
THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
6A	Engine Mechanical
6A3	Engine (4HF1/4HF1-2/4HE1-T/4HE1-TC/4HG1/4HG1-T)
6B	Engine Cooling
6C	Fuel System
6D	Engine Electrical
6E	Emission and Electrical Diagnosis
6F	Exhaust
6G	Turbocharger

1. HARD STARTING

1. STARTER MOTOR INOPERATIVE		
Checkpoint	Possible cause	Correction
Battery	Loose battery cable terminal Poor connections due to rusting	Clean and/or retighten the battery cable terminal
	Battery discharged or weak	Recharge or replace the battery
	Fan belt loose or broken	Adjust or replace the fan belt
Fusible link	Fusible link shorted	Replace the fusible link
Starter switch	Defective starter switch or starter relay	Replace the starter switch or the starter relay
Starter motor	Defective magnetic switch or starter relay	Repair or replace the magnetic switch
	Defective starter motor	Repair or replace the starter motor
2. STARTER MOTOR OPERATES BUT ENGINE DOES NOT TURN OVER		
Battery	Loose battery cable terminal Poor connections due to rusting	Clean and/or retighten the battery cable terminal
	Battery discharged or weak	Recharge or replace the battery
	Fan belt loose or broken	Adjust or replace the fan belt
Starter motor	Defective pinion gear	Replace the pinion gear
	Defective magnetic switch	Repair or replace the magnetic switch
	Brush wear, Weak brush spring	Replace the brush and/or the brush spring
Engine	Piston, crank bearing seizure, or other damage	Repair or replace the related parts

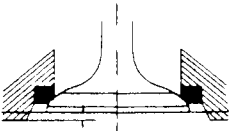

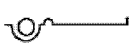
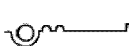

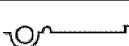
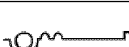

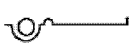
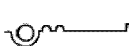

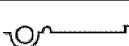
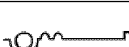

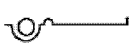
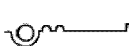

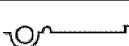
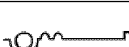
SERVICE STANDARD

Item	Service Standard	Service Limit
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ENGINE

Compression Pressure KPa (kg / cm ² / psi) / rpm	3040 (31 / 441) or more Variance in pressure between the cylinders: less than 294 (3 / 43) / 200	2,157 (22 / 312)
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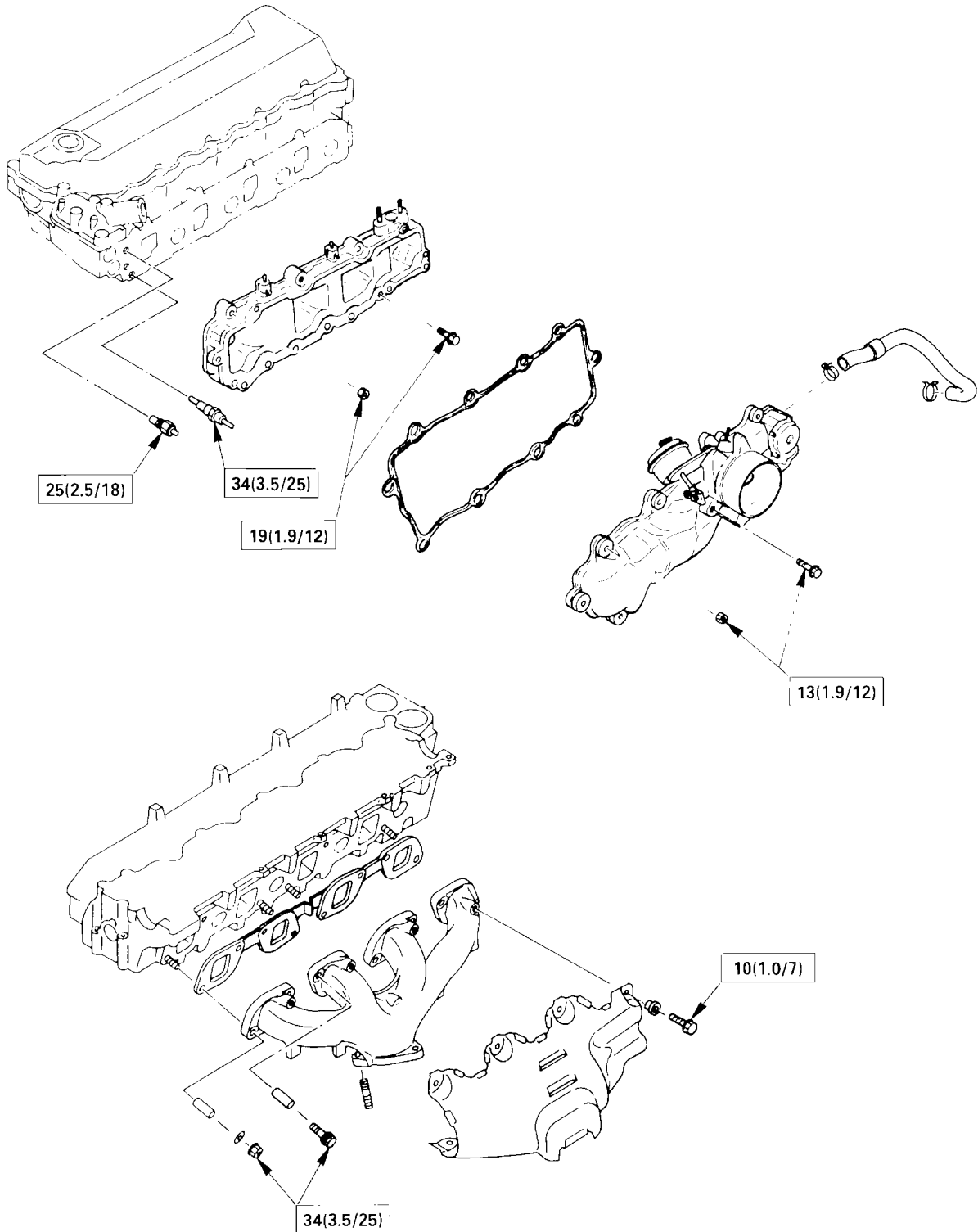
CYLINDER HEAD

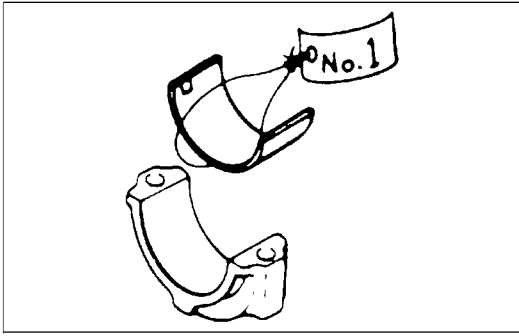
Inlet and Exhaust Valve Seat Depression mm (in) 	0.7 - 1.2 (0.028 - 0.047) Measurement should be taken by using a new valve.	2.5 (0.098)																																																
Cylinder Head Lower Face Warpage mm (in)	0.05 (0.002) or less Do not regrind the cylinder head lower face.	0.2 (0.008)																																																
Manifold Fitting Face Warpage mm (in)	0.05 (0.002) or less	0.2 (0.008)																																																
Water Leak Test kPa (kg / cm ² / psi)	490 (5 / 71) - 3 minutes	Repair or replace those having water leak.																																																
Cylinder Head Gasket Selection mm (in) Remarks: The grade mark of the cylinder head gasket is shown by semicircular notches on the left side of the front portion of the gasket.	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: left;">4HF1/4HF1-2/4HG1-T</th> </tr> <tr> <th colspan="3"></th> <th style="text-align: right;">mm (in)</th> </tr> <tr> <th colspan="2" style="text-align: center;">Gasket Grade</th> <th style="text-align: center;">Ti max</th> <th style="text-align: center;">Gasket Thickness (Reference)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;"></td> <td style="text-align: center;">0.579 - 0.659 (0.0228 - 0.0259)</td> <td style="text-align: center;">1.70 (0.0669)</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;"></td> <td style="text-align: center;">0.659 - 0.739 (0.0259 - 0.0291)</td> <td style="text-align: center;">1.75 (0.0689)</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;"></td> <td style="text-align: center;">0.739 - 0.819 (0.0291 - 0.0322)</td> <td style="text-align: center;">1.80 (0.0708)</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: left;">4HE1-T/4HE1-TC</th> </tr> <tr> <th colspan="3"></th> <th style="text-align: right;">mm (in)</th> </tr> <tr> <th colspan="2" style="text-align: center;">Gasket Grade</th> <th style="text-align: center;">Ti max</th> <th style="text-align: center;">Gasket Thickness (Reference)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;"></td> <td style="text-align: center;">0.529 - 0.609 (0.0208 - 0.0240)</td> <td style="text-align: center;">1.70 (0.0669)</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;"></td> <td style="text-align: center;">0.609 - 0.679 (0.0240 - 0.0267)</td> <td style="text-align: center;">1.75 (0.0689)</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;"></td> <td style="text-align: center;">0.679 - 0.759 (0.0267 - 0.0300)</td> <td style="text-align: center;">1.80 (0.0708)</td> </tr> </tbody> </table>		4HF1/4HF1-2/4HG1-T							mm (in)	Gasket Grade		Ti max	Gasket Thickness (Reference)	A		0.579 - 0.659 (0.0228 - 0.0259)	1.70 (0.0669)	B		0.659 - 0.739 (0.0259 - 0.0291)	1.75 (0.0689)	C		0.739 - 0.819 (0.0291 - 0.0322)	1.80 (0.0708)	4HE1-T/4HE1-TC							mm (in)	Gasket Grade		Ti max	Gasket Thickness (Reference)	A		0.529 - 0.609 (0.0208 - 0.0240)	1.70 (0.0669)	B		0.609 - 0.679 (0.0240 - 0.0267)	1.75 (0.0689)	C		0.679 - 0.759 (0.0267 - 0.0300)	1.80 (0.0708)
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INLET COVER AND EXHAUST MANIFOLD

N•m (kg•m/lb•ft)

4HF1 / 4HG1 Engine



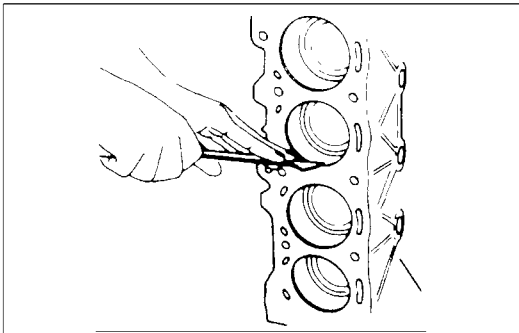


6A33-1.tif

35. Connecting Rod Cap

36. Connecting Rod Lower Bearing

- 1) Take out the connecting rod bearing cap bolts and remove the bearing cap with the lower bearing.
- 2) If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A33-2.tif

37. Piston and Connecting Rod Assembly

- 1) To facilitate smooth removal of piston, remove carbon from the upper part of the cylinder wall using a scraper or equivalent.
- 2) Remove the piston and connecting rod assembly upward by pushing on the edge of the connecting rod with a hammer handle or equivalent.
- 3) If the connecting rod bearing are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

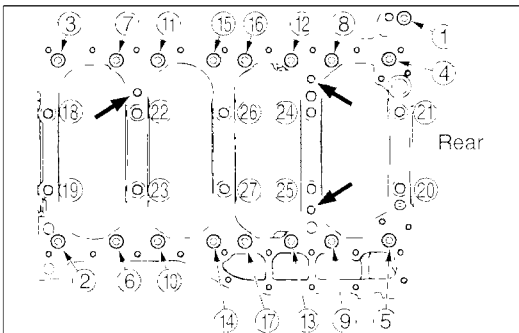


CAUTION:

Do not bend or damage the oiling jet.

NOTE:

When removing the piston and connecting rod assembly, pull the connecting rod in parallel with the cylinder bore.



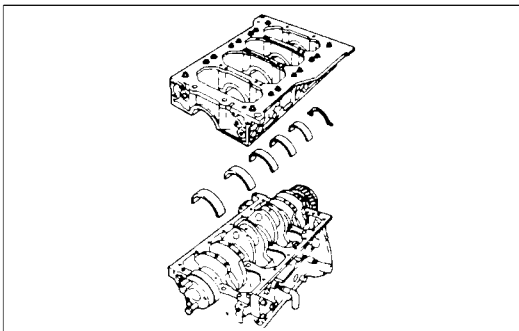
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38. Crankcase

- 1) Loosen the crankcase bolts in numerical order a little at a time.
- 2) Install the three crankcase fixing bolts (See left arrow marks) to the crankcase replacer holes as shown in the illustration, and tighten the bolts alternate a little at a time.

NOTE:

When removing the crankcase, be sure to remove the oil pump and the generator bracket before that.



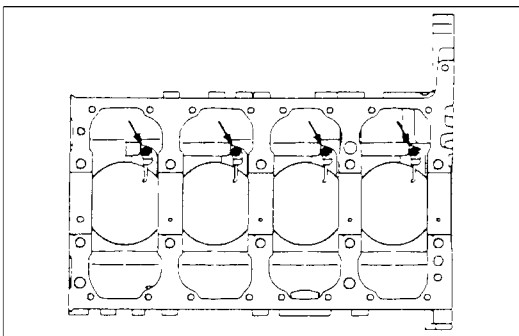
6A33-4.tif

39. Thrust Bearing Lower

40. Crankshaft Bearing Lower

- 34. Water Pump Pulley
- 35. Water Pump
- 36. Front Retainer
- 37. Oil Thermo Valve
- 38. Power Steering Pump Idle Gear Cover
- 39. Power Steering Pump Idle Gear
- 40. Flywheel Housing
- 41. Idle Gear A
- 42. Idle Gear B
- 43. Idle Gear B Shaft
- 44. Oil Pump Assembly
- 45. Connecting Rod Cap
- 46. Connecting Rod Lower Bearing
- 47. Piston and Connecting Rod Assembly
- 48. Crankcase
- 49. Thrust Bearing Lower
- 50. Crankshaft Bearing Lower
- 51. Crankshaft Assembly
- 52. Thrust Bearing Upper
- 53. Crankshaft Bearing Upper

Above works refer to "CRANKSHAFT" section in this manual.



6A66-1.tif

54. Oiling Jet

Loosen the check valves to remove both the check valves and the oiling jets.

Take care not to bend or damage the oiling jets.

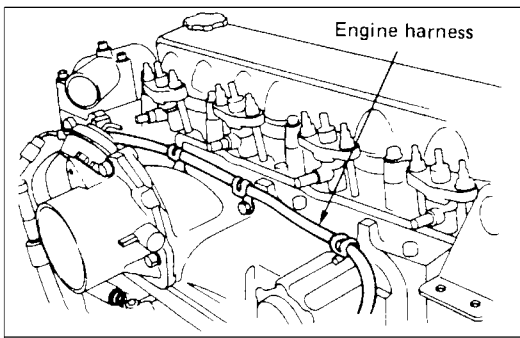
55. Cylinder Block

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

- 1) Remove the gasket and any other material adhering to the upper surface of the cylinder block.
Be very careful not to allow any material to accidentally drop into the cylinder block.
Be very careful not to scratch the cylinder block.
- 2) Carefully remove the oil pump, Rear Oil Seal, and oil pan installation surface seal.
- 3) Wipe the cylinder block clean.

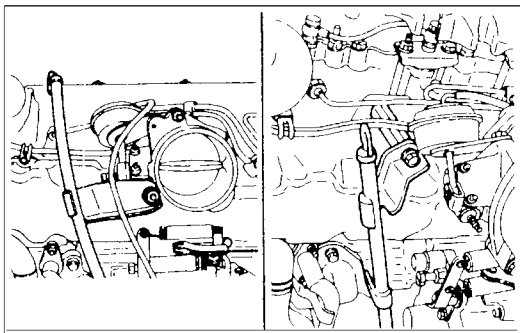




6A3-16-1.tif

8. Engine Harness

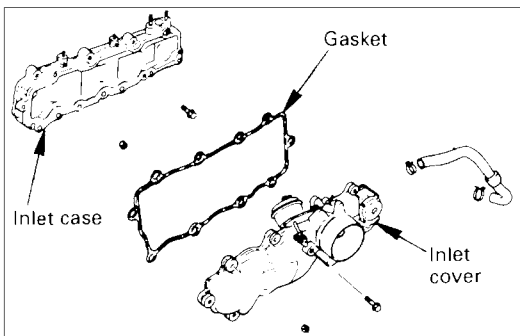
Disconnect thermometer unit, thermo switch, tachometer sensor and glow plug harness connectors and separate harness from clips.



6A3-16-2.tif

9. Oil Level Gauge Guide Tube

Remove the guide tube fixing bolt and pull out the guide tube.



6A3-16-3.tif

10. Inlet Cover

11. Inlet Case

Remove the inlet case while removing the liquid gasket.

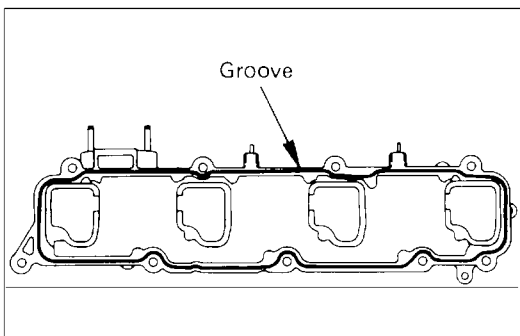
↔ INSTALLATION

11. Inlet Case



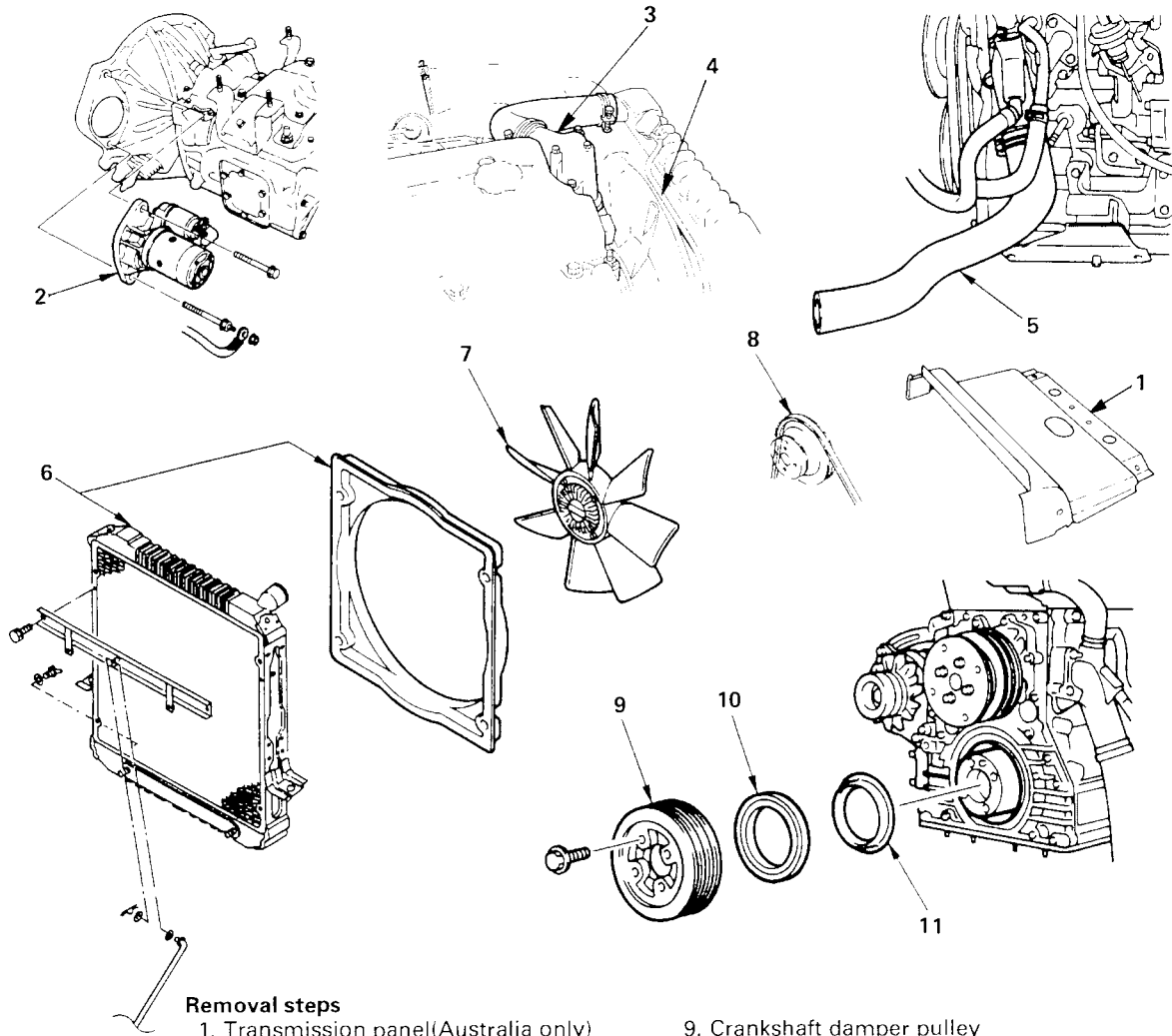
- 1) Apply 2 mm-3 mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the inlet case fitting surfaces shown in the illustration.
 - Clean the inlet case fitting surface of the cylinder head.
- 2) Install the inlet case to the cylinder head.
 - Install the inlet case within 7 minutes after application of liquid gasket.
- 3) Tighten the inlet case to the specified torque.

Inlet Case Nuts and Bolts Torque N•m (kg•m/lb•ft)



6A3-16-4.tif

CRANKSHAFT FRONT OIL SEAL



Removal steps

1. Transmission panel(Australia only)
2. Starter
3. Radiator upper hose
4. Coolant reserve tank hose/Bypass hose
5. Radiator lower hose
6. Radiator (with guide)
7. Fan assembly
8. Fan belt

9. Crankshaft damper pulley
10. Crankshaft front oil seal
11. Crankshaft front slinger

Installation steps

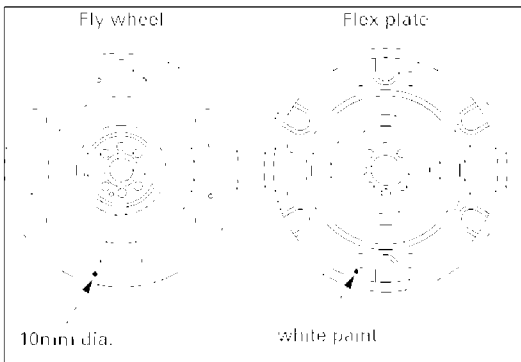
To install, follow the removal steps in the reverse order.

↔ REMOVAL

Preparation

- Disconnect battery ground cable.
- Tilt the cab.
- Drain coolant

**1. Transmission Panel
(M/T model only)**



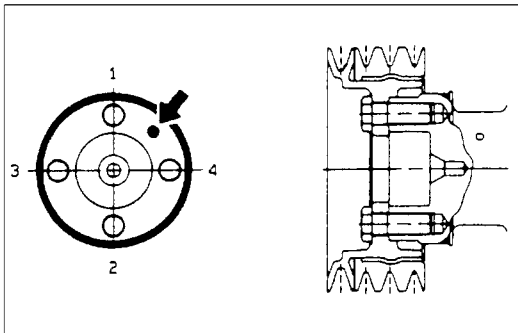
For A/T model

1. Align the knock pin on the crankshaft to install the flywheel.
2. Install the flexible plate with alignment mark (10 mm diameter dent on the flywheel and 10 mm diameter white paint on the flexible plate) and washer.
3. Apply molybdenum disulfide grease to the bolt thread and seat to install the flywheel fixing hole.
Tighten bolt to two stage tightening method in the numerical order.
1st step; 78 N•m (58 lbft)
2nd step; 90 - 120 degrees.

37. Crankshaft Front Slinger

36. Crankshaft Front Oil Seal

Above works refer to "CRANKSHAFT FRONT OIL SEAL" section in this manual.



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35. Crankshaft Damper Pulley



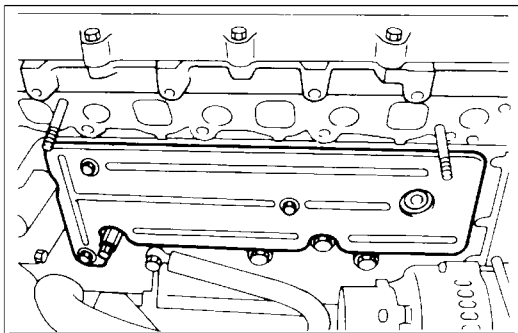
1) Apply a coat of the engine oil to the threads of the bolts.



2) Align the damper pulley with the crankshaft knock pin and tighten the bolts to the specified torque in the numerical order.



Damper Pulley Bolt Torque	N•m (kg•m/lb•ft)
	200 (20.4/147)

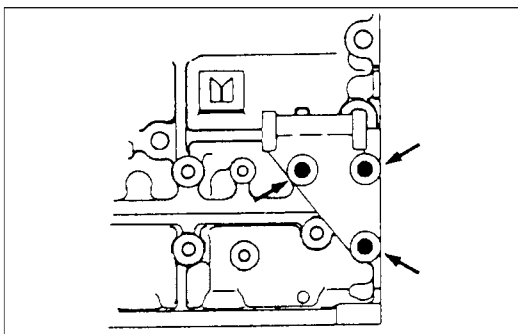


6A3-127-1.tif

34. Cover



Cover Bolt Torque	N•m (kg•m/lb•in)
	13 (1.3/113)



6A3-127-2.tif

33. Generator Bracket



Generator Bracket Bolt Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)

Leakage

Hold the tester handle to about 2070 kPa (300 psi) below the opening pressure. If no drops of fuel fall from the nozzle tip within 10 seconds, the nozzle is not leaking

Chatter

An easily audible chatter at all pump lever speeds should be heard.



WARNING:

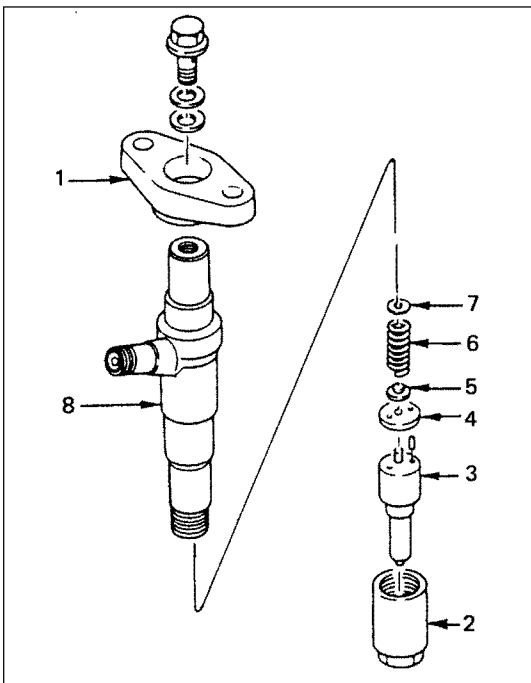
TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL TIMES.



DISASSEMBLY

Clamp the injection nozzle holder in a vice.

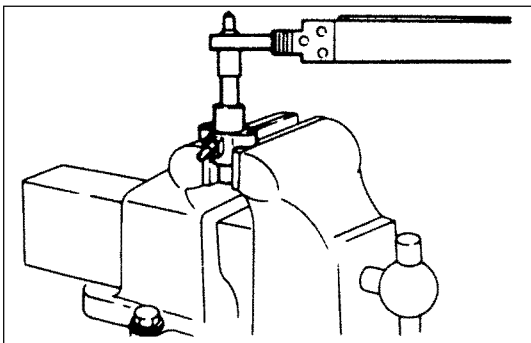
1. Flange



6C-16-1.tif

2. Retaining Nut

Use a wrench to remove the injection nozzle retainer nut.



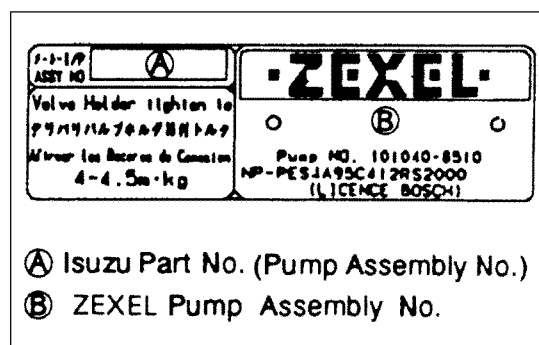
6C-16-2.tif

INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HE1-T

Item	Condition
Injection nozzle and holder assembly	ZEXEL Part No.: 105048-3831
Injection nozzle	ZEXEL Part No.: 105017-1840
Nozzle holder	ZEXEL Part No.: 105048-3831
Injection nozzle opening pressure kg/cm ² (psi/kPa)	185 (2,631/18,142)
Injection line dimensions	
Inside diameter mm (in)	2.0 (0.079)
Outside diameter mm (in)	6.0 (0.236)
Length mm (in)	600 (23.6)
Fuel delivery pressure kg/cm ² (psi/kPa)	2.6 (36.97/254.9)
Test fuel	SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature °C (°F)	40 - 45 (104 - 113)
Identification numbers	101401-7410 101401-7420 101401-7273



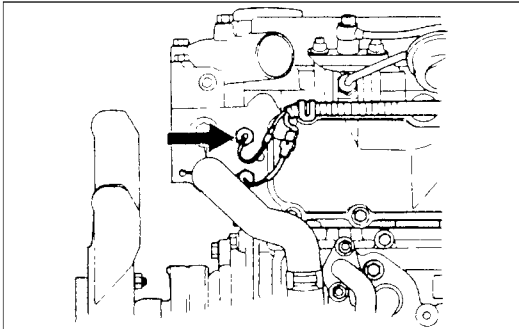
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IDENTIFICATION PLATE AND NUMBER

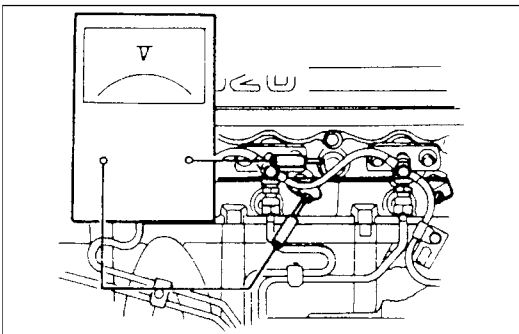
Use the data following the injection pump identification number to adjust the injection volume.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



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6D6-4-2.tif

QUICK-ON-START II (QOS II)

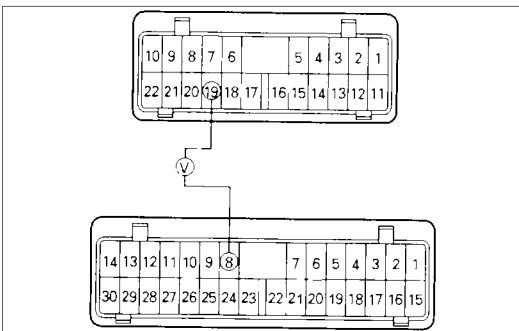
System

1. Disconnect the connector of the thermo switch.
2. Set the voltage meter in connection as shown in the illustration.
3. Turn the key switch to "ON" position without engine turned and check the following items.

Glow Indicator Lighting Time	Seconds
Standard	3.5
Power Source Voltage Indicating Time	Seconds
Standard	18

When abnormal, check the QOS timer, the glow relay and the thermo switch.

When normal, check the glow plug.



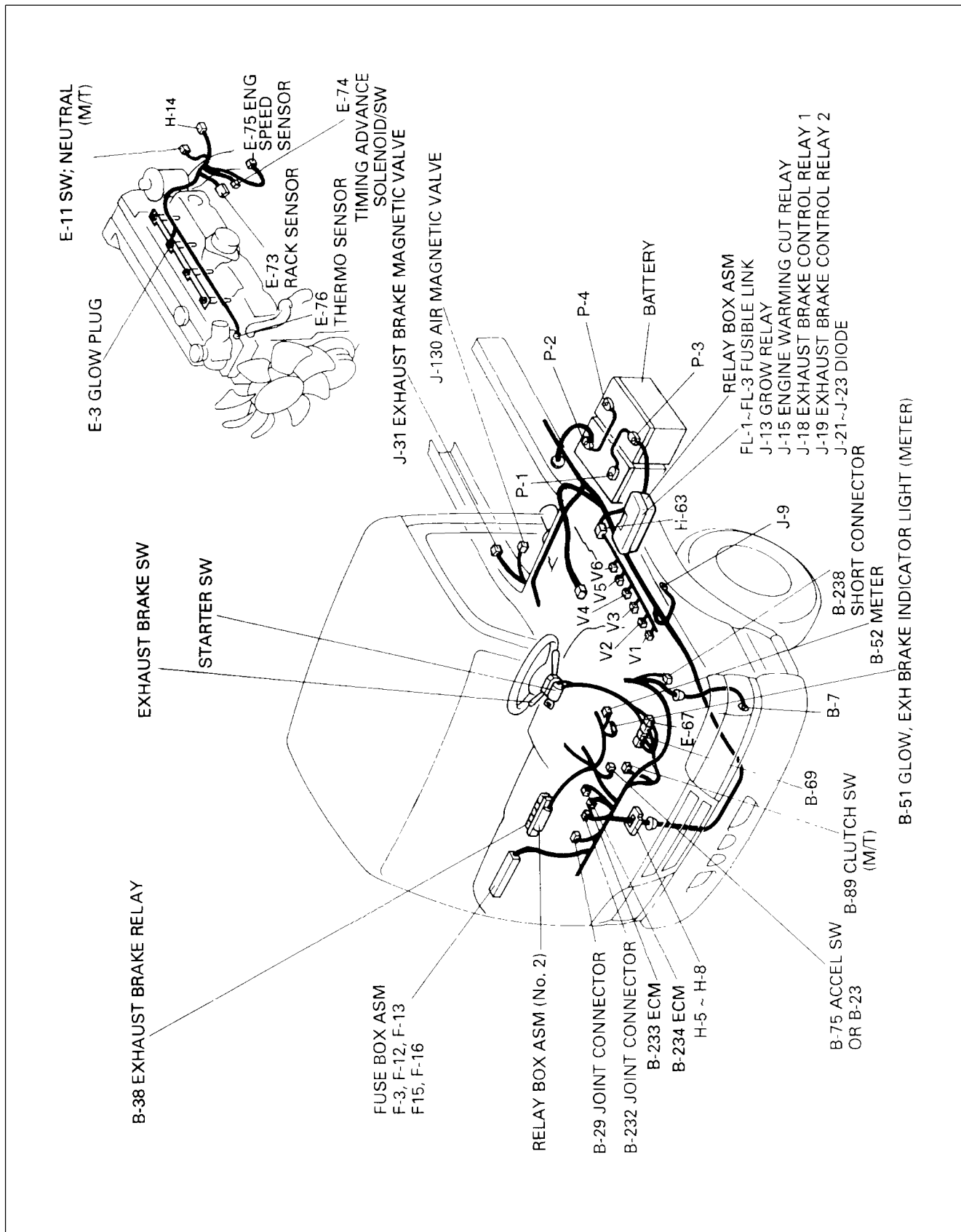
6D6-4-3.tif

Timer

1. Disconnect the connector of the thermo switch.
2. Set the voltage meter in connection as shown the illustration with connector connected.
3. Turn the key switch to "ON" position without engine turned, and check the following.

0 Volts Indicating Time	Seconds
Standard	18

PARTS LOCATION



6E – 104 EMISSION AND ELECTRICAL DIAGNOSIS

Step	Action	Value (s)	Yes	No
1	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 4	Go to Step 3
2	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector 4. Repair if necessary. 5. Clear trouble code by Scan Tool. 6. Ignition "ON" Engine "ON". 7. Does the MIL blink?	-	Go to Step 6	Go to Step 5
3	Replace the VSV Is the action complete?	-	Go to Step 6	-
4	Replace the ECM. Is the action complete?	-	Go to Step 6	-
5	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF". Clear trouble code by Scan Tool. 3. Ignition "ON" Engine "ON". 4. Does the MIL blink?	-	Go to Step 7	Go to Step 2
6	Connect Scan Tool. Is any current trouble other than DTC 44 displayed by scan tool?	-	Go to trouble code section	Trouble code clear