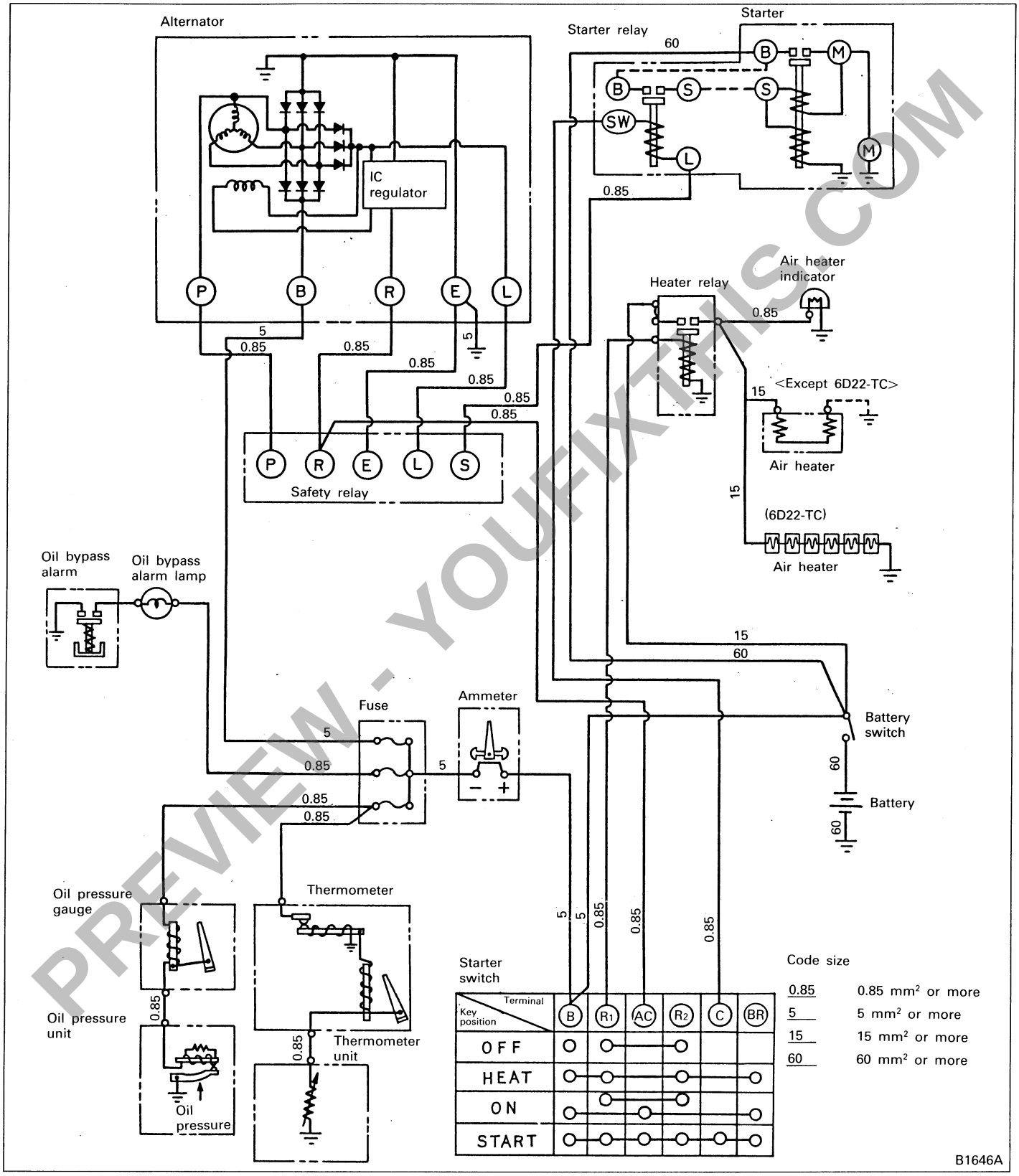
1. GENERAL



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4. GENERAL BOLTS AND NUTS TIGHTENING TORQUE TABLE

Unless otherwise specified, the parts and equipment of vehicle must be tightened by the following standard bolts and nuts. Tightening torques for these bolts and nuts are shown below.

NOTE:

Threads and seat surfaces must be in dry state.

Standard bolts and nuts

Unit: Nm (kgfm)

Dia. mm	Pitch mm	4T (Head mark 4 or ○)	7T (Head mark 7 or ⊘)	8T (Head mark 8 or ⊕)
5	0.8	2.0 to 2.9 (0.2 to 0.3)	3.9 to 5.9 (0.4 to 0.6)	4.9 to 6.9 (0.5 to 0.7)
6	1.0	3.9 to 5.9 (0.4 to 0.6)	6.9 to 10.8 (0.7 to 1.1)	7.8 to 11.8 (0.8 to 1.2)
8	1.25	8.8 to 13.7 (0.9 to 1.4)	16.7 to 25.5 (1.7 to 2.6)	19.6 to 29.4 (2.0 to 3.0)
10	1.25	18.6 to 27.5 (1.9 to 2.8)	34.3 to 53.9 (3.5 to 5.5)	44.1 to 58.8 (4.5 to 6.0)
	1.5	17.7 to 26.5 (1.8 to 2.7)	32.4 to 49.0 (3.3 to 5.0)	42.1 to 58.8 (4.3 to 6.0)
12	1.25	33.3 to 49.0 (3.4 to 5.0)	68.6 to 93.2 (7.0 to 9.5)	83.4 to 108 (8.5 to 11)
	1.75	30.4 to 46.1 (3.1 to 4.7)	63.7 to 83.4 (6.5 to 8.5)	73.5 to 98.1 (7.5 to 10)
14	1.5	58.8 to 83.4 (6.0 to 8.5)	118 to 157 (12 to 16)	127 to 177 (13 to 18)
	2.0	53.9 to 73.5 (5.5 to 7.5)	108 to 137 (11 to 14)	118 to 167 (12 to 17)
16	1.5	93.2 to 127 (9.5 to 13)	177 to 235 (18 to 24)	196 to 265 (20 to 27)
	2.0	88.3 to 118 (9.0 to 12)	157 to 216 (16 to 22)	186 to 255 (19 to 26)

Flange bolts and nuts

Unit: Nm (kgfm)

Dia. mm	Pitch mm	4T (Head mark 4 or ○)	7T (Head mark 7 or ⊘)	8T (Head mark 8 or ⊕)
6	1.0	3.9 to 5.9 (0.4 to 0.6)	7.8 to 11.8 (0.8 to 1.2)	8.8 to 13.7 (0.9 to 1.4)
8	1.25	9.8 to 14.7 (1.0 to 1.5)	18.6 to 27.5 (1.9 to 2.8)	21.6 to 32.4 (2.2 to 3.3)
10	1.25	20.6 to 30.4 (2.1 to 3.1)	38.2 to 58.8 (3.9 to 6.0)	49.0 to 63.7 (5.0 to 6.5)
12	1.25	37.3 to 53.9 (3.8 to 5.5)	78.5 to 108 (8.0 to 11)	88.3 to 118 (9.0 to 12)

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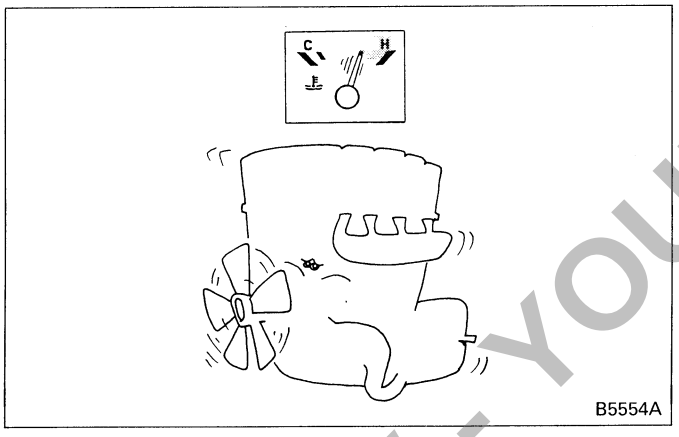
5. SERVICE PROCEDURES

5.1 ENGINE PROPER

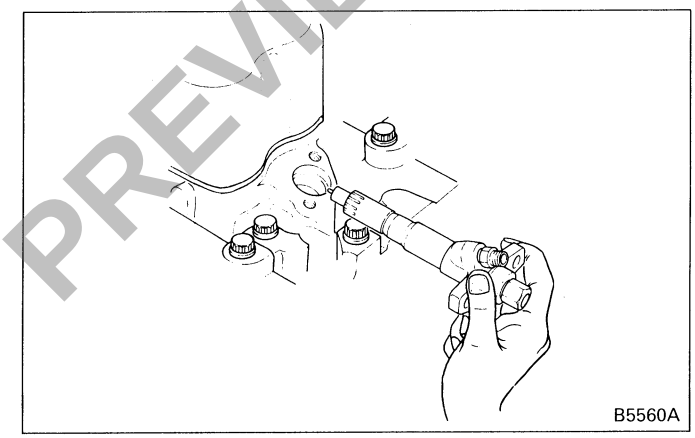
5.1.1 Measurement of Compression Pressure

Compression pressure must be measured prior to disassembly of the engine.
Measure the compression pressure at regular intervals and keep track of its changes. During the break-in period or after parts have been replaced with new ones, there is a slight increase in the pressure as the piston rings and valve seats fit snugly in position. As rough edges and friction between parts are gradually reduced, the pressure comes down.

Measurement Procedure

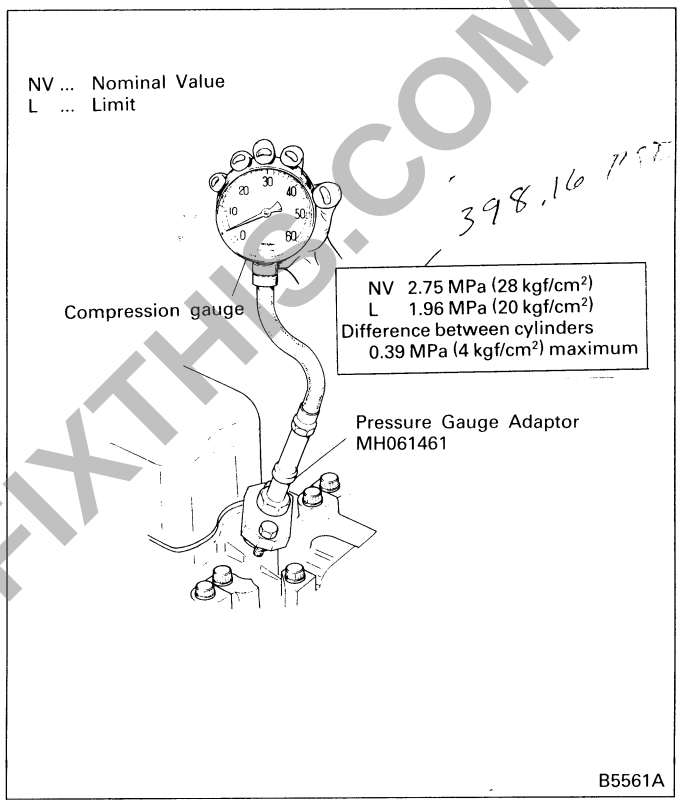


(1) Retighten the cylinder head bolts to specified torque and let the engine warm up until the coolant temperature reaches 75°C to 85°C.



(2) Remove all injection nozzles from the cylinder head.

NOTE:
Cover the mounting holes and injection pipes to prevent entry of dust and dirt.



(3) Install Compression Gauge Adaptor (special tool) on the injection nozzle mounting hole together with a gasket and connect the compression gauge (measuring instrument).
(4) Turn the engine with the starter and read the compression gauge pointer value with the specified engine speed.

NOTE:
1. **Keep no fuel injected.**
2. **Make sure that the engine speed is also measured as compression pressure varies with the engine speed.**
3. **Make measurement for all cylinders, as wear and other conditions vary from one cylinder to another.**

(5) If the reading is below the limit, disassemble and check.

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6. TROUBLESHOOTING

Engine is hard to start

- Inferior fuel quality or improper oil viscosity
  - YES → Replace the fuel or oil.
  - NO ↓
- Cooling system is abnormal.
  - YES → Repair or replace improper parts. Refer to Group 14 Cooling.
  - NO ↓
- Defective starting (including preheating) system
  - YES → Repair or replace defective parts. Refer to Group 16 Engine Electrical.
  - NO ↓
- Improper valve clearance or injection timing
  - YES → Adjust
  - NO ↓
- Defective injection pump, timer or defective nozzles or other parts
  - YES → Repair or replace defective parts. Refer to Group 13 Fuel and Engine control.
  - NO ↓
- Compression pressure is incorrect
  - YES →
    - The head gasket is defective.
    - Valves or valve seats are worn or have carbon deposits
    - Valve springs are worn.
    - Piston rings are worn or damaged.
    - Piston ring groove is worn or damaged.
    - Piston and cylinder liner have excessive clearance.

    Inspect and repair or replace parts for the above items

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2. MAJOR SPECIFICATIONS

2.1 MAJOR SPECIFICATIONS

Item / Model	Specifications		
	6D22	6D22-T (Turbocharged)	6D22-TC (Turbocharged, with after cooler)
Combustion method	Direct injection	Direct injection	Direct injection
No. and arrangement of cylinder	6 in-line	6 in-line	6 in-line
Cylinder bore x stroke mm	130 x 140	130 x 140	130 x 140
Total displacement cc	11 149	11 149	11 149
Empty weight kg*	930	970	990

* Empty weight as measured according to Mitsubishi Motors Corporation standard.

2.2 ENGINE OUTPUTS CLASSIFIED BY APPLICATION

Application / Engine model		6D22	6D22-T (Turbocharged)	6D22-TC (Turbocharged with after cooler)
Intermittent rated output	kW (HP)/rpm	112 (150)/1 500	158 (212)/1 500	183 (245)/1 500
		132 (177)/1 800	179 (241)/1 800	212 (284)/1 800
		144 (193)/2 000	188 (252)/2 000	224 (300)/2 000
		152 (204)/2 200	195 (261)/2 200	232 (311)/2 200
Continuous rated output	kW (HP)/rpm	102 (137)/1 500	143 (192)/1 500	167 (224)/1 500
		120 (161)/1 800	163 (219)/1 800	194 (259)/1 800
		131 (175)/2 000	171 (230)/2 000	204 (273)/2 000
		138 (185)/2 200	177 (237)/2 200	211 (283)/2 200

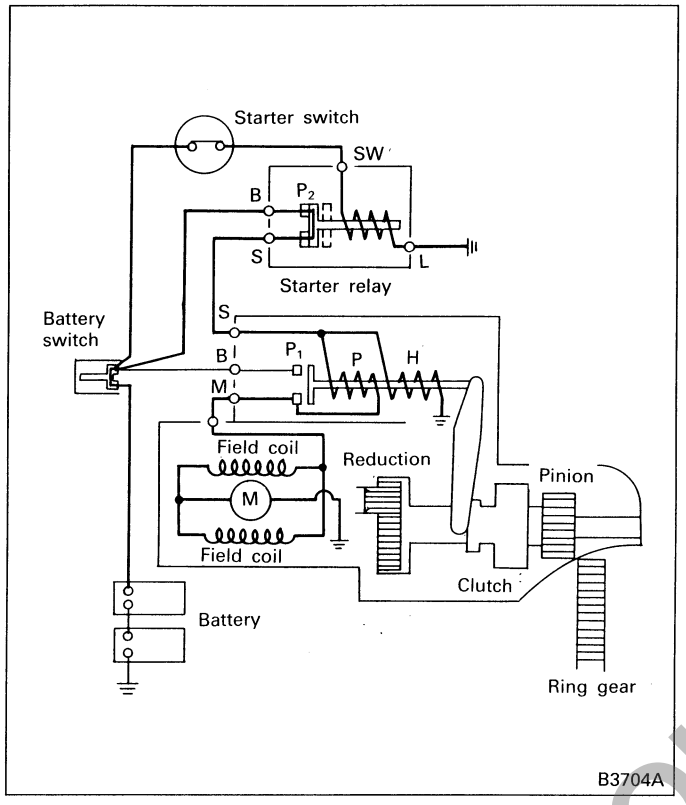
NOTE:

1. **The output (SAE, gross) is corrected to standard ambient conditions based on SAE J1349.**
2. **The continuous rated output allows 10% (one hour) overload operation.**

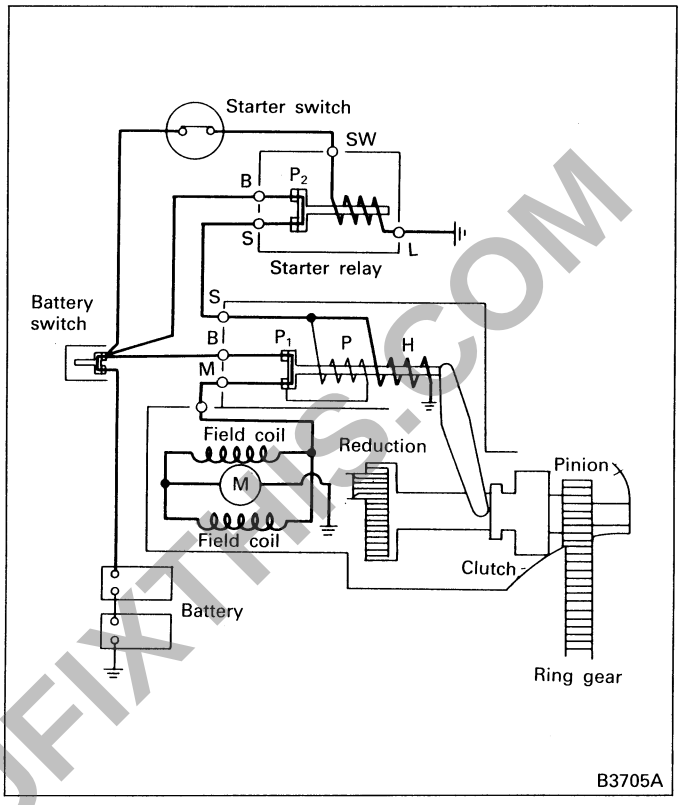
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(3) Operation



While the starter switch is ON, current flows from the terminal "SW" of the starter relay to the terminal "L" and closes the contact "P_2".
When the contact "P_2" closes, current from the battery flows from the terminal "S" of the magnetic switch to the pull-in coil "P" and holding coil "H". Furthermore, the current that has decreased flows from the terminal "M" to the motor section.
The plunger, attracted by the magnetic flux of the pull-in coil and holding coil, closes the contact "P_1" and simultaneously pushes out the pinion turning slowly on weak current.



When the pinion comes into complete mesh with the ring gear, the contact "P_1" closes and the large current of the battery directly flows to the motor section to turn the pinion powerfully.
In this condition, no current flows to the pull-in coil. The plunger is retained by the holding coil alone.

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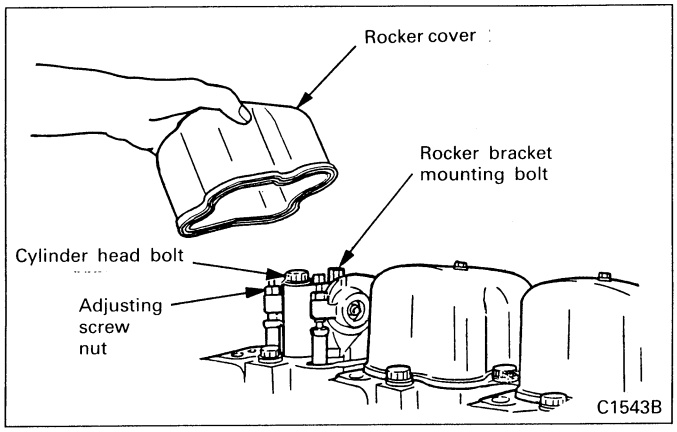
3.2 TIGHTENING TORQUE TABLE

Description			Thread size O.D. x Pitch mm	Tightening torque Nm (kgfm)	Remarks
Engine proper	Cylinder head bolt		M14 x 2	215 to 275 (22 to 28)	Wet For tightening procedure refer to 5.1.2 (3) (f).
		Tightening together with bracket		215 to 240 (22 to 24.5)	
	Rocker bracket bolt		M10 x 1.5	34 (3.5)	Dry
	Rocker cover screw		M10 x 1.25	9.8 (1)	Dry
	Rocker adjusting screw lock nut		M10 x 1.25	59 (6)	Dry
	Check valve		M12 x 1.75	34 (3.5)	Dry
	Connecting rod nut		M13 x 1.25	115 (12)	Wet
	Main bearing cap bolt		M18 x 2.5	370 (38)	Wet
	Crankshaft pulley bolt		M14 x 1.5	175 (18)	Dry
	Camshaft gear nut		M27 x 1.5	265 (27)	Wet
	Idler shaft bolt		M16 x 2	115 (12)	Dry
	Idler shaft nut (for mounting collar)		M16 x 1.5	98 to 115 (10 to 12)	Dry
	Flywheel bolt		M16 x 1.5	315 (32)	Wet
	Flywheel housing bolt		M12 x 1.75	59 (6)	Dry

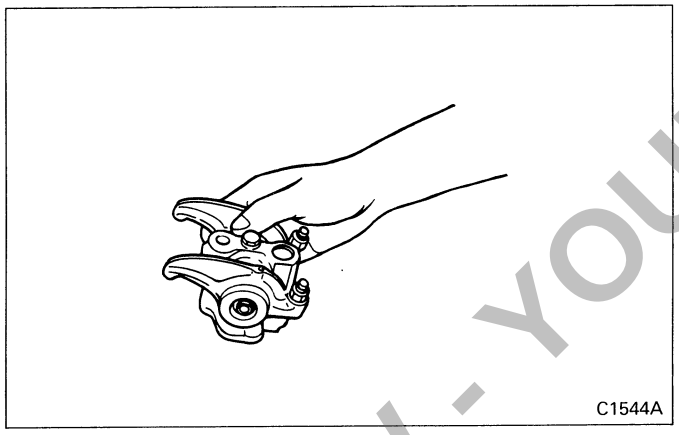
Nm X .738 = ft Lbs
kgfm X 7.233 = ft Lbs

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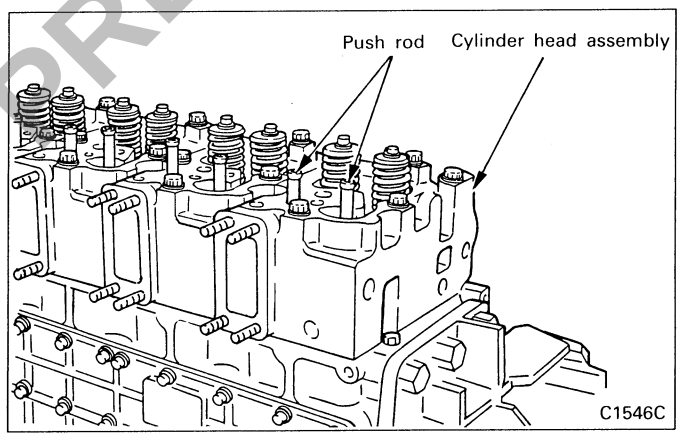


(a) Where the push rod is forcing the rocker up, the rocker adjusting screws should be loosened before all bolts are removed.

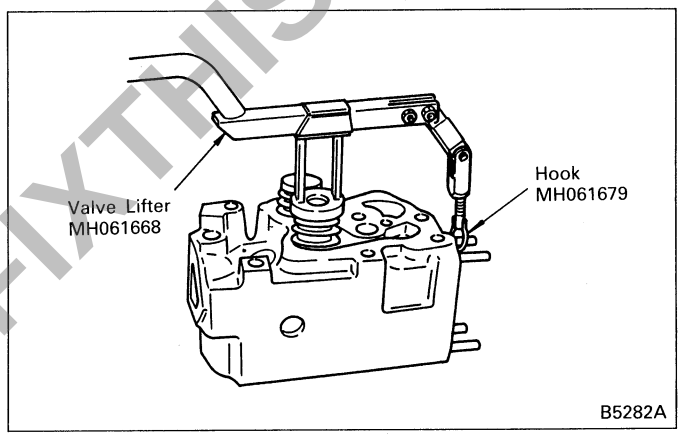


(b) To remove the rocker shaft assembly, lift it straight upwards.

NOTE:
The rocker shaft bracket assembly is set in position on the cylinder head by spring pins.



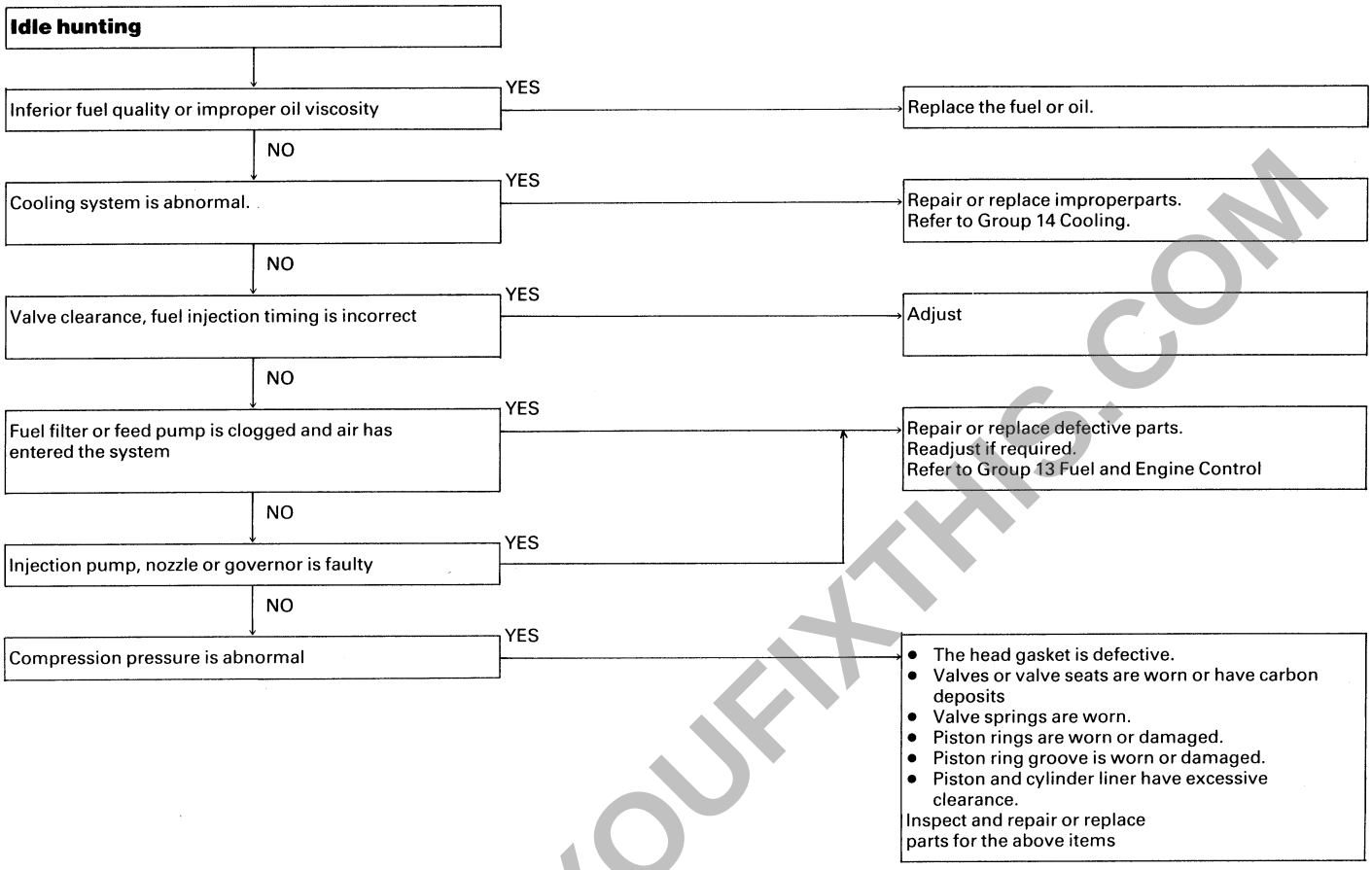
(c) To remove the cylinder head, make sure that the injection nozzle is removed beforehand. If the cylinder head with nozzle mounted in placed on the work table, damage to the nozzle end projecting from the bottom surface of the cylinder head will result.
(d) When the cylinder head gasket is removed, make sure that the cylinder head and crankcase are not scratched.
(e) Since the cylinder head is located by dowel pins on the top surface of the crankcase, make sure that the cylinder head is lifted straight upward when removed.



(f) To remove the valve cotter, use Valve Lifter and Hook (special tools) and compress evenly the valve spring.

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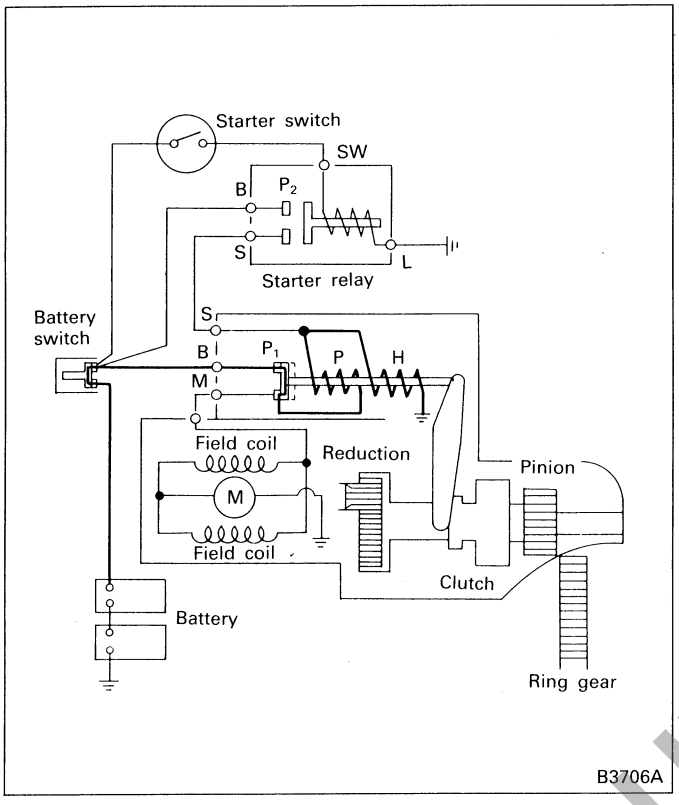
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2. SPECIFICATIONS

Item		Specifications		
Engine model		6D22	6D22-T	6D22-TC
Type		Water cooled, 4-cycle diesel	Water cooled, 4-cycle diesel	Water cooled, 4-cycle diesel
Number of cylinders-arrangement		6-in-line	6-in-line	6-in-line
Valve mechanism		Overhead valve	Overhead valve	Overhead valve
Combustion chamber		Direct injection type	Direct injection type	Direct injection type
Cylinder bore x stroke	mm	130 x 140	130 x 140	130 x 140
Total displacement	cc	11 149	11 149	11 149
Compression ratio		17	16	15.5
Firing order		1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Cylinder liner	Type	Wet type		
Piston	Type	Trunk, slipper skirt type		
Piston ring	Q'ty	Compression ring: 2 Oil ring: 1		

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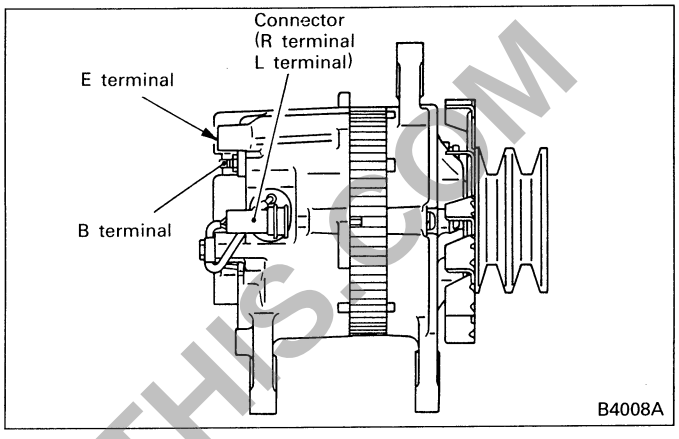
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When the starter switch is set to OFF, the contact point P2 opens.
The moment the starter switch is opened, the P1 is still in closed position and the battery current flows from the B terminal to the pull-in coil (P) and holding coil (H).
Since the direction of current that flows is reverse, the magnetic fluxes cancel each other, and the return spring pushes the plunger back to its original position. At the same time, the contact point P1 opens, so the current to the motor section is cut off.

1.2 ALTERNATOR

(1) Model A2T72987, A4T57987 Alternators (Idle-speed efficient type)



The alternator with a built-in IC regulator (abbreviated to the built-in alternator) is used.
The alternator consists of the IC regulator and brush holder accommodated in the rear bracket.

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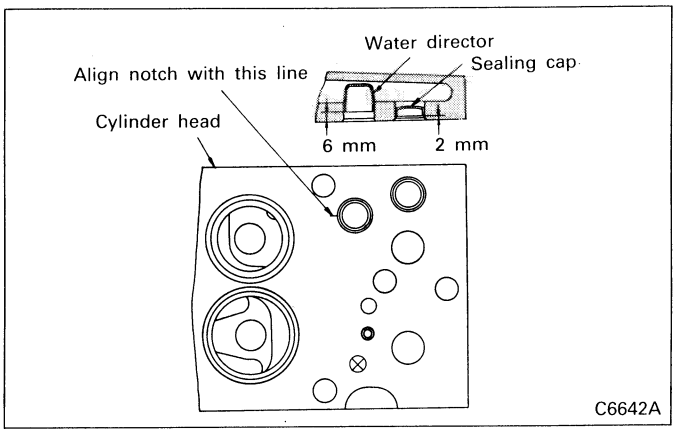
Description		Nominal value [Basic diameter]	Limit	Correction and remarks
Relief valve	Valve opening pressure	1180 kPa (12 kgf/cm²)		Replace.
	Spring load (Installed length: 46.3)	160 ± 7.8 N (16.1 ± 0.8 kgf)		
Oil bypass alarm valve opening pressure (ON start pressure)		345 to 390 kPa (3.5 to 4 kgf/cm²)		Replace.
Oil cooler bypass valve opening pressure		175 to 215 kPa (1.8 to 2.2 kgf/cm²)		Replace.
Regulator valve	Valve opening pressure	360 to 420 kPa (3.7 to 4.3 kgf/cm²)		Replace.
	Spring load (Installed length: 48.3)	76 to 80 N (7.8 to 8.2 kgf)		
Check valve opening pressure		265 to 325 kPa (2.7 to 3.3 kgf/cm²)		Replace.

3.2 TIGHTENING TORQUE TABLE

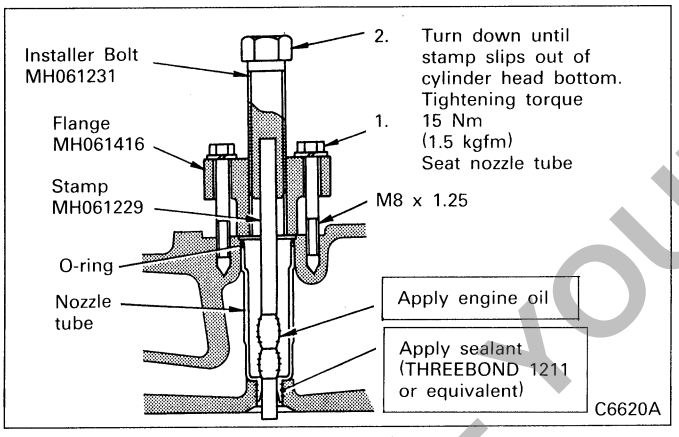
Description	Thread size O.D. x Pitch mm	Tightening torque Nm (kgfm)	Remarks
Oil pump idler gear shaft nut	M12 x 1.25	59 to 78 (6 to 8)	Apply LOCTITE No. 262.
Oil filter center bolt	M16 x 1.5	59 to 69 (6 to 7)	Dry
Regulator valve	M27 x 1.5	98 (10)	Dry
Check valve	M12 x 1.75	34 (3.5)	Dry

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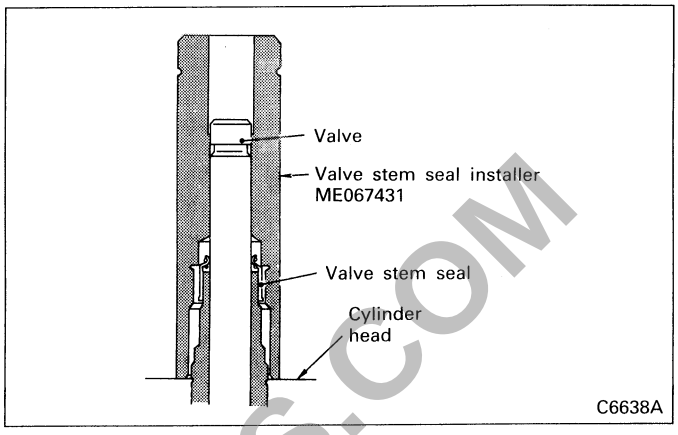


(a) Install the water director with its notch directed as shown.



(b) Installation of nozzle tube

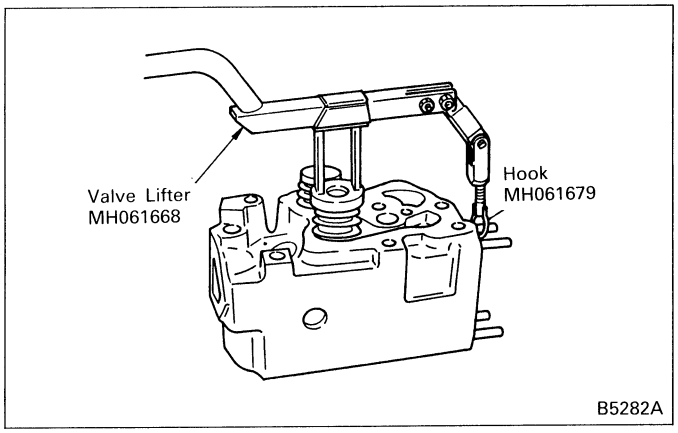
1) Apply sealant to the end of the nozzle tube and insert into the cylinder head together with the O-ring.
2) Using Flange (special tool), press the nozzle tube against the cylinder.
3) Apply engine oil to Stamp (special tool) and insert into the nozzle tube.
4) Thread Installer Bolt (special tool) to push the stamp until it can be removed from the bottom of the cylinder head.
5) After the nozzle tube has been installed, perform hydraulic test to check for water leaks. (Test pressure 195 kPa or 2 kgf/cm^2)



(c) The valve stem seal should be installed by applying engine oil to the lip and striking down Valve Stem Seal Installer (special tool) until it touches the cylinder head.

NOTE:

1. **Before the valve is installed, apply a small amount of engine oil to the stem.**
2. **After installation, check to ensure that the valve stem seal spring has not been deformed or damaged.**



(d) Install the valve cotter, while compressing the valve spring, using Valve Lifter (special tool).

NOTE:

1. **Install the inner valve spring with the closely coiled portion whity green painted) toward the cylinder head. Install the outer valve spring with the side painted in sky blue directed toward the upper retainer.**
2. **When the valve spring is compressed with the valve lifter, make sure that it is evenly compressed.**

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Unusual exhaust gas color

- Fuel of inferior quality is used.
  - YES → Replace the fuel.
  - NO ↓
- Cooling system is improper.
  - YES → Repair or replace defective parts. Refer to Group 14 Cooling.
  - NO ↓
- The air cleaner or muffler function is incorrect.
  - YES → Repair or replace improper parts. Refer to Group 15 Intake and Exhaust.
  - NO ↓
- The valve clearance or fuel injection timing improper
  - YES → Adjust
  - NO ↓
- The injection pump, timer or nozzle condition is improper.
  - YES → Repair or replace improper parts. Readjust if necessary.
  - NO ↓
- Compression pressure is abnormal.
  - YES →
    - The head gasket is defective.
    - Valves or valve seats are worn or have carbon deposits
    - Valve springs are worn.
    - Piston rings are worn or damaged.
    - The piston ring grooves are worn or damaged.
    - Piston and cylinder liner clearance is excessive.

    Inspect, and repair or replace parts for the above items

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2. SPECIFICATIONS

Item		Specifications	
Engine oil	Quality	[Without turbocharger] API classification Class CC or better	
		[With turbocharger] API classification Class CD or better	
		[For general power]	[For construction machinery]
Oil pan capacity		Approx. 27 lit.	Approx. 25 lit.
Oil filter capacity		3 lit.	3 lit.
Lubrication method		Forced lubrication by oil pump	
Oil pump	Type	Forced lubrication by gear pump (with built-in relief valve)	
Relief valve	Type	Ball valve	
Oil filter			
Full-flow filter element	Type	Filter paper type	
Bypass filter element	Type	Filter paper type	
Oil bypass alarm	Type	Piston valve type with built-in electric contacts	
Oil cooler	Type	Shell and plate type (multi-plate type)	
Oil bypass valve	Type	Piston valve type	
Regulator valve	Type	Piston valve type	
Oil jet			
Check valve	Type	Piston valve type	

3. SERVICE STANDARDS

3.1 SERVICE STANDARD TABLE

Unit: mm

Description		Nominal value [Basic diameter]	Limit	Correction and remarks
Oil pressure (Oil temperature at 70 to 90°C	At idle	145 kPa (1.5 kgf/cm²) or more	49 kPa (0.5 kgf/cm²)	Adjust.
	At maximum speed	295 to 490 kPa (3 to 5 kgf/cm²)	195 kPa (2 kgf/cm²)	Adjust.
Oil pump	Backlash between crankshaft gear oil pump idler gear	0.13 to 0.25	0.4	If clearance is less than 0.13, adjust with shims.
	Backlash between idler gear and oil pump gear	0.11 to 0.24	0.4	Replace.
	Difference between pump case depth and gear height	0.05 to 0.11	0.15	Replace.
	Gear tooth tip to pump case clearance	0.11 to 0.18	0.2	Replace.
	Drive gear shaft to cover clearance	[20] 0.04 to 0.07	0.15	Replace.
	Driven gear shaft to driven gear clearance	[20] 0.04 to 0.07	0.15	Replace.
	Idler gear shaft to idler gear clearance	[22] 0.03 to 0.05	0.15	Replace bushing.

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6D2

ENGINE

Shop Manual

FOREWORD

This shop manual contains the specification, construction, operation, adjustment and service procedures of the Model 6D22, 6D22-T, 6D22-TC diesel engine for service mechanics engaged in servicing of the Mitsubishi diesel engines.
Please make the most of this shop manual to perform correct servicing and wasteless operations.
Note that some of the contents of this shop manual are subject to change owing to improvements, etc. that may be introduced after publication of this shop manual.

SEP. 1987

Applicable Engine Models
6D22
6D22-T } For industrial use
6D22-TC

Applicable Engine No.
6D22-144531 ~

GROUP INDEX

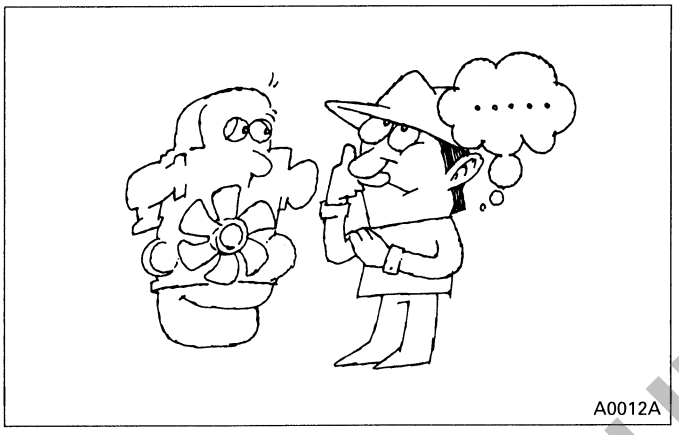
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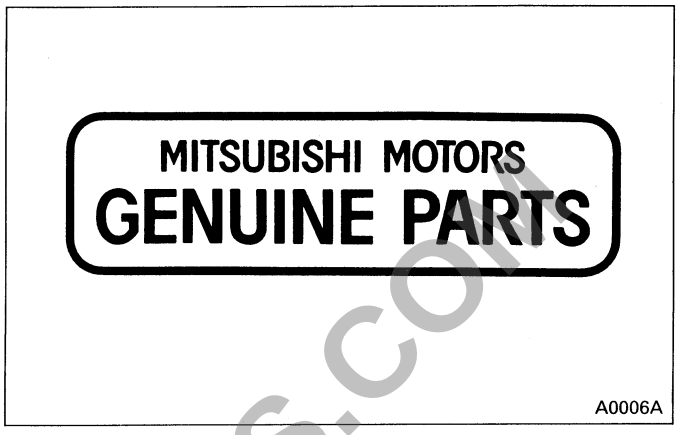
2. GENERAL PRECAUTIONS FOR SERVICING

Before starting the service procedures, check the vehicle for total time driven, use conditions, and user's complaints and requests to know exactly the engine conditions. Record information where necessary.
To ensure you are doing correct and effcient service jobs, observe the following precautions:


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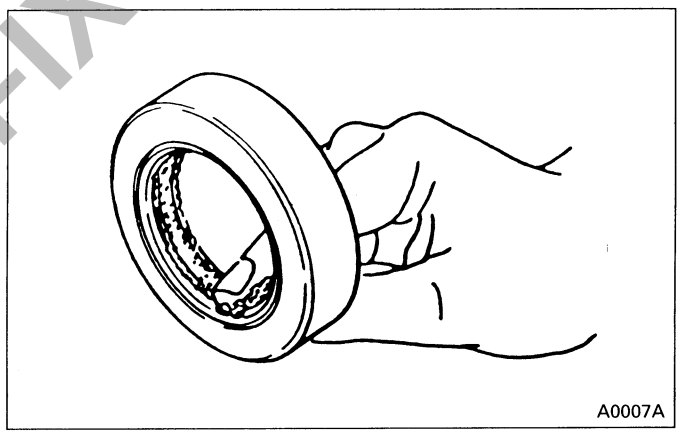
(1) Before performing the service procedures given in this manual, know the trouble spots and isolate the possible cause to determine whether the removal or disassembly procedure is required.
(2) Select a flat surface for the service job.
(3) When servicing the electrical system, be sure to disconnect the negative cable from the battery.
(4) Carefully check parts for oil leaks before cleaning. After cleaning, it may become difficult to spot defective areas.
(5) Ready and make the most of the special tools required for servicing. Use the right tools (specified special tools) in the right place to prevent damages to parts and personal injury.
(6) Make alignment marks and keep disassembled parts neatly arranged to ensure that they are reassembled into the right positions.

- Special care must be taken for assemblies involving a number of parts, similar parts, or parts identical at right- and left-hand sides to ensure correct reassembly.
- For alignment and punching markings, select a position that would not mar the appearance and function.
- Clearly distinguish parts to be replaced from those reused.



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(7) The oil seals, packings, O-rings, and other rubber parts, gaskets, and split pins must be replaced with a new one whenever they are removed. For replacement, use Mitsubishi Genuine parts.


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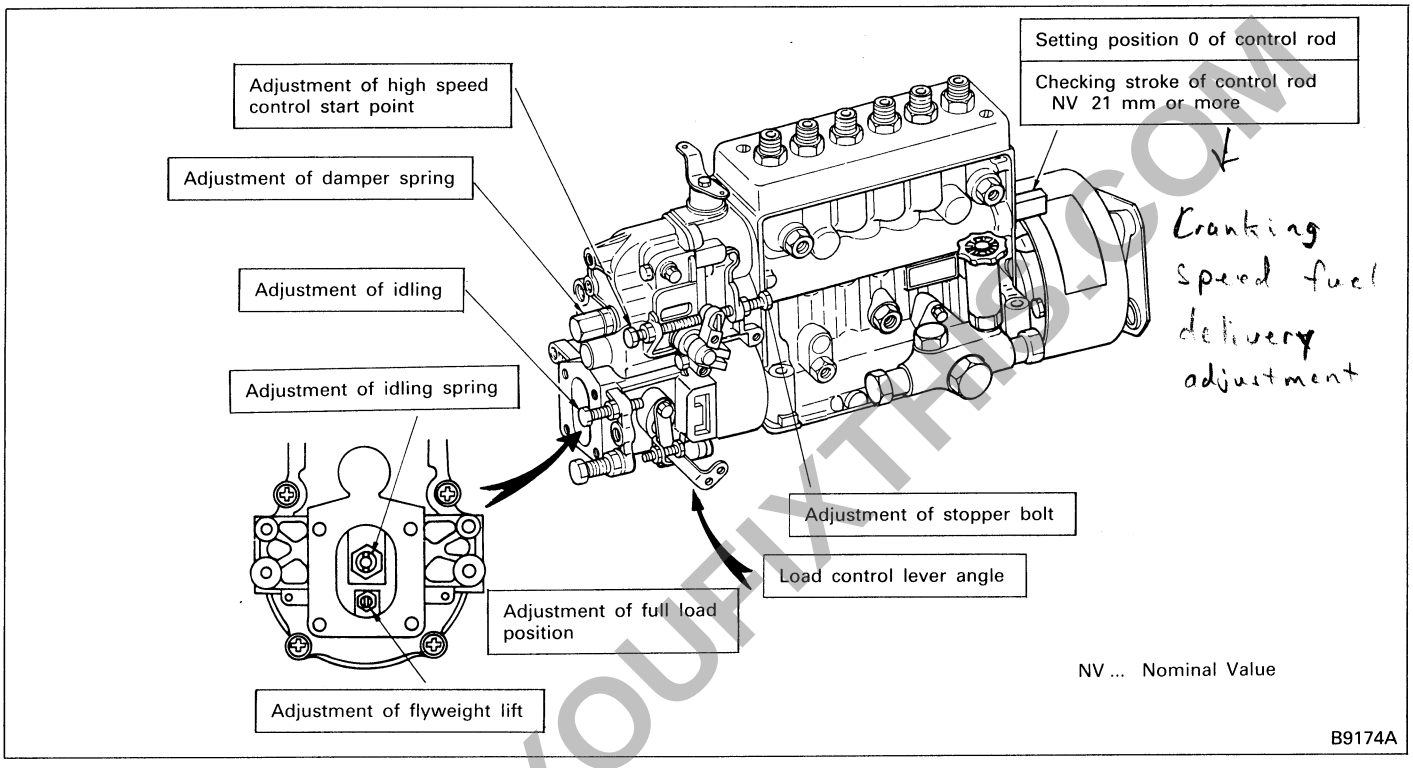
(8) Apply the specified grease to U-packings, oil seals, dust seals, and bearings before installation.
(9) When work requires an assistant or two, always make sure of the safety each other. Never play with switches and levers.
(10)Make sure that your shoes are free from grease and oil especially when working on a heavy item.
(11)When checking or changing lubricants, wipe off grease and oil from parts immediately with a waste.
(12)Special care must be taken in handling sensors and relays which are suspectible to shocks and heat.
(13)Use care so that hands and fingers are not injured by sharp edges or corners of the parts.
(14)Wear safety goggles whenever handling a grinder or welding machine. Wear gloves as required to ensure utmost safety.

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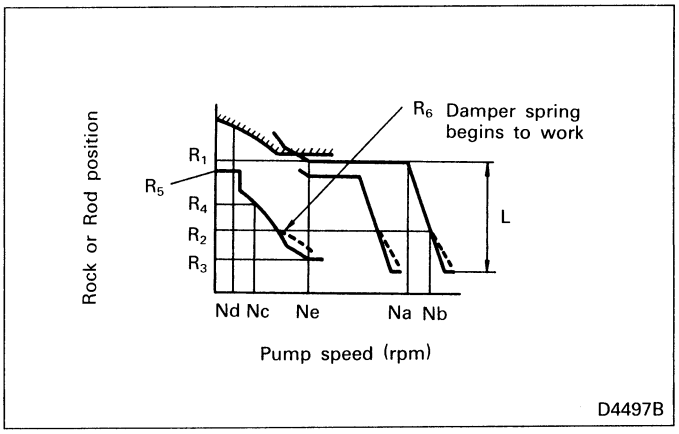
(2) RFD Type Governor

For governor performance curve, see Service Information published separately.



NOTE:

1. **Remove the damper spring.**
2. **Remove the idling spring.**
3. **Keep the stopper bolt of the speed control lever loosened.**
4. **Keep the stopper bolt of the load control lever loosened.**
5. **Supply engine oil to the injection pump cam chamber.**



Adjust the relation between pump speed and rod position to the specified governor performance diagram and perform adjustments in the following sequence.

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