The valve mechanism cover contains an open breather assembly. This device vents the gases, which are caused by blowby, from the valve mechanism cover to the outside air. The breather reduces emissions without reducing the power of the engine.

## Cylinder Head And Valves

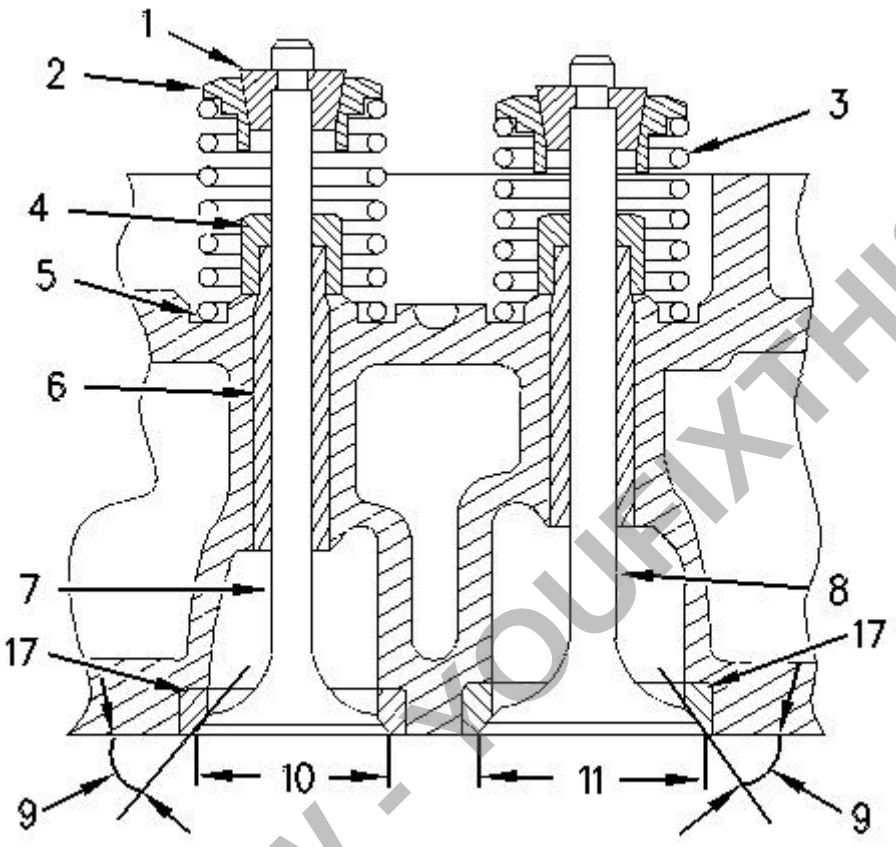



Illustration 1 g00468536

Cross section of the inlet valve and the exhaust valve in the cylinder head

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**Note:** If the service limit is exceeded, then the crankshaft must be replaced.

(6) Main bearing journal

Diameter of main bearing journal ... 45.964 to 45.975 mm (1.8096 to 1.8100 inch)
Service limit ... 45.90 mm (1.8071 inch)

**Note:** If the service limit is exceeded, then the crankshaft must be replaced.

(7) Lower half of the main bearing

The lower half of the main bearing does not have an oil groove.

## Measure Wear on the Crankshaft

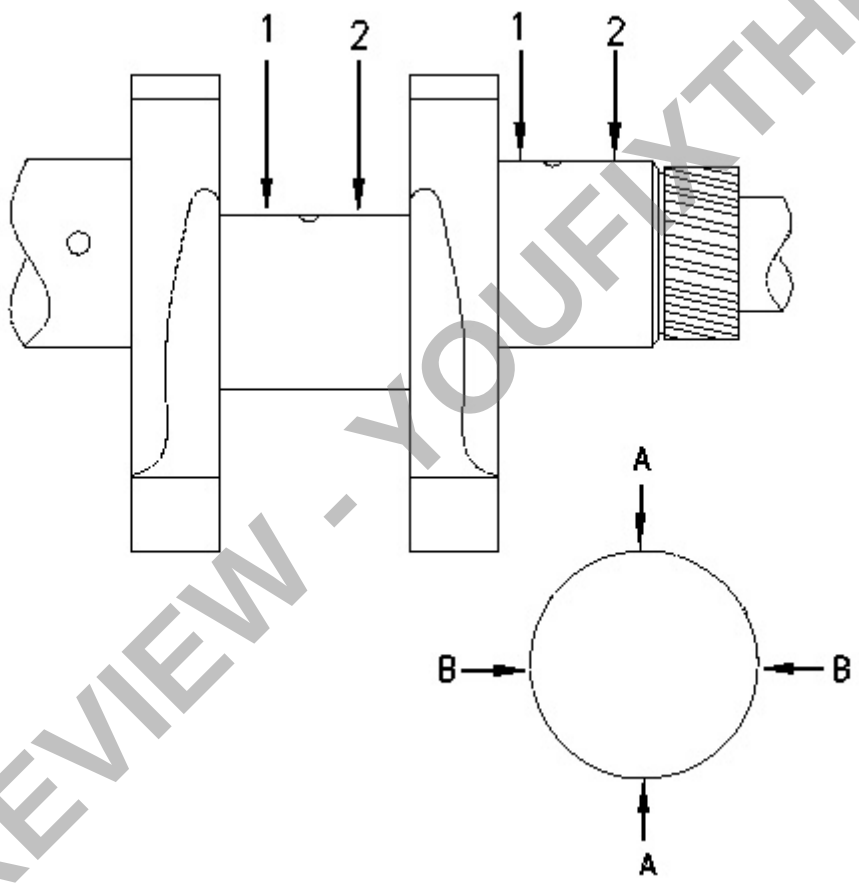



Illustration 3 g00464232

Measure the crankshaft journals for wear.

Measure the diameters of the crankshaft journals that is shown in Illustration 3. This procedure measures wear and eccentricity. Measure the diameters of the connecting rod journals (5) and main journals (6) in positions (1) and (2). Measure the diameter (A) and (B) in each position.

(1) (2) Taper

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Disassembly and Assembly
3003, 3013, 3014 and 3024 Engines for Caterpillar Built Machines
Media Number -SENR5027-05 Publication Date -01/05/2005 Date Updated -16/05/2005

i02350237

# Flywheel - Remove

**SMCS -** 1156-011

# Removal Procedure ( 3003 Engine)

**Start By:**

A. Remove the flywheel housing. Refer to Disassembly and Assembly, "Flywheel Housing - Remove and Install".

**NOTICE**

**Keep all parts clean from contaminants.**

**Contaminants may cause rapid wear and shortened component life.**

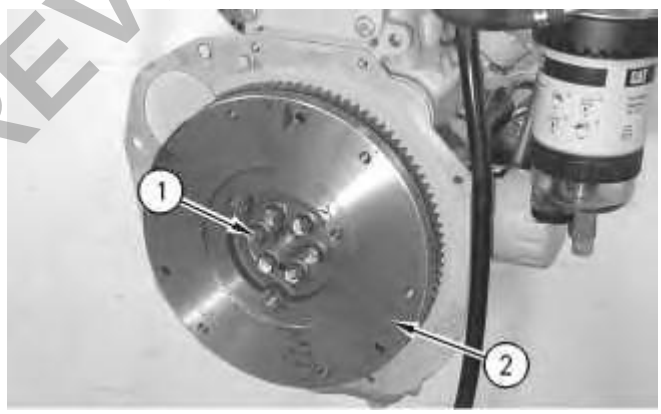



Illustration 1 g00582471

1. Remove bolts (1) .

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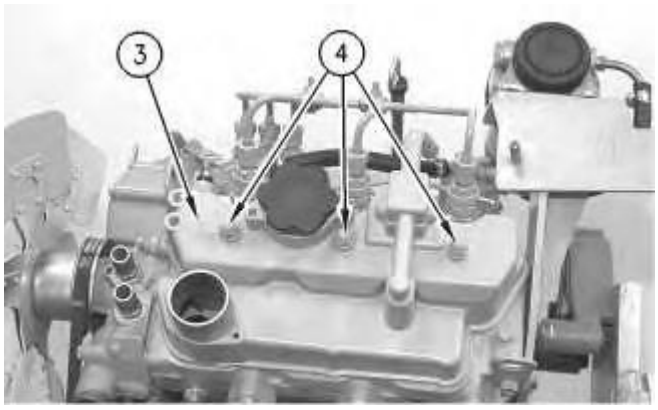



Illustration 3 g00592620

2. Position the gasket for the valve mechanism cover on the cylinder head and install valve mechanism cover (3) .

   **Note:** Before you install three cap nuts (4), lubricate the threads with clean engine oil.

3. Install cap nuts (4) and tighten the nuts to a torque of 11 N·m (8 lb ft).

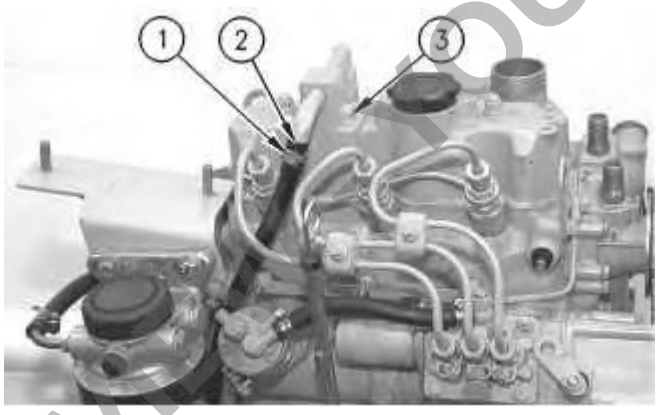



Illustration 4 g00592619

4. Install breather hose (2) and clamp (1) for the crankcase breather.

# Removal Procedure ( 3013, 3014, and 3024 Engines)

**NOTICE**

**Keep all parts clean from contaminants.**

**Contaminants may cause rapid wear and shortened component life.**

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- Boom Lowering Control Valve - Remove and Install
- Pilot and Travel Speed Manifold - Remove and Install

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| | | |
|---|---|---|
| | reported from other ECMs on the machine. | |
| "Event/Diagnostic Interval" | Determines when the Product Link will report a recurrence of an event or a diagnostic code, measured in units of machine operating hours. All events and diagnostics are recorded and may be viewed with the Electronic Technician. | Minimum value is 4 hours. The default is 20 hours, meaning that an event or diagnostic update message will not be present for a specific event or diagnostic update until the machine has operated for 20 hours after the last transmitted occurrence of that event or diagnostic update. At the next event or diagnostic occurrence after the time period elapses, another message will be sent. |
| "Next Scheduled Interval" | Sets the time period before an event or diagnostic message update is sent, measured in units of real time or clock hours. This time period is calculated from the "Report Start Time". | Minimum value is 24 hours. Default value is 168 hours or 1 week.<br>This value is only valid if the event or diagnostic report intervals are set to "Next". |
| "SMU/Fuel Reporting" | Defines whether the SMU or Fuel consumption report is sent as part of the daily standard message. | Fuel Only<br>SMU Only<br>Alternate SMU/Fuel |

From the "Transmission Registry" screen, you can select the check box next to a piece of equipment. Then, click the "Configuration" button. The "Over the Air Configuration" screen will appear. On this screen, you can edit the "General Registry" parameters, the "Digital Registry" parameters, and the "Transmission Registry" parameters. Refer to ""Over the Air Configuration"".

## "Over the Air Configuration"

You can use EquipmentManager over the air in order to change the configurable parameters for the registration of the PLM. This screen can be reached from the following screens by selecting the "Configuration button" that appears on each screen:

- "General Registry"
- "Equipment Registration Detail"
- "Digital Registry"
- "Transmission Registry"

Refer to the following procedure in order to configure parameters for the registration over the air from the "Equipment Registration Detail" screen:

1. In order for the "Over The Air Configuration" screen to appear , select the "Configuration" on the "Equipment Registration Detail" screen. The "Over The Air Configuration" screen will appear.

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Illustration 15 g01397888

# Fence Alarm Messages

After the fences have been set, the alarm for the associated fence is triggered. The alarm will occur when the machine crosses the defined fence.

## Initial Alarm Message

This message is sent at the time of the fence violation by all supported Product Link modules regardless of the type of module. The supported modules include PL151, PL201, PL121, and PL321.

**PL121 only -** The EquipmentManager software will not display an alarm on consecutive days (regardless of active status) unless the machine leaves the work site or the machine enters a restricted area again.

**PL321 only -** If the alarm is still active on consecutive days, the EquipmentManager software will display a new Product Watch Event. The EquipmentManager software will send the appropriate event reaction once with the daily standard message. The EquipmentManager software will send the appropriate event reaction the next time the alarm is activated.

Refer to Systems Operation, Troubleshooting, Testing and Adjusting, RENR7911, "Product Link 121/321", for more information about the PL121 and PL321 alarms.

## Subsequent Alarm Message

A subsequent alarm message may be sent while the Product Link module remains in the alarm state.

The following conditions will cause a subsequent alarm message. The type of message that is sent will depend on the type of Product Link module and the version of software that is on the module.

- **Daily** – The alarm message will be included in the Daily Status Message.
- **Accumulative** – If multiple fences are configured, and a fence is in an alarm state, then all fence alarms will be sent with any alarm message.
- **Machine Start** – While the modules remain in an alarm state, subsequent alarm messages are sent each time that a machine is started.

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Updating" Equipment List"

(2) Check box

(3) "Group Name" field

(4) "Group Description" field

(8) "Next" button

5. In the "Group Information" section, edit the name in the "Group Name" field (3) .
6. In the "Group Information" section, edit the description in the "Group Description" field (4) .
7. In the "Equipment List", select the check box (2) for the equipment you want to add to the group. Clear the check box for the equipment that you want to remove from the group.




Illustration 8 g01270517

"Modify Equipment Group Detail"

8. Click the "Next" button (8) . The "Modify Equipment Group Detail" screen will be displayed.

## Delete Equipment Group

Just as you may create and modify groupings of equipment, you may also delete equipment groups completely.

In order to delete an equipment group, use the following procedure:

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Illustration 1 g01710930

"Exception Dashboard"

(1) "Event Summary" section

(2) "Status" levels

(3) "Equipment Search" section

The default home screen of EquipmentManager is known as the "Exception Dashboard". Refer to Illustration 1. This screen features the following two sections:

- "Event Summary" section (1)
- "Equipment Search" section (3)

## "Event Summary"

EquipmentManager allows you to manage your equipment by an exception. There are three "Status" levels (2) of events:

**Action (red)** - The "Action" status indicates an event that is deemed of the highest importance. "Action" events should be given the most attention and "Action" events should be resolved first.

**Monitor (yellow)** - The "Monitor" status indicates an event that should have attention, but this event does not require immediate resolution.

**Normal (green)** - The "Normal" status indicates an event that is deemed of the least importance of the actions that require attention or resolution.

## Search Using "Event Summary"




Illustration 2 g01710926

"Event Summary" search with popup text

(4) "Select a Group" drop-down menu

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| | |
|---|---|
| "Saturday Security System Bypass Start Time" | 12:00 |
| "Saturday Security System Bypass Stop Time" | 12:00 |

Table 1 shows an example of "Security System Bypass". The "Start Time" is the time when the Machine Security System will disarm. The Machine Security System will return to the "armed" state at the "Stop Time". Between these two periods of time, any Caterpillar key will operate the machine. Thus, the MSS is disarmed during this period of time.

All times are based on a 24 hour clock. For example, 6:00 am is 06:00 and 3:00 pm is 15:00. The Machine Security System will be disarmed during the times that are listed below: Monday through Thursday from 06:00 to 18:00

On Friday, the MSS is disarmed for only half of the workday. After 12:00 on Friday, the Machine Security System will be armed automatically. Operation will be restricted to operators with electronic keys that are authorized in the MSS ECM on that machine. Refer to Table 1.

The Machine Security System is "armed" on the weekend. Because the "Start Time" and the "Stop Time" are set for the same time, the Machine Security System will be armed throughout the day.

---

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Illustration 2 g00584084

(1) Armature reduction gear

(2) Armature

(3) Field winding

(4) Brushes

(5) Idler reduction gear

(6) Overrunning clutch gear.

(7) Pinion

(8) Overrunning clutch

(9) Solenoid contacts

(10) Plunger

(11) Return spring

(12) Hold-in winding

(13) Solenoid

(14) Pull-in winding

(15) Key start switch

(16) Battery

When switch (15) is closed, battery current will flow in two directions. Current flows from battery (16) to switch (15). The current from the battery flows through the pull-in winding (14), field winding (3), armature (2), brushes (4), and ground. Current also flows through hold-in winding (12) to ground. The activation of pull-in winding (14) and hold-in winding (12) produces a magnetic force. The force that is produced pulls plunger (10) to the left. This moves clutch (8) and pinion (7) toward the flywheel ring gear.

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c. The connector contact should stay connected when the connector is held in the position shown in Illustration 4. The connector contact is the pin contact or the socket contact.

**Expected Result**: The pin contacts and the socket contacts appear to be OK.

**Results**:

**OK** - The pin contacts and the socket contacts appear to be OK. **STOP.**

**NOT OK** - A problem exists with the connector terminal.

**Repair**: Replace the connector contact.

**STOP.**

---

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**Repair:** The ECM has failed. It is unlikely that the ECM has failed. Perform the previous Test Steps again. If the cause of the problem is not found, replace the ECM. See Testing and Adjusting, "Electronic Control Module (ECM) - Replace".

**Stop.**

- **NO** - The resistance is less than 5 ohms. The wiring harness is shorted to the + battery circuit.

  **Repair:** Check the wiring harness for signs of damage. Repair the machine harness or replace the machine harness.

  **Stop.**

---

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C. Measure the Alternator R-Terminal input (J1-4) to verify that there is an 11 VDC to 32 VDC square-wave. The measurement should range from 5Hz to 2 kHz or a steady DC voltage equivalent to the battery present.

**Expected Result:**

The Alternator R-Terminal input does not measure at a steady DC voltage equivalent to the battery voltage.

**Results:**

- **OK -** The signal is an 11 VDC to 32 VDC square-wave. The measurement should range from 0kHz to 2 kHz or a steady DC voltage equivalent to the battery present. The PL522 or 523 harness is likely not faulty. Proceed to Test Step 3.
- **NOT OK -** The PL522 or 523 cable has a possible short to a DC voltage source other than battery voltage.

  **Repair:** Repair the cable and verify that the fault has been removed.

  **STOP**

**Test Step 3. CHECK THE MACHINE ALTERNATOR.**

A. Disconnect the PL522 or 523 machine cable from the alternator.

B. Start the engine.

C. Using a multimeter and scope, measure the Alternator R-Terminal to verify that there is 11 VDC to 32 VDC square-wave. The measurement should range from 0 kHz to 2 kHz.

**Expected Result:**

The alternator R-Terminal should be an 11 VDC to 32 VDC square-wave from 0 kHz to 2 kHz.

**Results:**

- **OK -** The alternator R-Terminal is an 11 VDC to 32 VDC square-wave from 0 kHz to 2 kHz. Proceed to Test Step 4.
- **NOT OK -** The alternator R-Terminal is not an 11 VDC to 32 VDC square-wave from 0 kHz to 2 kHz.

  **Repair:** Repair the alternator or replace the alternator.

  **STOP**

**Test Step 4. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.**

A. Clean the contacts of the harness connectors.

B. Reconnect all harness connectors.

C. Turn the key start switch to the ON position and operate the machine.

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Current through the glow plug for the 3003 and 3013 engines ... 85 amperes max
Current through the glow plug for the 3014 and 3024 engines ... 110 amperes max

Maximum voltage drop for all engines ... 0.5 volts

Maximum resistance for 3003 engines ... 0.0185 ohm
Maximum resistance for 3013, 3014, and 3024 engines ... 0.0139 ohm

Refer to Testing and Adjusting, "Glow Plugs - Test" for information on testing the glow plugs.

(2) Threaded hole in the cylinder head for the glow plug

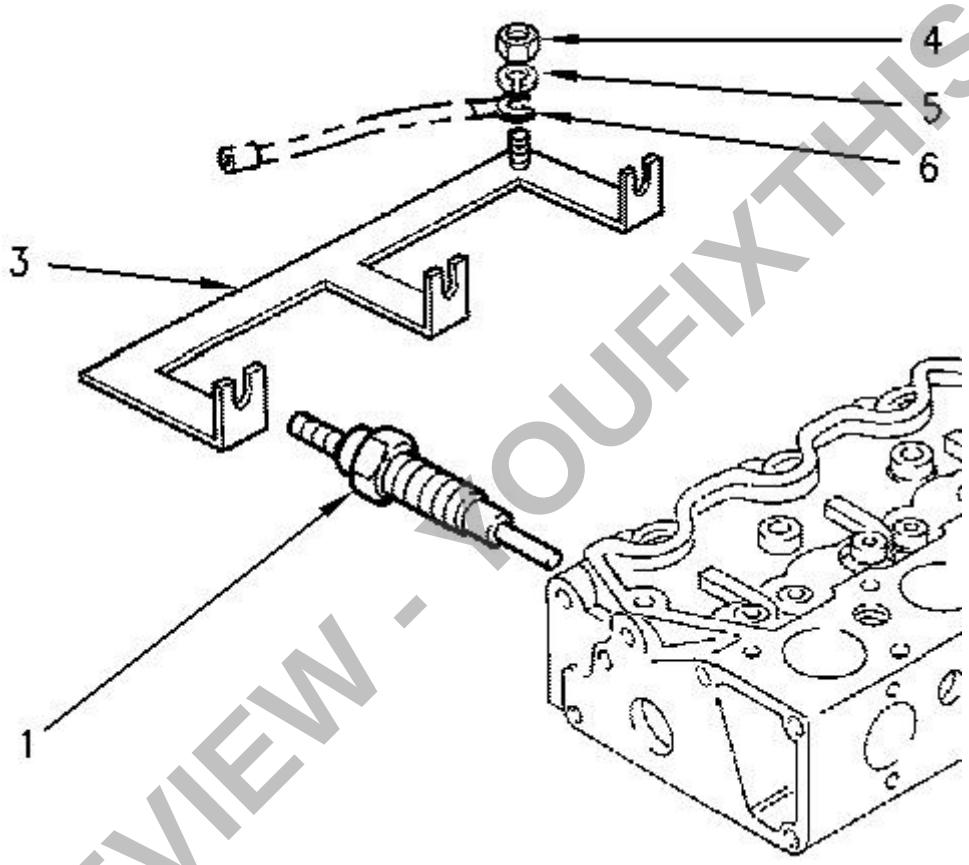



Illustration 2 g00697618

(3) Bus bar

(4) Nut for the electrical connector

Tighten the nut for the electrical connector to the following torque. ... 17 N·m (13 lb ft)

(5) Washer

(6) Electrical connector

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Make sure that all fuel injection nozzles are the correct replacement parts for the engine. Refer to the Parts Manual for the correct replacement part.

## Problem 3: The engine has lost power and the engine uses too much fuel.

### Probable Cause

1. The fuel injection nozzle does not seal in the cylinder head.

   Make sure that the gaskets, the insert and the mating surface of the cylinder head are clean. Make sure that the fuel injection nozzle is tightened to the correct torque in the threaded hole of the cylinder head.

2. Extra gaskets were not removed from the threaded recess in the cylinder head for the fuel injection nozzle. There is debris on the sealing surface for the fuel injection nozzle.

   Remove any extra gaskets or debris.

3. The connections of the high pressure fuel line leak.

   Tighten the fittings of the high pressure fuel line.

4. The fuel injection nozzle does not operate correctly.

   Make sure that the components of the fuel injection nozzle are tightened to the correct torques. Make sure that the gaskets and the insert are positioned correctly. Test the fuel injection nozzle on a nozzle tester in order to measure the pressure setting.

   Test the fuel injection nozzle on a nozzle tester.

5. The incorrect fuel injection nozzle is installed.

   Make sure that all fuel injection nozzles have the correct code for the engine.

6. A connection of the fuel return line leaks.

   Inspect all connections of the low pressure fuel line for tightening to the correct torque.

## Problem 4: The engine has the following symptoms: the engine knocks, the engine does not run evenly, and the engine misfires.

### Probable Cause

1. The fuel injection nozzle does not seal in the cylinder head.

   Make sure that the gaskets, the insert and the mating surface of the cylinder head are clean. Make sure that the fuel injection nozzle is tightened to the correct torque in the threaded hole of the cylinder head.

2. Extra gaskets were not removed from the threaded recess in the cylinder head for the fuel injection nozzle. There is debris on the sealing surface for the fuel injection nozzle.

   Remove any extra gaskets or debris.

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Testing and Adjusting
3003, 3013, 3014 and 3024 Engines for Caterpillar Built Machines
Media Number -SENR5023-04 Publication Date -01/11/2004 Date Updated -09/11/2004

i05182810

# Fuel Quality - Test

**SMCS -** 1280-081

## Introduction

This test checks for problems regarding fuel quality. Refer to Diesel Fuels and Your Engine, SEBD0717 for additional details.

Use the following procedure to test for problems regarding fuel quality:

## Required Tools

Table 1

| Required Tools | | |
|---|---|---|
| **Part Number** | **Part Description** | **Qty** |
| 5P-2712 | Thermometer/Hydrometer | 1 |

## Test Procedure

1. Determine if water and/or contaminants are present in the fuel. Check the water separator (if equipped). If a water separator is not present, proceed to Step 2. Drain the water separator, if necessary. A full fuel tank minimizes the potential for overnight condensation.

   **Note:** A water separator can appear to be full of fuel when the water separator is actually full of water.

2. Determine if contaminants are present in the fuel. Remove a sample of fuel from the bottom of the fuel tank. Visually inspect the fuel sample for contaminants. The color of the fuel is not necessarily an indication of fuel quality. However, fuel that is black, brown, and/or similar to sludge can be an indication of the growth of bacteria or oil contamination. In cold temperatures, cloudy fuel indicates that the fuel may not be suitable for operating conditions. The following methods can be used to prevent wax from clogging the fuel filter:

   - Fuel heaters

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When the combined flow valve is in the single pump auxiliary circuit supply position, pilot oil shifts the spool (36) to the right. Oil from the gear pump comes in through the bypass passage (33). The oil then flows through the opening (35) in the spool and to the return passage (32) .

The single pump auxiliary circuit supply position can only be obtained by switching the drain line and the pilot line on the combined flow valve. The combined flow valve is equipped with combined flow auxiliary circuit supply from the factory.

### Combined Flow Auxiliary Circuit Supply Position

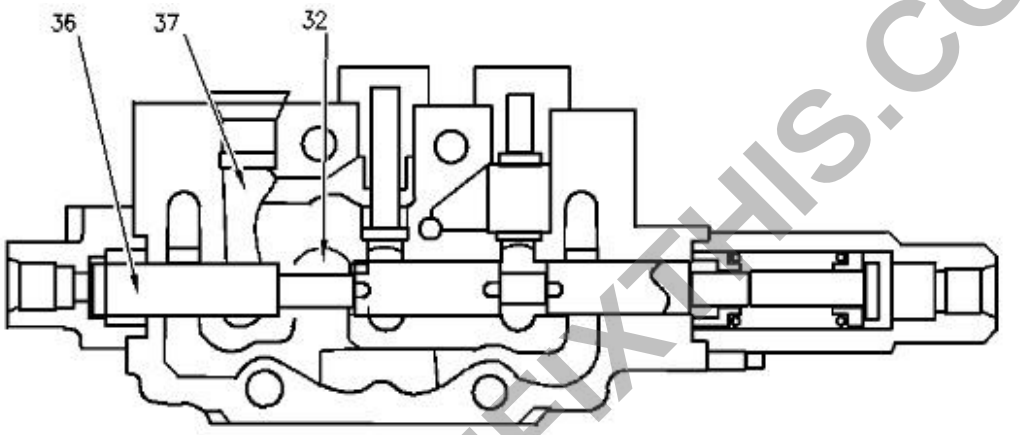



Illustration 14 g00592805

(32) Return passage. (36) Spool. (37) Passage.

When the combined flow valve is in the combined flow auxiliary circuit supply position, pilot oil shifts the spool (36) to the left. Oil from the piston pump flows through the valve for the auxiliary circuit and into the return passage (32) for the combined flow valve.

Oil from the gear pump is blocked in the passage and the parallel passage. The oil flows through the check valve and the oil joins the oil from the piston pump in the passage (37). This combined oil enters the valve for the auxiliary circuit.

The combined flow valve is equipped with combined flow auxiliary circuit supply from the factory. In order to obtain the single pump auxiliary circuit supply position, the drain line and the pilot line on the combined flow valve must be switched.

## Valve for the Auxiliary Hydraulic Circuit

The auxiliary hydraulic circuit is controlled by the left foot pedal. The left side of the foot pedal pressurizes the line that is connected to the female coupler. The right side of the foot pedal pressurizes the line that is connected to the male coupler. Refer to the Operation and Maintenance Manual, SEBU7203, "Auxiliary Hydraulic Control" for more information on the operation of the auxiliary hydraulic system.

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Testing and Adjusting
302.5 Mini Hydraulic Excavator
Media Number -RENR2846-02 Publication Date -01/06/2004 Date Updated -11/06/2004

i01286668

# Load Control Valve (Boom) - Test and Adjust

**SMCS -** 5127-081; 5130-081; 5472-081

**WARNING**

**Personal injury can result from hydraulic oil pressure and hot oil.**

**Hydraulic oil pressure can remain in the hydraulic system after the engine has been stopped. Serious injury can be caused if this pressure is not released before any service is done on the hydraulic system.**

**Make sure all of the attachments have been lowered, oil is cool before removing any components or lines. Remove the oil filler cap only when the engine is stopped, and the filler cap is cool enough to touch with your bare hand.**

**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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Disassembly and Assembly
302.5 Mini Hydraulic Excavator Machine Systems
Media Number -RENR2848-01 Publication Date -01/10/2003 Date Updated -16/10/2003

i01068548

# Gear Pump - Remove

**SMCS -** 5073-011

# Removal Procedure

**Start By:**

A. Release the hydraulic system pressure. Refer to Disassembly and Assembly, "Hydraulic System Pressure - Release".
B. Drain the hydraulic oil. Refer to Operation and Maintenance, SEBU7203, "Hydraulic System Oil - Change".

**WARNING**

**Personal injury can result from hydraulic oil pressure and hot oil.**

**Hydraulic oil pressure can remain in the hydraulic system after the engine has been stopped. Serious injury can be caused if this pressure is not released before any service is done on the hydraulic system.**

**Make sure all of the attachments have been lowered, oil is cool before removing any components or lines. Remove the oil filler cap only when the engine is stopped, and the filler cap is cool enough to touch with your bare hand.**

**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.**

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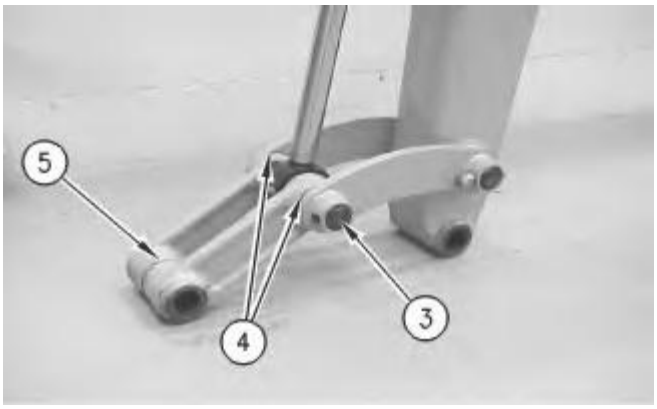



Illustration 2 g00575203

2. Remove pin (3) from the bucket cylinder with a brass punch.
3. Remove two shims (4) and linkage brackets (5) .

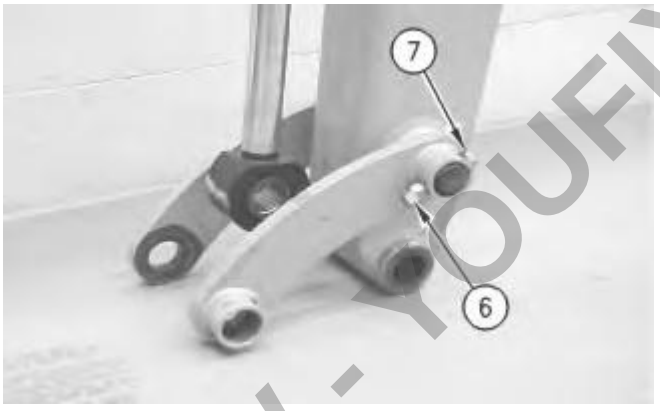



Illustration 3 g00575239

4. Remove two nuts (6) and bolt (7) .

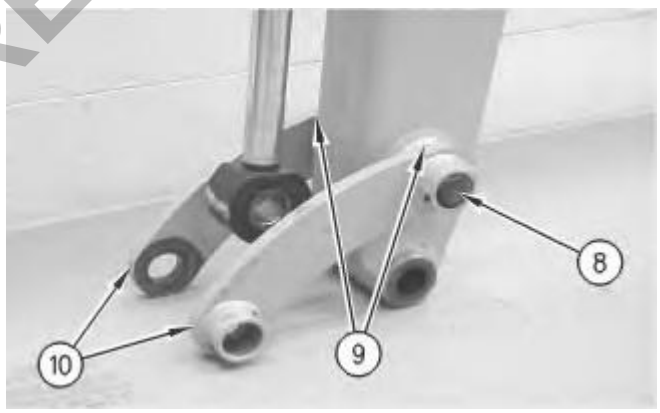



Illustration 4 g00575244

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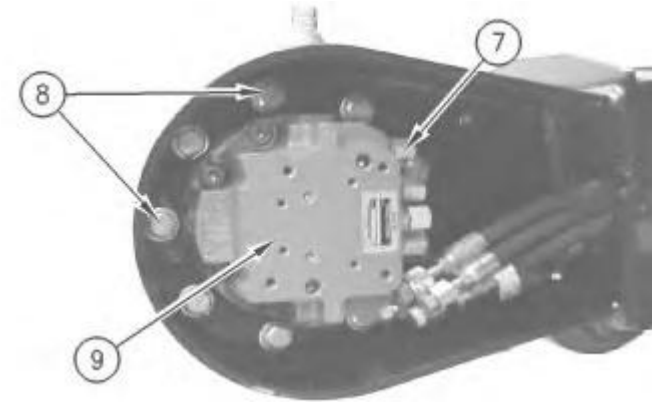



Illustration 3 g00577354

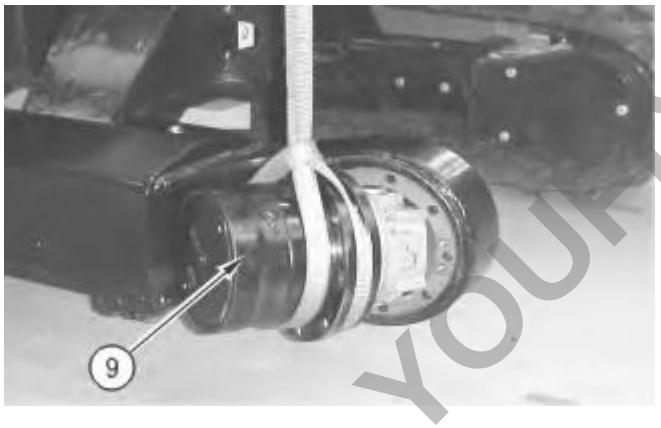



Illustration 4 g00577355

3. Use the suitable lifting strap to support the travel motor.
4. Remove hydraulic fitting (7) .
5. Remove nine bolts (8) and washers from the travel motor.
6. Remove travel motor (9) with the suitable lifting strap from the undercarriage frame. Weight of the travel motor is 36 kg (80 lb).

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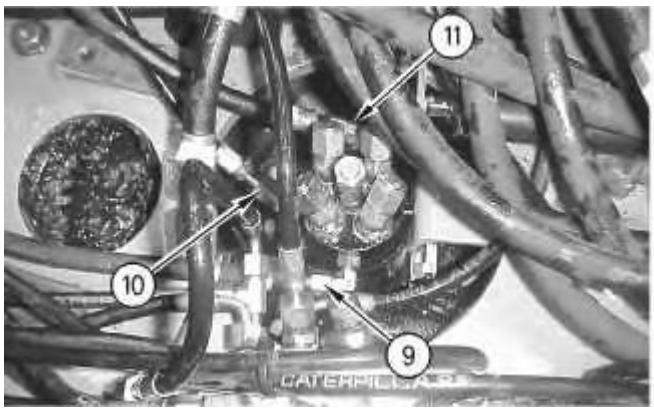



Illustration 23 g00600660

5. Connect lines (11), (10), and (9) to the swivel.

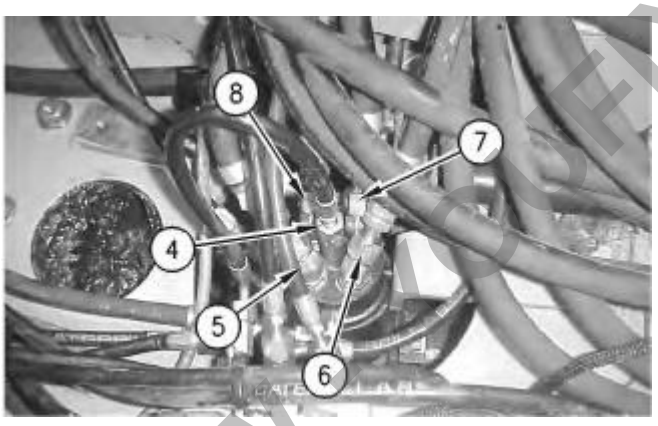



Illustration 24 g00600640

6. Connect lines (8), (7), (6), (5), and (4) to the swivel.




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Torque Specifications
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# Air Brake Fittings

**SMCS -** 7553

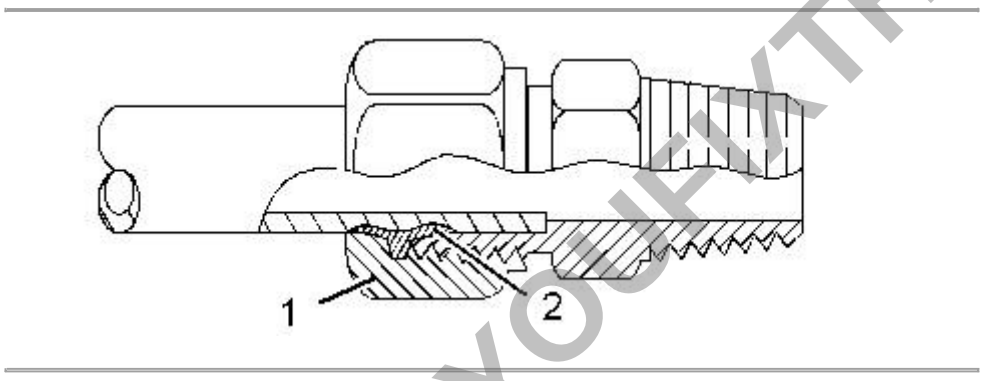



Illustration 1 g01848737

Put nut (1) and sleeve (2) over the tube. Push the tube into the counterbore of the fitting body as far as possible. There are two methods that may be used to tighten the nut. Tighten the nut with one of two methods.

- Tighten nut (1) to the torque that is specified in Table 1.
- Tighten nut (1) by the number of turns that is specified in Table 1. The number of turns is for the turns after the nut is finger tight.

Table 1

| Nominal Outer Diameter of the Tube | Torque | Turn Tightening | |
|---|---|---|---|
| | | Nonmetallic Tubing | Copper Tubing |
| 6.35 mm (0.250 inch) | 11 ± 3 N·m (97 ± 27 lb in) | 3 | 2 |
| 9.53 mm (0.375 inch) | 20 ± 3 N·m (175 ± 27 lb in) | 4 | 2 |

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