



ENGINE

WORKSHOP MANUAL

W04D

Hino Motors, Ltd.

FOREWORD

This workshop manual has been prepared to provide information covering repair procedures on Hino Vehicle.

Applicable models: W04C-T engine

When making any repair of your truck, be careful not to be injured through improper procedures.

As for maintenance items, refer to the Driver's Hand Book.

All information and specifications in this manual are based upon the latest product information available at the time of printing.

Hino Motors reserves the right to make changes at any time without prior notice.

HINO MOTORS, LTD.



WORKSHOP MANUAL

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**RECOMMENDED
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GENERAL PRECAUTIONS

Some recommended and standard maintenance services for your vehicle are mentioned in this section.

When performing maintenance on your vehicle be careful not to get injured by improper work.

Improper or incomplete work can cause a malfunction of the vehicle which may result in personal injury and/or property damage. If you have any question about performing maintenance, please consult your Hino dealer.

WARNING

When working on your vehicle, observe the following general precautions to prevent personal injury and/or property damage in addition to the particular NOTES or WARNINGS.

Most threaded fasteners are metric.

Be careful not to mix with threaded fasteners using the inch system.

- Always wear safety glasses or goggles to protect your eyes.
- Remove rings, watches, ties, loose hanging jewelry and loose clothing before starting work on the vehicle.
- Bind long hair securely behind the head.
- When working on the vehicle, apply the parking brake firmly, place the transmission shift lever in neutral or "N", and block the wheels.
- Use safety stands to support the vehicle whenever you need to work under it. It is dangerous to work under a vehicle supported only by a jack.
- To avoid serious burns, keep yourself away from hot metal parts such as the engine, exhaust manifold, radiator, muffler, exhaust pipe and tail pipe.
- Keep yourself, your clothing and your tools away from moving parts such as the cooling fan and V-belts when the engine is running.
- Always stop the engine by pulling out the engine stop knob. Leave the knob pulled out as long as the engine is stopped. And turn off the starter switch, unless the operation requires the engine running. Removing the key from the switch is recommended.
- If it is necessary to run the engine, make sure that the parking brake is firmly applied, the wheels are blocked, and the transmission shift lever is in "Neutral" before starting the engine.
- Run the engine only in a well-ventilated area to avoid inhaling of carbon monoxide.
- Do not smoke while working on the truck since fuel and gases from the battery are flammable.
- Take utmost care when working on the battery. It contains corrosive sulfuric acid.
- Large electric current flows through the battery cable and starter cable. Be careful not to cause a short which can result in personal injury and/or property damage.
- Be careful not to leave any tool in the engine compartment. The tool may be hit by moving parts and can cause personal injury.
- Read carefully and observe the instructions placed on the jack when using it.
- Be careful not to damage lines and hoses by stepping or holding your feet on them.

TOWING

When being towed, always place the transmission shift lever in Neutral and release the parking brake completely.

In order to protect the bumper, fit a protection bar against the lower edge of the bumper and put a wood block under the frame near the No. 1 crossmember when attaching the towing chain. Never lift or tow the vehicle if the chain is in direct contact with the bumper.

1) Front end towing (with front wheels raised off the ground)

When towing from the front end with the front wheels raised off the ground remove the rear axle shafts to protect the transmission and differential gears from being damaged. The hub openings should be covered to prevent the loss of axle lubricant or the entry of dirt or foreign matter.

The above-mentioned precautions should be observed for vehicles equipped with either the manual or automatic transmission, and for even short distance towing. After being towed, check and refill the rear axle housing with lubricant if necessary.

2) Rear end towing

When being towed with the rear wheels raised off the ground, fasten and secure the steering wheel in a straight-ahead position.

HOW TO USE THIS WORKSHOP MANUAL.

This workshop manual is designed as a guide for servicing vehicle.

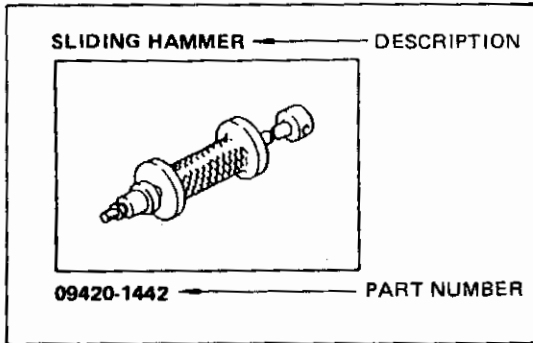
An INDEX is provided on the first page of each chapter.

TROUBLESHOOTING is dealt with each chapter.

When beginning operations, refer to the sections on for a guide to appropriate diagnoses.

SPECIAL TOOLS are dealt with in each chapter.

When ordering a special tool, make sure that the parts number is correct.

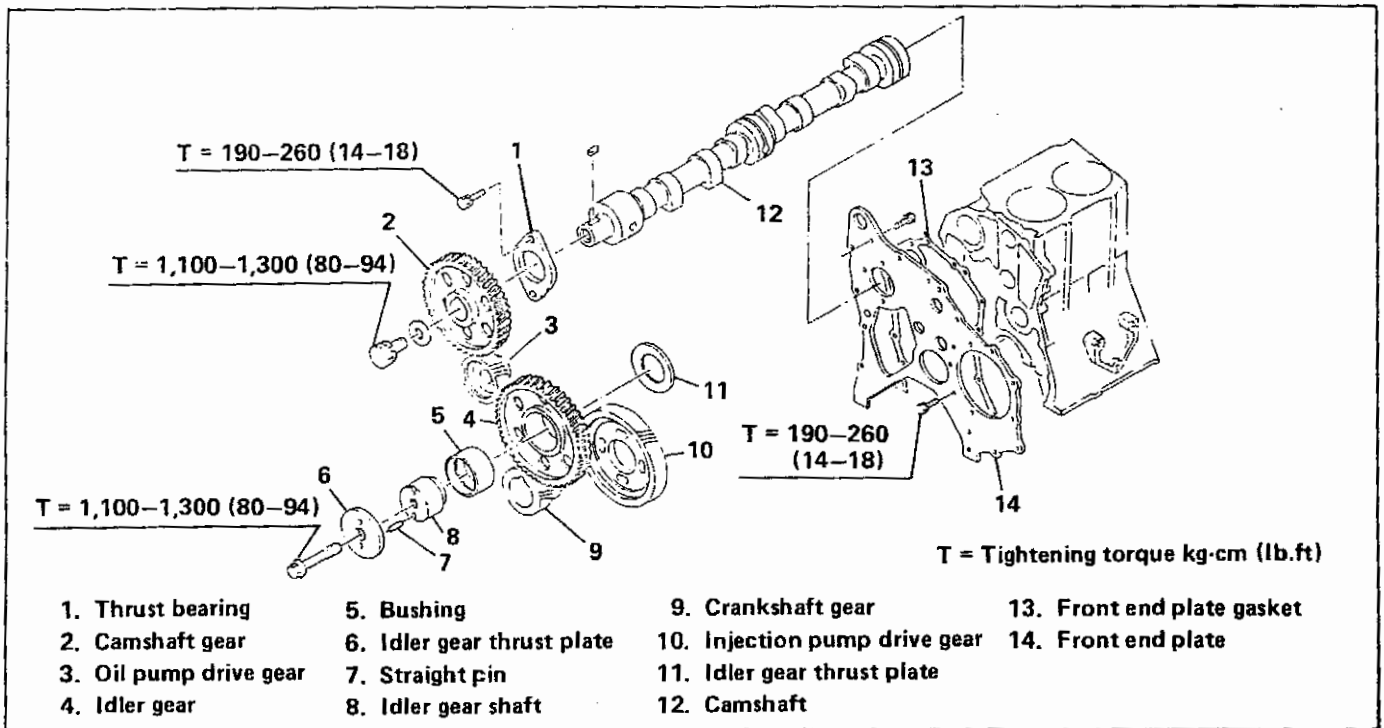


REPAIR PROCEDURES

Repair procedures which are self-explanatory such as simple installation and removal of parts have been omitted. Illustrations such as the one below have been provided to make such simple procedures clear. Only essential procedures requiring directions have been dealt with explicitly.

EXAMPLE:

TIMING GEAR AND CAMSHAFT



In some cases, illustrations may be of parts which differ in some nonessential way from the parts found on your particular vehicle. In such cases, however, the principle or procedure being illustrated applies regardless of such non-essential differences.

DEFINITION OF TERMS.

This engine rotates clockwise seen from the timing gear side.

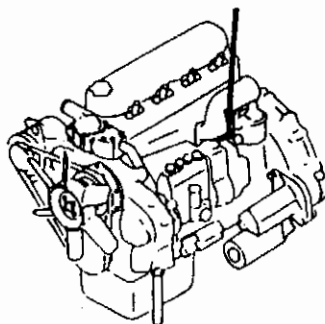
IDENTIFICATION INFORMATION

ENGINE SERIAL NUMBERS.

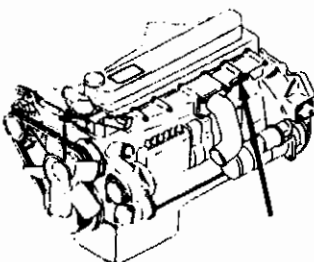
Please quote these numbers when ordering spare parts or reporting technical matter as they will give you prompt service attention.

The engine serial number is engraved on the engine cylinder block.

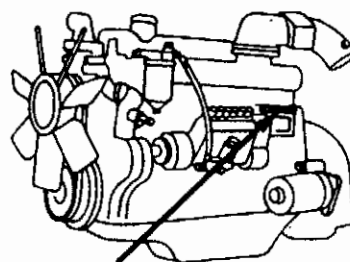
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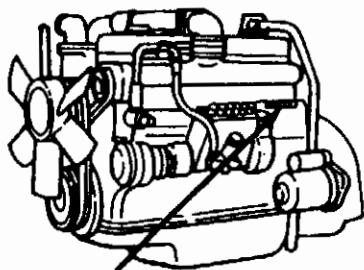
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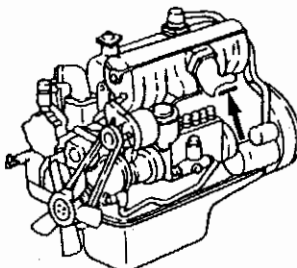
EH500, 700



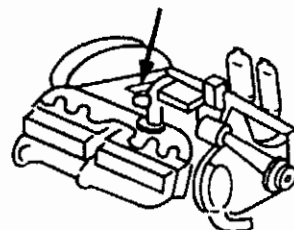
H06C, H07C, H06C (T)



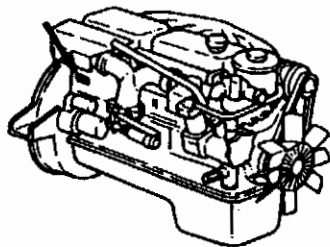
EM100



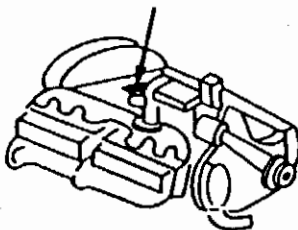
ER200



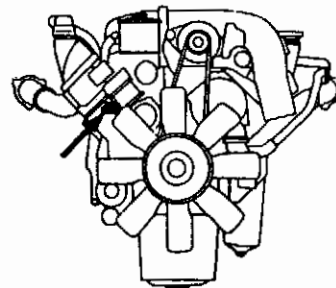
EK100



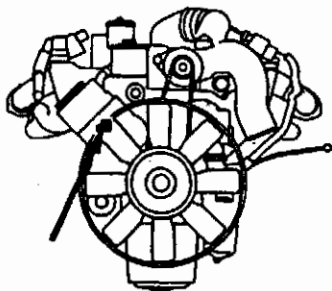
EK200



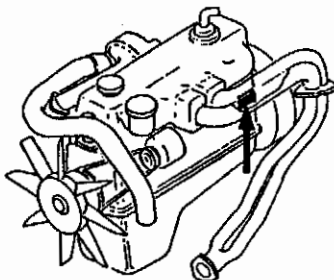
EF750



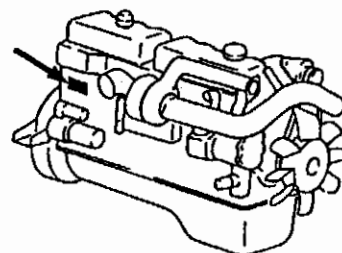
EF750 (T)



EP100



K13C



TIGHTENING TORQUE OF STANDARD BOLT

Bolt identification	Tightening conditions	Bolt diameter (mm)	Unit: kg.cm (lb.ft)											
			4	6	8	10	12	14	16	18	20	22	24	
4	Even tightening area. Bolt nut, coating, naked bolt, lubricant, etc. Optimum conditions.	10 ~ 15 (10.8 ~ 15.0)	36 ~ 53 (2.7 ~ 3.8)	174 ~ 255 (13 ~ 18)	304 ~ 445 (22 ~ 32)	486 ~ 712 (36 ~ 51)	758 ~ 1,110 (55 ~ 80)	1,040 ~ 1,530 (76 ~ 110)	1,480 ~ 2,170 (108 ~ 156)	2,030 ~ 2,880 (147 ~ 215)	2,560 ~ 3,750 (186 ~ 271)			
			5	Cast iron or aluminum tightening surface. Washers. Medium conditions.	14 ~ 20 (1.1 ~ 1.4)	48 ~ 71 (3.5 ~ 5.1)	222 ~ 340 (17 ~ 24)	405 ~ 592 (30 ~ 42)	647 ~ 950 (47 ~ 68)	1,010 ~ 1,480 (74 ~ 107)	1,380 ~ 2,040 (101 ~ 147)	1,970 ~ 2,900 (143 ~ 209)	2,700 ~ 3,970 (196 ~ 287)	3,410 ~ 5,000 (247 ~ 361)
						6	Tightening area having black coarse surface. Rusty. Naked bolt or lubricant unavailable. Poor tightening conditions.	17 ~ 25 (1.3 ~ 1.8)	80 ~ 88 (4.4 ~ 6.3)	290 ~ 425 (21 ~ 30)	506 ~ 742 (37 ~ 53)	809 ~ 1,180 (59 ~ 85)	1,260 ~ 1,850 (92 ~ 133)	1,740 ~ 2,540 (126 ~ 183)
7	Even tightening area. Bolt nut, coating, naked bolt, lubricant, etc. Optimum conditions.	16 ~ 24 (1.2 ~ 1.7)	58 ~ 83 (4.2 ~ 6.0)	273 ~ 400 (20 ~ 28)	477 ~ 700 (35 ~ 50)				764 ~ 1,120 (56 ~ 81)	1,190 ~ 1,750 (87 ~ 126)	1,640 ~ 2,400 (119 ~ 173)	2,320 ~ 3,410 (168 ~ 246)	3,180 ~ 4,680 (231 ~ 338)	4,020 ~ 5,360 (291 ~ 387)
			8	Cast iron or aluminum tightening surface. Washers. Medium conditions.	22 ~ 32 (1.6 ~ 2.3)	75 ~ 110 (5.5 ~ 7.9)	364 ~ 533 (27 ~ 38)	636 ~ 932 (47 ~ 67)	1,020 ~ 1,500 (74 ~ 108)	1,590 ~ 2,330 (116 ~ 168)	2,180 ~ 3,200 (156 ~ 231)	3,100 ~ 4,550 (225 ~ 329)	4,260 ~ 6,210 (308 ~ 449)	5,360 ~ 7,860 (388 ~ 567)
9	Tightening area having black coarse surface. Rusty. Naked bolt or lubricant unavailable. Poor tightening conditions.	27 ~ 40 (2.0 ~ 2.8)				94 ~ 138 (6.8 ~ 9.9)	455 ~ 687 (33 ~ 48)	795 ~ 1,165 (58 ~ 84)	1,270 ~ 1,870 (92 ~ 135)	1,890 ~ 2,920 (144 ~ 211)	2,730 ~ 4,000 (198 ~ 289)	3,870 ~ 5,680 (280 ~ 410)	5,310 ~ 7,800 (385 ~ 564)	6,700 ~ 9,850 (485 ~ 712)
			10	Even tightening area. Bolt nut, coating, naked bolt, lubricant, etc. Optimum conditions.	24 ~ 32 (1.8 ~ 2.3)	82 ~ 110 (6.0 ~ 7.9)	397 ~ 574 (29 ~ 41)	684 ~ 925 (51 ~ 68)	1,010 ~ 1,480 (74 ~ 107)	1,730 ~ 2,310 (126 ~ 167)	2,380 ~ 3,170 (173 ~ 229)	3,380 ~ 4,510 (244 ~ 326)	4,630 ~ 6,170 (335 ~ 446)	5,850 ~ 7,790 (424 ~ 563)
11	Cast iron or aluminum tightening surface. Washers. Medium conditions.	32 ~ 42 (2.4 ~ 3.0)				110 ~ 146 (8.0 ~ 10.5)	528 ~ 706 (38 ~ 51)	925 ~ 1,230 (67 ~ 88)	1,480 ~ 1,970 (108 ~ 142)	2,310 ~ 3,080 (168 ~ 222)	3,170 ~ 4,230 (230 ~ 306)	4,510 ~ 6,010 (327 ~ 434)	6,170 ~ 8,230 (447 ~ 595)	7,790 ~ 10,390 (564 ~ 751)
			11	Tightening area having black coarse surface. Rusty. Naked bolt or lubricant unavailable. Poor tightening conditions.	40 ~ 53 (2.8 ~ 3.8)	137 ~ 183 (10.0 ~ 13.2)	662 ~ 882 (48 ~ 63)	1,160 ~ 1,540 (84 ~ 111)	1,850 ~ 2,470 (134 ~ 178)	2,880 ~ 3,850 (210 ~ 278)	3,970 ~ 5,290 (288 ~ 382)	5,640 ~ 7,510 (408 ~ 543)	7,720 ~ 10,290 (559 ~ 744)	9,740 ~ 12,990 (705 ~ 939)

NOTE: The torque values given in this table should be applied where bolt torque is not specified.

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ENGINE

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DATA AND SPECIFICATIONS

Model	HINO W04D and W04C-T	
Type	W04D :	Diesel, 4-cycle, 4 cyl., vertical cylinder, in-line, overhead valve, water-cooled, direct injection type
	W04C-T :	Diesel, 4 cycle, 4 cyl., vertical cylinder, in-line, overhead valve, water-cooled, turbocharged, direct injection type
Bore and stroke	W04D :	104 x 118 mm (4.09 x 4.65 in)
	W04C-T :	104 x 113 mm (4.09 x 4.45 in)
Piston displacement	W04D :	4.009 liters (244.6 cu.in)
	W04C-T :	3.839 liters (234.3 cu.in)
Compression ratio	17.9 : 1	
Firing order	1-3-4-2	
	(A number of a cylinder is to be counted in order from the timing gear end.)	
Direction of rotation	Counter-clockwise viewed from flywheel	
Compression pressure	33-36 kg/cm ² (469-512 lb/sq.in) at 290-330 rpm	
Maximum revolution (at full load)	3,200 rpm	
Idling revolution	600-650 rpm	
Dry weight	W04D :	Approx. 335 kg (738.5 lb)
	W04C-T :	Approx. 400 kg (881.8 lb)
Valve seat angle;	Intake	30°
	Exhaust	45°
Valve face angle;	Intake	30°
	Exhaust	45°
Valve timing (flywheel travel),	Intake opens	16° before top dead center
	Intake closes	40° after bottom dead center
	Exhaust opens	55° before bottom dead center
	Exhaust closes	13° after top dead center
Valve clearance (when cold)	Intake	0.30 mm (0.0118 in)
	Exhaust	W04D : 0.40 mm (0.0157 in)
		W04C-T : 0.45 mm (0.0177 in)
Injection nozzle opening pressure	220 kg/cm ² (3,129 lb/sq.in)	
Thermostat	Wax type, bottom by pass system	
Injection timing (flywheel travel)	W04D :	14° before top dead center for No.1 cylinder on compression stroke
	W04C-T :	10° before top dead center for No.1 cylinder on compression stroke

NOTE: In case of equipped with fuel injection pump No. 22080-1470, set the injection timing at 11° before top dead center for No.1 cylinder on compression stroke.

TROUBLESHOOTING

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Engine overheating	Coolant	
	● Insufficient coolant	Add coolant.
	● Defective thermostat	Replace the thermostat.
	● Overflow of coolant due to leakage of exhaust into cooling system	Repair.
	● Coolant leakage from cylinder head gasket	Replace gasket.
	● Defective coolant pump	Repair or replace.
	Radiator	
	● Clogged with rust and scale	Clean radiator.
	● Clogged with iron oxide due to leakage of exhaust into cooling system	Clean coolant passage and correct exhaust leakage.
	● Clogged radiator core due to mud or other debris	Clean radiator.
	● Defective radiator cap pressure valve	Replace radiator cap.
	Abnormal combustion	
	● Incorrect injection timing	Adjust injection timing.
	● Reduced injection pressure	Adjust injection pressure.
	● Poor fuel	Use good quality fuel.
	● Poor nozzle spray	Adjust or replace nozzle.
	● Unsatisfactory automatic timer advance angle	Repair or replace timer.
Other problems		
● Defective or deteriorated engine oil	Change engine oil.	
● Unsatisfactory operation of oil pump	Replace or repair.	
● Insufficient oil	Add oil.	
● Brake drag	Repair or adjust.	
Excessive oil consumption	Pistons, cylinder liners, and piston rings	
	● Wear of piston ring and cylinder liner	Replace piston rings and cylinder liner.
	● Worn, sticking or broken piston rings	Replace piston rings and cylinder liner.
	● Insufficient tension on piston rings	Replace piston rings and cylinder liner.
	● Unsatisfactory break-in of piston rings	Replace piston rings and cylinder liner.
	● Unsuitable oil (viscosity too low)	Change oil as required and replace piston rings and cylinder liners.
	● Incorrectly fitted piston rings (upside down)	Replace piston rings.
	● Gaps of piston rings in line with each other	Reassemble piston rings.

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Excessive oil consumption	Valve and valve guides	
	● Worn valve stem	Replace valve and valve guide.
	● Worn valve guide	Replace valve guide.
	● Incorrectly fitted valve stem seal	Replace the stem seal.
	● Excessive lubricant on rocker arm	Check clearance of rocker arm and shaft.
	Excess oil feed	
	● Defective oil level gauge	Replace oil level gauge.
	● Oil level too high	Drain excess oil.
	Other problems	
	● Overcooled engine (low temperature wear)	Warm up engine before moving vehicle. Check cooling system.
● Oil leakage from miscellaneous parts	Repair.	
Piston seizure	Operation	
	● Abrupt stoppage of engine after running at highspeed	Operate engine properly.
	● Hill climbing using unsuitable gear	Select suitable gear.
	Oil	
	● Insufficient oil	Add oil.
	● Dirty oil	Change oil.
	● Poor quality oil	Replace with proper engine oil.
	● High oil temperature	Repair.
	● Low oil pressure	Repair.
	● Defective oil pump	Repair oil pump.
● Reduced performance due to worn oil pump	Replace oil pump.	
● Suction strainer sucking air	Add oil and/or repair strainer.	
Abnormal combustion	See Symptom: "Engine overheating."	
Coolant	See Symptom: "Engine overheating."	
Lack of power	Injection pump	Refer to CHAPTER IP, FUEL INJECTION PUMP.
	Intake	
	● Clogged air cleaner	Clean element or replace element.
Overheating	See Symptom: "Engine overheating."	

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Lack of power	Fuel and nozzle	
	● Poor nozzle spray	Adjust or replace injection nozzle.
	● Clogged nozzle with carbon	Clean nozzle.
	● Wear or seizure of nozzle	Replace nozzle.
	● Air in fuel system	Repair and bleed air from fuel system.
	● Clogged fuel filter	Replace element.
	● Use of poor fuel	Use good quality fuel.
	Abnormal combustion	See Symptom: "Engine overheating."
	Piston, cylinder liners, and piston rings	See Symptom "Engine overheating."
	Other problems	
● Breakage of turbine or blower	Replace the turbine or blower or turbocharger.	
Difficulty starting engine	Electrical system	
	● Discharged battery	Charge battery.
	● Defective wiring in starter circuit	Repair wiring of starter.
	● Loose or open-circuit battery cable	Tighten battery terminal connections or replace battery cable.
	● Breakdown of starter	Replace starter.
	● Break of glow plug or intake air heater (If so equipped)	Replace
	Injection pump	Refer to CHAPTER IP, FUEL INJECTION PUMP.
	Air cleaner	
	● Clogged element	Clean the element or replace the element.
	Fuel system	
	● No fuel in tank	Supply fuel and bleed air from fuel system.
	● Clogged fuel line	Clean fuel line.
	● Air sucked into fuel system through fuel line connections	Tighten fuel line connections.
	● Clogged fuel filter	Replace element.
	● Loose connection in high-pressure line	Tighten sleeve nut of high pressure line.
● Water in fuel	Drain and clean fuel system	

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>	
Difficulty starting engine	Nozzles		
	● Seized nozzle	Replace nozzle.	
	● Broken or fatigued nozzle spring	Replace spring.	
	Oil system		
	● Oil viscosity too high	Use proper viscosity oil, or install an oil immersion heater and warm up oil.	
	Other problems		
	● Seized piston	Replace piston, piston rings, and liner.	
	● Seized bearing	Replace bearing and/or crankshaft.	
	● Reduced compression pressure	Overhaul engine.	
	● Ring gear damaged or worn	Replace the ring gear and/or starter pinion.	
	● Improperly adjusted or broken accelerator cable	Adjust or replace the accelerator cable.	
	Rough idling	Injection pump	Refer to CHAPTER IP, FUEL INJECTION PUMP.
		Nozzles	
		● Uneven injection pressure	Adjust.
		● Poor nozzle spray	Adjust or replace nozzle.
● Carbon deposit on nozzle tip		Remove carbon.	
● Seized needle valve		Replace nozzle.	
Engine proper			
● Improper valve clearance		Adjust valve clearance.	
● Improper contact of valve seat		Replace or repair valve and valve seat.	
● Idling speed too low		Adjust idling speed.	
● Coolant temperature too low		Warm up engine.	
● Compression pressure of cylinders markedly different from one another		Overhaul engine.	
Leakage of exhaust		Cylinder head gasket	
		● Fatigued gasket (aging)	Replace gasket.
		● Damage	Replace gasket.
	● Improper installation	Replace gasket.	

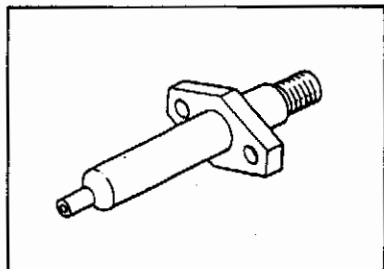
<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Leakage of exhaust	Cylinder head bolts	
	● Loose bolts	Tighten bolt.
	● Elongated bolts	Replace bolt.
	● Improper tightening torque or tightening sequence	Tighten properly.
	Cylinder block	
	● Cracking	Replace cylinder block.
	● Surface distortion	Repair or replace.
	● Fretting of cylinder liner insertion portion (insufficient projection of cylinder liner)	Replace cylinder liner or cylinder block.
	Cylinder head	
	● Cracking	Replace cylinder head.
	● Surface distortion	Repair or replace.
	Cylinder liners	
	● Cracking	Replace cylinder liner.
	● Corrosion	Replace cylinder liner.
	● Insufficient projection of cylinder liner	Replace cylinder liner.
	Other problems	
	● Incorrect injection timing	Adjust injection timing.

ENGINE OVERHAUL CRITERIA

SPECIAL TOOL

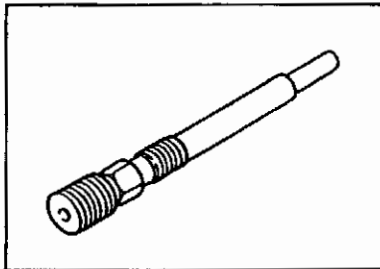
Prior to starting an engine overhaul, it is necessary to have these special tools.

COMPRESSION GAUGE ADAPTOR (NOZZLE HOLDER)



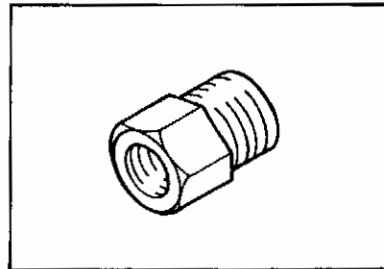
09408-1041

COMPRESSION GAUGE ADAPTOR (GLOW PLUG)



09552-1051

COMPRESSION GAUGE ADAPTOR



09552-1070

FACTORS WHICH DETERMINE WHEN AN ENGINE OVERHAUL IS NEEDED.

1. Lowered compression pressure
 - a. Before the measurement
 - a) Correct the valve clearance.
 - b) Warm up engine [Bring the coolant temperature to about 80°C (176°F)].
 - c) Charge the battery fully.
 - d) Remove the air cleaner.
 - b. Measurement
 - 1) Measure at nozzle holder hole.
 - a) Remove the nozzle holders.
 - b) Install the gauge adapter in the nozzle holder hole.

Special Tool: Compression Gauge Adapter (09408-1041) (09552-1070)

- 2) Measure at glow plug hole.
 - a) Remove the glow plug.
 - b) Install the gauge adapter in the glow plug hole.

Special Tool: Compression Gauge Adapter (09552-1051) (09552-1070)

- c) Connect a compression gauge to the gauge adapter.
- d) Drive the engine with the starter and read the compression pressure.

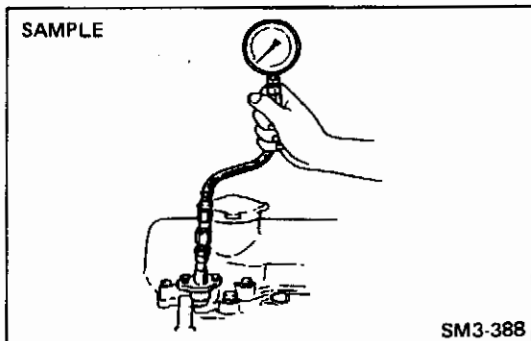
NOTE: Do not continuously operate the starter for more than 15 seconds at a time.

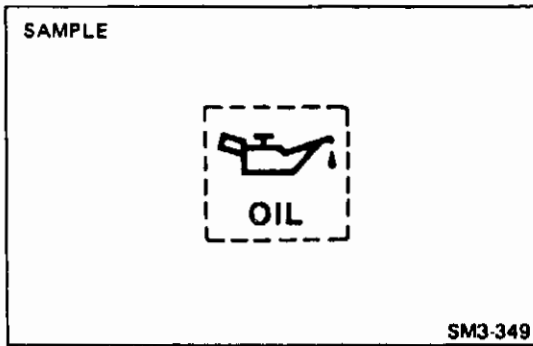
- e) Measure the compression pressure for each cylinder. If the compression pressure is low, be sure to repeat the measuring.

NOTE: Be sure not to leak through sealing face.

Unit: kg/cm² (lb/sq.in)

Engine model	Compression pressure		Difference between each cylinder	Engine speed (rpm)
	Standard	Limit		
W04D W04C-T	33-36 (469-511)	25 (356)	Less than 3 (43)	350
W04C-TI	30-33 (427-469)	22 (313)		
W06D W06E	33-36 (469-511)	25 (356)		280
W06D-TI	30-33 (427-469)	22 (313)		





S.A.E. GRADE	ATMOSPHERIC TEMPERATURE										° F
	-10	0	32	50	70	90	100			° C	
	-23	-18	0	10	21	32	39				
40											
30											
20W/20											
15W/40											

2. **Decreased oil pressure**
Check the oil pressure warning lamp when the oil and coolant temperature is hot [about 80°C (176°F)].
 - a. If the warning lamp is lighted, check the oil level.
 - b. Check oil deterioration.
If oil quality is poor, replace with a suitable grade oil.
 - c. Remove the oil pressure switch and install the oil pressure gauge.
 - d. Measure the oil pressure at coolant temperature 80°C (176°F) or more.

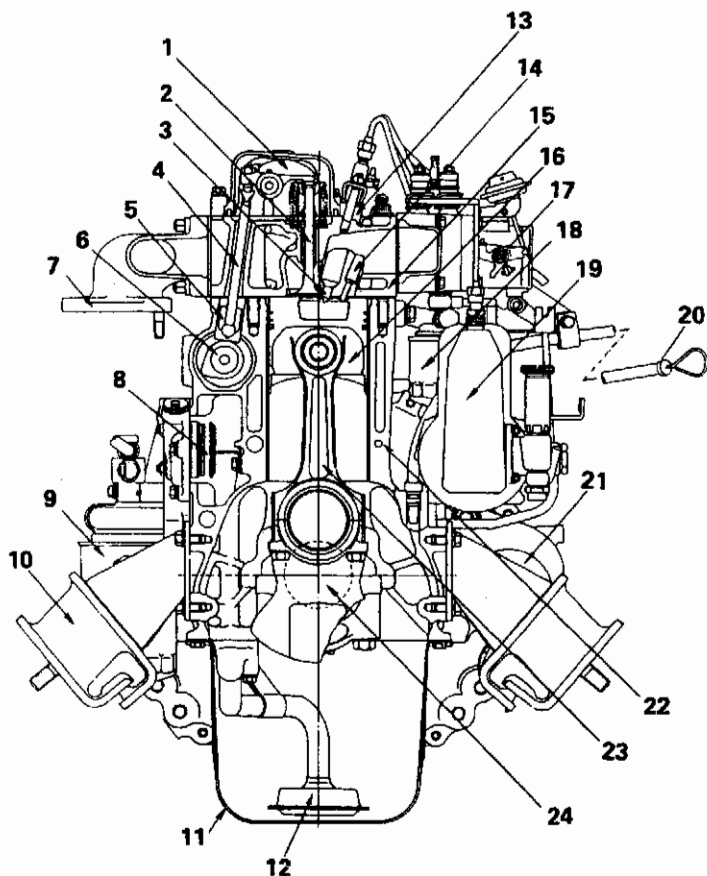
Standard oil pressure: 0.5–5.0 kg/cm² (7.11–71.10 lb/sq.in)

Service limit: Less than 0.5 kg/cm² (7.11 lb/sq.in)

3. **Other factors**
 - a. The blow-by gas increases.
 - b. The engine does not start easily.
 - c. Engine output decreases.
 - d. Fuel consumption increases.
 - e. Engine makes greater noise.
 - f. Excessive oil consumption.

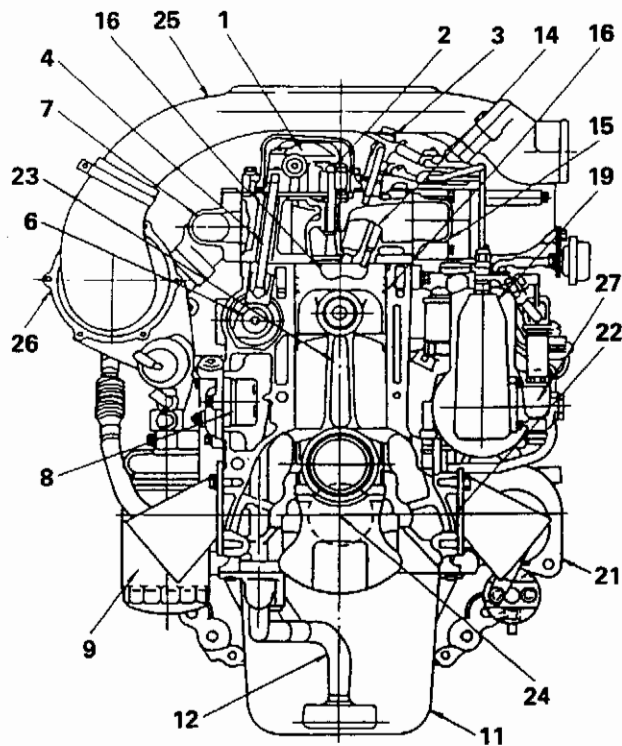
ENGINE MOVING PARTS

DESCRIPTION



SM3-898

Representative engine model W04D



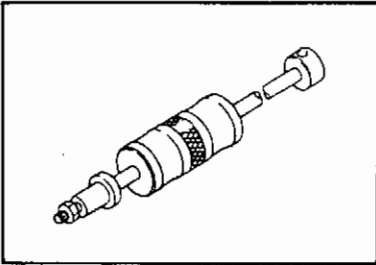
SM3-1438

Representative engine model W04C-T

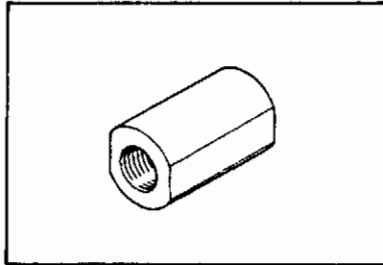
- | | | |
|---------------------|---------------------|----------------------|
| 1. Rocker arm | 10. Engine mounting | 19. Injection pump |
| 2. Valve | 11. Oil pan | 20. Oil level gauge |
| 3. Nozzle | 12. Oil strainer | 21. Starter |
| 4. Push rod | 13. Nozzle holder | 22. Cylinder block |
| 5. Tappet | 14. Grow plug | 23. Connecting rod |
| 6. Camshaft | 15. Cylinder head | 24. Crankshaft |
| 7. Exhaust manifold | 16. Piston | 25. Intake pipe, air |
| 8. Oil cooler | 17. Intake shutter | 26. Turbocharger |
| 9. Oil filter | 18. Fuel filter | 27. Feed pump |

SPECIAL TOOL

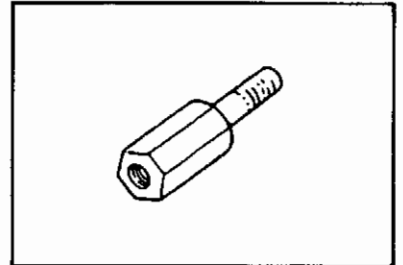
Prior to starting an engine overhaul, it is necessary to have the following.

SLIDING HAMMER

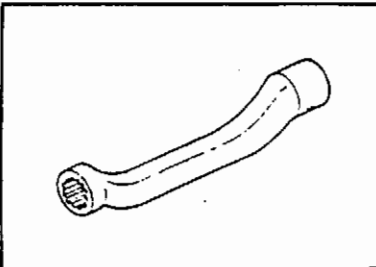
09420-1442

**ADAPTOR
(USED WITH 09420-1442)**

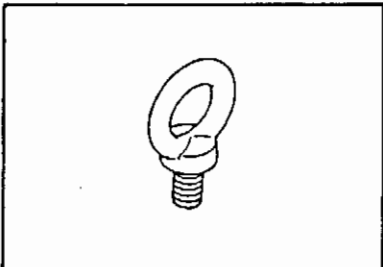
09462-1370 for model W04D

**ADAPTOR
(USED WITH 09420-1442)**

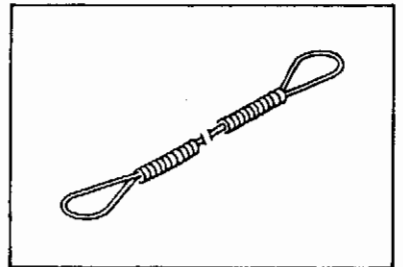
09462-1130 for model W04C-T

CYLINDER HEAD BOLT WRENCH

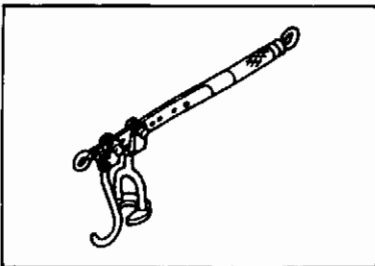
09411-1260

**EYE BOLT
(USED WITH 09470-1022)**

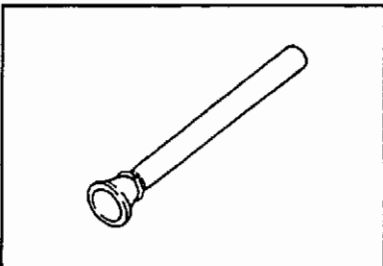
09433-1070

WIRE

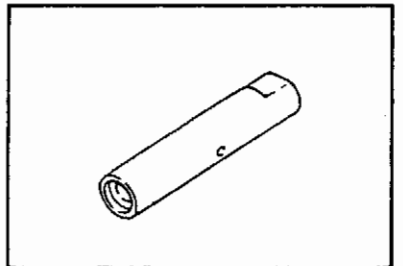
09491-1010

VALVE SPRING PRESS

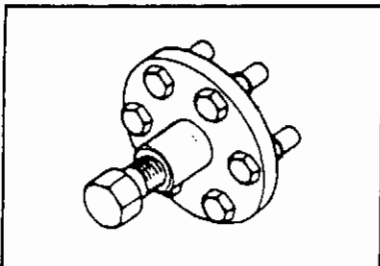
09470-1022

VALVE LAPPING TOOL

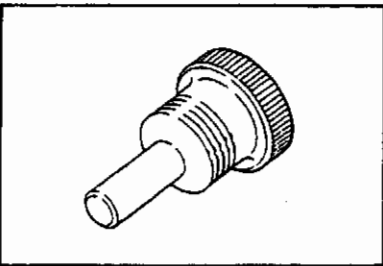
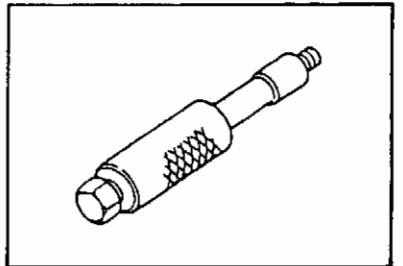
09431-1010

VALVE STEM SEAL PRESS

09472-1650

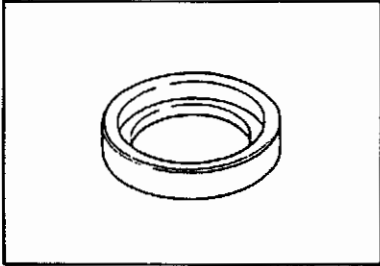
**CRANKSHAFT PULLEY
PULLER**

09420-1500

TIMER SETTING TOOL09512-2090 for model W04D
09512-2100 for model W04C-T**IDLER GEAR SHAFT PULLER**

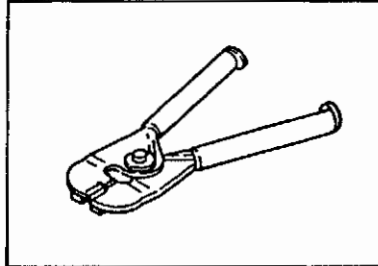
09420-1100

TIMING GEAR COVER OIL SEAL PRESS



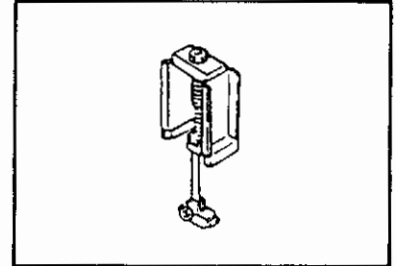
09482-1530

PISTON RING EXPANDER



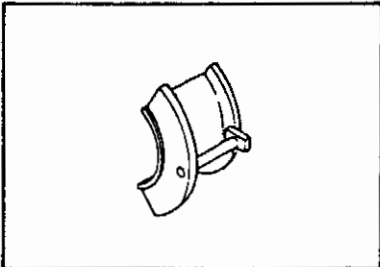
09442-1180

CYLINDER LINER PULLER



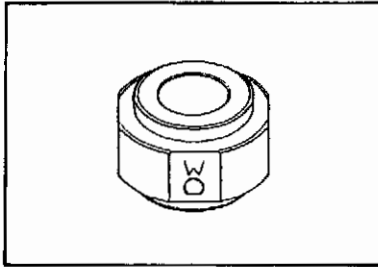
09420-1460

CYLINDER LINER GUIDE



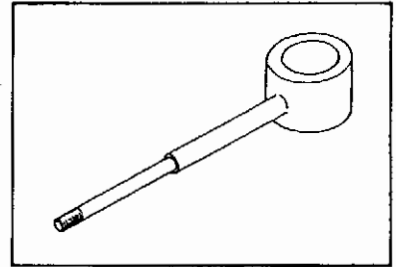
09480-1120

GUIDE



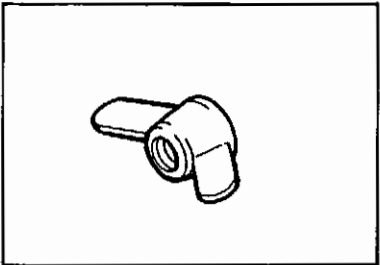
09481-1130

PRESS SUB-ASSEMBLY



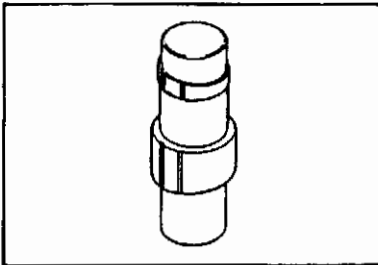
09402-1450

WING NUT



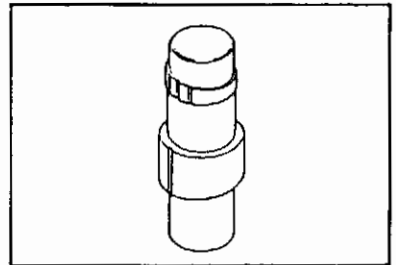
9233-10360

SPINDLE



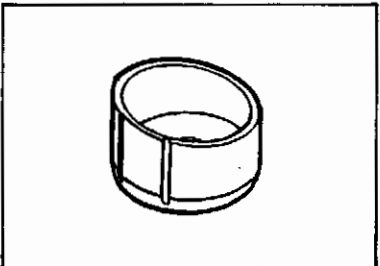
09402-1470 for model W04C-T

SPINDLE



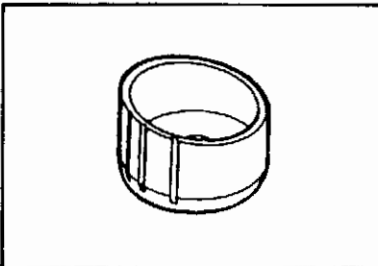
09402-1460 for model W04D

GUIDE



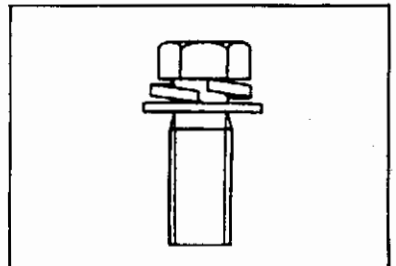
09481-1140 for model W04C-T

GUIDE



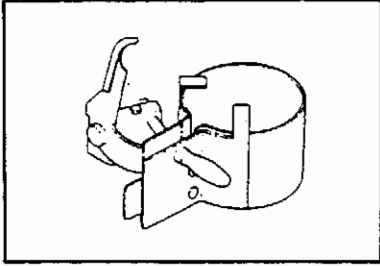
09481-1120 for model W04D

BOLT



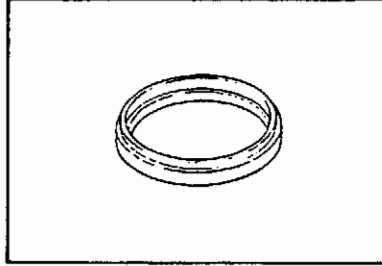
9191-08252

PISTON RING HOLDER



09441-1260

FLY WHEEL HOUSING OIL SEAL PRESS

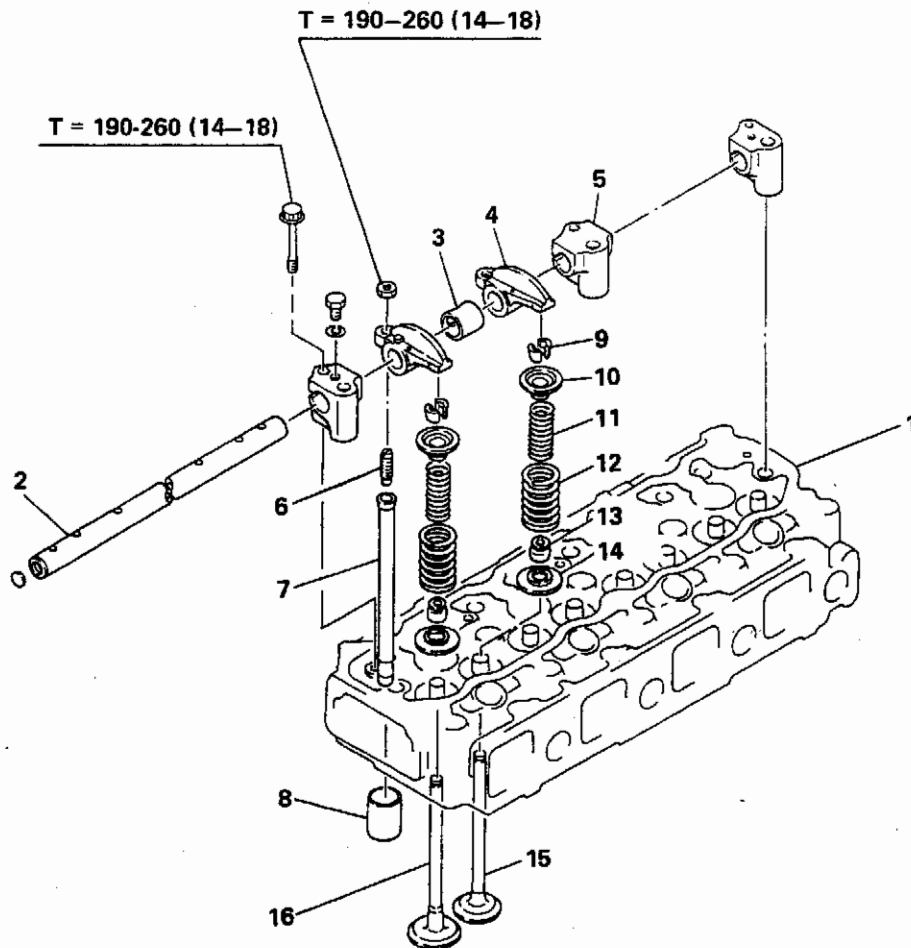


09482-1540

CYLINDER HEAD

OVERHAUL

ME11-040-00X02 (1310)

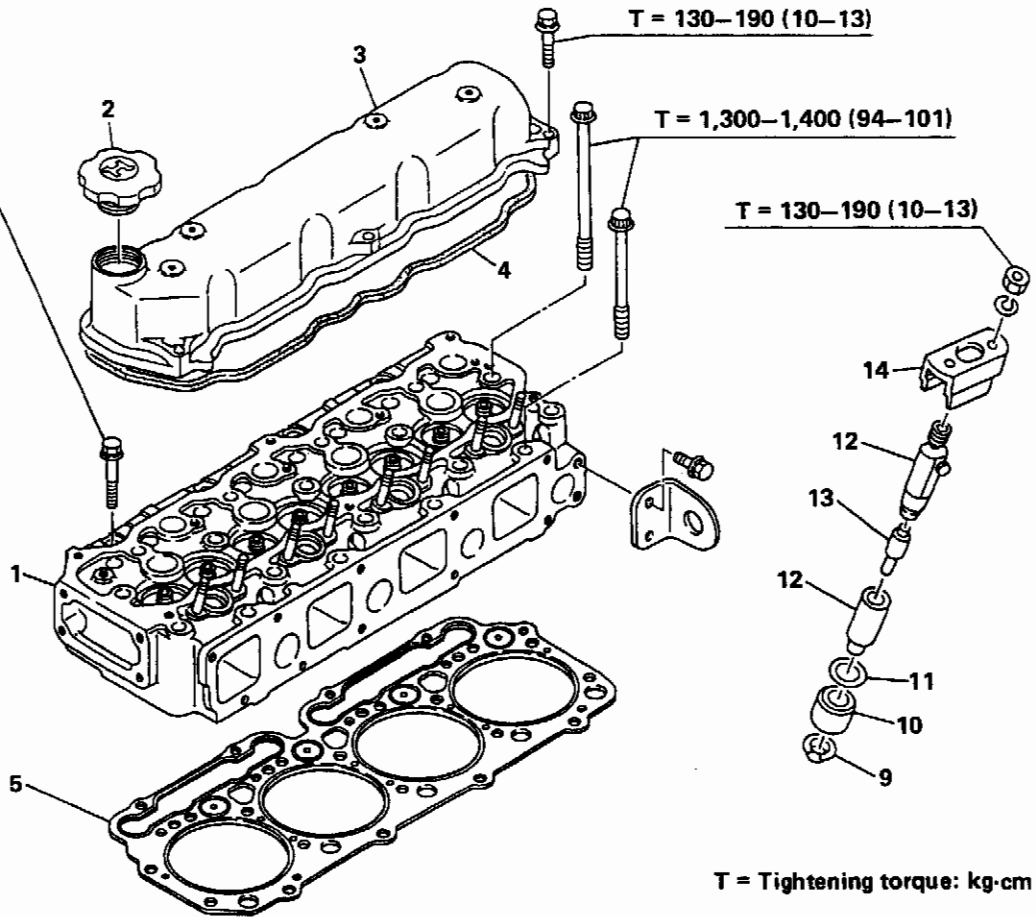


T = Tightening torque kg-cm (lb.ft)

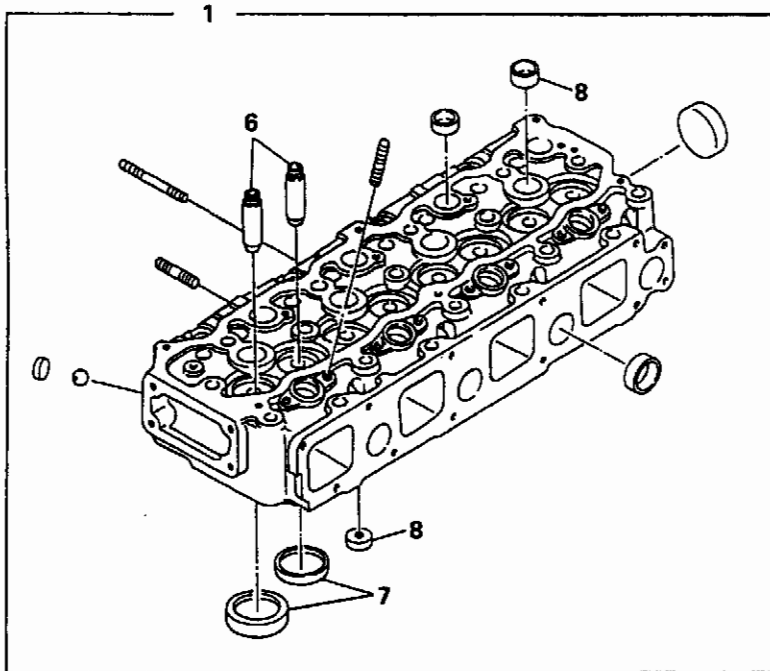
- | | | |
|------------------------------------|-----------------------------------|-----------------------------|
| 1. Cylinder head | 7. Push rod | 13. Valve stem oil seal |
| 2. Rocker arm shaft | 8. Tappet | 14. Valve spring lower seat |
| 3. Bushing | 9. Cotter key | 15. Exhaust valve |
| 4. Rocker arm | 10. Valve spring upper seat | 16. Intake valve |
| 5. Rocker arm support | 11. Inner valve spring (For W04D) | |
| 6. Valve clearance adjusting screw | 12. Outer valve spring | |

OVERHAUL

T = 450-500 (33-36)



T = Tightening torque: kg-cm (lb.ft)

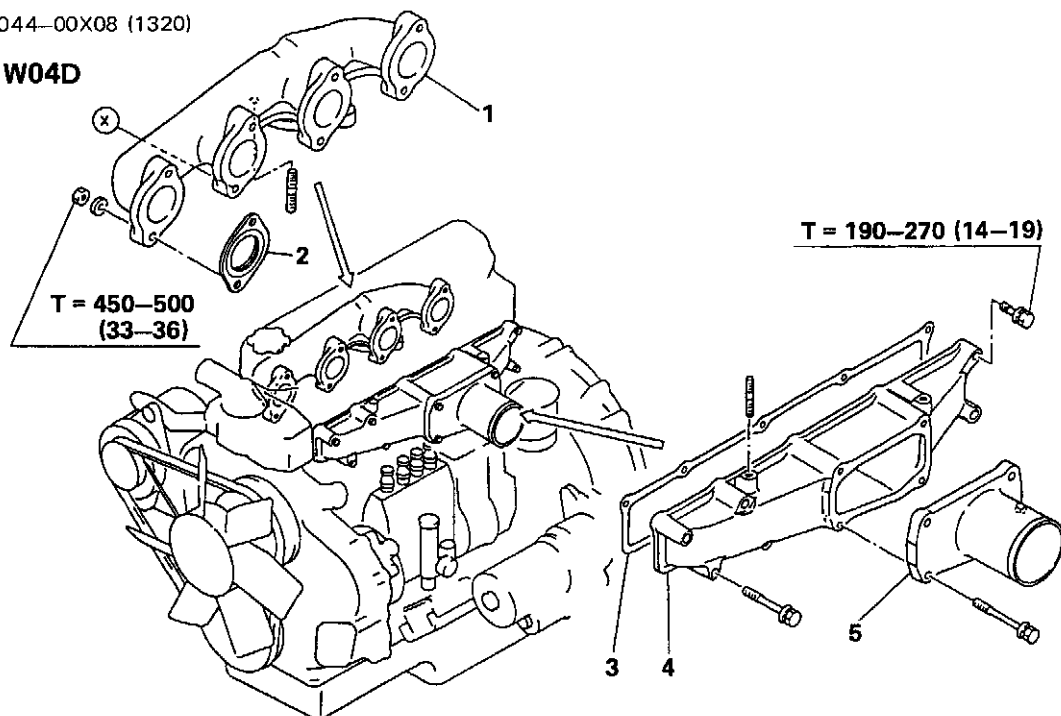


1. Cylinder head
2. Oil filler cap
3. Cylinder head cover
4. Cylinder head cover gasket
5. Cylinder head gasket
6. Valve guide
7. Valve seat
8. Expansion plug
9. Nozzle holder gasket
10. Packing ring
11. Shim
12. Nozzle holder
13. Nozzle
14. Nozzle holder adapter

OVERHAUL

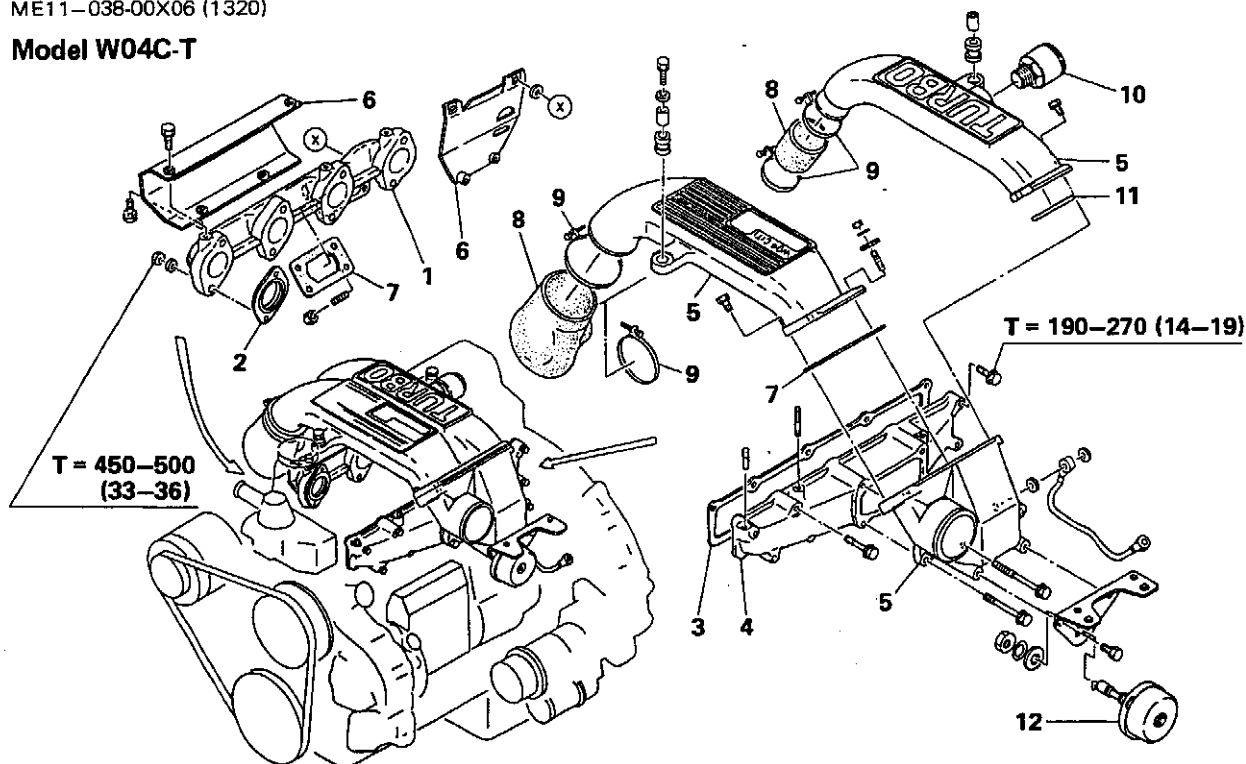
ME11-044-00X08 (1320)

Model W04D



ME11-038-00X06 (1320)

Model W04C-T

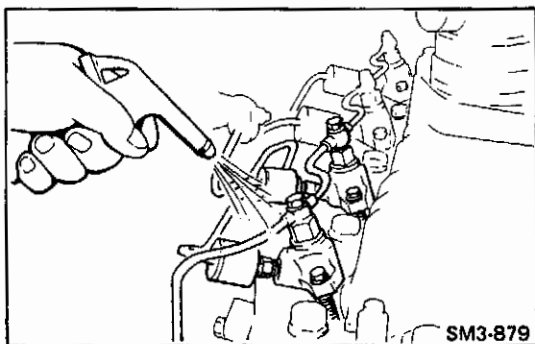


T = Tightening Torque: kg-cm (lb.ft)

- 1. Exhaust manifold
- 2. Exhaust manifold gasket
- 3. Intake manifold gasket
- 4. Intake manifold

- 5. Intake air pipe
- 6. Heat insulator
- 7. Gasket
- 8. Hose

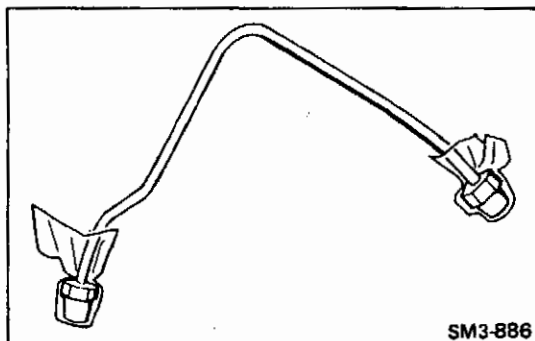
- 9. Clamp
- 10. Waste gate safety valve
- 11. O-ring
- 12. Idle up actuator (If so equipped)



IMPORTANT POINTS – DISASSEMBLY

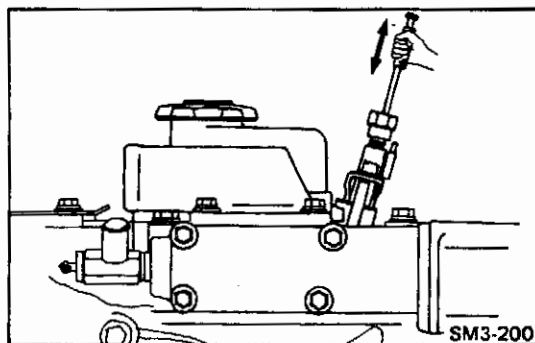
CLEAN OFF SURROUNDING AREA OF THE NOZZLES AND THE FUEL LINE CONNECTORS.

NOTE: If foreign matter is allowed to enter the combustion chamber, engine trouble may result.



REMOVE THE INJECTION PIPES.

NOTE: Cover open ends of the pipes to prevent entry of dirt.

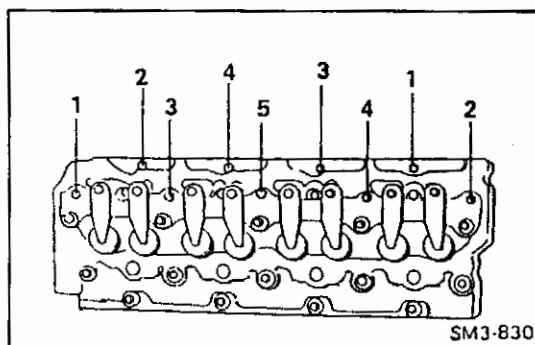


REMOVE THE NOZZLE ASSEMBLY.

Using a special tool, if the nozzle is difficult to remove by hand.

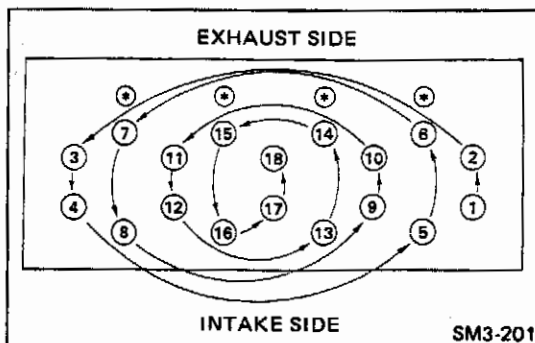
Special Tool: Sliding Hammer (09420-1442)
 Adapter (09462-1370) for model W04D
 (09462-1130) for model W04C-T

NOTE: ○ After removal of the nozzle holder, cover the nozzle holder with cloth. Also cover the cylinder head with a cloth to prevent dust from getting in.



REMOVE THE CYLINDER HEAD ADDITIONAL BOLTS AND ROCKER ARM SUPPORT BOLTS.

Loosen the cylinder head additional bolts and rocker arm support bolts in the numerical order as shown.

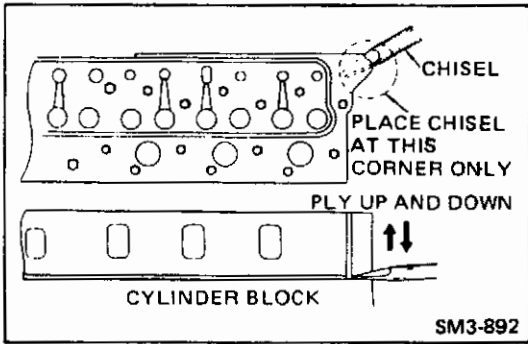


LOOSEN THE CYLINDER HEAD BOLTS AND REMOVE THEM.

Loosen the cylinder head bolts little by little in three stages and in the numerical order as shown.

Special Tool: Wrench (09411-1260)

* Mark position (Cylinder head additional bolts)

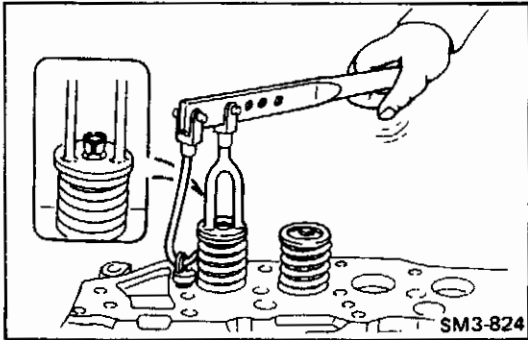


LIFT THE CYLINDER HEAD FROM THE DOWELS ON THE CYLINDER BLOCK AND PLACE IT ON WOODEN BLOCKS

1. If the cylinder head is difficult to lift off, pry with a chisel between the cylinder head and block.

NOTE: Do not damage the machined surface of the head or block when removing the cylinder head.

Special Tool: Eye Bolt (09433-1070)
Wire (09491-1010)

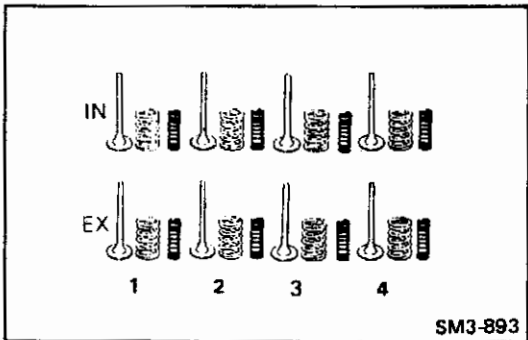


REMOVE THE VALVE SPRINGS.

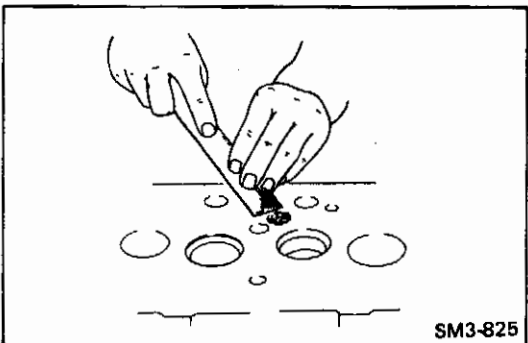
1. Remove the valve stem cotters, upper valve seats, and inner and outer valve springs from cylinder head.

Special Tool: Valve Spring Press (09470-1022)

2. Remove the intake and exhaust valves.



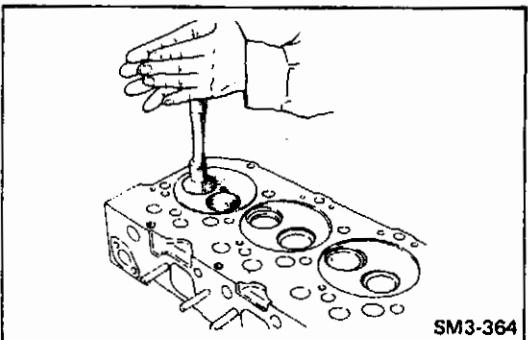
3. Tag valves to identify their cylinder numbers and to eliminate valve lapping.



IMPORTANT POINTS – ASSEMBLY

CLEAN THE CYLINDER HEAD THOROUGHLY WITH A SUITABLE SOLVENT.

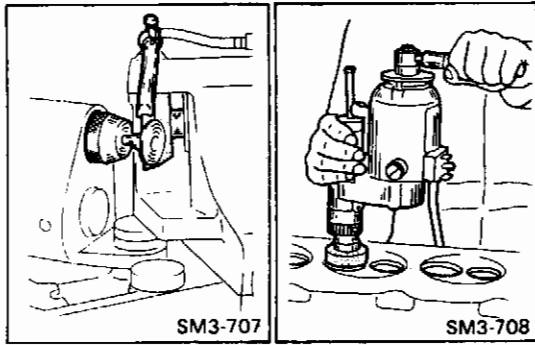
NOTE: Be careful not to damage the cylinder head surface.



IF NECESSARY, HAND-LAP THE VALVE AND VALVE SEAT.

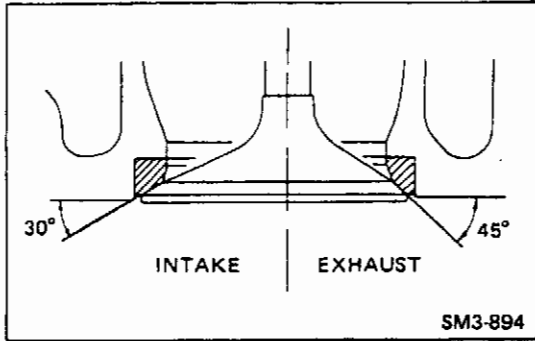
Lightly apply lapping compound to the valve face. Install the valve with a special tool, tap and rotate the valve against the seat.

Special Tool: Valve Lapping Tool (09431-1010)



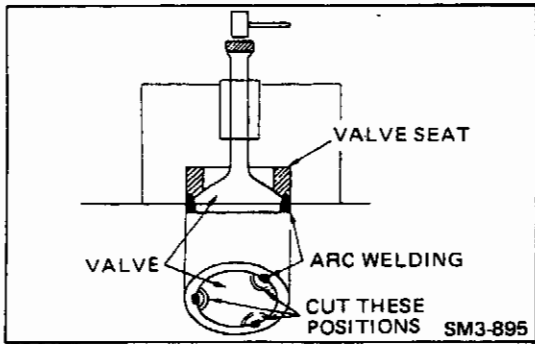
IF NECESSARY, GRIND THE VALVES AND VALVE SEATS.

- NOTE:**
- Grinding of valves and valve seats should only be performed when hand-lapping does not result in proper seating.
 - After grinding, always recheck the valve sink.



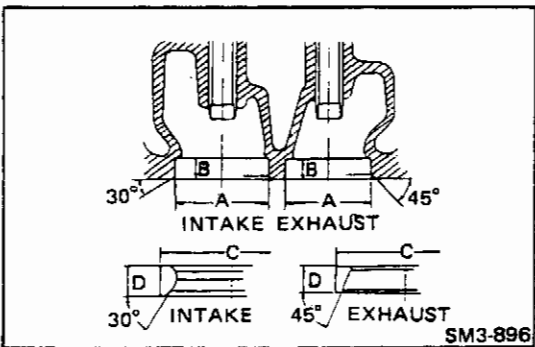
Standard:

- Valve Seat (Intake) : 30° – 30°30'
- Valve Face (Intake) : 29°30' – 30°
- Valve Seat (Exhaust) : 45° – 45°30'
- Valve Face (Exhaust) : 44°30' – 45°



IF NECESSARY, REPLACE THE VALVE SEAT.

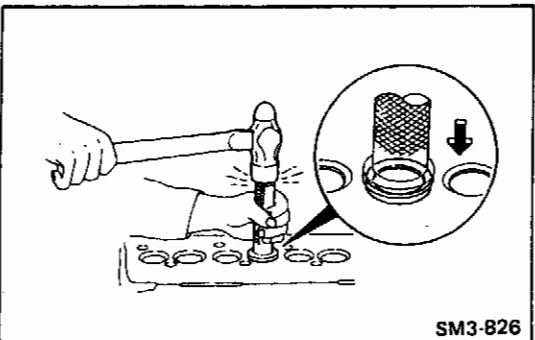
1. Cut the circumference of a valve head at three places with a grinder and install it into the seat as shown and weld the valve to the seat. Then drive the valve and the seat out with a hammer and a brass bar.

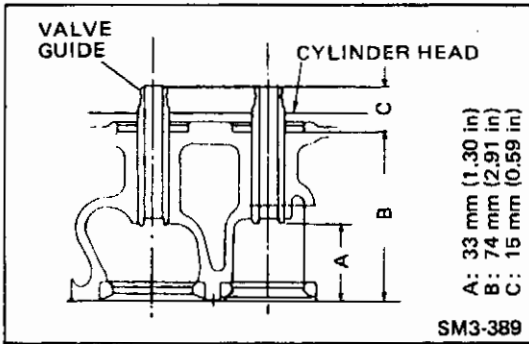


2. Valve seat section machining specifications. Unit: mm (in)

		Intake	Exhaust
Cylinder head dimension	A	46.500–46.516 (1.8308–1.8313)	41.000–41.016 (1.6142–1.6148)
	B	8.8–9.0 (0.3465–0.3543)	7.2–7.3 (0.2835–0.2874)
Valve seat dimension	C	46.585–46.600 (1.8341–1.8346)	41.130–41.145 (1.6193–1.6198)
	D	7.5–7.7 (0.2953–0.3031)	6.0–6.2 (0.2363–0.2440)

3. Valve seat installation
Heat the cylinder head to about 80° – 100°C (176 – 212°F) with hot water. On the other hand, cool the valve seat with dry ice or liquid freon for about 30 minutes. Hold the seat with pincers and place it into the heated cylinder head.

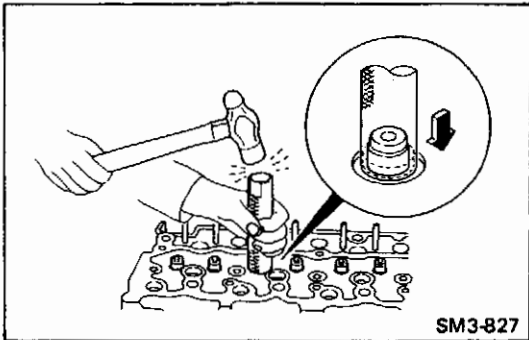




IF NECESSARY, REPLACE THE VALVE GUIDE.

1. Remove the valve stem seal.
2. Using a brass rod and hammer, drive out the valve guide.
3. Install the valve guide as shown.

NOTE: Apply engine oil lightly to the valve guide outer circumference before installing.

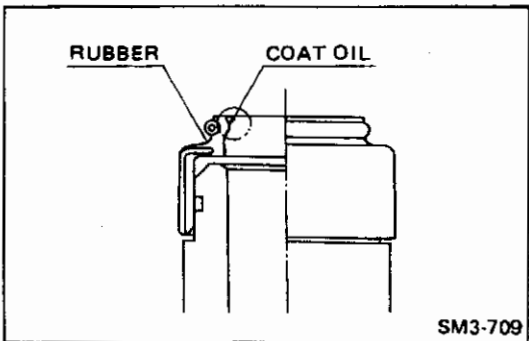


IF NECESSARY, REPLACE THE VALVE STEM SEAL.

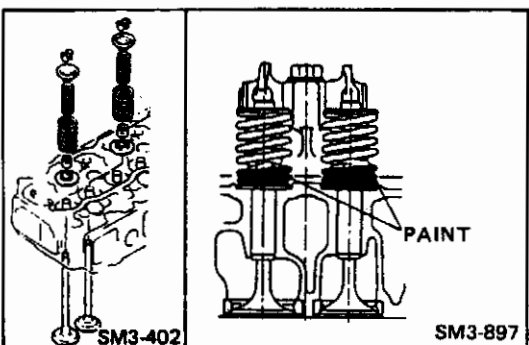
1. Remove the valve stem seal.
2. Install the valve stem seal.

First, install the lower spring seat (for stopper of special tool) and valve. Then apply engine oil to the lip of the stem seal and drive the special tool until it hits the lower spring seat.

Special Tool: Valve Stem Seal Press (09472-1650)



- NOTE:**
- After installing stem seal, make sure that check the rubber position for cracks or any other damage.
 - Do not use the special tool if its tip (surface contacting lower spring seat) is worn or deformed.



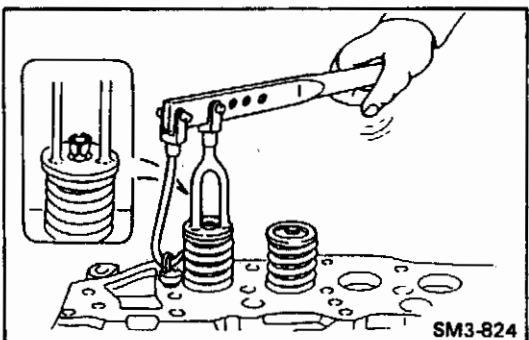
ASSEMBLE THE CYLINDER HEAD.

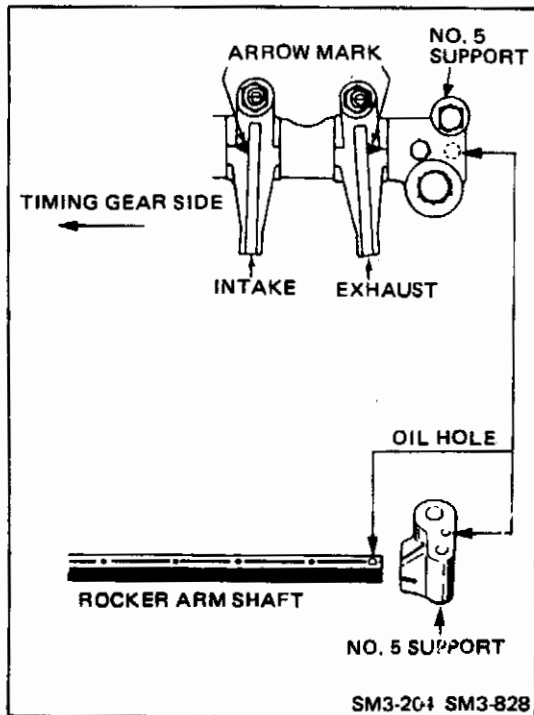
- NOTE:**
- Apply engine oil to contact surfaces of all parts.
 - Make sure that the valves are installed in the correct cylinders.
 - Install the valve springs with their painted side down, since they have variable pitches.

Press upper spring seats and install the valve stem keys securely in the upper spring seats.

Special Tool: Valve Spring Press (09470-1022)

- NOTE:**
- When pressing with the valve spring press, be careful not to damage the stem seals by contacting the upper seats.
 - Drive the valve stem lightly with a hammer to assure proper fit the valve stem key.





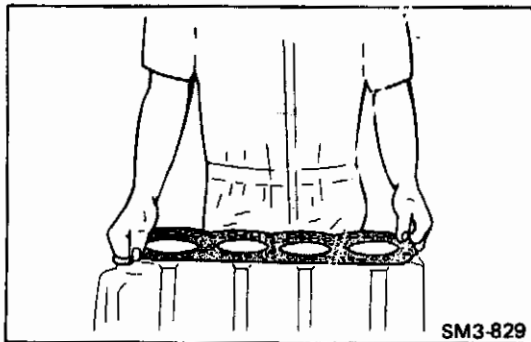
ASSEMBLE THE ROCKER ARM.

Lubricate the rocker arm shaft and bushing.

NOTE: Confirm that oil hole of rocker arm assembly No. 5 support aligns with shaft oil hole. Improper installation will result in burning of the entire valve assembly.

INSTALL THE TAPPETS IN THE CYLINDER BLOCK IN CORRECT ORDER.

NOTE: Apply engine oil to the tappet faces and tappet guide when installing them in the cylinder block.

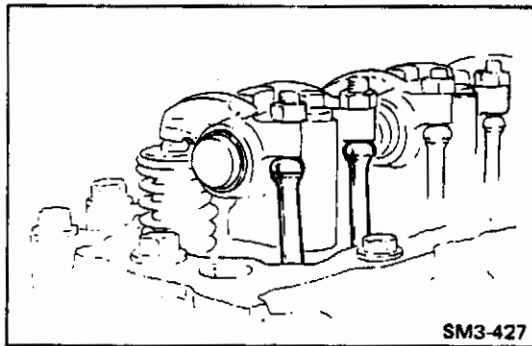


INSTALL THE CYLINDER HEAD AND ROCKER ARM ASSEMBLY.

1. Install the cylinder head gasket.

NOTE: Always use new cylinder head gasket after cleaning the surfaces of the cylinder head, cylinder block and head gasket free of all dirt, water and grease.

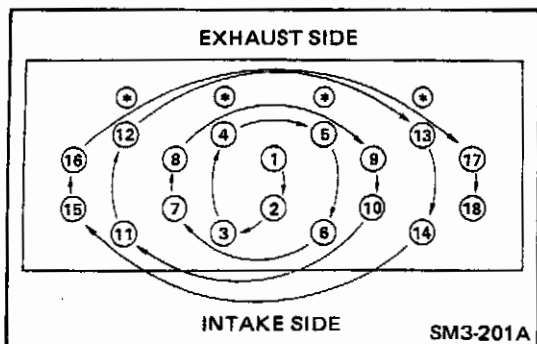
2. Install the cylinder head over the dowels on the cylinder block.



3. Insert the push rods in correct order, after applying engine oil to both ends.

4. Mount the rocker arm assembly on the cylinder head, make sure that the push rods interlock with the adjusting screws.

NOTE: Always loosen the lock nut and raise the adjusting screws fully to the top.



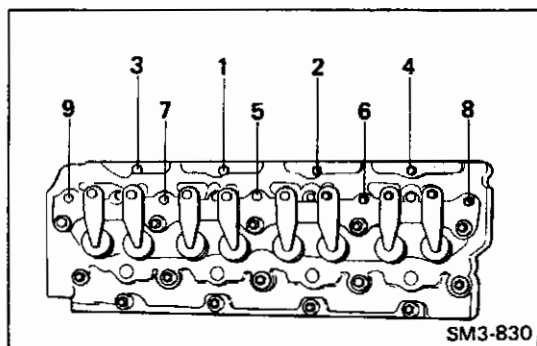
5. Tighten the cylinder head bolts little by little in three stages and in the numerical order as shown.

Tighten the bolts ϕ 12mm to the specified torque.

NOTE: Apply engine oil to the bolt threads and under the bolt head.

* Mark bolts (cylinder head additional bolt): ϕ 10 mm (0.39 in)
 No. 1 – No. 18 Bolts (Cylinder head bolt): ϕ 12 mm (0.47 in)

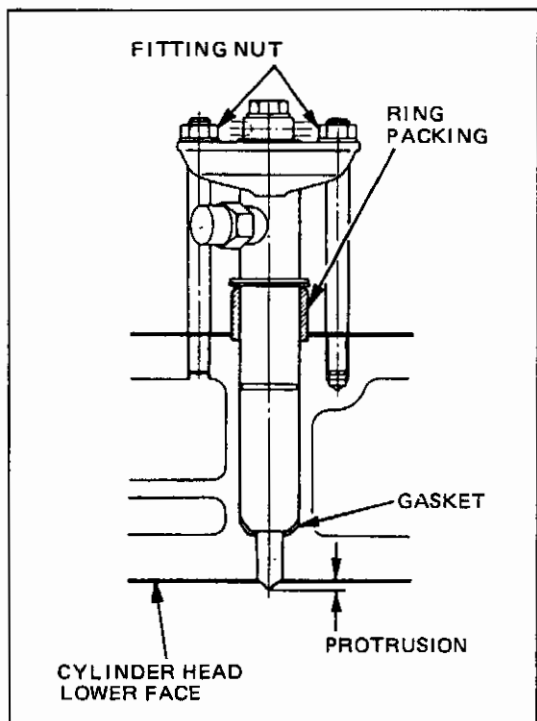
Special Tool: Wrench (09411-1260)



6. Tighten the cylinder head additional bolts and rocker arm support bolts little by little in three stages and in the numerical order as shown.
Tighten the bolts to the specified torque.

7. Retighten the cylinder head bolts.

NOTE: Refer to section ENGINE TUNE-UP.



INSTALL THE INJECTION NOZZLE HOLDER.

1. Install a new gasket in the nozzle hole.
2. Insert the nozzle and holder assemblies into the nozzle sleeves with their inlet connectors toward the injection pump.

NOTE: ○ Do not let dust fall into the nozzle holder. Fits carefully over the top end of the sleeve.

○ Do not damage the ring packing when installing the nozzle holder. If damaged, the entry of oil, and dust makes removing the nozzle difficult.

3. Tighten the nozzle holder fitting nuts gradually and alternately.

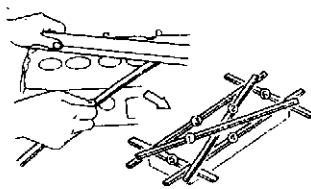
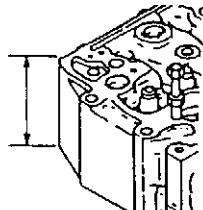
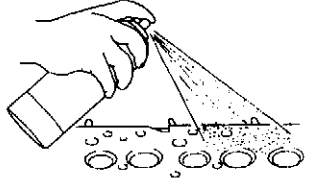
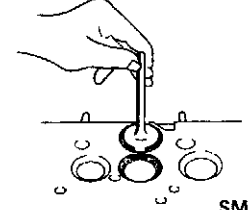
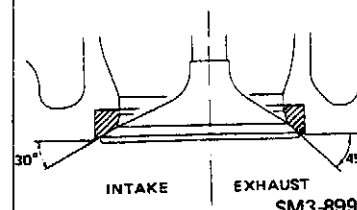
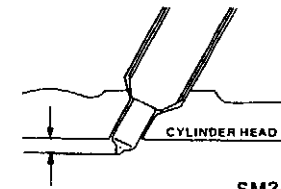
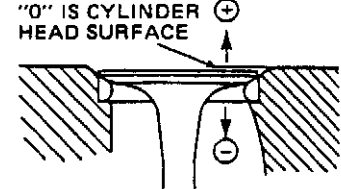
Tightening Torque: 130–190 kg-cm (10–13 lb.ft)

NOTE: Insufficient tightening torque causes gas leaks and could result in nozzle seizure.

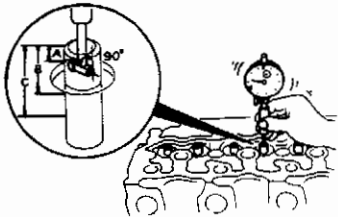
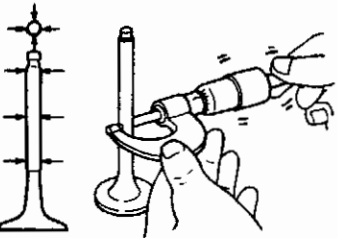
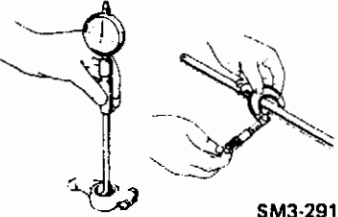
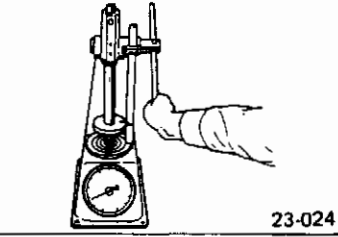
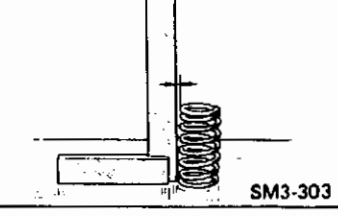
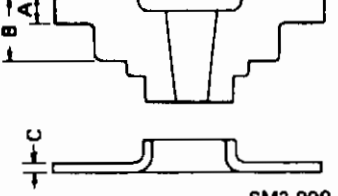
4. Inspect the protrusion of the nozzle.
Refer to INSPECTION AND REPAIR.

INSPECTION AND REPAIR

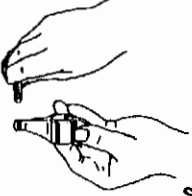
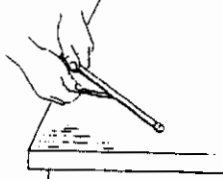
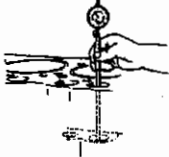
Unit: mm (in)

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Cylinder Head Flatness		Less than 0.05 (0.0019)	0.1 (0.0039)	Regrind or replace	 SM3-831
Cylinder Head Height		87.0 (3.425)	86.8 (3.417)	Replace	 SM3-887
Cylinder Head Cracks and Damage * Using a Dye Penetrant		-	-	Replace, if necessary	 SM3-832
Valve Seating Condition * Using Red Lead Marking Compound		There should be good contact around entire circumference of valve head.	-	Hand-lap with lapping compound	 SM3-833
Valve Seat Angle	Intake	30°-30°30'	-	Regrind or replace valve and/or valve seat	 SM3-899
	Exhaust	45°-45°30'			
Valve Angle	Intake	29°30'-30°			
	Exhaust	44°30'-45°			
Nozzle Protrusion from Cylinder Head Surface		2.75-3.25 (0.1083-0.1279)	-	Replace nozzle gasket	 SM3-391
Intake Valve Sink	W04D	-0.15 - -0.45 (-0.0059 - -0.0177)	-0.55 (-0.0216)	Replace valve and/or valve seat	 SM3-236
	W04C-T	0.05 - 0.35 (0.0019-0.0137)	-0.05 (-0.0019)		
Exhaust Valve Sink		-0.47 - -0.77 (-0.0185 - -0.0303)	-0.87 (-0.0342)		

Unit: mm (in)

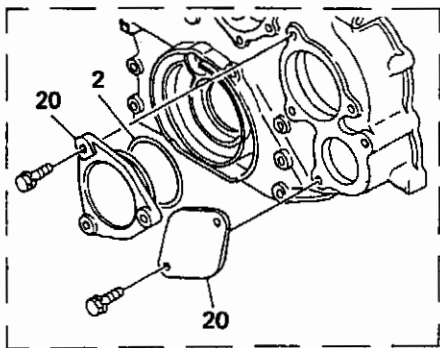
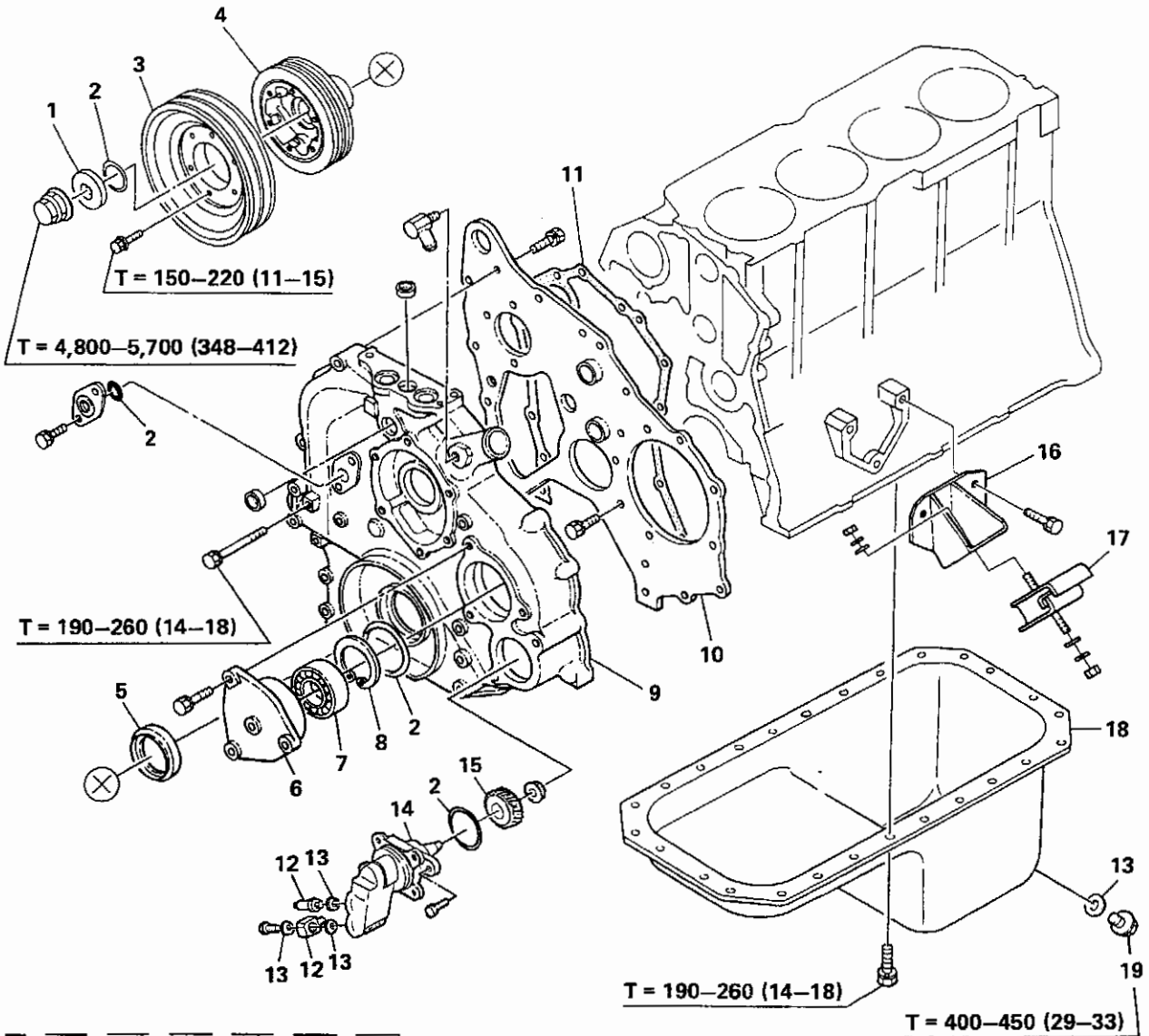
Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Intake Valve Stem Diameter	8.95—8.97 (0.3524—0.3531)	8.90 (0.3903)	Replace valve guide and/or valve	 <p>A: 5 (0.197) SM3-834 B: 25 (0.984) C: 45 (1.771)</p>
Exhaust Valve Stem Diameter	8.93—8.95 (0.3516—0.3524)	8.80 (0.3464)		
Intake and Exhaust Valve Guide Diameter	9.000—9.015 (0.3544—0.3549)	A & B: 9.05 (0.3562) C: 9.10 (0.3582)		
Clearance between Valve Stem and Valve Guide (Intake)	0.035—0.068 (0.0004—0.0026)	A & B: 0.10 (0.0040) C: 0.18 (0.0071)		
Clearance between Valve Stem and Valve Guide (Exhaust)	0.050—0.083 (0.0020—0.0032)	A & B: 0.12 (0.0047) C: 0.2 (0.0078)	 <p>SM3-835</p>	
Rocker Arm Shaft Diameter	18.97—18.98 (0.7469—0.7472)	18.95 (0.7461)	Replace rocker arm bushing and/or shaft	 <p>SM3-291</p>
Clearance between Rocker Arm Shaft and Bushing	0.036—0.079 (0.0015—0.0031)	0.1 (0.0039)		
Inner Valve Spring Setting Load	8.8 kg (19.4 lb) at 43.0 mm (1.69 in)	8.0 kg (17.6 lb)	Replace	 <p>23-024</p>
Outer Valve Spring Setting Load	27.4 kg (54.5 lb) at 45.5 mm (1.79 in)	25.5 kg (56.2 lb)		
Valve Spring Straightness (Inner and Outer)	—	2.0 (0.0787)	Replace	 <p>SM3-303</p>
Valve Spring Seat for Wear	A: 2.5 (0.0984)	—	Replace	 <p>SM3-909</p>
	B: 5.0 (0.1969)			
	C: 1.0 (0.0394)			

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Valve Stem Tip Surface for Wear	-	-	Resurface or replace	Visual Check  SM3-837
Valve Stem Contact Surface of Rocker Arm for Wear				
Push Rod Bend	-	0.3 (0.0118)	Replace	 SM3-292
Tappet Diameter	26.95–26.97 (1.0611–1.0618)	-	Replace tappet	 SM3-420
Tappet Guide Inside Diameter	27.00–27.02 (1.0630–1.0637)			
Clearance between Tappet and Tappet Guide	0.025–0.071 (0.0010–0.0029)	0.1 (0.0039)		
Tappet for Wear	Should not be worn unevenly.	-	Replace, if necessary	Visual Check

TIMING GEAR, CAMSHAFT AND OIL PAN

OVERHAUL



WITHOUT POWER STEERING OIL PUMP

SM3-2031

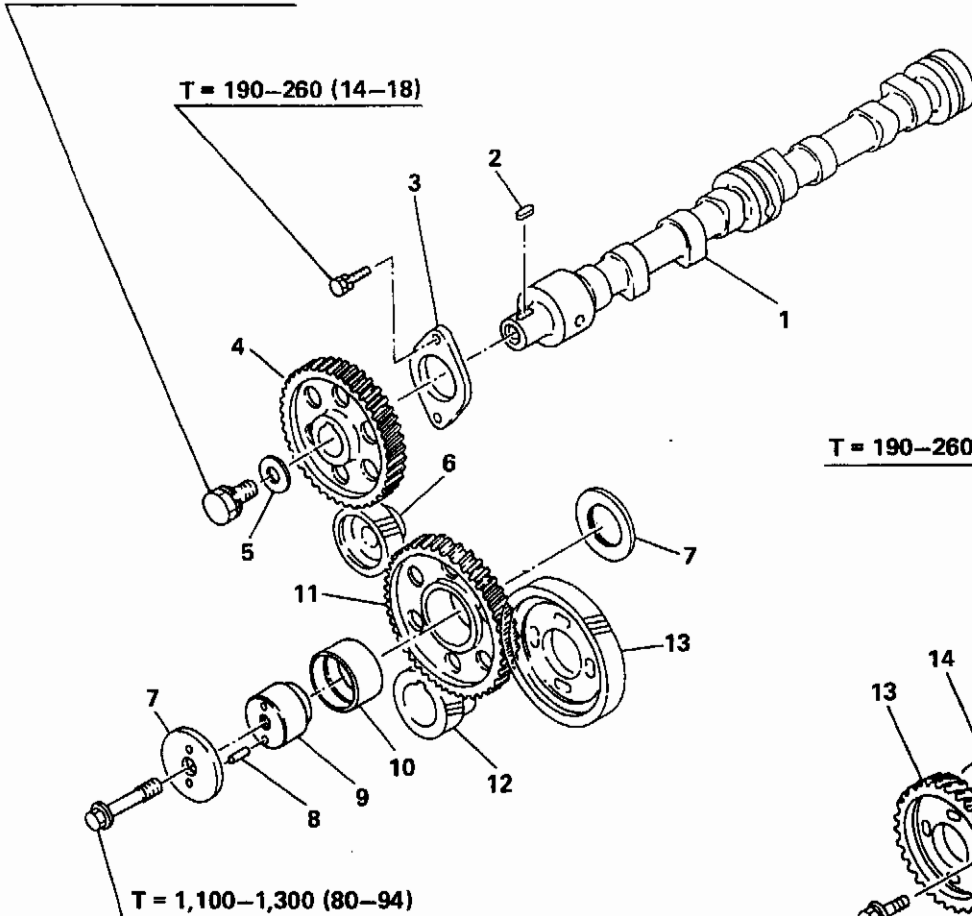
T = Tightening Torque: kg-cm (lb.ft)

- | | |
|--|---|
| 1. Washer | 11. Gasket |
| 2. O-ring | 12. Connector |
| 3. Crankshaft pulley
(If so equipped) | 13. Soft washer |
| 4. Crankshaft pulley | 14. Power steering oil pump |
| 5. Oil seal | 15. Power steering oil pump
drive gear |
| 6. Bearing holder | 16. Engine mounting bracket |
| 7. Ball bearing | 17. Engine mounting |
| 8. Retainer ring | 18. Oil pan |
| 9. Timing gear cover | 19. Drain plug |
| 10. Timing gear plate | 20. Plate |

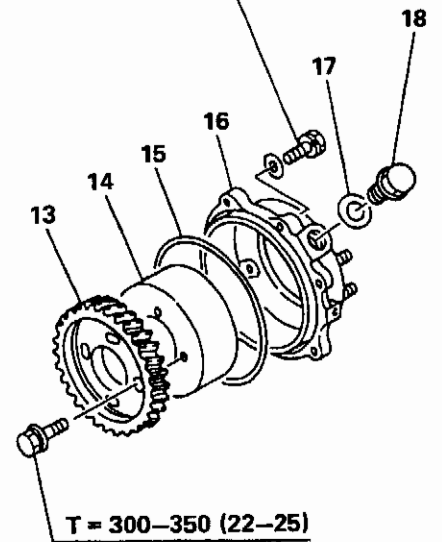
OVERHAUL

T = 1,100-1,300 (80-94)

T = 190-260 (14-18)



T = 190-260 (14-18)

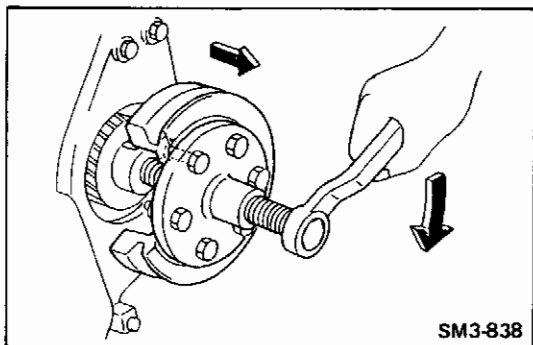


T = Tightening torque: kg-cm (lb.ft)

- 1. Camshaft
- 2. Key
- 3. Thrust bearing
- 4. Camshaft gear
- 5. Thrust washer
- 6. Oil pump drive gear

- 7. Idler gear thrust plate
- 8. Straight pin
- 9. Idler gear shaft
- 10. Bearing
- 11. Idler gear
- 12. Crankshaft gear

- 13. Injection pump drive gear
- 14. Coupling flange
- 15. O-ring
- 16. Timer cover
- 17. Soft washer
- 18. Plug

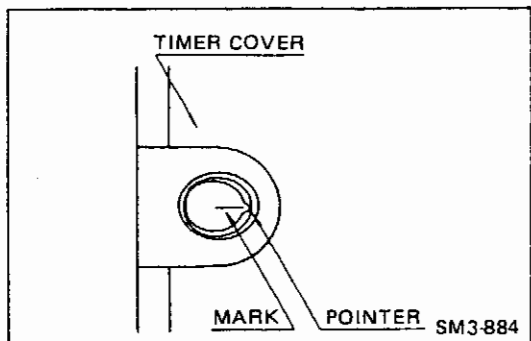


IMPORTANT POINTS – DISASSEMBLY

REMOVE THE CRANKSHAFT PULLY.

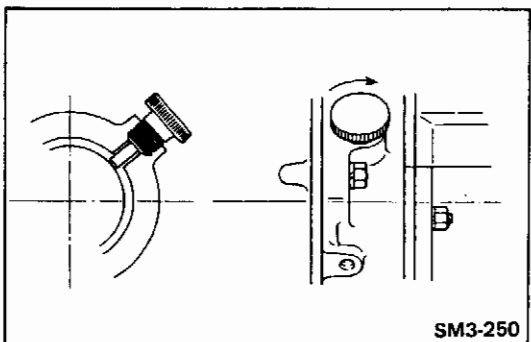
1. Remove the nut and spacer.
2. Using a special tool, remove the pulley.

Special Tool: Crankshaft pulley Puller (09420-1500)



DISMOUNT THE INJECTION PUMP ASSEMBLY.

1. Remove the inspection hole dust cover of the timer.
2. Turn the crankshaft clockwise viewing from the timing gear cover to align the injection timing mark.

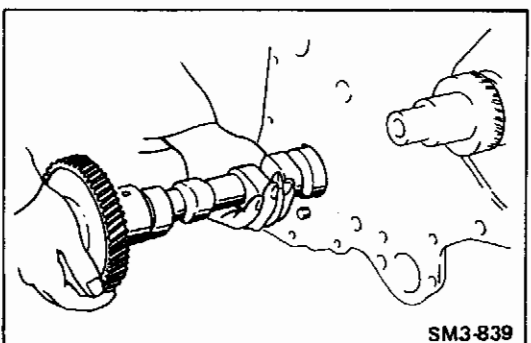


3. Lock the automatic timer with a special tool.

**Special Tool: Timer Setting Tool (09512-2090) for W04D
(09512-2100) for W04C-T**

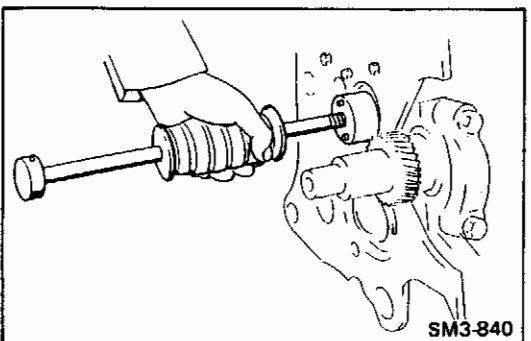
NOTE: Do not loosen the injection pump drive gear fitting bolts.

4. Remove the injection pump assembly.



REMOVE THE CAMSHAFT WITH GEAR.

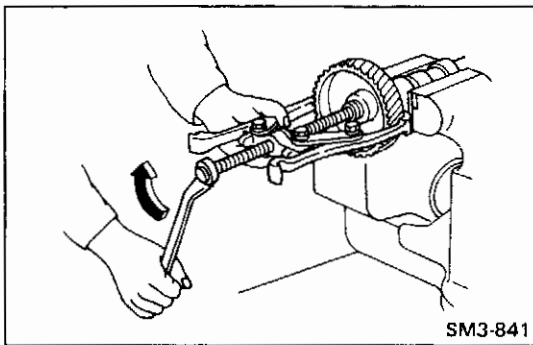
NOTE: Pull out the camshaft, slowly turning it so as not damage the bearings.



REMOVE THE IDLER GEAR SHAFT.

Using a special tool, remove the idler gear shaft.

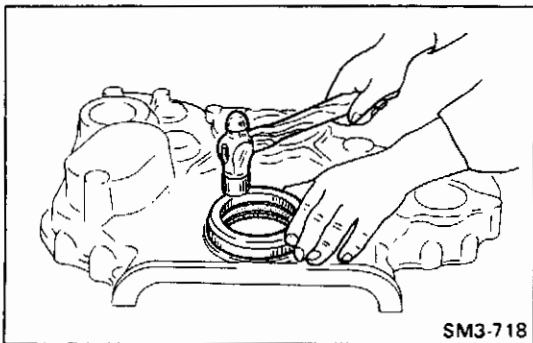
Special Tool: Sliding Hammer (09420-1100)



SM3-841

IF NECESSARY, REMOVE THE CAMSHAFT GEAR.

1. Hold the camshaft with a vice through wooden plates.
2. Remove the bolt and plain washer, then using a gear puller, remove the gear.

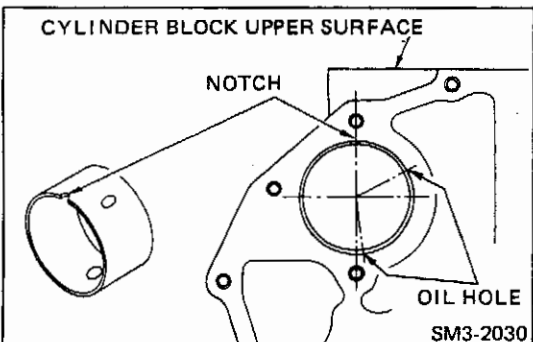


SM3-718

IMPORTANT POINTS – ASSEMBLY**IF NECESSARY, REPLACE THE TIMING GEAR CASE COVER OIL SEAL.**

1. Using a screwdriver, remove the oil seal.
2. Using a special tool, install the new oil seal.

Special Tool: Press (09482-1530)

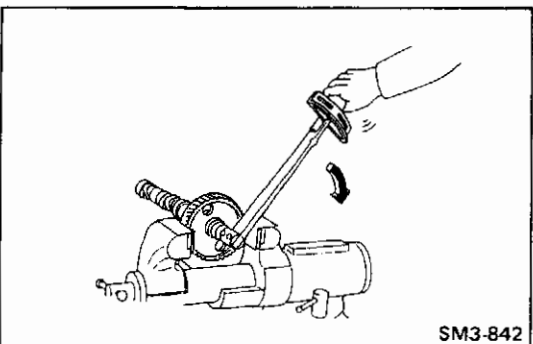


SM3-2030

IF NECESSARY, REPLACE THE CAMSHAFT BEARING.

1. Remove the old bearing.
2. Set the notch of bearing right above and install the new bearing.

NOTE: When install the No.3 bearing (with oil holes), make sure that the oil holes of the bearing and oil path in the cylinder block are aligned.



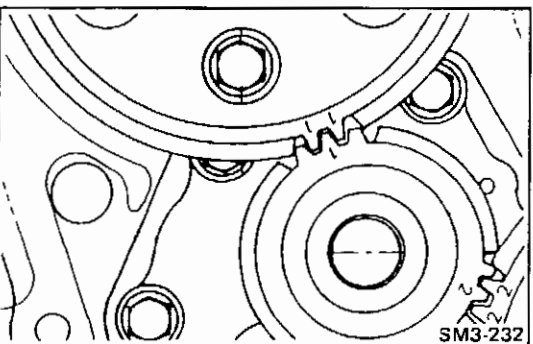
SM3-842

ASSEMBLE THE CAMSHAFT GEAR AND SHAFT.

Install the camshaft gear with thrust bearing.

NOTE: When installing the gear to the camshaft:

- Heat the gear in hot water [Approx. 100°C (212°F)], then install the gear to the camshaft by using a press.
- When tightening the bolt, apply engine oil to the threads and plate surface of the bolt.

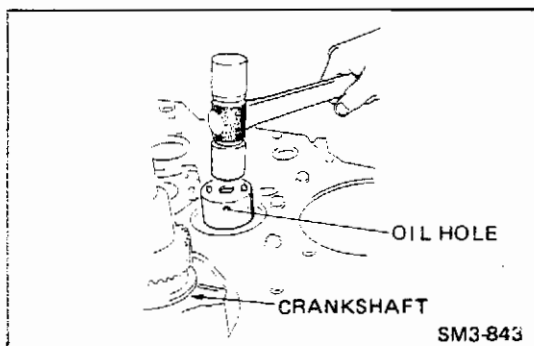


SM3-232

INSTALL THE CAMSHAFT.

Lubricate all journals of the camshaft and insert the camshaft assembly into the cylinder block.

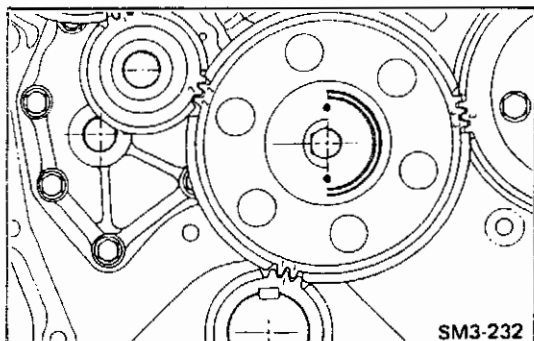
- NOTE:**
- Insert the camshaft, slowly turning while inserting so that the bearing will not be damaged.
 - When installing the camshaft, be sure that the match marks of the oil pump drive gear and camshaft gear are aligned correctly.



INSTALL THE IDLER GEAR SHAFT.

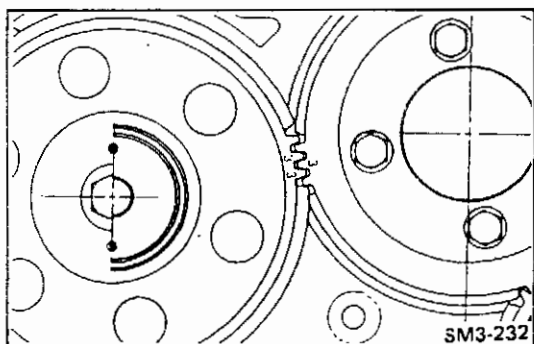
Install the idler gear shaft with thrust plate using a plastic hammer.

NOTE: Be sure that the oil hole is downward, if installed the wrong way, damage to the idler gear shaft and bushing can result.



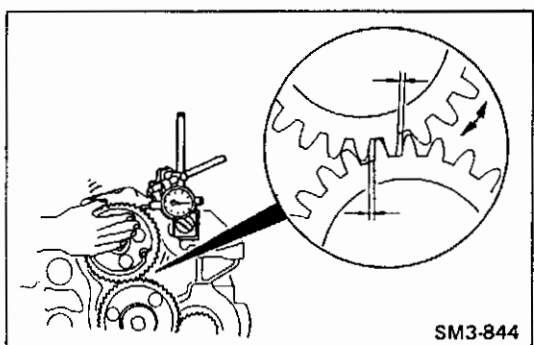
INSTALL THE IDLER GEAR.

NOTE: When installing the idler gear, be sure that the matching marks of the crankshaft gear, oil pump drive gear and idler gear are aligned correctly.



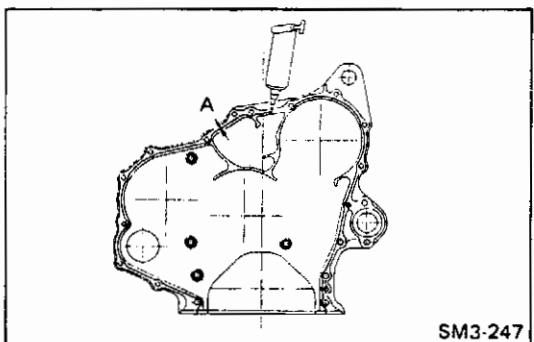
INSTALL THE INJECTION PUMP TEMPORARILY.

NOTE: When installing the injection pump, be sure that the match marks of the idler gear and injection pump drive gear are aligned correctly.



MEASURE THE GEAR BACKLASH.

Measure the backlash of each gear using a dial indicator.
Replace the gear if necessary.
Refer to INSPECTION AND REPAIR.

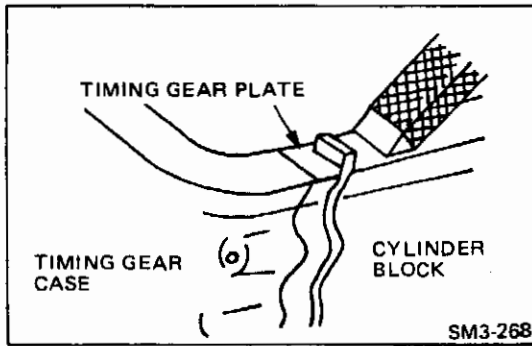


INSTALL THE TIMING GEAR CASE.

1. Clean the faces.
2. Apply the liquid gasket as shown and install the timing gear cover within 20 minutes.

NOTE: If leaving it more than 20 minutes, clean the liquid gasket completely and reapply the liquid gasket.

Coating Width (A): 1.5 – 2.5 mm (0.06 – 0.10 in)



INSTALL THE OIL STRAINER.

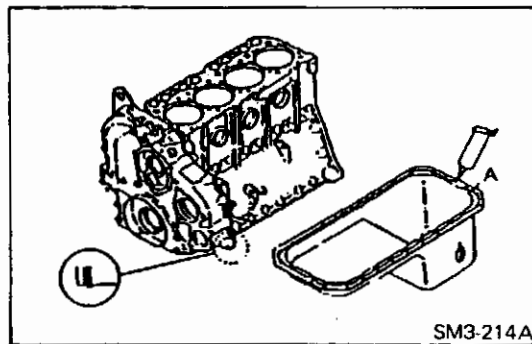
Refer to "OIL PUMP AND OIL STRAINER" in SECTION LUBRICATING SYSTEM.

INSTALL THE OIL PAN.

1. Cut the protrusion of the timing gear plate gasket from the oil pan mounting surface.
2. Clean the faces.
3. Apply the liquid gasket as shown and install the oil pan within 20 minutes.

NOTE: If leaving it more than 20 minutes, clean the liquid gasket completely and reapply the liquid gasket.

Coating Width (A): 3 – 4 mm (0.12 – 0.15 in)



TIGHTEN THE CRANKSHAFT PULLY.

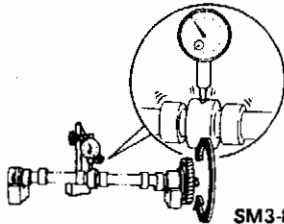
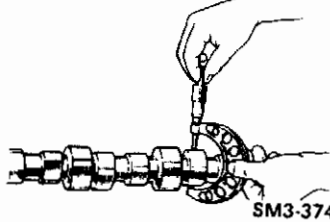
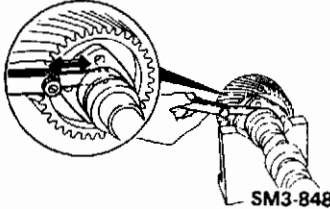
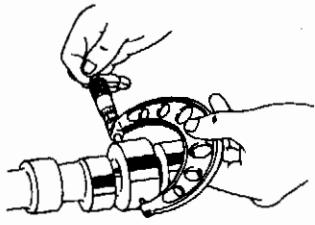
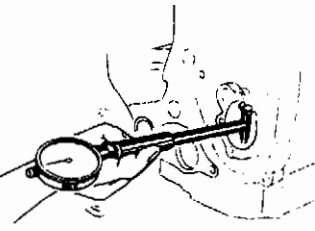
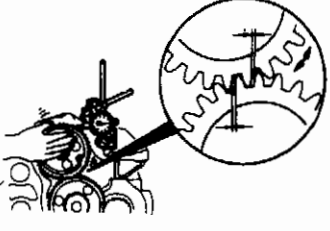
NOTE: Apply engine oil to the nut threads.

INSPECTION AND REPAIR

Unit: mm (in)

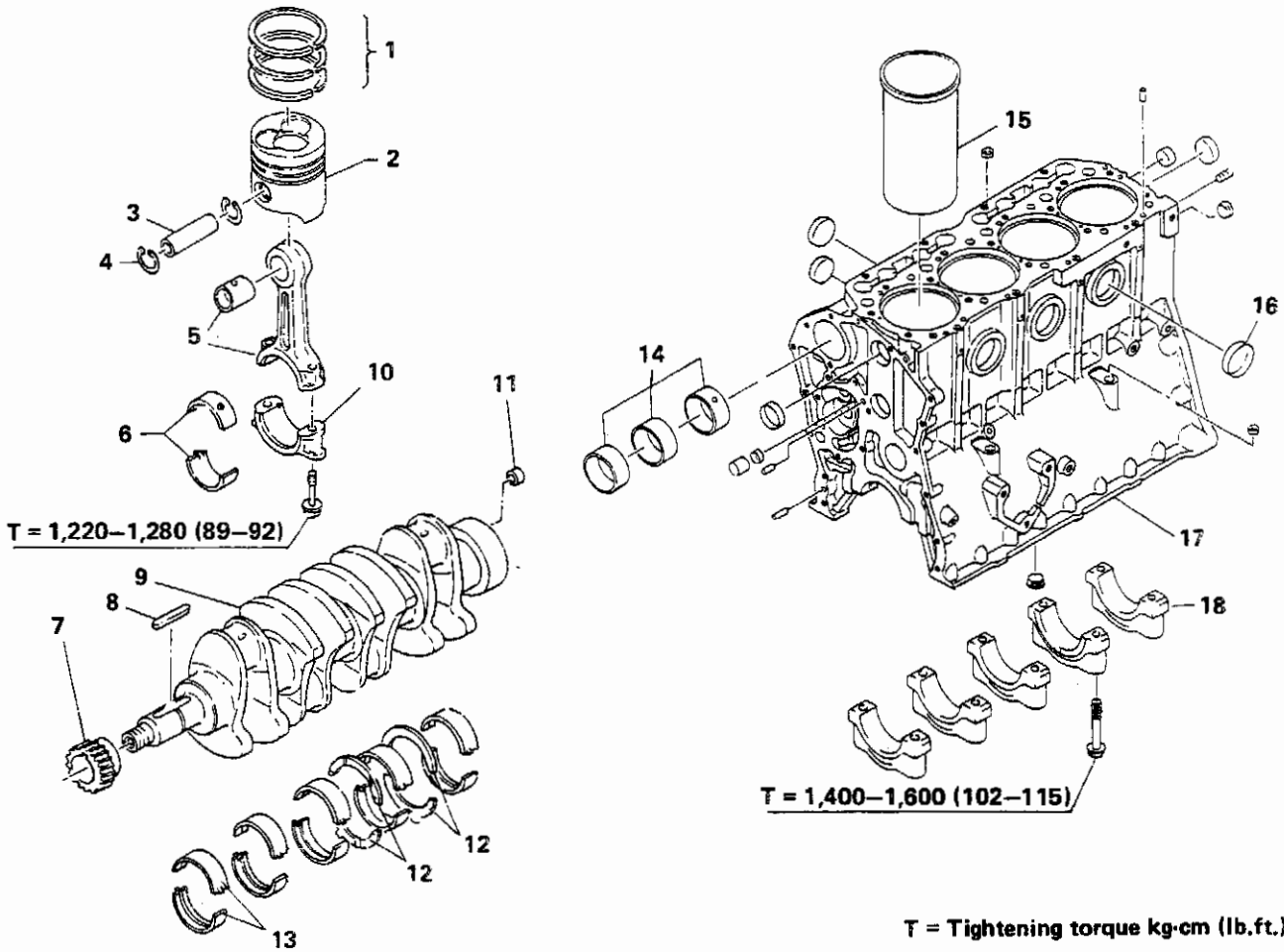
Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Gear Teeth for Pitting or Wear	—	—	Replace, if necessary	Visual check SM3-845
Idler Gear Shaft Diameter	49.95–49.97 (0.9311–1.9318)	49.94 (1.9307)	Replace bearing and/or shaft	 SM3-846
Idler Gear Bearing Inside Diameter	50.00–50.03 (1.9685–1.9696)	50.05 (1.9705)		
Oil Clearance between Idler Gear Shaft and Bearing	0.03–0.08 (0.0012–0.0031)	0.1 (0.039)		
Idler Gear end Play	0.04–0.10 (0.0016–0.0039)	0.15 (0.0059)	Replace thrust plate	 SM3-421

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure	
Camshaft Bend	-	0.05 (0.0020)	Replace	 SM3-858	
Camshaft Cam Height (Intake)	49.44 (1.9465)	48.90 (1.9251)	Replace	 SM3-374	
Camshaft Cam Height (Exhaust)	49.50 (1.9488)	48.95 (1.9271)			
Camshaft end Play	0.10-0.18 (0.0040-0.0070)	0.3 (0.0118)	Replace thrust plate	 SM3-848	
Camshaft Journal Diameter Journal No. :	No. 1: 57.0 (2.2441)	56.85 (2.2382)	Replace shaft and/or bearing	 SM3-849	
	No. 2: 56.8 (2.2362)	56.65 (2.2303)			
	No. 3: 56.6 (2.2283)	56.45 (2.2224)			
Camshaft Journal Bearing Inside Diameter Journal No. :	No. 1: 57.0 (2.2441)	57.15 (2.2500)		 SM3-850	
	No. 2: 56.8 (2.2362)	56.95 (2.2421)			
	No. 3: 56.6 (2.2283)	56.75 (2.2342)			
Oil Clearance between Camshaft Journal and Bearing	0.03-0.12 (0.0012-0.0047)	0.15 (0.0059)			
Timing Gear Backlash	Crankshaft Gear - Idler Gear	0.068-0.194 (0.0027-0.0076)	0.3 (0.0118)	Replace gear, if necessary	 SM3-844
	Idler Gear - Oil Pump Gear	0.065-0.182 (0.0026-0.0071)			
	Idler Gear - Injection Pump	0.065-0.232 (0.0026-0.0091)			
	Injection Pump Gear - Air Compressor Gear	0.065-0.274 (0.0026-0.0107)			
	Oil Pump Gear - Camshaft Gear	0.065-0.182 (0.0026-0.0071)			

PISTON, CRANKSHAFT, CYLINDER BLOCK AND FLYWHEEL HOUSING

OVERHAUL

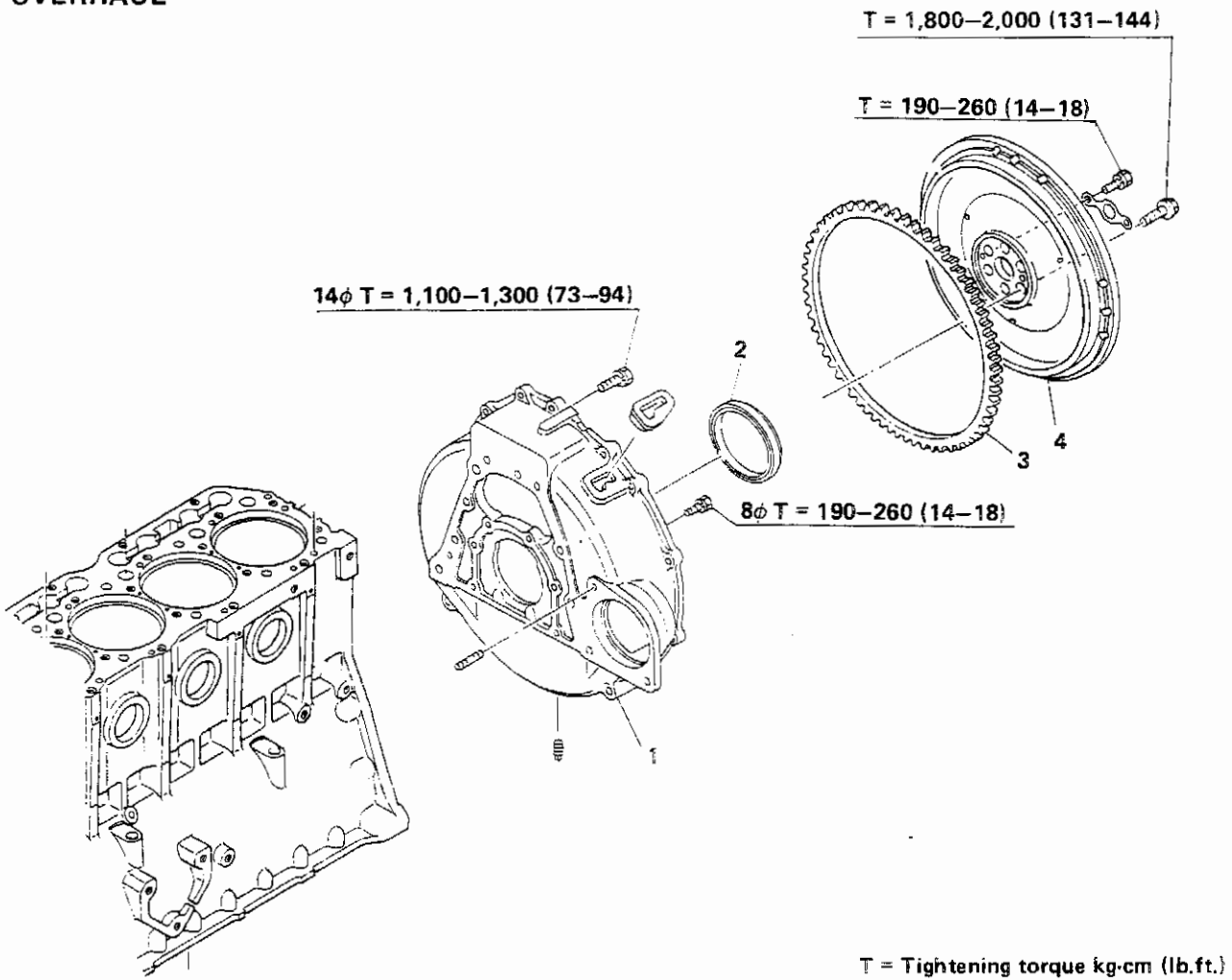


T = Tightening torque kg-cm (lb.ft.)

SM3-1284

- | | | |
|---------------------------|-------------------------------|------------------------|
| 1. Piston ring | 7. Crankshaft gear | 13. Crankshaft bearing |
| 2. Piston | 8. Key | 14. Camshaft bearing |
| 3. Piston pin | 9. Crankshaft | 15. Cylinder liner |
| 4. Retainer ring | 10. Connecting rod cap | 16. Expansion plug |
| 5. Connecting rod | 11. Collar | 17. Cylinder block |
| 6. Connecting rod bearing | 12. Crankshaft thrust bearing | 18. Bearing cap |

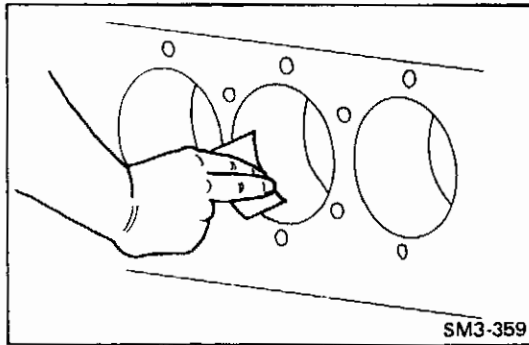
OVERHAUL



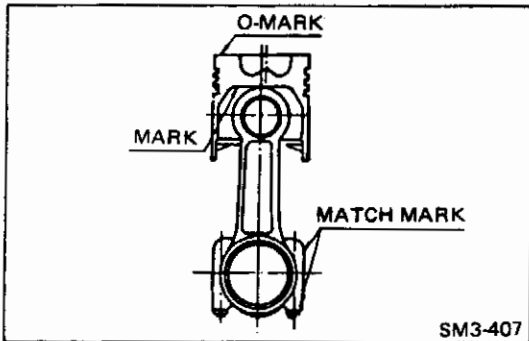
1. Flywheel housing
2. Oil seal
3. Ring gear
4. Flywheel

T = Tightening torque kg-cm (lb.ft.)

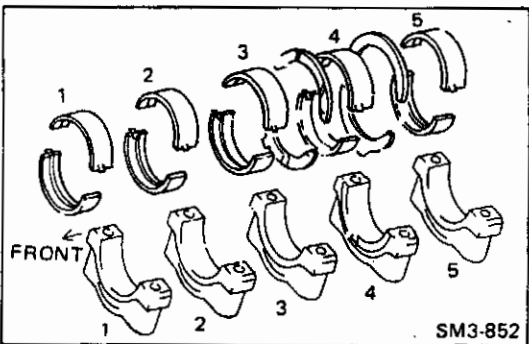
SM3-1285



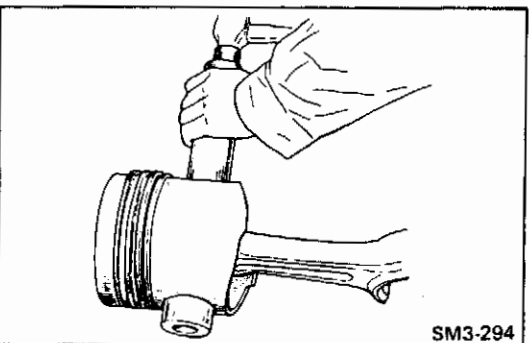
SM3-359



SM3-407



SM3-852



SM3-294



SM3-295

IMPORTANT POINTS – DISASSEMBLY

REMOVE THE PISTONS WITH CONNECTING RODS.

1. Remove the carbon from the upper end of the cylinder liner with a scraper or emery paper (recommended: No. 150) in a circular direction.

2. Extract the piston and connecting rod assembly out through the top of the cylinder.

NOTE: ○ Arrange the piston and connecting rod caps in order.

REMOVE THE CRANKSHAFT.

NOTE: Arrange the caps, bearings and thrust bearings in order.

REMOVE THE CONNECTING ROD.

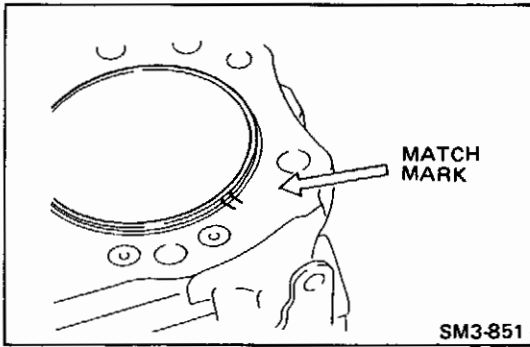
1. Remove the retainer ring installed on both ends of the piston pin, by means of retainer ring pliers.
2. Apply a metal pad to the pin and strike out the pin with a hammer.

NOTE: Warm up the piston first in hot water 80–90°C (176–194°F) for about 5 minutes before removing the pin.

REMOVE THE PISTON RINGS

Special Tool: Piston Ring Expander (09442-1180)

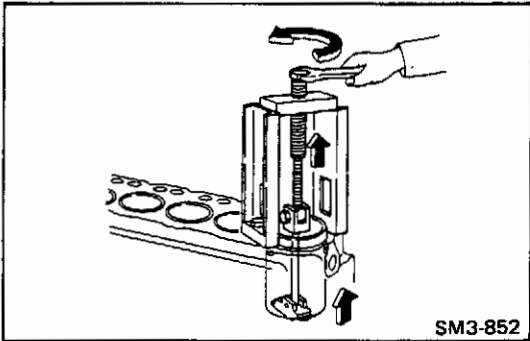
- NOTE:** ○ Handle the piston rings carefully because they are made of a special casting which is easily broken.
- Keep the rings for each cylinder separate.



REMOVE THE CYLINDER LINER.

1. Place the match marks with a pen on the cylinder block and liner flange, before removing the cylinder liners.

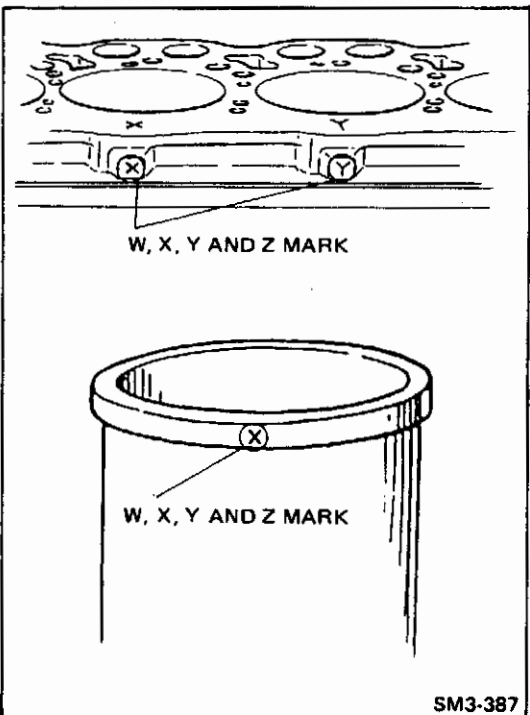
NOTE: Do not put the match marks with a punch.



2. Using a special tool, remove the cylinder liners.

Special Tool: Cylinder Liner Puller (09420-1460)

NOTE: After removing the cylinder liners, put numbers on their periphery or arrange them in sequence.

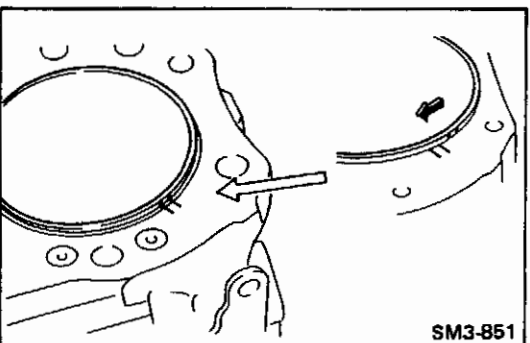


IMPORTANT POINTS – ASSEMBLY

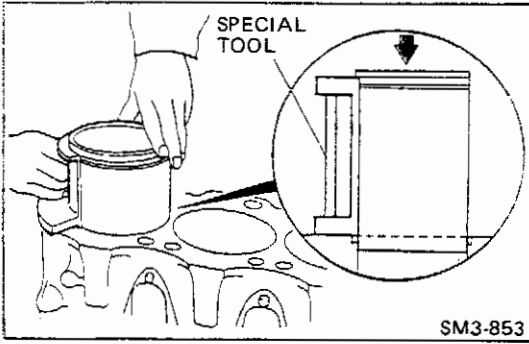
INSERT THE CYLINDER LINER INTO THE CYLINDER BLOCK.

1. When a new cylinder liner is used, make sure that the liner has the same mark as the mark on the cylinder block.

NOTE: ○ There are 4 different liner and cylinder block matches. The flange section of each liner has a marking any, W, X, Y, Z, or indicating the size of the outer diameter of the liner on which it is stamped. The markings W, X, Y and Z, indicating the inner diameter of the cylinder bore supporting the liner on the sides and top of the cylinder block (the boss section for attaching the coolant gallery cover), are inscribed on each cylinder.



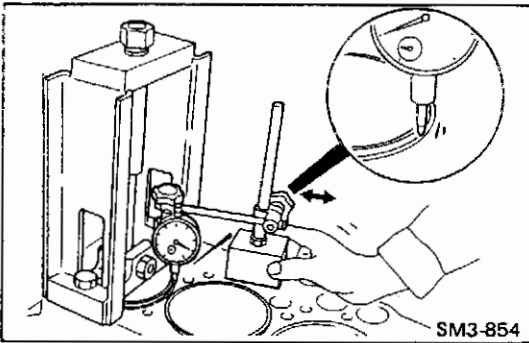
2. When reusing a liner, insert the liner its original position aligning the marking marked before disassembly.



Apply a small amount of fresh engine oil on the outer periphery of the liner, and apply pressure on the entire flange section of the liner. If insertion by hand is difficult, use a cylinder guide, and the cylinder liner will easily be pushed in.

Special Tool: Cylinder Liner Guide (09480-1120)

- NOTE:**
- Do not use a liner that has been dropped.
 - Take extra care when handling the liner since the liner is easily deformed.



MEASURE THE PROJECTION OF THE CYLINDER LINER.

Tighten a special tool with a tightening torque of 100 kg·cm (7.23 lb·ft) and measure the amount of projection of the top end of the liner from the cylinder block with a dial gauge or straight edge and a thickness gauge.

Special Tool: Cylinder Liner Puller (09420-1460)

Tightening Torque: 100 kg·cm (7.23 lb·ft)

Assembly Standard: 0.01–0.08 mm (0.0004–0.0031 in)

Unit: mm (in)

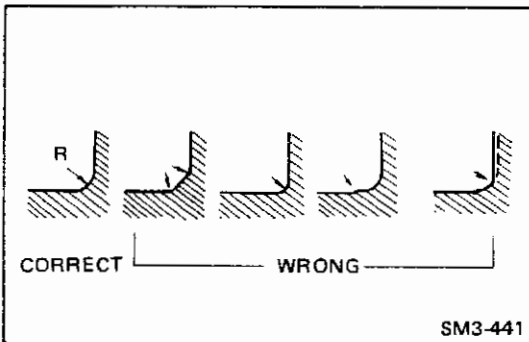
Under size	Outside diameter	
	Crankpin	Journal
0.25	61.89–61.71 (2.4288–2.4295)	72.69–72.71 (2.8619–2.8625)
0.50	61.44–61.46 (2.4189–2.4196)	72.44–72.46 (2.8520–2.8527)
0.75	61.19–61.21 (2.4091–2.4098)	72.19–72.21 (2.8422–2.8429)
1.00	60.94–60.96 (2.3992–2.4000)	71.94–71.96 (2.823–2.8330)

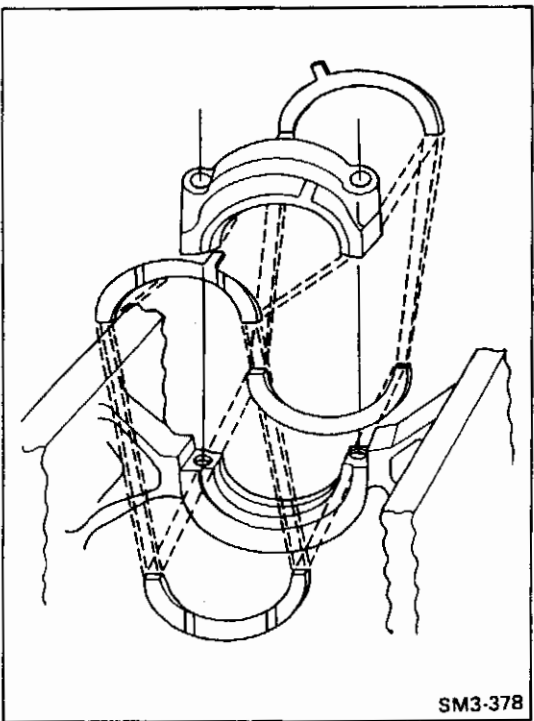
IF NECESSARY, GRIND THE CRANKSHAFT AND USE THE UNDER SIZE BEARINGS.

Dimension of Fillet R:

Crank pin: 3.50 – 4.00 mm (0.1378 – 0.1574 in)

Journal : 3.05 – 3.50 mm (0.1201 – 0.1377 in)





SM3-378

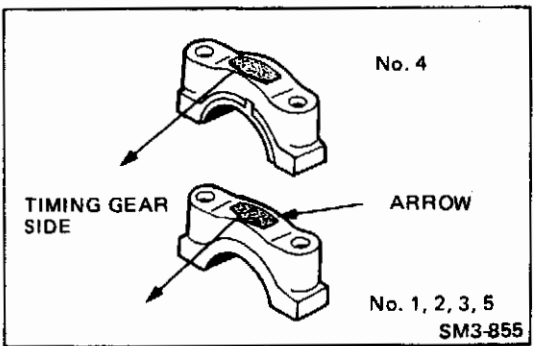
INSTALL THE CRANKSHAFT.

1. Install the crankshaft bearings on the cylinder block and bearing cap.

NOTE: Apply fresh engine oil to each bearing surface.

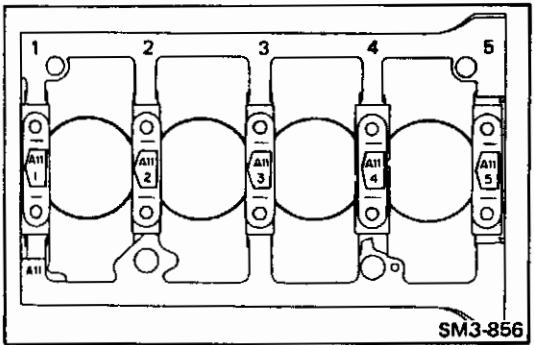
2. Install the crankshaft on the cylinder block.
3. Insert the crankshaft thrust bearings along the groove of the cylinder block.
4. Install the thrust bearings on the No. 4 bearing cap sides.

NOTE: Apply fresh engine oil to each thrust bearing surface.



SM3-855

5. Install the crankshaft bearing caps. Install the bearing caps in numbered order from timing gear side with the arrow point toward the timing gear side.



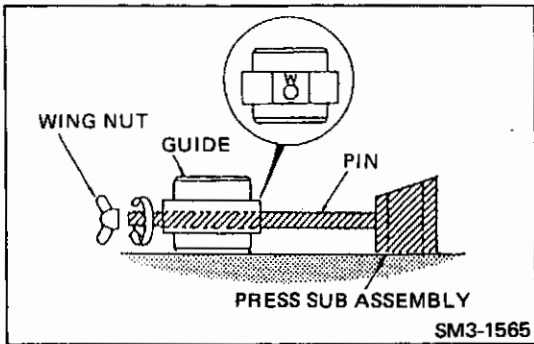
SM3-856

6. Tighten the cap bolts in three stages following the tightening order.

NOTE: Apply engine oil to the bolt threads and under the bolt head.

Tightening order: 3-2-4-1-5

- NOTE:**
- Make sure that the crankshaft rotates smoothly.
 - Inspect the crankshaft end play.



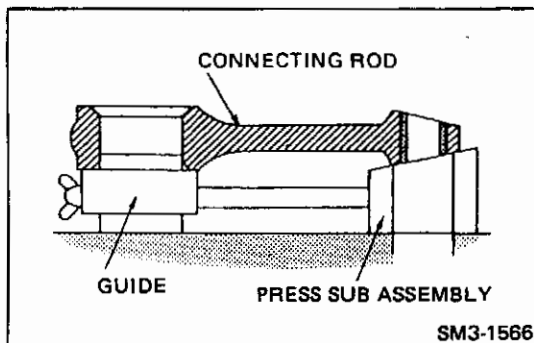
IF NECESSARY, REPLACE THE PISTON PIN BUSHING.

1. Prepare the special tools.

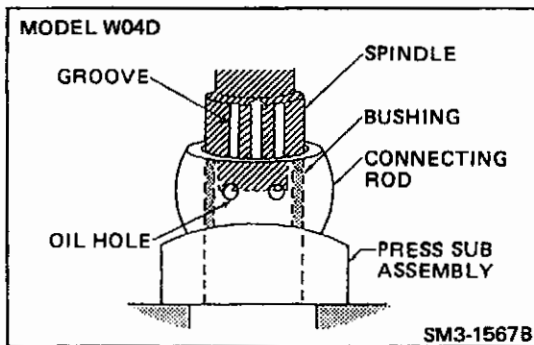
Assemble the guide and press sub assembly inserting its pin into the guide, then secure them with the wing nut.

Special tools: Guide (09481-1130)
Press sub assembly (09402-1450)
Wing nut (9233-10360)

NOTE: ○ Bring letter "W" punched on the guide above the pin.
○ Make sure to align both supporting surface of the guide and press sub assembly flush on a flat plane.



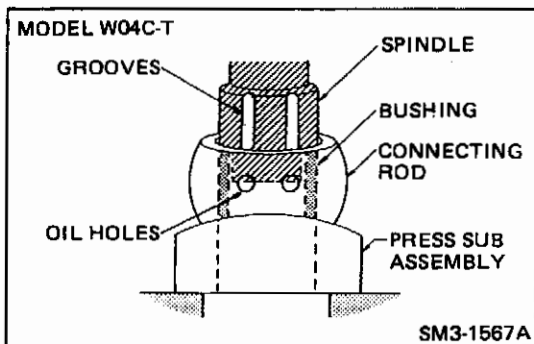
2. Using a special tool, remove the piston pin bushing.
- a. Set the connecting rod assembled without crank pin bore bearing on the guide and press sub assembly.

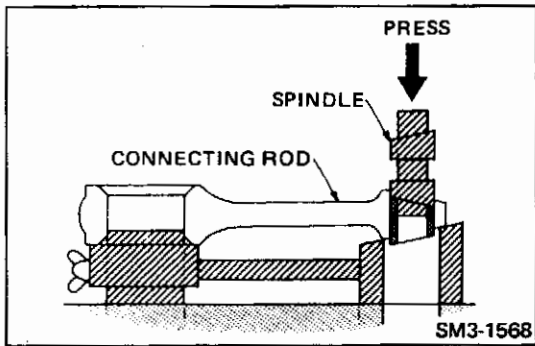


- b. Set the spindle on the bushing.

Special tool: Spindle (09402-1470) for W04C-T
(09402-1460) for W04D

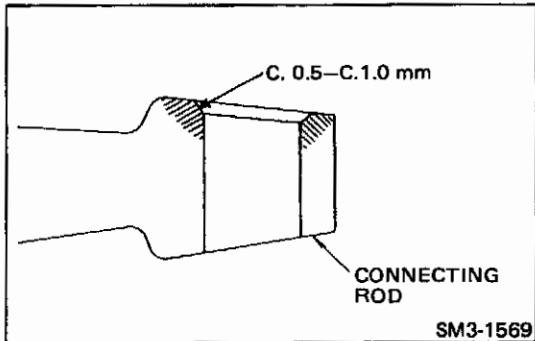
NOTE: Align the grooving of the spindle with the oil hole of the bushing.





c. Using a hydraulic press, remove the bushing.

NOTE: Always operate the press slowly and smoothly.

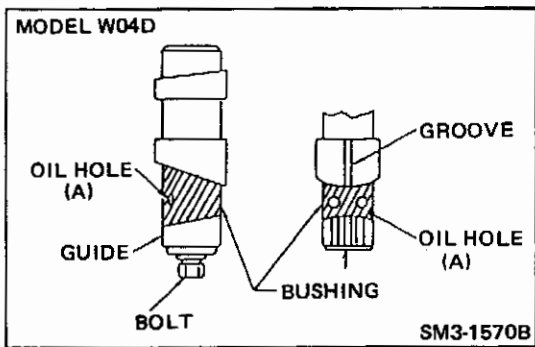


3. Assemble the piston pin bushing.

Chamfer one edge of the bushing hole at the small end of the connecting rod uniformly by C 0.5–1.0 mm (0.0196–0.0393 in).

NOTE: ○ Irregular chamfering can cause out-of-roundness of the pressed bushing, which may result in jamming during insertion.

○ Remove dust from the inner surface of the small-end hole.



4. Mount the bushing on the spindle.

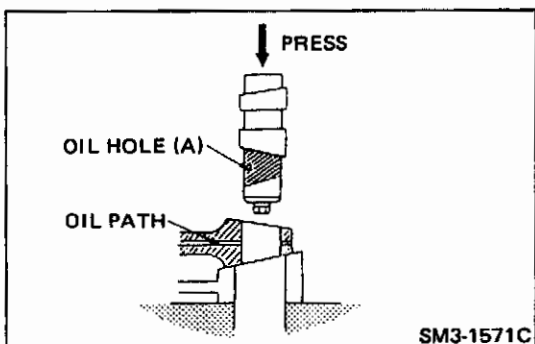
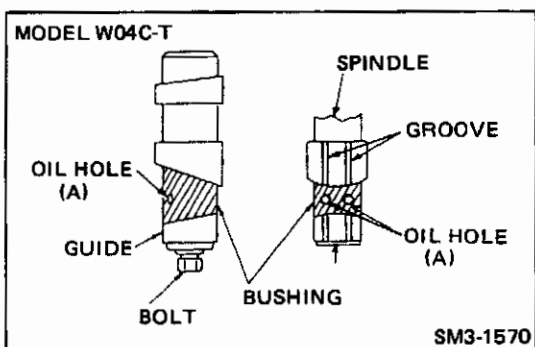
a. Set the bushing and guide on the spindle aligning oil hole (A) in the bushing the grooves on the both the spindle and guide.

b. Secure the bushing and guide with the bolt.

Special tools: Spindle (09402-1470) for W04C-T
(09402-1460) for W04D
Guide (09481-1140) for W04C-T
(09481-1120) for W04D
Bolt (9191-08252)

NOTE: ○ Be sure to slip the bushing over the spindle in the proper direction so that oil hole (A) will later align with the oil path in the connecting rod.

○ Apply fresh engine oil to the bushing and guide.

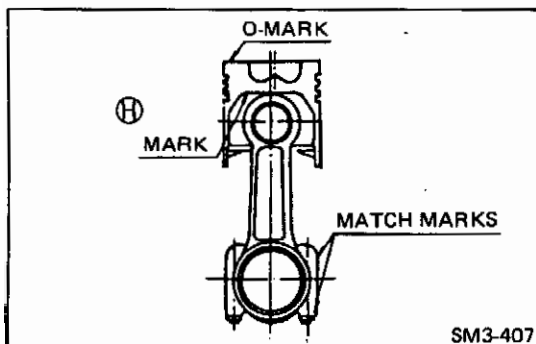
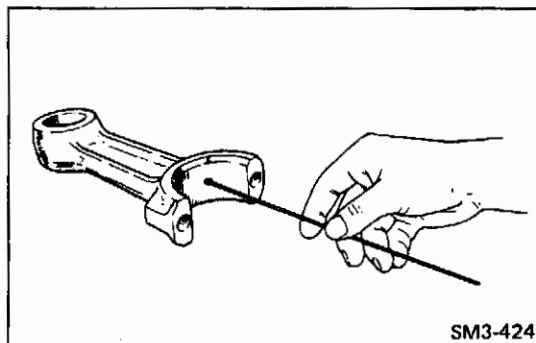
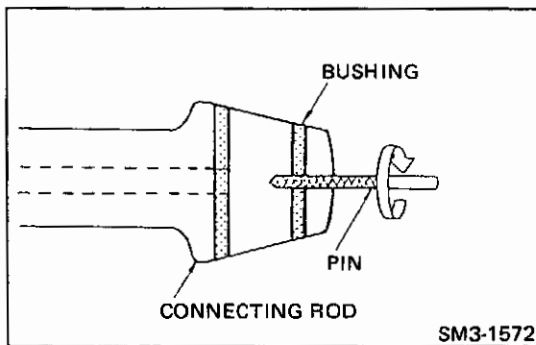


5. Install the bushing in the connecting rod.

Position the bushing–special tool assembly so that oil hole (A) align with the oil path through the connecting rod.

NOTE: ○ Fully coat the bore in the connecting rod with fresh engine oil.

○ Always operate the press slowly and smoothly.



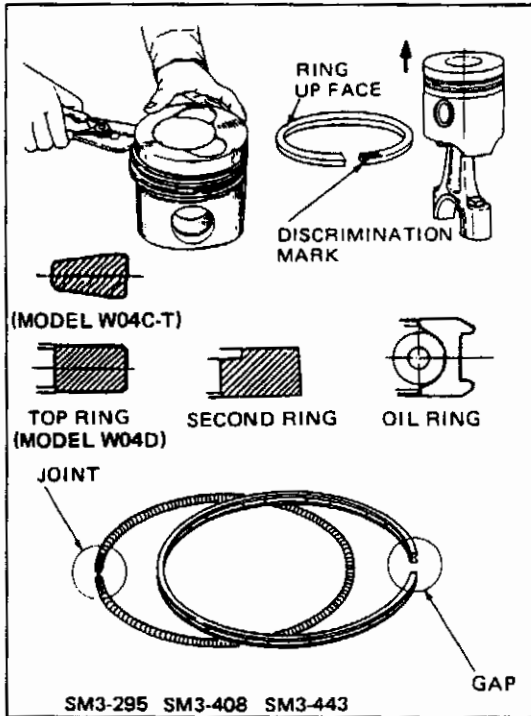
6. Inspect the bushing position after installation.

- NOTE:**
- Make sure that the oil holes of the bushing and connecting rod are aligned.
 - Insert a pin of 3 mm (0.1181 in) dia. into an hole at the end of the connecting rod, and make sure that the pin fully penetrates.
If there is any deviation in the alignment of the oil holes correct it with a drill of 3 mm (0.1181 in) dia.
 - Misalignment of the oil holes can lead to insufficient lubrication, which may result in seizure.
 - Insert a new piston pin and rotate it slowly to make sure that there is no rattling.

ASSEMBLE THE PISTON AND CONNECTING ROD.

Make sure that the O-mark at the top of the piston and the connecting rod match marks in opposite directions.

- NOTE:**
- Use the new retainer rings.
 - Heat the piston to about 80 – 90°C (176 – 194°F) in hot water about 5 minutes.



INSTALL THE PISTON RING.

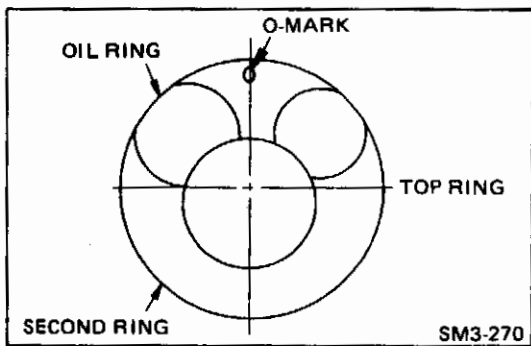
1. Install the piston rings in the sequence oil ring, second ring and top ring with the identification mark at the top of the ring facing up.

NOTE:

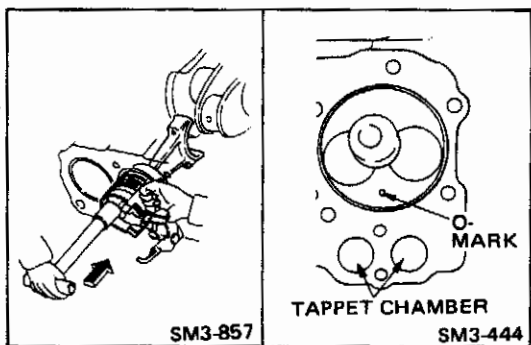
- Identification mark of second ring and oil ring is applied with gold paint.
- Apply oil to the piston rings.

Special Tool: Piston Ring Expander (09442-1180)

2. Connect the ends of the coil expander and then fit the coil inside the piston ring after ensuring that the gap of the piston ring is 180° away from the joint of the coil.



3. Arrange the piston rings so that their gaps are equally spaced.

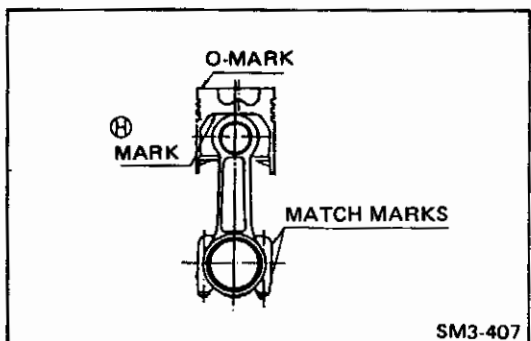


INSTALL THE PISTON IN THE CYLINDER LINER.

1. Apply engine oil to the piston, cylinder liner and connecting rod bearing surface.
2. Using a special tool, hold the piston rings and push the piston with connecting rod assembly with a wooden rod.

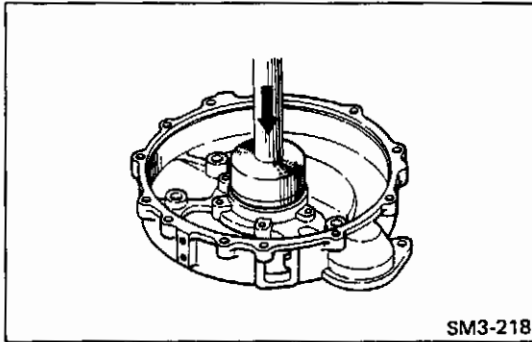
NOTE: Check the piston that the O-mark on the top is on the tappet chamber side.

Special Tool: Piston Ring Holder (09441-1260)



INSTALL THE CONNECTING ROD CAP.

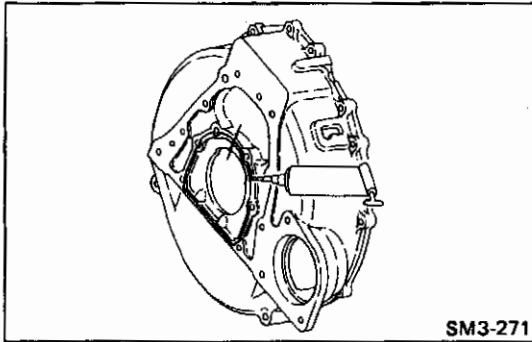
1. Apply engine oil to the cap bearing surface.
2. Align the match marks on the connecting rod and cap.
3. Apply engine oil to the bolt threads and under the bolt head.
4. Tighten the cap bolt in three stages.



INSTALL THE OIL SEAL IN THE FLYWHEEL HOUSING.

Using a special tool, press in the oil seal in the flywheel housing.

Special Tool: Press (09482-1540)

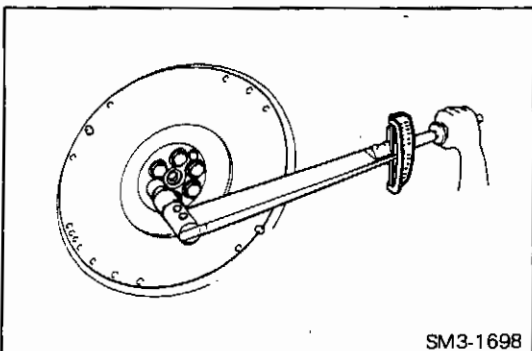


INSTALL THE FLYWHEEL HOUSING.

1. Clean the faces.
2. Apply the liquid gasket as shown and install the flywheel housing within 20 minutes.

NOTE: If leaving it more than 20 minutes, clean the liquid gasket completely and reapply the liquid gasket.

Coating Width: 1.5–2.5 mm (0.06–0.10 in)



INSTALL THE FLYWHEEL.

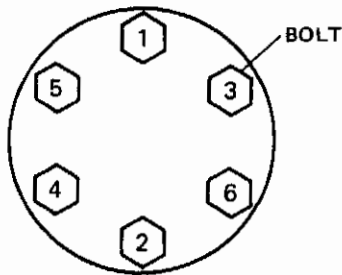
1. Install the flywheel and tighten the bolts through several repetitions of the tightening order so as to reach specified torque evenly and gradually, then slacken and tighten them one by one to the specified torque.

NOTE: ○ Align the "O" mark on the flywheel and crankshaft collar knock-in.

○ When tightening the bolt, apply engine oil to the threads and flywheel surface of the bolts.

2. Install the pilot bearing and stopper.

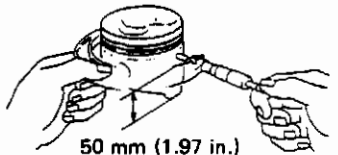
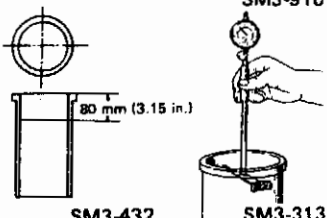
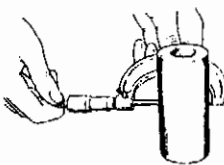
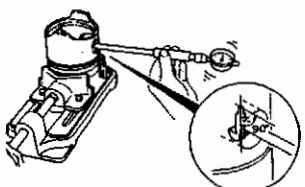
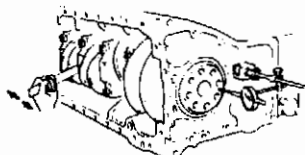
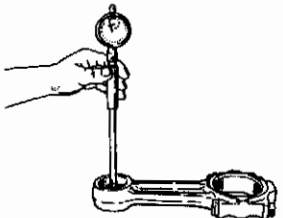
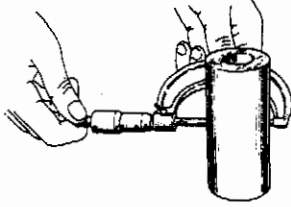
TIGHTENING ORDER



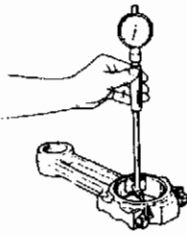
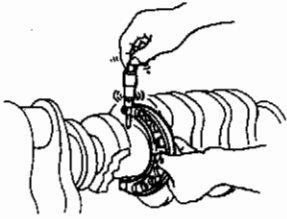
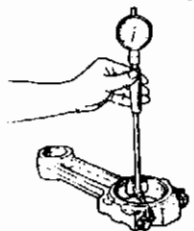
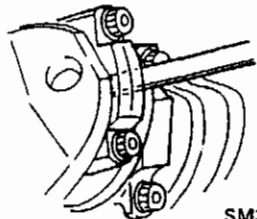
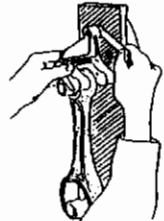
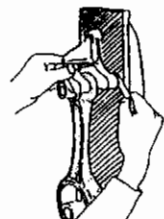
SM3-1697

INSPECTION AND REPAIR

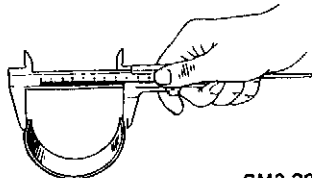
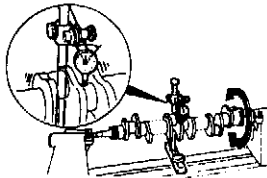
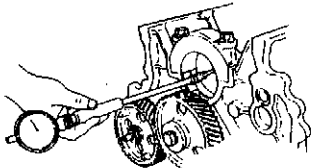
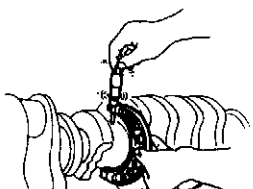
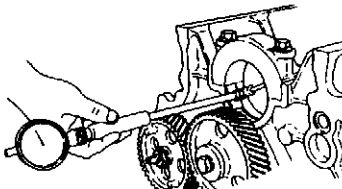
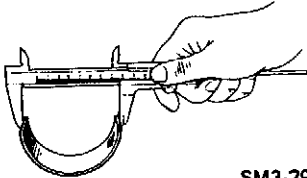
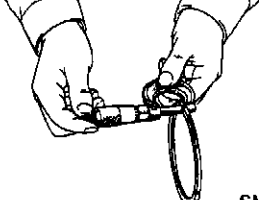
Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Piston Diameter	103.860–103.876 (4.0890–4.0896)	—	Replace piston and/or liner	 50 mm (1.97 in.)
Cylinder Liner Inside Diameter	104.008–104.040 (4.0949–4.0960)	104.15 (4.1003)		 SM3-910 80 mm (3.15 in.) SM3-432 SM3-313
Clearance between Piston and Cylinder Liner	0.140–0.172 (0.0056–0.0067)	—		
Piston Pin Diameter	W04D 34.989–35.000 (1.3776–1.3779)	34.980 (1.3771)	Replace piston and/or piston pin	 SM3-859
	W04C-T 36.989–37.000 (1.4563–1.4567)	36.98 (1.4559)		
Piston Pin Hole Inside Diameter	W04D 34.987–35.003 (1.3775–1.3780)	35.02 (1.3787)		 SM3-1585
	W04C-T 36.987–37.003 (1.4561–1.4568)	37.02 (1.4574)		
Clearance between Piston Pin and Piston Pin Hole	0.013T–0.014L (0.00052T–0.00055L) T: Tight L: Clearance	0.04 (0.0015)		
Crankshaft end Play	0.05–0.22 (0.0020–0.0086)	0.4 (0.0157)	Replace thrust bearing	 SM3-362
Connecting Rod Small End Bushing Inside Diameter	W04D 35.015–35.025 (1.3786–1.3789)	35.080 (1.3811)	Replace bushing and/or piston pin	 SM3-296
	W04C-T 37.015–37.025 (1.4573–1.4575)	37.080 (1.5172)		
Piston Pin Diameter	W04D 34.989–35.000 (1.3776–1.3779)	34.980 (1.3771)		 SM3-297
	W04C-T 36.989–37.000 (1.4563–1.4567)	36.98 (1.4559)		
Clearance between Piston Pin and Connecting Rod Small End Bushing	0.015–0.036 (0.00016–0.0014)	0.1 (0.0039)		

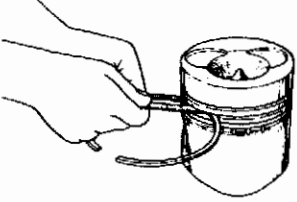
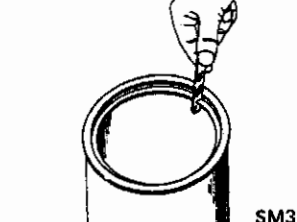
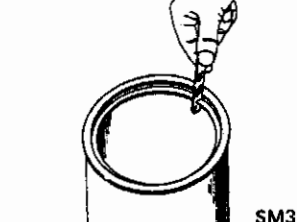
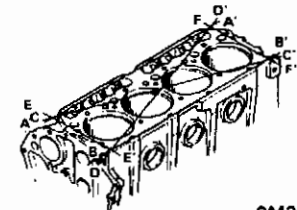
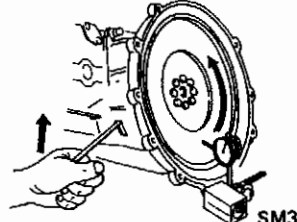
Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Connecting Rod Big end Inside Diameter (Without Bearings)	65.985–66.000 (2.5979–2.5984)	–	Replace connecting rod assembly	 <p style="text-align: right;">SM3-300</p>
Crank Pin Diameter	61.94–61.96 (2.4386–2.4393)	–0.20 (–0.0078)	Regrind and use undersize bearing	 <p style="text-align: right;">SM3-860</p>
		60.76 (2.3921)	Replace crankshaft	
Clearance between Connecting Rod and Crank Pin	0.031–0.082 (0.0013–0.0032)	0.12 (0.0047)	Replace bearing	 <p style="text-align: right;">SM3-300</p>
Connecting Rod End Play	0.20–0.52 (0.0079–0.0204)	0.6 (0.0236)	Replace connecting rod	 <p style="text-align: right;">SM3-862</p>
Connecting Rod Straightness	–	0.1 (0.0039) Per 200 (0.7874)	Replace	 <p style="text-align: right;">SM3-541</p>
Connecting Rod Twist	–	0.1 (0.0039) Per 200 (0.7874)	Replace	 <p style="text-align: right;">SM3-542</p>

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Connecting Rod Bearing Spread Dimension	67.05–67.55 (2.6398–2.6594)	–	Replace	 SM3-298
Crankshaft bearing spread dimension	79.00–79.60 (3.1102–3.1339)	–		
Crankshaft Bend	–	0.04	Repair or replace	 SM3-861
Crankshaft Main Bearing Cap Inside Diameter (Without Bearings)	77.985–78.000 (3.0703–3.0708)	–	Replace	 SM3-436
Crankshaft Journal Diameter	72.94–72.96 (2.8717–2.8724)	–0.20 (–0.0078)	Regrind and use undersize bearing	 SM3-860
		71.76 (2.8521)	Replace crankshaft	
Clearance between Crankshaft Journal and Main Bearing	0.039–0.090 (0.0016–0.0035)	0.13 (0.0051)	Replace bearing	 SM3-436
Crankshaft Main Bearing Spread Dimension	79.00–79.06 (3.1103–3.1125)	–	Replace	 SM3-298
Piston Ring Breadth Ring No.:	Top: 2.47–2.49 (0.0973–0.0980) (Model W04D only)	2.32 (0.0913)	Replace	 SM3-379
	2nd: 1.97–1.99 (0.0776–0.0783)	1.82 (0.0716)		
	Oil: 4.97–4.99 (0.1957–0.1964)	4.95 (0.1948)		

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Piston Ring Groove Breadth Ring No.:	Top: 2.57–2.59 (0.1012–0.1019) (Model W04D only) 2nd: 2.03–2.05 (0.0800–0.0807) Oil: 5.01–5.03 (0.1973–0.1980)	2.74 (0.1078) 2.2 (0.0866) 5.08 (0.2000)	Replace piston ring and/or piston	
Clearance between Piston Ring and Piston Ring Breadth Ring No.:	Top: 0.08–0.12 (0.0032–0.0047) (Model W04D only) 2nd: 0.04–0.08 (0.0016–0.0031) Oil: 0.02–0.06 (0.0008–0.0023)	0.3 (0.0118) 0.3 (0.0118) 0.08 (0.0031)		
Piston Ring Gap All Rings: * Insert the Piston Rings Where the Wear of the Liner is Small.	0.3–0.45 (0.0119–0.0177)	1.2 (0.0472)	Replace	
Cylinder Block Flatness	Less than 0.05 (0.0019)	0.1 (0.0039)	Regrind and/or replace	
Flywheel Face Alignment	—	0.15 (0.0059)	Regrind and/or replace	

SM3-301

SM3-302

SM3-216


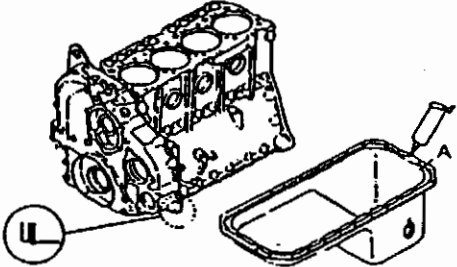
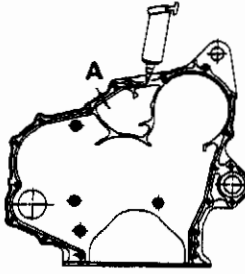
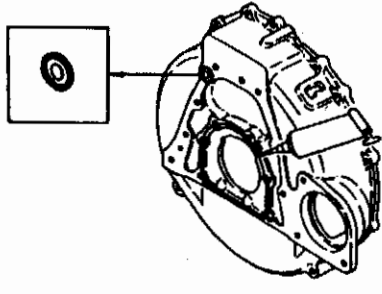
SM3-908


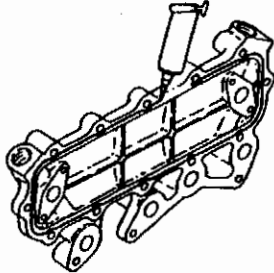
LIQUID GASKET AND APPLICATION POINTS

The W04D and W04C-T type engine use liquid gasket (Three Bond TB1207C 04132 1207) instead of conventional sheet gaskets. Apply liquid gasket, therefore, taking the the following items into account.

1. LIQUID GASKET APPLICATION POINTS AND COATING WIDTH

Unit: mm (in)

Parts name	Application point	Coating width 
(a) Oil pan	<p>Flange face which mates with cylinder block and timing gear cover</p>  <p style="text-align: right;">SM3-214A</p>	<p>3 – 4 (0.12 – 0.16)</p>
(b) Timing gear cover	<p>Faces which mate with timing gear plate (flange face, boss face)</p>  <p style="text-align: right;">SM3-247</p>	<p>1.5 – 2.5 (0.06 – 0.10)</p>
(c) Flywheel housing	<p>Faces which mate with cylinder block (flange face, boss face)</p>  <p style="text-align: right;">SM3-271</p>	<p>1.5 – 2.5 (0.06 – 0.10)</p>

Parts name	Application point	Coating width 
(d) Oil cooler	Flange face which mates with cylinder block  SM3-269	1.5 – 2.5 (0.06 – 0.10)
(e) Coolant pump	Flange face which mates with timing gear cover	1.5 – 2.5 (0.06 – 0.10)
(f) Thermostat case	Flange face which mates with cylinder head	1.5 – 2.5 (0.06 – 0.10)
(g) Seal plate	Flange face which mates with timing gear cover	1.5 – 2.5 (0.06 – 0.10)
(h) Camshaft end plate	Flange face which mates with cylinder block	1.5 – 2.5 (0.06 – 0.10)

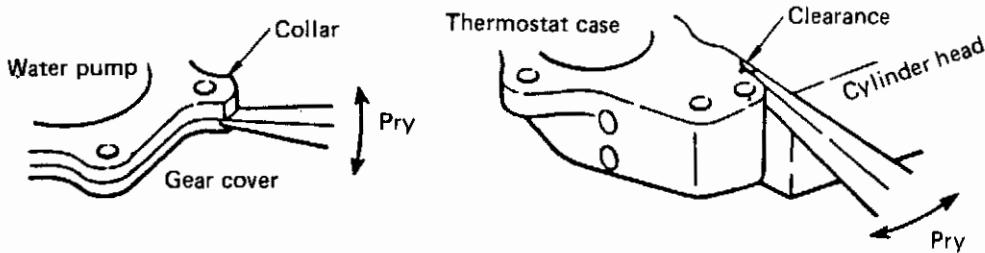
2. COATING LIQUID GASKET AND PARTS ASSEMBLY PROCEDURE

- (1) Completely remove old liquid gasket from each part and the respective mating part, and remove oil, water, and dirt using a cloth.
- (2) Be careful not to apply excessive or insufficient liquid gasket. Also, be sure to overlap the start and end of each coating.
- (3) When assembling coated parts, be careful that there is no misalignment between mating parts. If there is any misalignment, coat the parts again.

- (4) Assemble the various parts within 20 minutes after applying liquid gasket. If more than 20 minutes have elapsed, remove the liquid gasket and apply it again.
- (5) After assembling the various parts, wait for at least 15 minutes before starting the engine.

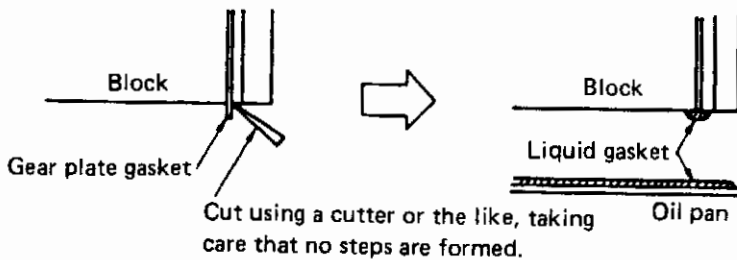
3. REMOVING PARTS

When removing each part, do not attempt to pry one portion of the flange alone but use the flange collar or clearance to pry the flange at several points alternately.



4. GEAR PLATE GASKET

When replacing the gear plate gasket, cut it so that no steps are formed in it, then liberally apply liquid gasket to the cut face and assemble the oil pan.



NOTE: When removing the oil pan, use a screwdriver, or the like.

During this operation, the flange of the oil pan may sometimes become deformed preventing it from being reused. To prevent this, therefore, first insert plates with a thin edge at several points around the periphery of the oil pan, then remove the oil pan using a screwdriver.

LUBRICATING SYSTEM

DATA AND SPECIFICATIONS

Oil pump

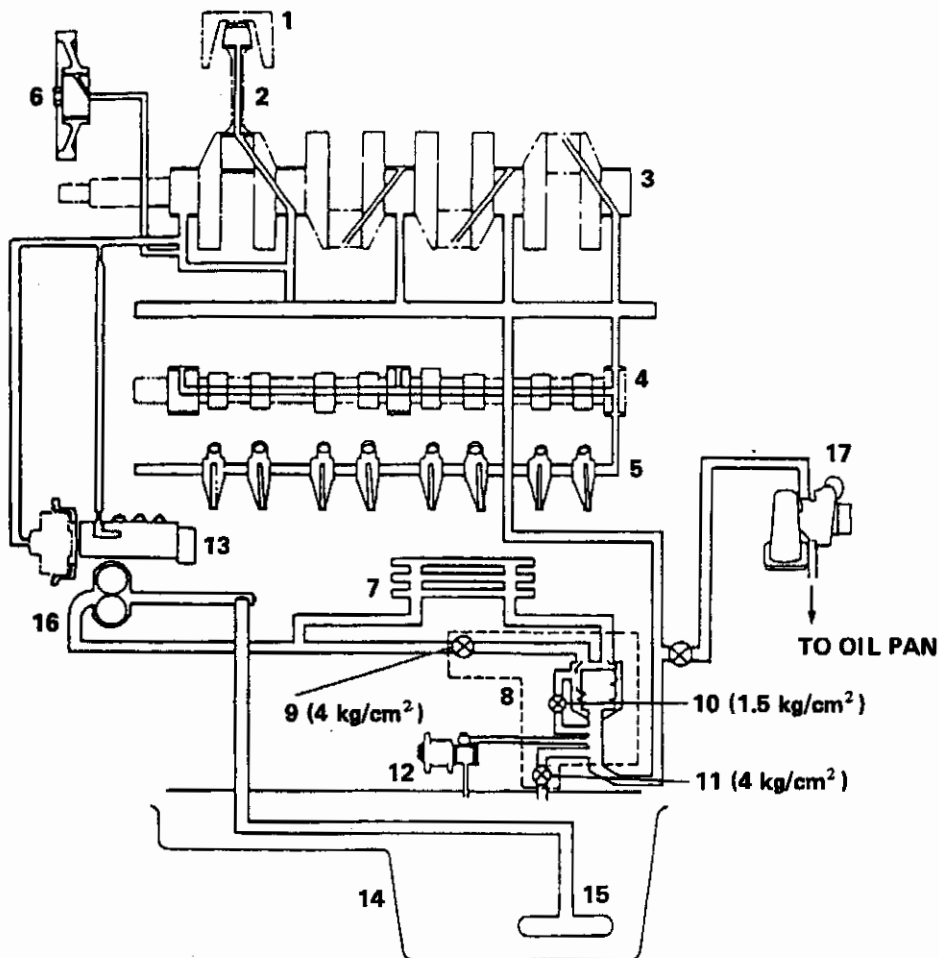
Type Full forced pressure feed by gear pump

Drive By gear

Oil cooler

Type Multi plates type, water-cooled

LUBRICATING SYSTEM DIAGRAM

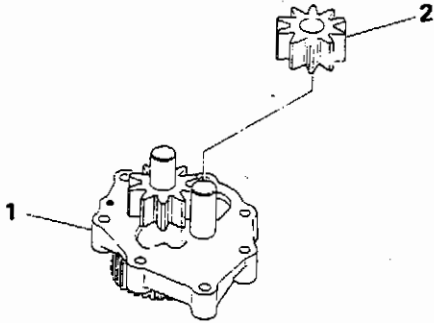
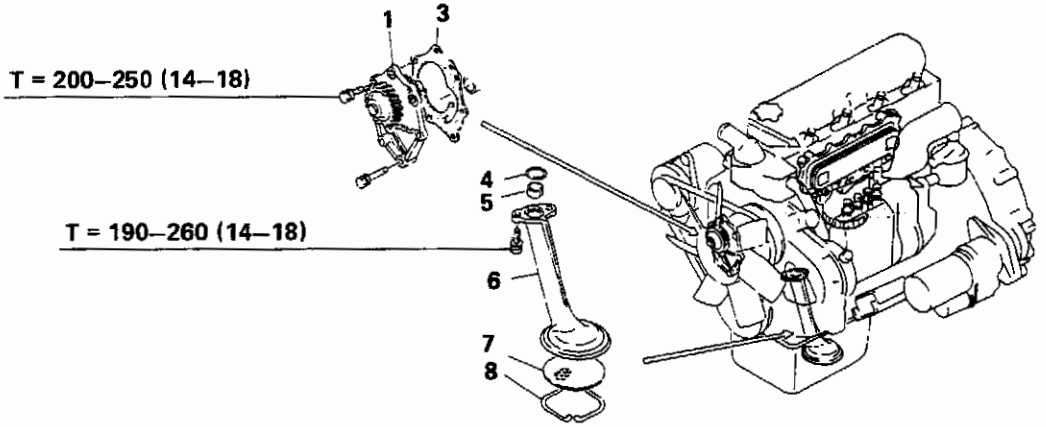


SM3-1356

- | | | |
|---------------------|-------------------------|--------------------|
| 1. Piston | 7. Oil cooler | 13. Injection pump |
| 2. Connecting rod | 8. Oil filter | 14. Oil pan |
| 3. Crankshaft | 9. Cooler safety valve | 15. Oil strainer |
| 4. Camshaft | 10. Filter safety valve | 16. Oil pump |
| 5. Rocker arm shaft | 11. Regulator valve | 17. Turbo charger |
| 6. Idle gear | 12. Vacuum pump | |

OIL PUMP AND OIL STRAINER

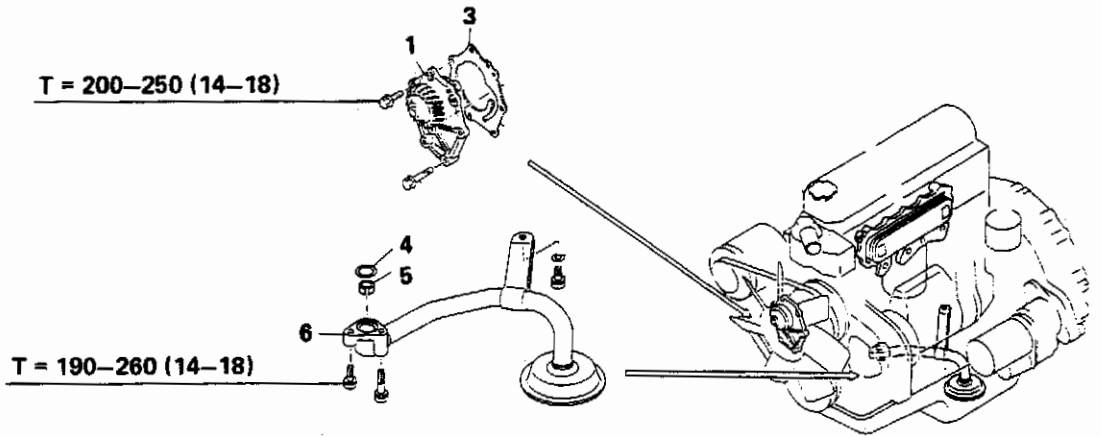
OVERHAUL FRONT SUMP



SM3-233

SM3-1435

REAR SUMP



T = Tightening torque: kg-cm (lb.ft)

SM3-1357

- 1. Oil pump case sub-assembly
- 2. Driven gear
- 3. Gasket

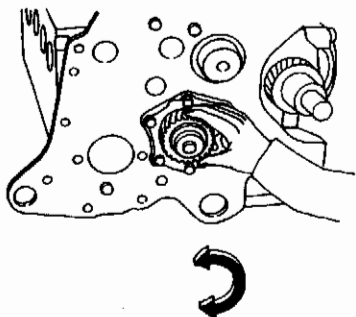
- 4. O-ring
- 5. O-ring guide
- 6. Oil strainer

- 7. Oil strainer screen
- 8. Snap ring

IMPORTANT POINTS – MOUNTING

INSTALL THE OIL PUMP

1. Apply oil liberally to cylinder block pump case and bearing before installing oil pump.
2. Confirm smooth rotation of oil pump after tightening bolts.



SM-864

INSTALL THE OIL STRAINER

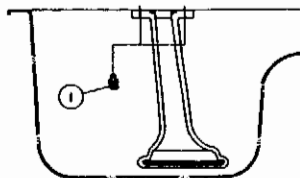
Front Sump Oil Strainer

For model KM

NOTE: Be sure to install O-ring.

Assemble strainer by inserting adapter between bottom surface of cylinder block and strainer.

NOTE: Be sure to install O-ring guide and O-ring on adapter.

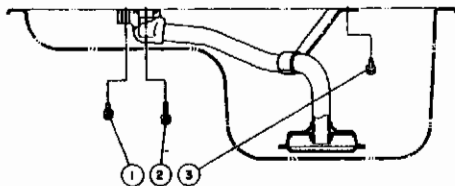


SM3-865

Rear Sump Oil Strainer

1. Tighten bolts (1) and (2) temporarily.
2. Align bolt holes of cylinder block and bracket.
3. Tighten bolts (1), (2) and (3) to specified torque.

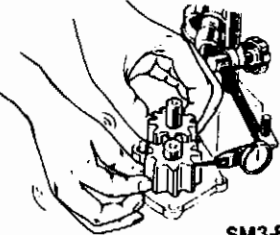
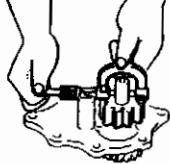

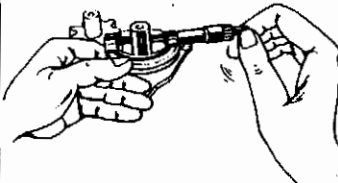
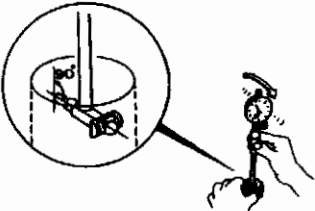

NOTE: Be sure to install O-ring.



SM3-866

INSPECTION AND REPAIR

Unit: mm (in)

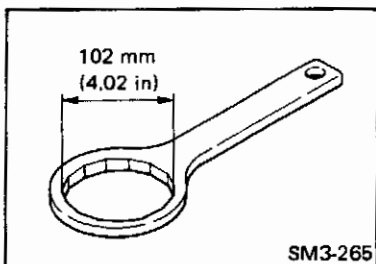
Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Gear Backlash	0.09–0.21 (0.0036–0.0082)	0.30 (0.0118)	Replace gear	 <p>SM3-867</p>
Drive Gear Shaft Diameter	18.088–18.106 (0.7122–0.7128)	18.060 (0.7110)	Replace	 <p>SM3-870</p>
Drive Shaft Bearing Inside Diameter	18.146–18.173 (0.7145–0.7154)	18.20 (0.7165)	Replace	 <p>SM3-1070</p>
Clearance between Drive Shaft and Bearing	0.040–0.085 (0.0080–0.0033)	0.1 (0.0039) (Model W04D) 0.15 (0.0059) (Model W04C-T)	Replace bearing and/or shaft	
Driven Gear Shaft Diameter	17.979–17.997 (0.7079–0.7085)	17.970 (0.7074)	Replace	 <p>SM3-868</p>
Driven Gear Inside Diameter	18.037–18.054 (0.7102–0.7107)	18.070 (0.7114)	Replace	 <p>SM3-869</p>
Clearance between Driven Gear and Shaft	0.040–0.075 (0.0080–0.0023)	0.1 (0.0039)	Replace gear and/or shaft	
Gear Teeth Pitting or Wear	—	—	Replace, if necessary	<p>Visual check</p>  <p>SM3-845</p>

OIL COOLER AND OIL FILTER

SPECIAL TOOL

Prior to starting an engine overhaul, it is necessary to have these special tools.

WRENCH

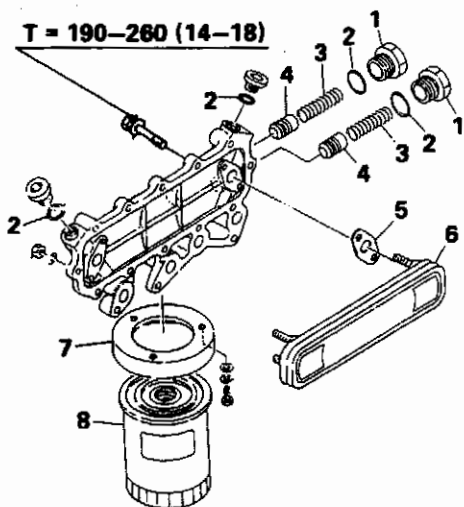


09553-1010

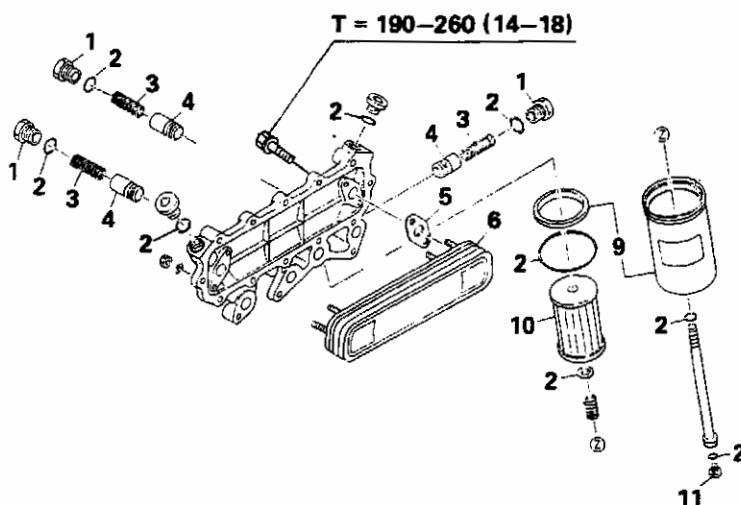
For spin-on type oil filter

OVERHAUL

SPIN-ON TYPE



PAPER ELEMENT TYPE



T = Tightening torque: kg-cm (lb.ft)

SM3-1230

- 1. Valve spring plug
- 2. O-ring
- 3. Oil valve spring
- 4. Valve

- 5. Element gasket
- 6. Oil cooler element
- 7. Oil filter plate
- 8. Oil filter element set

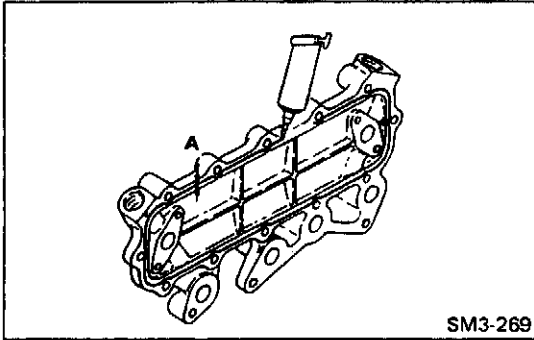
- 9. Element lower cover
- 10. Oil filter element
- 11. Drain plug

IMPORTANT POINT – DISMOUNTING

REMOVE THE SPIN-ON TYPE OIL FILTER.

Using a special tool, unscrew the oil filter.

Special Tool: Wrench (09553-1010)



IMPORTANT POINTS – MOUNTING

INSTALL THE OIL COOLER.

1. Clean the faces.
2. Apply the liquid gasket as shown and install the oil cooler within 20 minutes.

NOTE: If leaving it more than 20 minutes, clean the liquid gasket completely and reapply the liquid gasket.

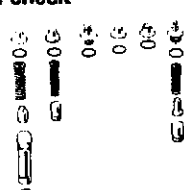
Coating Width (A): 1.5–2.5 mm (0.06–0.10 in)

INSTALL THE SPIN-ON TYPE OIL FILTER.

1. Apply a slight amount of engine oil to the gasket of the new filter.
2. Tighten the new filter by hand until the gasket touches the cover and then tighten another 3/4 to 1 full turn with a special tool.

Special Tool: Wrench (09553-1010)

INSPECTION AND REPAIR

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Valve and Springs of Oil Cooler and Oil Filter Wear or Damage	—	—	Replace, if necessary.	<p>Visual check</p>  <p style="text-align: right;">SM3-872</p>

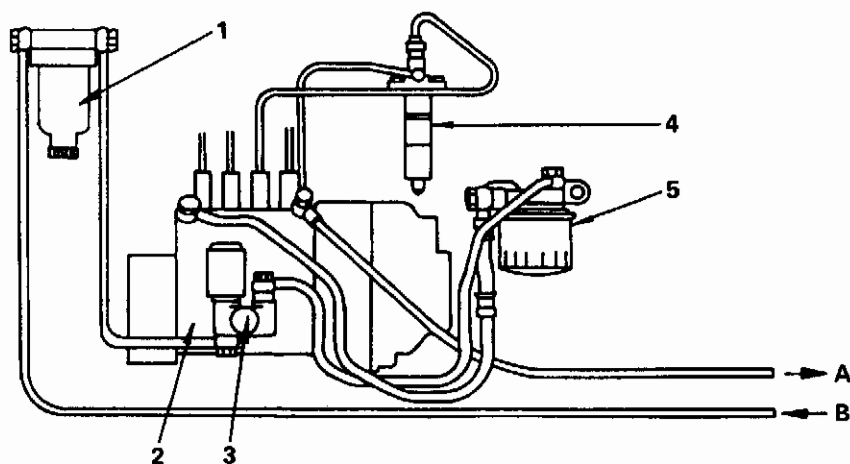
FUEL SYSTEM

DATA AND SPECIFICATIONS

Injection nozzle

- Type Multi-hole nozzle type
 Opening pressure 220 kg/cm² (3,129 lb/sq.in)

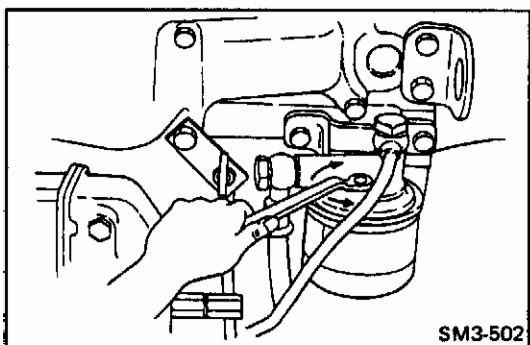
FUEL SYSTEM DIAGRAM



1. Water separator (If so equipped)
 2. Fuel injection pump
 3. Fuel feed pump
 4. Injection nozzle
 5. Fuel filter
- A. To fuel tank
 B. From fuel tank

NOTE: Figure illustrates 4-cylinder engine.

SM3-227A



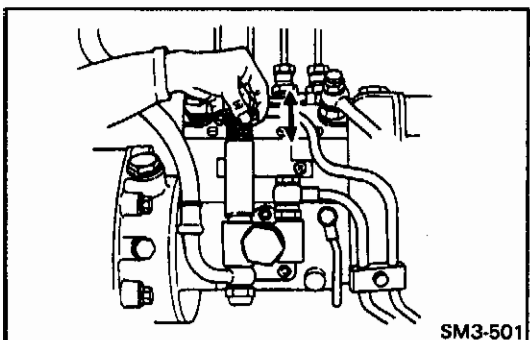
SM3-502

AIR BLEEDING FROM FUEL SYSTEM.

1. Loosen the bleeder plug on the fuel filter.
2. Loosen the priming pump knob.
3. Operate the priming pump knob until the air will not come out from the bleeder plug.
4. Tighten the bleeder plug.

Tightening Torque: 40–60 kg-cm (3–4 lb.ft)

NOTE: The bleeder plug should be tightened while the priming pump knob is operated.



SM3-501

5. Once again, operate the priming pump knob several times.
6. Push back the priming pump knob and tighten it.

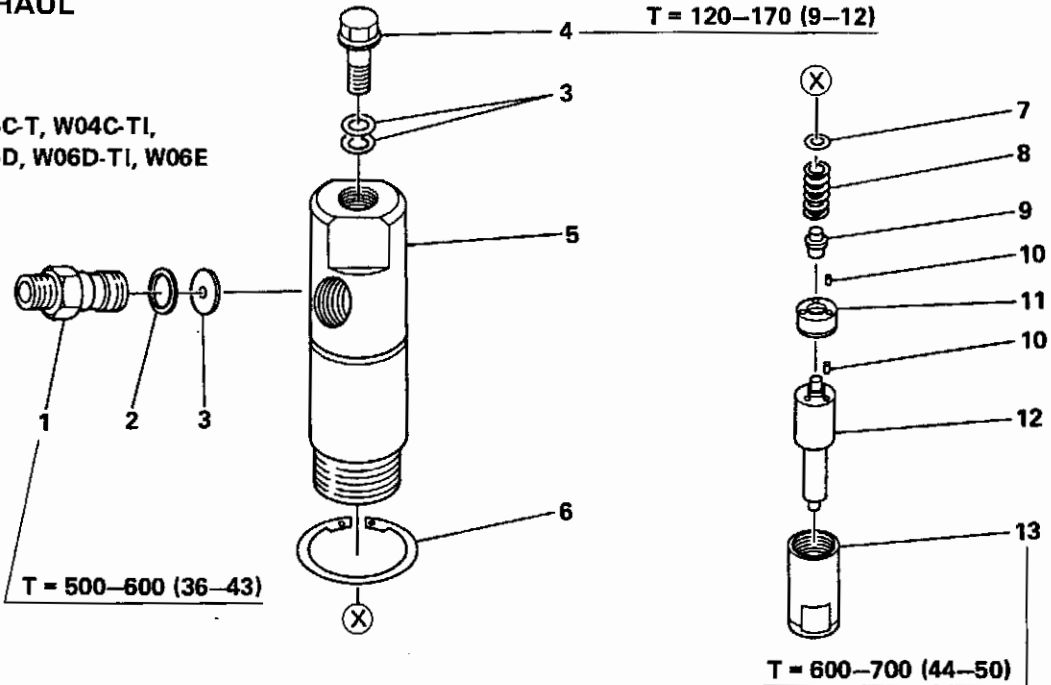
NOTE: Wipe off any splashed fuel.

INJECTION NOZZLE

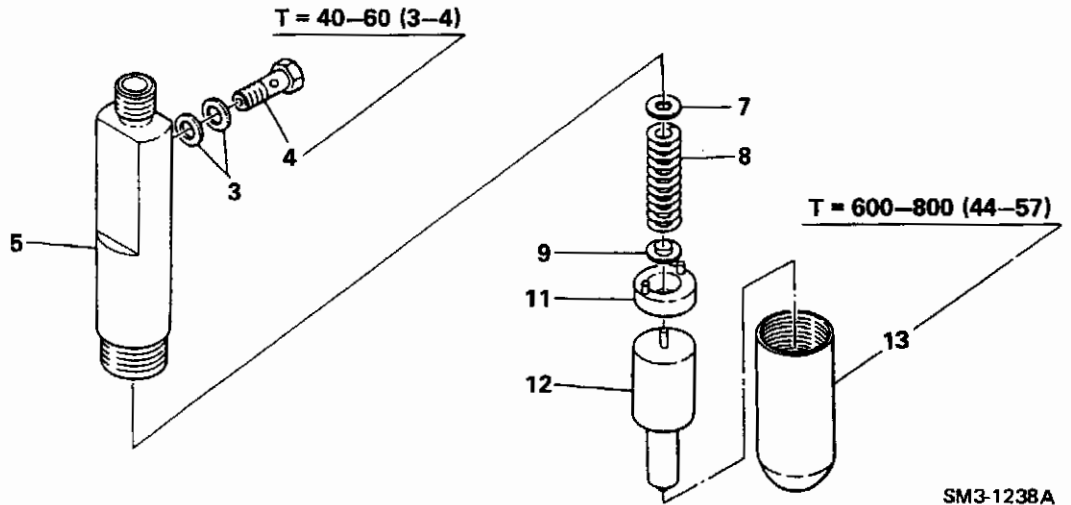
OVERHAUL

1530V
I-No. 20

For W04C-T, W04C-TI,
W06D, W06D-TI, W06E



For W04D



SM3-1238A

T = Tightening Torque: kg-cm (lb.ft)

- 1. Connector
- 2. Packing ring
- 3. Gasket
- 4. Joint bolt
- 5. Nozzle holder

- 6. Retainer ring
- 7. Shim
- 8. Spring
- 9. Nozzle holder pressure pin
- 10. Pin

- 11. Distance piece
- 12. Nozzle
- 13. Nozzle retaining nut

IMPORTANT POINTS – DISMOUNTING

REMOVE THE NOZZLE HOLDER ASSEMBLY.

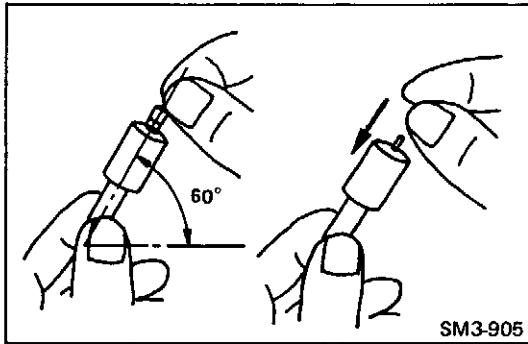
Refer to Section ENGINE MOVING PARTS.

IMPORTANT POINTS – ASSEMBLY

TEST THE NOZZLE SKINKING.

Wash the nozzle proper with diesel fuel oil, then immerse it in diesel fuel oil.

Next slide the needle inside the nozzle proper and ensure that it move smoothly. The needle valve should fall under its own weight when withdrawn vertically about 1/3 and released. If its motion is sluggish, replace the nozzle with a new one.



SM3-905

ADJUST THE INJECTION PRESSURE.

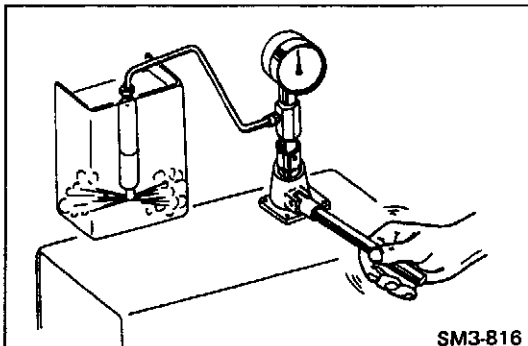
1. Connect the nozzle holder with a nozzle tester and move the lever at the rate of about 50 to 60 times per minute.

Injection Pressure: 220 kg/cm² (3,129 lb/sq.in)

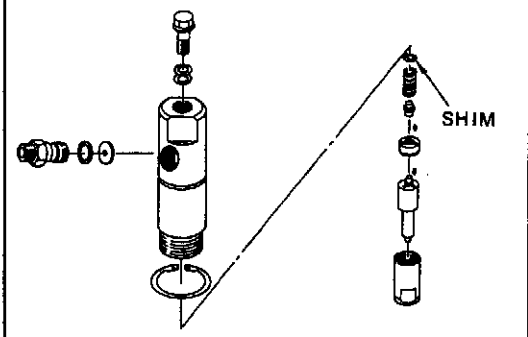
WARNING

- Diesel fuel is flammable. This nozzle adjusting should be done a well ventilated room and away from any open flames or electric spark.
- The spray must always be covered. Keep your face and body away from the spray. This is because of the risk of fuel oil getting in your eyes or passing into your body.

2. If the injection pressure is not within specification, change the shim.

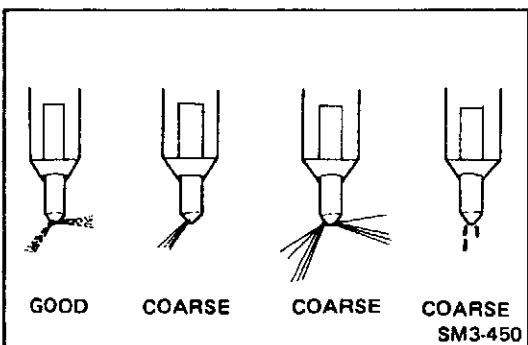


SM3-816



TEST THE SPRAY PROFILE.

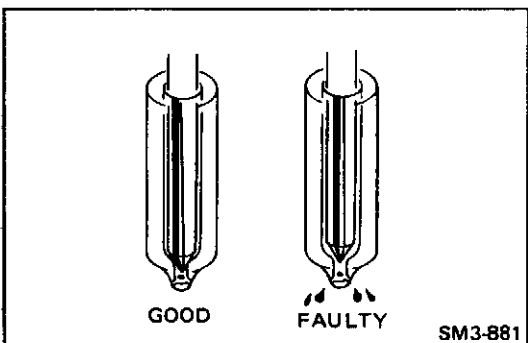
In the case of the new nozzle, operate the lever at the rate of 30 to 60 strokes per minute, and for a used nozzle, operate the lever at the rate of 15 to 60 strokes per minute.



SM3-450

TEST THE FUEL LEAKAGE.

When checking for fuel leakage from the nozzle, apply a pressure of about 10 to 20 kg/cm² (142–284 lb/sq.in) lower than the correct injection pressure to the nozzle by means of the nozzle tester. If there is no fuel leakage, the nozzle is normal.



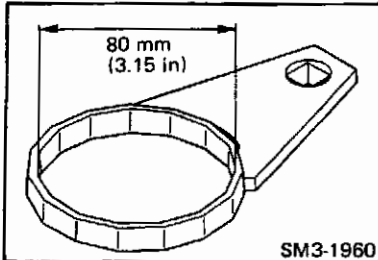
SM3-881

FUEL FILTER

SPECIAL TOOL

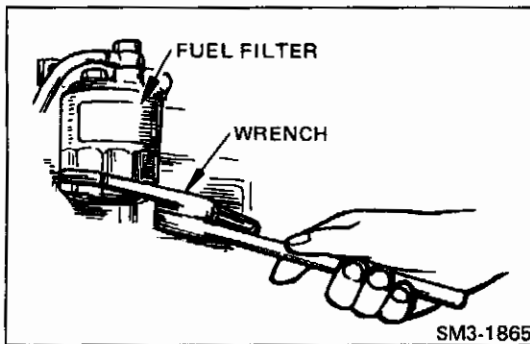
Prior to starting an engine overhaul, it is necessary to have these special tools.

WRENCH



09503-1040

For spin-on type fuel filter



IMPORTANT POINT – DISMOUNTING

REMOVE THE SPIN ON TYPE FUEL FILTER.

Using a special tool, unscrew the fuel filter.

- NOTE:**
- Be careful not to spill diesel fuel.
 - When removing the fuel filter for W04C-TI and W06D-TI, use a suitable wrench.

Special Tool: Wrench (09503-1040) for W04D, W04C-T, W06E

IMPORTANT POINT – MOUNTING

INSTALL THE SPIN-ON TYPE FUEL FILTER.

1. Apply a small amount of diesel fuel to the gasket of a new fuel filter.
2. Manually tighten the new fuel filter until its gasket touches the cover and then tighten another 2/3 turn with a special tool.

NOTE: When installing the fuel filter for W04C-TI and W06D-TI use a suitable wrench.

Special Tool: Wrench (09503-1040) for W04D, W04C-T, W06E

COOLING SYSTEM

DATA AND SPECIFICATIONS

Coolant pump

Type Forced circulation by volute pump

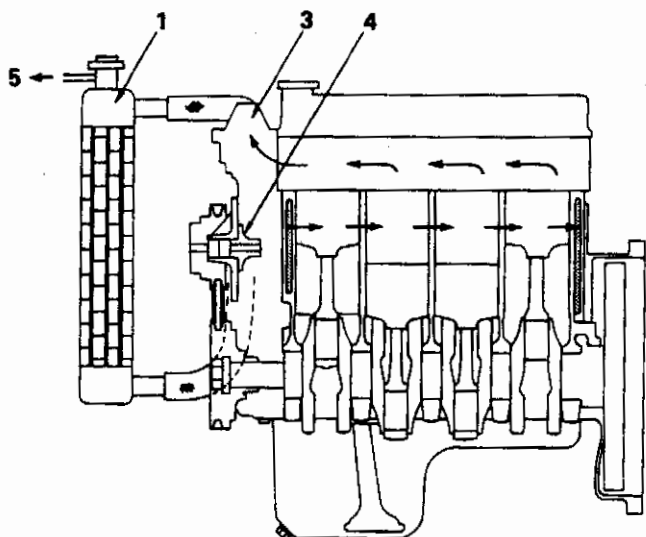
Drive By V-belt

Thermostat

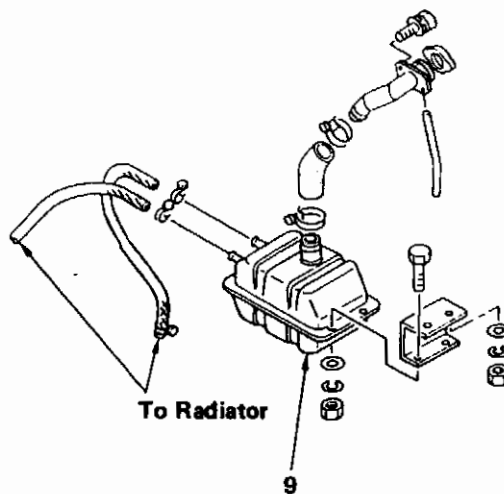
Type Wax type, bottom bypass system

Valve opening temperature 82°C (180°F)

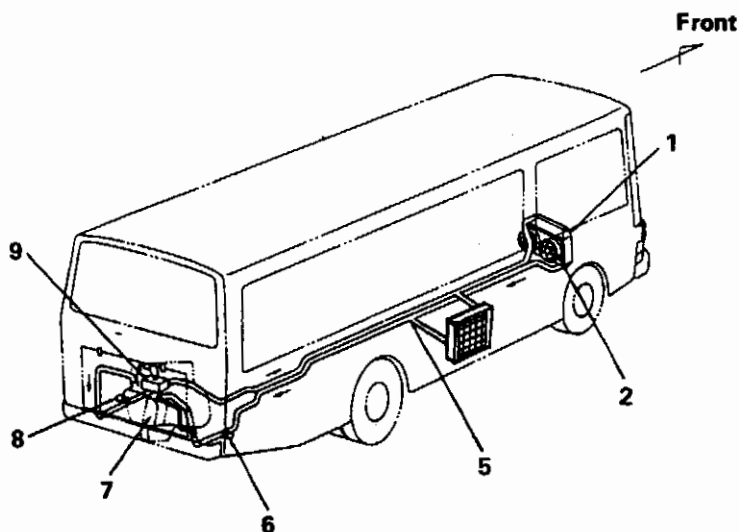
COOLING SYSTEM DIAGRAM



SM3-220A



SM3-1433



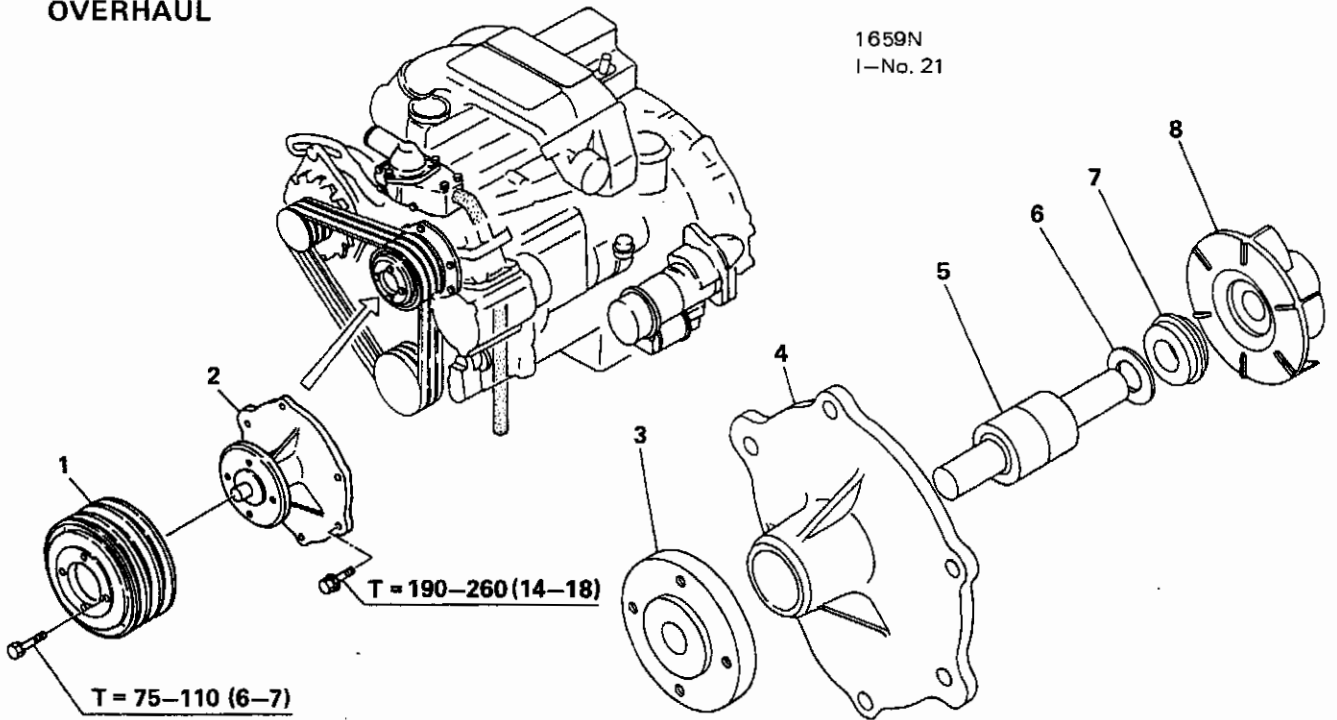
1. Radiator
2. Cooling fan
3. Thermostat
4. Coolant pump
5. Coolant pipe
6. Coolant temperature sensor
7. Engine
8. Overhead sensor
9. Reserve tank

SM3-1445

COOLANT PUMP

OVERHAUL

1659N
I-No. 21

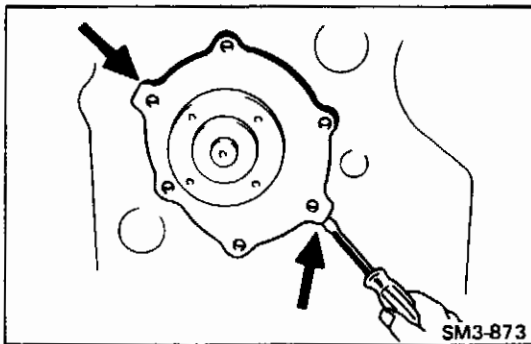


- 1. Coolant pump pulley
- 2. Coolant pump
- 3. Pulley center

- 4. Pump case
- 5. Shaft sub-assembly
- 6. Slinger

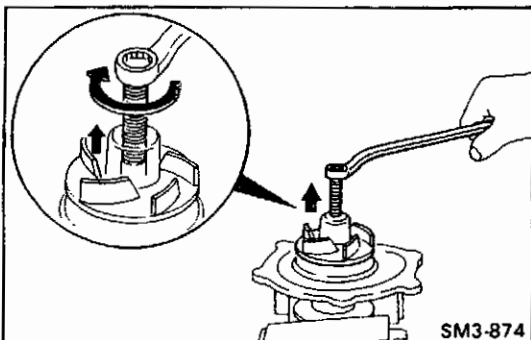
- 7. Coolant seal
- 8. Vane

T = Tightening torque: kg-cm (lb.ft)



IMPORTANT POINT – DISMOUNTING

REMOVE BY PRYING LOOSE WITH SCREWDRIVER AT THE 2 POINTS ON THE FLANGE.



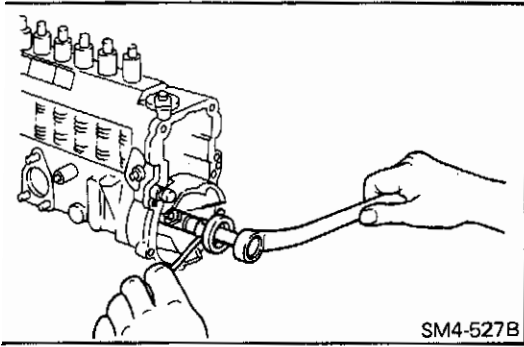
IMPORTANT POINTS – DISASSEMBLY

REMOVE VANE FROM SHAFT BY SCREWING IN A BOLT.

Bolt size;

Diameter: 10 mm (0.394 in)

Pitch: 1.5 mm (0.059 in)

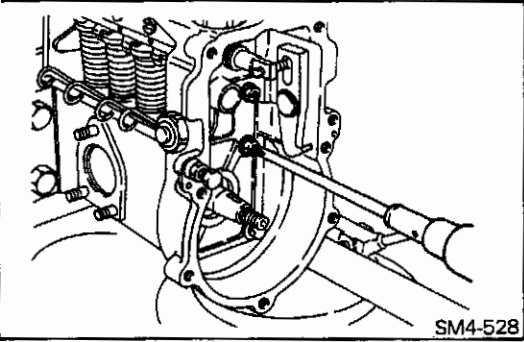


SM4-527B

REMOVE THE FLYWEIGHT FROM THE CAM SHAFT.

Using a flyweight extractor, remove the flyweight from cam shaft.

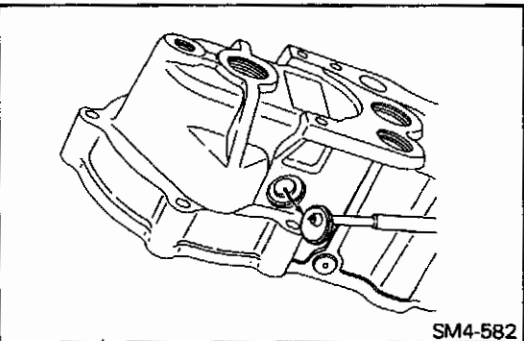
Special Tool: Flyweight extractor (09511-1900)



SM4-528

REMOVE THE GOVERNOR HOUSING FROM THE PUMP BODY.

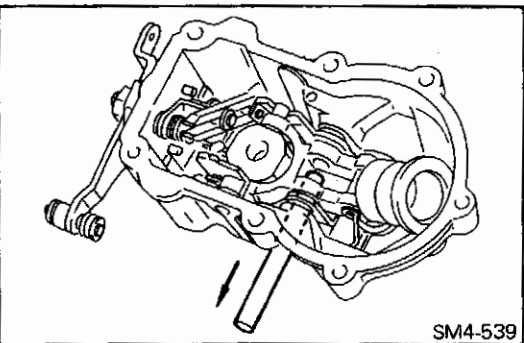
1. Remove the start spring eye.
2. Remove the governor housing fitting bolt and give the governor housing a light tap with a mallet to remove the governor housing from the pump body.



SM4-582

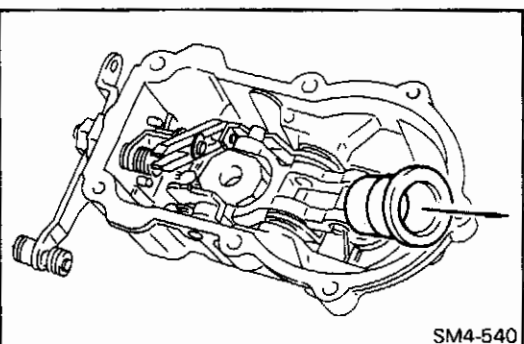
REMOVE THE TENSION LEVER SHAFT.

1. Using a punch, remove the two plugs press-fitted in the governor cover.



SM4-539

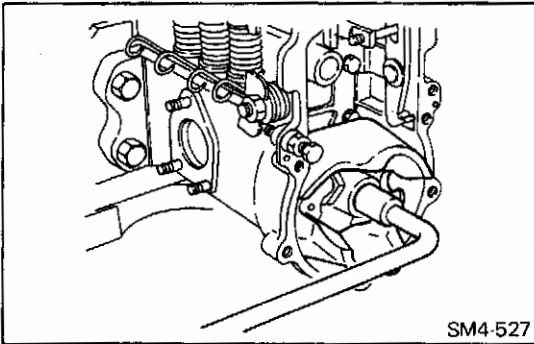
2. Pull out the tension lever shaft.



SM4-540

REMOVE THE TENSION LEVER ASSEMBLY.

1. Remove the snap ring, then remove the rod from the torque cam.
2. Remove the tension lever assembly.



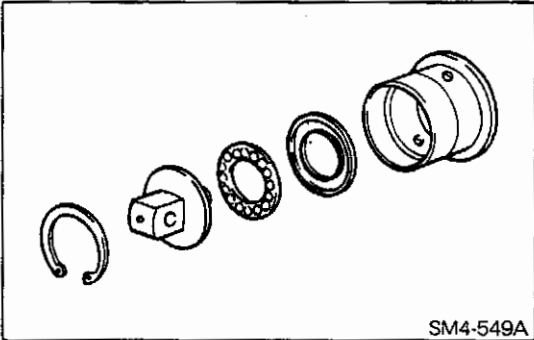
INSTALL THE FLYWEIGHT ASSEMBLY.

1. Install the flyweight assembly on the camshaft.
2. Using the special tool, hold the coupling, so that the camshaft will not turn.

**Special Tool: Coupling (09511-2000)
Holding wrench (09511-1520)**

3. Using a special tool, tighten the round nut.

**Special Tool: Round nut wrench (09511-1500)
Tightening Torque: 500–600 kg.cm (36–43 lb.ft)**



ASSEMBLE THE SLEEVE ASSEMBLY.

1. Install the shim on the shifter.
2. Use a press to install the outer ring on the shifter.
3. Install the bearing and shifter in the sleeve, then install the snap ring.

4. Adjust the shifter setting position.
Insert the sleeve until it comes into contact with the flyweight holder, keep the sleeve against the flyweight holder so that the flyweight lift will be maintained at 0.

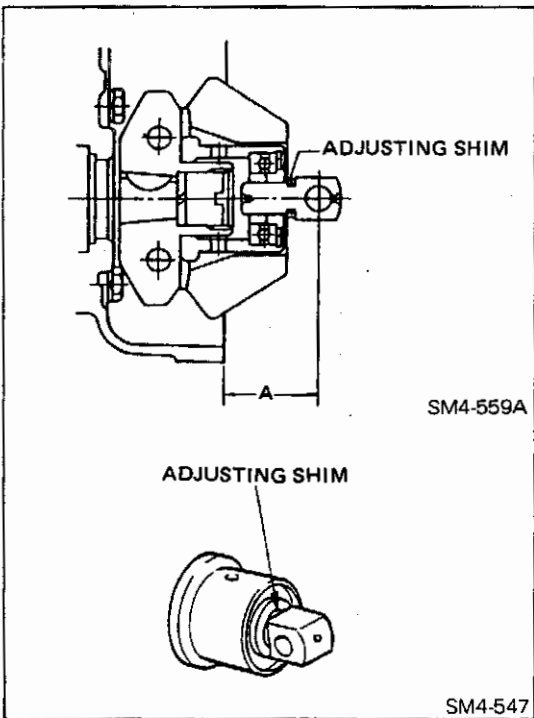
Dimension A: 28.8–29.2 mm (1.13–1.14 in)

If the distance is otherwise, adjust the adjusting shim.

**Shim Thickness: 0.20 mm (0.0078 in) 0.50 mm (0.0196 in)
0.30 mm (0.0118 in) 1.00 mm (0.0393 in)
0.40 mm (0.0157 in) 1.50 mm (0.0590 in)**

NOTE: Be sure to tighten the round nut in the flyweight assembly mounting with the specified torque.

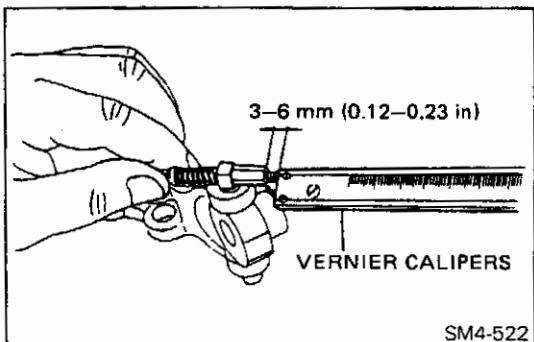
Tightening Torque: 500–600 kg.cm (36–43 lb.ft)



ADJUST THE TORQUE CAM POSITION.

Using the adjusting nut and locking screw to adjust the gap between the locking screw tip and the face of the adjusting nut to the correct dimension.

NOTE: If the adjusting nut is not locked at this time, both the lock screw and adjusting nut may work loose while the injection pump is being adjusted.

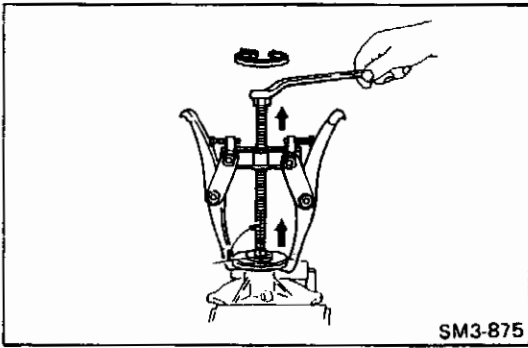


Hino Motors.Ltd.

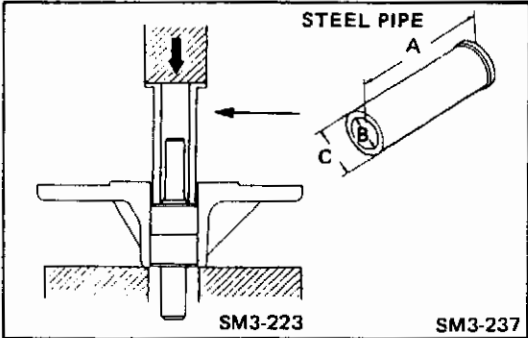
1-1,HINODAI 3-CHOME,HINO-SHI,TOKYO 191-8660 JAPAN

PRINTED IN JAPAN

Pub.No S5-W04E04D

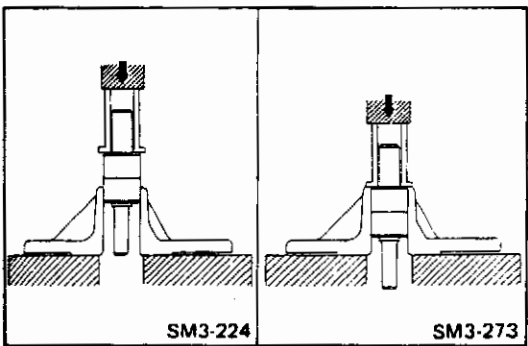


USING A PULLER, REMOVE THE PULLY CENTER FROM THE SHAFT.



USING A STEEL PIPE AND PRESS, REMOVE THE SHAFT FROM BODY.

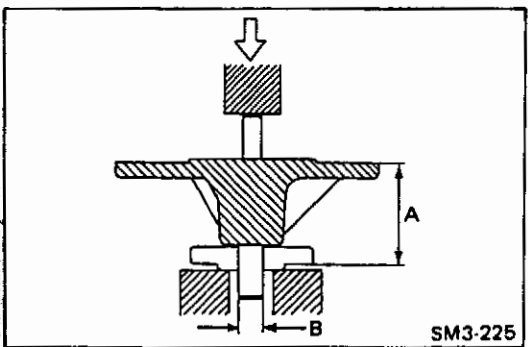
Steel Pipe Dimention: A: More than 57 mm (2.244 in)
B: 18 – 21 mm (0.7087 – 0.8267 in)
C: Less than 29.5 mm (1.161 in)



IMPORTANT POINTS – ASSEMBLY

USING A STEEL PIPE AND PRESS, INSTALL THE SHAFT TO THE CASE.

NOTE: Bearing-face must be aligned with edge of body.

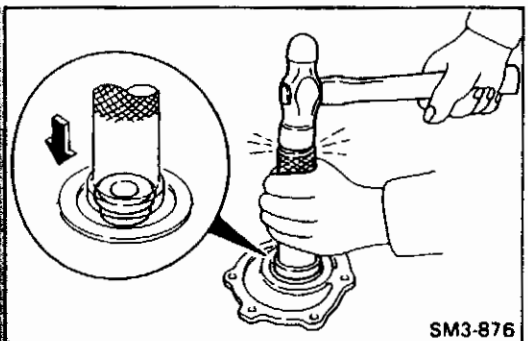


USING A PRESS, INSTALL THE PULLEY CENTER.

Dimension A:

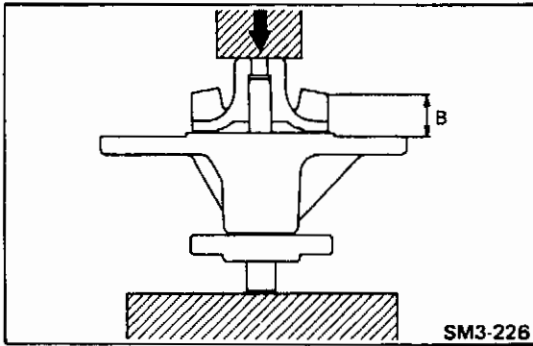
Shaft Diameter (B) 16 mm (0.63 in) : 61.5 mm (2.421 in)

Shaft Diameter (B) 18 mm (0.71 in) : 89.6–90.4 mm
(3.528–3.559 in)



INSTALL THE NEW COOLANT SEAL

1. Apply a little liquid sealer to the coolant seal outer circumference and coolant pump body.
2. Install the slinger and coolant seal.

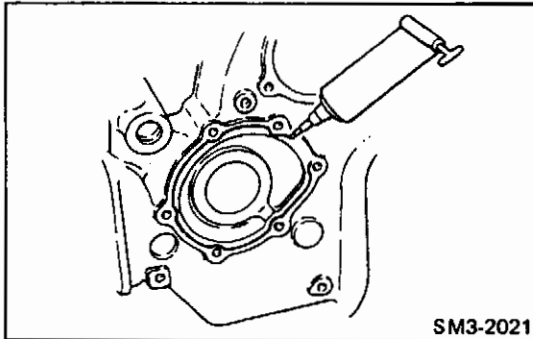


USING A PRESS, INSTALL THE VANE TO THE SHAFT.

NOTE: Apply a little engine oil to the coolant seal face.

Dimension B: 20.7–21.0 mm (0.815–0.826 in)

AFTER THE COOLANT PUMP HAS BEEN ASSEMBLED, CHECK THAT THE SHAFT ROTATES SMOOTHLY.



IMPORTANT POINT – MOUNTING

INSTALL THE COOLANT PUMP TO THE ENGINE.

1. Clean the contacting surface of the coolant pump and timing gear cover free of old sealer, water and oil.
2. Apply the liquid gasket as shown and install the coolant pump within 20 minutes.

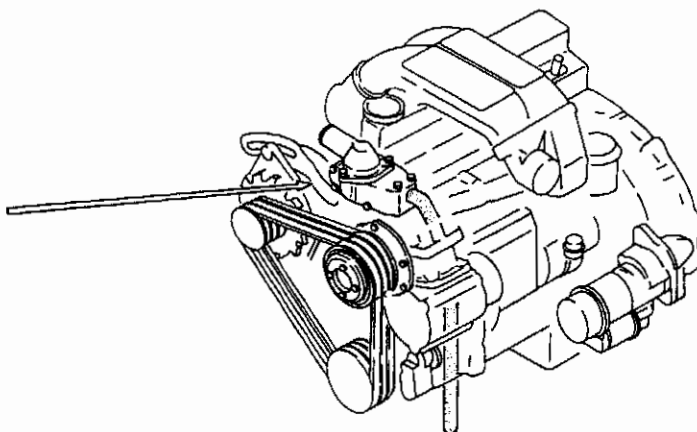
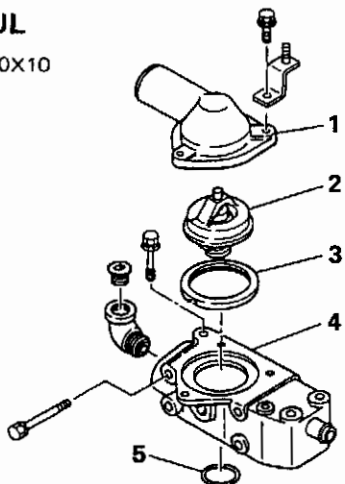
NOTE: If leaving it more than 20 minutes, clean the liquid gasket completely and reapply the liquid gasket.

Coating Width: 1.5–2.5 mm (0.06–0.10 in)

THERMOSTAT

OVERHAUL

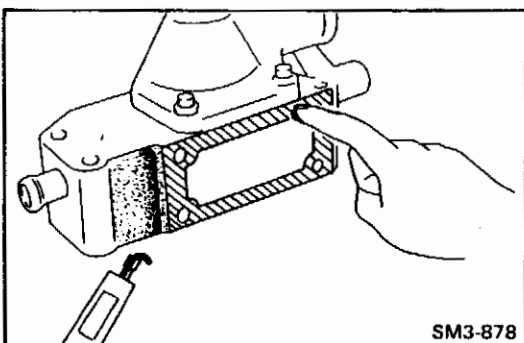
ME11-038-00X10
(1600)



1. Thermostat case cover
2. Thermostat

3. Thermostat gasket
4. Thermostat case

5. O-ring



SM3-878

IMPORTANT POINT – MOUNTING

INSTALL THE THERMOSTAT CASE.

1. Clean the faces.
2. Apply the liquid gasket as shown and install the thermostat case within 20 minutes.

NOTE: If leaving it more than 20 minutes, clean the liquid gasket completely and reapply the liquid gasket.

Coating Width: 1.5–2.5 mm (0.06–0.10 in)

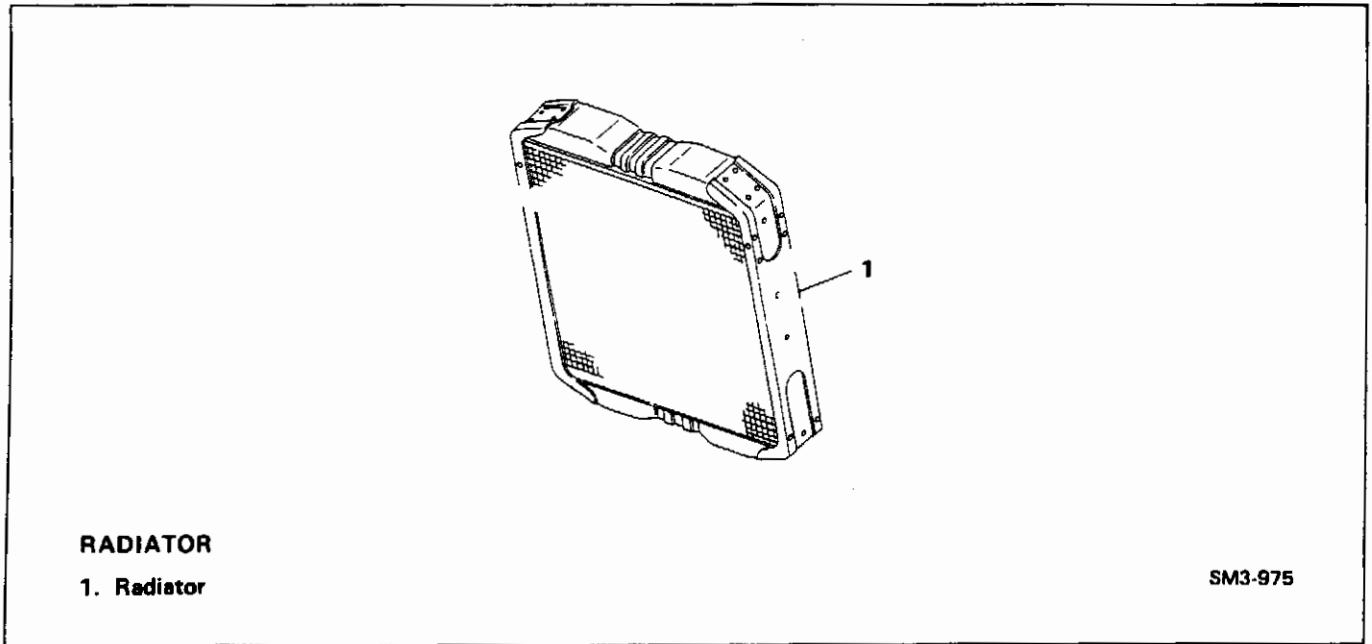
INSPECTION AND REPAIR

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Thermostat Valve Opening Temperature	80–84°C (176–183°F)	—	Replace thermostat	
Thermostat Valve Lift	At least 10 (0.4) at 95°C (203°F)	—		
Thermostat Closing Condition	Fully opened valve should close completely within 5 minutes when thermostat is immersed in water of normal temperature.	—		

SM3-888

RADIATOR



IMPORTANT POINT – DISMOUNTING

DISMOUNT THE RADIATOR.

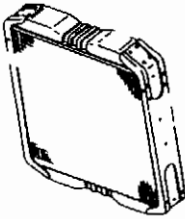
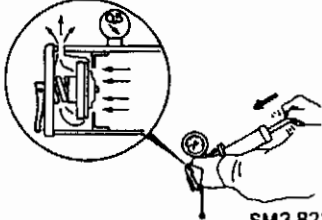
WARNING

To avoid the danger of burns to not drain the coolant while the engine and radiator are still hot.

NOTE: When dismantling and mounting the radiator, do not damage the radiator core.

INSPECTION AND REPAIR

Unit: kg/cm² (lb/sq.in)

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Coolant Leakage		—	—	Replace Radiator	 SM3-975
Clogging of the Fins		—	—	Clean	
Coolant Filler Cap Valve Opening Pressure	0.5	0.4–0.6 (5.7–8.5)	—	Replace, if necessary	 SM3-823
	0.9	0.75–1.05 (10.7–14.9)			

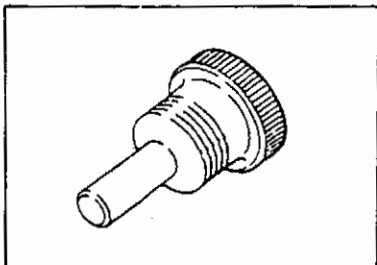
NOTE: The coolant filler cap pressure is shown on the coolant filler cap, and it should be confirmed.

ENGINE COMPONENT PARTS DISMOUNTING AND MOUNTING

SPECIAL TOOL

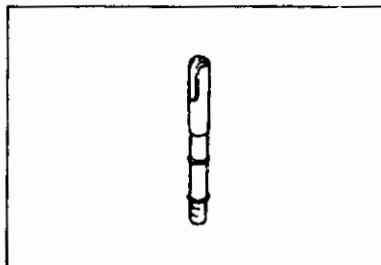
Prior to starting an engine overhaul, it is necessary to have these special tools.

TIMER SETTING TOOL

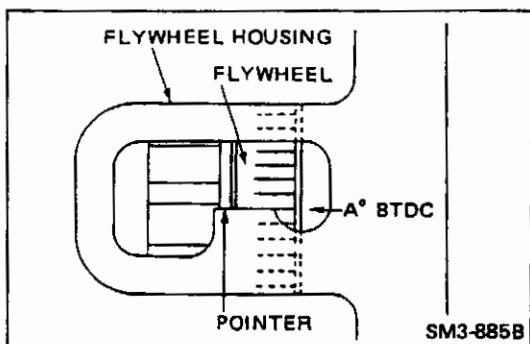


09512-2090 for W04D
09512-2100 for W04C-T

V-BELT TENSION GAUGE



09444-1210



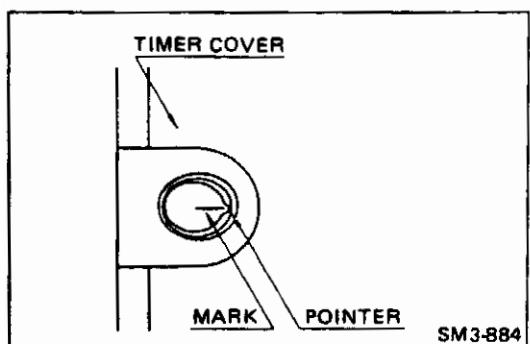
FUEL INJECTION PUMP

IMPORTANT POINTS – DISMOUNTING

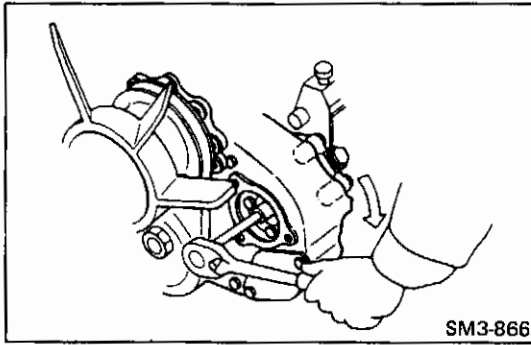
REMOVE THE INJECTION PUMP.

1. Disconnect the fuel lines, oil lines and engine control lines.
2. Turn the crankshaft counter-clockwise viewed from the flywheel side to align the injection timing marks on the flywheel at A° before top dead center for No.1 cylinder on compression stroke.

Injection Timing (A°): Refer to section DATA AND SPECIFICATIONS.



3. Remove the timing inspection hole plug. Check that the injection timing mark on the automatic timer is aligned with timer cover pointer.

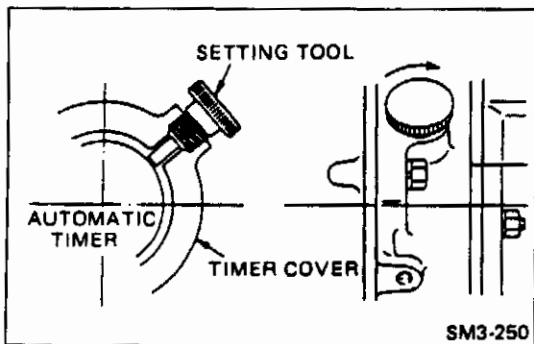


- If not, remove the timing gear cover and then loosen the drive gear fitting bolts.

NOTE: Do not remove the drive gear fitting bolts.

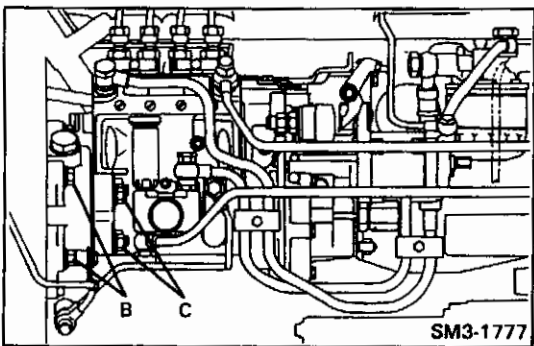
- Rotate the drive gear clockwise to align the injection timing and then tighten the drive gear fitting bolts.

Tightening Torque: 300–350 kg-cm (22–25 lb.ft)



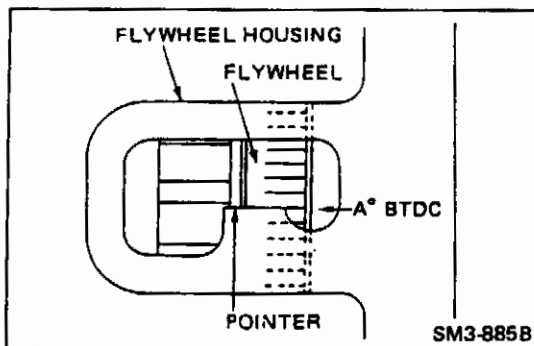
- Lock the automatic timer with a special tool.

**Special Tool: Timer Setting Tool (09512-2090) for W04D
(09512-2100) for W04C-T**



- Loosen the timer cover fitting bolts (B) and then remove the injection pump with timer cover.

NOTE: Do not loosen the injection pump body fitting nuts (C).

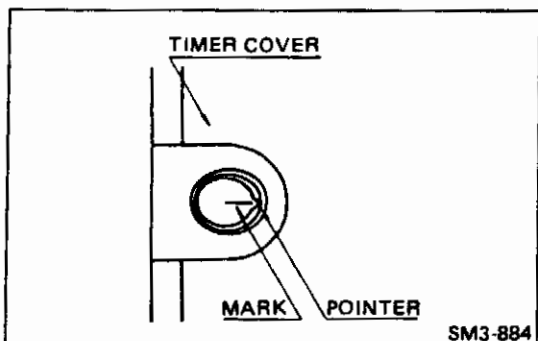


IMPORTANT POINTS – MOUNTING

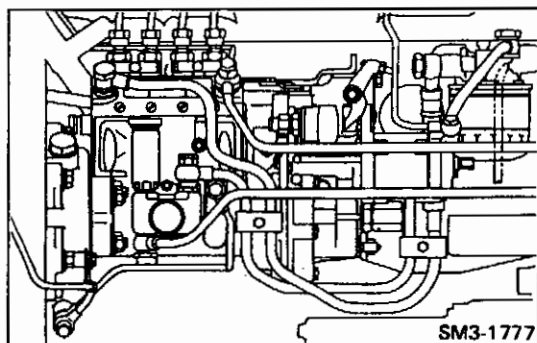
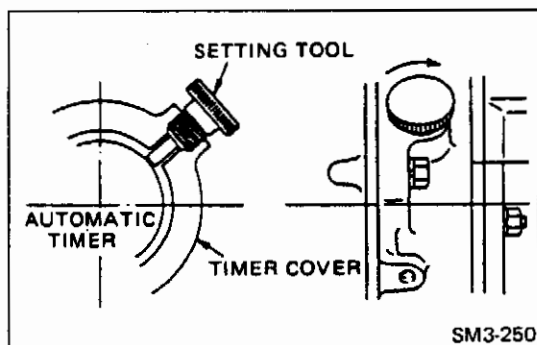
INSTALL THE INJECTION PUMP.

- Check that the injection timing mark on the flywheel is aligned with flywheel housing pointer.

Injection Timing (A°): Refer to section DATA AND SPECIFICATIONS.



- Check that the injection timing mark on the automatic timer is aligned with timer cover pointer.
If not, adjust the injection timing.



3. Lock the automatic timer with a special tool.

**Special Tool: Timer Setting Tool (09512-2090) for W04D
(09512-2100) for W04C-T**

4. Install the injection pump with timer cover.

Fitting Bolts Tightening Torque: 190–260 kg-cm (14–18 lb.ft)

5. Remove a special tool and install the timing inspection hole plug.
6. Connect the fuel lines, oil lines and engine control lines.

ALTERNATOR

IMPORTANT POINT – MOUNTING

1. Install the V-belts, and adjust the belt tension.

NOTE: ○ Do not under any circumstances apply the lever directly against the generator body owing to the risk of damaging the alternator.

- When installing a new V-belt or adjusting the tension, be sure to repeat the adjustment two or three times, after running the engine for several minutes each time.

2. V-belt deflection

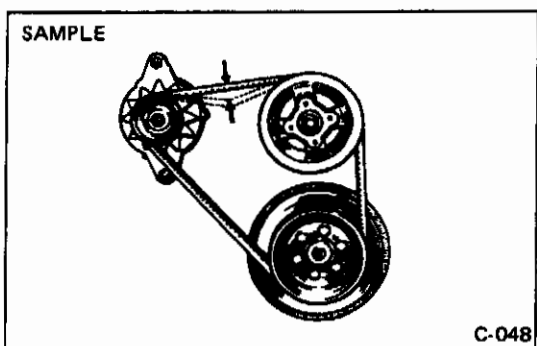
Apply a load of about 10 kg (22 lb) by pressing with your finger (or special tool).

Assembly Standard (A): 10–15 mm (0.40–0.59 in)

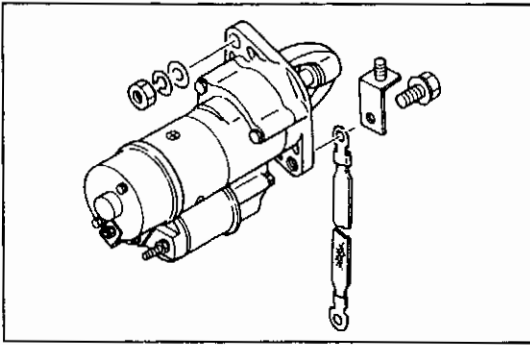
Special Tool: V-belt tension gauge (09444-1210)

NOTE: If the belt is excessively tensioned, there is a risk of damaging the bearings of the alternator or coolant pump and also shorting the life of the V-belt.

Conversely, if there is insufficient tension on the V-belt, the belt, will slip, unusual noise will be emitted, the battery may run down and the engine may overheat.



Through Bolt Tightening Torque: 450–500 kg-cm (33–36 lb.ft)



STARTER

IMPORTANT POINT – DISMOUNTING

REMOVE THE STARTER FROM THE ENGINE.

1. Disconnect the battery cable from the negative (-) terminal of battery.
2. Put the match marks on the harness and starter terminals with a pen and then disconnect the harness.
3. Remove the starter from the engine.

IMPORTANT POINT – MOUNTING

INSTALL THE STARTER ON THE ENGINE.

1. Install the starter on the engine.

Fitting Bolt and Nut Tightening Torque:

12 mm (0.47 in) dia.: 650–900 kg-cm (47–65 lb.ft)

14 mm (0.55 in) dia.: 1,100–1,500 kg-cm (80–108 lb.ft)

2. Connect the starter harness to match the marks.
3. Connect the battery cable.

TURBOCHARGER (FOR W04C-T)

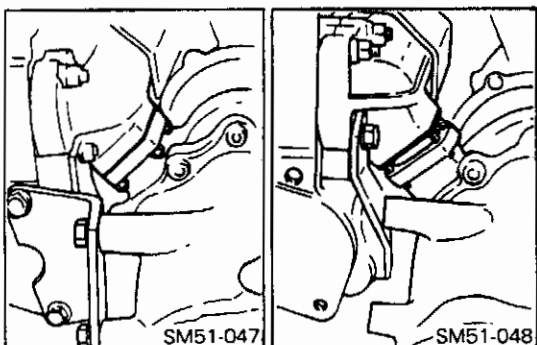
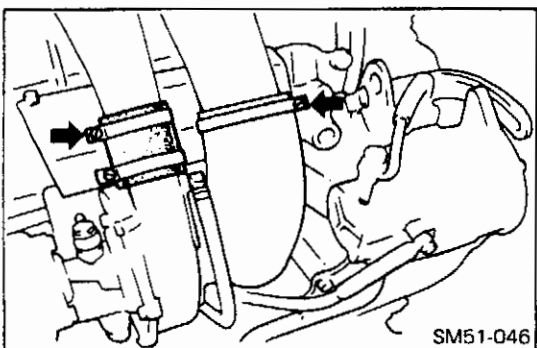
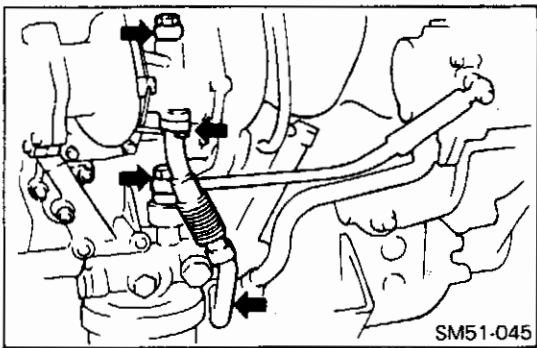
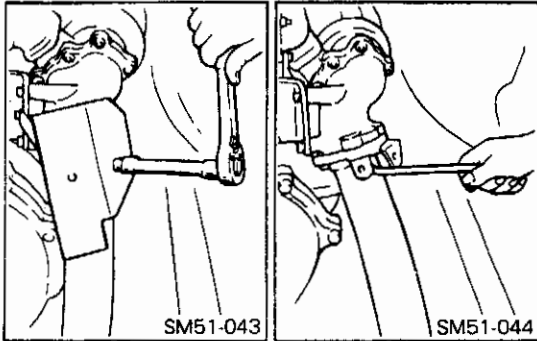
IMPORTANT POINTS – DISMOUNTING

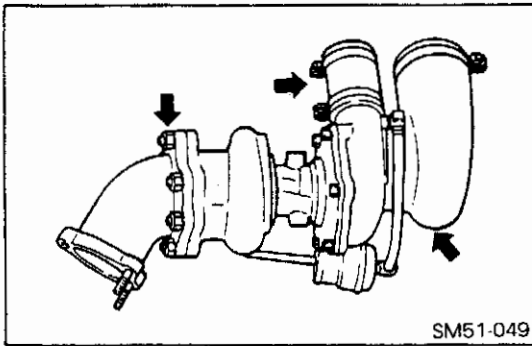
WARNING

Do not work on the turbocharger while it is still hot. This can result in personal injury.

REMOVE THE TURBOCHARGER

1. Remove the exhaust pipe insulator and exhaust pipe from the exhaust connector pipe.
2. Remove the oil lines (inlet oil line and outlet oil line) from the turbocharger.
3. Loosen the intake air duct clamp and intake air hose clamp.
4. Remove the exhaust connector pipe bracket.
5. Remove the turbocharger from the exhaust manifold.

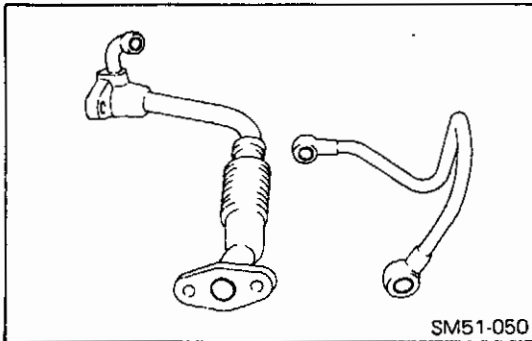




6. Remove the exhaust connector pipe.
7. Remove the intake duct and intake hose.
8. Turbocharger disassembly, inspection and assembly, refer to CHAPTER TU, TURBOCHARGER.

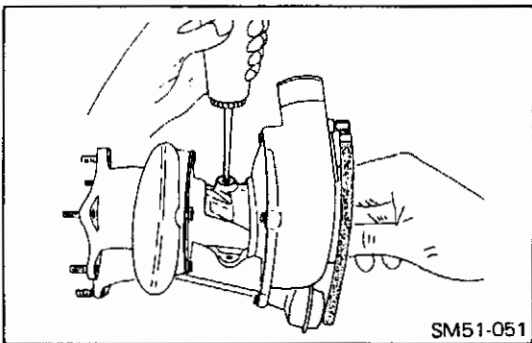
NOTE:

- When the turbocharger has been removed from the engine, openings must be protected to prevent entry of foreign matter.
- Do not carry the turbocharger holding it by the actuator rod.

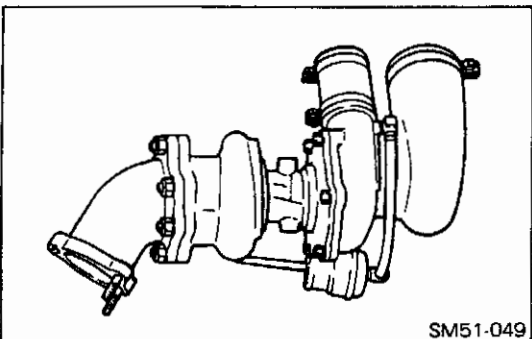


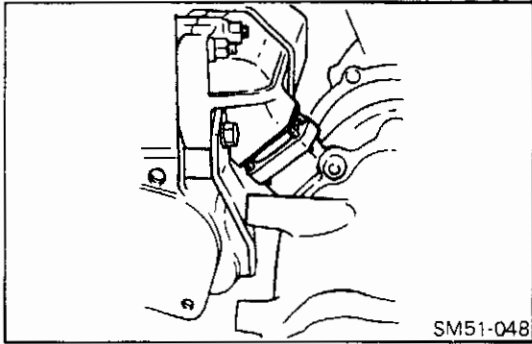
IMPORANT POINTS – MOUNTING PREPARATION

1. Clean the oil inlet pipe and the oil outlet pipe, and check that the pipes are not collapsed and that there is no foreign matter or dirt in the pipes.
2. Remove the protection from the openings of the turbocharger, and check that no dirt or foreign matter has entered.
3. Flow new engine oil into the bearing case through the oil inlet port and rotate the rotor by hand so that the bearings and thrust bearing are properly lubricated.



4. Install the exhaust connector pipe using a new gasket.
Tightening Torque: 200–250 kg-cm (15–18 lb.ft)
5. Install the intake duct and intake hose.

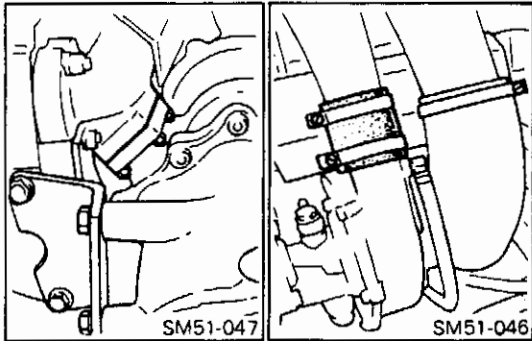




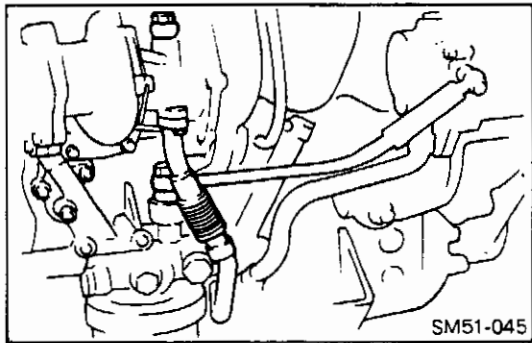
INSTALL THE TURBOCHARGER.

1. Install the turbocharger on the exhaust manifold using a new gasket.

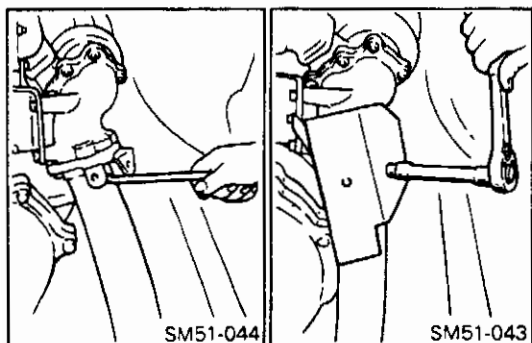
Tightening Torque: 450–500 kg-cm (33–36 lb.ft)



2. Install the exhaust connector pipe bracket.
3. Tighten the intake air duct clamp and intake air hose clamp.



4. Install the oil lines (inlet oil line and outlet oil line).



5. Install the exhaust pipe and insulator.

Tightening Torque:

Exhaust pipe: 450–500 kg-cm (33–36 lb.ft)

CHECK TURBOCHARGER OPERATION.

NOTE: When the engine starts, make sure the oil pressure warning lamp is off and then warm up the engine by running it at low idle.

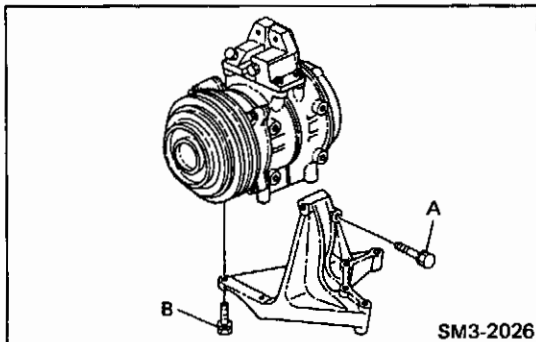
CAR COOLER COMPRESSOR

IMPORTANT POINTS – MOUNTING

ASSEMBLE THE COMPRESSOR TO THE COMPRESSOR BRACKET.

1. Temporarily install the compressor to the bracket.
2. Tighten the bolt (A).
3. Tighten the four bolts (B).

Tightening Torque: 320–460 kg-cm (24–33 lb.ft)

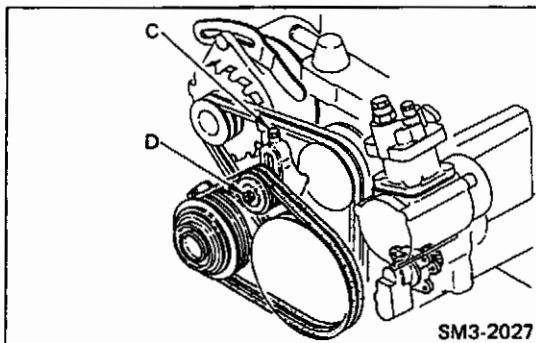


ADJUST THE V-BELT TENSION.

1. Adjust the belt tension using the adjusting bolt (C), then tighten the nut (D) of the idle pulley shaft.

Tightening torque of nut (D):

700–900 kg-cm (51–65 lb.ft)



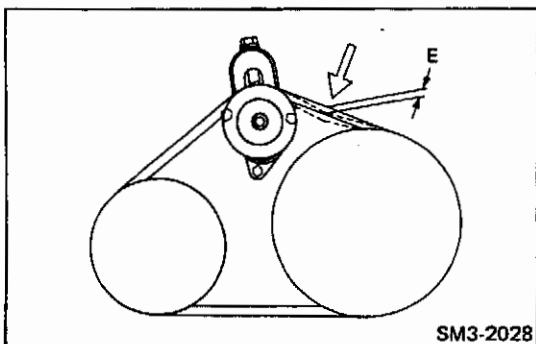
2. V-belt deflection.

Apply a load of approx. 10 kg (22 lb) by pressing with your finger or a special tool.

Assembly Standard E: 7–10 mm (0.28–0.39 in)

Special Tool: V-belt Tension Gauge (09444-1210)

NOTE: When installing a new V-belt, be sure to repeat the adjustment two or three times after running the engine for several minutes each time.



VACUUM PUMP

IMPORTANT POINT – MOUNTING

ADJUST THE V-BELT TENSION.

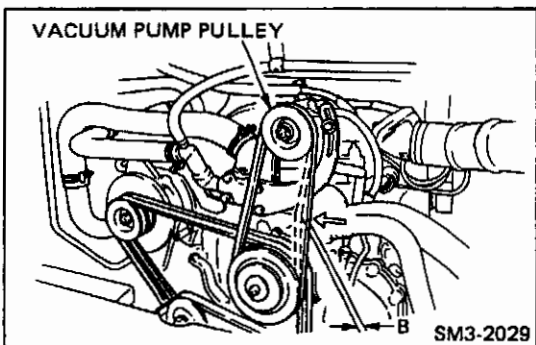
V-belt deflection

Apply a load of approx. 10 kg (22 lb) by pressing with your finger or a special tool.

Assembly Standard A: 10–14 mm (0.40–0.55 in)

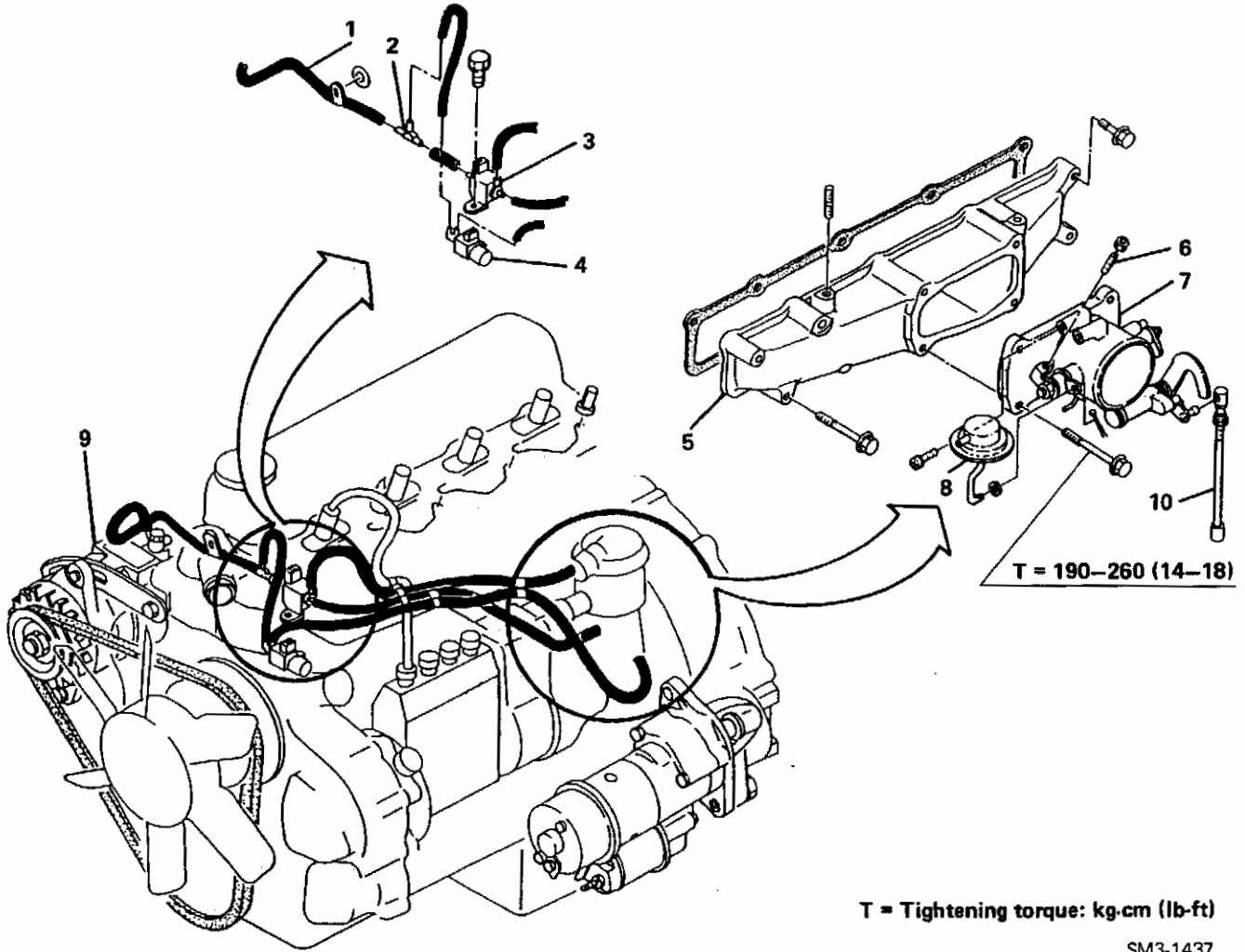
Special Tool: V-belt Tension Gauge (09444-1210)

NOTE: When installing a new V-belt, be sure to repeat the adjustment two or three times after running the engine for several minutes each time.



NOISE SUPPRESSOR (FOR W04D)

OVERHAUL



- 1. Vacuum hose
- 2. Pipe connector
- 3. Vacuum switching valve (Type I)
- 4. Vacuum switching valve (Type II)
- 5. Intake manifold

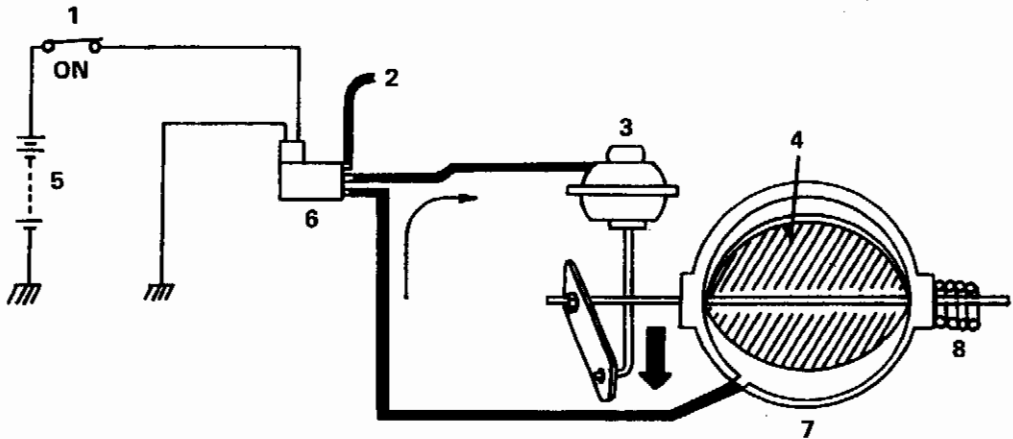
- 6. Adjusting screw
- 7. Noise suppressor assembly
- 8. Actuator assembly
- 9. Alternator assembly with vacuum pump
- 10. Link rod

T = Tightening torque: kg·cm (lb·ft)

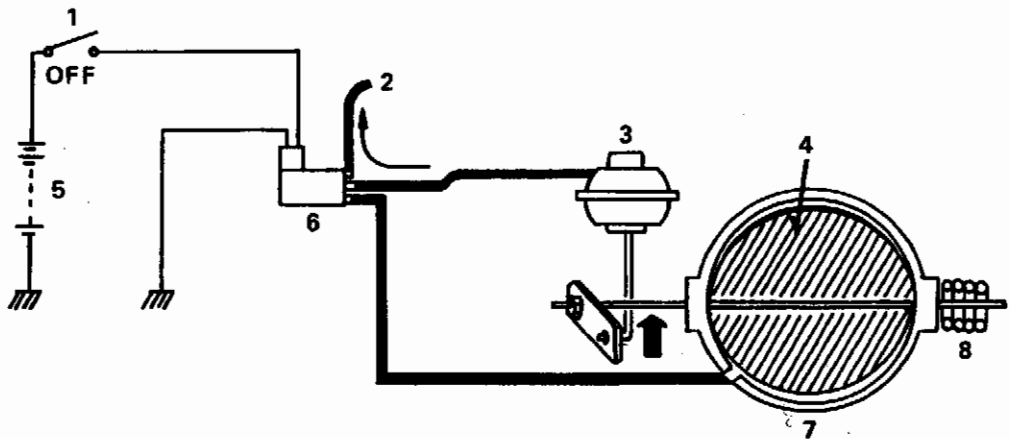
SM3-1437

Operation of the noise suppressor

Opening



Closed

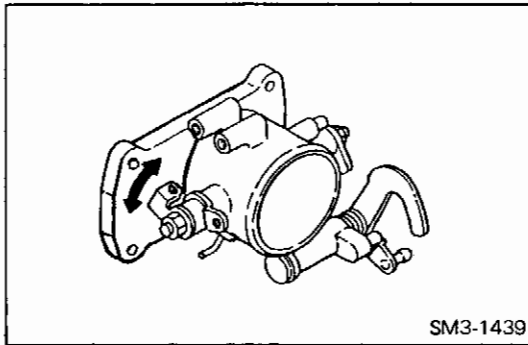


- 1. Stater switch
- 2. To vacuum pump
- 3. Actuator assembly
- 4. Butterfly valve

- 5. Battery
- 6. Vacuum switching valve
- 7. Noise suppressor assembly
- 8. Return spring

IMPORTANT POINTS – ASSEMBLY

INSPECT FOR THE BUTTERFLY VALVE SHAFT MOVES SMOOTHLY.



INSPECT THE NOIZE SUPPRESSOR FUNCTION.

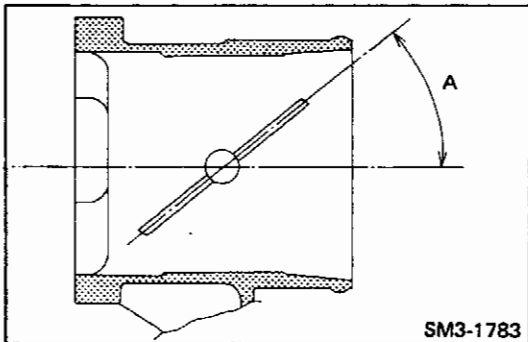
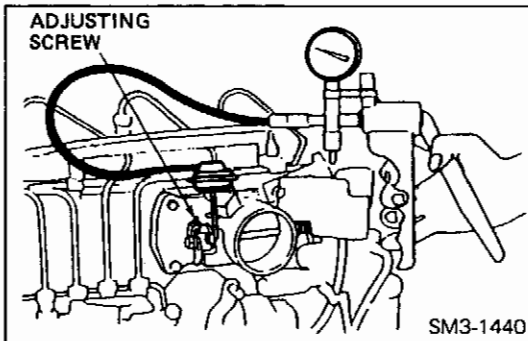
1. Using a vacuum generator, apply vacuum pressure and make sure that the butterfly valve moves from the opening position to the closed position.

Vacuum Pressure: Approx. 300 mmHg (11.8 inHg)

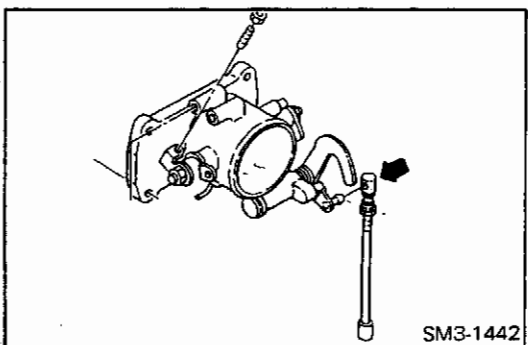
2. Check the butterfly valve opening angle. If not correct, adjust the opening angle with the adjusting screw.

Butterfly Valve Opening Angle (A): 38°–40°

3. Lock the adjusting screw with a lock nut.



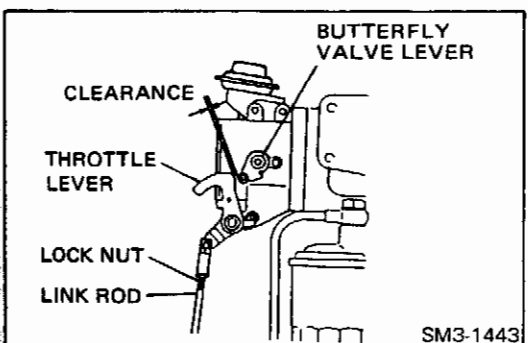
4. Inspect the clearance between the throttle lever and the butterfly valve lever.
 - a. Connect the throttle lever and the link rod.

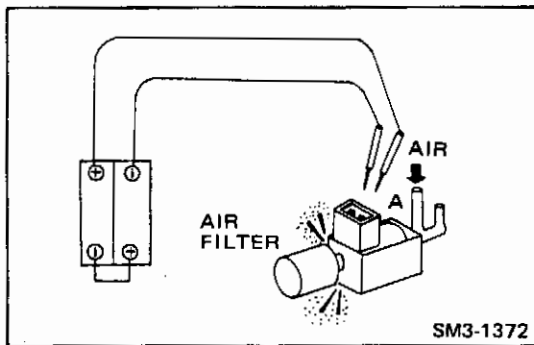
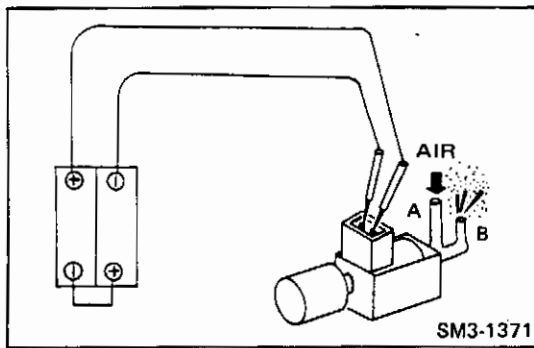
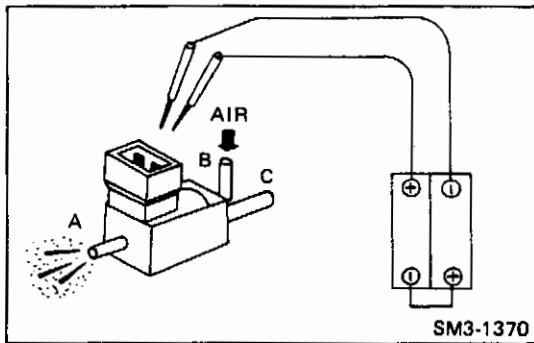
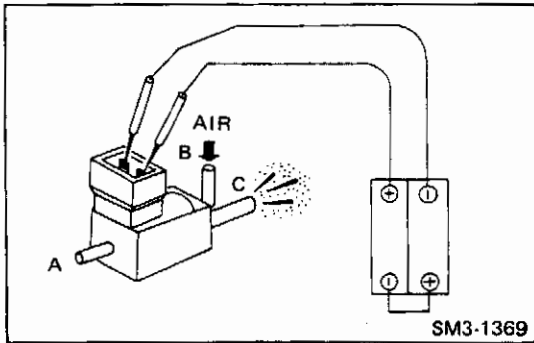


- b. Start the engine (Idling speed) and adjust the clearance between the throttle lever and the butterfly valve lever with the link rod.

Clearance: 3.3–4.7 mm (0.129–0.185 in)

- c. Lock the link rod with a lock nut.





INSPECT THE VACUUM SWITCHING VALVE FUNCTION.

1. Inspect the vacuum switching valve (Type I).
 - a. Connect the switching valve terminals to the battery terminals as shown.
 - b. Blow air into port B and check that air comes out of port C.
 - c. Disconnect the battery connections.
 - d. Blow air port B and check that air comes out of port A.

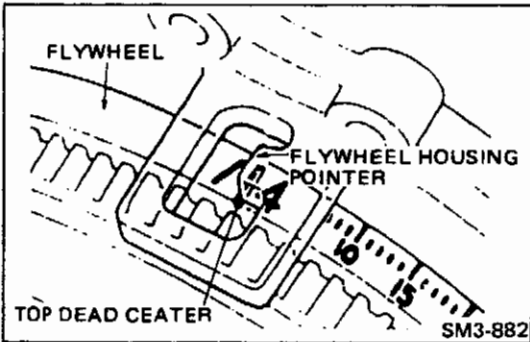
2. Inspect the vacuum switching valve (Type II)
 - a. Connect the switching valve terminals to the battery terminals as shown.
 - b. Blow air into port A and check that air comes out of port B.
 - c. Disconnect the battery connections.
 - d. Blow air port A and check that air comes out air filter.

ENGINE TUNE-UP

VALVE CLEARANCE

INSPECTION AND ADJUSTMENT OF THE VALVE CLEARANCE

1. Set the No. 1 piston to top dead center on compression stroke.



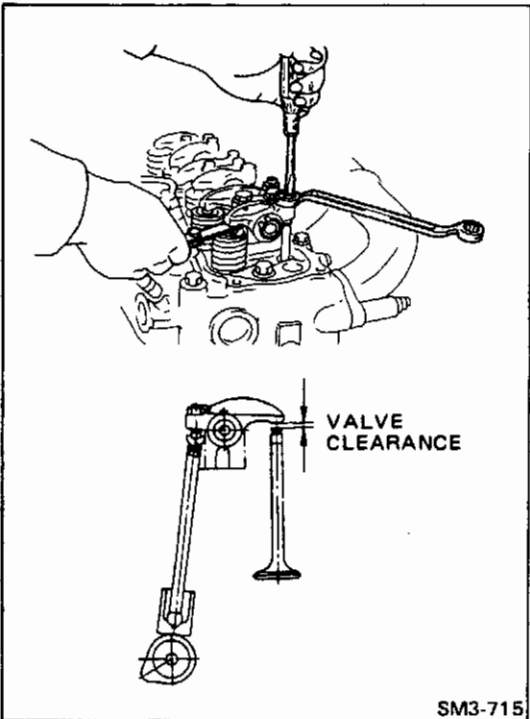
2. With the No. 1 piston positioned at top dead center and of the compression stroke, adjust the No. 1 valve clearance using a thickness gauge. The thickness gauge should move with a very slight pull.

Valve Clearance: Unit: mm (in)

Model	Intake	Exhaust
W04C-T	0.30 (0.0118)	0.45 (0.0177)
W04D	0.30 (0.0118)	0.40 (0.0157)

3. Adjust the other valves. Turn the crankshaft counter-clockwise 180° viewed from the flywheel side. Adjust the valve clearance for each cylinder in the firing order.

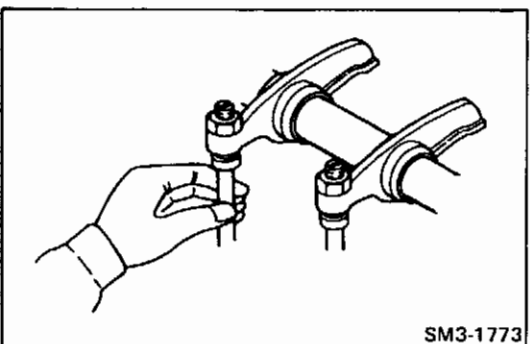
Firing Order: 1-3-4-2

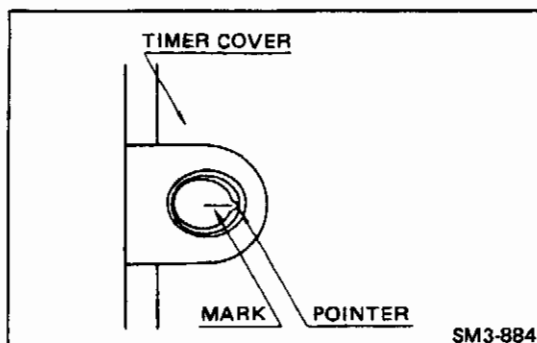
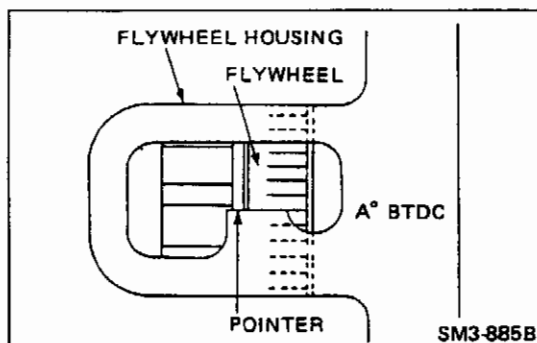
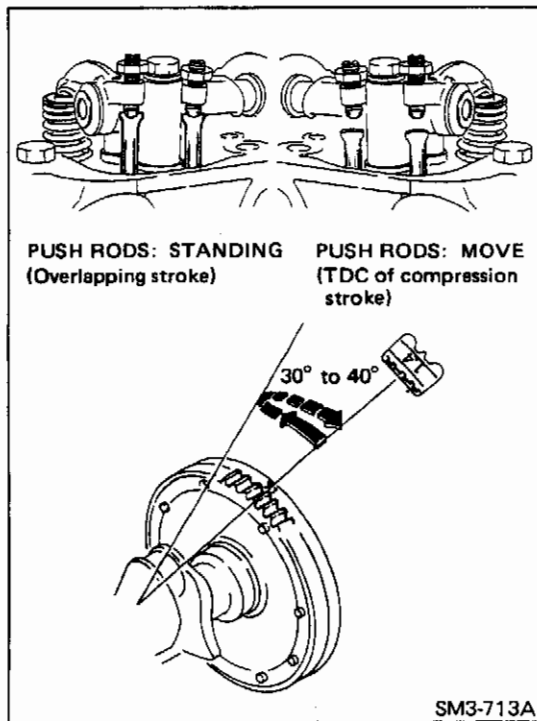
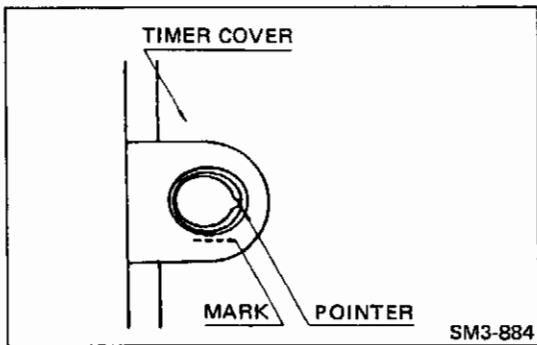


METHODE FOR DETERMINING IF THE NO.1 OR NO.4 PISTON IS AT THE TOP DEAD CENTER ON COMPRESSION STROKE.

Turning the crankshaft, align the mark "1-4" on the flywheel with the pointer on the flywheel housing. In this position either the No. 1 or No. 4 piston is at the top dead center on compression stroke.

1. If both the No. 1 intake and exhaust rocker arms can be moved easily by hand, the No. 1 piston is at top dead center on compression stroke.





- If the injection timing mark is nearly aligned with the pointer, the No. 1 piston is at top dead center of the compression stroke.

NOTE: If not, turn the crankshaft one complete revolution and align marks as above.

- While looking at the push rod of No. 1 and No. 4 pistons. Turn the flywheel anticlockwise and clockwise about 30° to 40° (see left figure).
If the piston whose exhaust and inlet push rods do not move during the interval, it is at the top dead center of the compression stroke.
If the piston whose push rods have moved, it is at the completion of the exhaust and begun of the intake stroke (overlapping stroke).

TDC: Top Dead Center

NOTE: Always loosen the lock nut and raise the adjusting screws fully to the top. If the adjusting screws are too low, the piston and valves may strike each other during valve clearance adjustment.

INJECTION TIMING

INSPECT THE INJECTION TIMING.

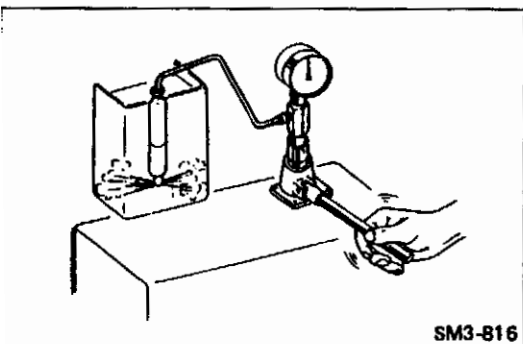
- Turn the crankshaft counter-clockwise viewed from the flywheel side to align the injection timing marks on the flywheel at A° before top dead center for No. 1 cylinder on compression stroke with pointer on the flywheel housing.

Injection Timing (A°): Refer to section **DATA AND SPECIFICATIONS**.

BTDC: Before Top Dead Center

- Check that the injection timing mark on the automatic timer is aligned with timer cover pointer.
If not, adjust the injection timing.

NOTE: When adjusting the injection timing, refer to "FUEL INJECTION PUMP" in section **ENGINE COMPONENT PARTS** for details.



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INJECTION NOZZLE

INSPECT AND ADJUST THE INJECTION PRESSURE.

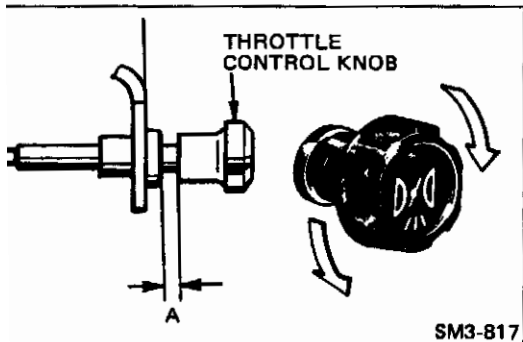
Refer to "INJECTION NOZZLE" in SECTION FUEL SYSTEM.

TEST THE SPRAY PROFILE.

Refer to "INJECTION NOZZLE" in SECTION FUEL SYSTEM.

TEST THE FUEL LEAKAGE.

Refer to "INJECTION NOZZLE" in SECTION FUEL SYSTEM.



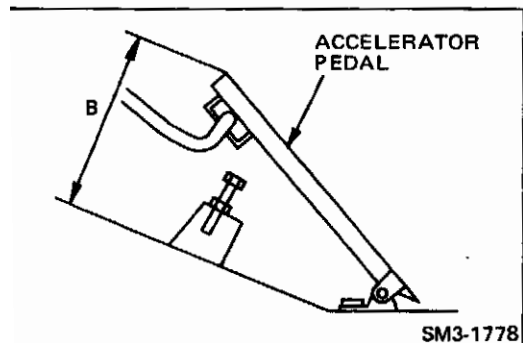
SM3-817

ENGINE CONTROL

ADJUST THE ACCELERATOR.

1. Rotate the throttle control knob and set the dimension to "A" mm.

Dimension A: Approx. 5 mm (0.20 in) for FB, FC, RB, AB
Approx. 8 mm (0.31 in) for KM



SM3-1778

2. Check that accelerator pedal height is "B" mm. If not, adjust the control cable adjusting nut.

Dimension B: Right hand drive

Right hand drive

131–136 mm (5.16–5.35 in) for FB, FC, RB, AB115KA

163–173 mm (6.42–6.81 in) for KM

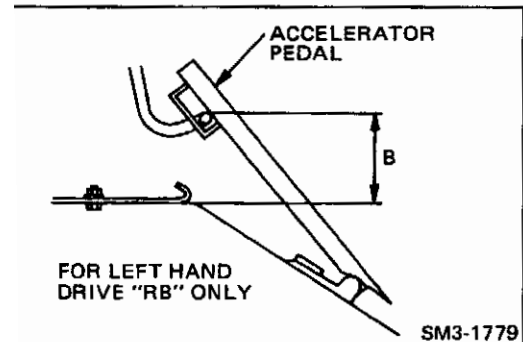
136–141 mm (5.36–5.55 in) for AB2WGKA

Left hand drive

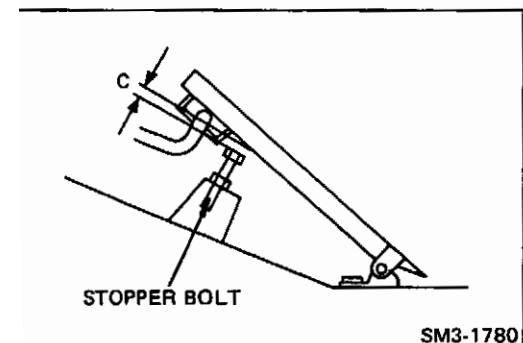
145–150 mm (5.71–5.90 in) for FB, FC

163–173 mm (6.42–6.81 in) for KM

60–63 mm (2.37–2.48 in) for RB



SM3-1779



SM3-1780

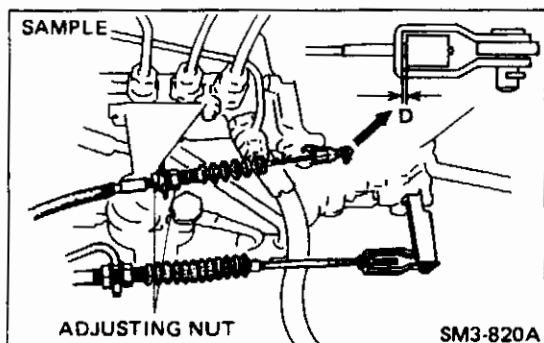
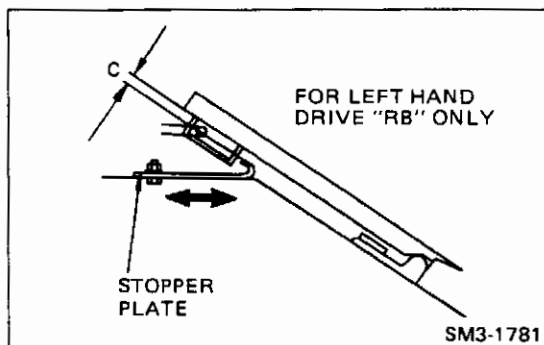
3. Adjust the accelerator stopper bolt or plate (for left hand drive RB) so that the distance between the pedal and pedal stopper is "C" mm when the control lever strikes the injection pump stopper.

Dimension C: 2–5 mm (0.08–0.20 in)

NOTE: Eliminate slack in the cable of the control lever of the injection pump.

4. Confirm the engine idling speed.

Engine idling speed: 600–650 rpm.



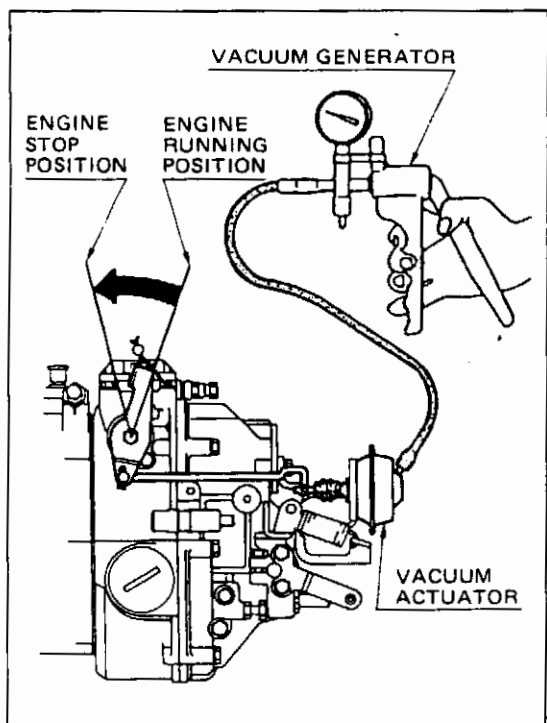
ADJUST THE ENGINE STOP.

(For model equipped with manual engine stop system.)

Adjust the adjusting nut so that the clearance is to "D" mm.

Dimension D: 1–3 mm (0.04–0.12 in)

NOTE: After the adjustment, confirm correct execution of engine start and stop.



INSPECT THE ENGINE STOP.

(For model equipped vacuum type engine stop system.)

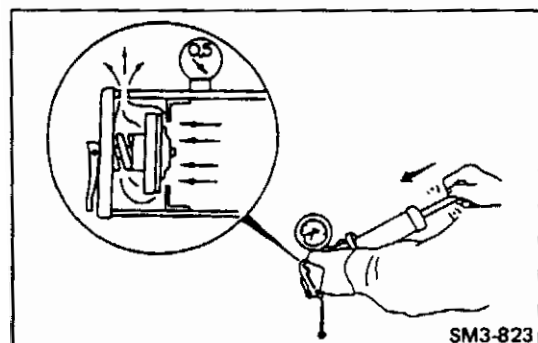
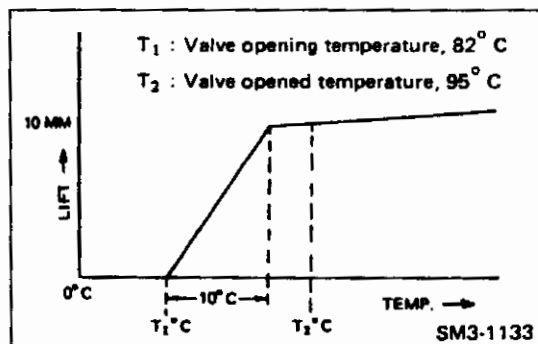
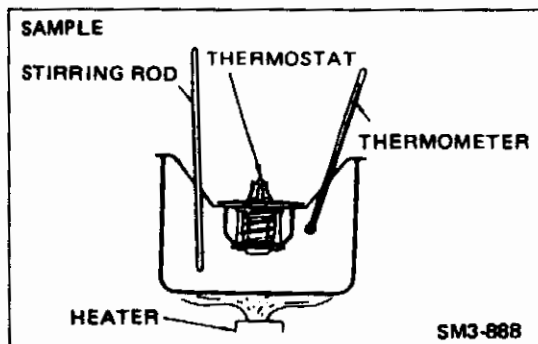
1. Disconnect the vacuum hose from the vacuum actuator, then cover open end of the vacuum hose to prevent entry of dirt.
2. Connect the vacuum generator to the vacuum actuator.
3. Start the engine and then confirm idling speed.

Engine idling speed: Refer to section DATA AND SPECIFICATIONS.

NOTE: Do not set the starter key at OFF or ACC position while engine running.

4. Apply vacuum pressure and make sure that engine is stopped.

Vacuum pressure: 570–600 mmHg (22.5–23.6 in.Hg)



THERMOSTAT

INSPECT THE THERMOSTAT FUNCTION.

1. Place the thermostat in hot water and check the opening temperature and the lift.
2. Using a thermometer, check to see the thermostat opens at the specified temperature: $80\text{--}84^{\circ}\text{C}$ ($176\text{--}183^{\circ}\text{F}$).
3. Immerse the thermostat in hot water of a temperature of 95°C (203°F), and measure the lift of the pellet after a period of 5 minutes using vernier calipers. Measure the position of the bottom of the pellet before and after heating the thermostat.

Lift: At least 10 mm (0.4 in) (95°C (203°F))

4. Immerse a heated thermostat in water of normal temperature. If it completely closes within 5 minutes it is satisfactory. If it remains even slightly open, it is defective and must be replaced.

COOLANT FILLER CAP

INSPECT THE COOLANT FILLER CAP FUNCTION.

Check the filler cap pressure using a cap tester.

0.5 : $0.4\text{--}0.6\text{ kg/cm}^2$ ($5.7\text{--}8.5\text{ lb/sq.in}$)

0.9 : $0.75\text{--}1.05\text{ kg/cm}^2$ ($10.7\text{--}14.9\text{ lb/sq.in}$)

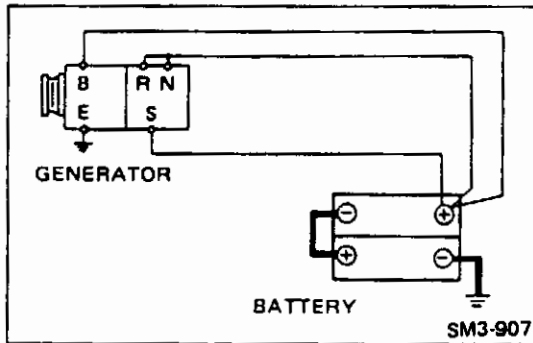
- NOTE:**
- The cap pressure is shown on the coolant filler cap, and it should be confirmed.
 - If the cap pressure is incorrect, there is a risk of abnormally high pressure being generated in the cooling system, which may cause the hose to drop off or burst and, in turn, damage the engine.

WARNING

Do not remove the cap while the engine and cooling system are still hot.

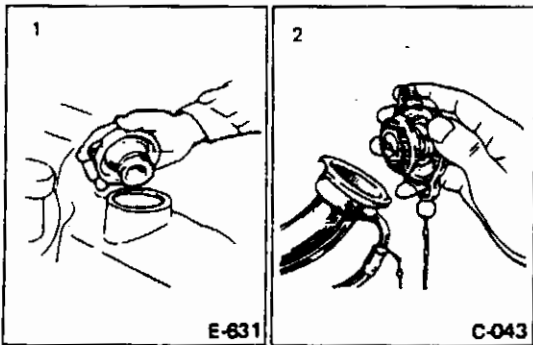
If the cap is removed while the engine and cooling system are still hot, scalding water and steam under pressure can be blown out. This can result in personal injury.

ENGINE TUNE-UP ON TEST BENCH



NOTE: ○ If the engine is started with the power steering oil pump installed, the oil pump may burn or oil may spurt out, so the following should be observed:

1. For belt-drive oil pumps, remove the V-belt.
 2. For gear-drive oil pumps, remove the oil pump from the engine and install a cover to prevent oil leakage from the point of removal.
- Starting the engine when the generator is not connected to the battery may damage the generator. Always connect to the battery.



SET THE ENGINE ASSEMBLY ON A TEST BENCH.

1. Add the proper amount of the specified engine oil through the oil filler cap on the cylinder head cover.
2. Add coolant.
Bleed out air from inside the coolant gallery through the cylinder block drain plug.

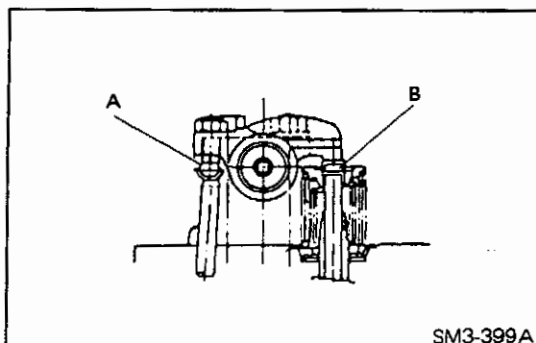
BLEED AIR FROM FUEL SYSTEM.

Refer to section FUEL SYSTEM.

CHECK THE INJECTION TIMING.

Refer to "FUEL INJECTION PUMP" in section ENGINE COMPONENT PARTS DISMOUNTING AND MOUNTING.

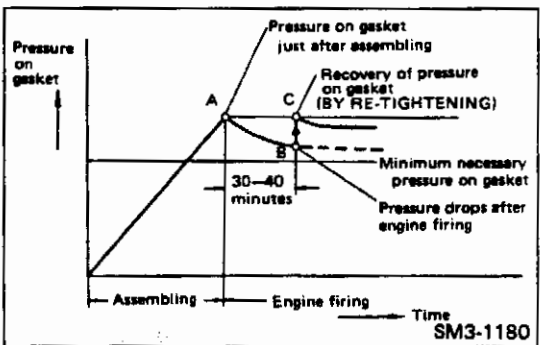
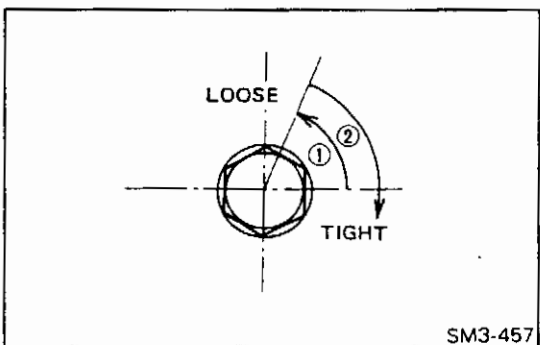
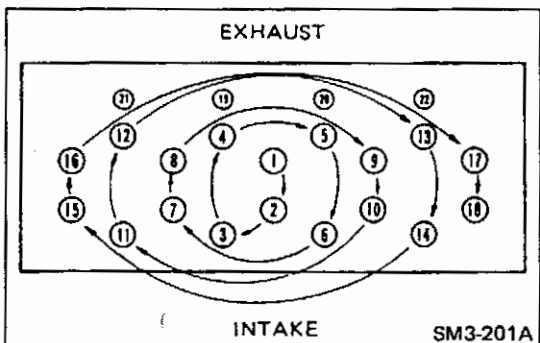
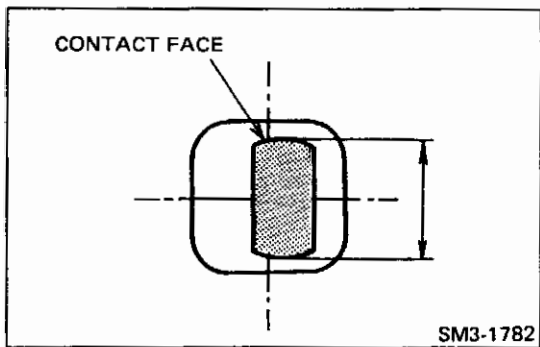
CHECK THE VALVE CLEARANCE.



START THE ENGINE.

NOTE: Before starting the engine, make sure that the fuel cut lever of the fuel injection pump is operating normally.

1. Check the oil feed to rocker arms.
 - a. Set the engine speed to 600–650 rpm.
 - b. Within one minute after starting the engine, oil should flow to the head (Face A) of all push rods and the head (Face B) of all valves. If the time required for the oil to flow to the rocker arms is long, various troubles such as seizing, abnormal wear and unusual noise may occur.



2. Check the contact of the rocker arm and valve stem caps. After running the engine, a contact of approx. 8 mm (0.315 in) should be obtained at the cap contact face of the rocker arm. If the contact face is one sided, the valve will tilt, resulting in valve seizure, breakage, damage, or wear of the rocker arm stem cap.

3. Retighten the cylinder head bolts. After tightening cylinder head bolt to specified torque, run the engine for about 30 to 40 minutes at a water temperature of about 80°C. Then loosen cylinder each head bolt 1/8-1/4 turn and retighten, in sequence, to specified torque.

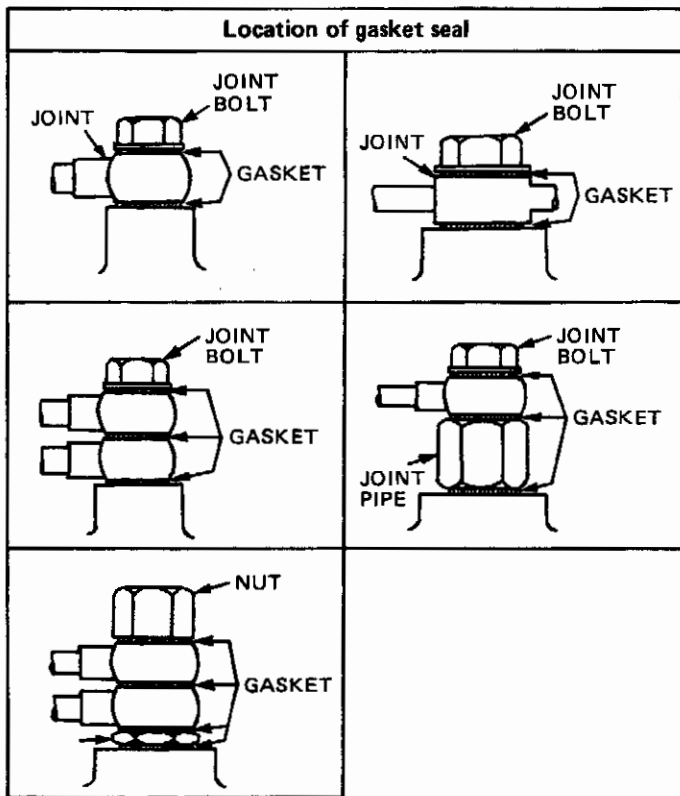
Special Tool: Socket wrench (09411-1260)

- NOTE:**
- Be sure to loosen one bolt at a time, then retighten it before going on to the next bolt.
 - By retightening, face pressure of cylinder head is restored from point B to C as shown.
 - Retighten at the first 1,000 km (600 miles) following servicing which involves the loosening or removal of any cylinder head bolt. Such servicing includes replacement of the cylinder head gasket, servicing of the valve gear parts, and the like.

RECHECK THE VALVE CLEARANCE, WHEN ENGINE IS COLD.

PROCEDURE FOR INSTALLING JOINTS AND GASKETS OF ENGINE PIPES

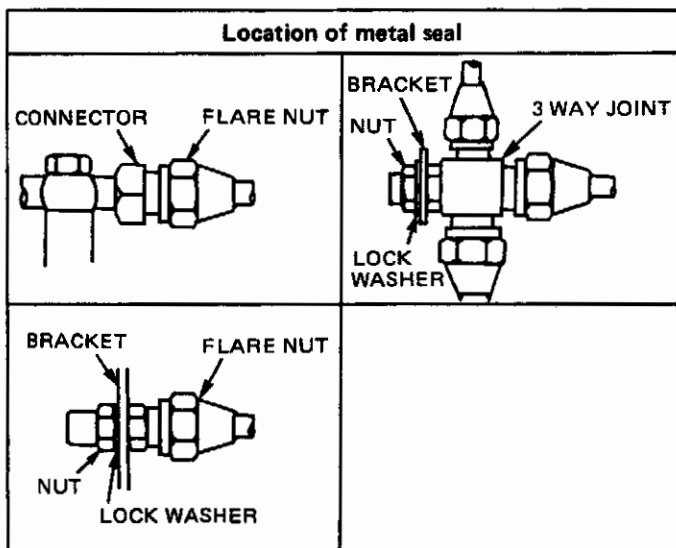
1. Gasket seal type (aluminum + rubber, asbestos or copper).



Tightening torque chart

Clamping screw size (Diameter) mm (in)	Tightening torque kg-cm (lb.ft)
8 (0.315)	120-170 (9-12)
10 (0.394)	180-230 (13-16)
12 (0.472)	230-280 (17-20)
14 (0.551)	230-280 (17-20)
16 (0.630)	300-350 (22-25)
18 (0.709)	400-450 (29-32)
20 (0.787)	400-450 (29-32)
22 (0.866)	530-600 (38-43)
24 (0.945)	720-800 (52-57)
28 (1.102)	1,300-1,500 (94-108)

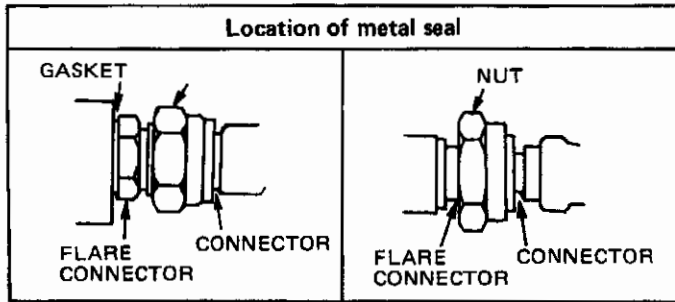
2. Metal seal type (Flares connector type).



Tightening torque chart

Clamping screw size (Diameter) mm (in)	Tightening torque kg-cm (lb.ft)
12 (0.472)	200-220 (15-16)
14 (0.551)	330-360 (24-26)
16 (0.630)	400-500 (29-36)
18 (0.709)	600-700 (43-51)
20 (0.787)	650-700 (47-51)

3. Metal seal type (Nipples connectors type)



Tightening torque chart

Clamping screw size (Diameter) mm (in)	Tightening torque kg-cm (lb.ft)
10 (0.394)	100–150 (7–10)
20 (0.787)	200–250 (14–18)

- NOTE:**
- Before installing the joints, ensure that there is no dirt or burrs adhering to the various seat faces (pipe joints, gaskets, etc.)
 - Because the pipes can move relatively free during installation and the seat faces are liable to tilt, first temporarily tighten the pipes, then tighten them to specification and ensure that there is no leakage from them.
 - When tightening two pipes together, be very careful that they do not rotate together.
 - After installing the pipes, apply the correct pressure to each pipe joint and ensure that there is no leakage.
 - Ensure that the various tightening torques conform to the above table.
 - If a soft washer #4840 FR-N (aluminum + rubber and carbon press fit part) is loosened or removed subsequent to being installed, be sure and replace it with a new one.
There is no need to replace it, however, for normal retightening.

CHAPTER TU

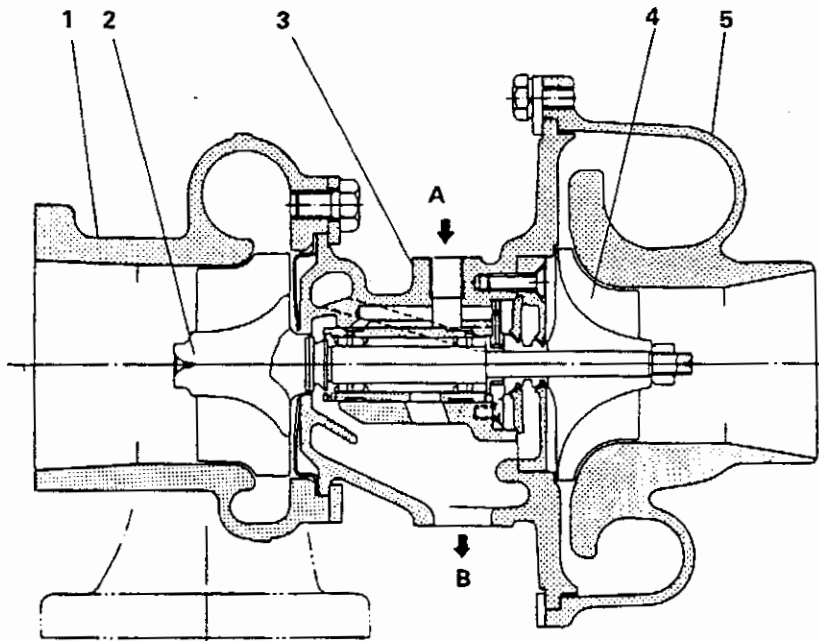
TURBOCHARGER

DATA AND SPECIFICATIONS	TU-2
DESCRIPTION	TU-2
TROUBLESHOOTING	TU-3
OVERHAUL CRITERIA	TU-5
SPECIAL TOOL	TU-5
TURBOCHARGER	TU-6

DATA AND SPECIFICATIONS

Type	RHC 6
Turbine type	Radial flow type
Blower type	Centrifugal type
Lubricating method	External lubrication type
Bearing type	Full floating type
Direction of rotation	Counterclockwise as seen from the turbine side

DESCRIPTION



1. Turbine case
2. Turbine rotor
3. Bearing case
4. Blower impeller
5. Blower case

- A: Oil inlet
B: Oil outlet

SM51-053

TROUBLESHOOTING

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Dense black smoke	Insufficient air intake	
	• Air cleaner is choked with dust, causing greater intake air resistance.	Disassemble and clean or replace the air cleaner element.
	• Air inlet is choked	Repair.
	• Air is leaking from intake manifold	Repair.
	Turbocharger does not rotate smoothly.	
	• Engine oil impurities deposited on rotor, resulting in heavy rotation or sticking.	Overhaul and clean turbocharger and/or change engine oil.
	Bearing sticking	
	• Insufficient lubrication or blockage of lubricating oil lines.	Check lubricating oil system, and/or repair.
	• Abnormal wear or damage of seal ring caused by wear of journal bearing, due to insufficient lubrication.	Repair.
	• Temperature of lubricating oil too high	Check cooling system.
	• Unbalanced rotating parts	Change rotating parts.
	• Incomplete warming-up, failure to idle before stopping engine, or jack rabbit starts.	Operate vehicle properly.
	Loose or damaged turbine rotor or blower impeller.	
	• Over-rotation	Check and adjust the engine.
	• Temperature of exhaust gas too high	Check and adjust the engine.
• Foreign matter present	Remove foreign material. Inspect the air cleaner and air intake manifold. Repair if necessary.	
• Worn thrust bearing	Overhaul and repair.	
• Incomplete assembly	Reassembly.	
High volume exhaust like noise.	Exhaust gas leaking before turbocharger, therefore insufficient revolution.	Check and repair connections.
	Deformed or blocked exhaust gas lines therefore insufficient revolution.	Repair.
White smoke	Choking defects, or deformation of oil return lines so that oil leaks around blower or turbine sides.	Repair and replace the lines.
	Seal ring may be broken or worn due to abnormal wear of thrust washer.	Replace the thrust washer.

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Loss of power	Gas leakage from exhaust system	Repair.
	Air leakage from air manifold	Repair.
	Clogged air cleaner element	Clean or replace.
	Turbocharger dirty or damaged	Repair or replace.
Poor response of turbocharger	Carbon accumulation on the turbine side seal ring and heavy rotation.	Change engine oil, clean turbocharger.
	Poor combustion	Check fuel system and improve combustion.
High pitched noise and vibration	Noise	
	<ul style="list-style-type: none"> • So called "surging" Overhaul and clean turbocharger. Surging sometimes occurs when the gas passage at the nozzle of the turbine housing is choked or when compressed air does not flow in proper responses to acceleration. • Loosen rotating parts Replace. 	
	Vibration	
	<ul style="list-style-type: none"> • Joints loose between turbocharger and intake, exhaust manifold or oil lines. Check the mounting and repair. • Damaged bearing, loose rotating parts, imbalanced rotating parts, etc. Repair. 	

OVERHAUL CRITERIA

CONDITIONS WHICH DETERMINE WHEN TURBOCHARGER OVERHAUL MAY BE NEEDED.

THE ENGINE LACKS POWER OR ENGINE EXHAUST EMITS BLACK SMOKE.

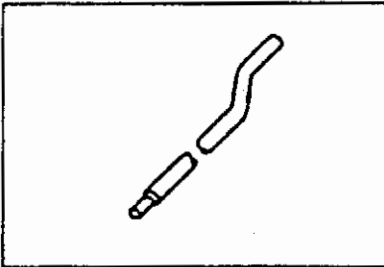
OTHER FACTORS

1. Noisy of excessive vibration of the turbocharger.
2. Excessive engine oil consumption.
3. Gas leakage at the turbine end or blower end.
4. Oil leakage from the turbocharger.

SPECIAL TOOL

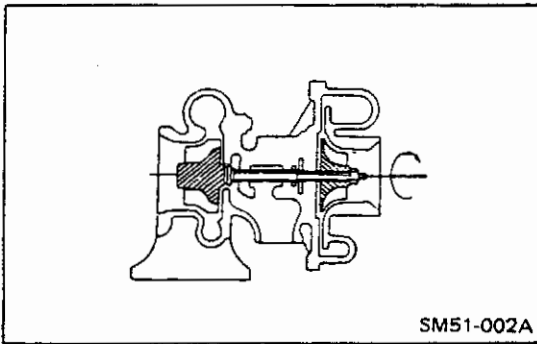
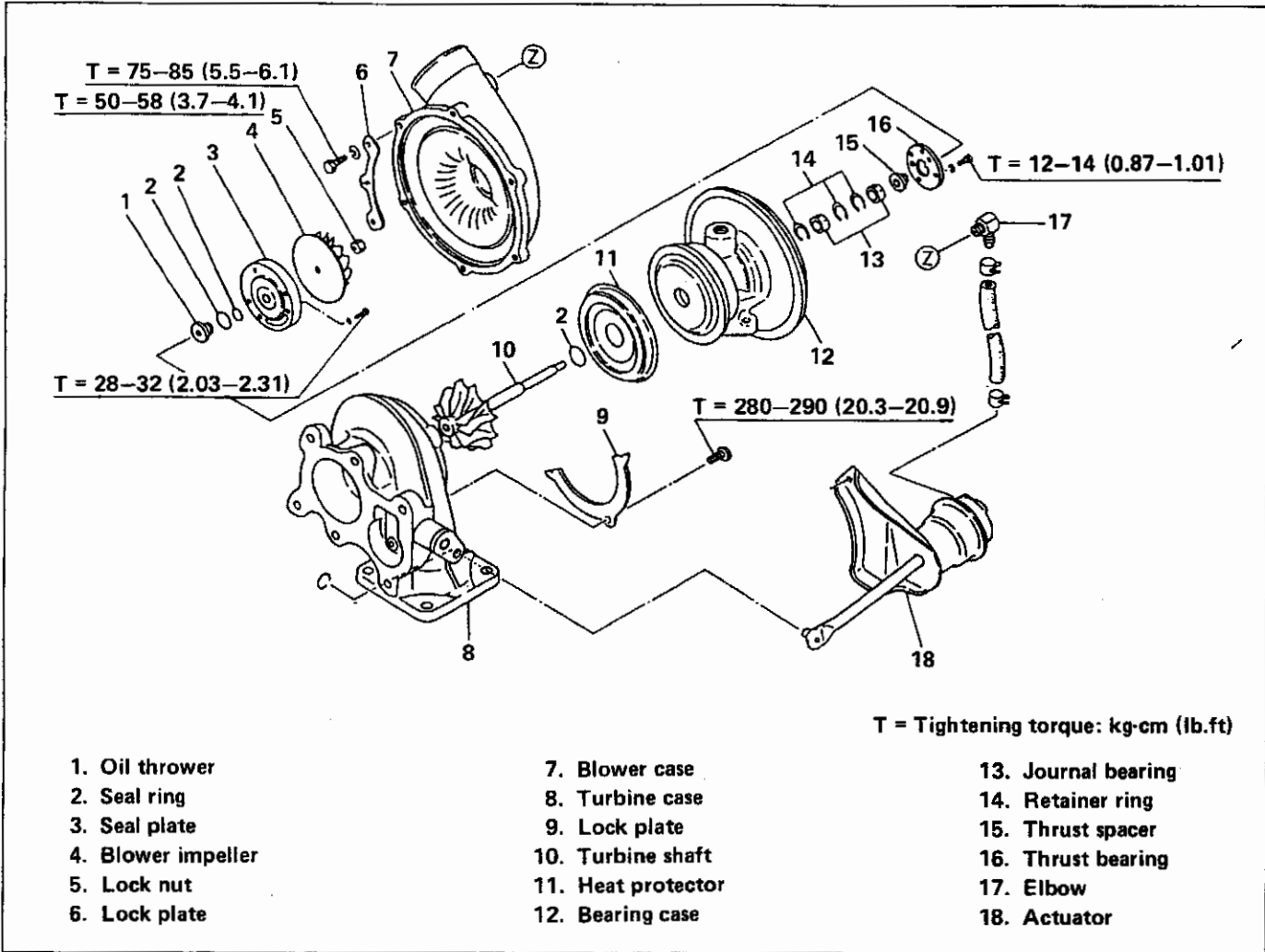
Prior to starting an turbocharger overhaul, it is necessary to have these special tools.

ATTACHMENT FOR MEASURING TURBINE SHAFT RADIAL PLAY



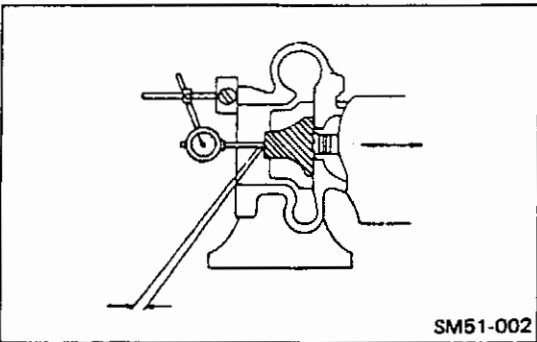
09444-1330

TURBOCHARGER



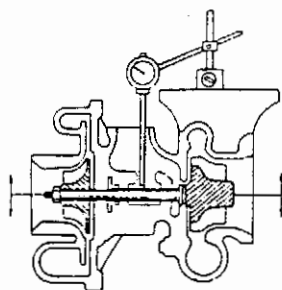
IMPORTANT POINT (S) -- BEFORE DISASSEMBLY

1. Rotate the blower impeller by hand to see if it turns smoothly. If it does not turn smoothly, clean and inspect the bearing and turbine rotor.



2. Check the turbine rotor for axial play (A). If the axial play is greater than the service limit, replace the thrust bearing and/or thrust spacer.

Axial Play: 0.05 – 0.08 mm (0.002 – 0.0031 in)
Service Limit: 0.11 mm (0.0043 in)



SM51-002A

3. Check the turbine rotor for radial play using a special tool.
If the radial play is greater than the service limit, replace the bearings and/or turbine rotor.

Special Tool: 09444-1330

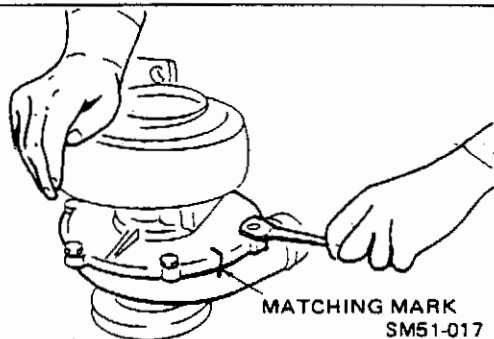
Radial Play: 0.10 – 0.15 mm (0.0039 – 0.0059 in)

Service Limit: 0.19 mm (0.0074 in)

IMPORTANT POINT (S) – DISASSEMBLY

REMOVE THE BLOWER CASING.

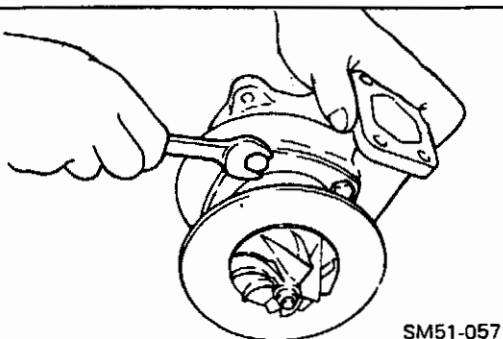
- NOTE:
- Make matching marks on the blower case and bearing case to aid alignment during reassembly.
 - If the blower casing cannot easily be removed by hand, tap it carefully all around using a plastic hammer and carefully remove it.
 - Be careful not to damage the blower impeller.



MATCHING MARK
SM51-017

REMOVE THE TURBINE CASING.

- NOTE:
- Make matching marks on the turbine case and bearing case to aid alignment during reassembly.
 - Because the bolts on the turbine side are exposed to high temperature, if they have seized, do not apply an unreasonable force to remove them because they may break. Spray a lubricant onto them, then wait for about 15 minutes and loosen them.
 - Be careful not to damage the turbine blades.
 - If the turbine casing cannot easily be removed by hand, tap it carefully all round using a plastic hammer and carefully remove it.



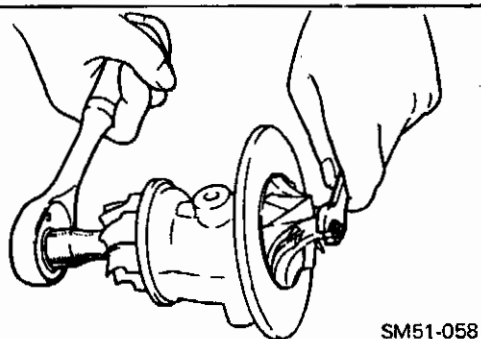
SM51-057

REMOVE THE BLOWER IMPELLER.

1. Remove the blower impeller fitting nut.

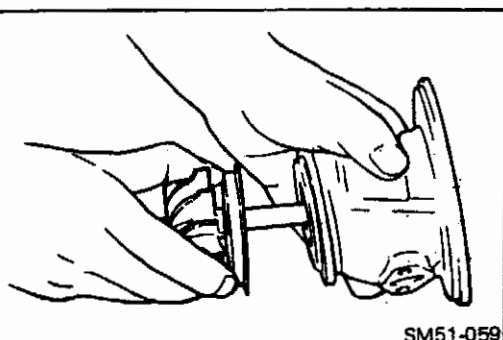
NOTE: Turn the lock nut clockwise to loosen the nut (left-hand threads).

2. Remove the blower impeller by hand.

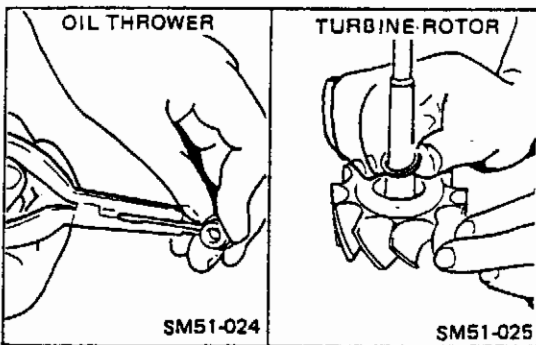
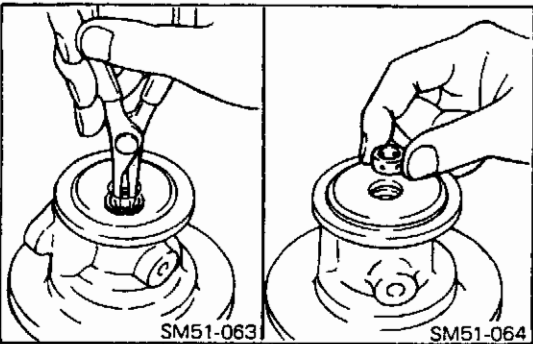
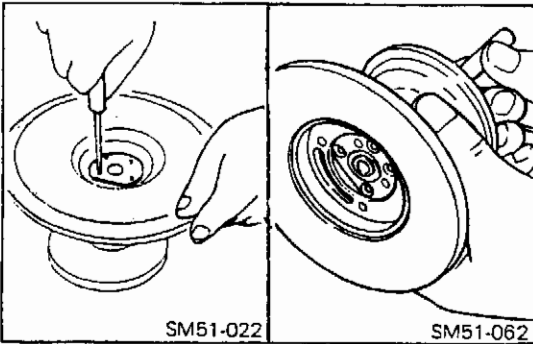
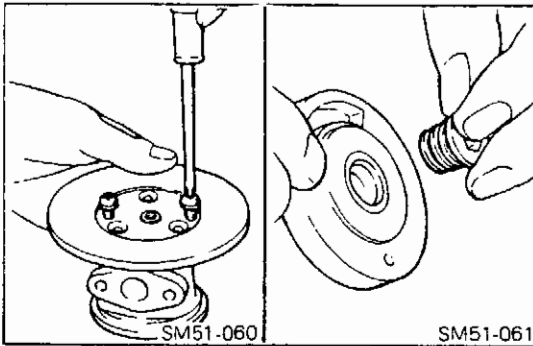


SM51-058

REMOVE THE TURBINE ROTOR WITH HEATER PROTECTOR.



SM51-059

**REMOVE THE BEARING**

1. Remove the seal plate.
Pull out the seal plate using the two screws.
2. Remove the oil thrower from the seal plate.

3. Remove the thrust bearing and thrust spacer.
Loosen the bolt, then remove the thrust bushing using a 10 dia. copper rod.

NOTE: When removing the thrust bearing and thrust spacer, be careful not to damage the thrust bearing hole in the bearing case.

4. Remove the retainer rings of each bearing.

NOTE: When removing the retainer ring, be careful not to damage the front face of the hole in the bearing case.

5. Remove the bearings.

REMOVE THE SEAL RINGS.

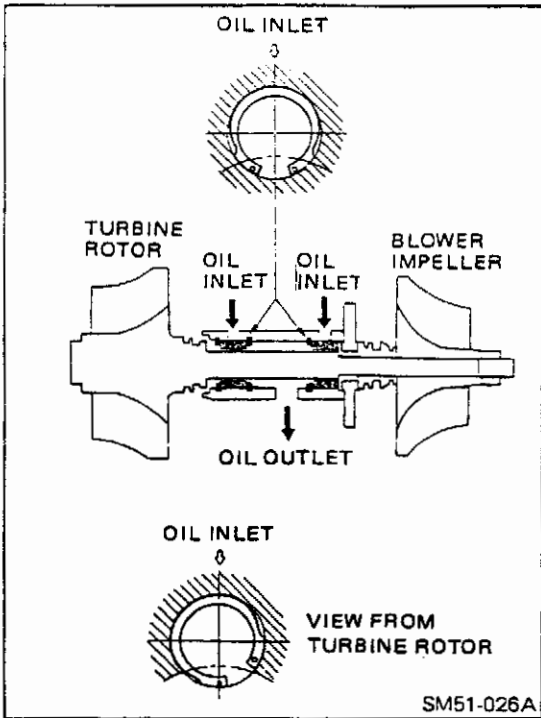
NOTE: When removing the seal ring, be very careful not to damage the groove of the seal ring.

IMPORTANT POINT (S) – ASSEMBLY**CLEAN ALL PARTS.**

1. Before cleaning, the disassembled parts should be visually inspected to check for burning, abrasion, carbon deposits, gas and oil leakage.
2. Thoroughly clean all the parts with diesel fuel, using a soft brush, and dry with compressed air.

NOTE: ○ Never use a caustic cleaning solution, as it may attack aluminum.

○ Never use a wire brush.



ASSEMBLE THE JOURNAL BEARINGS.

1. Install the first retainer ring in the bearing casing.

NOTE:

- Bevelled edge of the retainer ring should be towards the bearing.
- Make sure that the retainer ring is securely fitted in the groove.
- Install the retainer ring with the gap facing as shown in the drawing.

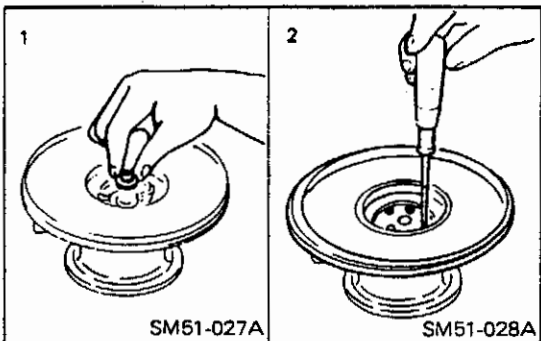
2. Install the bearing in the bearing case.

NOTE: Apply clean engine oil.

3. Install the other retainer ring.

NOTE: The only nearest turbine side of the retainer ring should be installed according to the figure on the left.

4. Repeat step 1) through 4) to install the second bearing.



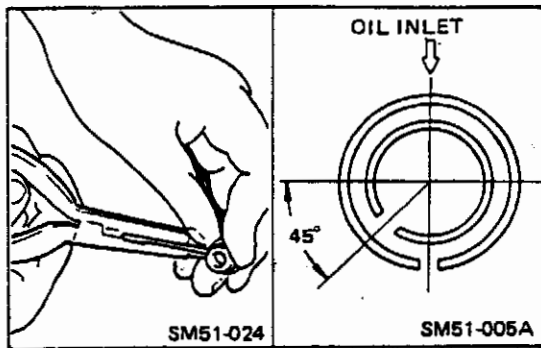
ASSEMBLE THE THRUST BEARING.

1. Install the thrust spacer on the turbine shaft.

NOTE: Lubricate thrust spacer surface.

2. Coat the thrust bearing with clean engine oil and install the thrust bearing.

NOTE: Always use new screws and lock washers.

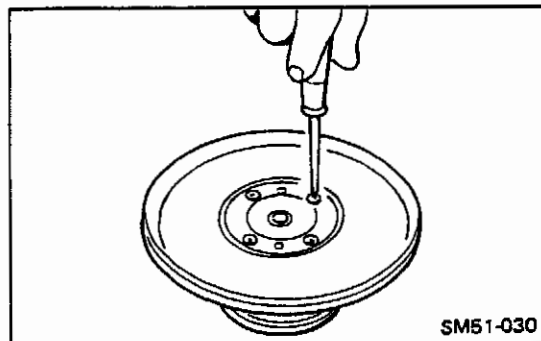


INSTALL THE SEAL PLATE.

1. Insert two new seal rings on the oil thrower.

2. Install the oil thrower in the seal plate.

NOTE: The openings of seal rings should be positioned as shown.



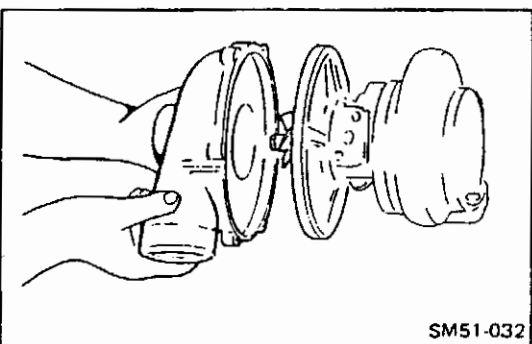
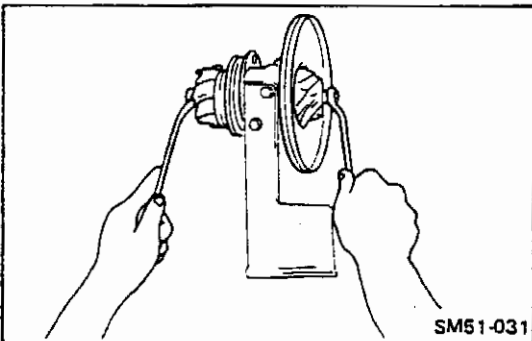
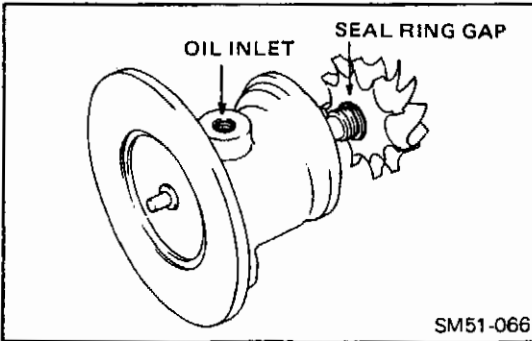
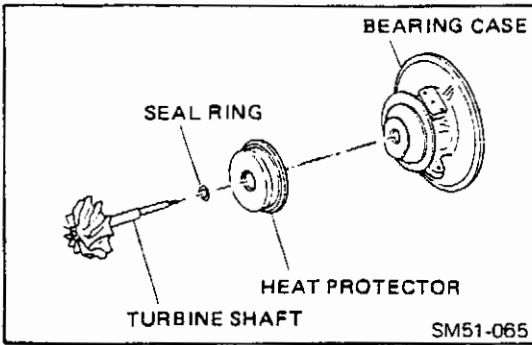
3. Install the seal plate in the bearing case.

NOTE:

- The oil return hole should face the oil outlet side. Apply silicone R.T.V. sealer to the flanged surface of the seal plate.
- Take care that the silicone sealer does not protrude from the flange.

4. Tighten the four screws with lock washers.

NOTE: Always use new screws and washers.



ASSEMBLE THE TURBINE ROTOR.

1. Install a new seal ring in the seal ring groove of the turbine shaft.
2. Position the heat protector on the bearing case.

3. Coat the journals of the turbine rotor with clean engine oil and install the turbine rotor in the bearing case.

- NOTE:**
- The gap in the seal ring of the turbine shaft must face towards the oil inlet.
 - Insert the seal ring concentric with the turbine shaft. If it is inserted with unreasonable force, it may be damaged.
 - When inserting the turbine shaft, be very careful not to damage the journal bearing.

FIT THE BLOWER IMPELLER ON THE TURBINE ROTOR AND TIGHTEN THE LOCK NUT.

NOTE: Remember that this nut has left-hand threads.

INSTALL THE TURBINE CASE TO THE BEARING CASE, BEING SURE TO ALIGN THE MATCHING MARKS.

NOTE: Always use new lock plates.

ASSEMBLE THE BLOWER CASE.

1. Install the blower case to the bearing case referring to the matching marks.

NOTE: Coat the flange face of the blower case with silicone R.T.V. sealant.

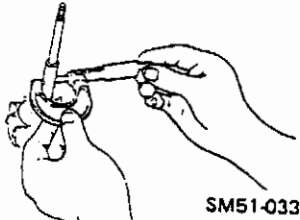
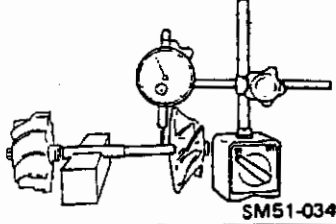
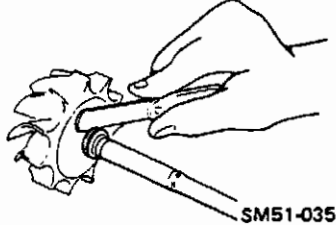
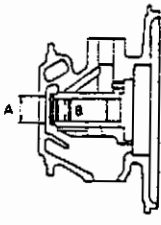
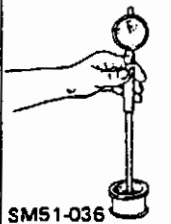

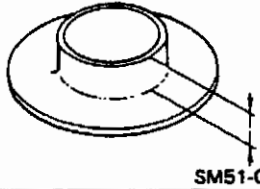
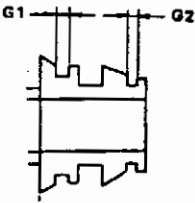
2. Tighten the six fitting bolts.

ASSEMBLY TEST

1. Rotate the blower impeller by hand to see if it turns smoothly. Refer to page TU-6.
2. Check the turbine rotor for axial play (A). Refer to page TU-6.
3. Check the turbine rotor for radial play using a special tool. Refer to page TU-7.

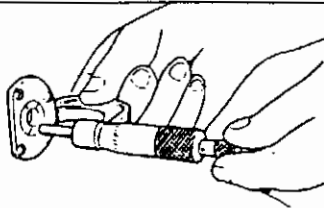
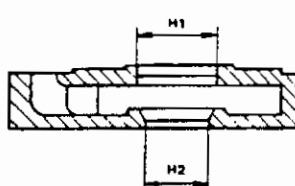
INSPECTION AND REPAIR

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Turbine Shaft Diameter	-	10.39 (0.4090)	Replace	 <p>SM51-033</p>
Turbine Shaft Bend	-	0.011 (0.0004)	Replace	 <p>SM51-034</p>
Seal Ring Groove Width of Turbine Shaft	-	1.34 (0.0527)	Replace shaft assembly.	 <p>SM51-035</p>
Bearing Case Inside Diameter	-	A: 13.09 (0.5153) B: 15.10 (0.5944)	Replace	 <p>SM51-006</p>
Journal Bearing Inside Diameter	-	10.45 (0.4114)	Replace	 <p>SM51-036</p>
Journal Bearing Outside Diameter	-	14.98 (0.5897)	Replace	 <p>SM51-037</p>
Thrust Spacer Height	-	4.09 (0.1610)	Replace	 <p>SM51-007</p>
Seal Ring Groove Width of Oil Thrower	-	G1: 1.52 (0.0598) G2: 1.32 (0.0519)	Replace	 <p>SM51-006A</p>

INSPECTION AND REPAIR

Unit: mm (in)

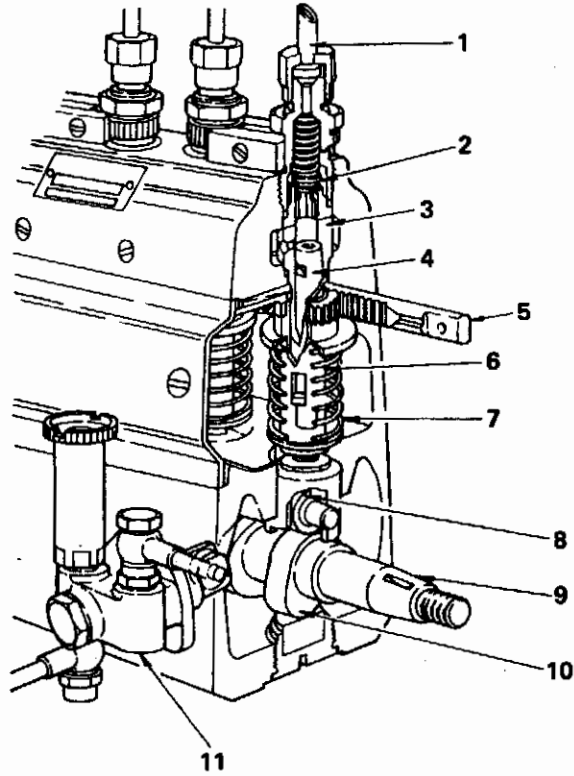
Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Thrust Bearing Thickness	—	3.98 (0.1566)	Replace	 <p>SM51-038</p>
Sealing Bore of Seal Plate	—	H1: 14.05 (0.5531) H2: 12.45 (0.4901)	Replace	 <p>SM51-005B</p>

CHAPTER IP

FUEL INJECTION PUMP

DESCRIPTION	IP- 2
TROUBLESHOOTING	IP- 3
SPECIAL TOOLS	IP- 6
INJECTION PUMP	IP- 8
FEED PUMP	IP-18
TIMER	IP-21

DESCRIPTION



SM4-064

FUEL INJECTION PUMP

- | | | |
|-----------------------|-------------------|--------------------|
| 1. High pressure pipe | 5. Control rod | 9. Cam shaft |
| 2. Delivery valve | 6. Control sleeve | 10. Cam |
| 3. Plunger barrel | 7. Plunger spring | 11. Fuel feed pump |
| 4. Plunger | 8. Tappet | |

TROUBLESHOOTING

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Engine does not start	Fuel not reaching injection pump	
	● Fuel lines clogged or damaged	Clean or replace fuel lines.
	● Fuel filter clogged	Clean or replace the filter element.
	● Air in fuel caused by improper connections of fuel line between fuel tank and feed pump	Repair connections.
	● Filter incorporated in inlet side of feed pump clogged	Remove foreign material.
	● Faulty feed pump check valve	Repair or replace it.
	● Feed pump piston spring broken	Replace it.
	● Feed pump push rod or tappet sticking	Repair or replace it.
	Fuel reaching injection pump	
	● Faulty connection of accelerator wire to pump adjusting lever	Repair connection.
	● Control rack faulty or sticking	Repair it.
	● Damaged camshaft bearing	Repair it.
	● Plunger worn or sticking	Correct or replace it.
	● Faulty connection of engine stop wire to pump stop lever	Repair it.
	Nozzle faulty	
	● Fuel leakage caused by loosened nozzle holder	Inspect and tighten it.
	● Low opening pressure of nozzle	Adjust it.
	● Nozzle pressure spring broken	Replace it.
	● Nozzle needle sticking to nozzle body	Correct or replace it.
	Pump out of timing	
	● Improperly retarded injection timing	Correct injection timing.
	● Incorrect timing caused by improper installation of pump	Check engine timing and correct it.
	● Woodruff key for pump camshaft cut off	Replace it.
	● Improper pre-stroke adjustment	Correct it to obtain specified injection timing.

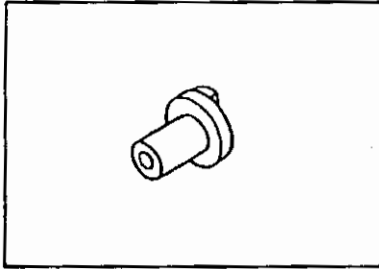
<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Excessive smoke	Black smoke	
	● Excessive fuel delivery caused by incorrect adjustment of fuel load stopper screw.	Adjust fuel delivery on test stand.
	● Excessively advanced injection timing.	Correct it.
	● Large spread in fuel delivery	Adjust it.
	● Bad nozzle fuel spray characteristics	Check and correct them.
	White smoke	
	● Improperly retarded injection timing.	Advance injection timing.
	● Water in fuel	Check and clean fuel lines.
Low idle speed irregular	Improper adjustment of idle button	Correct it.
	Bad fuel spray characteristic of nozzles.	Check and repair them.
	Incorrect injection timing	Correct it.
	Incorrect initial tension setting of idling spring or the spring broken.	Adjust or replace it.
	Control rack not smoothly move	Disassemble pump and repair it.
	Large spread in fuel delivery	Adjust it.
	Plunger worn	Replace it.
	Governor linkage not smoothly move.	Correct it.
Defective feed pump	Disassemble and repair it.	
Engine always runs at high speed	Accelerator cable sticking	Check and correct it.
	Governor linkage sticking	Disassemble and repair the governor.
	Control rack sticking	Check and correct it.
Engine starts and stops	Fuel lines clogged	Clean or replace fuel lines.
	Air in fuel caused by damaged fuel lines or improper connection of fuel lines.	Repair fuel lines or replace fuel lines and gaskets.

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Engine has low power	Pump out of timing	
	● Excessive advanced timing, resulting in loud knocking.	Check and correct it.
	● Excessively retarded timing resulting in black smoke.	Check and correct it.
	● Defective injection pump overflow valve.	Repair or replace it.
	● Feed pressure too low	Repair the feed pump.
	● Improper accelerator cable adjustment	Adjust it.
	Nozzle faulty	
	● Fuel leakage from nozzle holder	Check and repair nozzle holder.
	● Bad nozzle spray characteristic	Repair or replace it.
	● Loosened adjusting screw in nozzle holder, resulting in low opening pressure.	Adjust it.
	● Nozzle pressure spring broken	Replace it.
	Pump faulty	
	● Fuel leakage from delivery valve holder.	Retighten the delivery valve holder if it is loosened or replace O-ring if the O-ring is defective.
	● Defective seat of delivery valve assembly.	Repair or replace it.
	● Delivery valve spring broken	Replace the spring.
● Plunger worn	Replace it.	
● Large spread in fuel delivery	Adjust it.	
● Wear of tappet roller	Replace the roller.	
● Camshaft bearing worn or broken	Replace it.	
● Improper adjustment of governor fuel load stopper screw.	Adjust it.	
Loud knocking	● Improper injection timing	Correct it.
	● Bad fuel nozzle spray pattern after-dribble.	Check and correct it.
	● High nozzle opening pressure	Adjust the opening pressure.
	● Incorrect fuel deliveries to some nozzles.	Readjust the fuel deliveries.

SPECIAL TOOLS

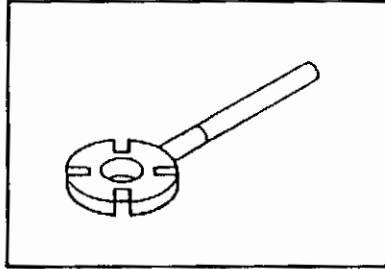
Prior to starting an injection pump overhaul, it is necessary to have these special tools.

COUPLING



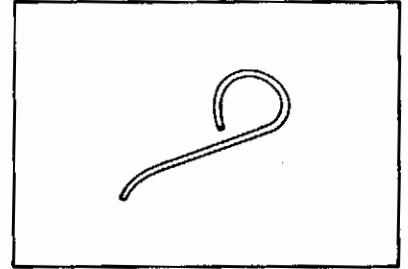
09511-2000

HOLDING WRENCH



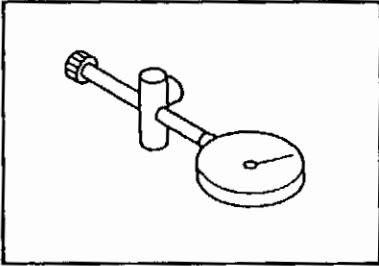
09511-1520

TAPPET HOLDER



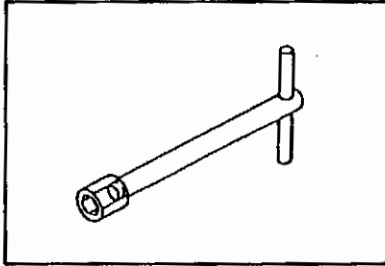
09511-1770

CAMSHAFT END PLAY GAUGE



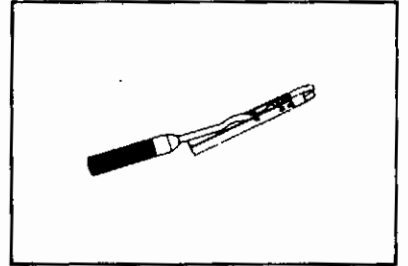
09511-1970

GAUGE ADAPTER



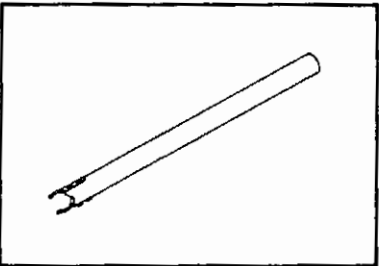
09511-1610 (Use with 09511-1970)

TAPPET ROLLER CLAMP



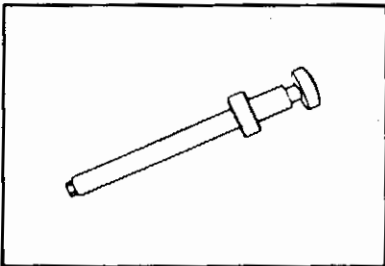
09511-1750

TAPPET CLAMP



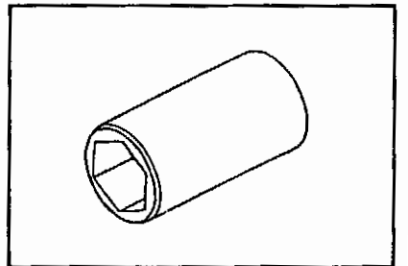
09511-1190

PLUNGER CLAMP



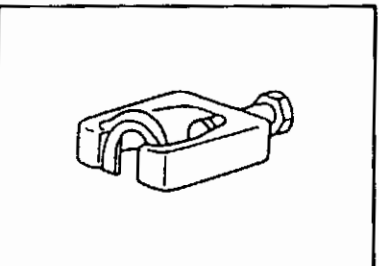
09511-1730

**DELIVERY VALVE HOLDER
REMOVER**



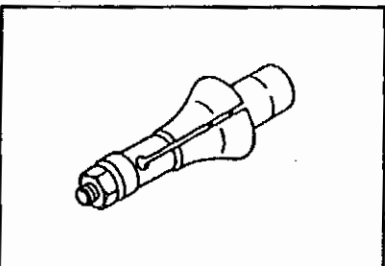
09511-1340

BEARING REMOVER



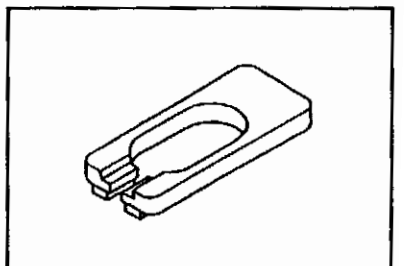
09500-1290

BEARING OUTER RACE PLUNGER



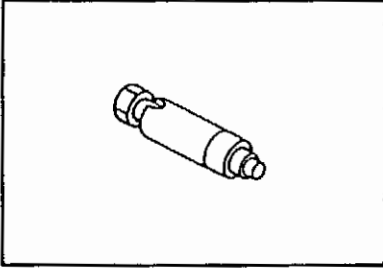
09511-1680

SPRING HOLDER



09511-1960

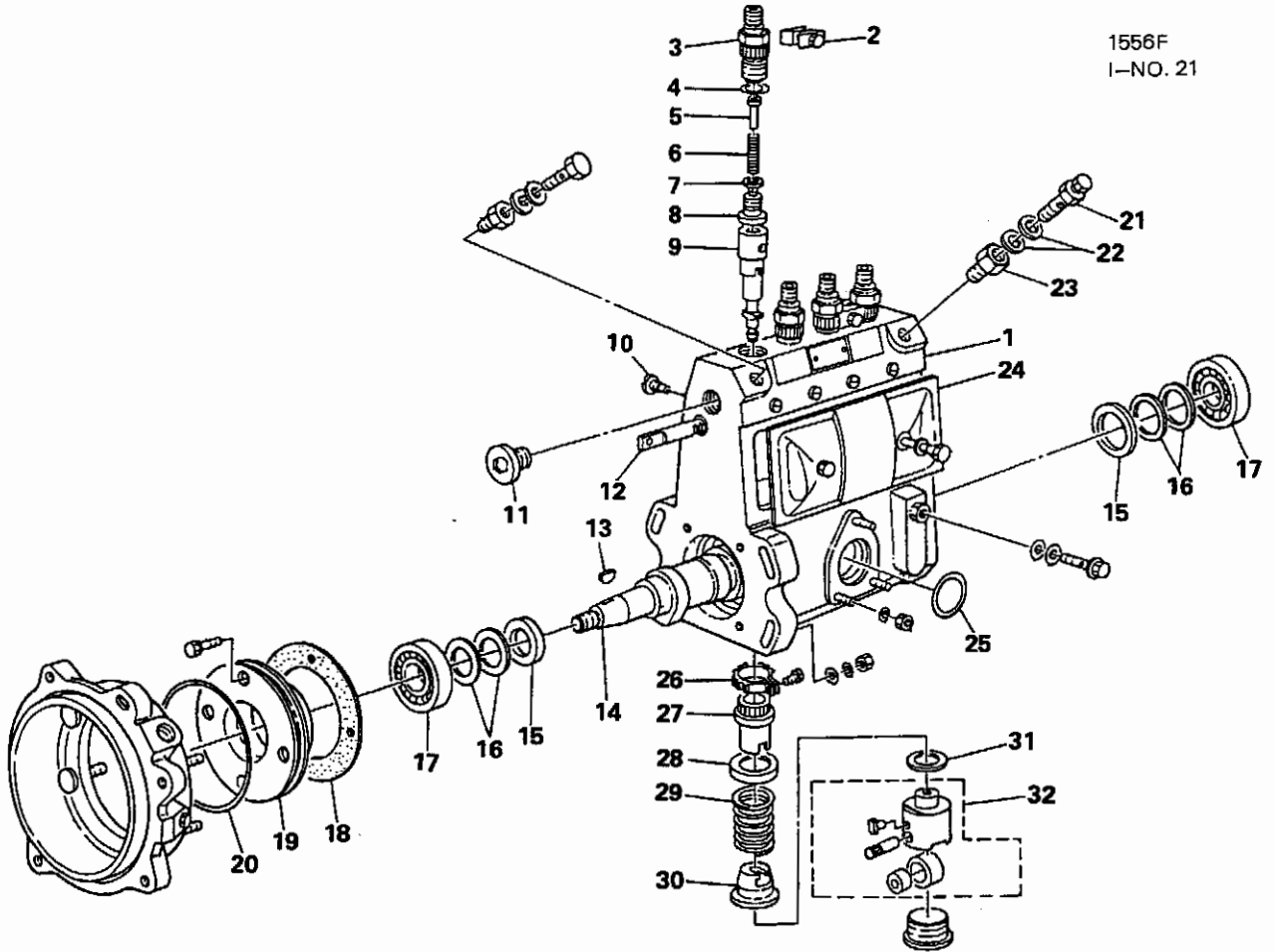
TIMER EXTRACTOR



09511-1990

INJECTION PUMP

A-TYPE PUMP



- | | |
|------------------------------------|-------------------------------|
| 1. Injection pump housing | 17. Bearing |
| 2. Valve holder lock plate | 18. Gasket |
| 3. Delivery valve holder | 19. Bearing cover |
| 4. O-ring | 20. O-ring |
| 5. Delivery valve stopper | 21. Over flow valve |
| 6. Delivery valve spring | 22. Soft washer |
| 7. Gasket | 23. Adapter |
| 8. Delivery valve | 24. Side cover |
| 9. Injection pump element | 25. O-ring |
| 10. Bolt | 26. Plunger control pinion |
| 11. Screw plug | 27. Plunger control sleeve |
| 12. Control rack | 28. Plunger spring upper seat |
| 13. Key | 29. Plunger spring |
| 14. Camshaft | 30. Plunger spring lower seat |
| 15. Camshaft shim plate and O-ring | 31. Shim |
| 16. Shim | 32. Tappet sub-assembly |

IMPORTANT POINT (S) – DISASSEMBLY

WARNING

- Breaking of the lead seals or crimp caps by anyone other than HINO or pump manufacture authorized service stations to make these adjustment will void the warranty.
- If fuel pump or governor difficulties are suspected, consult only HINO or pump manufacture authorized service stations, where the problem can be corrected and the injection pump lead seals and crimp caps can be reinstalled as required.
- Measure and record the fuel delivery characteristics of the pump before disassembling it.
- Keep the parts for each cylinder in separate groups and in an orderly arrangement. Parts to be replaced and parts to be used again must be kept separately.

REMOVE THE TIMER ASSEMBLY.

Refer to "TIMER AND COUPLING".

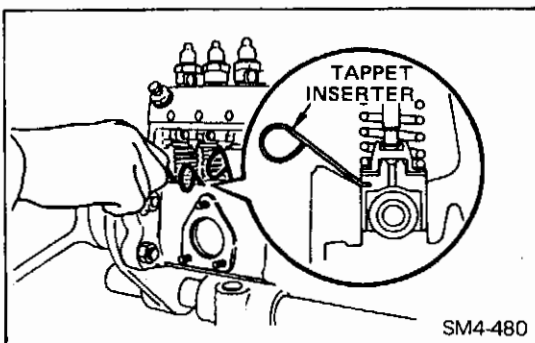
REMOVE THE GOVERNOR.

Refer to "GOVERNOR".

INSERT THE TAPPET INSERTER IN THE TAPPET HOLE.

Turn the camshaft and insert the tappet inserters in each tappet hole when their tappet is at the highest position.

Special Tool: Tappet Inserter (09511-1770)

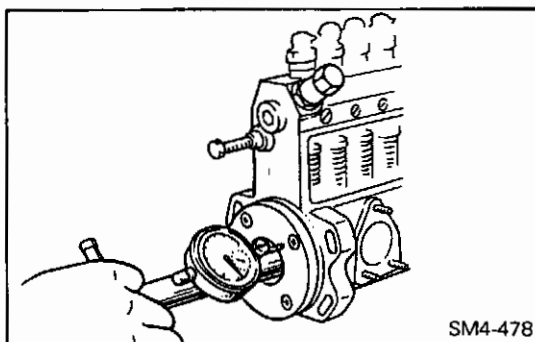


INSPECT THE END PLAY ON CAMSHAFT.

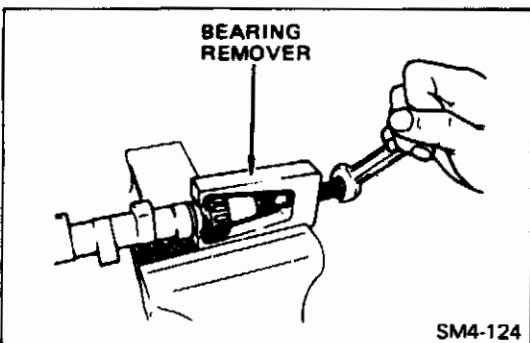
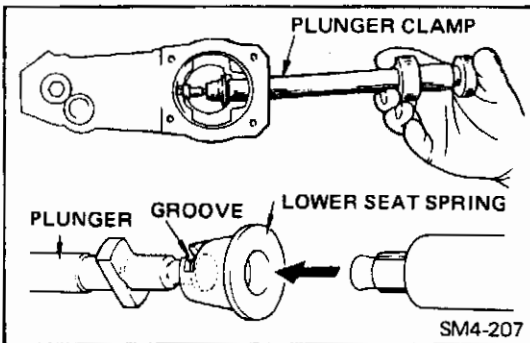
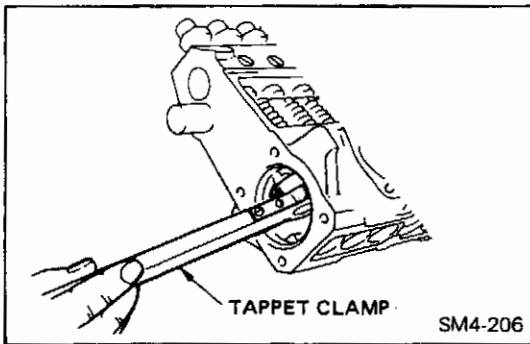
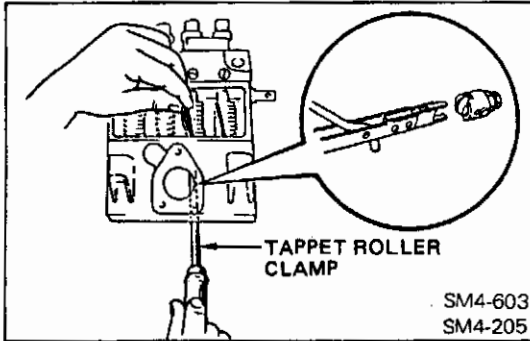
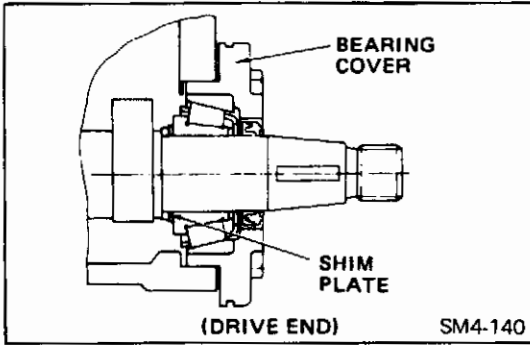
Using a special tool inspect the clearance in the axial direction on a camshaft installation.

Assembly Standard: 0.02–0.06 mm (0.0008–0.002 in)

**Special Tool: Camshaft End Play Gauge (09511-1970)
Gauge Adapter (09511-1610)**



If the specification is not met, use appropriate shim plates at the drive end of camshaft until the specification is met.



REMOVE THE TAPPET ASSEMBLY.

1. Push the tappet with the tappet roller clamp and remove the tappeter holder.

Special Tool: Tappet Roller Clamp (09511-1750)

NOTE: To prevent dropping of the plunger and the plunger spring, adjust the pump installation base so that the upper surface of the pump is slightly below the horizontal.

2. Remove the tappet through the camshaft bearing hole.

Special Tool: Tappet Clamp (09511-1190)

REMOVE THE PLUNGERS, SPRINGS AND CONTROL SLEEVE.

1. Use the plunger clamp hold the lower spring seat and remove it together with the plunger.

Special Tool: Plunger Clamp (09511-1730)

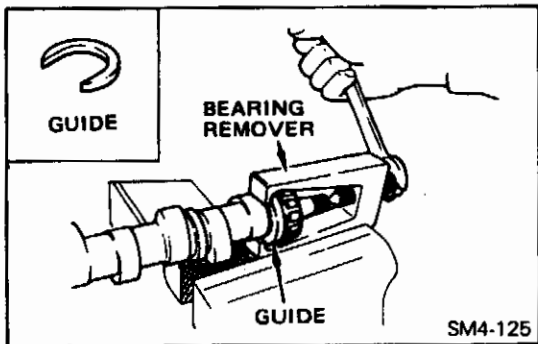
NOTE:

- The plungers may not be damaged.
- Arrange the removed plungers in the order of the cylinders in the disassembly box to prevent confusion.
- Bring the plunger insertion notch of the lower spring seat to the top, and remove so that the plunger will not drop.

REMOVE THE TAPER BEARING FROM THE CAMSHAFT.

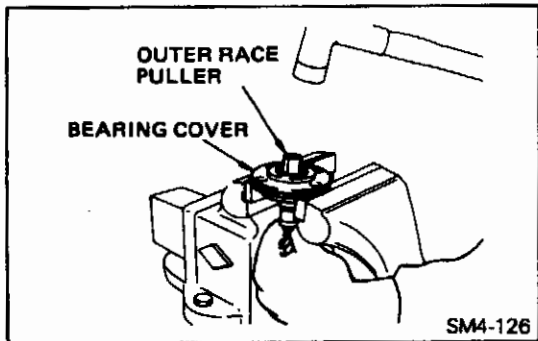
1. Remove the taper bearing from the drive end of the camshaft.

Special Tool: Bearing Remover (09500-1290)



2. Use the guide to remove the bearing at the governor side.

Special Tool: Bearing Remover (09500-1290)



3. Use the outer race puller, to tap out the outer race in the bearing cover.

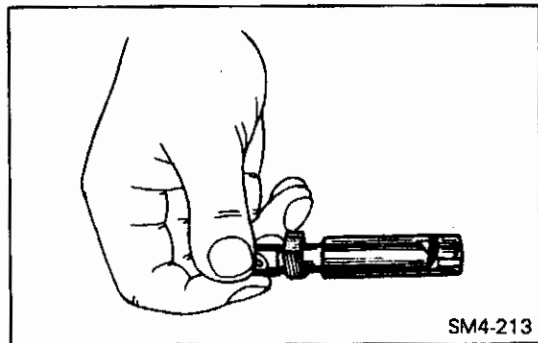
Special Tool: Outer Race Puller (09511-1680)

IMPORTANT POINT (S) – ASSEMBLY

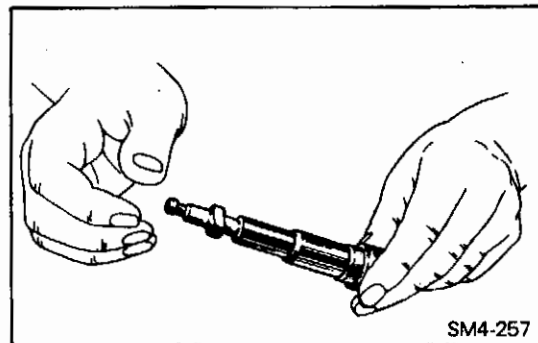
WARNING

- Wash all parts with clean diesel fuel before installing them, and any defective or damaged parts must be replaced.
- Do not allow dust or other foreign matter to enter the pump during assembly.
- Apply grease to O-rings and oil seals before installing them.
- Assemble the parts in correct order and to correct tightening torques, assembled dimensions etc.
- Assembly takes place in the reverse order of disassembly.

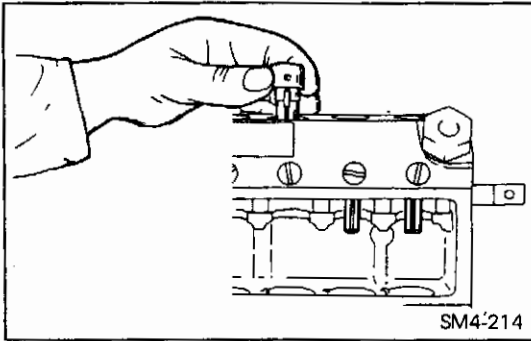
INSTALL THE PLUNGER BARRELS.



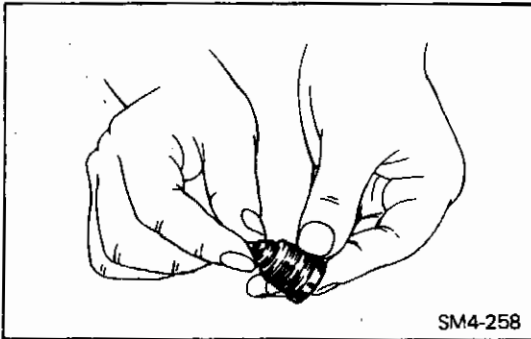
1. Before install the plunger barrels should be inspect the plunger barrels and plungers for wear, scratches, or discoloration.



2. Tilt the plunger to about 60°. Pull the plunger out approximately 10 to 15 mm (0.39–0.59 in) and release it to see if it slides down smoothly from its own weight. If the plunger slides into the barrel too or does not slides smoothly, replace the plunger assembly.

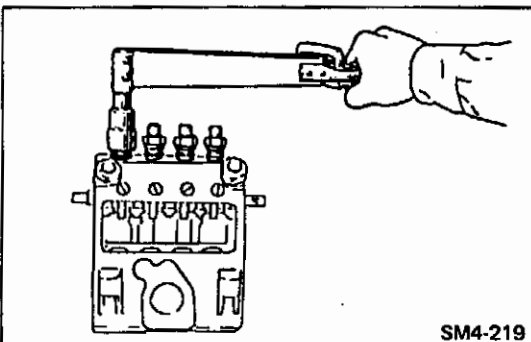


- Match the plunger notch with the injection pump housing knock pin.



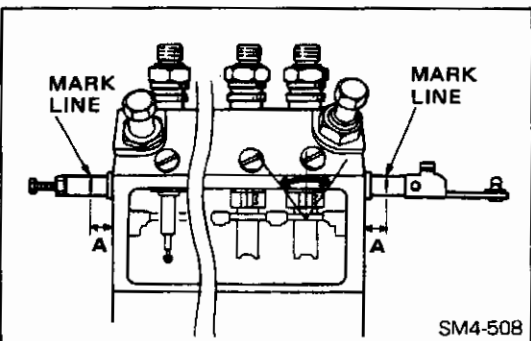
INSTALL THE DELIVERY VALVES, SPRINGS AND HOLDERS.

- Before install the delivery valves, inspect the delivery valves for scratches on the valve seat or the piston sections.



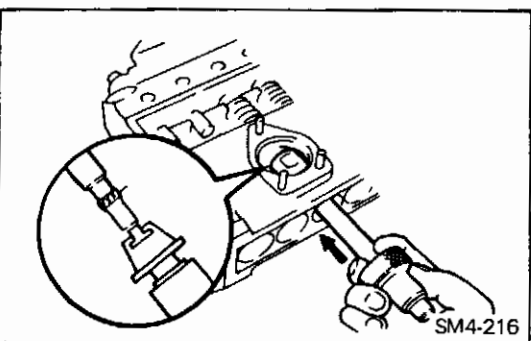
- Install the gasket, spring, shim and stopper on the delivery valve.
- Provisionally tighten the delivery valve holder with a new O-ring by hand.

NOTE: Tighten the delivery valve holder after installing the plunger.



INSTALL THE CONTROL SLEEVES ON THE BARRELS.

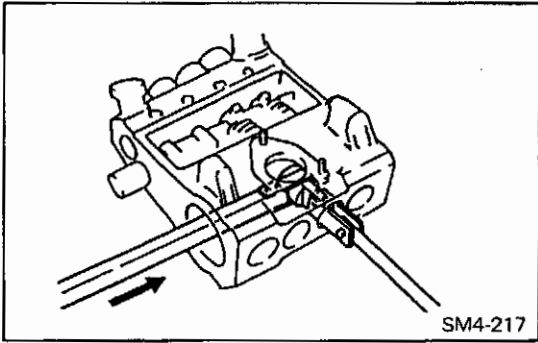
- NOTE:**
- Install with the control sleeve part to the front so that the mark lines on both ends of the control rack are equidistant from the body.
 - Make sure that the control sleeve swings evenly right and left when the control rack is moved to the right and left.



INSTALL THE PLUNGER AND TAPPET.

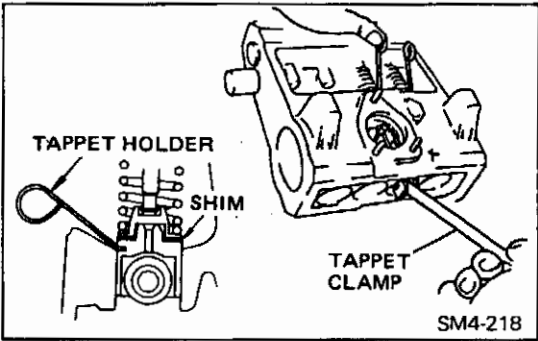
- Assembly the plunger and spring lower seat, inserting the driving face marked with a number and the lower seat notch part upward (cover plate side).

Special Tool: Plunger Clamp (09511-1730)



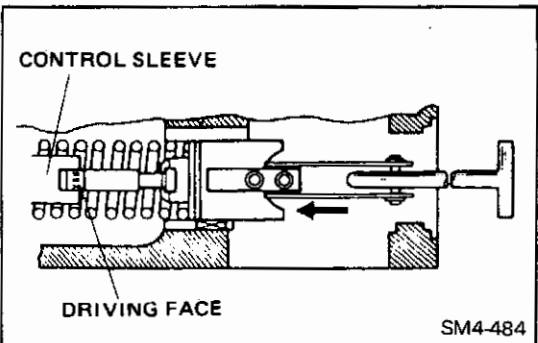
2. Install the tappet to the pump housing with the adjusting shim.

Special Tool: Tappet Roller Clamp (09511-1750)
 Tappet Clamp (09511-1190)

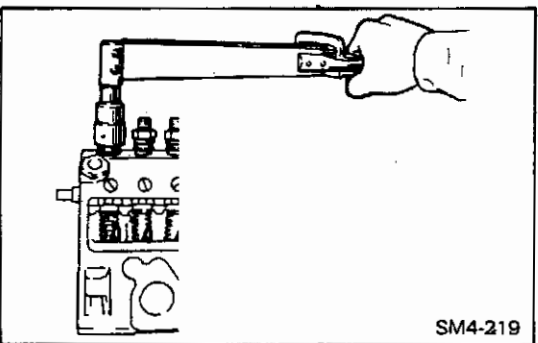


3. Using the tappet roller clamp to press in the tappet and hold it in with the tappet holder.

Special Tool: Tappet Holder (09511-1770)



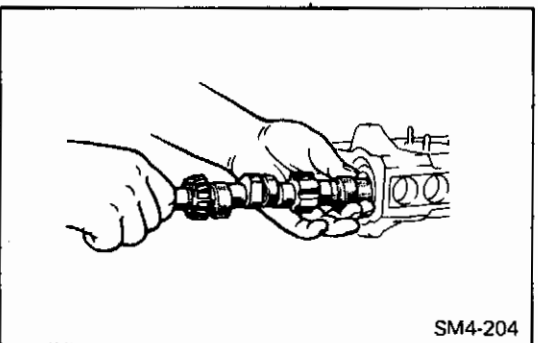
- NOTE:**
- Check that the driving face of the plunger fits to the groove of the control sleeve before inserting the tappet.
 - When inserting the tappet, check that the control rack slides smoothly and without catching.



TIGHTEN THE DELIVERY VALVE HOLDER.

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

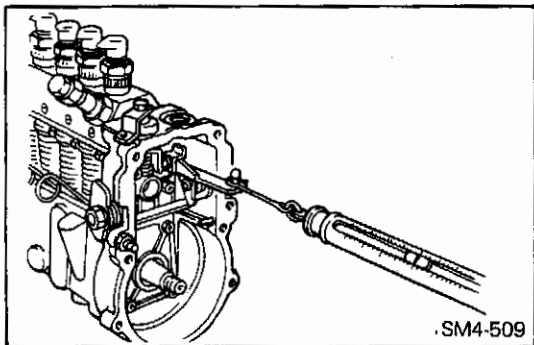
Tightening Torque: 400–450 kg-cm (29–32 lb.ft)



INSTALL THE CAMSHAFT WITH CENTER BEARING.

Place a small amount of oil or grease on the center bearing to hold it to camshaft and then install the camshaft in the pump housing.

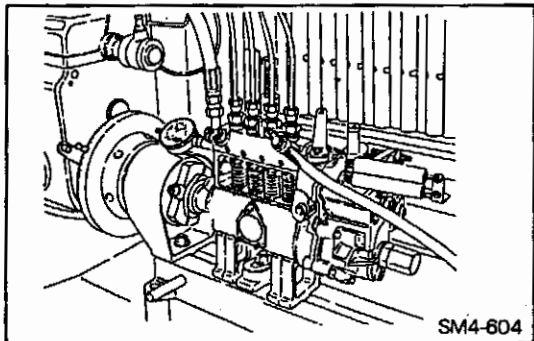
NOTE: A-TYPE 4-cylinder pump is without center bearing.



MEASURE THE SLIDING RESISTANCE OF THE CONTROL RACK.

Assembly Standard: Less Than 150 g (5.29 oz)

NOTE: Make sure that the control rack slides smoothly and without catching.

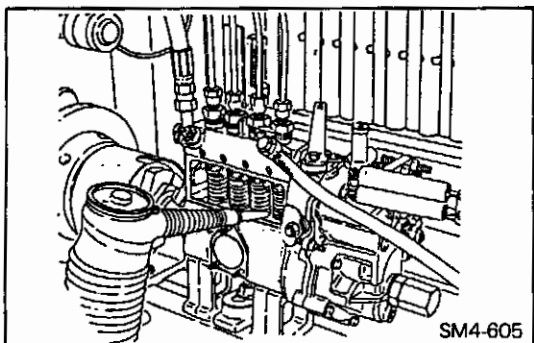


ADJUSTMENT

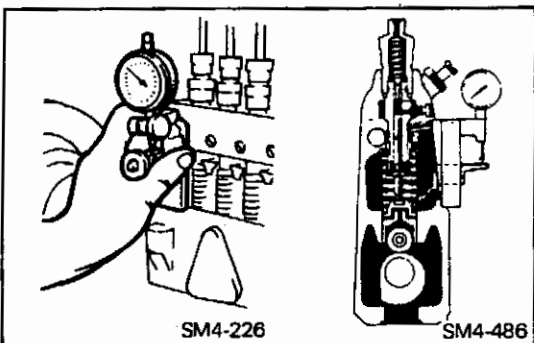
PREPARATION

1. Mount the injection pump correctly on the pump tester.
2. Attach a rack measuring device to the control rack and set to "0".
3. Install calibration nozzles and lines.

Nozzles and Lines: Refer to the chart "CALIBRATION."

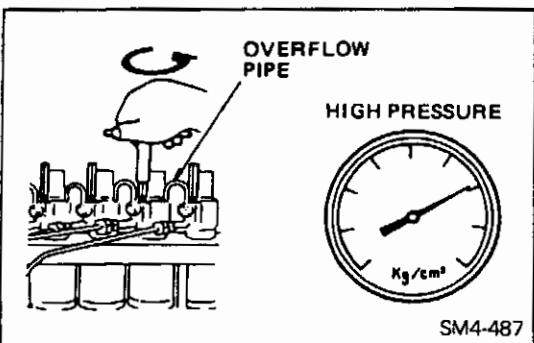


4. Install the cover on the feed pump mounting surface and fill the pump camshaft chamber with engine oil.

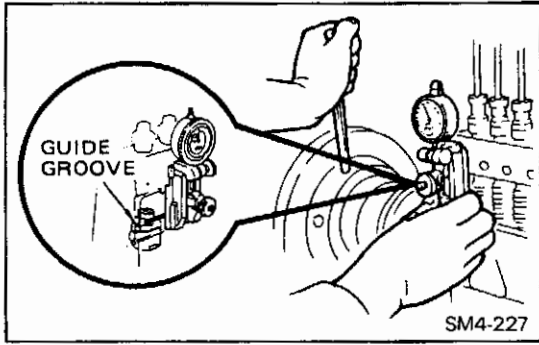


ADJUSTING THE INJECTION TIMING

1. Preparation of the pre-stroke.
 - a) Remove the plate cover.
 - b) Install a pre-stroke measuring instrument. Bring the tappet of the first cylinder to its bottom dead center, and set the pointer tip on the tappet.

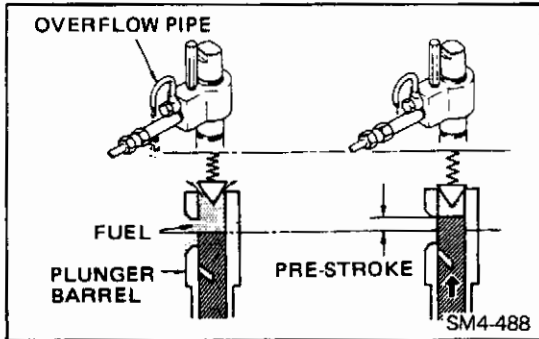


2. Measure the pre-stroke (No.1 plunger)
 - a) Set the control rack at full-load position.
 - b) Loosen the overflow screw of each nozzle holder.
 - c) Operate the high-pressure pump of the pump tester and let fuel run out of the overflow line.



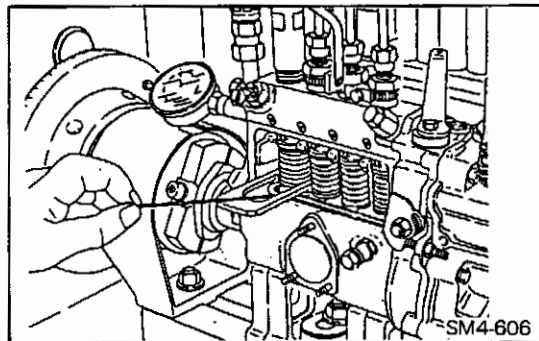
- d) Move the angle dial to set the first cylinder of the pump to bottom dead center and adjust the pre-stroke gauge to zero.

NOTE: Bottom dead center is the point at which the pointer of the dial gauge does not move even when the angle dial is rotated while fuel is flowing from the overflow line.



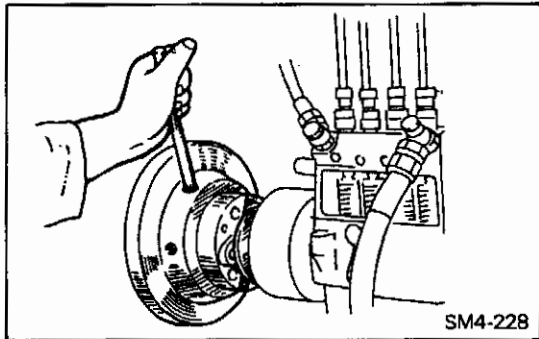
- e) Turn the camshaft clockwise with the angle dial and read the dial gauge when the fuel stops running out of the overflow line. This reading is the pre-stroke value of the pump.

Refer to the Chart "CALIBRATION".



- f) If the pre-stroke value is not within specification, adjust by changing the tappet adjusting shim.

Special Tool: Spring Holder (09511-1960)

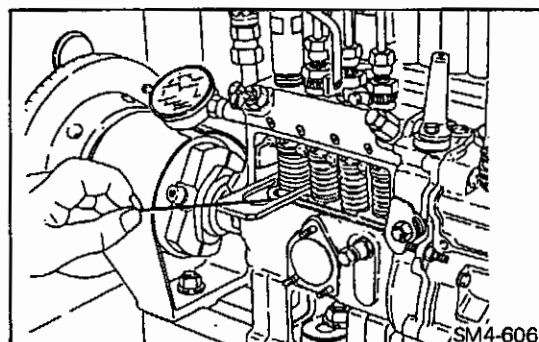


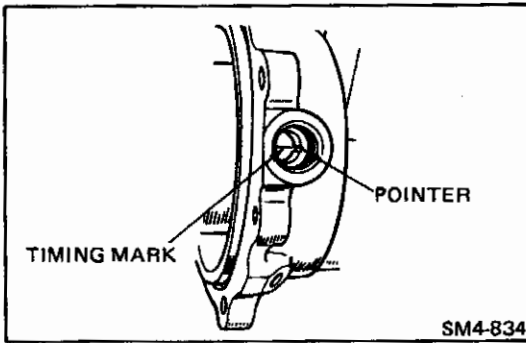
ADJUST THE INJECTION INTERVAL.

- Using the No.1 cylinder injection starting point as a base, inspect and adjust the injection interval in the order of injection.

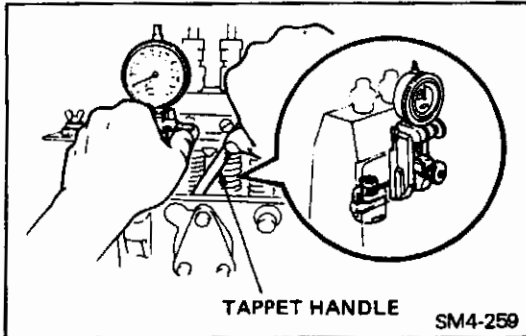
Injection Interval: 89° 45'—90° 15'
Injection Order: 1—3—4—2

- If the injection intervals are not within specification, adjust by using the same procedure as for pre-stroke adjustment.





3. Set the No.1 cylinder at the injection starting point, and check that the marks on the timer and the marks on the pump body are aligned.
If the timing marks are not aligned, make a new mark on the timer and erase the old mark.

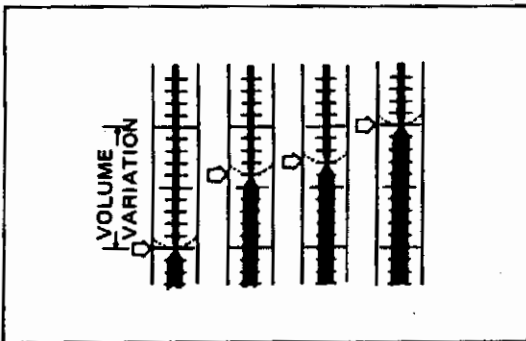


CHECK THE TAPPET TOP CLEARANCE.

1. Set the No.1 cylinder at the injection starting point, then move the tappet with the handle.

Tappet Top Clearance: More than 0.2 mm (0.0079 in)

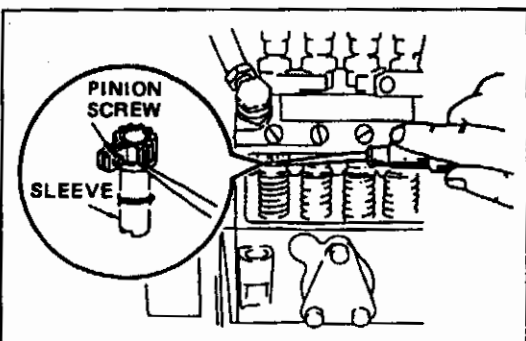
2. Follow the above procedure to check the other cylinders (No.2 through No.6).
3. If the tappet clearance is less than 0.2 mm (0.0079 in), re-check the pre-stroke.



MEASURING AND ADJUSTING THE INJECTION VOLUME.

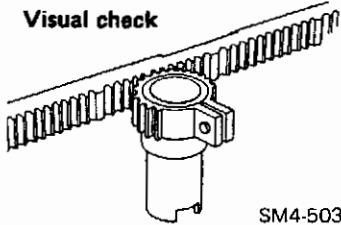
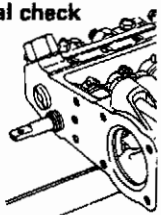
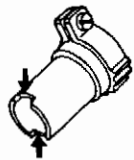
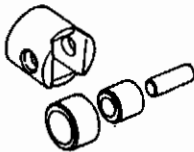

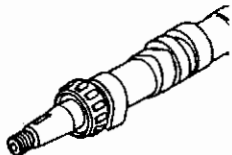
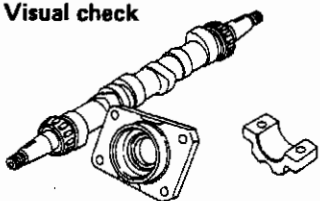
Measure the injection volume for each control rack position and pump revolution.

Injecton Volume: Refer to the chart "CALIBRATION".



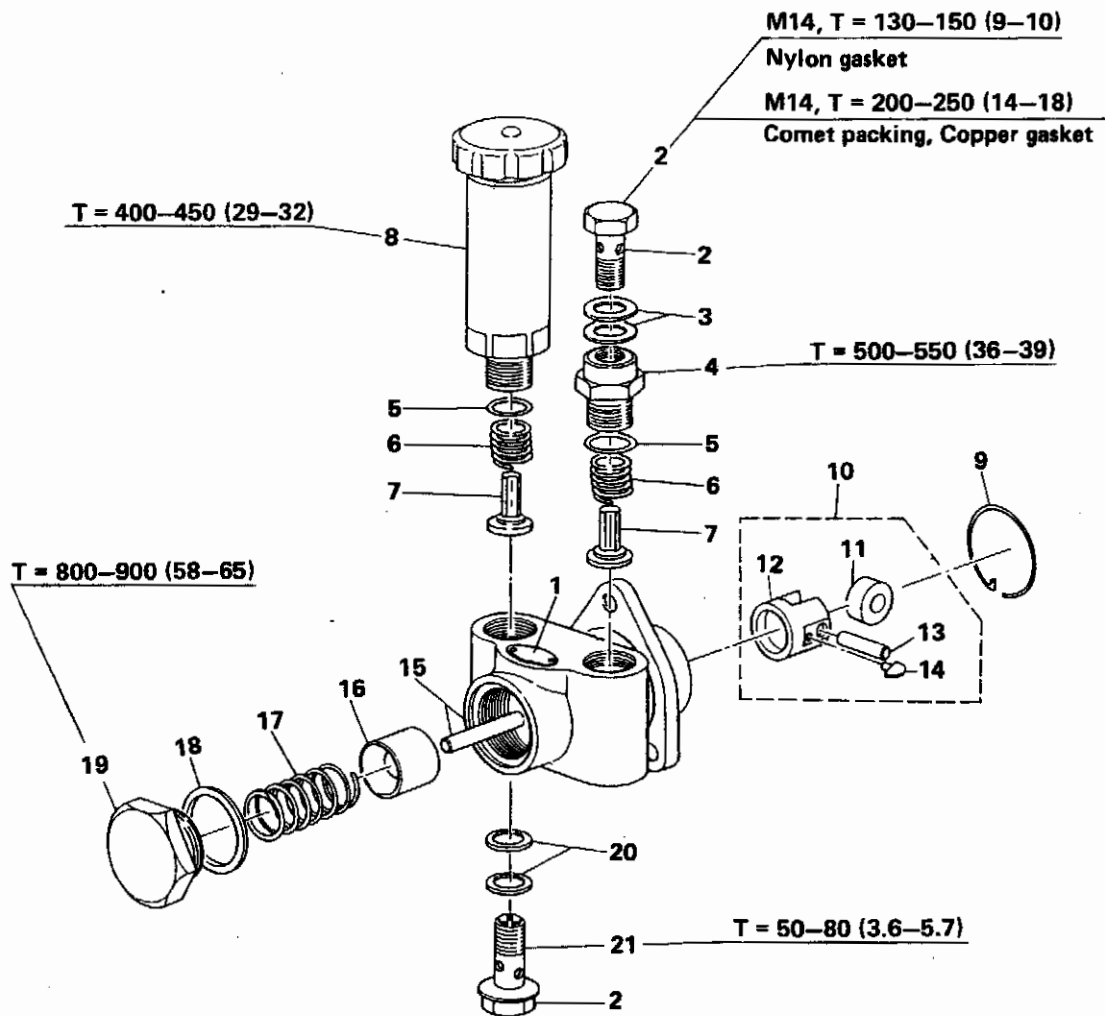
To adjust the injection volume, loosen the pinion screw and insert the adjusting pin into the hole in the control sleeve, then move the sleeve slightly.

INSPECTION AND REPAIR

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
<p>Control Rack. Bent, Wear</p> <p>Gear Teeth. Wear</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-503</p>
<p>Press-fitted bush. Wear</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-607</p>
<p>Control Sleeve. Wear, Damage</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-504</p>
<p>Tappet Roller, Bushing and Pin. Wear, Damage</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-499</p>
<p>Lower Spring Seat. Wear, Damage</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-500</p>
<p>Camshaft. Wear, Damage</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-501</p>
<p>Camshaft Bearing, Bearing Race and Center Bearing. Wear, Damage</p>	-	-	Replace, if necessary.	<p>Visual check</p>  <p>SM4-608</p>

FEED PUMP

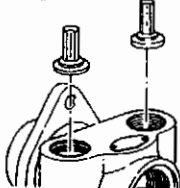
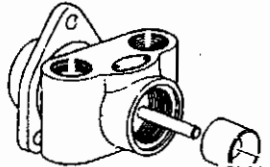
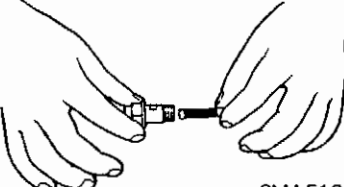
FP/KS-TYPE



T = Tightening torque: kg-cm (lb.ft)

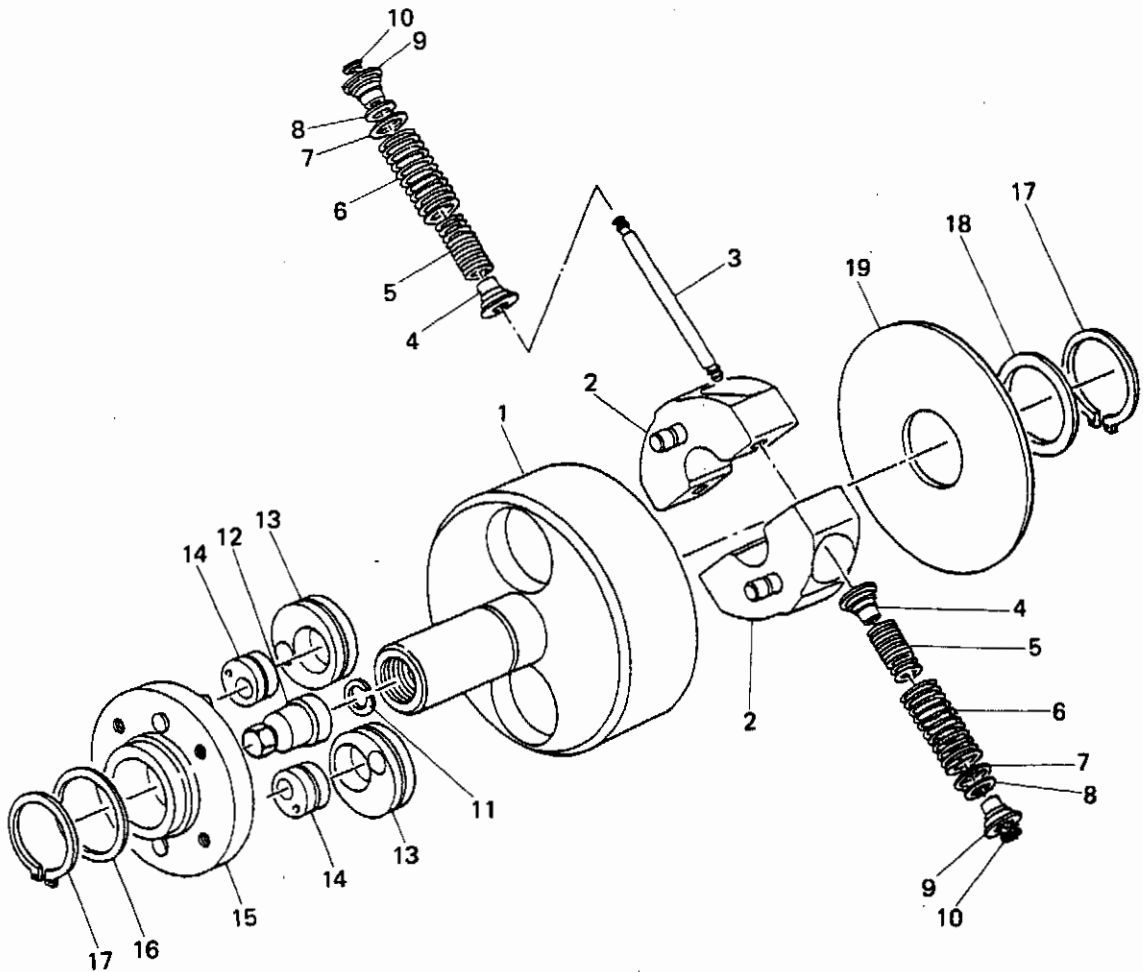
- | | |
|-------------------------|---|
| 1. Feed pump serial No. | 12. Tappet |
| 2. Joint bolt | 13. Pin |
| 3. Soft washer | 14. Sliding block |
| 4. Connector | 15. Feed pump housing, push rod, & oil seal |
| 5. O-ring | 16. Piston |
| 6. Check valve spring | 17. Spring |
| 7. Check valve | 18. Gasket |
| 8. Priming pump | 19. Plug |
| 9. Retainer ring | 20. Soft washer |
| 10. Tappet assembly | 21. Filter |
| 11. Roller | |

INSPECTION AND REPAIR

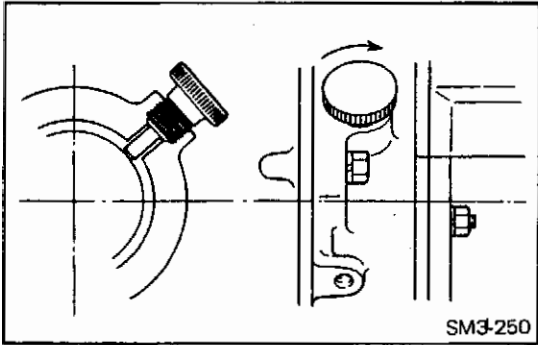
Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Valve Seat. Wear, Damage	-	-	Replace, if necessary.	Visual check  SM4-517
Piston, Cylinder and Oil Seal. Wear, Damage	-	-	Replace, if necessary.	Visual check  SM4-518
Filter, Clogged	-	-	Clean	Visual check  SM4-516

TIMER

SCDM-TYPE TIMER



- | | |
|----------------------|------------------------|
| 1. Timer hub | 11. Special washer |
| 2. Timer weight | 12. Bolt |
| 3. Timer weight rod | 13. Timer cam |
| 4. Timer spring seat | 14. Timer cam |
| 5. Timer spring | 15. Timer drive flange |
| 6. Timer spring | 16. Shim |
| 7. Shim | 17. Retainer ring |
| 8. Shim | 18. Shim |
| 9. Timer spring seat | 19. Timer cover |
| 10. Retainer ring | |



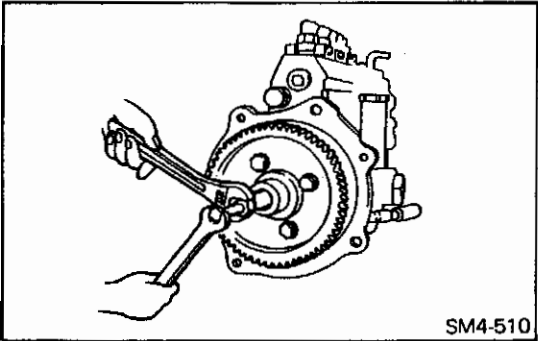
DISASSEMBLY

REMOVE THE TIMER FROM THE INJECTION PUMP.

1. Install the setting tool.

Special Tool: Timer Setting Tool (09512-2100)

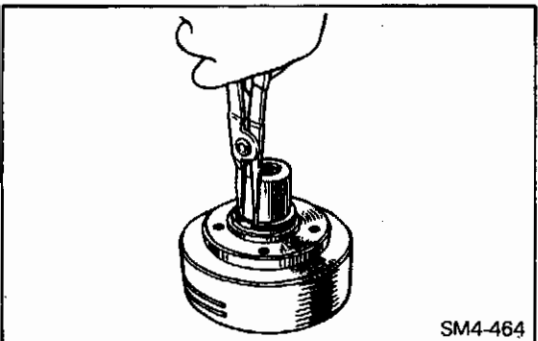
2. Remove the timer round nut.



3. Remove the timer from the injection pump, using the timer extractor.

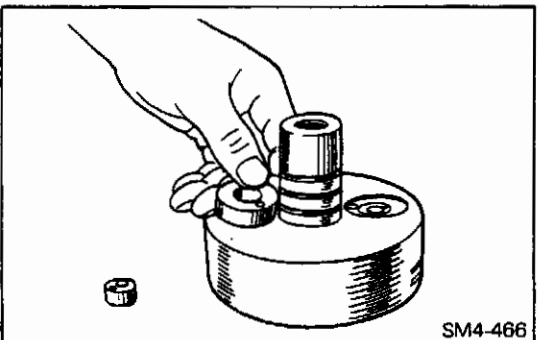
Special Tool: Timer Extractor (09511-1990)

4. Remove the injection pump drive gear.



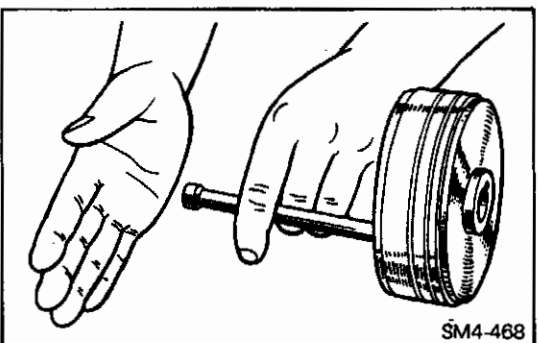
REMOVE THE DRIVE FLANGE.

1. Remove the retainer ring.
2. Remove the shims.
3. Remove the drive flange.



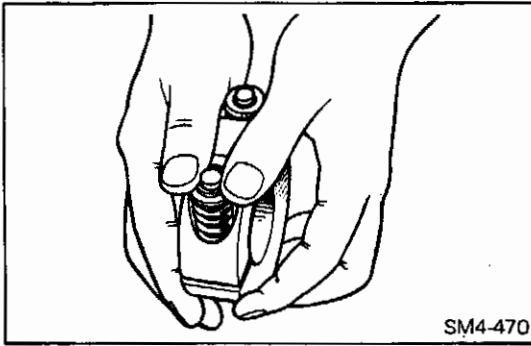
REMOVE THE TIMER CAMS.

NOTE: Before removing the timer cams, the positions of the large and small cams (cam hole positions) should be recorded in order to facilitate installation of the drive flange when reassembling.

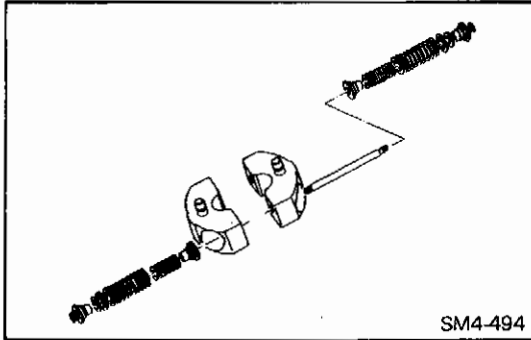
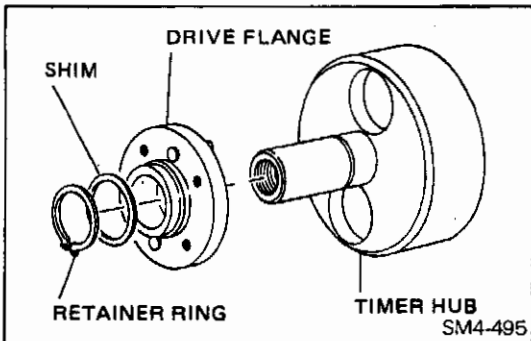


REMOVE THE TIMER COVER.

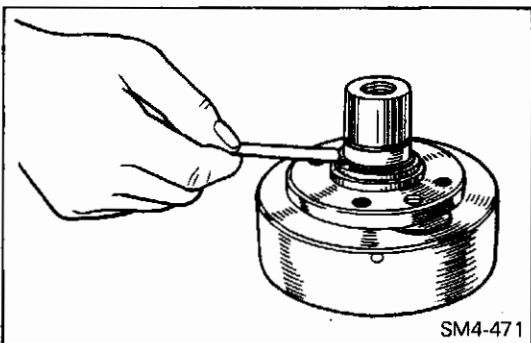
1. Remove the retainer ring.
2. Remove the shim.
3. Apply a brass rod to the timer cover and tap lightly by hand to remove.


DISASSEMBLY THE FLYWEIGHT ASSEMBLY.

Push the timer spring to compress it, then remove the retainer ring.


IMPORTANT POINT (S) – ASSEMBLY
ASSEMBLY THE FLYWEIGHT ASSEMBLY.

INSTALL THE DRIVE FLANGE.

1. Install the drive flange on the timer hub.
2. Install the shim.
3. Install the retainer ring.



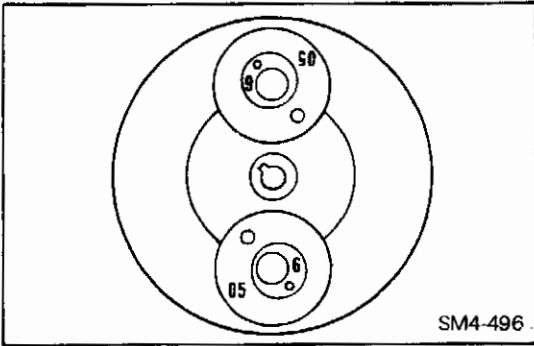
4. Inspect the end play of the drive flange.
Push the drive flange all the way towards the timer hub side, then measure the gap between the drive flange and the shim.

Assembly Standard: 0.02–0.1 mm (0.0008–0.0039 in)

If the end play is not within the standard value, use the following shims for adjustment.

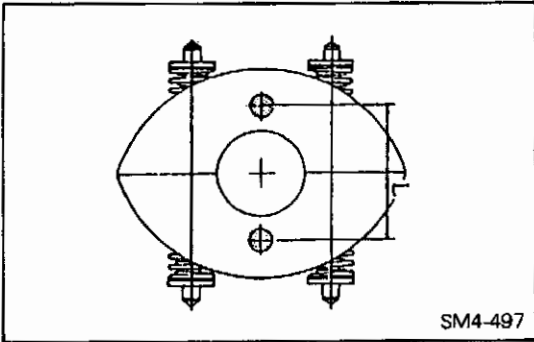
Shim Thickness:

0.10 mm (0.0039 in)	0.90 mm (0.0350 in)
0.12 mm (0.0047 in)	1.10 mm (0.0433 in)
0.14 mm (0.0055 in)	1.30 mm (0.0512 in)
0.16 mm (0.0062 in)	1.50 mm (0.0590 in)
0.18 mm (0.0070 in)	1.70 mm (0.0669 in)



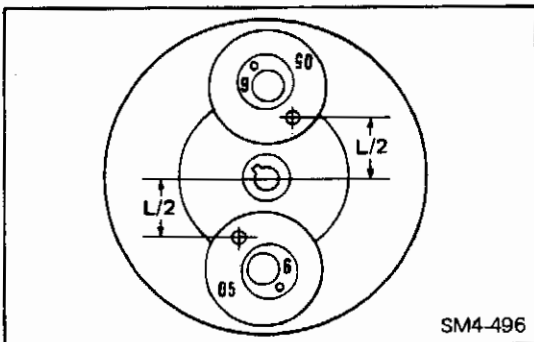
INSTALL THE CAMS.

Install the large and small cams on the timer hub as shown in the figure (as seen from the side of the timer cover).

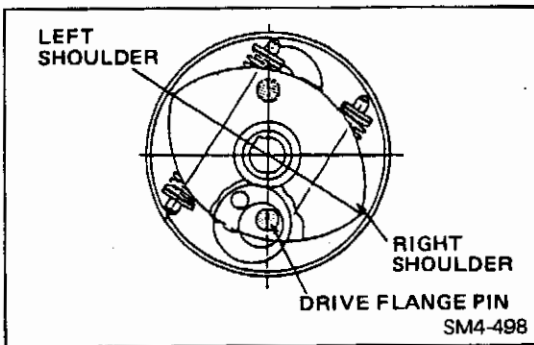


INSTALL THE FLYWEIGHT ASSEMBLY.

1. Measure the distance (L) between the flyweight pin centers after the flyweight spring has been installed.



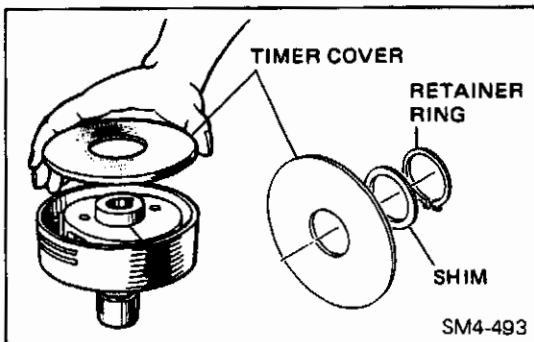
2. Turn the large cam so that the same dimension is obtained on the left and the right for the distance (L/2) between the large cam hole center and the timer hub rotation centers.

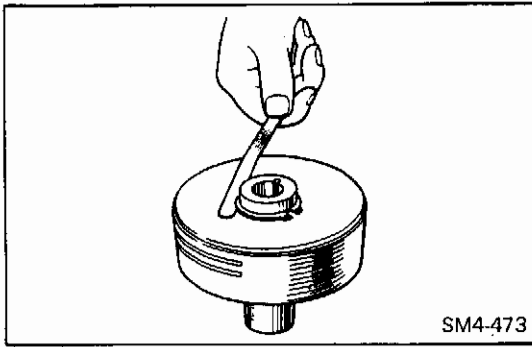


3. Install the flyweight assembly.
4. To confirm correct installation of the flyweight, check that the right shoulder part of the flyweight is lowered when the two pins of the driving hub are in the vertical axis position, as shown in the figure (as seen from the side of the timer cover).

INSTALL THE TIMER COVER.

1. Install the timer cover, shim, and retainer ring.





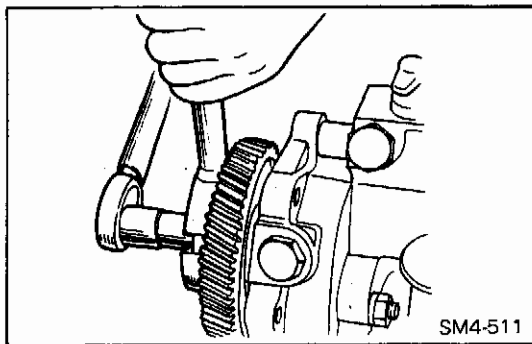
2. Inspect the end play of the timer cover.
 Push the timer cover by hand all the way to the timer hub side, then measure the distance between the timer cover and the shim.

Assembly Standard: 0.05–0.2 mm (0.002–0.007 in)

If the end play is not within the standard value, use the following shims for adjustment.

Shim Thicknesses:

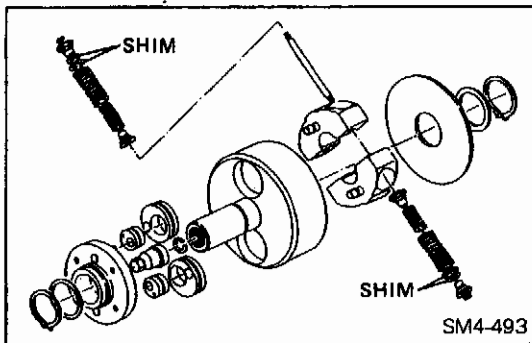
0.10 mm (0.0039 in)	0.90 mm (0.0350 in)
0.12 mm (0.0047 in)	1.10 mm (0.0433 in)
0.14 mm (0.0055 in)	1.30 mm (0.0512 in)
0.16 mm (0.0062 in)	1.50 mm (0.0590 in)
0.18 mm (0.0070 in)	1.70 mm (0.0669 in)



INSTALL THE TIMER ASSEMBLY ON THE INJECTION PUMP.

1. Install the injection pump drive gear.
2. Mount the timer assembly on the injection pump.

Tightening Torque: 850–1,000 kg-cm (62–72 lb.ft)



ADJUSTMENT OF THE TIMER

INSPECT THE TIMER ADVANCE.

1. Set a stroboscope on a pump tester.
2. Check the timer advance.

Advance Angle: Refer to the chart "CALIBRATION".

If the angle is not within specification, adjust with proper shim.

Outer Shim Thicknesses:

0.10 mm (0.0039 in)	0.5 mm (0.0196 in)
0.30 mm (0.0118 in)	1.0 mm (0.0393 in)

Inner Shim Thicknesses:

0.5 mm (0.0196 in)	1.0 mm (0.0393 in)
--------------------	--------------------

CHAPTER GV

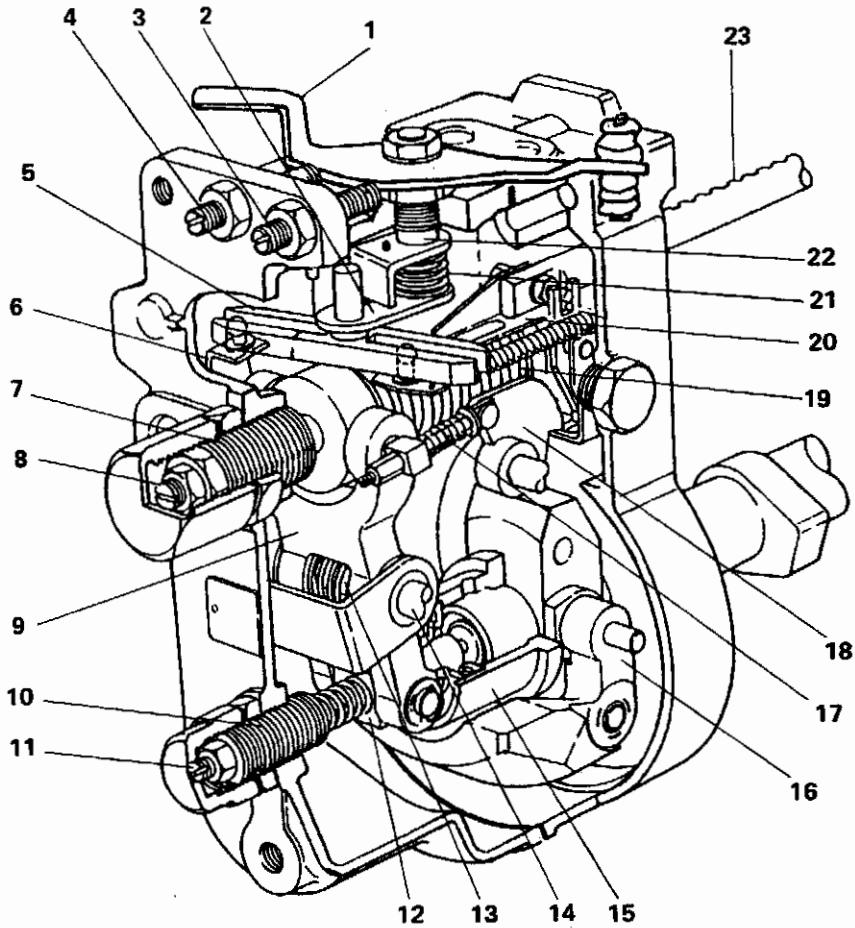
INJECTION PUMP GOVERNOR

(MODEL: RLD and RLD with BOOST COMPENSATOR)

DESCRIPTION	GV-2
SPECIAL TOOL	GV-3
GOVERNOR	GV-4



DESCRIPTION



SM4-570

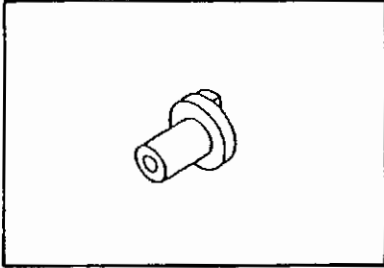
Representative model RLD

- | | | |
|-------------------------------|--------------------------------|--------------------------|
| 1. Speed control lever | 9. Tension lever | 17. Rod and spring |
| 2. Supporting lever | 10. Idling spring sub-assembly | 18. Torque cam |
| 3. Maximum-speed setting bolt | 11. Adjusting screw | 19. Governor spring |
| 4. Idling-speed setting bolt | 12. Shifter | 20. Rack connecting link |
| 5. Floating lever | 13. Cancel spring | 21. Cancel spring |
| 6. Guide lever | 14. Tension lever shaft | 22. Control lever shaft |
| 7. Guide screw | 15. Sleeve sub-assembly | 23. Control rack |
| 8. Governor shaft | 16. Flyweight assembly | |

SPECIAL TOOL

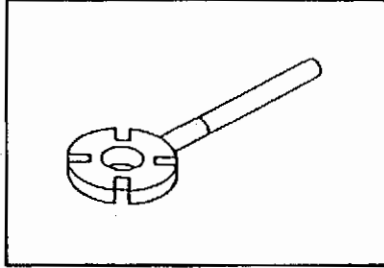
Prior to starting an injection pump overhaul, it is necessary to have these special tools.

COUPLING



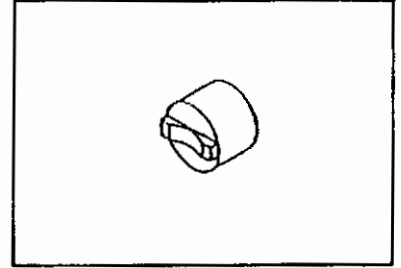
09511-2000

HOLDING WRENCH



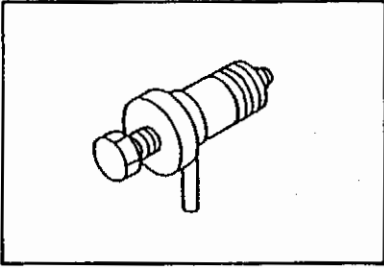
09511-1520

GOVERNOR ROUND NUT WRENCH



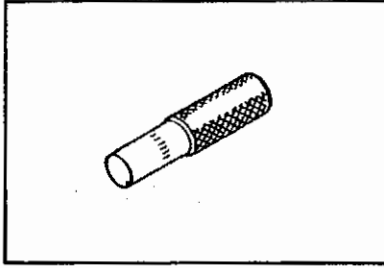
09511-1500

FLYWEIGHT EXTRACTOR



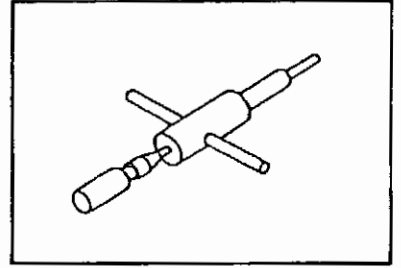
09511-1900

PLUG PRESS



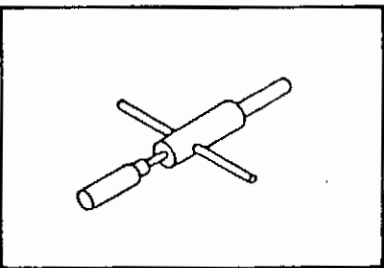
09511-2130

SPECIAL WRENCH



09511-1620

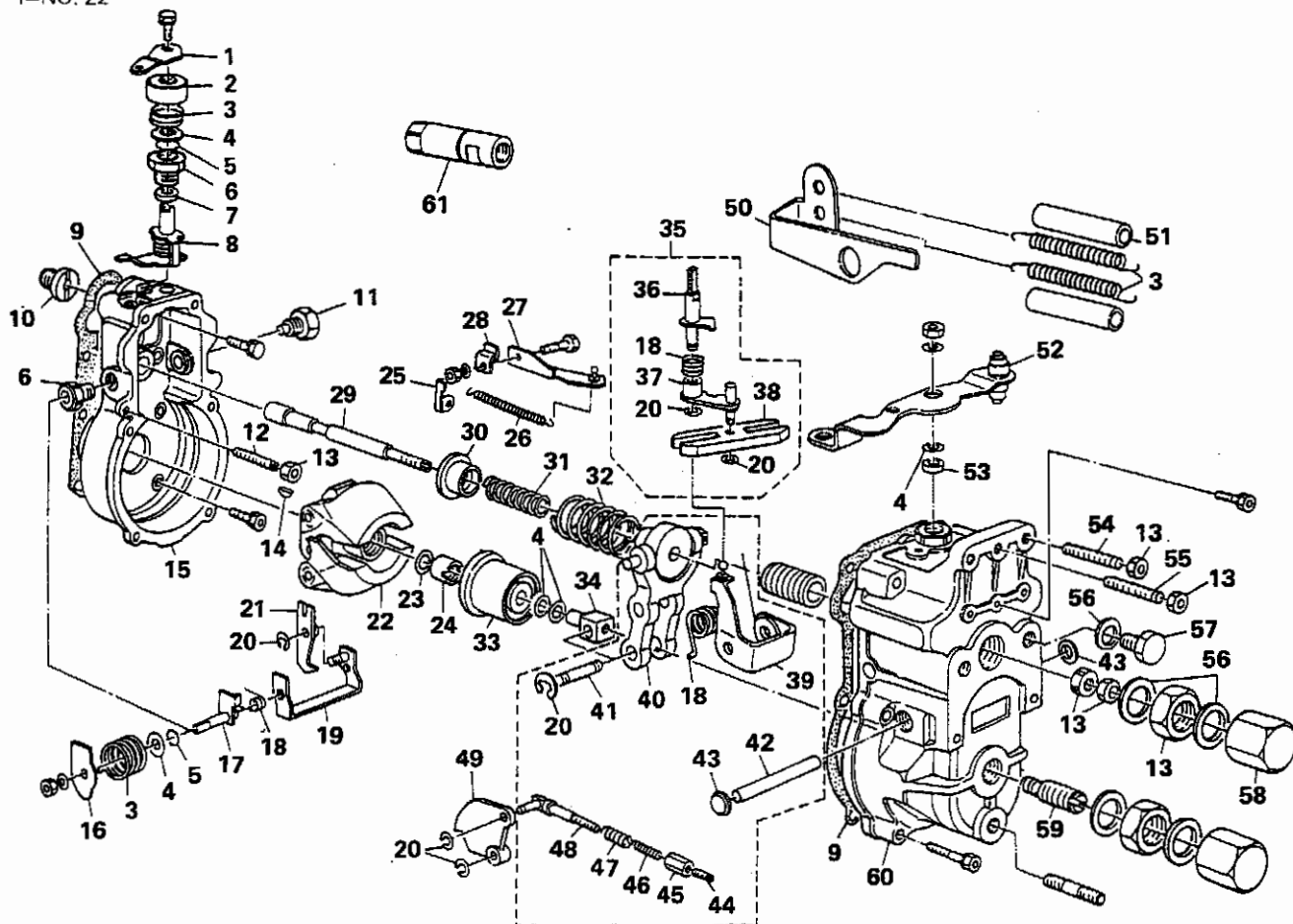
SPECIAL WRENCH



09511-1980

(Model RLD)

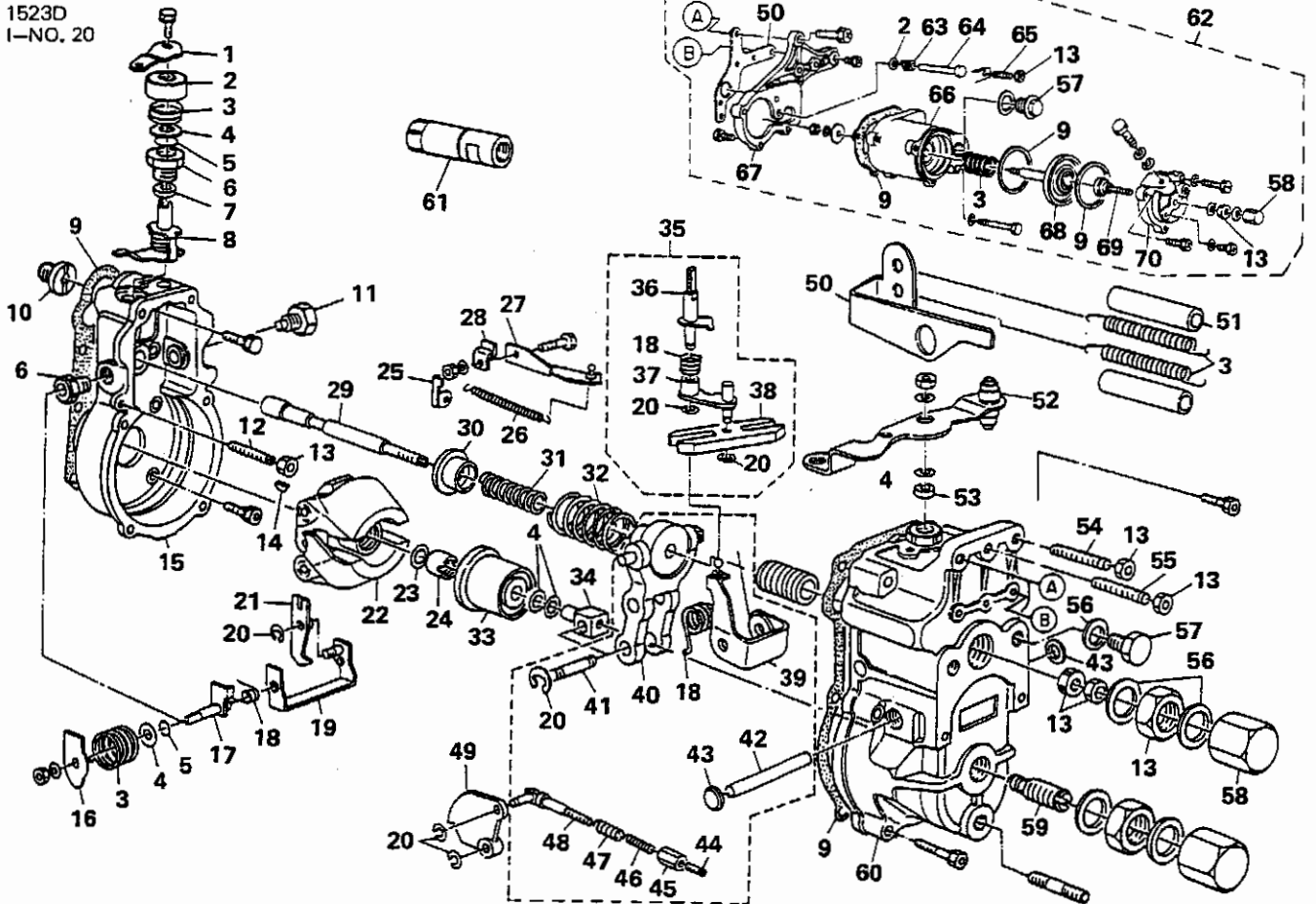
1523E
I-NO. 22



- | | | |
|-----------------------------------|---------------------------------|--------------------------------|
| 1. Engine stop lever | 22. Flyweight assembly | 43. Plug |
| 2. Spring seat | 23. Spring washer | 44. Lock screw |
| 3. Return spring | 24. Round nut | 45. Adjusting nut |
| 4. Shim | 25. Start spring eye | 46. Inner spring |
| 5. O-ring | 26. Start spring | 47. Outer spring |
| 6. Bushing | 27. Rack connecting link | 48. Rod |
| 7. Collar | 28. Plate | 49. Torque cam |
| 8. Supporting lever | 29. Governor shaft | 50. Bracket |
| 9. Gasket | 30. Spring seat | 51. Tube |
| 10. Adapter | 31. Governor spring, inner | 52. Speed control lever |
| 11. Guide plug | 32. Governor spring, outer | 53. Oil seal |
| 12. Full-load setting bolt | 33. Sleeve sub-assembly | 54. Maximum-speed setting bolt |
| 13. Lock nut | 34. Shifter | 55. Idling-speed setting bolt |
| 14. Woodruff key | 35. Floating lever sub-assembly | 56. Gasket |
| 15. Governor housing | 36. Speed control lever shaft | 57. Plug |
| 16. Full-load setting lever | 37. Supporting lever | 58. Cap nut |
| 17. Full-load setting lever shaft | 38. Floating lever | 59. Idling spring sub-assembly |
| 18. Cancel spring | 39. Guide lever | 60. Governor cover |
| 19. U-shape lever | 40. Tension lever | 61. Control rack cover |
| 20. Snap ring | 41. Pin | |
| 21. Sensor lever | 42. Tension lever shaft | |

(Model RLD with BOOST COMPENSATOR)

1523D
I-NO. 20

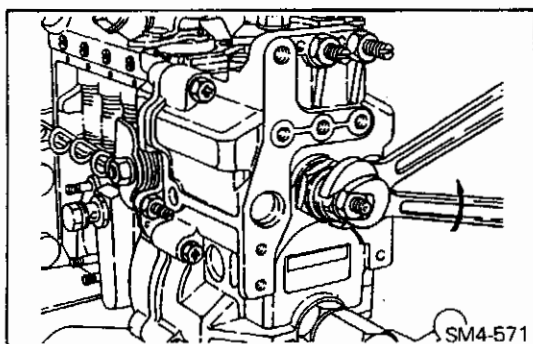


- | | | |
|-----------------------------------|---------------------------------|--------------------------------|
| 1. Engine stop lever | 25. Start spring eye | 49. Torque cam |
| 2. Spring seat | 26. Start spring | 50. Bracket |
| 3. Return spring | 27. Rack connecting link | 51. Tube |
| 4. Shim | 28. Plate | 52. Speed control lever |
| 5. O-ring | 29. Governor shaft | 53. Oil seal |
| 6. Bushing | 30. Spring seat | 54. Maximum-speed setting bolt |
| 7. Collar | 31. Governor spring, inner | 55. Idling-speed setting bolt |
| 8. Supporting lever | 32. Governor spring, outer | 56. Gasket |
| 9. Gasket | 33. Sleeve sub-assembly | 57. Plug |
| 10. Adapter | 34. Shifter | 58. Cap nut |
| 11. Guide plug | 35. Floating lever sub-assembly | 59. Idling spring sub-assembly |
| 12. Full-load setting bolt | 36. Speed control lever shaft | 60. Governor cover |
| 13. Lock nut | 37. Supporting lever | 61. Control rack cover |
| 14. Woodruff key | 38. Floating lever | 62. Boost compensator assembly |
| 15. Governor housing | 39. Guide lever | 63. Spring |
| 16. Full-load setting lever | 40. Tension lever | 64. Push rod |
| 17. Full-load setting lever shaft | 41. Pin | 65. Set screw |
| 18. Cancel spring | 42. Tension lever shaft | 66. Boost compensator housing |
| 19. U-shape lever | 43. Plug | 67. Spacer |
| 20. Snap ring | 44. Lock screw | 68. Diaphragm |
| 21. Sensor lever | 45. Adjusting nut | 69. Screw plug |
| 22. Flyweight assembly | 46. Inner spring | 70. Boost compensator cover |
| 23. Spring washer | 47. Outer spring | |
| 24. Round nut | 48. Rod | |

IMPORTANT POINT (S) – DISASSEMBLY

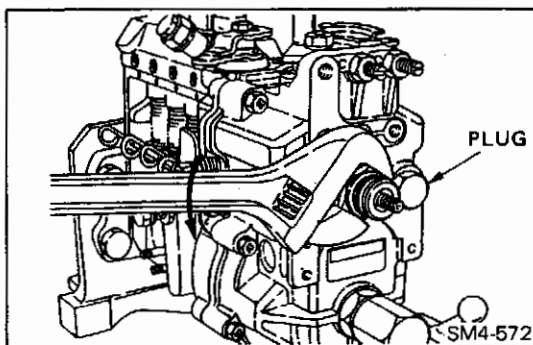
WARNING

- Breaking of the lead seals or crimp caps by any other than HINO or pump manufacture authorized service stations to make these adjustment will void the warranty.
- If fuel pump or governor difficulties are suspected, consult only HINO or pump manufacture authorized service stations, where the problem can be corrected and the injection pump lead seals and crimp caps can be reinstalled as required.

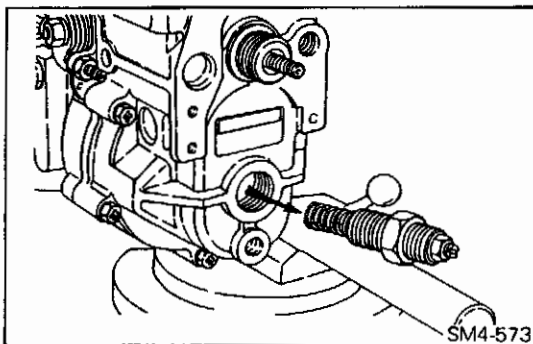


REMOVE THE GOVERNOR COVER FROM PUMP BODY.

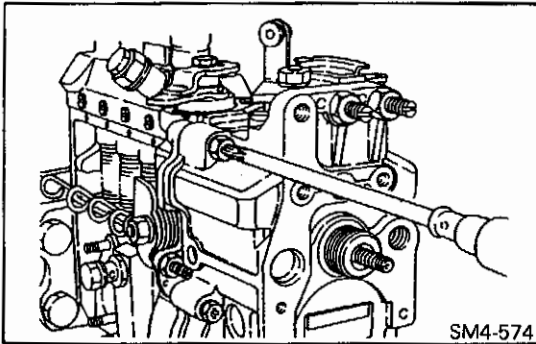
1. Remove the return spring from the speed control lever.
2. Remove the cap nut.
3. Using two spanners, remove two lock nuts from the governor shaft.



4. Loosen the lock nut.
5. Remove the access hole plug.

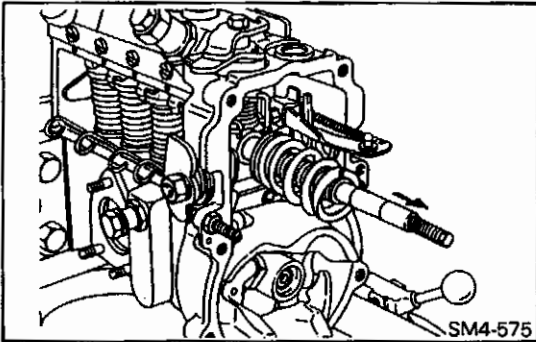


6. Remove the cap nut, and loosen the lock nut. Then remove the idling spring capsule.

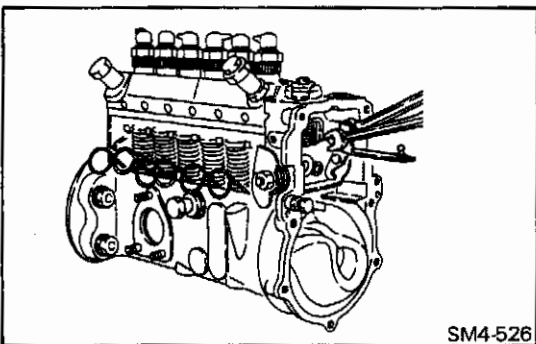


7. Using a philips-head screwdriver, remove the bolts to separate the governor cover from the governor housing. Then remove the governor cover.

NOTE: Be sure to keep an oil pan under the governor to catch lubricating oil.

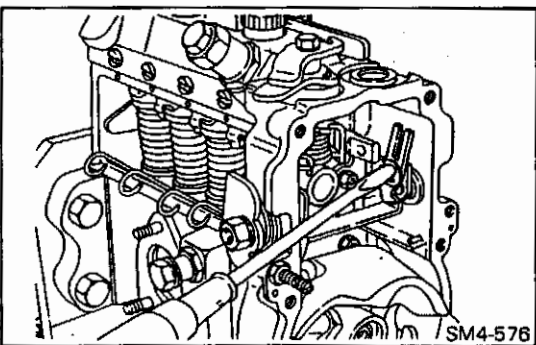


REMOVE THE GOVERNOR SHAFT TOGETHER WITH THE GOVERNOR SPRINGS AND SPRING SEAT.



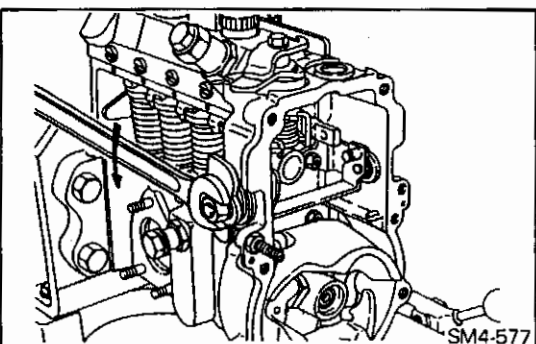
REMOVE THE RACK CONNECTING LINK.

1. Using long-nose pliers, remove the start spring from the rack connecting link.
2. Using two spanners, unscrew the bolt and nut holding the control rack and the rack connecting link in place.
3. Remove the rack connecting link and bolt together.



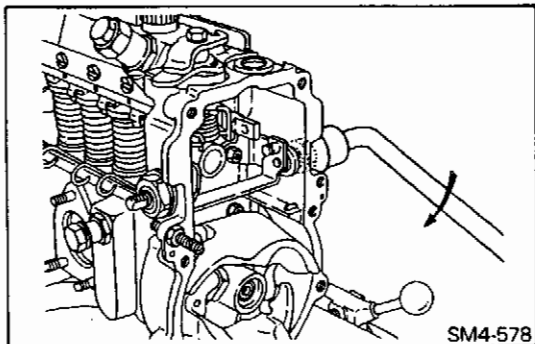
REMOVE THE SENSOR LEVER.

Remove the snap ring from the pin of the U-spaced lever and remove the sensor lever.



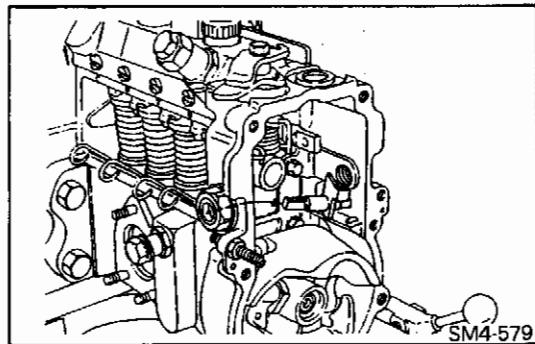
REMOVE THE FULL-LOAD SETTING LEVER AND RELATED PARTS.

1. Remove the nut.
2. Remove the full load setting bolt.
3. Remove the full load setting lever and return spring together. Then remove the O-ring and shim.

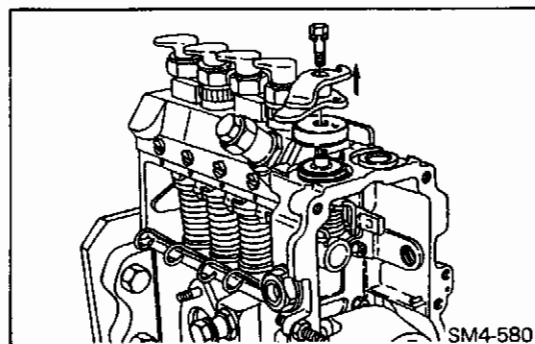


REMOVE THE U-SHAPED LEVER.

1. Remove the guide plug.
2. Remove the U-shaped lever.

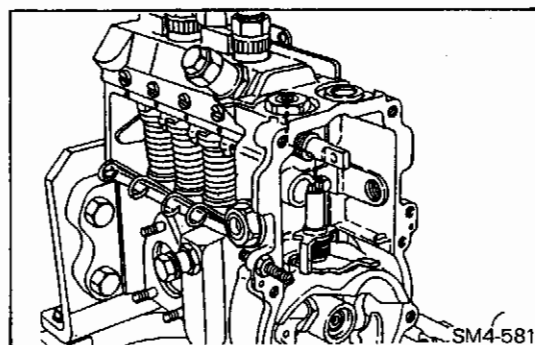


REMOVE THE FULL-LOAD LEVER SHAFT AND SPRING.

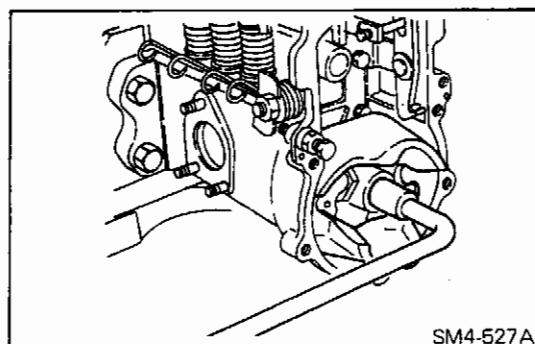


REMOVE THE ENGINE STOP LEVER AND RELATED PARTS.

Remove the bolt, and then remove the stop lever, cap, spring, O-ring, and shim.



PULL OUT THE SUPPORTING LEVER FROM GOVERNOR HOUSING.



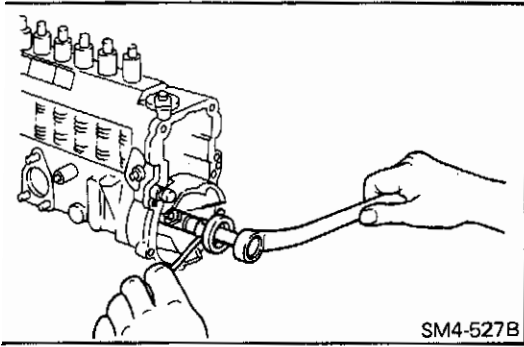
REMOVE THE FLYWEIGHT ROUND NUT.

1. Using the special tools, hold the coupling, so that the camshaft will not turn.

**Special Tool: Coupling (09511-2000)
Holding wrench (09511-1520)**

2. Using a special tool, remove the round nut.

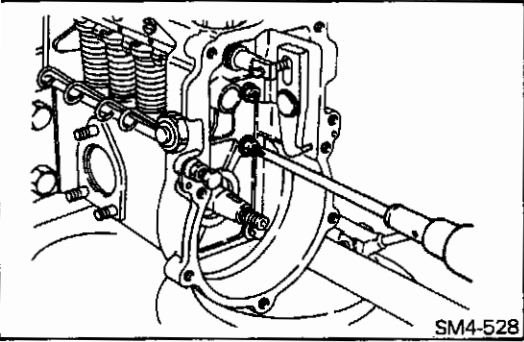
Special Tool: Round nut wrench (09511-1500)



REMOVE THE FLYWEIGHT FROM THE CAM SHAFT.

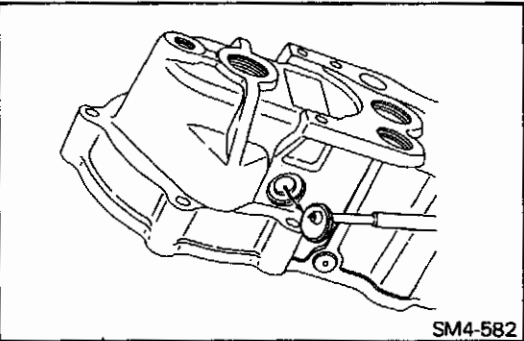
Using a flyweight extractor, remove the flyweight from cam shaft.

Special Tool: Flyweight extractor (09511-1900)



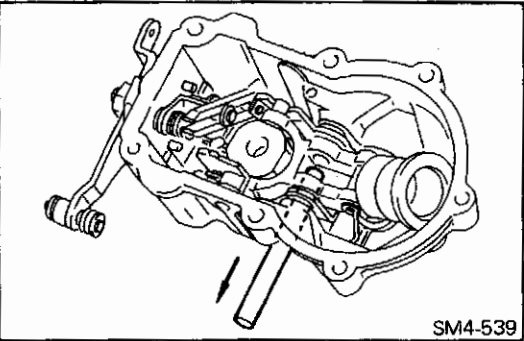
REMOVE THE GOVERNOR HOUSING FROM THE PUMP BODY.

1. Remove the start spring eye.
2. Remove the governor housing fitting bolt and give the governor housing a light tap with a mallet to remove the governor housing from the pump body.

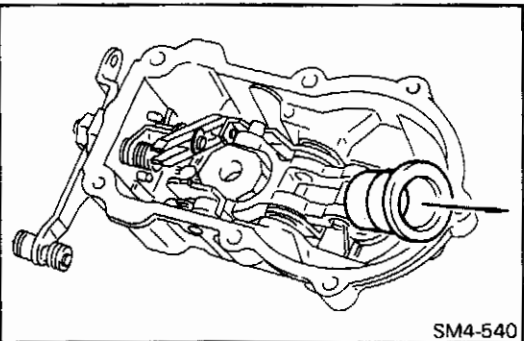


REMOVE THE TENSION LEVER SHAFT.

1. Using a punch, remove the two plugs press-fitted in the governor cover.

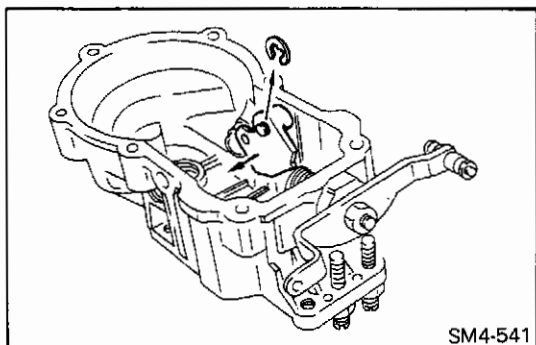


2. Pull out the tension lever shaft.



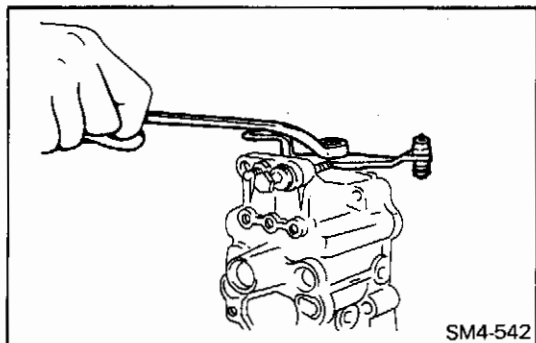
REMOVE THE TENSION LEVER ASSEMBLY.

1. Remove the snap ring, then remove the rod from the torque cam.
2. Remove the tension lever assembly.



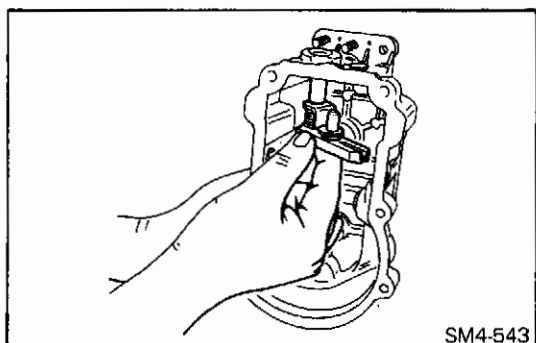
REMOVE THE TORQUE CAM.

Remove the snap ring, then remove the torque cam from the press-fitted pin in the governor cover.

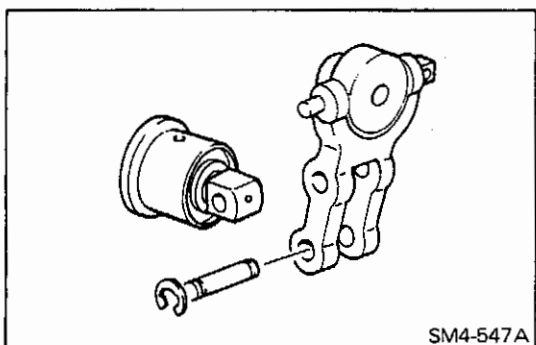


REMOVE THE SPEED CONTROL LEVER.

Remove the nut, and then remove the speed control lever and adjusting shim.

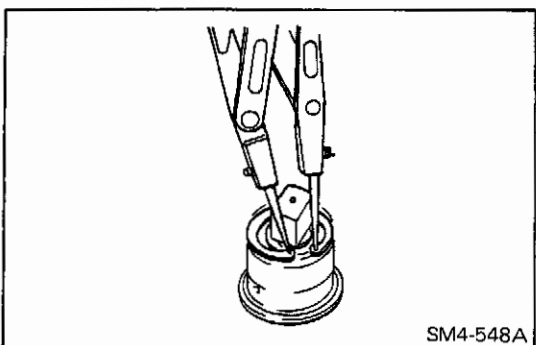


REMOVE THE FLOATING LEVER ASSEMBLY FROM THE GOVERNOR COVER.

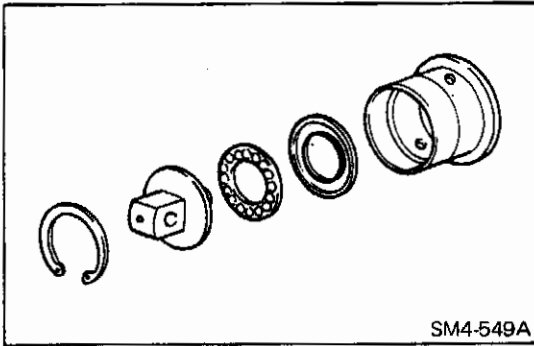


DISASSEMBLE THE SLEEVE SUB-ASSEMBLY FOR INSPECTION.

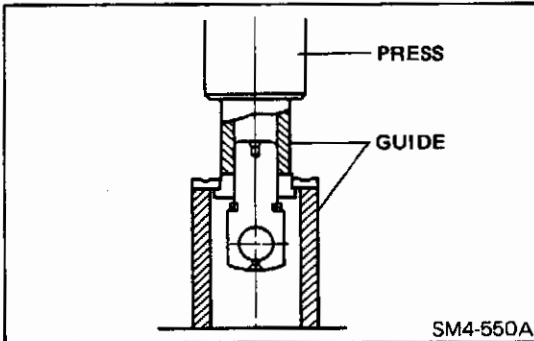
1. Remove the snap ring and pull out the pin.



2. Using snap ring pliers, remove the snap ring installed within the sleeve.



3. Separate the shifter and the bearing assembly from the sleeve.



4. Use a press to remove the outer ring of the bearing.


IMPORTANT POINT (S) – ASSEMBLY

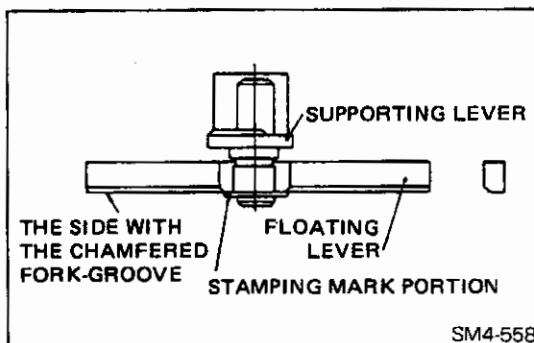
WARNING

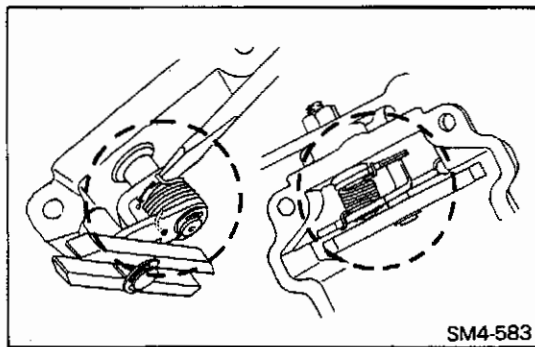
- Wash all parts with clean diesel fuel before installing them, and any defective or damaged parts must be replaced.
- Do not allow dust or other foreign matter to enter the pump during assembly.
- Apply grease to O-rings and oil seals before installing them.
- Assemble the parts in correct order and to correct tightening torque assembled dimensions etc.
- Assembly takes place in the reverse order of disassembly.

NOTE: Once removed, gasket, oil seals, O-rings, and snap rings cannot be reused. New ones must be used in reassembly.

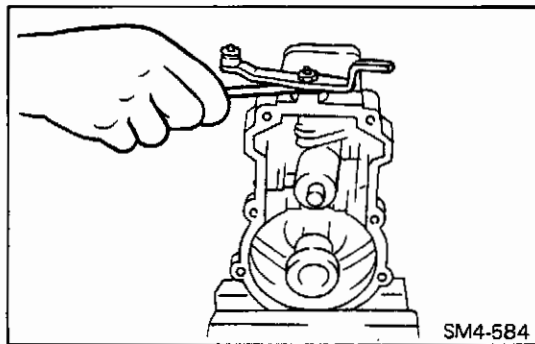
FIT THE FLOATING LEVER TO THE SUPPORTING LEVER WITH THE CHAMFERED FORK-GROOVE OF THE FLOATING LEVER FACING DOWN.

NOTE: A mark  is stamped on the side with the chamfered fork-groove.





SET THE FLOATING LEVER CANCEL SPRING.

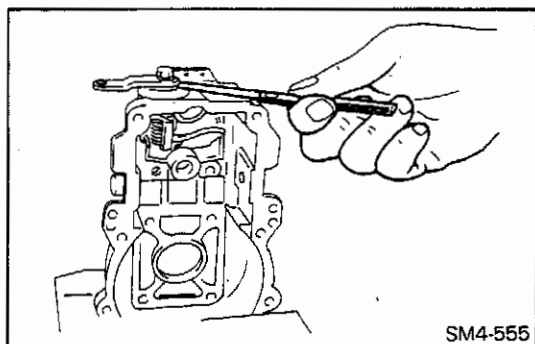


INSPECT THE END PLAY OF THE SPEED CONTROL LEVER.

Assembly Standard: Less than 0.1 mm (Less than 0.004 in)

If the end play is not within the standard value, use the following shims for adjustment.

Shim Thickness: 0.20 mm (0.0078 in)	0.40 mm (0.0157 in)
0.25 mm (0.0098 in)	0.50 mm (0.0196 in)
0.30 mm (0.0118 in)	

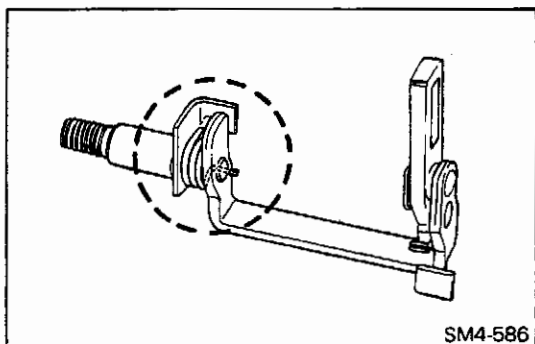


INSPECT THE END PLAY OF THE ENGINE STOP LEVER.

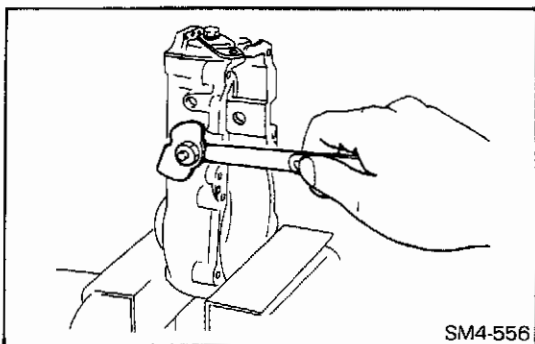
Assembly Standard: Less than 0.1 mm (Less than 0.004 in)

If the end play is not within the standard value, use the following shims for adjustment.

Shim Thickness: 0.20 mm (0.0078 in)	0.40 mm (0.0157 in)
0.25 mm (0.0098 in)	0.50 mm (0.0196 in)
0.30 mm (0.0118 in)	



SET THE FULL-LOAD LEVER SHAFT SPRING.

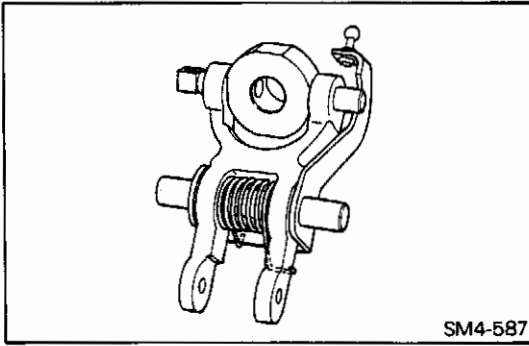


INSPECT THE END PLAY OF THE FULL-LOAD SETTING LEVER.

Assembly Standard: Less than 0.1 mm (Less than 0.004 in)

If the end play is not within the standard value, use the following shims for adjustment.

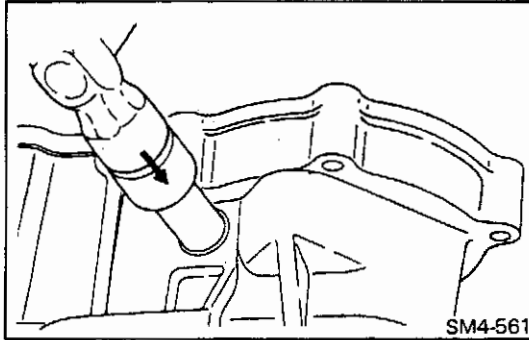
Shim Thickness: 0.20 mm (0.0078 in)	0.35 mm (0.0137 in)
0.25 mm (0.0098 in)	0.40 mm (0.0157 in)
0.30 mm (0.0118 in)	0.50 mm (0.0196 in)



SM4-587

SET THE TENSION LEVER CANCEL SPRING.

For ease in attaching the cancel spring, a V-notch screwdriver is recommended.

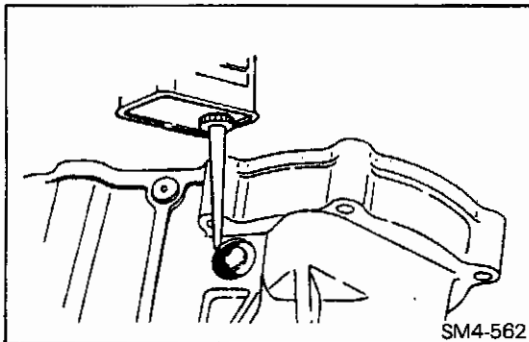


SM4-561

PRESS FIT THE TENSION LEVER SHAFT PLUGS

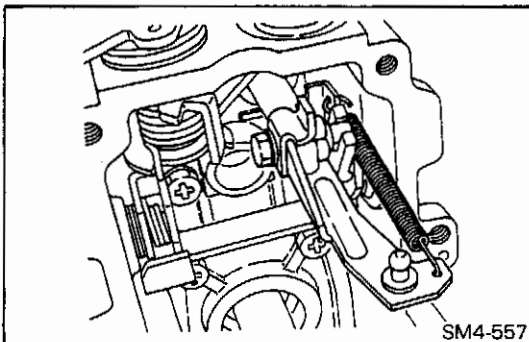
1. The governor must be reassembled with new plugs press-fitted into the governor cover, these plugs secure both ends of the tension lever shaft. Press-expand each plug to ensure seating.

Special Tool: Plug Press (09511-2130)



SM4-562

2. Apply liquid adhesive to the outside of each plug to prevent leakage of lubrication oil.



SM4-557

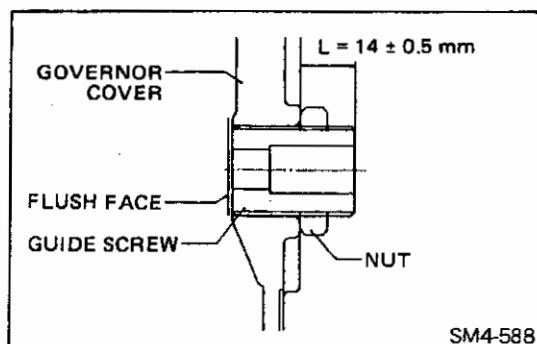
INSTALL THE START SPRING.

The start spring is set in position, with its hook securely fitted from above, in the hook hole of the rack connecting link.

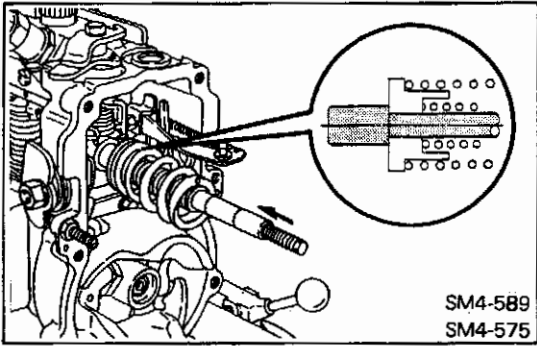
NOTE: If the start spring hook is fitted into place from underneath, they may catch in a fork groove of the floating lever, and interfere with its motion.

ADJUSTMENT OF THE GUIDE SCREW PROTRUSION.

Lock the guide screw, using the nut with a distance of 13.5–14.5 mm (0.53–0.57 in) maintained between the guide screw tip and the outer face of the governor cover. In this case, the opposing end of the guide screw is approximately flush with the inner face of the governor cover.



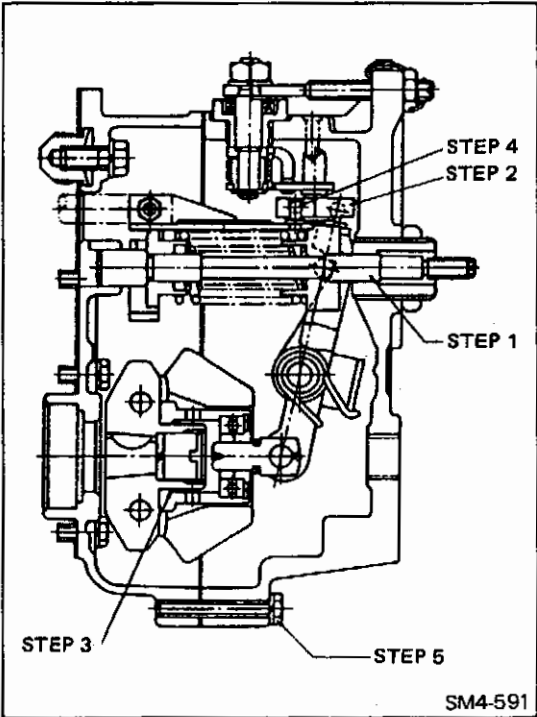
SM4-588



SM4-589
SM4-575

INSERT THE GOVERNOR SHAFT.

NOTE: The spring seat must be mounted on the governor shaft with the governor spring seat facing toward the governor springs (the governor housing side is level).

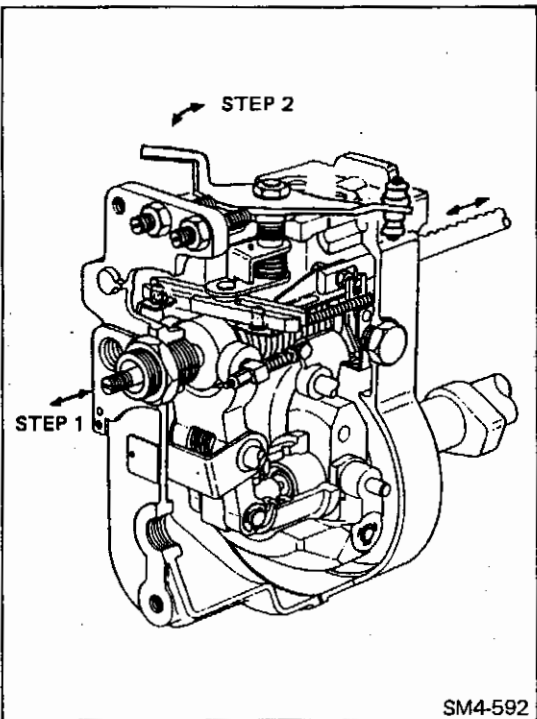


SM4-591

GOVERNOR COVER ASSEMBLY INSTALLATION SEQUENCE.

1. First set the spring seat of the tension lever with the step of the spring seat facing towards the governor springs, and insert the governor shaft into the center hole of the spring seat.
2. Insert the ball joint of the guide lever into the fork-groove in the floating lever.
3. Fit the sleeve into the flyweight holder.
4. Push the control rack toward the governor, and hold. Next, insert the ball joint of the connecting link into the fork groove of the floating lever.
5. Finally, tighten the seven bolts in diagonal sequence, with a uniform torque applied to each bolt.

Tightening Torque: 70–90 kg-cm (5–6 lb.ft)

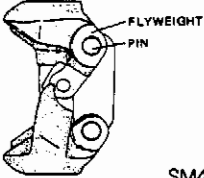
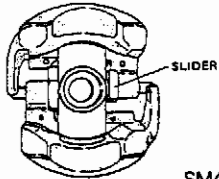

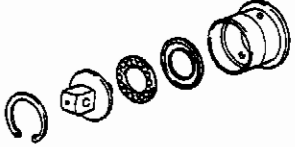
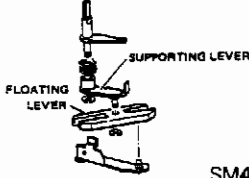
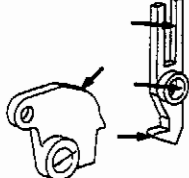



SM4-592

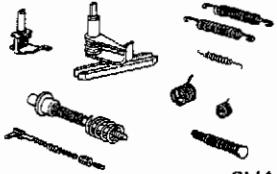
AFTER INSTALLATION OF THE GOVERNOR COVER ASSEMBLY. CHECK THE FOLLOWING ITEM.

1. Ensure the governor shaft can be moved smoothly by hand.
- NOTE:** If governor shaft movement is difficult, loosen the seven bolts of the governor cover so as to slide the governor cover until the governor shaft center is aligned with the guide screw hole center, and then reighten these bolts.
2. Check that the control rack moves smoothly when operating the control lever.
- NOTE:** Should the control rack movement be difficult, remove the governor cover assembly, and determine the cause.

INSPECTION AND REPAIR

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Flyweight Pin Hole and Pin. Wear or any other damage.	—	—	Replace Pin and/or Flyweight	Visual check  SM4-544
Flyweight Slider. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-545
Each part of the Tension Lever assembly. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-546A
Sleeve, Shifter and Bearing Assembly. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-549A
Floating Lever, Supporting Lever, Control Lever Shaft and Rack connecting Link. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-551
Sensor Lever and Torque Cam. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-552
Control Lever, Control Lever Shaft and Supporting Lever. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-553

INSPECTION AND REPAIR

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Springs. Wear or any other damage.	—	—	Replace, if necessary.	Visual check  SM4-554

ADJUSTMENT OF THE GOVERNOR

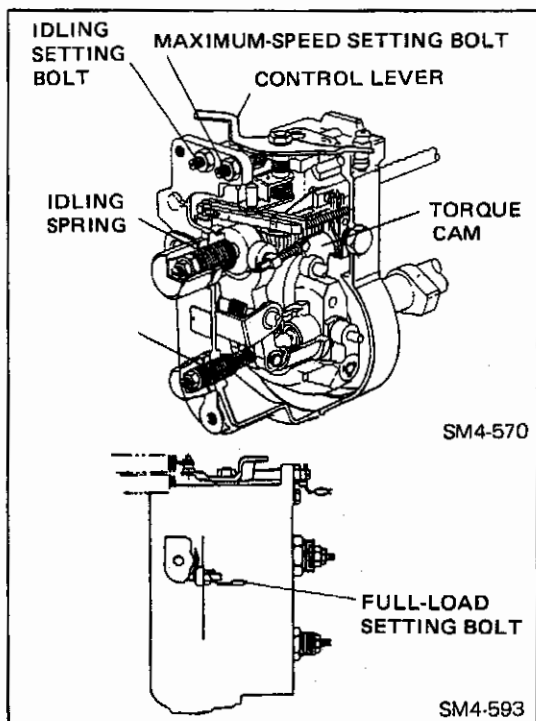
PREPARATION

1. Mount the injection pump correctly on the pump tester.
2. Connect the fuel line.
3. Refill the camshaft chamber and governor chamber with engine oil.
4. Install the angle gauge on the adjusting lever.
5. Remove the idling spring assembly.
6. Remove the governor shaft lock nut.
7. Loosen the maximum-speed setting bolt.
8. Loosen the idling-speed setting bolt.
9. Loosen the full-load setting bolt.
10. Adjust the torque cam position preliminary.
Refer to the chart "CALIBRATION" or "ASSEMBLY OF THE GOVERNOR".
11. Set the zero position of the control rack.
 - a. Mount the control rack travel measuring device on the end of the control rack.
 - b. Lock the control lever at the idling position.
 - c. Push the governor shaft until it comes into contact with the wall of the pump housing, and, keeping the pump speed between 1,000–1,200 rpm, set the control rack at the position where the dial gauge indicates a zero reading.

NOTE: The control rack of the RLD type governor-mounted fuel injection pump cannot be set at zero unless the pump is operated at between 1,000 to 1,200 rpm. If the control rack is pushed to the non-injection position while the injection pump is running at less than 1,000 rpm, the governor links may be damaged.

CAUTION:

- The injection timing adjustment and fuel injection quantity adjustment are executed before governor adjustment.
- Before shifting the control lever to the maximum-speed position, increase the pump speed to 500–600 rpm while the control lever is held at the idling position. Then shift the control lever to the maximum-speed position. Next, set the control rack 3 mm (0.12 in) beyond the full-speed position, using the full-load setting bolt. Various adjustments can now be made with the control rack locked in the specified position.



STEPS IN GOVERNOR ADJUSTMENT

ADJUSTMENT OF THE IDLING SPEED CONTROL.

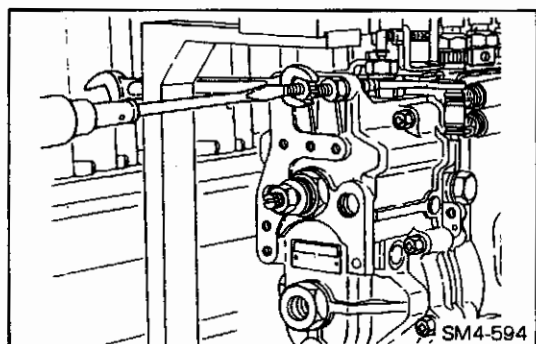
1. Temporarily setting of the control level.
2. Adjustment of the outer idling spring.
3. Adjustment of the inner idling spring.
4. Adjustment of the governor spring.
5. Adjustment of the idling setting bolt.

ADJUSTMENT OF THE FULL-LOAD RACK POSITION.

1. Temporarily setting the control lever.
2. Temporarily adjustment of the maximum-speed setting bolt.
3. Adjustment of the full-load setting bolt.
4. Adjustment of the torque cam position.
5. Measurement of fuel injection quantity.

ADJUSTMENT OF THE MAXIMUM-SPEED CONTROL.

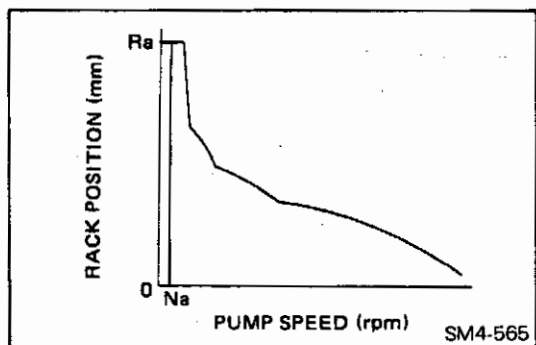
1. Adjustment of the maximum-speed setting bolt.
2. Checking of the speed droop.



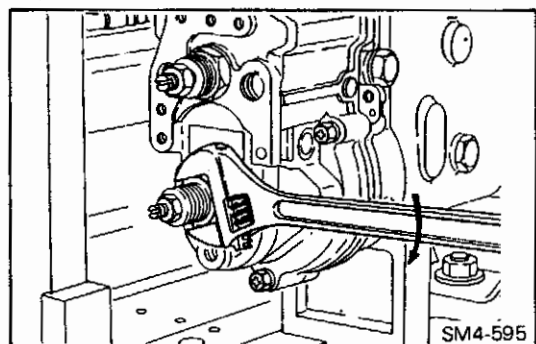
ADJUSTMENT OF THE GOVERNOR

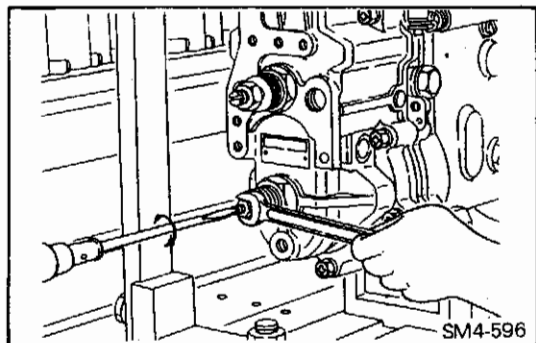
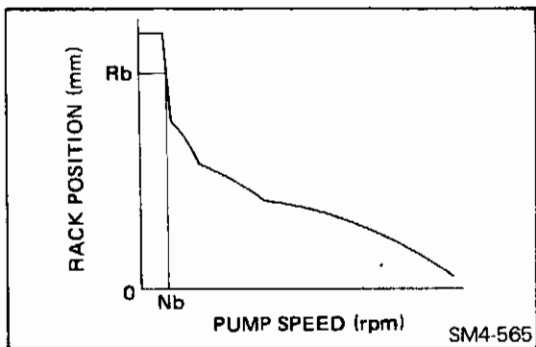
ADJUSTMENT OF THE IDLING SPEED CONTROL.

1. Temporary setting of the control lever.
While keeping the pump speed at Na (80–100 rpm), adjust the idling setting bolt so that the control rack will be at position Ra.

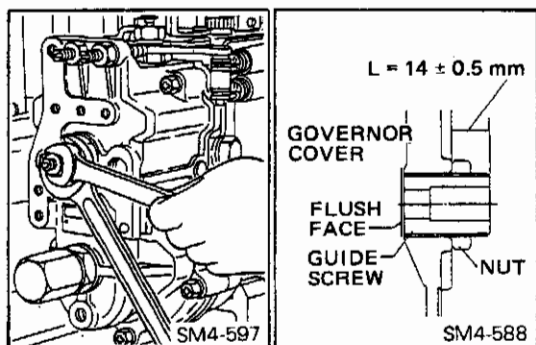
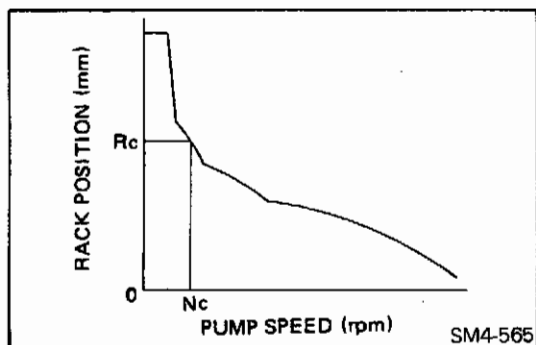


2. Adjustment of the outer idling spring.
Screw in the spring capsule until the control rack is set to position Rb with the pump speed increased to Nb rpm and then lock the nut. The outer idling spring is now set.

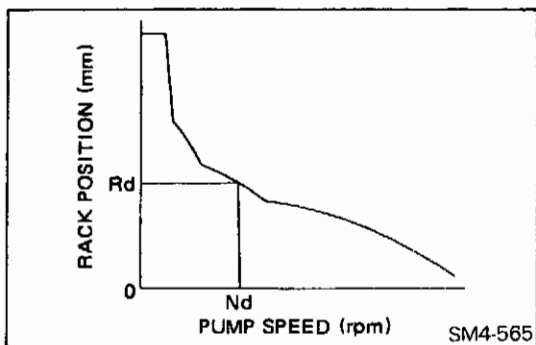




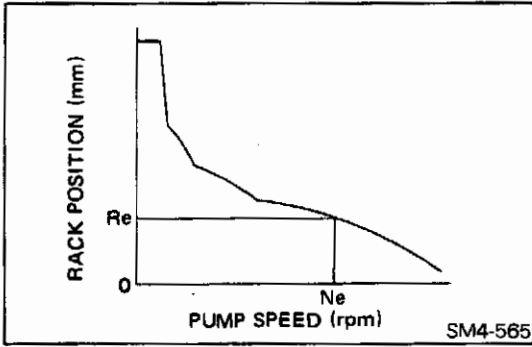
3. Adjust screw after increasing the pump speed to **Nc** rpm so that the control rack will be at **Rc**, and the lock the locking nut.
The inner idling spring is then set in position.
4. Fit the gasket and cap to the spring capsule.



5. Adjustment of the governor springs.
 - a. Recheck that the distance between the tip of the guide screw and the outer face of the governor cover is between 13.5–14.5 mm (0.53–0.57 in).
- NOTE:** If the distance exceeds 14.5 mm (0.57 in), it is difficult to adjust the governor spring with the two nuts.
Conversely, when the distance is less than 13.5 mm (0.53 in), the spring seat of the tension lever contacts the guide screw. If so, the flyweight cannot achieve its maximum lift.



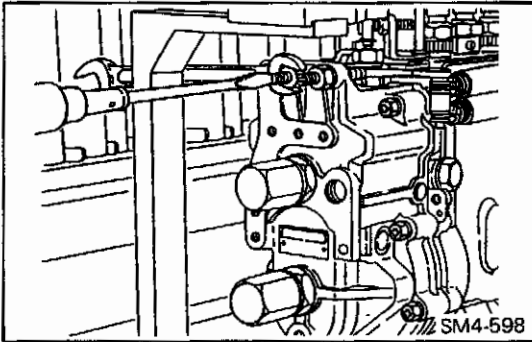
- b. Lock the control lever at the idling position.
 - c. Adjust the governor shaft with the pump speed fixe at **Nd** rpm so that the control rack will be at position **Rd**, and then lock it to the governor shaft with the nut.



- d. Increase the pump speed until the control rack position is at R_e , and then check that the pump is running at N_e rpm.

NOTE: The adjustment sequence may be reversed.

(Set to R_e mm at N_e rpm, check that N_d rpm at R_d mm).

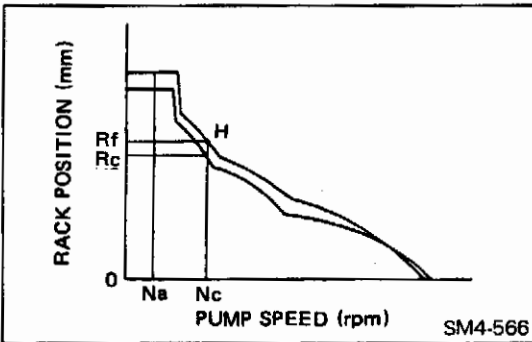


6. Adjustment of the idling setting bolt.

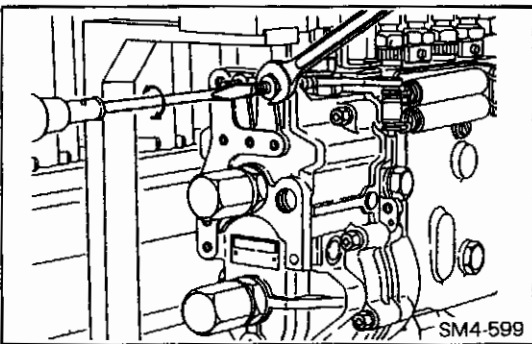
- a. Decrease the pump speed to N_c rpm, and adjust the idling setting bolt so that the control rack will be at position R_f mm. Then lock the nut.

H: Fuel injection volume check point.

Refer to the chart "CALIBRATION".



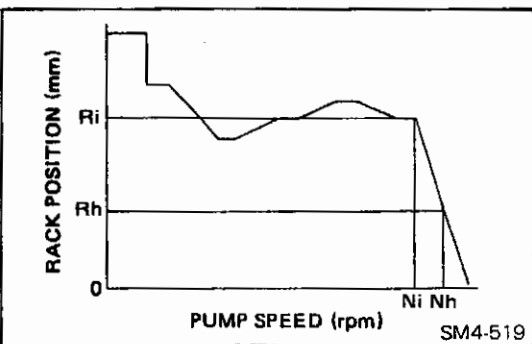
- b. Further decrease the pump speed to N_a (80–100 rpm), and ensure the control rack is positioned at R_a .

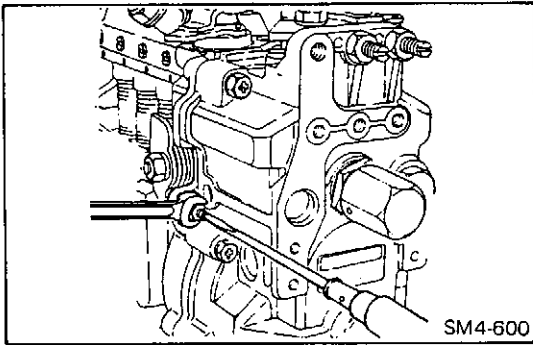


ADJUSTMENT OF FULL-LOAD RACK POSITION.

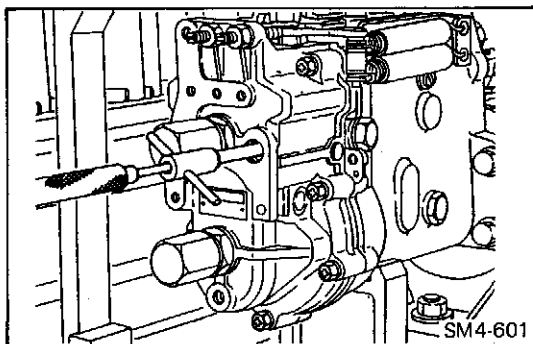
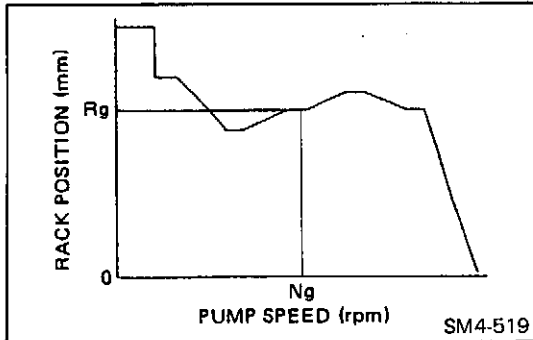
1. Adjustment of the maximum-speed setting bolt.

- a. Adjust the maximum-speed setting bolt so that the control rack position is at R_h when pump speed is N_h rpm. Then lock the maximum speed setting bolt with the nut.
- b. Ensure that the control rack begins moving in the fuel decrease direction at a pump speed of N_i rpm.



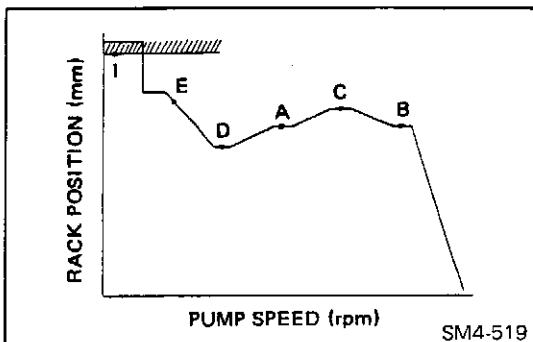
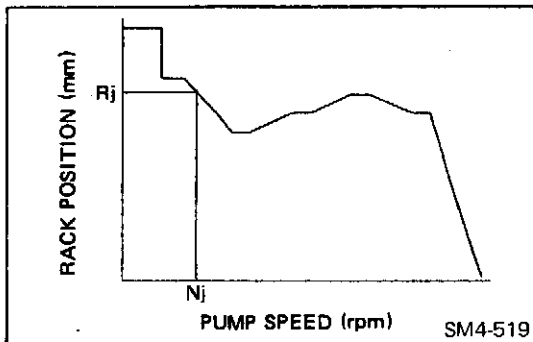


- Adjustment of the full-load setting bolt.
Adjust the full-load setting bolt so that the control rack position is at R_g mm when the pump speed is N_g rpm.



- Adjustment of the torque cam position.
Using a special tool, adjust the adjusting nut so that the control rack position is at R_j mm when the pump speed is N_j rpm. Lock the adjusting nut with a lock screw.

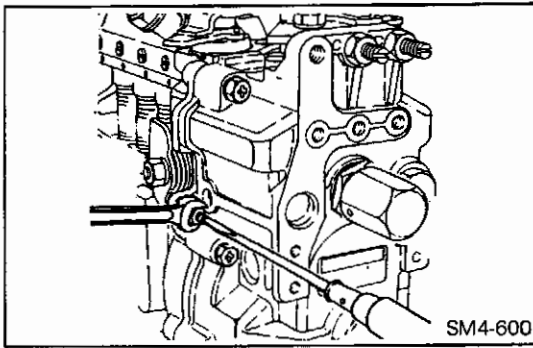
Special Tool: Special Wrench (09511-1980)



- Measurement of fuel injection quantity.
Measure the fuel injection quantity at each of adjusting points, A, B, C, D, E and I (the fuel injection characteristics for full-load). If the fuel injection quantity is not correct, adjust the full-load setting bolt and the torque cam adjusting nut carefully. Lock the nut and bolt after adjustments.

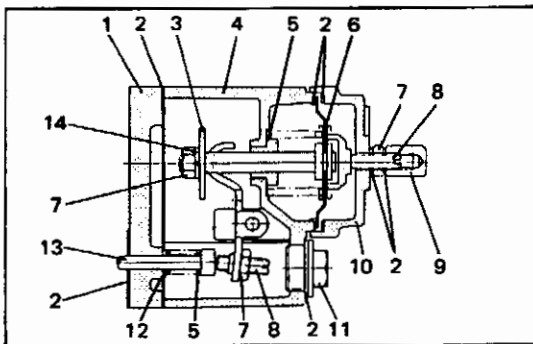
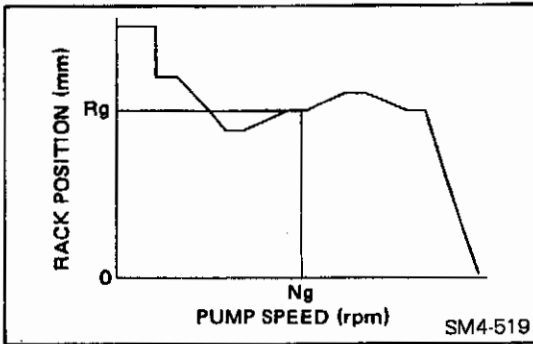
NOTE: If this adjustment is not executed properly, the specified fuel injection quantity cannot be obtained, there will be decreased engine output, and black smoke may be produced.

Refer to the chart "CALIBRATION".



ADJUSTMENT OF THE MAXIMUM SPEED CONTROL.

1. Lock the control lever where it contacts the maximum-speed setting bolt.
2. Adjustment of the maximum-speed setting bolt.
 - a. Adjust the maximum-speed setting bolt so that the control rack position becomes R_h when pump speed is N_h rpm. Then lock the maximum speed setting bolt with the nut.
 - b. Ensure that the control rack begins moving in the fuel decrease direction at a pump speed of N_i rpm.
 - c. Increase the pump speed further to ensure that the control rack reaches 0 mm.

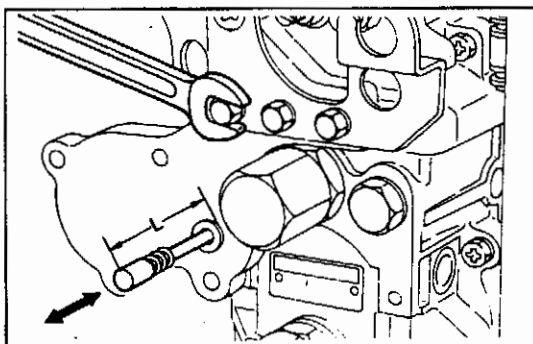


ADJUSTMENT OF BOOST COMPENSATOR

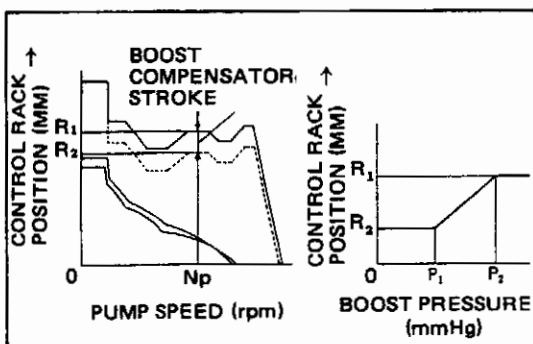
- | | |
|--------------|--------------------|
| 1. Spacer | 8. Adjusting screw |
| 2. Gasket | 9. Cap nut |
| 3. Disc | 10. Cover |
| 4. Housing | 11. Plug |
| 5. Spring | 12. Washer |
| 6. Diaphragm | 13. Push rod |
| 7. Nut | 14. Spring washer |

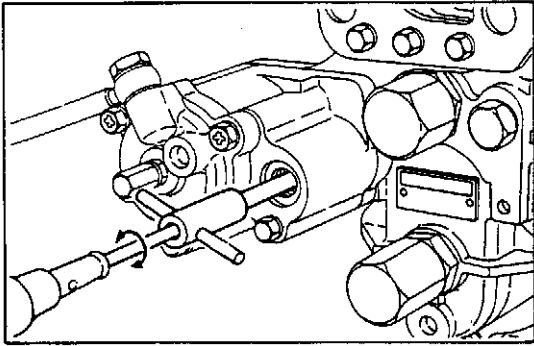
1. Install the spacer on the governor cover, and ensure the push rod can move smoothly.
2. Measure the protrusion (L) of push rod from the end face of the spacer.

$L = 19.4-19.6 \text{ mm (0.764-0.771 in)}$



3. Boost compensator stroke adjustment.
 - a. Maintain the pump speed at N_p rpm.

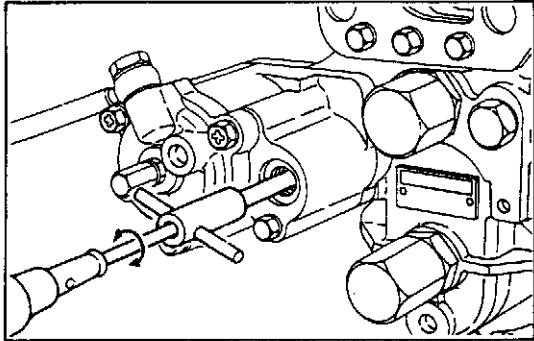




- b. Fully loosen the adjusting screw with the wrench, and then confirm that the control rack position R_1 mm can be obtained.

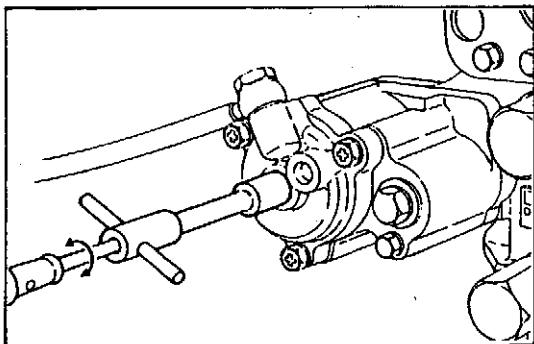
If the rack position R_1 mm is not as specified, readjust the full-load setting bolt and torque cam.

Special Tool: Special Wrench (09511-1620)

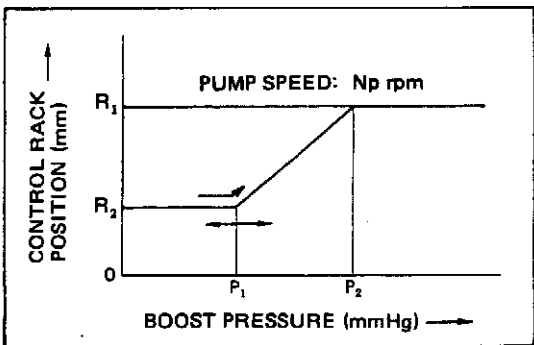


- c. Shift the control rack position from R_1 to R_2 using the adjusting screw, and then lock it with the nut.

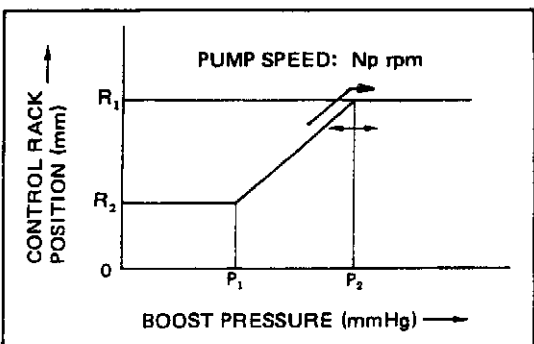
NOTE: During boost compensator stroke adjustment it is not necessary to supply compressed air.



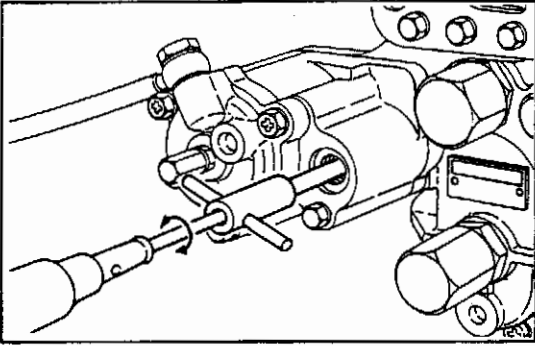
- 4. Setting the boost compensator spring force.
 - a. With the pump speed maintained at N_p rpm, gradually increase the boost pressure.



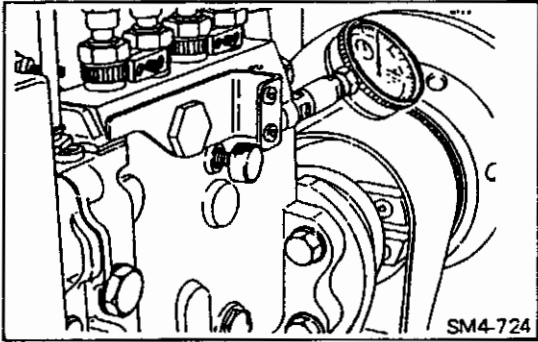
- b. Adjust the screw so that the control rack begins moving from R_2 mm in the fuel increase direction when the boost pressure reaches P_1 mmHg. Lock the screw with the nut.



- c. Increase the boost pressure, and ensure it reaches P_2 mmHg when the control rack is at R_1 mm. If the boost pressure is not as specified, replace the boost compensator spring.

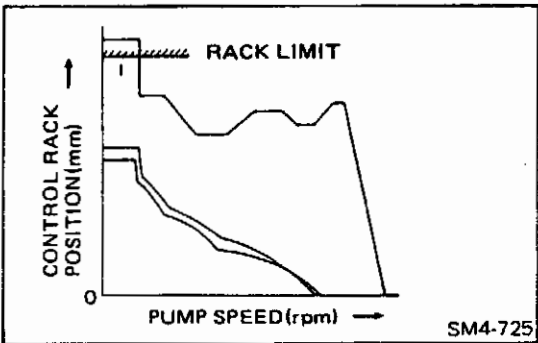


- d. Recheck the boost compensator stroke, and if not as specified readjust the screw.

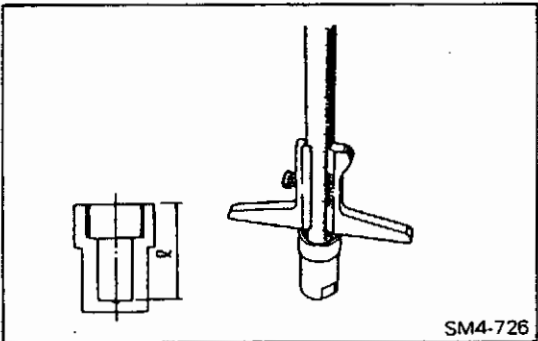


ADJUSTING THE CONTROL RACK STROKE LIMIT.

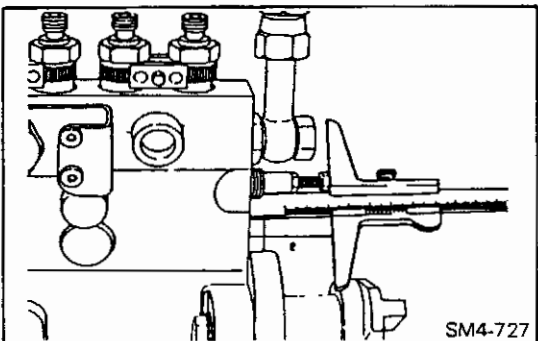
1. Remove the rack guide screw from the pump housing.
2. Lock the control rack at the position given with the chart "CALIBRATION", keeping the pump speed at 0 rpm.



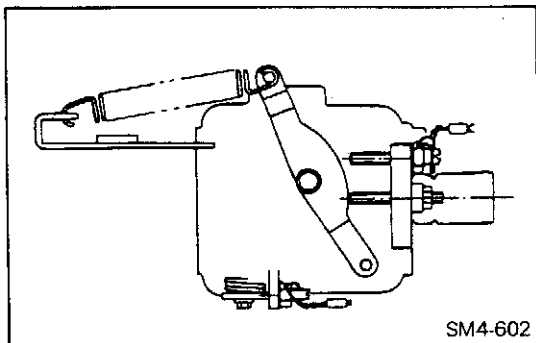
3. Measure the depth "ℓ" of the rack cap.



4. Attach both the bolt and nut the end of the control rack.
5. Adjust the bolt so that the distance between the end face of the pump housing and the bolt top is "ℓ", the rack cap depth. Now tighten the nut to lock the bolt, and install the rack cap.

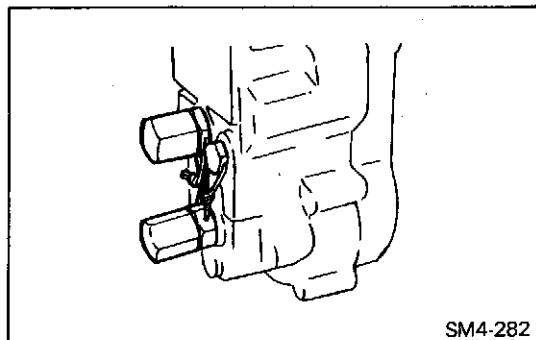


GOVERNOR



INSTALL THE GOVERNOR EXTERNAL CRIMP CAPS AND LEAD SEALS.

NOTE: All adjusting devices on the fuel injection pump governor, except the low idle adjustment screw, are sealed with crimp caps as a protection for the customer. This is to prevent unauthorized readjustment which may cause engine malfunction and/or engine failure. Periodically check to insure that these seals are not broken, as this will void the warranty.



CHAPTER GE

GENERATOR

(24V, 30A)

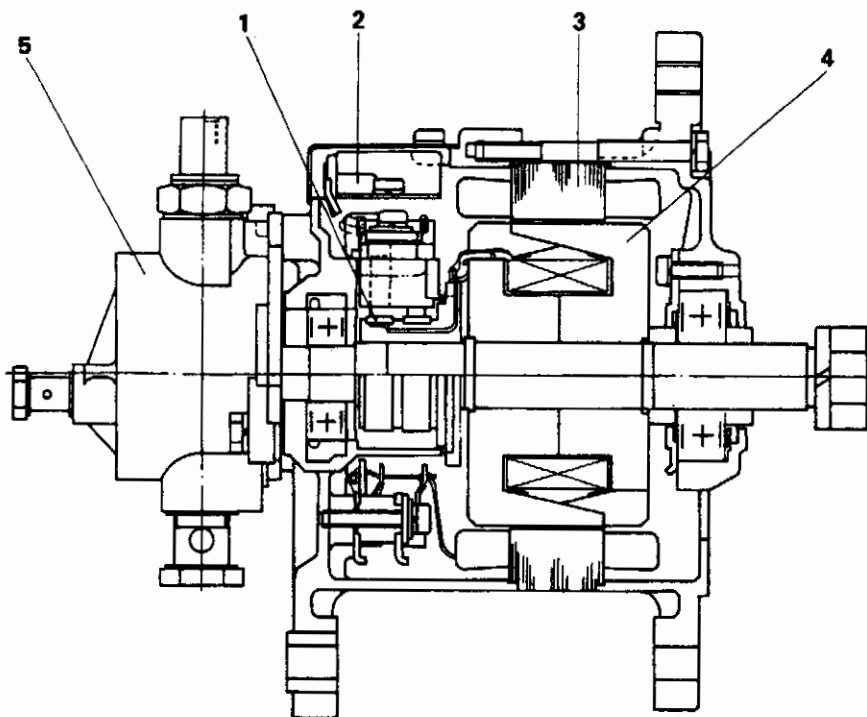
DATA AND SPECIFICATIONS	GE- 2
DESCRIPTION	GE- 2
TROUBLESHOOTING	GE- 4
GENERATOR	GE- 5

DATA AND SPECIFICATIONS

MODEL	27050-1081	27050-1350	27040-1290
GENERATOR			
Type	Alternator		
Output	24V, 30A		
Normal voltage	24V		
Charging rotation and voltage	900 r.p.m., 27V		
Direction of rotation	Right (From the pulley side)		
Allowable max. speed	7,200 r.p.m.		
Max. output	28V, 30A at 5,000 rpm		

DESCRIPTION

27050-1081
27050-1350

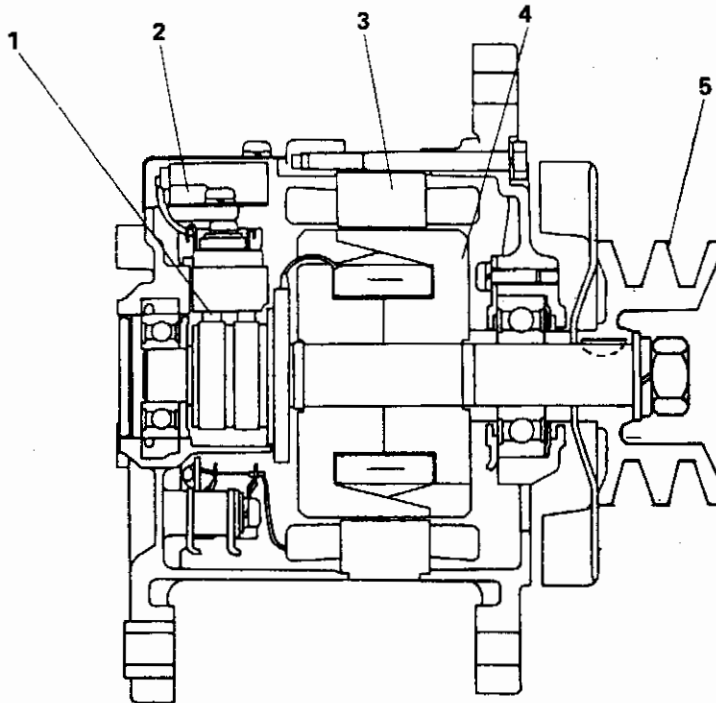


SMGE-132

GENERATOR WITH VACUUM PUMP

- | | |
|-------------------|-------------------------|
| 1. Brush | 4. Rotor |
| 2. I.C. Regulator | 5. Vacuum pump assembly |
| 3. Stator | |

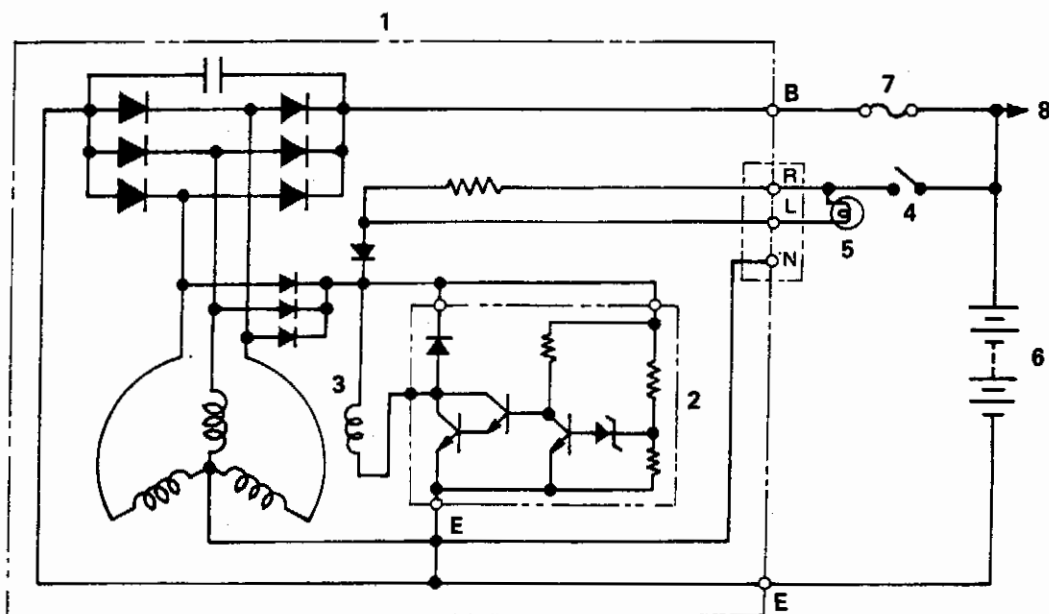
27040-1290



SMGE-115

GENERATOR WITHOUT VACUUM PUMP

- | | |
|-------------------|-----------|
| 1. Brush | 4. Rotor |
| 2. I.C. Regulator | 5. Pulley |
| 3. Stator | |



SMGE-116

CHARGING SYSTEM CIRCUIT

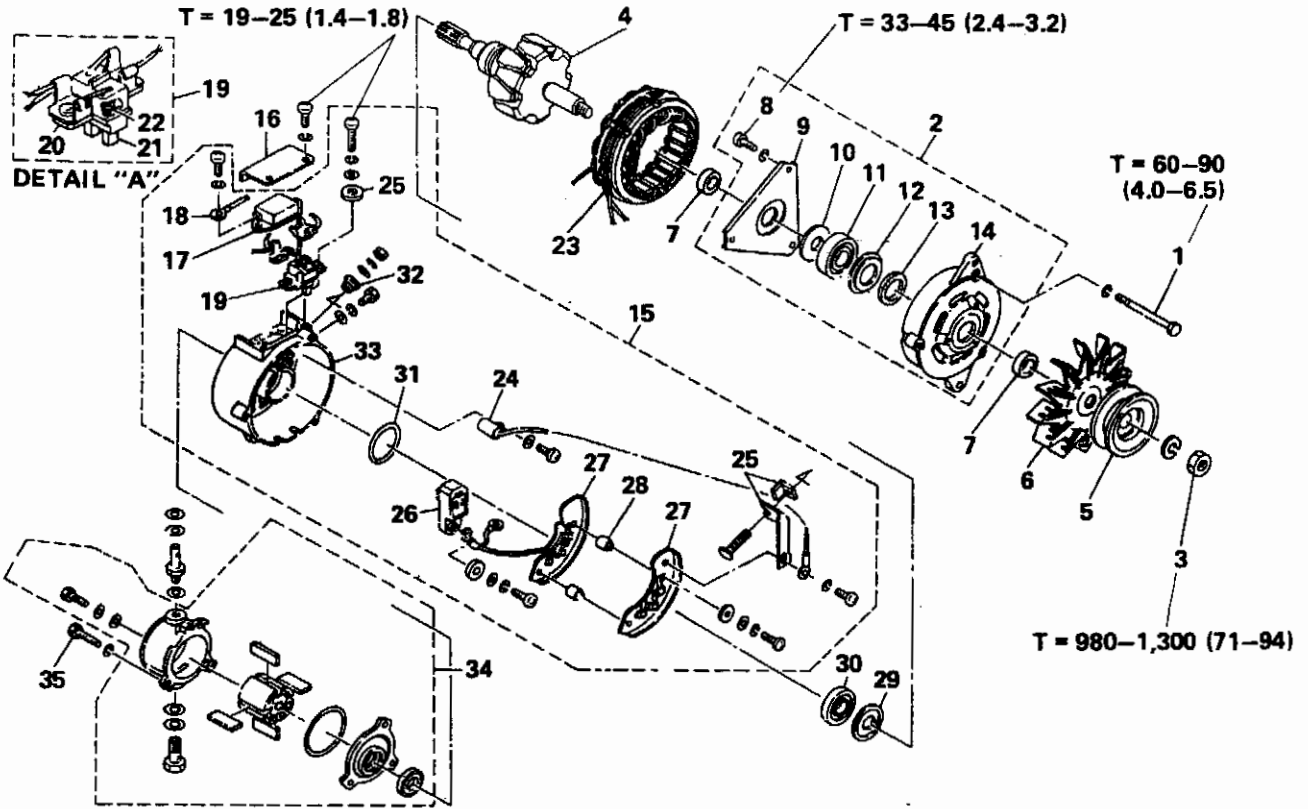
- | | | |
|-------------------|--------------------------|---------|
| 1. Alternator | 4. Starter switch | 7. Fuse |
| 2. I.C. regulator | 5. Charging warning lamp | 8. Load |
| 3. Field coil | 6. Battery | |

TROUBLESHOOTING

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Charging warning lamp does not light with starter switch ON and engine off	Fuse blown	Determine cause and replace fuse
	Lamp burned out	Replace lamp
	Wiring connection loose	Tighten loose connections
	Charge lamp relay faulty	Check relay
	IC regulator faulty	Replace IC regulator
Charge warning lamp does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	Charge lamp relay, IC regulator or generator faulty	Check charging system
	Wiring faulty	Repair wiring

GENERATOR

1824D
 1-NO.20

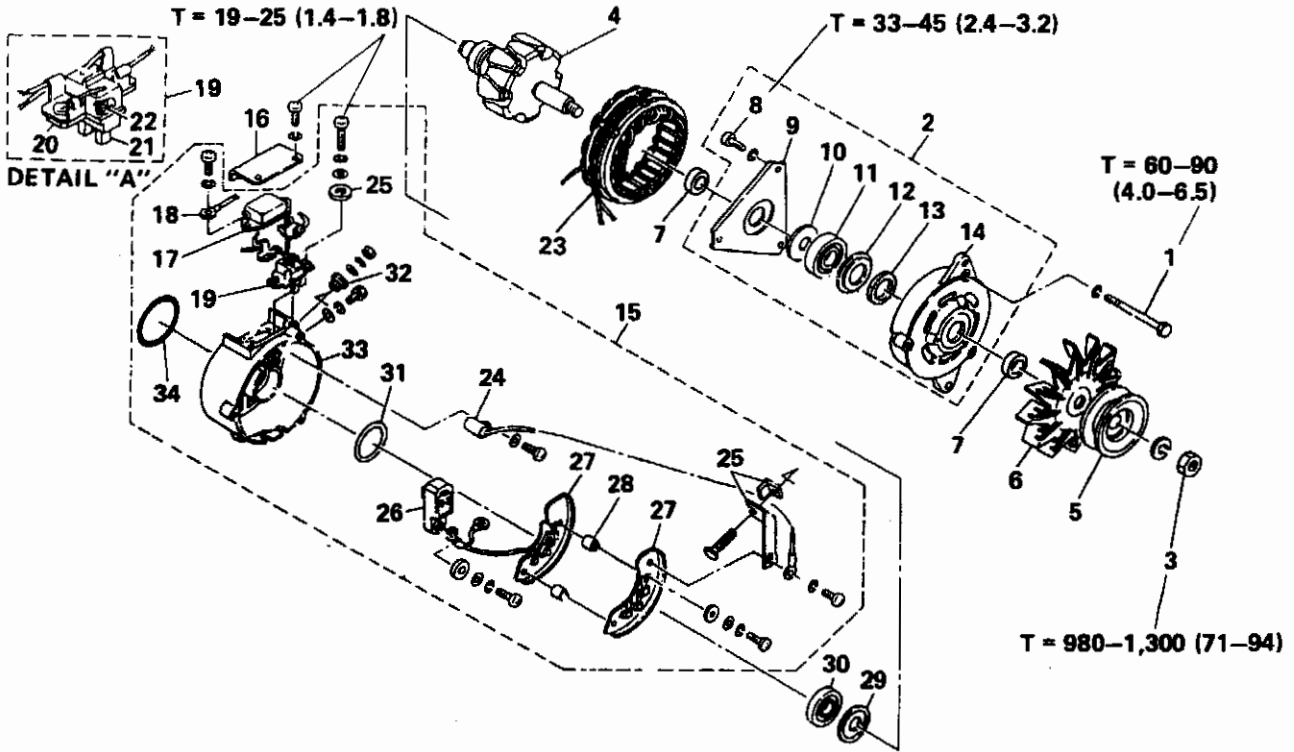


GENERATOR WITH VACUUM PUMP

T = Tightening torque: kg-cm (lb-ft)

- | | | |
|---------------------------|-----------------------------|------------------------------|
| 1. Through bolt | 13. Felt | 25. Insulator |
| 2. Front bracket assembly | 14. Front bracket | 26. Connector with lead wire |
| 3. Nut | 15. Rear bracket assembly | 27. Rectifier |
| 4. Rotor | 16. Cover | 28. Insulator |
| 5. Pulley | 17. Regulator assembly | 29. Gasket |
| 6. Fun | 18. Terminal with lead wire | 30. Ball bearing |
| 7. Collar | 19. Brush holder assembly | 31. O-ring |
| 8. Bolt | 20. Brush holder | 32. Insulator |
| 9. Bearing retainer | 21. Brush | 33. Rear bracket |
| 10. Retainer plate | 22. Brush spring | 34. Vacuum pump assembly |
| 11. Ball bearing | 23. Stator coil | 35. Through bolt |
| 12. Felt cover | 24. Condenser | |

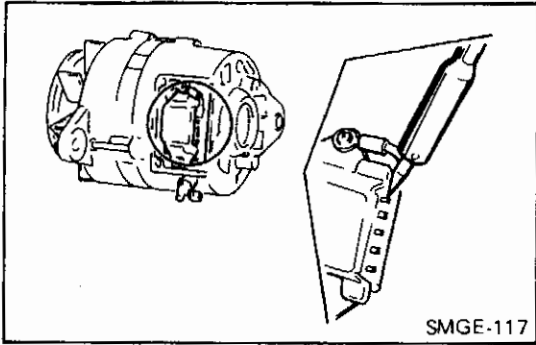
1824D
 1-NO.20



GENERATOR WITHOUT VACUUM PUMP

T = Tightening torque: kg-cm (lb-ft)

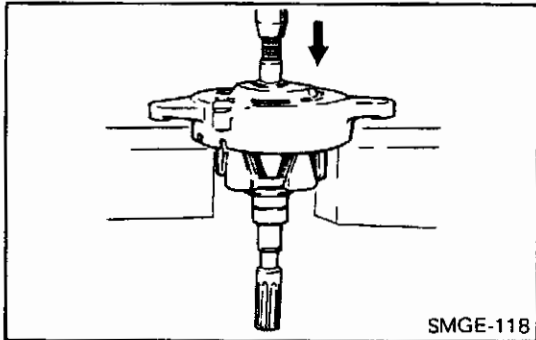
- | | | |
|---------------------------|-----------------------------|------------------------------|
| 1. Through bolt | 13. Felt | 25. Insulator |
| 2. Front bracket assembly | 14. Front bracket | 26. Connector with lead wire |
| 3. Nut | 15. Rear bracket assembly | 27. Rectifier |
| 4. Rotor | 16. Cover | 28. Insulator |
| 5. Pulley | 17. Regulator assembly | 29. Gasket |
| 6. Fun | 18. Terminal with lead wire | 30. Ball bearing |
| 7. Collar | 19. Brush holder assembly | 31. O-ring |
| 8. Bolt | 20. Brush holder | 32. Insulator |
| 9. Bearing retainer | 21. Brush | 33. Rear bracket |
| 10. Retainer plate | 22. Brush spring | 34. Cover |
| 11. Ball bearing | 23. Stator coil | |
| 12. Felt cover | 24. Condenser | |



IMPORTANT POINT (S) – DISASSEMBLY

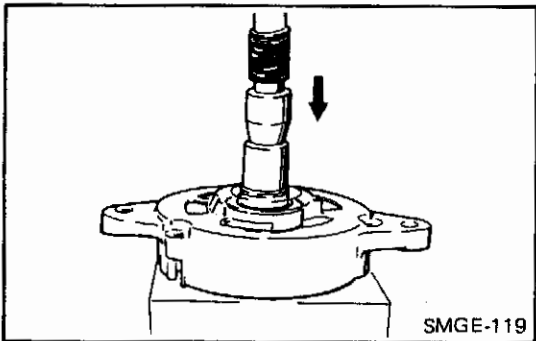
REMOVE THE REGULATOR AND THE BRUSH HOLDER.

1. Unsolder the lead wire from the regulator.
2. Remove the regulator and brush holder assembly.



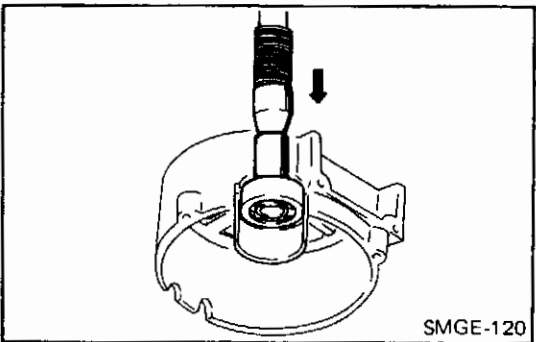
REMOVE THE ROTOR.

Using a press, remove the rotor.

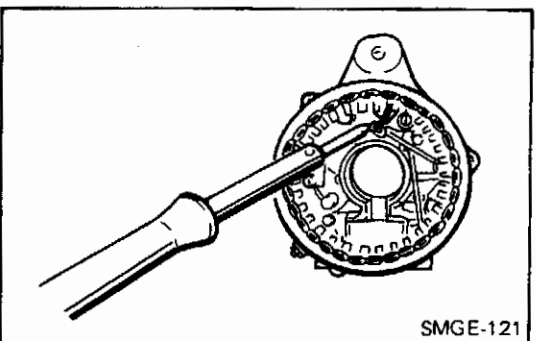


REMOVE THE FRONT AND REAR BEARINGS.

1. Using a press, remove the front ball bearing.

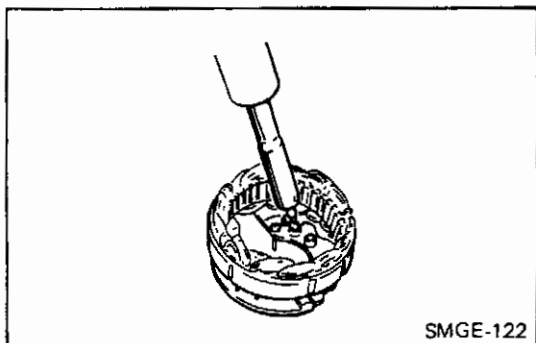


2. Using a puller, remove the rear ball bearing.



REMOVE THE STATOR ASSEMBLY.

1. Unsolder the regulator lead wire.



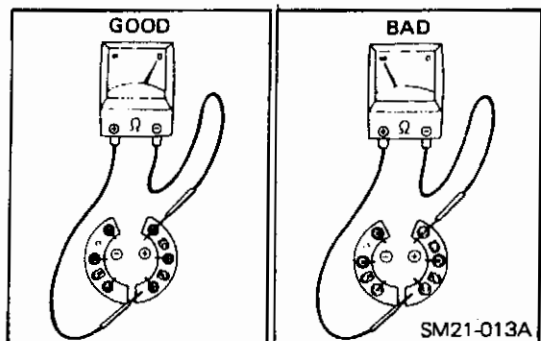
2. Unsolder the each terminal of stator coil then remove the stator coil assembly.

IMPORTANT POINT (S) – TESTING

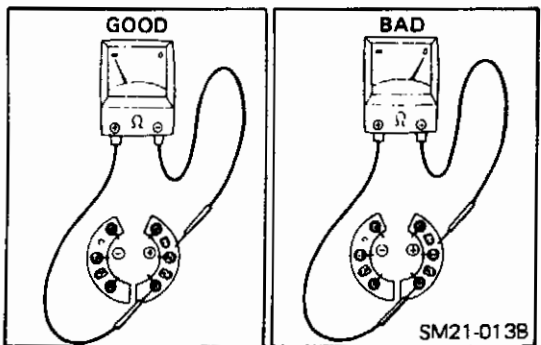
RECTIFIER.

Test the each positive side rectifier condition.

Connect the circuit tester \oplus lead to the rectifier holder and the \ominus lead to the rectifier terminal.

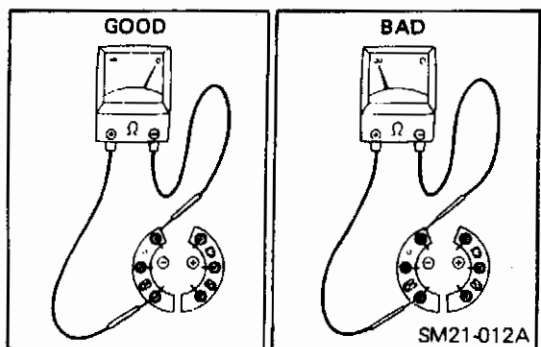


\oplus lead to the rectifier terminal and \ominus lead to the rectifier holder.

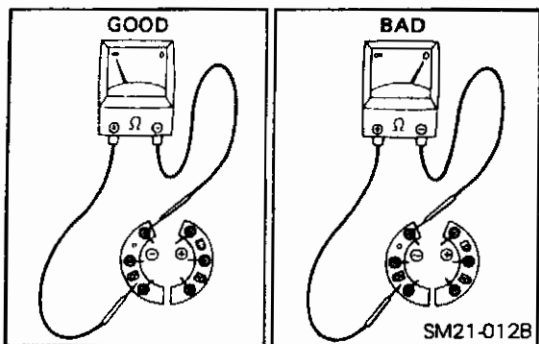


Test the each negative rectifier condition.

Connect the circuit tester \oplus lead to the rectifier terminal and the \ominus lead to the rectifier holder.



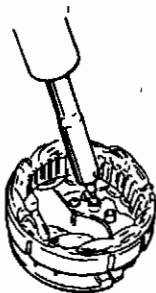
\oplus lead to the rectifier holder and \ominus lead to the rectifier terminal.



IMPORTANT POINT (S) – ASSEMBLY

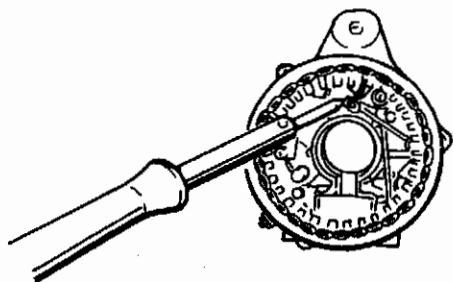
INSTALL THE STARTOR COIL ASSEMBLY.

1. Install the stator coil assembly, and then solder the each terminal of stator coil.



SMGE-122

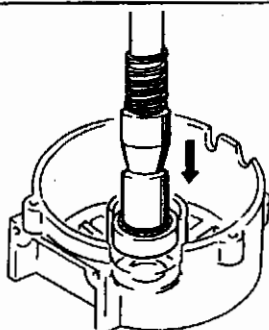
2. Solder the regulator lead wire.



SMGE-121

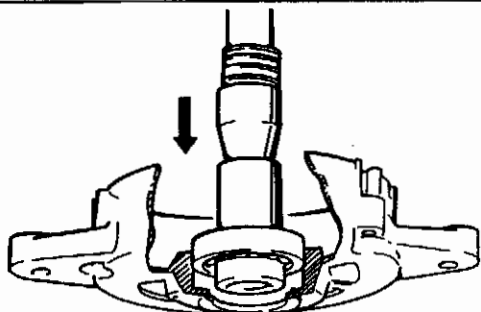
INSTALL THE FRONT AND REAR BALL BEARINGS.

1. Using a press, install the rear ball bearing.



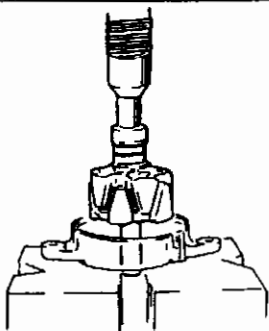
SMGE-123

2. Using a press, install the front ball bearing.

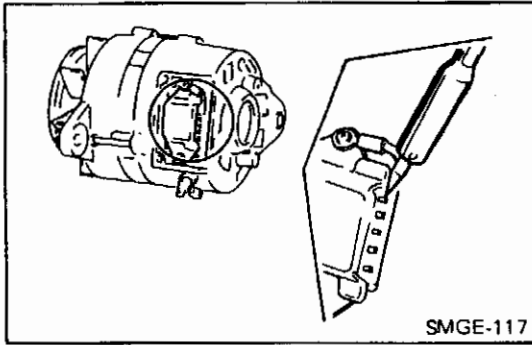


SMGE-124

3. Using a press, install the rotor into the front bracket.

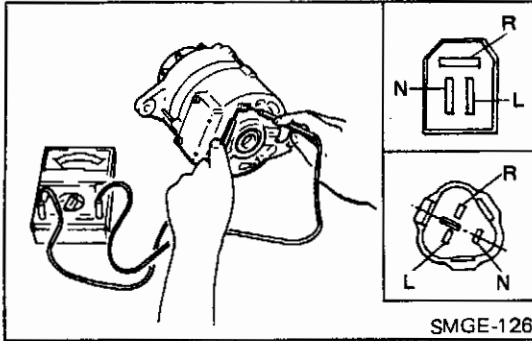


SMGE-125



INSTALL THE REGULATOR AND THE BRUSH HOLDER ASSEMBLY.

1. Install the brush holder assembly and regulator.
2. Solder the lead wire to the regulator.



AFTER ASSEMBLING THE GENERATOR, MEASURE THE RESISTANCE BETWEEN EACH TERMINAL.

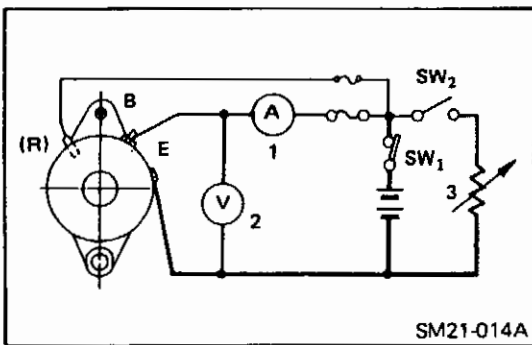
Tester		Resistance	Tester		Resistance
+ Lead	- Lead	(Ω)	+ Lead	- Lead	(Ω)
B	R	∞	N	E	7-10
B	N	7-10	N	B	∞
R	L	400-500	E	R	∞
R	E	∞	E	L	∞
L	E	∞	E	N	∞

PERFORMANCE TEST

NOTE: ○ Note the battery polarity carefully so as not to make reverse connections.

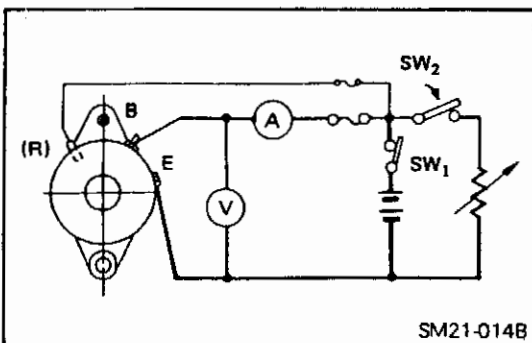
If the connections are reversed, the diodes will short the circuit and allow large current to flow through and damage the diodes and IC regulator as well as burn up the wiring harness.

- Use care not to make wrong connections of terminals.
- When charging the battery with a quick charge. Disconnect the battery terminals.
- Do not perform tests with high voltage insulation resistance tester.
- When in operation, never disconnect the battery.



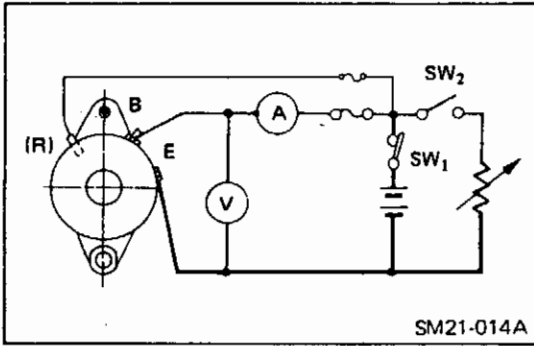
GENERATOR PERFORMANCE TEST.

1. Turn on switch SW₁ and off SW₂ to increase the rotation of the alternator slowly.



2. When voltage reaches 28V, turn on switch SW₂ regulate load resistance. Increase the rotation of the rotor keeping voltage at 28V.

Generator Speed: 5,000 rpm at 28V, 30A



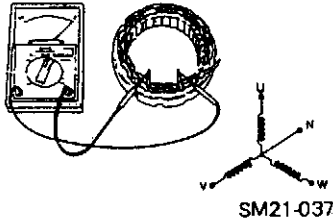
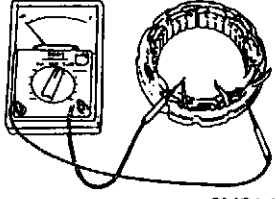
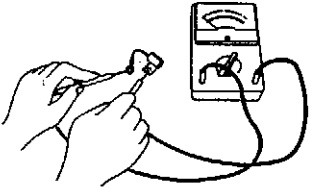
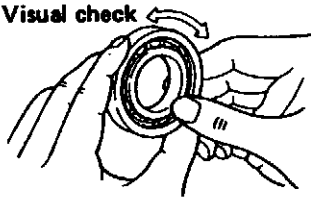
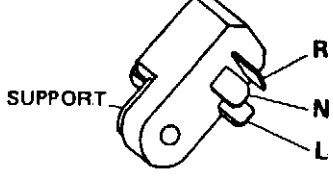
VOLTAGE REGULATION TEST.

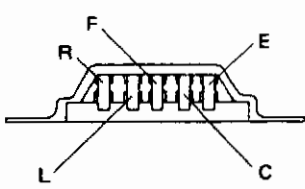
Turn on switch SW₁ and off SW₂ to increase the rotation of rotor to 5,000 rpm.

Standard Voltage: 28.5–29.5V

INSPECTION AND REPAIR

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Brush length.	16 mm (0.630 in)	7.0 mm	Replace	 SMGE-127
Function of the brush holder.	—	—	Replace, if necessary.	Visual check SMGE-128
Conductance of the rotor coil.	About 12.5Ω	Less than 11Ω or infinity (∞)	Replace.	 SMGE-129A
Insulation between the slip ring and the core.	More than 1.0 MΩ	Less than 0.5 MΩ	Replace.	 SMGE-130
Diameter of the slip ring.	34.5 mm (1.3583 in)	33.5 mm (1.3188 in)	Replace.	 SMGE-131A

Inspection Item	Standard		Limit	Remedy	Inspection Procedure
Conductance of the stator coil (U.V.W. terminal)	N-U	About 0.3Ω	—	Replace	 <p>SM21-037</p>
	N-V				
	N-W				
Insulation of the stator coil.	More than 1.0 MΩ		Less than 0.5 MΩ	Replace.	 <p>SM21-038</p>
Condenser capacity	0.5 μF		—	Replace.	 <p>SMGE-114</p>
Wear or damage of the bearings.	—		—	Replace, if necessary.	<p>Visual check</p>  <p>SM21-083</p>
Wear or damage of the oil seal and O-ring.	—		—	Replace, if necessary.	<p>Visual check</p> <p>—</p>
Resistance between each terminal of connector.			—	Replace.	 <p>SM21-074</p>
+ Lead Tester	- Lead Tester				
R	L	400 – 500 Ω			
L	Support	∞			
Support	L	9 – 12 Ω			
Support	N	∞			

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Resistance between each terminal of I.C. regulator.					
+ Lead Tester	- Lead Tester				
R	L	About 10 Ω	-	Replace.	 <p>SM21-035</p>
R	F	About 10 Ω			
R	C	∞			
R	E	About 1.5 K Ω			
L	F	About 10 Ω			
L	C	About 90 Ω			
L	E	About 100 Ω			
F	C	About 10 Ω			
F	E	About 180 Ω			
C	E	About 40 Ω			
L	R	∞			
F	R	∞			
C	R	∞			
E	R	∞			
F	L	About 2K Ω			
C	L	∞			
E	L	About 1.5K Ω			
C	F	∞			
E	F	∞			
E	C	∞			

CHAPTER GE

GENERATOR

(24V, 70A)

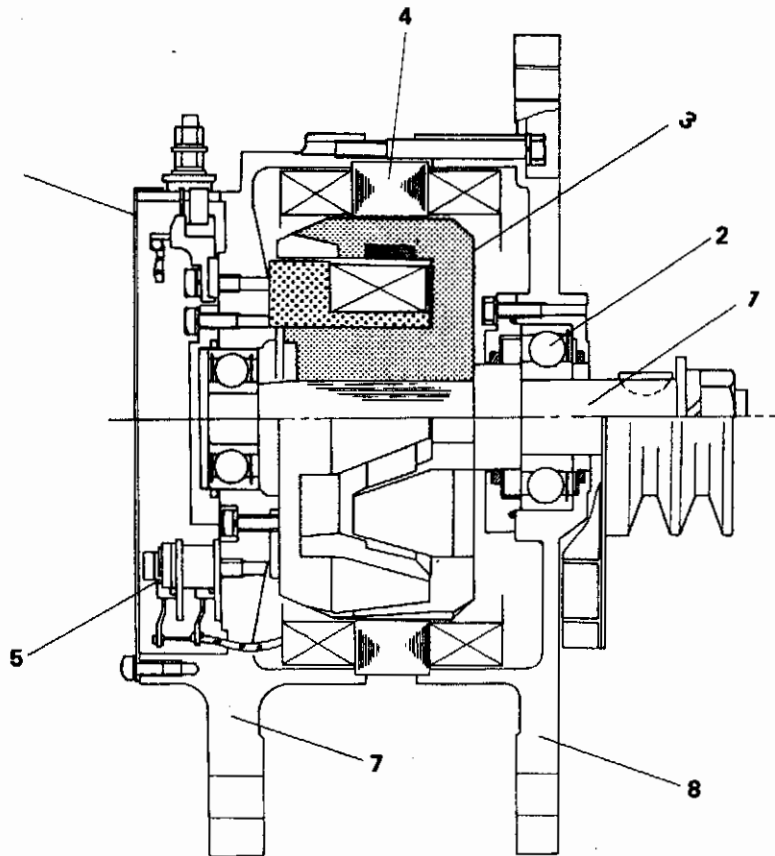
DATA AND SPECIFICATIONS	GE-2
DESCRIPTION	GE-2
TROUBLESHOOTING	GE-3
GENERATOR	GE-4



DATA AND SPECIFICATIONS

MODEL	27040-1210
GENERATOR	
Type	Alternator
Rated voltage	24V
Rated output	70A
Operating output and speed	70A, 28V at 5,000 rpm
Rotating direction	Clockwise (Seen from pulley side)
REGULATOR	
Type	I.C. Regulator (Built-in)

DESCRIPTION



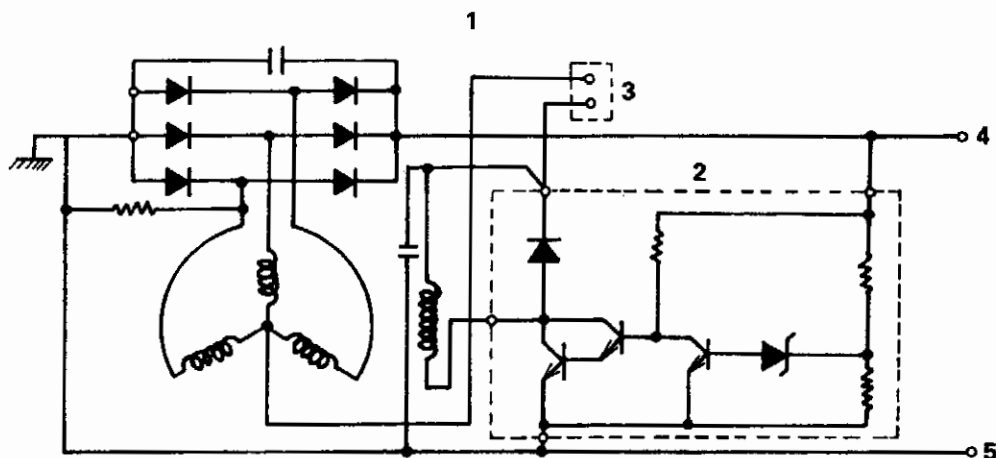
SMGE-177

GENERATOR

- 1. Rotor shaft
- 2. Ball bearing
- 3. Rotor assembly

- 4. Stator assembly
- 5. Diode assembly
- 6. Rear cover

- 7. Rear bracket assembly
- 8. Front bracket assembly



SMGE-178

CHARGING SYSTEM CIRCUIT

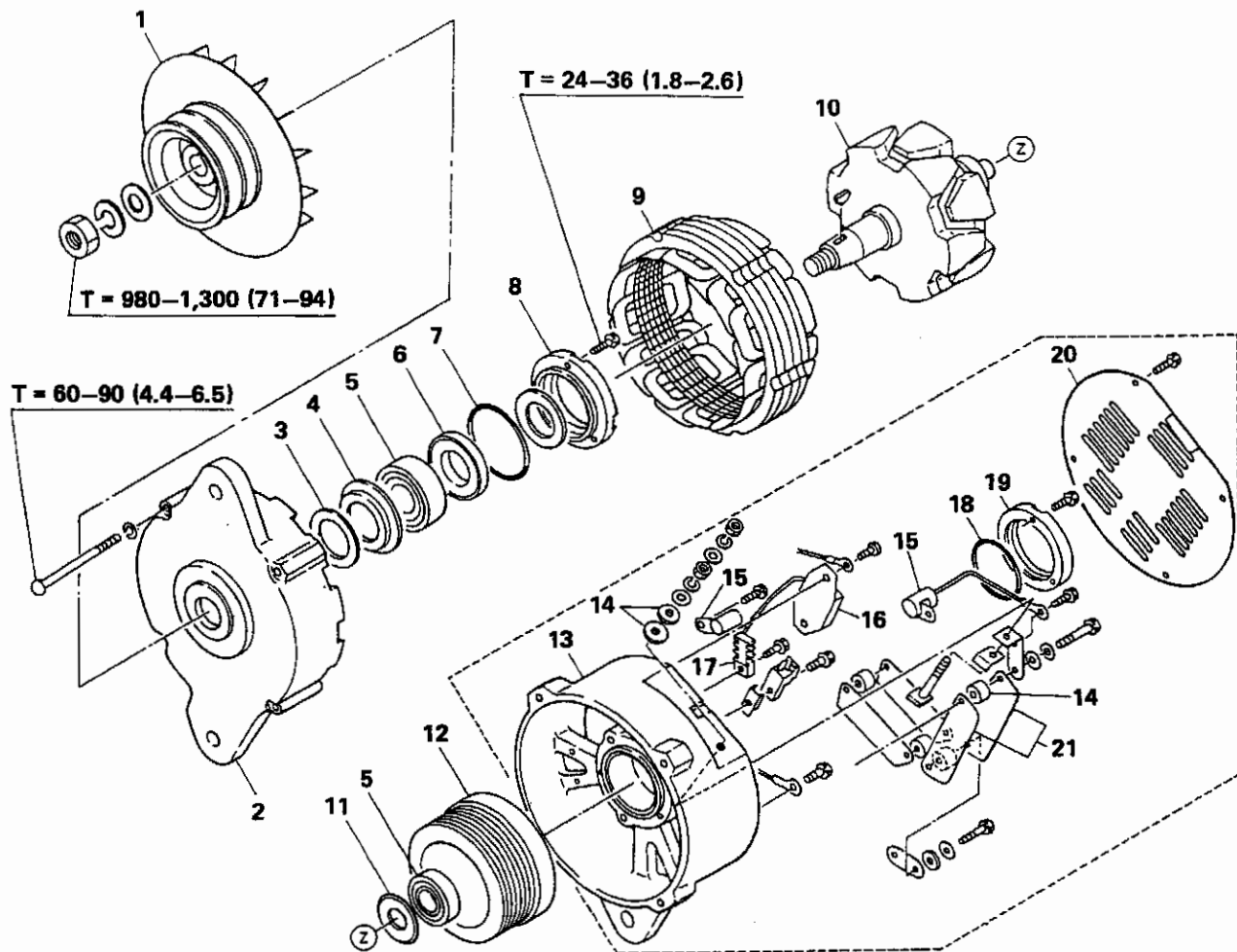
- 1. Alternator
- 2. I.C. regulator
- 3. Coupler
- 4. Battery
- 5. Earth

TROUBLESHOOTING

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Ammeter does not move to negative side (remained at the neutral position) with starter switch on and engine off	Fuse blown	Determine cause and replace fuse
	Wiring connection loose	Tighten loose connections
	IC regulator faulty	Replace IC regulator
Ammeter indicate the negative side with starter switch on and engine running	Drive belt loose or worn	Adjust or replace drive belt
	Battery cable loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	IC regulator or generator faulty	Check charging system
	Wiring faulty	Repair wiring

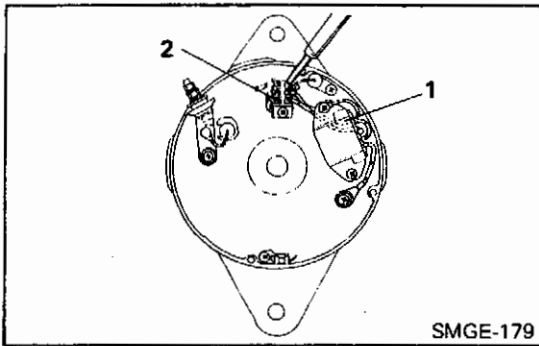
GENERATOR

1823E
 I-NO. 21



T = Tightening torque: kg-cm (lb.ft)

- | | |
|--------------------|------------------------|
| 1. Fan with pulley | 12. Field coil |
| 2. Front bracket | 13. Rear bracket |
| 3. Felt | 14. Insulator |
| 4. Felt cover | 15. Condenser |
| 5. Ball bearing | 16. I.C. regulator |
| 6. Retainer plate | 17. Connector |
| 7. Packing | 18. O-ring |
| 8. Retainer plate | 19. Bearing cover |
| 9. Stator assembly | 20. Cover |
| 10. Rotor assembly | 21. Rectifier assembly |
| 11. Retainer plate | |

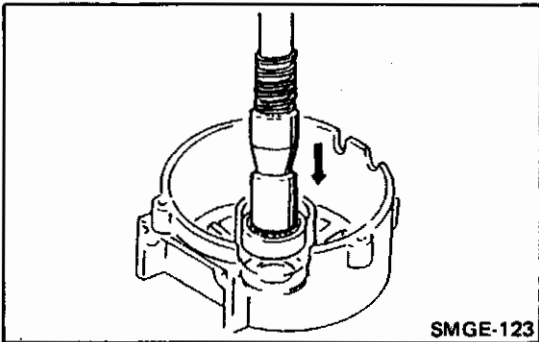


IMPORTANT (S) – DISASSEMBLY

REMOVE THE I.C. REGULATOR, CONNECTOR AND COUPLER.

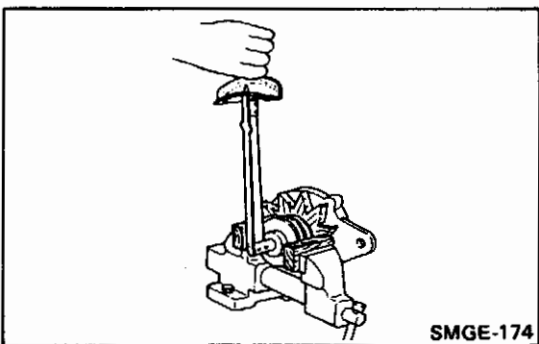
1. Unsolder the I.C. regulator lead wire.
2. Remove the connector lead wire.

NOTE: Protect rectifier from heat.



REMOVE THE REAR BALL BEARING.

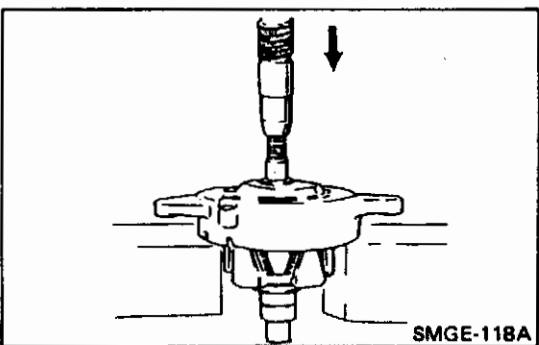
Using a press, remove the ball bearing.



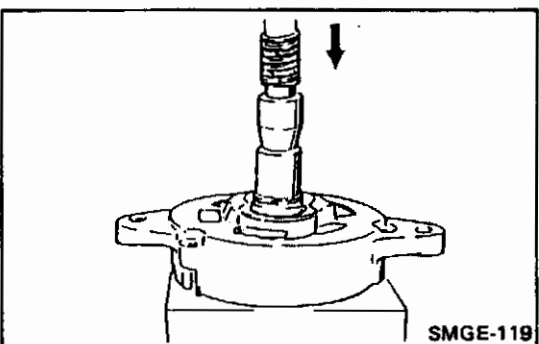
REMOVE THE ROTOR.

1. Place the pulley in a soft jaw vice.
Remove the fan and pulley.

NOTE: Do not hold the rotor assembly in a vice when disassemble the fan and pulley.

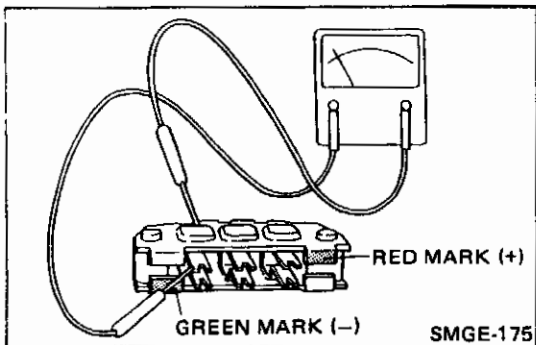


2. Remove the rotor.
Using a press, remove the rotor and collar.



REMOVE THE FRONT BALL BEARING.

1. Remove the retainer plate.
2. Using a press, remove the front ball bearing.
3. Remove the plate and felt.



IMPORTANT POINT (S) – TESTING

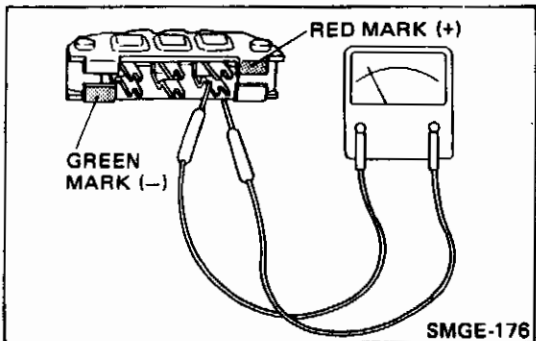
RECTIFIER

Test the each positive side rectifier condition.

Rectifier		Resistance
Terminal	Holder	
⊖ Lead	⊕ Lead	About 7–10 Ω
⊕ Lead	⊖ Lead	∞ Ω

Test the each negative rectifier condition.

Rectifier		Resistance
Terminal	Holder	
⊖ Lead	⊕ Lead	∞ Ω
⊕ Lead	⊖ Lead	About 7–10 Ω

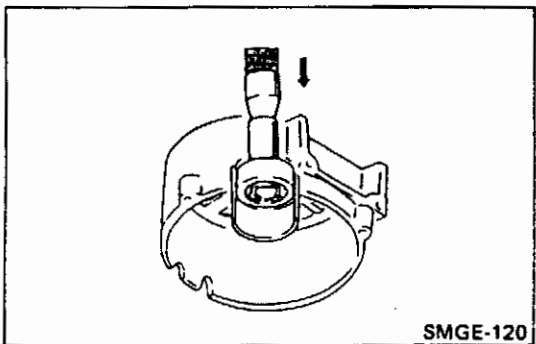


IMPORTANT POINTS (S) – ASSEMBLY

INSTALL THE REAR BALL BEARING.

- Using a press, install the ball bearing.
- Install the O-ring and bearing cover.

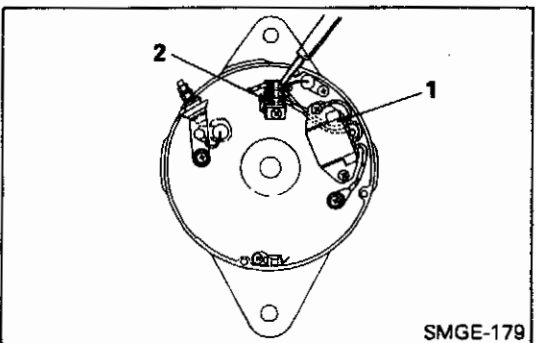
NOTE: Apply the bearing grease to bearing.



INSTALL THE I.C. REGULATOR, CONNECTOR AND COUPLER.

- Solder the I.C. regulator lead wire.
- Install the connector lead wire.

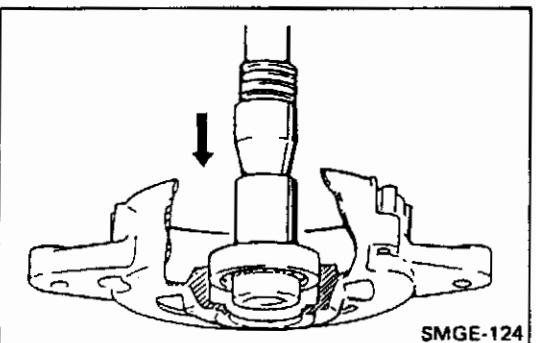
NOTE: Protect rectifier from heat.

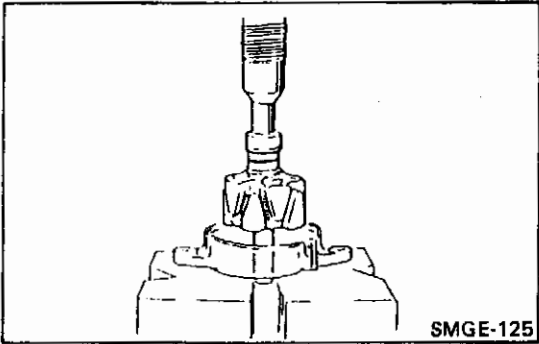


INSTALL THE FRONT BALL BEARING

- Install the felt and felt cover.
- Using a press, install the front ball bearing.
- Install the retainer plate.

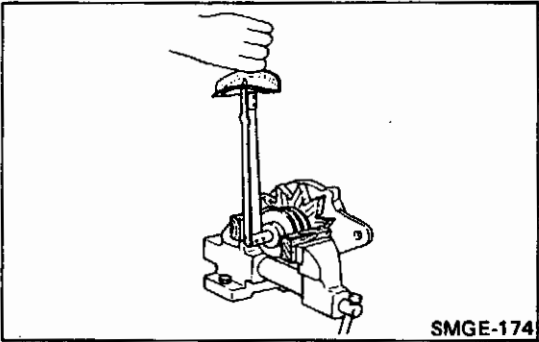
NOTE: Apply the bearing grease to bearing and oil seal lip.





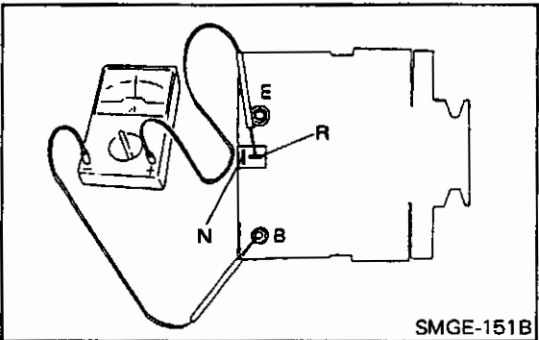
INSTALL THE ROTOR.

1. Install the rotor.
 Using a press, install the rotor and collar.



2. Place the pulley in a soft jaw vice.
 Install the fan and pulley.

NOTE: Do not hold the rotor assembly in a vice when assemble the fan and pulley.



AFTER ASSEMBLING THE GENERATOR, MEASURE THE RESISTANCE BETWEEN EACH TERMINAL.

Tester		Resistance	Tester		Resistance
+ Lead	- Lead	(Ω)	+ Lead	- Lead	(Ω)
B	E	35	R	B	2K
B	N	7	R	N	2K
B	R	∞	R	E	300
N	B	∞	E	B	1K
N	R	∞	E	N	1K
N	E	7	E	R	∞

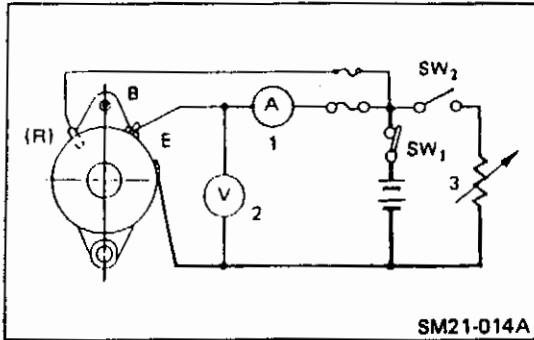
PERFORMANCE TEST

- NOTE:**
- Note the battery polarity carefully so as not to make reverse connections.
 If the connections are reversed, the diodes will short the circuit and allow large current to flow through and damage the diodes and IC regulator as well as burn up the wiring harness.
 - Use care not to make wrong connections of terminals.
 - When charging the battery with a quick charge. Disconnect the battery terminals.
 - Do not perform tests with high voltage insulation resistance tester.
 - When in operation, never disconnect the battery.

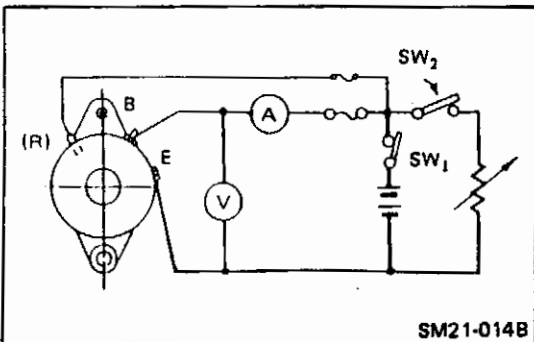
GENERATOR PERFORMANCE TEST.

1. Turn on switch SW₁ and off SW₂ to increase the revolution of the generator slowly.
2. When voltage reaches 28V, turn on switch SW₂ regulate load resistance. Increase the revolution of the rotor keeping voltage at 28V.

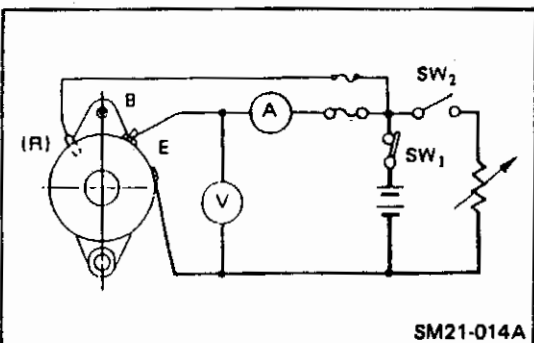
Generator Speed	Less than 5,000 rpm	28V, 70A
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SM21-014A



SM21-014B



SM21-014A

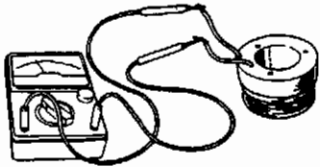
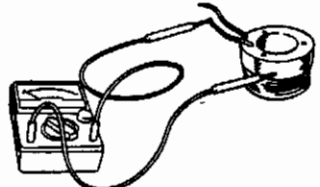
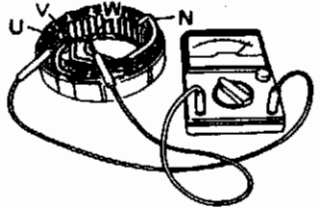
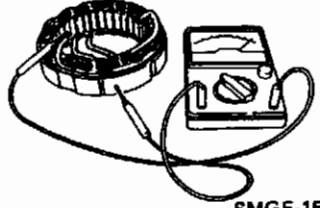


VOLTAGE REGULATOR TEST

Turn on switch SW₁ and off SW₂ to increase the revolution of rotor to 5,000 rpm.

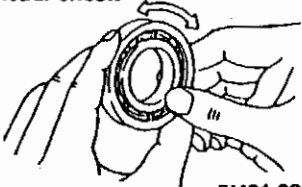

Standard Voltage: 28.5–29.5V

INSPECTION AND REPAIR

Unit: mm (in)

Inspection Item		Standard	Limit	Remedy	Inspection Procedure	
Resistance of field coil (at 20°C)		About 10Ω	—	Replace	 <p>SMGE-152</p>	
Insulation resistance of field coil		More than 1 MΩ	Less than 0.5 MΩ	Replace	 <p>SMGE-153</p>	
Resistance of stator coil (at 20°C)		U-V	—	Replace	 <p>SMGE-154</p>	
		U-W				About 0.13Ω
		V-W				
Insulation resistance of stator coil		More than 1 MΩ	Less than 0.5 MΩ	Replace	 <p>SMGE-155</p>	
Condenser capacity		0.5 μF	—	Replace	 <p>SMGE-114</p>	
Outside diameter of rotor shaft	Front	25.0 (0.984)	24.95 (0.982)	Replace	 <p>SMGE-156</p>	
	Rear	17.0 (0.669)	16.98 (0.668)			

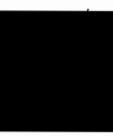
Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Wear or damage of front ball bearing			Replace, if necessary.	Visual check  SM21-083
Wear or damage of O-ring, seal and felt.			Replace, if necessary	Visual check  SMGE-158

CHAPTER ST

STARTER (24V, 4.5 KW)

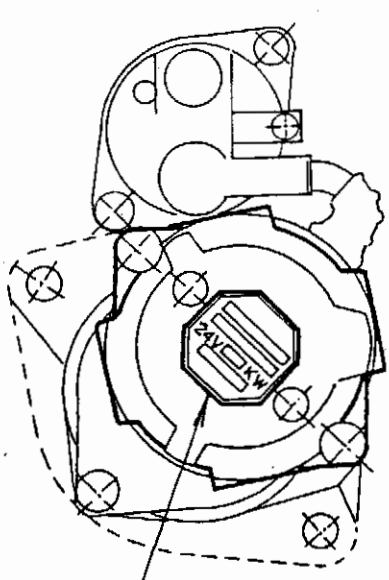
DATA AND SPECIFICATIONS	ST-2
DESCRIPTION	ST-2
TROUBLESHOOTING	ST-3
STARTER	ST-5



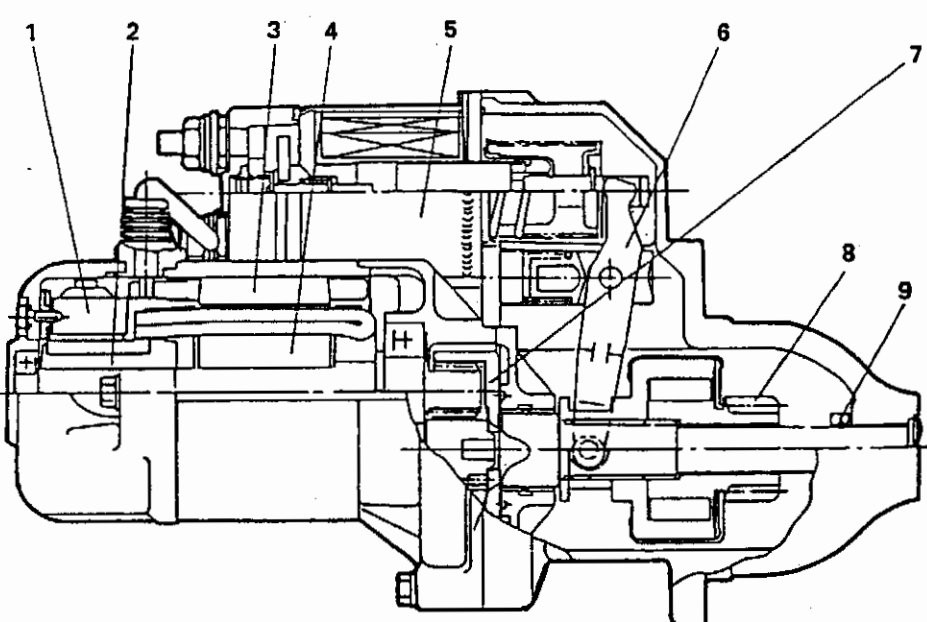
DATA AND SPECIFICATIONS

MODEL NO.	28100-1810	28100-1900	28100-2010	28100-1820
		28100-1980	28100-2130	28100-1891
Type	Reduction gear type			
Rated output	24V, 4.5 KW			
Number of teeth of pinion	11			
Module	3			
Rotating direction	Clockwise (Seen from pinion side)			

DESCRIPTION



The starter parts number is engraved at the commutator end frame



<ul style="list-style-type: none"> 1. Brush 2. Commutator 3. Field coil 4. Armature 5. Magnetic switch 	<ul style="list-style-type: none"> 6. Pinion shift lever 7. Reduction gear 8. Clutch and pinion 9. Pinion stopper
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SMST-124A

TROUBLESHOOTING

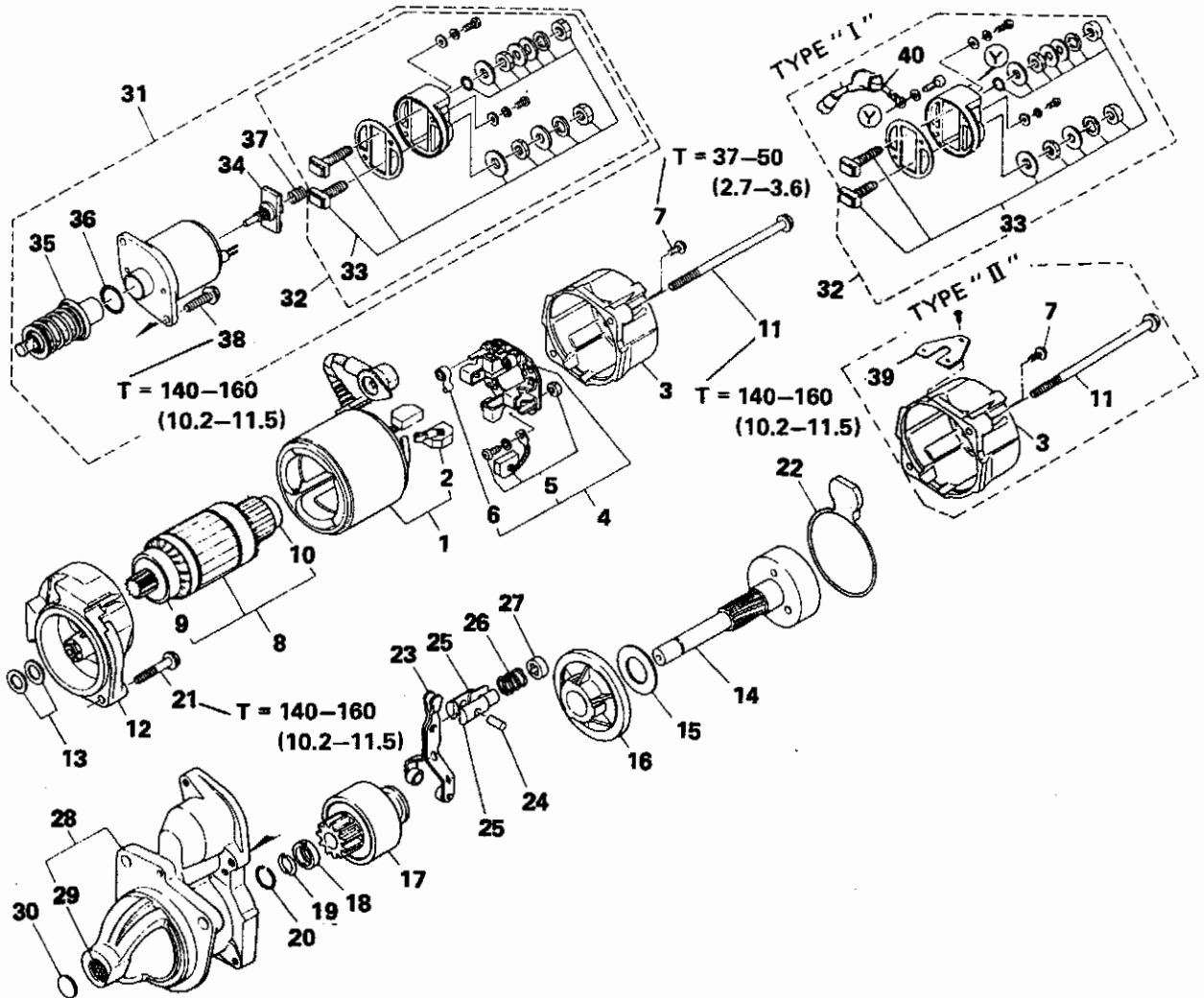
<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Engine does not crank, or cranks slowly.	Key switch	
	● Poor contact	Polish or replace contacts
	Battery	
	● Discharged battery	Charge
	● Short circuited between electrodes	Replace battery
	● Poor contact at battery terminal	Polish or retighten
	Engine oil	
	● Improper viscosity oil	Change oil
	Magnetic switch	
	● Poor contact caused by burnt contact plate	Polish or replace contact plate
	● Contact plate worn out	Repair
	● Hold-in coil disconnected	Replace field coil (Overrunning clutch moves back and forth)
	● Pull-in coil disconnected or short circuited	Replace
	Starter relay	
	● Defective or poor contact	Repair or replace
	Starter	
	● Brush worn out	Replace
	● Commutator burnt out	Correct on lathe
	● Commutator worn out	Correct by undercutting
● Field winding shorted or grounded	Rewind or replace	
● Armature winding shorted or grounded	Replace armature	
● Insufficient brush spring tension	Replace brush spring	
● Poor contact between magnetic switch	Repair and field windings	
● Armature contacts pole core because of worn	Replace bearing brush or armature bearing bush or bent armature shaft	
● Overrunning clutch malfunction	Replace	
Engine does not crank while starter is running in good condition.	Overrunning clutch	
	● Overrunning clutch malfunction	Replace
	● Pinion teeth worn out	Replace
	● Poor sliding of spline teeth	Remove foreign materials, dirt, or replace

STARTER

<u>Symptom</u>	<u>Possible cause</u>	<u>Remedy/Prevention</u>
Starter does not stop running.	Key switch	
	• Contacts keep closing	Replace
	• Key switch sticks	Replace
	• Overrunning clutch sticks to armature	Repair or replace overrunning clutch or armature
	Starter relay	
	• Contacts keep closing	Repair or replace

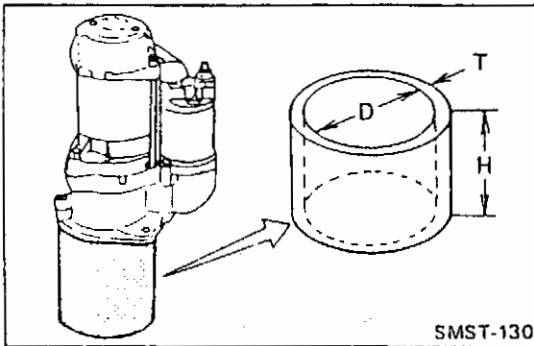
STARTER

TYPE I for 28100-1900 only
 TYPE II for 28100-2010 only



T = Tightening torque: kg-cm (lb.ft)

- | | | |
|--------------------------|--------------------------------|--|
| 1. Yoke assembly | 15. Shim | 29. Bushing |
| 2. Brush | 16. Bearing housing | 30. Plug |
| 3. Commutator end frame | 17. Clutch and pinion assembly | 31. Magnetic switch assembly |
| 4. Brush holder assembly | 18. Pinion stopper | 32. Contactor with terminal cover assembly |
| 5. Brush | 19. Hook | 33. Terminal assembly |
| 6. Brush spring | 20. Clip | 34. Contactor assembly |
| 7. Set bolt | 21. Set bolt | 35. Moving core assembly |
| 8. Armature assembly | 22. Gasket | 36. O-ring |
| 9. Ball bearing | 23. Drive pinion lever | 37. Contactor spring |
| 10. Ball bearing | 24. Lever pin | 38. Bolt |
| 11. Set bolt | 25. Lever holder | 39. Plate |
| 12. Gear housing | 26. Holder spring | 40. Harness |
| 13. Shim | 27. Insert | |
| 14. Drive shaft assembly | 28. Drive housing assembly | |



SMST-130

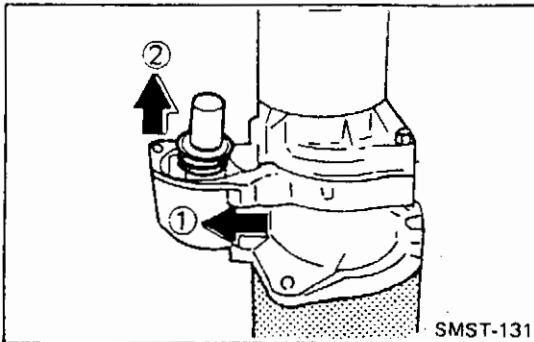
IMPORTANT POINT(S) – DISASSEMBLY

When disassembling the starter, prepare a work stand as shown in the figure.

D: Diameter = 110 mm (4.331 in)

T: Thickness = 10 mm (0.394 in)

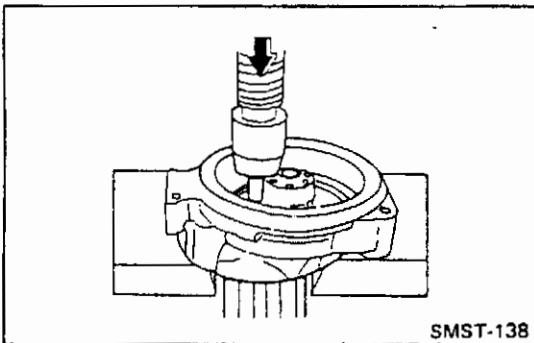
H: Height = 120 mm (4.724 in)



SMST-131

REMOVE THE MOVING CORE.

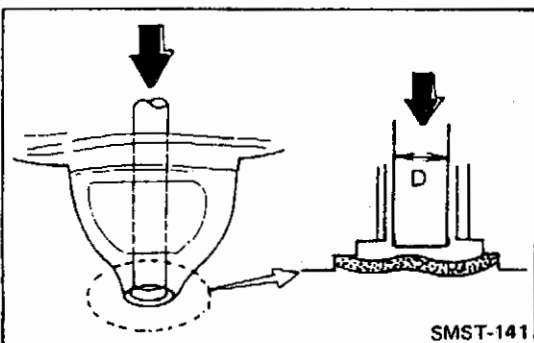
Remove the moving core in the direction of the marked arrow in the order ① and ②.



SMST-138

REMOVE THE ARMATURE ASSEMBLY.

Using a press, remove the armature assembly.

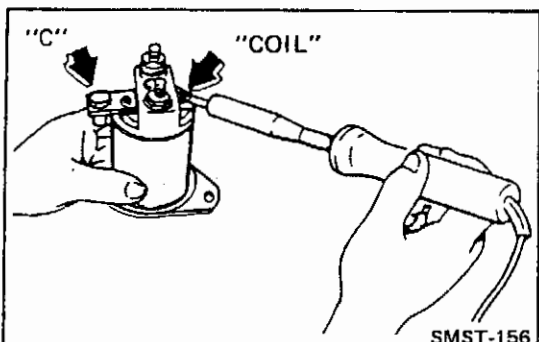


SMST-141

REMOVE THE PLUG

Remove the drive housing plug using a press.

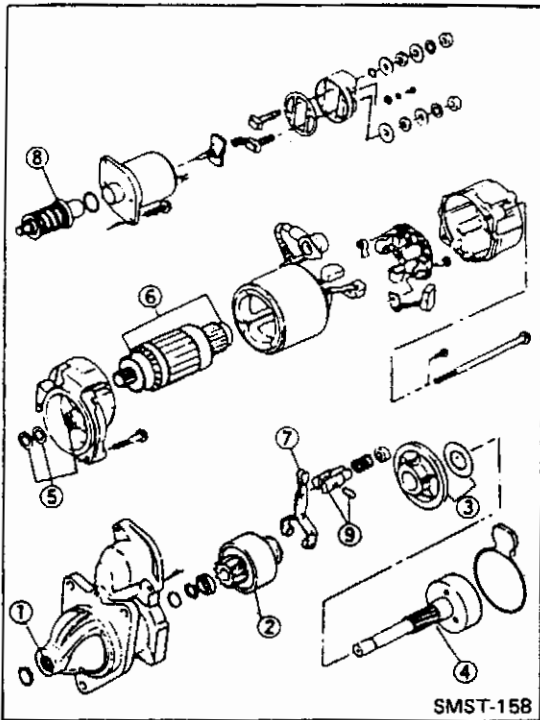
D: Diameter = 16 mm (0.620 in)



SMST-156

REMOVE THE MAGNETIC SWITCH.

Unsolder the "COIL" terminal and "C" terminal.

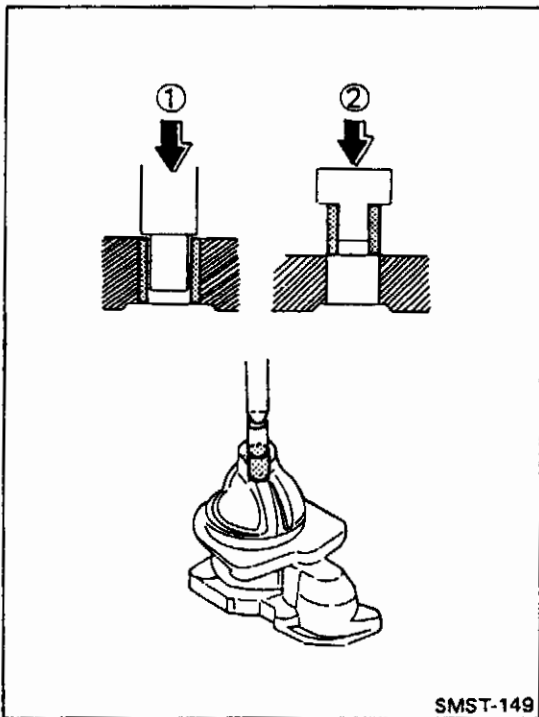


IMPORTANT POINT(S) – ASSEMBLY

LUBRICATION

Before reassembling, apply the recommended grease as follows and replace the O-ring with new one.

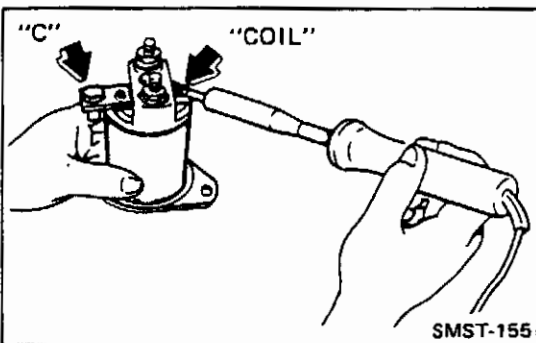
- ① Bushing
- ② Clutch and pinion assembly
- ③ Bushing and shim
- ④ Drive shaft
- ⑤ Gear housing and shim
- ⑥ Bearing
- ⑦ Drive pinion lever
- ⑧ Moving core
- ⑨ Lever holder and pin



REPLACEMENT OF BUSHING

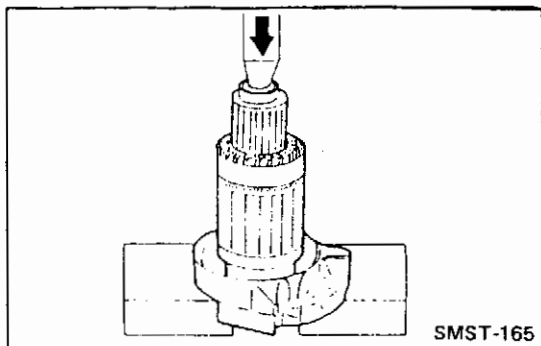
- ① Remove the bushing using a press.
- ② Replace the bushing with a new one using a press.

NOTE: In the case of the bearing housing bushing, also replace the bearing housing bushing.



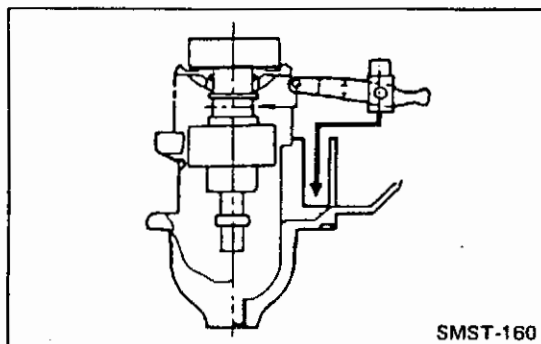
INSTALL THE MAGNETIC SWITCH.

Solder the "COIL" terminal and "C" terminal.



INSTALL THE ARMATURE ASSEMBLY.

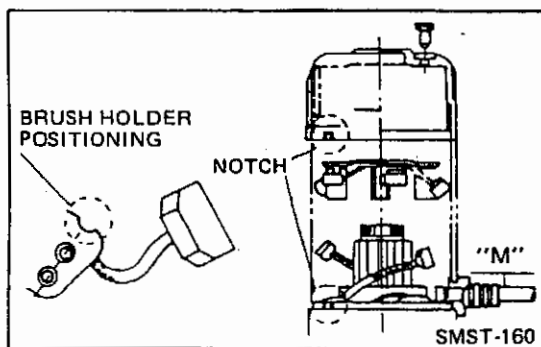
Using a press, install the armature assembly.



TO REASSEMBLE, FOLLOW THE DISASSEMBLY PROCEDURE IN REVERSE ORDER.

NOTE: When assembling the starter, pay attention to the following points.

1. When installing the drive pinion lever on the shaft, pay attention to the direction in which the lever is installed.
2. Match the positioning of the brush holder with the "M" lead.
3. Match the end frame positioning guide with the notch of the brush holder positioning guide.

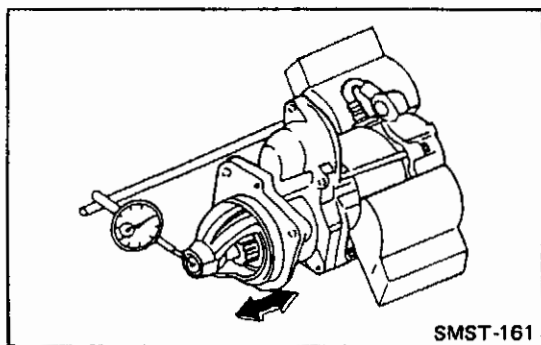


MEASURE THE THRUST GAP.

After assembling the starter (without the magnetic switch), use a dial gauge to measure the thrust gap as you move the drive shaft in and out by hand.

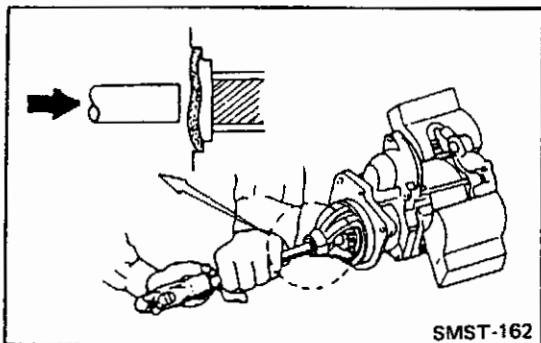
Standard: 0.1 – 0.5 mm (0.004 – 0.0196 in)

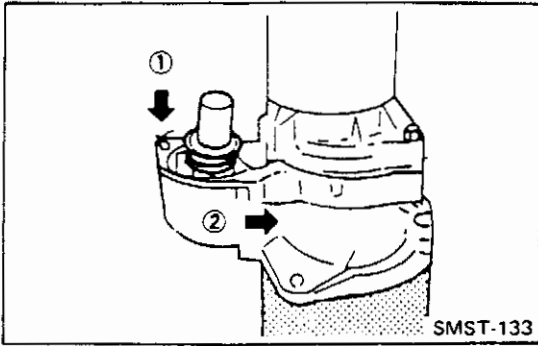
If the thrust gap exceeds the standard, adjust by decreasing or increasing the shim.



AFTER MEASURE THE NO-LOAD TEST OF THE STARTER, INSTALL THE DRIVE HOUSING PLUG.

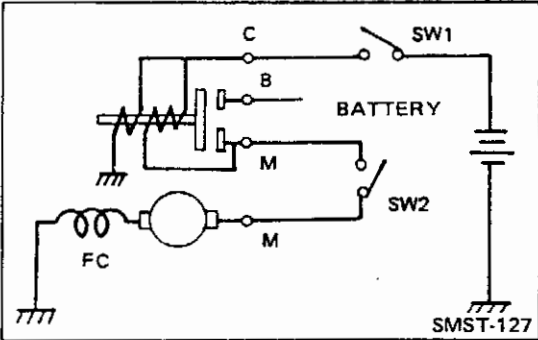
NOTE: Use a new plug.





INSTALL THE MOVING CORE.

Install the moving core in the direction of the marked arrow in the order ① and ②.



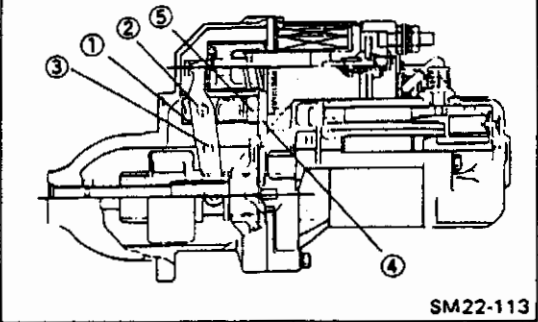
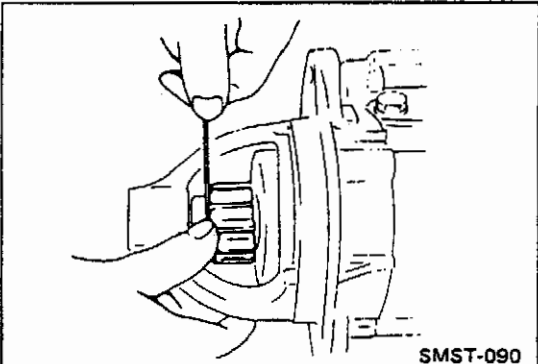
AFTER ASSEMBLING THE STARTER, MEASURE THE TIMING GAP.

- Arrange the circuit.
- Close switches SW1 and SW2.
- Open SW2 alone when the pinion pops out.
- In the above condition, push the pinion back to measure the gap.

Standard: 0.5 – 3.0 mm (0.020 – 0.118 in)

If the gap exceeds the standard, check the following parts and, if necessary, replace them.

- ① Lever holder
- ② Lever pin
- ③ Drive pinion lever
- ④ Gasket
- ⑤ Insert

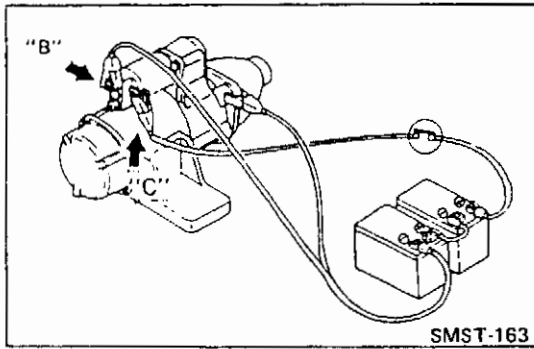


TEST

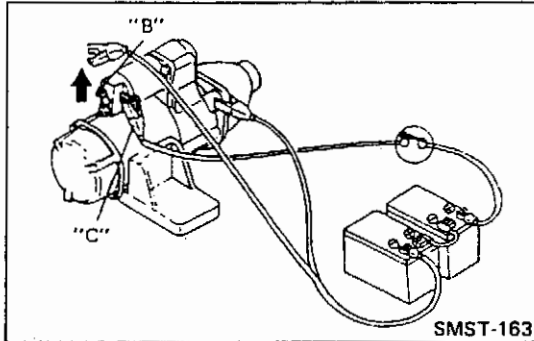
MAGNETIC SWITCH TEST.

The following test should be performed with the starter assembled without the "M" terminal lead with specified voltage applied.

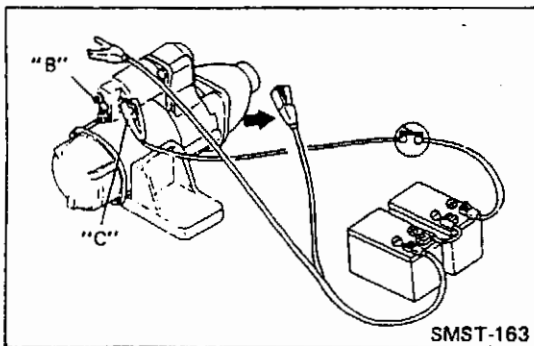
NOTE: Each test should be performed a short time (3 to 5 sec.) to prevent the magnetic switch winding from burning.



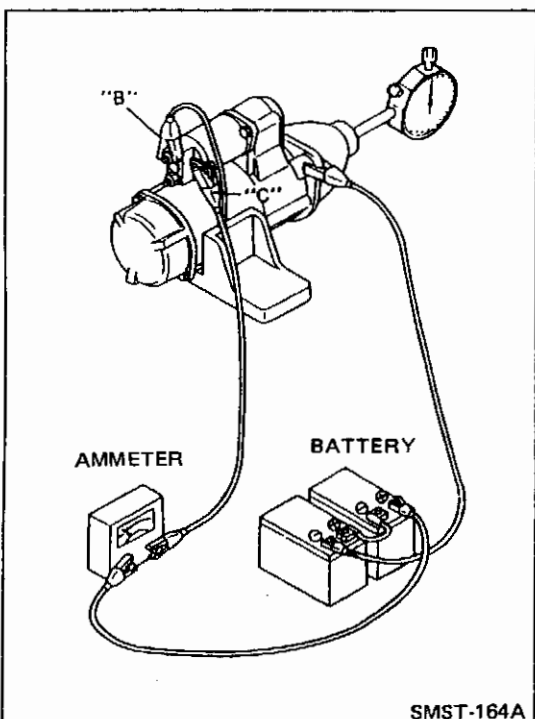
1. **Pull-in test**
Connect the test leads as shown. When the switch is closed, the pinion should jump out.



2. **Holding test**
With the same procedure as the pull-in test, disconnect the "B" terminal.
The pinion should remain in the "jumped out" position.



3. **Return-test**
With the same procedure as in the hold-in test, disconnect the "EARTH" jumper wire.
The pinion should return immediately.



PERFORMANCE TEST

The following test should be carried out after reassembling the starter. If suitable equipment is not available, at least the no-load test should be carried out.

No-load test

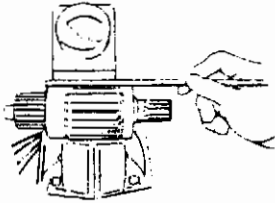
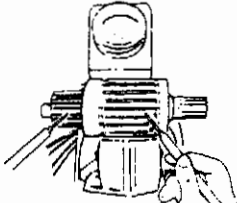
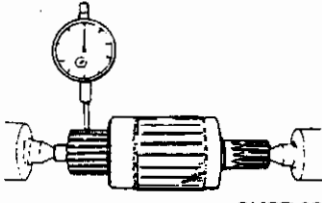
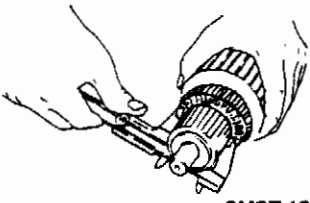
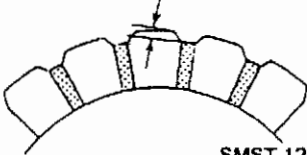
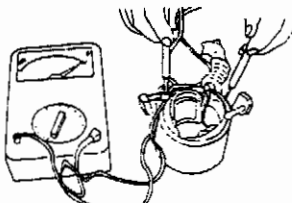
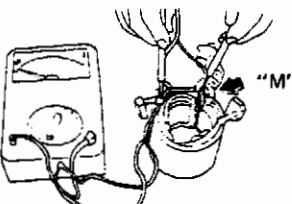
- With the starter securely clamped in a vice.
- Using a battery and suitable ammeter.
- Connect the positive lead to the ammeter, "B" and "C" terminal.
- Connect the negative lead to the starter body.

The starter should show smooth and steady rotation immediately after jumping out of the pinion and should draw less than the specified current.

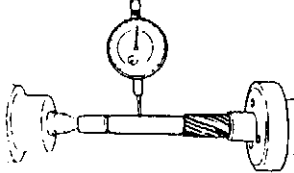
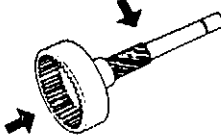

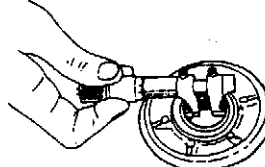
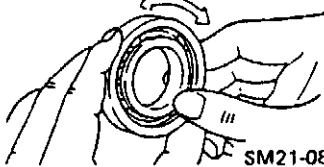
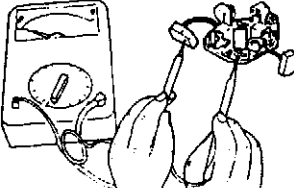
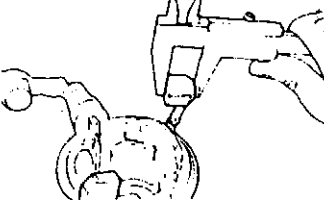
Revolution	More than 4,000 rpm
Current	Less than 100A

INSPECTION AND REPAIR

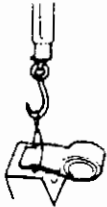
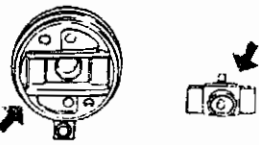
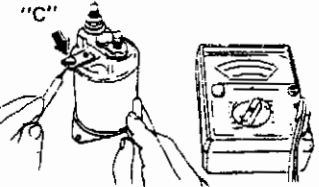
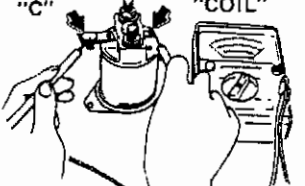
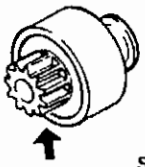
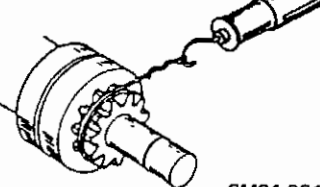
Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Armature Short Circuit Test	-	If the iron plate is not vibrated, the armature is good	Repaice	 <p>SMST-091</p>
Armature Insulation	More than 1 MΩ	Less than 0.5 MΩ	Replace	 <p>SMST-092</p>
Distortion the Commutator	0.05 (0.0020)	0.1 (0.0039)	Replace	 <p>SMST-093</p>
Outside Diameter of the Commutator	36.0 (1.417)	34.0 (1.339)	Replace	 <p>SMST-126</p>
Depth of Under Cut of the Mica	0.5-0.8 (0.0197-0.0315)	0.2 (0.0078)	Replace	<p>COMMUTATOR UNDERCUT</p>  <p>SMST-126</p>
Conductance between the Brush and the Yoke Body	-	Should be conducted	Replace	 <p>SMST-145</p>
Insulation between the Brush and the "M" Terminal	More than 1 MΩ	Less than 0.5 MΩ	Replace	 <p>"M"</p> <p>SMST-146</p>


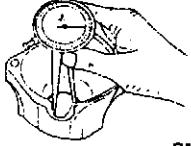
Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Bend of the Drive Shaft	0.05 (0.0019)	0.1 (0.0039)	Replace	 SMST-096
Wear or Damage of the Internal Gear and the Spline	-	-	Replace, if necessary	VISUAL CHECK  SMST-897
Drive Housing Bushing Inside Diameter	17.0 (0.6693)	17.2 (0.6772)	Replace	 SMST-147
Bearing Housing Inside Diameter.	28.0 (1.1024)	28.2 (1.1102)	Replace	 SMST-148
Wear or Damage of the Bearing	-	-	Replace, if necessary	VISUAL CHECK  SM21-083
Insulation between the Brush Holder and Bracket	More than 1 MΩ	Less than 0.5 MΩ	Replace	 SMST-151
Brush Length	18.0 (0.709)	12.0 (0.472)	Replace	 SMST-150

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Tension of the Brush Springs	1.4 kg (3.0 lb)	1.0 kg (2.0 lb)	Replace	 SMST-117
Wear or Damage of the Moving Core, Spring, Seal Rubber and Seat	—	—	Replace, if necessary	VISUAL CHECK
Damage of the Contactor Point	—	—	Replace, if necessary	VISUAL CHECK  SMST-104
Conductance between the C Terminal and the Body (Holding Coil)	0.5 – 2.0 Ω	Should be conducted	Replace	"C"  SMST-152
Conductance between the C Terminal and the Coil Terminal (Pulling Coil)	0.1 – 0.3 Ω	Should be conducted	Replace	"C" "COIL"  SMST-153
Damage of the Pinion Teeth	—	—	Replace, if necessary	VISUAL CHECK  SMST-158
Rotating Torque of Pinion	4–6 kg-cm (0.3–0.4 lb.ft)	—	Replace, if it turns both side or does not turn at all.	 SM21-031

Unit: mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Wear or Damage of the Pinion Shift Lever	—	—	Replace, if necessary	VISUAL CHECK  SMST-108
Damage of the O-rings	—	—	Replace, of necessary	VISUAL CHECK
Commutator End Frame Inside Diameter.	28.0 (1.1024)	28.1 (1.1063)	Replace	 SMST-159

C-48E-04

CHAPTER C

INJECTION PUMP CALIBRATION

INJECTION PUMP SPECIFICATION	Engine		W04C-T				
	Injection pump part number		22000-5660, 22080-1330, 22000-5280				
	Injection pump type		NP-PES4A95C 321R				
	Governor type		RLD with boost compensator (All-speed governor)				
	Timer type		NP-EP/SCDM				
	Feed pump type		NP-FP/KS-A				
TEST CONDITION	Test nozzle type		105780-8140				
	Test nozzle opening pressure		175 kg/cm ² (2,489 psi)				
	Injection pipe	Outer diameter		6.0 mm (0.24 in)			
		Inner diameter		2.0 mm (0.08 in)			
		Length		600 mm (23.6 in)			
	Calibration Oil	Type		SAE J967C			
		Oil temperature		40-45°C (104-113°F)			
Fuel feed pressure		1.6 kg/cm ² (22.8 psi)					
INJECTION TIMING	Rotation		Clockwise viewed from drive side				
	Injection order		1-3-4-2				
	Injection interval		90° ± 15'				
	Pre-stroke		3.17-3.23 mm (0.1248-0.1272 in)				
INJECTION VOLUME	Rack position mm (in)	Pump speed (rpm)	Measuring strokes	Injection volume cc (cu.in)	Max. variation limit cc (cu.in)	Boost pressure mmHg (inHg)	
		10.7 (0.4213)	900	500	38.25-40.25 (2.33-2.46)	1.18 (0.072)	0
	H	About 8.0 (0.3150)	300		3.75-5.25 (0.23-0.32)	0.68 (0.041)	0
	A	10.7 (0.4213)	900		38.75-39.75 (2.36-2.42)	-	More than 160 (6.30)
	B	10.2 (0.402)	1600		41.25-43.25 (2.52-2.64)	-	
	C	10.45 (0.411)	1300		40.15-42.15 (2.45-2.57)	-	
	D	10.2 (0.402)	650		30.35-32.35 (1.85-1.97)	-	
	E	-	400		24.0-26.0 (1.46-1.59)	-	0
	I	About 14.3 (0.5630)	100		50.0-60.0 (3.05-3.66)	-	(Rack limit)
	F	10.9 (0.429)	500		35.3 (2.15)	-	More than 160 (6.30)
	G	-	400		37.3 (2.28)	-	
	K	R ₂ : 9.0 (0.3543)	650		18.65-20.65 (1.14-1.26)	-	0

	Adjusting item	Adjusting lever position	Pump speed (rpm)	Control rack position mm (in)	Adjusting position
GOVERNOR ADJUSTMENT	Idle speed control	Idle	Na : 80-100 Nb : 195-205 Nc : 300 Nd : 350 Ne : 1,100-1,300 Nc : 300	Ra : 11.5 (0.453) Rb : 11 (0.433) Rc : 8 (0.315) Rd : 7.4 (0.291) Re : 2.5 (0.098) Rf : About 8 (0.315)	Setting of the control lever. Outer idling spring Inner idling spring Governor spring Confirmation Idling setting bolt
	Full load rack position	Full-load position	Ng : 900 Nh : Less than 1,875 Ni : 1,650 Ng : 900 Nj : 500	Rg : 10.7 (0.421) Rh : 6.7 (0.264) Ri : Should start to be pulled Rg : 10.7 (0.421) Rj : 10.9 (0.429)	Setting of the control lever Temporarily adjustment of the maximum-speed setting bolt Confirmation Full-load setting bolt Torque cam position
	Maximum speed control	Full-load position	Nh : Less than 1,875 Ni : 1,650	Rh : 6.7 (0.264) Ri : Should start to be pulled	Maximum-speed setting bolt Confirm the speed droop
	Boost compensator		Np : 650	R ₁ : 10.2 (0.402) R ₂ : 8.9-9.1 (0.350-0.358) When boost pressure is at P ₁ mmHg, Control rack begins to move from R ₂ mm in the fuel increase direction. When control rack returns to position R ₁ , the available pressure corresponds to P ₂ mmHg.	Confirmation (Fully loosened adjusting screw) Adjusting screw Confirmation

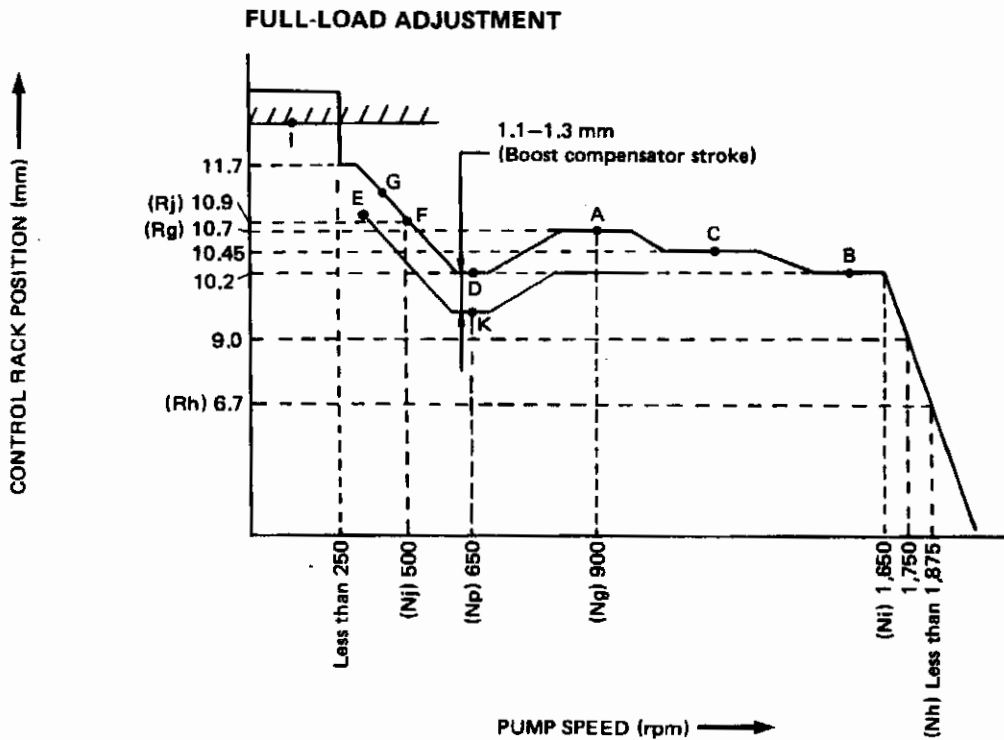
TIMER ADVANCE	Adjusting lever position	Pump speed (rpm)	Advance angle
	Full-load	Less than 1,300-1,350	0°
		1,600	3.2° - 3.8°

Adjusting position

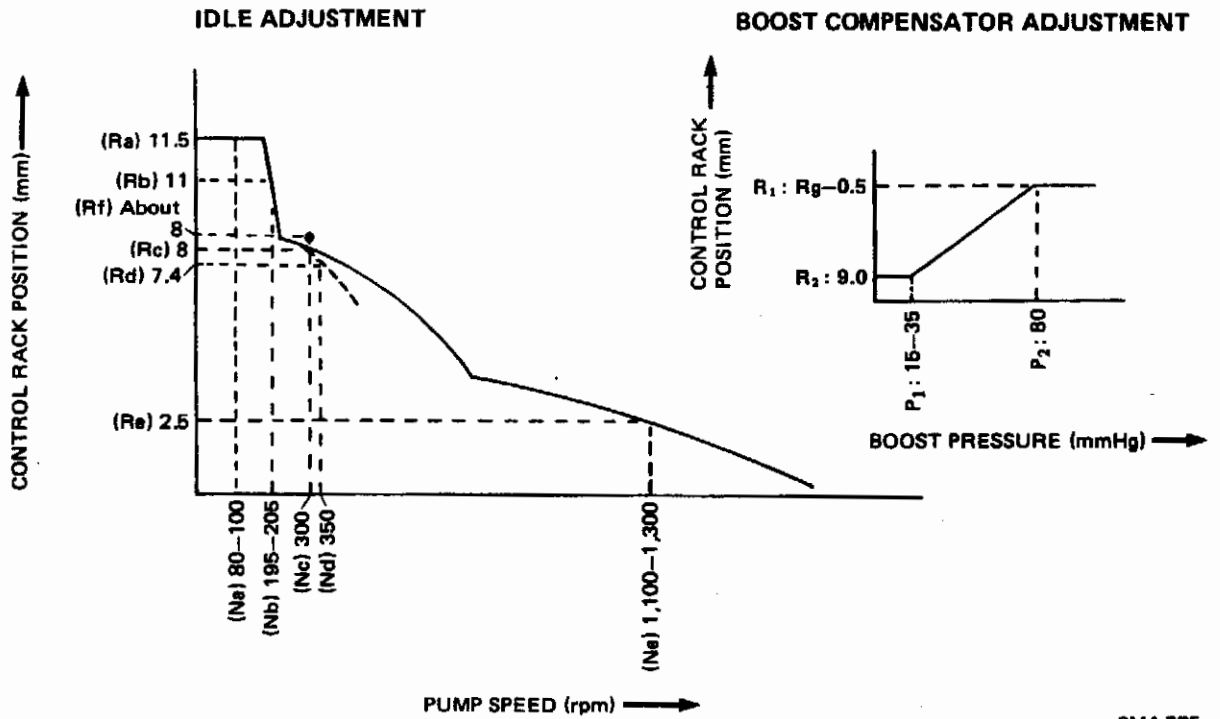
SM4-570

GOVERNOR ADJUSTMENT

Governor characteristic diagram



SM4-774



SM4-775



RECOMMENDED LUBRICANTS FOR ALL HINO VEHICLES

HINO MOTORS, LTD.
OVERSEAS OPERATIONS
SERVICE DIV.
TOKYO, JAPAN

<https://truckman1alshub.com/>

No.	LUBRICANTS	POSITIONS	ATMOS- PHERIC TEMP.	S.A.E. NO.	BP	CALTEX	CASTROL	ESSO	GULF	MOBIL	SHELL	TOTAL
1	ENGINE OIL (A.P.I. CD) Previous Classification (A.P.I. DS) (MIL-L-210AC) (MIL-L-46198B)	C-Wheel, Block Injection Pump Air Cleaner	Above 32°C (90°F)	40	Vanellus C-3 40	RPM DELO 400 OH	Castrol or Deasol	Esolube	Gulf Super Duty	Mobil Delvac 1340	Myrica OH 40	TOTAL
						SAE 40 or 15W/40	CRD 40, Turbomar	D-3 40,	Motor OH 40, 15W-40	Mobil Delvac Super	20W-40, 15W-40	Rubia S 40
						RPM DELO 300 OH	Control or Deasol	XD-3 40	Motor OH 30, 15W-40	Mobil Delvac Super	Rubia TM 15W/40	
2	ENGINE OIL (A.P.I. CC) Previous Classification (A.P.I. DM) (MIL-L-46192) (MIL-L-210BE)	Transmission Case P.T.O. Case Transfer Case Front & Rear Axle (Spiral bevel gear type)	Above 32°C (90°F)	30	Vanellus C-3 30	RPM DELO 400 OH	Castrol or Deasol	Esolube	Gulf Super Duty	Mobil Delvac 1330	Myrica OH 30	TOTAL
						SAE 40	CRD 20W/20	D-3 20W,	Motor OH 30, 15W-40	Mobil Delvac Super	20W-40, 15W-40	Rubia S 30
						RPM DELO 300 OH	Control or Deasol	XD-3 15W-40	Motor OH 20, 15W-40	Mobil Delvac Super	Rubia X OH 30,	Rubia TM 15W/40
3	HYPOID GEAR OIL (A.P.I. GL-5) (MIL-L-2105B)	Rear Axle (Hypoid gear type)	Above 32°C (90°F)	140	Gear Oil 140EP	Universal	Castrol Hypres	Esso Gear OH	Gulf	Mobilube	Spirax	TOTAL
						Thuban 140	140	GP 85W-140	Multi-Purpose	GX140	EP140	EP 85W/140
						Universal	Castrol Hypoy	GP 85W-90	Gear Lubricant	GX80	EP90	EP 85W/90
4	BOOSTER TYPE AND DUMP AND CRANE HOIST OIL (MIL-L-15017A) (MIL-L-17672B) (MIL-H-46001)	Power Steering, Booster Dump & Crane Hoist	Above 32°C (90°F)	90	Gear Oil 90EP	Universal	Castrol Hypoy	Esso Gear OH	Gulf	Mobilube	Spirax	TOTAL
						Thuban 90	90	GP 85W-90	Multi-Purpose	GX90	EP90	EP 85W/90
						Universal	Castrol Hypoy	GP 85W-90	Gear Lubricant	GX90	EP90	EP 85W/90
5	INTEGRAL TYPE POWER STEERING OIL	Power Steering, Booster Dump & Crane Hoist	Above 32°C (90°F)	20W	ENERGOL HLP45	Multi-purpose	Castrol Hypoy	Esso Gear OH	Gulf	Mobilube	Spirax	TOTAL
						Thuban EP-90	B 140, C80W/140	GX 85W-140	Multi-Purpose	HD 140, 80W-140	Heavy Duty	TM 85W/140
						Thuban EP-90	850, C80W/90	GX 85W-90	Gear Lubricant	85W-140	140, 85W-140	TM 80W/90
6	TORQUE CONVERTER OIL	Power Steering, Booster Dump & Crane Hoist	Above 32°C (90°F)	10W	ENERGOL HLP32	Multi-purpose	Castrol Hypoy	Esso Gear OH	Gulf	Mobilube	Spirax	TOTAL
						Thuban EP-90	850, C80W/90	GX 85W-90	Multi-Purpose	HD 140, 80W-140	Heavy Duty	TM 85W/140
						Thuban EP-90	850, C80W/90	GX 85W-90	Gear Lubricant	85W-140	140, 85W-140	TM 80W/90
7	SHOCK ABSORBER OIL	Shock Abs Inletage type	Above 32°C (90°F)	5W	ENERGOL HLP15	Multi-purpose	Castrol Hypoy	Esso Gear OH	Gulf	Mobilube	Spirax	TOTAL
						Thuban EP-90	850, C80W/90	GX 85W-90	Multi-Purpose	HD 140, 80W-140	Heavy Duty	TM 85W/140
						Thuban EP-90	850, C80W/90	GX 85W-90	Gear Lubricant	85W-140	140, 85W-140	TM 80W/90
8	AIR AND VACUUM CYLINDER OIL	Air Servo Cylinder Vacuum Servo Cylinder Cooler Compressor	Above 32°C (90°F)	20 5W	BP Auron GM-MP	Castrol TG	Esso Automatic	Esso Automatic	Gulf Automatic	Mobil ATF220	Shell Dextron II	TOTAL
						Deaon II	Fluid-Deaon II	Fluid-Deaon II	Fluid-Deaon II	ATF220	Shell Dextron II	Dextron
						Deaon II	Fluid-Deaon II	Fluid-Deaon II	Fluid-Deaon II	ATF220	Shell Dextron II	Dextron

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