Group Index, Alphabetical

Contents

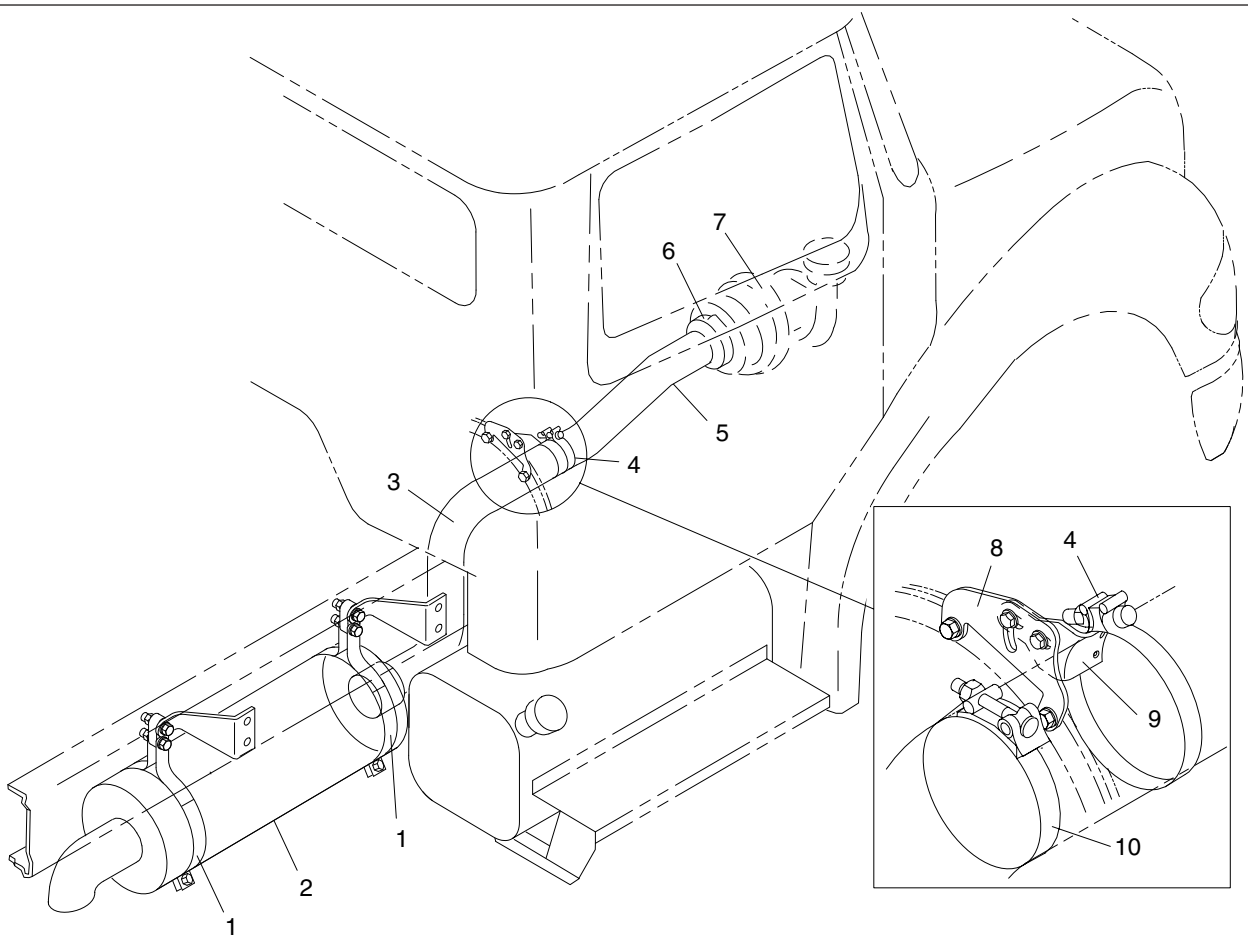
General Information

The exhaust system routes hot exhaust gas away from the cab, and reduces engine exhaust noise. See **Fig. 1**. Business Class M2 vehicles have a horizontally mounted muffler on the right side of the vehicle and are available with a horizontal outlet.

System components include the engine outlet exhaust pipe, muffler, muffler mounting components, narrow-band exhaust clamps, and tail pipe.

Most exhaust installations consist of an engine exhaust pipe, sometimes called the turbo pipe, mounted to the rear of the turbocharger and secured with a V-clamp. A narrow-band clamp holds the exhaust pipe to the muffler.

A horizontal muffler hangs from brackets mounted inside the frame rail web. All exhaust components attach to either the engine or the chassis frame rails.



12/20/2001 f490242

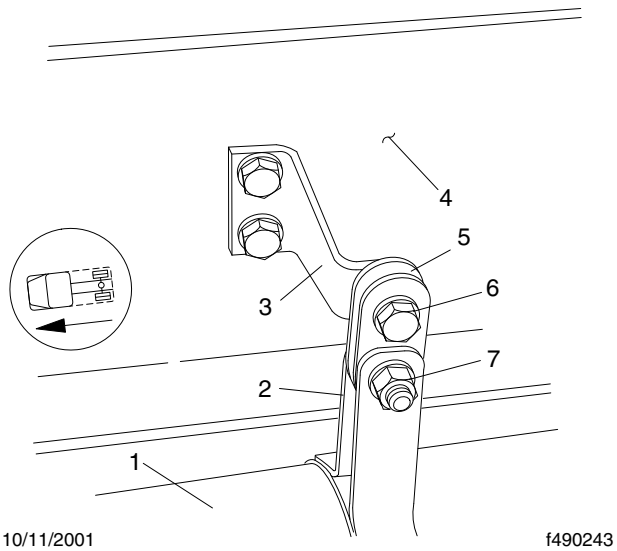
1. Muffler Mounting Band
2. Muffler
3. Exhaust Mid-Pipe
4. T-Bolt Clamp
5. Outlet Exhaust Pipe
6. V-Clamp Engine
7. Turbocharger
8. Exhaust Support Plate (attached to transmission)
9. Bracket
10. Narrow-Band Exhaust Clamp

Fig. 1, Horizontal Exhaust Mounting (Caterpillar 3126 engine)

Muffler Replacement

Removal

1. Park the vehicle on a level surface, shut down the engine, set the parking brake, and chock the tires.
2. Loosen the clamp holding the muffler to the exhaust pipe.
3. Remove the fasteners holding the muffler mounting clamps to the rubber isolators. See **Fig. 1**.



1. Muffler
2. Muffler Mounting Band
3. Mounting Bracket
4. Frame Rail
5. Rubber Isolator
6. Hexbolt and Washer
7. Hexnut and Washer

Fig. 1, Muffler Mounting Components

4. Remove the muffler and tailpipe from the vehicle.

Installation

1. If installing a new muffler, loosely install the muffler mounting bands to the muffler. The bands should be loose enough so you can rotate and slide them. See **Fig. 2**.
2. Position the muffler, aligning the ears of the muffler bands with the rubber isolators attached to the frame.

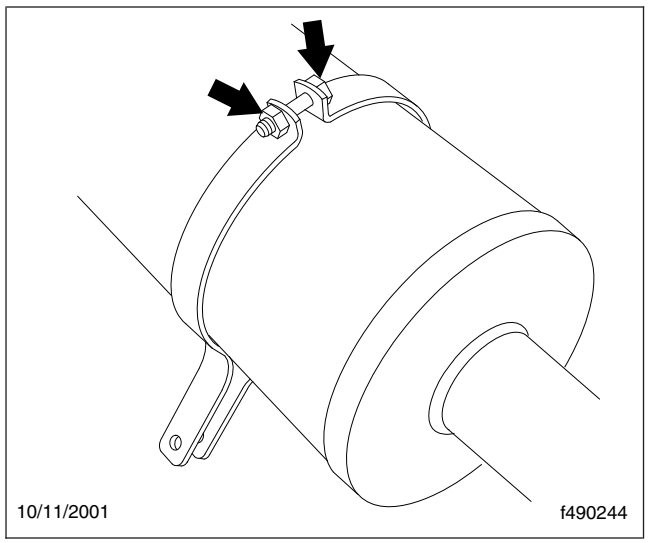


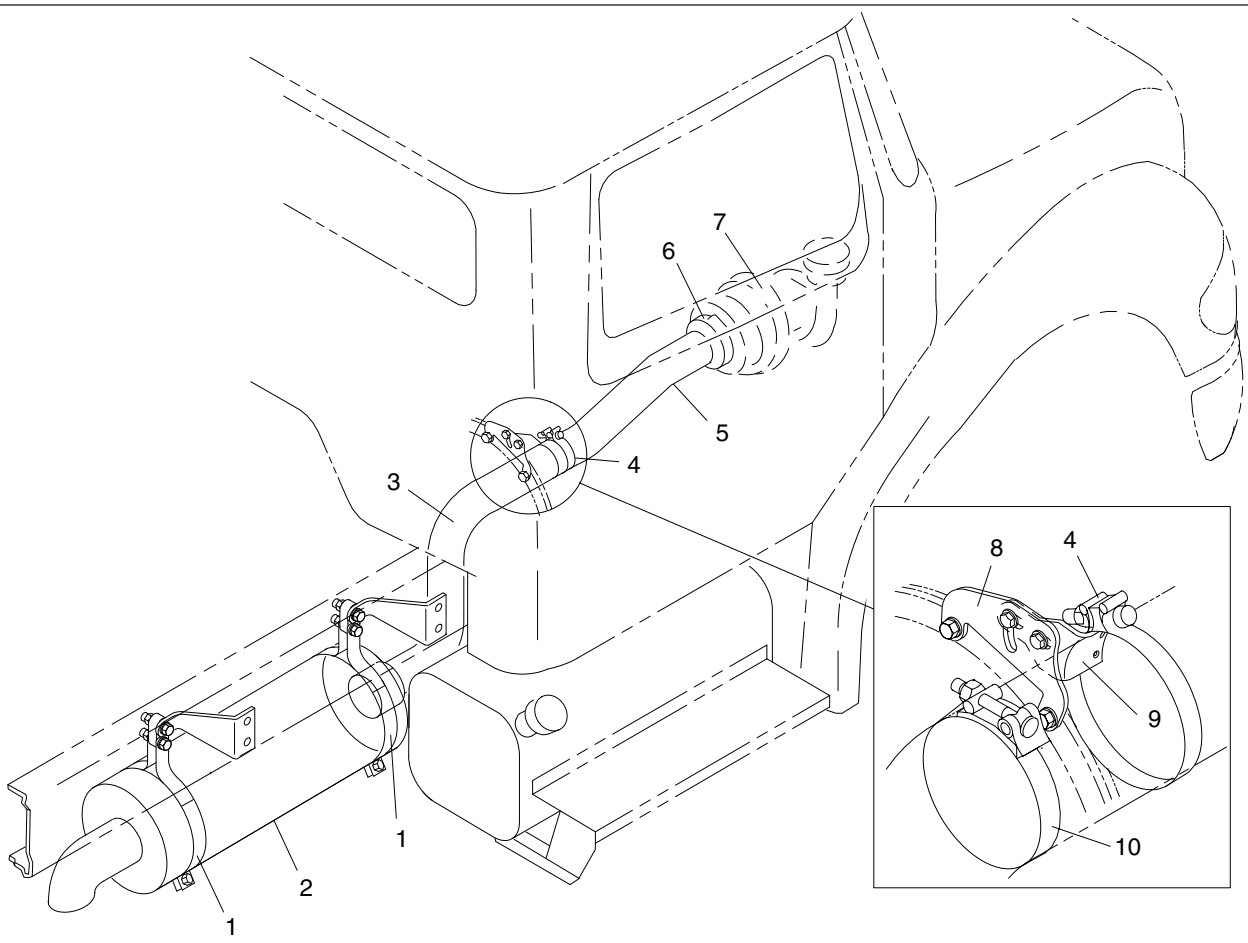
Fig. 2, Installing the Muffler Mounting Bands

3. Push the front of the muffler over the end of the exhaust pipe.
4. If needed, adjust the muffler mounting bands so the ears align with the rubber isolators.
5. Loosely attach the muffler bands to the isolators.
6. Make sure the muffler is pushed all the way onto the end of the exhaust pipe.
7. Install a narrow-band exhaust clamp onto the end of the muffler. Tighten it firmly.
8. Tighten the fasteners holding the muffler to the isolators.
9. If applicable, install the tail pipe to the end of the muffler, using a narrow-band exhaust clamp. Tighten the clamp firmly.
10. Start the engine and check for leaks. Tighten any fasteners as needed.
11. Remove the chocks from the tires.

Exhaust Piping Replacement

Removal

1. Park the vehicle on a level surface, shut down the engine, set the parking brake, and chock the tires.
2. Remove the section of exhaust pipe between the muffer and the transmission. See **Fig. 1**.
   - 2.1 Loosen the narrow-band clamp holding the front and rear sections of the exhaust piping together.
   - 2.2 Remove the fasteners holding the muffler mounting clamps to the rubber isolators. See **Fig. 2**.
   - 2.3 Remove the rear section of the exhaust pipe and the muffler together.
   - 2.4 Loosen the clamp holding the exhaust pipe to the muffler and disconnect the pipe from the muffler.
3. Remove the forward section of the exhaust pipe.



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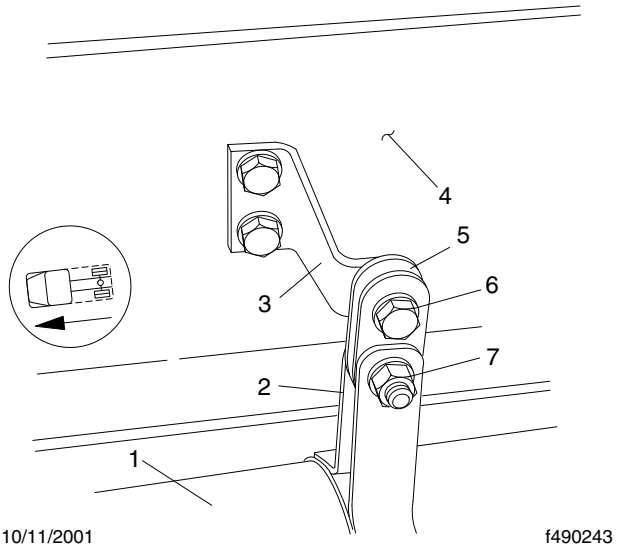
1. Muffler Mounting Band
2. Muffler
3. Exhaust Mid-Pipe
4. T-Bolt Clamp
5. Outlet Exhaust Pipe
6. V-Clamp Engine
7. Turbocharger
8. Exhaust Support Plate (attached to transmission)
9. Bracket
10. Narrow-Band Exhaust Clamp

Fig. 1, Horizontal Exhaust Mounting (Caterpillar 3126 engine)

Exhaust Piping Replacement



1. Muffler
2. Muffler Mounting Band
3. Mounting Bracket
4. Frame Rail
5. Rubber Isolator
6. Hexbolt and Washer
7. Hexnut and Washer

Fig. 2, Muffler Mounting Components

3.1 Loosen the V-clamp holding the exhaust pipe to the turbocharger.

3.2 Loosen the clamp holding the exhaust pipe to the bracket on the transmission.

3.3 Remove the exhaust pipe from the vehicle.

4. If applicable, remove the tailpipe.

Installation

1. Connect the forward section of the exhaust pipe to the turbocharger. Tighten the exhaust clamp just enough to hold it in place.
2. If it was removed, connect the muffler to the rear section of the exhaust pipe. Make sure the exhaust pipe is all the way inside the end of the muffler, then tighten the exhaust clamp snugly.
3. Place the rear section of the exhaust pipe and the muffler in position and push the rear exhaust pipe over the end of the front exhaust pipe.
4. Loosely connect the muffler to the frame mounted isolators.
5. Install the narrow band exhaust clamp.
6. As needed, adjust the pipes so that they are in a straight line.
7. Fully tighten the two exhaust clamps and the muffler mounting fasteners.
8. Start the engine and check for leaks. Tighten any connections as needed.
9. Remove the chocks from the tires.

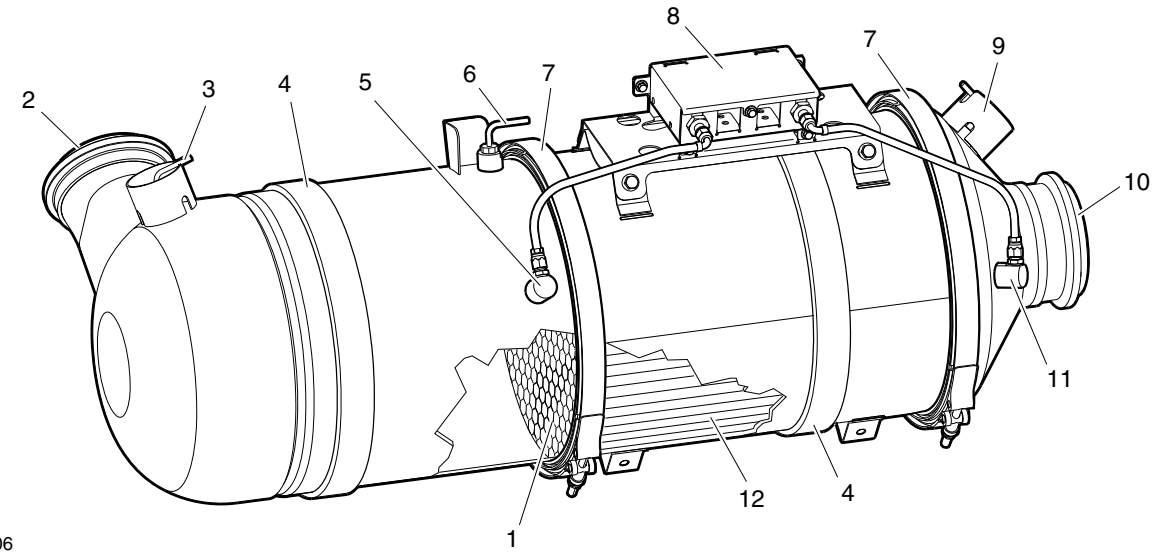
Contents

General Information

The aftertreatment system (ATS), introduced to meet the requirements of the EPA07 emission control regulations, includes all the piping and equipment between the turbocharger outlet and the tip of the exhaust pipe. It resembles the exhaust system on pre-EPA07 vehicles, but includes an aftertreatment device (ATD) instead of a muffler (see **Fig. 1**), and other equipment. Monitoring and operation of the ATS is controlled by an electronic control module (ECM).

ways chassis-mounted, but can be mounted either vertically or horizontally. ATS exhaust piping is stainless steel.

Inside the ATD, the exhaust first passes through the diesel oxidation catalyst (DOC) where combustion gases are chemically broken down to water and carbon dioxide, then through the (DPF), where solid particles are trapped. The trapped particles are almost completely vaporized in the DPF in regeneration, sometimes shortened to the term, "regen." The soot from engine oil additives which cannot be vaporized is burned to ash and held in the DPF until it eventu-



1. Diesel Particulate Filter (DPF) Ceramic Honeycomb Substrate Openings
2. Marmon Fitting at Inlet from Turbocharger
3. Diesel Oxidation Catalyst (DOC) Intake Temperature Sensor
4. ATD Mounting Band
5. DPF Intake Pressure Sensor
6. DOC Outlet Temperature Sensor (connection to sensor housing not shown)
7. DPF V-Band Mounting Clamps
8. Sensor Housing
9. DPF Outlet Temperature Sensor (connection to sensor housing not shown)
10. Exhaust Outlet Marmon Fitting
11. DPF Outlet Pressure Sensor
12. DPF Substrate Tubes

Fig. 1, ATD Components (typical)

EPA07 emissions regulations limit NOx to just over 1 gram per brake horsepower hour (g/bhp-hr) and particulate matter cannot exceed 0.01 g/bhp-hr. EPA07 engines require ultralow sulphur diesel (ULSD) fuel, for low emissions and long life of the diesel particulate filter (DPF), a honeycomb soot filter inside the ATD.

Engine manufacturers use different methods and equipment to reduce emissions from their engines, but an ATD is used on all of them. The ATD is ally builds up, and the DPF must be removed and physically cleaned.

IMPORTANT: To minimize soot buildup on the DPF, low-ash oil is necessary for maximum service between physical cleanings. Only low-ash oil should be used in EPA07 engines.

NOTE: Freightliner documentation deals only with removal and installation of the components of the ATS. Refer to the engine manufacturer's

service literature for all testing, disassembly, cleaning, and repair of the ATD and other components.

IMPORTANT: The ATS is part of an integrated engine and emissions management system, controlled by the ECM. Follow the engine manufacturer's procedures, and use the correct equipment when diagnosing or working on any part of the ATS.

Regeneration

There are two types of regeneration; passive and active.

Passive regeneration happens whenever the ATD internal temperature is 572°F (300°C) or higher. This happens during normal loaded vehicle operation, and exhaust gas temperature is no higher than normal. Under load and at highway speeds, passive regeneration may be all that is necessary to keep the DPF clear. But running light loads, or at low speeds, does not generate enough heat in the ATD for passive regeneration, and soot builds up in the DPF.

As soot builds up in the DPF, it creates back pressure and decreases engine efficiency. So at intervals determined by the ECM, which keeps track of measurements such as engine hours, fuel consumed, and mileage, the ATS raises the temperature inside the ATD to burn the built-up soot to ash. This reduces the back pressure and allows the DPF to continue operating efficiently for tens of thousands of miles.

During active regeneration, engine rpm rise to fast-idle speed and extra fuel is injected into the ATD to raise its interior temperature very high, over 1112°F (600°C), and turn the trapped soot to harmless ash. There are two types of active regeneration; at-speed and parked.

- When conditions permit, the ECM automatically initiates at-speed regeneration. The exact conditions for regeneration vary, according to the engine manufacturer's design. Generally, it can happen only when the vehicle speed is above 7.5 mph, and active regeneration stops when the vehicle slows to 5 mph or below.
- Parked regeneration is initiated by a driver or technician when the vehicle is safely parked with the exhaust outlet well away from any flammable substance, a specific sequence of procedures is followed, and the driver pushes the regeneration button on the dashboard. The parked regeneration sequence varies according to engine and vehicle configuration, but it must be exactly followed or regeneration cannot happen. Follow the exact sequence prescribed for the vehicle, according to the engine manufacturer's literature.

EPA07 Aftertreatment Device Removal and Installation

Removal

These instructions are generalized, because vehicle configurations vary widely. The basic procedures apply to all aftertreatment systems. For service and repair beyond removal and installation, refer to the engine manufacturer's service literature.

NOTE: For test or service procedures on components of the ATS, consult the engine manufacturer's service literature.

NOTICE

The ATD assembly weighs from 125 to 150 pounds (57 to 68 kg) and must be protected from impact or sharp jolts. Dropping the ATD, or subjecting it to jarring impact can crack the diesel particulate filter (DPF) inside, which is built on a ceramic substrate. If that happens, the DPF is ruined and must be replaced.

A secure support is necessary to remove and install the ATD safely. The ATD must be held securely to protect it from falling, or hitting hard against something else.

The horizontal ATD lifting device (TLZ00785) is designed to handle a horizontal ATD. Vertical ATDs require a shop hoist secured to the lifting ears on top.

The aftertreatment device (ATD) is constructed so that its exterior operating temperature is comparable to that of a standard muffler, but during active regeneration, when a fuel mist is injected to raise its temperature and destroy soot deposits, its interior (see **Fig. 1**) and the outlet become hot enough to melt or ignite many common materials.

⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

1. Set the parking brake and chock the tires.

NOTE: Never attempt to start the vehicle with the ATD removed or with the ATD sensors disconnected, unless the engine manufacturer's documentation allows it for a diagnostic procedure.

2. Disconnect the connections at the sensor housing and the diesel oxidation catalyst (DOC) inlet temperature sensor. See **Fig. 1**.
3. Mark the Marmon fitting joints and mounting bracket orientation to the ATD, so that it can be installed exactly as it was removed. See **Fig. 2**.

NOTE: There are guide pins (see **Fig. 3**) to position the ATD during vehicle manufacture, but they are designed to break off if they are stressed. The most important thing about ATD mounting is that the other ATS components, particularly the bellows, must align correctly.

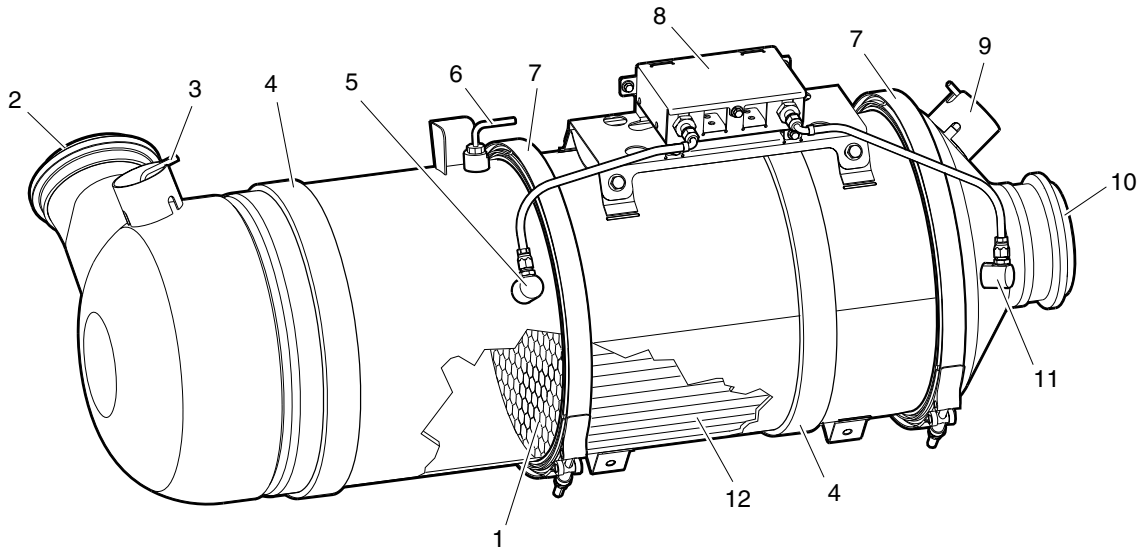
4. If the ATD is horizontally mounted, raise the ATD-handling device into place against it, so that the ATD is supported securely. If the ATD is vertically mounted, attach a shop crane or similar device to the lifting ears and take up the slack so that the lifting device is beginning to take the weight of the ATD.
5. The exhaust pipe may require support, such as a rope sling, to support it when the ATD is removed. If such support is required, install it now.

NOTICE

Be careful not to stress or twist the bellows as the ATD is manipulated. The bellows is not designed to support weight or withstand undue stress and can easily be damaged, requiring expensive replacement.

6. Remove the clamps from the Marmon fittings at the ATD inlet and outlet.
7. Remove the two mounting bands that hold the ATD to its mounting brackets, so that the ATD is held by the ATD handling device.

EPA07 Aftertreatment Device Removal and Installation



1. Diesel Particulate Filter (DPF) Front End Honeycomb
2. Marmon Fitting at Inlet from Turbocharger
3. Diesel Oxidation Catalyst (DOC) Intake Temperature Sensor
4. ATD Mounting Band
5. DPF Intake Pressure Sensor
6. DOC Outlet Temperature Sensor (connection to sensor housing not shown)
7. DPF V-Band Mounting Clamp
8. Sensor Housing
9. DPF Outlet Temperature Sensor (connection to sensor housing not shown)
10. Exhaust Outlet Marmon Fitting
11. DPF Outlet Pressure Sensor
12. DPF Ceramic Substrate

Fig. 1, Typical ATD

NOTE: It may be necessary to raise the vehicle, or remove heat shields or body panels, to remove the ATD.

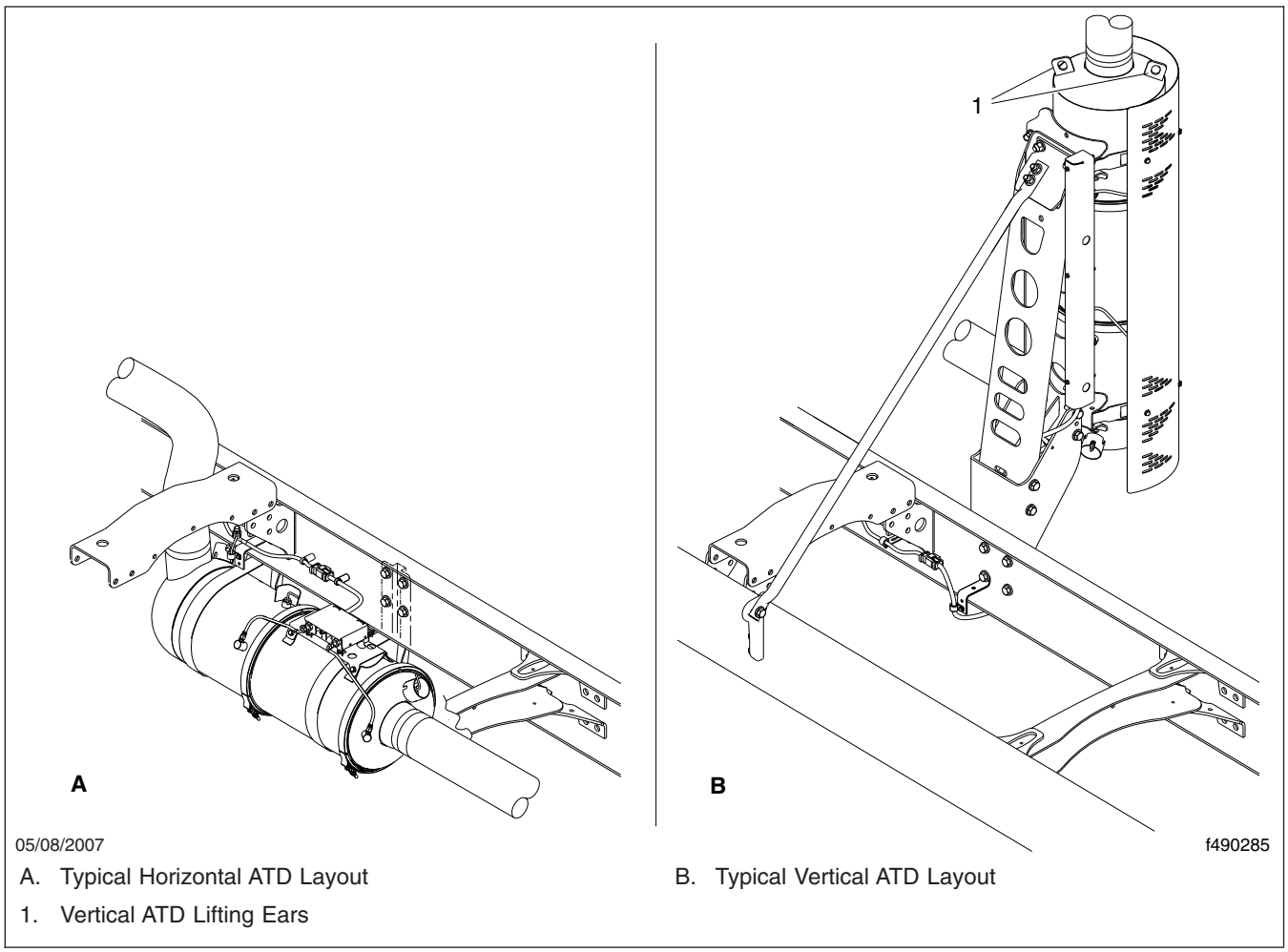
8. Move the ATD handling device slightly, so that the ATD positioning pin (see **Fig. 4**) clears its hole in the mounting bracket. Carefully remove the ATD from the vehicle.

NOTE: ATD component service procedures, such as cleaning the DPF or servicing the sensors, are documented in the engine manufacturers' service literature.

Installation

1. Use the ATD handling device to move the ATD into position, so the inlet and exhaust align with the inlet and exhaust piping. Be sure the ATD positioning pin engages its hole in the ATD mounting bracket, or that the positioning marks align.
2. Install the ATD mounting bands, but do not tighten them yet.
3. Position the V-band clamps on the Marmon fittings and tighten them to the value shown in **Table 1**.
4. Tighten the ATD mounting bands to the value shown in **Table 1**.
5. Connect the harness to the sensor housing and the front temperature sensor.
6. Remove the ATD handling device.
7. If a support was fastened around the exhaust pipe, remove it.
8. Operate the vehicle and check for leaks.

EPA07 Aftertreatment Device Removal and Installation



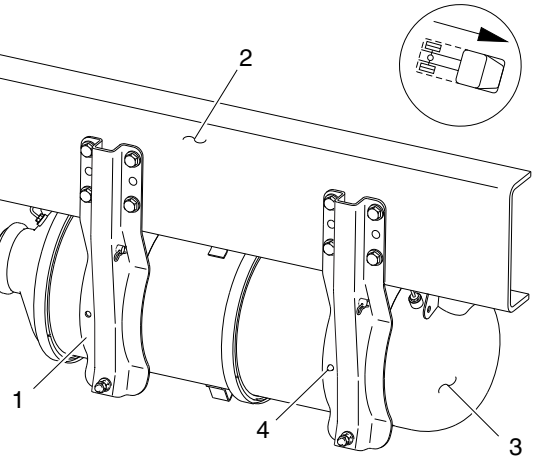
A. Typical Horizontal ATD Layout

B. Typical Vertical ATD Layout

1. Vertical ATD Lifting Ears

Fig. 2, ATD Mounting Options

EPA07 Aftertreatment Device Removal and Installation



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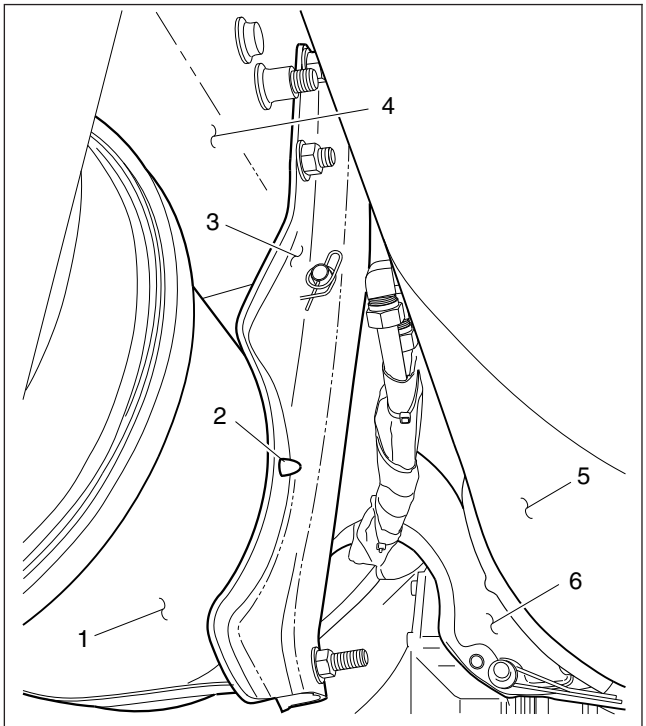
1. ATD Mounting Bracket
2. Chassis Frame Rail
3. ATD Inlet End
4. ATD Positioning Pin

Fig. 3, ATD Mounting on Frame Rail

ATD Torque Values	
Fitting	**Torque: lbf·ft (N·m)**
Mounting Bands	Initial: 15 (20) Final: 30 (41)
Temperature Sensor Nuts	26–29 (35–39)
Pressure Line Tube Nuts	11–13 (15–17)
Pressure Sensor Jam Nuts	15–18 (20–25)
Marmon V-Band Clamps	12–13 (16–17)
Compression Fittings	15–18 (20–25)
Bellows Torco Clamps	Target: 41 (56) Range: 35–48 (48–64)

Table 1, ATD Torque Values



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1. ATD
2. ATD Positioning Pin
3. ATD Mounting Bracket
4. Chassis Frame Rail
5. Fuel Tank
6. Fuel Tank Mounting Bracket

Fig. 4, ATD Mounting Bracket

EPA07 Aftertreatment System Bellows Replacement

Replacement

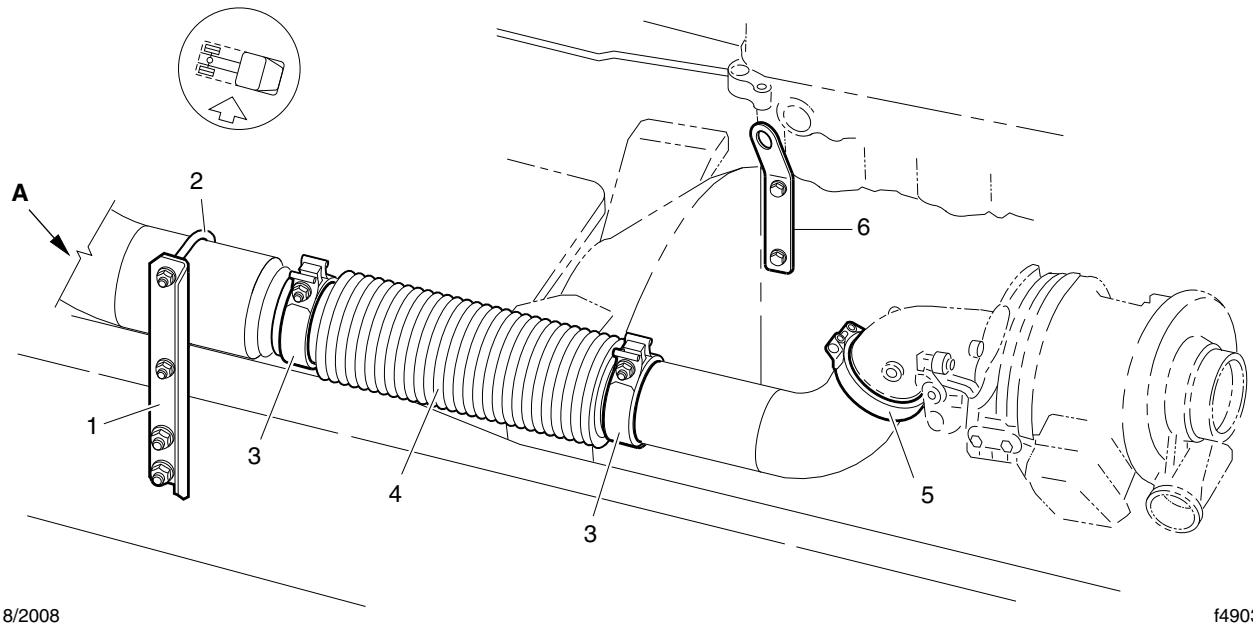
1. Open the hood.
2. Open the tool box under the passenger-side door, and remove the cover.
3. Remove the right quarter fender and mud flap. For instructions, see **Group 88**.
4. Remove the V-clamp (**Fig. 1**, Item 5) that holds the turbo outlet pipe to the turbocharger.
5. Remove the U-clamp that holds the aftertreatment device (ATD) inlet pipe to the support bracket on the frame rail (**Fig. 1**, Item 2).
6. Remove the clamp that holds the exhaust pipe to the front of the ATD, then disconnect the exhaust pipe from the ATD.
7. Remove the bellows and exhaust pipes as a unit from under the vehicle. If the vehicle is equipped with side fairings, remove the parts from the rear of the vehicle.
8. Place the assembly on a work bench. Loosen and spread the seal clamps on the ends of the bellows. Pry the ends of the bellows off the exhaust pipes, being careful not to damage the exhaust pipe ends. If it is not possible to remove the bellows this way, proceed as follows:

⚠ WARNING

Always wear a face shield and other appropriate protection when using a cutting wheel.

The cut edges of the bellows are extremely sharp, and can cause serious injury. Wear appropriate protective gear, including heavy gloves and a face shield, when removing the bellows from the exhaust pipes.

9. If you cannot remove the bellows by prying, use a cutoff wheel to cut through each end of the bellows between the exhaust pipe ends. Be careful not to cut the exhaust pipes. Discard the center section of the bellows when it is cut loose.



A. To the Aftertreatment Device (ATD)

1. Frame-rail Support Bracket
2. U-Clamp
3. Seal Clamp
4. Bellows
5. V-Clamp
6. Bellows Support Bracket

Fig. 1, Bellows Installation

EPA07 Aftertreatment System Bellows Replacement

10. Carefully remove the bellows ends and clamps from the exhaust pipes, either by prying them off, or by driving them off with a soft drift. Be careful not to damage the exhaust pipes.

IMPORTANT: Take the following measurements *before* installing the bellows.

The main section of the ATD inlet pipe is a larger diameter than the turbo outlet pipe. Make sure you measure at the **end** of the pipe, where it inserts into the bellows. The two measurements should be identical. If they are not, loosen the U-clamp nuts that hold the ATD inlet pipe to the frame-rail support bracket, and move the pipe up or down as needed.

NOTICE

The ends of the ATD inlet pipe and the turbo outlet pipe must be in exact vertical and horizontal alignment before installing the new bellows. If they are not aligned the bellows will be twisted, and will fail after a short time.

11. Attach the turbo outlet pipe to the turbocharger, then to the bellows support bracket. Tighten the clamps enough to hold the pipe in place.
12. Attach the ATD inlet pipe to the ATD and the frame-rail support bracket. Tighten the clamps enough to hold the pipes in place.
13. Using a ruler or tape measure, measure the vertical distance between the end of the ATD inlet pipe and the frame rail. See **Fig. 2**. Do the same for the end of the turbo outlet pipe. The two measurements must be the same. If the measurements are different, loosen the U-clamp nuts on the frame-rail support bracket, and raise or lower the ATD inlet pipe as needed. Tighten the U-clamp nuts enough to hold the pipe in place.
14. Using a ruler (or a T-square) and a tape measure, measure the distance between each pipe end and the frame rail. See **Fig. 3**. If these two measurements are different, do one or more of the following adjustments (see **Fig. 4**):
    - Check that the U-clamp on the bellows support bracket is installed correctly, and is not crooked.
    - Rotate the turbo outlet pipe at the turbocharger.
    - Support the ATD with a suitable jack, then loosen the ATD straps and rotate the ATD.
    - Rotate the ATD inlet pipe at the Marmon flange on the ATD.
15. With the two pipe ends in horizontal and vertical alignment and the bellows not installed, measure the distance between them. See **Fig. 5**.

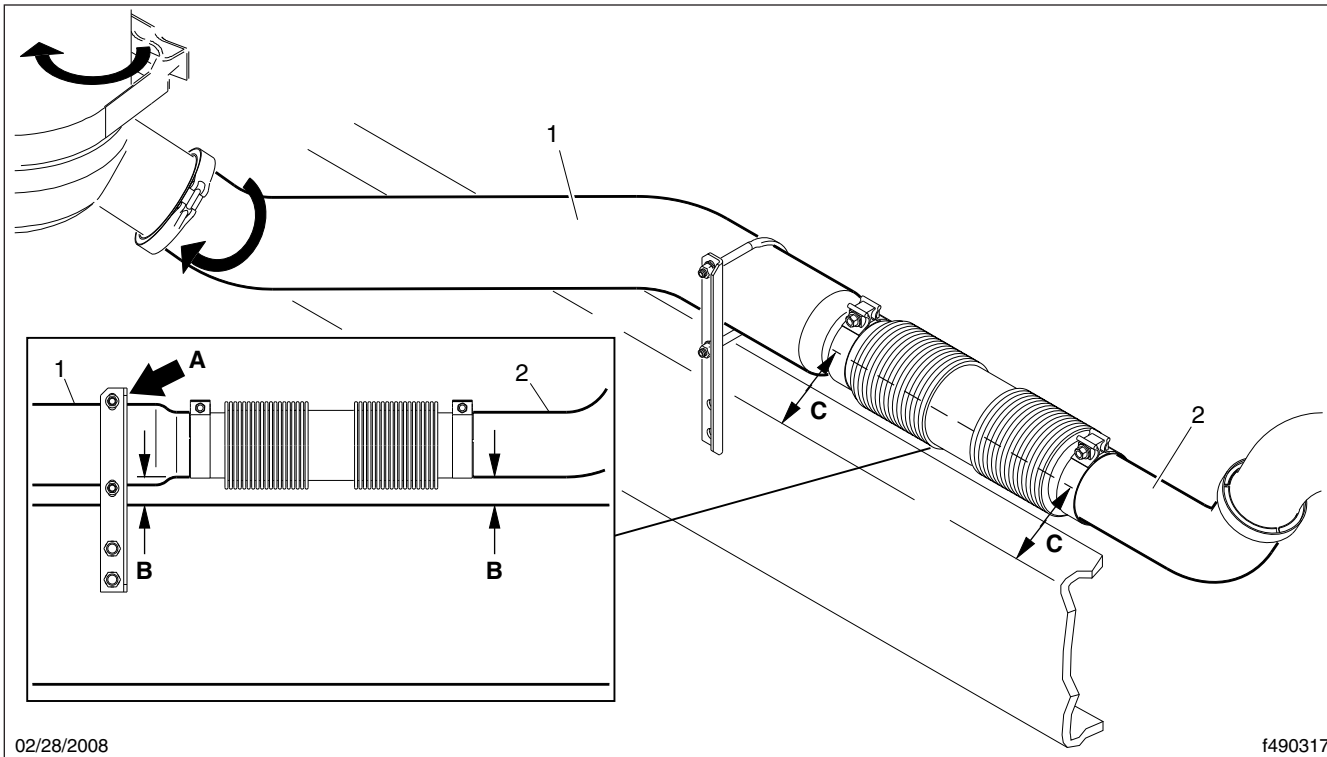
    The distance between the pipe ends is to be at least 14 inches (35.5 cm), but not more than 14-3/8 inches (36.5 cm).

    If the distance is less than the above, remove the turbo outlet pipe and the ATD inlet pipe, and cut off an equal amount from each pipe end, as needed; otherwise, go to the next step. Make sure you remove all burrs from the cut ends of the pipes.

IMPORTANT: If they were loosened, do not tighten the ATD mounting straps until the U-clamp nuts on the frame-rail support bracket are tightened to their final torque. To do otherwise will affect the alignment of the exhaust pipes.

16. When the horizontal and vertical alignment is the same for both exhaust pipes and the distances between the pipe ends is correct, tighten the U-clamp nuts on the frame-rail support bracket that holds the ATD inlet pipe in place. See **Subject 100** for torque values.
17. Tighten the V-clamp that holds the inlet pipe to the ATD. See **Subject 100** for torque values.
18. If applicable, tighten the mounting straps on the ATD, then remove the jack.
19. Remove the turbo outlet pipe from the turbocharger.
20. Remove any dirt or soot from the outer surface of the exhaust pipe ends to ease the installation of the new bellows.
21. Install the new bellows on the ATD inlet pipe, with the clamp nuts on top and facing outboard (**Fig. 2**).
22. Insert the end of the turbo outlet pipe into the bellows, then connect the pipe to the turbocharger and to the new bellows support bracket. See **Subject 100** for torque values.
23. Tighten the bellows seal clamps; see **Subject 100** for torque values.

EPA07 Aftertreatment System Bellows Replacement



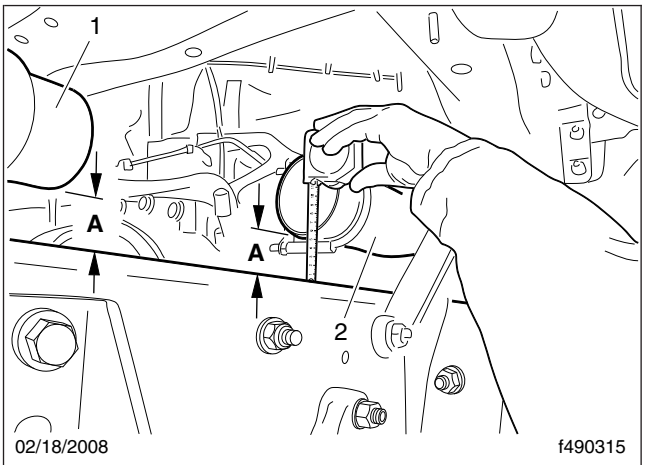
A. Up-and-down adjustment to be done at this bracket.
B. Vertical measurements to be the same.
C. Horizontal (in-and-out) measurements to be the same.

1. ATD Inlet Pipe
2. Turbo Outlet Pipe (support bracket not shown)

Fig. 2, Rotation and Adjustment Areas for Exhaust Pipe alignment (vertical ATD installation shown)

24. Start the engine and check for leaks. Shut down the engine, and tighten any clamps as needed.

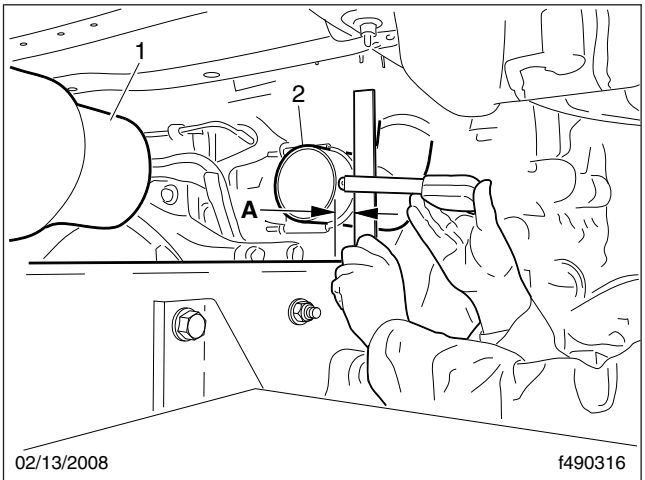
EPA07 Aftertreatment System Bellows Replacement



A. This distance must be the same at both exhaust-pipe ends.

1. ATD Inlet Pipe 2. Turbo Outlet Pipe

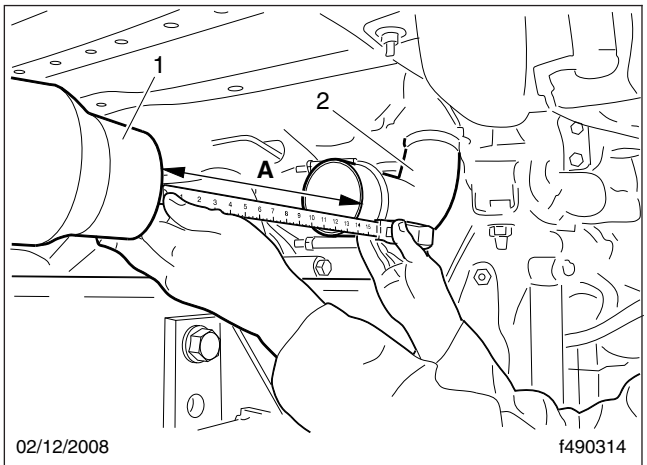
Fig. 3, Measuring the Vertical Distance



A. This distance must be the same at both exhaust-pipe ends.

1. ATD Inlet Pipe 2. Turbo Outlet Pipe

Fig. 4, Measuring the Horizontal Distance



A. This distance should be a minimum of 14 inches (35.5 cm) and a maximum of 14-3/8 inches (36.5 cm).

1. ATD Inlet Pipe 2. Turbo Outlet Pipe

Fig. 5, Measuring the Distance Between Pipe Ends

Contents

General Information

The Environmental Protection Agency (EPA) mandated that all engines built after December 31, 2009 must reduce the level of emissions exhausted by the engine to 0.2 grams per brake horsepower hour (g/bhp-hr) of nitrogen oxides (NOx).

To meet the EPA10 requirements, Daimler Trucks North America is using technology known as Selective Catalytic Reduction (SCR) in the exhaust aftertreatment system (ATS). The SCR process requires the introduction of diesel exhaust fluid (DEF) into the exhaust stream. DEF is colorless, non-toxic, and biodegradable.

IMPORTANT: The ATS is part of an integrated engine and emissions management system, controlled by the ACM. Follow the engine manufacturer's procedures, and use the correct equipment when diagnosing or working on any part of the ATS.

The ATS is always chassis-mounted, but there are several different installation options available to fit any needed vehicle configuration. ATS exhaust piping is stainless steel. The EPA10 aftertreatment system (ATS) includes all the piping and equipment between the turbocharger outlet and the tip of the exhaust pipe. It includes an aftertreatment device (ATD), an SCR catalyst, a DEF tank, tank header unit, pump, metering unit, DEF, aftertreatment control module (ACM), coolant, and air lines that run between each component. See **Fig. 1** for system components and function. Monitoring and operation of the ATS is controlled by an electronic control module (ACM).

EPA10 engines require ultralow sulfur diesel (ULSD) fuel, for low emissions and long life of the diesel particulate filter (DPF), a honeycomb soot filter inside the ATD. Inside the ATD, the exhaust first passes through the diesel oxidation catalyst (DOC) where combustion gasses are chemically broken down to water and carbon dioxide, then through the DPF, where solid particles are trapped. The soot is reduced to ash during regeneration, and the ash is collected in the DPF until the DPF is full, at which time the DPF must be removed and cleaned. The DPF needs to be removed and cleaned of ash at specific cleaning intervals. For DPF maintenance and repair information, see the specific engine manufacturer's service literature.

If the exhaust temperature is high enough, the trapped soot is reduced to ash in a process called passive regen, which occurs as the vehicle is driven normally. Passive regen, however, cannot always keep the DPF clean, so the ATD must also periodically undergo active regen. During active regen, extra fuel is injected into the exhaust stream to superheat and reduce the soot trapped in the DPF to ash. Active regen happens only when the vehicle is moving above a certain speed, as determined by the engine manufacturer.

Both active and passive regen happen automatically, without driver input. When operating conditions do not allow for active or passive regen, the vehicle may require a driver-activated parked regen which takes 20 to 60 minutes, depending on ambient conditions.

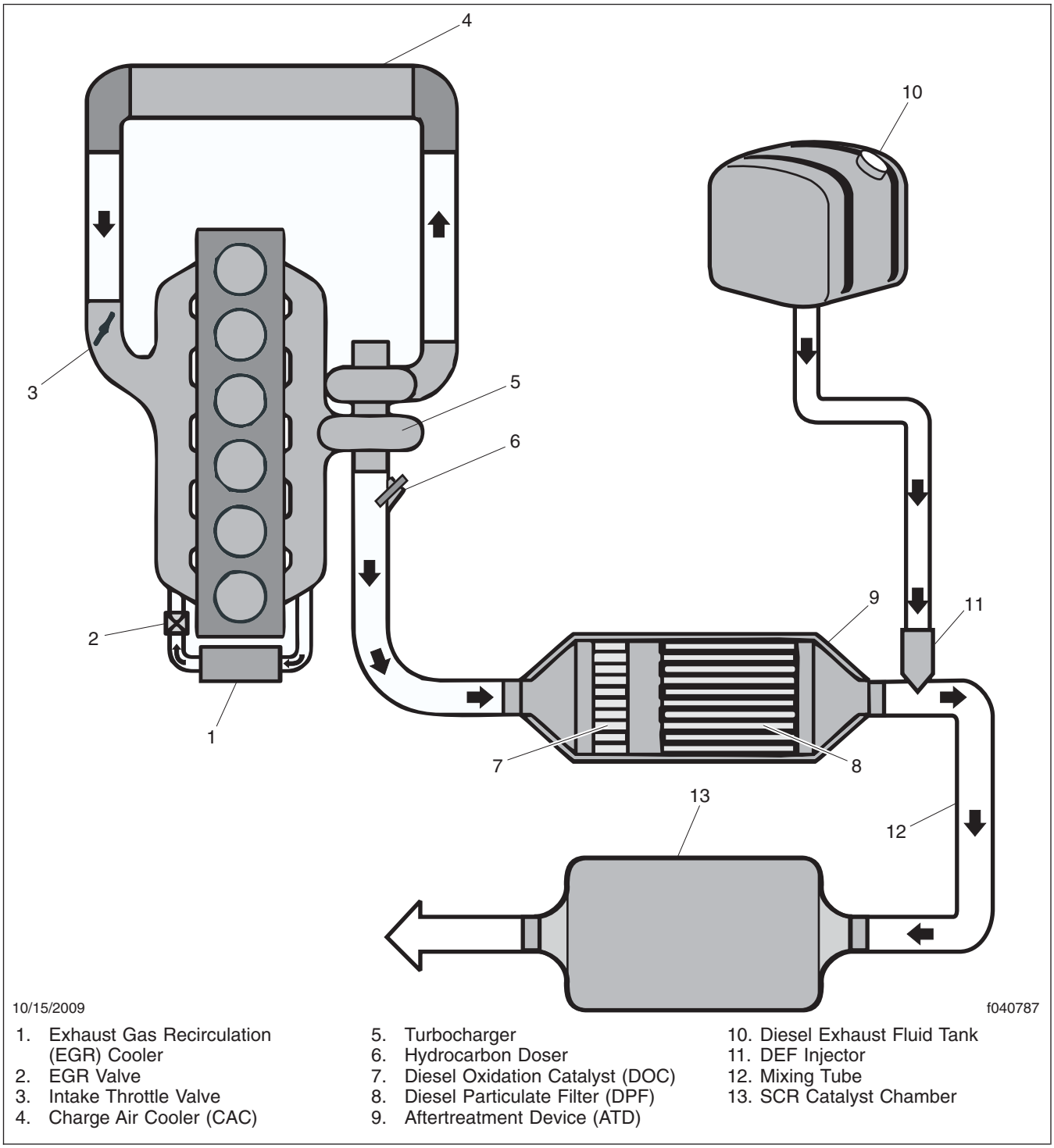
After exhaust gases leave the ATD, a controlled quantity of diesel exhaust fluid (DEF) is injected into the exhaust stream. DEF is colorless, non-toxic, and biodegradable. In the presence of heat, DEF is converted to ammonia gas, which reacts with NOx in the SCR chamber to yield nitrogen and water vapor, which exit through the tailpipe.

EPA10 compliant DTNA vehicles are equipped with an additional tank to carry the DEF necessary for the SCR process. The DEF tank will require filling a minimum of every second diesel refuel, dependant on the DEF tank capacity. DEF consumption will vary depending on ambient conditions and vehicle application.

IMPORTANT: All EPA10 compliant DTNA vehicles require the use of ULSD fuel with a maximum sulfur content of 15 parts per million (PPM). In addition, DTNA vehicles require the use of CJ-4 engine oils with less than 1% ash. See the specific engine manufacturer's literature for additional information.

NOTE: Freightliner documentation deals only with removal and installation of the components of the ATS. Refer to the engine manufacturer's service literature for all testing, disassembly, cleaning, and repair of the ATS components.

General Information

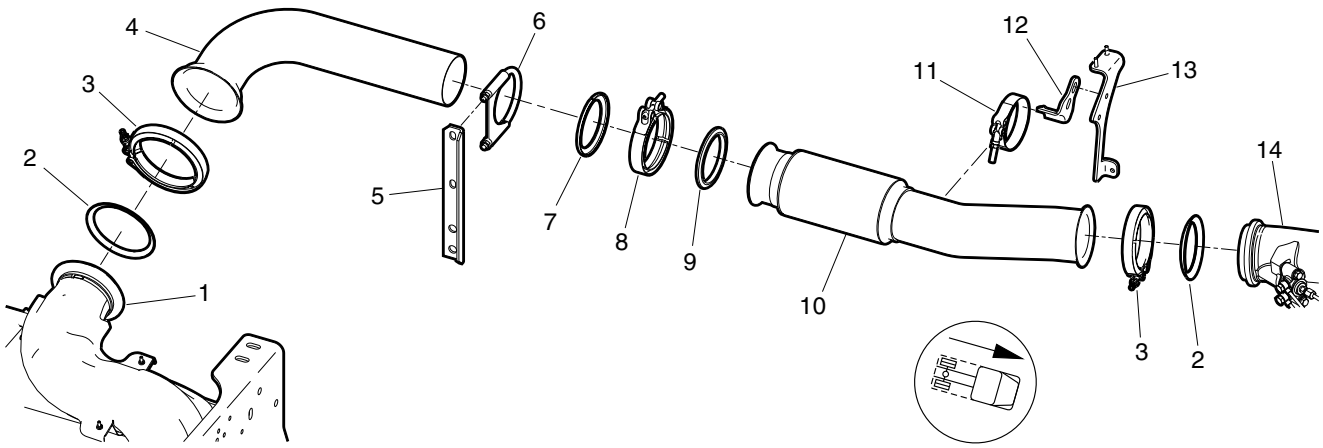


1. Exhaust Gas Recirculation (EGR) Cooler
2. EGR Valve
3. Intake Throttle Valve
4. Charge Air Cooler (CAC)
5. Turbocharger
6. Hydrocarbon Doser
7. Diesel Oxidation Catalyst (DOC)
8. Diesel Particulate Filter (DPF)
9. Aftertreatment Device (ATD)
10. Diesel Exhaust Fluid Tank
11. DEF Injector
12. Mixing Tube
13. SCR Catalyst Chamber

Fig. 1, Aftertreatment System (typical)

Bellows Replacement

Refer to **Fig. 1** for bellows replacement.



1. ATD Inlet
2. Spherical Clamp Gasket
3. Spherical Clamp
4. ATD Inlet Pipe
5. Bracket
6. Clamp
7. Compression Gasket
8. Slip-Joint Clamp
9. Conical Gasket
10. Bellows
11. Bellows Pipe Support Clamp
12. L-Bracket
13. Bellows Pipe Support Bracket
14. Turbocharger Outlet Pipe

Fig. 1, Exhaust Bellows Installation (DD13 engine shown)

NOTE: Always use new exhaust pipe clamps and gaskets when installing exhaust system components.

1. Shut down the engine and chock the tires.

⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

2. Allow the exhaust system to cool before working on it.
3. Remove the inner fender/splash shield.
4. Remove the spherical clamp at the turbocharger outlet pipe. Discard the clamp and gasket.
5. Remove the spherical clamp at the ATD inlet. Discard the clamp and gasket.
6. Remove the turbocharger-outlet-pipe support bracket clamp. Save the clamp for reuse.
7. Remove the ATD-inlet-pipe support bracket clamp. Save the clamp for reuse.
8. If needed to make clearance, remove the ATD-inlet-pipe support bracket form the framerail.
9. Remove the bellows and ATD inlet pipe as an assembly.
10. On the workbench, replace the bellows as follows.
    - 10.1 Remove the bellows-to-ATD inlet-pipe slip-joint clamp and gaskets. Discard the clamp and gaskets.
    - 10.2 Slide the new slip-joint clamp, then the two new gaskets onto the ATD inlet pipe in the order shown in **Fig. 1**.

Bellows Replacement

10.3 Slide the new bellows onto the ATD inlet pipe.

10.4 Position the slip-joint clamp over the gaskets. Do not tighten at this time.

11. Position the bellows and ATD inlet pipe assembly on the vehicle.
12. Slide the ATD inlet pipe in or out of the bellows to align it with the ATD inlet.
13. Install the new spherical clamp and gasket at the ATD inlet. Do not tighten at this time.
14. Install the new spherical clamp and gasket at the bellows-to-the turbocharger outlet-pipe connection. Do not tighten at this time.
15. If removed, install the ATD-inlet-pipe support bracket on the framerail.
16. Install the turbocharger-outlet-pipe support bracket clamp. Do not tighten at this time.
17. Install ATD-inlet-pipe support bracket clamp. Do not tighten at this time.
18. Using a straight edge, align the bellows, the ATD inlet pipe, and the turbocharger outlet pipe. Check from at least two positions about 90 degrees apart. All three components should form a straight line through the connections.
19. Tighten the spherical clamp at the turbocharger outlet pipe connection as follows.

    19.1 Tighten the nut 126 to 138 lbf·in (1425 to 1560 N·cm).

    19.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.

    19.3 Tighten the nut a second time 126 to 138 lbf·in (1425 to 1560 N·cm).

20. Tighten the spherical clamp at the ATD inlet connection as follows.

    20.1 Tighten the nut 126 to 138 lbf·in (1425 to 1560 N·cm).

    20.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.

    20.3 Tighten the nut a second time 126 to 138 lbf·in (1425 to 1560 N·cm).

21. Tighten the slip-joint clamp at the ATD inlet to bellows connection as follows.

    21.1 Tighten the nut 13 lbf·ft (18 N·m).

    21.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.

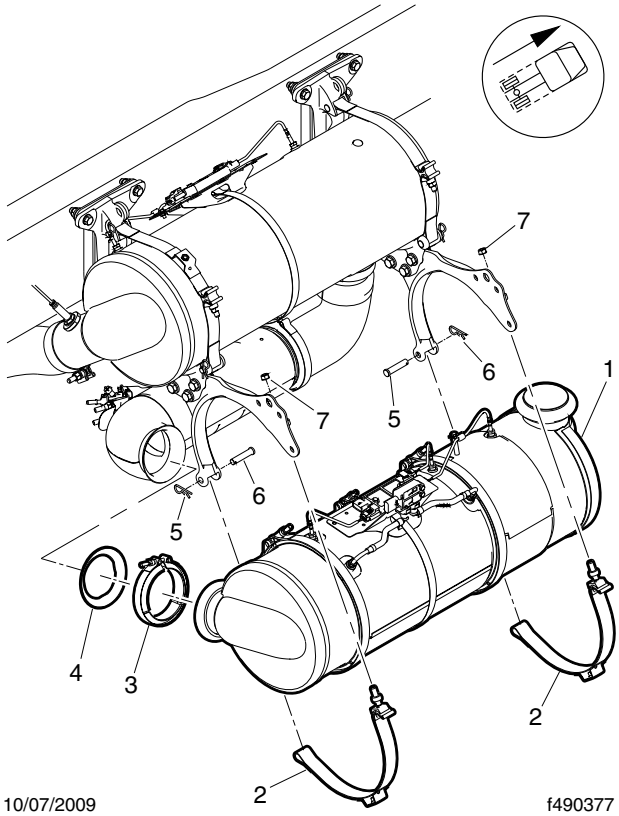
    21.3 Tighten the nut a second time 13 lbf·ft (18 N·m).

22. Tighten the turbocharger-outlet-pipe support bracket clamp 24 lbf·ft (30 N·m).
23. Tighten the ATD-inlet-pipe support bracket clamp 24 lbf·ft (30 N·m).
24. Start the engine and check for leaks. Further tighten the clamps on any leaking connections as needed.
25. Install the inner fender/splash shield.

Cummins ISB/ISC Under-Step Switchback ATD Removal and Installation

Removal

Refer to **Fig. 1** for removal and installation of the ATD components.



1. ATD
2. Clamping Straps
3. Spherical Clamp
4. Gasket
5. Retaining Pin
6. Clamping Strap Pin
7. Clamping Strap Nut

Fig. 1, Cummins ISB/ISC Under-Step Switchback ATS

NOTE: The ATD can be removed and installed without disturbing the SCR catalyst.

1. Set the parking brakes and chock the tires.

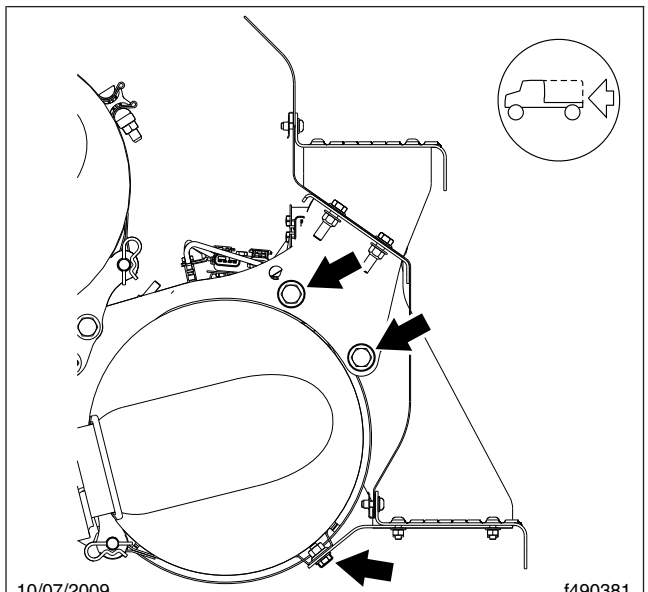
⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

2. Allow the ATS to completely cool before attempting to work on it.
3. Remove the right side inner fender. See **Group 60**.
4. Remove the upper step plate. See **Fig. 2**.



Remove these bolts.

Fig. 2, Step Removal

5. Remove the step unit from the ATS brackets.

NOTICE

Component alignment is critical to proper installation of ATS components. Before removing any components, put alignment marks (use both clocking and longitudinal marks where applicable) on all ATS components. This will aid in faster and more accurate alignment during as-

Cummins ISB/ISC Under-Step Switchback ATD Removal and Installation

sembly. Failure to accurately align all of the components of the ATS may result in component damage.

6. Make alignment marks on all of the components to be removed.
7. Disconnect the wiring harness at the control box on the ATD.

NOTICE

It is not necessary to disconnect the lines from the DEF metering unit to the DEF injector on the mixer tube unless one of these components is being replaced. However, it should be handled carefully to prevent damaging the hose connections.

8. Remove the mixer-tube clamp at the ATD and support the mixer tube as needed. Discard the clamp.
9. Remove the clamp, and disconnect the exhaust pipe from the engine at the ATD. Discard the clamp.
10. Position the ATD jack under the ATD.
11. Remove the nuts from the ATD clamping straps. Remove the straps, and discard the straps and hardware.

NOTICE

Be careful not to bump any of the sensors while removing the ATD. The sensors are easily damaged.

12. Carefully lower the ATD.
13. If replacing the ATD, transfer the control box from the old ATD to the new one.

Installation

IMPORTANT: Always use new gaskets when installing exhaust system components.

1. Using the jack, raise the ATD into position.

NOTICE

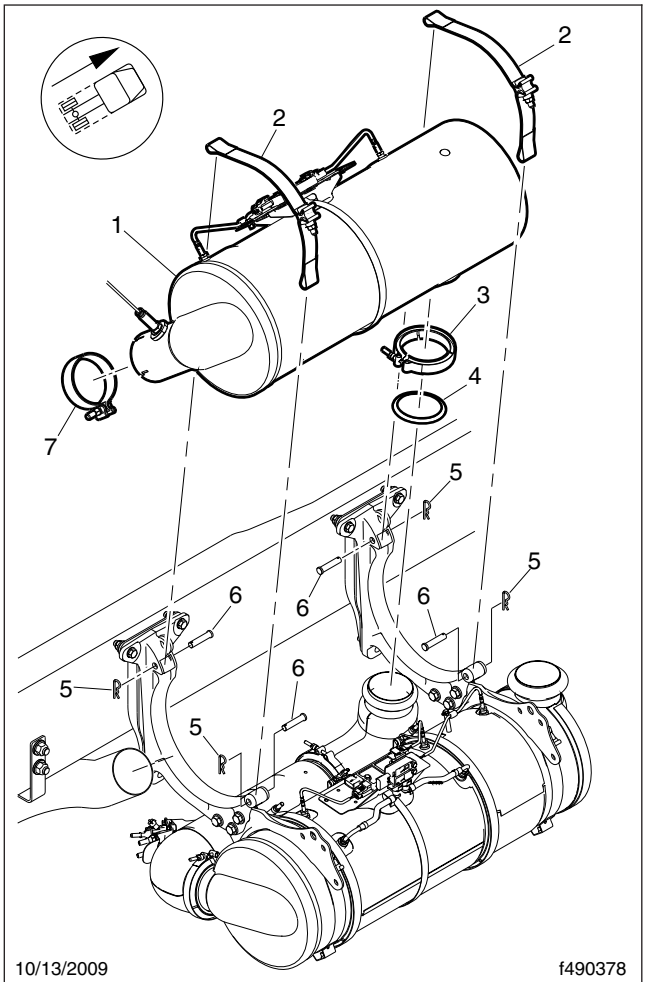
The ATD may rotate while tightening the clamps. It is important that this is prevented. Check the alignment during and after the clamping procedure and make adjustments as needed. Improper installation may lead to component failure.

2. Align the ATD, and install the new clamping straps. Do not tighten at this time.
3. Connect the exhaust pipe from the engine and install the new spherical clamp and gasket. Do not tighten at this time.
4. Position the mixer tube and install the new spherical clamp and gasket. Do not tighten at this time.
5. Check all alignment marks, and tighten the clamping strap nuts incrementally, first 15 lbf·ft (20 N·m), then 30 lbf·ft (40 N·m).
6. Check all alignment marks again. If not correct, loosen the clamp and repeat the previous step. Check the alignment on all connections. Make adjustments as needed.
7. Tighten the spherical clamps at the ATD inlet and the mixer tube elbow as follows.
   - 7.1 Tighten the nut 114 to 126 lbf·in (1290 to 1425 N·cm).
   - 7.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.
   - 7.3 Tighten the nut a second time 114 to 126 lbf·in (1290 to 1425 N·cm).
8. Connect the wiring harness to the control box on the ATD.
9. Start the engine and check for leaks. Further tighten the clamps on any leaking connections as needed.
10. Install the steps.
11. Install the inner fender.

Cummins ISB/ISC Under-Step Switchback SCR Catalyst Removal and Installation

Removal

Refer to **Fig. 1** for removal and installation of the SCR catalyst components.



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1. SCR Catalyst
2. Clamping Strap
3. Spherical Clamp
4. Gasket
5. Retaining Pin
6. Clamping Strap Pin
7. Clamp, Exhaust Pipe

Fig. 1, Cummins ISB/ISC Under-Step Switchback SCR Catalyst Installation

NOTE: The SCR catalyst can be removed and installed without disturbing the ATD.

1. Set the parking brakes and chock the tires.

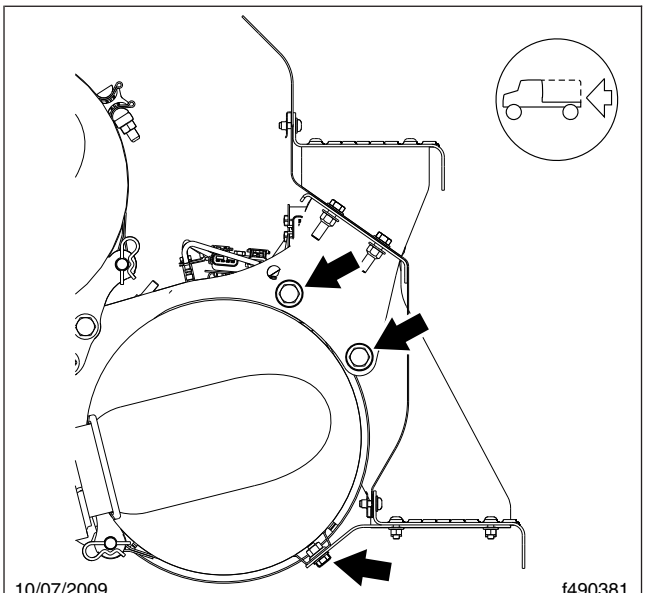
⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

2. Allow the ATS to completely cool before attempting to work on it.
3. Remove the right side inner fender. See **Group 60**.
4. Remove the upper step plate. See **Fig. 2**.



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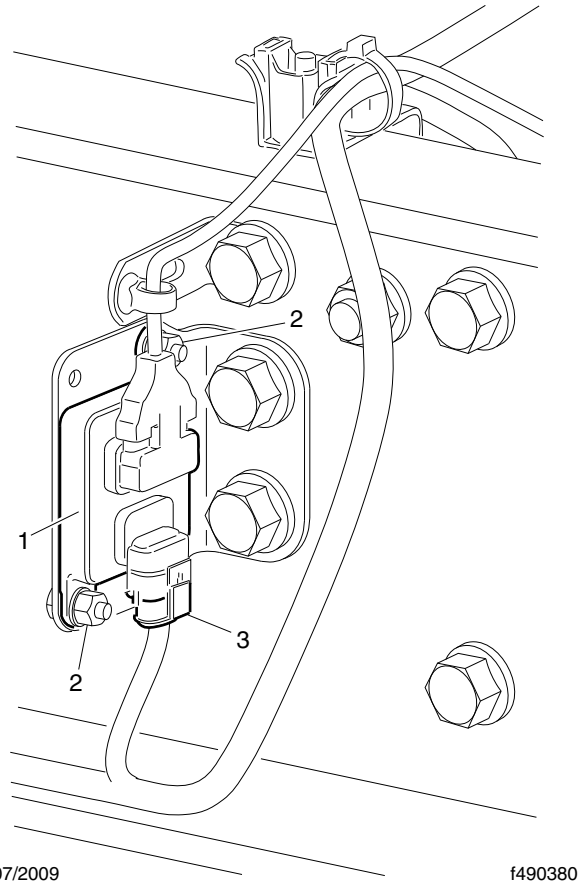
Remove these bolts.

Fig. 2, Upper Step Removal

5. Remove the step unit from the ATS brackets.

Cummins ISB/ISC Under-Step Switchback SCR Catalyst Removal and Installation

6. Disconnect the NOx sensor module from the main harness, and remove it from the frame rail bracket. See **Fig. 3**



1. NOx Sensor Module
2. Mounting Bolts and Nuts
3. Chassis Harness Connector

Fig. 3, NOx Sensor Module Installation

NOTICE

Component alignment is critical to proper installation of ATS components. Before removing any components, put alignment marks (use both clocking and longitudinal marks where applicable) on all ATS components. This will aid in faster and more accurate alignment during assembly. Failure to accurately align all of the components of the ATS may result in component damage.

7. Make alignment marks on all of the ATS components that will be removed.
8. Disconnect the exhaust outlet pipe at the SCR catalyst as needed.
9. Remove the clamp on the mixer tube. Discard the clamps.
10. Carefully let the mixer tube swing down, and support it as needed.

NOTICE

Do not bump any of the sensors while removing the SCR catalyst. The sensors are easily damaged.

11. Remove the nuts from the SCR catalyst clamping straps. Discard the straps and hardware.
12. With help from an assistant, lift the SCR catalyst out.

Installation

IMPORTANT: Always use new clamps and gaskets when installing exhaust system components.

1. With help from an assistant, position the SCR catalyst in the bracket, and align the alignment marks.
2. Install the new clamping straps. Do not tighten at this time.
3. Position the mixer tube and install the clamp. Do not tighten at this time.
4. If removed, connect the exhaust pipe to the SCR catalyst and install the clamp. Do not tighten at this time.

NOTICE

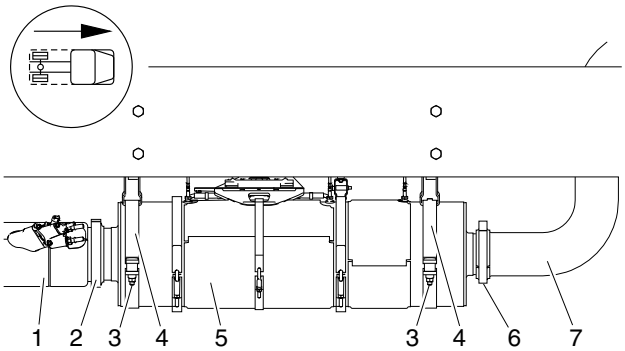
The SCR catalyst may rotate while tightening the clamps. It is important that this is prevented. Check the alignment during and after the clamping procedure and make adjustments as needed. Improper alignment may lead to component failure.

5. Check all alignment marks, and tighten the clamping strap nuts incrementally, first 15 lbf·ft (20 N·m) then 30 lbf·ft (41 N·m).

6. Check all alignment marks again. If not correct, loosen the clamp and repeat the previous step.
7. Tighten the spherical clamps at the ATD inlet and the mixer tube elbow as follows.
   - 7.1 Tighten the nut 114 to 126 lbf·in (1290 to 1425 N·cm).
   - 7.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.
   - 7.3 Tighten the nut a second time 114 to 126 lbf·in (1290 to 1425 N·cm).
8. Tighten the exhaust pipe clamp at the outlet of the SCR catalyst 45 to 60 lbf·ft (60 to 80 N·m).
9. Install the NOx sensor module on the bracket on the frame rail, then connect it to the chassis harness.
10. Connect the wiring harness to the control box on the SCR catalyst.
11. Start the engine and check for exhaust leaks. Further tighten the clamps on any leaking connections as needed.
12. Install the steps.
13. Install the inner fender.

Removal

Refer to **Fig. 1** for removal and installation of the ATS components.



1. Mixer Tube
2. Spherical Clamp
3. Mounting-Strap Bolt and Nut
4. Mounting Strap
5. Aftertreatmment Device (ATD)
6. Spherical Clamp
7. ATD Inlet Pipe

Fig. 1, Cummins ISB/ISC 2HH ATD Installation

1. Shut down the engine and chock the tires.

⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

2. Allow the ATS to completely cool before working on it.

NOTICE

Component alignment is critical to proper installation of ATS components. Before removing any components, put alignment marks (use both clocking and longitudinal marks where applicable) on all ATS components. This will aid in faster and more accurate alignment during assembly. Failure to accurately align all of the components of the ATS may result in component damage.

3. Make alignment marks on all of the components to be removed.
4. Disconnect the wire harness to the control module on the ATD.
5. Remove the spherical clamp and gasket that connects the ATD inlet pipe to the ATD. Discard the clamp and gasket.
6. Remove the spherical clamp and gasket that connects the ATD to the mix-tube. Discard the clamp and gasket.
7. Position the jack and cradle under the assembly and secure it with straps.
8. Remove the bolts and nuts from the four mounting straps.
9. Lower the unit.
10. Remove and discard the mounting straps and hardware.

Installation

1. Position the assembly in the jack cradle and secure it with straps.
2. Slide the unit under the vehicle and raise it into position.
3. Install the new mounting straps.
4. Position the assembly in the mounting straps, then install the clamp bolts and nuts. Do not tighten at this time.

IMPORTANT: Always use new gaskets when installing exhaust system components.

5. Connect the ATD to the ATD inlet pipe and install the new spherical clamp and gasket. Do not tighten at this time.

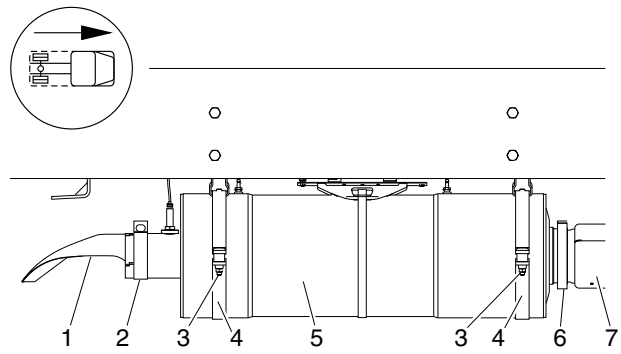
Cummins 2HH ATD Removal and Installation

6. Connect the ATD outlet to the mix tube and install the new spherical clamp and gasket. Do not tighten at this time.
7. Recheck the alignment of all components. Make adjustments to the mounting straps (and brackets) as needed then incrementally tighten the bolts 15 lbf·ft (20 N·m), them 30 lbf·ft (41 N·m).
8. Tighten the spherical clamps at the ATD inlet and the mixer tube elbow as follows.
    - 8.1 Tighten the nut 114 to 126 lbf·in (1290 to 1425 N·cm).
    - 8.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.
    - 8.3 Tighten the nut a second time 114 to 126 lbf·in (1290 to 1425 N·cm).
9. Connect the wiring harnesses to the control module on the ATD.
10. Remove the jack and cradle.
11. Start the engine and check for leaks. Further tighten the clamps on any leaking connections as needed.

Cummins 2HH SCR Catalyst Removal and Installation

Removal

Refer to **Fig. 1** for removal and installation of the ATS components.



1. Exhaust Pipe Tip
2. Wide-Band Clamp
3. Mounting-Strap Bolt and Nut
4. Mounting Strap
5. SCR Catalyst
6. Spherical Clamp
7. Mixer Tube

Fig. 1, Aftertreatment System Installation

1. Shut down the engine and chock the tires.

⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

2. Allow the ATS to completely cool before working on it.

NOTICE

Component alignment is critical to proper installation of ATS components. Before removing any components, put alignment marks (use both clocking and longitudinal marks where applicable) on all ATS components. This will aid in faster and more accurate alignment during assembly. Failure to accurately align all of the components of the ATS may result in component damage.

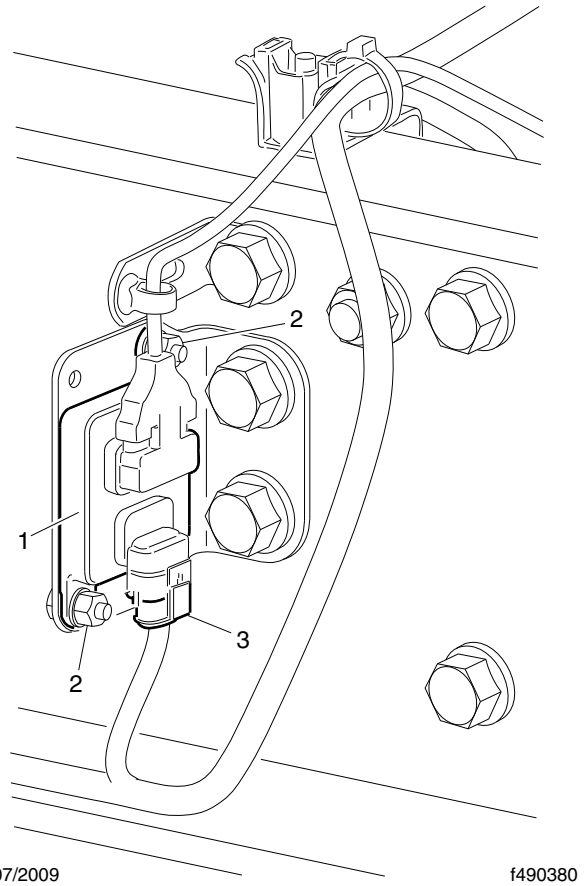
3. Make alignment marks on all components to be removed.
4. Disconnect the wire harness to the NOx sensor.
5. Remove the NOx sensor module from the frame rail bracket and secure it to the SCR catalyst. See **Fig. 2**.
6. Disconnect the wire harness to the control module on the SCR catalyst.
7. Remove the spherical clamp that connects the SCR catalyst to the mixer tube. Discard the clamp.
8. Remove the wide-band clamp that connects the SCR catalyst to the exhaust pipe. Discard the clamp.
9. Position the jack and cradle under the assembly and secure it with straps.
10. Remove the bolts and nuts from the four mounting straps.
11. Remove and discard the mounting straps and hardware.
12. Lower the unit.

Installation

1. Position the assembly in the jack cradle and secure it with straps.
2. Install the new clamp straps.
3. Slide the unit under the vehicle and raise it into position.
4. Position the assembly in the mounting straps, and install the clamp bolts and nuts. Do not tighten at this time.

IMPORTANT: Always use new gaskets when installing exhaust system components.

Cummins 2HH SCR Catalyst Removal and Installation



1. NOx Sensor Module
2. Mounting Bolts and Nuts
3. Chassis Harness Connector

Fig. 2, NOx Sensor Module Installation

5. Connect the SCR catalyst to the mixer tube and install the new spherical clamp and gasket. Do not tighten at this time.
6. Connect the SCR catalyst to the exhaust outlet pipe and install the new wide-band clamp. Do not tighten at this time.
7. Recheck the alignment of all components. Make adjustments to the mounting straps (and brackets) as needed then tighten the bolts 15 lbf·ft (20 N·m), then 30 lbf·ft (41 N·m).
8. Tighten the spherical clamps at the ATD inlet and the mixer tube elbow as follows.
   - 8.1 Tighten the nut 114 to 126 lbf·in (1290 to 1425 N·cm).
   - 8.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.
   - 8.3 Tighten the nut a second time 114 to 126 lbf·in (1290 to 1425 N·cm).
9. Install the NOx sensor module on the bracket on the frame rail, then connect it to the chassis harness.
10. Connect the wiring harness to the control box on the SCR catalyst.
11. Remove the jack and cradle.
12. Start the engine and check for leaks. Further tighten the clamps on any leaking connections as needed.

DDC 2V2 ATD and SCR Catalyst Removal and Installation

General Information

Removing the DDC 2V2 ATD and SCR catalyst as a unit is the quickest, and easiest, way to remove it from the vehicle. The ATD or the SCR catalyst can be removed separately. When removing the components separately, mark all parts to assist in proper assembly. Daimler Trucks North America LLC does not recommend disassembling the ATD on the vehicle. Remove the component following the instructions below, and then disassemble it on a workbench following the instructions in the engine manufacturer's service literature.

⚠ WARNING

Aftertreatment Device (ATD) internal temperatures can remain hot enough to cause personal injury, or ignite combustible materials, for hours after the engine is shut down.

To avoid potentially serious burns or material damage:

- **Let the ATD cool before handling it; be especially careful when opening it to expose the DPF.**
- **Wear appropriate protective gear.**
- **Be careful not to place the ATD where flammable gases or other combustible materials may come into contact with hot interior parts.**

ATD and SCR Catalyst Removal and Installation

Removal

Refer to **Fig. 1** for the following procedure.

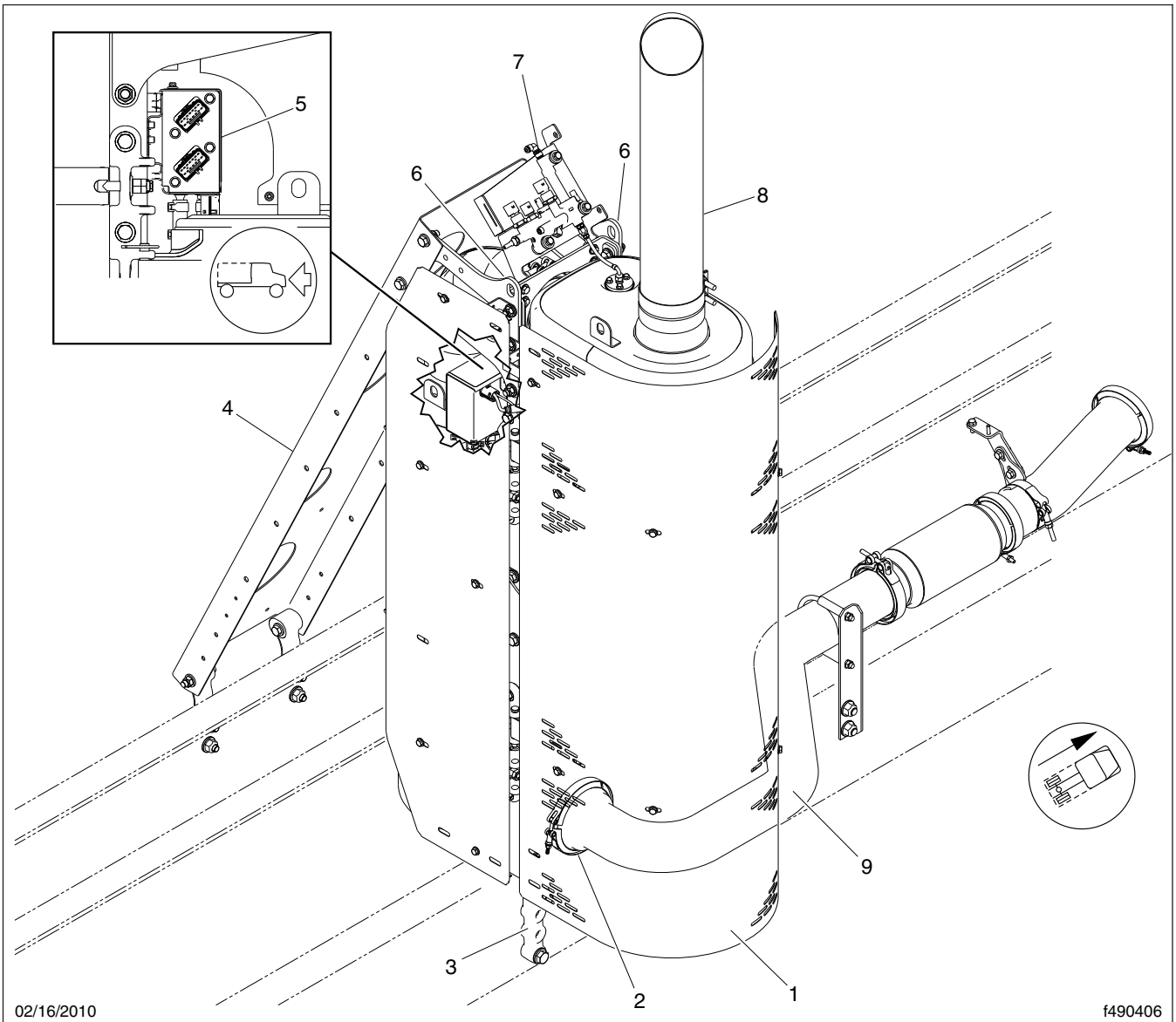
1. Shut down the engine and chock the tries.
2. Allow the ATS time to cool.
3. Remove the heat shield.
4. Remove the exhaust stack from the SCR catalyst.
5. Disconnect the two 14-pin connectors at the sensor box.
6. Disconnect the wiring connectors from the metering unit.
7. Disconnect the air lines from the metering unit.
8. Disconnect and cap/plug the DEF lines from the metering unit.
9. Remove the metering unit mounting plate with the metering unit attached.
10. Loosen the lower fasteners on the diagonal support brace. Disconnect the diagonal support brace from the lifting bracket that attaches to the vertical stanchion and swing it out of the way. Secure it as needed.
11. Disconnect the exhaust pipe at the intake to the ATD. Support it as needed so there is no stress on the bellows.
12. Position the overhead lifting device over the vertical stanchion and connect the hooks at the lifting points. Apply enough pressure to the lift points to prevent the unit from dropping when loosened.
13. Remove the four mounting fasteners that attach the vertical stanchion to the frame rail.
14. Lower the unit away from the vehicle.

Installation

1. Using the overhead lifting device, position the unit at the frame rail, and install the mounting fasteners. Tighten 159 to 201 lbf·ft (212 to 268 N·m).
2. Position the diagonal support brace and install the mounting fasteners. Tighten the upper and lower fasteners 49 to 63 lbf·ft (66 to 86 N·m).
3. Connect the two 14-pin connectors at the sensor box.
4. Install the metering unit and mounting plate.
5. Connect the wiring connectors to the metering unit.
6. Connect the air lines to the metering unit.
7. Connect the DEF lines to the metering unit.
8. Using a new seal, connect the exhaust pipe to the ATD. See **Fig. 2** for proper installation. Tighten the clamp as follows.

   8.1 Tighten the nut 114 to 126 lbf·in (1290 to 1425 N·cm).

DDC 2V2 ATD and SCR Catalyst Removal and Installation



1. Heat Shield
2. Inlet Clamp
3. Vertical Stanchion
4. Diagonal Support Brace
5. Sensor Box
6. Lifting Points
7. Metering Unit and Mounting Plate
8. Exhaust Stack
9. Exhaust Pipe

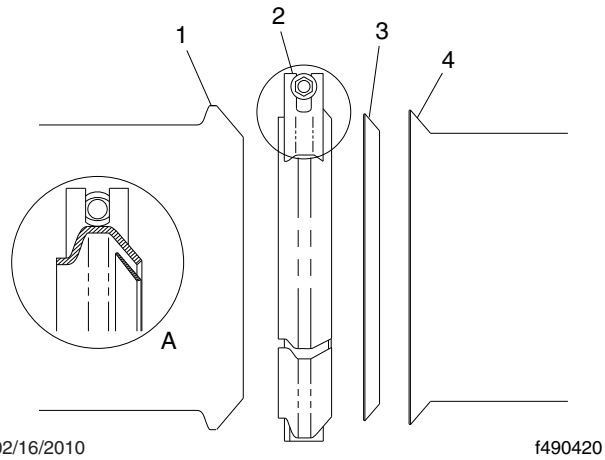
Fig. 1, 2V2 ATD and SCR Catalyst Installation

8.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.

8.3 Tighten the nut a second time 114 to 126 lbf·in (1290 to 1425 N·cm).

9. Install the exhaust stack. Tighten the clamp 27 to 37 lbf·ft (37 to 50 N·m).

10. Install the heat shield. Tighten 13 to 17 lbf·ft (18 to 22 N·m).



NOTE: Clamp and seal are directional.

A. Correct Clamp and Seal Installation

1. ATD
2. Clamp
3. Gasket
4. Exhaust Pipe

Fig. 2, Spherical Clamp Installation

11. Start the engine and check for leaks. Tighten any connections as needed.

ATD Removal and Installation

Refer to **Fig. 3** for the following procedure.

NOTICE

Alignment is essential. Mark every component's position prior to disassembling it on the truck. Improper assembly may result in leaks or damage to the ATS.

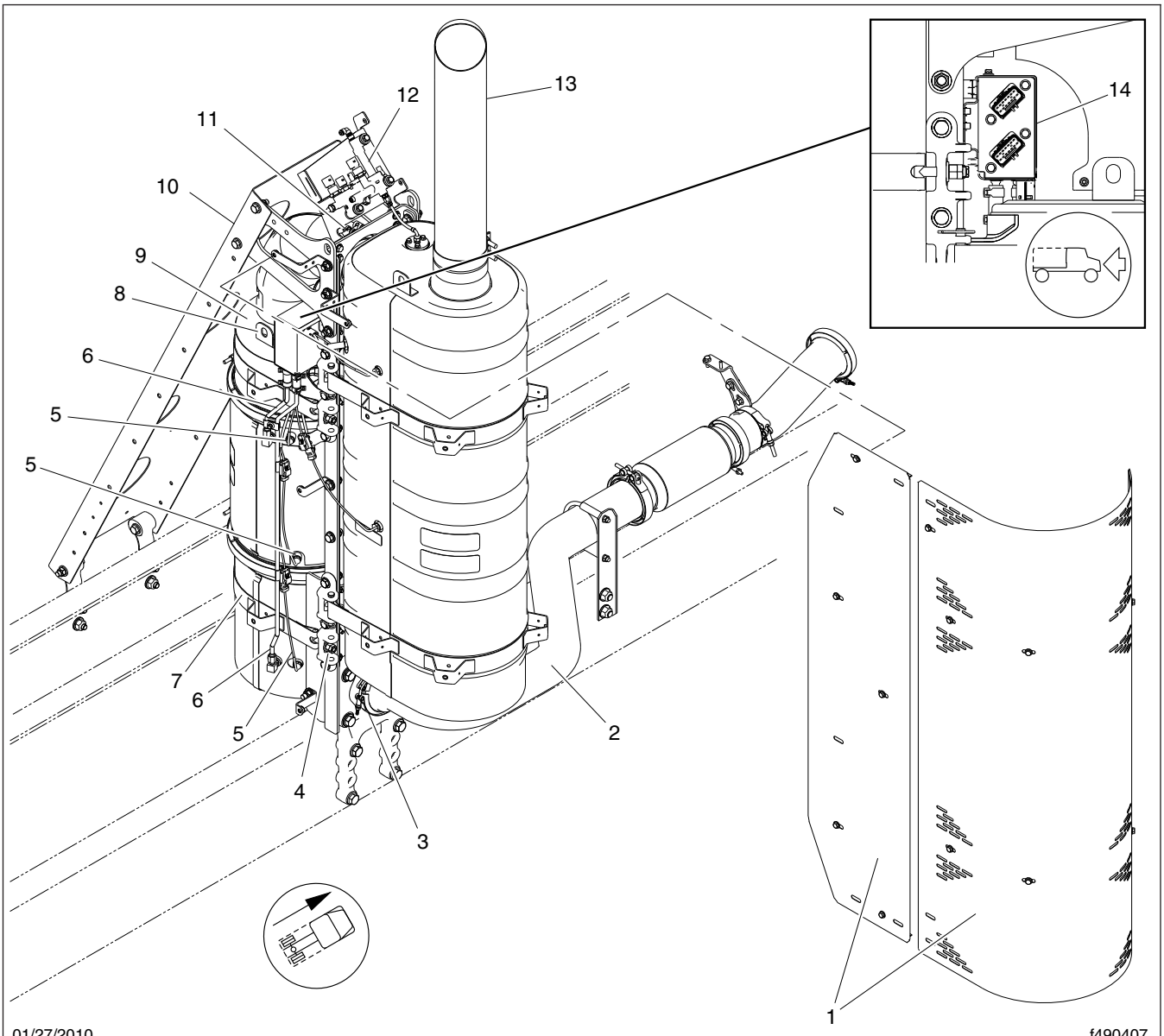
Removal

1. Shut down the engine and chock the tries.
2. Allow the ATS time to cool.
3. Remove the heat shield.
4. Disconnect the two pressure tubes at the connection to the ATD.
5. Disconnect the three temperature sensors on the ATD.
6. Disconnect the two 14-pin connectors at the sensor box.
7. Disconnect the wiring connectors from the metering unit.
8. Disconnect the air lines from the metering unit.
9. Disconnect and cap/plug the DEF lines from the metering unit.
10. Remove the metering unit mounting plate with the metering unit attached.
11. Loosen the lower fasteners on the diagonal support brace. Disconnect the diagonal support brace from the vertical stanchion, and swing it out of the way. Secure it as needed.
12. Remove the intake and outlet clamps from the ATD. Support the turbo outlet pipe as needed so there is no stress on the bellows.
13. Position the overhead lifting device over the ATD and connect the hooks at the lifting points. Apply enough pressure to the lift points to prevent the unit from dropping when loosened.
14. Remove the mounting clamps.
15. Lift the ATD away from the vehicle.

Installation

1. Using the overhead lifting device, position the ATD on the vertical stanchion, and secure it in position with the mounting clamps. Do not tighten the straps at this time.
2. Align the connection with the SCR catalyst, and using a new seal, install the clamp. See **Fig. 2** for proper installation. Tighten the clamp as follows.
   - 2.1 Tighten the clamp 114 to 126 lbf·in (1290 to 1425 N·cm).
   - 2.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.
   - 2.3 Tighten the clamp a second time 114 to 126 lbf·in (1290 to 1425 N·cm).
3. Align the connection with the exhaust pipe from the turbocharger, and, using a new seal, install the clamp. See **Fig. 2** for proper installation. Tighten the clamp as follows.
   - 3.1 Tighten the clamp 114 to 126 lbf·in (1290 to 1425 N·cm).

DDC 2V2 ATD and SCR Catalyst Removal and Installation



1. Heat Shield
2. Exhaust Pipe
3. Intake Clamp
4. Clamping Strap Nuts
5. Temperature Sensor
6. Pressure Tube
7. Clamping Strap
8. Lifting Points
9. ATD
10. Diagonal Support Brace
11. Outlet Clamp
12. Metering Unit and Mounting Plate
13. Exhaust Stack
14. Sensor Box

Fig. 3, 2V2 ATD Installation

3.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.

3.3 Tighten the clamp a second time 114 to 126 lbf·in (1290 to 1425 N·cm).

4. Check all alignment marks, and tighten the clamping strap nuts incrementally, first 15 lbf·ft (20 N·m), then 30 lbf·ft (40 N·m).

   Install the jam nuts. Using a back-up wrench, tighten 30 lbf·ft (40 N·m).
5. Connect the two pressure tubes.
6. Connect the three temperature sensors.
7. Position the diagonal support brace and install the mounting fasteners. Tighten the upper and lower fasteners 49 to 63 lbf·ft (66 to 86 N·m).
8. Connect the two 14-pin connectors at the sensor box.
9. Install the metering unit and mounting plate.
10. Connect the wiring connectors to the metering unit.
11. Connect the air lines to the metering unit.
12. Connect the DEF lines to the metering unit.
13. Install the heat shield.
14. Start the engine and check for leaks. Tighten any connections as needed.

SCR Catalyst Removal and Installation

Refer to **Fig. 4** for the following procedure.

Removal

1. Shut down the engine and chock the tries.
2. Allow the ATS time to cool.
3. Remove the heat shield.
4. Remove the exhaust stack from the SCR catalyst.
5. Remove the SCR catalyst inlet clamp.
6. Disconnect the two temperature sensors and the NOx sensor.
7. Disconnect the DEF nozzle.
8. Position the overhead lifting device over the SCR catalyst and connect the hooks at the lifting points. Apply enough pressure to the lift points to prevent the unit from dropping when loosened.
9. Remove the clamping strap nuts.
10. Lift the SCR catalyst away from the vehicle.

Installation

1. Using the overhead lifting device, position the SCR catalyst on the vertical stanchion, and secure it in position with the mounting clamps. Do not tighten the straps at this time.
2. Align the connection with the ATD, and using a new seal, install the clamp. See **Fig. 2** for proper installation. Tighten the clamp as follows.

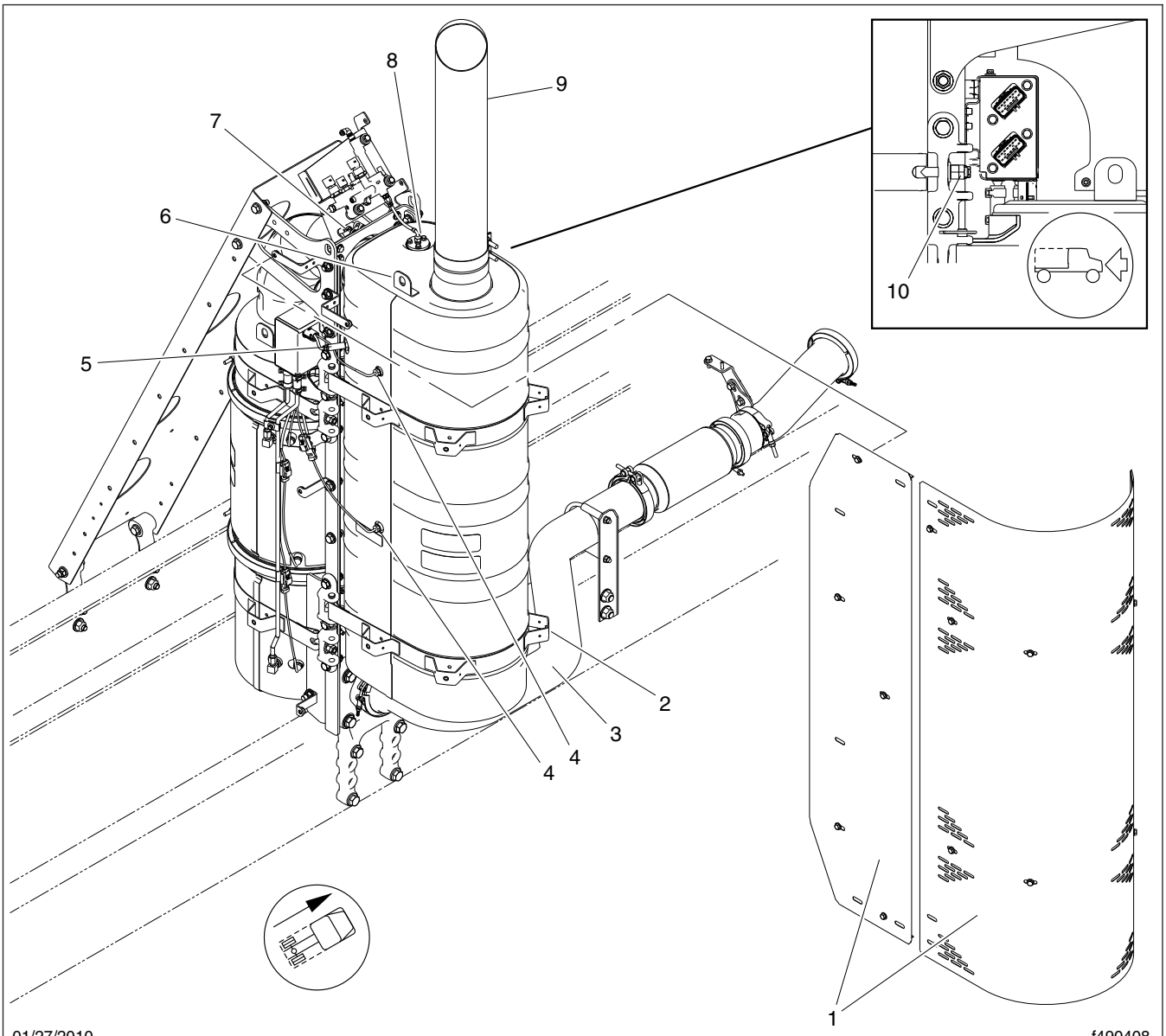
   2.1 Tighten the clamp 114 to 126 lbf·in (1290 to 1425 N·cm).

   2.2 Using a plastic or rubber mallet, tap around the outside of the clamp to seat the clamp against the pipe.

   2.3 Tighten the clamp a second time 114 to 126 lbf·in (1290 to 1425 N·cm).
3. Check all alignment marks, and tighten the clamping strap nuts incrementally, first 15 lbf·ft (20 N·m), then 30 lbf·ft (40 N·m).

   Install the jam nuts. Using a back-up wrench, tighten 30 lbf·ft (40 N·m).
4. Connect the two temperature sensors and the NOx sensor.
5. Connect the DEF nozzle.
6. Install the exhaust stack. Tighten the clamp 27 to 37 lbf·ft (37 to 50 N·m).
7. Install the heat shield. Tighten 13 to 17 lbf·ft (18 to 22 N·m).
8. Start the engine and check for leaks. Tighten any connections as needed.

DDC 2V2 ATD and SCR Catalyst Removal and Installation



1. Heat Shield
2. Clamping Straps
3. Exhaust Pipe
4. Temperature Sensor
5. NOx Sensor
6. Lifting Points
7. SCR Catalyst Inlet Clamp
8. DEF Nozzle
9. Exhaust Stack
10. Clamping Strap Nuts

Fig. 4, 2V2 SCR Catalyst Installation

Contents

General Description

The Environmental Protection Agency (EPA) mandated that all engines built after December 31, 2009 must reduce the level of emissions exhausted by the engine to 0.2 grams per brake horsepower hour (g/bhp-hr) of nitrogen oxides (NOx).

To meet the EPA10 requirements, Daimler Trucks North America is using technology known as Selective Catalytic Reduction (SCR) in the exhaust aftertreatment system (ATS). See **Fig. 1**.

The SCR process requires the introduction of diesel exhaust fluid (DEF) into the exhaust stream. DEF is colorless, non-toxic, and biodegradable. In the ATS, the exhaust gases pass through the ATD, then are treated with precisely-controlled quantities of DEF, and then pass into the SCR catalyst. DEF consumption is dependent on ambient conditions and vehicle operation.

DEF is drawn from the tank by the DEF pump. The DEF is then filtered and, from the pump, transported through the DEF lines to the metering unit. The metering unit measures the correct amount of DEF, which is then injected into the hot exhaust flow after exhaust gases have passed through the ATD. In the presence of heat, DEF is converted to ammonia gas, which reacts with NOx in the selective catalyst chamber to yield harmless nitrogen and water vapor, which exit out the tailpipe.

DEF causes mild discoloration to aluminum, but will not affect its strength or structure. White crystals may be noticeable around components that come into contact with DEF. The crystals can be easily removed using water.

DEF freezes to a slush consistency at 12°F (-11°C). Because DEF can freeze, the DEF lines and metering unit are designed to purge whenever the engine is shut down to prevent damage. Complete purging of the DEF lines requires approximately five minutes after the engine is shut down.

DEF in the tank is allowed to freeze while the vehicle is non-operational. The DEF temperature sensor detects when the temperature of the DEF in the tank is approaching its freezing point. After the engine has been started and the engine coolant reaches a certain temperature, the coolant valve opens, allowing the coolant to flow through the coolant lines inside the DEF tank. The lines transfer heat, causing any frozen DEF in the tank to thaw and preventing liquid DEF from freezing during operation in cold weather. After flowing through the tank, the coolant is redirected back to the engine.

DEF will degrade over an extended period of time; shelf life is between twelve and eighteen months in standard operating conditions and temperatures. As DEF begins to degrade, it is usable but may be consumed at a slightly higher rate than normal.

A minor engine derate (approximately 25%) will occur when the DEF level registers below 5% on vehicles with Detroit Diesel engines, or 2.5% on vehicles with Cummins engines. If the DEF tank is empty, a major engine derate (vehicle speed is limited to 5 mph) will occur after an engine shut down and restart if the diesel tank has been refueled and the DEF tank is not refilled.

There are also safety controls that derate the engine if a contaminant has been introduced into the DEF tank. When a contaminant is detected, a minor engine derate will occur. When the vehicle has operated for 20 hours or 1000 miles with a contaminated tank, the vehicle will experience a major engine derate once the system determines that the vehicle is in a safe situation. Once the DEF tank has been filled with clean DEF, engine performance will return to normal.

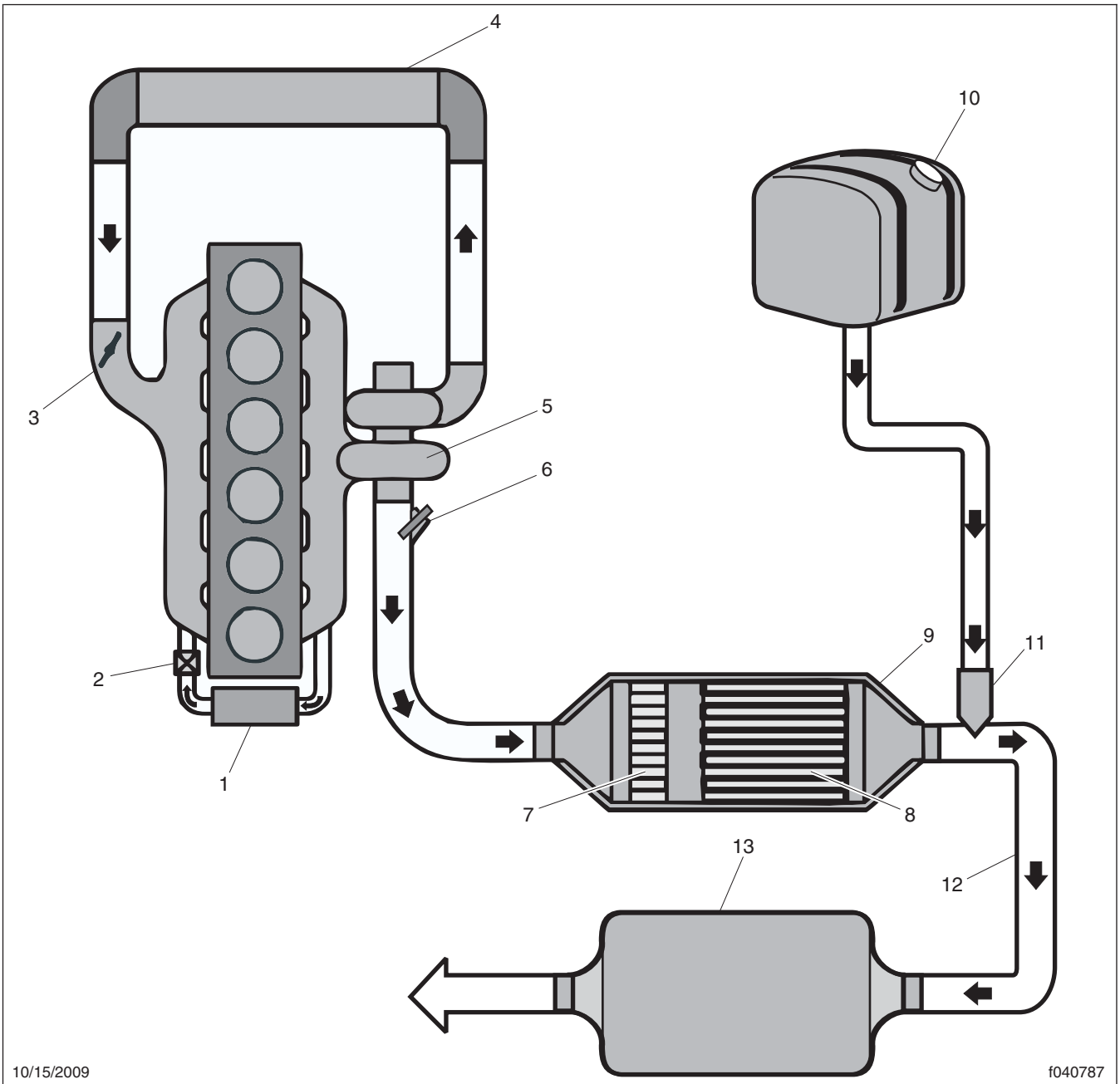
DTNA-covered components of the DEF system include the DEF tank, tank header unit, pump, and coolant, DEF, and air lines between these components. See the engine manufacturer's service literature for information regarding other DEF system components such as the metering unit and injector, and DEF system maintenance instructions and intervals.

For additional operating information, see the *Business Class M2 Driver's Manual*.

For additional information on and definitions for EPA10-compliant systems and components, see **Section 01.02**, EPA07/EPA10 Engine Information.

For additional information on the ATS, see **Section 49.02**, Aftertreatment System, EPA10.

General Information



1. Exhaust Gas Recirculation (EGR) Cooler
2. EGR Valve
3. Intake Throttle Valve
4. Charge Air Cooler (CAC)
5. Turbocharger
6. Hydrocarbon Doser
7 Diesel Oxidation Catalyst (DOC)
8. Diesel Particulate Filter (DPF)
9. Aftertreatment Device (ATD)
10. DEF Tank
11. DEF Injector
12. Mixing Tube
13. SCR Catalyst Chamber

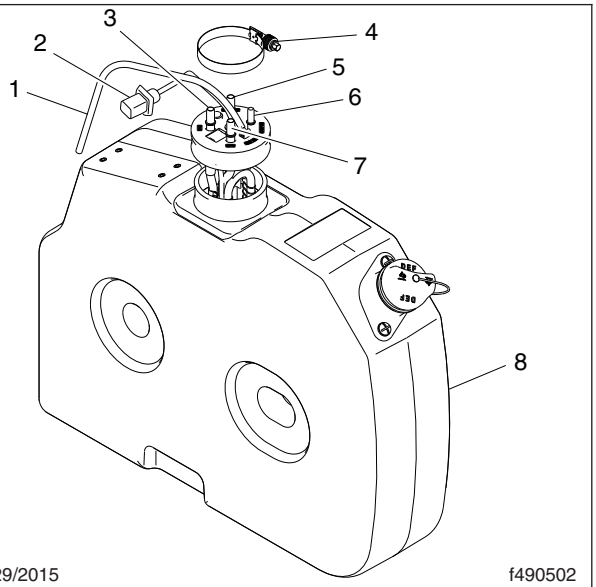
Fig. 1, EPA10 Aftertreatment System

Daimler Trucks North America vehicles carry diesel exhaust fluid (DEF) tanks in three sizes: 6 gallons, 13 gallons, or 23 gallons.

NOTE: DEF creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or components is not necessary unless there is a system failure or a fault code.

6-Gallon Tank (January 2013 and later)

This tank is installed on vehicles manufactured from January 2013. All of the connections are at the header. See **Fig. 1**.



1. Vent Tube
2. DEF Level and Temperature Sensor Wiring Harness
3. Coolant Inlet
4. Clamp
5. DEF Inlet
6. DEF Outlet
7. Coolant Outlet
8. Tank

Fig. 1, 6-Gallon DEF Tank (January 2013 and later)

Removal

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Open the hood.
3. Drain the coolant from the cooling system. For instructions, see **Group 20**.
4. Remove the DEF tank beauty cover, if equipped.
5. Using a siphon, empty the DEF from the tank into a clean container. Uncontaminated DEF may be reused.
6. Place a drain pan underneath the tank to catch any remaining DEF or coolant that drains out.

NOTICE

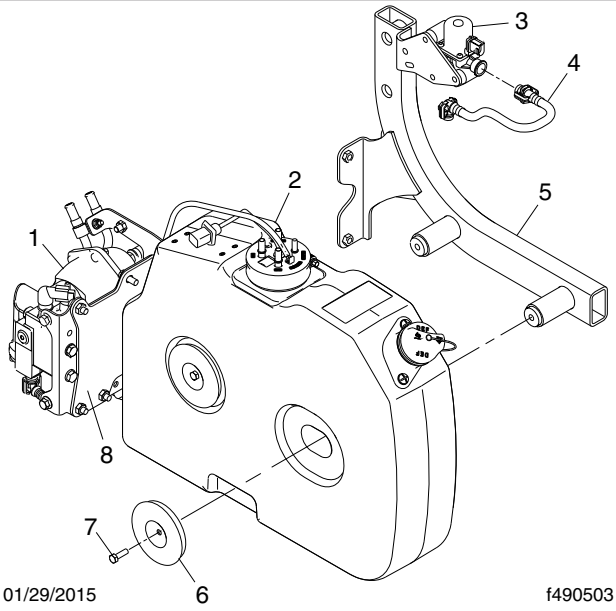
To disconnect a DEF line, push the line coupling in towards the male connector to move the holding clip to the unlocked position, then compress the prongs of the holding clip and pull the line off of the male connector. Failure to properly remove a DEF line can result in damage to a line coupling or DEF fitting.

7. Disconnect the DEF lines from the supply and return ports.
8. Disconnect the wiring harness from the tank header unit.
9. Disconnect the coolant lines from the supply and return ports.
10. If another chassis-mounted component is located directly aft of the DEF tank, check if the component is mounted close enough to prevent the tank from sliding off the mounting studs. If so, remove the nuts, bolts, and washers that secure the tank assembly to the frame casting, and remove the assembly from the frame casting.
11. Remove the two capscrews that secure the tank and retaining washers on the mounting studs. See **Fig. 2**.
12. Remove the two tank retaining washers from the tank mounting studs.
13. Slide the tank off of the mounting studs.

Installation

1. Slide the tank onto the mounting studs.

Tank Removal and Installation



1. DEF Pump
2. DEF Tank
3. Coolant Valve
4. Coolant Supply Line
5. Tank Mounting Bracket
6. Tank Retaining Washer (Qty 2)
7. Capscrew (Qty 2)
8. Pump Mounting Bracket

Fig. 2, 6-Gallon Tank Mounting Assembly

2. Install two tank retaining washers on the tank mounting studs.
3. Install two capscrews onto the mounting studs, securing the tank and retaining washers on the tank mounting studs. Tighten the capscrews 11 to 18 lbf·ft (15 to 25 N·m).
4. If the tank assembly was previously removed from the frame casting, install the tank assembly on the frame casting. Tighten the four tank assembly mounting bolts 112 lbf·ft (152 N·m).
5. Connect the coolant supply and return lines to the coolant ports on the tank.
6. Remove any white DEF crystals from the DEF ports on the tank and the DEF line couplings.

IMPORTANT: To connect a DEF line, push the line coupling onto the DEF port male connector, then pull back gently on the coupling to engage the holding clip in the locked position.

7. Connect the DEF supply and return lines to the DEF ports on the back of the tank.
8. Connect the wiring harness to the tank header unit.
9. Fill the DEF tank.
10. Fill the cooling system and check for leaks. For instructions, see **Group 20**.

6-Gallon Tank (pre-January 2013)

Removal

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

1. Shut down the engine, apply the parking brake, and chock the tires.
2. Open the hood.
3. Drain the coolant from the cooling system. For instructions, see **Group 20**.
4. Place a clean drain pan underneath the tank to catch draining DEF. Uncontaminated DEF may be reused.

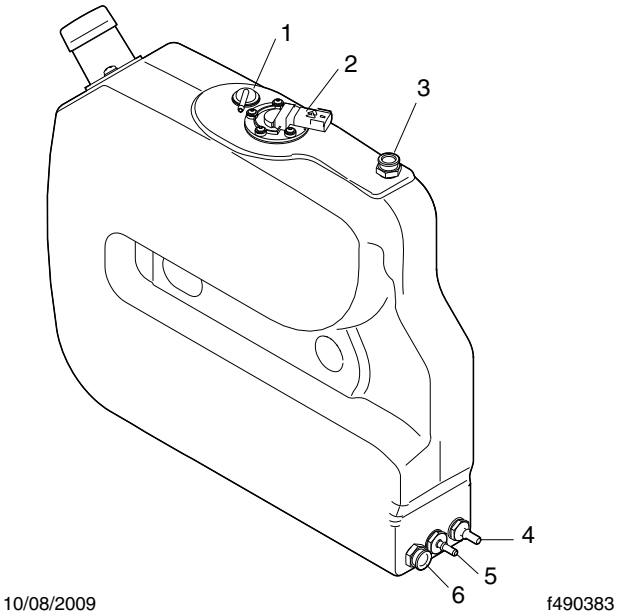
IMPORTANT: Wait at least five minutes after shutting down the engine to disconnect the DEF lines. Complete purging of the DEF lines requires approximately five minutes after the engine is shut down.

5. Disconnect the DEF line heater wiring harnesses from the DEF lines at the tank.

NOTICE

To disconnect a DEF line, push the line coupling in towards the male connector to move the holding clip to the unlocked position, then compress the prongs of the holding clip and pull the line off of the male connector. Failure to properly remove a DEF line can result in damage to a line coupling or DEF fitting.

6. Disconnect the DEF lines from the supply and return ports and let the DEF drain into the drain pan. See **Fig. 3** or **Fig. 4**.
7. Disconnect the wiring harness from the tank header unit.



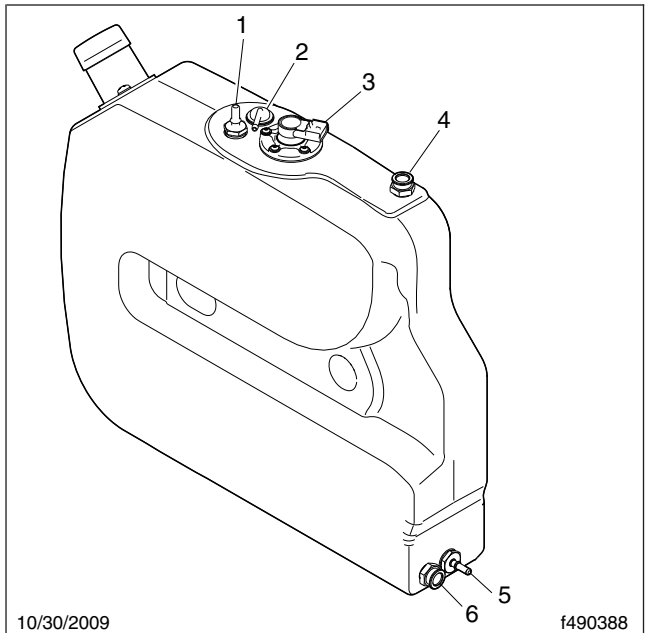
1. Vent
2. DEF Level and Temperature Sensor Wiring Harness
3. Coolant Inlet
4. DEF Outlet
5. DEF Inlet
6. Coolant Outlet

Fig. 3, 6-Gallon Tank Ports (Detroit Diesel shown)

8. Disconnect the coolant lines from the supply and return ports.
9. Disconnect the vent line.
10. If another chassis-mounted component is located directly aft of the DEF tank, check to see if the component is mounted close enough to prevent the tank from sliding off the mounting studs. If so, remove the nuts, bolts, and washers that secure the tank assembly to the frame casting, and remove the assembly from the frame casting.
11. Remove the two capscrews that secure the tank and retaining washers on the mounting studs. See **Fig. 5**.
12. Remove the two tank retaining washers from the tank mounting studs.
13. Slide the tank off of the mounting studs.

Installation

1. Slide the tank onto the mounting studs.



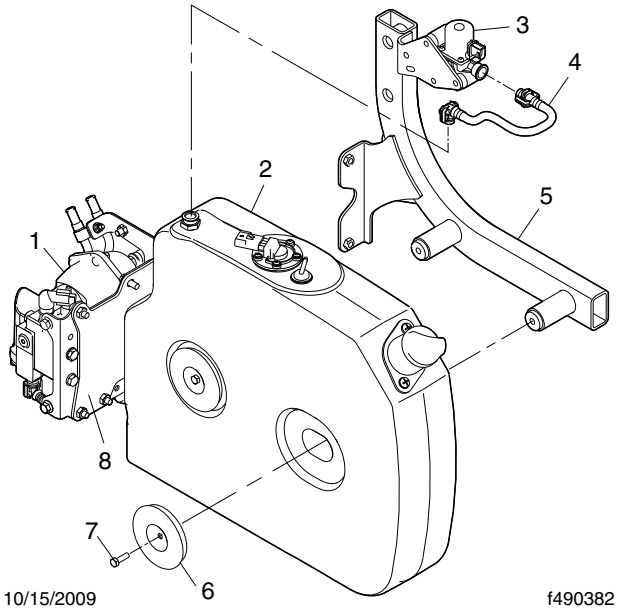
1. DEF Inlet
2. Vent
3. DEF Level and Temperature Sensor Wiring Harness
4. Coolant Inlet
5. DEF Outlet
6. Coolant Outlet

Fig. 4, 6-Gallon Tank Ports (Cummins shown)

2. Install two tank retaining washers on the tank mounting studs.
3. Install two capscrews onto the mounting studs, securing the tank and retaining washers on the tank mounting studs. Tighten the capscrews 11 to 18 lbf·ft (15 to 25 N·m).
4. If the tank assembly was previously removed from the frame casting, install the tank assembly on the frame casting. Tighten the four tank assembly mounting bolts 112 lbf·ft (152 N·m).
5. Connect the vent line.
6. Connect the coolant supply and return lines to the coolant ports on the tank.
7. Remove any white DEF crystals from the DEF ports on the tank and the DEF line couplings.

IMPORTANT: To connect a DEF line, push the line coupling onto the DEF port male connector, then pull back gently on the coupling to engage the holding clip in the locked position.

Tank Removal and Installation



1. DEF Pump
2. DEF Tank
3. Coolant Valve
4. Coolant Supply Line
5. Tank Mounting Bracket
6. Tank Retaining Washer (Qty 2)
7. Capscrew (Qty 2)
8. Pump Mounting Bracket

Fig. 5, 6-Gallon Tank Mounting Assembly

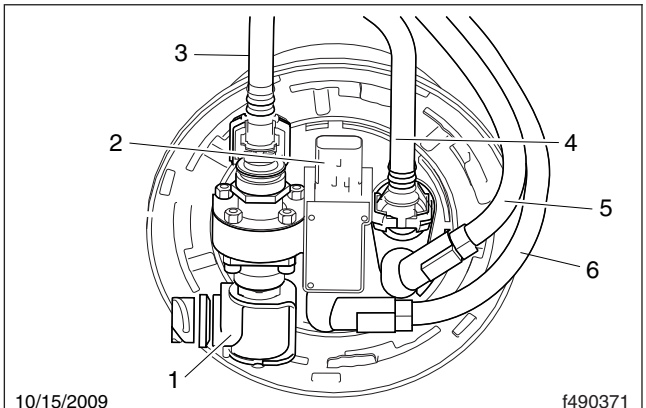
8. Connect the DEF supply and return lines to the DEF ports on the back of the tank.
9. Connect the DEF line heater wiring harnesses to the DEF lines at the tank.
10. Connect the wiring harness to the tank header unit.
11. Fill the DEF tank.
12. Fill the cooling system and check for leaks. For instructions, see **Group 20**.
13. Close the hood.

13- or 23-Gallon Tank

Removal

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

1. Shut down the engine, apply the parking brake, and chock the tires.
2. Open the hood.
3. Drain the coolant from the cooling system. For instructions, see **Group 20**.
4. Remove the beauty cover, if equipped.
5. Using a siphon, empty the DEF from the tank into a clean container. Uncontaminated DEF may be reused.
6. Place a drain pan underneath the tank to catch any remaining DEF or coolant that drains out.
7. Disconnect the coolant valve and DEF level and temperature sensor wiring harnesses from the tank header unit. See **Fig. 6**.



1. Coolant Valve Wiring Harness
2. DEF Level and Temperature Sensor Wiring Harness
3. Coolant Return Line
4. Coolant Supply Line
5. DEF Return Line
6. DEF Supply Line

Fig. 6, DEF Tank Header Unit (Detroit Diesel shown)

8. Disconnect the coolant lines from the tank header unit.

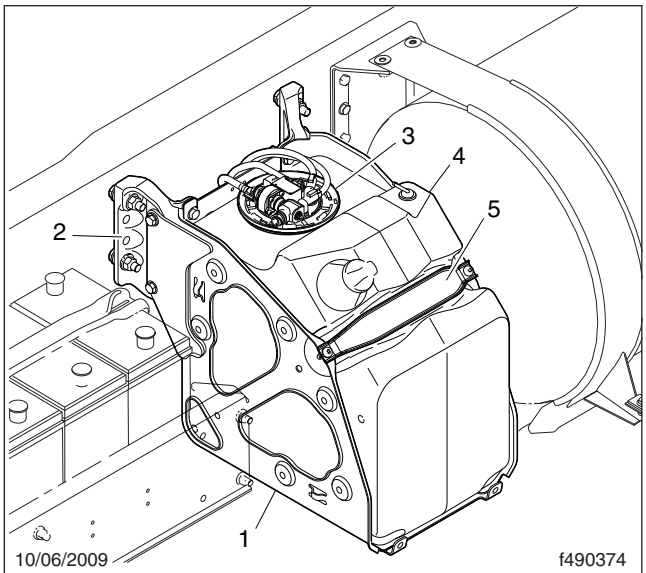
IMPORTANT: Wait at least five minutes after shutting down the engine to disconnect the DEF lines. Complete purging of the DEF lines requires approximately five minutes after the engine is shut down.

9. Disconnect the DEF line heater wiring harnesses from the DEF lines at the tank.

NOTICE

To disconnect a DEF line, push the line coupling in towards the male connector to move the holding clip to the unlocked position, then compress the prongs of the holding clip and pull the line off of the male connector. Failure to properly remove a DEF line can result in damage to a line coupling or DEF fitting.

10. Disconnect the DEF lines from the tank header unit.
11. Disconnect the vent line.
12. Remove the two nuts that secure the tank retaining bracket to the tank mounting cage and remove the retaining bracket. See **Fig. 7**.



1. Mounting Cage
2. Mounting Support Bracket
3. Tank Header Unit
4. Tank
5. Tank Retaining Bracket

Fig. 7, 13- or 23-Gallon DEF Tank Mounting Assembly

13. Remove the tank from the mounting cage.

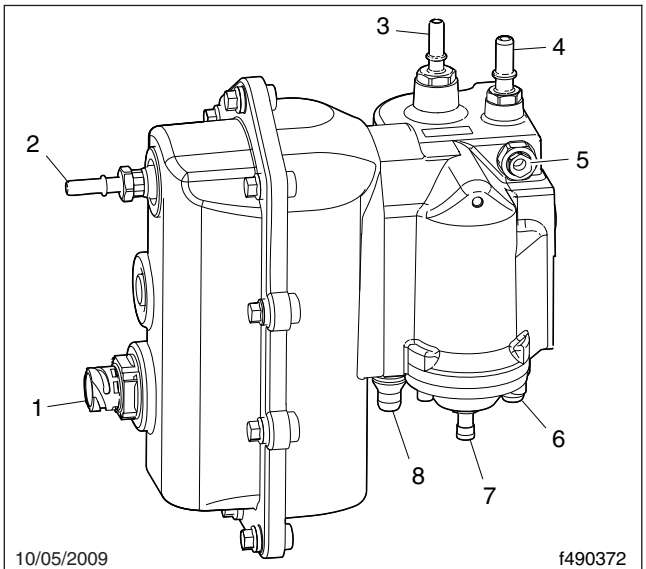
Installation

1. Install the tank into the mounting cage.
2. Install the tank retaining bracket on the tank mounting cage studs. Install two nuts on the tank retaining bracket and tighten the nuts 12 lbf·ft (16 N·m).
3. Connect the vent line.
4. Remove any white DEF crystals from the DEF ports on the header unit and the DEF line couplings.

IMPORTANT: To connect a DEF line, push the line coupling onto the DEF port male connector, then pull back gently on the coupling to engage the holding clip in the locked position.

5. Connect the DEF supply and return lines to the tank header unit.
6. Connect the DEF line heater wiring harnesses to the DEF lines at the tank.
7. Connect the coolant lines to the tank header unit.
8. Connect the coolant valve and DEF level and temperature sensor wiring harnesses to the tank header unit.
9. Fill the DEF tank.
10. Install the beauty cover, if equipped.
11. Fill the cooling system and check for leaks. For instructions, see **Group 20**.
12. Close the hood.

EPA10-compliant vehicles have a diesel exhaust fluid (DEF) pump module (**Fig. 1**) mounted in a protective box to the back of the DEF tank.



1. Wiring Harness Connector
2. DEF Inlet Port
3. DEF Outlet Port (to metering unit)
4. DEF Outlet Port (to tank)
5. Compressed Air Port
6. Coolant Outlet Port
7. Air Bladder Fill Valve
8. Coolant Inlet Port

Fig. 1, DEF Pump (Detroit Diesel shown)

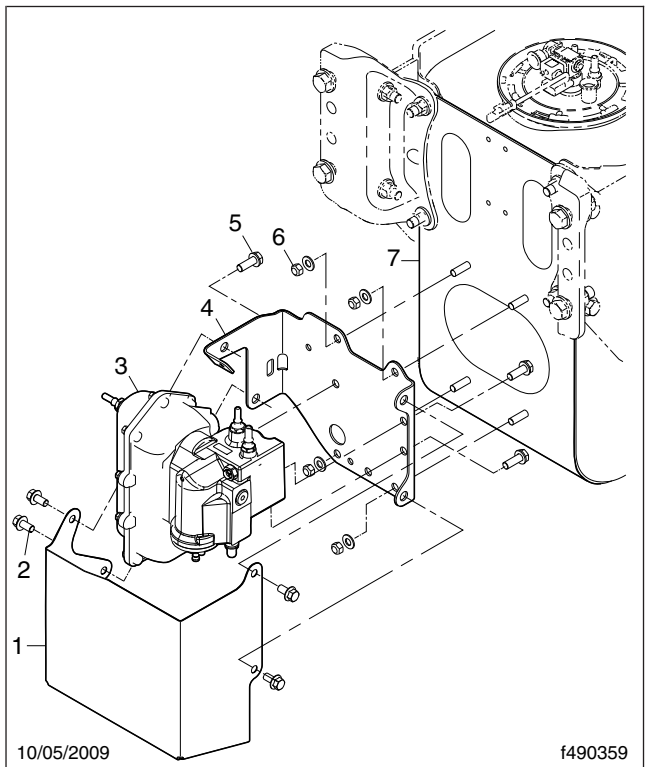
The DEF pump module filters and supplies DEF to the metering unit. The only serviceable components of the pump module are the air bladder and the filter. See the engine manufacturer's service literature for maintenance instructions and intervals.

NOTE: DEF creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or components is not necessary unless there is a system failure or a fault code.

Removal

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

1. Shut down the engine, apply the parking brake, and chock the tires.
2. Open the hood.
3. Drain the air system.
4. On a vehicle equipped with a Detroit Diesel engine, drain the coolant from the cooling system. For instructions, see **Group 20**.
5. Place a drain pan underneath the pump to catch any DEF or remaining coolant that drains out.
6. Remove the four mounting bolts that secure the protective cover over the pump. Remove the cover. See **Fig. 2**.



1. Protective Cover
2. Protective Cover Mounting Fasteners
3. DEF Pump
4. Pump Mounting Bracket
5. Pump Mounting Fasteners
6. Mounting Bracket Fasteners
7. DEF Tank Mounting Cage

Fig. 2, DEF Pump Removal and Installation

7. Disconnect the wiring harness from the pump.

Pump Removal and Installation

8. Disconnect the coolant lines and air line, if equipped, from the pump.

IMPORTANT: Wait at least five minutes after shutting down the engine to disconnect the DEF lines. Complete purging of the DEF lines requires approximately five minutes after the engine is shut down.

9. Disconnect the DEF line heater wiring harnesses from the DEF lines at the pump.

NOTICE

To disconnect a DEF line, push the line coupling in towards the male connector to move the holding clip to the unlocked position, then compress the prongs of the holding clip and pull the line off of the male connector. Failure to properly remove a DEF line can result in damage to a line coupling or DEF fitting.

10. Disconnect the DEF lines from the pump.
11. Loosen and remove the four nuts that secure the pump mounting bracket to the tank mounting cage.
12. Remove the DEF pump and mounting bracket.
13. Remove the three fasteners that secure the pump to the mounting bracket, and remove the pump from the bracket.

Installation

1. Using the three pump mounting fasteners, secure the pump to the pump mounting bracket. Tighten the fasteners 26 lbf·ft (35 N·m).
2. Install the four nuts that secure the pump mounting bracket to the DEF tank mounting bracket. Tighten the nuts 23 lbf·ft (31 N·m).
3. Remove any white DEF crystals from the DEF ports on the pump and the DEF line couplings.

IMPORTANT: To connect a DEF line, push the line coupling onto the DEF port male connector, then pull back gently on the coupling to engage the holding clip in the locked position.

4. Connect the DEF supply and return lines to the three DEF ports on the pump.
5. Connect the DEF line heater wiring harnesses to the DEF lines at the pump.
6. Connect the air line and coolant lines, if equipped, to the pump.
7. Connect the wiring harness to the pump.
8. Place the protective cover over the pump and install the four mounting bolts that secure the protective cover to the pump mounting bracket. Tighten the bolts 37 lbf·ft (50 N·m).
9. On a vehicle equipped with a Detroit Diesel engine, fill the cooling system and check for leaks. For instructions, see **Group 20**.
10. Fill the air system.
11. Close the hood.

NOTE: Diesel exhaust fluid (DEF) creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or components is not necessary unless there is a system failure or a fault code.

Replacement

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

1. Shut down the engine, apply the parking brake, and chock the tires.

IMPORTANT: Wait at least five minutes after shutting down the engine to disconnect the battery ground cable. Disconnecting the battery ground cable too soon will prevent purging of the DEF lines after the engine is shut down.

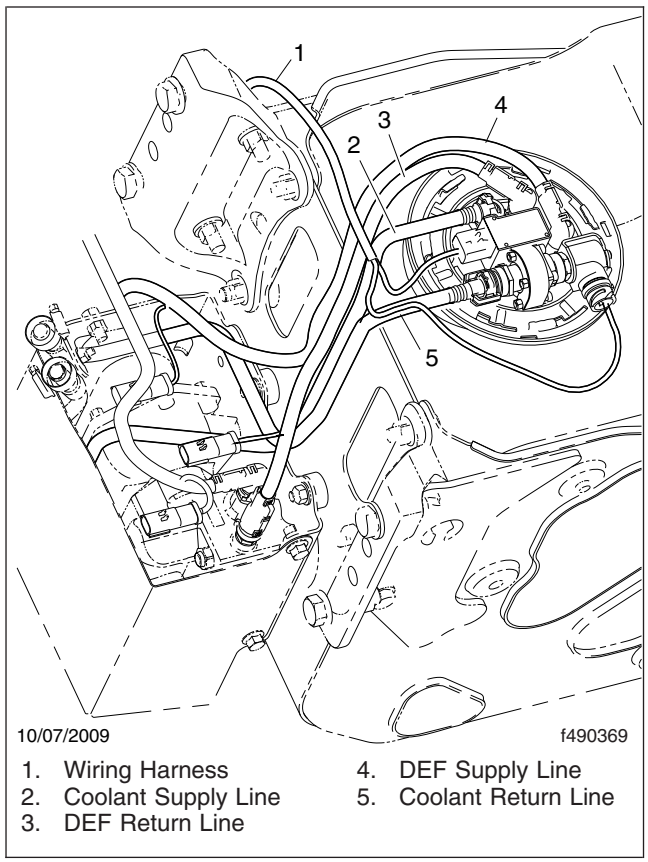
2. Disconnect the batteries.
3. Place drain pans underneath the DEF pump and the DEF metering unit to catch any draining DEF.
4. Disconnect the DEF line heater wiring harnesses from the DEF lines at the tank, pump, and metering unit.

NOTICE

To disconnect a DEF line, push the line coupling in towards the male connector to move the holding clip to the unlocked position, then compress the prongs of the holding clip and pull the line off of the male connector. Failure to properly remove a DEF line can result in damage to a line coupling or DEF fitting.

5. Disconnect the DEF lines between the DEF pump and the tank. See **Fig. 1**.
6. Disconnect the DEF lines between the pump and the metering unit.
7. Discard the lines.
8. Ensure the new DEF lines are undamaged and free of dirt or debris.
9. Remove any white DEF crystals from the DEF ports on the tank, pump, and metering unit.

IMPORTANT: To connect a DEF line, push the line coupling onto the DEF port male connector, then pull back gently on the coupling to engage the holding clip in the locked position.



1. Wiring Harness
2. Coolant Supply Line
3. DEF Return Line
4. DEF Supply Line
5. Coolant Return Line

Fig. 1, DEF Pump Line Connections

10. Install new DEF lines between the DEF pump and the tank.
11. Install new DEF lines between the DEF pump and the metering unit.
12. Connect the DEF line heater wiring harnesses to the DEF lines at the tank, pump, and metering unit.
13. Connect the batteries.

NOTE: DEF creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or components is not necessary unless there is a system failure or a fault code.

Replacement, 6-Gallon Tank (January 2013 and later)

This tank is installed on vehicles manufactured beginning in January 2013. All of the connections are at the header. See **Fig. 1**.

IMPORTANT: The header for Detroit and Cummins tanks look identical. Verify the part number before installing the new header. The wrong header will read backwards on the gauge and generate a fault code.

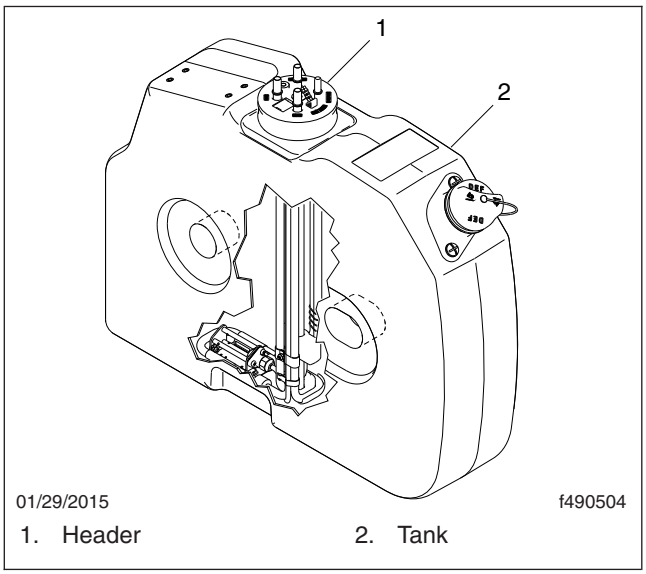


Fig. 1, 6-Gallon DEF Tank and Header Unit (January 2013 and later)

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Remove the tank from the vehicle. For instructions, see **Subject 100**.
3. Loosen the clamp that secures the header to the tank.

NOTICE

The the foot of the header is oriented away from the filler port. It must be "maneuvered" out of the tank. Applying excessive force the header during removal or installation may damage it.

4. Remove the header unit from the tank.
   - 4.1 Raise it up until in stops (about eight inches).
   - 4.2 Rock the unit away from the filler neck to clear the internal structure, then lift the unit out of the tank.
5. Install a new header unit into the tank.
   - 5.1 Orient the foot of the unit pointing away from the filler neck, and slide it into the tank.
   - 5.2 Lower the unit until it contacts the inner structure, then carefully rock the top toward the filler neck working the unit into the tank.
   - 5.3 Lower the unit into position.
6. Ensure that the header unit is seated evenly over the raised lip of the tank.
7. Install and tighten the clamp to secure the header unit to the tank.
8. Install the DEF tank on the vehicle. For instructions, see **Subject 100**.

Replacement, 6-Gallon Tank (Pre-January 2013)

The DEF header unit on vehicles with a 6-gallon DEF tank is secured to the top of the tank, and contains the DEF level sensor and the DEF temperature sensor.

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

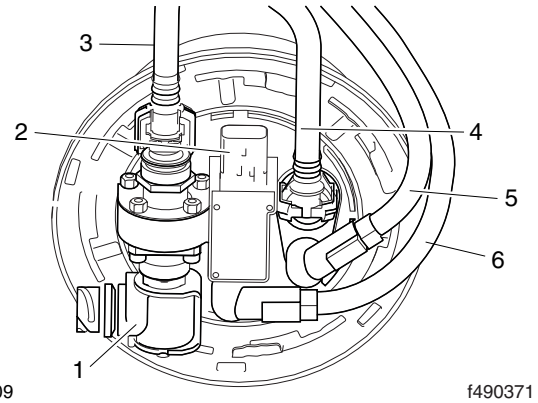
1. Shut down the engine, apply the parking brake, and chock the tires.
2. Remove the tank from the vehicle. See **Subject 100** for instructions.
3. Remove the header unit mounting capscrews and washers that secure the header to the tank.

Tank Header Unit Replacement

4. Remove the header unit from the tank.
5. Install a new header unit into the tank.
6. Ensure that the header unit is situated securely on the raised lip of the tank, and is not tilted to the side.
7. Install the mounting capscrews and washers to secure the header unit to the tank. Tighten the capscrews 5 lbf·ft (7 N·m).
8. Connect the DEF level and temperature sensor wiring harness.
9. Install the DEF tank on the vehicle. See **Subject 100** for instructions.

Replacement, 13- or 23-Gallon Tank

The DEF header unit on vehicles with a 13- or 23-gallon DEF tank is secured to the top of the tank, and contains the engine coolant lines that run through the tank, the coolant valve, the DEF level sensor, and the DEF temperature sensor. See **Fig. 2**.



1. Coolant Valve Wiring Harness
2. DEF Level and Temperature Sensor Wiring Harness
3. Coolant Return Line
4. Coolant Supply Line
5. DEF Return Line
6. DEF Supply Line

Fig. 2, DEF Tank Header Unit (Detroit Diesel shown)

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

1. Shut down the engine, apply the parking brake, and chock the tires.
2. Remove the tank from the vehicle. See **Subject 100** for instructions.
3. Rotate the header lockring counter-clockwise to loosen it, then remove the lockring.
4. Remove the header unit from the tank by pulling the assembly straight up, then tilting it to pull the horizontal end clear of the tank; see **Fig. 3**.

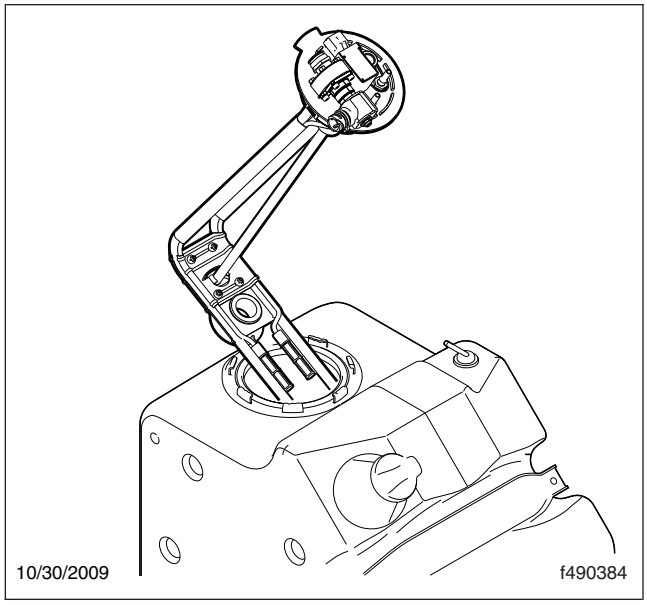


Fig. 3, Header Unit

5. Install a new header unit by tilting it to insert the horizontal end into the tank. Once the horizontal segment is inside the tank, tilt the header unit back to vertical to settle the bracket on top of the tank.
6. Ensure that the header unit is situated securely on the raised lip of the tank, and is not tilted to the side.
7. Install the header lockring and rotate it clockwise to secure it to the tank.
8. Remove any white DEF crystals from the DEF ports on the header unit and the DEF line couplings.
9. Install the DEF tank on the vehicle. See **Subject 100** for instructions.

NOTE: Diesel exhaust fluid (DEF) creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or components is not necessary unless there is a system failure or a fault code.

Periodic maintenance of the DEF pump filter is required. For instructions and intervals, see the engine manufacturer's service literature.

Replacement

Detroit Diesel

IMPORTANT: Discard contaminated DEF in accordance with EPA regulations.

1. Shut down the engine, apply the parking brake, and chock the tires.

IMPORTANT: Wait at least five minutes after shutting down the engine to disconnect the battery ground cable. Disconnecting the battery ground cable too soon will prevent purging of the DEF lines after the engine is shut down.

2. Disconnect the batteries.
3. Remove the four mounting bolts that secure the protective cover over the pump. Remove the cover. The pump is located next to, or inboard of, the DEF tank.
4. Unscrew the filter cartridge; see **Fig. 1**. The cartridge includes both the filter case and the filter element, which are replaced as a unit. Verify that the filter element was removed with the case. If the filter element was not removed, use a suitable tool to remove it from the pump.

   Discard the filter element and case.
5. Lubricate the O-rings with clean DEF.
6. Check the new filter cartridge to ensure that the O-ring end of the filter element is facing out of the cartridge. Install the cartridge into the DEF pump. Tighten the filter cartridge 22 to 25 lbf·ft (30 to 34 N·m).
7. Place the protective cover over the pump and install the four mounting bolts that secure the protective cover to the pump mounting bracket. Tighten the bolts 37 lbf·ft (50 N·m).

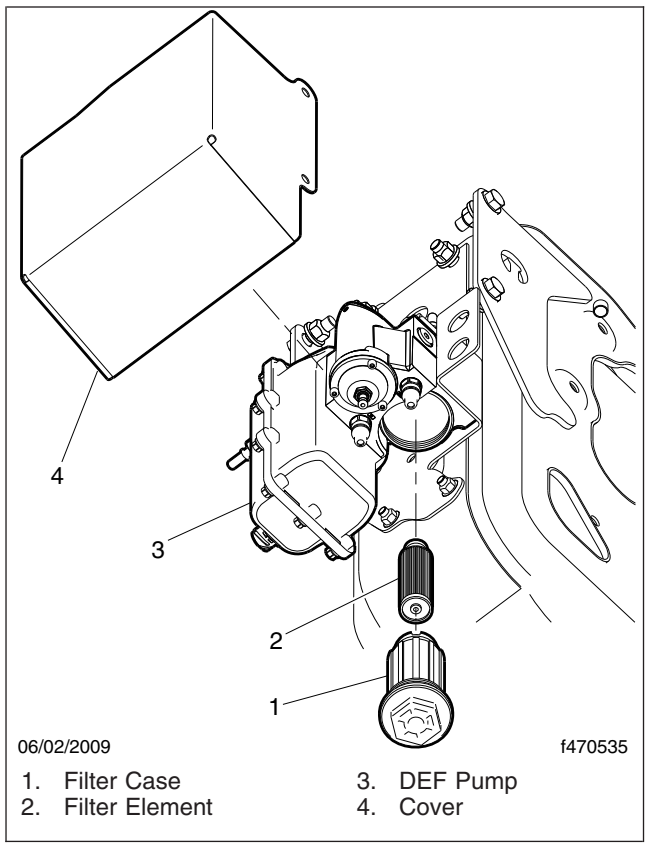


Fig. 1, DEF Filter Replacement, Detroit Diesel Engine

8. Connect the batteries.

Cummins

IMPORTANT: Discard contaminated DEF in accordance with EPA regulations.

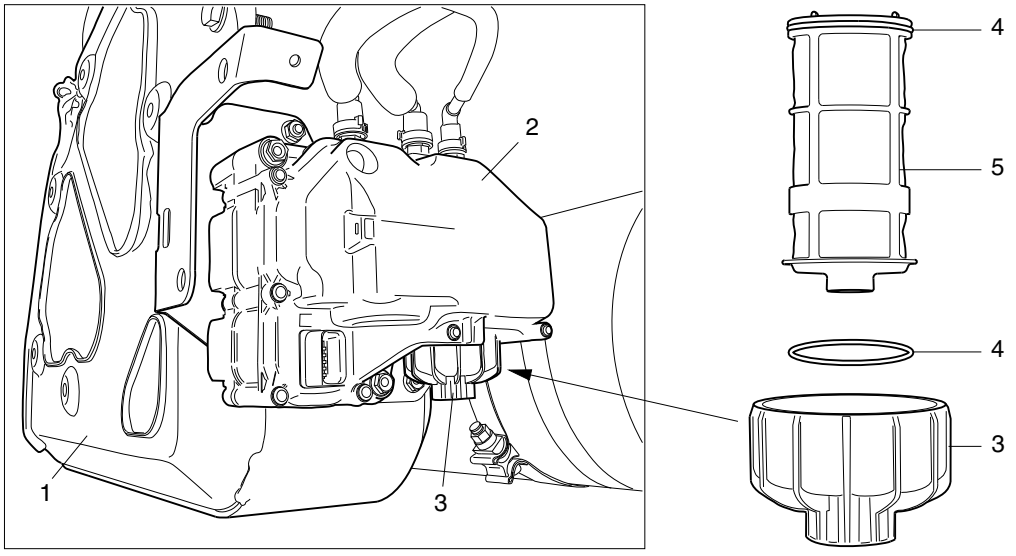
1. Shut down the engine, apply the parking brake, and chock the tires.

IMPORTANT: Wait at least five minutes after shutting down the engine to disconnect the battery ground cable. Disconnecting the battery ground cable too soon will prevent purging of the DEF lines after the engine is shut down.

2. Disconnect the batteries.
3. Remove the four mounting bolts that secure the protective cover over the pump. Remove the cover. The pump is located inboard of the DEF tank.

Pump Filter Replacement

4. Unscrew the filter cap, then remove and discard the filter element. See **Fig. 2**.
5. Install the new filter element into the DEF pump with the O-ring end facing into the pump.
6. Install the filter cap. Tighten the cap 15 to 18 lbf·ft (20 to 25 N·m).
7. Place the protective cover over the pump and install the four mounting bolts that secure the protective cover to the pump mounting bracket. Tighten the bolts 37 lbf·ft (50 N·m).
8. Connect the batteries.



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1. DEF Tank
2. DEF Pump
3. Filter Cap
4. O-Ring
5. Filter Element

Fig. 2, DEF Filter Replacement, Cummins Engine

If a contaminant has been introduced into the diesel exhaust fluid (DEF) system and the engine has been started, the following DEF components must be replaced:

- Tank
- Pump
- Header unit
- Metering unit
- Injector

See the other subjects in this section for tank, pump, and header unit replacement.

See the engine manufacturer's service literature for other component replacement instructions.

Flushing

If a contaminant has been introduced to the DEF tank, but the engine has not been started, complete the following steps.

1. Apply the parking brake and chock the tires.
2. Place a suitable container underneath the DEF tank to catch any draining DEF.

IMPORTANT: Discard contaminated DEF or coolant in accordance with EPA regulations.

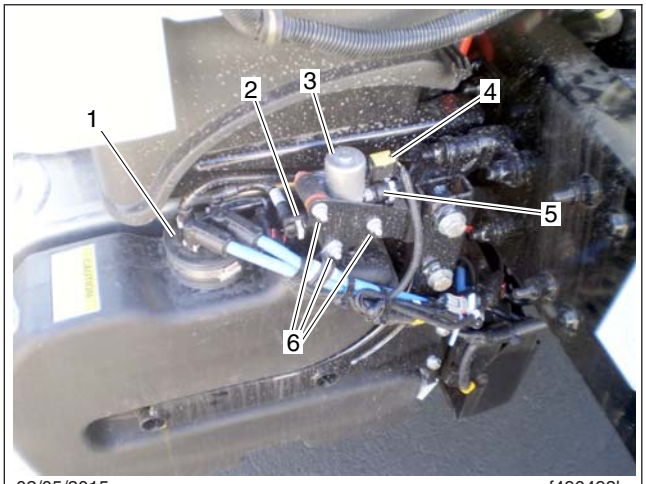
3. Remove the DEF and contaminant from the tank.

   On vehicles with a 6-gallon DEF tank, disconnect the DEF line from the DEF outlet port and let the DEF drain into the drain pan.

   On vehicles with a 13- or 23-gallon DEF tank, use a siphon to empty the DEF from the tank.
4. Remove the DEF tank. See **Subject 100** for instructions.
5. Thoroughly flush the tank with water until the tank is free of all contaminants.
6. Install the DEF tank. See **Subject 100** for instructions.

Replacement

Refer to **Fig. 1** for this procedure.



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1. DEF Tank Header
2. Coolant Line Connector
3. Coolant Flow Control Valve Solenoid
4. Electrical Connector
5. Coolant Line Connector
6. Fasteners

Fig. 1, Coolant Flow Control Valve Installation

1. Park the vehicle on a level surface, shut down the engine, and set the park brakes. Chock the tires.
2. Disconnect the battery at the negative posts.
3. Clamp the DEF tank coolant hoses with hose clamps.
4. Remove the spring clamps on the DEF pump coolant hoses.
5. Disconnect the DEF tank coolant hoses and plug them.
6. Disconnect the two DEF tank coolant lines from the DEF tank coolant solenoid.
7. Disconnect the wiring harness from the coolant solenoid.
8. Remove the three coolant solenoid mounting fasteners and remove the solenoid.
9. Install the solenoid and the three mounting fasteners. Tighten 112 lbf·in (1266 N·cm).
10. Connect the wiring harness to the coolant solenoid.
11. Connect the two DEF tank coolant lines to the DEF tank coolant solenoid.
12. Remove the plugs from the DEF tank coolant hoses and install on the metal DEF tank lines.
13. Install the spring clamps on the DEF pump coolant hoses.
14. Remove the clamps on the DEF tank coolant hoses.
15. Connect the batteries.
16. Start the engine and check for leaks. Repair as needed.