

# SAFETY.CAT.COM™

## MAINTENANCE INTERVALS

Operation and Maintenance  
Manual Excerpt



# Operation and Maintenance Manual

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## **988G Wheel Loader**

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BNH1-Up (Machine)  
2TW1-Up (Machine)

i02354211

## Maintenance Interval Schedule

**SMCS Code:** 7000

**Note:** All safety information, warnings, and instructions must be read and understood before you perform any operation or any maintenance procedure.

Before each consecutive interval is performed, all of the maintenance requirements from the previous interval must also be performed.

### When Required

Automatic Lubrication Grease Tank - Fill .....	88
Battery - Recycle .....	91
Battery or Battery Cable - Inspect/Replace .....	92
Bucket Lift and Bucket Tilt Control - Inspect/Clean .....	95
Circuit Breakers - Reset .....	98
Engine Air Filter Primary Element - Clean/Replace .....	107
Engine Air Filter Secondary Element - Replace ..	109
Engine Air Precleaner - Clean .....	111
Ether Starting Aid Cylinder - Replace .....	121
Fuel System - Prime .....	121
Fuses - Replace .....	126
Lift Cylinder Pin Oil Level - Check .....	133
Loader Boom Pin Oil Level - Check .....	135
Oil Filter - Inspect .....	137
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Seat Side Rails - Adjust .....	140
Window Washer Reservoir - Fill .....	147
Window Wiper - Inspect/Replace .....	147

### Every 10 Service Hours or Daily

Backup Alarm - Test .....	90
Bucket Cutting Edges - Inspect/Replace .....	94
Bucket Stops - Inspect/Replace .....	95
Bucket Tips - Inspect/Replace .....	95
Bucket Wear Plates - Inspect/Replace .....	97
Cooling System Coolant Level - Check .....	102
Engine Air Filter Service Indicator - Inspect .....	110
Engine Oil Level - Check .....	115
Hydraulic System Oil Level - Check .....	130
Loader Boom Pin and Lift Cylinder Pin - Inspect ..	136
Loader Pins and Bearings - Lubricate .....	136
Seat Belt - Inspect .....	139
Transmission Oil Level - Check .....	145
Walk-Around Inspection .....	146
Windows - Clean .....	147

### Every 50 Service Hours or Weekly

Cab Air Filter - Clean/Replace .....	97
Fuel System Primary Filter (Water Separator) - Check/Drain .....	122
Fuel Tank Water and Sediment - Drain .....	125

Tire Inflation - Check .....	141
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### Every 100 Service Hours or 2 Weeks

Axle Oscillation Bearings - Lubricate .....	90
Steering Cylinder Bearings - Lubricate .....	140

### Initial 250 Service Hours

Transmission Oil Filter - Replace .....	143
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### Every 250 Service Hours

Engine Oil Sample - Obtain .....	116
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### Every 250 Service Hours or Monthly

Battery - Clean .....	91
Belts - Inspect/Adjust/Replace .....	92
Brake Accumulator - Check .....	93
Braking System - Test .....	93
Differential and Final Drive Oil Level - Check .....	105
Engine Air Filter Service Indicator - Inspect/Replace .....	111
Engine Oil (High Speed) and Oil Filter - Change ..	113
Engine Oil and Filter - Change .....	116

### Initial 500 Service Hours

Seat Side Rails - Adjust .....	140
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### Initial 500 Hours (for New Systems, Refilled Systems, and Converted Systems)

Cooling System Coolant Sample (Level 2) - Obtain .....	102
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### Every 500 Service Hours

Differential and Final Drive Oil Sample - Obtain ..	106
Hydraulic System Oil Sample - Obtain .....	131
Transmission Oil Sample - Obtain .....	145

### Every 500 Service Hours or 3 Months

Axle Oil Cooler Filter - Replace .....	89
Cooling System Coolant Sample (Level 1) - Obtain .....	101
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Engine Oil and Filter - Change .....	116
Fuel System Primary Filter (Water Separator) Element - Replace .....	123
Fuel System Secondary Filter - Replace .....	124
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Hydraulic System Oil Filter - Replace .....	129
Transmission Oil Filter - Replace .....	143

### Every 1000 Service Hours or 6 Months

Articulation Bearings - Lubricate .....	88
Battery Hold-Down - Tighten .....	92
Case Drain Oil Filters - Replace .....	98
Drive Shaft Support Bearing - Lubricate .....	107

Rollover Protective Structure (ROPS) - Inspect ..	139
Transmission Oil - Change .....	141

### Every 2000 Service Hours or 1 Year

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Engine Valve Lash - Check .....	120
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Hydraulic System Oil - Change .....	127
Hydraulic Tank Breaker Relief Valve - Clean .....	131
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Loader Boom Pin Oil - Change .....	134
Refrigerant Dryer - Replace .....	138

### Every 3000 Service Hours or 2 Years

Crankshaft Vibration Damper - Inspect .....	104
Engine Mounts - Inspect .....	112

### Every 3 Years After Date of Installation or Every 5 Years After Date of Manufacture

Seat Belt - Replace .....	139
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### Every 4000 Service Hours or 2 Years

Hydraulic System Oil - Change .....	127
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### Every 4000 Service Hours or 2.5 Years

Electronic Unit Injector - Inspect/Adjust .....	107
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### Every 5000 Service Hours or 3 Years

Alternator - Inspect .....	88
Lift Cylinder Pin Oil - Change .....	132
Starting Motor - Inspect .....	140
Turbocharger - Inspect .....	146

### Every 6000 Service Hours or 3 Years

Cooling System Coolant Extender (ELC) - Add ..	100
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### Every 6000 Service Hours or 6 Years

Cooling System Water Temperature Regulator - Replace .....	103
Engine Water Pump - Inspect .....	120

### Every 12 000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change .....	99
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i02154861

## Alternator - Inspect

SMCS Code: 1405-040

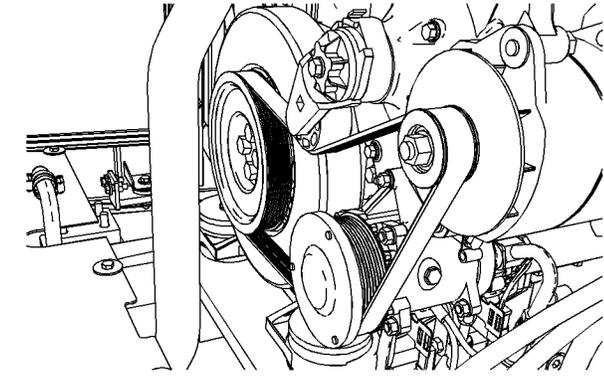


Illustration 132

g01092657

The alternator is located on the right side of the machine.

Caterpillar recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and for proper battery charging.

Keep the batteries fully charged.

Air temperature affects the cranking power of the batteries. Keep the batteries warm. The engine will not crank if the batteries are too cold. A warm engine will not crank if the batteries are too cold.

When the engine is operated for short periods of time, the batteries may not fully recharge. Make sure that the alternator is properly functioning. The alternator will charge the batteries.

**Reference:** For additional information, refer to the appropriate Service Manual for this machine.

i02147795

## Articulation Bearings - Lubricate

SMCS Code: 7057-086-BD; 7065-086-BD;  
7066-086-BD

Wipe off the fittings before any lubricant is applied.

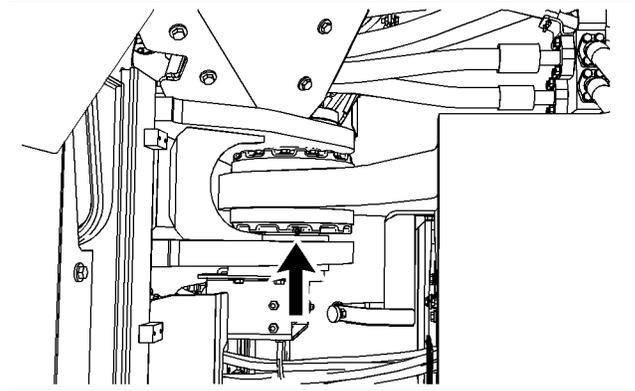


Illustration 133

g01092660

Apply grease through one fitting on the upper pivot bearing.

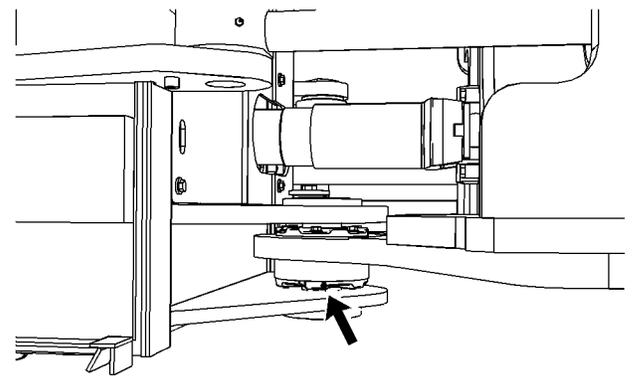


Illustration 134

g01092661

Apply grease through one fitting on the lower pivot bearing.

i02216552

## Automatic Lubrication Grease Tank - Fill (If Equipped)

SMCS Code: 7540-544-TNK

### **WARNING**

A pressure hazard is present. Severe personal injury or death can result from removing hoses or fittings that are under pressure. Relieve the pressure in the system before you remove hoses or fittings.

i02335496

## The Centro-Matic Lubrication System

**Reference:** Before any service work is performed on the lubrication system, refer to Special Instructions, REHS1394 or consult your Caterpillar dealer.

### Bulk Fill

1. In order to fill the reservoir, remove the lower and upper plugs from the side of the reservoir.
2. Attach the appropriate pump to the lower inlet.
3. Fill the reservoir until visual indicator on the lid of the tank indicates FULL or until the grease appears at the top vent port.

**Reference:** For the correct type of grease, refer to Operation and Maintenance Manual, "Lubricant Viscosities".

4. Remove the pump and replace both plugs.

## The Quicklub Lubrication System

**Reference:** Before any service work is performed on the lubrication system, refer to Special Instructions, REHS1396 or consult your Caterpillar dealer.

### Filling the Reservoir

1. Fill the reservoir through the grease fitting. The grease fitting is located at the base of the reservoir.

**Reference:** For the correct type of grease, refer to Operation and Maintenance Manual, "Lubricant Viscosities".

2. Refill the reservoir when the grease reaches the "MIN" mark on the reservoir.
3. Fill the reservoir to the "MAX" mark on the reservoir.

### Priming the System

After the reservoir has been filled with the recommended lubricant, loosen the fitting to the supply line. Operate the pump until lubricant flows from the outlet. Then, tighten fitting.

## Axle Oil Cooler Filter - Replace

**SMCS Code:** 3004-510-AOC

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

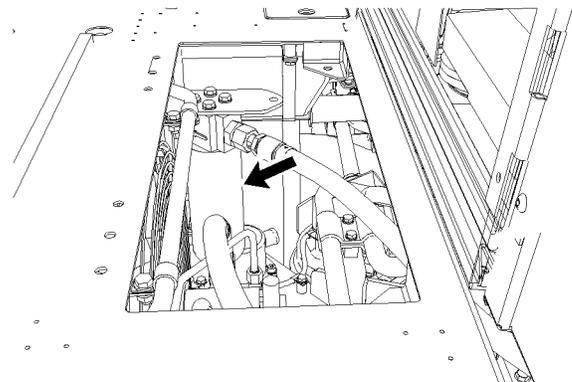


Illustration 135  
Front Filter

g01092743

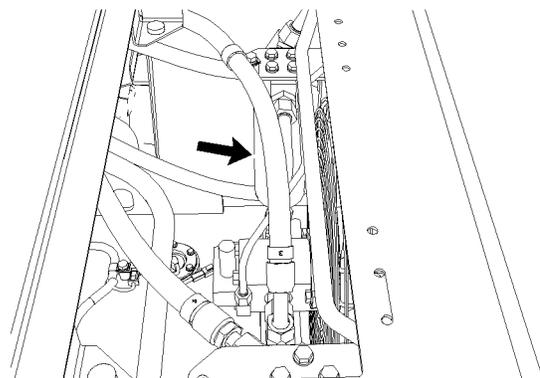


Illustration 136  
Rear Filter

g01092745

The filters are located under the access door on the left cab platform.

1. Stop the engine.

2. Use a strap type wrench to remove the filters. Dispose of the used filters properly.
3. Clean the filter mounting bases. Make sure that all of the used seal is removed from each filter mounting base.

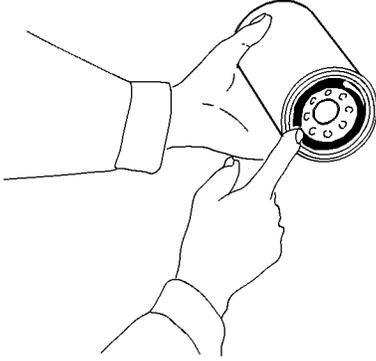


Illustration 137

g00101318

4. Apply a thin coat of clean differential oil to the seal of each new oil filter. Install each new oil filter hand tight until the seals of the oil filters contacts each base. Note the position of each index mark on each filter in relation to a fixed point on each filter base.

**Note:** There are rotation index marks on each oil filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten each oil filter, use the rotation index marks as a guide.

5. Tighten each filter according to the instructions that are printed on each filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

**Note:** You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

6. Start the engine and run the engine at low idle. Check for leaks.
7. Check the level of the differential oil.

**Reference:** Refer to Operation and Maintenance Manual, "Differential and Final Drive Oil Level - Check" for the correct procedure.

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## Axle Oscillation Bearings - Lubricate

**SMCS Code:** 3268-086-BD; 3278-086-BD

Wipe off the fittings before any lubricant is applied.

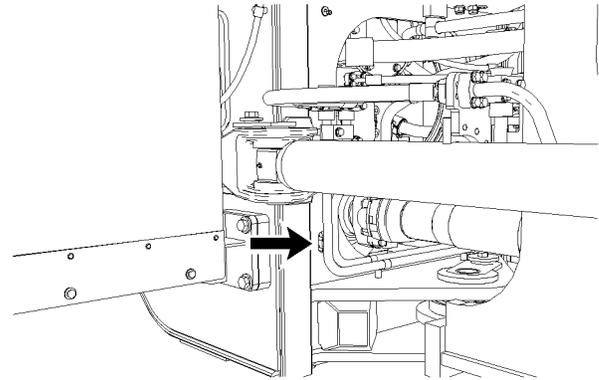


Illustration 138

g01092451

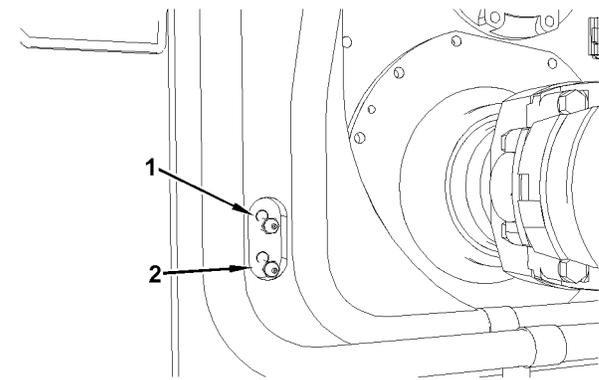


Illustration 139

g01092452

Apply lubricant through the two remote fittings on the right side of the machine. Fitting (1) applies grease to the rear axle oscillation bearing. Fitting (2) applies grease to the front axle oscillation bearing.

i02319912

## Backup Alarm - Test

**SMCS Code:** 7406-081

**S/N:** 2TW1-Up

Turn the engine start switch key to the ON position in order to perform the test.

Apply the service brake.

Move the transmission direction control lever to the REVERSE position.

The alarm should start to sound immediately. The alarm will continue to sound until the transmission direction control lever is moved to the NEUTRAL position or to the FORWARD position.

i02155427

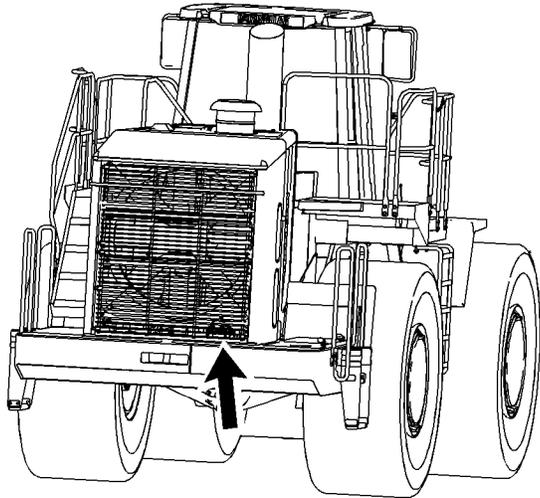


Illustration 140

g01091949

The backup alarm is located behind the rear grill.

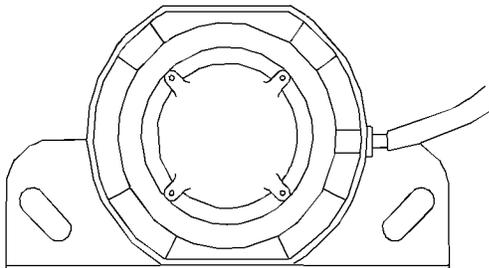


Illustration 141

g01117861

The volume for the backup alarm is nonadjustable.

## Battery - Clean

SMCS Code: 1401-070

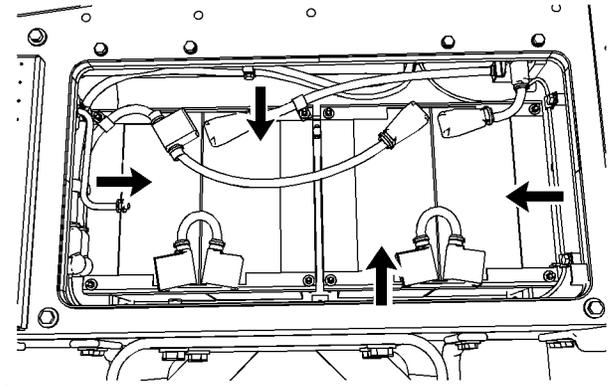


Illustration 142

g01093084

Open the battery compartment on the right rear side of the machine.

Clean the battery terminals and the surfaces of the batteries with a clean cloth. Coat the battery terminals with petroleum jelly. Make sure that the battery cables are installed securely.

i00993589

## Battery - Recycle

SMCS Code: 1401-561

Always recycle a battery. Never discard a battery.

Always return used batteries to one of the following locations:

- A battery supplier
- An authorized battery collection facility
- Recycling facility

i02155501

## Battery Hold-Down - Tighten

SMCS Code: 7257-527

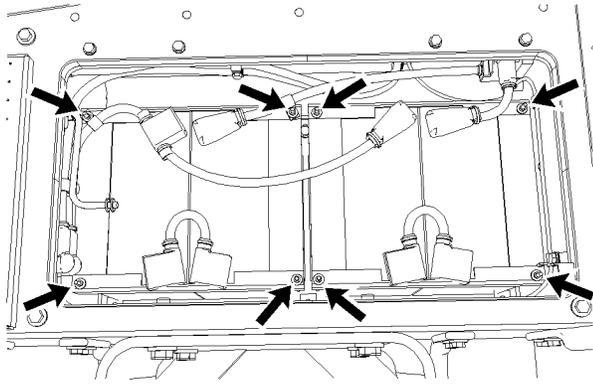


Illustration 143

g01093110

Open the battery compartment on the right rear side of the machine.

Over time, the vibration of an operating machine can cause the battery hold-downs to loosen. To help to prevent loose batteries and the possibility of loose cable connections, tighten the eight nuts on the two hold-downs to a torque of  $2.50 \pm 0.25$  N·m ( $22 \pm 2$  lb in).

i01770834

## Battery or Battery Cable - Inspect/Replace

SMCS Code: 1401-040; 1401-510; 1402-040; 1402-510

1. Turn the engine start switch key OFF. Turn all of the switches OFF.
2. Turn the battery disconnect switch OFF. Remove the key.
3. Disconnect the negative battery cable from the disconnect switch.

**Note:** Do not allow the disconnected battery cable to contact the disconnect switch.

4. Disconnect the negative battery cable at the battery.
5. Disconnect the positive battery cable at the battery.
6. Inspect the battery terminals for corrosion. Inspect the battery cables for wear or damage.

7. Make any necessary repairs. If necessary, replace the battery cables or the battery.
8. Connect the positive battery cable at the battery.
9. Connect the negative battery cable at the battery.
10. Connect the battery cable at the battery disconnect switch.
11. Install the key and turn the battery disconnect switch ON.

i01916166

## Belts - Inspect/Adjust/Replace

SMCS Code: 1397-025; 1397-040; 1397-510

**Note:** The alternator and the refrigerant compressor are driven by a single serpentine belt.

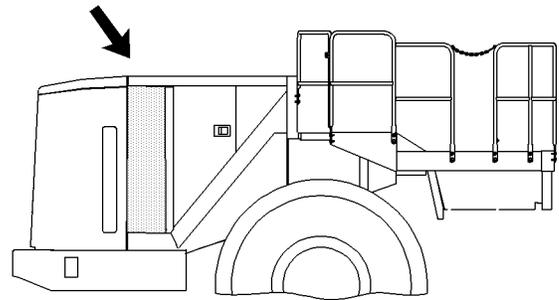


Illustration 144

g00935723

1. Stop the engine. Access the belt from the right side of the machine.

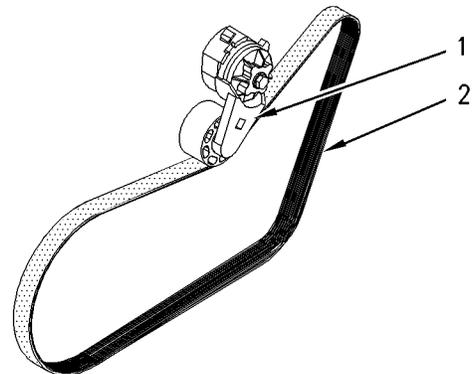


Illustration 145

g00998184

**Note:** The belt can be serviced via the engine access door or the vent and the firewall can be removed for easier access.

2. Inspect the condition of belt (2). If the belt is cracked or frayed, replace the belt.
3. Use a ratchet with a square head to loosen belt tensioner (1) during replacement. Make sure that the belt is installed in the correct pattern, as shown.

i02215711

## Brake Accumulator - Check

**SMCS Code:** 4263-535

1. Turn the engine start switch to the ON position. The alert indicator for brake oil pressure should come on if the braking system is not at normal operating pressure. Refer to Operation and Maintenance Manual, "Monitoring System" for the location of the alert indicators.
2. Start the engine. Run the engine at half speed for two minutes in order to increase the accumulator pressure. The alert indicator for brake oil pressure should go off.
3. Stop the engine. Apply the service brake pedal and release the service brake pedal. The rate for this process is 1 second on and 1 second off. Do this process until the alert indicator for brake oil pressure comes on. This will decrease the accumulator pressure. A minimum of five applications of the service brake pedal are required with new discs. The number of applications could be as low as three when the lining material on the brake discs is at replacement thickness.
4. If the alert indicator comes on after less than 3 applications of the brake, measure the accumulator precharge pressure. An authorized Caterpillar dealer can measure the nitrogen gas pressure in the accumulator. Use only dry nitrogen gas for recharging.

**Reference:** Refer to Testing and Adjusting, RENR6365, "834H/836H Tier 3 Braking System", "Accumulator Charging Valve (Brake)-Test and Adjust" for the correct procedure.

i01739721

## Braking System - Test

**SMCS Code:** 4251-081; 4267-081

- Fasten the seat belt before you test the brakes.
- Park the machine on a dry, level surface.

- Check the area around the machine. Make sure that the machine is clear of personnel and clear of obstacles.
- Make sure that the steering frame lock is in the unlocked position.

The following tests are used to determine whether the braking system is functional. These tests are not intended to measure the maximum brake holding effort. The required brake holding effort for sustaining a machine at a specific engine rpm varies from one machine to another machine. The variations include differences in the engine setting, the power train efficiency, the brake holding ability, etc.

## Service Brake Holding Ability Test

### **WARNING**

**Personal injury can result if the machine moves while testing.**

**If the machine begins to move during test, reduce the engine speed immediately and engage the parking brake.**

1. Start the engine. Raise the implement slightly. Apply the service brake. Release the parking brake.
2. Move the transmission control to THIRD SPEED FORWARD while the service brakes are applied. Make sure that the autoshift control is in the OFF position.
3. Gradually increase the engine speed to high idle. The machine should not move.
4. Reduce the engine speed to low idle. Move the transmission direction control to the NEUTRAL position. Engage the parking brake. Lower the implement to the ground. Stop the engine.

If the machine moved during the test, consult your Caterpillar dealer for a brake inspection. Make any necessary repairs before the machine is returned to operation.

## Parking Brake Holding Ability Test

### **WARNING**

Personal injury can result if the machine moves while testing.

If the machine begins to move, reduce the engine speed immediately and apply the service brake pedal.

This test is performed when the parking brake is engaged. If the machine begins to move, compare the engine rpm to the engine rpm of a prior test. This will indicate the amount of system deterioration.

1. Start the engine. Raise the implement slightly. Engage the parking brake.
2. Move the transmission control to THIRD SPEED FORWARD. Make sure that the autoshift control is in the OFF position.  
  
The parking brake indicator light should come on.
3. Gradually increase the engine speed to high idle. The machine should not move.
4. Reduce the engine speed to low idle. Move the transmission direction control to the NEUTRAL position. Lower the implement to the ground. Stop the engine.

If the machine moved during the test, consult your Caterpillar dealer for a brake inspection. Make any necessary repairs before the machine is returned to operation.

i01548255

## Bucket Cutting Edges - Inspect/Replace

SMCS Code: 6801-040; 6801-510

### **WARNING**

Personal injury or death can result, if the bucket is not blocked up. Block the bucket before changing cutting edge.

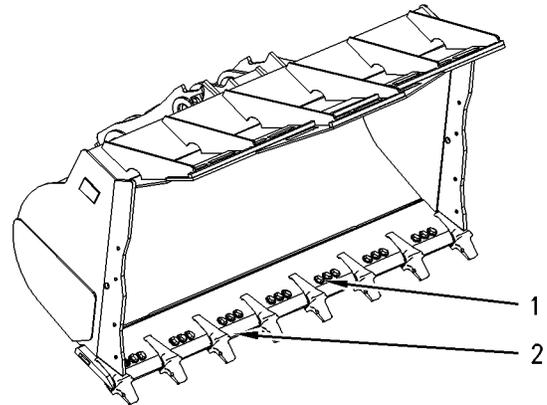


Illustration 146

g00804790

Check for bolts that are missing or loose. Replace any missing bolts and tighten any loose bolts.

**Reference:** Refer to Operation and Maintenance Manual, "Torques for Ground Engaging Tool Bolts" for the correct torque.

Inspect the cutting edges and the end bits. If wear or damage is evident, use the following procedure to replace the components.

1. Raise the bucket and place blocking under the bucket. Lower the bucket onto the blocking.  
  
**Note:** Do not block up the bucket too high. Block up the bucket enough for removing the cutting edges and the end bits.
2. Remove bolts (1). Remove cutting edges (2) and the end bits.
3. Clean the contact surfaces. Inspect the cutting edges and install the cutting edges.  
  
If the opposite side of the cutting edge is not worn, use that side. If both sides of the cutting edge are worn, install a new cutting edge.
4. Install bolts (1). Tighten the bolts to the specified torque.
5. Raise the bucket and remove the blocking. Lower the bucket to the ground.
6. After a few hours of operation, check the bolts for proper torque.

i01923042

i01916176

## Bucket Lift and Bucket Tilt Control - Inspect/Clean

**SMCS Code:** 5258-571; 5702-571

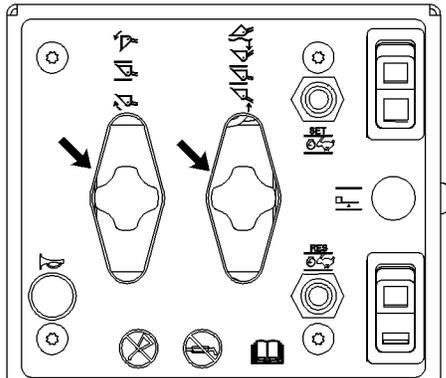


Illustration 147

g01000783

**Note:** Do not use any lubricants on any part of this control. The moving parts of this control are self-lubricated.

Use the following procedure in order to clean the control levers.

1. Disconnect the wiring from the controls.
2. Disassemble the controls.
3. Wash the parts with warm soapy water.
4. Rinse the parts thoroughly with water.
5. Dry the parts thoroughly.
6. Reassemble the controls.
7. Reconnect the wiring to the controls.

## Bucket Stops - Inspect/Replace

**SMCS Code:** 6001-040-SQ; 6001-510-SQ;  
6102-040-SQ; 6102-510-SQ

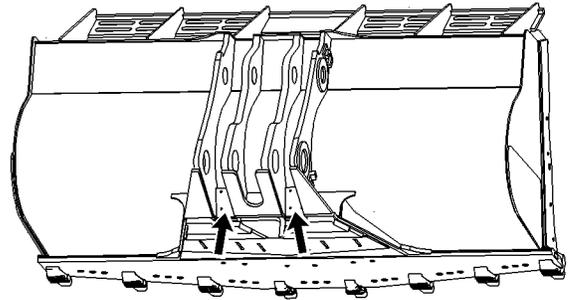


Illustration 148

g00554961

Check for bucket stops that are damaged or missing. Replace the bucket stops, if necessary.

**Note:** Recalibrate the tilt position sensor after you recalibrate the bucket stops. Refer to Operation and Maintenance Manual, "Position Sensor for the Tilt Linkage (Caterpillar Monitoring System) - Calibrate" for more information.

i02105676

## Bucket Tips - Inspect/Replace

**SMCS Code:** 6805-040; 6805-510

**WARNING**

Personal injury or death can result from the bucket falling.

**Block the bucket before changing bucket tips.**

## Bucket Tips

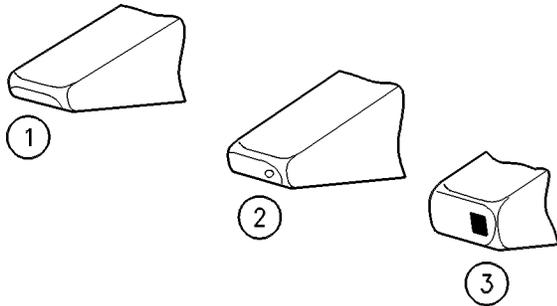


Illustration 149 g00101352

- (1) Usable
- (2) Replace
- (3) Replace

Check the bucket tips for wear. If the bucket tip has a hole, replace the bucket tip.

1. Remove the pin from the bucket tip. The pin can be removed by one of the following methods.
  - Use a hammer and a punch from the retainer side of the bucket to drive out the pin.
  - Use a Pin-Master. Follow Step 1.a through Step 1.c for the procedure.

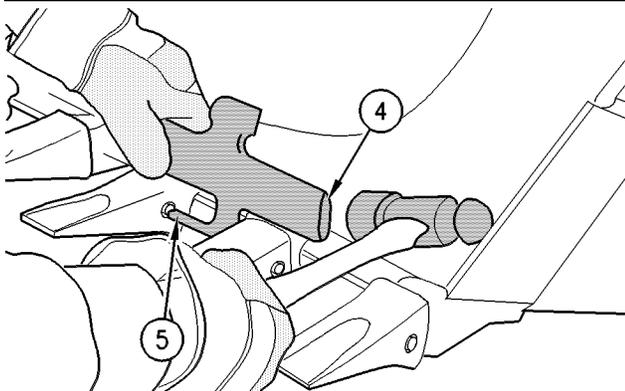


Illustration 150 g00590670

- (4) Back of Pin-Master
- (5) Extractor

- a. Place the Pin-Master on the bucket tooth.
- b. Align extractor (5) with the pin.
- c. Strike the Pin-Master at the back of the tool (4) and remove the pin.

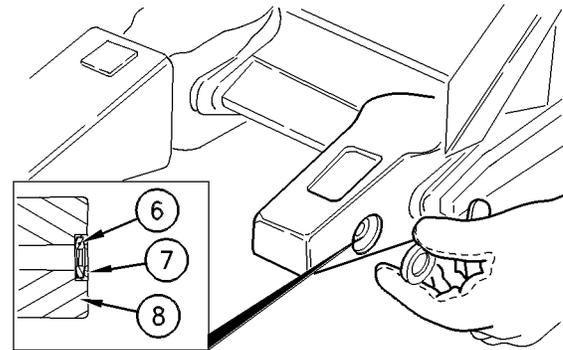


Illustration 151

g00590819

- (6) Retainer
- (7) Retaining washer
- (8) Adapter

2. Clean the adapter and the pin.
3. Fit retainer (6) into retaining washer (7). Install this assembly into the groove that is in the side of adapter (8).

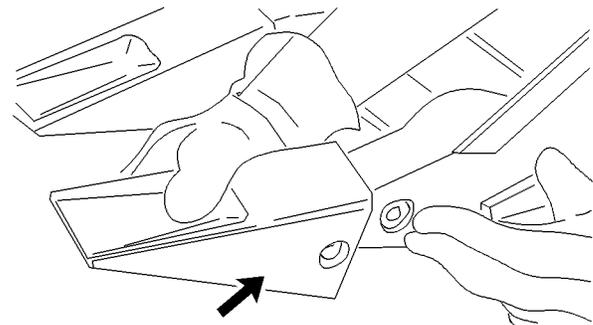


Illustration 152

g00101359

4. Install the new bucket tip onto the adapter.  
**Note:** The bucket tip can be rotated by 180 degrees in order to allow greater penetration or less penetration.
5. Drive the pin through the bucket tip. The pin can be installed by using one of the following methods:
  - From the other side of the retainer, drive the pin through the bucket tip, the adapter, and the retainer.
  - Use a Pin-Master. Follow Step 5.a through Step 5.e for the procedure.

**Note:** To correctly install the pin into the retainer, the pin must be driven in from the right side of the tooth. Improper installation of the pin can result in the loss of the bucket tip.

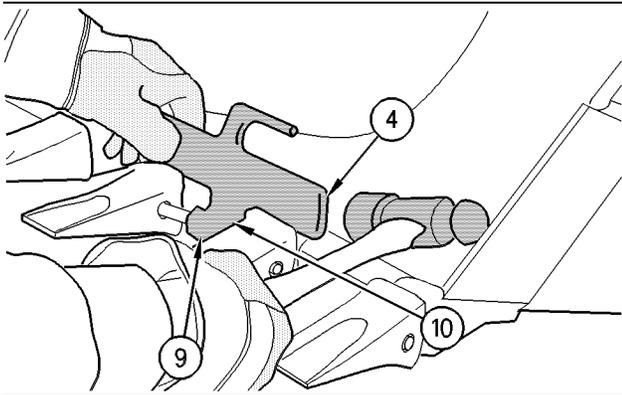


Illustration 153

g00590666

- (4) Back of Pin-Master  
(9) Pin setter  
(10) Pin holder

- a. Insert the pin through the bucket tooth.
  - b. Place the Pin-Master over the bucket tooth and locate the pin in the hole of holder (10).
  - c. Strike the tool with a hammer at the back of the tool (4) in order to start the pin.
  - d. Slide pin holder (10) away from the pin and rotate the tool slightly in order to align pin setter (9) with the pin.
  - e. Strike the end of the tool until the pin is fully inserted.
6. After you drive the pin, make sure that the retainer fits snugly into the pin groove.

i01098709

## Bucket Wear Plates - Inspect/Replace

**SMCS Code:** 6120-040; 6120-510

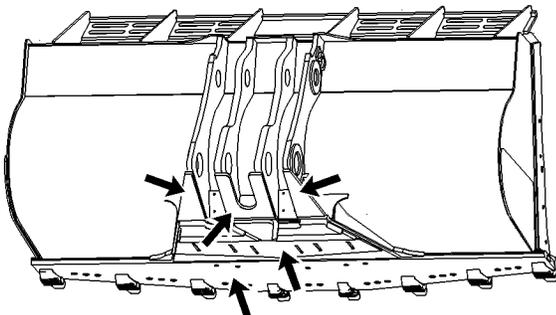


Illustration 154

g00577650

Before damage to the bottom of the bucket occurs, repair damaged bucket wear plates or replace damaged bucket wear plates.

Consult your Caterpillar dealer for the procedures.

i01908538

## Cab Air Filter - Clean/Replace

**SMCS Code:** 7342-070; 7342-510

**Note:** Clean the cab air filters more often if the machine is being operated in dusty conditions.

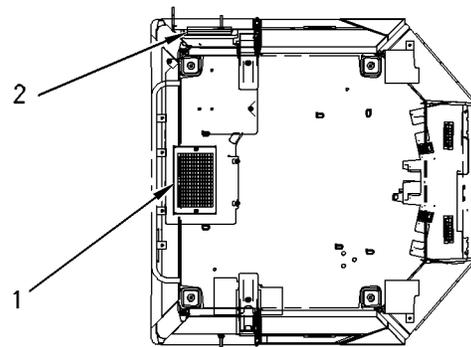


Illustration 155

g00994599

1. Remove the filter cover behind the seat. Remove the filter element.
2. Open the access door on the left side of the cab. Remove the filter element.
3. Clean the filter elements with pressure air or wash the filter elements in warm water with a nonsudsing household detergent.
4. If water and detergent are used to clean the filter elements, rinse the filter elements in clean water and allow the filter elements to air dry thoroughly.

**Note:** If either filter element is damaged, install a new filter element.

5. Install the filter elements. Install the filter cover and close the access door.

i01543124

i02155537

## Case Drain Oil Filters - Replace (If Equipped)

SMCS Code: 5091-510

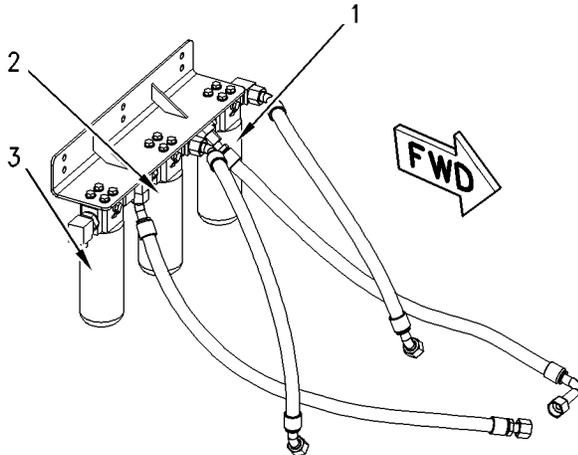


Illustration 156

g00801622

(1) Case drain filter for the steering pump. (2) Case drain filter for the implement pump. (3) Case drain filter for the fan motor.

The case drain filters are located under the access door in the platform behind the cab.

1. Stop the engine.
2. Use a strap type wrench to remove the filter element. Dispose of the used filter element properly.
3. Clean the filter mounting base. Make sure that all of the used gasket is removed from the filter mounting base.
4. Lubricate the gasket of a new filter element with clean hydraulic oil.
5. Install the new filter element by hand. When the gasket contacts the filter mounting base, tighten the filter element by an additional 3/4 turn.
6. Repeat the above steps for the other two case drain filters.
7. Start the engine and run the engine at low idle. Operate the steering, the brakes, and the implement.
8. Stop the engine. Inspect the filters for leaks. Make any necessary repairs.

## Circuit Breakers - Reset

SMCS Code: 1420-529

 **Circuit Breakers** – Depress the button in order to reset the circuit breaker. If the circuit is functioning properly, the button will remain depressed. If the button will not remain depressed, check the appropriate electrical circuit.

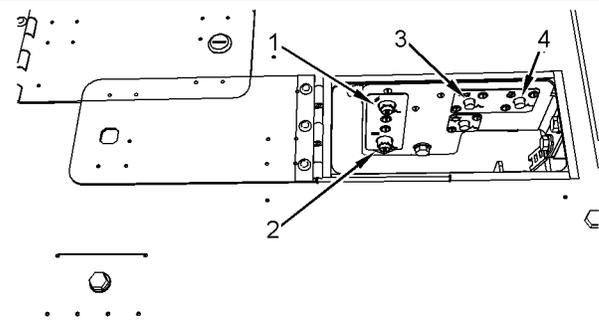


Illustration 157

g01093167

The circuit breakers are located under a small access door on the right cab platform.

-  **Main Circuit (1) – 105 amp**
-  **Alternator (2) – 105 amp**
-  **Engine Start Switch (3) – 10 amp**
-  **Electronic Control Module (ECM) (4) – 15 amp**

i02156049

## Cooling System Coolant (ELC) - Change

SMCS Code: 1350-044-NL

### WARNING

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

### NOTICE

Topping off or mixing Cat ELC with other products that do not meet Caterpillar EC-1 specifications reduces the effectiveness of the coolant and shortens coolant service life.

Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for pre-mixed or concentrate coolants. Use only Extender with Cat ELC.

Failure to follow these recommendations can result in shortened cooling system component life.

**Reference:** For information about the addition of Extender to your cooling system, refer to Operation and Maintenance Manual, "Cooling System Coolant Extender (ELC) - Add" or consult your Caterpillar dealer.

If you change the coolant of a machine to Extended Life Coolant from another type of coolant, use a Caterpillar cleaning agent to flush the cooling system. After you drain the cooling system, thoroughly flush the cooling system with clean water. **All of the cleaning agent must be removed from the cooling system.**

If an Extended Life Coolant was previously used, flush the cooling system with clean water. No other cleaning agents are required. Use the following procedure to change the cooling system coolant (ELC).

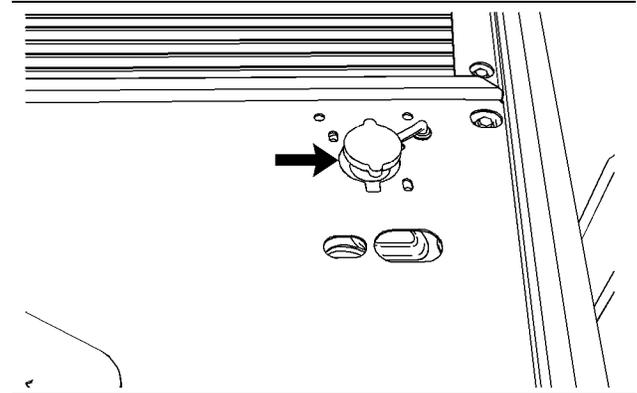


Illustration 158

g01093449

The cooling system pressure cap is located on the left side of the machine on the top of the radiator.

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

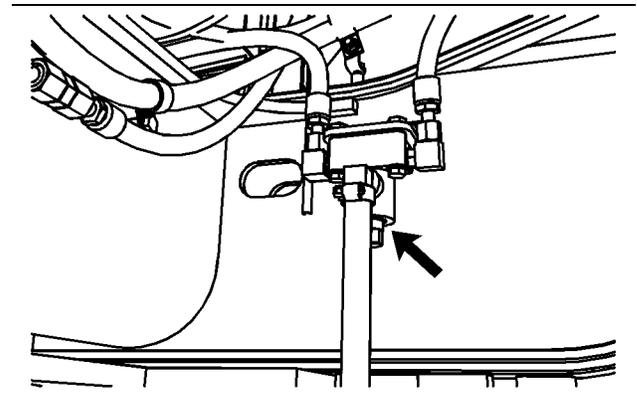


Illustration 159

g01093450

The drain valve is located at the rear of the machine under the engine compartment.

2. If equipped, remove the bottom guard in order to access the coolant drain valve.
3. Open the drain valve. Allow the coolant to drain into a suitable container.
4. Flush the cooling system with clean water until the draining water is transparent.
5. Close the drain valve. Replace the bottom guard, if equipped.
6. Replace the water temperature regulator.

**Reference:** Refer to Operation and Maintenance Manual, "Cooling System Water Temperature Regulator - Replace" for the correct procedure.

7. Add the coolant solution.

**Reference:** Refer to Operation and Maintenance Manual, "Capacities (Refill) " for the capacity of the cooling system.

8. Start the engine. Run the engine without the cooling system pressure cap until the water temperature regulator opens and the coolant level stabilizes.

9. Check the coolant level.

**Reference:** Refer to Operation and Maintenance Manual, "Cooling System Level - Check" for the correct procedure.

10. Install the cooling system pressure cap. Stop the engine.

i02156106

## Cooling System Coolant Extender (ELC) - Add

SMCS Code: 1352-544-NL

### WARNING

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

### NOTICE

Topping off or mixing Cat ELC with other products that do not meet Caterpillar EC-1 specifications reduces the effectiveness of the coolant and shortens coolant service life.

Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for pre-mixed or concentrate coolants. Use only Extender with Cat ELC.

Failure to follow these recommendations can result in shortened cooling system component life.

When a Caterpillar Extended Life Coolant (ELC) is used, an Extender must be added to the cooling system.

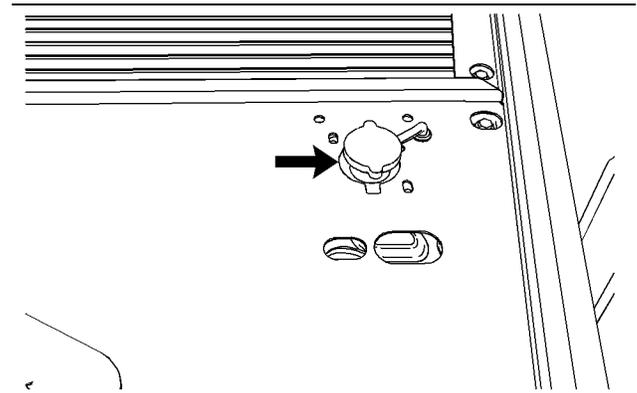


Illustration 160

g01093449

The cooling system pressure cap is located on the left side of the machine on the top of the radiator.

1. Slowly loosen the cooling system pressure cap in order to relieve system pressure. Remove the cooling system pressure cap.
2. Use a 8T-5296 Coolant Test Kit to check the concentration of the coolant. If it is necessary, adjust the concentration of the coolant.

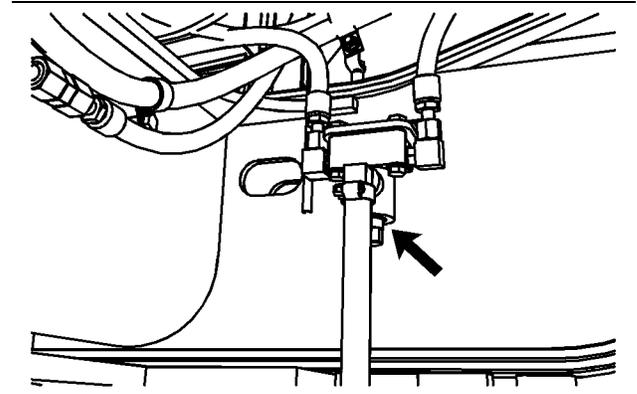


Illustration 161

g01093450

3. If necessary, drain enough coolant from the radiator in order to allow the addition of the Extender. The coolant drain valve is located at the rear of the machine under the engine compartment.
4. Add 3 L (100 fl oz) of Extender to the cooling system.
5. Check the coolant level.

**Reference:** Refer to Operation and Maintenance Manual, "Cooling System Level - Check" for the correct procedure.

6. Install the cooling system pressure cap.

i02279454

## Cooling System Coolant Sample (Level 1) - Obtain

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

**Note: It is not necessary to obtain a Coolant Sample (Level 1) if the cooling system is filled with Cat ELC (Extended Life Coolant).** Cooling systems that are filled with Cat ELC should have a Coolant Sample (Level 2) that is obtained at the recommended interval that is stated in the Maintenance Interval Schedule.

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

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

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

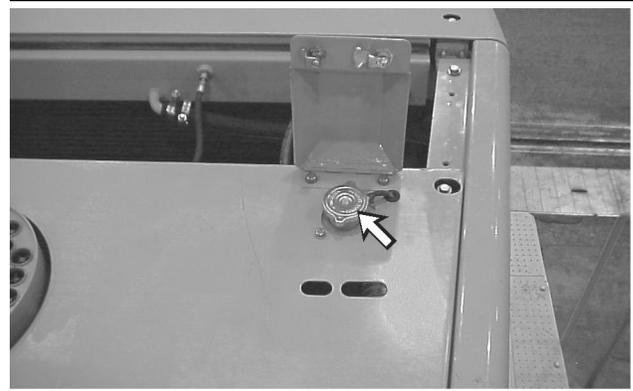


Illustration 162

g00545995

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

Use the following guidelines for proper sampling of the coolant:

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

Submit the sample for Level 1 analysis.

For additional information about coolant analysis, see Special Publication, SEBU6250, "Caterpillar Machine Fluids Recommendations" or consult your Caterpillar dealer.

i01917168

## Cooling System Coolant Sample (Level 2) - Obtain

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

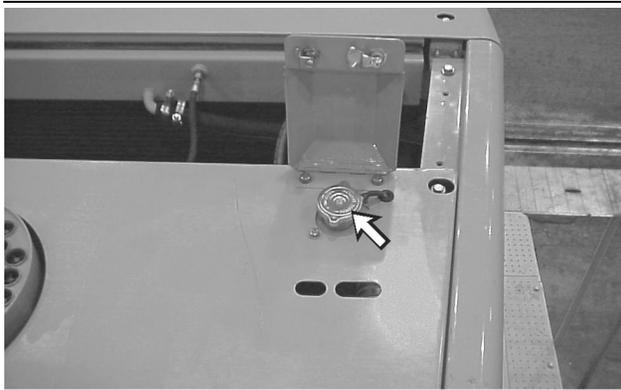


Illustration 163

g00545995

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

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

Submit the sample for Level 2 analysis.

**Reference:** For additional information about coolant analysis, refer to Special Publication, SEBU6250, "Caterpillar Machine Fluids Recommendations" or consult your Caterpillar dealer.

i02281837

## Cooling System Coolant Level - Check

**SMCS Code:** 1350-535-FLV

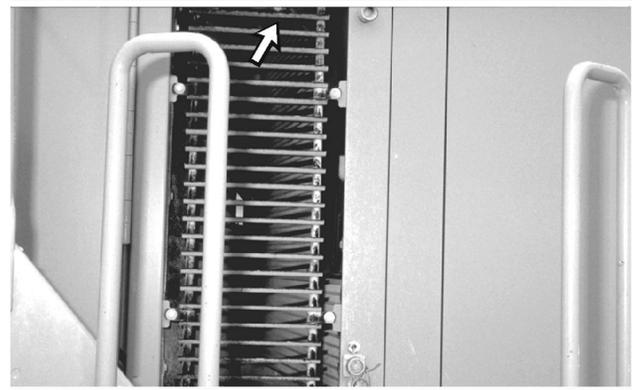


Illustration 164

g00551021

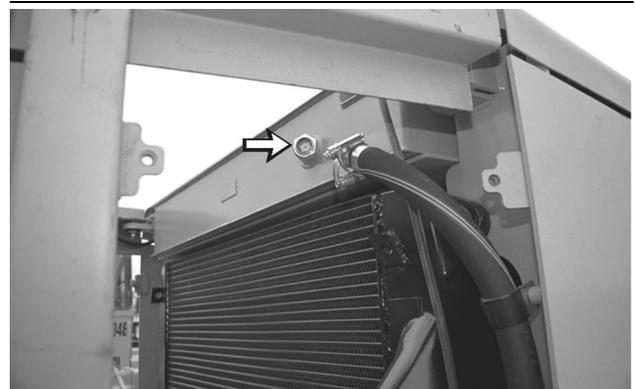


Illustration 165

g00500295

The sight gauge is located on the left side of the machine. The sight gauge can be viewed through the vents on the left side of the machine.

1. Maintain the coolant level within the sight gauge.

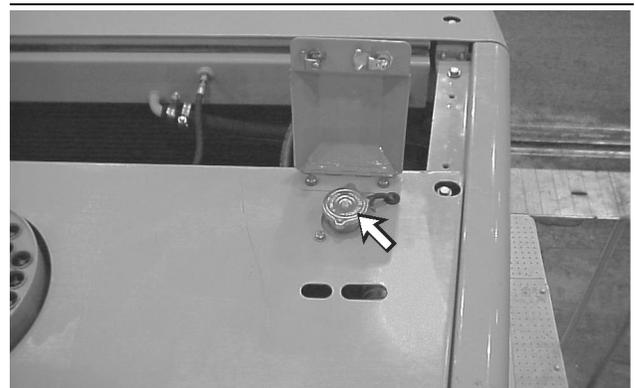


Illustration 166

g00545995

**NOTICE**

Topping off or mixing Cat ELC with other products that do not meet Caterpillar EC-1 specifications reduces the effectiveness of the coolant and shortens coolant service life.

Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for pre-mixed or concentrate coolants. Use only Extender with Cat ELC.

Failure to follow these recommendations can result in shortened cooling system component life.

2. If the coolant level is low, slowly remove the cooling system pressure cap on the top left side of the machine and add the required coolant in order to maintain the coolant level within the sight gauge.

**Note:** If it is necessary to add coolant daily, check for leaks.

3. Inspect the cooling system pressure cap and the cap seal. Clean the cap and install the cap. If the cap is damaged, install a new cooling system pressure cap.
4. Inspect the radiator core for debris. Clean the radiator core, if necessary.

**Reference:** Refer to Operation and Maintenance Manual, "Radiator Core - Clean" for more information.

i01629860

## Cooling System Water Temperature Regulator - Replace

SMCS Code: 1355-510; 1393-010

### WARNING

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

Replace the water temperature regulator on a regular basis in order to reduce the chance of unscheduled downtime and the chance of problems with the cooling system.

The water temperature regulator should be replaced after the cooling system has been cleaned. Replace the water temperature regulator and replace the seals while the cooling system is completely drained or while the cooling system coolant is drained to a level that is below the water temperature regulator housing.

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

**NOTICE**

Failure to replace the engine's thermostat on a regularly scheduled basis could cause severe engine damage.

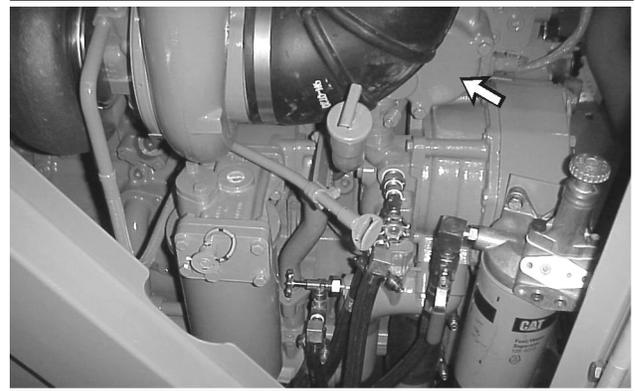


Illustration 167

g00546349

The water temperature regulator is located on the left side of the engine near the fuel filter.

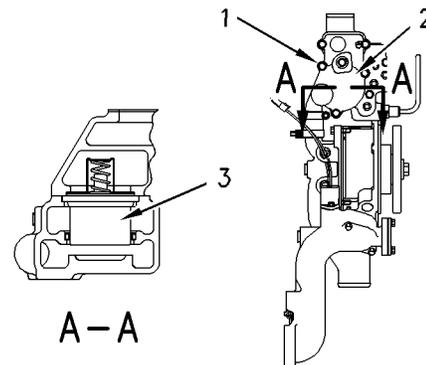


Illustration 168

g00844391

1. Remove bolts (1) and cover (2). Remove all of the used gasket from the regulator housing.
2. Remove the elbow and water temperature regulator (3).

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**NOTICE**

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

If the thermostat is installed wrong, it will cause the engine to overheat. Inspect gaskets before assembly and replace if worn or damaged.

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3. Install a new gasket on the regulator housing. Install a new water temperature regulator.
4. Install the bolts and the cover.

i01923122

## Crankshaft Vibration Damper - Inspect

**SMCS Code:** 1205-040

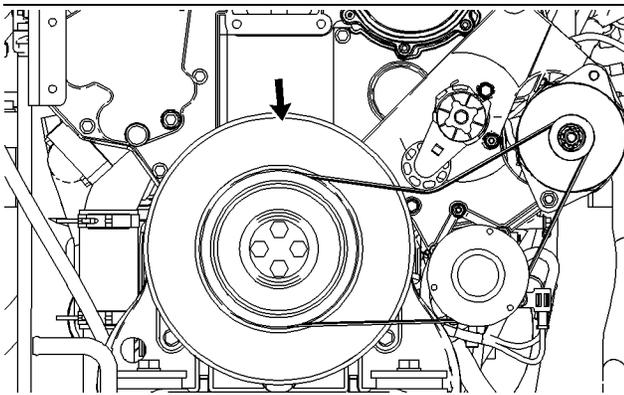


Illustration 169

g01000821

The crankshaft vibration damper is located at the rear end of the engine compartment.

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

Caterpillar recommends replacing the vibration damper for any of the following reasons:

- The engine has had a failure because of a broken crankshaft.
- The S·O·S oil analysis detected a worn crankshaft front bearing.
- The S·O·S oil analysis detected a large amount of gear train wear that is not caused by a lack of oil.

The vibration damper can be used again if none of the above conditions are found and the damper is not damaged.

Inspect the vibration damper for dents in the outer case. Dents in the outer case may cause failure of the damper. Install a new vibration damper if the damper is damaged.

**Reference:** Refer to the Disassembly and Assembly manual for your machine's engine for the necessary replacement procedure.

i01830728

## Differential and Final Drive Oil - Change

**SMCS Code:** 3278-044; 4050-044

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**NOTICE**

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

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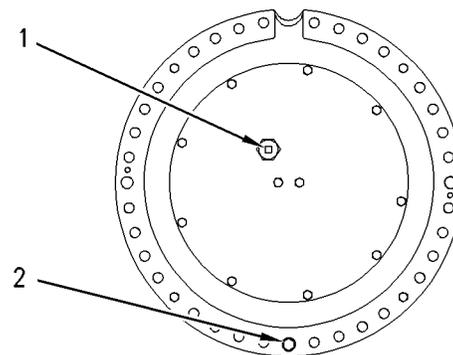


Illustration 170

Final Drive

g00801038

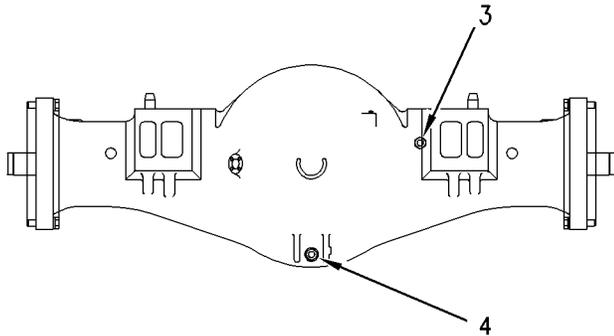


Illustration 171

g00840713

Front Differential

1. Position the wheels so that the front final drive drain plugs (2) are facing downward. Remove the front final drive drain plugs (2) and the front differential drain plug (4). Allow the oil to drain into a suitable container.
2. Remove the front final drive filler plugs (1) and the front differential filler plug (3).
3. After the oil has drained, clean the drain plugs and install the drain plugs.
4. Fill the final drives to the bottom of the filler plug openings.

**Reference:** Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct type of oil and for the correct amount of oil.

5. Add three 1 L (1.1 qt) bottles of 1U-9891 Hydraulic Oil Additive to the differential.
6. Clean the filler plugs and install the filler plugs.

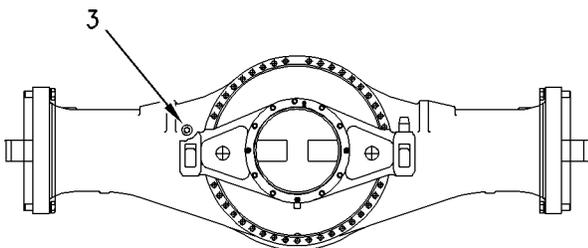


Illustration 172

g00840708

Rear Differential Filler Plug (3)

7. Repeat steps 2 through 6 for the rear final drives and the rear differential.

8. If the specified amount of oil will not fit in the final drives, install the final drive filler plugs. Operate the machine on level ground for a few minutes in order to equalize the oil level in the axles.
9. Remove the final drive filler plugs and add the remaining oil. The oil level should reach the bottom of the filler plug opening.

**Note:** If the oil level is higher than the filler plug opening, do not allow the oil to drain to the proper level. Install the filler plug.

i01624405

## Differential and Final Drive Oil Level - Check

**SMCS Code:** 3278-535-FLV; 4050-535-FLV

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

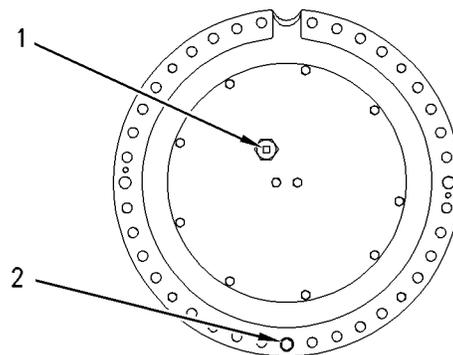


Illustration 173

g00801038

1. Position the wheels so that final drive drain plug (2) is facing downward. Remove oil filler plug (1). The oil level should be at the bottom of the filler plug opening. Add oil, if necessary.

**Reference:** Refer to Operation and Maintenance Manual, "Lubricant Viscosities" for the correct type of oil.

If the oil level is higher than the filler plug opening, do not allow the oil to drain to the proper level. Install the filler plug.

i02339342

## Differential and Final Drive Oil Sample - Obtain

SMCS Code: 3278-008; 4050-008; 4070-008; 7542

### NOTICE

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Operate the machine for a few minutes before obtaining the oil sample. This will thoroughly mix the oil for a more accurate sample.

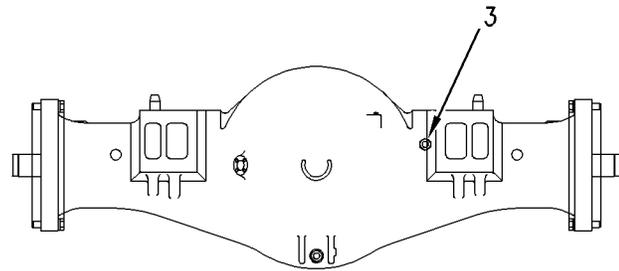


Illustration 174  
Front Differential

g00801039

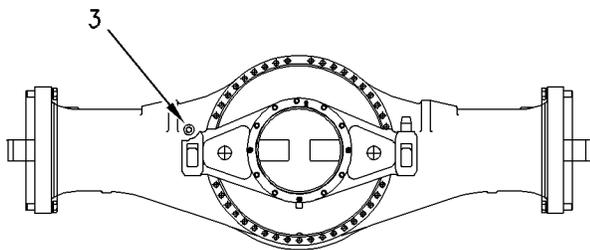


Illustration 175  
Rear Differential

g00840708

2. Remove differential filler plug (3). The oil level should be at the bottom of the filler plug opening. Add oil, if necessary.

**Reference:** Refer to Operation and Maintenance Manual, "Lubricant Viscosities" for the correct type of oil.

If the oil level is higher than filler plug opening, do not allow the oil to drain to the proper level. Install filler plug (3).

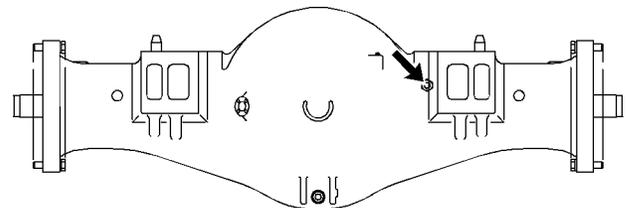


Illustration 176  
Differential Filler Plug

g01167372

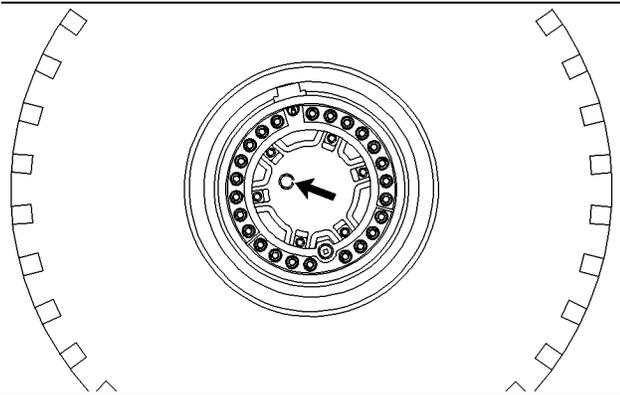


Illustration 177

g00760182

Final Drive Filler Plug

- The differential and final drives are not equipped with sampling valves. Obtaining an oil sample will require the use of a vacuum pump or equivalent in order to extract the oil from the component. Extract the oil through the filler openings on the differential and final drives.

**Note:** This procedure requires a sample for each final drive and each differential. There will be a total of three samples per axle and six samples for this procedure in total. Make sure that you properly record the location of each oil sample.

**Reference:** For more information, refer to Special Publication, SEBU6250, "Caterpillar Machine Fluids Recommendations" and Special Publication, PEHP6001, "How To Take A Good Oil Sample".

i02156189

## Drive Shaft Support Bearing - Lubricate

**SMCS Code:** 3267-086-BD

Wipe off the fitting before any lubricant is applied.

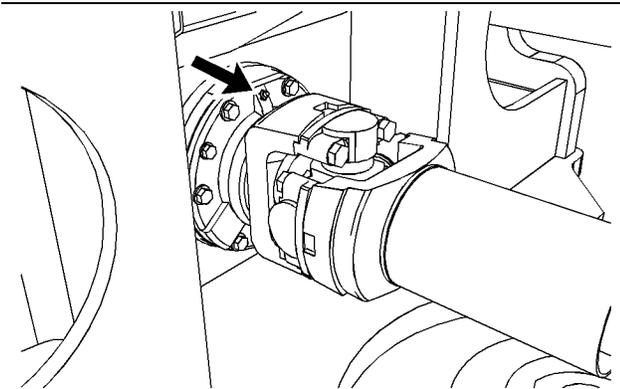


Illustration 178

g01093575

Center Drive Shaft

The fitting for the drive shaft support bearing is located toward the front of the articulation joint.

Apply lubricant through one fitting.

i02061807

## Electronic Unit Injector - Inspect/Adjust

**SMCS Code:** 1251-025; 1251-040; 1290-025; 1290-040

### WARNING

The Electronic Control module produces high voltage. To prevent personal injury make sure the Electronic Control Module is not powered and the unit injector solenoids are disconnected.

### NOTICE

The camshafts must be correctly timed with the crankshaft before an adjustment of the unit injector lash is made. The timing pins must be removed from the camshafts before the crankshaft is turned or damage to the cylinder block will be the result.

The operation of Caterpillar engines with improper adjustments of the electronic unit injector can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

Adjust the electronic unit injector at the same interval as the valve lash adjustment.

Refer to your machine's Service Manual or your Caterpillar dealer for the complete adjustment procedure.

i01902270

## Engine Air Filter Primary Element - Clean/Replace

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

### WARNING

To avoid personal injury, always wear eye and face protection when using pressurized air.

**NOTICE**

Caterpillar recommends certified air filter cleaning services that are available at Caterpillar dealers. The Caterpillar cleaning process uses proven procedures to assure consistent quality and sufficient filter life.

Observe the following guidelines if you attempt to clean the filter element:

Do not tap or strike the filter element in order to remove dust.

Do not wash the filter element.

Use low pressure compressed air in order to remove the dust from the filter element. Air pressure must not exceed 207 kPa (30 psi). Direct the air flow up the pleats and down the pleats from the inside of the filter element. Take extreme care in order to avoid damage to the pleats.

Do not use air filters with damaged pleats, gaskets, or seals. Dirt entering the engine will cause damage to engine components.

**NOTICE**

Service the air filter only with the engine stopped. Engine damage could result.

1. Open the engine compartment. The air filter is located on the right side of the machine.

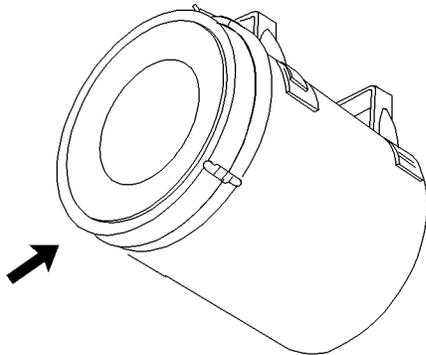


Illustration 179

g00845360

2. Loosen the cover latches and remove the air cleaner cover.

**Note:** The latches for the air cleaner housing may snap open when you release the latches.

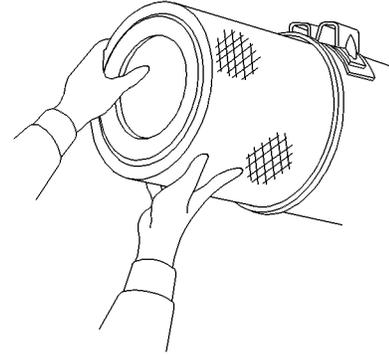


Illustration 180

g00101415

3. Remove the primary filter element from the air cleaner housing. In order to remove the engine air filter primary element, pull the element outward. While you pull the element outward, rock the element.

**Use Steps 4 through 6 in order to clean the primary element:**

4. Inspect the primary element. If the pleats, the gaskets, or the seals are damaged, discard the element. Replace a damaged primary element with a clean primary element.

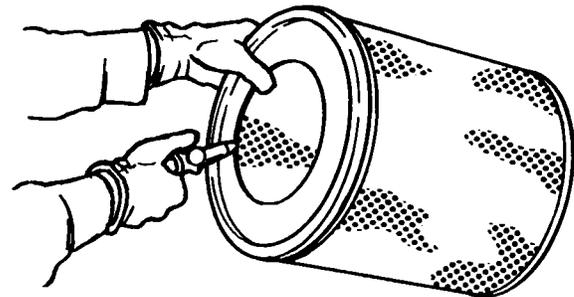


Illustration 181

g00328468

5. If the primary element is not damaged, clean the primary element.

Pressurized air can be used to clean a primary element that has not been cleaned more than two times. Use filtered, dry air at a maximum pressure of 207 kPa (30 psi).

**Note:** Pressurized air will not remove deposits of carbon and oil.

6. When you clean the primary element, always begin in the inside of the element (clean side). This will force dirt particles toward the outside of the element (dirty side).

Direct the air along the length (inside) of the filter. This will help prevent damage to the paper pleats.

**Note:** Do not aim the stream of air directly at the primary element. Dirt could be forced further into the pleats.

**Use Steps 7 through 10 in order to inspect the primary element:**

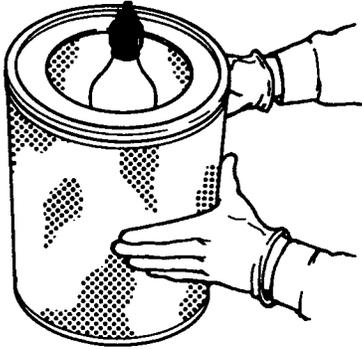


Illustration 182

g00328470

7. Place a light bulb inside the filter element. Use a 60 watt blue light in a dark room or in a similar facility. Inspect the primary element for light that may show through the filter material.
8. Inspect the primary element while you rotate the element. Inspect the primary element for tears and/or holes. Do not use a primary element that has any tears and/or holes in the filter material. Do not use a primary element with damaged pleats, gaskets, or seals.
9. If it is necessary, compare the primary element to a new primary element. Use a new primary element that has the same part number. This may be necessary in order to confirm the results of the inspection.
10. Discard a damaged primary element.

**Use Steps 11 through 13 to install a clean primary element:**

**NOTICE**

Do not use a filter if the pleats, the gaskets or the seals are damaged.

11. Install a clean primary filter element over the engine air filter secondary element. Apply firm pressure to the end of the primary element as you gently rock the filter element. This seats the primary element.

12. Clean the cover for the air cleaner housing. Align the slot on the cover with the pin on the air cleaner housing. Install the cover.

13. Close the engine.

i01625408

## Engine Air Filter Secondary Element - Replace

**SMCS Code:** 1054-510-SE

**NOTICE**

Service the air filter only with the engine stopped. Engine damage could result.

**NOTICE**

Always replace the secondary element. Do not attempt to reuse it by cleaning. Engine damage could result.

**Note:** Replace the secondary element when you service the primary element for the third time. If a clean primary element has been installed but a warning for the air filter still occurs, replace the secondary element. Also replace the secondary element if the exhaust smoke remains black after installation of a clean primary element.

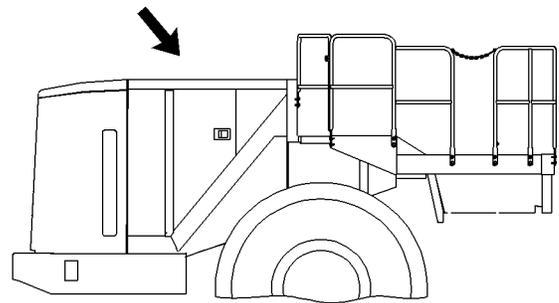


Illustration 183

g00841360

1. Open the engine access door on the right side of the machine.

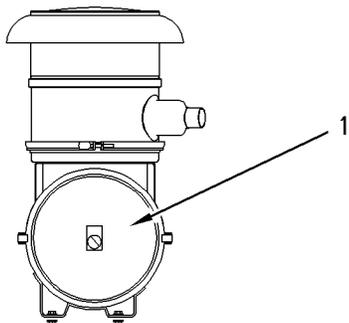


Illustration 184

g00804954

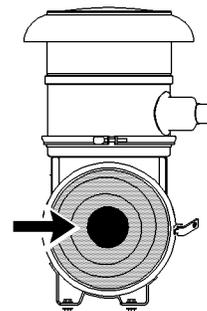


Illustration 187

g00841372

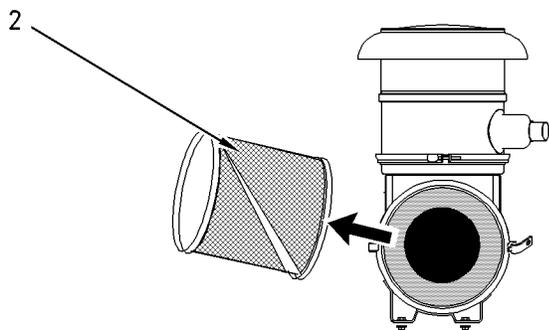


Illustration 185

g00804960

2. Remove cover (1) and primary element (2).

**Reference:** Refer to Operation and Maintenance Manual, "Engine Air Filter Primary Element - Clean/Replace" for the correct procedure for servicing the primary element.

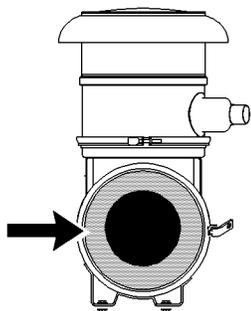


Illustration 186

g00805000

3. Remove the secondary filter element.

4. Cover the air inlet opening. Clean the inside of the air filter housing.
5. Inspect the gasket between the air inlet pipe and the air cleaner housing. Replace the gasket if the gasket is damaged.
6. Uncover the air inlet opening. Install a new secondary filter element.
7. Install a clean primary element and install the cover on the air filter housing. Fasten the clips in order to secure the cover.
8. Close the engine access door.

i01549255

## Engine Air Filter Service Indicator - Inspect

SMCS Code: 7452-040

### NOTICE

Service the air cleaner only with the engine stopped. Engine damage could result.

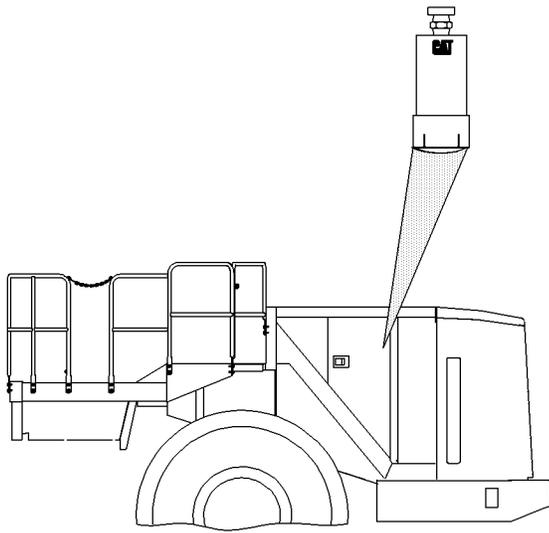


Illustration 188

g00804672

Open the engine access door on the left side of the machine.

The air filter service indicator is located on the air inlet line.

If the yellow piston in the filter service indicator is in the red zone, service the air cleaner.

i01548088

## Engine Air Filter Service Indicator - Inspect/Replace

**SMCS Code:** 7452-040; 7452-510

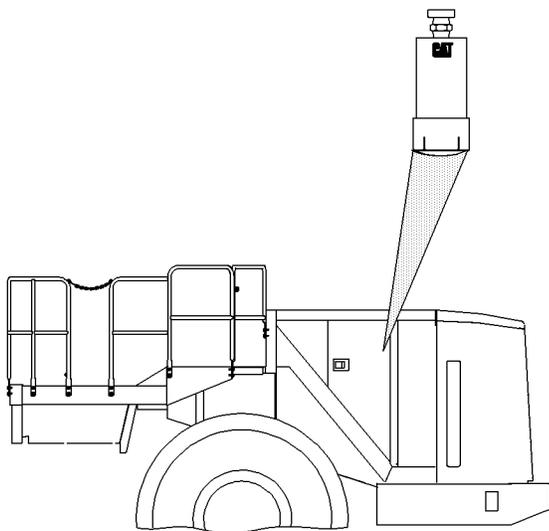


Illustration 189

g00804672

Open the access door on the left side of the machine.

To check the condition of the service indicator, try resetting the service indicator. This should require less than three pushes of the reset button.

Next, check the movement of the yellow piston in the service indicator. Start the engine and accelerate the engine to high idle for a few seconds. After the governor control pedal is released, the yellow piston should remain at the highest position that was achieved during acceleration.

If either of these conditions are not met, replace the service indicator.

i01625411

## Engine Air Precleaner - Clean

**SMCS Code:** 1055-070

### NOTICE

Service the air cleaner only with the engine stopped. Engine damage could result.

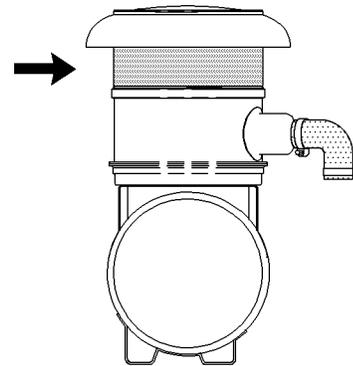


Illustration 190

g00841375

1. Remove the precleaner.
2. Inspect the air inlet screen for dirt and for trash. Remove the screen. Clean the screen if the screen is dirty.
3. Inspect the precleaner tube openings. Remove dirt and debris.
4. Clean the precleaner with compressed air or wash the precleaner in warm water. Dry all the parts.
5. Install the precleaner screen.

i01647648

## Engine Crankcase Breather - Clean

**SMCS Code:** 1317-070

**S/N:** 2TW1-Up

**Note:** The engine crankcase breather on the 988G(S/N: BNH1-Up) is located inside the valve cover. This breather does not require a maintenance interval. Caterpillar recommends replacing the crankcase breather during an engine overhaul. In order to replace the breather element, the valve cover will need to be replaced.

### NOTICE

Attempts to clean the engine crankcase breather on the 988G(S/N: BNH1-Up) may cause damage to the element.

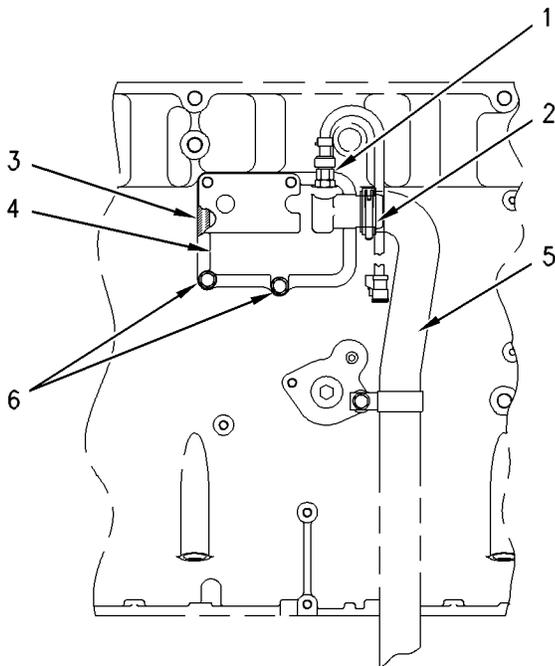


Illustration 191

g00844437

The engine crankcase breather on the 988G(S/N: 2TW1-Up) is located on the left side of the engine near the fuel priming pump.

1. Disconnect sensor (1) from breather (4). Loosen hose clamp (2) and remove hose (5) from the breather.
2. Remove bolts (6), the washers and breather (4). Remove seal (3).

3. Wash the breather in a clean, nonflammable solvent. Inspect the breather and the seal for damage. Replace the seal, if necessary.
4. Use pressure air to dry the breather.
5. Install seal (3). Install breather (4), the washers and bolts (6).
6. Install hose (5) on the breather and tighten hose clamp (2). Connect sensor (1) to breather (4).

i01062428

## Engine Mounts - Inspect

**SMCS Code:** 1152-040



Illustration 192

g00552201

Caterpillar recommends checking the engine mounts for deterioration. Checking the engine mounts will ensure that the bolts have the proper torque. This will prevent excessive engine vibration that is caused from improper mounting.

**Reference:** For the proper bolt torques, refer to the Specifications manual for your machine's engine.

i02356181

## Engine Oil (High Speed) and Oil Filter - Change (If Equipped)

SMCS Code: 1318-510-HZ

### Selection of the Oil Change Interval

#### NOTICE

A 500 hour engine oil change interval is available, provided that the operating conditions and recommended multigrade oil types are met. When these requirements are not met, shorten the oil change interval to 250 hours, or use an S-O-S Services oil sampling and analysis program to determine an acceptable oil change interval.

If you select an interval for oil and filter change that is too long, you may damage the engine.

Caterpillar oil filters are recommended.

Recommended multigrade oil types are listed in Table 10. Do not use single grade oils.

Abnormally harsh operating cycles or harsh environments can shorten the service life of the engine oil. Arctic temperatures, corrosive environments, or extremely dusty conditions may require a reduction in engine oil change intervals from the recommendations in Table 10. Also refer to Special Publication, SEBU5898, "Cold Weather Recommendations". Poor maintenance of air filters or of fuel filters requires reduced oil change intervals. See your Caterpillar dealer for more information if this product will experience abnormally harsh operating cycles or harsh environments.

Table 10

Engine Oil Change Intervals <sup>(1)</sup>				
Multigrade Oil Type	Operating Conditions			
	Normal <sup>(2)</sup>	High Load Factor <sup>(3)</sup> above 69 L (17 US gal) per hr of fuel	Severe	
			Fuel Sulfur from 0.3% to 0.5% <sup>(4)</sup>	Altitude above 1830 m (6000 ft)
Cat DEO Preferred	500 hr	500 hr	500 hr	250 hr <sup>(6)</sup>
Cat ECF-1 11.0 minimum TBN <sup>(4)</sup> Preferred	500 hr	500 hr	500 hr	250 hr <sup>(6)</sup>
Cat ECF-1 TBN <sup>(4)</sup> below 11.0	500 hr	500 hr	250 hr <sup>(5)</sup>	250 hr <sup>(6)</sup>
API CG-4	250 hr	250 hr <sup>(5)</sup>	250 hr <sup>(5)</sup>	250 hr <sup>(6)</sup>

<sup>(1)</sup> The traditional oil change interval for engines is 250 hours. The standard oil change interval in this machine is 500 hours, if the operating conditions and recommended oil types that are listed in this table are met. Improvements in the engine allow this engine oil change interval. This new standard interval is not permitted for other machines. Refer to the applicable Operation and Maintenance Manuals for the other machines.

<sup>(2)</sup> Normal conditions include these factors: Fuel sulfur below 0.3%, altitude below 1830 m (6000 ft), and good air filter and fuel filter maintenance. Normal conditions do not include high load factor, harsh operating cycles, or harsh environments.

<sup>(3)</sup> High load factors can shorten the service life of your engine oil. Continuous heavy load cycles and very little idle time result in increased fuel consumption and oil contamination. These factors deplete the oil additives more rapidly. If the average fuel consumption of your machine exceeds 69 L (17 US gal) per hour, follow the "High Load Factor" recommendations in Table 10. To determine average fuel consumption, measure average fuel consumption for a period of 50 to 100 hours. If the application of the machine is changed, the average fuel consumption may change.

<sup>(4)</sup> For sulfur content above 0.5%, refer to Operation and Maintenance Manual, SEBU6250, "Total Base Number (TBN) and Fuel Sulfur Levels for Direct Injection (DI) Diesel Engines".

<sup>(5)</sup> In order to verify an oil change interval of 500 hours, refer to "Program A" below.

<sup>(6)</sup> Use "Program B" below to determine an appropriate interval.

### Adjustment of the Oil Change Interval

**Note:** Your Caterpillar dealer has additional information on these programs.

#### Program A

Verification for an Oil Change Interval of 500 Hours

This program consists of three oil change intervals of 500 hours. Oil sampling and analysis is done at 250 hours and 500 hours for each of the three intervals for a total of six oil samples. The analysis includes oil viscosity and infrared (IR) analysis of the oil. If all of the results are satisfactory, the 500 hour oil change interval is acceptable for the machine in that application. Repeat Program A if you change the application of the machine.

If a sample does not pass the oil analysis, take one of these actions:

- Shorten the oil change interval to 250 hours.
- Proceed to Program B.
- Change to a preferred oil type in Table 10.

### Program B

#### Optimizing Oil Change Intervals

Begin with a 250 hour oil change interval. The oil change intervals are adjusted by increments. Each interval is adjusted an additional 50 hours. Periodic oil sampling and analysis is done during each interval. The analysis includes oil viscosity and infrared (IR) analysis of the oil. Repeat Program B if you change the application of the machine.

If an oil sample does not pass the analysis, shorten the oil change interval, or change to a preferred multigrade oil type in the listing above.

### References

**Reference:** Form, PEDP7035, "Optimizing Oil Change Intervals"

**Reference:** Form, PEDP7036, "S-O-S Fluid Analysis"

**Reference:** Form, PEDP7076, "Understanding the S-O-S Oil Analysis Tests"

## Procedure for Changing the Engine Oil and Filter

### WARNING

Hot oil and components can cause personal injury.

Do not allow hot oil or components to contact skin.

### NOTICE

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

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

Dispose of all fluids according to local regulations and mandates.

Your machine may be equipped with a high speed arrangement for changing the engine oil. The high speed arrangement allows the engine oil to be changed faster than the conventional method.

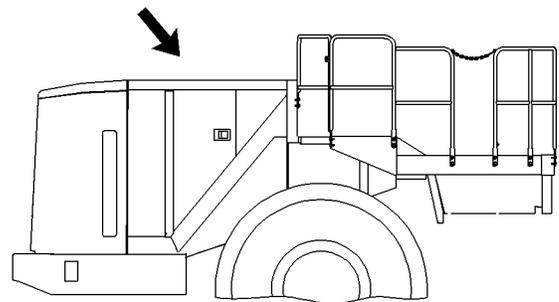


Illustration 193

g00841360

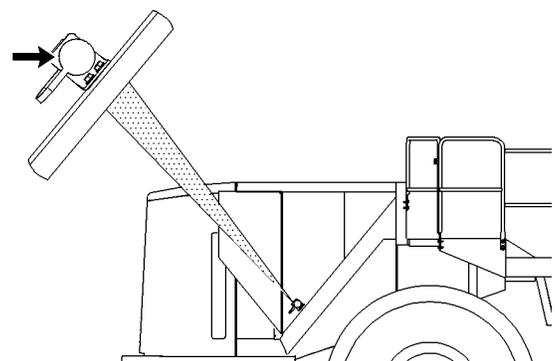


Illustration 194

g01000950

1. Open the engine access door on the right side of the machine. The high speed arrangement is located on the right side of the engine compartment.

- Remove the cap that protects the male coupler. Connect an oil pump to the male coupler. Turn on the oil pump and withdraw the engine oil.

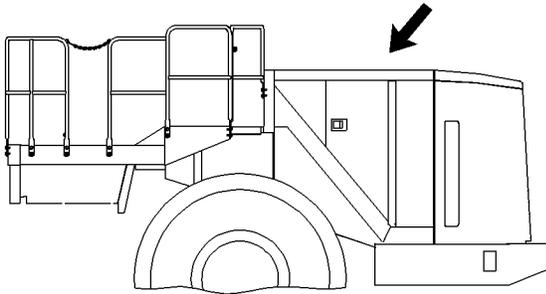


Illustration 195

g00841382

- Open the engine access door on the left side of the machine.

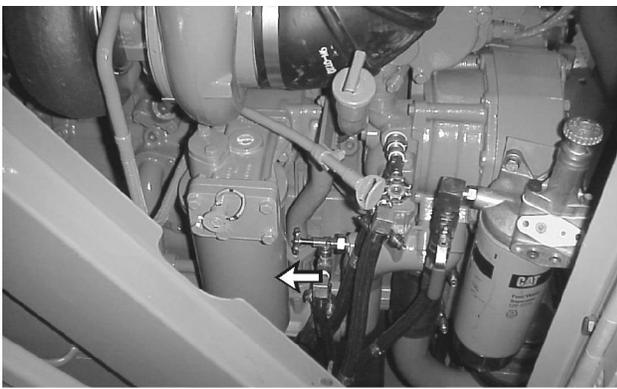


Illustration 196

g00546663

- Use a strap type wrench to remove the engine oil filter. Dispose of the used filter properly.
- Clean the filter mounting base. Make sure that the used seal is completely removed.

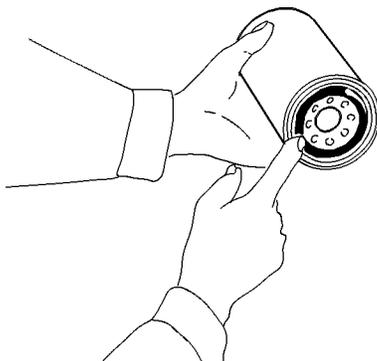


Illustration 197

g00101318

- Apply a thin film of clean engine oil to the seal on the new filter element. Install a new engine oil filter hand tight until the seal of the engine oil filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

**Note:** There are rotation index marks on the engine oil filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the engine oil filter, use the rotation index marks as a guide.

- Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

**Note:** You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

- Clean the end of the male coupler for the high speed arrangement. Connect an oil pump to the male coupler for the high speed arrangement. Fill the crankcase with oil.

**Reference:** Refer to Operation and Maintenance Manual, "Capacities (Refill)" for the proper amount of oil.

- Clean the end of the male coupler for the high speed arrangement. Clean the cap that covers the male coupler and install the cap.

- Start the engine and allow the oil to circulate. Check for leaks.

- Check the engine oil level.

**Reference:** Refer to Operation and Maintenance Manual, "Engine Oil Level - Check" for the correct procedure.

- Close the engine access doors.

i02281851

## Engine Oil Level - Check

**SMCS Code:** 1000-535-FLV

### NOTICE

Do not under fill or overfill engine crankcase with oil. Either condition can cause engine damage.

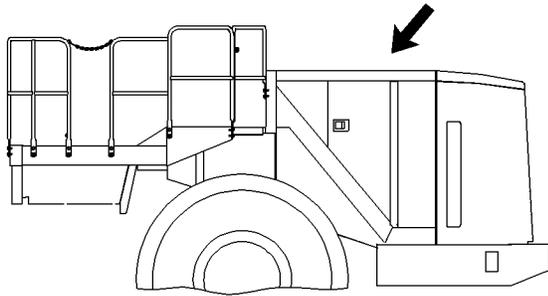


Illustration 198

g00841382

1. Open the engine access door on the left side of the machine.

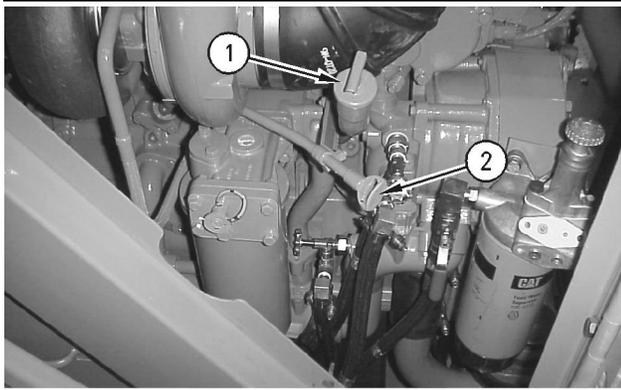


Illustration 199

g00501649

2. Remove engine oil dipstick (2) and wipe the dipstick with a clean cloth. Then, insert the dipstick and remove the dipstick again. This will ensure a more accurate measurement of the engine oil level.



Illustration 200

g00999790

3. When the engine is stopped, maintain the oil level within crosshatched region (A) of the dipstick. This region of the dipstick is marked "Safe Starting Range".
4. If necessary, remove oil filler cap (1) and add oil. Clean the oil filler cap and install the oil filler cap.
5. Close the engine access door.

i01917218

## Engine Oil Sample - Obtain

SMCS Code: 1348-008; 7542

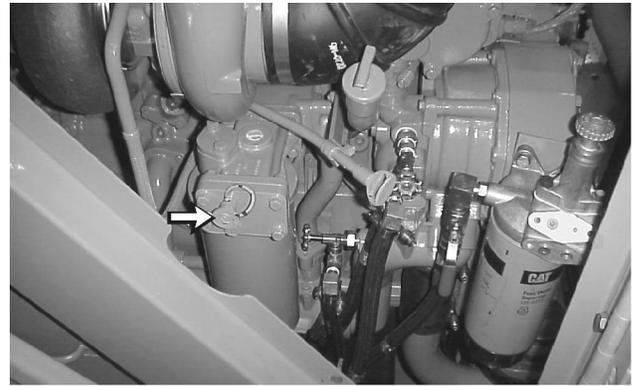


Illustration 201

g00501726

Obtain a sample of the engine oil from the engine oil sampling valve. The sampling valve is located on the engine oil filter base on the left side of the engine compartment. Refer to Special Publication, SEBU6250, "S-O-S Oil Analysis" for information that pertains to obtaining a sample of the engine oil. Refer to Special Publication, PEHP6001, "How To Take A Good Oil Sample" for more information about obtaining a sample of the engine oil.

i02356182

## Engine Oil and Filter - Change

SMCS Code: 1318-510

### Selection of the Oil Change Interval

#### NOTICE

A 500 hour engine oil change interval is available, provided that the operating conditions and recommended multigrade oil types are met. When these requirements are not met, shorten the oil change interval to 250 hours, or use an S-O-S Services oil sampling and analysis program to determine an acceptable oil change interval.

If you select an interval for oil and filter change that is too long, you may damage the engine.

Caterpillar oil filters are recommended.

Recommended multigrade oil types are listed in Table 11. Do not use single grade oils.

Abnormally harsh operating cycles or harsh environments can shorten the service life of the engine oil. Arctic temperatures, corrosive environments, or extremely dusty conditions may require a reduction in engine oil change intervals from the recommendations in Table 11. Also refer to Manual, SEBU5898, "Cold Weather Recommendations". Poor maintenance of air filters or of fuel filters requires reduced oil change intervals. See your Caterpillar dealer for more information if this product will experience abnormally harsh operating cycles or harsh environments.

Table 11

Engine Oil Change Intervals <sup>(1)</sup>				
Multigrade Oil Type	Operating Conditions			
	Normal <sup>(2)</sup>	High Load Factor <sup>(3)</sup> above 69 L (17 US gal) per hr of fuel	Severe	
			Fuel Sulfur from 0.3% to 0.5% <sup>(4)</sup>	Altitude above 1830 m (6000 ft)
Cat DEO Preferred	500 hr	500 hr	500 hr	250 hr <sup>(6)</sup>
Cat ECF-1 11.0 minimum TBN <sup>(4)</sup> Preferred	500 hr	500 hr	500 hr	250 hr <sup>(6)</sup>
Cat ECF-1 TBN <sup>(4)</sup> below 11.0	500 hr	500 hr	250 hr <sup>(5)</sup>	250 hr <sup>(6)</sup>
API CG-4	250 hr	250 hr <sup>(5)</sup>	250 hr <sup>(5)</sup>	250 hr <sup>(6)</sup>

(1) The traditional oil change interval for engines is 250 hours. The standard oil change interval in this machine is 500 hours, if the operating conditions and recommended oil types that are listed in this table are met. Improvements in the engine allow this engine oil change interval. This new standard interval is not permitted for other machines. Refer to the applicable Operation and Maintenance Manuals for the other machines.

(2) Normal conditions include these factors: Fuel sulfur below 0.3%, altitude below 1830 m (6000 ft), and good air filter and fuel filter maintenance. Normal conditions do not include high load factor, harsh operating cycles, or harsh environments.

(3) High load factors can shorten the service life of your engine oil. Continuous heavy load cycles and very little idle time result in increased fuel consumption and oil contamination. These factors deplete the oil additives more rapidly. If the average fuel consumption of your machine exceeds 69 L (17 US gal) per hour, follow the "High Load Factor" recommendations in Table 11. To determine average fuel consumption, measure average fuel consumption for a period of 50 to 100 hours. If the application of the machine is changed, the average fuel consumption may change.

(4) For sulfur content above 0.5%, refer to Operation and Maintenance Manual, SEBU6250, "Total Base Number (TBN) and Fuel Sulfur Levels for Direct Injection (DI) Diesel Engines".

(5) In order to verify an oil change interval of 500 hours, refer to "Program A" below.

(6) Use "Program B" below to determine an appropriate interval.

## Adjustment of the Oil Change Interval

**Note:** Your Caterpillar dealer has additional information on these programs.

### Program A

Verification for an Oil Change Interval of 500 Hours

This program consists of three oil change intervals of 500 hours. Oil sampling and analysis is done at 250 hours and 500 hours for each of the three intervals for a total of six oil samples. The analysis includes oil viscosity and infrared (IR) analysis of the oil. If all of the results are satisfactory, the 500 hour oil change interval is acceptable for the machine in that application. Repeat Program A if you change the application of the machine.

If a sample does not pass the oil analysis, take one of these actions:

- Shorten the oil change interval to 250 hours.
- Proceed to Program B.
- Change to a preferred oil type in Table 11.

### Program B

#### Optimizing Oil Change Intervals

Begin with a 250 hour oil change interval. The oil change intervals are adjusted by increments. Each increment is an additional 50 hours. Periodic oil sampling and analysis is done during each interval. The analysis includes oil viscosity and infrared (IR) analysis of the oil. Repeat Program B if you change the application of the machine.

If an oil sample does not pass the analysis, shorten the oil change interval, or change to a preferred multigrade oil type in the listing above.

### References

**Reference:** Form, PEDP7035, "Optimizing Oil Change Intervals"

**Reference:** Form, PEDP7036, "S-O-S Fluid Analysis"

**Reference:** Form, PEDP7076, "Understanding the S-O-S Oil Analysis Tests"

## Procedure for Changing the Engine Oil and Filter

### NOTICE

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

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

Dispose of all fluids according to local regulations and mandates.

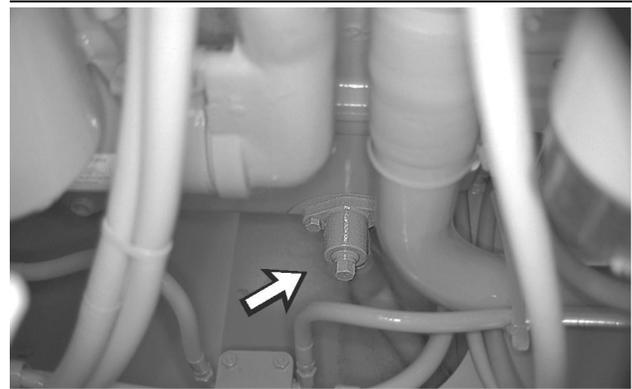


Illustration 202

g00841391



Illustration 203

g00841390

1. Open the crankcase drain valve and allow the oil to drain into a suitable container.
2. Close the drain valve.

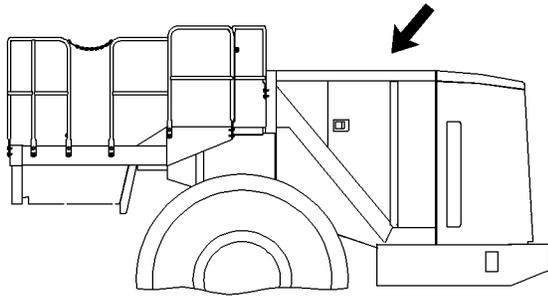


Illustration 204

g00841382

3. Open the engine access door on the left side of the machine.

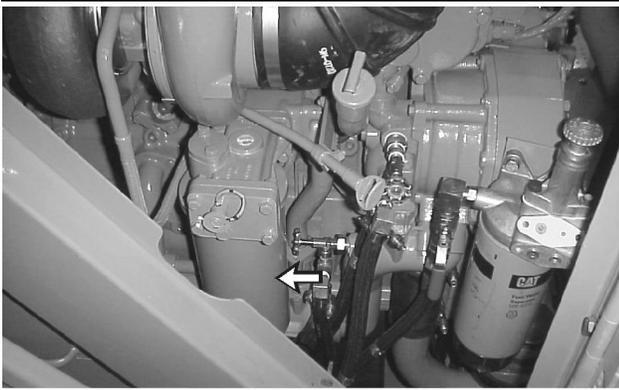


Illustration 205

g00546663

4. Use a strap type wrench to remove the engine oil filter. Dispose of the used filter properly.
5. Clean the filter mounting base. Make sure that the used gasket is completely removed.

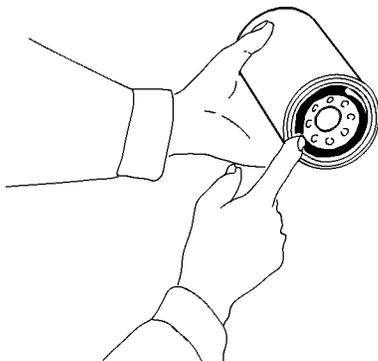


Illustration 206

g00101318

6. Apply a thin film of clean engine oil to the seal on the new filter element. Install a new engine oil filter hand tight until the seal of the engine oil filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

**Note:** There are rotation index marks on the engine oil filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the engine oil filter, use the rotation index marks as a guide.

7. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

**Note:** You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

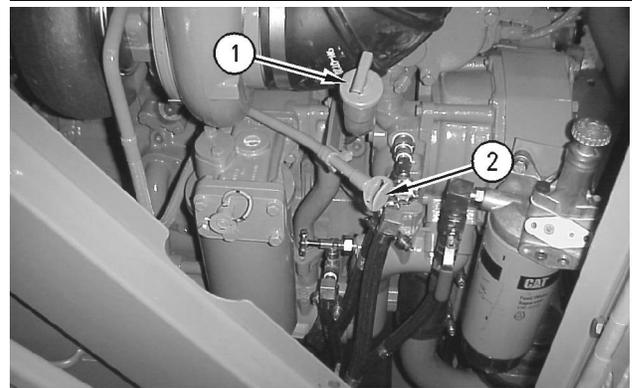


Illustration 207

g00501649

8. Remove the engine oil filler cap (1) and fill the engine crankcase with oil.

**Reference:** Refer to Operation and Maintenance Manual, "Capacities (Refill)" for the proper amount of oil.

9. Clean the oil filler cap and install the oil filler cap.
10. Start the engine and allow the oil to circulate. Check for leaks.
11. Check the engine oil level on dipstick (2).

**Reference:** Refer to Operation and Maintenance Manual, "Engine Oil Level - Check" for the correct procedure.

i01648537

## Engine Valve Lash - Check

**SMCS Code:** 1105-535

For the correct procedure, refer to the appropriate Service Manual module for your machine's engine or consult your Caterpillar dealer.

**Note:** A qualified mechanic should adjust the engine valve lash because special tools and training are required.

**Note:** The engine crankcase breather on the 988G(S/N: BNH1-Up) is located inside the valve cover. This breather does not require a maintenance interval. Caterpillar recommends replacing the crankcase breather during an engine overhaul. In order to replace the breather element, the valve cover will need to be replaced.

### NOTICE

Attempts to clean the engine crankcase breather on the 988G(S/N: BNH1-Up) may cause damage to the element.

i01935374

## Engine Valve Rotators - Inspect

**SMCS Code:** 1109-040

### **WARNING**

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

Caterpillar recommends replacing valve rotators that are operating improperly. An improperly operating valve rotator will shorten valve life because of accelerated wear on the valves. Also, metal particles from a damaged valve rotator could fall into the cylinder and damage to the piston head and to the cylinder head may result.

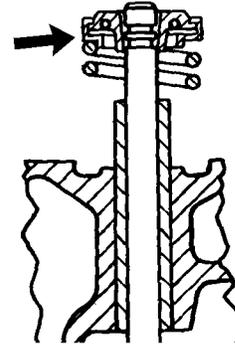


Illustration 208

g00882731

Start the engine and run the engine at low idle. Watch the top surface of each valve rotator. Whenever an inlet valve closes or an exhaust valve closes, each valve rotator should turn.

If a valve rotator fails to turn, consult your Caterpillar dealer for service.

i01394313

## Engine Water Pump - Inspect

**SMCS Code:** 1361-040

Failure of the engine water pump may cause severe engine overheating problems such as cracks in the cylinder head or piston seizure.

Visually inspect the water pump for leaks. If you find leaks, all of the seals on the water pump must be replaced.

**Note:** For more information, refer to the appropriate Disassembly and Assembly manual for your machine's engine.

i01548876

## Ether Starting Aid Cylinder - Replace (If Equipped)

SMCS Code: 1456-510-CD

### WARNING

Ether is poisonous and flammable.

Breathing ether vapors or repeated contact of ether with skin can cause personal injury.

Use ether only in well ventilated areas.

Do not smoke while changing ether cylinders.

Use ether with care to avoid fires.

Do not store replacement ether cylinders in living areas or in the operator's compartment.

Do not store ether cylinders in direct sunlight or at temperatures above 49 °C (120 °F).

Discard cylinders in a safe place. Do not puncture or burn cylinders.

Keep ether cylinders out of the reach of unauthorized personnel.

To avoid possible injury, be sure the brakes are applied and all controls are in Hold or Neutral when starting the engine.

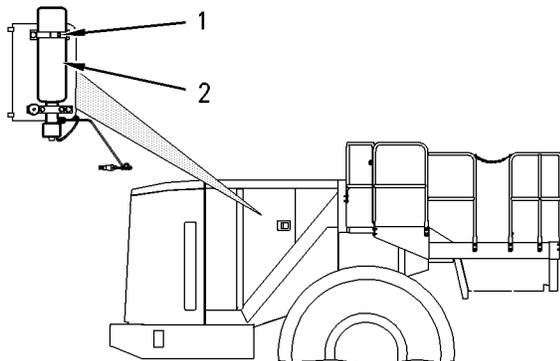


Illustration 209

g00805191

1. Open the engine access door on the right side of the machine.
2. Loosen cylinder retaining clamp (1). Remove empty ether starting aid cylinder (2) and discard the empty ether starting aid cylinder.

3. Remove the used gasket. Install the new gasket that is provided with every new ether starting aid cylinder.
4. Install new ether starting aid cylinder. Tighten the ether starting aid cylinder hand tight. Tighten the cylinder retaining clamp securely.
5. Close the engine access door.

i01624411

## Fuel System - Prime

SMCS Code: 1250-548



Illustration 210

g00549858



Illustration 211

g00502068

1. Open the engine access door on the left side of the machine. The priming pump is mounted on the top of the primary fuel filter.
2. Turn the priming pump plunger counterclockwise and pull out the priming pump plunger.
3. Operate the fuel priming pump in order to fill the new filter element. Continue to operate the fuel priming pump until the pump resists operation. This indicates that the filter element is full of fuel.

i01549331

4. Push the priming pump plunger downward and turn the priming pump plunger clockwise in order to lock the priming pump plunger.
5. Start the engine. Look for leaks around the fuel filter element. If the engine will not start or the engine misfires, more priming is necessary.
6. If the engine runs rough after start-up, stop the engine. Perform the following procedure:

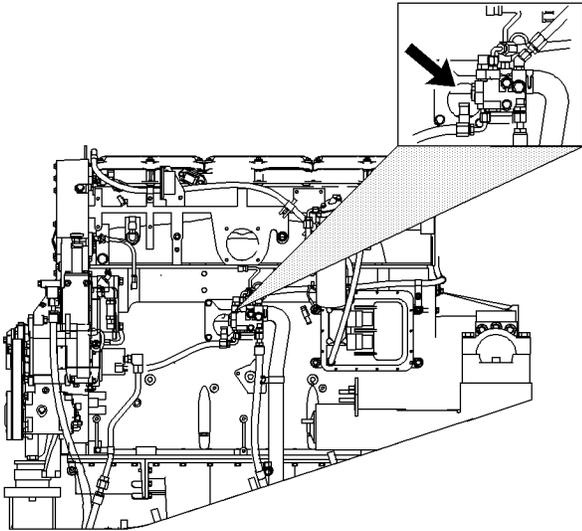


Illustration 212 g00840716

The vent plug is located on the right side of the machine.

- a. Loosen the vent plug on the fuel return manifold.
  - b. Release the priming pump plunger and prime the fuel system until a continuous stream of fuel is flowing from the opening. Catch the fuel in a suitable container.
  - c. Install the vent plug in the fuel return manifold and lock the priming pump plunger.
  - d. Start the engine. Continue to operate the engine at low idle until the engine operates smoothly.
7. Close the engine access door.

## Fuel System Primary Filter (Water Separator) - Check/Drain

SMCS Code: 1263-535; 1263-543

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

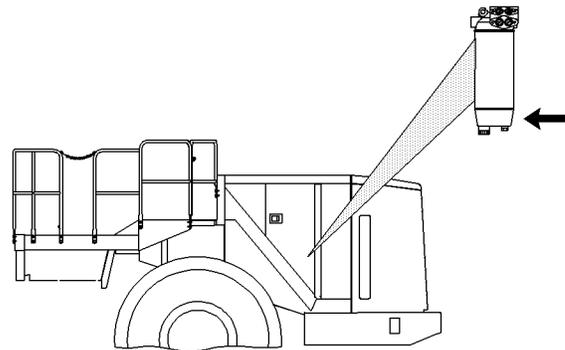


Illustration 213 g00805407

1. Open the engine access door on the left side of the machine. The water separator is located on the bottom of the primary fuel filter.
2. Open the drain valve on the bottom of the water separator bowl. Allow the water and the fuel to drain into a suitable container.
3. Tighten the drain valve.

**Note:** The water separator is under suction during normal engine operation. The drain valve must be tightened in order to prevent air leakage into the fuel system.

4. Close the engine access door.

i02281860

## Fuel System Primary Filter (Water Separator) Element - Replace

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

### NOTICE

Do not fill fuel filters with fuel before installing them. The fuel will not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts. The fuel system should be primed prior to starting the engine.

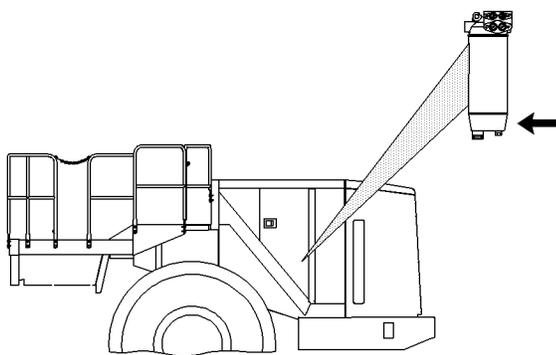


Illustration 214

g00805407

1. Open the engine access door on the left side of the machine. The water separator is located on the bottom of the primary fuel filter.
2. Open the drain valve on the water separator bowl. Allow the water and the fuel to drain into a suitable container.
3. Use a strap type wrench to remove the filter from the filter mounting base.

4. Remove the water separator bowl from the filter element. Clean the water separator bowl and the O-ring groove.

**Note:** The water separator bowl is reusable. Do not discard the water separator bowl.

5. Inspect the O-ring seal in the water separator bowl for damage. Replace the O-ring seal, if necessary.
6. Lubricate the O-ring seal with clean diesel fuel or with engine oil. Place the O-ring seal in the water separator bowl.
7. Install the water separator bowl onto the new filter element by hand. Do not use tools to tighten the water separator bowl.

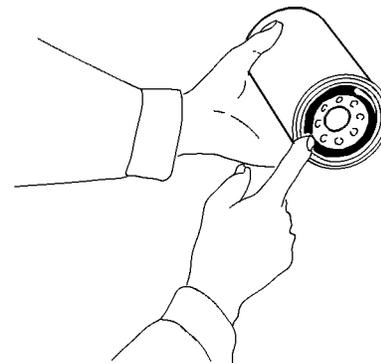


Illustration 215

g00101318

8. Apply a thin coat of oil to the seal on the new filter. Install the new fuel filter hand tight until the seal of the engine oil filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

**Note:** There are rotation index marks on the fuel filter that are spaced 90 degrees or 1/4 or a turn away from each other. When you tighten the fuel filter, use the rotation index marks as a guide.

9. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

10. Tighten the drain valve on the water separator bowl.

**Note:** The water separator element is under suction during normal engine operation. The drain valve must be tightened in order to prevent air leakage into the fuel system.

11. Prime the fuel system in order to fill the filter element with fuel.

**Reference:** Refer to Operation and Maintenance Manual, "Fuel System Prime" for the correct procedure.

i02281881

## Fuel System Secondary Filter - Replace

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

### NOTICE

Do not fill fuel filters with fuel before installing them. The fuel will not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts. The fuel system should be primed prior to starting the engine.



Illustration 216

g00550189

1. Open the engine access door on the right side of the machine.

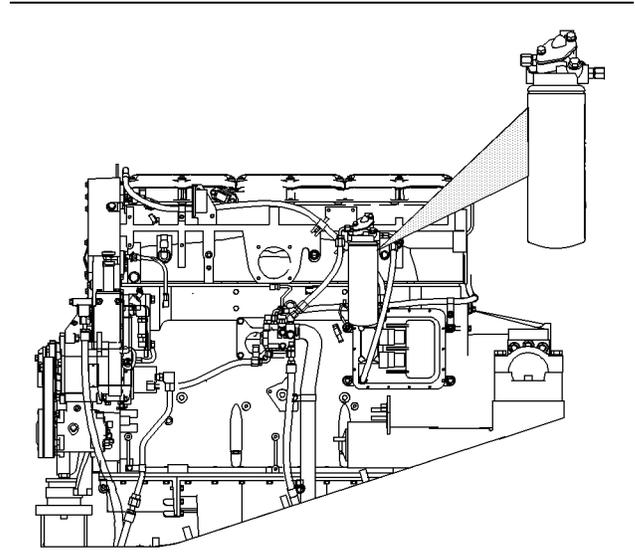


Illustration 217

g00802224

2. Remove the used filter element. Dispose of the used filter element properly.
3. Clean the filter mounting base. Make sure that all of the used seal is removed.

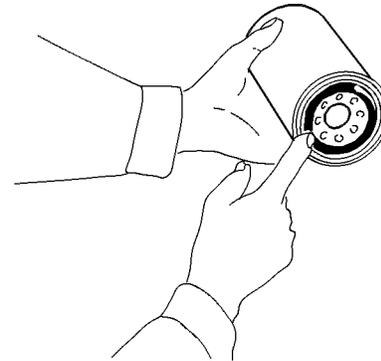


Illustration 218

g00101318

4. Apply a thin coat of clean diesel fuel to the seal on the new fuel filter. Install the new fuel filter hand tight until the seal of the fuel filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

**Note:** There are rotation index marks on the fuel filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the fuel filter, use the rotation index marks as a guide.

5. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

**Note:** You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

6. Prime the fuel system.

**Reference:** Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

7. Close the engine access door.

i01822422

## Fuel Tank Cap and Strainer - Clean

**SMCS Code:** 1273-070-STR; 1273-070-Z2

The fuel tank cap is located on the left side of the machine.

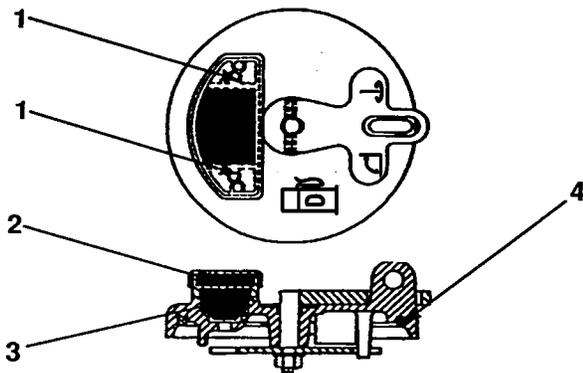


Illustration 219

g00930455

7x-7700 Fuel Tank Cap (Vented)

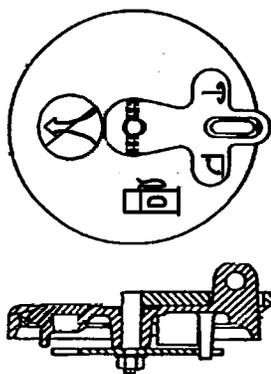


Illustration 220

g00930484

Use 101-8909 Fuel Tank Cap (non-vented) if your machine is equipped with a fast fill fuel adapter.

1. Lift the lever and turn the lever counterclockwise until the lever stops. Remove the fuel tank cap.

2. Inspect seal (4) for damage. Replace the seal, if necessary.
3. Remove screws (1), filter assembly (2), drain valve (3) and the gaskets.

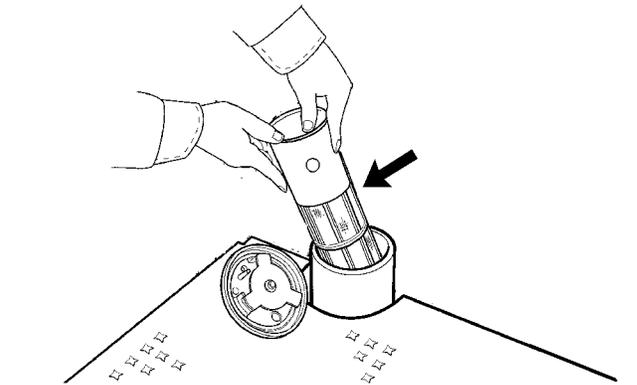


Illustration 221

g00930457

**Note:** Refer to Operation and Maintenance Manual, "General Hazard Information" for information on Containing Fluid Spillage.

4. Remove the strainer from the filler tube.
5. Wash the fuel tank cap and the strainer in a clean, nonflammable solvent.
6. Install a new cap filter kit. Install the other components in reverse order.
7. Install the strainer and the fuel tank cap.

i02156799

## Fuel Tank Water and Sediment - Drain

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

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

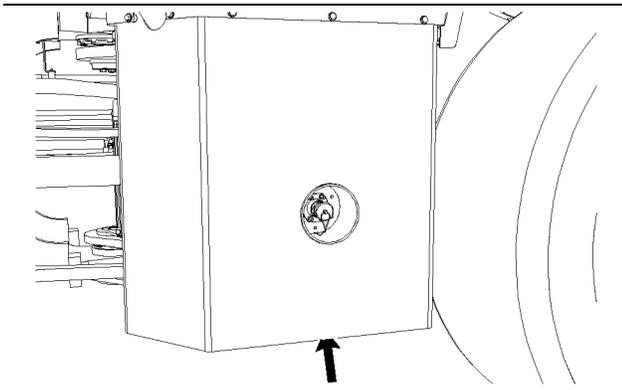


Illustration 222

g01093885

The fuel tank drain valve is located on the left side of the machine at the bottom of the fuel tank.

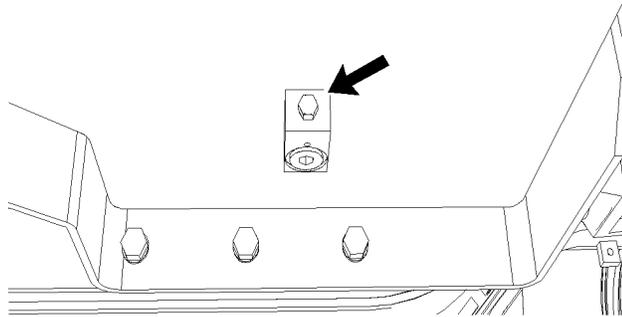


Illustration 223

g01093886

Open the fuel tank drain valve. Allow the water and sediment to drain into a suitable container. Close the fuel tank drain valve.

i01061054

## Fuses - Replace

**SMCS Code:** 1417-510



**Fuses** – The fuses protect the electrical system from damage that is caused by overloaded circuits. Replace a fuse if the element separates. If the element of a new fuse separates, inspect the circuit. Repair the circuit, if necessary.

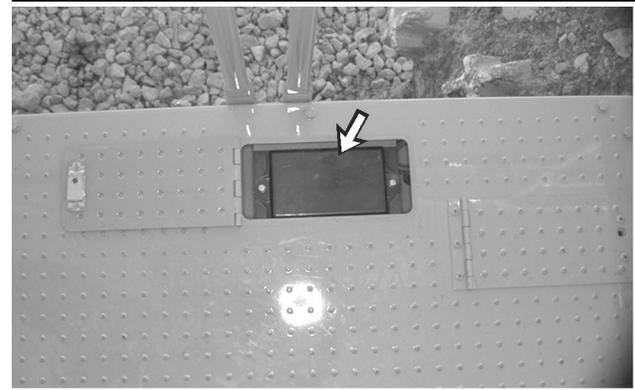


Illustration 224

g00503503

The fuses are located under a small access door on the right cab platform.

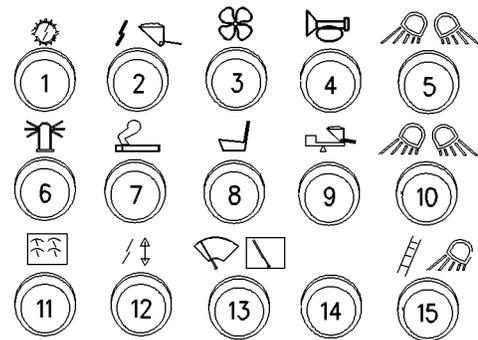


Illustration 225

g00502446



**Transmission Electronic Control (1) – 10 amp**



**Implement Electronic Control (2) – 10 amp**



**Blower Fan (3) – 20 amp**



**Horn (4) – 10 amp**



**Front Floodlights (5) – 15 amp**



**Rotating Beacon (6) (if equipped) – 10 amp**

**Lighter (7) – 10 amp****Seat (8) – 15 amp****Payload Control System (9) – 10 amp****Rear Floodlights (10) – 15 amp****Electronic Gauges (11) – 10 amp****Voltage Converter (12) – 10 amp****Window Wipers (13) – 10 amp****Open (14) – 10 amp****Stairway Access Light (15) – 10 amp**

i02301275

## Hydraulic System Oil - Change

**SMCS Code:** 5056-044

### Selection of the Oil Change Interval

Your machine may be able to use a 4000 hour interval for the hydraulic oil. The hydraulic oil is in the system that is not integral to the service brakes, the clutches, the final drives, or the differentials. The standard change interval is 2000 hours. The oil should be monitored in additional increments of 500 hours. The extended 4000 hour interval can be used if the following criteria are met.

### Oil Filters

Caterpillar oil filters are recommended. The interval for changing the oil filter should be 500 hours.

### Oil

The 4000 hour interval for changing the oil is for the following oil types.

- Caterpillar Hydraulic Oil (HYDO)
- Caterpillar Transmission/Drive Train Oil (TDTO)
- Caterpillar TDTO (TMS)
- Caterpillar Diesel Engine Oil
- Caterpillar Biodegradable Hydraulic Oil (HEES)
- Caterpillar Multipurpose Tractor Oil (MTO)
- Heavy-Duty Diesel Engine Oil with a minimum zinc content of 900 parts per million (ppm)

Heavy-duty oils are identified by the following classifications: Cat ECF-1, API CF, API CG-4, and TO-4. Cat ECF-1, API CF, API CG-4, and TO-4 oils must have a minimum zinc additive of 900 parts per million (ppm) in order to be considered acceptable for use in a hydraulic system.

**Note:** Industrial hydraulic oils are not recommended in Caterpillar hydraulic systems. These oils are more likely to cause corrosion and excessive wear.

### Monitoring the Condition of the Oil

The oil should be monitored during intervals of 500 hours. Caterpillar's standard S-O-S Fluids Analysis or an equivalent oil sampling program should be used.

The current guidelines for cleanliness of the oil should be observed. Refer to "Measured Data".

If an oil sampling program is not available, the standard 2000 oil change interval should be used.

### Measured Data

The following information should be monitored when you sample the oil:

- Significant changes in wear metals should be monitored. These metals include iron, copper, chromium, lead, aluminum, and tin.
- The following additives should be observed for significant changes: Zinc, calcium, magnesium, and phosphorus.

- Contaminants should not be present. These contaminants include fuel and antifreeze. Water content should be .5 percent or less.
- The silicon level should not exceed 15 parts per million for new oil. The particle counts should be monitored.
- The recommended level of cleanliness for Caterpillar machines that are operated in the field is ISO 18/15 or cleaner. The cleanliness should be monitored by particle count analysis. The levels of contamination should not exceed normal levels by more than two ISO codes. Action should be taken in order to determine the cause of the contamination. The system should be returned to the original levels of contamination.
- There should not be significant changes in sodium, silicon, copper, and potassium.
- The allowable level of oxidation is 40 percent (0.12 Abs units).
- The kinematic viscosity at 100 °C (212 °F) should not exceed a 2 cSt change.

## Procedure for Changing the Hydraulic Oil

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Operate the machine in order to warm the hydraulic oil.
2. Park the machine on level ground. Lower the attachment to the ground and apply slight downward pressure. Engage the parking brake and stop the engine.

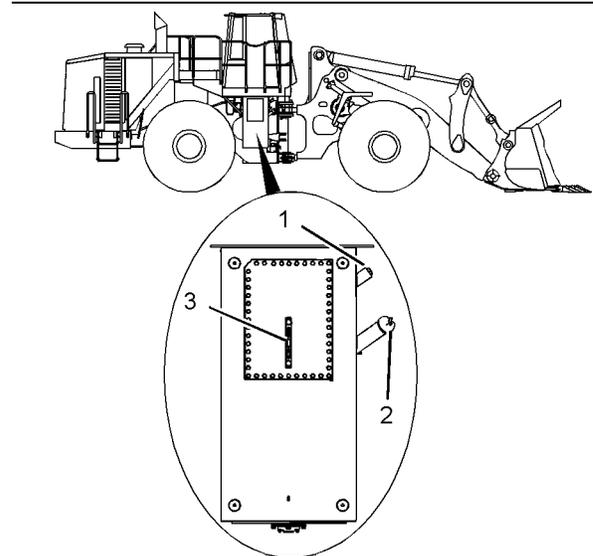


Illustration 226

g01152499

3. The hydraulic tank is located on the right side of the machine. Press the button on the breaker relief valve (1) in order to relieve any tank pressure.
4. Remove the hydraulic tank filler cap (2). Remove the filler strainer from the hydraulic tank filler neck. Wash the filler cap and the strainer in a clean, nonflammable solvent. Install the strainer.
5. Inspect the gasket on the hydraulic tank filler cap for damage. Replace the gasket, if necessary.
6. Remove the drain plug from the bottom of the hydraulic tank. Wash the drain plug in a clean, nonflammable solvent.
7. Install a 6B-3156 Pipe Nipple into the drain valve in order to unseat the drain valve. Allow the hydraulic oil to drain into a suitable container.

### NOTICE

Never start the engine while the hydraulic oil tank is being drained or while the hydraulic oil tank is empty. Excessive wear and damage to the hydraulic components can occur.

8. Remove the pipe nipple in order to close the drain valve. Install the hydraulic tank drain plug.
9. Change the hydraulic oil filter.

**Reference:** Refer to Operation and Maintenance Manual, "Hydraulic System Oil Filter - Replace" for the correct procedure.

10. Fill the hydraulic tank with clean oil. Make sure that the oil level is at the "FULL" mark on sight gauge (4).

**Reference:** Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct type of oil and for the correct amount of oil.

**11.** Install filler cap (2).

**Note:** The steering pump and the implement pump must be primed before the engine is started. This is necessary in order to ensure proper operation of the pumps.

### Filling the Cases of the Implement Pump and the Steering Pump

The cases of the steering pump and the implement pump must be filled with oil before the engine is started. This is necessary in order to ensure proper operation of the pumps.

**1.** Open the access doors that are located behind the operator compartment.

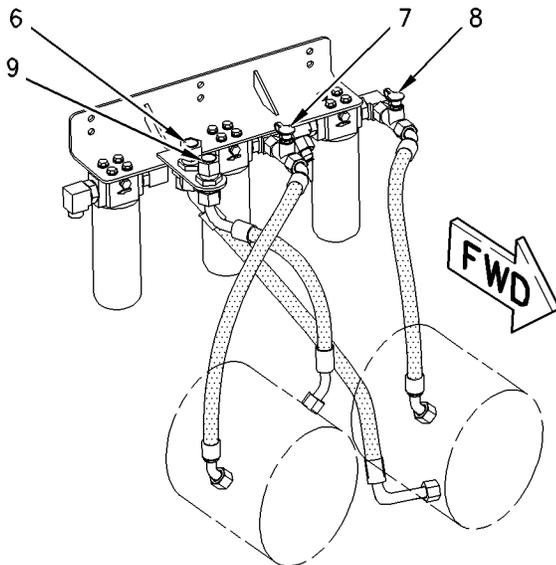


Illustration 227

g00935858

**2.** Remove the cap from port (6). Attach a drain hose that is equipped with a quick-connect fitting to tee (8). Place the end of the drain hose into a suitable container in order to collect excess hydraulic oil. Pour clean hydraulic oil into port (6). Continue to pour hydraulic oil until the hydraulic oil comes out of the drain hose that is attached to tee (8).

**3.** Remove the drain hose and install the cap onto port (6). The steering pump case is now filled.

**4.** Remove the cap from port (9). Attach a drain hose that is equipped with a quick-connect fitting to tee (7). Place the end of the drain hose into a suitable container in order to collect excess hydraulic oil. Pour clean hydraulic oil into port (9). Continue to pour hydraulic oil until the hydraulic oil comes out of the drain hose that is attached to tee (7).

**5.** Remove the drain hose and install the cap onto port (9). The case for the implement pump is now filled.

**6.** Replace any hydraulic oil that was lost during the installation of the hoses.

**Reference:** Refer to Operation and Maintenance Manual, "Hydraulic System Oil Level - Check" for more information.

**Note:** The oil must be free of bubbles. If bubbles are present in the oil, air is entering the hydraulic system. Inspect the suction hoses and the hose clamps.

i02281903

## Hydraulic System Oil Filter - Replace

SMCS Code: 5068-510

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

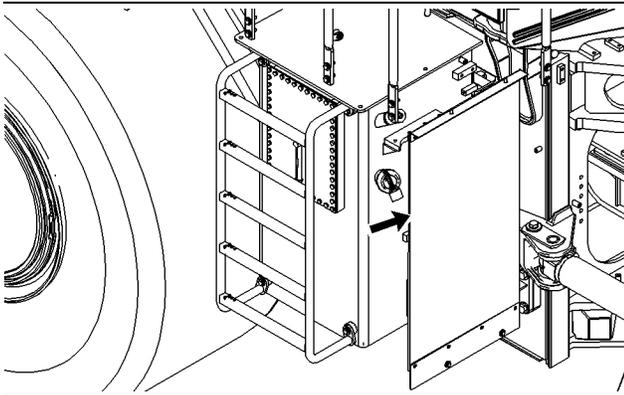


Illustration 228

g01001201

The hydraulic oil filter is located behind the mud flap on the front of the hydraulic tank.

**Note:** The mud flap may be removed for easier access to the filter.

1. Stop the engine.

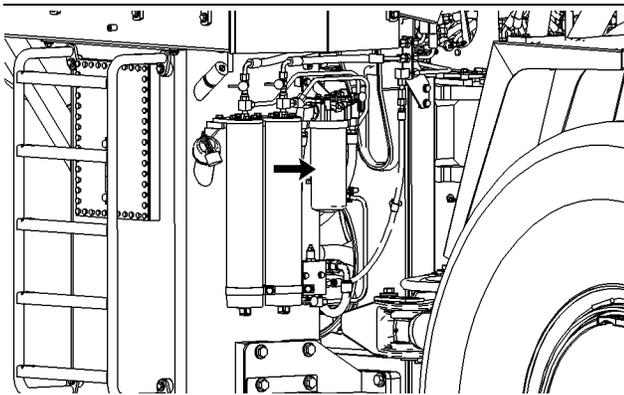


Illustration 229

g01001186

2. Use a strap type wrench to remove the hydraulic oil filter element. Dispose of the used filter properly.
3. Remove the filler cap and the strainer from the hydraulic oil filler tube. Wash the filler cap and the strainer in a clean nonflammable solvent. Allow the strainer to air dry.
4. Inspect the strainer for damage. Replace the strainer, if necessary. Install the strainer and the filler cap.
5. Clean the filter mounting base. Make sure that all of the used gasket is removed from the filter mounting base.

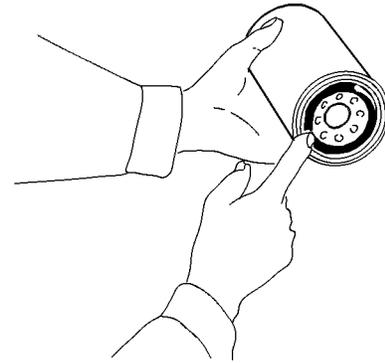


Illustration 230

g00101318

6. Apply a thin coat of hydraulic oil to the seal on the new filter. Install the new hydraulic oil filter hand tight until the seal of the hydraulic oil filter contacts the filter base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

**Note:** There are rotation index marks on the hydraulic oil filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the hydraulic oil filter, use the rotation index marks as a guide.

7. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

**Note:** You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

8. Start the engine and run the engine at low idle. Inspect the hydraulic system for leaks.
9. Check the level of the hydraulic oil.

**Reference:** Refer to Operation and Maintenance Manual, "Hydraulic System Oil Level - Check" for the correct procedure.

i01832234

## Hydraulic System Oil Level - Check

**SMCS Code:** 5056-535-FLV

**Note:** The work tool must be positioned on the ground in order to have an accurate reading.

i02156928

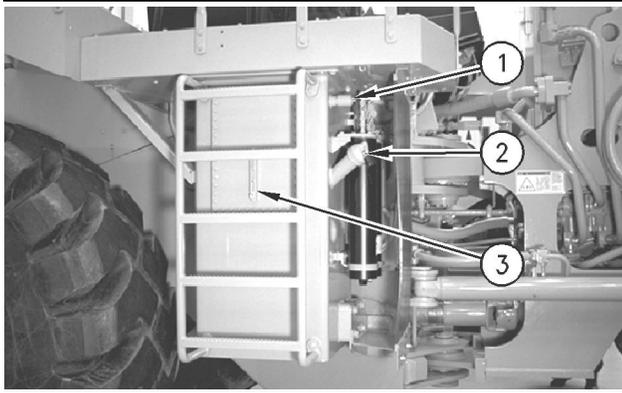


Illustration 231

g00838902

The hydraulic tank is located on the right side of the machine.

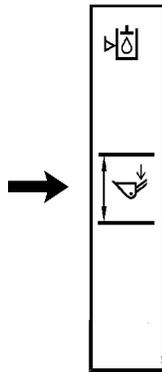


Illustration 232

g00935879

1. Maintain the hydraulic oil level within the designated range (3).
2. If necessary, press hydraulic tank breaker relief valve (1) in order to relieve any tank pressure. Then, remove hydraulic tank filler cap (2) and add hydraulic oil.
3. If hydraulic oil was added, clean the hydraulic tank filler cap and install the hydraulic tank filler cap.

## Hydraulic System Oil Sample - Obtain

SMCS Code: 5050-008; 5056-008; 7542

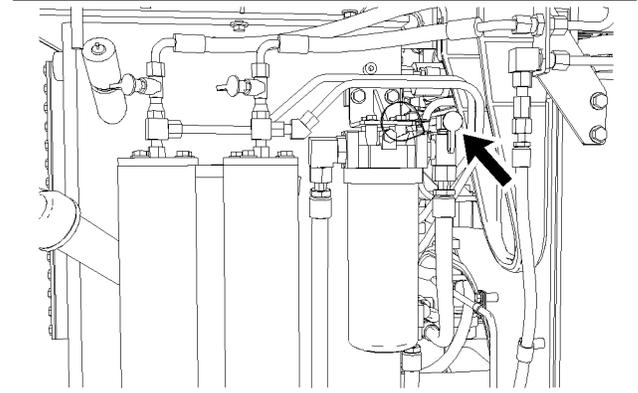


Illustration 233

g01093962

Obtain a sample of the hydraulic oil from the hydraulic oil sampling valve. The sampling valve is located on the hydraulic oil filter base on the front of the hydraulic tank. Refer to Special Publication, SEBU6250, "S·O·S Oil Analysis" for information that pertains to obtaining a sample of hydraulic oil. Refer to Special Publication, PEHP6001, "How To Take A Good Oil Sample" for more information about obtaining a sample of hydraulic oil.

i01923846

## Hydraulic Tank Breaker Relief Valve - Clean

SMCS Code: 5118-070

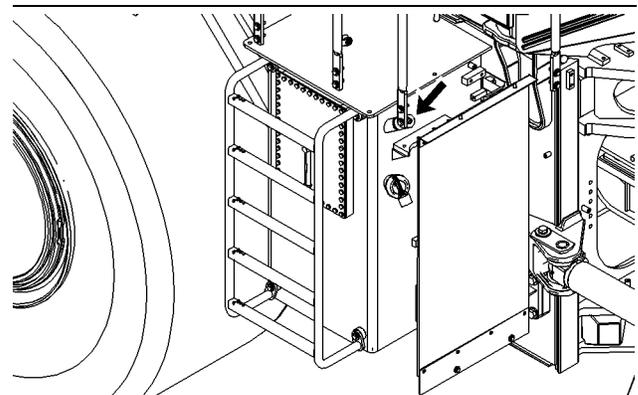


Illustration 234

g01001206

The hydraulic tank breaker relief valve is located on the side of the hydraulic tank.

1. To relieve the pressure in the hydraulic tank, press the button on the top of the hydraulic breaker. Remove the hydraulic tank breaker relief valve.
2. Clean the hydraulic tank breaker relief valve in a clean, nonflammable solvent. Shake the relief valve dry or use pressure air.
3. Install the hydraulic tank breaker relief valve.

i02157156

## Lift Cylinder Pin Oil - Change

**SMCS Code:** 7070-044-OC

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

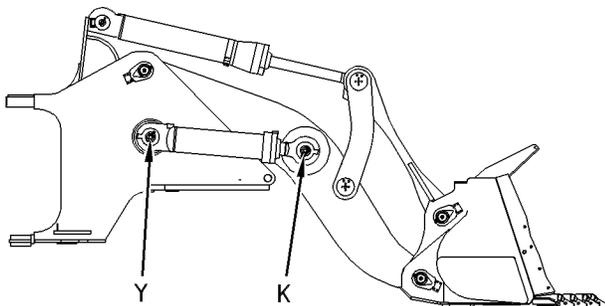


Illustration 235

g00560502

1. Park the machine on level ground and engage the parking brake. Lower the bucket so that the bottom of the bucket is flat on the ground. Stop the engine.

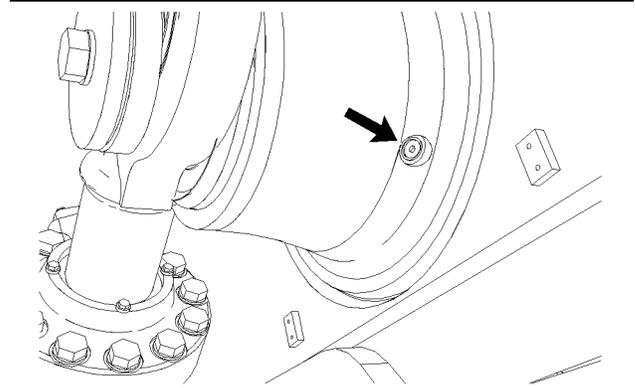


Illustration 236

g01094056

Pin Joint (K)

2. Remove the drain plug for pin joint (K). The drain plug is located on the right side of the machine. Allow the oil to drain into a suitable container.
3. Remove the filler plug for pin joint (K). The filler plug is located on the right side of the machine.
4. After the oil has drained, clean the drain plug and install the drain plug.

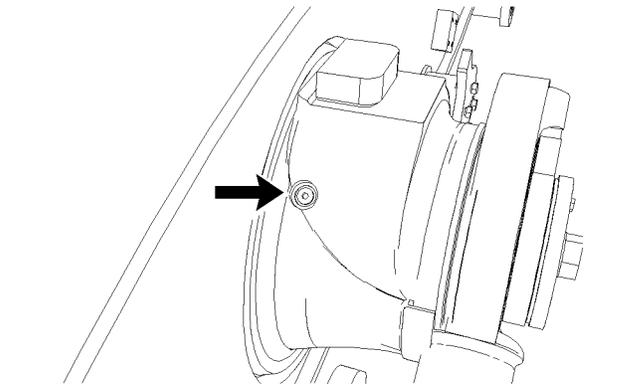


Illustration 237

g01094058

Pin Joint (K)

5. Fill the pin joint with SAE 80W90 oil until oil escapes from the filler opening.
6. Clean the filler plug and install the filler plug.

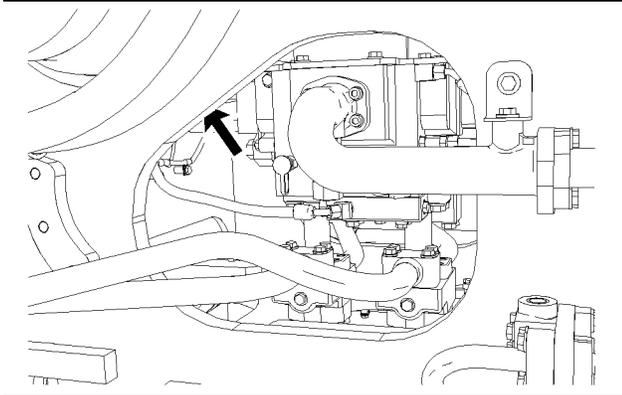


Illustration 238

g01094059

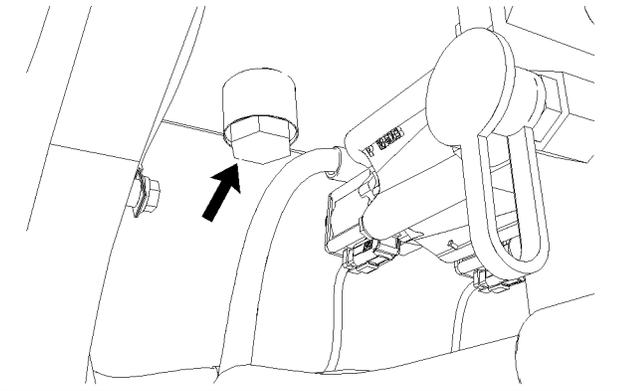


Illustration 239

g01094061

Pin Joint (Y)

- Remove the drain plug for pin joint (Y). The drain plug is located on the inside of the left front loader frame. Allow the oil to drain into a suitable container.

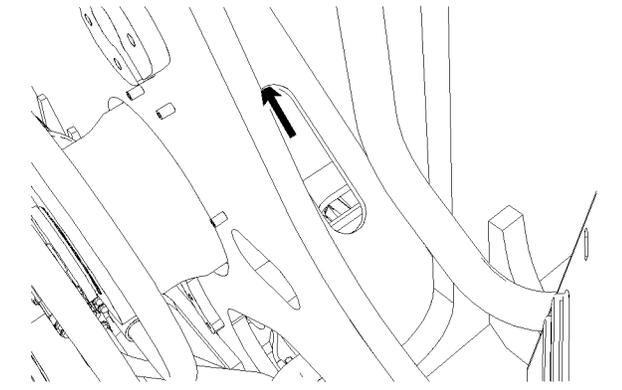


Illustration 240

g01094064

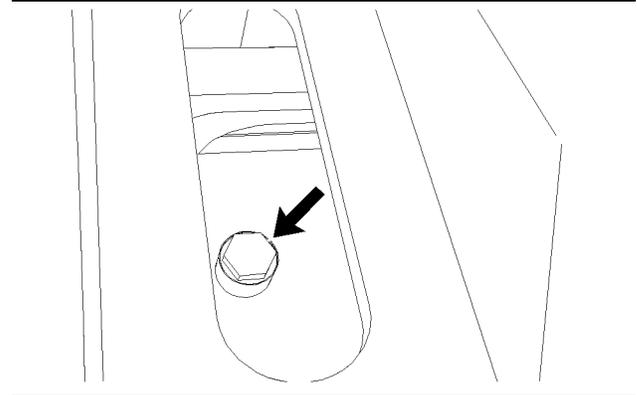


Illustration 241

g01094065

Pin Joint (Y)

- Remove the filler plug for pin joint (Y). The filler plug is located on the inside of the left front loader frame.
- After the oil has drained, clean the drain plug and install the drain plug.
- Fill the pin joint with SAE 80W90 oil until oil escapes from the filler opening.

**Note:** It will be necessary to use a funnel and a hose to fill the pin joint through the filler opening.

- Clean the filler plug and install the filler plug.

i02157325

## Lift Cylinder Pin Oil Level - Check

**SMCS Code:** 7070-535-FLV

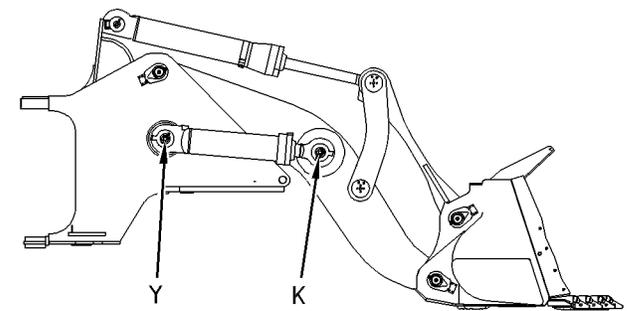


Illustration 242

g00560502

- Park the machine on level ground and engage the parking brake. Lower the bucket so that the bottom of the bucket is flat on the ground.

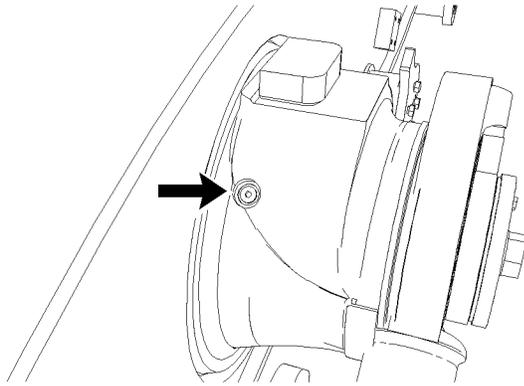


Illustration 243 g01094058  
Pin Joint (K)

2. Clean the area around the filler plug for pin joint (K). Slowly loosen the filler plug.
3. If the oil escapes from the filler opening, the oil level in the pin joint is correct. If the oil level is low, add SAE 80W90 until oil escapes from the filler opening.
4. Clean the filler plug and install the filler plug.

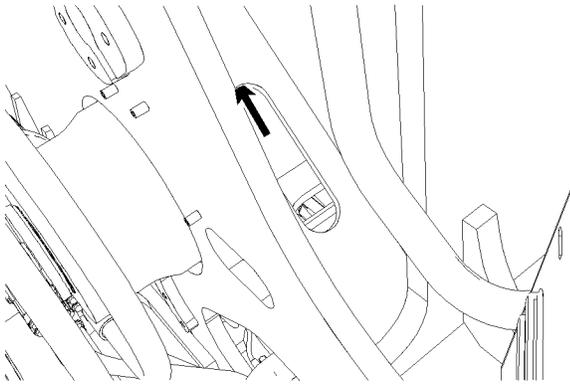


Illustration 244 g01094064

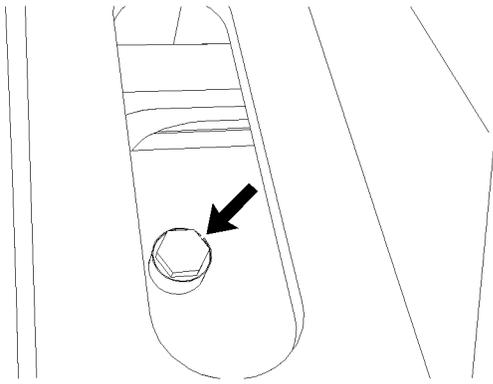


Illustration 245 g01094065  
Pin Joint (Y)

5. Repeat the procedure for pin joint (Y).

i02280356

## Loader Boom Pin Oil - Change

SMCS Code: 6118-044-OC

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Park the machine on level ground and engage the parking brake. Lower the bucket so that the bottom of the bucket is flat on the ground. Stop the engine.

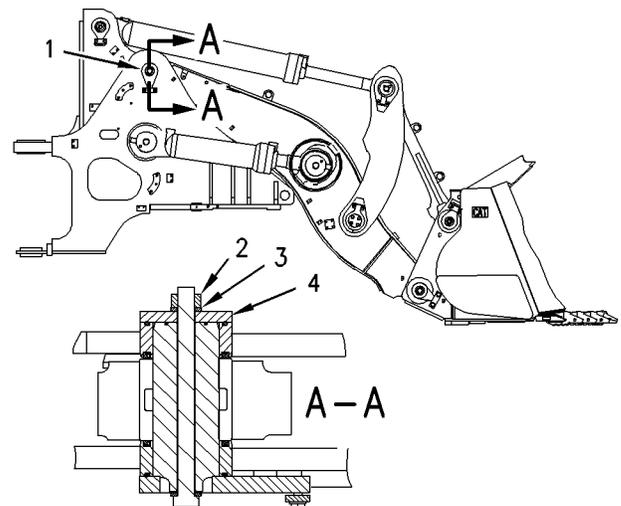


Illustration 246

g00811718

The A-pin joints (1) do not have drain plugs.

i02157449

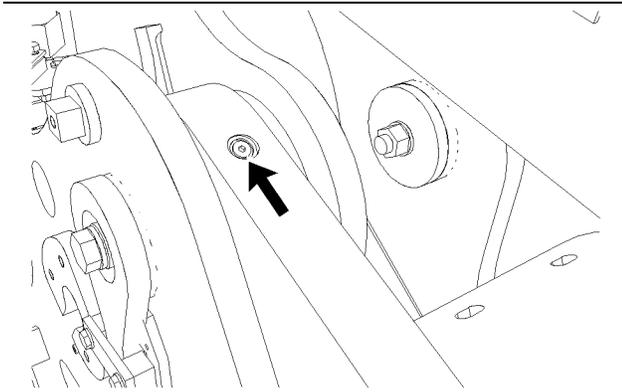


Illustration 247

g01094359

A-Pin Joint

2. Remove the filler plugs for both A-pin joints.
3. Attach a piece of tubing that is at least 610 mm (2 ft) to a 1U-5718 vacuum pump. Mark the tubing 305 mm (12 inch) from the open end. Cut the open end of the tube at a 45 degree angle in order to allow the tube to be inserted into the joint properly.
4. Install a sampling bottle onto the vacuum pump and insert 305 mm (12 inch) of the tubing through the filler plug opening. Insert the correct amount of tubing through the filler plug opening in order to make sure that the end of the tubing is at the bottom of the oil cavity. Use the mark on the tubing from step 3 as a guide.
5. Fill the sampling bottle and withdraw the tube from the filler plug opening.
6. Drain the sampling bottle into a suitable container.
7. Until no oil remains in the A-pin joints, repeat the following steps: 4, 5, and 6.
8. Fill each pin joint with 0.25 L (8 oz) of SAE 80W90 oil.
9. Install the filler plugs for both A-pin joints.
10. Start the engine. Move the boom through a minimum of four complete cycles. This will force any trapped air to the top of the joint. Inspect the joint for leaks. Check the oil level of the joint.

**Reference:** Refer to Operation and Maintenance Manual, "Loader Boom Pin Oil Level - Check" for more information.

**Reference:** Refer to Special Publication, NEHP6013, "S-O-S Fluid Analysis Products" for more information.

## Loader Boom Pin Oil Level - Check

SMCS Code: 6118-535-FLV

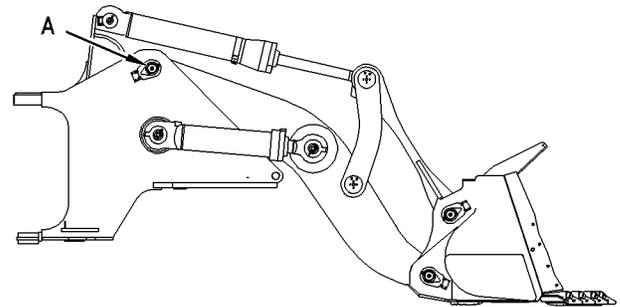


Illustration 248

g00560643

1. Park the machine on level ground and engage the parking brake. Lower the bucket so that the bottom of the bucket is flat on the ground.

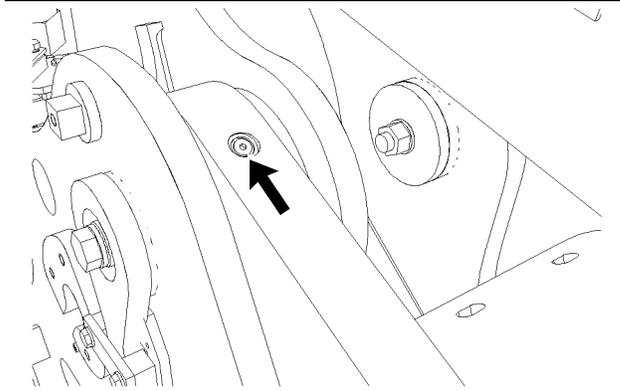


Illustration 249

g01094359

A-Pin Joint

2. Clean the area around the filler plugs for both A-pin joints. Slowly loosen each filler plug.
3. If the oil escapes from the filler opening, the oil level is correct. If the oil level is low, add SAE 80W90 until oil escapes from the filler opening.
4. Clean the filler plugs and install the filler plugs.

i01613549

## Loader Boom Pin and Lift Cylinder Pin - Inspect

SMCS Code: 5102-040-PN; 6501-040-PN

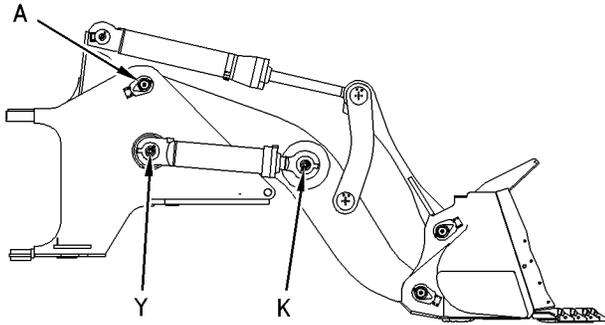


Illustration 250

g00818239

Inspect the Loader Boom Pin (A) for signs of leakage. If signs of leakage are found, check the oil level in the pin joint. Refer to Operation and Maintenance Manual, "Loader Boom Pin Oil Level - Check" for the correct procedure.

Inspect Lift Cylinder Pins (Y) and (K) for signs of leakage. If signs of leakage are found, refer to Operation and Maintenance Manual, "Lift Cylinder Pin Oil Level - Check" for information on checking the oil level of the pins.

i02158811

## Loader Pins and Bearings - Lubricate

SMCS Code: 5104-086; 6117-086; 7070-086

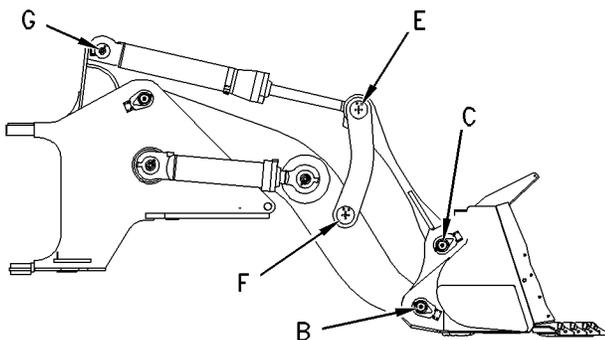


Illustration 251

g00560806

Wipe off the fittings before any lubricant is applied.

There is a total of nine fittings.

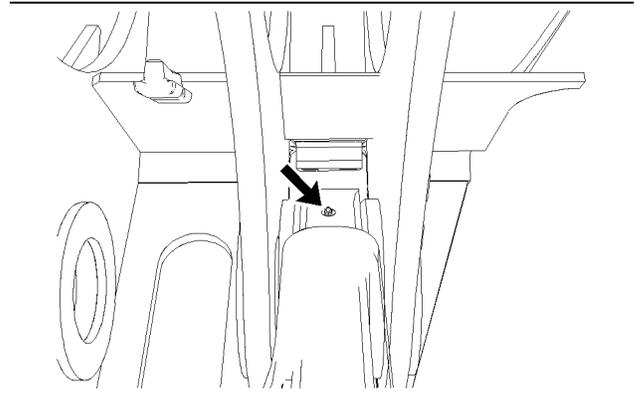


Illustration 252

g01094968

B-Pin Joint

For the B-pin joint, apply lubricant through the fitting on the top of the boom.

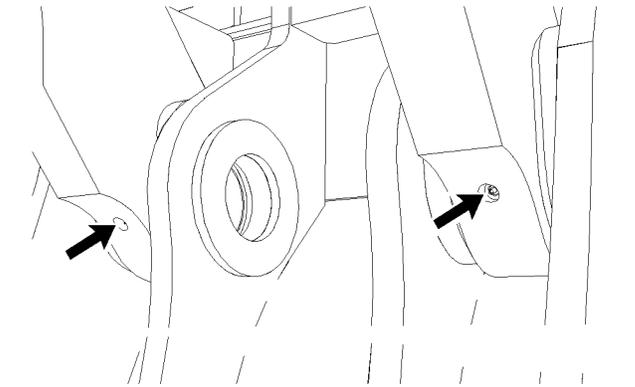


Illustration 253

g01094969

C-Pin Joints

For the C-pin joints, apply lubricant through the fittings at the bottom of each bucket link.

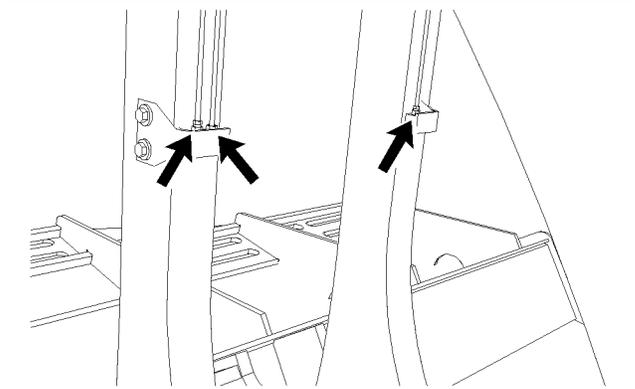


Illustration 254

g01094970

E-Pin Joints

For the E-pin joints, apply lubricant through three remote fittings on the bucket links.

i02106227

## Oil Filter - Inspect

**SMCS Code:** 1308-507; 3004-507; 3067-507;  
5068-507

**S/N:** BNH1-Up

### Inspect a Used Filter for Debris

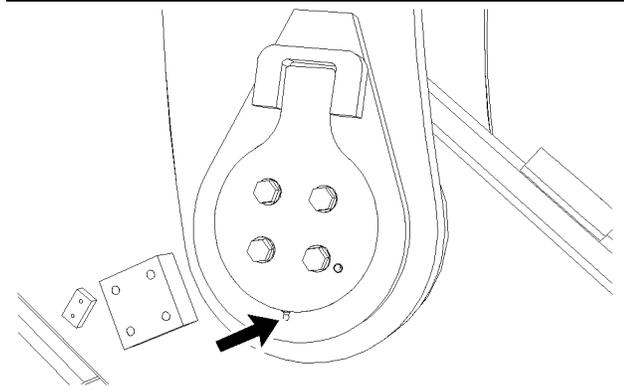


Illustration 255  
F-Pin Joint (Right Side)

g01094972

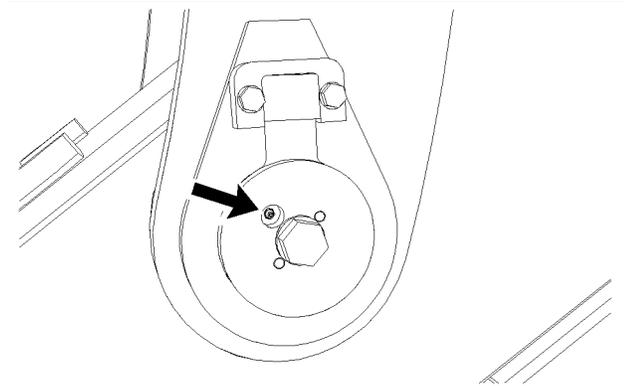


Illustration 256  
F-Pin Joint (Left Side)

g01094974

For the F-pin joints, apply lubricant through the fittings at the bottom of each tilt lever.

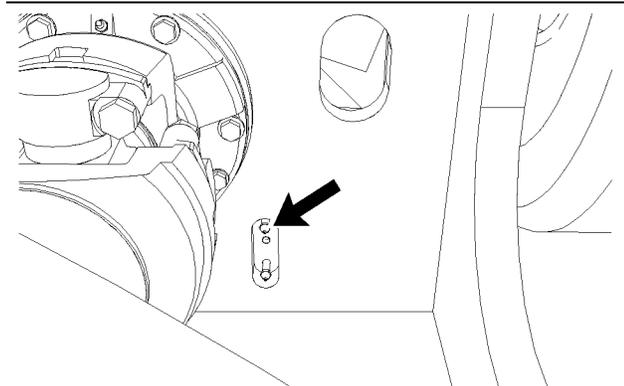


Illustration 257  
G-Pin Joint

g01094975

For the G-pin joint, apply lubricant through one remote fitting on the inside of the right front loader frame.

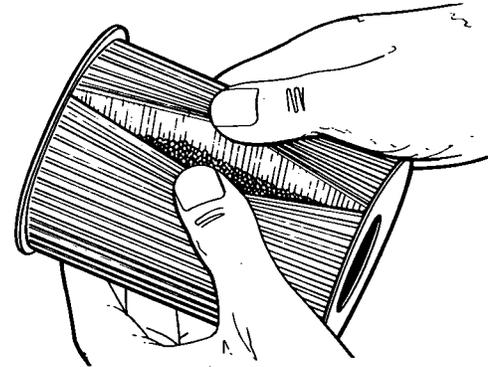


Illustration 258  
The element is shown with debris.

g00100013

Use a filter cutter to cut the filter element open. Spread apart the pleats and inspect the element for metal and for other debris. An excessive amount of debris in the filter element can indicate a possible failure.

If metals are found in the filter element, a magnet can be used to differentiate between ferrous metals and nonferrous metals.

Ferrous metals can indicate wear on steel parts and on cast iron parts.

Nonferrous metals can indicate wear on the aluminum parts of the engine such as main bearings, rod bearings, or turbocharger bearings.

Small amounts of debris may be found in the filter element. This could be caused by friction and by normal wear. Consult your Caterpillar dealer in order to arrange for further analysis if an excessive amount of debris is found.

Using an oil filter element that is not recommended by Caterpillar can result in severe engine damage to engine bearings, to the crankshaft, and to other parts. This can result in larger particles in unfiltered oil. The particles could enter the lubricating system and the particles could cause damage.

i02158840

i02252730

## Radiator Core - Clean

SMCS Code: 1353-070-KO

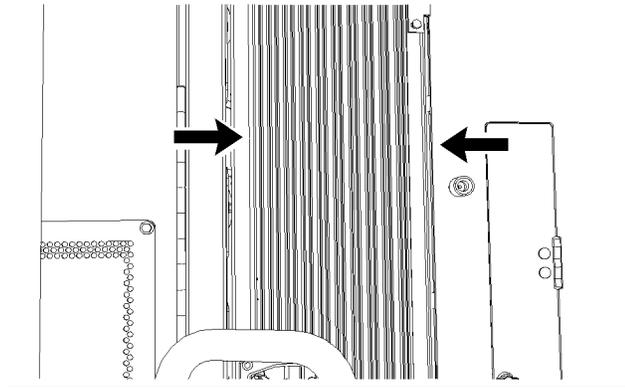


Illustration 259

g01094991

On each side of the machine, the radiator core can be accessed through the vents and through the narrow access doors.

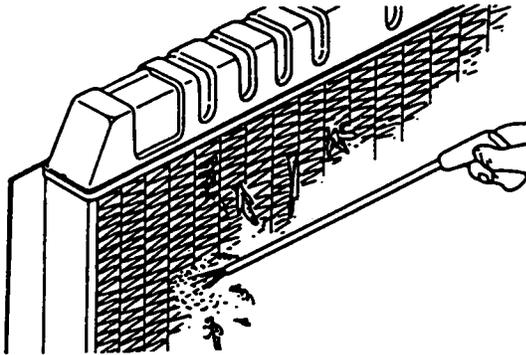


Illustration 260

g00100062

You can use compressed air, high pressure water, or steam to remove dust and other debris from the radiator core. However, the use of compressed air is preferred.

Refer to Special Publication, SEBD0518, "Know Your Cooling System" for the complete procedure for cleaning the radiator core.

## Refrigerant Dryer - Replace

SMCS Code: 7322-510

### **WARNING**

Personal injury can result from contact with refrigerant.

Contact with refrigerant can cause frost bite. Keep face and hands away to help prevent injury.

Protective goggles must always be worn when refrigerant lines are opened, even if the gauges indicate the system is empty of refrigerant.

Always use precaution when a fitting is removed. Slowly loosen the fitting. If the system is still under pressure, release it slowly in a well ventilated area.

Personal injury or death can result from inhaling refrigerant through a lit cigarette.

Inhaling air conditioner refrigerant gas through a lit cigarette or other smoking method or inhaling fumes released from a flame contacting air conditioner refrigerant gas, can cause bodily harm or death.

Do not smoke when servicing air conditioners or wherever refrigerant gas may be present.

Use a certified recovery and recycling cart to properly remove the refrigerant from the air conditioning system.

### NOTICE

If the refrigerant system has been open to the outside air (without being plugged) for more than 30 minutes, the receiver-dryer must be replaced. Moisture will enter an open refrigerant system and cause corrosion which will lead to component failure.

Refer to Service Manual, SENR5664, "Air Conditioning and Heating System with R-134a Refrigerant for All Caterpillar Machines" for the proper procedure to change the receiver-dryer assembly and for the procedure to reclaim the refrigerant gas.

i02159129

## Rollover Protective Structure (ROPS) - Inspect

**SMCS Code:** 7325-040

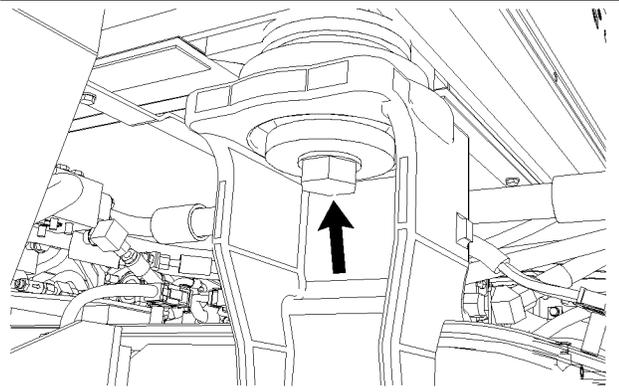


Illustration 261

g01095101

Inspect the ROPS for bolts that are loose or damaged. Use original equipment parts only to replace bolts that are damaged or missing. Tighten the four cab mounting bolts to a torque of  $1500 \pm 200$  N·m ( $1106 \pm 147.5$  lb ft).

**Note:** Apply oil to all bolt threads before installation. Failure to apply oil can result in improper bolt torque.

Do not repair the ROPS by welding reinforcement plates to the ROPS. Consult your Caterpillar dealer for repair of cracks in any welds, in any castings, or in any metal section of the ROPS.

i02301796

## Seat Belt - Inspect

**SMCS Code:** 7327-040

Always check the condition of the seat belt and the condition of the seat belt mounting hardware before you operate the machine. Replace any parts that are damaged or worn before you operate the machine.

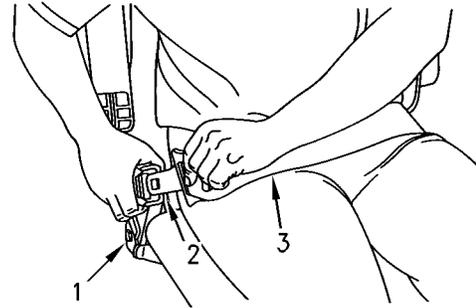


Illustration 262

g00932801

Typical example

Check the seat belt mounting hardware (1) for wear or for damage. Replace any mounting hardware that is worn or damaged. Make sure that the mounting bolts are tight.

Check buckle (2) for wear or for damage. If the buckle is worn or damaged, replace the seat belt.

Inspect the seat belt (3) for webbing that is worn or frayed. Replace the seat belt if the seat belt is worn or frayed.

Contact your Caterpillar dealer for the replacement of the seat belt and the mounting hardware.

**Note:** Within three years of the date of installation or within five years of the date of manufacture, replace the seat belt. Replace the seat belt at the date which occurs first. A date label for determining the age of the seat belt is attached to the seat belt, the seat belt buckle, and the seat belt retractor.

If your machine is equipped with a seat belt extension, also perform this inspection procedure for the seat belt extension.

i02303477

## Seat Belt - Replace

**SMCS Code:** 7327-510

Within three years of the date of installation or within five years of the date of manufacture, replace the seat belt. Replace the seat belt at the date which occurs first. A date label for determining the age of the seat belt is attached to each seat belt.

i01061080

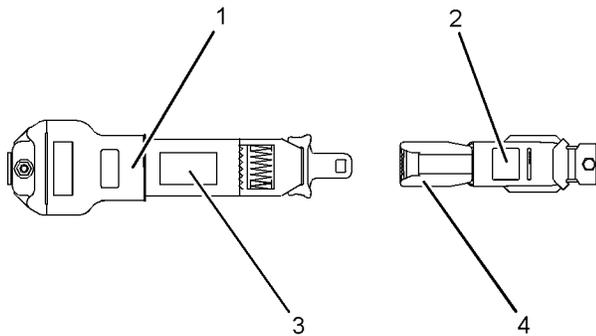


Illustration 263

g01152685

- (1) Date of installation (retractor)
- (2) Date of installation (buckle)
- (3) Date of manufacture (tag) (fully extended web)
- (4) Date of manufacture (underside) (buckle)

Contact your Caterpillar dealer for the replacement of the seat belt.

If your machine is equipped with a seat belt extension, also perform this replacement procedure for the seat belt extension.

i01547608

## Seat Side Rails - Adjust

**SMCS Code:** 7312-025

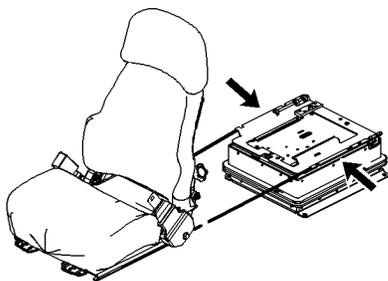


Illustration 264

g00804394

Caterpillar recommends adjusting the side rails after the initial 500 hours of machine operation. After the initial 500 service hours, perform this procedure when it is necessary.

**Reference:** Refer to Service Manual, SENR6615, "Contour Series Seat" for the adjustment procedure.

## Starting Motor - Inspect

**SMCS Code:** 1453-040

Caterpillar recommends a scheduled inspection of the starting system.

Check the starting motor and the battery charger for proper operation. Check for loose electrical connections.

**Reference:** For the complete procedure for inspecting the starting system, refer to the Systems Operation/Testing and Adjusting manual for your machine's engine.

i02168764

## Steering Cylinder Bearings - Lubricate

**SMCS Code:** 4303-086-BD

Wipe off the fittings before any lubricant is applied.

There is a total of four fittings.

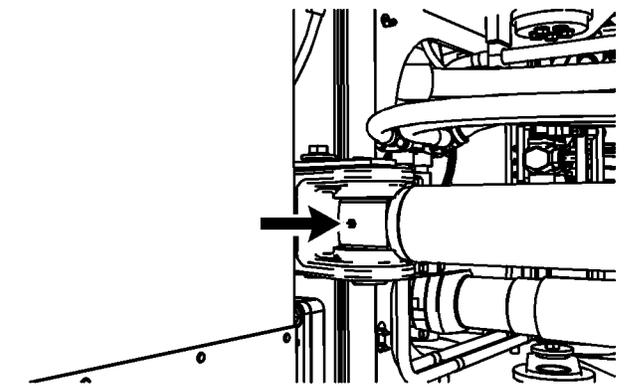


Illustration 265

g01098863

Apply lubricant through the fitting on the head end of each steering cylinder.

i02160651

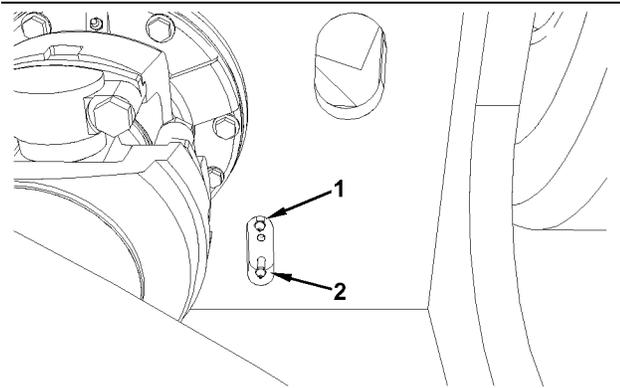


Illustration 266

g01098864

The bearing on the rod end of each steering cylinder is lubricated through two remote fittings on the inside of the right front loader frame.

Apply lubricant through fitting (1) for the right steering cylinder. Apply lubricant through fitting (2) for the left steering cylinder.

i02305841

## Tire Inflation - Check

**SMCS Code:** 4203-535-AI

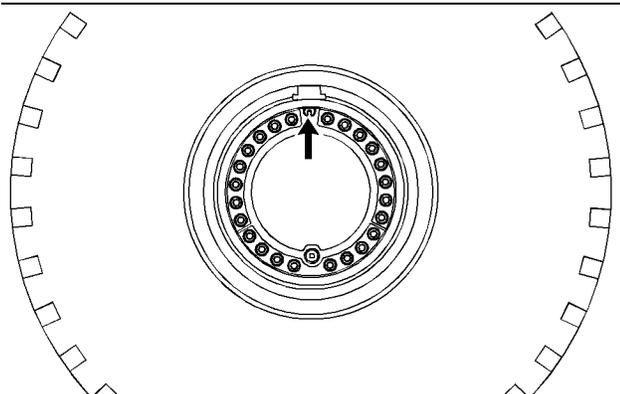


Illustration 267

g01160201

Always obtain proper tire inflation pressures and maintenance recommendations for the tires on your machine from your tire supplier. Measure the tire pressure on each tire.

Inflate the tires with nitrogen, if necessary.

**Reference:** Refer to the "Tire Inflation Information" section of the Operation and Maintenance Manual for more information.

## Transmission Oil - Change

**SMCS Code:** 3030-044

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Operate the machine in order to warm the transmission oil.
2. Park the machine on level ground. Lower the bucket to the ground and apply slight downward pressure. Engage the parking brake. Stop the engine.

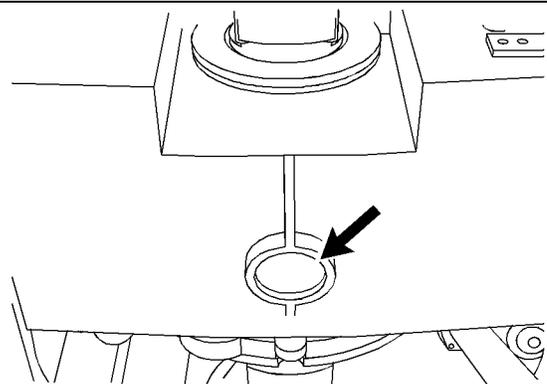


Illustration 268

g01095645

3. Earlier machines will need to remove the transmission guard from the bottom of the machine in order to access the drain plug. Later machines have an access hole in the transmission guard for the transmission drain plug.

**Note:** The drain valve is an ecology drain valve.

4. Remove the transmission drain plug from the bottom of the transfer gear case. Attach a hose to a 126-7914 Oil Drain Coupling. Install the threaded end of the coupling into the drain valve in order to unseat the internal drain valve. Allow the oil to drain into a suitable container.

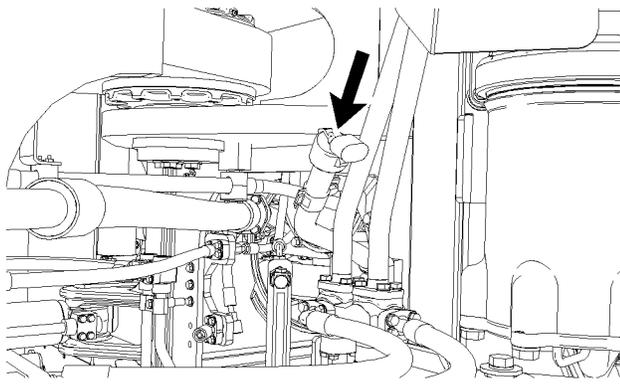


Illustration 269

g01095647

5. The transmission oil filler tube is located near the articulation joint on the left side of the machine. Remove the transmission oil filler cap in order to ease drainage.

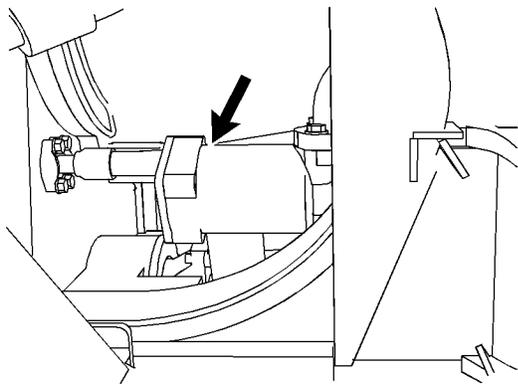


Illustration 270

g01095648

6. The transmission magnetic screen is located on the left side of the transfer gear case. The screen may be accessed through the left side of the rear frame, as shown.

Use the following procedure to clean the transmission magnetic screen:

**NOTICE**

Do not drop or rap the magnets against any hard objects. Replace any damaged magnets.

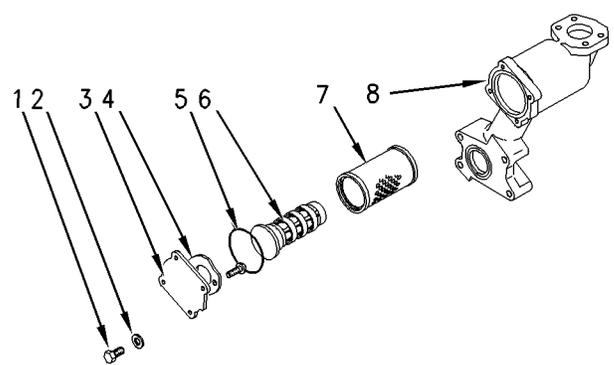


Illustration 271

g00838905

- a. Remove bolts (1) and washers (2). Remove cover assembly (3) and seal (5).
  - b. Remove screen tube assembly (6) and suction screen (7).
  - c. Wash the screen tube assembly and the suction screen in a clean, nonflammable solvent.
  - d. Install screen tube assembly (6) and suction screen (7).
  - e. Inspect seal (5) for damage. Replace the seal, if necessary. Install seal (5) and cover assembly (3).
7. Replace the transmission oil filter.  
**Reference:** Refer to Operation and Maintenance Manual, "Transmission Oil Filter - Replace" for the correct procedure.
  8. Clean the transmission drain plug. Install the transmission drain plug.
  9. Fill the transmission with oil.  
**Reference:** Refer to Operation and Maintenance Manual, "Capacities (Refill)" for the proper amount of oil.
  10. Clean the filler cap and install the filler cap.

i02161140

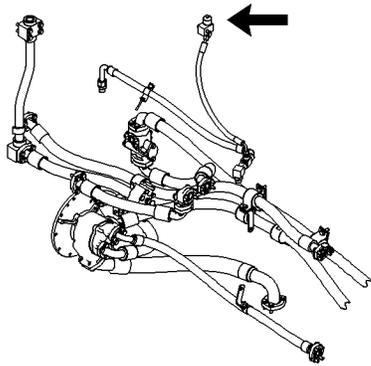


Illustration 272

g00935383

Transmission Breather

11. Open the access door in the platform behind the cab. Remove the transmission breather.
12. Wash the breather in a clean, nonflammable solvent. Allow the breather to air dry or use air pressure to dry the breather. Install the breather.
13. Start the engine and run the engine at low idle.
14. Slowly operate the transmission control in order to circulate the oil. Return the transmission to neutral.
15. Stop the engine. Inspect the entire transmission for leaks.

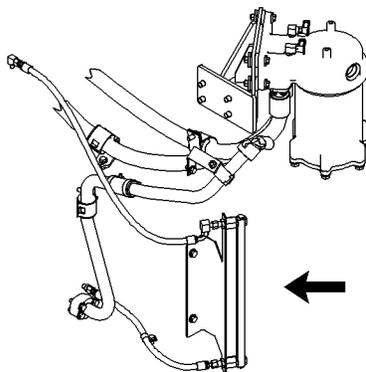


Illustration 273

g00935572

16. Check the transmission oil level.

**Reference:** Refer to Operation and Maintenance Manual, "Transmission Oil Level - Check" for the correct procedure.

## Transmission Oil Filter - Replace

**SMCS Code:** 3067-510

### NOTICE

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

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

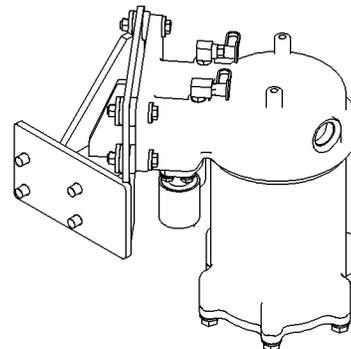


Illustration 274

g00935569

The transmission oil filter is located on the left side of the machine near the articulation joint.

**Note:** The hose for the steering cylinder may obstruct the bottom of the filter.

1. Stop the engine and remove the key.
2. Turn the battery disconnect switch to the OFF position.

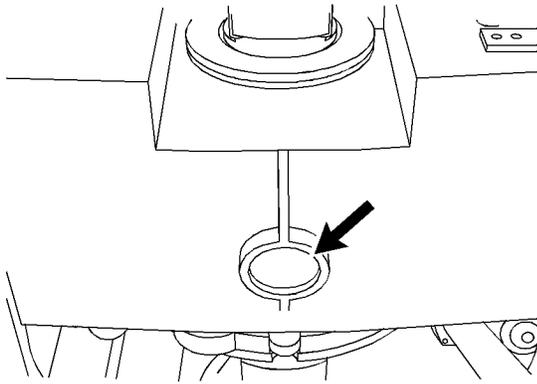


Illustration 275

g01095645

3. Earlier machines will need to remove the transmission guard from the bottom of the machine in order to access the drain plug. Later machines have an access hole in the transmission guard for the transmission drain plug.

**Note:** The drain valve is an ecology drain valve.

4. Remove the transmission drain plug from the bottom of the transfer gear case. Attach a hose to a 126-7914 Oil Drain Coupling. Install the threaded end of the coupling into the drain valve in order to unseat the internal drain valve. Allow the oil to drain into a suitable container.

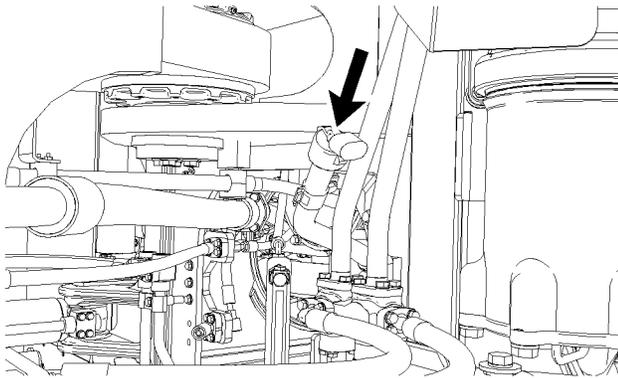


Illustration 276

g01095647

5. The transmission oil filler tube is located near the articulation joint on the left side of the machine. Remove the transmission oil filler cap in order to ease drainage.

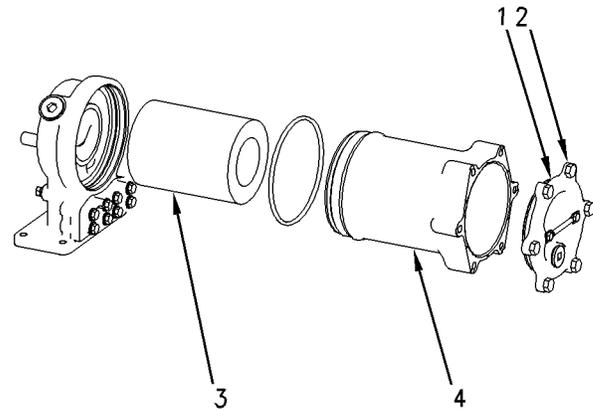


Illustration 277

g00930161

6. Remove bolts (2) and cover plate (1) from the bottom of filter housing (4).
7. Remove filter element (3) from filter housing (4). Dispose of the used filter element properly.
8. Clean the filter housing and the filter housing base with a clean, nonflammable solvent.
9. Inspect the cover seal for the filter housing. Replace the seal if the seal is damaged.
10. Clean the transmission drain plug. Install the transmission drain plug.
11. Install a new filter element, the cover plate and bolts on the bottom of the transmission oil filter housing.
12. Fill the transmission with oil.  
**Reference:** Refer to Operation and Maintenance Manual, "Capacities (Refill)" for the proper amount of oil.
13. Clean the filler cap and install the filler cap.
14. Start the engine and run the engine at low idle.
15. Slowly operate the transmission control in order to circulate the transmission oil. Return the transmission to neutral.
16. Stop the engine. Check the transmission oil filter for leaks.

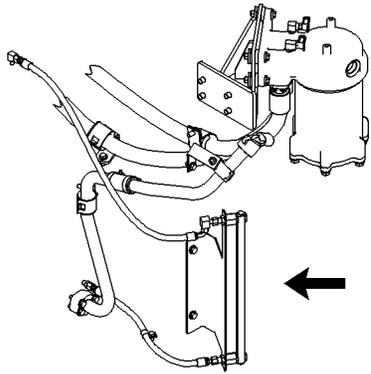


Illustration 278

g00935572

### 17. Check the transmission oil level.

**Reference:** Refer to Operation and Maintenance Manual, "Transmission Oil Level - Check" for the correct procedure.

i01833015

## Transmission Oil Level - Check

**SMCS Code:** 3030-535-FLV

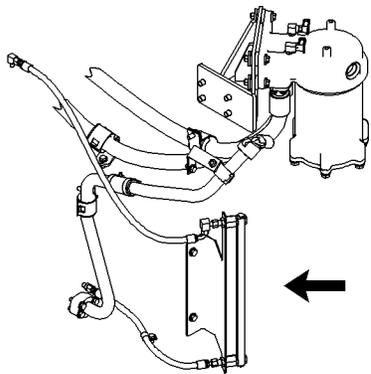


Illustration 279

g00936405

The sight gauge is located on the left side of the machine near the articulation joint.

1. Operate the machine for a few minutes in order to warm the oil. Park the machine on level ground.

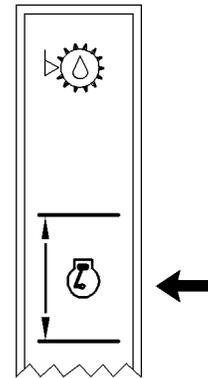


Illustration 280

g00936406

2. Check the oil level in the sight gauge. Maintain the oil level within the operating range while the engine is running.

**Note:** The oil level varies significantly when the engine is stopped. The oil level will be considerably higher than the operating range. The oil level should be above the middle of the gauge before the engine is started.

3. If necessary, remove the filler cap and add oil. Clean the filler cap and install the filler cap.

i02161205

## Transmission Oil Sample - Obtain

**SMCS Code:** 3080-008; 7542-008

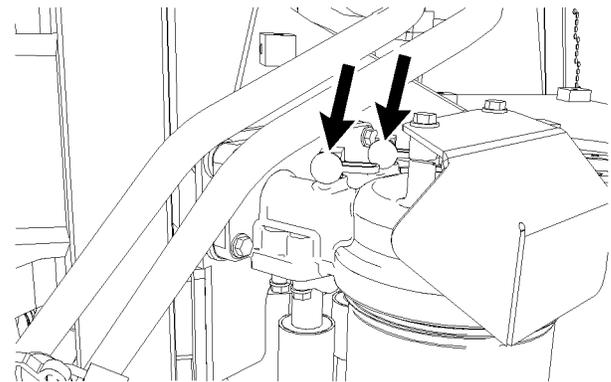


Illustration 281

g01095817

The sampling valve for the transmission oil is located on the transmission oil filter base on the left side of the machine.

Refer to Special Publication, SEBU6250, "Caterpillar Machine Fluids Recommendations", "S·O·S Oil Analysis" for information that pertains to obtaining an oil sample from the transmission housing. Refer to Special Publication, PEHP6001, "How To Take A Good Oil Sample" for more information about obtaining an oil sample from the transmission housing.

i01394768

## Turbocharger - Inspect

**SMCS Code:** 1052-040

If the turbocharger fails during engine operation, severe damage to the turbocharger compressor wheel and to the entire engine can result.

Turbocharger bearing failures can cause large quantities of oil to enter the intake system and the exhaust system. Loss of engine oil can result in serious engine damage.

Do not continue to operate the engine when a turbocharger bearing failure is accompanied by a significant loss of engine performance. Engine smoke and speeding up of the engine with no load are characteristics of a loss of engine performance.

**Reference:** For more information about inspecting the turbocharger, refer to the appropriate Service Manual for your machine's engine.

i01832606

## Walk-Around Inspection

**SMCS Code:** 7000-040

**Note:** Inspect the machine for leaks. If leaks are observed, find the source of the leak and correct the leak. If leaks are suspected, check the fluid levels more frequently than the recommended intervals.

- Inspect the cooling system for leaks and for faulty hoses. Fix any leaks and replace hoses, as needed. Remove any debris buildup from the radiator. For more information, refer to Operation and Maintenance Manual, "Radiator Core - Clean".
- Inspect the engine compartment. Remove any debris buildup from the engine compartment. Clean the engine access doors.
- Inspect the engine for any obvious component damage.
- Inspect the precleaner bowl for dirt buildup. Clean the precleaner bowl if dirt has accumulated to the "FULL" mark. For more information, refer to Operation and Maintenance Manual, "Engine Air Precleaner - Clean".
- Inspect the tires for damage. Replace any missing valve caps.
- Inspect the axles, the differentials, the wheel brakes and the transmission for leaks. Fix any leaks.
- Inspect the hydraulic system for leaks. Check the hydraulic tank, all hoses and all tubes. Also, check all plugs, all seals, all couplings and all fittings. Fix any leaks and replace hoses, as needed.
- Inspect all attachments and the linkages for wear and for damage.
- Make sure that all access doors, all access covers and all guards are secured. Inspect the access doors, the access covers and the guards for damage.
- Inspect the steps, the walkways and the handholds. Remove any debris. Repair any damage or replace any damaged parts.
- If equipped, inspect the automated lubrication system. Fix any leaks and replace any damaged fittings or hoses.
- Inspect the Rollover Protective Structure (ROPS) for obvious damage. Consult your Caterpillar dealer for repairs.
- Inspect the lights. Replace any broken bulbs and any broken lenses.
- Inspect the operator compartment. Remove any trash buildup. Keep the operator compartment clean.
- Inspect the dash panel for broken gauges and for broken indicator lights. Replace any broken parts.
- Inspect the seat belt, the buckle and the mounting hardware. Replace any components that are worn or damaged. For more information, refer to Operation and Maintenance Manual, "Seat Belt - Replace".
- Adjust the mirrors for best visibility.
- Inspect the windows. Make sure that the operator's vision is not impaired by dust, by mud, or by other foreign materials. Clean the windows, if necessary. For more information, refer to Operation and Maintenance Manual, "Windows - Clean".

i02161333

i00037755

## Window Washer Reservoir - Fill

**SMCS Code:** 7306-544

### NOTICE

When operating in freezing temperatures, use Caterpillar nonfreezing window washer solvent or equivalent. System damage can result from freezing.

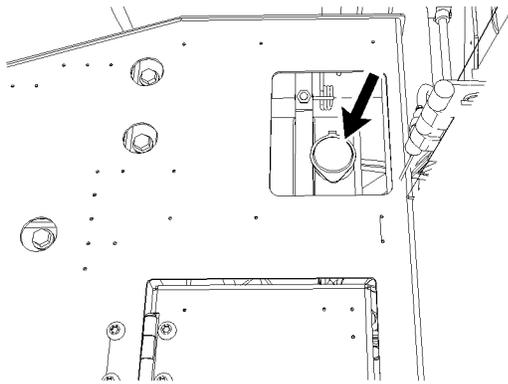


Illustration 282

g01095908

The window washer reservoir is located beneath an access panel on the left cab platform .

Fill the reservoir with window washer solvent.

i02168843

## Window Wiper - Inspect/Replace

**SMCS Code:** 7305-040; 7305-510

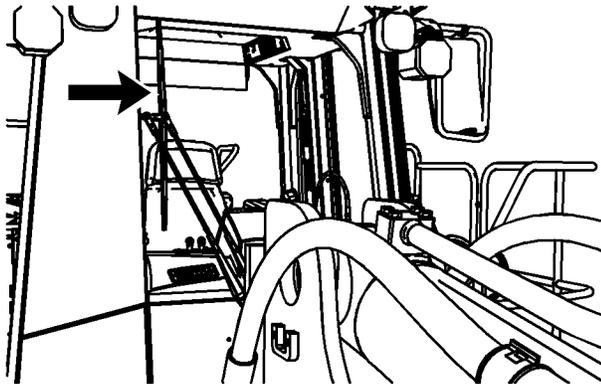


Illustration 283

g01098903

Inspect the front wiper blade and the rear wiper blade. Replace the wiper blades if the wiper blades are worn or damaged or if streaking occurs.

## Windows - Clean

**SMCS Code:** 7310-070

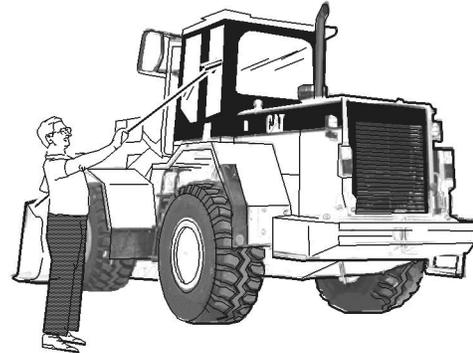


Illustration 284

g00038949

Use commercially available window cleaning solutions in order to clean the windows. Clean the outside windows from the ground unless handholds are available.