

# SECTION 7 ENGINE

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# ENGINE MAINTENANCE 7.1

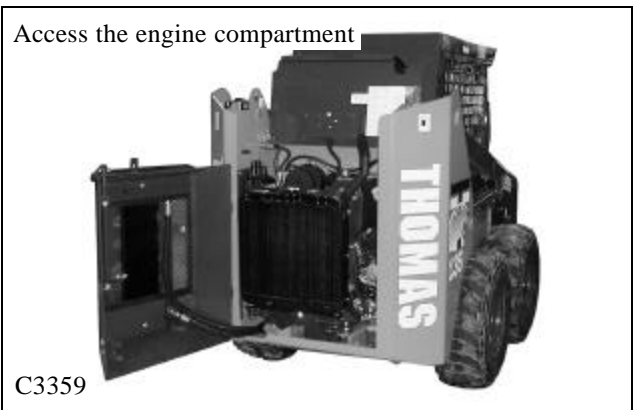
## Lubrication System

### Engine Oil and Filter:

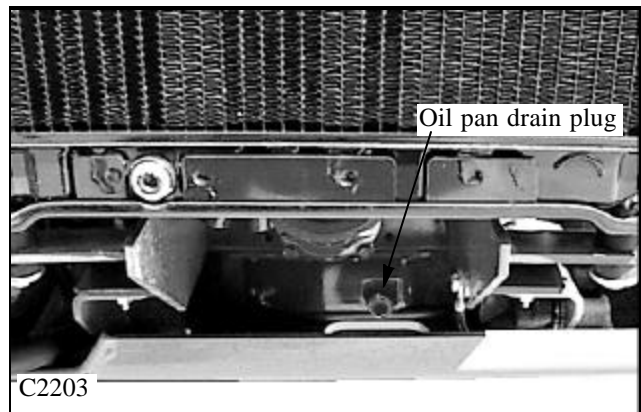
Engine oil and filter changes should be made with the engine warm. Change the engine oil every 75 hours and the oil filter every 150 hours of operation.

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

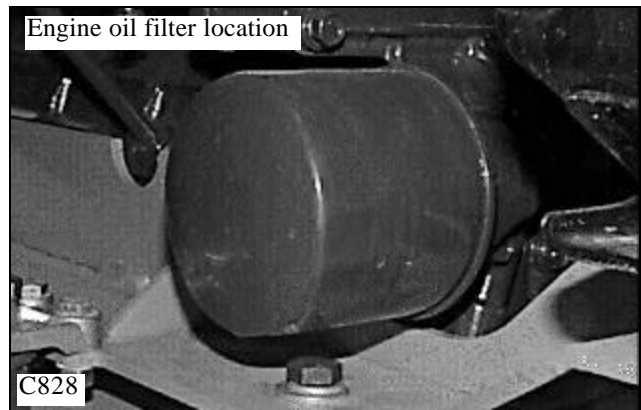
1 Access the engine compartment by opening the rear door and lifting the engine cover. (fig. C3359)



2 Remove the oil pan drain plug located at the bottom of the engine oil pan to drain the oil. Have a catch container ready to contain approximately 8.5 qts (8 liters) of fluid. (fig. C2203)

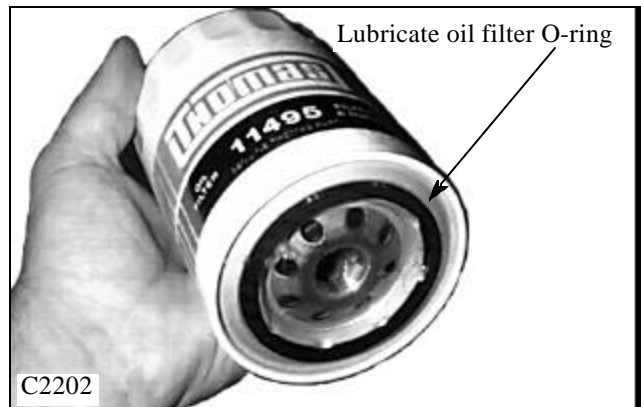


3 Remove the oil filter using an appropriate filter wrench. If the oil filter area is excessively dirty, clean around the filter area before removing the oil filter to prevent contaminant's reaching the engine lubricating system. (fig. C828)



4 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.

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



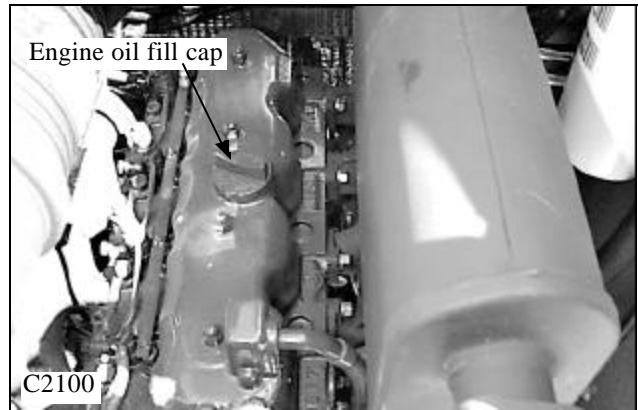
6 Replace the oil pan drain plug. Make sure the seal is still in place and in good condition. Tighten the oil pan drain plug not exceeding 33 ft lbs (45 Nm).

7

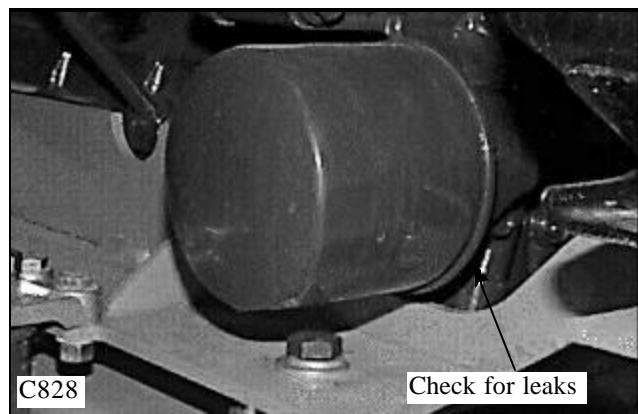
# ENGINE MAINTENANCE 7.1

## Lubrication System (cont'd)

7 Remove the oil fill cap located in the engine rocker arm cover. (fig. C2100) Add 8 qts (7.5 liters) of 10W30 API classification CF engine oil. Replace the fill cap in the rocker arm cover.

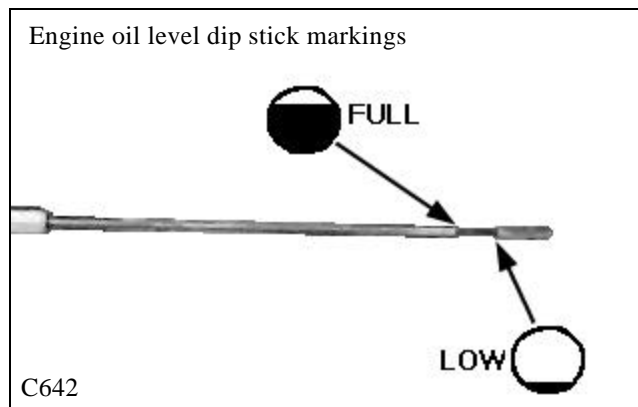
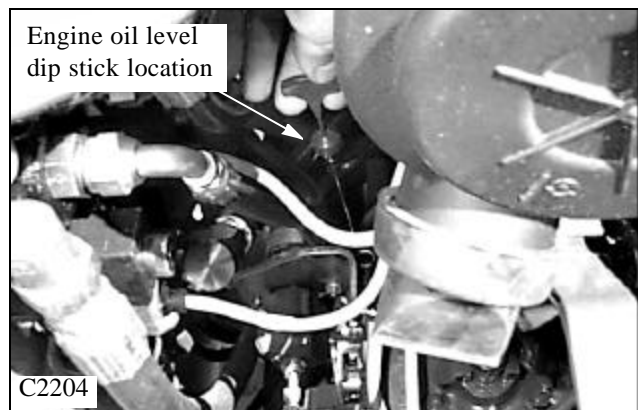


8 Start the engine and check for leaks around the oil filter and oil pan drain plug. (fig. C828) Allow the engine to operate for approximately 5 minutes and then shut it off.



9 Check the level of the engine oil. (fig. C2204) Add oil as required to bring the oil to the top mark of the engine oil dip stick. (fig. C642) 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

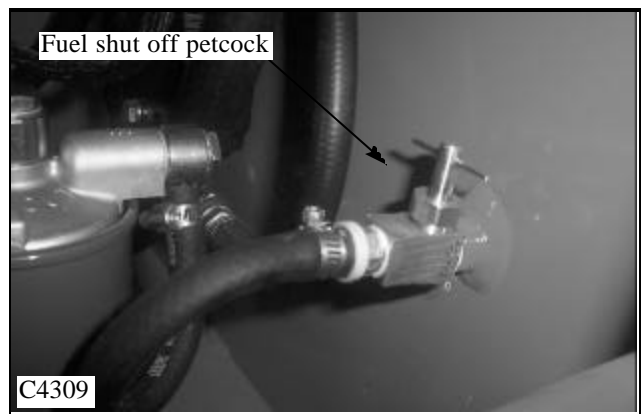
### Fuel Filter:

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. Loader S / N's LE008500 ~ 8799 have the filter mounted to the left hand side of the engine. S / N's LE008800 onward are mounted to the right hand side of the engine. To change the fuel filter: Park the loader on a level surface, lower the boom arms, engage the parking brake and shut off the engine.

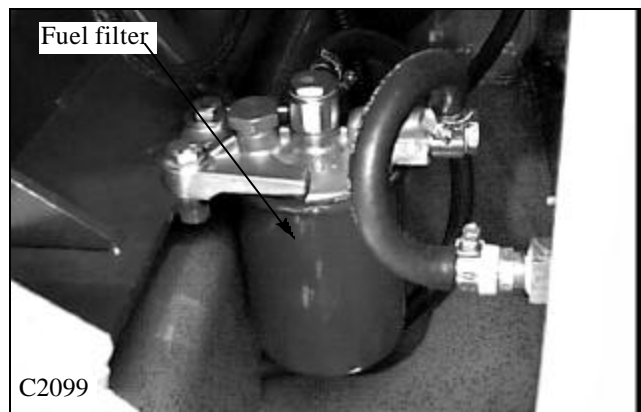
- 1 Access the engine compartment by opening the rear door and lifting the engine cover. (fig. C3359)
- 2 Close the fuel line shut off petcock located on the lower right hand side of the fuel tank. (fig. C4309) This will prevent fuel loss due to siphoning.
- 3 Remove the fuel filter using a filter wrench. (fig. C2099) 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.



C3359



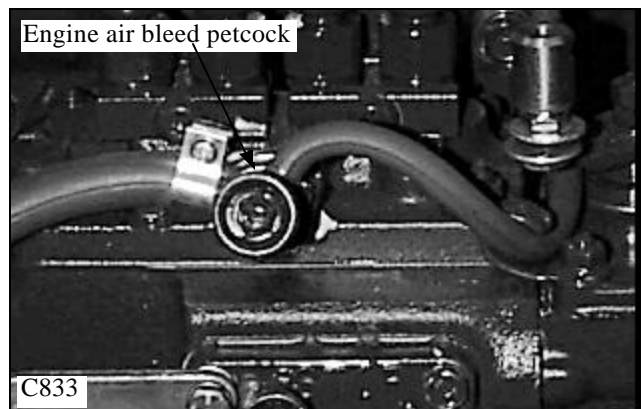
C4309



C2099

- 6 Open the engine fuel line / air bleed petcock located just to the left of the fuel injection pump. (fig. C833) Start the engine and allow to idle for 5 minutes. Close the fuel line / air bleed petcock.

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.



C833

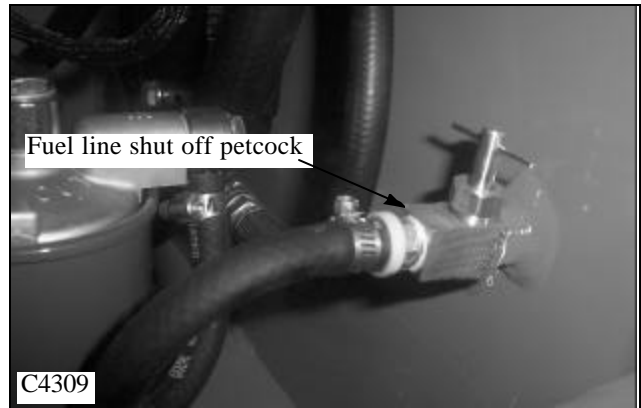
# ENGINE MAINTENANCE 7.1

## Fuel System (cont'd)

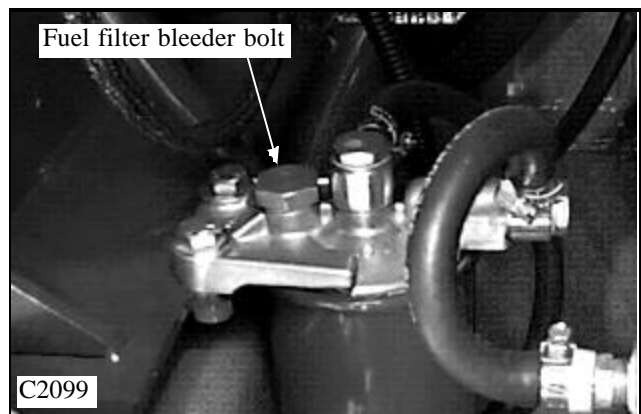
### Bleeding the Fuel System:

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.

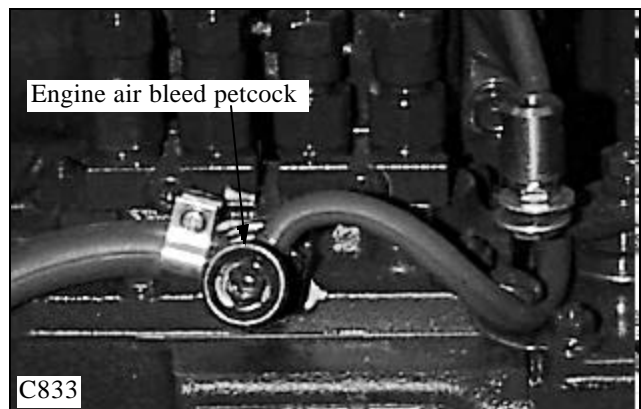
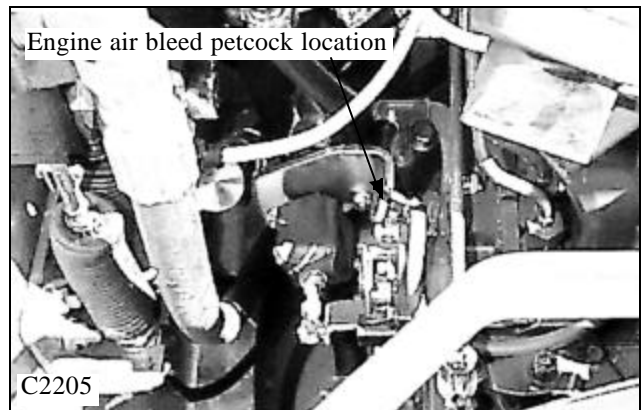
- 1 Replenish the fuel reservoir (tank) with a minimum of 10 gallons (45 liters) of fuel.
- 2 Make sure the fuel line shut off petcock is fully open. (fig. C4309)



- 3 Loosen the fuel filter bleeder bolt and allow the fuel to siphon through the fuel line and filter. (fig. C2099) Tighten the fuel filter bleeder bolt.



- 4 Loosen the air bleed petcock located to the left of the fuel injection pump. (fig. C2205, C833)
- 5 Turn the engine over with the starter until the engine starts to smoke. Do not engage the starter for more than 15 second intervals. Allow the starter to cool between starting attempts for 1 (one) minute.
- 6 Pre-heat the and start engine. Allow to operate at idle speed for 5 minutes. Shut off the engine.
- 7 Close the air bleed petcock.



# ENGINE MAINTENANCE 7.1

## Air Filter

The loader is equipped with dual dry cartridge, radial seal type filter elements. The larger outside element is called a primary and the one inside the the primary is referred to as a safety element. (fig. C653)

The loader is equipped with an air restriction indicator that functions while the engine is operating. When the air filter elements require servicing the indicator light on the dash panel will illuminate.

**Over servicing the air filters can damage the seals and pleated filter material. When the air restriction indicator light illuminates in the dash panel, replace the primary air filter element with a new one.** On average, the safety air filter element will be replaced once for every three (3) primary air filter element changes, if the primary filter hasn't been damaged due to over servicing.

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

## Daily Checks

### Checking the Restriction Sensor:

1 The air filter restriction sender wires should be visually checked daily for breaks and proper connection. (fig. C1107)

2 With the engine operating, place your hand over the air intake inlet to restrict air flow to the engine. The indicator light on the dash panel should illuminate promptly. Do not hold your hand over the air intake excessively, just long enough for the indicator light to illuminate then quickly release your hand from the intake.

**NOTE:** If the indicator light fails to function replace the restriction sender or check for shorts in the wiring circuit.

3 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.

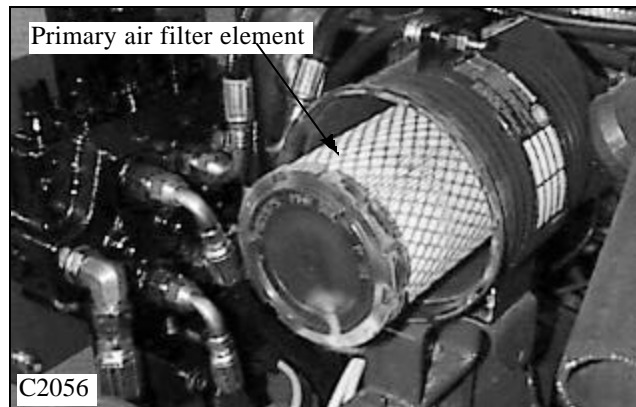
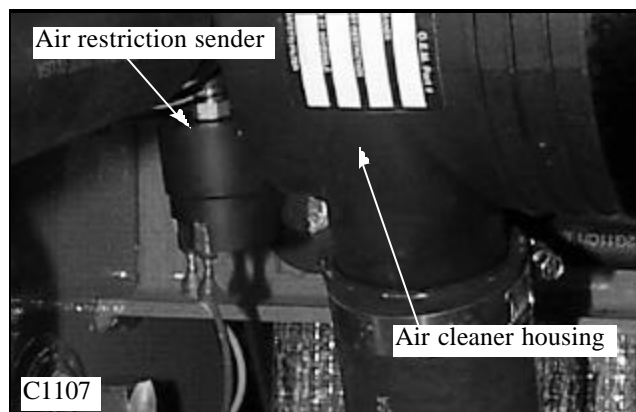
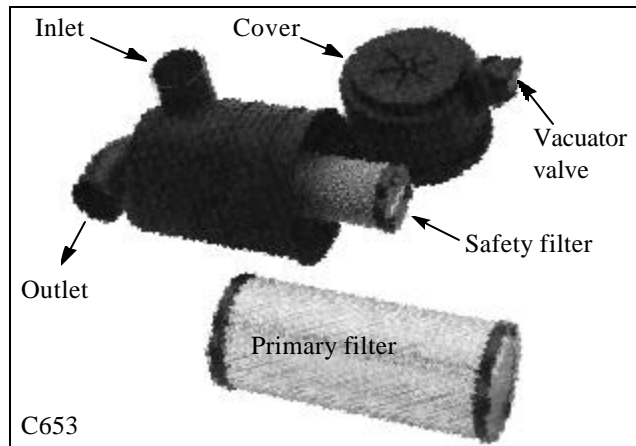
### IMPORTANT

**Air filter service recommended only when the service indicator light illuminates.**

### Servicing the Air Filter Elements:

1 Release the latches holding the air cleaner cover to the canister body. (fig. C2054)

2 Pull straight out on the primary element to remove from the air cleaner housing. (fig. C2056) 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)

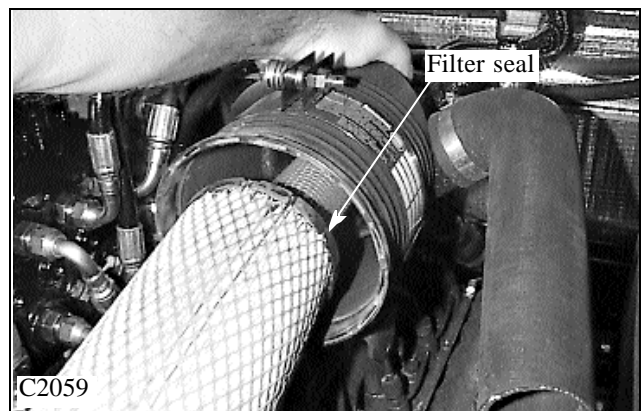
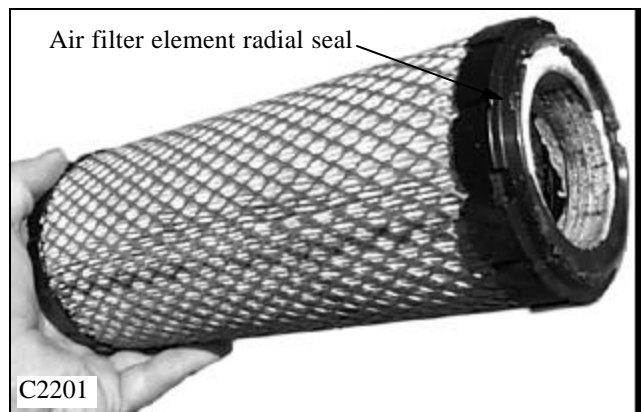
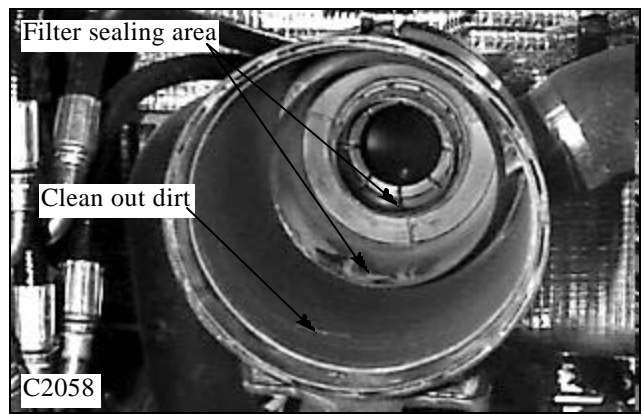
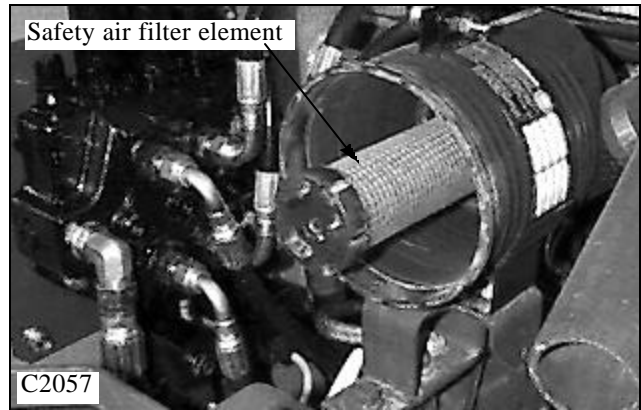
3 If required, remove the safety air filter element by pulling straight out of the air cleaner housing. (fig. C2057)

4 After removing the air filter elements, carefully wipe out any excess dirt from the air cleaner housing. (fig. C2058)

5 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.

6 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. C2059)

7 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 latches to push the air filter elements into position.**



# ENGINE MAINTENANCE 7.1

## Cooling System

### Daily Checks:

The loader is equipped with a liquid cooled diesel engine that requires daily coolant level checks and radiator service if necessary.

The cooling system should always be checked when the engine is cool.

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 compartment cover.

2 Visually inspect the radiator cooling fins for dirt or debris build up that may be blocking air flow through the radiator. (fig. C552) Blow any dirt or debris out with compressed air and / or water. Do not exceed 40 psi (2.7 kg / cm<sup>2</sup>) Any bent cooling fins should be carefully straightened to prevent core damage.

3 Visually inspect the coolant overflow tank for the proper coolant level marked on the tank. (fig. C2210) Add a 50 / 50 mixture of ethylene glycol and water as required.



### WARNING

To prevent eye injury, wear safety goggles when cleaning with compressed air



### CAUTION

To prevent radiator fin damage, do not use air pressure higher than 40 psi (2.7 kg / cm<sup>2</sup>)



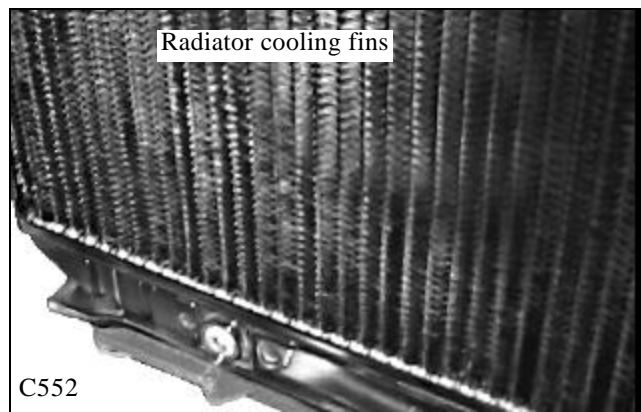
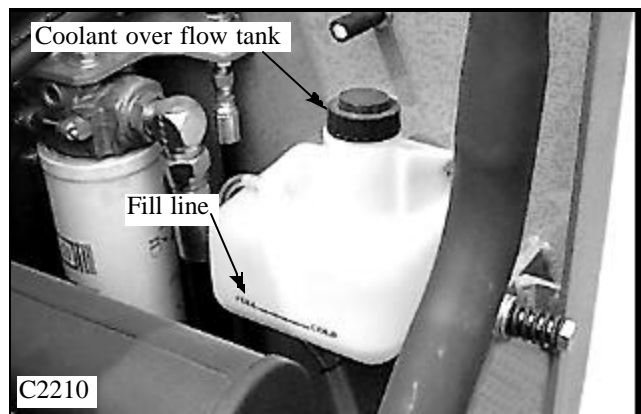
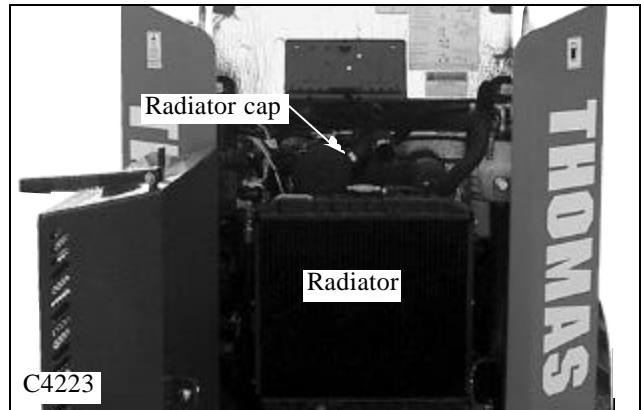
### WARNING

Do not remove the radiator cap when the engine is hot.

4 Remove the radiator cap to verify the coolant level in the radiator. If the coolant level is below the upper part of the radiator tank, and the coolant bottle is still full, then either the radiator cap is defective or there is a coolant leak in the cooling system. Perform a pressure test of the cooling system.

### Testing the Cooling System:

- 1 Ensure the radiator is full of coolant.
- 2 Start the engine operate until warm, **NOT HOT!**
- 3 Shut off the engine and carefully remove the radiator cap. Use extreme caution.



### WARNING

Always use a pre - mixed or diluted coolant to prevent engine over heating, freezing and proper water pump lubrication



# ENGINE MAINTENANCE 7.1

## Cooling System (cont'd)

4 Attach a radiator tester and increase the pressure to 12.8 psi (0.9 kg / cm<sup>2</sup>). (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 12.8 psi (0.9 kg / cm<sup>2</sup>) pressure to the radiator cap. The pressure should not drop more than 4.3 psi (0.3kg / cm<sup>2</sup>) 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

**Do not 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.

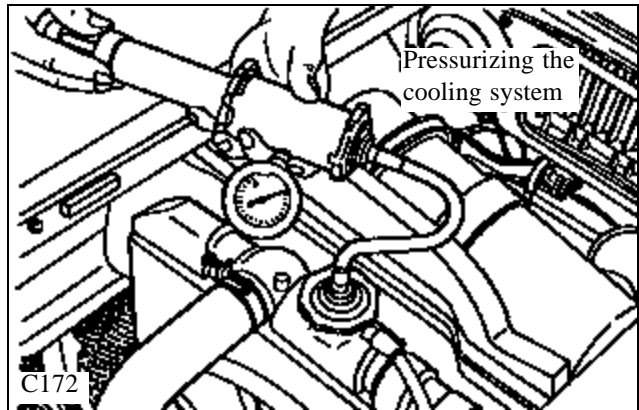
2 Remove the radiator drain plug located lower left corner of radiator. (fig. C2203) Be prepared to contain 3.2 gal (12 liters) of fluid.

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.

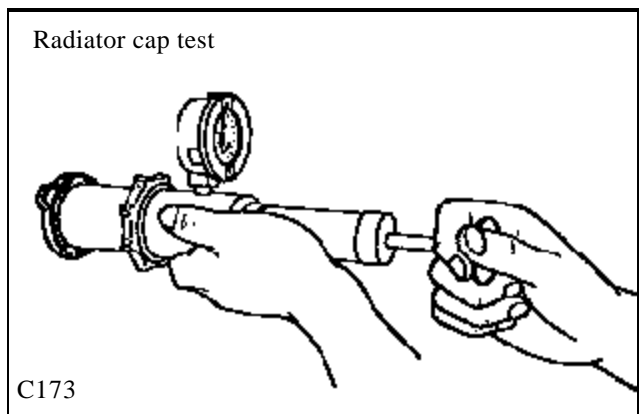
**Note:** Attaching a piece of 5 / 16" (8mm) hose to the drain petcock and routing to a container, lessens waste and fluid clean up. Please dispose of waste fluid in an environmentally friendly manner.

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.

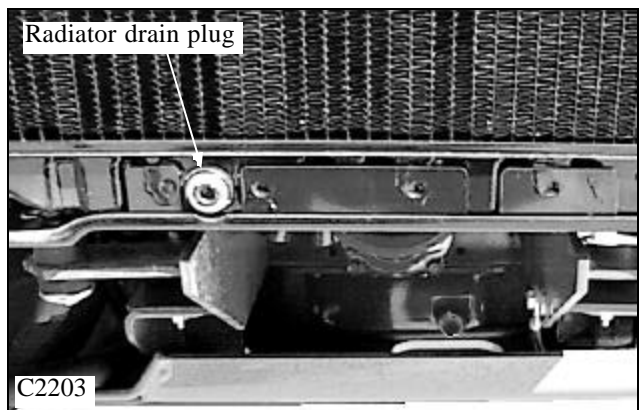
5 Pre - mix the engine coolant, ethylene glycol, to equal parts of water. (50 / 50 ratio) Add the mixed coolant to the engine radiator. The cooling system will hold approximately 3.2 gal (12 liters) of coolant for the 137 / 153 and 1.8 gal (7 liter) for the 1300 /135. Never use coolant undiluted. Pure coolant does not absorb and pass heat efficiently. It will also gel in cold weather.



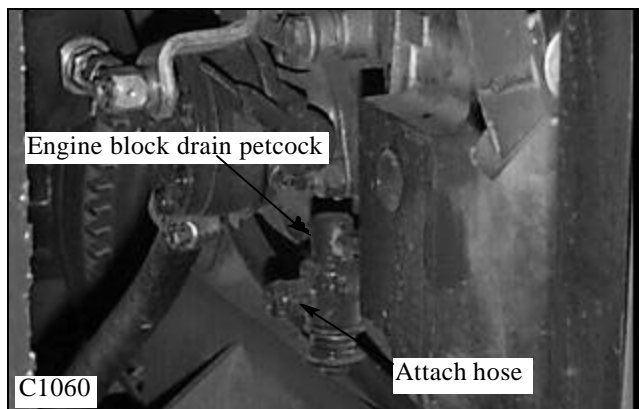
C172



C173



C2203



C1060

# MAINTENANCE 7.7

## Fan Belt Adjustment

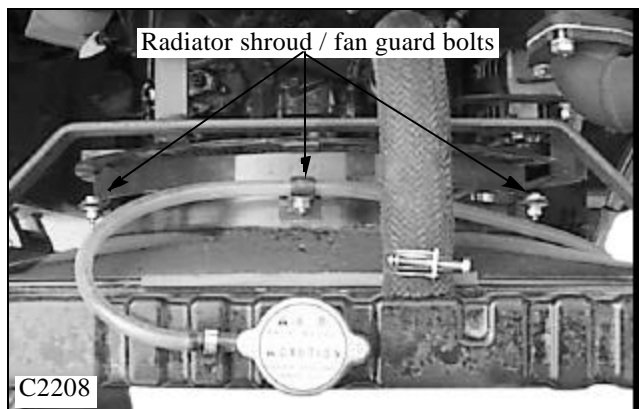
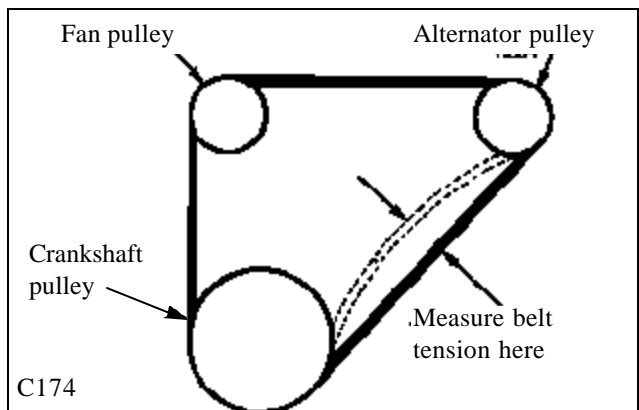
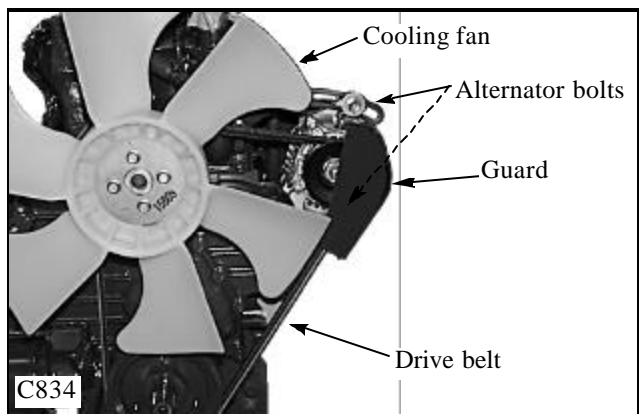
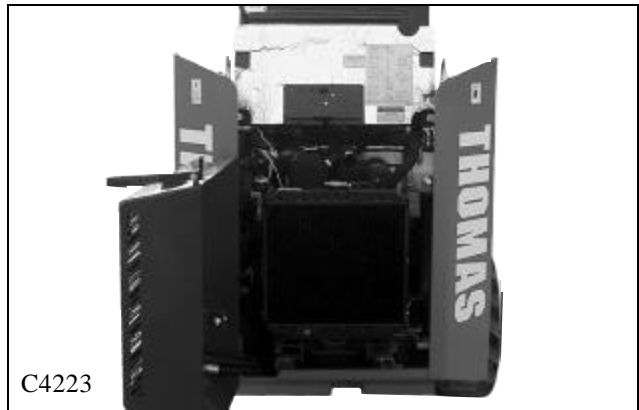
The fan (alternator) drive belt should be checked daily for tension and wear. The drive belt should be replaced promptly when fraying of the belt cords or cracks in the rubber are observed. Failure to replace the drive belt could lead to slippage or complete failure, causing the engine to over heat and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

### To Adjust the Fan 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. C4223)
- 3 Locate the drive belt. Fig. C834 shows the drive belt without the radiator obstructing the view.
- 4 Check the drive belt tension midway between the alternator and crankshaft drive pulley. (fig. C174) Correct tension is  $3/8 \sim 1/2$ " deflection @ 22 lbs force (10 ~ 12mm deflection @ 98 newtons force).

### Fan Belt Replacement:

- 1 Loosen the 2 bolts on the alternator and allow the belt tension to loosen off. (fig. C834)
- 2 Remove the bolts retaining the fan guard to the radiator shroud. (fig.C2208)
- 3 Pull the drive belt off the alternator pulley, crankshaft pulley and remove from around the fan.
- 4 Replace in reverse order and adjust belt tension as described above.



# ENGINE MAINTENANCE 7.1

## Universal Joint

The engine drive universal is located and accessed by removing the operators seat, and removing the service access cover. The universal joint should be serviced every 50 hours. Check the universal joint for wear and lubricate with a standard grade of multi purpose grease.

### To Service the U- Joint:

- 1 Remove any attachment, raise the boom arms, engage the boom supports, engage the parking brake and shut off the engine. Remove the ignition key.
- 2 Remove the seat assembly. Be sure to disconnect the electrical plug on the seat switch, left hand side.



### WARNING

**Never work under the boom arms without the boom supports engaged**

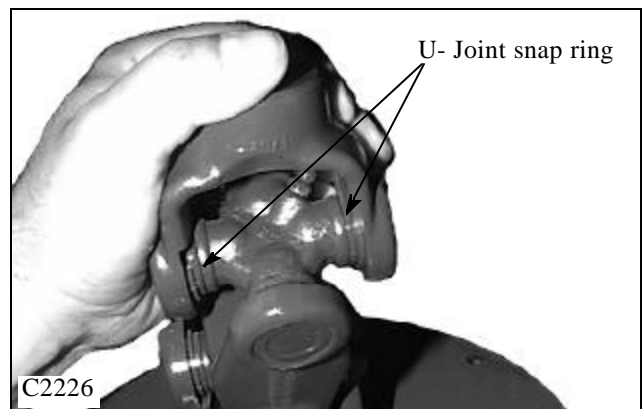
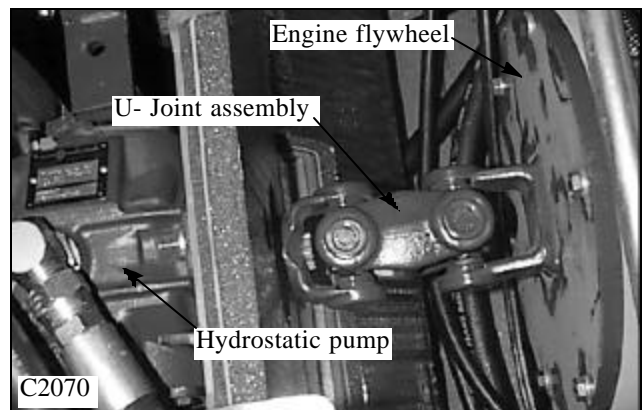
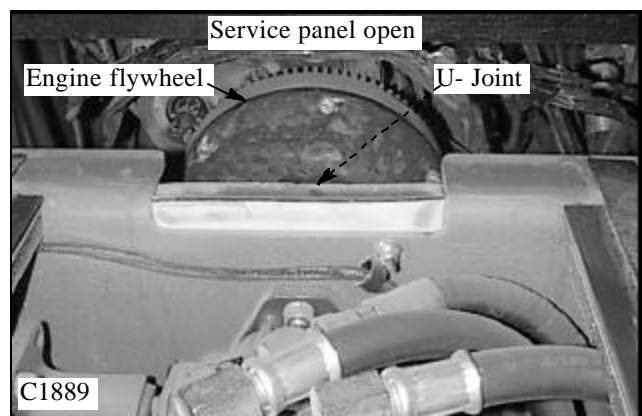
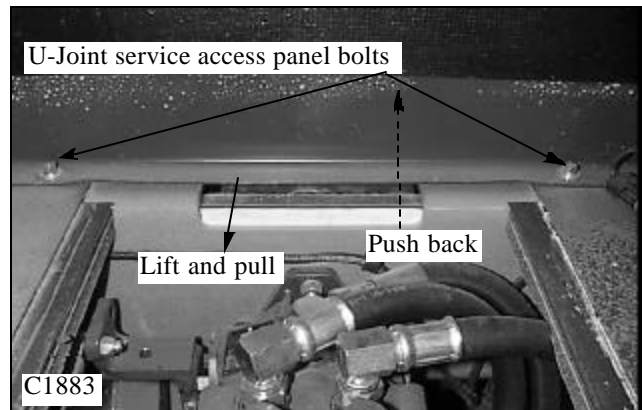
- 3 Remove the service access panel, located below the battery compartment cover, by removing the 2 bolts and pushing rearward on the top part of the cover, lifting and pulling forward from the bottom. (fig. C1883)

- 4 Grasp the U- Joint assembly with your hands and rotate the joint left and right, forward and back to check U- Joint wear.

- 5 Check the condition of the splined yoke and spline on the hydrostatic pump input shaft.

- 4 Rotate the U- Joint if necessary to locate the grease fittings on the U- Joint crosses. Apply 2 ~ 3 pumps of multi purpose grease to each U- Joint cross.

**NOTE:** Remove the U- Joint assembly from the loader to replace worn U- Joints. (fig. C2226) The U- Joints are retained by internal snap ring clips. Loosen the engine mounting isolators to move the engine rearward enough to allow the engine U-joint to come off the hydraulic tandem pump splined shaft.



# 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 0.0071 ~ 0.0087 in (0.18 ~ 0.22mm).**

### 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.



### WARNING

**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 0.0071 ~ 0.0087 in (0.18 ~ 0.22mm).**

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.

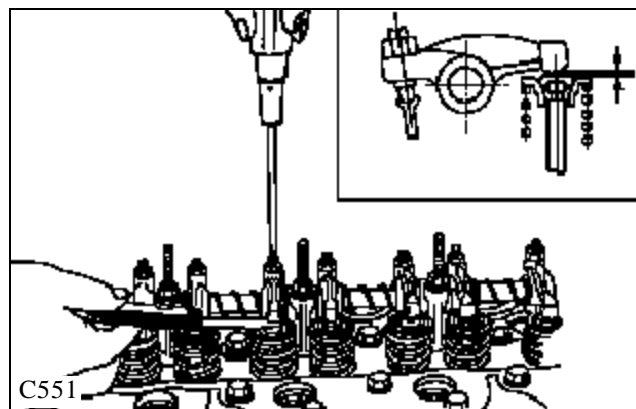
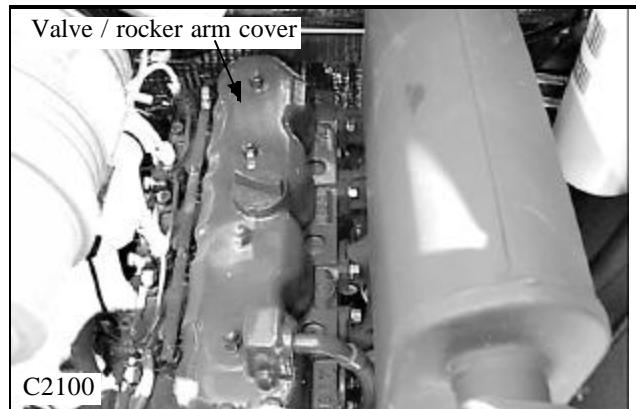
**Correct valve clearance is 0.0071 ~ 0.0087 in (0.18 ~ 0.22mm).**

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 0.0071 ~ 0.0087 in (0.18 ~ 0.22mm).**

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 5.1 ~ 6.6 ft lbs (6.9 ~ 8.8 Nm).



7

**CYLINDER HEAD 7.2 (NOTES)**



**7**

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.

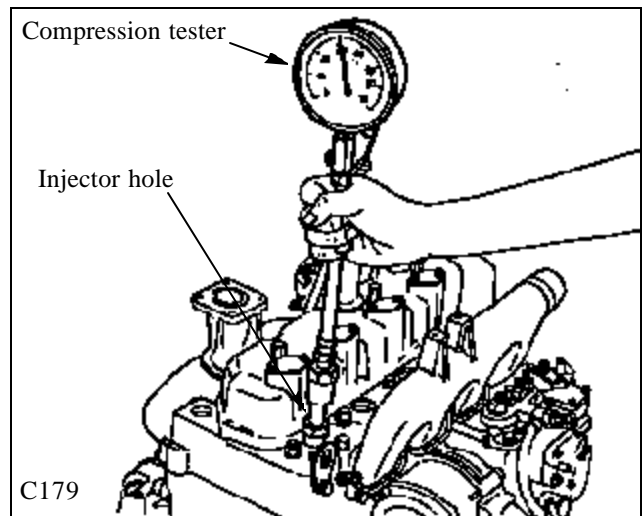
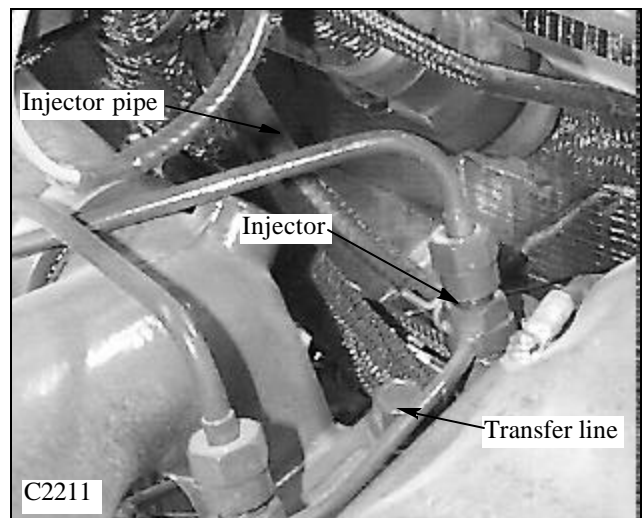
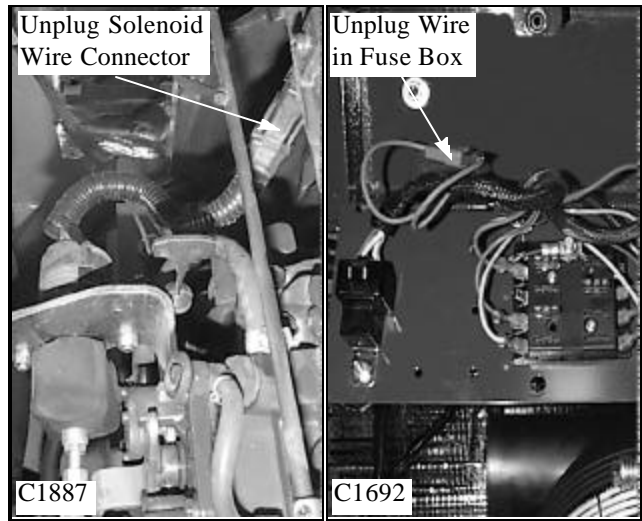
**Before performing a compression test, be sure the battery is fully charged and valve clearances are correctly adjusted. See page 7-12. Be sure the air cleaner and exhaust systems are free of obstructions, to prevent a false or low reading**

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. C1887)(fig. C1692) 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 and 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, pg. 7-24, Engine Specifications.

continued...



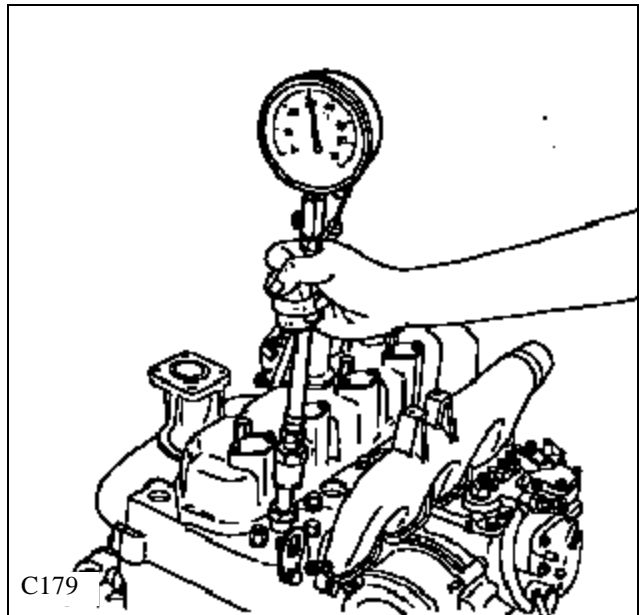
7

## 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

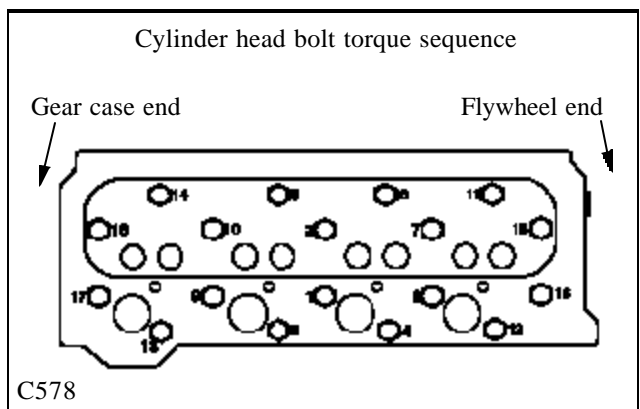
After replacement of the engine cylinder head, the proper bolt torquing sequence must be followed. (fig. C578)

Torque the bolts in 3 separate steps, increasing tightness to the specified 68.7 ~ 72.3 ft lbs (93.1 ~ 98 Nm).

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 retorque the cylinder head bolts.

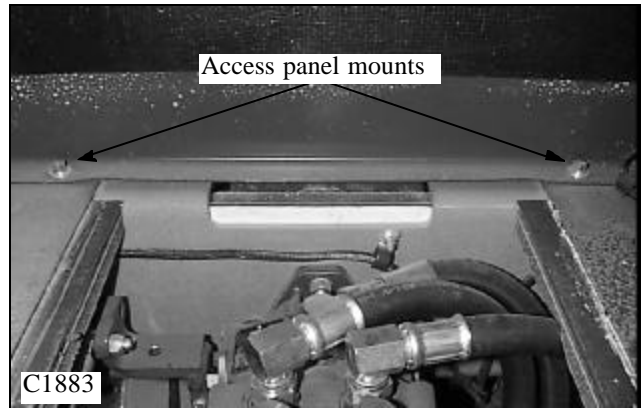


C578

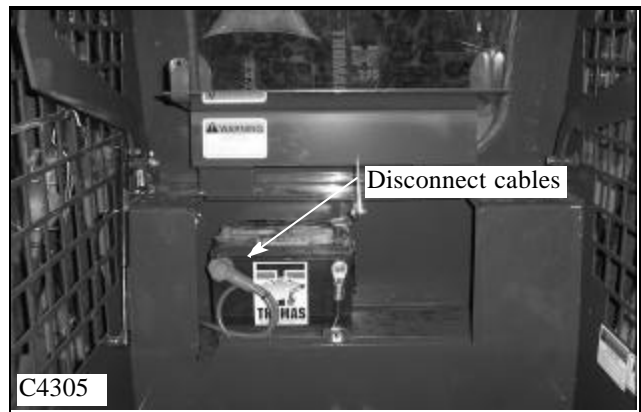
# ENGINE REPLACEMENT 7.3

## Removal

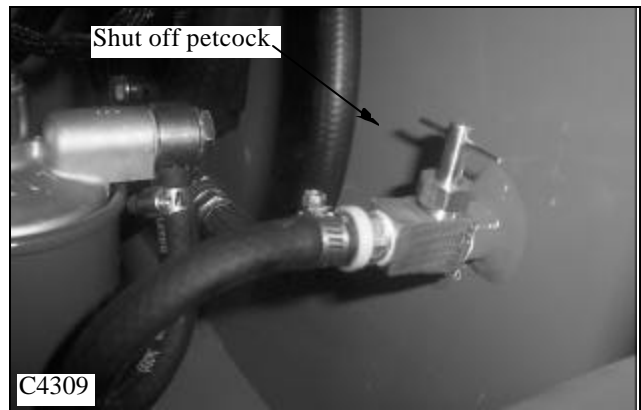
- 1 Move the loader to a level surface. Raise the boom arms, engage the boom supports, apply the parking brake, shut off the engine and remove the ignition key.
- 2 Remove the seat, hydrostatic shield and U- Joint service access panel. (fig. C1883)



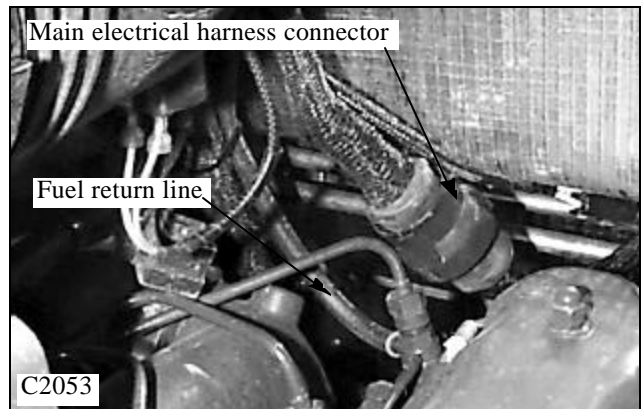
- 3 Access the battery compartment and disconnect the battery cables from the battery terminals. ( fig. C4305, Ground cable first)



- 4 Shut off the fuel petcock located at the bottom of the right hand fuel tank, inside the engine compartment.
- 5 Loosen the fuel line clamp and disconnect the fuel line.



- 6 Disconnect the fuel return line from the behind the rear fuel injector. (fig. C2053) Disconnect the main Engine harness / ROPS harness plug connector.
- 7 Drain the engine oil and coolant. See Section 7.1 Lubrication system and Cooling System.



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# ENGINE REPLACEMENT 7.3

## Removal (cont'd)

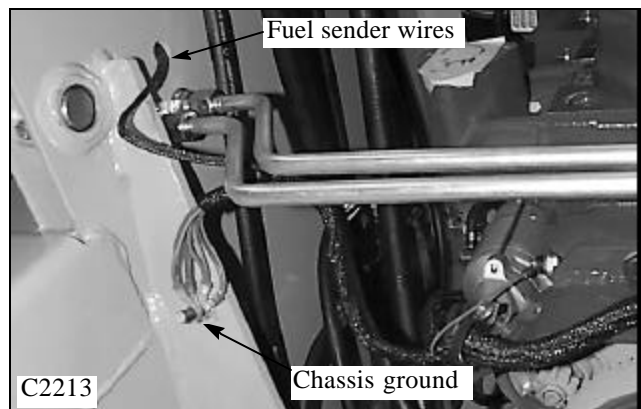
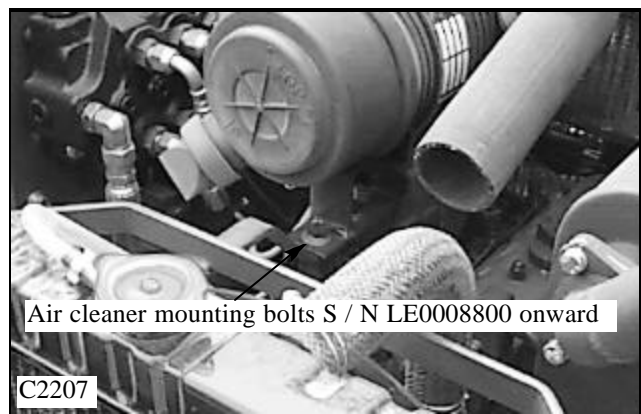
8 Disconnect the air filter sensor wires located at the rear of the air cleaner canister. Loader S / N's LE008500 ~ 8799 will need to have the compartment cover / air cleaner assembly removed. (fig. C1055)

9 Remove the exhaust system from the loader. Cover or plug any open exhaust ports to the engine.

11 Remove the air cleaner canister assembly. (fig. C2207) S / N LE0008800 onward shown. Plug or cover any open air lines to prevent contamination.

10 Disconnect the hoses going to the coolant over flow tank, or remove the bolts holding the tank to the loader frame. (fig. C2210)

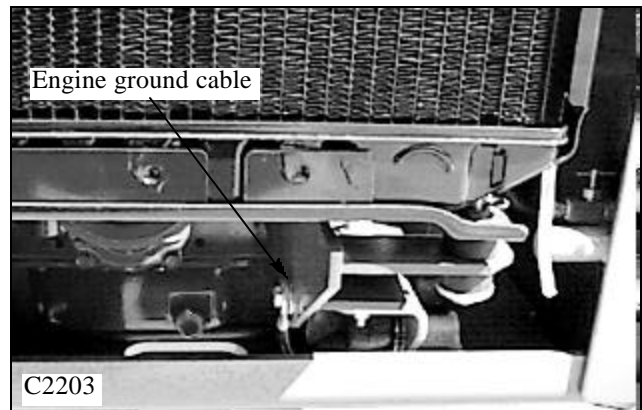
12 Remove the ground wires from the chassis ground bolt. (fig. C2213) Disconnect the wires going to the fuel level sender in the fuel tank.



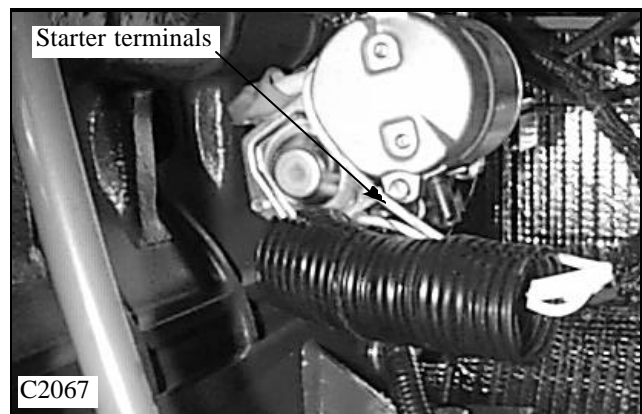
# ENGINE REPLACEMENT 7.3

## Removal (cont'd)

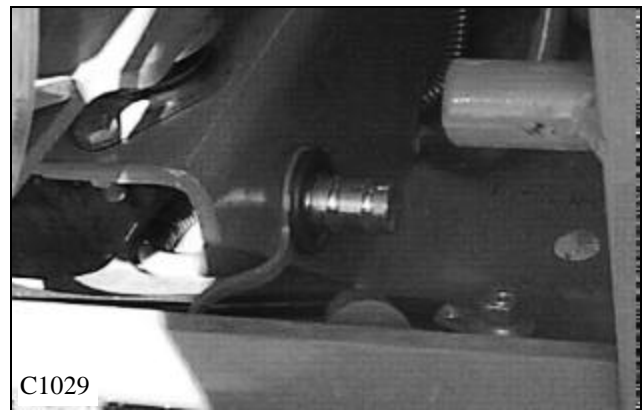
13 Disconnect the ground straps (cables) mounted from the engine to the loader frame. (fig. C2203)



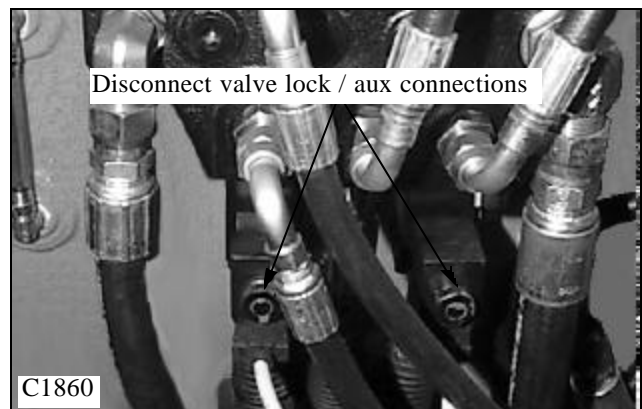
14 Disconnect the engine starter cable coming from the positive terminal of the battery. (fig. C2067)



15 Disconnect the electrical cable from the boosting lug terminal. (fig. C1029)



16 Disconnect the hydraulic control valve electrical connections. (fig. C1860) Tag the connections for location to prevent mixing up upon engine replacement.

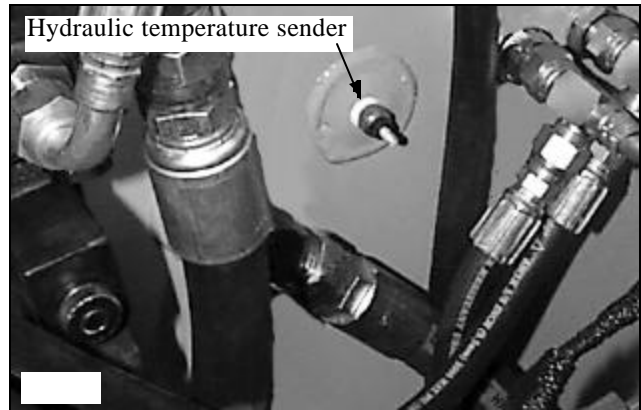


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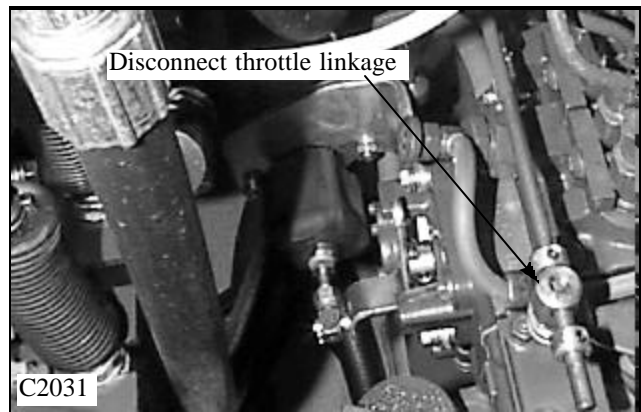
# ENGINE REPLACEMENT 7.3

## Removal (cont'd)

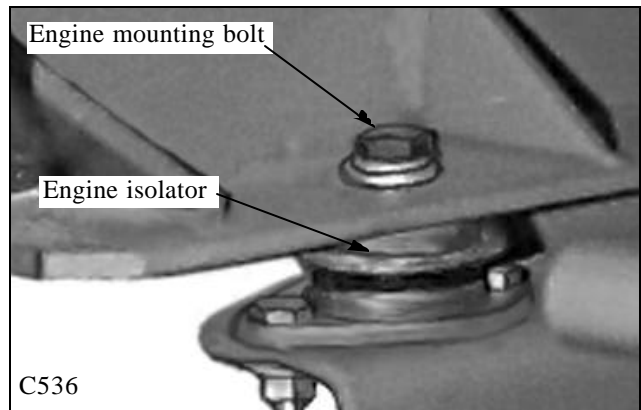
17 Disconnect the hydraulic oil temperature sender located on the left hand oil tank, inside the engine compartment.



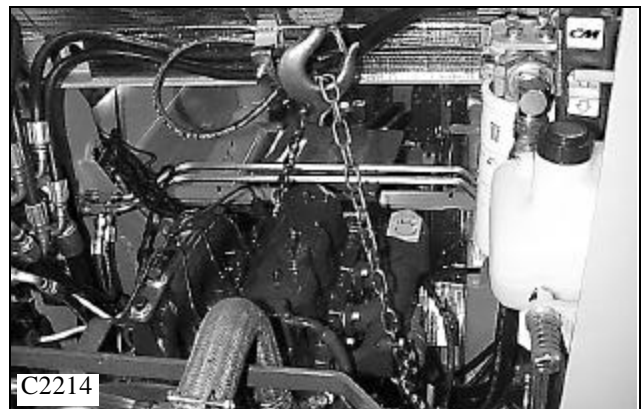
18 Disconnect the throttle linkage. (fig. C2031)



19 Remove the 4 bolts retaining the engine to its rubber composite mounting isolators. (fig. C536)



20 Using a suitable lift point, raise the engine slightly and pull rearward slowly. (fig. C2214) Check frequently for wires or hoses that may still be connected or tied to the engine and frame. Remove the engine.



### CAUTION

Use a chain size of 3/8" grade 40 minimum when replacing the engine

# ENGINE REPLACEMENT 7.3

## Installation

If the engine is being replaced with a new assembly, the engine will require some preparation.

1 Remove the protective rust preventative coating from the flywheel. Use a solvent to remove. The flywheel must be cleaned to the surface metal.

2 Install the engine U- Joint adapter. (fig. C2216) There are 6 bolts holding the adapter to the engine flywheel. Note that 2 of the bolts are longer than the rest. These 2 bolts must be used in the counter sunk holes in the engine flywheel. Torque the adapter bolts 20 ft lbs. (27.2 Nm)

3 Install the flywheel shield to the rear of the engine block. (fig. C2216)

4 Paint must be removed from the engine block where the engine ground strap is attach to the front of the engine. This will provide proper grounding of the engine with the loader chassis. (fig. C2217)

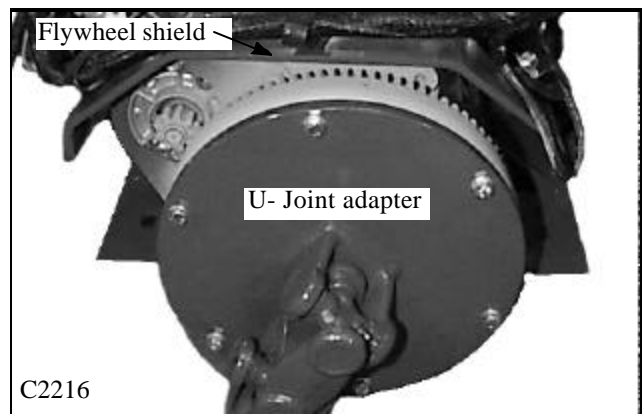
5 Install the engine mounts. Apply Loctite 242 (blue) to the threads of the mounting bolts. Torque the mounting bolts to 80 ft lbs. (108.8 Nm).

6 Install the engine temperature sender.

7 Install the engine shut off solenoid. See Section 7.3 for special installation instructions of the engine stop solenoid.



C2215



C2216

### IMPORTANT

**The engine shut off solenoid requires proper adjustment. Improper adjustment will lead to premature solenoid failure.**

8 Install the engine wire harness.

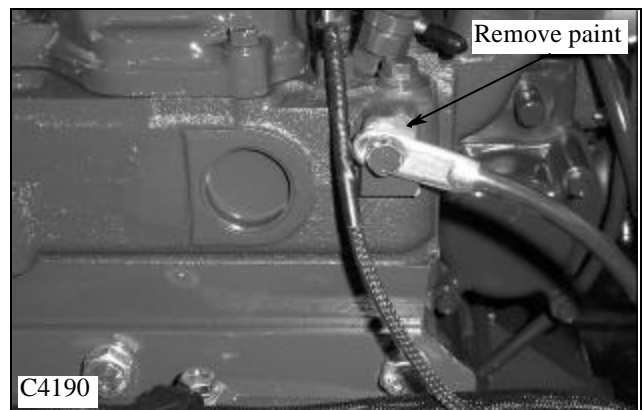
9 Install the radiator to the engine mounts and install the radiator hoses.

10 Install the fan guard to the radiator shroud.

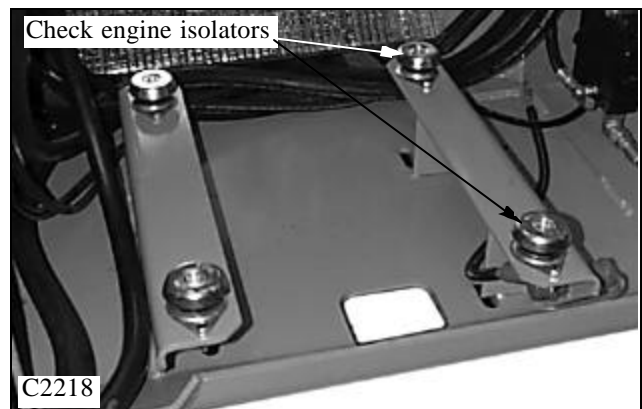
11 Install the upper radiator mounting bracket.

12 Add engine oil and coolant.

13 Check the engine mounting isolators in the loader frame. (fig. C2218) Make sure the isolators are not separating or the rubber is deteriorated in any way. Replace engine isolators as required.



C4190



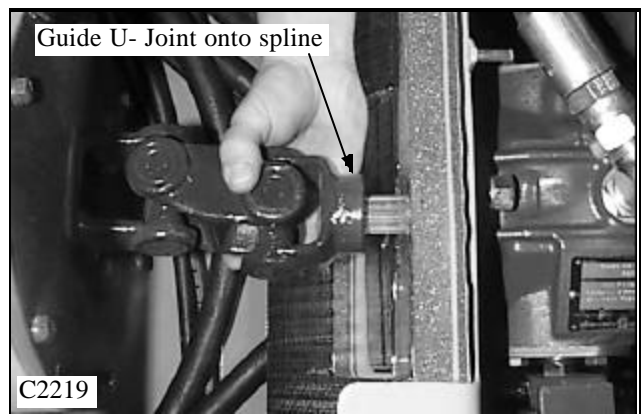
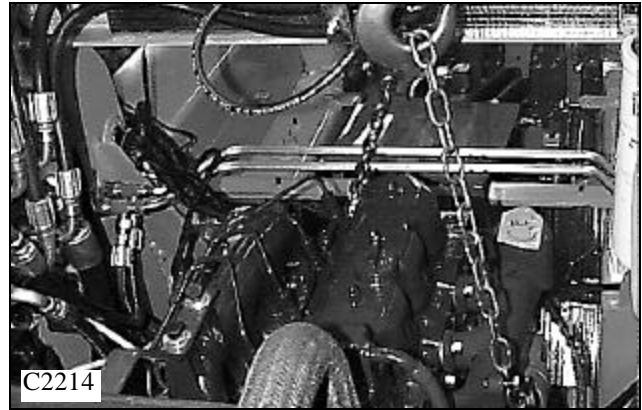
C2218

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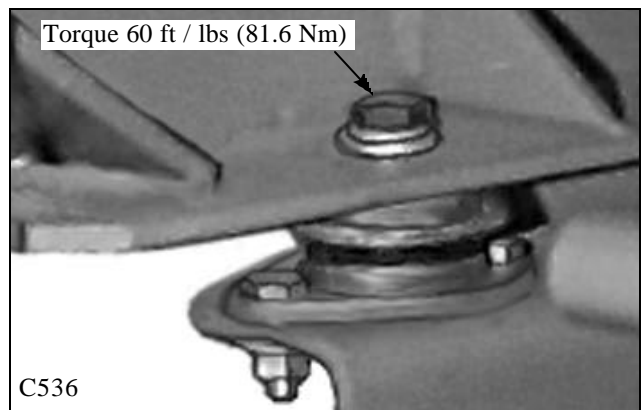
# ENGINE REPLACEMENT 7.3

## Installation

14 Install the engine to the loader. (fig. C2214) Have a helper inside the cab to line up the engine U- Joint to the hydrostatic pump input shaft. (fig. C2219) Align the engine U-Joint in a straight line with the hydrostatic pump. Failure to align the U- Joint properly will cause premature U- Joint failure.



- 15 Install the engine mounting bolts to the isolators. Torque the bolts to 60 ft lbs. (81.6 Nm).(fig. C536)
- 16 Connect the various electrical connections, routing wires carefully to prevent chaffing. Tie the wires with Zip ties as required. Be sure all ground point are clean.
- 17 Install the intake and exhaust systems.



- 18 Install the coolant over flow tank and hoses. (fig. C2222)
- 19 Connect the fuel supply and turn on the fuel tank petcock.
- 20 Bleed the air from the fuel lines.
- 20 Check the engine oil and coolant level.
- 21 Check again for any loose wires that may be dangling free.
- 22 Test fire the engine.
- 23 Check the oil cooler shroud to make sure presses against the engine radiator. See section 1-6.

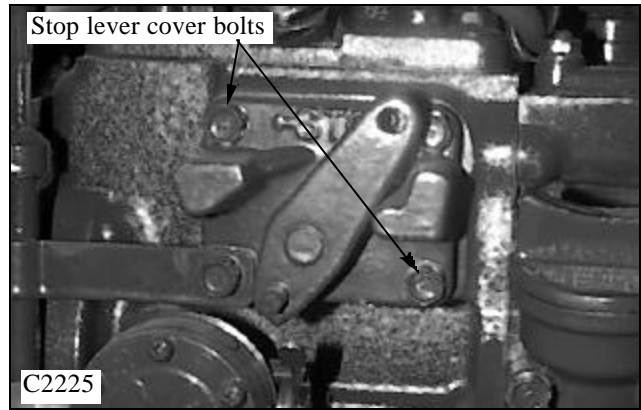


# ENGINE REPLACEMENT 7.3

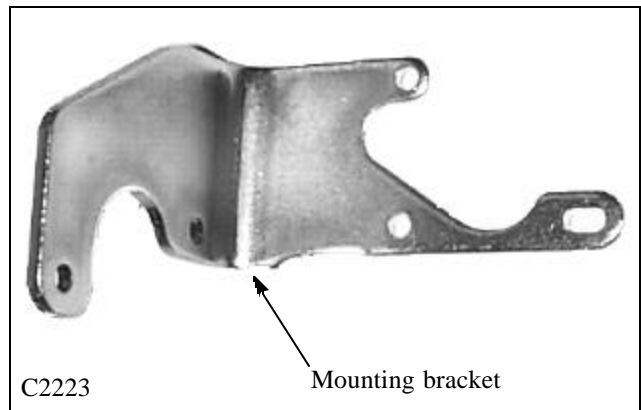
## Stop Solenoid

The engine stop solenoid requires special attention when replacing. If not properly adjusted, the stop solenoid will fail prematurely.

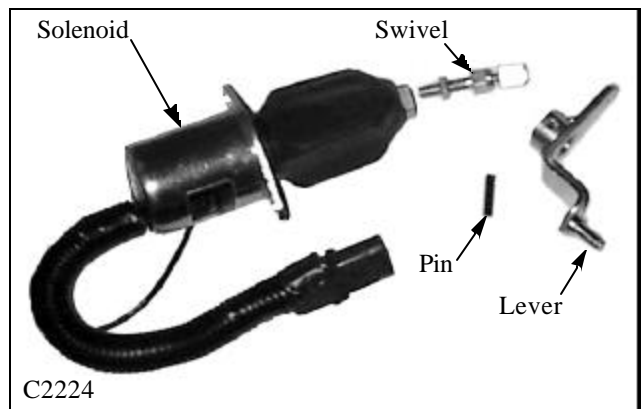
- 1 Remove the 4 bolts retaining the engine stop cover and lever assembly. (fig. C2225) Remove the cover.
- 2 Knock out the roll pin retaining the stop lever to the stop cover.
- 3 Replace the stop lever with the new stop lever and roll pin provided in the stop solenoid kit. (fig. C2275) Attach the stop lever so the end with the protruding pin is on the bottom of the stop cover as installed to the engine.
- 4 Replace the stop cover to the engine using the new gasket provided in the stop solenoid kit.



- 5 Using the washers and bolts provided in the kit, attach the solenoid mounting bracket and stop cover to the engine. (fig. C2223, C2276) Flat washers are provided to space the solenoid mounting bracket away from the stop cover and provide a "square" and level point for the stop solenoid to mount. Do not bend the mounting bracket to fit.



- 6 Install the jam nut and lock washer to the swivel, and screw the swivel into the solenoid. (fig. C2224)



7

# ENGINE REPLACEMENT 7.3

## Stop Solenoid (cont'd)

7 Attach the stop solenoid to the shut off lever making sure the cable tie around the solenoid dust boot is facing down, away from the mounting bracket. (fig. C2277) Failure to do so may cause the solenoid to bind and fail prematurely. Use the cotter pin provided to secure the solenoid to the stop lever.

### IMPORTANT

**The boot cable tie clamp must face away from the mounting bracket to prevent binding**

8 Bolt the stop solenoid to the mounting bracket. (fig. C2220)

9 Pull the stop lever and solenoid by hand to initially adjust the clearance between the stop lever and the stop cover lever limiter. (fig. C2221) Adjust stop lever clearance to 1 / 16 in. (1.5mm) by turning the swivel.

10 Plug in the solenoid connector to the engine electrical harness.

11 Turn on the ignition key but do not start the engine.

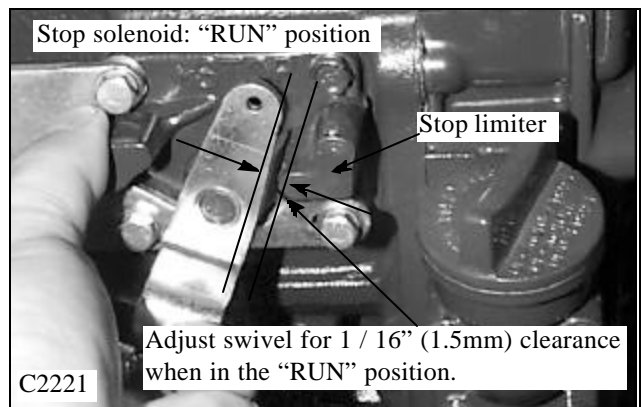
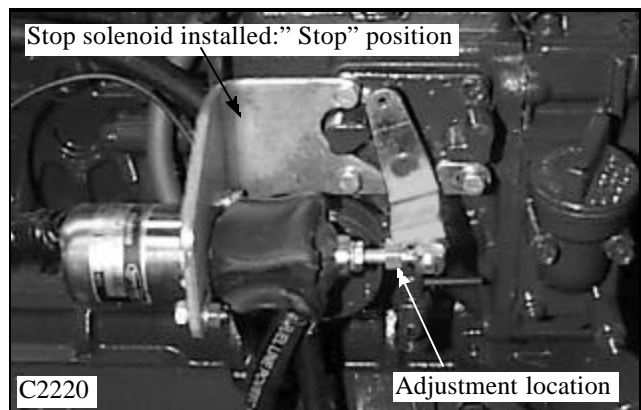
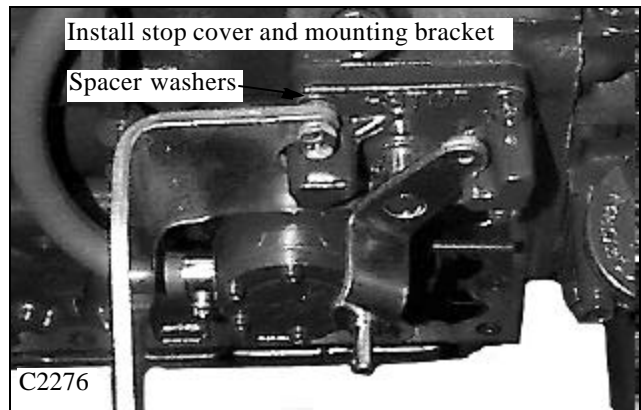
12 Manually push the stop solenoid to the run position. Check for smooth engagement, no binding should occur. The solenoid must remain in the "RUN" position now, without holding by hand.

13 Check the stop lever clearance again as the solenoid is engaged. Adjust to 1 / 16 in. (1.5mm).

14 Apply Loctite 242 (blue) to the swivel and jam nut and turn the jam nut against the end of the solenoid plunger. Be sure to support the solenoid as the jam nut is tightened.

### IMPORTANT

**To prevent premature failure of the engine stop solenoid, follow the recommended starting procedure. Maximum energizing of the pull coil must not exceed three 30 second cranking attempts with 2 minutes rest between each attempt. After the third 30 second cranking attempt, the stop solenoid must be allowed to cool to ambient 77 ° F (25 ° C) before further cranking attempts.**



7

# ENGINE SPECIFICATIONS 153 7.4

Make and model .....	Kubota V2203
Type.....	Vertical , In Line, 4 Cycle
Number of cylinders.....	4
Displacement .....	134.08 cu in (2197cc)
Cylinder bore.....	3.43 inches (87 mm)
Allowable limit: 3.4252 ~ 3.432 inches (87 ~ 87.037mm).	
Stroke.....	3.64 inches (92.4 mm)
Maximum engine speed (no load) .....	2950 rpm
Low idle setting.....	1300 rpm
Cooling system .....	Liquid
Cold starting aid.....	Glow plug in combustion chamber
Horsepower (Gross).....	50 @ 2800 rpm
Power (ISO 9249 Net Power).....	34.3 kW (46 hp) @ 2800 rpm
Power (ISO 9249 Net Power) CE.....	33.8 kW (45.3 hp) @ 2600 rpm
Max Torque.....	115 ft lbs (15.9 kg/m)
Compression ratio .....	23.0: 1
Engine compression.....	427 - 469 psi (30 - 33 kgf / cm <sup>2</sup> )
.....	Service limit: 355 psi (26 kgf / cm <sup>3</sup> ) 10 % variance among cylinders
Firing order (viewed from gear case end) .....	1 - 3 - 4 - 2
Fuel injection pump.....	Bosch type mini pump (PFR 4M)
Fuel injection timing.....	18° BTDC (0.314 rad)
Injector working pressure .....	1990 - 2133 psi (140 - 150 kgf / cm <sup>3</sup> )
Direction of rotation (viewed from flywheel end) .....	Counter - clockwise
Location of timing marks .....	N / A
Valve clearance, (cold).....	0.0071 - 0.0087 in (0.18 - 0.22 mm)
Valve seat angle.....	Intake 1.047 rad (60°)
.....	Exhaust 0.785 rad (45°)
Valve seat width .....	Intake 0.0835 in (2.12mm)
.....	Exhaust 0.0835 in (2.12mm)
Valve face angle .....	Intake 1.047 rad (60°)
.....	Exhaust 0.785 Rad (45°)
Valve recessing .....	Protrusion 0.0020 in (0.05mm)
.....	Recess 0.0059 in (0.15mm)
Fuel type .....	Diesel No. 2
Fuel filter .....	Single spin on type
Air cleaner.....	Dual dry cartridge elements (primary and secondary) with restriction indicator
Oil filter .....	Single spin on type
Engine oil pressure.....	@ Idle speed 14 psi (98 kPa) minimum
.....	@ Rated speed 42.7 psi (294 kPa) minimum
Oil pressure switch .....	Closes @ 7 psi (49 kPa)
Engine oil capacity with filter.....	8. 5 qts (8 liters).
Oil type.....	10W30 API CF
Cooling system capacity .....	3.2 gal (14.5 liters).
Radiator cap pressure setting.....	12. 8 psi (88kPa)
Thermostat rating .....	Fully open 185°F (85°C)

**For complete engine service repair manual: Order P / N 97897-0109-5 from your nearest Kubota dealer, or order P / N 40916 from your local Thomas dealer.**



# ENGINE SPECIFICATIONS 137/135/1300 7.4

Make and model .....	Kubota V1903E
Type .....	Vertical , In Line, 4 Cycle
Number of cylinders.....	4
Displacement .....	113.3 cu in (1857cc)
Cylinder bore.....	3.15 inches (80 mm)
Allowable limit: 3.1496 ~ 3.1563 inches (80 ~ 80.034 mm).	
Stroke.....	3.64 inches (92.4 mm)
Maximum engine speed (no load) .....	2950 rpm
Low idle setting.....	1300 rpm
Cooling system .....	Liquid
Cold starting aid.....	Glow plug in combustion chamber
Horsepower (Gross).....	42 @ 2800 rpm
Power (ISO 9249 Net Power) .....	29.1 kW (39 hp) @ 2800 rpm
Power (ISO 9249 Net Power) CE.....	28.9 kW (38.8 hp) @ 2600 rpm
Max Torque .....	96 ft.lbs (13.25 kg/m)
Compression ratio .....	23.0: 1
Engine compression.....	512 - 540 psi (36 - 38 kgf / cm <sup>2</sup> )
.....	Service limit: 355 psi (26 kgf / cm <sup>3</sup> ) 10 % variance among cylinders
Firing order (viewed from gear case end).....	1 - 3 - 4 - 2
Fuel injection pump .....	Bosch type mini pump (PFR 4M)
Fuel injection timing.....	18° BTDC (0.314 rad)
Injector working pressure .....	1990 - 2133 psi (140 - 150 kgf / cm <sup>2</sup> )
Direction of rotation (viewed from flywheel end) .....	Counter - clockwise
Location of timing marks .....	N / A
Valve clearance, (cold) .....	0.0071 - 0.0087 in (0.18 - 0.22 mm)
Valve seat angle .....	Intake 1.047 rad (60°)
.....	Exhaust 0.785 rad (45°)
Valve seat width.....	Intake 0.0835 in (2.12mm)
.....	Exhaust 0.0835 in (2.12mm)
Valve face angle .....	Intake 1.047 rad (60°)
.....	Exhaust 0.785 rad (45°)
Valve recessing.....	Protrusion 0.0020 in (0.05mm)
.....	Recess 0.0059 in (0.15mm)
Fuel type .....	Diesel No.2
Fuel filter .....	Single spin on type
Air cleaner .....	Dual dry cartridge elements (primary and secondary) with restriction indicator
Oil filter .....	Single spin on type
Engine oil pressure .....	@ Idle speed 14 psi (98 kPa) minimum
.....	@ Rated speed 42.7 psi (294 kPa) minimum
Oil pressure switch.....	Closes @ 7 psi (49 Kpa)
Engine oil capacity with filter .....	8. 5 qts (8 liters)
Oil type .....	10W30 API CF
Cooling system capacity .....	1.8 gal (7 liters)
Radiator cap pressure setting .....	12.8 psi (88 kPa)
Thermostat rating .....	Fully open 185°F (85°C)

**For complete engine service repair manual: Order P / N 97897-0109-5 from your nearest Kubota dealer, or order P / N 40916 from your local Thomas dealer.**



# 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	Clean or change
	Air cleaner clogged	Clean or change
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

7

# 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	

