



Operation & Maintenance Manual

*Original Instructions
Keep this manual with machine at all times.*

Models
TH336C, TH337C,
TH406C, TH407C,
TH414C, TH514C,
TH417C

S/N MJR00150 & After, S/N THM00150 & After
S/N DJB00150 & After, S/N SXJ00150 & After
S/N GAT00150 & After, S/N RCH00150 & After
S/N MLH00150 & After, S/N JJT00150 & After
S/N KEK00150 & After, S/N RWW00150 & After
S/N MWC00150 & After, S/N KKW00150 & After
S/N RRJ00150 & After, S/N RRW00150 & After

31200752
SEBU9285-04

*Revised
June 27, 2016*

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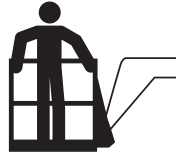
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Inspection, Maintenance and Repair Log

Section 1—General Safety Practices

Lifting Personnel



OW0171

- When lifting personnel, **USE ONLY** an approved personnel work platform, with proper capacity chart displayed in the cab.



OD0921

- **DO NOT** drive machine from cab when personnel are in platform.

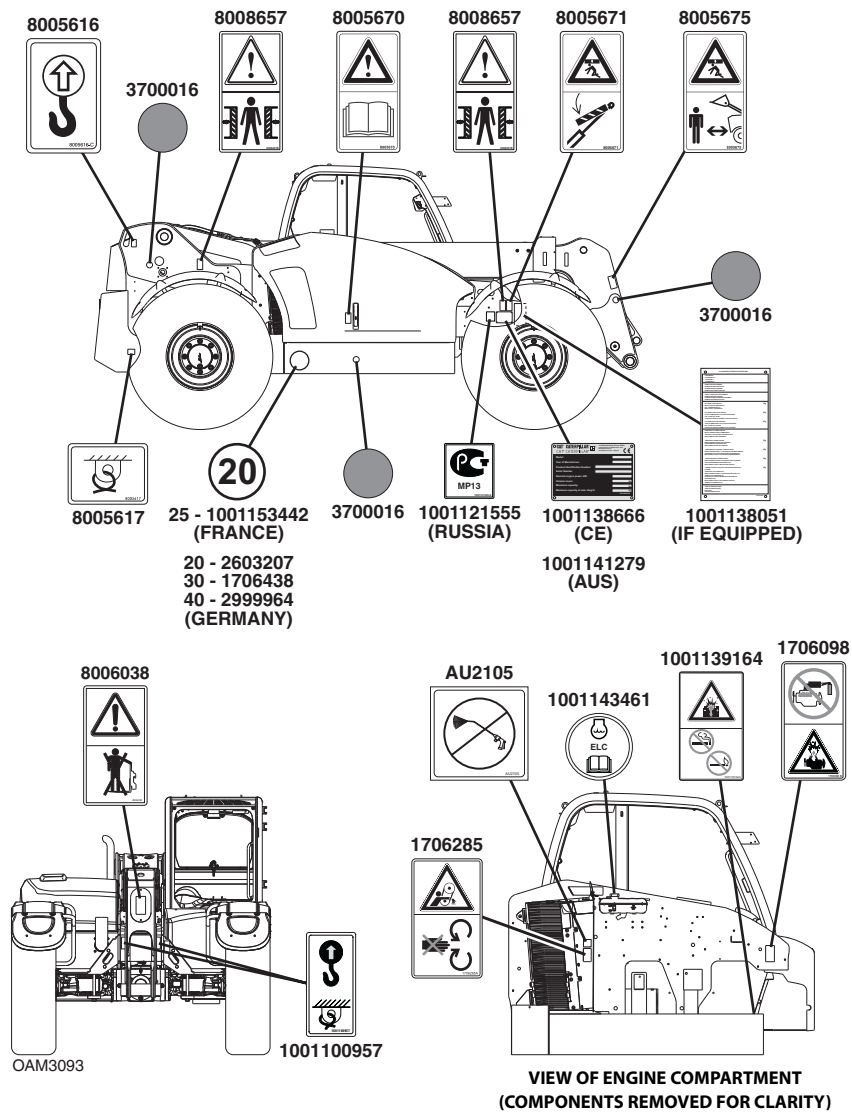
Section 2 - Pre-Operation and Inspection

2.2 SAFETY DECALS

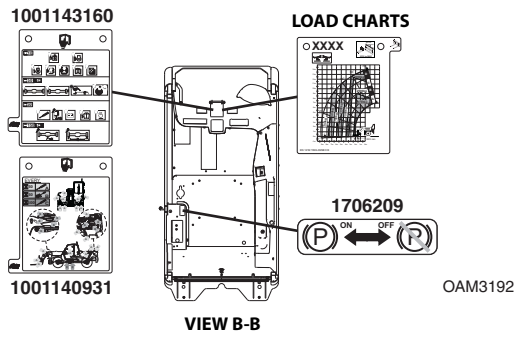
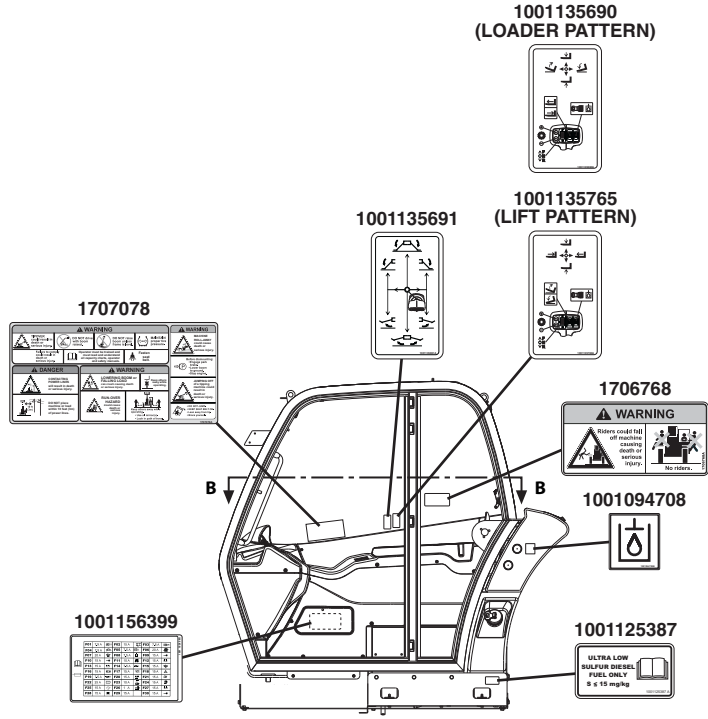
Ensure all **DANGER, WARNING, CAUTION** and instructional decals and proper load charts are legible and in place. Clean and replace as required.

Note: Part numbers referenced are for inspection and identification purposes only. Refer to the Parts Manual when ordering replacement parts.

TH336C, TH337C, TH406C & TH407C (CE & AUS)



Section 2 - Pre-Operation and Inspection

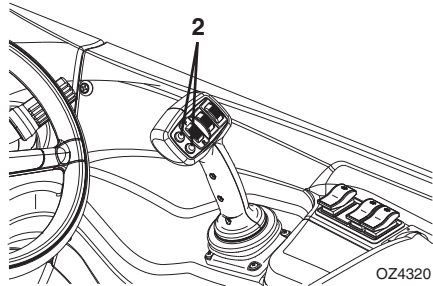


Section 3 - Controls and Indicators

10. Frame Level Indicator: Enables operator to determine the left to right level condition of the telehandler.
11. Keypad: See page 3-8.
12. LSI Indicator (CE & AUS): See page 3-14.
13. Accessory Control Lever (if equipped): See page 3-28.
14. Power/Emergency Stop Switch (if equipped for platform): Push down to shut off power and stop engine.
15. Boom Joystick and Transmission Control: See page 3-18.
16. Longitudinal Level Indicator (AUS): Enables operator to determine the front to back level condition of the telehandler.
17. Power Outlet: 12V receptacle.
18. Right Console Switches: See page 3-26.

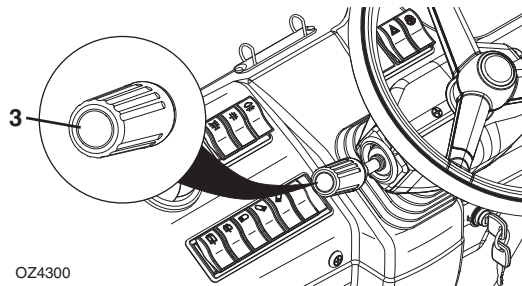
Section 3 - Controls and Indicators

Gear Selection



Gear selection is made with joystick buttons (2). See page 3-20 or page 3-23 for details.

Horn



Horn button (3) is located on the end of transmission control lever.

- Depress to sound horn.

Section 3 - Controls and Indicators

Transmission Control

Note: Transmission control lever (see page 3-12) takes priority over joystick transmission controls.

Transmission switch (8) engages forward or reverse travel.

- Depress top of switch for forward travel; Depress bottom of switch for reverse travel. Move switch to centered position for neutral.
- Forward or reverse travel can be selected while in any gear.
- When traveling in reverse, the back-up alarm will automatically sound.
- Travel at slow rates of speed when making turns and driving in reverse.



WARNING

TIP OVER/CRUSH HAZARD. Bring telehandler to a complete stop before shifting transmission. A sudden change in direction of travel could reduce stability and/or cause load to shift or fall.

Gear selection is controlled by buttons (9 & 10).

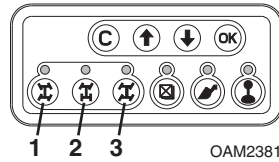
- Depress upshift button (9) to select a higher gear; Depress downshift button (10) to select a lower gear.
- The Transmission is equipped with either six forward and three reverse gears or four forward and three reverse gears. Default gear at start-up is third gear.
- Select the appropriate gear for the task being performed. **Use a lower gear when transporting a load.** Use a higher gear only when driving unloaded for longer distances.
- Slow down prior to downshifting. **Do not downshift more than one gear at a time.**

Section 3 - Controls and Indicators

All Wheel Assisted Steering Alignment Mode Change

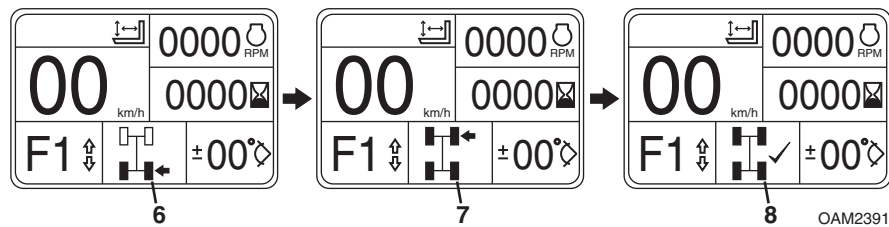
If all wheel assisted steering alignment mode is active under the Operator Tools menu (see page 3-7), use the following procedure for steer mode change.

1. Bring machine to a stop using service brake.



2. Select desired steer mode: circle steer (1), front steer (2) or crab steer (3).

Note: Selected steer mode LED will flash and display will show steering alignment screens until the change is complete. After steering alignment is complete, steer mode LED will illuminate solid.



3. Turn the steering wheel until the rear wheels are centered (6). This step will be skipped if changing from front steer mode and rear wheels are already centered.
4. Turn the steering wheel until the front wheels are centered (7). This step will be skipped if changing to front steer mode.
5. Wheels are now aligned and steer mode change is complete (8).

Note: Avoid turning steering wheel while machine is shut down. If wheels are not correctly aligned, manual adjustment may be required. See page 3-32.

Section 4 - Operation

Normal Engine Operation

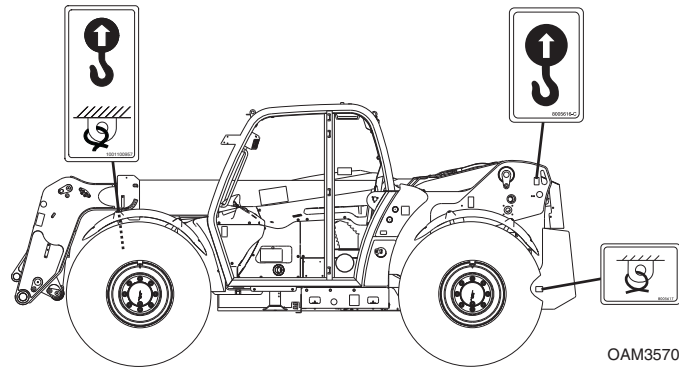
- Observe instrument panel and display frequently to be sure all systems are functioning properly.
- **Be alert for unusual noises or vibration.** When an unusual condition is noticed, park machine in safe position and perform shut-down procedure. Report condition to your supervisor or local Caterpillar dealer.
- **Avoid prolonged idling.** If the engine is not being used, turn it off.

Shut-Down Procedure

When parking the telehandler, park in a safe location on flat level ground and away from other equipment and/or traffic lanes.

1. Apply the park brake.
2. Shift the transmission to Neutral.
3. Lower forks or attachment to the ground.
4. Operate engine at low idle for 3 to 5 minutes. **DO NOT over rev engine.**
5. Shut off engine and remove ignition key.
6. If equipped for platform, push the power/emergency stop switch down.
7. Exit telehandler properly.
8. Turn off electrical master switch (if equipped).
9. Block wheels (if necessary).

4.6 LOADING AND SECURING FOR TRANSPORT



Tiedown

1. If equipped, level the telehandler prior to loading.
2. Using a spotter, load the telehandler with boom as low as possible.
3. Once loaded, apply parking brake and lower boom until boom or attachment is resting on deck. Move all controls to "Neutral," stop engine and remove ignition key.
4. Secure machine to deck by passing chains through the designated tiedown points as shown in the figure.
5. Do not tiedown front of boom.

Note: The user assumes all responsibility for choosing the proper method of transportation and tie-down devices, making sure the equipment used is capable of supporting the weight of the vehicle being transported and that all manufacturer's instructions and warnings, regulations and safety rules of their employer, the Department of Transportation and/or any other local, state or federal/provincial laws are followed.



WARNING

TELEHANDLER SLIDE HAZARD. Before loading telehandler for transport, make sure deck, ramps and telehandler wheels are free of mud, snow and ice. Failure to do so could cause telehandler to slide.

Section 5 - Attachments and Hitches

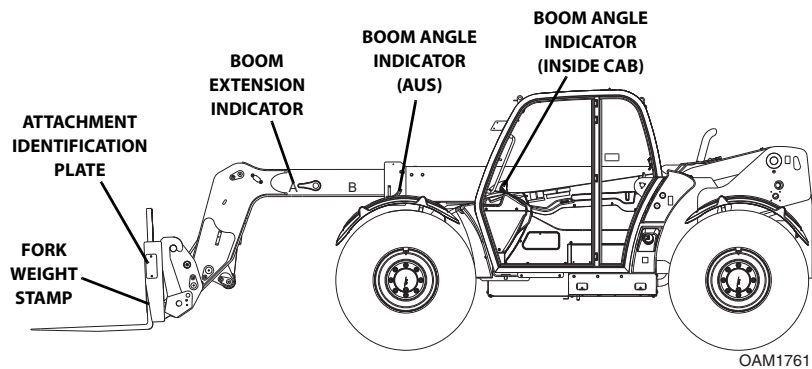
5.5 USE OF THE LOAD CHART

To properly use the load chart (see page 5-10), the operator must first determine and/or have the following:

1. An approved attachment. See "Approved Attachments" on page 5-1.
2. The proper Load Chart.
3. Weight of the load being lifted.
4. Load placement information:
 - a. HEIGHT where the load is to be placed.
 - b. DISTANCE from the front tires of the telehandler where the load is to be placed.
5. On the load chart, find the line for the height and follow it over to the distance.
6. The number in the load zone where the two cross is the maximum capacity for this lift. If the two cross at a division between zones, the smaller number must be used.

The number in the load zone must be equal to or greater than the weight of the load to be lifted. Determine the limits of the load zone on the load chart and keep within these limits.

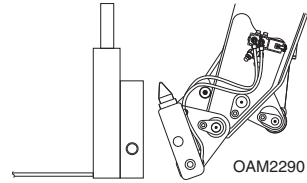
Capacity Indicator Locations



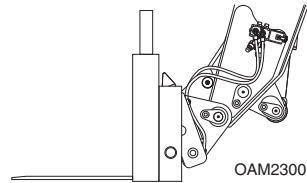
Section 5 - Attachments and Hitches

This installation procedure is designed for one-person operation.

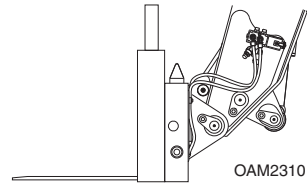
1. Tilt coupler forward to provide clearance. Check to be sure lock pin is disengaged.



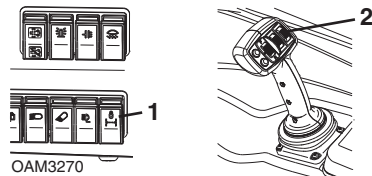
2. Align coupler point with opening in attachment. Raise boom slightly to engage coupler point in opening.



3. Tilt coupler back to engage attachment.



4. Press and hold button (1) and at the same time push roller switch down (2) to engage lock pin or push roller switch up to disengage lock pin.



5. Raise boom to eye level and visually check that the lock pin protrudes through the attachment hole. If the pin does not protrude through the attachment hole, place the attachment on the ground and return to step 2.
6. If attachment is equipped, connect auxiliary hydraulic hoses. See "Hydraulic Operated Attachment" on page 5-26.

Section 5 - Attachments and Hitches

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Section 5 - Attachments and Hitches

Operation:

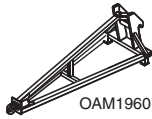
- Raise or lower boom to appropriate height for loading material from stockpile.
- Align telehandler with face of stockpile and drive slowly and smoothly into pile to load bucket.
- Tilt bucket up far enough to retain load and back away from pile.
- Travel in accordance with requirements set forth in Section 1—General Safety Practices.
- Tilt bucket down to dump load.

Equipment Damage Precautions

- Except for lifting or dumping a load, the boom must be fully retracted for all bucket operations.
- Do not corner-load bucket. Distribute material evenly within the bucket. Bucket load charts are for evenly distributed loads only.
- Do not use bucket as a lever to pry material. Excessive prying forces could damage bucket or machine structure.
- Do not attempt to load material which is hard or frozen. This could cause severe damage to quick coupler or machine structure.
- Do not use bucket for "back dragging." This could cause severe damage to quick coupler.

Section 5 - Attachments and Hitches

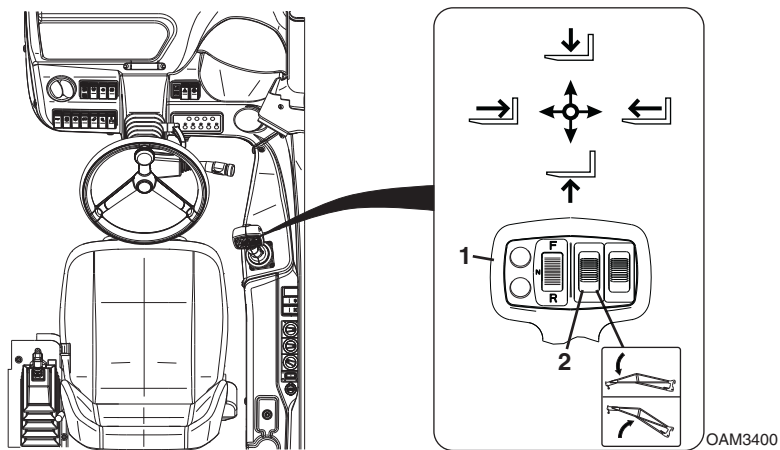
Truss Boom



Use Truss Boom Load Chart

To determine maximum capacity, refer to "Telehandler/Attachment/Fork Capacity" on page 5-8.

Suspend loads in accordance with requirements set forth in Section 1—General Safety Practices.



The joystick (1) controls movement of the boom.

The attachment tilt roller switch (2) controls truss boom tilt.

- Push roller switch down to tilt up.
- Push roller switch up to tilt down.

Installation Procedure:

- Refer to "Attachment Installation" on page 5-15.

Operation:

- Weight of rigging must be included as part of total load being lifted.

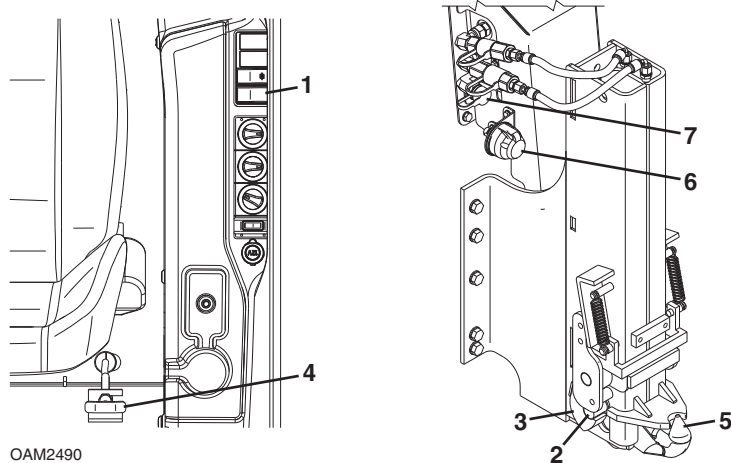
Section 5 - Attachments and Hitches

Hydraulic Hitch

Hitch Capacities

Maximum combined weight of trailer and load12 000 kg (26 450 lb)

Maximum vertical load at hitch interface.....2000 kg (4400 lb)



Connecting trailer for towing:


1. Depress and hold right side of hydraulic hitch switch (1) to raise hitch safety posts (2) off safety hooks (3).
2. Pull safety hook release (4).
3. Depress and hold left side of hydraulic hitch switch to lower the hitch (5) to the required height.
4. Reverse machine until the hitch is under the center of the tow eye.
5. Depress and hold right side of hydraulic hitch switch to raise hitch until the safety hooks are engaged.
6. If equipped, connect trailer harness to trailer plug (6).
7. If equipped, connect trailer brake line to trailer coupling (7). See page 5-60.



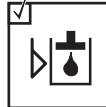



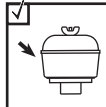
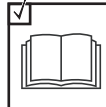
Section 7 - Lubrication and Maintenance


7.3 SERVICE AND MAINTENANCE SCHEDULES

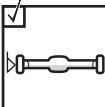
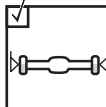

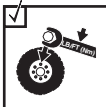
10 & 1st 50 Hour Maintenance Schedule



EVERY
10 

 Check Fuel Level	 Check Engine Oil Level	 Check Hydraulic Oil Level	 Check Tire Condition & Pressure	 Check Engine Coolant Level
 Check Transmission Oil Level	 Check Cab Air Prefilter	 Additional Checks - Section 8		

1st
50 

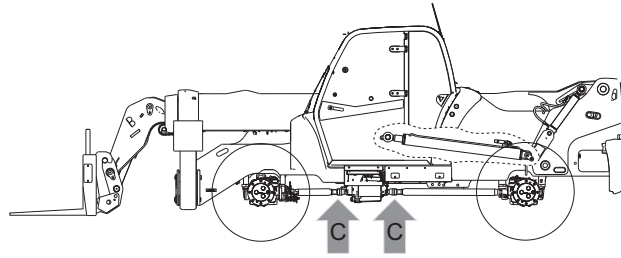
 Check Axle Differential Oil Level	 Check Wheel End Oil Levels	 Check Boom Chain & Tension (TH414C & TH417C)	 Check Wheel Lug Nut Torque
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OAM3491

Section 7 - Lubrication and Maintenance

TH414C, TH514C & TH417C

EVERY
500 



OAM2212

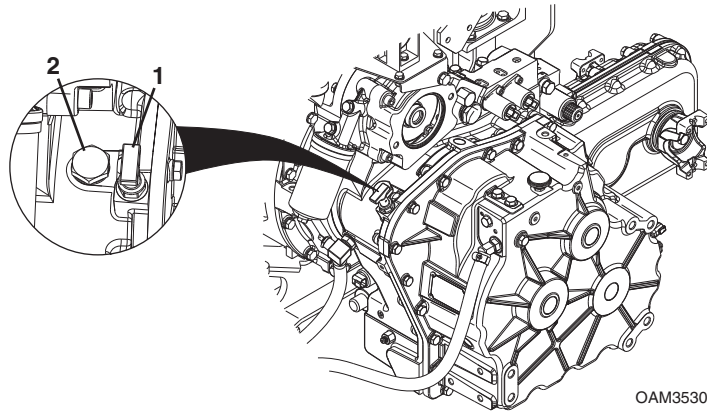
Section 7 - Lubrication and Maintenance

Transmission Oil

A. Transmission Oil Level Check

10 
OW0970


OW1050



1. Check transmission oil level with engine at idle and transmission oil cold.
2. Apply park brake, shift transmission to "Neutral" and lower forks or attachment to the ground.
3. Open the engine cover.
4. Remove the transmission dipstick (1) and check oil level. The oil level should be between the Min and Max marks.
5. Replace transmission dipstick.
6. If oil is low, remove plug (2) and add fluid as required.
7. Replace plug.
8. Close and secure the engine cover.

SECTION 9 - SPECIFICATIONS

9.1 PRODUCT SPECIFICATIONS

Fluids

S/N MJR00150 & After, S/N DJB00150 & After, S/N GAT00150 & After,
S/N MLH00150 & After, S/N KEK00150 & After, S/N MWC00150 & After,
S/N RRJ00150 & After

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	CAT DEO ULS API CJ-4	SAE 0W-20	-22	50	-30	10
		SAE 0W-30	-22	86	-30	30
		SAE 0W-40	-22	104	-30	40
		SAE 5W-30	-13	86	-25	30
		SAE 5W-40	-13	122	-25	50
		SAE 10W-30	-4	104	-20	40
		SAE 10W-40	-4	122	-20	50
		SAE 15W-40	14	122	-10	50
Hydraulic System	CAT HYDO Advanced	SAE 10W	-4	104	-20	40
		SAE 30	50	122	10	50
Transmission and Transfer Case	CAT TDTO	SAE 10W	0	95	-18	35
		SAE 30	32	95	0	35
		SAE 50	50	122	10	50
		SAE 5W-30	-22	68	-30	20
		SAE 0W-20	-40	68	-40	20
Axle Differential* and Wheel End	CAT TDTO TO-4	SAE 30	-4	104	-20	40
Cylinder, Boom Wear Pad and Axle Grease	CAT Multipurpose Grease	NLGI Grade 2	-22	104	-30	40
Engine Coolant	CAT Extended Life Coolant (ELC)	50/50 Mix				
Fuel	#2 Diesel	Ultra Low Sulfur (S ≤ 15 mg/kg)				
Air Conditioning	Refrigerant R-134a	Tetrafluoroethane				

Note: Friction Modifier (197-0017) required for front axle differential.

Section 9 - Specifications

Maximum Ground Bearing Pressure

TH336C & TH406C

Pneumatic

15.5-25 L-2.....	7,9 kg/cm ² (112 lb/in ²)
15.5/80-24 TR01	9,3 kg/cm ² (132 lb/in ²)
15.5/80-24 SGI	10,7 kg/cm ² (152 lb/in ²)
460/70 R24 XMCL	11,5 kg/cm ² (164 lb/in ²)
460/70 R24 TL	10,0 kg/cm ² (142 lb/in ²)
400/80-24	11,5 kg/cm ² (164 lb/in ²)

Foam (ANSI)

15.5-25 L-2.....	9,0 kg/cm ² (128 lb/in ²)
------------------	--

TH337C & TH407C

Pneumatic

15.5-25 L-2.....	7,9 kg/cm ² (112 lb/in ²)
15.5/80-24 TR01	9,3 kg/cm ² (132 lb/in ²)
15.5/80-24 SGI	10,7 kg/cm ² (152 lb/in ²)
15.5 R25 XHA TL.....	Not Available at Publication
460/70 R24 XMCL	11,5 kg/cm ² (164 lb/in ²)
460/70 R24 TL	10,0 kg/cm ² (142 lb/in ²)
460/70 R24 Bibload.....	Not Available at Publication
500/70 R24	10,5 kg/cm ² (149 lb/in ²)
400/80-24	11,5 kg/cm ² (164 lb/in ²)
440/80-24	9,6 kg/cm ² (137 lb/in ²)

Foam (ANSI)

15.5-25 L-2.....	9,0 kg/cm ² (128 lb/in ²)
------------------	--

TH414C

Pneumatic

15.5/80-24 TR01	9,6 kg/cm ² (137 lb/in ²)
15.5-25 L-2.....	8,0 kg/cm ² (114 lb/in ²)
400/80-24	12,7 kg/cm ² (181 lb/in ²)
440/80-24	10,8 kg/cm ² (154 lb/in ²)

TH514C & TH417C

Pneumatic

14-24 TG02.....	9,0 kg/cm ² (128 lb/in ²)
14-24 SGG-2A.....	11,2 kg/cm ² (159 lb/in ²)
400/80-24	Not Available at Publication
460/80 R24.....	Not Available at Publication

Foam (TH514 - ANSI)

14-24 TG02.....	10,3 kg/cm ² (147 lb/in ²)
14-24 SGG-2A.....	12,9 kg/cm ² (183 lb/in ²)

Read This First

This product must comply with all safety related bulletins. Contact JLG Industries, Inc. or the local Caterpillar dealer representative for information regarding safety-related bulletins which may have been issued for this product.

JLG Industries, Inc. sends safety related bulletins to the owner of record of this machine. Contact JLG Industries, Inc. to ensure that the current owner records are updated and accurate.

JLG Industries, Inc. must be notified immediately in all instances where JLG products have been involved in an accident involving bodily injury or death of personnel or when damage has occurred to personal property or the JLG product.

FOR:

- Accident Reporting and Product Safety Publications
- Current Owner Updates
- Questions Regarding Product Applications and Safety
- Standards and Regulations Compliance Information
- Questions Regarding Product Modifications

CONTACT:

Product Safety and Reliability Department
JLG Industries, Inc.
13224 Fountainhead Plaza
Hagerstown, MD 21742
USA

In USA:

Toll Free: 1-877-JLG-SAFE (1-877-554-7233)

Outside USA:

Phone: +1-717-485-6591

E-mail:

ProductSafety@JLG.com

Section 1 - General Safety Practices

Load Falling Hazard



OW0130

- Never suspend load from forks or other parts of carriage.
- **DO NOT** burn or drill holes in fork(s).
- Forks must be centered under load and spaced apart as far as possible.

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Section 2 - System Operation

Note: *To change display brightness, depress ESC for 2-3 seconds. As the display cycles through various levels of brightness, depress ENT when the desired brightness is reached.*

Section 3 - Service and Maintenance

Alarm Code	Description	What To Do
12	Reading pressure of the Lift cylinder (rod side) lower than minimum value.	<ul style="list-style-type: none"> • Verify that the cable or the connector wiring are not in short circuit. • Verify the pressure transducer integrity. • If the alarm persists, please, contact Technical Assistance
13	Reading pressure of the Lift cylinder (rod side) higher than maximum value.	<ul style="list-style-type: none"> • Verify that the cable or the connector wiring are not open. • Verify the pressure transducer integrity. • If the alarm persists, please, contact Technical Assistance
14	Reading pressure of the Compensation cylinder (bottom side) lower than minimum value.	<ul style="list-style-type: none"> • Verify that the cable or the connector wiring are not in short circuit. • Verify the pressure transducer integrity. • If the alarm persists, please, contact Technical Assistance
15	Reading pressure of the Compensation cylinder (bottom side) higher than maximum value.	<ul style="list-style-type: none"> • Verify that the cable or the connector wiring are not open. • Verify the pressure transducer integrity. • If the alarm persists, please, contact Technical Assistance
16	Reading pressure of the Compensation cylinder (rod side) lower than minimum value.	<ul style="list-style-type: none"> • Verify that the cable or the connector wiring are not in short circuit. • Verify the pressure transducer integrity. • If the alarm persists, please, contact Technical Assistance
17	Reading pressure of the Compensation cylinder (rod side) higher than maximum value.	<ul style="list-style-type: none"> • Verify that the cable or the connector wiring are not open. • Verify the pressure transducer integrity. • If the alarm persists, please, contact Technical Assistance
50	ByPass LMIS active.	<ul style="list-style-type: none"> • Advise that the external BYPASS of LMIS it's active.
60	Redundance alarm of the output shut-off LMIS.	<ul style="list-style-type: none"> • Verify connection. • Verify CLS integrity. • If the alarm persists, please, contact Technical Assistance

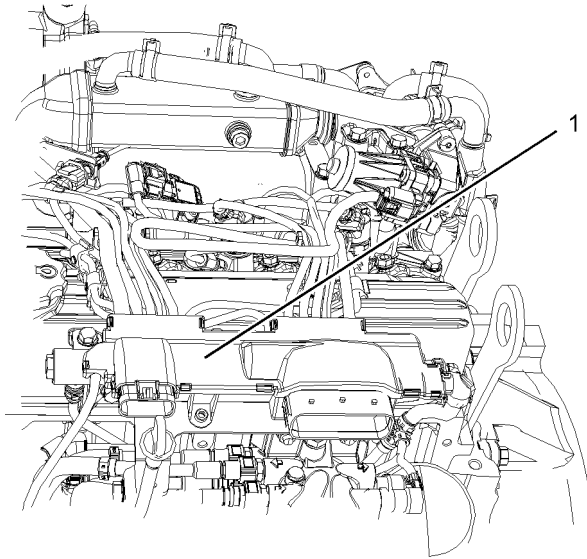


Illustration 2
Typical example

g02582556

i04261691

General Hazard Information

SMCS Code: 1000; 7405

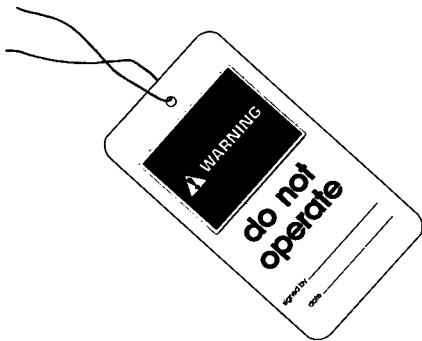


Illustration 3

g00104545

Attach a “Do Not Operate” warning tag or a similar warning tag to the start switch or to the controls before the engine is serviced or before the engine is repaired. These warning tags (Special Instruction, SEHS7332) are available from your Caterpillar dealer. Attach the warning tags to the engine and to each operator control station. When it is appropriate, disconnect the starting controls.

Do not allow unauthorized personnel on the engine, or around the engine when the engine is being serviced.

- Tampering with the engine installation or tampering with the OEM supplied wiring can be dangerous. Personal injury, death and/or engine damage could result.
- Vent the engine exhaust to the outside when the engine is operated in an enclosed area.
- If the engine is not running, do not release the secondary brake or the parking brake systems unless the vehicle is blocked or unless the vehicle is restrained.
- Wear a hard hat, protective glasses, and other protective equipment, as required.
- When work is performed around an engine that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.
- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.
- Report all necessary repairs.

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

i04346349

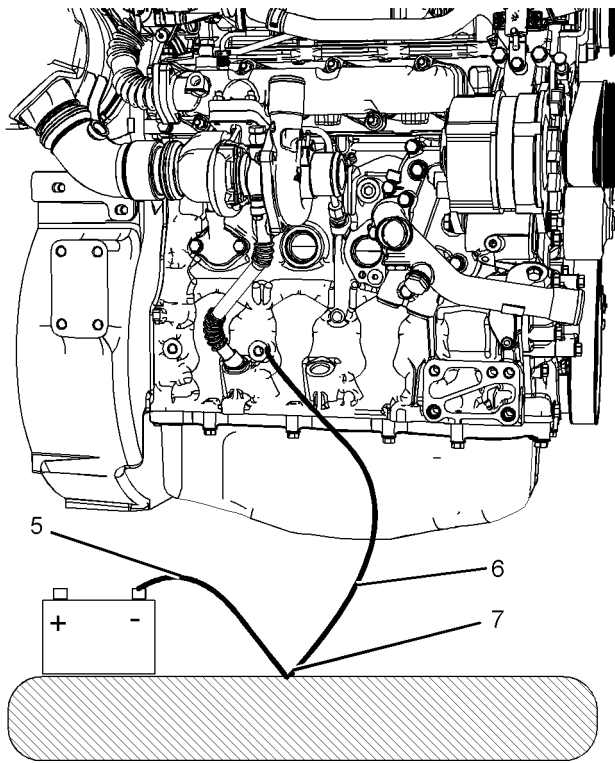


Illustration 13

g02315900

Typical example

- (5) Ground to battery
- (6) Ground to engine block
- (7) Primary position for grounding

Correct grounding for the engine electrical system is necessary for optimum engine performance and reliability. Incorrect grounding will result in uncontrolled electrical circuit paths and in unreliable electrical circuit paths.

Uncontrolled electrical circuit paths can result in damage to engine components.

Engines that are installed without engine-to-frame ground straps can be damaged by electrical discharge.

To ensure the engine and the engine electrical systems function correctly, an engine-to-frame ground strap with a direct path to the battery must be used. This path may be provided by way of a direct engine ground to the frame.

The connections for the grounds should be tight and free of corrosion. The engine alternator must be grounded to the negative “-” battery terminal with a wire adequate to handle the full charging current of the alternator.

The power supply connections and the ground connections for the engine electronics should always be from the isolator to the battery.

Engine Electronics

SMCS Code: 1000; 1400; 1900

WARNING

Tampering with the electronic system installation or the OEM wiring installation can be dangerous and could result in personal injury or death and/or engine damage.

WARNING

Electrical Shock Hazard. The electronic unit injectors use DC voltage. The ECM sends this voltage to the electronic unit injectors. Do not come in contact with the harness connector for the electronic unit injectors while the engine is operating. Failure to follow this instruction could result in personal injury or death.

This engine has a comprehensive, programmable Engine Monitoring System. The Electronic Control Module (ECM) has the ability to monitor the engine operating conditions. If any of the engine parameters extend outside an allowable range, the ECM will initiate an immediate action.

The following actions are available for engine monitoring control:

- Warning
- Derate
- Shutdown

The following monitored engine operating conditions and components have the ability to limit engine speed and/or the engine power:

- Engine Coolant Temperature
- Engine Oil Pressure
- Engine Speed
- Intake Manifold Air Temperature
- Engine Intake Throttle Valve Fault
- Wastegate Regulator
- Supply Voltage to Sensors
- Fuel Pressure in Manifold (Rail)
- NOx Reduction System

On a non-stressed cylinder block the serial number is located in position (2). On the left-hand side on the cylinder block.

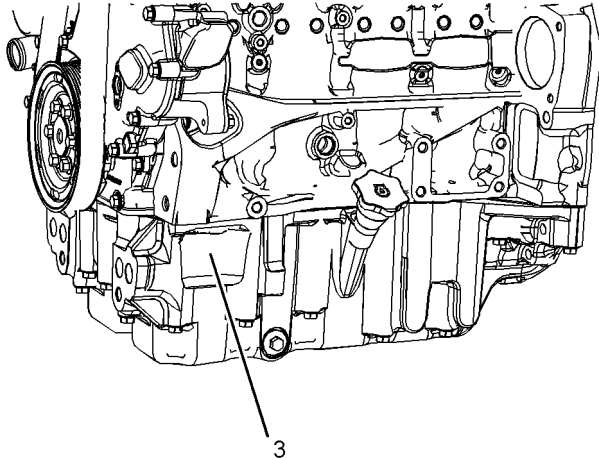


Illustration 21
Typical example

g02832639

On a stressed cylinder block the serial number is located in position (3).

The engine serial number will be stamped on the emissions plate.

i03867276

Reference Numbers

SMCS Code: 1000

Information for the following items may be needed to order parts. Locate the information for your engine. Record the information in the appropriate space. Make a copy of this list for a record. Keep the information for future reference.

Record for Reference

Engine Model _____

Engine Serial number _____

Engine Low Idle rpm _____

Engine Full Load rpm _____

Primary Fuel Filter _____

Water Separator Element _____

Secondary Fuel Filter Element _____

Lubrication Oil Filter Element _____

Auxiliary Oil Filter Element _____

Total Lubrication System Capacity _____

Total Cooling System Capacity _____

Air Cleaner Element _____

Drive Belt _____

Engine Aftertreatment System

Part Number _____

Serial Number _____

i04460799

Emissions Certification Film

SMCS Code: 1000; 7405

The emission label will be installed on the left side of the non-stressed cylinder block.

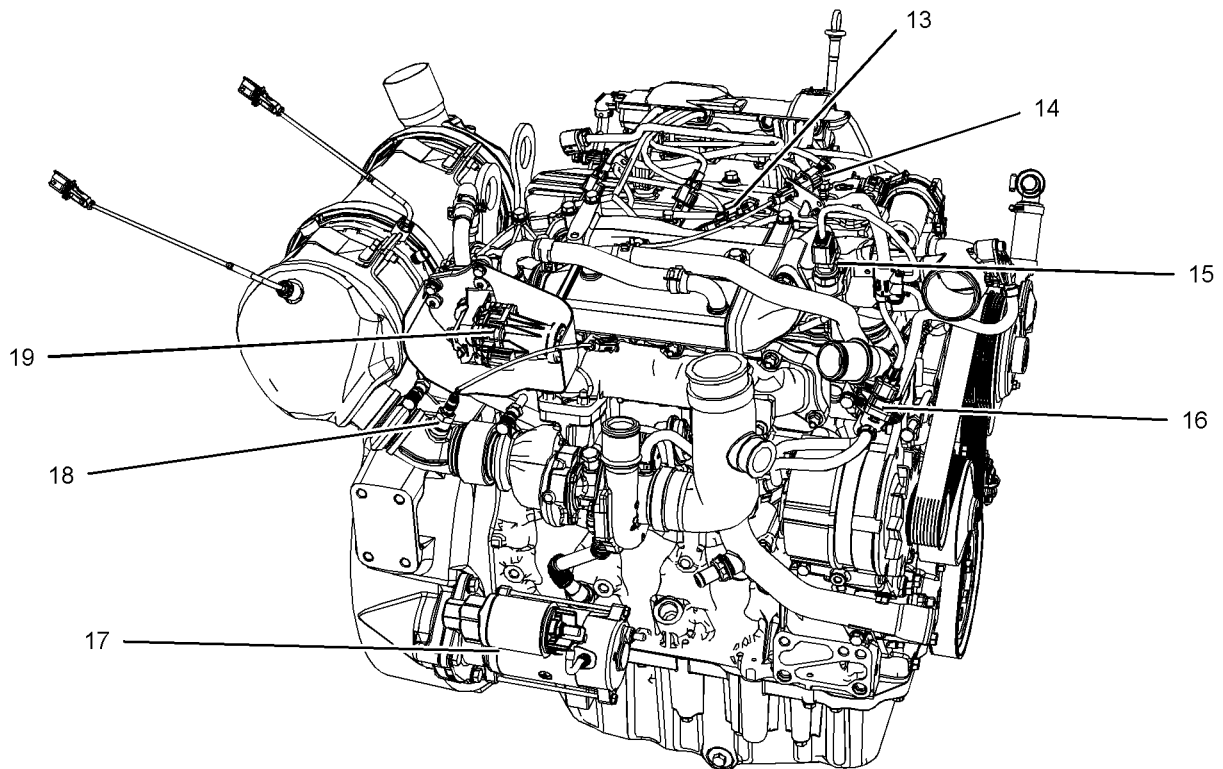


Illustration 26

g02529496

Typical example

(13) Inlet manifold pressure and temperature sensor.

(14) Exhaust temperature sensor connection

(15) Exhaust pressure sensor

(16) Waste gate regulator

(17) Starting motor

(18) Oxygen sensor

(19) Control valve for the NOx reduction system

Note: Item (13), lower powered engines have separate inlet manifold pressure sensors and inlet manifold temperature sensors.

i01902995

Engine Operation with Intermittent Diagnostic Codes

SMCS Code: 1000; 1900; 1901; 1902

If a diagnostic lamp illuminates during normal engine operation and the diagnostic lamp shuts off, an intermittent fault may have occurred. If a fault has occurred, the fault will be logged into the memory of the Electronic Control Module (ECM).

In most cases, it is not necessary to stop the engine because of an intermittent code. However, the operator should retrieve the logged fault codes and the operator should reference the appropriate information in order to identify the nature of the event. The operator should log any observation that could have caused the lamp to light.

- Low power
- Limits of the engine speed
- Excessive smoke, etc

This information can be useful to help troubleshoot the situation. The information can also be used for future reference. For more information on diagnostic codes, refer to the Troubleshooting Guide for this engine.

i04349071

Configuration Parameters

SMCS Code: 1000; 1900; 1901; 1902

The engine electronic control module (ECM) has two types of configuration parameters. The system configuration parameters and the customer specified parameters.

The electronic service tool is required in order to alter the configuration parameters.

System Configuration Parameters

System configuration parameters affect the emissions of the engine or the power of the engine. System configuration parameters are programmed at the factory. Normally, system configuration parameters would never require changing through the life of the engine. System configuration parameters must be reprogrammed if an ECM is replaced.

Customer Specified Parameters

Customer specified parameters allow the engine to be configured to the exact needs of the application.

The electronic service tool is required in order to alter the customer configuration parameters.

Customer parameters may be changed repeatedly as operational requirements change.

i04018250

Fuel Conservation Practices

SMCS Code: 1000; 1250

The efficiency of the engine can affect the fuel economy. Caterpillar's design and technology in manufacturing provides maximum fuel efficiency in all applications. Follow the recommended procedures in order to attain optimum performance for the life of the engine.

- Avoid spilling fuel.

Fuel expands when the fuel is warmed up. The fuel may overflow from the fuel tank. Inspect fuel lines for leaks. Repair the fuel lines, as needed.

- Be aware of the properties of the different fuels. Use only the recommended fuels. Refer to the Operations and Maintenance Manual, "Fuel Recommendations" for further information.
- Avoid unnecessary idling.

Shut off the engine rather than idle for long periods of time.

- Observe the service indicator frequently. Keep the air cleaner elements clean.
- Ensure that the turbocharger is operating correctly. For more information refer to this Operation and Maintenance Manual, "Turbocharger - Inspect".
- Maintain a good electrical system.

One faulty battery cell will overwork the alternator. This fault will consume excess power and excess fuel.

- The belt should be in good condition. Refer to the Systems Operation, Testing and Adjusting, "V - Belt Test" for further information.
- Ensure that all of the connections of the hoses are tight. The connections should not leak.
- Ensure that the driven equipment is in good working order.
- Cold engines consume excess fuel. Utilize heat from the jacket water system and the exhaust system, when possible. Keep cooling system components clean and keep cooling system components in good repair. Never operate the engine without water temperature regulators. All of these items will help maintain operating temperatures.

Before selecting a grease products for any application, the performance requirements must be determined. Consult the grease recommendations that are made by the OEM for the equipment when the equipment is operated in the expected conditions. Then, consult with your Cat dealer for a list of greases and the following related characteristics.

- Performance specifications
- Available sizes of containers
- Part numbers

Always choose a grease that meets the recommendations that are specified by the equipment manufacturer for the application, or choose a grease that exceeds the recommendations that are specified by the equipment manufacturer for the application.

If it is necessary to choose a single grease for use on all of the equipment at one site, always choose a grease that meets the requirements of the most demanding application. A product that barely meets the minimum performance requirements will shorten the life of the part. Use the grease that yields the least total operating cost. Base this cost on an analysis that includes the costs of the parts, the labor, the downtime, and the cost of the grease that is used.

Some greases are not chemically compatible. Consult your supplier in order to determine if two or more greases are compatible.

Purge the grease from a joint at the following times:

- Switching from one grease to another grease
- Switching from one supplier to another supplier

Note: All Caterpillar brand name greases are compatible with each other.

Note: Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" for additional information that relates to lubrication for your engine.

Fuel

Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" for the Caterpillar Specification for distillate fuel and for additional information that relates to fuel for your engine.

Ultra low Sulfur Diesel (ULSD)

Your Caterpillar Diesel Engine must use ultra low sulfur diesel fuel. This fuel complies with the emissions regulations that are prescribed by the Environmental Protection Agency of the United States.

Engines that are manufactured by Caterpillar are certified with the fuel that is prescribed by the United States Environmental Protection Agency. Engines that are manufactured by Caterpillar are certified with the fuel that is prescribed by the European Certification. Caterpillar does not certify diesel engines on any other fuel.

Note: The owner and the operator of the engine has the responsibility of using the fuel that is prescribed by the United States Environmental Protection Agency and other appropriate regulatory agencies.

Fuel tank inlet labels are installed in order to ensure that the correct fuels are used. Illustration 37 is an example of one of the labels designs that will be installed.

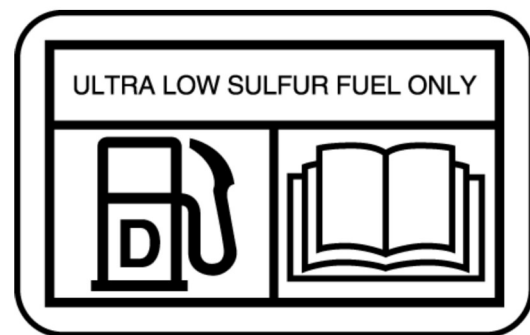


Illustration 37
Typical example

g02157153

Fuel Additives

Many types of fuel additives are available. Caterpillar does not generally recommend the use of fuel additives.

In special circumstances, Caterpillar recognizes the need for fuel additives. Fuel additives need to be used with caution. The additive may not be compatible with the fuel. Some additives may precipitate. This action causes deposits in the fuel system. The deposits may cause seizure. Some additives may be corrosive and some additives may be harmful to the elastomers in the fuel system.

Some additives may damage emission control systems. Some additives may cause the amount of sulfur in the fuel to be greater than 15 ppm.

3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 15 L (4 US gal) of the cooling system capacity. Install the cooling system filler cap.
4. Start and run the engine at low idle for a minimum of 30 minutes. The coolant temperature should be at least 82 °C (180 °F).

NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Clean the drain plugs. Install the drain plugs. Refer to Torque Specifications, SENR3130 for more information on the correct torques.

Cooling Systems with Heavy Deposits or Plugging

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

1. Flush the cooling system with clean water in order to remove any debris.
2. Clean the drain plugs. Install the drain plugs. Refer to Torque Specifications, SENR3130 for more information on the correct torques.

NOTICE

Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 3.8 to 7.6 L (1 to 2 US gal) of the cooling system capacity. Install the cooling system filler cap.
4. Start and run the engine at low idle for a minimum of 90 minutes. The coolant temperature should be at least 82 °C (180 °F).

NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Clean the drain plugs. Install the drain plugs. Refer to Torque Specifications, SENR3130 for more information on the correct torques.

Fill

NOTICE

Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

1. Fill the cooling system with the coolant/antifreeze. Refer to this Operation and Maintenance Manual, "Refill Capacities and Recommendations" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
2. Start and run the engine at low idle. Increase the engine rpm to high idle. Operate the engine in order to open the engine thermostat. This operation will allow any air in the system to be purged. Decrease the engine speed to low idle. Stop the engine.
3. Maintain the coolant level at the maximum mark that is correct for your application.
4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, perform a pressure test. A 9S-8140 Pressurizing Pump is used to perform the pressure test. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

Inspecting the Primary Air Cleaner Elements

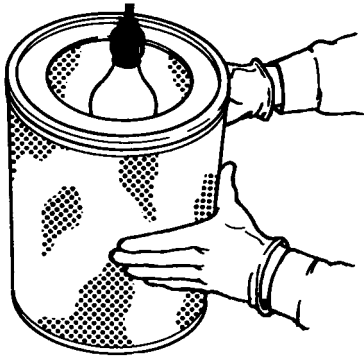


Illustration 48

g00281693

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

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

Storing Primary Air Cleaner Elements

If a primary air cleaner element that passes inspection will not be used, the primary air cleaner element can be stored for future use.

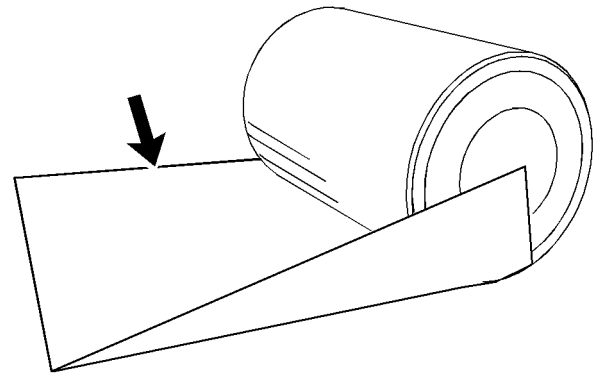


Illustration 49

g02595738

Typical example

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

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

- Date of cleaning
- Number of cleanings

Store the box in a dry location.

i01432811

Engine Air Cleaner Element (Single Element) - Inspect/Replace

SMCS Code: 1054-040; 1054-510

Perform the Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect" procedure and perform the Operation and Maintenance Manual, "Engine Air Precleaner Check/Clean" procedure (if equipped) before performing the following procedure.

i04405558

1. Ensure that the fuel system is in working order. Check that the fuel supply valve (if equipped) is in the "ON" position.

2. Operate the hand priming pump. Count the number of operations of the pump. After approximately 80 depression of the pump stop.

Note: As the fuel system is primed, the pressure will increase within the fuel system and this increase in pressure can be felt during priming.

3. The fuel system should now be primed and the engine should be able to start.

4. Operate the engine starter and crank the engine. After the engine has started, operate the engine at low idle for a minimum of 5 minutes. Ensure that the fuel system is free from leaks.

Note: Operating the engine for this period will help ensure that the fuel system is free of air. **DO NOT loosen the high-pressure fuel lines in order to purge air from the fuel system. This procedure is not required.**

After the engine has stopped, you must wait for 10 minutes in order to allow the fuel pressure to be purged from the high-pressure fuel lines before any service or repair is performed on the engine fuel lines. If necessary, perform minor adjustments. Repair any leaks from the low-pressure fuel system and from the cooling, lubrication, or air systems. Replace any high-pressure fuel line that has leaked. Refer to Disassembly and Assembly Manual, "Fuel Injection Lines - Install".

If you inspect the engine in operation, always use the proper inspection procedure in order to avoid a fluid penetration hazard. Refer to Operation and Maintenance Manual, "General hazard Information".

If the engine will not start, refer to Troubleshooting, "Engine Cranks but will not Start".

Fuel System Primary Filter (Water Separator) Element - Replace

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

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

Note: Refer to Systems Operation, Testing, and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

NOTICE

Ensure that the engine is stopped before any servicing or repair is performed.

Remove the Element

1. Turn the fuel supply valve (if equipped) to the OFF position before performing this maintenance.
2. Place a suitable container under the water separator in order to catch any fuel that might spill. Clean up any spilled fuel. Clean the outside body of the filter assembly.
3. Make a temporary Mark (A) across the filter before the assembly is removed.

i02348493

Due to individual applications, it is not possible to identify all of the factors which can contribute to severe service operation. Consult your Caterpillar dealer for the unique maintenance that is necessary for the engine.

The operating environment, improper operating procedures and improper maintenance procedures can be factors which contribute to severe service conditions.

Environmental Factors

Ambient temperatures – The engine may be exposed to extended operation in extremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped in very cold temperatures. Extremely hot inlet air reduces engine performance.

Air Quality – The engine may be exposed to extended operation in an environment that is dirty or dusty, unless the equipment is cleaned regularly. Mud, dirt and dust can encase components. Maintenance can be very difficult. The buildup can contain corrosive chemicals.

Buildup – Compounds, elements, corrosive chemicals and salt can damage some components.

Altitude – Problems can arise when the engine is operated at altitudes that are higher than the intended settings for that application. Necessary adjustments should be made.

Improper Operating Procedures

- Extended operation at low idle
- Frequent hot shutdowns
- Operating at excessive loads
- Operating at excessive speeds
- Operating outside the intended application

Improper Maintenance Procedures

- Extending the maintenance intervals
- Failure to use recommended fuel, lubricants and coolant/antifreeze

Starting Motor - Inspect

SMCS Code: 1451-040; 1453-040

Caterpillar recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for correct operation. Check the electrical connections and clean the electrical connections. Refer to the Systems Operation, Testing and Adjusting Manual, "Electric Starting System - Test" for more information on the checking procedure and for specifications or consult your Caterpillar dealer for assistance.

i04407666

Turbocharger - Inspect

SMCS Code: 1052-040; 1052

WARNING

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

NOTICE

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

Minor leakage of oil into a turbocharger under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occurred.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is renewed.

A visual inspection of the turbocharger can minimize unscheduled downtime. A visual inspection of the turbocharger can also reduce the chance for potential damage to other engine parts. Do not inspect the engine with the engine in operation.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

i04016709

Mounting and Dismounting

SMCS Code: 1000; 7405

Do not climb on the engine or the engine aftertreatment. The engine and aftertreatment have not been designed with mounting or dismounting locations.

Refer to the OEM for the location of foot and hand holds for your specific application.

i03814031

High Pressure Fuel Lines

SMCS Code: 1274

WARNING

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

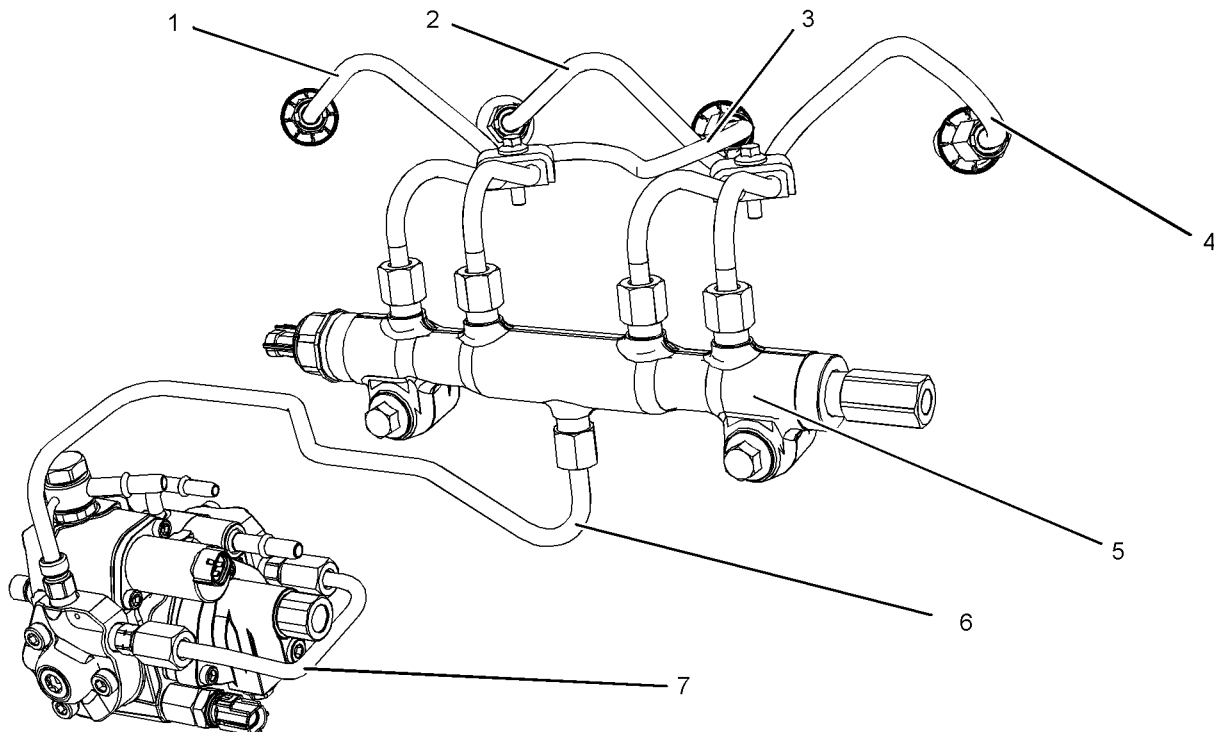


Illustration 14

g02067853

(1) High-pressure line
(2) High-pressure line
(3) High-pressure line

(4) High-pressure line
(5) High-pressure fuel manifold (rail)
(6) High-pressure line

(7) Fuel transfer line that is high pressure

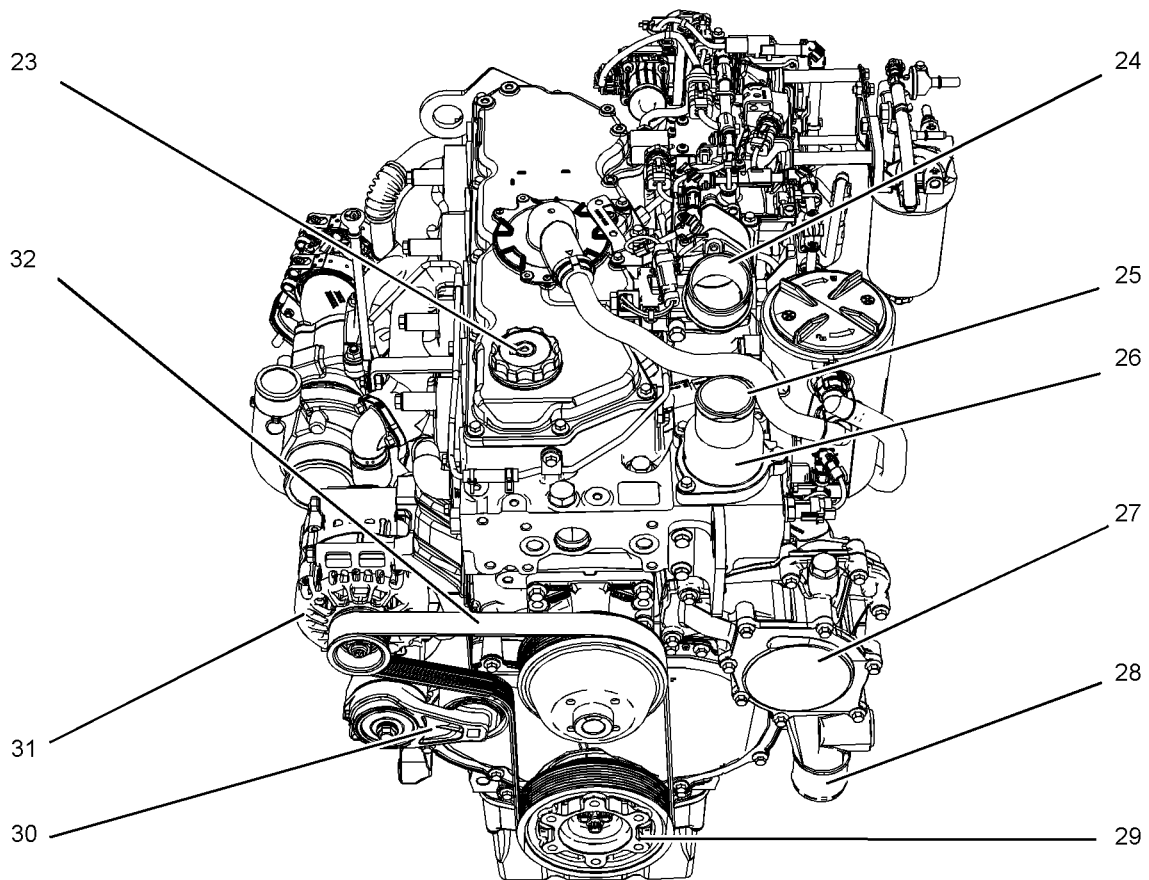


Illustration 22

g02407537

(23) Oil filler
(24) Air intake
(25) Coolant outlet connection
(26) Thermostat housing

(27) Water pump
(28) Coolant intake connector
(29) Crankshaft pulley
(30) Belt tensioner

(31) Alternator
(32) Belt



Service Hour Meter – The gauge indicates total operating hours of the engine.

Indicator Lamps

There are four indicator lamps that are available.

- Shutdown Lamp
- Warning Lamp
- Wait to Start Lamp
- Low Oil Pressure Lamp

For information, refer to this manual, “Monitoring System (Table for the Indicator Lamps)” for the sequence of operation of the shutdown lamp and the warning lamp.

The function of the wait to start lamp is automatically controlled at engine start-up.

The function of the low oil pressure lamp is controlled by the engine ECM. If low oil pressure is detected, the lamp will be illuminated. The reason for the illumination of the low-pressure lamp should be investigated immediately.

All lamps will illuminate for 2 seconds in order to check that the lamps are functioning when the keyswitch is turned to the ON position. If any of the lamps stay illuminated, the reason for illumination should be investigated immediately.

Instrument panels and Displays

In order to monitor the engine a wide variety of instrument panels are available. These instrument panels can contain the indicator lamps and the gauges for the application.

Also available are mini power displays and performance monitors. These displays and monitors can show the operator the following engine information.

- The system configuration parameters
- The customer specified parameters
- Diagnostic codes
- Event codes
- Coolant temperature
- Oil temperature

- Oil pressure
- Intake temperature
- Intake pressure
- Atmospheric pressure
- Fuel temperature

i03554501

Intake manifold pressure – The intake manifold pressure sensor checks the rated pressure in the engine manifold.

Fuel rail pressure – The fuel rail pressure sensor checks for high pressure or low pressure in the fuel rail.

Engine oil pressure – The engine oil pressure sensor indicates when oil pressure drops below rated system pressure, at a set engine speed.

Engine overspeed – If the engine rpm exceeds the overspeed setting, the alarm will be activated.

Air filter restriction – The switch checks the air filter when the engine is operating.

User-Defined switch – This switch can shut down the engine remotely.

Water in fuel switch – This switch checks for water in the primary fuel filter when the engine is operating.

Fuel temperature – The fuel temperature sensor monitors the pressurized fuel in the high-pressure fuel pump.

Note: The sensing element of the coolant temperature switch must be submerged in coolant in order to operate.

Engines may be equipped with alarms in order to alert the operator when undesirable operating conditions occur.

NOTICE

When an alarm is activated, corrective measures must be taken before the situation becomes an emergency in order to avoid possible engine damage.

If corrective measures are not taken within a reasonable time, engine damage could result. The alarm will continue until the condition is corrected. The alarm may need to be reset.

Testing

Turning the keyswitch to the ON position will check the indicator lights on the control panel. All the indicator lights will be illuminated for 2 seconds after the keyswitch is operated. Replace suspect bulbs immediately.

Refer to Troubleshooting, KENR9111 for more information.

Overspeed

SMCS Code: 1900; 1907; 1912; 7427

- ECM _____ Electronic Control Module
- RPM _____ Revolutions Per Minute

An overspeed is detected by the speed/timing sensors.

The default setting for an overspeed is 3000 rpm. The ECM will cut the power to the electronic unit injectors, until the rpm drops below 200 rpm of the overspeed setting. A diagnostic fault code will be logged into the ECM memory and a warning lamp will indicate a diagnostic fault code.

An overspeed can be set from 2600 rpm to 3000 rpm. This setting depends on the application.

Engine Operation

i03858430

Engine Operation

SMCS Code: 1000

Proper operation and maintenance are key factors in obtaining the maximum life and economy of the engine. If the directions in the Operation and Maintenance Manual are followed, costs can be minimized and engine service life can be maximized.

The time that is needed for the engine to reach normal operating temperature can be less than the time taken for a walk-around inspection of the engine.

The engine can be operated at the rated rpm after the engine is started and after the engine reaches operating temperature. The engine will reach normal operating temperature sooner during a low engine speed (rpm) and during a low-power demand. This procedure is more effective than idling the engine at no load. The engine should reach operating temperature in a few minutes.

Avoid excess idling. Excessive idling causes carbon buildup, engine slobber, and soot loading of the Diesel Particulate Filter (DPF). These issues are harmful to the engine.

Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

Reduction of Particulate Emissions

The Diesel Particulate Filter (DPF) will reduce particulate emissions. The DPF collects the soot and any ash that is produced by the combustion in the engine. During regeneration, the soot is converted into a gas which is released into the atmosphere. The Ash remains in the DPF.

The temperature of the DPF must be above a particular value in order for regeneration to occur. The exhaust gas provides heat for the regeneration process.

Passive Regeneration – The engine provides sufficient exhaust gas temperature for regeneration.

Engine Operation and a DPF

During normal engine operation, the operator of the engine may notice the lack of black smoke from the exhaust system.

Passive regeneration is the process that is used by the DPF in order to remove soot from the DPF. In some applications, the engine idle speed will automatically be increased in order to allow passive regeneration to occur.

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Engaging the Driven Equipment

SMCS Code: 1000

1. Operate the engine at one-half of the rated rpm, when possible.
2. Engage the driven equipment without a load on the equipment, when possible.

Interrupted starts put excessive stress on the drive train. Interrupted starts also waste fuel. To get the driven equipment in motion, engage the clutch smoothly with no load on the equipment. This method should produce a start that is smooth and easy. The engine rpm should not increase and the clutch should not slip.

3. Ensure that the ranges of the gauges are normal when the engine is operating at one-half of the rated rpm. Ensure that all gauges operate properly.
4. Increase the engine rpm to the rated rpm. Always increase the engine rpm to the rated rpm before the load is applied.
5. Apply the load. Begin operating the engine at low load. Check the gauges and equipment for proper operation. After normal oil pressure is reached and the temperature gauge begins to move, the engine may be operated at full load. Check the gauges and equipment frequently when the engine is operated under load.

Extended operation at low idle or at reduced load may cause increased oil consumption and carbon buildup in the cylinders. This carbon buildup results in a loss of power and/or poor performance.

Lubricant Viscosity Recommendations

The proper SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation.

Refer to illustration 41 (minimum temperature) in order to determine the required oil viscosity for starting a cold engine.

Refer to illustration 41 (maximum temperature) in order to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

Note: Generally, use the highest oil viscosity that is available to meet the requirement for the temperature at start-up.

If ambient temperature conditions at engine start-up require the use of multigrade SAE 0W oil, SAE 0W-40 viscosity grade is preferred over SAE 0W-20 or SAE 0W-30.

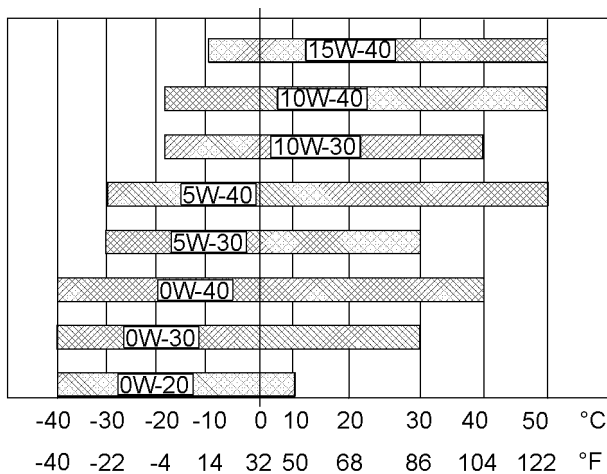


Illustration 41

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Supplemental heat is recommended for cold soaked starts below the minimum ambient temperature. Supplemental heat may be required for cold soaked starts that are above the minimum temperature that is stated, depending on the parasitic load and other factors. Cold soaked starts occur when the engine has not been operated for a period. This action will allow the oil to become more viscous due to cooler ambient temperatures.

S-O-S Oil Analysis

Caterpillar has developed a tool for maintenance management that evaluates oil degradation and the tool also detects the early signs of wear on internal components. The Caterpillar tool for oil analysis is called S-O-S Oil Analysis and the tool is part of the S-O-S Services program. S-O-S Oil Analysis divides oil analysis into three categories:

- Wear Analysis
- Oil condition
- Additional tests

The wear analysis monitors metal particles, some oil additives, and some contaminants.

Oil condition uses infrared (IR) analysis to evaluate the chemistry of the oil. Infrared analysis is also used to detect certain types of contamination.

Additional tests are used to measure contamination levels from water, fuel, or coolant. Oil viscosity and corrosion protection can be evaluated, as needed.

Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" or contact your local Caterpillar dealer for additional information concerning the S-O-S Oil Analysis program.

Lubrication System

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters. Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications in order to find the capacity of the auxiliary oil filter.

Table 7

Engine Refill Capacities		
Compartment or System	Minimum ⁽¹⁾	Maximum ⁽²⁾
Crankcase Oil Sump	6 L (1.6 US gal)	14 L (3.7 US gal)

⁽¹⁾ The minimum value is the approximate capacity for the crankcase oil sump (aluminum) which includes the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter. The design of the oil pan can change the oil capacity of the oil pan.

⁽²⁾ Approximate capacity of the largest crankcase oil sump. Refer to OEM for more information.

These values are the approximate capacities for the crankcase oil sump (aluminum) which includes the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter. The design of the oil pan can change the oil capacity of the oil pan.

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Battery or Battery Cable - Disconnect

SMCS Code: 1402-029

WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, two negative connections must be disconnected.
3. Remove the positive connection.
4. Clean all disconnected connection and battery terminals.
5. Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit correctly. Coat the clamps and the terminals with a suitable silicone lubricant or petroleum jelly.
6. Tape the cable connections in order to help prevent accidental starting.
7. Proceed with necessary system repairs.
8. In order to connect the battery, connect the positive connection before the negative connector.

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Belt - Inspect

SMCS Code: 1357-040; 1357; 1397-040; 1397

NOTICE

Ensure that the engine is stopped before any servicing or repair is performed.

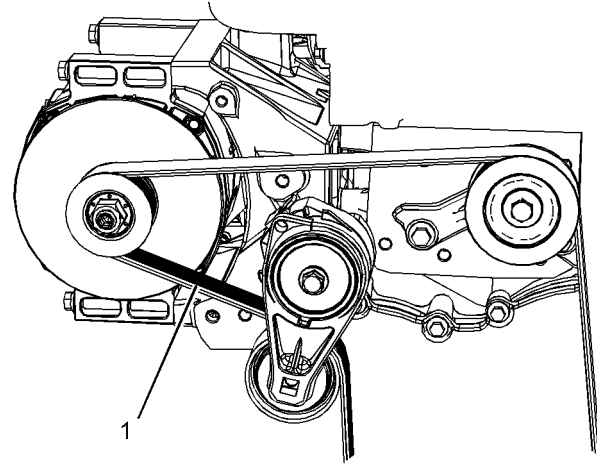


Illustration 43

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Typical example

To maximize the engine performance, inspect the belt (1) for wear and for cracking. Replace the belt if the belt is worn or damaged.

- Inspect the belt for cracks, splits, glazing, grease, displacement of the cord and evidence of fluid contamination.

The belt must be replaced if the following conditions are present.

- The belt has a crack in more than one rib.
- More than one section of the belt is displaced in one rib of a maximum length of 50.8 mm (2 inch).

To replace the belt, refer to Disassembly and Assembly, "Alternator Belt - Remove and Install". If necessary, replace the belt tensioner. Refer to Disassembly and Assembly, "Alternator Belt - Remove and Install" for the correct procedure.

- The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

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

Dual Element Air Cleaners

The dual element air cleaner contains a primary air cleaner element and a secondary air cleaner element. The primary air cleaner element can be used up to six times if the element is properly cleaned and inspected. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

The secondary air cleaner element is not serviceable or washable. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element. When the engine is operating in environments that are dusty or dirty, air cleaner elements may require more frequent replacement.

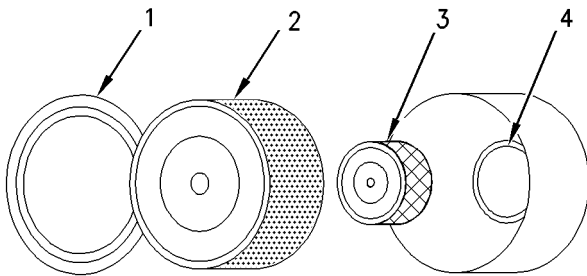


Illustration 49

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- (1) Cover
- (2) Primary air cleaner element
- (3) Secondary air cleaner element
- (4) Turbocharger air inlet

1. Remove the cover. Remove the primary air cleaner element.
2. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element.

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

3. Cover the turbocharger air inlet with tape in order to keep dirt out.
4. Clean the inside of the air cleaner cover and body with a clean, dry cloth.
5. Remove the tape for the turbocharger air inlet. Install the secondary air cleaner element. Install a primary air cleaner element that is new or cleaned.
6. Install the air cleaner cover.
7. Reset the air cleaner service indicator.

Cleaning the Primary Air Cleaner Elements

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.

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

Use clean primary air cleaner elements while dirty elements are being cleaned.

NOTICE

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

NOTICE

Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

6. Apply clean engine oil to O ring seal (3) for the new oil filter (4).
7. Install the new oil filter. Spin on the oil filter (4) until the O ring contacts the sealing surface (2). Then rotate the oil filter $\frac{3}{4}$ of a full turn. Remove the container and disposal of the waste oil in accordance with local regulations.

Fill the Oil Pan

1. Remove the oil filler cap. Refer to this Operation and Maintenance Manual, "Fluid Recommendations" for more information on suitable oils. Fill the oil pan with the correct amount of new engine lubricating oil. Refer to this Operation and Maintenance Manual, "Refill Capacities" for more information on refill capacities.

NOTICE

If equipped with an auxiliary oil filter system or a remote filter system, follow the OEM or the filter manufacturer's recommendations. Under filling or over filling the crankcase with oil can cause engine damage.

2. Start the engine and run the engine at "LOW IDLE" for 2 minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.
 3. Stop the engine and allow the oil to drain back to the oil pan for a minimum of 10 minutes.
-

4. Remove the engine oil level gauge in order to check the oil level. Maintain the oil level between "L" and "H" marks on the engine oil level gauge. Do not fill the crankcase above the "H" mark.

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Fan Clearance - Check**SMCS Code:** 1356; 1359; 1360

There are different types of cooling systems. Refer to the OEM for information on clearance for the fan.

Ensure that the engine is stopped. Ensure that the cooling system is full. The clearance between the cover (1) and the fan (2) will require checking. The gap (A) between the edge of the cover and the tip of the fan blade must be checked in four equally spaced positions.



Illustration 66

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"L" Low

"H" High

Note: Caterpillar Inc. recommends the use of Hydrosolv Liquid Cleaners. Table 12 lists the Hydrosolv Liquid Cleaners that are available from your Caterpillar dealer.

Table 12

Hydrosolv Liquid Cleaners		
Part Number	Description	Size
1U-8812	Hydrosolv4165	4 L (1 US gallon)
1U-5490		19 L (5 US gallon)
8T-7570		208 L (55 US gallon)
1U-8804	Hydrosolv100	4 L (1 US gallon)
1U-5492		19 L (5 US gallon)
8T-5571		208 L (55 US gallon)

- Use steam to clean the oil cooler core. The steam will remove any remaining residue from the cleaner. Flush the fins of the oil cooler core. Remove any other trapped debris.
- Wash the oil cooler core with hot, soapy water. Rinse the oil cooler core thoroughly with clean water.

WARNING

Personal injury can result from air pressure.

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

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

- Dry the oil cooler core with compressed air. Direct the air in the reverse direction of the normal flow.
- Inspect the components in order to ensure cleanliness. The oil cooler core should be pressure tested. Repair the oil cooler core, if necessary. Install the oil cooler core.

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

Obtain Coolant Analysis

The concentration of supplemental coolant additive (SCA) should be checked regularly with test kits or with S-O-S Coolant Analysis (Level 1). Further coolant analysis is recommended when the engine is overhauled.

For example, considerable deposits are found in the water jacket areas on the external cooling system, but the concentrations of coolant additives were carefully maintained. The coolant probably contained minerals that were deposited on the engine over time.

A coolant analysis can be conducted in order to verify the condition of the water that is being used in the cooling system. A full water analysis can be obtained by consulting your local water utility company or an agricultural agent. Private laboratories are also available for water analysis.

Caterpillar Inc. recommends an S-O-S Coolant Analysis (Level 2).

S-O-S Coolant Analysis (Level 2)

An S-O-S Coolant Analysis (Level 2) is a comprehensive coolant analysis which completely analyzes the coolant and the effects on the cooling system. An S-O-S Coolant Analysis (Level 2) provides the following information:

- Complete S-O-S Coolant Analysis (Level 1)
- Visual inspection of properties
- Identification of metal corrosion
- Identification of contaminants
- Identification of built up impurities (corrosion and scale)

S-O-S Coolant Analysis (Level 2) provides a report of the results of both the analysis and the maintenance recommendations.

For more information about coolant analysis, see your Caterpillar dealer.

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Radiator - Clean

SMCS Code: 1353-070

Note: Some applications will require a fuel cooler to be installed. The fuel cooler is a type of radiator that uses air to cool the fuel and the fuel cooler will require cleaning.

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

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

- Part number
- Part name
- Quantity

If there is a question concerning the part number, please provide your dealer with a complete description of the needed item.

Discuss the problem with the dealer. Inform the dealer about the conditions of the problem and the nature of the problem. Inform the dealer about when the problem occurs. This will help the dealer in troubleshooting the problem and solving the problem faster.

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