



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
SEBU9285-03**

*Revised
July 15, 2014*

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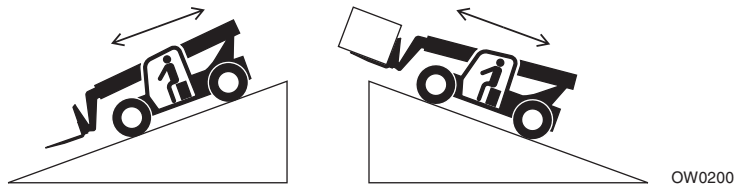
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Inspection, Maintenance and Repair Log

Section 1 - General Safety Practices

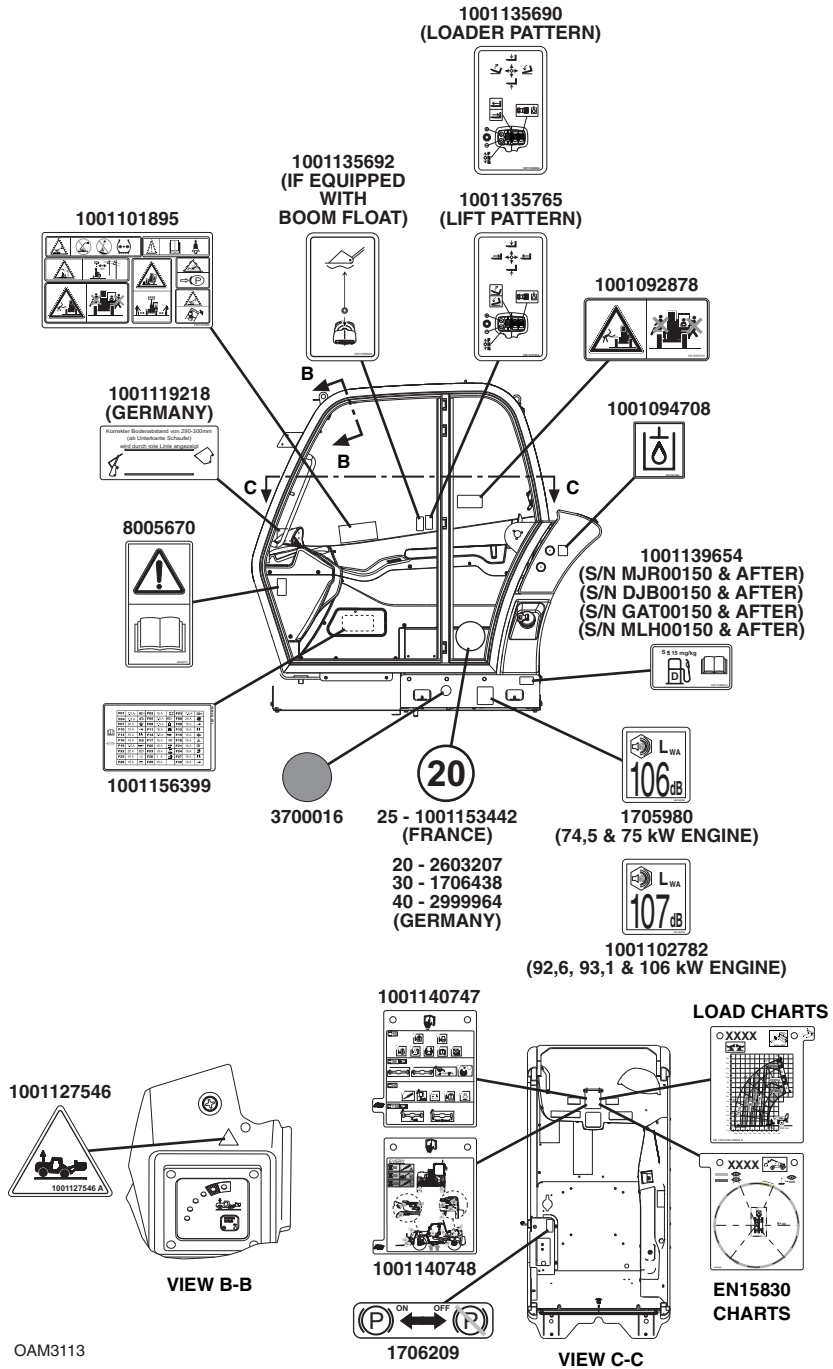
Driving Hazards on Slopes



To maintain sufficient traction and braking capabilities, travel on slopes as follows:

- When unloaded, drive with forks pointed downhill.
- When loaded, drive with the forks pointed uphill.
- For additional travel requirements, refer to the appropriate load chart.
- To avoid overspeeding the engine and drivetrain when driving down slopes, downshift to a lower gear and use the service brake as necessary to maintain a slow speed. **DO NOT shift into neutral and coast downhill.**
- Avoid excessively steep slopes or unstable surfaces. To avoid tip over **DO NOT** drive across excessively steep slopes under *any* circumstances.
- Avoid turning on a slope. Never engage “inching” or shift to “Neutral” when going downhill.
- **DO NOT** park on a slope.

Section 2 - Pre-Operation and Inspection



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Section 2 - Pre-Operation and Inspection

5. Mirror - Clean and undamaged.
6. Cab and Electrical -
 - General appearance; no visible damage.
 - Frame level indicator(s) and window glass undamaged and clean.
 - Gauges, switches, joystick, foot controls and horn operational.
 - Check seat belt for damage, replace belt if frayed or cut webbing, damaged buckles or loose mounting hardware.
7. Wheel/Tire Assembly - Properly inflated and secured; no loose or missing lug nuts. Inspect for worn tread, cuts, tears or other discrepancies.
8. Rear Axle - Steer cylinders undamaged, not leaking; pivot pins secure; hydraulic hoses undamaged, not leaking.
9. LSI Sensor (CE & AUS) - See inspection note.
10. Main Control Valve - See inspection note.
11. Wheel Chock (if equipped) - See inspection note.
12. Wheel/Tire Assembly - Properly inflated and secured; no loose or missing lug nuts. Inspect for worn tread, cuts, tears or other discrepancies.
13. Engine Compartment -
 - Drive belts, check condition and replace as required.
 - Engine mounts - See inspection note.
 - Battery cables tight, no visible damage or corrosion.
 - Engine cover properly secured.
14. Boom Sensor (CE & AUS) - See inspection note.
15. Mirrors - Clean and undamaged.
16. Wheel/Tire Assembly - Properly inflated and secured; no loose or missing lug nuts. Inspect for worn tread, cuts, tears or other discrepancies.
17. Frame Level Cylinder (TH414C, TH514C & TH417C) - Pins secure; hydraulic hoses undamaged, not leaking.
18. Right Outrigger (TH414C, TH514C & TH417C) - Pins secure; hydraulic hoses and cylinder undamaged, not leaking.
19. Boom Prop (if equipped) - See inspection note.
20. Platform Recognition Sensor (AUS - if equipped for platform): See inspection note.
21. Attachment - Properly installed, see “*Attachment Installation*” on page 5-13.

Section 3 - Controls and Indicators

16. System Distress Indicator: Illuminates and buzzer sounds when critical machine and engine faults exist.
17. Engine Fault Critical Indicator: Illuminates and buzzer sounds when a critical engine fault exists.
18. Engine Fault Warning Indicator: Illuminates and buzzer sounds when engine is operating outside the normal range.
19. Air Filter Restriction Indicator: Illuminates and buzzer sounds briefly when air filter(s) require maintenance.
20. Engine Oil Pressure Indicator: Illuminates and buzzer sounds when engine oil pressure is too low.
21. Battery Charge Indicator: Illuminates when battery is at low charge or charging system is not functioning properly.
22. Transmission Oil Temperature Indicator: Illuminates and buzzer sounds when transmission oil temperature is too high.
23. Steering Pressure Indicator: Illuminates and buzzer sounds when steering pressure is too low.
24. Hydraulic Filter Restriction Indicator: Illuminates and buzzer sounds briefly when hydraulic filter requires maintenance.

NOTICE

EQUIPMENT DAMAGE. When the engine fault, system distress or a red indicator illuminates (except park brake), immediately bring machine to a stop, lower boom and attachment to ground and stop the engine. Determine cause and correct before continued use.

Note: All indicators (except high beam and turn signals) perform a bulb check at system start up.

Section 3 - Controls and Indicators

Passive Mode (TH336C, TH337C, TH406C & TH407C)

- The orange LED (15) illuminates when either of the following occurs:
 - The boom is fully retracted.
 - The park brake is not applied and transmission is in forward or reverse.
- When approaching forward stability limitations, visual and audible indication is provided and the automatic function cut-out and/or slow down feature is disabled.
- Travel in accordance with the requirements set forth in Section 1 - General Safety Practices.
- Test LSI (14) at the beginning of each work shift. See Section 8 - Additional Checks.
- When placing a load, ensure axles are not fully steered in either direction.



WARNING

TIP OVER HAZARD. If the green, orange and red LEDs flash and warning buzzer sounds, retract and lower boom immediately. Determine cause and correct before continued use.

Section 3 - Controls and Indicators

12. High Exhaust System Temperature (HEST) Light (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 - if equipped with 75 kW engine) Illuminates during active regeneration. See page 4-4 for details.



WARNING

HIGH EXHAUST TEMPERATURE. Keep flammables and people away from hot exhaust.

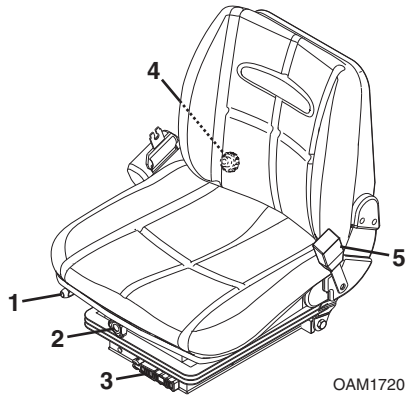
13. Boom Ride Control Indicator (TH336C, TH337C, TH406C & TH407C, if equipped): Illuminates when boom ride control system is activated.
14. Hazard Lights Switch (if equipped): On/Off switch.
15. Reversing Fan Switch (if equipped): See page 3-29.

Section 3 - Controls and Indicators

Adjustments

Prior to starting the engine adjust seat for position and comfort.

Mechanical Suspension Seat



1. Fore/Aft: Use handle to move seat fore and aft.
2. Height: Use knob to adjust height of the seat.
3. Suspension: Use the knob to adjust the suspension to the appropriate weight setting.
4. Backrest: Use knob to adjust backrest angle.
5. Seat Belt: Always fasten seat belt during operation. If required, a 76 mm (3 in) seat belt is available.

Section 4 - Operation

Manual Regeneration

If inhibit function is continually utilized, the regeneration indicator (4) illuminates, check engine indicator (5) flashes and engine will derate. A manual regeneration is required at this point.

1. Move telehandler to an area free of flammables and people that could be exposed to hot exhaust.
2. Apply park brake, shift transmission to neutral and lower boom.
3. Deactivate inhibit function by depressing bottom of regeneration switch until indicator (3) goes out.
4. To activate ATS regeneration, depress top of regeneration switch (2) until engine rpm begins to increase. Engine will ramp up to approximately 2000 rpm.
5. Do not depress accelerator pedal or other controls during an active regeneration.

Note: *If a manual regeneration must be interrupted, the operator can do so by depressing the bottom of the regeneration switch, releasing the park brake, shifting the transmission into forward or reverse, depressing the accelerator pedal or by turning off the engine.*

6. HEST indicator (1) illuminates during and shortly after active regeneration.



WARNING

HIGH EXHAUST TEMPERATURE. Keep flammables and people away from hot exhaust.

7. Manual regeneration takes up to approximately 25 minutes to complete.
8. Manual regeneration is complete after engine returns to idle and HEST indicator goes out.

NOTICE

EQUIPMENT DAMAGE. If manual regeneration requirement is continually ignored, the regeneration (4), check engine (5) and engine warning (6) indicators will illuminate. Immediately bring machine to a stop, retract and lower boom and stop the engine. Regeneration is no longer available and machine must be serviced. Contact the local Caterpillar dealer for further information.

Section 5 - Attachments and Hitches

SECTION 5 - ATTACHMENTS AND HITCHES

5.1 APPROVED ATTACHMENTS

To determine if an attachment is approved for use on the specific telehandler you are using, perform the following prior to installation.

- The attachment type, weight, dimensions and load center must be equal to or less than the data shown on a load chart located in the operator cab.
- The model on the load chart must match the model telehandler being used.
- Hydraulically powered attachments must only be used on machines equipped with auxiliary hydraulics.

If any of the above conditions are not met, do not use the attachment. The telehandler may not be equipped with the proper load chart or the attachment may not be approved for the model telehandler being used. Contact JLG or the local Caterpillar dealer for further information.

5.2 UNAPPROVED ATTACHMENTS

Do not use unapproved attachments for the following reasons:

- Range and capacity limitations for “will fit,” homemade, altered, or other non-approved attachments cannot be established.
- An overextended or overloaded telehandler can tip over with little or no warning and cause serious injury or death to the operator and/or those working nearby.
- The ability of a non-approved attachment to perform its intended function safely cannot be assured.



WARNING

Use only approved attachments. Attachments which have not been approved for use with your telehandler could cause machine damage or an accident.

Section 5 - Attachments and Hitches

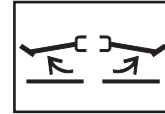


WARNING

TIP OVER HAZARD. All loads shown on rated load chart are based on machine being on firm ground with frame level (see page 4-7); the forks being positioned evenly on carriage; the load being centered on forks; proper size tires being properly inflated; and the telehandler being in good operating condition.

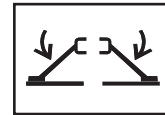
To identify the proper load chart on telehandlers equipped with outriggers, refer to the following icons which may be located on the load chart.

- Use when lifting a load with outriggers up.



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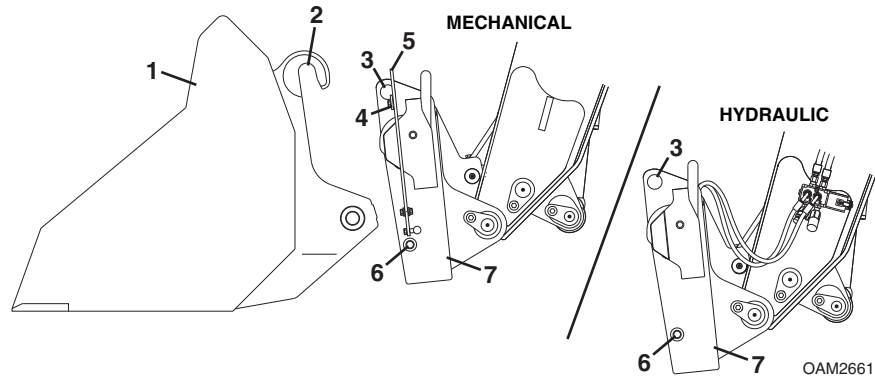
- Use when lifting a load with outriggers down.



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Section 5 - Attachments and Hitches

JCB Coupler



1. Attachment
2. Attachment Pin Recess
3. Attachment Pin
4. Hook (mechanical coupler)
5. Lock Pin Handle (mechanical coupler)
6. Lock Pin
7. JCB Coupler (attachment tilt control in cab, see page 3-19 or 3-22)



WARNING

CRUSH HAZARD. Always be certain that carriage or attachment is properly positioned on boom and is secured by lock pin. Failure to ensure proper installation could permit carriage/attachment/load to disengage.

Section 5 - Attachments and Hitches

To Side Shift:

The attachment auxiliary hydraulic roller switch (3) controls side shift.

- Push roller switch down to shift forks left.
- Push roller switch up to shift forks right.

Installation Procedure:

- Refer to “Attachment Installation” on page 5-13.



WARNING

CRUSH HAZARD. Do not use side shift to push or pull objects or load. Failure to comply could cause object or load to fall.

Equipment Damage Precautions:

- Do not use forks as a lever to pry material. Excessive prying forces could damage forks or machine structure.
- Do not attempt to lift loads that are attached or connected to another object.

Section 5 - Attachments and Hitches

To open/close manure fork:

The attachment auxiliary hydraulic roller switch (3) controls open/close movement of the manure fork attachment.

- Push roller switch down to open forks.
- Push roller switch up to close forks.

Installation Procedure:

- Refer to "Attachment Installation" on page 5-13.

Operation:

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

Equipment Damage Precautions

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

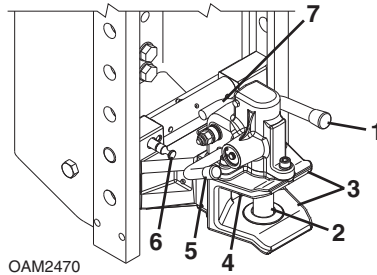
Section 5 - Attachments and Hitches

EEC Auto Hitch

Hitch Capacities

Maximum combined weight of trailer and load 12 000 kg (26 450 lb)

Maximum vertical load at hitch interface 2500 kg (5500 lb)



Connecting trailer for towing:

1. Rotate lever (1) until pin (2) fully retracts.
2. Align hitch mouth (3) and tow eye of trailer.
3. Reverse machine toward trailer.
4. After the tow eye contacts trigger (4), the pin and lever will be released.
5. If equipped, connect trailer harness to trailer plug.
6. If equipped, connect trailer hydraulics to rear auxiliary fittings.

Note: Use lever (5) to lower pin (2) after disconnecting from trailer.

Adjusting Hitch Height:


1. Pull lock pin (6) and lift handle (7) to release locking mechanism.
2. Move hitch to desired height.
3. Lower handle. When locking mechanism engages, lock pin will return to locked position



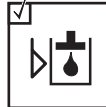



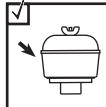
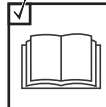
Section 7 - Lubrication and Maintenance


7.3 SERVICE AND MAINTENANCE SCHEDULES

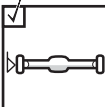
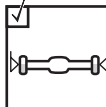

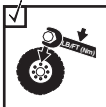
10 & 1st 50 Hour Maintenance Schedule



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 

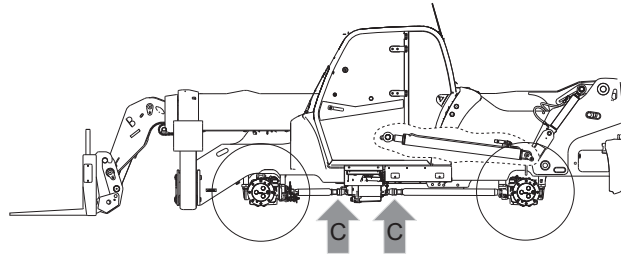
 Check Axle Differential Oil Level	 Check Wheel End Oil Levels	 Check Boom Chain & Tension (TH414C & TH417C)	 Check Wheel Lug Nut Torque
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Section 7 - Lubrication and Maintenance

TH414C, TH514C & TH417C

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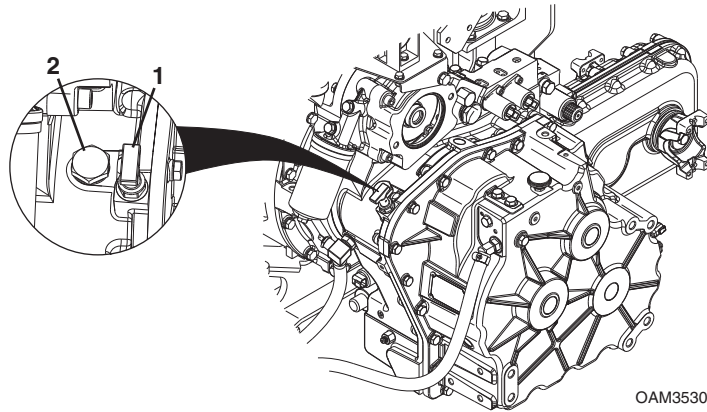
Section 7 - Lubrication and Maintenance

Transmission Oil

A. Transmission Oil Level Check

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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.

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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)
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)
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)

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

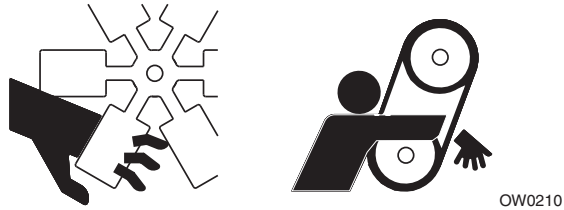
E-mail:

ProductSafety@JLG.com

Section 1 - General Safety Practices

Pinch Points and Crush Hazards

Stay clear of pinch points and rotating parts on the telehandler.



- Stay clear of moving parts while engine is running.



- Keep clear of tires and platform or other objects.



- Keep clear from under boom.



- Keep clear of boom holes.

SECTION 3 - OPERATION

3.1 PLATFORM OPERATION

- JLG recommends the user comply with local, provincial and federal regulations as they pertain to telehandler mounted personnel work platforms.
- Capacities and range limits for the telehandler change depending on the platform in use.
- Separate attachment instructions must be kept in manual holder in cab with this Operation & Safety Manual. An additional copy must be kept with the attachment if it is equipped with a manual holder.
- For fork mounted platforms, the combined weight of the platform, load and personnel shall not exceed one-third of the capacity at the related load center position as indicated on the capacity chart for the attachment on which the personnel work platform is being used.

Lifting/Lowering Personnel

- Secure work area.
- Without personnel in the platform, perform a simulated lift with designated signal person on ground as spotter to assure adequate telehandler range and attachment clearances.
- With the park brake applied, lift/lower personnel only at their request and in accordance with the requirements set forth in Section 1 - General Safety Practices and Section 4 - Types of Personnel Work Platforms. The operator shall always sound horn to alert personnel prior to lifting/lowering the platform and operate the joystick slowly and cautiously.

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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.

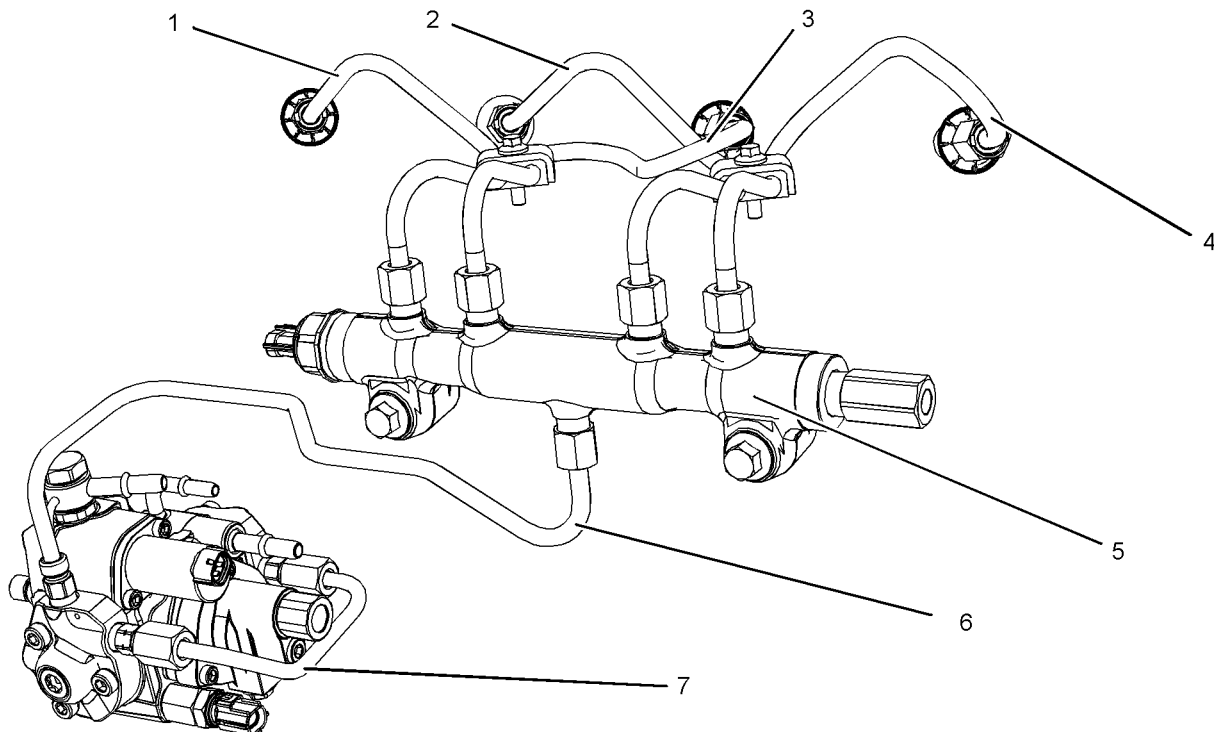


Illustration 14

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(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

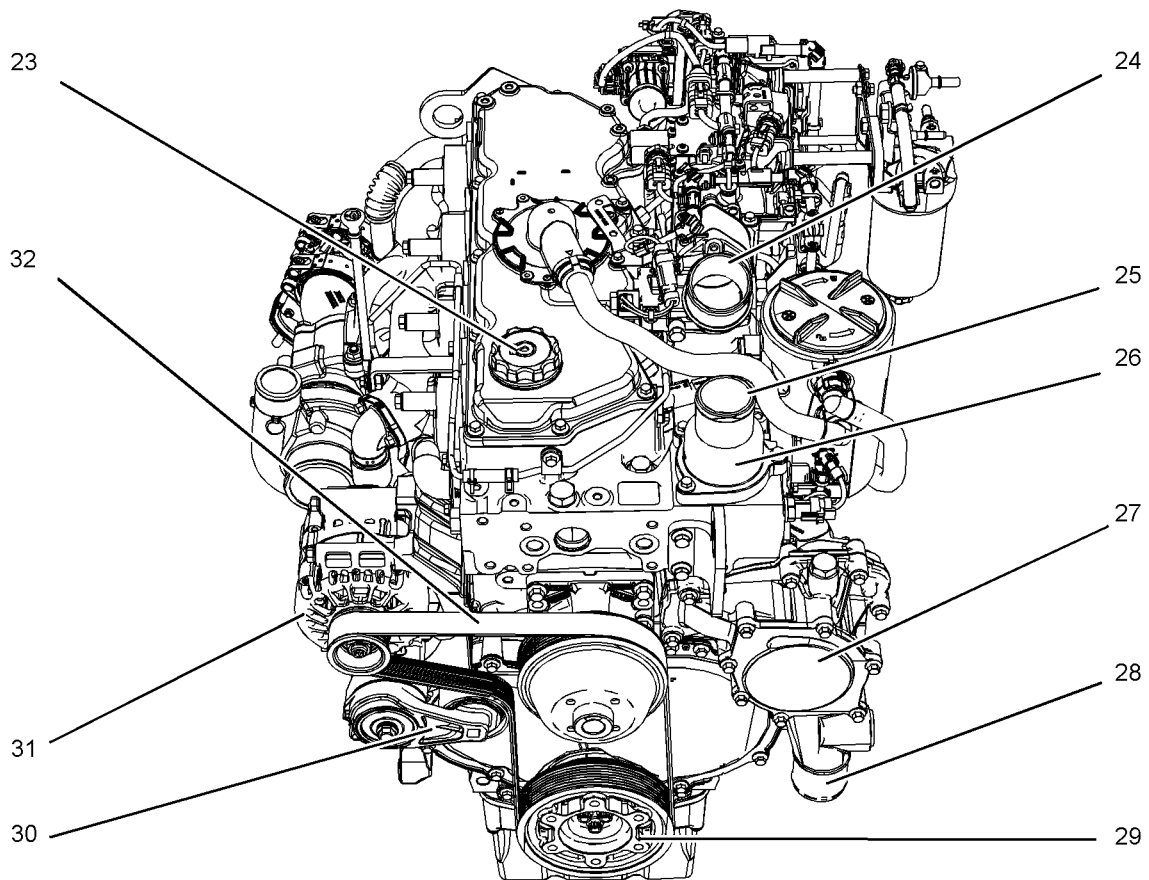


Illustration 22

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(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

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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

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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.

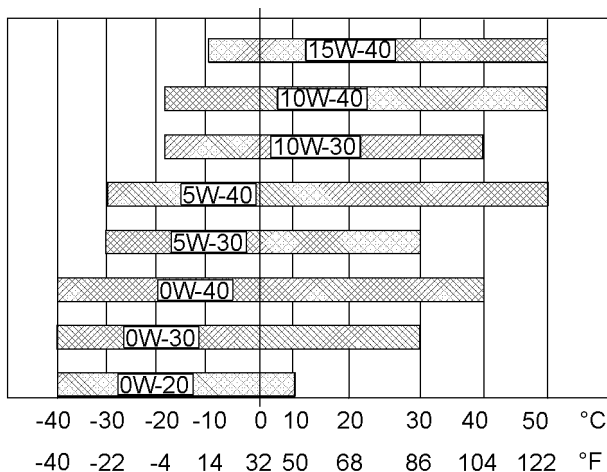


Illustration 41

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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.

i02323088

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 connections 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.

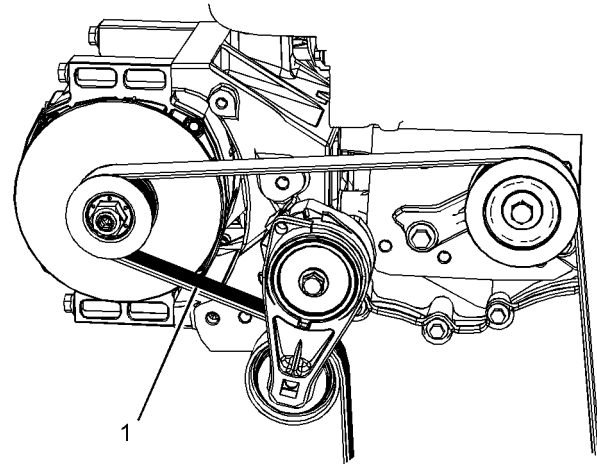


Illustration 43

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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.

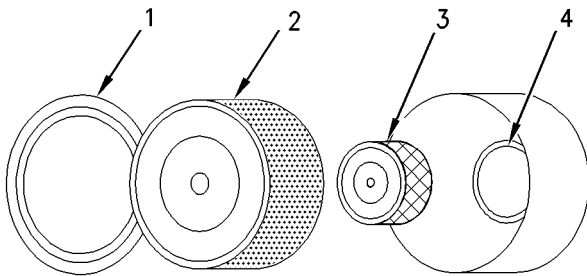


Illustration 49

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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.

i04323342

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

g02173847

"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.

i04248509

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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