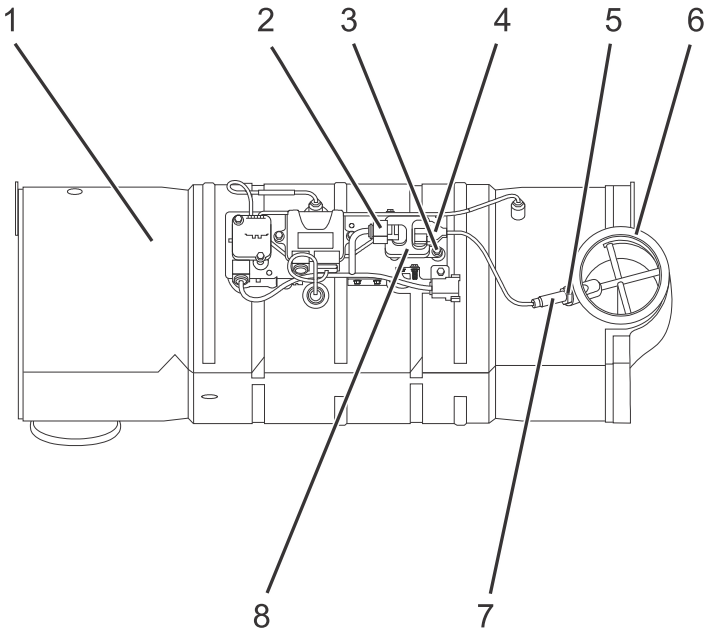
9.1.10. Selective Catalyst Reduction (SCR) NOx Out Sensor Module – Installation

1. Install NOx out sensor module (Figure 87) (Item 8) to SCR canister (Figure 87) (Item 1) using two NOx out sensor module mounting bolts (Figure 87) (Item 3).

2. Connect NOx out sensor electrical connector (Figure 87) (Item 4) to NOx out sensor module (Figure 87) (Item 8).

3. Connect NOx out sensor electrical connector (Figure 87) (Item 4) to NOx out sensor module (Figure 87) (Item 8).

9.1.11. Selective Catalyst Reduction (SCR) NOx Out Sensor – Removal



1. SCR canister
2. NOx out sensor harness electrical connector
3. NOx out sensor mounting bolt (2)
4. NOx out sensor electrical connector
5. NOx out sensor mounting nut
6. SCR canister outlet
7. NOx out sensor
8. NOx out sensor module

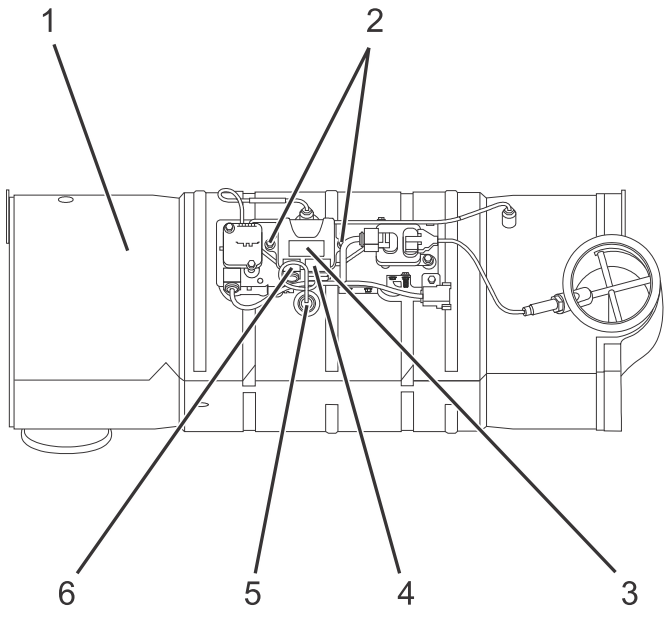
Figure 88 Selective Catalyst Reduction (SCR) NOx Out Sensor.

1. Disconnect NOx out sensor electrical connector (Figure 88) (Item 4) from NOx out sensor module (Figure 88) (Item 8).
2. Remove NOx out sensor mounting nut (Figure 88) (Item 5) from SCR canister outlet (Figure 88) (Item 6).
3. Remove NOx out sensor (Figure 88) (Item 7) from SCR canister outlet (Figure 88) (Item 6).

9.1.12. Selective Catalyst Reduction (SCR) NOx Out Sensor – Installation

1. Install NOx out sensor (Figure 88) (Item 7) into SCR canister outlet (Figure 88) (Item 6) .
2. Install NOx out sensor mounting nut (Figure 88) (Item 5) into SCR canister outlet (Figure 88) (Item 6).
3. Connect NOx out sensor electrical connector (Figure 88) (Item 4) to NOx out sensor module (Figure 88) (Item 8).

9.1.13. Selective Catalyst Reduction (SCR) Ammonia (NH3) Sensor Module – Removal



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1. SCR canister
2. Ammonia (NH3) sensor module mounting bolt (2)
3. Ammonia (NH3) sensor module
4. Ammonia (NH3) sensor electrical connector
5. Ammonia (NH3) sensor
6. Ammonia (NH3) sensor module electrical connector

Figure 89 Selective Catalyst Reduction (SCR) Ammonia (NH3) Sensor Module.

1. Disconnect ammonia (NH3) sensor electrical connector (Figure 89) (Item 4) from ammonia (NH3) sensor module (Figure 89) (Item 3).

2. Disconnect ammonia (NH3) sensor module electrical connector (Figure 89) (Item 6) from ammonia (NH3) sensor module (Figure 89) (Item 3).

3. Remove two ammonia (NH3) sensor module mounting bolts (Figure 89) (Item 2) from SCR canister (Figure 89) (Item 1).

4. Remove ammonia (NH3) sensor module (Figure 89) (Item 3) from SCR canister (Figure 89) (Item 1).

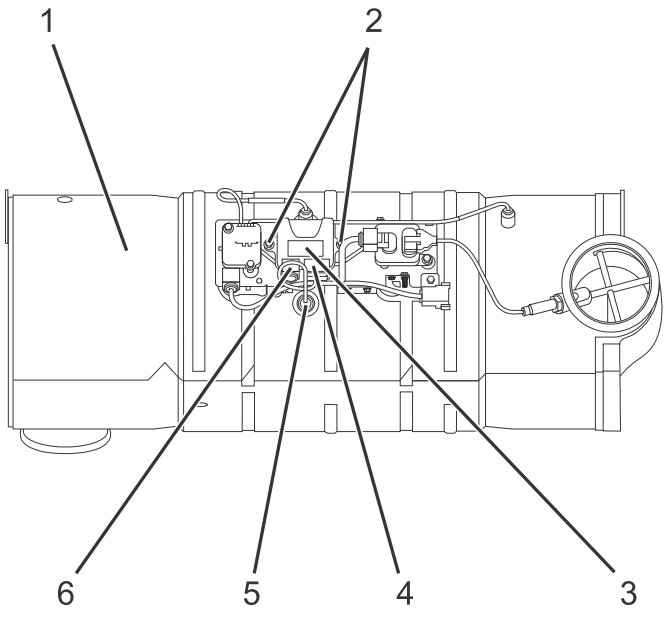
9.1.14. Selective Catalyst Reduction (SCR) Ammonia (NH3) Sensor Module – Installation

1. Install ammonia (NH3) sensor module (Figure 89) (Item 3) to SCR canister (Figure 89) (Item 1) using two ammonia (NH3) sensor module mounting bolts (Figure 89) (Item 2).

2. Connect ammonia (NH3) sensor module electrical connector (Figure 89) (Item 6) to ammonia (NH3) sensor module (Figure 89) (Item 3).

3. Connect ammonia (NH3) sensor electrical connector (Figure 89) (Item 4) to ammonia (NH3) sensor module (Figure 89) (Item 3).

9.1.15. Selective Catalyst Reduction (SCR) Ammonia (NH3) Sensor – Removal



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1. SCR canister
2. Ammonia (NH3) sensor module mounting bolt (2)
3. Ammonia (NH3) sensor module
4. Ammonia (NH3) sensor electrical connector
5. Ammonia (NH3) sensor / mounting nut
6. Ammonia (NH3) sensor module electrical connector

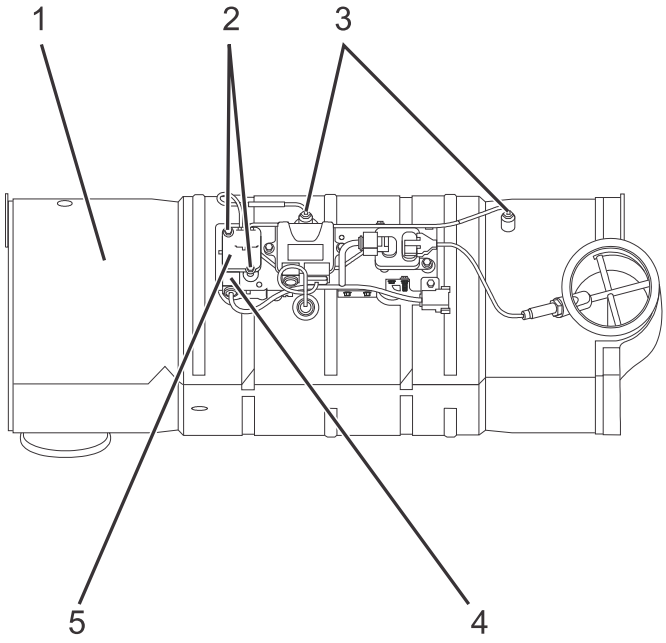
Figure 90 Selective Catalyst Reduction (SCR) Ammonia (NH3) Sensor.

1. Disconnect ammonia (NH3) sensor electrical connector (Figure 90) (Item 4) from ammonia (NH3) sensor module (Figure 90) (Item 3).
2. Remove ammonia (NH3) sensor mounting nut (Figure 90) (Item 5) from SCR canister (Figure 90) (Item 1).
3. Remove ammonia (NH3) sensor (Figure 90) (Item 5) from SCR canister (Figure 90) (Item 1).

9.1.16. Selective Catalyst Reduction (SCR) Ammonia (NH3) Sensor – Installation

1. Install ammonia (NH3) sensor (Figure 90) (Item 5) into SCR canister (Figure 90) (Item 1).
2. Install ammonia (NH3) sensor mounting nut (Figure 90) (Item 5) into SCR canister (Figure 90) (Item 1) .
3. Connect ammonia (NH3) sensor electrical connector (Figure 90) (Item 4) to ammonia (NH3) sensor module (Figure 90) (Item 3).

9.1.17. Selective Catalyst Reduction (SCR) Temperature Sensors and Module – Removal



1. SCR canister
2. SCR temperature sensor module mounting bolt (2)
3. SCR temperature sensor / nut(2)
4. SCR temperature sensor module electrical connector
5. SCR temperature sensor module

Figure 91 Selective Catalyst Reduction (SCR) Temperature Sensors and Module.

1. Disconnect SCR temperature sensor module electrical connector (Figure 91) (Item 4) from SCR temperature sensor module (Figure 91) (Item 5).

2. Remove two SCR temperature sensor module mounting bolts (Figure 91) (Item 2) from SCR temperature sensor module. (Figure 91) (Item

3. Remove one SCR temperature sensor mounting nut (Figure 91) (Item 3) from each SCR temperature sensor (Figure 91) (Item 3).

4. Remove SCR temperature sensor module (Figure 91) (Item 5) and two SCR temperature sensors (Figure 91) (Item 3) from SCR canister (Figure 91) (Item 1).

9.1.18. Selective Catalyst Reduction (SCR) Temperature Sensors and Module – Installation

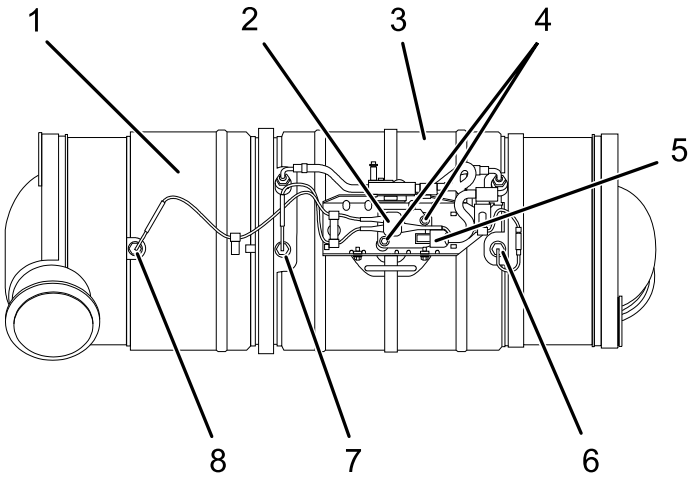
1. Install two SCR temperature sensors (Figure 91) (Item 3) into SCR canister (Figure 91) (Item 1).

2. Install one SCR temperature sensor mounting nut (Figure 91) (Item 3) into SCR canister (Figure 91) (Item 1) for each SCR temperature sensor (Figure 91) (Item 3).

3. Install SCR temperature sensor module (Figure 91) (Item 5) to SCR canister (Figure 91) (Item 1) using two SCR temperature sensor module mounting bolts (Figure 91) (Item 2).

4. Connect SCR temperature sensor module electrical connector (Figure 91) (Item 4) to SCR temperature sensor module (Figure 91) (Item 5).

9.1.19. Diesel Particulate Filter (DPF) Temperature Sensors and Module – Removal



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1. Diesel Oxidation Catalyst (DOC)
2. Diesel Particulate filter (DPF) temperature sensor module
3. DPF
4. DPF temperature sensor mounting bolt (2)
5. DPF temperature sensor module electrical connector
6. DPF outlet temperature sensor and mounting nut
7. DPF inlet temperature sensor and mounting nut
8. DOC inlet temperature sensor and mounting nut

Figure 92 Diesel Particulate Filter (DPF) Temperature Sensors and Module.

NOTE – The DPF temperature sensor module, DPF inlet temperature sensor, DPF outlet temperature sensor, and DOC inlet temperature sensor are removed as a unit.

1. Remove DOC inlet temperature sensor and mounting nut (Figure 92) (Item 8) from DOC (Figure 92) (Item 1).

2. Remove DPF inlet temperature sensor and mounting nut (Figure 92) (Item 7) from DPF (Figure 92) (Item 3).

3. Remove DPF outlet temperature sensor and mounting nut (Figure 92) (Item 6) from DPF (Figure 92) (Item 3).

4. Remove two DPF temperature sensor module mounting bolts (Figure 92) (Item 4) from DPF temperature sensor module (Figure 92) (Item 2).

5. Disconnect DPF temperature sensor module electrical connector (Figure 92) (Item 5) from DPF temperature sensor module (Figure 92) (Item 2).

6. Remove DPF temperature sensor module (Figure 92) (Item 2) from DPF (Figure 92) (Item 3).

9.1.20. Diesel Particulate Filter (DPF) Temperature Sensors and Module– Installation

1. Install DPF temperature sensor module (Figure 92) (Item 2) to DPF (Figure 92) (Item 3) using two DPF temperature sensor module mounting bolts (Figure 92) (Item 4).

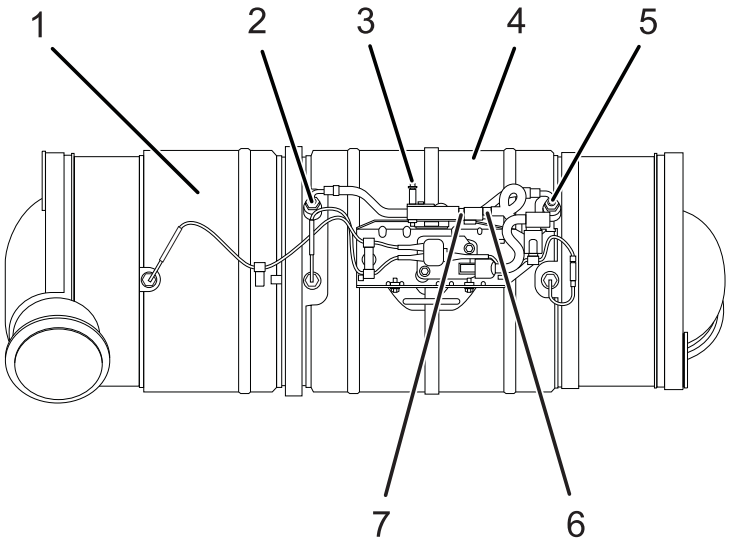
2. Connect DPF temperature sensor module electrical connector (Figure 92) (Item 5) to DPF temperature sensor module (Figure 92) (Item 2).

3. Install DPF outlet temperature sensor and mounting nut (Figure 92) (Item 6) to DPF (Figure 92) (Item 3).

4. Install DPF inlet temperature sensor and mounting nut (Figure 92) (Item 7) to DPF (Figure 92) (Item 3).

5. Install DOC inlet temperature sensor and mounting nut (Figure 92) (Item 8) to DOC (Figure 92) (Item 1).

9.1.21. Diesel Particulate Filter (DPF) Pressure Sensor Module – Removal



1. Diesel Oxidation Catalyst (DOC)
2. DPF high pressure tube
3. DPF pressure sensor mounting bolt (2)
4. DPF
5. DPF low pressure tube
6. DPF pressure sensor module electrical connector
7. DPF pressure sensor module

Figure 93 Diesel Particulate Filter (DPF) Pressure Sensor Module.

1. Remove two DPF pressure sensor module mounting bolts (Figure 93) (Item 3) from DPF pressure sensor module (Figure 93) (Item 7).

2. Disconnect DPF pressure sensor module electrical connector (Figure 93) (Item 6) from DPF pressure sensor module (Figure 93) (Item 7).

3. Disconnect DPF high pressure tube (Figure 93) (Item 2) from DPF pressure sensor module (Figure 93) (Item 7).

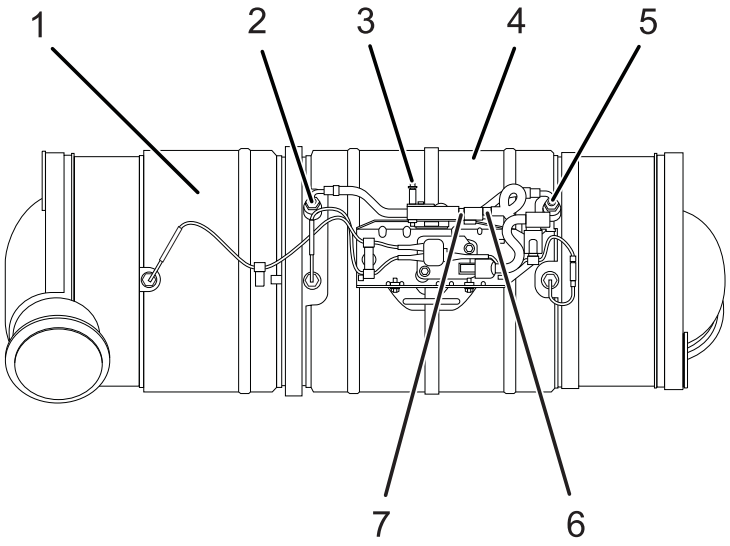
4. Disconnect DPF low pressure tube (Figure 93) (Item 5) from DPF pressure sensor module (Figure 93) (Item 7).

5. Remove DPF pressure sensor module (Figure 93) (Item 7) from DPF (Figure 93) (Item 4).

9.1.22. Diesel Particulate Filter (DPF) Pressure Sensor Module – Installation

1. Connect DPF low pressure tube (Figure 93) (Item 5) to DPF pressure sensor module (Figure 93) (Item 7).
2. Connect DPF high pressure tube (Figure 93) (Item 2) to DPF pressure sensor module (Figure 93) (Item 7).
3. Connect DPF pressure sensor module electrical connector (Figure 93) (Item 6) to DPF pressure sensor module (Figure 93) (Item 7).
4. Install two DPF pressure sensor module mounting bolts (Figure 93) (Item 3) to DPF pressure sensor module (Figure 93) (Item 7).

9.1.23. Diesel Particulate Filter (DPF) High Pressure Tube – Removal



1. Diesel Oxidation Catalyst (DOC)
2. DPF high pressure tube and mounting nut
3. DPF pressure sensor mounting bolt (2)
4. DPF
5. DPF low pressure tube
6. DPF pressure sensor module electrical connector
7. DPF pressure sensor module

Figure 94 Diesel Particulate Filter (DPF) Pressure Tubes.

1. Disconnect DPF high pressure tube (Figure 94) (Item 2) from DPF pressure sensor module (Figure 94) (Item 7).

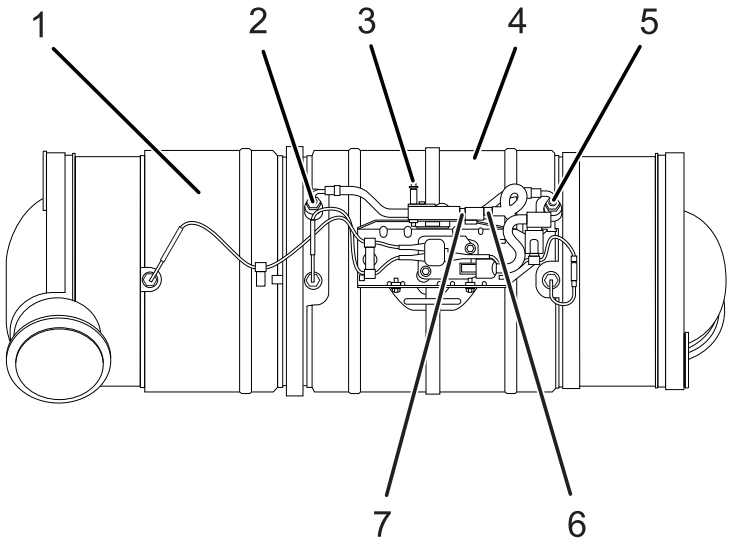
2. Remove DPF high pressure tube and mounting nut (Figure 94) (item 2) from DPF (Figure 94) (Item 4).

9.1.24. Diesel Particulate Filter (DPF) High Pressure Tube – Installation

1. Install DPF high pressure tube and mounting nut (Figure 94) (item 2) to DPF (Figure 94) (Item 4).

2. Connect DPF high pressure tube (Figure 94) (Item 2) to DPF pressure sensor module (Figure 94) (Item 7).

9.1.25. Diesel Particulate Filter (DPF) Low Pressure Tube – Removal



1. Diesel Oxidation Catalyst (DOC)
2. DPF high pressure tube
3. DPF pressure sensor mounting bolt (2)
4. DPF
5. DPF low pressure tube and mounting nut
6. DPF pressure sensor module electrical connector
7. DPF pressure sensor module

Figure 95 Diesel Particulate Filter (DPF) Interface Module.

1. Disconnect DPF low pressure tube (Figure 95) (Item 5) from DPF pressure sensor module (Figure 95) (Item 7).

2. Remove DPF low pressure tube and mounting nut (Figure 95) (Item 5) from DPF (Figure 95) (Item 4).

9.1.26. Diesel Particulate Filter (DPF) Low Pressure Tube – Installation

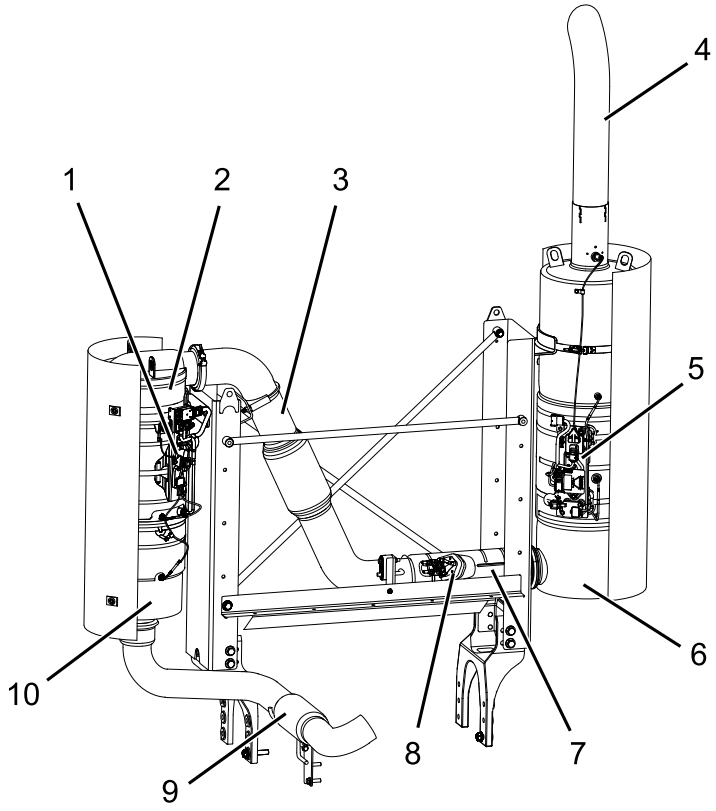
1. Install DPF low pressure tube and mounting nut (Figure 95) (Item 5) to DPF (Figure 95) (Item 4).

2. Connect DPF low pressure tube (Figure 95) (Item 5) to DPF pressure sensor module (Figure 95) (Item 7).

10. VERTICAL / VERTICAL

10.1. NAVISTAR® N13 ENGINE

10.1.1. Vertical / Vertical



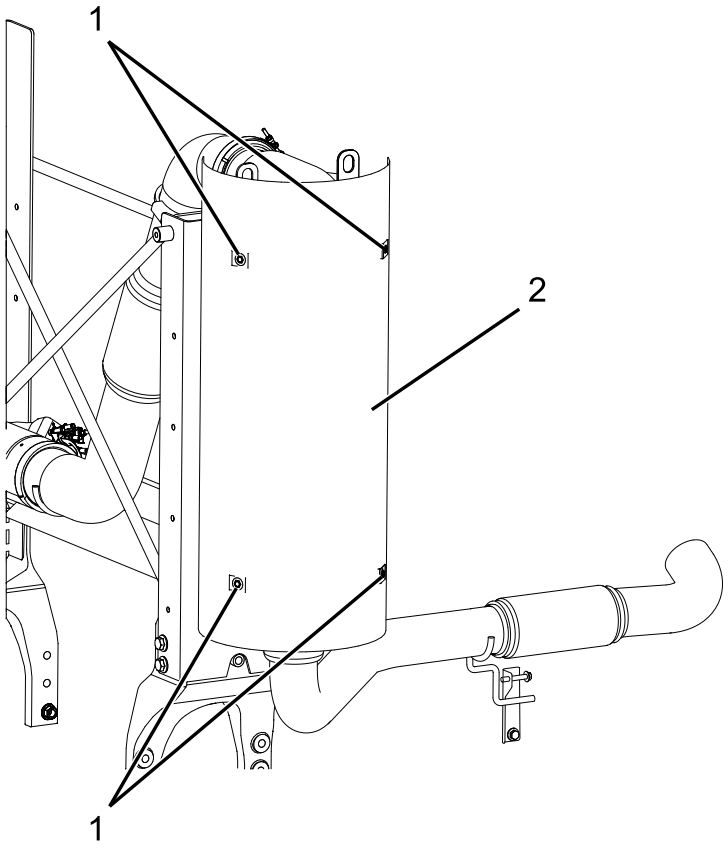
0000052630

1. Diesel particulate filter (DPF) interface module
2. DPF
3. Decomposition reactor tube inlet
4. Tailpipe
5. Selective catalyst reduction (SCR) interface module
6. SCR canister
7. Decomposition reactor tube
8. Diesel exhaust fluid (DEF) dosing valve
9. Turbo pipe
10. Diesel Oxidation Catalyst (DOC)

Figure 96 Vertical / Vertical.

NOTE – Removal and installation procedures for the Vertical / Vertical system are similar to the Switchback system. Depending on vehicle configuration, specific component location may vary. This section will provide removal and installation procedures for the components that differ from the Switchback system.

10.1.2. Diesel Particulate Filter (DPF) or Selective Catalyst Reduction (SCR) Heat Shield – Removal



1. Heat shield mounting bolt (4)
2. Heat shield

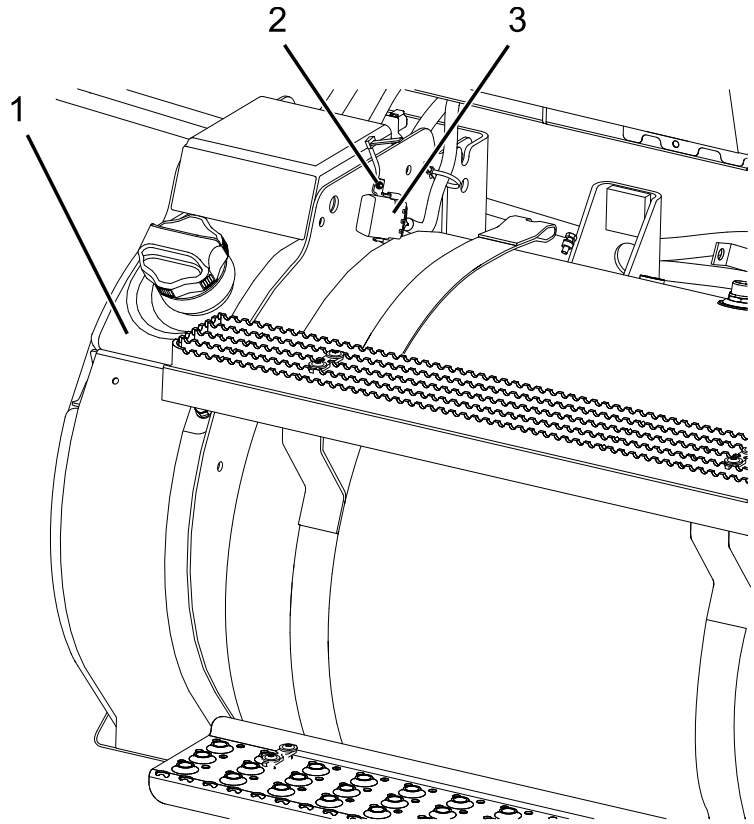
Figure 97 Heat Shield.

1. Remove four heat shield mounting bolts (Figure 97) (Item 1) from heat shield (Figure 97) (Item 2).
2. Remove heat shield (Figure 97) (Item 2) from DPF or SCR canister.

10.1.3. Diesel Particulate Filter (DPF) or Selective Catalyst Reduction (SCR) Heat Shield – Installation

1. Install heat shield (Figure 97) (Item 2) to DPF or SCR canister.
2. Install four heat shield mounting bolts (Figure 97) (Item 1) to heat shield (Figure 97) (Item 2).

10.1.4. Power Distribution Module (PDM) – Removal



0000052652

1. Diesel Exhaust Fluid (DEF) tank
2. PDM mounting bolt
3. PDM

Figure 98 PDM.

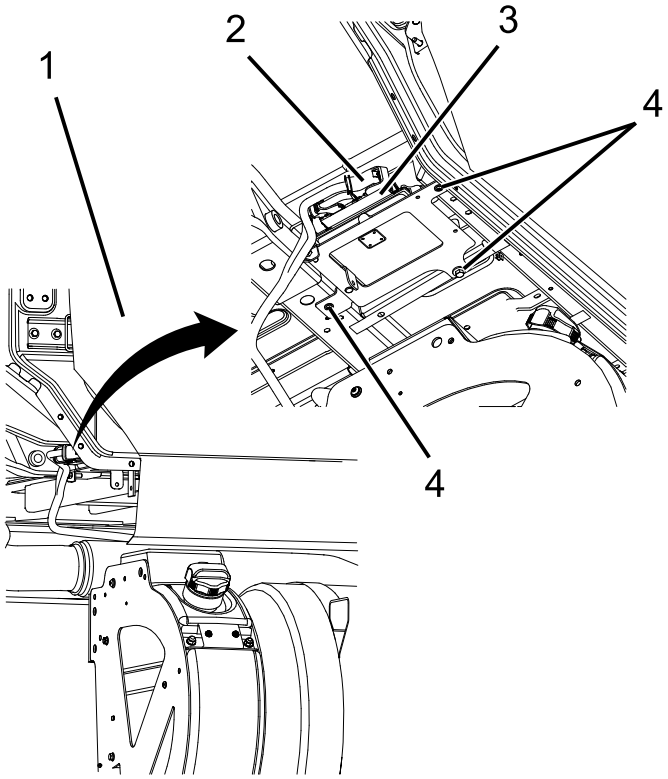
NOTE – Optional PDM location, depending on vehicle configuration.

1. Remove PDM mounting bolt (Figure 98) (Item 2) from DEF tank (Figure 98) (Item 1).
2. Remove PDM (Figure 98) (Item 3) from DEF tank (Figure 98) (Item 1).

10.1.5. Power Distribution Module (PDM) – Installation

1. Install PDM (Figure 98) (Item 3) to DEF tank (Figure 98) (Item 1).
2. Install PDM mounting bolt (Figure 98) (Item 2) to DEF tank (Figure 98) (Item 1).

10.1.6. Aftertreatment Control Module (ACM) – Removal



0000053252

1. Left side cab
2. ACM connector
3. ACM
4. ACM mounting bolt (3)

Figure 99 ACM.

NOTE – Optional ACM location, depending on vehicle configuration.

1. Unplug ACM connector (Figure 99) (Item 2) from ACM (Figure 99) (Item 3).
2. Remove three ACM mounting bolts (Figure 99) (Item 4) from ACM (Figure 99) (Item 3).
3. Remove ACM (Figure 99) (Item 3) from vehicle.

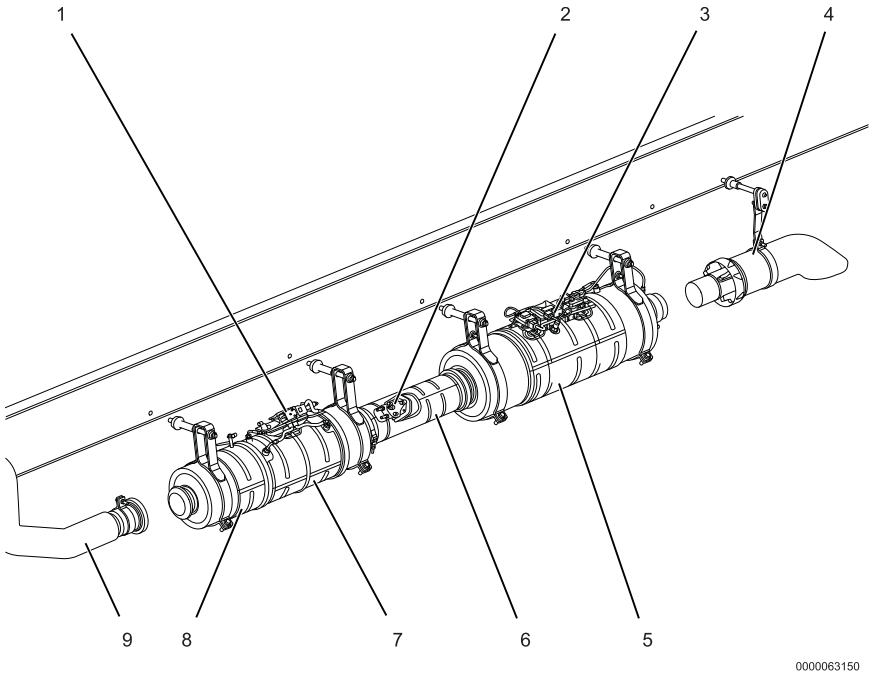
10.1.7. Aftertreatment Control Module (ACM) – Installation

1. Install ACM (Figure 99) (Item 3) under left side cab (Figure 99) (Item 1).
2. Install three ACM mounting bolts (Figure 99) (Item 4) to ACM (Figure 99) (Item 3).
3. Connect ACM connector (Figure 99) (Item 2) to ACM (Figure 99) (Item 3).

11. IN–LINE

11.1. CUMMINS ISB ENGINE

11.1.1. In–Line



1. Diesel particulate filter (DPF) interface module
2. Diesel exhaust fluid (DEF) dosing valve
3. Selective catalyst reduction (SCR) interface module
4. Tailpipe
5. Selective catalyst reduction (SCR) canister
6. Decomposition reactor tube
7. Diesel Particulate Filter (DPF)
8. Diesel Oxidation Catalyst (DOC)
9. Turbo pipe

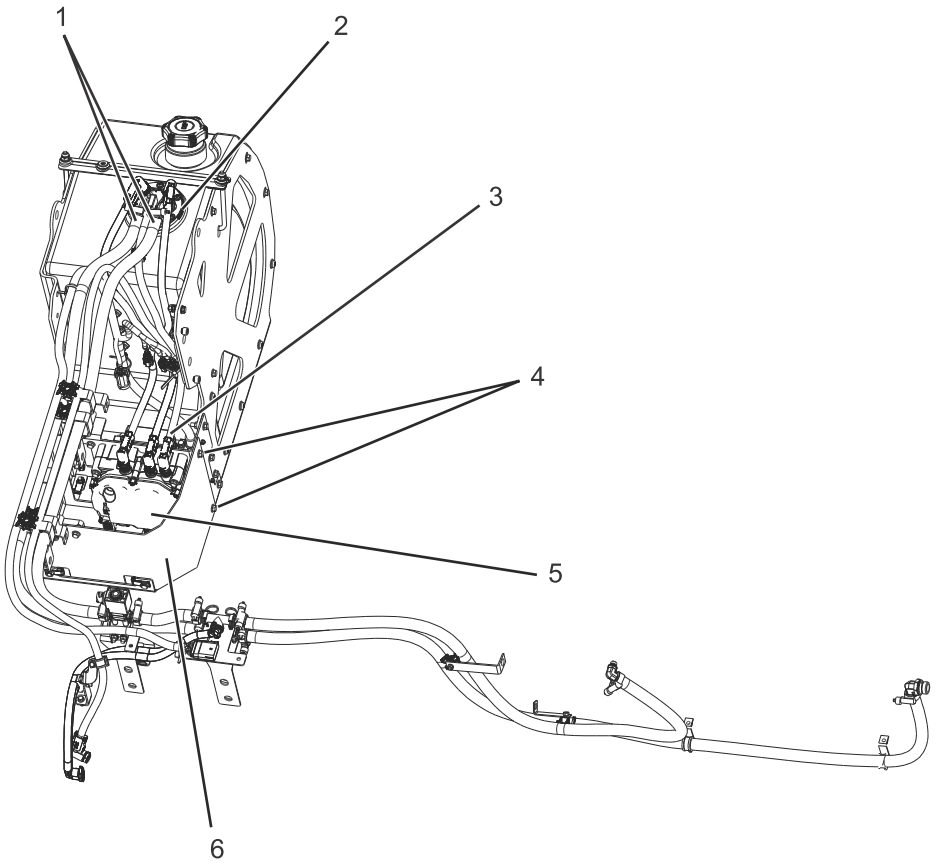
Figure 100 In–Line.

NOTE – Removal and installation procedures for the In–Line system are similar to the Switchback and Vertical / Vertical system. Depending on vehicle configuration, specific component location may vary.

12. DIESEL EXHAUST FLUID (DEF) SYSTEM

12.1. CUMMINS ISX15 OR NAVISTAR® N13 ENGINE

12.1.1. Diesel Exhaust Fluid (DEF) Tank – Removal



1. Diesel Exhaust Fluid (DEF) tank coolant line (2)
2. DEF tank pickup assembly
3. DEF supply module pressure line
4. DEF supply module cover bolt (4)
5. DEF supply module
6. DEF supply module cover

Figure 101 Diesel Exhaust Fluid (DEF) Tank and Lines.

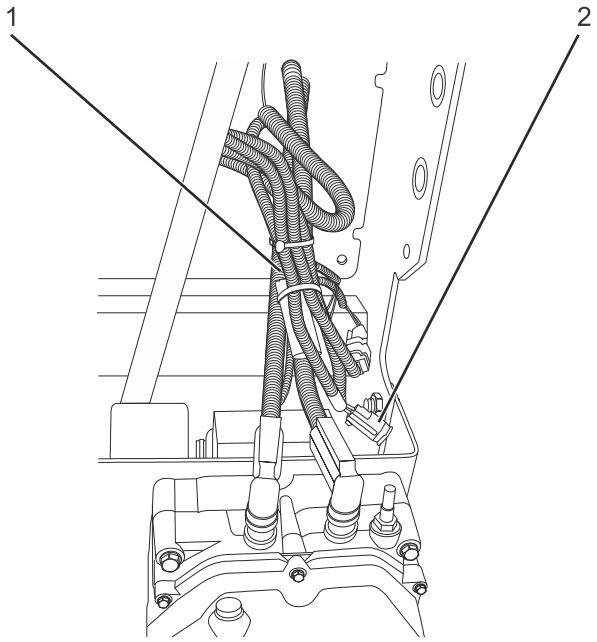
NOTE – There are several configurations of the diesel exhaust fluid (DEF) system on Cummins ISX15 and Navistar® N13. All variations have similar removal / installation procedures.

NOTE – Depending on vehicle configuration, it may be necessary to remove the side skirts and side skirt mounting brackets prior to removing the Diesel Exhaust Fluid (DEF) tank.

1. Disconnect two DEF coolant lines (Figure 101) (Item 1) from DEF tank pickup assembly (Figure 101) (Item 2).

2. Remove four DEF supply module cover bolts (Figure 101) (Item 4) from DEF supply module cover (Figure 101) (Item 6) , and remove DEF supply module cover.

3. Disconnect DEF pressure line (Figure 101) (Item 3) from DEF supply module (Figure 101) (Item 5).



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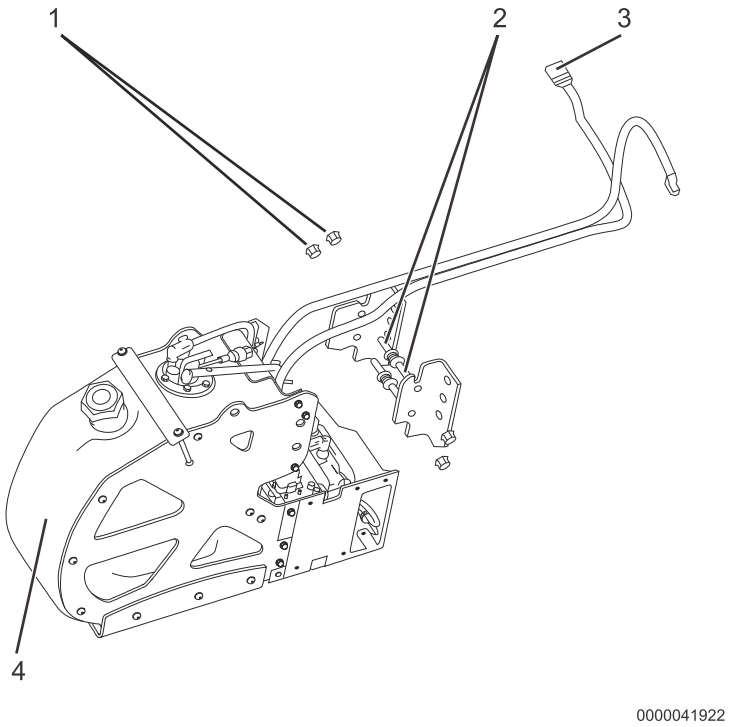
1. Diesel Exhaust Fluid (DEF) tank harness
2. DEF pressure line heater electrical connector

Figure 102 Diesel Exhaust Fluid (DEF) Tank Wiring Harness.

NOTE – DEF pressure line heater is routed within DEF pressure line harness.

4. Disconnect DEF pressure line heater electrical connector (Figure 102) (Item 2) from DEF tank harness (Figure 102) (Item 2).



1. Diesel Exhaust Fluid (DEF) tank mounting bracket nut (4)
2. DEF tank mounting bracket bolt (4)
3. DEF tank assembly electrical connector
4. DEF tank assembly

Figure 103 Diesel Exhaust Fluid (DEF) Tank.

5. Disconnect DEF tank assembly electrical connector (Figure 103) (Item 3) from DPF and SCR assembly mounting bracket.

6. Support DEF tank assembly (Figure 103) (item 4) with a suitable lifting device.

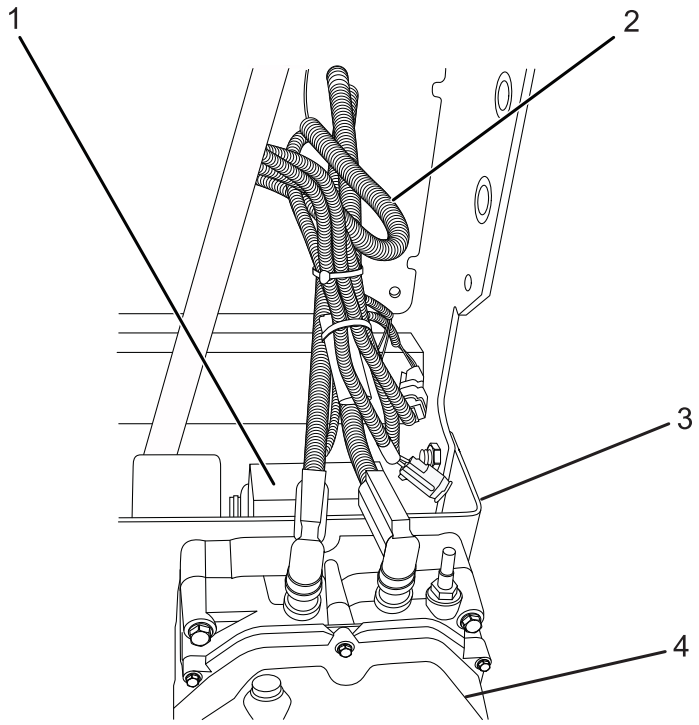
7. Remove four DEF tank assembly mounting bracket bolts and nuts (Figure 103) (Items 1 and 2) from vehicle frame.

8. Lower DEF tank assembly (Figure 103) (Item 4).

12.1.2. Diesel Exhaust Fluid (DEF) Tank – Installation

1. Raise DEF tank assembly (Figure 103) (Item 4) with a suitable lifting device.
2. Install four DEF tank assembly mounting bracket bolts and nuts (Figure 103) (Items 1 and 2) to vehicle frame.
3. Connect DEF tank assembly electrical connector (Figure 103) (Item 3) to DPF and SCR assembly mounting bracket.
4. Connect DEF pressure line heater electrical connector (Figure 102) (Item 2) to DEF tank harness (Figure 102) (Item 2).
5. Connect DEF pressure line (Figure 101) (Item 3) to DEF supply module (Figure 101) (Item 5).
6. Install four DEF supply module cover bolts (Figure 101) (Item 4) to DEF supply module cover (Figure 101) (Item 6).
7. Connect two DEF coolant lines (Figure 101) (Item 1) to DEF tank pickup assembly (Figure 101) (Item 2).

12.1.3. Aftertreatment Power Distribution Module (PDM) – Removal



0000041928

1. Aftertreatment Power Distribution Module (PDM)
2. Diesel Exhaust Fluid (DEF) tank assembly
3. DEF supply module bracket
4. DEF supply module

Figure 104 Aftertreatment Power Distribution Module (PDM).

NOTE – The PDM contains majority of the fuses and relays for the aftertreatment system.

NOTE – Depending on vehicle configuration, it may be necessary to completely remove DEF tank assembly to gain access to the PDM.

1. Remove four aftertreatment PDM mounting bolts (not shown) from DEF supply module bracket (Figure 104) (Item 3).

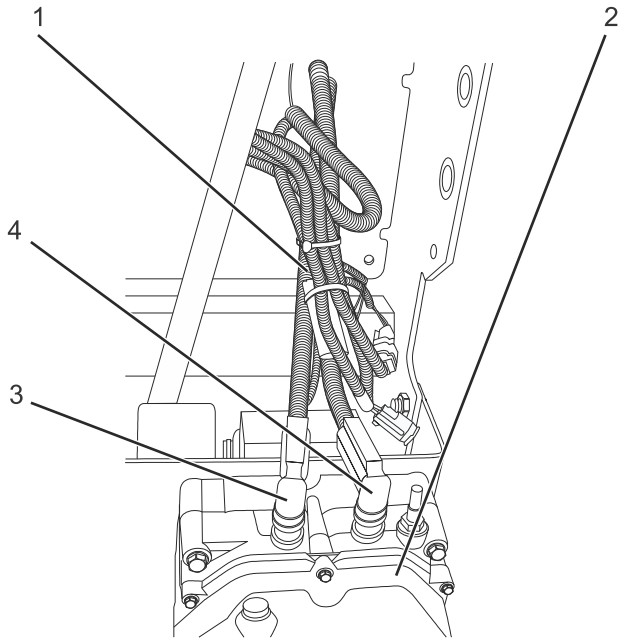
2. Remove aftertreatment PDM (Figure 104) (Item 1) from DEF supply module bracket (Figure 104) (Item 3).

12.1.4. Power Distribution Module (PDM) – Installation

1. Install aftertreatment PDM (Figure 104) (Item 1) to DEF supply module bracket (Figure 104) (Item 3).

2. Install four aftertreatment PDM mounting bolts (not shown) to DEF supply module bracket (Figure 104) (Item 3). Torque bolts to 35 lb-in (4 N•m).

12.1.5. Diesel Exhaust Fluid (DEF) Tank Wiring Harness – Removal



1. Diesel Exhaust Fluid (DEF) tank wiring harness
2. DEF supply module
3. DEF suction line
4. DEF return line

Figure 105 Diesel Exhaust Fluid (DEF) Tank Wiring Harness.

NOTE – Depending on vehicle configuration, it may be necessary to completely remove the DEF tank to gain access to the DEF tank wiring harness.

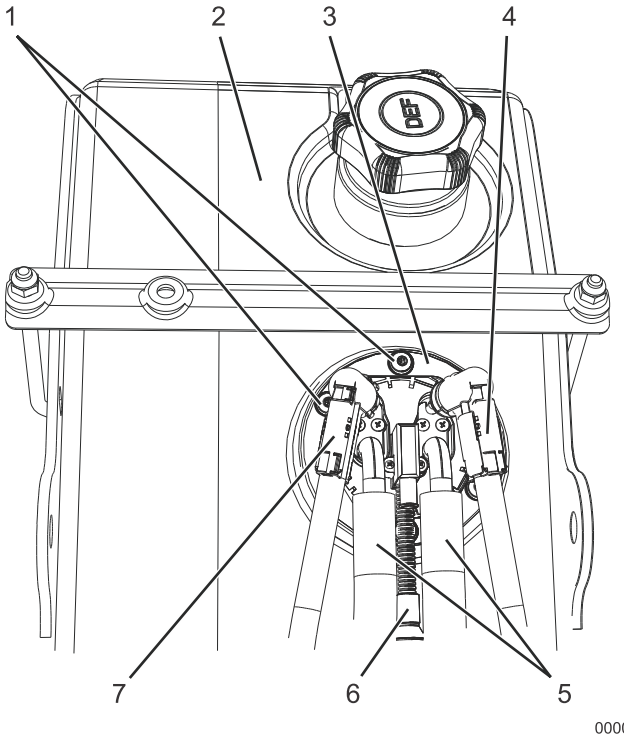
NOTE – Each DEF line will have an individual DEF line heater electrical connector that must be disconnected to separate DEF tank wiring harness from DEF tank lines.

1. Remove Aftertreatment Power Distribution Module (PDM) (See Aftertreatment Power Distribution Module (PDM) – Removal, page 132).

2. Disconnect DEF supply module electrical connector (not shown) from DEF supply module (Figure 105) (Item 2).

3. Disconnect DEF suction line heater electrical connector (part of DEF tank wiring harness) from DEF suction line (Figure 105) (Item 3).

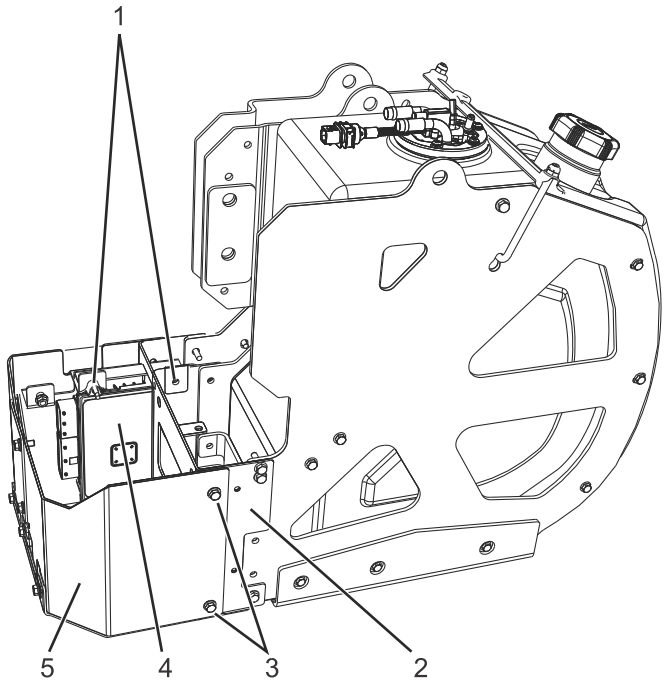
4. Disconnect DEF return line heater electrical connector (part of DEF tank wiring harness) from DEF return line (Figure 105) (Item 4).



1. Diesel Exhaust Fluid (DEF) tank pickup assembly torx screw (6)
2. DEF tank
3. DEF tank pickup assembly
4. DEF suction line
5. DEF coolant line (2)
6. DEF tank pickup assembly electrical connector
7. DEF return line

Figure 106 Diesel Exhaust Fluid (DEF) Tank Pickup Assembly.

5. Disconnect DEF tank pickup assembly electrical connector (Figure 106) (Item 6) from DEF tank wiring harness (Figure 105) (Item 1).



1. Aftertreatment Control Module (ACM) mounting bolt (4)
2. Diesel Exhaust Fluid (DEF) supply module bracket
3. DEF supply module bracket cover mounting bolt (4)
4. ACM
5. DEF supply module bracket cover

Figure 107 Aftertreatment Control Module (ACM) – (If Equipped).

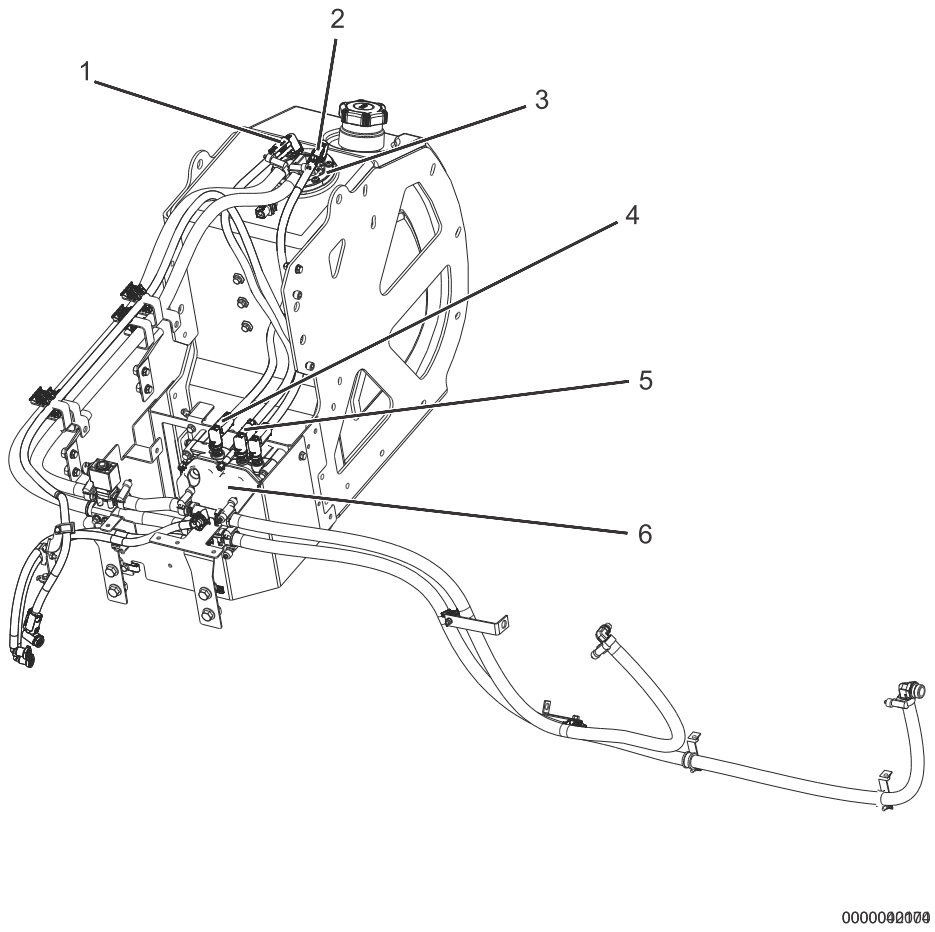
6. Disconnect Aftertreatment Control Module (ACM) electrical connector from ACM (if equipped).

7. Remove DEF tank wiring harness (Figure 105) (Item 1).

12.1.6. Diesel Exhaust Fluid (DEF) Tank Wiring Harness – Installation

1. Connect ACM electrical connector to ACM (Figure 107) (Item 4).
2. Connect DEF tank pickup assembly electrical connector (Figure 106) (Item 6) to DEF tank wiring harness (Figure 105) (Item 1).
3. Connect DEF return line heater electrical connector (part of DEF tank wiring harness) to DEF return line (Figure 105) (Item 4).
4. Connect DEF suction line heater electrical connector (part of DEF tank wiring harness) to DEF suction line (Figure 105) (Item 3).
5. Connect DEF supply module electrical connector (not shown) to DEF supply module (Figure 105) (Item 2).
6. Install Aftertreatment Power Distribution Module (PDM) (See Power Distribution Module (PDM) – Installation, page 132).

12.1.7. Diesel Exhaust Fluid (DEF) Tank Lines – Removal



1. Diesel Exhaust Fluid (DEF) tank pickup assembly DEF return line
2. DEF tank pickup assembly DEF suction line
3. DEF tank pickup assembly
4. DEF supply module suction line
5. DEF supply module return line
6. DEF supply module

Figure 108 Diesel Exhaust Fluid (DEF) Tank Lines.

NOTE – To disconnect DEF lines from fittings, push inward on white quick-release clip.

NOTE – Each DEF line will have an individual DEF line heater electrical connector that must be disconnected to separate DEF tank lines from the DEF tank wiring harness.

1. Disconnect DEF tank pickup assembly DEF return line (Figure 108) (Item 1) from DEF tank pickup assembly (Figure 108) (Item 3).

2. Disconnect DEF tank pickup assembly DEF suction line (Figure 108) (Item 2) from DEF tank pickup assembly (Figure 108) (Item 3).

3. Disconnect DEF supply module return line (Figure 108) (Item 5) from **white** DEF supply module (Figure 108) (Item 6) return fitting.

4. Disconnect DEF supply module suction line (Figure 108) (Item 4) from **black** DEF supply module (Figure 108) (Item 6) suction fitting.

5. Disconnect DEF return line heater electrical connector (part of DEF tank wiring harness) from DEF supply module return line (Figure 108) (Item 5).

6. Disconnect DEF suction line heater electrical connector (part of DEF tank wiring harness) from DEF supply module suction line (Figure 108) (Item 4).

7. Remove DEF tank lines.

12.1.8. Diesel Exhaust Fluid (DEF) Tank Lines – Installation

1. Connect DEF suction line heater electrical connector (part of DEF tank wiring harness) to DEF suction line DEF supply module suction line (Figure 108) (Item 6).

2. Connect DEF return line heater electrical connector (part of DEF tank wiring harness) to DEF supply module return line (Figure 108) (Item 5).

NOTE – Do not install suction or return lines on incorrect DEF supply module fittings, or damage to DEF supply module will occur.

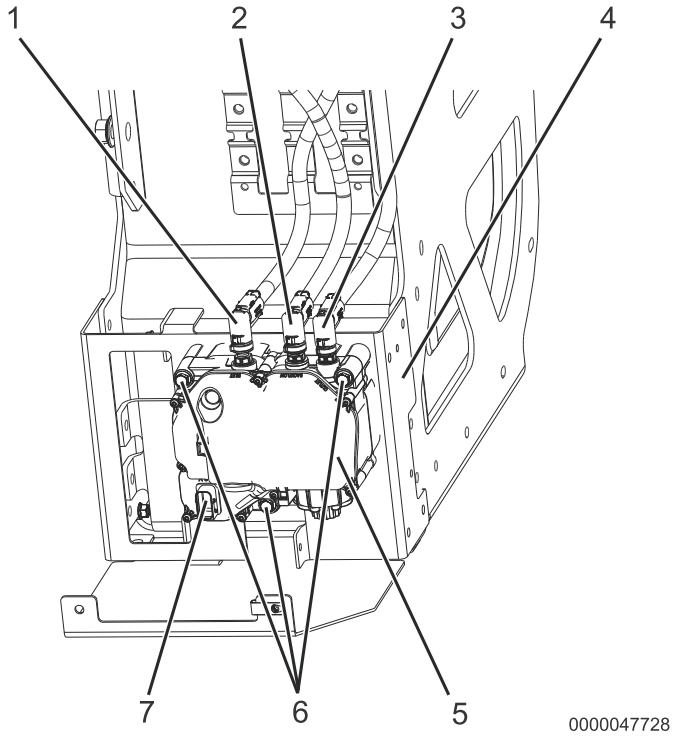
3. Connect DEF supply module suction line (Figure 108) (Item 4) to **black** DEF supply module (Figure 108) (Item 6) suction fitting (Figure 108) (Items 4 and 6).

4. Connect DEF supply module return line (Figure 108) (Item 5) to **white** DEF supply module (Figure 108) (Item 6) return fitting (Figure 108) (Items 5 and 6).

5. Connect DEF tank pickup assembly DEF suction line (Figure 108) (Item 2) to DEF tank pickup assembly (Figure 108) (Item 3).

6. Connect DEF tank pickup assembly DEF return line (Figure 108) (Item 1) to DEF tank pickup assembly (Figure 108) (Item 3).

12.1.9. Diesel Exhaust Fluid (DEF) Supply Module – Removal



1. DEF supply module suction line
2. DEF supply module return line
3. DEF supply module pressure line
4. DEF supply module bracket
5. DEF supply module
6. DEF supply module mounting bolts
7. DEF supply module electrical connector

Figure 109 Diesel Exhaust Fluid (DEF) Supply Module.

NOTE – For correct DEF line routing from DEF supply module to DEF tank pickup assembly, (See Diesel Exhaust Fluid (DEF) Tank Pickup Assembly – Removal, page 148).

NOTE – Do not install suction or return lines on incorrect DEF supply module fittings, or damage to DEF supply module will occur.

1. Disconnect DEF supply module return line (Figure 109) (Item 2) from **white** DEF supply module return fitting.

2. Disconnect DEF supply module suction line (Figure 109) (Item 1) from **black** DEF supply module suction fitting.

3. Disconnect DEF supply module pressure line (Figure 109) (Item 3) from DEF supply module pressure fitting.

4. Disconnect DEF supply module electrical connector (Figure 109) (Item 7) from DEF supply module (Figure 109) (Item 5).

5. Remove three DEF supply module mounting bolts (Figure 109) (Item 6) from DEF supply module (Figure 109) (Item 5).

6. Remove DEF supply module (Figure 109) (Item 5) from DEF supply module bracket (Figure 109) (Item 4).

12.1.10. Diesel Exhaust Fluid (DEF) Supply Module – Installation

1. Install DEF supply module (Figure 109) (Item 5) to DEF supply module bracket (Figure 109) (Item 4) three DEF supply module mounting bolts (Figure 109) (Item 6).

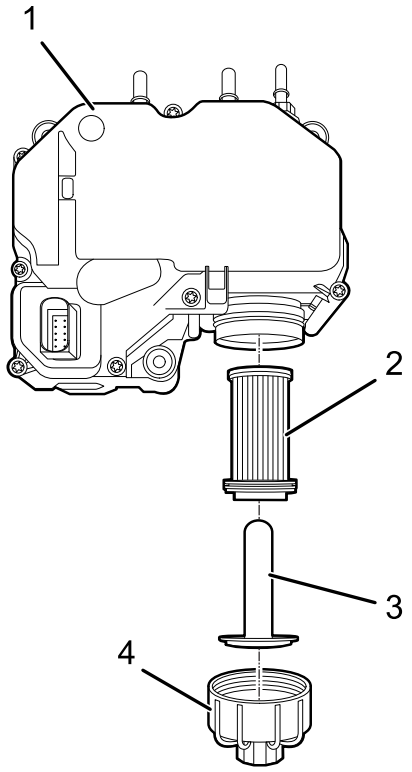
2. Connect DEF supply module electrical connector (Figure 109) (Item 7) to DEF supply module (Figure 109) (Item 5).

3. Connect DEF supply module pressure line (Figure 109) (Item 3) to DEF supply module pressure fitting (Figure 109) (Item 3).

4. Connect DEF supply module suction line (Figure 109) (Item 1) to **black** DEF supply module suction fitting.

5. Connect DEF supply module return line (Figure 109) (Item 2) to **white** DEF supply module return fitting.

12.1.11. Diesel Exhaust Fluid (DEF) Supply Module Filter – Removal



0000060719

1. DEF supply module
2. DEF supply module filter
3. DEF supply module filter equalizing element
4. DEF supply module filter cap

Figure 110 Diesel Exhaust Fluid (DEF) Supply Module Filter.

NOTE – If the filter element and equalizing element are removed from the DEF supply module, they must be discarded and replaced, regardless of condition.

1. Remove DEF supply module filter cap (Figure 110) (Item 4) from DEF supply module (Figure 110) (Item 1).

2. Remove DEF supply module filter equalizing element (Figure 110) (Item 3) from DEF supply module (Figure 110) (Item 1).

3. Remove DEF supply module filter (Figure 110) (Item 2) from DEF supply module (Figure 110) (Item 1).

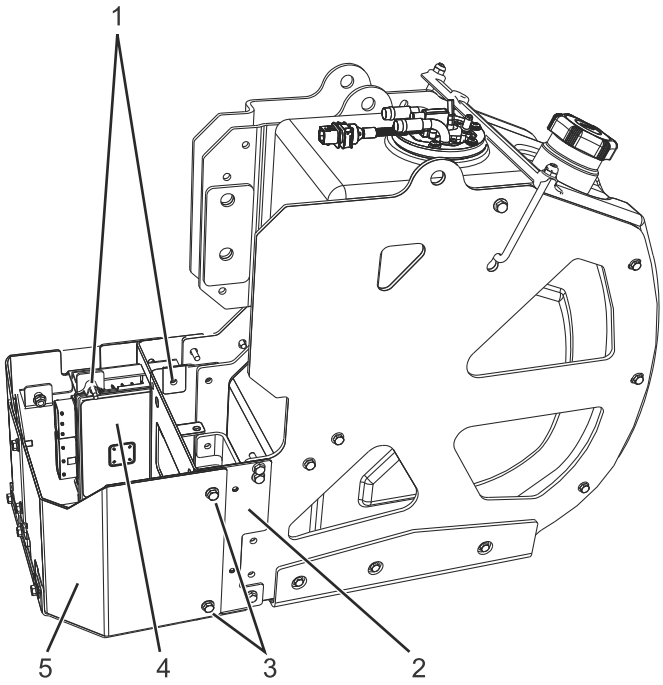
12.1.12. Diesel Exhaust Fluid (DEF) Supply Module Filter – Installation

1. Install DEF supply module filter equalizing element (Figure 110) (Item 3) into DEF supply module filter (Figure 110) (Item 2).

2. Install DEF supply module filter equalizing element (Figure 110) (Item 3) and DEF supply module filter (Figure 110) (Item 2) into DEF supply module (Figure 110) (Item 1).

3. Install DEF supply module filter cap (Figure 110) (Item 4) on DEF supply module (Figure 110) (Item 1). Torque cap to 177 lb-in (20 N•m).

12.1.13. Aftertreatment Control Module (ACM) – Removal



1. Aftertreatment Control Module (ACM) mounting bolt (4)
2. Diesel Exhaust Fluid (DEF) supply module bracket
3. DEF supply module cover mounting bolt (4)
4. ACM
5. DEF supply module cover

Figure 111 Aftertreatment Control Module (ACM) – (If Equipped).

1. Remove four DEF supply module cover bolts (Figure 111) (Item 3) from DEF supply module bracket (Figure 111) (Item 2), and remove DEF supply module cover (Figure 111) (Item 5).

2. Disconnect ACM electrical connector from ACM (Figure 111) (Item 4).

3. Remove four ACM mounting bolts (Figure 111) (Item 1) from DEF supply module bracket (Figure 111) (Item 2).

4. Remove ACM (Figure 111) (Item 4) from DEF supply module bracket (Figure 111) (Item 2).

12.1.14. Aftertreatment Control Module (ACM) – Installation

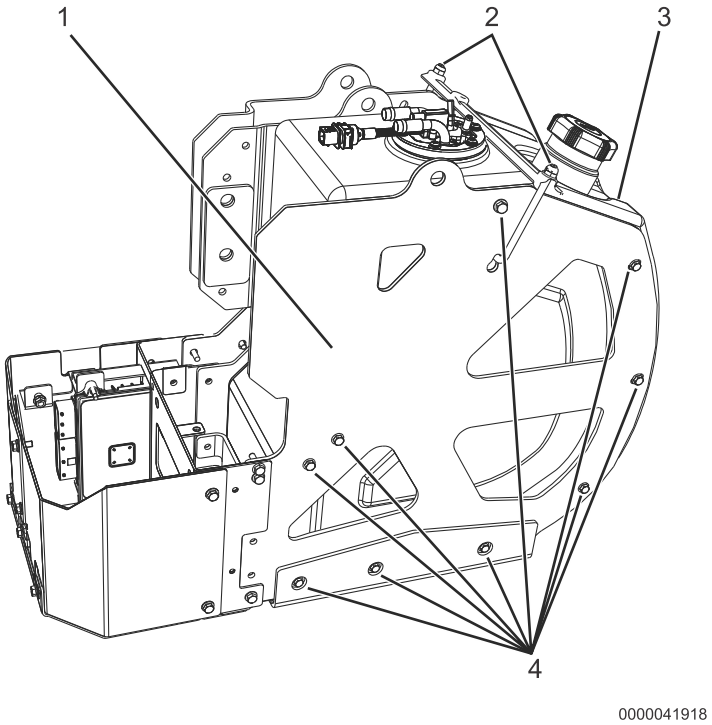
1. Install ACM (Figure 111) (Item 4) in DEF supply module bracket (Figure 111) (Item 2).

2. Install four ACM mounting bolts (Figure 111) (Item 1) to DEF supply module bracket (Figure 111) (Item 2). Torque nut to 62 lb-in (7 N•m).

3. Connect ACM electrical connector to ACM (Figure 111) (Item 4).

4. Install four DEF supply module cover bolts (Figure 111) (Item 3) to DEF supply module bracket (Figure 111) (Item 2).

12.1.15. Diesel Exhaust Fluid (DEF) Tank Bracket – Removal



1. Diesel Exhaust Fluid (DEF) tank bracket
2. DEF tank hold down strap nut (2)
3. DEF tank
4. DEF tank bracket bolt (18)

Figure 112 Diesel Exhaust Fluid (DEF) Tank Bracket.

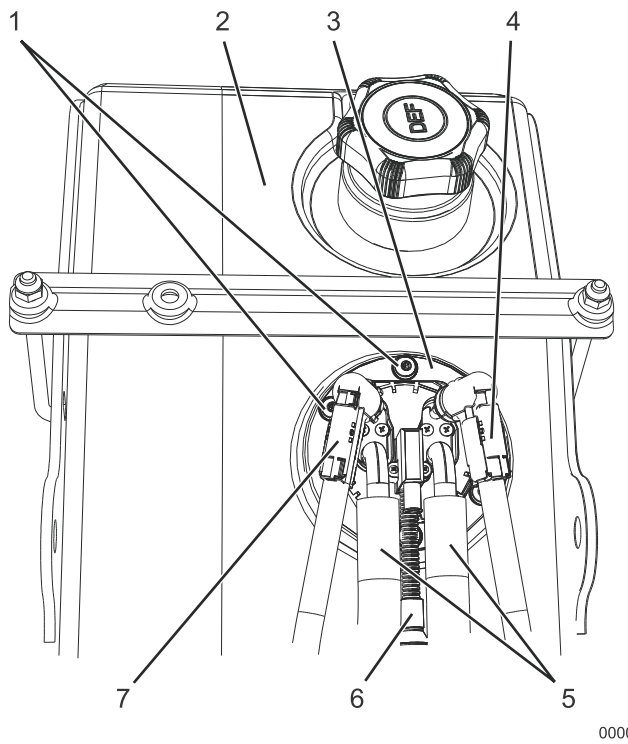
NOTE – Actual number of bolts or mounting configuration may vary.

1. Remove DEF tank assembly from vehicle (See Diesel Exhaust Fluid (DEF) Tank – Removal, page 128).
2. Remove 18 DEF tank bracket bolts (Figure 112) (Item 4) from DEF tank bracket (Figure 112) (Item 1).
3. Remove two DEF tank hold down strap nuts (Figure 112) (Item 2) from DEF tank hold down strap.
4. Remove DEF tank (Figure 112) (Item 3) from DEF tank bracket (Figure 112) (Item 1).

12.1.16. Diesel Exhaust Fluid (DEF) Tank Bracket – Installation

1. Install DEF tank (Figure 112) (Item 3) into DEF tank bracket (Figure 112) (Item 1).
2. Install DEF tank hold down strap using two DEF tank hold down strap nuts (Figure 112) (Item 2). Torque nut to 16 lb-ft (22 N•m).
3. Install 18 DEF tank bracket bolts (Figure 112) (Item 4) to DEF tank bracket (Figure 112) (Item 1). Torque nut to 106 lb-in (12 N•m).
4. Install DEF tank assembly to vehicle (See Diesel Exhaust Fluid (DEF) Tank – Installation, page 131).

12.1.17. Diesel Exhaust Fluid (DEF) Tank Pickup Assembly – Removal



1. Diesel Exhaust Fluid (DEF) tank pickup assembly torx screw (6)
2. DEF tank
3. DEF tank pickup assembly
4. DEF suction line
5. DEF coolant line (2)
6. DEF tank pickup assembly electrical connector
7. DEF return line

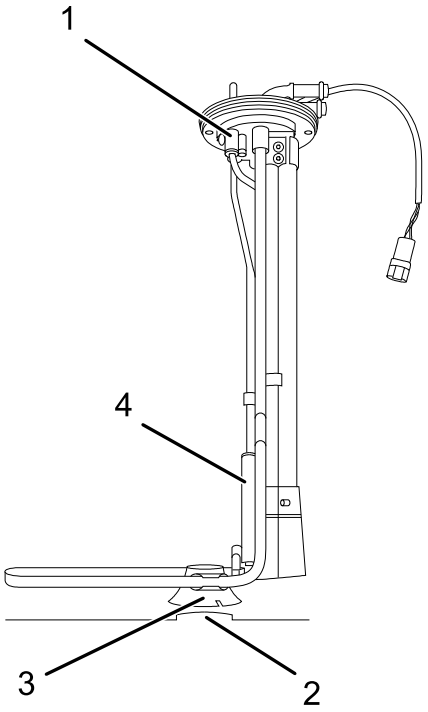
Figure 113 Diesel Exhaust Fluid (DEF) Tank Pickup Assembly.

NOTE – To disconnect DEF lines from fittings, push inward on white quick-release clip.

1. Remove DEF tank assembly from vehicle (See Diesel Exhaust Fluid (DEF) Tank – Removal, page 128).
2. Disconnect DEF return line (Figure 113) (Item 7) from DEF tank pickup assembly (Figure 113) (Item 3).
3. Disconnect DEF suction line (Figure 113) (Item 4) from DEF tank pickup assembly (Figure 113) (Item 3).
4. Disconnect DEF tank pickup assembly electrical connector (Figure 113) (Item 6) from DEF tank wiring harness.
5. Remove six DEF tank pickup assembly torx screws (Figure 113) (Item 1) from DEF tank (Figure 113) (Item 2).
6. Remove DEF tank pickup assembly (Figure 113) (Item 3) from DEF tank (Figure 113) (Item 2).

12.1.18. Diesel Exhaust Fluid (DEF) Tank Pickup Assembly – Installation

1. Install DEF tank pickup assembly (Figure 114) (Item 3) in DEF tank (Figure 114) (Item 2).



1. Diesel Exhaust Fluid (DEF) tank pickup assembly
2. DEF tank molded boss
3. DEF tank pickup assembly rubber grommet
4. DEF tank pickup assembly filter

Figure 114 Diesel Exhaust Fluid (DEF) Tank Pickup Assembly

2. Engage DEF tank pickup assembly rubber grommet (Figure 114) (Item 3) to DEF tank molded boss (Figure 114) (Item 2) on bottom of DEF tank.

3. Apply PTFE thread sealant (Loctite 565 or equivalent) to six DEF pickup assembly torx screws (Figure 113) (Item 1).

4. Install six DEF pickup assembly torx screws (Figure 113) (Item 1) to DEF tank (Figure 113) (Item 2).

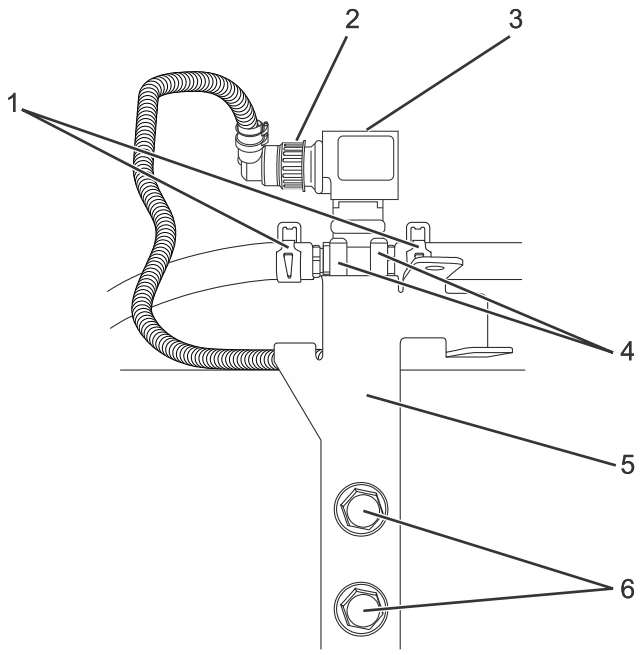
5. Connect DEF tank pickup assembly electrical connector (Figure 113) (Item 6) to DEF tank wiring harness.

6. Connect DEF suction line (Figure 113) (Item 4) to DEF tank pickup assembly (Figure 113) (Item 3).

7. Connect DEF return line (Figure 113) (Item 7) to DEF tank pickup assembly (Figure 113) (Item 3).

8. Install DEF tank assembly to vehicle (See Diesel Exhaust Fluid (DEF) Tank – Installation, page 131).

12.1.19. Diesel Exhaust Fluid (DEF) Tank Heater Valve – Removal



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1. Diesel Exhaust Fluid (DEF) coolant line (2)
2. DEF tank heater valve electrical connector
3. DEF tank heater valve
4. DEF tank heater valve mounting bolt (4)
5. DEF tank heater valve mounting bracket
6. DEF tank heater valve mounting bracket bolt (2)

Figure 115 Diesel Exhaust Fluid (DEF) Tank Heater Valve.

1. Disconnect two DEF coolant lines (Figure 115) (Item 1) from DEF tank heater valve (Figure 115) (Item 3).
2. Disconnect DEF tank heater valve electrical connector (Figure 115) (Item 2) from DEF tank heater valve (Figure 115) (Item 3).
3. Remove two DEF tank heater valve mounting bracket bolts (Figure 115) (Item 6) from DEF tank heater valve mounting bracket (Figure 115) (Item 5).
4. Remove four DEF tank heater valve mounting bolts (Figure 115) (Item 4) from DEF tank heater valve (Figure 115) (Item 3).
5. Remove DEF tank heater valve (Figure 115) (Item 3).

12.1.20. Diesel Exhaust Fluid (DEF) Tank Heater Valve – Installation

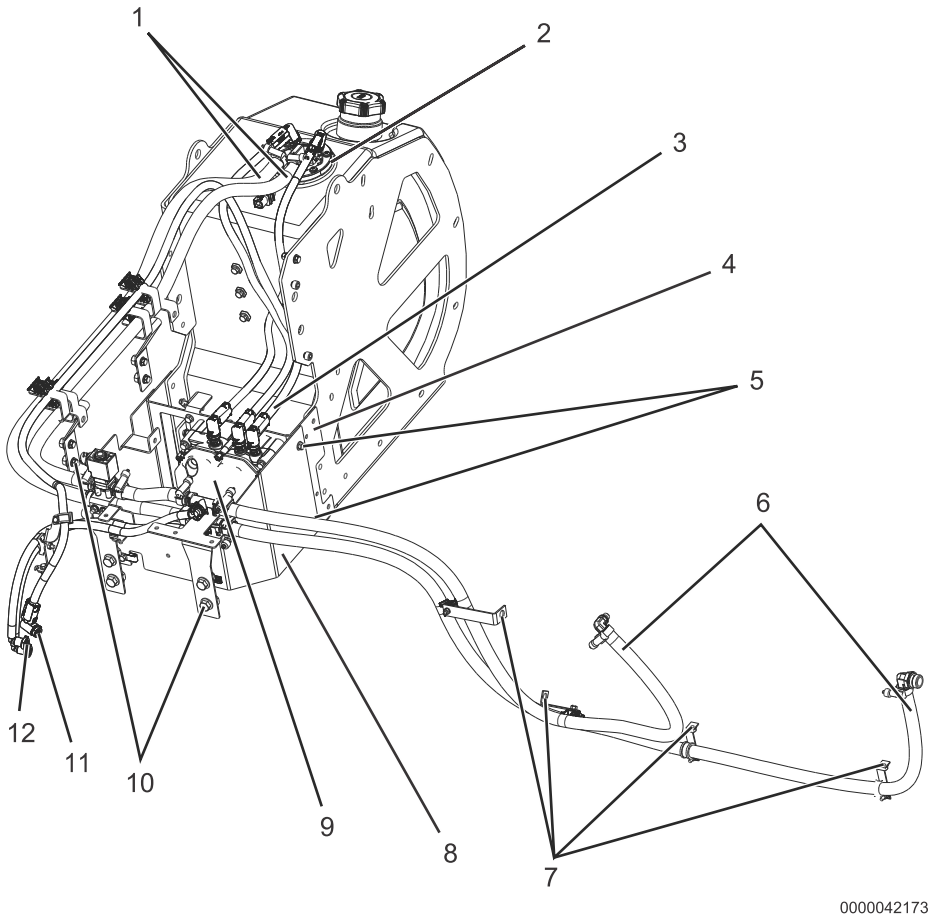
1. Install four DEF tank heater valve mounting bolts (Figure 115) (Item 4) to DEF tank heater valve mounting bracket (Figure 115) (Item 5). Torque nut to 62 lb-in (7 N•m).

2. Install two DEF tank heater valve mounting bracket bolts (Figure 115) (Item 6) to vehicle frame.

3. Connect DEF tank heater valve electrical connector (Figure 115) (Item 2) to DEF tank heater valve (Figure 115) (Item 3).

4. Connect two DEF coolant lines (Figure 115) (Item 1) to DEF tank heater valve (Figure 115) (Item 3).

12.1.21. Diesel Exhaust Fluid (DEF) Pressure Line and Coolant Lines – Removal



1. Diesel Exhaust Fluid (DEF) tank coolant line (2)
2. DEF tank pickup assembly
3. DEF supply module pressure line
4. DEF supply module bracket
5. DEF supply module cover bolt (4)
6. DEF engine block coolant line (2)
7. DEF coolant line support bracket (4)
8. DEF supply module cover
9. DEF supply module
10. DEF line and coolant line mounting bracket bolt (8)
11. DEF dosing valve pressure line
12. DEF dosing valve coolant line (2)

Figure 116 Diesel Exhaust Fluid (DEF) Pressure Line and Coolant Lines.

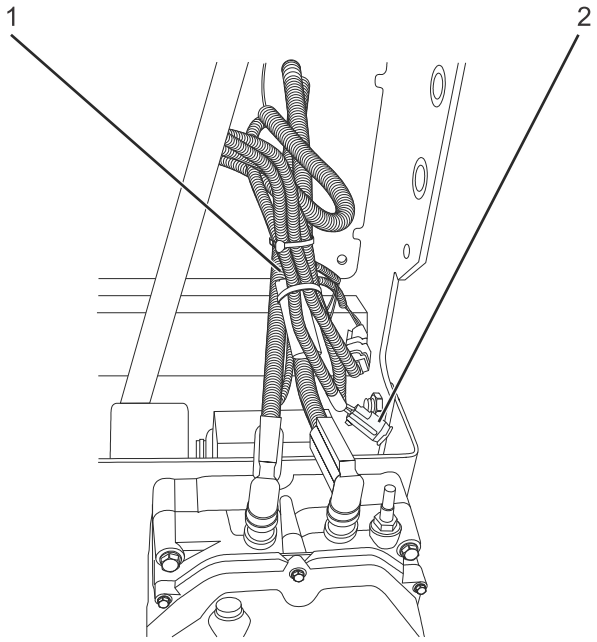
NOTE – To disconnect DEF lines from fittings, push inward on white quick-release clip.

NOTE – Depending on vehicle configuration, DEF coolant lines may be equipped with quick disconnect fittings. To disconnect fittings, press inward on release tab.

1. Disconnect two DEF coolant lines (Figure 116) (Item 1) from DEF tank pickup assembly (Figure 116) (Item 2).

2. Disconnect DEF dosing valve pressure line (Figure 116) (Item 11) from DEF dosing valve.

3. Disconnect two DEF dosing valve coolant lines (Figure 116) (Item 12) from DEF dosing valve.
4. Remove eight DEF line and coolant line mounting bracket bolts (Figure 116) (Item 10) from vehicle frame.
5. Remove four DEF coolant line support bracket bolts (Figure 116) (Item 7) from engine block.
6. Disconnect two DEF engine block coolant lines (Figure 116) (Item 6) from engine block coolant line fittings.
7. Remove four DEF supply module cover bolts (Figure 116) (Item 5) from DEF supply module bracket (Figure 116) (Item 4), remove DEF supply module cover (Figure 116) (Items 4 and 5).
8. Disconnect DEF supply module pressure line (Figure 116) (Item 3) from DEF supply module (Figure 116) (Item 9).



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1. Diesel Exhaust Fluid (DEF) tank harness
2. DEF pressure line heater electrical connector

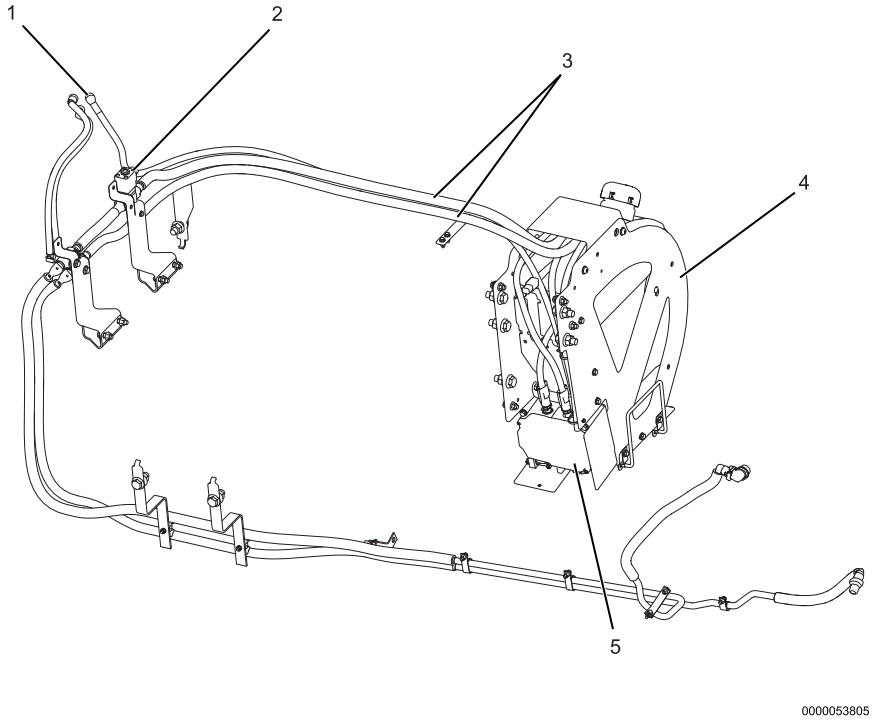
Figure 117 Diesel Exhaust Fluid (DEF) Tank Wiring Harness.

9. Disconnect DEF pressure line heater electrical connector (Figure 117) (Item 2) from DEF tank wiring harness (Figure 117) (Item 1).
10. Remove DEF pressure line (Figure 116) (Items 11 and 3) and DEF coolant lines (Figure 116) (Items 1, 6 and 12) from vehicle.

12.1.22. Diesel Exhaust Fluid (DEF) Pressure Line and Coolant Lines – Installation

1. Install eight DEF line and coolant line mounting bracket bolts (Figure 116) (Item 10) to vehicle frame.
2. Connect DEF pressure line heater electrical connector (Figure 117) (Item 2) to DEF tank wiring harness (Figure 117) (Item 1).
3. Connect DEF supply module pressure line (Figure 116) (Item 3) to DEF supply module (Figure 116) (Item 9).
4. Install four DEF supply module cover bolts (Figure 116) (Item 5) to DEF supply module bracket (Figure 116) (Item 4).
5. Connect two DEF engine block coolant lines (Figure 116) (Item 6) to engine block coolant fittings.
6. Install four DEF coolant line support bracket bolts (Figure 116) (Item 7) to engine block.
7. Connect two DEF dosing valve coolant lines (Figure 116) (Item 12) to DEF dosing valve.
8. Connect DEF dosing valve pressure line (Figure 116) (Item 11) to DEF dosing valve..
9. Connect two DEF coolant lines (Figure 116) (Item 1) to DEF tank pickup assembly (Figure 116) (Item 2).

12.1.23. Diesel Exhaust Fluid (DEF) System



1. Diesel exhaust fluid (DEF) pressure line
2. DEF tank heater valve
3. DEF tank coolant line (2)
4. DEF tank
5. DEF tank supply module

Figure 118 DEF System.

NOTE – Removal and installation procedures for the DEF system shown above are similar to the conventional system previously mentioned. Actual component location may vary depending on vehicle configuration.

13. ACRONYM LIST

Table 32 Acronym List.

Component	Abbreviation
Aftertreatment Control Module	ACM
Selective Catalyst Reduction	SCR
Diesel Particulate Filter	DPF
Diesel Exhaust Fluid	DEF
Diesel Oxidation Catalyst	DOC
Engine Control Module	ECM

TORQUE

Table 33 Torque Chart.

MaxxForce® 7, DT, 9, or 10 Systems	
Pressure Tube Nuts on Pressure Tubes	9 - 15 lb-ft (12 - 20 N•m)
P - Clamp Mount Bolts	84 - 96 lb-in (9 - 11 N•m)
Pressure Sensor Mount Bolts	84 - 96 lb-in (9 - 11 N•m)
Temperature Sensor	18 - 30 lb-ft (25 - 40 N•m)
Aftertreatment Control Module (ACM) Torx Screws	48 - 72 lb-in (5 - 8 N•m)
Diesel Particulate Filter (DPF) Mount Bolts	35 - 37 lb-ft (47 - 50 N•m)
Diesel Particulate Filter (DPF) V-Clamp Nut	13 - 16 lb-ft (18 - 22 N•m)
Mount Band	35 - 46 lb-ft (47 - 62 N•m)
MaxxForce® 11, 13, or 15 Systems	
Pressure Sensor Mount Bolts	84 - 96 lb-in (9 - 11 N•m)
Pressure Nuts on Pressure Tubes	11 - 13 lb-ft (15 - 17 N•m)
P-Clamp Mount Bolts	84 - 96 lb-in (9 - 11 N•m)
Temperature Sensor	18 - 26 lb-ft (25 - 35 N•m)
Sensor Junction Box Band Strap	15 lb-ft (20 N•m)
Mount Band	97 lb-in (11 N•m)
Diesel Particulate Filter (DPF) V-Clamp Nut	28 - 30 lb-ft (38 - 40 N•m)
Cummins ISX15, ISB 6.7, or Navistar® N13 Systems	
Aftertreatment Out/tailpipe V-Clamp Nut	106 lb-in (12 N•m)
Aftertreatment In/Turbo Pipe V-Clamp Nut	106 lb-in (12 N•m)
Mount Bands	97 lb-in (11 N•m)
Aftertreatment Power Distribution Module (PDM) Mount Bolts	35 lb-in (4 N•m)
Aftertreatment Control Module (ACM) Mount Bolts	62 lb-in (7 N•m)
Diesel Exhaust Fluid (DEF) Tank Mount Bolts	16 lb-ft (22 N•m)
Diesel Exhaust Fluid (DEF) Hold Down Strap Nuts	106 lb-in (12 N•m)
Diesel Exhaust Fluid (DEF) tank pickup assembly torx screws	27 lb-in (N•m)
Diesel Exhaust Fluid (DEF) Tank Heater Valve Mount Bolts	62 lb-in (7 N•m)