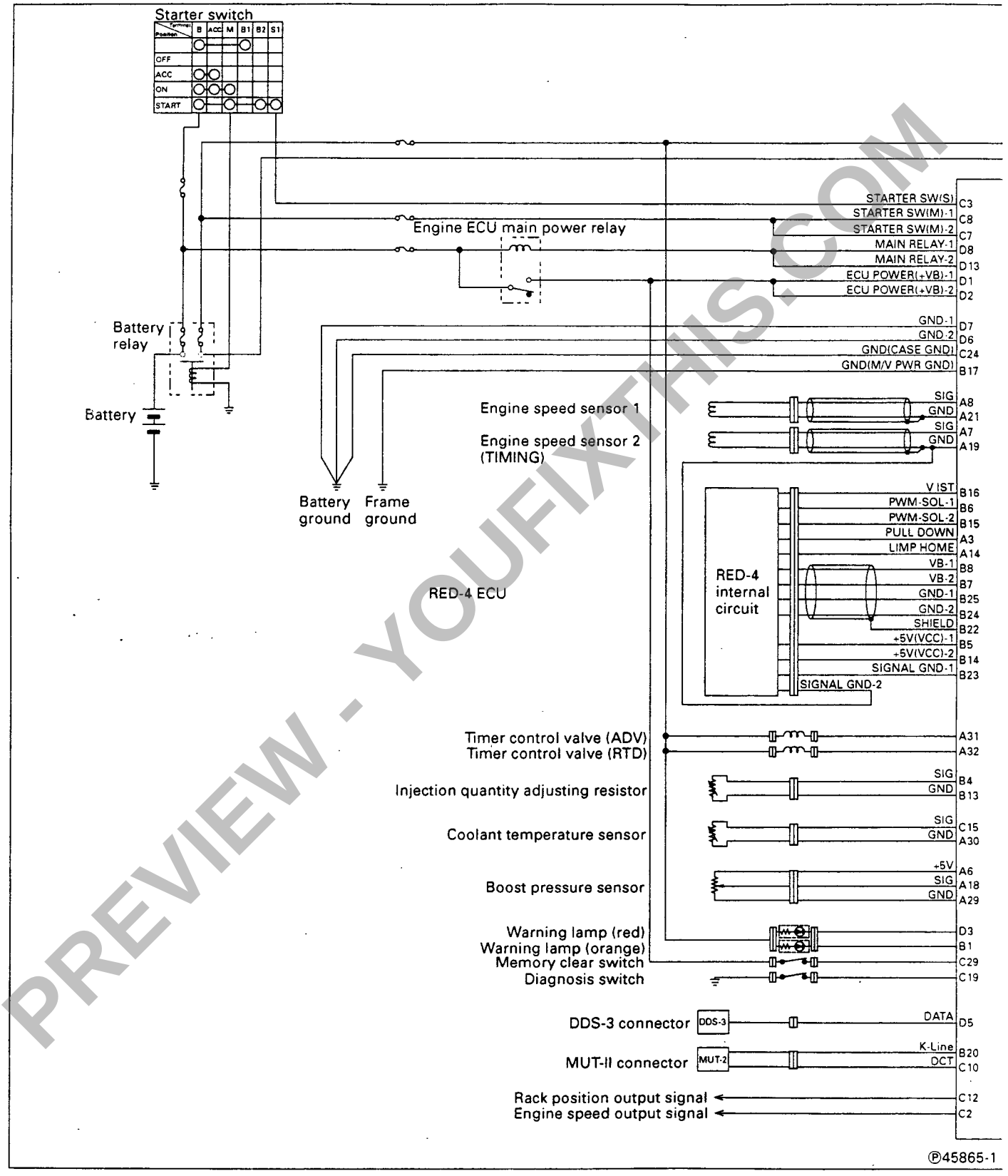


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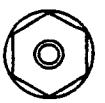
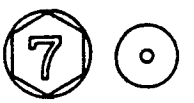
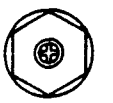
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5. GENERAL BOLTS AND NUTS TIGHTENING TORQUE TABLE

- Use specified bolts and nuts and tighten them with the applicable torques according to the following table, unless otherwise specified.
- Threads and contact seats shall be dry.
- Where there is difference in strength classification between nut and bolt (or stud bolt), the torque specified for bolt shall apply.

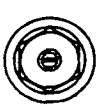
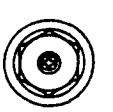
Hex-head Bolt and Stud Bolt

Unit: N·m {kgf·m}

Strength classification	4T		7T		8T	
Representation / Diameter symbol	 (Stud)		 (Stud)		 (Stud)	
M5	2 to 3 {0.2 to 0.3}	–	4 to 6 {0.4 to 0.6}	–	5 to 7 {0.5 to 0.7}	–
M6	4 to 6 {0.4 to 0.6}	–	7 to 11 {0.7 to 1.1}	–	8 to 12 {0.8 to 1.2}	–
M8	9 to 14 {0.9 to 1.4}	–	17 to 26 {1.7 to 2.6}	–	20 to 29 {2.0 to 3.0}	–
M10	19 to 28 {1.9 to 2.8}	18 to 26 {1.8 to 2.7}	36 to 52 {3.5 to 5.5}	33 to 49 {3.3 to 5.0}	45 to 60 {4.5 to 6.0}	41 to 59 {4.3 to 6.9}
M12	35 to 50 {3.4 to 5.0}	31 to 46 {3.1 to 4.7}	70 to 95 {7.0 to 9.5}	65 to 85 {6.5 to 8.5}	85 to 110 {8.5 to 11}	75 to 100 {7.5 to 10}
M14	60 to 85 {6.0 to 8.5}	55 to 75 {5.5 to 7.5}	120 to 160 {12 to 16}	110 to 140 {11 to 14}	130 to 180 {13 to 18}	120 to 160 {12 to 17}
M16	90 to 130 {9.5 to 13}	90 to 120 {9.0 to 12}	180 to 240 {18 to 24}	160 to 220 {16 to 22}	200 to 270 {20 to 27}	190 to 260 {19 to 26}
M18	140 to 190 {14 to 19}	120 to 160 {12 to 16}	260 to 340 {25 to 35}	220 to 290 {22 to 30}	290 to 390 {30 to 40}	260 to 340 {26 to 35}
M20	190 to 260 {19 to 26}	170 to 230 {17 to 23}	350 to 470 {36 to 48}	320 to 420 {32 to 43}	410 to 550 {41 to 56}	370 to 490 {37 to 50}
M22	260 to 340 {26 to 35}	230 to 300 {23 to 31}	470 to 640 {48 to 65}	430 to 570 {43 to 58}	550 to 740 {56 to 75}	490 to 670 {50 to 68}
M24	340 to 450 {34 to 46}	290 to 390 {29 to 40}	630 to 840 {63 to 86}	540 to 730 {55 to 74}	730 to 980 {74 to 100}	630 to 840 {64 to 86}

Hex-head Flange Bolt

Unit: N·m {kgf·m}

Strength classification	4T		7T		8T	
Representation / Diameter symbol						
M6	4 to 6 {0.4 to 0.6}	–	8 to 12 {0.8 to 1.2}	–	9 to 14 {0.9 to 1.4}	–
M8	10 to 15 {1.0 to 1.5}	–	19 to 28 {1.9 to 2.8}	–	22 to 32 {2.2 to 3.3}	–
M10	21 to 30 {2.1 to 3.1}	20 to 28 {1.9 to 2.9}	39 to 58 {3.9 to 6.0}	37 to 53 {3.6 to 5.4}	50 to 65 {5.0 to 6.5}	45 to 65 {4.5 to 6.5}
M12	38 to 54 {3.8 to 5.5}	35 to 51 {3.4 to 5.2}	80 to 110 {8.0 to 11}	70 to 95 {7.0 to 9.5}	90 to 120 {9.0 to 12}	85 to 110 {8.5 to 11}

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3.4 Causes of Diagnostic Trouble Code Issue, and Inspection Items

3.4.1 Diagnostic trouble codes

Multi-Use Tester II display		Page of reference
Diagnostic trouble code	Message	
07	OVER REV.	P13E-21
11	GOV. SERVO	
14	SUB NE SNSR	P13E-22
15	NE SNSR	
16	ACCEL. SNSR-2	P13E-23
17	TCV FEEDBACK	
19	AIR PRES SNSR	
21	WTR TEMP SNSR	P13E-24
22	RACK SNSR	

Multi-Use Tester II display		Page of reference
Diagnostic trouble code	Message	
23	TCV	P13E-24
24	ACCEL. SNSR-1	P13E-25
32	BST PRES SNSR	
33	ECU SYSTEM	
34	Q RESISTOR	
45	ENG. REVERSE	P13E-26
65	ACCEL SW	
78	HEATER RELAY	

3.4.2 Diagnostic trouble code issue conditions, and check items

Perform service operations with reference to the diagnostic trouble code issue conditions and probable causes shown below.

07 OVER REV.		
Code issue condition [Reset condition]	Diagnostic trouble code 07 indicates that the engine speed is too high. [The code is reset when the engine speed returns to a specified range.]	
Action taken by ECU	Governor operation is stopped.	
Probable cause and check item	Injection pump assembly's control sleeve faulty • Over-revving of engine (for example, on downhill road) • ECU faulty	Inspection of injection pump assembly (Have inspection performed by Bosch Automotive Systems service station.)

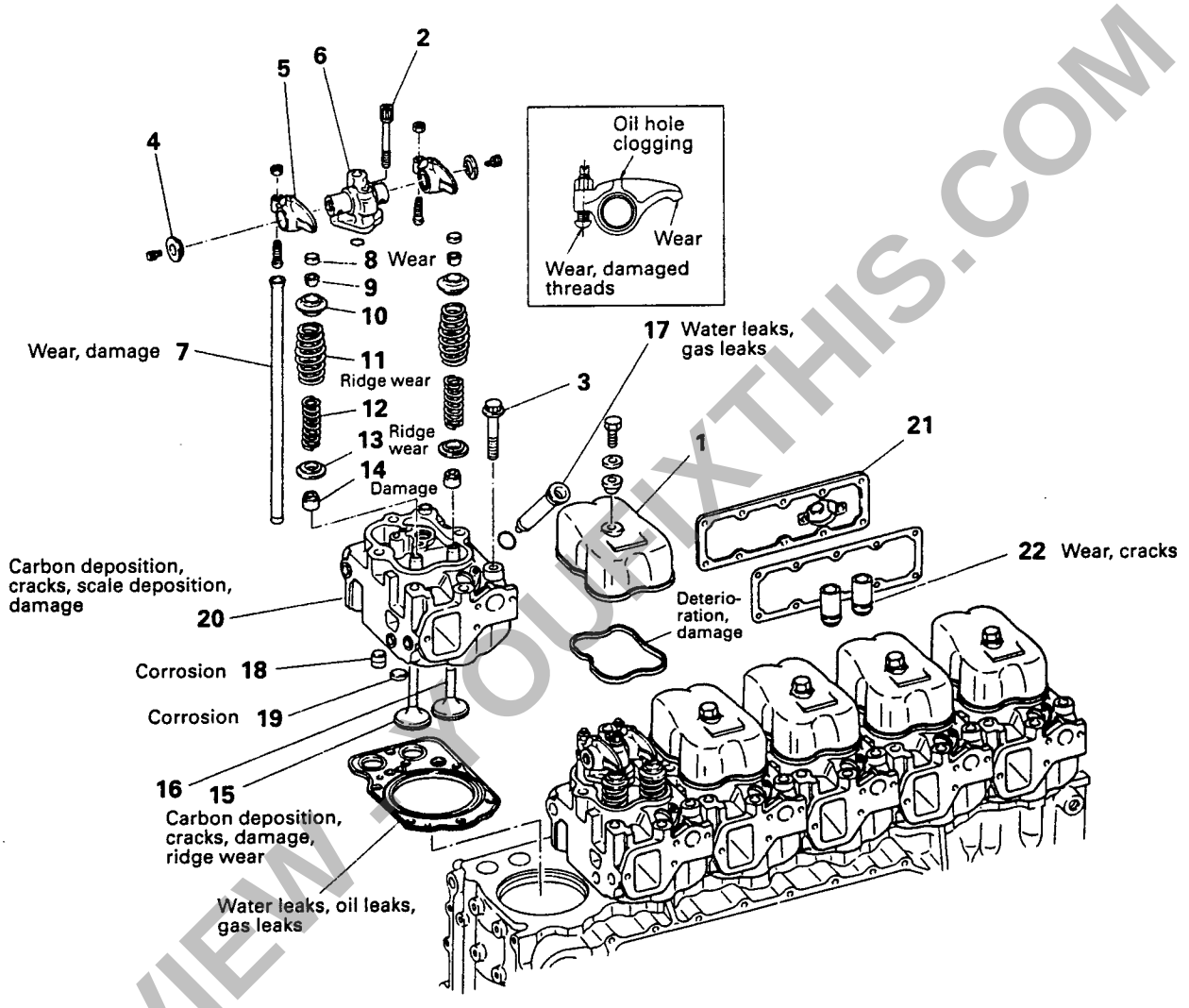
11 GOV. SERVO		
Code issue condition [Reset condition]	Diagnostic trouble code 11 indicates that the difference between the target control rack position and actual control rack position is too large. [No reset condition]	
Action taken by ECU	Governor operation is stopped.	
Probable cause and check item	• Control rack position sensor faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester II service data. P13E-27 No. 09: Measurement of target rack position No. 0A: Measurement of actual rack position • Inspection of control rack position sensor (Have inspection performed by Bosch Automotive Systems service station.)

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5.2 Cylinder Head and Valve Mechanism

5.2.1 Disassembly



Disassembly sequence

1 Rocker cover
2 Rocker shaft bracket mounting bolt
3 Cylinder head bolt
4 Thrust plate
5 Rocker
⑥ Rocker shaft bracket
7 Push rod
8 Valve cap
⑨ Valve cotter
10 Upper retainer
11 Outer valve spring
12 Inner valve spring
13 Lower retainer
*1 14 Valve stem seal
15 Inlet valve
16 Exhaust valve
*2 ⑰ Nozzle tube
*2 18 Water director
*2 19 Sealing cap
⑳ Cylinder head
21 Crankcase side cover
22 Tappet

For parts with circled numbers, refer to the following section, "Disassembly Procedure."
Parts marked with "*1" should be replaced and not reused, even if only the valve is removed.
Parts marked with "*2" should not be removed unless defects are evident.

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6. TROUBLESHOOTING

Symptom	Probable cause	Remedy	Reference
Engine will not start	Incorrect oil viscosity	Replace	Group 12
	Incorrect/defective fuel		Group 13A
	Low compression pressure • Incorrect valve clearance(s)	Adjust	
	• Defective cylinder head gasket	Replace	
	• Worn valve and valve seat/carbon deposits		
	• Weakened valve spring		
	• Worn/damaged piston ring(s)		
	• Worn/damaged piston ring groove(s)		
	• Worn piston(s)/cylinder liner(s)	Change to oversize	
	Defective preheater • Defective starter switch	Repair or replace	Group 16
	• Defective heater relay		
	Incorrect injection timing	Adjust	Group 13A
	Insufficient fuel injection volume • Defective injection pump	Repair or replace	Group 13A, E
	• Incorrect fuel injection volume		
	Defective cooling system	Repair or replace	Group 14
Rough idling	Incorrect oil viscosity	Replace	Group 12
	Incorrect/defective fuel		Group 13A
	Defective cooling system	Repair or replace	Group 14
	Low compression pressure (see "Engine will not start")		
	Incorrect injection timing	Adjust	Group 13A
	Defective fuel system • Defective injection pump	Repair or replace	Group 13A, E
	• Defective injection nozzle		
	• Air trapped in fuel system		
Abnormal exhaust gas color	Incorrect/defective fuel	Replace	Group 13A
	Cooling system malfunctioning	Repair or replace	Group 14
	Intake/exhaust system malfunctioning • Clogged air cleaner	Repair or replace	Group 15
	• Clogged muffler		
	• Oil leaking into intake/exhaust pipes		
	Low compression pressure (see "Engine will not start")		
	Defective fuel system • Malfunctioning injection pump	Repair or replace	Group 13A, E
	• Defective injection nozzle		
	Incorrect injection timing	Adjust	
	Excessive engine oil	Adjust	Group 12
	Seizure of major moving parts	Repair or replace	

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2. MAJOR SPECIFICATIONS

2.1 Major Specifications

Item \ Engine model	6D24	6D24-T	6D24-TC	6D24-TL
Type	Diesel, 4-cycle, water-cooled			
Combustion method	Direct injection			
No. and arrangement of cylinder	6, in-line			
Cylinder bore x stroke mm	130 x 150			
Total displacement cm^3	11945			
Engine dimension (with fan)				
Overall length mm	1473	1473	1473	1473
Overall width mm	866	881	881	869
Overall height mm	1058	1169	1209	1246
Empty weight kg*	905	930	960	940

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

2.2 Engine Outputs Classified by Application

Application \ Engine speed rpm \ Engine model		6D24	6D24-T Turbocharged	6D24-TC Turbocharged with Aftercooler
Intermittent rated output kW (PS)	1500	114 {115}	163 {222}	182 {247}
	1800	136 {185}	191 {260}	207 {282}
	2000	144 {196}	201 {273}	217 {295}
	2200	151 {205}	206 {280}	228 {310}
Continuous rated output kW (PS)	1500	104 {141}	148 {202}	165 {224}
	1800	124 {168}	174 {236}	188 {256}
	2000	131 {178}	182 {248}	197 {268}
	2200	137 {186}	187 {255}	207 {282}

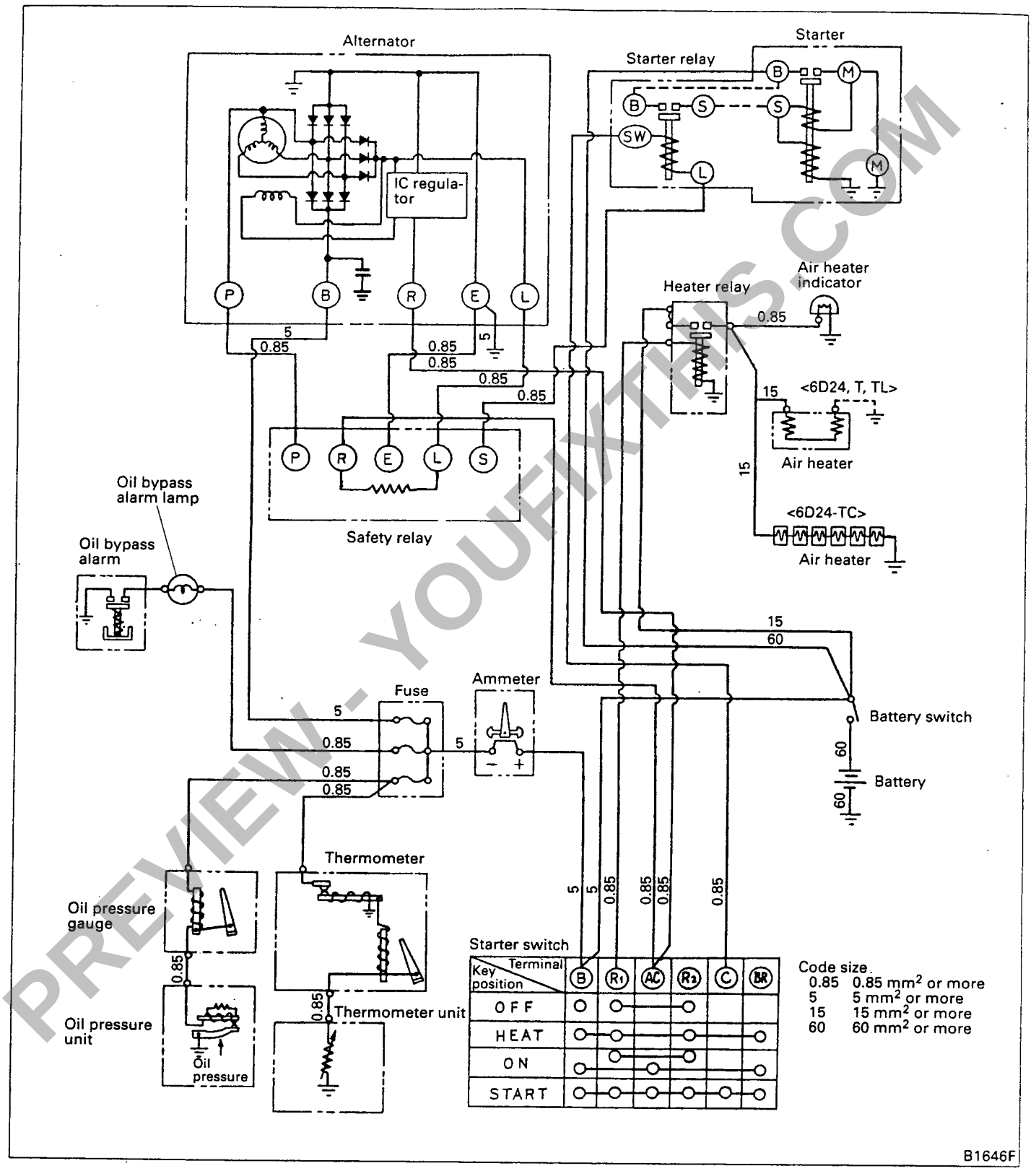
NOTE:

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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1. GENERAL



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Unit: mm

Maintenance item		Nominal value (Basic diameter in [ ])	Limit	Remedy and remarks
Crankshaft pin and journal	Roundness	0.01 or less	0.08	Correct
	Cylindricity	0.006 or less	–	
Crankshaft bend		0.04 or less	0.1	Correct or replace
Valve clearance (when cold)	Inlet	0.4	–	Adjust
	Exhaust	0.6	–	

3.2 Tightening Torque Table

Location tightened	*Screw size O. D. x pitch (mm)*	*Tightening torque N·m {kgf·m}*	*Remarks*
Cylinder head bolt	M14 x 2	–	Wet. See item (6) of section 5.2.3 for tightening procedure.
Rocker shaft bracket mounting bolt	M10 x 1.5	59 {6}	
Rocker cover bolt	M8 x 1.25	4.9 {0.5}	
Rocker adjusting screw lock nut	M10 x 1.25	59 {6}	
Flywheel mounting bolt	M16 x 1.5	315 {32}	Wet
Idler shaft bolt A	M16 x 2	155 {16}	
Idler shaft bolt C	M16 x 2	155 {16}	
Idler shaft nut (for mounting collar)	M16 x 1.5	98 {10}	
Flywheel housing bolt	M12 x 1.75	69 {7}	
Oil jet check valve	M12 x 1.75	34 {3.5}	Cannot be reused
Connecting rod cap nut	M13 x 1.25	115 {12}	Wet
Main bearing cap bolt	M18 x 2.5	–	Wet. See item (7) of section 5.4.3 for tightening procedure.
Crankshaft pulley mounting bolt	M14 x 1.5	175 {18}	
Front cover mounting bolt	M12 x 1.75	33 {3.4}	

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14 SUB NE SNSR (injection pump side)		
Code issue condition [Reset condition]	Diagnostic trouble code 14 indicates that the number of pulses from engine speed sensor 2 (on the injection pump) is smaller than the number of pulses from engine speed sensor 1 (on the flywheel housing). [The code is reset when engine speed sensor 1 is normal and the number of pulses from engine speed sensor 2 returns to normal].	
Action taken by ECU	• Normal control is effected using only engine speed sensor 1. • If engine speed sensor 1 is also faulty, governor operation is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and engine speed sensor 2 • Engine speed sensor 2 faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester II service data. 📖 P13E-27 No. 02: Measurement of engine speed • Inspection using ECU connector 📖 P13E-29 01 : Measurement of resistance of engine speed sensor 2 • Inspection of engine speed sensor 2 📖 P13E-32: Inspection of Electrical Equipment 263 • Check of circuit between ECU and engine speed sensor 2

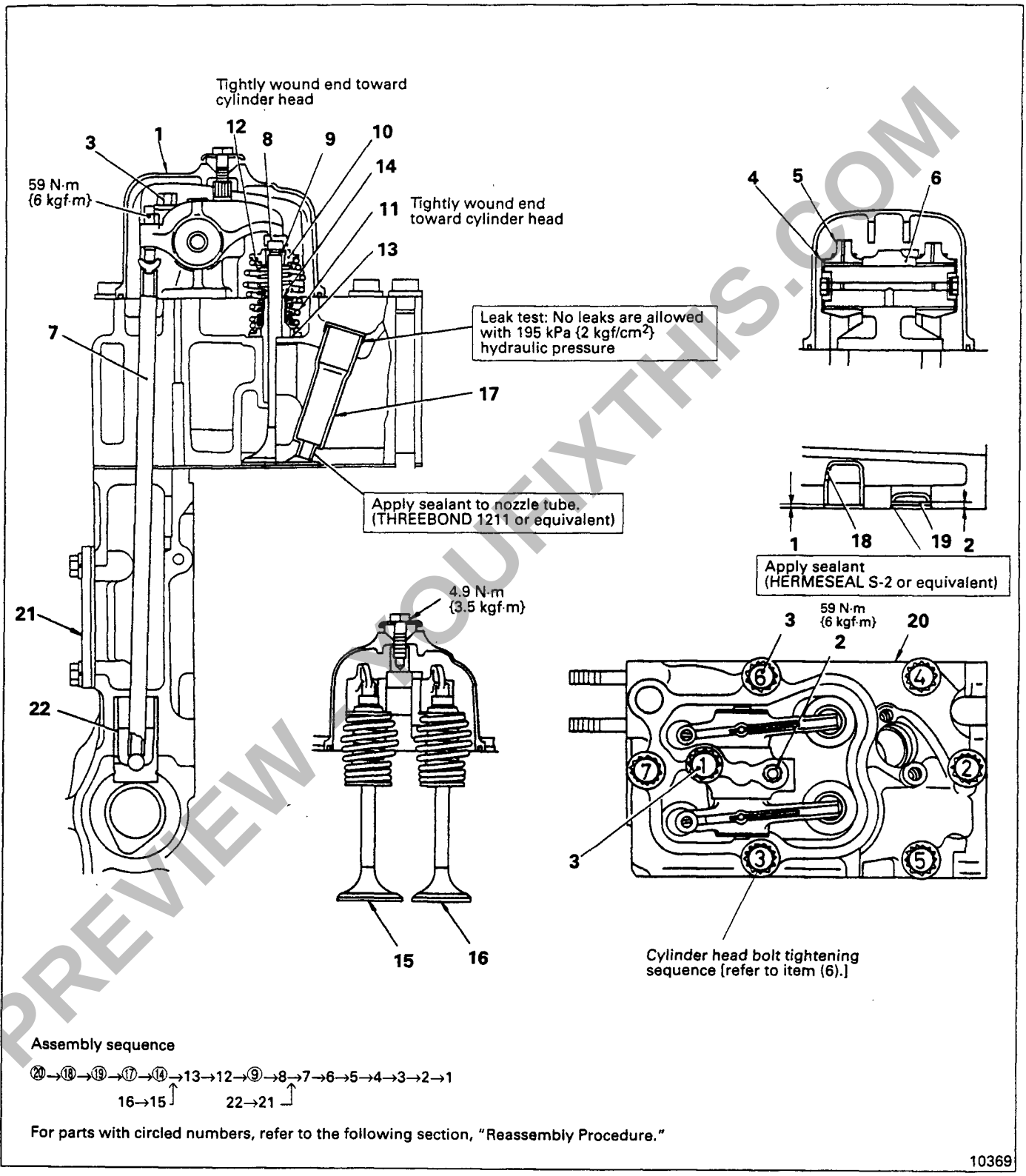
14 SUB NE SNSR (injection pump side) **15 NE SNSR** (flywheel housing side)		
Code issue condition [Reset condition]	Diagnostic trouble codes 14 and 15 are both issued if engine speed sensor 1 (on the flywheel housing) and engine speed sensor 2 (on the injection pump) fail at the same time. [The code is reset when pulses are applied from engine speed sensor 1 or engine speed sensor 2 following engine startup.]	
Action taken by ECU	Fuel injection timing control is stopped, and governor operation is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and engine speed sensors 1 and 2 • Engine speed sensors 1 and 2 faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester II service data. 📖 P13E-27 No. 02: Measurement of engine speed • Inspection using ECU connector 📖 P13E-29 01 : Measurement of resistance of engine speed sensor 2 02 : Measurement of resistance of engine speed sensor 1 • Inspection of engine speed sensors 1 and 2 📖 P13E-32: Inspection of Electrical Equipment 263 • Check of circuit between ECU and engine speed sensors 1 and 2

15 NE SNSR (flywheel housing side)		
Code issue condition [Reset condition]	Diagnostic trouble code 15 indicates that the number of pulses from engine speed sensor 1 (on the flywheel housing) is smaller than the number of pulses from engine speed sensor 2 (on the injection pump). [The code is reset when engine speed sensor 2 is normal and the number of pulses from engine speed sensor 1 returns to normal.]	
Action taken by ECU	• Normal control is effected using only engine speed sensor 2. • If engine speed sensor 2 is also faulty, governor operation is stopped.	
Probable cause and check item	• Open circuit or short circuit in harness between ECU and engine speed sensor 1 • Engine speed sensor 1 faulty • ECU faulty	• Perform checks on basis of Multi-Use Tester II service data. 📖 P13E-27 No. 02: Measurement of engine speed • Inspection using ECU connector 📖 P13E-29 02 : Measurement of resistance of engine speed sensor 1 • Inspection of engine speed sensor 1 📖 P13E-32 Inspection of Electrical Equipment 263 • Check of circuit between ECU and engine speed sensor 1

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5.2.3 Reassembly



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5. TROUBLESHOOTING

Symptom	Probable cause	Remedy	Ref. group
Overheating	Abnormal oil level • Oil leaks into coolant	Correct and fill to specified level	
	• Oil leaks		
	Incorrect oil viscosity • Oil out of life	Replace	
	• Fuel in oil	Change oil after repair of faulty parts	
Oil pressure does not increase	Oil pressure switch not functioning properly	Replace	
	Loaded oil filter element	Replace element	
	Loaded oil strainer, loose oil pump joint, cracked pipe	Correct or replace	
	Relief valve, bypass valve not functioning properly		
	Worn or damaged oil pump proper	Replace	
Excessive oil consumption	Oil leaks from engine	Correct or replace	Group 11
	Oil leaks from crankshaft front or rear oil seal	Correct or replace	
	Leaks to cooling system • Defective oil cooler water jacket	Correct or replace	
	Abnormal compression pressure	Check	Group 11

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2. SPECIFICATIONS

Item	Specification			
Engine model	6D24	6D24-T	6D24-TC	6D24-TL
Type	6-cylinder, in-line, water-cooled, 4-cycle diesel	←	←	←
Combustion chamber type	Direct injection	←	←	←
Valve mechanism	Overhead valve	←	←	←
Cylinder bore x stroke (mm)	130 x 150	←	←	←
Total displacement (cm^3)	11945	←	←	←
Compression ratio	19.5	16.5	←	17.5
Fuel injection sequence	1-5-3-6-2-4	←	←	←
Cylinder liner type	Wet	←	←	←
Piston type	Trunk-type slipper skirt	← (with cooling cavity)	←	←
No. of piston rings	Compression ring: 2 Oil ring: 1	←	←	←

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6D2

diesel engine

Shop Manual

FOREWORD

This shop manual contains the specification, construction, operation, adjustment and service procedures of the Model 6D2 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.

FEBRUARY 2001

Applicable Engine Models

6D24
6D24-T
6D24-TC
6D24-TL

GROUP INDEX

GENERAL 00
ENGINE 11
LUBRICATION 12
FUEL AND ENGINE CONTROL 13A
ELECTRONICALLY CONTROLLED FUEL SYSTEM 13E
COOLING 14
INTAKE AND EXHAUST 15
ENGINE ELECTRICAL 16
CLUTCH 21
SPECIAL EQUIPMENT 61

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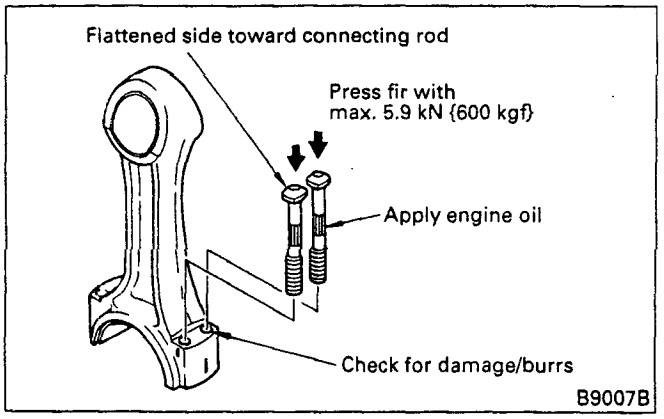
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2. UNITS 5
3. READING THE ILLUSTRATION 6

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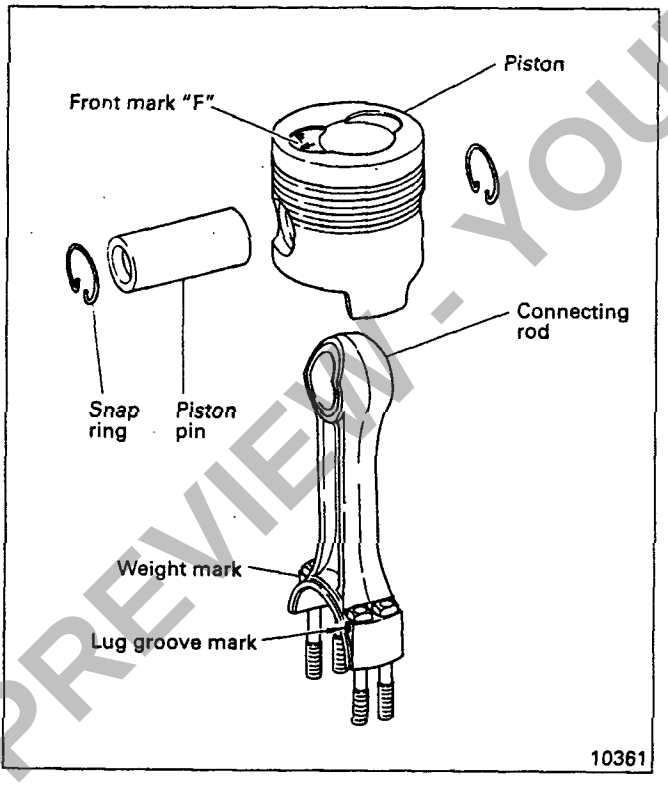
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(8) Installing connecting rod bolts



Check that there are no burrs or damage in the connecting rod's bolt holes. Apply engine oil to the connecting rod bolts, then press fit the bolts such that the flattened side of their heads face inward.

(9) Reassembling piston and connecting rod



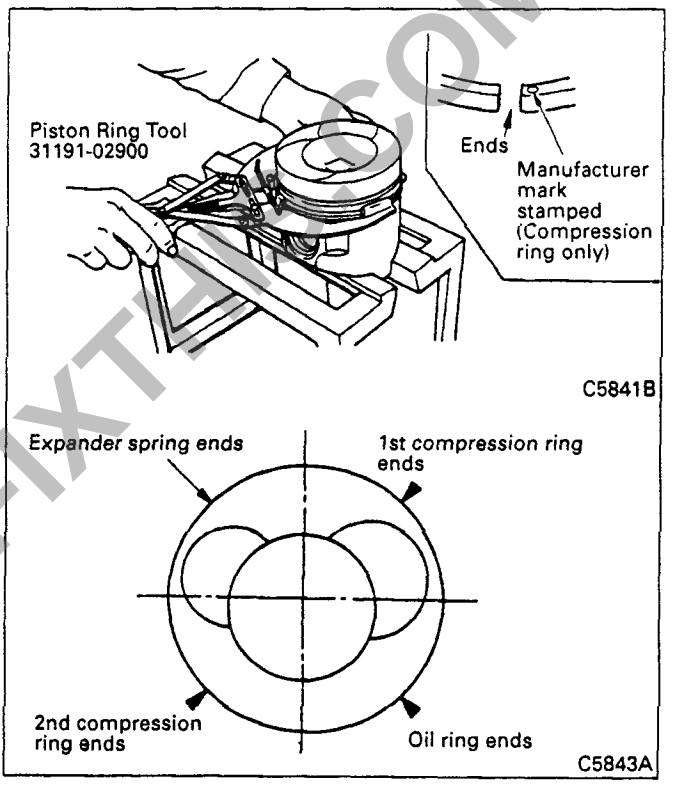
Connect the piston to the connecting rod with the piston pin such that the piston's front mark "F" is on the same side as the connecting rod's lug groove mark. If the piston pin is difficult to insert, heat the piston in hot water or with a piston heater.

NOTE:
All the connecting rods in an engine must have the same weight mark. Weight marks are as follows:

Heavy ⟵⟶ ***Light***

A B C D E F G H J K

(10) Fitting piston rings



Using the Piston Ring Tool (special tool), fit the piston rings in the positions shown in the illustration. Ensure that the manufacturer's marks on the compression rings face upward. Fit the rings in the following order:

1. Oil ring
2. 2nd compression ring
3. 1st compression ring

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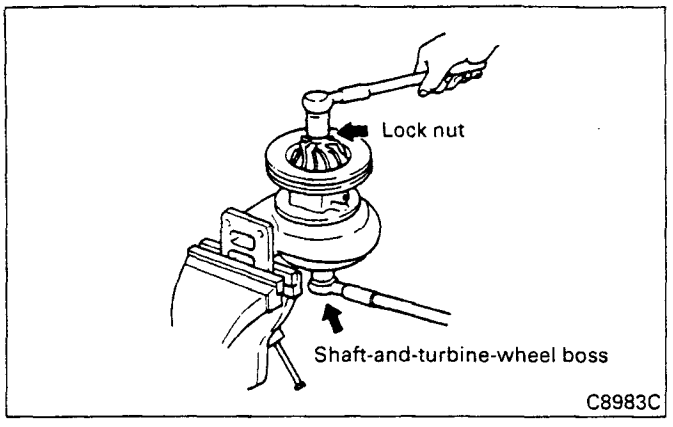
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6. TROUBLESHOOTING

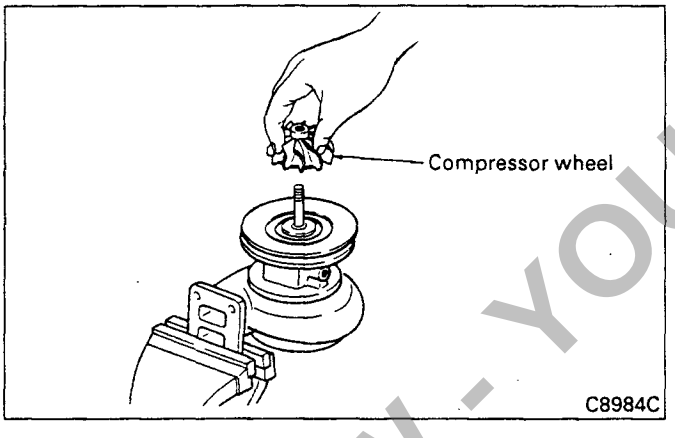
Symptom	Probable cause	Remedy	Ref. group
Engine will not start	Defective feed pump • Loaded gauze filter	Clean	
	• Check valve inoperative	Replace	
	• Seized or worn piston	Replace	
	• Seized push rod	Replace	
	• Worn tappet	Replace	
	Defective injection pump • Defective pump	Replace	
	• Incorrect installation (incorrect adjustment of injection timing)	Adjust	
	• Malfunctioning overflow valve	Replace	
	Defective injection nozzle • Seized needle valve	Replace	
	• Valve opening pressure too low	Adjust	
	• Clogged injection orifice	Clean	
	• Nozzle not air-tight	Correct or replace	
	Fuel tank empty	Supply fuel	
	Clogged fuel pipe or fuel leaks from connection	Correct or replace	
	Air or water trapped in fuel system	Bleed or replace	
	Loaded fuel filter	Replace	
	Open circuit, short circuit, or poor connection in engine speed sensor or backup engine speed sensor	Replace	
	Defective main relay or blown fuse	Replace	
Engine starts but soon stops	Clogged fuel filter	Correct or replace	
	Air or water trapped in fuel system	Bleed or replace	
	Defective feed pump	Check	
	Defective injection pump operation • Defective pump	Replace	
	• Defective governor	Replace	
	• Clogged gauze filter	Clean	
Engine knocks	Injection timing too advanced	Adjust	
	Defective injection nozzle • Valve opening pressure too high	Adjust	
	• Clogged injection orifice	Clean	
	• Nozzle not air-tight	Correct or replace	
	Low quality fuel in use	Replace	
	Defective injection pump operation • Defective pump	Replace	
	• Defective governor	Replace	
	• Defective prestroke actuator	Replace	
	Poor connection in injection quantity adjusting resistor	Replace	
	Poor contact in idle speed adjustment variable resistor	Replace	

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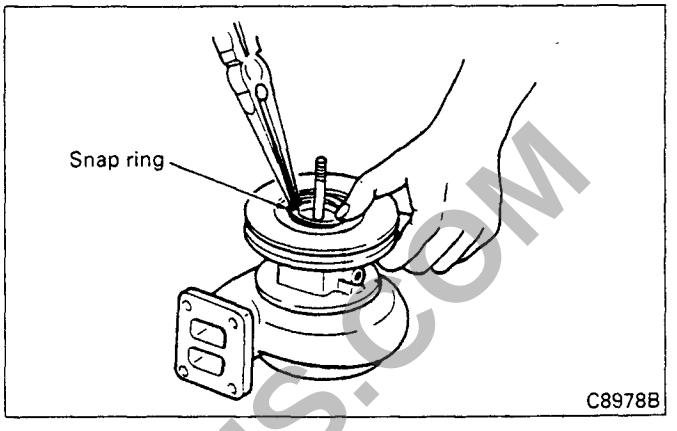


(b) While holding the shaft-and-turbine-wheel boss, remove the lock nut that secures the compressor wheel.



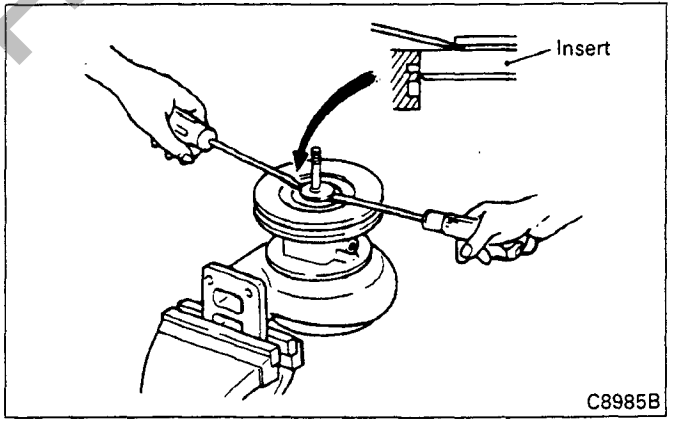
(c) Slowly slide off the compressor wheel upward.

(5) Removal of insert



(a) Snap off the snap ring that secures the insert onto the bearing housing.

NOTE:
Retain the snap ring by hand to prevent it from springing out when slipping off the snap ring pliers.

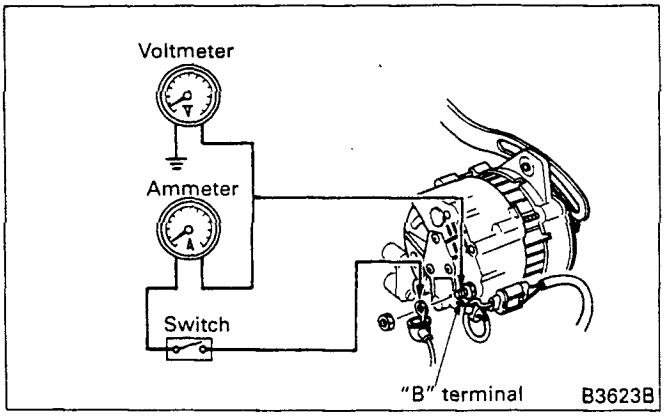


(b) Fit the tip of a screwdriver into the portion of the insert shown and carefully remove it from the bearing housing.

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(b) On-vehicle inspection

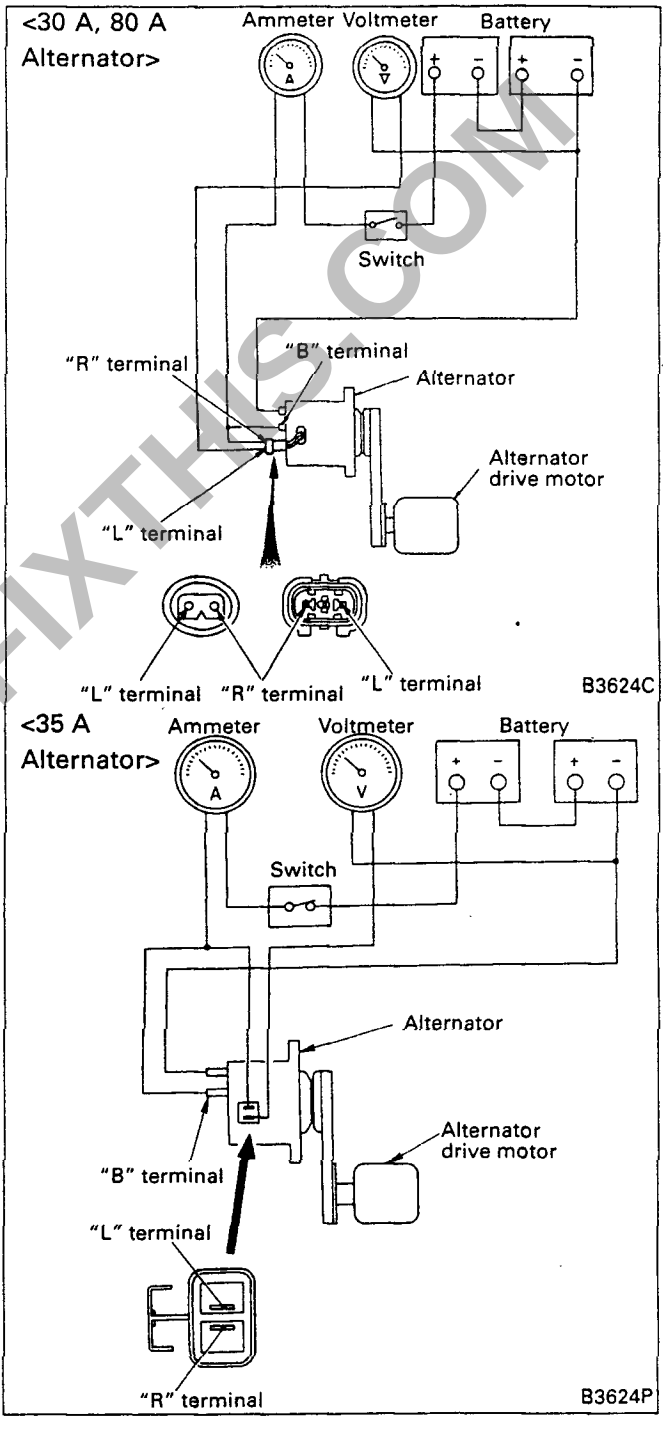


- Provide a switch between the battery and alternator "B" terminal. With the switch turned off, connect an ammeter (with 60 A full-scale to the 30 A alternator and 100 A full-scale to the 35 A, 80 A alternator) and voltmeter.
- Turn on the switch and make sure that the voltmeter indicates the battery voltage.
- Start up the engine and immediately turn on all lamp switches. Then, increase the engine speed and read the maximum current value when the alternator speed reaches 5000 rpm.
- If the current reading is 70% or more of the nominal output, the alternator may be regarded as in good condition.

NOTE:
The on-vehicle test is an easier way of inspection; the test bench inspection is necessary for more accurate results.

(3) Inspection of regulator

(a) Test bench inspection



Inspect the regulator regulated voltage as follows using the circuit shown above.

- Use a fully-charged battery. Turn on the switch.
- Gradually increase the alternator speed up to 5000 rpm. Check that the current value at this speed is 5 A or less.

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