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# **3126E COMMERCIAL and TRUCK ENGINES and 3126B ENGINE**

**Maintenance Intervals**

Excerpted from Operation & Maintenance Manual (SEBU7011-17-01)

i02660876

# Maintenance Interval Schedule (Engines with a Shallow Oil Sump)

**SMCS Code:** 1000; 7500

Ensure that all safety information, warnings and instructions are read and understood before any operation or any maintenance procedures are performed.

The user is responsible for the performance of maintenance, including all adjustments, the use of proper lubricants, fluids, filters, and the replacement of components due to normal wear and aging. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components.

Use mileage, fuel consumption, service hours, or calendar time, **WHICHEVER OCCURS FIRST**, in order to determine the maintenance intervals. Products that operate in severe operating conditions may require more frequent maintenance.

**Note:** Before each consecutive interval is performed, all maintenance from the previous interval must be performed.

## When Required

Air Dryer - Check .....	120
Battery - Replace .....	121
Battery or Battery Cable - Disconnect .....	124
Engine Oil Level Gauge - Calibrate .....	153
Engine Storage Procedure - Check .....	164
Exhaust Filter (Particulate Trap) - Clean .....	166
Exhaust Filter (Particulate Trap) - Test .....	172
Fuel System - Prime .....	179
Severe Service Application - Check .....	192

## Daily

Cooling System Coolant Level - Check .....	138
Engine Air Cleaner Service Indicator - Inspect .....	146
Engine Oil Level - Check .....	150
Fuel System Water Separator - Drain .....	184
Walk-Around Inspection .....	196

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**Initial 17 700 km (11 000 miles) or 4150 L (1100 US gal) of Fuel  
or 250 Service Hours or 6 Months**

Engine Valve Lash - Inspect/Adjust .....	165
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**PM Level 1 - Every 17 700 km (11 000 miles) or 4150 L  
(1100 US gal) of Fuel or 250 Service Hours or 6 Months**

Aftercooler Core - Inspect .....	116
Air Compressor Filter - Clean/Replace .....	119
Battery Electrolyte Level - Check .....	123
Belt - Inspect .....	124
Cooling System Supplemental Coolant Additive (SCA) - Test/Add .....	139
Cylinder Head Grounding Stud - Inspect/Clean/Tighten .....	144
Engine Crankcase Breather - Clean .....	148
Engine Oil Sample - Obtain .....	155
Engine Oil and Filter - Change .....	157
Fan Drive Bearing - Lubricate .....	177
Fuel Inlet Screen - Clean/Inspect/Replace .....	178
Fuel System Primary Filter - Clean/Replace .....	182
Fuel System Secondary Filter - Replace .....	182
Fuel Tank Water and Sediment - Drain .....	186
Hoses and Clamps - Inspect/Replace .....	187
Radiator - Clean .....	191

**PM Level 2 - Every 161 000 km (100 000 miles) or 56 850 L  
(15 000 US gal) of Fuel or 2000 Service Hours or 2 Years**

Aftercooler Core - Clean/Test .....	115
Air Compressor - Inspect .....	118
Alternator - Inspect .....	120
Belt Tensioner - Inspect .....	128
Cooling System Water Temperature Regulator - Replace .....	142
Crankshaft Vibration Damper - Inspect .....	143
Engine - Clean .....	145
Engine Air Cleaner Element - Clean/Replace .....	146
Engine Mounts - Inspect .....	150
Engine Valve Lash - Inspect/Adjust .....	165
Starting Motor - Inspect .....	193
Turbocharger - Inspect .....	193
Water Pump - Inspect .....	198

**Every 3 Years or 322 000 km (200 000 miles)**

Cooling System Coolant (DEAC) - Change .....	128
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**Every 483 000 km (300 000 miles)**

Cooling System Coolant Extender (ELC) - Add .....	136
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**Every 6 Years or 966 000 km (600 000 miles)**

Cooling System Coolant (ELC) - Change .....	133
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**Every 114 000 L (30 000 US gal) of Fuel**

Overhaul Considerations .....	190
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## Maintenance Interval Schedule (Engines with a Deep Oil Sump)

**SMCS Code:** 1000; 7500

Ensure that all safety information, warnings and instructions are read and understood before any operation or any maintenance procedures are performed.

The user is responsible for the performance of maintenance, including all adjustments, the use of proper lubricants, fluids, filters, and the replacement of components due to normal wear and aging. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components.

Use mileage, fuel consumption, service hours, or calendar time, **WHICHEVER OCCURS FIRST**, in order to determine the maintenance intervals. Products that operate in severe operating conditions may require more frequent maintenance.

**Note:** Before each consecutive interval is performed, all maintenance from the previous interval must be performed.

### When Required

Air Dryer - Check .....	120
Battery - Replace .....	121
Battery or Battery Cable - Disconnect .....	124
Engine Oil Level Gauge - Calibrate .....	153
Engine Storage Procedure - Check .....	164
Exhaust Filter (Particulate Trap) - Clean .....	166
Exhaust Filter (Particulate Trap) - Test .....	172
Fuel System - Prime .....	179
Severe Service Application - Check .....	192

### Daily

Cooling System Coolant Level - Check .....	138
Engine Air Cleaner Service Indicator - Inspect .....	146
Engine Oil Level - Check .....	150
Fuel System Water Separator - Drain .....	184
Walk-Around Inspection .....	196

## **Initial 24 000 km (15 000 miles) or 5700 L (1500 US gal) of Fuel or 400 Service Hours or 6 Months**

Engine Valve Lash - Inspect/Adjust .....	165
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## **PM Level 1 - Every 24 000 km (15 000 miles) or 5700 L (1500 US gal) of Fuel or 400 Service Hours or 6 Months**

Aftercooler Core - Inspect .....	116
Air Compressor Filter - Clean/Replace .....	119
Battery Electrolyte Level - Check .....	123
Belt - Inspect .....	124
Cooling System Supplemental Coolant Additive (SCA) - Test/Add .....	139
Cylinder Head Grounding Stud - Inspect/Clean/Tighten .....	144
Engine Crankcase Breather - Clean .....	148
Engine Oil Sample - Obtain .....	155
Engine Oil and Filter - Change .....	157
Fan Drive Bearing - Lubricate .....	177
Fuel Inlet Screen - Clean/Inspect/Replace .....	178
Fuel System Primary Filter - Clean/Replace .....	182
Fuel System Secondary Filter - Replace .....	182
Fuel Tank Water and Sediment - Drain .....	186
Hoses and Clamps - Inspect/Replace .....	187
Radiator - Clean .....	191

## **PM Level 2 - Every 161 000 km (100 000 miles) or 56 850 L (15 000 US gal) of Fuel or 2000 Service Hours or 2 Years**

Aftercooler Core - Clean/Test .....	115
Air Compressor - Inspect .....	118
Alternator - Inspect .....	120
Belt Tensioner - Inspect .....	128
Cooling System Water Temperature Regulator - Replace .....	142
Crankshaft Vibration Damper - Inspect .....	143
Engine - Clean .....	145
Engine Air Cleaner Element - Clean/Replace .....	146
Engine Mounts - Inspect .....	150
Engine Valve Lash - Inspect/Adjust .....	165
Starting Motor - Inspect .....	193
Turbocharger - Inspect .....	193
Water Pump - Inspect .....	198

## **Every 3 Years or 322 000 km (200 000 miles)**

Cooling System Coolant (DEAC) - Change .....	128
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**Every 483 000 km (300 000 miles)**

Cooling System Coolant Extender (ELC) - Add ..... 136

**Every 6 Years or 966 000 km (600 000 miles)**

Cooling System Coolant (ELC) - Change ..... 133

**Every 114 000 L (30 000 US gal) of Fuel**

Overhaul Considerations ..... 190

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# Aftercooler Core - Clean/Test

**SMCS Code:** 1064-070; 1064-081

- 1. Remove the core. Refer to the Service Manual for the procedure.
- 2. Turn the aftercooler core upside-down in order to remove debris.

**NOTICE**

Do not use a high concentration of caustic cleaner to clean the core. A high concentration of caustic cleaner can attack the internal metals of the core and cause leakage. Only use the recommended concentration of cleaner.

- 3. Back flush the core with cleaner.

Caterpillar recommends the use of Hydrosolv liquid cleaner. Table 13 lists Hydrosolv liquid cleaners that are available from your Caterpillar dealer.

Table 13

Hydrosolv Liquid Cleaners <sup>(1)</sup>		
Part Number	Description	Size
1U-5490	Hydrosolv 4165	19 L (5 US gallon)
174-6854	Hydrosolv 100	19 L (5 US gallon)

<sup>(1)</sup> Use a two to five percent concentration of the cleaner at temperatures up to 93°C (200°F). Refer to Application Guide, NEHS0526 or consult your Caterpillar dealer for more information.

- 4. Steam clean the core in order to remove any residue. Flush the fins of the aftercooler core. Remove any other trapped debris.
- 5. Wash the core with hot, soapy water. Rinse the core thoroughly with clean water.





## WARNING

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

6. Dry the core with compressed air. Direct the air in the reverse direction of the normal flow.
7. Inspect the core in order to ensure cleanliness. Pressure test the core. Many shops that service radiators are equipped to perform pressure tests. If necessary, repair the core.
8. Install the core. Refer to the Service Manual for the procedure.

For more information on cleaning the core, consult your Caterpillar dealer.

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## Aftercooler Core - Inspect

**SMCS Code:** 1064-040

**Note:** Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.

**WARNING**

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

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Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb".

**Note:** If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended. The FT1984 Aftercooler Testing Group is used to perform leak tests on the aftercooler. Refer to the Systems Operation/Testing and Adjusting, "Aftercooler - Test" and the Special Instruction, SEHS8622 for the proper testing procedure.

Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, see Special Publication, SEBD0518, "Know Your Cooling System".

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## Air Compressor - Inspect

SMCS Code: 1803-040



### WARNING

**Do not disconnect the air line from the air compressor governor without purging the air brake and the auxiliary air systems. Failure to purge the air brake and the auxiliary air systems before removing the air compressor and/or the air lines could cause personal injury.**

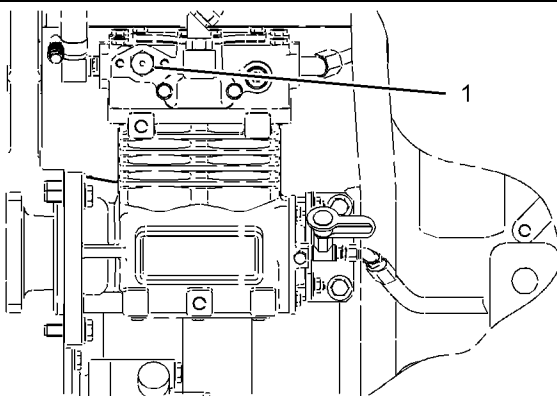


Illustration 16

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(1) Pressure relief valve

**WARNING**

**If the air compressor pressure relief valve that is mounted in the air compressor cylinder head is bypassing compressed air, there is a malfunction in the air system, possibly ice blockage. Under these conditions, your engine may have insufficient air for normal brake operation.**

**Do not operate the engine until the reason for the air bypass is identified and corrected. Failure to heed this warning could lead to property damage, personal injury, or death to the operator or bystanders.**

The function of the pressure relief valve is to bypass air when there is a malfunction in the air compressor system.

The pressure relief valve releases air at 1723 kPa (250 psi). Do not stand near the pressure relief valve. Compressed air may be released without warning. All personnel should also stay clear of the air compressor when the engine is operating and the air compressor is exposed.

Refer to the Service Manual or refer to the OEM specifications in order to find information concerning the air compressor. Consult your Caterpillar dealer for assistance.

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## **Air Compressor Filter - Clean/Replace**

**SMCS Code:** 1803-070-FQ; 1803-510-FQ

One of the single most important aspects of preventive maintenance for the air compressor is the induction of clean air. The type of maintenance that is required for the air compressor and the maintenance interval depends on the type of air induction system that is used. Operating conditions (dust, dirt and debris) may require more frequent service.

Refer to the Service Manual for the type of air compressor that is installed on the engine. Follow the maintenance recommendations that are provided by the OEM of the air compressor. Some engines use boost air pressure so the engine air cleaner will require servicing.

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## Air Dryer - Check

**SMCS Code:** 4285-535

Follow the maintenance recommendations that are provided by the OEM or consult your Caterpillar dealer for assistance.

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## Alternator - Inspect

**SMCS Code:** 1405-040

Caterpillar recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and proper battery charging. Inspect the ammeter (if equipped) during engine operation in order to ensure proper battery performance and/or proper performance of the electrical system. Make repairs, as required. Refer to the Service Manual.

Check the alternator and the battery charger for proper operation. If the batteries are properly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. The battery will not crank the engine, even if the engine is warm. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

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## Battery - Replace

**SMCS Code:** 1401-510



### **WARNING**

**Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.**

**Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.**



### **WARNING**

**The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.**

**Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.**

1. Turn the key start switch to the OFF position. Remove the key and all electrical loads.
2. Turn OFF the battery charger. Disconnect the charger.
3. The NEGATIVE “-” cable connects the NEGATIVE “-” battery terminal to the ground plane. Disconnect the cable from the NEGATIVE “-” battery terminal.
4. The POSITIVE “+” cable connects the POSITIVE “+” battery terminal to the starting motor. Disconnect the cable from the POSITIVE “+” battery terminal.

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**Note:** Always recycle a battery. Never discard a battery. Return used batteries to an appropriate recycling facility.

5. Remove the used battery.

6. Install the new battery.

**Note:** Before the cables are connected, ensure that the key start switch is OFF.

7. Connect the cable from the starting motor to the POSITIVE "+" battery terminal.

8. Connect the cable from the ground plane to the NEGATIVE "-" battery terminal.

## Battery Electrolyte Level - Check

**SMCS Code:** 1401-535

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing.



### WARNING

**All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.**

1. Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.

If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.

2. Check the condition of the electrolyte with the 245-5829 Coolant Battery Tester Refractometer.
3. Keep the batteries clean.

Clean the battery case with one of the following cleaning solutions:

- A mixture of 0.1 kg (0.2 lb) of baking soda and 1 L (1 qt) of clean water
- A mixture of 0.1 L (0.11 qt) of ammonia and 1 L (1 qt) of clean water

Thoroughly rinse the battery case with clean water.

Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit properly. Coat the clamps and the terminals with 5N-5561 Silicone Lubricant, petroleum jelly or MPGM.



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## Battery or Battery Cable - Disconnect

**SMCS Code:** 1402-029



### **WARNING**

**The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.**

**Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.**

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal at the battery that goes to the start switch. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, the negative side of two batteries must be disconnected.
3. Tape the leads in order to help prevent accidental starting.
4. Proceed with necessary system repairs. Reverse the steps in order to reconnect all of the cables.

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## Belt - Inspect

**SMCS Code:** 1357-040; 1357; 1397-040; 1397

### Inspection

**Belt tension should be checked initially between the first 20 to 40 hours of engine operation.**

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Check the belt tension. Refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" topic (Maintenance Section) for the proper intervals.

To check the belt tension, apply 110 N (25 lb ft) of force midway between the pulleys. A correctly adjusted belt will deflect 9 mm (0.35 inch) to 15 mm (0.59 inch).

To maximize the engine performance, inspect the belts for wear and for cracking. Replace belts that are worn or damaged.

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belt is stretched. The additional load on the new belt could cause the new belt to break.

If the belts are too loose, vibration causes unnecessary wear on the belts and pulleys. Loose belts may slip enough to cause overheating.

If the belts are too tight, unnecessary stresses are placed on the pulley bearings and on the belts. This may shorten the service life of the components.

Remove the belt guard. Inspect the condition and adjustment of the alternator belts and accessory drive belts (if equipped).

If the belt does not require replacement or adjustment, install the belt guard. If the belt requires adjustment or replacement, perform the following procedure to adjust the belt tension.

- If the engine is equipped with a refrigerant compressor (air conditioner), the belt for the fan drive, the alternator, and the accessories will have an automatic belt tensioner.
- If the engine is not equipped with a refrigerant compressor, the alternator is used to adjust the belt tension.

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## Adjustment

### Alternator Belt

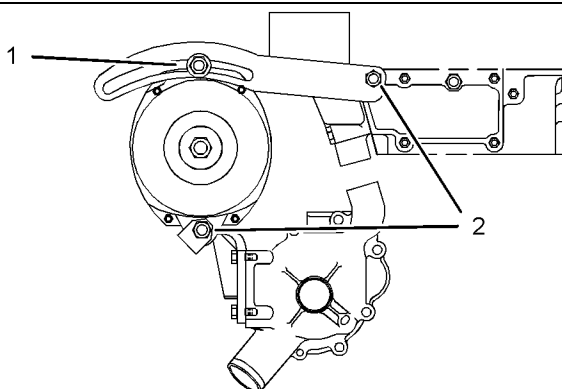


Illustration 17

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- (1) Adjusting bolt  
(2) Mounting bolts

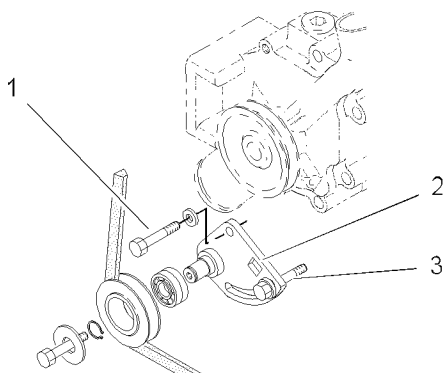
1. Slightly loosen mounting bolts (2) and adjusting bolt (1).
2. Move the pulley in order to adjust the belt tension.
3. Tighten adjusting bolt (1) and mounting bolts (2). For the proper torque, refer to the Specifications Manual, SENR3130, "Torque Specifications".
4. Install the belt guard.

If new belts are installed, check the belt tension again after 30 minutes of engine operation at the rated rpm.

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## Water Pump Belt

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Illustration 18

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Exploded view of the drive assembly for a water pump belt

- (1) Mounting bolt
- (2) Square hole
- (3) Adjusting bolt

1. Slightly loosen mounting bolts (1) and adjusting bolt (3).
2. Adjust the belt tension with a square drive in square hole (2).
3. Tighten adjusting bolt (3) and mounting bolt (1). For the proper torque, refer to the Specifications Manual, SENR3130, "Torque Specifications".
4. Install the belt guard.

If new belts are installed, check the belt tension after 30 minutes of engine operation at the rated rpm.

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## Belt Tensioner - Inspect (If Equipped)

**SMCS Code:** 1358-040

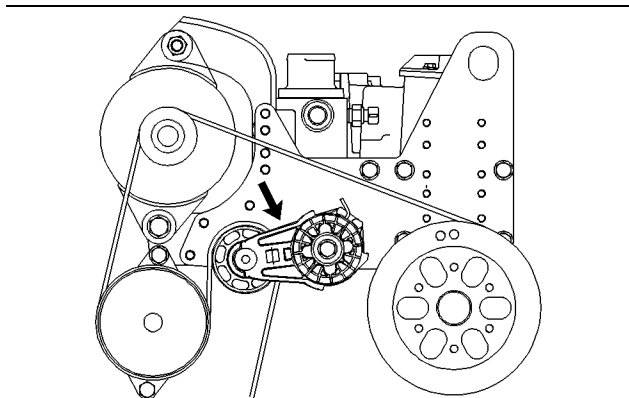


Illustration 19  
Belt tensioner

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Inspect the belt tensioner for unusual noise, excessive looseness and/or shaking of the bearings.

If the belt tensioner should require disassembly, refer to the Service Manual for the procedure.

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## Cooling System Coolant (DEAC) - Change

**SMCS Code:** 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.

- The fuel has entered the cooling system and the coolant is contaminated.

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#### NOTICE

Use of commercially available cooling system cleaners may cause damage to cooling system components. Use only cooling system cleaners that are approved for Caterpillar engines.

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**Note:** Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

## Drain



### WARNING

**Pressurized System:** Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

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1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove one of the drain plugs.

**Note:** If equipped, be sure to drain the heater and any related supply and return lines.

Allow the coolant to drain.

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#### NOTICE

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

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For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Dealer Service Tool Group:

Outside Illinois: 1-800-542-TOOL  
Inside Illinois: 1-800-541-TOOL  
Canada: 1-800-523-TOOL

## Flush

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual, SENR3130, "Torque Specifications" for more information on the proper torques.

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### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

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3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 15 L (4 US gal) of the cooling system capacity. Install the cooling system filler cap.
4. Start and run the engine at low idle for a minimum of 30 minutes. The coolant temperature should be at least 82 °C (180 °F).

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### NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

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5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. If equipped, be sure to flush the heater and any related supply and return lines. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual, SENR3130, "Torque Specifications" for more information on the proper torques.

## Cooling Systems with Heavy Deposits or Plugging

**Note:** For the following procedure to be effective, there must be some active flow through the cooling system components.

1. Flush the cooling system with clean water in order to remove any debris.

**Note:** If equipped, be sure to flush the heater and any related supply and return lines.

2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual, SENR3130, "Torque Specifications" for more information on the proper torques.

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### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

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3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 3.8 to 7.6 L (1 to 2 US gal) of the cooling system capacity. Install the cooling system filler cap.
4. Start and run the engine at low idle for a minimum of 90 minutes. The coolant temperature should be at least 82 °C (180 °F).



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#### NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

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5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual, SENR3130, "Torque Specifications" for more information on the proper torques.

## Fill

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#### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

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1. Fill the cooling system with coolant/antifreeze. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
2. Start and run the engine at low idle. Increase the engine rpm to 1500 rpm. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.
3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).

4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, perform a pressure test. A 9S-8140 Pressurizing Pump is used to perform the pressure test. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

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## Cooling System Coolant (ELC) - Change

**SMCS Code:** 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

**Note:** When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

**Note:** Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

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## Drain



### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

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1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove the cooling system drain plugs.

Allow the coolant to drain.

---

### NOTICE

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

---

For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Dealer Service Tool Group:

Outside Illinois: 1-800-542-TOOL  
Inside Illinois: 1-800-541-TOOL  
Canada: 1-800-523-TOOL

## Flush

1. Flush the cooling system with clean water in order to remove any debris.

**Note:** If equipped, be sure to flush the heater and any related supply and return lines.

- 
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. For the proper torque, refer to the Specifications Manual, SENR3130, "Torque Specifications".

---

**NOTICE**

Fill the cooling system no faster than 19 L (5 US gal)  
per minute to avoid air locks.

---

3. Fill the cooling system with clean water. Install the cooling system filler cap.
4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).
5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. For the proper torque, refer to the Specifications Manual, SENR3130, "Torque Specifications".

## Fill

---

**NOTICE**

Fill the cooling system no faster than 19 L (5 US gal)  
per minute to avoid air locks.

---

1. Fill the cooling system with Extended Life Coolant (ELC). See Special Publication, SEBU6385, "Caterpillar On-highway Diesel Truck Engine Fluids Recommendations" for more information on cooling system specifications. Do not install the cooling system filler cap.
2. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.
3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).

- 
4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a 9S-8140 Pressurizing Pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
  5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

i02482066

## Cooling System Coolant Extender (ELC) - Add

**SMCS Code:** 1352-045; 1395-081

Cat ELC (Extended Life Coolant) does not require the frequent additions of any supplemental cooling additives which are associated with the present conventional coolants. The Cat ELC Extender only needs to be added once.

---

### NOTICE

Use only Cat Extended Life Coolant (ELC) Extender with Cat ELC.

Do NOT use conventional supplemental coolant additive (SCA) with Cat ELC. Mixing Cat ELC with conventional coolants and/or conventional SCA reduces the Cat ELC service life.

---

Check the cooling system only when the engine is stopped and cool.

**WARNING**

**Personal injury can result from hot coolant, steam and alkali.**

**At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.**

**Remove cooling system pressure cap slowly to relieve pressure only when engine is stopped and cooling system pressure cap is cool enough to touch with your bare hand.**

**Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.**

**Cooling System Coolant Additive contains alkali. Avoid contact with skin and eyes.**

---

---

**NOTICE**

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Dealer Service Tool Catalog" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

---

1. Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.
2. It may be necessary to drain enough coolant from the cooling system in order to add the Cat ELC Extender.

3. Add Cat ELC Extender according to the requirements for your engine's cooling system capacity. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" article for more information.
4. Clean the cooling system filler cap. Inspect the gaskets on the cooling system filler cap. Replace the cooling system filler cap if the gaskets are damaged. Install the cooling system filler cap.

i01197583

## Cooling System Coolant Level - Check

**SMCS Code:** 1395-082

Check the coolant level when the engine is stopped and cool.

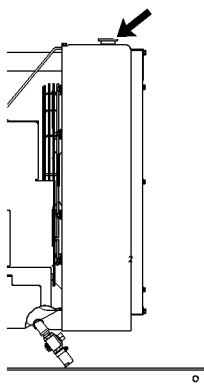


Illustration 20

g00285520

Cooling system filler cap



### **WARNING**

**Pressurized System:** Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Remove the cooling system filler cap slowly in order to relieve pressure.

- 
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the proper level in the sight glass.

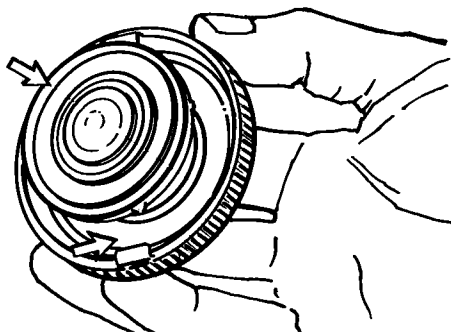


Illustration 21

g00103639

Typical filler cap gaskets

3. Clean the cooling system filler cap and check the condition of the filler cap gaskets. Replace the cooling system filler cap if the filler cap gaskets are damaged. Reinstall the cooling system filler cap.
4. Inspect the cooling system for leaks.

i02440893

## Cooling System Supplemental Coolant Additive (SCA) - Test/Add

**SMCS Code:** 1352-045; 1395-081

---

### NOTICE

Cooling system coolant additive contains alkali. To help prevent personal injury, avoid contact with the skin and the eyes. Do not drink cooling system coolant additive.

---

**Note:** Test the Supplemental Coolant Additive (SCA) or test the SCA concentration as part of an S·O·S Coolant Analysis.



## Test the SCA Concentration

### Coolant and SCA

---

#### NOTICE

Do not exceed the recommended six percent supplemental coolant additive concentration.

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#### WARNING

**Cooling system coolant additive contains alkali. To help prevent personal injury, avoid contact with the skin and the eyes. Do not drink cooling system coolant additive.**

---

Use the 8T-5296 Coolant Conditioner Test Kit or use the 4C-9301 Coolant Conditioner Test Kit in order to check the concentration of the SCA. See Special Publication, SEBU6385, "Caterpillar On-highway Diesel Truck Engine Fluids Recommendations" for more information.

## S·O·S Coolant Analysis

S·O·S coolant samples can be analyzed at your Caterpillar dealer. S·O·S Coolant Analysis is a program that is based on periodic samples.

### Level I

Level I is a basic analysis of the coolant. The following items are tested:

- Glycol Concentration
- Concentration of SCA
- pH
- Conductivity

The results are reported, and recommendations are made according to the results. Consult your Caterpillar dealer for information on the benefits of managing your equipment with an S·O·S Coolant Analysis.

---

## Add the SCA, If Necessary

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### NOTICE

Do not exceed the recommended amount of supplemental coolant additive concentration. Excessive supplemental coolant additive concentration can form deposits on the higher temperature surfaces of the cooling system, reducing the engine's heat transfer characteristics. Reduced heat transfer could cause cracking of the cylinder head and other high temperature components. Excessive supplemental coolant additive concentration could also result in radiator tube blockage, overheating, and/or accelerated water pump seal wear. Never use both liquid supplemental coolant additive and the spin-on element (if equipped) at the same time. The use of those additives together could result in supplemental coolant additive concentration exceeding the recommended maximum.

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### WARNING

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

---

1. Slowly loosen the cooling system filler cap in order to relieve the pressure. Remove the cooling system filler cap.

**Note:** Always discard drained fluids according to local regulations.

2. If necessary, drain some coolant from the cooling system into a suitable container in order to allow space for the extra SCA.
3. Add the proper amount of SCA. Refer to Operation and Maintenance Manual, SEBU6385, "Caterpillar On-highway Diesel Truck Engines Fluids Recommendations" for more information on SCA requirements.
4. Clean the cooling system filler cap. Inspect the gaskets of the cooling system filler cap. If the gaskets are damaged, replace the old cooling system filler cap with a new cooling system filler cap. Install the cooling system filler cap.

i02623972

## Cooling System Water Temperature Regulator - Replace

**SMCS Code:** 1355-510

Replace the water temperature regulator before the water temperature regulator fails. This is a recommended preventive maintenance practice. Replacing the water temperature regulator reduces the chances for unscheduled downtime.

A water temperature regulator that fails in a partially opened position can cause overheating or overcooling of the engine.

A water temperature regulator that fails in the closed position can cause excessive overheating. Excessive overheating could result in cracking of the cylinder head or piston seizure problems.

A water temperature regulator that fails in the open position will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon buildup inside the cylinders. This excessive carbon buildup could result in an accelerated wear of the piston rings and wear of the cylinder liner.

---

### NOTICE

Failure to replace your water temperature regulator on a regularly scheduled basis could cause severe engine damage.

Caterpillar engines incorporate a shunt design cooling system and require operating the engine with a water temperature regulator installed.

If the water temperature regulator is installed incorrectly, the engine may overheat, causing cylinder head damage. Ensure that the new water temperature regulator is installed in the original position. Ensure that the water temperature regulator vent hole is open.

Do not use liquid gasket material on the gasket or cylinder head surface.

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Refer to two articles in the Disassembly and Assembly Manual, "Water Temperature Regulators - Remove and Water Temperature Regulators - Install" for the replacement procedure of the water temperature regulator, or consult your Caterpillar dealer.

**Note:** If only the water temperature regulators are replaced, drain the coolant from the cooling system to a level that is below the water temperature regulator housing.

i00072369

## Crankshaft Vibration Damper - Inspect

**SMCS Code:** 1205-040

Damage to the crankshaft vibration damper or failure of the crankshaft vibration damper can increase torsional vibrations. This can result in damage to the crankshaft and to other engine components. A deteriorating damper can cause excessive gear train noise at variable points in the speed range.

The damper is mounted to the crankshaft which is located behind the belt guard on the front of the engine.

## Removal and Installation

Refer to the Service Manual for the damper removal procedure and for the damper installation procedure.

## Visconic Damper

The visconic damper has a weight that is located inside a fluid filled case. The weight moves in the case in order to limit torsional vibration. Inspect the damper for evidence of dents, cracks or leaks of the fluid.

Replace the damper if the damper is dented, cracked or leaking. Refer to the Service Manual or consult your Caterpillar dealer for damper replacement.

i00856194

## Cylinder Head Grounding Stud - Inspect/Clean/Tighten

**SMCS Code:** 7423-040; 7423-070; 7423-079

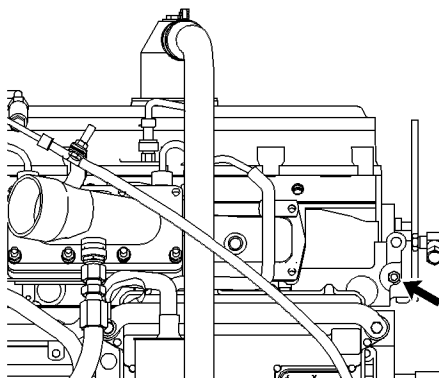


Illustration 22

g00427181

Cylinder head grounding stud

Inspect the OEM harness for good connections and condition.

The cylinder head grounding stud must have a wire ground to the battery. Tighten the cylinder head grounding stud at every oil change. Ground wires and straps should be combined at engine grounds. All grounds should be tight and free of corrosion.

- Clean the cylinder head grounding stud and the terminals for the cylinder head ground strap with a clean cloth.
- If the connections are corroded, clean the connections with a solution of baking soda and water.
- Keep the cylinder head grounding stud and the strap clean and coated with MPGM grease or petroleum jelly.

i01646701

## Engine - Clean

**SMCS Code:** 1000-070



### WARNING

**Personal injury or death can result from high voltage.**

**Moisture can create paths of electrical conductivity.**

**Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls "DO NOT OPERATE".**

---

### NOTICE

Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

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Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

**Note:** Caution must be used in order to prevent electrical components from being damaged by excessive water when you clean the engine. Avoid electrical components such as the alternator, the starter, and the ECM.

i00857000

## Engine Air Cleaner Element - Clean/Replace

**SMCS Code:** 1054-070; 1054-510

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### NOTICE

Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

---

If the air cleaner element becomes plugged, the air can split the material of the air cleaner element. Unfiltered air will drastically accelerate internal engine wear.

- Operating conditions (dust, dirt and debris) may require more frequent service of the air cleaner element.
- The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Replace the dirty paper air cleaner elements with clean air cleaner elements. Before installation, the air cleaner elements should be thoroughly checked for tears and/or holes in the filter material. Inspect the gasket or the seal of the air cleaner element for damage. Maintain a supply of suitable air cleaner elements for replacement purposes.

Your Caterpillar dealer has the proper air cleaner elements for your application. Consult your Caterpillar dealer for the correct air cleaner element or follow the instructions that are provided by the OEM.

i01900118

## Engine Air Cleaner Service Indicator - Inspect (If Equipped)

**SMCS Code:** 7452-040

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner housing or in a remote location.

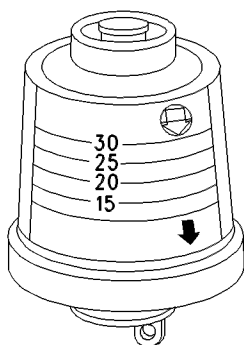


Illustration 23

g00103777

Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

## Test the Service Indicator

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.



- 
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be plugged.

The service indicator may need to be replaced frequently in environments that are severely dusty, if necessary. Replace the service indicator annually regardless of the operating conditions. Replace the service indicator when the engine is overhauled, and whenever major engine components are replaced.

**Note:** When a new service indicator is installed, excessive force may crack the top of the service indicator. Tighten the service indicator to a torque of 2 N·m (18 lb in).

i02150070

## Engine Crankcase Breather - Clean

**SMCS Code:** 1317-070

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### NOTICE

Perform this maintenance with the engine stopped.

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---

### NOTICE

If the crankcase breather is not maintained on a regular basis, it can become plugged. A plugged breather will cause excessive crankcase pressure that may cause crankshaft seal leakage.

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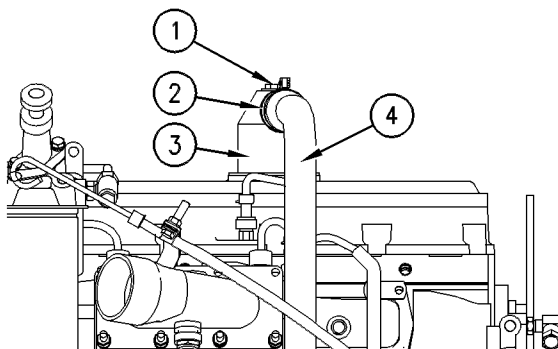


Illustration 24

g00428148

- (1) Bolt
- (2) Hose clamp
- (3) Breather assembly
- (4) Hose

1. Loosen hose clamp (2) and remove the hose from breather assembly (3).
2. Loosen the retaining clamp. Remove the breather assembly (3) and the seal.
3. Wash the breather element in solvent that is clean and nonflammable. Allow the breather element to dry before installation.
4. Install a breather element that is clean and dry. Install breather assembly and seal (3) and install the retaining clamp. Refer to the Operation and Maintenance Manual for the proper torques.
5. Install the hose. Install hose clamp (2). For proper torque, refer to the Specifications Manual, SENR3130, "Torque Specifications".

i02139969

## Engine Mounts - Inspect

**SMCS Code:** 1152-040

Inspect the engine mounts for deterioration and for proper bolt torque. Engine vibration can be caused by the following conditions:

- Improper mounting of the engine
- Deterioration of the engine mounts

Any engine mount that shows deterioration should be replaced. Refer to the Specifications Manual, SENR3130, "Torque Specifications". Refer to your Caterpillar dealer for more information.

i02113104

## Engine Oil Level - Check

**SMCS Code:** 1348-535-FLV



### **WARNING**

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

---

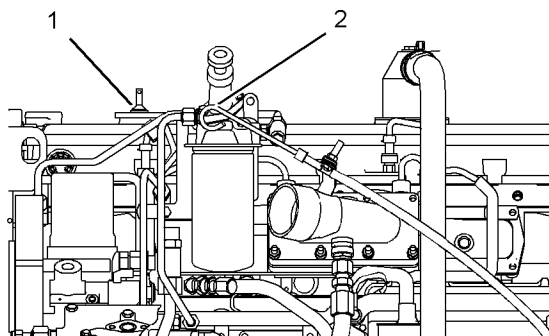


Illustration 25

g01076429

- (1) Oil filler cap  
(2) Oil level gauge

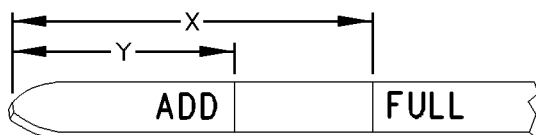


Illustration 26

g00110310

- (Y) "ADD" mark  
(X) "FULL" mark

### NOTICE

Perform this maintenance with the engine stopped.

**Note:** Before you perform this maintenance, do not operate the engine for at least 10 minutes in order to allow the engine oil to return to the oil pan.

1. Maintain the oil level between "ADD" mark (Y) and "FULL" mark (X) on oil level gauge (1). Do not fill the crankcase above "FULL" mark (X).

---

#### NOTICE

Engine damage can occur if the crankcase is filled above the "FULL" mark on the oil level gauge (dipstick).

An overfull crankcase can enable the crankshaft to dip into the oil. This will reduce the power that is developed and also force air bubbles into the oil. These bubbles (foam) can cause the following problems: reduction of the oil's ability to lubricate, reduction of oil pressure, inadequate cooling of the pistons, oil blowing out of the crankcase breathers, and excessive oil consumption.

Excessive oil consumption will enable deposits to form on the pistons and in the combustion chamber. Deposits in the combustion chamber lead to the following problems: guttering of the valves, packing of carbon under the piston rings, and wear of the cylinder liner.

If the oil level is above the "FULL" mark on the oil level gauge, drain some of the oil immediately.

---

2. Remove oil filler cap (2) and add oil, if necessary. For the correct oil to use, refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations". Do not fill the crankcase above "FULL" mark (X) on the oil level gauge. Clean the oil filler cap. Install the oil filler cap.
3. Record the amount of oil that is added. For the next oil sample and analysis, include the total amount of oil that has been added since the previous sample. This will help to provide the most accurate oil analysis.

i02005382

## Engine Oil Level Gauge - Calibrate

**SMCS Code:** 1326-524

### Check Calibration at the First Oil Change

The engine oil level will vary depending on the angle and the slant of the engine installation. The angle is the front to back tilt. The slant is the sideways tilt.

The oil level gauge markings must be verified in order to ensure that the markings are correct. Verify the oil level gauge markings at the first oil change.

Verify the “ADD” mark and verify the “FULL” mark that is on the oil level gauge. Use the following procedure.

---

#### NOTICE

The vehicle must be parked on a level surface in order to perform this maintenance procedure.

---

1. Operate the engine until normal operating temperature is achieved. Stop the engine. Remove the crankcase oil drain plugs. The oil drain plug from the deep portion of the oil pan should be removed. Drain the oil from the crankcase for 20 minutes.
2. Remove the used oil filter(s). Install the new oil filter(s). Install the oil drain plugs and tighten to  $70 \pm 15 \text{ N}\cdot\text{m}$  ( $50 \pm 11 \text{ lb ft}$ ).

**Note:** Your engine may be equipped with auxiliary oil filters. The auxiliary oil filters require a different volume of oil. Refer to the OEM specifications for the auxiliary oil filter.

Table 14

Refill Capacities for 3126 On-highway Engines				
Sump	“ADD” Mark	“Full” Mark	Additional	Total Fill
Shallow (178 mm (7 inch) deep)	16 L (17 qt)	4 L (4 qt)	1 L (1 qt)	21 L (22 qt)
Deep (241 mm (9.5 inch) deep)	23 L (24 qt)	4 L (4 qt)	1 L (1 qt)	28 L (30 qt)

3. Determine the sump that is installed on the engine and locate the sump capacity in table 14.
4. Pour the correct volume of oil into the crankcase. The correct volume will be found under the “ADD” Mark in table 14. Allow enough time for the oil to drain into the crankcase. Approximately 20 minutes should be allowed. Check the oil level. Wait for several minutes and check the oil level again. Proceed after the oil level stops changing.
5. Check the oil level on the oil level gauge. The oil level should be at the “ADD” mark. If the oil level is not at the existing “ADD” mark, grind off the “ADD” mark and engrave the new “ADD” level. Use an engraving pen in order to engrave the new “ADD” mark.
6. Locate the sump capacity of the engine again in table 14. Pour the correct volume of oil into the crankcase. The correct volume will be found under the “Full” Mark in table 14. Allow enough time for the oil to drain into the crankcase.
7. Check the oil level on the oil level gauge. The oil level should be at the “FULL” mark. If the oil level is not at the existing “FULL” mark, grind off the “FULL” mark. Use an engraving pen in order to engrave the new “FULL” mark.
8. Locate the sump capacity of the engine again in table 14 and add the “additional” amount in order to allow oil to fill the engine oil filter.

---

**NOTICE**

Do not crank the engine for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking again.

---

9. Start the engine and run the engine enough to ensure that the lubrication system is filled. Inspect the engine for oil leaks.
10. Stop the engine and allow enough time for the oil to drain into the crankcase.
11. Check the oil level on the oil level gauge. If the oil level is not at the calibrated "FULL" mark, fill the crankcase to the calibrated "FULL" mark. Record the amount of oil that was added. This additional oil and the "Total Fill" volume of oil that was in the crankcase is the oil capacity of the lubrication system. Record the oil capacity of the lubrication system for future oil changes.

i01935337

## Engine Oil Sample - Obtain

**SMCS Code:** 1000-008; 1348-554-SM; 7542-554-OC, SM

In addition to a good preventive maintenance program, Caterpillar recommends using S·O·S oil analysis at regularly scheduled intervals in order to monitor the condition of the engine and the maintenance requirements of the engine. S·O·S oil analysis provides infrared analysis, which is required for determining nitration and oxidation levels.

## Obtain the Sample and the Analysis

**WARNING**

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

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Before you take the oil sample, complete the Label, PEEP5031 for identification of the sample. In order to help obtain the most accurate analysis, provide the following information:



- 
- Engine model
  - Service hours on the engine
  - The number of hours that have accumulated since the last oil change
  - The amount of oil that has been added since the last oil change

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

Caterpillar recommends using the sampling valve in order to obtain oil samples. The quality and the consistency of the samples are better when the sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

The 169-8373 Fluid Sampling Bottle is recommended for use with the sampling valve. The fluid sampling bottle includes the parts that are needed for obtaining oil samples. Instructions are also provided.

---

#### NOTICE

Always use a designated pump for oil sampling, and use a separate designated pump for coolant sampling. Using the same pump for both types of samples may contaminate the samples that are being drawn. This contaminate may cause a false analysis and an incorrect interpretation that could lead to concerns by both dealers and customers.

---

If the engine is not equipped with a sampling valve, use the 1U-5718 Vacuum Pump. The pump is designed to accept sampling bottles. Disposable tubing must be attached to the pump for insertion into the sump.

For instructions, see Special Publication, PEHP6001, "How To Take A Good Oil Sample". Consult your Caterpillar dealer for complete information and assistance in establishing an S-O-S program for your engine.

i01947041

## Engine Oil and Filter - Change

**SMCS Code:** 1318-510; 1348-044

### WARNING

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

### NOTICE

The vehicle must be parked on a level surface for this maintenance procedure.

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase while the oil is warm. This draining method will allow the waste particles that are suspended in the oil to be properly drained.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

## Drain the Engine Oil

After the engine has been run at the normal operating temperature, stop the engine. Attach a "DO NOT OPERATE" or a similar warning tag to the ignition key switch before the engine is serviced. Catch the oil in a suitable container. Recycle the used oil, or dispose of the used oil properly.

1. Remove the oil drain plug in order to allow the oil to drain.
2. After the oil has drained, the oil drain plug should be cleaned and installed.

Tighten the oil drain plug to the following torque: ..... 70 ± 15 N·m  
(50 ± 11 lb ft)

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## Replace the Oil Filter

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### NOTICE

Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

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1. Remove the oil filter with a 185-3630 Chain Wrench.
- 

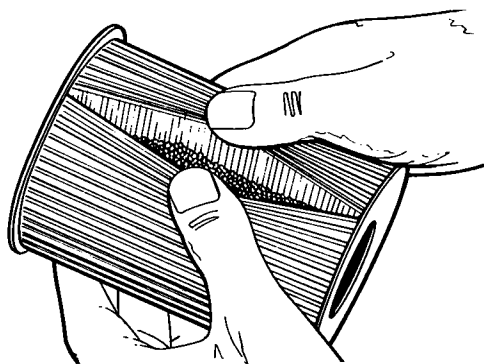


Illustration 27

g00588944

Element with debris

2. Cut the oil filter open with a 175-7546 Oil Filter Cutter. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter. Consult your Caterpillar dealer in order to arrange for a further analysis if an excessive amount of debris is found in the oil filter.

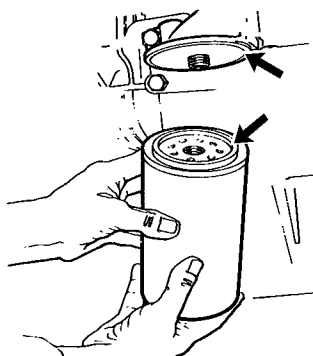


Illustration 28

g00103713

Typical filter mounting base and filter gasket

3. Clean the sealing surface of the filter mounting base. Ensure that all of the old oil filter gasket is removed.
4. Apply clean engine oil to the new oil filter gasket.

---

#### NOTICE

Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

---

5. Install the oil filter. Tighten the oil filter until the oil filter gasket contacts the base. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

## Fill the Engine Crankcase

1. Remove the oil filler cap. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" topic (Maintenance Section) for more information. Fill the crankcase with the proper amount of oil.

---

#### NOTICE

If equipped with an auxiliary oil filter or system, extra oil must be added when filling the crankcase. Follow the OEM or filter manufacturer's recommendations. If the extra oil is not added, the engine may starve for oil.

---

---

#### NOTICE

To help prevent crankshaft or bearing damage, crank engine to fill all filters before starting. Do not crank engine for more than 30 seconds.

---

2. Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.
3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.
4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the "ENGINE STOPPED" side of the oil level gauge.

## Oil Change Interval Adjustments

There are many circumstances under certain conditions that may allow an adjustment to the normal oil change interval. Many conditions that can affect the selection of the best oil change interval exist. The decision is based on the fundamental requirement that lubrication oil should be in an acceptable condition that provides continuous engine protection. The quality of the oil and amount of the oil that is available is balanced against the oil's ability to absorb by-products that are caused by combustion.

Due to the manufacturing tolerances, the engine application, and the maintenance variations, all engines do not consume fuel and oil at the same rate. The amount of fuel that is consumed is in direct relation to the maximum oil change interval that is selected. It is essential to include an S·O·S oil analysis before an adjustment of the oil change interval is considered. For more information on extending oil change intervals, contact your local Caterpillar dealer. S·O·S oil analysis should be used to verify the oil change interval adjustments. Table 15 can be used in order to determine the oil change interval adjustments.

S·O·S oil analysis should be used to verify the oil change interval adjustments. Table 15 can be used in order to determine your oil change interval adjustments.

## Table for the Oil Change Interval Adjustments

**Note: Metric units are listed before English units.**

**Note: Use of table 15 assumes the use of a recommended oil type.**

Table 15

Permissible Oil Change Interval				
Oil Capacity of the Engine in Liters (quarts)	Vehicle Applications			
	Light Duty <sup>(1)</sup>	Medium Duty <sup>(2)</sup>	Heavy Duty <sup>(3)</sup>	Severe Service <sup>(4)</sup>
	KM (Miles) to Next Oil Change			
18 (20)	19,320 (12,000)	16,000 (10,000)	12,890 (8,000)	9,670 (6,000)
21 (22) <sup>(5)</sup>	21,260 (13,200)	17,710 (11,000)	14,170 (8,800)	10,960 (6,800) <sup>(6)</sup>
23 (24)	23,190 (14,400)	19,320 (12,000)	15,460 (9,600)	12,230 (7,600)
25 (26)	25,110 (15,600)	20,930 (13,000)	16,750 (10,400)	13,530 (8,400)
27 (28)	27,040 (16,800)	22,540 (14,000)	18,040 (11,200)	14,810 (9,200)
28 (30) <sup>(7)</sup>	28,980 (18,000)	24,000 (15,000)	19,320 (12,000)	16,100 (10,000) <sup>(6)</sup>
30 (32)	30,900 (19,200)	25,760 (16,000)	20,510 (12,800)	17,380 (10,800)
32 (34)	32,850 (20,400)	27,370 (17,000)	21,900 (13,600)	18,670 (11,600)
34 (36)	34,770 (21,600)	28,980 (18,000)	23,190 (14,400)	19,970 (12,400)
36 (38)	36,700 (22,800)	30,590 (19,000)	24,470 (15,200)	21,260 (13,200)

(continued)

(Table 15, contd)

38 (40)	38,640 (24,000)	32,200 (20,000)	25,760 (16,000)	22,540 (14,000)
40 (42)	40,580 (25,200)	33,810 (21,000)	27,050 (16,800)	23,830 (14,800)

- (1) Typical applications are Recreational Vehicles and intercity delivery (average that is greater than 10 mpg).
- (2) Typical applications are intracity driving (average 8 to 10 mpg).
- (3) Typical applications are bus services and pickup and/or delivery services (less than 8 mpg).
- (4) Less than 6 mpg refer to the Operation and Maintenance Manual, "Severe Service Application - Check" for the requirements.
- (5) The capacity of the shallow oil sump is 21 L (22 qt).
- (6) It is important to understand the operation of your vehicle. Use the fuel consumption, service hours, or calendar time, **whichever occurs first**, in order to determine the maintenance intervals. Engines which operate in severe operating conditions may require more frequent maintenance.
- (7) The capacity of the deep oil sump is 28 L (30 qt).

There are many applications of medium duty truck engines. It is important to understand the operation of your vehicle. Use the fuel consumption, service hours, or calendar time, **whichever occurs first**, in order to determine the maintenance intervals. Engines which operate in severe operating conditions may require more frequent maintenance.

•

## Instructions for the Table

1. Determine your type of vehicle application. Locate the column which lists your type of vehicle application.
2. Determine your available oil in liters or quarts. The oil quantity equals the sum of the capacities of the oil sump and the oil filter. Locate the row which lists your available oil.
3. The intersection of the column and the row lists the maximum permissible number of kilometers or miles between oil change intervals.

---

**Example**

You determined that the vehicle application is light duty commercial. The oil capacity of the engine is 21 L (22 qt) and the oil capacity of the auxiliary oil filter is 10 L (10 qt). With S·O·S Oil Analysis verification, the maximum permissible oil change interval is 30900 kilometers (19200 miles).

For more information on optimizing oil change intervals, see your Caterpillar dealer.



## Engine Storage Procedure - Check

**SMCS Code:** 1000-535

The oil change interval may be extended to 12 months for a vehicle that is operated seasonally and placed in storage for the remainder of the year by using the required storage procedures and the required start-up procedures. This extension is permitted if the following categories for oil change intervals in the Operation and Maintenance Manual, "Maintenance Interval Schedule" have not been reached:

- Mileage
- Operating hours
- Fuel consumption

If an engine is out of operation and if use of the engine is not planned, special precautions should be made. If the engine will be stored for more than three months, a complete protection procedure is recommended. For more detailed information on engine storage, see Special Instruction, SEHS9031, "Storage Procedure For Caterpillar Products".

If the engine will not be started for several weeks, the lubricating oil will drain from the cylinder walls and from the piston rings. Rust can form on the cylinder liner surface. Rust on the cylinder liner surface will cause increased engine wear and a reduction in engine service life. Caterpillar recommends the use of volatile corrosion inhibitor (VCI) oil in order to prevent internal engine damage due to moisture during storage. These inhibitors in the VCI oil act by evaporating inside the engine. The inhibitors then condense over the inside surfaces of the engine. The evaporation process and the condensing process offers full protection to surfaces that cannot be reached with preservatives. 0.9 L (1.0 qt) of 4C-6792 VCI oil will treat 28.4 L (30.0 qt) of engine oil. This will give a 3 percent concentration of VCI oil. The engine must be completely sealed when the engine is stored in order for the VCI oil to function properly. The VCI oil is easily cleaned from the engine when you remove the engine from storage. The volatile vapors are removed by simply running the engine to operating temperature. A mineral oil base is left behind after the volatile vapors are removed.

i00869628

## Engine Valve Lash - Inspect/Adjust

**SMCS Code:** 1102-025

The initial valve lash adjustment on new engines, rebuilt engines, or remanufactured engines is recommended at the first scheduled oil change. The adjustment is necessary due to the initial wear of the valve train components and to the seating of the valve train components.

This maintenance is recommended by Caterpillar as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

---

### NOTICE

Only qualified service personnel should perform this maintenance. Refer to the Service Manual or your Caterpillar dealer for the complete valve lash adjustment procedure.

Operation of Caterpillar engines with improper valve adjustments can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.



### WARNING

**Ensure that the engine can not be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.**

**Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.**

Ensure that the engine is stopped before measuring the valve lash. To obtain an accurate measurement, allow the valves to cool before this maintenance is performed.

Refer to the Service Manual for more information.

i02657492

## Exhaust Filter (Particulate Trap) - Clean

**SMCS Code:** 1091-070

**S/N:** DPF1-Up



### WARNING

**Wear goggles, gloves, protective clothing and a dust respirator certified by the National Institute for Occupational Safety and Health (NIOSH) and by the Mine Safety and Health Administration (MSHA) when cleaning the diesel particulate filter. Failure to do so could result in personal injury.**

The diesel particulate filter (DPF) can be cleaned. Perform a back pressure test in order to determine if the DPF needs to be cleaned. Refer to Operation and Maintenance Manual, "Exhaust Particulate Filter - Test".

**Note:** If the red warning light has been activated, do not perform a back pressure test. The catalyst section could begin to regenerate. This will damage the DPF.

Caterpillar recommends recording when the DPF is cleaned. Record the cleaning in the Operation and Maintenance Manual, "Maintenance Log". Perform a back pressure test prior to cleaning the DPF and record the results. After cleaning the DPF, run the engine on high idle for 5 to 15 minutes. Perform another back pressure test and record the results. Refer to this Operation and Maintenance Manual, "Exhaust Particulate Filter - Test" for the testing procedure.

## Removal of the Filter Module



### WARNING

**Hot engine components can cause injury from burns. Before performing maintenance on the engine, allow the engine and the components to cool.**

Use a marker on the catalyst module and on the filter module in order to indicate the direction of flow prior to disassembly.

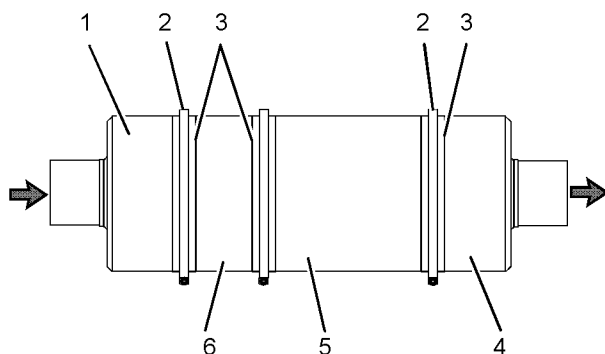


Illustration 29

g01335326

- (1) Inlet module
- (2) Clamp
- (3) Gasket
- (4) Outlet module
- (5) Filter module
- (6) Catalyst module

**Note:** Lifting equipment should be used for a DPF that is installed in a horizontal position and for a DPF that is installed in a vertical position. A filter that is damaged from contact is not covered by the Caterpillar warranty.

The DPF is divided into 4 modules. Each module of the DPF is secured to the previous module with a clamp and with a gasket. Use the following procedure in order to disassemble the DPF.

1. Remove the gasket and the clamp between the inlet module and the catalyst module. Separate the inlet module from the catalyst module.
2. Remove the gasket and the clamp between the catalyst module and the filter module. Separate the catalyst module from the filter module.
3. Remove the gasket and the clamp between the filter module and the outlet module. Separate the filter module from the outlet module.
4. Inspect the inlet module and inspect the outlet module. If there is damage to either of the modules, replace the module that is damaged.
5. Inspect the clamps. If the clamps are not damaged, the clamps can be used again. The gaskets can not be used again. Dispose of the gaskets.

---

**Note:** See your Caterpillar dealer in order to replace any of the components of the DPF. Also see your Caterpillar dealer in order to replace the entire DPF.

## Inspection of the Filter Module

The inlet surface of the filter module will be black due to a coating of soot. The outlet surface should show no evidence of soot. Replace the filter module if there are black deposits on the outlet side. The black deposits are soot.

**Note:** Inspect the inlet surface and inspect the outlet surface of the filter module for missing or cracked ceramic pieces. Replace the filter module if any ceramic pieces are damaged or lost. A damaged filter module will not meet the emissions requirements. A damaged filter module must be replaced. Refer to the "Installation of the DPF" information in this article.

## Inspection of the Catalyst Module

Inspect the inlet surface and inspect the outlet surface of the catalyst module for missing or cracked ceramic pieces. Replace the catalyst module if any ceramic pieces are damaged or lost. A damaged catalyst module will not meet the emissions requirements. A damaged catalyst module must be replaced. Refer to the "Installation of the DPF" information in this article.

## Filter Module Cleaning Equipment



### **WARNING**

**Wear goggles, gloves, protective clothing and a dust respirator certified by the National Institute for Occupational Safety and Health (NIOSH) and by the Mine Safety and Health Administration (MSHA) when cleaning the diesel particulate filter. Failure to do so could result in personal injury.**

---

The following equipment is required to clean the DPF:

- Dry pressurized air supply with 690 kPa (100 psi)
- A high pressure sprayer with a short rubber hose on the end of the nozzle

- 
- 229-0766 filter bag or equivalent filter bag

## **Filter Bags**

The filter bags are available from your Caterpillar dealer. The filter bags will trap particles as small as 5 microns. A filter bag can be used 5 to 10 times.

Note: Disposal of filter bags and disposal of the contents of the filter bags should be in accordance with the following applicable laws and regulations:

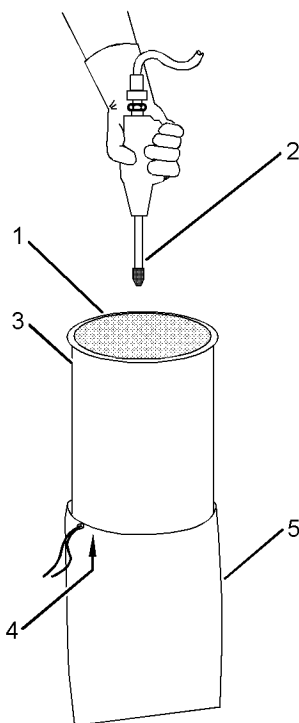
- Federal laws
- State laws
- Local laws or local regulations

Disposal of the filter bags and disposal of the contents of the filter bags should also be in accordance with best management practices.

---

## Cleaning of the Filter Module

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Illustration 30

g01335327

- (1) Outlet surface
- (2) Rubber hose
- (3) Filter module
- (4) Inlet surface
- (5) Filter bag

Use the following procedure in order to properly clean the filter module.

1. Place a filter bag around the inlet side of the filter module. Secure the filter bag to the filter module with the draw string. Position the filter module in a vertical position. Positioning the filter module in this manner will allow the ash to fall into the bag.

2. Blow the ash from the filter module with compressed air. The compressed air must be regulated at 690 kPa (100 psi). The compressed air must be reduced to 205 kPa (30 psi) when the nozzle is deadheaded and with effective chip guarding (if applicable) and personal protective equipment. The air should be dry and free from oil. Do not damage the DPF with the nozzle.
3. The nozzle should be 12.70 mm (0.5 inch) away from the filter module. By using slow circular motions, direct the compressed air through the filter module. Work from the center of the filter module toward the outside of the filter module. Cleaning the DPF will require 30 to 40 minutes. Larger filters generally require longer cleaning times.

## Installation of the DPF

**Note:** The filter module and the catalyst module must be installed with the correct orientation of flow in order to properly function. .

**Note:** The gaskets that are removed from the DPF can not be used again. The clamps that are removed from the DPF can be used again if the clamps are undamaged. If necessary, contact your Caterpillar dealer for new gaskets and for new clamps. Apply 4C-5599 anti-seize compound to the threads of each clamp before installation.

Perform the following procedure to install the catalyst module onto the inlet module. Refer to figure 29.

1. Verify that the arrow on the catalyst module is pointed away from the inlet module.
2. Install a new gasket and an undamaged clamp between the inlet module and the catalyst module. Tighten the clamps to a torque of 20 N·m (15 lb ft).
3. Install a new gasket and an undamaged clamp between the catalyst module and the filter module. Verify that the arrow on the filter module is pointed away from the catalyst module . Tighten the clamps to a torque of 20 N·m (15 lb ft).
4. Install a new gasket and an undamaged clamp between the filter module and the outlet module. Tighten the clamps to a torque of 20 N·m (15 lb ft).



- 
5. Use proper lifting equipment and reinstall the assembled DPF to the chassis. A chassis clamp attaches the DPF to the chassis. When possible, the chassis clamp that attaches the DPF to the chassis should not be installed around the filter module. If the chassis clamp that attaches the DPF to the chassis is attached around the filter module, ensure that the clamp does not exceed 2580 kPa (374 psi) on the filter module.
  6. Check the system for leaks by running the engine at high idle with no load.
  7. Reset the diagnostic module if any alarms have been activated.

## **Performing the Back Pressure Test on the DPF**

Perform a back pressure test after cleaning the DPF. The engine should be at operating temperature. Refer to this Operation and Maintenance Manual, "Exhaust Particulate Filter - Test" for the testing procedure.

i02660911

## **Exhaust Filter (Particulate Trap) - Test**

**SMCS Code:** 1091-081

**S/N:** DPF1-Up

The particulate trap exhaust filter will become restricted with ash and soot from the engine. The restriction will cause the back pressure of the exhaust from the DPF to increase. Testing the back pressure of the exhaust system will determine when the filter module and catalyst module needs to be cleaned.

# Testing Back Pressure

Table 16

Required Tools		
Part Number	Part Name	Quantity
1U-5470 or 198-4240 or 220-3778	Engine Pressure Group or Digital Pressure Indicator or Adapter Cable As	1

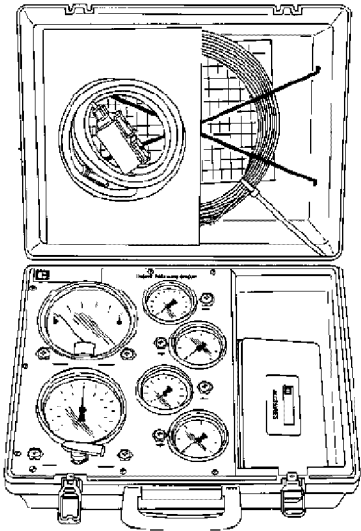


Illustration 31

1U-5470 Engine Pressure Group

g01337083

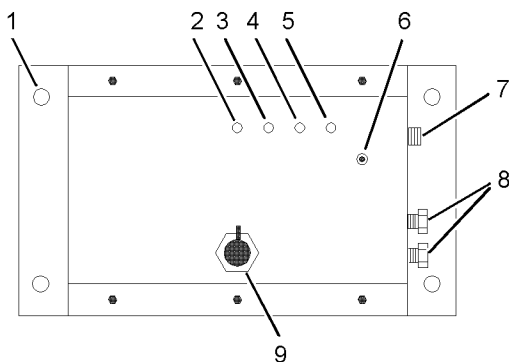


Illustration 32

g01335328

diagnostic module for the DPF

- (1) Mounting holes
- (2) "System status"
- (3) "Over-pressure alarm"
- (4) "Over-temp alarm"
- (5) "System problem"
- (6) "Alarm reset button"
- (7) "Pressure transducer port"
- (8) Wire passage
- (9) "Serial data comm port"

Back pressure can be measured in many different ways. The diagnostic module for the DPF can be connected to a computer and port (9) with 220-3778 Adapter Cable As. You will be able to monitor the back pressure. The history of the back pressure can be downloaded. Refer to Special Instruction, REHS1342, "CRTdm Interface Software Guide".

The back pressure can also be measured with 198-4240 Digital Pressure Indicator. Refer to Special Instruction, NEHS0818, "Using the 198-4240 Digital Pressure Indicator" for the instructions that are needed to use the tool.

The 1U-5470 Engine Pressure Group can also be used to measure the back pressure. Refer to Special Instruction, SEHS8907, "Using the 1U-5470 Engine Pressure Group" for the instructions that are needed to use the tool.

**Back pressure measurements are required at the following intervals:**

- Amber dash light turns on.

- Every 6 months
- 40,234 kilometers (25,000 miles)

**⚠ WARNING**

The muffler and converter will become extremely hot during engine operation. A hot muffler and converter can cause serious burns. Allow adequate cooling time before working on or near the muffler and converter.

**⚠ WARNING**

Making contact with a running engine can cause burns from hot parts and can cause injury from rotating parts.

When working on an engine that is running, avoid contact with hot parts and rotating parts.

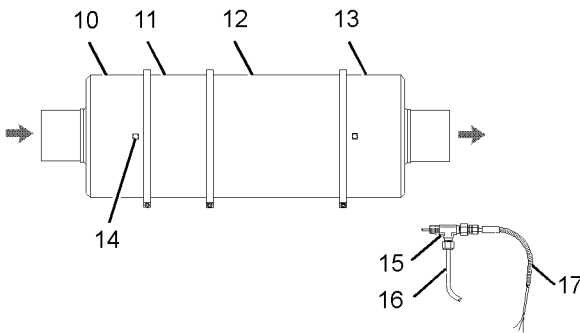


Illustration 33

g01335329

Typical example

- (10) Inlet Module
- (11) Catalyst module
- (12) Filter module
- (13) Outlet Module
- (14) Test location
- (15) Tee fitting
- (16) Copper tubing
- (17) Thermocouple

---

**Note:** Do not test the exhaust back pressure if the “Over-pressure alarm” (3) has been activated. Clean the DPF. Refer to Operation and Maintenance Manual, SEBU7011, “Exhaust Filter (Particulate Trap) - Clean” for the proper procedure.

1. Remove Tee fitting (15) from test port (14). The test location is on the DPF.
2. Connect the pressure port of the differential pressure gauge to the test port.
3. Leave the vacuum port of the differential pressure gauge open to the atmosphere.

**Note:** Watch the back pressure reading as the engine begins to warm up. Stop the test immediately if the back pressure goes above 25 kPa (100 inch of H<sub>2</sub>O). The filter module needs to be cleaned. Refer to Operation and Maintenance Manual, “Exhaust Filter (Particulate Trap) - Clean” for the proper cleaning procedure.

4. Start the engine and run the engine in the no-load condition at high idle until the engine reaches normal operating temperature.
5. Record the value while the engine is operating at high idle.
6. Multiply the value from 5 by 1.8.
7. If the results from Step 6 are greater than 25 kPa (100 inch of H<sub>2</sub>O) the DPF needs to be cleaned. Refer to the Operation and Maintenance Manual, SEBU7011, “Exhaust Particulate Filter - Clean” for the proper cleaning procedure.

i02239650

## Fan Drive Bearing - Lubricate

**SMCS Code:** 1359-086-BD

Some of the fan drives have grease fittings and some of the fan drives do not have grease fittings. If there is no grease fitting, periodic lubrication is not required. The fan drive requires grease only if the fan drive is equipped with a zerk.

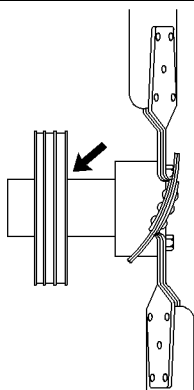


Illustration 34

g00746166

Typical location of the grease fitting (if equipped) that is for the fan drive bearing

The pulley is shown with the belt guards that have been removed.

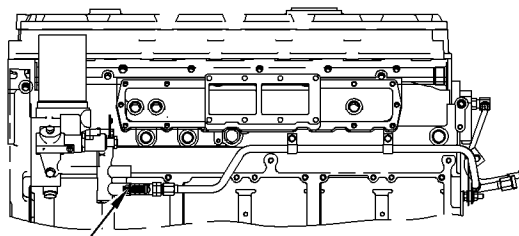
Lubricate the grease fitting that is on the fan drive bearing with Bearing Lubricant or the equivalent.

Inspect the fan drive pulley assembly for wear or for damage. If the shaft is loose, an inspection of the internal components should be performed. Refer to the Service Manual for additional information.

i01632506

## Fuel Inlet Screen - Clean/Inspect/Replace (If Equipped)

**SMCS Code:** 1250-510-Z3; 1250-571-Z3; 1252-040-Z3; 1252-070-Z3;  
1252-510-Z3; 1252-571-Z3; 1252-571; 1252; 1256-040-Z3;  
1256-070-Z3; 1256-510-Z3; 1256



Fuel Inlet Screen

Left Side View

Illustration 35

g00845620

1. Remove the fuel inlet screen. The fuel inlet screen is positioned at the inlet to the fuel transfer pump.
2. Wash the fuel inlet screen in a clean, nonflammable solvent.
3. Inspect the fuel inlet screen. If the fuel inlet screen is damaged, replace the fuel inlet screen.
4. Use pressure air to dry the fuel inlet screen.
5. Inspect the seal in the fuel transfer pump. If the seal is damaged, replace the seal.
6. Install the seal in the fuel transfer pump. Install the clean fuel inlet screen in the fuel transfer pump.

i02113137

## Fuel System - Prime

**SMCS Code:** 1258-548

### WARNING

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

### NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

Prime the fuel system in order to fill the fuel filter. Prime the fuel system in order to purge trapped air. The fuel system should be primed under the following conditions:

- Running out of fuel
- Storage
- Replacement of the fuel filter

## Engines that are Equipped with a Fuel Priming Pump

### NOTICE

Do not loosen the fuel lines at the fuel manifold. The fittings may be damaged and/or a loss of priming pressure may occur when the fuel lines are loosened.

1. Open the fuel priming pump and operate the fuel priming pump until a strong pressure is felt. This procedure will require considerable strokes. Lock the fuel priming pump.



---

**NOTICE**

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

---

2. Promptly start the engine. If the engine runs rough, continue to operate the engine at low idle. Do not raise the engine rpm above an idle, until the engine operates smoothly.
3. If the engine does not start, open the fuel priming pump and repeat Steps 1 and 2 in order to start the engine.

## **Engines that are Not Equipped with a Fuel Priming Pump**

If the engine is not equipped with a fuel priming pump, you can use the following procedures to prime the fuel system. These procedures will allow only filtered fuel to enter the fuel system.

### **Fuel Filter Bases that are Equipped with a Plug**

---

**NOTICE**

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

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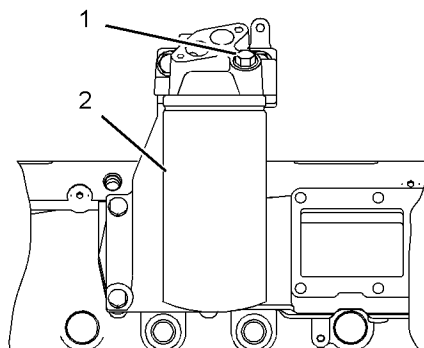


Illustration 36

g01076450

- (1) Plug  
(2) Fuel filter

1. Remove plug (1) in order to fill fuel filter (2). Ensure that air is able to vent from the fitting of the plug while the fuel filter is being filled. Clean up any spilled fuel immediately. Clean plug (1). Install plug (1).

#### NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

2. Start the engine and operate the engine at low idle. Do not raise the engine speed above an idle, until the engine operates smoothly.

### Fuel Filter Bases that are Not Equipped with a Plug

#### NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

1. Operate the starting motor. This will fill the fuel filter and the fuel lines with fuel.
2. Once the engine starts, operate the engine at low idle. Do not raise the engine speed above an idle, until the engine operates smoothly.

i00861167

## Fuel System Primary Filter - Clean/Replace

**SMCS Code:** 1260-070; 1260-510



### **WARNING**

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

### **NOTICE**

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

For more information on the maintenance of the primary fuel filter, refer to the literature that is provided by the OEM of the vehicle, or refer to the literature that is provided by the OEM of the primary fuel filter.

i01503750

## Fuel System Secondary Filter - Replace

**SMCS Code:** 1261-510-SE



### **WARNING**

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

---

**NOTICE**

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

---

---

**NOTICE**

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

---

1. Stop the engine. Turn the ignition switch to the OFF position or disconnect the battery. Refer to the Operation and Maintenance Manual, "Battery or Battery Cable - Disconnect" topic (Maintenance Section) for more information. Shut off the fuel supply valve (if equipped).
2. Remove the used fuel filter and discard the used fuel filter.
3. Clean the gasket sealing surface of the fuel filter base. Ensure that all of the old gasket is removed.
4. Apply clean diesel fuel to the new fuel filter gasket.

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**NOTICE**

Do not fill the secondary fuel filter with fuel before installing. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

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**NOTICE**

In order to maximize fuel system life and prevent premature wear out from abrasive particles in the fuel, a two micron absolute high efficiency fuel filter is required for all Caterpillar Hydraulic Electronic Unit Injectors. Caterpillar High Efficiency Fuel Filters meet these requirements. Consult your Caterpillar dealer for the proper part numbers.

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5. Install the new fuel filter. Spin the fuel filter onto the fuel filter base until the gasket contacts the base. Use the rotation index marks on the filters as a guide for proper tightening. Tighten the filter for an additional one turn (360 degrees) by hand. Do not overtighten the filter.
6. Open the fuel supply valve. Prime the fuel system. Refer to the Operation and Maintenance Manual, "Fuel System - Prime" topic (Maintenance Section) for more information. Start the engine and inspect the fuel system for leaks.

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**NOTICE**

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

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**Note:** There should be enough residual fuel in the cylinder head in order to start the engine. If the engine stops after starting, do not crank the engine for more than 30 seconds. Then allow the starting motor to cool for two minutes. Repeat this procedure until the engine starts and the engine operates.

i02112513

## Fuel System Water Separator - Drain

**SMCS Code:** 1263-543



### **WARNING**

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

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**NOTICE**

The water separator is not a filter. It separates water from the fuel.

The engine should never be allowed to run with the water level in the separator more than 1/2 full or engine damage may result.

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A water separator is recommended. The water separator should be installed between the fuel tank and the engine fuel inlet. Drain the water and sediment from the water separator on a daily basis.

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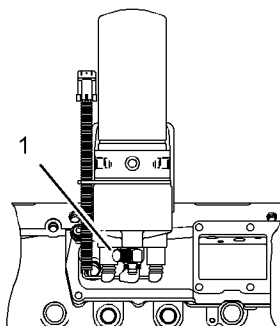


Illustration 37

g01076474

(1) Drain

1. Open drain (1). Catch the draining water in a suitable container. Dispose of the water properly.

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#### NOTICE

The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

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2. Close drain (1).

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## Fuel Tank Water and Sediment - Drain

**SMCS Code:** 1273-543-M&S

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### NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Dealer Service Tool Catalog" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

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## Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive wear to the fuel system. Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

## Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.

Check the fuel daily. Drain the water and sediment from the fuel tank after operating the engine or drain the water and sediment from the fuel tank after the fuel tank has been filled. Allow five to ten minutes before performing this procedure.

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Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

## Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank during the following conditions:

- Weekly
- Oil change
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank. A 4 micron [c] filter for the breather vent on the fuel tank is also recommended. Refer to Special Publication, SENR9620, "Improving Fuel System Durability".

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i02121526

## Hoses and Clamps - Inspect/Replace

**SMCS Code:** 7554-040; 7554-510

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps



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Replace hoses that are cracked or soft. Tighten any loose clamps.

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**NOTICE**

Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque.

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Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will heat set. Heat setting causes hose clamps to loosen. This can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

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## Replace the Hoses and the Clamps



### WARNING

**Pressurized System:** Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

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1. Stop the engine. Allow the engine to cool.
2. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

**Note:** Drain the coolant into a suitable, clean container. The coolant can be reused.

3. Drain the coolant from the cooling system to a level that is below the hose that is being replaced.
4. Remove the hose clamps.
5. Disconnect the old hose.
6. Replace the old hose with a new hose.
7. Install the hose clamps with a torque wrench.

**Note:** Refer to the Specifications, SENR3130, "Torque Specifications" in order to locate the proper torques.

8. Refill the cooling system.
9. Clean the cooling system filler cap. Inspect the cooling system filler cap's gaskets. Replace the cooling system filler cap if the gaskets are damaged. Install the cooling system filler cap.
10. Start the engine. Inspect the cooling system for leaks.

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## Overhaul Considerations

**SMCS Code:** 7595-043

Refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" topic (Maintenance Section) for the proper intervals in order to perform an overhaul of the engine.

Several factors are important when an overhaul of the engine is considered. The following factors are included:

- The performance of preventive maintenance
- The ratio of oil consumption to fuel consumption
- Fuel consumption
- The quality of the fuel that has been consumed
- The mileage of the vehicle
- The operating conditions of the vehicle
- The results of the S·O·S oil analysis
- The loss of engine power

An overhaul is a regular maintenance interval when the engine is inspected and worn components are replaced with rebuilt parts or new parts.

A top end overhaul is generally indicated by increased fuel consumption and reduced power. This interval consists of completely reconditioning the cylinder head. Normally, it is not necessary to repair the cylinder components at this time.

A major overhaul is an interval when the items that have major wear in the engine should be replaced. Items that can have major wear include the following items: piston rings, main bearings, rods, and valves.

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## Overhaul Options

**Caterpillar Dealer** – Consult your Caterpillar dealer in order to schedule a before failure overhaul.

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## Radiator - Clean

**SMCS Code:** 1353-070

**Note:** Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.



### WARNING

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**The maximum air pressure for cleaning purposes must be reduced to 205 kPa (30 psi) when the air nozzle is deadheaded.**

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Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

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After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a “comb”. Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, refer to Special Publication, SEBD0518, “Know Your Cooling System”.

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## Severe Service Application - Check

**SMCS Code:** 1000-535

**Operation and maintenance practices affect the service life of the component when the engine is operated in certain applications that require severe service.**

The level of maintenance is crucial to the service life of the engine. Other major factors that affect service life are operating speed and loads.

Reduce the maintenance intervals for engines that operate under conditions that are severe.

- Frequent operation with more than 22700 kg (50000 lb) of gross vehicle weight
- Frequent low speed operation (less than 20 Miles per Hour)
- Use of API CF-4 oil
- Use of fuel with more than 0.05% sulfur
- No water separator
- Frequent operation in dusty conditions or off-highway operation
- High load factor operation (less than 6 miles per gallon or off-highway operation)
- Frequent high altitude operation above 1525 m (5000 ft)

- Frequent operation at low idle (more than 20%)
- Frequent cold starts at temperatures below  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ )
- Frequent dry starting (starting after more than 3 days of shutdown)
- Frequent hot shutdowns (minimum three minute cool down periods after high load factor operation)
- If the engine is stored over 3 months, see Special Instruction, SEHS9031, "Storage Procedure for Caterpillar Products".

i00651416

## Starting Motor - Inspect

**SMCS Code:** 1451-040; 1453-040

Caterpillar Inc. recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for proper operation. Check the electrical connections and clean the electrical connections. Refer to the Service Manual for more information on the checking procedure and for specifications or consult your Caterpillar dealer for assistance.

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## Turbocharger - Inspect

**SMCS Code:** 1052-040; 1052

Periodic inspection and cleaning is recommended for the turbocharger compressor housing (inlet side). Any fumes from the crankcase are filtered through the air inlet system. Therefore, by-products from oil and from combustion can collect in the turbocharger compressor housing. Over time, this buildup can contribute to loss of engine power, increased black smoke and overall loss of engine efficiency.

If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can cause additional damage to the pistons, the valves, and the cylinder head.

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### NOTICE

Turbocharger bearing failures can cause large quantities of oil to enter the air inlet and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of a turbocharger housing under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occurred.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is repaired or replaced.

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An inspection of the turbocharger can minimize unscheduled downtime. An inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

**Note:** Turbocharger components require precision clearances. The turbocharger cartridge must be balanced due to high rpm. Severe Service Applications can accelerate component wear. Severe Service Applications require more frequent inspections of the cartridge.

## Removal and Installation

For options regarding the removal, installation, repair and replacement, consult your Caterpillar dealer. Refer to the Service Manual for this engine for the procedure and specifications.

## Cleaning and Inspecting

1. Remove the exhaust outlet piping and remove the air inlet piping from the turbocharger. Visually inspect the piping for the presence of oil. Clean the interior of the pipes in order to prevent dirt from entering during reassembly.

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2. Turn the compressor wheel and the turbine wheel by hand. The assembly should turn freely. Inspect the compressor wheel and the turbine wheel for contact with the turbocharger housing. There should not be any visible signs of contact between the turbine wheel or compressor wheel and the turbocharger housing. If there is any indication of contact between the rotating turbine wheel or the compressor wheel and the turbocharger housing, the turbocharger must be reconditioned.
  3. Check the compressor wheel for cleanliness. If only the blade side of the wheel is dirty, dirt and/or moisture is passing through the air filtering system. If oil is found only on the back side of the wheel, there is a possibility of a failed turbocharger oil seal.

The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the line for the inlet air (plugged air filters), which causes the turbocharger to slobber.

4. Use a dial indicator to check the end clearance on the shaft. If the measured end play is greater than the Service Manual specifications, the turbocharger should be repaired or replaced. An end play measurement that is less than the minimum Service Manual specifications could indicate carbon buildup on the turbine wheel. The turbocharger should be disassembled for cleaning and for inspection if the measured end play is less than the minimum Service Manual specifications.
5. Inspect the bore of the turbine housing for corrosion.
6. Clean the turbocharger housing with standard shop solvents and a soft bristle brush.
7. Fasten the air inlet piping and the exhaust outlet piping to the turbocharger housing.



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## Walk-Around Inspection

**SMCS Code:** 1000-040

### Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the proper place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

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#### NOTICE

For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

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#### NOTICE

Accumulated grease and/or oil on an engine or deck is a fire hazard. Remove this debris with steam cleaning or high pressure water.

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- Ensure that the cooling lines are properly clamped and that the cooling lines are tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pumps for coolant leaks.

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**Note:** The water pump seal is lubricated by coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of water pumps and the installation of water pumps and/or seals, refer to the Service Manual for the engine or consult your Caterpillar dealer.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the valve cover.
- Inspect the fuel system for leaks. Look for loose fuel line clamps or for loose fuel line tie-wraps.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps. Ensure that hoses and tubes are not contacting other hoses, tubes, wiring harnesses, etc.
- Inspect the alternator belt and the accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from fuel tanks on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Inspect the ECM to the cylinder head ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges that are cracked. Replace any gauge that can not be calibrated.

## **Water Pump - Inspect**

**SMCS Code:** 1361-040; 1361

Overconcentration of coolant additive (conditioner), mineral deposits from hard water, or cooling system contamination can accelerate the wear on the water pump seal.

### **Replace the Water Pump Seal, If Necessary**

Inspect the water pump for leaks. The water pump seal is lubricated by coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

### **Removal and Installation**

Refer to the Service Manual for more information on the removal and installation of the water pump, or consult your Caterpillar dealer for assistance.

### **Inspect the Bearing for the Water Pump Pulley**

Inspect the water pump pulley for unusual noise, excessive looseness and/or vibration of the bearings.

Refer to the Service Manual for more information on the removal and installation of the water pump pulley, or consult your Caterpillar dealer for assistance.