

Cetane Number

Under average starting conditions, direct injection engines require a minimum cetane number of 40. A higher cetane value may be required for high altitude or cold weather operation.

Filterability

Clean fuels should have no more than 0.1 percent of sediment and water. Fuel stored for extended periods of time may oxidize and form solids, causing filtering problems.

Pour Point

Fuel pour point should be at least 6°C (10°F) below the lowest ambient temperature at which the engines must start and operate. Lower pour points of No.1 or No.1-D fuel may be necessary in extremely cold weather.

Cloud Point

The cloud point should be below the lowest ambient temperature at which the engines must start and operate, to prevent the fuel filter elements from plugging with wax crystals. Refer to Fuel Problems in Cold Weather Operation for additional information.

Viscosity

Fluid viscosity is a measure of resistance to flow. Fuel viscosity is important because it effects lubrication of fuel system components, and fuel atomization. The provided viscosity limits address both of those effects.

Additives

Fuel additives are generally not recommended or needed for the specified fuels listed. Cetane improvers can be used as necessary for direct injection engine requirements. Biocides may be needed to eliminate microorganism growth in storage tanks. In cold conditions, treatment for entrained water may also be necessary.

Consult your fuel supplier about the use of additives to prevent incompatibility among additives already in the fuel and the additives to be used.

Fuel Sulfur

The percentage of sulfur in fuel affects engine oil recommendations. Fuel sulfur can change chemically during combustion, forming both sulfurous and sulfuric acids. The acids attack metal surfaces and cause corrosive wear. Sulfur oxides formed during combustion also produce particulate exhaust emissions.

Some lubricating oil additives contain alkaline compounds to neutralize acids in combustion gases and minimize corrosive wear. Reserve alkalinity in lubricating oil is measured and defined with a Total Base Number (TBN).

Periodically request fuel sulfur content information from your fuel supplier. Fuel sulfur content can change with each bulk delivery.

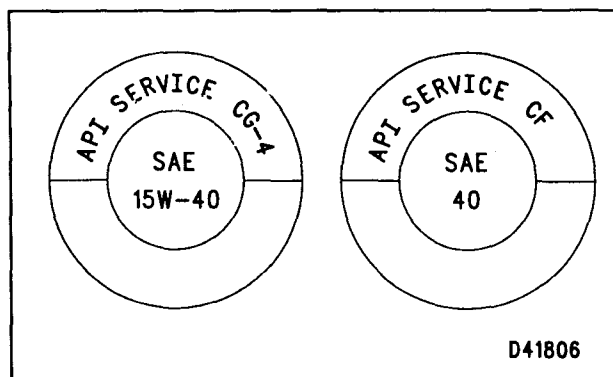
More information concerning fuel sulfur and lubrication can be found in the Lubricant Specifications section of this manual.

Refer to Diesel Fuels and Your Engine, SEBD0717, or contact your Caterpillar dealer for more information on fuel selection and fuel properties.

Lubricant Specifications

General Information

Caterpillar recognizes and supports the American Petroleum Institute (API) "Engine Oil Licensing and Certification System" for engine oils. The API publication No. 1509, 13th edition, contains the detailed information concerning this system. Engine oils bearing the API symbol are licensed by the API.



Examples of the API symbol.

Diesel engine oil classifications CD, CD-2 and CE will not be API licensed categories after January 1, 1996. Caterpillar will only reference those categories that are licensed by the API. The following chart summarizes the status of the categories.

OIL CLASSIFICATION STATUS	
Obsolete	Current
CC, CD	CF
CD-2 ¹	CF-2 ¹
CE	CF-4, CG-4

¹ CD-2 and CF-2 are oil categories for two cycle diesel engines. These oils are NOT recommended for Caterpillar engines.

Engine Lubricant Specifications

Caterpillar Oil

Caterpillar Oils have been developed, tested, and approved by Caterpillar to provide the performance and life that has been designed and built into Caterpillar diesel engines. Caterpillar Oils are used for engine development and factory fill. They are available from Caterpillar dealers. Due to significant variations in the quality and performance of commercially available oils, Caterpillar recommends the following.

Caterpillar Diesel Engine Oil (DEO) (multi-grade)

Caterpillar DEO multi-grade oils are formulated with detergents, dispersants, and sufficient alkalinity to provide superior performance in Caterpillar diesel engines. DEO multi-grade oils are blended in two viscosity grades: SAE 10W30 and SAE 15W40. Refer to the lubricant viscosity chart to choose the correct viscosity grade based on ambient temperatures. Multi-grade oils provide the correct viscosity for a broad range of operating temperatures and for cold engine starts. Multi-grade oils are also effective in maintaining low oil consumption and low levels of piston deposits.

Caterpillar DEO multi-grade oils are also qualified for use in other diesel engines and in gasoline engines. Consult the engine manufacturer's guide for the recommended specifications, and compare to the specifications of Caterpillar DEO multi-grade. The current Caterpillar DEO industry specifications are listed on the label and on the product data sheets.

Commercial Diesel Engine Oils

The performance of commercial diesel engine oils are based on API categories. These API categories are developed to provide commercial lubricants for a wide variety of diesel engines that operate at various conditions.

If Caterpillar DEO (multi-grade) is not used, the following multi-grade commercial oils are recommended.

- API CG-4 Preferred
- API CF-4 Allowed

API CG-4 oils are preferred for Caterpillar engines because of the fuel sulfur level. API CG-4 is the only oil category that evaluates oils with engine tests utilizing 0.05 percent sulfur fuel.

The following explanations of these API categories can be used to make the proper choice of a commercial oil.

CG-4: This is the newest oil category. CG-4 oils were primarily developed for diesel engines that are operating on 0.05 percent sulfur diesel fuel. All of the laboratory engine tests for this category were run with 0.05 percent sulfur diesel fuel. This category also defines oils that have superior soot dispersancy. CG-4 oils will provide improved viscosity control and improved crankcase cleanliness in applications where oil soot is a problem. CG-4 oils should also be used in engines that contain hydraulically actuated fuel injection pumps: these are the first oils to pass industry tests for foam control and viscosity shear loss. CG-4 oils must also pass recently developed tests for metals corrosion, and wear. CG-4 oils can be used in all Caterpillar engines where CF-4 oils are recommended.

CF-4 oils service a wide variety of modern diesel engines. This oil classification was developed with 0.40 percent sulfur diesel fuel. The fuel used in the CF-4 tests represents the type of diesel fuels commonly available world wide. CF-4 oils provide improved piston deposit control and improved oil control when compared to the CE category oils. CF-4 oils also provide improved soot dispersancy compared to CD or CF category oils.

Some commercial oils meeting these API specifications may require shortened oil change intervals as determined by close monitoring of oil condition and wear metals (Caterpillar's S•O•S Oil Analysis Program preferred).

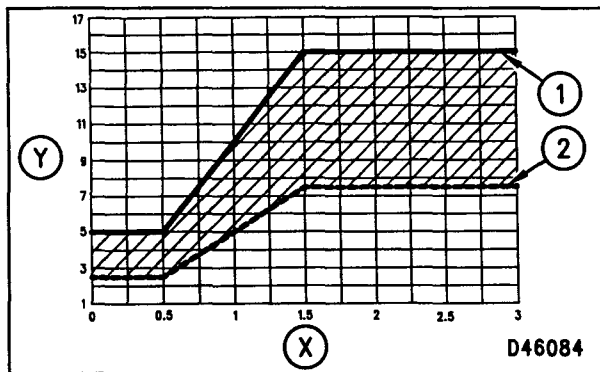
Consult with your Caterpillar dealer for the latest oil recommendations or refer to the following Caterpillar Supplements: SEBU6250, SEBU6251, and SEBU6385.

NOTICE

Failure to follow these oil recommendations can cause shortened engine life due to deposits and or excessive wear.

Total Base Number (TBN) and Fuel Sulfur Levels For Caterpillar Diesel Engines**Caterpillar Direct Injection Diesel Engines**

For direct injection engines running on distillate diesel fuel, the minimum new oil TBN (by ASTM D 2896) must be 10 times the fuel sulfur level, and the minimum TBN is 5 regardless of low fuel sulfur level, see the chart below.



Y = oil TBN shown by ASTM D2896.

X = percent of fuel sulfur by weight.

New oil TBN (1).

Change oil when the used oil TBN limit (2) is reached.

In areas where the fuel sulfur exceeds 0.5 percent, choose an oil with the highest TBN that is within the API CF-4 or CG-4 categories, and shorten the oil change period based on oil analysis. The oil analysis should evaluate oil condition and wear metals. High TBN oils that are not within the API CF-4 or CG-4 categories can produce excessive piston deposits leading to a loss of oil control and bore polishing.

NOTICE

Operation at fuel sulfur levels over 0.5 percent may require shortened oil change periods to maintain adequate wear protection.

Lubricant Viscosity Recommendations

The proper SAE viscosity grade oil is determined by the minimum outside temperature at cold engine start up, and the maximum outside temperature during engine operation. Use the minimum temperature column on the chart to determine the oil viscosity required for starting a "cold soaked" engine. Use the maximum temperature column on the chart to select the viscosity for operation at the highest temperature anticipated. In general, use the highest viscosity oil available that still meets the start up temperature requirements.

ENGINE OIL VISCOSITY PROTECTION		
Engine Oil Viscosity Grade	Ambient Temperature	
	Minimum °C (°F)	Maximum °C (°F)
SAE 0W20	-40° (-40°)	10° (50°)
SAE 5W30	-30° (-22°)	30° (86°)
SAE5W40	-30° (-22°)	40° (104°)
SAE 10W30	-20° (-4°)	40° (104°)
SAE 15W40	-15° (5°)	50° (122°)

Synthetic Base Stock Oils

Synthetic base stock oils are acceptable for use in Caterpillar engines and machines if these oils meet the performance requirements specified by Caterpillar for a particular compartment.

Synthetic base stock oils generally outperform non-synthetics in two areas:

1. Improved low temperature viscosity characteristics, especially in Arctic conditions.
2. Improved oxidation stability, especially at high operating temperatures.

Some synthetic base stock oils have performance characteristics that enhance the useful life of the oil. However, Caterpillar does NOT recommend the automatic extension of oil drain intervals for any oil, including synthetic base stock oils. For Caterpillar diesel engines, oil drain intervals can only be adjusted through an oil analysis program that contains the following elements: oil condition and wear metals (Caterpillar's S•O•S Oil Analysis preferred), trend analysis, fuel consumption, and oil consumption.

Re-Refined Base Stock Oils

Re-refined base stock oils are acceptable for use in Caterpillar engines and machines if these oils meet the performance requirements specified by Caterpillar for a particular compartment. Re-refined oils can be used exclusively in a finished oil or in combination with new base stocks. The US Military and other heavy equipment manufacturers have also accepted the use of re-refined base stock oils with the same criteria.

The re-refining process should be adequate to remove all wear metals and oil additives that were present in the used oil. This type of re-refining is generally accomplished by vacuum distillation and hydrotreating the used oil. Filtering alone is inadequate for producing a high quality re-refined base stock from used oil.

After-Market Oil Additives

Caterpillar does NOT recommend the use of after-market oil additives. After-market oil additives are not necessary to achieve life predictions or to achieve rated performance. Fully formulated finished oils are made up of base stocks and commercial additive packages. These additive packages are blended into the base stocks at precise percentages to provide finished oils with performance characteristics that meet lubricant industry standards.

Lubricant industry standard tests do not exist to evaluate the performance of after-market oil additives. There are also no lubricant industry standard tests to evaluate the compatibility of these after-market additives in a finished oil. After-market additives could be incompatible with the finished oil additive package, and lower the performance of the finished oil. The after-market additive could fail to mix with the finished oil, and produce a sludge in the crankcase. Caterpillar discourages the use of after-market additives in finished oils.

To achieve all the performance that was built into a Caterpillar engine, follow these guidelines:

- Select the proper Caterpillar oil or commercial oil that meets the compartment specifications.
- Select the proper oil viscosity based on the Engine Oil Viscosity Chart in this manual.
- Service the engine at the specified interval with new oil and oil filter.
- Perform maintenance at the intervals specified by the Operation and Maintenance Manual.

Caterpillar Lubricating Grease

The National Lubricating Grease Institute (NLGI) classifies grease, based on ASTM D217-68 Worked Penetration characteristics. Grease characteristics are given a defined consistency number.

Caterpillar has grease and lubricants for all applications. Your Caterpillar dealer can provide you with complete information regarding all of the different types and sizes of Caterpillar lubrication and special application products.

CATERPILLAR LUBRICATING GREASE		
Part No.	Item	Size
2S3230	Bearing Lubricant ¹	411 g (14.5 oz)
5P0960	Molybdenum Grease ²	411 g (14.5 oz)
1P0808	All-Purpose Lubricant ³	411 g (14.5 oz)
4C4774	Water & Temperature Resistant Grease ⁴	454 g (16 oz)

¹ NLGI No. 2 Grade, services heavily loaded ball and roller bearings operating at high speeds, extreme pressure, and temperatures from -34 to 163°C (-18 to 300°F). Use for bearings in electric motors, fan drives, starting motors, alternators/generators and to pack similar bearings in many other applications.

² NGLI No. 2 Grade, three to five percent molybdenum disulfide, multi-purpose grease with an operating temperature range from -28 to 149°C (-18 to 300°F).

³ NGLI No. 2 Grade lithium grease has mechanical stability, resists oxidation, protects from rust, excellent breakaway torque. For light-duty automotive-type applications and temperatures up to 175°C (350°F).

⁴ This NLGI No 2 Grade has exceptional water resistance, meets ASTM D-1264 Water Washout Test. This low and high temperature resistant grease has a starting torque at -40°C (-40°F), and is still not fluid at 316°C (600°F).

Caterpillar Specialty Lubricants

CATERPILLAR SPECIALTY LUBRICANTS		
Part No.	Item	Size
6V4876	Molykote Paste Lubricant ¹	500 g (17.6 oz)
5P3931	High Temperature Anti-Seize ²	150 g (5.3 oz)

¹ Recommended for typical uses such as on head bolt threads and washers.

² Recommended for connectors such as exhaust manifold studs and nuts.

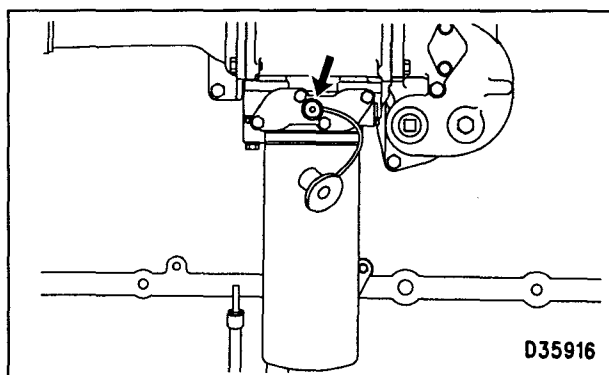
Caterpillar's Scheduled Oil Sampling (S•O•S) Analysis

Caterpillar's Scheduled Oil Sampling (S•O•S) analysis is the best indicator for determining what is happening inside your engine.

S•O•S analysis is a diagnostic tool used to determine oil performance and component wear rates with a series of tests designed to identify and measure contamination such as soot, sulfur, etc. and degradation such as the presence of fuel, water and antifreeze in a sample of oil.

The tests also determine the amount of wear metals present in the oil sample, which is compared to established Caterpillar norms to determine acceptability. To be effective as an indicator, S•O•S analysis must be performed on a continuing basis. Intermittent sampling will not allow wear rate trend lines to be established.

S•O•S INTERVAL CHART	
Compartment	Interval
Engine Crankcase	Every 250 Hours



Typical sampling valve.

Obtain Every 250 Hour Interval.

Obtain oil samples at regularly scheduled intervals to monitor the condition and maintenance requirements of your engine. Each oil sample should be taken when the oil is warm and well mixed to ensure that the sample is representative of the oil in the engine crankcase.

Consult your Caterpillar dealer for complete information and assistance in establishing an S•O•S oil analysis program for your engine(s).

S•O•S Oil Analysis

S•O•S oil analysis is composed of three basic tests:

- Wear Analysis
- Chemical and Physical Tests
- Oil Condition Analysis

Wear analysis is performed with an atomic absorption spectrophotometer to monitor component wear by identifying and measuring concentrations, in parts per million, of wear elements present in the oil. Based on known normal concentration data, maximum limits of wear elements are established. Impending failures can be identified when test results deviate from concentration levels established as acceptable, based on normal wear.

Chemical and physical tests detect the presence of water, fuel and glycol (antifreeze) in the oil and determine whether or not their concentrations exceed established maximum limits.

Oil condition is evaluated with infrared analysis. This test determines the presence and measures the amount of contaminants such as soot, sulfur products, oxidation, and nitration products in the oil. Infrared analysis can also assist in customizing (reducing, maintaining or extending) oil change intervals for particular conditions and applications.

Infrared analysis should always be accompanied by wear element analysis and chemical and physical tests to assure accurate diagnosis.

NOTE: Infrared analysis must be used to determine oil change intervals.

The test results of the oil samples will then be used as a basis for determining the oil change interval for your engine, giving you the ultimate time between oil changes without the risk of engine damage.

Terminology

Adjust – to conform and correspond to specifications.

Check – to observe for satisfactory conditions, accuracy, safety or performance.

Exchange – to trade a worn or failing component for a remanufactured or rebuilt component.

Inspect – to examine closely, in critical appraisal, while testing or evaluating components or systems.

Inspect/Rebuild or Exchange – to examine closely, then making the decision on repair option (i.e. Rebuild or Exchange).

Lubricate – to apply a lubricant (oil, grease, etc.) as specified for reducing friction, heat and wear between solid surfaces.

Protective Devices – indicators such as gauges, lights, emergency shutoffs, etc., that alert an operator that a potential problem may exist. Failure to respond to these indicators in a timely manner could result in serious engine damage.

Rebuild – to repair a worn or failing component with new parts, components and/or remanufactured components.

Replace – to install something new, remanufactured or rebuilt in place of an existing worn or failing component.

Service Hours (Electrical) – records the time (clock hours) the engine is actually running but does not reflect variations in speed, load, etc.

NOTE: Some engines are equipped with mechanical service meters reading in Service Meter Units (SMU). The Maintenance Schedules are developed for clock hours or fuel consumption. For most users, SMU's can be roughly equal to clock hours, however, Caterpillar recommends that fuel consumption be used as the preferred method of determining intervals rather than SMU's or clock hours.

Interval Terminology

Engine components can generally be grouped into "speed sensitive" and "load sensitive" categories. Therefore, the maintenance interval for each item listed in the Maintenance Schedule is primarily based on the item and its relationship to either engine speed or load.

Speed sensitive items such as water pumps, air compressors, etc., are not primarily affected by the load on your engine during operation. The load on an engine will not significantly accelerate the repair or replacement cycle for speed sensitive items.

Therefore, the maintenance intervals established for speed sensitive items are based on service hours.

Load sensitive items such as piston rings, cylinder liners, etc., are affected by the load on your engine during operation. Generally speaking, the lower the load, the longer the engine life and conversely, the higher the load, the shorter the engine life. A heavy load on an engine will accelerate the repair or replacement cycle for load sensitive items.

Load sensitive items are normally internal engine components. The amount of fuel consumed is directly related to the load on your engine.

Therefore, the maintenance interval for load sensitive items also includes quantity of fuel used, since the amount of fuel consumed is directly related to the load on your engine.

Since the amount of fuel consumed is a better indicator of performing an maintenance than service hours, Caterpillar recommends performing maintenance on these items at the specified maintenance interval based on the quantity of fuel consumed.

NOTE: Ensure that the Maintenance Schedule in this publication is adhered to.

Refill Capacities

Lubrication System

The Engine Crankcase REFILL CAPACITIES reflect the approximate crankcase/sump capacity plus standard oil filter(s). Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications for auxiliary oil filter capacity. Refer to the Lubricant Specifications section in this manual for lubricant recommendations.

Cooling System

The total cooling system capacity will vary, depending on the engine model, radiator system size (or heat exchanger) and aftercooler (if equipped).

In order to properly maintain the cooling system, the Total Cooling System capacity must be known. The approximate Engine Only cooling system capacity is listed in the REFILL CAPACITIES chart. External System capacities will vary among applications. This capacity information will be needed to determine the amount of antifreeze/coolant required for the cooling system. Refer to the Cooling System Specifications in this manual for the proper antifreeze/coolant mixtures to use.

REFILL CAPACITIES (APPROXIMATE)			
Compartment Or System	3114 (All)	3116 Stationary	3116 Mobile & 3126 (All)
Engine Crankcase ¹	12 L (12.7 qt)	21 L (22 qt)	32 L (34 qt)
COOLING SYSTEM CAPACITIES			
Engine Only	10.4 L (11 qt)	13.2 (14 qt)	13.2 L (14 qt)
External System ²			
Total Cooling System ³			

¹ Approximate crankcase/sump capacity including standard oil filter(s). Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications for auxiliary oil filter capacity.

² The External System consists of either an expansion tank or a radiator, and piping. Refer to the Caterpillar or the OEM specifications for your engine's External System capacity. Enter the capacity in this row.

³ The Engine Only plus the External System capacity equals the Total Cooling System capacity. Enter the Total in this row.

Maintenance Schedule

3114 Industrial and EPG Diesel Engines

Use fuel consumption, calendar interval or service hours, whichever occurs first. Experience has shown that maintenance intervals are most accurately scheduled on the basis of fuel consumed rather than service hours. Performance of all lubrication and maintenance items in the Maintenance Schedule is the owner's responsibility.

NOTE: For all information regarding the generator and control panel maintenance, refer to SEBU6150 for Caterpillar SR4 Generators and Control Panels.

Daily

Walk-Around Inspection – Inspect engine for leaks, loose connections, and radiator debris	51
Engine Crankcase – Check oil level	52
Cooling System – Check coolant level	52
Engine Air Cleaner – Check service indicator, Check/Clean Precleaner (If Equipped)	53
Water Separator (If Equipped) – Drain water	54
Clutch (If Equipped) – Check/Adjust/Lubricate	54

First 250 Hours or 4000 L (1000 gal) of Fuel

Valve Lash – Check/Adjust	56
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Every 250 Hours or 4000 L (1000 gal) of Fuel

Engine Oil and Filter(s) – Obtain oil analysis, Replace oil and filter(s)	57
Fuel System – Replace water separator element (if equipped), Replace secondary filter(s)	61
Fuel Inlet Screen – Clean	62
Cooling System (Conventional Coolant/Antifreeze Only) – Test for SCA OR Obtain Level I Analysis, Add SCA if required	63
Radiator Fins – Inspect/Check	64
Batteries – Clean/Check electrolyte level	65
Belts and Hoses – Inspect/Replace	66
Engine Air Cleaner – Clean/Replace element	68
Fuel Tank – Drain water & sediment	69

Every 500 Hours or 8000 L (2000 gal) of Fuel

Crankcase Breather – Clean	70
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Every 1000 Hours or 15,000 L (4000 gal) of Fuel

Engine Protective Devices – Inspect/Check	71
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Every 2000 Hours or 30,000 L (8000 gal) of Fuel

Valve Lash – Check/Adjust	72
Governor – Clean/Replace oil supply screen	72

Every 3000 Hours or Two Years or 45,000 L (12,000 gal) of Fuel

Thermostat – Replace	73
Cooling System (Long Life Coolant/Antifreeze Only) – Add Extender	74
Cooling System (Conventional Coolant/Antifreeze Only) – Drain/Clean/Replace coolant	74

Every 6000 Hours or Four Years

Cooling System (Long Life Coolant/Antifreeze Only) – Drain/Flush/Replace LLCA	76
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Maintenance Schedule

3116 and 3126 Industrial and EPG Diesel Engines

Use fuel consumption, calendar interval or service hours, whichever occurs first. Experience has shown that maintenance intervals are most accurately scheduled on the basis of fuel consumed rather than service hours. Performance of all lubrication and maintenance items in the Maintenance Schedule is the owner's responsibility.

NOTE: For all information regarding the generator and control panel maintenance, refer to SEBU6150 for Caterpillar SR4 Generators and Control Panels.

Daily

Walk-Around Inspection – Inspect engine for leaks, loose connections, and radiator debris	51
Engine Crankcase – Check oil level	52
Cooling System – Check coolant level	52
Engine Air Cleaner – Check service indicator, Check/Clean Precleaner (If Equipped)	53
Water Separator (If Equipped) – Drain water	54
Clutch (If Equipped) – Check/Adjust/Lubricate	54

First 250 Hours or 6000 L (1500 gal) of Fuel

Valve Lash – Check/Adjust	56
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Every 250 Hours or 6000 L (1500 gal) of Fuel

Engine Oil and Filter(s) – Obtain oil analysis, Replace oil and filter(s)	57
Fuel System – Replace water separator element (if equipped), Replace secondary filter(s)	61
Fuel Inlet Screen – Clean	62
Cooling System (Conventional Coolant/Antifreeze Only) – Test for SCA OR Obtain Level I Analysis, Add SCA if required	63
Radiator Fins – Inspect/Check	64
Batteries – Clean/Check electrolyte level	65
Belts and Hoses – Inspect/Replace	66
Engine Air Cleaner – Clean/Replace element	68
Fuel Tank – Drain water & sediment	69

Every 500 Hours or 1200 L (3000 gal) of Fuel

Crankcase Breather – Clean	70
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Every 1000 Hours or 22,750 L (6000 gal) of Fuel

Engine Protective Devices – Inspect/Check	71
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Every 2000 Hours or 45,000 L (12,000 gal) of Fuel

Valve Lash and Injector Fuel Timing – Check/Adjust	72
Governor – Clean/Replace oil supply screen	72

Every 3000 Hours or Two Years or 68,000 L (18,000 gal) of Fuel

Thermostat – Replace	73
Cooling System (Long Life Coolant/Antifreeze Only) – Add Extender	74
Cooling System (Conventional Coolant/Antifreeze Only) – Drain/Clean/Replace coolant	74

Every 6000 Hours or Four Years

Cooling System (Long Life Coolant/Antifreeze Only) – Drain/Flush/Replace LLCA	76
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Daily

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Walk-Around Inspection

Inspect Engine for Leaks and Loose Connections

A walk-around inspection is recommended to ensure the installation is clean and fluid leaks (coolant and/or lubricant) are kept to a minimum. This should only take a few minutes and by taking the time to make these checks, costly repairs and accidents can be avoided and the equipment will be ready to run when necessary.

For maximum service life of your engine, make a thorough inspection before starting the engine. Look for such items as oil or coolant leaks, loose bolts, worn belt(s), loose wire and/or hose connections and trash build-up. Remove trash build-up and have repairs made as needed. Refer to the Before Starting the Engine section in this manual for additional information.

Keep a close watch for leaks after starting the engine. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more frequently until a leak is found and fixed. Continue to check fluid levels until the leak has been fixed or the suspicion proven to be unwarranted.

- After starting the engine, operate the engine at slow speed until it is at operating temperature. Check the coolant level and stop the engine to add coolant if necessary. Check for any obvious cooling system leaks or loose connections. Inspect the water pump for evidence of leaks.
- Wipe all fittings, caps and plugs before servicing to keep dirt and debris from entering engine components.
- Check the engine, cooling system, driven equipment and/or generator (if equipped) for dirt and debris. Inspect the cooling system or radiator (if equipped) for leaks.
- Inspect the radiator for debris and clean as necessary.

- Inspect the cooling system hoses or piping for cracks and loose clamps.
- Inspect the water pump, fan and alternator drive belts for cracks, breaks or other damage.

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

- Inspect the water pump weep hole for 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 parts contract.

- Inspect the engine for oil leaks, in places such as the front and rear crankshaft seals, oil pan, oil filters and valve covers.
- Inspect air inlet system hoses and elbows for cracks and loose clamps.
- Inspect the fuel system for leaks, loose fuel line clamps and fittings and loose or worn hoses.
- Inspect wiring for loose connections and worn or frayed wires.
- Check all electrical connections and wiring. Tighten all connections and repair all wiring that may show signs of wear or cracking of the insulation.
- Inspect engine-to-frame ground strap for good connection and condition.
- Disconnect any battery chargers that are not protected against the starter current drain. Check condition of batteries and the level of electrolyte.
- All guards must be in place. Repair or replace missing or damaged guards.
- Check condition of gauges. Replace if cracked or cannot be calibrated.
- While operating, frequently observe the engine oil pressure gauge, the water temperature gauge, and the air cleaner indicator.

Engine Crankcase

Check Oil Level

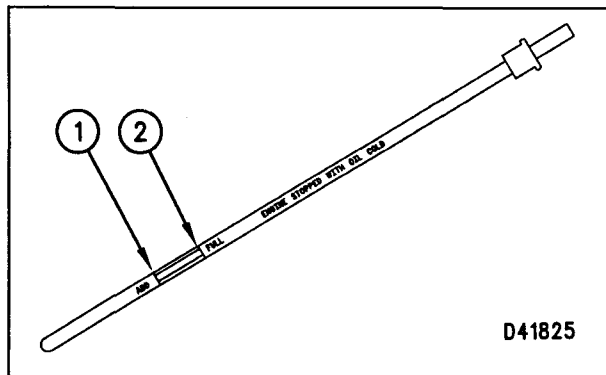
NOTICE

Make sure you read and understand the information in the Lubricant Specifications section of this manual before you proceed with maintenance of the engine lubrication system.

Check the oil level with the engine stopped. DO NOT check the oil level with the engine running.

NOTICE

DO NOT overfill to reach above or to the top of the FULL mark on the dipstick. Operating your engine when the oil level is above the FULL mark could cause your crankshaft to dip into the oil. The crankshaft dipping into the oil could cause excessively high oil temperatures which can reduce the lubricating characteristics of the oil, lead to bearing damage and could result in the loss of engine power.



Oil Level Gauge (Dipstick) ADD (1) and FULL (2) marks.

Maintain the oil level between the ADD and FULL marks on the dipstick. Remove the oil filler cap and pour oil into the filler tube, if necessary. Do not fill the crankcase above the FULL mark.

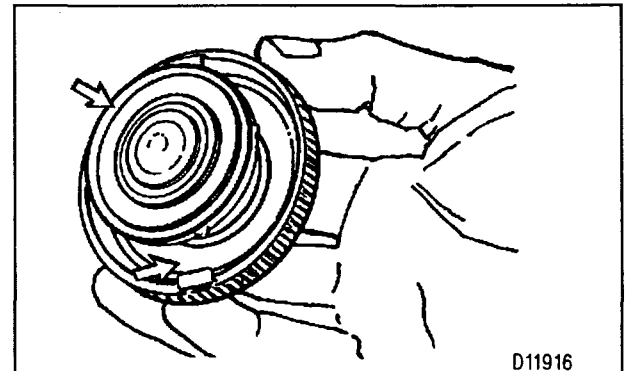
Cooling System

Check Coolant Level

NOTICE

Make sure you read and understand the information in the Cooling System Specifications section of this manual before you proceed with maintenance of the cooling system.

1. Check the coolant level with the engine stopped and cold.
2. Remove the filler cap slowly to relieve any pressure.
3. Maintain the coolant level within 13 mm (½ inch) below the bottom of the fill pipe or to the proper level on the sight glass (if equipped).



Typical filler cap gaskets.

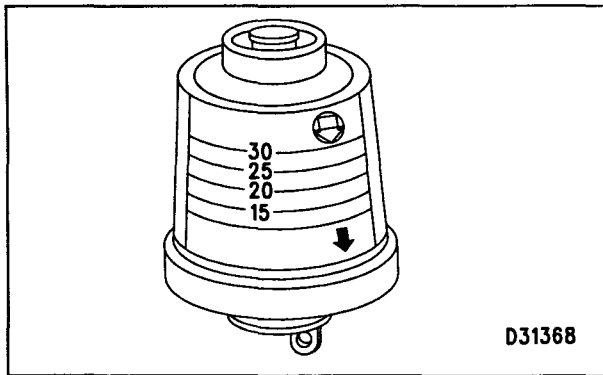
4. Inspect the filler cap. Replace the old cap with a new cap if the gaskets are damaged. Install the filler cap.

Engine Air Cleaner

Check Service Indicator

NOTICE

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



Typical air cleaner service indicator.

Your engine may be equipped with a different indicator or gauge.

A service indicator (if equipped) may be mounted on the air cleaner or in a remote location. A colored piston showing in the window indicates the need for servicing the air cleaner.

- Observe the air cleaner service indicator (if equipped). Clean or replace the air cleaner when the yellow diaphragm enters the red zone or the red piston locks in the visible position.

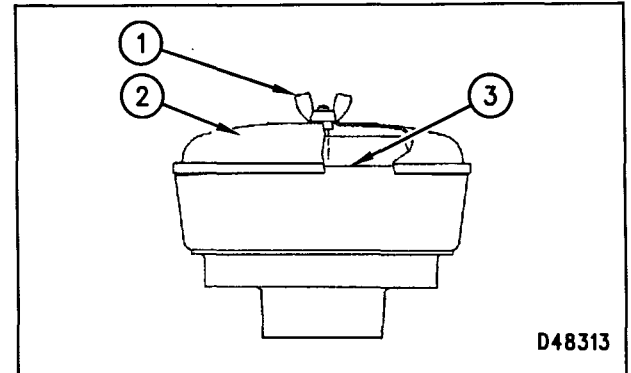
As the air cleaner element becomes plugged, the difference of air pressure between the inlet side (dirty side) and the engine side (clean side) will increase.

- If the air cleaner indicator shows red at any time, install a clean or new air cleaner element.

If equipped with an air inlet restriction gauge, change the air cleaner element when the gauge reading approaches 7.5 kPa (30 inches of H₂O).

Precleaner (If Equipped)

Check/Clean



Typical precleaner wing nut (1), cover (2), and body (3).

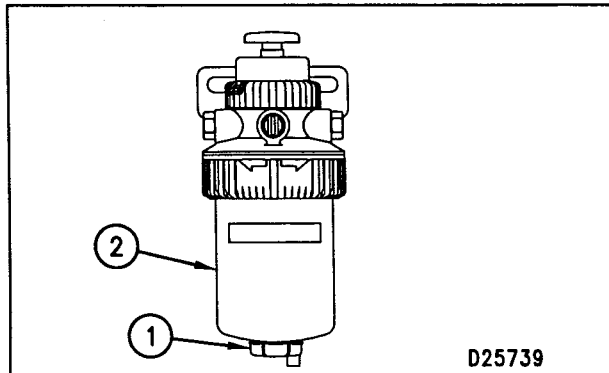
Remove wing nut (1) and cover (2). Check for an accumulation of dirt and debris in body (3). Clean the body if necessary.

After cleaning, install the cover and wing nut.

NOTE: More frequent cleaning will be required in dusty applications.

Water Separator

Drain Water



Typical water separator drain valve (1) and element (2).

1. Open drain valve (1). Catch the draining water in a suitable container and dispose of properly.
2. Close drain valve (1).

NOTICE

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

Clutch

Check/Adjust/Lubricate

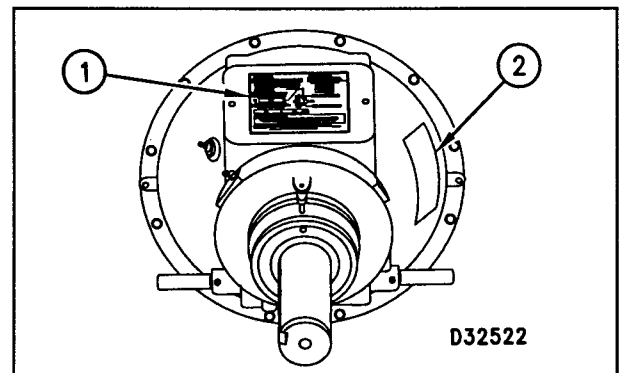
Check/Adjust

NOTICE

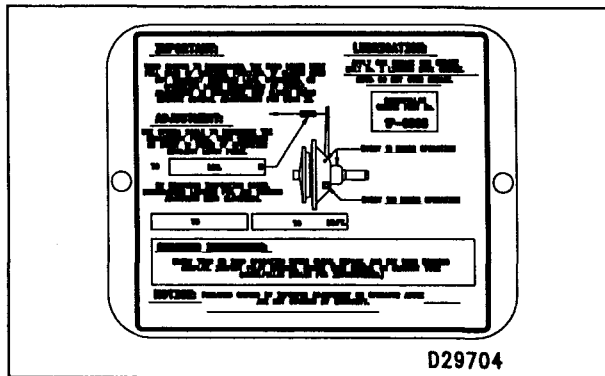
New power take-offs should have clutch adjustment checked before being placed in service. Clutch adjustment should be checked again after the first ten hours of operation. New clutch plates have a "wear in" period, and the clutch may require several adjustments until the new plates are "worn in."

Clutch adjustment should be checked regularly after "wear in." Heavy duty applications which have frequent engagements and relatively long periods of clutch slip require more frequent adjustment than light duty applications. Operating torque should be measured to determine if clutch adjustment is required.

Refer to the clutch OEM service instructions and the clutch instruction plate for adjustment and other service recommendations. Perform the maintenance specified on the instruction plate.



Typical clutch Instruction Plate (1) and Serial Number Plate (2) locations.



Typical clutch Instruction Plate.

⚠ WARNING

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

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

Lubricate

Refer to the clutch OEM service recommendations and the clutch instruction plate for lubrication instructions. Perform the maintenance specified on the instruction plate.

First 250 Hours

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Valve Lash

Check/Adjust

Initial valve lash check and/or adjustment on new or rebuilt engines is recommended at the first scheduled oil change interval, or 250 Hours, whichever occurs first. This is due to initial wear and seating of valve train components. Subsequent checks and adjustments should be made at the Every 2000 Hour interval.

Refer to the Service Manual or your Caterpillar dealer for the complete valve adjustment procedure.

Every 250 Hours

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Engine Oil and Filters

Obtain Oil Analysis

Scheduled Oil Sampling (S•O•S) Analysis

To compliment a good preventive maintenance program, Caterpillar recommends using S•O•S at regular scheduled intervals to monitor the condition of the engine oil and maintenance requirements of your engine.

Obtain Sample

Each oil sample should be taken when the oil is warm and well mixed to ensure that the sample is representative of the oil in the crankcase. There are two methods recommended to obtain oil samples from 1.1 Liter engines.

- Use the sampling valve (if equipped).
- Use a sampling gun inserted into the sump.

The sample valve should be flushed with engine oil to rinse the dirt and debris from the valve.

Refer to How to Take a Good Oil Sample, form PEHP6001 for a step-by-step explanation if using this method of sampling crankcase oil.

Caterpillar recommends using one of the methods previously mentioned. However, if either of these methods are not possible, then use a drain stream method when changing the oil.

NOTE: When using the drain stream to obtain the oil sample, do not sample from the beginning or end of drain stream. The oil at the beginning or end of the drain stream is not mixed well enough to be representative of the oil in the crankcase.

Consult your Caterpillar dealer for complete information or assistance in establishing an S•O•S oil analysis program for your engine.

Oil Change Intervals

NOTICE

Engines operating at an altitude of 1830 m (6000 ft) or higher should change oil and filters at an interval of 200 service hours or less.

NOTICE

If the fuel sulfur content is 1.5 percent or greater by weight, reduce the oil change interval by 1/2.

Oil change intervals should be adjusted according to S•O•S results. It is essential that an S•O•S analysis be performed to analyze oil condition before oil change period adjustment is considered.

Due to manufacturing tolerances, engine application and maintenance variation, all engines do not consume fuel and oil at the same rate. Some history of fuel and oil consumed for each engine (or group of engines) in a similar application must be established.

For a group of engines, determine the average fuel consumption and add oil rate. This is performed by dividing the total quantity of fuel or oil consumed by the operating (service) hours of the engines.

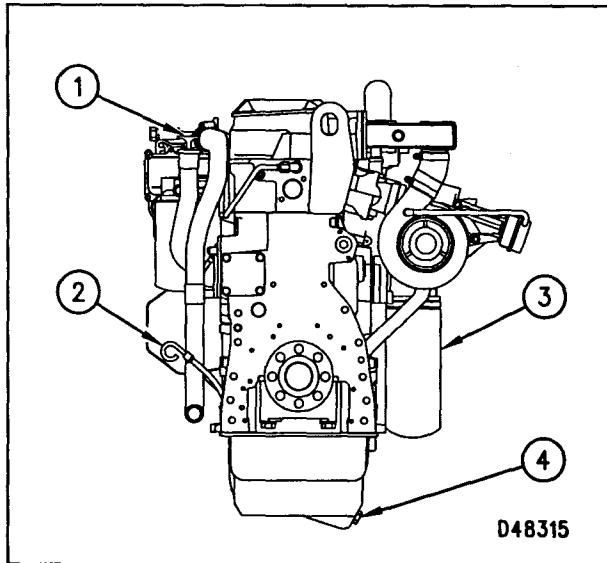
Consult with your Caterpillar dealer for more information on adjusting oil change intervals for specific applications.

Replace Oil

As oil cools, suspended waste particles settle on the bottom of the crankcase or oil pan and will not be removed with the draining oil.

Drain the crankcase with the engine stopped and the oil warm to allow for the draining of waste particles that are suspended in the oil.

Failure to follow this recommended procedure would result in these waste particles being recirculated through your engine lubrication system with the new oil.



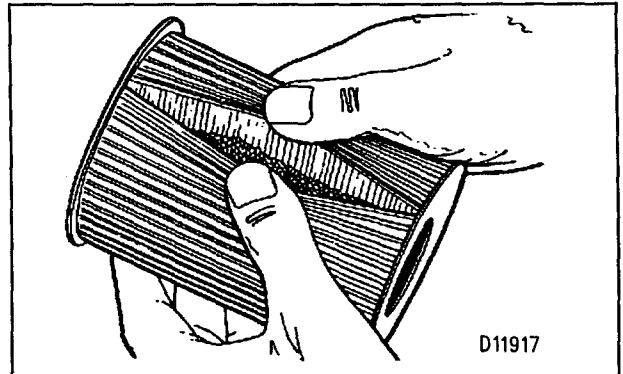
Oil filler cap (1), oil level gauge (dipstick, 2), oil filter (3), and drain plug (4).

1. Depending on your equipment, remove the oil drain plug or open the oil drain valve (if equipped) and allow the oil to drain.

2. Wipe clean and install the drain line plug or close the drain valve. Tighten the plug (if equipped) to 25 ± 5 N•m (18 ± 4 lb ft).

Change Filter(s)

1. Use a 2P8250 Filter Wrench to remove the oil filter(s).

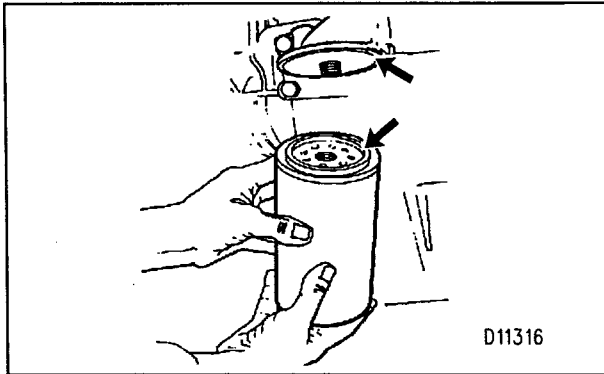


Element with debris.

2. Use a 4C5084 Oil Filter Cutter to cut the oil filter element open. Spread pleats apart and inspect the element for metal debris. Due to normal wear and friction, it is not uncommon to find small amounts of debris in your oil filter element. An excessive amount of debris in the oil filter element may be indicative of a pending failure.

Use a magnet to differentiate between the ferrous and non-ferrous metals found in your oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of your engine. Non-ferrous metals may indicate wear on the aluminum parts of your engine, such as main and rod bearings, turbocharger bearings and cylinder head wear.

Consult your Caterpillar dealer to arrange for further analysis if an excessive amount of debris is found in your oil filter element.



Mounting base and oil filter gasket.

3. Wipe the sealing surface of the filter element mounting base. Make sure all of the old gasket is removed.

NOTE: Make sure to use the correct Caterpillar oil filter element for your engine arrangement.

Caterpillar oil filter elements are built to Caterpillar specifications to ensure you receive a quality part at a competitive price.

Caterpillar oil filter elements are inspected as part of an inspection program that was developed to ensure compliance with established quality standards.

NOTICE

Use of an oil filter element not recommended by Caterpillar could result in severe engine damage to your engine bearings, crankshaft, etc., as a result of the larger debris particles or unfiltered oil entering your engine lubricating system.

4. Apply a small amount of clean engine oil to the new filter element gasket.
5. Install the new filter element. Tighten by hand until the gasket contacts the base. Tighten the filter $\frac{3}{4}$ of a turn more by hand. Do not over tighten.

Fill

NOTICE

Either under filling or overfilling of engine crankcase oil can cause engine damage. **DO NOT** fill beyond the FULL mark on the dipstick. **DO NOT** add more oil than is listed for your engine in the Refill Capacities chart, unless equipped with auxiliary filters.

1. Remove the oil filler cap and fill the crankcase. Refer to the Lubricant Specifications and the Refill Capacities chart in this manual for the proper grade and quantity of oil to use.

NOTICE

If equipped with an auxiliary oil filter, extra oil must be added when filling the crankcase. Follow the filter's OEM recommendations.

NOTE: In some applications it may be necessary to verify the dipstick calibration. Refer to the Dipstick Calibration topic in this section.

2. Start the engine according to the instructions in the Engine Starting section. Run the engine at LOW IDLE for two minutes. Inspect for oil leaks. Stop the engine.
3. Wait ten minutes to allow the oil to drain back into the crankcase. Check the oil level. Maintain the oil level between the ADD and FULL marks on the dipstick.

Dipstick Calibration

Your engine's dipstick was calibrated to use when the engine is mounted on a level surface. Perform the following procedure to verify the dipstick calibration.

Verify Calibration

A convenient time to verify calibration is at first oil change interval.

To verify the ADD mark and establish the actual FULL mark:

1. Operate the engine until it reaches normal operating temperature.
 2. Stop the engine. Refer to the Engine Crankcase topic in this manual to drain the oil and change the oil filter.
 3. Refer to the Lubricant Specifications Section in this Manual for the proper grade of oil to use. Fill the crankcase with:
 - 10 L (10.7 qt) for the 3114.
 - 19 L (20 qt) for the 3116 Stationary.
 - 30 L (32 qt) for the 3116 Mobile or 3126.
- NOTE: Remote mounted or auxiliary filters require additional oil. Refer to the OEM instructions for all auxiliary oil filter information.
4. Start the engine and run until the water temperature gauge reaches normal. Stop the engine.
 5. Allow the oil to drain back to the sump for a minimum of five minutes.
 6. Remove the dipstick. The oil level should be at the ADD mark. If it is not, file off the old mark and mark the actual level on the dipstick with an engraving pen. This is now the correct ADD mark.
 7. Add an additional 2 L (2 qt) of oil to the sump. Allow enough time for the oil to drain into the sump. Again, check the level on the dipstick.
 8. This is the correct FULL mark in the FULL RANGE zone on the dipstick. If it is not, file off the old mark and mark the new FULL level on the dipstick with an engraving pen.

9. Start the engine and operate until it reaches normal operating temperature. Stop the engine.

10. Allow the oil to drain back to the sump for a minimum of ten minutes.

11. Remove the dipstick. The oil level should be near the FULL mark.

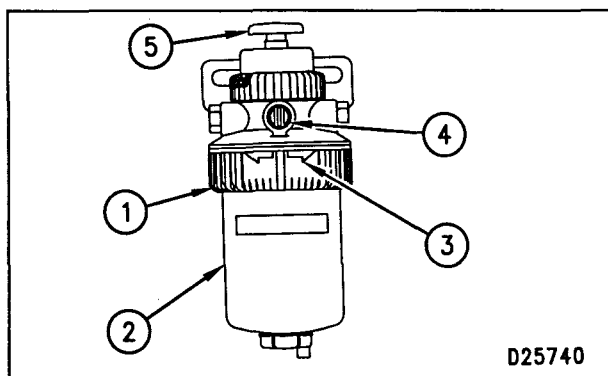
Fuel System

Water Separator

Replace Element

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.



Typical water separator: retaining ring (1), element (2), arrows (3), vent valve (4), and pump plunger (5).

1. Rotate retaining ring (1) CCW to unlock element (2).
2. Remove element (2) from the mounting base.
3. Clean the mounting base.
4. Install a new element. Slide retaining ring (1) into position and rotate CW to lock. Arrows (3) should be in position shown.
5. Open vent valve (4) one turn to allow air to escape from the element.
6. Operate pump plunger (5) until fuel flows from the vent valve.
7. Tighten vent valve (4).

NOTICE

The water separator is under suction during normal engine operation. Ensure that vent valve (4) is tightened securely to prevent air from entering the fuel system.

8. Prime the fuel system. Refer to the Priming The Fuel System topic in this Manual.

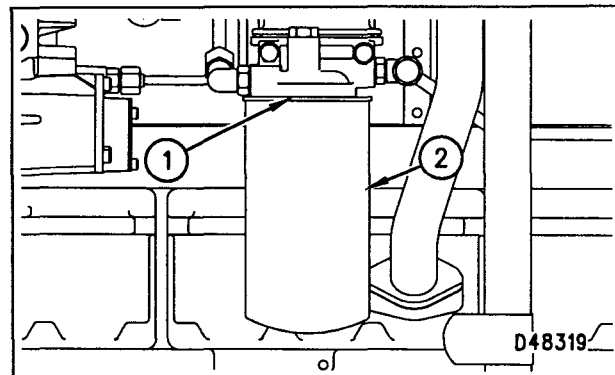
Replace Secondary Filter(s)

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Turn the electrical disconnect switch OFF or disconnect the battery cables when changing fuel filters.

1. Stop the engine.
2. Close the fuel tank supply valve.
3. Turn the START switch OFF and/or disconnect the battery cables.



Fuel filter mounting base (1) and fuel filter (2).

4. Remove and discard the fuel filter element.
5. Clean the gasket sealing surface of the filter base. Make sure all of the old gasket is removed.

NOTICE

Do not fill the fuel filters with fuel before installing them. This fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to the fuel system parts.

NOTE: Use only fuel as recommended in the Fuel Specifications section of this publication.

6. Apply clean diesel fuel or oil to the new fuel filter gasket.
7. Install the new filter and tighten by hand until the filter gasket contacts the base. Tighten the filter $\frac{3}{4}$ turn more by hand. Do not over tighten.

NOTICE

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

8. After changing the fuel filters, crank and start the engine. Refer to the Engine Starting section in this manual for correct engine starting procedure.

NOTE: There should be enough residual fuel in the head to allow the engine to start. If the engine runs, and then stops, crank the engine for a period of 30 seconds, then allow the starter to cool for 2 minutes. Repeat this cranking and cooling cycle until the engine starts and runs.

NOTE: If equipped with a fuel priming pump, prime the fuel system. Refer to the Priming The Fuel System topic in this Manual.

Priming the Fuel System

NOTE: This topic only applies to engines equipped with a priming pump plunger.

1. Operate the priming pump plunger until an increase in resistance is felt.
2. Push the plunger in and tighten by hand.
3. Start the engine.

If the engine:

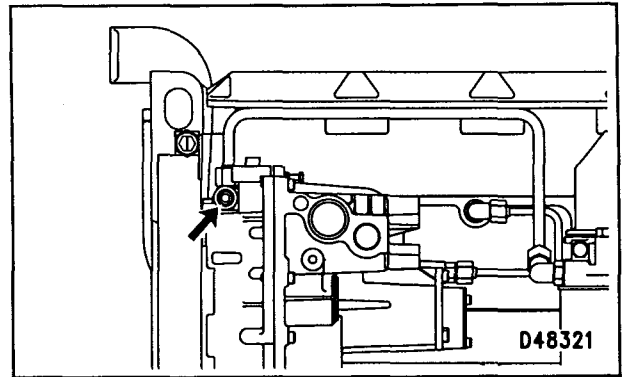
- will not start, or
 - starts, but misfires or smokes,
- further priming is necessary.

If the engine starts, but runs rough, continue running the engine at low speed until the engine runs smoothly.

Fuel Inlet Screen

Clean

The fuel supply line must be disconnected to perform this procedure.



Fuel inlet screen location.

1. Remove the fuel inlet screen located at the inlet to the fuel transfer pump in the governor.
2. Clean the screen with a nonflammable solvent.
3. Install the screen.

Reconnect the fuel supply line.

Cooling System

NOTICE

Make sure you read and understand the information in the Safety and Cooling System Specifications sections of this manual before you proceed with cooling system maintenance.

Check the cooling system only after the engine is stopped and cool. Remove the filler cap slowly to relieve pressure. To prevent engine damage, never add cooling system products to an overheated engine. Allow the engine to cool first.

Test for SCA Or Obtain Level I Analysis (Conventional Coolant/Antifreeze Only)

The use of Caterpillar SCA will prevent internal damage to the engine, such as liner or block pitting. If the concentration level is too low, pitting of the cylinder wall may occur, which can lead to costly engine damage.

If the concentration level is too high, sludge and mud-like deposits may form in the cooling system. This adversely affects engine performance and can also lead to costly repairs of the engine and cooling system.

NOTICE

The over concentration of a supplemental coolant additive will result in deposits on the higher temperature surfaces of the cooling system and create a barrier that reduces the engine's heat transfer characteristics.

Reduced heat transfer could cause cracking of the cylinder head and other high temperature components. Excessive concentrations of additive could also accelerate water pump seal wear.

Use the 8T5296 Test Kit to check for SCA concentration. Add SCA if the concentration is too low. If the SCA concentration is excessive, drain half the coolant, and replace with the proper water/antifreeze mixture.

NOTE: You may test your coolant SCA concentration OR have the SCA concentration tested as part of a S•O•S Coolant Analysis (Level I).

Obtain Level I Analysis

S•O•S Coolant Analysis is the best way to monitor the condition of your coolant and your cooling system.

Level I: Basic Coolant Maintenance Check

Checks for correct chemical balance for proper heat and corrosion control. Tests for:

- glycol
- SCA concentrations
- pH
- conductivity

Caterpillar's S•O•S Coolant Analysis reports results and makes recommendations, usually within 24 hours. Consult with your Caterpillar dealer for more information.

Add Liquid Supplemental Coolant Additive (SCA)

NOTICE

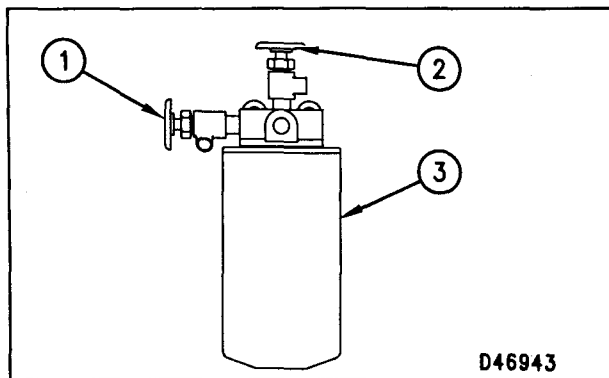
ONLY add SCA if required by the SCA test results.

1. Loosen the radiator or expansion tank filler cap slowly to relieve pressure and remove the cap.
2. It may be necessary to drain enough coolant from the radiator to allow for the addition of the liquid SCA.
3. Add liquid SCA according to the requirements for your cooling system capacity. Refer to the Cooling System Specifications section of this manual for the necessary amount of liquid SCA to add.
4. Inspect the radiator filler cap gaskets. Replace the cap if the gaskets are damaged. Install the filler cap.

Replace SCA Element (If Equipped)

NOTICE

ONLY replace the SCA element if required by the SCA test results.



1. Close coolant additive element inlet valve (1) and outlet valve (2). Remove and discard coolant additive element (3).
2. Clean the element mounting base. Make sure all of the old gasket is removed.
3. Refer to the Cooling System Specifications in this manual for the proper SCA element for your system. Coat the gasket of the new SCA element with a thin film of engine oil. Install the SCA element. Spin the element until the gasket contacts the base, then tighten $\frac{3}{4}$ turn more by hand. DO NOT over tighten.
4. Open inlet and outlet valves (1) and (2).
5. Remove the radiator filler cap. Start the engine and check for leaks. Allow the coolant level to stabilize.
6. Add the proper premixed coolant/water, if necessary, to bring the coolant to within 13 mm ($\frac{1}{2}$ inch) below the bottom of the fill pipe or to the proper level on the sight glass, if equipped.
7. Inspect the filler cap. Replace the cap if the gasket is damaged. Install the filler cap.

Radiator Fins

Inspect/Clean

Inspect the radiator fins for debris.

WARNING

Always inspect/clean the radiator fins with the engine stopped. Failure to do so, could result in personal injury caused by moving fan blades.

1. Inspect and clean the radiator fins.
2. Check the radiator fins for debris. High pressure water is recommended to clean debris from the radiator fins. If necessary, use a light behind the radiator fins to see if they are completely clean.

Refer to Know your Cooling System, form SEBD0518, for more detailed information on cleaning your radiator fins.

Batteries

Clean/Check Electrolyte Level (if equipped)

BATTERY ELECTROLYTE CHART	
Battery	Interval
Conventional	125 Hour
Low Maintenance	250 Hours
Maintenance Free	None Required

1. Remove fill caps. Inspect the electrolyte level in each battery cell, except maintenance free. Maintain electrolyte to bottom on fill plug openings with distilled water.

If 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. The salts used in the treatment of artificially softened water will damage or reduce the efficiency of your batteries.

At the proper charging rate, in a moderate climate, a battery should not require more than 30 cc (1 ounce) water per cell per week. Check the cells weekly in extreme temperatures, cell water usage could be higher.

2. Keep batteries clean. Clean the top of the batteries with a clean cloth.

3. Loosen and remove cable clamps from all battery terminals.

4. Clean all battery terminals.

5. Clean all cable clamps.

6. Install and tighten cable clamps to battery terminals. Keep the terminals clean.

7. Coat cable clamps and terminals with 5N5561 Silicone Lubricant, petroleum jelly or MPGM grease. Install the post cover after coating.

Check Battery Charger (if equipped)

Check the battery charger for proper operation. If batteries are properly charged, ammeter reading should be very near zero. All batteries should be kept charged to a corrected specific gravity of 1.250 or above. The batteries should be kept warm, if possible.

The battery temperature affects the cranking power. If the battery is too cold, it will not crank the engine, even if the engine is warm.

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

Battery, Battery Cable or Disconnect Switch Replacement

NOTE: When replacing batteries, battery cables or the disconnect switch, use the following procedure.

1. Turn off the start switch and all electrical loads. Turn off (open) the disconnect switch and remove the key.

2. Disconnect the ground cable to the frame at the disconnect switch (one cable connects to frame and one to battery negative). Be sure the disconnect cable cannot contact the switch stud where it was just removed. Disconnect the negative battery cable terminal at the battery(s) that goes to the disconnect switch.

Where four 12 volt batteries are involved, the negative side of two batteries must be disconnected.

3. Proceed with necessary system repairs.

4. Reverse the step 2 procedure.

Belts and Hoses

Inspect/Replace Alternator, Fan and Accessory Drive Belts

Your engine may be equipped with water pump, fan drive, alternator, and accessory drive belts. For maximum engine performance and utilization of your engine, inspect the belts for wear and cracking. Check/adjust the belt tension to minimize belt slippage to increase belt life and improve performance of the belt driven components.

If one belt in a set requires replacement, always install a new matched set of belts. Never replace just the worn belt. If only the worn belt is replaced, the new belt will carry all the load, as it will not be stretched as much as the older belts. All the belts will fail in rapid succession.

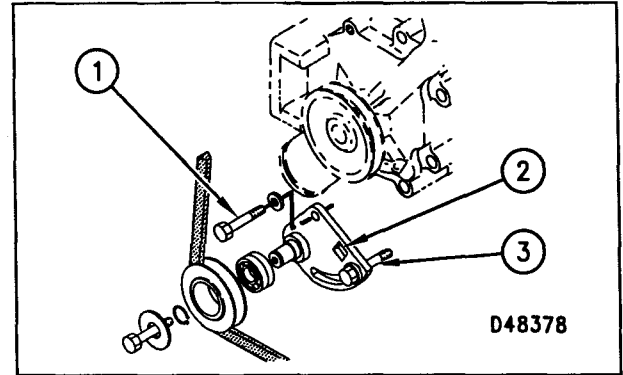
If belts are too loose, they vibrate enough to cause unnecessary wear on the belts and pulleys.

If belts are too tight, unnecessary stresses are placed upon the pulley bearings and belts which might shorten the life of both.

If new belt(s) are installed, check belt adjustment again after 30 minutes of operation.

1. Inspect the condition and adjustment of water pump, alternator and fan drive belts. Replace if they show any signs of wear.
2. To check the belt tension, apply 110 N (25 lbs) of force midway between the pulleys. Correctly adjusted belts will deflect 13 to 19 mm ($\frac{1}{2}$ to $\frac{3}{4}$ in).

To Adjust Water Pump Belt

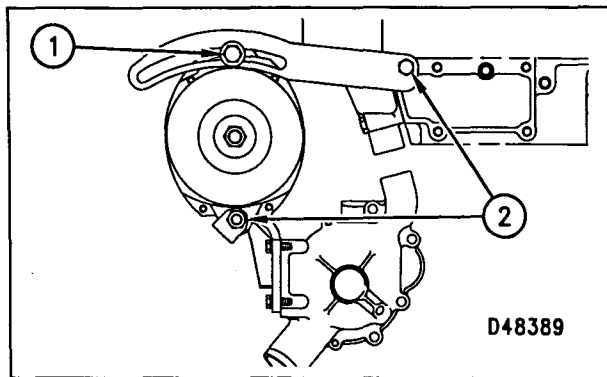


Exploded view of a water pump belt drive assembly: mounting bolt (1), square hole (2), and adjusting bolt (3).

1. Slightly loosen mounting bolt (1) and adjusting bolt (3).
2. Adjust the belt tension with a square drive in the square hole (2).
3. Tighten adjusting bolt (3). Tighten mounting bolt (1).

If a new belt is installed, check the belt adjustment again after 30 minutes of engine operation at rated speed.

To Adjust Alternator/Fan Belts



Adjusting bolt (1), and mounting bolts (2).

1. Slightly loosen mounting bolts (2) and adjusting bolt (1).
2. Move the pulley to adjust the belt tension.
3. Tighten adjusting bolt (1). Tighten mounting bolts (2).

If a new belt is installed, check the belt adjustment again after 30 minutes of engine operation at rated speed.

Inspect/Replace Hoses and Clamps

Hose replacement prior to failure is cost effective and a recommended preventive maintenance practice. Replacing a hose before it fails saves money and reduces the chances for unscheduled downtime.

By replacing a hose that is cracked, soft or leaking, major repairs from severe engine overheating will be avoided.

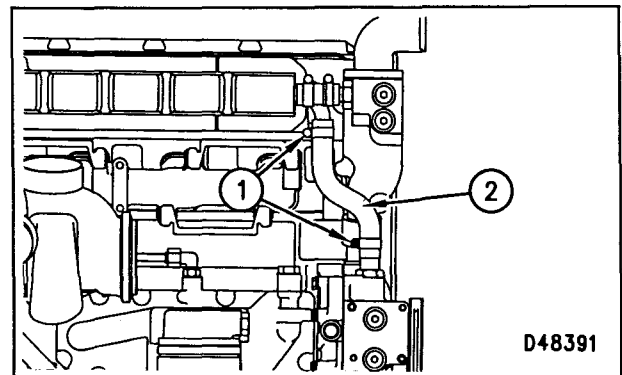
- Inspect all hoses for leaks due to cracking, softness next to clamps and loose clamps.
- Replace hoses that are cracked or soft and tighten loose clamps.

Replace

The engine should be stopped and cool before performing this maintenance.

1. Loosen the radiator filler cap slowly to relieve any pressure and remove the cap.

2. Drain the coolant from the cooling system to a level below the hose being replaced.



Hose clamps (1) and hose (2) example.

3. Remove the hose clamps, disconnect the old hose.
4. Replace the old hose with a new hose and install hose clamps. Refer to the Torque Specifications section of this publication for the appropriate torque value.

NOTE: For constant torque hose clamps, also refer to the Torque Specifications section in this publication.

After Replacing Hoses

NOTE: Refer to Cooling System Specifications in this publication for the proper coolant/antifreeze mixture for your engine.

1. Add the proper coolant/antifreeze mixture to the cooling system. Bring it to the proper level. Add liquid SCA if NOT using Caterpillar DEAC.
2. Install the filler cap.
3. Start the engine and inspect for leaks. Check water temperature gauge for proper operating temperature.

Engine Air Cleaner

Clean/Replace Element

NOTICE

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

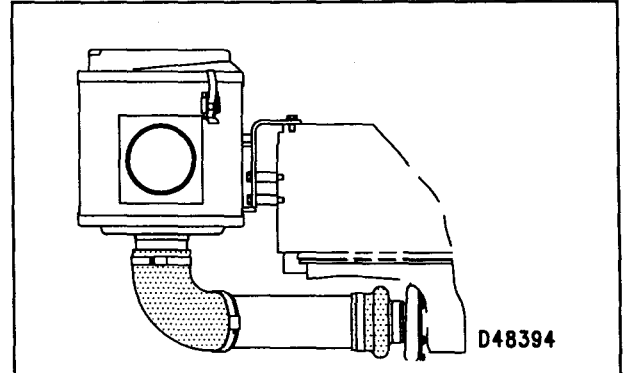
The primary element (Caterpillar air filters) can be cleaned several times before replacement. The element, when cleaned, should be thoroughly checked for rips or tears in the filter material. Replace the primary element at least every year regardless of operating hours it has accumulated.

With the engine shutdown, check the air cleaner element for rips or tears or gasket damage. Replace the element if any rips or tears are found. If equipped with a heavy duty air cleaner and the element is dirty, clean the element.

Two-filter Air Cleaners

NOTE: The two-stage air cleaner contains a primary and secondary element. The primary element may be cleaned up to six times but should be replaced annually.

The secondary element is not serviceable (washable) and should be replaced at every third maintenance interval of the primary element. When the engine is operating in a dusty or dirty environment, air cleaner elements may require more frequent replacement than recommended in the Maintenance Management Schedule.



Typical air cleaner.

1. Remove the cover and primary element.
2. Remove and discard the secondary element.
3. Cover the turbocharger air inlet opening with tape to keep dirt out.
4. Clean the inside of the air cleaner cover and body with a clean, dry cloth.
5. Remove the tape covering the inlet opening. Install a new secondary element. Install either a new or cleaned, undamaged primary element. Make sure the gasket is facing up.
6. Install and secure the air cleaner cover.
7. Reset the service indicator by pushing on the piston plunger.

Cleaning Air Cleaner Elements

NOTICE

Do not clean the filter elements by bumping or tapping them. Engine damage could result.

Do not use filter elements with damaged pleats, gaskets or seals.

NOTE: Most air cleaner filter elements can be cleaned with air, water or detergent. Have spare elements on hand to use while cleaning used elements.

Filter elements can be cleaned with:

- pressure air, 205 kPa (30 psi) maximum, or
- pressure water, 280 kPa (40 psi) maximum, or
- detergent washing.

1. Direct air or water along the pleats inside and outside of filter element. The element can be washed in warm water and nonsudsing household detergent. Rinse inside and outside the pleats and air dry fully.

2. Inspect the filter elements after cleaning. Do not use a filter element with damaged pleats, gaskets or seals.

3. Wrap and store the clean filter elements in a clean, dry place.

For more information on air cleaner element cleaning, refer to Guideline for Reusable Parts—Cleaning and Inspection of Air Filters, form SEBF8062.

Fuel Tank

Drain Water and Sediment

Water is an engine's worst enemy and most diesel fuel contains a slight amount. Condensation also occurs as fuel is heated when passing through the fuel system and cools when returned to the fuel tank. This causes water to accumulate in fuel storage tanks.

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

Drain water and sediment from the fuel storage tank weekly, and before the tank is refilled. This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

Open the drain valve on the fuel tank and drain the water and sediment. Close the valve.

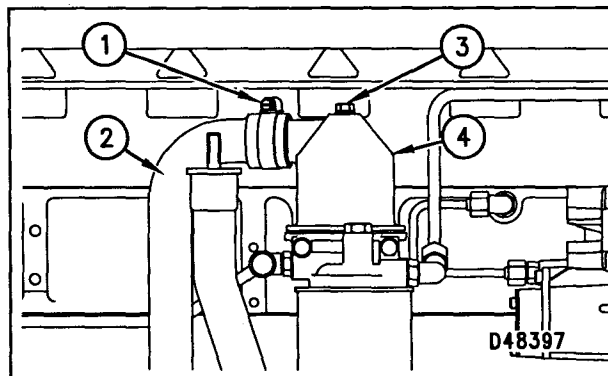
NOTE: Fill the fuel tank at the end of each day of operation to drive out moist air and to prevent condensation. Do not fill the tank to the top. Fuel expands as it gets warm and may overflow.

Every 500 Hours

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Crankcase Breather

Clean



Hose clamp (1), hose (2), bolt (3), and breather assembly (4).

1. Loosen hose clamp (1), and slide hose (2) from breather assembly (4).
2. Loosen bolt (3), remove breather (4) and O-ring seal.
3. Wash breather (4) in clean nonflammable solvent. Allow the breather to dry.
4. Inspect the O-ring seal, and replace if damaged.
5. Install O-ring seal and clean, dry breather (4). Tighten bolt (3) to $14 \pm 3 \text{ N}\cdot\text{m}$ ($10 \pm 2 \text{ lb ft}$).
6. Slide hose (2) on to breather (4) and tighten hose clamp (1). Refer to the Torque Specifications.

Every 1000 Hours

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Engine Protection Devices

Inspect/Check

An inspection and test should be performed for all alarm and shutoff components Every 1000 service hours.

Alarms and shutoffs must work properly in order to provide timely warning to the operator and protection for the engine. It is impossible to tell if the engine protection devices are in good working order during normal operation. Engine malfunctions must be simulated in order to test the alarm and shutoff components.

To prevent damage to the engine, only authorized service personnel or your Caterpillar dealer should perform the tests. Contact your Caterpillar dealer or refer to the Service Manual for more information.

Visual Inspection

Visually check the condition of all sensors and wiring. Look for loose, broken, or damaged wiring and components. Repair or replace any damaged wiring or components immediately.

Every 2000 Hours

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Valve Lash and Injector Fuel Timing

Check/Adjust

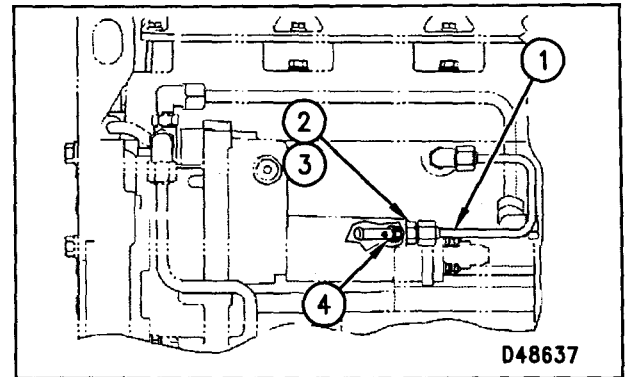
Refer to the Service Manual or your Caterpillar dealer for the complete valve adjustment procedure.

Only qualified service personnel should check and/or adjust injector fuel timing. Special tools and training are required.

NOTE: The correct fuel timing specification is given on the Engine Information Plate. Fuel timing specifications may be different for different engine applications and power ratings.

Governor

Clean/Replace Oil Supply Screen



1. Remove oil supply tube and seals (1) from the cylinder head and remove the fitting (2) and seal (3) from the governor housing.
2. Remove the screen (4) using a 6mm hexagon wrench.
3. Wash the screen in solvent to remove any debris. Inspect the screen and seals for damage and deterioration. Install new seals if necessary.
4. Install the screen into the housing. The screen should be far enough into the housing to allow clearance for the seals and fitting.
5. Install the seals, fittings, and oil supply tube.

Every 3000 Hours or Two Years

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Thermostat

NOTICE

Make sure you read and understand the information in the Safety and Cooling System Specifications sections of this manual before you proceed with cooling system maintenance.

Replace Thermostat, Gaskets and Seal

Replacing your thermostat prior to failure is a recommended preventive maintenance practice because it reduces the chances for unscheduled downtime. Caterpillar recommends the replacement of the thermostat on a regularly scheduled basis to be the most cost effective way to operate your engine.

NOTICE

Failure to replace your thermostat on a regularly scheduled basis could cause severe engine damage.

Since Caterpillar engines incorporate a shunt design cooling system, it is mandatory to always operate the engine with a thermostat.

If the thermostat fails in the closed position, it will cause excessive overheating, which could result in cylinder head cracking or piston seizure problems.

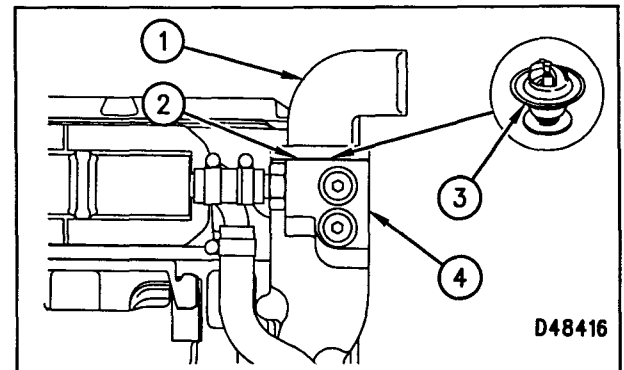
If the thermostat fails in the open position, it will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon build-up inside the cylinder. This excessive carbon build-up could result in accelerated ring and cylinder wear, and reduced efficiency.

Depending on load, a thermostat that fails in a partially opened position will cause either an overheating or an overcooling condition.

NOTE: All tools required for the removal and installation of thermostats are available through any Caterpillar dealer.

Refer to the Engine Service Manual for the complete procedure to perform this maintenance.

A good time to replace the thermostat is during the coolant/antifreeze change-out, when the cooling system has been drained.



Elbow (1), gasket (2), thermostat (3), and thermostat housing (4).

1. Stop the engine and allow to cool. Loosen the coolant filler cap slowly to relieve any pressure and remove the cap.
2. If you are replacing the thermostat **ONLY**, drain the coolant from the cooling system to a level below the thermostat housing.
3. Loosen the hose clamp and remove radiator hose from the elbow (1).
4. Remove gasket (2) and thermostat (3) from the thermostat housing (4).

NOTICE

If the thermostat is installed wrong, it will cause the engine to overheat.

5. Install new thermostat in the thermostat housing.
6. Install a new gasket on the thermostat housing. Install the elbow.
7. Install radiator hose and tighten hose clamps.
8. Add the proper antifreeze/coolant mixture to the cooling system to bring it to the proper level.
9. Start the engine and inspect for leaks and proper operating temperature.

Add Extender (Long Life Coolant/Antifreeze Only)

Extender should be added to LLCA after 3,000 service hours or two years, whichever comes first. The cooling system should be treated with .95 L (1 qt) of Extender for every 46 L (12 US gal) of cooling system capacity.

For more Extender information, refer to the Cooling System Specifications LLCA Extender topic in this manual.

Drain/Clean/Replace Coolant (Conventional Coolant/Antifreeze Only)

NOTICE

Do not flush the system or change the coolant until you read and understand the material in the Cooling System Specifications section of this publication.

This procedure is to be used for normal maintenance of cooling system surfaces to return to "like new" condition.

For heavy build-up of scale and deposits, a severe acid-type, commercial cleaner or mechanical cleaning will be required.

By performing maintenance on the cooling system, you will avoid spending money on repairs that could have been prevented.

Disregard for, or improper maintenance can result in a variety of problems that could shorten the engine's service life or lead to poor engine performance.

When you drain, clean/flush the system and replace the coolant, small particles, undesirable chemicals, scale and other deposit formations are removed. These deposits reduce the necessary heat transfer characteristics of the cooling system.

Conventional coolant should be drained and the cooling system cleaned every 3000 Hours or Two Years.

If you do not clean/flush the cooling system and replace the coolant as recommended, efficiency of the cooling system will be reduced and, in some cases, result in an increase in fuel consumption.

- 1.** Loosen the filler cap slowly to relieve any pressure and remove the cap slowly to relieve pressure.
- 2.** Remove the cooling system drain plugs or open the drain valve on bottom of cooling system radiator or expansion tank and allow the coolant to drain.

NOTICE

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

For information regarding disposal and recycling of used coolant:

Contact Caterpillar Service Technology Group:
Outside Illinois: 1-800-542-TOOL
Inside Illinois: 1-800-541-TOOL
Canada: 1-800-523-TOOL

3. Flush the cooling system with clean water to remove any debris.
4. Clean and install all drain plugs or close the drain valve.

NOTICE

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

5. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add .5 L (1 pt) of Cleaner per 15 L (4 US gal) of cooling system capacity. Install the radiator filler cap.
6. Start and run the engine for a minimum of 30 minutes with the coolant temperature at 82°C (180°F). Stop the engine and allow the engine to cool.
7. Loosen the filler cap slowly to relieve any pressure, and remove the cap. Remove the cooling system drain plug(s) or open the drain valve(s). Allow the cleaning solution to drain. Flush the cooling system with clean water until the draining water is clear. Clean and install all drain plugs and/or close the drain valve(s).

Refer to the Cooling System Specifications for all information regarding acceptable water, coolant/antifreeze, and supplemental coolant additive requirements.

8. Fill the system with the recommended coolant/antifreeze mixture.

9. Start and run the engine with the filler cap removed. Allow the coolant to warm, the thermostat to open and the coolant level to stabilize. Check the coolant level. Add coolant mixture if necessary to bring the coolant to within 13 mm (½ in) below the bottom of the fill tube or the correct level on the sight glass (if equipped).

10. Check the condition of the filler cap gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a 9S8140 Service Tool (available from your Caterpillar dealer) to pressure test the filler cap. The correct filler cap pressure is stamped on the face of the filler cap. If the filler cap does not hold the correct pressure, install a new filler cap.

11. Start the engine and inspect for coolant leaks and proper operating temperature. Check for coolant leaks.

Cooling Systems with Heavy Deposits or Plugging

NOTE: For the following procedure to be effective, there must be some active flow through the radiator and the other cooling system components.

Follow the same steps as outlined above, with the following modifications to steps 5 and 6:

5. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add .5 L (1 pt) of Cleaner per 3.8 to 7.6 L (1 to 2 US gal) of cooling system capacity. Install the radiator filler cap.
6. Start and run the engine for a minimum of 90 minutes with the coolant temperature at 82°C (180°F). Stop the engine and allow the engine to cool.

Every 6000 Hours

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Cooling System

NOTICE

Do not perform this maintenance until you read and understand the material in the Safety and Cooling System Specifications sections of this publication.

Drain/Flush/Replace Coolant (Long Life Coolant/Antifreeze Only)

Caterpillar Long Life Coolant/Antifreeze should be replaced every 6,000 service hours or 4 Years, whichever comes first. Only clean water is needed to clean and flush the cooling system when LLCA is drained and replaced.

Drain

1. Stop the engine and allow the engine to cool. Loosen the coolant filler cap slowly to relieve any pressure, and remove the cap.
2. Remove the radiator drain plug, or open the radiator drain valve (if equipped). Remove the block and oil cooler drain plugs. Remove the drain plug from the bottom of the water pump housing. Allow the coolant to drain.

NOTICE

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

For information regarding disposal and recycling of used coolant:

Contact Caterpillar Service Technology Group:
Outside Illinois: 1-800-542-TOOL
Inside Illinois: 1-800-541-TOOL
Canada: 1-800-523-TOOL

Flush

3. Flush the cooling system with clean water to remove any debris.
4. Clean and install all drain plugs and/or close the drain valve(s).
5. Fill the cooling system with clean water. Install the filler cap. Operate the engine until warm 49 to 66°C (150 to 120°F).
6. Stop the engine and allow the engine to cool. Loosen the coolant filler cap slowly to relieve any pressure, and remove the cap. Remove the cooling system drain plug(s) or open the drain valve. Allow the water to drain. Flush the cooling system with clean water.
7. Repeat steps 6 and 7.

Fill

8. Fill the cooling system with LLCA. Refer to the refill capacities chart in this manual for the amount of LLCA needed to refill your system.
9. Start and run the engine with the filler cap removed. Allow the LLCA to warm, the thermostat to open, and the coolant level to stabilize. Add LLCA if necessary to bring the coolant to the proper level.
10. Check the condition of the filler cap gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a 9S8140 Service Tool (available from your Caterpillar dealer) to pressure test the filler cap. The correct filler cap pressure is stamped on the face of the filler cap. If the filler cap does not hold the correct pressure, install a new filler cap.
11. Start the engine and inspect for coolant leaks and proper operating temperature.

Overhaul

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Overhaul Instructions

If you elect to perform an overhaul yourself, without having a Caterpillar dealer perform the overhaul for you, then you should be aware of the following.

Rebuild or Exchange

Cylinder Head Assembly, Connecting Rods, Pistons, Cylinder Walls, Piston Pins, Turbocharger, Oil Pump, Fuel Transfer Pump, Damper and Governor

These components should be inspected according to the instructions found in various Caterpillar reusability publications. Refer to the Index Of Publications On Reusability Or Salvage Of Used Parts section of the Guideline For Reusable Parts and Salvage Operations, form SEBF8029, to determine the reusability publications needed for inspecting your parts.

- Governor – Have your Caterpillar dealer check your governor for proper operation and correct settings. He can rebuild or furnish an exchange governor.

The Guidelines For Reusable Parts and Salvage Operations is part of an established Caterpillar parts reusability program. These guidelines were developed to assist Caterpillar dealers and customers reduce costs by avoiding unnecessary expenditures for new parts when existing parts can be used as is, repaired or salvaged.

If your parts comply with the established visual, dimensional, etc., inspection specifications expressed in the reusable parts guideline, then they should be reused.

NOTE: Parts complying with the specifications outlined in the reusable parts guideline will give an additional service life.

If your parts are not within specification, then they should be salvaged, repaired or replaced. Failure to salvage, repair or replace out-of-spec parts will result in unscheduled downtime and could result in costly repairs caused by potential damage to other engine parts.

Furthermore, the use of out-of-spec parts can reduce your engine's efficiency and increase fuel consumption. Reduced engine efficiency and increased fuel consumption translates into higher operating costs for you. Therefore, Caterpillar recommends that you salvage, repair or replace your out-of-spec parts.

Install New

Piston Rings, Main Bearings, Rod Bearings and Crankshaft Seals

In most probability, your piston rings, main and rod bearings and crankshaft seals will not last until your second overhaul. Therefore, Caterpillar recommends the installation of these new components at each overhaul period.

Inspect

Crankshaft, Camshaft, Camshaft Followers and Bearings, Fuel System Linkage, Gear Train, Gear Train Bushings, Balancer Bushings (3114 Engines Only) and Driven Unit Alignment

The ideal time for inspecting these items is while your engine is disassembled for overhaul. Inspect each component for potential damage according to the following information.

- Crankshaft – Inspect for deflection, journal damage and bearing material seized to the journal. At the same time, check the taper and profile of the crankshaft journals by interpreting your main and rod bearing wear patterns.

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

- Camshaft – Inspect the camshaft for journal damage and lobe damage.

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

- Camshaft Followers and Bearings – Inspect the cam bearings for fatigue and wear.
- Dampers (If Equipped) – It is our recommendation to replace dampers for any of the reasons that follow. For Steps 1 through 3, the inspection must be made during overhaul.

1. The engine has had a failure because of a broken crankshaft.
2. The crankshaft front bearing is badly worn.
3. There is a large amount of gear train wear that is not caused by a lack of oil.
4. Inspection shows slippage (movement) between the inner and outer member of rubber dampers.
5. Inspection shows rubber deterioration because of cracking, spalling, splitting, etc..
6. Leaks, cracks or physical damage to visconic dampers.

If none of the above conditions is found, dampers can be used again at overhaul, providing the damper is not damaged.

- Fuel System Linkage – Inspect the fuel racks and control linkage for excessive wear.
- Gear Train and Gear Train Bushings – Inspect for worn gear teeth, unusual fits and unusual wear.
- Balancer Bushings (3114 Engines Only) – Inspect for worn gear teeth, unusual fits and unusual wear.
- Driven Unit Alignment – Upon reassembly of the drive line and driven unit check alignment as outlined in the Agricultural and Material Handling Application and Installation Guide, LEBH9324 and the following other publications:

SEHS7654 - Alignment-General Instructions

NOTE: For additional information regarding these items, contact your local Caterpillar dealer for assistance.

Clean/Test

Oil Cooler and Aftercooler Cores

Caterpillar recommends that the oil cooler and aftercooler cores be removed, cleaned and pressure tested at Overhaul.

NOTICE

Do not use caustic cleaners to clean the core. Caustic cleaners will attack the internal metals of the core and cause leakage.

NOTE: This cleaning procedure may be used for both the oil cooler and the aftercooler cores.

1. Remove the core. Turn the core upside down to remove debris from the inlet.
2. Back flush internally with cleaner to loosen foreign substances and to remove oil. Caterpillar recommends the use of Caterpillar Hydrosolv Liquid Cleaners. The following chart lists part numbers and quantities of recommended cleaners available from your Caterpillar dealer.

HYDROSOLV LIQUID CLEANERS		
Part No.	Description	Size
1U8812 1U5490 8T7570	Hydrosolv 4165	4 L (1 US gal) 19 L (5 US gal) 208L (55 US Gal)
1U8804 1U5492 8T7571	Hydrosolv 100	4 L (1 US gal) 19 L (5 US gal) 208L (55 US gal) Drum

The cleaners listed in this chart should be used at a two to five percent concentration and at temperatures up to 93°C (200°F). For more information, see NEHS0526, Application Guide, or contact your Caterpillar dealer.

3. Steam clean the core to remove cleaner film. Flush air and side fins of aftercooler cores. Remove any other trapped debris.
4. Wash the core with hot, soapy water. Rinse thoroughly with clean water.
5. Dry the core with compressed air. Blow air in reverse direction of the normal flow. Use all necessary safety equipment while working with compressed air.

6. Inspect the system to ensure cleanliness. The core should be pressure tested. Test and repair the core as necessary. Install the core.

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

Dealer Exchange Components

This cost cutting service permits exchanging worn engine components for quality Cat dealer rebuilt components on an over-the-counter basis. When needed, these parts are ready for a substantial savings in both time and money.

Caterpillar Remanufactured Components – Manufacturing techniques and processes are used to restore components to "like-new" performance capabilities and are exchanged for existing parts. The processes used result in an end product that conforms to the manufacturer's original functional specifications.

The following is a list of (R) Remanufactured components currently being offered by Caterpillar* in many countries.

- Short block
- Cylinder head – bare
- Cylinder head – assembly and group
- Crankshaft – undersized
- Crankshaft – upgrade to new
- Complete turbocharger
- Turbocharger cartridges
- Water pump
- Oil pump
- Connecting rods
- Compressors
- Alternator
- Starting motor
- Governor
- Fuel Injectors

NOTE: If the component you need is not listed here, contact your Caterpillar dealer to see if it is offered under a dealer exchange component program (* X).

* The current parts book will asterisk a part number when a (R) Remanufactured unit is offered by Caterpillar.

Caterpillar Remanufactured Engine – When downtime is critical or a complete overhaul is required, a Caterpillar Remanufactured engine may prove to be the most economical option. It can usually be installed quickly and provides like-new performance at a cost of less than 65 percent of a new engine (with like exchange core).

Caterpillar Recommendation

To further control overhaul costs, Caterpillar recommends that you contact your dealer for information regarding the availability of a Flat Rate After Failure Overhaul.

Maintenance Records

Maintenance records are a key element of a well managed maintenance program. With accurate maintenance records your Caterpillar dealer can help you fine tune the recommended maintenance intervals to meet your specific operating situation. This should result in a lower engine operating cost.

The key elements to keep records on are:

- Liters (Gallons) of Fuel Consumed

This is essential for determining when load-sensitive items should be inspected or repaired, and for determining overhaul intervals.

- Service Hours

This is essential for determining when revolution-sensitive items should be inspected or repaired.

- Documents

The following types of documents should be kept as proof of maintenance or repair for warranty and should not be difficult to obtain and keep in the engine history file. All documents should show date, service hours, liters (gallons) of fuel consumed, unit number and engine serial number. If the engine is sold, transfer the records with the engine.

1. Dealer work orders and itemized bills
2. Owner's repair orders.
3. Owner's receipts.
4. Maintenance log (see following example).

Maintenance Log

Engine Model _____

Customer Identifier_____

Serial Number _____

Arrangement Number_____

[illegible]

Troubleshooting

Troubleshooting a failure on an engine can be a difficult procedure. For a troubleshooting manual, see the Service Manual for your engine. All repairs should be made by a properly trained mechanic. Your Caterpillar dealer has the personnel and special tools needed to troubleshoot and make repairs to your engine.

See the Service Manual for a troubleshooting manual. The list of problems, causes and corrections given in the Service Manual, will only give an indication of where a possible problem can be, and what repairs may be needed.

Remember that a problem is not normally caused only by one part, but by the relation of one part with other parts.

The Service Manual can not give all possible problems and corrections. The serviceman must find the problem and its source, then make the necessary repairs.

Your Caterpillar dealer is equipped with the necessary tools and personnel to provide assistance when necessary.

Literature Reference Materials

Caterpillar Reference Material

The following literature can be obtained through any Caterpillar dealer.

SEBD0518, Know Your Cooling System
SEBD0970, Coolant and Your Engine
SEBD0717, Diesel Fuels and Your Engine
SEBU6042, Recommended Preventive Maintenance Manual for Standby Generator Sets
SEBU6150, SR4 Generators and Control Panels Operation and Maintenance Manual
SEBD0640, Oil and Your Engine
PEGP2802, Caterpillar Remanufactured Products Core Acceptance Guide
SEHS7654, Alignment-General Instructions
SEHS9031, Storage Procedure for Caterpillar Products
SEBF8029, Guideline For Reusable Parts and Salvage Operations (An index of publications on reusability or salvage of used parts.)
SEBF8062, Guideline for Reusable Parts – Cleaning and Inspection of Air Filters
SENR3940, 3114 and 3116 Generator Set Engines Service Manual
SENR3945, 3114, 3116, and 3126 Industrial Engines Service Manual
SENR6454, 3114, 3116, & 3126 Engine Governor Service Manual

LEBH9324, Engine Application and Installation Guide (Agriculture and Material Handling)

SEHS9124, Cleaning and Drying of Caterpillar Electric Set Generators

LEKQ2364 The Caterpillar Engine Technical Manual

LE00002, The Caterpillar Engine Technical Manual (Volume I)

LE00003, The Caterpillar Engine Technical Manual (Volume II)

PEDP7122, Question and Answer Booklet

PEHP0002, Cat Molybdenum Grease (MPGM)

PEHP0003, Cat Lithium Grease (MPGL)

PEHP0017, Cat Special Purpose Grease (SPG)

PEWP0017, Cat Fluids Selector

PEHP7504, Cat Engine Oil Spec Sheets

PEHP7505, Cat Diesel Engine Oil Spec Sheets

Your Caterpillar dealer can provide you with all of the service literature necessary to maintain your engine.

Emissions Warranty

The engine described in this Manual may be Certified and covered by an Emissions Warranty. A detailed explanation of the Emissions Warranty, applicable to Certified engines, is found in SEBU6981, Emissions Control Warranty Information. The Engine is Certified if it has a special Certification Label. A Caterpillar dealer can also inform you if the engine is Certified.

Additional Reference Material

ASTM D217-68, Worked Penetration

ASTM D 445, Viscosity

ASTM D874, Ash Content

ASTM D 893, Insolubles

ASTM D 2896, TBN Measurements

ASTM D 2982B, Ethylene Glycol Content

ASTM D 3828, Fuel Dilution

ASTM 4985-89, Antifreeze

American Society of Testing and Materials (ASTM) specifications can normally be obtained from your local technological society, library or college.

SAE J183 Classification

SAE J313 Diesel Fuels

SAE J754 Nomenclature

Society of Automotive Engineers (SAE) Specs can be found in your SAE handbook or can be obtained from your local library, college or technological society, or contacting:

- Society of Automotive Engineers, Inc.
SAE International
400 Commonwealth Drive
Warrendale, PA USA 15096-0001
(412) 776-4841

American Petroleum Institute (API) classification system and oil selection for API Publication No. 1509 can be obtained from your local library, college or technological society, or contact:

- American Petroleum Institute
1220 L St.
Washington, DC 20005
(202) 682-8000

Engine Manufacturers Association (EMA) information for lube oil selection can be obtained from your local library, college or technological society, or contact:

- Engine Manufacturers Association
Lubricating Oils Data Book
401 N. Michigan Ave. Ste. 2400
Chicago, IL 60611
(312) 644-6610 ext. 3626

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