Group Index, Alphabetical

Contents

Description of Operation

Three mounts support the engine and transmission: one in the front and two in the rear. The mounts use rubber isolators to isolate the engine and transmission from road shock, and to isolate the vehicle frame from engine vibration. The upper support brackets fastened to the engine or transmission are often called "legs."

NOTE: On Detroit DD13 mounts, the rubber isolators are bonded to the metal, and cannot be replaced separately. On Cummins ISB/ISC/ISL engines, the isolators are replaceable.

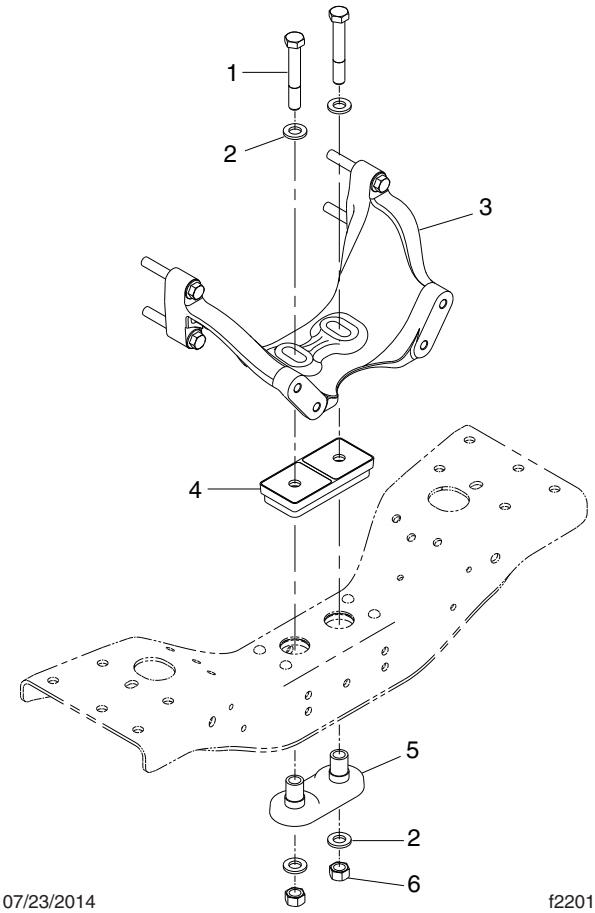
The front engine leg attaches to an underslung crossmember under the front of the engine. The front leg is is fastened to the engine at either side of the vibration damper pulley.

The rear engine legs are fastened to the flywheel housing. The legs attach to lower support brackets fastened to the inside of the frame rail near the flywheel housing.

Mounts by Engine Model

For DD13 engines, see **Fig. 1** and **Fig. 2**.

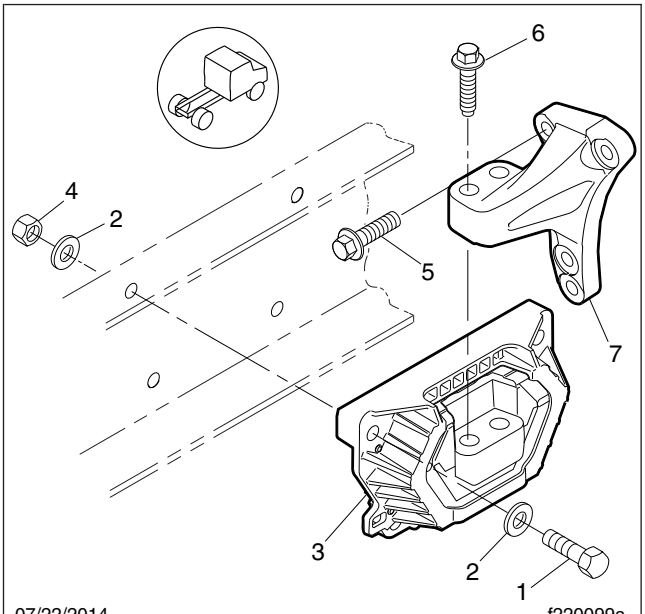
For ISB/ISC/ISL engines, see **Fig. 3** and **Fig. 4**.



1. Bolt, 3/4–10
2. Hardened Washer
3. Front Engine Leg
4. Upper Isolator
5. Lower Isolator
6. Nut, 3/4–10

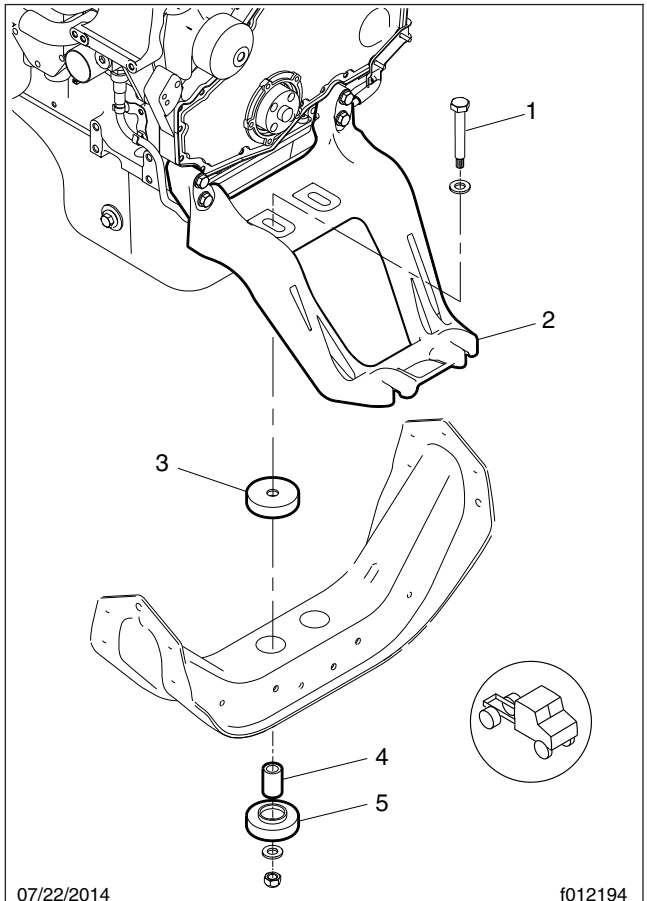
Fig. 1, Front Engine Mount, Detroit DD13

General Information



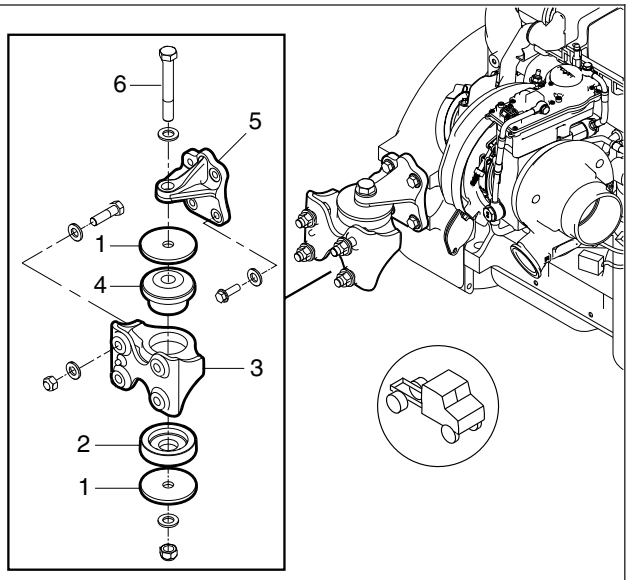
1. Bolt, 5/8–11
2. Hardened Washer
3. Rear Engine Frame Bracket
4. Nut, 5/8–11
5. Flanged Capscrew, M16–1.5
6. Flanged Capscrew, 3/4–10
7. Rear Engine Leg

Fig. 2, Rear Engine Mounts, Detroit DD13



1. Bolt, M16–2
2. Front Engine Leg
3. Upper Isolator
4. Sleeve
5. Lower Isolator

Fig. 3, Front Engine Mount, Cummins ISB/ISC/ISL



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1. Washer, Rear Engine Support
2. Lower Isolator
3. Rear Engine Frame Bracket
4. Upper Isolator
5. Rear Engine Leg
6. Bolt, 3/4–10

Fig. 4, Rear Engine Mounts, Cummins ISB/ISC/ISL

Rear Engine Mount Replacement

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Drain the air tanks.

⚠ WARNING

The jack used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

3. Disconnect the right rear engine mount from the right rear frame mount.
   - 3.1 Place a jack under the rear of the engine and raise the jack until it's braced against the engine.
   - 3.2 Remove the bolt from the right rear engine mount. Save the fasteners, rubber isolator cushions, and snubbers.
   - 3.3 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.
4. Remove the bolts that secure the mount to the frame rail. Remove the mount from the frame rail.

   If necessary, remove the four bolts that secure the right engine leg to the flywheel housing, and remove the engine leg.
5. Place a new engine mount against the inside of the frame rail, and secure it with bolts, washers, and nuts. Tighten the fasteners according to **Specifications, 400**.
6. If removed, install the engine leg on the right side of the flywheel housing. Tighten the fasteners according to **Specifications, 400** .

NOTICE

Do not lubricate the components with oil, grease, or silicone lubricants; they will degrade the rubber isolators.

7. Inspect the engine mount rubber isolators for wear or damage and replace them if necessary.
8. Install the upper isolator in the engine mount. If applicable, place the snubber on the isolator.

⚠ WARNING

The jack used to lower the engine must be capable of safely lifting and supporting two metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely installed on the engine mount. An unsecured engine may fall, causing personal injury or death, and component damage.

9. Secure the engine to the frame mount.
   - 9.1 If not in place, set a jack under the rear of the engine and raise the jack until it is braced against the engine.
   - 9.2 Lift the engine slightly to remove the engine stands. Remove the stands, and carefully lower the engine onto the engine mount.
   - 9.3 Holding the lower isolator and snubber in place, install the bolt in the right rear engine mount, and secure it with the nut and hardened washer. Tighten the fasteners according to **Specifications, 400**.

⚠ WARNING

The jack used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

10. Disconnect the left rear engine mount from the left rear frame mount.
    - 10.1 Place a jack under the rear of the engine, and raise the jack until it's braced against the engine.

Rear Engine Mount Replacement

10.2 Remove the bolt from the left rear engine mount. Save the fasteners, rubber isolator cushions, and snubbers.

10.3 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.

11. Remove the capscrews that secure the mount to the frame rail. Remove the mount from the frame rail.

    If necessary, remove the four capscrews that secure the left engine leg to the flywheel housing, and remove the bracket from the engine.

12. Place a new engine mount against the inside of the frame rail, and secure it with bolts, washers, and nuts. Tighten the fasteners according to **Specifications, 400**.

13. If removed, install the engine leg on the left side of the flywheel housing. Tighten the fasteners according to **Specifications, 400**.

14. Inspect the engine mount rubber isolators for wear or damage and replace them if necessary.

15. Install the upper isolator in the engine mount. If applicable, place the snubber on the isolator.

⚠ WARNING

The jack used to lower the engine must be capable of safely lifting and supporting two metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely installed on the engine mount. An unsecured engine may fall, causing personal injury or death, and component damage.

16. Secure the engine mount to the frame mount.

    16.1 If not in place, set a jack under the rear of the engine and raise the jack until it is braced against the engine.

    16.2 Lift the engine slightly to remove the engine stands. Remove the stands, and carefully lower the engine onto the engine mount.

    16.3 Holding the lower isolator in place, install the bolt in the left rear engine mount, and secure it with the nut and hardened washer. Tighten the fasteners according to **Specifications, 400**.

17. Remove the jack from under the engine.

Front Engine Mount Replacement

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Drain the air tanks.

WARNING

The lifting device and chain used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

3. Disconnect the front engine mount from the frame crossmember.
   - 3.1 Attach a chain to the front engine lifting hook(s), and position a lifting device to lift the engine. Attach the chain to the lifting device, and raise the chain to remove any slack.
   - 3.2 Remove the bolt(s) from the front engine mount. Save the fasteners, rubber isolator cushions, and snubber(s).
   - 3.3 In order to raise the front of the engine, loosen the bolts that run through the rear engine mounts.
   - 3.4 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.
4. If necessary, remove the bolts which secure the engine support bracket to the front of the engine. Remove the bracket from the engine.
5. If necessary, install a new engine support bracket on the front of the engine. Secure per manufacturer specifications.

NOTICE

Do not lubricate the components with oil, grease, or silicone lubricants; they will degrade the rubber isolators.

6. Inspect the engine mount rubber isolators for wear or damage and replace them if necessary.
7. Install the upper isolator(s) in the engine mount. If applicable, place the snubber(s) on the isolator(s).

WARNING

The lifting device and chain used to lower the engine must be capable of safely lifting and supporting two metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely installed on the engine mount. An unsecured engine may fall, causing personal injury or death, and component damage.

8. Secure the front engine mount to the frame crossmember.
   - 8.1 Attach a chain to the front engine lifting hook(s). Attach the chain to a lifting device and remove any slack.
   - 8.2 Lift the engine slightly to remove the engine stands. Remove the stands, and carefully lower the engine onto the engine mount.
   - 8.3 Holding the lower isolators and tubes in place, install the bolts in the front engine mount and secure it with the nuts and washers. Tighten the fasteners according to **Specifications, 400**.
   - 8.4 Tighten the fasteners that run through the rear-engine mounts according to **Specifications, 400**.
   - 8.5 Remove the lifting chain from the engine lifting hooks.

Rear Engine Mount Isolator Replacement

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Drain the air tanks.

⚠ WARNING

The jack used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

3. Disconnect the right rear engine mount from the right rear frame mount.
   - 3.1 Place a jack under the rear of the engine, and raise the jack until it's braced against the engine.
   - 3.2 Remove the bolt from the right rear engine mount. Save the fasteners and snubbers. Discard the rubber isolators.
   - 3.3 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.

NOTICE

Do not lubricate the components with oil, grease, or silicone lubricants; they will degrade the rubber isolators.

4. Inspect the new engine mount rubber isolators for wear or damage and replace them if necessary.
5. Install the new upper isolator in the engine mount. If applicable, place the snubber on the isolator.

⚠ WARNING

The jack used to lower the engine must be capable of safely lifting and supporting two metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely installed on the engine mount. An unsecured engine may fall, causing personal injury or death, and component damage.

6. Disconnect the engine from the right rear engine mount.
   - 6.1 If not in place, set a jack under the rear of the engine and raise the jack until it is braced against the engine.
   - 6.2 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.
   - 6.3 Holding the lower isolator in place, install the bolt in the right rear engine mount, and secure it with the nut and hardened washer.Tighten the fasteners according to **Specifications, 400**.

⚠ WARNING

The jack used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

7. Disconnect the left rear engine mount from the left rear frame mount.
   - 7.1 Place a jack under the rear of the engine, and raise the jack until it's braced against the engine.
   - 7.2 Remove the bolt from the left rear engine mount. Save the fasteners and snubbers. Discard the rubber isolators.
   - 7.3 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.
8. Inspect the new engine mount rubber isolators for wear or damage and replace them if necessary.
9. Install the new upper isolator in the engine mount. If applicable, place the snubber on the isolator.

Rear Engine Mount Isolator Replacement

⚠ WARNING

The jack used to lower the engine must be capable of safely lifting and supporting two metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely installed on the engine mount. An unsecured engine may fall, causing personal injury or death, and component damage.

10. Secure the engine to the engine mount.
    - 10.1 If not in place, set a jack under the rear of the engine and raise the jack until it is braced against the engine.
    - 10.2 Lift the engine slightly to remove the engine stands. Remove the stands, and carefully lower the engine onto the engine mount.
    - 10.3 Holding the lower isolator in place, install the bolt in the left rear engine mount, and secure it with the nut and hardened washer. Tighten the fasteners according to **Specifications, 400**.
11. Remove the jack from under the engine.

Front Engine Mount Isolator Replacement

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Drain the air tanks.

⚠ WARNING

The lifting device and chain used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

3. Disconnect the front engine mount from the frame crossmember.
   - 3.1 Attach a chain to the front engine lifting hook(s), and position a lifting device to lift the engine. Attach the chain to the lifting device and remove any slack.
   - 3.2 Remove the bolts from the front engine mount. Save the fasteners, tubes, and snubbers. Discard the rubber isolator cushions.
   - 3.3 In order to raise the front of the engine, loosen the bolts that run through the rear engine mounts.
   - 3.4 Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.

NOTICE

Do not lubricate the components with oil, grease, or silicone lubricants; they will degrade the rubber isolators.

4. Inspect the new front engine mount rubber isolators for wear or damage and replace them if necessary.
5. Install the upper isolators in the engine mount.

⚠ WARNING

The lifting device and chain used to lower the engine must be capable of safely lifting and supporting two metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely installed on the engine mount. An unsecured engine may fall, causing personal injury or death, and component damage.

6. Secure the front engine mount to the frame crossmember.
   - 6.1 Attach a chain to the front engine lifting hook(s). Attach the chain to a lifting device and.remove any slack.
   - 6.2 Lift the engine slightly to remove the engine stands. Remove the stands, and carefully lower the engine onto the engine mount.
   - 6.3 Holding the lower isolators and tubes in place, install the bolts in the front engine mount and secure them with the nuts and washers. Tighten the fasteners according to **Specifications, 400**.
   - 6.4 Tighten the fasteners that run through the rear-engine mounts according to **Specifications, 400**.
   - 6.5 Remove the lifting chain from the engine lifting hooks.

DD13 Rear Engine Mount Replacement

Replacement

NOTE: The isolators on the DD13 rear engine support frame brackets are bonded to the metal and cannot be replaced separately.

If the frame brackets need replacing due to damage, or if you are removing and installing the engine, follow this procedure.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Drain the air tanks.
3. Disconnect the batteries.
4. Open the hood.
5. Remove the rain tray as follows.
   - 5.1 Mark the position of each wiper arm on the splined shaft, then remove the wiper arms.
   - 5.2 Disconnect any hoses or drains from the bottom of the rain tray.
   - 5.3 Remove the fasteners that hold the rain tray to the frontwall.
   - 5.4 Remove the rain tray from the vehicle.
6. Remove the right and left quarter fenders and the inner splash shields.
7. Remove the air cleaner.
8. Disconnect the air lines from the primary air tank, then remove the tank from the vehicle.
9. Remove the cab skirts from both sides of the vehicle.

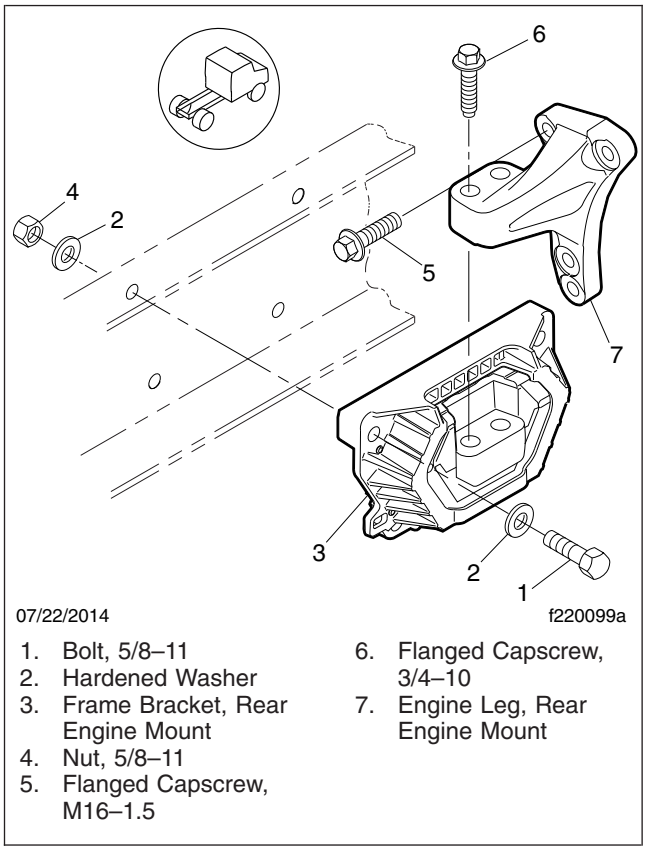
NOTICE

Do not disassemble or bend the exhaust piping at the bellows; damage could occur.

10. Remove the exhaust pipes, as an assembly. Refer to **Group 49** in this manual for instructions.
11. As applicable, remove the steps, air fairings, fuel tank(s), and/or the battery box.

    For instructions on removing the fuel tank(s), refer to **Group 47** in this manual.
12. Remove the fasteners that hold the driveline midship-bearing bracket to the frame crossmember.
13. Using suitable straps, secure the driveline and the midship bearing to the frame crossmember. Make sure the driveshaft is supported loosely enough so that the slip joint aft of the midship bearing will be able to extend when the engine is raised.
14. Remove the overslung crossmember. If applicable, remove the transmission support spring.
15. Disconnect both ends of the clutch linkage and remove it from the vehicle.
16. Remove the shifter and shifter boot from the transmission.
17. Disconnect the front shocks from both sides of the vehicle.
18. Raise the front of the vehicle so the tires are off the ground, and support it with safety stands. Put the safety stands behind the rear spring hangers of the front suspension.
19. On both sides of vehicle, remove the two 3/4–10 capscrews that fasten the rear engine leg to the frame bracket. See **Fig. 1**.
20. Place a jack under the flywheel housing or the transmission and gradually raise the back of the engine until the engine legs are above the top of the frame rail.
21. Remove the five fasteners that hold the frame bracket to the frame rail.
22. Remove the frame bracket from the vehicle.
23. If needed, remove the four 5/8–11 capscrews that attach the engine leg to the flywheel housing. Remove the engine leg.
24. If applicable, install the engine legs on the flywheel housing. Tighten 195±10 lbf·ft (264±14 N·m).
25. With the engine supported, install each frame bracket in the frame rail. Install the five 5/8–11 capscrews of each with the bolt heads inboard. Tighten the nuts 136±16 lbf·ft (184±21 N·m).
26. Repeat the above step for the second engine mount.
27. Lower the engine onto the frame bracket.

DD13 Rear Engine Mount Replacement



1. Bolt, 5/8–11
2. Hardened Washer
3. Frame Bracket, Rear Engine Mount
4. Nut, 5/8–11
5. Flanged Capscrew, M16–1.5
6. Flanged Capscrew, 3/4–10
7. Engine Leg, Rear Engine Mount

Fig. 1, Rear Engine Mounts, DD13

NOTE: The right-hand engine leg has oval holes to allow for alignment. Fasten the left-side engine leg with circular holes first, then install the right-side with the oval holes.

28. For each leg, install the 3/4–10 bolts and hardened washers through the holes of the engine leg and frame bracket. Tighten the bolts 375±56 lbf·ft (508±76 N·m).
29. Install the clutch linkage.
30. If removed, install the transmission support spring.
31. Install the shifter and shifter boot on the transmission.
32. Attach the driveline midship bearing and its bracket to the frame crossmember.
33. Install the exhaust system. See **Group 49** in this manual for instructions.
34. Attach the cab skirts to the bottom of the cab.
35. Install the primary air tank and connect the air lines.
36. Install the air cleaner.
37. Install the right and left inner splash shields.
38. Install the right and left quarter fenders.
39. As applicable, install the steps, air fairings, fuel tank(s), and/or the battery box.

    For instructions on installing the fuel tank(s), refer to **Group 47** in this manual.
40. Using the previously removed fasteners, install the rain tray on the frontwall.
41. Connect the hoses and drains to the bottom of the rain tray.
42. Install each wiper arm in the position previously marked.
43. Close the hood.
44. Connect the batteries.

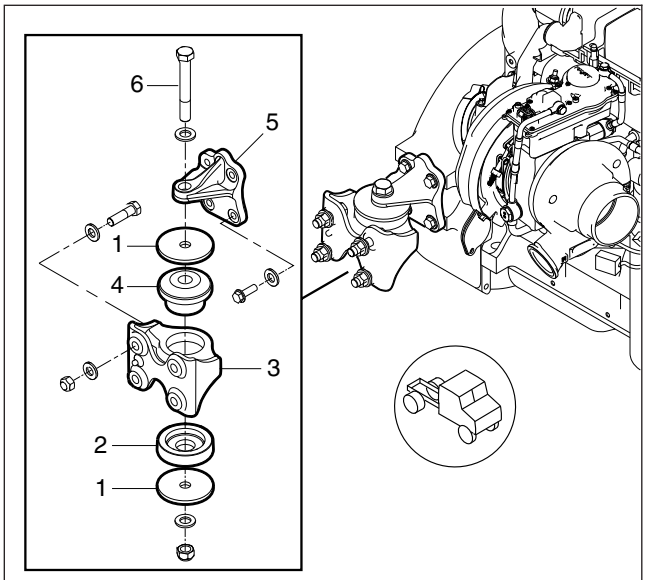
ISB/ISC/ISL Rear Engine Mount Replacement

⚠ WARNING

The jack used to lift the engine must be capable of safely lifting and supporting two metric tons. Once the engine mount is disconnected, do not get under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing personal injury or death, and component damage.

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Place a jack under the rear of the engine and raise the jack until it is braced against the engine. The jack must be capable of safely lifting and supporting two metric tons.
3. Remove the bolt that fastens the isolator and bracket assembly together. Save the fasteners, isolators, and washers. See **Fig. 1**.



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1. Washer, Rear Engine Support
2. Lower Isolator
3. Frame Bracket, Rear Engine Mount
4. Upper Isolator
5. Engine Leg, Rear Engine Mount
6. Bolt, 3/4–10

Fig. 1, Rear Engine Mounts, Cummins ISB/ISC/ISL

4. Lift the engine slightly to take the weight off the engine mount. Place engine stands under the engine, then lower the engine slightly to ensure the engine stands take the weight of the engine.
5. Remove the fasteners that secure the frame bracket to the frame, then remove the bracket from the frame rail.
6. Remove the four bolts that secure the engine leg to the flywheel housing, then remove the leg.
7. Place a new frame bracket on the inside of the frame rail, and secure it with the bolts, washers, and nuts that had been removed. Tighten 122 to 149 lbf·ft (166 to 202 N·m).
8. Install the engine leg on the side of the flywheel housing. Tighten 58 to 72 lbf·ft (79 to 98 N·m).
9. Inspect the isolators for wear or damage and replace them if necessary.

NOTICE

Do not lubricate the components with oil, grease, or silicone lubricants; they will degrade the rubber isolators.

10. Place the upper isolator and washer in the frame bracket.
11. Lift the engine slightly and remove the engine stands, then carefully lower the engine until the engine leg rests on the frame bracket and isolator.
12. Holding the lower isolator and washer in place, install the bolt through the engine leg, isolators, and frame bracket, then secure it with the nut and hardened washer. Tighten to 216 to 265 lbf·ft (294 to 359 N·m).

Specifications

Engine Mount Torque Values, EPA07 and Earlier Engines			
Description	**Fastener Size**	**Grade/Class**	**Torque: lbf·ft (N·m)**
MBE900 Engines			
Front Leg to Engine	Refer to OEM.		
Front Leg to Underslung Crossmember	M16–2 x 100	10.9	136 (184)
Rear Leg to Flywheel Housing	M16–2 x 55	10.9	92 (125)
Rear Leg to Frame Bracket	3/4–10 x 5.25	8	241 (327)
Rear Frame Bracket to Frame Rail	5/8 or M16 Huck	8 or 10.9	N/A
MBE4000 Engines			
Front Leg to Engine	Refer to OEM.		
Front Leg to Underslung Crossmember	3/4–10 x 5	8	241±28 (327±38)
Rear Leg to Flywheel Housing	M16–1.5 x 50, flange M16–1.5 x 60, flange	10.9	195±10 (264±14)
Rear Leg to Frame Bracket	3/4–10 x 4.25	8	375±56 (508±76)
Rear Frame Bracket to Frame Rail	5/8–11 x 2.25 5/8–11 x 3	8	136±16 (184±21)
CAT C11/C13 Engines			
Front Leg to Engine	Refer to OEM.		
Front Leg to Underslung Crossmember	3/4–10 x 5	8	213-269 (289-364)
Rear Leg to Flywheel Housing	5/8–11 x 2.25	8	136±16 (184±21)
Rear Leg to Frame Bracket	3/4–10 x 3, dog point	8	375±56 (508±76)
Rear Frame Bracket to Frame Rail	5/8–11 x 3 5/8–11 x 2.25	8	136±16 (184±21)

Table 1, Engine Mount Torque Values, EPA07 and Earlier Engines

Engine Mount Torque Values, EPA10 Engines			
Description	**Fastener Size**	**Grade/Class**	**Torque: lbf·ft (N·m)**
ISB/ISC/ISL Engines			
Front Leg to Engine	Refer to OEM.		
Front Leg to Underslung Crossmember	M16–2 x 100	10.9	122-149 (166-202)
Rear Leg to Flywheel Housing	M12 x 40	10.9	58-72 (79-98)
Rear Leg to Frame Bracket	3/4–10 x 5.25	8	216-265 (294-359)
Rear Frame Bracket to Frame Rail	5/8–11 x 2.25	8	122-149 (166-202)
DD13 Engines			
Front Leg to Engine	M16–1.5	10.9	92 (125), then turn 90°
Front Leg to Underslung Crossmember	3/4–10 x 5	8	241±28 (327±38)
Rear Leg to Flywheel Housing	M16–1.5 x 65	10.9	195±10 (264±14)

Specifications

Engine Mount Torque Values, EPA10 Engines			
Description	**Fastener Size**	**Grade/Class**	**Torque: lbf·ft (N·m)**
Rear Leg to Frame Bracket	3/4–10 x 3, dog point	8	375±56 (508±76)
Rear Frame Bracket to Frame Rail	5/8–11 x 3 5/8–11 x 2.25 5/8–11 x 4.25	8	136±16 (184±21)

Table 2, Engine Mount Torque Values, EPA10 Engines

Contents

Principles of Operation

EPA 2007

The Environmental Protection Agency (EPA) mandated that all engines built after December 31, 2006 meet lower exhaust emissions levels:

- 1.1 grams per brake horsepower hour (g/bhp-hr) of nitrogen oxides (NOx)
- 0.01 g/bhp-hr of particulate matter (PM)

To meet the EPA07 requirements, most engine manufacturers developed an aftertreatment system (ATS). The ATS varies according to engine and vehicle configuration, but instead of a muffler, an ATS has an aftertreatment device (ATD) that outwardly resembles a muffler.

Inside the ATD on Cummins, Detroit Diesel, and Mercedes-Benz engines, the exhaust first passes over the diesel oxidation catalyst (DOC), which uses a chemical process to break down pollutants into less harmful components. The exhaust then passes through the diesel particulate filter (DPF), which traps soot particles. See **Fig. 1**.

The DPF core in all ATDs is comprised of ceramic channels that are blocked off at alternate ends to force the exhaust through the porous walls.

As soot accumulates in the DPF, it periodically needs to be converted to its basic parts: carbon dioxide, water, and ash. The conversion takes place through an event in the ATD referred to as regeneration (regen). 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.

Over time, ash collects in the ATS and needs to be removed through cleaning at specific intervals. For ATS maintenance and repair information, see the engine manufacturer's service literature.

EPA 2010

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 ATS will rely on existing EPA07 technology, which includes an aftertreatment device (ATD), with the addition of SCR. See **Fig. 2**. The SCR process requires the introduction of diesel exhaust fluid (DEF) into the exhaust stream.

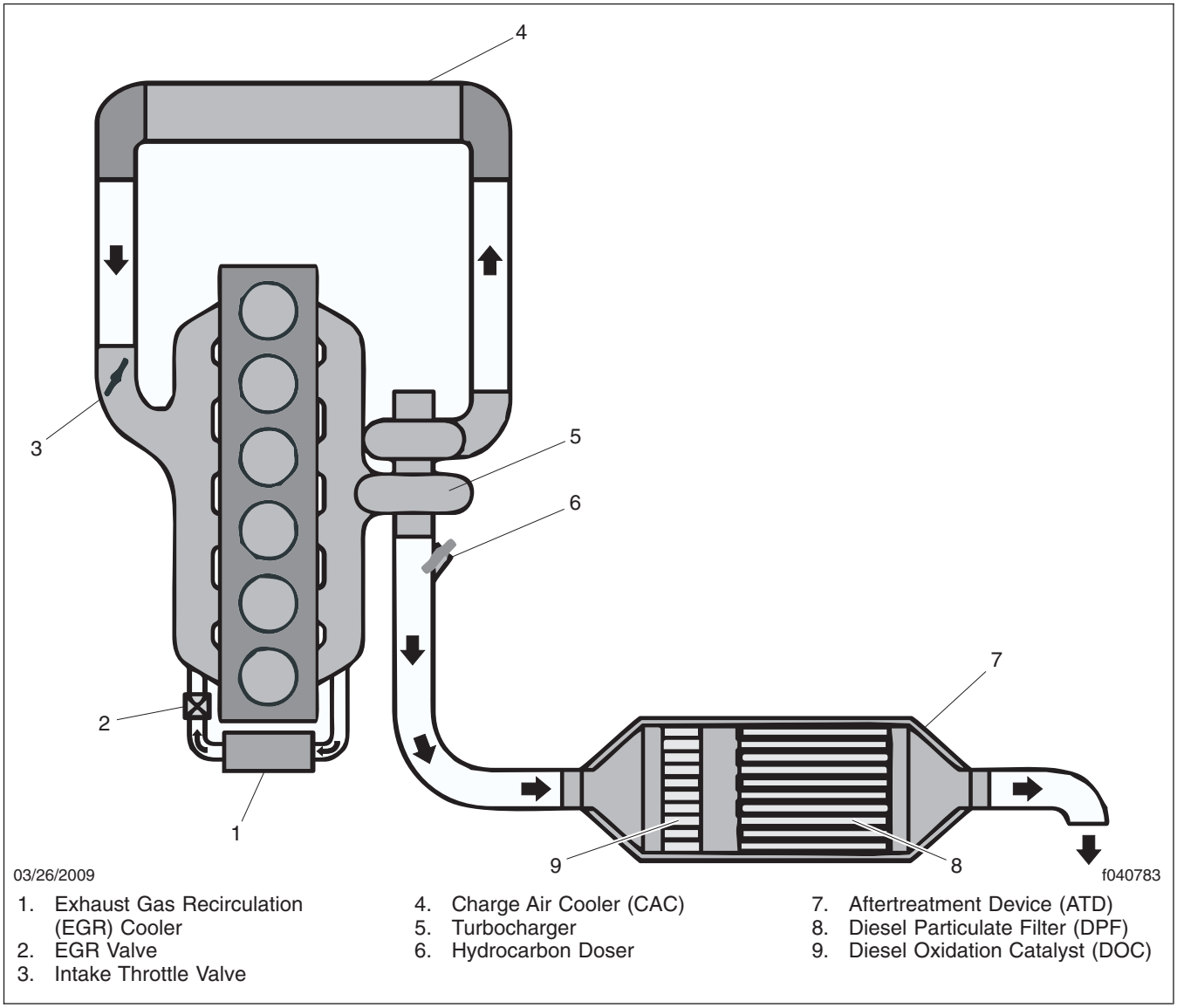
The ATS is always chassis-mounted, with several different installation options available to fit various vehicle configurations. ATS exhaust piping is made of stainless steel. The ATS includes all piping and equipment between the turbocharger outlet and the end of the exhaust pipe, including the aftertreatment device (ATD), SCR catalyst, DEF tank, DEF tank header unit, DEF pump, DEF metering unit, and the DEF, coolant, and air lines that run between each component.

All EPA10-compliant DTNA vehicles require the use of ultra-low sulfur diesel (ULSD) fuel with a sulfur content of 15 parts per million (ppm) for low emissions and long life of the diesel particulate filter (DPF) in the ATD. In addition, DTNA vehicles require the use of CJ-4 engine oils with less than 1% ash.

Inside the ATD, the exhaust first passes over the diesel oxidation catalyst (DOC), where combustion gases are chemically broken down into water and carbon dioxide. The exhaust then passes through the DPF, a honeycomb-like filter that traps solid soot particles. The soot particles trapped in the DPF are reduced to ash during regeneration (regen).

If the exhaust temperature is high enough, a process called passive regen 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

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. Aftertreatment Device (ATD)
8. Diesel Particulate Filter (DPF)
9. Diesel Oxidation Catalyst (DOC)

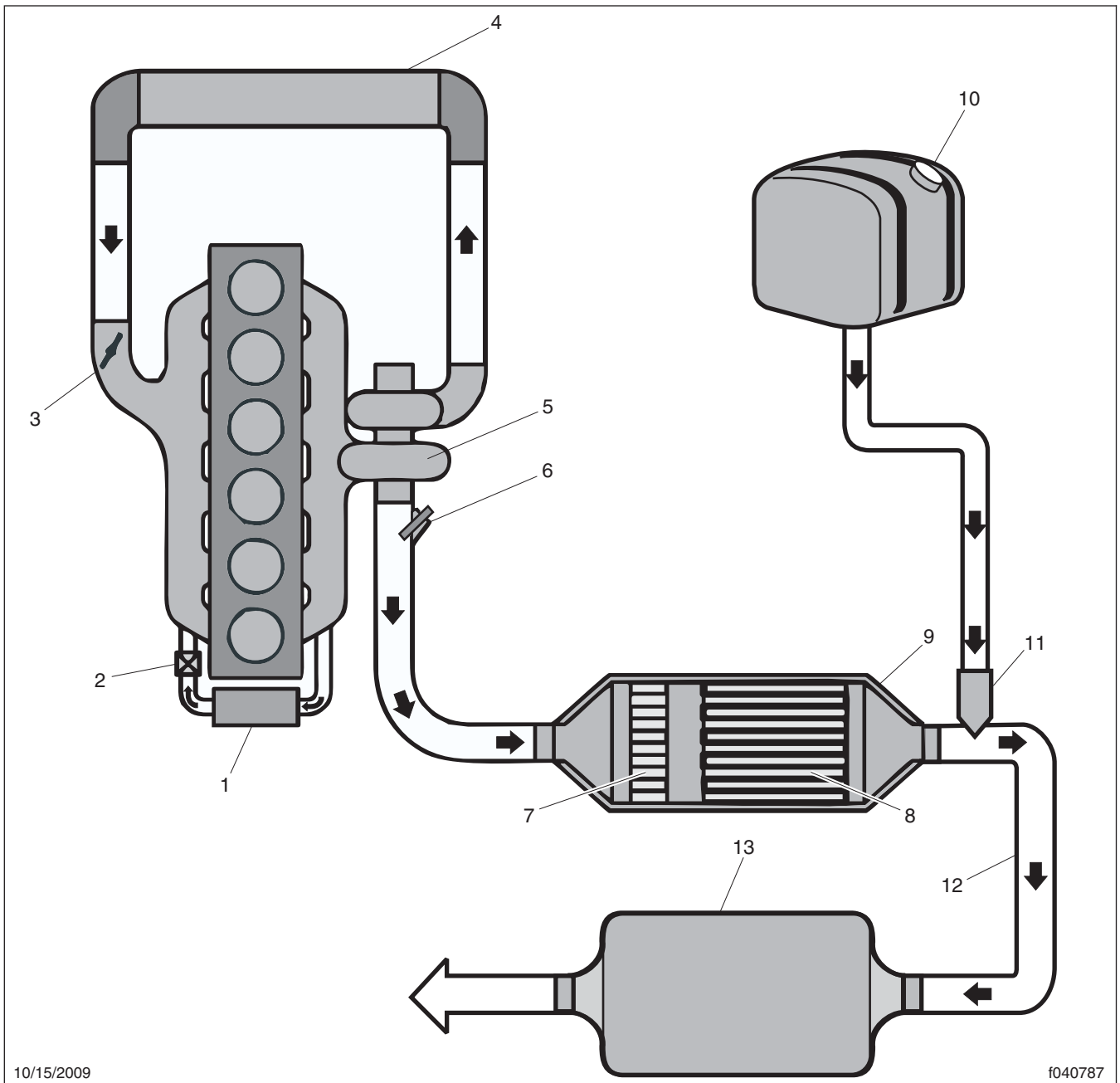
Fig. 1, EPA07 ATS (Detroit Diesel engine shown)

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.

Despite the regen process, ash collects in the DPF over time and needs to be removed through cleaning at specific intervals. For DPF maintenance intervals and repair information, see the engine manufacturer's service literature.

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



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. 2, EPA10 ATS (Detroit Diesel engine shown)

EPA10-compliant DTNA vehicles are equipped with an additional tank to carry the DEF necessary for the SCR process. DEF is colorless, non-toxic, and biodegradable. DEF consumption will vary depending on ambient conditions and vehicle application.

Service Literature Coverage

Engine service procedures in this manual are limited to components installed by Daimler Trucks North America. See the following sections for information on EPA07/10-compliant parts and systems installed by Daimler Trucks North America:

- **Section 01.01**, Engine Mounts
- **Section 30.00**, Electronic Throttle Control
- **Section 49.01**, Aftertreatment System, EPA07
- **Section 49.02**, Aftertreatment System, EPA10
- **Section 49.03**, Diesel Exhaust Fluid System, EPA10
- **Section 83.00**, Cab Heater and Air Conditioner, Valeo
- **Section 88.00**, Hood

Complete engine coverage including engine adjustment, preventive maintenance, and engine repair are covered in each engine manufacturer's service literature:

- Cummins: **www.cummins.com**
- Detroit Diesel: **www.detroitdiesel.com**
- Mercedes-Benz: **www.detroitdiesel.com**

Periodic inspection of the ATS is required. For instructions, see the *Business Class M2 Maintenance Manual*.

For driver pre- and post-trip inspection information, see the *Business Class M2 Driver's Manual*.

Definition of Terms

Refer to the following terms for a better understanding of EPA07/10 engines.

Ash Unburnable solids that remain after regeneration in the ATD.

Aftertreatment Device (ATD) A device that removes pollutants from exhaust gas after the gas leaves the combustion chamber.

Aftertreatment System (ATS) The entire exhaust system from the turbocharger to the exhaust stack or tail pipe.

Diesel Exhaust Fluid (DEF) A colorless, non-toxic, and biodegradable fluid used in the SCR process.

Diesel Oxidation Catalyst (DOC) A flow-through device that enhances the oxidation of hydrocarbons in the ATD on Cummins, Detroit Diesel, and Mercedes-Benz engines.

Diesel Particulate Filter (DPF) A component in the ATD that captures particulate matter from the exhaust gas, preventing discharge from the tailpipe.

Exhaust Gas Recirculation (EGR) A process whereby exhaust is recirculated into the air intake system, creating lower cylinder temperatures.

Nitrogen Oxides (NOx) Air pollutants composed of nitrogen and oxygen in various forms that contribute to the formation of smog.

Particulate Matter (PM) Soot particles formed by incomplete combustion of fuel that contribute to atmospheric pollution.

Regeneration (Regen) A process that occurs inside the ATD whereby accumulated soot is superheated and burned to ash, carbon dioxide, and water.

Selective Catalytic Reduction (SCR) A vehicle emissions control technology to reduce diesel engine emissions for passenger cars, and light and heavy-duty trucks.

ULSD (Ultra-Low Sulfur Diesel) Fuel A clean burning diesel fuel containing a maximum of 15-ppm sulfur. To meet EPA requirements, all highway diesel fuel sold in the U.S. must be ULSD.

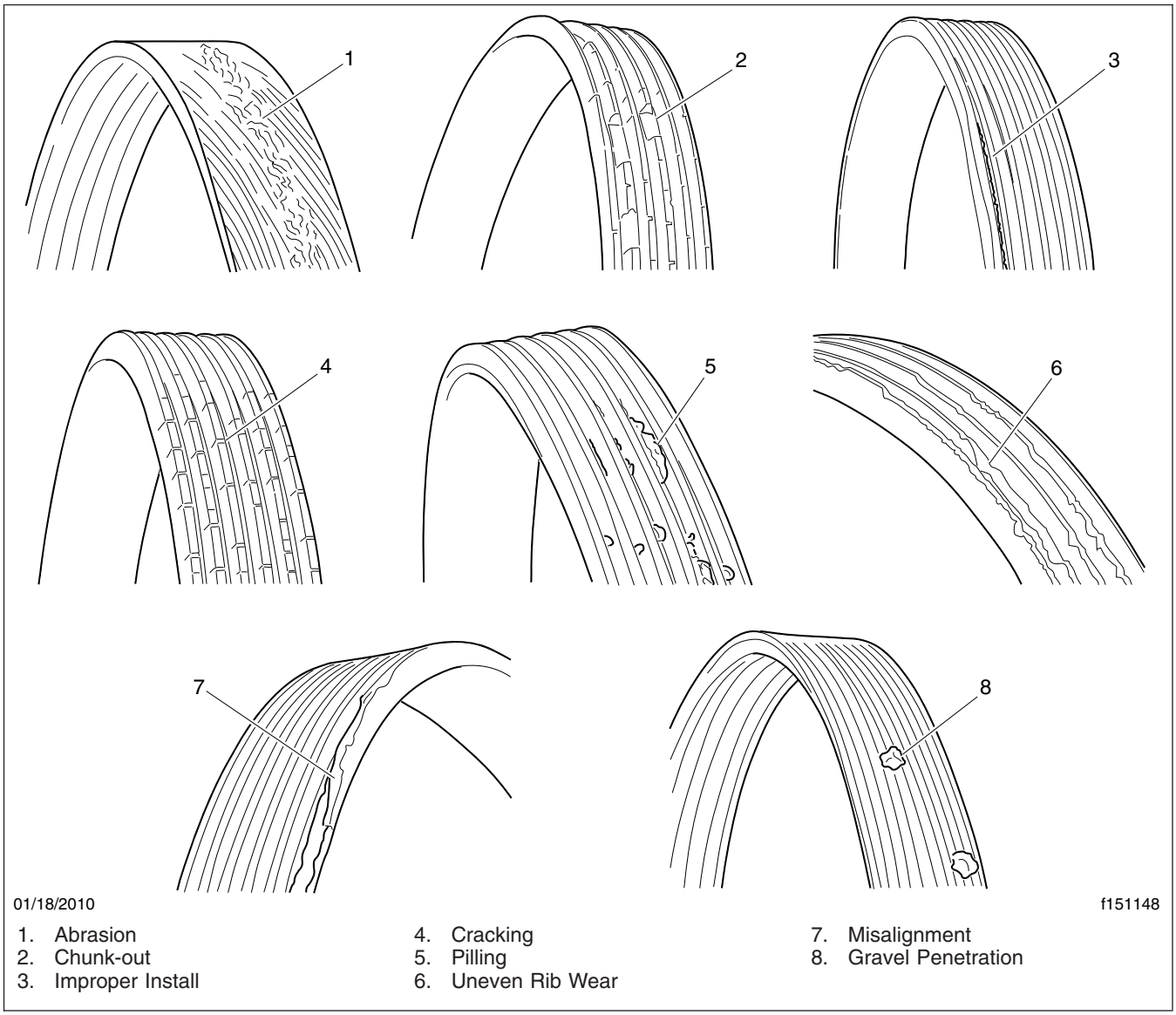
Contents

NOTE: For diagnostic procedures and engine component replacement, refer to the engine manufacturer's service literature. See **Detroit Diesel www.detroitdiesel.com** or **Cummins Engine www.cummins.com**.

Inspection

1. Inspect the belt contact surfaces for chips, flaking, cracks, discoloration, and other damage. See **Fig. 1**.
2. Inspect the bearings in the idler pulleys, and accessories, by rotating the pulleys to look for bearing slop, or choppy feeling bearings.
3. Inspect the springs on the belt tensioner. If the springs are damaged, change the belt tensioner following the engine manufacturer's instructions.
4. Inspect the pulleys for damage. If the pulleys are damaged, change both the damaged pulley and the belt following the engine manufacturer's instructions. See **Fig. 2**.
5. Check the belt allignment on all idler pulleys. If the alignment is incorrect as shown in **Fig. 3**, and pulley wear is visible, replace the pulley and bracket following the engine manufacturer's instructions.

Drive Belt Inspection



1. Abrasion
2. Chunk-out
3. Improper Install
4. Cracking
5. Pilling
6. Uneven Rib Wear
7. Misalignment
8. Gravel Penetration

Fig. 1, Damaged Belts

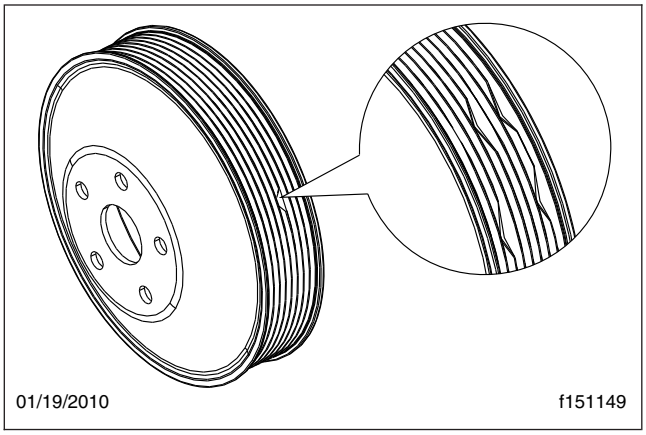
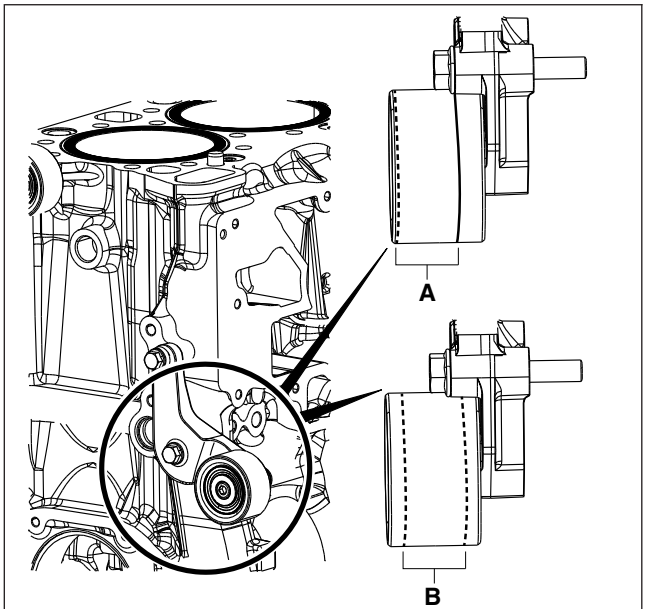


Fig. 2, Damaged Pulley



A. Incorrect Belt-Alignment Area
B. Correct Belt-Alignment Area

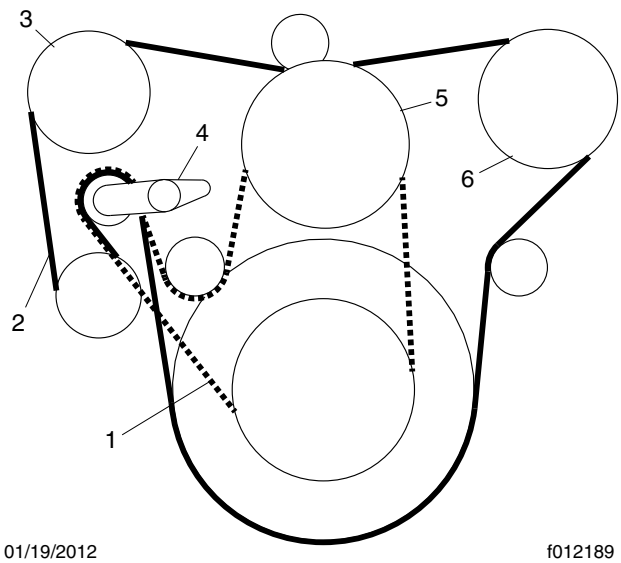
Fig. 3, Idler-Pulley Belt Alignment

Drive Belt Replacement, Detroit Diesel Engines

Detroit Diesel engines are equipped with two serpentine poly-V drive belts. The rear belt (closest to the engine block surface) drives the alternator, the A/C compressor, and the water pump. The front belt drives the engine fan. See **Fig. 1**. Both drive belts are kept at the correct tension with pulleys and a dual automatic belt-tensioner assembly.

NOTICE

When replacing the drive belts for the DD engine, it is crucial to follow the correct procedure for releasing and locking the belt tensioners. The belt tensioners must be released and locked separately, and in the correct sequence, or the assembly may be damaged.

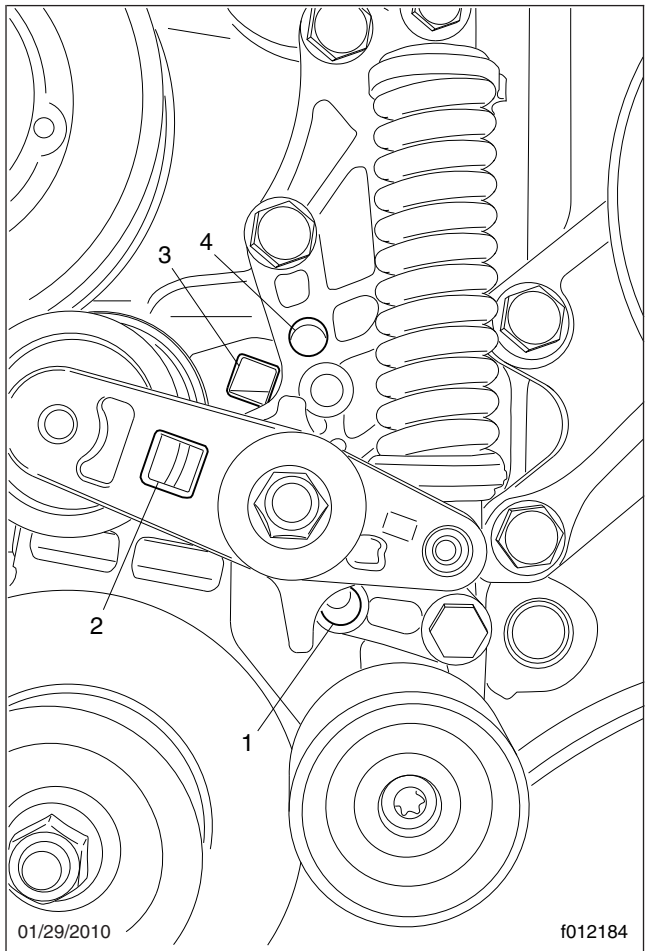


1. Front Drive Belt
2. Rear Drive Belt
3. AC Compressor
4. Spring Loaded Tensioner
5. Fan Clutch
6. Water Pump

Fig. 1, DD13/15/16 Drive Belt Routing

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Disconnect the batteries at the negative terminals.
3. Raise the hood.
4. Locate the automatic belt tensioner assembly, on the left (passenger) side of the engine, as you are facing it. Note the location of the square 1/2-inch drive holes, and the round holes for the locking bolts. See **Fig. 2**.



1. Front Round Hole for 10-mm Locking Bolt
2. Front Square1/2-inch Drive Hole
3. Rear Square 1/2-inch Drive Hole
4. Rear Round Hole for 10-mm Locking Bolt

Fig. 2, Belt Tensioners

NOTICE

To prevent damage to the belt tensioners, always rotate them counterclockwise. Never rotate the automatic belt tensioners clockwise, to do so may damage them, and require replacement of

Drive Belt Replacement, Detroit Diesel Engines

the entire assembly. Never use more force than 66 to 73 lbf (90 to 100 N).

IMPORTANT: Always release the front tensioner and belt (fan drive) first, then the rear tensioner and belt (alternator, A/C compressor, and water pump). When removing the locking bolts reverse the procedure by unlocking the rear belt tensioner first, then the front one.

5. Insert a 1/2-inch breaker bar, or 1/2-inch ratchet into the square hole in the idler arm of the front belt tensioner (grooved pulley), then smoothly rotate it downward (counterclockwise) until you feel resistance. See **Fig. 3**.

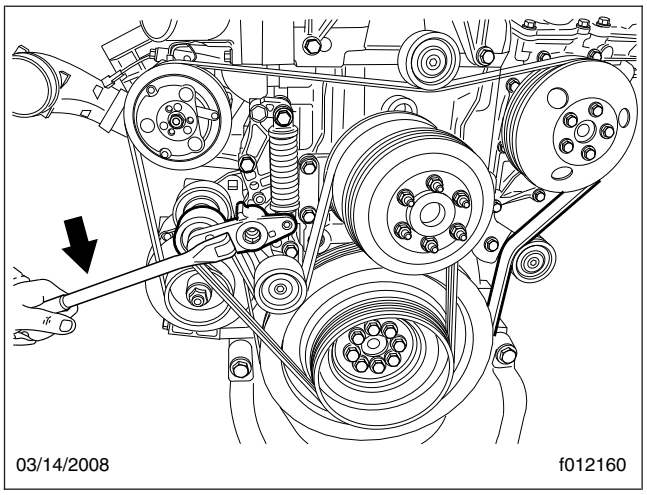
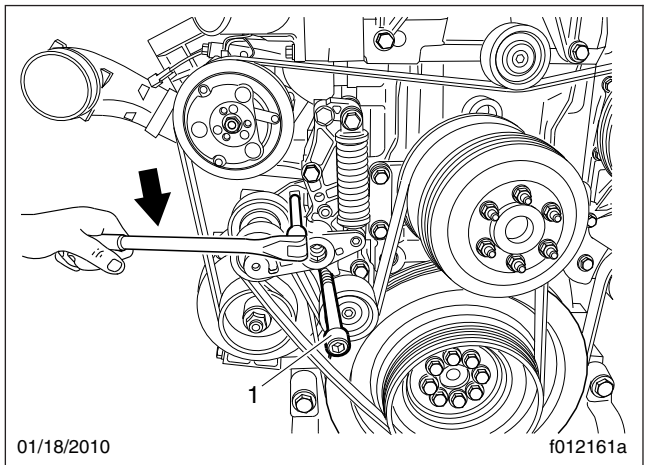


Fig. 3, Releasing the Front Tensioner

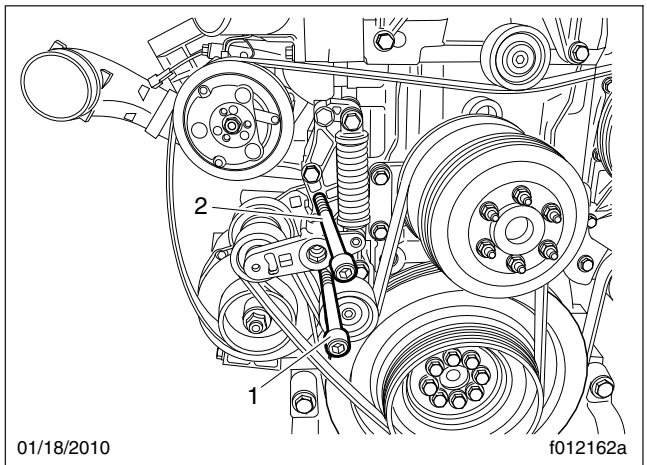
6. Insert a 10-mm diameter x 80 mm long bolt into the round hole on the idler arm of the tensioner as shown in **Fig. 4**, then push it all the way in to lock the tensioner in the released position. Remove the socket wrench from the square hole.
7. Insert a 1/2-inch breaker bar, or 1/2-inch ratchet, into the square hole in the idler arm of the rear belt tensioner (smooth pulley), then smoothly rotate it downward (counterclockwise) until you feel resistance. See **Fig. 4**.
8. Insert a second 10-mm diameter x 80 mm long bolt into the round hole on the idler arm of the rear tensioner as shown in **Fig. 5**, then push it all the way in to lock the tensioner in the released position. Remove the wrench from the square hole.



Note: For clarity, the locking bolt is shown in position but not pushed all the way in.

1. Front Belt Tensioner Locking Bolt Position

Fig. 4, Releasing the Rear Tensioner (smooth pulley)



Note: For clarity, the locking bolts are shown in position but not pushed all the way in.

1. Locking Bolt for Front Belt Tensioner
2. Locking Bolt for Rear Belt Tensioner

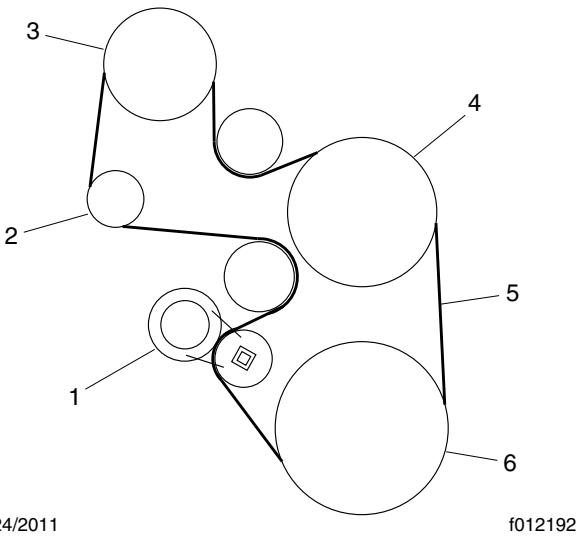
Fig. 5, Belt Tensioner Locking Bolts in Position

9. Replace the drive belts, making sure the new belts are correctly installed on all the pulleys.
10. Using the 1/2-inch breaker bar, or 1/2-inch ratchet, rotate the idler arm on the rear (smooth pulley) tensioner downward (counterclockwise), until you can remove the locking bolt. Smoothly release the idler arm all the way up, being careful not to jerk it.

11. In the same manner as the previous step, remove the locking bolt from the front tensioner.
12. Do a final check to make sure both drive belts are configured correctly, and correctly installed on all the pulleys.
13. Close the hood, connect the batteries, then remove the chocks.

Drive Belt Replacement, Cummins Engines

Cummins ISC/ISL and ISB engines are equipped with one poly-V drive belt. The drive belt is kept at the correct tension by a system of pulleys and an automatic belt tensioner. See **Fig. 1** and **Fig. 2**.

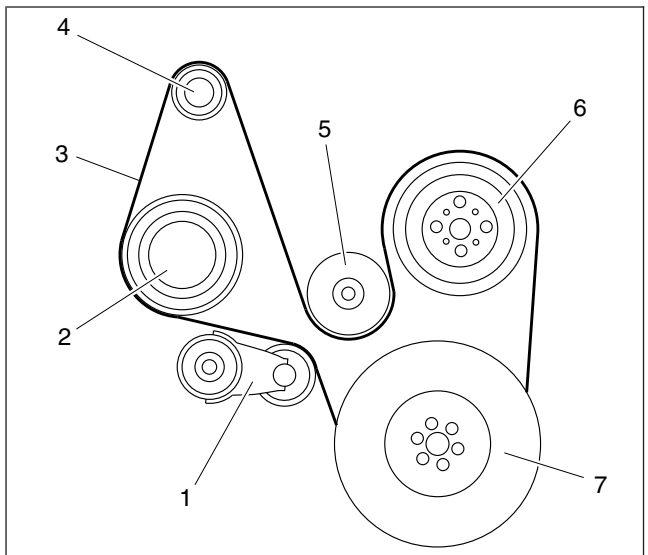


1. Spring Loaded Tensioner
2. Alternator Pulley
3. AC Compressor
4. Fan Clutch
5. Drive Belt
6. Crank Shaft Pulley

Fig. 1, Cummins ISC/ISL Drive Belt Routing

Replacement

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Disconnect the batteries at the negative terminals.
3. Raise the hood.
4. Locate the drive-belt-tensioner assembly on the left (passenger) side of the engine, as you are facing it. Insert a 1/2-inch-drive ratchet or 1/2-inch breaker bar into the pivot point on the small end of the tensioner. See **Fig. 3**. Push downward on the breaker bar, rotating the tensioner counter-clockwise until you feel resistance.
5. Holding the tensioner released, remove the drive belt.
6. Install a new drive belt, ensuring it is routed correctly, and centered on all the pulleys.



1. Spring Loaded Tensioner
2. AC Compressor
3. Drive Belt
4. Alternator Pulley
5. Water Pump
6. Fan Clutch
7. Crank Shaft Pulley

Fig. 2, Cummins ISB Drive Belt Routing

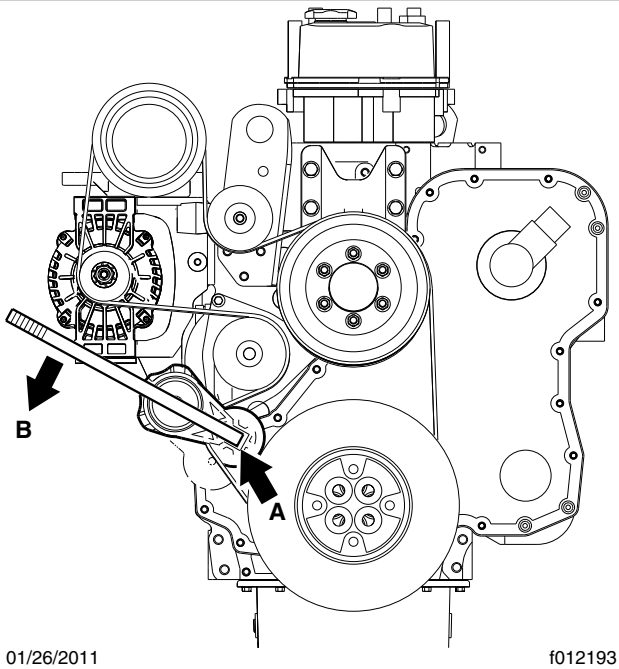
7. Smoothly release the pressure from the breaker bar.

NOTICE

Never allow the tensioner to slam back against the stop, or damage may occur.

8. Start the engine, standing clear of the belt and accessories. Check the belt tracking on all pulleys to ensure correct belt operation.
9. Close the hood and connect the batteries.

Drive Belt Replacement, Cummins Engines



A. Pivot Point for Belt Tensioner
B. Push Downward

Fig. 3, Releasing the Tensioner

Contents

Removal

NOTE: This procedure involves removing and installing the engine and the transmission as a single unit.

1. Apply the parking brakes, chock the tires, and drain the air system.
2. Disconnect the batteries.
   - 2.1 Disconnect the battery ground cable from the frame rail.
   - 2.2 Disconnect the positive battery cable from the batteries.
3. Drain the air tanks.
4. Remove the hood and bumper. For instructions, refer to **Group 88** and **Group 31** of this workshop manual.
5. Remove the air-intake filter housing.

⚠ WARNING

Drain the coolant only when the coolant and engine are cool. Draining it when these are hot could cause severe personal injury due to scalding.

6. Drain the radiator.
   - 6.1 Place a suitable container under the left side of the radiator.
   - 6.2 Remove the surge tank cap.
   - 6.3 Loosen the draincock at the bottom of the radiator.

     After the coolant has drained, tighten the draincock firmly.
7. If so equipped, disconnect the transmission oil cooler from the bottom of the radiator.

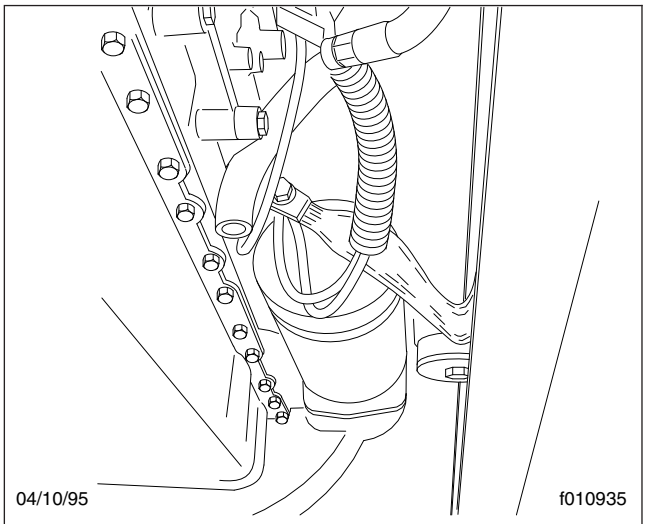
   If the transmission oil cooler is separate from the radiator: place a suitable container under it, then disconnect the hoses. Cover the hoses to keep out dirt. Remove the fasteners holding the transmission oil cooler to the bottom of the radiator. Remove the transmission oil cooler.

   If the transmission oil cooler is integral with the radiator: place a suitable container under the hose connections at the bottom of the radiator. Disconnect the hoses, drain them, then cover the hose ends to keep out dirt.
8. Mark, disconnect and remove the charge air cooler hoses.
9. If so equipped, remove the air conditioning condenser from the front of the radiator.
   - 9.1 Remove the fasteners holding the condenser to the front of the radiator.
   - 9.2 Keeping the refrigerant lines connected, move the condenser aside.
   - 9.3 Using cardboard or other suitable material, wrap the condenser to protect it from damage.
   - 9.4 Using tie straps, secure the condenser to a suitable bracket.
10. Remove the radiator.
    - 10.1 Disconnect the upper and lower radiator hoses at both ends.
    - 10.2 Mark and disconnect the hoses between the radiator and the top of the surge tank.
    - 10.3 Mark and disconnect the hose leading from the bottom of the surge tank to the engine block.
    - 10.4 Disconnect the left and right radiator struts from the radiator side channels
    - 10.5 Remove the fasteners holding the fan shroud to the radiator, and move the shroud back against the engine.
    - 10.6 Remove the lower radiator mounting nuts.
    - 10.7 Attach a lifting chain to the top of the radiator, and using a suitable lifting device, remove the radiator and charge air cooler from the vehicle.
    - 10.8 Remove the fan shroud.
11. Disconnect and remove the left-side radiator struts from the front wall.
12. Disconnect and remove the right-side radiator strut from the air filter housing bracket.
13. Disconnect the hose between the air filter housing and the engine, then remove the air filter housing from its bracket.

Engine Removal and Installation

14. Using a suitable breaker bar in the belt tensioner, rotate the tensioner counterclockwise. Remove the serpentine drive belt from the engine.
15. Mark and disconnect the wiring from the refrigerant compressor.
16. Free the refrigerant lines from all routing clamps and stand-off brackets as needed. Leaving the refrigerant lines connected, remove the refrigerant compressor from its bracket, and move it aside. Secure the compressor with tie straps.
17. Disconnect the heater hoses.
    - 17.1 Disconnect the heater return hose from the water pump inlet tube, and move the hose aside.
    - 17.2 Disconnect the heater supply hose from the rear of the engine block and move the hose aside.
18. Mark and disconnect the wiring from the alternator. Remove the alternator from the engine.
19. If so equipped, mark and disconnect the wiring from the block heater.
20. Remove the V-clamp holding the exhaust pipe to the turbocharger.
21. Mark and disconnect the air lines from the air compressor.
22. If so equipped, disconnect the air line from the fan clutch.
23. Leaving the hoses connected, remove the power steering pump from the engine. Using tie straps, secure it to a suitable place on the frame rail.
24. Mark and disconnect the wiring from the starter. See **Fig. 1**. Remove the starter from the engine.
25. Mark and disconnect all the wiring from the engine and the ECM.
26. At the fuel/water separator, disconnect the fuel delivery line that runs to the engine, then disconnect the fuel return line from the engine.
27. If equipped with an automatic transmission, mark and disconnect the wiring harness from the transmission.

    If equipped with a standard transmission, remove the shift tower. For instructions, refer to **Group 26** of this manual.



NOTE: Not all the wiring is shown.

Fig. 1, Starter Wiring Connections

28. If so equipped, disconnect the forward end of the clutch rod and tie-strap the rod to the engine.
29. Remove the forward midship bearing from the frame rail. See **Group 41** for instructions.
30. Disconnect the driveline from the transmission U-joint. See **Group 41** for instructions.
31. From under the cab, disconnect the exhaust pipe from the saddle clamp mounted on the transmission housing.

⚠ WARNING

The crane and lifting chains used to remove the engine must be capable of safely lifting and supporting 2 metric tons. Once the engine mounts are disconnected, do not crawl under the engine until it is securely supported on engine stands. An unsecured engine may fall, causing severe personal injury or death, and component damage.

32. Remove the engine and transmission from the vehicle.
    - 32.1 Attach the chain to the lifting eyes at the front and the rear of the engine. See **Fig. 2**.
    - 32.2 Using a suitable jack, support the transmission. If they are present, remove the transmission mounting fasteners.

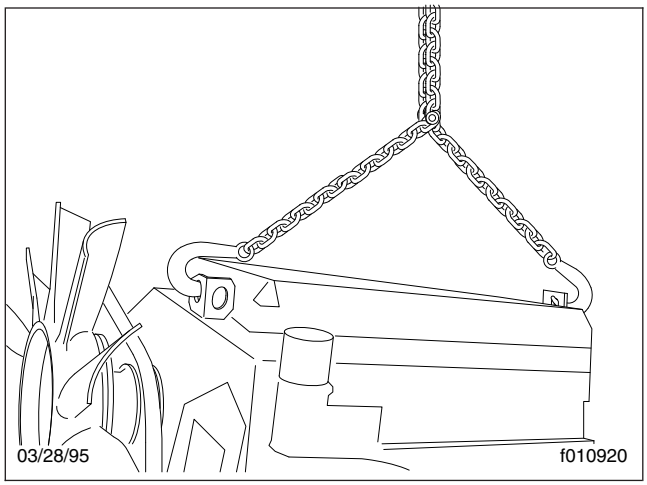


Fig. 2, Lifting Chain Installed

32.3 With the engine lifting eyes connected by chain to the crane, raise the crane enough to tighten the chains, but not enough to lift the front of the vehicle.

32.4 With the engine securely supported by the crane and lifting chains, disconnect the rear engine legs from the engine mounts on the frame rails.

On each engine leg, remove the nut from the bolt that runs down through the engine leg, rubber isolators, and engine mount. Save the fasteners and isolators.

32.5 Remove the nuts from the bolts that fasten the front engine support bracket to the underslung crossmember. See **Fig. 3**.

32.6 Using the crane and a transmission jack, lift the engine and pull it forward.

32.7 Once the engine and transmission are clear of the vehicle, place the engine on an engine stand.

33. Remove the transmission from the engine. See **Group 26** for instructions.

Installation

1. Install the transmission onto the engine. See **Group 26** for instructions.

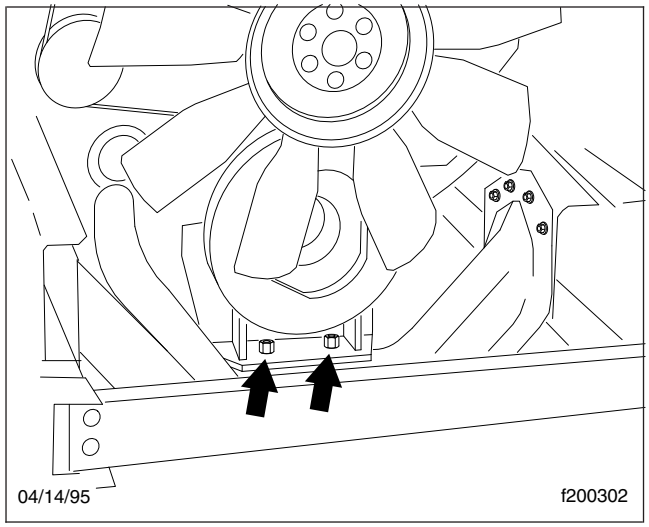


Fig. 3, Front Engine Mount Fasteners

⚠ WARNING

The crane and lifting chains used to install the engine must be capable of safely lifting and supporting 2 metric tons. Once the engine is removed from the engine stands, do not get under the engine until it is securely supported on the engine mounts. An unsecured engine may fall, causing personal injury or death, and component damage.

2. Install the engine and the transmission in the vehicle.

2.1 Attach the chain to the existing lifting eyes at the front and the rear of the engine.

2.2 With the two engine lifting eyes connected by chain to the crane, and supporting the transmission with a jack, lift the engine and transmission and position them in the vehicle.

2.3 Connect the engine to the rear engine mounts, and tighten each bolt that runs down through the engine leg, rubber isolators, and engine mount 241 lbf·ft (327 N·m).

2.4 Place the lower isolators under the underslung crossmember and the front engine support bracket, and secure the front engine mount with nuts and washers. Tighten the nuts 136 lbf·ft (184 N·m).

Engine Removal and Installation

2.5 Once the engine and transmission are securely installed in the vehicle, remove the lifting chains.

3. If applicable, install the transmission mounting fasteners. Tighten 136 lbf·ft (184 N·m).
4. If equipped with an automatic transmission, connect the wiring harness to it.

   If equipped with a standard transmission, install the shift tower. For instructions, see **Group 26**.
5. Connect the driveline.

   5.1 Connect the driveline to the transmission. For instructions, refer to **Group 41**.

   5.2 Connect the driveline midship bearing bracket. For instructions, refer to **Group 41**.
6. If so equipped, connect the forward end of the clutch rod, and remove any tie straps that hold the rod to the engine.
7. Install the exhaust pipe.

   7.1 Under the engine, connect the exhaust pipe to the saddle clamp mounted on the transmission.

   7.2 Install the forward end of the exhaust pipe to the rear of the turbocharger. Tighten the V-band clamp 85 lbf·in (940 N·cm).
8. If so equipped, connect the air line to the fan clutch.
9. Connect the fuel delivery line.
10. Install the power steering pump onto the engine.
11. As previously marked, connect all the engine and ECM wiring.
12. Connect the heater hoses.

    12.1 Connect the heater return hose to the water pump

    12.2 Connect the heater supply hose to the rear of the engine block.
13. Install the refrigerant compressor onto the engine. For instructions, refer to **Group 83**.
14. Install the serpentine drive belt onto the engine.
15. Install the radiator.

    15.1 Set the radiator shroud back against the engine.

    15.2 Attach a lifting chain to the top of the radiator, then attach the chain to a lifting crane.

    15.3 Lift the radiator/charge air cooler assembly, and position it on the radiator mounts.

    15.4 Install the radiator/charge air cooler onto the frame crossmember mounts. For instructions, refer to **Group 20**.

    15.5 Install the fan shroud onto the radiator.

    15.6 Connect the upper and lower radiator hoses.

    15.7 As previously marked, connect the two hoses to the top of the surge tank.

    15.8 Connect the hose at the bottom of the surge tank to the engine block.

    15.9 Install the condenser onto the front of the radiator and charge air cooler.

    15.10 Install the two left-side and one right-side radiator struts.
16. Route the refrigerant lines between the compressor and the condenser, and secure the lines with clamps and stand-off brackets.
17. Install the air-intake filter housing onto its bracket. For instructions, see **Group 09**.
18. If not already done, connect the hose between the air-intake filter housing and the engine.
19. Install the charge air cooler hoses.
20. If so equipped, install the transmission oil cooler.

    If the transmission oil cooler is separate from the radiator: install the fasteners holding the transmission oil cooler to the bottom of the radiator. Connect the hoses.

    If the transmission oil cooler is integral with the radiator: connect the hoses to the bottom of the radiator.
21. Fill the radiator with coolant. Use a 50/50 antifreeze-water mixture.
22. If equipped with a transmission oil cooler, check the fluid level in the transmission and add automatic transmission fluid as needed. Refer to Group 26 of the *Business Class M2 Maintenance Manual* for approved automatic transmission fluids.

23. Install the hood and bumper. For instructions, refer to **Group 88** of this manual.
24. Connect the batteries.
25. Remove the chocks from the tires.
26. Start the engine, and check for leaks. Repair any leaks found.
27. Test drive the vehicle.