

SECTION 7 ENGINE

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ENGINE MAINTENANCE 7.1

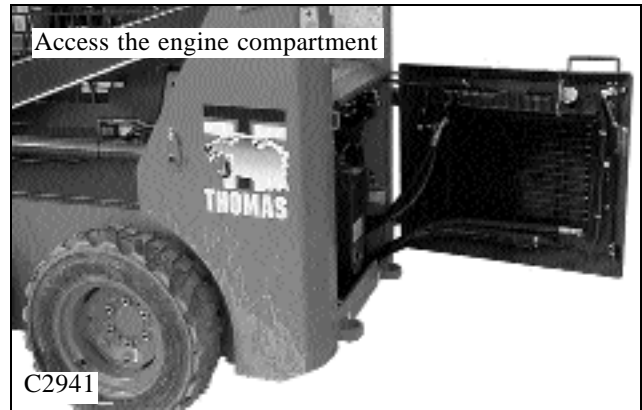
Lubrication System

Engine Oil and Filter:

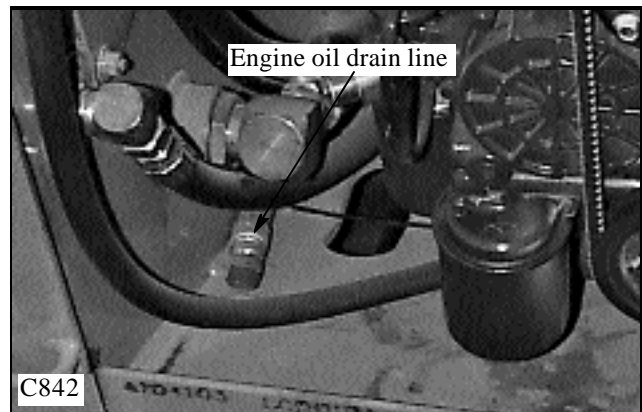
Engine oil and filter changes should be made with the engine warm. Change the engine oil every 75 hours and the oil filter every 150 hours of operation.

Park the loader on a level surface, lower the boom arms, engage the parking brake and shut off the engine.

1 Access the engine compartment by opening the rear door and lifting the engine cover. (fig. C2941)



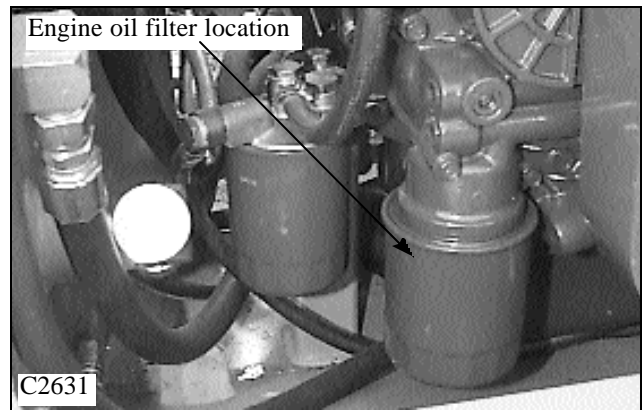
2 Locate the engine oil drain line and loosen the cap. (fig. C842)



3 Place the line through the hole in the chassis and route to a container that will contain at least 8 liters (1.5gal) of fluid.

4 Remove the cap from the line and allow the oil to drain thoroughly.

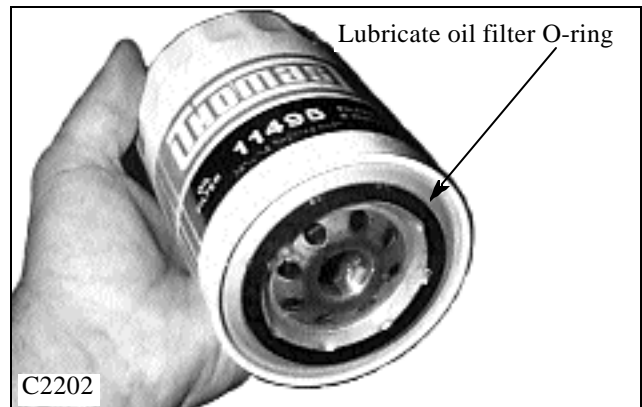
5 Remove the oil filter using an appropriate filter wrench. If the oil filter area is excessively dirty, clean around the filter area before removing the oil filter to prevent contaminant's reaching the engine lubricating system. (fig. C2631).



6 Check the oil filter mounting adapter area after removing the oil filter and check for dirt on the sealing surface and to make sure the oil filter O-ring seal has not stuck to the oil filter adapter.

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7 Lubricate the new oil filter O-ring seal with engine oil and install to the engine hand tightened. (fig. C2202)



8 Replace the oil line drain cap and place the line back in the engine compartment.

ENGINE MAINTENANCE 7.1

Lubrication System (cont'd)

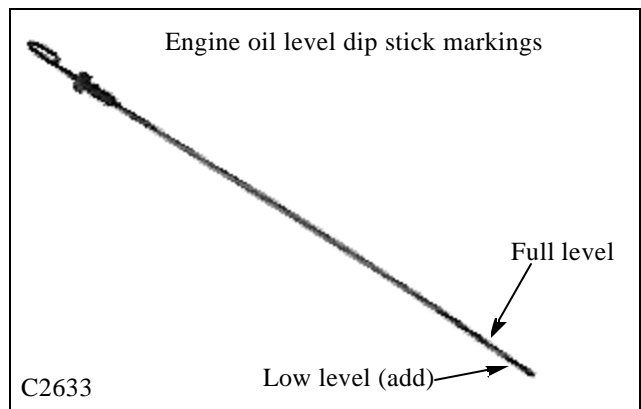
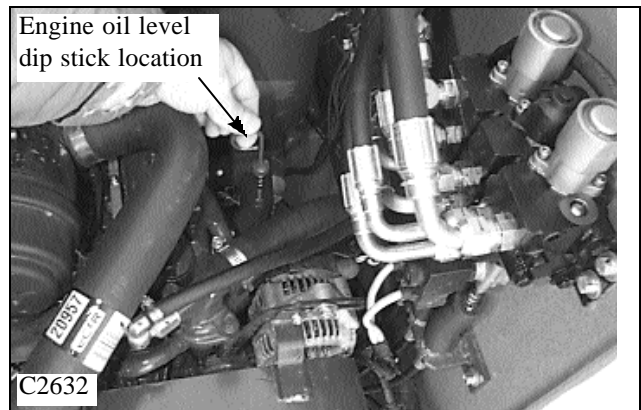
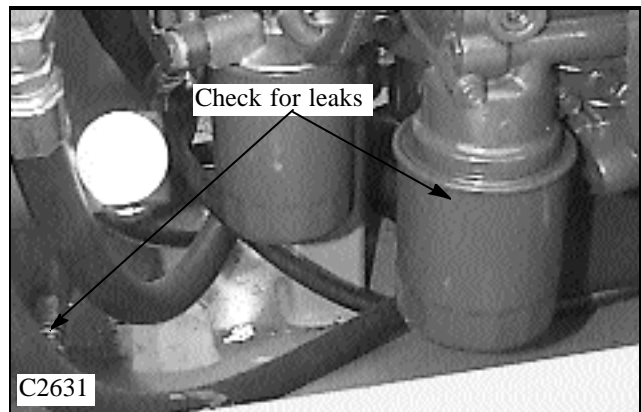
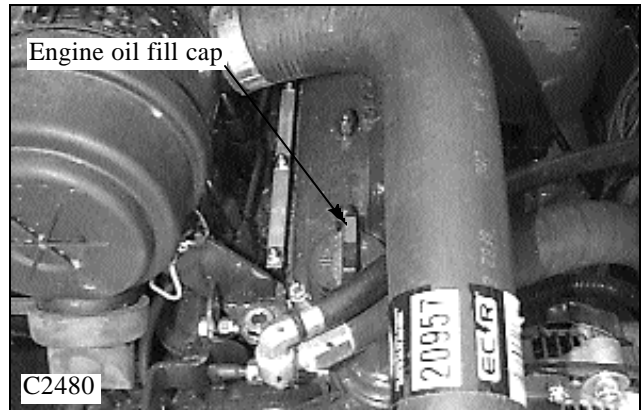
9 Remove the oil fill cap located in the engine rocker arm cover. (fig. C2480) Add 6.5 liters (7qts) of 10W30 API classification SE / CD engine oil. Replace the fill cap in the rocker arm cover.

NOTE: Oil capacity includes the oil filter. Reduce oil added by 0.5 liters (0.5qts) if the oil filter is not replaced.

10 Start the engine and check for leaks around the oil filter and oil drain line. (fig. C2631). Allow the engine to operate for approximately 3 ~ 5 minutes and then shut it off.

11 Check the level of the engine oil. (fig. C2632). Add oil as required to bring the oil to the top mark of the engine oil dip stick if required. (fig. C2633). Do not over fill.

Change the engine oil every 75 hours and the engine oil filter every 150 hours.



ENGINE MAINTENANCE 7.1

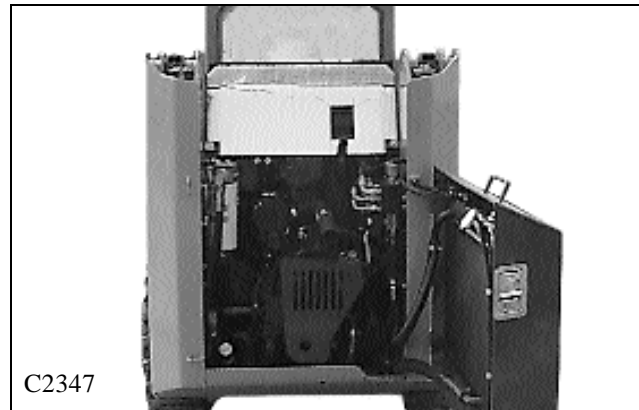
Fuel System

Fuel Filter:

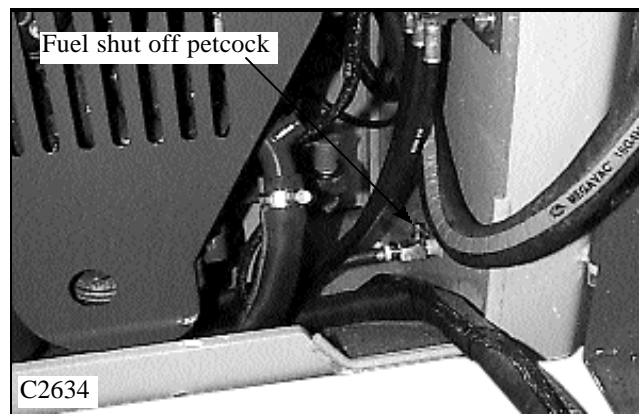
The fuel filter is a spin on type and is located in the engine compartment on the engine mounting bracket. Change the fuel filter every 400 operating hours.

To change the fuel filter: Park the loader on a level surface, lower the boom arms, engage the parking brake, shut off the engine and remove the key.

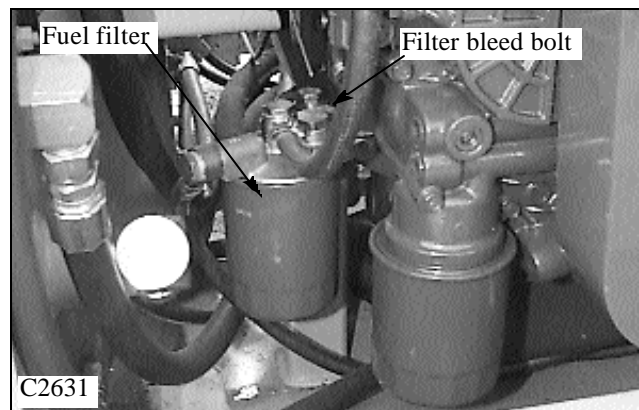
1 Access the engine compartment by opening the rear door and lifting the engine cover. (fig. C2347)



2 Close the fuel line shut off petcock located on the lower right hand side of the fuel tank. (fig. C2634) This will prevent fuel loss due to siphoning.



3 Remove the fuel filter using a filter wrench. (fig. C2631) Check to make sure the fuel filter O-ring seal has not stuck to the filter adapter mount.

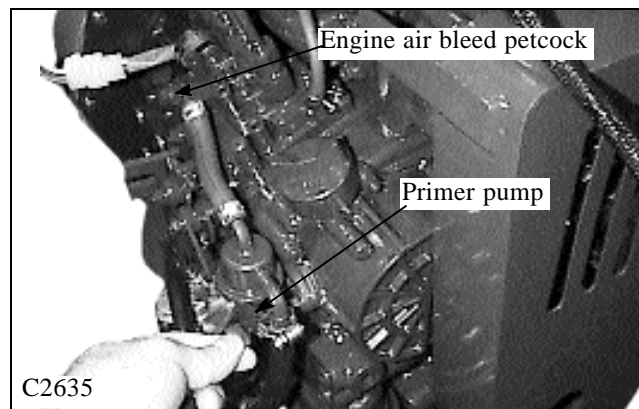


4 Lubricate the new fuel filter O-ring seal with light oil. Tighten the filter to the adapter mount hand tight.

5 Open the fuel line shut off petcock.

6 Open the fuel filter bleed bolt on the filter adapter housing and allow the fuel to dribble out. (fig. C2631) Tighten the bleed bolt.

7 Open the engine fuel line / air bleed bolt located just to the left of the fuel injection pump. (fig. C2635) Start the engine and set to idle. Close the fuel line / air bleed petcock when fuel starts to spit out. This can be accomplished easier with help from an assistant.



If the engine fails to continue operating, it may be necessary to bleed the fuel system of air after changing the fuel filter or running out of fuel. See Bleeding the Fuel System, next page.

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ENGINE MAINTENANCE 7.1

Fuel System (cont'd)

Bleeding the Fuel System:

If the loader has been run dry of fuel, or the fuel filter has been changed, it may be necessary to bleed the air from the fuel lines.

- 1 Replenish the fuel reservoir (tank) with a minimum of 10 gallons (45 L) of fuel. This will allow the fuel to siphon through readily.
- 2 Make sure the fuel line shut off petcock is fully open. (fig. C2634)
- 3 Loosen the fuel filter bleeder bolt and allow the fuel to siphon through the fuel line and filter. (fig. C2631) Tighten the fuel filter bleeder bolt.
- 4 Loosen the air bleed bolt located to the left of the fuel injection pump. (fig. C2635).
- 5 Crank the hand primer pump (fig. C2635) until fuel trickles out the engine air bleed bolt. Tighten the bolt.
- 6 Pre- heat and the start engine. Allow to operate at idle speed for few minutes. Shut off the engine.

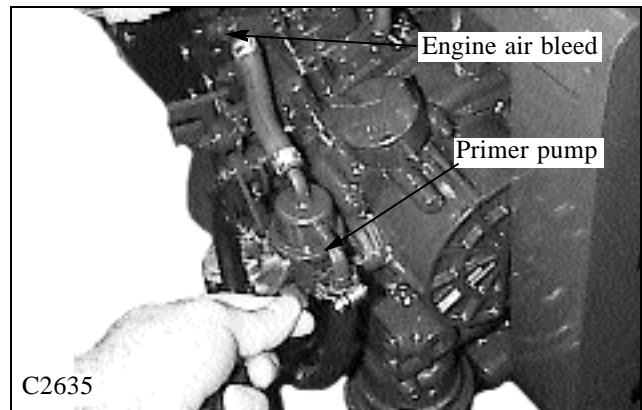
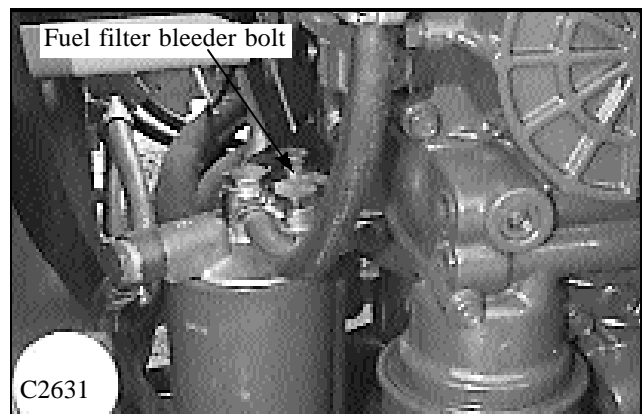
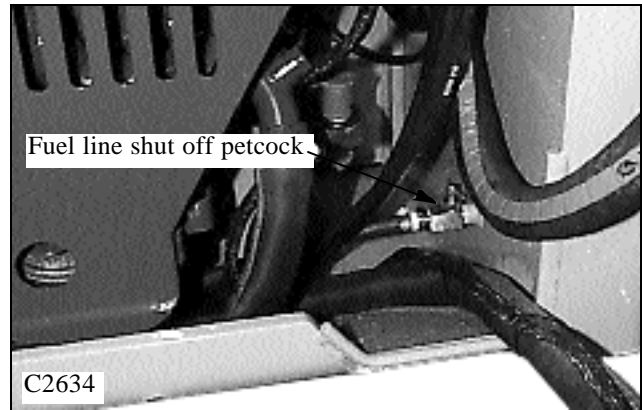
If the engine fails to continue operating it may be necessary to repeat the procedure, or try the following.

- 1 Open the engine air bleed bolt. Turn the engine over with the starter until the engine starts to smoke. Close the air bleed bolt. Do not engage the starter for more than 15 second intervals. Allow the starter to cool between starting attempts for 1 (one) minute.
- 2 Pre- heat and the start engine. Allow to operate at idle speed for few minutes. Shut off the engine.

If the engine operates but idles roughly, or knocks (has an air lock in an injector line), it may be necessary to bleed the individual injection lines while the engine is operating.

Loosen the injection lines, one at a time, starting at the injector pump. Tighten the line when fuel spits out then move onto the next injection line if required. Do all the lines on the injector pump first, then move to the injector connection next.

TIP: A quick way to bleed the fuel system if air pressure is readily available is to pressurize the fuel tank via the fuel return line and open the engine air bleed bolt. Do not over pressurize, 5 ~ 10 psi is adequate.



WARNING

Use extreme caution when bleeding air from the injection lines. Fuel is pressurized over 2000 psi and can penetrate the skin causing serious injury.

ENGINE MAINTENANCE 7.1

Air Filter

The loader is equipped with a dry cartridge, radial seal type filter element.

The loader is equipped with an air restriction indicator, located inline between the air cleaner and the engine air inlet. When the air filter element requires servicing the indicator will turn red in color.

Over servicing the air filters can damage the seals and pleated filter material if proper care is not taken. Never beat, shake or bend a filter element to clean. Cleaning with pressurized air can damage the pleated material.

Recommended service intervals are as the restriction indicator dictates, then replacement is required. Filters improperly serviced and leading to engine failure are not warrantable by Thomas or the engine manufacturer.

To service the air filter: park the loader on a level surface, lower the boom arms, engage the parking brake shut off the engine and remove the key.

Daily Checks

1 The air inlet restriction indicator should be visually checked daily, and for proper function by pushing in on the reset button. (fig. C2636). If the indicator is showing a red color, then the filter system will need to be serviced.

NOTE: If the indicator fails to reset after servicing, replace the indicator.

2 Air cleaner hoses and clamps should be inspected daily for proper tightness and verify air inlet hose integrity. Replace any worn or cracked inlet hoses immediately. Check the air cleaner mounting hardware for tightness.

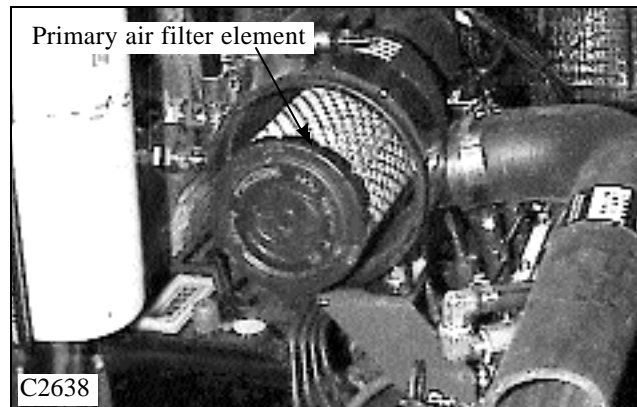
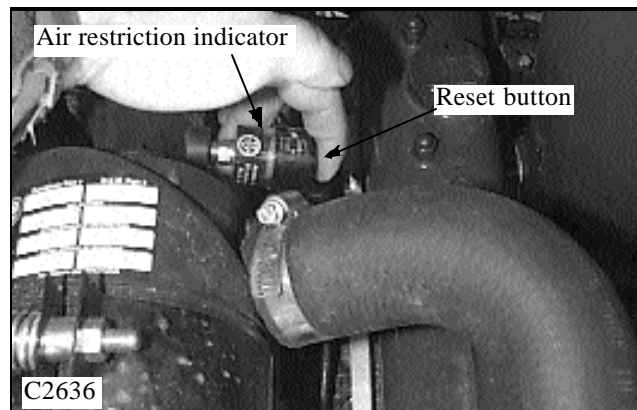
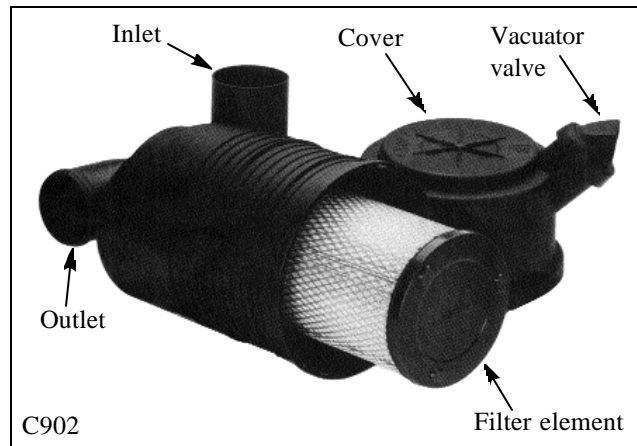
IMPORTANT

Air filter service intervals recommended only when the service indicator dictates.

Servicing the Air Filter Elements:

1 Release the latches holding the air cleaner cover to the canister body. (fig. C2637)

2 Pull straight out on the primary element to remove from the air cleaner housing. (fig. C2638) Do not twist or force the filter. This may damage the sealing area around the end of the air filter element.



ENGINE MAINTENANCE 7.1

Air Filter (cont'd)

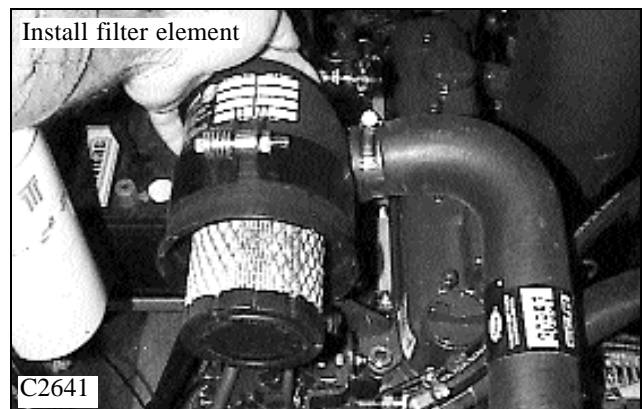
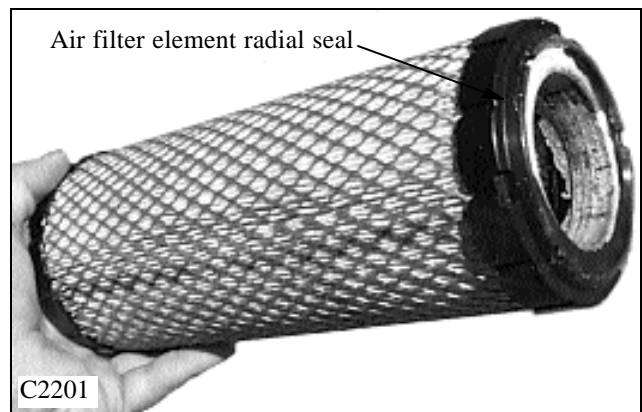
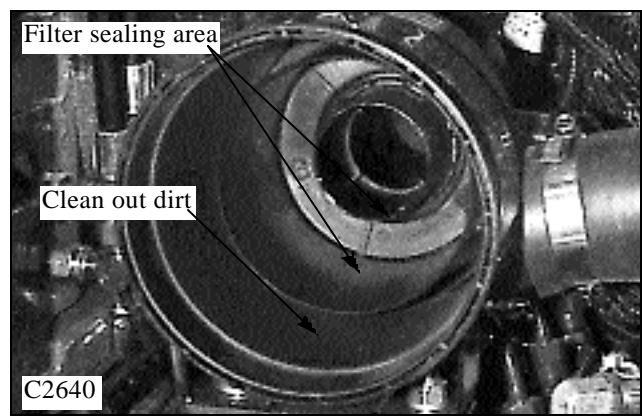
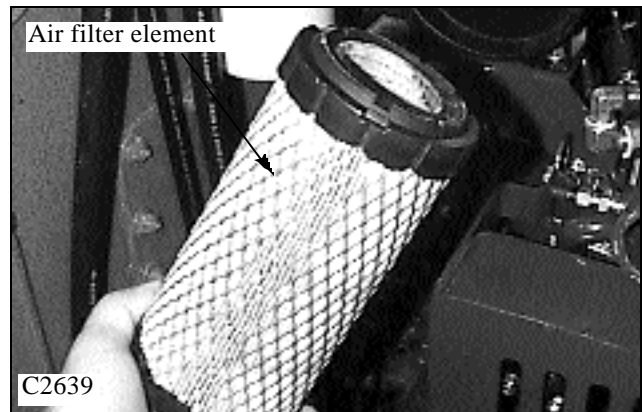
3 After removing the air filter elements, carefully wipe out any excess dirt from the air cleaner housing. (fig. C2640).

4 Check the air filter element seal before installing to the air cleaner housing. (fig. C2201). Be sure the seal is not damaged, torn or gouged. Do not use a filter with a damaged seal.

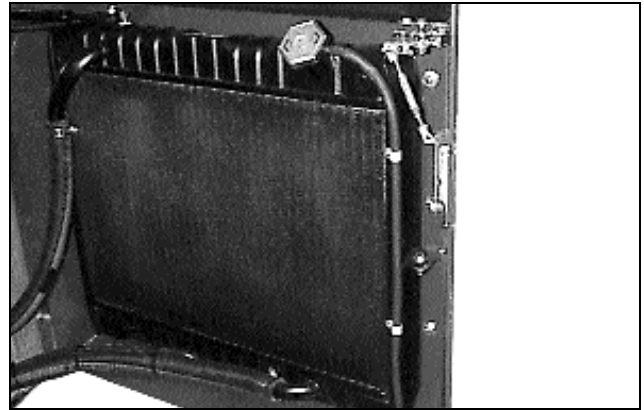
5 When installing the air filter elements to the air cleaner housing, support the back of housing with one hand and push the air filter element into position as gently as possible. (fig. C2641). Make sure it has fully seated to the air cleaner housing.

6 Install the air cleaner cover onto the housing. Be sure to align the latch hooks with the notches in the air cleaner housing.

Do not use the covers latches to push the air filter elements into position.



ENGINE MAINTENANCE 7.1



C2499

ENGINE MAINTENANCE 7.1

Cooling System (cont'd)

4 Attach a radiator tester and increase the pressure to 0.9 kg / cm² (12.8 psi). (fig. C172) Inspect the radiator, hoses and engine block for external leaks. Repair as required.

5 Attach a radiator tester to the radiator cap. (fig. C173) Apply 0.9 kg / cm² (12.8 psi) pressure to the radiator cap. The pressure should not drop more than 0.3kg / cm² (4.3 psi) in 10 seconds. Replace the radiator cap if required.

If no external leaks are found, and the radiator cap tests good, there may be an internal problem with the engine such as a gasket, cylinder head or block defect. Consult a Kubota Repair Manual P / N 40916 (Kubota P / N 97897-0109-5) to assist in engine disassembly and inspection.

WARNING

Never remove the radiator cap when the engine is hot.

Coolant Replacement:

The engine coolant should be changed every 1000 hours of operation. To change the coolant:

Park the loader on a level surface, lower the boom arms, engage the parking brake and shut off the engine.

1 Make sure the engine is not hot to touch. Remove the radiator cap.

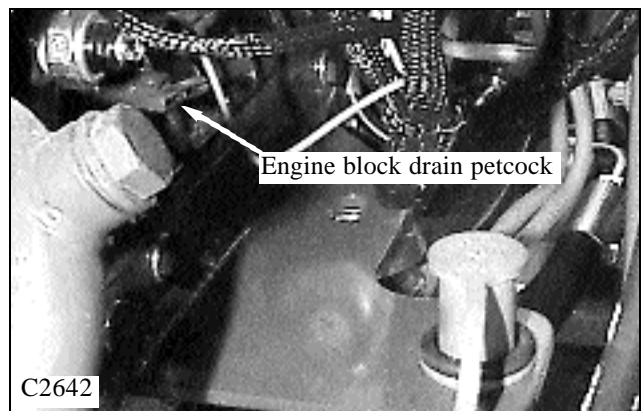
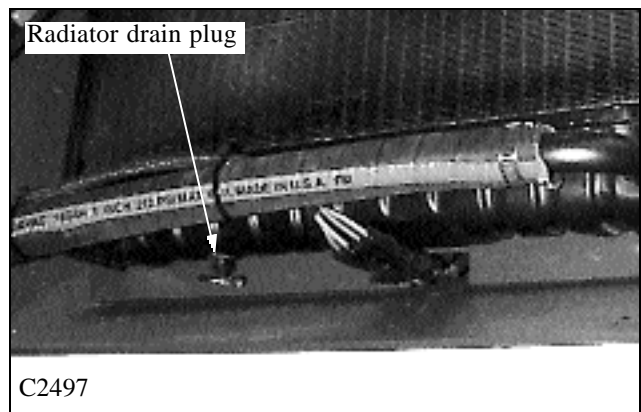
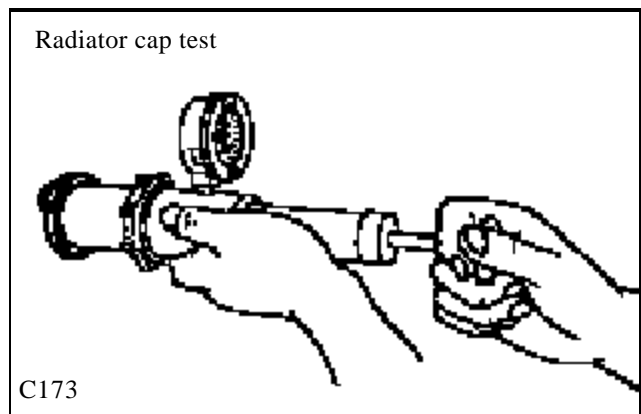
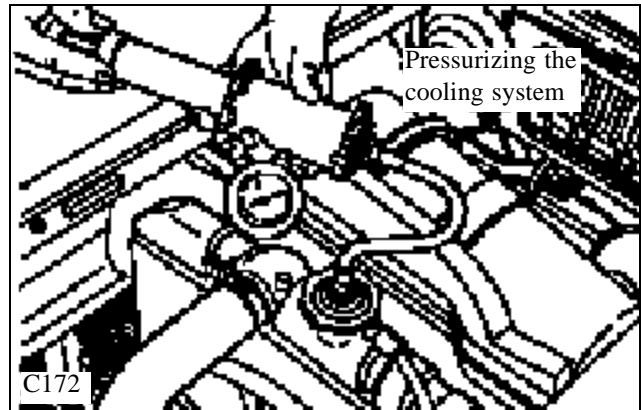
2 Remove the radiator drain plug located lower left corner of radiator. (fig. C2203) Be prepared to contain 7 liters (1.8 gal) of fluid.

3 Open the engine drain petcock located next to the engine fuel pump, just below the engine solenoid shut off. (fig. C1060) Close the drain petcock after the engine is completely drained.

Note: Attaching a piece of 5 / 16" (8mm) hose to the drain petcock and routing to a container, lessens waste fluid clean up. Please dispose of waste fluid in an environmentally friendly manner.

4 Replace the radiator drain plug using teflon tape or equivalent on the threads. Be sure to tighten the drain plug so it does not protrude past the radiators lower mount. This will prevent interference with the hydraulic oil cooler.

5 Pre - mix the engine coolant, ethylene glycol, to equal parts of water. (50 / 50 ratio) Add the mixed coolant to the engine radiator. The cooling system will hold approximately 7 liters (1.8 gal) of coolant. Never use coolant undiluted. Pure coolant does not absorb and pass heat efficiently. It will also gel in cold weather.



MAINTENANCE 7.1

Drive Belt Adjustment

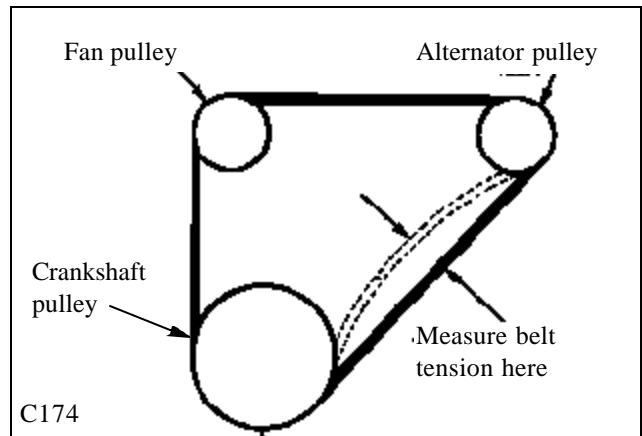
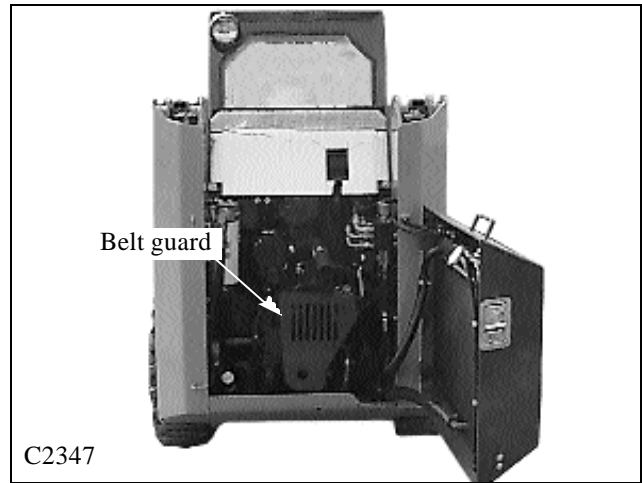
The fan (alternator) drive belt should be checked daily for tension and wear. The drive belt should be replaced promptly when fraying of the belt cords or cracks in the rubber are observed. Failure to replace the drive belt could lead to slippage or complete failure, causing the engine to over heat and lead to extensive repairs.

To Adjust the Drive Belt:

- 1 Park the loader on a level surface, lower the boom arms, engage the parking brake and shut off the engine.
- 2 Access the engine compartment by opening the rear door and lifting the engine cover. (fig. C2347)
- 3 Remove the drive belt / pulley guard to access the drive belt (fig. C2347).
- 4 Check the drive belt tension midway between the alternator and crankshaft drive pulley. (fig. C174) Correct tension is 10 ~ 12mm deflection @ 98 newtons force. (3 / 8 ~ 1 / 2" deflection @ 22 lbs force).

Drive Belt Replacement:

- 1 Remove the bolts retaining the guard to the radiator shroud. (fig. C2347)
- 2 Loosen the 2 bolts on the alternator and allow the belt tension to loosen off.
- 3 Pull the drive belt off the alternator pulley, crankshaft pulley and remove.
- 4 Replace in reverse order and adjust belt tension as described above.



ENGINE MAINTENANCE 7.1



THOMAS

CYLINDER HEAD 7.2

Valve Adjustment

The engine used in this application uses a solid lifter (tappet) design that requires periodic maintenance of the rocker arm to valve clearance. (Valve lash)

Valve clearance should be checked every 500 hours of operation. Always check the valve clearance while the engine is cold. **Correct valve clearance is 0.18 ~ 0.22mm (0.0071 ~ 0.0087in).**

Procedure to Check / Adjust the Valve Clearance:

- 1 Park the loader on a level surface, lower the boom arms, engage the parking brake and shut off the engine. Remove the ignition key for safety.
- 2 Allow the engine to cool to room temperature.

IMPORTANT

Do not adjust the valve clearance while the engine is hot. Clearances provided are for cold engine adjustment only.

3 Access the engine compartment by opening the rear door and lifting the engine compartment cover.

4 Remove the 4 nuts and washers retaining the valve cover to the engine cylinder head and remove the cover. (fig. C2100)

NOTE: The crankshaft pairs pistons # 1 and # 4, and pistons # 2 and # 3 to rise and fall at the same time. The camshaft valve timing though, has the cylinder pairs on different cycles of operation.

Example: If both pistons on # 1 and # 4 were at top dead center (TDC), one of the cylinders would be on the compression stroke (both valves closed) the other cylinder would be starting the intake stroke. (Intake valve starting to open).

5 Turn the engine over until the intake valve is just starting to opening on number 1 (one) cylinder. (Cylinder closest to radiator) This valve action means that cylinder number 4 (next to flywheel) is on the compression stroke, with both valves closed. This is the proper point to check and / or adjust the intake and exhaust valves on cylinder number 4.

6 Insert a feeler gauge between the rocker arm and the intake or exhaust valve on cylinder number 4. (fig. C551) If necessary, loosen the jam nut on top of the rocker arm and turn the adjustment screw to acquire correct valve clearance. **Correct valve clearance is 0.18 ~ 0.22mm (0.0071 ~ 0.0087in).**

7 Rotate the engine after checking / setting cylinder number 4 valves, until cylinder number 4 intake valve start to open. This position means that cylinder number 1 (one) is on the compression stroke and can have the intake and exhaust valves checked and / or adjusted.

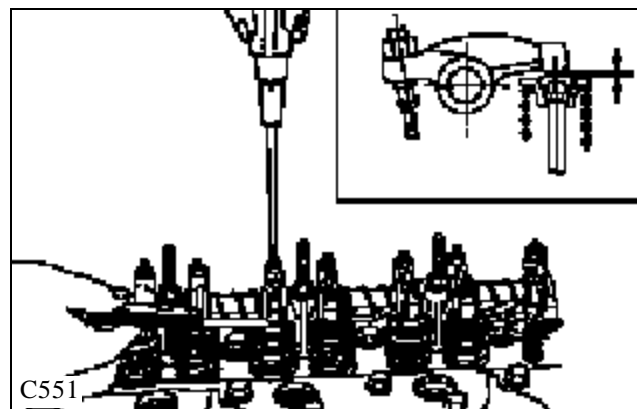
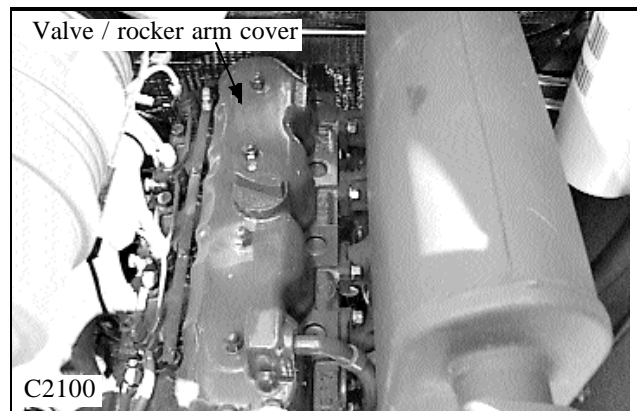
Correct valve clearance is 0.18 ~ 0.22mm (0.0071 ~ 0.0087in).

8 Repeat the procedure for cylinder pairs 2 and 3. As one of the cylinders intake valves are just starting to open the opposite cylinder is on the compression stroke and can have it's valves adjusted.

Correct valve clearance is 0.18 ~ 0.22mm (0.0071 ~ 0.0087in).

9 Rotate the engine 2 ~ 3 complete revolutions and recheck the valve clearances by repeating the procedure above.

10 Replace the valve cover. Tighten the mounting nuts to 6.9 ~ 8.8 Nm (5.1 ~ 6.6 ft / lbs).



7

CYLINDER HEAD 7.2 (notes)



THOMAS



CYLINDER HEAD 7.2

Compression Testing

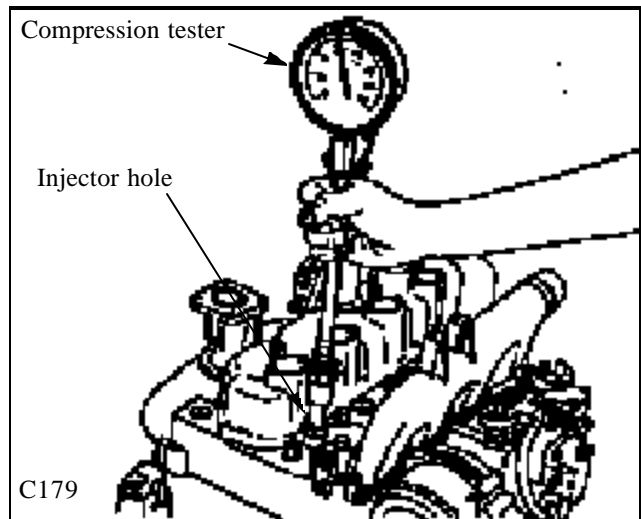
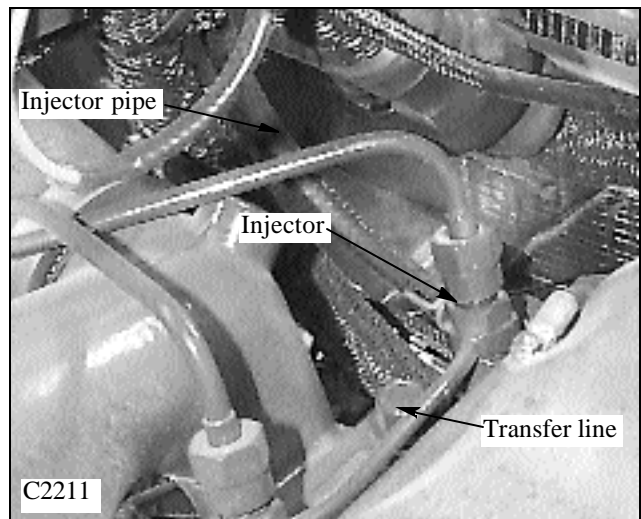
Testing the engine for compression is not a normal part of a scheduled maintenance procedure, but is important when trying to diagnose engine power or unusual performance related problems with the engine.

Before performing a compression test, be sure the battery is fully charged and valve clearances are correctly adjusted. See page 7-12. Be sure the air cleaner and exhaust systems are free of obstructions, to prevent a false or low reading

The engine should be warmed up for approximately 5 minutes prior to compression testing.

To Perform Compression Test:

- 1 Move the loader to a level surface, lower the boom arms, engage the parking brake and shut off the engine. Remove the ignition key for safety.
- 2 Access the engine by opening the rear door and raising the engine compartment cover.
- 3 Disconnect the wiring plug connection on the engine stop solenoid. (fig. C) This will prevent fuel flowing to the engine when the engine is turning over.
- 4 Clean dirt from the top of the engine area to prevent contaminants entering the engine.
- 5 Remove the fuel injection pipes from the fuel injectors. (fig. C2211) If the injector pipes are corroded or the pipes twist with the nut when loosening, replace the injection pipe before putting the loader back into service. Cap the open lines and injectors to prevent contamination entering the fuel injection system.
- 6 Remove the fuel transfer lines from the injectors.
- 7 Remove the fuel injectors from each cylinder. Use caution. Do not damage the injector while removing from the cylinder head.
- 8 Connect a compression tester (see Special Tools in Section 8) to the cylinder to be tested. (fig. C179) Be sure to use the correct thread on the adapter screwed into the injector hole.
- 9 Rotate the engine with the starter (200 ~ 300 RPM) 2 ~ 3 complete revolutions. Note the compression reading on the gauge. Repeat the process again to verify the first test reading.
- 10 Continue the compression test on the remaining cylinders keeping written notes of all the registered test readings.
- 11 Compare the compression test readings with the specifications given in Section 7.4, Engine Specifications.



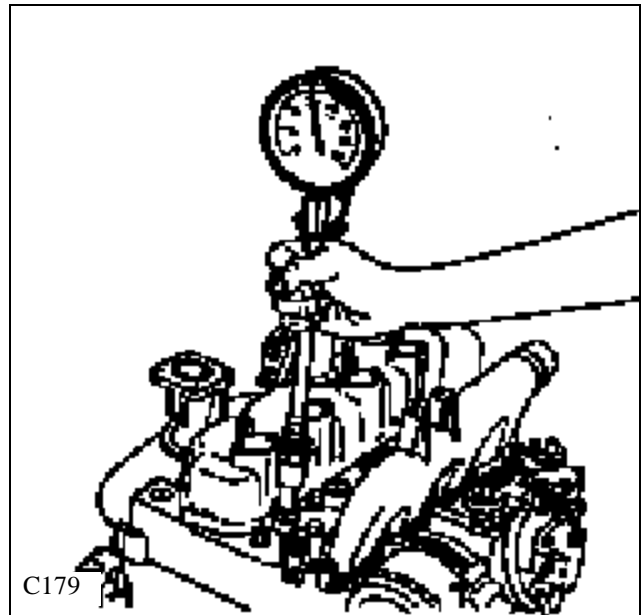
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CYLINDER HEAD 7.2

Compression Testing (cont'd)

If the compression test readings are low, add a small amount of oil, through the injector hole, to the affected cylinder (s). Recheck the compression test readings. If the readings improve from the first test then the piston rings or cylinder bores are likely worn.

If the compression reading does not improve the problem is likely a cylinder head related problem such as valve train, cylinder head gasket, or a bad piston. The cylinder head should be removed for further inspection. See the Kubota Service / Repair Manual P / N 97897-109-5 or Thomas P / N 40916.



C179

Cylinder Head

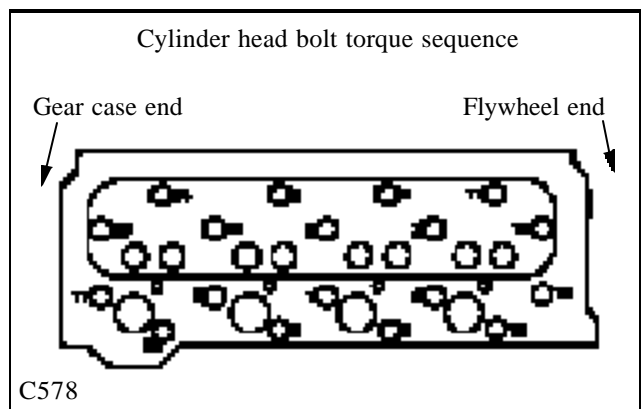
After replacement of the engine cylinder head, the proper bolt torquing sequence must be followed. (fig. C578)

Torque the bolts in 3 separate steps, increasing tightness to the specified 63.7 ~ 68.6 Nm (47 ~ 50.6 ft / lbs).

Apply oil to the threads of the bolt and to the heads of the bolt where they contact the cylinder head casting.

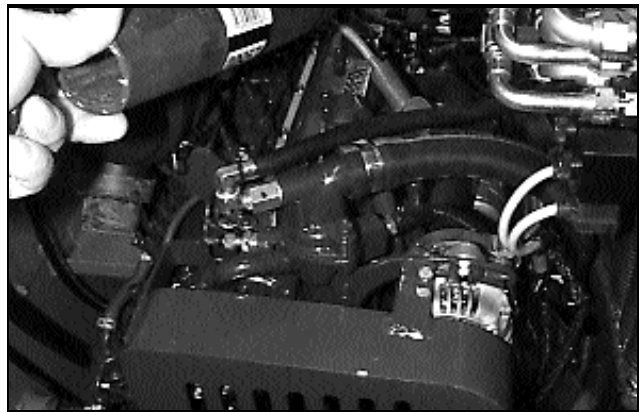
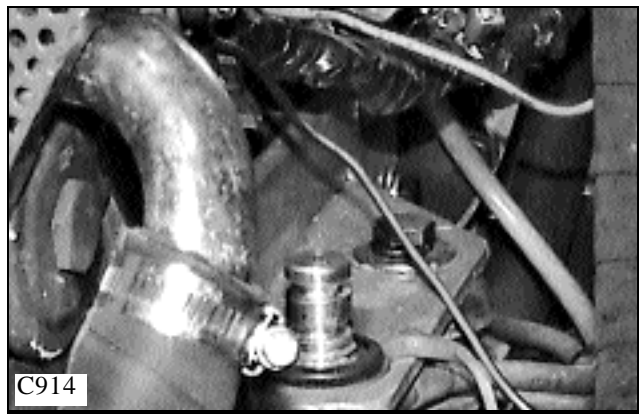
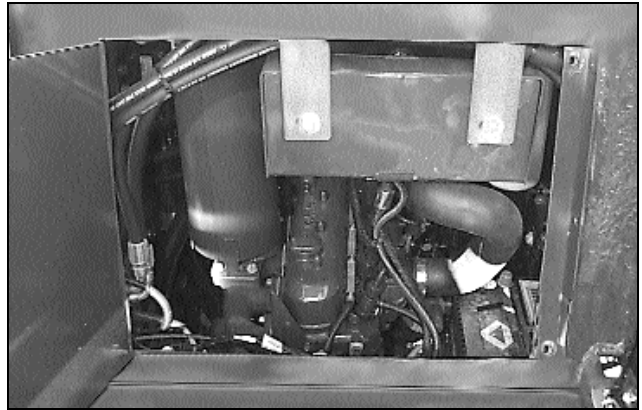
Always install a new head gasket and oil gallery O-ring when replacing the cylinder head.

After installation, operate the engine for half an hour to bring to full operating temperature. Allow the engine to fully cool and retorquing the cylinder head bolts.

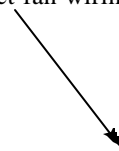


C578

ENGINE REPLACEMENT 7.3



Disconnect fan wiring



C2407

ENGINE REPLACEMENT 7.3

Engine Removal (continued)

11 Open the fuse panel and remove the bolts retaining to the frame (fig. C2484). The fuse panel and harness may stay with the engine during removal.

12 Remove the bolts retaining the tandem pump to the bellhousing. (fig. C2608) Support the pump from dropping before proceeding. See note below.

Note: If desired, the hydrostatic tandem pump may be removed with the engine assembly as a single unit. Bypass step 12 if preferred. Drain the hydraulic reservoir, remove and cap all hydraulic hoses as required. See section 1 and 2 for details.

13 The engine rests on three (3) isolator mounts. One (1) on each side of the engine block and one (1) located further forward under the hydrostatic pump (fig. 2779). Remove the mounting bolts retaining the engine to the frame isolator mounts.

14 Attach lifting device to engine to prevent damage to injector lines etc., remove the engine.

Engine Replacement

Transfer the engine mounts, bellhousing, flywheel adapter coupling, air cleaner assembly, electrical harness, sender and switches as required.

Note: The painted surface of the engine block and mounts, where the mounting bolts are used, must have the paint removed to assure adequate grounding for electrical components.

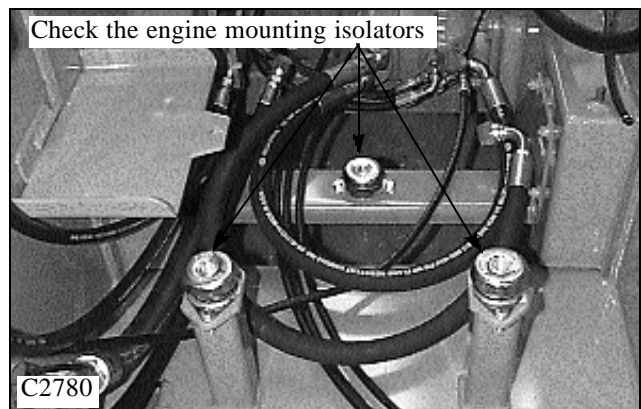
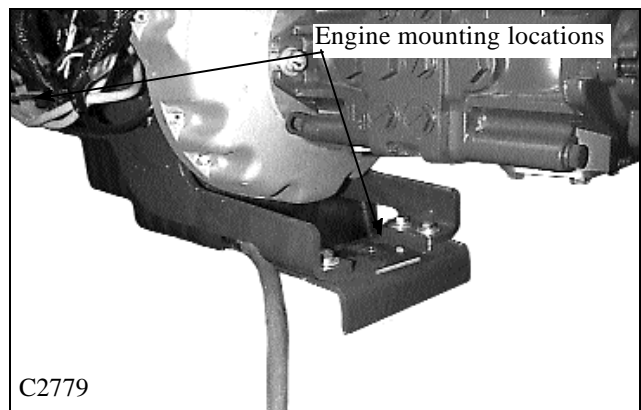
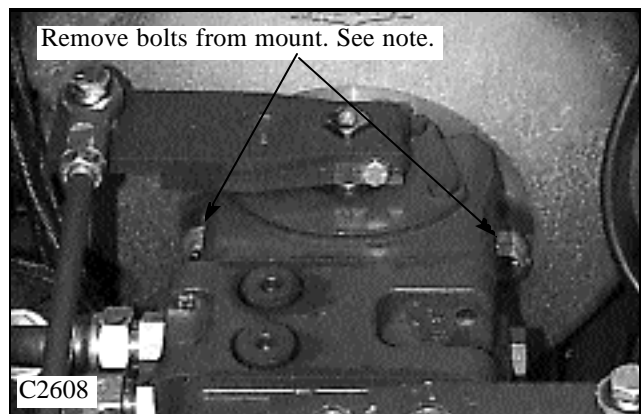
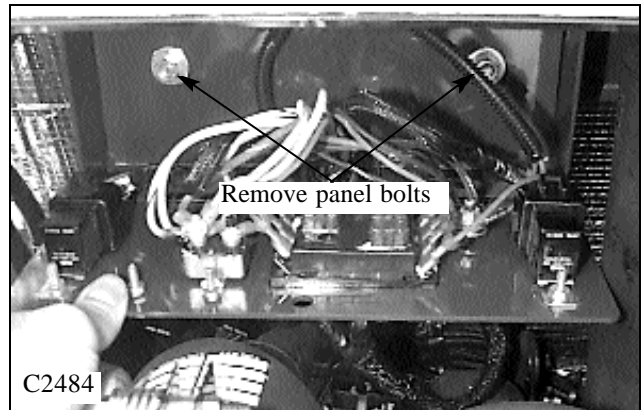
Use loctite 242 (blue) on all engine mount to engine block bolts and torque as outlined.

Use teflon sealant on electrical sender and switches.

Check the engine mounting isolators for deterioration and replace as required (fig. C2780).

Torque Specifications:

Engine mounts to engine block	37 ft / lbs (50.3nm)
Engine mounts to frame isolators	60 ft / lbs (81.6nm)
Flywheel adapter coupler	20 ft / lbs (27.2nm)
Bellhousing to engine	20 ft / lbs (27.2nm)
Tandem pump to bellhousing	55 ft / lbs (74.8nm)



ENGINE SPECIFICATIONS 7.4

Make and model	Kubota V1305E
Type	Vertical , In Line, 4 Cycle
Number of cylinders	4 (four)
Displacement	1335cc (81.5 cu. in.)
Cylinder bore	76 mm (2.99 inches)
..... Allowable limit: 76.0 ~ 76.019mm + 0.15mm. (2.9921 ~ 2.9929 + 0.0059 inches)	
..... Oversize Cylinder Bore +0.5mm (0.0197 inches)	
Ring Gap	Allowable Service Limit 1.25mm (0.0492 inches)
Top Compression Ring	0.25 ~ 0.40mm (0.0098 ~ 0.0157 inches)
Second Compression Ring	0.25 ~ 0.40mm (0.0098 ~ 0.0157 inches)
Oil Ring	0.25 ~ 0.40mm (0.0098 ~ 0.0157 inches)
Stroke	73.6 mm (2.9 inches)
Bearing clearance	Main journals: 0.04 ~ 0.118mm (0.0006 ~ 0.0015 in) < 0.2 mm (0.0079 in) allowable limit >
..... Rod journals: 0.025 ~ 0.087 mm (0.0009 ~ 0.0034 in) < 0.2 mm (0.0079 in) allowable limit >	
..... Thrust bearing end play: 0.15 ~ 0.31 mm (0.0059 ~ 0.0122 in) < 0.5 mm (0.0197 in) allowable limit	
Maximum engine speed (no load)	3000 RPM
Low idle setting	1300 RPM
Cooling system	Liquid
Cold starting aid	Glow plug in combustion chamber
Power (ISO 9249 Net Power)	22.5Kw (30 hp) @ 3000 RPM
Torque (ISO 9249 Net Power)	6 kg / m. (43.4 lbs / ft.) @ 2400 RPM
Compression ratio	22.0: 1
Engine compression	29 - 33kgf / cm ² (412 - 469psi)
..... Service limit: 23kgf / cm ³ (327psi) 10 % variance among cylinders	
Firing order (viewed from gear case end)	1 - 3 - 4 - 2
Fuel injection pump	Bosch MD type mini pump
Fuel injection timing	21° ~ 23° BTDC (0.37 ~ 0.40 Rad)
Injector working pressure	140 - 150 kgf / cm ³ (1990 - 2133 psi)
Direction of rotation (viewed from flywheel end)	Counter - clockwise
Location of timing marks	N / A
Valve clearance, (cold)	0.145 - 0.185 mm (0.0057 - 0.0072 in)
Valve seat angle	Intake 1.047 Rad (60°)
..... Exhaust 0.785 Rad (45°)	
Valve seat width	Intake 2.12mm (0.0835 in)
..... Exhaust 2.12mm (0.0835 in)	
Valve face angle	Intake 1.047 Rad (60°)
..... Exhaust 0.785 Rad (45°)	
Valve recessing	- 0.05mm ~ 0.4mm (0.0020 ~ 0.016in)



ENGINE SPECIFICATIONS 7.4

Fuel type	Diesel No. 2
Fuel filter	Single spin on type
Air cleaner	Single dry cartridge element with restriction indicator
Oil filter	Single spin on type
Engine oil pressure	@ Idle speed 98 Kpa (14 psi) minimum
.....	@ Rated speed 245 Kpa (36 psi) minimum
Oil pressure switch	Closes @ 49 Kpa (7 psi)
Engine oil capacity with filter	8 l. (8.5 qts)
Oil type	10W30API SE,CD
Cooling system capacity	14.5 l (3.2 gal.)
Radiator cap pressure setting	88 KPa (12.8 psi)
Thermostat rating	Fully open 85°C (185°F)

TIGHTENING TORQUES FOR SPECIAL BOLTS AND NUTS

Valve Cover Cap Nuts	6.9 ~ 8.8 nm (5.1 ~ 6.5lbs / ft)
Head Bolts	63.7 ~ 68.6nm (47 ~ 50.6lbs / ft)
Bearing Case Bolts (8mm)	29.4 ~ 34.3nm (21.7 ~ 25.3lbs / ft)
Bearing Case Bolts (9mm)	49 ~ 53.9nm (36.2 ~ 39.8lbs / ft)
Flywheel Bolts (10mm)	53.9 ~ 58.8nm (39.8 ~ 43.4lbs / ft)
Connecting Rod Bolts (8mm)	41.2 ~ 46.1nm (30.4 ~ 34lbs / ft)
Rocker Arm Bracket Nuts (7mm)	21.6 ~ 26.5nm (15.9 ~ 19.5lbs / ft)
Idle Gear Shaft Bolts (6mm)	9.8 ~ 11.3nm (7.2 ~ 8.3lbs / ft)
Glow Plugs (S / N ~ 488290 [10mm])	19.6 ~ 24.5nm (14.5 ~ 18.1lbs / ft)
(S / N 488291 ~ [8mm])	7.8 ~ 14.7nm (5.8 ~ 10.8lbs / ft)
Nozzle Holder Assembly (Injector, 20mm)	49 ~ 68.6nm (36.2 ~ 50.6lbs / ft)
Injector Pipe Nuts (12mm)	24.5 ~ 34.3nm (18.1 ~ 25.3lbs / ft)
Engine mounts to engine block	50.3nm (37 ft / lbs)
Engine mounts to frame isolators	81.6nm (60 ft / lbs)
Flywheel adapter coupler	27.2nm (20 ft / lbs)
Bellhousing to engine	27.2nm (20 ft / lbs)
Tandem pump to bellhousing	74.8nm (55 ft / lbs)



ENGINE TROUBLE SHOOTING 7.5

SYMPTOM	PROBABLE CAUSE	SOLUTION
Excessive lubricant oil consumption	Piston rings gap facing the same direction	Shift gap direction
	Oil ring worn or stuck	Replace
	Piston ring groove worn	Replace
	Valve stem and guide worn	Replace
	Crankshaft bearing and crank pin bearing worn	Replace
Fuel mixed into lubricant oil	Injection pump's plunger worn	Replace pump element or pump
	Injection pump broken	Replace
Water mixed into lubricant oil	Head gasket defective	Replace
	Cylinder block or cylinder head flawed	Replace
Low oil pressure	Engine oil insufficient	Replenish
	Oil strainer clogged	Clean
	Relief valve stuck with dirt	Clean
	Relief valve spring weakened or broken	Replace
	Excessive oil clearance of crankshaft bearing	Replace
	Excessive oil clearance of crank pin bearing	Replace
	Excessive oil clearance of rocker arm bearing	Replace
	Oil passage clogged	Clean
	Oil pump defective	Replace
Different type of oil	Use the specified oil type	
High oil pressure	Relief valve defective	Replace
	Engine oil insufficient	Replenish
Engine overheated	Fan belt broken or elongated	Change or adjust
	Cooling water insufficient	Replenish
	Radiator net and radiator fin clogged with dust	Clean
	Inside of radiator corroded	Clean or replace
	Cooling water flow route corroded	Clean or replace
	Radiator cap defective	Replace
	Overload running	Loosen the load
	Head gasket defective	Replace
	Incorrect injection timing	Adjust
Deficient output	Unsuitable fuel used	Use the specified fuel
	Incorrect injection timing	Adjust
	Engine's moving parts seem to be seizing	Repair or replace
	Uneven fuel injection	Repair or replace injection pump
	Deficient nozzle injection	Repair or replace nozzle
Battery quickly discharges	Compression leak	Replace head gasket, tighten cylinder head bolt, glow plug and nozzle holder
	Battery electrolyte insufficient	Replenish distilled water
	Fan belt slips	Adjust belt tension or change
	Wiring disconnected	Connect
	Rectifier defective	Replace
	Alternator defective	Replace
Battery defective	Change	

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ENGINE TROUBLE SHOOTING 7.5

Symptom	Cause	Remedy
Engine does not start	No fuel	Replenish fuel
	Air in the fuel	Vent air
	Water in the fuel	Change fuel and repair or replace fuel system
	Fuel pipe clogged	Clean
	Fuel filter clogged	Clean or change
	Excessively high viscosity of fuel or engine oil at low temperature	Use the specified fuel or engine oil
	Fuel with low octane number	Use the specified fuel
	Fuel leak due to loose injection pipe retaining nut	Tighten nut
	Incorrect injection timing	Adjust
	Fuel cam shaft worn	Replace
	Injection nozzle clogged	Clean
	Injection pump malfunctioning	Repair or replace
	Seizure of crankshaft, camshaft, piston, cylinder liner or bearing	Repair or replace
	Compression leak from cylinder	Replace head gasket, tighten cylinder head bolt, glow plug and nozzle holder
	Improper valve timing	Correct or replace timing gear
	Piston ring and liner worn	Replace
Excessive valve clearance	Adjust	
Starter does not run	Battery discharged	Charge
	Starter malfunctioning	Repair or replace
	Key switch malfunctioning	Repair or replace
	Wiring disconnected	Connect
Engine revolution is not smooth	Fuel filter clogged or dirty	Clean or change
	Air cleaner clogged	Clean or change
	Fuel leak due to loose injection pipe retaining nut	Tighten nut
	Injection pump malfunctioning	Repair or replace
	Incorrect nozzle opening pressure	Adjust
	Injection nozzle stuck or clogged	Repair or replace
	Fuel overflow pipe clogged	Clean
Governor malfunctioning	Repair	
Either white or blue exhaust gas is observed	Excessive engine oil	Reduce to the specified level
	Low grade fuel used	Repair or replace
	Fuel filter clogged	Adjust
	Air cleaner clogged	Adjust top clearance
Either black or dark gray exhaust gas is observed	Overload	Lessen the load
	Low grade fuel used	Use the specified fuel
	fuel filter clogged	Clean or change
	Air cleaner clogged	Clean or change



NOTES



7

THOMAS