JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Compact Utility Tractor
790

TM2088 DECEMBER 2002

TECHNICAL MANUAL



JOHN DEERE

North American Version
Litho in U.S.A.

INTRODUCTION

Safety

Specifications and Information

Engine

Electrical

Power Train

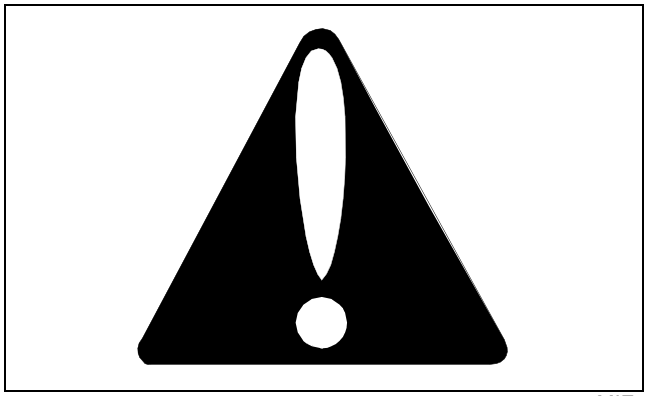
Hydraulics

Steering

Brakes

Miscellaneous

Recognize Safety Information



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This is the safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

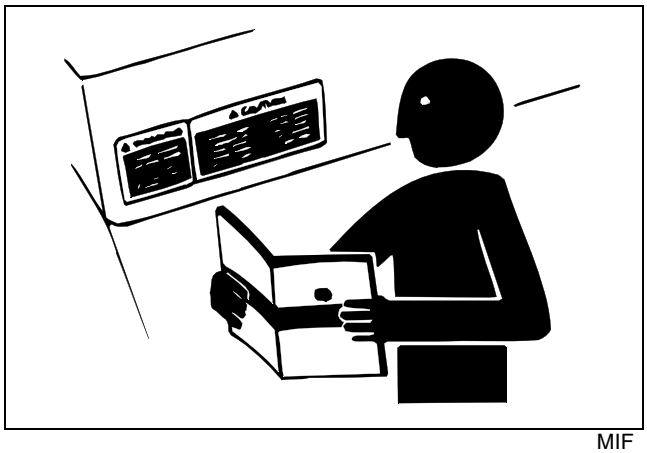
Follow recommended precautions and safe servicing practices.

Understand Signal Words

A signal word - DANGER, WARNING, or CAUTION - is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

Replace Safety Signs

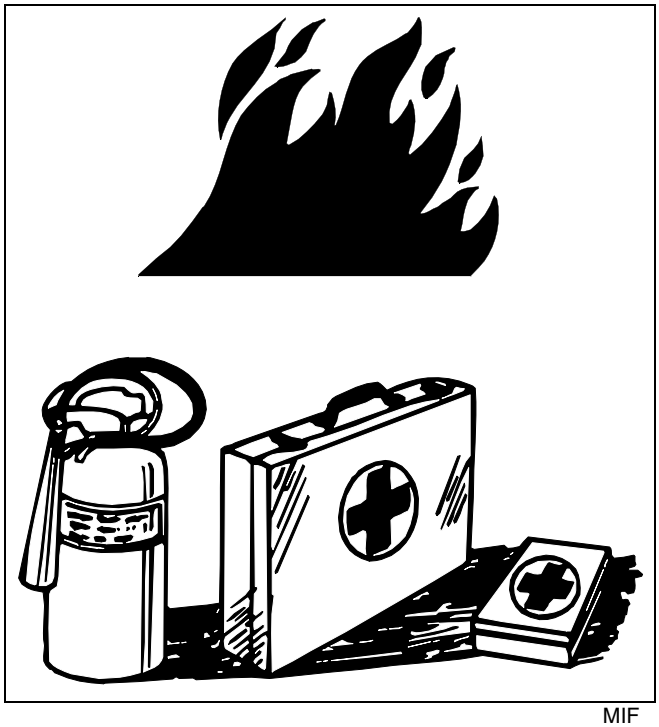


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Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

Handle Fluids Safely - Avoid Fires

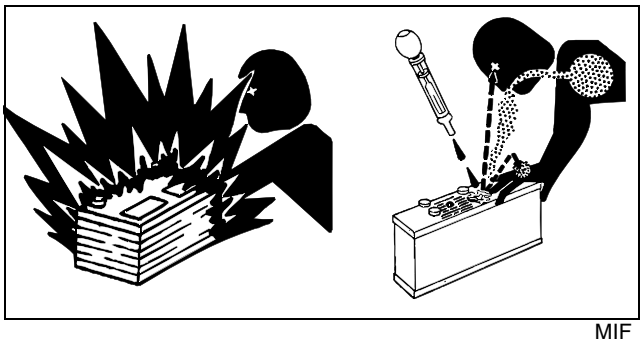
Be Prepared For Emergencies



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- When you work around fuel, do not smoke or work near heaters or other fire hazards.
- Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.
- Make sure machine is clean of trash, grease, and debris.
- Do not store oily rags; they can ignite and burn spontaneously.
- Be prepared if a fire starts.
- Keep a first aid kit and fire extinguisher handy.
- Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

Use Care In Handling and Servicing Batteries



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Prevent Battery Explosions

- Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.
- Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.
- Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

Prevent Acid Burns

- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid acid burns by:

1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

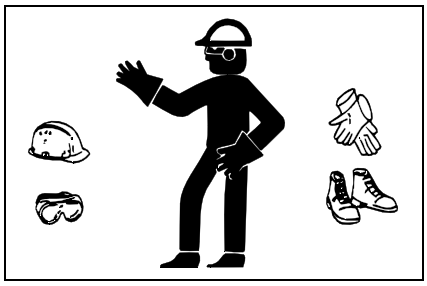
If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10 - 15 minutes.
4. Get medical attention immediately.

If acid is swallowed:

1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.

Wear Protective Clothing



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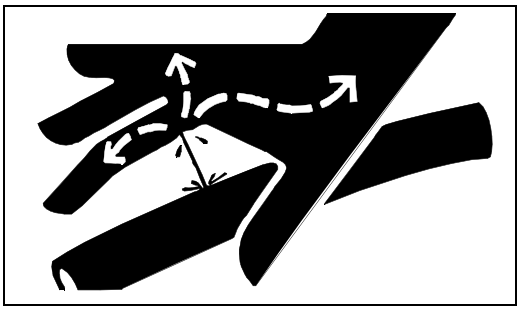
Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

Use Care Around High-pressure Fluid Lines

Avoid High-Pressure Fluids



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Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid injury from escaping fluid under pressure by stopping the engine and relieving pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

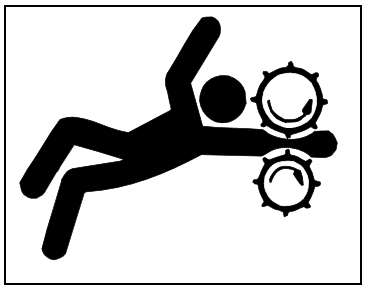
Avoid Heating Near Pressurized Fluid Lines



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Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.

Service Machines Safely



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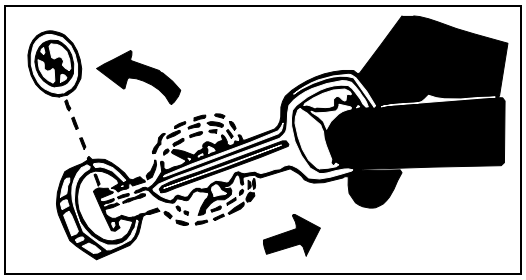
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards. Use power tools only to loosen threaded parts and fasteners. For loosening and tightening hardware, use the correct size tools. **DO NOT** use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches. Use only service parts meeting John Deere specifications.

Park Machine Safely

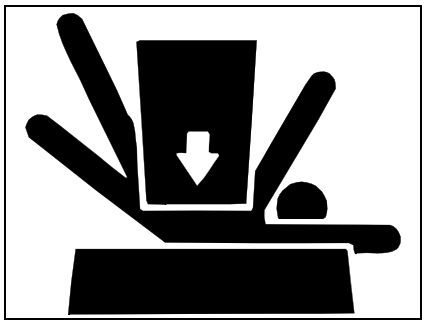


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Before working on the machine:

1. Lower all equipment to the ground.
2. Stop the engine and remove the key.
3. Disconnect the battery ground strap.
4. Hang a “DO NOT OPERATE” tag in operator station.

Support Machine Properly and Use Proper Lifting Equipment



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If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

Lifting heavy components incorrectly can cause severe injury or machine damage. Follow recommended procedure for removal and installation of components in the manual.

Work In Clean Area

Before starting a job:

1. Clean work area and machine.
2. Make sure you have all necessary tools to do your job.
3. Have the right parts on hand.
4. Read all instructions thoroughly; do not attempt shortcuts.

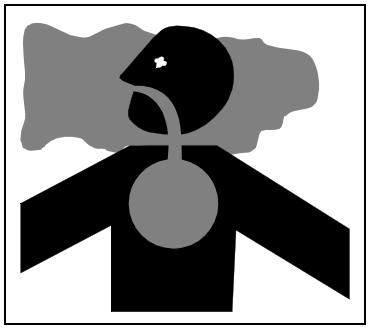
Using High Pressure Washers

Directing pressurized water at electronic/electrical components or connectors, bearings, hydraulic seals, fuel injection pumps or other sensitive parts and components may cause product malfunctions. Reduce pressure and spray at a 45 to 90 degree angle.

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

Work In Ventilated Area



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Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

Warning: California Proposition 65 Warning

Gasoline engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly. Remove paint before welding or heating: If you sand or grind paint, avoid breathing the dust. Wear an approved respirator. If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

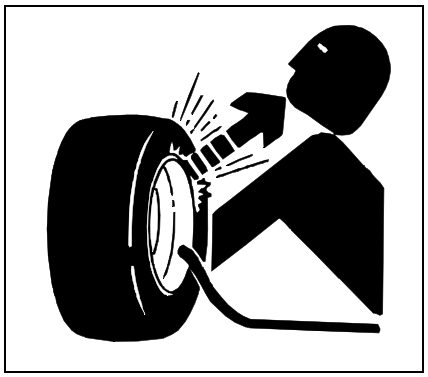
Avoid Harmful Asbestos Dust

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos. Keep bystanders away from the area.

Service Tires Safely



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Explosive separation of a tire and rim parts can cause serious injury or death.

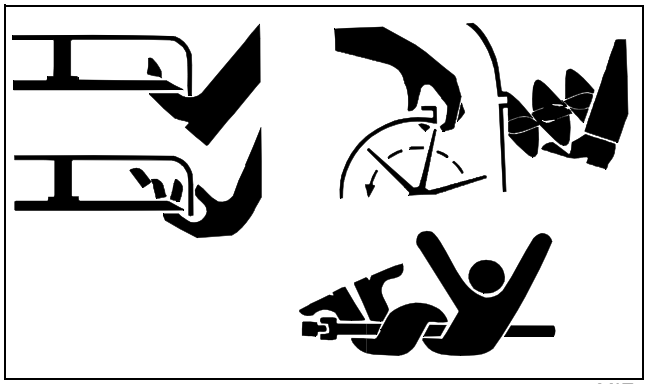
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and NOT in front of or over the tire assembly. Use a safety cage if available.

Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

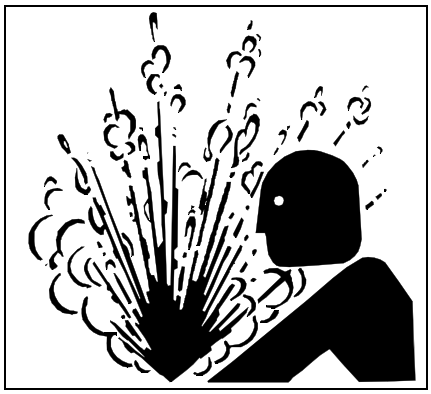
Avoid Injury From Rotating Blades, Augers and PTO Shafts



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Keep hands and feet away while machine is running. Shut off power to service, lubricate or remove mower blades, augers or PTO shafts.

Service Cooling System Safely



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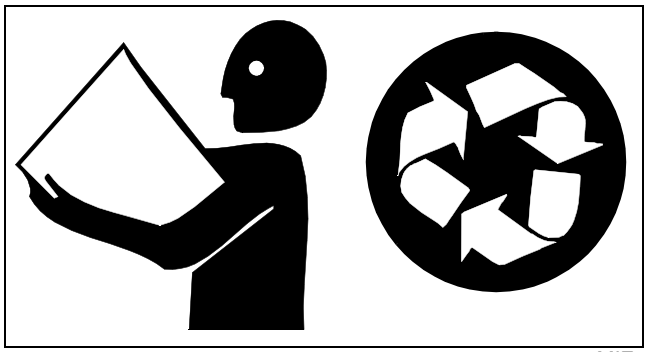
Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off machine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

Dispose Of Waste Properly

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries. Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them. Do not pour waste onto the ground, down a drain, or into any water source. Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.

Handle Chemical Products Safely



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Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques. Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

Live With Safety

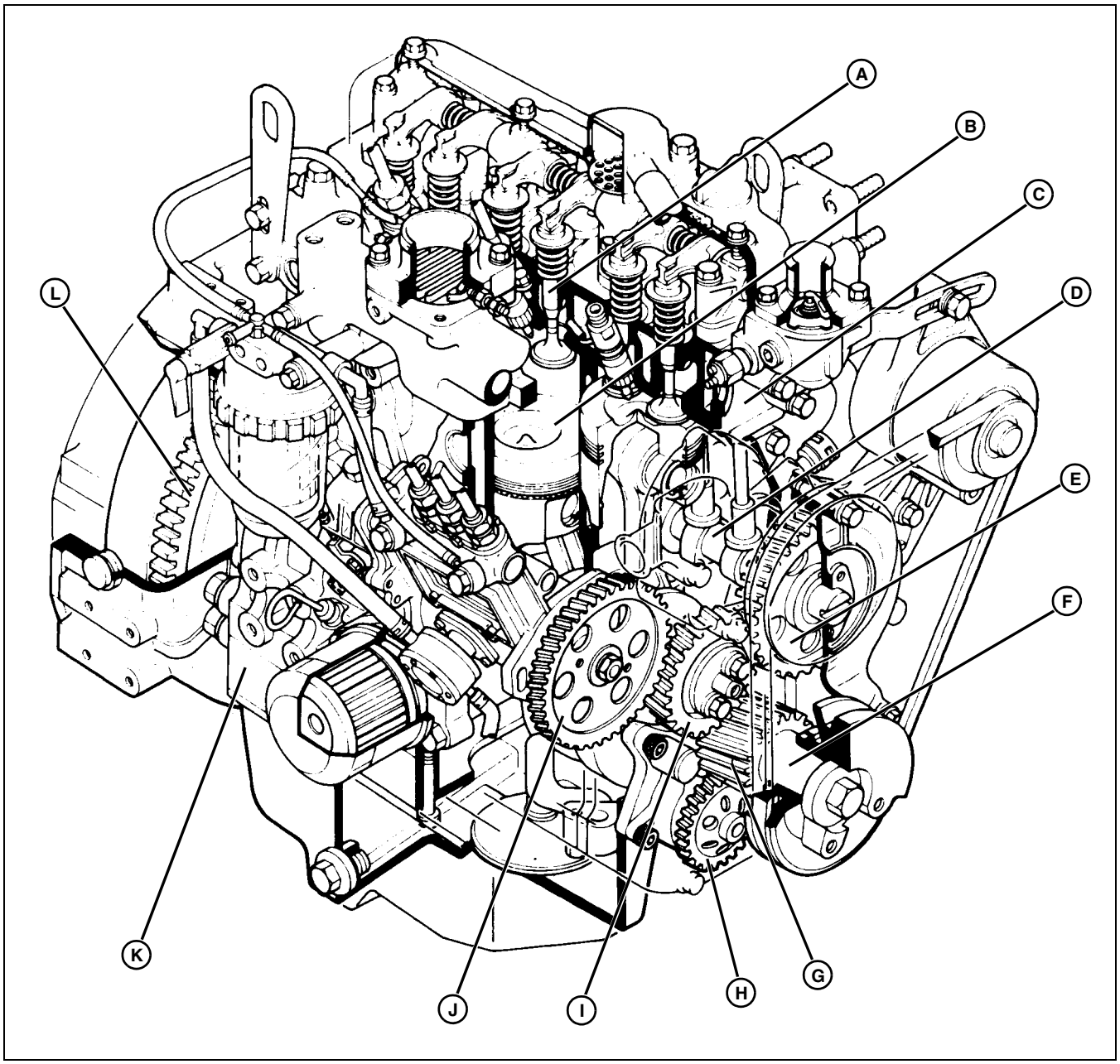


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Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

Component Location

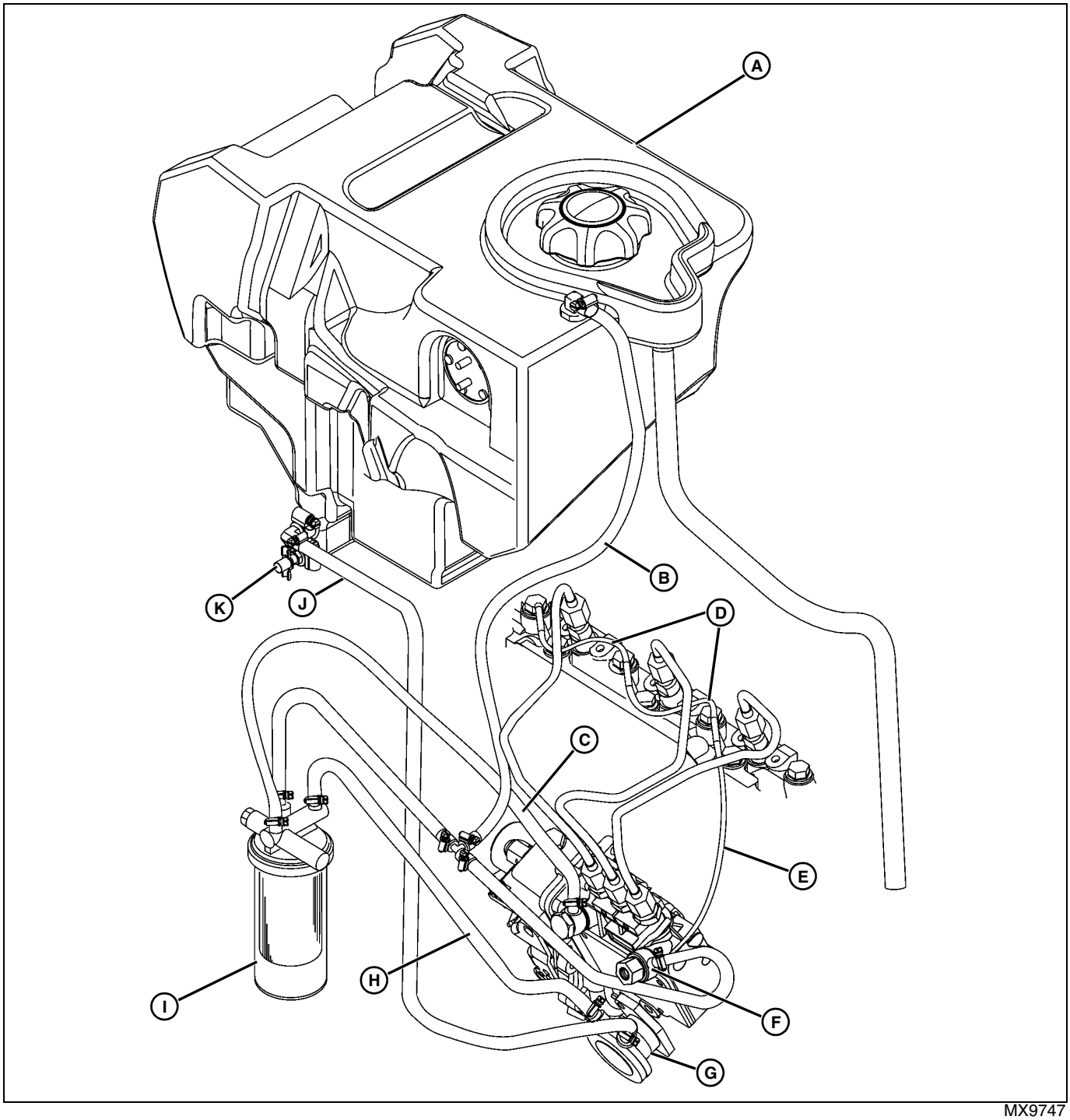
Engine



MX19735

A - Valves
B - Pistons
C - Cylinder Head
D - Camshaft
E - Camshaft Gear
F - Crankshaft
G - Crankshaft Gear
H - Oil Pump Gear
I - Idler Gear
J - Injection Pump Gear
K - Cylinder Block
L - Flywheel

Fuel Supply



MX9747

A - Fuel Tank
B - Return Fuel Hose
C - Fuel Filter-to-Injection Pump Hose
D - Nozzle Leak-Off Hose (Short)
E - Nozzle Leak-Off Hose (Long)
F - Air Vent Check Valve
G - Transfer Pump
H - Transfer Pump-to-Filter Hose
I - Fuel Filter
J - Fuel Tank-to-Transfer Pump Hose
K - Drain Valve

Theory of Operation

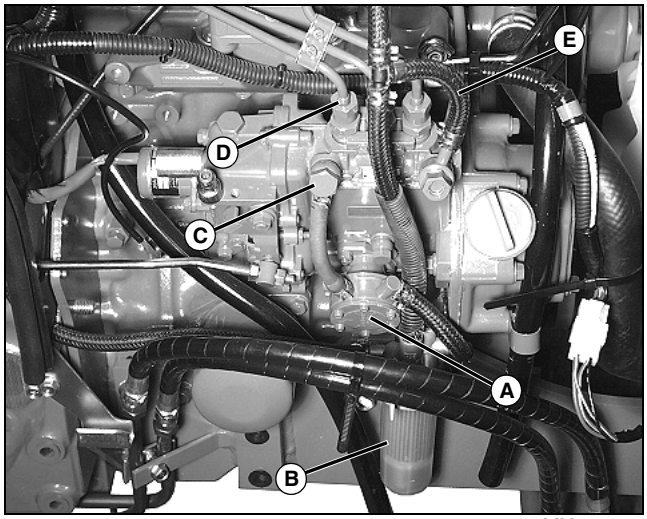
Fuel and Air System Operation

Function:

Fuel system supplies fuel to injection nozzles.

The air intake system filters and supplies air needed for combustion.

Theory of Operation:



MX19843

Fuel System:

A mechanical fuel transfer pump (A) draws fuel from the tank outlet. The low pressure fuel from the fuel pump flows through the filter/water separator (B) to the fuel the injector pump inlet (C). The injection pump then directs high pressure fuel through the injector lines (D) for combustion. Excess fuel is returned, along with fuel from the injectors, through the return line (E) to the fuel tank.

If the machine runs out of fuel, there are two air bleed lines that allow air to escape from the top of the filter and the injection pump. These two lines allow the system to be self bleeding.

The engine speed is controlled by the throttle lever and rod. The rod is connected to the injection pump governor control lever. The fuel shutoff solenoid controls the injection pump shutoff shaft. When the solenoid is retracted (key in the START or ON position), the engine can be started. When the key is turned off, return springs on the shutoff shaft, extend the solenoid, moving the shutoff linkage to the shutoff position. The solenoid also closes if the machine is operated in an unsafe condition. See “Engine Shutoff Circuit Operation” in the Electrical section.

The injection pump meters fuel as determined by the governor and delivers it at high pressure to the injection nozzles.

The injection nozzle prevents flow until high pressure is reached, opening the valve and spraying atomized fuel into the combustion chamber. Injection lines contain trapped fuel whenever injection is not taking place.

A small amount of fuel leaks past the nozzle valve to lubricate the fuel injection nozzle. This leakage combines with excess fuel from the injection pump and is returned to tank. Any air in the fuel system is bled out with return fuel to the fuel tank.

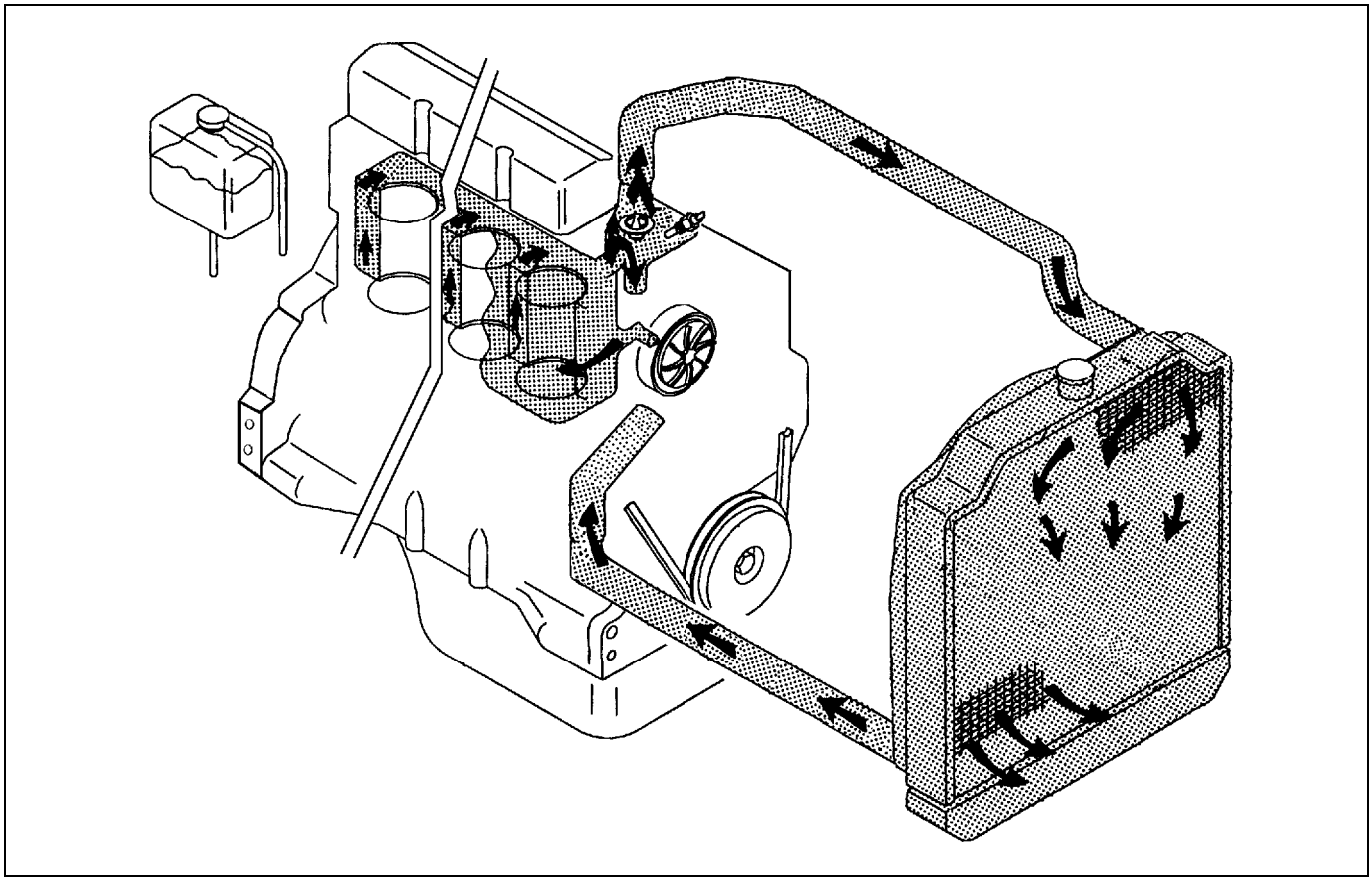
A fuel level sensor mounted in the fuel tank informs the operator of the fuel level.

Air Intake System:

Engine intake air enters the inlet hose (A) behind the grille, and flows into the air filter body (B). The air cleaner also has a rubber, one way, unloading valve (C), that ejects heavy dirt particles from the air stream during engine operation before they reach the filters. The operator can squeeze the valve to remove the large particles. The air cleaner elements filter the air, which then flows through hose (D) to the intake manifold.

An air filter restriction indicator (E) at the rear of the air cleaner informs the operator when the air filter needs servicing.

Cooling System Operation



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Function:

The coolant pump circulates coolant through the cooling system, drawing hot coolant from the engine block, circulating it through the radiator for cooling.

Theory of Operation:

The pressurized cooling system includes the radiator, water pump, fan and thermostat.

During the warm-up period, the thermostat remains closed and the impeller type coolant pump draws coolant from the bypass tube. Coolant from the pump flows to the cylinder block water jacket and up through the cylinder head providing a fast warm-up.

Once the engine has reached operating temperature, the thermostat opens and coolant is pumped from the bottom of the radiator via the lower radiator hose into the cylinder block. Here it circulates through the block and around the cylinders.

From the block, coolant is then directed through the cylinder head, and into thermostat housing. With the thermostat open, warm engine coolant passes through the housing into the top of the radiator where it is circulated to dissipate heat.

When coolant system pressure exceeds 88.3 kPa (12.8 psi), a valve in the radiator cap opens to allow coolant to discharge into the coolant recovery tank.

When temperature is reduced, a vacuum is produced in the radiator and coolant is drawn back out of the coolant recovery tank through a valve in the radiator cap.

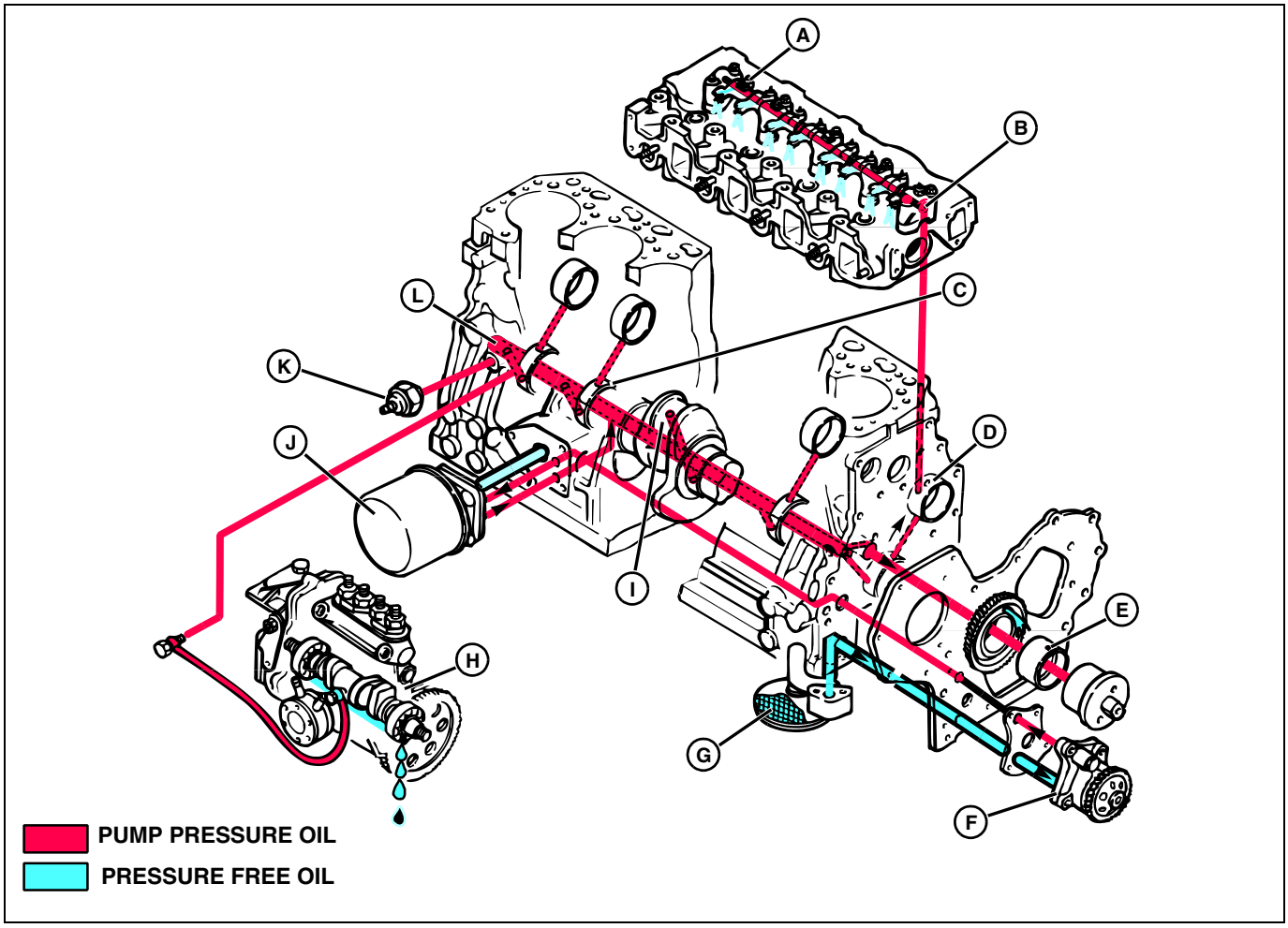
A coolant temperature sensor informs the operator of the engine coolant temperature and warns of a high temperature condition by lighting a lamp.

Thermostat Settings:

Start To Open . . . . . 69.5 - 72.5° C (157 - 163° F)

Fully Opened . . . . . 85° C (185° F)

Lubrication System Operation



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Function:

A full pressure system lubricates engine parts with filtered oil.

Theory of Operation:

The pressure lubrication system consists of a positive displacement gear-driven pump (F), oil strainer (G), full flow oil filter (J), oil pressure regulating valve and an electrical pressure warning switch. (K)

The pump draws lubrication oil from the oil pan through a strainer and a suction tube. The oil is then pumped through an oil passage to the oil filter and through the engine block main oil galley (L).

From the main oil galley, oil is forwarded under pressure to the crankshaft main bearing journals (C) and idler gear bushing (E). Drilled cross-passages in the crankshaft (I) distribute the oil from the main bearings to connecting rod bearings.

Lube oil holes in main bearing oil grooves direct oil to the camshaft bearings (D).

A drilled passage from the rear camshaft bearing through the cylinder block and cylinder head supplies lubricating oil to the rocker arm shaft (B). The hollow shaft distributes oil to the rocker arms (A), cam followers and valves.

Lubrication oil is supplied to the fuel injection pump (H) from the main oil galley through external oil lines.

An oil pressure sensor (K) activates an indicator light to alert the operator to shut down the engine if oil pressure drops below specification.

Test/Check Point	Normal Condition	If Not Normal
Injection pump fast idle speed (engine running)	Engine runs at 2850 ± 25 rpm.	See “Injection Pump Static Timing Adjustment” on page 47 in this section.
Governor	Engine runs smoothly through out rpm range with low smoke and good power.	Have governor torque capsule adjusted by a certified CARB/EPA service center.
Oil pressure sender port	Oil pressure to specification.	Test engine oil pressure. See “Tests and Adjustments” in this section.
Thermostat	Opening temperature within specification.	Perform thermostat opening test. See “Tests and Adjustments” in this section.
Muffler	Not restricted.	Replace muffler.

Tests and Adjustments

Cylinder Compression Test

Reason:

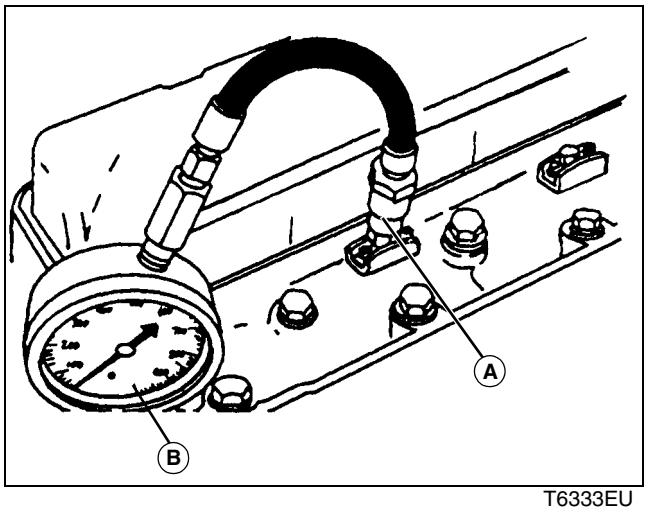
To determine the condition of the pistons, rings, cylinder walls and valves.

Equipment:

- JT01682 Compression Gauge Assembly
- JDG560 Adapter

Procedure:

1. Remove the injection nozzles.



T6333EU

2. Install the heat protector from end of injector and install JDG560 adapter (A).

3. Install JT01682 Compression Gauge Assembly (B) and JDG560 Adapter.

4. Disconnect the fuel control solenoid connector.

IMPORTANT: Avoid damage! DO NOT overheat starting motor during test.

5. Crank the engine for five seconds with the starting motor. Minimum cranking speed is 250 rpm.

6. Record the pressure reading for each cylinder.

Specifications:

Cylinder Compression. . . . . 3334 kPa (483 psi)

(Minimum) . . . . . 3138 kPa (455 psi)

Difference Between Cylinders (Maximum) . . . . . 294 kPa (42 psi)

Results:

- If the pressure reading is below specification, perform “Radiator Bubble Test” to help determine the cause of compression loss.

Slow Idle Adjustment

IMPORTANT: Avoid damage! The slow idle adjustment is the only adjustment that can be made on this engine.

The fast idle and torque capsule adjustments are pre-set by the engine manufacturer to comply with strict EPA/CARB emissions requirements, and are adjustable ONLY by authorized diesel service facilities.

Reason:

To achieve proper slow idle rpm setting. Provides adequate rpm to keep the engine running smoothly without stalling.

Equipment:

- JT05719 Hand Held Digital Tachometer

NOTE: Make sure the air cleaner is clean and not restricted. Replace the air cleaner element as necessary.

Procedure:

1. Place a small piece of reflective tape on the crankshaft pulley.

2. Start the engine and run for 5 minutes to attain operating temperature.

3. Move the throttle lever to slow idle position.

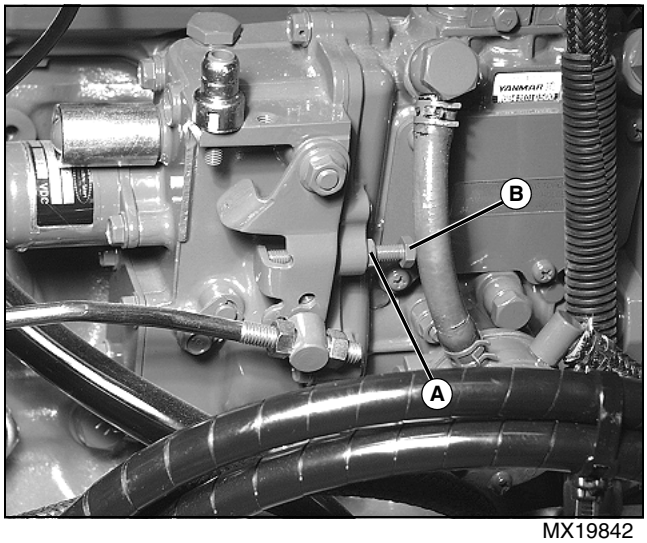
4. Use JT05719 Hand Held Digital Tachometer to check engine speed at the crankshaft pulley.

5. Visually check that the injection pump throttle lever is against slow idle stop screw. Slow idle speed is set to specification.

Specifications:

Low Idle . . . . . 925 ± 25 rpm

Results:



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- If the slow idle rpm is not according to specifications, loosen the nut (A) and turn the slow idle stop screw (B) clockwise to increase the engine speed, or counterclockwise to decrease the engine speed until the slow idle speed is correct. After adjustment, tighten the nut.

Valve Clearance Adjustment

Reason:

To be sure the valves are fully opening and closing at the correct time, and not wearing the valve train unnecessarily.

Equipment:

- Feeler Gauge
- 10 mm End Wrench
- Flat Blade Screwdriver
- 17 mm Wrench

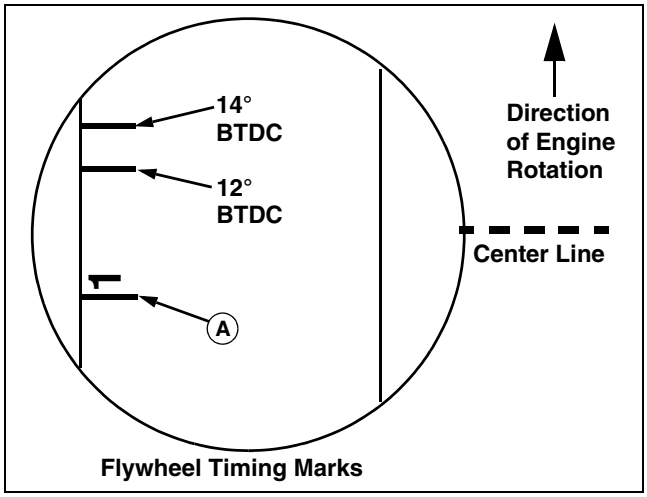
Procedure:

1. The engine must be cool (room temperature) before the valve clearance is checked.

2. Be sure ignition key is OFF before attempting to turn engine by hand.

3. Open the hood and remove the engine side covers.

4. Remove the rocker arm cover. See “Rocker Cover Removal and Installation” on page 54.



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5. Locate the inspection hole in right side of the transmission tunnel. The flywheel can be seen inside the inspection hole.

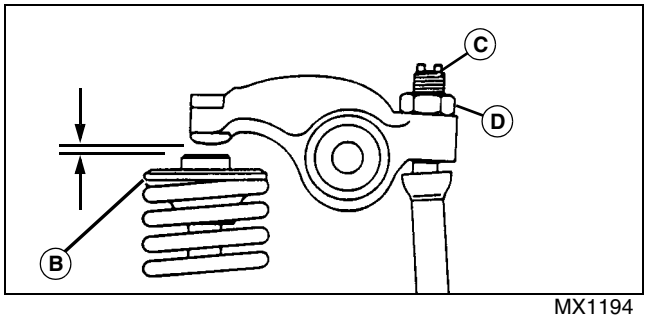
NOTE: "Top dead center (TDC)" is when the piston is at its' highest point of travel in the cylinder on the compression stroke.
Number one cylinder is located at rear of engine (flywheel side).

6. Turn the crankshaft pulley while watching the flywheel inside the inspection hole. Align the number one TDC mark (A) on the flywheel with the pointer on the tunnel.

NOTE: When top dead center is reached, the rocker arms for that cylinder will be motionless as the crankshaft if rotated. If rocker arms are still moving when TDC is approached, rotate crankshaft one full revolution and try again.

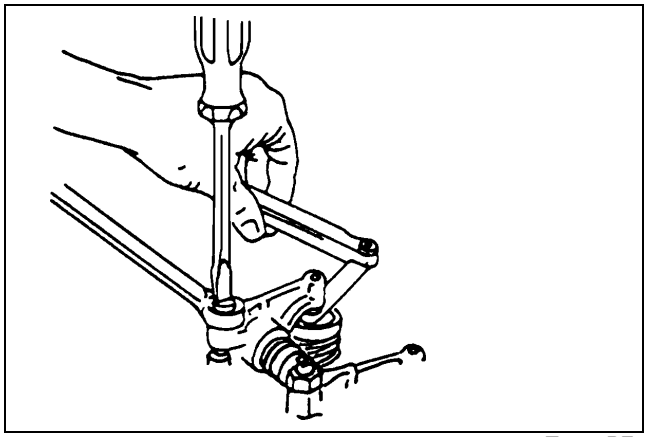
7. Try to move rocker arms and/or push rods for No. 1 cylinder:

- If the rocker arms and push rods are loose, the piston is at TDC on the compression stroke. Go to step 8.
- If the rocker arms and/or push rods are not loose, rotate the flywheel one revolution (360°), and recheck the rocker arms and push rods.



MX1194

8. Slide a feeler gauge between the valve cap (B) and rocker arm to measure the clearance.



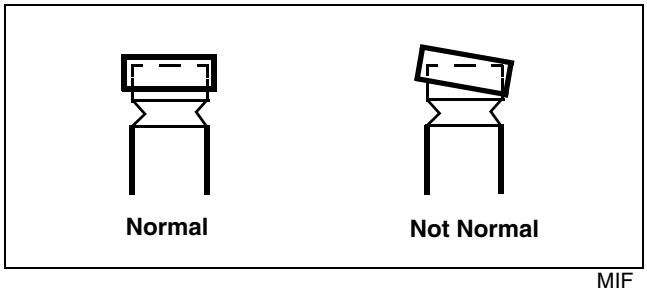
T6105BF

9. To adjust the valves, loosen the lock nut (D) and turn the adjusting screw (C) until the blade of the feeler gauge can be inserted between the rocker arm and valve cap. Hold the adjusting screw while tightening the lock nut.

10. Recheck the valve clearance after tightening the lock nut.

Specification:

Valve Clearance . . . . . **0.15 - 0.25 mm (0.006 - 0.010 in.)**



MIF

11. Check that the valve cap on the valve stem remained seated on the valve and inside the valve spring retainer.

12. Turn the crankshaft pulley counter clockwise (as viewed from operator's seat or flywheel end) approximately 2/3 of a revolution (240°) while watching the observation hole for the number three timing mark.

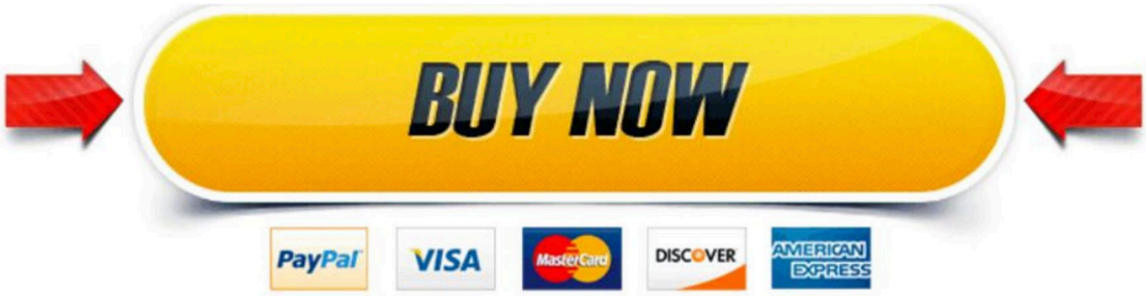
13. Check that the rocker arms and push rods for cylinder number three are loose.

14. Repeat steps 7 - 13 for number three cylinder.

15. Repeat steps 7 - 11 for number two cylinder.

16. Replace the rocker arm cover, air cleaner bracket and housing, and the muffler.

17. Replace the engine side covers and hood.


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