

TOYOTA

B & 2B ENGINE

REPAIR MANUAL

 TOYOTA MOTOR SALES CO., LTD.

FOREWORD

This repair manual has been prepared to provide information covering normal service repair for the new B and 2B engine equipped on the TOYOTA DYNA, COASTER and LAND CRUISER.

Applicable models:

BU20, 30 series

BB10 series

BJ40, 43 series (From F. No. BJ40-013531 and BJ43-001392)

All information contained in this manual is the most up-to-date at the time of publication. However, specifications and procedures are subject to change without previous notice.

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GENERAL

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GENERAL REPAIR INSTRUCTIONS

1. Use fender, seat, and floor covers to keep the car clean and prevent damage.
2. During disassembly, keep parts in order for reassembly.
3. Before performing electrical work, disconnect the cable to the positive (+) battery terminal.
4. Always replace gaskets and O-ring with new ones.
5. Always use sealer on gaskets to prevent leaks.
6. Carefully observe all specifications for bolt torques. Always use a torque wrench.
7. Use genuine Toyota parts.
8. If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels in order to ensure safety.
9. After the vehicle is jacked up, do not fail to support it on stands. It is extremely dangerous to do any work on the vehicle raised on jack alone, even for a small job that can be finished quickly.
10. Use of a special service tool (SST) may be required, depending on the nature of the repair. Be sure to use SST where specified and follow the proper work procedure. A list of the SST is found at the back of this manual.

ABBREVIATIONS USED IN THIS MANUAL

For convenience, the following codes are used in this manual.

Abbreviation	Term	Definition
BDC	Bottom Dead Center	
BTDC	Before Top Dead Center	
EX.	Exhaust	
IN.	Intake	
MP	Multipurpose	Use in the case of MP grease.
O/S	Oversize	Sizes larger than STD are indicated as O/S.
SST	Special Service Tool	This term designates tools that have been manufactured specially for the servicing of this vehicle. Their part numbers are shown in the text enclosed by [].
STD	Standard	This term refers to the dimension of the part when originally manufactured.
TDC	Top Dead Center	
U/S	Undersize	Sizes smaller than STD are indicated as U/S.

HOW TO USE THIS MANUAL

1. OVERVIEW ILLUSTRATION

Many service operations begin with an overview illustration as a general guide.

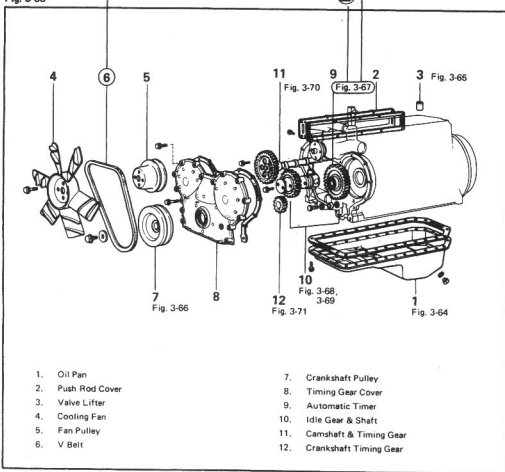
3-22 ENGINE SERVICE — Timing Gear

TIMING GEAR

DISASSEMBLY

Disassemble in numerical order.

Fig. 3-63



(A) The bold numerals show the order in which the components should be assembled.

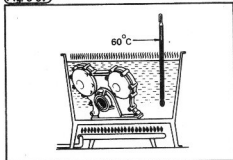
(B) The figure numbers refer to more detailed instructions, and specifications.

2. ILLUSTRATED INSTRUCTIONS

All important steps in every service job are illustrated, but obvious steps are omitted to save space.

Experienced technicians may only need to glance at the overview illustration and/or specifications.

Fig. 3-67



Remove the automatic timer from the timing gear cover after heating the cover to about 60°C (140°F).

E

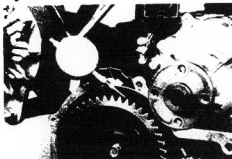
— Note —

For disassembly and assembly of the automatic timer, refer to "FUEL SYSTEM" section.

D

C

Fig. 3-68



Install the automatic timer to the injection pump spline shaft, and measure the timing gear backlashes.

Back lash

Camshaft, Timer to idle gear

Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.09 mm (0.0024 – 0.0035 in.)

Crankshaft to idle gear

Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.10 mm (0.0024 – 0.0039 in.)

F

- C: The picture gives basic information on what to do in the step.
- D: A symbol is often used to explain the action required.
- E: The text explains how to do the step.
- F: Specifications, Notes, and Cautions are given in bold type so you won't miss them.

SYMBOL MARKS

The following symbols have been adapted for simplicity and for easy comprehension.



REMOVE or DISASSEMBLE



INSTALL or ASSEMBLE



INSPECT



MEASURE



TIGHTEN



CLEAN



IMPORTANT

Fig. 1-1

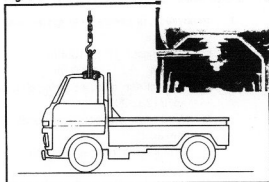


Fig. 1-2

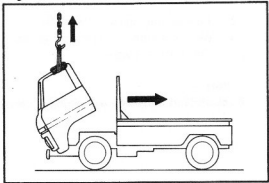


Fig. 1-3

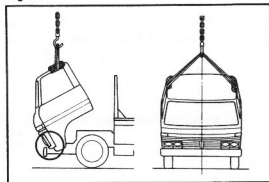
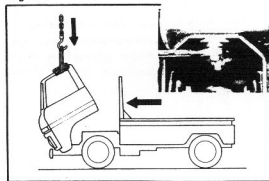


Fig. 1-4



FRONT CAB TILT PROCEDURE

When it is necessary to tilt the cab to perform major maintenance procedures, either of the following two methods may be used.

— Note —

Insure working safety at all times.

HOIST METHOD

1. Remove the cab mounting bolts.
2. Install the hoist to the cab.
3. Insuring that the hoist is kept perpendicular, tilt the cab by slowly pushing the vehicle backwards.

— Note —

Be careful not to damage any wiring or hoses.

4. Insure that there is no interference between the front grill and bumper.

— Note —

Always keep the cab supported by the hoist during work.

5. To lower the cab, slowly push the vehicle forward.
6. Install the mounting bolts after the cab has fully returned to its original position.

Fig. 1-5

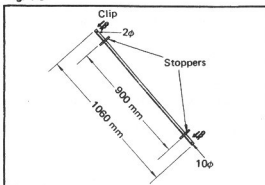


Fig. 1-6

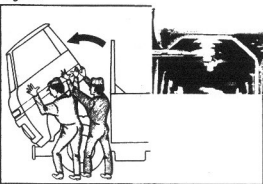


Fig. 1-7

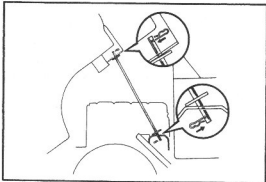
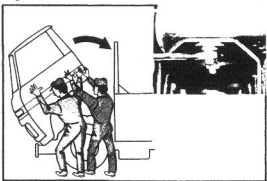


Fig. 1-8



LOCKING STAY METHOD

1. In advance, prepare a locking stay as shown in the figure.
 - Thickness 10 mm
 - Length 1060 mm
 - Clip (clutch release bearing clip) part no. 31232-30010
 - Weld two stoppers positioned 900 mm apart.
 - Drill a 2 mm hole at each end.

2. Remove the cab mounting bolts.
3. With 2 persons on both the left and right side, lift the upward.

— Note —

Be careful not to damage any wiring or hoses.

4. Insuring that there is no interference between the front bumper and grill, install the locking stay in the mounting bolt holes.

— Note —

Be careful that the cab does not overturn.

5. After necessary work is completed, the cab should be lowered slowly by four persons.
6. Install the mounting bolts after the cab has been fully lowered to its original position.

ENGINE TUNE-UP

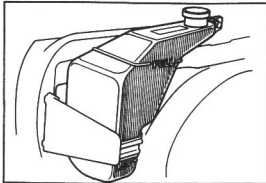
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ENGINE TUNE-UP ITEMS

	ITEM		SPECIFICATION		
1	COOLING SYSTEM	Coolant level	"Full" line		
		Coolant quality			
		Leakage			
		Radiator cap valve opening pressure	Limit	0.6 kg/cm ²	8.5 psi
			STD	0.75 – 1.05 kg/cm ²	
				10.7 – 14.9 psi	
		Coolant capacity (w/Heater)			
		B Engine	13.0 liter	13.7 USqt	
				11.4 Imp.qt	
		2B Engine	14.0 liter	14.8 USqt	
		12.3 Imp.qt			
2	DRIVE BELT	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.	
3	AIR CLEANER	Clean element			
		Oil capacity (Oil bath type)	Indicated level		
4	BATTERY	Specific gravity	1.25 – 1.27 at 20°C (68°F)		
		Electrolyte level			
5	ENGINE OIL	Oil level	"F" line		
		Oil quality			
		Replenishment	API service CC-CD classification		
		Oil capacity Total	7.3 liter	7.7 USqt	
				6.4 Imp.qt	
		Crankcase	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		STD	30.0 kg/cm ²	427 psi
			Limit	20.0 kg/cm ²	284 psi
				2.0 kg/cm ²	28 psi
		Variation limit between cylinders			

	ITEM		SPECIFICATION	
8	INJECTION NOZZLE	Injection starting pressure New nozzle Reused nozzle Spray condition Leakage test Cleaning	115 — 125 kg/cm ² 1636 — 1778 psi 105 — 125 kg/cm ² 1493 — 1778 psi 4° conical form At 90 kg/cm ²	1280 psi
9	INJECTION TIMING (STATIONARY)		10° BTDC	
	AIR BLEEDING	Fuel filter Injection pump High pressure pipe		
10	VALVE CLEARANCE (HOT)	Intake Exhaust	0.20 mm 0.008 in. 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 24V type Load current 12V type 24V type	About 20 seconds About 15 seconds 7.7 — 10.3 A 4.1 — 5.5 A	

Fig. 2-1

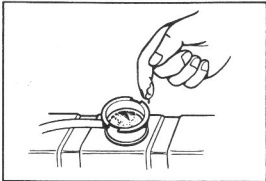


COOLING SYSTEM

CHECK COOLANT LEVEL

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

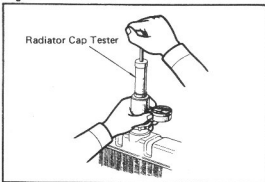
Fig. 2-2



CHECK COOLANT

Check for evidences of oil in coolant and deposit of rust or scales.

Fig. 2-3

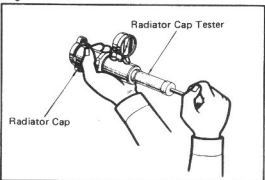


INSPECT COOLING SYSTEM

1. Install the radiator cap tester to the radiator, apply pressure and check for leakage in the cooling system under normal operating temperature.

Applicable pressure 1.2 kg/cm²
(17.1 psi)

Fig. 2-4

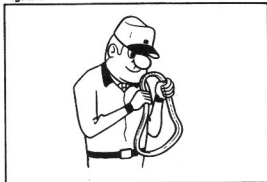


2. Check pressure sealing and vacuum relief valve operation.

Valve opening pressure	
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



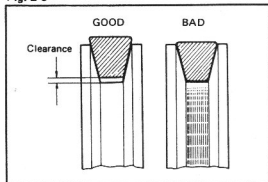
DRIVE BELT

VISUAL CHECK

Check belt for the following defects.

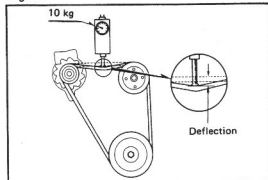
1. Cracks, deterioration or stretches.
2. Adherence of oil or grease.

Fig. 2-6



3. Improper contacting between belt and pulley.

Fig. 2-7



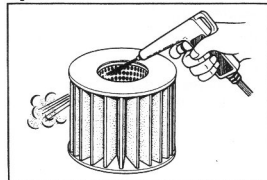
CHECK & ADJUST TENSION

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



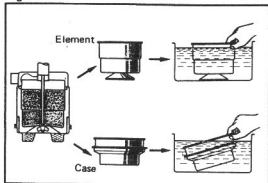
AIR CLEANER

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.

Fig. 2-9

**[Oil Bath Type]**

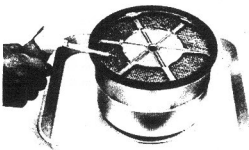
1. Wash the element and the case with kerosene, and dry them thoroughly.

Fig. 2-10



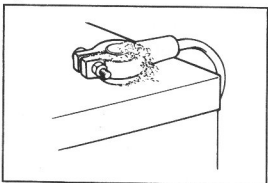
2. Refill the case up to the indicated level with clean engine oil.

Fig. 2-11



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

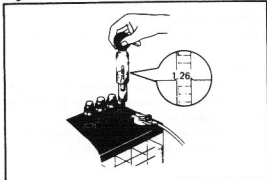
Fig. 2-12

**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.

Fig. 2-13

**MEASURE SPECIFIC GRAVITY**

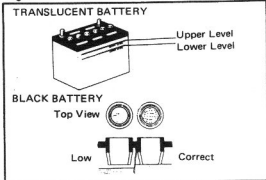
Specific gravity

1.25 - 1.27
at 20° (68°F)

— Note —

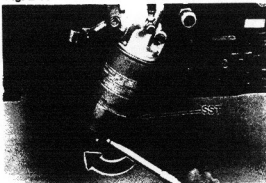
If reading is less than 1.23, recharge the battery.

Fig. 2-14

**CHECK ELECTROLYTE LEVEL**

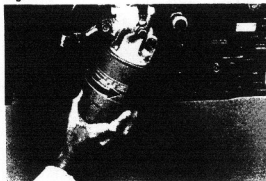
If low, add distilled water (or purified water) up to the proper level.

Fig. 2-15

**OIL FILTER****REPLACEMENT****[Cartridge Type]**

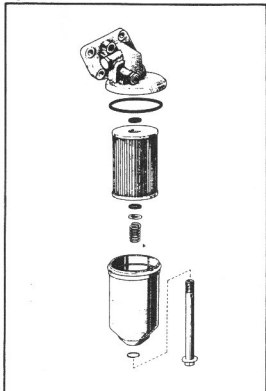
1. Remove the oil filter by using SST [09228-44010].

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.

Fig. 2-17

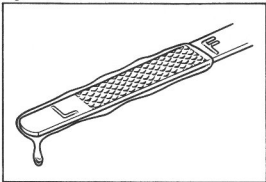
**[Paper Element Type]**

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**

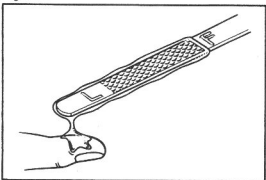
Oil level should be up to the "F" line on level gauge.

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

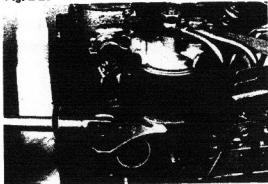


Fig. 2-21

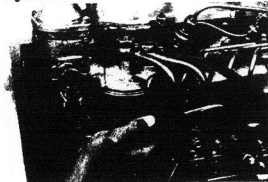


Fig. 2-22

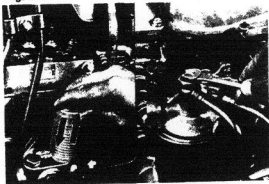
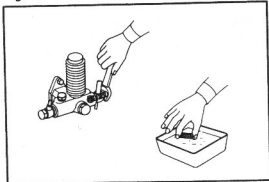


Fig. 2-23



FUEL FILTER



REPLACEMENT

[Cartridge Type]

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



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



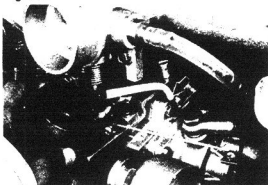
3. Bleed the air from fuel filter by operating priming pump.
4. After starting the engine, check for fuel leaks.



[Feed Pump Filter]

Remove the inlet union, and clean the filter.

Fig. 2-24

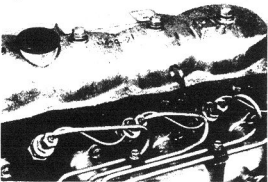


INJECTION PUMP

LUBRICATE DIAPHRAGM HOUSING

Place 3 or 4 drops of diaphragm oil to diaphragm.

Fig. 2-25



COMPRESSION PRESSURE

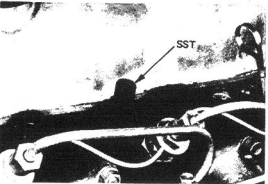


1. Warm up engine.
2. Remove all glow plugs.

— Caution —

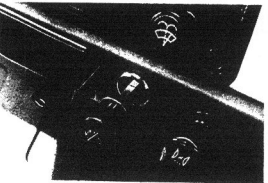
Make sure the load wire is not grounded.

Fig. 2-26



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

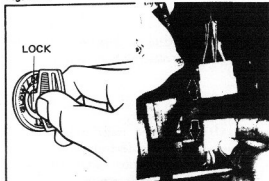
Fig. 2-27



[Without EDIC System]

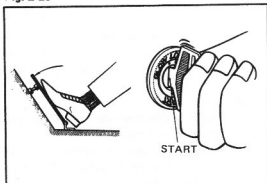
4. Pull the stop button all the way out.

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

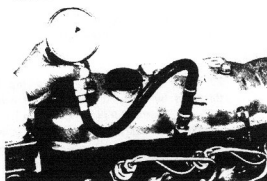


5. Depress accelerator pedal all the way down.
6. Measure the compression pressure while cranking the engine with starter motor.

— Note —

Keep pressure measuring time to a minimum.

Fig. 2-30



Cranking speed 250 rpm

Compression pressure

STD 30.0 kg/cm² (427 psi)

Limit 20.0 kg/cm² (284 psi)

Variation limit between cylinders

2.0 kg/cm² (28 psi)

Fig. 2-31

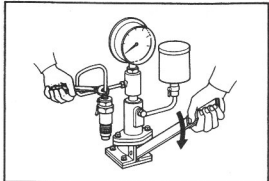


Fig. 2-32

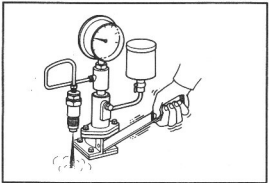


Fig. 2-33

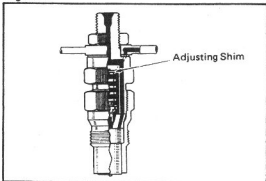
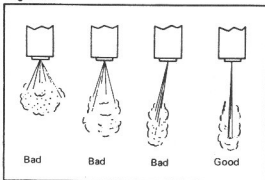


Fig. 2-34



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.

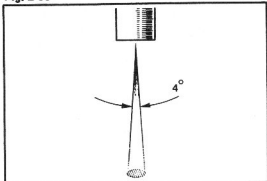
— Note —

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

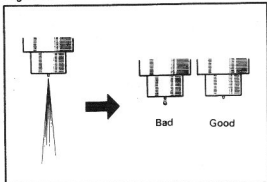
- (1) Check the spray patterns when pumping the tester handle 50 — 60 times/minutes by hand.

Fig. 2-35



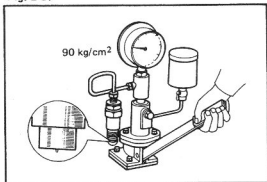
- (2) Spray should spread evenly down the nozzle center line in 4° conical form.
- (3) Place a white sheet of paper about 30 cm (12 in.) away from the nozzle to check if spray pattern is in circular form.

Fig. 2-36



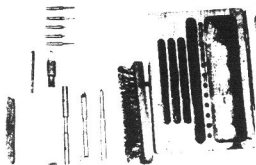
5. There should be no dripping after injection.

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.

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.

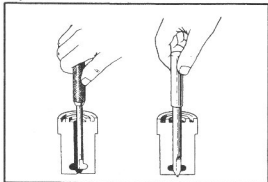
Fig. 2-39



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.

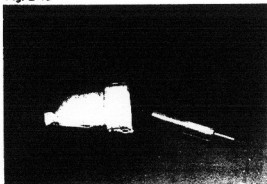


Fig. 2-42



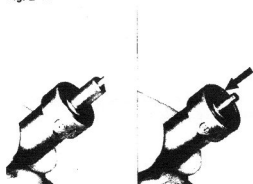
6. Remove the carbon from the exterior of the nozzle body (except wrapping angle) with a brass brush.

Fig. 2-43



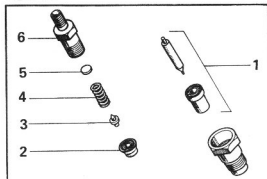
7. Wash the nozzle in clean diesel fuel or light oil.

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.

Fig. 2-46

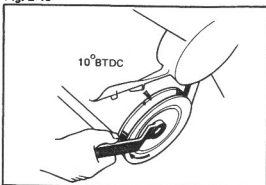


Fig. 2-47

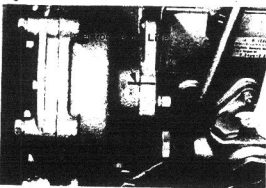


Fig. 2-48

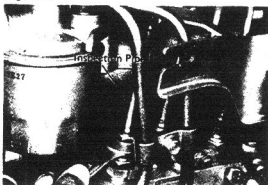
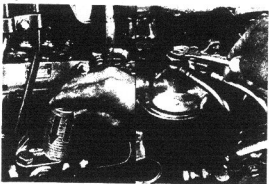


Fig. 2-49



INJECTION TIMING



INSPECTION & ADJUSTMENT

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



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

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

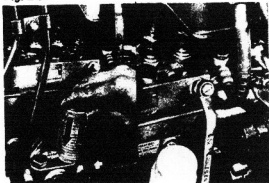
— Note —

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



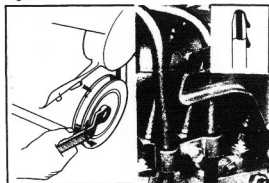
- (2) Bleed air from the fuel filter by operating the priming pump.

Fig. 2-50



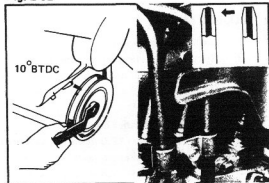
- (3) Bleed air from the injection pump by operating the priming pump.

Fig. 2-51



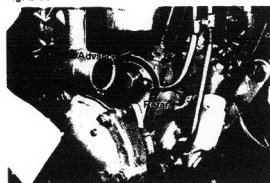
- (4) Rotate the crank pulley slightly to the left and right. Repeat this action until fuel surfaces from the inspection pipe.

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

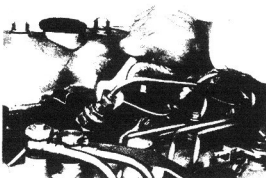


4. Adjust the injection timing by tilting the injection pump body slightly.
5. Recheck the injection timing.

— Note —

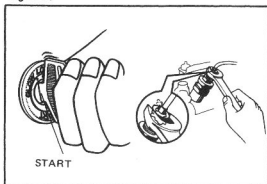
This operation should be repeated at least two or three times.

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

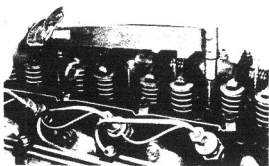
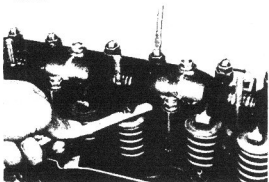


Fig. 2-57



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)

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.)

Fig. 2-58

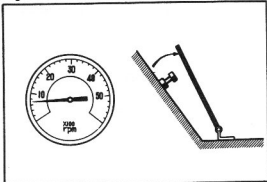


Fig. 2-59

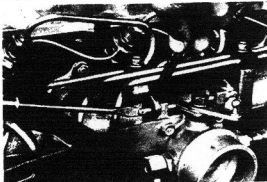


Fig. 2-60

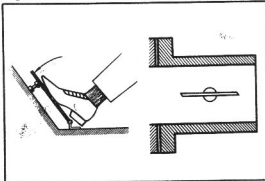
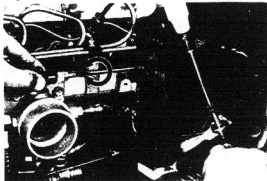


Fig. 2-61



IDLE SPEED & MAXIMUM SPEED

INSPECTION & ADJUSTMENT

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

Idle speed 625 — 675 rpm

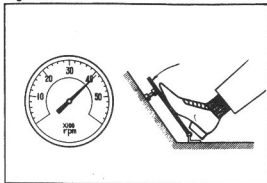
3. Adjust the idle speed by turning the stop plate adjusting screw, if it is not within specification.



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

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

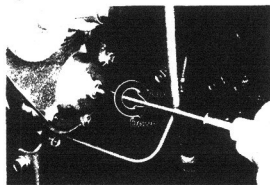
Fig. 2-62



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.

ENGINE SERVICE

	Page
CROSS SECTIONAL VIEW	3-2
CYLINDER HEAD	3-4
TIMING GEAR	3-22
CYLINDER BLOCK.....	3-33

CROSS SECTIONAL VIEW

Fig. 3-1

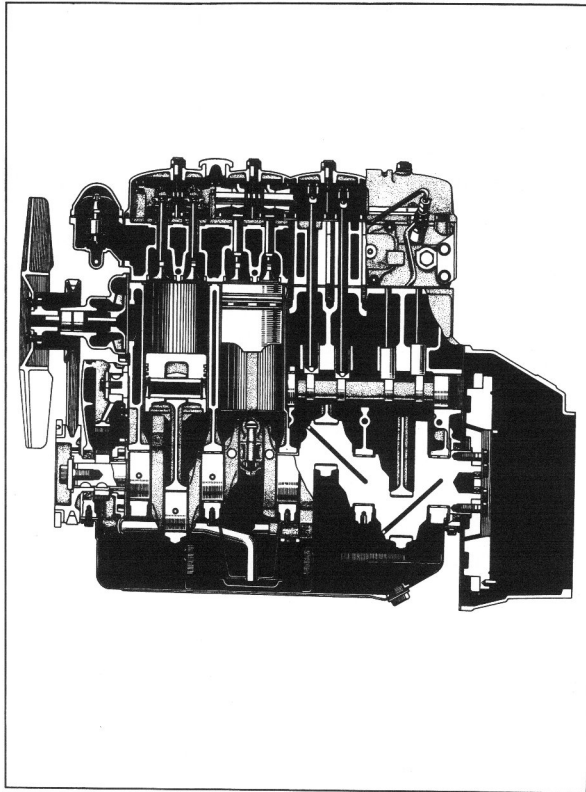
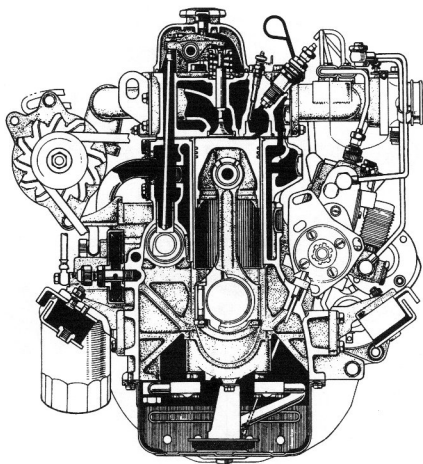


Fig. 3-2



CYLINDER HEAD

DISASSEMBLY

Disassemble in numerical order.

Fig. 3-3

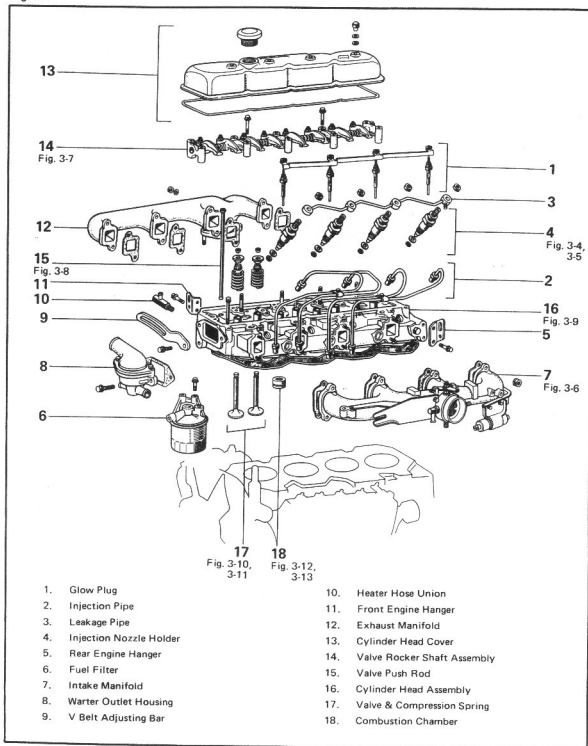
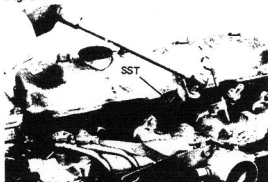


Fig. 3-4



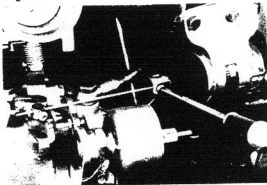
Remove injection nozzle holders with SST [09268-46011].

Fig. 3-5



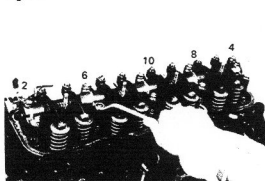
Keep the nozzle holders in correct order.

Fig. 3-6



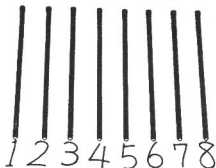
Disconnect the overinjection magnet connecting wire, and remove the intake manifold.

Fig. 3-7



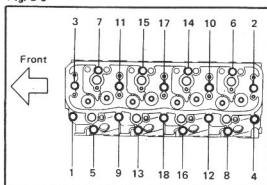
Loosen valve rocker support bolts little by little in three or four steps in the specified numerical sequence.

Fig. 3-8



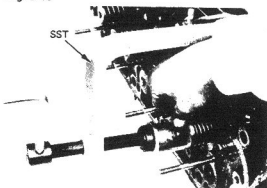
Keep push rods in correct order.

Fig. 3-9



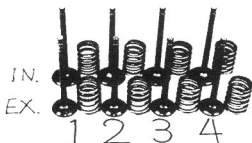
Loosen cylinder head bolts little by little in two or three steps in the indicated numerical sequence.

Fig. 3-10



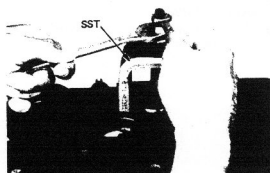
Compress the valve spring with SST[09202-43011] and remove the spring retainer locks.

Fig. 3-11



Keep valves and springs in correct order.

Fig. 3-12



Pull out the combustion chamber with SST [09208-48010].

— Caution —
Be careful not to damage the hole.

Fig. 3-13



Keep combustion chambers in correct order.



Fig. 3-14

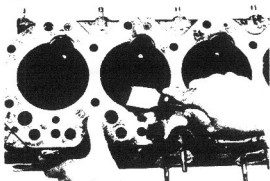


Fig. 3-15

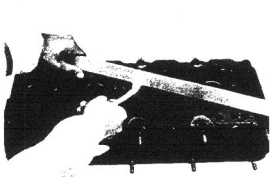


Fig. 3-16

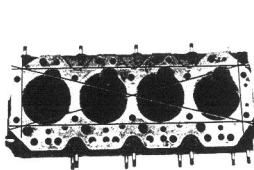
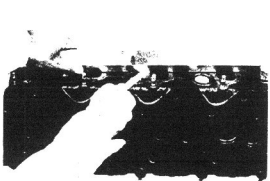


Fig. 3-17



INSPECTION & REPAIR



Cylinder Head

1. Clean and Check the cylinder head for cracks or scoring.



2. Check cylinder head underside surface for warpage with a precision straight edge and thickness gauge.

Underside surface warpage limit
0.05 mm (0.0020 in.)



3. Check surfaces along the indicated line for warpage.



4. Inspect the manifold mounting surface for warpage.

Manifold mounting surface warpage limit
0.2 mm (0.008 in.)

5. If the warpage exceeds the limit, either machine flat or replace cylinder head.

Fig. 3-18



Fig. 3-19

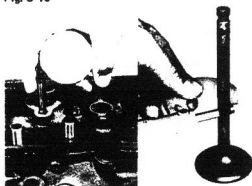
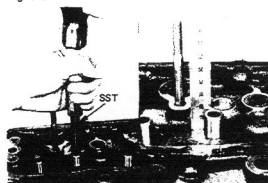


Fig. 3-20



Fig. 3-21

**Valve & Guide**

1. Clean and check the valves for wear, scores and bend.

2. Measure valve stem clearance.

- (1) Measure inside diameter of valve guide.

Guide inside diameter (for both IN. and EX.)

9.01 – 9.03 mm
(0.3547 – 0.3555 in.)

- (2) Measure valve stem diameter.

Stem diameter

IN. 8.97 – 8.99 mm
(0.3531 – 0.3539 in.)

EX. 8.95 – 8.97 mm
(0.3524 – 0.3531 in.)

Oil clearance limit

IN. 0.10 mm
(0.0039 in.)

EX. 0.12 mm
(0.0047 in.)



3. If the oil clearance exceeds the limit, replace guides and valves.

- (1) Drive out valve guide from top end toward the combustion chamber with SST [09201-60011].

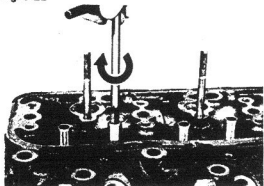


- (2) Drive in new valve guide until its end projects from the top of the cylinder head to the specified length below.

Projected length

16.6 – 17.4 mm
(0.654 – 0.685 in.)

Fig. 3-22

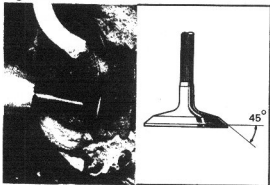


- (3) Ream valve guide to obtain specified clearance with a sharp reamer.

Oil clearance (STD)

IN.	0.02 – 0.06 mm (0.0008 – 0.0024 in.)
EX.	0.04 – 0.08 mm (0.0016 – 0.0031 in.)

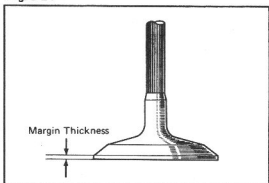
Fig. 3-23



4. Reface valve seating face with a valve refacer.

Valve face angle 45°

Fig. 3-24

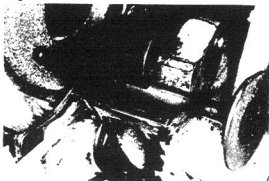


5. Check valve head margin thickness.

Margin thickness limit

IN.	0.9 mm (0.035 in.)
EX.	1.0 mm (0.039 in.)

Fig. 3-25



6. Resurface valve stem tip with a valve grinder.

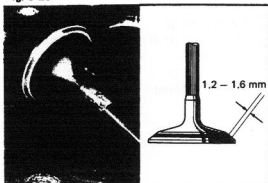
Stem tip resurfacing limit

0.5 mm (0.020 in.)

Overall length

IN.	127.95 mm (5.0374 in.)
EX.	127.75 mm (5.0295 in.)

Fig. 3-26

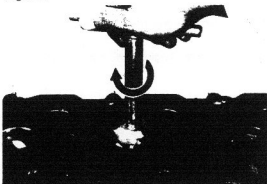
**Valve Seat**

1. Check the position of valve contact with seat. Coat valve face with prussian blue or red lead. Locate contact point on valve by rotating valve against seat.



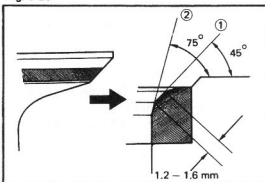
Contact width 1.2 – 1.6 mm
(0.047 – 0.063 in.)
Contact position Middle of valve face

Fig. 3-27



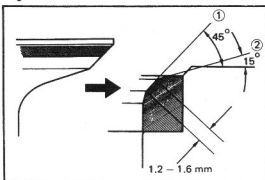
2. Resurface valve seat with 45° cutter.

Fig. 3-28



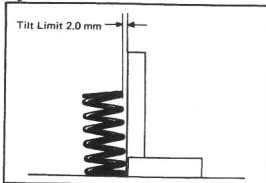
3. Correct seat position.
(1) If seat position is too high, use 45° and 75° cutters in the order indicated.

Fig. 3-29



- (2) If seat position is too low, use 45° and 15° cutters in the order indicated.

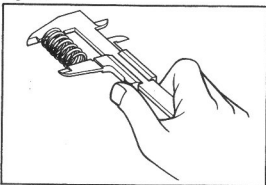
Fig. 3-30

**Valve Springs**

1. Check squareness of valve spring with a square.

Tilt limit 2.0 mm (0.079 in.)

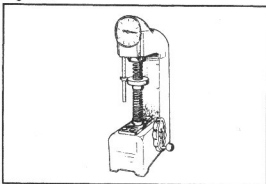
Fig. 3-31



2. Measure free height of valve springs.

Free height 45.5 mm (1.791 in.)

Fig. 3-32



3. Using a spring tester, measure spring tension at the specified installed height.

Installed height

EX. 39.5 mm (1.555 in.)

Installed tension

Limit 23.1 kg (50.9 lb)

STD IN. 25.5 kg (56.2 lb)

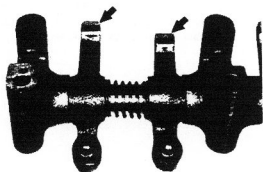
EX. 26.0 kg (57.3 lb)

Fig. 3-33

**Combustion Chamber**

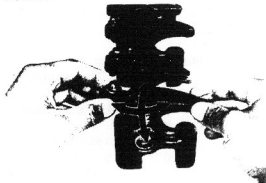
Clean and check combustion chamber for cracks and extreme damages.

Fig. 3-34

**Rocker Arms & Shaft**

1. Check the valve contacting surface of the rocker arm for wear.
Correct or replace if necessary.

Fig. 3-35



2. Check rocker arm-to-shaft clearance by moving each rocker arm as shown. Little or no movement should be possible.
If movement is felt, disassemble and inspect.

3. Disassemble valve rocker shaft assembly in numerical order.

— Note —

Keep rocker arms in correct order.

Fig. 3-36

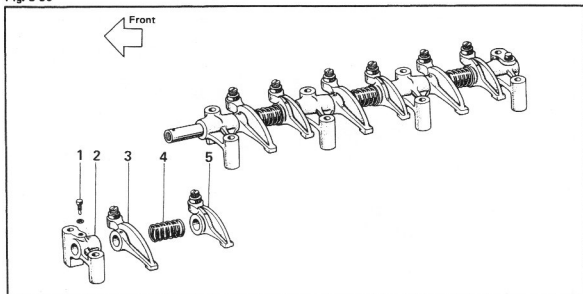
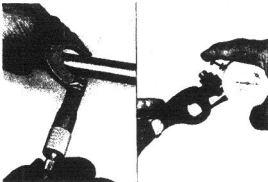


Fig. 3-37



4. Correct the valve contacting surface of the rocker arm with a valve refacer and oil stone, if only a light ridged wear.

Fig. 3-38



5. Measure oil clearance between rocker arm to shaft.

Shaft diameter limit	
	18.44 mm (0.7260 in.)
Rocker arm bore limit	
	18.60 mm (0.7323 in.)
Oil clearance	
Limit	0.1 mm (0.004 in.)
STD	0.02 – 0.06 mm (0.0008 – 0.0024 in.)

6. Assemble valve rocker shaft assembly in numerical order.

— Note —

Align oil hole of the front rocker support with the shaft oil hole.

Fig. 3-39

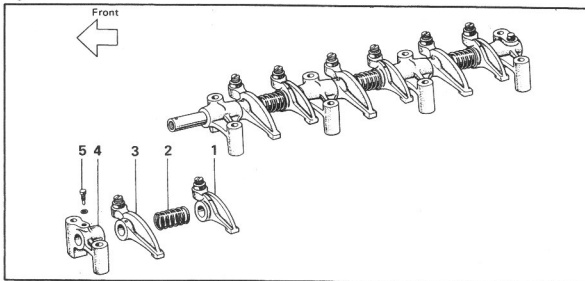


Fig. 3-40

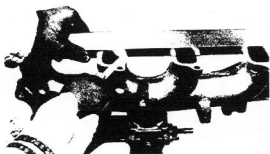
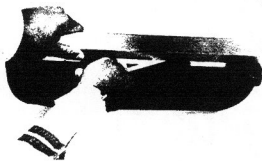


Fig. 3-41

**Manifold**

Using a precision straight edge and thickness gauge, inspect surfaces in contact with the cylinder head for warpage, and correct or replace if warped over the specified limit.

**Warpage limit**

0.4 mm (0.016 in.)

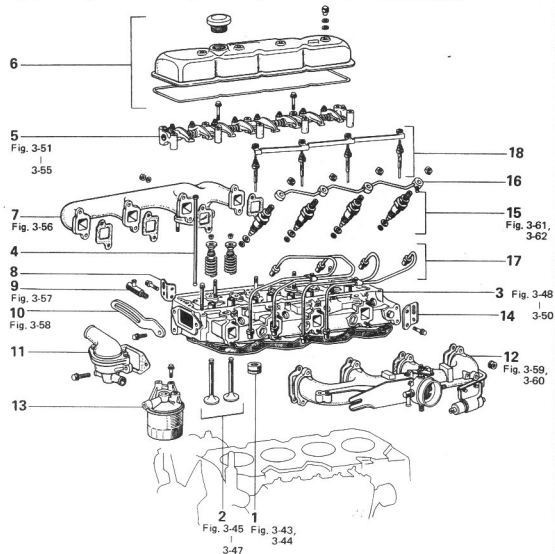
ASSEMBLY

Assemble in numerical order.

Fig. 3-42

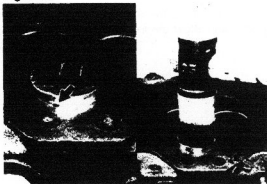
Thoroughly clean all parts to be assembled.

Apply clean engine oil to all sliding and rotating surfaces of the parts before assembly.



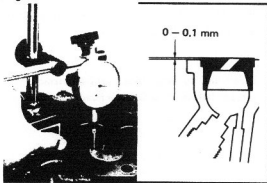
- | | |
|--------------------------------|-----------------------------|
| 1. Combustion Chamber | 10. V Belt Adjusting Bar |
| 2. Valve & Compression Spring | 11. Water Outlet Housing |
| 3. Cylinder Head Assembly | 12. Intake Manifold |
| 4. Valve Push Rod | 13. Fuel Filter |
| 5. Valve Rocker Shaft Assembly | 14. Rear Engine Hanger |
| 6. Cylinder Head Cover | 15. Injection Nozzle Holder |
| 7. Exhaust Manifold | 16. Leakage Pipe |
| 8. Front Engine Hanger | 17. Injection Pipe |
| 9. Heater Hose Union | 18. Glow Plug |

Fig. 3-43



Match the combustion chamber knock pin with the cylinder head notch, and drive in the combustion chamber.

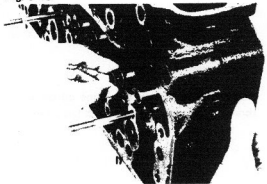
Fig. 3-44



Check combustion chamber protrusion.

Combustion chamber protrusion
0 - 0.10 mm (0 - 0.0039 in.)

Fig. 3-45

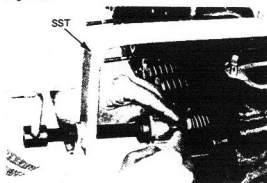


Install oil seal before assembling the valve spring.

— Note —

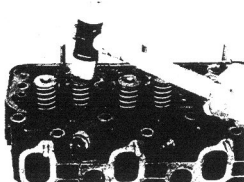
A new oil seal should be used whenever valve is disassembled.

Fig. 3-46



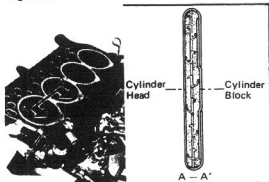
Compress the valve spring with SST[09202-43011] and insert the spring retainer locks.

Fig. 3-47



After installing the springs, lightly tap the stem ends and allow the springs to settle down snugly.

Fig. 3-48

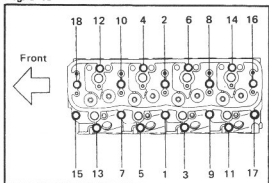


Put cylinder head gasket on the cylinder block, aligning the bolt holes as shown.

— Note —

Clean the cylinder block upper surface with a scraper before installing the head gasket.

Fig. 3-49

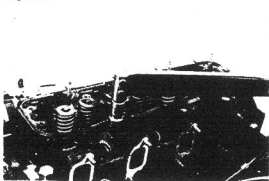


Tighten cylinder head bolts little by little in two or three steps in the specified numerical sequence.

— Note —

Apply a light coating of engine oil on the bolt threads and under the bolt head before installing.

Fig. 3-50



Tighten cylinder head bolts to specified torque.

Torque

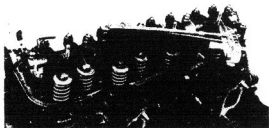
11.5 — 12.0 kg-m
(84 — 87 ft-lb)

Fig. 3-51



Tighten valve rocker support bolts little by little in three or four steps in the specified numerical sequence.

Fig. 3-52

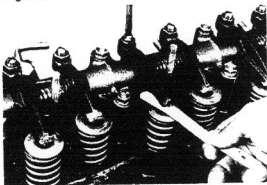


Tighten valve rocker support bolts to specified torque.

Torque

1.0 – 1.6 kg-m
(8 – 11 ft-lb)

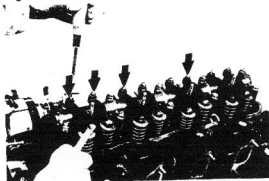
Fig. 3-53



Tentatively, adjust valve clearance.

1. Set No.1 cylinder to TDC/Compression.

Fig. 3-54

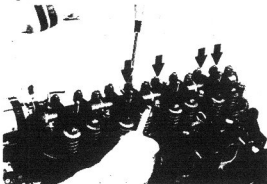


2. Adjust valve clearances indicated by arrows.

Valve clearance

IN. 0.20 mm (0.008 in.)
EX. 0.36 mm (0.014 in.)

Fig. 3-55



3. Rotate crankshaft one turn in normal direction.
4. Adjust remaining valves indicated by arrows.

Valve clearance

IN.	0.20 mm (0.008 in.)
EX.	0.36 mm (0.014 in.)

Fig. 3-56



Install exhaust manifold.

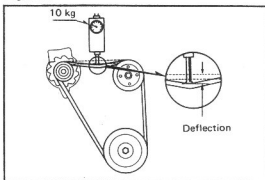
Torque	1.5 – 2.2 kg-m (11 – 15 ft-lb)
---------------	---

Fig. 3-57



Apply liquid sealer on the threads of the heater hose union, and assemble so that the union faces upward.

Fig. 3-58

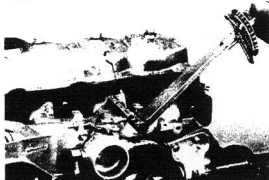


Adjust the "V" belt tension.

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. 3-59

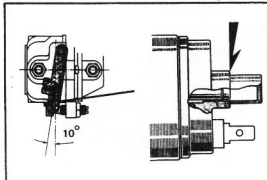


Install intake manifold.

Torque

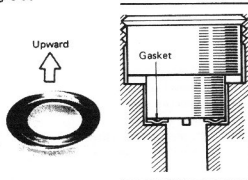
1.5 – 2.2 kg-m
(11 – 15 ft-lb)

Fig. 3-60



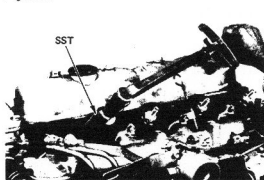
Connect and adjust the overinjection magnet connecting wire with the magnet core end surface positioned as shown.

Fig. 3-61



Note the orientation of the nozzle seat gasket as shown.

Fig. 3-62



Tighten nozzle holder with SST[09260-46011].

Torque

6.0 – 8.0 kg-m
(44 – 57 ft-lb)

TIMING GEAR**DISASSEMBLY**

Disassemble in numerical order.

Fig. 3-63

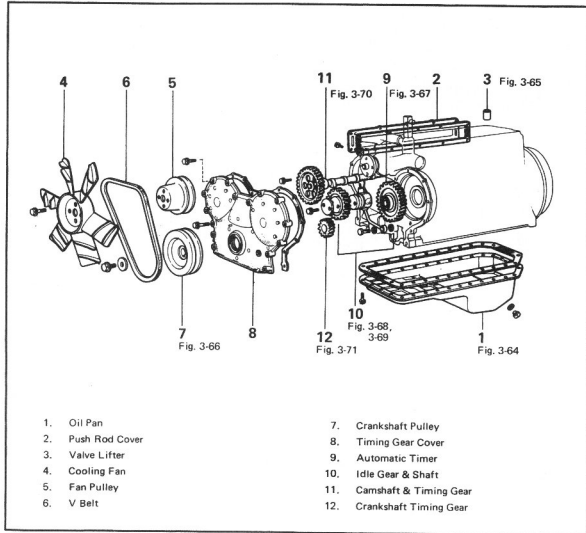
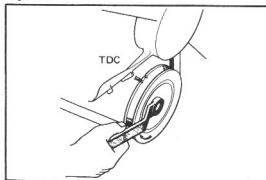


Fig. 3-64



Before starting work, set No.1 cylinder piston at TDC/Compression.

Fig. 3-65



Keep valve lifters in correct order.

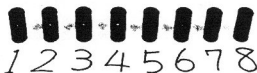
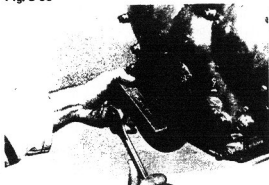
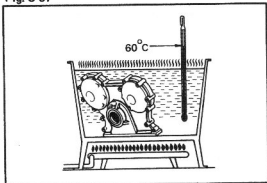


Fig. 3-66



Pull out the crankshaft pulley with SST[09213-31021].

Fig. 3-67

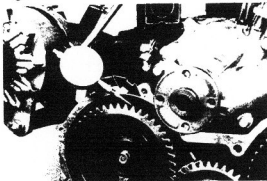


Remove the automatic timer from the timing gear cover after heating the cover to about 60°C (140°F).

— Note —

For disassembly and assembly of the automatic timer, refer to "FUEL SYSTEM" section.

Fig. 3-68



Install the automatic timer to the injection pump spline shaft, and measure the timing gear backlashes.

Back lash

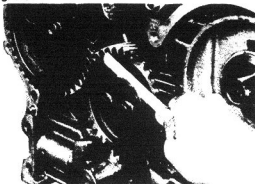
Camshaft, Timer to idle gear

Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.09 mm (0.0024 – 0.0035 in.)

Crankshaft to idle gear

Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.10 mm (0.0024 – 0.0039 in.)

Fig. 3-69

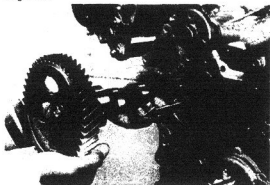


Measure idle gear thrust clearance.

Thrust clearance

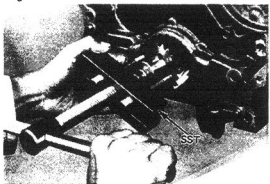
Limit	0.3 mm (0.012 in.)
STD	0.08 – 0.20 mm (0.0031 – 0.0079 in.)

Fig. 3-70



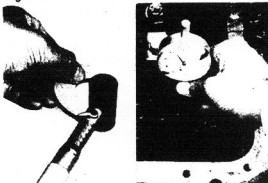
Pull out camshaft using care not to damage the camshaft bearings.

Fig. 3-71



Pull out crankshaft timing gear with SST[09213-60015].

Fig. 3-72

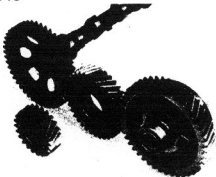
**INSPECTION & REPAIR****Valve Lifter**

Inspect lifters and lifter bores for wear or damage.

Oil clearance

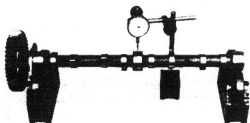
Limit	0.1 mm (0.004 in.)
STD	0.02 – 0.06 mm (0.0008 – 0.0024 in.)

Fig. 3-73

**Timing Gears**

Inspect gears for cracks, wear and chipped teeth. If damaged, replace both timing gears.

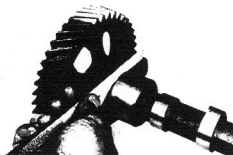
Fig. 3-74

**Camshaft**

1. Inspect camshaft for straightness, damage or wear.
2. Measure the run out.

Run out limit 0.04 mm (0.0016 in.)

Fig. 3-75

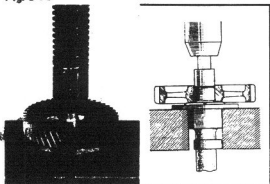


3. Measure camshaft thrust clearance.

Thrust clearance

Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.13 mm (0.0024 – 0.0051 in.)

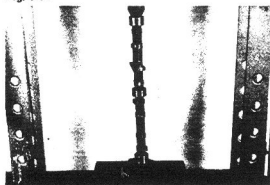
Fig. 3-76



4. Replace thrust plate if the thrust clearance exceeds the limit.

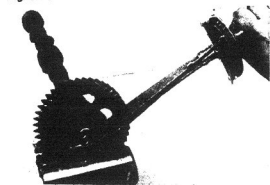
(1) Using a press and a spacer, press out the timing gear from the camshaft.

Fig. 3-77



- (2) Using a press, press in the timing gear.

Fig. 3-78



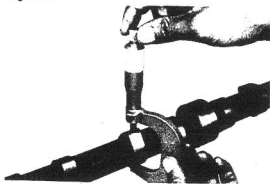
- (3) Tighten retaining bolt.

Torque 3.0 – 4.5 kg-m
(22 – 32 ft-lb)

— Note —

Apply a light coating of engine oil on the bolt threads and under the bolt head before installing.

Fig. 3-79



5. Measure cam height.

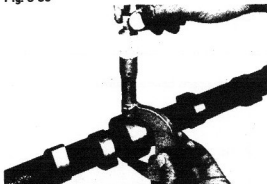
Cam Height (for both IN. and EX.)

Limit 39.0 mm (1.535 in.)

STD 39.47 – 39.56 mm

(1.5539 – 1.5575 in.)

Fig. 3-80

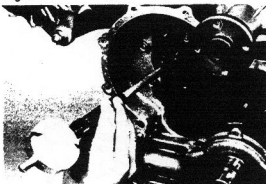


6. Measure journal oil clearance.
(1) Measure camshaft journal diameter.

Journal diameter (STD)

No.1	47.16 — 47.18 mm (1.8567 — 1.8575 in.)
No.2	46.96 — 46.98 mm (1.8488 — 1.8496 in.)
No.3	46.76 — 46.78 mm (1.8409 — 1.8417 in.)

Fig. 3-81

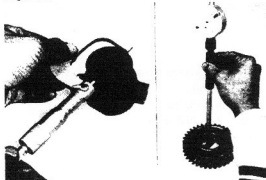


- (2) Measure bearing inner diameter, referring to "CYLINDER BLOCK" section.

Oil clearance

Limit	0.1 mm (0.004 in.)
STD	0.03 — 0.07 mm (0.0012 — 0.0028 in.)

Fig. 3-82

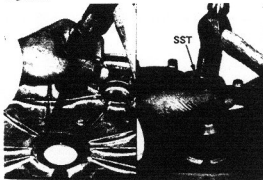
**Idle Gear**

Measure idle gear oil clearance.

Oil clearance

Limit	0.3 mm (0.012 in.)
STD	0.04 — 0.09 mm (0.0016 — 0.0035 in.)

Fig. 3-83

**Crankshaft Front Oil Seal**

1. Check oil seal for wear or damage.
2. Replace oil seal with SST [09223-46010].



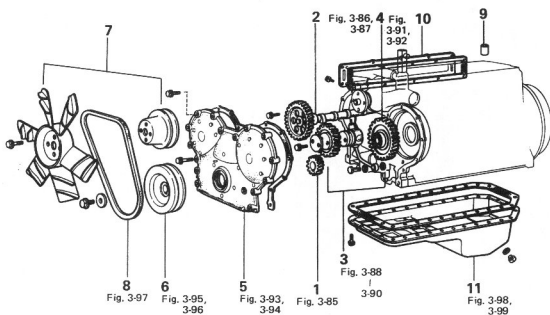
ASSEMBLY

Assemble in numerical order.

Fig. 3-84

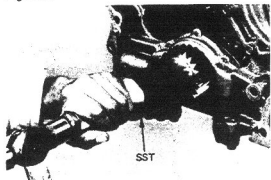
Thoroughly clean all parts to be assembled.

Apply clean engine oil to all sliding and rotating surfaces of the parts before assembly.



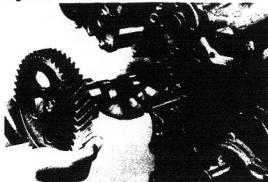
- | | |
|---------------------------|-----------------------------|
| 1. Crankshaft Timing Gear | 7. Cooling Fan & Fan Pulley |
| 2. Camshaft & Timing Gear | 8. V Belt |
| 3. Idle Gear & Shaft | 9. Valve Lifter |
| 4. Automatic Timer | 10. Push Rod Cover |
| 5. Timing Gear Cover | 11. Oil Pan |
| 6. Crankshaft Pulley | |

Fig. 3-85



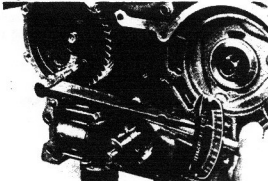
Drive in crankshaft timing gear with SST [09214 -60010].

Fig. 3-86



Insert camshaft using care not to damage the camshaft bearings.

Fig. 3-87

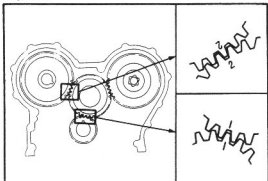


Tighten camshaft thrust plate.

Torque

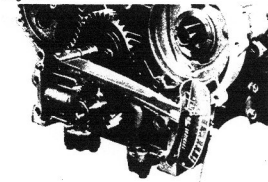
**1.0 – 1.6 kg-m
(8 – 11 ft-lb)**

Fig. 3-88



Set idle gear aligning marks "1" and "2" respectively against crankshaft gear mark "1" and camshaft gear mark "2".

Fig. 3-89



Tighten the idle gear and shaft.

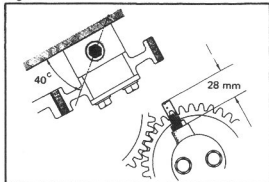
Torque

**4.0 – 5.5 kg-m
(29 – 39 ft-lb)**

— Note —

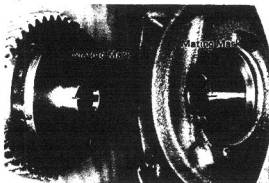
Apply a light coating of engine oil on the bolt threads and under head (thrust plate contacting surface) before installing the bolts.

Fig. 3-90



Oil injection hole should face the side where the camshaft and idle gears are engaged.

Fig. 3-91

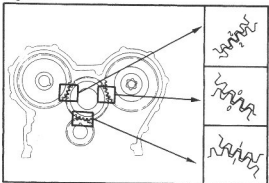


Align the mating marks on injection pump spline shaft and timer drive shaft when installing the automatic timer.

— Note —

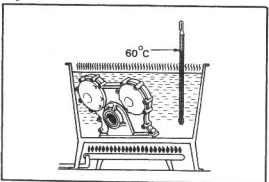
Coat the splines and bearing with MP grease.

Fig. 3-92



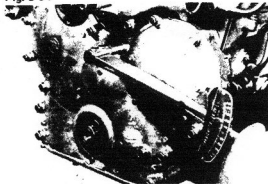
Align the idle gear mark "O" against the timer drive gear mark "O".

Fig. 3-93



Heat the timing gear cover to about 60°C (140°F) before installing.

Fig. 3-94

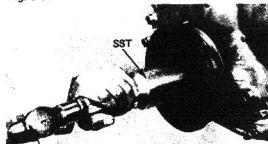


Tighten timing gear cover.

Torque

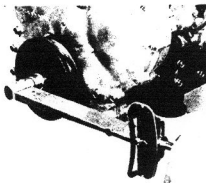
8 mm bolt	1.5 – 2.2 kg-m (11 – 15 ft-lb)
10 mm bolt	3.0 – 4.5 kg-m (22 – 32 ft-lb)

Fig. 3-95



Drive in the crankshaft pulley with SST[09214-60010].

Fig. 3-96



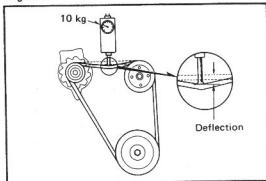
Tighten retaining bolt.

Torque	20.0 – 24.0 kg-m (145 – 173 ft-lb)
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— Note —

Apply a light coating of engine oil on the bolt threads and under the bolt head before installing.

Fig. 3-97

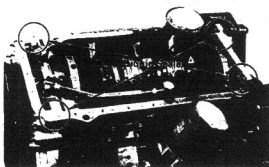


Adjust "V" belt tension.

Deflection at 10 kg (22 lb) force

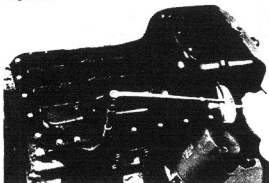
B engine	10 – 13 mm (0.4 – 0.5 in.)
2B engine	8 – 11 mm (0.3 – 0.4 in.)

Fig. 3-98



Apply liquid sealer to the cylinder block and gear cover as shown.

Fig. 3-99



Install oil pan.

Torque

0.5 — 1.0 kg-m
(4 — 7 ft-lb)

CYLINDER BLOCK**DISASSEMBLY**

Disassemble in numerical order.

Fig. 3-100

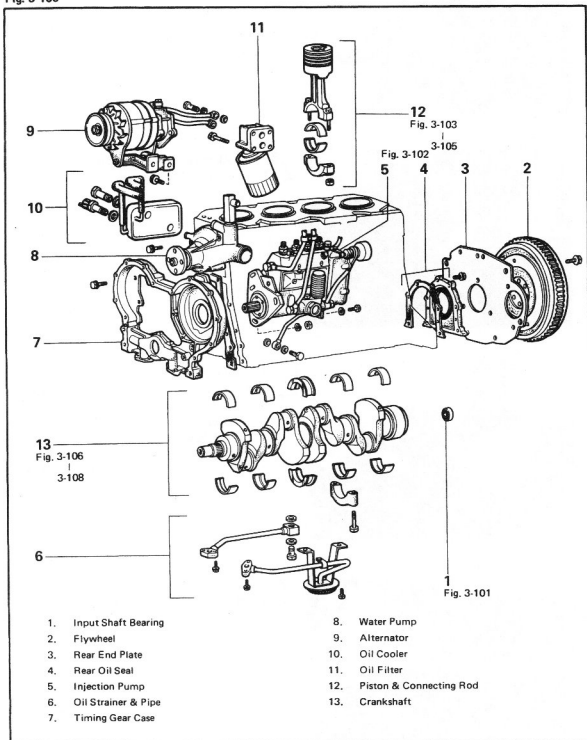
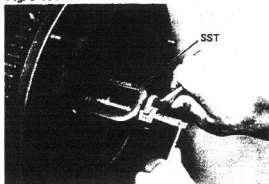
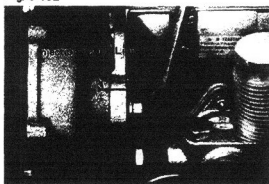


Fig. 3-101



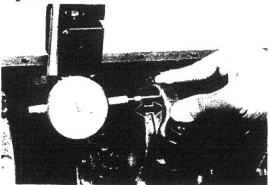
Remove input shaft bearing with SST[09303-35010].

Fig. 3-102



Check the position of injection period line before removing injection pump.

Fig. 3-103

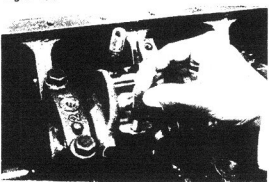


Measure connecting rod thrust clearance. If it exceeds the limit, replace connecting rod.

Thrust clearance

Limit	0.3 mm (0.012 in.)
STD	0.08 – 0.20 mm (0.0031 – 0.0079 in.)

Fig. 3-104



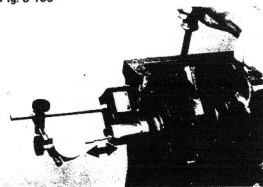
Cover rod bolts with a short hose to protect crankshaft pins from damage.

Fig. 3-105



Keep connecting rods and bearings in correct order.

Fig. 3-106



Measure crankshaft thrust clearance.
If it exceeds the limit, replace bearings as a set.

Thrust clearance

Limit	0.3 mm (0.012 in.)
STD	0.07 – 0.18 mm (0.0028 – 0.0071 in.)
U/S bearing type	0.25, 0.50, 1.00

Fig. 3-107

Front
←



Keep crankshaft bearings and caps in correct order.

Fig. 3-108

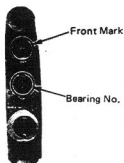


Fig. 3-109

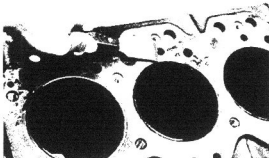


Fig. 3-110

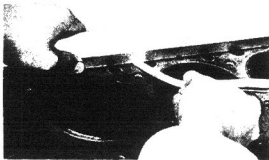


Fig. 3-111

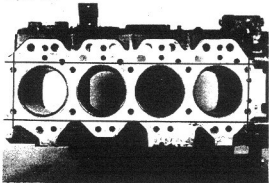
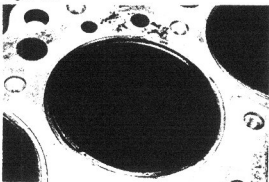


Fig. 3-112



INSPECTION & REPAIR

Cylinder Block & Liner

1. Clean and check cylinder block for cracks or scores.

2. Using a precision straight edge and thickness gauge, inspect the cylinder block topside surface for warpage.

Topside surface warpage limit
0.05 mm (0.0020 in.)

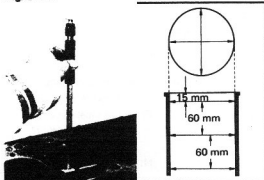
3. Inspect for warpage at the indicated lines shown in left.

4. Visually inspect cylinders for vertical scratches.
If there are deep scratches, the cylinder liner must be rebored.

— Note —

When reboring cylinder, rebore all cylinders to the same size.

Fig. 3-113



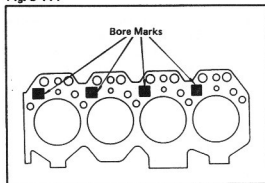
5. Measure cylinder bores at top, middle and bottom as shown. If the bore exceeds the limit, it must be rebored.

Wear limit 0.3 mm (0.012 in.)

Standard Bore

M a k	Size	
	B Engine	2B Engine
1	95.00 — 95.01 mm (3.7402 — 3.7405 in.)	98.00 — 98.01 mm (3.8583 — 3.8587 in.)
2	95.01 — 95.02 mm (3.7405 — 3.7409 in.)	98.01 — 98.02 mm (3.8587 — 3.8590 in.)
3	95.02 — 95.03 mm (3.7409 — 3.7413 in.)	98.02 — 98.03 mm (3.8590 — 3.8594 in.)

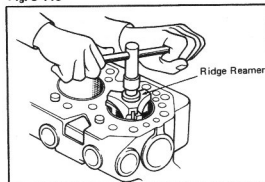
Fig. 3-114



— Note —

The bore marks are stamped on cylinder block topside surface as shown.

Fig. 3-115

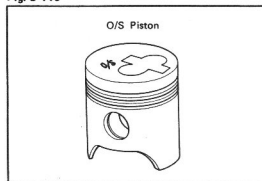


6. If the wear is less than 0.3 mm (0.012 in.), machine piston ring ridge at the top of bore with a ridge reamer.

— Note —

If this step is not performed prior to removing pistons the piston ring lands will be damaged.

Fig. 3-116



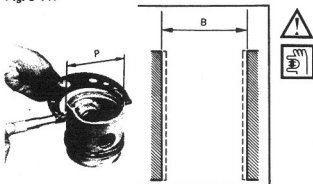
7. Use oversize pistons when cylinder liners are rebored.

Oversize piston diameter, O/S 1.00

**B engine 95.88 — 95.91 mm
(3.7748 — 3.7760 in.)**

**2B engine 98.88 — 98.91 mm
(3.8929 — 3.8941 in.)**

Fig. 3-117



8. Use following equation to determine reboring finished diameter.

$$B = P + C - H$$

Where B: Reboring finished diameter

P: O/S piston diameter

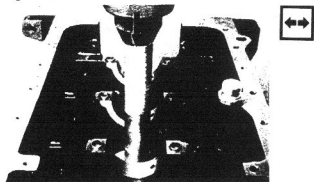
C: Piston clearance

0.11 – 0.13 mm
(0.0043 – 0.0051 in.)

H: Honing allowance

Less than 0.02 mm
(0.0008 in.)

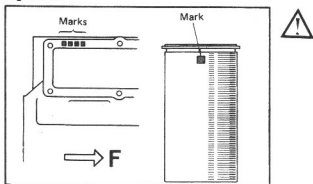
Fig. 3-118



9. Replace cylinder liner if the bore damage is excessive, or if the bore is worn so much that O/S 1.00 piston cannot be used.

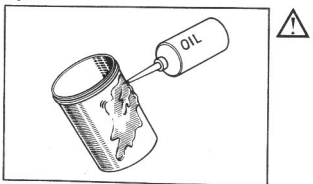
(1) Press out cylinder liner with SST [09218-56010].

Fig. 3-119



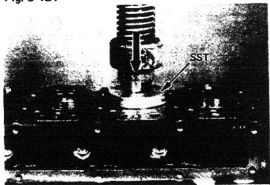
- (2) Select the liner having the same mark with the cylinder block, "A" or "B".

Fig. 3-120



- (3) Lubricate outside surface of the liner with engine oil before installing.

Fig. 3-121



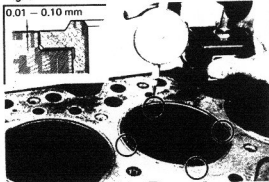
- (4) Press in the liner with SST [09218-56010].

Pressing force
5,000 kg (11,000 lb)

— Note —

After pressing in the liner, rebore and hone the liner bore to fit STD piston.

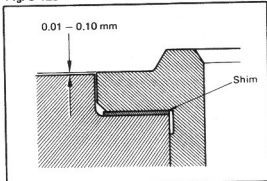
Fig. 3-122



10. Measure protrusion of cylinder liner above cylinder block topside surface at four positions.

Protrusion 0.01 — 0.10 mm
(0.0004 — 0.0039 in.)

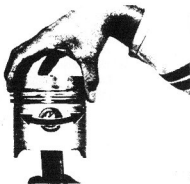
Fig. 3-123



11. Adjust protrusion of cylinder liner with cylinder liner shims.

Cylinder liner shim thickness
0.05, 0.10 mm (0.002, 0.004 in.)

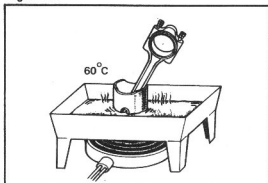
Fig. 3-124



Piston Pin & Connecting Rod

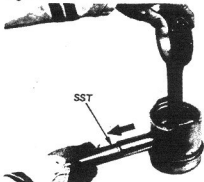
1. Check pin fit by rocking piston at right angle to pin.
If any movement is felt, replace piston and pin.

Fig. 3-125



2. Heat piston in a piston heater to about 60°C (140°F) before removing piston pin.

Fig. 3-126



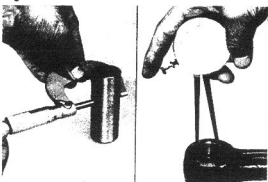
3. Remove piston pin with SST[09221-46010].

Fig. 3-127



4. Check piston pin fitness. Heat piston to about 60°C (140°F), and coat pin with engine oil. It should then be possible to push the pin into the piston hole with thumb pressure.

Fig. 3-128

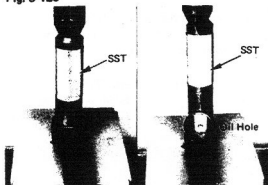


5. Measure oil clearance between bushing and piston pin.

Oil clearance

Limit	0.05 mm (0.0020 in.)
STD	0.004 – 0.012 mm (0.0002 – 0.0005 in.)

Fig. 3-129

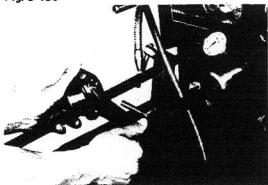


6. Replace bushing with SST [09222-66010].

— Note —

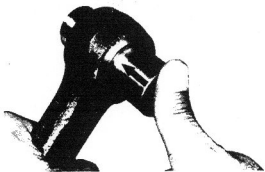
Align the bushing oil hole with the connecting rod oil hole.

Fig. 3-130



7. After installing the bushing, finish bushing bore with a pin hole grinder.

Fig. 3-131



8. The fitting between bushing and pin should be such that the pin, when coated with engine oil, can be pushed in with the thumb at normal temperature.

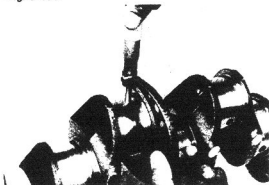
Fig. 3-132



Crankpin Bearing

1. Check bearings for flaking or scoring. If damaged, replace.

Fig. 3-133

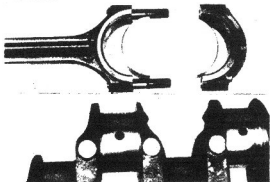


2. Measure crankpin diameter.
If wear is excessive, crankshaft must be reground or replaced.

Crankpin diameter (STD)

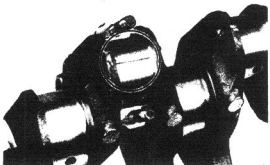
58.98 — 59.00 mm
(2.3220 — 2.3228 in.)

Fig. 3-134



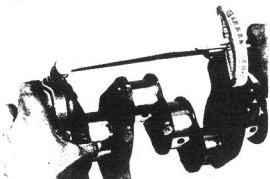
3. Measure crankpin oil clearance.
(1) Clean crankshaft pin, connecting rod, cap and bearings.

Fig. 3-135



- (2) Lay strip of plastigage across pin.

Fig. 3-136



- (3) Tighten cap nuts to specified torque.

Torque 6.5 — 7.5 kg-m
(48 — 54 ft-lb)

— Caution —
Do not turn connecting rod or crankshaft.

Fig. 3-137

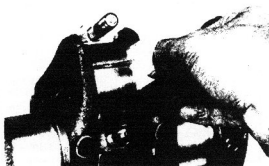


Fig. 3-138



Fig. 3-139

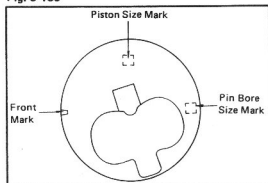
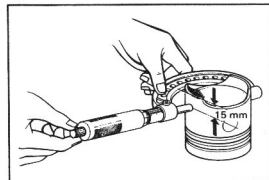


Fig. 3-140



- (4) Measure plastigage at its widest point.

If clearance is not within specification, replace bearings.

Oil clearance

Limit 0.1 mm (0.004 in.)

STD 0.03 – 0.07 mm

(0.0012 – 0.0028 in.)

U/S bearing type 0.25, 0.50, 1.00



Piston

1. Check piston for wear and damage, especially in the piston ring grooves and ring lands.



— Note —

At the piston top surface there is a mark indicating the front side, and stamped codes indicating piston diameter and piston pin bore.

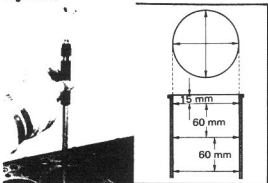
2. Check piston clearance.

- (1) Measure piston diameter, in the thrust direction about 15 mm (0.59 in.) up from skirt bottom edge. Measurement must be made at normal temperature 20°C (68°F).



Mark	Piston Size	
	B Engine	2B Engine
1	94.88 – 94.89 mm (3.7354 – 3.7358 in.)	97.88 – 97.89 mm (3.8535 – 3.8539 in.)
2	94.89 – 94.90 mm (3.7358 – 3.7362 in.)	97.89 – 97.90 mm (3.8539 – 3.8543 in.)
3	94.90 – 94.91 mm (3.7362 – 3.7366 in.)	97.90 – 97.91 mm (3.8543 – 3.8547 in.)

Fig. 3-141



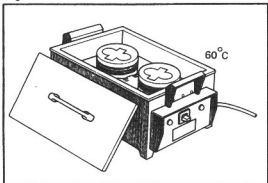
- (2) Measure cylinder bore and subtract piston size.

Mark	Cylinder Size	
	B Engine	2B Engine
1	95.00 – 95.01 mm (3.7402 – 3.7405 in.)	98.00 – 98.01 mm (3.8583 – 3.8587 in.)
2	95.01 – 95.02 mm (3.7405 – 3.7409 in.)	98.01 – 98.02 mm (3.8587 – 3.8590 in.)
3	95.02 – 95.03 mm (3.7409 – 3.7413 in.)	98.02 – 98.03 mm (3.8590 – 3.8594 in.)

Piston clearance

0.11 – 0.13 mm
(0.0043 – 0.0051 in.)

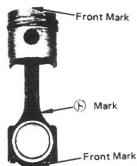
Fig. 3-142



- 3 Assemble piston and connecting rod as follows.

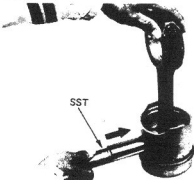
- (1) Heat piston to about 60°C (140°F) before installing piston pin.

Fig. 3-143



- (2) Align front mark of the piston and "B" mark of the connecting rod as shown.

Fig. 3-144



- (3) Install piston pin with SST[09221-46010].

Fig. 3-145

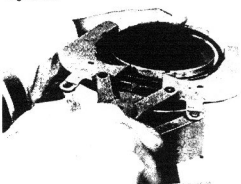


(4) Install snap ring on both side.

— Caution —

Make sure snap ring is completely in place.

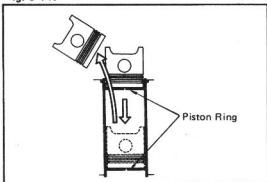
Fig. 3-146



Piston Ring

1. Remove piston ring with a piston ring expander.

Fig. 3-147

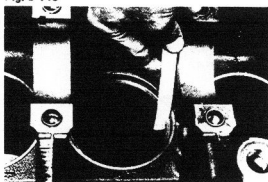


2. Measure piston ring end gap with the ring at the lower part of the cylinder bore Where the wear is least.

— Note —

Use correct size rings to match the piston size.

Fig. 3-148



3. Measure end gap.

End Gap

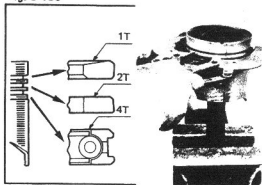
Ring	B Engine	2B Engine
No.1	0.35 — 0.55 mm (0.0138 — 0.0217 in.)	0.40 — 0.60 mm (0.0157 — 0.0236 in.)
No.2	0.30 — 0.50 mm (0.0118 — 0.0197 in.)	←
Oil Ring	0.30 — 0.50 mm (0.0118 — 0.0197 in.)	←

Fig. 3-149



4. Clean ring grooves with groove cleaning tool or broken ring.

Fig. 3-150

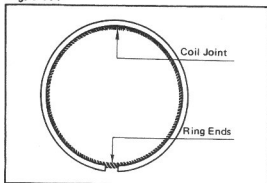


5. Install piston ring with the piston ring expander.

— Note —

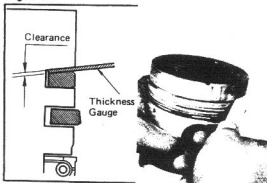
1. Always install the rings with code marks facing up.

Fig. 3-151



2. To assemble the oil ring and expander coil, insure that expander coil joint is at the opposite side of the ring ends.

Fig. 3-152



6. With a thickness gauge, measure the clearance between No.1 ring and ring groove when ring is flush with piston surface.

No.1 ring to groove clearance
 0.03 – 0.07 mm
 (0.0012 – 0.0028 in.)

Fig. 3-153



Fig. 3-154

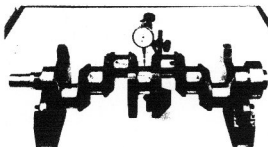
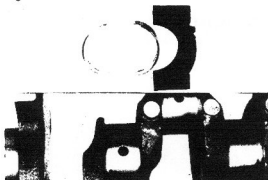


Fig. 3-155



Fig. 3-156



7. Measure No.2 and oil ring groove clearance. If it exceeds specification, replace ring and/or piston.

Ring to groove clearance

No.2	0.04 – 0.08 mm (0.0016 – 0.0031 in.)
Oil ring	0.03 – 0.07 mm (0.0012 – 0.0028 in.)

**Crankshaft & Bearing**

1. Check crankshaft for run out and if it exceeds limit, replace.

Run out limit 0.06 mm (0.0024 in.)



2. Measure crankshaft main journal. If wear is excessive, crankshaft must be reground or replaced.

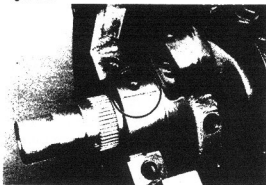
Main journal diameter (STD)

69.98 – 70.00 mm
(2.7551 – 2.7559 in.)



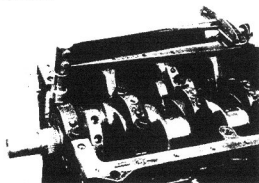
3. Measure main journal oil clearance.
(1) - Clean journal, cap and bearing.

Fig. 3-157



- (2) Lay a strip of plastigage across journal.

Fig. 3-158

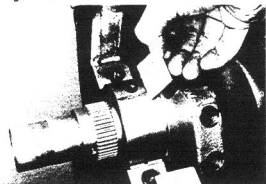


- (3) Tighten cap bolts to specified torque.

Torque 9.8 – 11.2 kg-m
(71 – 81 ft-lb)

— Caution —
Do not turn crankshaft.

Fig. 3-159



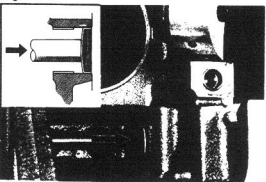
- (4) Measure plastigage at its widest point. If clearance is not within specification, replace bearings.

Oil clearance

Limit 0.1 mm (0.004 in.)
STD 0.03 – 0.07 mm
(0.0012 – 0.0028 in.)

U/S bearing type 0.25, 0.50, 1.00

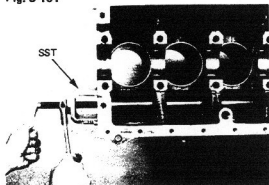
Fig. 3-160



Camshaft Bearing

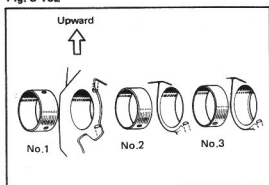
1. Remove camshaft rear expansion plug.

Fig. 3-161



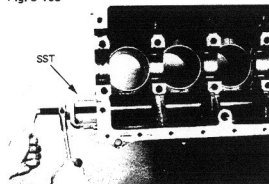
2. Remove camshaft bearings with SST[09210-56010].

Fig. 3-162



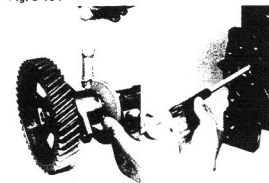
3. Align the bearing oil holes.

Fig. 3-163



4. Install new bearings with SST[09210-56010].

Fig. 3-164

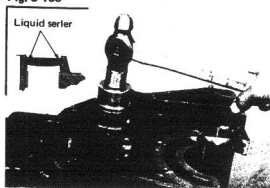


5. Check bearing oil clearance.

Oil clearance

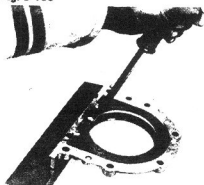
Limit	0.1 mm (0.004 in.)
STD	0.03 - 0.07 mm (0.0012 - 0.0028 in.)

Fig. 3-165



6. Install new expansion plug with liquid sealer.

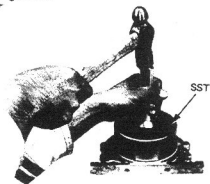
Fig. 3-166



Crankshaft Rear Oil Seal

1. Remove oil seal.

Fig. 3-167



2. Install new oil seal with SST[09223-56010].

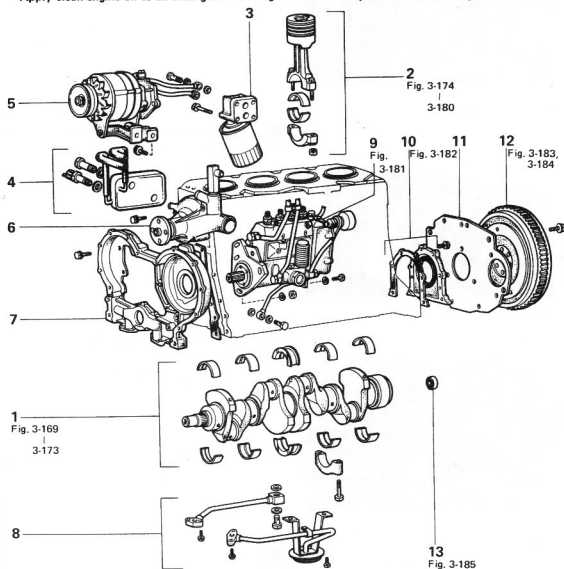
ASSEMBLY

Assemble in numerical order.

Fig. 3-168

Thoroughly clean all parts to be assembled.

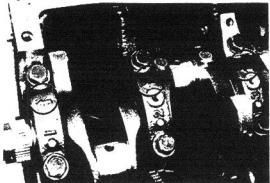
Apply clean engine oil to all sliding and rotating surfaces of the parts before assembly.



1. Crankshaft
2. Piston & Connecting Rod
3. Oil Filter
4. Oil Cooler
5. Alternator
6. Water Pump
7. Timing Gear Case

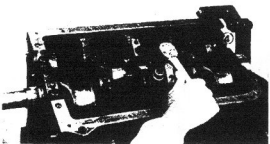
8. Oil Strainer & Pipe
9. Injection Pump
10. Rear Oil Seal
11. Rear End Plate
12. Flywheel
13. Input Shaft Bearing

Fig. 3-169



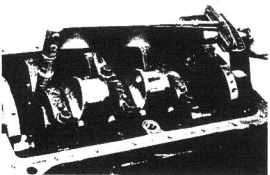
Face arrow mark toward the front.

Fig. 3-170



Tighten bearing cap bolts little by little in two or three steps in the specified numeral sequence.

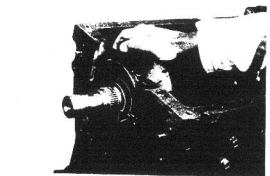
Fig. 3-171



Tighten bearing caps to specified torque.

Torque 9.8 — 11.2 kg-m (71 — 81 ft-lb)

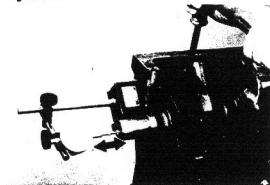
Fig. 3-172



— Note —

Check for tightness of crankshaft rotation after each tightening of bearing.

Fig. 3-173



Measure crankshaft thrust clearance.

Thrust clearance

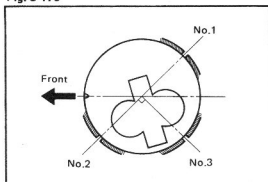
Limit	0.3 mm (0.012 in.)
STD	0.07 – 0.18 mm (0.0028 – 0.0071 in.)

Fig. 3-174



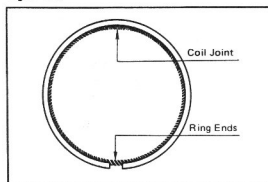
Cover rod bolts with a hose to protect crankpins from damage.

Fig. 3-175



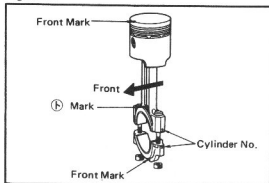
Position ring gap in the direction shown.

Fig. 3-176



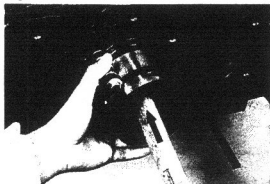
The oil ring ends should be at the opposite side of the expander coil joint.

Fig. 3-177



Assemble correctly numbered piston/rod assembly with the notch on piston and the "(D)" mark on connecting rod facing the front.

Fig. 3-178

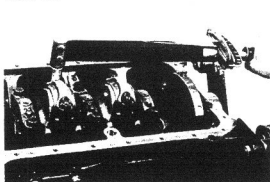


Insert piston into cylinder while compressing rings with a piston ring compressor.

— Caution —

Use care not to break piston ring.

Fig. 3-179



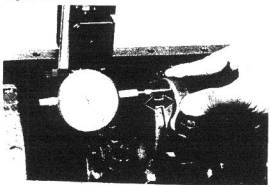
Tighten connecting rod cap to specified torque.

Torque 6.5 — 7.5 kg-m (48 — 54 ft-lb)

— Note —

Check for tightness of crankshaft rotation after each tightening of bearing.

Fig. 3-180

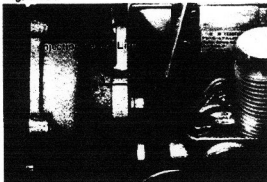


Check connecting rod thrust clearance.

Thrust clearance

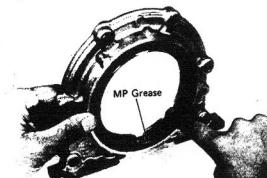
Limit	0.3 mm (0.012 in.)
STD	0.08 — 0.20 mm (0.0031 — 0.0079 in.)

Fig. 3-181



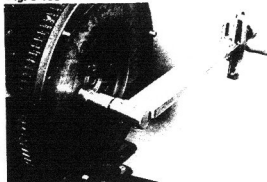
Set the injection period line back to the former position.

Fig. 3-182



Apply MP grease on oil seal lip before assembling.

Fig. 3-183



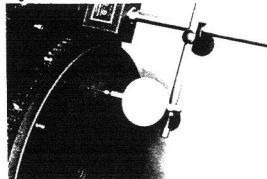
Tighten bolts to specified torque.

Torque 11.5 – 12.5 kg-m (84 – 90 ft-lb)

– Note –

Apply a light coating of engine oil on the bolt threads and under head before installing.

Fig. 3-184

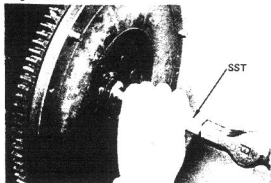


Check flywheel for run out.

Run out limit

0.2 mm (0.008 in.)

Fig. 3-185



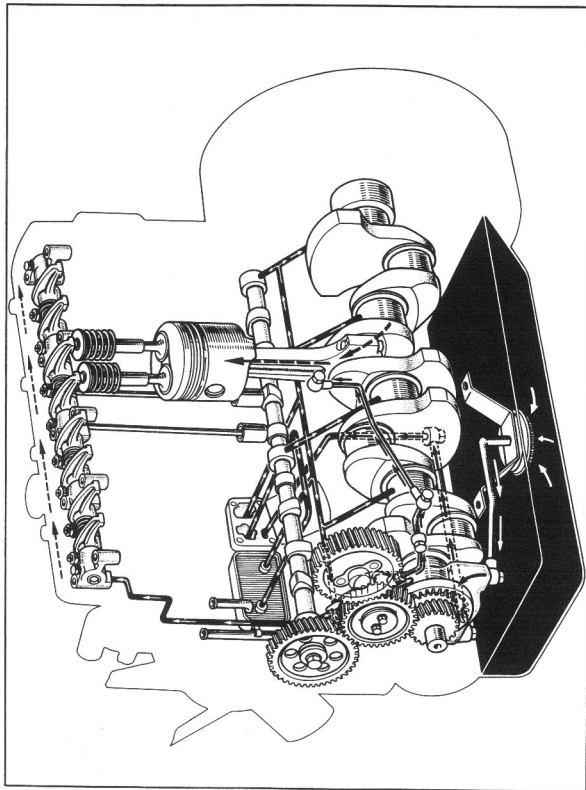
Drive in input shaft bearing with SST[09304-30012].

LUBRICATION SYSTEM

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OIL PUMP	4-7

LUBRICATION SYSTEM CIRCUIT

Fig. 4-1



OIL FILTER**DISASSEMBLY**

Disassemble in numerical order.

Fig. 4-2

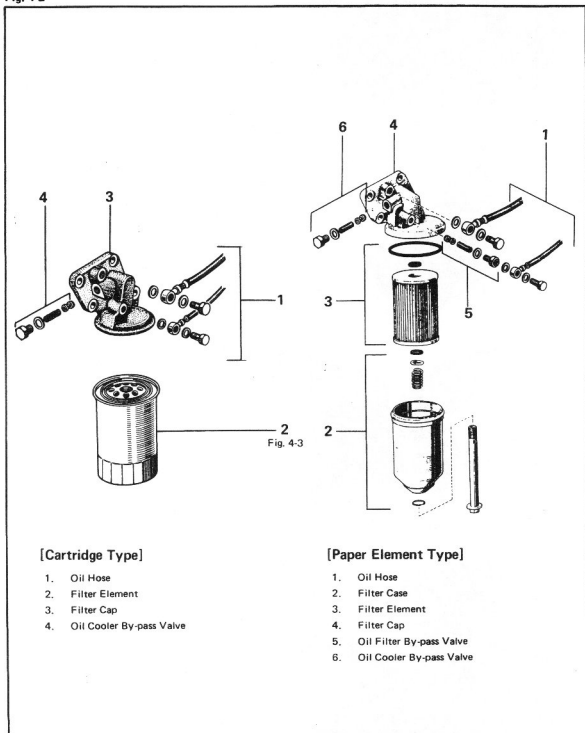
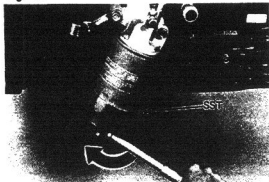
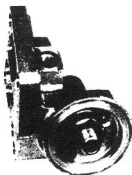


Fig. 4-3



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

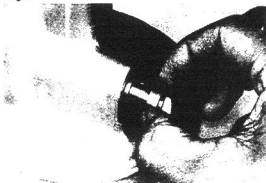
Fig. 4-4



INSPECTION

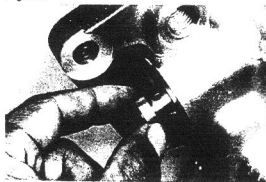
1. Check the contacting surface of the oil filter cap for scoring and cracks.

Fig. 4-5



2. Check valve for valve sliding.
(1) Oil filter by-pass valve

Fig. 4-6



- (2) Oil cooler by-pass valve

ASSEMBLY

Assemble in numerical order.

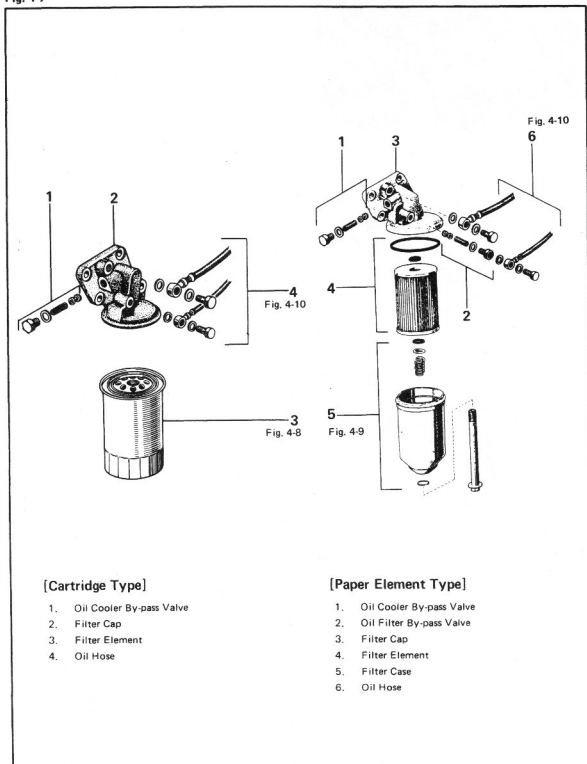
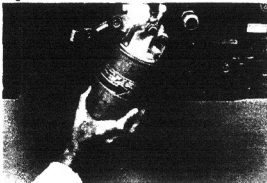
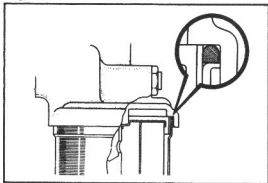
Fig. 4-7

Fig. 4-8



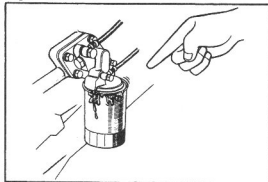
To install, hand-tighten oil filter.

Fig. 4-9



Use new gaskets and assemble the filter body gasket with the rounded side facing upward (toward cap).

Fig. 4-10



After installing, start the engine and check for oil leaks.

Stop the engine and check oil level.

OIL PUMP**REMOVAL**

Remove in numerical order.

Fig. 4-11

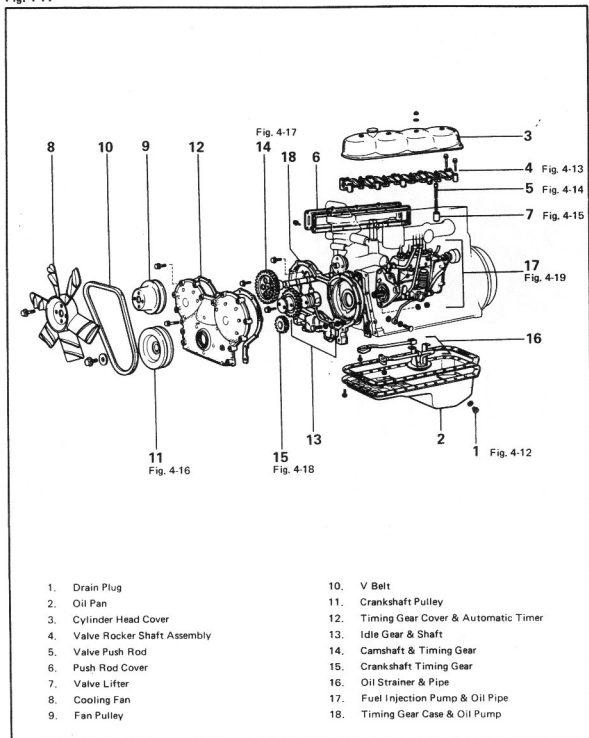
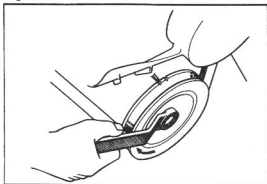
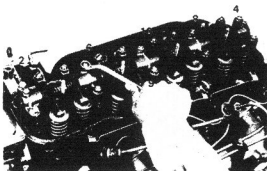


Fig. 4-12



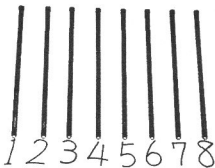
Before starting work, set No.1 cylinder piston at TDC/Compression.

Fig. 4-13



Loosen valve rocker support bolts little by little in three or four steps in the specified numerical sequence.

Fig. 4-14



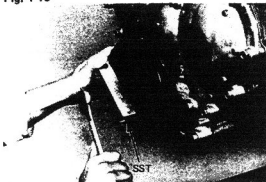
Keep push rods in correct order.

Fig. 4-15



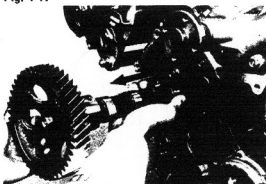
Keep valve lifters in correct order.

Fig. 4-16



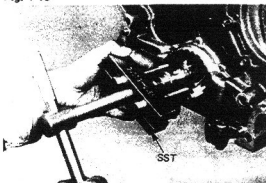
Pull out crankshaft pulley with SST[09213-31021].

Fig. 4-17



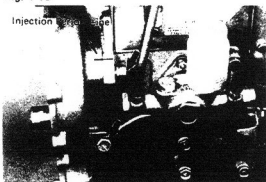
Pull out camshaft using care not to damage the camshaft bearings.

Fig. 4-18



Pull out crankshaft timing gear with SST[09213-60015].

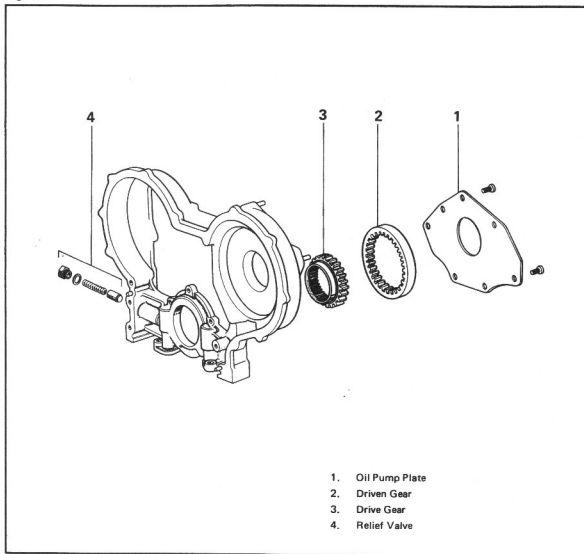
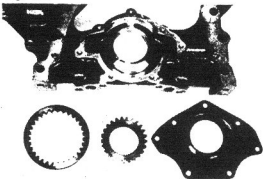
Fig. 4-19



Check the position of the injection period line, and remove the three injection pump mounting nuts and oil pipe union bolt.

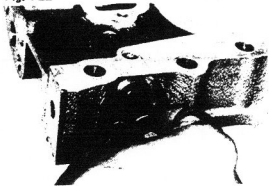
DISASSEMBLY

Dissemble in numerical order.

Fig. 4-20**Fig. 4-21****INSPECTION**

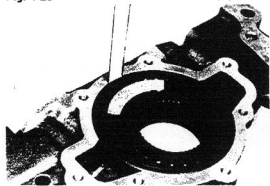
1. Check disassembled parts for wear or damage.

Fig. 4-22



2. Check relief valve for wear or scoring, and see if it slides smoothly.

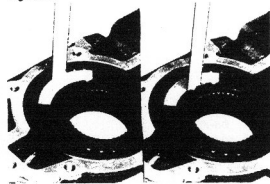
Fig. 4-23



3. Measure body clearance.

Limit	0.2 mm (0.008 in.)
STD	0.06 – 0.15 mm (0.0024 – 0.0059 in.)

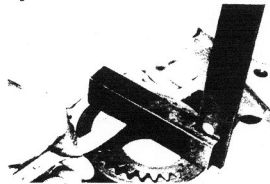
Fig. 4-24



4. Measure tip clearances.

Limit	0.3 mm (0.012 in.)
STD	Driven gear-crescent 0.15 – 0.21 mm (0.0059 – 0.0083 in.) Drive gear-crescent 0.22 – 0.25 mm (0.0087 – 0.0098 in.)

Fig. 4-25



5. Measure side clearance.

Limit	0.15 mm (0.0059 in.)
STD	0.03 – 0.09 mm (0.0012 – 0.0034 in.)

ASSEMBLY

Assemble in numerical order.

Fig. 4-26

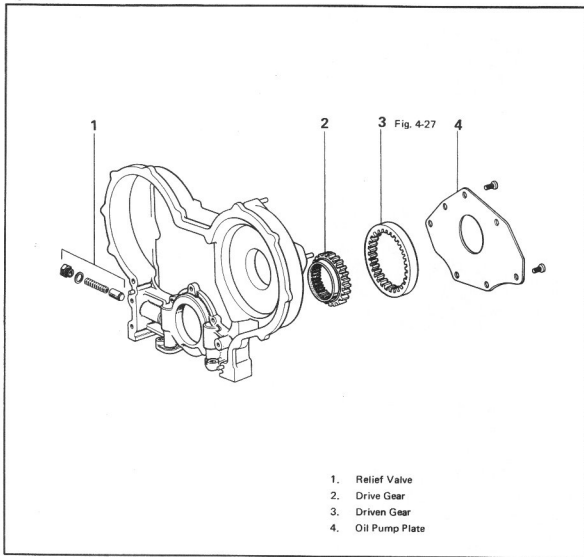
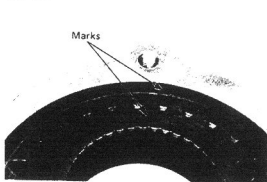
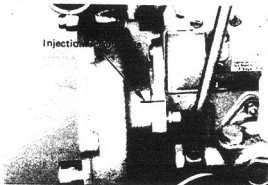


Fig. 4-27



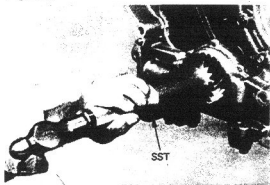
Assemble the drive and driven gears into pump body, with its triangular marks facing the pump plate side.

Fig. 4-29



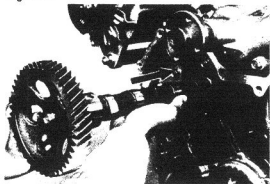
Set the injection period line back to the former position.

Fig. 4-30



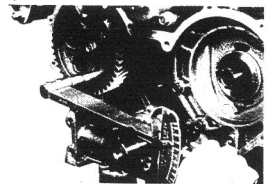
Drive in crankshaft timing gear with SST[09214-60010].

Fig. 4-31



Insert camshaft using care not to damage the camshaft bearings.

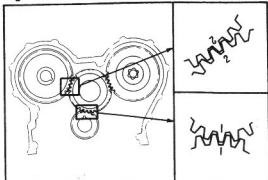
Fig. 4-32



Tighten camshaft thrust plate.

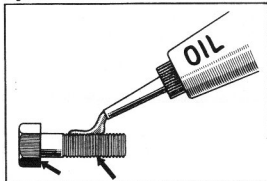
Torque 1.0 – 1.6 kg-m (8 – 11 ft-lb)

Fig. 4-33



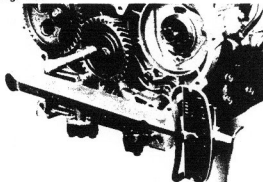
Set the idle gear aligning marks "1" and "2" respectively against crankshaft gear mark "1" and camshaft gear mark "2".

Fig. 4-34



Apply a light coating of engine oil on the bolt threads and under head (Thrust plate contacting surface) before installing the bolts.

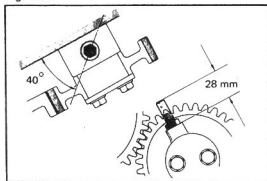
Fig. 4-35



Tighten idle gear and shaft.

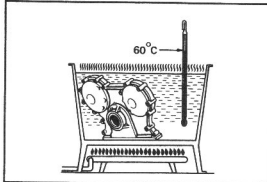
Torque 4.0 – 5.5 kg-m (29 – 39 ft-lb)

Fig. 4-36



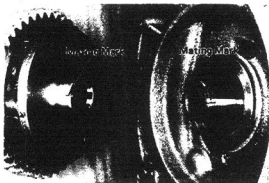
Oil injection hole should face the side where the camshaft and idle gears are engaged.

Fig. 4-37



Remove the automatic timer from the timing gear cover after heating the cover to about 60°C (140°F).

Fig. 4-38

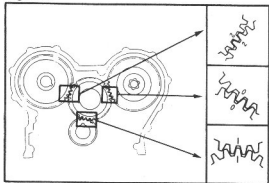


Align the mating marks on injection pump spline shaft and timer drive shaft when installing the automatic timer.

— Note —

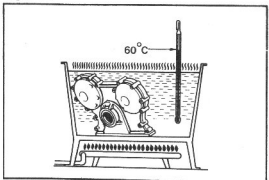
Coat the splines and bearing with MP grease.

Fig. 4-39



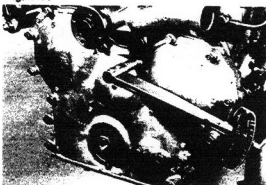
Align the idle gear mark "O" against the timer drive gear mark "O".

Fig. 4-40



Heat the timing gear cover to about 60°C (140°F) before installing.

Fig. 4-41

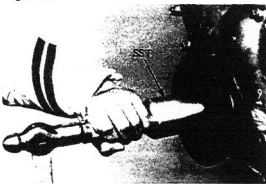


Tighten timing gear cover.

Torque

8 mm bolt	1.5 – 2.2 kg-m (11 – 15 ft-lb)
10 mm bolt	3.0 – 4.5 kg-m (22 – 32 ft-lb)

Fig. 4-42



Drive in the crankshaft pulley with SST[09214-60010].

Fig. 4-43



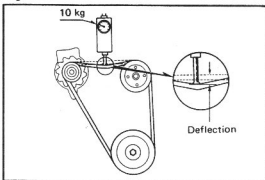
Tighten retaining bolt.

Torque	20.0 – 24.0 kg-m (145 – 173 ft-lb)
---------------	---

— Note —

Apply a light coating of engine oil on the bolt threads and under head before installing.

Fig. 4-44

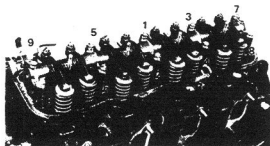


Adjust "V" belt tension.

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. 4-45



Tighten valve rocker support bolts little by little in three or four steps in the specified numerical sequence.

Fig. 4-46

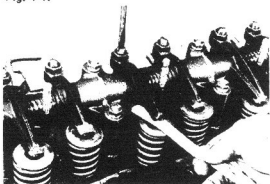


Tighten valve rocker support bolts to specified torque.

Torque

1.0 — 1.6 kg-m (8 — 11 ft-lb)

Fig. 4-47

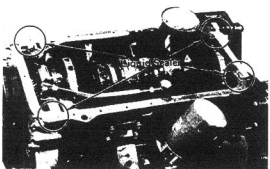


Tentatively, adjust valve clearance.

Valve clearance

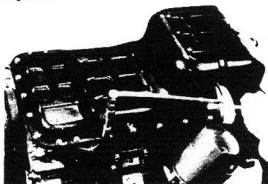
IN.	0.20 mm (0.008 in.)
EX.	0.36 mm (0.014 in.)

Fig. 4-48



Apply liquid sealer to the cylinder block and gear cover.

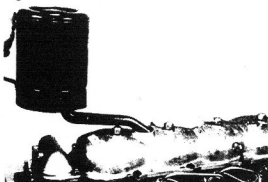
Fig. 4-49



Install the oil pan.

Torque 0.5 – 1.0 kg-m (4 – 7 ft-lb)

Fig. 4-50



Fill the engine with engine oil.

Oil grade API service CC-CD

Oil capacity (Total)

7.3 liter, 7.7 USqt, 6.4 Imp.qt

COOLING SYSTEM

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COOLING SYSTEM CIRCUIT	5-2
WATER PUMP CROSS SECTIONAL VIEW	5-2
WATER PUMP	5-3
RADIATOR	5-8
THERMOSTAT	5-8

COOLING SYSTEM CIRCUIT

Fig. 5-1

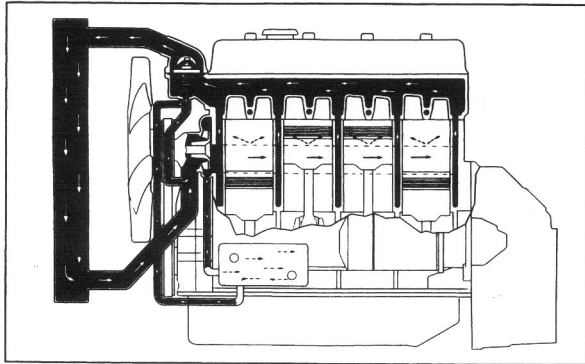
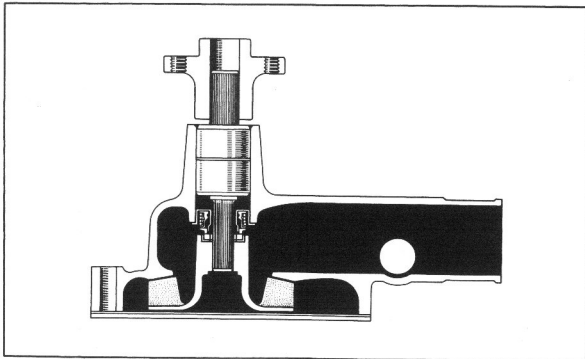
**WATER PUMP CROSS SECTIONAL VIEW**

Fig. 5-2



WATER PUMP**DISASSEMBLY**

Disassemble in numerical order.

Fig. 5-3

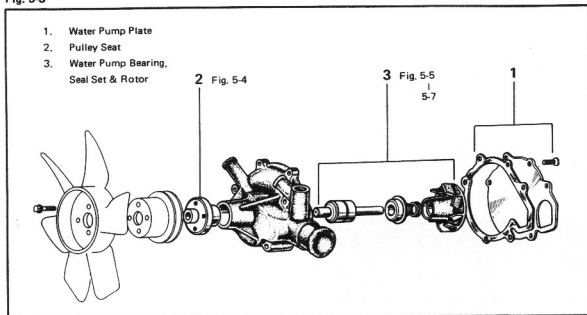


Fig. 5-4

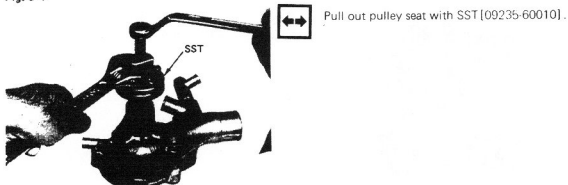
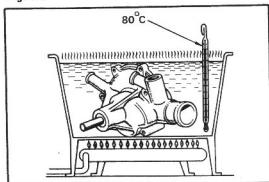
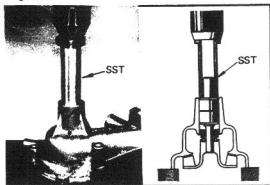


Fig. 5-5



Heat the water pump body to about 80°C (176°F).

Fig. 5-6

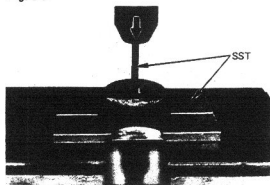


Press out the water pump bearing together with the rotor and seal set with SST [09238-48010].

— Note —

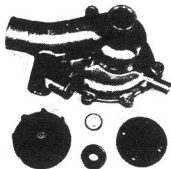
Always replace the seal set upon assembly.

Fig. 5-7



Press out the pump bearing from the rotor with SST [09236-36010].

Fig. 5-8

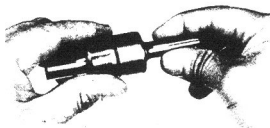


INSPECTION



1. Check the disassembled parts for cracks, damage and wear, and replace if defective.

Fig. 5-9



2. Check the bearing.
If it is damaged, produces noise or does not turn properly, replace.

ASSEMBLY

Assemble in numerical order.

Fig. 5-10

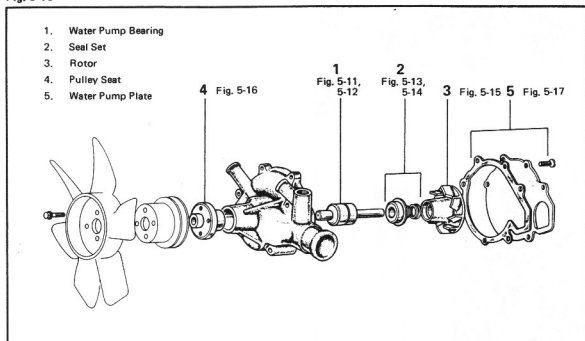
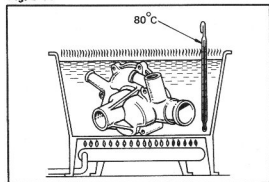
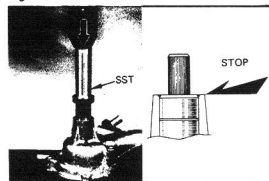


Fig. 5-11



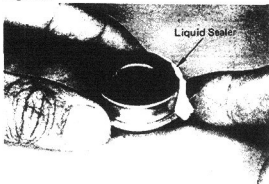
Heat the water pump body to about 80°C (176°F).

Fig. 5-12



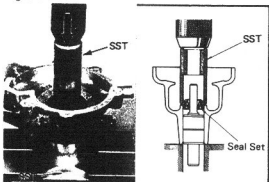
Press in the water pump bearing into the pump body with SST[09238-48010].

Fig. 5-13



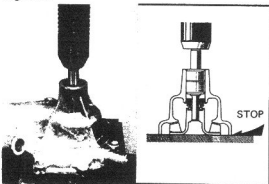
Apply liquid sealer to the surface contacting with the pump body.

Fig. 5-14



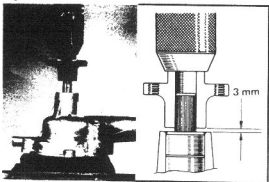
Press in the seal set with SST [09236-36010].

Fig. 5-15



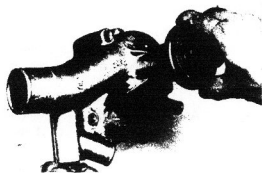
Press in the rotor.

Fig. 5-16



Press in the pulley seat to the specified depth.

Fig. 5-17



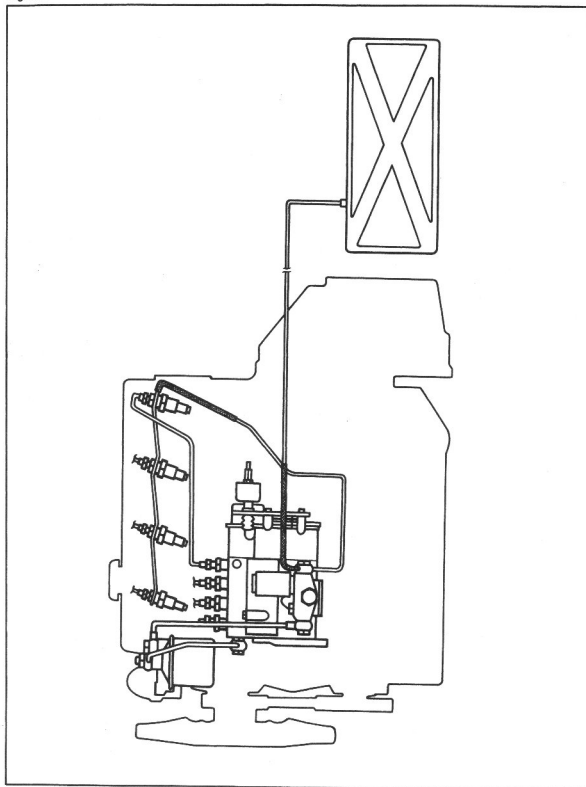
After assembling, make sure the rotor rotates smoothly with the water pump plate in installed condition.

FUEL SYSTEM

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FUEL FILTER	6-3
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INJECTION PUMP	6-28

FUEL SYSTEM CIRCUIT

Fig. 6-1



FUEL FILTER**DISASSEMBLY**

Disassemble in numerical order.

Fig. 6-2

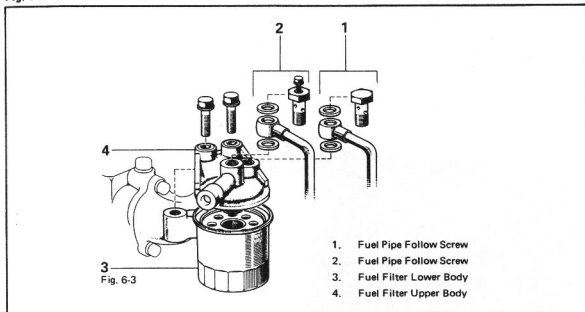
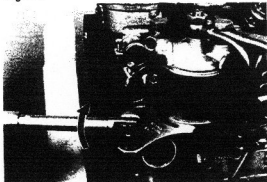
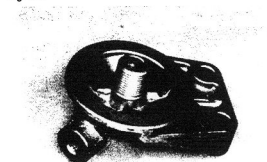


Fig. 6-3



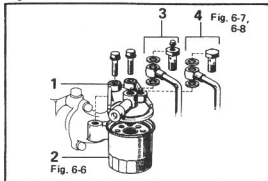
Remove fuel filter with SST[09228-34010].

Fig. 6-4

**INSPECTION**

Check the contacting surface for score and cracks.

Fig. 6-5

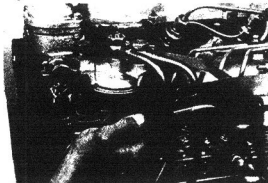


ASSEMBLY

Assemble in numerical order.

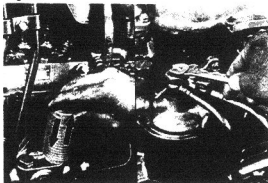


Fig. 6-6



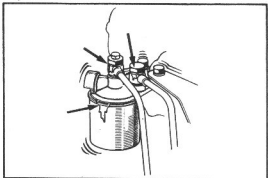
To install, firmly hand tighten the fuel filter.

Fig. 6-7



After installing, bleed air from fuel filter by operating the priming pump.

Fig. 6-8



After bleeding air, check gasket and union for fuel leaks.

INJECTION NOZZLE**REMOVAL**

Remove in numerical order.

Fig. 6-9

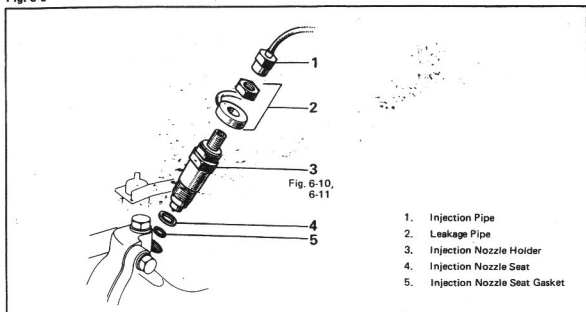
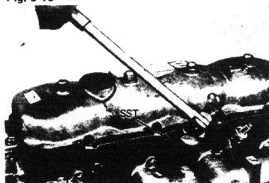


Fig. 6-10



Remove injection nozzle holders with SST[09268-46011].

Fig. 6-11



Keep injection nozzle holders in correct order.



Fig. 6-12

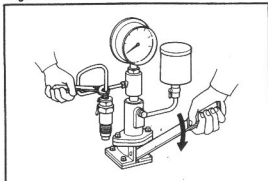


Fig. 6-13

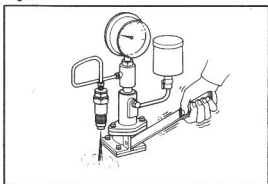


Fig. 6-14

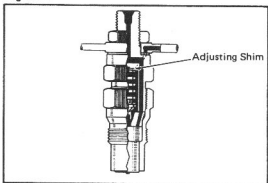
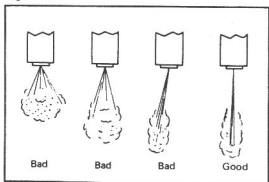


Fig. 6-15



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.

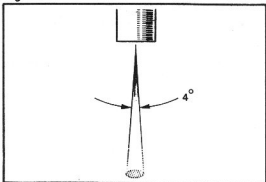
— Note —

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).



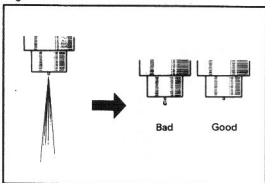
4. Spray patterns.
 - (1) Check the spray patterns, by pumping the tester handle 50 — 60 times/minutes by hand.

Fig. 6-16



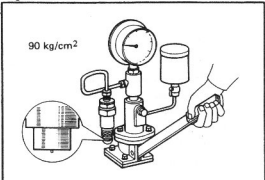
- (2) Spray should spread evenly down the nozzle center line in 4° conical form.
- (3) Place a white sheet of paper about 30 cm (12 in.) away from the nozzle to check if spray pattern is in circular form.

Fig. 6-17



5. There should be no dripping after injection.

Fig. 6-18



6. Leakage test.
Apply 90 kg/cm² (1,280 psi) of fuel pressure, and check for leaks at nozzle valve seat and retaining nut.

DISASSEMBLY

Disassemble in numerical order.

Fig. 6-19

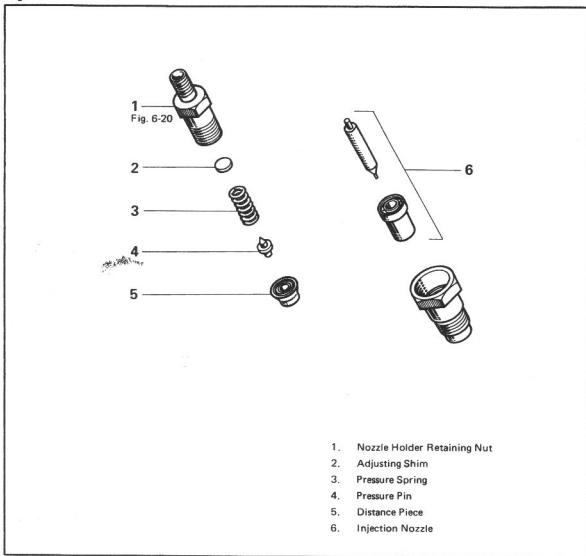


Fig. 6-20

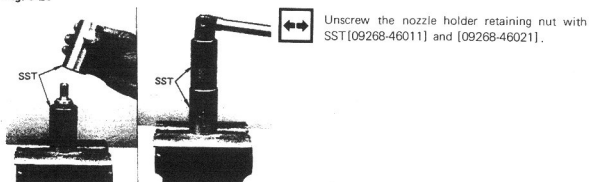
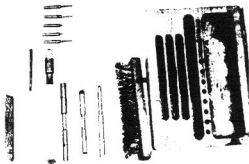


Fig. 6-21

**NOZZLE CLEANING**

1. To wash nozzle, use nozzle cleaning kit, and wash in clean diesel fuel or light oil.

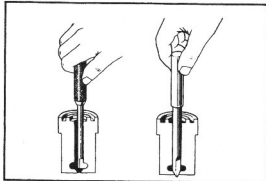
Fig. 6-22



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



Fig. 6-23



3. Clean the nozzle seat with a cleaning scraper.

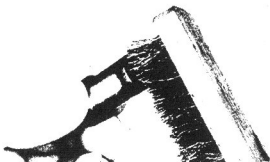
Fig. 6-24



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

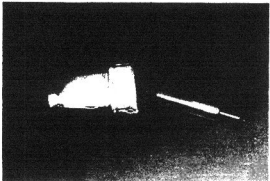


Fig. 6-25



5. Remove the carbon on nozzle body exterior (except wrapping angle) with a brass brush.

Fig. 6-26



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

Fig. 6-27



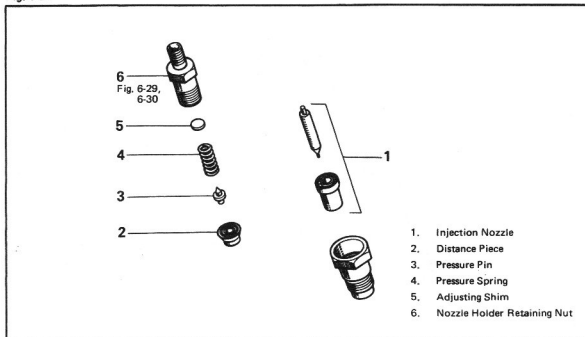
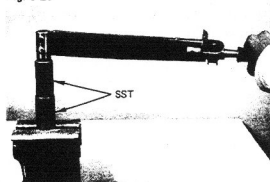
7. Perform the sinking test.
- (1) Pull out the needle about half way from the body and then release.
 - (2) Needle should sink down into the body extremely smoothly by its own weight.
 - (3) Repeat this test rotating needle slightly after each test.

— Note —

If the needle fails to sink smoothly at any position, replace both the needle and the body as a unit.

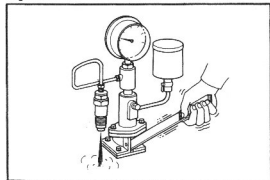
ASSEMBLY

Assemble in numerical order.

Fig. 6-28**Fig. 6-29**

Tighten the retaining nut with SST [09268-46011] and [09268-46021].

Torque 6.0 – 8.0 kg-m (43.4 – 57.8 ft-lb)

Fig. 6-30

After assembling the injection nozzle, perform the spray test and adjust if necessary.



INSTALLATION

Install in numerical order.

Fig. 6-31

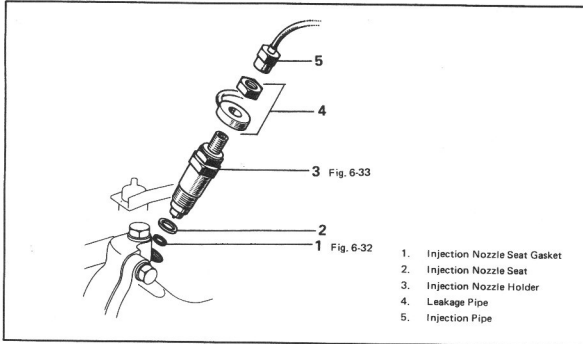
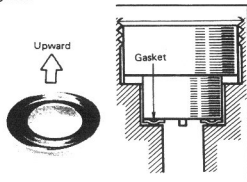
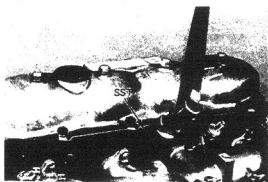


Fig. 6-32



Note the orientation of the nozzle seat gasket as shown in the figure.

Fig. 6-33



Tighten the nozzle holder with SST[09268-46011].

Torque 6.0 — 8.0 kg-m (44 — 57 ft-lb)

— Note —
After installing, bleed out the air.

FUEL FEED PUMP**CROSS SECTIONAL VIEW**

Fig. 6-34

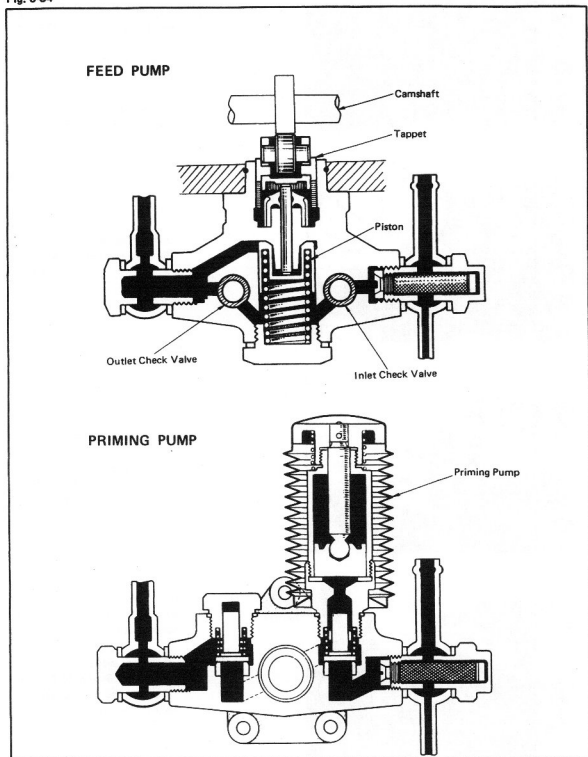


Fig. 6-35

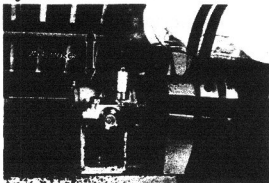


Fig. 6-36

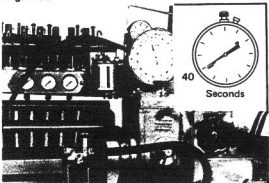


Fig. 6-37

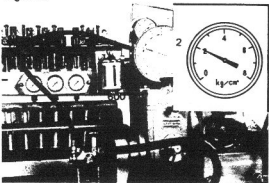
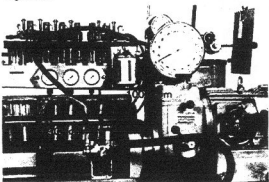


Fig. 6-38



FEED PUMP TEST

1. Suction capacity test

The size of the suction pipes should be:

Pipe inner diameter	8 mm (0.31 in.)
Pipe length	2 m (78.7 in.)
Suction height	1 m (39.4 in.)

- (1) Operate the priming pump for one minute at 60 strokes per minute.

Suction capacity
Fuel must discharge within
25 strokes.

- (2) Set the feed pump tester at 150 rpm and test the feed pump suction capacity.

Suction capacity
Fuel must discharge within
40 seconds.

2. Discharge performance test

Connect the pressure gauge to the feed pump discharge side.

- (1) Operate the feed pump at 600 rpm.

Discharge pressure
1.8 – 2.2 kg/cm²
(25.6 – 31.3 psi)

- (2) Operate the feed pump at 1,000 rpm. Measure discharge volume from the discharge side nozzle.

Discharge side nozzle diameter
1.54 mm (0.0606 in.)
Discharge volume capacity
More than 900 cc (54.9 cu.in.)/
min.

DISASSEMBLY

Disassemble in numerical order.

Fig. 6-39

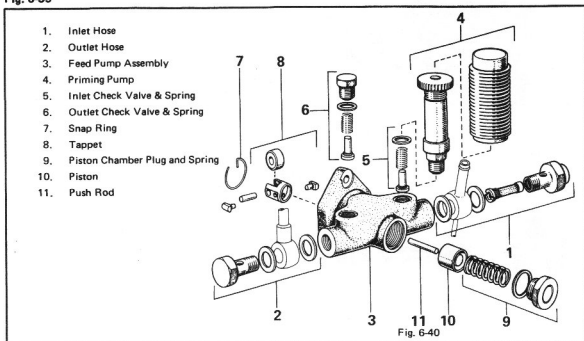
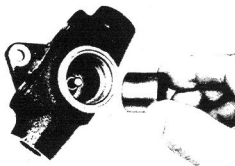


Fig. 6-40



Since the push rod is precisely fitted into the feed pump housing, do not remove the rod unless necessary. If removed, make sure to confirm assembly direction.

Fig. 6-41



INSPECTION

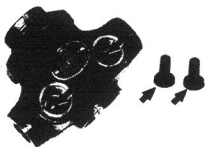


Inspect the piston, push rod and feed pump housing for wear and damage.

Clearance STD (Reference)

Piston	0.009 – 0.013 mm (0.0004 – 0.0005 in.)
Push Rod	0.003 – 0.006 mm (0.0001 – 0.0002 in.)

Fig. 6-42



Inspect the check valve and valve seat for wear.

Fig. 6-43



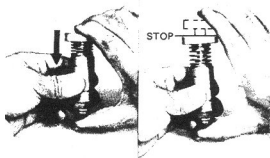
Inspect the tappet and roller for wear.

Fig. 6-44



Inspect the check valve and piston springs for damage.

Fig. 6-45



Plug the priming pump inlet port strongly with a finger, and inspect if the pressure and vacuum are created when the pump is operated.

ASSEMBLY

Assemble in numerical order.

Fig. 6-46

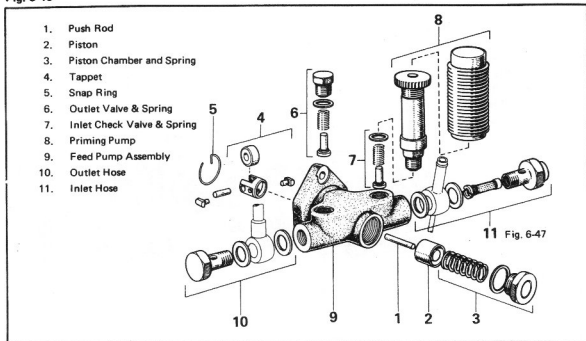
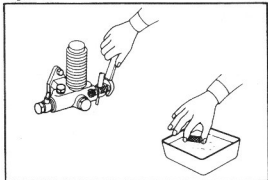


Fig. 6-47



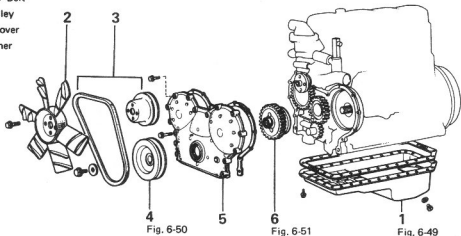
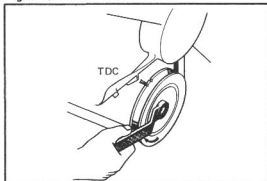
Before assembling, clean the filter inside the union bolt.

AUTOMATIC TIMER**REMOVAL**

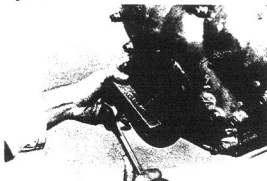
Remove in numerical order.

Fig. 6-48

1. Oil Pan
2. Cooling Fan
3. Fan Pulley & V Belt
4. Crankshaft Pulley
5. Timing Gear Cover
6. Automatic Timer

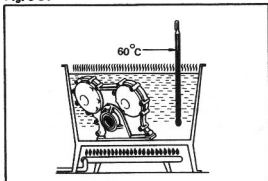
**Fig. 6-49**

Before starting work, set the No.1 cylinder piston at TDC/Compression.

Fig. 6-50

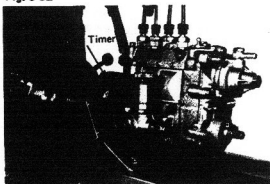
Pull out the crankshaft pulley with SST[09213-31021].

Fig. 6-51



Remove the timer from timing gear cover after heating the cover to about 60°C (140°F).

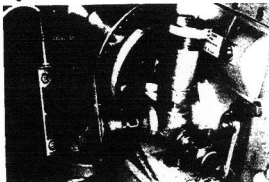
Fig. 6-52



INSPECT ADVANCE ANGLE

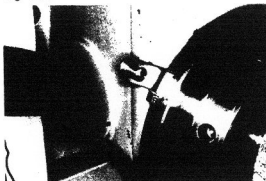
1. Install the automatic timer on the pump spline shaft and mount the injection pump on the pump tester.
2. Fill the pump camshaft chamber with engine oil.

Fig. 6-53



3. Install the timer breaker box to the piston bore of the feed pump by using an adapter.

Fig. 6-54



4. Check advance angle by using the timing light.

Pump rpm	Advance Angle
500	Advance begins ($\leq 0.5^\circ$)
700	2.0 – 3.0°
900	4.5 – 5.5°
1200	6.0 – 7.0°
1600	8.0 – 9.0°
1700	8.0 – 9.0°

Fig. 6-55

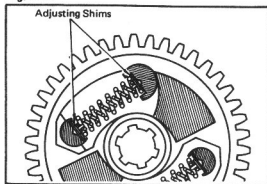
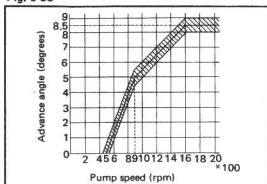


Fig. 6-56



5. If the advance angle is not within specified range, adjust by changing inner and outer timer spring shims.

— Note —

1. Use outer spring shim to adjust the timing advance characteristics in low speed range, and inner spring shim in high speed range.
 Outer adjusting shim thickness
 0.1, 0.2, 0.5 mm
 (0.004, 0.008, 0.020 in.)
 Inner adjusting shim thickness
 0.1, 0.2, 0.5 mm
 (0.004, 0.008, 0.020 in.)
2. When injection timing is retarded, decrease shim thickness.
 When injection timing is advanced, increase shim thickness.

DISASSEMBLY

Disassemble in numerical order.

Fig. 6-57

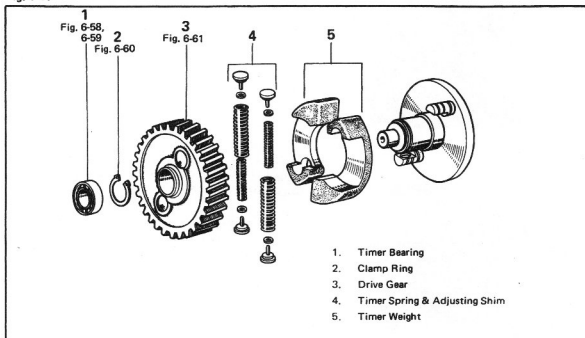
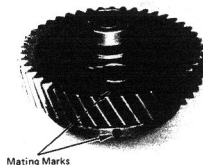
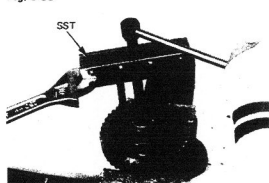


Fig. 6-58



Put the mating marks onto the timer hub and drive gear.

Fig. 6-59



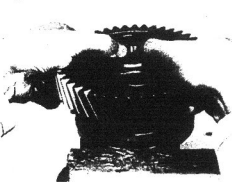
Pull out the timer bearing with SST[09213-36010].

Fig. 6-60



Remove the snap ring with a snap ring expander.

Fig. 6-61

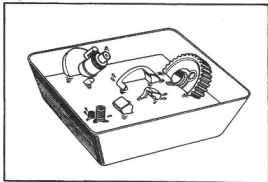


Hold the timer hub in a vise and pull up the drive gear.

— Caution —

Make sure that the springs and shims do not fly out.

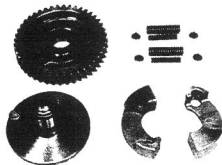
Fig. 6-62



INSPECTION

Clean the parts.

Fig. 6-63



Check all parts for wear or damage.

ASSEMBLY

Assemble in numerical order.

Fig. 6-64

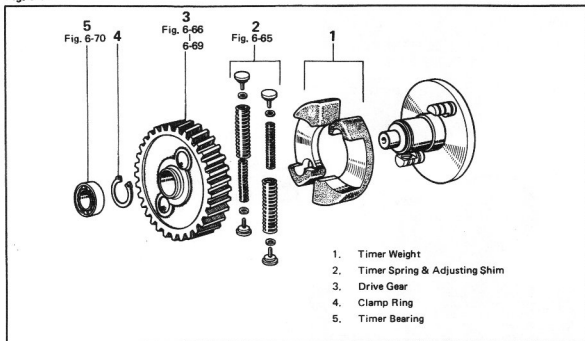
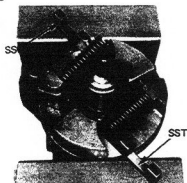
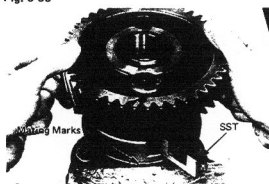


Fig. 6-65



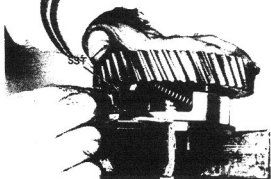
Set the timer springs, adjusting shims and spring seats with SST [09280-76010].

Fig. 6-66



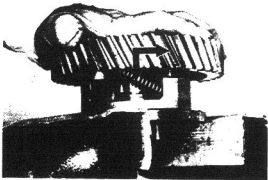
Match the mating marks when installing the drive gear.

Fig. 6-67



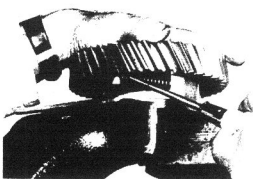
Remove the SST[09280-76010] by holding the drive gear so that the springs will not fall out.

Fig. 6-68



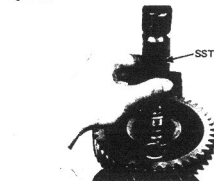
Press down and turn drive gear to install on the hub.

Fig. 6-69



Seat the timer spring snugly with a screw driver.

Fig. 6-70



Drive in the timer bearing into the timer hub by using SST[09238-76010].

INSTALLATION

Install in numerical order.

Fig. 6-71

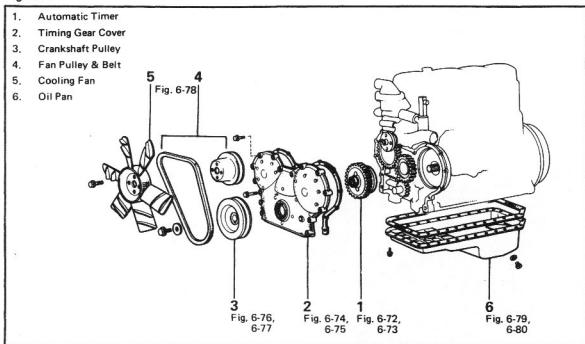
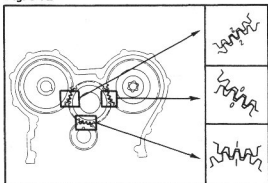
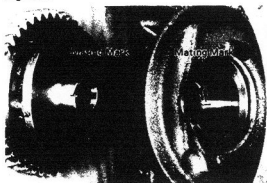


Fig. 6-72



Set the idle gear aligning marks "1" and "2" respectively against crankshaft gear mark "1" and camshaft gear mark "2".

Fig. 6-73



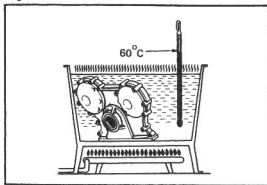
Align the mating marks on injection pump spline shaft and timer drive shaft, and at the same time align the idle gear mark "O" against the timer drive gear mark "O" as shown in Fig. 6-72.



— Note —

Coat MP grease on the splines and bearing.

Fig. 6-74

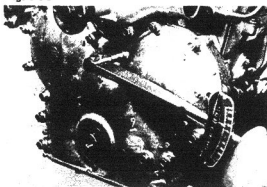


Heat the timing gear cover to about 60°C (140°F) before installing.

– Note –

The timing gear cover should be installed over a new gasket.

Fig. 6-75



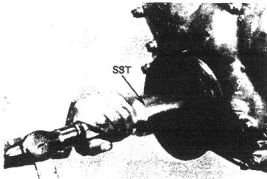
Tighten the timing gear cover.

Torque

8 mm bolt 1.5 – 2.2 kg-m (11 – 15 ft-lb)

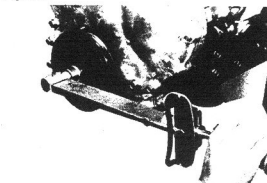
10 mm bolt 3.0 – 4.5 kg-m (22 – 32 ft-lb)

Fig. 6-76



Drive in the crankshaft pulley with SST [09214-60010].

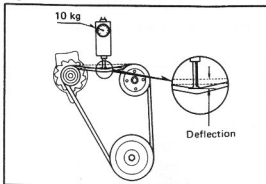
Fig. 6-77



Tighten the retaining bolt.

Torque 20.0 – 24.0 kg-m (145 – 173 ft-lb)

Fig. 6-78

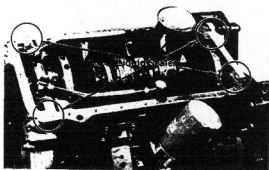


Adjust the "V" belt tension.

Deflection at 10 kg (22 lb) force

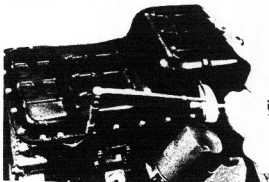
B engine	10 – 13 mm (0.4 – 0.5 in.)
2B engine	8 – 11 mm (0.3 – 0.4 in.)

Fig. 6-79



Apply liquid sealer to the cylinder block and gear cover.

Fig. 6-80



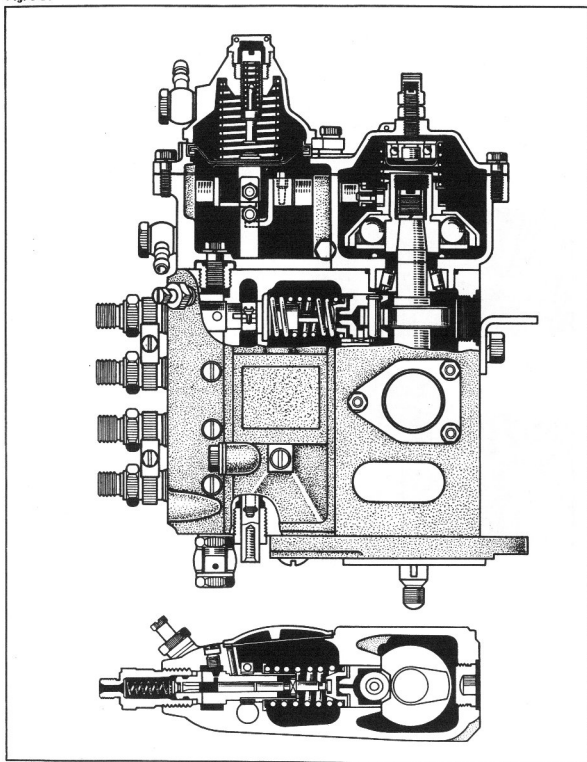
Install the oil pan.

Torque	0.5 – 1.0 kg-m (4 – 7 ft-lb)
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INJECTION PUMP

CROSS SECTIONAL VIEW

Fig. 6-81



REMOVAL

Remove in numerical order.

Fig. 6-82

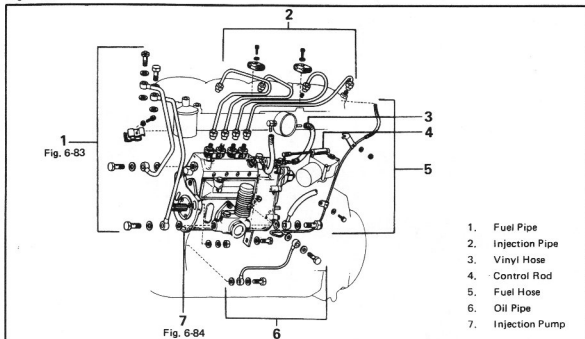
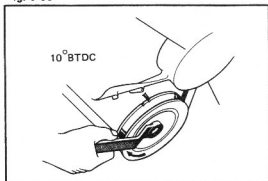
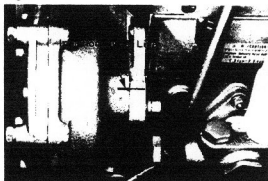


Fig. 6-83



Set No.1 cylinder piston to 10° BTDC /Compression before removing the injection pump.

Fig. 6-84



Check the position of the injection period line.

DISASSEMBLY

Disassemble in numerical order.

Fig. 6-85

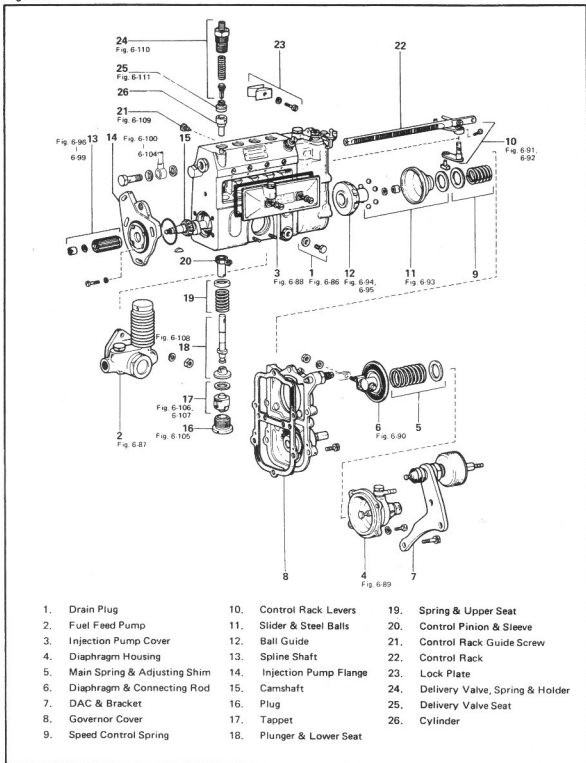
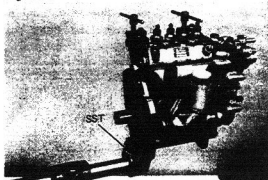
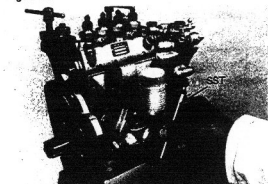


Fig. 6-86



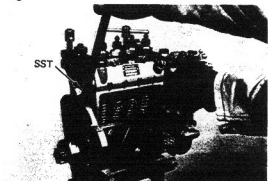
Mount the injection pump on work stand, SST[09241-76021].

Fig. 6-87



Remove the fuel pump with SST[09276-76010].

Fig. 6-88



Using SST[09278-46010], turn the camshaft and insert SST[09274-46010] into the tappet service openings respectively when the tappets are at their highest positions.

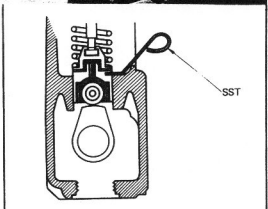
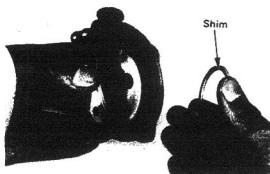
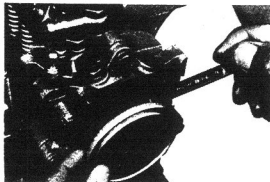


Fig. 6-89



When a number of main spring shims are used, use special care to prevent any from being misplaced or getting mixed up.

Fig. 6-90

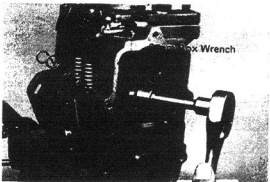


Disconnect the diaphragm from control rack.

— Caution —

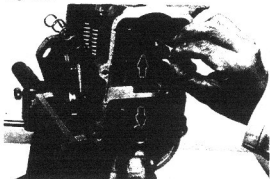
Do not allow any engine oil, fuel or grease to get on the diaphragm.

Fig. 6-91



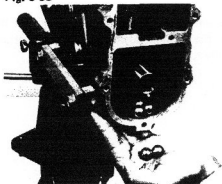
Remove the stop lever bolt with 6 mm box wrench.

Fig. 6-92



Remove two control rack levers by pulling respectively upwards and downwards.

Fig. 6-93

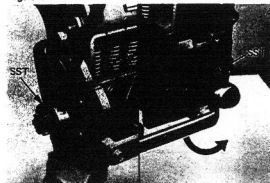


Remove the spring seat and slider, and then take out the six steel balls.

— Caution —

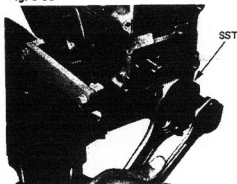
Take care not to allow the steel balls to drop.

Fig. 6-94



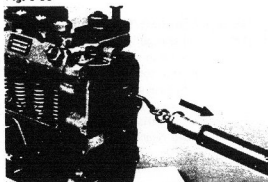
Hold the spline shaft with SST[09278-46010] and remove the round nut with SST[09266-67011].

Fig. 6-95



Pull out the ball guide with SST [09267-76011].

Fig. 6-96

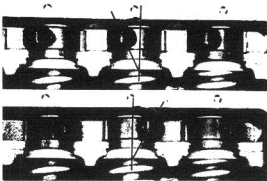


Check the sliding resistance of control rack.

Sliding resistance

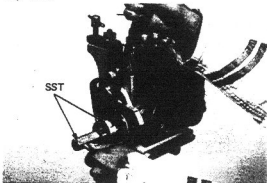
Less than 150 g (5.3 oz)

Fig. 6-97



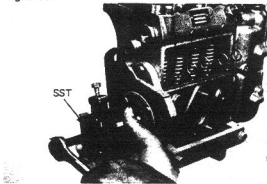
To prevent error upon assembling, confirm the control pinion stop position by moving control rack fully to left and right.

Fig. 6-98



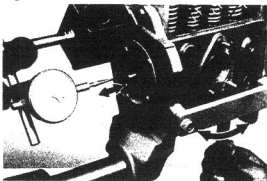
Hold the spline shaft with SST[09278-46010] and remove the round nut with SST[09266-46011].

Fig. 6-99



Pull out the spline shaft with SST[09286-46011].

Fig. 6-100



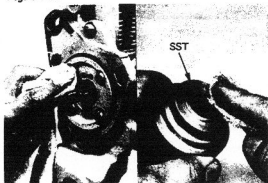
Measure Camshaft Thrust Clearance. [When Dial Gauge is used]

1. Set the magnetic base on injection pump flange and contact the dial gauge to the end of the camshaft.
2. Pry the camshaft with a wooden rod and check the thrust clearance.

Thrust clearance

STD	0.03 – 0.05 mm (0.0012 – 0.0020 in.)
Limit	0.1 mm (0.004 in.)

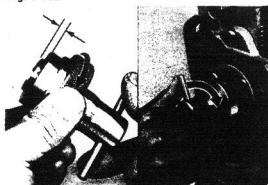
Fig. 6-101



[When SST[09287-76010] is used]

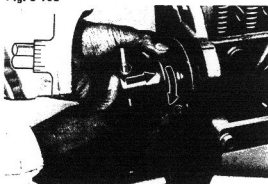
1. Clean the injection pump flange and SST[09287-76010].

Fig. 6-102



2. Firmly install SST[09287-76010] to the camshaft.

Fig. 6-103

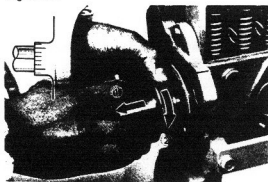


3. Push SST toward the pump side, and contact the outer dial to the pump flange by screwing the outer dial.
4. Read the scale on outer dial.

— Note —

A unit on the outer dial scale is equivalent to indicate 0.01 mm (0.0004 in.).

Fig. 6-104



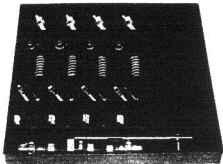
5. Pull SST toward the front, and contact the outer dial to the pump flange by screwing the outer dial.
6. The screwing distance is camshaft thrust clearance.

Thrust clearance

STD 0.03 — 0.05 mm
(0.0012 — 0.0020 in.)

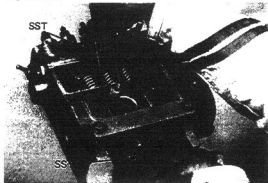
Limit 0.1 mm (0.004 in.)

Fig. 6-105



Keep all parts in order for each cylinder in the disassembly pan.

Fig. 6-106



Using SST[09272-76011], lift the tappet to remove SST[09274-46010].

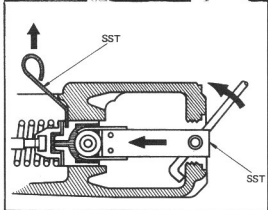
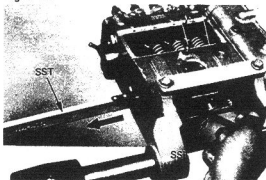
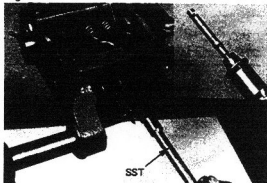


Fig. 6-107



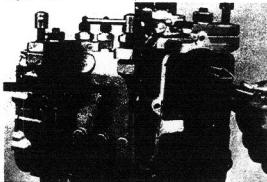
Hold the tappet in the camshaft chamber with SST[09272-76011] and take out the tappet through the camshaft bearing hole by using SST[09273-76011].

Fig. 6-108



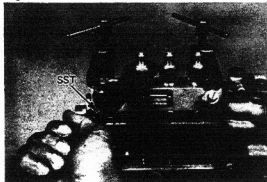
Using SST[09275-46010], hold the spring lower seat and take it out together with the plunger.

Fig. 6-109



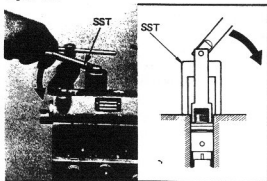
Loosen the rack guide screw and pull out the control rack.

Fig. 6-110



Remove the delivery valve holder with SST[09271-76011].

Fig. 6-111



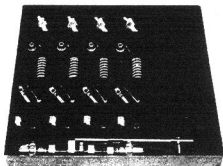
Turn the handle of SST[09271-76011] and screw SST into the valve seat service thread. Using the handle as lever, pull out the delivery valve seat and gasket as a set.

Fig. 6-112

**INSPECTION & REPAIR**

Use care not to touch the sliding surfaces of pump elements and delivery valves with your hand when handling them.

Fig. 6-113



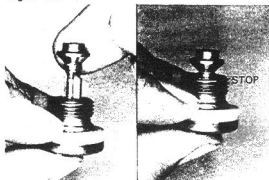
Wash the parts in clean light oil before inspecting. Wash and clean the outer surfaces of housings with a soft brush, and blow out the tapped holes with compressed air.

Fig. 6-114

**Diaphragm**

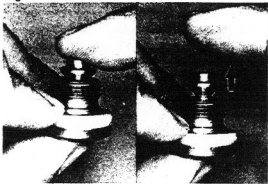
Wipe the diaphragm with cloth. Do not allow gasoline, light oil or other petroleum products to get on the diaphragm.

Fig. 6-115

**Delivery Valve**

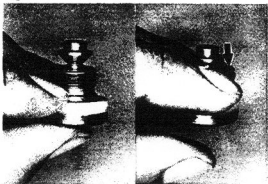
1. Pull up the valve and close the hole at valve seat bottom end with the thumb. When the valve is released, it should sink down quickly and stop at the position where the relief ring closes the valve seat hole. If defective, replace the valve as a set.

Fig. 6-116



2. Close the hole at valve seat bottom end with the thumb.
Insert the valve into the valve seat and press down with finger. When the finger is released, the valve should rise back to its original position.
Replace if defective.

Fig. 6-117



3. Remove thumb from the valve seat hole.
The valve should close completely by its own weight.
Replace if defective.

— Note —

Before using a new valve set, wash off the rust preventing compound with light oil or gasoline. Then re-wash with light oil and perform the above tests.

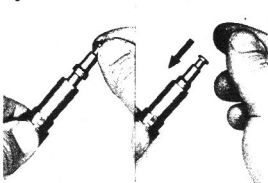
Fig. 6-118



Plunger and Cylinder

Inspect the sliding parts, and if damaged, replace the element as a set.

Fig. 6-119



Test for fit. (Sinking test)

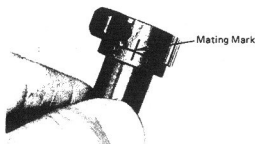
1. Tilt the cylinder slightly and pull out the plunger.
2. The plunger when released should sink down smoothly in the cylinder by its own weight.
3. Rotate the plunger and repeat the test at various positions. If the plunger sticks at any position, replace the element as a set.

Fig. 6-120

**Control Rack and Pinion**

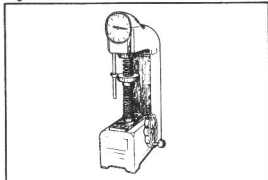
Inspect the tooth faces of control rack and pinion for damage and wear, and replace if defective.

Fig. 6-121



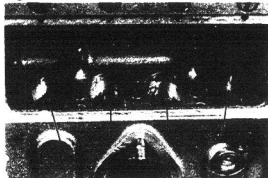
If necessary to disassemble, make sure of the installed condition of pinion and sleeve before disassembling.

Fig. 6-122

**Spring**

Spring Items	Plunger Spring	Delivery Valve Spring	Governor Main Spring	Speed Control Spring
Free Length	49.4 mm (1.944 in.)	37.0 mm (1.457 in.)	45.6 mm (1.795 in.)	38.0 mm (1.496 in.)
Installed Length	44.0 mm (1.732 in.)	25.9 mm (1.020 in.)	35.0 mm (1.378 in.)	27.0 mm (1.063 in.)
Installed Load	15.1 kg (33.3 lb)	4.42 kg (9.74 lb)	0.95 kg (33.5 oz)	3.30 kg (7.28 lb)

Fig. 6-123

**Tappet**

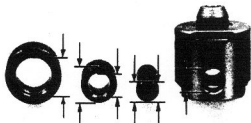
Check the tappet holes of pump housing for wear and excessive damage.

Fig. 6-124



Check the tappet, roller bushing and pin for wear and damage.

Fig. 6-125



Measure the overall looseness with the tappet roller in assembled state, and replace if it exceeds the specified limit.

Overall looseness limit 0.3 mm (0.012 in.)

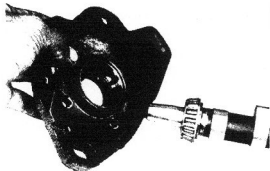
Fig. 6-126



Camshaft

Check the oil seal contacting part and cam surfaces for damage and wear.

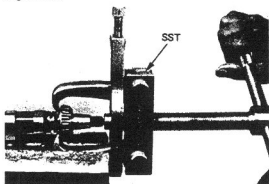
Fig. 6-127



Camshaft Bearing

Check the roller and race for wear and damage.

Fig. 6-128

**Replace Camshaft Bearing**

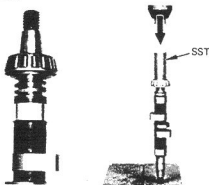
1. Pull out the front bearing with SST[09950-20011].

Fig. 6-129



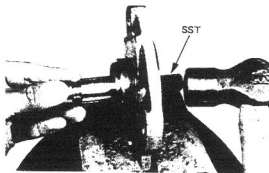
2. Keep the removed shims separately to prevent being lost or getting mixed up with other shims.

Fig. 6-130



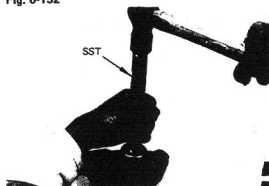
3. Press in the camshaft adjusting ring, shims and bearing onto the camshaft by using SST[09285-76010] and a press.

Fig. 6-131



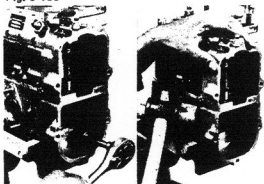
4. Remove the bearing outer race from bearing cover by using SST[09286-76011].

Fig. 6-132



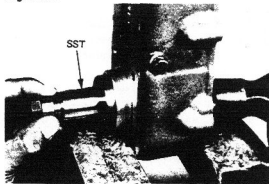
5. Drive in the new bearing outer race into the cover with SST[09608-12010].

Fig. 6-133



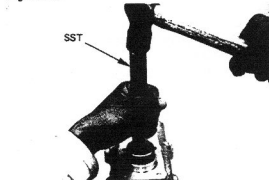
6. Remove the governor housing from pump body.

Fig. 6-134



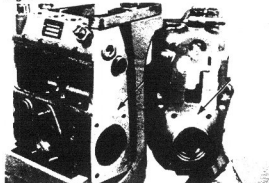
7. Remove the bearing outer race from governor housing by using SST[09286-76011].

Fig. 6-135



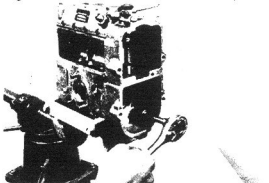
8. Drive in the new bearing outer race into the governor housing with SST[09608-12010].

Fig. 6-136



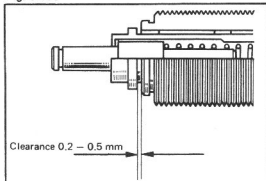
9. Clean the installing surfaces.

Fig. 6-137



10. Install the new gasket and the governor housing.

Fig. 6-138



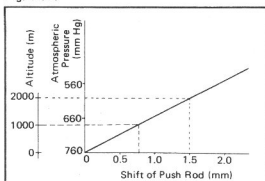
Diesel Altitude Compensator (DAC)

1. Check DAC for correct clearance between full stop capsule flange and DAC body.

Clearance at seal level

0.2 – 0.5 mm
(0.008 – 0.020 in.)

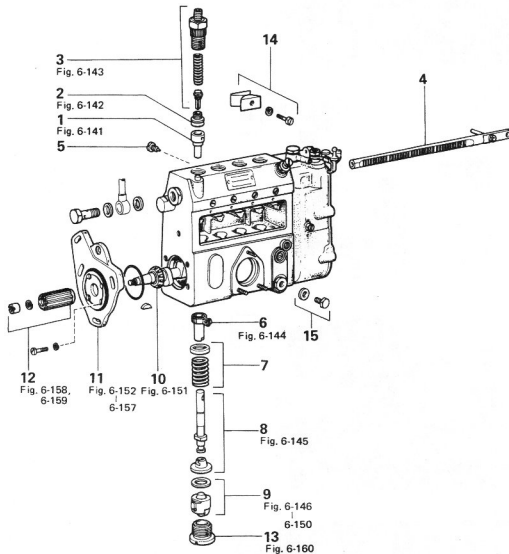
Fig. 6-139



2. Since the position of the push rod depends on altitude, the clearance mentioned above must be 0.2 to 0.5 mm (0.008 – 0.020 in.) plus amount of push rod shift as shown.

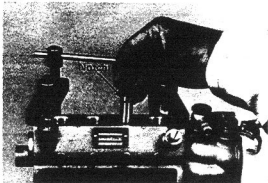
ASSEMBLY (PUMP BODY)

Assemble in numerical order.

Fig. 6-140

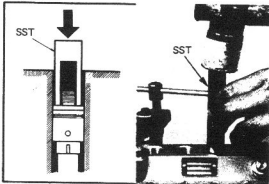
- | | | |
|------------------------------------|----------------------------|---------------------------|
| 1. Cylinder | 6. Control Pinion & Sleeve | 11. Injection Pump Flange |
| 2. Delivery Valve Seat | 7. Spring & Upper Seat | 12. Spline Shaft |
| 3. Delivery Valve, Spring & Holder | 8. Plunger & Lower Seat | 13. Plug |
| 4. Control Rack | 9. Tappet | 14. Lock Plate |
| 5. Control Rack Guide Screw | 10. Camshaft | 15. Drain Plug |

Fig. 6-141



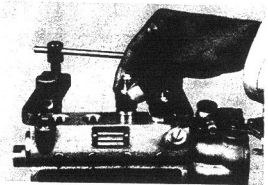
Match the pump cylinder notch with the pump housing knock pin to assemble the cylinder.

Fig. 6-142



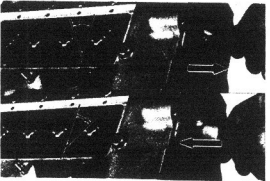
Drive in the pump cylinder lightly with SST [09262-76010].

Fig. 6-143



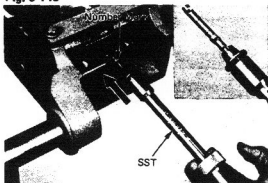
Lightly tighten the delivery valve holder by hand.

Fig. 6-144



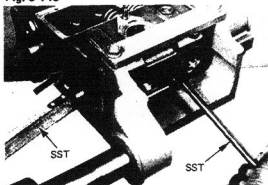
Assemble so that the pinion swings evenly to left and right when rack is moved to right and left. When assembling the sleeves, inspect fitting condition by moving rack.

Fig. 6-145



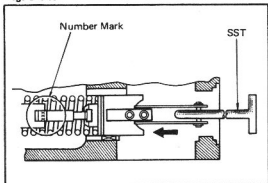
Assemble the plunger and spring lower seat, inserting the driving face marked with number and lower seat notch part upward (cover plate side) by using SST [09275-46010].

Fig. 6-146



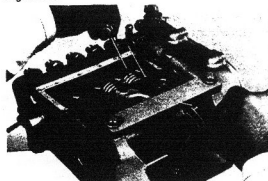
Insert the tappet into housing with SST [09273-76011] and [09272-76011].

Fig. 6-147



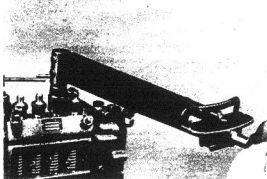
Fit the driving face into the cylinder groove, facing its number mark to pump cover side.

Fig. 6-148



Press in tappet with SST [09272-76011] and hold it with SST [09274-46010].

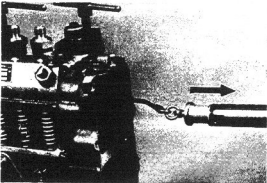
Fig. 6-149



When one delivery valve holder is tightened, move the control rack to right and left and inspect the tightness of rack.

Torque **2.5 – 3.5 kg-m**
 (18.1 – 25.3 ft-lb)

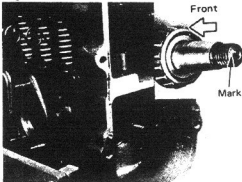
Fig. 6-150



Measure the control rack sliding resistance with a spring scale, and make sure that the resistance is less than 150 g (5.3 oz) and the rack moves smoothly.

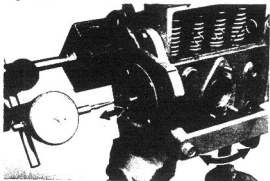
Sliding resistance
 Less than 150 g (5.3 oz)

Fig. 6-151



To assemble the camshaft, the mark at the end of the camshaft should be at the governor side.

Fig. 6-152



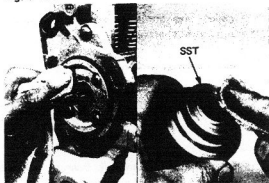
Measure Camshaft Thrust Clearance.
[When Dial Gauge is used]

1. Set the magnetic base on injection pump flange and contact the dial gauge to the end of camshaft.
2. Pry the camshaft with a wooden stick and check the thrust clearance.

Thrust clearance

STD	0.03 – 0.05 mm (0.0012 – 0.0020 in.)
Limit	0.1 mm (0.004 in.)

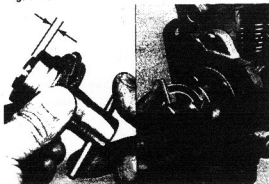
Fig. 6-153



Measure Camshaft Thrust Clearance.
[When SST [09287-76010] is used]

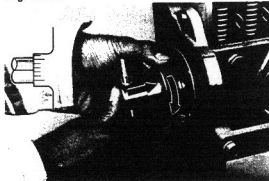
1. Clean the injection pump flange and SST [09287-76010].

Fig. 6-154



2. Firmly install SST [09287-76010] to the camshaft.

Fig. 6-155

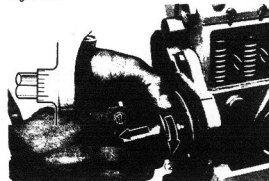


3. Push SST toward the pump side, and contact the outer dial to the pump flange by screwing the outer dial.
4. Read the scale on outer dial.

— Note —

A unit on the outer dial scale is equivalent to 0.01 mm (0.0004 in.).

Fig. 6-156

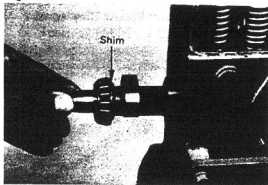


5. Pull SST toward the front side, and contact outer dial to the pump flange by screwing the outer dial.
6. The screwing distance is camshaft thrust clearance.

Thrust clearance

STD	0.03 – 0.05 mm (0.0012 – 0.0020 in.)
Limit	0.1 mm (0.004 in.)

Fig. 6-157



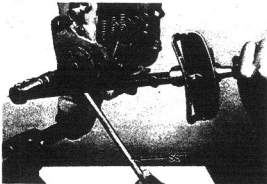
To adjust the thrust clearance, increase or decrease camshaft adjusting shim.

Shim thickness: 0.10, 0.12, 0.14, 0.16, 0.18,
0.50 mm
(0.0039, 0.0047, 0.0055, 0.0063, 0.0071,
0.0197 in.)

— Note —

Refer to "Replace Camshaft Bearing" on page 6-42 for replacement of adjusting shim.

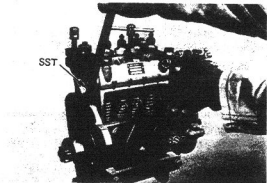
Fig. 6-158



Hold the spline shaft with SST[09278-46010] and tighten the round nut with SST[09266-46011] and torque wrench.

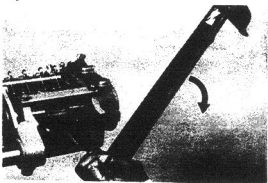
Torque 6.0 — 7.0 kg-m
(43.4 — 50.6 ft-lb)

Fig. 6-159



Using SST[09278-46010], rotate the camshaft and remove SST[09274-46010].

Fig. 6-160



Install the felt plate plugs.

Torque 5.5 — 7.5 kg-m
(39.8 — 54.2 ft-lb)

ADJUST (PUMP BODY)

Pump Body Adjustment Items

Preparations of Pump Tester

Nozzle type		DN 4 SD-24	
Nozzle	Opening pressure	120 — 130 kg/cm ²	(1707 — 1849 psi)
Injection pipe	Outer diameter	6 mm	(0.24 in.)
	Inner diameter	2 mm	(0.08 in.)
	Length	600 mm	(23.62 in.)
	Minimum bending radius	More than 25 mm	(0.98 in.)
Fuel temperature		40 — 45°C	(104 — 113°F)
Fuel feeding pressure		0.5 kg/cm ²	(7.1 psi)

Control Rack Sliding Resistance

Pump rpm	Sliding Resistance	
0	Less than 150 g	(5.3 oz)
1000	Less than 50 g	(1.8 oz)

Injection Timing

Pre-stroke	1.9 — 2.0 mm	(0.075 — 0.079 in.)
	[Control rack position at 8 mm (0.31 in.)]	
Injection Interval	90° ± 30'	
Tappet Clearance	More than 0.2 mm	(0.008 in.)

Injection Volume Adjustment

For B Engine

Rack Position	Pump rpm	Measuring Strokes	Injection Volume	Variation Limit
16.0 mm (0.630 in.)	100	200	14.0 — 16.0 cc (0.854 — 0.976 cu.in.)	1.2 cc (0.073 cu.in.)
12.0 mm (0.472 in.)	1100	200	10.6 — 11.2 cc (0.647 — 0.683 cu.in.)	0.4 cc (0.024 cu.in.)
8.6 mm (0.330 in.)	1000	200	4.6 — 5.6 cc (0.281 — 0.342 cu.in.)	0.4 cc (0.024 cu.in.)
6.5 mm (0.256 in.)	300	500	2.5 — 4.5 cc (0.153 — 0.275 cu.in.)	1.0 cc (0.061 cu.in.)

For 2B Engine

Rack Position	Pump rpm	Measuring Strokes	Injection Volume	Variation Limit
16.0 mm (0.630 in.)	100	200	14.0 — 16.0 cc (0.854 — 0.976 cu.in.)	1.2 cc (0.073 cu.in.)
11.9 mm (0.469 in.)	1100	200	11.0 — 11.6 cc (0.671 — 0.708 cu.in.)	0.4 cc (0.024 cu.in.)
8.0 mm (0.315 in.)	1000	200	4.3 — 5.1 cc (0.262 — 0.311 cu.in.)	0.4 cc (0.024 cu.in.)
6.5 mm (0.256 in.)	300	500	2.5 — 4.5 cc (0.153 — 0.275 cu.in.)	1.0 cc (0.061 cu.in.)

Pressure Test

Plunger pressure	More than 150 kg/cm ² (2133 psi) [Pump speed at 200 rpm, Rack position at 6.5 mm (0.256 in.)]
Delivery valve pressure	More than 5 seconds for holder internal pressure to drop 10 kg/cm ² (142 psi) [Holder internal pressure more than 150 kg/cm ² (2133 psi), Rack position at 0 mm]

Fig. 6-161

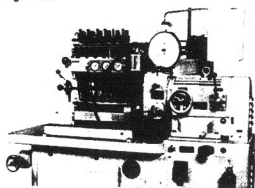


Fig. 6-162

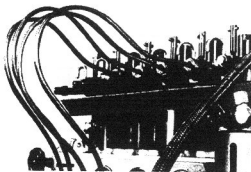


Fig. 6-163

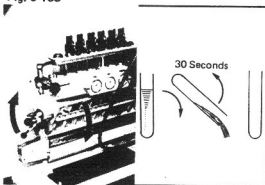
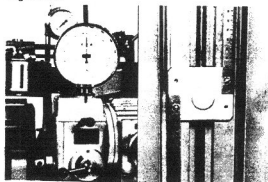


Fig. 6-164



Check & Preparations before Test

1. Specifications for test nozzle and nozzle holder are as follows:

Nozzle	ND4 SD-24
Nozzle holder valve opening pressure	120 — 130 kg/cm²
	(1707 — 1849 psi)

2. Use injection pipes with the following specifications.

Outer diameter	6 mm (0.24 in.)
Inner diameter	2 mm (0.08 in.)
Length	600 mm (23.62 in.)
Minimum bending radius	More than 25 mm (0.98 in.)

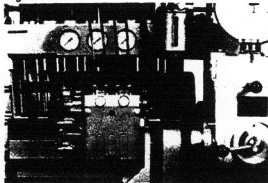
3. Measure injection of each cylinder with specified measuring cylinder.
4. Tilt the measuring cylinders for 30 seconds for light oil to gush out, and then, raise cylinders upright and measure.

5. Check tachometer accuracy.

± 40 rpm

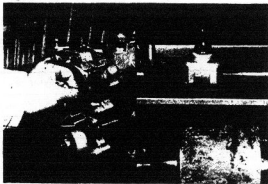
6. To measure vacuum pressure, observe water column of U-tube at zero point and at adjusting points, and correct if necessary.

Fig. 6-165



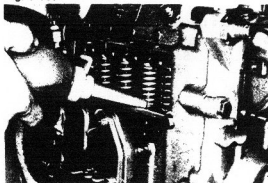
7. Mount the injection pump body on the pump tester.

Fig. 6-166



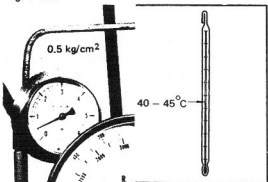
8. Install the rack scale so that its zero point will be at the position where the control rack is pushed fully toward the governor side, and set to allow easy reading of scale graduations.

Fig. 6-167



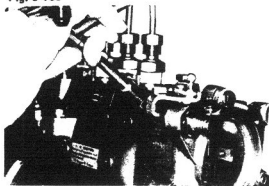
9. Install cover to the feed pump mounting surface, and fill the pump camshaft chamber with lubricating oil.

Fig. 6-168



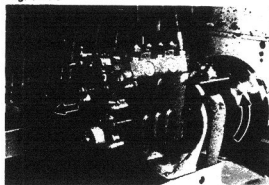
10. Fuel feeding pressure to injection pump should be 0.5 kg/cm^2 (7.1 psi).
11. Fuel temperature to use pump testing should be $40^\circ - 45^\circ\text{C}$ ($104^\circ - 113^\circ\text{F}$).

Fig. 6-169



12. Bleed air from pump housing.

Fig. 6-170

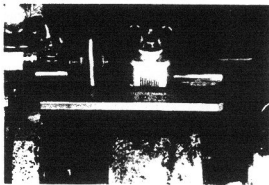


Control Rack Sliding Resistance

Measure the control rack sliding resistance with spring scale (spring balancer).

Pump Revolution	Sliding Resistance
0 rpm	Less than 150 g (5.3 oz)
1,000 rpm	Less than 50 g (1.8 oz)

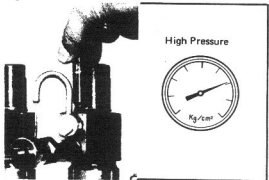
Fig. 6-171



Adjust Injection Timing

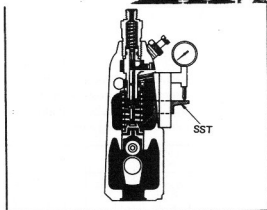
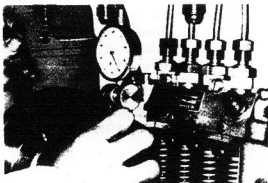
1. Pre-stroke (for No.1 plunger)
 - (1) Set the control rack position at 8 mm (0.315 in).

Fig. 6-172



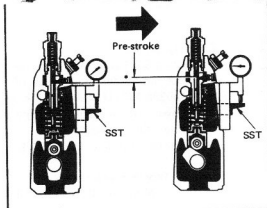
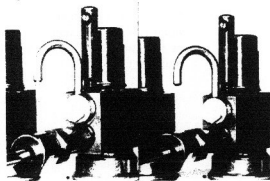
- (2) Loosen overflow cock of the pump tester bench nozzle holder.
- (3) Fuel feeding pressure to injection pump should be on the high side.

Fig. 6-173



- (4) Set No.1 tappet to BDC position, and set dial gauge on No.1 tappet by using SST [09283-46010].

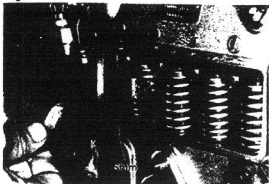
Fig. 6-174



- (5) Rotate the camshaft clockwise, and measure the lift of No.1 plunger when the plunger moves from BDC to injection starting position (Until fuel flowing from overflow pipe just stops).

Pre-stroke 1.9 – 2.0 mm
 (0.075 – 0.079 in.)

Fig. 6-175

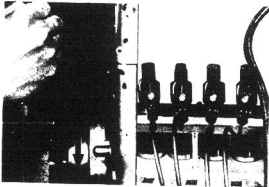


- (6) If the pre-stroke is not within specification, use SST [09280-46010] and adjust by changing tappet adjusting shim.

— Note —

15 shims are available, each varying in thickness by 0.1 mm (0.004 in.) from 0.1 – 1.5 mm (0.004 – 0.059 in.).

Fig. 6-176

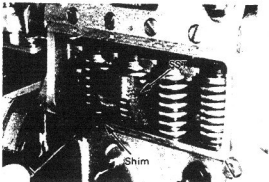


2. Injection Interval

- (1) Setting No.1 cylinder injection starting time position as a base, inspect and adjust injection starting angle in the order of injection.
- (2) Injection starting angle.

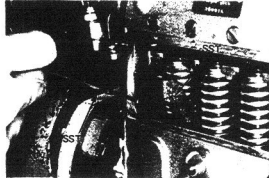
Cylinder No.	1	3	4	2
Injection Starting Angle	89°30'	179°30'	269°30'	270°30'

Fig. 6-177



- (3) If the injection starting angle is not within specification, adjust by using the same procedure as for pre-stroke adjustment.

Fig. 6-178



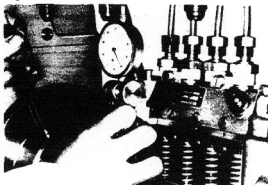
3. Tappet Clearance

- (1) Using SST [09280-46010], insert the 0.2 mm (0.008 in.) gauge of SST [09288-46011] between the spring lower seat and adjusting shim, and rotate the camshaft slowly.
- (2) The camshaft should turn easily.

Tappet clearance

More than 0.2 mm (0.008 in.)

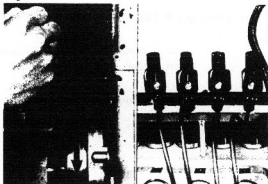
Fig. 6-179



- (3) If the tappet clearance is less than 0.2 mm (0.008 in.), recheck and adjust the pre-stroke.

**Pre-stroke 1.9 – 2.0 mm
(0.075 – 0.079 in.)**

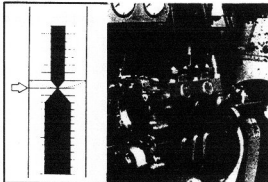
Fig. 6-180



- (4) Recheck and adjust the injection starting angle.

Cylinder No.	1	3	4	2
Injection Starting Angle	89°30' 90°30'	179°30' 180°30'	289°30' 270°30'	

Fig. 6-181

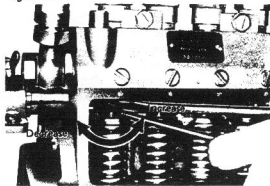


Adjust Injection Volume

1. Measure the injection volume for each control rack position and pump rpm.

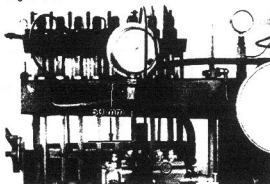
Engine Model	Rack Position	Pump rpm	Measuring Strokes	Injection Volume	Variation Limit
8	16.0 mm (0.630 in.)	100	200	14.0 – 16.0 cc (0.854 – 0.976 cu.in.)	1.2 cc (0.073 cu.in.)
	12.0 mm (0.472 in.)	1100	200	10.6 – 11.2 cc (0.647 – 0.683 cu.in.)	0.4 cc (0.024 cu.in.)
	8.6 mm (0.339 in.)	1000	200	4.6 – 5.6 cc (0.281 – 0.342 cu.in.)	0.4 cc (0.024 cu.in.)
	6.5 mm (0.256 in.)	300	500	2.5 – 4.5 cc (0.153 – 0.275 cu.in.)	1.0 cc (0.061 cu.in.)
28	16.0 mm (0.630 in.)	100	200	14.0 – 16.0 cc (0.854 – 0.976 cu.in.)	1.2 cc (0.073 cu.in.)
	11.9 mm (0.469 in.)	1100	200	11.0 – 11.6 cc (0.671 – 0.708 cu.in.)	0.4 cc (0.024 cu.in.)
	8.0 mm (0.315 in.)	1000	200	4.3 – 5.1 cc (0.262 – 0.311 cu.in.)	0.4 cc (0.024 cu.in.)
	6.5 mm (0.256 in.)	300	500	2.5 – 4.5 cc (0.153 – 0.275 cu.in.)	1.0 cc (0.061 cu.in.)

Fig. 6-182



2. To adjust the injection volume, loosen the pinion clamp screw and rotate the control sleeve.

Fig. 6-183

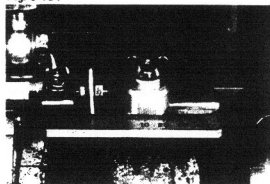
**Test Plunger & Delivery Valve**

1. Plunger test

- (1) Install pressure gauge on delivery valve holder.

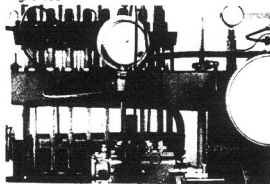
**Injection pipe length 50 mm
(1.97 in.)**

Fig. 6-184



- (2) Set control rack position at 6,5 mm (0,256 in.).

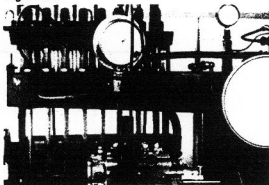
Fig. 6-185



- (3) Measure the maximum pressure with pump revolution at 200 rpm.

**Pressure Above 150 kg/cm²
(2133 psi)**

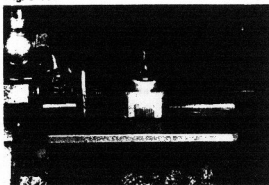
Fig. 6-186



2. Delivery valve test

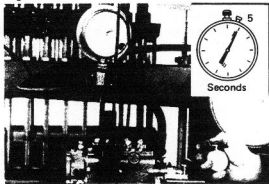
- (1) Stop the pump revolution when the pressure gauge reading exceeds 150 kg/cm^2 (2133 psi).

Fig. 6-187



- (2) Set the control rack position at 0 mm.

Fig. 6-188



- (3) Measure the time required by valve holder to lose its pressure by 10 kg/cm^2 (142 psi).

Time required for losing 10 kg/cm^2 (142 psi)
More than 5 seconds

- (4) If under the limit, replace both plunger and delivery valve.

ASSEMBLY (COMBINED GOVERNOR)

Assemble in numerical order.

Fig. 6-189

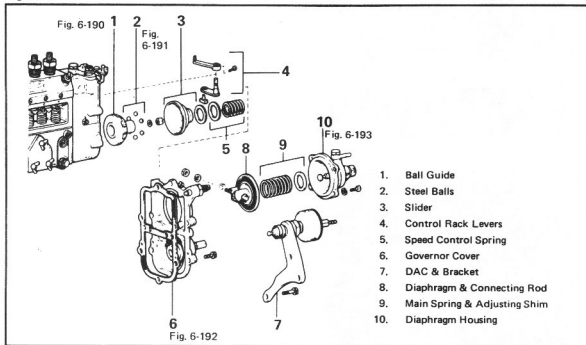
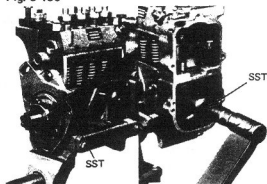


Fig. 6-190

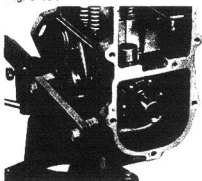


Hold the spline shaft with SST[09278-46010] and tighten the round nut with SST[09266-67011].

Torque

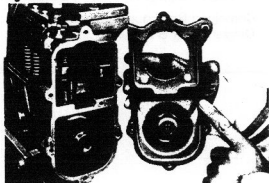
5.0 – 6.0 kg-m
(36.2 – 43.4 ft-lb)

Fig. 6-191



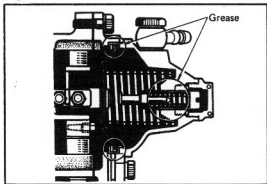
Apply grease to the ball guide groove and put six steel balls in the groove.
Place slider onto the ball guide.

Fig. 6-192



Lightly coat the liquid sealer to the new governor cover gasket before installing.

Fig. 6-193

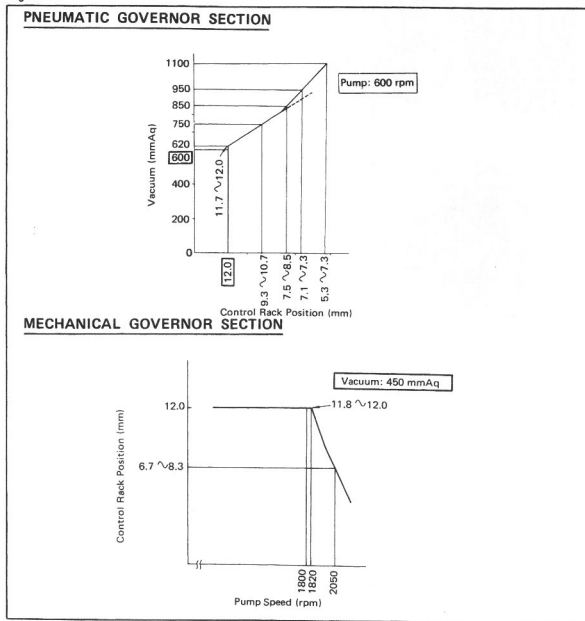


Coat diaphragm housing and idling capsule with grease to keep vacuum chamber airtight.

ADJUST (COMBINED GOVERNOR)

Combined Governor Characteristic
Diagram (For B Engine)

Fig. 6-194

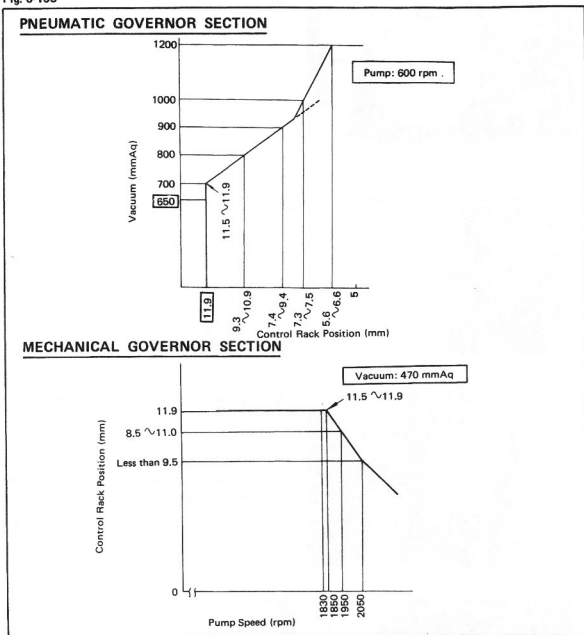


Total Injection Volume (For B Engine)

Measuring Strokes	Pump rpm	Vacuum	Total Injection Volume
500	1100	120 mmAq (4.72 in.Aq)	106.0 — 110.0 cc (6.47 — 6.71 cu.in.) For ECE 101.0 — 105.0 cc (6.16 — 6.41 cu.in.)

Combined Governor Characteristic Diagram (For 2B Engine)

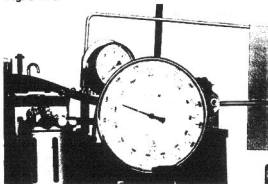
Fig. 6-195



Total Injection Volume (For 2B Engine)

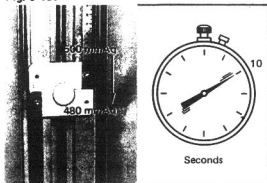
Measuring Strokes	Pump rpm	Vacuum	Total Injection Volume
500	1100	200 mmAq (7.87 in.Aq)	111.0 — 115.0 cc (6.77 — 7.02 cu.in.)

Fig. 6-196

**Test Airtightness**

1. Set the injection pump revolution at 600 rpm.

Fig. 6-197

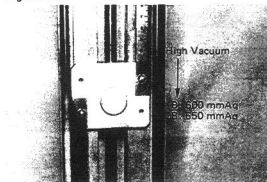


2. Measure the time required by vacuum chamber to lose its vacuum down to 480 mmAq (18,90 in.Aq).

Vacuum Loss	Time
From 500 mmAq to 480 mmAq (19,69 in.Aq) (18,90 in.Aq)	More than 10 seconds

3. Retighten the diaphragm housing or inspect the diaphragm if airtightness is unsatisfactory.

Fig. 6-198

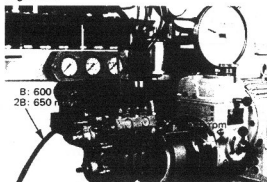
**Adjust Initial Set of Control Rack**

1. Set the vacuum to specified value.

— Note —

When altering the vacuum, set to specified value after altering largely, and read graduation when it becomes steady.

Fig. 6-199



2. Check the initial set point of control rack.

Engine Model	Pump rpm	Vacuum	Control Rack Position
B	600	600 mmAq (23,62 in.Aq)	12,0 mm (0,472 in.)
2B	600	650 mmAq (25,59 in.Aq)	11,9 mm (0,469 in.)

Fig. 6-200

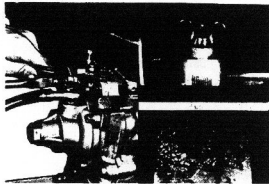


Fig. 6-201

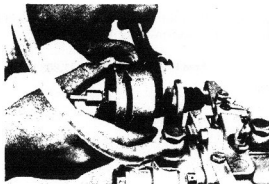


Fig. 6-202

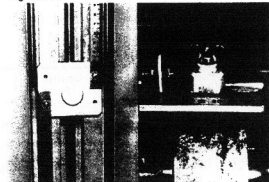
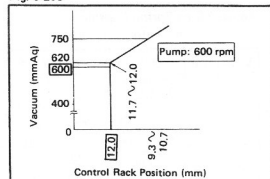


Fig. 6-203



- Adjust the initial set of control rack by turning full stop capsule.

- If the governor is equipped with diesel altitude compensator (DAC) instead of full stop capsule, adjust by it.



Adjust Main Spring

- Check the control rack position.

Engine Model	Pump rpm	Vacuum	Rack Position
B	600	620 mmAq (24.41 in.Aq)	11.7 — 12.0 mm (0.461 — 0.472 in.)
		750 mmAq (29.53 in.Aq)	9.3 — 10.7 mm (0.366 — 0.429 in.)
2B	600	700 mmAq (27.56 in.Aq)	11.5 — 11.9 mm (0.453 — 0.469 in.)
		800 mmAq (31.50 in.Aq)	9.3 — 10.9 mm (0.366 — 0.429 in.)
		900 mmAq (35.43 in.Aq)	7.4 — 9.4 mm (0.291 — 0.370 in.)

Fig. 6-204

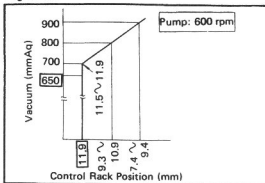


Fig. 6-205

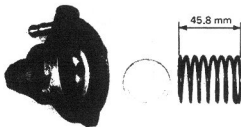


Fig. 6-206

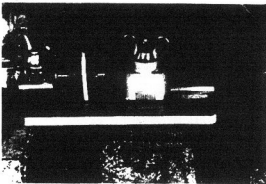
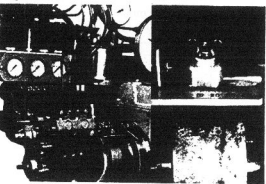


Fig. 6-207



- Adjust the control rack position by increasing number of main spring shim.

Shim Thickness

0.5, 1.0, 2.0, 3.0 mm

(0.020, 0.039, 0.079, 0.118 in.)

— Note —

When rack position is increased.

Increase shim thickness.

When rack position is decrease.

Decrease shim thickness.

- If the control rack position is not within specification, check the main spring.

Free length 45.8 mm (1.803 in.)

- When adjustment is completed, reconfirm initial setting.

Initial Set of Control Rack

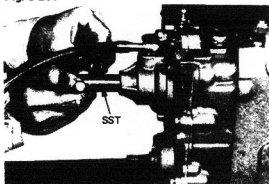
Engine Model	Pump rpm	Vacuum	Control Rack Position
B	600	600 mmAq (23.62 in.Aq)	12.0 mm (0.472 in.)
2B	600	650 mmAq (25.59 in.Aq)	11.9 mm (0.469 in.)

Adjust Idling Spring Capsule

- Check the control rack position.

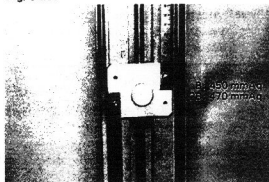
Engine Model	Pump rpm	Vacuum	Control Rack Position
B	600	850 mmAq (33.46 in.Aq)	7.5 – 8.5 mm (0.295 – 0.335 in.)
		950 mmAq (37.40 in.Aq)	7.1 – 7.3 mm (0.280 – 0.287 in.)
		1100 mmAq (43.31 in.Aq)	5.3 – 7.3 mm (0.209 – 0.287 in.)
		1000 mmAq (39.37 in.Aq)	7.3 – 7.5 mm (0.287 – 0.295 in.)
2B	600	1200 mmAq (47.24 in.Aq)	5.6 – 6.6 mm (0.220 – 0.260 in.)

Fig. 6-208



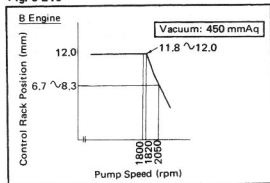
- Using SST[09282-76010], adjust the control rack position by turning idling capsule.

Fig. 6-209

**Adjust Mechanical Governor Section**

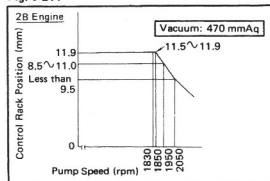
- Set the vacuum to specified value.

Fig. 6-210



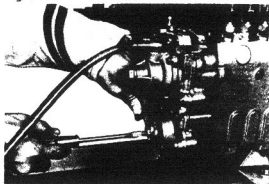
- Check the control rack position.

Fig. 6-211



Engine Model	Vacuum	Pump rpm	Control Rack Position
B	450 mmAq (17.72 in.Aq)	1800	12.0 mm (0.472 in.)
		1820	11.8 – 12.0 mm (0.465 – 0.472 in.)
		2050	6.7 – 8.3 mm (0.264 – 0.327 in.)
2B	470 mmAq (18.50 in.Aq)	1830	11.9 mm (0.469 in.)
		1850	11.5 – 11.9 mm (0.453 – 0.469 in.)
		1950	8.5 – 11.0 mm (0.335 – 0.433 in.)
		2050	Less than 9.5 mm (0.374 in.)

Fig. 6-212



3. Adjust the control rack position by turning speed control screw.

Fig. 6-213

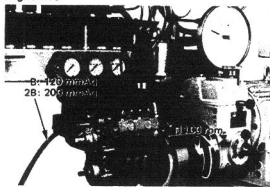
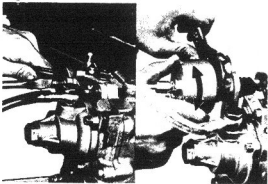


Fig. 6-214



Total Injection Volume

1. Measure the total injection volume at 500 strokes.

Engine Model	Pump rpm	Vacuum	Total Injection Volume
B	1100	120 mmHg (4.72 in.Aq)	106.0 – 110.0 cc (6.47 – 6.71 cu.in.)
B(For ECE)	1100	120 mmHg (4.72 in.Aq)	101.0 – 105.0 cc (6.16 – 6.41 cu.in.)
2B	1100	200 mmHg (7.87 in.Aq)	111.0 – 115.0 cc (6.77 – 7.02 cu.in.)

2. If the total injection volume is not within specified value, adjust it by turning full stop capsule or diesel altitude compensator.

INSTALLATION

Install in numerical order.

Fig. 6-215

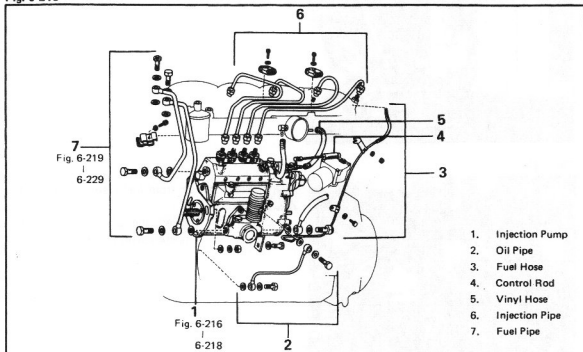
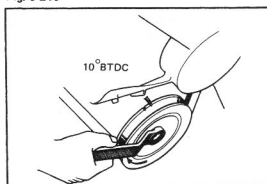
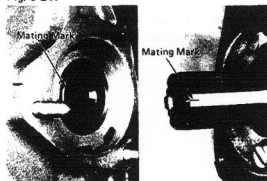


Fig. 6-216



Make sure that the No. 1 cylinder piston is at 10° BTDC/Compression before installing the injection pump.

Fig. 6-217

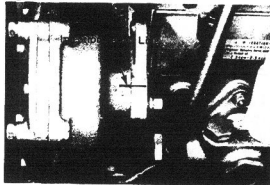


Align the mating marks on the injection pump spline shaft and timer drive shaft when installing the Injection pump.



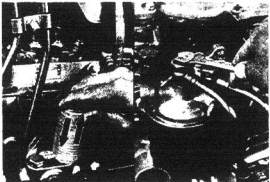
— Note —
Coat MP grease on the splines.

Fig. 6-218



Set the injection period line to the former position.

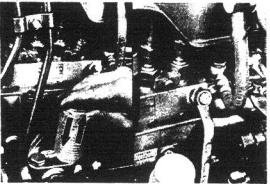
Fig. 6-219



Bleed the air from fuel system after installation is completed.

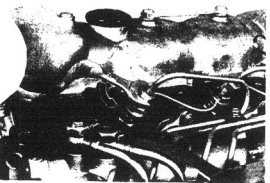
- (1) Bleed the air from fuel filter by operating priming pump.

Fig. 6-220



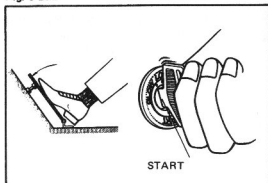
- (2) Bleed the air from injection pump by operating priming pump.

Fig. 6-221



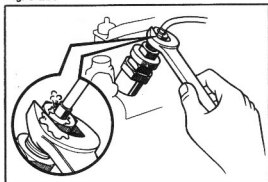
- (3) Loosen all union nuts of the injection pipe at nozzle holder side.

Fig. 6-222



- (4) Turn the engine with the accelerator pedal depressed all the way.

Fig. 6-223

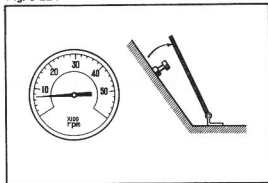


- (5) Bleed the air by cranking the engine and force out the fuel from injection pipe.

— Note —

Start the engine and inspect all pipe lines for fuel leaks.

Fig. 6-224

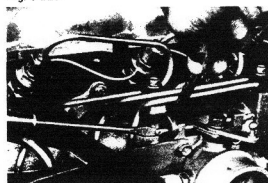


Adjust the engine idle speed and the maximum speed after installation is completed.

- (1) Warm up the engine.
- (2) Check the engine idle speed.

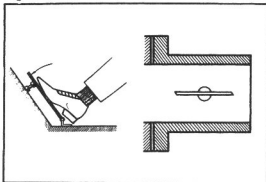
Idle speed 625 — 675 rpm

Fig. 6-225



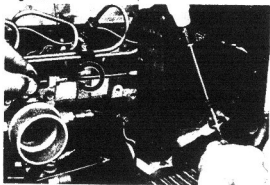
- (3) Adjust the idle speed to specification by turning the stop plate adjusting screw.

Fig. 6-226



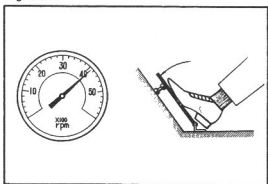
- (4) Make sure that the throttle valve is fully open when the accelerator pedal is depressed all the way.

Fig. 6-227



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

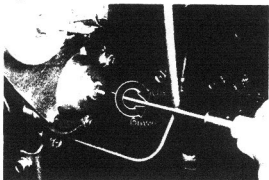
Fig. 6-228



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

Maximum speed 4050 — 41000 rpm

Fig. 6-229



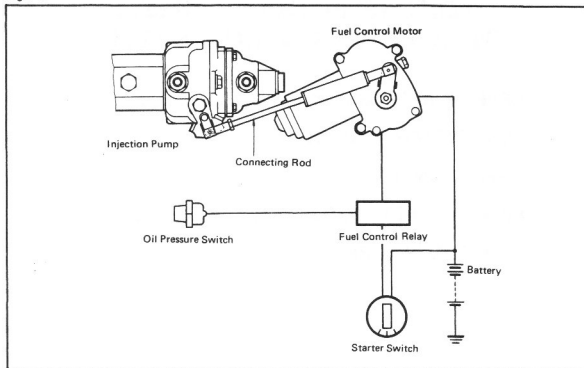
- (7) If the maximum speed is not within specification, adjust by turning the adjusting screw of the injection pump.

EDIC (ELECTRICAL DIESEL INJECTION CONTROL) SYSTEM

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OPERATING DIAGRAM	7-2
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FUEL CONTROL MOTOR	7-4
FUEL CONTROL RELAY	7-5

OPERATING DI AGRAM

Fig. 7-1



EDIC SYSTEM CIRCUIT

Fig. 7-2

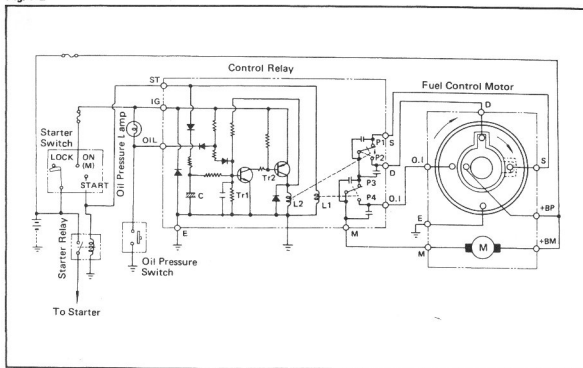
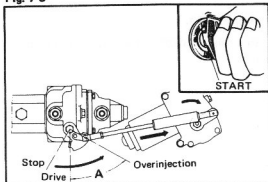


Fig. 7-3



OPERATIONAL CHECK

STARTING OVERINJECTION

When the starter is turned, the injection pump lever should move to the overinjection position.

- A: 60.5°
 54.5° (With DAC)

AFTER STARTING (DRIVE POSITION)

After starting the engine, the fuel control motor lever and also the injection pump lever should be positioned between the two marks.

- B: 19.5°

Fig. 7-4

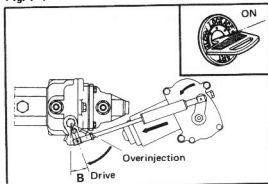
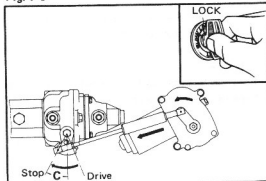


Fig. 7-5

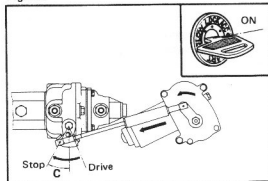


ENGINE STOPPING ACTION

When the starter switch is turned to "LOCK", the injection pump lever should move to the stop position and the engine should stop.

- C: 29.5°
 25.0° (With DAC)

Fig. 7-6

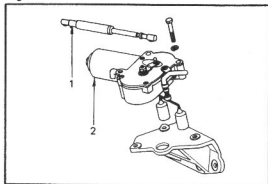


REVERSE ROTATION PREVENTION

Start the engine, and ground the oil pressure switch connector.

Then, the injection pump lever should move to the stop position and the engine should stop.

Fig. 7-7



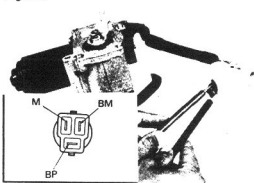
FUEL CONTROL MOTOR



REMOVAL

Remove connecting rod (1) and fuel control motor (2).

Fig. 7-8



INSPECTION



Measure resistance between "M" and "BM" terminals.

Resistance

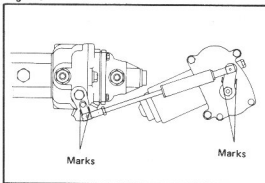
12V type

24V type

About 0.8 Ω

About 3.3 Ω

Fig. 7-9



INSTALLATION

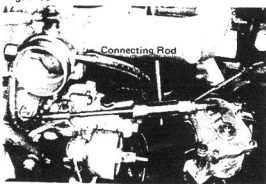


1. Install the motor and connecting rod in reverse order of removal.

— Note —

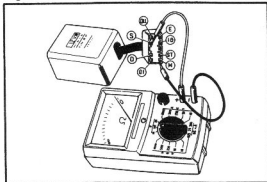
Fuel control motor lever should be positioned between the two marks.

Fig. 7-10



2. Adjust the connecting rod length so that the injection pump lever is positioned between the two marks.

Fig. 7-11



FUEL CONTROL RELAY

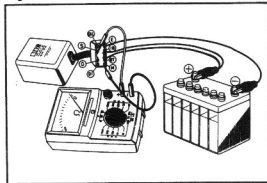
INSPECTION

1. Measure the resistance between terminals.

Resistance

S — M 0 Ω ST — E, 12V type About 40 Ω 24V type About 65 Ω

Fig. 7-12



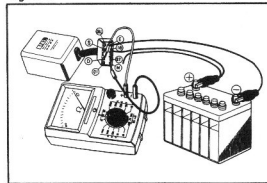
2. Apply positive voltage from battery to "ST" and "IG" terminals, and negative voltage to "E" terminal. Measure the resistance between terminals.

Resistance

S — M Infinite

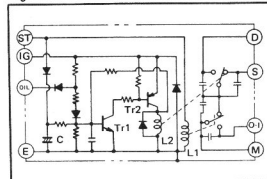
O.I — M 0 Ω

Fig. 7-13



3. Applying voltage as mentioned above, connect tester probes to "D" and "M" terminals. Cut the voltage for "ST" terminal. Then, the reading of the circuit tester should continue at 0 Ω for about 8 seconds.

Fig. 7-14



STARTING SYSTEM

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PREHEATING SYSTEM	8-3
STARTER RELAY & OVERINJECTION MAGNET	8-5
STARTER	8-6

STARTING SYSTEM CIRCUIT

Fig. 8-1

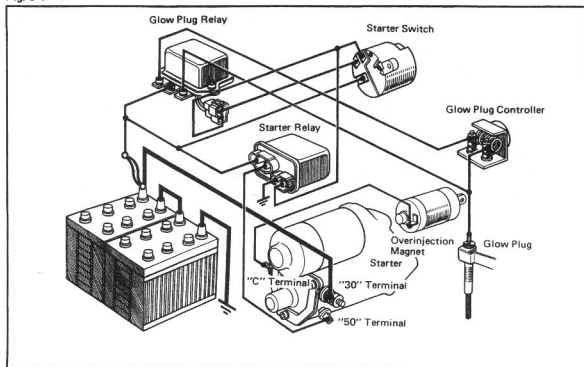


Fig. 8-2

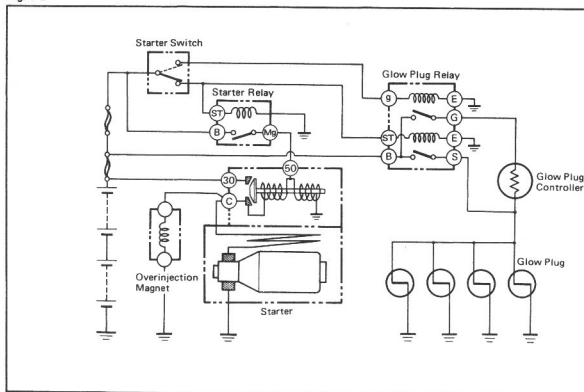
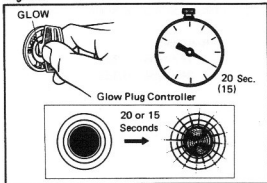


Fig. 8-3



PREHEATING SYSTEM



INSPECTION

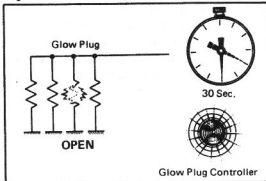
1. To check the heating time of the glow controller, turn the starter switch to "GLOW" position.

Glow time at 0°C (32°F)

12V type About 20 seconds

24V type About 15 seconds

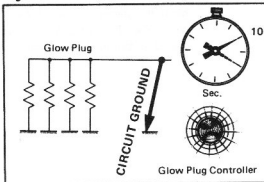
Fig. 8-4



2. If glow time more than 30 seconds, check following conditions:

- (1) Open circuit in wiring
- (2) Loose terminal connection
- (3) Burnt switch or relay points
- (4) Open glow plug or controller

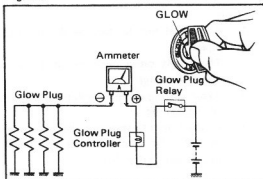
Fig. 8-5



3. If glow time less than 15 seconds, check following conditions:

- (1) Short circuit in wiring
- (2) Shorted glow plug or controller

Fig. 8-6



4. Measure load current.

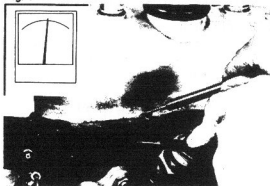
- (1) Connect the ammeter to the No.4 glow plug lead wire.
- (2) Turn the starter switch to "GLOW" position.

Load current

12V type 7.7 — 10.3 A

24V type 4.1 — 5.5 A

Fig. 8-7



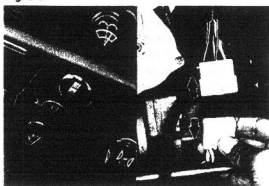
5. Check glow plug resistance.

Resistance

12V type 0.2 Ω

24V type 0.9 Ω

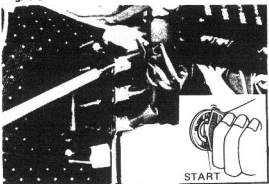
Fig. 8-8



6. Check glow plug relay.

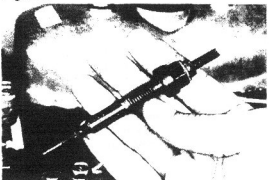
- (1) Pull the stop button all the way out, or disconnect the connector of EDIC motor wires to prevent accidental starting of the engine.

Fig. 8-9



- (2) When the starter switch is turned to the "START" position, a voltage should register at "S" terminal.

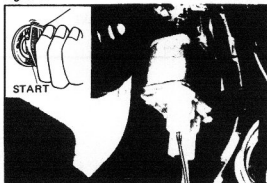
Fig. 8-10



— Note —

1. Be careful not to damage the glow plug pipes.
This might cause open circuit or shorten life of the plugs.
2. Avoid getting oil and gasoline on glow plug when cleaning.
3. At the time of inspection, be sure to wipe oil off glow plug terminals and bakelite washer with a dry cloth.

Fig. 8-11



STARTER RELAY & OVERINJECTION MAGNET

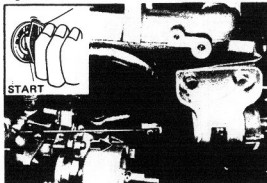


INSPECTION

Starter Relay

Check the contact "click" noise when starter switch is turned to the "START" position.

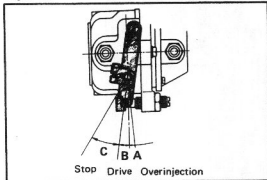
Fig. 8-12



Overinjection Magnet

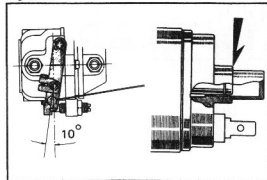
Check to see if the injection pump lever moves to the overinjection position when starter switch is turned to "START" position.

Fig. 8-13



- A: 5°
- B: 10°
- C: 25°

Fig. 8-14



When connecting the overinjection magnet connecting wire, position the magnet core end surface as shown.

STARTER**CROSS SECTIONAL VIEW**

Fig. 8-15

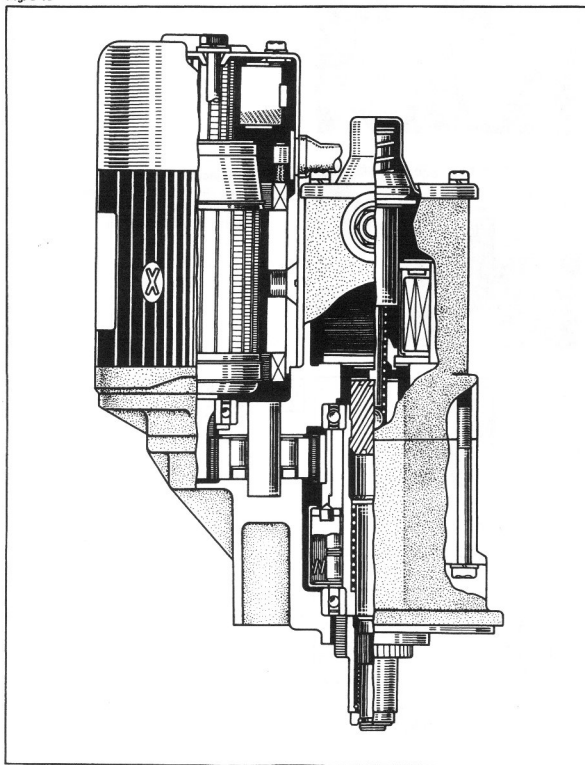


Fig. 8-16

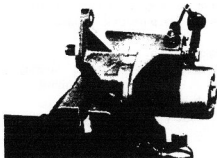


Fig. 8-17

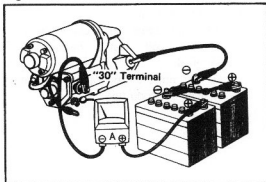


Fig. 8-18

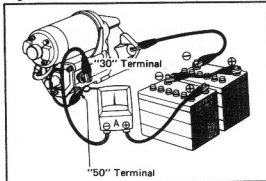
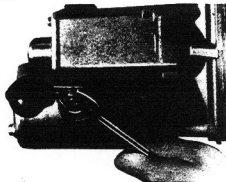


Fig. 8-19



PERFORMANCE TEST

No-Load Performance Test



1. Secure the starter in a vise to prevent accident.



2. Connect starter to battery as shown.

Positive side

Battery (+) → Ammeter (+)

Ammeter (-) → "30" Terminal

Negative side

Battery (-) → Starter housing



3. Connect the positive wire to "50" terminal.

If the starter shows smooth and steady rotation with the pinion jumping out and draws less than specified current, it is satisfactory.

Specified current

12V type Less than 180A

24V type Less than 90A



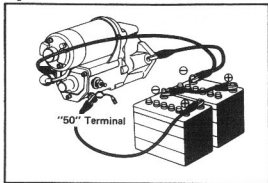
Test Magnetic Switch

— Caution —

Each test must be performed within a short time (3 — 5 seconds) to prevent the coil from burning out.

1. Disconnect "C" terminal.

Fig. 8-20



2. Test pull-in coil.
Connect magnetic switch to battery as shown. The pinion should jump out.

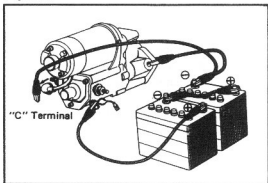
Negative side

Battery (—) → Starter housing and
"C" terminal

Positive side

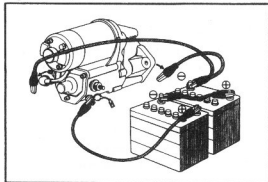
Battery (+) → "50" terminal

Fig. 8-21



3. Test hold-in coil.
With the same connections as in the "Pull-in coil test", disconnect "C" terminal.
At this time, the pinion should remain in jumped out condition.

Fig. 8-22



4. Check pinion return.
When disconnecting the cable from starter housing, the jumped out pinion should return quickly.

DISASSEMBLY

Disassemble in numerical order.

Fig. 8-23

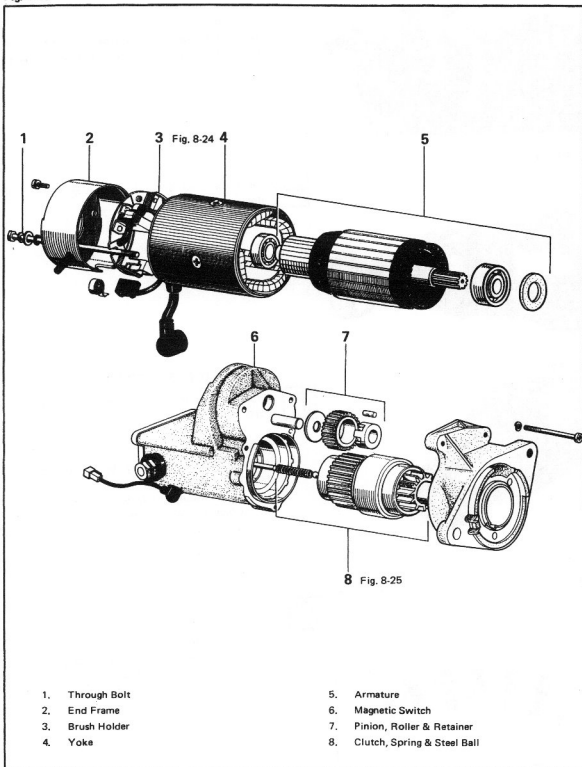
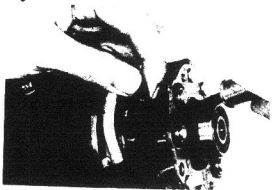


Fig. 8-24

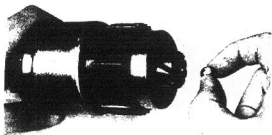


Lift up the brush spring and pull out the brush from the brush holder.

— Caution —

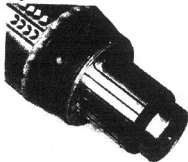
Use care not to damage the brush and commutator. Also avoid oil or grease to get on.

Fig. 8-25



Take the steel ball out from the clutch shaft hole.

Fig. 8-26



INSPECTION & REPAIR



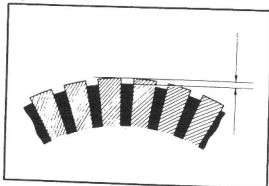
Wipe off dirt and grease from the disassembled parts.

Commutator

Inspect for the following items and repair or replace as necessary.

1. Dirty or burnt surface:
Correct with sandpaper or a lathe if necessary.

Fig. 8-27



2. Depth of segment (Mica depth):

Mica depth

Limit	0.2 mm (0.008 in.)
STD	0.5 — 0.8 mm (0.020 — 0.031 in.)

Fig. 8-28

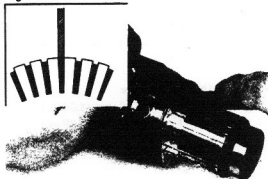


Fig. 8-29

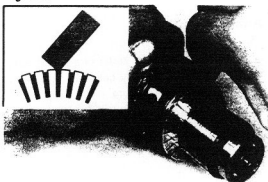


Fig. 8-30

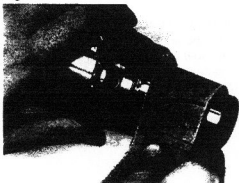
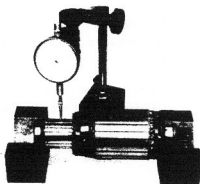


Fig. 8-31



3. If the mica depth is below the limit, correct with a hacksaw blade.

4. Smooth out the edge with a hacksaw blade.

5. After correcting, eliminate chips with sandpaper.

— Note —

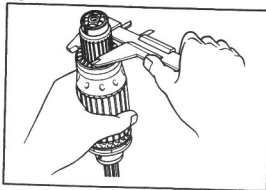
Use # 400 sandpaper.



6. Run out:
Correct on a lathe if it exceeds the limit.

Run out	
Limit	0.05 mm (0.002 in.)
STD	Less than 0.02 mm (0.001 in.)

Fig. 8-32

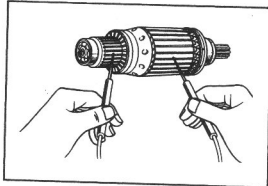


7. Diameter wear:
If the diameter is less than the limit,
replace armature.

Outside diameter

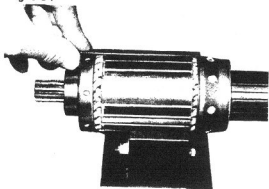
Limit	34 mm (1.34 in.)
STD	35 mm (1.38 in.)

Fig. 8-33

**Armature Coil**

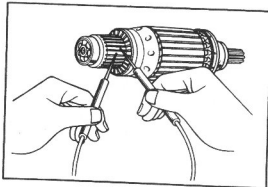
1. Ground test:
Using an armature tester or a circuit tester,
check for continuity between commutator
and armature coil core.
If there is continuity, the armature is
grounded and must be replaced.

Fig. 8-34



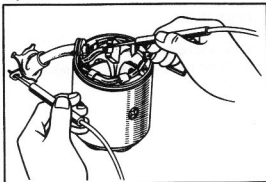
2. Short-circuit test:
Place the armature on the armature tester
and hold a hacksaw blade against the
armature core while turning the armature.
If the hacksaw blade is attracted or
vibrates, the armature is shorted and must
be replaced.

Fig. 8-35



3. Open-circuit test:
Using the armature tester or a circuit
tester, check for continuity between the
segments.
If there is no continuity at any test point,
there is an open-circuit and the armature
must be replaced.

Fig. 8-36

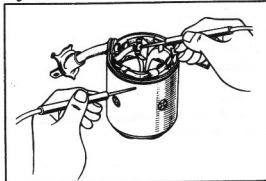
**Field Coil**

1. Open-circuit test:

Check for continuity between the "C" terminal lead wire and field coil brush.

If there is no continuity, there is an open-circuit in the field coil, and it should be replaced.

Fig. 8-37

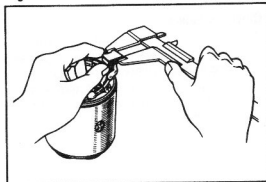


2. Ground test:

Check for continuity between the brush and yoke core.

If there is continuity, repair or replace the field coil.

Fig. 8-38

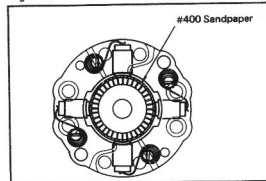
**Brushes**

1. Measure the brush length and replace if below the limit.

Brush length

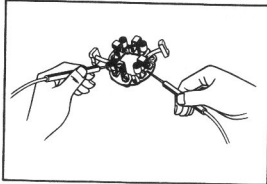
Limit	13 mm (0.51 in.)
STD	19 mm (0.75 in.)

Fig. 8-39



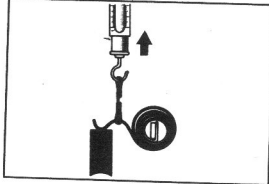
2. Using # 400 sandpaper, clean or fit the brushes to make proper contact with the commutator.

Fig. 8-40

**Brush Holder**

Check insulation between the (+) side brush holder and holder plate.
If there is continuity, repair or replace the brush holder.

Fig. 8-41

**Brush Spring**

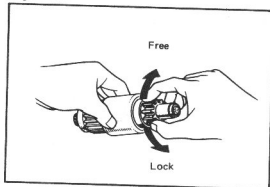
Measure the brush spring load with a pull-scale.
If the reading is below standard, replace the spring.

— Note —

Take the pull-scale reading at the very instant the brush spring separates from the brush.

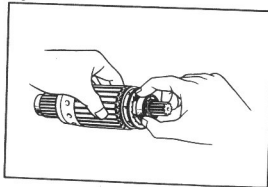
Tension 3.2 – 4.0 kg (7.1 – 8.8 lb)

Fig. 8-42

**Clutch & Gears**

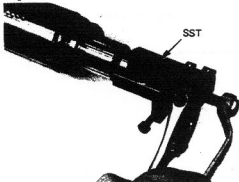
1. Inspect the gear teeth for wear and damage. Replace if damaged. If damaged, also inspect flywheel ring gear for same.
2. Rotate pinion. It should turn freely in clockwise direction and lock when turned counterclockwise.

Fig. 8-43

**Bearings**

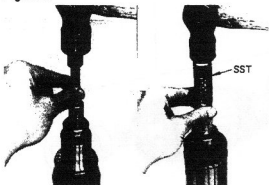
1. Check for sticking and abnormal noise while turning rapidly.

Fig. 8-44



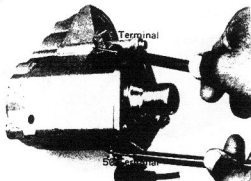
2. Replace armature bearing if defective.
 - (1) Remove the bearing by using SST [09286-46011].

Fig. 8-45



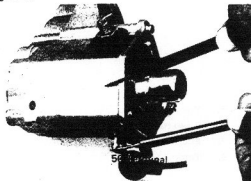
- (2) Replace the front bearing, and using SST [09285-76010] drive in the rear bearing.

Fig. 8-46

**Magnetic Switch**

1. Pull-in coil open circuit test:
Check for continuity between "50" terminal and "C" terminal.

Fig. 8-47

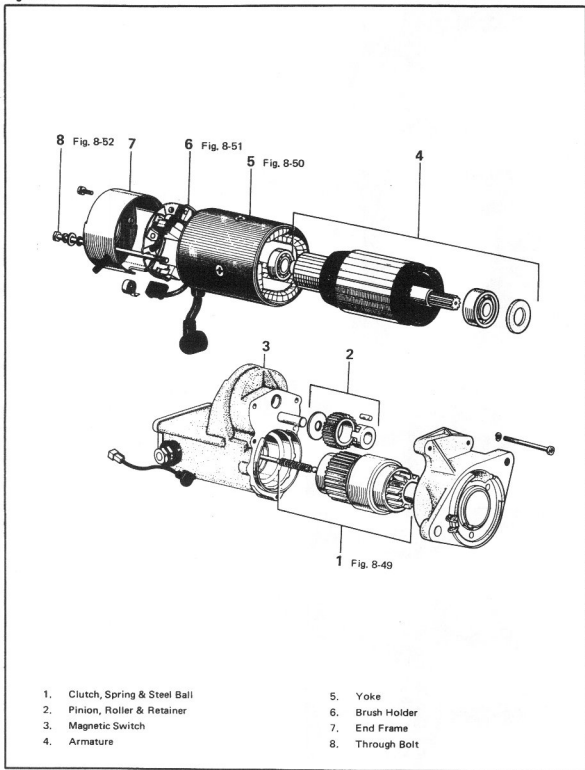


2. Hold-in coil open circuit test:
Check for continuity between "50" terminal and magnetic switch body.

ASSEMBLY

Assemble in numerical order.

Fig. 8-48



Use high temperature grease to lubricate bearings and gears as shown below.

Fig. 8-49

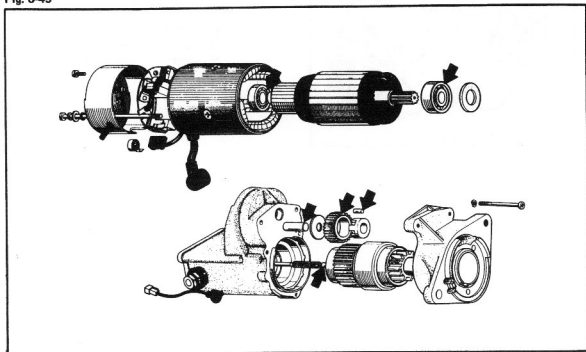
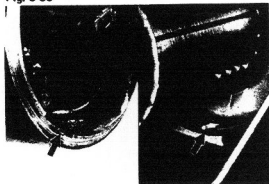
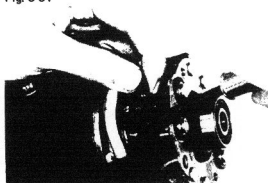


Fig. 8-50



Match the protrusion of the yoke core with the starter housing notch.

Fig. 8-51

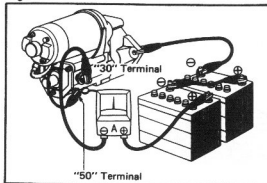


Assemble the brush holder.

— Caution —

Use care not to damage or get oil on the brushes and commutator.

Fig. 8-52



Check performance of the starter after assembling.

Specified current

12V type	Less than 180A
24V type	Less than 90A

CHARGING SYSTEM

	Page
CHARGING SYSTEM CIRCUITS	9-2
ON-VEHICLE INSPECTION	9-3
ALTERNATOR (CONVENTIONAL TYPE)	9-8
ALTERNATOR (HEAVY DUTY TYPE)	9-20
ALTERNATOR REGULATOR	9-30

CHARGING SYSTEM CIRCUITS

Fig. 9-1

12V TYPE

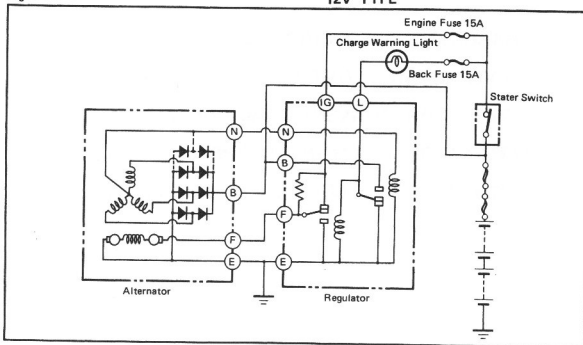


Fig. 9-2

24V TYPE

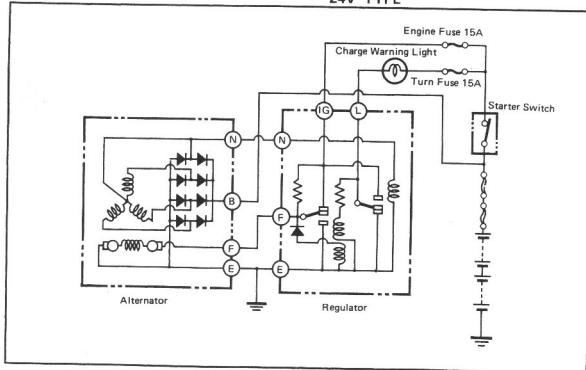
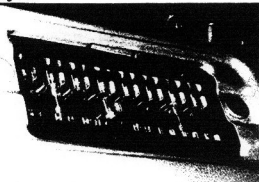
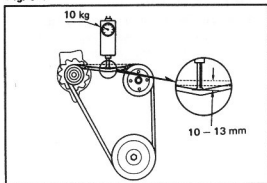


Fig. 9-3

**ON-VEHICLE INSPECTION****CHECK FOLLOWING ITEMS**

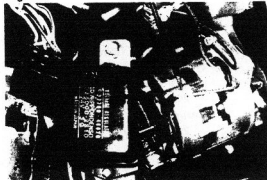
1. Fuses

Fig. 9-4



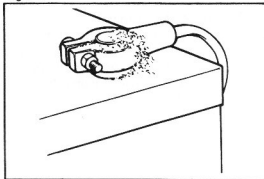
2. Drive belt tension

Fig. 9-5



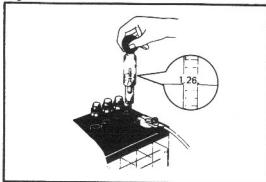
3. Wiring condition

Fig. 9-6



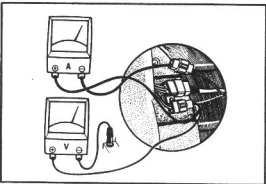
4. Battery terminal
Looseness
Corrosion
Burn

Fig. 9-7



5. Specific gravity
1.25 – 1.27 at 20°C (68°F)

Fig. 9-8

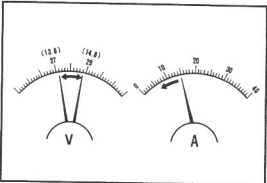


PERFORMANCE TEST

When Voltmeter & Ammeter are Used.

1. Connect voltmeter and ammeter as illustrated, and switch off all accessory parts.

Fig. 9-9



2. No-load performance test

Engine speed Idling to 2000 rpm

Regulated voltage

12V type 13.8 – 14.8V

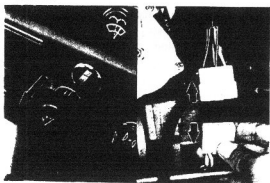
24V type 27 – 29V

Current

24V, 15A type Less than 10A

Others Less than 15A

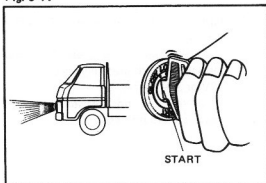
Fig. 9-10



3. Load performance test

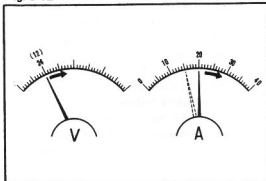
- (1) Pull the stop button all the way out, or disconnect the connector of EDIC motor wires, and crank the engine by turning starter motor for 5 to 10 seconds.

Fig. 9-11



- (2) Turn on head lights and accessories.
- (3) Start the engine, and run it at approximately 2000 rpm.

Fig. 9-12



Regulated voltage 12V or 24V

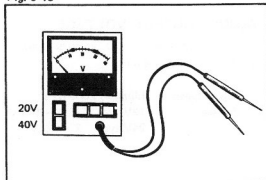
Current

24V, 15A & 20A type

More than 15A

Others More than 20A

Fig. 9-13

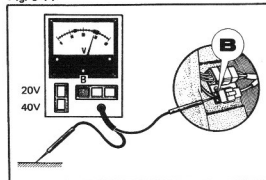


PERFORMANCE TEST

When Alternator Checker is Used.

1. Attach tester wirings to tester.
2. Push "20V" button when testing 12V type alternator, and push "40V" button when testing 24 V type alternator.

Fig. 9-14



3. Start the engine.
4. Push "B" button and check "B" terminal voltage with the engine speed from idling to 2000 rpm.

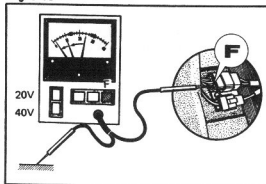
Standard voltage

12V type 13.8 – 14.8V

24V type 27 – 29V

If not within standard, probable cause is alternator regulator.

Fig. 9-15

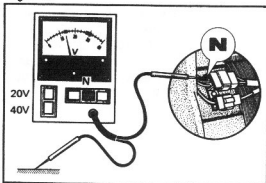


5. Push "F" button and check "F" terminal voltage.

Gradually raise engine speed. The checker reading should gradually decrease from 12V or 24V to 2V.

If decrease is not registered, probable cause is alternator regulator.

Fig. 9-16



6. Push "N" button and check "N" terminal voltage by maintaining engine speed at approximately 1500 rpm.

The needle should be at about half the "B" terminal voltage.

Standard voltage

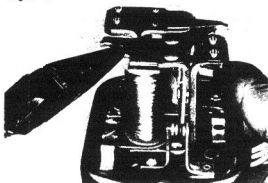
12V type 6.9 – 7.4V

24 type 13.5 – 14.5V

If the voltage is higher, the cause will be (+) rectifier.

If the voltage is lower, the cause will be (–) rectifier.

Fig. 9-17



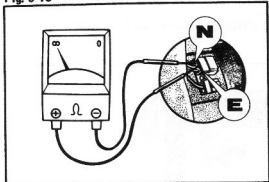
ADJUST OUTPUT VOLTAGE

If not within the output voltage, adjust by bending the adjusting arm.

Engine speed	Idling to 2000 rpm
Voltage	12V type 13.8 – 14.8V
	24V type 27 – 29V

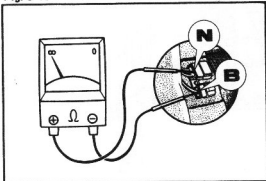


Fig. 9-18

**INSPECT ALTERNATOR**

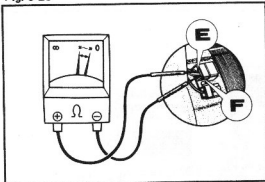
1. Negative side rectifier short test
Connect an ohmmeter (—) lead to "N" terminal and (+) lead to "E" terminal.
Meter should indicate infinity.

Fig. 9-19



2. Positive side rectifier short test
Connect an ohmmeter (—) lead to "B" terminal and (+) lead to "N" terminal.
Meter should indicate infinity.

Fig. 9-20

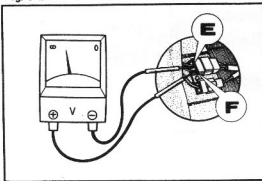


3. Check rotor coil resistance.

Resistance

12V, 35A type	4.2Ω
24V, 15A type	19.0Ω
24V, 20A type	19.0Ω
24V, 65A type	19.0Ω

Fig. 9-21



4. Check if there is battery voltage at "F" terminal when the ignition switch is turned to "ON" position.
If not, check "ENGINE" fuse.

ALTERNATOR (CONVENTIONAL TYPE)

CROSS SECTIONAL VIEW

Fig. 9-22

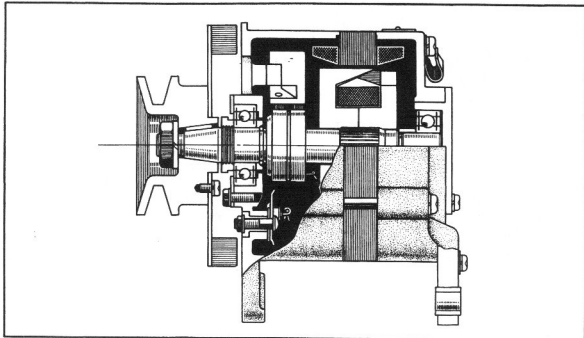


Fig. 9-23

(With Vacuum Pump Type)

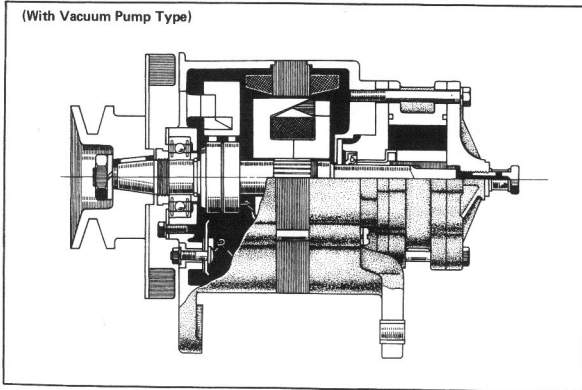
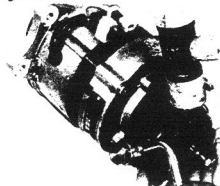
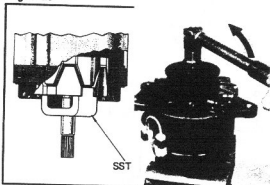


Fig. 9-25



Lightly tap the vacuum pump with a plastic hammer, and remove the pump.

Fig. 9-26

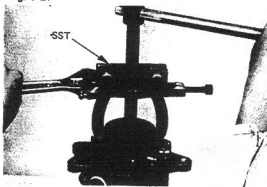


Lock SST [09841-56010] in a vise, and secure rotor core onto SST. Loosen pulley nut.

— Note —

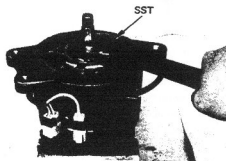
Do not damage stator coil.

Fig. 9-27



Remove pulley together with fan with SST [09950-20011].

Fig. 9-28

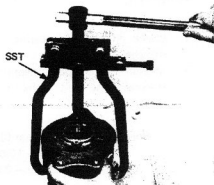


Remove bearing lock nut with SST [09333-55011].

— Note —

The lock nut has left-hand thread.

Fig. 9-29

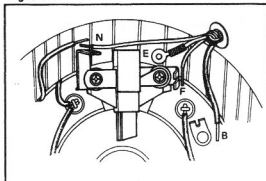


Remove rotor with SST [09950-20011].

— Note —

Do not damage stator coil.

Fig. 9-30



Disconnect "E", "N", "F" and "B" leads by melting solder, and remove stator coil with rectifier holders.

Fig. 9-31

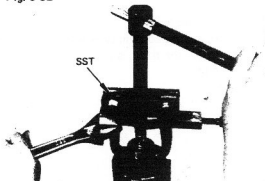


Disconnect stator coil from rectifier holder by melting solder.

— Note —

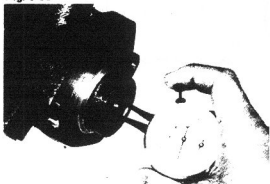
To unsolder the leads, hold the rectifier lead with a long nose pliers to protect rectifier from heat.

Fig. 9-32



Remove rotor shaft rear bearing with SST [09286-46011].

Fig. 9-33



INSPECTION

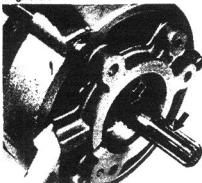


Vacuum Pump

1. Check oil seal and bearing for wear and damage.
2. Measure vacuum pump bearing bore and if it exceeds the limit, replace vacuum pump assembly.

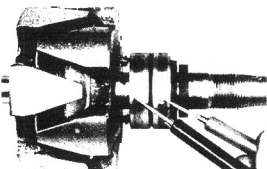
Bore Limit	16.14 mm (0.6354 in.)
STD	16.04 – 16.06 mm
	(0.6315 – 0.6323 in.)

Fig. 9-34



3. Check the bushing journal and spline tooth for wear.

Fig. 9-35

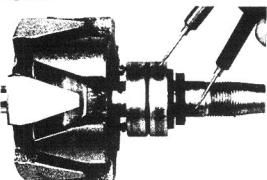


Rotor

1. Open circuit test
If there is no continuity between the rings, the circuit is open and the rotor must be replaced.

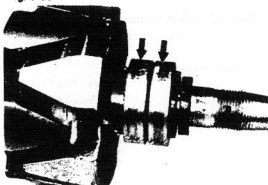
Resistance	
12V, 35A type	4.2Ω
24V, 15A type	19.0Ω
24V, 20A type	19.0Ω

Fig. 9-36



2. Ground test
If there is continuity between slip ring and rotor, the rotor is grounded and must be replaced.

Fig. 9-37



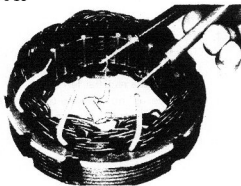
3. Check to see that the slip ring is not dirty or burnt.

Fig. 9-38

**Bearing**

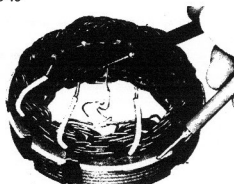
Check bearing for wear or roughness.

Fig. 9-39

**Stator**

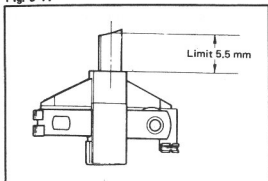
1. Open circuit test
Check all four leads for continuity.
If there is no continuity, circuit is open and the stator assembly must be replaced.

Fig. 9-40



2. Ground test
If there is continuity between stator core and stator coil lead, coil is grounded and the stator assembly must be replaced.

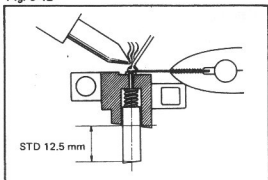
Fig. 9-41

**Brush & Brush Holder**

Check exposed brush length.

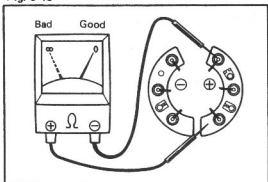
Exposed length**Limit****5.5 mm (0.217 in.)****STD****12.5 mm (0.492 in.)**

Fig. 9-42



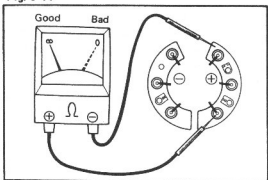
When replacing the brushes, solder brush lead wire with brush exposed about 12.5 mm (0.492 in.), and cut off excess wire.

Fig. 9-43

**Rectifier**

1. Rectifier holder, positive side
Connect an ohmmeter (+) lead to the rectifier holder, and the (-) lead of the meter to the rectifier terminal.
If there is no continuity, the rectifier assembly must be replaced.

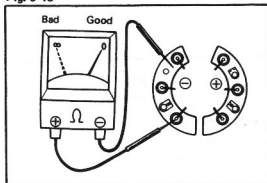
Fig. 9-44



Reverse polarity of test leads and check again.

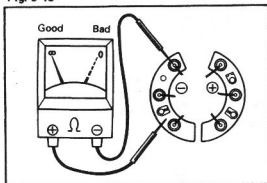
If there is continuity, the rectifier assembly must be replaced.

Fig. 9-45



2. Rectifier holder, negative side
Connect an ohmmeter (+) lead to the rectifier terminal, and the (-) lead of the meter to the rectifier holder. If there is no continuity, the rectifier assembly must be replaced.

Fig. 9-46



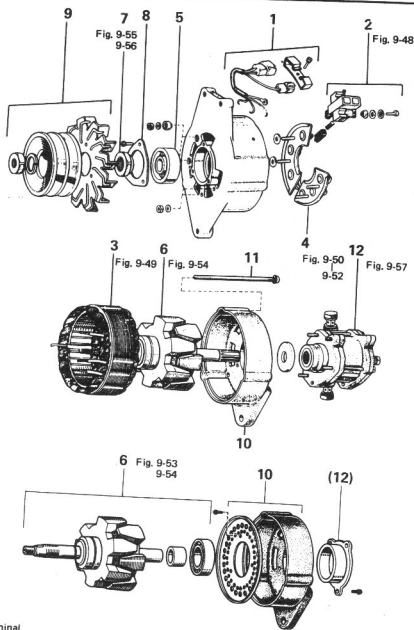
Reverse polarity of test leads and check again.

If there is continuity, the rectifier assembly must be replaced.

ASSEMBLY

Assemble in numerical order.

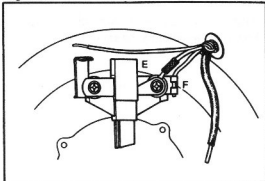
Fig. 9-47



1. Terminal
2. Brush Holder
3. Stator Coil
4. Rectifier Holder
5. Front Bearing
6. Rotor
7. Lock Nut

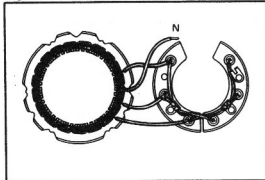
8. Plate
9. Pulley & Fan
10. Rear End Frame & Cover
11. Through Bolt
12. Vacuum Pump
- (12). Bearing Cover

Fig. 9-48



Tie lead wires and solder "F" terminal onto the brush holder.
Connect "E" terminal.

Fig. 9-49



Solder each stator lead to the positive rectifier.

— Note —

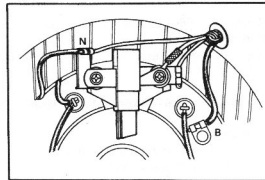
When soldering the leads, hold the rectifier terminal with a long nose pliers to protect the rectifier from heat.

Fig. 9-50



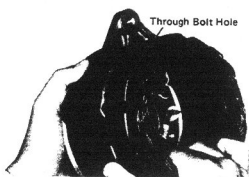
Assemble the rectifier holders and stator coil with insulators onto the drive end frame.

Fig. 9-51



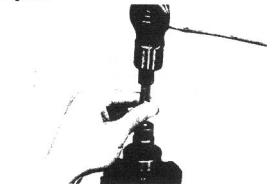
Solder stator coil "N" lead together with the socket "N" lead onto the brush holder, and "B" lead onto the positive rectifier holder.

Fig. 9-52



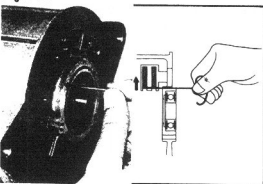
Align stator coil notch with the through bolt hole when assembling the stator coil.

Fig. 9-53



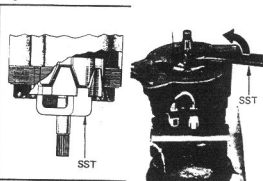
Drive in rotor shaft rear bearing onto rotor shaft.

Fig. 9-54



Push in brushes and temporarily hold in place with wire.

Fig. 9-55



Lock SST [09841-56010] in a vise, and secure rotor core onto SST.

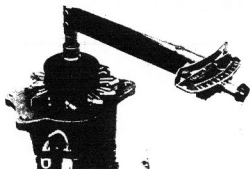
Tighten bearing lock nut with SST [09333-55011].

Torque 5.6 – 8 kg-m (41 – 58 ft-lb)

— Note —

1. The lock nut has left-hand thread.
2. Do not damage stator coil.

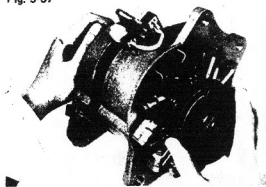
Fig. 9-56



Tighten pulley nut.

Torque 5.0 — 6.5 kg-m (37 — 47 ft-lb)

Fig. 9-57

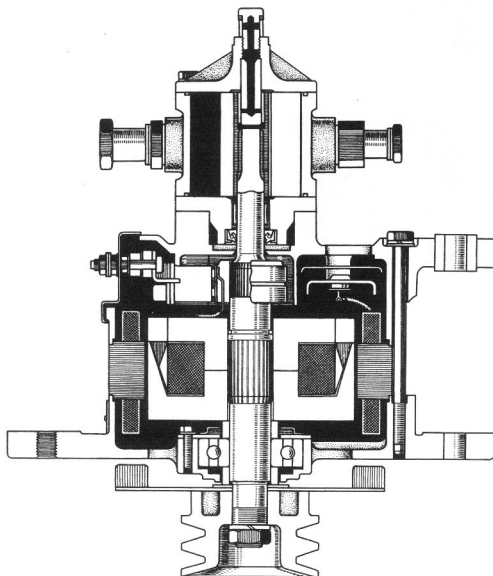


Check rotor for smooth rotation after assembly is completed.

ALTERNATOR (HEAVY DUTY TYPE)

CROSS SECTIONAL VIEW

Fig. 9-58



DISASSEMBLY

Disassemble in numerical order.

Fig. 9-59

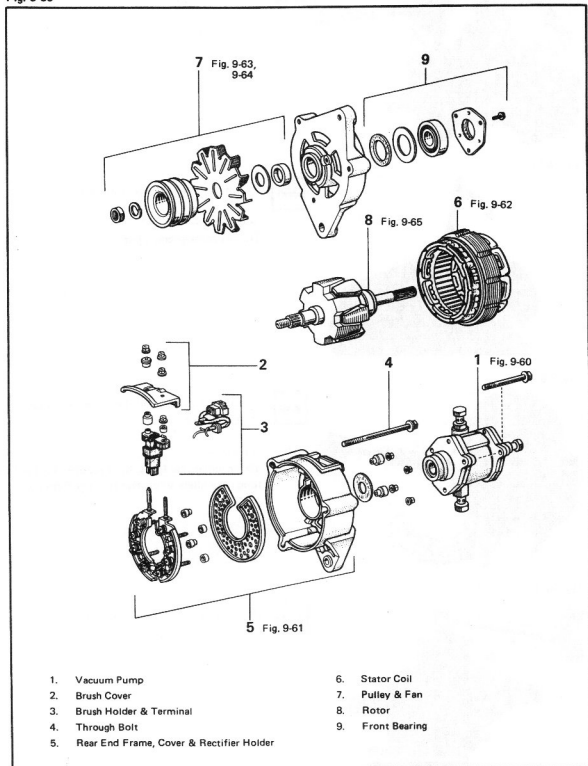
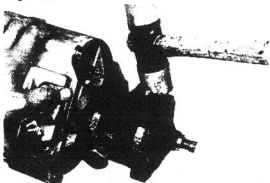
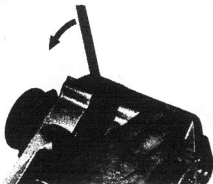


Fig. 9-60



Lightly tap vacuum pump with a plastic hammer to remove the pump.

Fig. 9-61

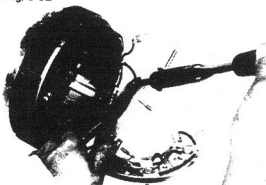


Pry off drive end frame from stator.

— Caution —

Do not damage coil wires.

Fig. 9-62

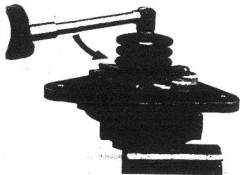


Disconnect stator coil from rectifier holder by melting solder.

— Note —

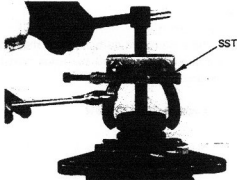
To unsolder the leads, hold rectifier lead with a long nose pliers to protect rectifier from heat.

Fig. 9-63



Using a soft jaw vise, loosen pulley nut.

Fig. 9-64



Remove pulley with SST[09950-20011].

Fig. 9-65



Remove drive end frame with SST[09950-20011].

Fig. 9-66



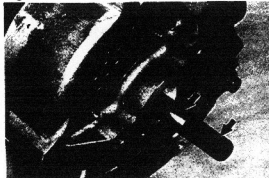
INSPECTION



Vacuum Pump

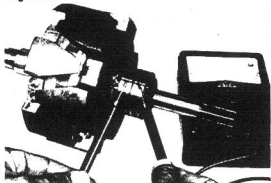
1. Check oil seal and bearing for wear and damage.

Fig. 9-67



2. Check bearing journal and spline tooth for wear.

Fig. 9-68

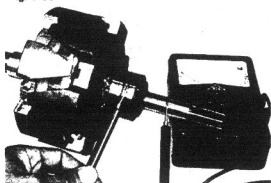
**Rotor**

1. Open circuit test

If there is no continuity between the rings, the circuit is open and the rotor must be replaced.

Resistance **19.0Ω**

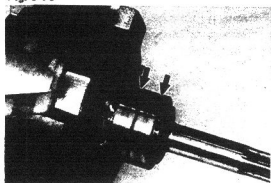
Fig. 9-69



2. Ground test

If there is continuity between slip ring and rotor, the rotor is grounded and must be replaced.

Fig. 9-70



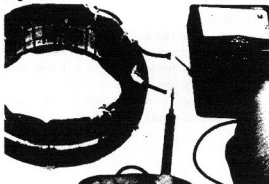
3. Check to see that the slip ring is not dirty or burnt.

Fig. 9-71

**Bearing**

Check bearing for wear or roughness.

Fig. 9-72

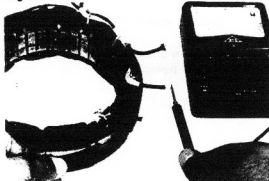
**Stator**

1. Open circuit test

Test all five leads for continuity.

If there is no continuity, circuit is open and the stator assembly must be replaced.

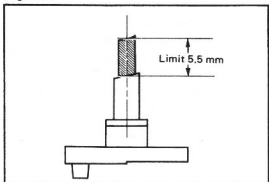
Fig. 9-73



2. Ground test

If there is continuity between stator core and stator coil lead, coil is grounded and the stator assembly must be replaced.

Fig. 9-74

**Brush & Brush Holder**

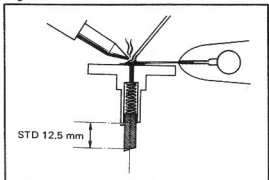
Check exposed brush length.

Exposed length

Limit 5.5 mm (0.217 in.)

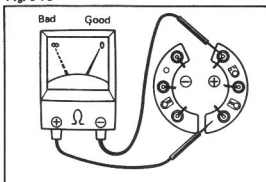
STD 12.5 mm (0.492 in.)

Fig. 9-75



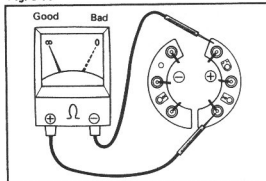
When replacing brushes, solder brush lead wire with brush exposed about 12.5 mm (0.492 in.). Cut off excess wire.

Fig. 9-76

**Rectifier**

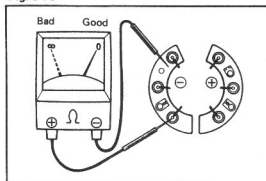
1. Rectifier holder, positive side
Connect an ohmmeter (+) lead to the rectifier holder, and the (-) lead of the meter to the rectifier terminal.
If there is no continuity, the rectifier assembly must be replaced.

Fig. 9-77



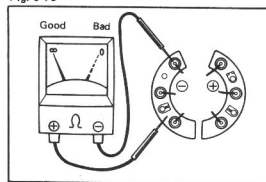
Reverse polarity of test leads and check again.
If there is continuity, the rectifier assembly must be replaced.

Fig. 9-78



2. Rectifier holder, negative side
Connect an ohmmeter (+) lead to the rectifier terminal, and the (-) lead of the meter to the rectifier holder.
If there is no continuity, the rectifier assembly must be replaced.

Fig. 9-79

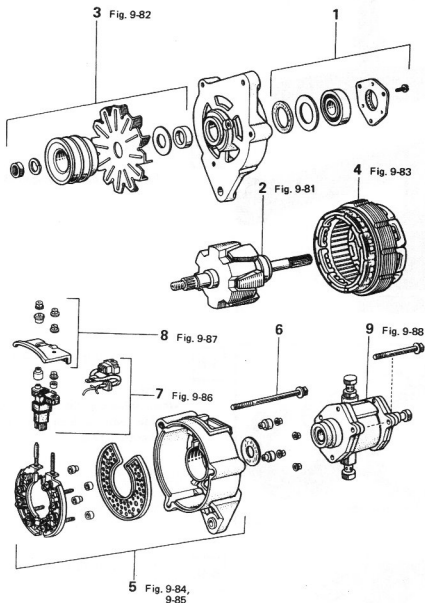


Reverse polarity of test leads and check again.
If there is continuity, the rectifier assembly must be replaced.

ASSEMBLY

Assemble in numerical order.

Fig. 9-80



1. Front Bearing

2. Rotor

3. Pulley & Fan

4. Stator Coil

5. Rear End Frame, Cover & Rectifier Holder

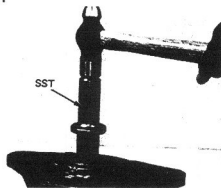
6. Through Bolt

7. Brush Holder & Terminal

8. Brush Cover

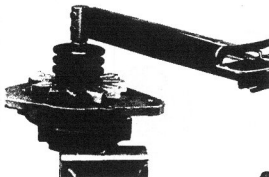
9. Vacuum Pump

Fig. 9-81



Drive the end frame assembly onto the rotor shaft with SST[09325-12010].

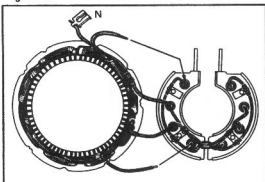
Fig. 9-82



Tighten pulley nut.

Torque 5.0 — 6.5 kg-m (37 — 47 ft-lb)

Fig. 9-83

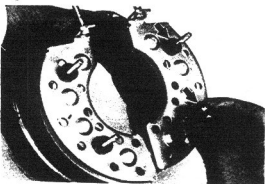


Solder each stator lead to the positive rectifier.

— Note —

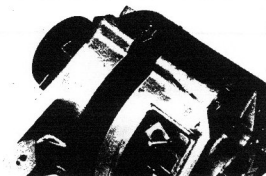
When soldering the leads, hold the rectifier terminal with a long nose pliers to protect rectifier from heat.

Fig. 9-84



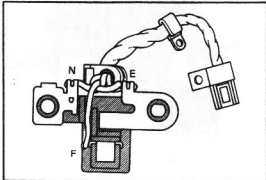
Position the insulators between "B" terminal and drive end frame.

Fig. 9-85



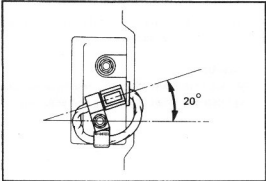
Align the stator coil notch with the through bolt hole of the drive end frame.

Fig. 9-86



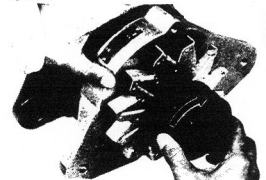
Solder "E", "F" and "N" leads to the brush holder.

Fig. 9-87



Assemble the connector in the position as shown.

Fig. 9-88



Check the rotor for smooth rotation after assembly is completed.

ALTERNATOR REGULATOR

Fig. 9-89

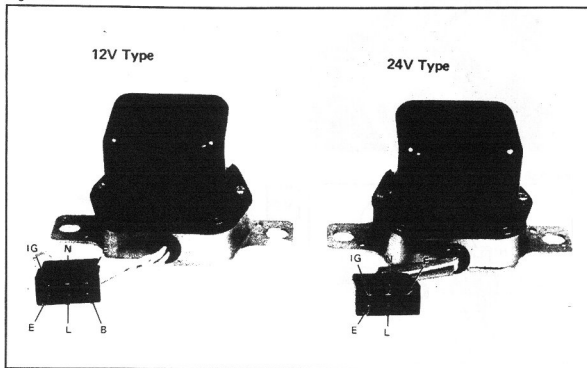
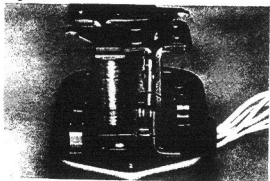


Fig. 9-90



Fig. 9-91

**INSPECTION & ADJUSTMENT**

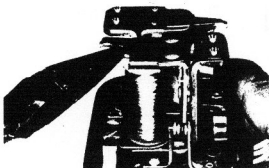
1. Check connector fitting condition before inspecting regulator.

— Caution —

Always make sure that the regulator connector is pulled out when inspecting and adjusting.

2. Inspect each point surface for burns or excessive damage. Replace if defective.

Fig. 9-92



3. To adjust voltage regulator, bend the regulator adjusting arm.

Regulating voltage

12V type 13.8 – 14.8V

24V type 27 – 29V

Fig. 9-93



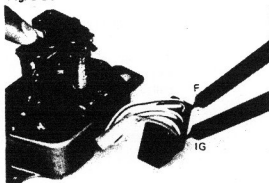
4. To adjust voltage relay, bend the relay adjusting arm.

Relay actuating voltage

12V type 4 – 5.8V

24V type 8 – 11.6V

Fig. 9-94



5. Measure resistance between terminals.

(1) IG – F

Voltage Regulator	12V Type	24V Type
At rest	0Ω	0Ω
Pulled in	About 11Ω	About 200Ω

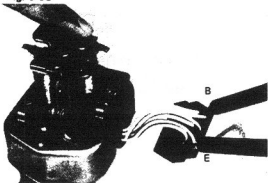
Fig. 9-95



(2) L – E

Voltage Relay	12V Type	24V Type
At rest	0Ω	0Ω
Pulled in	About 100Ω	About 200Ω

Fig. 9-96

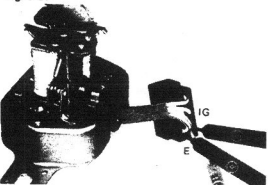


(3) B — E (For 12V type)

Voltage relay

At rest	Infinity
Pulled in	About 100Ω

Fig. 9-97



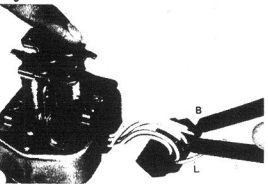
(3) IG — E (For 24V type)

Connect an ohmmeter (+) lead to the "E" terminal, and the (—) lead of the meter to the "IG" terminal.

Voltage relay

At rest	Infinity
Pulled in	About 200Ω

Fig. 9-98

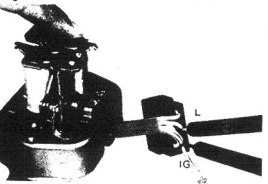


(4) B — L (For 12V type)

Voltage relay

At rest	Infinity
Pulled in	0Ω

Fig. 9-99



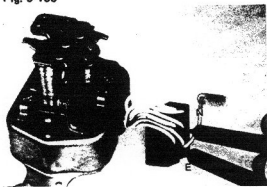
(4) IG — L (For 24V type)

Connect an ohmmeter (+) lead to the "L" terminal, and the (—) lead of the meter to the "IG" terminal.

Voltage relay

At rest	Infinity
Pulled in	0Ω

Fig. 9-100




(5) N – E

12V type	About 24 Ω
24V type	About 100 Ω


SST & SERVICE SPECIFICATIONS

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SST (SPECIAL SERVICE TOOL)**ENGINE TUNE-UP****Oil Filter**

Illustration	Tool No.	Tool Name
	09228-44010	Oil Filter Wrench


Fuel Filter

Illustration	Tool No.	Tool Name
	09228-34010	Oil Filter Wrench





Compression Pressure

Illustration	Tool No.	Tool Name
	09992-00020	Cylinder Compression Check Gage Set





ENGINE SERVICE**Cylinder Head**

Illustration	Tool No.	Tool Name
	09201-60011	Valve Stem Guide Remover & Replacer








Cylinder Head (Cont'd)

Illustration	Tool No.	Tool Name
	09202-43011	Valve Spring Compressor
	09208-48010	Precombustion Chamber Remover
	09260-46011	Injection Pump Tool Set
	(09268-46011)	(Nozzle Holder Body Wrench)

Timing Gear


Illustration	Tool No.	Tool Name
	09213-31021	Crankshaft Pulley Puller
	09213-60015	Crankshaft Pulley & Gear Puller
	09214-60010	Crankshaft Pulley & Gear Replacer
	09223-46010	Crankshaft Front Oil Seal Replacer

Cylinder Block

Illustration	Tool No.	Tool Name
	09215-56010	Camshaft Bearing Remover & Replacer
	09218-56010	Cylinder Liner Remover & Replacer
	09221-46010	Piston Pin Remover & Replacer
	09222-66010	Connecting Rod Bushing Remover & Replacer
	09223-56010	Crankshaft Rear Oil Seal Replacer
	09303-35010	Input Shaft Front Bearing Puller
	09304-30012	Input Shaft Front Bearing Replacer

LUBRICATION SYSTEM




Oil Filter

Illustration	Tool No.	Tool Name
	09228-44010	Oil Filter Wrench


Oil Pump

Illustration	Tool No.	Tool Name
	09213-31021	Crankshaft Pulley Puller
	09213-60015	Crankshaft Pulley & Gear Puller
	09214-60010	Crankshaft Pulley & Gear Replacer




COOLING SYSTEM**Water Pump**

Illustration	Tool No.	Tool Name
	09235-60010	Water Pump Pulley Seat Puller
	09236-36010	Water Pump Overhaul Tool
	09238-48010	Water Pump Bearing Remover & Replacer







FUEL SYSTEM**Fuel Filter**

Illustration	Tool No.	Tool Name
	09228-34010	Oil Filter Wrench









Injection Nozzle

Illustration	Tool No.	Tool Name
	09260-46011	Injection Pump Tool Set
	(09268-46011)	(Nozzle Holder Body Wrench)
	(09268-46021)	(Nozzle Holder Retaining Nut Wrench)



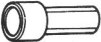



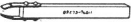



Automatic Timer

Illustration	Tool No.	Tool Name
	09213-31021	Crankshaft Pulley Puller
	09213-36010	Timing Gear Remover
	09214-60010	Crankshaft Pulley & Gear Replacer
	09238-76010	Water Pump Bearing Replacer
	09260-76015	Injection Pump Tool Set
	(09280-76010)	(Automatic Timer Spring Holder)







Injection Pump

Illustration	Tool No.	Tool Name
	09241-76021	Injection Pump Stand Set
	09260-46011	Injection Pump Tool Set
	(09266-46011)	(Round Nut Wrench)
	(09274-46010)	(Tappet Insert)
	(09275-46010)	(Plunger Clamp)
	(09278-46010)	(Splined Shaft Holding Tool)
	(09280-46010)	(Plunger Spring Holder)
	(09283-46010)	(Tappet Holder Attachment Gage)


Injection Pump (Cont'd)

Illustration	Tool No.	Tool Name
	09260-76015	Injection Pump Tool Set
	(09262-76010)	(Delivery Valve Gasket Replacer)
	(09266-67011)	(Fly Weight Round Nut Wrench)
	(09267-76011)	(Automatic Timer Extractor)
	(09271-76011)	(Delivery Valve Extractor)
	(09272-76011)	(Tappet Roller Clamp)
	(09273-76011)	(Tappet Clamp)
	(09276-76010)	(T Type Box Wrench)
	(09282-76010)	(Idling Adjust Wrench)
	09285-76010	Injection Camshaft Bearing Cone Replacer


Injection Pump (Cont'd)

Illustration	Tool No.	Tool Name
	09286-46011	Injection Pump Spline Shaft Puller
	09286-76011	Injection Pump Camshaft Bearing Cup Puller
	09287-76010	Injection Pump Camshaft End Play Micrometer
	09288-46011	Tappet Adjusting Gage
	09608-12010	Front Hub & Drive Pinion Bearing Replacer
	09950-20011	Universal Puller

STARTING SYSTEM**Starter**




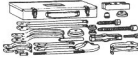
Illustration	Tool No.	Tool Name
	09285-76010	Injection Camshaft Bearing Cone Replacer

Starter (Cont'd)


Illustration	Tool No.	Tool Name
	09286-46011	Injection Pump Spline Shaft Puller

CHARGING SYSTEM


Alternator (Conventional Type)

Illustration	Tool No.	Tool Name
	09286-46011	Injection Pump Spline Shaft Puller
	09333-55011	Wrench (55 x 32 mm)
	09841-56010	Alternator Stand
	09950-20011	Universal Puller

Alternator (Heavy Duty Type)

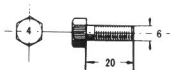
Illustration	Tool No.	Tool Name
	09325-12010	Transmission Oil Plug

Alternator (Heavy Duty Type)

Illustration	Tool No.	Tool Name
	09950-20011	Universal Puller

STANDARD BOLT TIGHTENING TORQUE

9 1 1 1 1 - 4 0 6 2 0 ————— Part Number
 ————— Length of Bolt: 20 mm
 ————— Basic Major Dia. of Thread:
 6 mm
 ————— Bolt Head Mark *



* Bolt Head Mark has the following indications.

SPECIFIED TORQUE FOR STANDARD BOLT

Class	Basic Dia. mm	Pitch mm	Torque Limit kg-m (ft-lb)
4T	6	1	0.4 - 0.6 (3 - 4)
	8	1.25	1.0 - 1.6 (8 - 11)
	10	1.25	1.9 - 3.1 (14 - 22)
	10	1.5	1.8 - 3.0 (14 - 21)
	12	1.25 (ISO)	3.5 - 5.5 (26 - 39)
	12	1.5	3.5 - 5.0 (26 - 36)
	12	1.75	3.0 - 5.0 (22 - 36)
	13	1.5	4.5 - 7.0 (33 - 50)
	14	1.5	5.0 - 8.0 (37 - 57)
	14	2	4.7 - 7.7 (34 - 55)
	16	1.5	7.5 - 11.0 (55 - 79)
	16	2	7.1 - 10.6 (52 - 76)
5T	6	1	0.6 - 0.9 (5 - 6)
	8	1.25	1.5 - 2.2 (11 - 15)
	10	1.25	3.0 - 4.5 (22 - 32)
	10	1.5	2.7 - 4.2 (20 - 30)
	12	1.25 (ISO)	5.0 - 8.0 (37 - 57)
	12	1.5	5.0 - 7.0 (37 - 50)
	12	1.75	4.8 - 6.8 (35 - 49)
	13	1.5	6.5 - 9.0 (48 - 65)
	14	1.5	7.5 - 11.0 (55 - 79)
	14	2	7.0 - 10.5 (51 - 75)
	16	1.5	12.0 - 17.0 (87 - 122)
	16	2	11.5 - 16.5 (84 - 119)
6T	6	1	0.6 - 0.9 (5 - 6)
	8	1.25	1.5 - 2.2 (11 - 15)
	10	1.25	3.0 - 4.5 (22 - 32)
	10	1.5	2.7 - 4.2 (20 - 30)
	12	1.25 (ISO)	5.0 - 8.0 (37 - 57)
	12	1.5	5.0 - 7.0 (37 - 50)
	12	1.75	4.8 - 6.8 (35 - 49)

SPECIFIED TORQUE FOR STANDARD BOLT (Cont'd)

Class	Basic Dia. mm	Pitch mm	Torque Limit kg-m (ft-lb)
7T	6	1	0.8 – 1.2 (6 – 8)
	8	1.25	2.0 – 3.0 (15 – 21)
	10	1.25	4.0 – 5.5 (29 – 39)
	10	1.5	3.7 – 5.2 (27 – 37)
	12	1.25 (ISO)	7.5 – 10.5 (55 – 75)
	12	1.5	7.0 – 9.0 (51 – 65)
	12	1.75	6.0 – 8.5 (44 – 61)
	13	1.5	8.0 – 12.0 (58 – 86)
	14	1.5	10.0 – 15.0 (73 – 108)
	14	2	9.5 – 14.0 (69 – 101)
	16	1.5	15.0 – 23.0 (109 – 166)
	16	2	14.0 – 22.0 (102 – 159)

– Note –

The above specified tightening torque is applicable only for female threads cut into a steel material.

If the female threads are cut into materials other than steel, and tightening surface is subjected to heat or vibrations, these specified tightening torque values would not be applicable.

MAIN PARTS TIGHTENING TORQUE

Tightening Parts		Torque	
		kg-m	ft-lb
Cylinder head		11.5 — 12.0	84 — 87
Valve rocker support		1.0 — 1.6	8 — 11
Manifold		1.5 — 2.2	11 — 15
Camshaft x Camshaft gear		3.0 — 4.5	22 — 32
Camshaft thrust plate		1.0 — 1.6	8 — 11
Idle gear		4.0 — 5.5	29 — 39
Timing gear cover	8 mm bolt	1.5 — 2.2	11 — 15
	10 mm bolt	3.0 — 4.5	22 — 32
Crankshaft pulley		20.0 — 24.0	145 — 173
Crankshaft bearing cap		9.8 — 11.2	71 — 81
Connecting rod cap		6.5 — 7.5	48 — 54
Flywheel		11.5 — 12.5	84 — 90
Nozzle holder x Cylinder head		6.0 — 8.0	44 — 57
Nozzle retaining nut		6.0 — 8.0	44 — 57
Injection pipe union nut		1.0 — 1.6	8 — 11
Delivery valve holder		2.5 — 3.5	19 — 25

SERVICE SPECIFICATIONS

ENGINE TUNE-UP

Coolant capacity (W/Heater)				
	B engine	13.0 ℓ	13.7 US qt	11.4 Imp.qt
	2B engine	14.0 ℓ	14.8 US qt	12.3 Imp.qt
Drive belt deflection (Crank pulley x Alternator)				
	B engine	10 — 13 mm (0.4 — 0.5 in.) at 10 kg (22 lb)		
	2B engine	8 — 11 mm (0.3 — 0.4 in.) at 10 kg (22 lb)		
Battery specific gravity		1.25 — 1.27 at 20°C (68°F)		
Engine oil capacity	Total	7.3 ℓ	7.7 US qt	6.4 Imp.qt
	Crankcase	5.4 ℓ	5.7 US qt	4.8 Imp.qt
Engine oil pressure (Idling)		0.8 kg/cm ²		11.4 psi
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
Injection order		1 — 3 — 4 — 2		
Injection timing (Stationary)		10°BTDC		
Valve clearance (Hot)	Intake	0.20 mm		0.008 in.
	Exhaust	0.36 mm		0.014 in.
Idle speed		625 — 675 rpm		
Maximum speed (No load)		4050 — 4100 rpm		

ENGINE**Cylinder Head**

Underside surface warpage limit		0.05 mm	0.0020 in.
Manifold mounting surface warpage limit		0.2 mm	0.008 in.
Valve seat	Contact width	1.2 — 1.6 mm	0.047 — 0.063 in.
	Contact angle	45°	
	Refacing angles	15°, 45°, 75°	

Valve Guide Bushing

Overall length		62 mm	2.44 in.	
Projected length (From valve spring contact surface)		16.6 – 17.4 mm	0.654 – 0.685 in.	
Valve guide inside diameter		9.01 – 9.03 mm	0.3547 – 0.3555 in.	
Valve stem to guide bushing clearance (Oil clearance)				
	Limit	Intake	0.10 mm	0.0039 in.
		Exhaust	0.12 mm	0.0047 in.
	STD	Intake	0.02 – 0.06 mm	0.0008 – 0.0024 in.
		Exhaust	0.04 – 0.08 mm	0.0016 – 0.0031 in.

Valve

Head outside diameter	Intake	44.8 — 45.2 mm	1.764 — 1.780 in.
	Exhaust	37.3 — 37.7 mm	1.469 — 1.484 in.
Overall length	Intake	127.95 mm	5.0374 in.
	Exhaust	127.75 mm	5.0295 in.
Stem tip resurfacing limit		0.5 mm	0.020 in.
Stem outside diameter	Intake	8.97 — 8.99 mm	0.3531 — 0.3539 in.
	Exhaust	8.95 — 8.97 mm	0.3524 — 0.3531 in.
Valve face angle		45°	
Head margin thickness limit	Intake	0.9 mm	0.035 in.
	Exhaust	1.0 mm	0.039 in.

Valve Spring

Free height			45.5 mm	1.791 in.
Installed height		Intake	39.6 mm	1.559 in.
		Exhaust	39.5 mm	1.555 in.
Installed tension	Limit		23.1 kg	50.9 lb
	STD	Intake	25.5 kg	56.2 lb
		Exhaust	26.0 kg	57.3 lb
Tilt limit			2.0 mm	0.079 in.

Valve Rocker Shaft & Arm

Shaft diameter limit		18.44 mm	0.7260 in.
Rocker arm bore limit		18.60 mm	0.7323 in.
Oil clearance	Limit	0.1 mm	0.004 in.
	STD	0.02 – 0.06 mm	0.0008 – 0.0024 in.

Manifold

Cylinder head mounting surface warpage limit	0.4 mm	0.016 in.
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Combustion Chamber

Protrusion amount	0 – 0.10 mm	0 – 0.0039 in.
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Timing & Idle Gear

Gear backlash			
Idle gear to cam gear, timer drive gear	Limit	0.3 mm	0.012 in.
	STD	0.06 – 0.09 mm	0.0024 – 0.0035 in.
Crankshaft gear to idle gear	Limit	0.3 mm	0.012 in.
	STD	0.06 – 0.10 mm	0.0024 – 0.0039 in.
Idle gear thrust clearance	Limit	0.3 mm	0.012 in.
	STD	0.08 – 0.20 mm	0.0031 – 0.0079 in.
Idle gear oil clearance	Limit	0.3 mm	0.012 in.
	STD	0.04 – 0.09 mm	0.0016 – 0.0035 in.
Idle gear bore	STD	45.00 – 45.03 mm	1.7717 – 1.7728 in.
Idle gear shaft diameter	Limit	44.91 mm	1.7681 in.
	STD	44.94 – 44.96 mm	1.7693 – 1.7701 in.

Valve Lifter & Push Rod

Lifter diameter	STD	23.96 – 23.98 mm	0.9433 – 0.9441 in.
Lifter to block bore clearance (Oil clearance)	Limit	0.1 mm	0.004 in.
	STD	0.02 – 0.06 mm	0.0008 – 0.0024 in.
Push rod bend limit		0.5 mm	0.020 in.

Camshaft & Bearing

Circle run out limit		0.04 mm	0.0016 in.
Thrust clearance	Limit	0.3 mm	0.012 in.
	STD	0.06 – 0.13 mm	0.0024 – 0.0051 in.
Oil clearance	Limit	0.1 mm	0.004 in.
	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in.
Cam height	Limit	39.0 mm	1.535 in.
	STD	39.47 – 39.56 mm	1.5539 – 1.5575 in.
Journal diameter	No.1	47.16 – 47.18 mm	1.8567 – 1.8575 in.
	No.2	46.96 – 46.98 mm	1.8488 – 1.8496 in.
	No.3	46.76 – 46.78 mm	1.8409 – 1.8417 in.

Cylinder Block

Upperside surface warpage limit		0.05 mm	0.0020 in.	
Valve lifter bore	STD	24.00 – 24.02 mm	0.9449 – 0.9457 in.	
Cylinder bore	STD	B Engine	95.00 – 95.03 mm	3.7402 – 3.7413 in.
		2B Engine	98.00 – 98.03 mm	3.8583 – 3.8594 in.
Liner	Max. wear limit	0.3 mm	0.012 in.	
	Pressing force	5000 kg	11000 lb	
	Protrusion	0.01 – 0.10 mm	0.0004 – 0.0039 in.	
	Shim thickness	0.05 mm	0.002 in.	
		0.10 mm	0.004 in.	

Piston, Piston Pin & Piston Ring

Piston diameter	STD	B Engine	94.88 – 94.91 mm	3.7354 – 3.7366 in.
		2B Engine	97.88 – 97.91 mm	3.8535 – 3.8547 in.
	O/S 1.00	B Engine	95.88 – 95.91 mm	3.7748 – 3.7760 in.
		2B Engine	98.88 – 98.91 mm	3.8929 – 3.8941 in.
Piston to cylinder clearance			0.11 – 0.13 mm	0.0043 – 0.0051 in.
Piston pin diameter			29.00 – 29.01 mm	1.1417 – 1.1421 in.
Piston pin fitting temperature			60°C	140°F
Piston ring end gap	No.1	B Engine	0.35 – 0.55 mm	0.0138 – 0.0217 in.
		2B Engine	0.40 – 0.60 mm	0.0157 – 0.0236 in.
	No.2		0.30 – 0.50 mm	0.0118 – 0.0197 in.
	Oil ring		0.30 – 0.50 mm	0.0118 – 0.0197 in.
Piston ring to groove clearance	No.1		0.03 – 0.07 mm	0.0012 – 0.0028 in.
	No.2		0.04 – 0.08 mm	0.0016 – 0.0031 in.
	Oil ring		0.03 – 0.07 mm	0.0012 – 0.0028 in.

Connecting Rod

Large end thrust clearance	Limit	0.3 mm	0.012 in.
	STD	0.08 – 0.20 mm	0.0031 – 0.0079 in.
Bushing to pin clearance	Limit	0.05 mm	0.0020 in.
	STD	0.004 – 0.012 mm	0.0002 – 0.0005 in.

Crankshaft

Circle run out limit		0.06 mm	0.0024 in.
Thrust clearance	Limit	0.3 mm	0.012 in.
	STD	0.07 – 0.18 mm	0.0028 – 0.0071 in.
Main journal oil clearance	Limit	0.1 mm	0.004 in.
	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in.
Journal diameter	STD	69.98 – 70.00 mm	2.7551 – 2.7559 in.
	U/S 0.25	69.74 – 69.75 mm	2.7457 – 2.7461 in.
	U/S 0.50	69.49 – 69.50 mm	2.7358 – 2.7362 in.
	U/S 1.00	68.99 – 69.00 mm	2.7161 – 2.7165 in.
Journal and crankpin	Tapered limit	0.02 mm	0.0008 in.
	Out-of-round limit	0.02 mm	0.0008 in.
Crankpin oil clearance	Limit	0.1 mm	0.004 in.
	STD	0.03 – 0.07 mm	0.0012 – 0.0028 in.
Crankpin diameter	STD	58.98 – 59.00 mm	2.3220 – 2.3228 in.
	U/S 0.25	58.74 – 58.75 mm	2.3126 – 2.3130 in.
	U/S 0.50	58.49 – 58.50 mm	2.3028 – 2.3031 in.
	U/S 1.00	57.99 – 58.00 mm	2.2831 – 2.2835 in.

Flywheel

Run out limit	0.2 mm	0.008 in.
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LUBRICATION SYSTEM**Oil Pump**

Body clearance	Limit	0.2 mm	0.008 in.
	STD	0.06 – 0.15 mm	0.0024 – 0.0059 in.
Tip clearance			
Driven gear to crescent	Limit	0.3 mm	0.012 in.
	STD	0.15 – 0.21 mm	0.0059 – 0.0083 in.
Drive gear to crescent	Limit	0.3 mm	0.012 in.
	STD	0.22 – 0.25 mm	0.0087 – 0.0098 in.
Side clearance	Limit	0.15 mm	0.0059 in.
	STD	0.03 – 0.09 mm	0.0012 – 0.0034 in.

COOLING SYSTEM**Water Pump**

Bearing fitting temperature	80°C	176°F
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Radiator

Overall coolant capacity (W/Heater)	B Engine	13.0 ℓ	13.7 US qt	11.4 Imp.qt
	2B Engine	14.0 ℓ	14.8 US qt	12.3 Imp.qt
Coolant capacity		3.3 ℓ	3.5 US qt	2.9 Imp.qt
Radiator cap valve opening pressure	Limit	0.6 kg/cm ²	8.5 psi	
	STD	0.75 – 1.05 kg/cm ²	10.7 – 14.9 psi	

Thermostat

Full open temperature	95°C	203°F	100°C	212°F
Valve opening temperature	80.5° – 83.5°C		86.5° – 89.5°C	
	177° – 182°F		188° – 193°F	
Valve lift	10 mm	0.39 in.	10 mm	0.39 in.

FUEL SYSTEM**Injection Nozzle & Nozzle Holder**

Nozzle opening pressure	New nozzle	115 – 125 kg/cm ²	1636 – 1778 psi
	Reused nozzle	105 – 125 kg/cm ²	1493 – 1778 psi
	Injection angle	About 4°	
Adjusting shim thickness (For adjusting nozzle opening pressure)		1.00 ... 1.95 mm	0.0394 ... 0.0768 in.
		[20 sizes in 0.05 mm (0.0020 in.) increment]	

Fuel Pump Performance Test

Suction test	Suction pipe spec.	Inner dia.	8 mm	0.31 in.
		Length	2 m	78.7 in.
	Suction height		1 m	39.4 in.
	Feed pump		Fuel must discharge within 40 seconds at 150 rpm.	
	Priming pump		Fuel must discharge within 25 strokes at 60 strokes/min.	
Discharge test	Discharge nozzle dia.		1.54 mm	0.0606 in.
	Pressure at 600 rpm		1.8 – 2.2 kg/cm ²	25.6 – 31.3 psi
	Volume at 1000 rpm		More than 900 cc/min.	54.9 cu.in./min.

Fuel Feed Pump

Housing to piston clearance	0.009 – 0.013 mm	0.0004 – 0.0005 in.
Housing to push rod clearance	0.003 – 0.006 mm	0.0001 – 0.0002 in.
Feed pump tappet stroke (Max.)	8 mm	0.31 in.
Priming pump stroke	25 mm	0.98 in.

Automatic Timer

Timer fitting temperature	60°C	140°F
Timer advance angle	Advance begins ($\leq 0.5^\circ$)	
500 rpm	2.0 – 3.0°	
700 rpm	4.5 – 5.5°	
900 rpm	6.0 – 7.0°	
1200 rpm	8.0 – 9.0°	
1600 rpm	8.0 – 9.0°	
1700 rpm	8.0 – 9.0°	
Timer spring adjusting shim thickness (For both inner and outer)	0.1, 0.2, 0.5 mm	0.004, 0.008, 0.020 in.

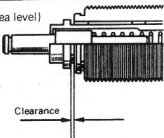
Injection Pump

Direction of rotation	Clockwise as seen from drive side	
Cam lift	8 mm	0.31 in.
Injection order	1 – 3 – 4 – 2	
Control rack sliding resistance		
Pump stopped	Less than 150 g	5.3 oz
Pump at 1,000 rpm	Less than 50 g	1.8 oz
Pre-stroke	Control rack at 8 mm (0.31 in.)	1.9 – 2.0 mm 0.075 – 0.079 in.
Injection interval	89.5 – 90.5°	
Tappet clearance	More than 0.2 mm	0.008 in.
Tappet adjusting shim thickness	0.1 ... 1.5 mm	0.004 ... 0.059 in. [15 sizes in 0.1 mm (0.004 in.) increment]
Camshaft thrust clearance	Limit	0.1 mm
	STD	0.03 – 0.05 mm
Camshaft adjusting shim thickness	0.10, 0.12, 0.14, 0.16, 0.18, 0.50 mm 0.0039, 0.0047, 0.0055, 0.0063, 0.0071, 0.0197 in.	
Tappet overall looseness limit	0.3 mm	
Plunger spring	Free length	49.4 mm
	Installed length	44.0 mm
	Installed load	15.1 kg
Delivery valve spring	Free length	37.0 mm
	Installed length	25.9 mm
	Installed load	4.42 kg

Combined Governor

Main spring	Free length	45.6 mm	1.795 in.
	Installed length	35.0 mm	1.378 in.
	Installed load	0.95 kg	33.5 oz
Adjusting shim thickness		0.5, 1.0, 2.0, 3.0 mm	
		0.020, 0.039, 0.079, 0.118 in.	
Speed control spring	Free length	38.0 mm	1.496 in.
	Installing length	27.0 mm	1.063 in.
	Installing load	3.30 kg	7.28 lb

Diesel Altitude Compensator (DAC)

	0.2 – 0.5 mm	0.008 – 0.020 in.

INJECTION PUMP ADJUSTMENT & TEST**Preparations of Pump Tester**

Nozzle type		DN 4 SD-24	
Nozzle	Opening pressure	120 – 130 kg/cm ²	(1707 – 1849 psi)
Injection pipe	Outer diameter	6 mm	(0.24 in.)
	Inner diameter	2 mm	(0.08 in.)
	Length	600 mm	(23.62 in.)
	Minimum bending radius	More than 25 mm	(0.98 in.)
Fuel temperature		40 – 45°C	(104 – 113°F)
Fuel feeding pressure		0.5 kg/cm ²	(7.1 psi)

Control Rack Sliding Resistance

Pump rpm	Sliding Resistance	
0	Less than 150 g	(5.3 oz)
1000	Less than 50 g	(1.8 oz)

Injection Timing

Pre-stroke	1.9 – 2.0 mm	0.075 – 0.079 in.
	[Control rack position at 8 mm (0.31 in.)]	
Injection Interval	90° ± 30°	
Tappet clearance	More than 0.2 mm	0.008 in.

Injection Volume Adjustment**(For B Engine)**

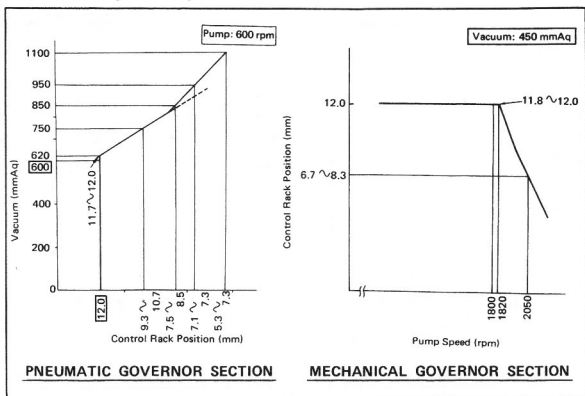
Rack Position	Pump rpm	Measuring Strokes	Injection Volume	Variation Limit
16.0 mm (0.630 in.)	100	200	14.0 – 16.0 cc (0.854 – 0.976 cu.in.)	1.2 cc (0.073 cu.in.)
12.0 mm (0.472 in.)	1100	200	10.6 – 11.2 cc (0.647 – 0.683 cu.in.)	0.4 cc (0.024 cu.in.)
8.6 mm (0.330 in.)	1000	200	4.6 – 5.6 cc (0.281 – 0.342 cu.in.)	0.4 cc (0.024 cu.in.)
6.5 mm (0.256 in.)	300	500	2.5 – 4.5 cc (0.153 – 0.275 cu.in.)	1.0 cc (0.061 cu.in.)

(For 2B Engine)

Rack Position	Pump rpm	Measuring Strokes	Injection Volume	Variation Limit
16.0 mm (0.630 in.)	100	200	14.0 – 16.0 cc (0.854 – 0.976 cu.in.)	1.2 cc (0.073 cu.in.)
11.9 mm (0.469 in.)	1100	200	11.0 – 11.6 cc (0.671 – 0.708 cu.in.)	0.4 cc (0.024 cu.in.)
8.0 mm (0.315 in.)	1000	200	4.3 – 5.1 cc (0.262 – 0.311 cu.in.)	0.4 cc (0.024 cu.in.)
6.5 mm (0.256 in.)	300	500	2.5 – 4.5 cc (0.153 – 0.275 cu.in.)	1.0 cc (0.061 cu.in.)

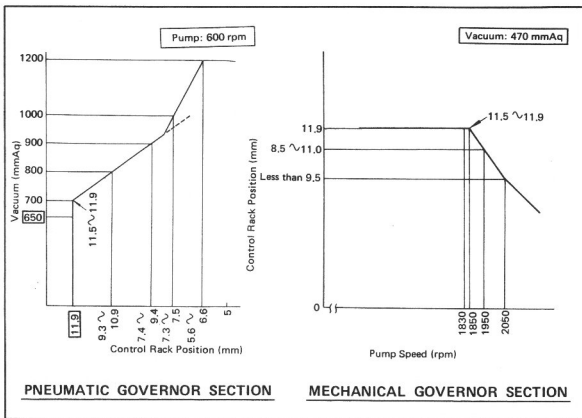
Pressure Test

Plunger pressure	More than 150 kg/cm ² (2133 psi) [Pump speed 200 rpm, Rack position 6.5 mm (0.256 in.)]
Delivery valve pressure	More than 5 seconds for holder internal pressure to drop 10 kg/cm ² (142 psi) [Internal pressure More than 150 kg/cm ² (2133 psi), Rack position 0 mm]

COMBINED GOVERNOR ADJUSTMENT & TEST**Characteristic Diagram (B Engine)****Governor Adjustment (B Engine)**

Tests & Adjustments	Pump Speed rpm	Vacuum mm Aq (in.Aq)	Rack Position mm (in.)	Time second
Governor air tightness	600	500 → 480 (19.69 → 18.90)	—	10 (Minimum)
Control rack initial set	600	600 (23.62)	12.0 (0.472)	—
Main spring	600	620 (24.41) 750 (29.53)	11.7 – 12.0 (0.461 – 0.472) 9.3 – 10.7 (0.366 – 0.421)	—
Idling spring capsule	600	850 (33.46) 950 (37.40) 1100 (43.31)	7.5 – 8.5 (0.295 – 0.335) 7.1 – 7.3 (0.280 – 0.287) 5.3 – 7.3 (0.209 – 0.287)	—
Speed control spring	1800 1820 2050	450 (17.72)	12.0 (0.472) 11.8 – 12.0 (0.465 – 0.472) 6.7 – 8.3 (0.264 – 0.327)	—

Characteristic Diagram (2B Engine)

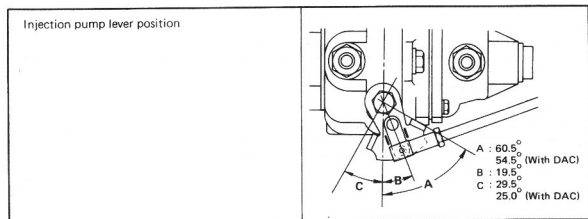


Governor Adjustment (2B Engine)

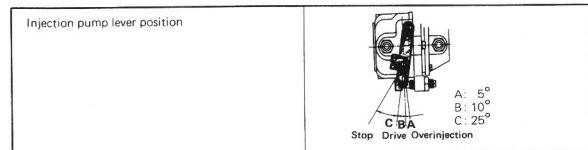
Tests & Adjustments	Pump Speed rpm	Vacuum mm Aq (in. Aq)	Rack Position mm (in.)	Time second
Governor air tightness	600	500 → 480 (19.69 → 18.90)	—	10 (Minimum)
Control rack initial set	600	650 (25.59)	11.9 (0.469)	—
Main spring	600	700 (27.56)	11.5 – 11.9 (0.453 – 0.469)	—
		800 (31.50)	9.3 – 10.9 (0.366 – 0.429)	
		900 (35.43)	7.4 – 9.4 (0.291 – 0.370)	
Idling spring capsule	600	1000 (39.37)	7.3 – 7.5 (0.287 – 0.295)	—
		1200 (47.24)	5.6 – 6.6 (0.220 – 0.260)	
Speed control spring	1830	470 (18.50)	11.9 (0.469)	—
	1850		11.5 – 11.9 (0.453 – 0.469)	
	1950		8.5 – 11.0 (0.335 – 0.433)	
	2050		≤ 9.5 (0.374)	

Total Injection Volume

Engine Model	Pump rpm	Vacuum	Measuring Strokes	Total Injection Volume
B	1100	120 mm Aq (4.72 in.Aq)	500	106.0 – 110.0 cc (6.47 – 6.71 cu.in.)
B (For ECE)				101.0 – 105.0 cc (6.16 – 6.41 cu.in.)
2B		200 mm Aq (7.87 in.Aq)		111.0 – 115.0 cc (6.77 – 7.02 cu.in.)

EDIC (ELECTORICAL DIESEL INJECTION CONTROL) SYSTEM**Operational Check****STARTING SYSTEM****Preheating System**

Item	12V Type	24V Type
Glow time at 0°C (32°F)	About 20 seconds	About 15 seconds
Load current	7.7 – 10.3 A	4.1 – 5.5 A
Glow plug resistance	0.2 Ω	0.9 Ω

Overinjection Magnet (Operational Check)

Starter

Type		12V type 2.5 kw	24V type 4.5 kw
Rated output			
No load characteristics		180 A max. and 3500 rpm min. at 11V	90 A max. and 3500 rpm min. at 23V
Mica depth	Limit	0.2 mm	0.008 in.
	STD	0.5 — 0.8 mm	0.020 — 0.031 in.
Commutator run out	Limit	0.05 mm	0.002 in.
	STD	Less than 0.02 mm	0.001 in.
Commutator outside diameter	Limit	34 mm	1.34 in.
	STD	35 mm	1.38 in.
Brush length	Limit	13 mm	0.51 in.
	STD	19 mm	0.75 in.
Brush spring tension		3.2 — 4.0 kg	7.1 — 8.8 lb

CHARGING SYSTEM**Alternator**

Type		12V — 35 A	24V — 15A	24V — 20A	24V — 65A
Maximum output		35A, 14V	15A, 28V	20A, 28V	65A, 28V
Rotor coil resistance		4.2 Ω	19.0 Ω	19.0 Ω	19.0 Ω
Brush exposed length	Limit	5.5 mm		0.217 in.	
	STD	12.5 mm		0.492 in.	

Alternator Regulator

Type		12V type	24V type
Regulating voltage		13.8 — 14.8V	27 — 29V
Voltage relay actuating voltage		4 — 5.8V	8 — 11.6V

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