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MAINTENANCE INTERVALS

Operation and Maintenance
Manual Excerpt

CATERPILLAR®

CATERPILLAR®

SEBU7681-15
June 2010

Operation and Maintenance Manual

G3500E and G3500C Generator Sets

GZA1-Up (Generator Set)
GSB1-Up (Generator Set)
GZB1-Up (Generator Set)
TJB1-Up (Generator Set)
GZC1-Up (Generator Set)
TJC1-Up (Generator Set)
MAD1-Up (Generator Set)
GZG1-Up (Generator Set)
GZH1-Up (Generator Set)
GZJ1-Up (Generator Set)
GZK1-Up (Generator Set)
GZL1-Up (Generator Set)
HAL1-Up (Generator Set)
GZM1-Up (Generator Set)
GZN1-Up (Generator Set)
B9P1-Up (Generator Set)
RLP1-Up (Generator Set)
SSR1-Up (Generator Set)
GAS1-Up (Generator Set)
LGS1-Up (Generator Set)
NGS1-Up (Generator Set)
HAT1-Up (Generator Set)
CWW1-Up (Generator Set)
GTX1-Up (Generator Set)
CWY1-Up (Generator Set)
SLY1-Up (Generator Set)
SXY1-Up (Generator Set)
GZZ1-Up (Generator Set)

i03937669

Maintenance Interval Schedule (Standard G3500E)

SMCS Code: 1000; 4450; 7500

S/N: GZG1-Up

S/N: GZH1-Up

S/N: GAS1-Up

S/N: SSR1-Up; GHD1-Up

S/N: GTX1-Up; GHF1-Up

S/N: SXY1-Up; GHM1-Up

S/N: NGS1-Up; GYM1-Up

S/N: SLY1-Up; GHP1-Up

S/N: HAL1-Up; GHR1-Up

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 all maintenance which includes the following items: performing all adjustments, using proper lubricants, fluids, and filters, and replacing old components with new 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.

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

Choose the interval that occurs first in order to determine the correct maintenance interval: fuel consumption, service hours, and calendar time . Products that operate in severe operating conditions may require more frequent maintenance.

To determine the maintenance intervals for the overhauls, refer to this Operation and Maintenance Manual, “Maintenance Recommendations” .

When Required

Daily

Initial 250 Service Hours

Every 250 Service Hours

Every 1000 Service Hours

Every 2000 Service Hours

Every Year

Every 3000 Service Hours

Every 4000 Service Hours

Every 8000 Service Hours

Between 10 000 and 20 000 Service Hours

Every 10 000 Service Hours

Between 22 000 and 40 000 Service Hours

Every 24 000 Service Hours or 3 Years

Between 45 000 and 80 000 Service Hours

i03897388

Maintenance Interval Schedule (Standby)

SMCS Code: 1000; 4450; 7500

S/N: GSB1-Up

S/N: GZG1-Up

S/N: GZH1-Up

S/N: GZL1-Up

S/N: GZM1-Up

S/N: GZN1-Up

S/N: RLP1-Up

S/N: GAS1-Up

S/N: GZZ1-Up

S/N: TJB1-Up; RWA1-Up

S/N: CWY1-Up; GDB1-Up

S/N: B9P1-Up; GHC1-Up

S/N: SSR1-Up; GHD1-Up

S/N: CWW1-Up; GHE1-Up

S/N: GTX1-Up; GHF1-Up

S/N: SXY1-Up; GHM1-Up

S/N: NGS1-Up; GYM1-Up

S/N: SLY1-Up; GHP1-Up

S/N: TJC1-Up; DKR1-Up

S/N: HAL1-Up; GHR1-Up

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 all maintenance which includes the following items: performing all adjustments, using proper lubricants, fluids, and filters, and replacing old components with new 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.

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

Choose the interval that occurs first in order to determine the correct maintenance interval: fuel consumption, service hours, and calendar time . Products that operate in severe operating conditions may require more frequent maintenance.

To determine the maintenance intervals for the overhauls, refer to this Operation and Maintenance Manual, “Maintenance Recommendations” .

When Required

Daily

Every Week

Every 250 Service Hours

Every 1000 Service Hours

Every 1000 Service Hours or 6 Months

Every 2000 Service Hours

Every Year

Every 3000 Service Hours

Every 3 Years

Every 4000 Service Hours

Every 8000 Service Hours

Between 10 000 and 20 000 Service Hours

Every 10 000 Service Hours

i03897390

Maintenance Interval Schedule (Landfill)

SMCS Code: 1000; 4450; 7500

S/N: GZA1-Up

S/N: GZB1-Up

S/N: GZC1-Up

S/N: GZJ1-Up

S/N: GZK1-Up

S/N: LGS1-Up

S/N: MAD1-Up; JBX1-Up

S/N: HAT1-Up; JBZ1-Up

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 all maintenance which includes the following items: performing all adjustments, using proper lubricants, fluids, and filters, and replacing old components with new 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.

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

Choose the interval that occurs first in order to determine the correct maintenance interval: fuel consumption, service hours, and calendar time . Products that operate in severe operating conditions may require more frequent maintenance.

To determine the maintenance intervals for the overhauls, refer to this Operation and Maintenance Manual, “Maintenance Recommendations” .

When Required

Daily

Initial 250 Service Hours

Every 250 Service Hours

Every 1000 Service Hours

Every 2000 Service Hours

Every Year

Every 4000 Service Hours

Between 7500 and 8000 Service Hours

Every 8000 Service Hours

Between 10 000 and 20 000 Service Hours

Every 10 000 Service Hours

Between 22 500 and 24 000 Service Hours

Every 24 000 Service Hours or 3 Years

Between 37 500 and 40 000 Service Hours

i03897384

Maintenance Interval Schedule (Standard G3500C)

SMCS Code: 1000; 4450; 7500

S/N: GSB1-Up

S/N: GZL1-Up

S/N: GZM1-Up

S/N: GZN1-Up

S/N: RLP1-Up

S/N: GZZ1-Up

S/N: TJB1-Up; RWA1-Up

S/N: CWY1-Up; GDB1-Up

S/N: B9P1-Up; GHC1-Up

S/N: CWW1-Up; GHE1-Up

S/N: TJC1-Up; DKR1-Up

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 all maintenance which includes the following items: performing all adjustments, using proper lubricants, fluids, and filters, and replacing old components with new 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.

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

Choose the interval that occurs first in order to determine the correct maintenance interval: fuel consumption, service hours, and calendar time . Products that operate in severe operating conditions may require more frequent maintenance.

To determine the maintenance intervals for the overhauls, refer to this Operation and Maintenance Manual, “Maintenance Recommendations” .

When Required

Daily

Initial 250 Service Hours

Every 250 Service Hours

Every 1000 Service Hours

Every 2000 Service Hours

Every Year

Every 3000 Service Hours

Every 4000 Service Hours

Every 8000 Service Hours

Between 10 000 and 20 000 Service Hours

Every 10 000 Service Hours

Between 22 000 and 40 000 Service Hours

Every 24 000 Service Hours or 3 Years

Between 45 000 and 80 000 Service Hours

i01721862

Aftercooler Condensation - Drain

SMCS Code: 1063

The air/fuel mixture that is compressed and warmed by the turbocharger compressor is directed through the aftercooler core. The air/fuel mixture is cooled in the aftercooler.

Condensation can form in the housing of the aftercooler. A drain plug is provided for draining the condensation.

Note: An automatic drain is available for use with 32° C (90 °F) separate circuit aftercoolers. Consult your Caterpillar dealer for details.

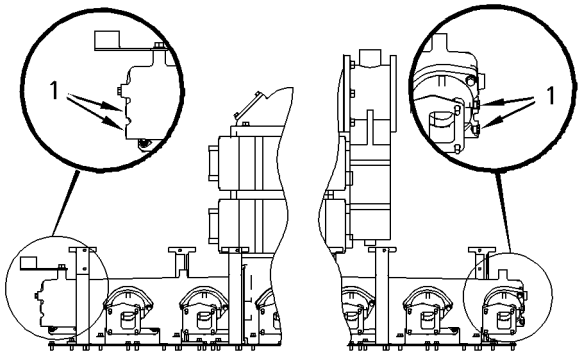


Illustration 44 g00885207

Remove the drain plugs (1) from the ends of the plenum. Drain the moisture into a suitable container. Reinstall the plugs.

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.

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.

i02667833

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.

Adjusting the Alternator Belt

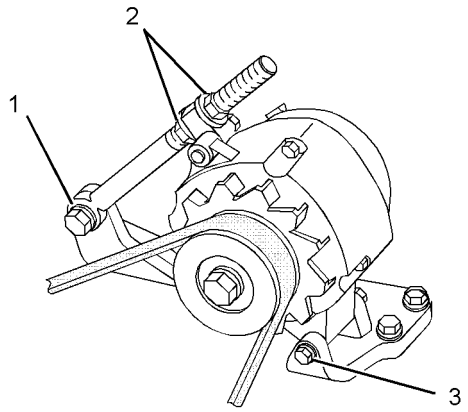


Illustration 45 g01092641

Typical alternator

(1) Mounting bolt
(2) Adjusting nuts
(3) Mounting bolt

1. Remove the drive belt guard.

2. Loosen mounting bolt (1), adjusting nuts (2) and mounting bolt (3).

3. Turn adjusting nuts (2) in order to increase or decrease the drive belt tension.

4. Tighten adjusting nuts (2). Tighten mounting bolt (3). Tighten mounting bolt (1). For the proper torque, see the Service Manual, “Specifications” module.

5. Reinstall the drive belt guard.

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

Adjusting the Fan Drive Belt

1. Loosen the mounting bolt for the pulley.

2. Loosen the adjusting nut for the pulley.

3. Move the pulley in order to adjust the belt tension.

4. Tighten the adjusting nut to the proper torque.

5. Tighten the mounting bolt to the proper torque.

For the proper torque specifications, refer to the Service Manual, “Specifications” module.

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.

i02904927

Carburetor Air/Fuel Ratio - Check/Adjust

SMCS Code: 1266-535; 1266

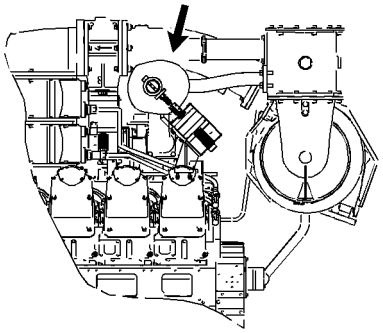
An engine failure may occur if the air/fuel ratio is not appropriate for the fuel and for the operating conditions. The service life of the turbocharger, of the valves, and of the other components may be reduced.

Refer to the Systems Operation, Testing and Adjusting for the correct procedure.

i02896718

Compressor Bypass - Check

SMCS Code: 1050-535



g01340674

Illustration 46

Hydraulically operated valve

Check for leaks. If necessary, remove the actuator according to the instructions in the Service Manual, “Disassembly and Assembly” manual. Inspect the throat for wear marks. Check for free movement of the butterfly valve. If necessary, replace the valve.

Inspect the gaskets for wear or damage. If necessary, replace the gaskets. Reinstall the actuator according to the instructions in the Service Manual, “Disassembly and Assembly” manual.

Inspect the coupling for the compressor bypass for wear and play. If necessary, replace the coupling. Excessive wear in the coupling can cause low power or instability in the engine.

i03909811

Cooling System Coolant (NGEC) - 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.
- The oil has entered the cooling system and the coolant is contaminated.
- Coolant analysis indicates that the coolant has broken down.

Draining the Cooling System

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.

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

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

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

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.

Draining the Jacket Water

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

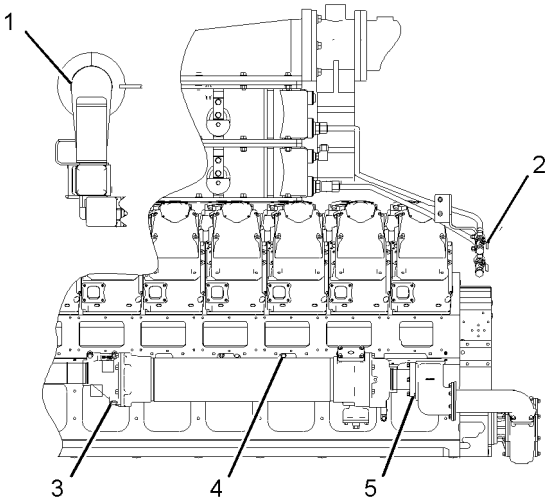


Illustration 47 g01445608

Locations of the vent and drain plugs

(1) Coolant outlet
(2) Aftercooler drain plug
(3) Oil cooler drain plug
(4) Engine block drain plug
(5) Drain plug for the adapter

2. Remove the vent plug from coolant outlet (1). Open drain (2). Remove drain plugs (3), (4), and (5).

Draining the Separate Circuit

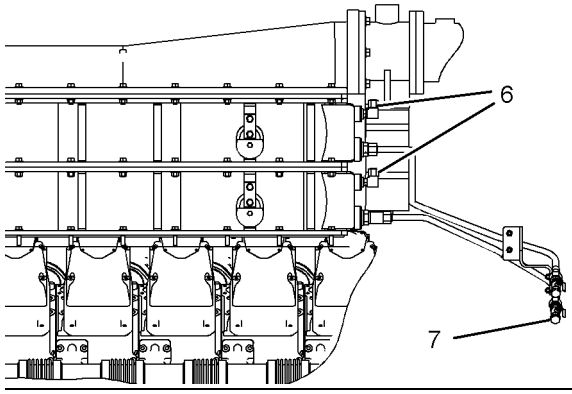


Illustration 48 g01445599

1. Remove vent plugs (6).

2. Open coolant drain valve (7).

Clean the Cooling System

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.

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 valves. Clean the drain plugs and install the drain plugs.

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

NOTICE
If the aftercooler circuit has been drained, the vent plug must be opened to allow the aftercooler to fill properly. Failure to do this will cause an air lock resulting in engine damage.

3. When the separate circuit is filled, be sure to remove the vent plug.

4. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pt) of cleaner per 15 L (4 US gal) of the cooling system capacity. Install the cooling system filler cap. Install vent plugs (1).

5. Start the engine. Operate the engine for a minimum of 30 minutes with a coolant temperature of at least 82 °C (180 °F).

6. Stop the engine and allow the engine to cool. For the jacket water and the separate circuit, loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the cooling system drain valves and remove the drain plugs. Remove the vent plugs. Allow the cleaning solution 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.

7. Flush the cooling system with clean water until the water that drains is clean. Close the cooling system drain valves. Clean the drain plugs and install the drain plugs.

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 valves. Clean the drain plugs and install the drain plugs.

3. Remove the vent plugs.

4. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pt) 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 the vent plugs.

5. Start the engine. Operate the engine for a minimum of 90 minutes with a coolant temperature of at least 82 °C (180 °F).

6. 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 valves and remove the drain plugs. Remove the vent plugs. Allow the cleaning solution 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.

7. Flush the cooling system with clean water until the water that drains is clean. Close the cooling system drain valves. Clean the drain plugs and install the drain plugs.

Fill the Cooling System

NOTICE
It is recommended that the cooling system is filled from the bottom with the cap removed from the expansion tank.

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 for the capacity of the cooling system, refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” (Maintenance Section).

1. Remove the vent plugs.

2. Fill the cooling system with coolant or antifreeze. Install the vent plugs. Do not install the cooling system filler cap yet.

3. Start the engine. Run the engine at low idle for 10 minutes.

4. Increase the engine speed to a high idle until the thermostat is open and the coolant level is stabilized.

5. Maintain the coolant at the proper level as the thermostat opens while air is purged from the system. Refer to Operation and Maintenance Manual, “Coolant Level - Check”.

6. 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 filler cap.

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

i02017615

Cooling System Coolant Level - Check

SMCS Code: 1350-535-FLV

⚠ WARNING

Climbing equipment may be required to access this service point. Refer to the Operation and Maintenance Manual, "Mounting and Dismounting" topic for safety information.

NOTICE
Overfilling the overflow tank (if equipped) will result in damage to the cooling system.

If the cooling system has an overflow tank, maintain the coolant level in the tank below 1/2 full in order to avoid damage to the cooling system.

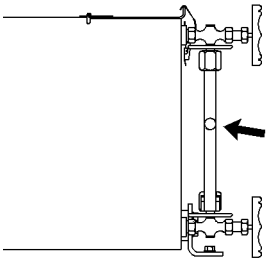


Illustration 49 g00760290

Normal position of the coolant in the sight gauge during rated operation

Observe the coolant level in the sight gauge (if equipped). When the engine is running at normal operating temperature, the coolant should be in the upper half of the sight gauge. If the coolant level is low, add the proper coolant mixture.

Add Coolant

Note: For the proper coolant mixture to use, see this Operation and Maintenance Manual, "Refill Capacities and Recommendations" topic.

1. Stop the engine. Allow the engine to cool.
2. Remove the cooling system filler cap slowly in order to relieve any pressure. Pour the proper coolant mixture into the filler pipe.

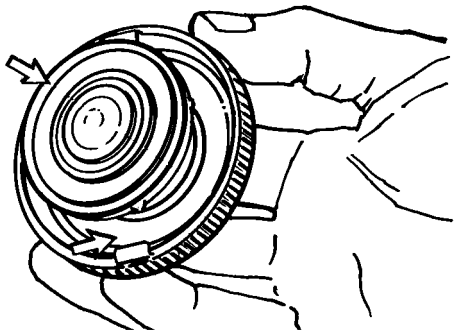


Illustration 50 g00103639

Filler cap gaskets

3. Clean the cooling system filler cap. Inspect the gaskets of the cooling system filler cap. If the gaskets are damaged, replace the old cooling system filler cap with a new cooling system filler cap. Install the cooling system filler cap.
4. Start the engine. Inspect the cooling system for leaks.

i02064894

Cooling System Coolant Sample (Level 1) - Obtain

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

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

For conventional heavy-duty coolant/antifreeze, check the concentration of supplemental coolant additive (SCA) regularly. The concentration of SCA can be checked with an S·O·S coolant analysis (Level 1).

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:

- Never collect samples from expansion bottles.
- Never collect samples from the drain for a system.
- Keep the unused sampling bottles stored in plastic bags.
- Keep the lids on empty sampling bottles until you are ready to collect the sample.
- Complete the information on the label for the sampling bottle before you begin to take the samples.
- Obtain coolant samples directly from the coolant sample port. You should not obtain the samples from any other location.
- In order to avoid contamination, immediately place the sample in the tube that is provided for mailing.

Submit the sample for Level 1 analysis.

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

For additional information about coolant analysis, see the Special Publication, SEBU6400, “Caterpillar Gas Engine Lubricant, Fuel and Coolant Recommendations” or consult your Caterpillar dealer.

i02168823

Cooling System Coolant Sample (Level 2) - Obtain

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

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

Obtain the sample of the coolant as close as possible to the recommended sampling interval. Supplies for collecting samples can be obtained from your Caterpillar dealer.

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

Submit the sample for Level 2 analysis.

For additional information about coolant analysis, see the Special Publication, SEBU6400, “Caterpillar Gas Engine Lubricant, Fuel, and Coolant Recommendations” or consult your Caterpillar dealer.

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 16 to interpret the results.

Table 16

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.

i01935045

Crankcase Blowby - Measure/Record

SMCS Code: 1317

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 engines.

Note: Crankcase blowby is one of the three factors that help to determine the in-frame overhaul interval. For more information, see this Operation and Maintenance manual, “Overhaul (In-Frame)” topic.

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 1U-8860 Large Engine Blowby Pickup Group with the 8T-2701 Blowby Indicator. For instructions, see Special Instruction, SEHS8984, “Using the 1U-8860 Large Engine Blowby Pickup Group” and Special Instruction, SEHS8712, “Using the 8T-2700 Blowby/Air Flow Indicator”.

For assistance, consult your Caterpillar dealer.

i01601829

Crankcase Pressure - Measure (Engines with Fumes Disposal Filters)

SMCS Code: 1074

Measure the crankcase pressure during normal operation.

With a fumes disposal filter that is properly installed, the crankcase pressure will be within 0.25 kPa (1 inch of H_2O) of the atmospheric pressure.

i02896726

Crankshaft Vibration Damper - Inspect

SMCS Code: 1205-040

The crankshaft vibration damper limits the torsional vibration of the crankshaft. The visconic damper has a weight that is located inside a fluid filled case.

Damage to the crankshaft vibration damper or failure of the 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.

A damper that is hot is typically due to excessive torsional vibration. A hot damper can also be due to the operating environment. See the Service Manual, “Application and Installation Guideline”. Monitor the temperature of the damper during operation.

The 8T-2821 Temperature Indicator or the 8T-2822 Temperature Indicator are recommended for monitoring the temperature of the damper. Evenly space four of the adhesive indicators around the outer diameter of the damper.

Note: If you use an infrared thermometer to monitor the temperature of the damper, use the thermometer during operation with similar loads and speeds. Keep a record of the data. If the temperature begins to rise, reduce the interval for inspecting the damper and install temperature indicator strips for more accurate readings.

If the temperature of the damper reaches 90 °C (194 °F), reduce the interval for inspecting the damper. If the temperature of the damper reaches 100 °C (212 °F), consult your Caterpillar dealer.

Inspect the damper for evidence of dents, cracks, and leaks of the fluid.

If a fluid leak is found, repair the damper or replace the damper. The fluid in the damper is silicone. Silicone has the following characteristics: transparent, viscous, smooth, and sticky.

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.
- An analysis of the oil has revealed that the front bearing of the crankshaft is badly worn.
- There is a large amount of gear train wear that is not caused by a lack of oil.

Removal and Installation

Refer to the Service Manual, “Disassembly and Assembly” or consult your Caterpillar dealer for information about damper replacement.

i03529602

Crankshaft Vibration Damper - Inspect (1500 RPM G3520 engines (if equipped with an oil fed damper))

SMCS Code: 1205-040

S/N: GZB1-Up

S/N: GZH1-Up

S/N: HAL1-Up

S/N: GZN1-Up

S/N: RLP1-Up

S/N: LGS1-Up

There are two service intervals for the crankshaft vibration damper, a short interval, and a long interval. The following maintenance procedure must be completed at each service interval:

1. Remove the damper.
2. Separate the inner member of the damper from the outer member of the damper.

Note: Do not disassemble the damper spring assembly.

3. Clean all parts of the damper. Pay special attention to the oil supply and venting holes.
4. Replace all accessible rubber seal rings.
5. Replace all disc springs from bolts that have been removed.
6. Replace all lockwashers on the bolts that have been removed.
7. Check the service literature that is provided by the OEM of the damper for permissible wear.

Parts that are exposed to wear may need to be repaired or exchanged.

At each long service interval, the following steps must also be completed:

1. Disassemble the outer member of the damper.
2. Service the spring packs. If necessary, replace the spring packs. Check permissible wear according to the service literature that is provided by the OEM of the damper.
3. Service the inner star. If necessary, replace the inner star. Check permissible wear according to the service literature that is provided by the OEM of the damper.

Refer to Service Manual, RENR5980, “Disassembly and Assembly” for proper procedures.

i01664707

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.

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 to 3 or 4 revolutions. 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 51 is a graph of typical cylinder pressures for engines with different compression ratios.

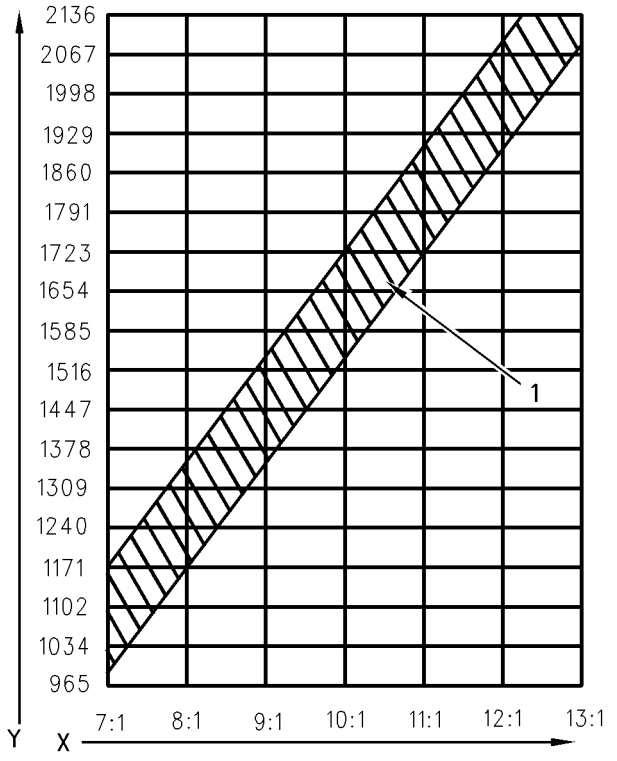


Illustration 51 g00828960

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

i01935223

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 air-borne 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.

Note: Use of a platform may be necessary to reach the air cleaner element.

Clean the air cleaner elements or replace the air cleaner elements when the following conditions occur:

- Inspect the air cleaner elements before the air filter restriction reaches 2.5 kPa (10 inches of H_2O). A loss of engine performance may occur when the air filter restriction exceeds this limit.
- The air cleaner elements must be cleaned or replaced before the air filter restriction exceeds 3.75 kPa (15 inches of H_2O).

Note: The air filter restriction is measured before the air inlet to the turbocharger compressor.

Servicing the Air Cleaner Elements

Note: If the air cleaner is not manufactured by Caterpillar, follow the instructions that are provided by the OEM of the air cleaner.

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

- Check the precleaner (if equipped) daily for accumulation of dirt and debris. Remove any dirt and debris, as needed.

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

1. Remove the air cleaner cover. Remove the air cleaner element.
2. Cover the air inlet to the turbocharger with tape in order to keep dirt out.
3. Clean the inside of the air cleaner cover and body with a clean, dry cloth.

4. Remove the tape for the air inlet to the turbocharger. Install an air cleaner element that is new or cleaned.

5. Install the air cleaner cover.

Inspecting Air Cleaner Elements

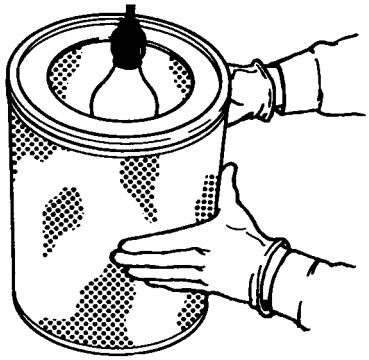


Illustration 52 g00281693

Inspect the clean, dry air cleaner 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 Air Cleaner Elements

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

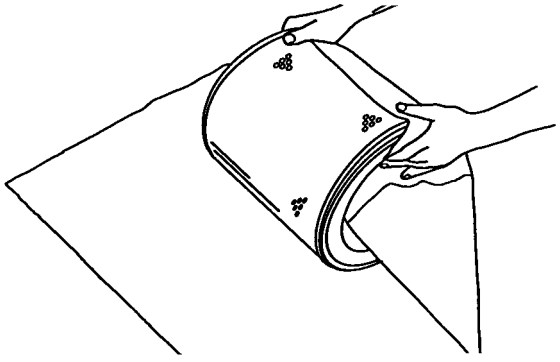


Illustration 53 g00281694

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 box for storage. For identification, mark the outside of the box.

Store the box in a dry location.

i03914190

Engine Air Filter Service Indicator - Inspect

SMCS Code: 7452-040

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

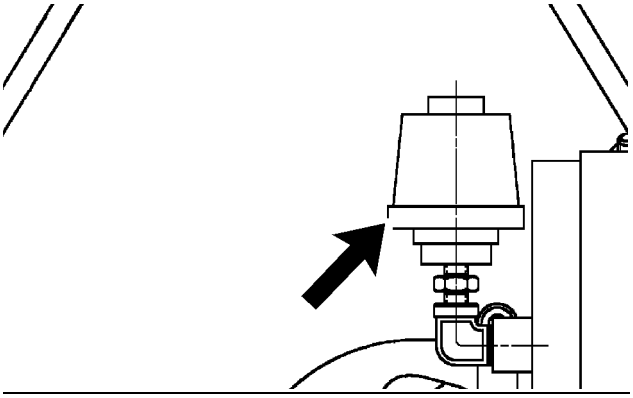


Illustration 54 g00947059

Some engines may be equipped with a different service indicator.

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

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.
- The air restriction reaches 3.75 kPa (15 inch of H_2O).

Test the Service Indicator

- Apply vacuum (suction) to the service indicator.
- Reset the service indicator.

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

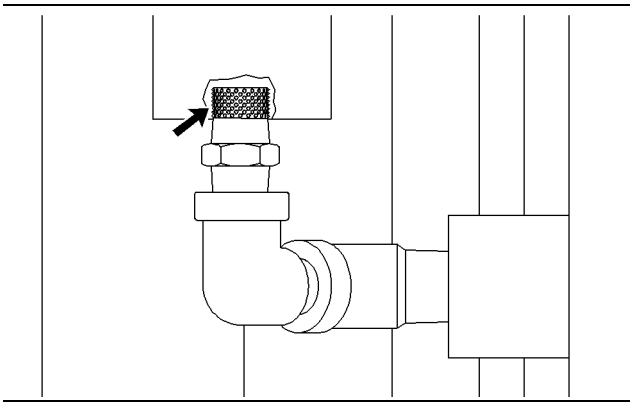


Illustration 55 g00924884

A porous filter is part of the 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.

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

Replace the service indicator annually regardless of the operating conditions.

i02895754

Engine Crankcase Breather - Clean

SMCS Code: 1317-070

Clean the crankcase breather regularly in order to prevent excessive crankcase pressure that will damage the engine's seals.

Perform this maintenance when the engine is stopped.

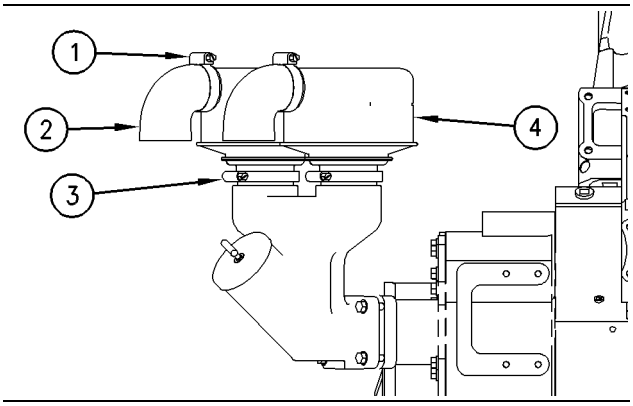


Illustration 56 g00882365

1. Loosen clamps (1). Slide the clamps off tubes (2). Remove the tubes.

2. Loosen clamps (3). Remove each breather assembly (4) from the elbow assembly.

3. Remove O-ring seals from the elbow assembly. Inspect the O-ring seals for good condition. Obtain new O-ring seals, if necessary.

4. Turn the breathers upside-down in order to inspect the condition of the breather elements.

Note: Do not replace the breathers in the upside-down position. If breathers are not replaced properly water could enter the crankcase and damage to the engine could result.

   Clean the breather elements with clean, nonflammable solvent. If the breather elements remain contaminated after the cleaning, discard the breather assemblies and obtain new breather assemblies. Do not attempt to disassemble the breather assemblies.

   Allow the breather elements to dry before installation.

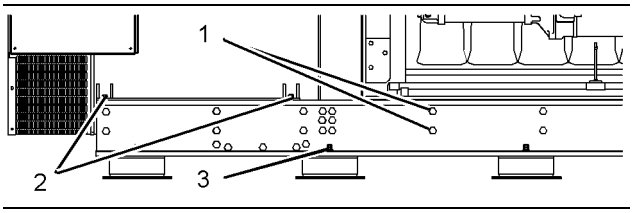
Note: Lubricate the bore of the elbow assembly with clean engine oil and install the O-ring seals.

5. Install breather assemblies (4) and tighten clamps (3). Install elbows (2) and clamps (1). Tighten the clamps.

i03214182

Engine Mounts - Check

SMCS Code: 1152-535



g01340704

Illustration 57

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.

i02017618

Engine Oil - Change

SMCS Code: 1348-044; 1348

⚠ WARNING

Hot oil and components can cause personal injury.

Do not allow hot oil or components to contact 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 draining method allows the waste particles that are suspended in the oil to be drained properly. Failure to follow this recommended procedure will allow the waste particles to be recirculated through the engine lubrication system with the new 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 by using one of the following methods. Use the method that corresponds to the equipment on the engine.

Note: If a suction device is used in order to remove the oil from the oil pan, ensure that the suction device is clean. This will prevent dirt from entering into the oil pan. Be careful not to strike the engine oil suction tubes or the piston cooling jets.

   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 has a pump for removing dirty oil, connect a hose to the outlet of the pump. Place the hose in a suitable container. Open the valve for the drain line. Operate the pump until the crankcase is empty. Close the valve to the drain line. Disconnect the hose.

c. If the oil drain valve has a “quick connect” coupling, attach the coupling. Open the drain valve in order to drain the crankcase. After the oil has drained, close the drain valve. Disconnect the coupling.

d. If the engine does not have a drain valve or a pump, remove an oil drain plug. Allow the oil to drain. After the oil has drained, clean the drain plug and clean the fitting for the drain plug. Install the drain plug. Tighten the drain plug to 145 ± 15 N·m (105 ± 10 lb ft).

Note: Ensure that the dirty oil is thoroughly drained from the pan. Caterpillar recommends a thorough cleaning of the oil pan with a vacuum and with rags in order to completely remove all of the old oil. This will help prevent inaccurate oil analysis results and/or shortened life of the oil.

3. Replace the engine oil filter elements before filling the crankcase with new oil.

a. For the procedure to change the engine oil filters, refer to the Operation and Maintenance Manual, “Engine Oil Filter - Change” 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.

Note: For the appropriate oil to use, and for the amount of oil to use, refer to this Operation and Maintenance Manual, “Refill Capacities and Recommendations” article (Maintenance Section).

4. Remove the oil filler cap. Fill the crankcase through the oil filler tube only. Clean the oil filler cap. Install the oil filler cap.

NOTICE
To prevent crankshaft damage and to prevent bearing damage, manually operate the prelube pump or crank the engine with the fuel supply line closed for 15 to 30 seconds. This will ensure that all of the oil filters are filled with oil before the engine is started.

5. Close the fuel supply line. Crank the engine until the oil pressure gauge indicates 70 kPa (10 psi). Open the fuel supply line. Allow the starting motor to cool for two minutes before cranking again.

6. Follow this Operation and Maintenance Manual, “Starting The Engine” procedure (Operation Section). Operate the engine at low idle for two minutes. This will ensure that the lubrication system and the oil filters are filled with oil. Inspect the engine for oil leaks. Ensure that the oil level is between the “ADD” and the “FULL” marks on the “LOW IDLE” side of the oil level gauge.

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

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

i02895793

Engine Oil Filter - Change

SMCS Code: 1308-510; 1308

Replace the engine oil filters when any of the following conditions are met:

- The engine oil is changed.
- The engine oil filter differential pressure reaches 100 kPa (15 psi).
- The engine oil filters have been used for 1000 operating hours.

Replace the Oil Filter Elements

⚠ WARNING

Hot oil and components can cause personal injury.

Do not allow hot oil or components to contact skin.

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

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.

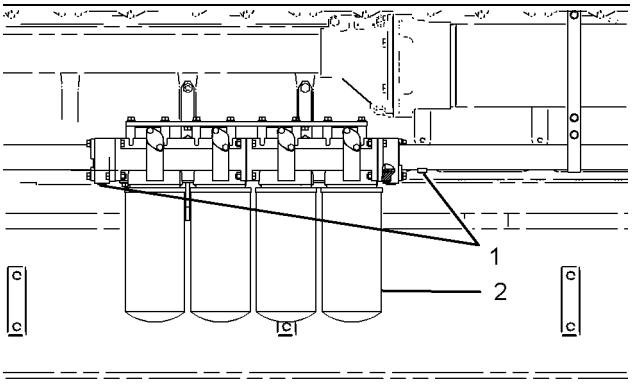


Illustration 58 g01441663

1. Remove oil drain plug (1). Drain the oil into a suitable container.

2. Remove spin-on oil filters (2) with a 2P-8250 Strap Wrench As.

3. Reinstall the oil drain plug.

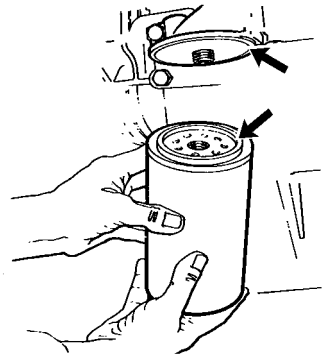


Illustration 59 g00103713
Mounting base and gasket

4. Clean the sealing surface of the mounting base. Ensure that all of the old gasket is removed.

5. Apply clean engine oil to the gasket of the new oil filter.

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

6. Place the oil filter in position. Tighten the oil filter by hand until the gasket contacts the base. Tighten the oil filter by hand for an additional 1 full turn (360 degrees). Do not overtighten the oil filter.

7. Check the oil level according to the instructions in this Operation and Maintenance Manual, “Engine Oil Level - Check”.

Inspect the Used Oil Filter Elements

Cut the used oil filter element open with a 4C-5084 Oil Filter Cutter Gp.

Remove the metal wrap. Cut the filter element free from the end caps. Spread apart the pleats and inspect the element for metal debris. Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter element. An excessive amount of debris in the element may indicate early wear or a pending failure. 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.

Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the element. Ferrous metals may indicate wear on the steel and the cast iron parts of the engine. Nonferrous metals may indicate wear on the aluminum parts, the brass parts, or the bronze parts of the engine. Parts that may be affected include the following components: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

i02225089

Engine Oil Level - Check

SMCS Code: 1348-535-FLV

The most accurate check of the engine oil level is obtained when the engine is stopped.

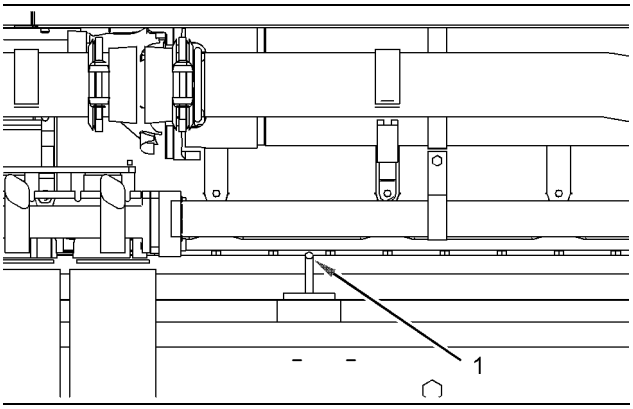


Illustration 60 g01122349

(1) Engine oil level gauge (dipstick)

1. Remove the filler cap (not shown) in order to ensure that the crankcase pressure is equal to the atmospheric pressure.

Excess pressure or a slight vacuum will affect engine oil level that is measured.

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

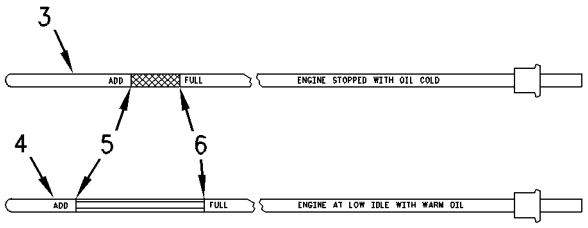


Illustration 61 g00735162

(3) “ENGINE STOPPED WITH OIL COLD” side
(4) “ENGINE AT LOW IDLE WITH WARM OIL” side
(5) “ADD” mark
(6) “FULL” mark

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

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

The engine 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.

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

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

i03542996

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. S·O·S oil analysis provides infrared analysis, which is required for determining nitration and oxidation levels.

Obtain the Sample and the Analysis

⚠ WARNING

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

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

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

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

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

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

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

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

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

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

i02861779

Engine Protective Devices - Check

SMCS Code: 7400-535

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.

Calibration Check

NOTICE
During testing, abnormal operating conditions must be simulated.

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

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

Consult your Caterpillar dealer or refer to the Service Manual for more information.

i03900462

Engine Speed/Timing Sensor - Clean/Inspect

SMCS Code: 1905-040; 1905-070; 1907-040; 1907-070

An engine speed/timing sensor is mounted in the housing of the camshaft at the rear of the engine. The speed/timing sensor provides information about engine speed and the position of the crankshaft to the ECM. There are two possible types of speed/timing sensors: fixed head and slip head.

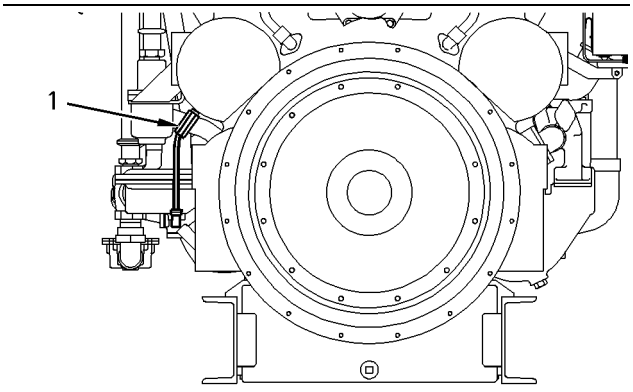


Illustration 62 g00760464

Fixed head sensors (if equipped)

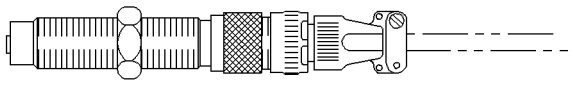


Illustration 63 g00293337

The fixed head sensor has a threaded end, and screws directly into the flywheel housing.

1. Remove the speed sensor (1) from the housing. Check the condition of the plastic end of the speed sensors for wear and/or contaminants.
2. Clean the metal shavings and other debris from the face of the speed sensors.
3. Install the engine speed/timing sensor.

Slip head sensors (if equipped)

1. Remove engine speed/timing sensor (1). Inspect the condition of the end of the magnet. Look for signs of wear and contaminants.
2. Clean any debris from the face of the magnet.

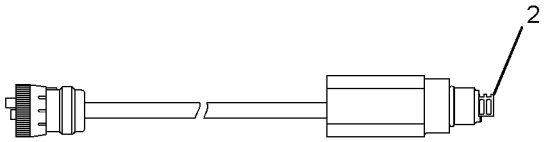


Illustration 64 g01115363

3. Check the tension of the slip head. Gently extend the slip head (2) for a minimum of 4 mm (0.16 inch). Then push back the slip head.

   When the slip head has the correct tension, at least 22 N (5 lb) of force is required to push in the slip head from the extended position.

NOTICE
The sliphead must be fully extended when the speed/timing sensor is installed so that the sensor maintains the correct clearance with the speed-timing wheel. If the correct clearance is not maintained, the signal from the sensor will not be generated.

Do not install the sensor between the teeth of the speed-timing wheel. Damage to the sensor would result. Before installing the sensor, ensure that a tooth of the wheel is visible in the mounting hole for the sensor.

4. Install the engine speed/timing sensor.

   a. Ensure that a tooth on the speed-timing wheel is visible in the mounting hole for the sensor.

   b. Extend the slip head (2) by a minimum of 4 mm (0.16 inch).

   c. Coat the threads of the sensor with 4C-5597 Anti-Seize Compound.

Note: The slip head is designed to contact a tooth during the first revolution of the speed-timing wheel. For the maximum allowable clearance between the slip head and the tooth, refer to the engine's Specifications manual.

   d. Install the sensor. Tighten the locknut to 40 ± 5 N·m (30 ± 4 lb ft).

i02754665

Engine Valve Lash and Bridge - Adjust

SMCS Code: 1102-025; 1102

⚠ WARNING

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

Do not attempt to remove the valve covers when the engine is operating. The transformers are grounded to the valve covers. Personal injury or death may result and the ignition system will be damaged if the valve covers are removed during engine operation. The engine will not operate without the valve covers.

For procedures on adjusting the valve bridge and the engine valve lash, refer to the following publications:

- Special Instruction, REHS0128, “Using the 147-5482 Indicator Gauge for Valve Lash and Valve Bridge Adjustment”
- The Systems Operation/Testing and Adjusting manual for the engine
- The Specifications manual for the engine

Consult your Caterpillar dealer for assistance.

Valve Bridge

Check the valve bridge and adjust the valve bridge, if necessary. Perform the procedure for both valve bridges for each cylinder.

After the valve bridge for each cylinder is satisfactory, measure the valve lash.

Engine Valve Lash

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. Improper valve lash may also lead to valve failure, and result in catastrophic failure.

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

Perform valve lash adjustment if the dimension is not within the tolerance. The valve bridge adjustment must be performed before making a valve lash adjustment.

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.

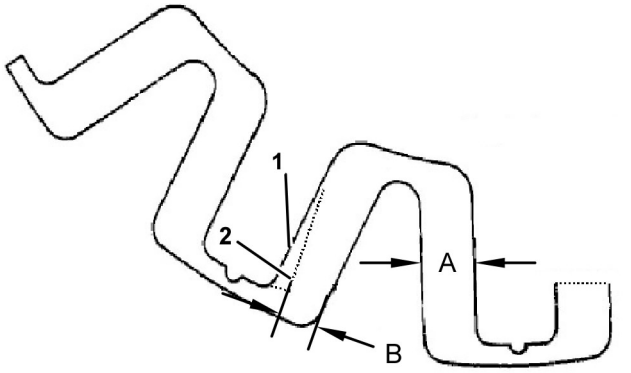
For further information, refer to Systems Operation Test and Adjust, “Valve Lash and Valve Bridge Adjustment”.

i03523641

Flexible Coupling - Inspect

SMCS Code: 3279-040

Coupling Boot Maintenance



g01232244

Illustration 65

(1) 5N-3272 Rubber Coupling Boot

(2) Wear step

(A) Thickness of a new boot

(B) Replacement thickness

Inspect boot (1) at a minimum of 1500 hour service intervals. Look for wear steps (2) in boot (1). A measurement of the wear step can also be taken at the same time. Use the results of the inspection to adjust the service interval.

Do not measure the wear step directly due to displaced rubber material. Measure the thickness at the highest point of wear. Refer to Table 17. Replace boot (1) when the boot is worn to thickness (B).

Table 17

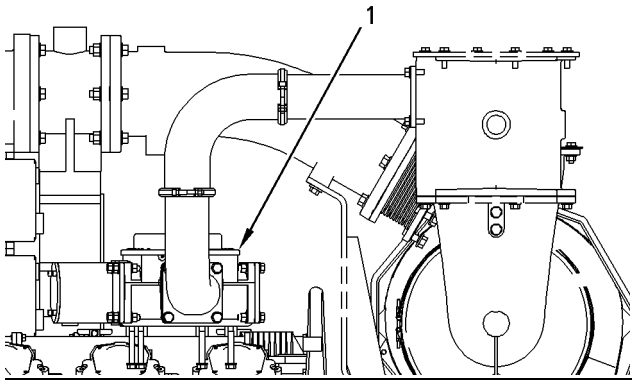
Dimensions for Usage of Boot (1)	
A	**B**
22.1 mm (0.870 inch)	14.1 mm (0.555 inch)(1)

(1) The boot must be replaced.

i01724567

Fuel Metering Valve - Check (Raptor)

SMCS Code: 1741-535



g00886284

Illustration 66

(1) Fuel metering valve

For information regarding the fuel metering valve, refer to Installation and Operation Manual, SEBU7630, “Raptor Gas Regulation and Metering Valve/Actuator System for Caterpillar”.

i01949940

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 rpm and at the rated load. Check the fuel filter differential pressure. Service the fuel filter when the fuel filter differential pressure reaches 1.7 kPa (0.25 psi).

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

i01857938

Fumes Disposal Filter - Drain

SMCS Code: 1074

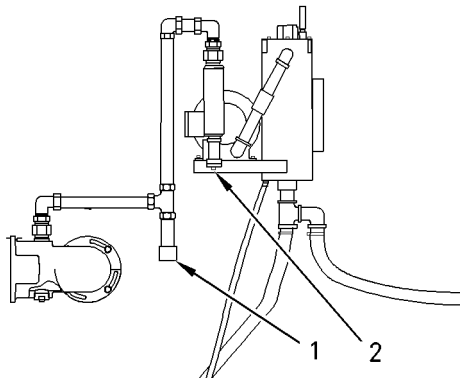
⚠ WARNING

Hot oil and components can cause personal injury.

Do not allow hot oil or components to contact skin.

Note: Always disconnect power to the fumes collector prior to servicing. The motor is protected by a thermal protector. If the motor is shut down due to excessive heat, the motor will automatically restart when the protector resets.

1. Shut down the engine and the fumes disposal filter.



g00947065

Illustration 67

(1) Drip leg
(2) Condensation trap drain valve

2. Open drip leg (1) and drain the fluid into a suitable container.

   If the filter is installed and maintained properly, no more than 28 g (1 ounce) of fluid will be drained.

   If more than one 28 g (1 ounce) is drained, make sure that the filter is installed according to the instructions in Special Instruction, REHS0883. Ensure that the system is operating properly.

3. Close the drip leg.

4. Open condensation trap drain valve (2) and drain the fluid into a suitable container.

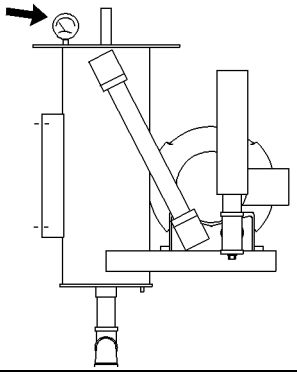
5. Close the condensation trap drain valve.

   Resume normal operation.

i01601766

Fumes Disposal Filter Differential Pressure - Check

SMCS Code: 1074



g00829797

Illustration 68

Pressure gauge on top of the filter

Check the differential pressure across the filter element. Observe the pressure that is indicated by the pressure gauge on top of the filter. Record the measurement.

The restriction of a new element is approximately 1.7 kPa (7 inches of H_2O).

The normal restriction of the element is approximately 5.7 to 9.95 kPa (23 to 40 inches of H_2O).

- Replace the filter element when the differential pressure reaches 11.2 kPa (45 inches of H_2O).
- Replace the element after every year regardless of the differential pressure.

i01749518

Fumes Disposal Filter Element - Replace

SMCS Code: 1074

⚠ WARNING

Hot oil and components can cause personal injury.

Do not allow hot oil or components to contact skin.

Note: Always disconnect power to the fumes collector prior to servicing. The motor is protected by a thermal protector. If the motor is shut down due to excessive heat, the motor will automatically restart when the protector resets.

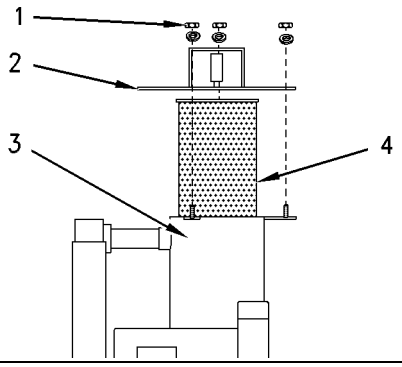


Illustration 69 g00763796

(1) Nuts and washers
(2) Cover
(3) Body
(4) Filter element

Note: The filter element is mounted above the engine. A ladder or a platform will be required for servicing the element.

1. Remove three nuts and washers (1) in order to remove cover (2) from body (3).
2. Remove element (4).
3. Clean the inside of cover (2) and body (3).
4. Install new element (4) into body (3).
5. Place cover (2) in position and install three nuts and washers (1).

i01950516

Gas Pressure Regulator Condensation - Drain

SMCS Code: 1270-543

To collect condensation, drip legs should be installed in the following locations:

- Supply line for the gas pressure regulator
- Balance line for the gas pressure regulator
- Supply line to the gas shutoff valve

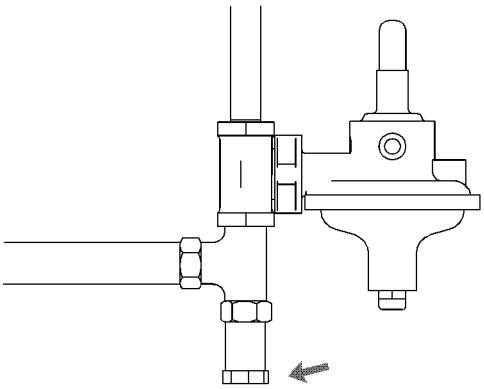


Illustration 70 g01014926

Cap on the drip leg for the gas supply line to the gas pressure regulator

1. Close the main gas supply valve.
2. Remove the caps from the drip legs.
3. Allow the moisture to drain into a suitable container. Inspect the drip legs for debris. Clean the drip legs, if necessary.
4. Clean the caps. Install the caps.
5. Open the main gas supply valve.

i03214248

Generator - Dry

SMCS Code: 4450-569

NOTICE
Do not operate the generator if the windings are wet. If the generator is operated when the windings are wet, damage can occur due to insulation breakdown.

⚠ WARNING

Personal injury or death can result from improper troubleshooting and repair procedures.

The following troubleshooting and repair procedures should only be performed by qualified personnel familiar with this equipment.

Refer to Safety Section, “Generator Isolating for Maintenance” for information regarding the procedure to safely isolate the generator.

When moisture is present or when moisture is suspected in a generator, the generator must be dried before being energized.

If the drying procedure does not restore the insulation resistance to an acceptable value, the winding should be reconditioned.

Drying Methods

The following methods can be used for drying a generator:

- Self-circulating air method
- Oven method
- Controlled current method
- Energize the optional space heaters.

NOTICE
Do not allow the winding temperature to exceed 85 °C (185.0 °F). Temperatures that are greater than 85 °C (185.0 °F) will damage the winding insulation.

Self-Circulating Air Method

Run the engine and disconnect the generator load. This will help circulate air. Operate the generator space heaters.

Oven Method

Place the entire generator inside a forced air drying oven for four hours at 65 °C (149 °F).

NOTICE
Use a forced air type oven rather than a radiant type oven.

Radiant type ovens can cause localized overheating.

Controlled Current Method

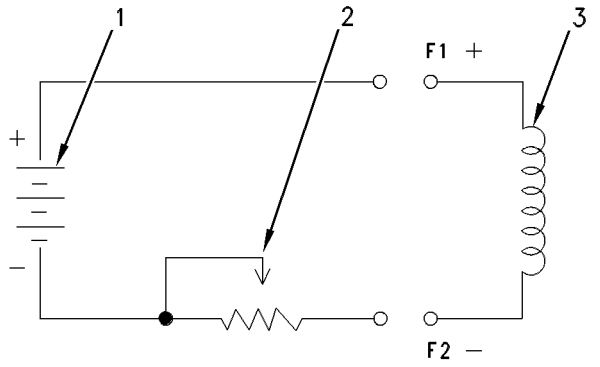


Illustration 71 g00614674

External Power Source Circuit

(1) Battery (12 VDC)
(2) Rheostat (15 ohm 25 watt)
(3) Exciter Field (Stator “L1”)

Table 18

TOOLS NEEDED		
Quantity	**Part Number**	**Description**
1	225-8266	Clamp-on ammeter (1200 amperes)
1		External power source circuit

Heat can be used in order to dry the generator windings. This heat can be created by allowing a controlled current to flow through the generator. No high voltages are generated during the following procedure. Therefore, insulation breakdown will not occur.

1. Make an external power source. Refer to Illustration 71.
2. Disconnect F1+ from the voltage regulator. Disconnect F2- from the voltage regulator. Disconnect the generator load. Connect the generator output leads T0, T1, T2, and T3 together. Install the clamp-on ammeter to generator output lead T1.

Note: When the line current is measured on multiple lead units, measure the current in each conductor per phase. The currents can then be added.

3. Refer to Illustration 71. Adjust the rheostat to the maximum resistance value. Connect the external power source to wires F1+ and F2-.
4. Start the generator set. Run the generator set at idle speed.

NOTICE
Do not exceed the rated phase current that is listed on the generator nameplate. Exceeding the rated phase current will easily damage the generator windings.

5. Monitor the phase current. In order to maintain use of the circuits for the protection of safety, use the control panel for the “EMCP 3” to gradually increase the engine rpm. Increase the engine rpm until one of the following conditions are met:
   - The rated phase current is obtained.
   - The full generator set speed is obtained.
6. If more phase current is necessary, slowly turn the rheostat. Turn the rheostat until the rated phase current is reached.
7. On an hourly basis, stop the drying procedure. Check the insulation resistance. Repeat the above steps until the insulation resistance is acceptable.

Guidelines for Space Heaters

1. Energize the space heaters when the generator is not operating.
2. Maintain the winding temperature at least 5 °C (9 °F) over the ambient temperature. In order to maintain the desired temperature in some conditions, a supplemental heat source or temporary covers may be required.
3. Check the insulation resistance until the resistance is acceptable.

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

i01880220

Generator - Inspect

SMCS Code: 4450-040

⚠ WARNING

Personal injury or death can result from improper troubleshooting and repair procedures.

The following troubleshooting and repair procedures should only be performed by qualified personnel familiar with this equipment.

⚠ 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.

Refer to Safety Section, “Generator Isolating for Maintenance” for information regarding the procedure to safely isolate the generator.

Proper maintenance of electrical equipment requires periodic visual examination of the generator and periodic visual examination of the windings. Proper maintenance of electrical equipment also requires appropriate electrical checks and appropriate thermal checks. Insulation material should be examined for cracks. The insulation material should be examined for accumulations of dirt and dust. If there is an insulation resistance value that is below normal, a conductive path may be present. This conductive path may be made of one of the following materials:

- Carbon
- Salt
- Metal dust
- Dirt that is saturated with moisture

These contaminants will develop a conductive path which may produce shorts. Cleaning is advisable if heavy accumulations of dirt can be seen or if heavy accumulations of dust can be seen. If excess dirt is the cause of a restriction in the ventilation, cleaning is also advisable. Restricted ventilation will cause excessive heating.

NOTICE
To avoid the possibility of deterioration to the generator windings, do not clean the generator unless there is visual, electrical, or thermal evidence that dirt is present.

If harmful dirt accumulations are present, a variety of cleaning techniques are available. The cleaning procedure that is used may be determined by one of the items on the following list:

- The extent of the cleaning procedure that is being attempted

- The type of enclosure of the generator
- The voltage rating of the generator
- The type of dirt that is being removed

Cleaning (Assembled Generators)

Cleaning may be required at the point of installation. At this point, complete disassembly of the generator may not be necessary or feasible. In this case, a vacuum cleaner should be used to pick up the following items: dry dirt, dust, and carbon. This will prevent the spreading of these contaminants.

A small nonconductive tube may need to be connected to the vacuum cleaner. This will allow the vacuum cleaner to clean the surfaces that are not exposed. After most of the dust has been removed, a small brush may be attached to the vacuum hose in order to loosen dirt that is more firmly attached to the surface.

After the initial cleaning with a vacuum, compressed air may be used to remove the remaining dust and dirt. Compressed air that is used for cleaning should be free of moisture and free of oil. Air pressure should be a maximum of 210 kPa (30 psi) in order to prevent mechanical damage to the insulation. If the above cleaning procedures are not effective, consult a Caterpillar dealer.

Cleaning (Disassembled Generators)

An initial insulation resistance check should be made on the generator in order to confirm electrical integrity. A minimum reading of one megohm would be expected with severely contaminated generators. A zero megohm reading may indicate an insulation breakdown. An insulation breakdown requires more than cleaning. An insulation breakdown requires repair.

A high pressure wash is normally an effective way to clean windings. This includes windings that have been exposed to flooding or windings that have been contaminated by salt. A solution of hot water and detergent is used for this method of cleaning.

A high pressure wash sprays a high velocity fluid stream of this solution over the generator that is being cleaned. This detergent washing is followed by multiple sprays of clean water. The clean water is used in order to remove the detergent or the clean water is used in order to dilute the detergent.

Allow the generator to dry at room temperature. Check the insulation resistance. The insulation resistance should now be normal. If the insulation resistance is not normal, repeat the procedure. It may be necessary to use solvents if the generator is contaminated with oil or if the generator is contaminated with grease.

Note: For more information on drying methods, refer to Special Instructions, SEHS9124, “Cleaning and Drying of Electric Set Generators”.

i03956351

Generator Bearing - Inspect

SMCS Code: 4471-040

The following maintenance procedure for generator bearings should be followed:

1. Remove the bearing bracket. Inspect the following items: bracket bore, bearing outer race, and rolling elements. On standby power units, the bearing must be inspected and the grease must be replaced at 3 yr intervals. The sleeve in the bearing bracket should be inspected for out of roundness, excessive wear, and a bracket step that is less than 0.0762 mm (0.0030 inch). If there is no sleeve in the bearing bracket, inspect the bore of the bearing bracket. The bearing should be inspected for damage to the outer race, severe fretting, and smoothness of operation. When possible, the bearing elements should be inspected. Some double shielded ball bearings prevent visual inspection of the elements of the bearing. Other double shielded ball bearings have a retaining ring. This retaining ring can be removed in order to allow access for a visual inspection of the elements of the bearing.

   On two-bearing generators, the front bearing can only be removed after the hub is removed. In order to remove the hub, cut off the hub with a saw. Do not use a torch to remove the hub. Do not pull on the hub. Pulling the hub will damage the shaft.

Note: Bearings that are being removed for failure analysis should not be cut off with a torch.

2. All ball bearings should be cleaned. The cavity in the bracket should be repacked with 2S-3230 Grease. Pack the ball bearings (one-third to one-half of the volume of the cavity). Refer to Table 19

To reinstall the ball bearings, use an induction heater to heat the ball bearings to 107 °C (224.6 °F) for 10 minutes. Mount the bearings on the shaft. To reinstall the hub, heat the hub to 400 °C (752.0 °F) for 3 hours. Mount the hub to the shaft.

3. Ensure that the tube of the grease gun is filled with grease.

4. Remove the bracket drain plug and operate the generator for 1 hour. Operating the generator will allow the grease to expand. The expanding grease will force the excess grease from the cavity. When the excess grease is forced from the cavity, the internal pressure will be reduced. The generator should continue to operate until the grease stops purging.

5. Stop the engine. Install the bracket drain plug. Wipe off the excess grease.

6. For greasing intervals, follow the recommendations on the lubrication plate (if equipped) or refer to Maintenance Schedule, “Bearing - Lubricate”. Whenever the bearings are greased, repeat Step 4. DO NOT MIX GREASES.

   For additional information, refer to Special Instructions, REHS 4892, “Generator Bearing Service”.

Table 19

Bearing Outside Diameter mm (inch)	Bearing Inside Diameter mm (inch)	Part Number	Generator Frame Size	Bearing Bore in Bracket mm (inch)	Bearing Shield (Type)	Bearing Cavity Grease mL (oz)	Rotor Shaft Diameter mm (inch)
225 mm (8.8582 inch)	105 mm (4.1338 inch)	6V-0410	680(1)	225.003 mm (8.8584 inch) to 225.034 mm (8.8596 inch)	Single	139.12 mL (4.7 oz) to 230.88 mL (7.8 oz)	105.029 mm (4.1350 inch) to 105.034 mm (4.1352 inch)
225 mm (8.8582 inch)	105 mm (4.1338 inch)	108-1760	680(1)	225.003 mm (8.8584 inch) to 225.034 mm (8.8596 inch)	Double	148.00 mL (5.0 oz) to 236.80 mL (8.0 oz)	105.029 mm (4.1350 inch) to 105.034 mm (4.1352 inch)
240 mm (9.4488 inch)	110 mm (4.3307 inch)	108-1761	690(1)	240.002 mm (9.4489 inch) to 240.033 mm (9.4501 inch)	Double	207.20 mL (7.0 oz) to 296.00 mL (10.0 oz)(2) 414.40 mL (14.0 oz) to 621.60 mL (21 oz)(3)	110.012 mm (4.3312 inch) to 110.028 mm (4.3318 inch)
240 mm (9.4488 inch)	110 mm (4.3307 inch)	6V-3310	800(1)	240.002 mm (9.4489 inch) to 240.033 mm (9.4501 inch)	Single	145.04 mL (4.9 oz) to 239.76 mL (8.1 oz)	110.012 mm (4.3312 inch) to 110.028 mm (4.3318 inch)
240 mm (9.4488 inch)	110 mm (4.3307 inch)	6V-6752	800(1)	240.002 mm (9.4489 inch) to 240.033 mm (9.4501 inch)	Single	145.04 mL (4.9 oz) to 239.76 mL (8.1 oz)	110.012 mm (4.3312 inch) to 110.028 mm (4.3318 inch)
240 mm (9.4488 inch)	110 mm (4.3307 inch)	108-1761	800(1)	240.002 mm (9.4489 inch) to 240.033 mm (9.4501 inch)	Double	148.00 mL (5.0 oz) to 236.80 mL (8.0 oz)	110.012 mm (4.3312 inch) to 110.028 mm (4.3318 inch)
280 mm (11.024 inch)	130 mm (5.1181 inch)	154-3032	820	280.002 mm (11.0237 inch) to 280.032 mm (11.0249 inch)	Double	N/A	130.028 mm (5.1192 inch) to 130.051 mm (5.1201 inch)

(1) Inboard bearing
(2) This bearing is on the same end as the exciter.
(3) This bearing is on the drive end of the generator.

i03840850

Generator Bearing - Lubricate

SMCS Code: 4471-086

Lubricating Process (If Applicable)

Note: If the generator already has a visible grease point, go to Step 4.

1. Remove either the louver assembly or the rear plate from the rear of the generator housing.
2. Remove the top grease pipe plug and remove the lower grease pipe plug.
3. Install a grease fitting in the grease pipe.
4. Grease the bearings with the appropriate grease from Table 20. Do not mix greases.

Table 20

Bearing Part Number	Bearing Type	Frame Size	Temperature Min/Max[1]	Grease Part Number	Interval	Weight	Volume	Shaft Diameter
108-1760 Ball Bearing	321 BC 225.0 mm (8.9 inch) OD 105.0 mm (4.1 inch) ID	680	−29 °C (−20.2 °F) minimum / 80 °C (176 °F) maximum	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	105.0 mm (4.1 inch)
108-1761 Ball Bearing	322 BC 240.0 mm (9.4 inch) OD 110.0 mm (4.3 inch) ID	690 / 800	−29 °C (−20.2 °F) / 80 °C (176 °F)	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	110.0 mm (4.3 inch)
139-0349 Roller Bearing	Roller	2900 / 2800	−40 °C (−40 °F) / 80 °C (176 °F)	Mobilith SHC220	Every 250 service hours	2.8 g (0.1 oz)	NA	127.0 mm (5.0 inch)
139-0350 Roller Bearing	Roller	2900 / 2800	−40 °C (−40 °F) / 80 °C (176 °F)	Mobilith SHC220	Every 250 service hours	2.8 g (0.1 oz)	NA	127.0 mm (5.0 inch)
154-3032 Ball Bearing	326 BC 280.0 mm (11.0 inch) OD 130.0 mm (5.1 inch) ID	820 / 2600 / 2700	−29 °C (−20.2 °F) / 80 °C (176 °F)	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	130.0 mm (5.1 inch)
241-4644 Bearing	320 BC 215.0 mm (8.5 inch) OD 100.0 mm (3.9 inch) ID	LC7	−29 °C (−20.2 °F) / 60 °C (140 °F)[2]	UNIREX N3	Every 4500 service hours or 12 months	60 g (2.1 oz)	NA	100.0 mm (3.9 inch)
243-5220 Bearing	315 BB 160.0 mm (6.3 inch) OD 75.0 mm (3.0 inch) ID	LC6100 / LC5000	−29 °C (−20.2 °F) / 60 °C (140 °F)[2]	UNIREX N3	Non-regreasable bearing[3]	Non-regreasable bearing	Non-regreasable bearing	75.0 mm (3.0 inch)
261-3545 Bearing	307 BB 80.0 mm (3.1 inch) OD 35.0 mm (1.4 inch) ID	LC2000	−29 °C (−20.2 °F) / 50 °C (122 °F)[2]	UNIREX N3	Non-regreasable bearing[3]	Non-regreasable bearing	Non-regreasable bearing	35.0 mm (1.4 inch)

(continued)

(Table 20, contd)

Bearing Part Number	Bearing Type	Frame Size	Temperature Min/Max[1]	Grease Part Number	Interval	Weight	Volume	Shaft Diameter
262-5921 Bearing	307 BC 80.0 mm (3.1 inch) OD 35.0 mm (1.4 inch) ID	LC2000	−29 °C (−20.2 °F) / 60 °C (140 °F)[2]	UNIREX N3	Non-regreasable bearing[3]	Non-regreasable bearing	Non-regreasable bearing	35.0 mm (1.4 inch)
263-0161 Bearing	309 BC 100.0 mm (3.9 inch) OD 45.0 mm (1.8 inch)	LC3000	−29 °C (−20.2 °F) / 60 °C (140 °F)[2]	UNIREX N3	Non-regreasable bearing[3]	Non-regreasable bearing	Non-regreasable bearing	45.0 mm (1.8 inch)
5P-2448 Ball Bearing	315 BC 160.0 mm (6.3 inch) OD 75.0 mm (3.0 inch) ID	580 / 590	−29 °C (−20.2 °F) / 80 °C (176 °F)	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	75.0 mm (3.0 inch)
6Y-3955 Ball Bearing	220 BC 180.0 mm (7.1 inch) OD 100.0 mm (3.9 inch) ID	450	−29 °C (−20.2 °F) / 80 °C (176 °F)	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	100.0 mm (3.9 inch)
6Y-6488 Ball Bearing	318 BC 190.0 mm (7.5 inch) OD 90.0 mm (3.5 inch)	597	−29 °C (−20.2 °F) / 80 °C (176 °F)	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	90.0 mm (3.5 inch)
311-0843 Ball Bearing	326 BC 280.0 mm (11.0 inch) OD 130.0 mm (5.1 inch) ID	1800 FR	−40 °C (−40 °F) / 80 °C (176 °F)	EA6	Non-regreasable bearing[1]	Non-regreasable bearing	Non-regreasable bearing	130.0 mm (5.1 inch)
311-0844 Ball Bearing	322 BC 240.0 mm (9.4 inch) OD 110.0 mm (4.3 inch) ID	1600 FR	−40 °C (−40 °F) / 80 °C (176 °F)	EA6	Non-regreasable bearing[1]	Non-regreasable bearing	Non-regreasable bearing	110.0 mm (4.3 inch)
253-9789 Bearing	320 BC 215.0 mm (8.5 inch) OD 100.0 mm (3.9 inch) ID	1400 FR	−29 °C (−20.2 °F) / 80 °C (176 °F)	UNIREX N3	Non-regreasable bearing[1]	Non-regreasable bearing	Non-regreasable bearing	100.0 mm (3.9 inch)

(continued)

(Table 20, contd)

Bearing Part Number	Bearing Type	Frame Size	Temperature Min/Max[1]	Grease Part Number	Interval	Weight	Volume	Shaft Diameter
193-4070 Ball Bearing	018 BC 140.0 mm (5.5 inch) OD 90.0 mm (3.5 inch) ID	498/499	−29 °C (−20.2 °F) / 80 °C (176 °F)	2S-3230 Bearing Lubricant	Every 2000 service hours or 12 months	51.2 g (1.8 oz)	59 mL (2 oz)	90.0 mm (3.5 inch)

(1) This temperature is for a generator set that is equipped with a resistive temperature detector (RTD).
(2) Do not exceed 60 °C (140 °F) above the ambient temperature.
(3) This bearing cannot be greased. Refer to this Operation and Maintenance Manual, “Generator Bearing - Replace” article for information concerning the replacement of these bearings.
(2) Do not exceed 50 °C (122 °F) above the ambient temperature.

5. Wipe off the excess grease. Remove the top grease fitting. Install the plug.

6. Operate the generator for one hour. This will allow the grease to expand. The expanding grease will force the excess grease from the cavity. When the excess grease is forced from the cavity, the internal pressure will be reduced. The generator should continue to operate until the grease stops purging.

7. Stop the engine. Install the plug in the bottom grease pipe. Wipe off the excess grease.

8. Install the louver assembly or install the rear plate.

i03873412

Generator Bearing Temperature - Test/Record

SMCS Code: 4471-081-TA

The monitoring of bearing temperature may prevent premature bearing failure. A generator set should never operate above the recommended set points. Keep records in order to monitor the changes in the temperature of the bearing.

Note: Measure the bearing temperature after the generator reaches normal operating temperature.

Resistive Temperature Detectors (RTDs)

Caterpillar Generators may be equipped with resistance temperature detectors for generator bearings. These detectors are 100 ohm resistance temperature detectors. A resistance temperature detector may be monitored by equipment that is provided by the customer. Consult with your Caterpillar dealer about other methods of measuring the bearing temperature.

Infrared Thermometers

Bearing temperatures can also be recorded with the use of an infrared thermometer. Refer to Special Publication, NENG2500, “Caterpillar Dealer Service Tools Catalog” for a variety of infrared thermometers. Follow the instructions that come with your infrared thermometer.

i03642825

Generator Load - Check

SMCS Code: 4450-535-LA

During normal operation, monitor the power factor and monitor generator loading.

When a generator is installed or when a generator is reconnected, ensure that the total current in any one phase does not exceed the nameplate rating. Each phase should carry the same load. This allows the generator to work at the rated capacity. If one phase current exceeds the nameplate amperage, an electrical imbalance will occur. An electrical imbalance can result in an electrical overload and an electrical imbalance can result in overheating.

The power factor can be referred to as the efficiency of the load. This can be expressed as the ratio of kVA to actual kW. The power factor can be calculated by dividing kW by kVA. Power factor is expressed as a decimal. Power factor is used to mean the portion of current that is supplied to a system that is doing useful work. The portion of the current that is not doing useful work is absorbed in maintaining the magnetic field in motors. This current (reactive load) can be maintained without engine power.

Generator sets normally have a low idle setting that is higher than industrial engines. Low idle will be approximately 66 percent of the full speed that is achieved by 60 Hz units. This would be equal to 80 percent of the full speed that is achieved by 50 Hz units.

Some generator sets are equipped with Woodward governors and some generator sets are equipped with Caterpillar electronic governors. These generator sets have no low idle stop. On generator sets with mechanical governors and generators that are natural gas, the low idle is set at the factory. Adjustment of the low idle on these machines should only be done by a Caterpillar dealer.

Note: Operating the generator set at low idle speed for an extended time will cause some voltage regulators to shut off. The generator set must be completely shut down and the generator set must be restarted. This will allow the voltage regulator to again produce an output.

i01754617

Generator Set - Test

SMCS Code: 4450-081

⚠ WARNING

Personal injury or death can result from high voltage.

When power generation equipment must be in operation to make tests and/or adjustments, high voltage and current are present.

Improper test equipment can fail and present a high voltage shock hazard to its user.

Make sure the testing equipment is designed for and correctly operated for high voltage and current tests being made.

When servicing or repairing electric power generation equipment:

- **Make sure the unit is off-line (disconnected from utility and/or other generators power service), and either locked out or tagged DO NOT OPERATE.**
- **Make sure the generator engine is stopped.**
- **Make sure all batteries are disconnected.**
- **Make sure all capacitors are discharged.**

Table 21

Tools Needed[1]		
Part Number	**Part**	**Quantity**
6V-7070	Digital Multimeter	1
146-4080	Digital Multimeter	1
9U7330	Digital Multimeter	1

(1) Any one of these multimeters may be used.

The generator set functional test is a simplified test that can be performed in order to determine if the generator is functional. The generator set functional test should be performed on a generator set that is not under load. The generator set functional test determines if the generator is operating at expected voltage and frequency levels. Perform this test at the regulator and terminal strips. Do not perform this test at the output connections.

The generator set functional test consists of the following steps:

1. Stop the generator. Remove the panels in order to allow access to the regulator and control terminal strips. Determine the part number for the regulator. Record the sensing voltage of the regulator. The sensing voltage is 120 V ± 3%, 240 V ± 3%, or 480 V ± 3%. If the multimeter has the capability, also record the frequency.
2. Verify that the generator set is ready to start. Start the generator set and bring the generator set to rated speed. Measure the sensing voltage with the multimeter on terminals 20-22, 22-24, and 20-24. If these voltages match the sensing voltage of the regulator and if these voltages are nearly equal, then the output of the generator at the bus bar should be the correct value.
3. If the voltages do not match the sensing voltage of the regulator, see the service manual for the regulator for further troubleshooting instructions.

i03112463

Generator Set Vibration - Inspect

SMCS Code: 4450-040-VI

Check for vibration damage. Vibration may cause the following problems:

- Loose fittings
- Loose belts

- Excessive noise
- Cracked insulation

The following areas are susceptible to vibration damage:

- Stator output leads
- Protective sleeving
- Insulation
- Exposed electrical connections
- Transformers
- Fuses
- Capacitors
- Lightning arresters

When a generator set is installed a vibration plot should be recorded in order to assist in diagnosing potential problems. This vibration plot should be updated yearly. The vibration plot should also be updated when the generator set is moved. Refer to Data Sheet, LEKQ4023, “Linear Vibration” for the allowable limits of vibration.

Contact the Caterpillar Dealer Service Tools group for information on ordering a vibration analyzer that will meet your needs.

i03847809

Hoses and Clamps - Inspect/Replace

SMCS Code: 7554-040; 7554-510

Hoses and clamps must be inspected periodically in order to ensure safe operation and continuous operation of the engine. Take proper safety precautions before inspecting or replacing hoses and clamps.

Note: Always use a board or cardboard when the engine components are checked for leaks. Leaking fluid that is under pressure can cause serious injury or possible death. This includes leaks that are the size of a pin hole. Refer to Operation and Maintenance Manual, “General Hazard Information” for more information.

Inspect the Hoses and the Clamps

Inspect all hoses for leaks that are caused by the following conditions. Replace any hose which exhibits any of the following conditions. Failure to replace a hose which exhibits any of the following conditions may result in a hazardous situation.

- Hoses which are cracked
- Hoses which are soft
- 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
- Hoses which exhibit signs of leakage which are not the result of loose couplings or clamps

Inspect all clamps for the following conditions. Replace any clamp which exhibits signs of any of the following conditions.

- Cracking
- Looseness
- Damage

Inspect all couplings for leaks. Replace any coupling which exhibits signs of leaks.

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

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.

Replace hoses that are cracked or soft. Replace hoses that show signs of leakage. Replace hoses that show signs of damage. Replace hose clamps that are cracked or damaged. Tighten or replace hose clamps which are loose.

Replace the Hoses and the Clamps

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” or refer to Special Publication, PECJ0003, “Caterpillar Shop Supplies and Tools Catalog” for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

Cooling System

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.

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. Stop the engine.
2. Allow the engine to cool.
3. Before servicing a coolant hose, slowly loosen the filler cap for the cooling system in order to relieve any pressure.
4. Remove the filler cap for the cooling system.
5. Drain the coolant from the cooling system to a level that is below the hose that is being replaced. Drain the coolant into a suitable clean container. The coolant can be reused.
6. Remove the hose clamps.
7. Disconnect the old hose.
8. Replace the old hose with a new hose.
9. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, “Torque Specifications”, “Hose Clamps” for information about selecting and installing the proper hose clamps.
10. Refill the cooling system.
11. Clean the filler cap for the cooling system. Inspect the gaskets on the filler cap. Replace the filler cap if the gaskets are damaged. Install the filler cap.
12. Start the engine. Inspect the cooling system for leaks.

Fuel System

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.

WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

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.

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

Note: High pressure fuel lines may be installed between the high pressure fuel pump and the fuel injectors. High pressure fuel lines are constantly charged with high pressure. Do not check the high pressure fuel lines with the engine or the starting motor in operation. Wait for 10 minutes after the engine stops before you perform any service or repair on high pressure fuel lines in order to allow pressure to be purged.

1. Drain the fuel from the fuel system to a level that is below the hose that is being replaced.
2. Remove the hose clamps.
3. Disconnect the old hose.
4. Replace the old hose with a new hose.
5. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, “Torque Specifications”, “Hose Clamps” for information about selecting and installing the proper hose clamps.
6. Carefully inspect the engine for any spilled fuel. Make sure that no fuel remains on or close to the engine.

Note: Fuel must be added to the fuel system ahead of the fuel filter.

7. Refill the fuel system. Refer to this Operation and Maintenance Manual, “Fuel System - Prime” for information about priming the engine with fuel.
8. Start the engine. Inspect the fuel system for leaks.

Lubrication System

⚠ WARNING

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

1. Drain the oil from the lubrication system to a level that is below the hose that is being replaced.
2. Remove the hose clamps.
3. Disconnect the old hose.
4. Replace the old hose with a new hose.
5. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, “Torque Specifications”, “Hose Clamps” for information about selecting and installing the proper hose clamps.
6. Refill the lubrication system. Refer to this Operation and Maintenance Manual, “Engine Oil Level - Check” in order to ensure that the lubrication system is filled with the proper amount of engine oil.
7. Start the engine. Inspect the lubrication system for leaks.

Air System

1. Remove the hose clamps.
2. Disconnect the old hose.
3. Replace the old hose with a new hose.
4. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, “Torque Specifications”, “Hose Clamps” for information about selecting and installing the proper hose clamps.
5. Start the engine. Inspect the air lines for leaks.

i02896855

Ignition System Spark Plugs - Inspect/Replace (Spark Plugs with Adjustable Electrode Gaps)

SMCS Code: 1555-535

S/N: GZA1-Up

S/N: GZB1-Up

S/N: GZC1-Up

S/N: GZJ1-Up

S/N: GZK1-Up

S/N: LGS1-Up

S/N: MAD1-Up; JBX1-Up

S/N: HAT1-Up; JBZ1-Up

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, operation with leaner lean air/fuel ratios, a higher compression ratio, and retarding of ignition timing. Higher voltage reduces the service life of components such as spark plugs, wires, and transformers.

The service life of spark plugs in applications with low BTU can be affected by the conditions that are listed above and by fuel related impacts. The poor ignitability of low BTU fuels causes high voltage to fire the plug. Silicon fuel contaminants that are found in gas with low BTU can cause fouling of the spark plug due to deposits.

Removing the Spark Plug

⚠ WARNING

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

Do not attempt to remove the valve covers when the engine is operating. The transformers are grounded to the valve covers. Personal injury or death may result and the ignition system will be damaged if the valve covers are removed during engine operation. The engine will not operate without the valve covers.

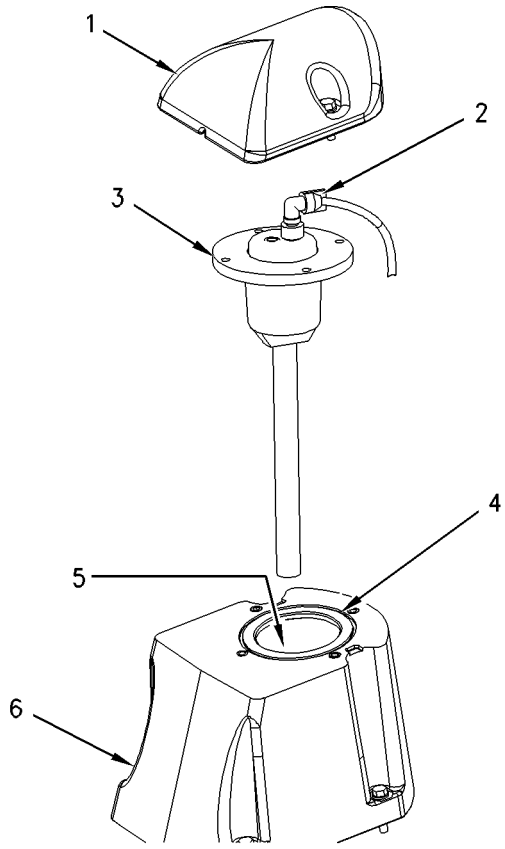


Illustration 72 g00925913

(1) Cover
(2) Wiring harness
(3) Transformer
(4) Seal
(5) Spark plug
(6) Valve cover

1. Remove cover (1).
2. Remove wire harness (2) from transformer (3).
3. Remove the two remaining bolts that secure transformer (3). Remove the transformer from valve cover (6).
4. Inspect O-ring seal (4). If the seal is hard, cracked, or melted, install a new seal.

⚠ WARNING

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

Note: Excessive buildup of oil in the spark plug well is an indication of a damaged lip seal on the transformer.

5. 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.

6. Use a 4C-4601 deep well socket, an extension, and a breaker bar to loosen spark plug (5). After the spark plug has been loosened, use the socket and extension to 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.

If the spark plug resists removal by hand, apply penetrating oil to the threads. To help the oil penetrate the threads, turn the spark plug back and forth until the spark plug is loose.

If the spark plug cannot be removed by hand, clean the threads with 9U-7511 Spark Plug Seat Cleaner. This tool scrapes debris from the seat and from the threads in the cylinder head. Be sure to clean any debris from the cylinder.

NOTICE
Do not use a thread tap. A thread tap will remove metal unnecessarily. The threads could be stripped and the cylinder head could be damaged.

Inspecting the Spark Plug

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

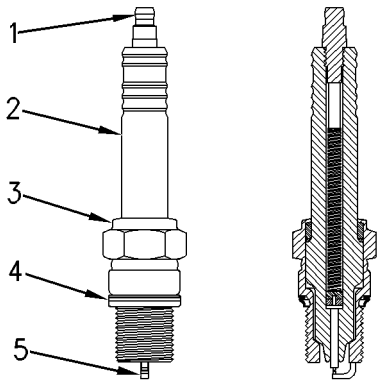


Illustration 73 g00838300

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

Terminal post (1) must not move. If the terminal post can be moved by hand, carefully tighten the post into the threads of the insulator. If the post cannot be tightened, 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 potential 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 yield the metal which loosens the shell. Discard any spark plug that has a shell that is cracked or loose.

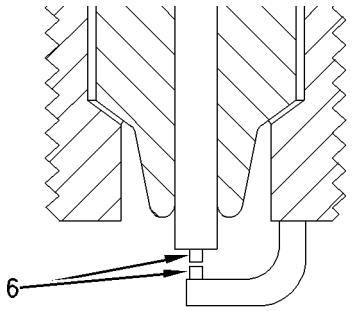


Illustration 74 g00787372

(6) Precious metal tips on the electrode and the ground strap

Caterpillar spark plugs have precious metal tips (6) on the electrode and the ground strap. This material will gradually erode. Use extreme care when you set the electrode gap. Maintain even spacing and proper alignment between the two precious metal surfaces.

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

A light brown deposit or a beige deposit around the electrode is produced by normal operation.

Deposits that are gray or black 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
- Poor combustion because of a rich air/fuel mixture

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.
- Only use glass beads on the electrode and the insulator near the electrode.
- Do not use glass beads on any other area of the spark plug.
- Clean the rest of the spark plug with nonflammable solvent.

Installing the Spark Plug

Note: Use the 9U-7516 Spark Plug Gauge to measure the electrode gap. Do not use a flat feeler gauge for measuring the electrode gap of used spark plugs. A feeler gauge will incorrectly measure the actual electrode gap because the used precious metal tips are curved.

1. Before installing the spark plug, set the electrode gap according to the engine's Specifications manual.

   Adjust the electrode gap, if necessary. Bend the ground strap at the existing bend. Then bend the strap near the weld in order to achieve proper alignment and even spacing between the two 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. Contact of the metal surfaces must be maintained 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 9Y-6792 Spark Plug Gasket on the spark plug. Orient the tabs of the gasket toward the spark plug's electrode gap. 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 according to the engine's Specifications manual.
5. Ensure that the transformer and the extension are clean and free from dirt and oil. Lubricate O-ring seal (4) (Illustration 72) with one of the following lubricants:
   - 4C-9504 Dielectric Grease
   - 5N-5561 Silicone Lubricant
   - 8T-9020 Dielectric Grease
6. Install the transformer. Orient the transformer toward the wiring harness. Carefully align the socket of the transformer with the wiring harness connector. Connect the wiring harness.
7. Install the valve cover.

i02896755

Ignition System Spark Plugs - Replace

SMCS Code: 1555-510

S/N: GSB1-Up

S/N: GZG1-Up

S/N: GZH1-Up

S/N: GZL1-Up

S/N: GZM1-Up

S/N: GZN1-Up

S/N: RLP1-Up

S/N: GAS1-Up

S/N: GZZ1-Up

S/N: TJB1-Up; RWA1-Up

S/N: CWY1-Up; GDB1-Up

S/N: B9P1-Up; GHC1-Up

S/N: SSR1-Up; GHD1-Up

S/N: CWW1-Up; GHE1-Up

S/N: GTX1-Up; GHF1-Up

S/N: SXY1-Up; GHM1-Up

S/N: NGS1-Up; GYM1-Up

S/N: SLY1-Up; GHP1-Up

S/N: TJC1-Up; DKR1-Up

S/N: HAL1-Up; GHR1-Up

Note: Condensation can form in spark plugs that have precombustion chambers. This can cause difficulty for cold start-ups. To avoid condensation, maintain the coolant in the cylinder block at a minimum temperature of 43 °C (110 °F) continuously.

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, leaner air to fuel operation, a higher compression ratio, and retardation of the timing. Higher voltage reduces the service life of components such as spark plugs, wires, and transformers.

The service life of the spark plug is different for different applications. The expected service life of the spark plug is approximately 3000 service hours for an engine that is running on pipeline natural gas at standard performance sheet settings and conditions. To help predict the spark plug's service life, use Caterpillar Electronic Technician (ET) to monitor the “Cylinder #X Transformer Secondary Output Voltage Percentage” parameter. The value of this parameter will increase as the spark plug gap wears over time. Experience at the particular site will help to determine the proper interval for replacement of the spark plugs.

If a diagnostic code is generated for the ignition transformer's secondary circuit, the spark plug may need to be replaced. Misfire and a cold cylinder are other indications of a worn spark plug. Use Cat ET to monitor the exhaust port temperatures in order to locate a cold cylinder.

Removing the Spark Plug

⚠ WARNING

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

Do not attempt to remove the valve covers when the engine is operating. The transformers are grounded to the valve covers. Personal injury or death may result and the ignition system will be damaged if the valve covers are removed during engine operation. The engine will not operate without the valve covers.

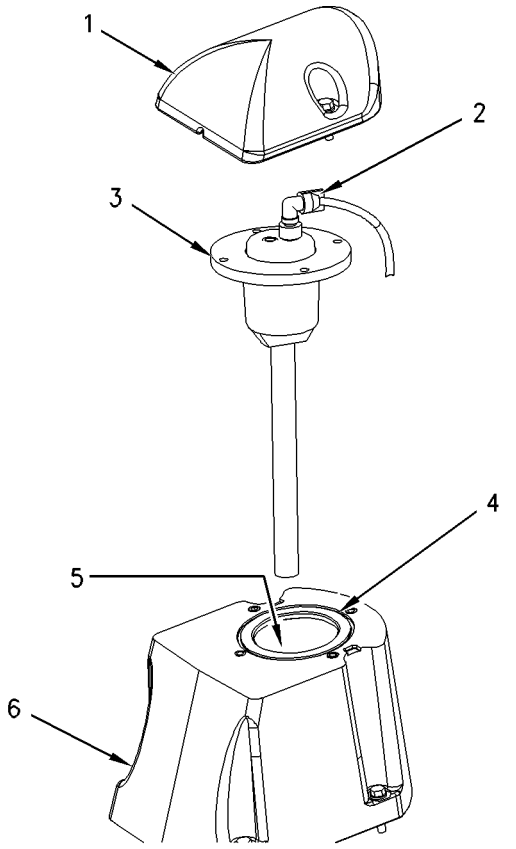


Illustration 75 g00925913

(1) Cover
(2) Wiring harness
(3) Transformer
(4) Seal
(5) Spark plug
(6) Valve cover

1. Remove cover (1).

2. Remove wire harness (2) from transformer (3).

3. Remove the two remaining bolts that secure transformer (3). Remove transformer (3) from valve cover (6).

4. Inspect O-ring seal (4). If the seal is hard, cracked, or melted, install a new seal.

⚠ WARNING

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

Note: Excessive buildup of oil in the spark plug well is an indication of a damaged lip seal on the transformer.

5. 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.

6. Use a 216-1685 deep well socket, an extension, and a breaker bar to loosen spark plug (5). After the spark plug has been loosened, use the socket and extension to 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.

If the spark plug resists removal by hand, apply penetrating oil to the threads. To help the oil penetrate the threads, turn the spark plug back and forth until the spark plug is loose.

If the spark plug could not be removed by hand, clean the threads with a Spark Plug Seat Cleaner. This tool scrapes debris from the seat and from the threads in the cylinder head. Be sure to clean any debris from the cylinder.

NOTICE
Do not use a thread tap. A thread tap will remove metal unnecessarily. The threads could be stripped and the cylinder head could be damaged.

Inspecting the Spark Plug

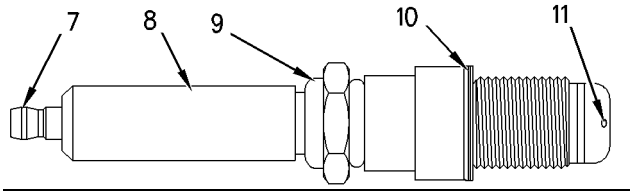


Illustration 76 g00935078

(7) Terminal post
(8) Insulator
(9) Shell
(10) Gasket
(11) Hole in the spark plug's precombustion chamber

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

Terminal post (7) must not move. If the terminal post can be moved by hand, carefully tighten the post into the threads of the insulator. If the post cannot be tightened, discard the spark plug.

Insulator (8) is covered with Teflon. If the cover is cracked or loose, discard the spark plug.

Faint marks may extend from shell (9) onto the insulator. The marks may be a result of a corona that forms at the top of the shell. The conductor will develop a corona when a very high voltage potential ionizes the air. This is a normal condition. This is not an indication of leakage between the shell and the insulator.

Inspect shell (9) for damage. Cracks can be caused by overtightening the spark plug. Overtightening can also yield the metal which loosens the shell. Discard any spark plug that has a shell that is cracked or loose.

Inspect the spark plug's precombustion chamber for deposits. Make sure that holes (11) in the spark plug's precombustion chamber are not blocked.

A light brown deposit or a beige deposit is produced by normal operation.

Deposits that are gray or black 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
- Poor combustion because of a rich air/fuel mixture

A spark plug can operate despite a buildup of ash. Large deposits may retain heat which can cause premature fuel ignition. This can lead to uncontrollable detonation.

Cleaning the Spark Plug

Do not use glass beads to clean the spark plug. The beads could enter the precombustion chamber through the holes. The beads could clog the holes in the spark plug's precombustion chamber.

Use a brass wire brush to clean the spark plug. Be careful not to damage the Teflon cover.

Installing the Spark Plug

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. Contact of the metal surfaces must be maintained in order to provide the heat transfer that is required.

1. Ensure that the spark plug is clean and free of dirt and oil.
2. Always use a new gasket when a spark plug is installed. If a used spark plug is installed, place a new gasket on the spark plug. Orient the tabs of the gasket toward the spark plug's precombustion chamber. 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.

3. Install spark plug (5) by hand until the spark plug contacts the gasket. Torque the spark plug to the proper specification. Refer to Specifications, “Spark Plug” for the proper torque specification.
4. Ensure that the transformer and the extension are clean and free from dirt and oil. Lubricate O-ring seal (4) with one of the following lubricants:
   - Dielectric Grease
   - Silicone Lubricant
5. Install transformer (3). Orient the transformer toward wiring harness (2). Connect the wiring harness.
6. Install cover (1).

i03460071

Ignition System Timing - Check/Adjust

SMCS Code: 1550-025; 1550-535

Ignition timing for gas engines varies with the gas chemistry. Obtain a fuel analysis in order to determine if the timing for the ignition system is correct. Enter the data from the fuel analysis into the Caterpillar Software Program, LEKQ6378, “Methane Number Program”. Alternatively, you may provide the results of a gas analysis to your Caterpillar dealer for assistance in determining the correct timing for your application.

Use the Caterpillar Electronic Technician (ET) to adjust the timing. Adjust the timing according to the instructions in Special Instruction, REHS1438, “Installation and Initial Start-Up Procedures for G3500C and G3500E Engines”. Consult your Caterpillar dealer for assistance.

i01935380

Inlet Air System - Inspect

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

Use of a platform may be necessary to inspect the following components of the air inlet system:

- Piping between the air cleaner and the turbocharger
- Rubber hoses in the air lines
- 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

Inspect the components for the following conditions:

- Cracks
- Leaks
- Loose connections
- Debris

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

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

i01689065

Insulation - Test

SMCS Code: 4453-081; 4454-081; 4457-081; 4470-081

Recommended Periodic Insulation Tests

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.

Note: The results from the insulation resistance checks indicate when cleaning and/or repairing is becoming critical. Generally, insulation resistance will vary greatly with temperature. Therefore, always test at the same temperature and humidity. Refer to Illustration 77.

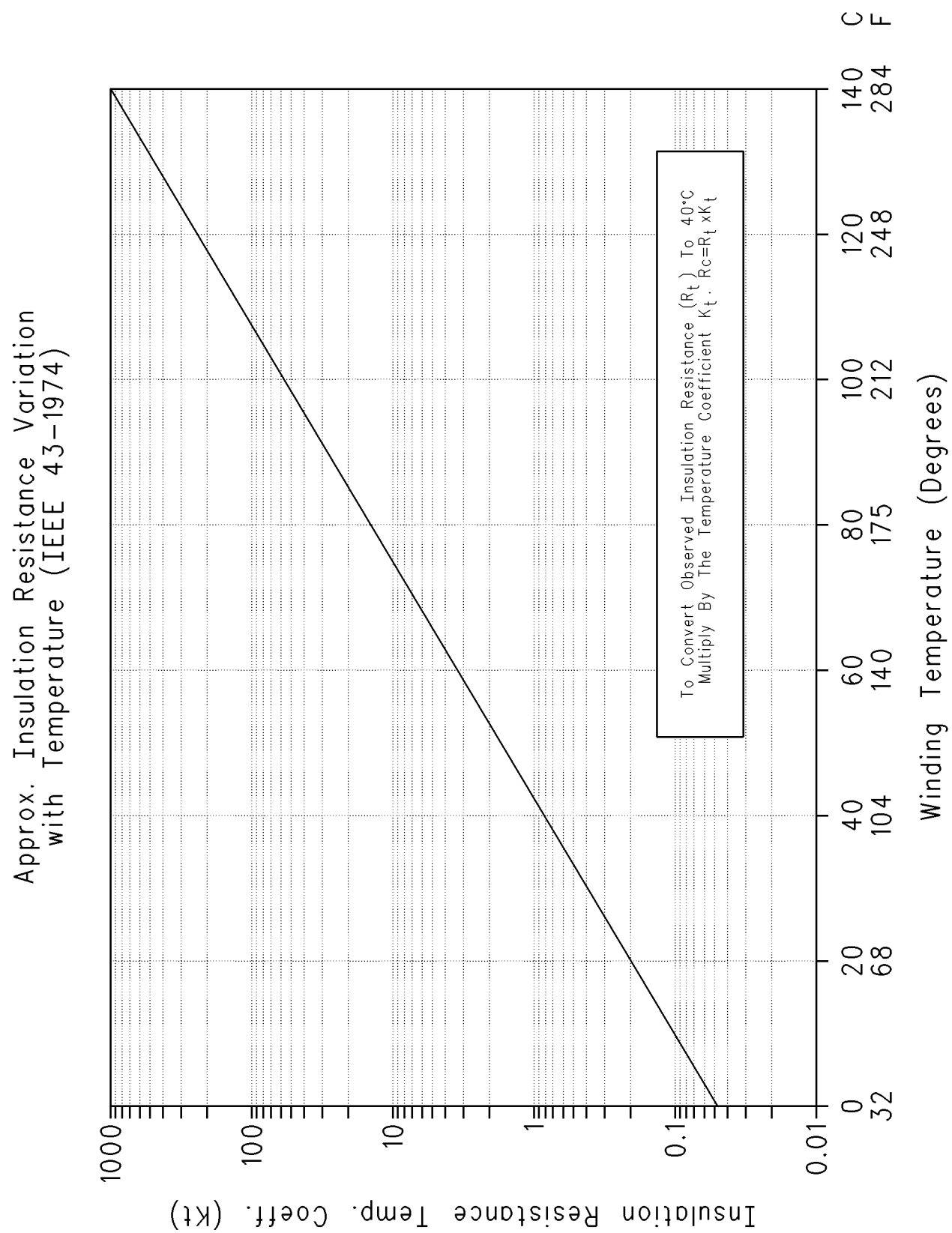


Illustration 77

g00633226

Periodically, use an insulation tester to check the insulation resistance of the generator's main stator winding. Caterpillar recommends the 142-5055 Insulation Testing Gp for testing the insulation resistance on Caterpillar generator sets. The frequency of this test is determined by the generator's environment. Previous insulation tester readings will also determine the frequency of this test.

Test the main stator windings with an insulation tester in the following situations:

- The generator set is started for the first time.
- The generator set is removed from storage.
- The generator set is operating in a humid environment. Test every three months.
- The generator set is not protected from the elements in an enclosed area. Test every three months.
- The generator set is installed in an enclosed area. This area needs to be low in humidity and this area needs to have steady temperatures. Test every twelve months (minimum).
- The generator set has not been run under load for three months. Test the generator set weekly.

For additional information, refer to Special Instruction, SEHS9124, “Cleaning and Drying of Electric Set Generators”.

Recommended Periodic Insulation Test Procedure

⚠ WARNING

Personal injury or death can result from electrocution.

The megohmmeter is applying a high voltage to the circuit.

To avoid electrocution, do not touch the instrument leads without first discharging them. When finished testing also discharge the generator windings.

1. Take the generator out of service.
2. Visually inspect the generator for moisture. If moisture exists, do not perform this insulation test. Dry the unit first. Refer to Special Instruction, SEHS9124, “Cleaning and Drying of Electric Set Generators”.
3. Inspect the installation. Determine the equipment that will be tested by the insulation tester.
4. Discharge the capacitance of the windings.
5. Disconnect “T0” from ground.
6. Disconnect the regulator sensing lead wires: “20”, “22”, and “24”.
7. Connect the insulation tester's RED lead to ground.
8. Connect the insulation tester's BLACK lead to “T0”.
9. For units that are 600 volts or less, set the voltage to 500 Volts. For units that are more than 600 volts, set the voltage to 1000 Volts.
10. Use the 30/60 Time Resistance Method:
    a. Apply voltage.
    b. Observe the readings at 30 seconds. Observe the readings at 60 seconds.
    c. Record the 60 second reading. This reading must be corrected for temperature.
    d. Record temperature.
    e. Record humidity.
    f. Remove voltage.
11. Evaluate the readings. The actual value of the resistance may vary greatly between generators. For this reason, the insulation's condition must be evaluated. Base this evaluation on the comparison between the 60 second resistance readings and the readings that were taken on previous dates. These two readings must be taken under similar conditions. If a 60 second resistance reading has a 50 percent reduction from the previous reading, the insulation may have absorbed too much moisture.

Switch the insulation tester to the “OFF” position. This will discharge the insulation tester's leads. Disconnect the insulation tester's leads.

Engine Serial Number_____

Generator Serial Number_____

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).

i02902446

Oil Temperature Regulators - Replace

SMCS Code: 1330

The oil temperature regulators divert the engine oil to the oil cooler in order to maintain engine oil temperature.

For instructions on replacing the oil temperature regulators, see the Service Manual, “Disassembly and Assembly” module.

i03460083

Overhaul (In-Frame)

SMCS Code: 1000-020

Scheduling an In-Frame Overhaul

Generally, an in-frame overhaul is performed for every third top end overhaul. Scheduling an in-frame overhaul normally depends on the following three conditions:

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

Each individual condition may not indicate a need for an overhaul. However, evaluating the three conditions together is the most accurate method of determining when an overhaul is necessary.

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

Periodically measure each of the three conditions. The first measurement should occur during the engine commissioning. This establishes a baseline for future measurements. Additional measurements are scheduled at regular intervals in order to determine a schedule for the next in-frame overhaul.

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.

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

Usually, an in-frame overhaul does not require removal of the engine. Instead, the service is performed with the engine in place. If the customer requires a minimum disruption in the production of power, the engine can be replaced with a rebuilt model of identical specifications.

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

In-Frame Overhaul Information

An in-frame overhaul includes all of the work that is done for a top end overhaul. Additionally, some other components that wear are replaced. The condition of components is inspected. Those components are replaced, if necessary.

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

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

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

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

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

If you elect to perform an overhaul without the services of a Caterpillar dealer, be aware of the recommendations in Table 22.

Table 22

In-Frame Overhaul	
Clean	Oil suction screen
Clean Inspect Test	Aftercooler core
Inspect Rebuild Replace	Compressor bypass valve
	Exhaust system (landfill)
	Fuel metering valve
	Oil cooler
	Oil pump
	Pistons
	Throttle
	Transformers and extenders
Rebuild	Prelube pump
	Starting motor
	Turbochargers
	Water pumps
Replace	Connecting rod bearings
	Cylinder head assemblies
	Cylinder liners
	Main bearings
	Piston rings
	Water temperature regulators

i03460103

Overhaul (Major)

SMCS Code: 7595-020-MJ

Scheduling a Major Overhaul

Generally, a major overhaul is performed for every fifth top end overhaul. The need for a major overhaul is determined by several factors. Some of those factors are the same factors that determine the in-frame overhaul:

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

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

- Power output

- The service hours of the engine
- Reduced oil pressure
- 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 generator or 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 and in-frame overhauls. 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. 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.

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 can be reconditioned in order to comply with reusability guidelines.

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

If you elect to perform an overhaul without the services of a Caterpillar dealer, be aware of the recommendations in Table 23. Your Caterpillar dealer can provide these services and components.

Table 23

Major Overhaul	
Clean	Oil suction screen
Clean Inspect Test	Aftercooler core
Inspect Rebuild Replace	Camshafts
	Camshaft followers
	Compressor bypass valve
	Connecting rods
	Crankshaft
	Exhaust system (landfill)
	Fuel metering valve
	Gear train
	Inlet air piping
	Oil cooler
	Oil pump
	Pistons
	Throttle valve
	Transformers and extenders
Rebuild	Prelube pump
	Starting motor
	Turbochargers
	Water pumps
	Vibration damper
Replace	Camshaft bearings
	Connecting rod bearings
	Coupling (tandem engines)
	Cylinder liners
	Gaskets and seals
	Gear train bushings
	Main bearings
	Piston rings
	Water temperature regulators
	Wiring harnesses

i03906477

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.

To determine a baseline, measure the projection of the exhaust valve stems after 100 to 250 service hours. The baseline is a reference for subsequent measurements. Continue to measure the projection periodically.

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 (.09 inch). Do not allow the projection of the exhaust valve stems to exceed this limit.

Note: Generally, cylinder heads wear out at different rates. In some cases, servicing the cylinder heads at different times may be the most economic decision. This decision depends on the valve stem projection of the individual cylinders. However, this decision must include the costs of additional downtime that is caused by this procedure. Perform an economic analysis in order to determine if cylinder heads should be serviced as a group or divided into smaller groups.

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

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.

- Build up in the cylinders from excessive oil consumption
- Build up 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 the hydrogen sulfide in the fuel
- Deterioration of exhaust manifold components

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 can be reconditioned in order to comply with reusability guidelines.

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

If you elect to perform an overhaul without the services of a Caterpillar dealer, be aware of the recommendations in Table 24. Your Caterpillar dealer can provide these services and components. Your Caterpillar dealer can ensure that the components are operating within the appropriate specifications.

Table 24

Top End Overhaul	
Clean	Oil suction screen
Clean Inspect Test	Aftercooler core Oil cooler core Exhaust manifolds
Inspect	Transformers Flexible coupling
Rebuild	Prelube pump
	Starting motor
	Turbochargers
	Water pumps
Replace	Cylinder head assemblies
	Spark plugs
	Water temperature regulators

Cleaning and Inspection of Components

Aftercooler and Oil Cooler

Clean the aftercooler core and the oil cooler core. Perform pressure tests on the components. Replace the components, if necessary.

Note: If the cooling system is not properly maintained, cleaning of the aftercooler can be difficult. The tank that is opposite of the inlet port and the outlet port cannot be removed for cleaning.

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

1. Remove the core.
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.

3. Back flush the core with cleaner.

   Caterpillar recommends the use of Hydrosolv liquid cleaner. Consult your Caterpillar dealer for part numbers and sizes of containers.

   Use a 2 to 5 percent concentration of the cleaner at temperatures up to 93°C (200°F).

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 (0.74 psi).

7. Inspect the core in order to ensure cleanliness. Perform a pressure test of the core. Many shops that service radiators are equipped to perform pressure tests. If necessary, repair the core.

8. Install the core.

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

Oil Suction Screen

⚠ WARNING

Hot oil and components can cause personal injury.

Do not allow hot oil or components to contact skin.

Clean the oil suction screen after the engine oil pan has been drained.

Note: Approximately 1 L (1 qt) of engine oil will remain in the housing after the sump has been drained. This engine oil will pour out of the housing when cover (1) is removed. Prepare to catch the engine oil in a pan. Clean up any spills with absorbent towels or pillows. DO NOT use absorbent particles.

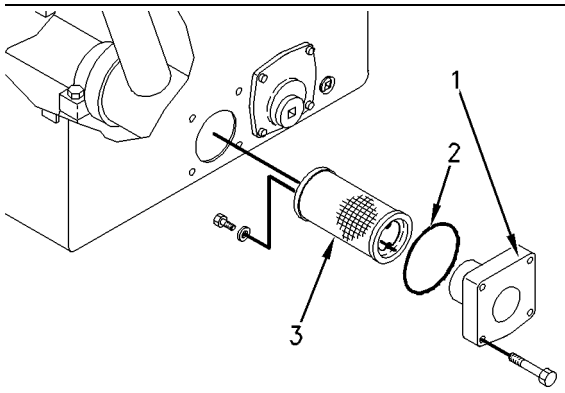


Illustration 78 g00760655

(1) Cover
(2) O-ring seal
(3) Screen assembly

1. Loosen the bolts from cover (1). Remove cover (1) and O-ring seal (2). Discard the seal. Remove screen assembly (3).

2. Wash screen assembly (3) in clean nonflammable solvent. Allow the screen assembly to dry before installation.

3. Clean the engine oil sump. Remove the side covers in order to gain access to the sump. After the sump is clean, install the side covers.

4. Inspect screen assembly (3) for good condition. Obtain a new screen assembly, if necessary. Install the screen assembly. Install a new O-ring seal (2). Install cover (1).

Transformers

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

- Damaged O-rings
- Dirty insulator
- Loose connections
- Loose connector
- Moisture

Measure the voltage of the diode for the primary circuit and measure the resistance of the secondary circuit according to Troubleshooting, “G3500C Engines”. Consult your Caterpillar dealer for assistance.

i01950926

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 the 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. In-frame overhauls are determined by cylinder compression, crankcase blowby, and oil consumption. Major overhauls are determined by the in-frame tests, and by 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 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.

i01216962

Power Factor - Check

SMCS Code: 4450-535-PWR

The power factor of a system can be determined by a power factor meter or by calculations. The power factor can be calculated by dividing kW by kVA. Power factor is expressed as a decimal.

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”.

i02246950

Rotating Rectifier - Check

SMCS Code: 4465-535

Check the exciter armature. Ensure that the rotating rectifier is tight. If a failure of a rectifier is suspected, proceed to the “Testing a Three-Diode Rectifier Block” section.

Testing a Three-Diode Rectifier Block

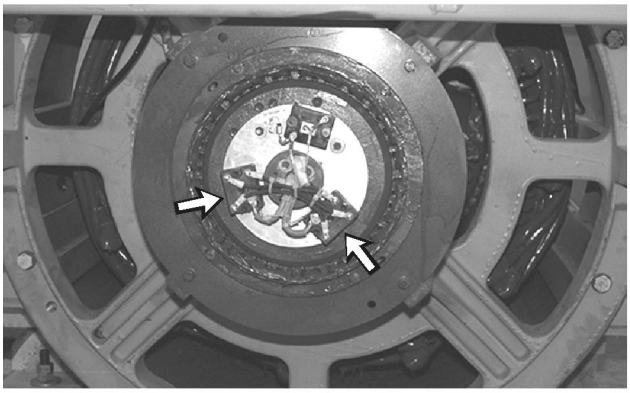


Illustration 79 g00610240

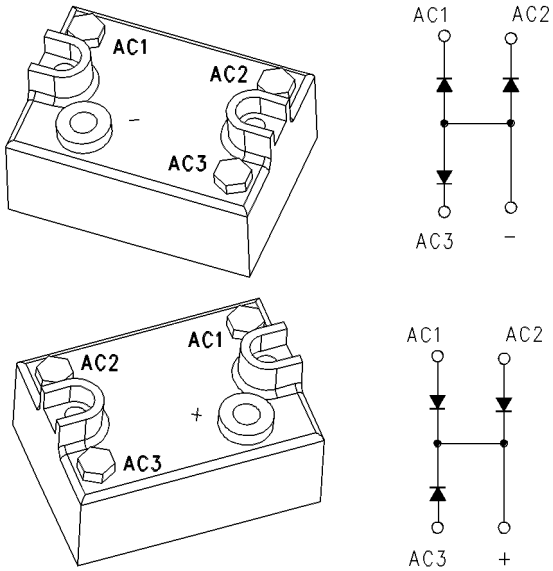


Illustration 80 g00613971

Three-Diode Rectifier Block (two pieces)

The following procedure tests all three diodes within a block. Check the positive rectifier block and the negative rectifier block. If any meter reading does not fall within the given ranges, replace the rectifier block.

1. Set the digital multimeter on the diode range. Remove all leads from the rectifier block.

2. To test the negative rectifier block, follow these steps:

   a. Place the red test lead on the negative “-” terminal. Place the black test lead on the following rectifier terminals: “AC1”(3), “AC2”(4), and “AC3”(5). All readings on the meter should be between 0.4 and 1.0.

   b. Place the black test lead on the negative “-” terminal. Place the red test lead on the following rectifier terminals: “AC1”(3), “AC2”(4), and “AC3”(5). In all cases, the meter should read “OL” (overload).

3. To test the positive rectifier block, follow these steps:

   a. Place the red test lead on the positive “+” rectifier terminal. Place the black test lead on the following rectifier terminals: “AC1”(3), “AC2”(4), and “AC3”(5). In all cases, the meter should read “OL” (overload).

   b. Place the black test lead on the positive “+” rectifier terminal. Place the red test lead on the following rectifier terminals: “AC1”(3), “AC2”(4), and “AC3”(5). All readings on the meter should be between 0.4 and 1.0.

Note: A shorted diode can cause damage to the exciter rotor. If a diode is shorted, check the exciter rotor. Refer to the Testing and Adjusting, “Winding - Test” and Testing and Adjusting, “Insulation - Test”. Perform these tests.

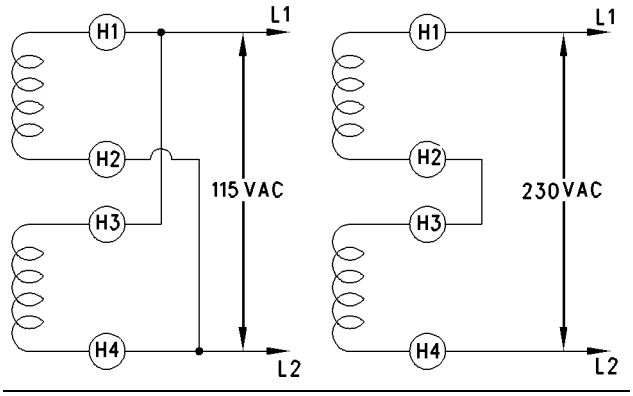
Note: This rectifier block also contains varistor “CR7”. “CR7” can be checked by measuring the resistance between the positive “+” rectifier terminal and the negative “-” rectifier terminal. The resistance should be a minimum of 15000.

i02985289

Space Heater - Check

SMCS Code: 4450-535-HTR

The space heater is attached to the rear bearing bracket. The space heater is located in the generator's exciter end.



g00610396

Illustration 81

Space Heater Connection Diagram

An SR5 generator can operate in high humidity conditions without problems. The humidity can be as high as 100% non-condensing humidity. However, problems can occur when the generator is idle and the surrounding air is warmer than the generator. Moisture can form on the windings. Moisture will result in poor performance or even damage to the windings. Whenever the generator is not active, the optional space heaters should be operated.

An external source is required to operate the space heaters. Both of the sources must be a single phase. This source can be either 115 vac or 230 vac. When the external source is 50 hertz, 200 vac must be used. Refer to Illustration 81.

See your Caterpillar dealer for information on checking your Caterpillar generator.

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.

i03230840

Stator Lead - Check

SMCS Code: 4459-535

Ensure that the stator output leads are routed out of the generator in a manner that prevents the leads from rubbing against metal objects.

Visually inspect the following areas for cracking and physical damage:

- stator output leads
- protective sleeving
- insulation

i02514961

Stator Winding Temperature - Measure/Record

SMCS Code: 4453-082-TA

Some generators are provided with optional 100 Ohm Resistance Temperature Detectors (RTD). When the temperature of the stator winding is suspected to be high, measure the temperature. If the generator is furnished with Resistance Temperature Detectors, the detectors are installed in the slots of the main armature (stator). The detectors are used with equipment that is available from the factory. This equipment is used in order to measure the main armature's winding temperature.

i02293325

Throttle Control Valve - Check

SMCS Code: 1269-535

If a decrease in performance is observed or if the Engine Control Module signals that there is a problem with the manifold pressure, check the throttle.

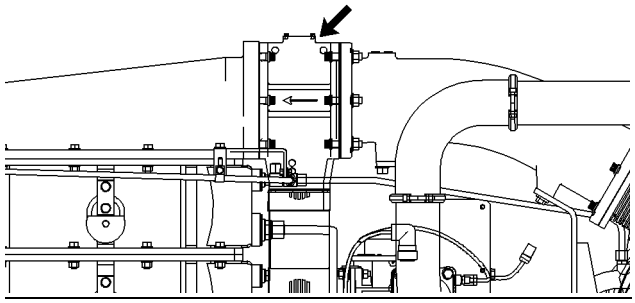


Illustration 82 g01007524

Check the throttle for leaks. If necessary, remove the throttle according to the instructions in the Disassembly and Assembly manual. Inspect the throat of the throttle for wear marks. Check for free movement of the butterfly valve.

Inspect the gaskets for wear or damage. If necessary, replace the gaskets. Reinstall the throttle according to the instructions in the Disassembly and Assembly manual.

i03909633

Turbocharger - Inspect

SMCS Code: 1052-040

Periodic inspection and cleaning are 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 which could damage engine components.

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 information regarding removal and installation, see the Disassembly and Assembly manual or consult your Caterpillar dealer. For information about repair of the turbocharger or about replacement of the turbocharger, 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. Inspect the compressor wheel for damage or bent blades. Do not attempt to repair the damaged blades. Replace the cartridge or turbocharger if the blades are damaged.

3. Check the compressor wheel for cleanliness. If only the inlet 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 result from restriction of the inlet air (plugged air filters). This causes oil to leak past the seal for the turbocharger compressor.

   A restriction in the oil drain tube may result in an oil leak. Remove and inspect the oil drain tube for restrictions.

   If oil is found on the compressor wheel and/or at the air inlet, the source is the fuel compressor or the PCV system.

Note: Deposits of ash and silicone can accumulate on the turbine wheel. Turbine wheel will become unbalanced when the deposits flake off. The turbocharger cartridge must be replaced when the turbine wheel becomes unbalanced. However, removing deposits from the housing will prevent wear on the blades of the new turbine wheel.

4. Inspect the turbine wheel and the nozzle for deposits of ash and silicone. If deposits of 1.6 mm (0.06 inch) thickness are found or if the turbine is in contact with the housing, the turbocharger must be disassembled and cleaned. Removal of the deposits can be difficult.

5. Inspect the turbine wheel and nozzle vanes for damage or bent blades. Do not attempt to repair the turbine wheel or nozzle vanes. Replace the damaged parts.

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

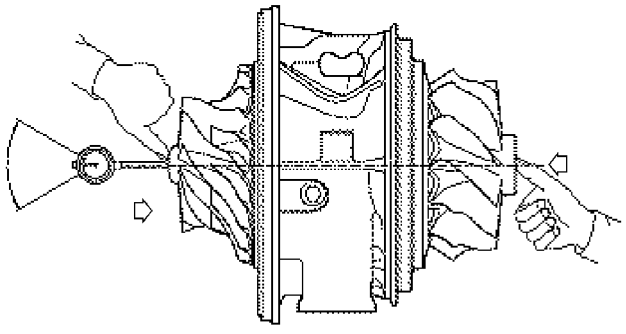


Illustration 83 g01955362

Axial clearance

Note: The axial clearance is the free axial displacement of the rotor. The rotor is moved back and forth with an approximate force between 150 N (34 lb) and 200 N (45 lb). Tolerances are shown in Table 25. The deflection of the measuring device corresponds to the axial clearance.

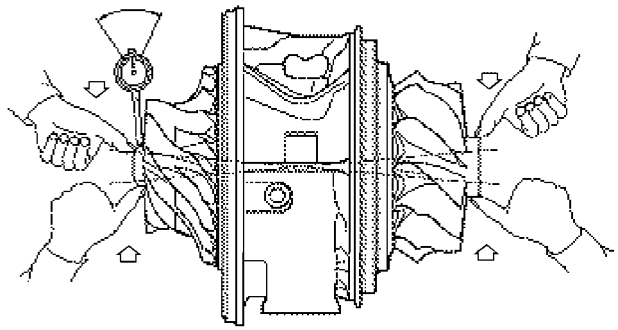


Illustration 84 g01955369

Radial clearance

Note: Radial clearance is the maximum deflection at the hub of the impeller at reciprocal neutralizing of the radial bearing clearance. Radial clearance is measured with the measuring device on the hub of the compressor wheel. Tolerances are shown in Table 26. The rotor is tilted with an approximate force between 150 N (34 lb) and 200 N (45 lb). The total deflection corresponds to the radial clearance.

Note: Axial clearance and radial clearance must be measured after the cartridge group has been removed, but prior to reinstallation.

7. Check the axial clearance and radial clearance.

8. Clean the turbocharger compressor and turbine housing with a non-metallic bristle brush and standard shop solvents to remove deposits. Blasting the turbine housing and nozzle ring may be necessary in order to remove deposits. Plastic or walnut shell media can be used for blasting. All turbocharger components and surfaces must be clean and dry prior to assembly.

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

Table 25

Axial Clearance(1)	
TPC47	0.12 ± 0.04 mm (0.0047 ± 0.0015 inch)
TPC49	0.12 ± 0.04 mm (0.0047 ± 0.0015 inch)
TPS52	−.14 ± 0.04 mm (0.0055 ± 0.0015 inch)

(1) The clearances apply to new parts and used parts. Oil films are not taken into account. The values in the table are valid at an ambient temperature of 20° C (68° F). The clearances take account of manufacturing tolerances of the applicable components.

Table 26

Radial Clearance(1)	
TPC47	−.635 ± 0.265 mm (0.025 ± 0.010 inch)
TPC49	−.69 ± 0.29 mm (0.027 ± 0.011 inch)
TPS52	−.88 ± 0.27 mm (0.034 ± 0.010 inch)

(1) The clearances apply to new parts and used parts. Oil films are not taken into account. The values in the table are valid at an ambient temperature of 20° C (68° F). The clearances take account of manufacturing tolerances of the applicable components.

i03470080

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 top end overhaul is typically scheduled according to the amount of valve recession. The amount of valve recession should be monitored on both intake and exhaust valves. However, it is difficult to measure the actual valve recession in the cylinder head. A simpler method is used to determine the valve recession:

- Measure the projection of the valve rotator above the cylinder head.

Measure the projection of the exhaust valve rotators with a 155-1536 Valve Recession Tool Group. Follow the instructions that are provided with the tool group.

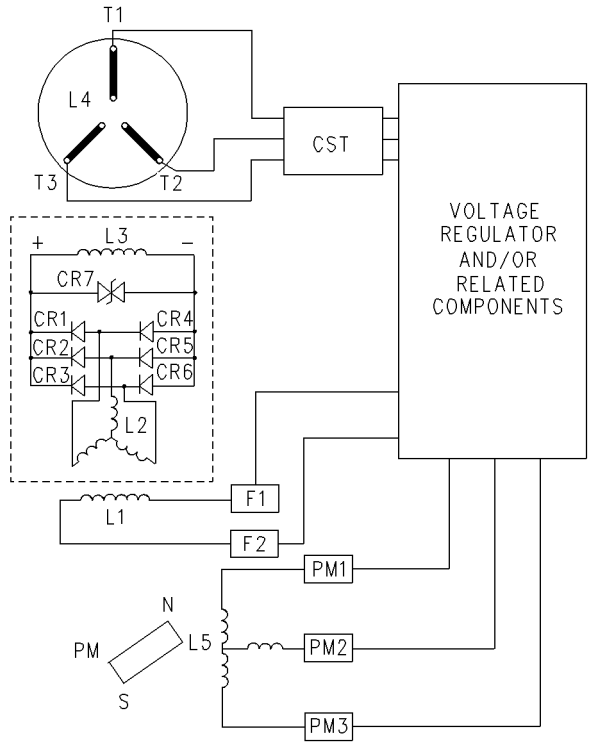
Record the measurements on the Operation and Maintenance Manual, “Valve Data Sheet” (Reference Materials Section).

- Measure the projection of the exhaust valve rotators after 250 service hours. This measurement is the baseline. The baseline is a reference for subsequent measurements.
- Measure the projection of the exhaust valve rotators at the first 1000 service hours.
- Plan for the top end overhaul as the projection of the valve rotator approaches the maximum limit. Perform the top end overhaul when the projection of the valve rotator has increased by a total of 2.3 mm (0.09 inch). **Do not allow the recession of the exhaust valves to exceed this limit.** The valve head can break. This will cause severe damage in the combustion chamber.
- Check the measurement data for a difference in the valve recession that is greater than 1 mm (0.039 inch) for the valves that share a valve bridge. If this measurement is exceeded for two successive measurements, replacement of the cylinder head is necessary.

i01494879

Varistor - Test

SMCS Code: 4466-081



g00677004

Illustration 85

PMPE Generator Wiring Diagram

(CR1-CR6) Diodes
(CR7) Varistor
(L1) Exciter field (stator)
(L2) Exciter armature (rotor)
(L3) Main field (rotor)
(L4) Main armature (stator)
(L5) Pilot exciter armature
(PM) Permanent magnet
(RFA) Rotating field assembly
(CST) Customer supplied transformer

Ohmmeter

An ohmmeter can be used to check a varistor (CR7). Place an ohmmeter across the varistor. The resistance should be a minimum of 15000 ohms. If the resistance is less than 15000 ohms, the varistor is faulty.

Test Light

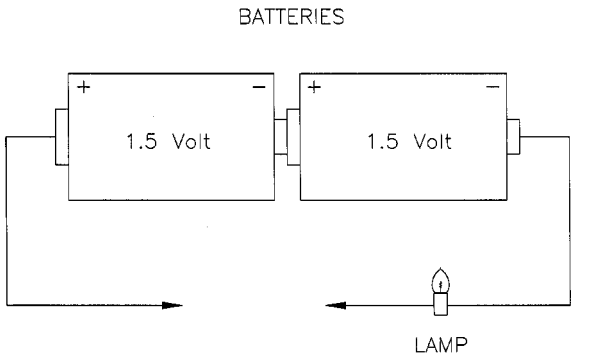


Illustration 86 g00555113
Test Light

Refer to the test light that is shown in Illustration 86. Follow these steps in order to test the varistor:

1. Disconnect either lead of the varistor (CR7).

2. Place the test light across the varistor.

3. Observe the results. The lamp should not light.

4. Reverse the test light.

5. Observe the results. The lamp should not light.

If the test light illuminates in either direction, there is a short in the varistor. Replace any faulty varistors with varistors that have comparable operating characteristics. Include the following information when a varistor is being ordered for replacement:

- Part number of the varistor
- Serial number of the generator

After the varistor has been replaced, verify that the strapping of the field winding lead is securely wound on the shaft. Also, verify that the strapping of the field winding lead is securely tied.

i01189996

Voltage and Frequency - Check

SMCS Code: 4450-535-EL

Check for proper voltage and frequency setting. Check for stability.

Refer to the generator set Serial Plate for correct voltage and frequency.

i02591373

Walk-Around Inspection

SMCS Code: 1000-040

⚠ WARNING

Personal injury or death can result from improper troubleshooting and repair procedures.

The following troubleshooting and repair procedures should only be performed by qualified personnel familiar with this equipment.

Inspect the Engine for Leaks and for Loose Connections

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

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

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

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

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

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

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

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

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the valve cover.
- Inspect the Closed Crankcase Ventilation (CCV) filter, if equipped. If the restriction indicator is visible, service the CCV.
- Inspect 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 alternator belt and the accessory drive belts for cracks, breaks or other damage.

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

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

Inspect the Generator

Refer to Safety Section, “Generator Isolating for Maintenance” for information regarding the procedure to safely isolate the generator.

A visual inspection should be initially directed at the areas that are most prone to damage and deterioration. The most prone areas to damage and deterioration are listed below:

Ground insulation – Ground insulation is insulation that is intended to isolate components that are carrying current from components that are not carrying current.

Support insulation – Support insulation is usually made from one of the following items: a compressed lamination of fibrous materials, polyester, or felt pads that have been impregnated with various types of bonding agents.

There are many different types of damage that can occur in these areas. Several of the different types of damage are listed below:

Thermal aging – Thermal aging can cause the degradation of insulation or the deterioration of insulation. An examination of the coils may reveal that the insulation has expanded into the ventilation ducts. This is the result of a loss of bond which will cause the insulation material to separate. The insulation material could also separate from the conductors on the windings.

Abrasion – The surfaces of coils and the surfaces of connectors may be damaged by abrasion. These surfaces may also be damaged by contamination from other sources. An example of these sources would be chemicals or abrasive substances.

Cracking – Cracking of insulation may result from mechanical stress. The structure that is used to brace the stator winding will become loose if the problem is not corrected. Further mechanical damage or electrical damage may also result.

Erosion – Erosion can be caused when foreign substances rub against the insulation that is on the surface of the coil .

i01985173

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 the Service Manual for the disassembly and assembly procedure.

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

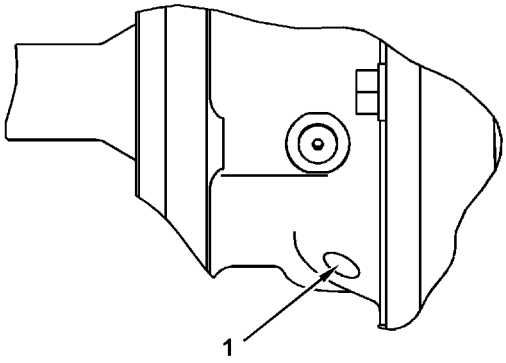


Illustration 87 g01028701

Some water pumps have a filter in the weephole (1). This filter helps prevent dirt from entering the water pump. Inspect the filter with a flashlight in order to ensure that the filter is clean. Replace the filter annually or replace the filter when the filter becomes plugged.

i03518000

Water Temperature Regulator - Replace

SMCS Code: 1355-510

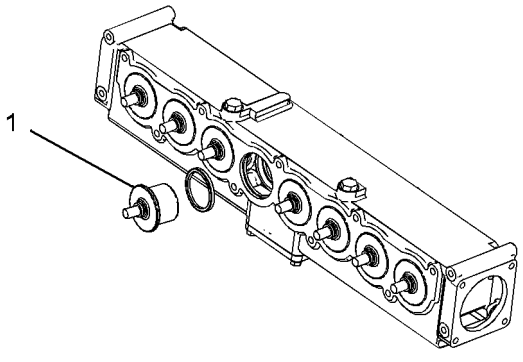


Illustration 88 g01848875

Replace the water temperature regulators (1) before the water temperature regulators fail. This is a recommended preventive maintenance practice. Replacing the water temperature regulators reduces the chances for unscheduled downtime.

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

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

A water temperature regulator that fails in the open position will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon buildup inside the cylinders. This excessive carbon buildup could result in an accelerated wear of the piston rings and wear of the cylinder liner. Also, a low temperature can allow moisture to condense in the oil. This can form damaging acids.

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

Never operate an engine without the water temperature regulator installed.

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

For the procedure to replace the water temperature regulators, see the Service Manual, “Disassembly and Assembly” module. Consult your Caterpillar dealer for assistance.

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

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Winding - Test

SMCS Code: 4453-081; 4454-081; 4457-081; 4470-081

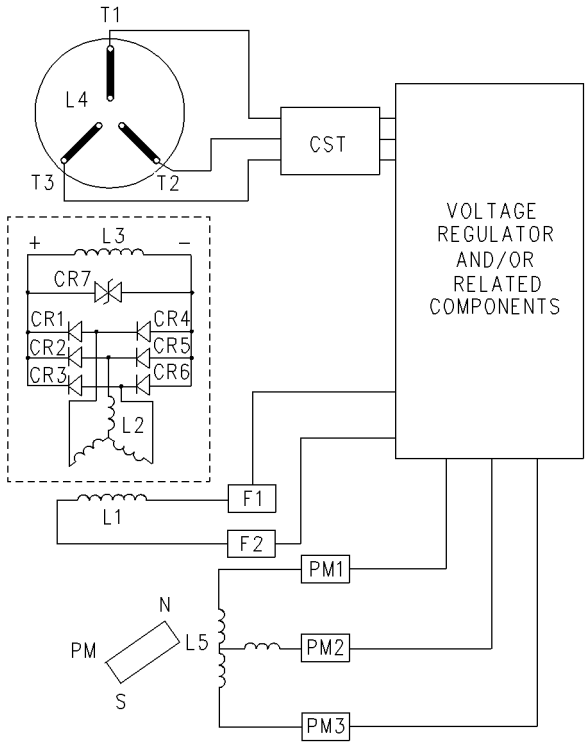

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Illustration 89

PMPE Generator Wiring Diagram

(CR1-CR6) Diodes
(CR7) Varistor
(L1) Exciter field (stator)
(L2) Exciter armature (rotor)
(L3) Main field (rotor)
(L4) Main armature (stator)
(L5) Pilot exciter armature
(PM) Permanent magnet
(RFA) Rotating field assembly
(CST) Customer supplied transformer

Table 27

Tools Needed		
Part Number	**Part**[1]	**Quantity**
6V-7070	Digital Multimeter	1
146-4080	Digital Multimeter (RS232)	1

(1) Only one multimeter is necessary for this test. Either of the multimeters that are shown will work.

⚠ 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.

Measure the resistance of the following windings: (L1), (L2), (L3), (L4), and (L5). The winding that is being tested must be disconnected from the other components before the resistance can be measured. The following resistance measurements are approximations. If the measured value is not near the listed approximation, the winding is probably damaged. For a more precise resistance value, consult the Technical Marketing Information (TMI). Refer to the generator arrangement that is in question.

Note: The winding temperature affects the resistance. When the winding temperature increases, the winding resistance also increases. When the winding temperature decreases, the winding resistance also decreases. Therefore, a correct measurement can be performed only when the winding is at room temperature.

The following armature windings have very little resistance: (L2), (L4), and (L5). The resistance of these windings will measure near 0 ohms. Use a milliohmmeter to measure the resistance of the armature windings.

Exciter Armature (Rotor) (L2) – less than 0.1 ohm

Main armature (Stator) (L4) – less than 0.1 ohm

Pilot Exciter Armature (L5) – less than 0.1 ohm

Use a multimeter in order to measure the resistance of field windings (L1) and (L3).

Exciter Field (Stator) (L1) – approximately 3.0 ohms to 6.0 ohms

Main Field (Rotor) (L3) – approximately 0.75 ohms to 2.0 ohms

Note: There should be no continuity between any winding and ground. There should be no continuity between any winding and another winding.