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MAINTENANCE INTERVALS

Operation and Maintenance
Manual Excerpt

CATERPILLAR®

CATERPILLAR®

SEBU6356-06
September 2008

Operation and Maintenance Manual

G3304 and G3306 Engines

H4D1-Up (Engine)
H6D1-Up (Engine)
N4F1-Up (Engine)
G6X1-Up (Engine)
07Y1-Up (Engine)
37Y1-Up (Engine)

i03246620

Maintenance Interval Schedule ((Standby Generator Set Engines))

SMCS Code: 1000; 4450; 7500

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

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

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

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

Every Week

Every 250 Service Hours or 1 Year

Every 500 Service Hours

Every Year

Every 3 Years

i03246601

Maintenance Interval Schedule ((Naturally Aspirated Engines))

SMCS Code: 1000; 4450; 7500

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

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

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

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

When Required

Daily

Every 250 Service Hours

Every 500 Service Hours

Every 750 Service Hours

Initial 750 Service Hours

Initial 1500 Service Hours

Every 1500 Service Hours

Every Year

Every 3000 Service Hours

Every 3 Years

Between 12 000 and 16 000 Service Hours

Between 36 000 and 44 000 Service Hours

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Maintenance Interval Schedule ((Turbocharged Engines))

SMCS Code: 1000; 4450; 7500

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

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

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

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

When Required

Daily

Every 250 Service Hours

Every 500 Service Hours

Every 750 Service Hours

Initial 750 Service Hours

Every 1500 Service Hours

Every Year

Every 3000 Service Hours

Every 3 Years

Every 4000 Service Hours

Every 8000 Service Hours

Between 9000 and 12 000 Service Hours

Between 18 000 and 24 000 Service Hours

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Actuator Control Linkage - Lubricate

SMCS Code: 1265-086

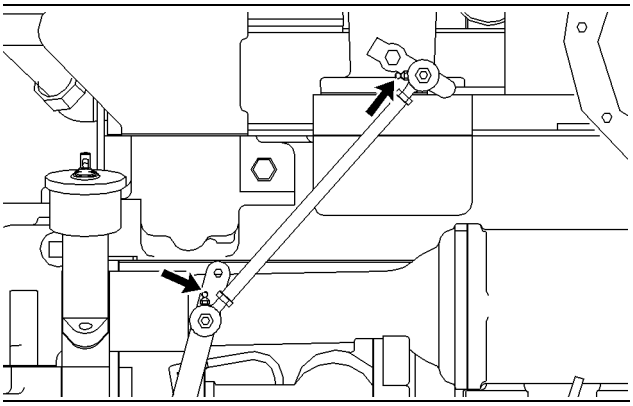

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Illustration 28

Grease fittings

Apply grease to the grease fittings. Use a hand grease gun and lubricate the grease fittings with MPGM.

Check the Linkage

Check the linkage for proper operation. Adjust the linkage, if necessary. For the adjustment procedure, see the Service Manual, “Systems Operation/Testing and Adjusting” module.

i02708645

Aftercooler Core - Clean/Test (Air-To-Air Aftercooler)

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

S/N: H4D1-Up

S/N: H6D1-Up

S/N: G6X1-Up

S/N: 07Y1-Up

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

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

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

⚠ WARNING

Personal injury can result from air pressure.

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

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

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan’s air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. The maximum air pressure for cleaning purposes must be below 205 kPa (30 psi) when the air nozzle is deadheaded. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

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

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

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

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

Note: If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

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

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

i02654935

Air Starting Motor Lubricator Bowl - Clean

SMCS Code: 1451-070

If the engine is equipped with an air starting motor, use the following procedure:

⚠ WARNING

Personal injury can result from removing hoses or fittings in a pressure system.

Failure to relieve pressure can cause personal injury.

Do not disconnect or remove hoses or fittings until all pressure in the system has been relieved.

1. Ensure that the air supply to the lubricator is OFF.

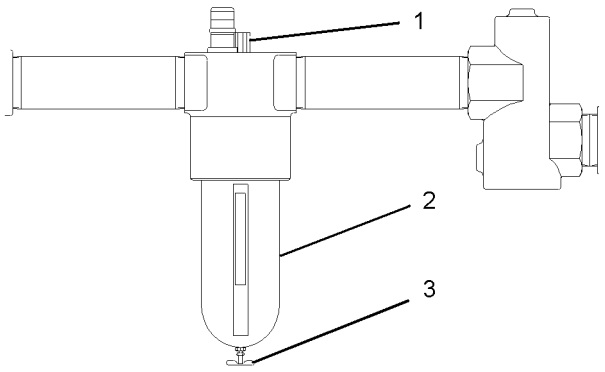

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Illustration 29

(1) Filler plug
(2) Bowl
(3) Drain valve

2. Slowly loosen filler plug (1) in order to release the pressure from the lubricator.

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.

3. Place a suitable container under bowl (2) and open drain valve (3) in order to drain the oil from the bowl.

4. Remove bowl (2). Clean the bowl with warm water.

5. Dry the bowl. Inspect the bowl for cracks. If the bowl is cracked, replace the damaged bowl with a new bowl. Inspect the gasket. If the gasket is damaged, replace the gasket.

6. Install the bowl.

7. Make sure that drain valve (3) is closed.

8. For instructions on filling the lubricator, see this Operation and Maintenance Manual, “Air Starting Motor Lubricator Oil Level - Check” topic.

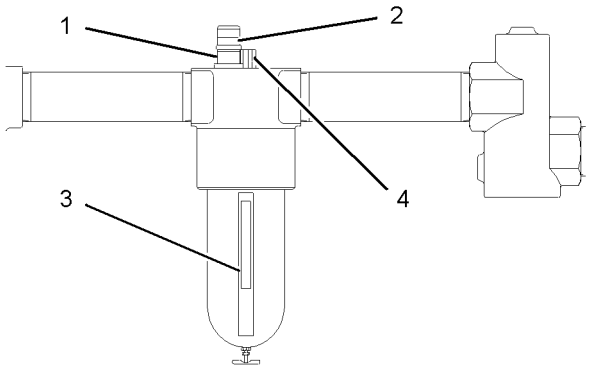
i02654969

Air Starting Motor Lubricator Oil Level - Check

SMCS Code: 1451-535

NOTICE

Never allow the lubricator bowl to become empty. The air starting motor will be damaged by a lack of lubrication. Ensure that sufficient oil is in the lubricator bowl.



g01333366

Illustration 30

1. Observe the oil level in sight gauge (3). If the oil level is less than 1/2, add oil to the lubricator bowl.

⚠ WARNING

Personal injury can result from removing hoses or fittings in a pressure system.

Failure to relieve pressure can cause personal injury.

Do not disconnect or remove hoses or fittings until all pressure in the system has been relieved.

2. Ensure that the air supply to the lubricator is OFF. Slowly loosen filler plug (4) in order to release pressure from the lubricator bowl.

3. Remove filler plug (4). Pour oil into the lubricator bowl. Use nondetergent SAE 10W oil for temperatures that are greater than 0 °C (32 °F). Use air tool oil for temperatures that are below 0 °C (32 °F).

4. Install filler plug (4).

Adjust the Lubricator

Note: Adjust the lubricator with a constant rate of air flow. After the adjustment, the lubricator will release oil in proportion to variations of the air flow.

1. Ensure that the fuel supply to the engine is OFF.

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

2. Operate the air starting motor. Observe the drops of oil that are released in dome (1).

Note: Some lubricators have an adjustment screw rather than a knob.

3. If necessary, adjust the lubricator in order to release from one to three drops of oil per second. To increase the rate, turn knob (2) counterclockwise. To decrease the rate, turn the knob clockwise.

i00351324

Air Tank Moisture and Sediment - Drain

SMCS Code: 1466-543-M&S

Moisture and sediment in the air starting system can cause the following conditions:

- Freezing
- Corrosion of internal parts
- Malfunction of the air starting system

⚠ WARNING

When opening the drain valve, wear protective gloves, a protective face shield, protective clothing, and protective shoes. Pressurized air could cause debris to be blown and result in personal injury.

1. Open the drain valve that is on the bottom of the air tank. Allow the moisture and sediment to drain.

2. Close the drain valve.

i02084374

Alternator - Inspect

SMCS Code: 1405-040

Inspect the alternator for the following conditions:

- Proper connections
- Clean ports for cooling airflow
- Proper charging of the battery

Observe the ammeter during engine operation in order to ensure proper battery performance and/or proper performance of the electrical system.

Make repairs, if necessary. See the Service Manual for service procedures. Consult your Caterpillar dealer for assistance.

i01039675

Automatic Start/Stop - Inspect (Generator Set)

SMCS Code: 4462

The generator set must be ready to operate under a load at any time. After performing maintenance on the generator set, inspect the position of the control switches. Ensure the following conditions:

- The starting system is enabled.
- The control switches are in the correct position for automatic starting.

- The switchgear and the automatic transfer switches that are associated with the generator are enabled.

For more information, see the Operation and Maintenance Manual for the generator and the control panel.

i01041029

Batteries - 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.

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 connecting the cables, 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.

i01039758

Battery Charger - Check

SMCS Code: 1401-535

Checking Before Start-Up

Check the battery charger for proper operation. If the batteries are properly charged, the needle of the ammeter will register near "0" (zero).

The battery charger must not produce excessive current during start-up. Alternatively, the charger must be automatically disconnected for start-up. If the engine has an alternator, the charger must be automatically disconnected during start-up and during engine operation.

Charging the Battery

⚠ WARNING

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operated. A spark can cause an explosion from the flammable vapor mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Injury to personnel can be the result.

Perform the following procedure to charge the battery:

1. Ensure that the charger is turned OFF.
2. Adjust the voltage of the charger in order to match the voltage of the battery.
3. Connect the POSITIVE "+" lead of the charger to the POSITIVE "+" battery terminal. Connect the NEGATIVE "-" lead of the charger to the NEGATIVE "-" battery terminal.
4. Turn ON the battery charger.

Overcharging of Batteries

Overcharging reduces the service life of batteries. Use a battery charger that will not overcharge the battery. DO NOT charge the battery if the meter of the battery charger is in the RED zone.

Overcharging is indicated by the following symptoms:

- The battery is very warm to the touch.
- A strong odor of acid is present.
- The battery emits smoke or a dense vapor (gas).

Perform one of the following procedures if the battery shows symptoms of overcharging:

- Reduce the rate of charging by a significant amount. Complete the charging at the reduced rate.
- Turn OFF the charger.

Table 16 describes the effects of overcharging on different types of batteries.

Table 16

Effects of Overcharging Batteries	
Type of Battery	**Effect**
Caterpillar General Service Batteries Caterpillar Premium High Output Batteries	All of the battery cells have a low level of electrolyte.
	When the plates of the battery are inspected through the filler holes, the plates may appear to be warped. This is caused by an excessive temperature.
	The battery may not pass a load test.
Caterpillar Maintenance Free Batteries	The battery may not accept a charging current.
	The battery may not pass a load test.

Checking After Stopping

Ensure that the battery charger is connected properly. Observe the meter of the charger. Record the amperage.

i02601752

Battery Electrolyte Level - Check

SMCS Code: 1401-535-FLV

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.

i02042962

Belts - Inspect/Adjust/Replace

SMCS Code: 1357-025; 1357-040; 1357-510

Inspection

Inspect the alternator belt and the fan drive belts for wear and for cracking. Replace the belts if the belts are not in good condition.

Check the belt tension according to the information in the Service Manual, “Specifications”.

Slippage of loose belts can reduce the efficiency of the driven components. Vibration of loose belts can cause unnecessary wear on the following components:

- Belts

- Pulleys
- Bearings

If the belts are too tight, unnecessary stress is placed on the components. This reduces the service life of the components.

Replacement

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

Alternator Belt Adjustment

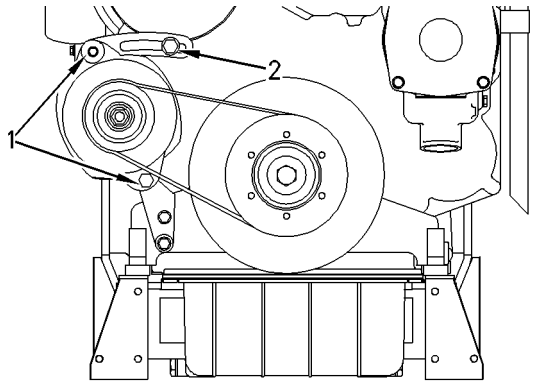


Illustration 31 g00788814

1. Remove the belt guard.
2. Loosen mounting bolts (1) and adjusting bolt (2).
3. Move the assembly in order to increase or decrease the belt tension.
4. Tighten adjusting bolt (2). Tighten mounting bolts (1).
5. Reinstall the belt guard.

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

Adjustment of the Fan Drive Belt

1. Remove the belt guard.
2. Loosen the mounting bolt for the pulley.
3. Loosen the adjusting nut for the pulley.
4. Move the pulley in order to adjust the belt tension.
5. Tighten the adjusting nut.
6. Tighten the mounting bolt.
7. Reinstall the belt guard.

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

i01041135

Belts - Replace

SMCS Code: 1357-510

Remove the used fan drive belt and the accessory drive belt. Install new belts.

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

Check the belt tension according to the information in the Service Manual, “Specifications” module. To adjust the belt tension, see this Operation and Maintenance Manual, “Alternator and Fan Belts - Inspect/Adjust/Replace” topic (Maintenance Section).

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

i01519364

Carburetor - Inspect/ Recondition

SMCS Code: 1512-020

Note: See the Service Manual, “Disassembly and Assembly” module for information on these topics: removal, disassembly, assembly, and installation.

1. Remove the carburetor.
2. Disassemble the carburetor.

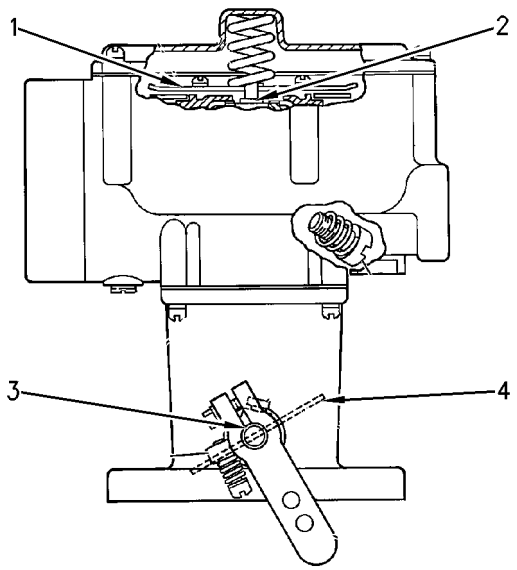


Illustration 32 g00788856

3. Inspect diaphragm (1). If the diaphragm is worn or damaged, replace the diaphragm.

4. Inspect piston (2). If the piston is excessively worn, replace the carburetor body and the diaphragm assembly.

5. Inspect throttle shaft (3) for wear near the bearing. Inspect throttle plate (4) and the throttle body for wear and/or damage. Replace any component that is worn or damaged.

6. Assemble the carburetor. Use new gaskets for assembly.

7. Install the carburetor.

8. Adjust the carburetor according to Special Instruction, REHS0371, “Installation and Intitial Start-Up Procedure for G3300 and G3400 Engines”.

i01005891

Carburetor Air/Fuel Ratio - Check/Adjust

SMCS Code: 1266-535; 1266

An engine failure may occur if the air/fuel ratio is not appropriate for the fuel and for the operating conditions. The service life of the turbocharger, of the valves, and of the other components may be reduced.

Ensure that the carburetor is adjusted properly so that the air/fuel ratio is correct.

For information on adjusting the carburetor, refer to the Service Manual, “Systems Operation/Testing and Adjusting”, or refer to the Special Instruction, “Installation and Initial Start-Up Procedure”.

i01762721

Control Panel - Inspect

SMCS Code: 4490-040; 7451-040

Inspect the condition of the panel. If a component is damaged, ensure that the component is repaired or that the component is replaced. If equipped, ensure that the electronic displays are operating properly.

Inspect the wiring for good condition. Ensure that the wiring connections are secure.

Record the Data and Review the Data

If equipped, check the gauges and check the indicators frequently during normal operation. Record the data in a log. Compare the new data to the data that was previously recorded. Comparing the new data to the recorded data will establish the normal gauge readings for the engine. A gauge reading that is abnormal may indicate a problem with operation or with the gauge.

i02155505

Cooling System Coolant (DEAC) - Change

SMCS Code: 1350-044

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

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

Drain the Cooling System

1. Stop the engine and allow the engine to cool. Ensure that the engine will not start when the cooling system is drained.

Note: When maintenance for the jacket water system is performed, perform the same maintenance for the aftercooler’s cooling system (if equipped).

2. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

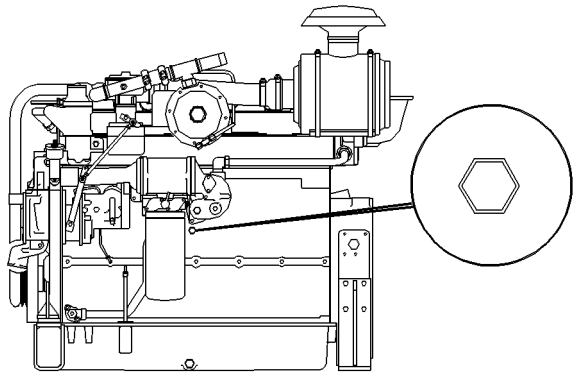


Illustration 33 g00518449

Engine block drain plug

3. Open the cooling system drain valve. Remove the engine block drain plug.

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

Clean the Cooling System

1. After the cooling system has been drained, flush the cooling system with clean water in order to remove any debris.

2. Close the cooling system drain valve. Clean the engine block drain plug and install the plug.

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.

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. Operate the engine for a minimum of 30 minutes with a coolant temperature of at least 82 °C (180 °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 cooling system drain valve. Remove the engine block drain plug.

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.

6. Allow the water to drain. Flush the cooling system with clean water until the water that drains is clean. Close the cooling system drain valve. Clean the engine block drain plug and install the plug.

Cleaning a Cooling System that has Heavy Deposits or Plugging

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

1. After the cooling system has been drained, flush the cooling system with clean water in order to remove any debris.

2. Close the cooling system drain valve. Clean the engine block drain plug and install the plug.

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.

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. Install vent plug (4).

4. Start the engine. Operate the engine for a minimum of 90 minutes with a coolant temperature of at least 82 °C (180 °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 cooling system drain valve. Remove the engine block drain plug. Allow the water to drain.

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.

6. Flush the cooling system with clean water until the water that drains is clean. Close the cooling system drain valve. Clean the engine block drain plug and install the plug.

Fill the Cooling System

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

Note: For information about the proper coolant to use and the capacity of the cooling system, see this Operation and Maintenance Manual, “Refill Capacities and Recommendations” (Maintenance Section).

1. Fill the cooling system with coolant/antifreeze. Do not install the cooling system filler cap.

2. Start the engine. Operate the engine in order to purge the air from the cavities of the engine block. Allow the coolant to warm and allow the coolant level to stabilize. Stop the engine.

3. Check the coolant level. Maintain the coolant to the proper level on the sight gauge (if equipped). If a sight gauge is not equipped, maintain the coolant within 13 mm (0.5 inch) below the bottom of the filler pipe.

4. Clean the cooling system filler cap. Inspect the gaskets of the cooling system filler cap. If the gaskets of the cooling system filler cap are damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gaskets of the cooling system filler cap are not damaged, use a 9S-8140 Pressurizing Pump in order to pressure test the cooling system filler cap. The correct pressure is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not maintain 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.

i02068741

Cooling System Coolant (NGEC) - Change

SMCS Code: 1350-044

The procedure that is used to change Natural Gas Engine Coolant (NGEC) is identical to the procedure that is used to change Diesel Engine Antifreeze/Coolant (DEAC). Refer to Operation and Maintenance Manual, “Cooling System Coolant (DEAC) - Change” for the proper procedure.

i01934272

Cooling System Coolant Analysis (Level I) - Obtain

SMCS Code: 1350

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 Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engine Fluids Recommendations” or consult your Caterpillar dealer.

i01934327

Cooling System Coolant Analysis (Level II) - Obtain

SMCS Code: 1350

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.

i01197583

Cooling System Coolant Level - Check

SMCS Code: 1350-535-FLV

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

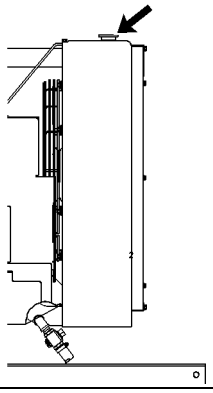


Illustration 34 g00285520
Cooling system filler cap

⚠ WARNING

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

1. Remove the cooling system filler cap slowly in order to relieve pressure.
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the proper level in the sight glass.

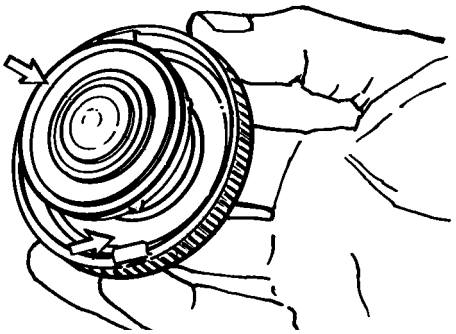


Illustration 35 g00103639
Typical filler cap gaskets

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

4. Inspect the cooling system for leaks.

i02017557

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 eyes. Do not drink cooling system coolant additive.

Note: Caterpillar recommends an S·O·S coolant analysis (Level 1).

Test the Concentration of the SCA

Coolant/Antifreeze and SCA

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

Test the concentration of the SCA with the 8T-5296 Coolant Conditioner Test Kit. Follow the instructions that are provided in the kit.

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. Use the instructions that follow:

1. Fill the syringe to the “1.0 ml” mark with the coolant.

2. Dispense the 1.0 mL coolant sample from the syringe into the empty mixing bottle.

3. Add tap water to the mixing bottle in order to bring the level up to the “10 ml” mark. Place the cap on the bottle and shake the bottle.

4. Add 2 to 3 drops of the “NITRITE INDICATOR SOLUTION B” to the mixing bottle. Move the bottle in a circular motion in order to mix the solution.

5. Add 1 drop of “NITRITE TEST SOLUTION A” to the mixing bottle. Move the bottle in a circular motion in order to mix the solution.

6. Repeat 5 until the solution changes color from red to light gray, green, or blue. Record the number of drops of “NITRITE TEST SOLUTION A” that were required to cause the color change.

7. Use Table 17 to interpret the results.

Table 17

Number of Drops	Concentration of SCA	Maintenance Required
Less than 25	Less than the recommended concentration of SCA	Add SCA. Retest the coolant.
25 to 30	The recommended concentration of SCA	None
More than 30	More than the recommended concentration of SCA	Remove the coolant. Replace with water only Retest the coolant.

Add the SCA, If Necessary

⚠ 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.

Note: Always dispose of fluids according to local regulations.

2. If necessary, drain some coolant in order to allow space for the addition of the SCA.

NOTICE
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 blockage of the heat exchanger, overheating, and/or accelerated wear of the water pump seal.

Do not exceed the recommended amount of supplemental coolant additive concentration.

3. Add the proper amount of SCA. The concentration of the SCA depends on the type of coolant that is used. To determine the proper amount, see this Operation and Maintenance Manual, "Refill Capacities and Recommendations" topic.

4. Clean the cooling system filler cap. Install the cooling system filler cap.

i01012683

Crankcase Blowby - Measure/Record

SMCS Code: 1317

Note: For a new G3304 Engine that is operating at 1800 rpm, the typical range for crankcase blowby is approximately 30 to 45 L/min (1 to 1.5 ft^3/min). For a new G3306 Engine that is operating at 1800 rpm, the typical range for crankcase blowby is approximately 60 to 120 L/min (2 to 4 ft^3/min).

Measure the crankcase blowby of new engines. Record the data. Continue to periodically measure the blowby. Comparing the recorded data to the new data provides information about the condition of the engine.

Note: Crankcase blowby is one of the three factors that help to determine the major overhaul interval. For more information, see this Operation and Maintenance manual, "Overhaul (Major)" topic (Maintenance Section).

After a new engine is used for a short time, the blowby can decrease as the piston rings are seated. The blowby will gradually increase as the following components show wear:

- piston rings
- cylinder liners

Note: A problem with the piston rings causes the oil to deteriorate rapidly. Information regarding the condition of the piston rings can be obtained from the measurement of the blowby and the results of oil analysis.

The blowby of a worn engine may exceed the blowby of a new engine by two times or more.

A sudden increase in blowby could indicate a broken piston ring. The following conditions are other potential sources of blowby:

- Worn valve guides
- A turbocharger seal that leaks

A rebuilt engine can have a high blowby due to the following factors:

- The piston rings are not seated properly.
- Worn parts such as valve guides were not replaced.

Excessive blowby may indicate the need for an overhaul. By keeping a record of the results, a gradual increase in the amount of the blowby will be noted until the amount has become excessive.

To measure the blowby, use the 8T-2700 Blowby/Air Flow Indicator. Refer to Special Instruction, SEHS8712, "Using the 8T-2700 Blowby/Airflow Indicator Group". The instruction is provided with the tool.

Keep a record of the results.

For more information, see the Service Manual, "Systems Operation/Testing and Adjusting". For assistance, consult your Caterpillar dealer.

i00894991

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.

Rubber Damper

Your engine may be equipped with a rubber damper. The rubber damper uses a ring which is mounted in rubber in order to reduce vibrations in the crankshaft.

Inspect the damper and repair or replace the damper for any of the following reasons:

- There is deterioration and cracking of the rubber.
- There is slippage of the outer ring from the original position.
- The engine has had a failure because of a broken crankshaft.
- Analysis of the oil has revealed that the front main bearing is badly worn.
- There is a large amount of gear train wear that is not caused by lack of oil.

Refer to the Service Manual or consult your Caterpillar dealer for information about damper replacement.

Visconic Damper

Your engine may be equipped with a visconic damper. The visconic damper has a weight that is located inside a fluid filled case. The weight moves in the case in order to limit torsional vibration.

Inspect the damper for evidence of fluid leaks. If a fluid leak is found, determine the type of fluid. The fluid in the damper is silicone. Silicone has the following characteristics: transparent, viscous, smooth, and difficult to remove from surfaces.

If the fluid leak is oil, inspect the crankshaft seals for leaks. If a leak is observed, replace the crankshaft seals.

Inspect the damper and repair or replace the damper for any of the following reasons:

- The damper is dented, cracked, or leaking.
- The paint on the damper is discolored from heat.
- The engine has had a failure because of a broken crankshaft.
- Analysis of the oil has revealed that the front main bearing is badly worn.
- There is a large amount of gear train wear that is not caused by a lack of oil.

Refer to the Service Manual or consult your Caterpillar dealer for information about damper replacement.

i01519864

Cylinder Pressure - Measure/Record

SMCS Code: 1223-082-CC; 1223; 7450-082

Measure the cylinder pressure of new engines. Record the data. Continue to periodically measure the cylinder pressure. Comparing the recorded data to the new data provides information about the condition of the engine.

Note: Cylinder pressure is one of the three factors that help to determine the major overhaul interval. For more information, see this Operation and Maintenance manual, “Overhaul (Major)” (Maintenance Section).

Cylinder pressure can be measured during inspection of the spark plugs. Use the following guidelines for checking the cylinder pressure:

- Remove all of the spark plugs.
- Fully open the throttle plate.
- Minimize the cranking time. This will enable a maximum consistent cranking speed for the check. Also, the battery power will be conserved.

A loss of cylinder pressure or a change of pressure in one or more cylinders may indicate the following conditions. These conditions may indicate a problem with lubrication:

- Excessive deposits
- Guttering of valves
- A broken valve
- A piston ring that sticks
- A broken piston ring
- Worn piston rings
- Worn cylinder liners

If the cylinder pressure has risen by one or more compression ratios, the engine needs a top end overhaul in order to remove deposits. Failure to remove the deposits will increase the chance for detonation. Severe guttering of the valves will occur.

To measure the cylinder pressure, use the 193-5859 Cylinder Pressure Gauge Gp. Follow the procedure in the Special Instruction, NEHS0798 that is included with the gauge group. Record the pressure for each cylinder. Use the Operation and Maintenance Manual, “Valve Data Sheet” (Reference Materials Section).

Illustration 36 is a graph of typical cylinder pressures for engines with different compression ratios.

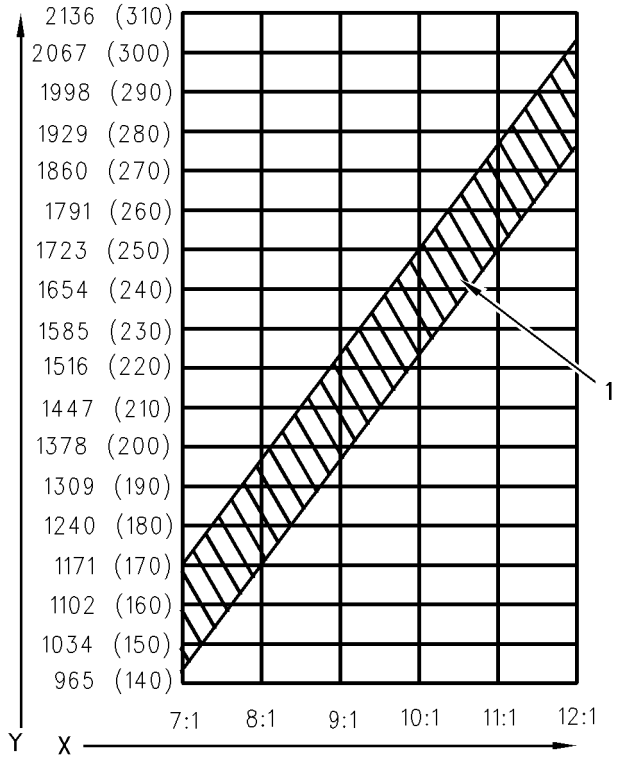


Illustration 36 g00760309

(Y) Cylinder pressure in kPa (psi)
(X) Compression ratio
(1) Normal range for cylinder pressure

i00449093

Driven Equipment - Check

SMCS Code: 3279-535

To minimize bearing problems and vibration of the engine crankshaft and the driven equipment, the alignment between the engine and driven equipment must be maintained properly.

Check the alignment according to the instructions that are provided by the following manufacturers:

- Caterpillar
- OEM of the coupling
- OEM of the driven equipment

i00935098

Driven Equipment - Inspect/Replace/Lubricate

SMCS Code: 3279-040

Observe the driven equipment during operation. Look for the following items:

- Unusual noise and vibration
- Loose connections
- Damaged parts

Perform any maintenance that is recommended by the OEM of the driven equipment. Refer to the literature of the OEM of the driven equipment for the following service instructions.

- Inspection
- Lubricating grease and lubricating oil requirements
- Specifications for adjustment
- Replacement of components
- Requirements for ventilation

i02062908

Engine - Clean

SMCS Code: 1000-070

WARNING

Personal injury or death can result from high voltage.

Moisture could create paths of electrical conductivity.

Make sure the unit is off line (disconnected from utility and/or other generators), locked out and tagged "Do Not Operate".

NOTICE
Water or condensation can cause damage to generator components. Protect all electrical components from exposure to water.

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

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

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

NOTICE
Water and/or condensation can cause damage to electrical components. Protect all electrical components from exposure to water.

Note: For more information on cleaning and drying electric generators, refer to Special Instruction, SEHS9124, “Cleaning and Drying of Electric Set Generators”.

i01749609

Engine Air Cleaner Element - Replace

SMCS Code: 1051-510; 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 airborne debris from entering the air inlet.

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

Servicing the Air Cleaner Elements

If the air cleaner element becomes plugged, the air pressure can split the filter material of the element. Unfiltered air will drastically accelerate internal engine wear. Your Caterpillar dealer has the proper air cleaner elements for your application.

The air cleaner may be mounted high above the engine. If necessary, use a ladder or a platform to reach the air cleaner.

- Check the precleaner (if equipped) daily for accumulation of dirt and debris. Remove any dirt and debris, as needed.
- Operating conditions (dust, dirt and debris) may require more frequent service of the air cleaner element.
- The air cleaner element may be cleaned up to six times if the element is properly cleaned and inspected.
- The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

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

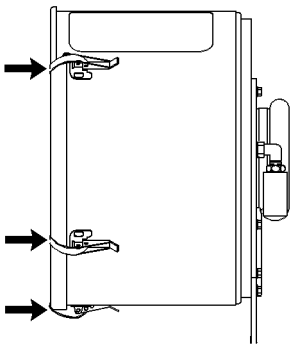


Illustration 37 g00317608
Fasteners for the air cleaner cover

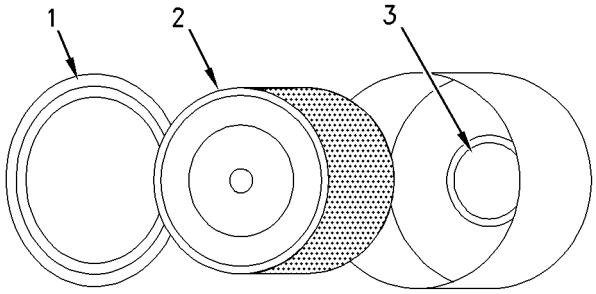


Illustration 38 g00781084
(1) Cover
(2) Element
(3) Air inlet

1. Release the fasteners for cover (1).
2. Remove the cover and element (2).
3. Cover air inlet (3) with tape in order to keep dirt out.
4. Clean the inside of the cover and the body with a clean, dry cloth.
5. Remove the tape for the air inlet. Install a new element or a clean element.
6. Install the cover.
7. If necessary, reset the air cleaner service indicator.

Cleaning the Primary Air Cleaner Elements

The primary air cleaner element can be used up to six times if the element is properly cleaned and inspected. When the element is cleaned, check the filter material for rips or tears. Replace the element at least one time per year regardless of the number of cleanings.

Use clean elements while dirty elements are being cleaned.

NOTICE
Do not clean the air cleaner elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

Visually inspect the elements before cleaning. Inspect the elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged elements.

Air cleaner elements can be cleaned with pressurized air and with a vacuum.

Pressurized Air

Pressurized air can be used to clean elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

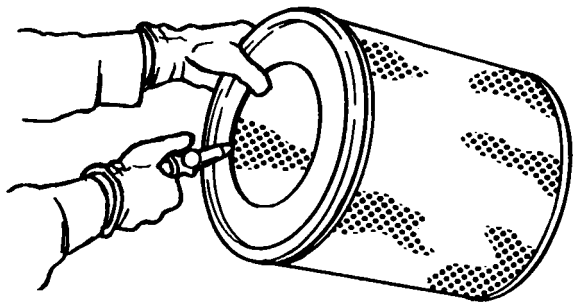


Illustration 39 g00281692

Note: When the elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air cleaner element. Dirt could be forced into the pleats.

Note: Refer to “Inspecting the Primary Air Cleaner Elements”.

Vacuum Cleaning

Vacuum cleaning is a good method for cleaning elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

Note: Refer to “Inspecting the Primary Air Cleaner Elements”.

Inspecting the Primary Air Cleaner Elements

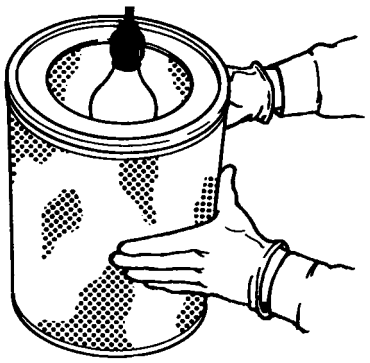


Illustration 40 g00281693

Inspect the clean, dry element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the element. Rotate the element. Inspect the element for tears and/or holes. Inspect the element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the element to a new element that has the same part number.

Do not use an element that has any tears and/or holes in the filter material. Do not use an element with damaged pleats, gaskets or seals. Discard damaged elements.

Storing Primary Air Cleaner Elements

If an element that passes inspection will not be used immediately, store the element for future use.

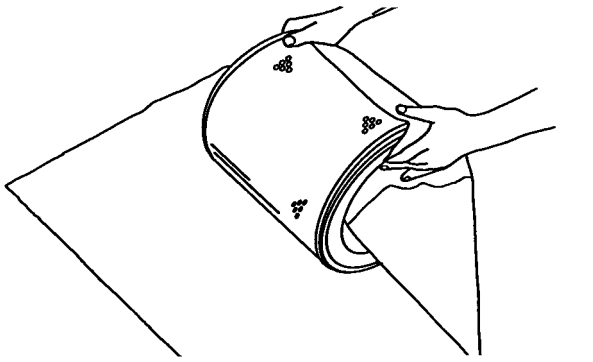


Illustration 41 g00281694

Do not use paint, a waterproof cover, or plastic as a protective covering for storage. Restricted air flow may result. To protect against dirt and damage, wrap the elements in Volatile Corrosion Inhibited (VCI) paper.

Place the element into a cardboard box for storage. For identification, mark the outside of the container and mark the element. Include the following information:

- Date of cleaning
- Number of cleanings

Store the container in a dry location.

For more detailed information on cleaning the primary air cleaner element, refer to Special Publication, SEBF8062, “Procedure to Inspect and Clean Air Filters”.

i01505252

Engine Air Cleaner Service Indicator - Inspect

SMCS Code: 7452-040

A service indicator may be mounted on the air cleaner element or in a remote location.

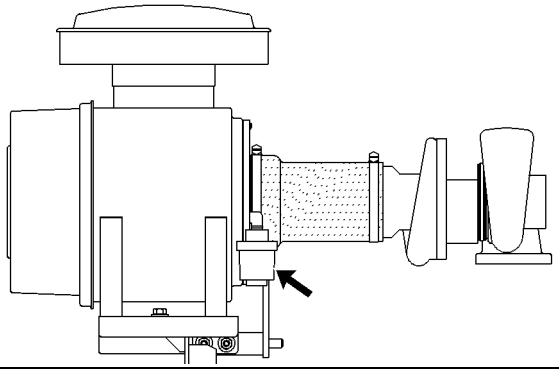


Illustration 42 g00517797

Service indicator

Some engines may be equipped with a different service indicator.

Observe the service indicator. Clean the air cleaner element or replace the element when the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.
- The air restriction reaches 3.7 kPa (15 inches of H_2O).

Inspect the service indicator daily for cracks, holes, or loose fittings. If any of these conditions are present, repair the service indicator or replace the service indicator.

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 rpm. 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, replace the service indicator. If the new service indicator will not reset, the fitting for the service indicator may be plugged.

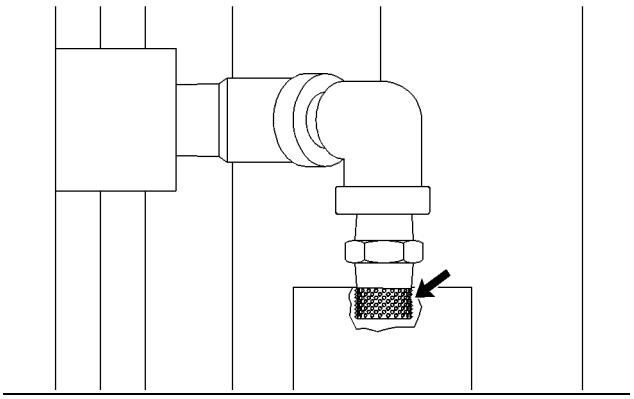


Illustration 43 g00351792

Porous filter

A porous filter is part of a fitting that is used for mounting of the service indicator. Inspect the filter for cleanliness. Clean the filter, if necessary. Use compressed air or a clean, nonflammable solvent.

The service indicator may need to be replaced frequently in environments that are severely dusty. 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).

i01397717

Engine Air Precleaner - Clean

SMCS Code: 1055-070

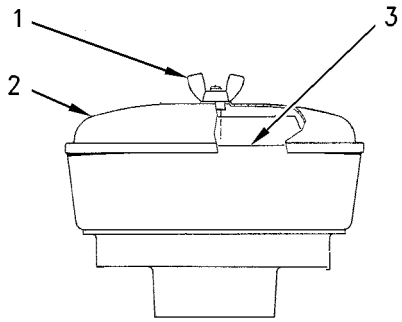


Illustration 44 g00736588

Typical precleaner

(1) Wing nut
(2) Cover
(3) Body

Remove wing nut (1) and cover (2). Check for an accumulation of dirt and debris in body (3). Clean the body, if necessary.

After cleaning the precleaner, install cover (2) and wing nut (1).

Note: When the engine is operated in dusty applications, more frequent cleaning is required.

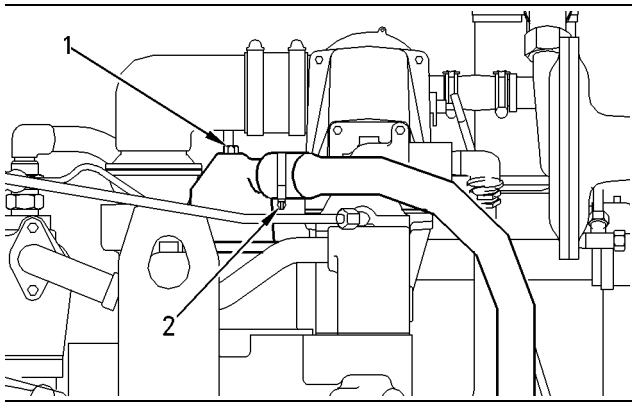
i01519474

Engine Crankcase Breather - Clean

SMCS Code: 1317-070

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.

Perform this maintenance when the engine is stopped.



g00788947

Illustration 45

(1) Retaining bolt
(2) Hose clamp

1. Loosen retaining bolt (1).

2. Loosen hose clamp (2). Remove the breather assembly and the seal.

3. Wash the breather in clean nonflammable solvent. Allow the breather to dry.

4. Inspect the seal for good condition. Obtain a new seal, if necessary.

Note: Coat the rubber parts with clean engine oil or petroleum jelly in order to make installation easier.

5. Install the seal and the breather in the original position.

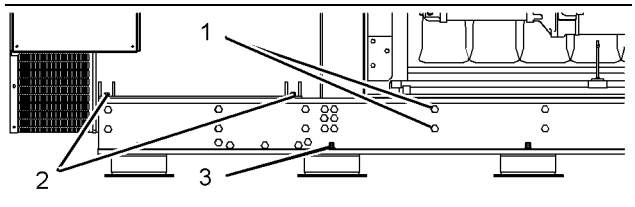
Tighten the hose clamp. For the proper torque, see this Operation and Maintenance Manual, “Torque Specifications” (Maintenance Section).

Install the retaining bolt. For the proper torque, see the Service Manual, “Specifications” module.

i03214182

Engine Mounts - Check

SMCS Code: 1152-535



g01340704

Illustration 46

Typical configuration of mounting bolts for a Caterpillar genset

(1) Mounting bolts for the engine
(2) Mounting bolts for the generator
(3) Levelling bolts for the isolators

Misalignment of the engine and the driven equipment will cause extensive damage. Excessive vibration can lead to misalignment. Excessive vibration of the engine and the driven equipment can be caused by the following conditions:

- Improper mounting
- Misalignment of driven equipment
- Loose bolts
- Deterioration of the isolators

Ensure that the mounting bolts are tightened to the proper torque. For standard torques, see Specifications, SENR3130, “Torque Specifications”.

Ensure that the isolators are free of oil and contamination. Inspect the isolators for deterioration. Ensure that the bolts for adjusting the isolator are correctly adjusted and secured with the locking nut. Correctly adjusted isolators provide even support for the engine base. Each isolator should impose nearly identical force on the base rail. Each isolator should bear the same portion of the weight of the genset.

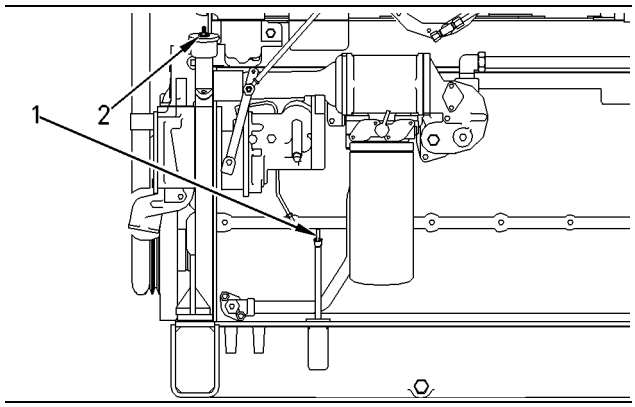
Replace any isolator that shows deterioration. For more information, see the literature that is provided by the OEM of the isolators. Also see the Application and Installation Guide for the engine. Consult your Caterpillar dealer for assistance.

i02150939

Engine Oil Level - Check

SMCS Code: 1348-535-FLV

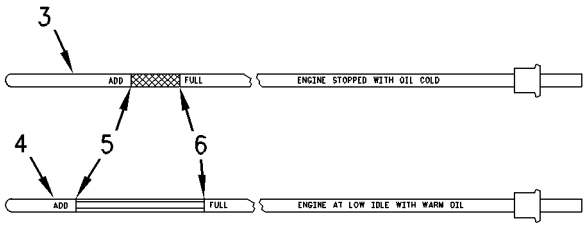
The most accurate check of the oil level is performed when the engine is stopped. Perform this maintenance on a surface that is as level as possible.



g00788953

Illustration 47

(1) Oil level gauge (dipstick)
(2) Oil filler



g00735162

Illustration 48

(3) “ENGINE STOPPED” side
(4) “LOW IDLE” side
(5) “ADD” mark
(6) “FULL” mark

1. Ensure that oil level gauge (1) is seated.

a. If the engine is stopped, remove oil level gauge (1). Observe the oil level on “ENGINE STOPPED” side (3).

b. If the engine is operating, reduce the engine speed to low idle. Remove oil level gauge (1) and observe the oil level on “LOW IDLE” side (4).

The oil level should be between “ADD” mark (5) and “FULL” mark (6).

NOTICE

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

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

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

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

2. If necessary, remove oil filler cap (2) and add oil. For the correct oil to use, see this Operation and Maintenance Manual, “Refill Capacities and Recommendations” topic (Maintenance Section). Do not fill the crankcase above “FULL” mark (6). Clean the oil filler cap. Install the oil filler cap.

3. Record the amount of oil that is added. For the next oil sample and analysis, include the total amount of oil that has been added since the previous oil sample. This will help to provide the most accurate oil analysis.

i01004097

Engine Oil Sample - Obtain

SMCS Code: 1348-554-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.

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 taking the sample, complete the Label, PEEP5031 for identification of the sample. To help obtain the most accurate analysis, provide the following information:

- Engine model
- Service hours on the engine
- The oil’s hours of use
- 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.

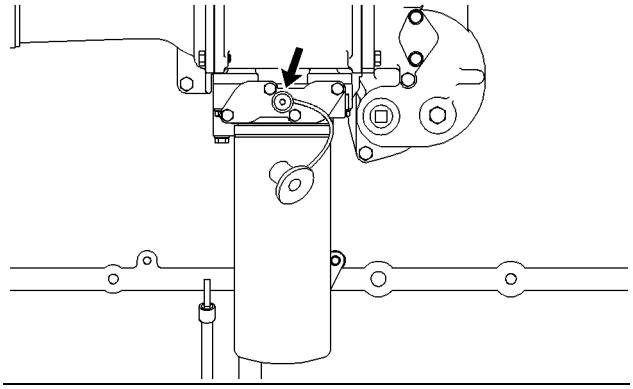


Illustration 49 g00403338

Oil sampling valve

Caterpillar recommends using the sampling valve in order to obtain oil samples. The quality and the consistency of the samples is 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 8T-9190 Fluid Sampling Bottle Group is recommended for use with the sampling valve. The bottle group includes the parts that are needed for obtaining oil samples. Instructions are also provided.

NOTICE
Do not use the same vacuum sampling pump for extracting oil samples that is used for extracting coolant samples.

A small residue of either type sample may remain in the pump and may cause a false positive analysis for the sample being taken.

Always use a designated pump for oil sampling and a designated pump for coolant sampling.

Failure to do so may cause a false analysis which could lead to customer and dealer concerns.

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

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

i02155500

Engine Oil and Filter - Change

SMCS Code: 1318-510

⚠ WARNING

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

NOTICE
Ensure that the engine is stopped before performing this procedure. Attach a DO NOT OPERATE tag to the starting controls.

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 when the cold oil is drained. Drain the crankcase with the oil warm, immediately after the engine is stopped. This method of draining allows the waste particles that are suspended in the oil to be drained.

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

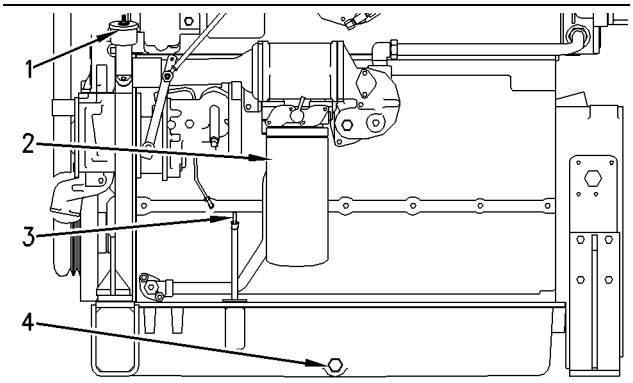


Illustration 50 g00788965

(1) Oil filler
(2) Oil filter
(3) Oil level gauge (dipstick)
(4) Oil drain plug

Drain the Engine Oil

1. After the engine has been operated at normal operating temperature, STOP the engine.

Note: Drain the oil into a suitable container. Dispose of fluids according to local regulations.

2. Drain the oil.

a. If the engine has an oil drain valve, open the valve in order to drain the oil. After the oil has drained, close the valve.

b. If the engine does not have a drain valve, remove an oil drain plug. Allow the oil to drain.

After the oil has drained, install the oil drain plug and tighten the plug according to the engine's Specifications.

Replace the Oil Filter

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

2. Cut the oil filter open with a 4C-5084 Oil Filter Cutter. Break apart the pleats and inspect the oil filter for metal debris.

An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

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

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

Aluminum debris may indicate problems with the bearings of the front gears. If you find aluminum debris, inspect the vibration damper and the bearings of the front idler gear.

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

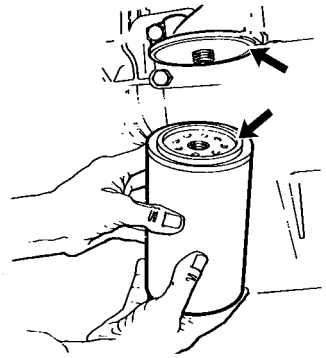


Illustration 51 g00103713

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.

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.

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

NOTICE
Only use oils that are recommended by Caterpillar. For the proper oil to use, refer to this Operation and Maintenance Manual, "Engine Oil" topic (Maintenance Section).

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

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

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

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

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

NOTICE
To prevent crankshaft damage or bearing damage, crank the engine with the fuel supply line closed. This will ensure that all of the oil filters are filled with oil before the engine is started. Do not crank the engine for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking again.

2. Close the fuel supply line. Crank the engine until normal oil pressure shows on the oil pressure gauge. Open the fuel supply line.

3. Start the engine according to this Operating and Maintenance Manual, “Starting the Engine” procedure (Operation Section). Operate the engine at low idle rpm for two minutes.

   This will ensure that the lubrication system has oil and that the oil filters are filled. Inspect the engine for oil leaks.

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

5. Remove the oil level gauge and check the oil level. Maintain the oil level between the “ADD” and “FULL” marks on the “ENGINE STOPPED” side of the oil level gauge.

i01042067

Engine Performance - Test

SMCS Code: 1000-081

Operate the engine for a minimum of two hours at a minimum load of 60 percent.

- Monitor the operation of the generator set.
- Observe the gauges. Ensure that the gauges are in the normal ranges.
- Record the data. Maintain a record of the data for the engine performance.

i00626013

Engine Protective Devices - Check

SMCS Code: 7400-535

Alarms and shutoffs must function properly. Alarms provide timely warning to the operator. Shutoffs help to prevent damage to the engine. It is impossible to determine if the engine protective devices are in good working order during normal operation. Malfunctions must be simulated in order to test the engine protective devices.

A calibration check of the engine protective devices will ensure that the alarms and shutoffs activate at the setpoints. Ensure that the engine protective devices are functioning properly.

NOTICE
During testing, abnormal operating conditions must be simulated.

The tests must be performed correctly in order to prevent possible damage to the engine.

To prevent damage to the engine, only authorized service personnel or your Caterpillar dealer should perform the tests.

Visual Inspection

Visually check the condition of all gauges, sensors and wiring. Look for wiring and components that are loose, broken, or damaged. Damaged wiring or components should be repaired or replaced immediately.

i01626234

Engine Valve Lash - Inspect/Adjust

SMCS Code: 1102-025

⚠ WARNING

Ignition systems can cause electrical shocks. Avoid contacting the ignition system components and wiring during operation.

For procedures on adjusting the engine valve lash, refer to the engine's Service Manual, "Systems Operation/Testing and Adjusting" .

Consult your Caterpillar dealer for assistance.

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.

If the valve lash is within the tolerance, an adjustment of the valve lash is NOT necessary.

Perform the valve lash adjustment if the dimension is not within the tolerance.

Perform the valve lash setting when the engine is cold. After the engine has been shut down and the valve covers are removed, the engine is considered cold.

Before performing maintenance, prevent the entry of foreign matter into the top of the cylinder head and the valve mechanism. Thoroughly clean the area around the valve mechanism covers.

For the valve lash setting, refer to the Operation and Maintenance Manual, "Engine Description" topic (Product Information Section).

i01765711

Engine Valve Rotators - Inspect

SMCS Code: 1109-040

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.

Note: Use of a platform may be necessary to reach the engine valve rotators.

Perform this procedure after the valve lash has been set.

1. Mark the tops of the valve rotators with a permanent marker. Note the position of the marks.
2. Install the valve covers. See the Service Manual for the procedure.
3. Start the engine. Operate the engine for 5 minutes. Stop the engine.
4. Remove the valve covers. Observe the position of the marks that are on the valve rotators.

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

i01505507

Exhaust Bypass - Inspect

SMCS Code: 1057-040

S/N: H4D1-Up

S/N: H6D1-Up

S/N: G6X1-Up

S/N: 07Y1-Up

For instructions on removal and installation, see the Service Manual, "Disassembly and Assembly".

1. Remove the exhaust bypass valve.

⚠ WARNING

The exhaust bypass valve cover is under spring compression. To prevent personal injury, use caution when removing the cover.

2. Disassemble the valve.

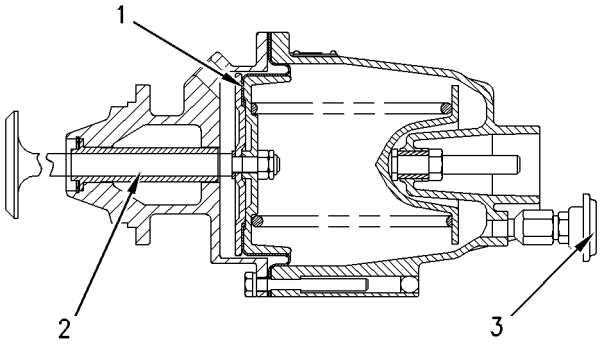


Illustration 52 g00781274

Exhaust bypass valve

(1) Diaphragm
(2) Valve stem
(3) Breather

3. Inspect diaphragm (1). If the diaphragm is worn or cracked, replace the diaphragm.
4. Inspect valve stem (2) and the valve guide. If the parts are excessively worn, replace the parts.
5. Clean breather (3).
6. Assemble the valve.
7. Install the valve.

i00721010

Exhaust Piping - Inspect

SMCS Code: 1061-040

⚠ WARNING

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

Inspect the components of the exhaust system. Repair the components or replace the components if any of the following conditions occur:

- Damage
- Cracks
- Leaks
- Loose connections

Consult your Caterpillar dealer for assistance.

Water Cooled Exhaust Manifolds

The water cooled exhaust manifolds do not require maintenance unless excessive deposits build up in the exhaust passages. Buildup of deposits cause an increase in back pressure that will cause the following conditions:

- Increased fuel consumption
- Reduced boost pressure

If excessive deposits build up in the exhaust passages, clean the passages in order to remove the deposits.

i01505536

Fuel System Fuel Filter Differential Pressure - Check

SMCS Code: 1261-535

A fuel filter differential pressure gauge must be installed in order to determine when the fuel filter requires service. This gauge and the fuel filter are supplied by the customer.

A fuel filter differential pressure gauge indicates the difference in fuel pressure between the inlet side and the outlet side of the fuel filter. The differential pressure increases as the fuel filter becomes plugged.

Operate the engine at the rated speed and at the normal operating temperature. Check the fuel filter differential pressure. Service of the fuel filter depends on the pressure of the fuel system:

- For low pressure gas fuel systems, service the fuel filter when the fuel filter differential pressure reaches 1.7 kPa (0.25 psi).
- For high pressure gas fuel systems, service the fuel filter when the fuel filter differential pressure reaches 34 kPa (5 psi).

For instructions, see Special Instruction, SEHS9298, “Installation and Maintenance of Gaseous Fuel Filters”. Consult your Caterpillar dealer for assistance.

i02062420

Gas Pressure Regulator - Check

SMCS Code: 1270-535

Check the fuel pressure before the gas pressure regulator and after the gas pressure regulator. Table 18 lists the fuel pressure that is required for the gas pressure regulator.

Table 18

Requirements for Fuel Pressure To the Gas Pressure Regulator	
Fuel System	**Pressure**
Low pressure gas for naturally aspirated engines	10.3 to 34 ± 2 kPa (1.50 to 5 ± 0.25 psi)
High pressure gas for turbocharged engines	172 to 207 ± 7 kPa (25 to 30 ± 1 psi)

Pressure of the Fuel Supply To the Carburetor

The gas pressure regulator maintains a pressure differential between the air and the fuel that is supplied to the carburetor. After setting, the gas pressure regulator will maintain the pressure differential in response to changes in the air pressure.

Use a water manometer for measuring the pressure differential. Obtain the measurement when the engine is operating at high idle rpm. After a load is applied, the fuel pressure will usually decrease by approximately 0.1 to 0.25 kPa (0.50 to 1 inches of H_2O). If the performance of the gas pressure regulator is erratic, the gas pressure regulator may require service.

Natural Gas

Set the pressure of the fuel supply to a maximum of 1 to 1.2 kPa (4 to 4.5 inches of H_2O) HIGHER than the ambient air pressure.

Propane

Set the pressure of the fuel supply to −0.37 ± −0.06 kPa (−1.5 ±0.250 inches of H_2O) LOWER than the ambient air pressure. Refer to Special Instruction, REHS0371, “Installation And Initial Start Up Procedures For G3300 And G3400 Engines”.

i01041704

Governor - Inspect

SMCS Code: 1264-040

Inspect the governor for oil leaks.

For service information, see the literature that is provided by the OEM of the governor.

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.

i02164888

Hoses and Clamps - Replace

SMCS Code: 1380-510

Note: For instructions on draining the cooling system and filling the cooling system, see this Operation and Maintenance Manual, “Cooling System Coolant (DEAC) - Change” topic or see the Operation and Maintenance Manual, “Cooling System Coolant (ELC) - Change” topic (Maintenance Section).

1. Drain the cooling system.
2. Remove the used hoses and clamps. Discard the items.
3. Install new hoses and clamps. For the correct torque to use on the hose clamps, see the Specifications, SENR3130, “Torque Specifications”, “Hose Clamps” topic.
4. Fill the cooling system.
5. Start the engine. Inspect the hose connections for leaks.

i01042052

Ignition System Spark Plug Wires - Replace (Standard Ignition Systems)

SMCS Code: 1558-510

WARNING

Ignition systems can cause electrical shocks. Avoid contacting the ignition system components and wiring during operation.

NOTICE
Pulling on the wiring harness may break the wires. Do not pull on the wiring harness.

1. Disconnect the spark plug wire assembly from the transformer.
2. Disconnect the wire assembly from the spark plug. Discard the wire assembly.
3. Connect the new wire assembly to the spark plug.
4. Connect the wire assembly to the transformer.

i01626118

Ignition System Spark Plugs - Inspect/Replace

SMCS Code: 1555-535

⚠ WARNING

Ignition systems can cause electrical shocks. Avoid contacting the ignition system components and wiring during operation.

Maintenance of the spark plugs is required in order to achieve the following benefits:

- Normal fuel consumption
- Normal level of emissions
- Maximum service life of the spark plugs

The service life of the spark plugs is affected by fouling due to deposits from the oil and by peak voltage. Maintenance of the ignition system is also affected by voltage. Higher voltage is required by higher inlet manifold air pressure and a higher compression ratio. Higher voltage reduces the service life of components such as spark plugs, wires, and transformers.

Remove the Spark Plug

NOTICE
Pulling on the wiring harness may break the wires. Do not pull on the wiring harness.

Standard Ignition System

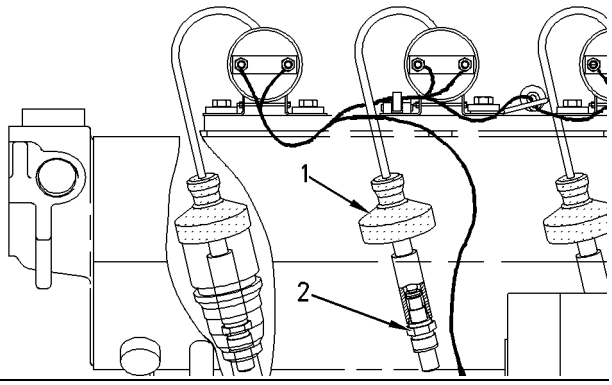


Illustration 53 g00842026

Standard ignition system

(1) Cover
(2) Spark plug

1. Remove cover (1).

Ignition Systems With Integral Transformers

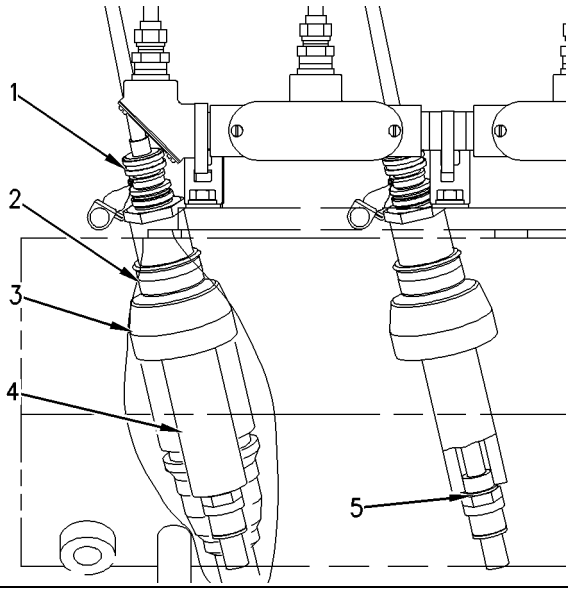


Illustration 54 g00842035

Ignition system with integral transformers

(1) Connector
(2) Clamp
(3) Boot
(4) Transformer
(5) Gasket

1. Loosen connector (1).

2. Loosen clamp (2).

3. Remove boot (3).

4. Unscrew transformer (4).

5. Remove gasket (5). Discard the gasket.

Removing the Spark Plug

⚠ WARNING

Pressurized air can cause personal injury. When pressurized air is used for cleaning, wear a protective face shield, protective clothing, and protective shoes.

1. Debris may have collected in the spark plug well. Thoroughly remove any debris. Use compressed air. The maximum air pressure for cleaning purposes must be below 207 kPa (30 psi). Ensure that the area around the spark plug is clean and free of dirt and debris.

2. To loosen the spark plug, use a 2P-5481 Deep Well Socket. After the spark plug has been loosened, remove the spark plug by hand in order to detect problems with the threads. After the spark plug has been removed, discard the used spark plug gasket.

NOTICE
The use of a thread tap will remove metal unnecessarily. This will also reduce the heat transfer for the spark plug. This can result in a reduction of the spark plug service life and a reduction of the detonation margin.

If the spark plug resists removal by hand, apply penetrating oil to the threads. Use the wrench and apply steady pressure to the spark plug until the spark plug is loose.

If the spark plug can not be removed by hand, clean the threads with a 154-9521 Spark Plug Seat Cleaner. This tool scrapes debris from the seat and from the threads in the cylinder head.

Inspecting the Spark Plug

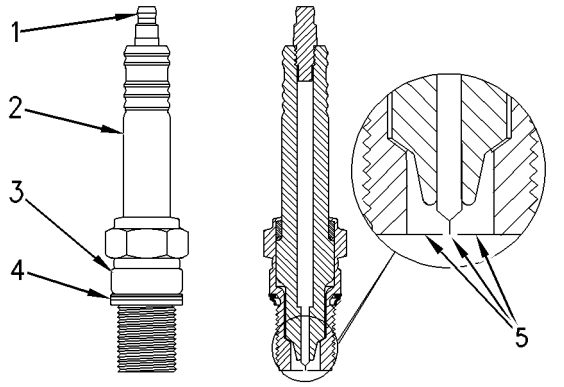


Illustration 55 g00842036

(1) Terminal post
(2) Insulator
(3) Shell
(4) Gasket
(5) Electrode and ground straps

Inspect the spark plug closely for damage. The condition of the spark plug can indicate the operating condition of the engine.

Terminal post (1) must not move. If the terminal post can be moved by hand, discard the spark plug.

Inspect insulator (2) for cracks. If a crack is found, discard the spark plug.

Faint marks may extend from shell (3) onto the insulator. The marks may be a result of corona that forms at the top of the shell. The conductor will develop a corona when a very high voltage ionizes the air. This is a normal condition. This is not an indication of leakage between the shell and the insulator.

Inspect shell (3) for damage. Cracks can be caused by overtightening the spark plug. Overtightening can also loosen the shell. Discard any spark plug that has a shell that is cracked or loose.

Inspect the electrode and ground straps (5) for excessive wear. Flat surfaces with sharp edges provide the best conditions for creating a spark. An electrode will become worn from use. The surfaces erode. A higher voltage is required in order to produce a spark.

Caterpillar spark plugs have precious metal tips on the electrode and the ground straps. This material will gradually erode. Use extreme care for setting the electrode gap. Maintain even spacing between the two ground straps and the electrode.

Replace the spark plug if the precious metal is worn off.

Normal operation will produce a light brown deposit around the electrode.

White deposits or gray deposits may be caused by the following substances:

- Excessive oil
- Use of the wrong oil
- A substance that is introduced through the fuel system or the air system

A spark plug can operate despite a buildup of ash. However, a buildup of ash can cover the electrode gap. This will cause misfire. Large deposits may retain heat which can cause premature fuel ignition. This can lead to uncontrollable detonation.

Cleaning the Spark Plug

Thoroughly clean the spark plug. Do not use a wire brush. Glass beads are the preferred method for cleaning.

Follow these guidelines for using glass beads:

- Always use clean glass beads.
- Use care in order to clean only the electrode and the insulator near the electrode.

- Do not use glass beads on the outside of the shell or on the upper part of the insulator.

Installing the Spark Plug

Note: Do not use a flat feeler gauge for measuring the electrode gap of used spark plugs. A feeler gauge will falsely measure the actual electrode gap. This is due to the curvature of the used precious metal surfaces.

1. Before installing the spark plug, set the electrode gap to 0.635 ± 0.025 mm (.0250 ± .0010 inch). Use the 9U-7516 Spark Plug Gauge.

   Adjust the electrode gap in order to achieve proper alignment and even spacing between the precious metal surfaces. Measure the electrode gap after the alignment. Correct the electrode gap, if necessary.

Note: Do not use anti-seize compound on spark plugs. Most of the heat is transferred through the threads and the seat area of the spark plug. The surfaces must be in contact in order to provide the heat transfer that is required.

2. Ensure that the spark plug is clean and free of dirt and oil.

3. **Always use a new gasket when a spark plug is installed.** If a used spark plug is installed, place a new 108-3515 Plug Gasket on the spark plug. Orient the tabs of the gasket toward the electrode. Otherwise, the gasket may not seat properly. If a gasket for a spark plug is installed incorrectly, do not increase the torque on the spark plug in order to improve the seal. Do not reuse the gasket. Install a new gasket.

NOTICE

Do not overtighten the spark plug. The shell can be cracked and the gasket can be deformed. The metal can deform and the gasket can be damaged. The shell can be stretched. This will loosen the seal that is between the shell and the insulator, allowing combustion pressure to blow past the seal. Serious damage to the engine can occur.

Use the proper torque.

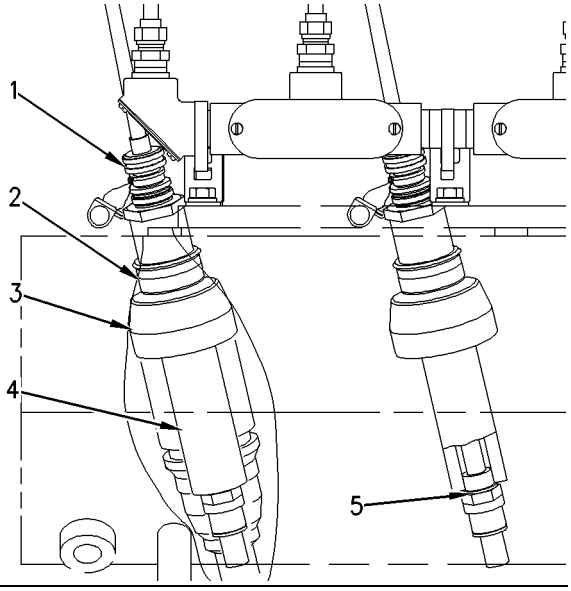
4. Install the spark plug by hand until the spark plug bottoms out. Tighten the spark plug to 30 ± 4 N·m (22 ± 3 lb ft).

5. Ensure that the cover is clean and free from dirt and oil. Inspect the connector for cleanliness.

6. Install the cover. Ensure a good connection for the connector and the spark plug.

Installing the Spark Plugs and the Integral Transformer

1. Follow Steps 1 through 4 from the “Installing the Spark Plug” instructions.



g00842035

Illustration 56

Ignition system with integral transformers

(1) Connector
(2) Clamp
(3) Boot
(4) Transformer
(5) Gasket

2. Install new 108-6561 Gasket (5) on the spark plug.

   The gasket is copper. **Whenever the transformer is removed, always install a new gasket.**

3. Ensure that transformer (4) is clean and free from dirt and oil. Screw the transformer by hand onto the spark plug.

   Tighten the transformer until the transformer bottoms out on the copper gasket. Tighten the transformer for an additional 1/8 of a turn (45 degrees). Do not overtighten the transformer.

4. Inspect boot (3) for cleanliness and good condition. Install the boot.

5. Tighten clamp (2).

6. Inspect connector (1) for cleanliness and good condition. Reconnect the connector. Align the threads properly. For a correctly fastened connector, very little thread or no thread is visible.

i01005974

Ignition System Timing - Check/Adjust

SMCS Code: 1550-025; 1550-535

After maintenance has been performed on the ignition system, check the timing of the ignition system. Adjust the timing, if necessary.

The optimum ignition timing for a gas engine varies according to several factors:

- Compression ratio of the engine
- Inlet air temperature
- Methane number of the gas

For the proper timing, see the Engine Performance publication for the engine.

Adjust the timing according to the Service Manual, “Systems Operation/Testing and Adjusting” module. Consult your Caterpillar dealer for assistance.

i00682407

Ignition System Transformer Resistance - Test

SMCS Code: 1550-081

The transformers produce a voltage increase. For good operation, the connections must be clean and secure. Inspect the transformers for the following conditions. If any of the conditions are found, correct the condition:

- Corrosion
- Dirty insulator
- Loose connections
- Moisture
- Open circuits
- Short circuits

Test the resistance of the transformers. Test each transformer at both the side with high voltage and the side with low voltage. See the Service Manual, “Specifications” module for the procedure. Consult your Caterpillar dealer for assistance.

i01113853

Inlet Air System - Inspect

SMCS Code: 1058-040; 1071-040; 1087-040

Inspect the components of the air inlet system for the following conditions:

- Cracks
- Leaks
- Loose connections

Inspect the following components:

- Piping between the air cleaner and the turbocharger
- Turbocharger
- Piping between the turbocharger and the aftercooler
- Aftercooler
- Connection of the aftercooler to the air plenum
- Connection of the air plenum to the cylinder head

Ensure that all of the connections are secure. Ensure that the components are in good condition.

Make repairs, if necessary. For information regarding removal and installation of the components, see the Service Manual, “Disassembly and Assembly” module. Consult your Caterpillar dealer for assistance.

i01021379

Instrument Panel - Inspect

SMCS Code: 7451-040

Inspect the instrument panel for good condition. Check the condition of all of the gauges. If a gauge is broken, repair the gauge or replace the gauge immediately.

Frequently monitor the following parameters during normal operation:

- Fuel filter differential pressure
- Inlet air restriction
- Inlet manifold air temperature
- Jacket water temperature

- Oil filter differential pressure
- Oil pressure

Record the data in a log. Compare the new data to the data that was previously recorded. Comparing the new data to the recorded data will establish the normal gauge readings for the engine. A gauge reading that is abnormal may indicate a problem with operation or a problem with the gauge.

i03230758

Jacket Water Heater - Check

SMCS Code: 1383-535

Jacket water heaters help to improve startability in ambient temperatures that are below 21 °C (70 °F). All installations that require automatic starting should have jacket water heaters.

Check the operation of the jacket water heater. Check the operation of the circulation pump, if equipped. For an ambient temperature of 0 °C (32 °F), the heater should maintain the jacket water coolant temperature at approximately 32 °C (90 °F).

i02049014

Overhaul (Major)

SMCS Code: 7595-020-MJ

Scheduling a Major Overhaul

The need for a major overhaul is determined by several factors.

- An increase of oil consumption
- An increase of crankcase blowby
- A decrease and variation of cylinder compression

The following changes in the three conditions normally require a scheduled overhaul:

- A 300 percent increase in oil consumption
- A 200 percent increase in crankcase blowby
- A 20 percent loss of cylinder compression

Note: These indications do not require an engine to be shut down for service. These indications only mean that an engine should be scheduled for service in the near future. If the engine operation is satisfactory, an immediate overhaul is not a requirement.

The engine does not require an overhaul if the engine is operating within acceptable limits for oil consumption, crankcase blowby, and cylinder compression.

Other factors must also be considered for determining a major overhaul:

- The service hours of the engine
- The wear metal analysis of the lube oil
- An increase in the levels of noise and vibration

An increase of wear metals in the lube oil indicates that the bearings and the surfaces that wear may need to be serviced. An increase in the levels of noise and vibration indicates that rotating parts require service.

Note: It is possible for oil analysis to indicate a decrease of wear metals in the lube oil. The cylinder liners may be worn so that polishing of the bore occurs. Also, the increased use of lube oil will dilute the wear metals.

Monitor the engine as the engine accumulates service hours. Consult your Caterpillar dealer about scheduling a major overhaul.

Note: The driven equipment may also require service when the engine is overhauled. Refer to the literature that is provided by the OEM of the driven equipment.

Major Overhaul Information

A major overhaul includes all of the work that is done for top end overhauls. A major overhaul includes additional parts and labor. Additional parts and labor are required in order to completely rebuild the engine. In some cases, the engine is relocated for disassembly.

For the major overhaul, all of the bearings, seals, gaskets, and components that wear are disassembled. The parts are cleaned and the parts are inspected. If necessary, the parts are replaced. The crankshaft is measured for wear. The crankshaft may require regrinding. Alternatively, the crankshaft may be replaced with a Caterpillar replacement part.

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

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

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 may be reconditioned in order to comply with reusability guidelines. If the component cannot be rebuilt, replace the component.

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. Consult your Caterpillar dealer about repair options for your engine.

Table 19

Major Overhaul	
Inspect	Aftercooler
	Alternator
	Camshafts
	Camshaft followers
	Connecting rods
	Crankshaft
	Gear train
	Governor
	Inlet air piping
	Oil cooler
	Oil pump
	Pistons
	Transformers

(continued)

(Table 19, contd)

Major Overhaul	
Rebuild	Carburetor
	Cylinder packs
	Exhaust bypass (if equipped)
	Gas regulator
	Inlet air piping
	Oil pump
	Starting motor
	Turbocharger
	Water pumps
Replace	Alternator and fan drive belts
	Camshaft bearings
	Connecting rod bearings
	Crankshaft bearings
	Crankshaft seals
	Crankshaft vibration damper
	Cylinder liners
	Cylinder head and gaskets
	Exhaust manifold
	Gaskets and seals
	Gear train bearings
	Governor
	Hoses and clamps
	Piston rings
	Rod ends
	Spark plugs
	Spark plug wires
	Transformers
	Water temperature regulators
	Wiring harnesses

i02049048

Overhaul (Top End)

SMCS Code: 7595-020-TE

Scheduling a Top End Overhaul

Top end overhauls are scheduled according to the recession of the exhaust valve stems. This measurement provides an accurate indication of the rate of valve wear. This measurement can be used to predict when a cylinder head requires replacement. For more information, see this Operation and Maintenance Manual, “Valve Stem Projection - Measure/Record” topic.

Note: The generator or the driven equipment may also require service when the engine overhaul is performed.

Top End Overhaul Information

A top end overhaul involves servicing the cylinder heads and turbochargers. Also, some other engine components are inspected.

Top end overhauls require more tools than preventive maintenance. The following tools are needed for restoring the engine to factory specifications:

- Torque wrenches
- Dial indicators
- Accurate measurement tools
- Cleaning equipment
- Rebuilding equipment

Caterpillar dealers are equipped with these tools. Caterpillar dealers can provide a flat rate price for a top end overhaul.

Unexpected problems may be found during a top end overhaul. Plan to correct these problems, if necessary.

- Buildup in the cylinders from excessive oil consumption
- Buildup in the cylinders from contamination of the fuel
- Plugging of the aftercooler from coolant that is poorly maintained
- Plugging of the aftercooler from contamination of the inlet air
- Degradation of the oil cooler from hydrogen sulfide in the fuel

Inspect the following 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”.

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

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

Replacing of Components

Note: The cylinder head may be rebuilt, when possible.

Replace the following components during a top end overhaul.

- Alternator and fan drive belts
- Cylinder heads and gaskets
- Hoses and clamps
- Rod ends for the control linkage of the actuator
- Spark plugs
- Spark plug wires
- Water temperature regulator

Rebuilding of Components

Rebuild the following components during a top end overhaul:

- Carburetor
- Gas regulator
- Magneto
- Starting motor
- Turbocharger
- Water pumps

Note: Periodic inspection of the turbocharger is recommended for determining when the turbocharger will require an overhaul. In a few applications, the turbocharger may require rebuilding prior to the top end overhaul. An example is an application with loads that vary frequently. In these cases, rebuilding the turbocharger normally occurs separately from rebuilding the cylinder heads. Some applications can operate longer before the turbocharger requires rebuilding. Only experience can determine the actual need.

Inspecting of Components

Clean the following components. Pressure test the components. Replace the components, if necessary:

- Aftercooler core (if equipped)
- Oil cooler core

Note: If proper maintenance of the cooling system is not performed, the aftercooler core can be very difficult to clean.

Note: This procedure may be used for cleaning both the aftercooler core and the oil cooler core.

1. Remove the core. For the procedure, see the Service Manual, “Disassembly and Assembly” module.

2. Turn the 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.

NOTICE
Do not use a high pressure spray for cleaning the fins of the core. A high pressure spray can damage the surface of the fins and reduce the flow of air through the core.

3. Back flush the core with cleaner.

   Caterpillar recommends the use of Hydrosolv liquid cleaner. 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 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.

Note: The test pressure for the oil cooler is 790 kPa (115 psi). The maximum differential pressure of water for the aftercooler is 44 kPa (6 psi). The maximum differential pressure of air for the aftercooler is 5.1 kPa (.74 psi).

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. For the procedure, see the Service Manual, “Disassembly and Assembly” module.

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

Exhaust Bypass

Inspect the condition of the exhaust bypass (if equipped). Recondition the component, if necessary. See this Operation and Maintenance Manual, “Exhaust Bypass - Inspect” topic (Maintenance Section).

Governor

Inspect the governor for proper operation. Make any repairs that are necessary.

Transformers

The transformers produce a voltage increase. For good operation, the connections must be clean and secure. Inspect the transformers for the following conditions:

- Dirty insulator
- Loose connections
- Loose connector

- Moisture

Test the resistance of the transformers according to the Service Manual, “Specifications” module. Consult your Caterpillar dealer for assistance.

i02049051

Overhaul Considerations

SMCS Code: 7595-043

Overhaul Information

An overhaul is replacing the major worn components of the engine. An overhaul is a maintenance interval that is planned. The engine is rebuilt with certain rebuilt parts or new parts that replace the worn parts.

An overhaul also includes the following maintenance:

- Inspection of all the parts that are visible during the disassembly
- Replacement of the seals and gaskets that are removed
- Cleaning of the internal passages of the engine and the engine block

Most owners will save money by overhauling the engine at the intervals that are recommended in this Operation and Maintenance Manual. It is not practical to wait until the engine exhibits symptoms of excessive wear or failure. It is not less costly to wait. 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 guidelines for reusable parts.
- The service life of the engine can be extended without the risk of a major catastrophe due to engine failure.
- Achieve the best cost/value relationship per hour of extended service life.

Overhaul Intervals

Top end overhauls are determined by the projection of exhaust valve stems. Major overhauls are determined by cylinder compression, crankcase blowby, oil consumption, and results of S·O·S oil analysis.

Some other factors that are important for determining the overhaul intervals include the following considerations:

- Performance of preventive maintenance
- Use of recommended lubricants
- Use of recommended coolants
- Use of recommended fuels
- Proper installation
- Operating conditions
- Operation within acceptable limits
- Engine load
- Engine speed

Note: To avoid oil problems, engines that are turbocharged and aftercooled must be operated at a minimum of 60 percent of rated load.

Generally, engines that are operated at a reduced load and/or speed achieve more service life before an overhaul. However, this is for engines that are properly adjusted, operated and maintained.

Overhaul Inspection

Refer to the Service Manual for the disassembly and assembly procedures that are necessary in order to perform the required maintenance on the items that are listed. Consult your Caterpillar dealer for assistance.

To determine the reusability publications that are needed to inspect the engine, refer to Guidelines for Reusable Parts and Salvage Operations, SEBF8029, “Index of Publications on Reusability or Salvage of Used Parts”.

The Guidelines For Reusable Parts and Salvage Operations is part of an established Caterpillar parts reusability program. These guidelines were developed in order to assist Caterpillar dealers and customers reduce costs by avoiding unnecessary expenditures for new parts. If the engine parts comply with the established inspection specifications, the parts can be reused. New parts are not necessary if the old parts can be reused, repaired, or salvaged.

If the parts are not within the inspection specifications, the parts should be salvaged, repaired, replaced, or exchanged. The use of out-of-spec parts could result in unscheduled downtime and/or costly repairs. The use of out-of-spec parts can also contribute to increased fuel consumption and reduction of engine efficiency.

Your Caterpillar dealer can provide the parts that are needed to rebuild the engine at the least possible cost.

Overhaul Programs

An economical way to obtain most of the parts that are needed for overhauls is to use Caterpillar remanufactured parts. Caterpillar remanufactured parts are available at a fraction of the cost of new parts. These parts have been rebuilt by Caterpillar and certified for use. The following components are examples of the remanufactured parts:

- Alternators
- Connecting rods
- Crankshafts
- Cylinder heads
- Oil Pumps
- Starting motors
- Turbochargers
- Water pumps

Consult your Caterpillar dealer for details and for a list of the remanufactured parts that are available.

Your Caterpillar dealer may be offering a variety of overhaul options.

A Flat Rate Overhaul guarantees the maximum price that you will pay for an overhaul. Flat rate prices on preventive maintenance programs or major repair options are available from many servicing dealers for all Caterpillar Engines. Consult your Caterpillar dealer in order to schedule a before failure overhaul.

Overhaul Recommendation

Caterpillar recommends a scheduled overhaul in order to minimize downtime. A scheduled overhaul will provide the lowest cost and the greatest value. Schedule an overhaul with your Caterpillar dealer.

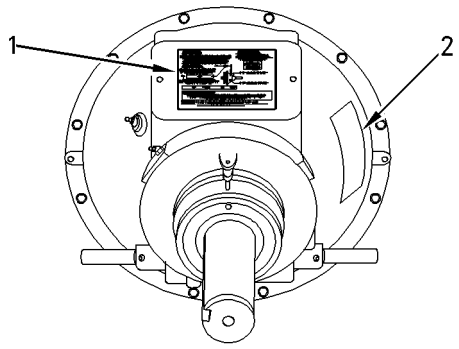
Overhaul programs vary between dealers. To obtain specific information about the types of overhaul programs and services, consult your Caterpillar dealer.

i01506009

Power Take-Off Clutch - Check/Adjust/Lubricate

SMCS Code: 3055-036; 3055-086

NOTICE
New power take-offs should have the clutch adjustment checked before being placed into service. The clutch adjustment should be checked again after the first ten hours of operation. New clutch plates have a “wear in” period, and the clutch may require several adjustments until the new plates are “worn in”.



g00781502
Illustration 57

(1) Instruction plate
(2) Serial number plate

Check the clutch adjustment regularly after “wear in”. Heavy-duty applications which have engagements that are frequent and relatively long periods of clutch slippage require more frequent adjustment than light-duty applications. The operating torque should be measured in order to determine if a clutch adjustment is required.

Refer to the OEM information and instruction plate (1) for instructions on lubrication, adjustment, and other recommendations for service. Perform the maintenance that is specified on the instruction plate.

⚠ WARNING

Do not operate the engine with the Instruction Plate cover removed from the clutch. Personal injury may result.

If the clutch is damaged to the point of burst failure, expelled pieces can cause personal injury to anyone in the immediate area. Proper safeguards must be followed to help prevent accidents.

i02559063

Radiator - Clean

SMCS Code: 1353-070

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

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

⚠ WARNING

Personal injury can result from air pressure.

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

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

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

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

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

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

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

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

i01511915

Speed Sensor - Clean/Inspect

SMCS Code: 1907-040; 1907-070

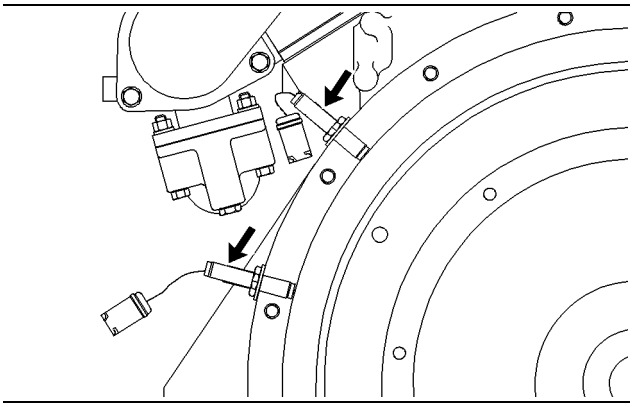


Illustration 58 g00784740

Speed sensors

1. Remove the speed sensor from the flywheel housing. Check the condition of the end of the magnet. Check for signs of wear and contaminants.
2. Clean the metal shavings and other debris from the face of the magnet.
3. Install the speed sensor and adjust the speed sensor according to the engine's Specifications module.

i01038735

Standby Generator Set Maintenance Recommendations

SMCS Code: 4450-041

A standby generator set may not need to be used very often. However, the generator set is usually needed for operation in an emergency situation. Maintenance of the standby generator set is very important for the following reasons:

- The generator set must always be in excellent operating condition.
- The generator set must be ready to work under load at any time.

Establishing a Preventive Maintenance Program will provide these benefits:

- Maximum availability of the standby generator set

- Longer service life for the generator set
- Minimum of expensive repairs

Your Caterpillar dealer can help you to establish an effective Preventive Maintenance Program for your generator set. Consult your Caterpillar dealer for details.

Maintenance and Operation Procedures

⚠ WARNING

The high voltage that is produced by an operating generator set can cause severe injury or death. Before performing any maintenance or repairs, ensure that the generator will not start.

Place the engine control switch in the "OFF" position. Attach "DO NOT OPERATE" tags to all starting controls. Disconnect the batteries or disable the starting system. Lock out all switchgear and automatic transfer switches that are associated with the generator.

The recommended maintenance for the engine is listed in this Operation and Maintenance Manual, "Maintenance Interval Schedule (Standby Generator Set Engines)" (Maintenance Section).

For the recommended generator maintenance, see the Operation and Maintenance Manual for the generator and the control panel.

Maintenance and Repair

The maintenance that is recommended for Every Week can be performed by an authorized operator. The maintenance that is recommended for the subsequent maintenance intervals must be performed by an authorized service technician or by your Caterpillar dealer.

Unless other instructions are provided, perform maintenance and repairs under the following conditions:

- The engine is stopped.
- The starting system is disabled.
- The generator does not pose an electrical shock hazard.

Operation

To ensure proper operation, the generator set must be exercised regularly. For instructions on operating the generator set, see the Operation and Maintenance Manual for the generator set control panel.

For these operation procedures, follow the instructions that are provided in this Operation and Maintenance Manual, "Operation Section": starting the engine, engine operation, and stopping the engine.

Record Keeping

Maintain a record in order to document these items: gauge readings, maintenance that is performed, problems, and repairs.

Space Heaters

Moisture causes damage to generators and other electrical equipment. Make every effort to keep the generator set as dry as possible.

Generators can operate without problems in humid environments. However, problems can occur when the generator is inactive. Moisture can condense on the windings. This can result in poor performance. Also, damage to the windings can occur.

Use space heaters in order to help keep the windings dry. When the generator is not active, ensure that the space heaters are operating. When the generator is operating, turn OFF the space heaters.

i01113939

Starting Motor - Inspect

SMCS Code: 1451-040; 1453-040

If the starting motor fails, the engine may not start in an emergency situation. A scheduled inspection of the starting motor is recommended.

The starting motor pinion and the flywheel ring gear must be in good condition in order for the engine to start properly. The engine will not start if the starting motor pinion does not engage the flywheel ring gear. The teeth of the starting motor pinion and the flywheel ring gear can be damaged because of irregular engagement.

Inspect the starting motor for proper operation. Listen for grinding when the engine is started. Inspect the teeth of the starting motor pinion and the flywheel ring gear. Look for patterns of wear on the teeth. Look for teeth that are broken or chipped. If damaged teeth are found, the starting motor pinion and the flywheel ring gear must be replaced.

Electric Starting Motor

Note: Problems with the electric starting motor can be caused by the following conditions: malfunction of the solenoid and malfunction of the electric starting system.

Inspect the electrical system for the following conditions:

- Loose connections
- Corrosion
- Wires that are worn or frayed
- Cleanliness

Make repairs, if necessary.

Air Starting Motor

⚠ WARNING

Personal injury or death can result from improperly checking for a leak.

Always use a board or cardboard when checking for a leak. Escaping air or fluid under pressure, even a pin-hole size leak, can penetrate body tissue causing serious injury, and possible death.

If fluid is injected into your skin, it must be treated immediately by a doctor familiar with this type of injury.

Inspect all of the components in the air circuit for the starting motor. Inspect all of the air lines and connections for leaks.

If the teeth of the starting motor pinion and/or the flywheel ring gear are damaged, the air circuit for the starting motor must be examined in order to determine the cause of the problem.

Removal and Installation of the Starting Motor

Refer to the Service Manual, “Disassembly and Assembly” module for information on removing the starting motor and installing the starting motor.

Consult your Caterpillar dealer for assistance.

i01012850

Turbocharger - Inspect

SMCS Code: 1052-040

S/N: H4D1-Up

S/N: H6D1-Up

S/N: G6X1-Up

S/N: 07Y1-Up

Periodic inspection and cleaning is recommended for the turbocharger.

Fouling of the turbine wheels can contribute to loss of engine power 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 could allow parts from the compressor wheel to enter an engine cylinder. This 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. Also, the chance for potential damage to other engine parts is reduced.

Note: Turbocharger components require clearances that are precise. The turbocharger cartridge must be balanced due to high rpm.

The following conditions can cause the turbocharger to be out-of-balance:

- The buildup of deposits
- Chipping and/or flaking of deposits

If the turbocharger must be removed for inspection, use caution. Do not break deposits from the turbine wheel. Do not attempt to clean the turbine wheel. For options regarding removal, installation, repair and replacement, see the Service Manual or consult your Caterpillar dealer.

1. Remove the exhaust outlet piping and remove the air inlet piping from the turbocharger. Visually inspect the piping for the presence of oil.

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 should 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.

Note: Deposits can accumulate on the turbine wheel. The turbine wheel will become unbalanced when the deposits flake off. The turbocharger cartridge must be replaced when this occurs. However, remove deposits from the housing. This will prevent wear on the blades of the turbine wheel.

4. Inspect the turbine wheel for deposits. If deposits of 25 mm (1/16 inch) thickness are found or if the turbine is in contact with the housing, the turbocharger must be disassembled and cleaned. The deposits can be very difficult to remove.

5. Inspect the bore of the turbine housing for corrosion and deposits.

6. Clean the turbocharger compressor housing with standard shop solvents and a soft bristle brush.

7. Check the clearances of the turbocharger bearing. Compare the clearances to the Service Manual, “Specifications”. If the clearances are not within the specifications, the turbocharger must be repaired.

8. Fasten the air inlet piping and the exhaust outlet piping to the turbocharger housing.

i01360109

Valve Stem Projection - Measure/Record

SMCS Code: 1105-082

Valve Recession – The valves and the valve seats are worn over time. This causes the valves to recede into the cylinder head. This condition is called “valve recession”.

The exhaust valves and valve seats show the greatest wear due to high operating temperatures. The top end overhaul is normally scheduled according to the exhaust valve recession.

It is difficult to obtain an accurate measurement of valve recession inside the cylinder head. Use the following method in order to determine the valve recession:

1. Remove the valve cover. For instructions, see the Service Manual, “Disassembly and Assembly” module.

2. Move the rocker arm from the top of the valve stem.

3. Use a depth micrometer. Obtain the measurement from the tip of the valve stem to the cylinder head. Obtain this measurement for each exhaust valve.

Make several copies of this Operation and Maintenance Manual, “Valve Data Sheet” (Reference Materials Section). Record the measurements on the sheets.

- The projection of the exhaust valve stems should be measured after completion of the initial start-up tests and the engine commissioning. This measurement is the baseline. The baseline is a reference for subsequent measurements.

- Measure the projection of the exhaust valve rotators at the first oil change interval. Illustration 59 shows schedules for determining subsequent intervals.

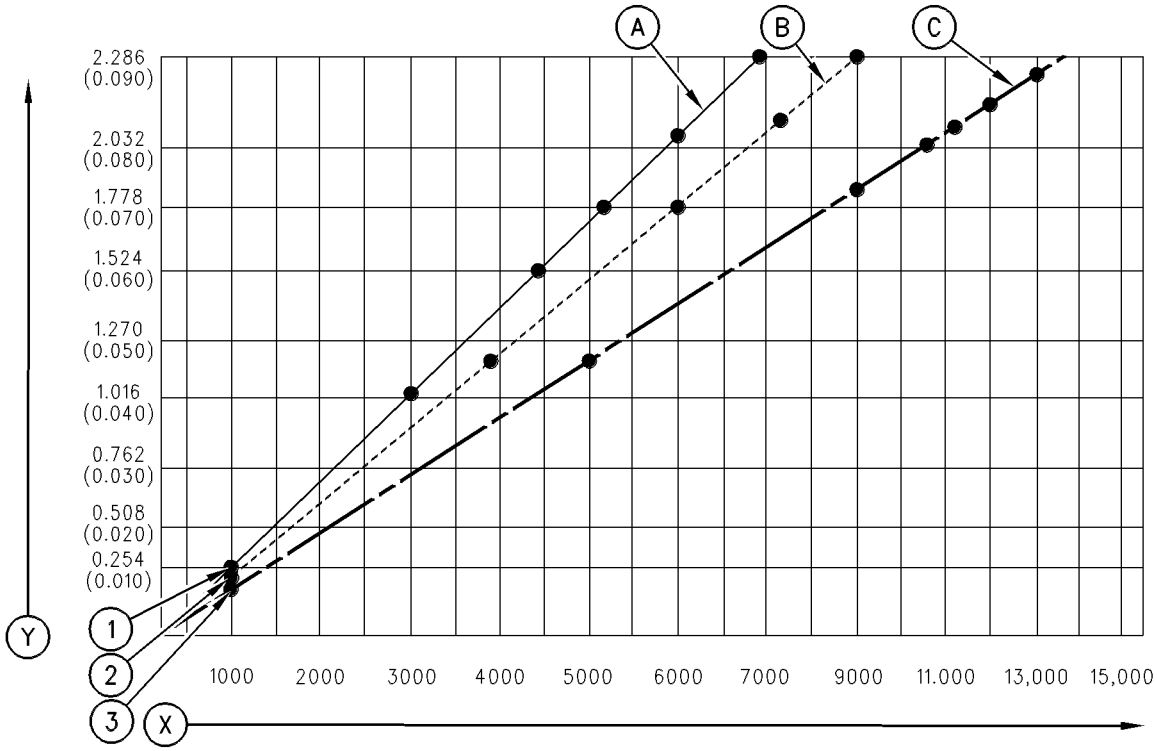


Illustration 59 g00320513

(A) Schedule
(B) Schedule
(C) Schedule
(Y) Valve recession in millimeters (inches)
(X) Hours of operation
(1) 0.254 mm (0.0100 inch)
(2) 0.218 mm (0.0086 inch)
(3) 0.152 mm (0.0060 inch)

To determine intervals, use the point on the graph in Illustration 59 that is closest to the measurement for each cylinder.

For example, suppose that the measurement that was obtained at the initial oil change shows a valve recession of approximately 0.152 mm (0.0060 inch). According to Schedule (C), the next interval for measuring that cylinder is at 5000 service hours. Another cylinder may have a valve recession of approximately 0.254 mm (0.0100 inch). According to Schedule (A), the next interval for measuring that cylinder is at 3000 service hours.

- After 70 percent of the maximum limit has been reached, measure the projection of the exhaust valve stems at every 750 hours of operation (turbocharged engines). For Naturally aspirated engines, perform the measurement at every 1500 hours of operation.
- Plan for the top end overhaul as the valve stem projection approaches the maximum limit. Perform the top end overhaul when the valve stem projection has increased by a total of 2.3 mm (0.09 inch). **Do not allow the valve recession to exceed this limit.** The valve head can break. This will cause severe damage in the combustion chamber and the turbocharger.

Consult your Caterpillar dealer for assistance.

i01492446

Walk-Around Inspection

SMCS Code: 1000-040

Inspect the Engine for Leaks and for Loose Connections

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

For maximum engine service life, thoroughly inspect the engine room before starting the engine. Look for items such as leaks, loose bolts, 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, 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 cooling lines are properly clamped. Check for leaks. Check the condition of all pipes.
- 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 when the engine cools and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For instructions on removal and installation of water pumps and/or seals, refer to the Service Manual, “Disassembly and Assembly” module 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 covers.

⚠ WARNING

NEVER use a flame to check for gas leaks. Use a gas detector.

An open flame can ignite mixtures of air and fuel. This will cause explosion and/or fire which could result in severe personal injury or death.

- Check the fuel system for leaks. Look for loose fuel line clamps.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground straps for good connections and for good condition.
- Check the condition of the gauges. Replace any gauge that is damaged. Replace any gauge that can not be calibrated.
- Inspect the exhaust system for leaks. If a leak is found, make repairs.

i01041757

Walk-Around Inspection (Exercise Inspection of Standby Generator Set Engines)

SMCS Code: 1000-040

⚠ WARNING

NEVER use a flame to check for gas leaks. Use a gas detector.

An open flame can ignite mixtures of air and fuel. This will cause explosion and/or fire which could result in severe personal injury or death.

1. Perform the procedures that are described in this Operation and Maintenance Manual, “Before Starting Engine” topic (Operation Section).
2. Start the engine according to the instructions in this Operation and Maintenance Manual, “Engine Starting” topic (Operation Section).

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.

3. Perform an inspection of the installation after the engine is started. Look for leaks. Listen for unusual noises.
   - Check the engine oil level when the engine is operating at low idle rpm. Observe the oil level on the “LOW IDLE” side of the oil level gauge (dipstick).
   - Inspect the lubrication system for leaks at the oil pan, the oil filter, and the valve covers.
   - Inspect the cooling system for leaks at the hose connections.
   - Check the fuel system for leaks with a gas detector.
   - Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.

- Inspect the exhaust system for leaks.
- If the enclosure has louvers, inspect the louvers for proper operation.
- Observe the gauges. Ensure the correct readings for the engine rpm. Record the engine oil pressure and the jacket water temperature.
- Record the data for the performance of the generator. See the Operation and Maintenance Manual for the generator and the control panel.

4. After exercising the generator set, stop the engine according to this Operation and Maintenance Manual, “Engine Stopping” topic (Operation Section).
5. Perform the procedures that are described in this Operation and Maintenance Manual, “After Stopping Engine” topic (Operation Section).
6. Ensure that the control switches are in the correct position for automatic starting of the generator set.

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Water Pump - Inspect

SMCS Code: 1361-040

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.