

ENGINE TUNE-UP

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2-2 ENGINE TUNE-UP – Engine Tune-up Items

ENGINE TUNE-UP ITEMS

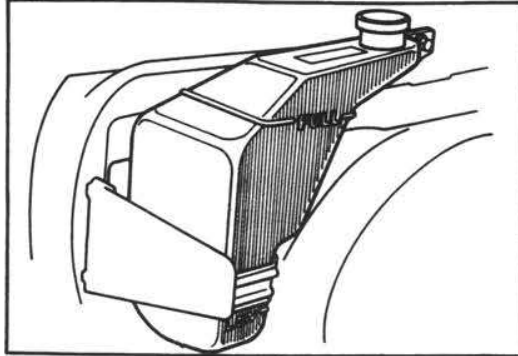
	ITEM	SPECIFICATION
1	COOLING SYSTEM Coolant level Coolant quality Leakage Radiator cap valve opening pressure Coolant capacity (w/Heater) B Engine 2B Engine	"Full" line Limit 0.6 kg/cm ² 8.5 psi STD 0.75 – 1.05 kg/cm ² 10.7 – 14.9 psi 13.0 liter 13.7 USqt 11.4 Imp.qt 14.0 liter 14.8 USqt 12.3 Imp.qt
2	DRIVE BELT Deflection at 10 kg (22 lb) force B Engine 2B Engine	10 – 13 mm 0.4 – 0.5 in. 8 – 11 mm 0.3 – 0.4 in.
3	AIR CLEANER Clean element Oil capacity (Oil bath type)	Indicated level
4	BATTERY Specific gravity Electrolyte level	1.25 – 1.27 at 20°C (68°F)
5	ENGINE OIL Oil level Oil quality Replenishment Oil capacity Total Crankcase	"F" line API service CC-CD classification 7.3 liter 7.7 USqt 6.4 Imp.qt 5.4 liter 5.7 USqt 4.8 Imp.qt
6	INJECTION PUMP Lubricate diaphragm housing	3 or 4 drops of diaphragm oil
7	COMPRESSION PRESSURE Variation limit between cylinders	STD 30.0 kg/cm ² 427 psi Limit 20.0 kg/cm ² 284 psi 2.0 kg/cm ² 28 psi

ENGINE TUNE-UP – Engine Tune-up Item

2-3

	ITEM		SPECIFICATION	
8	INJECTION NOZZLE	Injection starting pressure		
		New nozzle	115 – 125 kg/cm ² 1636 – 1778 psi	
		Reused nozzle	105 – 125 kg/cm ² 1493 – 1778 psi	
		Spray condition	4° conical form	
		Leakage test	At 90 kg/cm ²	1280 psi
		Cleaning		
9	INJECTION TIMING (STATIONARY)		10° BTDC	
	AIR BLEEDING	Fuel filter		
		Injection pump		
		High pressure pipe		
10	VALVE CLEARANCE (HOT)	Intake	0.20 mm	0.008 in.
		Exhaust	0.36 mm	0.014 in.
11	IDLE SPEED		625 – 675 rpm	
12	MAXIMUM SPEED (NO LOAD)		4050 – 4100 rpm	
13	PREHEATING SYSTEM	Glow time at 0°C (32°F)		
		12V type	About 20 seconds	
		24V type	About 15 seconds	
		Load current		
		12V type	7.7 – 10.3 A	
		24V type	4.1 – 5.5 A	

Fig. 2-1



A line drawing showing a person's hands using a 'Radiator Cap Tester' to check a radiator cap. The tester is a vertical device with a handle at the top and a plunger at the bottom. The plunger is being pushed down onto the radiator cap, which is held in a vice on a workbench. A label 'Radiator Cap Tester' with a leader line points to the device.

Radiator Cap Tester

Radiator Cap

If coolant level is low, fill to "FULL" line of reservoir tank.

INSPECT COOLING SYSTEM

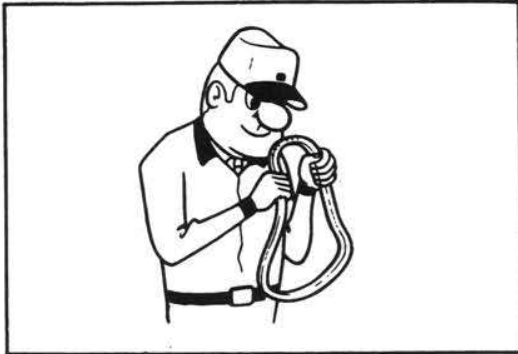


- Applicable pressure** 1.2 kg/cm²
(17.1 psi)

Limit	0.6 kg/cm ² (8.5 psi)
STD	0.75 – 1.05 kg/cm ² (10.7 – 14.9 psi)

3. If readings are not within acceptable limits, replace the radiator cap.

Fig. 2-5



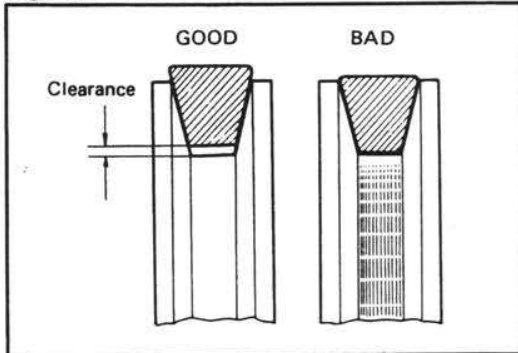
DRIVE BELT

VISUAL CHECK

Check belt for the following defects.

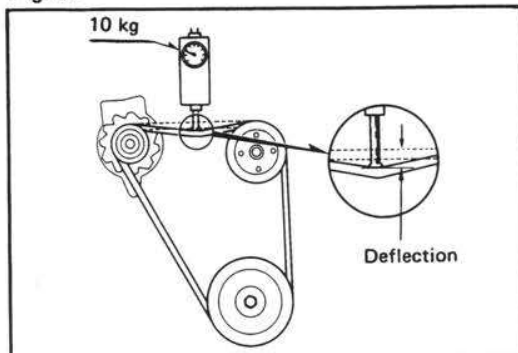
1. Cracks, deterioration or stretches.
2. Adherence of oil or grease.

Fig. 2-6



3. Improper contacting between belt and pulley.

Fig. 2-7



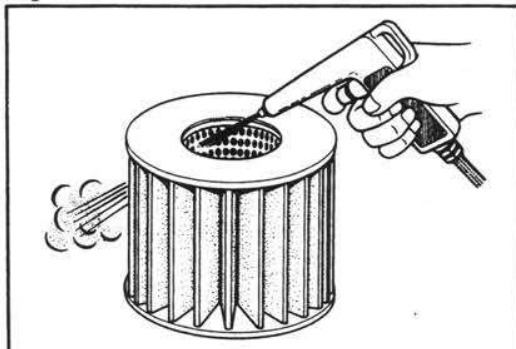
CHECK & ADJUST TENSION

When the belt is depressed with a force of 10 kg (22 lb), it should sag a specified amount.

Deflection at 10 kg (22 lb) force

B engine	10 – 13 mm (0.4 – 0.5 in.)
2B engine	8 – 11 mm (0.3 – 0.4 in.)

Fig. 2-8



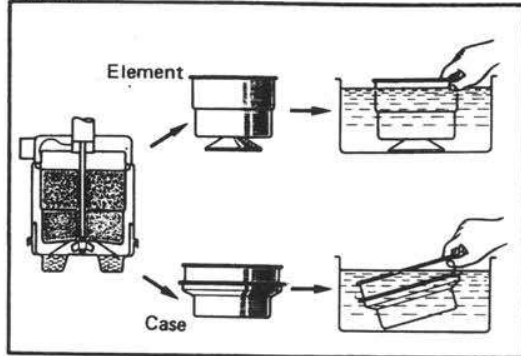
AIR CLEANER

CLEAN ELEMENT

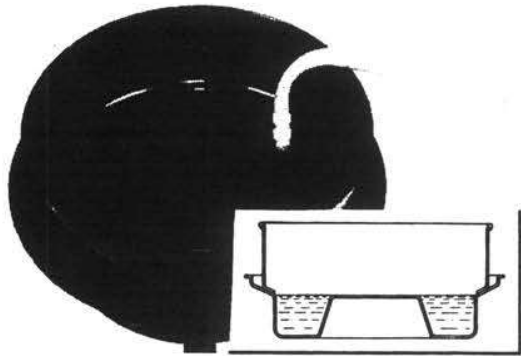
[Cyclone Type]

1. In removing the air cleaner or the element, use care not to drop dirt or dust down into the air horn.
2. In cleaning the element, blow air from the inner side.
3. In case the element is damaged or excessively dirty, replace with new one.
4. Replace the air cleaner gasket if it is badly worn or damaged.

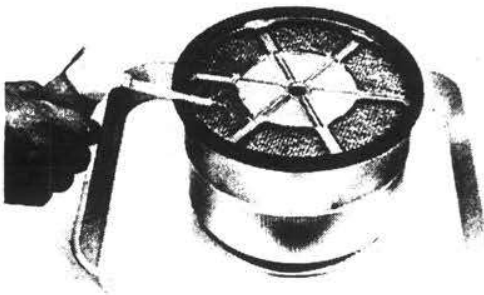
2-6

ENGINE TUNE-UP – Air Cleaner, Battery**Fig. 2-9****[Oil Bath Type]**

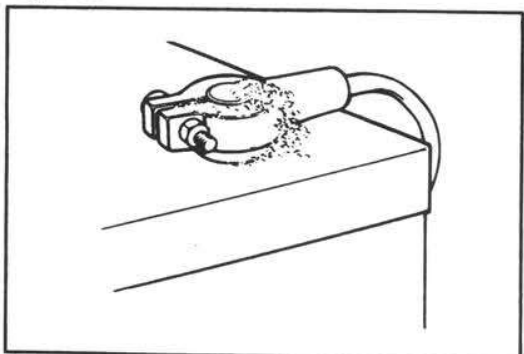
1. Wash the element and the case with kerosene, and dry them thoroughly.

Fig. 2-10

2. Refill the case up to the indicated level with clean engine oil.

Fig. 2-11

3. Saturate the element with clean engine oil.
4. Install the case and element.

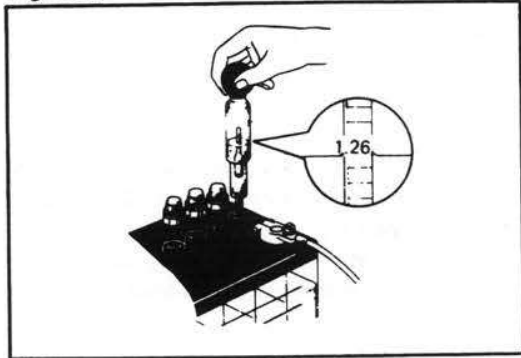
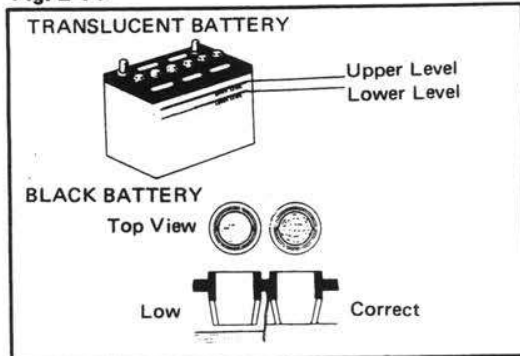
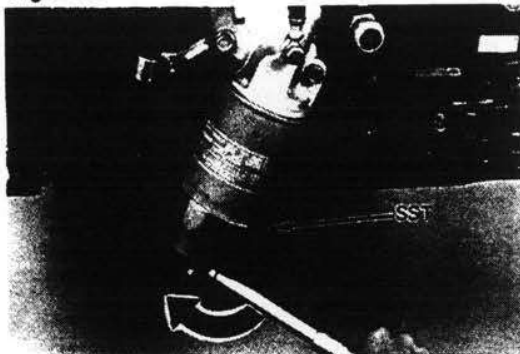
Fig. 2-12**BATTERY****VISUAL CHECK**

If the top of the battery is dirty, clean before checking. There should be no defects such as listed below:

1. Damage or leakage in battery.
2. Loose connection, rusting, deterioration or corrosion of battery terminals.

ENGINE TUNE-UP – Battery, Oil Filter

2-7

Fig. 2-13**MEASURE SPECIFIC GRAVITY****Specific gravity****1.25 - 1.27**
at 20°C (68°F)**— Note —****If reading is less than 1.23, recharge the battery.****Fig. 2-14****CHECK ELECTROLYTE LEVEL****If low, add distilled water (or purified water) up to the proper level.****Fig. 2-15****OIL FILTER****REPLACEMENT****[Cartridge Type]**

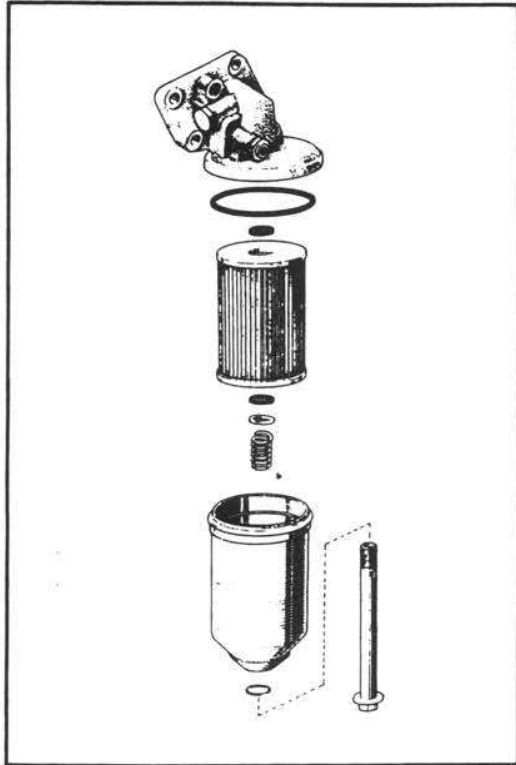
1. Remove the oil filter by using SST [09228-44010].

Fig. 2-16

2. To install, hand-tighten the oil filter.
3. After starting the engine, check for oil leaks and recheck the oil level.

2-8 ENGINE TUNE-UP – Oil Filter, Engine Oil

Fig. 2-17



[Paper Element Type]

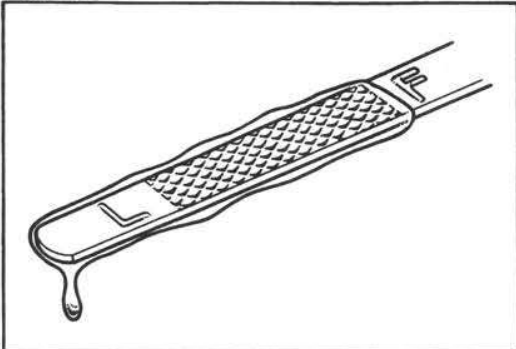
Refer to "LUBRICATION SYSTEM" section.



— Note —

1. Use new gaskets. Assemble the filter body gasket with the rounded side facing upward (toward cap).
2. After starting the engine, check for oil leaks and recheck the oil level.

Fig. 2-18



ENGINE OIL

CHECK LEVEL

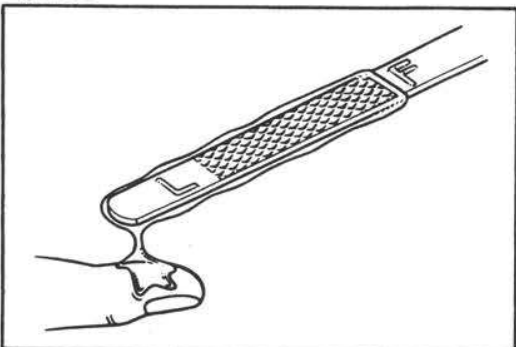
Oil level should be up to the "F" line on level gauge.

If low, add oil up to the "F" line.

— Note —

Use API service CC-CD classification engine oil.

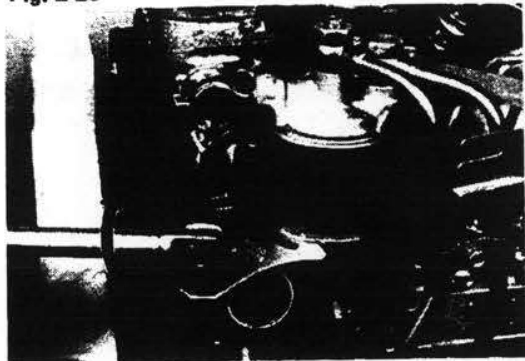
Fig. 2-19



CHECK QUALITY

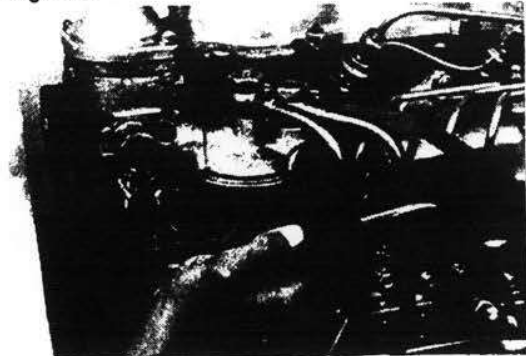
Pull out the oil level gauge and examine the oil adhering on the graduated part. The oil should not be discolored or thin.

Fig. 2-20

**FUEL FILTER****REPLACEMENT****[Cartridge Type]**

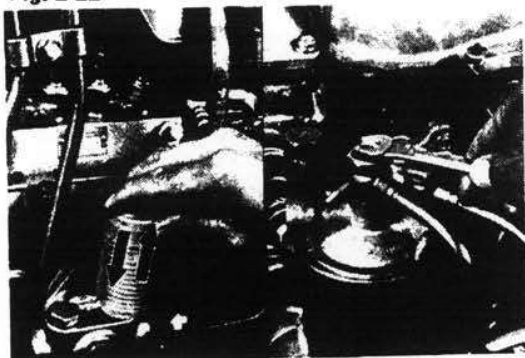
1. Remove the fuel filter by using SST [09228-34010].

Fig. 2-21



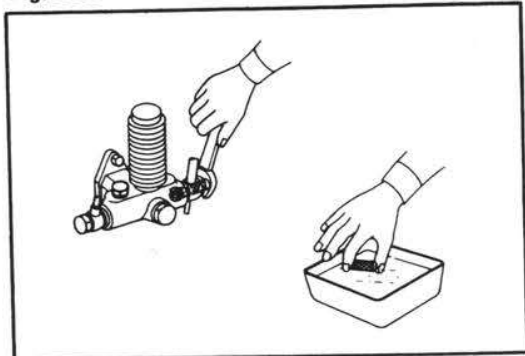
2. To install, hand-tighten the fuel filter.

Fig. 2-22



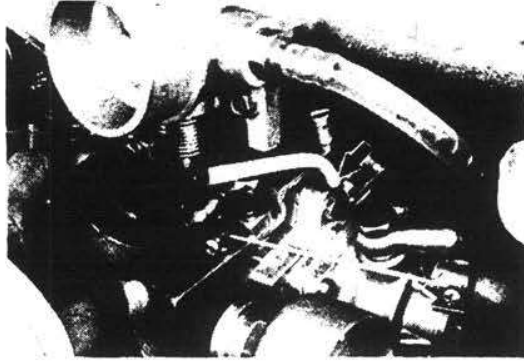
3. Bleed the air from fuel filter by operating priming pump.
4. After starting the engine, check for fuel leaks.

Fig. 2-23

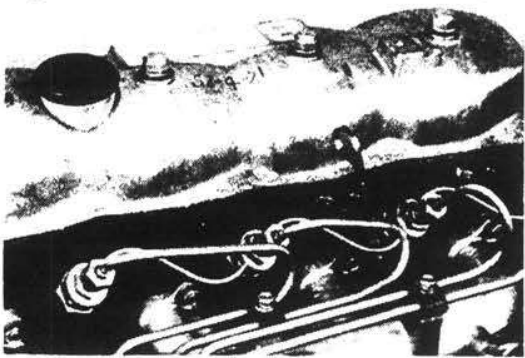
**[Feed Pump Filter]**

Remove the inlet union, and clean the filter.

2-10

ENGINE TUNE-UP – Injection Pump, Compression Pressure**Fig. 2-24****INJECTION PUMP****LUBRICATE DIAPHRAGM HOUSING**

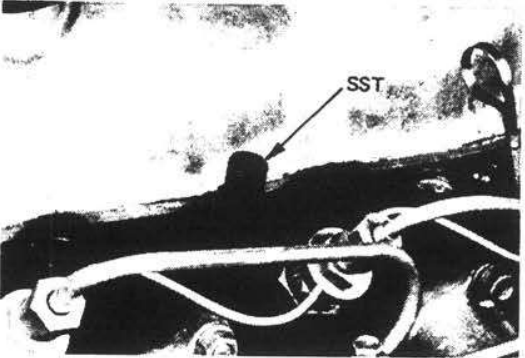
Place 3 or 4 drops of diaphragm oil to diaphragm.

Fig. 2-25**COMPRESSION PRESSURE**

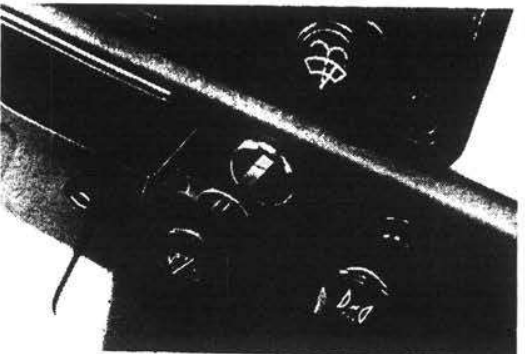
1. Warm up engine.
2. Remove all glow plugs.

— Caution —

Make sure the load wire is not grounded.

Fig. 2-26

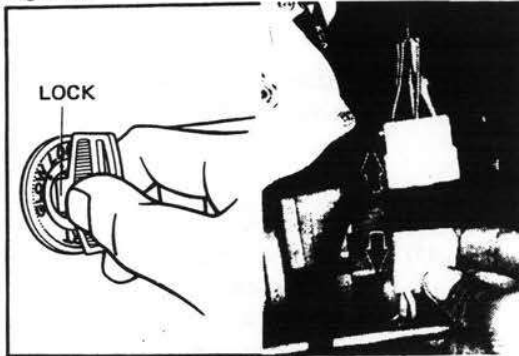
3. Install SST[09992-00020] to the glow plug mounting hole and insert a compression gauge.

Fig. 2-27**[Without EDIC System]**

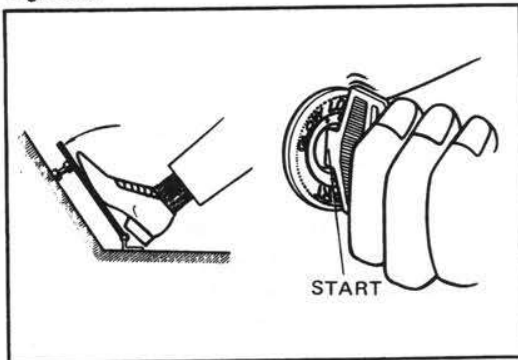
4. Pull the stop button all the way out.

ENGINE TUNE-UP – Compression Pressure

2-11

Fig. 2-28**[With EDIC System]**

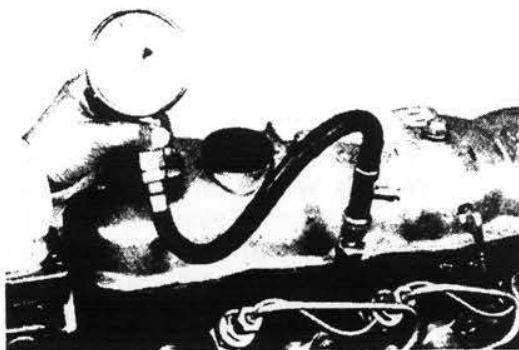
4. Disconnect the connector of EDIC motor wires after turning the engine key to "LOCK" position.

Fig. 2-29

5. Depress accelerator pedal all the way down.
6. Measure the compression pressure while cranking the engine with starter motor.

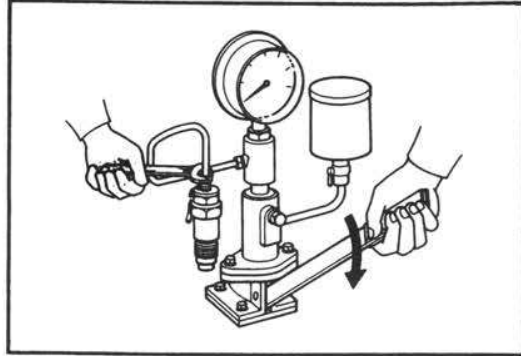
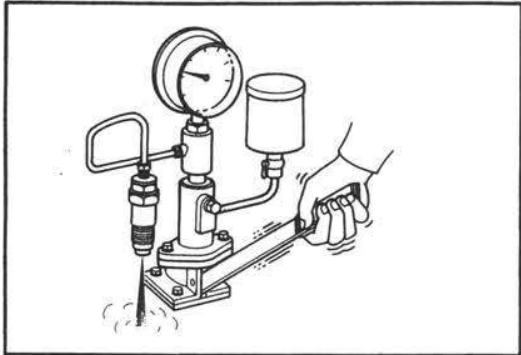
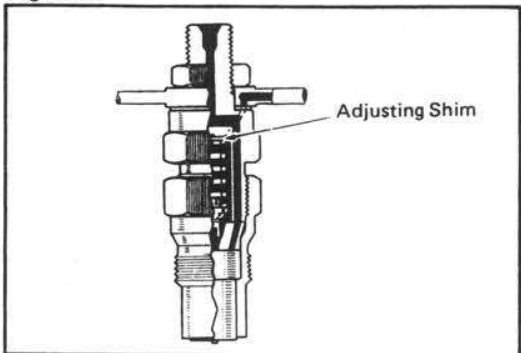
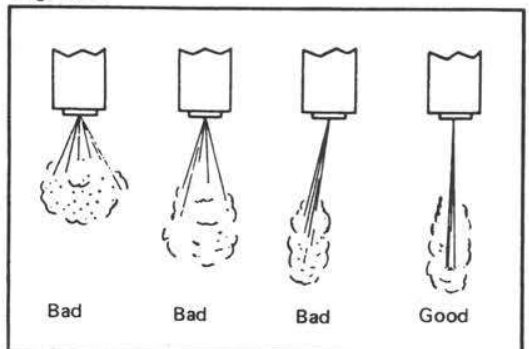
— Note —

Keep pressure measuring time to a minimum.

Fig. 2-30

Cranking speed	250 rpm
Compression pressure	
STD	30.0 kg/cm ² (427 psi)
Limit	20.0 kg/cm ² (284 psi)
Variation limit between cylinders	
	2.0 kg/cm ² (28 psi)

2-12

ENGINE TUNE-UP — Injection Nozzle**Fig. 2-31****Fig. 2-32****Fig. 2-33****Fig. 2-34****INJECTION NOZZLE****SPRAY TEST**

1. Install nozzle to injection nozzle hand tester and bleed air from union nut.
2. Injection pressure.
 - (1) Pump the tester handle 50 – 60 times/minutes by hand.
 - (2) Read injection starting pressure.

Opening pressure**New nozzle**

115 – 125 kg/cm²
(1636 – 1778 psi)

Reused nozzle

105 – 125 kg/cm²
(1493 – 1778 psi)

— Note —

1. Proper nozzle operation can be determined by the sound of snarl.
2. Adjust the injection starting pressure to 110 – 125 kg/cm² (1565 – 1778 psi), if the reused nozzle was overhauled.

3. To adjust the injection pressure, change the shim on the top of pressure spring.

— Note —

1. 20 shims are available, each varying in thickness by 0.05 mm (0.0020 in.) from 1.00 – 1.95 mm (0.0394 – 0.0768 in.).
2. Varying the adjusting shim thickness by 0.05 mm (0.0020 in.) changes the injection pressure by about 5 kg/cm² (71 psi).

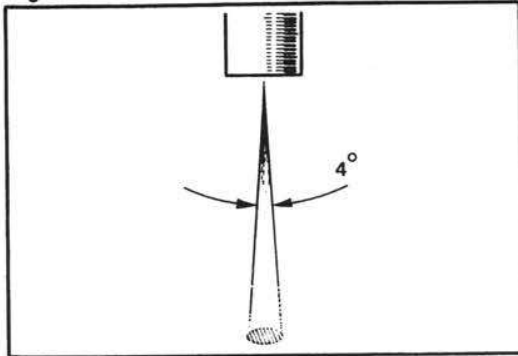
4. Spray patterns

- (1) Check the spray patterns when pumping the tester handle 50 – 60 times/minutes by hand.

ENGINE TUNE-UP – Injection Nozzle

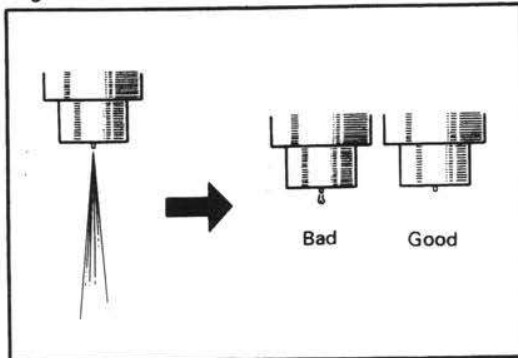
2-13

Fig. 2-35



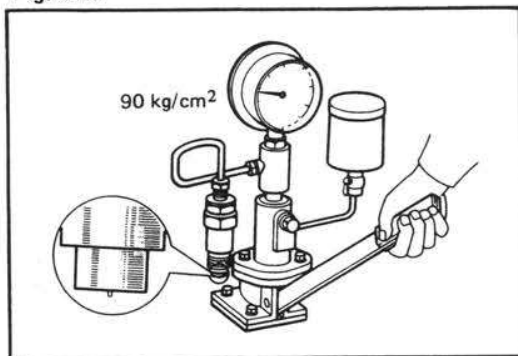
- (2) Spray should spread evenly down the nozzle center line in 4° conical form.
- (3) Place a white sheet of paper about 30 cm (12 in.) away from the nozzle to check if spray pattern is in circular form.

Fig. 2-36



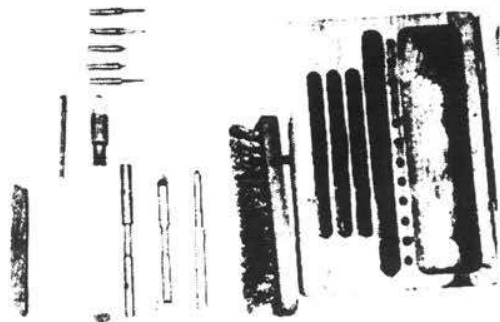
5. There should be no dripping after injection.

Fig. 2-37



6. Leakage test.
Apply 90 kg/cm^2 (1,280 psi) of fuel pressure, and check for leaks at nozzle valve seat and retaining nut.

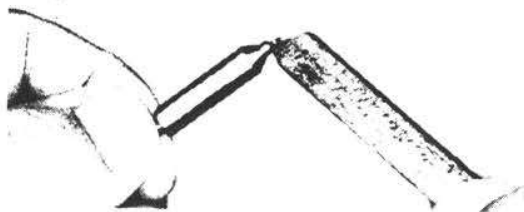
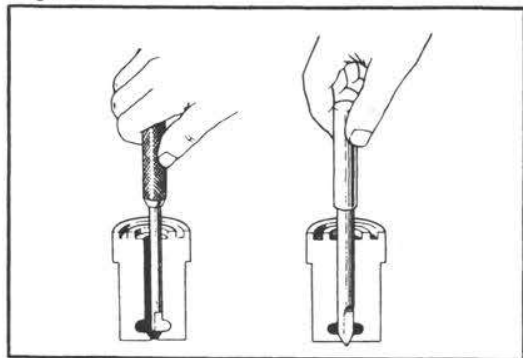
2-14

ENGINE TUNE-UP — Injection Nozzle**Fig. 2-38****NOZZLE CLEANING**

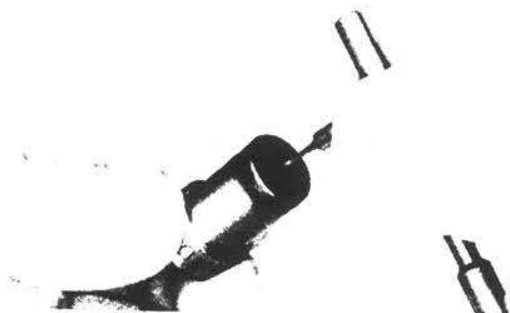
1. Refer to "FUEL SYSTEM" section and disassemble the nozzle holder.
2. To wash nozzle, use nozzle cleaning kit, and wash in clean diesel oil or light oil.

Fig. 2-39

3. Remove the carbon adhering on nozzle needle tip, using a wooden stick.

**Fig. 2-40**

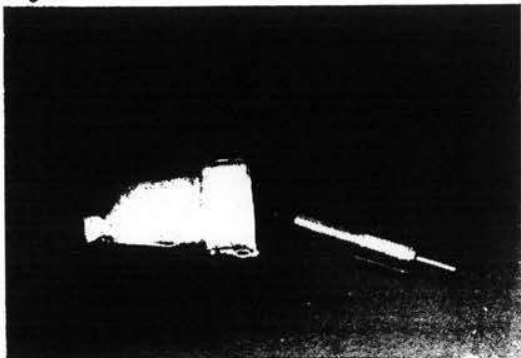
4. Clean the nozzle seat with a cleaning scraper.

Fig. 2-41

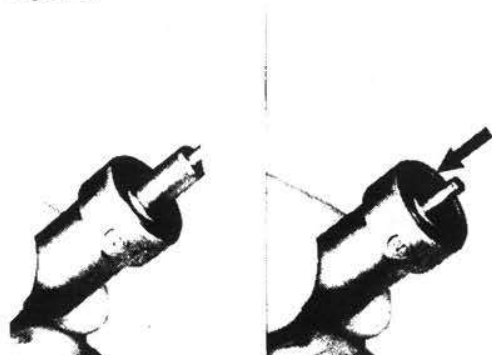
5. Clean the nozzle body orifice with a cleaning needle.

ENGINE TUNE-UP — Injection Nozzle**2-15****Fig. 2-42**

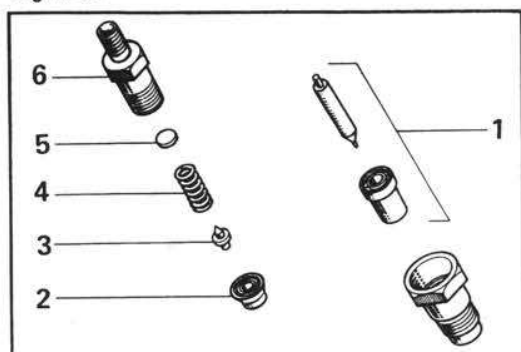
6. Remove the carbon from the exterior of the nozzle body (except wrapping angle) with a brass brush.

Fig. 2-43

7. Wash the nozzle in clean diesel fuel or light oil.

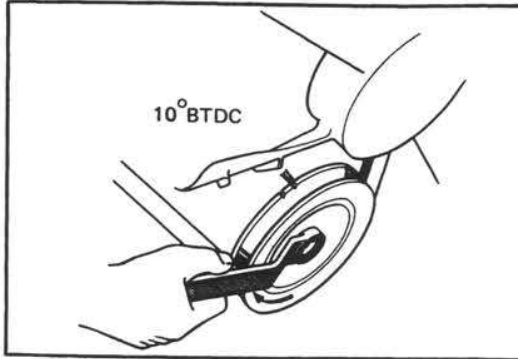
Fig. 2-44

8. Pull out the needle about half way from the body and then release.
9. Needle should sink into the body extremely smoothly by its own weight.
10. Repeat this test rotating needle slightly after each test.

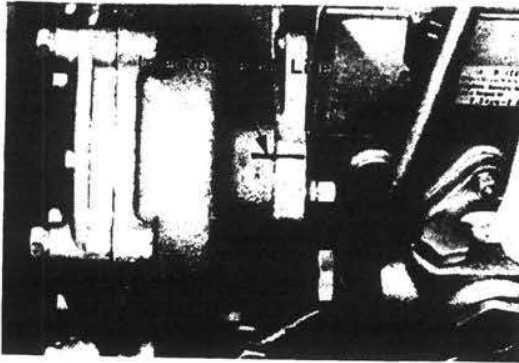
Fig. 2-45

11. Refer to "FUEL SYSTEM" section and assemble the nozzle holder.
12. Perform spray test.

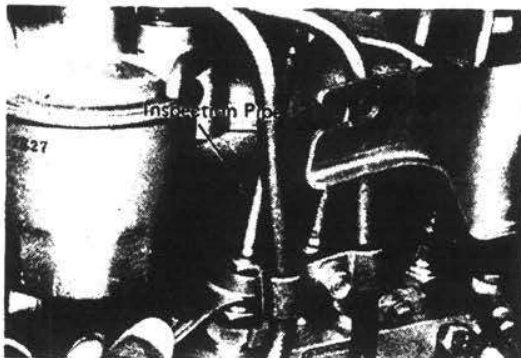
2-16

ENGINE TUNE-UP – Injection Timing**Fig. 2-46****INJECTION TIMING****INSPECTION & ADJUSTMENT**

1. Set the No.1 cylinder piston to 10° BTDC/Compression.

Fig. 2-47

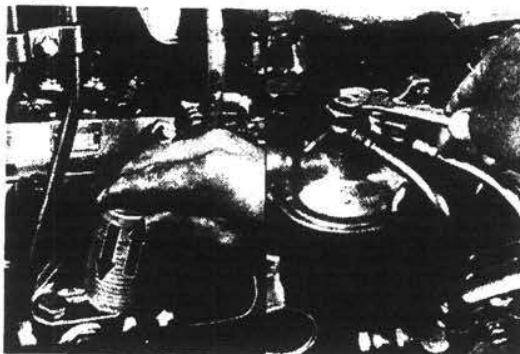
2. Set the aligning mark on the injection pump flange against the index mark on the timing gear case.

Fig. 2-48

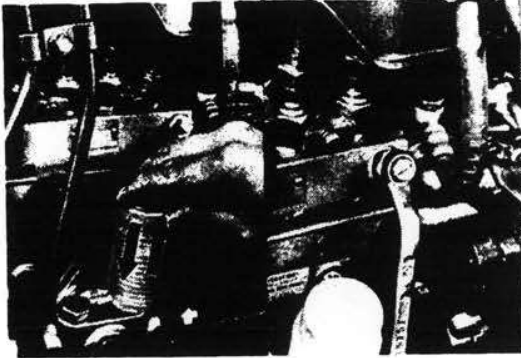
3. Check the injection timing
 - (1) Install the inspection pipe on the No.1 delivery valve holder.

— Note —

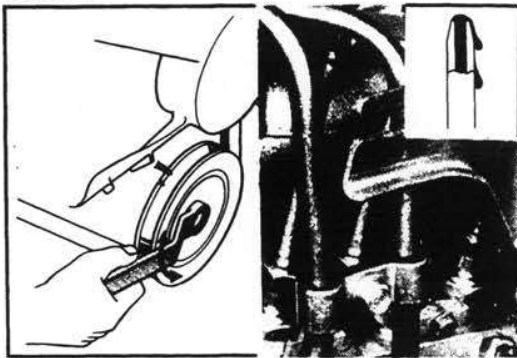
The length of the inspection pipe should be kept as short as possible.

Fig. 2-49

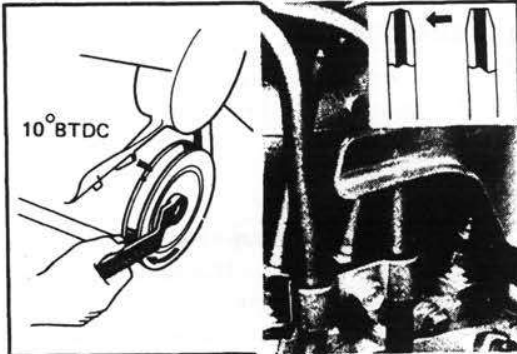
- (2) Bleed air from the fuel filter by operating the priming pump.

ENGINE TUNE-UP – Injection Timing**2-17****Fig. 2-50**

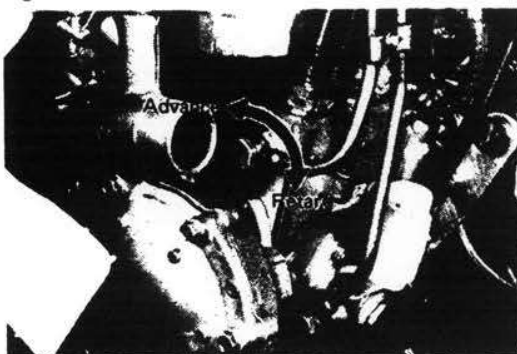
- (3) Bleed air from the injection pump by operating the priming pump.

Fig. 2-51

- (4) Rotate the crank pulley slightly to the left and right. Repeat this action until fuel surfaces from the inspection pipe.

Fig. 2-52

- (5) Slowly rotate the crank pulley. The fuel level in the inspection pipe should start to rise when the No.1 piston is at 10° BTDC/Compression.

Fig. 2-53

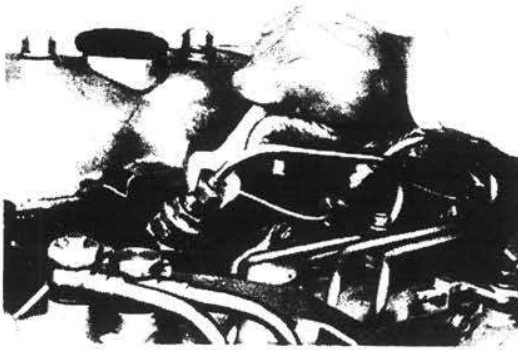
4. Adjust the injection timing by tilting the injection pump body slightly.
5. Recheck the injection timing.

— Note —

This operation should be repeated at least two or three times.

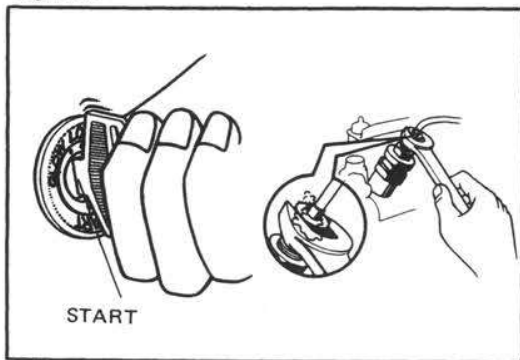
2-18 ENGINE TUNE-UP — Injection Timing, Valve Clearance

Fig. 2-54



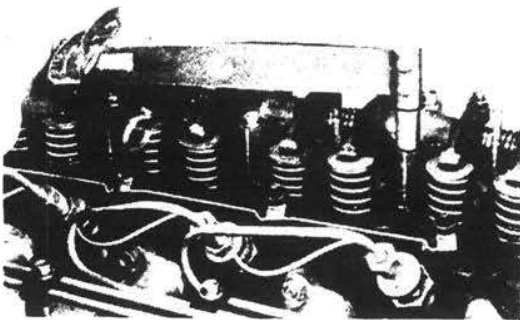
6. Remove the inspection pipe and install the No.1 injection pipe.

Fig. 2-55



7. Bleed air from the injection pipe by activating the starter motor.
8. Start the engine and inspect all pipe lines for fuel leaks.

Fig. 2-56



VALVE CLEARANCE



ADJUSTMENT

1. Warm up the engine.
2. Remove the cylinder head cover.
3. Retighten the head bolts and rocker support bolts.

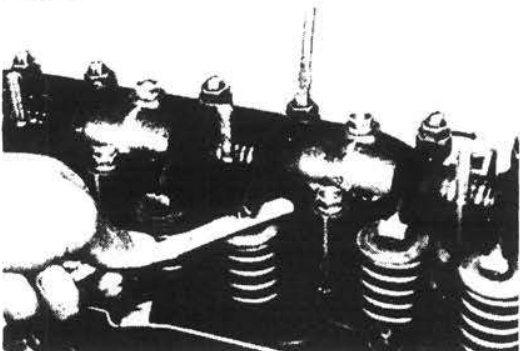
Torque, Cylinder head

11.5 – 12.0 kg-m (84 – 87 ft-lb)

Rocker support

1.0 – 1.6 kg-m (8 – 11 ft-lb)

Fig. 2-57



4. Start the engine and run at idle speed.
5. Adjust valve clearance.

Valve clearance

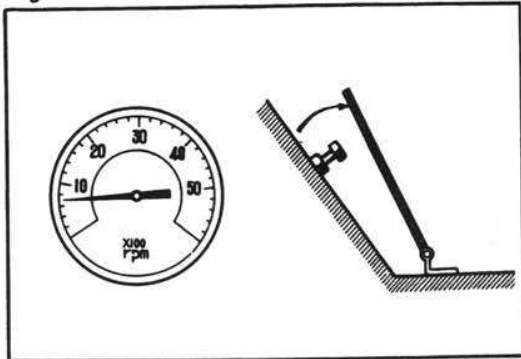
IN. 0.20 mm (0.008 in.)

EX. 0.36 mm (0.014 in.)

ENGINE TUNE-UP — Idle Speed & Maximum Speed

2-19

Fig. 2-58



IDLE SPEED & MAXIMUM SPEED

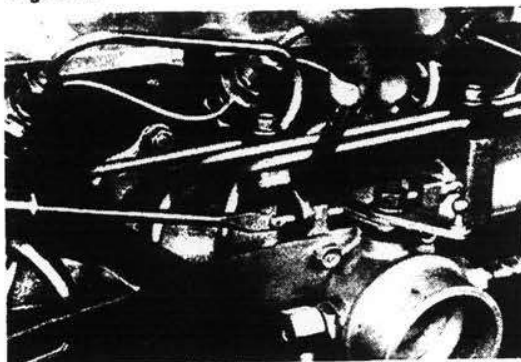


INSPECTION & ADJUSTMENT

1. Warm up the engine.
2. Check the engine idle speed.

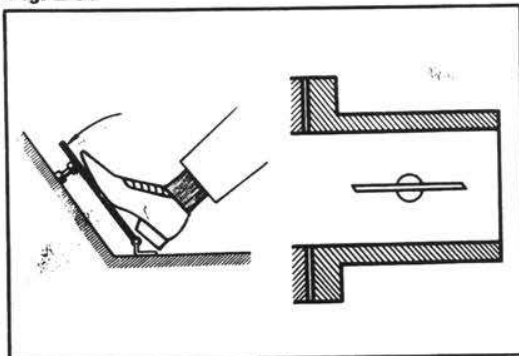
Idle speed 625 — 675 rpm

Fig. 2-59



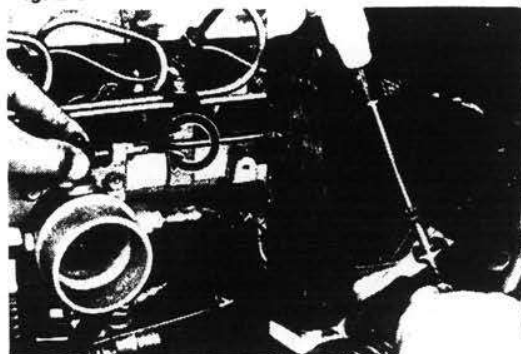
3. Adjust the idle speed by turning the stop plate adjusting screw, if it is not within specification.

Fig. 2-60



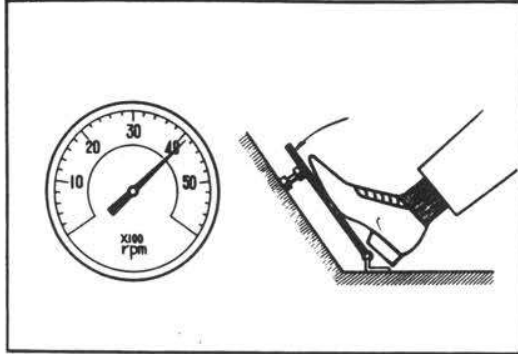
4. Make sure that the throttle valve is fully open when the accelerator pedal is depressed all the way.

Fig. 2-61



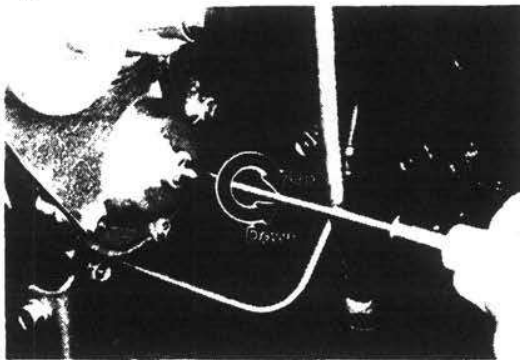
5. Make the full open adjustment through the full throttle adjusting bolt or accelerator pedal stop bolt.

2-20

ENGINE TUNE-UP — Idle Speed & Maximum Speed**Fig. 2-62**

6. Check the engine maximum speed when the accelerator pedal is depressed all the way.

Maximum speed 4050 — 4100 rpm

Fig. 2-63

7. If the maximum speed is not within specification, adjust by turning the adjusting screw of the injection pump.

