Yale
Industrial Trucks

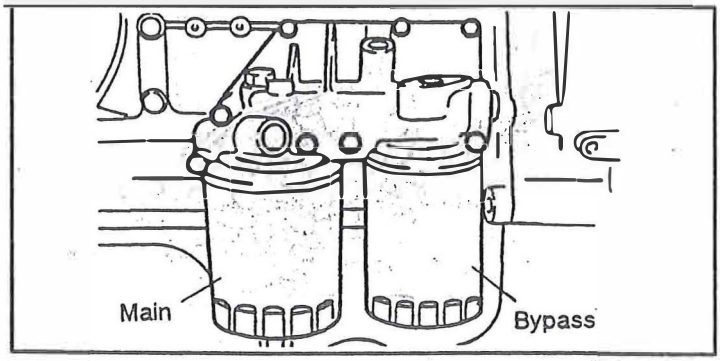
SECTION 2 – CONTENTS

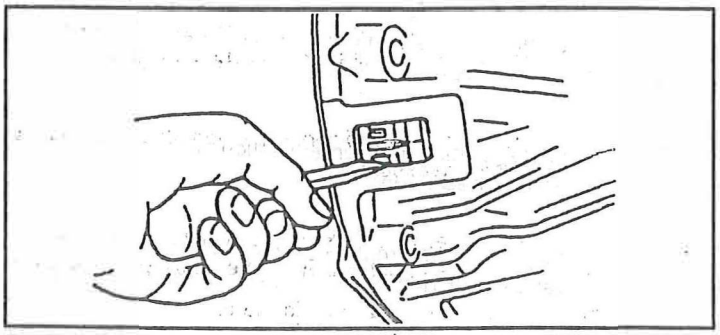
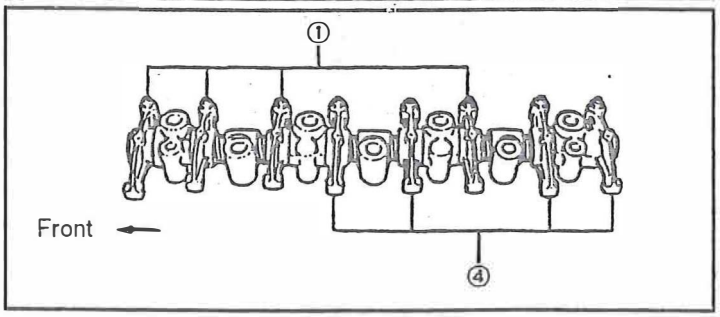
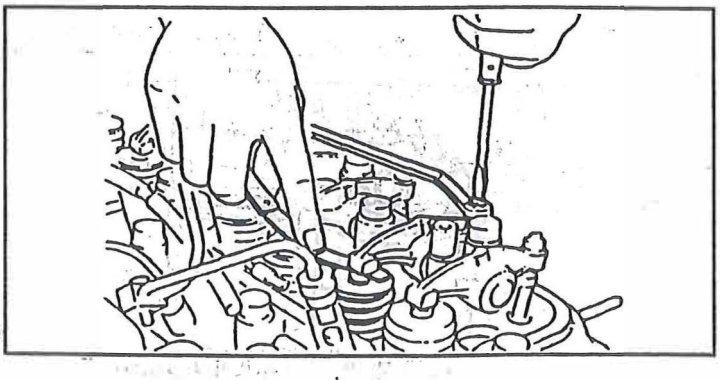
ENGINE INSPECTION AND ADJUSTMENT

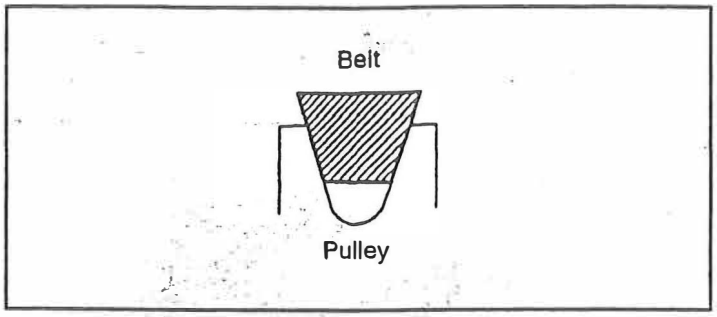
ENGINE INSPECTION AND ADJUSTMENT

Periodic inspection and maintenance are necessary to keep engine performing at peak efficiency.

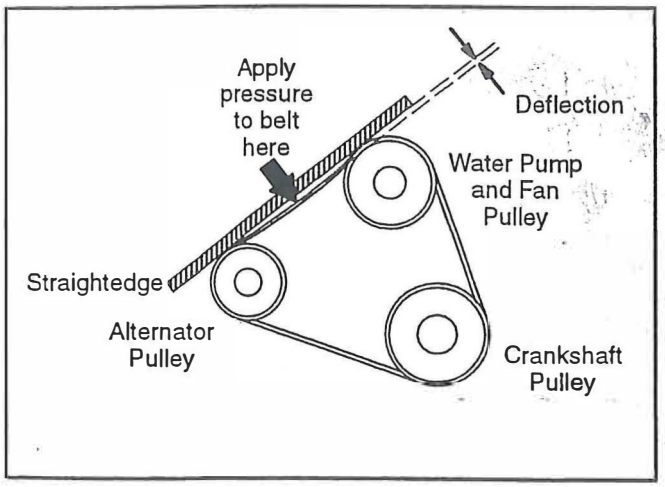
For regular inspections and visual checking, ordinary tools, measuring tools and special testers are used. When using any special tester or tool, be sure to understand its proper use. See: **"Recommended Schedule of Preventive Maintenance"** for information regarding the inspection and maintenance intervals of each item.

Item	Procedure	Value
Oil Level Inspection	1. Check that oil is not leaking from any of the engine parts. If any leaks are found, repair the leak or replace the part. 2. Check for deterioration and contamination of the oil. Replace the engine oil when necessary. 3. Inspect the oil level, and make sure that it is between F and L on the oil level gauge (dipstick). Refill the oil when necessary.	Oil level between F (Full) and L (Low) 2.0 litres / (2.11 qt) Oil pan capacity At F (Full) position 7.0 litres / (7.4 qt)
Oil Change and Refill	1. Remove the drain plug and drain the oil. 2. Remove the oil cap and refill the oil. 3. Use the specified oil. Classified according to API, grade CD SAE 10W-30 (for all seasons). **DO NOT OVERFILL.**	Total Capacity 9.3 litres / (9.8 qt)
Oil Filter Replacement	1. A dual filter method (main oil filter, bypass oil filter) is used. 2. Replace the main oil filter and bypass oil filter at the same time. 1. Use an oil filter wrench, and remove the main oil filter and bypass oil filter. (Wrench for main filter: commercial product) (Wrench for bypass filter: special tool 9224473-00) 2. Apply a light coat of engine oil on the O-ring of the new filters. 3. Install the filters on the filter body. Hand tighten the filter until it stops. Tighten it another 1/4 turn with the oil filter wrench. (Reference tightening torque) Main oil filter: 1.8-2.3 kgm / (156-200 lbf in) Bypass oil filter: 2.0-2.5 kgm / (174-217 lbf in) **NOTE:** Do not over tighten the filter. (The filter can be damaged.)  	

Item	Procedure	Value
Valve Clearance Inspection	1. Remove the seal cover and cylinder head cover. 2. Remove the floor plate. 3. Using a screwdriver or other suitable tool, rotate the crank shaft forward (CCW). Take care not to bend the timing indicator pin. Set the number 1 or number 4 cylinder at Top Dead Center, compression stroke.   4. With cylinder number 1 at Top Dead Center, measure the clearance of the valves indicated by (1) in the above illustration. With cylinder number 4 at Top Dead Center, measure the valves indicated by (4).	
Valve Clearance Adjustment	Use the following procedure if adjustment is required. 1. Loosen the lock nut and turn the adjustment screw to adjust. 2. Tighten the lock nut, and measure the valve clearance again to verify that the clearance is correct.  3. Turn the crank shaft forward one turn, and inspect the remaining valve clearances, and adjust as necessary. 4. Install the floor plate. 5. Install the cylinder head cover and seal cover.	Valve clearance (cold) Intake: 0.30 mm / (.012 in) Exhaust: 0.45 mm / (.018 in) Tightening torque Cylinder head cover 0.35-0.55 kgm (30-48 lbf in) Seal cover 0.35-0.55 kgm (30-48 lbf in)

Item	Procedure	Value
Alternator Belt		
Belt Inspection	1. Inspect for wear and cracks. If defective, replace the belt. 2. Check the adjustment of the belt by pressing down between the water pump and alternator (pressure, 10 kg / 22 lbs). Adjust the belt tension if the deflection is out of the specified range.	Deflection amount pressure 10 kg / (22 lbs) For a new belt: 10-11 mm / (.39-.43 in) For adjustment: 11-12 mm / (.43-.47 in)
Belt Adjustment	1. Loosen the alternator bolts and adjust the belt deflection to the specified value by moving the alternator.	
Belt Replacement	2. Loosen the alternator bolts to loosen the belt. Remove the belt and replace it. Adjust the belt tension and tighten the mounting bolts.	

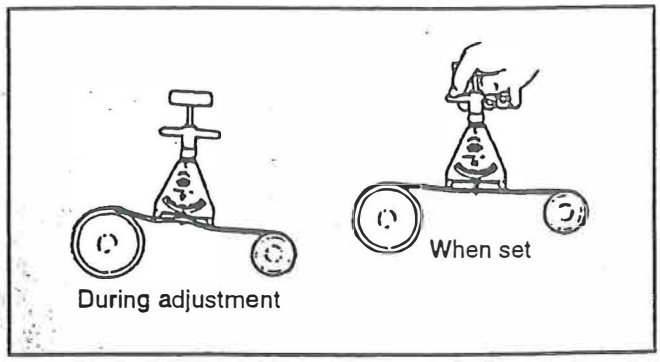
NOTE: Measure the belt deflection between the alternator and the fan pulleys as illustrated below when checking deflection using a straight edge (without a ND tension gauge).



Deflection amount / pressure @ 10 kg / (22 lbs)
For a new belt:
10-11 mm / (.39-.43 in)
For adjustment:
11-12 mm / (.43-.47 in)

NOTE: When installing a new belt, adjust the belt tension to the mid point of the given value for a new belt.

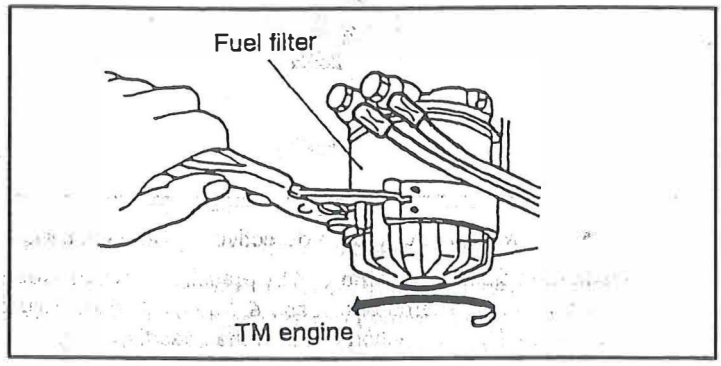
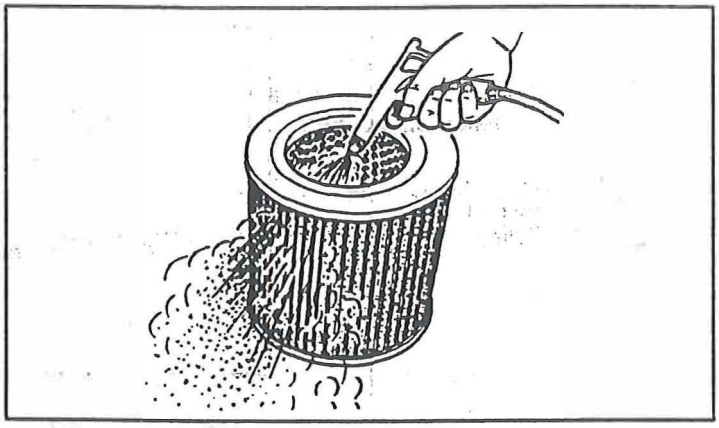
NOTE: When checking belt tension with the ND tension gauge, the belt tension can be measured between any two pulleys.

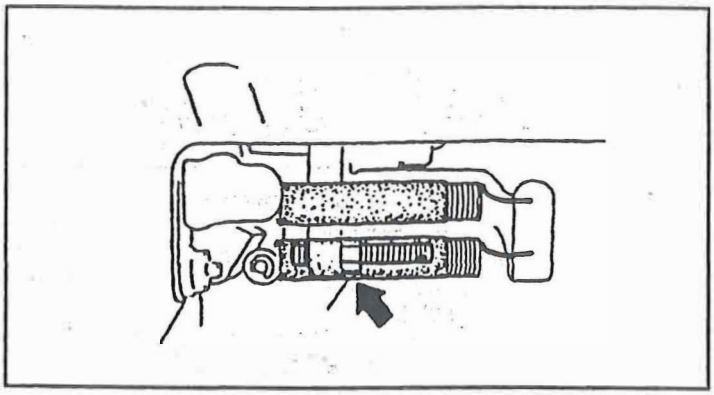


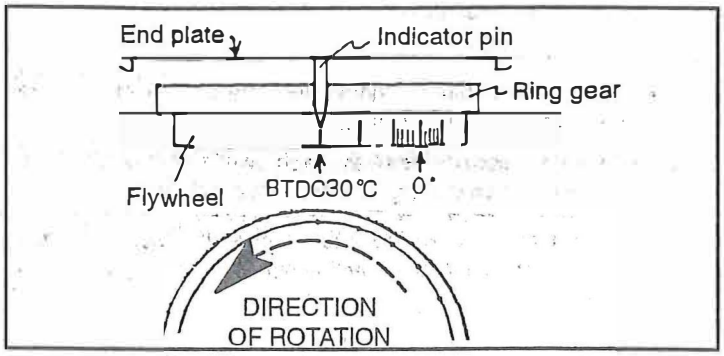
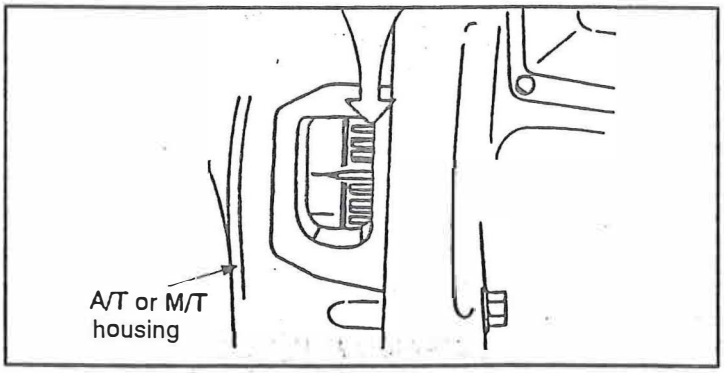
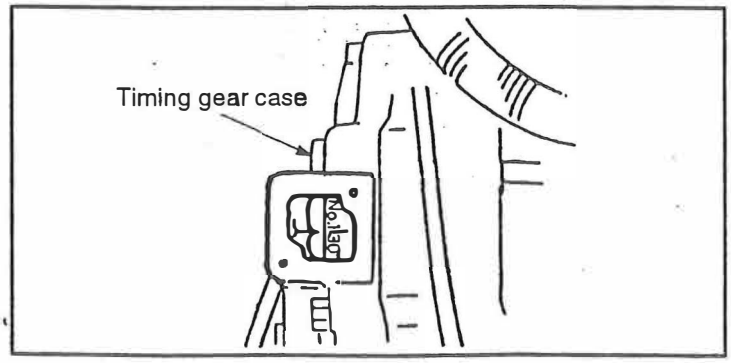
NOTE: Standard tension values listed below are for use with a ND tension gauge.

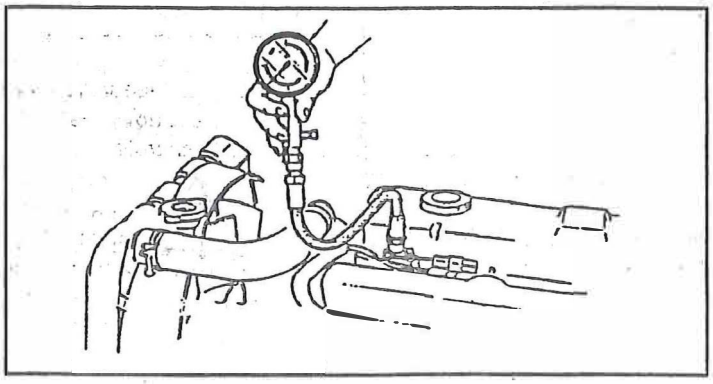
Belt Type	Standard Value — Engine Model	When installing new belt kg / (lbs)	When inspecting kg / (lbs)
Alternator	TM	29.4-33.9 (65-75)	24.9-29.4 (55-65)

NOTE: When installing a new belt, adjust the belt tension to the mid point of the given value for a new belt.

Item	Procedure	Value
Fuel Filter Replacement	The fuel filter is located below air cleaner . 1. Remove the filter cartridge using an oil filter wrench (commercial product).  2. Apply a light coat of fuel to the O-ring on the filter cartridge before installing. Tighten the filter securely by hand, and then tighten an additional one-third turn with the oil filter wrench. 3. After installing the filter, bleed the air in the fuel, and verify that there are no fuel leaks. See: **"BLEEDING AIR FROM THE FUEL SYSTEM"**.	
Air Cleaner Service	1. Remove the air cleaner cover. Remove the wing nut and the element. 2. Clean the element from the inside with compressed air. 	
Air Cleaner Replacement	1. Replace the air filter if it is heavily clogged.	

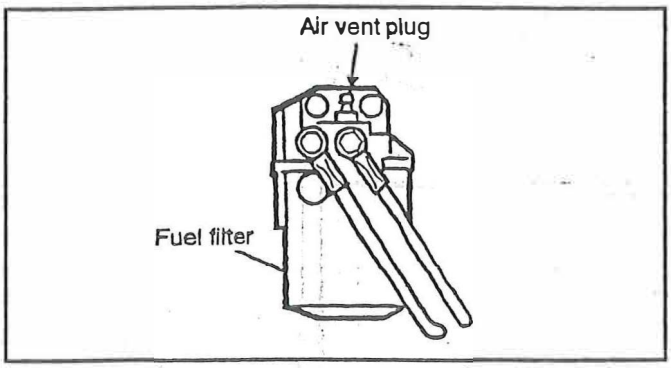
Item	Procedure	Value
Idle Inspection	1. Place a piece of reflective tape on the crank shaft pulley or flywheel. 2. Start the engine and allow it to reach operating temperature. 3. Check the accelerator cable adjustment at the fuel injection pump. The throttle arm on the fuel injection pump must be allowed to completely return to the idle position with the accelerator pedal in the full up position. The throttle arm on the fuel injection pump must move to the full speed position with the accelerator pedal in the full down position. 4. Idle the engine. 5. Using a photoelectric tachometer, shine the light on the reflective tape to check the idle speed. 6. **Alternate Method:** Install the tach dwell tester (9125483-58) to the fuel injection pipe, to check the idle speed.	Idle speed: 825-875 rpm
Idle Adjustment	1. If not within the specified value, loosen the lock nut of the idle adjustment bolt over the injection pump. Turn the bolt to adjust the speed. 2. Tighten the lock nut after adjustment. 3. Accelerate the engine two or three times and verify that the idle speed returns to the specified value. Tightening torque: 1.0-1.4 kgm / (87-122 lbf in) 	

Item	Procedure	Value
Injection Pump Timing Inspection	**NOTE:** The injection timing is very critical in a direct injection engine. Incorrect adjustment can cause increased engine noise (knock) and / or power loss. Always check the injection timing after installing the pump, and verify that it is correct. The actual injection timing is 9° BTDC. Inspection must be performed as follows to verify the correct injection timing: 1. Remove the floor plate. 2. Rotate the flywheel CCW, and set the indicator pin to 30° BTDC.   3. Remove the access cover on the pump side of the timing gear case. Verify that the markings on the case pointer and the timer circumference are aligned. If both match, the number 1 cylinder is 30° BTDC, and the injection timing is correct. (Injection pump timing is set at 9° BTDC.) 	Injection timing 9° BTDC Maximum allowable variation: ±2°
Injection Pump Timing Adjustment	See: **"INSPECTION AND ADJUSTMENT OF THE INJECTION TIMING"(FUEL SYSTEM SECTION** for the adjustment procedure.	

Item	Procedure	Value
Compression Test	1. Verify that the battery is completely charged. 2. Start the engine and allow it to reach operating temperature. 3. Turn off the ignition key to stop the engine. 4. With the key switch off, unplug and completely disconnect the wiring harness connector at the fuel stop motor to disable the fuel supply to the fuel injectors.	
		
	5. Remove all the injector nozzles. Crank the engine to purge any fuel from the cylinders. Install the compression gauge adapter (9225423-19) and the compression gauge (9125483-71). **NOTE:** All the injector nozzles must be removed to insure accurate results during the compression test. **WARNING:** Diesels are self igniting engines, using only the heat of compression to ignite the diesel fuel. Accidental starting can occur if the engine cylinders are not completely free of fuel before installing the compression gauge or performing any testing. To prevent accidental starting, be sure to remove **all** the injector nozzles **and** then crank the engine **before** installing the compression gauge.	Compression pressure: 30 kg/cm^2 @ 270 rpm 426.7 psi @ 270 rpm Limit: (90% of standard value): 27 kg/cm^2 @ 270 rpm 384 psi @ 270 rpm Difference between cylinders: 3 kg/cm^2 @ 270 rpm 43 psi @ 270 rpm
	6. Crank the engine and measure the compression pressure. 7. Repeat steps (4) to (6) for the remaining cylinders. If the measurement value is below the limit value, the cylinder, piston, or piston rings may be worn or damaged. A valve or valve seat may be defective, or the cylinder head gasket may be leaking.	

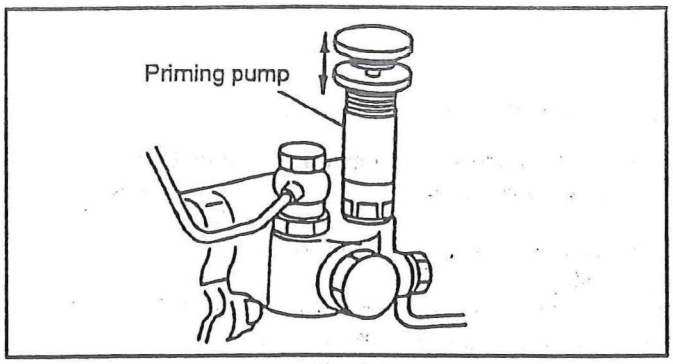
BLEEDING AIR FROM THE FUEL SYSTEM

1. Loosen the air vent plug on the top of the fuel filter body.

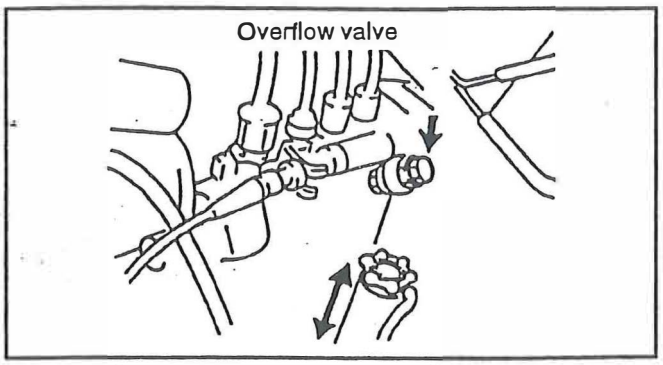


2. Loosen the top of the priming pump. The priming pump is located on the side of the fuel injection pump.

3. Pump the priming pump until fuel without air bubbles is discharged from the air vent plug on the fuel filter body. Close the air vent plug on the fuel filter body.
   Tightening torque: 0.6-0.9 kgm / (52-78 lbf in)



4. Next, loosen the injection pump's overflow valve, and pump the priming pump until fuel without air bubbles is discharged from the overflow valve. Close the overflow valve.
   Tightening torque: 1.2-1.5 kgm / (104-130 lbf in)

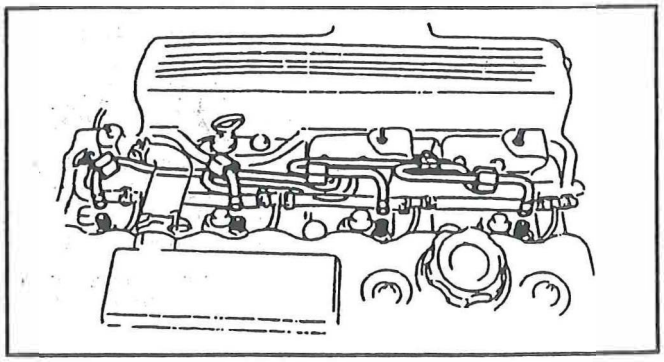


5. After bleeding the air out of the fuel filter and injection plug, press down the top of the priming pump plunger, and tighten it securely.

CAUTION: If you forget to tighten the priming pump plunger after completing the air bleeding process, fuel leaks can occur and / or the fuel injection pump can receive an insufficient fuel supply. A loose priming pump plunger can cause a hazardous situation (fuel leaks, fire hazard) or result in improper engine operation (low output, stalling, rough idling). Always push down the priming pump plunger and tighten it securely after completing the bleeding process.

6. After completing air bleeding, verify that there is no fuel leaking from the air vent plug or the overflow valve.

7. Loosen the four flare nuts on the injection nozzle side of the injector fuel lines.



8. Crankthe engine until fuel without air bubbles is discharged from the injector fuel lines.

NOTE: Do not crank the engine for extended periods without allowing the starter to cool.

9. Install the injector fuel lines.
   Tightening torque: 2.5-3.0 kgm / (217-260 lbf in)

10. Start the engine and verify that there are no fuel leaks.