3412E and C30 MARINE ENGINES

Maintenance Intervals

Excerpted from Operation & Maintenance Manual (SEBU7178-06)

CATERPILLAR®

Maintenance Recommendations

i03126761

System Pressure Release

SMCS Code: 1250; 1300; 1350; 5050

⚠ WARNING

Personal injury or death can result from sudden machine movement.

Sudden movement of the machine can cause injury to persons on or near the machine.

To prevent injury or death, make sure that the area around the machine is clear of personnel and obstructions before operating the machine.

Coolant System

⚠ WARNING

Pressurized system: Hot coolant can cause serious burn. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.

To relieve the pressure from the coolant system, turn off the machine. Allow the cooling system system pressure cap to cool. Remove the cooling system pressure cap slowly in order to relieve pressure.

i03642798

Welding on Engines with Electronic Controls

SMCS Code: 1000

NOTICE
Because the strength of the frame may decrease, some manufacturers do not recommend welding onto a chassis frame or rail. Consult the OEM of the equipment or your Caterpillar dealer regarding welding on a chassis frame or rail.

Proper welding procedures are necessary in order to avoid damage to the engine's ECM, sensors, and associated components. When possible, remove the component from the unit and then weld the component. If removal of the component is not possible, the following procedure must be followed when you weld on a unit that is equipped with a Caterpillar Electronic Engine. The following procedure is considered to be the safest procedure to weld on a component. This procedure should provide a minimum risk of damage to electronic components.

NOTICE
Do not ground the welder to electrical components such as the ECM or sensors. Improper grounding can cause damage to the drive train, the bearings, hydraulic components, electrical components, and other components.

Do not ground the welder across the centerline of the package. Improper grounding could cause damage to the bearings, the crankshaft, the rotor shaft, and other components.

Clamp the ground cable from the welder to the component that will be welded. Place the clamp as close as possible to the weld. This will help reduce the possibility of damage.

Note: Perform the welding in areas that are free from explosive hazards.

1. Stop the engine. Turn the switched power to the OFF position.
2. Disconnect the negative battery cable from the battery. If a battery disconnect switch is provided, open the switch.
3. Disconnect the J1/P1 and J2/P2 connectors from the ECM. Move the harness to a position that will not allow the harness to accidentally move back and make contact with any of the ECM pins.

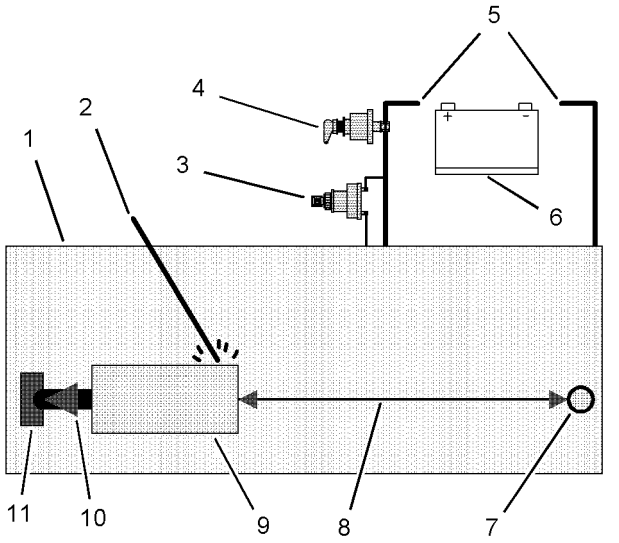


Illustration 24 g01075639

Use the example above. The current flow from the welder to the ground clamp of the welder will not cause damage to any associated components.

(1) Engine
(2) Welding electrode
(3) Keyswitch in the OFF position
(4) Battery disconnect switch in the open position
(5) Disconnected battery cables
(6) Battery
(7) Electrical/Electronic component
(8) Minimum distance between the component that is being welded and any electrical/electronic component
(9) The component that is being welded
(10) Current path of the welder
(11) Ground clamp for the welder

4. Connect the welding ground cable directly to the part that will be welded. Place the ground cable as close as possible to the weld in order to reduce the possibility of welding current damage to bearings, hydraulic components, electrical components, and ground straps.

Note: If electrical/electronic components are used as a ground for the welder, or electrical/electronic components are located between the welder ground and the weld, current flow from the welder could severely damage the component.

5. Protect the wiring harness from welding debris and spatter.

6. Use standard welding practices to weld the materials.

i03651158

Maintenance Interval Schedule (Standard Rated Engine)

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 installation of new components due to normal wear and aging. The performance of this product may be diminished if proper maintenance intervals and procedures are not followed. Components may experience accelerated wear if proper maintenance intervals and procedures are not followed.

Note: Use whichever of the following that occurs first in order to determine the maintenance intervals: fuel consumption, service hours, and calendar time . Before each consecutive interval is performed, all maintenance from the previous intervals must be performed.

Products that operate in severe operating conditions may require more frequent maintenance.

When Required

Daily

Every 250 Service Hours

Every Year

Every 6000 Service Hours or 3 Years

Every 12 000 Service Hours or 6 Years

Every 3800 L (1000 US gal) of Fuel or 50 Service Hours

Initial Oil Change

PM Level 1 - Every 15 000 L (4000 US gal) of Fuel or 200 Service Hours (Shallow Sump)

PM Level 1 - Every 30 000 L (8000 US gal) of Fuel or 400 Service Hours (Deep Sump)

PM Level 2 - Every76 000 L (20 000 US gal) of Fuel or 1000 Service Hours

PM Level 2 - Every 76 000 L (20 000 US gal) of Fuel or 1000 Service Hours (Engines Equipped with Crankcase Fumes Recirculation System)

PM Level 3 - Every 174 000 L (46 200 US gal) of Fuel or 3000 Service Hours or 2 Years

PM Level 3 - Every 228 000 L (60 000 US gal) of Fuel or 3000 Service Hours

Overhaul

i03651154

Maintenance Interval Schedule (Fast Craft Rated Engine)

SMCS Code: 1000; 7500

Contact your Caterpillar dealer in order to determine whether your engine is a fast craft rated engine.

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 installation of new components due to normal wear and aging. The performance of this product may be diminished if proper maintenance intervals and procedures are not followed. Components may experience accelerated wear if proper maintenance intervals and procedures are not followed.

Note: Use whichever of the following that occurs first in order to determine the maintenance intervals: fuel consumption, service hours, and calendar time . Before each consecutive interval is performed, all maintenance from the previous intervals must be performed.

Products that operate in severe operating conditions may require more frequent maintenance.

When Required

Daily

Every 250 Service Hours

Every Year

Every 6000 Service Hours or 3 Years

Every 12 000 Service Hours or 6 Years

Every 3800 L (1000 US gal) of Fuel or 50 Service Hours

Every 4700 L (1250 US gal) of Fuel or 50 Service Hours

Initial Oil Change

PM Level 1 - Every 15 000 L (4000 US gal) of Fuel or 150 Service Hours or 1 Year (Shallow Sump)

PM Level 1 - Every 30 000 L (8000 US gal) of Fuel or 300 Service Hours or 1 Year (Deep Sump)

PM Level 2 - Every 76 000 L (20 000 US gal) of Fuel or 800 Service Hours

PM Level 2 - Every 76 000 L (20 000 US gal) of Fuel or 800 Service Hours (Engines Equipped with Crankcase Fumes Recirculation System)

PM Level 3 - Every 228 000 L (60 000 US gal) of Fuel or 2400 Service Hours

PM Level 3 - Every 228 000 L (60 000 US gal) of Fuel or 3000 Service Hours

Overhaul

i02018705

Aftercooler Core - Clean/Test (Engines That Are Equipped with Crankcase Fumes Recirculation System)

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 22 lists Hydrosolv liquid cleaners that are available from your Caterpillar dealer.

Table 22

Hydrosolv Liquid Cleaners(1)	
Description	**Container**
1U-5490 Hydrosolv 4165	19 L (5 US gal)
174-6854 Hydrosolv 100	19 L (5 US gal)

(1) 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.

i00997205

Alternator - Inspect

SMCS Code: 1405-040

Note: This engine is equipped with an alternator circuit breaker. Note the location of the alternator circuit breaker for your particular application. If the alternator circuit breaker trips, you will need to reset the breaker in order for the charging system to operate. Refer to the information that is provided by the OEM for more information.

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.

i02456322

Alternator Belt - Inspect/Adjust/Replace

SMCS Code: 1357-036; 1357-510

Inspection

To maximize the engine performance, inspect the belt for wear and for cracking. Check the belt tension. Adjust the belt tension in order to minimize belt slippage. Belt slippage will decrease the life of the belt.

To check the belt tension, apply 110 N (25 lb) of force midway between the pulleys. A correctly adjusted belt will deflect 13 to 19 mm (0.50 to 0.75 inch).

Adjustment

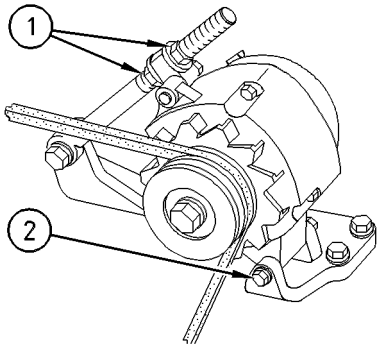


Illustration 25 g00122875

(1) Adjusting nuts
(2) Mounting bolt

1. Remove the belt guard.
2. Loosen mounting bolt (2) and adjusting nuts (1).
3. Turn adjusting nuts (1) in order to increase or decrease the belt tension.
4. Tighten adjusting nuts (1). Tighten mounting bolt (2). Refer to the Specifications, SENR3130, “Torque Specifications” for the proper torques.
5. Reinstall the belt guard.

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

Replacement

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 belts are stretched. The additional load on the new belt could cause the new belt to break.

Refer to the Service Manual for more information on the procedures for the following topics: belt removal and installation of the belt.

i01042055

Auxiliary Water Pump (Bronze Impeller) - Inspect

SMCS Code: 1371-040

Impellers and seals require periodic inspection. Impellers have a service life that is limited. The service life depends on the engine operating conditions.

Inspect the components more frequently when the pump is exposed to debris, sand, or other abrasive materials. Inspect the components if the pump is operating at a differential pressure of more than 103 kPa (15 psi).

Check the following components for wear or damage:

- Bearings
- Impeller
- Seals
- Wear plate

If wear or damage is found, replace the components which are worn or damaged. Use the proper repair kit for the pump. Refer to the Disassembly and Assembly for more information on servicing the auxiliary water pump.

i01041983

Auxiliary Water Pump (Rubber Impeller) - Inspect

SMCS Code: 1371-040

Impellers and seals require periodic inspection. Impellers have a service life that is limited. The service life depends on the engine operating conditions.

Inspect the components more frequently when the pump is exposed to debris, sand, or other abrasive materials. Inspect the components if the pump is operating at a differential pressure of more than 103 kPa (15 psi).

Check the following components for wear or damage:

- Bearings
- Impeller
- Seals
- Wear plate

If wear or damage is found, replace the components which are worn or damaged. Use the proper repair kit for the pump. Refer to the Disassembly and Assembly for more information on servicing the auxiliary water pump.

i02153996

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.

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.

i02601752

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.

i01492654

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.

i01735844

Closed Crankcase Ventilation (CCV) Fumes Disposal Filter - Replace

SMCS Code: 1317-510-FI

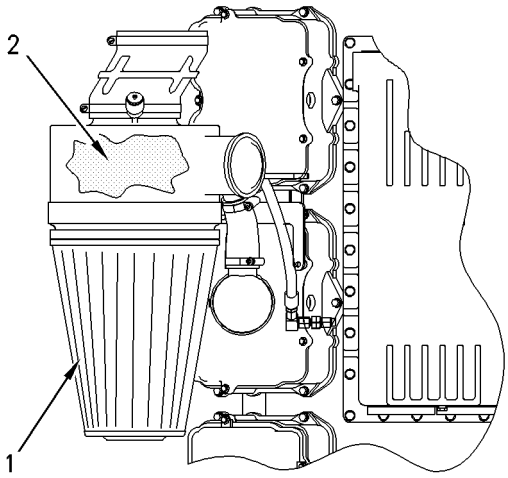


Illustration 26 g00889933

(1) Air cleaner element
(2) Fumes disposal filter

The Closed Crankcase Ventilation system (CCV) requires the replacement of the fumes disposal filter. The service interval of the CCV will be affected by the following items:

- Engine load
- Soot concentration
- Condition of the engine

Use the following steps in order to ensure the proper replacement of the fumes disposal filter.

1. Remove air cleaner element (1).
2. Remove fumes disposal filter (2).
3. Install a new fumes disposal filter (2).
4. Install air cleaner element (1).

i02535540

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.

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.

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.

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.

   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 CaterpillaService Technology Groupr:

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 for your particular engine for additional specific information on the proper torques. Refer to the Specifications, SENR3130, “Torque Specifications” for additional general information on the proper torques.

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 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 the engine and run the engine at low idle for a minimum of 30 minutes. The coolant temperature should be at least 82 °C (180 °F).

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.

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 for your particular engine for additional specific information on the proper torques. Refer to the Specifications, SENR3130, “Torque Specifications” for additional general 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.

2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual for your particular engine for additional specific information on the proper torques. Refer to the Specifications, SENR3130, “Torque Specifications” for additional general information on the proper torques.

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 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 the engine and run the engine at low idle for a minimum of 90 minutes. The coolant temperature should be at least 82 °C (180 °F).

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.

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 for your particular engine for additional specific information on the proper torques. Refer to the Specifications, SENR3130, “Torque Specifications” for additional general information on the proper torques.

Fill

Refer to the Special Publication, SEBU6251, “Commercial Diesel Engine Fluids Recommendations” for information regarding acceptable water, antifreeze/coolant, and supplemental coolant additive requirements.

Engines that are Equipped with a Coolant Recovery Tank

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 antifreeze/coolant. Refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” for additional information on cooling system specifications. Do not install the cooling system filler cap.

2. Start the engine 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. Return the engine to low idle. Stop the engine.

3. Add coolant to the cooling system until the cooling system is full.

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.

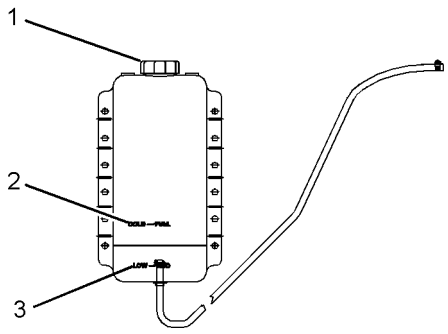


Illustration 27 g01268104

(1) Recovery tank filler cap
(2) “COLD FULL” mark
(3) “LOW ADD” mark

5. Loosen the cap for the coolant recovery tank slowly in order to relieve any pressure. Remove the cap for the coolant recovery tank.

6. Pour coolant into the coolant recovery tank until the coolant reaches the “COLD FULL” mark.

Note: Pleasure craft that are cooled by a heat exchanger may require the coolant recovery tank to be overfilled approximately 102 mm (4 inch) above the “COLD FULL” mark.

7. Clean the cap for the coolant recovery tank. Install the cap for the coolant recovery tank.

8. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

9. Stop the engine and allow the engine to cool. Verify the coolant level in the coolant recovery tank.

Note: If necessary, refer to step 8 through step 9 in order to purge air from the cooling system.

Engines that are Not Equipped with a Coolant Recovery Tank

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 antifreeze/coolant. Refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” for additional information on cooling system specifications. Do not install the cooling system filler cap.

2. Start the engine 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. Return the engine to low idle. 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.

i02529444

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 of the coolant
- 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.

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.

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 Service Technology 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 for your particular engine for additional specific information on the proper torques. Refer to the Specifications, SENR3130, “Torque Specifications” for additional general information on the proper torques.

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 the engine 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. Refer to the Specifications Manual for your particular engine for additional specific information on the proper torques. Refer to the Specifications, SENR3130, “Torque Specifications” for additional general information on the proper torques.

Fill

Engines that are Equipped with a Coolant Recovery Tank

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). Refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” for additional information on cooling system specifications. Do not install the cooling system filler cap.

2. Place the transmission in neutral. Start the engine and operate the engine at low idle. Increase the engine rpm to 1500 rpm. Operate the engine at 1500 rpm for one minute in order to purge air from the cavities of the engine block. Return the engine to low idle. Stop the engine.

3. Pour more ELC into the cooling system until the cooling system is full.

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.

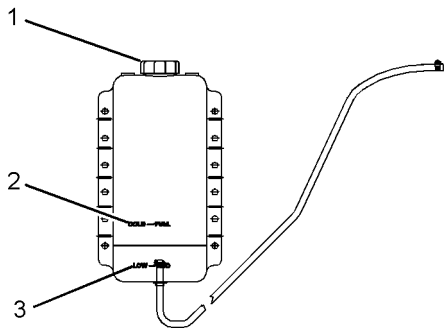


Illustration 28 g01268104

(1) Recovery tank filler cap
(2) “COLD FULL” mark
(3) “LOW ADD” mark

5. Loosen the cap for the coolant recovery tank slowly in order to relieve any pressure. Remove the cap for the coolant recovery tank.

6. Pour Extended Life Coolant (ELC) into the coolant recovery tank until the coolant reaches the “COLD FULL” mark. DO NOT fill the coolant recovery tank above the “COLD FULL” mark.

Note: Pleasure craft that are cooled by a heat exchanger may require the coolant recovery tank to be overfilled approximately 102 mm (4 inch) above the “COLD FULL” mark.

7. Clean the cap for the coolant recovery tank. Install the cap for the coolant recovery tank.

8. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

9. Stop the engine and allow the engine to cool. Verify the coolant level in the coolant recovery tank.

Note: If necessary, refer to step 8 through 9 in order to purge air from the cooling system.

Engines that are NOT Equipped with a Coolant Recovery Tank

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). Refer to this Operation and Maintenance Manual, “Refill Capacitites and Recommendations” for additional information on cooling system specifications. Do not install the cooling system filler cap.

2. Place the transmission in neutral. Start the engine and operate the engine at low idle. Increase the engine rpm to 1500 rpm. Operate the engine at 1500 rpm for one minute in order to purge air from the cavities of the engine block. Return the engine to low idle. Stop the engine.

3. Check the coolant level. Maintain the coolant level within 13 mm (.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (.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.

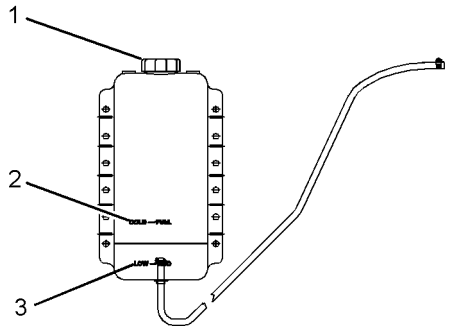
i02538100

Cooling System Coolant Level - Check

SMCS Code: 1395-082

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

Engines That Are Equipped with a Coolant Recovery Tank



g01268104

Illustration 29

(1) Recovery tank filler cap
(2) “COLD FULL” mark
(3) “LOW ADD” mark

1. Observe the coolant level in the coolant recovery tank. Maintain the coolant level to “COLD FULL” mark (2) on the coolant recovery tank.

2. Loosen filler cap (1) slowly in order to relieve any pressure. Remove the filler cap.

3. Pour the proper coolant mixture into the tank. Refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” for information about coolants. Do not fill the coolant recovery tank above “COLD FULL” mark (2).

4. Clean filler cap (1) and the receptacle. Reinstall the filler cap and inspect the cooling system for leaks.

Note: The coolant will expand as the coolant heats up during normal engine operation. The additional volume will be forced into the coolant recovery tank during engine operation. When the engine is stopped and cool, the coolant will return to the engine.

Engines That Are Not Equipped with a Coolant Recovery Tank

⚠ 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.

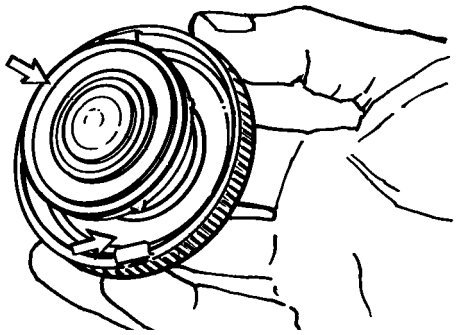


Illustration 30 g00103639

Typical filler cap gaskets

3. Clean the cooling system filler cap and inspect 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.

i02837191

Cooling System Coolant Sample (Level 1) - Obtain

SMCS Code: 1350-008; 1395-008; 1395-554; 7542

Note: Obtaining a Coolant Sample (Level 1) is optional if the cooling system is filled with Cat ELC (Extended Life Coolant). Cooling systems that are filled with Cat ELC should have a Coolant Sample (Level 2) that is obtained at the recommended interval that is stated in the Maintenance Interval Schedule.

Note: Obtain a Coolant Sample (Level 1) if the cooling system is filled with any other coolant instead of Cat ELC. This includes the following types of coolants:

- Commercial long life coolants that meet the Caterpillar Engine Coolant Specification -1 (Caterpillar EC-1)
- Cat DEAC (Diesel Engine Antifreeze/Coolant)
- Commercial heavy-duty coolant/antifreeze

Table 23

Recommended Interval		
Type of Coolant	**Level 1**	**Level 2**
Cat DEAC	Every 250 Hours(1)	Yearly(1)(2)
Cat ELC	Optional(2)	Yearly(2)

(1) This is the recommended interval for coolant samples for all conventional heavy-duty coolant/antifreeze. This is also the recommended interval for coolant samples of commercial coolants that meet the Cat EC-1 specification for engine coolant.

(2) The Level 2 Coolant Analysis should be performed sooner if a problem is suspected or identified.

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.

Note: Level 1 results may indicate a need for Level 2 Analysis.

Obtain the sample of the coolant as close as possible to the recommended sampling interval. In order to receive the full effect of S·O·S analysis, you must establish a consistent trend of data. In order to establish a pertinent history of data, perform consistent samplings that are evenly spaced. Supplies for collecting samples can be obtained from your Caterpillar dealer.

Use the following guidelines for proper sampling of the coolant:

- Complete the information on the label for the sampling bottle before you begin to take the samples.
- Keep the unused sampling bottles stored in plastic bags.

- Obtain coolant samples directly from the coolant sample port. You should not obtain the samples from any other location.
- Keep the lids on empty sampling bottles until you are ready to collect the sample.
- Place the sample in the mailing tube immediately after obtaining the sample in order to avoid contamination.
- Never collect samples from expansion bottles.
- Never collect samples from the drain for a system.

Submit the sample for Level 1 analysis.

For additional information about coolant analysis, see this Operation and Maintenance Manual, “Refill Capacities and Recommendations” or consult your Caterpillar dealer.

i01987714

Cooling System Coolant Sample (Level 2) - Obtain

SMCS Code: 1350-008; 1395-008; 1395-554; 7542

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.

Refer to Operation and Maintenance Manual, “Cooling System Coolant Sample (Level 1) - Obtain” for the guidelines for proper sampling of the coolant.

Submit the sample for Level 2 analysis.

For additional information about coolant analysis, see Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engines Fluids Recommendations” or consult your Caterpillar dealer.

i02456600

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

SMCS Code: 1352-045; 1395-081

⚠ 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.

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

Test for SCA Concentration

Coolant and SCA

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

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. Refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” for more information.

Water and SCA

NOTICE
Do not exceed the recommended eight percent supplemental coolant additive concentration.

Test the concentration of the SCA with the 8T-5296 Coolant Conditioner Test Kit. Refer to the Special Publication, SEBU6251, “Caterpillar Commercial Diesel 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 1

Level 1 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.

Level 2

This level coolant analysis is recommended when the engine is overhauled. Refer to this Operations and Maintenance Manual, “Overhaul Considerations” for further information.

Add the SCA, If Necessary

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.

⚠ 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 the Special Publication, SEBU6251, “Caterpillar Commercial Diesel 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.

i01061981

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 the temperature regulators on a regularly scheduled basis could cause severe engine damage.

Never operate the engine without the temperature regulators installed.

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

Refer to the Service Manual 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. Fill the engine with coolant to the correct level once the new water temperature regulators have been installed. Be sure to use the correct type of coolant. The coolant should always be maintained at the correct concentration.

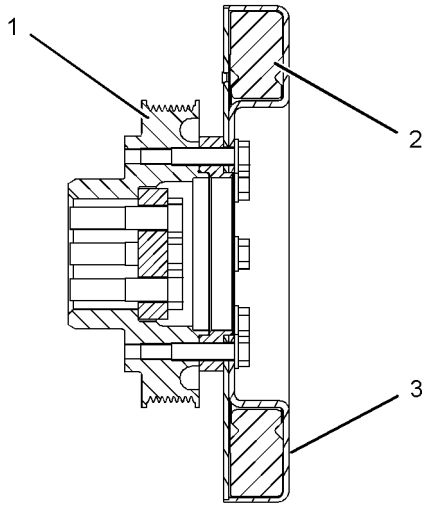
i03175962

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.



g01134779

Illustration 31

Viscous vibration damper

Typical example

(1) Crankshaft pulley
(2) Weight
(3) Case

Inspection

Inspect the damper for the following conditions:

- The damper is dented, cracked, or fluid is leaking from the damper.
- The paint on the damper is discolored from excessive heat.
- The damper is bent.
- The bolt holes are worn or there is a loose fit for the bolts.
- The engine has had a crankshaft failure due to torsional forces.

Replace the damper if any of these conditions exist.

Removal and Installation

Refer to this Operation and Maintenance Manual, “Belts - Inspect/Adjust/Replace” for information on removing and on installing the belt. Refer to the Disassembly and Assembly Manual, “Vibration Damper and Pulley - Remove and Install” for information on removing and installing the damper.

i01727320

Engine Air Cleaner Element - Clean/Replace

SMCS Code: 1054-070; 1054-510

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent air-borne debris from entering the air inlet.

Type 1

Note: Use the 102-9720 Cleaning Kit. This product contains the detergent and oil that is made specifically for the maintenance of the air cleaner elements.

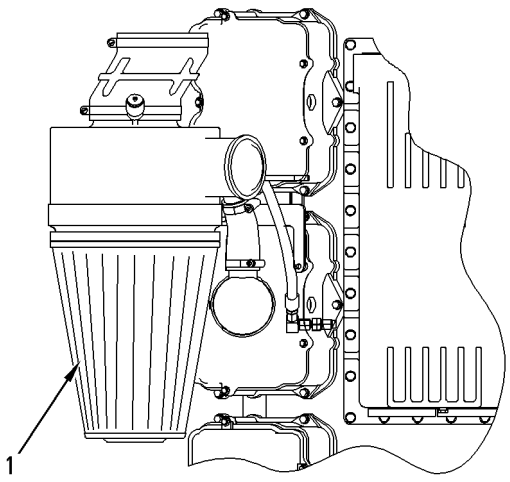


Illustration 32 g00887344

Note: This type of air cleaner element should be replaced after three cleanings.

1. Remove the air cleaner element (1). Tap the air cleaner element in order to dislodge dirt particles. Gently brush the air cleaner element with a soft bristle brush.

NOTICE
Do not use gasoline, steam, caustic or unapproved detergents, or parts cleaning solvents. Do not use high pressure water or air to clean the air cleaner element. Any of those liquids or methods can cause air cleaner element damage.

2. Spray the air cleaner element with the cleaning solution. Allow the air cleaner element to stand for 10 minutes.

3. Rinse the air cleaner element with low water pressure. The maximum water pressure for this procedure is 275 kPa (40 psi). Tap water is acceptable. Start to rinse the air cleaner element from the clean side (inside). Next, clean the dirty side (outside) in order to flush out dirt. Inspect the air cleaner element for tears and/or holes after the air cleaner element is cleaned. Do not reuse damaged air cleaner elements.

NOTICE
Do not use compressed air, open flame, or hot air to dry the air cleaner element. Excess heat shrinks cotton fiber, and compressed air may blow holes in the material. Allow the air cleaner element to air dry.

4. Shake excess water off the air cleaner element , and allow the air cleaner element to air dry. Drying the air cleaner element in the sun speeds the process.

NOTICE
Do not use transmission fluid, engine oil, diesel fuel, or other lubricant to oil the air cleaner element. The air cleaner element can not function correctly if improper oil is used. Never operate an engine with a dry air cleaner element. The air cleaner element can not function correctly without oil. Always saturate the clean air cleaner element with the recommended oil.

5. The dry air cleaner element should be oiled before installation. Apply small amounts of oil across the top of each pleat. Allow the oil to soak into the air cleaner element for 20 minutes. Oil any remaining “white” spots.

6. Inspect the housing and the clamp for air cleaner element (1). Install the clean, oiled air cleaner element. Replace the housing and the clamp, if necessary. Refer to Specifications, SENR3130, “Torque Specifications” for the proper torque of the clamp.

Type 2

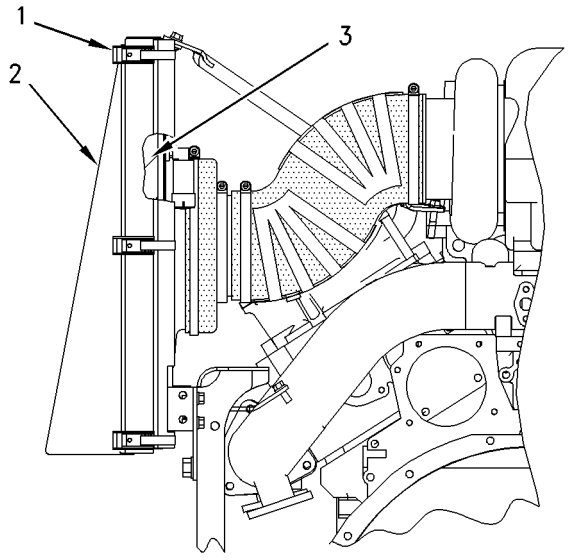


Illustration 33 g00888130

1. Disconnect latches (1).

2. Remove cover (2).

3. Remove air cleaner element (3).

Note: This type of air cleaner element may be cleaned up to six times.

4. Refer to Guideline for Reusable Parts and Salvage Operations, SEBF8062 for cleaning instructions or replace the air cleaner element.

5. Install the air cleaner element (3).

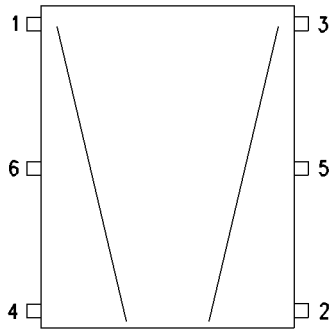


Illustration 34 g00888209
Sequence for latches

6. Install cover (2). Fasten cover (2) with latches(1) in the sequence that is shown in Illustration 34.

Type 3

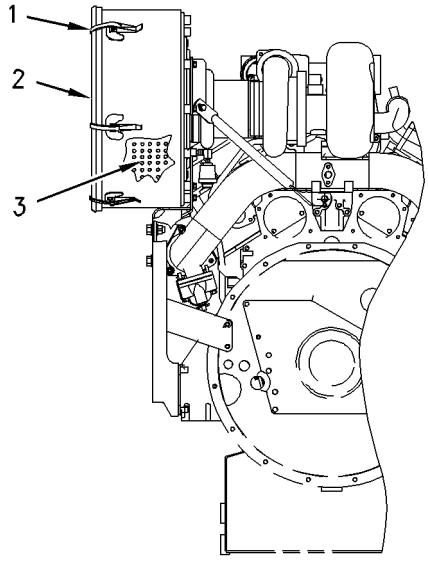


Illustration 35 g00888128

1. Disconnect latches (1).

2. Remove cover (2).

3. Remove air cleaner element (3).

Note: This type of air cleaner element may be cleaned up to six times.

4. Refer to Guideline for Reusable Parts and Salvage Operations, SEBF8062 for cleaning instructions or replace the air cleaner element.

5. Install the air cleaner element (3).

6. Install cover (2).

7. Fasten cover (2) with latches (1).

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.

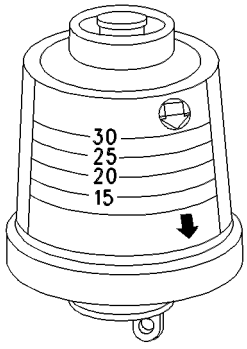


Illustration 36 g00103777
Typical service indicator

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).

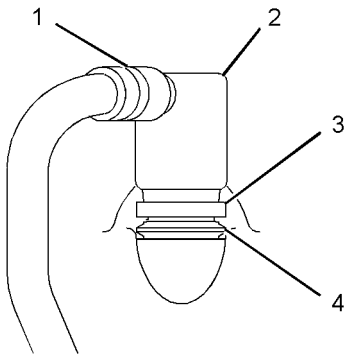
i02263740

Engine Crankcase Breather - Clean

SMCS Code: 1317-070

NOTICE
Perform this maintenance with the engine stopped.

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



g01136454

Illustration 37

Typical example

(1) Hose clamp
(2) Breather assembly
(3) Retaining clamp
(4) Seal

1. Loosen hose clamp (1) and remove the hose from breather assembly (2).
2. Loosen retaining clamp (3). Remove the breather assembly and seal (4).
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 the seal, the breather assembly, and the clamp. Refer to the Specifications, SENR3130 in order to locate the proper torques.
5. Install the hose. Install the hose clamp. Refer to the Specifications, SENR3130 in order to locate the proper torques.

i02456872

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 Special Publication, SENR3130, “Torque Specifications” for the recommended torques. Refer to the OEM recommendations for more information.

i00623423

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.

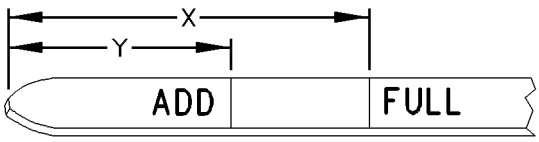


Illustration 38 g00110310

(Y) “ADD” mark. (X) “FULL” mark.

NOTICE
Perform this maintenance with the engine stopped.

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
Operating your engine when the oil level is above the “FULL” mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil's lubricating characteristics and could result in the loss of power.

2. Remove the oil filler cap and add oil, if necessary. Clean the oil filler cap. Install the oil filler cap.

i01741595

Engine Oil Level Gauge - Calibrate

SMCS Code: 1326-524

The engine is shipped with an engine oil level gauge that is not marked. The engine oil level gauge is not marked because the angle of the installation and the location of the engine oil level gauge can be different for each engine. The angle of the installation and the location of the engine oil level gauge will affect “ADD” mark (X) and “FULL” mark (Y). These marks are engraved on the engine oil level gauge.

The engine oil level gauge must be calibrated after the engine is installed in the vessel.

Tables 24 through 27 list the installation angles (front to rear) and the corresponding oil level marks. Use a marking pen in order to engrave “ADD” mark (X) and “FULL” mark (Y) on the engine oil level gauge according to the information in Tables 24 through 27.

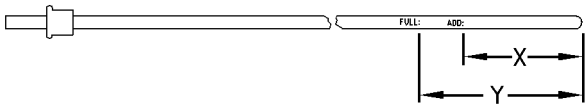


Illustration 39 g00539533

Oil level gauge

(X) “ADD” mark
(Y) “FULL” mark

Table 24

3412E and C30 Marine Engine Calibration of the Engine Oil Level Gauge Shallow Sump Left Hand Service		
Angle[1]	**(X) “ADD” Mark**	**(Y) “FULL” Mark**
15 degrees	140 mm (5.5 inch)	195 mm (7.7 inch)
14 degrees	136 mm (5.4 inch)	191 mm (7.5 inch)
13 degrees	131 mm (5.2 inch)	186 mm (7.3 inch)
12 degrees	126 mm (5.0 inch)	182 mm (7.2 inch)
11 degrees	122 mm (4.8 inch)	179 mm (7.0 inch)
10 degrees	118 mm (4.6 inch)	175 mm (6.9 inch)
9 degrees	114 mm (4.5 inch)	172 mm (6.8 inch)
8 degrees	110 mm (4.3 inch)	169 mm (6.7 inch)
7 degrees	107 mm (4.2 inch)	167 mm (6.6 inch)
6 degrees	103 mm (4.1 inch)	164 mm (6.5 inch)
5 degrees	100 mm (3.9 inch)	162 mm (6.4 inch)
4 degrees	97 mm (3.8 inch)	160 mm (6.3 inch)
3 degrees	95 mm (3.7 inch)	158 mm (6.2 inch)
2 degrees	93 mm (3.7 inch)	156 mm (6.1 inch)
1 degree	91 mm (3.6 inch)	154 mm (6.1 inch)
0 degrees	87 mm (3.4 inch)	150 mm (5.9 inch)
-1 degree	84 mm (3.3 inch)	145 mm (5.7 inch)
-2 degrees	82 mm (3.2 inch)	140 mm (5.5 inch)
-3 degrees	80 mm (3.1 inch)	135 mm (5.3 inch)
-4 degrees	77 mm (3.0 inch)	132 mm (5.2 inch)
-5 degrees	75 mm (3.0 inch)	128 mm (5.0 inch)
-6 degrees	72 mm (2.8 inch)	124 mm (4.9 inch)
-7 degrees	70 mm (2.8 inch)	121 mm (4.8 inch)
-8 degrees	67 mm (2.6 inch)	118 mm (4.6 inch)
-9 degrees	64 mm (2.5 inch)	114 mm (4.5 inch)
-10 degrees	60 mm (2.4 inch)	111 mm (4.4 inch)
-11 degrees	56 mm (2.2 inch)	108 mm (4.3 inch)
-12 degrees	53 mm (2.1 inch)	105 mm (4.1 inch)
-13 degrees	49 mm (1.9 inch)	102 mm (4.0 inch)
-14 degrees	46 mm (1.8 inch)	99 mm (3.9 inch)
-15 degrees	42 mm (1.7 inch)	96 mm (3.8 inch)

(1) A positive angle indicates that the front of the engine is raised. A negative angle indicates that the front of the engine is lowered.

Table 25

3412E and C30 Marine Engine Calibration of the Engine Oil Level Gauge Shallow Sump Right Hand Service		
Angle[1]	**(X) “ADD” Mark**	**(Y) “FULL” Mark**
15 degrees	144 mm (5.7 inch)	197 mm (7.8 inch)
14 degrees	140 mm (5.5 inch)	193 mm (7.6 inch)
13 degrees	136 mm (5.4 inch)	189 mm (7.4 inch)
12 degrees	130 mm (5.1 inch)	185 mm (7.3 inch)
11 degrees	125 mm (4.9 inch)	182 mm (7.2 inch)
10 degrees	120 mm (4.7 inch)	178 mm (7.0 inch)
9 degrees	116 mm (4.6 inch)	175 mm (6.9 inch)
8 degrees	113 mm (4.4 inch)	172 mm (6.8 inch)
7 degrees	109 mm (4.3 inch)	170 mm (6.7 inch)
6 degrees	105 mm (4.1 inch)	167 mm (6.6 inch)
5 degrees	102 mm (4.0 inch)	165 mm (6.5 inch)
4 degrees	99 mm (3.9 inch)	163 mm (6.4 inch)
3 degrees	96 mm (3.8 inch)	161 mm (6.3 inch)
2 degrees	93 mm (3.7 inch)	158 mm (6.2 inch)
1 degree	91 mm (3.6 inch)	155 mm (6.1 inch)
0 degrees	88 mm (3.5 inch)	152 mm (6.0 inch)
-1 degree	85 mm (3.3 inch)	148 mm (5.8 inch)
-2 degrees	82 mm (3.2 inch)	144 mm (5.7 inch)
-3 degrees	80 mm (3.1 inch)	140 mm (5.5 inch)
-4 degrees	77 mm (3.0 inch)	136 mm (5.4 inch)
-5 degrees	74 mm (2.9 inch)	132 mm (5.2 inch)
-6 degrees	71 mm (2.8 inch)	128 mm (5.0 inch)
-7 degrees	68 mm (2.7 inch)	124 mm (4.9 inch)
-8 degrees	64 mm (2.5 inch)	120 mm (4.7 inch)
-9 degrees	60 mm (2.4 inch)	116 mm (4.6 inch)
-10 degrees	56 mm (2.2 inch)	112 mm (4.4 inch)
-11 degrees	52 mm (2.0 inch)	109 mm (4.3 inch)
-12 degrees	49 mm (1.9 inch)	106 mm (4.2 inch)
-13 degrees	46 mm (1.8 inch)	103 mm (4.1 inch)
-14 degrees	42 mm (1.7 inch)	100 mm (3.9 inch)
-15 degrees	38 mm (1.5 inch)	97 mm (3.8 inch)

(1) A positive angle indicates that the front of the engine is raised. A negative angle indicates that the front of the engine is lowered.

Table 26

3412E Marine Engine Calibration of the Engine Oil Level Gauge Deep Sump Left Hand Service		
Angle[1]	**(X) "ADD" Mark**	**(Y) "FULL" Mark**
15 degrees	202 mm (8.0 inch)	263 mm (10.4 inch)
14 degrees	200 mm (7.9 inch)	259 mm (10.2 inch)
13 degrees	197 mm (7.8 inch)	253 mm (10.0 inch)
12 degrees	193 mm (7.6 inch)	246 mm (9.7 inch)
11 degrees	191 mm (7.5 inch)	240 mm (9.4 inch)
10 degrees	187 mm (7.4 inch)	235 mm (9.3 inch)
9 degrees	183 mm (7.2 inch)	230 mm (9.1 inch)
8 degrees	178 mm (7.0 inch)	223 mm (8.8 inch)
7 degrees	173 mm (6.8 inch)	219 mm (8.6 inch)
6 degrees	168 mm (6.6 inch)	213 mm (8.4 inch)
5 degrees	164 mm (6.5 inch)	208 mm (8.2 inch)
4 degrees	159 mm (6.3 inch)	203 mm (8.0 inch)
3 degrees	155 mm (6.1 inch)	195 mm (7.7 inch)
2 degrees	151 mm (5.9 inch)	192 mm (7.6 inch)
1 degree	145 mm (5.7 inch)	186 mm (7.3 inch)
0 degrees	139 mm (5.5 inch)	183 mm (7.2 inch)
-1 degree	132 mm (5.2 inch)	179 mm (7.0 inch)
-2 degrees	129 mm (5.1 inch)	175 mm (6.9 inch)
-3 degrees	124 mm (4.9 inch)	170 mm (6.7 inch)
-4 degrees	120 mm (4.7 inch)	166 mm (6.5 inch)
-5 degrees	116 mm (4.6 inch)	161 mm (6.3 inch)
-6 degrees	110 mm (4.3 inch)	157 mm (6.2 inch)
-7 degrees	105 mm (4.1 inch)	153 mm (6.0 inch)
-8 degrees	101 mm (4.0 inch)	148 mm (5.8 inch)
-9 degrees	97 mm (3.8 inch)	143 mm (5.6 inch)
-10 degrees	92 mm (3.6 inch)	139 mm (5.5 inch)
-11 degrees	87 mm (3.4 inch)	136 mm (5.4 inch)
-12 degrees	84 mm (3.3 inch)	133 mm (5.2 inch)
-13 degrees	78 mm (3.1 inch)	130 mm (5.1 inch)
-14 degrees	76 mm (3.0 inch)	127 mm (5.0 inch)
-15 degrees	71 mm (2.8 inch)	124 mm (4.9 inch)

(1) A positive angle indicates that the front of the engine is raised. A negative angle indicates that the front of the engine is lowered.

Table 27

3412E Marine Engine Calibration of the Engine Oil Level Gauge Deep Sump Right Hand Service		
Angle[1]	**(X) "ADD" Mark**	**(Y) "FULL" Mark**
15 degrees	223 mm (8.8 inch)	278 mm (10.9 inch)
14 degrees	219 mm (8.6 inch)	272 mm (10.7 inch)
13 degrees	217 mm (8.5 inch)	269 mm (10.6 inch)
12 degrees	213 mm (8.4 inch)	261 mm (10.3 inch)
11 degrees	210 mm (8.3 inch)	256 mm (10.1 inch)
10 degrees	208 mm (8.2 inch)	250 mm (9.8 inch)
9 degrees	204 mm (8.0 inch)	246 mm (9.7 inch)
8 degrees	199 mm (7.8 inch)	241 mm (9.5 inch)
7 degrees	194 mm (7.6 inch)	236 mm (9.3 inch)
6 degrees	190 mm (7.5 inch)	233 mm (9.2 inch)
5 degrees	185 mm (7.3 inch)	227 mm (8.9 inch)
4 degrees	181 mm (7.1 inch)	223 mm (8.8 inch)
3 degrees	176 mm (6.9 inch)	217 mm (8.5 inch)
2 degrees	174 mm (6.9 inch)	214 mm (8.4 inch)
1 degree	168 mm (6.6 inch)	210 mm (8.3 inch)
0 degrees	165 mm (6.5 inch)	205 mm (8.1 inch)
-1 degree	158 mm (6.2 inch)	199 mm (7.8 inch)
-2 degrees	155 mm (6.1 inch)	195 mm (7.7 inch)
-3 degrees	150 mm (5.9 inch)	190 mm (7.5 inch)
-4 degrees	144 mm (5.7 inch)	186 mm (7.3 inch)
-5 degrees	140 mm (5.5 inch)	182 mm (7.2 inch)
-6 degrees	135 mm (5.3 inch)	176 mm (6.9 inch)
-7 degrees	131 mm (5.2 inch)	174 mm (6.9 inch)
-8 degrees	126 mm (5.0 inch)	169 mm (6.7 inch)
-9 degrees	124 mm (4.9 inch)	166 mm (6.5 inch)
-10 degrees	116 mm (4.6 inch)	162 mm (6.4 inch)
-11 degrees	113 mm (4.4 inch)	160 mm (6.3 inch)
-12 degrees	109 mm (4.3 inch)	159 mm (6.3 inch)
-13 degrees	105 mm (4.1 inch)	154 mm (6.1 inch)
-14 degrees	101 mm (4.0 inch)	151 mm (5.9 inch)
-15 degrees	98 mm (3.9 inch)	148 mm (5.8 inch)

(1) A positive angle indicates that the front of the engine is raised. A negative angle indicates that the front of the engine is lowered.

i03542996

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.

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, PEgj0047, “How To Take A Good S·O·S Oil Sample”. Consult your Caterpillar dealer for complete information and assistance in establishing an S·O·S program for your engine.

i02107152

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.

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 with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

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. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.

- If the engine is not equipped with a drain valve, remove the oil drain plug in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

After the oil has drained, the oil drain plugs should be cleaned and installed.

Replace the Oil Filter

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.

1. Remove the oil filter with a 1U-8760 Chain Wrench.

2. Cut the oil filter open with a 175-7546 Oil Filter Cutter Gp. 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.

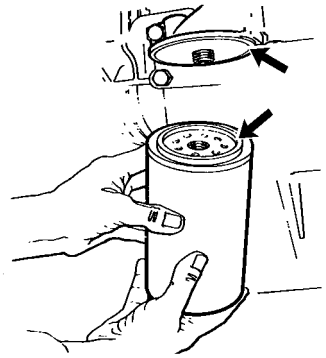


Illustration 40 g00103713
Typical filter mounting base and filter gasket

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” for more information.

NOTICE
If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

NOTICE
To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the 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.

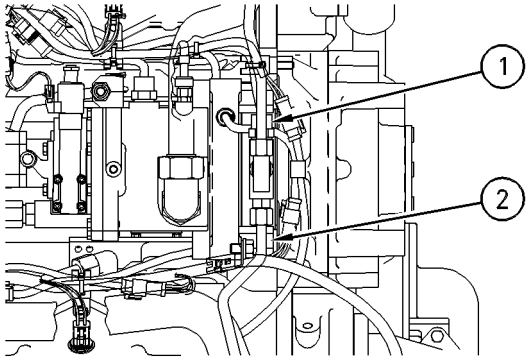
3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.

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 oil level gauge.

i01061121

Engine Speed/Timing Sensors - Check/Clean/Calibrate

SMCS Code: 1912-040; 1912-070; 1912-524



g00372612

Illustration 41

Top view

(1) Secondary speed/timing sensor
(2) Primary speed/timing sensor

1. Remove the speed/timing sensors from the front housing. Check the condition of the plastic end of the speed/timing sensors for wear and/or contaminants.

2. Clean the metal shavings and other debris from the face of the speed/timing sensors. Use the procedure in the Service Manual in order to calibrate the speed/timing sensors.

Refer to the Service Manual for more information on the speed/timing sensors.

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.

i01597115

Engine Valve Rotators - Inspect

SMCS Code: 1109-040

⚠ WARNING

When inspecting the valve rotators, protective glasses or face shield and protective clothing must be worn, to help prevent being burned by hot oil or spray.

Engine valve rotators rotate the valves when the engine runs. This helps to prevent deposits from building up on the valves and the valve seats.

Perform the following steps after the engine valve lash is set, but before the valve covers are installed:

1. Start the engine according to Operation and Maintenance Manual, “Engine Starting” (Operation Section) for the procedure.

2. Operate the engine at low idle.

3. Observe the top surface of each valve rotator. The valve rotators should turn slightly when the valves close.

NOTICE
A valve rotator which does not operate properly will accelerate valve face wear and valve seat wear and shorten valve life. If a damaged rotator is not replaced, valve face guttering could result and cause pieces of the valve to fall into the cylinder. This can cause piston and cylinder head damage.

If a valve fails to rotate, consult your Caterpillar dealer.

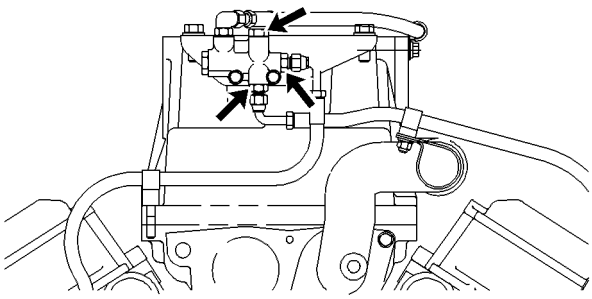
i02553422

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.



g00395938

Illustration 42

Fuel supply connections

The fuel system should be primed after a unit injector is changed or when the fuel system is totally dry.

Note: The fuel system does not typically need to be primed when the primary fuel filters or secondary fuel filters are changed or when an Electronic Control Module (ECM) is replaced. When the engine is started under these circumstances, the engine may momentarily run rough until the air is purged from the system.

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.

1. Loosen a fuel supply connection to the regulating valve, as shown.

Note: The fuel priming pump is located on the secondary fuel filter. Operating the fuel priming pump without loosening a fuel connection upstream of the regulating valve can cause a failure of the fuel transfer pump seal.

2. Open the fuel priming pump and operate the pump until air is purged and the fuel appears at the fuel connection. Tighten the fuel connection.

3. Crank the engine after pressurizing the system.

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.

4. If the engine does not start, repeat Steps 1 through 3 in order to start the engine.

i02927282

Fuel System Primary Filter (Water Separator) Element - Replace

SMCS Code: 1260-510-FQ; 1263-510-FQ

Water in the fuel can cause the engine to run rough. Water in the fuel may cause an electronic unit injector to fail. If the fuel has been contaminated with water, the element should be changed before the regularly scheduled interval.

The primary filter/water separator also provides filtration in order to help extend the life of the secondary fuel filter. The element should be changed regularly. If a vacuum gauge is installed, the primary filter/water separator should be changed at 50 to 70 kPa (15 to 20 inches Hg).

Replace the Element

⚠ 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
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.

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 disconnected fuel system component.

1. Close the main fuel supply valve.

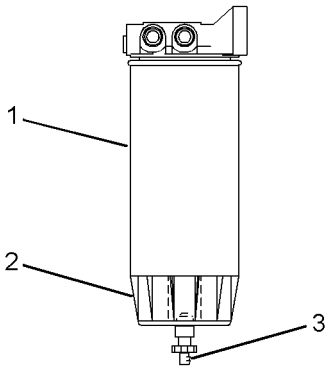


Illustration 43 g01453091

(1) Element
(2) Bowl
(3) Drain

2. Remove element (1) from the element mounting base while bowl (2) is attached.

3. Dispose of the contents of the filter. Remove bowl (2) from element (1). The bowl is reusable. Do not discard the bowl. Dispose of the used element.

4. Remove the O-ring from the gland of the bowl. Clean the following components:

   - Bowl
   - O-ring
   - Mounting base

   Inspect the O-ring for damage and for deterioration. Replace the O-ring, if necessary.

5. Lubricate the O-ring with clean diesel fuel.

6. Install bowl (2) on a new element. Tighten the bowl by hand. Do not use tools in order to tighten the bowl.

NOTICE
The primary filter/water separator may be prefilled with fuel to avoid rough running/stalling of the engine due to air. Do not fill the secondary filter with fuel before installation. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

7. Lubricate the top seal of element (1) with clean diesel fuel. The element may be filled with fuel at this time. Install the new element on the mounting base. Tighten the element by hand.

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

8. Open the main fuel supply valve.

9. Start the engine and check for leaks. Run the engine for one minute. Stop the engine and check for leaks again.

   Detecting leaks is difficult while the engine is running. The primary filter/water separator is under suction. A leak will allow air to enter the fuel. The air in the fuel can cause low power due to aeration of the fuel. If air enters the fuel, check the components for overtightening or undertightening.

i01463757

Fuel System Primary Filter/Water Separator - Drain

SMCS Code: 1260-543; 1263-543

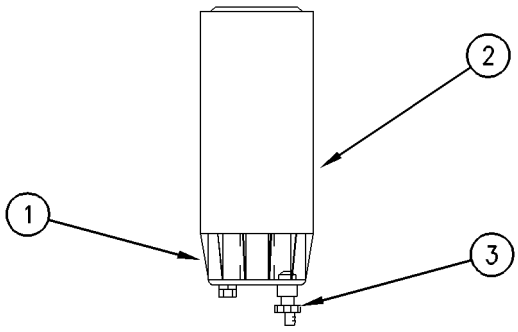


Illustration 44 g00668636

(1) Bowl
(2) Element
(3) Drain

Bowl (1) should be monitored daily for signs of water. If water is present, drain the water from the bowl.

1. Open drain (3). The drain is a self-ventilated drain. Catch the draining water in a suitable container. Dispose of the water properly.

2. Close drain (3).

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.

i00823807

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.

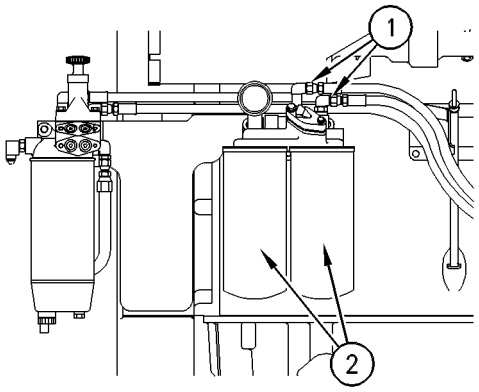


Illustration 45 g00396257

(1) Fuel supply connections
(2) Fuel filters

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. It may be necessary to relieve residual fuel pressure from the fuel system before removing the fuel filter.

   Loosen one of the fuel supply connections (1) in order to purge any residual pressure.

NOTICE
Do not loosen fuel lines or fittings at the fuel manifold or ECM. The engine components may be damaged.

2. Remove 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.

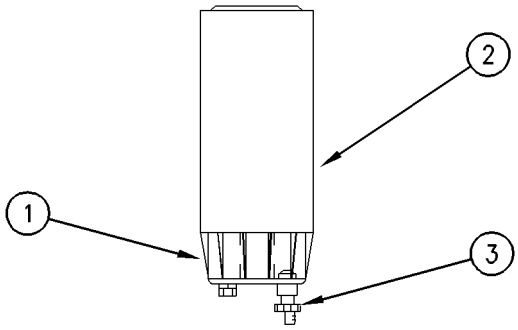
NOTICE
Do not fill the secondary fuel filter with fuel before installing. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

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 3/4 turn by hand. Do not overtighten the filter.

i02379747

Fuel System Water Separator - Drain

SMCS Code: 1263-543



g00668636

Illustration 46

(1) Bowl
(2) Element
(3) Drain

Bowl (1) should be monitored daily for signs of water. If water is present, drain the water from the bowl.

1. Open drain (3). The drain is a self-ventilated drain. Catch the draining water in a suitable container. Dispose of the water properly.

2. Close drain (3).

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.

i01065537

Heat Exchanger - Inspect

SMCS Code: 1379-040

The interval for the maintenance of the plate type heat exchanger depends on the operating environment of the vessel and on the operating time. The raw/sea water that is circulated through the heat exchanger and the amount of operating time of the vessel affects the following items:

- Cleanliness of the heat exchanger plates
- Effectiveness of the heat exchanger system

Operating the engine in water that contains silt, sediment, salt, algae, or other significant contaminants will have an adverse effect on the heat exchanger system. In addition, intermittent use of the vessel will adversely affect the heat exchanger system.

The following items indicate that the heat exchanger may require cleaning:

- Increased coolant temperature
- Engine overheating
- Excessive pressure drop between the water inlet and the water outlet

An operator that is familiar with the normal operating temperature of the coolant can determine when the coolant temperature is out of the normal range. Inspection and maintenance of the heat exchanger is required if the engine is overheating.

For information on maintenance of the heat exchanger and cleaning of the heat exchanger, refer to Disassembly and Assembly, “Heat Exchanger - Disassemble”.

Your Caterpillar dealer has the equipment and the personnel in order to measure the pressure drop across the heat exchanger.

Consult your Caterpillar dealer or refer to the Service Manual for service information for the heat exchanger.

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

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

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.

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

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.

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.

i01089872

Marine Transmission Oil Level - Check

SMCS Code: 3081-535

Check the marine transmission oil level according to the instructions that are provided by the OEM of the transmission or the OEM of the vessel.

For the lubrication requirements of the transmission, refer to the recommendations on the nameplate or the “Owner's Manual” for the transmission.

Marine Transmission Operation, Maintenance, Warranty, and Parts Support

For information on maintenance and operation of the marine transmission, consult your Caterpillar dealer and/or the OEM dealer of the transmission.

All support for the warranty of the transmission will be the responsibility of the OEM. All parts support for the transmission will be the responsibility of the OEM. This parts support includes both the installation of parts and the resolution of any service problems.

i02417406

Overhaul (Top End)

SMCS Code: 7595-020-TE

A top end overhaul involves the removal, the inspection, and the rework of the cylinder head components. A few additional components are replaced and serviced.

Your Caterpillar dealer can provide these services and components. Your Caterpillar dealer can ensure that the components are operating within the appropriate specifications.

The following definitions explain the terminology for the services that are performed during an overhaul:

Inspect – Inspect the components according to the instructions that are in Caterpillar reusability publications. Refer to Guidelines for Reusable Parts and Salvage Operations, SEBF8029, “Index of Publications on Reusability or Salvage of Used Parts”. The guidelines were developed in order to help Caterpillar dealers and customers to avoid unnecessary expenditures. New parts are not required if the existing parts can still be used, reconditioned, or repaired. If the components are not in the reusability guidelines, refer to the Service Manual, “Specifications” module.

Rebuild – The component is reconditioned in order to comply with reusability guidelines.

Replace – The service life of the part is exhausted. The part may fail before the next maintenance interval. The part must be replaced with a part that meets functional specifications. The replacement part may be a new part, a CAT remanufactured part, a rebuilt part, or a used part. Some worn components may be exchanged with your Caterpillar dealer for a credit on replacement parts. Consult your Caterpillar dealer about repair options for your engine.

If you elect to perform an overhaul without the services of a Caterpillar dealer, be aware of the recommendations in Table 28.

Table 28

Recommendations for Top End Overhauls (1)	
Service	**Top End Overhaul**
Inspect Rebuild Replace	Cylinder head assemblies
	Valves
Inspect Replace	Rocker arms
	Valve bridges
Replace	Cylinder head gaskets

(1) For instructions on removal and installation of components, see the Service Manual, “Disassembly and Assembly” module.

i02018788

Overhaul Considerations

SMCS Code: 7595-043

Reduced hours of operation at full load will result in a lower average power demand. A decreased average power demand should increase both the engine service life and the overhaul interval.

The need for an overhaul is generally indicated by increased fuel consumption and by reduced power.

The following factors are important when a decision is being made on the proper time for an engine overhaul:

- The need for preventive maintenance
- The quality of the fuel that is being used
- The operating conditions
- The results of the S·O·S analysis

Oil Consumption as an Overhaul Indicator

Oil consumption, fuel consumption, and maintenance information can be used to estimate the total operating cost for your Caterpillar engine. Oil consumption can also be used to estimate the required capacity of a makeup oil tank that is suitable for the maintenance intervals.

Oil consumption is in proportion to the percentage of the rated engine load. As the percentage of the engine load is increased, the amount of oil that is consumed per hour also increases.

The oil consumption rate (brake specific oil consumption) is measured in grams per kW/h (lb per bhp). The brake specific oil consumption (BSOC) depends on the engine load. Consult your Caterpillar dealer for assistance in determining the typical oil consumption rate for your engine.

When an engine's oil consumption has risen to three times the original oil consumption rate due to normal wear, an engine overhaul should be scheduled. There may be a corresponding increase in blowby and a slight increase in fuel consumption.

Overhaul Options

Before Failure Overhaul

A planned overhaul before failure may be the best value for the following reasons:

- Costly unplanned downtime can be avoided.
- Many original parts can be reused according to the standards for reusable parts.
- The engine service life can be extended without the risk of a major catastrophe due to engine failure.
- The best cost/value relationship per hour of extended life can be attained.

After Failure Overhaul

If a major engine failure occurs and the engine must be removed, many options are available. An overhaul should be performed if the engine block or the crankshaft needs to be repaired.

If the engine block is repairable and/or the crankshaft is repairable, the overhaul cost should be between 40 percent and 50 percent of the cost of a new engine with a similar exchange core.

This lower cost can be attributed to three aspects:

- Specially designed Caterpillar engine features
- Caterpillar dealer exchange components
- Caterpillar Inc. remanufactured exchange components

Overhaul Recommendation

To minimize downtime, a scheduled engine overhaul by your Caterpillar dealer is recommended. This will provide you with the best cost/value relationship.

Note: Overhaul programs vary according to the engine application and according to the dealer that performs the overhaul. Consult your Caterpillar dealer for specific information about the available overhaul programs and about overhaul services for extending the engine life.

If an overhaul is performed without overhaul service from your Caterpillar dealer, be aware of the following maintenance recommendations.

Unit Fuel Injector

Clean the fuel injector body and replace the O-rings. Replace the O-rings and the gasket on the injector sleeve. Clean the area around the injector seating in the injector sleeve. Refer to the Service Manual for the complete procedure, or consult with your Caterpillar dealer for assistance.

Rebuild or Exchange

Cylinder Head Assembly, Connecting Rods, Pistons, Cylinder Liners, Turbocharger, Cylinder Packs, Oil Pump, and Fuel Transfer Pump

These components should be inspected according to the instructions that are found in various Caterpillar reusability publications. The Special Publication, SEBF8029 lists the reusability publications that are needed for inspecting the engine parts.

If the parts comply with the established inspection specifications that are expressed in the reusable parts guideline, the parts should be reused.

Parts that are not within the established inspection specifications should be dealt with in one of the following manners:

- Salvaging
- Repairing
- Replacing

Using out-of-spec parts can result in the following problems:

- Unscheduled downtime
- Costly repairs
- Damage to other engine parts
- Reduced engine efficiency
- Increased fuel consumption

Reduced engine efficiency and increased fuel consumption translates into higher operating costs. Therefore, Caterpillar Inc. recommends repairing out-of-spec parts or replacing out-of-spec parts.

Inspection and/or Replacement

Piston Rings, Crankshaft Bearings, Valve Rotators, and Crankshaft Seals

The following components may not last until the second overhaul.

- Thrust bearings
- Main bearings
- Rod bearings
- Valve rotators
- Crankshaft seals

Caterpillar Inc. recommends the installation of new parts at each overhaul period.

Inspect these parts while the engine is disassembled for an overhaul.

Inspect the crankshaft for any of the following conditions:

- Deflection
- Damage to the journals
- Bearing material that has seized to the journals

Check the journal taper and the profile of the crankshaft journals. Check these components by interpreting the wear patterns on the following components:

- Rod bearing
- Main bearings

Note: If the crankshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the crankshaft.

Inspect the camshaft for damage to the journals and to the lobes.

Note: If the camshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the camshaft.

Inspect the following components for signs of wear or for signs of scuffing:

- Camshaft bearings
- Camshaft followers

Caterpillar Inc. recommends replacing the crankshaft vibration damper.

Oil Cooler Core and Aftercooler Core

During an overhaul, the removal of the oil cooler core and the aftercooler core is recommended. The oil cooler core and the aftercooler core should be cleaned and pressure tested.

NOTICE
Do not use caustic cleaners to clean the core.

Caustic cleaners can attack the internal metals of the core and cause leakage.

Note: Use this cleaning procedure to clean the oil cooler core and the aftercooler core.

1. Remove the oil cooler core and the aftercooler core.
2. Remove any debris from the oil cooler core and the aftercooler core. To remove debris from the oil cooler core, turn the oil cooler core onto one end. To remove debris from the aftercooler core, turn the aftercooler core upside-down.
3. Flush the oil cooler core and the aftercooler core internally with cleaner in order to loosen foreign substances. This will also help to remove oil from the oil cooler core and the aftercooler core.

Note: The use of Hydrosolv Liquid Cleaners is recommended. Table 29 lists the Hydrosolv Liquid Cleaners that are available from your Caterpillar dealer.

Table 29

Hydrosolv Liquid Cleaners[1]		
Part Number	**Description**	**Size**
1U-5490	Hydrosolv 4165	19 L (5 US gallon)
174-6854	Hydrosolv 100	19 L (5 US gallon)

(1) 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. Use steam to clean the oil cooler core and the aftercooler core. This removes any remaining residue from the cleaner. Flush the fins of the oil cooler core and the aftercooler core. Remove any other trapped debris.

5. Wash the oil cooler core and the aftercooler core with hot, soapy water. Rinse the oil cooler core and the aftercooler 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 oil cooler core and the aftercooler core with compressed air. Direct the air in the reverse direction of the normal flow.

7. Inspect the components in order to ensure cleanliness. The oil cooler core and the aftercooler core should be pressure tested. Repair the oil cooler core and the aftercooler core, if necessary. Install the oil cooler core and the aftercooler core.

For more information about cleaning the cores, consult your Caterpillar dealer.

Obtain Coolant Analysis

The concentration of supplemental coolant additive (SCA) should be checked regularly with test kits or with S·O·S Coolant Analysis (Level 1). Further coolant analysis is recommended when the engine is overhauled.

A coolant analysis can be conducted in order to verify the condition of the water that is being used in the cooling system. A full water analysis can be obtained by consulting your local water utility company or an agricultural agent. Private laboratories are also available for water analysis.

Caterpillar Inc. recommends an S·O·S Coolant Analysis (Level 2).

S·O·S Coolant Analysis (Level 2)

An S·O·S Coolant Analysis (Level 2) is a comprehensive coolant analysis which completely analyzes the coolant and the effects on the cooling system. An S·O·S Coolant Analysis (Level 2) provides the following information:

- Complete S·O·S Coolant Analysis (Level 2)
- Visual inspection of properties
- Identification of metal corrosion
- Identification of contaminants
- Identification of built up impurities (corrosion and scale)

S·O·S Coolant Analysis (Level 2) provides a report of the results of both the analysis and the maintenance recommendations.

For more information about coolant analysis, consult your Caterpillar dealer.

i00905687

Sea Water Strainer - Clean/Inspect

SMCS Code: 1371-040; 1371-070

The sea water strainer must be clean in order to allow proper engine cooling. Check the sea water strainer for plugging. Inspect the sea water strainer more frequently if the vessel is being operated in water which is shallow or dirty. Refer to the OEM recommendations for more information about inspecting and cleaning the sea water strainer.

Ensure that the auxiliary water pump is primed and that the suction line is open.

1. Remove the sea water strainer and clean the screen. Remove any dirt and debris.

2. Install the sea water strainer. Fill the sea water strainer and the suction line for the auxiliary water pump with water.

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.

i01539769

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.

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.

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.

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.

i01063972

Walk-Around Inspection

SMCS Code: 1000-040

Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only require a few minutes. When the time is used 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 you start 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.

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.

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.

- Ensure that the cooling lines are properly clamped. Check for leaks. Check the condition of all pipes.
- Check the marine transmission oil level. Refer to the OEM specification for the marine transmission or refer to the OEM specification for the vessel.
- Inspect the water pumps for coolant leaks.

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.

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. Inspect the hose that goes from the unit injector hydraulic pump to the left side fluid manifold.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.
- 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 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 which are cracked. Replace any gauges that can not be calibrated.

i03543200

Water Pump - Inspect

SMCS Code: 1361-040; 1361

A failed water pump might cause severe engine overheating problems that could result in the following conditions:

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

A failed water pump might cause severe engine overheating problems that could result in cracks in the cylinder head, a piston seizure or other potential damage to the engine.

Visually inspect the water pump for leaks. If leaking of the water pump seals is observed, replace all of the water pump seals. Refer to two articles in the Disassembly and Assembly Manual, “Water Pump - Disassemble and Water Pump - Assemble” for the disassembly and assembly procedure. If it is necessary to remove the water pump, refer to two articles in the Disassembly and Assembly Manual, “Water Pump - Remove and Water Pump - Install”.

Inspect the water pump for wear, cracks, pin holes and proper operation. Refer to the Parts Manual for the correct part numbers for your engine or consult your Caterpillar dealer if repair is needed or replacement is needed.

i01040881

Zinc Rods - Inspect/Replace

SMCS Code: 1388-040; 1388-510

Corrosion in sea water circuits can result in premature deterioration of system components, leaks, and possible cooling system contamination. A lack of zinc rods in the sea water system can cause corrosion in the sea water cooling system.

Zinc rods are inserted in the sea water cooling system of the engine in order to help prevent the corrosive action of salt water. The reaction of the zinc to the sea water causes the zinc rods to deteriorate. The zinc rods deteriorate instead of engine parts for the cooling system that are more critical. Rapid deterioration of zinc rods may indicate the presence of uncontrolled electrical currents from improperly installed electrical attachments or improperly grounded electrical attachments.

The zinc rods must be inspected at the proper intervals. The zinc rods must be replaced when deterioration occurs.

Inspect the Zinc Rods

The zinc rods are red for easy identification. Table 30 shows the locations of the zinc rods and the quantities of the zinc rods.

Table 30

Locations of the Zinc Rods	
Location	**Quantity**
Inlet Elbow for Sea Water On the Heat Exchanger	1
Outlet Elbow for Sea Water On the Heat Exchanger	1

1. Remove the zinc rod.

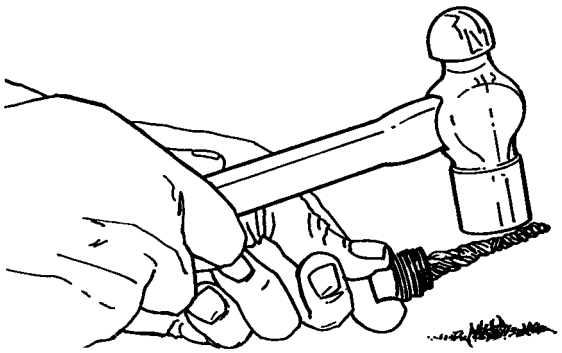


Illustration 47 g00104048

2. Tap the zinc rod lightly with a hammer. If the zinc rod has deteriorated, or if the zinc rod flakes, install a new zinc rod.

Replace the Zinc Rods

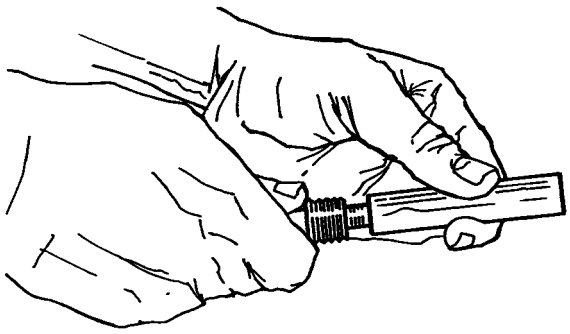


Illustration 48 g00104049

1. Unscrew the old zinc rod or drill the old zinc rod from the plug. Clean the plug.

2. Apply 9S-3263 Compound to the shoulder of a new zinc rod. Apply the compound only to the shoulder of the zinc rod. Install the zinc rod into the plug.

3. Coat the external threads of the plug with 5P-3413 Pipe Sealant. Install the zinc rod. Refer to Operation and Maintenance Manual for more information on torque specifications.