WORKSHOP MANUAL

TFR-TFS

ENGINE

4J SERIES

SECTION 6

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section - 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on the latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model : TFR/S 54, TFR/S 55, TFR/S 69, TFR/S 77

This manual is applicable to 1997 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

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6	Troubleshooting
6A	Engine Mechanical
6B	Engine Cooling
6C	Fuel System
6D	Engine Electrical
6E	Exhaust Gas Recirculation (EGR) System
6F	Exhaust System

SECTION 6
TROUBLESHOOTING

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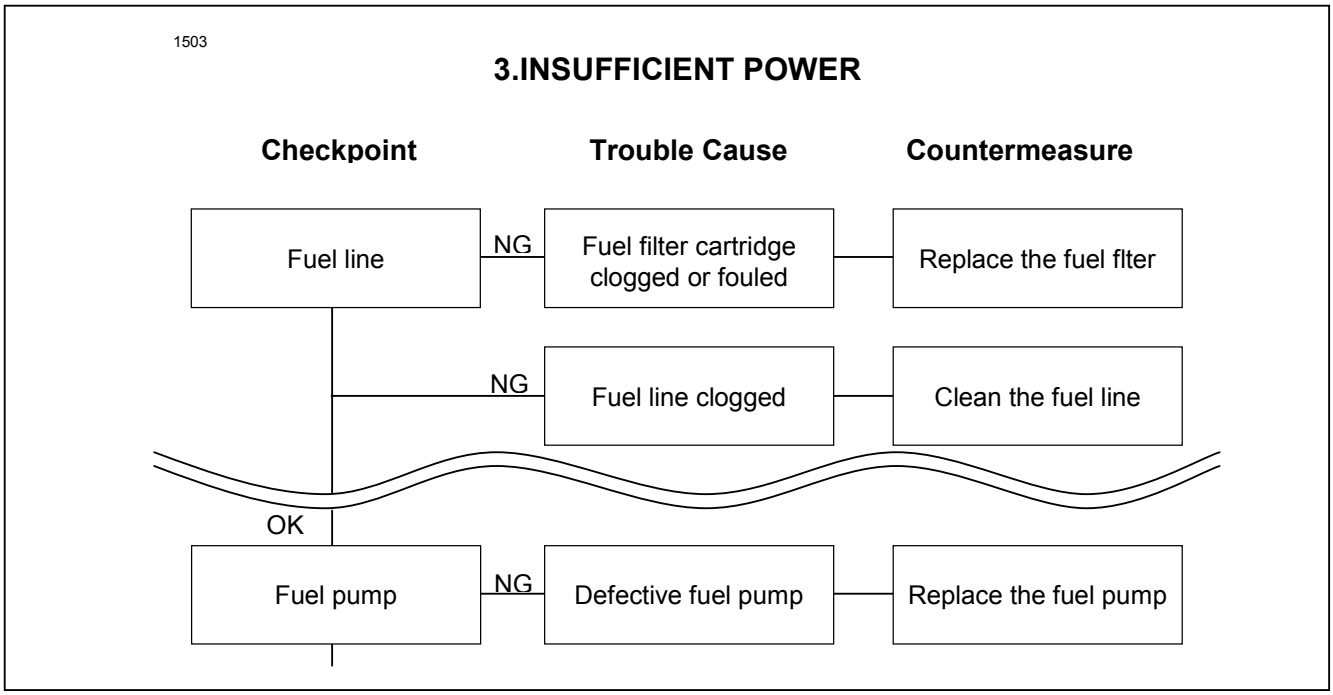
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6 – 2 TROUBLESHOOTING

Refer to the following troubleshooting charts to quickly pinpoint and repair engine problems.

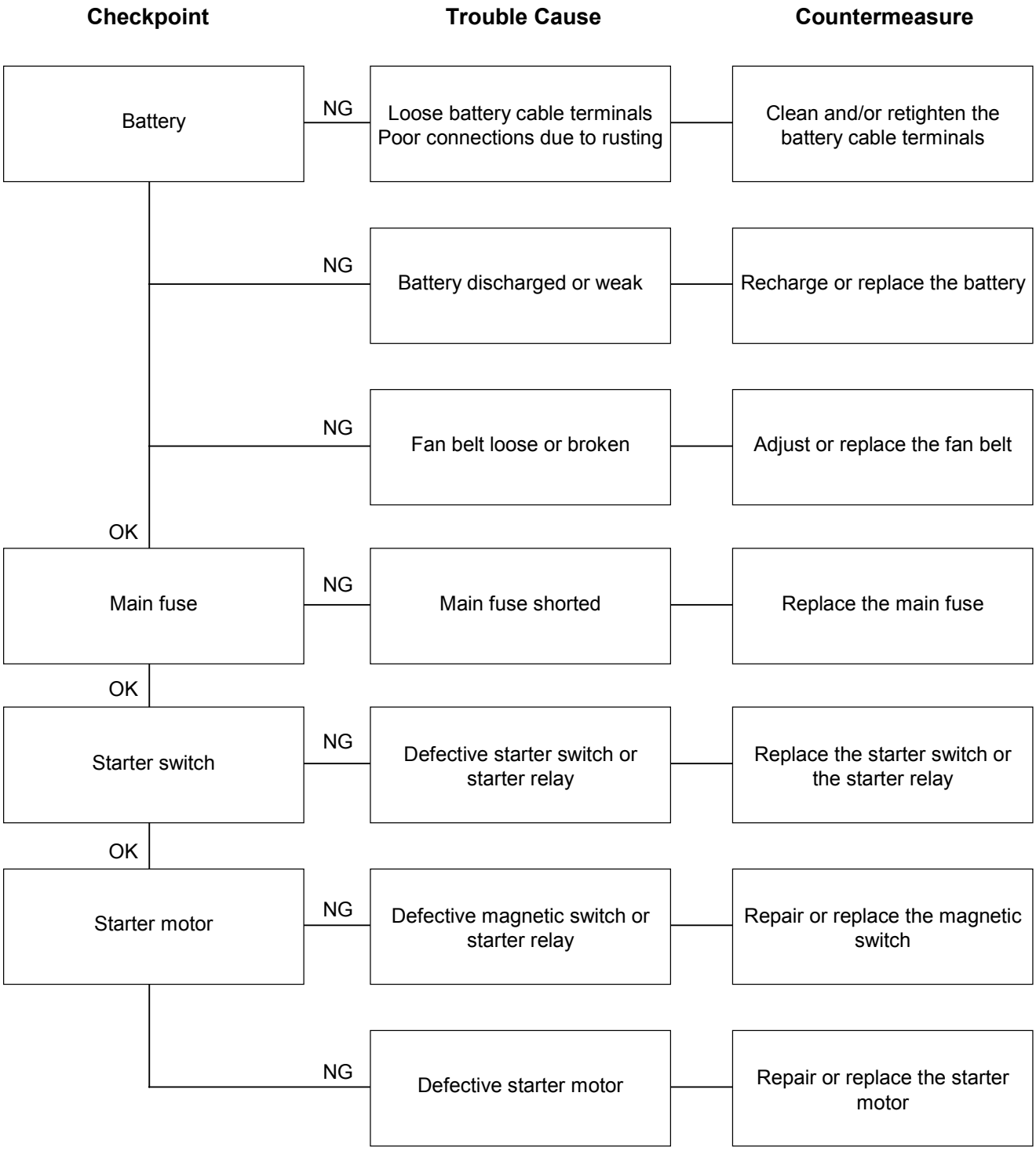
1. This Section is divided into ten Sub-Sections.
   Refer to the Table of Contents.
2. Each troubleshooting chart has three headings arranged from left to right.
   Example:



3. Easily checked areas are presented at the beginning of the troubleshooting chart. Procedures become more complex as the chart progresses.
4. It is suggested that you work from the beginning of the troubleshooting chart. Do not start from the middle.
5. It is possible that a seemingly apparent engine problem is not related to the engine.
   For example, the engine may appear to have insufficient power. This could be caused by dragging brakes or a slipping clutch instead of an engine malfunction.
   Refer to the other troubleshooting charts if required.
6. Optional equipment and variations are included in the troubleshooting charts.
   If the vehicle you are servicing is not equipped with a particular option or variation noted in the “Checkpoint” frame, disregard the frame and move on to the next one.

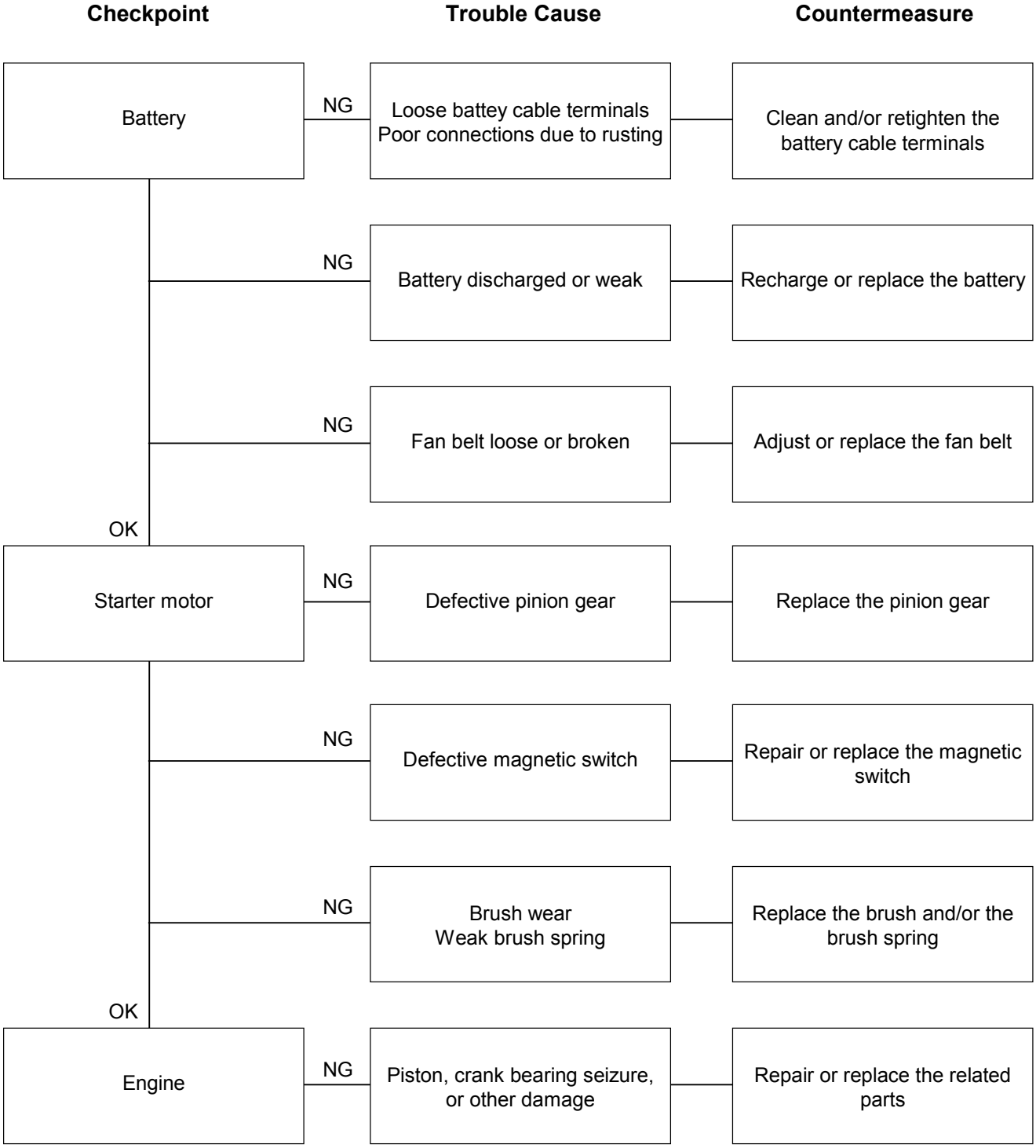
HARD STARTING

1. STARTER INOPERATIVE



150102

2. STARTER MOTOR OPERATES BUT ENGINE DOES NOT TURN OVER



3. ENGINE TURNS OVER BUT DOES NOT START

Checkpoint		Trouble Cause	Countermeasure
Engine stop mechanism	NG	Defective fuel cut solenoid value	Replace the fuel cut solenoid valve

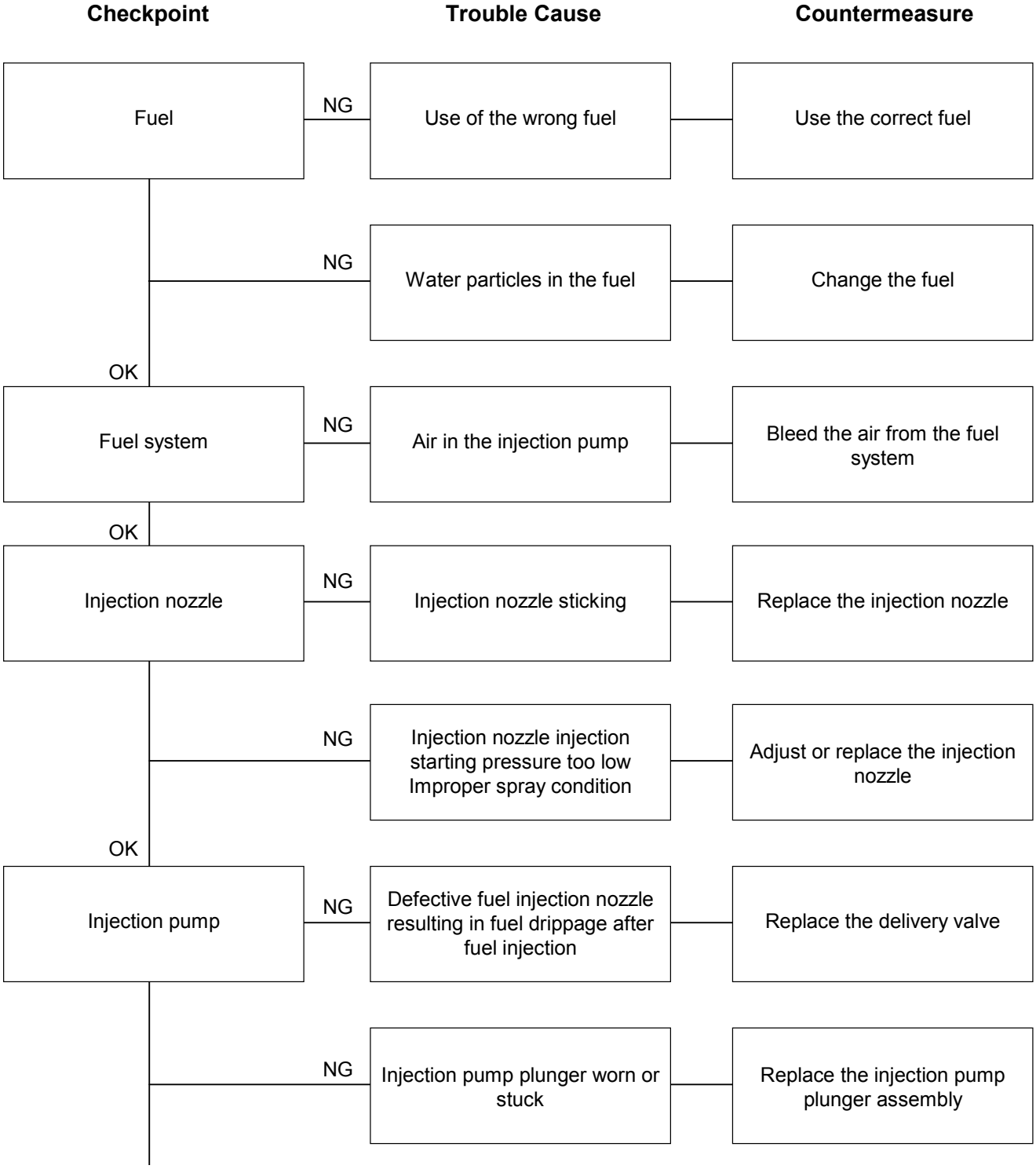
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FUEL IS NOT BEING DELIVERED TO THE INJECTION PUMP

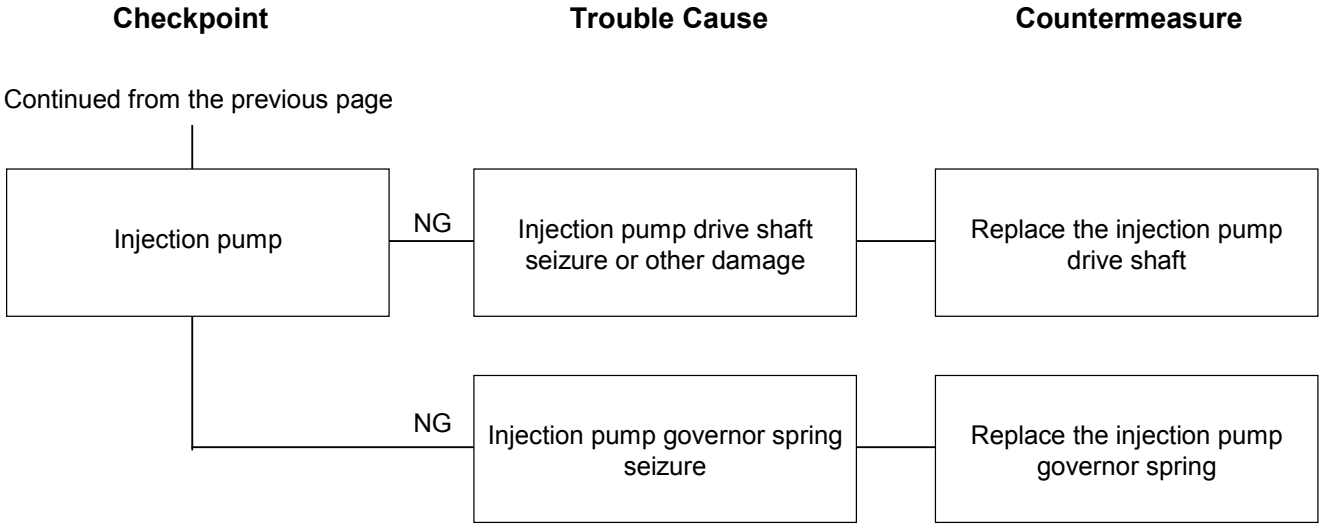
Fuel	NG	Fuel tank is empty	Fill the fuel tank
OK			
Fuel piping	NG	Clogged or damaged fuel lines Loose fuel line connections	Repair or replace the fuel lines Retighten the fuel line connections
OK			
Fuel filter	NG	Fuel filter overflow valve does not close	Repair or replace the fuel filter overflow valve
	NG	Clogged fuel filter element	Replace the fuel filter element or the fuel filter cartridge
OK			
Fuel system	NG	Air in the fuel system	Bleed the air from the fuel system
OK			
Fuel feed pump	NG	Defective feed pump	Repair or replace the feed pump

1500010302

FUEL IS BEING DELIVERED TO THE INJECTION PUMP



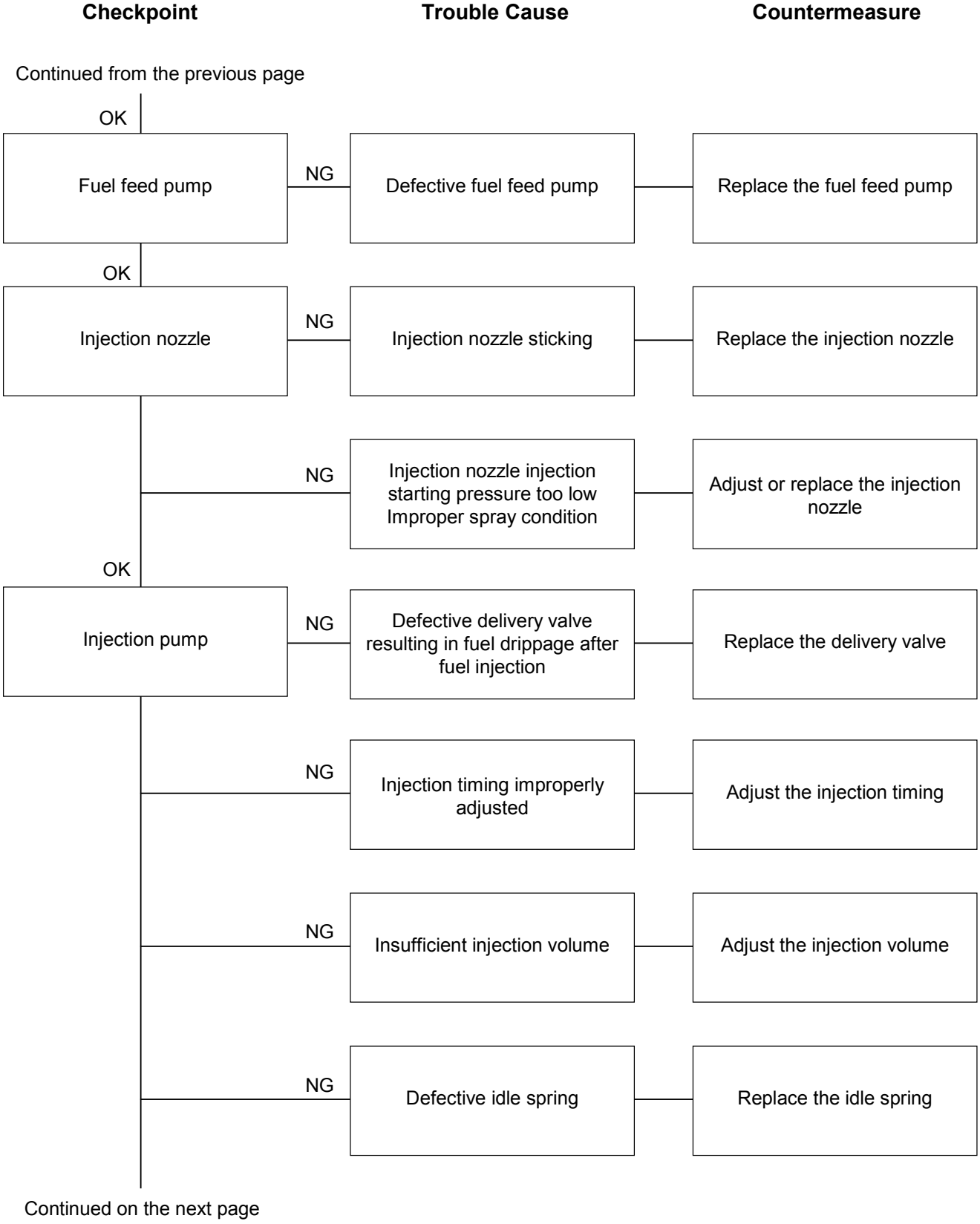
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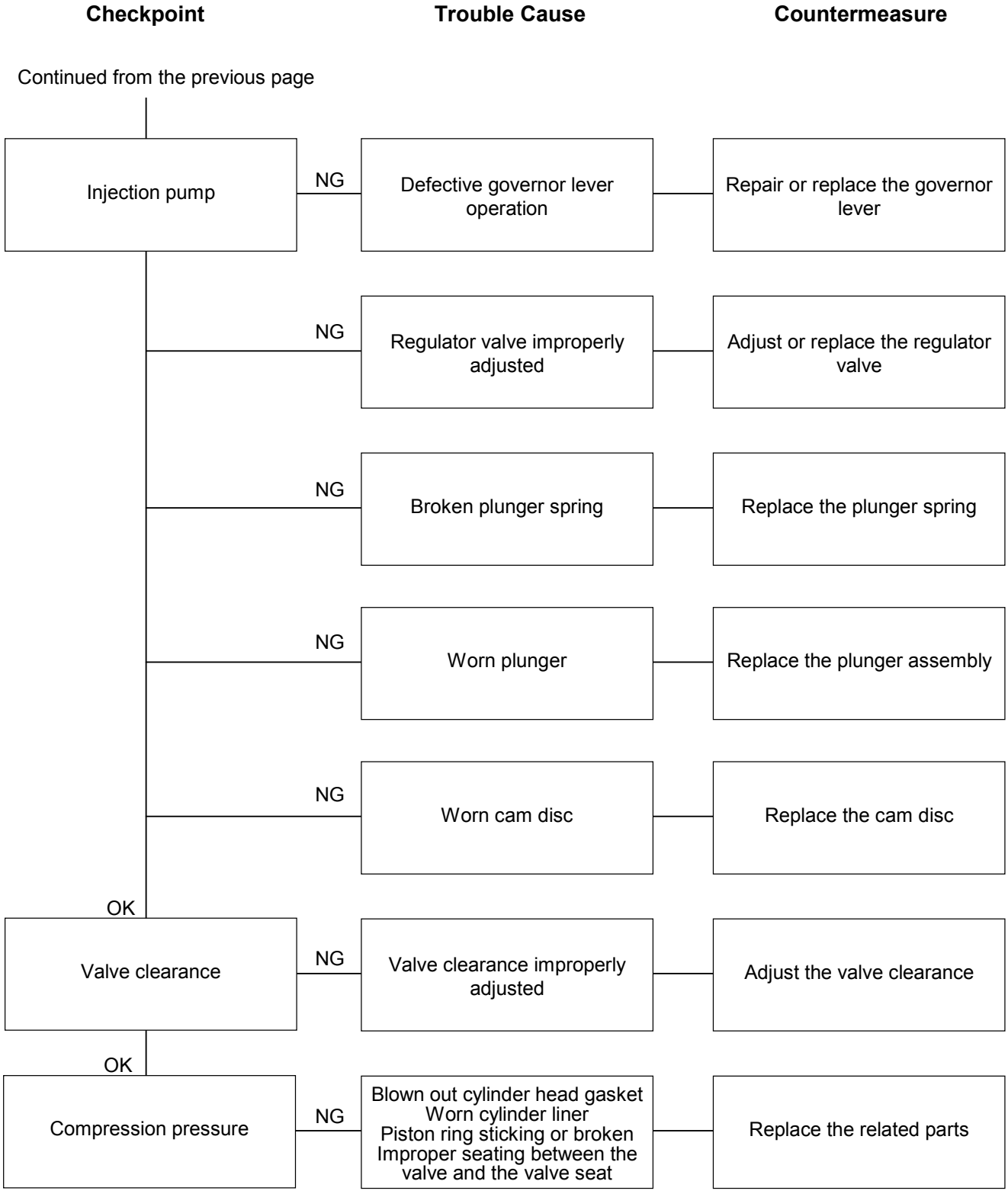

Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
Injection pump
NG
Injection pump drive shaft seizure or other damage
Replace the injection pump drive shaft
NG
Injection pump governor spring seizure
Replace the injection pump governor spring

UNSTABLE IDLING



Continued on the next page


Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Fuel feed pump
NG
Defective fuel feed pump
Replace the fuel feed pump
OK
Injection nozzle
NG
Injection nozzle sticking
Replace the injection nozzle
NG
Injection nozzle injection starting pressure too low
Improper spray condition
Adjust or replace the injection nozzle
OK
Injection pump
NG
Defective delivery valve resulting in fuel drippage after fuel injection
Replace the delivery valve
NG
Injection timing improperly adjusted
Adjust the injection timing
NG
Insufficient injection volume
Adjust the injection volume
NG
Defective idle spring
Replace the idle spring
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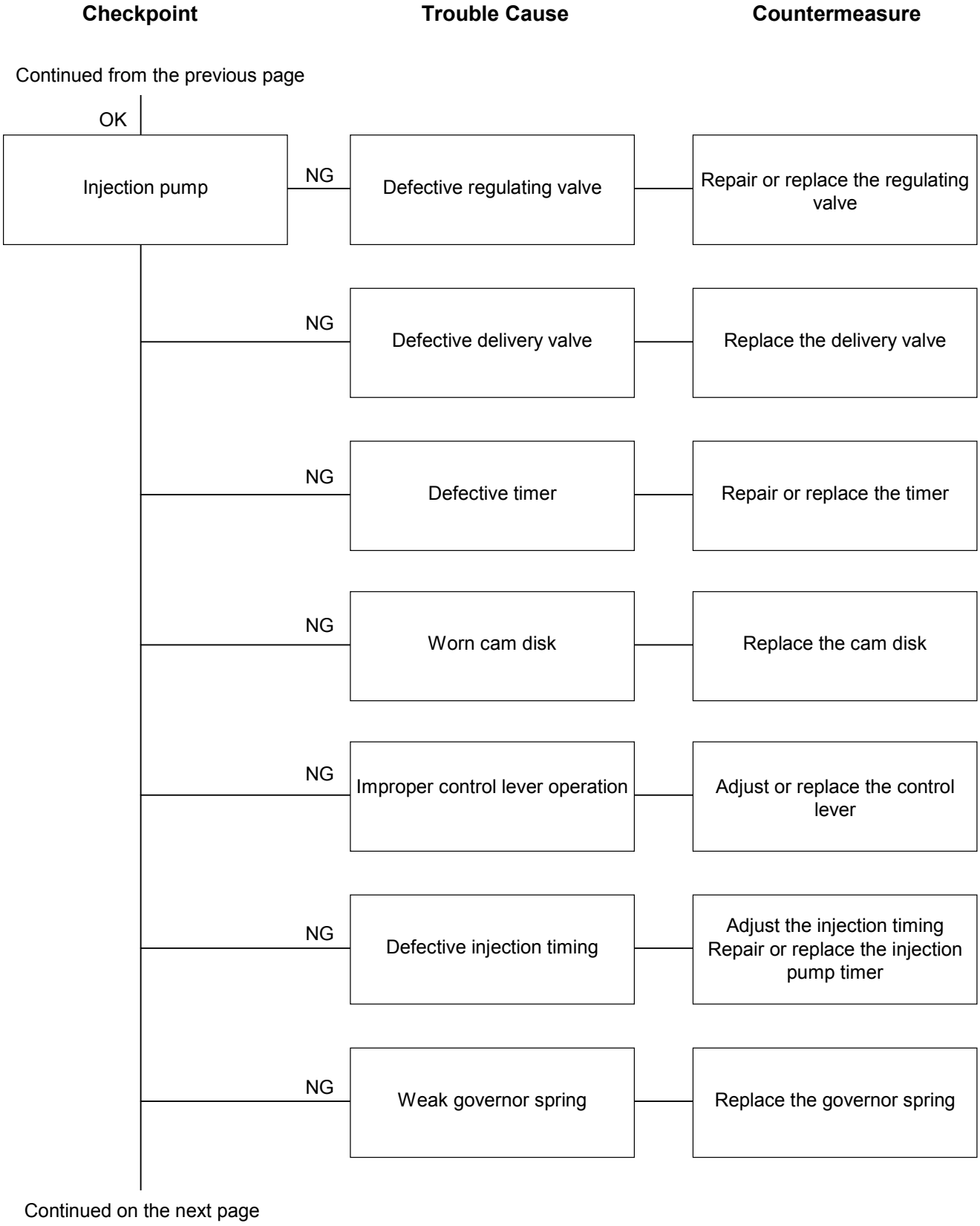

Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
Injection pump
NG
Defective governor lever operation
Repair or replace the governor lever
NG
Regulator valve improperly adjusted
Adjust or replace the regulator valve
NG
Broken plunger spring
Replace the plunger spring
NG
Worn plunger
Replace the plunger assembly
NG
Worn cam disc
Replace the cam disc
OK
Valve clearance
NG
Valve clearance improperly adjusted
Adjust the valve clearance
OK
Compression pressure
NG
Blown out cylinder head gasket
Worn cylinder liner
Piston ring sticking or broken
Improper seating between the valve and the valve seat
Replace the related parts

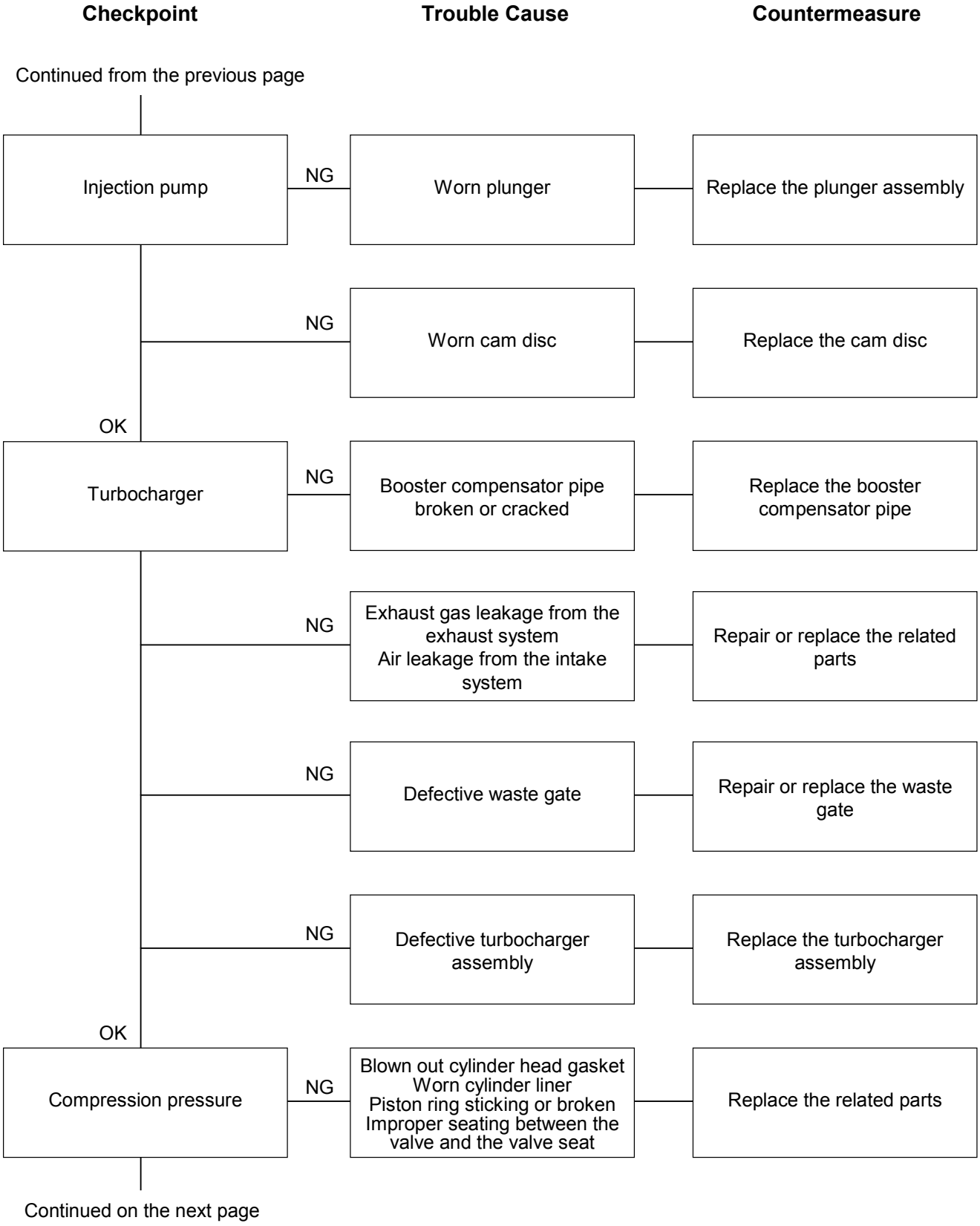
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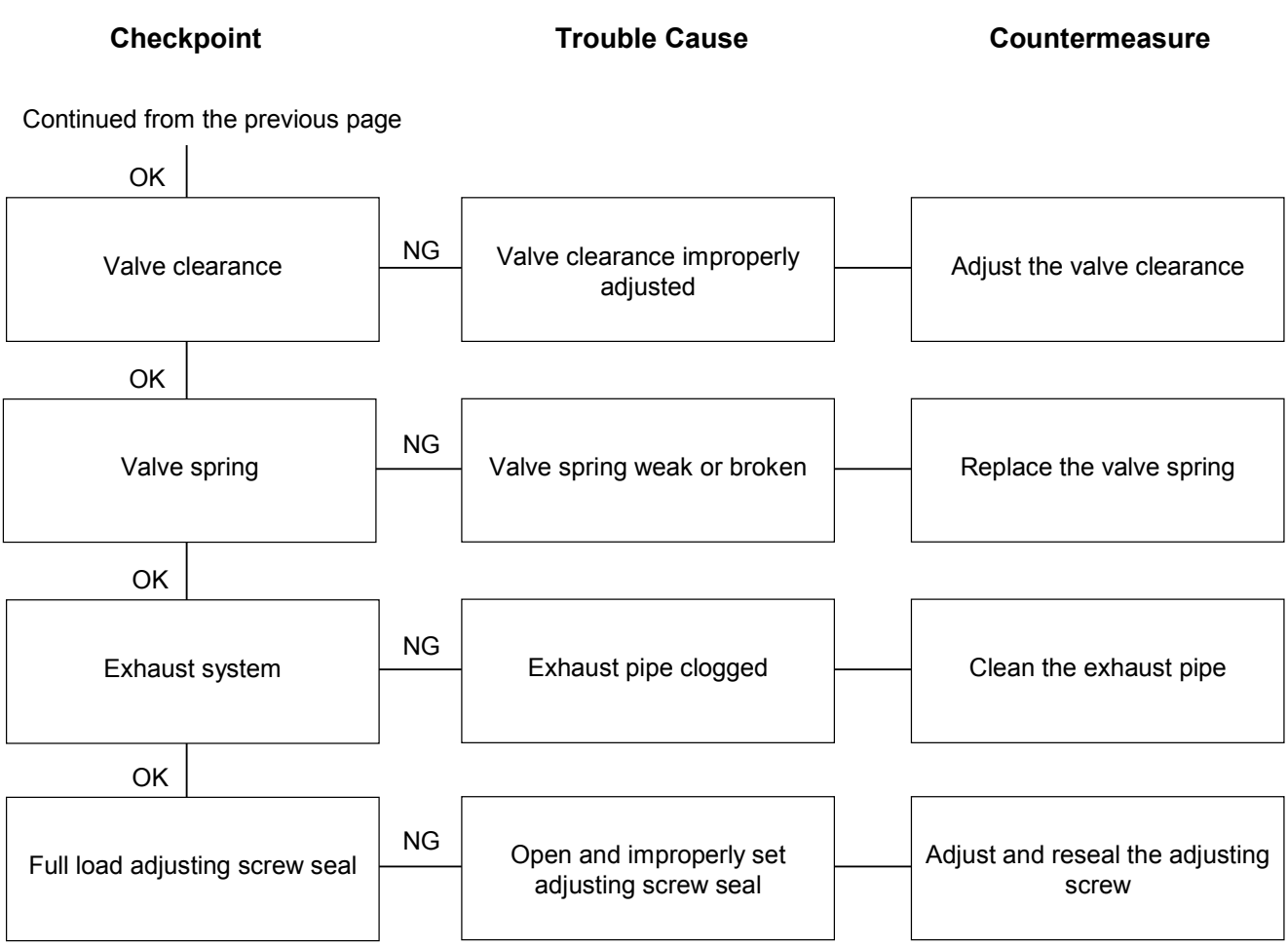
INSUFFICIENT POWER



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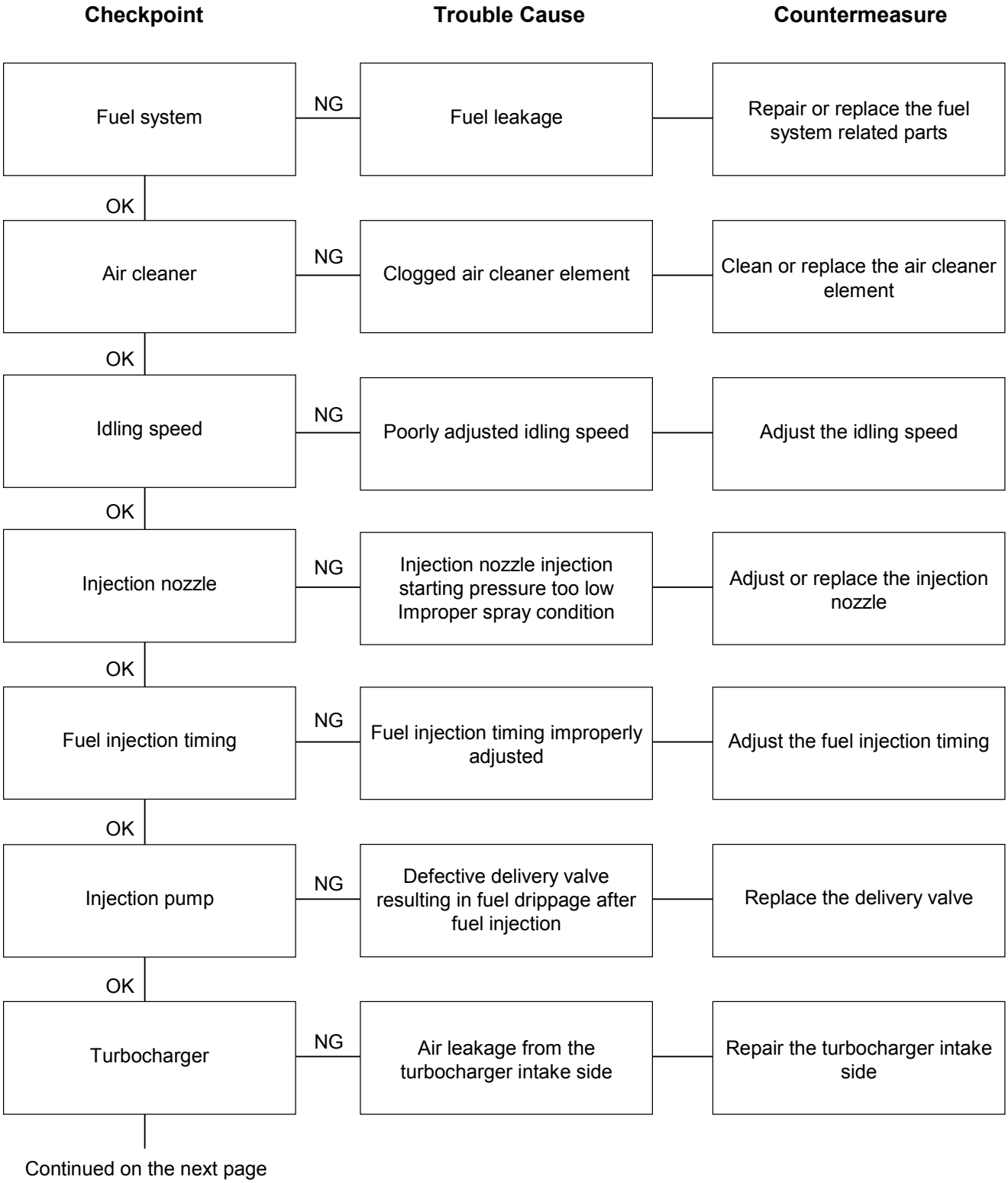

Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Injection pump
NG
Defective regulating valve
Repair or replace the regulating valve
NG
Defective delivery valve
Replace the delivery valve
NG
Defective timer
Repair or replace the timer
NG
Worn cam disk
Replace the cam disk
NG
Improper control lever operation
Adjust or replace the control lever
NG
Defective injection timing
Adjust the injection timing
Repair or replace the injection pump timer
NG
Weak governor spring
Replace the governor spring
Continued on the next page


Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
Injection pump
NG
Worn plunger
Replace the plunger assembly
NG
Worn cam disc
Replace the cam disc
OK
Turbocharger
NG
Booster compensator pipe broken or cracked
Replace the booster compensator pipe
NG
Exhaust gas leakage from the exhaust system
Air leakage from the intake system
Repair or replace the related parts
NG
Defective waste gate
Repair or replace the waste gate
NG
Defective turbocharger assembly
Replace the turbocharger assembly
OK
Compression pressure
NG
Blown out cylinder head gasket
Worn cylinder liner
Piston ring sticking or broken
Improper seating between the valve and the valve seat
Replace the related parts
Continued on the next page

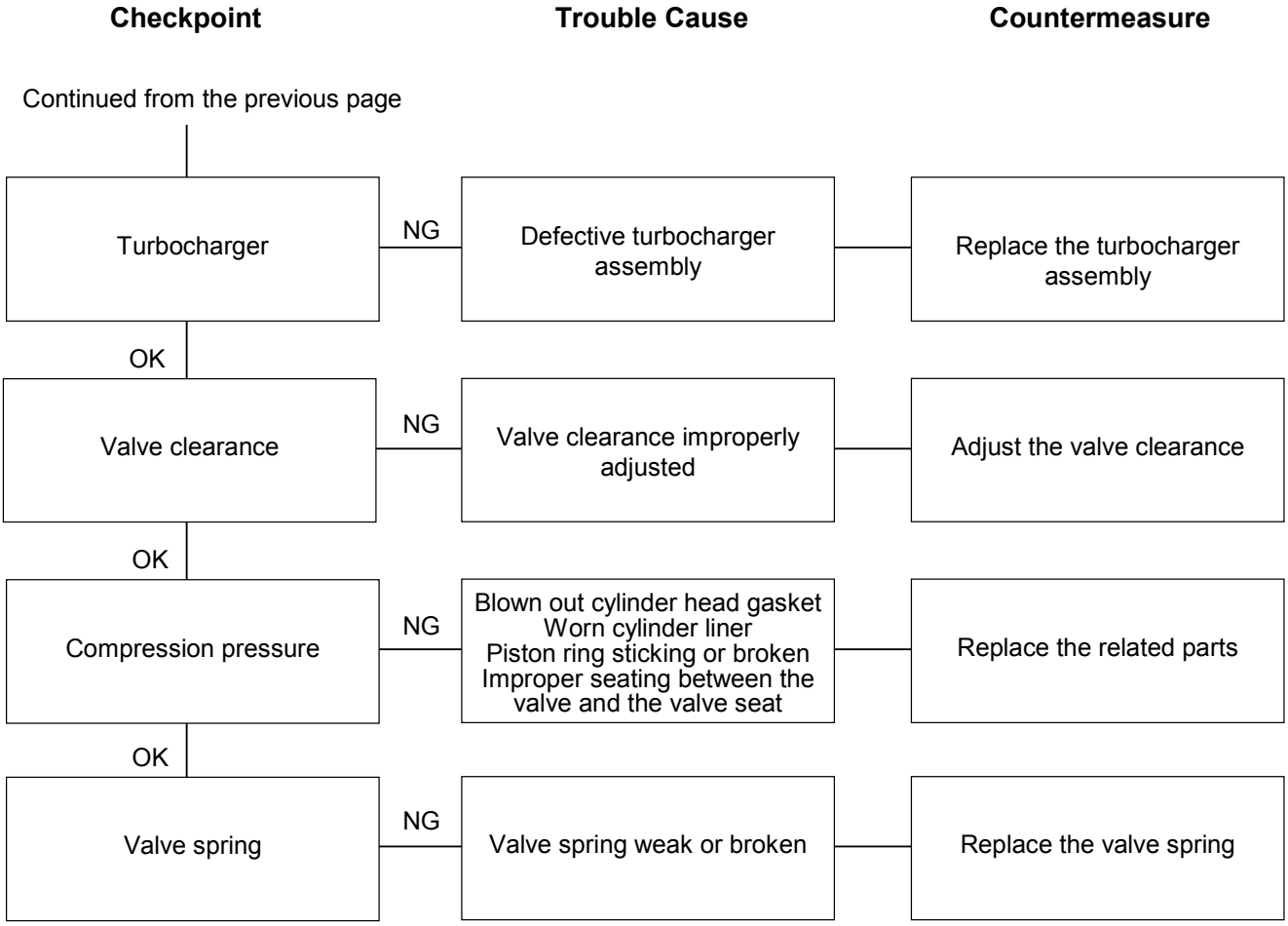

Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Valve clearance
NG
Valve clearance improperly adjusted
Adjust the valve clearance
OK
Valve spring
NG
Valve spring weak or broken
Replace the valve spring
OK
Exhaust system
NG
Exhaust pipe clogged
Clean the exhaust pipe
OK
Full load adjusting screw seal
NG
Open and improperly set adjusting screw seal
Adjust and reseal the adjusting screw

1504

EXCESSIVE FUEL CONSUMPTION

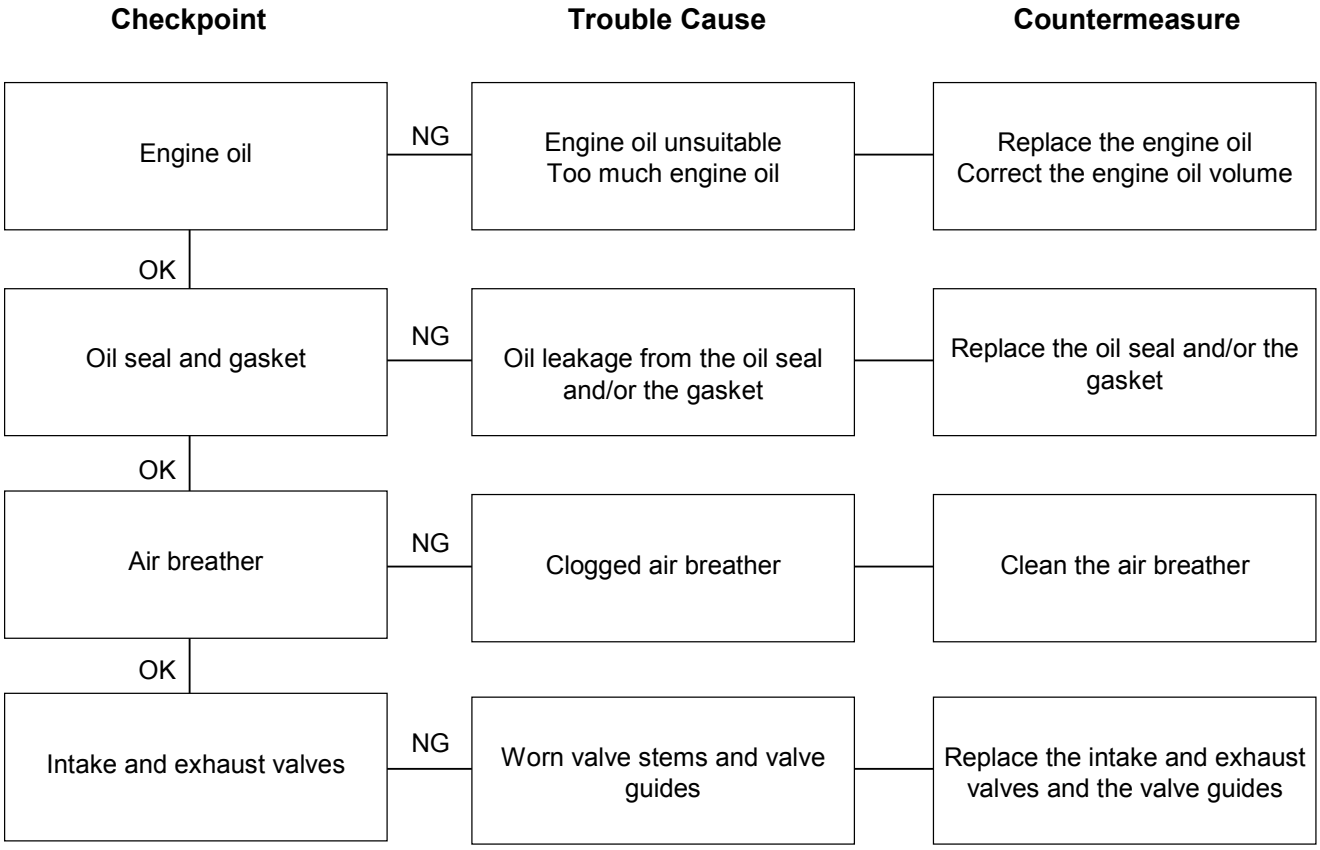


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Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
Turbocharger
NG
Defective turbocharger assembly
Replace the turbocharger assembly
OK
Valve clearance
NG
Valve clearance improperly adjusted
Adjust the valve clearance
OK
Compression pressure
NG
Blown out cylinder head gasket
Worn cylinder liner
Piston ring sticking or broken
Improper seating between the valve and the valve seat
Replace the related parts
OK
Valve spring
NG
Valve spring weak or broken
Replace the valve spring

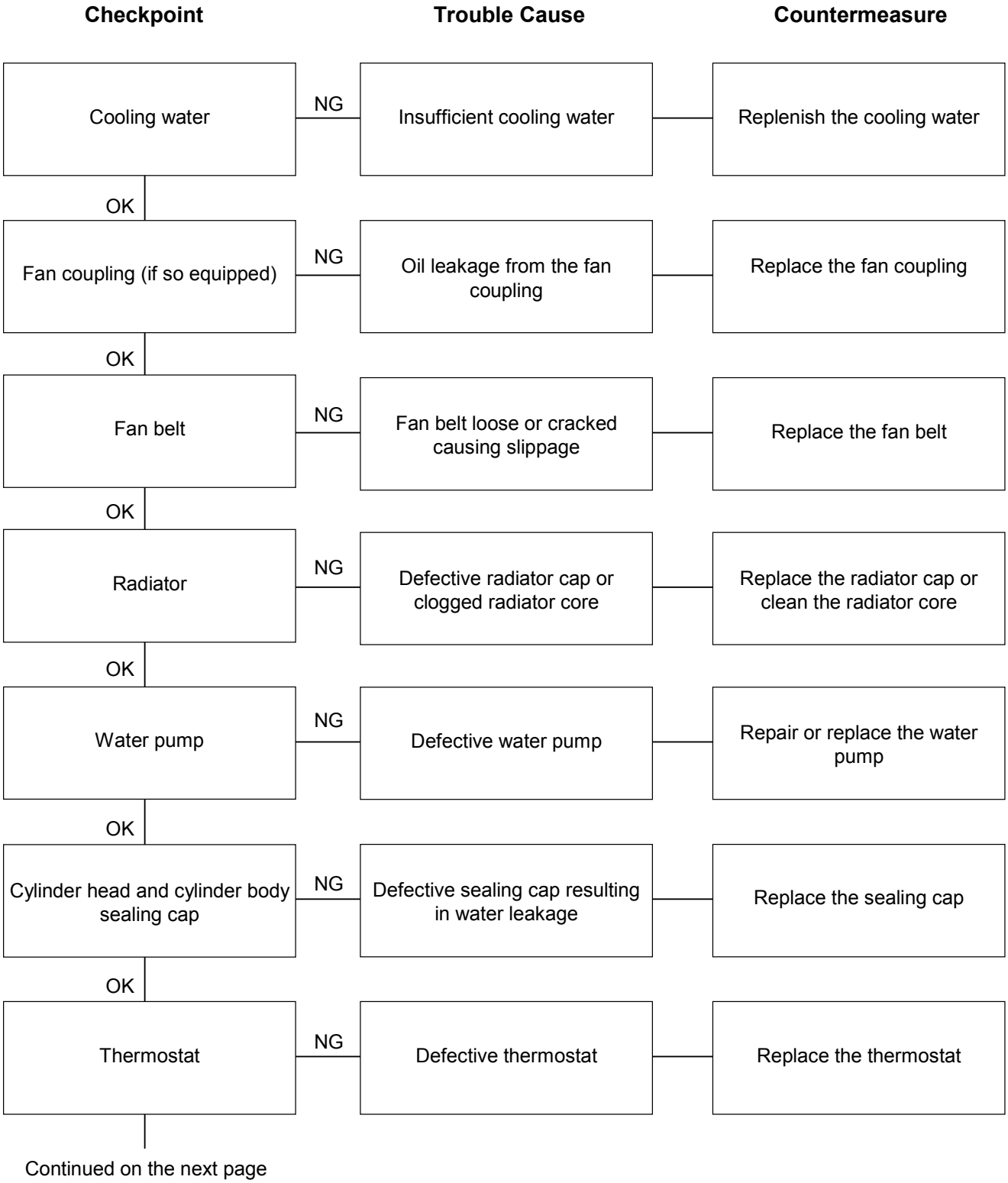
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EXCESSIVE OIL CONSUMPTION



1506

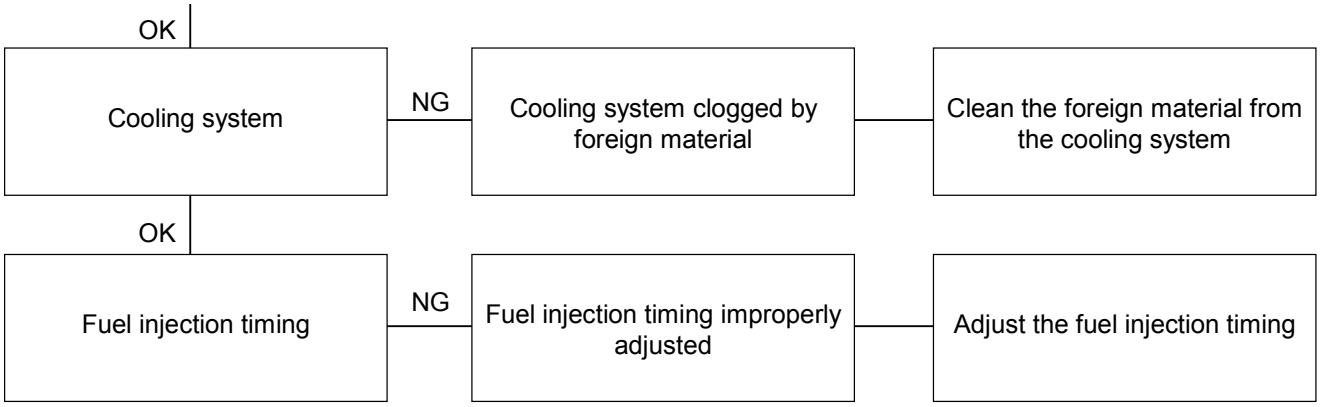
OVERHEATING



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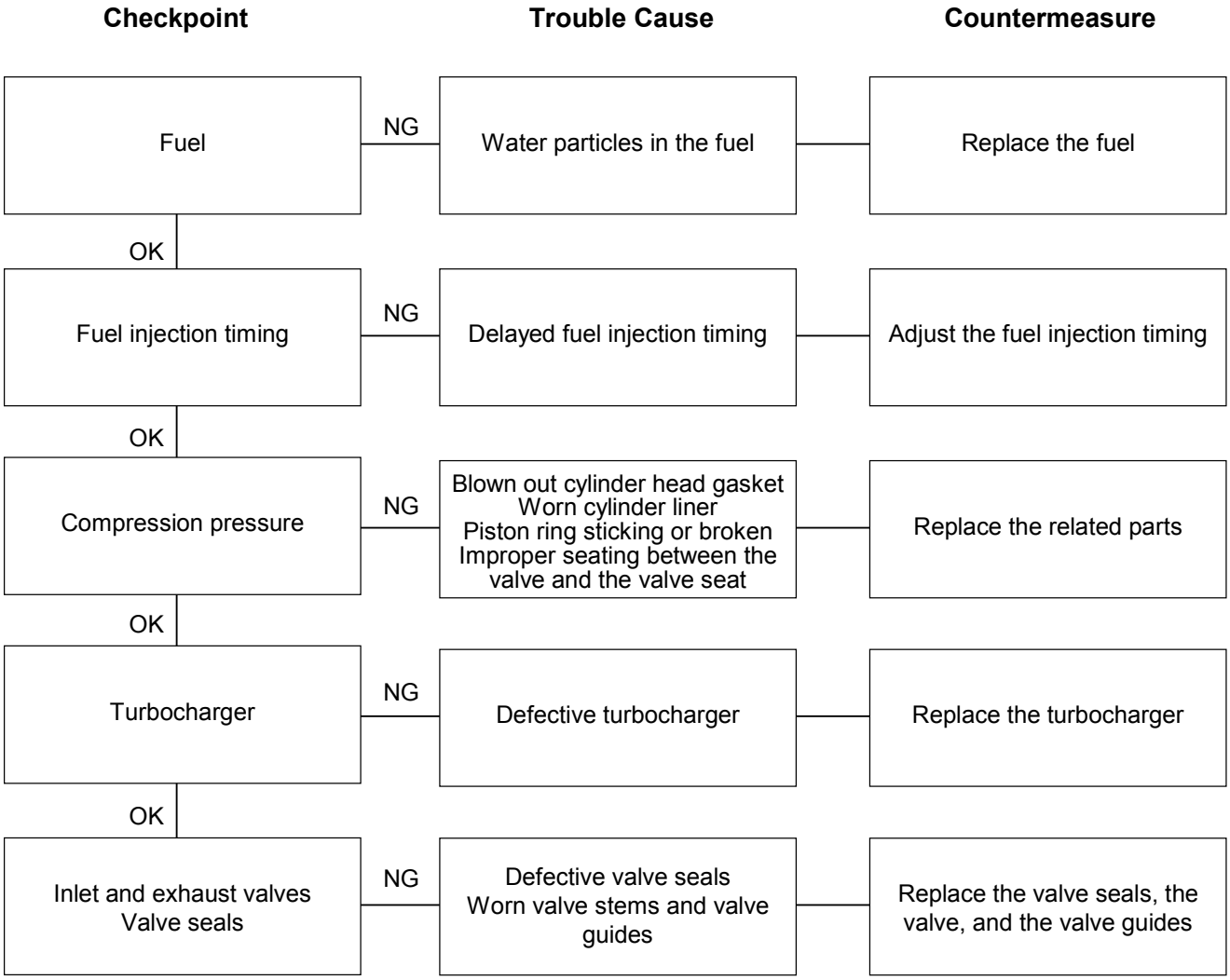
Checkpoint	Trouble Cause	Countermeasure

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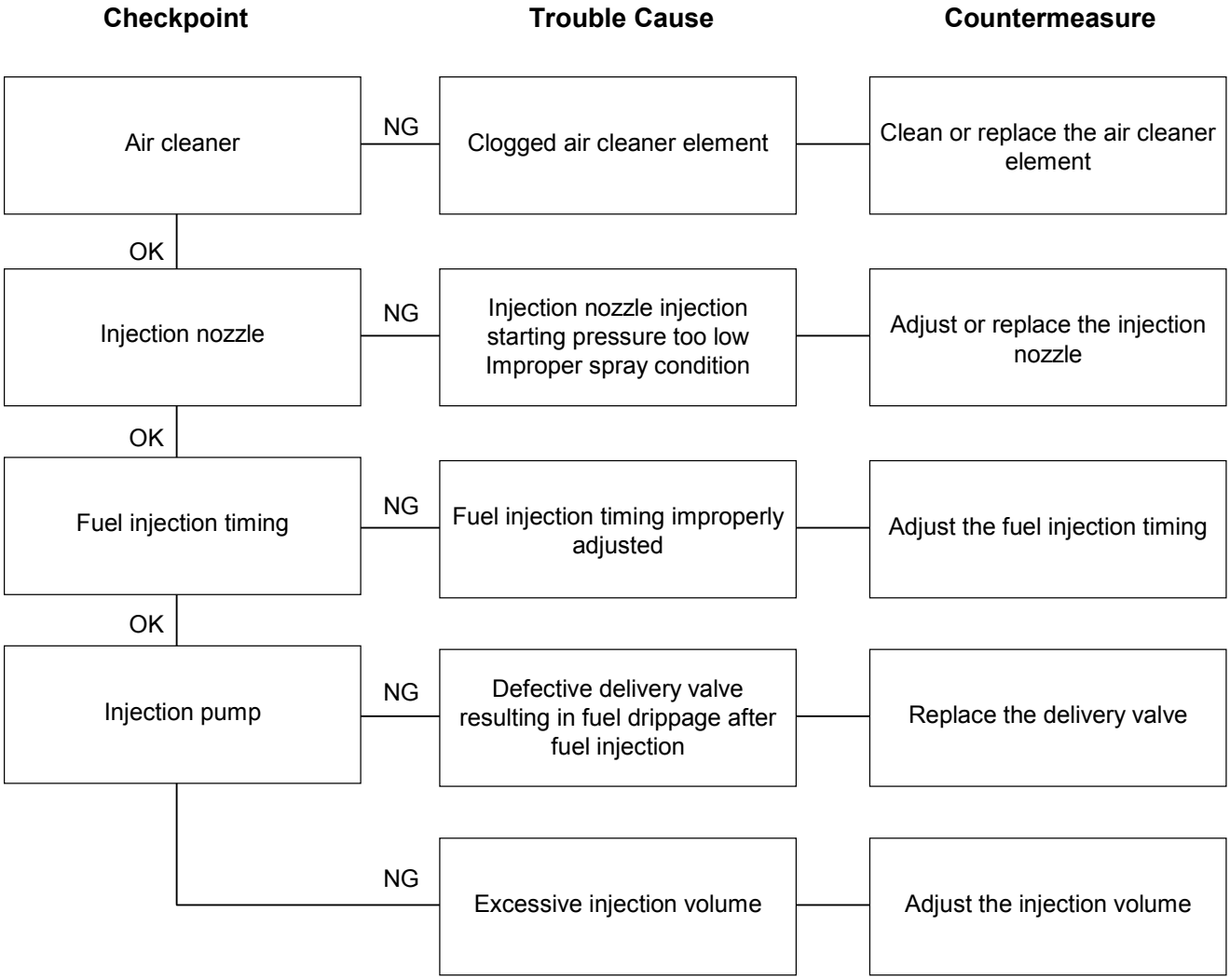
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WHITE EXHAUST SMOKE



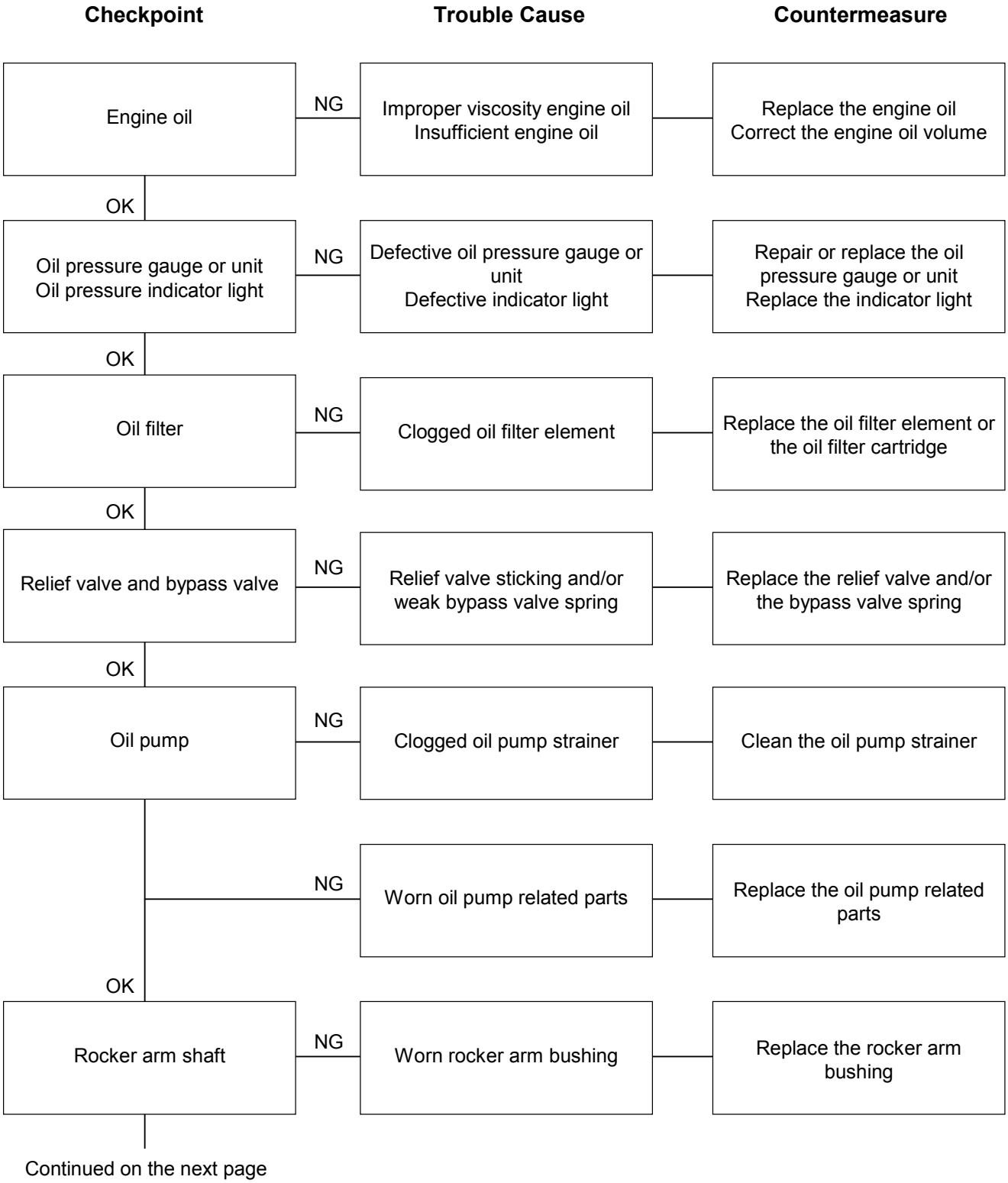
1508

DARK EXHAUST SMOKE



1509

OIL PRESSURE DOES NOT RISE



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Checkpoint		Trouble Cause	Countermeasure
Continued from the previous page			
OK Camshaft	NG	Worn camshaft and camshaft bearing	Replace the camshaft and the camshaft bearings
OK Crankshaft and bearings	NG	Worn crankshaft and bearings	Replace the crankshaft and/or the bearings

1510

ABNORMAL ENGINE NOISE

1. Engine knocking

Checkpoint		Trouble Cause	Countermeasure
Check to see that the engine has been thoroughly warmed up before beginning the troubleshooting procedure.			
Fuel	NG	Fuel unsuitable	Replace the fuel
OK			
Fuel injection timing	NG	Fuel injection timing improperly adjusted	Adjust the fuel injection timing
OK			
Injection nozzle	NG	Improper injection nozzle starting pressure and spray condition	Adjust or replace the injection nozzle
OK			
Compression pressure	NG	Blown out head gasket Broken piston ring	Replace the head gasket or the piston ring

2. Gas Leakage Noise

Exhaust pipes	NG	Loosely connected exhaust pipes Broken exhaust pipes	Tighten the exhaust pipe connections Replace the exhaust pipes
OK			
Injection nozzles and/or glow plugs	NG	Loose injection nozzles and/or glow plugs	Replace the washers Tighten the injection nozzles and/or the glow plugs

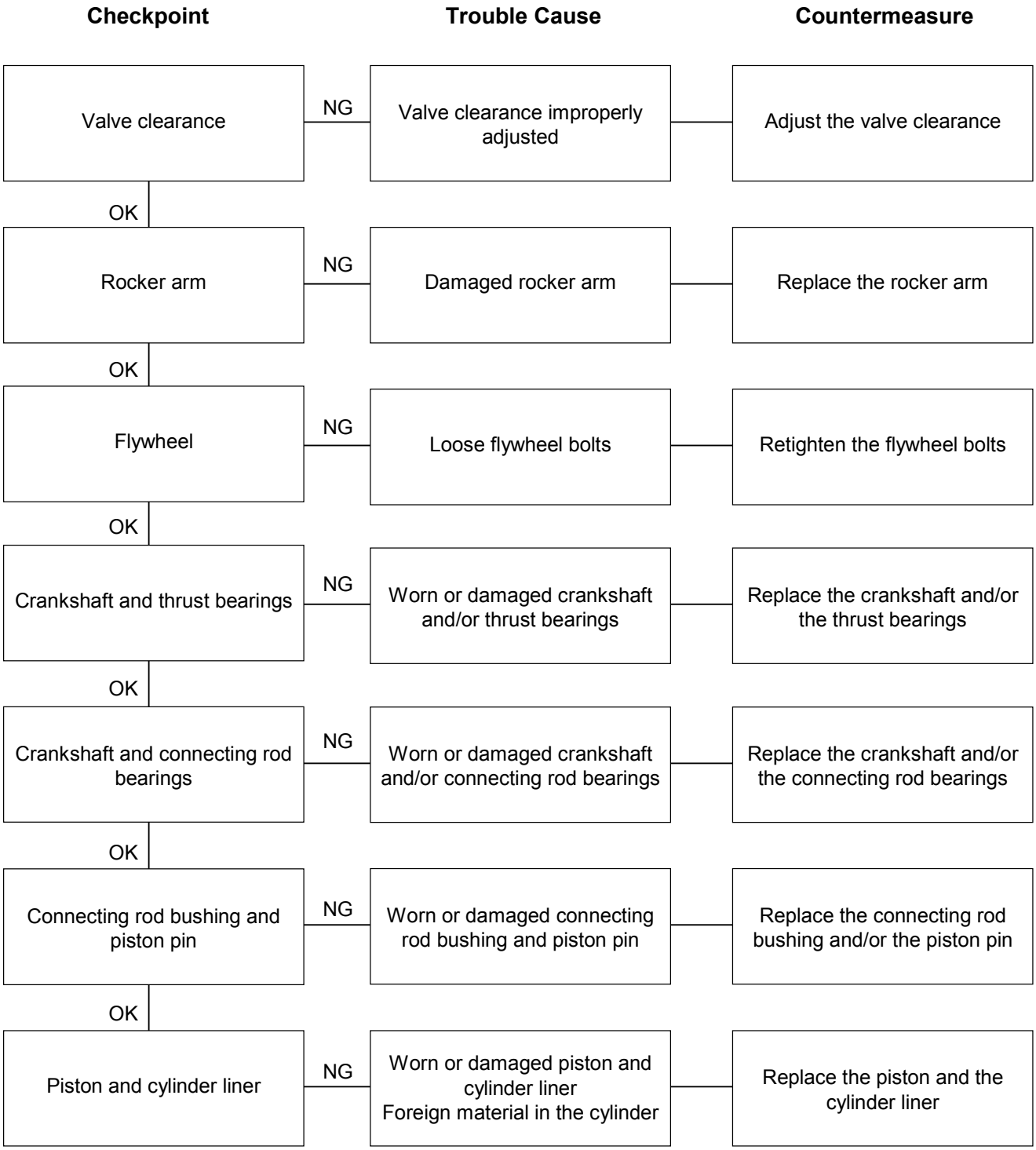
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Checkpoint		Trouble Cause	Countermeasure
Continued from the previous page			
Exhaust manifold	NG	Loosely connected exhaust manifold and/or glow plugs	Tighten the exhaust manifold connections
Cylinder head gasket	NG	Damaged cylinder head gasket	Replace the cylinder head gasket

3. Continuous Noise

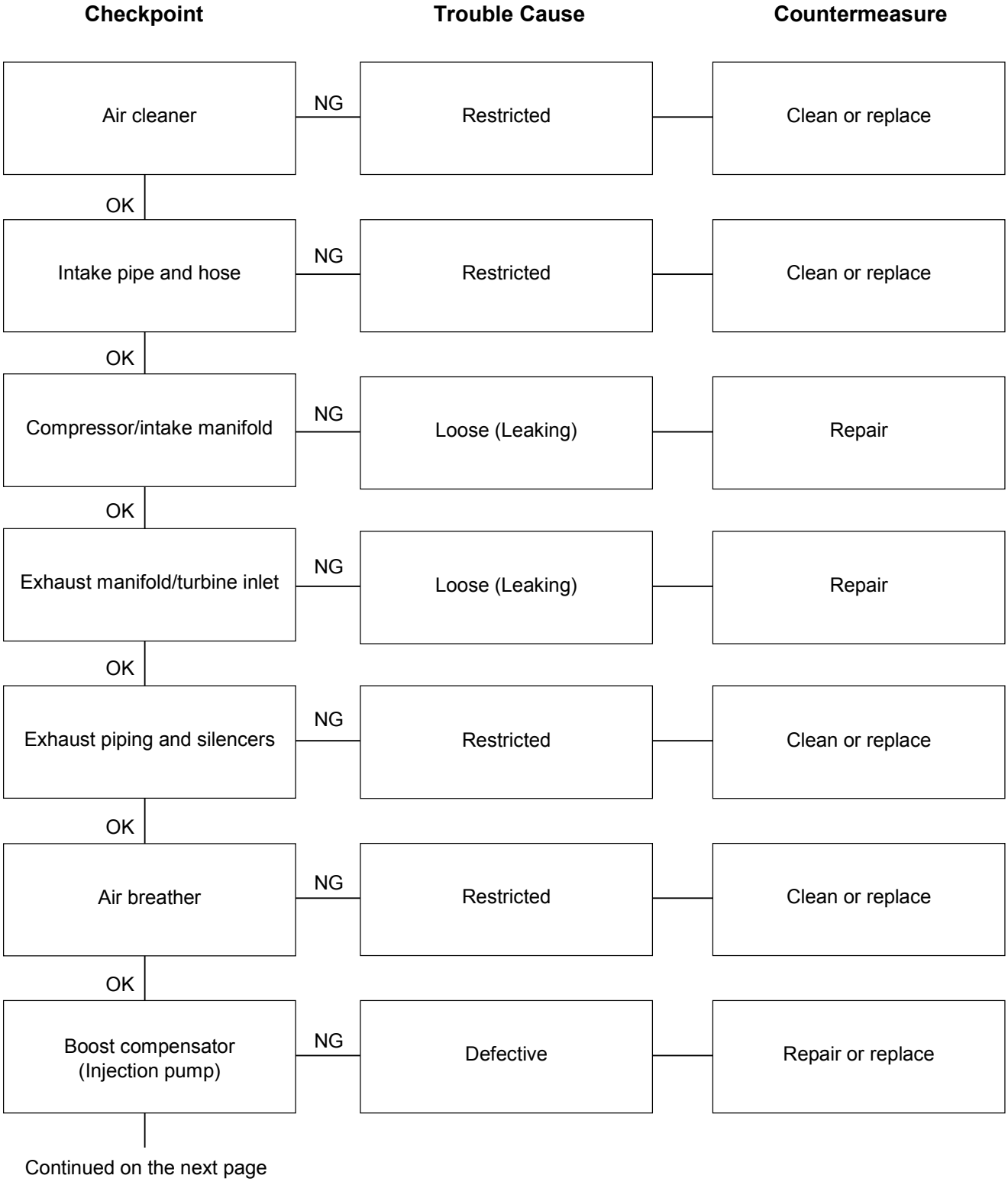
Fan belt	NG	Loose fan belt	Readjust the fan belt tension
Cooling fan	NG	Loose cooling fan	Retighten the cooling fan
Water pump bearing	NG	Worn or damaged water pump bearing	Replace the water pump bearing
Generator or vacuum pump	NG	Defective generator or vacuum pump	Repair or replace the generator or the vacuum pump
Valve clearance	NG	Valve clearance improperly adjusted	Adjust the valve clearance

4. Slapping Noise

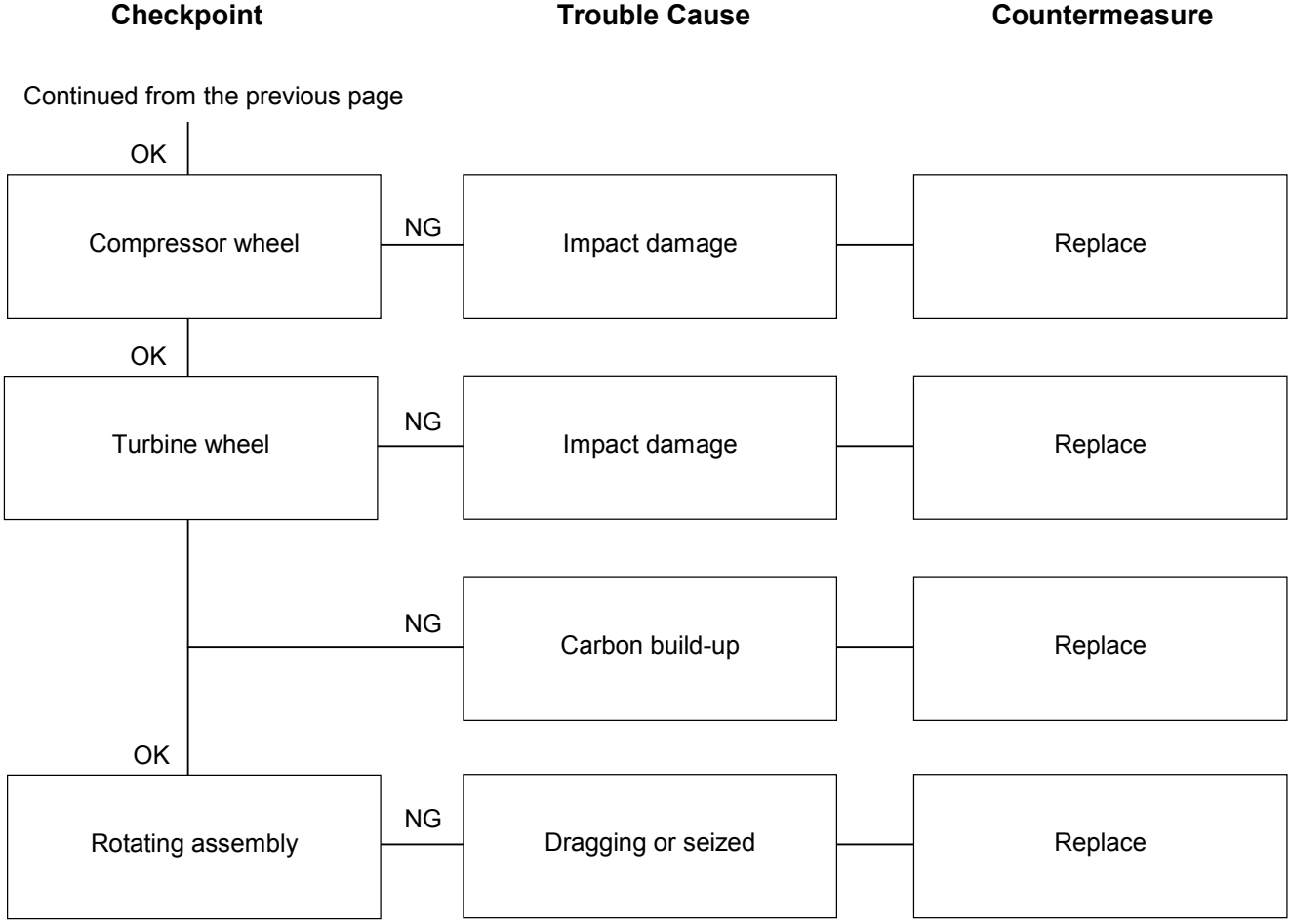


TURBOCHARGER

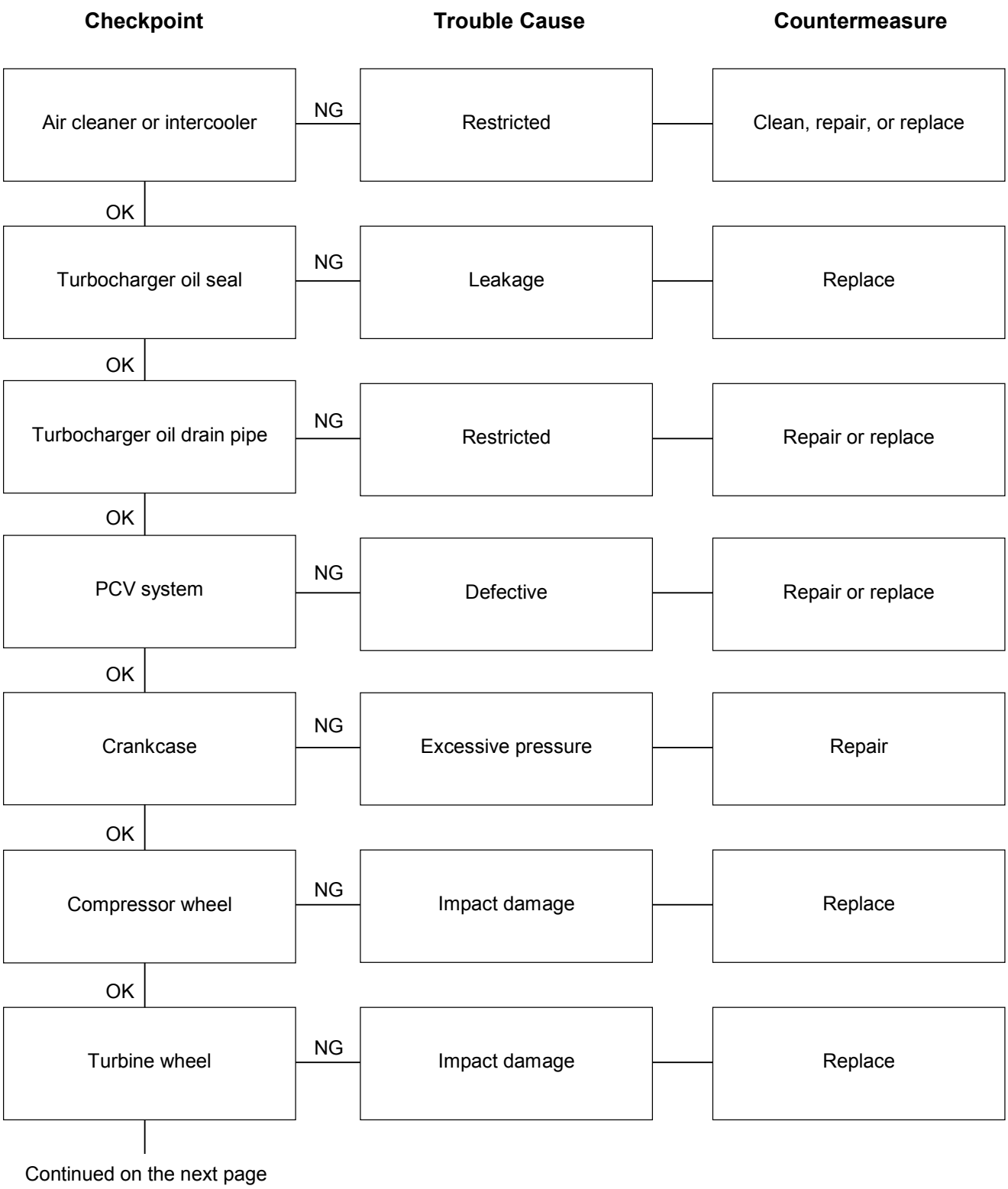
1) ENGINE HAS LESS THAN NORMAL POWER



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Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Compressor wheel
NG
Impact damage
Replace
OK
Turbine wheel
NG
Impact damage
Replace
NG
Carbon build-up
Replace
OK
Rotating assembly
NG
Dragging or seized
Replace

2) BLUE OR BLACK SMOKE



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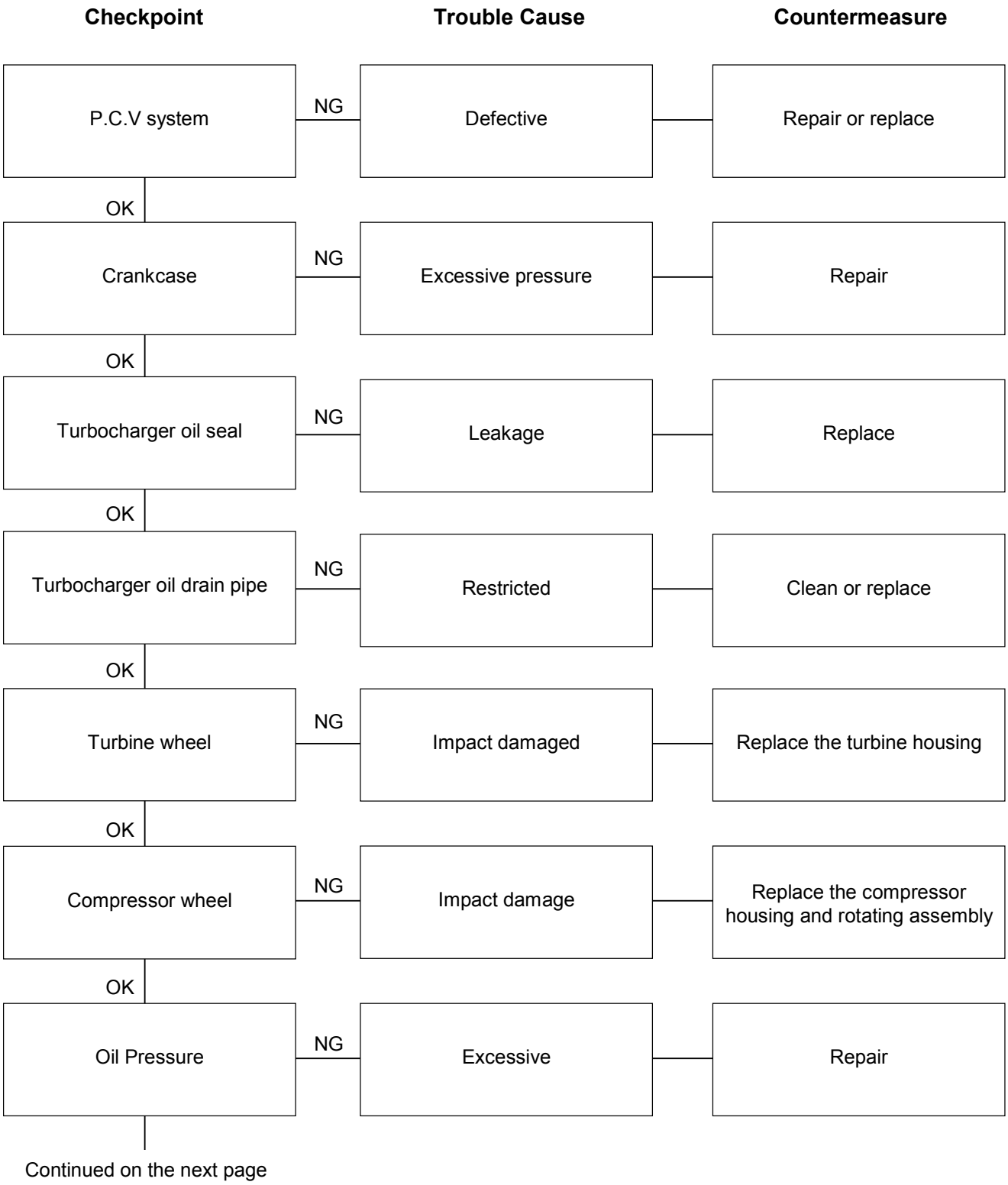
Checkpoint	Trouble Cause	Countermeasure

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OK

Checkpoint		Trouble Cause	Countermeasure
Center housing oil drain passage	NG	Restricted	Clean or replace

3) EXCESSIVE OIL CONSUMPTION



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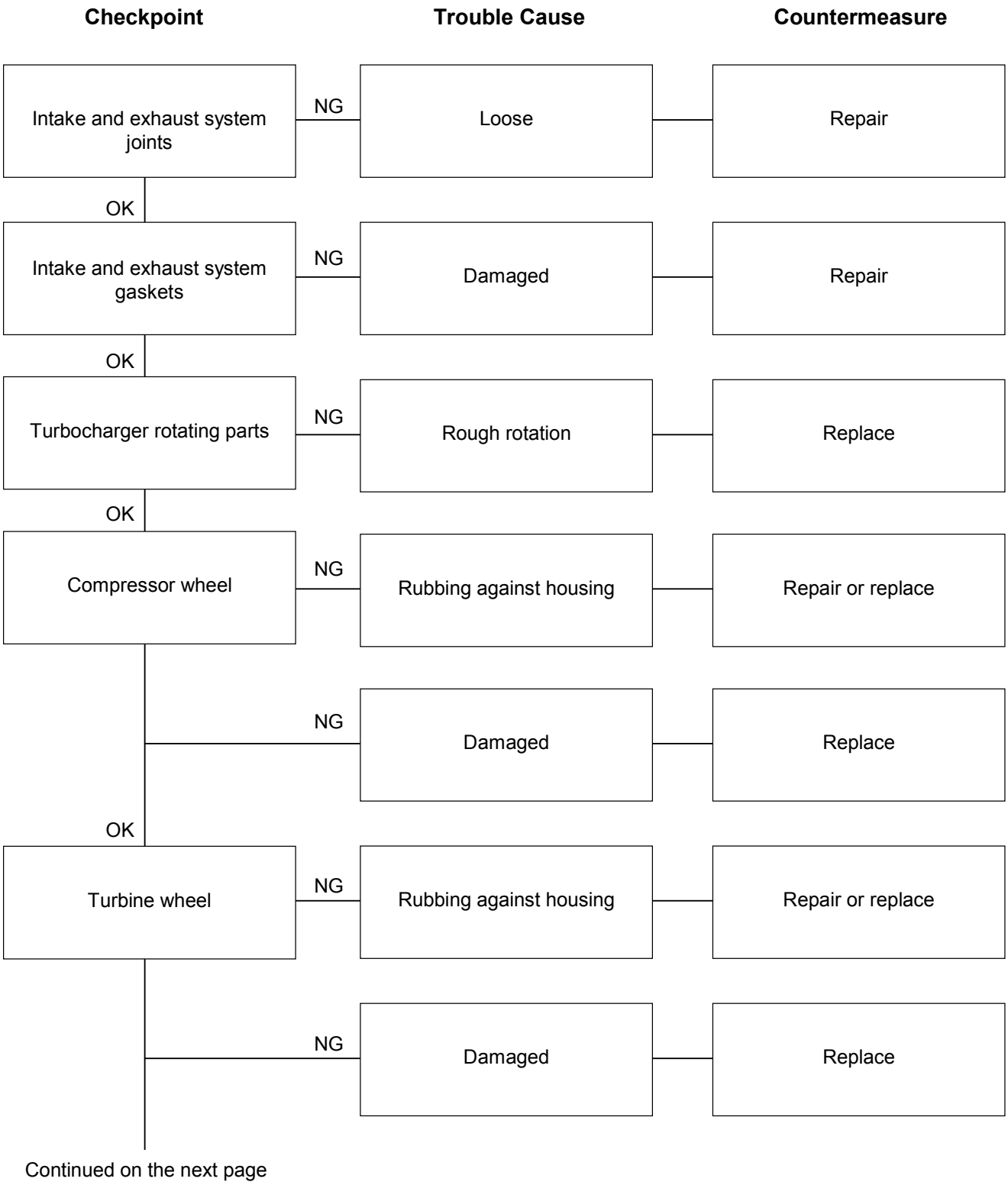
Checkpoint	Trouble Cause	Countermeasure

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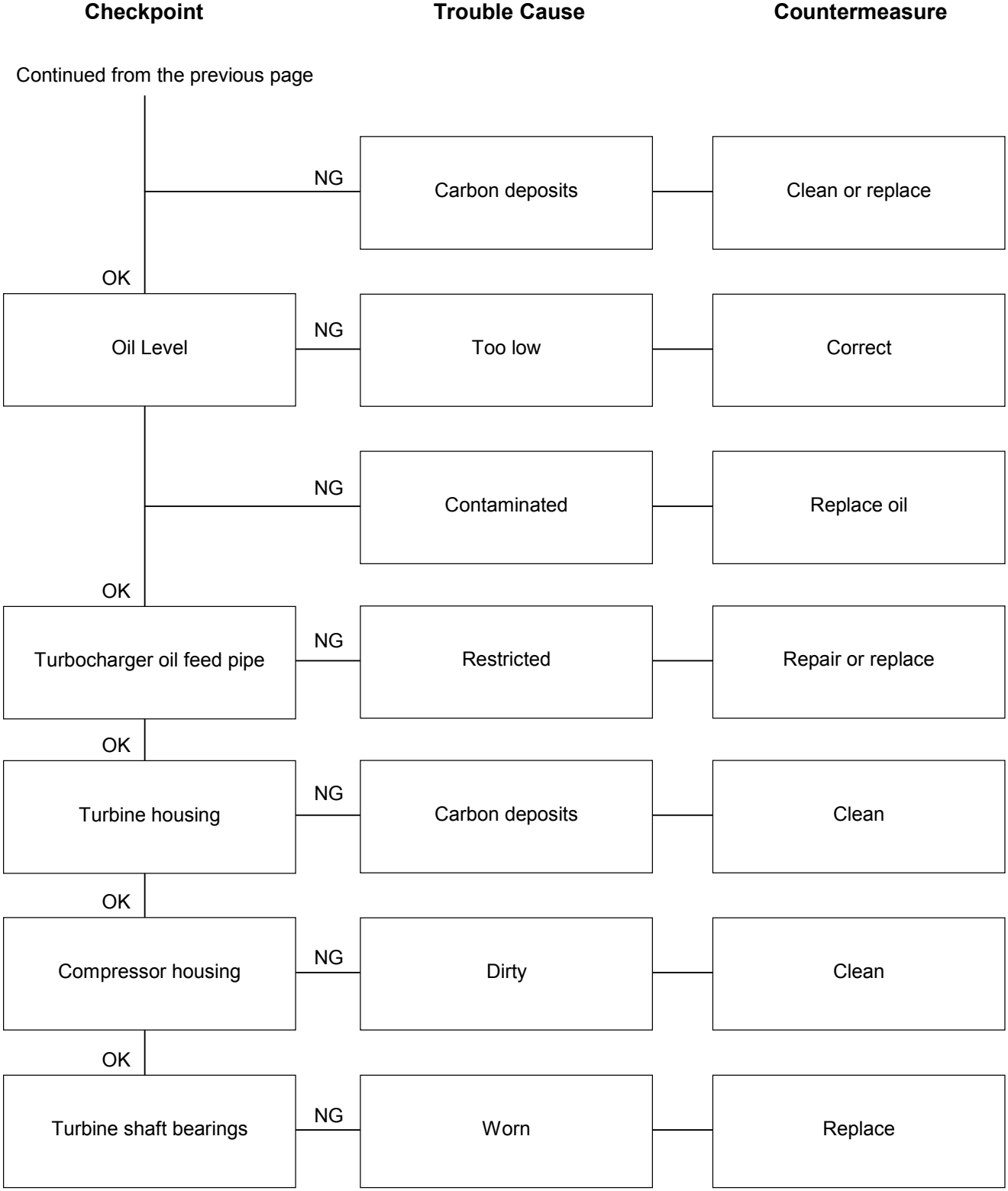
OK

Checkpoint		Trouble Cause	Countermeasure
Center housing oil drain passage	NG	Restricted	Clean or replace

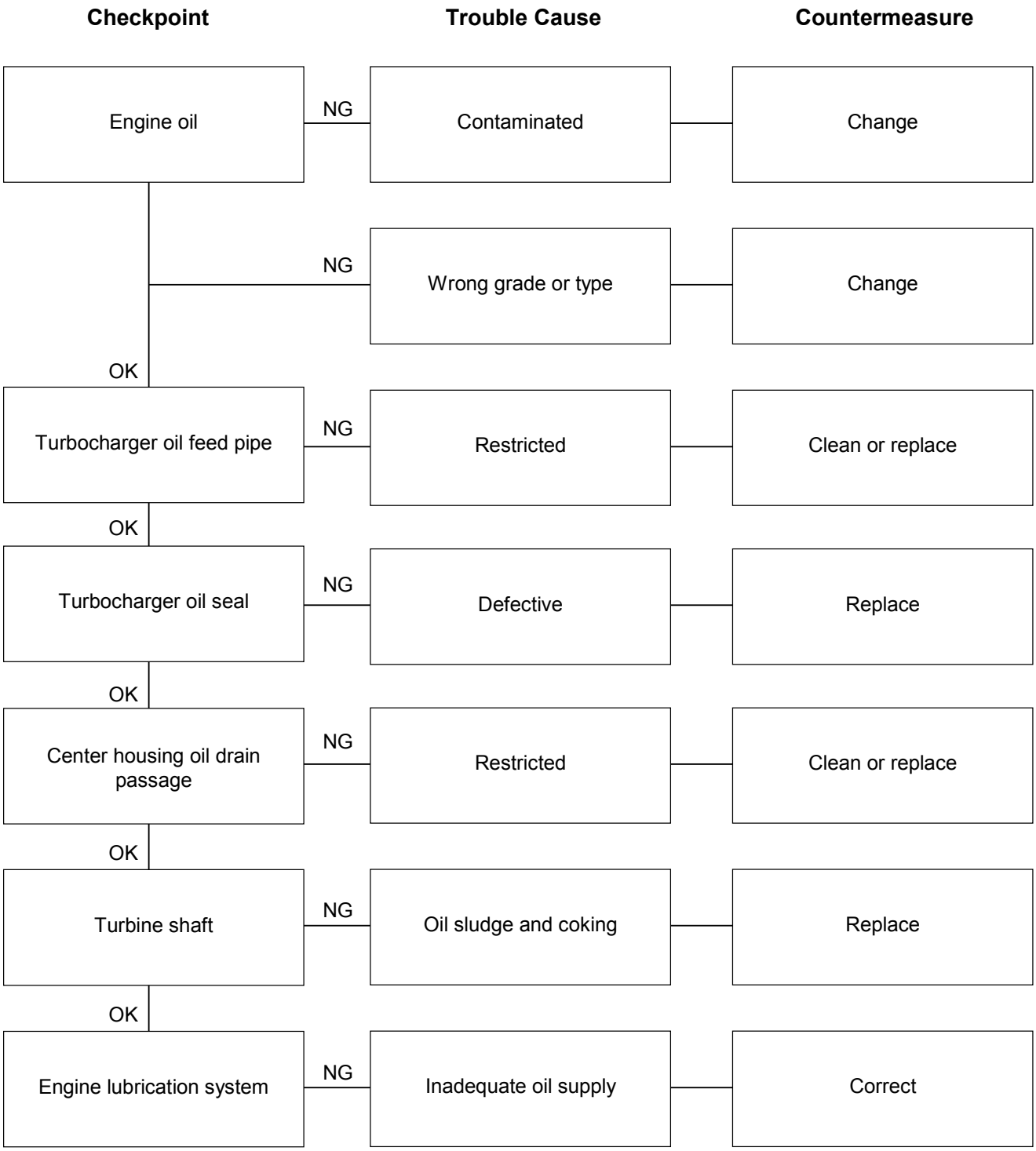
4) EXCESSIVE TURBOCHARGER NOISE



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Checkpoint
Trouble Cause
Countermeasure
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NG
Carbon deposits
Clean or replace
OK
Oil Level
NG
Too low
Correct
NG
Contaminated
Replace oil
OK
Turbocharger oil feed pipe
NG
Restricted
Repair or replace
OK
Turbine housing
NG
Carbon deposits
Clean
OK
Compressor housing
NG
Dirty
Clean
OK
Turbine shaft bearings
NG
Worn
Replace

5) EXCESSIVE ROTATING PART WEAR



MEMO

SECTION 6A
ENGINE MECHANICAL

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MAIN DATA AND SPECIFICATIONS

Item \ Engine model			4JA1	4JB1T
Engine type			Four-cycle, overhead valve, water cooled	
Combustion chamber type			Direct injection	
Cylinder liner type			Dry type, chrome plated, stainless steel tube	
Timing gear train system			Gear drive	
No. of cylinders-bore × stroke		mm (in)	4 – 93 × 92 (3.66 × 3.62)	4 – 93 × 102 (3.66 × 4.02)
No. of piston rings			Compression ring: 2 / Oil ring: 1	
Total piston displacement		cm^3 (in^3)	2,499 (152.4)	2,771 (169.0)
Compression ratio (to 1)			18.5	18.1
Compression pressure		kg/cm^2 (psi/MPa)	31 (441/3.0) – 200 rpm	
Engine weight		kg (lb)	Approximately 226 (498)	Approximately 250 (550)
Fuel injection order			1 – 3 – 4 - 2	
Fuel injection timing BTDC		deg	12	11
Specified fuel type			SAE No. 2 diesel fuel	
Idling speed		rpm	750	
Valve clearances (At cold): Intake		mm (in)	0.4 (0.016)	
	Exhaust	mm (in)	0.4 (0.016)	
Intake valves	Open at (BTDC)	deg	24.5	
	Close at (ABDC)	deg	55.5	
Exhaust valves	Open at (BBDC)	deg	54.0	
	Close at (ATDC)	deg	26.0	
Fuel system				
Injection pump type			BOSCH distributor VE type	
Governor type			Mechanical (Variable speed)	Mechanical (Limit speed)
Injection nozzle type			Hole with 5 orifices	
Injection nozzle opening pressure				
(Design value)		kg/cm^2 (psi/MPa)	185 (2,631/18.1)	
Single spring type				
Main fuel filter type			Cartridge paper element and water separator	
Lubricating system				
Lubricating method			Pressure circulation	
Specified engine oil (API grade)			CC or CD	CD
Oil pump type			Gear	
Oil filter type			Cartridge paper element	
Oil capacity		lit(US/UK gal)	6.5 (1.7/1.43)	
Oil cooler type			Water cooled	

4JB1T : 4JB1 Engine with turbocharger.

Item \ Engine model		4JA1	4JB1T
Cooling system			
Water pump type		Centrifugal	
Thermostat type		Wax pellet with jiggle valve	
Air cleaner type		Dry paper element	
Battery type/voltage × No. of units		95D31R-12 × 1	
Generator capacity	V-A (kw)	12 – 40 (480)	12 – 50 (600)
Starter motor output	V-kw	12 – 2.0 or 12 – 2.8	
Turbocharger model			*IHI RHF4H
Turbine type			Radial-inflow
Compressor type			Radial-outflow

*IHI : Ishikawajima-Harima Heavy Industries., Ltd.

MAIN DATA AND SPECIFICATIONS

Item \ Engine model			4JA1T (L)	4JG2T
Engine type			Four-cycle, overhead valve, water cooled	
Combustion chamber type			Direct injection	In Direct injection
Cylinder liner type			Dry type, chrome plated, stainless steel tube	
Timing gear train system			Belt drive	
No. of cylinders-bore × stroke		mm (in)	4 – 93 × 92 (3.66 × 3.62)	4 – 95.4 × 107 (3.76 × 4.21)
No. of piston rings			Compression ring: 2 / Oil ring: 1	
Total piston displacement		cm^3 (in^3)	2,499 (152.4)	3,059 (186.6)
Compression ratio (to 1)			18.5	20.0
Compression pressure		kg/cm^2 (psi/MPa)	31 (441/3.0) – 200 rpm	
Engine weight		kg (lb)	Approximately 226 (498)	Approximately 267 (588.7)
Fuel injection order			1 – 3 – 4 - 2	
Fuel injection timing BTDC		deg	12	0
Specified fuel type			EC diesel fuel	
Idling speed		rpm	770	720
Valve clearances (At cold): Intake		mm (in)	0.4 (0.016)	
	Exhaust	mm (in)	0.4 (0.016)	
Intake valves	Open at (BTDC)	deg	24.5	
	Close at (ABDC)	deg	55.5	
Exhaust valves	Open at (BBDC)	deg	54.0	
	Close at (ATDC)	deg	26.0	
Fuel system				
Injection pump type			BOSCH distributor VE type	
Governor type			Mechanical (HALF variable speed)	
Injection nozzle type			Hole with 5 orifices	Throttle
Injection nozzle opening pressure (Design value)		kg/cm^2 (psi/MPa)	185 (2,631/18.1)	150 (2,133/14.7)
Single spring type				
Main fuel filter type			Cartridge paper element and water separator	
Lubricating system				
Lubricating method			Pressure circulation	
Specified engine oil (API grade)			CD	
Oil pump type			Gear	
Oil filter type			Cartridge paper element	
Oil capacity		lit (US/UK gal)	6.5 (1.7/1.4)	6.5 (1.7/1.4) For 4 × 2 7.3 (1.9/1.6) For 4 × 4
Oil cooler type			Water cooled	

4JG2T : 4JG2 Engine with turbocharger. 4JA1T : 4JA1 Engine with turbocharger.

Item \ Engine model		4JA1T (L)	4JG2T
Cooling system			
Water pump type		Centrifugal	
Thermostat type		Wax pellet with jiggle valve	
Air cleaner type		Wet paper element	
Battery type/voltage × No. of units		95D31R-12 × 1	
Generator capacity	V-A (kw)	12 – 50 (600)	
Starter motor output	V-kw	12 – 2.3	12 – 2.8
Turbocharger model		IHI RHF 4H	IHI RHB52W (manual T/M)
			IHI RHF5 (automatic T/M)
Turbine type		Radial-inflow	
Compressor type		Radial-outflow	

*IHI : Ishikawajima-Harima Heavy Industries., Ltd.

MAIN DATA AND SPECIFICATIONS

Item \ Engine model			4JA1TC	4JH1TC
Engine type			Four-cycle, overhead valve, water cooled	
Combustion chamber type			Direct injection	
Cylinder liner type			Dry type, chrome plated, stainless steel tube	
Timing gear train system			Gear drive	
No. of cylinders-bore × stroke		mm (in)	4 – 93 × 92 (3.66 × 3.62)	4 – 95.4 × 104.9 (3.76 × 4.13)
No. of piston rings			Compression ring: 2 / Oil ring: 1	
Total piston displacement		cm^3 (in^3)	2,499 (152.4)	2,999 (183.3)
Compression ratio (to 1)			18.5	18.3
Compression pressure		kg/cm^2 (psi/MPa)	31 (441/3.0) – 200 rpm	28 (398/2.8) – 200 rpm
Engine weight		kg (lb)	Approximately 274 (604.2)	
Fuel injection order			1 – 3 – 4 - 2	
Fuel injection timing BTDC		deg	Not Adjustment	
Specified fuel type			EC diesel fuel	
Idling speed		rpm	730±25	700±25
Valve clearances (At cold): Intake		mm (in)	0.4 (0.016)	
	Exhaust	mm (in)	0.4 (0.016)	
Intake valves	Open at (BTDC)	deg	24.5	
	Close at (ABDC)	deg	55.5	
Exhaust valves	Open at (BBDC)	deg	54.0	
	Close at (ATDC)	deg	26.0	
Fuel system				
Injection pump type			BOSCH VP44 (electronic controlled fuel injection pump)	
Injection nozzle type			Double spring type (Hole type)	
Injection nozzle opening pressure (Design value)		kg/cm^2 (psi/MPa)	1st: 199(2,830/19.5) 2nd: 347(4,934/33,500)	1st: 198(2,816/19.4) 2nd: 344(4,906/33,800)
Number of injection nozzle orifices			5	
Main fuel filter type			Cartridge paper element and water separator	
Lubricating system				
Lubricating method			Pressure circulation	
Specified engine oil (API grade)			CD	
Oil pump type			Gear	
Oil filter type			Cartridge paper element	
Oil capacity		lit (US/UK gal)	6.5 (1.7/1.4) For 4 × 2 7.3 (1.9/1.6) For 4 × 4	
Oil cooler type			Water cooled	

4JA1TC, 4JH1TC : 4JA1, 4JH1 Engine with turbocharger and inter cooler

Item \ Engine model		4JA1TC	4JH1TC
Cooling system			
Water pump type		Centrifugal	
Thermostat type		Wax pellet with jiggle valve	
Air cleaner type		Wet paper element	
Battery type/voltage × No. of units		95D31R-12 × 1	
Generator capacity	V-A (kw)	12 – 60 (720)	
Starter motor output	V-kw	12 – 2.3	
Turbocharger model		*IHI RHF4H	*IHI RHF5H
Turbine type		Radial-inflow	
Compressor type		Radial-outflow	

*IHI : Ishikawajima-Harima Heavy Industries., Ltd.

TORQUE SPECIFICATIONS

STANDARD BOLTS

The torque values given in the following table should be applied whenever a particular torque is not specified.

kg·m (lb·ft/N·m)

Strength Class / Bolt Identification / Bolt Diameter × Pitch (mm)	4.8 (4T)	(7T)	8.8		9.8 (9T)
			Refined	Non-Refined	
Bolt Identification					
Bolt Diameter × Pitch (mm)	 No mark	——			
M 6 × 1.0	0.60 ± 0.20 (4.33 ± 1.44/5.88 ± 1.96)	0.75 ± 0.25 (5.43 ± 1.80/7.35 ± 2.45)			-
M 8 × 1.25	1.30 ± 0.50 (9.40 ± 3.62/12.74 ± 4.90)	1.75 ± 0.55 (12.66 ± 4.00/17.15 ± 5.39)			2.40 ± 0.70 (17.36 ± 5.06/23.52 ± 6.86)
M10 × 1.25	2.80 ± 0.70 (20.25 ± 5.06/27.44 ± 6.86)	3.75 ± 0.95 (27.12 ± 6.87/36.75 ± 9.31)			5.10 ± 1.30 (36.89 ± 9.40/49.98 ± 12.74)
M12 × 1.25	6.25 ± 1.25 (45.21 ± 9.04/61.25 ± 12.25)	7.75 ± 1.55 (56.06 ± 11.21/75.95 ± 15.19)			9.65 ± 1.95 (69.80 ± 14.10/94.57 ± 19.11)
M14 × 1.5	9.75 ± 1.95 (70.52 ± 14.10/95.55 ± 19.11)	11.85 ± 2.35 (85.71 ± 17.00/116.13 ± 23.03)			14.50 ± 2.90 (104.88 ± 21.00/142.10 ± 28.42)
M16 × 1.5	13.30 ± 2.70 (96.20 ± 19.53/130.34 ± 26.46)	17.30 ± 3.50 (125.13 ± 25.32/169.54 ± 34.30)			20.40 ± 4.10 (147.55 ± 29.66/199.92 ± 40.18)
M18 × 1.5	19.20 ± 3.80 (138.87 ± 27.49/188.16 ± 37.24)	24.90 ± 5.00 (180.10 ± 36.17/244.02 ± 49.00)			29.30 ± 5.90 (211.93 ± 42.67/287.14 ± 57.82)
M20 × 1.5	26.30 ± 5.30 (190.23 ± 38.33/257.74 ± 51.94)	34.40 ± 6.90 (248.82 ± 49.41/337.12 ± 67.62)			40.40 ± 8.10 (292.21 ± 58.59/395.92 ± 79.38)
M22 × 1.5	33.90 ± 8.30 (245.20 ± 60.03/332.22 ± 81.34)	46.25 ± 9.25 (334.53 ± 66.91/453.25 ± 90.65)			54.10 ± 10.80 (391.30 ± 78.12/530.18 ± 105.84)
M24 × 2.0	45.80 ± 9.20 (331.27 ± 66.54/448.84 ± 90.16)	58.20 ± 14.30 (420.96 ± 103.43/570.36 ± 140.14)			70.60 ± 14.10 (510.65 ± 101.99/691.88 ± 138.18)
*** M10 × 1.5**	2.70 ± 0.70 (19.53 ± 5.06/26.46 ± 6.86)	3.70 ± 0.90 (26.76 ± 6.50/36.26 ± 8.82)			4.90 ± 1.20 (35.44 ± 8.68/48.02 ± 11.76)
*** M12 × 1.5**	5.80 ± 1.20 (41.95 ± 8.68/56.84 ± 11.76)	7.20 ± 1.40 (52.08 ± 10.13/70.56 ± 13.72)			9.10 ± 1.80 (65.82 ± 13.02/89.18 ± 17.64)
*** M14 × 2.0**	9.10 ± 1.80 (65.82 ± 13.02/89.18 ± 17.64)	11.20 ± 2.20 (81.01 ± 15.91/109.76 ± 21.56)			13.60 ± 2.70 (98.37 ± 19.53/133.28 ± 26.46)
*** M16 × 2.0**	12.70 ± 2.50 (91.86 ± 18.08/124.46 ± 24.50)	16.50 ± 3.30 (119.34 ± 23.87/161.70 ± 32.34)			19.50 ± 3.90 (141.04 ± 28.21/191.10 ± 38.22)

An asterisk (*) indicates that the bolts are used for female threaded parts that are made of soft materials such as casting. Those shown in parentheses in the strength class indicate the classification by the old standard.

FLARE NUTS

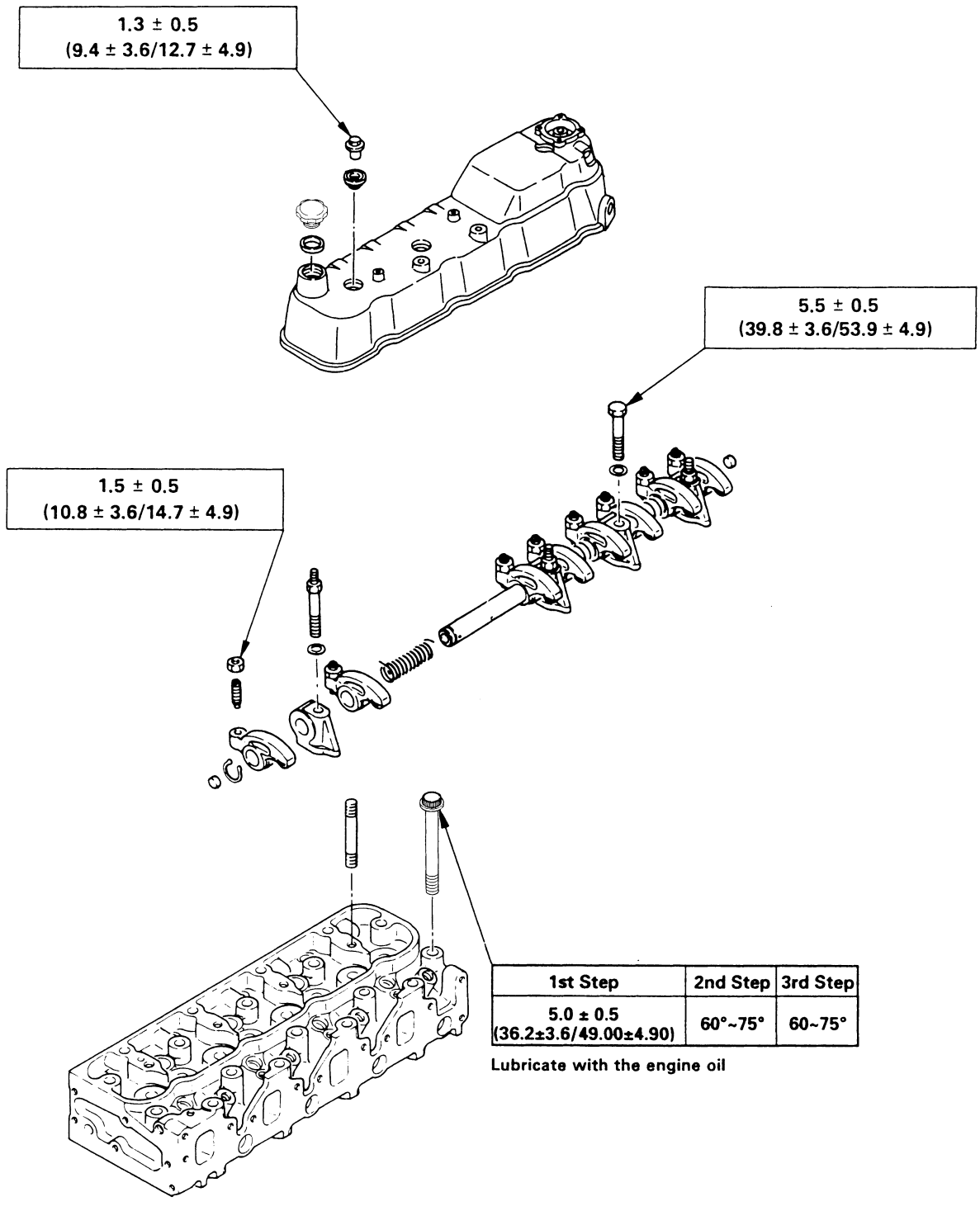
kg·m (lb·ft/N·m)

Pipe diameter mm (in)	Torque	Pipe diameter mm (in)	Torque
4.76 (0.187)	1.55 ± 0.25 (11.2 ± 1.8/15.2 ± 2.45)	10.00 (0.394)	5.50 ± 0.5 (39.7 ± 3.6/53.95 ± 4.90)
6.35 (0.250)	2.70 ± 0.30 (19.5 ± 2.1/26.48 ± 2.94)	12.00 (0.472)	9.00 ± 1.0 (65.0 ± 7.2/88.29 ± 9.80)
8.00 (0.315)	4.50 ± 0.50 (32.5 ± 3.6/44.14 ± 4.90)	15.00 (0.591)	10.75 ± 1.25 (77.7 ± 9.0/105.45 ± 12.26)

SPECIAL PARTS FIXING NUTS AND BOLTS

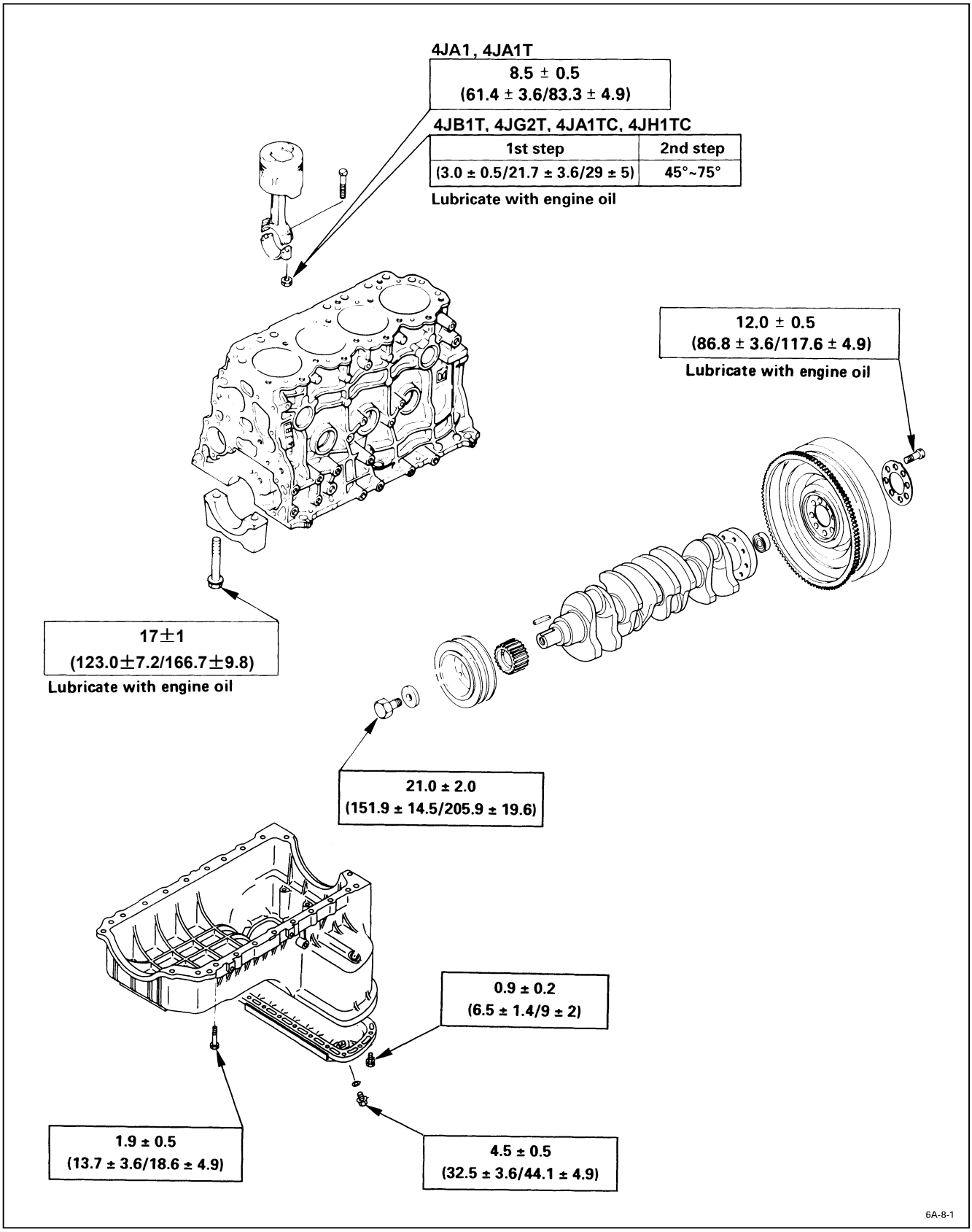
Cylinder Head Cover, Cylinder Head, and Rocker Arm Shaft Bracket

kg·m (lb·ft/N·m)



Crankshaft Bearing Cap, Connecting Rod Bearing Cap, Crankshaft Damper Pulley, Flywheel, and Oil Pan

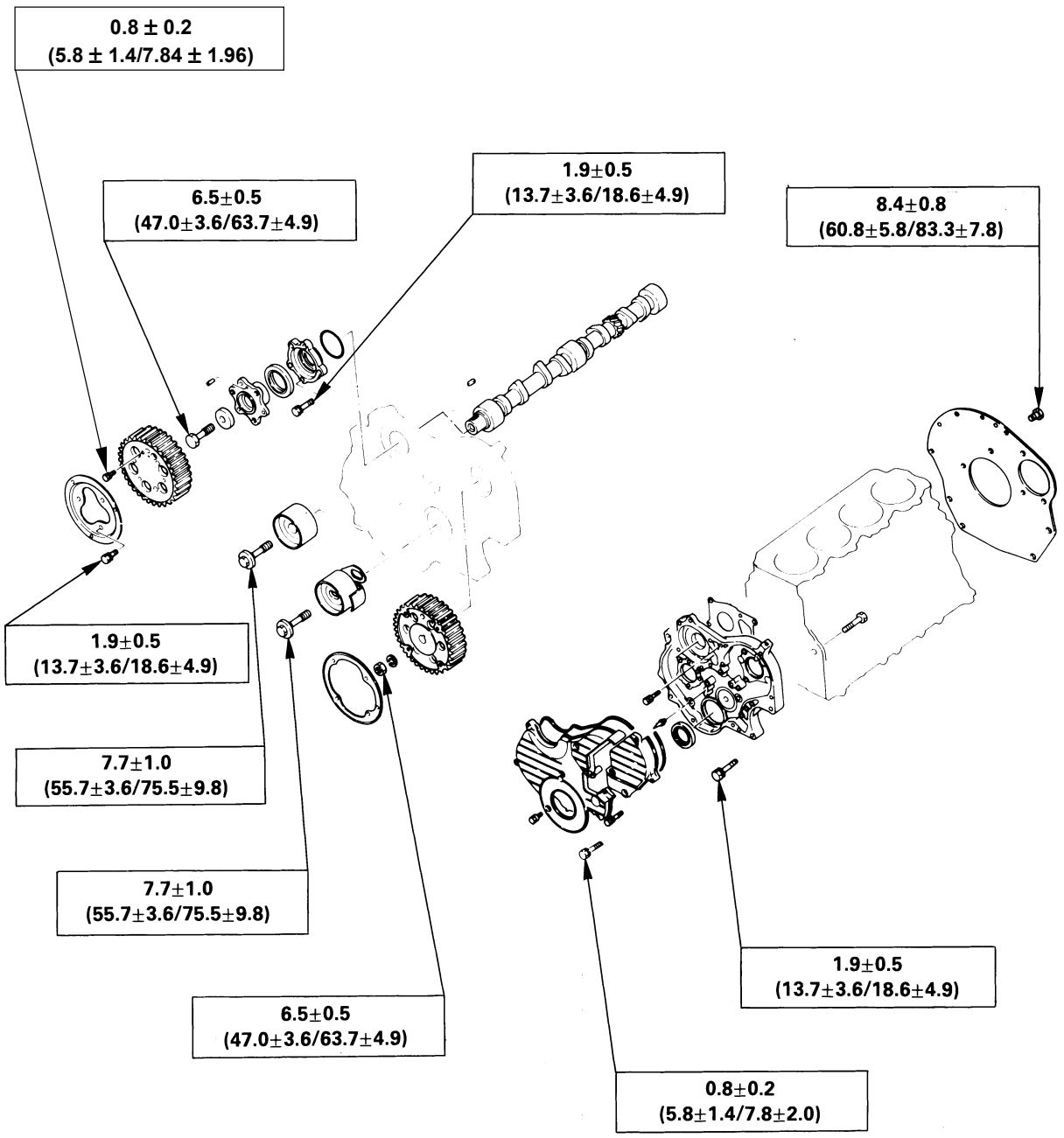
kg·m (lb·ft/N·m)



Timing Pulley, and Camshaft

kg·m (lb·ft/N·m)

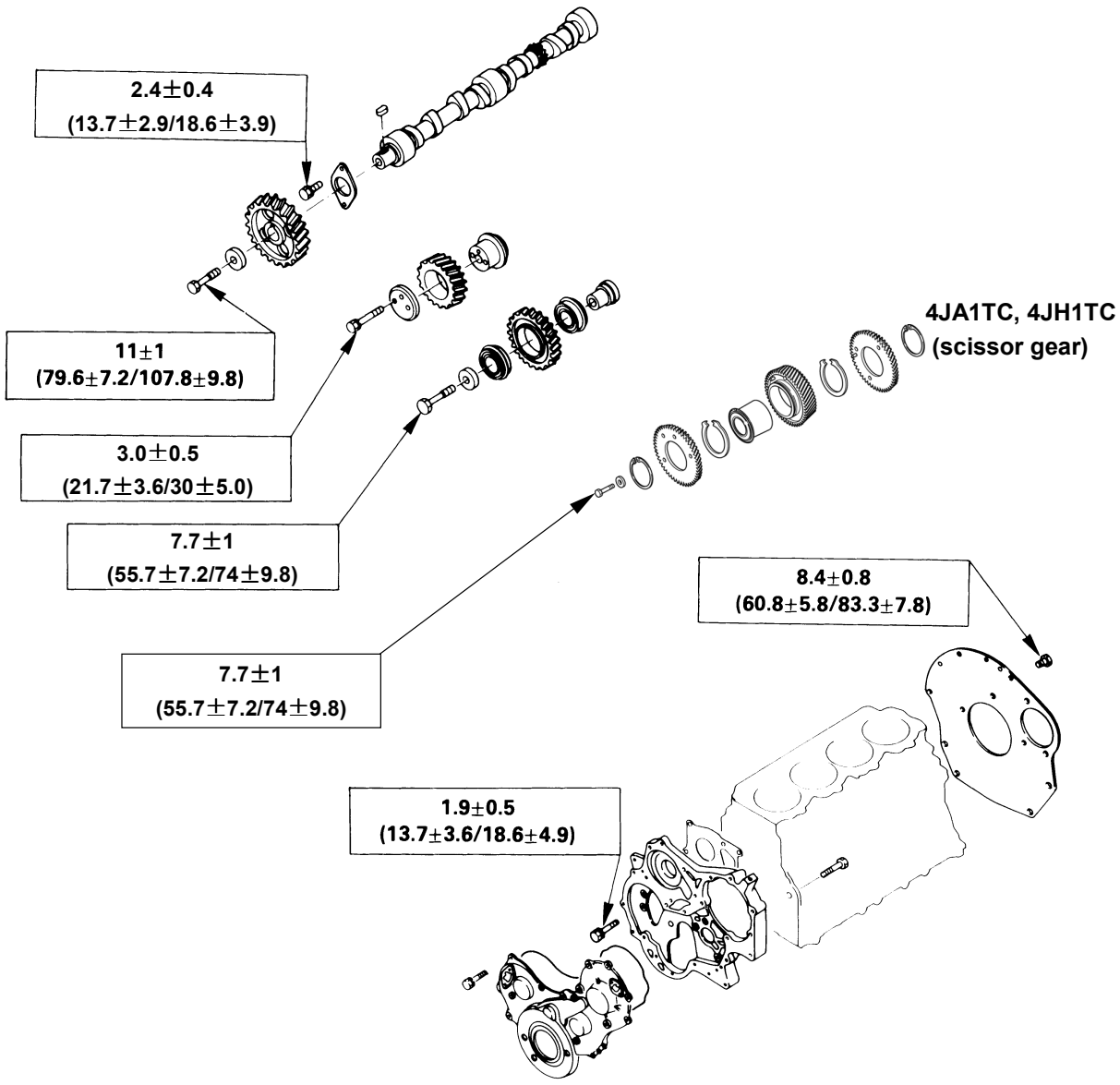
Belt Drive Type



Timing Gear Case, Pulley Housing, Timing Gear, and Camshaft

kg·m (lb·ft/N·m)

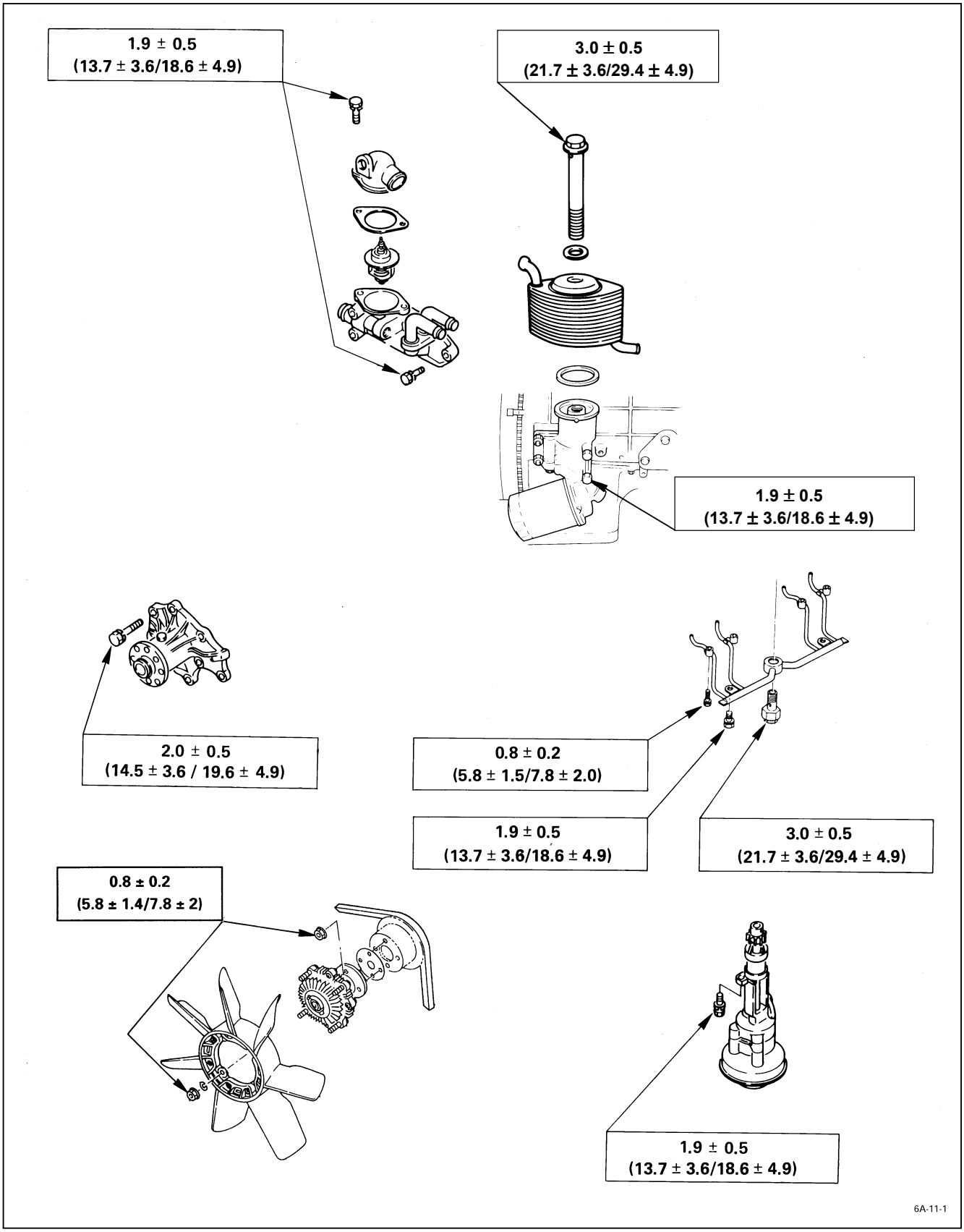
Gear Drive Type



6A-10-1

Cooling and Lubricating System

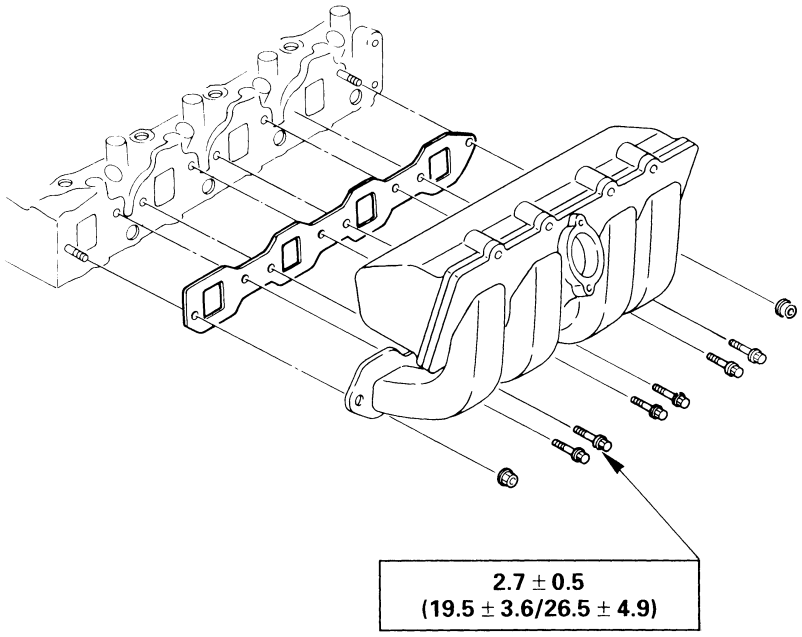
kg·m (lb·ft/N·m)

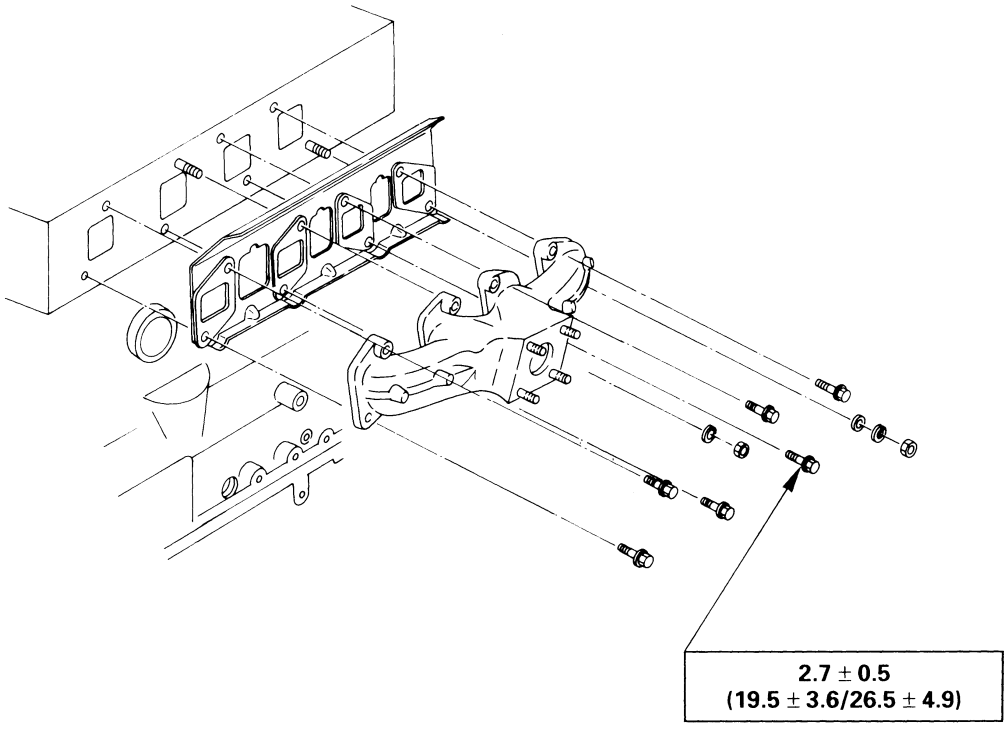


Intake and Exhaust Manifold

kg·m (lb·ft/N·m)

4JA1 ENGINE Model



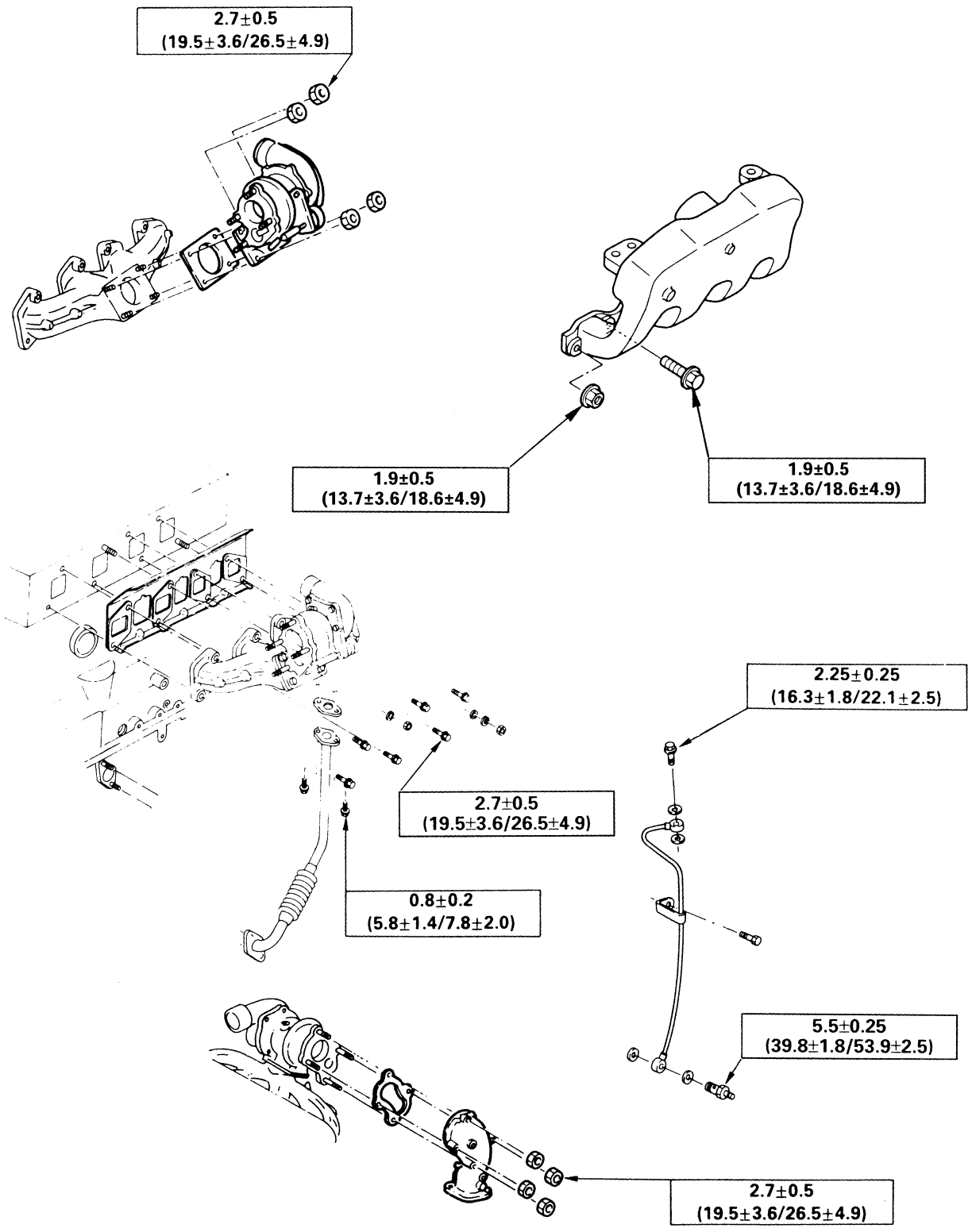


6A-12-1

Intake Manifold, Exhaust Manifold, and Turbocharger

kg·m (lb·ft/N·m)

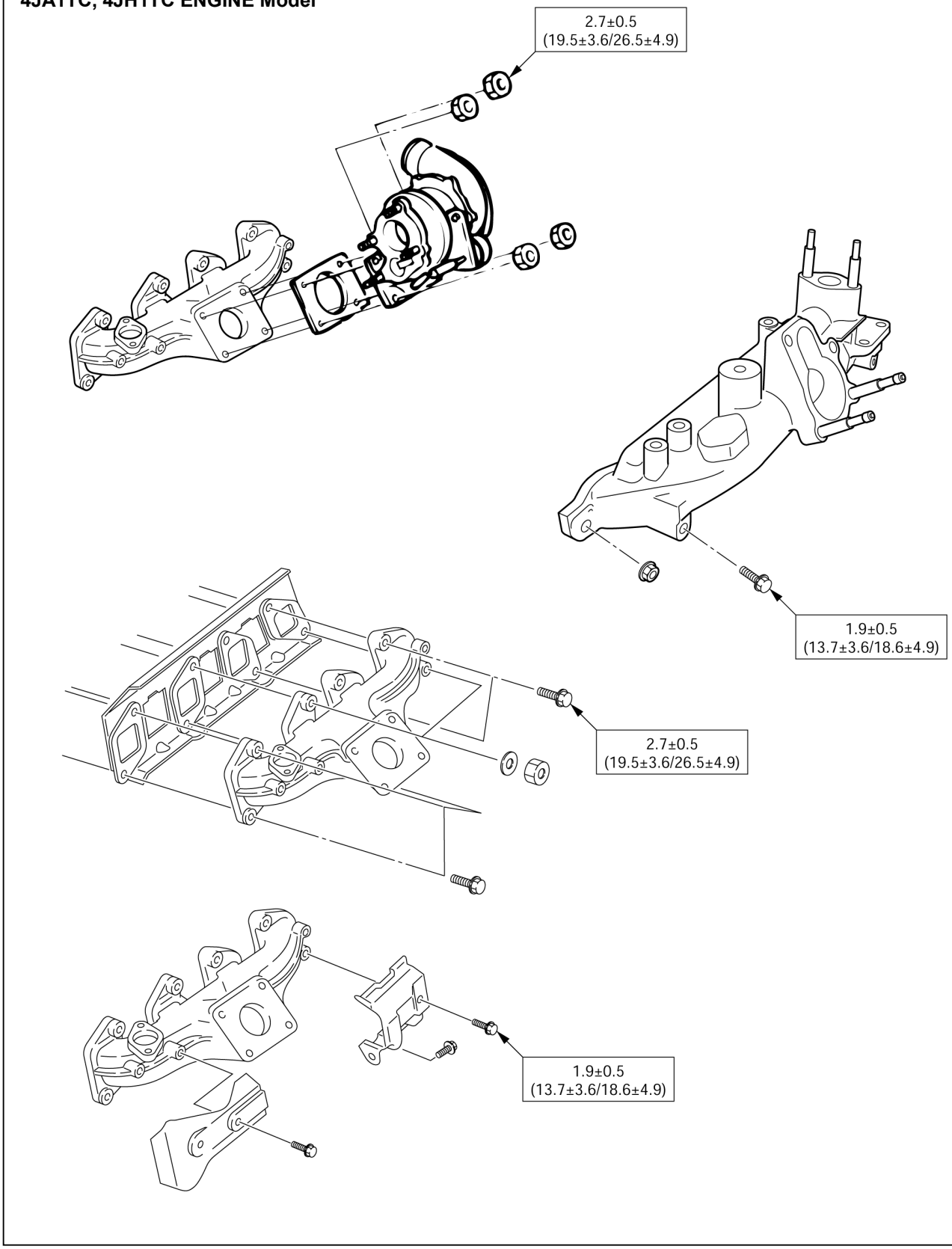
4JB1T, 4JA1T, 4JG2T ENGINE Model



Intake Manifold, Exhaust Manifold, and Turbocharger

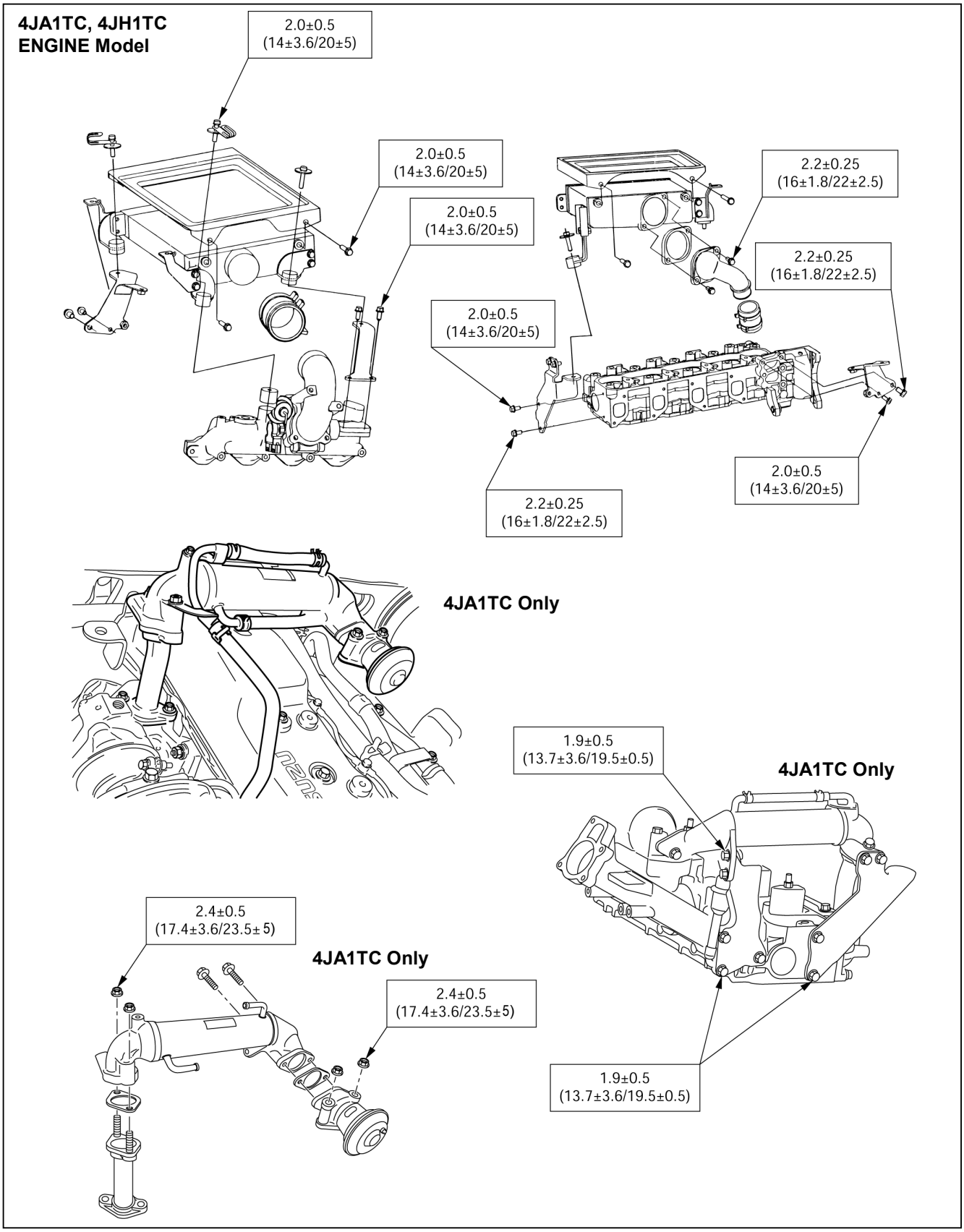
kg·m (lb·ft/N·m)

4JA1TC, 4JH1TC ENGINE Model



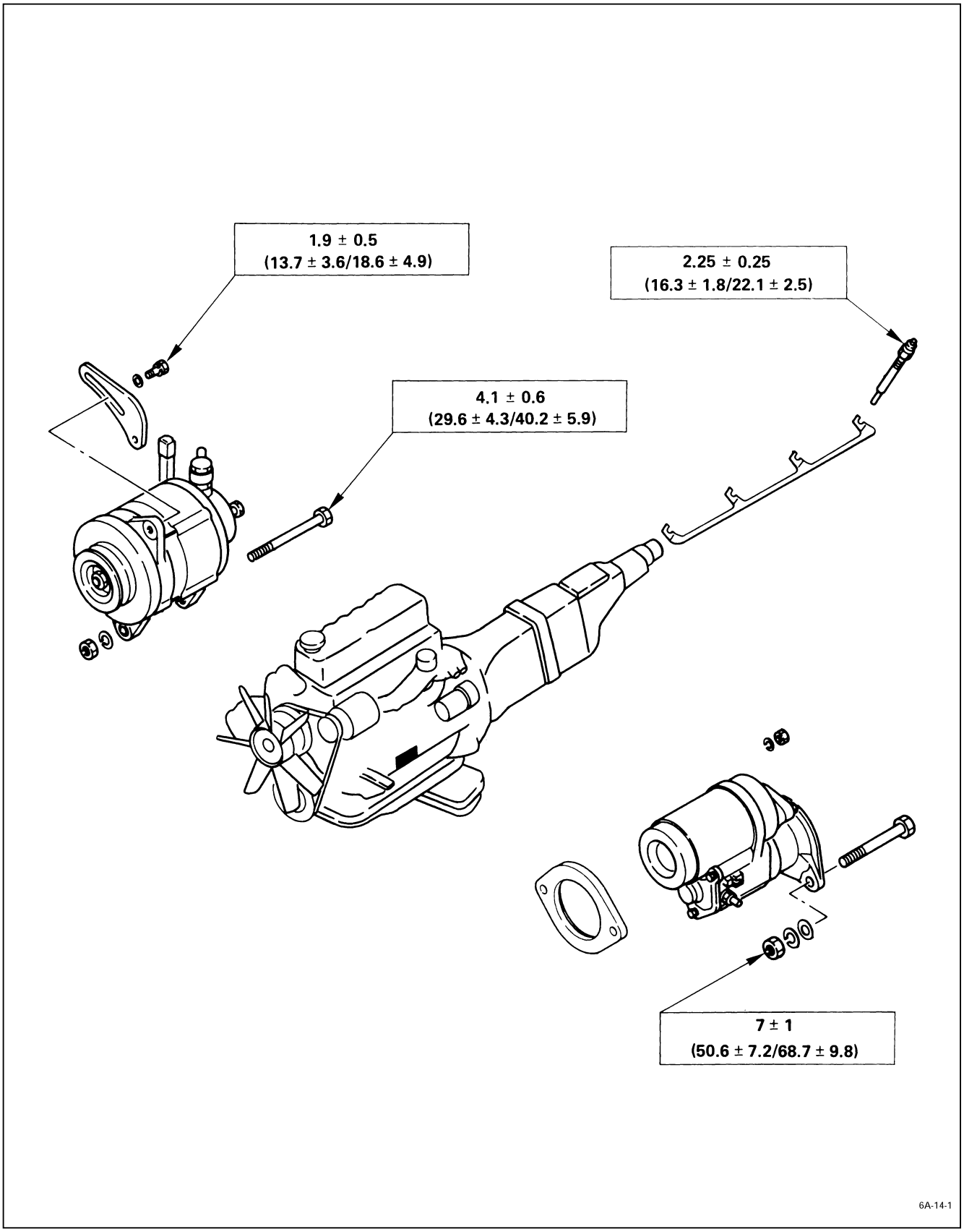
Inter Cooler, EGR Cooler

kg·m (lb·ft/N·m)



Engine Electricals

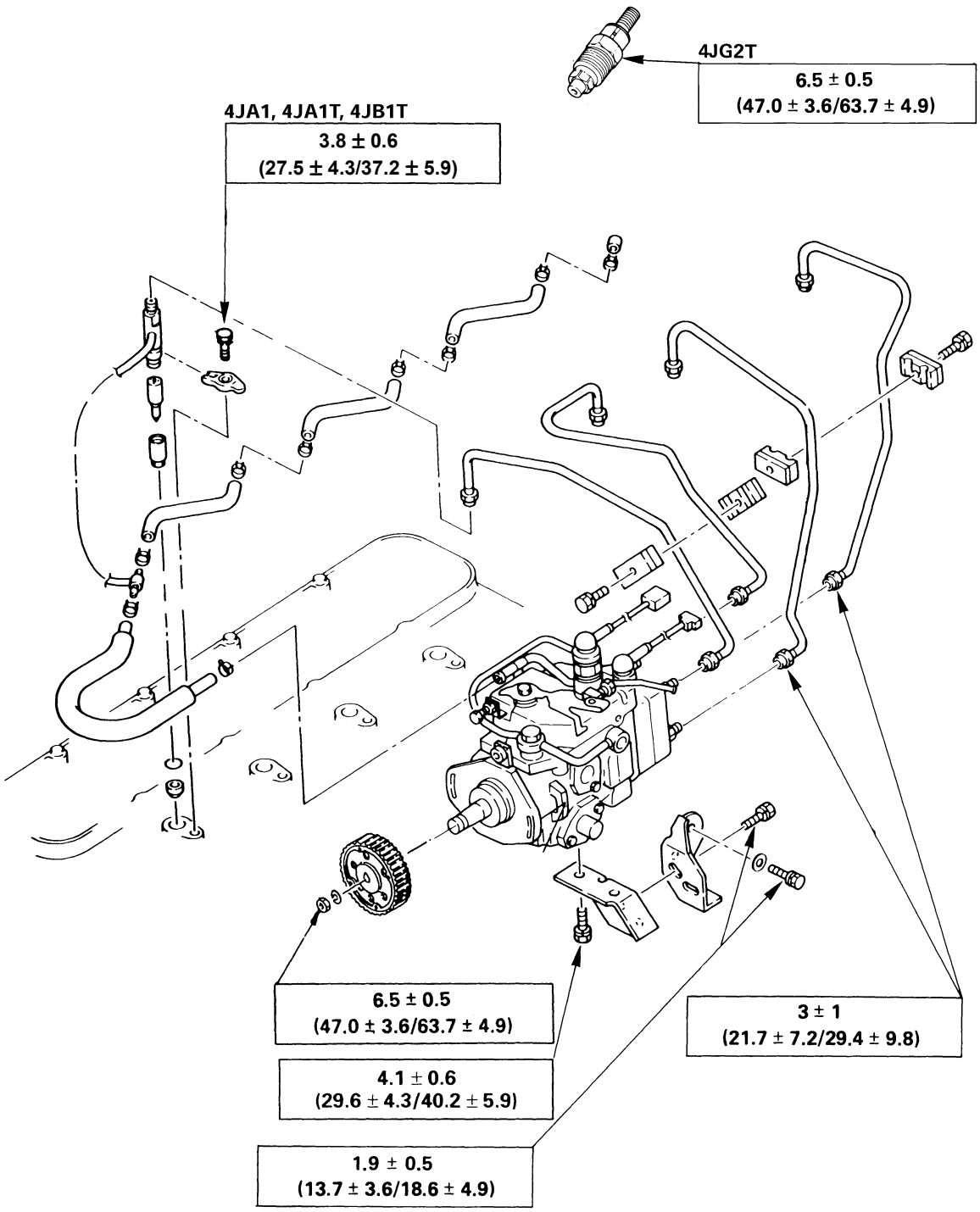
kg·m (lb·ft/N·m)



Fuel Injection System

kg·m (lb·ft/N·m)

4JA1, 4JA1T, 4JB1T, 4JG2T ENGINE Model

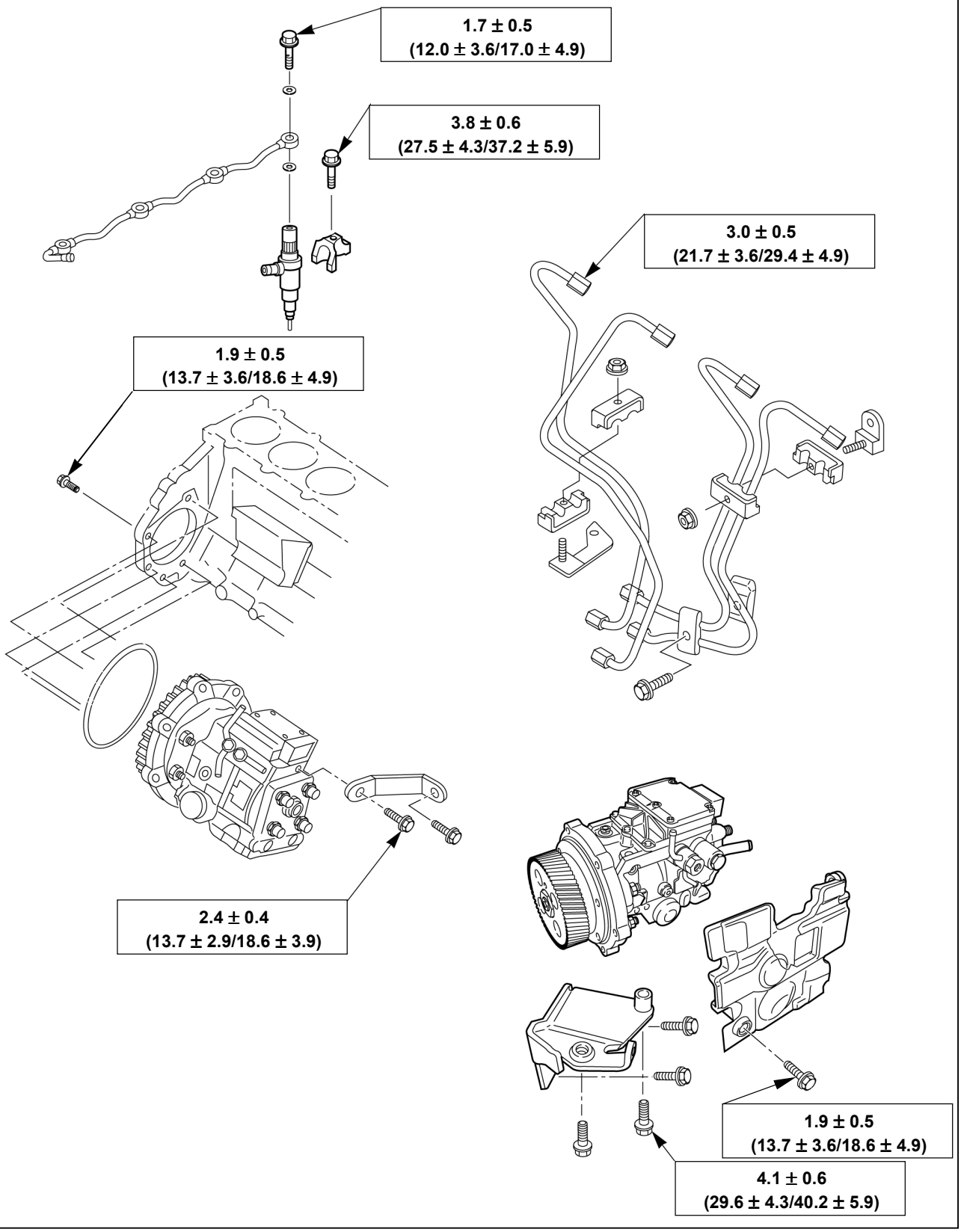


6A-15-1

Fuel Injection System

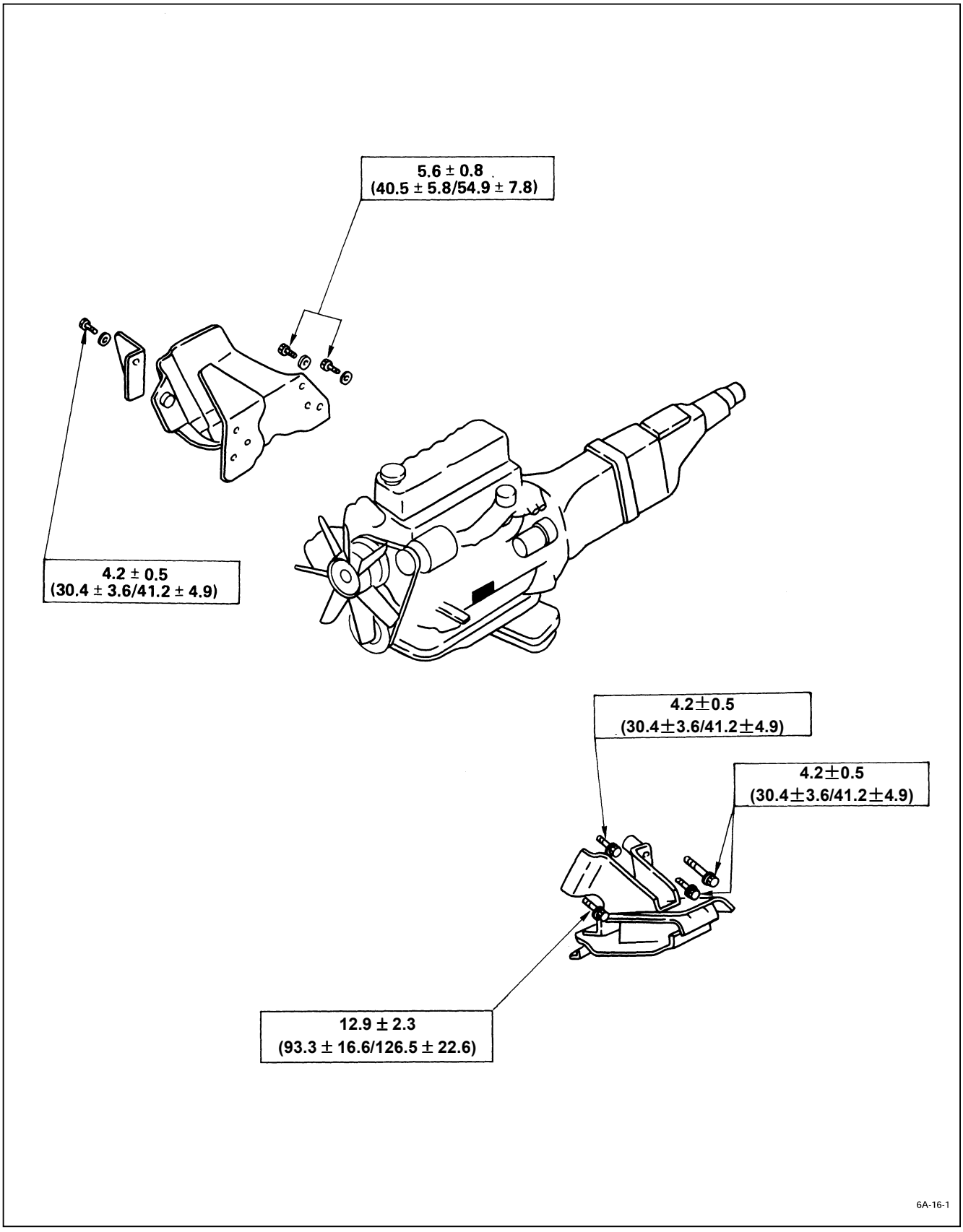
kg·m (lb·ft/N·m)

4JA1TC, 4JH1TC ENGINE Model



Engine Mounting Bracket

kg·m (lb·ft/N·m)



RECOMMENDED LIQUID GASKET

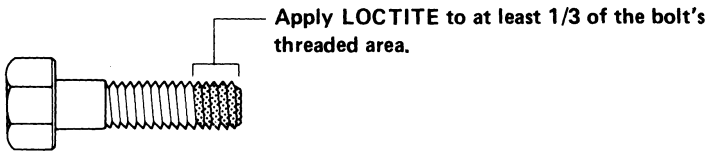
Type	Brand Name	Manufacturer	Remarks
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C	Three Bond Three Bond	
Water Base	ThreeBond 1141E	Three Bond	
Solvent	ThreeBond 1104 BelcoBond 4 BelcoBond 401 BelcoBond 402	Three Bond Isuzu Isuzu Isuzu	
Anaerobic	LOCTITE 515 LOCTITE 518	Loctite Loctite	Recommended for transaxle repairs

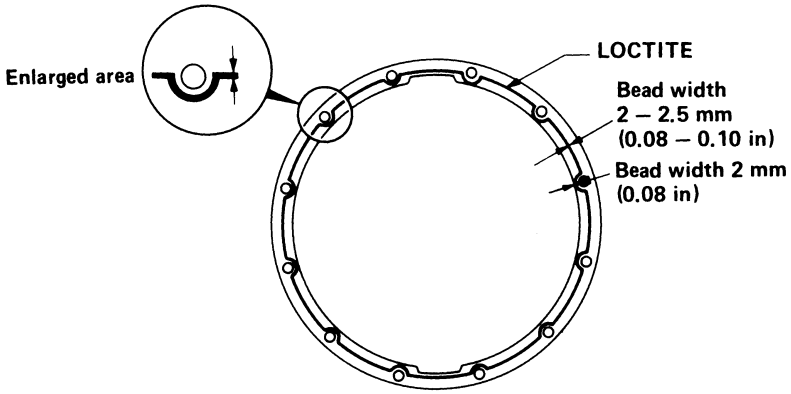
* RTV : Room Temperature Vulcanizer

Note:

1. **It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.**
2. **Be careful to use the specified amount of liquid gasket.**
   Follow the manufacturer's instructions at all times.
3. **Be absolutely sure to remove all lubricants and moisture from the connecting surfaces before applying the liquid gasket.**
   The connecting surfaces must be perfectly dry.
4. **LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.**
   Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.01 in). Poor adhesion will result.

LOCTITE APPLICATION PROCEDURE

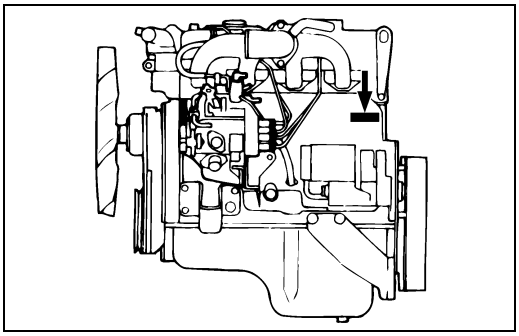
<table>
<tr><th>LOCTITE Type</th><th>LOCTITE Color</th><th>Application Steps</th></tr>
<tr><td>LOCTITE 242</td><td>Blue</td><td rowspan="4">1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined.
The surfaces must be perfectly dry.
2. Apply LOCTITE to the bolts.
 

3. Tighten the bolts to the specified torque.
4. Wait at least one hour before continuing the installation procedure.</td></tr>
<tr><td>LOCTITE 262</td><td>Red</td></tr>
<tr><td>LOCTITE 270</td><td>Green</td></tr>
<tr><td>LOCTITE 271</td><td>Red</td></tr>
<tr><td>LOCTITE 515</td><td>Violet</td><td>1. Completely remove lubricant and moisture from the connecting surfaces.
The surfaces must be perfectly dry.
2. Apply a 2.0 – 2.5 mm bead of LOCTITE to one of the connecting surfaces.
There must be no gaps in the bead.
 

3. Tighten the bolts to the specified torque.
4. Let the joined parts set for at least thirty minutes.</td></tr>
</table>

SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.

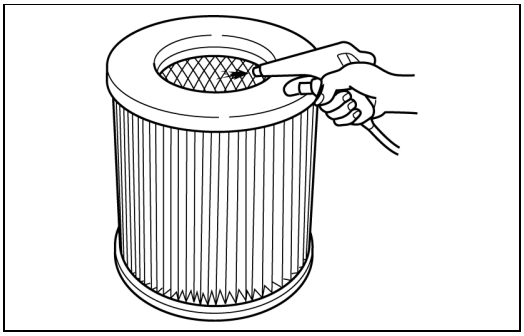


A06RY00006

MODEL IDENTIFICATION

Engine Serial Number

The engine number is stamped on the front left hand side of the cylinder body.



AIR CLEANER

Element cleaning procedures will vary according to the condition of the element.

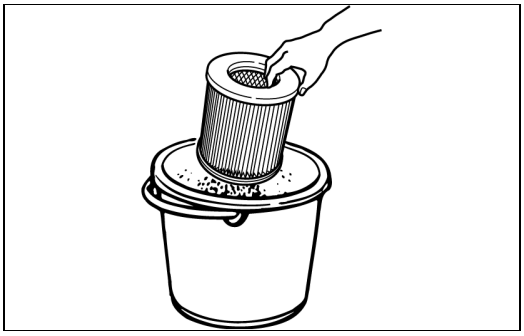
Oil Wetted (Viscous Type) Paper Element

The air cleaner has an oil wetted paper element. No servicing is required until the replacement interval is reached. Never attempt to clean the element, no matter how dirty may appear. The element is designed to provide normal filtering efficiency until it becomes due for replacement. Refer to the Item “Service and Maintenance” in the Owner’s and Driver’s Manual for general service information.

Dust Fouled Element

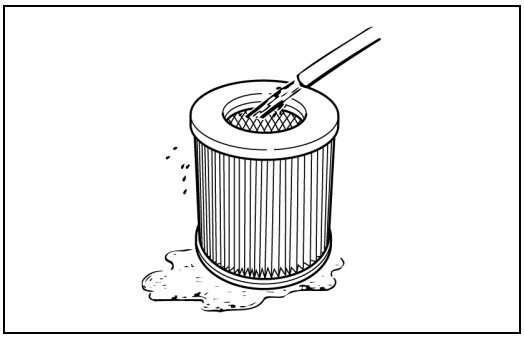
Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure must not exceed 7 kg/cm^2 (100 psi/690 kPa).

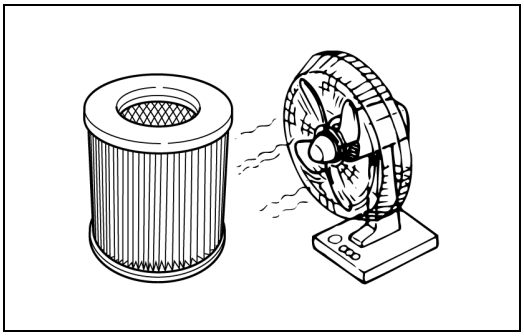


Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Submerge the element in the solution for twenty minutes.



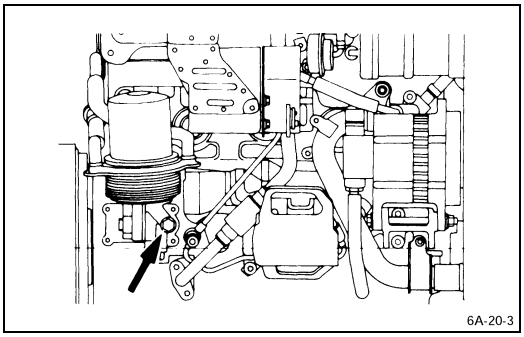
3. Remove the element from the solution and rinse it well with running water.
   Water pressure must not exceed 2.8 kg/cm^2 (40 psi/270 kPa).



4. Dry the element in a well ventilated area.
   An electric fan will hasten drying.

Note:

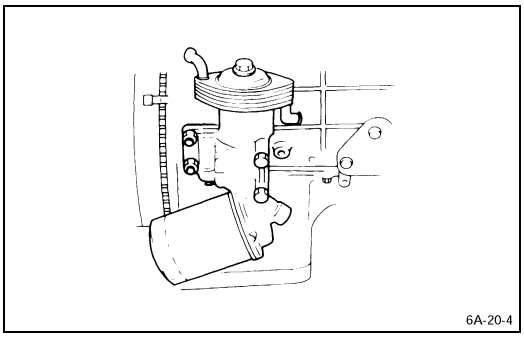
Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result. It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.



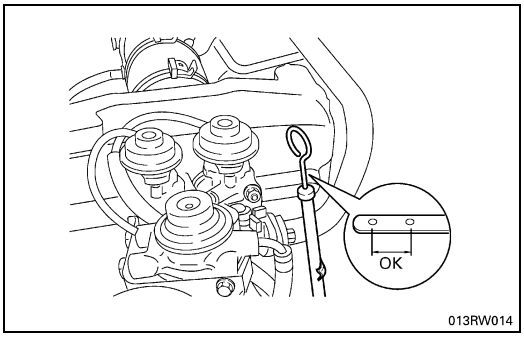
LUBRICATING SYSTEM

Main Oil Filter (Cartridge Type Paper Element) Replacement Procedure

1. Loosen the drain plug to drain the engine oil.
2. Wait a few minutes and then retighten the drain plug.
3. Loosen the used oil filter by turning it counterclockwise with a filter wrench.



4. Clean the oil cooler fitting face. This will allow the new oil filter to seat properly.
5. Apply a light coat of engine oil to the O-ring.
6. Turn in the new oil filter until the filter O-ring is fitted against the sealing face.
7. Use the filter wrench to turn in the filter an additional 1 and 1/8 turns.
   Filter Wrench: 5-8840-0200-0 (4JB1T, 4JG2T, 4JA1T, 4JA1TC, 4JH1TC)
   : 5-8840-0201-0 (4JA1)

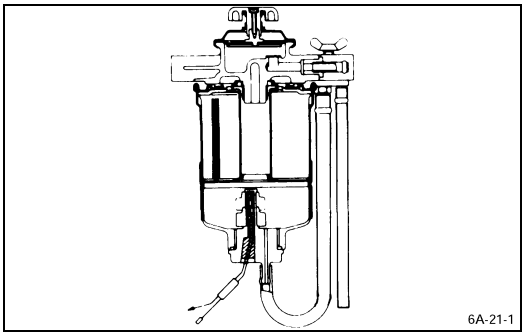


8. Check the engine oil level and replenish to the specified level if required.

Replenished Engine Oil — lit (US/UK gal)

4JA1, 4JA1T 4JB1T	4 × 2	6.5 (1.7/1.4)
	4 × 4	
4JG2T, 4JA1-TC 4JH1TC	4 × 2	6.5 (1.7/1.4)
	4 × 4	7.3 (1.9/1.6)

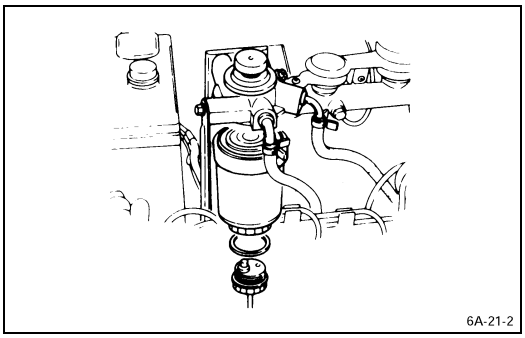
9. Start the engine and check for oil leakage from the main oil filter.



FUEL SYSTEM

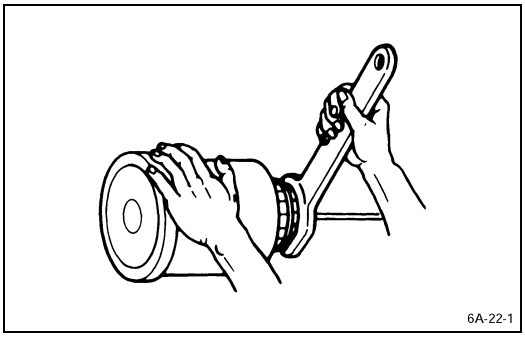
Fuel Filter Replacement Procedure

1. Place the end of the vinyl hose (beneath the drain plug) in a container.
2. Open the drain plug.
3. Operate the priming pump several times to drain water from the fuel filter.
4. Close the drain plug.
5. Operate the priming pump and check for fuel leakage.
6. Check that the water level warning light is off.



Fuel Filter Replacement Procedure

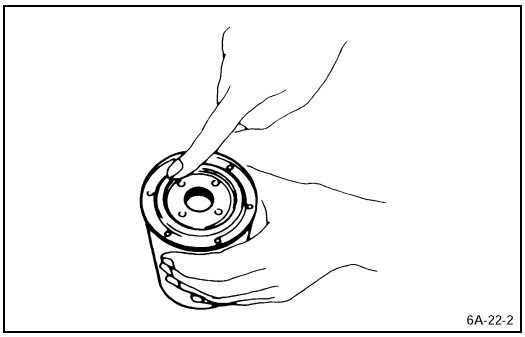
1. Remove the fuel filter by turning it counterclockwise with a filter wrench.
   Filter Wrench: 5-8840-0253-0 (J-22700)
2. Remove the level sensor from the filter by turning it counterclockwise with a wrench.



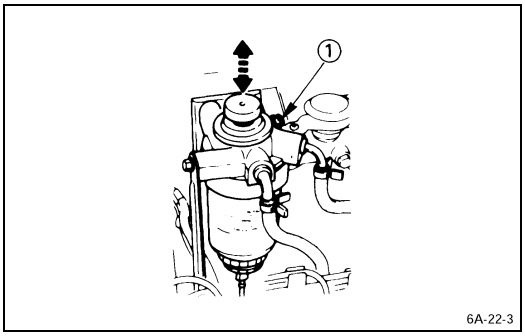
3. Install the level sensor to the water separator body with wrench.

Level Sensor Torque	kg·m (lb.in/N·m)
	1.3 (113/13)

4. Clean the water separator cover fitting faces.
   This will allow the new fuel filter to seat properly.



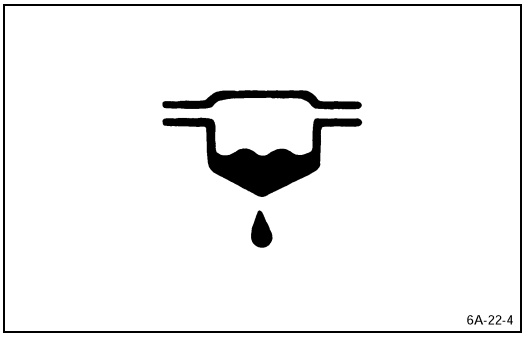
5. Apply a light coat of engine oil to the O-ring.
6. Turn in the fuel filter until the sealing face comes in contact with the O-ring.
7. Turn in the fuel filter an additional 2/3 of a turn with a filter wrench.
   Filter Wrench : 5-8840-0253-0 (J-22700)



8. Loosen the bleeder plug ① on the priming pump body.
9. Operate the priming pump until fuel begins to flow from the fuel filter.
10. Retighten the bleeder plug ①.
11. Operate the priming pump several times and check for fuel leakage.

Note:

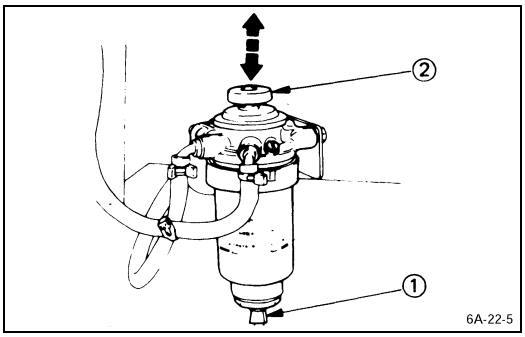
The use of an ISUZU genuine fuel filter is strongly recommended.



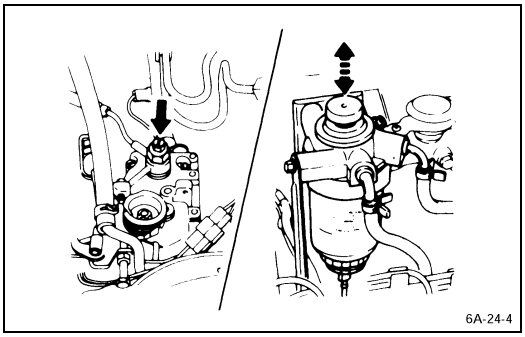
Draining Procedure

The indicator light will come on when the water level in the water separator exceeds the specified level.

Drain the water and foreign material from the water separator with the following procedure.



1. Place the end of the vinyl hose (beneath the drain plug) in a container.
2. Loosen the drain plug ①.
3. Operate the priming pump ② several times to drain the water.
4. After draining the water, tighten the drain plug ① .
5. Operate the priming pump several times and check for fuel leakage.
6. Check the water separator indicator light. It should be off.



Air Bleeding

1. Loosen the bleeder screw on the injection pump overflow valve.
2. Operate the priming pump until fuel mixed with foam flows from the bleeder screw.
3. Tighten the bleeder screw.
4. Operate the priming pump several times and check for fuel leakage.

Injection Pump Air Bleeding (4JA1TC, 4JH1TC)

Injection pump air bleeding is required to start the engine when —

- The fuel supply has been exhausted (running out of gas).
- The fuel filter has been replaced.
- The injection pump has been replaced.

CAUTION:

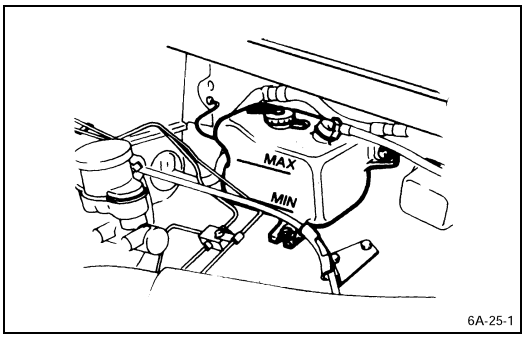
If the injection pump has been replaced, the air bleeding procedure will require more time and effort (this is because there is no fuel in the pump).

1. Loosen the air bleed nut on the priming pump plunger (at the top of the fuel filter).
2. Move the priming pump plunger up-and-down until strong resistance is felt (about 15 cycles).
3. Stop pumping and tighten the air bleed nut.
4. Wait for 1 minute.
5. Loosen the air bleed nut on the priming pump plunger again.
6. Move the priming pump plunger up-and-down until strong resistance if felt (about 10 cycles).
7. Stop pumping and tighten the air bleed nut.
8. Wait for 1 minute.
9. Loosen the air bleed nut on the priming pump plunger again.
10. Move the priming pump plunger up-and-down until strong resistance is felt (about 5 cycles).
11. Stop pumping and tighten the air bleed nut.
12. Press the accelerator and clutch pedals all the way to the floor and hold them down. Turn the ignition switch to the ON position. Wait until the glow indicator lamp turns on and off.

CAUTION:

If the engine is cold, the glow indicator light will stay on for 4～7 seconds before turning off.
However, if the engine is hot, the lamp will not turn on.

13. Turn the ignition switch to the START position and crank the engine until it starts (do not crank the engine for more than 10 seconds).
    If the engine does not start, repeat Steps 9～13.
14. Allow the engine to idle for 5 minutes.

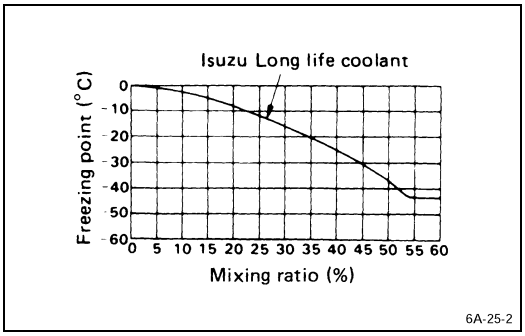


COOLING SYSTEM

Coolant Level

Check the coolant level and replenish the radiator reserve tank as necessary.

If the coolant level falls below the “MIN” line, carefully check the cooling system for leakage. Then add enough coolant to bring the level up to the “MAX” line.



Engine coolant Filling up procedure

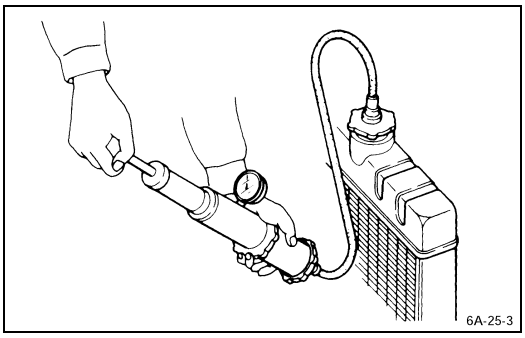
1. Make sure that the engine is cool

Warning:

When the coolant is heated to a high temperature, be sure not to loosen or remove the rediator cap. Otherwise you might get scalded by hot vapor or boiling water.

To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

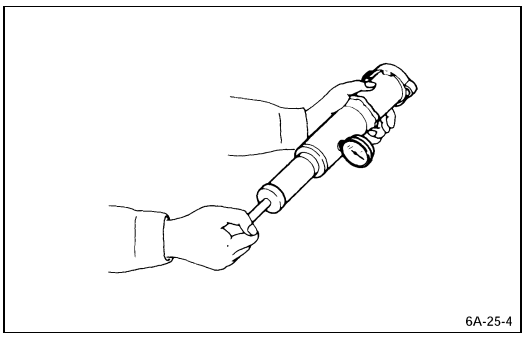
2. Open rediator cap pour coolant up to filler neck
3. Pour coolant into reservoir tank up to “MAX” line
4. Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.
5. After replenish the coolant tighten radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also intoheater water system.
6. Chech to see the thermometer, continuously idling 5 minutes and stop the engine.
7. When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the coolant system and reservoir tank hosefor leakage.
8. Pour coolant into the reservoir tank up to “MAX” line.



Cooling System Inspection

Install a radiator filler cap tester to the radiator. Apply testing pressure to the cooling system to check for leakage. The testing pressure must not exceed the specified pressure.

Testing Pressure	kg/cm^2 (psi/kPa)
2 (28/200)	



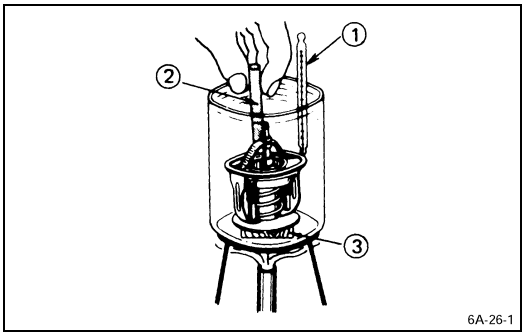
Radiator Cap Inspection

The radiator filler cap is designed to maintain coolant pressure in the cooling system at 1.05 kg/cm^2 (15 psi/103 kPa).

Check the radiator filler cap with a radiator filler cap tester. The radiator filler cap must be replaced if it fails to hold the specified pressure during the test procedure.

Radiator Filler Cap Pressure Pressure Valve	kg/cm^2 (psi/kPa)
0.9 – 1.2 (13 – 17/90 – 120)	

Negative Valve (Reference)	kg/cm^2 (psi/kPa)
0.01 – 0.04 (0.14 – 0.57/0.98 – 3.92)	



Thermostat Operating Test

1. Completely submerge the thermostat in water.
2. Heat the water.
   Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

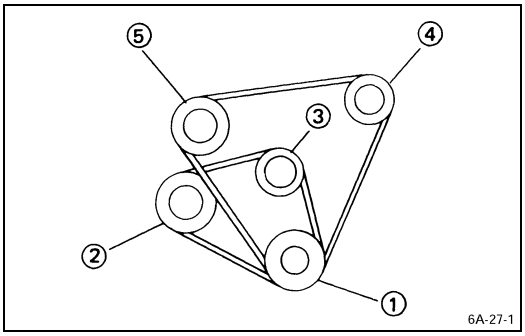
Thermostat Initial Opening Temperature	°C (°F)
82 (180)	

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature	°C (°F)
95 (203)	

Valve Lift at Fully Open position	mm (in)
9.5 (0.37)	

① Thermometer
② Agitating rod
③ Wooden piece



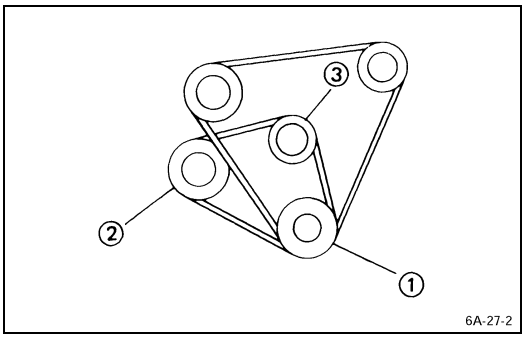
Drive Belt Adjustment

Depress the drive belt mid-portion with a 10 kg (22 lb/98N) force.

Drive Belt Deflection	mm (in)
10 (0.39)	

Check the drive belt for cracking and other damage.

① Crankshaft damper pulley
② Generator pulley
③ Cooling fan pulley
④ Oil pump pulley or idler pulley
⑤ Compressor pulley or idler pulley



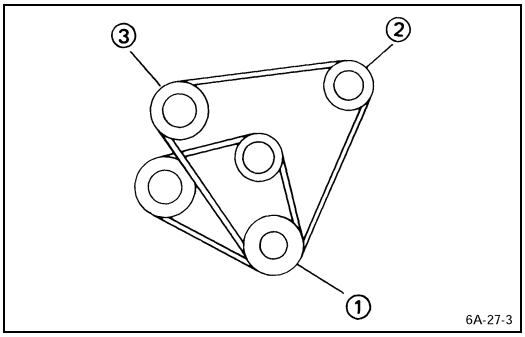
Cooling Fan Pulley Drive Belt

Fan belt tension is adjusted by moving the generator.

Depress the drive belt mid-portion with a 10 kg (22 lb/98N) force.

Drive Belt Deflection	mm (in)
10 (0.39)	

① Crankshaft damper pulley
② Generator pulley
③ Cooling fan pulley



Compressor Pulley Drive Belt

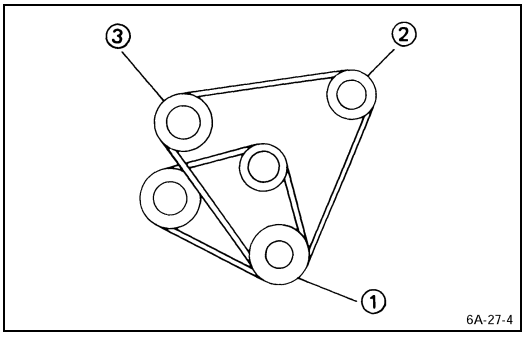
Move the idler pulley as required to adjust the compressor drive belt tension.

If the vehicle is equipped with power steering, move the oil pump as required

Depress the drive belt mid-portion with a 10 kg (22 lb/98 N) force.

Belt Deflection	mm (in)
12 – 15 (0.47 – 0.59)	

① Crankshaft damper pulley
② Oil pump pulley or idler pulley



Power Steering Oil Pump Pulley Drive Belt

Move the oil pump as required to adjust the oil pump drive belt tension.

On air conditioner equipped models, both drive belts pulley must always be replaced as a set.

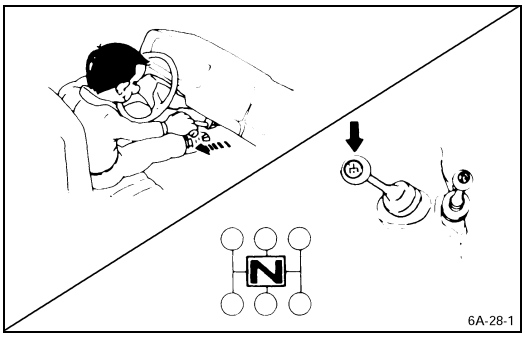
Depress the drive belt mid-portion with a 10 kg (22 lb/98 N) force.

Belt Deflection	mm (in)
14 - 17 (0.55 – 0.67)	

① Crankshaft damper pulley

② Oil pump pulley

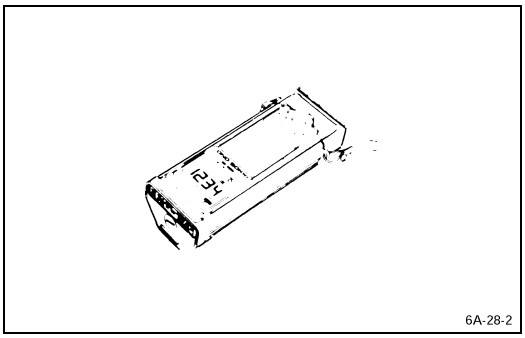
③ Compressor pulley or idler pulley



ENGINE CONTROL

Idling Speed Adjustment

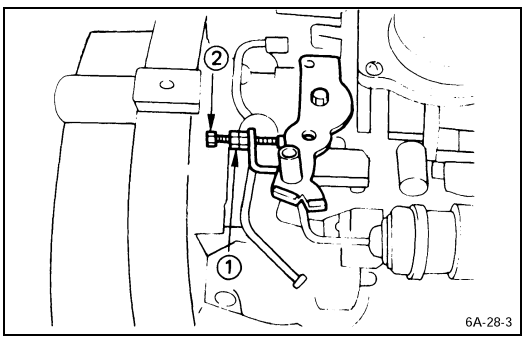
1. Set the vehicle parking brake and chock the drive wheels.
2. Place the transmission in neutral.
3. Start the engine and allow it to idle until the coolant temperature reaches 70 - 80°C (158 - 176°F).



4. Disconnect the engine control cable from the control lever.
5. Set a tachometer to the engine.
6. Check the engine idling speed.

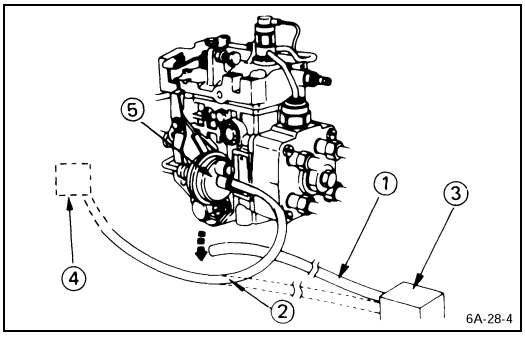
   If the engine idling speed is outside the specified range, it must be adjusted.

Engine Idling Speed	rpm
4JA1, 4JB1	750 ± 50
4JA1T	770 ± 50
4JG2T	720 ± 50
4JA1TC	730 ± 25
4JH1TC	700 ± 25



Idling Speed Adjustment (Except 4JA1TC, 4JH1TC)

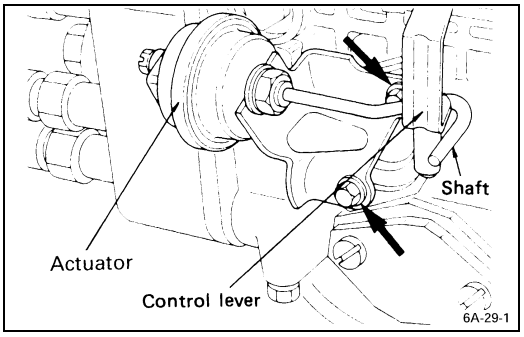
1. Loosen the idling set screw lock nut ① on the injection pump idling set bolt.
2. Adjust the idling speed to the specified range by turning the idling set bolt ②.
3. Lock the engine set nut ① with the idling set bolt lock nut.
4. Check that the idling control cable is tight (free of slack). If required, remove the slack from the cable.



Fast Idling Speed Inspection

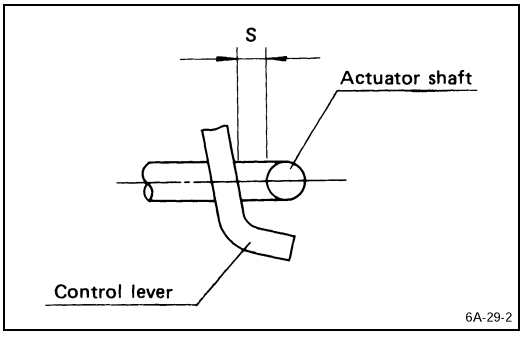
1. Set tachometer to the engine.
2. Disconnect the vacuum hose ① from the fast idle actuator ⑤ on the injection pump.
3. Disconnect the other vacuum hose ② from the vacuum switching valve ③ and connect it to the fast idle actuator ⑤.
   The vacuum line will now be connected directly from the vacuum pump ④ to the fast idle actuator.
4. Check the engine fast idling speed.
   If the engine idling speed is outside the specified range, it must be adjusted.

Fast Idling Speed	rpm
850 - 950	

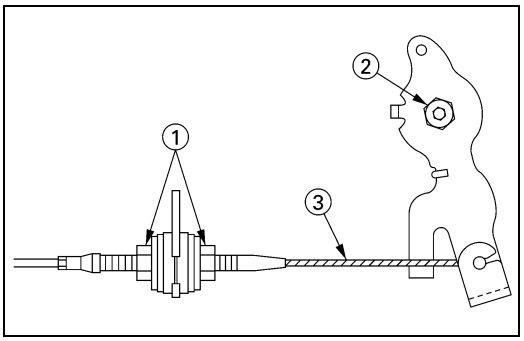


Fast Idling Speed Adjustment

1. Loosen the fast idle actuator bracket bolts.



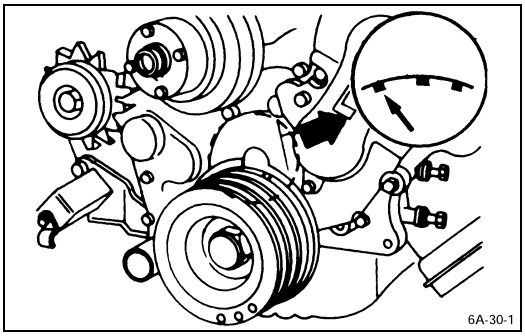
1. Adjust the fast idling speed by moving the actuator bracket, so that the clearance “S” can be 1 ~ 2 mm (0.04 ~ 0.08 in.).
2. Tighten the bracket bolts.



101RY00014

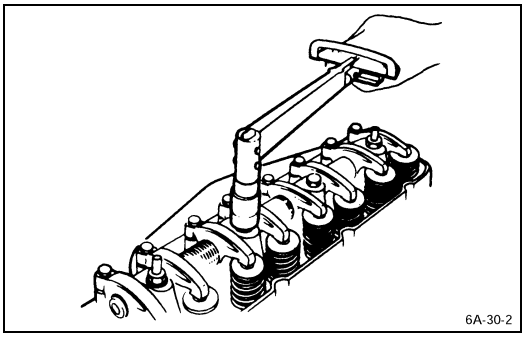
Accelerator Control
Accelerator Control Cable Adjustment

1. Loosen the accelerator cable clamp bolt ①.
2. Check that the idling control knob is in the engine idling position.
3. Hold the accelerator lever ② in the fully closed position and stretch the control cable ③ in the direction indicated by the arrow to remove any slack.



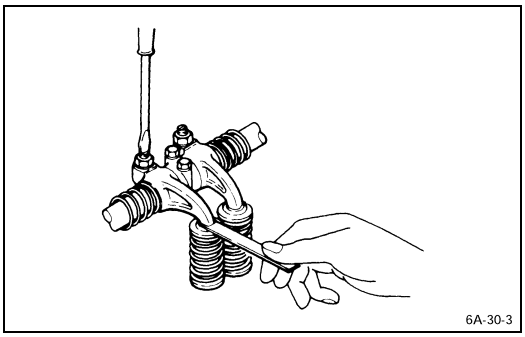
VALVE CLEARANCE ADJUSTMENT

1. Bring the piston in either the No. 1 cylinder or the No. 4 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft damper pulley TDC line is aligned with the timing pointer.

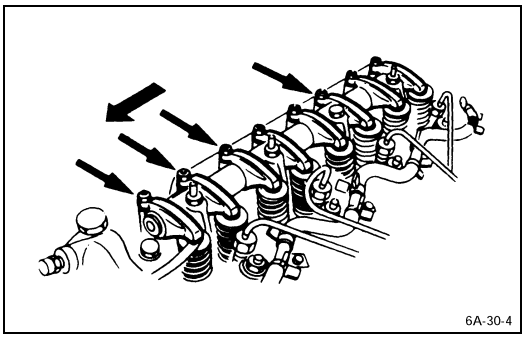


2. Check the rocker arm shaft bracket nuts for looseness.
   Tighten any loose rocker arm shaft bracket nuts before adjusting the valve clearance.

Rocker Arm Shaft Bracket Nut Torque	kg·m (lb·ft/N·m)
5.5 ± 0.5 (39.8 ± 3.6/53.9 ± 4.9)	



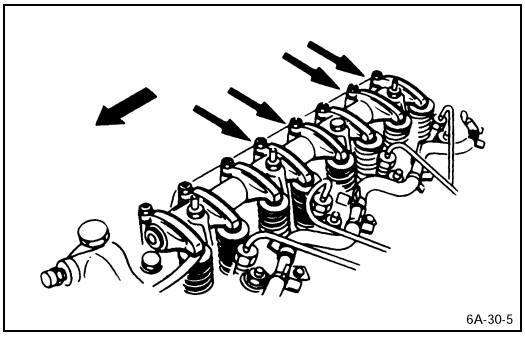
3. Check for play in the No. 1 intake and exhaust valve push rods.
   If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.
   If the No. 1 cylinder intake and exhaust valve push rods are depressed, the No. 4 piston is at TDC on the compression stroke.



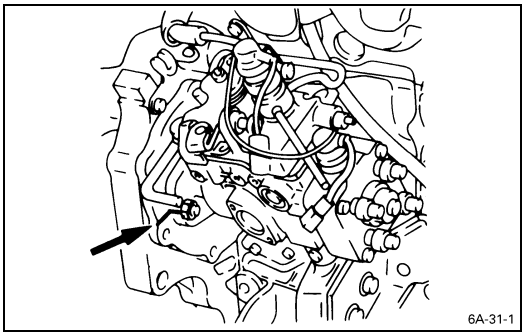
Adjust the No.1 or the No. 4 cylinder valve clearances while their respective cylinders are at TDC on the compression stroke.

Valve Clearance (At Cold)	mm (in)
0.4 (0.016)	

4. Loosen each valve clearance adjusting screw as shown in the illustration.
5. Insert a feeler gauge of the appropriate thickness between the rocker arm and the valve stem end.

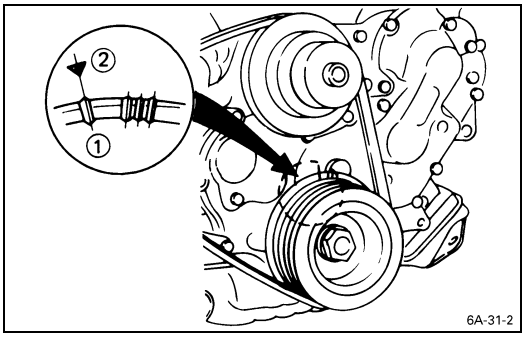


6. Turn the valve clearance adjusting screw until a slight drag can be felt on the feeler gauge.
7. Tighten the lock nut securely.
8. Rotate the crankshaft 360°.
9. Realign the crankshaft damper pulley TDC notched line with the timing pointer.
10. Adjust the clearances for the remaining valves as shown in the illustration.



INJECTION TIMING ADJUSTMENT (Except 4JA1TC, 4JH1TC)

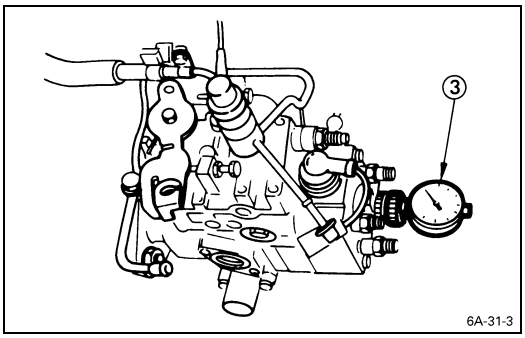
1. Check that the notched line on the injection pump flange is aligned with the front plate or the timing gear case notched line.



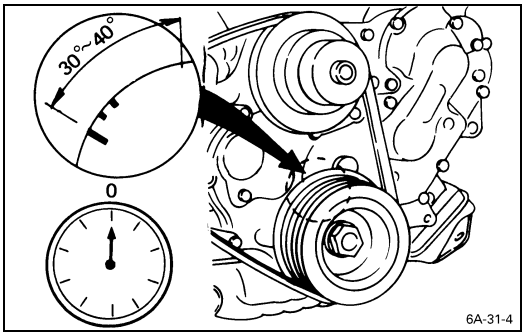
2. Bring the piston in the No. 1 cylinder to TDC ① on the compression stroke by turning the crankshaft until the crankshaft pulley TDC line is aligned with the timing mark ②.

Note:

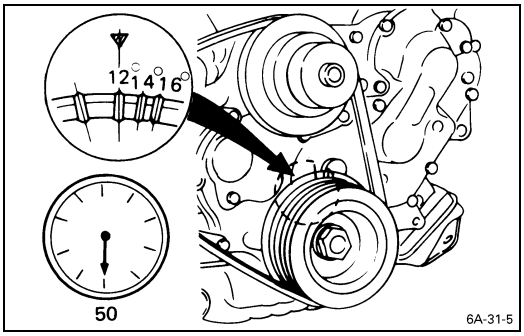
Check for play in the No. 1 intake and exhaust valve push rods.
If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.



3. Disconnect the injection pipe from the injection pump
4. Remove one bolt from the distributor head.
5. Insert a screwdriver into a hole in the fast idle lever and turn the lever to release the W-C.S.D. function. (if so equipped)
6. Install the static timing gauge ③.
   The probe of the gauge should be depressed inward approximately 2 mm (0.079 in).
   Static Timing Gauge: 5-8840-0145-0 (J-28827)



7. Rotate the crankshaft to bring the piston in the No. 1 cylinder to a point 30 - 40° BTDC.
8. Set the timing gauge needle to zero.
9. Move the crankshaft pulley slightly in both directions to check that the gauge indication is stable.

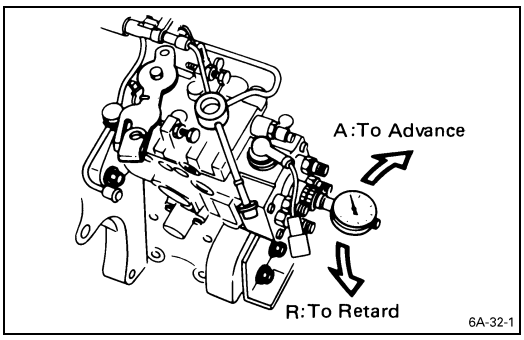


10. Turn the crankshaft clockwise and read the gauge indication when the crankshaft pulley timing mark (12° (4JA1, 4JA1T) 11° (4JB1T) 0° (4JG2T) on pulley) is aligned with the pointer.

4JA1	4JA1T	4JB1T	4JG2T
BTDC 12 ± 2°	BTDC 12 ± 2°	BTDC 11 ± 2°	TDC 0 ± 2°

Standard Reading	mm (in)
0.5 (0.02)	

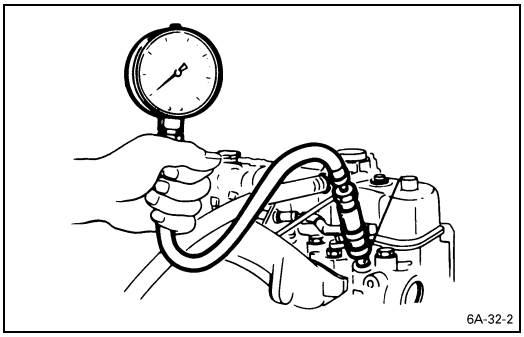
If the injection timing is outside the specified range, continue with the following steps.



11. Loosen the injection pump fixing nuts and bracket bolts.
12. Adjust the injection pump setting angle.

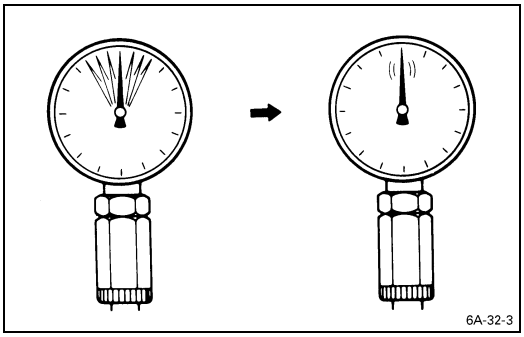
	When large than standard value	When smaller than standard value
Gear drive	R	A

A: Move the injection pump toward the engine.
R: Move the injection pump away from the engine.



COMPRESSION PRESSURE MEASUREMENT

1. Start the engine and allow it to idle until the coolant temperature reaches 70 – 80 °C (158 – 176 °F).
2. Remove the following parts.
   - Glow plugs
   - Fuel cut solenoid connector
3. Set the adapter and compression gauge to the No. 1 cylinder glow plug hole.
   Compression Gauge: 5-8840-2675-0
   Adapter; Compression Gauge: 5-8531-7001-0

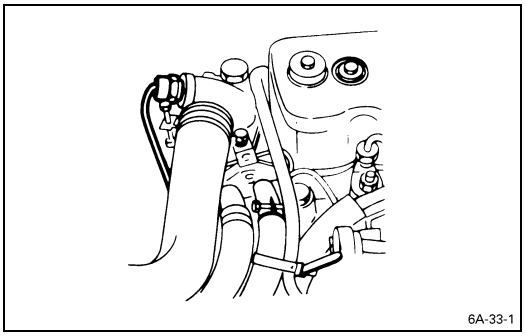


4. Turn the engine over with the starter motor and take the compression gauge reading.

Compression Pressure kg/cm^2 (psi/MPa) at 200 rpm

	Standard	Limit
4JH1TC	28 (398/2.8)	20 (284/2.0)
Others	31 (441/3.0)	22 (313/2.2)

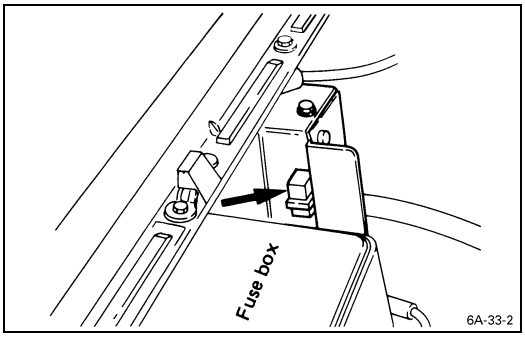
5. Repeat the procedure (Steps 3 and 4) for the remaining cylinders.
   If the measured value is less than the specified limit, refer to “Troubleshooting” in this Manual.



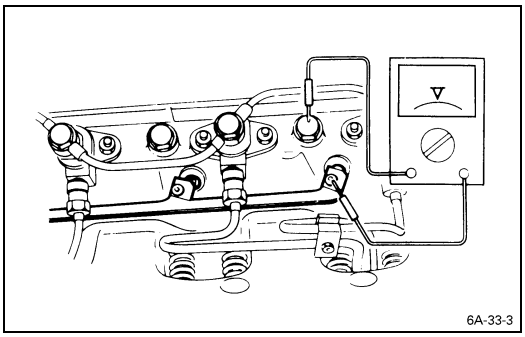
PRE-HEATING SYSTEM

System Inspection Procedure

1. Disconnect the thermo-switch on the thermostat outlet pipe.



2. Turn the starter switch to the “ON” position.
   If the Pre-heating System is operating properly, the glow relay will make a clicking sound about seven seconds after the starter switch is turned on.

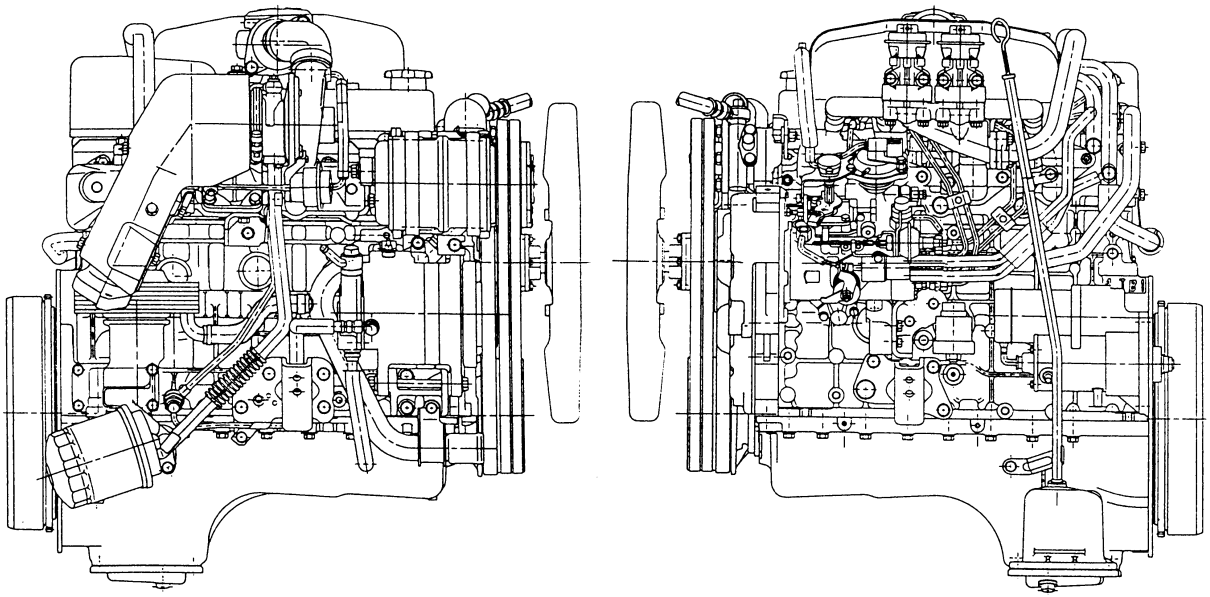


3. Measure the glow plug terminal voltage with a circuit tester immediately after turning the starter switch to the “ON” position.

Glow Plug Terminal Voltage	V
Approx. 11	

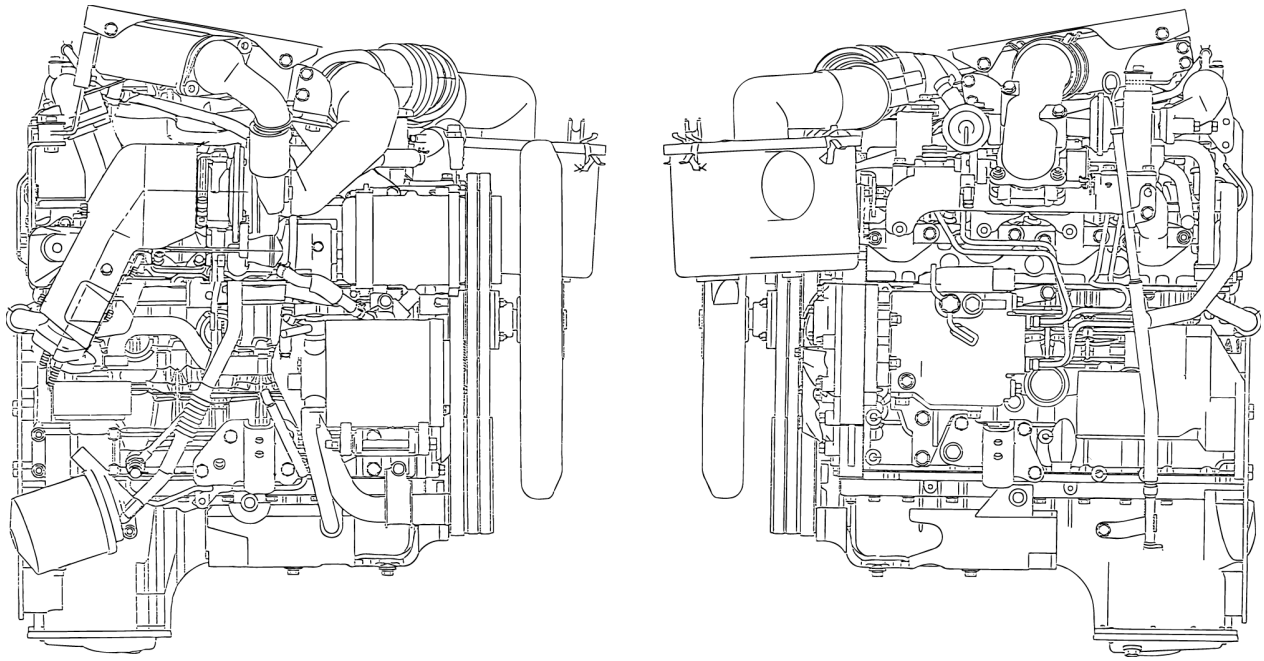
GENERAL DESCRIPTION

4JB1T

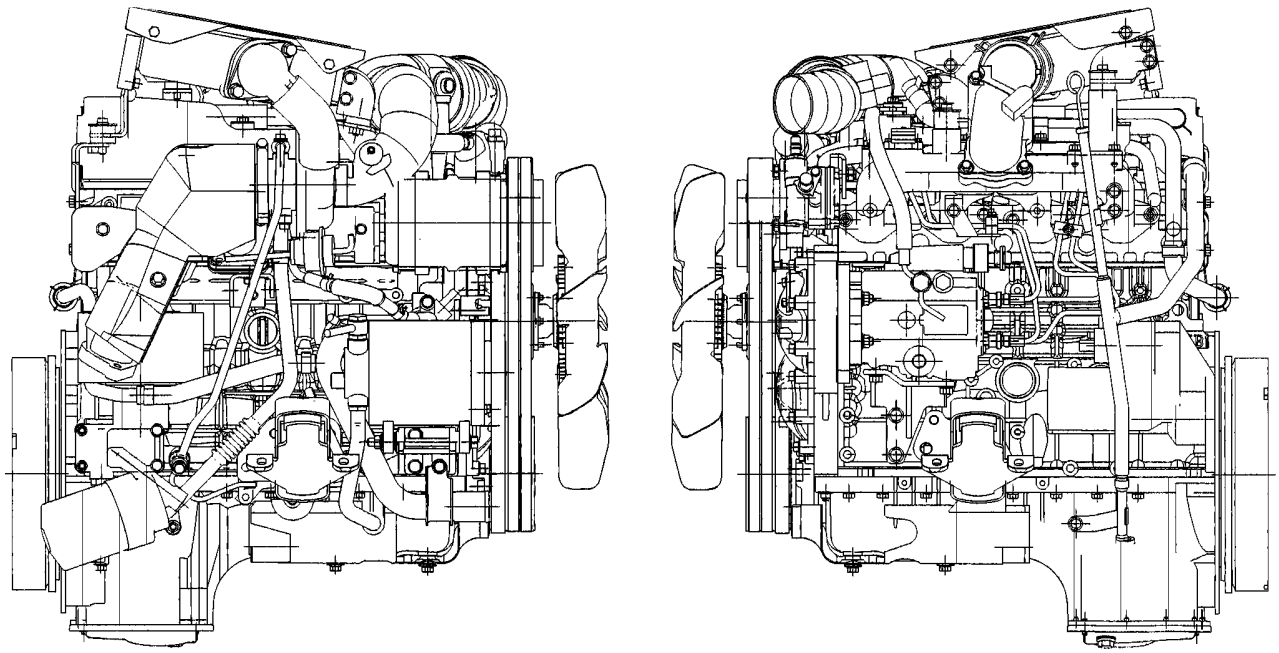


6A-34

4JA1TC



4JH1TC



F06L200022

The 4J series automotive diesel engine has SPECIAL DESIGNED combustion chambers in the piston. This design provides superior fuel economy over a wide range of driving conditions.

The model 4JG2 diesel engine has swirl type combustion chambers.

Auto-thermatic pistons with cast steel struts are used to reduce thermal expansion and resulting engine noise when the engine is cold.

Chrome plated dry type cylinder liners provide the highest durability.

The laminated steel sheet cylinder head gasket is very durable and, to increase the head gasket reliability.

The crankshaft has been tufftrided to provide a longer service life. Because the crankshaft is tufftrided, it cannot be reground.

The 4JA1, 4JB1T, 4JA1T and 4JG2T engines are equipped with the VE-Type distributor injection pump.

The 4JA1TC, 4JH1TC are equipped with the electronic controlled fuel injection pump. The type of this pump is VP44 in the product made from BOSCH

The 4JG2T, 4JB1T, 4JA1TC, 4JH1TC and 4JA1T engines are equipped with turbocharger.

The 4JA1TC engine is equipped with intercooler and EGR cooler.

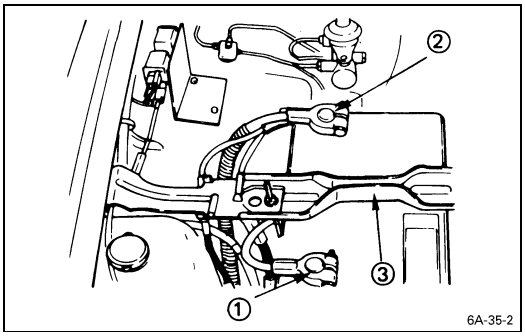
The 4JH1TC engine is equipped with intercooler.

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

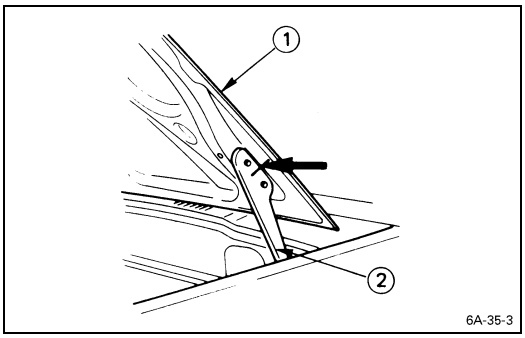
Important Operations – Removal

1. Carefully remove the piping, hoses, wiring harness connectors, engine control cables, and control rods from the engine.
2. Remove the clutch slave cylinder, the back up light switch connector, and the speedometer cable from the transmission.



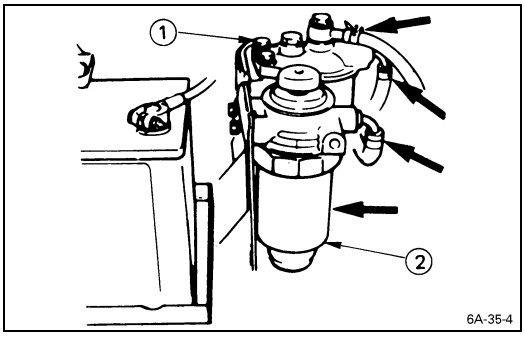
Battery

1. Disconnect the battery cable ① and the grounding cable ② from the battery terminals.
2. Remove the battery clamp ③.
   Take care not to accidentally short the battery with the spanner or some other tool.
3. Remove the battery.
4. Disconnect the battery cable at the starter motor and the ground cable at the cylinder body.



Engine Hood

Apply setting marks to the engine hood ① and the engine hood hinges ② before removing the engine hood.
This will facilitate reinstallation of the engine hood to its original position.

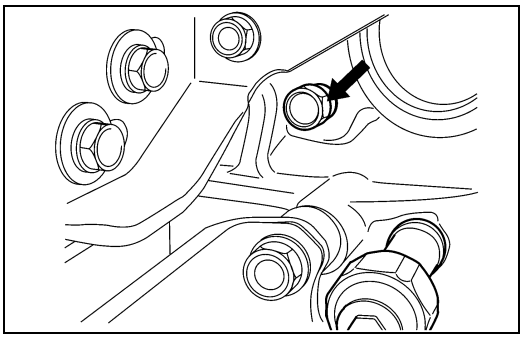


Fuel Filter and Water Separator

1. Pull the fuel hose from the fuel filter ① and the water separator ②.
2. Plug the fuel hose to prevent fuel leakage.
3. Remove the fuel filter and the water separator.

Air Cleaner

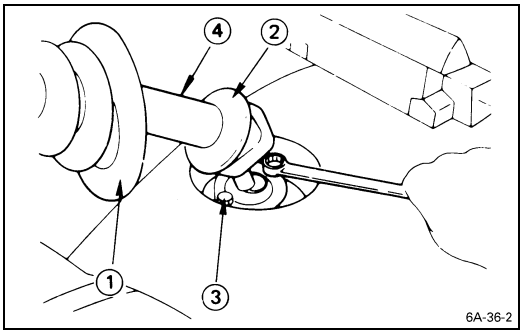
Remove the air cleaner duct from the engine.



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Coolant

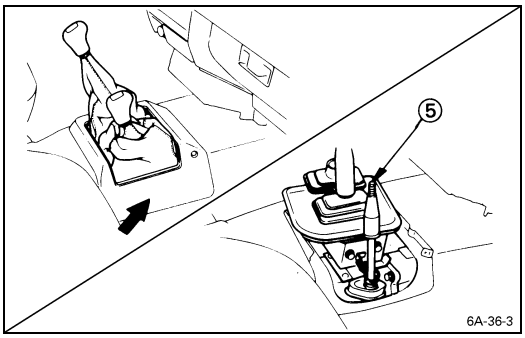
Remove the coolant drain plug (at the lower left of the engine) and the radiator drain plug.
Allow the engine coolant to drain completely.



6A-36-2

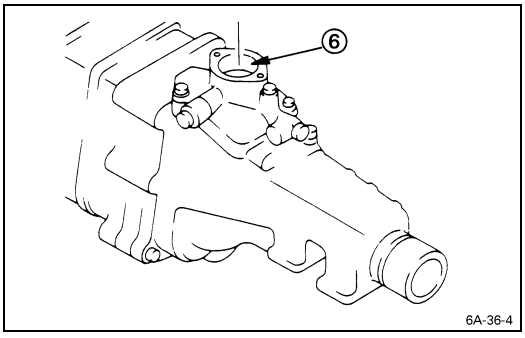
Gear Shift Lever

1. Place the gear shift lever in the neutral position.
2. Remove the front console from the floor panel.
3. Pull the gear shift lever grommet ① and the dust cover ② to the top of the gear shift lever.
4. Remove the gear shift lever cover bolt ③.
5. Remove the gear shift lever ④.



6A-36-3

6. Remove the gear shift lever hole cover ⑤ or the center console from the floor.

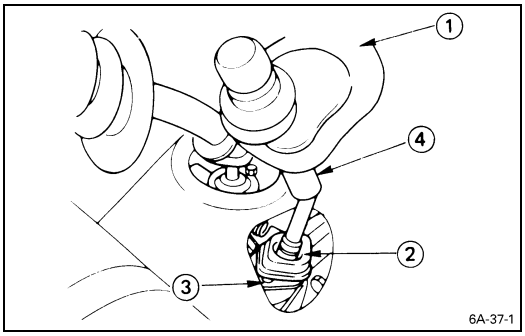


6A-36-4

7. Remove the quadrant box ⑥ from the transmission rear cover.

Note:

Cover the quadrant box hole to prevent the entry of foreign material into the transmission.



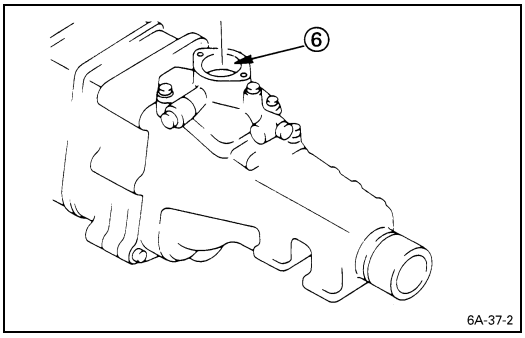
Transfer Change Lever (For 4 × 4)

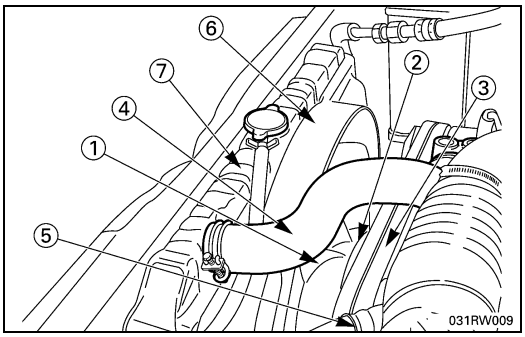
Perform this procedure after removing the gear shift lever.

1. Place the transfer change lever in the “H” position.
2. Pull the transfer change lever grommet ① and the dust cover ② to the top of the transfer change lever.
3. Remove the retainer bolts ③.
4. Remove the transfer change lever ④ along with the retainer and the ball seat cover.
5. Remove the change lever hole cover ⑤ or the center console from the floor.
6. Remove the quadrant box ⑥ from the transfer case adapter.

Note:

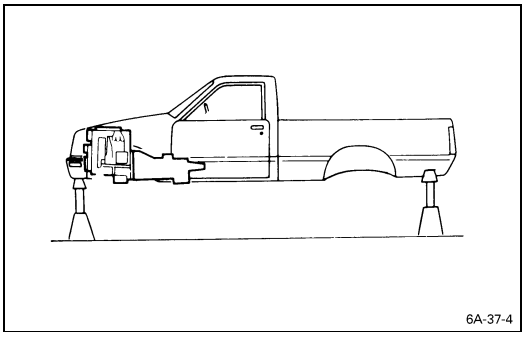
Cover the quadrant box hole and the change lever hole to prevent the entry of foreign material into the transmission.





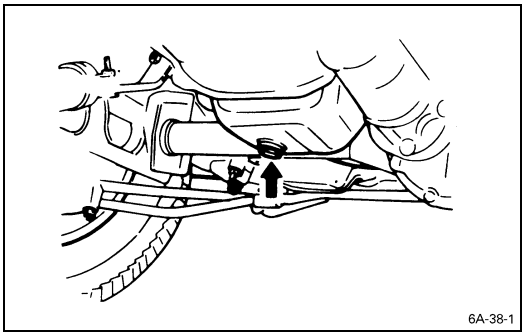
Radiator

1. Remove the cooling fan ①, the pulley ②, and the belt ③.
2. Disconnect the radiator upper hose ④ and the radiator lower hose ⑤ from the engine.
3. Remove the radiator shroud ⑥.
4. Remove the radiator grille from the deflector panel.
5. Remove the radiator ⑦.
   Take care not to damage the radiator core.
6. Remove the radiator undercover from the chassis frome.



Supporting the Vehicle

1. Jack up the vehicle.
2. Place chassis stands at the front and the rear of the vehicle.
3. Remove the wheels from the vehicle.

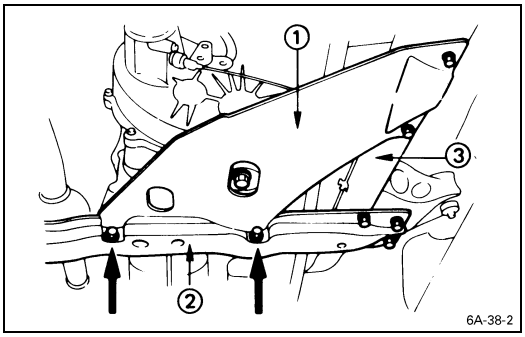


Engine Oil Draining

Remove the oil pan drain plug to drain the engine oil.

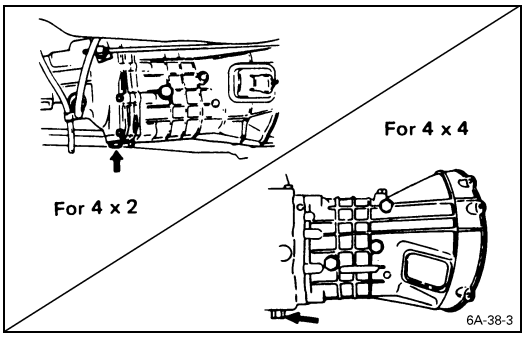
Do this while the engine is hot.

Do not forget to reinstall the drain plug after draining the engine oil.



Transfer Case Protector (4 × 4 model)

Remove the transfer case protector ① from the transmission mounting member ② and the side menber ③.

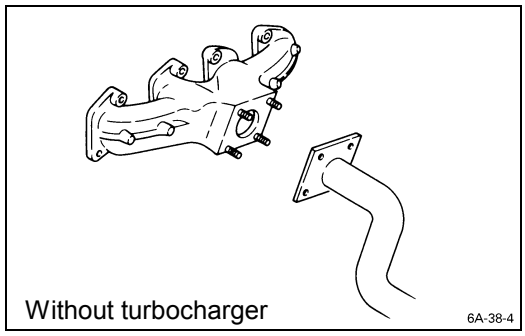


Transmission Oil Draining

1. Remove the transmission oil drain plug.
2. Replace the drain plug after draining the oil.

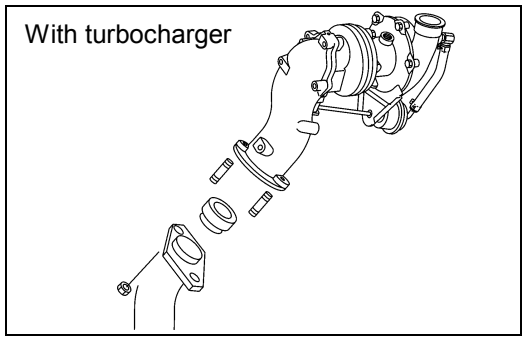
Control Cables or Rods

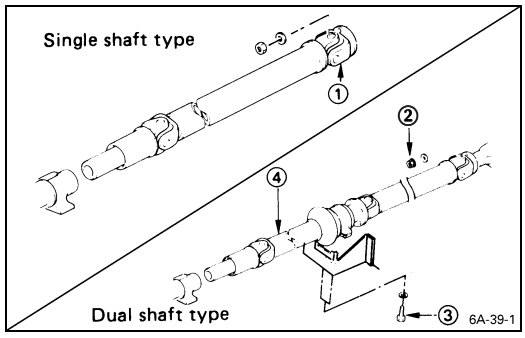
1. Disconnect the clutch control cable or the hydraulic cylinder from the transmission.
2. Disconnect the parking brake control cable from the rear wheel brake back plate.
3. Disconnect the speedometer drive cable from the transmission.



Exhaust Pipe

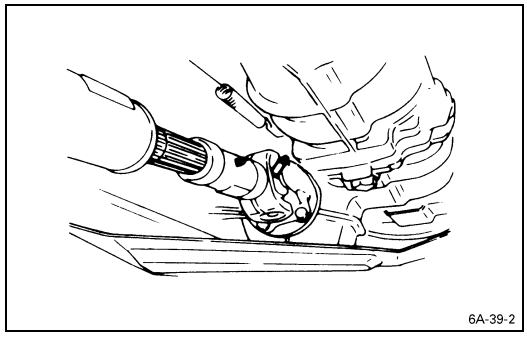
1. Disconnect the exhaust pipe from the exhaust manifold.





Rear Propeller Shaft

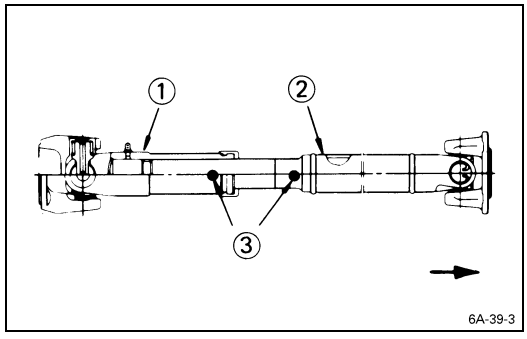
1. Remove the propeller shaft flange yoke at the drive pinion ①.
2. Remove the 2nd propeller shaft flange yoke bolts ② at the center bearing.
3. Remove the center bearing retainer bolts ③.
4. Remove the 1st propeller shaft ④ together with the center bearing from the transmission mainshaft spline.



Front Propeller Shaft (For 4 × 4)

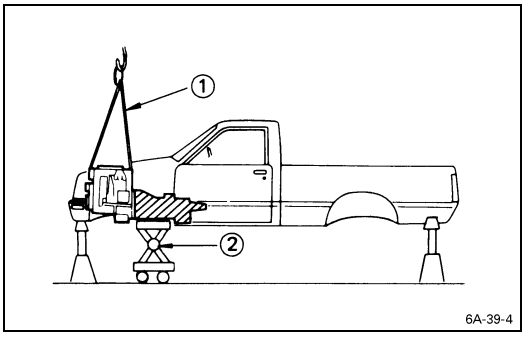
Remove the splined yoke flange bolt at the transfer output shaft.

Do not allow the splined yoke to fall away from the front propeller shaft.



If the splined yoke should fall away from the front propeller shaft, align the setting marks ③ on the splined yoke ① and the propeller shaft ② to reassemble the two parts.

The setting marks are puncked circles approximately ③ mm (0.12 in) in diameter.



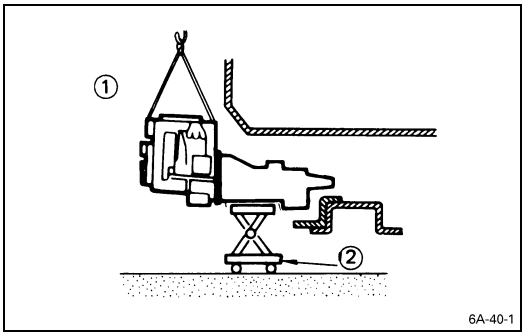
Transmission

1. Check that the lifting wires ① are securely attached.
2. Operate the hoist to slightly raise the engine.

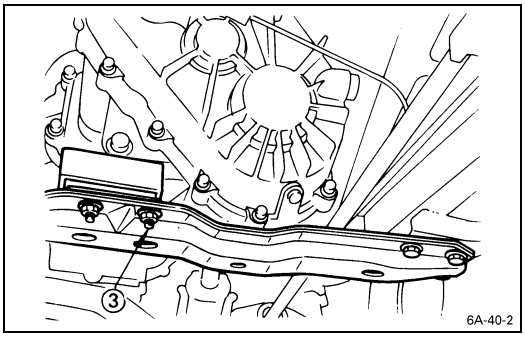
Warning:

Take care not to lift the chassis from the chassis stands.

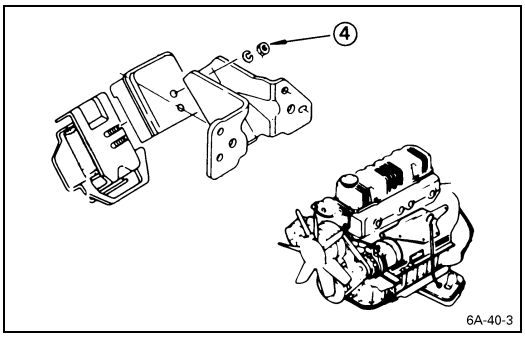
If you do accidentally raise the chassis from the chassis stands, make absolutely certain that the chassis stands are correctly positioned before lowering the chassis.



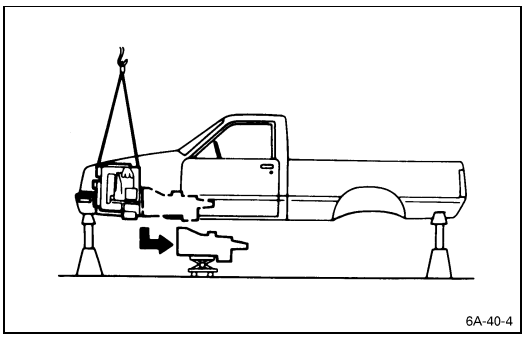
3. Place the jack ② beneath the transmission case.
4. Operate the jack to slightly raise the transmission.



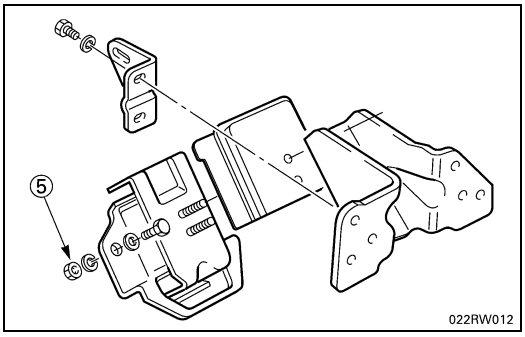
5. Remove the transmission member lower mounting bolts ③ fixing the transmission member to the chassis frame rail.



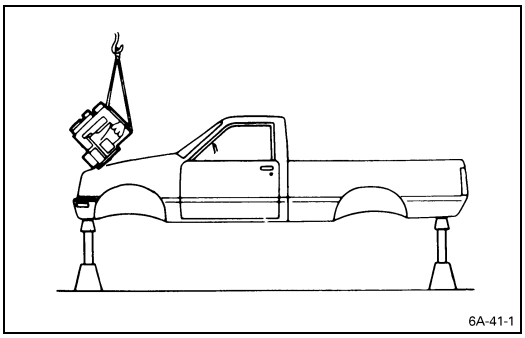
6. Loosen the engine mounting nuts ④ at the rubber mountings.
7. Use the jack to slightly lower the transmission.
8. Remove the remaining transmission coupling bolts.
9. Separate the transmission from the engine.
   Take care not to damage the transmission, the engine, and their related parts.



10. Use the jack to lower the transmission together with the mounting member to the floor.



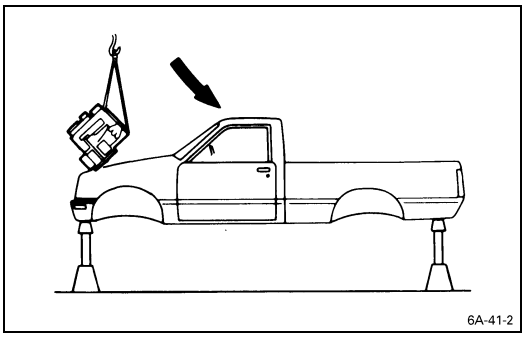
11. Remove the engine mounting bolts ⑤ from the chassis frame.



12. Use the hoist to lift the engine from the engine compartment.

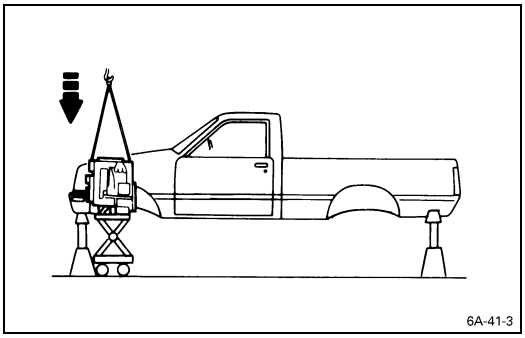
Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.



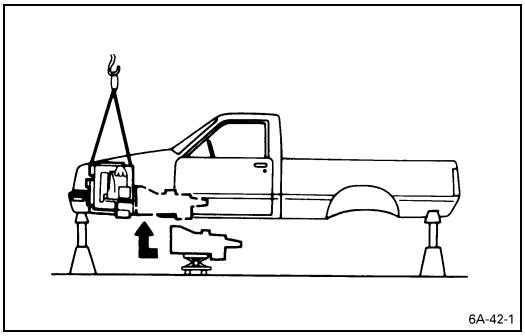
Engine

1. Attach a lifting wire to the engine lifting hanger.
2. Operate the hoist to position the engine above the engine compertment.
   Hold the front of the engine slightly higher than the rear.
3. Slowly lower the engine into the engine compartment.
   Be careful not to damage the brake pipes, the fuel pipes, and other exposed parts.



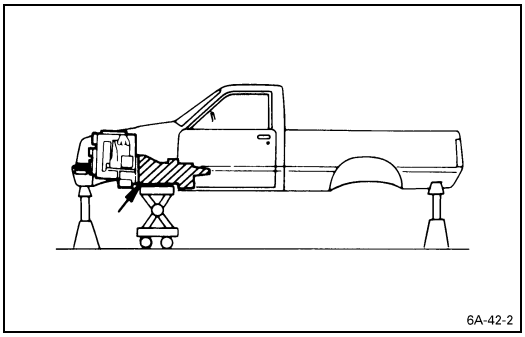
4. Support the oil pan with a jack.

5. Temporarily tighten the engine front mounting rubber nuts.



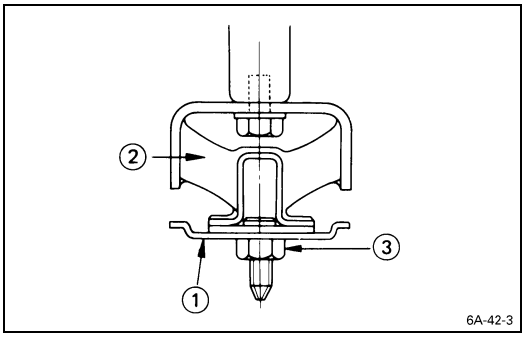
Transmission

1. Apply a thin coat of molybdenum disulfide grease to the top gear shaft spline.
2. Place the transmission with the mounting rubbers on a transmission jack.
3. Carefully move the transmission jack and transmission into position behind the cab.



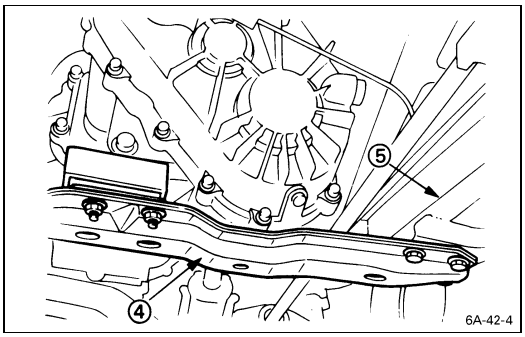
4. Slowly raise the transmission jack until the front of the transmission is aligned with the engine flywheel.
   The slope of the engine and the transmission must be the same.
5. Align the top gear shaft spline with the clutch driven plate internal spline.
6. Install the transmission to the engine.
   Tighten the transmission coupling nuts and bolts to the specified torque.

Transmission Coupling Nut and Bolt Torque	kg·m (lb.ft/N·m)
3.8 ± 0.8 (27.5 ± 5.8/37.2 ± 7.8)	



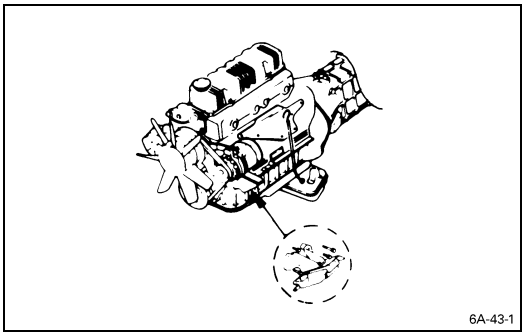
7. Install the mounting member ① to the mounting rubber ②.
8. Tighten the mounting member nuts ③ to the specified torque.

Mounting Rubber Nut Torque	kg·m (lb.ft/N·m)
4.2 ± 0.5 (30.4 ± 3.6/41.2 ± 4.9)	



9. Install the mounting member ④ to the sidemembers ⑤.
10. Tighten the mounting member bolts to the specified torque.

Mounting Member Bolt Torque	kg·m (lb.ft/N·m)
7.8 ± 1.6 (56.1 ± 11.2/76.0 ± 15.2)	



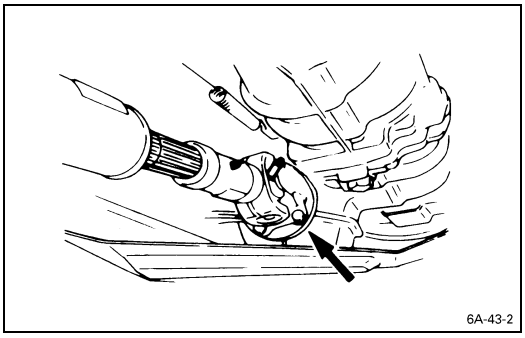
11. Tighten the engine mounting rubber nuts to the specified torque.

Engine Mounting Rubber Nut Torque	kg·m (lb.ft/N·m)
4.2 ± 0.5 (30.4 ± 3.6/41.2 ± 4.9)	

Exhaust Pipe

Connect the exhaust pipe to the exhaust manifold.

Torque	kg·m (lb.ft/N·m)
6.8 ± 0.5 (49 ± 3.6/67 ± 5)	



Front Propeller Shaft (For 4 × 4)

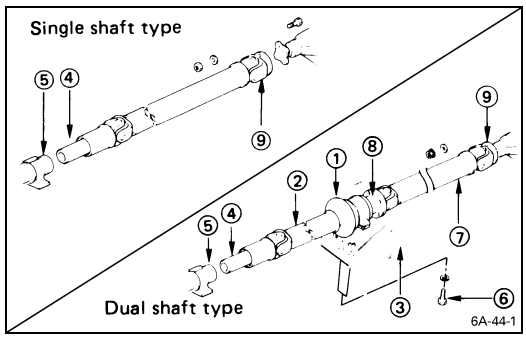
1. Connect the propeller shaft flange yoke to the matching flange.
2. Tighten the propeller shaft flange yoke bolt to the specified torque.

Propeller Shaft Flange Yoke Bolt Torque	kg·m (lb.ft/N·m)
3.6 ± 0.3 (26.0 ± 2.2/35.3 ± 2.9)	

Note:

If the splined yoke and the front propeller shaft have accidentally separated, align their setting marks and recouple them.

Refer to "FRONT PROPELLER SHAFT REMOVAL."



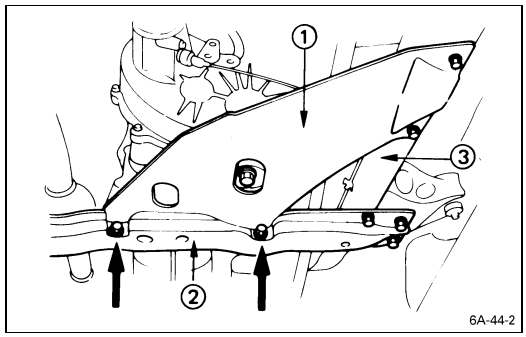
Rear Propeller Shaft

1. Place the center bearing and retainer ① together with the 1st propeller shaft ② on the No. 4 crossmember ③.
2. Insert the splined yoke ④ into the transmission main shaft spline ⑤.
3. Tighten the center bearing retainer bolts ⑥ to the specified torque.

Center Bearing Retainer Bolt Torque	kg·m (lb.ft/N·m)
6.2 ± 0.2 (44.8 ± 1.5/60.8 ± 2.0)	

4. Connect the 2nd propeller shaft ⑦ center coupling side ⑧ and drive pinion side ⑨.

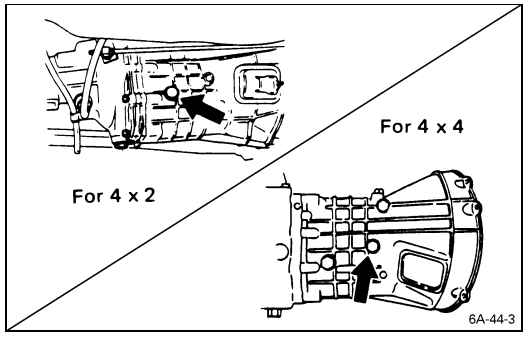
Propeller Shaft Flange Yoke Bolt Torque	kg·m (lb.ft/N·m)
3.6 ± 0.3 (26.0 ± 2.2/35.3 ± 2.9)	



Transfer Case Protector (For 4 × 4)

1. Install the transfer case protector ① to the mounting member ② and the sidemembers ③.
2. Tighten the transfer case protector bolts to the specified torque.

Transfer Case Protector Bolt Torque	kg·m (lb.ft/N·m)
3.7 ± 1.0 (26.8 ± 7.2/36.3 ± 9.8)	



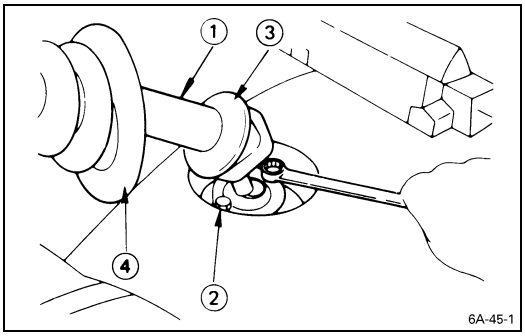
Gear Shift Lever

1. Replenish the transmission case and the transfer case with the specified engine oil.

Transmission and Transfer Case Oil lit (US/UK gal)

	4 × 2	4 × 4
MSG	1.55 (0.41/0.34)	4.40 (1.16/0.97)
MUA	2.95 (0.65/0.54)	2.95 (T/M) 1.45 (Transter)

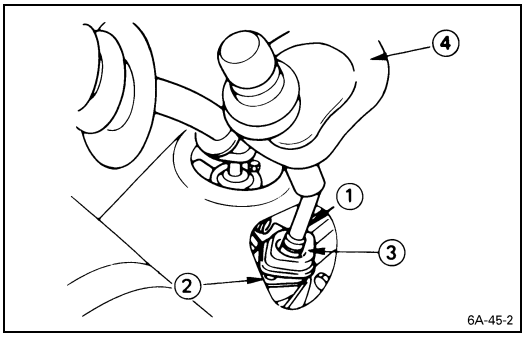
2. Install the quadrant box to the transmission rear cover.



3. Install the gear shift lever ① to the transmission case.
4. Tighten the gear shift lever cover ② bolts to the specified torque.

Shift Lever Cover Bolt Torque	kg·m (lb.ft/N·m)
	2.0 ± 0.2 (14.5 ± 1.5/19.6 ± 2.0)

5. Install the dust cover ③ and the grommet ④.

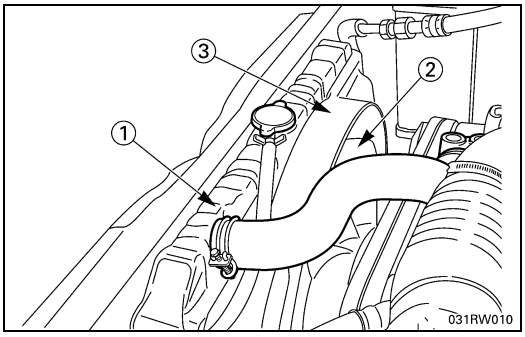


Transfer Change Lever (For 4 × 4)

1. Insert the transfer change lever ① into the transfer side case.
2. Install the ball seat cover along with the change lever retainer ②.
3. Tighten the change lever retainer bolts to the specified torque.

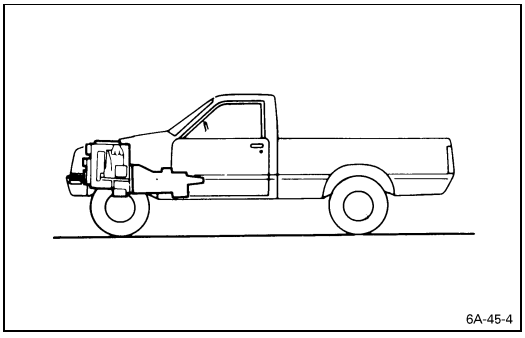
Change Lever Retainer Bolt Torque	kg·m (lb.ft/N·m)
	2.0 ± 0.2 (14.5 ± 1.5/19.6 ± 2.0)

4. Install the dust cover ③ and the grommet ④.



Radiator

1. Install the radiator ①.
   Be careful not to damage the radiator core.
2. Install the cooling fan ② and the fan shroud ③.
3. Connect the radiator upper and lower hoses.
4. Install the radiator undercover to the chassis frame.
5. Install the radiator grill to the deflector panel.



Lowering the Vehicle

1. Install the wheels to the vehicle.
2. Place a jack beneath the vehicle.
3. Raise the jack to remove the chassis stands.
4. Lower the vehicle to the ground.

Coolant Replenishment

Replenish the cooling system with coolant.

When radiator is emptied (for coolant change, etc.):

After filling with coolant up to the inlet port level, put the radiator cap on and idle the engine for 5 to 6 consecutive minute. Then remove the radiator cap and check and see the coolant level. If the coolant is short, add to the radiator as well as to the reserve tank.

If the reserve tank coolant level is lower than MIN, replenish coolant to the reserve tank only.

In case there is no coolant in the reserve tank, make sure of a drop in coolant temperature and add coolant through the radiator inlet port. Then remove the cap and check the coolant level after idling the engine for 5 to 6 consecutive minutes.

Then add coolant into reserve tank fill up to full level.

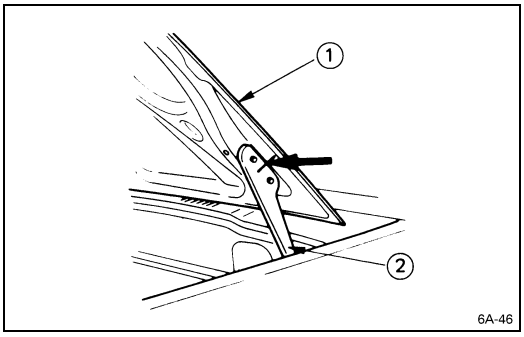
Coolant Capacity	lit (US/UK gal)
4JA1, 4JA1T	7.0 (1.8/1.5)
4JB1 with turbo engine	9.5 (2.5/2.1)
4JG2T	8.6 (2.3/1.9)
4JA1-TC, 4JH1TC	8.4 (2.2/1.8)

Engine Oil Replenishment

1. Fill the engine through the filler port with new engine oil of the specified grade.

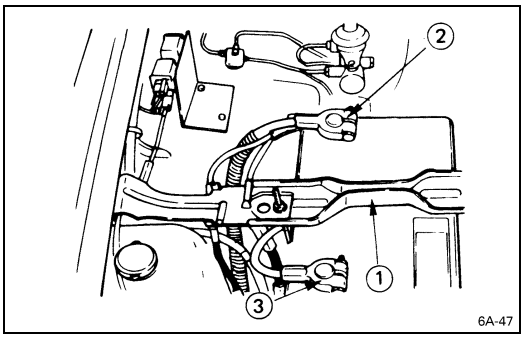
Engine Oil Capacity and Grade			lit (US/UK gal)
Capacity	4JA1, 4JA1T, 4JB1T	4 × 2	6.5 (1.7/1.4)
		4 × 4	
	4JG2T, 4JA1TC, 4JH1TC	4 × 2	6.5 (1.7/1.4)
		4 × 4	7.3 (1.9/1.6)
Grade	For 4JA1		CC or CD
	For 4JB1T, 4JG2T, 4JA1T, 4JA1TC, 4JH1TC		CD

2. Start the engine and allow it to idle for several minutes.
3. Stop the engine and wait five minutes for the oil to settle.
4. Recheck the oil level and replenish if necessary.



Engine Hood

Align the setting marks (applied at removal) on the engine hood ① and the engine hood hinges ② to install the engine hood.



Battery

1. Check the battery fluid level and the specific gravity.
2. Secure the battery with the battery clamp.
   Do not overtighten the battery clamp.
3. Connect the battery cable ② and the ground cable ③ to the battery.
4. Connect the battery cable to the starter motor and the ground cable to the cylinder body.
5. Apply grease to the battery terminals.
6. Install the battery clamp ①.
   Take care not to accidentally short the battery with the spanner or some other tool.

Engine Warm-Up

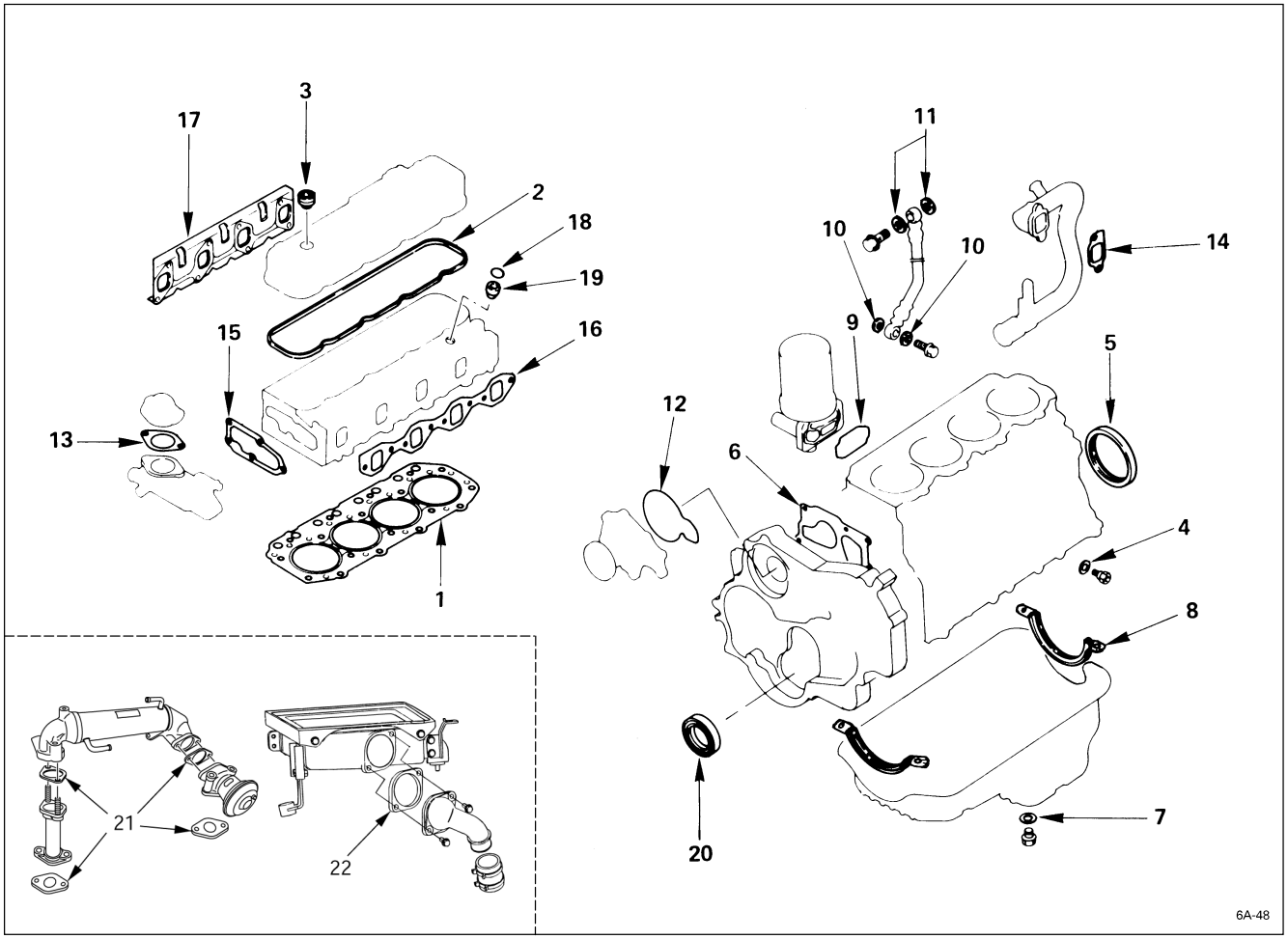
After completing the required maintenance procedures, start the engine and allow it to idle until it is warm.

Check the following:

1. Engine idling speed
   Refer to “SERVICING” for the idle speed adjustment procedure.
2. Engine noise level.
3. Engine lubricating system and cooling system
   Carefully check for oil and coolant leakage.
4. Engine control cable operation
5. Clutch engagement
6. Indicator warning light operation

ENGINE REPAIR KIT

All of the numbered parts listed below are included in the Engine Repair Kit.
The gaskets marked with an asterisk (*) are also included in the Top Overhaul Kit.



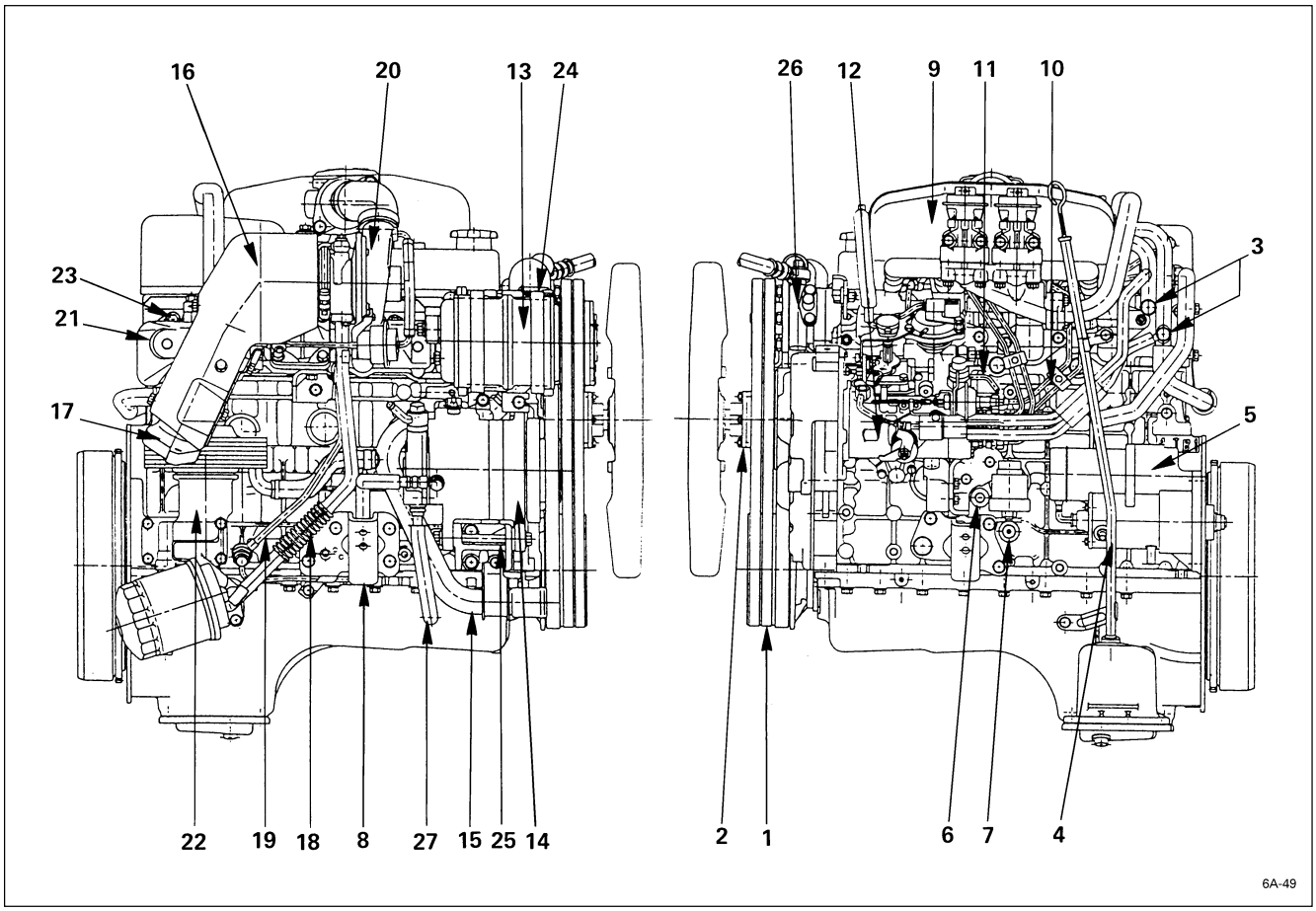
*	1.	Cylinder head gasket		12.	Water pump O-ring
*	2.	Head cover gasket	*	13.	Water outlet pipe gasket
*	3.	Head cover cap nut gasket	*	14.	Intake pipe gasket
	4.	Drain cock gasket		15.	Thermostat housing gasket
	5.	Crankshaft rear oil seal	*	16.	Intake manifold gasket
	6.	Gear case gasket	*	17.	Exhaust manifold gasket
	7.	Oil pan drain plug gasket	*	18.	Nozzle holder O-ring
	8.	Oil pan gasket	*	19.	Nozzle holder gasket
	9.	Oil filter gasket		20.	Crankshaft front oil seal
	10.	Joint bolt gasket		21.	EGR Cooler gasket (4JA1TC only)
	11.	Vacuum pump gasket		22.	Inter cooler outlet pipe gasket (4JA1TC, 4JH1TC only)

ENGINE OVERHAUL

REMOVAL

EXTERNAL PARTS

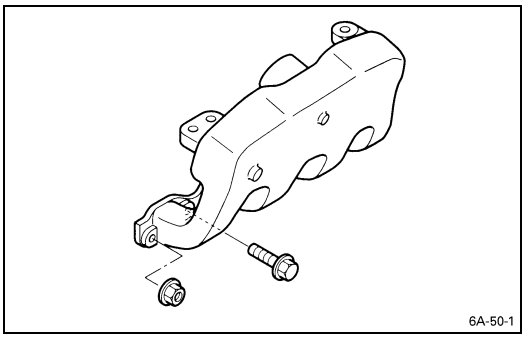
These removal steps are based on the 4JB1T engine.
The triangle (▲) mark indicates the important operations.



Removal Steps

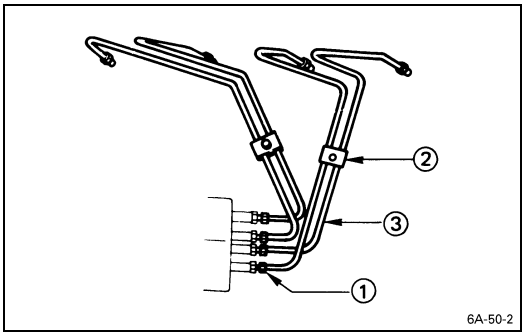
1. Cooling fan drive belt
2. Cooling fan pulley
3. Heater pipe (rear side)
4. Oil level gauge and guide tube
5. Starter motor
6. Water drain cock
7. Oil pressure warning switch and nipple
8. Engine mounting bracket
9. ▲ Intake manifold
10. ▲ Fuel injection pipe with clip
11. Fuel leak off pipe
12. Injection pump
13. Compressor
14. Generator and adjusting plate
15. Water inlet pipe
16. Turbocharger heat protector
17. Exhaust adaptor
18. Turbocharger oil return pipe
19. Turbocharger oil feed pipe
20. ▲ Turbocharger
21. Exhaust manifold heat protector
22. Oil cooler with Oil filter
23. Exhaust manifold
24. Compressor bracket
25. Generator bracket
26. Power steering oil pump
27. Vacuum pipe

Important Operations



9. Intake Manifold

1) Disconnect the PCV hose from the cylinder head cover.
2) Disconnect the intake duct and intake rubber hose from the turbocharger.
3) Remove the upper intake manifold the lower intake manifold with intake duct, and the PCV hose.



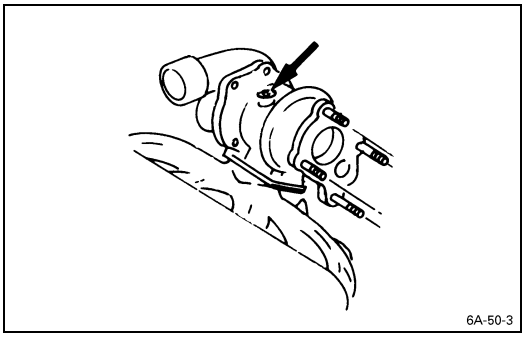
10. Fuel Injection Pipe with Clip

1) Loosen the injection pipe sleeve nuts at the delivery valve side ① and injection nozzle side.

   Do not apply excessive force to the injection pipes.
2) Loosen the injection pipe clips ②.
3) Remove the injection pipes ③.

Note:

Plug the delivery holder ports with the shipping caps to prevent the entry of foreign material.

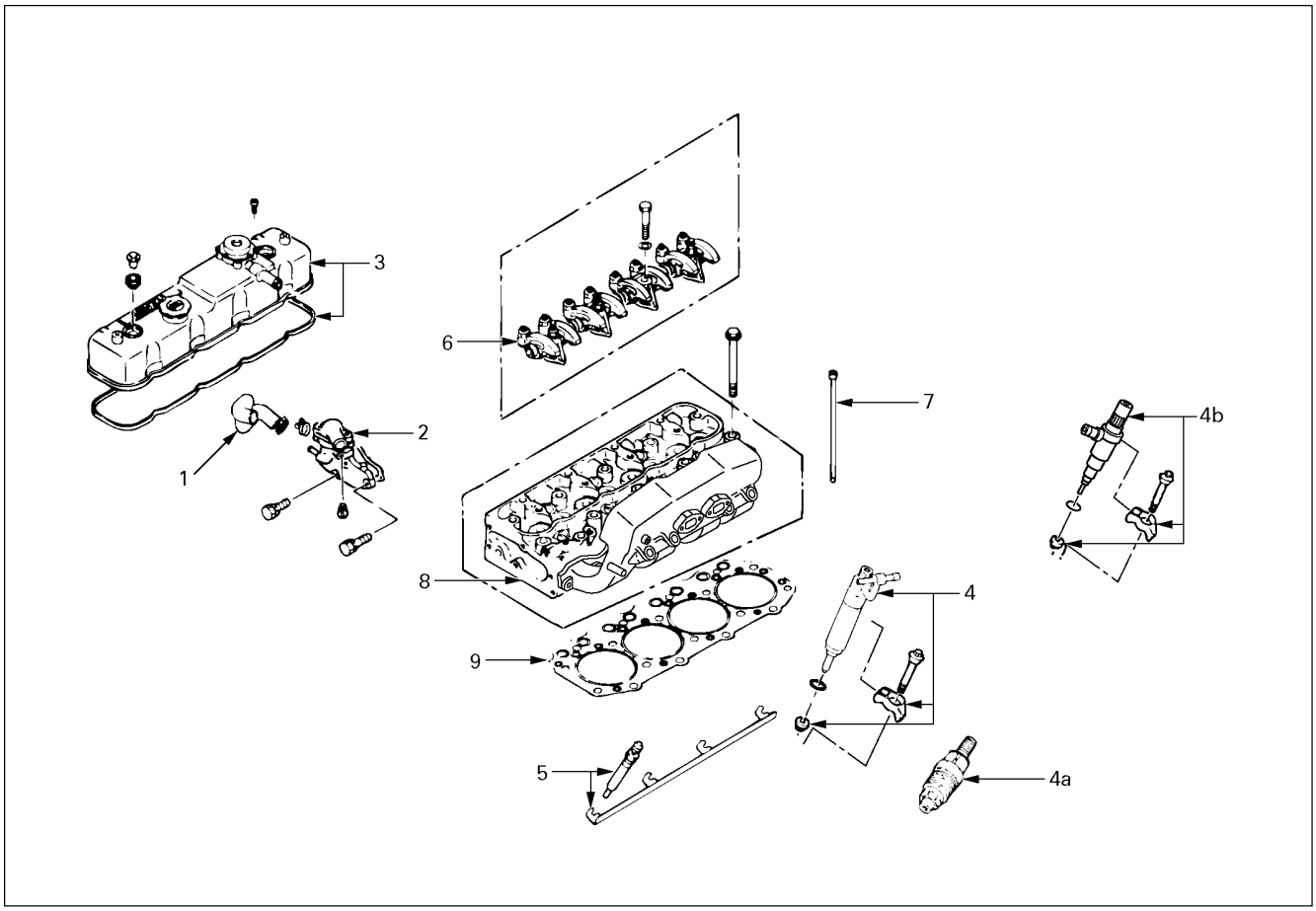


20. Turbocharger

Plug the turbocharger body oil ports after removing the turbocharger assembly to prevent the entry of foreign material.

INTERNAL PARTS

MAJOR COMPONENTS

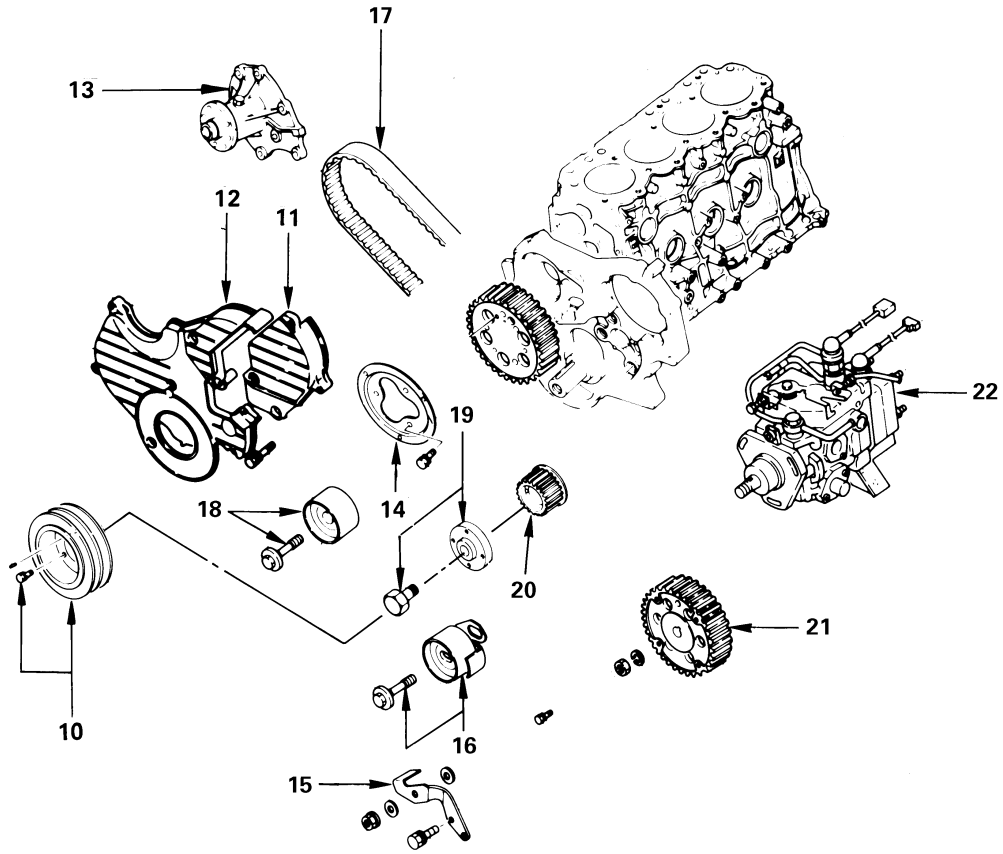


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Disassembly Steps-1

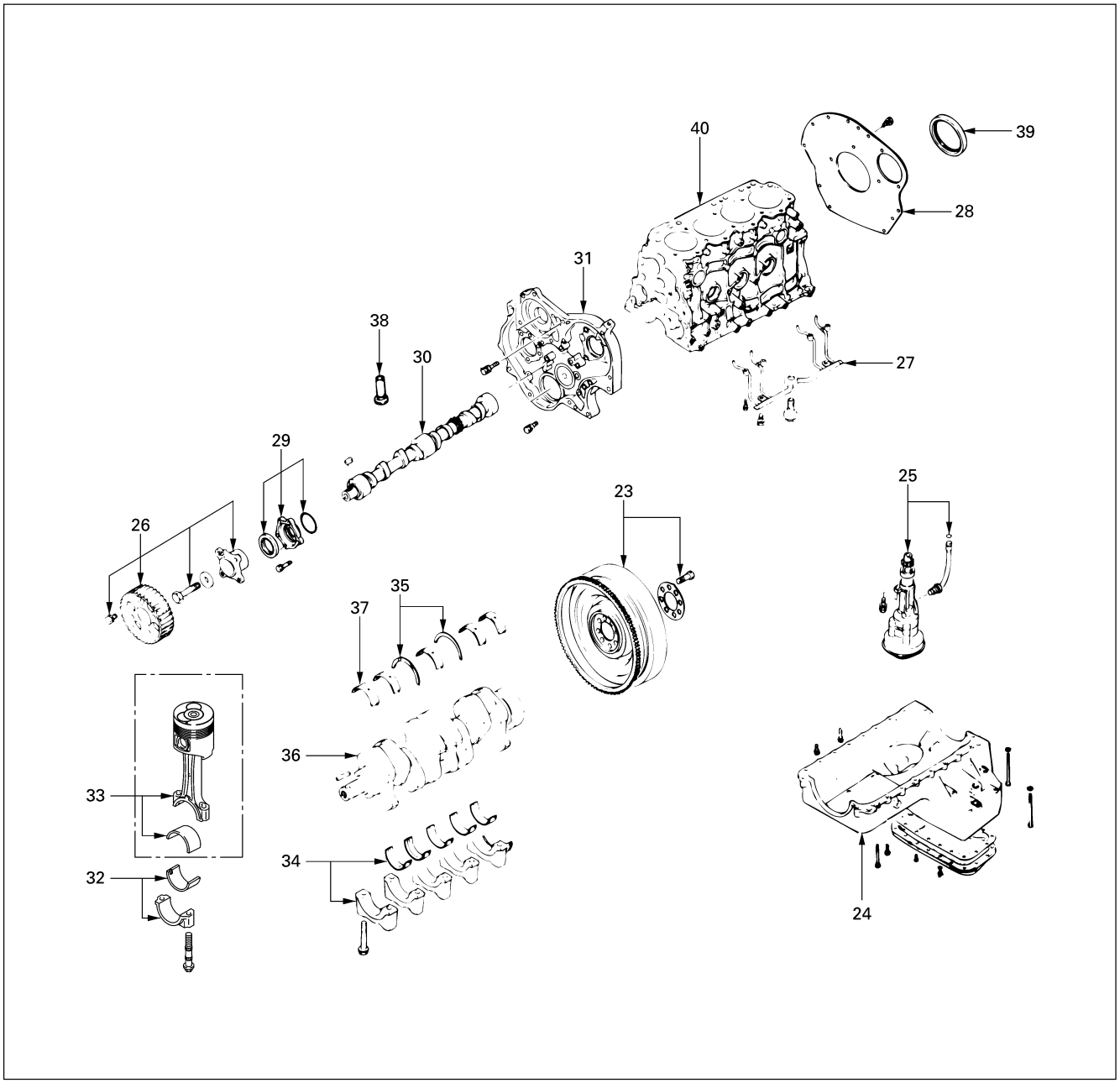
1. Water bypass pipe
2. Thermostat housing with thermo switch
3. Cylinder head cover
4. ▲ Injection nozzle and Injection nozzle holder
   - 4a. Injection nozzle (4JG2T)
   - 4b. Injection nozzle and Injection Nozzle holder (4JA1TC, 4JH1TC)
5. Glow plug and glow plug connector
6. ▲ Rocker arm shaft and rocker arm
7. Push rod
8. ▲ Cylinder head
9. Cylinder head gasket

Belt Drive Model



Disassembly Steps-2 (Belt Drive Model)

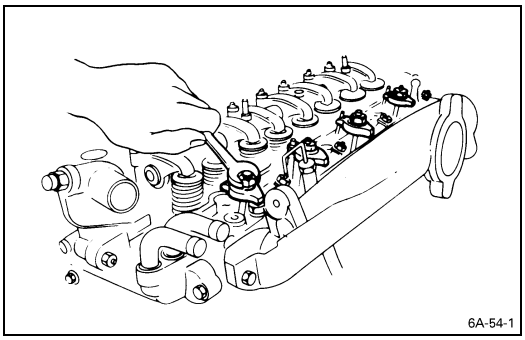
10. Crankshaft damper pulley
11. Timing pulley housing upper cover
12. Timing pulley housing lower Cover
13. Water pump
14. Camshaft timing pulley flange
15. Timing belt tension adjusting Lever
16. Timing belt tensioner
17. Timing belt
18. Tension idler
- ▲ 19. Crankshaft timing pulley center
- ▲ 20. Crankshaft timing pulley
- ▲ 21. Injection pump timing pulley
- ▲ 22. Injection pump



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Disassembly Steps-3 (Belt Drive Model)

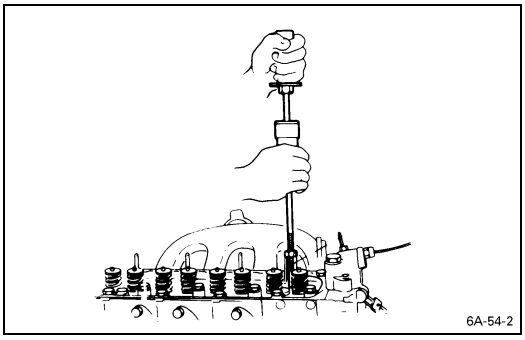
- ▲ 23. Flywheel
- 24. Oil pan
- 25. Oil pump with oil pipe
- 26. Camshaft timing pulley
- ▲ 27. Piston cooling oil pipe
- 28. Cylinder body rear plate
- 29. Oil seal retainer
- ▲ 30. Camshaft
- 31. Timing pulley housing
- ▲ 32. Connecting rod bearing cap with lower bearing
- ▲ 33. Piston and connecting road with upper bearing
- ▲ 34. Crankshaft bearing cap with lower bearing
- 35. Crankshaft thrust bearing
- 36. Crankshaft
- ▲ 37. Crankshaft upper bearing
- ▲ 38. Tappet
- ▲ 39. Crankshaft rear oil seal
- 40. Cylinder body



Important Operations

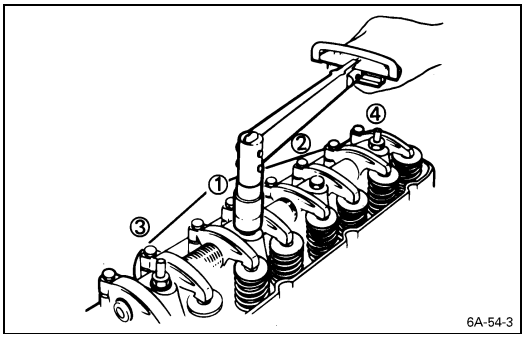
4. Injection Nozzle Holder

1. Remove the nozzle holder bracket nuts.



2. Use the nozzle holder remover and the sliding hammer to remove the nozzle holder together with the holder bracket.

Nozzle Holder Remover: 5-8840-2034-0
Sliding Hammer: 5-8840-0019-0

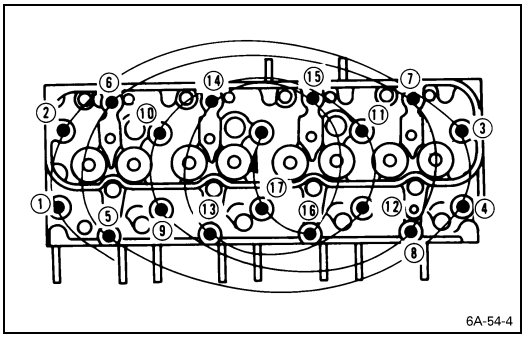


6. Rocker Arm Shaft and Rocker Arm

Loosen the rocker arm shaft bracket bolts in numerical order a little at a time.

Note:

Failure to loosen the rocker arm shaft bracket bots in numerical order a little at a time will adversely affect the rocker arm shaft.

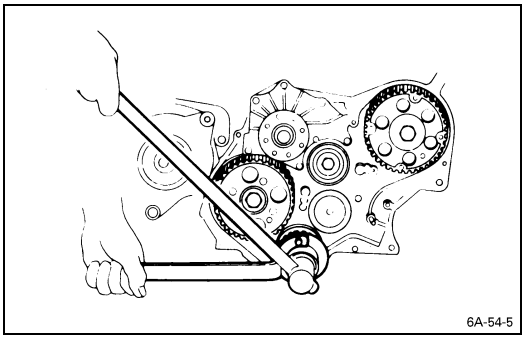


8. Cylinder Head

Loosen the cylinder head bolts in numerical order a little at a time.

Note:

Failure to loosen the cylinder head bolts in numerical order a little at a time will adversely affect the cylinder head lower surface.

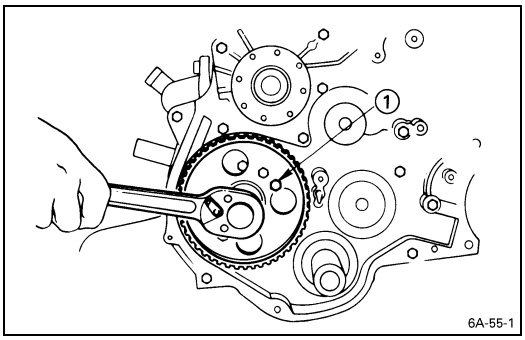


19. Crankshaft Timing Pulley Center

1. Use the fixing wrench to prevent the cranksahft from turning.

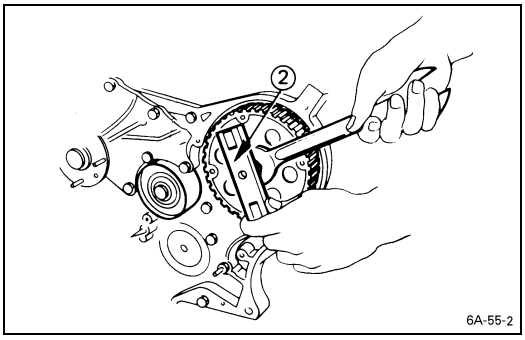
   Fixing Wrench: 5-8840-0161-0

2. Remove the timing pulley center from the crankshaft.



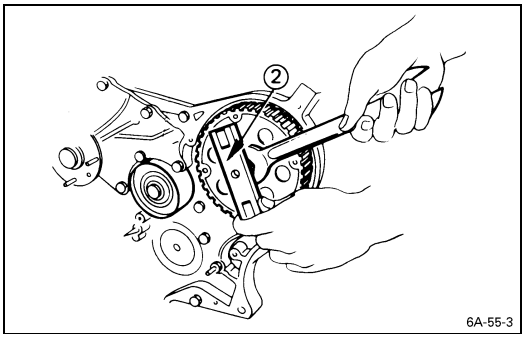
20. Camshaft Timing Pulley

1. Install the stopper bolt ① to the timing pulley to prevent it from turning.

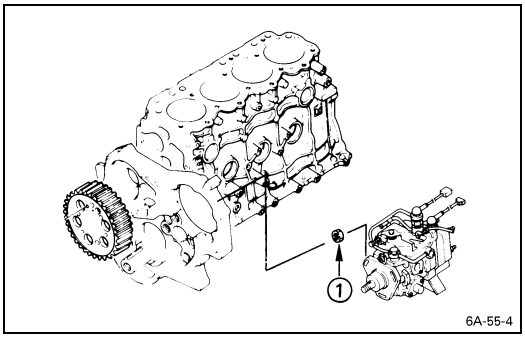


21. Injection Pump Timing Pulley

1. Install the stopper bolt ① to the timing pulley to prevent it from turning.

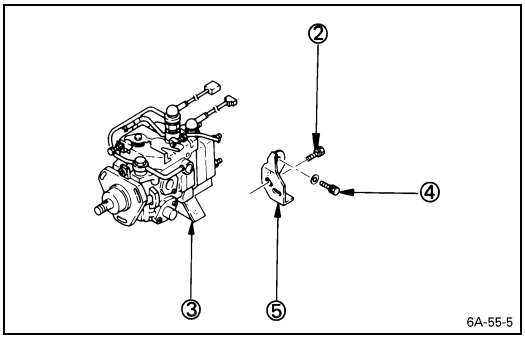


2. Use the timing pulley remover ② to remove the injection pump timing pulley.
   Timing Pulley Puller: 5-8840-0086-0
3. Remove the stopper bolt.



22. Injection Pump

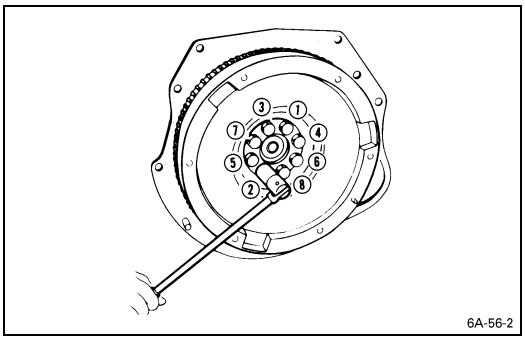
1. Remove the three injection pump bracket nuts ① at the rear of the timing pulley housing.



2. Remove the injection pump rear bracket bolts ② from the injection pump bracket ③.
3. Remove the injection pump rear bracket bolts ④ and the bracket ⑤ from the cylinder body.
4. Pull the injection pump free toward the rear of the engine.

Note:

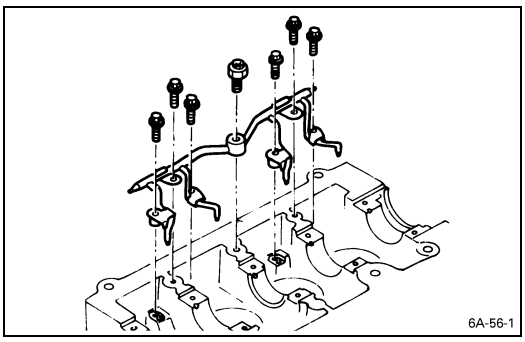
Plug the injection pump delivery holder ports with the shipping caps (or the equivalent) to prevent the entry of foreign material.



23. Flywheel

Block the crankshaft with a piece of hard wood to prevent the flywheel from turning.

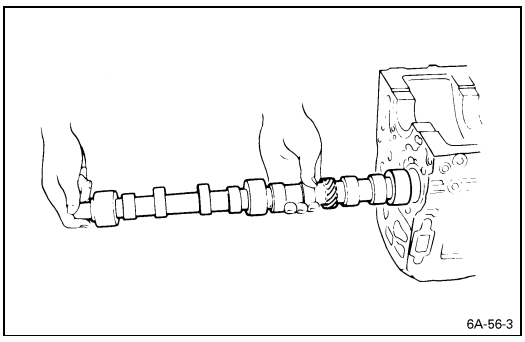
Loosen the flywheel bolts in numerical order a little at a time.



27. Piston Cooling Oil Pipe

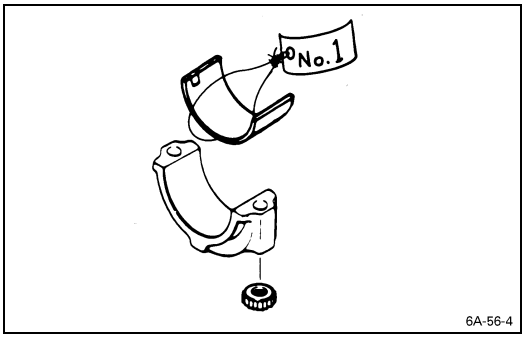
The oiling jet uses thin steel tubing which is easily bent. Accidental contact between the oiling jet and the cylinder body, piston, or a tool will damage the oiling jet.

Never attempt to repair a damaged oiling jet. Replace it with a new one.



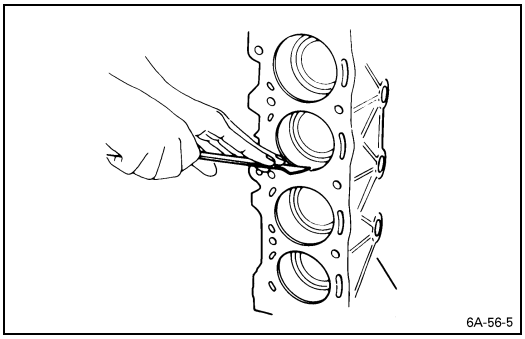
30. Camshaft

Jiggle the camshaft with your hand as you pull it free from the front of the engine.



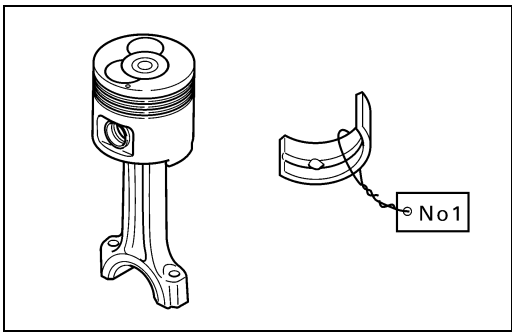
32. Connecting Rod Bearing Cap with Lower Bearing

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.



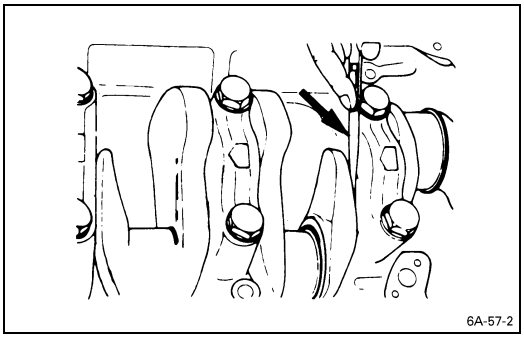
33. Piston and Connecting Rod with Upper Bearing

1) Remove carbon deposits from the upper portion of the cylinder wall with a scraper before removing the piston and connecting rod.
2) Move the piston to the top of the cylinder and tap it with a hammer grip or a similar object from the connecting rod lower side to drive it out.



015R100020

If the connecting rod upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A-57-2

34. Crankshaft Bearing Cap with Lower Bearing

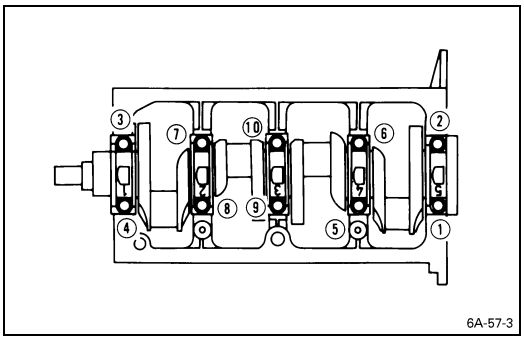
1) Measure the crankshaft end play at the center journal of the crankshaft.

   Do this before removing the crankshaft bearing caps.

   If the measured value exceeds the specified limit, the crankshaft thrust bearing must be replaced.

Crankshaft End Play mm (in)

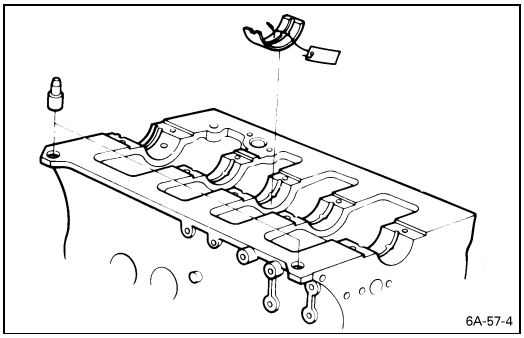
Standard	Limit
0.10 (0.004)	0.30 (0.012)



6A-57-3

2) Loosen the crankshaft bearing cap bolts in numerical order a little at a time.

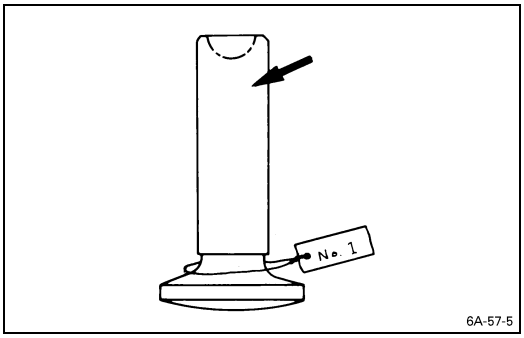
   If the crankshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A-57-4

37. Crankshaft Upper Bearing

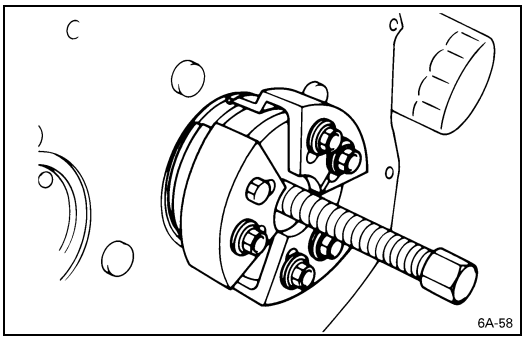
If the crankshaft upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A-57-5

38. Tappet

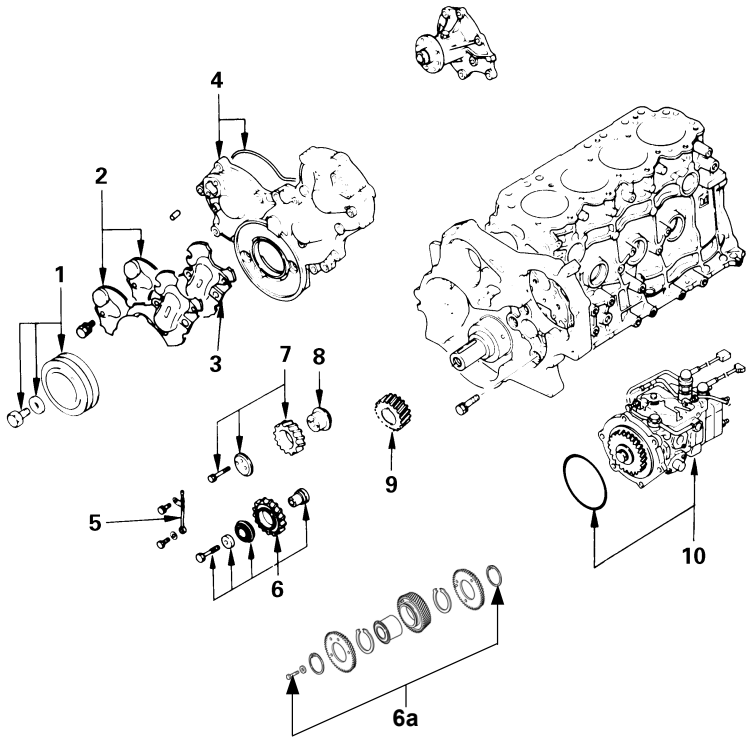
If the tappets are to be reinstalled, mark their fitting positions by tagging each tappet with the cylinder number from which it was removed.



39. Crankshaft Rear Oil Seal

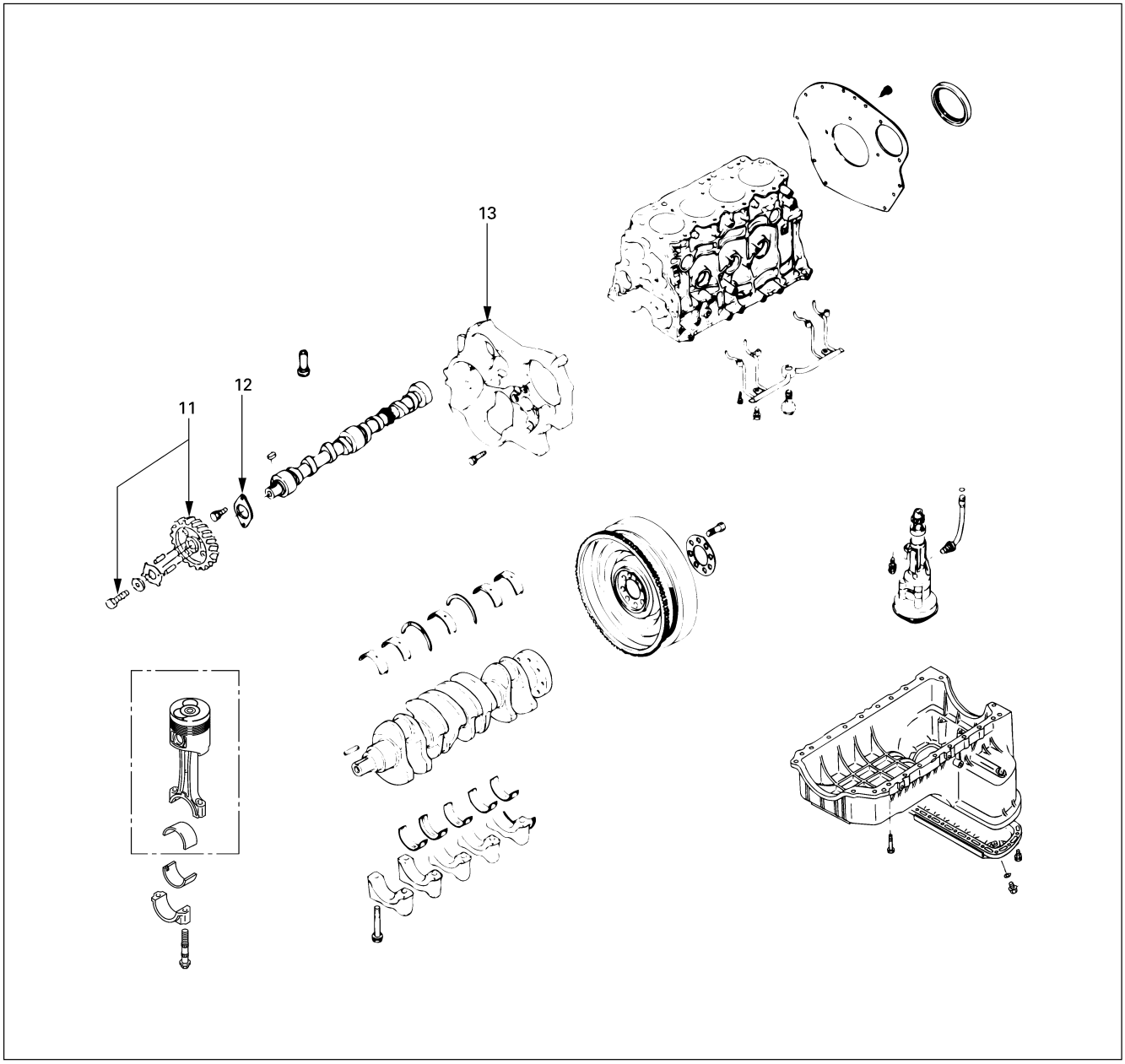
- With the oil seal pushed in deep, install the special tool as shown in the illustration and remove the oil seal.
  Oil Seal Remover: 5-8840-2362-0

Gear Drive Model



Disassembly Steps-2 (Gear Drive Model)

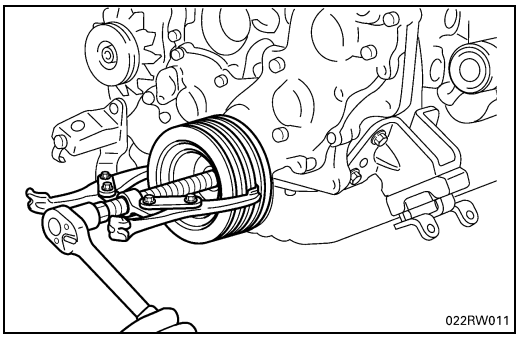
- ▲ 1. Crankshaft damper pulley
- 2. Gear case upper cover and lower cover
- 3. Space rubber
- ▲ 4. Timing gear case cover
- 5. Timing gear oil pipe (Except 4JA1TC, 4JH1TC)
- 6. Idler gear “B” and shaft
- ▲ 6a. Idler gear “B” and shaft (scissor gear) (4JA1TC, 4JH1TC only)
- ▲ 7. Idler gear “A”
- 8. Idler gear shaft
- 9. Crankshaft timing gear
- ▲ 10. Injection pump



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Disassembly Steps-3 (Gear Drive Model)

▲ 11. Camshaft timing gear
12. Camshaft thrust plate
13. Timing gear case

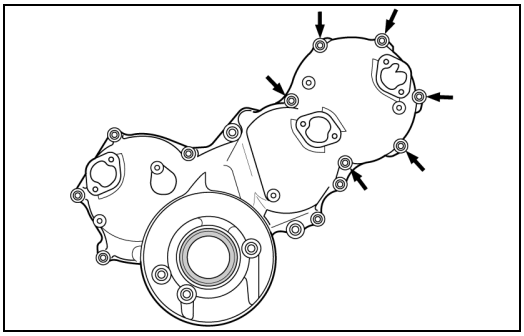


1. Crankshaft Damper Pulley

Use the remover to remove the damper pulley

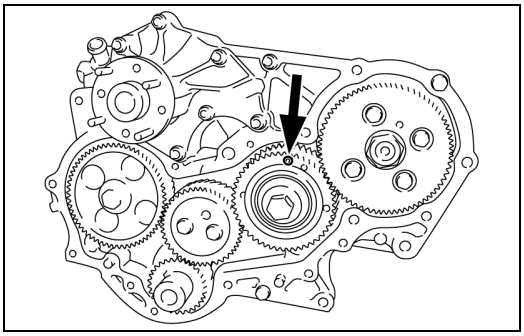
NOTE:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when removing the crankshaft pulley.



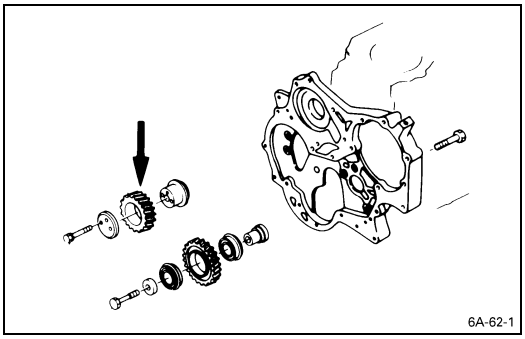
4. Timing Gear Case Cover

The timing gear case is tightened together with the injection pump at the 6 points indicated by the arrows in the illustration.



6a. Idle Gear B (4JA1TC, 4JH1TC only)

Install lock bolts to the holes marked with an arrow in the illustration to hold the gear in place. Remove the gear.

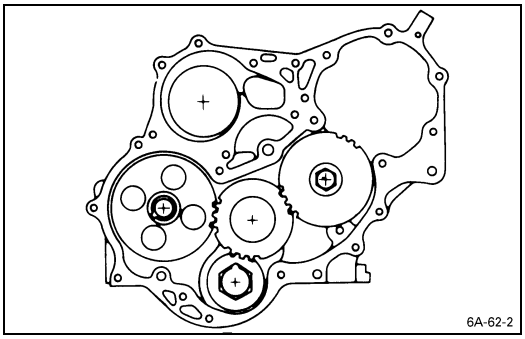


7. Idler Gear "A"

1. Measure the camshaft timing gear backlash and the crankshaft timing gear backlash before removing the idler gear.
2. Measure the idler gear end play before removing the idler gear.

Note:

Refer to the following items for details on the backlash and end play measurement procedures.

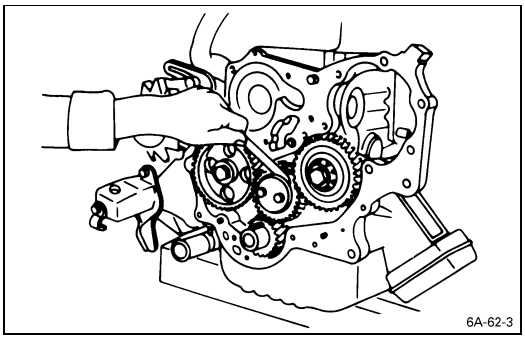


Timing Gear Backlash Measurement

1) Set a dial indicator to the timing gear to measured.
   Hold both the gear to be checked and the adjusting gear stationary.
2) Move the gear to be checked as far as possible to both the right and the left.
   Take the dial indicator reading.
   If the measured value exceeds the specified limit, the timing gear must be replaced.

Timing Gear Backlash mm (in)

Standard	Limit
0.10 – 0.17 (0.0039 – 0.0067)	0.30 (0.012)



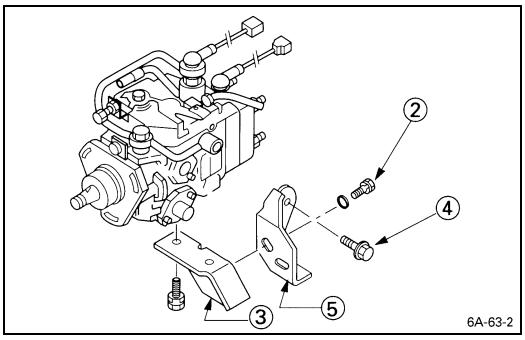
Idler Gear "A" End Play Measurement

Insert a feeler gauge between the idler gear and the thrust collar to measure the gap and determine the idler gear end play.

If the measured value exceeds the specified limit, the thrust collar must be replaced.

Idler Gear End Play mm (in)

Standard	Limit
0.07 (0.0028)	0.2 (0.0079)

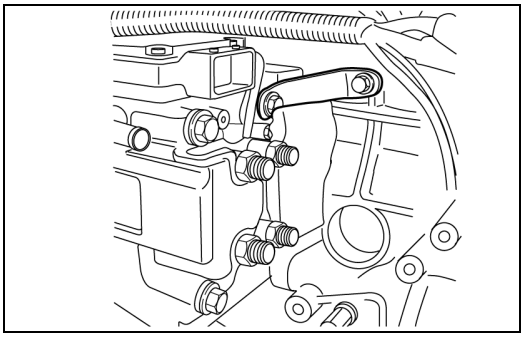


10. Injection Pump

1 Remove the injection pump rear bracket bolts ② from the injection pump bracket ③.

2 Remove the injection pump rear bracket bolts ④ and the bracket ⑤ from the cylinder body.

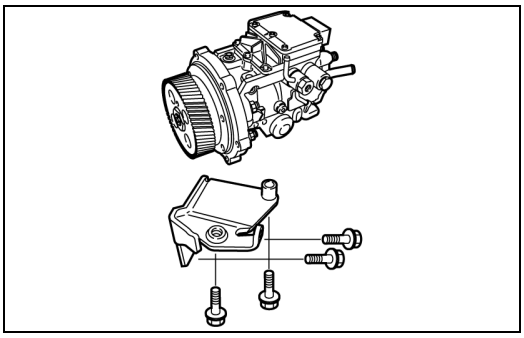
3. Pull the injection pump along with the injection pump timing gear free toward the rear of the engine.



080L200005

4JA1TC, 4JH1TC

1 Remove the injection pump upper bracket from the injection pump.



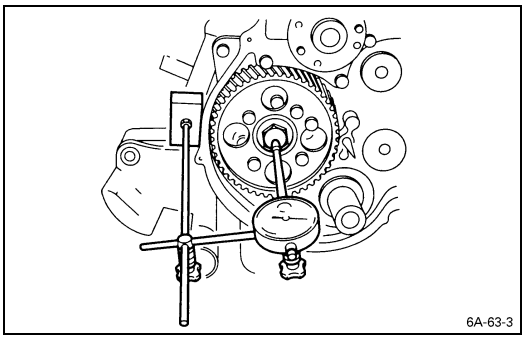
080L200006

2 Remove the injection pump bottom bracket from the injection pump.

3 Pull the injection pump along with the injection pump timing gear free toward the rear of the engine.

Note:

Plug the injection pump delivery holder ports with the shipping caps (or the equivalent) to prevent the entry of foreign material.



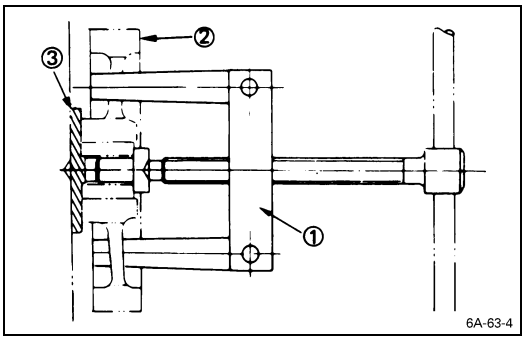
6A-63-3

11. Camshaft Timing Gear

1. Use a dial indicator to measure the camshaft end play.
   This must be done before removing the camshaft gear.
   If the camshaft end play exceeds the specified limit, the thrust plate must be replaced.

Camshaft End Play mm (in)

Standard	Limit
0.050 – 0.114 (0.002 – 0.0044)	0.20 (0.008)



6A-63-4

2. Remove the camshaft timing gear bolt from the camshaft.

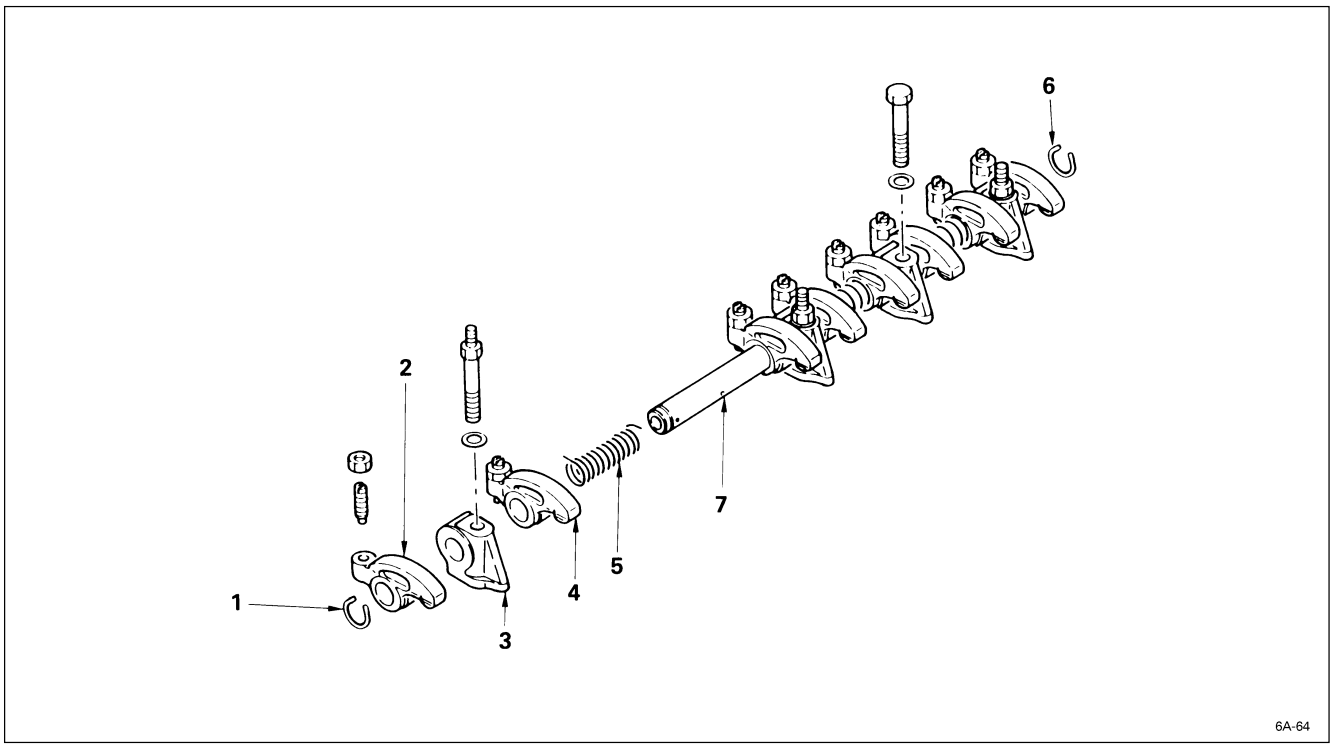
Note:

Hold the camshaft stationary to prevent the camshaft from turning.

3. Use the universal puller ① to pull out the camshaft timing gear ②.
   Universal Puller: 5-8521-0002-0
4. Remove the thrust plate ③.

MINOR COMPONENTS

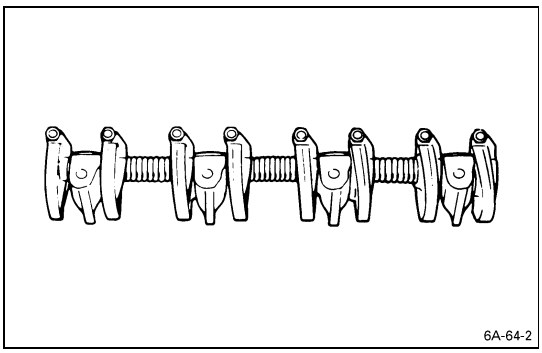
ROCKER ARM SHAFT AND ROCKER ARM



Disassembly Steps

- ▲ 1. Rocker arm shaft snap ring
- ▲ 2. Rocker arm
- ▲ 3. Rocker arm shaft bracket
- 4. Rocker arm
- 5. Rocker arm shaft spring
- 6. Rocker arm shaft snap ring
- 7. Rocker arm shaft

Important Operations



1. Rocker Arm Shaft Snap Ring

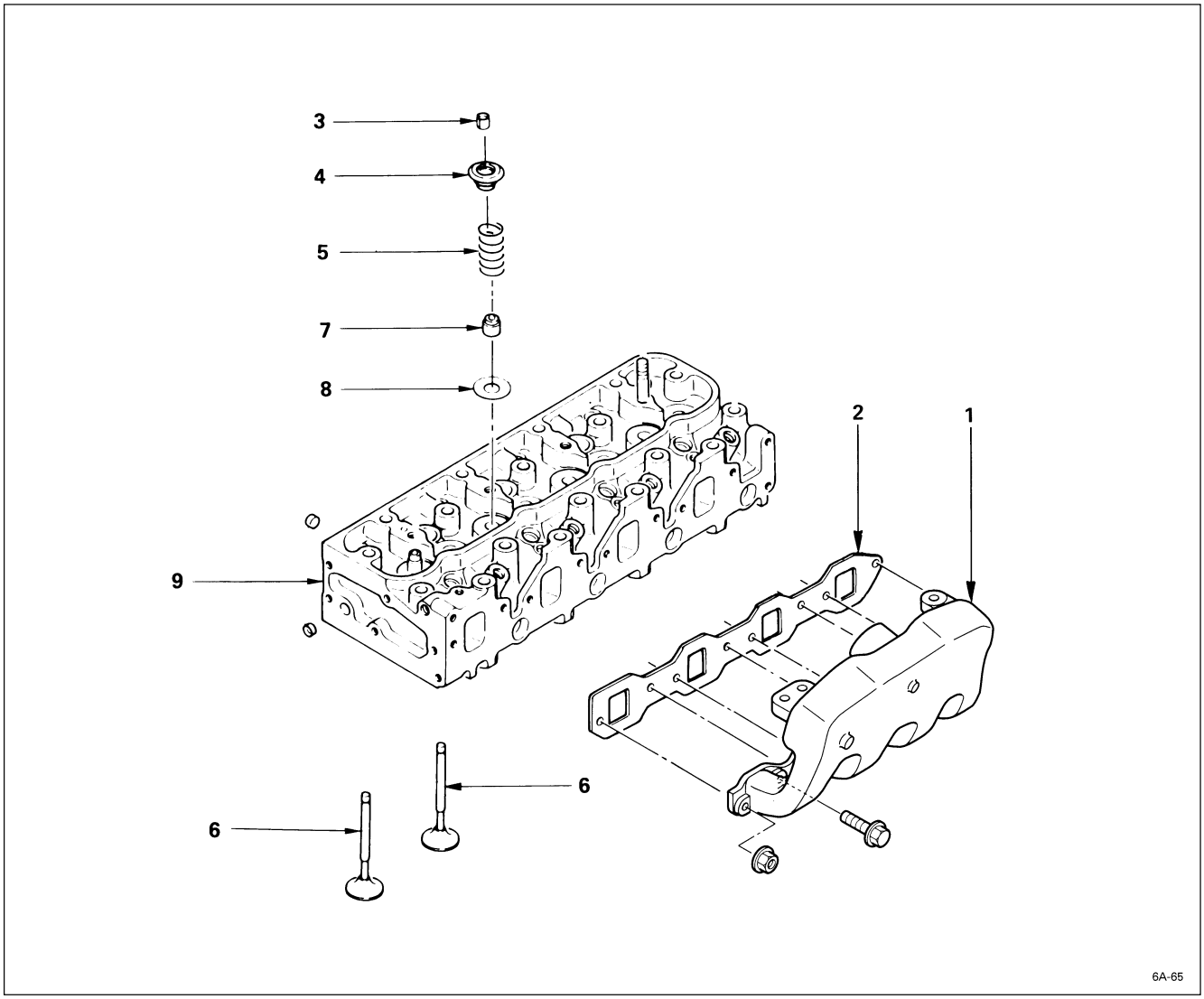
2. Rocker Arm

3. Rocker Arm Shaft Bracket

1) Use a pair of pliers to remove the snap rings.
2) Remove the rocker arms.
3) Remove the rocker arm shaft brackets.

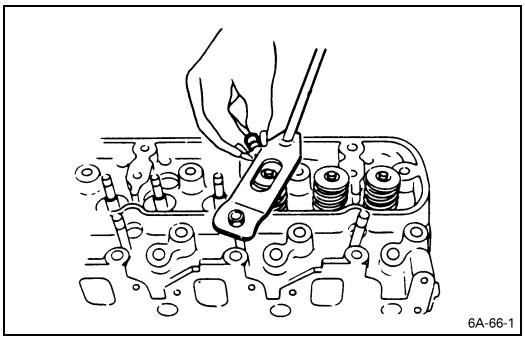
If the rocker arms and rocker arm shaft brackets are to be reinstalled, mark their installation positions by tagging each rocker arm and rocker arm shaft bracket with the cylinder number from which it was removed.

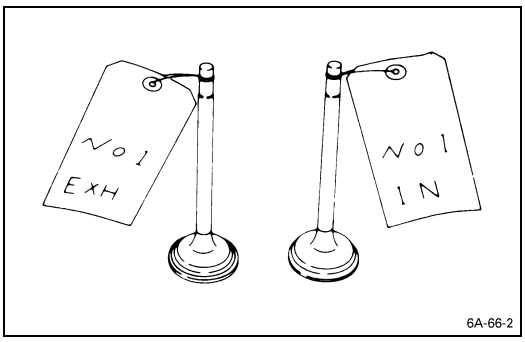
CYLINDER HEAD



Disassembly Steps

1. Intake manifold
2. Intake manifold gasket
▲ 3. Split collar
4. Valve spring upper seat
5. Valve spring
▲ 6. Intake and exhaust valve
7. Valve stem oil seal
8. Valve spring lower seat
9. Cylinder head


6A-66-1



6A-66-2

Important Operations

3. Split Collar

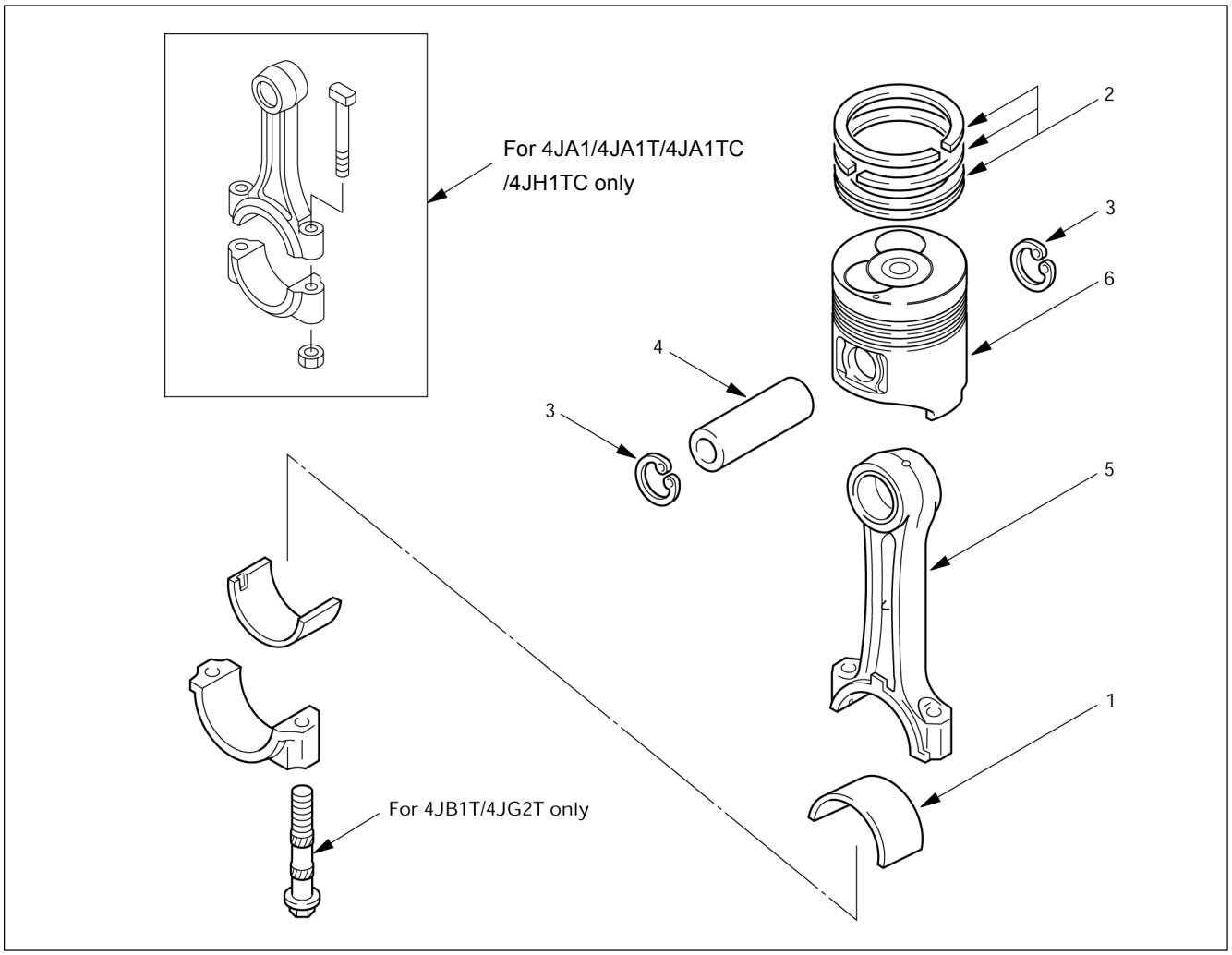
1) Place the cylinder head on a flat wooden surface.
2) Use the spring compressor to remove the split collars.
   Do not allow the valve to fall from the cylinder head.
   Spring Compressor: 9-8523-1423-0 (J-29760)

6. Intake and Exhaust Valve

If the intake and exhaust valves are to be reinstalled, mark their installation positions by tagging each valve with the cylinder number from which it was removed.

If the intake and exhaust valves are to be replaced, the valve guides must also be replaced.

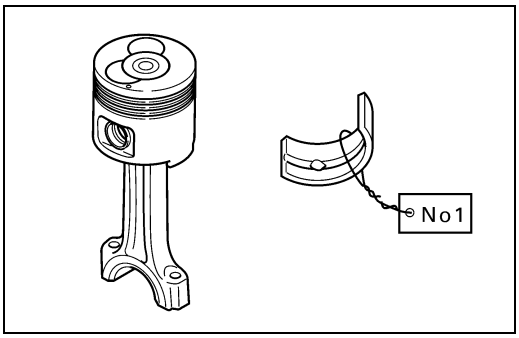
PISTON AND CONNECTING ROD



015L200002

Disassembly Steps

- ▲ 1. Connecting rod bearing
- ▲ 2. Piston ring
- ▲ 3. Piston pin snap ring
- ▲ 4. Piston pin
- 5. Connecting rod
- ▲ 6. Piston

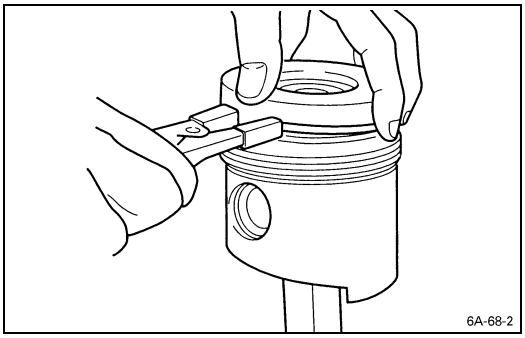


015R100020

Important Operations

1. Connecting Rod Bearing

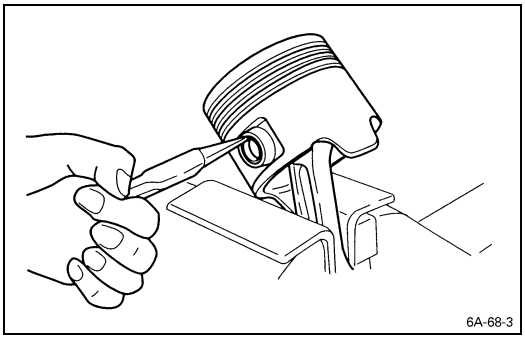
If the connecting rod bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A-68-2

2. Piston Ring

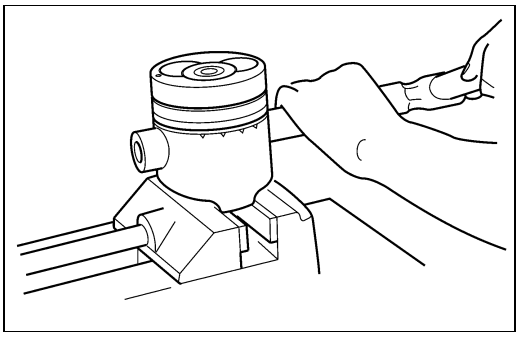
1) Clamp the connecting rod in a vise.
   Take care not to damage the connecting rod.
2) Use a piston ring replacer to remove the piston rings.
   Piston Ring Replacer
   Do not attempt to use some other tool to remove the piston rings. Piston ring stretching will result in reduced piston ring tension.



6A-68-3

3. Piston Pin Snap Ring

Use a pair of pliers to remove the piston pin snap rings.



015R100015

4. Piston Pin

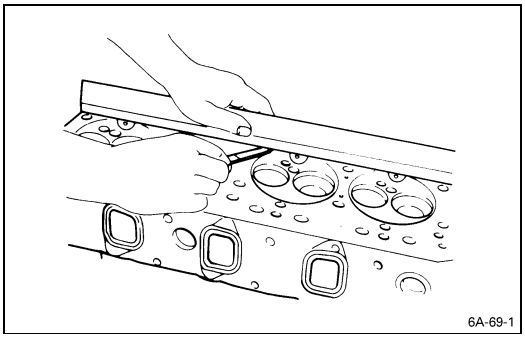
6. Piston

Tap the piston pin out with a hammer and a brass bar.

If the pistons and piston pins are to be reinstalled, mark their installation positions by tagging each piston and piston pin with the cylinder number from which it was removed.

INSPECTION AND REPAIR

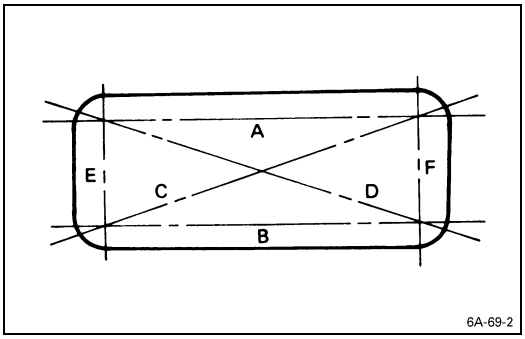
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.


6A-69-1

FACE WARPAGE

Cylinder Head Lower Face Warpage

1. Use a straight edge and a feeler gauge to measure the four sides and the two diagonals of the cylinder head lower face.



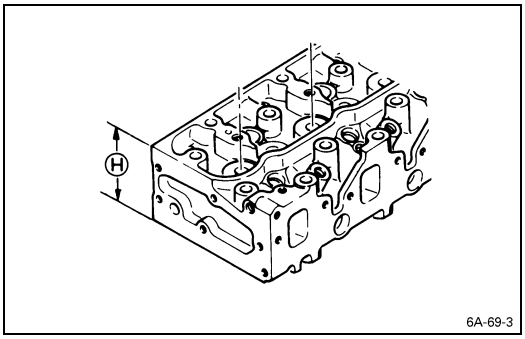
6A-69-2

If the measured values exceed the limit, the cylinder head must be replaced.

Cylinder Head Lower Face Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.008)

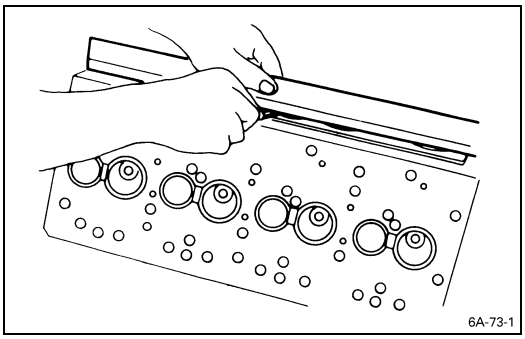
Note:
The cylinder head lower face cannot be reground.



6A-69-3

Cylinder Head Height Ⓗ (Reference) mm (in)

Standard
91.95 – 92.05 (3.620 – 3.624)


6A-73-1

Manifold Fitting Face Warpage

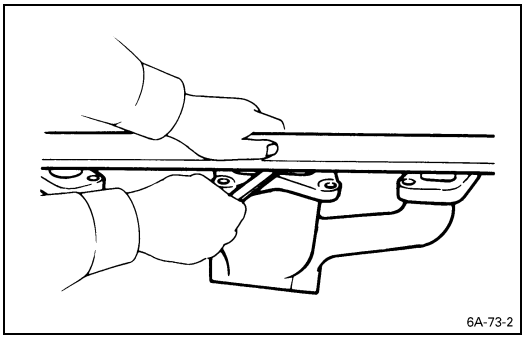
Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the manifold cylinder head fitting surfaces if the measured values are greater than the specified limit but less than the maximum grinding allowance.

If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

Manifold Fitting Face Warpage mm (in)

Standard	Limit	Maximum Grinding Allowance
0.05 (0.002) or less	0.20 (0.008)	0.40 (0.016)



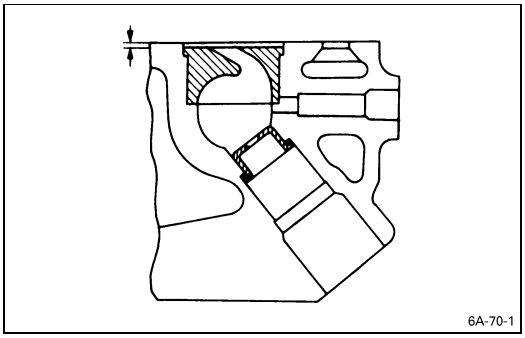
Exhaust Manifold Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

If the measured values exceed the specified limit, the manifold must be replaced.

Exhaust Manifold Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.008)



HOT PLUG (4JG2T ENGINE ONLY)

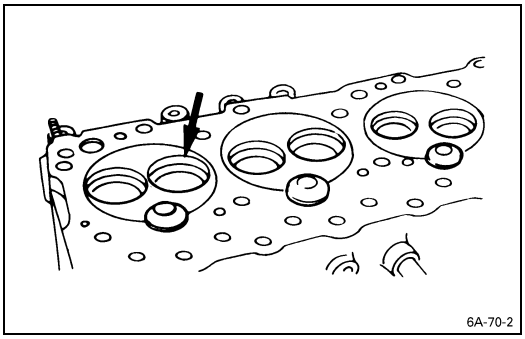
Hot Plug Depression

1. Clean the cylinder head lower face, taking care not to damage the hot plug surfaces.
2. Use a straight edge and a feeler gauge to measure hot plug depression in a straight line from the No. 1 hot plug to the No. 4 hot plug.

   If the measured value exceeds the specified limit, the hot plugs must be replaced.

Hot Plug Depression mm (in)

Limit
0.02 (0.0008)



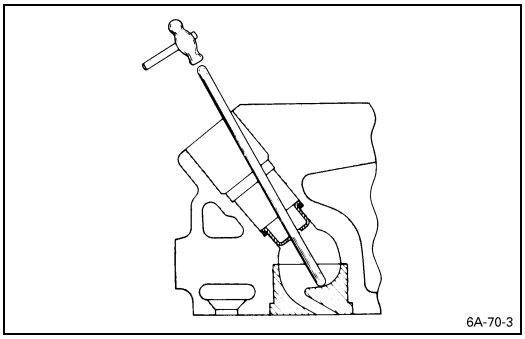
Combustion Chamber Inspection

1. Remove the carbon adhering to the inside of the combustion chamber. Take care not to damage the hot plug fitting positions.
2. Inspect the inside of the combustion chamber, the hot plug hole, and the hot plug machined faces for cracking and other damage.

   If cracking or damage is present, the cylinder head must be replaced.

Note:

Be absolutely certain that there are no scratches or protuberances on the combustion chamber surfaces which will be in contact with the hot plug after it is installed. These flaws will prevent the hot plug from seating correctly.



Hot Plug Replacement

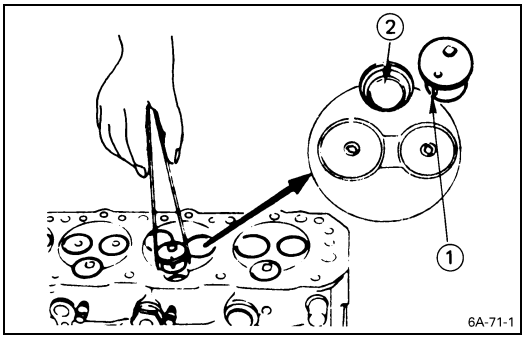
Hot Plug Removal

1. Insert a 3 – 5 mm (0.12 – 0.20 in) diameter brass bar into the nozzle holder fitting hole until it makes contact with the hot plug.
2. Lightly tap the bar with a hammer to drive the hot plug free.

Hot Plug Inspection

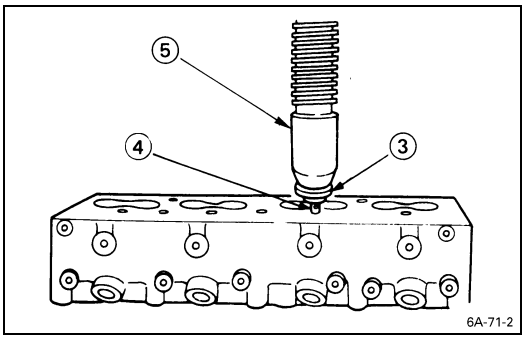
Inspect the hot plugs for excessive wear and other damage. Replace the hot plugs if either of these conditions are discovered.

Refer to “Hot Plug Installation”.



Hot Plug Installation

1. Align the hot plug knock ball ① with the cylinder head groove ② and tap it temporarily into position with a plastic hammer.



2. Place a metal plate ③ approximately 25 mm (1 in) thick over the hot plug upper surface ④.
3. Use a bench press ⑤ to exert a pressure of 4,500 – 5,500 kg (9,923 – 12,128 lb/44,100 – 53,900 N) on the metal plate covering the hot plug upper surface.

   This will drive the hot plug into position.
4. Lightly tap the hot plug head to make sure that it is firmly seated.
5. Repeat the procedure (Steps 1 – 4) for the remaining hot plugs.

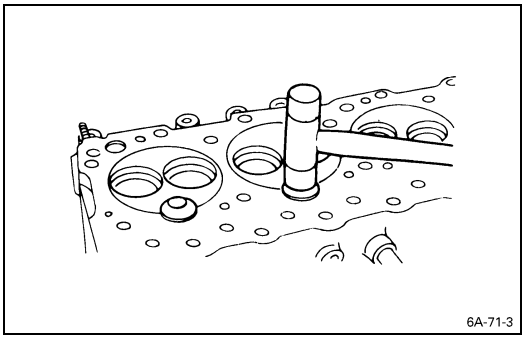
Note:

Do not apply pressure greater than that specified.

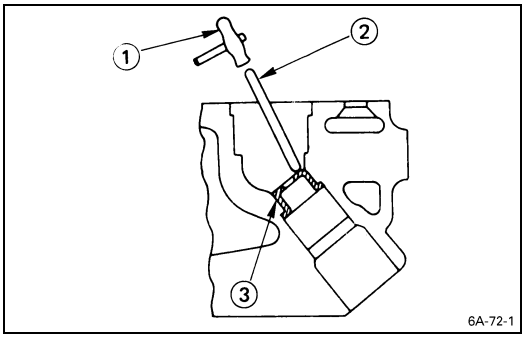
Damage to the cylinder head will result.

6. Use a surface grinder to grind off any hot plug surface protuberances.

   The hot plug surfaces must be perfectly flush with the cylinder head lower face.



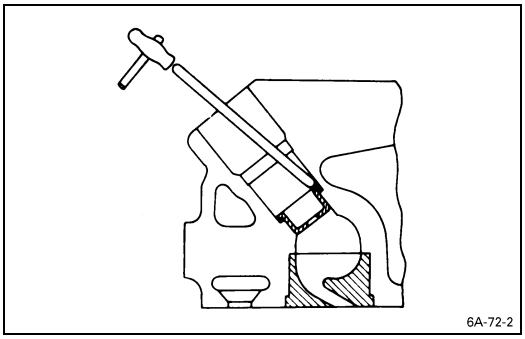
7. After grinding, make sure that the hot plug surfaces are completely free of protuberances.
   The hot plug surfaces must also be free of depressions.
   Once again, lightly tap the hot plug heads to make sure that they are firmly seated.



Heat Shield Replacement

Heat Shield Removal

After removing the hot plugs, use a hammer ① and a brass bar ② to lightly tap the lower side of the heat shield ③ and drive it free.



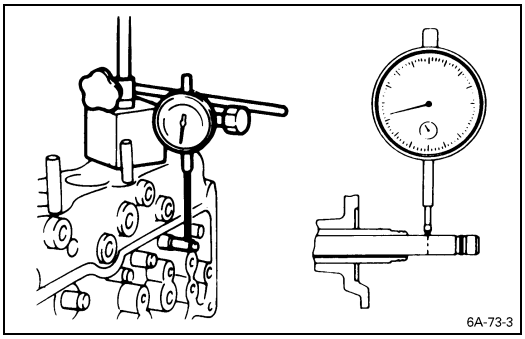
Heat Shield Installation

Install the heat shield to the cylinder head from the nozzle holder installation hole side. Lightly tap the heat shield flange into place with a hammer and a brass bar.

The heat shield flange side must be facing up.

Note:

Always install a new heat shield. Never reuse the old heat shield.



VALVE GUIDE

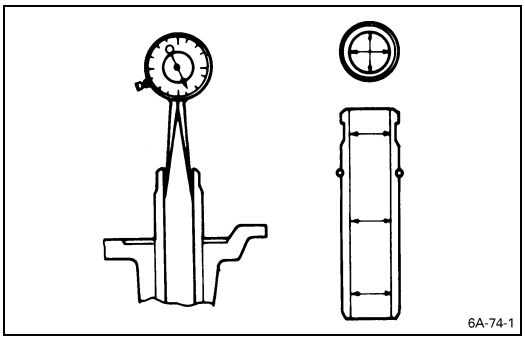
Valve Stem and Valve Guide Clearance

Measuring Method-I

1. With the valve stem inserted in the valve guide, set the dial indicator needle to “0”.
2. Move the valve head from side to side.
   Read the dial indicator.
   Note the highest dial indication.
   If the measured values exceed the specified limit, the valve and the valve guide must be replaced as a set.

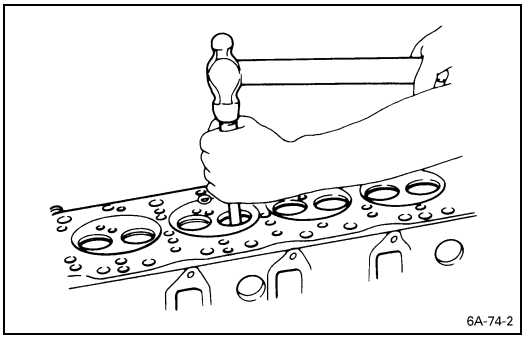
Valve Stem Clearance mm (in)

	Standard	Limit
Intake Valve	0.039 – 0.069 (0.0015 – 0.0027)	0.200 (0.008)
Exhaust Valve	0.064 – 0.093 (0.0025 – 0.0037)	0.250 (0.0098)



Measuring Method-II

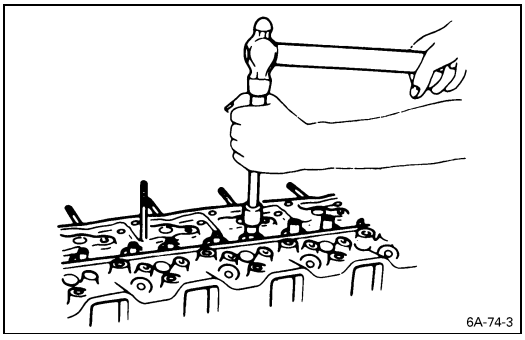
1. Measure the valve stem outside diameter.
   Refer to the Item “Valve Stem Outside Diameter”.
2. Use a caliper calibrator or a telescoping gauge to measure the valve guide inside diameter.



Valve Guide Replacement

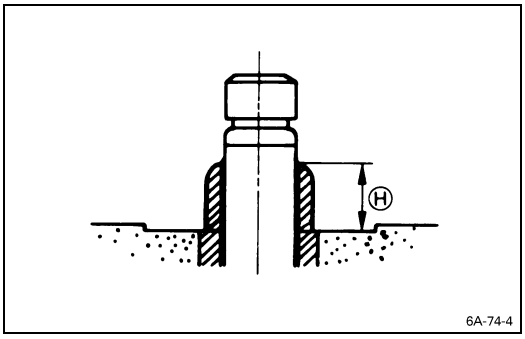
Valve Guide Removal

Use a hammer and the valve guide replacer to drive out the valve guide from the cylinder head lower face.
Valve Guide Replacer: 9-8523-1212-0



Valve Guide Installation

1. Apply engine oil to the valve guide outer circumference.
2. Attach the valve guide installer to the valve guide.
3. Use a hammer to drive the valve guide into position from the cylinder head upper face.
   Valve Guide Replacer: 9-8523-1212-0

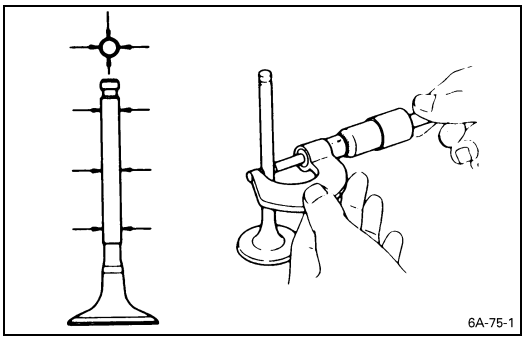


4. Measure the height of the valve guide upper end from the upper face of the cylinder head.

Valve Guide Upper End Height Ⓗ (Reference) mm (in)
13 (0.51)

Note:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.



VALVE AND VALVE SEAT INSERT

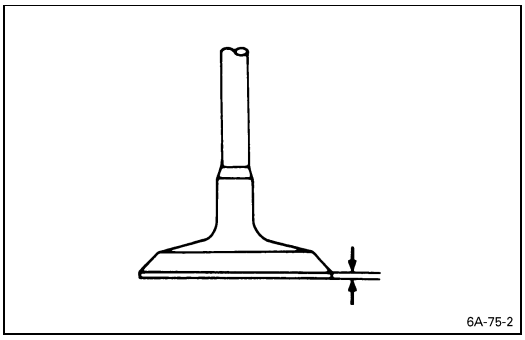
Valve Stem Outside Diameter

Measure the valve stem diameter at three points.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Outside Diameter mm (in)

	Standard	Limit
Intake Valve	7.946 – 7.961 (0.3128 – 0.3134)	7.880 (0.3102)
Exhaust Valve	7.921 – 7.936 (0.3119 – 0.3124)	7.850 (0.3090)



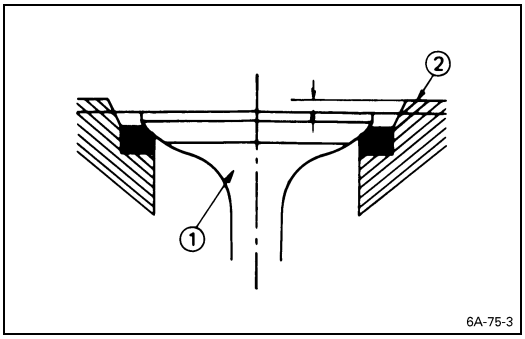
Valve Thickness

Measure the valve thickness.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Intake and Exhaust Valve Thickness mm (in)

		Standard	Limit
4JA1T, 4JA1, 4JB1T, 4JA1TC Engine		1.8 (0.07)	1.5 (0.06)
4JG2T Engine	Inlet	1.34 (0.0528)	1.1 (0.043)
	Exhaust	1.38 (0.0544)	
4JH1TC	Inlet	1.41 (0.0555)	1.1 (0.043)
	Exhaust	1.38 (0.0543)	



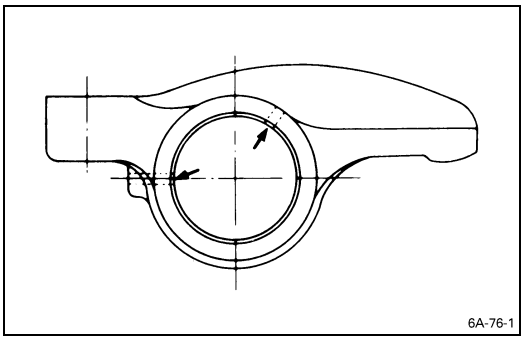
Valve Depression

1. Install the valve ① to the cylinder head ②.
2. Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.

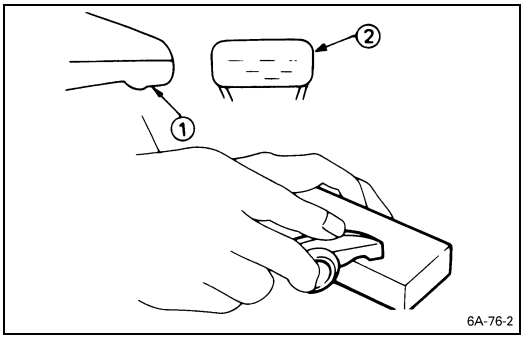
   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Depression mm (in)

		Standard	Limit
4JA1T, 4JA1, 4JB1T, 4JA1TC Engine	Intake	0.73 (0.029)	1.28 (0.050)
	Exhaust	0.70 (0.028)	1.20 (0.047)
4JG2T, 4JH1TC Engine		1.1 (0.043)	1.6 (0.063)



3. Check that the rocker arm oil port is free of obstructions.
   If necessary, use compressed air to clean the rocker arm oil port.



Rocker Arm Correction

Inspect the rocker arm valve stem contact surfaces for step wear ① and scoring ②.

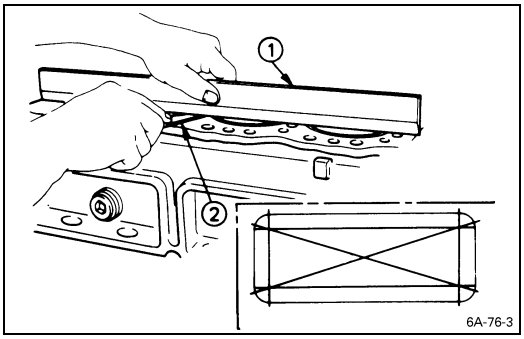
If the contact surfaces have light step wear or scoring, they may be honed with an oil stone.

If the step wear or scoring is severe, the rocker arm must be replaced.

CYLINDER BODY

Cylinder Body Upper Face Warpage

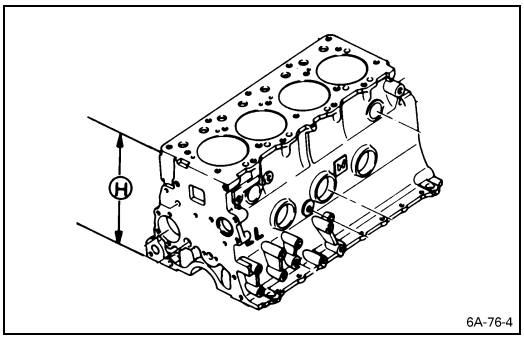
1. Remove the cylinder body dowel.
2. Remove the cylinder liner.
   Refer to “Cylinder Liner Replacement”.



3. Use a straight edge ① and a feeler gauge ② to measure the four sides and the two diagonals of the cylinder body upper face.
   If the measured values exceeds the limit, the cylinder body must be replaced.

Cylinder Body Upper Face Warpage mm (in)

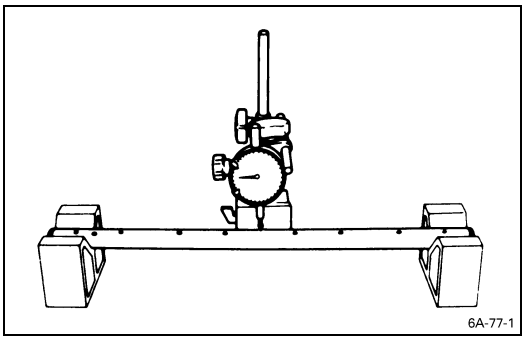
Standard	Limit
0.05 (0.002) or less	0.20 (0.008)



Cylinder Body Height Ⓗ (Reference) mm (in)

	Standard
4JA1, 4JA1T, 4JA1TC	244.945 – 245.055 (9.6430 – 9.6478)
4JB1T, 4JG2T, 4JH1TC	269.945 – 270.055 (10.6277 – 10.6320)

5. Reinstall the cylinder liner.
   Refer to “Cylinder Liner Replacement”.
6. Reinstall the cylinder body dowel.



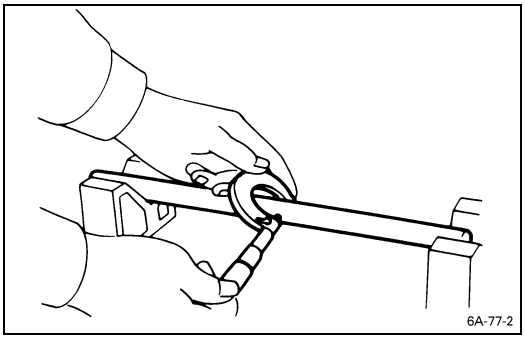
ROCKER ARM SHAFT AND ROCKER ARM

Rocker Arm Shaft Run-Out

1. Place the rocker arm shaft on a V-block.
2. Use a dial indicator to measure the rocker arm shaft central portion run-out.
   If the run-out is very slight, correct the rocker arm shaft run-out with a bench press. The rocker arm must be at cold condition.
   If the measured rocker arm shaft run-out exceeds the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Run-Out mm (in)

Limit
0.3 (0.012)



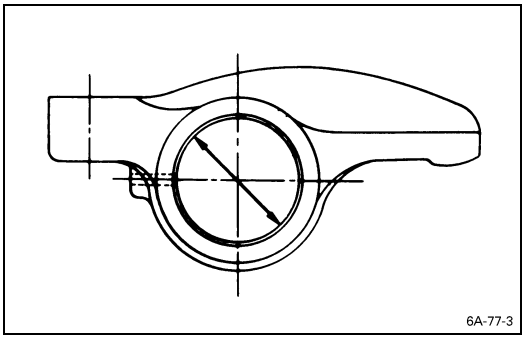
Rocker Arm Shaft Outside Diameter

Use a micrometer to measure the rocker arm fitting portion outside diameter.

If the measured value is less than the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Outside Diameter mm (in)

Standard	Limit
18.98 – 19.00 (0.747 – 0.748)	18.90 (0.744)



Rocker Arm Shaft and Rocker Arm Clearance

1. Use either a vernier caliper or a dial indicator to measure the rocker arm inside diameter.

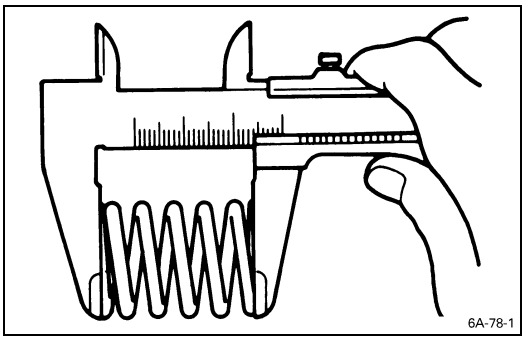
Rocker Arm Inside Diameter mm (in)

Standard	Limit
19.010 – 19.030 (0.748 – 0.749)	19.100 (0.752)

2. Measure the rocker arm shaft outside diameter.
   If the measured value exceeds the specified limit, replace either the rocker arm or the rocker arm shaft.

Rocker Arm Shaft and Rocker Arm Clearance mm (in)

Standard	Limit
0.01 – 0.05 (0.0004 – 0.0020)	0.20 (0.008)



VALVE SPRING

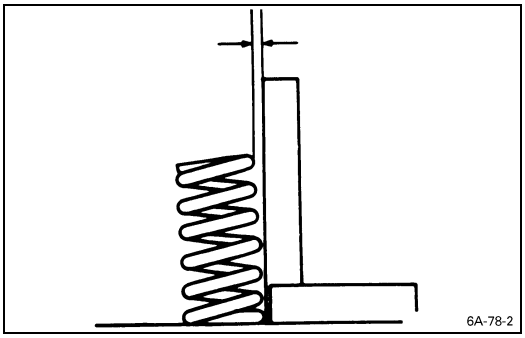
Valve Spring Free Height

Use a vernier caliper to measure the valve spring free height.

If the measured value is less than the specified limit, the valve spring must be replaced.

Inner and Outer Spring Free Height mm (in)

		Standard	Limit
4JA1, 4JA1T, 4JA1TC	Inner spring	45.3 (1.78)	44.4 (1.75)
	Outer spring	49.7 (1.96)	48.2 (1.90)
4JB1T, 4JG2T, 4JH1TC	Single spring	48.0 (1.89)	47.1 (1.85)



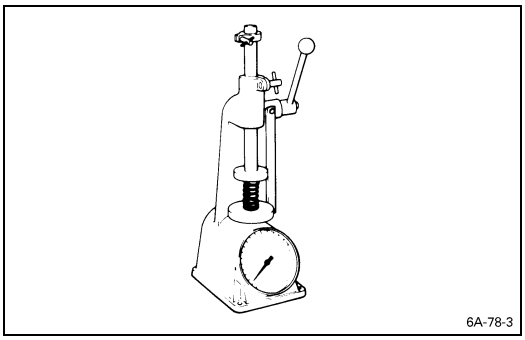
Valve Spring Squareness

Use a surface plate and a square to measure the valve spring squareness.

If the measured value exceeds the specified limit, the valve spring must be replaced.

Inner and Outer Spring Squareness mm (in)

		Limit
4JA1, 4JA1T, 4JA1TC	Inner Spring	3.0 (0.120)
	Outer Spring	3.2 (0.126)
4JB1T, 4JG2T, 4JH1TC	Single Spring	1.7 (0.07)



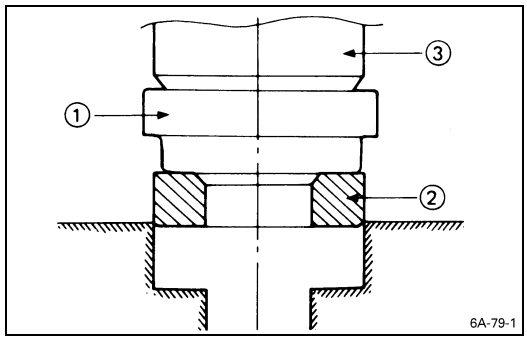
Valve Spring Tension

Use a spring tester to measure the valve spring tension.

If the measured value is less than the specified limit, the valve spring must be replaced.

Valve Spring Tension kg (lb/N)

		Compressed Height	Standard	Limit
4JA1, 4JA1T, 4JA1TC	Inner Spring	37.0 mm (1.46 in)	5.9 (13.0/57.9)	5.0 (11.0/49.0)
	Outer Spring	39.0 mm (1.54 in)	20.9 (46.0/205.0)	18.1 (39.8/177.4)
4JB1T, 4JG2T, 4JH1TC	Single Spring	38.9 mm (1.53 in)	30.2 (66.4/296.0)	26.3 (57.9/257.7)



Valve Seat Insert Installation

1. Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

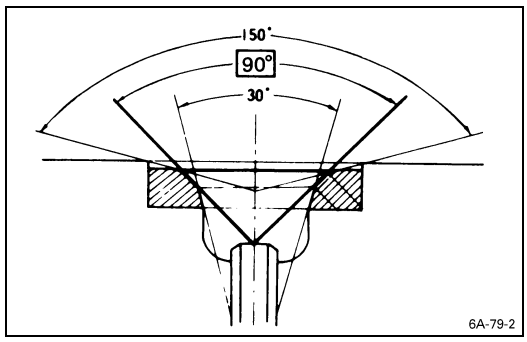
Note:

The smooth side of the attachment must contact the valve seat insert.

2. Use a bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

Note:

Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.



Valve Seat Insert Correction

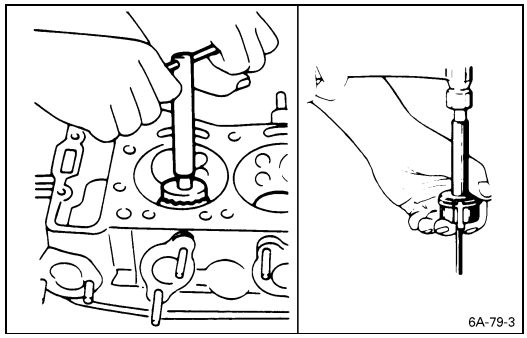
1. Remove the carbon from the valve seat insert surface.
2. Use a valve cutter (15°, 45°, and 75° blades) to minimize scratches and other rough areas. This will bring the contact width back to the standard value. Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished areas of the valve seat surface.

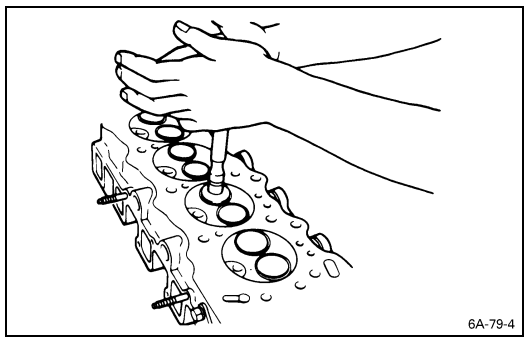
Valve Seat Angle	degree
45	

Note:

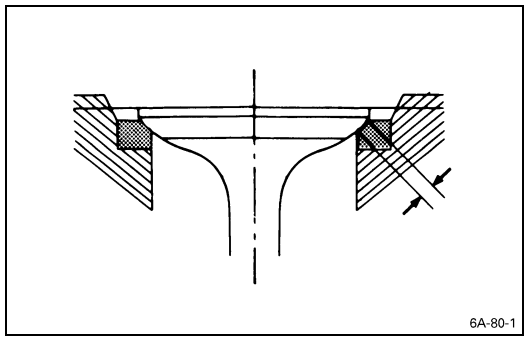
Use an adjustable valve cutter pilot.

Do not allow the valve cutter pilot to wobble inside the valve guide.





3. Apply abrasive compound to the valve seat insert surface.
4. Insert the valve into the valve guide.
5. Turn the valve while tapping it to fit the valve seat insert.
6. Check that the valve contact width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.

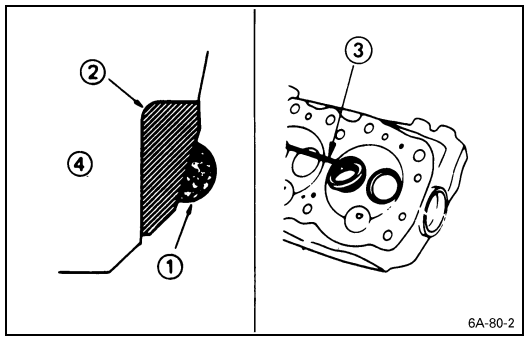


Valve Contact Width

1. Check the valve contact faces for roughness and unevenness. Make smooth the valve contact surfaces.
2. Measure the valve contact width.
   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Contact Width mm (in)

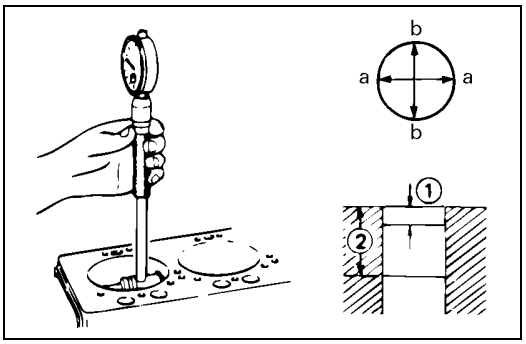
	Standard	Limit
Intake	1.7 (0.067)	2.2 (0.087)
Exhaust	2.0 (0.079)	2.5 (0.078)



Valve Seat Insert Replacement

Valve Seat Insert Removal

1. Arc weld the entire inside circumference ① of the valve seat insert ②.
2. Allow the valve seat insert to cool for a few minutes.
   This will invite contraction and make removal of the valve seat insert easier.
3. Use a screwdriver ③ to pry the valve seat insert free.
   Take care not to damage the cylinder head ④.
4. Carefully remove carbon and other foreign material from the cylinder head insert bore.



012L200001

Cylinder Liner Bore Measurement

Use a cylinder indicator to measure the cylinder bore at measuring point ①, ② in the thrust a-a and axial b-b directions of the crankshaft.

If the measured value exceeds the specified limit, the cylinder liner must be replaced.

Measuring Points ① 20 mm (0.8 in) for 4JA1, 4JA1TC and 4JB1T, 4JG2T, 4JH1TC

②140 mm(5.5 in) for 4JA1, 4JA1TC

②160 mm(6.3 in) for 4JB1T, 4JG2T, 4JH1TC

Cylinder Liner Bore (Service Part) mm (in)

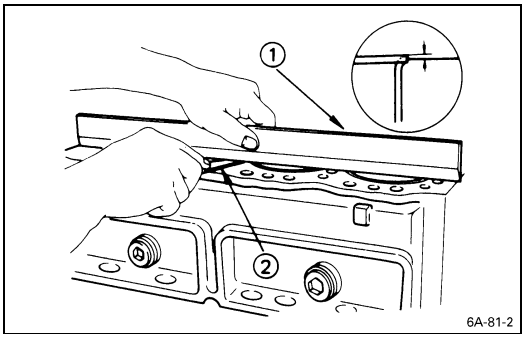
Grade	4JA1, 4JA1T, 4JB1T	4JG2T, 4JH1TC
AX	93.035 – 93.050 (3.6628 – 3.6634)	95.435 – 95.450 (3.7573 – 3.7579)
CX	93.051 – 93.066 (3.6634 – 3.6640)	95.451 – 95.466 (3.7579 – 3.7585)

Grade	4JA1TC
AX	93.021 – 93.040 (3.6622 – 3.6630)
CX	93.041 – 93.060 (3.6630 – 3.6638)

Note:

The inside of the dry type cylinder liner is chrome plated. It cannot be rebored or honed.

If the inside of the cylinder liner is scored or scorched, the cylinder liner must be replaced.



6A-81-2

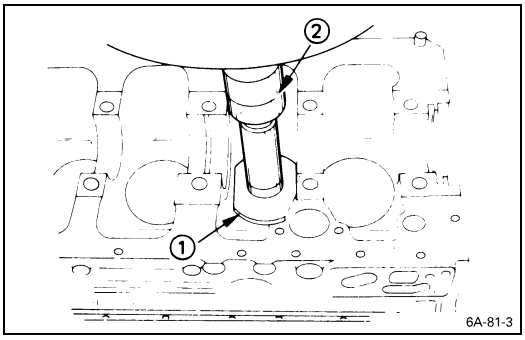
Cylinder Liner Projection Inspection

1. Hold a straight edge ① along the top edge of the cylinder liner to be measured.
2. Use a feeler gauge ② to measure each cylinder liner projection.

Cylinder Liner Projection mm (in)

Standard
0 – 0.1 (0 – 0.004)

The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 mm (0.0012 in).



Cylinder Liner Replacement

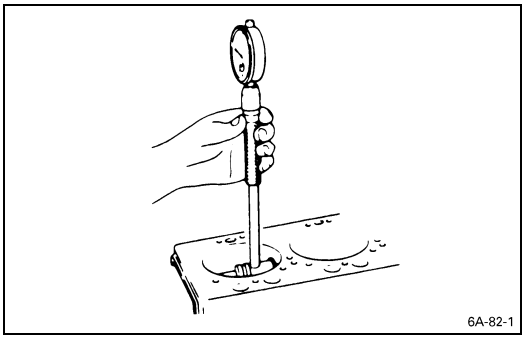
Cylinder Liner Removal

1. Insert the cylinder liner remover ① into the cylinder body (from the lower side of the cylinder body) until it makes firm contact with the cylinder liner.
   Cylinder Liner Remover:
   5-8840-2039-0
   5-8840-2304-0: 4JG2T, 4JH1TC Engine
2. Use a bench press ② to slowly force the cylinder liner from the cylinder body.

Note:

Take care not to damage the cylinder body upper face during the cylinder liner removal procedure.

3. Measure the cylinder body upper face warpage.
   Refer to “Cylinder Body Upper Face Warpage”.



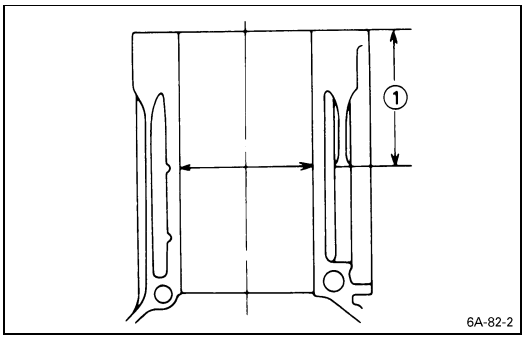
Cylinder Liner Grade Selection

Subtract the average cylinder body bore from the average cylinder liner outside diameter to obtain the fitting interference.

Fitting Interference mm (in)

Standard
– 0.0010* – 0.019 (– 0.00004* – 0.0007)

* A minus (–) value indicates that the cylinder body bore is smaller than the liner outside diameter.

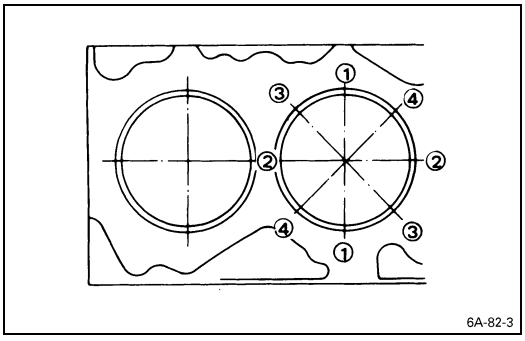


Cylinder Body Bore Measurement

1. Take measurements at measuring point ① across positions ①-①, ②-②, ③-③, and ④-④.

Measuring Point ① 98 mm (3.86 in)

2. Calculate the average value of the four measurements to determine the correct cylinder grade.
3. Consult the following table with the resultant diameter for the correct liner application.

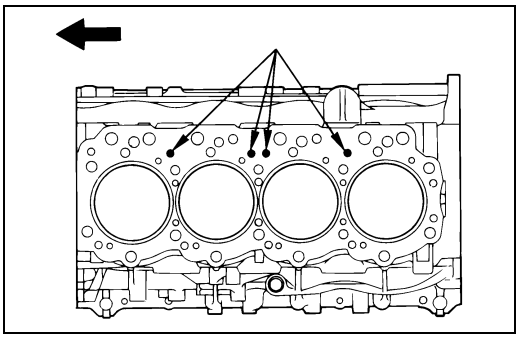


Cylinder Liner Grade Selection and Standard Fitting Interference

Accurately measured fitting interference and proper cylinder liner grade selection are extremely important.

If the cylinder liner fitting interference is too small, engine cooling efficiency will be adversely affected.

If the cylinder liner fitting interference is too large, it will be difficult to insert the cylinder liner into the cylinder body.



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A mark was stamped on the upper of the cylinder block during production to indicate the correct liner.

The liner grade (i.e.1.2.3.4) is indicated in metal stamp.

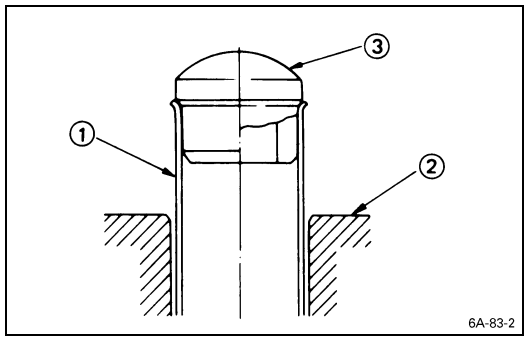
Cylinder Liner Grade

4JA1, 4JA1T, 4JB1T, 4JA1TC mm (in)

Liner Outside Grade	Cylinder Body Bore Diameter	Liner Outside Diameter	Liner Bore Grade	Service Liner Bore Measurement
1	95.001 – 95.010 (3.7402 – 3.7405)	95.011 – 95.020 (3.7406 – 3.7409)	AX	93.035 – 93.050 (3.6628 – 3.6634)
			CX	93.051 – 93.066 (3.6634 – 3.6640)
2	95.011 – 95.020 (3.7406 – 3.7409)	95.021 – 95.030 (3.7410 – 3.7413)	AX	93.035 – 93.050 (3.6628 – 3.6634)
			CX	93.051 – 93.066 (3.6634 – 3.6640)
3	95.021 – 95.030 (3.7410 – 3.7413)	95.031 – 95.040 (3.7414 – 3.7417)	AX	93.035 – 93.050 (3.6628 – 3.6634)
			CX	93.051 – 93.066 (3.6634 – 3.6640)
4	95.031 – 95.040 (3.7414 – 3.7417)	95.041 – 95.050 (3.7418 – 3.7421)	AX	93.035 – 93.050 (3.6628 – 3.6634)
			CX	93.051 – 93.066 (3.6634 – 3.6640)

4JG2T, 4JH1TC mm (in)

Liner Outside Grade	Cylinder Body Bore Diameter	Liner Outside Diameter	Liner Bore Grade	Service Liner Bore Measurement
1	97.001 – 97.010 (3.8189 – 3.8193)	97.011 – 97.020 (3.8193 – 3.8197)	AX	95.435 – 95.450 (3.7573 – 3.7579)
			CX	95.451 – 95.466 (3.7579 – 3.7585)
2	97.011 – 97.020 (3.8193 – 3.8197)	97.021 – 97.030 (3.8197 – 3.8200)	AX	95.435 – 95.450 (3.7573 – 3.7579)
			CX	95.451 – 95.466 (3.7579 – 3.7585)
3	97.021 – 97.030 (3.8197 – 3.8200)	97.031 – 97.040 (3.8200 – 3.8205)	AX	95.435 – 95.450 (3.7573 – 3.7579)
			CX	95.451 – 95.466 (3.7579 – 3.7585)
4	97.031 – 97.040 (3.8200 – 3.8205)	97.041 – 97.050 (3.8205 – 3.8209)	AX	95.435 – 95.450 (3.7573 – 3.7579)
			CX	95.451 – 95.466 (3.7579 – 3.7585)



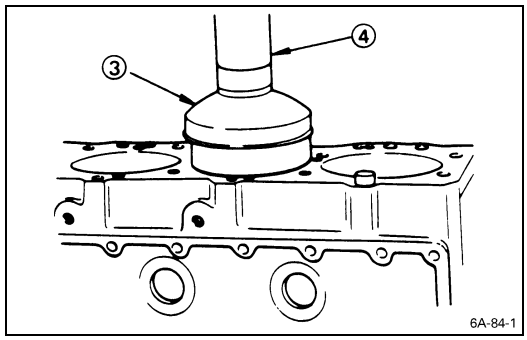
Cylinder Liner Installation

1. Cylinder Liner Installation Using The Special Tool
   1) Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
   2) Use compressed air to blow-dry the cylinder liner and bore surfaces.

Note:

All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.

   3) Insert the cylinder liner ① into the cylinder body ② from the top of the cylinder body.



   4) Set the cylinder liner installer ③ to the top of the cylinder liner.
      Cylinder Liner Installer: 5-8840-2040-0
      5-8840-2313-0 (4JG2T, 4JH1TC)
   5) ③ is directly beneath the bench press shaft center ④.

Note:

Check that the cylinder liner is set perpendicular to the bench press and that there is no wobble.

   6) Use the bench press to apply a seating force of 500 kg (1,100 lb/4,900 N) to the cylinder liner.
   7) Apply a force of 2,500 kg (5,500 lb/24,500 N) to fully seat the cylinder liner.
   8) After installing the cylinder liner, measure the cylinder liner projection.
      Refer to “Cylinder Liner Projection Inspection”.

2. Cylinder Liner Installation Using Dry Ice
   Cylinder liner is a chrome plated dry type, it is advisable to use dry ice during the installation procedure.
   Cooling the cylinder liner with dry ice will cause the cylinder liner to contract, thus making installation easier.

Note:

It is important that the cylinder liner be inserted to the cylinder body immediately after it has been cooled.

Warning:

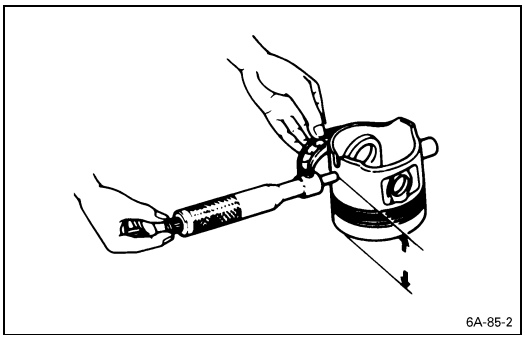
Dry ice must be used with great care. Careless handling of dry ice can result in severe frostbite.

Piston Grade Selectin

Measure the cylinder liner bore after installing the cylinder liner. Then select the appropriate piston grade for the installed cylinder liner.

1. Measure the cylinder liner bore.
   Refer to “Cylinder Liner Bore Measurement”

Note:
It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.



2. Measure the piston diameter.

Piston Measuring Point mm (in)

4JA1	70 (2.76)
4JA1T	78 (3.07)
4JB1T	74 (2.91)
4JG2T, 4JH1TC	71 (2.79)
4JA1TC	68.1 (2.68)

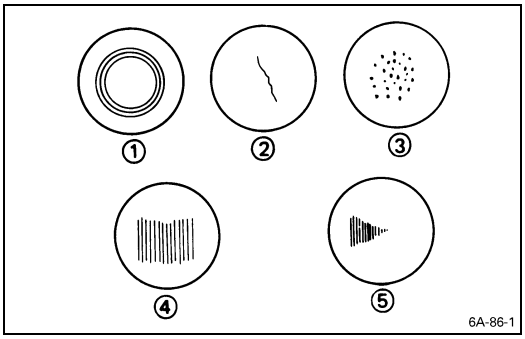
Grade	4JA1T/4JA1	4JB1T	4JG2T
AX	92.979 – 92.994 (3.6606 – 3.6612)	92.974 – 92.989 (3.6604 – 3.6610)	95.369 – 95.384 (3.7547 –3.7553)
CX	92.995 – 93.010 (3.6612 – 3.6618)	92.990 – 93.005 (3.6610 – 3.6616)	95.385 – 95.400 (3.7553 – 3.7559)

Grade	4JA1TC	4JH1TC
AX	92.945 – 92.964 (3.6592 – 3.6600)	95.359 – 95.374 (3.7543 – 3.7549)
CX	92.965 – 92.984 (3.6600 – 3.6607)	95.375 – 95.390 (3.7549 – 3.7555)

Cylinder Liner and Piston Clearance mm (in)

4JA1T/4JA1	0.041 – 0.071 (0.0016 – 0.0027)
4JB1T	0.046 – 0.076 (0.0018 – 0.0030)
4JG2T	0.051 – 0.081 (0.0020 – 0.0032)
4JA1TC	0.057 – 0.095 (0.0022 – 0.0029)
4JH1TC	0.061 – 0.091 (0.0024 – 0.0036)

Note:
Cylinder liner kit clearances are preset. However, the cylinder liner installation procedure may result in slight decreases in cylinder liner clearances. Always measure the cylinder liner clearance after installation to be sure that it is correct.



TAPPET AND PUSH ROD

Visually inspect the tappet contact surfaces for pitting, cracking, and other abnormal conditions. The tappet must be replaced if any of these conditions are present.

Refer to the illustration at the left.

① Normal contact

② Cracking

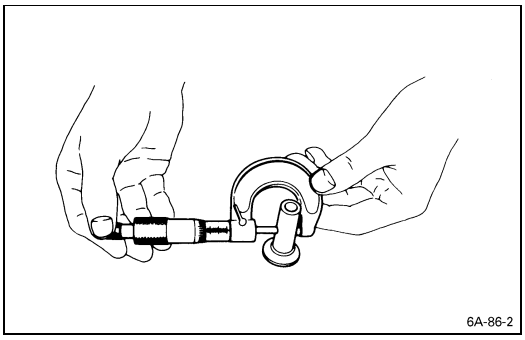
③ Pitting

④ Irregular contact Uneven contact

⑤ Irregular contact One-sided contact

Note:

The tappet surfaces are spherical. Do not attempt to grind them with an oil stone or similar tool in an effort to repair the tappet. If the tappet is damaged, it must be replaced.



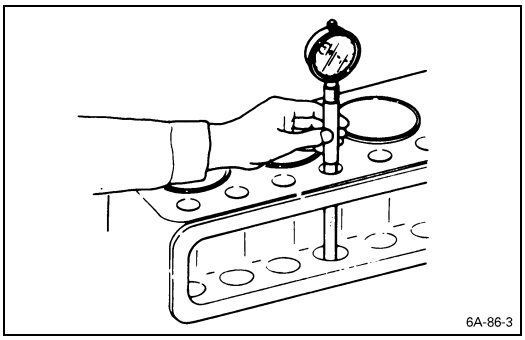
Tappet Outside Diameter

Measure the tappet outside diameter with a micrometer.

If the measured value is less than the specified limit, the tappet must be replaced.

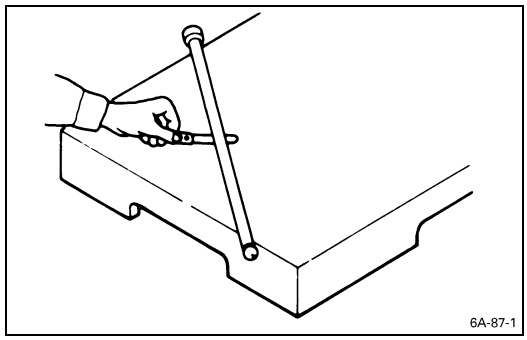
Tappet Outside Diameter mm (in)

Standard	Limit
12.97 – 12.99 (0.510 – 0.511)	12.95 (0.510)



Tappet and Cylinder Body Clearance mm (in)

Standard	Limit
0.01 – 0.046 (0.0004 – 0.0018)	0.10 (0.004)



Push Rod Curvature

1. Lay the push rod on a surface plate.
2. Roll the push rod along the surface plate and measure the push rod curvature with a thickness gauge.
   If the measured value exceeds the specified limit, the push rod must be replaced.

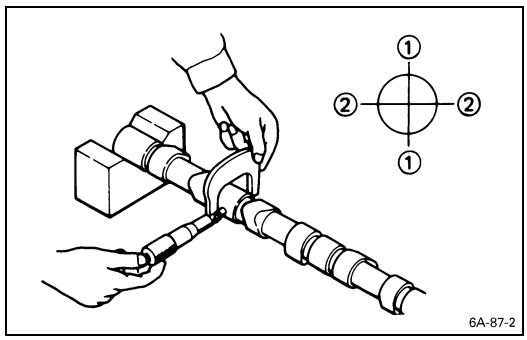
Pushrod Curvature mm (in)

Limit
0.3 (0.012)

3. Visually inspect both ends of the push rod for excessive wear and damage. The push rod must be replaced if these conditions are discovered during inspection.

CAMSHAFT

Visually inspect the journals, the cams, the oil pump drive gear, and the camshaft bearings for excessive wear and damage. The camshaft and the camshaft bearings must be replaced if these conditions are discovered during inspection.

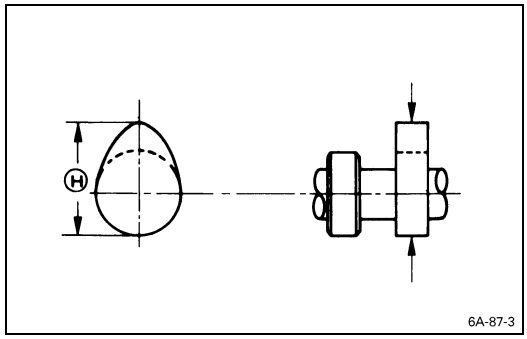


Camshaft Journal Diameter

Use a micrometer to measure each camshaft journal diameter in two directions (① and ②). If the measured value is less than the specified limit, the camshaft must be replaced.

Camshaft Journal Diameter mm (in)

Standard	Limit
49.945 – 49.975 (1.9663 – 1.9675)	49.60 (1.953)

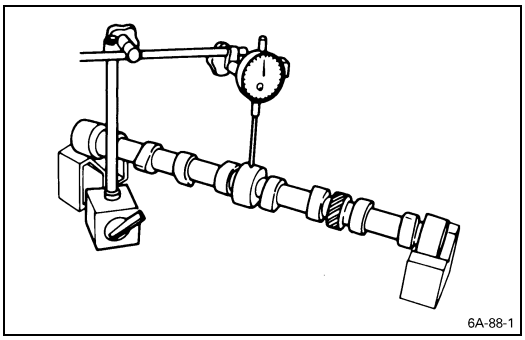


Cam Height

Measure the cam height (H) with a micrometer. If the measured value is less than the specified limit, the camshaft must be replaced.

Cam Height (H) mm (in)

Standard	Limit
42.08 (1.657)	41.65 (1.640)

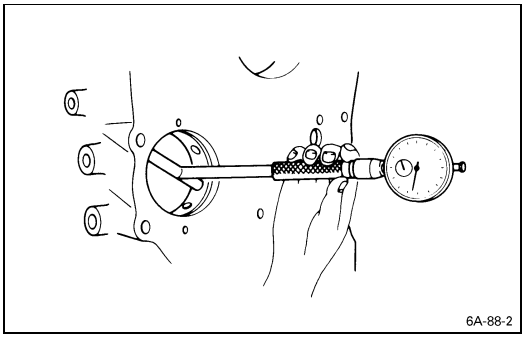


Camshaft Run-Out

1. Mount the camshaft on V-blocks.
2. Measure the run-out with a dial indicator.
   If the measured value exceeds the specified limit, the camshaft must be replaced.

Camshaft Run-Out mm (in)

Standard	Limit
0.02 (0.0008)	0.10 (0.004)



Camshaft and Camshaft Bearing Clearance

Use an inside dial indicator to measure the camshaft bearing inside diameter.

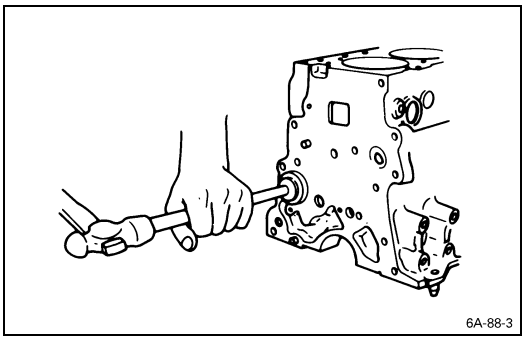
Crankshaft Bearing Inside Diameter mm (in)

Standard	Limit
50.00 – 50.03 (1.968 – 1.970)	50.08 (1.972)

If the clearance between the camshaft bearing inside diameter and the journal exceeds the specified limit, the camshaft bearing must be replaced.

Camshaft Bearing Clearance mm (in)

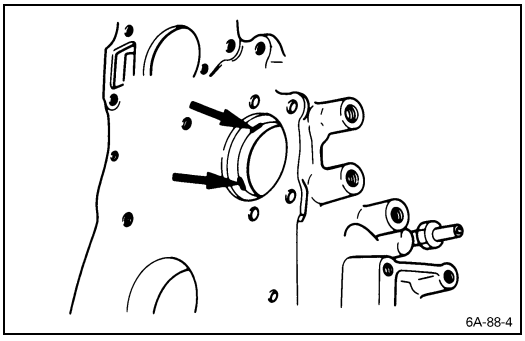
Standard	Limit
0.05 (0.002)	0.12 (0.005)



Camshaft Bearing Replacement

Camshaft Bearing Removal

1. Remove the cylinder body plug plate.
2. Use the bearing replacer to remove the camshaft bearing.
   Bearing Replacer: 5-8840-2038-0



Camshaft Bearing Installation

1. Align the bearing oil holes with the cylinder body oil holes.
2. Use the replacer to install the camshaft bearing.
   Bearing Replacer: 5-8840-2038-0

CRANKSHAFT AND BEARING

Inspect the surface of the crankshaft journals and crankpins for excessive wear and damage.

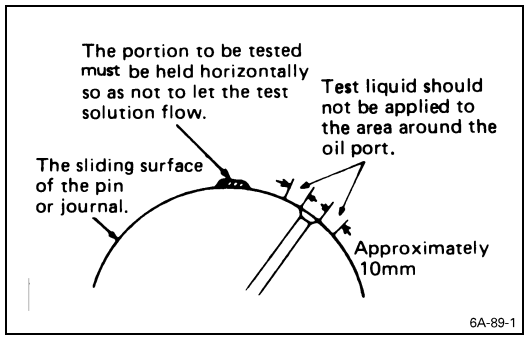
Inspect the oil seal fitting surfaces for excessive wear and damage.

Inspect the oil ports for obstructions.

Note:

To increase crankshaft strength, tufftriding (Nitrizing Treatment) has been applied. Because of this, it is not possible to regrind the crankshaft surfaces.

Therefore, under size bearing are not available.



Crankshaft Tufftriding Inspection

1. Use an organic cleaner to thoroughly clean the crankshaft. There must be no traces of oil on the surfaces to be inspected.
2. Prepare a 5 – 10% solution of ammonium cuprous chloride (dissolved in distilled water).
3. Use a syringe to apply the solution to the surface to be inspected.

   Hold the surface to be inspected perfectly horizontal to prevent the solution from running.

Note:

Do not allow the solution to come in contact with the oil ports and their surrounding area.

Judgment

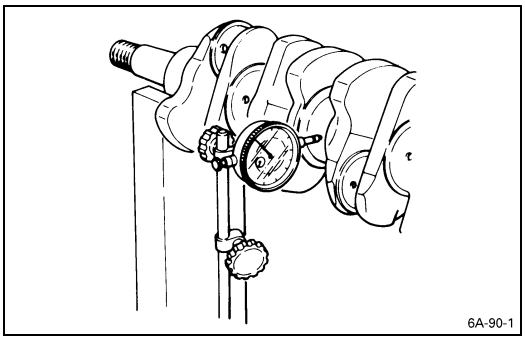
1. Wait for thirty to forty seconds.

   If there is no discoloration after thirty or forty seconds, the crankshaft is usable.

   If discoloration appears (the surface being tested will become the color of copper), the crankshaft must be replaced.
2. Steam clean the crankshaft surface immediately after completing the test.

Note:

The ammonium cuprous chloride solution is highly corrosive. Because of this, it is imperative that the surfaces being tested be cleaned immediately after completing the test.

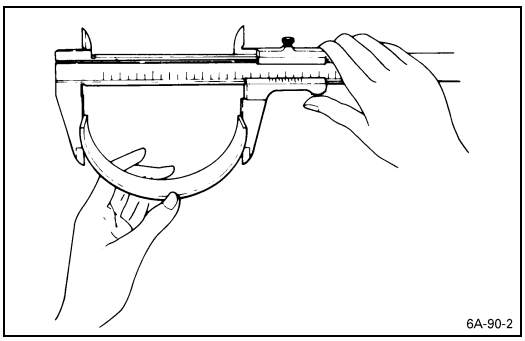


Crankshaft Run-Out

1. Set a dial indicator to the center of the crankshaft journal.
2. Gently turn the crankshaft in the normal direction of rotation.
   Read the dial indicator as you turn the crankshaft.
   If the measured value exceeds the specified limit, the crankshaft must be replaced.

Crankshaft Run-Out mm (in)

Standard	Limit
0.05 (0.002) or less	0.08 (0.003)

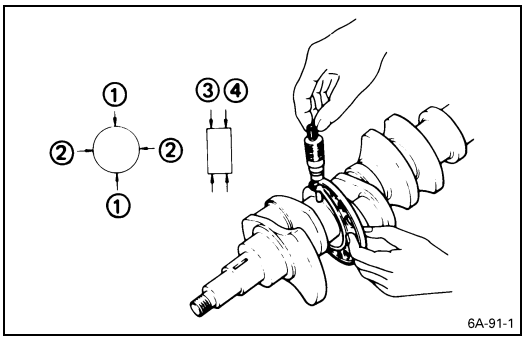


Bearing Spread

Use a vernier caliper to measure the bearing spread.
If the measured value is less than the specified limit, the bearing must be replaced.

Bearing Spread mm (in)

	Limit	
Crankshaft Bearing	4JA1, 4JA1T, 4JA1TC	64.5 (2.54)
	4JB1T, 4JG2T, 4JH1TC	74.5 (2.93)
Connecting Rod Bearing	56.5 (2.22)	



Crankshaft Journal and Crankpin Diameter

1. Use a micrometer to measure the crankshaft journal diameter across points ① - ① and ② - ②.
2. Use the micrometer to measure the crankshaft journal diameter at the two points (③ and ④).
3. Repeat Steps ① and ② to measure the crankpin diameter.
   If the measured values are less than the specified limit, the crankshaft must be replaced.

Crankshaft Journal Diameter mm (in)

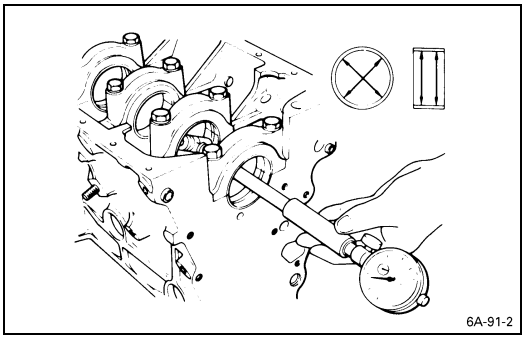
	Standard	Limit
4JA1T, 4JA1, 4JA1TC	59.92 – 59.93 (2.3591 – 2.3594)	59.91 (2.3586)
4JG2T, 4JB1T, 4JH1TC	69.92 – 69.93 (2.7527 – 2.7531)	69.91 (2.7524)

Crankpin Diameter mm (in)

Standard	Limit
52.92 – 52.93 (2.0833 – 2.0839)	52.90 (2.083)

Crankshaft Journal and Crankpin Uneven Wear mm (in)

Standard	Limit
0.05 (0.002) or less	0.08 (0.003)

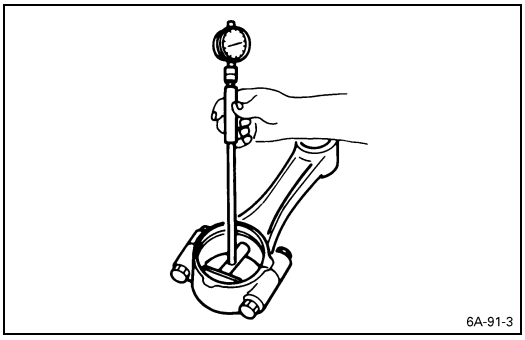


Crankshaft Journal and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankshaft journal diameter exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankshaft Journal and Bearing Clearance mm (in)

Standard	Limit
0.031 – 0.064 (0.0012 – 0.0025)	0.110 (0.0043)



Connecting Rod Bearing Inside Diameter

1. Install the bearing to the connecting rod big end.
2. Tighten the bearing cap to the specified torque.

Connecting Rod Bearing Cap Bolt Torque kg·m (lb.ft/N·m)

4JA1 / 4JA1T engine	8.5 ± 0.5(61.4 ± 3.6 / 83.3 ± 4.9)
4JB1T / 4JG2T / 4JA1TC / 4JH1TC engine	1st step ; 3.0 ± 0.5(21.7 ± 3.6 / 29 ± 5)
	2nd step ; 45° ~ 75°

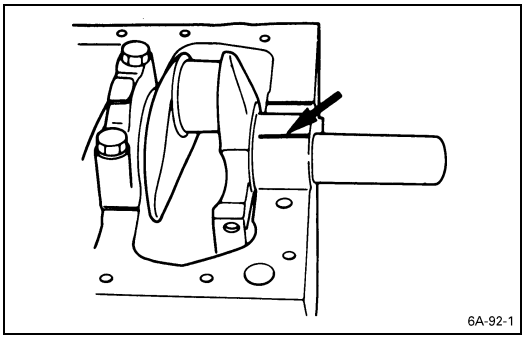
3. Use an inside dial indicator to measure the connecting rod bearing inside diameter.

Crankpin and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankpin exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankpin and Bearing Clearance mm (in)

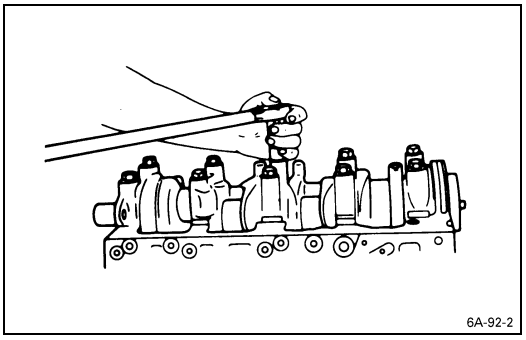
Standard	Limit
0.029 – 0.066 (0.0011 – 0.0026)	0.100 (0.0039)


6A-92-1

Clearance Measurements (With Plastigage)

Crankshaft Journal and Bearing Clearance

1. Clean the cylinder body, the journal bearing fitting surface, the bearing caps, and the bearings.
2. Install the bearings to the cylinder body.
3. Carefully place the crankshaft on the bearings.
4. Rotate the crankshaft approximately 30° to seat the bearing.
5. Place the Plastigage (arrow) over the crankshaft journal across the full width of the bearing.
6. Install the bearing caps with the bearing.


6A-92-2

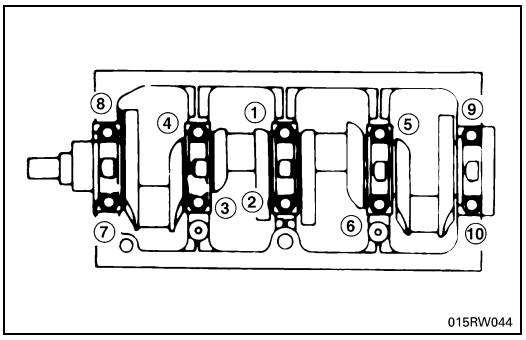
7. Tighten the bearing caps to the specified torque.

Crankshaft Bearing Cap Bolt Torque kg·m (lb.ft/N·m)

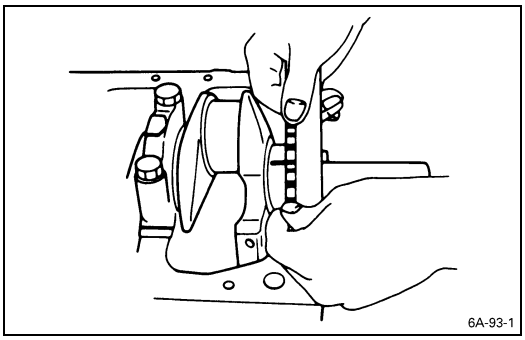
17 ± 1 (123.0 ± 7.2/166.7 ± 9.8)

Do not allow the crankshaft to turn during bearing cap installation and tightening.

8. Remove the bearing cap.



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9. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

   If the measured value exceeds the limit, perform the following additional steps.

   1) Use a micrometer to measure the crankshaft outside diameter.
   2) Use an inside dial indicator to measure the bearing inside diameter.

      If the crankshaft journal and bearing clearance exceeds the limit, the crankshaft and/or the bearing must be replaced.

Crankshaft Journal and Bearing Clearance mm (in)

Standard	Limit
0.031 – 0.064 (0.0012 – 0.0025)	0.110 (0.0043)

Crankpin and Bearing Clearance

1. Clean the crankshaft, the connecting rod, the bearing cap, and the bearings.
2. Install the bearing to the connecting rod and the bearing cap.

   Do not allow the crankshaft to move when installing the bearing cap.
3. Prevent the connecting rod from moving.
4. Attach the Plastigage to the crankpin.

   Apply engine oil to the Plastigage to keep it from falling.
5. Install the bearing cap and tighten it to the specified torque.

   Do not allow the connecting rod to move when installing and tightening the bearing cap.

Connecting Rod Bearing Cap Bolt Torque kg·m (lb.ft/N·m)

4JA1 / 4JA1T engine	8.5 ± 0.5(61.4 ± 3.6 / 83.3 ± 4.9)
4JB1T / 4JG2T / 4JA1TC / 4JH1TC engine	1st step ; 3.0 ± 0.5(21.7 ± 3.6 / 29 ± 5)
	2nd step ; 45° ~ 75°

6. Remove the bearing cap.
7. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

   If the measured value exceeds the specified limit, perform the following additional steps.

   1) Use a micrometer to measure the crankpin outside diameter.
   2) Use an inside dial indicator to measure the bearing inside diameter.

      If the crank pin and bearing clearance exceeds the specified limit, the crankshaft and/or the bearing must be replaced.

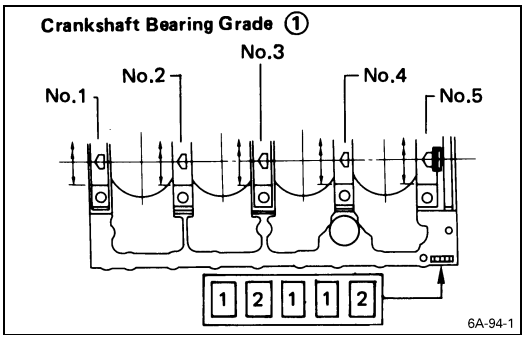
Crankpin and Bearing Clearance mm (in)

Standard	Limit
0.029 – 0.066 (0.0011 – 0.0026)	0.100 (0.0039)

CRANKSHAFT BEARING SELECTION

Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing inserts.

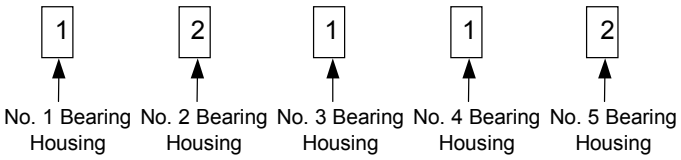
Match the crankshaft bearing housing grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.

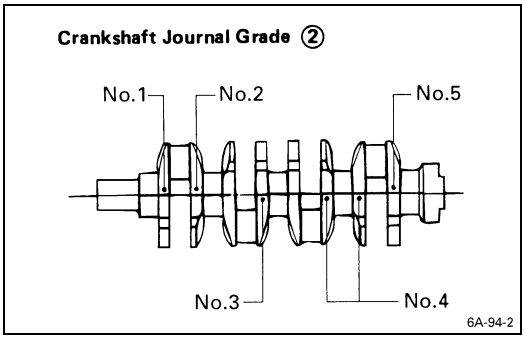


Crankshaft Bearing Housing Grade Mark Position

Crankshaft bearing housing grade marks 1 or 2 are stamped on the rear right hand side of the cylinder body.

Example:





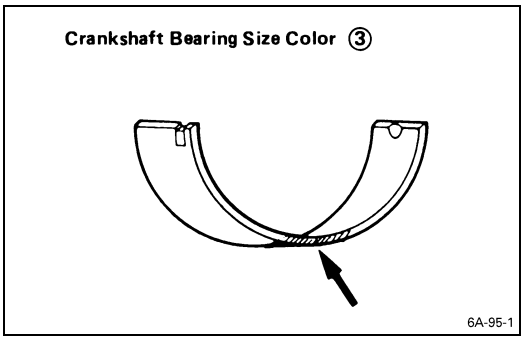
Crankshaft Journal Grade Mark Position

The crankshaft journal grade marks (1 or -) are stamped on each crankshaft journal web.

The crankshaft journal and bearing clearance must be the same for each position after installation of the crankshaft and the crankshaft bearings.

Note:

The crankshaft journal mark No. 4 is stamped on crankshaft No. 4 journal web front side or rear side.



REFERENCE

4JA1, 4JA1T, 4JA1TC ENGINE mm (in)

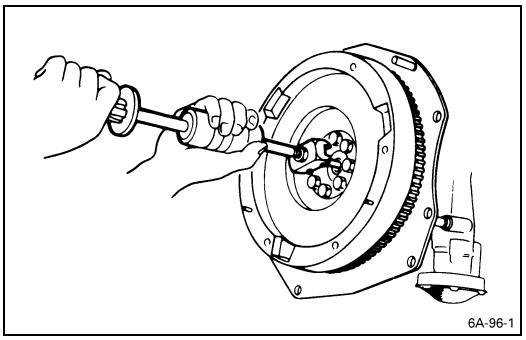
Crankshaft Bearing①		Crankshaft Journal ②		Crankshaft Bearing Size Color Code ③
Grade Mark	Diameter	Grade Mark	Diameter	
1	63.987 – 64.000 (2.5191 – 2.6196)	1 or -	59.927 – 59.932 (2.3593 – 2.3595)	Black
		2 or - -	59.922 – 59.927 (2.3591 – 2.3593)	Blue
		3 or - - -	59.917 – 59.922 (2.3589 – 2.3591)	
2	63.975 – 63.987 (2.5186 – 2.5191)	1 or -	59.927 – 59.932 (2.3593 – 2.3595)	Green
		2 or - -	59.922 – 59.927 (2.3591 – 2.3593)	
		3 or - - -	59.917 – 59.922 (2.3589 – 2.3591)	Black

4JB1T, 4JG2T, 4JH1TC ENGINE mm (in)

Crankshaft Bearing①		Crankshaft Journal ②		Crankshaft Bearing Size Color Code ③
Grade Mark	Diameter	Grade Mark	Diameter	
1	73.987 – 74.000 (2.9129 – 2.9134)	1 or -	69.927 – 69.932 (2.7530 – 2.7532)	Black
		2 or - -	69.922 – 69.927 (2.7528 – 2.7530)	Blue
		3 or - - -	69.917 – 69.922 (2.7556 – 2.7528)	
2	73.975 – 73.987 (2.9124 – 2.9129)	1 or -	69.927 – 69.932 (2.7530 – 2.7532)	Green
		2 or - -	69.922 – 69.927 (2.7528 – 2.7530)	
		3 or - - -	69.917 – 69.922 (2.7556 – 2.7528)	Black

CRANKSHAFT PILOT BEARING

Check the crankshaft pilot bearing for excessive wear and damage and replace it if necessary.



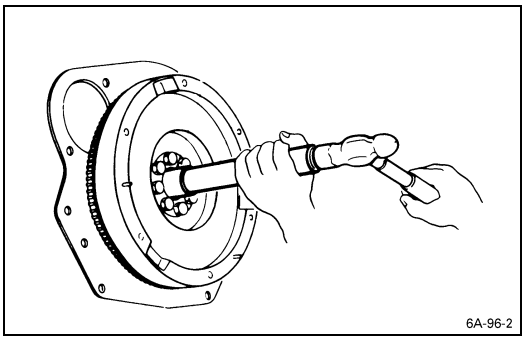
Crankshaft Pilot Bearing Replacement

Crankshaft Pilot Bearing Removal

Use the pilot bearing remover to remove the crankshaft pilot bearing.

Pilot Bearing Remover: 5-8840-2000-0

Sliding Hammer: 5-8840-0019-0 (J-23907)



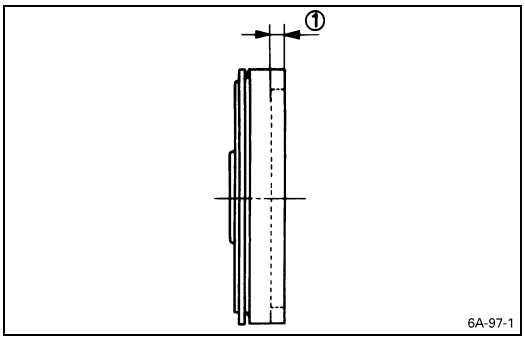
Crankshaft Pilot Bearing Installation

1. Place the crankshaft pilot bearing right angle across the crankshaft bearing installation hole.
2. Tap around the edges of the crankshaft pilot bearing outer races with a brass hammer to drive the bearing into the crankshaft bearing installation hole.

   Pilot Bearing Installer: 5-8522-0024-0

Note:

Strike only the crankshaft pilot bearing outer race with the hammer. Do not strike the bearing inner race. Bearing damage and reduced bearing service life will result.



FLYWHEEL AND RING GEAR

Flywheel

1. Inspect the flywheel friction surface for excessive wear and heat cracks.
2. Measure the flywheel friction surface depth.
   If the measured value is within the specified limit, the flywheel may be reground.
   If the measured value exceeds the specified limit, the flywheel must be replaced.

Flywheel Friction Surface Depth ① mm (in)

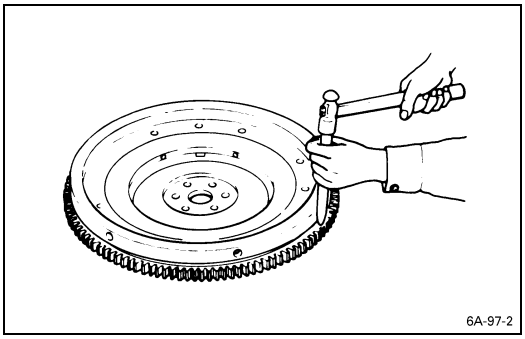
	Standard	Limit
4JA1, 4JA1T, 4JA1TC	20 (0.787)	21 (0.827)
4JB1T	14 (0.551)	15 (0.591)
4JG2T, 4JH1TC	18 (0.708)	19 (0.748)

Flywheel Friction Surface Roughness mm (in)

Less than 0.006 (0.00024)

Ring Gear

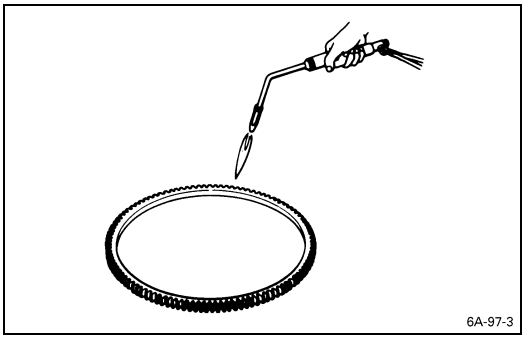
Inspect the ring gear.
If the ring gear teeth are broken or excessively worn, the ring gear must be replaced.



Ring Gear Replacement

Ring Gear Removal

Strike around the edges of the ring gear with a hammer and chisel to remove it.



Ring Gear Installation

1. Heat the ring gear evenly with a gas burner to invite thermal expansion.
   Do not allow the temperature of the gas burner to exceed 200°C (390°F).
2. Install the ring gear when it is sufficiently heated.
   The ring gear must be installed with the chamfer facing the clutch.

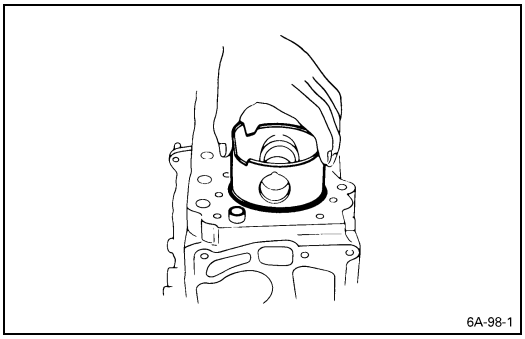
PISTON

Piston Grade Selection and Cylinder Bore Measurement

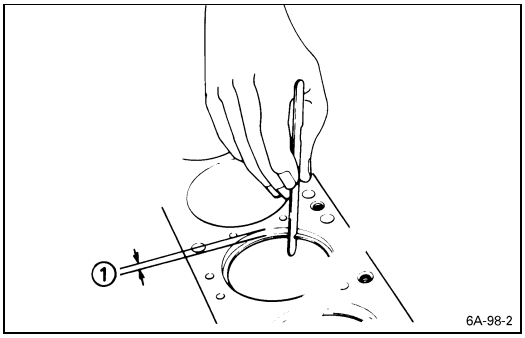
Refer to the Section “CYLINDER BODY”, Item “Cylinder Liner Bore Measurement” for details on piston grade selection and cylinder liner bore measurement.

PISTON RING

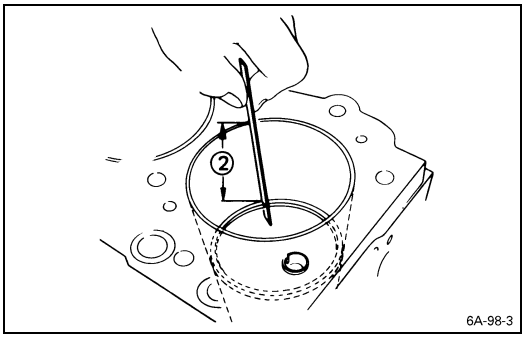
Piston Ring Gap



1. Insert the piston ring horizontally (in the position it would assume if it were installed to the piston) into the cylinder liner.



2. Push the piston ring into the cylinder bore until it reaches the measuring point ① or ② where the cylinder liner bore is the smallest.
   Do not allow the piston ring to slant to one side or the other. It must be perfectly horizontal.
   Measuring Point ① 10 mm (0.4 in)
   or
   Measuring Point ② 120 mm (4.7 in)



3. Use a feeler gauge to measure the piston ring gap.
   If the measured value exceeds the specified limit, the piston ring must be replaced.

Piston Ring Gap mm (in)

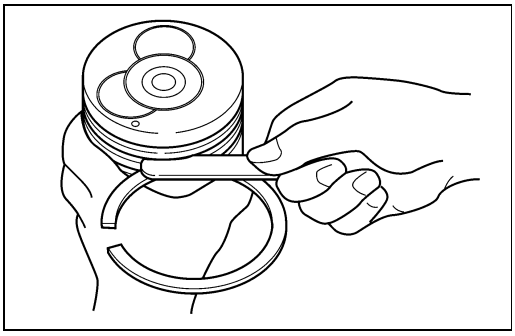
	Standard	Limit
1st Compression Ring	0.2 – 0.4 (0.008 – 0.016)	1.5 (0.059)
2nd Compression Ring		
Oil Ring	0.1 – 0.3 (0.004 – 0.012)	

4JG2 mm (in)

		Standard	Limit
Compression ring	1st	0.20 – 0.35 (0.0079 – 0.0138)	1.5 (0.059)
	2nd	0.37 – 0.52 (0.0146 – 0.0205)	
Oil ring		0.20 – 0.40 (0.0079 – 0.0157)	

4JH1TC mm (in)

		Standard	Limit
Compression ring	1st	0.30 – 0.50 (0.0118 – 0.0197)	0.15 (0.0059)
	2nd	0.30 – 0.50 (0.0118 – 0.0197)	
Oil ring		0.25 – 0.45 (0.0098 – 0.0117)	



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Piston Ring and Piston Ring Groove Clearance

Use a feeler gauge to measure the clearance between the piston ring and the piston ring groove at several points around the piston.

If the clearance between the piston ring and the piston ring groove exceeds the specified limit, the piston ring must be replaced.

Piston Ring and Piston Ring Groove Clearance

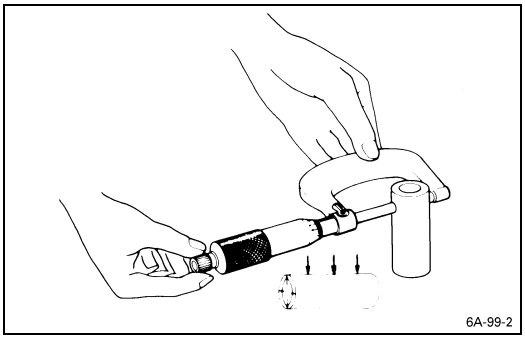
4JA1, 4JB1T, 4JA1T, 4JA1TC mm (in)

	Standard	Limit
1st Compression Ring	0.09 – 0.125 (0.0035 – 0.0049)	0.15 (0.0059)
2nd Compression Ring	0.05 – 0.085 (0.002 – 0.0033)	
Oil Ring	0.03 – 0.070 (0.0012 – 0.0028)	

4JG2, 4JH1TC mm (in)

		Standard	Limit
Compression ring	1st	0.09 – 0.13 (0.0035 – 0.0051)	0.15 (0.0059)
	2nd	0.05 – 0.09 (0.0020 – 0.0035)	
Oil ring		0.03 – 0.07 (0.0012 – 0.0028)	

4. Visually inspect the piston rings.
   If a piston ring groove is damaged or distorted, the piston must be replaced.



PISTON PIN

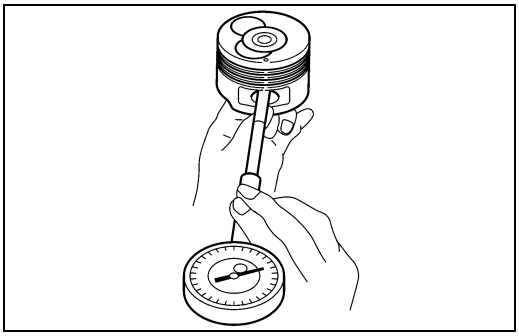
Piston Pin Diameter

Use a micrometer to measure the piston pin diameter at several points.

If the measured value is less than the specified limit, the piston pin must be replaced.

Piston Pin Diameter mm (in)

	Standard	Limit
4JA1 4JA1T 4JA1TC 4JH1TC	30.995 – 31.000 (1.2202 – 1.2204)	30.97 (1.219)
4JB1T 4JG2T	33.994 – 34.000 (1.3383 – 1.3386)	33.97 (1.337)



015RY00030

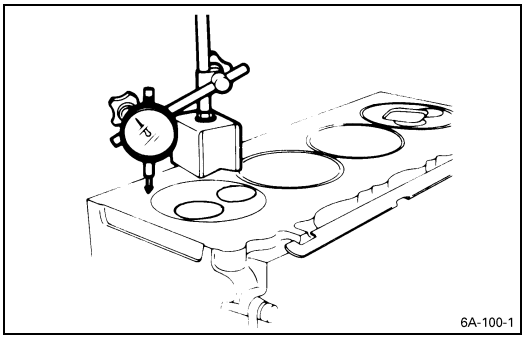
Piston Pin and Piston Clearance

Use and inside dial indicator to measure the piston pin hole (in the piston).

Piston Pin Hold mm (in)

	Standard
4JA1, 4JA1T	31.002 – 31.010 (1.2206 – 1.2208)
4JB1T 4JG2T	34.002 – 34.010 (1.3387 – 1.3390) (1.3383 – 1.3386)
4JA1TC 4JH1TC	31.005 – 31.013 (1.2207 – 1.2210)

Piston Pin and Piston Pin Hole Clearance mm (in)
0.002 – 0.015 (0.00008 – 0.0006)
4JA1TC, 4JH1TC
0.005 – 0.018 (0.00019 – 0.0007)

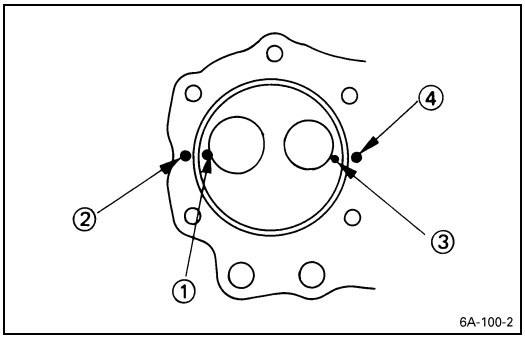


CYLINDER HEAD GASKET SELECTION

Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

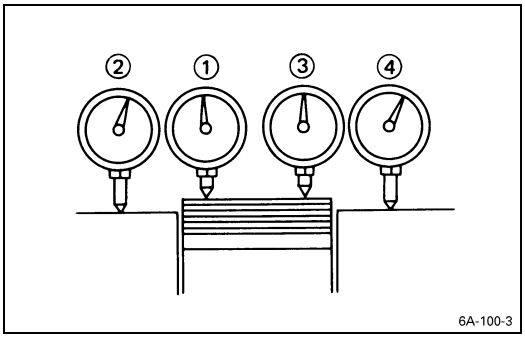
Three types of gasket are provided by the difference of thickness. Select the adequet one out of three grades of gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where a gasket was installed.



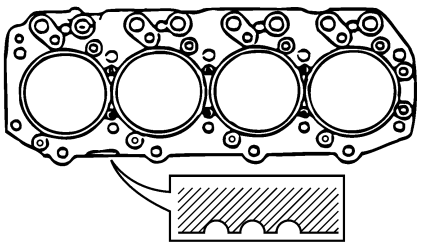
Piston Head Projection Measuring Point

1. Use a dial indicator to measure the piston projection amount.
2. Refer to the illustration for the piston head projection measuring positions.
   All measuring positions should be as close as possible to the cylinder liner.



3. Measure the points ① ② ③ ④ and obtain two differences ①–② and ③–④ on each cylinder.
   Calculate the average value of the piston head projection on each cylinder.
4. Obtain the maximum value in the four cylinders.
5. Determine the gasket grade required to the maximum value described above in accordance with the following table.

For 4JA1/4JA1T/4JB1T/4JA1TC/4JH1TC

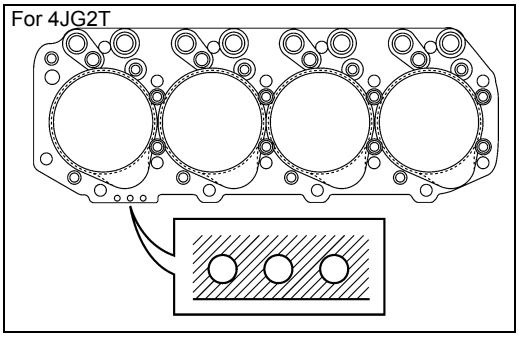


Cylinder Head Gasket Combination mm (in)

Gasket Grade Mark		Piston Projection		Gasket Thickness (Reference)
		4JA1, 4JA1TC	4JB1T	
Ⓐ		0.718 – 0.773 (0.0283 – 0.0304)	0.758 – 0.813 (0.0298 – 0.0320)	1.6 (0.0630)
Ⓑ		0.773 – 0.819 (0.0304 – 0.0322)	0.813 – 0.859 (0.0320 – 0.0338)	1.65 (0.0650)
Ⓒ		0.819 – 0.874 (0.0322 – 0.0344)	0.859 – 0.914 (0.0338 – 0.0360)	1.70 (0.0669)

4JH1TC Cylinder Head Gasket Thickness mm (in)

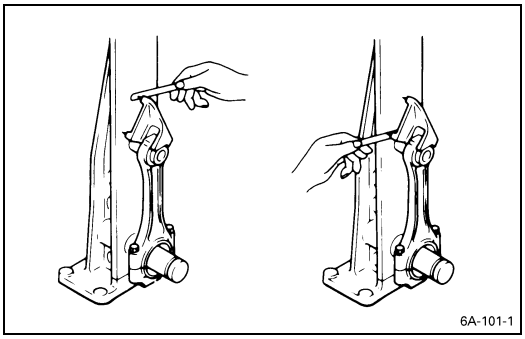
Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
Ⓐ		0.215 – 0.265 (0.0085 – 0.0104)	1.3 (0.5118)
Ⓑ		0.265 – 0.315 (0.0104 – 0.0124)	1.35 (0.5315)
Ⓒ		0.315 – 0.365 (0.0124 – 0.0144)	1.4 (0.5512)



4JG2T Cylinder Head Gasket Combination mm (in)

Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
Ⓐ		0.658 – 0.712 (0.0259 – 0.0281)	1.6 (0.0630)
Ⓑ		0.713 – 0.758 (0.0281 – 0.0299)	1.65 (0.0650)
Ⓒ		0.759 – 0.813 (0.0299 – 0.0320)	1.70 (0.0669)

Note:
Difference of the each piston projection and must be equal or within 0.1 mm (0.004 in).



CONNECTING ROD

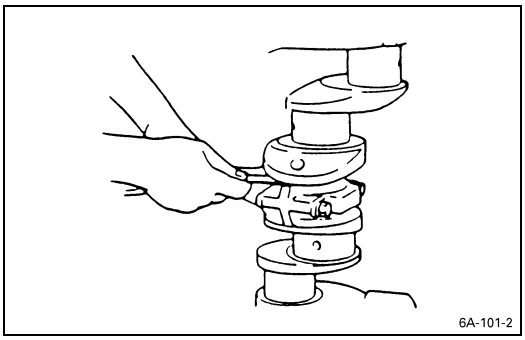
Connecting Rod Alignment

Use a connecting rod aligner to measure the distortion and the parallelism between the connecting rod big end hole and the connecting rod small end hole.

If either the measured distortion or parallelism exceed the specified limit, the connecting rod must be replaced.

Connecting Rod Alignment
Per Length of 100 mm (3.94 in) mm (in)

	Standard	Limit
Distortion	0.08 or Less (0.003)	0.20 (0.008)
Parallelism	0.05 or Less (0.002)	0.15 (0.006)



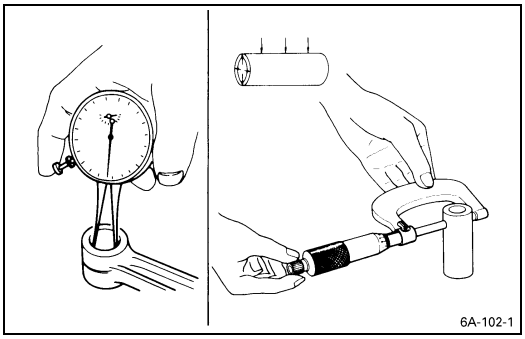
Connecting Rod Side Face Clearance

1. Install the connecting rod to the crankpin.
2. Use a feeler gauge to measure the clearance between the connecting rod big end side face and the crankpin side face.

   If the measured value exceeds the specified limit, the connecting rod must be replaced.

Connecting Rod Big End and Crankpin Side Face Clearance mm (in)

Standard	Limit
0.23 (0.009)	0.35 (0.014)



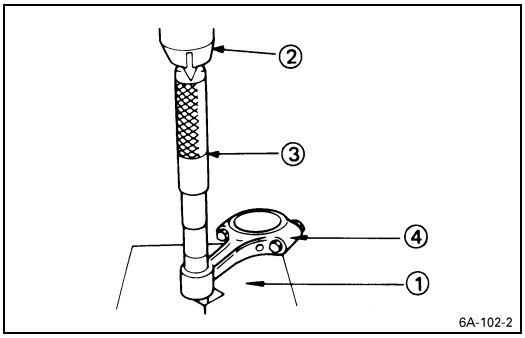
Piston Pin and Connecting Rod Small End Bushing Clearance

Use a caliper calibrator and a dial indicator to measure the piston pin and connecting rod small end bushing clearance.

If the clearance between the piston pin and the connecting rod small end bushing exceeds the specified limit, replace the piston pin and/or the connecting rod bushing.

Piston Pin and Connecting Rod Small End Bushing Clearance mm (in)

Standard	Limit
0.008 – 0.020 (0.0003 – 0.0008)	0.050 (0.002)



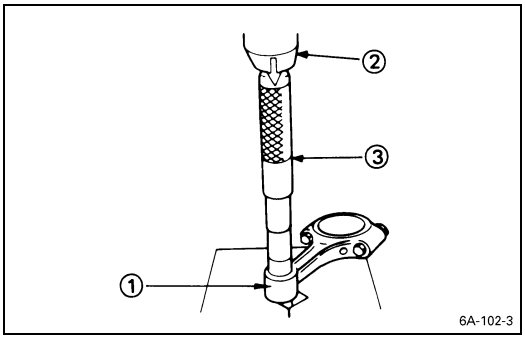
Connecting Rod Bushing Replacement

Connecting Rod Bushing Removal

1. Set the connecting rod small end to the bench press V-block ①.
2. Use the bench press ② and the bar ③ to slowly force the bushing from the connecting rod ④.

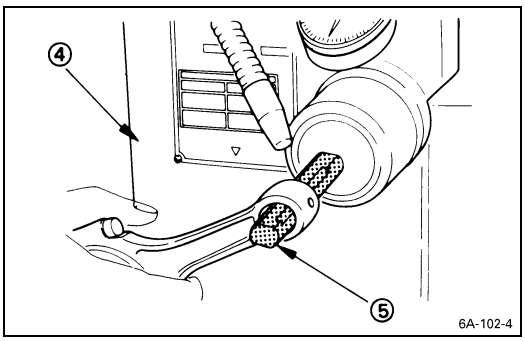
Note:

Take care not to damage the connecting rod with the bar when removing the bushing.



Connecting Rod Bushing Installation

1. Set the connecting rod small end ① to the bench press V-block.
   The connecting rod must be perfectly horizontal.
2. Use the bench press ② and the bar ③ to slowly force the bushing with oil hole into position.

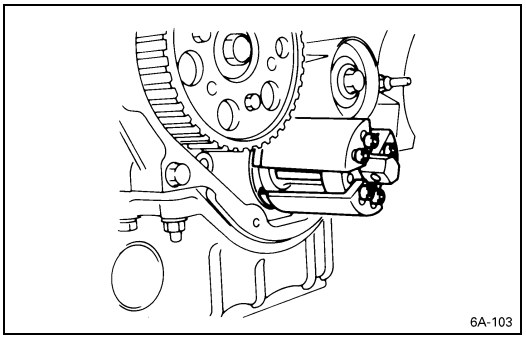


3. Use a pin hole grinder ④ fitted with a reamer ⑤ to ream the piston pin hole.

TIMING PULLEY HOUSING

Replace the crankshaft front oil seal if it is worn or damaged.

Take care not to damage the oil seal fitting surfaces.



Crankshaft Front Oil Seal Replacement

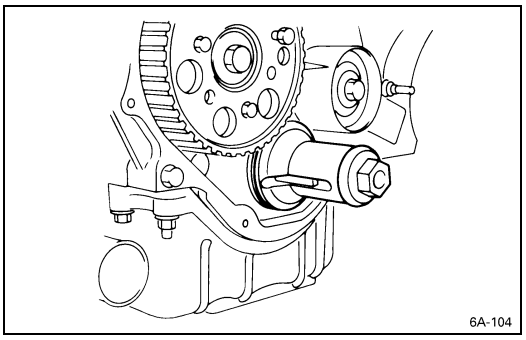
Oil Seal Removal

With the oil seal pushed in deep, install the special tool as shown in the illustration and remove the oil seal.

Oil Seal Remover: 5-8840-2362-0

Note:

Take care not to damage sealing surface of front plate and crankshaft when removing oil seal.



Oil Seal Installation

Use the special tool to install the oil seal.

1. With the oil seal attached to the sleeve, insert it into the front end section of the crankshaft.
2. With the oil seal end section attached securely to the crankshaft, tighten up the center bolt until the sleeve hits the front end reference plane of the crankshaft securely.
3. Remove the sleeve.
4. With the seal pressed in, check the dimension of the oil seal section.

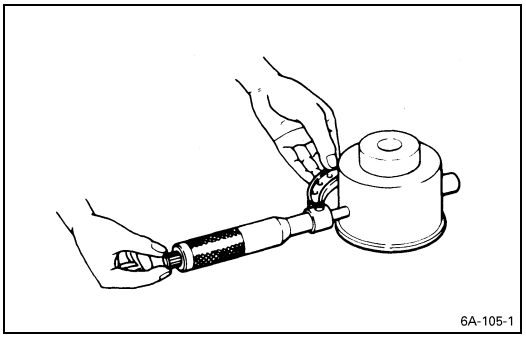
   Standard Dimension = 0.9 ± 0.3 mm

Note:

Install the oil seal after assembling the timing pulley housing. The oil seal lip section is applied with oil.

Take notice of the press-in direction of the oil seal.

Front Oil Seal Installer: 5-8840-2361-0



IDLER GEAR SHAFT AND IDLER GEAR (GEAR Drive Model)

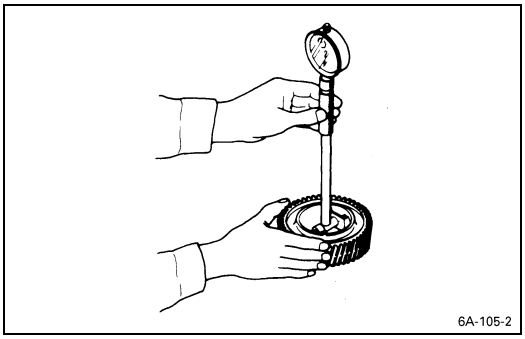
Idler Gear “A” Shaft Outside Diameter

Use a micrometer to measure the idler gear shaft outside diameter.

If the measured value is less than the specified limit, the idler gear shaft must be replaced.

Idler Gear “A” Shaft Outside Diameter mm (in)

Standard	Limit
44.945 – 44.975 (1.769 – 1.770)	44.845 (1.766)



Idler Gear "A" Shaft inside Diameter

1. Use an inside dial indicator or an inside micrometer to measure the idler gear inside diameter.

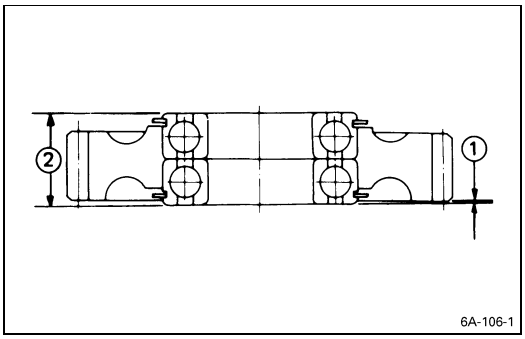
Idler Gear Inside Diameter mm (in)

Standard	Limit
45.0 – 45.03 (1.7717 – 1.7718)	45.10 (1.7756)

If the clearance between the idler gear shaft outside diameter and the idler gear inside diameter exceeds the limit, the idler gear must be replaced.

Idler Gear Shaft and Idler Gear Clearance mm (in)

Standard	Limit
0.025 – 0.085 (0.0010 – 0.0033)	0.200 (0.008)



Idler Gear "B"

Bearing Replacement

Bearing Removal

Use a bench press or a hammer and a bar to remove the bearing from the idler gear.

Bearing Installation

Use a bench press and bar to install the bearing into the idler gear.

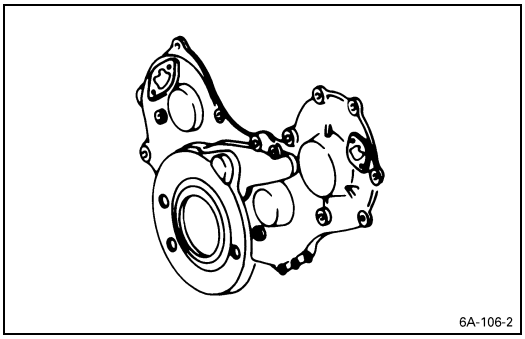
Bearing Projection and Height mm (in)

Projection ①	0.4 – 0.6 (0.016 – 0.024)
Height ②	23.7 – 24.0 (0.933 – 0.945)

Note:

The bench press and bar should make contact only with the bearing outer races. Do not allow them to make contact with the bearing inner races.

Bearing damage and reduced bearing service life will result.


6A-106-2

TIMING GEAR CASE COVER

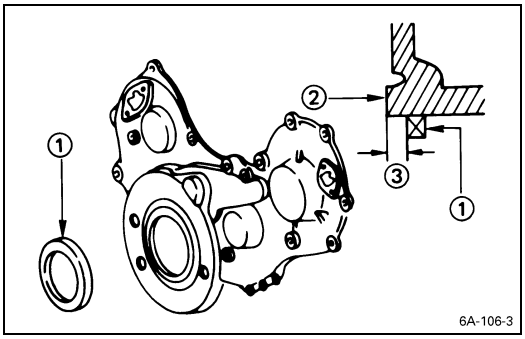
Replace the crankshaft front oil seal if it is excessively worn or damaged.

Crankshaft Front Oil Seal Replacement

Oil Seal Removal

Use a plastic hammer and a screwdriver to tap around the oil seal to free it from the gear case cover.

Take care not to damage the oil seal lip surfaces.



6A-106-3

Oil Seal Installation

Use the installer to install the front oil seal ① to the gear case cover ②.

Oil Seal Installer: 5-8840-2061-0

Note the oil seal installation depth ③ shown in the illustration.

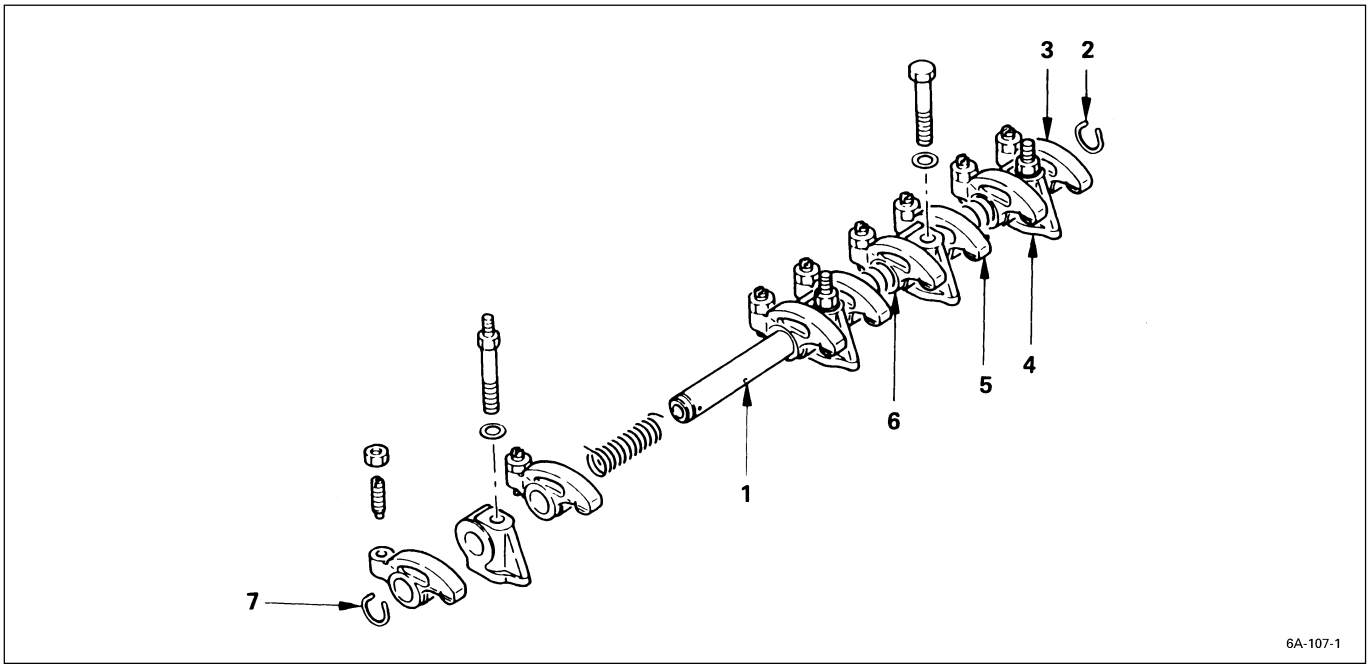
Depth ③ = 1 mm (0.039 in.)

REASSEMBLY

INTERNAL PARTS

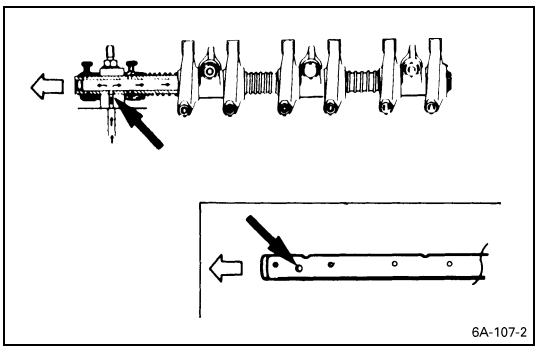
MINOR COMPONENTS

ROCKER ARM SHAFT AND ROCKER ARM



Reassembly Steps

▲ 1. Rocker arm shaft
2. Rocker arm shaft snap ring
3. Rocker arm
4. Rocker arm shaft bracket
5. Rocker arm
6. Rocker arm shaft spring
7. Rocker arm shaft snap ring

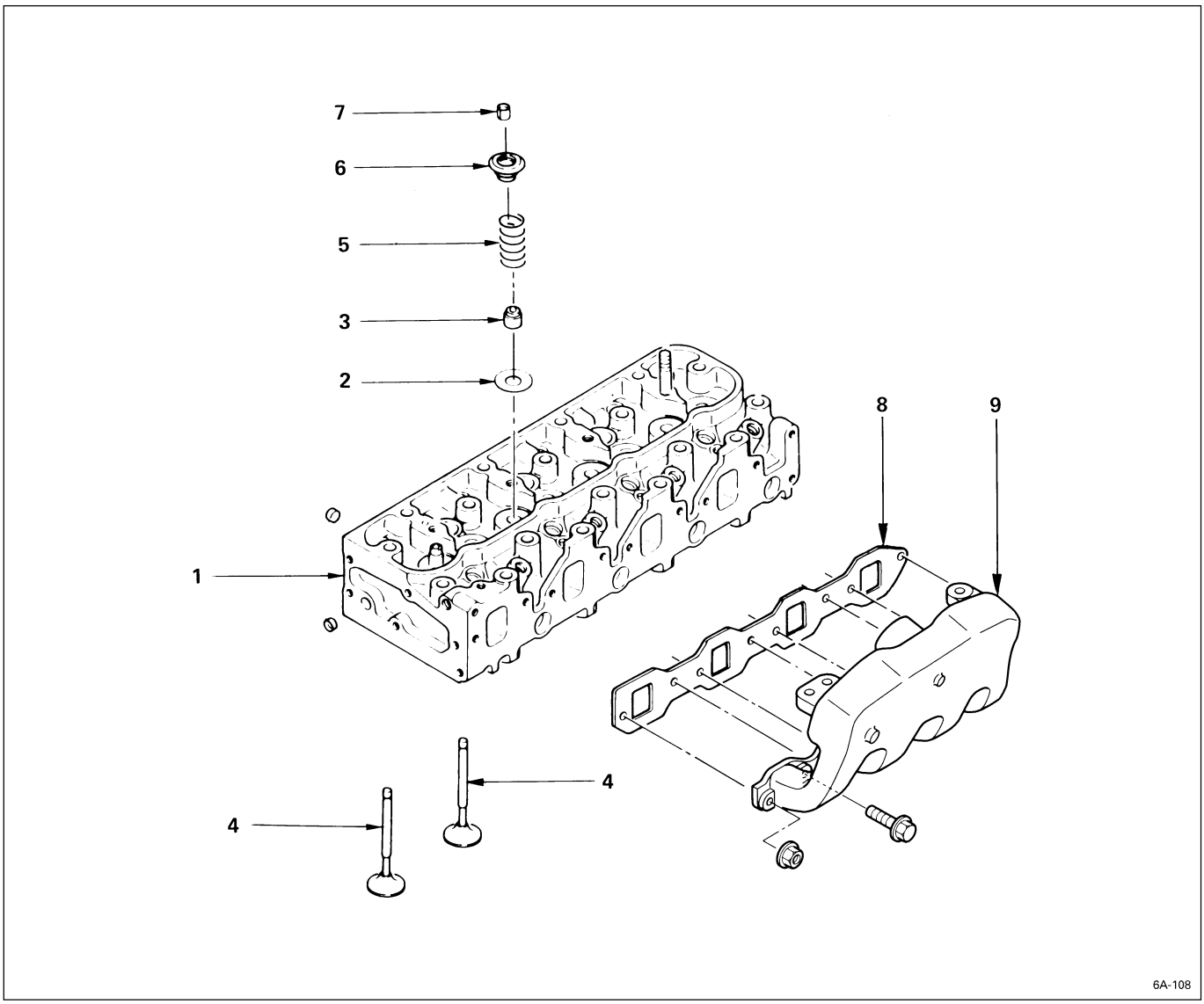


Important Operations

1. Rocker Arm Shaft

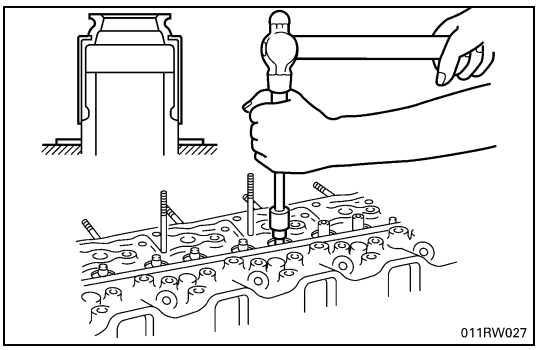
1) Position the rocker arm shaft with the large oil hole (4ϕ) facing the front of the engine.
2) Install the rocker arm shaft together with the rocker arm, the rocker arm shaft bracket, and the spring.

CYLINDER HEAD



Reassembly Steps

1. Cylinder head
2. Valve spring lower seat
3. ▲ Valve stem oil seal
4. ▲ Intake and exhaust valve
5. ▲ Valve spring
6. Valve spring upper seat
7. ▲ Split collar
8. ▲ Intake manifold gasket
9. ▲ Intake manifold



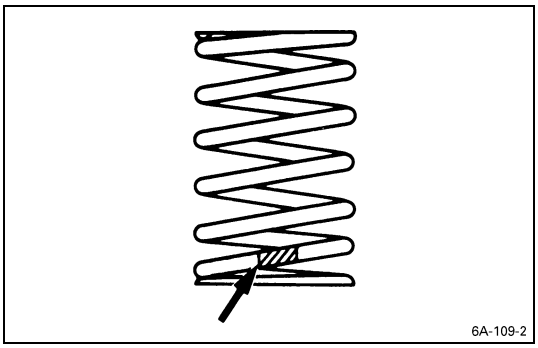
Important Operations

3. Valve Stem Oil Seal

1) Apply a coat of engine oil to the oil seal inner face.
2) Use an oil seal installer to install the oil seal to the valve guide.
   Oil Seal Installer: 5-8840-2033-0

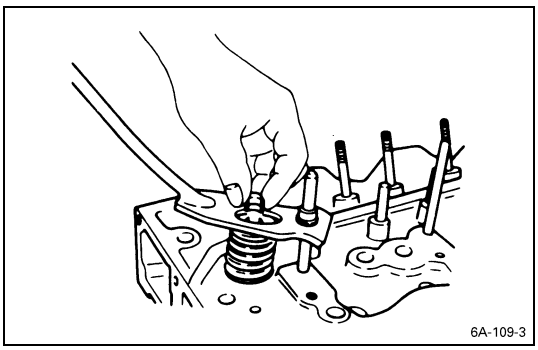
4. Intake and Exhaust Valve

1) Apply a coat of engine oil to each valve stem before installation.
2) Install the intake and exhaust valves.
3) Turn the cylinder head up to install the valve springs.
   Take care not to allow the installed valves to fall free.



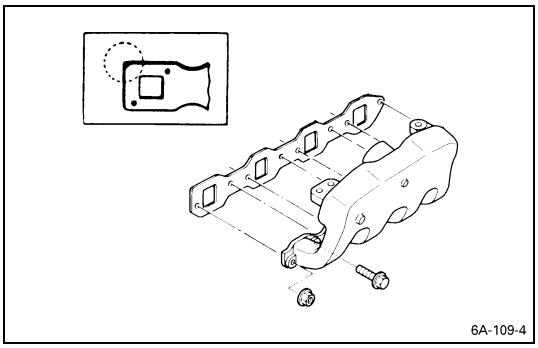
5. Valve Spring

Install the valve spring with their fine pitched end (painted) facing down.



7. Split Collar

1) Use the spring compressor to compress the valve spring into position.
   Spring Compressor: 9-8523-1423-0 (J-29760)
2) Install the split collars to the valve stem.
3) Set the split collars by tapping around the head of the collar with a rubber hammer.



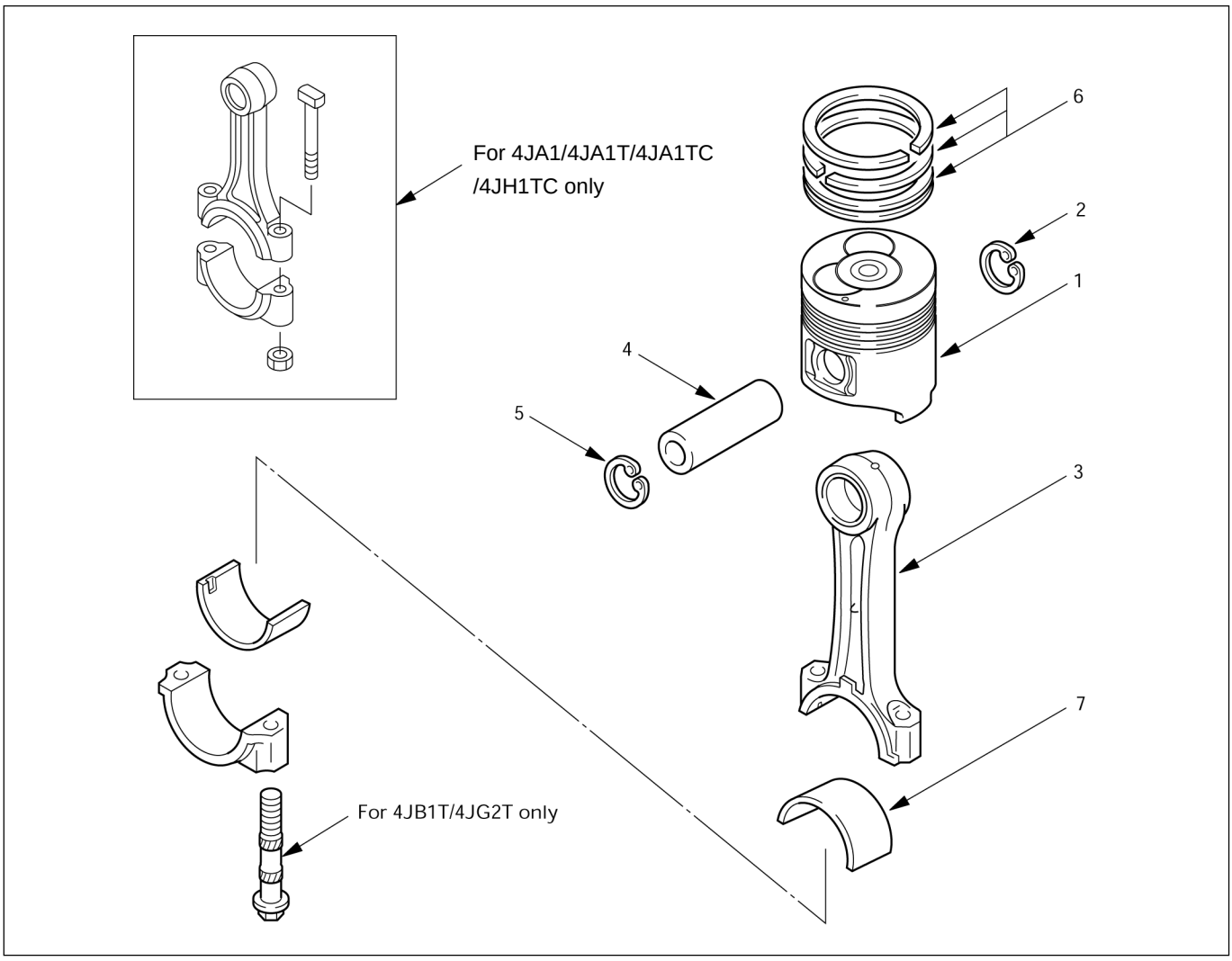
8. Intake Manifold Gasket

9. Intake Manifold

1) Install the manifold gasket with the end having the sharp corners facing the front of the engine.
2) Install the intake manifold to the cylinder head.
3) Tighten the manifold bolts to the specified torque.

Manifold Bolt Torque	kg·m (lb.ft/N·m)
	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)

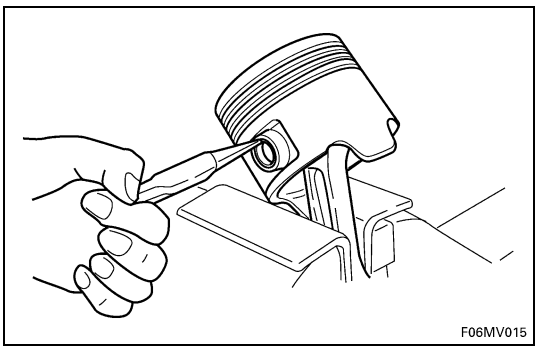
PISTON AND CONNECTING ROD



015L200003

Reassembly Steps

- ▲ 1. Piston
- ▲ 2. Piston pin snap ring
- ▲ 3. Connecting rod
- ▲ 4. Piston pin
- ▲ 5. Piston pin snap ring
- ▲ 6. Piston ring
- ▲ 7. Connecting rod bearing



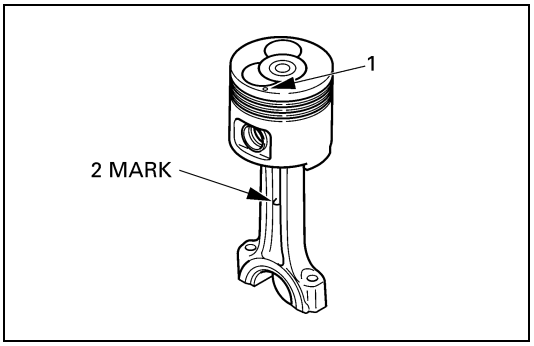
Important Operations

1. Piston

2. Piston Pin Snap Ring

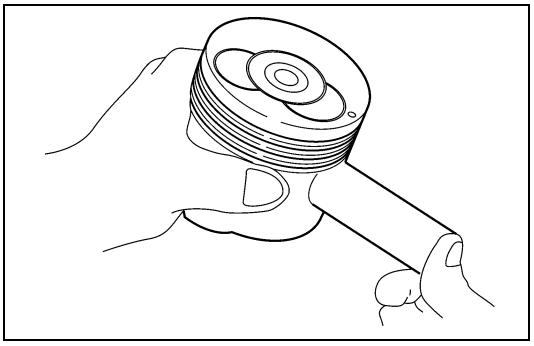
3. Connecting Rod

1) Clamp the connecting rod in a vise.
   Take care not to damage the connecting rod.
2) Use a pair of pliers to install the piston pin snap ring to the piston.



015R100022

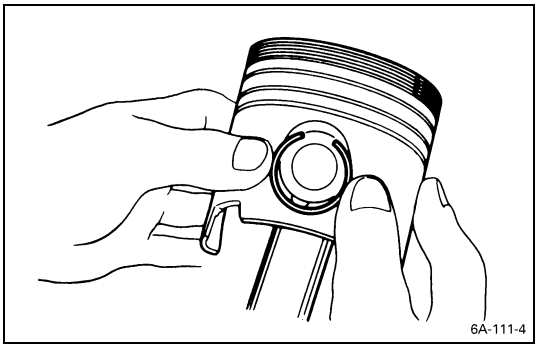
Install the piston to the connecting rod so that the piston head front mark ① and the connecting rod “ISUZU” casting mark ② are facing in the same direction.



015R100018

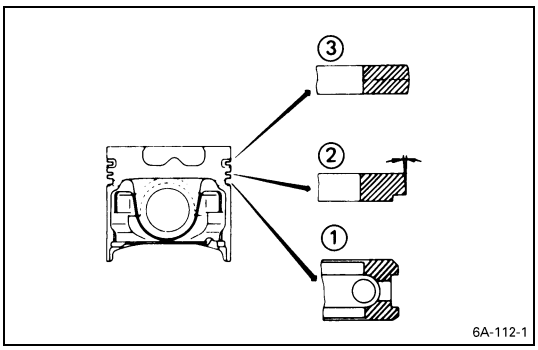
4. Piston Pin

1) Apply a coat of engine oil to the piston pin and the piston pin hole.
2) Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.



5. Piston Pin Snap Ring

3) Use your fingers to force the piston pin snap ring into the piston snap ring groove.
4) Check that the connecting rod moves smoothly on the piston pin.



6. Piston Ring

1) Use a piston ring replacer to install the three piston rings.

   Piston Ring Replacer

   Install the piston rings in the order shown in the illustration.

   ① Oil ring

   ② 2nd compression ring

   ③ 1st compression ring

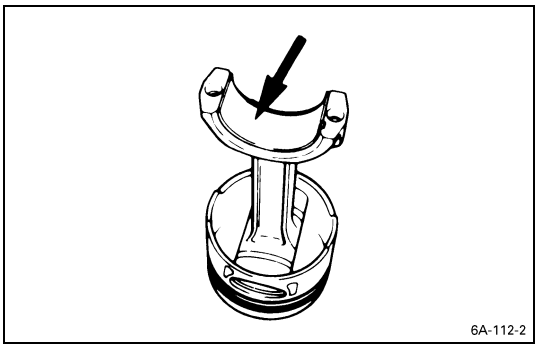
Note:

Install the compression rings with the stamped side facing up.

Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

2) Apply engine oil to the piston ring surfaces.

3) Check that the piston rings rotate smoothly in the piston ring grooves.



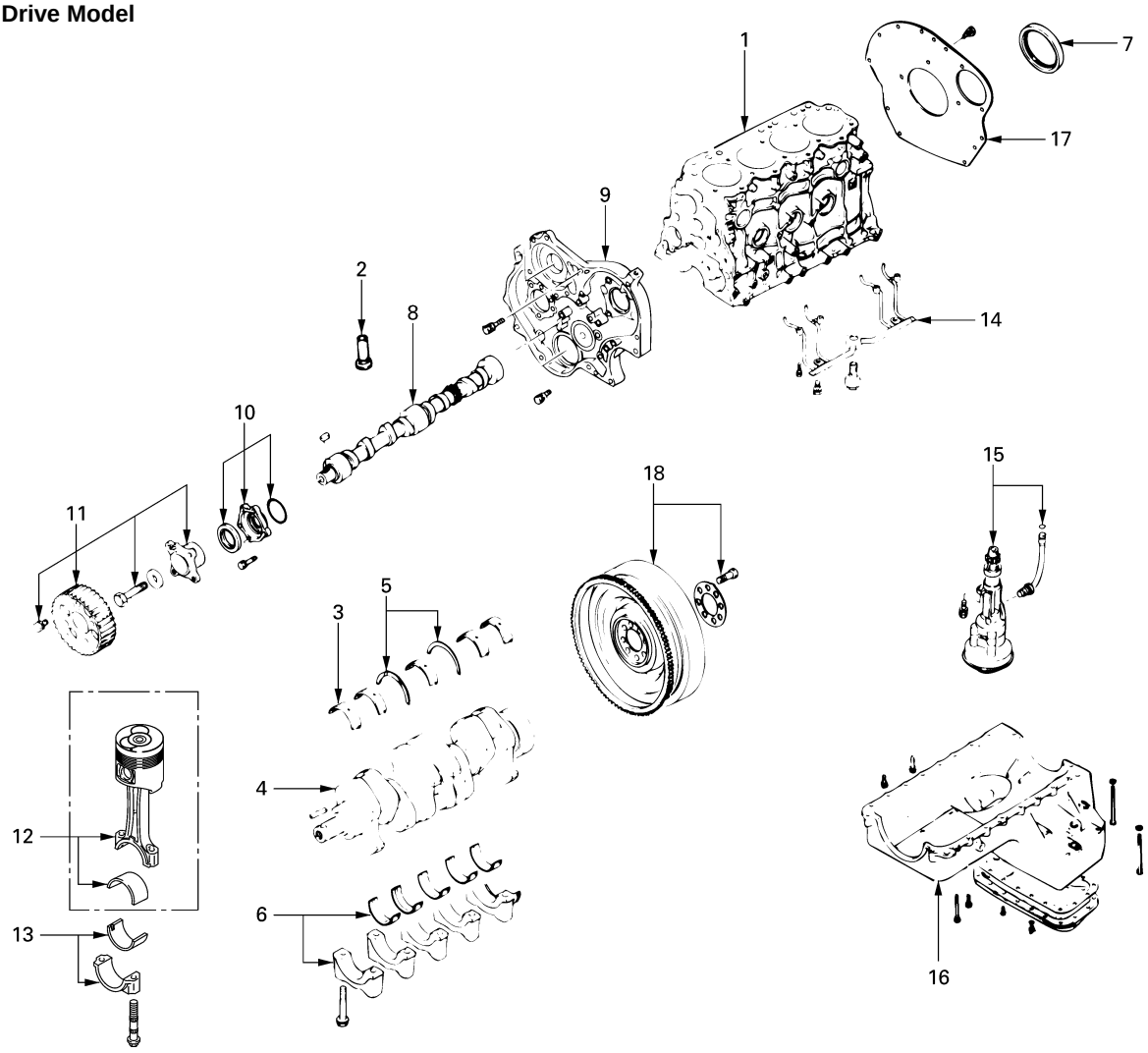
7. Connecting Rod Bearing

Carefully wipe any oil or other foreign material from the connecting rod bearing back face and the connecting rod bearing fitting surface.

INTERNAL PARTS

MAJOR COMPONENTS

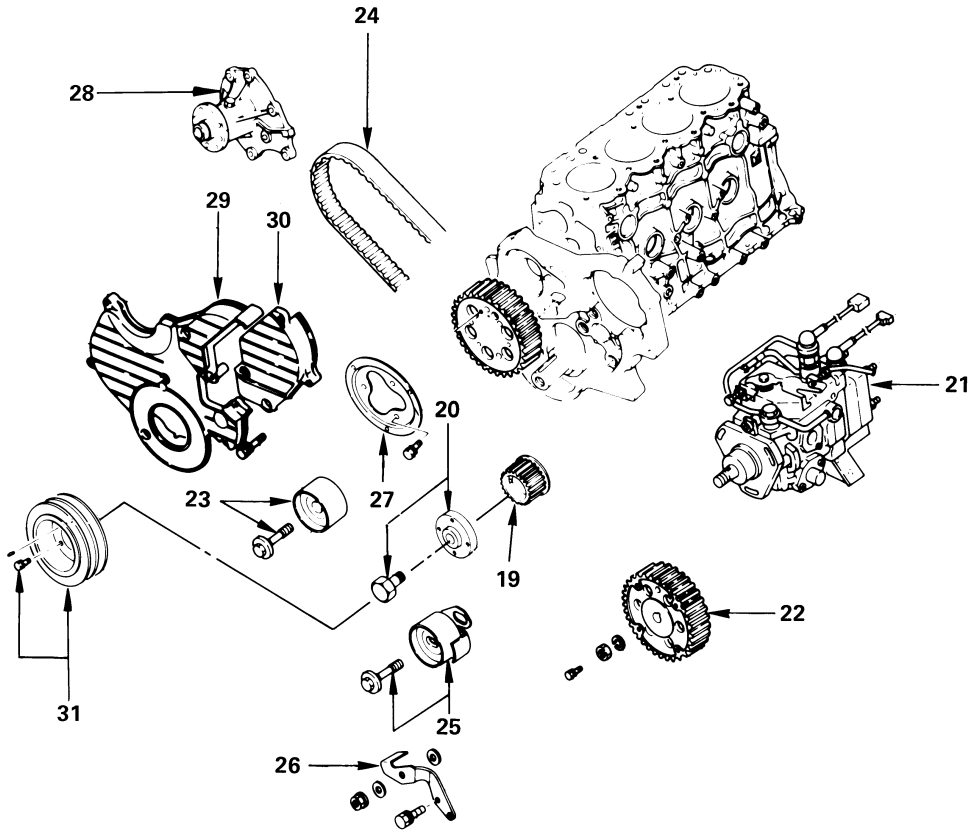
Belt Drive Model



014RY00047

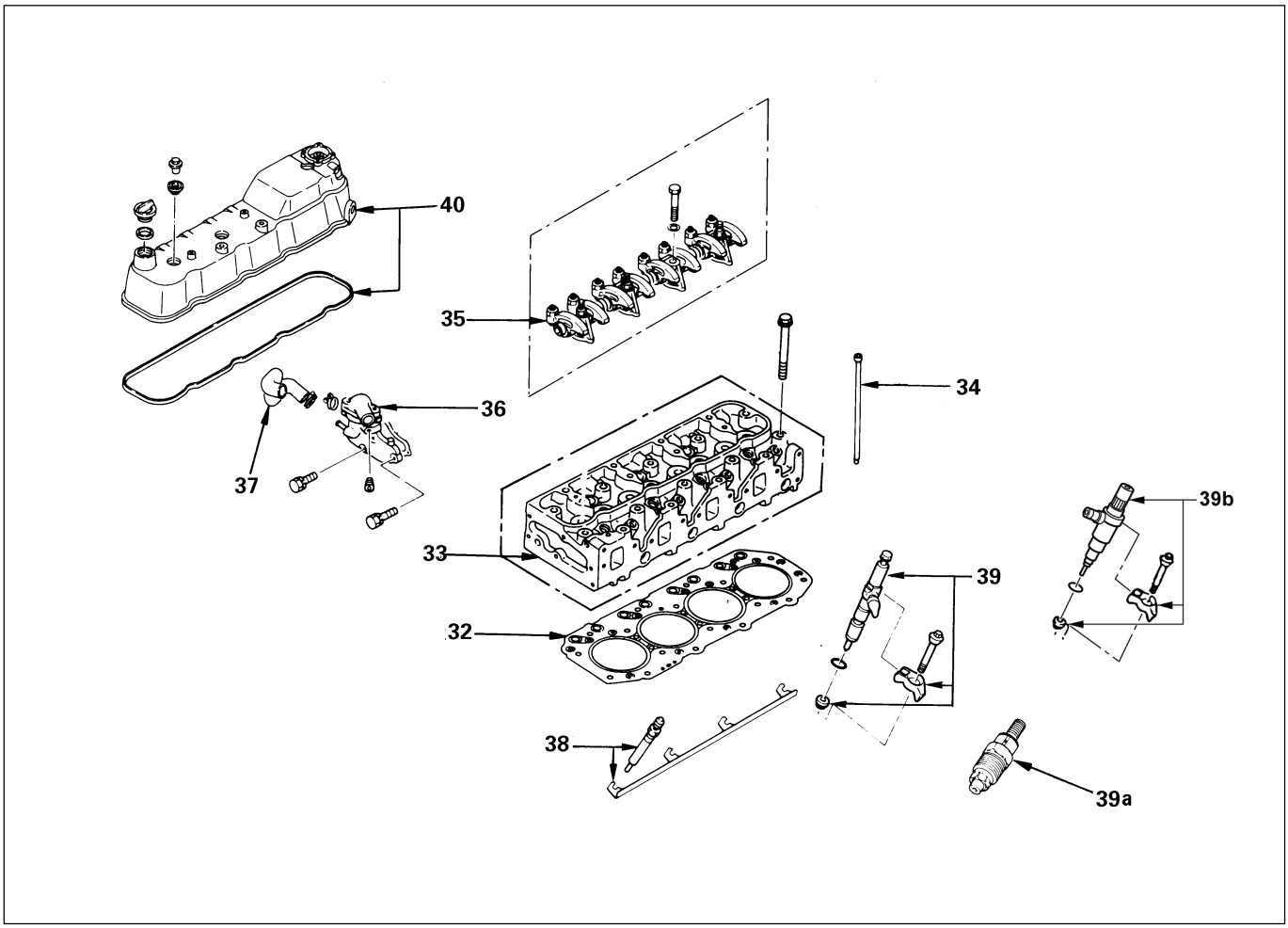
Reassembly Steps-1 (Belt Drive Model)

- ▲ 1. Cylinder body
- ▲ 2. Tappet
- ▲ 3. Crankshaft upper bearing
- ▲ 4. Crankshaft
- ▲ 5. Crankshaft thrust bearing
- ▲ 6. Crankshaft bearing cap with lower bearing
- ▲ 7. Crankshaft rear oil seal
- ▲ 8. Camshaft
- ▲ 9. Timing pulley housing
- ▲ 10. Oil seal retainer
- ▲ 11. Camshaft timing pulley
- ▲ 12. Piston and connecting rod with upper bearing
- ▲ 13. Connecting rod bearing cap with lower bearing
- ▲ 14. Piston cooling oil pipe
- ▲ 15. Oil pump with oil pipe
- ▲ 16. Oil pan
- ▲ 17. Cylinder body rear plate
- ▲ 18. Flywheel



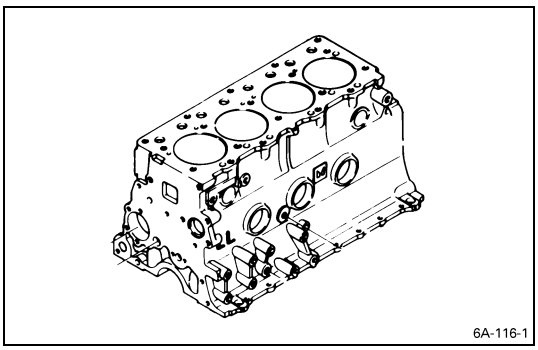
Reassembly Steps-2 (Belt Drive Model)

- ▲ 19. Crankshaft timing pulley
- ▲ 20. Crankshaft timing pulley center
- ▲ 21. Injection pump
- ▲ 22. Injection pump timing pulley
- ▲ 23. Tension idler
- ▲ 24. Timing belt
- ▲ 25. Timing belt tensioner
- ▲ 26. Timing belt tension adjusting lever
- ▲ 27. Camshaft timing pulley flange
- ▲ 28. Water pump
- ▲ 29. Timing pulley housing lower cover
- ▲ 30. Timing pulley housing upper cover
- 31. Crankshaft damper pulley



Reassembly Steps-3

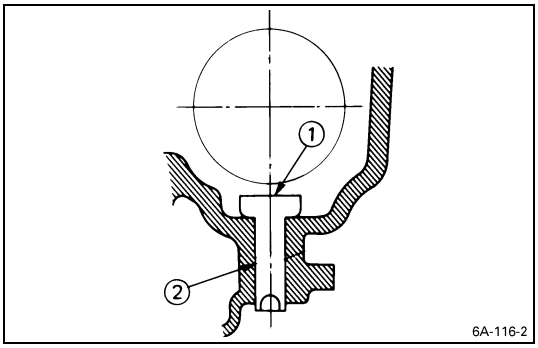
- ▲ 32. Cylinder head gasket
- ▲ 33. Cylinder head
- 34. Push rod
- ▲ 35. Rocker arm shaft and rocker arm
- ▲ 36. Thermostat housing with thermo switch
- 37. Water by-pass hose
- ▲ 38. Glow plug and glow plug connector
- ▲ 39. Injection nozzle and Injection nozzle holder
- ▲ 39a. Injection nozzle (4JG2T engine)
- 39b. Injection nozzle and injection nozzle holder (4JA1TC, 4JH1TC)
- ▲ 40. Cylinder head cover



Important Operations

1. Cylinder Body

Use compressed air to thoroughly clean the inside and outside surfaces of the cylinder body, the oil holes, and the water jackets.

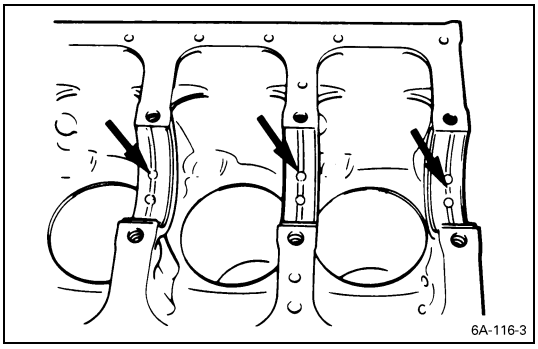


2. Tappet

1) Apply a coat of engine oil to the tappet ① and the cylinder body tappet insert holes ②.
2) Locate the position mark applied at disassembly (if the tappet is to be reused).

Note:

The tappet must be installed before the camshaft installation.



3. Crankshaft Upper Bearing

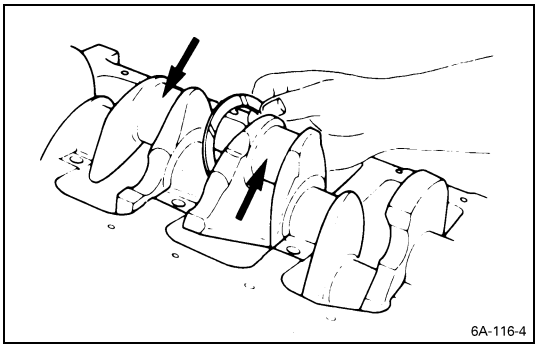
The crankshaft upper bearings have an oil hole and an oil groove. The lower bearings do not.

1) Carefully wipe any foreign material from the upper bearing.

Note:

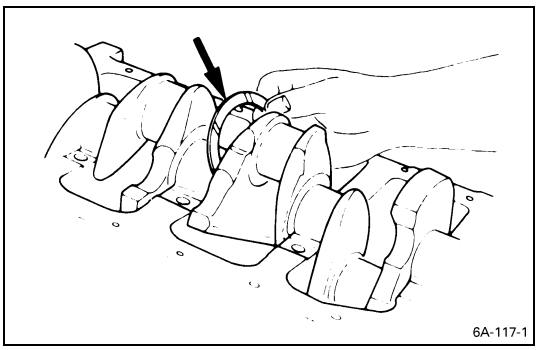
Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

2) Locate the position mark applied at disassembly if the removed upper bearings are to be reused.



4. Crankshaft

Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft.

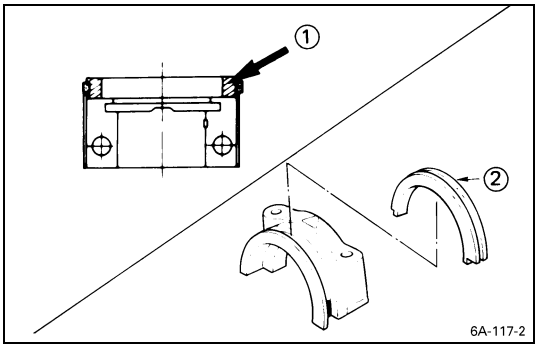


5. Crankshaft Thrust Bearing

Apply an ample coat of engine oil to the thrust bearings before installation.

Install the thrust bearings to the crankshaft center journal.

The thrust bearing oil grooves must be facing the sliding faces.



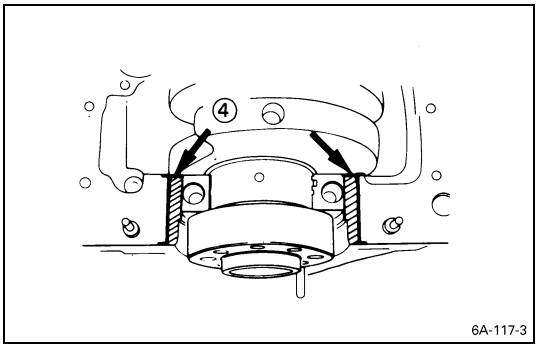
6. Crankshaft Bearing Cap With Lower Bearing

Before the crankshaft bearing installation, select the appropriate bearings in accordance with the description in **CRANK BEARING SELECTION of INSPECTION AND REPAIR.**

1) Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap ① as shown in the illustration.
2) Install the arch gasket ② to the No. 5 bearing cap.

   Use your fingers to push the arch gasket into the bearing cap groove.

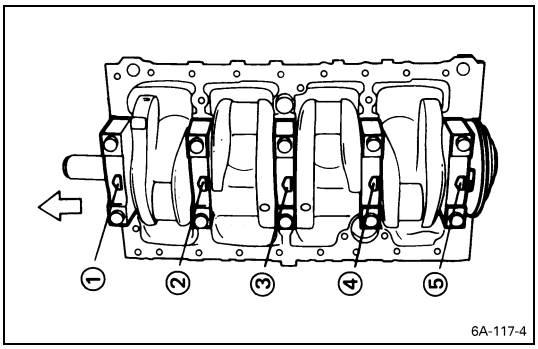
   Take care not to scratch the arch gasket outer surface.
3) Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap cylinder body fitting surfaces at the points (④) shown in the illustration.



Note:

Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket.

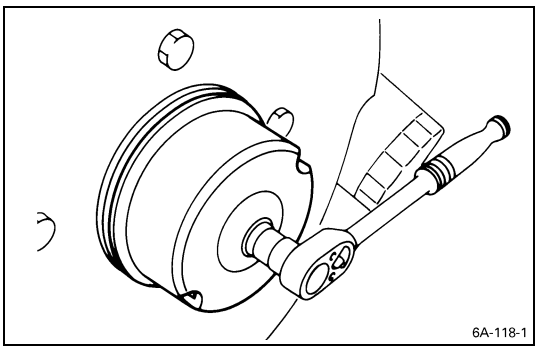
Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.



4) Install the bearing caps with the bearing cap head arrow mark facing the front of the engine.

   The bearing cap numbers must be facing up.
5) Apply engine oil to the crankshaft bearing cap bolts.
6) Temporarily tighten the bearing cap bolts.

   The bolts will be tightened to the specified torque after the crankshaft rear oil seal is installed.

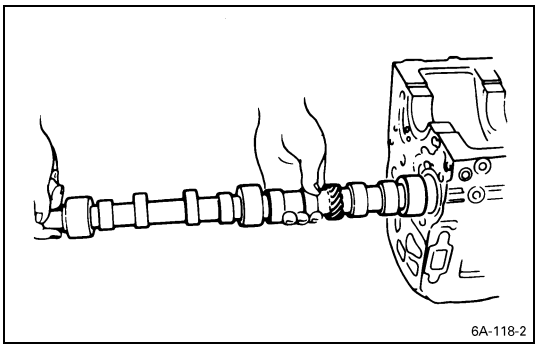


7. Crankshaft Rear Oil Seal

1) Tighten the adapter to the crankshaft rear end section with 2 bolts.
2) Insert the oil seal into the peripheral section of the adapter.
3) Insert the sleeve into the adapter section, and 1) tighten it with a bolt (M12 × 1.75L = 70) until the adapter section hits the sleeve.
4) Remove the adapter and the sleeve.
5) With the seal pressed in, check the dimension of the oil seal section.

   Standard Dimension = 12.5 ± 0.3 mm

   Oil Seal Installer: 5-8840-2359-0

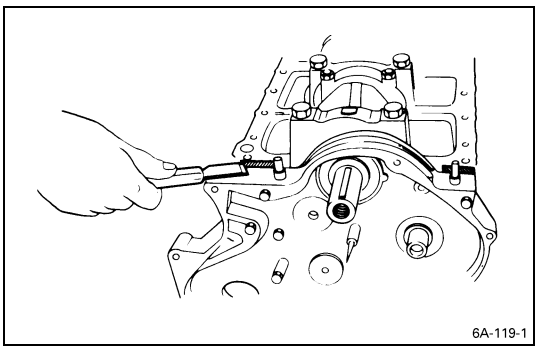


8. Camshaft

1) Apply a coat of engine oil to the camshaft and the camshaft bearings.

   Install the camshaft to the cylinder body.

   Take care not to damage the camshaft bearings.

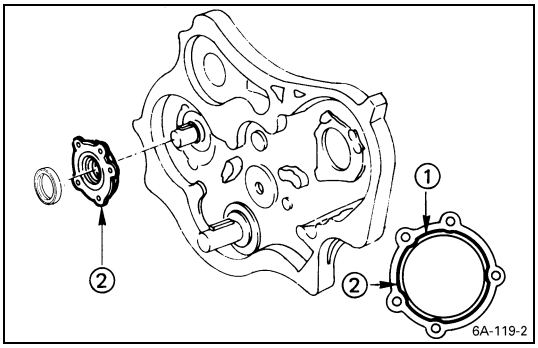


9. Timing Pulley Housing (For Belt Drive)

1) Install the timing pulley housing to the cylinder body. Take care not to twist the front oil seal.
2) Tighten the timing pulley housing together with the timing pulley housing gasket to the specified torque.

Timing Pulley Housing Bolt Torque	kg·m (lb.ft/N·m)
	1.9 ± 0.5 (13.7 ± 3.6/18.62 ± 490)

3) Cut away the flash from the gasket.

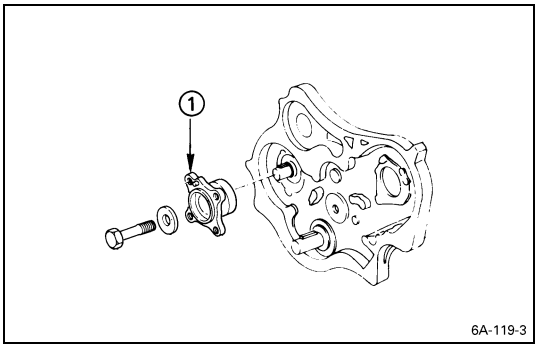


10. Oil Seal Retainer

1) Apply engine oil to the oil seal lip of the oil seal retainer.
2) Apply the recommended liquid gasket or its equivalent ① to the reatiner ② at the position shown in the illustration.

   Do not apply an excessive amount of liquid gasket.
3) Install the oil seal retainer ②.
4) Tighten the reatiner bolts to the specified torque.

Oil Seal Retainer Bolt Torque	kg·m (lb.ft/N·m)
	1.9 ± 0.5 (13.7 ± 3.6/18.62 ± 4.90)

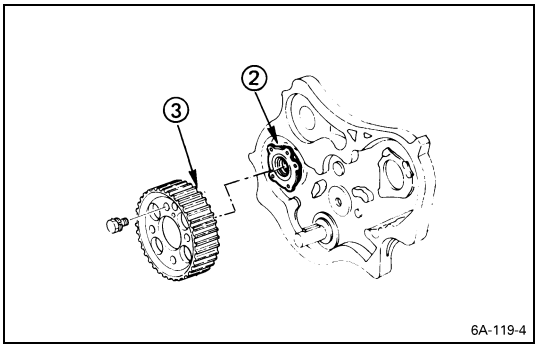


11. Camshaft Timing Pulley

1) Align the timing pulley center ① with the camshaft key.
2) Tighten the timing pulley center bolts to the specified torque.

   Prevent the camshaft from turning when tightening the timing center.

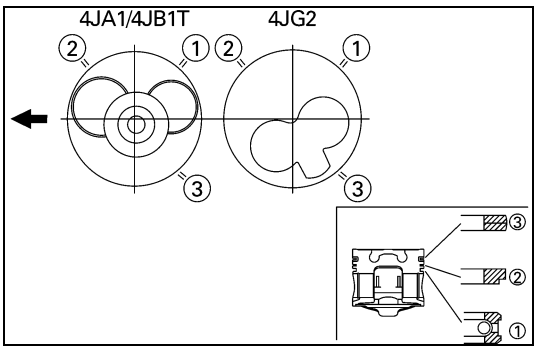
Timing Center Bolt Torque	kg·m (lb.ft/N·m)
	6.5 ± 0.5 (47.0 ± 3.6/63.70 ± 4.90)



3) Align the timing pulley with the timing center knock pin ② and then install the timing pulley ③ to the center.

   Install the stopper bolt to the camshaft timing pulley to prevent it from turning.
4) Tighten the timing pulley bolts to the specified torque.

Timing Pulley Bolt Torque	kg·m (lb.ft/N·m)
	0.8 ± 0.2 (5.8 ± 1.4/7.84 ± 1.96)

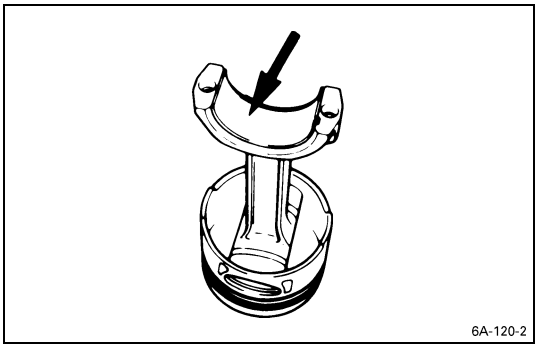


015RY00033

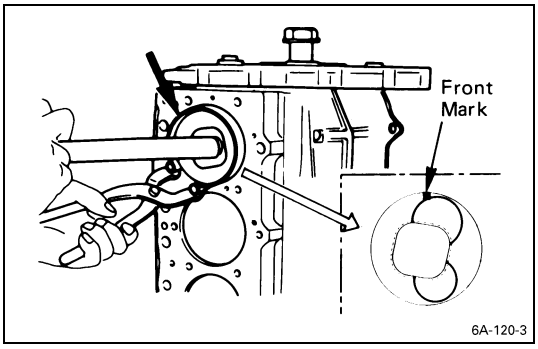
12. Piston and Connecting Rod with Upper Bearing

13. Connecting Rod Bearing Cap with Lower Bearing

1) Apply a coat of engine oil to the circumference of each piston ring and piston.
2) Position the piston ring gaps as shown in the illustration.
   ① Oil ring
   ② 2nd compression ring
   ③ 1st compression ring

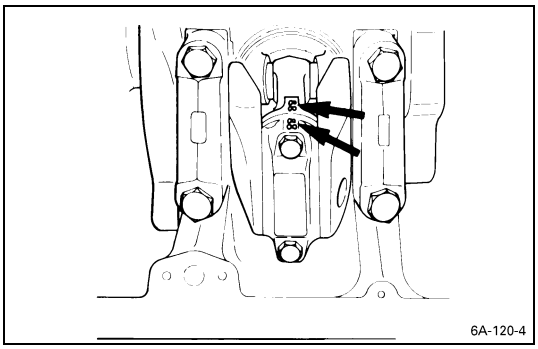

6A-120-2

3) Apply a coat of molybdenum disulfide grease to the two piston skirts.
   This will facilitate smooth break-in when the engine is first started after reassembly.
4) Apply a coat of engine oil to the upper bearing surfaces.
5) Apply a coat of engine oil to the cylinder wall.

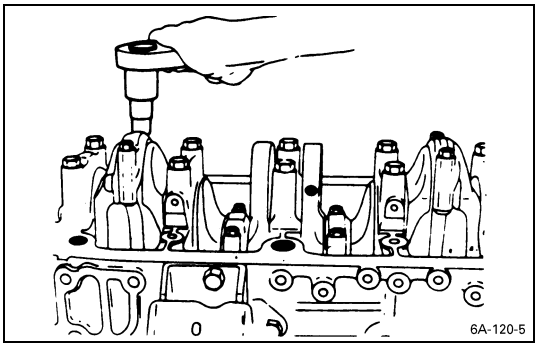


6A-120-3

6) Position the piston head front mark so that it is facing the front of the engine.
7) Use the piston ring compressor to compress the piston rings.
   Piston Ring Compressor: 5-8840-9018-0 (J-8037)
8) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.
   At the same time, rotate the crankshaft until the crankpin is at BDC.


6A-120-4

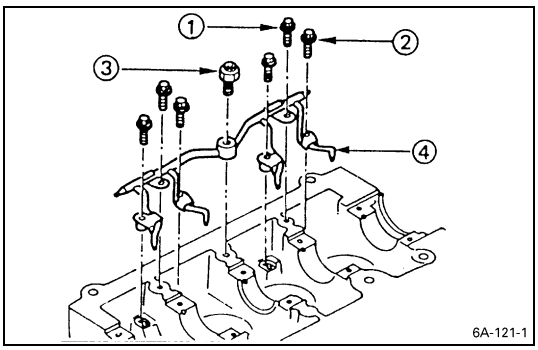
9) Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.
   The cylinder number marks must be turned toward the exhaust manifold.


6A-120-5

10) Apply a coat of engine oil to the threads and setting faces of each connecting rod cap bolt.
11) Tighten the connecting rod caps to the specified torque.

Connecting Rod Bearing Cap Bolt
Torque kg·m (lb.ft/N·m)

4JA1 / 4JA1T engine	8.5 ± 0.5(61.4 ± 3.6 / 83.3 ± 4.9)
4JB1T / 4JG2T / 4JA1TC / 4JH1TC engine	1st step ; 3.0 ± 0.5(21.7 ± 3.6 / 29 ± 5)
	2nd step ; 45° ~ 75°



14. Piston Cooling Oil Pipe

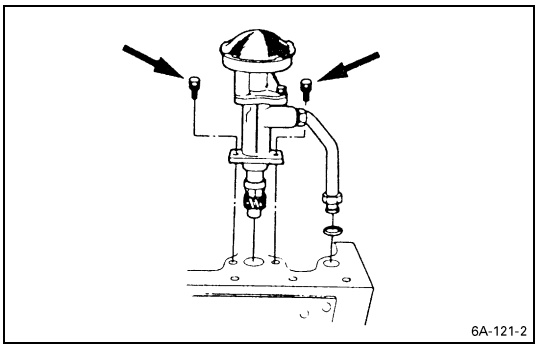
1) Install the piston cooling oil pipe to the cylinder body.
2) Tighten the oil pipe bolts and relief valve to the specified torque.

Oil Pipe Bolt Torque	kg·m (lb.ft/N·m)
① M8 × 1.25	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)
② M6 × 1.00	0.8 ± 0.2 (5.8 ± 1.5/7.8 ± 2.0)

Relief valve Torque	kg·m (lb.ft/N·m)
③ M16 × 1.5	3.0 ± 0.5 (21.7 ± 3.6/29.4 ± 4.9)

Note:

Check that there is no interference between the piston and the oiling jet pipe ④ by slowly rotating the crankshaft.



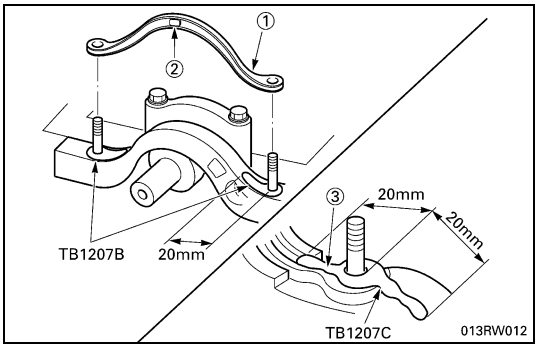
15. Oil Pump with Oil Pipe

Install the oil pump with the oil pipe and tighten the bolts to the specified torque.

Oil Pump Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	

Note:

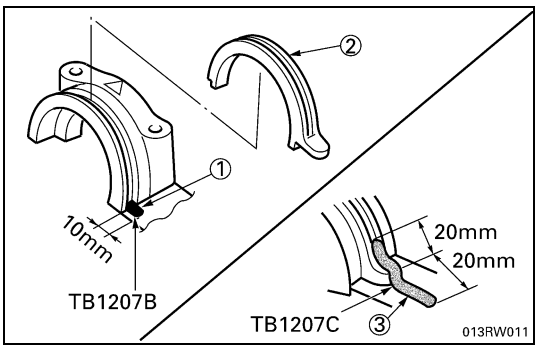
Take care not to damage the O-rings when tightening the oil pipe bolts.



16. Oil Pan

1) Apply the recommended liquid gasket (three bond TB1207 & TB1207C) or its equivalent to arch gasket fitting surface as shown in the illustration.
2) Install the crank case front gasket 1 to the timing gear case arches.

   The gasket projection 2 must be facing forward.

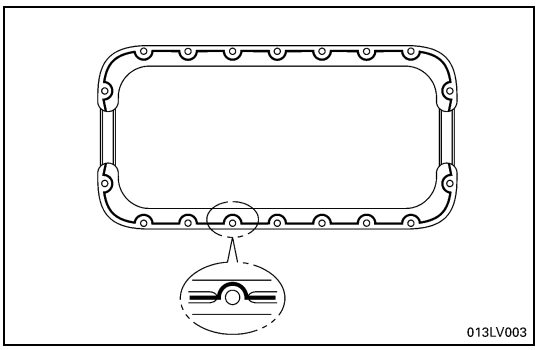


3) Install the rear arch gasket 2 to the No. 5 bearing cap.

   Use your fingers to push the arch gasket into the bearing cap groove.

   Take care not to scratch the arch gasket outer surface.

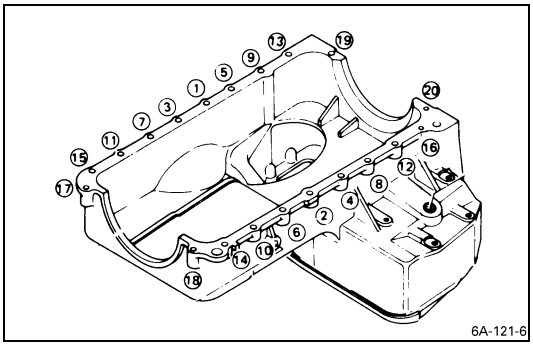
   Also apply the recommended liquid gasket (TB1207B & TB1207C) or its equivalent to arch gasket fitting area as indicated in the illustration.



4) Apply the recommended liquid gasket or its equivalent to groove of the crank case fitting surface as shown in the illustration.

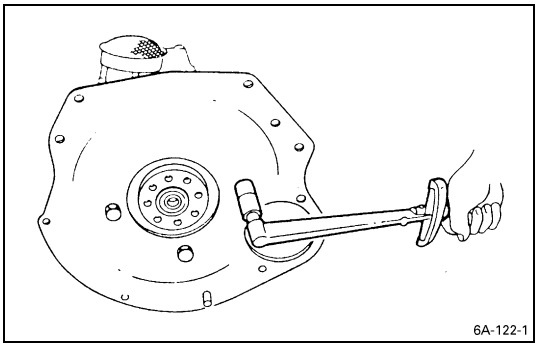
Note:

Be sure that the crank case fitting surface is completely free of oil and dust before applying the liquid gasket.



5) Install the crank case to the cylinder body.
6) Tighten the crank case bolts to the specified torque a little at a time in the sequence shown in the illustration.

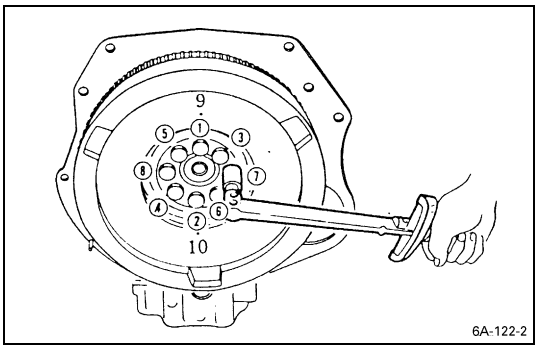
Crank Case Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	



17. Cylinder Body Rear Plate

1) Align the rear plate with the cylinder body knock pins.
2) Tighten the rear plate to the specified torque.

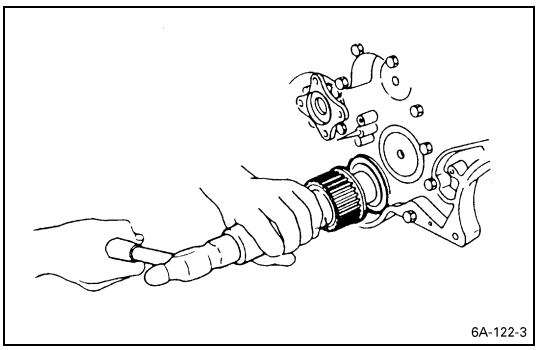
Rear Plate Torque	kg·m (lb.ft/N·m)
8.4 ± 0.8 (60.8 ± 5.8/83.3 ± 7.8)	



18. Flywheel

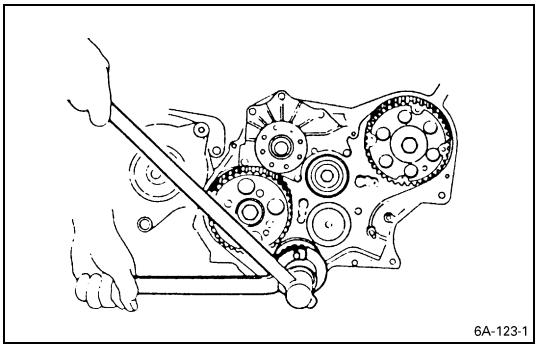
1) Block the crankshaft with a piece of hard wood to prevent the flywheel from turning.
2) Apply a coat of engine oil to the threads of the flywheel bolts.
3) Align the flywheel with the crankshaft dowel pin.
4) Tighten the flywheel bolts to the specified torque in the numerical order shown in the illustration.

Flywheel Bolt Torque	kg·m (lb.ft/N·m)
12.0 ± 0.5 (86.8 ± 3.6/117.6 ± 4.9)	



19. Crankshaft Timing Pulley

1) Install the timing pulley to the crankshaft.
2) Use the crankshaft timing pulley installer to install the timing pulley.
   The timing pulley flange must be facing the cylinder body.

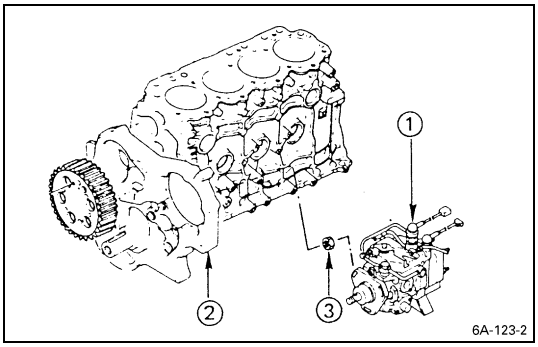


20. Crankshaft Timing Pulley Center

1) Install the crankshaft timing pulley center.
2) Use the fixing wrench to prevent the crankshaft from turning.
   Fixing Wrench: 5-8840-0161-0
3) Tighten the crankshaft pulley center bolt to the specified torque.

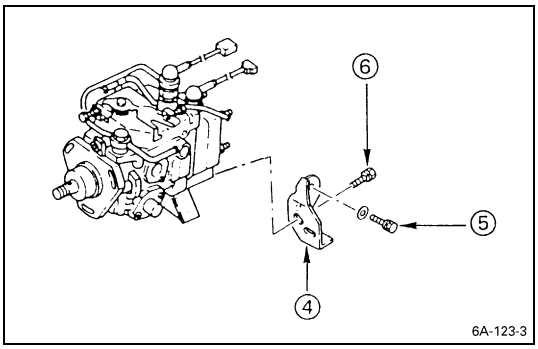
Crankshaft Pulley Center Bolt Torque kg·m (lb.ft/N·m)

4JA1T	19.0 ± 2 (137.4 ± 14.5/186.20 ± 19.60)
4JG2T	28.0 ± 4.5 (202.5 ± 32.5/274.4 ± 44.1)



21. Injection Pump

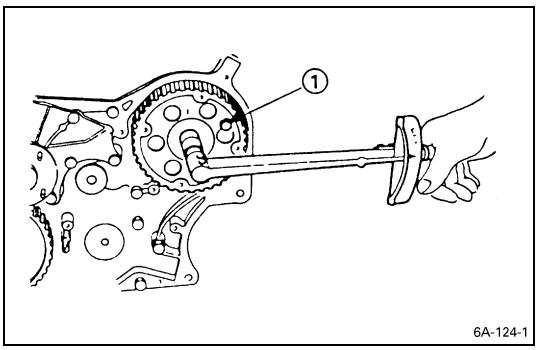
1) Install the injection pump ① to the timing pulley housing ②.
2) Temporarily tighten the three injection pump nuts ③.
   The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.



3) Install the injection pump rear bracket ④ and the rear bracket bolts ⑤ to the cylinder body.
4) Install the rear bracket bolts ⑥ to the injection pump bracket.
   Do not tighten the bolts.
   The rear bracket bolts ⑤ and ⑥ will be finally tighten tened to the specified torque after the injection pump nuts.
5) Tighten the injection pump nuts to the specified torque.

Injection Pump Nut and Bracket Bolt Torque kg·m (lb.ft/N·m)

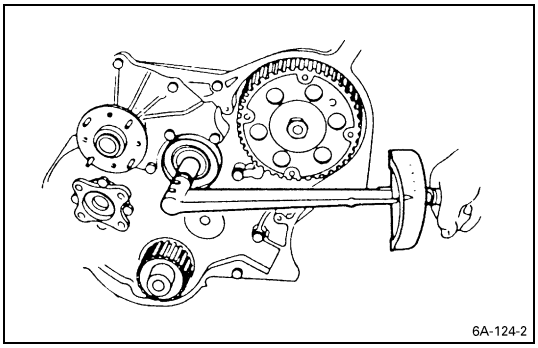
⑤, ⑥	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)



22. Injection Pump Timing Pulley

1) Align the timing pulley with the pump shaft key.
2) Install the stopper bolt ① to the timing pulley.
   This will prevent the timing pulley from turning.
3) Tighten the timing pulley nut to the specified torque.

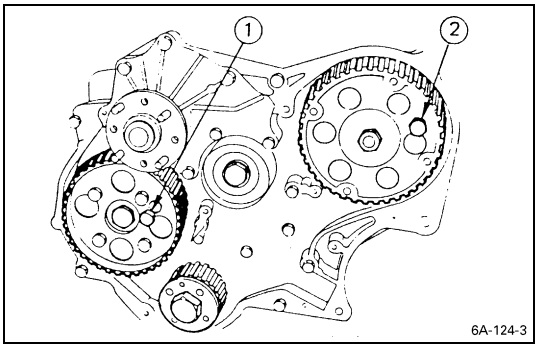
Injection Pump Timing Pulley Nut Torque	kg·m (lb.ft/N·m)
6.5 ± 0.5 (47.0 ± 3.6/63.7 ± 4.9)	



23. Tension Idler

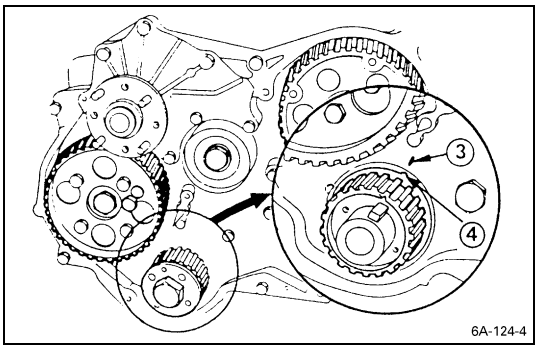
1) Install the tensioner idler to the timing pulley housing.
2) Tighten the tensioner idler to the specified torque.

Tensioner Idler Bolt Torque	kg·m (lb.ft/N·m)
7.7 ± 1.0 (55.7 ± 3.6/75.5 ± 9.8)	

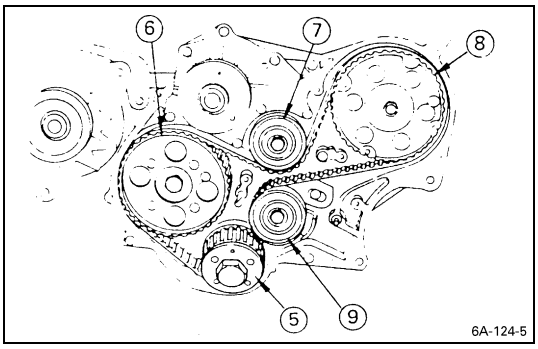


24. Timing Belt
25. Timing Belt Tensioner
26. Timing Belt Tension Adjusting Lever

1) Check that the stopper bolts are properly installed to the camshaft timing pulley ① and the injection pump timing pulley ②.

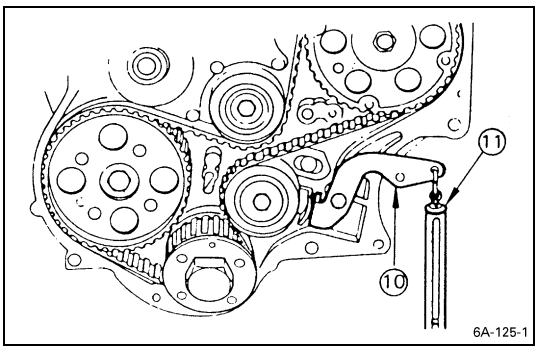


2) Check that the timing pulley housing mark ③ and the crankshaft timing pulley mark ④ are aligned.

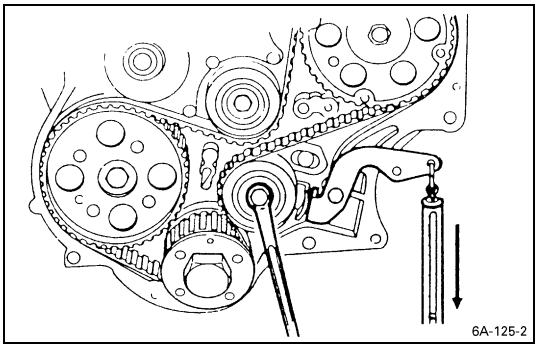


3) Install the timing belt to the crankshaft timing pulley ⑤, the camshaft timing pulley ⑥, the tensioner idler ⑦, and the injection timing pulley ⑧.
   Follow the numerical order.
4) Install the timing belt tensioner ⑨ to the timing pulley housing.
5) Temporarily tighten the tnesioner bolt.
   The tensioner should move freely.

Note:
The timing belt is easily damaged. Be careful.



6) Set the tensioner adjusting lever ⑩ to the timing pulley housing.
7) Remove the stopper bolts from the camshaft timing pulley ① and the injection pump timing pulley ②.
8) Attach the spring balancer ⑪.



9) Adjust timing belt tension by pulling straight down on the spring balancer with the specified force.

Tension Adjusting Lever Force	kg (lb/N)
10 - 12 (22.1 – 26.5/98.1 – 117.7)	

Note:

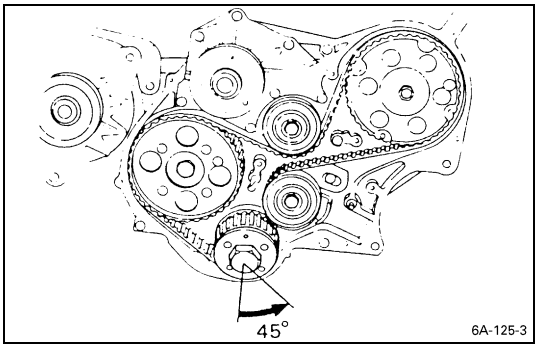
Timing belt tension must be adjusted.

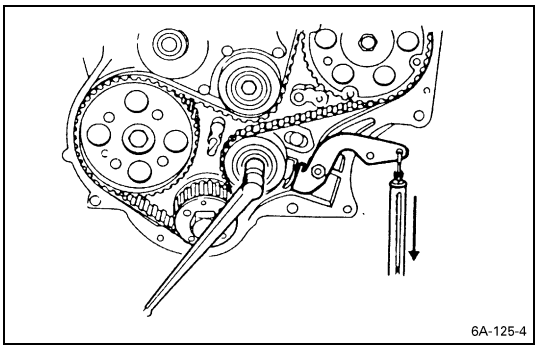
Failure to adjust the timing belt tension will result in timing belt damage.

10) Tighten the tension bolt.
11) Rotate the crankshaft 45 degrees counterclockwise.

Note:

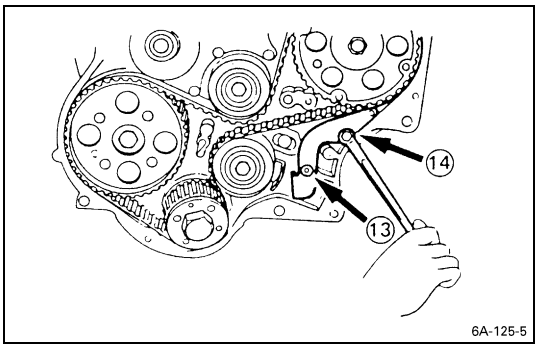
Never rotate crankshaft clockwise when adjusting the timing belt.





12) Readjust the timing belt tension.
Refer to Step 9
This will remove any remaining timing belt slack.
13) Tighten the tensioner bolt to the specified torque.

Tensioner Bolt Torque	kg·m (lb.ft/N·m)
7.7 ± 1.0 (55.7 ± 3.6/75.5 ± 9.8)	

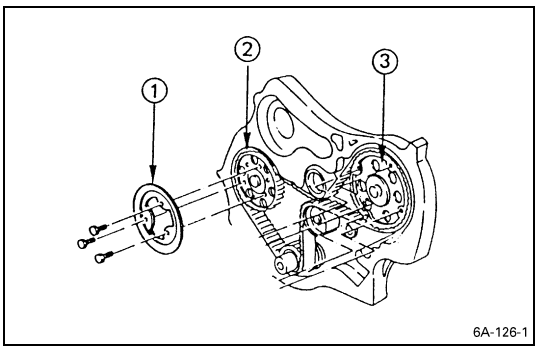


14)Tighten the tension adjusting lever nut ⑬ and bolt ⑭.

Note:

If on-vehicle timing belt replacement is performed, the crankshaft must not be allowed to turn.

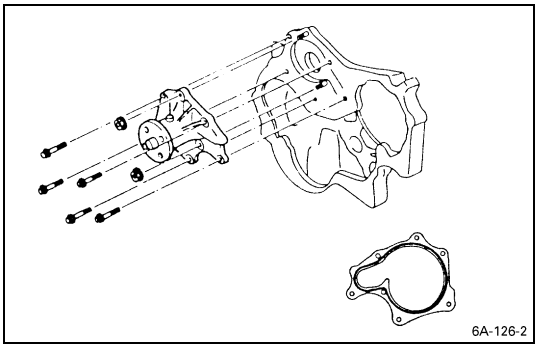
If the crankshaft is allowed to turn, piston and valve damage will result.



27. Camshaft Timing Pulley Flange

Tighten the timing pulley flange bolts to the specified torque.

Timing Puley Flange Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	



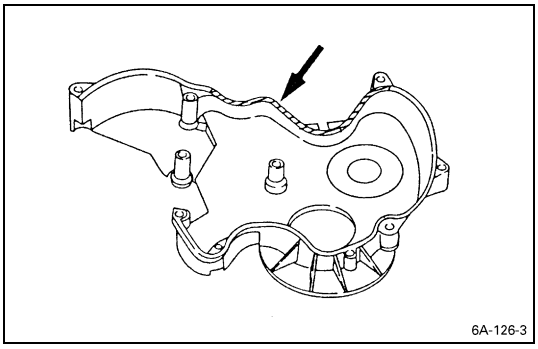
28. Water Pump

1) Apply the recommended liquid gasket or its equivalent to the water pump at the position shown in the illustration.

   Do not apply an excessive amount of liquid gasket.

2) Tighten the water pump bolts to the specified torque.

Water Pump Bolt Torque	kg·m (lb.ft/N·m)
2.0 ± 0.5 (14.5 ± 3.6/19.6 ± 4.9)	



29. Timing Pulley Housing Lower Cover

30. Timing Pulley Housing Upper Cover

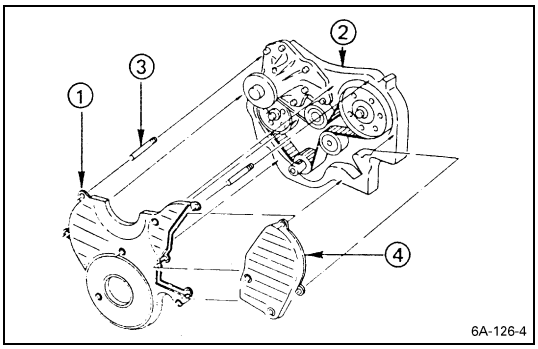
1) Apply the recommended liquid gasket or its equivalent to the timing pulley lower cover.
2) Install the lower cover ① to the timing pulley housing ②.

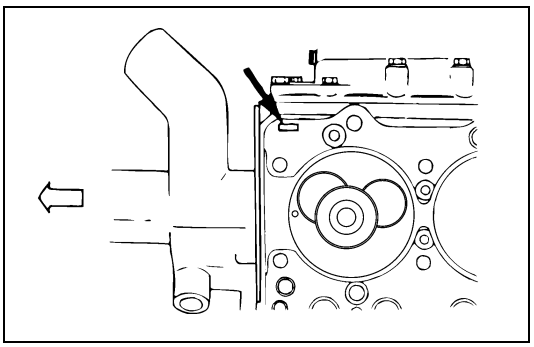
   Use the lower cover guide bolts ③ to prevent the liquid gasket from running.

3) Install the upper cover ④ to the lower cover and pulley housing.
4) Tighten the timing cover bolts to the specified torque a little at a time in the sequence shown in the illustration.

Timing Pulley Cover Bolt Torque	kg·m (lb.ft/N·m)
0.8 ± 0.2 (5.8 ± 1.4/7.8 ± 2.0)	

5) Remove the lower cover guide pin.





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32. Cylinder Head Gasket

The cylinder head gasket “TOP” mark must be facing up.

Note:

Before the gasket installation, measure the piston head projection and select the appropriate head gasket.

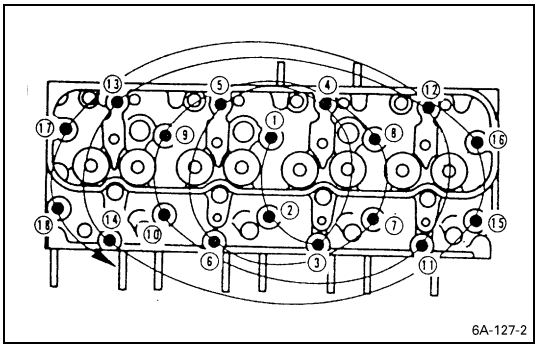
Refer to “INSPECTION AND REPAIR”, “Cylinder Head Gasket Selection”.

33. Cylinder Head

1) Align the cylinder body dowels and the cylinder head dowel holes.

   Carefully place the cylinder head on the cylinder head gasket.

2) Apply a coat of engine oil to the cylinder head bolt threads and setting faces.



6A-127-2

3) Tighten the cylinder head bolts in two steps.

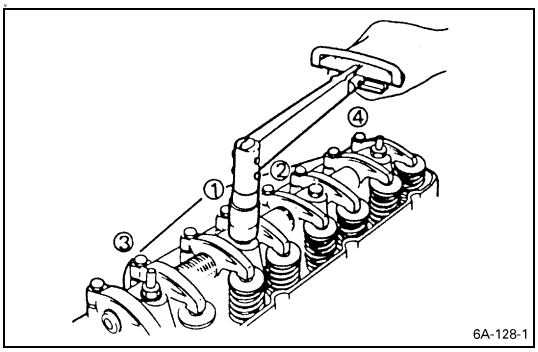
   Follow the numerical sequence shown in the illustration.

Cylinder Head Bolt Torque kg·m (lb.ft/N·m)

1st Step	2nd Step	3rd Step
5.0 ± 0.5 (36.2 ± 3.6/49.00 ± 4.90)	60° ~ 75°	60° ~ 75°

Cylinder Head Bolt Torque kg·m (lb.ft/N·m)

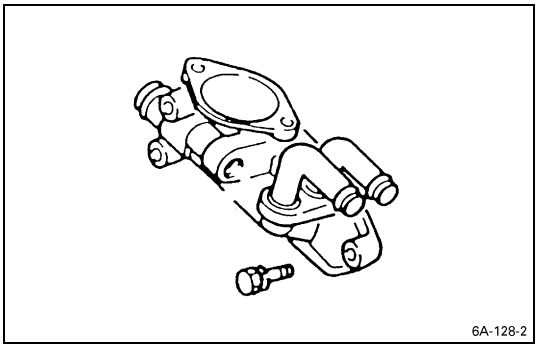
		1st Step	2nd Step
4JB1 For CHINA only	New bolt	5.0 ± 0.5 (36.2 ± 3.6/ 83.3 ± 4.9)	8.7 ± 0.5 (62.9 ± 3.6/ 85.26 ± 4.90)
	Reuse bolt	8.5 ± 0.5 (61.4 ± 3.6/ 83.3 ± 4.9)	10.5 ± 0.5 (75.9 ± 3.6/ 102.90 ± 4.90)



35. Rocker Arm Shaft and Rocker Arm

Tighten the rocker arm shaft bracket bolts in the numerical order shown in the illustration.

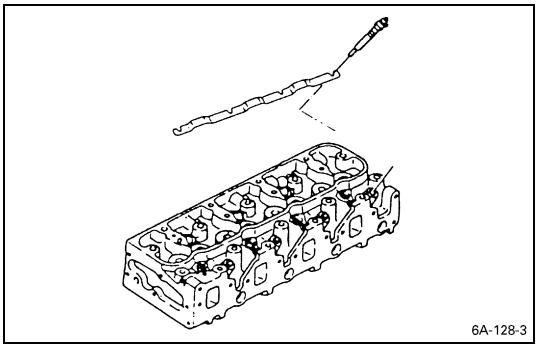
Rocker Arm Shaft Bracket Bolt Torque	kg·m (lb.ft/N·m)
5.5 ± 0.5 (39.8 ± 3.6/53.9 ± 4.9)	



36. Thermostat Housing

1) Install the thermostat housing.
2) Tighten the thermostat housing bolts to the specified torque.

Thermostat Housing Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	

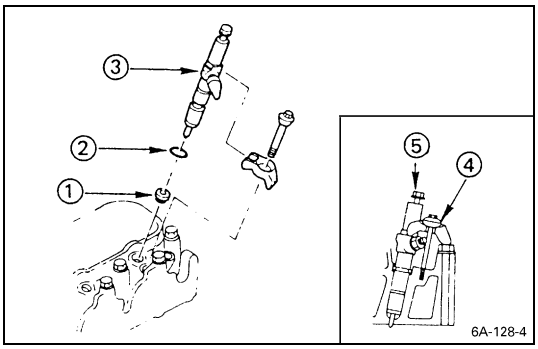


38. Glow Plug and Glow Plug Connector

1) Install the glow plugs to the cylinder head.
2) Tighten the glow plugs to the specified torque.

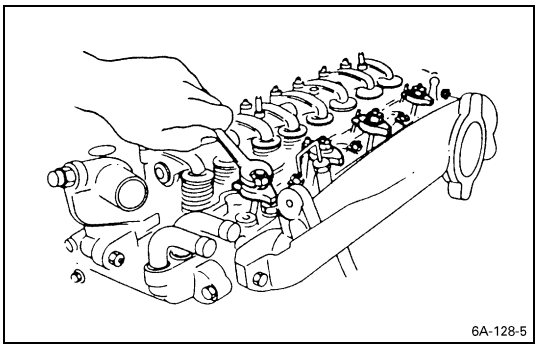
Glow Plug Torque	kg·m (lb.ft/N·m)
2.25 ± 0.25 (16.3 ± 1.8/22.1 ± 2.5)	

3) Install the glow plug connector.



39. Injection Nozzle Holder

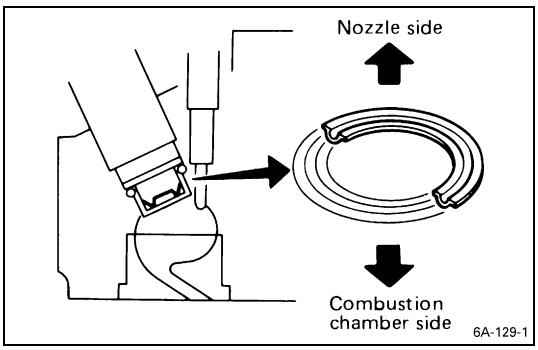
1) Install the injection nozzle gasket ① and the O-ring ② to the injection nozzle holder ③.
   Be sure that the O-ring fits snugly in the injection nozzle groove.
2) Install the nozzle holder toghther with the nozzle holder bracket ④ to the cylinder head.



Nozzle Holder Bracket Bolt Torque	kg·m (lb.ft/N·m)
3.8 ± 0.6 (27.5 ± 4.3/37.2 ± 5.9)	

3) Tighten the holder nut with washer ⑤ to the specified torque.

Injection Nozzle Holder Nut Torque	kg·m (lb.ft/N·m)
3.8 ± 0.6 (26.0 ± 4.3/37.2 ± 5.9)	



Important Operations

39a.Nozzle Holder Assembly (4JG2T Engine)

Install the parts in sequence of corrugated washer, nozzle gasket and nozzle holder.

Do not reuse the corrugated washer and nozzle gasket.

Use the new one.

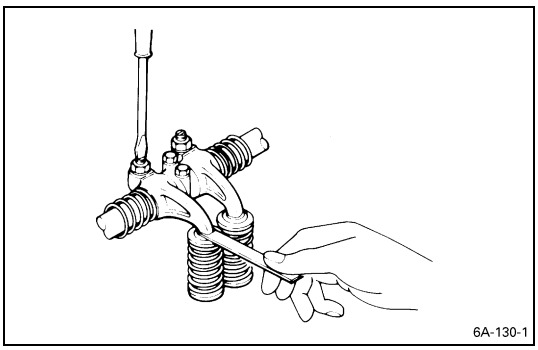
The corrugated washer should be installed with blue color painted side turned to the nozzle.

Tighten the nozzle holder.

Nozzle Holder Torque	kg·m (lb.ft/N·m)
6.5 ± 0.5 (47.0 ± 3.6/63.7 ± 4.9)	

Install the leak-off pipe via the copper gasket.

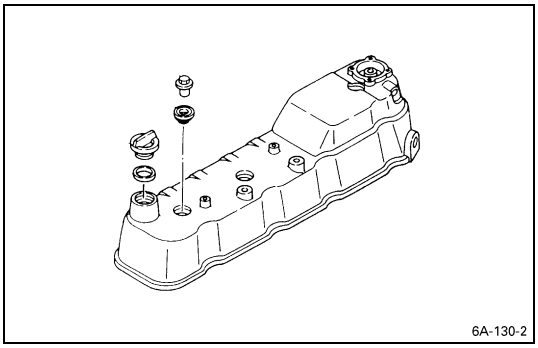
Leak Off Pipe Torque	kg·m (lb.ft/N·m)
3.5 – 4.7 (25.3 – 34.0/34.3 – 46.1)	



Note on Valve Clearance Adjustment

Valve clearances must be adjusted before the cylinder head cover is reinstalled.

Refer to “Valve Clearance Adjustment” in the “Servicing” Section of this Manual.



40. Cylinder Head Cover

1) Apply engine oil to the rocker arm and the valve spring.
2) Install the cylinder head cover gasket to the head cover.

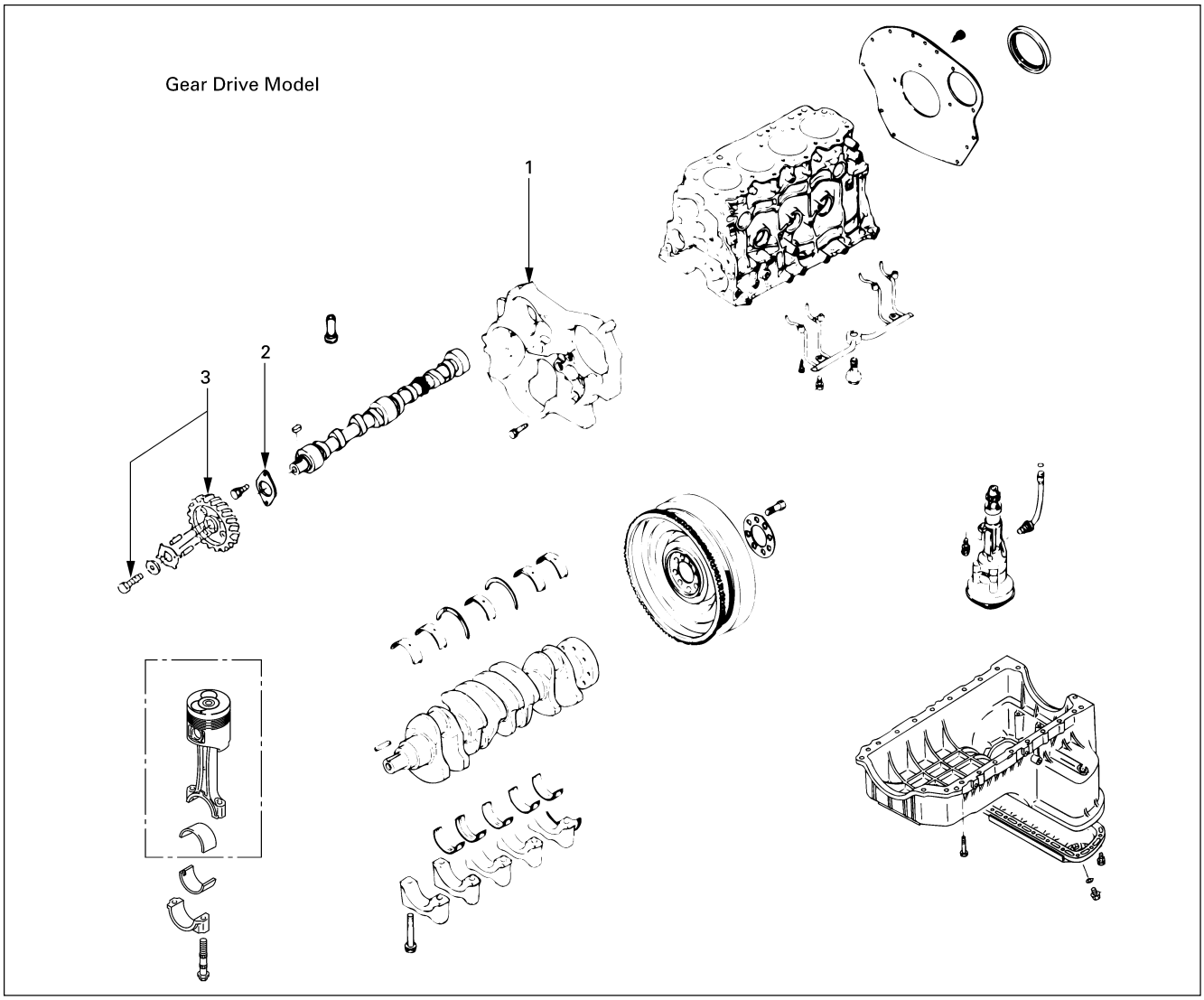
   Check to see that the head cover gasket has no loose areas.
3) Tighten the cylinder head cover nuts in the numerical order shown in the illustration.

Cylinder Head Cover Bolt Torque	kg·m (lb.ft/N·m)
	1.3 ± 0.5 (9.4 ± 3.6/12.7 ± 4.9)

4) Connect the PCV hose to the cylinder head cover.

INTERNAL PARTS

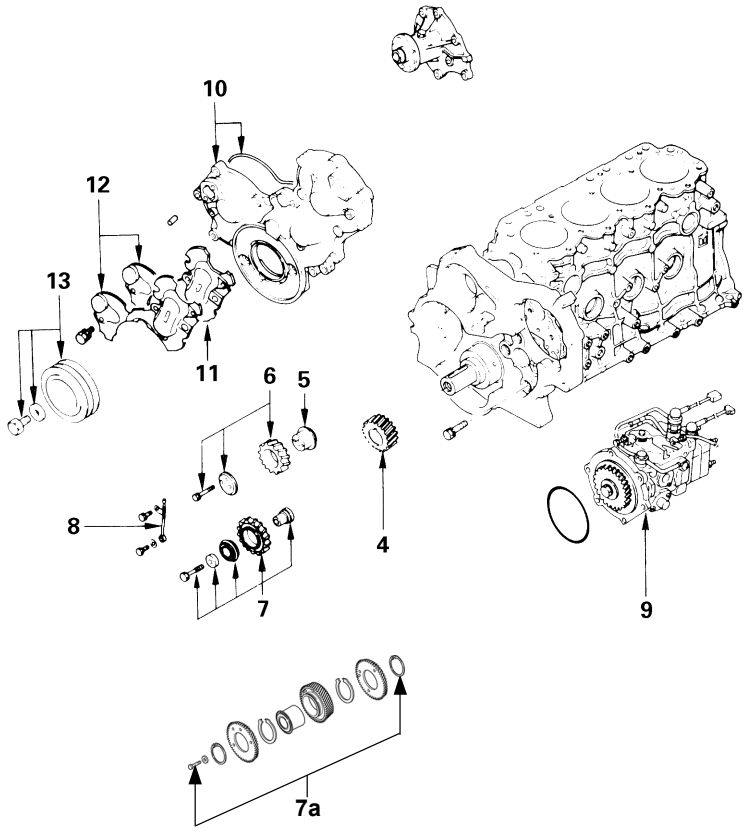
MAJOR COMPONENTS



014RY00048

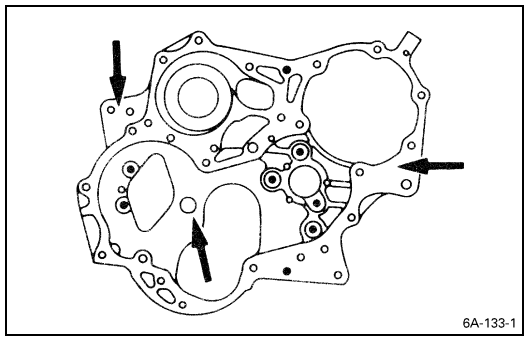
Reassembly Steps-1 (Gear Drive Model)

- ▲ 1. Timing gear case
- ▲ 2. Camshaft thrust plate
- ▲ 3. Camshaft timing gear



Reassembly Steps-2 (Gear Drive Model)

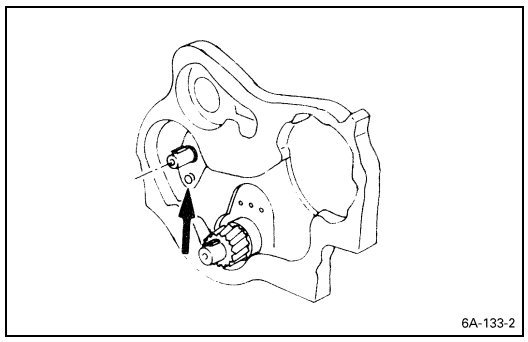
- ▲ 4. Crankshaft timing gear
- ▲ 5. Idler gear shaft
- ▲ 6. Idler gear “A”
- ▲ 7. Idler gear “B” and shaft
- ▲ 7a. Idler gear “B” and shaft (Scissor gear
- ▲ 8. Timing gear oil pipe (Except 4JA1TC, 4JH1TC)
- ▲ 9. Injection pump
- ▲ 10. Timing gear case cover
- 11. Space rubber
- 12. Gear case cover upper cover and lower cover
- ▲ 13. Crankshaft damper pulley



1. Timing Gear Case

1) Tighten the timing gear case with timing gear case gasket to the specified torque.

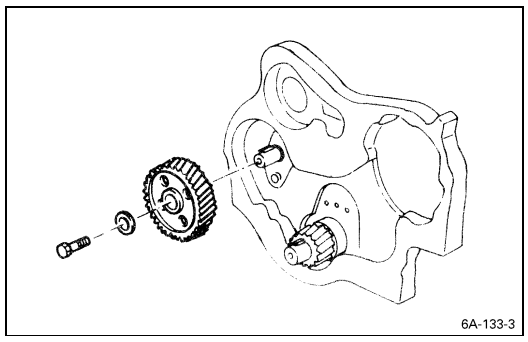
Timing Gear Case Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	



2. Camshaft Thrust Plate

Install the thrust plate to the cylinder body and tighten the thrust plate bolts to the specified torque.

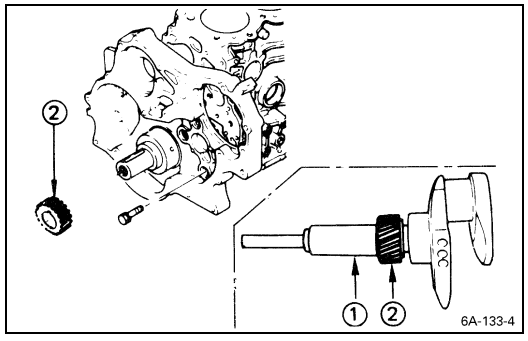
Thrust Plate Bolt Torque	kg·m (lb.ft/N·m)
1.8 ± 0.5 (13.0 ± 3.6/17.6 ± 4.9)	



3. Camshaft Timing Gear

1) Install the camshaft timing gear to the camshaft.
   The timing gear mark ("Y – Y" or "：") must be facing outward.
2) Tighten the timing gear to the specified torque.

Timing Gear Bolt Torque	kg·m (lb.ft/N·m)
11.0 ± 1 (79.6 ± 7.2/107.8 ± 9.8)	

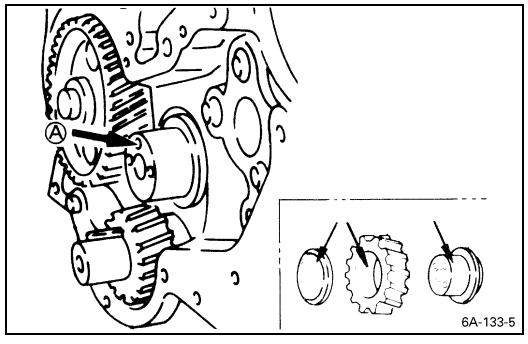


4. Crankshaft Timing Gear

Use the crankshaft timing gear installer ① to install the crankshaft timing gear ②.

The crankshaft timing gear setting mark ("X – X" or "・") must be facing outward.

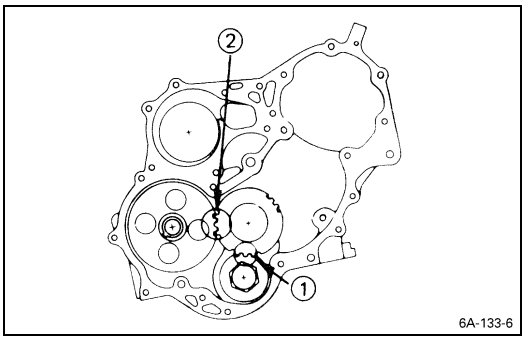
Crankshaft Timing Gear Installer: 9-8522-0020-0



5. Idler Gear Shaft

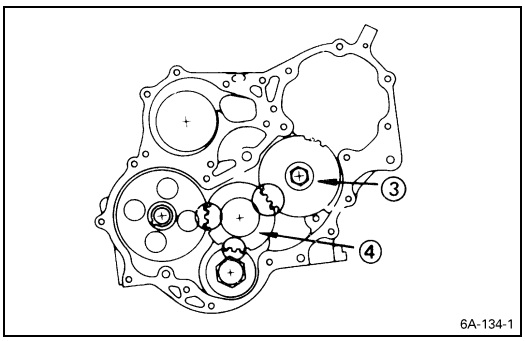
6. Idler Gear "A"

1) Apply engine oil to the idler gear and the idler gear shaft.
   The idler gear shaft oil hole Ⓐ must be facing up.
2) Position the idler gear setting marks "X" or "・", "Y" or "：" and "Z" or "∴" so that they are facing the front of the engine.



3) Align the idler gear “X” or “ : ” setting mark with the crankshaft timing gear ① “X – X” or “ : ” setting mark.
4) Align the idler gear “Y” or “ • ” setting mark with the camshaft timing gear ② “Y – Y” or “ • ” setting mark.
5) Install the thrust collar and bolts to the cylinder body through the shaft.
   The thrust collar oil hole must be facing up, and the thrust collar chamfered must be outward.
6) Tighten the idler gear bolt to the specified torque.

Idler Gear “A” Bolt Torque	kg·m (lb.ft/N·m)
	3.0 ± 0.5 (21.7 ± 3.6/30 ± 5.0)

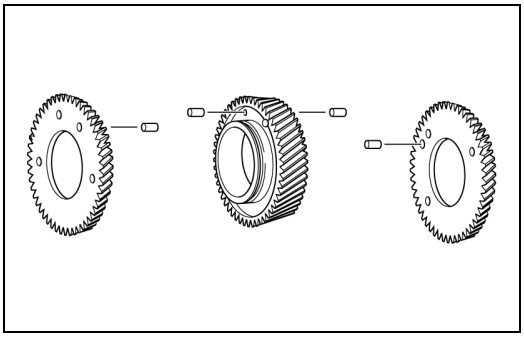


7. 7a. Idler Gear “B” and Shaft

1) Apply engine oil to the idler gear and the idler gear shaft.
2) Align the idler gear “B” ③ “Z” or “∴” setting mark with the idler gear “A” ④ “Z – Z” or “∴” setting mark.
3) Tighten the idler gear bolt to the specified torque.

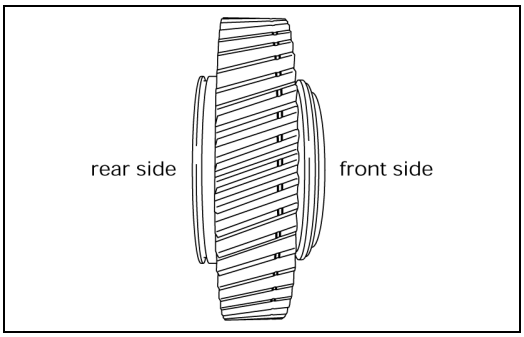
Idler Gear “B” Bolt Torque	kg·m (lb.ft/N·m)
	7.7 ± 1.0 (55.7 ± 7.2/74 ± 9.8)

7a. If the idle gear “B” is disassemble, reassemble in the following procedure.


020L200019

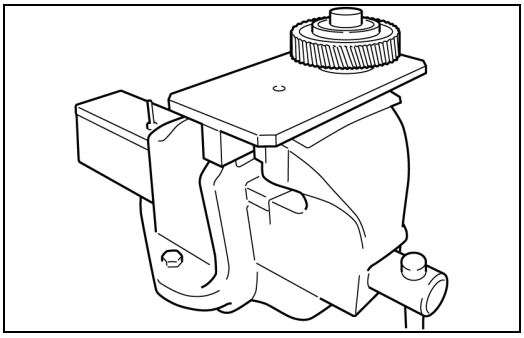
Idle Gear B (scissor gear) Reassembly Steps (4JA1TC, 4JH1TC only)

1) Drive pins into the main gear, the front gear, and the rear gear.



020L200007

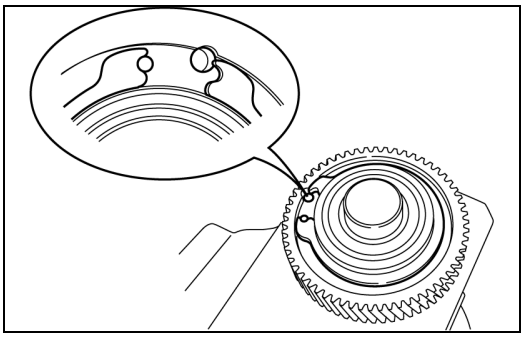
2) Apply pressure to the main gear bearing from the front side of the main gear (the side with the groove).



020L200008

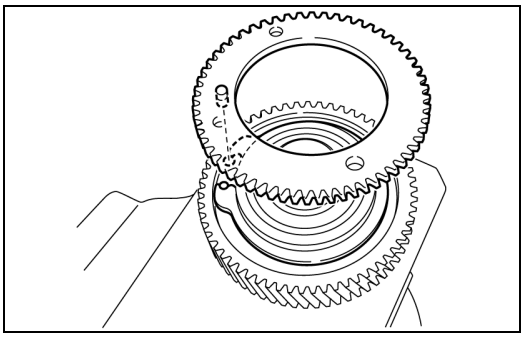
3) Place the special tool in a vise so that the main gear is pushed up toward the rear side.

Scissor gear setting tool
Base 5-8673-9149-0



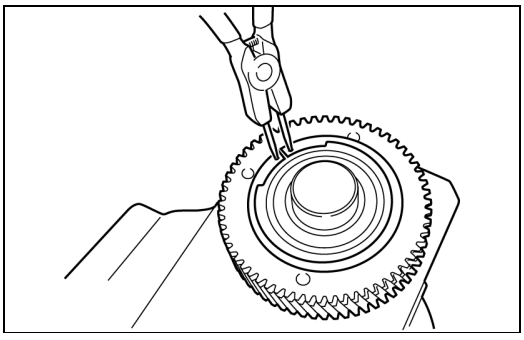
020L200009

4) Set the spring as shown in the illumination.



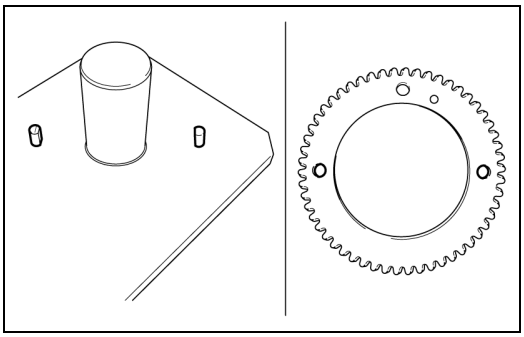
020L200010

5) Position the rear gear so that it pin is aligned with the receiving end of the spring.



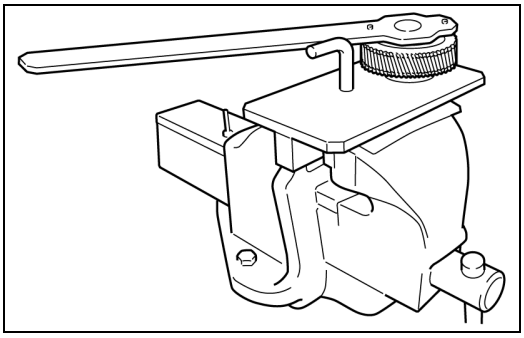
020L200011

6) Install the snap ring to the main gear groove.



020L200013

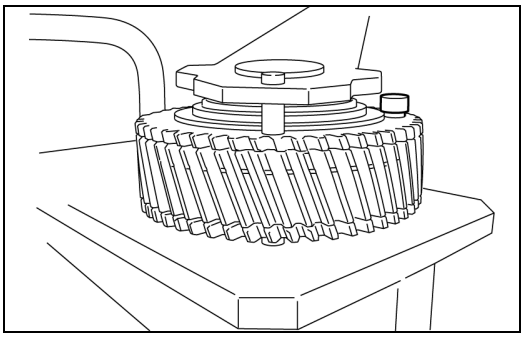
7) Set the rear gear setting hole to the pin of the special tool.
8) Place the special tool in a vise so that the main gear is pushed up toward the front side.
9) Repeat Steps 3, 4, and 5.



020L200014

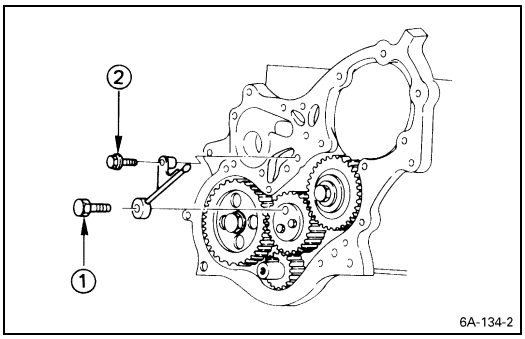
10) Use the special tool to mesh the teeth of the front gear, the main gear, and the rear gear.

Scissor gear setting tool
Lever 5-8673-9150-0



020L200012

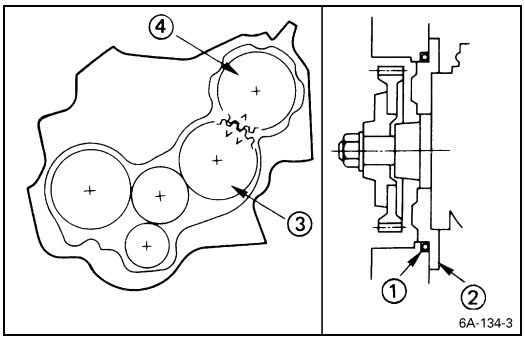
11) Insert a lock bolt (M6×1 L=30) into the scissor gear fixing hole to prevent the scissor gear from turning.



8. Timing Gear Oil Pipe (Except 4JA1TC, 4JH1TC)

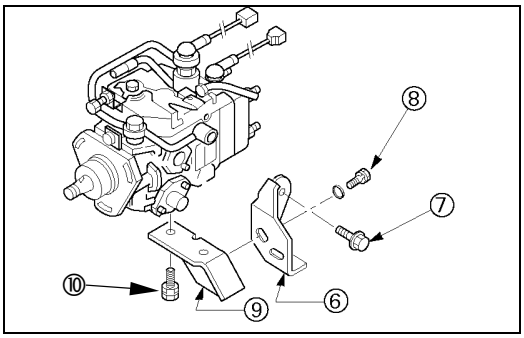
1) Install the oil pipe to the timing gear case and idler gear “A”.
2) Tighten the oil pipe eye bolt ① and bolt ② to the specified torque.

Eye Joint and Bolt Torque	kg·m (lb.ft/N·m)
	1.25 ± 0.25 (9.0 ± 1.8/12.3 ± 2.5)



9. Injection Pump

1) Install the O-ring ① to the injection pump flange ②.
2) Install the injection pump to the timing gear case.
   Align the idler gear “B” ③ “V – V” or “· ·” mark with the injection pump timing gear ④ “V” or “· ·” mark.

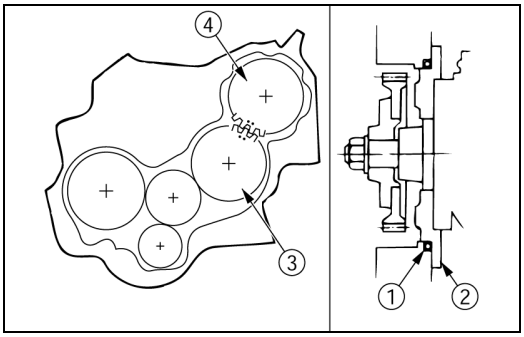


3) Install the injection pump rear bracket ⑥ and the rear bracket bolts ⑦ to the cylinder body.
4) Install the rear bracket bolts ⑧ to the injection pump bracket ⑨.

5) Tighten the injection pump bracket bolts to the specified torque.

Injection Pump Bracket Bolt Torque kg·m (lb.ft/N·m)

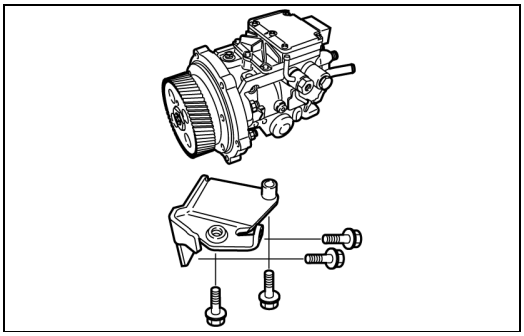
⑦, ⑧	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)
⑩	4.1 ± 0.6 (29.6 ± 4.3/40.2 ± 5.9)



020L200021

4JA1TC, 4JH1TC

1) Install the O-ring ① to the injection pump flange ②.
2) Install the injection pump to the timing gear case.
Align the idler gear "B" ③ "· ·" mark with the injection pump timing gear ④ "· ·" mark.

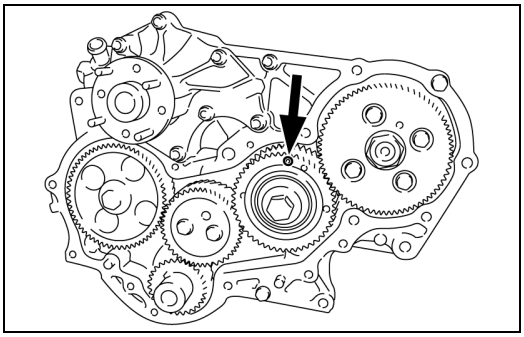


080L200006

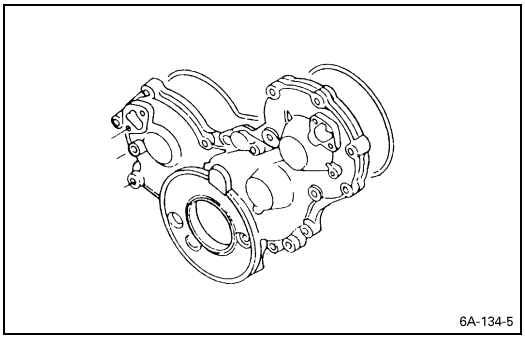
3) Install the injection pump bracket.
4) Tighten the injection pump bracket bolts to the specified torque.

Injection Pump Bracket Bolt Torque kg·m (lb.ft/N·m)

4.1 ± 0.6 (29.6 ± 4.3/40.2 ± 5.9)



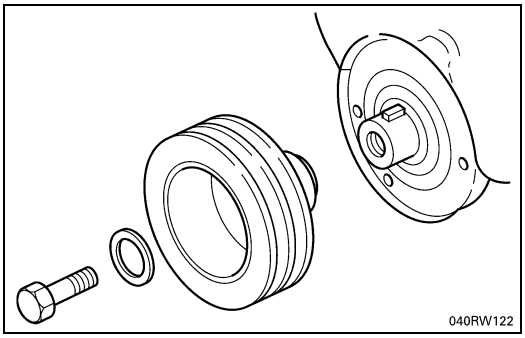
5) Remove the scissor gear set bolt.



10. Timing Gear Case Cover

6) Align the gear case with the timing gear case knock pin and then install the timing gear case cover.
7) Tighten the gear case cover bolts to the specified torque.

Gear Case cover Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	



13. Crankshaft Damper Pulley

Tighten the crankshaft damper pulley bolt to the specified torque.

Note:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley.

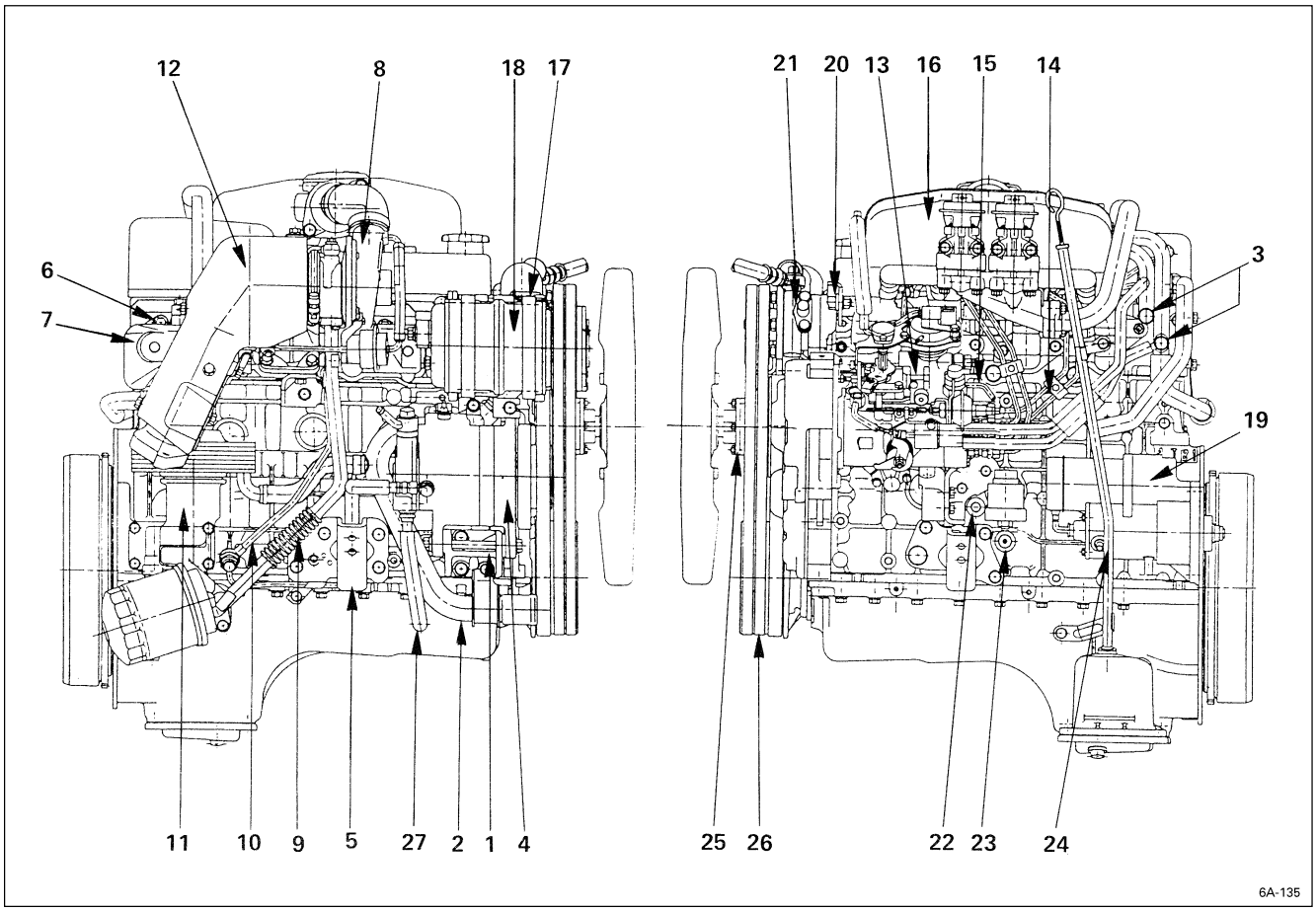
Crankshaft Damper Pulley Bolt Torque	kg·m (lb.ft/N·m)
21.0 ± 2.0 (151.9 ± 14.5/206.0 ± 19.6)	

Take care not to damage the crankshaft damper pulley boss.

INSTALLATION

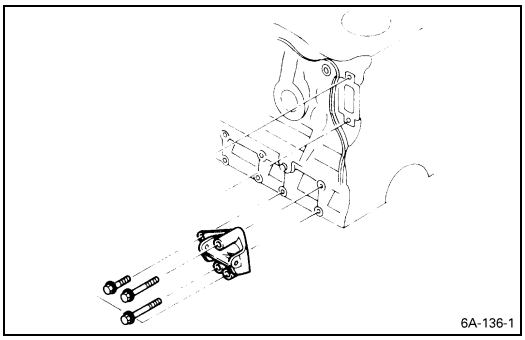
EXTERNAL PARTS

These installation steps are based on the 4JB1T engine.



Installation Steps

- ▲ 1. Generator bracket
- ▲ 2. Water inlet pipe
- ▲ 3. Heater pipe (Rear side)
- ▲ 4. Generator and adjusting plate
- ▲ 5. Engine mounting bracket
- ▲ 6. Exhaust manifold
- 7. Exhaust manifold heat protector
- ▲ 8. Turbocharger
- ▲ 9. Turbocharger oil return pipe
- ▲ 10. Turbocharger oil feed pipe
- ▲ 11. Oil cooler with Oil filter
- 12. Turbocharger heat protector
- 13. Injection pump
- ▲ 14. Fuel injection pipe with clip
- 15. Fuel leak off pipe
- ▲ 16. Intake manifold
- ▲ 17. Compressor bracket
- ▲ 18. Compressor
- ▲ 19. Starter motor
- ▲ 20. Power steering oil pump bracket
- ▲ 21. Power steering oil pump
- 22. Water drain cock
- 23. Oil pressure warning switch and nipple
- 24. Oil level gauge guide tube
- ▲ 25. Cooling fan pulley
- ▲ 26. Cooling fan drive belt
- 27. Vacuum pipe

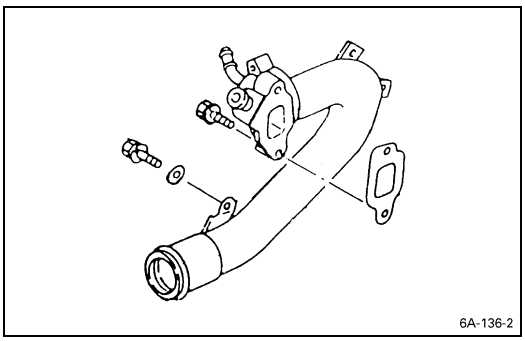


Important Operations

1. Generator Bracket

Install the generator bracket to the cylinder body and tighten the bracket bolts to the specified torque.

Bracket Bolt Torque	kg·m (lb.ft/N·m)
4.1 ± 0.6 (29.7 ± 4.3/40.2 ± 5.9)	



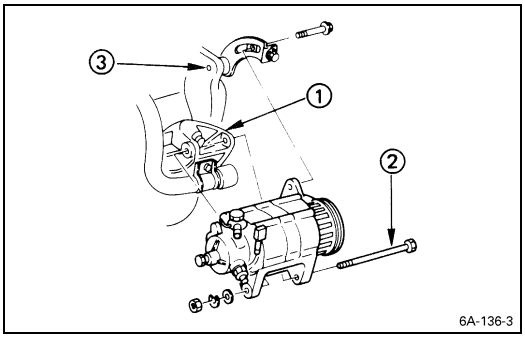
2. Water Inlet Pipe

1) Tighten the water inlet pipe bolts to the specified torque.

Suction Pipe Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	

3. Heater Pipe (Rear Side)

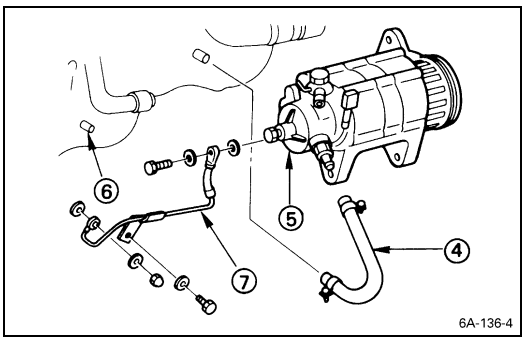
1) Install the heater pipe to the cylinder head.
2) Connect the oil cooler return hose and feed hose to the oil cooler.
3) Connect the water rubber hose to the heater pipe.



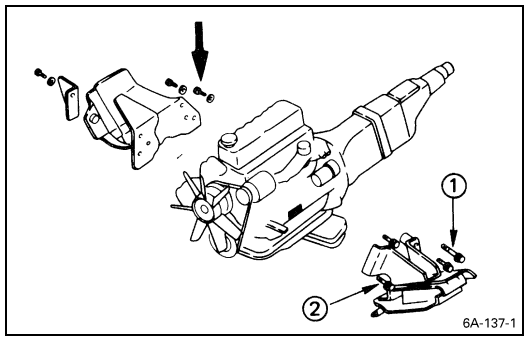
4. Generator and Adjusting Plate

1) Install the generator to the bracket ①.
2) Temporarily tighten the generator bolt ② and adjusting plate bolts ③.

   The bolts will be finally tightened after installation of the cooling fan drive belt.



3) Connect the vacuum pump rubber hose ④ to the vacuum pump ⑤, and the oil pan ⑥.
4) Connect the vacuum oil pipe ⑦ to the vacuum pump, and the cylinder body.

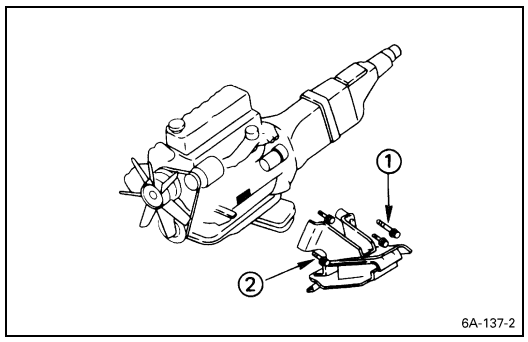


5. Engine Mounting Bracket

Install the engine mounting bracket to the cylinder body and tighten the bracket bolts to the specified torque.

Mounting Bracket Bolt Torque kg·m (lb.ft/N·m)

Right Side	M10 × 1.25 (9T)	5.6 (40.5/54.9)
Left Side	② M10 × 1.25 (7T)	4.1 (30/40)
	② M14 × 1.50 (7T)	12 (86.7/118)

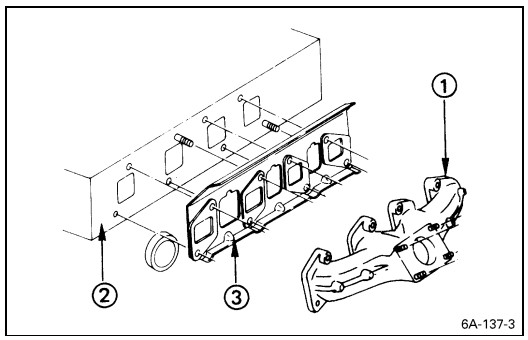


6. Exhaust Manifold

1) Install the exhaust manifold ① to the cylinder head ② with the manifold gasket ③.
2) Tighten the exhaust manifold bolts to the specified torque a little at a time.

Exhaust Manifold Bolt Torque kg·m (lb.ft/N·m)

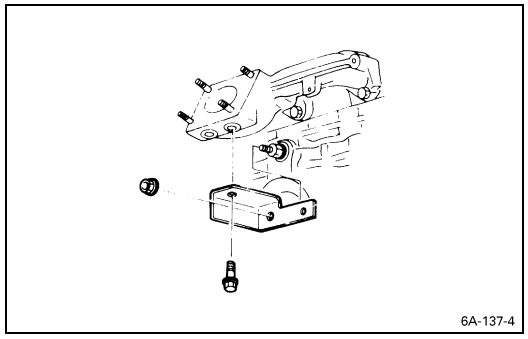
2.7 ± 0.5 (19.5 ± 3.6/26.5 ± 4.9)



3) Install the exhaust manifold bracket to the manifold and the cylinder body.

Manifold Bracket Bolt Torque kg·m (lb.ft/N·m)

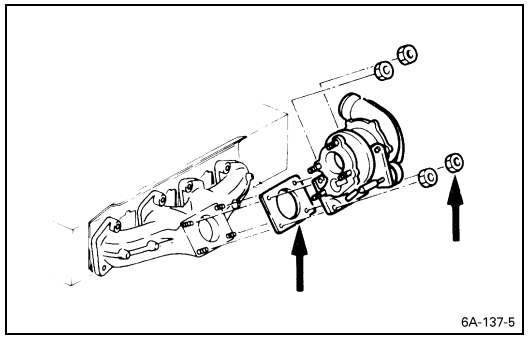
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)

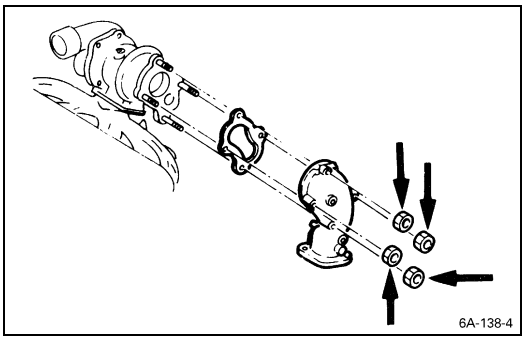


8. Turbocharger

1) Install the turbocharger and the gasket.
2) Temporarily tighten the turbocharger nuts at this time. They will be fully tightened after the installation of the turbocharger oil pipe.

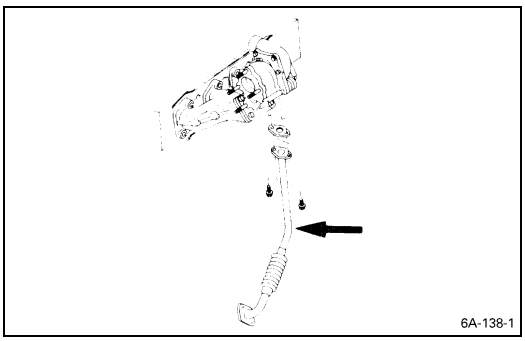
Always install new nuts and new gasket.





3) Install the exhaust adapter with gasket and tighten the adapter nut to the specified torque.

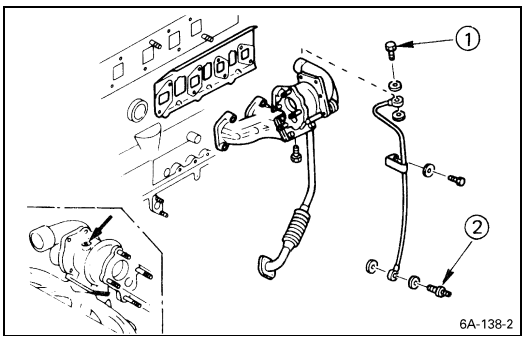
Adapter Nut Torque	kg·m (lb.ft/N·m)
2.7 ± 0.5 (19.5 ± 3.6/26.5 ± 4.9)	



9. Turbocharger Oil Return Pipe

1) Install the oil return pipe with gasket to the turbocharger.
2) Tighten the turbocharger oil return pipe to the specified torque.

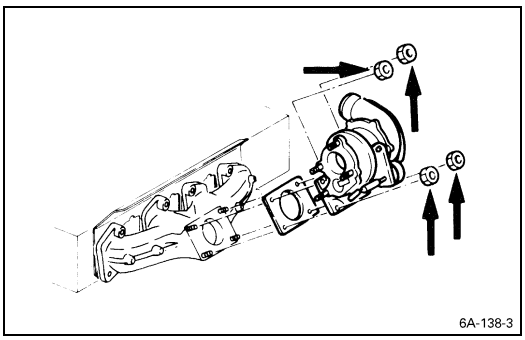
Turbocharger Oil Reutrn Pipe Torque	kg·m (lb.ft/N·m)
0.8 ± 0.2 (5.8 ± 1.4/7.8 ± 2.0)	



10. Turbocharger Oil Feed Pipe

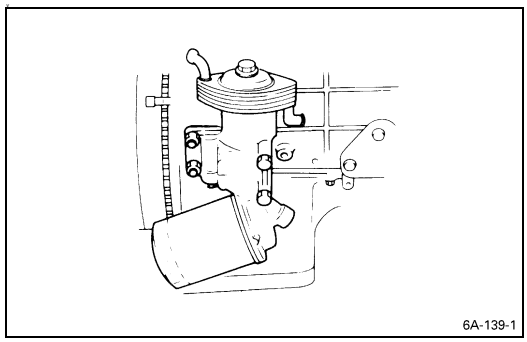
1) Before installing the oil feed pipe, supply 10 – 20 cc of clean engine oil to the turbocharger center housing through the oil feed opening.
2) Turn the rotating assembly with your hand to thoroughly lubricate the internal parts.
3) Tighten the oil feed pipe to the specified torque.

Turbocharger Oil Feed Pipe Joint Bolt Torque	kg·m (lb.ft/N·m)
①M10 × 1.5	2.25 ± 0.25 (16.3 ± 1.8/22.1 ± 2.5)
②M14 × 1.5	5.5 ± 0.25 (39.8 ± 1.8/53.9 ± 2.5)



4) Tighten the turbocharger nut to the specified torque.

Turbocharger Nut Torque	kg·m (lb.ft/N·m)
2.7 ± 0.5 (19.5 ± 3.6/26.5 ± 4.9)	

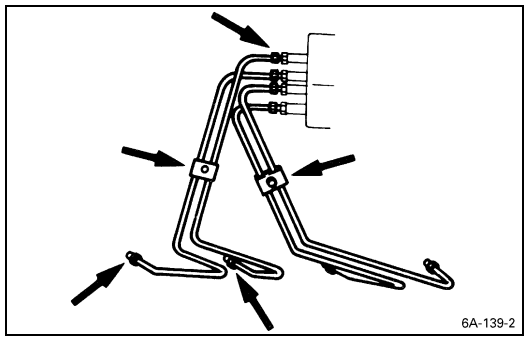


11. Oil Cooler with Oil Filter

1) Install the O-ring to the oil filter flange groove.
2) Tighten the oil filter and oil cooler to the specified torque.

Oil Filter Flange Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	

3) Lightly oil the O-ring of oil filter cartridge.
4) Turn in the new oil filter cartridge by hand until the sealing face is fitted again the O-ring.
5) Use the filter wrench to turn in the oil filter and additional one and 1·1/8 turns.
6) Start the engine and check for oil leakage from oil filter.



14. Fuel Injection Pipe with Clip

1) Temporarily tighten the injection pipe sleeve nut.
2) Set the clip in the illustrated position.

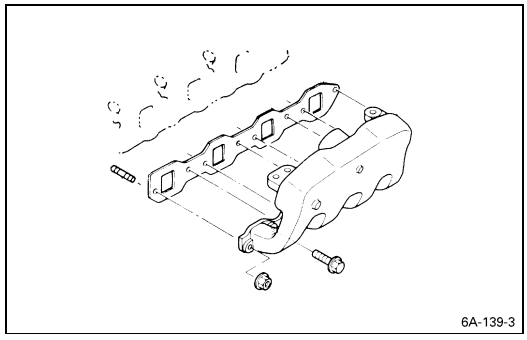
Note:

Make absolutely sure that the clip is correctly positioned.

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

3) Tighten the injection pipe sleeve nut to the specified torque.

Injection Pipe Sleeve Nut Torque	kg·m (lb.ft/N·m)
3 ± 1 (21.7 ± 7.2/29.4 ± 9.8)	



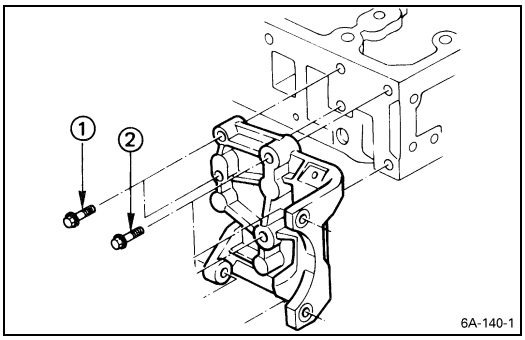
16. Intake Manifold

1) Install the manifold gasket to the intake manifold.
2) Connect the intake rubber hose to the intake duct.
3) Tighten the intake manifold bolts and the flange nuts to the specified torque.

Intake Manifold Bolt Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	

Intake Manifold Flange Nut Torque	kg·m (lb.ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)	

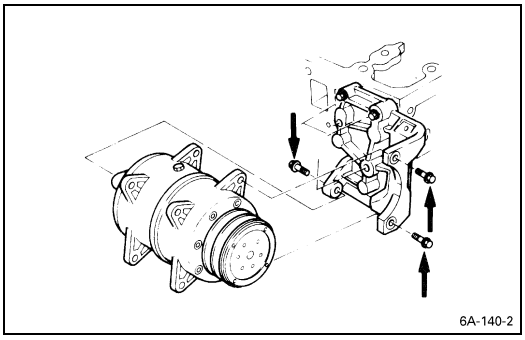
4) Connect the PCV hose to the cylinder head cover.



17. Compressor Bracket

1) Install the compressor bracket to the cylinder head.
2) Tighten the bracket bolts to the specified torque.

Bracket Bolt Torque	kg·m (lb.ft/N·m)
①M 8 × 1.25	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)
②M10 × 1.25	4.1 ± 0.6 (30 ± 7.2/40 ± 6)



18. Compressor

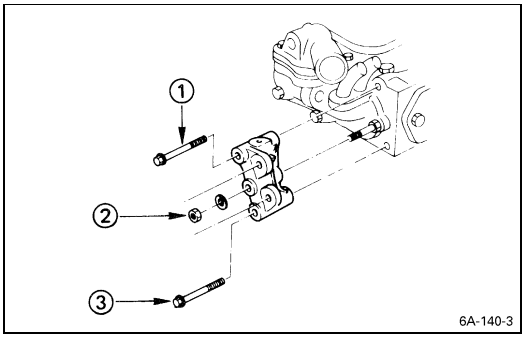
1) Install the compressor to the compressor bracket.
2) Tighten the compressor bolts to the specified torque.

Compressor Bolt Torque	kg·m (lb.ft/N·m)
3.8 ± 1.0 (27.5 ± 7.2/37.2 ± 9.8)	

19. Starter Motor

Tighten the starter motor bolts to the specified torque.

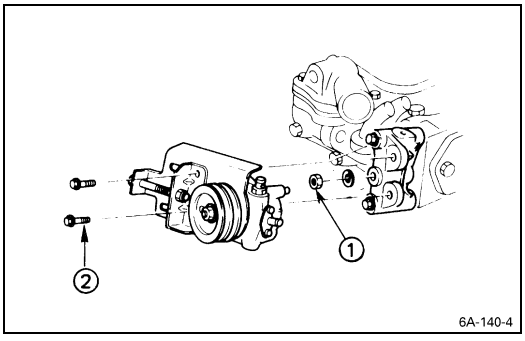
Starter Motor Bolt Torque	kg·m (lb.ft/N·m)
7.0 ± 1.0 (50.6 ± 7.2/68.6 ± 9.8)	



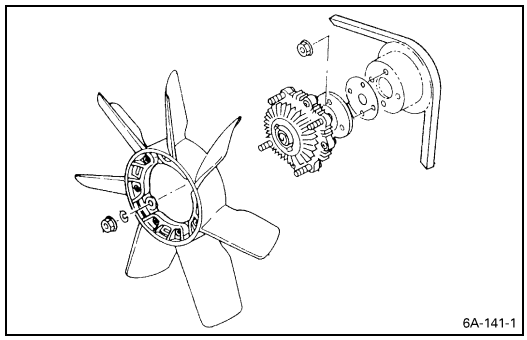
20. Power Steering Oil Pump Bracket
21. Power Steering Oil Pump

1) Install the oil pump bracket to the cylinder head.
2) Tighten the pump bracket nut and bolts to the specified torque.

Oil Pump Bracket Nut and Bolt Torque	kg·m (lb.ft/N·m)
①M10 × 1.25 (7T)	3.75 ± 0.95 (27.1 ± 6.9/36.75 ± 9.31)
②M 8 × 1.25 (7T)	1.75 ± 0.55 (12.7 ± 4.0/17.75 ± 5.39)
③M 8 × 1.25 (4T)	1.30 ± 0.50 (9.4 ± 3.6/12.74 ± 4.90)



3) Install the oil pump to the bracket.
4) Temporarily tighten the oil pump nut ① and bolts ②.
   The nut and bolts will be finally tightened after installation of the drive belt.



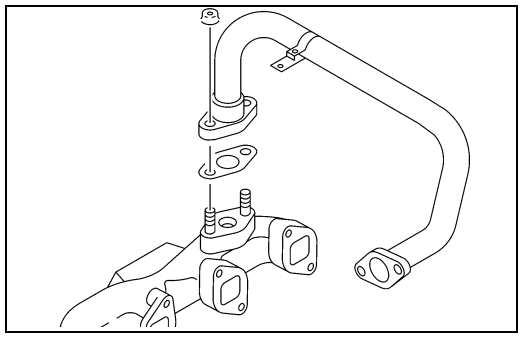
25. Cooling Fan Pulley

1) Install the cooling fan pulley to the water pump with spacer.
2) Tighten the cooling fan pulley bolts to the specified torque.

Cooling Fan Pulley Bolt Torque	kg·m (lb.ft/N·m)
	0.8 ± 0.2 (5.8 ± 1.4/7.8 ± 2.0)

26. Cooling Fan Drive Belt

Install the fan drive belt and adjust the belt tension referring **SERVICING** of this section.



EGR Pipe (If equipped)

Install EGR pipe and tighten fixing bolt and nuts to the specified torque.

Bolt	kg·m (lb.ft/N·m)
	2.7 ± 0.5 (19.5 ± 3.6/26.5 ± 4.9)

Nuts	kg·m (lb.ft/N·m)
	2.4 ± 0.5 (17.4 ± 3.6/23.5 ± 4.9)

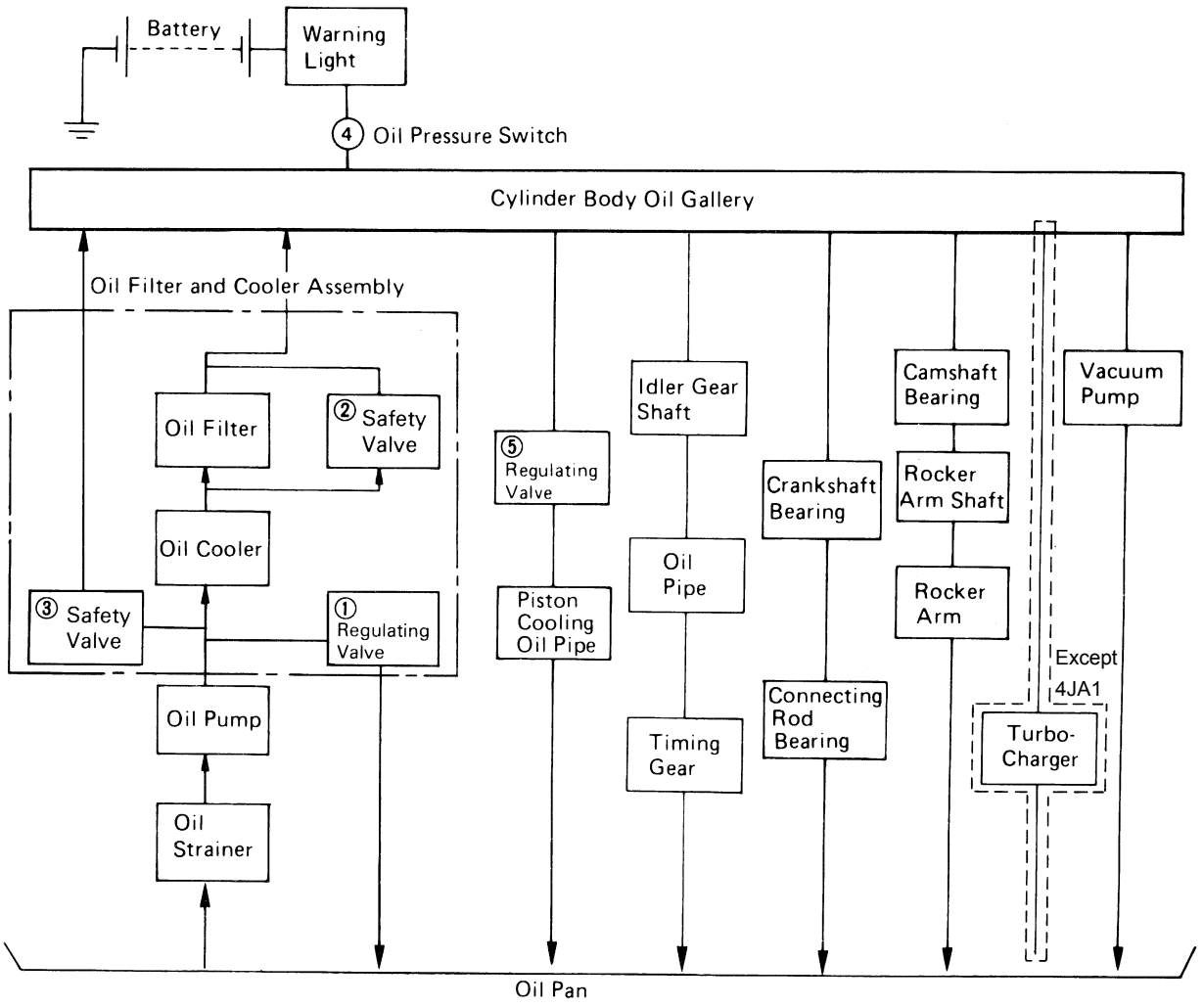
LUBRICATING SYSTEM

MAIN DATA AND SPECIFICATIONS

Engine Model		4JA1, 4JA1T	4JB1T, 4JG2T, 4JA1TC, 4JH1TC
Oil pump type		Gear	
Oil pressure switch operating pressure	kg/cm^2 (psi/kPa)	0.2 – 0.5 (2.8 – 7.1/19.6 – 49.0)	
Oil filter type		Full flow with cartridge paper element	
Relief valve opening pressure	kg/cm^2 (psi/kPa)	4.3 – 4.7 (61.1 – 66.8/421.4 – 460.6)	5.7 – 6.3 (82.5 – 89.5/558.6 – 617.4)
Safety valve opening pressure	kg/cm^2 (psi/kPa)	0.8 – 1.2 (11.38 – 17.07/78.9 – 117.6)	
Oil cooler type		Water-cooled	
Safety valve opening pressure	kg/cm^2 (psi/kPa)	2.3 – 2.7 (32.7 – 38.4/225.4 – 264.6)	

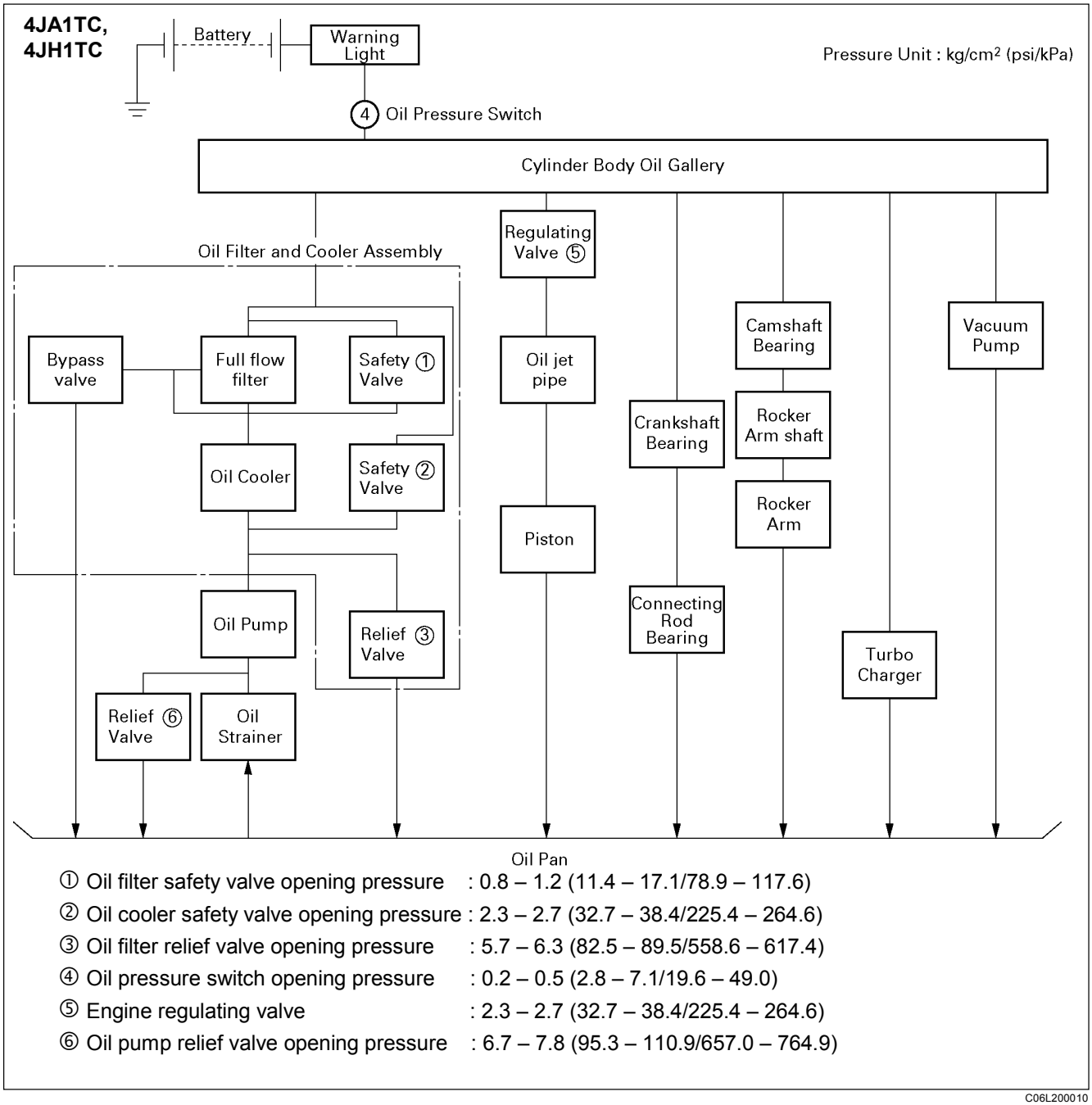
GENERAL DESCRIPTION

LUBRICATING OIL FLOW



① Oil filter regulating valve opening pressure : 5.7 – 6.3 (82.5 – 89.5/558.6 – 617.4)
② Oil filter safety valve opening pressure : 0.8 – 1.2 (11.38 – 17.07/78.9 – 117.6)
③ Oil cooler safety valve opening pressure : 2.3 – 2.7 (32.7 – 38.4/225.4 – 264.6)
④ Oil pressure switch opening pressure : 0.2 –0.5 (2.8 – 7.1/19.6 – 49.0)
⑤ Engine regulating valve : 2.3 – 2.7 (32.7 – 38.4/225.4 – 264.6)

6A-143



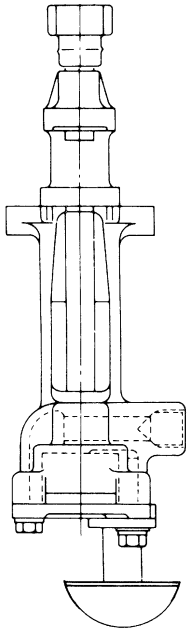
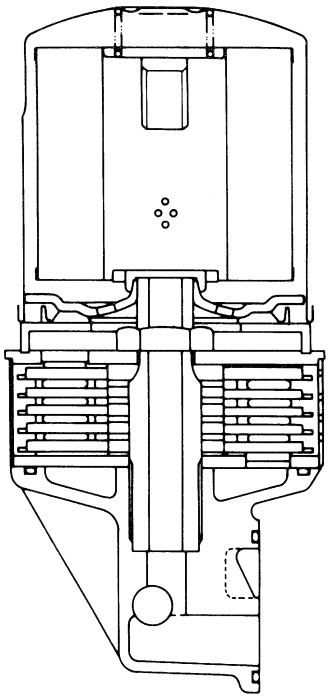
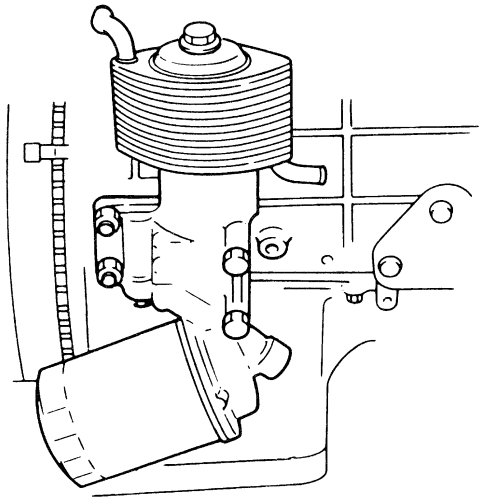
C06L200010

The 4J series engine has a full flow type lubricating system.

Lubricating oil is pumped from the oil pump to the cylinder body oil gallery through the oil cooler and the oil filter. It is then delivered to the vital parts of the engine from the cylinder body oil gallery.

Oiling jets installed on the cylinder body spray engine oil to the piston backside faces to achieve maximum piston cooling effect.

OIL PUMP AND OIL FILTER

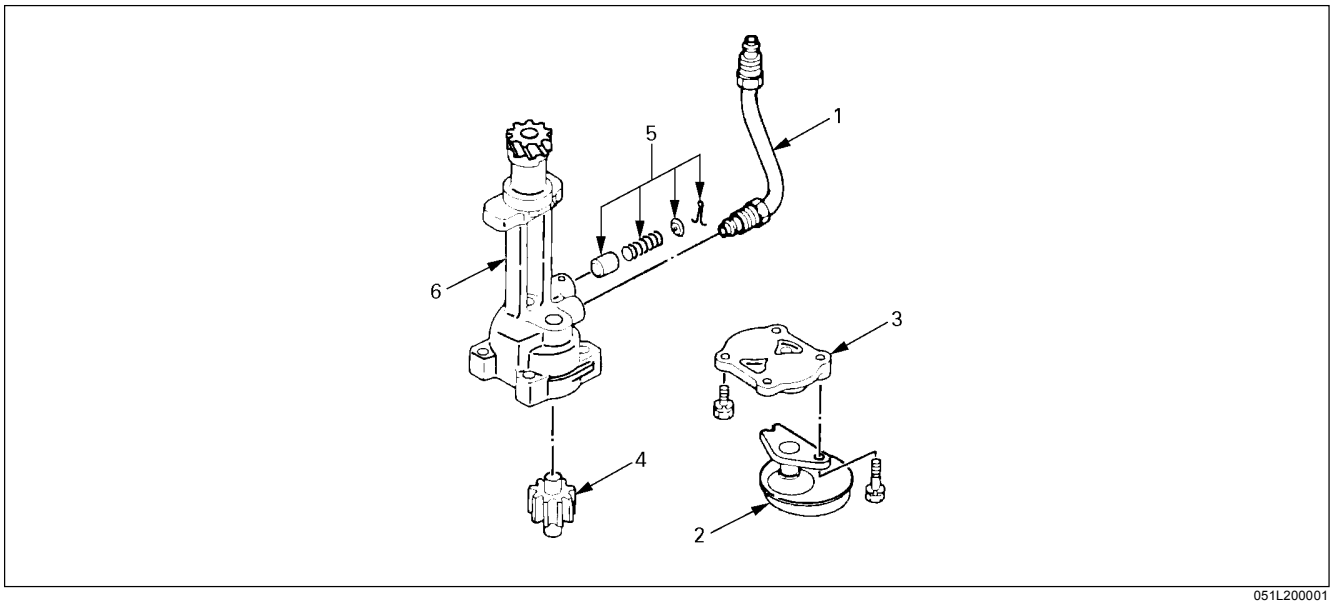
OIL PUMP	OIL FILTER AND OIL COOLER	
	For 4JA1	Except 4JA1
		

6A-144

The 4J series engine is equipped with a gear type oil pump.
The oil filter and the water cooled oil cooler integrated a single unit to increase the cooling effect.

OIL PUMP

DISASSEMBLY



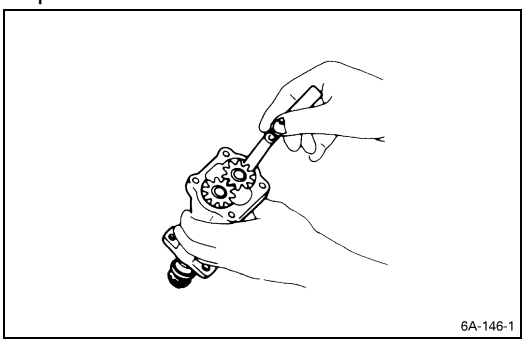
051L200001

Disassembly Steps

1. Oil pipe
2. Strainer
3. Pump cover
4. Driven gear with bush
5. Relief valve asm.
6. Oil pump body

INSPECTION AND REPAIR

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


6A-146-1

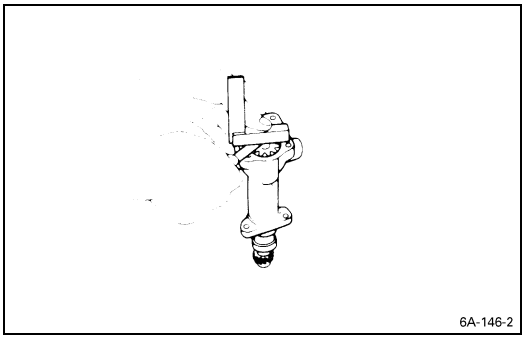
Gear Teeth and Body Inner Wall Clearance

Use a feeler gauge to measure the clearance between the gear teeth and the body inner wall.

If the clearance between the gear teeth and the body inner wall exceeds the specified limit, either the gear or the body must be replaced.

Gear Teeth and Body Inner Wall Clearance mm (in)

Standard	Limit
0.14 (0.0055)	0.20 (0.0079)


6A-146-2

Gear and Body Clearance

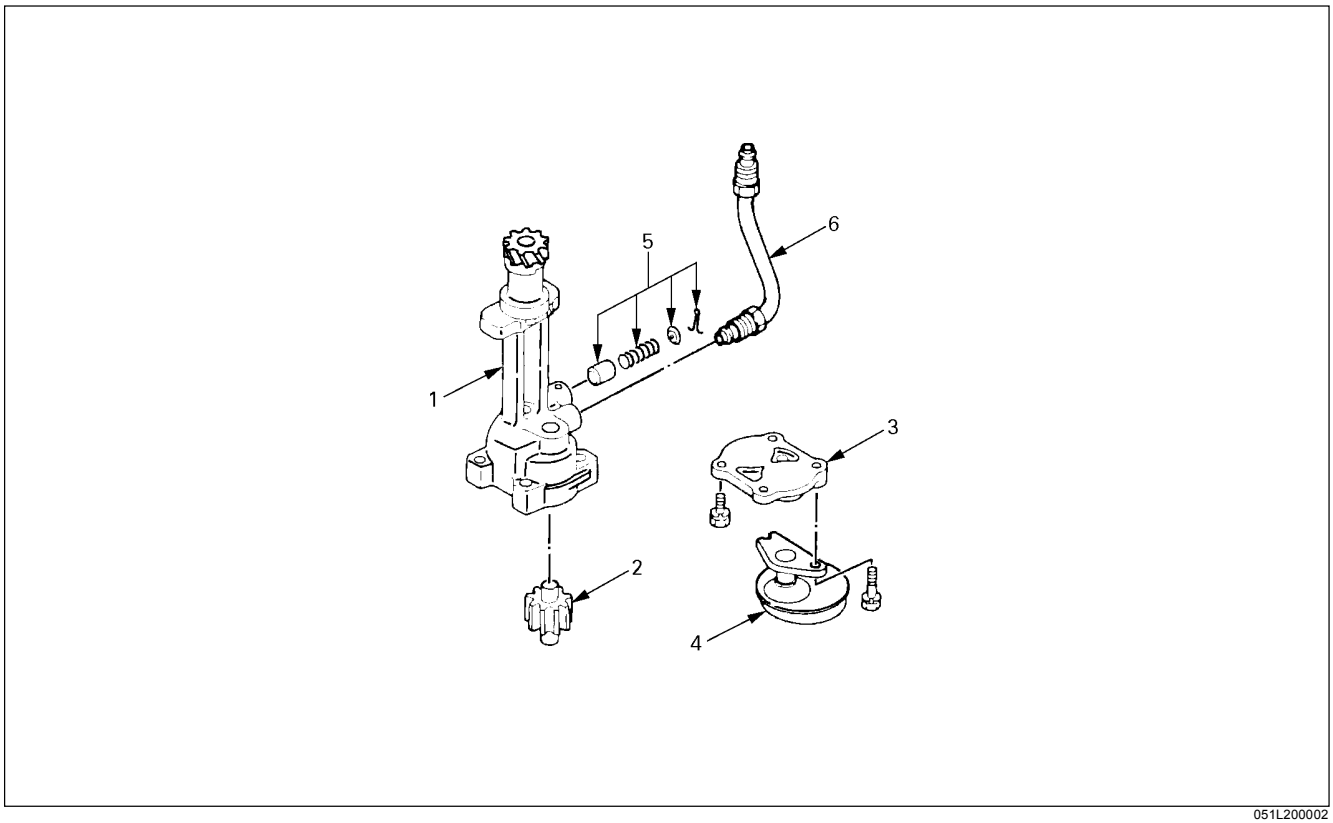
Use a feeler gauge to measure the clearance between the body and the gear.

If the clearance between the gear and the body exceeds the specified limit, the body must be replaced.

Gear and Body Clearance mm (in)

Standard	Limit
0.06 (0.024)	0.15 (0.0059)

REASSEMBLY



051L200002

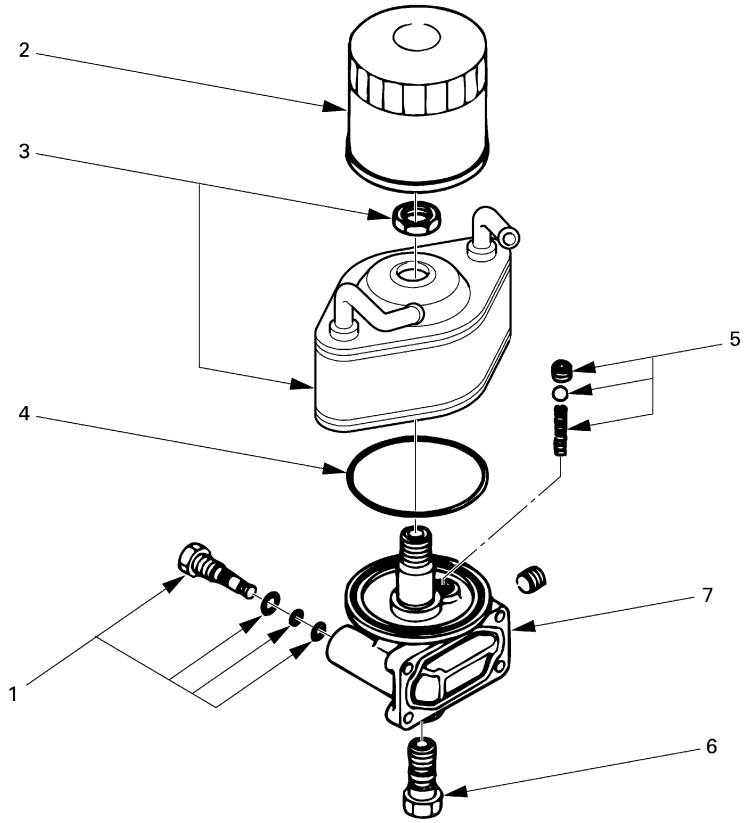
Reassembly Steps

1. Oil pump body
2. Driven gear with bush
3. Pump cover
4. Strainer
5. Relief valve asm.
6. Oil pipe

OIL FILTER AND OIL COOLER

DISASSEMBLY

For 4JA1

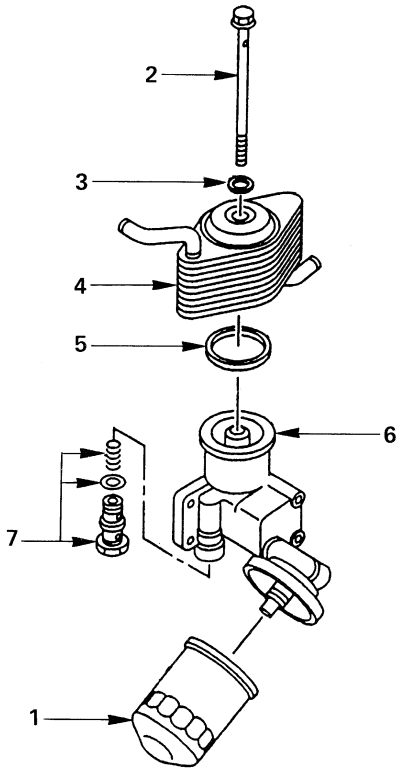


Disassembly Steps

1. Drain plug
2. Cartridge oil filter
3. Oil cooler
4. O-ring
5. Safety valve
6. Relief valve
7. Oil filter body

DISASSEMBLY

Except 4JA1

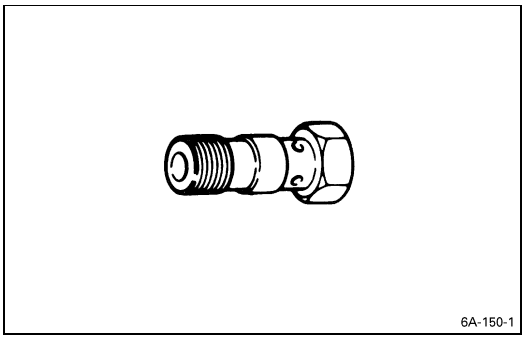


Disassembly Steps

1. Oil filter cartridge
2. Bolt
3. Gasket
4. Oil cooler
5. Gasket
6. Body
7. Relief valve

INSPECTION AND REPAIR

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

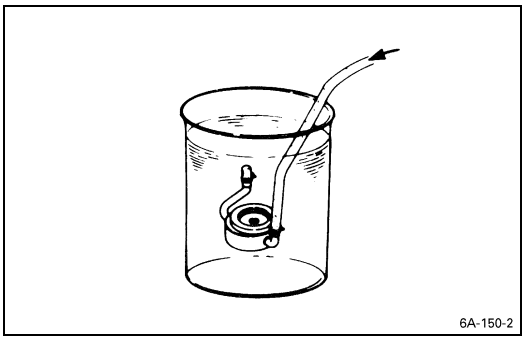


Relief Valve

1. Attach an oil pressure gauge to the oil gallery near the oil filter.
2. Start the engine to check the relief valve opening pressure.

Relief Valve Opening Pressure kg/cm^2 (psi/kPa)

4JA1, 4JA1T	4.3 – 4.7 (61.1 – 66.8/421.4 – 460.6)
4JB1T, 4JG2T, 4JA1TC, 4JH1TC	5.7 – 6.3 (82.5 – 89.5/558.6 – 617.4)



Oil Cooler

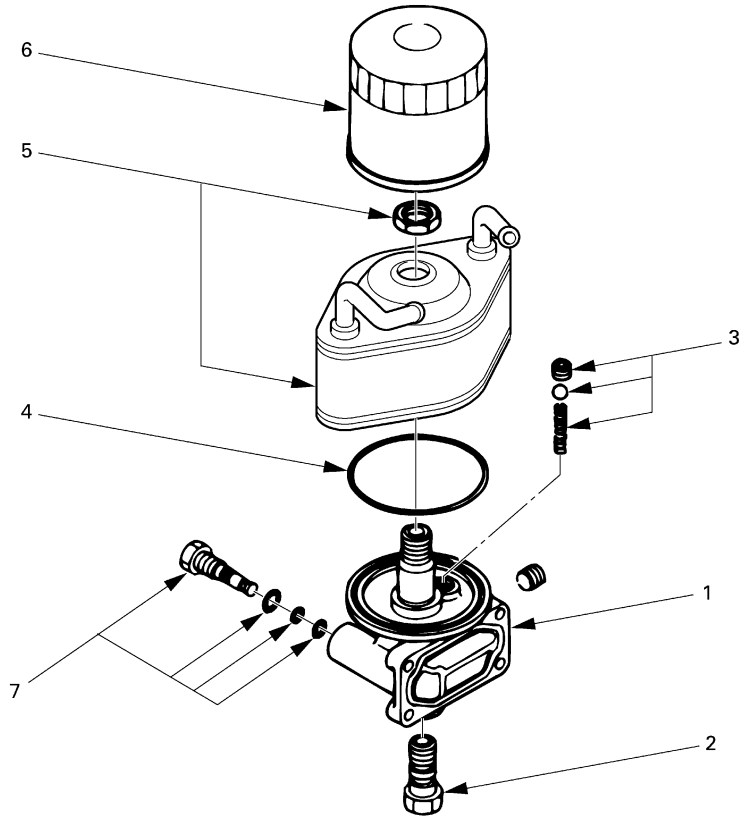
Water Leakage at Water Passage

1. Plug one side of the oil cooler water passage.
2. Submerge the oil cooler in water.
3. Apply compressed air (2 kg/cm^2 (28 psi/200 kPa)) to the other side of the oil cooler water passage.

If air bubbles rise to the surface, there is water leakage.

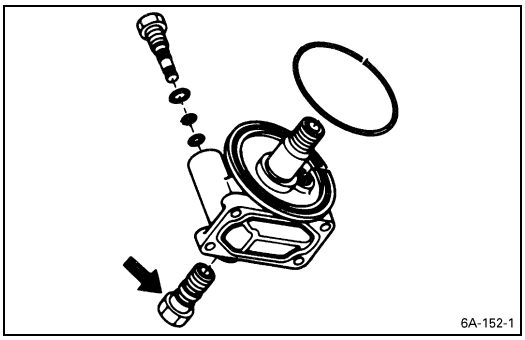
REASSEMBLY

For 4JA1



Reassembly Steps

1. Oil filter body
▲ 2. Relief valve
3. Safety valve
4. O-ring
▲ 5. Oil cooler
▲ 6. Oil filter cartridge
▲ 7. Drain plug

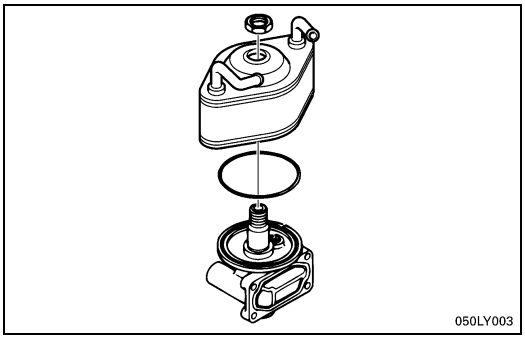


Important Operations

2. Relief Valve

Tighten the relief valve to the specified torque.

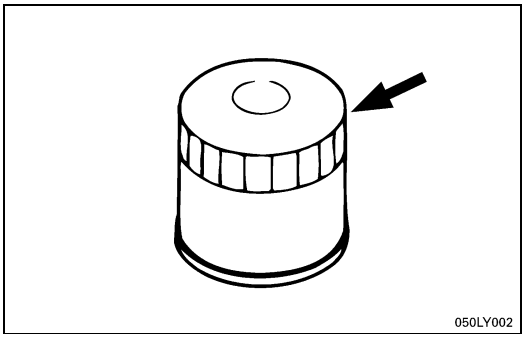
Relief Valve Torque	kg·m (lb.ft/N·m)
	3.0 ± 0.5 (21.7 ± 3.6/29.4 ± 4.9)



5. Oil Cooler

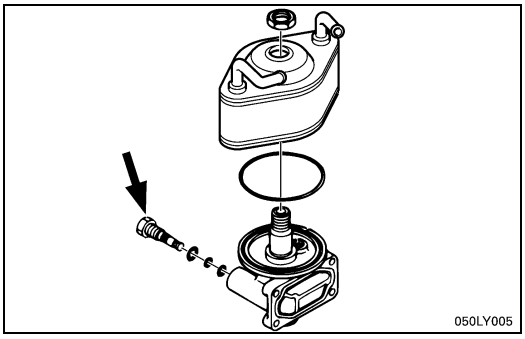
1) Align the oil filter holes with the body knock pins at installation.
2) Tighten the oil cooler nut to the specified torque.

Oil Cooler Nut Torque	kg·m (lb.ft/N·m)
	3.0 ± 0.5 (21.7 ± 3.6/29.4 ± 4.9)



6. Oil Filter Cartridge

1) Apply engine oil to the O-ring.
2) Turn in the cartridge oil filter until the filter sealing face makes contact with the O-ring.
3) Turn in the cartridge oil filter an additional one and 1/8 of a turn.



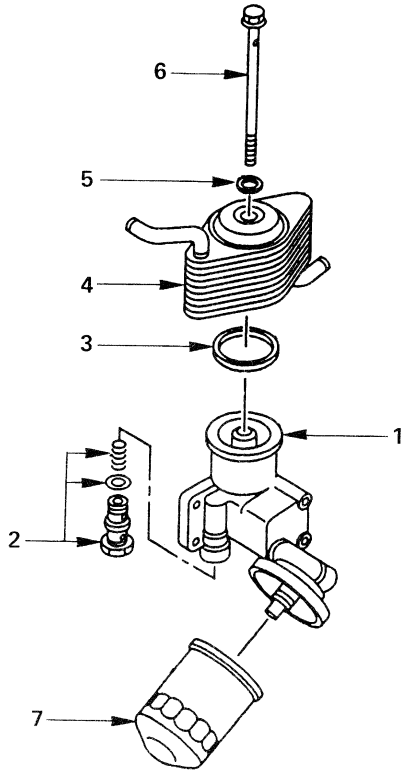
7. Drain Plug

Tighten the drain plug to the specified torque.

Drain Plug Torque	kg·m (lb.ft/N·m)
	2.5 ± 0.5 (18.1 ± 3.6/24.5 ± 4.9)

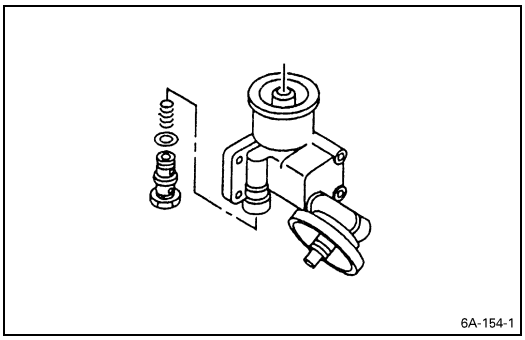
REASSEMBLY

Except 4JA1



Reassembly Steps

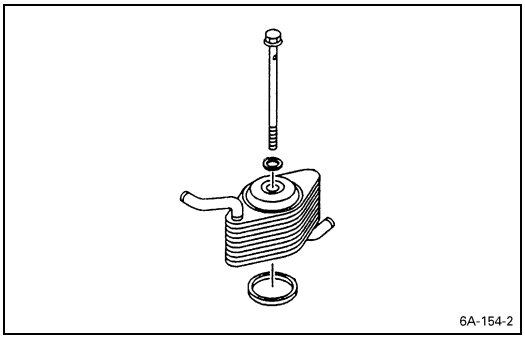
1. Body
▲ 2. Relief valve
3. Gasket
▲ 4. Oil cooler
5. Gasket
▲ 6. Bolt
▲ 7. Oil filter cartridge



2. Relief Valve

Tighten the safety valve to the specified torque.

Safety Valve Torque	kg·m (lb.ft/N·m)
0.3 ± 00.5 (4.3 ± 0.7/29.4 ± 4.9)	

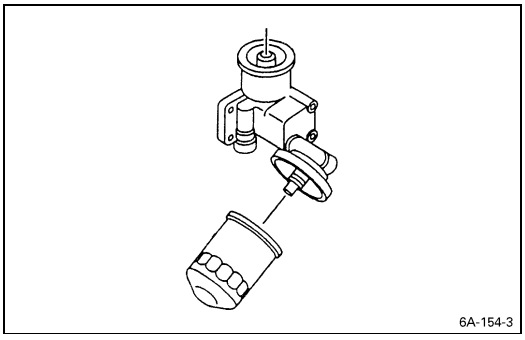


4. Oil Cooler

6. Bolt

Tighten Bolt with gaskets and oil cooler to the specified torque.

Bolt Torque	kg·m (lb.ft/N·m)
3.0 ± 0.5 (21.7 ± 3.6/29.4 ± 4.9)	



7. Oil Filter Cartridge

1) Lightly oil the O-ring of oil filter cartridge.
2) Turn in the new oil filter cartridge by hand until the sealing face is fitted again the O-ring.
3) Use the filter wrench to turn in the oil filter and additional one and 1·1/8 turns.
4) Start the engine and check for oil leakage from oil filter.

SPECIAL TOOLS

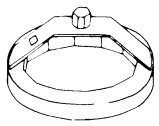
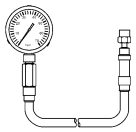
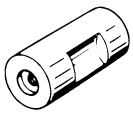
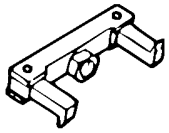
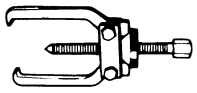
Illustration	Tool Number	Tool Name
 6A-155-1	5-8840-0200-0 (4JG2T, 4JB1T, 4JA1T, 4JA1TC, 4JH1TC) 5-8840-0201-0 (4JA1)	Filter Wrench
 6A-155-2	5-8840-0253-0 (J-22700)	Filter Wrench
 6A-155-3	5-8840-0145-0 (J-28827)	Static Timing Gauge
 901LX057	5-8840-2675-0	Compression Gauge
 6A-155-5	5-8531-7001-0	Adapter; Compression Gauge
 6A-155-6	5-8840-2034-0	Nozzle Holder Remover
 6A-155-7	5-8840-0019-0 (J-23907)	Sliding Hammer
	5-8840-0161-0	Fixing Wrench
	5-8840-0086-0	Timing Pulley Puller
 6A-155-8	5-8521-0002-0	Universal Puller
 6A-155-9	5-8840-2362-0	Oil Seal Remover

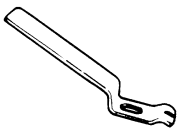
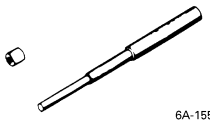
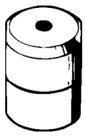
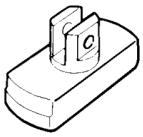
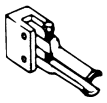
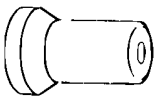
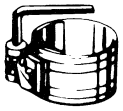
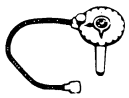
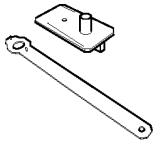
Illustration	Tool Number	Tool Name
 6A-155-10	9-8523-1423-0 (J-29760)	Spring Compressor
 6A-155-11	9-8523-1212-0	Valve Guide Replacer
	5-8840-2039-0	Cylinder Liner Remover
	5-8840-2304-0 (4JG2T, 4JH1TC)	
 6A-156-1	5-8840-2040-0 5-8840-2313-0 (4JG2T, 4JH1TC)	Cylinder Liner Installer
 6A-156-2	5-8840-2038-0	Bearing Replacer; Camshaft
 6A-156-3	5-8840-2000-0	Pilot Bearing Remover
 6A-156-4	5-8522-0024-0	Pilot Bearing Installer
	5-8840-2361-0	Front Oil Seal Installer
 6A-156-5	5-8840-2033-0	Oil Seal Installer
 6A-156-6	5-8840-9018-0 (J-8037)	Piston Ring Compressor

Illustration	Tool Number	Tool Name
 6A-156-7	5-8840-2359-0	Oil Seal Installer
 6A-156-8	9-8522-0020-0	Crankshaft Timing Gear Installer
 6A-156-9	5-8840-0266-0	Angle Gauge
	Base 5-8673-9149-0 Lever 5-8673-9150-0	Scissor gear setting tool

SECTION 6B
ENGINE COOLING

TABLE OF CONTENTS

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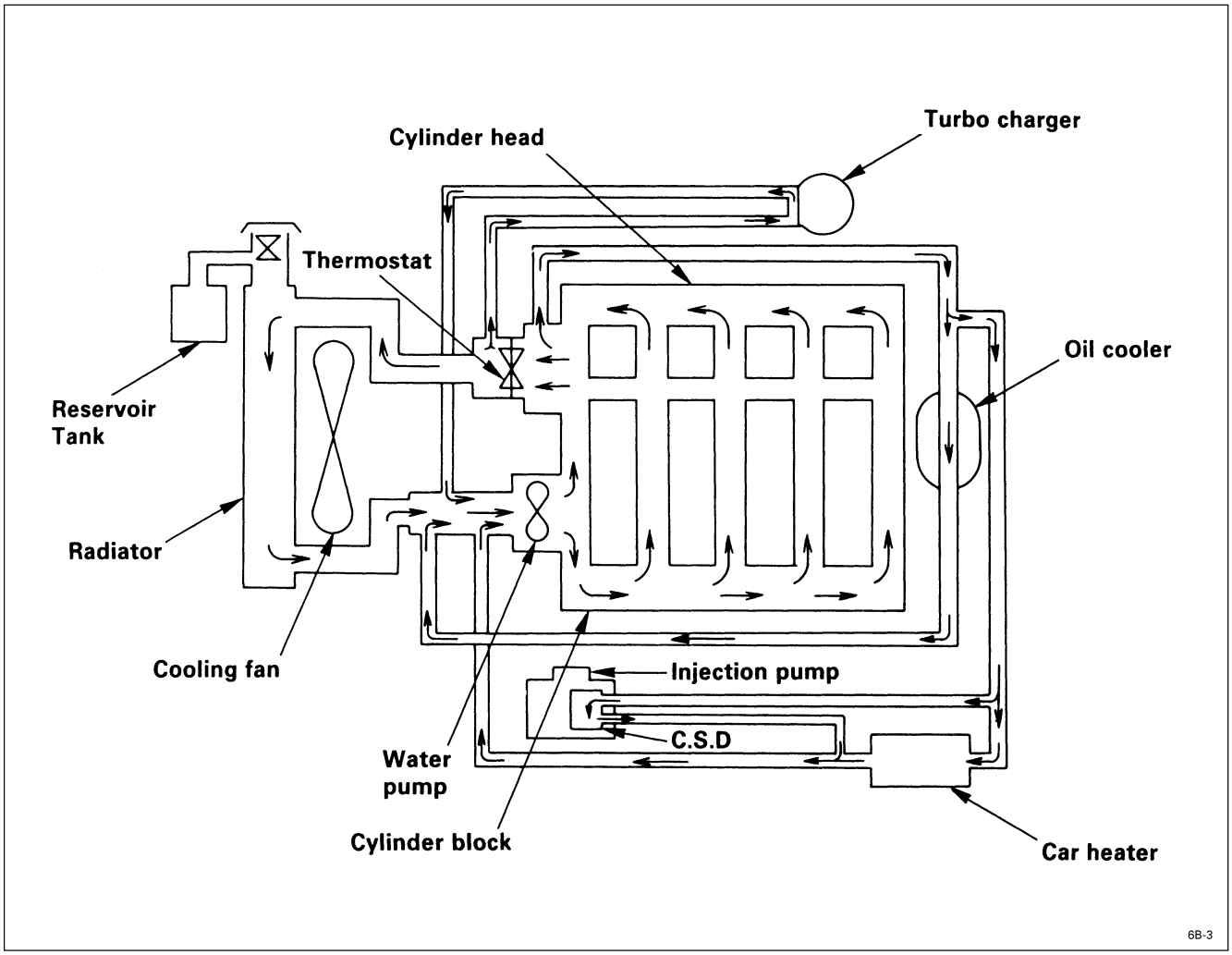
Main Data and Specifications ..... 6B - 2
General Description ..... 6B - 3
Water Pump ..... 6B - 7
  Removal and Installation ..... 6B - 7
Thermostat ..... 6B - 9
  Removal and Installation ..... 6B - 9
  Inspection and Repair ..... 6B - 10
Fan Clutch with Cooling Fan ..... 6B - 11
  Inspection and Repair ..... 6B - 11

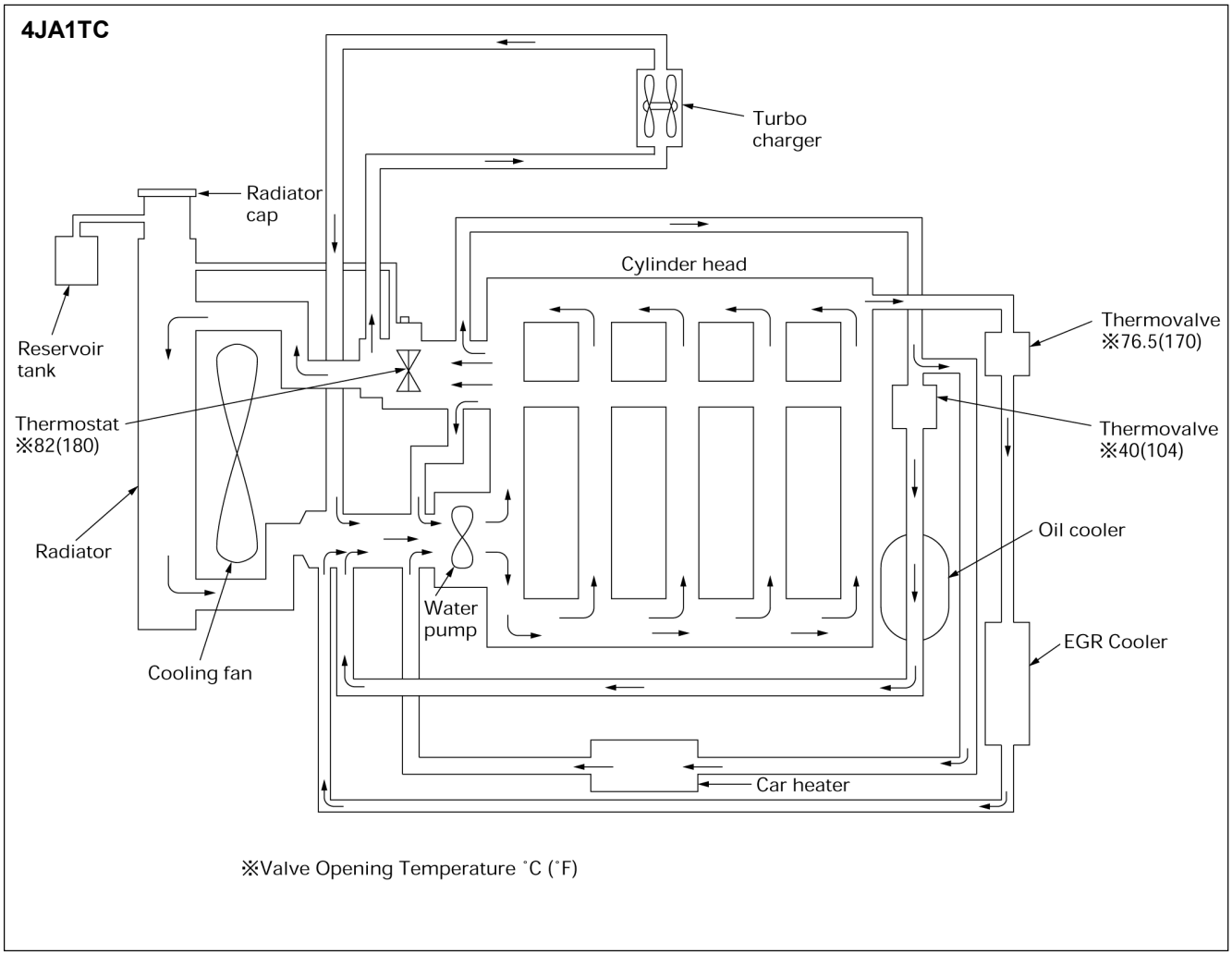
MAIN DATA AND SPECIFICATIONS

Item		Description
Water pump type		Centrifugal
Pump to crankshaft speed ratio	(To 1)	1.1
Delivery volume	lit (US/UK gal)/min	100 (26.3/22.2)
Pump speed at 3000 rpm		
Water temperature at 30°C (86°F)		
Pump bearing type		Double row shaft
Thermostat type		Wax pellet with jiggle valve
Valve initial opening temperature	°C (°F)	82 (180)
Valve full opening temperature	°C (°F)	95 (203)
Valve lift at fully open position	mm (in)	9.5 (0.37)

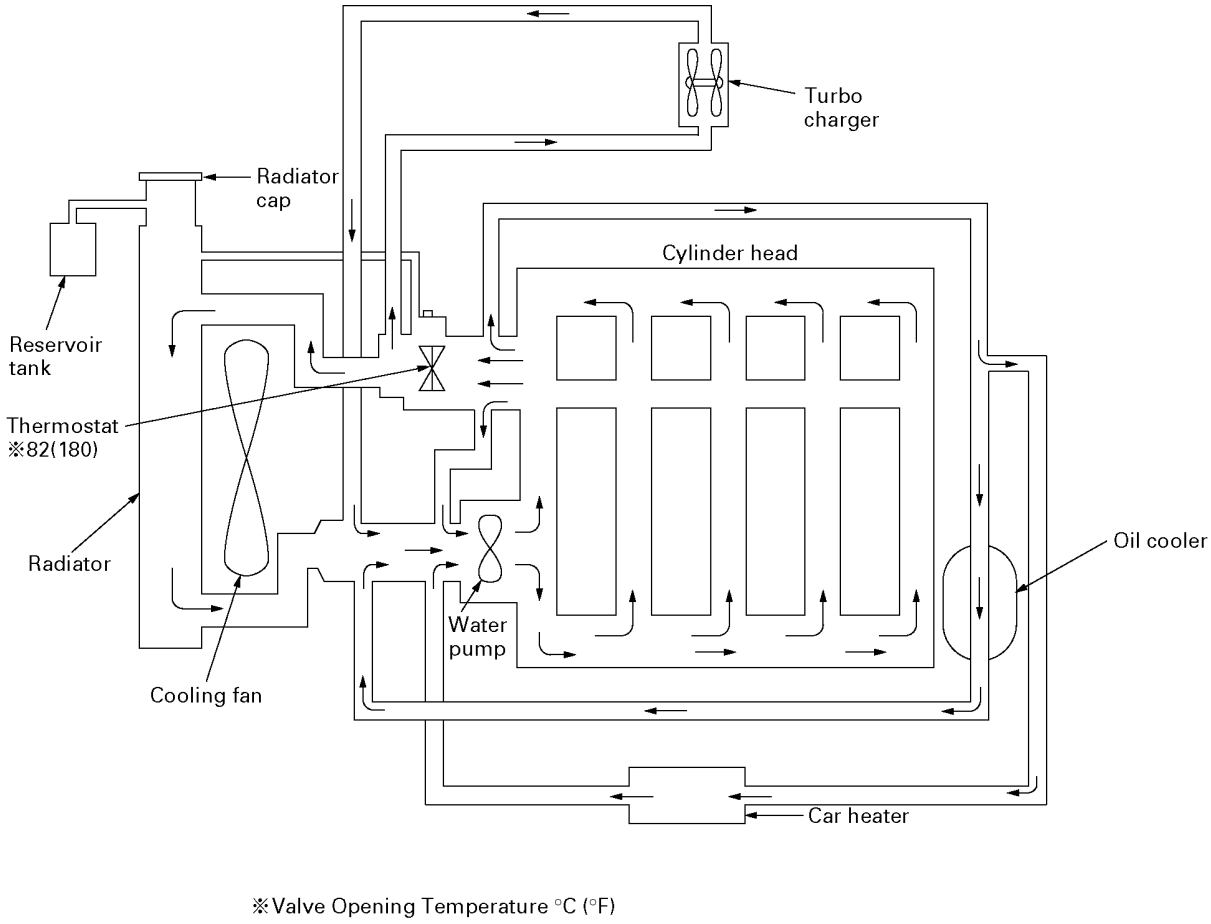
GENERAL DESCRIPTION

COOLANT FLOW




4JA1TC
Turbo charger
Radiator cap
Cylinder head
Reservoir tank
Thermovalve ※76.5(170)
Thermostat ※82(180)
Thermovalve ※40(104)
Radiator
Oil cooler
Water pump
EGR Cooler
Cooling fan
Car heater
※Valve Opening Temperature ˚C (˚F)

4JH1TC



C06L200009

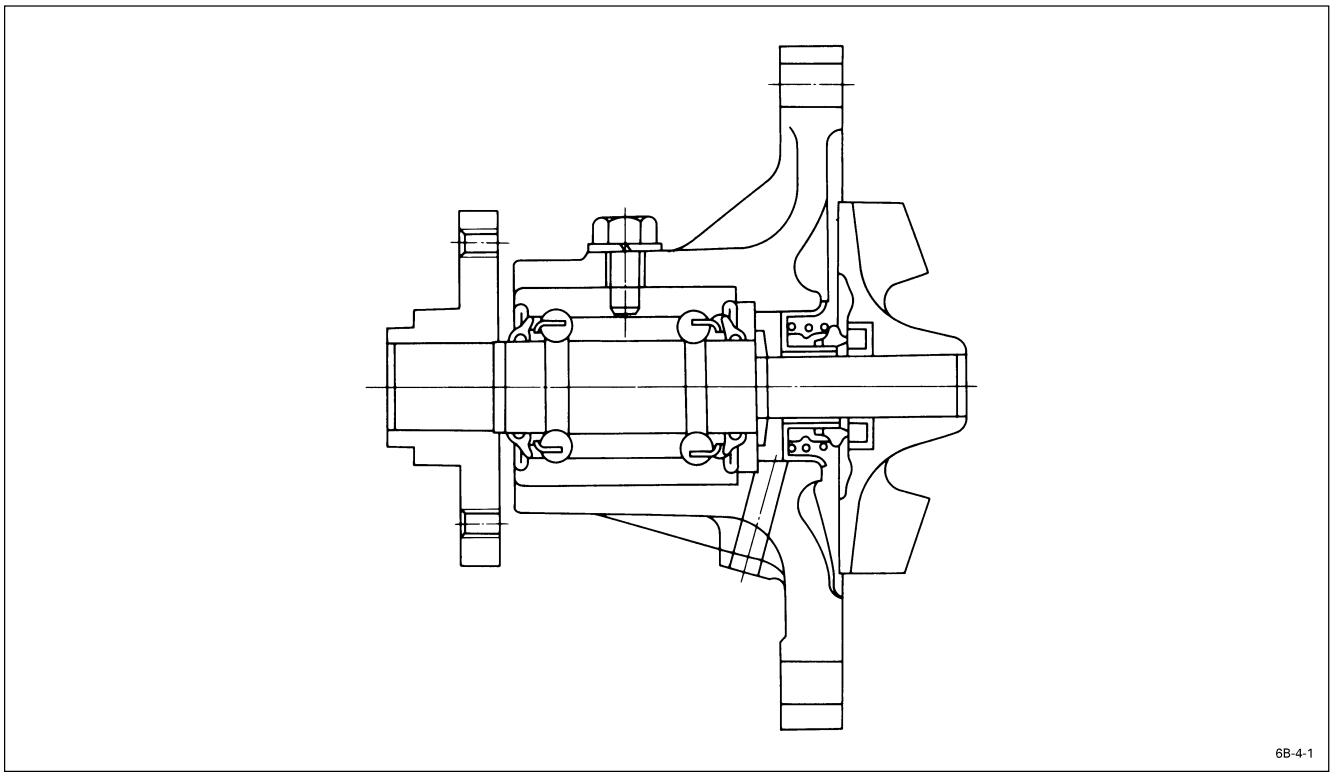
The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat.

To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and thermostat through the bypass hose and back to the cylinder body. The coolant does not circulate through the radiator.

When the coolant temperature reaches specified value, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

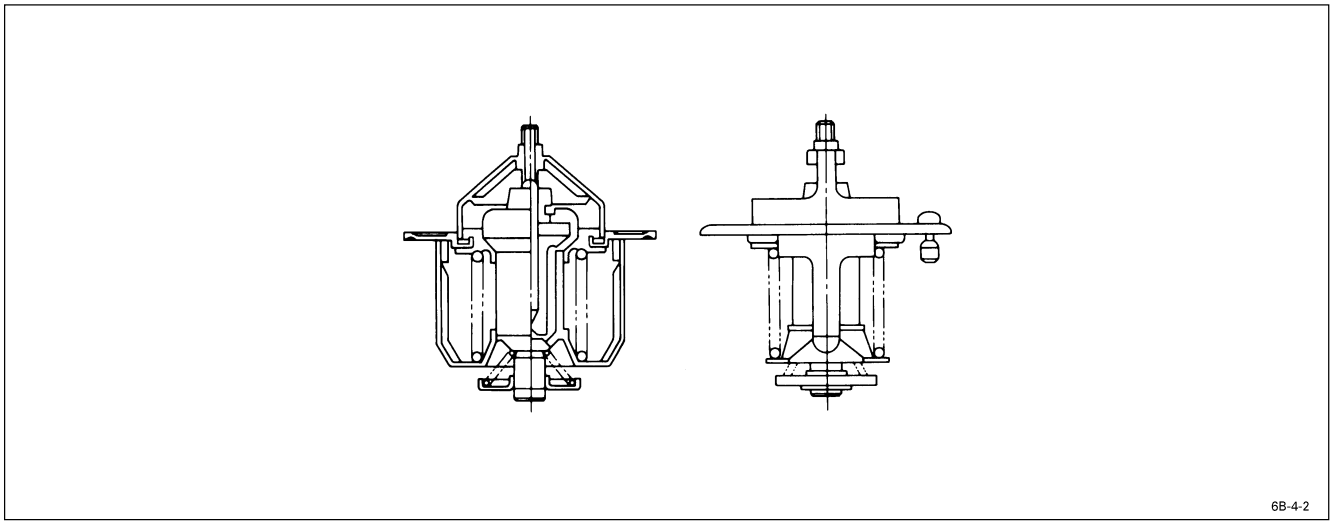
The thermostat will be fully open when the coolant temperature reaches specified value. All of the coolant is now circulating through the radiator for effective engine cooling.

WATER PUMP



A centrifugal type water pump forcefully circulates the coolant through the cooling system.
The water pump is not disassembled type.

THERMOSTAT



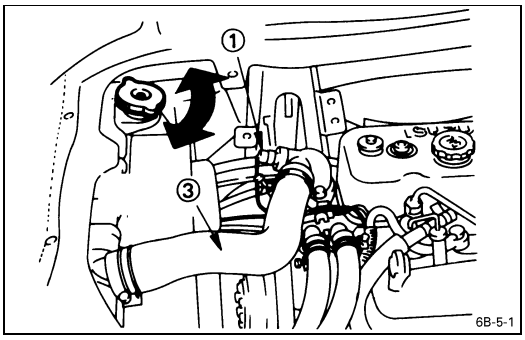
A wax pellet type thermostat is used.
The jiggle valve accelerates engine warm-up.

WATER PUMP

REMOVAL AND INSTALLATION

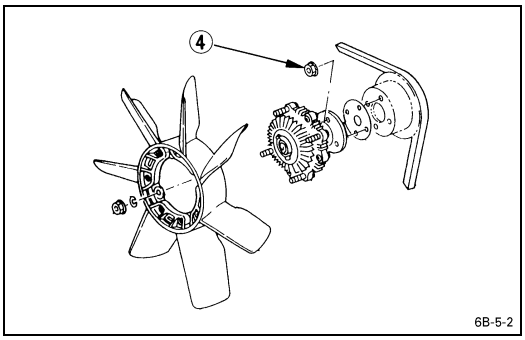
Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Important Operations - Removal



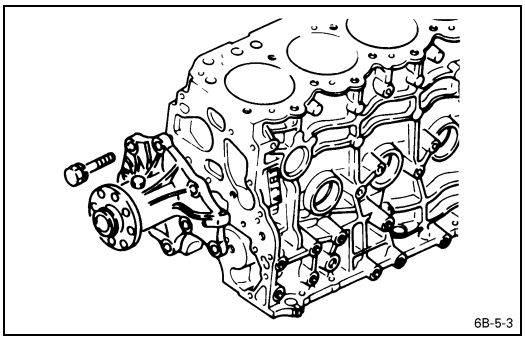
Radiator Upper Hose

1. Disconnect the wiring harness ①.
2. Partially drain the engine coolant.
3. Remove the radiator upper hose ③.



Fan and Fan Clutch

1. Loosen the fan clutch nuts ④.
2. Remove the fan together with the fan clutch.
   Take care not to damage the radiator core.

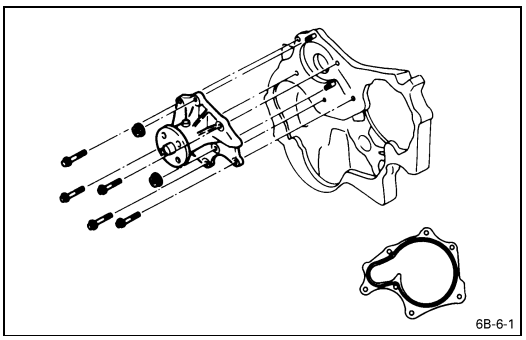


Water Pump

1. Remove the water pump bolts.
2. Remove the water pump.

Important Operations – Installation

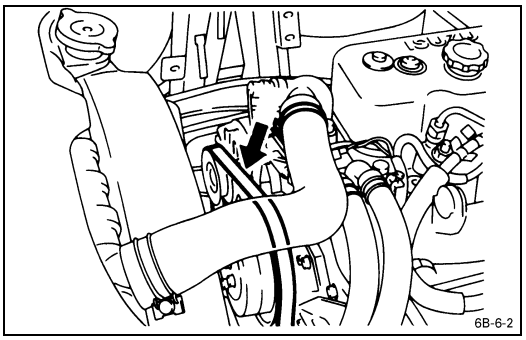
Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.



Water Pump

1) Apply the recommended liquid gasket or its equivalent to the water pump at the position shown in the illustration.
   Do not apply an excessive amount of liquid gasket.
2) Tighten the water pump bolts to the specified torque.

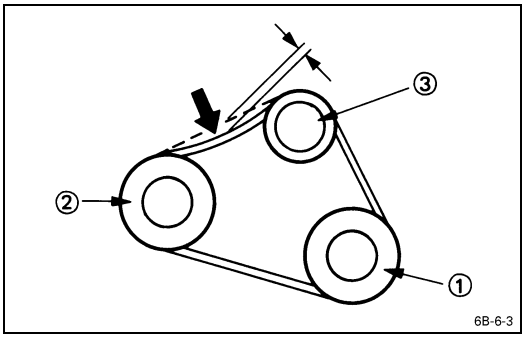
Water Pump Bolt Torque	kg·m (lb.ft/N·m)
	2.0 ± 0.5 (14.5 ± 3.6/19.6 ± 4.9)



Cooling Fan Drive Belt

1. Install the cooling fan drive belt.
2. Apply tension to the cooling fan drive belt by moving the generator .
3. Apply a force of 10 kg (22 lb/98 N) to the drive belt mid-portion to check the drive belt deflection.

Cooling Fan Drive Belt Deflection	mm (in)
	10 (0.4)



① Crankshaft damper pulley
② Generator pulley
③ Cooling fan drive pulley

4. Tighten the remaining water pump bolt to the specified torque.



Radiator Upper Hose

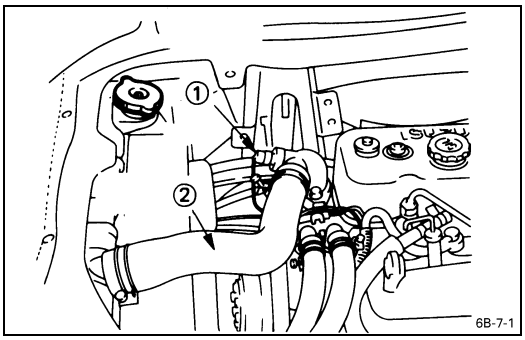
Heater Hose

1. Connect the radiator upper hose to the water outlet pipe.
2. Replenish the engine coolant.
3. Make sure the wiring harness is properly connected.
4. Start the engine and allow it to warm up.
5. Check the temperature gauge operation.

THERMOSTAT

REMOVAL AND INSTALLATION

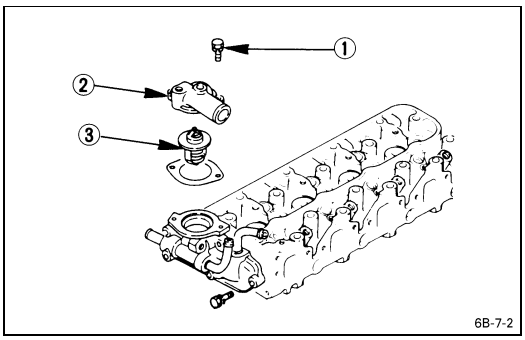
Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.



Important Operations – Removal

Radiator Upper Hose

1. Disconnect the wiring harness ①.
2. Partially drain the engine coolant.
3. Disconnect the radiator upper hose ②.



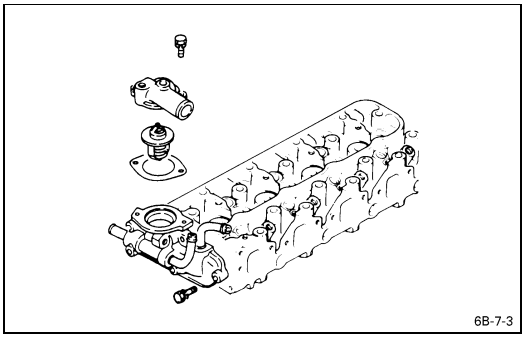
Water Outlet Pipe

Thermostat

1. Loosen the water outlet pipe bolt ①.
2. Remove the water outlet pipe ②.
3. Remove the thermostat ③ from the thermostat housing.
   Take care not to damage the thermostat.

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

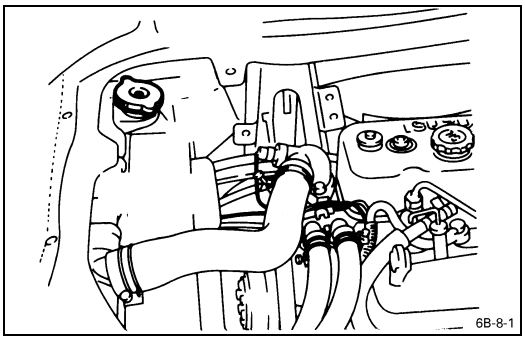


Thermostat

Water Outlet Pipe

1. Install the thermostat to the thermostat housing.
2. Install the water outlet pipe with the gasket to the thermostat housing.
3. Tighten the outlet pipe to the specified torque.

Outlet Pipe Bolt Torque	kg·m (lb.ft/N·m)
	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)

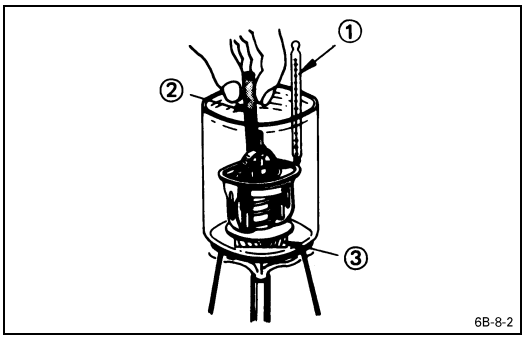


Radiator Upper Hose

1. Connect the radiator upper hose to the water outlet pipe.
2. Replenish the engine coolant.
3. Make sure the wiring harness is properly connected.
4. Start the engine and allow it to warm up.
5. Check the temperature gauge operation.

INSPECTION AND REPAIR

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



Operating Test

1. Completely submerge the thermostat in water.
2. Heat the water.
   Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

Thermostat Initial Opening Temperature	°C (°F)
82 (180)	

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature	°C (°F)
95 (203)	

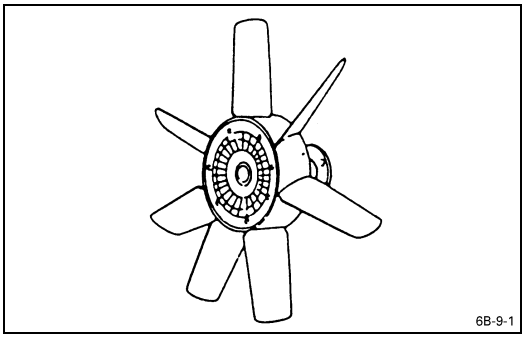
Valve Lift At Fully Open Position	mm (in)
9.5 (0.37)	

① Thermometer
② Agitating rod
③ Wooden piece

FAN CLUTCH WITH COOLING FAN

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.

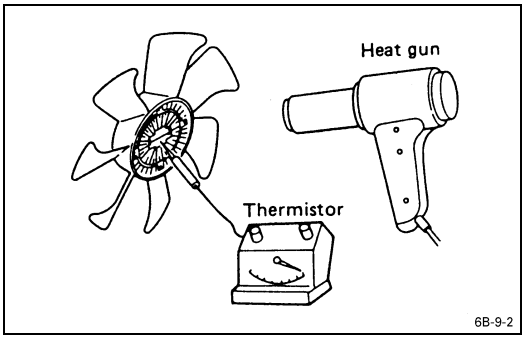


Visually inspect for damage, leak (sillicon grease) or other abnormal conditions.

1. Inspection (on-vehicle)

1) Turn the fan clutch by hand when in a low temperature condition before starting the engine, and confirm that it can be turned readily.
2) Start the engine to warm it up until the temperature at the fan clutch portion gets to around 80°C. Then stop the engine and confirm that the fan clutch can be turned with considerable effort (clutch torque) when turned by hand.

   If the fan clutch rotates more readily, however, this indicates that the silicone grease is leaking internally. Replace the fan clutch with a new one.



2. Inspection (in unit)

Warm up the bimetal of the fan clutch by using the heat gun until the temperature gets to about 80°C when measured with the thermistor. Then confirm that the fan clutch can be turned with considerable effort (clutch torque).

If the fan clutch retates more readily at this time, this indicates that the silicone grease is leaking internally.

Replace the fan clutch with a new one.

MEMO

SECTION 6C
FUEL SYSTEM

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MAIN DATA AND SPECIFICATIONS

Item		Description	
		4JA1	4JB1T
Injection pump type		Bosch Distributor	
Plunger outside diameter	mm (in)	11 (0.43)	
Plunger prestroke	mm (in)	0.45 (0.0177)	
Governor type		Mechanical variable all speed	Mechanical limit speed
Timer type		Oil pressure	
Fuel feed pump type		Vane with input shaft	
Injection nozzle type		Hole type	
Number of injection nozzle orifices		5	
Injection nozzle orifices Inside diameter	mm (in)	0.21 (0.0083)	0.27 (0.0106)
Injection nozzle opening	kg/cm^2 (psi/MPa)	185 (2,631/18.1)	
Main fuel filter type		Disposable cartridge paper element and water separator	

Item		4JA1T	4JG2T
Injection pump type		Bosch Distributor	
Plunger outside diameter	mm (in)	11 (0.43)	
Plunger prestroke	mm (in)	0.45 (0.0177)	-
Governor type		Mechanical variable (Variable half speed)	
Timer type		Oil pressure	
Fuel feed pump type		Vane with input shaft	
Injection nozzle type		Hole type	Throttle type
Number of injection nozzle orifices		5	1
Injection nozzle orifices Inside diameter	mm (in)	0.21 (0.0083)	1 (0.04)
Injection nozzle opening	kg/cm^2 (psi/MPa)	185 (2,631/18.1)	150 (2,133/14.7)
Main fuel filter type		Disposable cartridge paper element and water separator	

Item	4JA1TC	4JH1TC
Injection pump type	BOSCH VP44 (electronic controlled fuel injection pump)	
Injection nozzle type	Hole type (Double spring type)	
Number of injection nozzle orifices	5	
Injection nozzle orifices Inside diameter mm (in)	0.17 (0.0067)	0.21 (0.0083)
Injection nozzle opening kg/cm^2 (psi/MPa)	1st: 199 (2,830/19.5)	1st: 198 (2,816/19.4)
	2nd: 347 (4,934/34,000)	2nd: 344 (4,906/33,800)
Main fuel filter type	Disposable cartridge paper element and water separator	

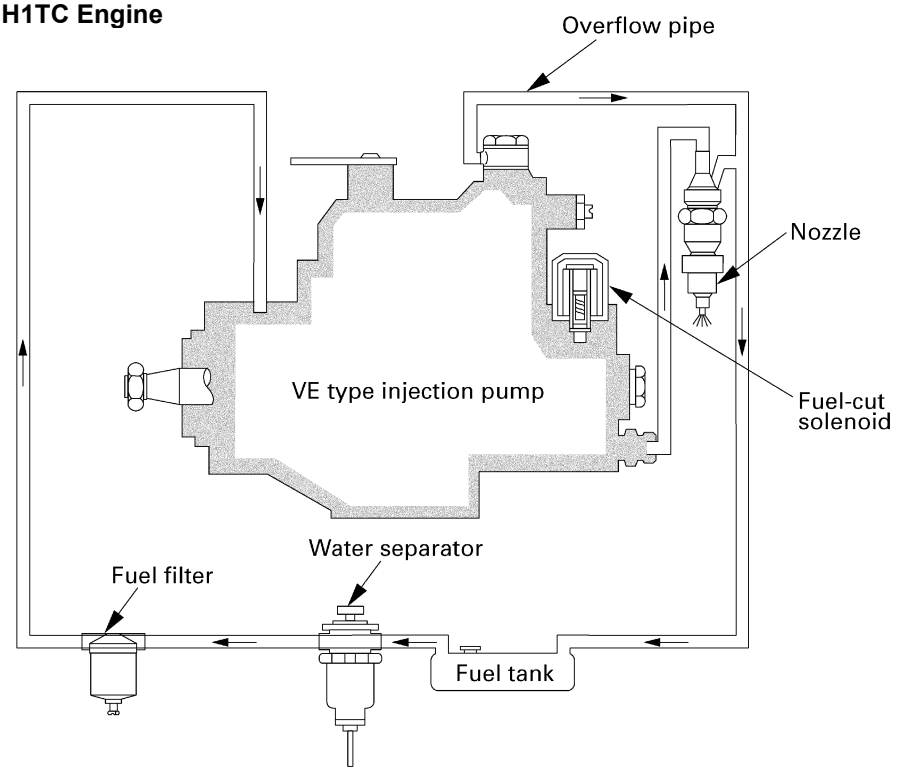
GENERAL DESCRIPTION

When working on the fuel system, there are several things to keep in mind:

- Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Replace all pipes with the same pipe and fittings that were removed.
  Clean and inspect “O” rings. Replace where required.
- Always relieve the line pressure before servicing any fuel system components.
- Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repairs.

FUEL FLOW

Except 4JA1TC, 4JH1TC Engine

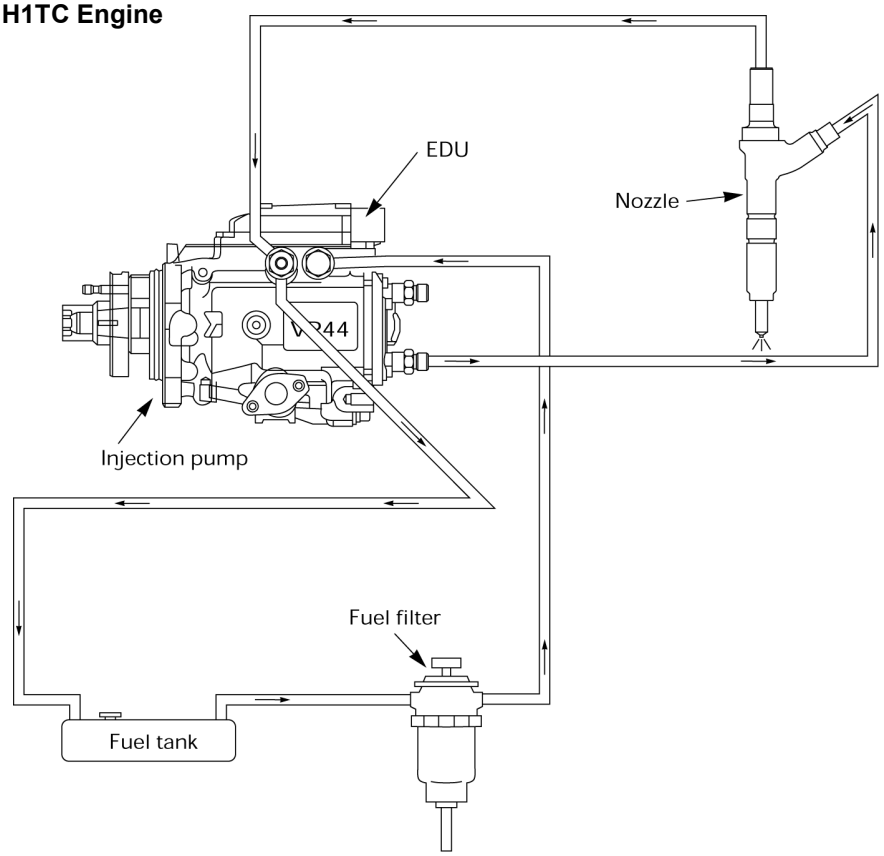


The fuel system consists of the fuel tank, the water separator, the fuel filter, the injection pump, and the injection nozzle.

The fuel from the fuel tank passes through the water separator and the fuel filter where water particles and other foreign material are removed from the fuel.

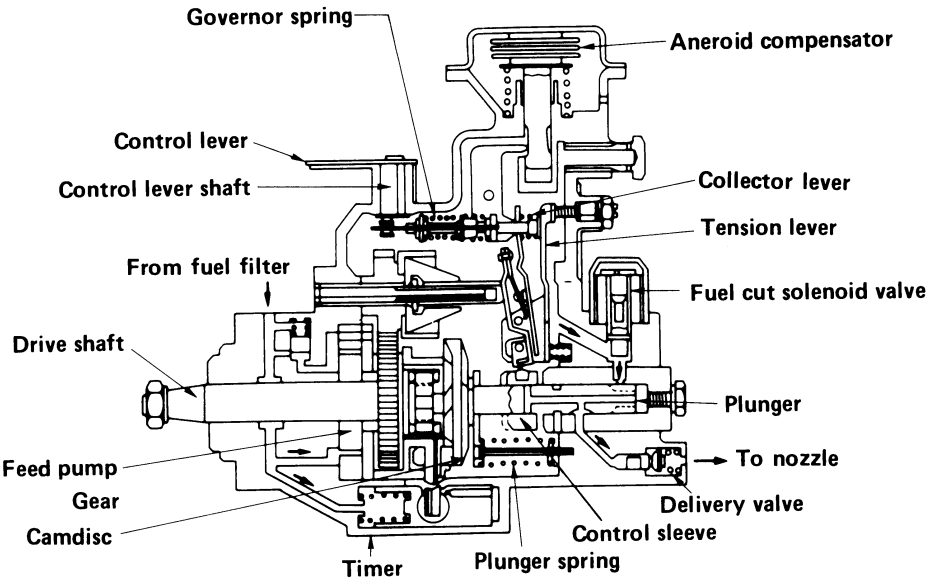
Fuel, fed by the injection pump plunger, is delivered to the injection nozzle in the measured volume at the optimum timing for efficient engine operation.

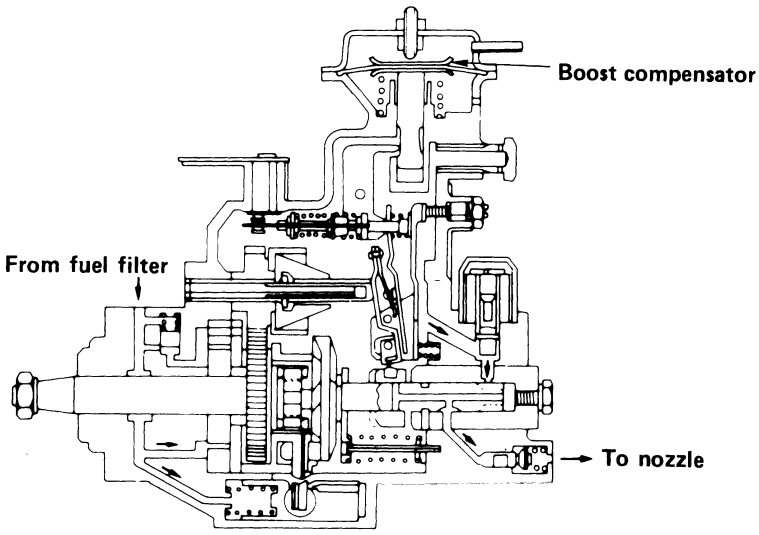
For 4JA1TC, 4JH1TC Engine



- The 4JA1TC, 4JH1TC engine are equipped with the electronically controlled fuel injection system. For information on fuel injection pump maintenance and/or part replacement, contact the Bosch Automotive Systems Corporation.
- Contact the Bosch Automotive Systems Corporation for information on 4JA1TC, 4JH1TC engine fuel injection nozzle maintenance.

INJECTION PUMP





6C-4

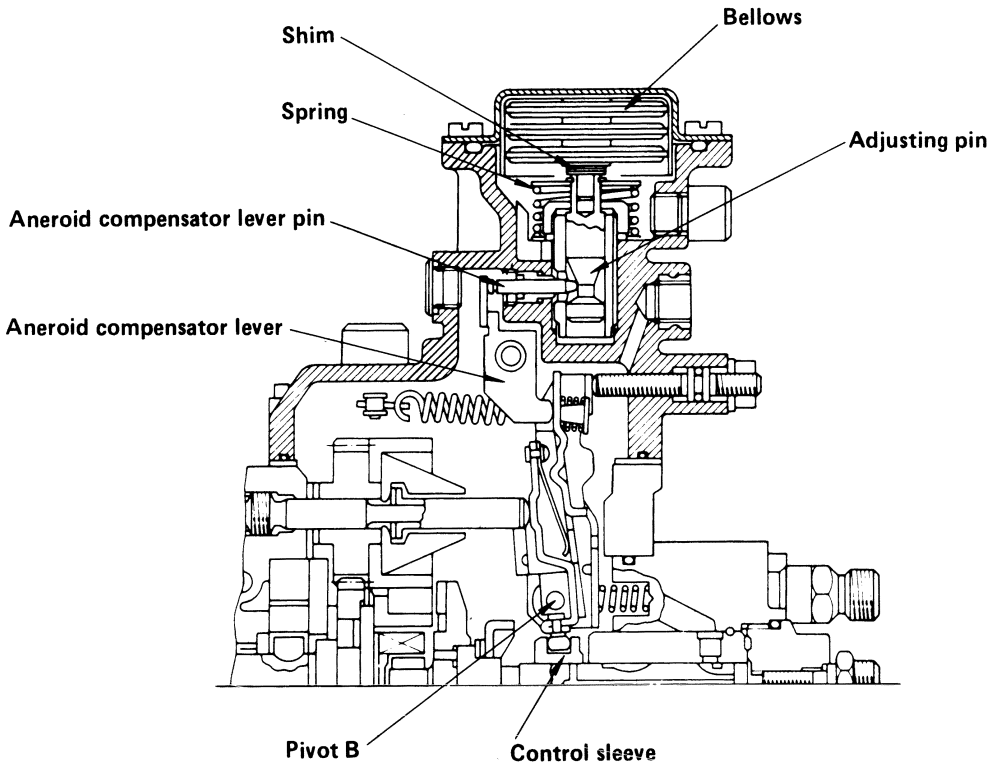
A Bosch Distributor Type Injection Pump is used. A single reciprocating/revolving plunger delivers the fuel uniformly to the injection nozzles, regardless of the number of cylinders.

The governor, the injection timer, and the feed pump are all contained in the injection pump housing. The injection pump is compact, light weight, and provides reliable high-speed operation.

An aneroid compensator is available as an option for vehicles to be operated at high altitudes. It adjusts the fuel and air mixing ratio.

A boost compensator is installed on turbocharger equipped vehicles.

ANEROID COMPENSATOR



The aneroid compensator consists of the compensator housing, the bellows, the adjusting pin, the aneroid compensator lever pin, and the aneroid compensator lever.

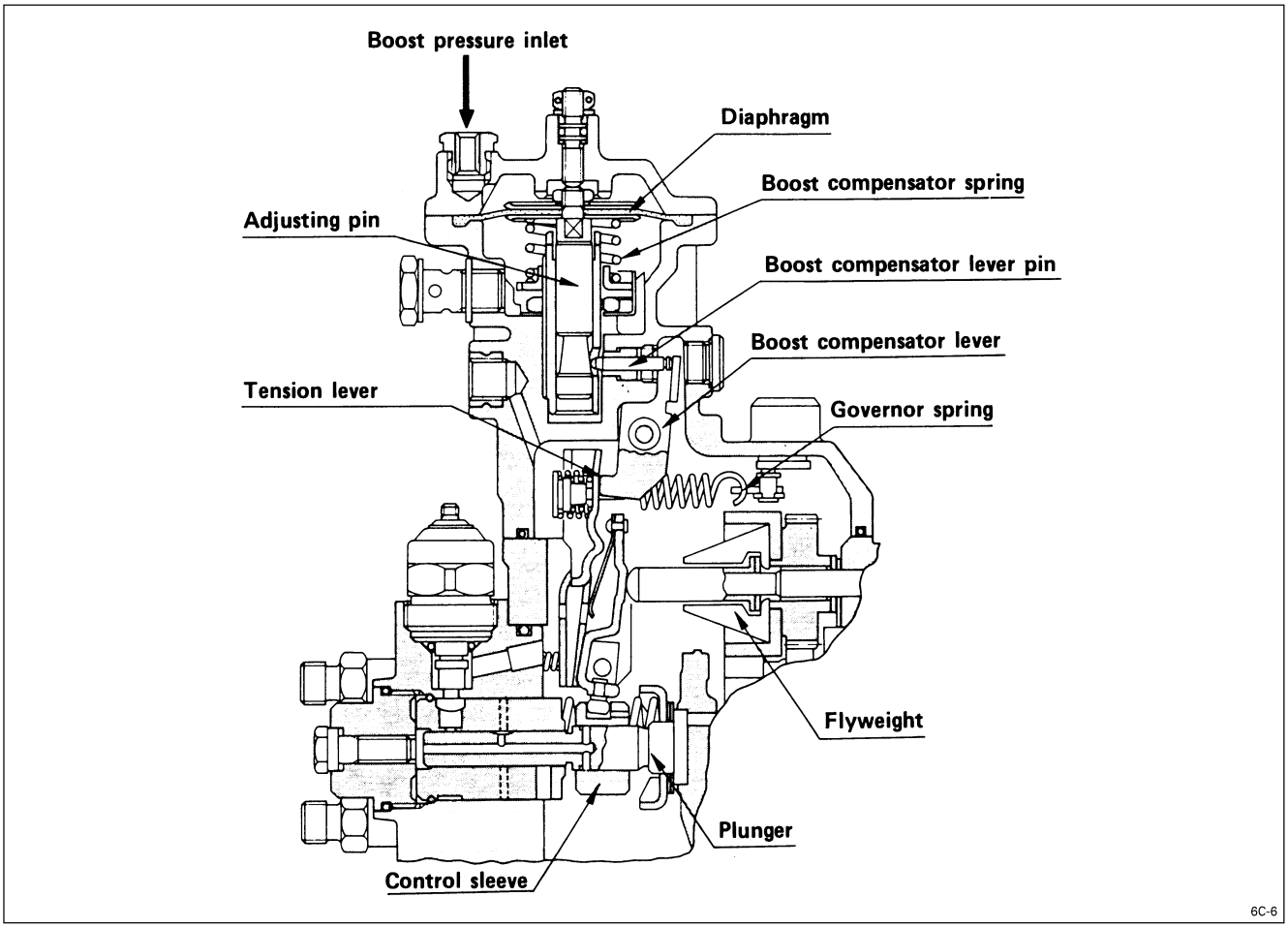
Atmospheric pressure decreases as altitude increases. The decreased atmospheric pressure causes the bellows to expand and push the adjusting pin down.

The adjusting pin pushes the aneroid compensator lever pin and the aneroid compensator lever to the left.

The aneroid compensator lever pushes the tension lever to the right.

The tension lever actuates the control sleeve to decrease the fuel flow.

BOOST COMPENSATOR



The boost compensator consists of the compensator housing, the diaphragm, the adjusting pin, the boost compensator lever pin, and the boost compensator lever.

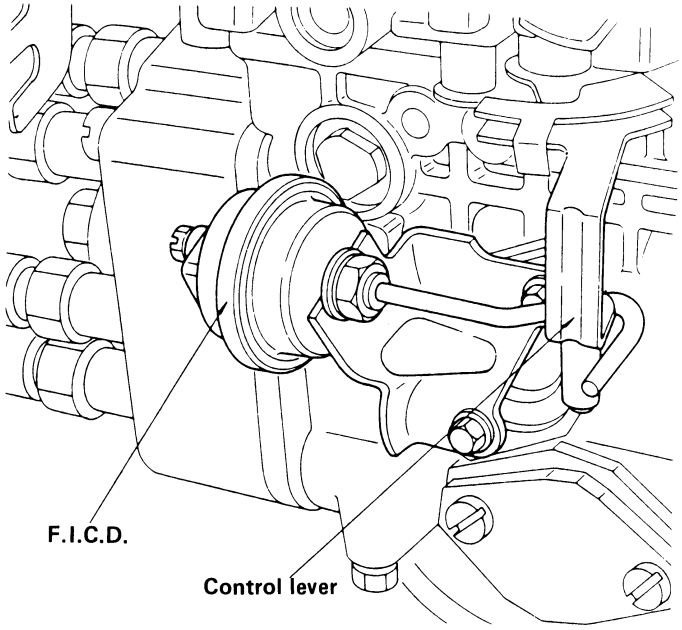
The increase boost pressure cause the diaphragm to lower and push the adjusting pin down.

The adjusting pin pushes the boost compensator lever pin and the boost compensator lever to the left.

The boost compensator lever pushes the tension lever to the right.

The tension lever actuates the control sleeve to increase the fuel flow.

FAST IDLE ACTUATOR

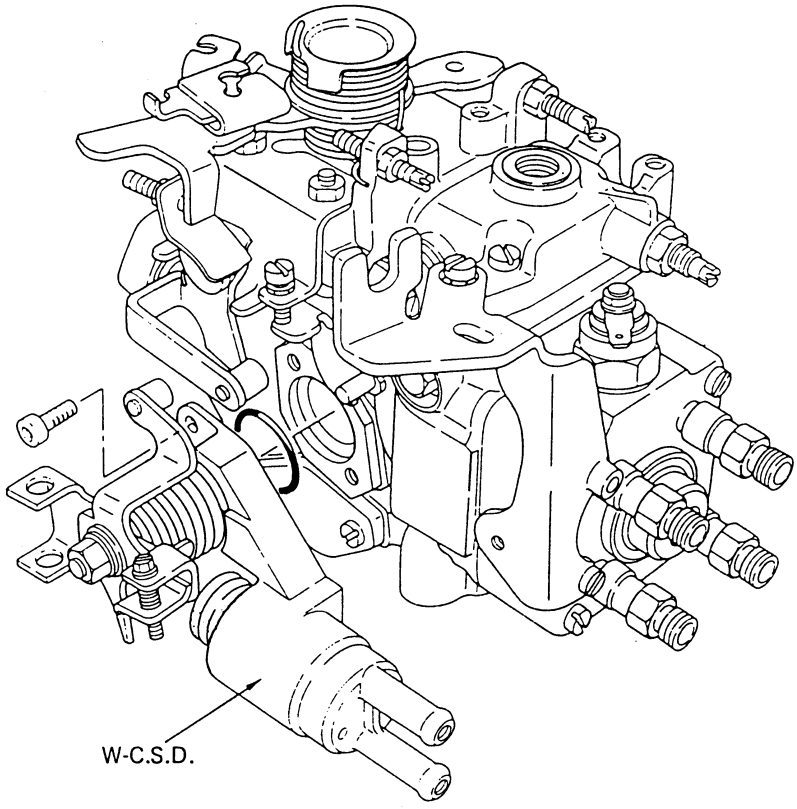


The vacuum-type fast idle actuator increases the engine idling speed to provide the additional power required to operate the air conditioner.

Fast idler diaphragm movement is caused by changes in the negative pressure created by the engine's vacuum pump.

The diaphragm motion is transferred to the injection pump control lever to increase or decrease the idling speed.

WAX TYPE COLD START DEVICE (W–CSD) (If so equipped)



6C-8

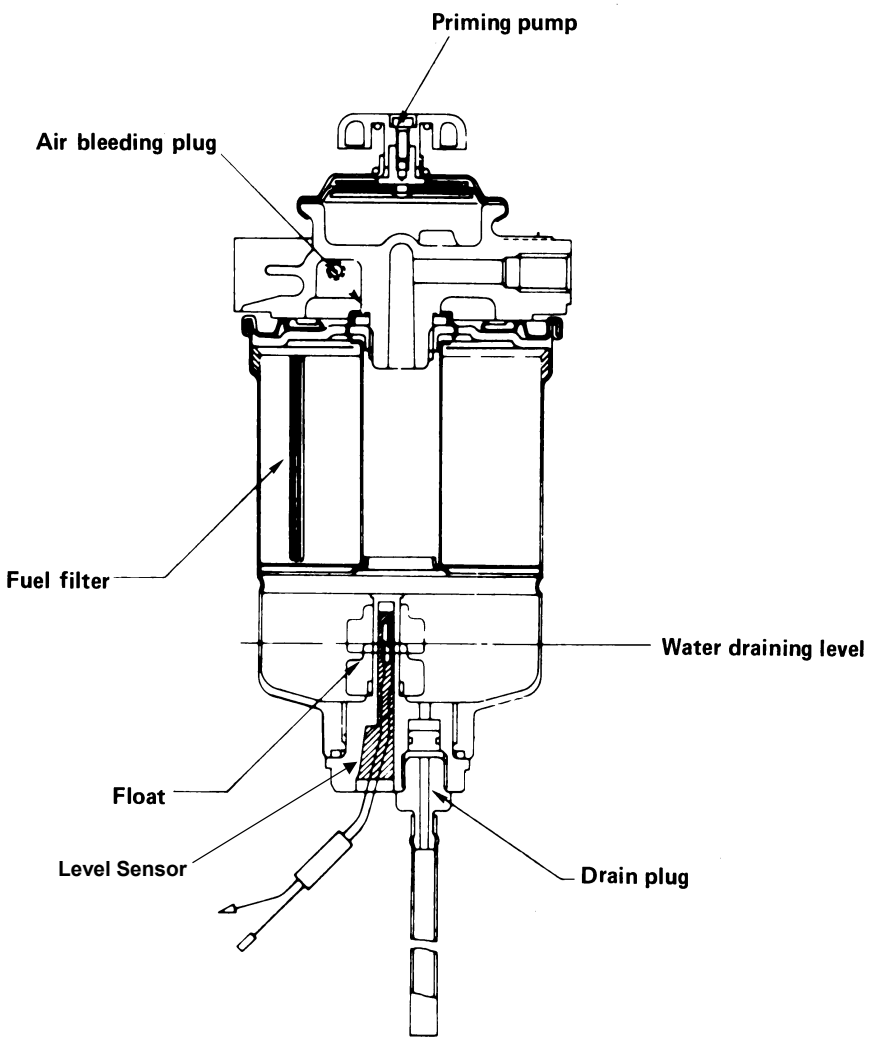
Because engine starting in cold conditions is very difficult, the W-C.S.D. (wax type cold start device) has been developed to provide the optimum fuel injection timing for engine starting by responding to temperature changes.

The thermo-wax piston contains a wax that changes its volume according to the temperature changes of the engine coolant which flows through the unit at all times.

The engine coolant temperature above A °C the wax expands in proportion to the coolant temperature, below A °C it contracts.

The coolant temperature A is classified as –20, -10 and 0°C.

FUEL FILTER WITH BUILT-IN WATER SEPARATOR



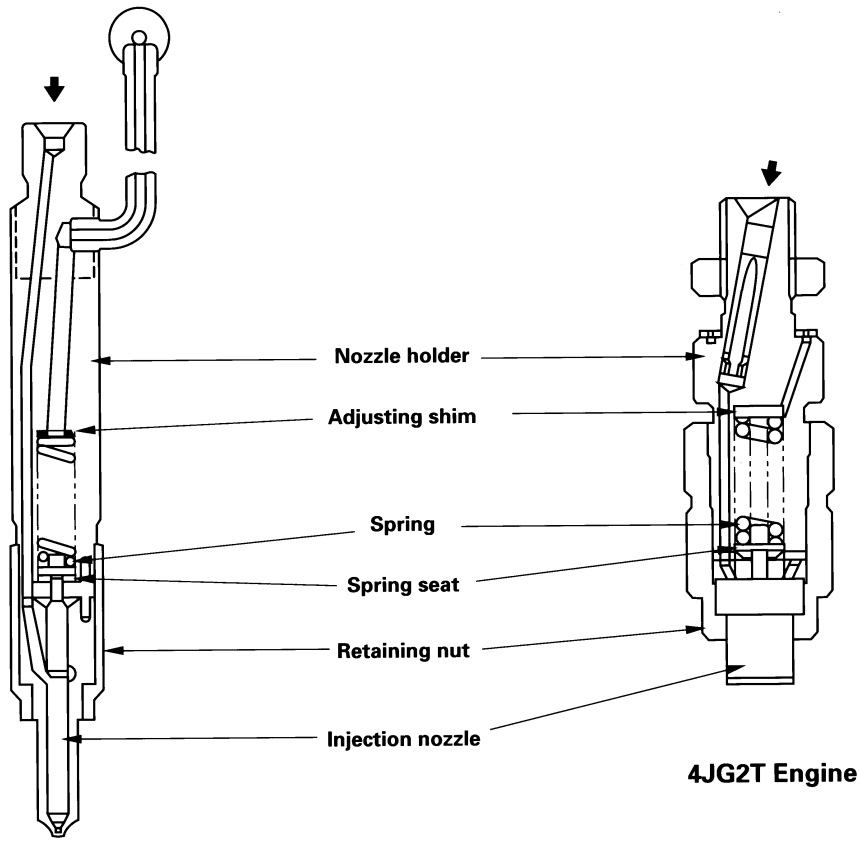
A fuel filter with a built-in water separator is used along with the VE type injection pump.

As the inside of the injection pump is lubricated by the fuel which it is pumping, the fuel must be perfectly clean. The fuel filter and the water separator remove water particles and other foreign material from the fuel before it reaches the injection pump.

The water separator has an internal float. When the float reaches the specified level, a warning light comes on to remind you to drain the water from the water separator.

A diaphragm type priming pump is installed at the top of the water separator. It is used during the water draining and the air bleeding procedures.

INJECTION NOZZLE



A hole (with 5 orifices) type injection nozzle is used for 4JA1T, 4JA1, 4JB1T Engine and a throttle type injection is used for 4JG2T Engine. It consists of the nozzle body and the needle valve assembly.

The injection nozzle assembly sprays pressurized fuel from the injection pump into the combustion chamber through the nozzle body injection orifice.

INJECTION PUMP

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

BELT DRIVE MODEL (4JA1T, 4JG2T)

Removal Steps

1. Cooling Fan

Drain the engine coolant.

The following parts must be removed before the cooling fan can be removed.

Battery, Air cleaner duct, Radiator

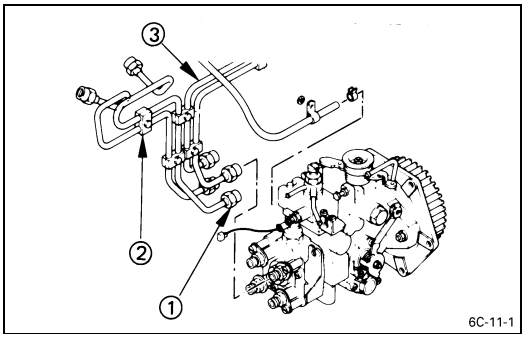
Additionally, all piping, wiring, and hoses which will interfere with the removal of the cooling fan must be disconnected.

Refer to Section 6A, “REMOVAL AND INSTALLATON” of this Manual for detailed information on part removal.

2. Crankshaft Damper Pulley

Turn the crankshaft to align the damper pulley mark with the timing pointer.

This will bring the No. 1 piston to TDC on the compression stroke.



3. Fuel Injection Pipe with Clip

1. Loosen the injection pipe sleeve nuts at the delivery valve side ①.
   Do not apply excessive force to the injection pipes.
2. Loosen the injection pipe clips ②.
3. Remove the injection pipes ③.

Note:

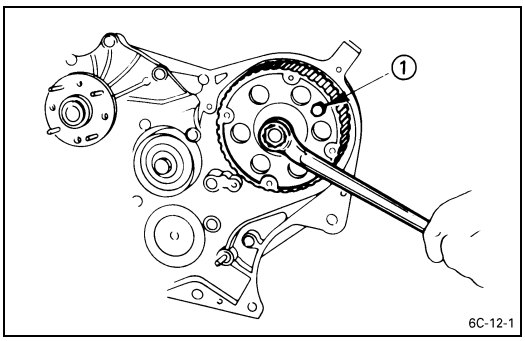
Plug the delivery holder ports with the shipping caps to prevent the entry of foreign material.

4. Timing Case Cover Upper

5. Timing Case Cover Lower

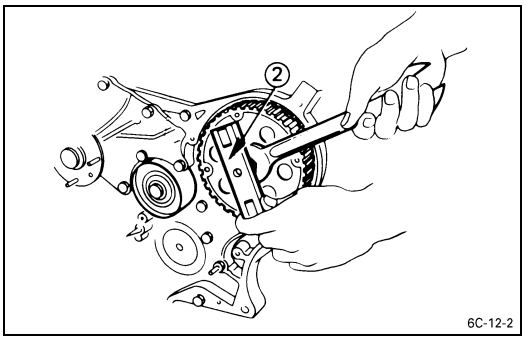
6. Timing Belt

1. Loosen the timing belt tensioner bolt and remove the timing belt.

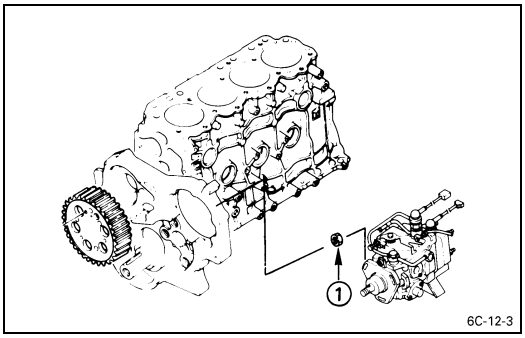


7. Injection Pump Timing Pulley

1. Install the stopper bolt ① to the timing pulley to prevent it from turning.

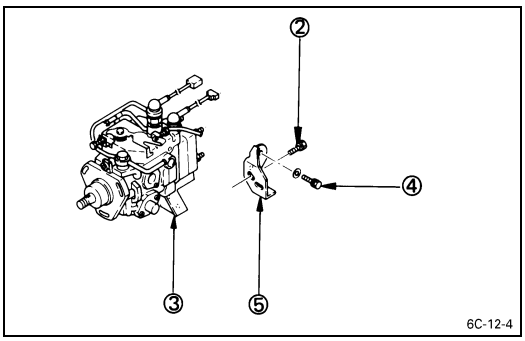


2. Use the timing pulley remover ② to remove the injection pump timing pulley.
   Timing Pulley Puller: 5-8840-0086-0
3. Remove the stopper bolt.



8. Injection Pump

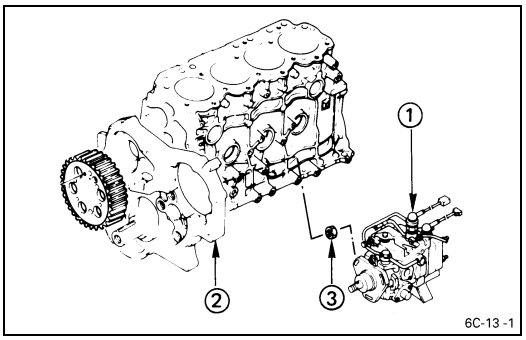
1. Remove the three injection pump bracket nuts ① at the rear of the timing pulley housing.

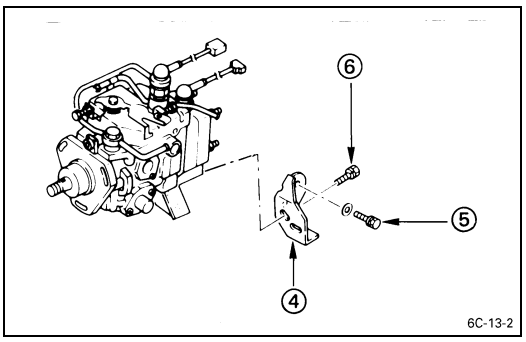


2. Remove the injection pump rear bracket bolts ② from the injection pump bracket ③.
3. Remove the injection pump rear bracket bolts ④ and the bracket ⑤ from the cylinder body.
4. Pull the injection pump free toward the rear of the engine.

Note:

Plug the injection pump delivery holder ports with the shipping caps (or the equivalent) to prevent the entry of foreign material.





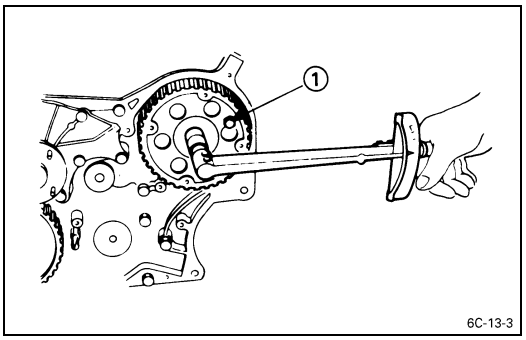
Installation Steps

To install, follow the removal procedure in reverse order and note the following point.

1. Injection Pump

1) Install the injection pump ① to the timing pulley housing ②.
2) Temporarily tighten the three injection pump nuts ③.
   The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.
3) Install the injection pump rear bracket ④ and the rear bracket bolts ⑤ to the cylinder body.
4) Install the rear bracket bolts ⑥ to the injection pump bracket.
   Do not tighten the bolts.
   The rear bracket bolts ⑤ and ⑥ will be finally tighten tened to the specified torque after the injection pump nuts.
5) Tighten the injection pump nuts to the specified torque.

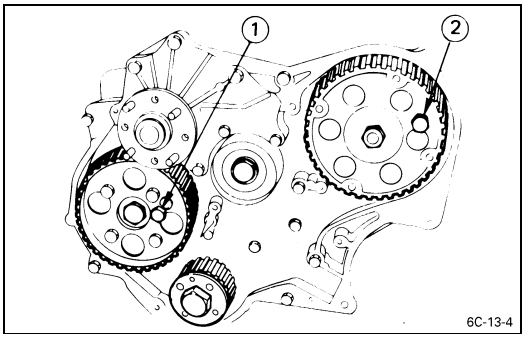
Injection Pump Nut and Bracket Bolt Torque	kg·m (lb.ft/N·m)
1.5 ± 0.5 (10.8 ± 3.6/14.7 ± 4.9)	



2. Injection Pump Timing Pulley

1) Align the timing pulley with the pump shaft key.
2) Install the stopper bolt ① to the timing pulley.
   This will prevent the timing pulley from turning.
3) Tighten the timing pulley nut to the specified torque.

Injection Pump Timing Pulley Nut Torque kg·m (lb.ft/N·m)
6.5 ± 0.5 (47.0 ± 3.6/63.7 ± 4.9)

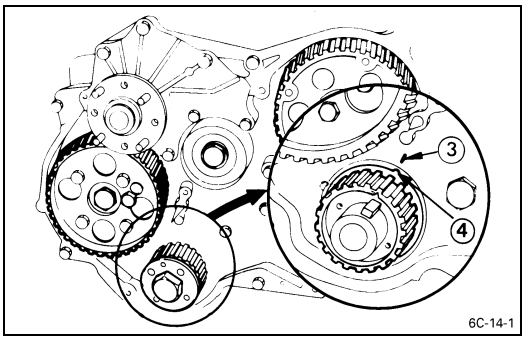


3. Timing Belt

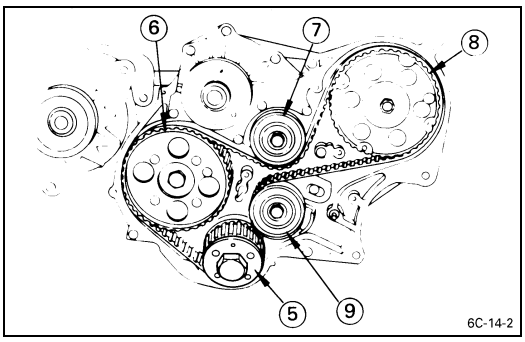
4. Timing Belt Tensioner

5. Timing Belt Tension Adjusting Lever

1) Check that the stopper bolts are properly installed to the camshaft timing pulley ① and the injection pump timing pulley ②.



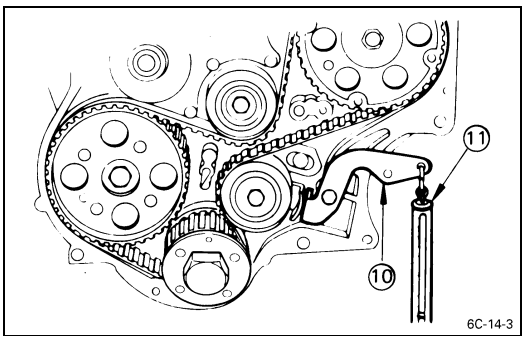
2) Check that the timing pulley housing mark ③ and the crankshaft timing pulley mark ④ are aligned.



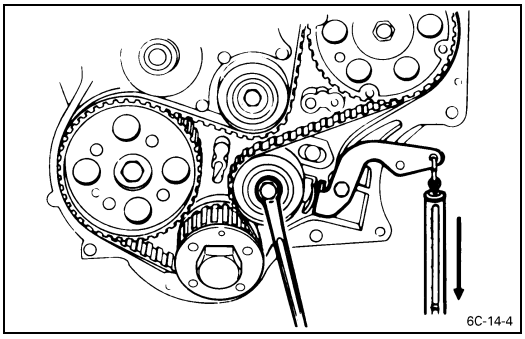
3) Install the timing belt to the crankshaft timing pulley ⑤, the camshaft timing pulley ⑥, the tensioner idler ⑦, and the injection timing pulley ⑧.
Follow the numerical order.
4) Install the timing belt tensioner ⑨ to the timing pulley housing.
5) Temporarily tighten the tnesioner bolt.
The tensioner should move freely.

Note:

The timing belt is easily damaged. Be careful.



6) Set the tensioner adjusting lever ⑩ to the timing pulley housing.
7) Remove the stopper bolts from the camshaft timing pulley ① and the injection pump timing pulley ②.
8) Attach the spring balancer ⑪.



9) Adjust timing belt tension by pulling straight down on the spring balancer with the specified force.

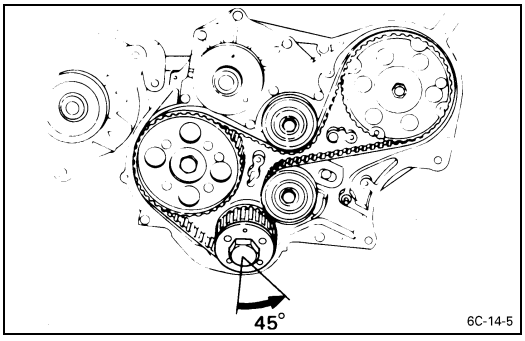
Tension Adjusting Lever Force	kg (lb/N)
10 - 12 (22.1 – 26.5/98.1 – 117.7)	

Note:

Timing belt tension must be adjusted.

Failure to adjust the timing belt tension will result in timing belt damage.

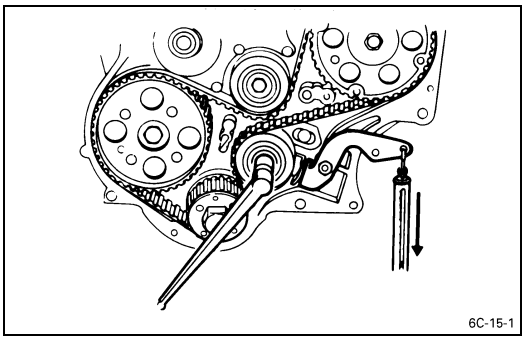
10) Tighten the tension bolt.



11) Rotate the crankshaft 45 degrees counterclockwise.

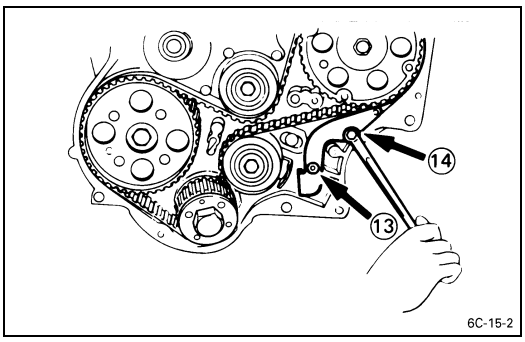
Note:

Never rotate crankshaft clockwise when adjusting the timing belt.



12) Readjust the timing belt tension.
Refer to Step 9
This will remove any remaining timing belt slack.
13) Tighten the tensioner bolt to the specified torque.

Tensioner Bolt Torque	kg·m (lb.ft/N·m)
7.7 ± 1.0 (55.7 ± 3.6/75.5 ± 9.8)	



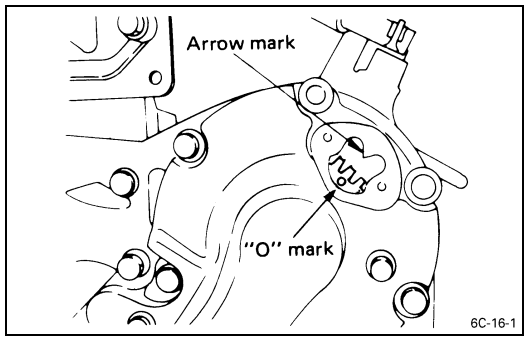
14) Tighten the tension adjusting lever nut ⑬ and bolt ⑭.

Note:

If on-vehicle timing belt replacement is performed, the crankshaft must not be allowed to turn.

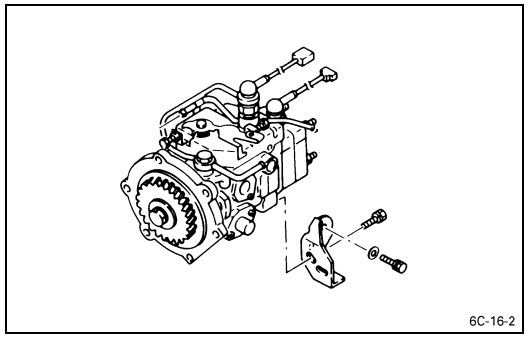
If the crankshaft is allowed to turn, piston and valve damage will result.

GEAR DRIVE MODEL (4JA1, 4JB1T)

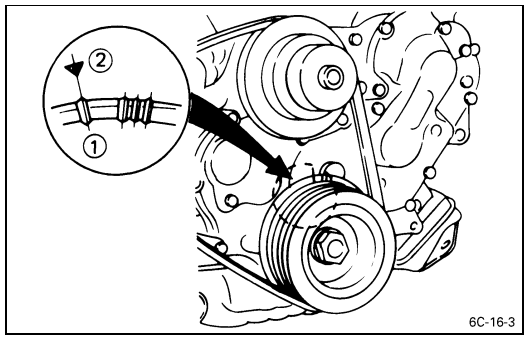


Removal Steps

1. Disconnect the battery ground cable.
2. Disconnect the air cleaner duct.
3. Disconnect the PCV hose.
4. Remove the head cover.
5. Remove the power steering V belt. (if so equipped)
6. Disconnect the accelerator cable and harness from injection pump.
7. Remove the fuel pipes and injection pipes.
8. Remove the cover of timing gear case cover. (injection pump side only)
9. Remove the timing hole cover.
10. For ease in reinstalling the injection pump, align the timing “O” mark on the pump gear with the allow mark on the timing gear case cover using the crank shaft turning wrench.



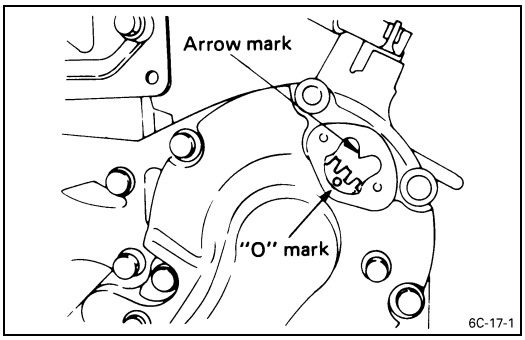
11. Remove the six injection pump mounting bolts from the timing gear case cover.
12. Remove the rear bracket bolts from the injection pump bracket.
13. Pull the injection pump together with pump gear free toward the rear of the engine.



Installation Steps

To install, follow the removal procedure in reverse order and note the following point.

- Recheck the crankshaft to align the timing mark on the crank pulley with the TDC mark.

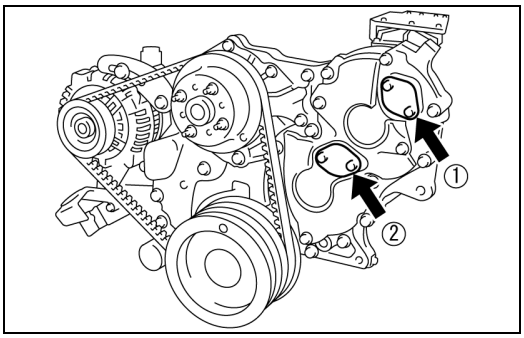


- Install injection pump so that the timing “O” mark on the pump gear the arrow mark on the timing gear case cover.

GEAR DRIVE MODEL (4JA1TC, 4JH1TC)

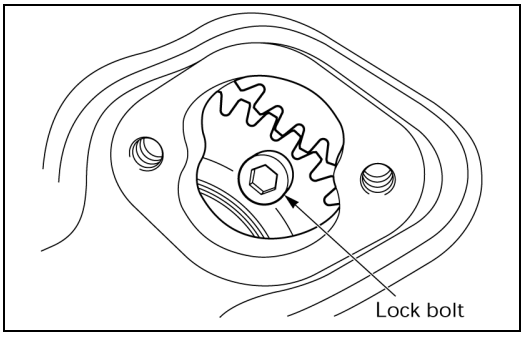
Removal Steps

1. Disconnect the battery ground cable.
2. Remove the intercooler.
3. Separate the air cleaner duct from the air cleaner.
4. Disconnect the radiator upper hose.
5. Remove the air conditioner V-belt.
6. Remove the power steering V-belt.
7. Remove the power steering oil tank. Place the tank in a safe place.
8. Remove the fuel filter and its bracket.
9. Disconnect the accelerator cable and connector at the intake duct.
10. Remove the intake duct.
11. Remove the accelerator control lever.



020L200016

12. Remove the check hole cover from the timing gear case.
13. Rotate the crank pulley until the scissor gear fixing hole becomes visible through the check hole (2).

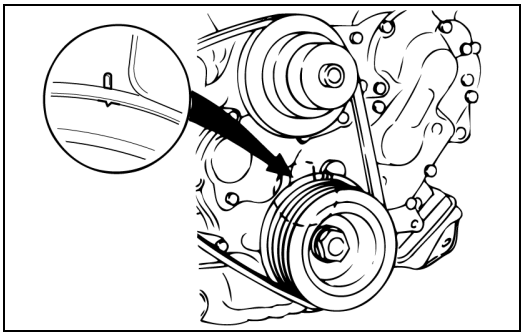


020L200018

14. Insert a lock bolt (M6×1 L=30) into the scissor gear fixing hole to prevent the scissor gear from turning.

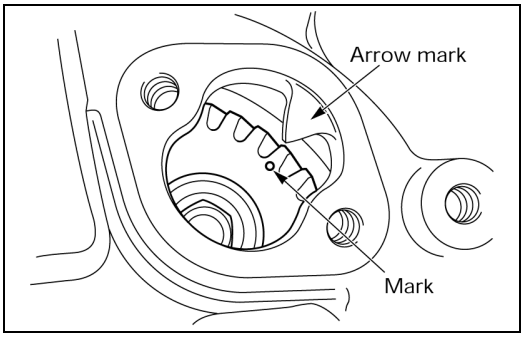
Note:

If the check hole cover is reinstalled with the lock bolt still in place, the crank pulley will not turn.



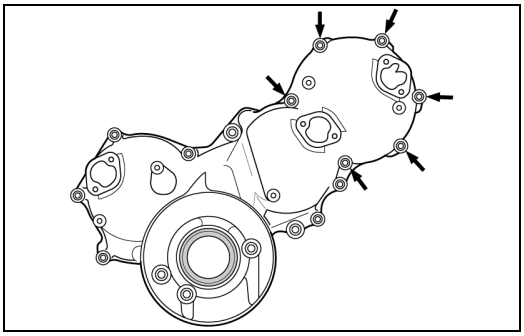
015L200004

15. Rotate the crank pulley to align the crank pulley TDC mark and the timing gear case TDC mark.
16. Look through check hole (1) to confirm that the injection pump alignment mark is visible. If it is not visible, turn the crank pulley an additional full turn.

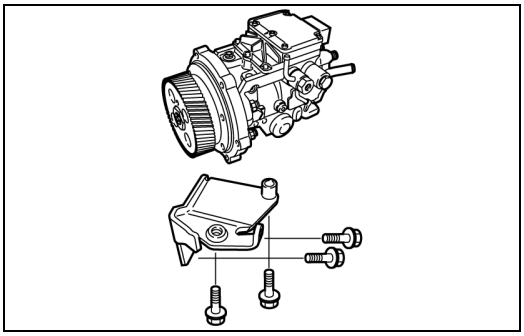


020L200017

17. Remove the fuel piping and the injection pipes.
18. Remove the connector from the injection pump.

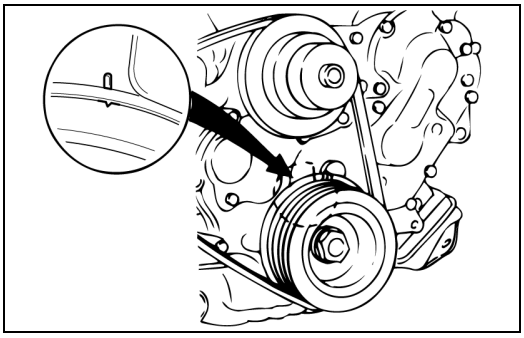


19. Remove the injection pump mounting bolts (6 bolts) from the timing gear case.



080L200006

20. Remove the injection pump bracket.
21. Remove the injection pump and pump gear by pulling it toward the rear of the engine.



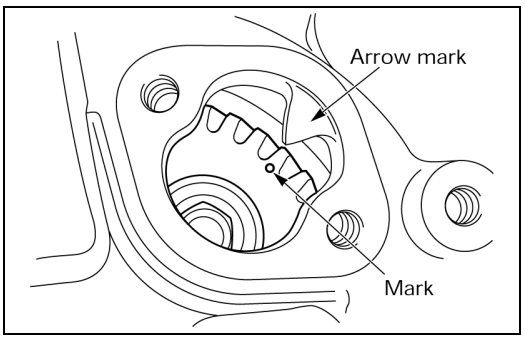
015L200004

Installation Steps

Follow the removal procedure in reverse order.

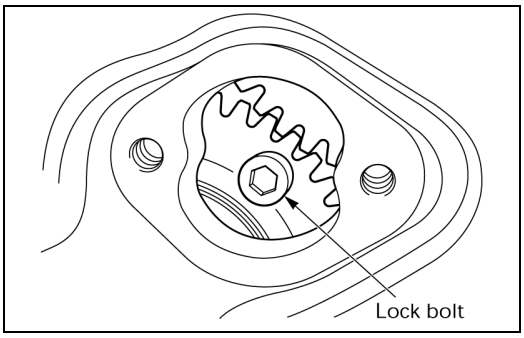
Pay close attention to the following.

- Be sure to align the crank pulley TDC mark and the timing gear case TDC mark.



020L200017

- Install the injection pump and pump gear so that the timing mark (dot) on the pump gear is aligned with the arrow on the timing gear case cover.



020L200018

Note:

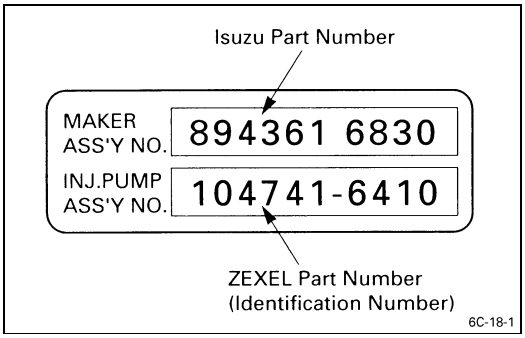
- **Do not forget to remove the lock bolt from the scissor gear. (if you have forgotten to remove the bolt, the bolt will strike the check hole guides and the crank pulley will not turn)**
- **Injection pump Air bleeding is required to start the engine when the injection pump has been replaced.**
  Refer to Injection Pump Air Bleeding (Section 00).

INJECTION PUMP CALIBRATION DATA

INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

Item		Condition
Injection nozzle		ZEXEL Part No.: 105780-0060
		Bosch Type No.: DNOSD1510
Injection nozzle holder		ZEXEL Part No.: 105780-2150
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	133 (1,891/13,000)
Injection line dimensions	mm (in)	
Inside diameter		2 (0.079)
Outside diameter		6 (0.236)
Length		450 (17.7)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	0.2 (2.84/19.6)
Test fuel		Bosch Diesel Fuel OL61V11
		SAE Standard Test Diesel Fuel (SAE967D)
Test fuel temperature	°C (°F)	45 – 50 (113 – 122)
Identification numbers		104746-6192
		104746-6162



IDENTIFICATION PLATE AND NUMBER

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

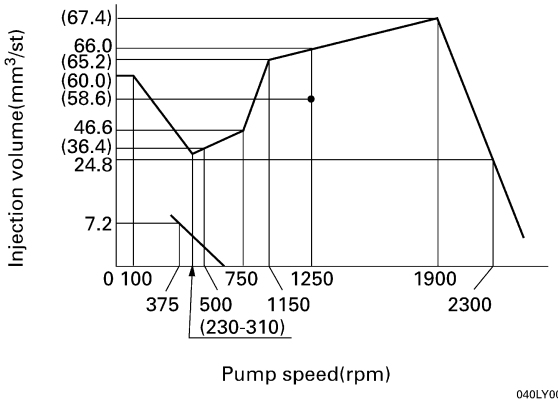
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine: 4JB1T

Identification Numbers: 104746-6152 (ISUZU Part Number 8-97132-678-2)

Test Fuel: Standard Diesel Fuel SAE J967D (or ISO 4113)

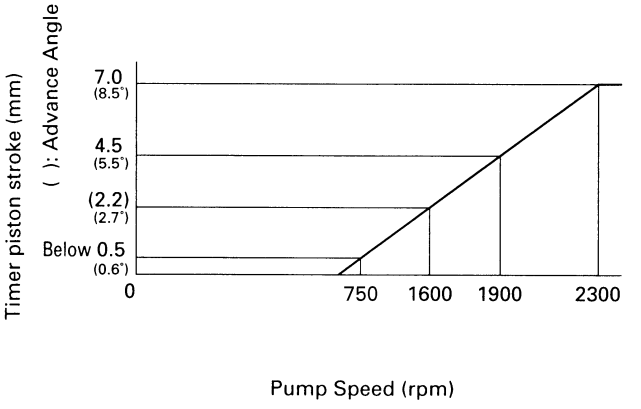
Governor Adjustment



Timer and Pump Case Pressure

Pump speed rpm	Timer piston stroke mm	Pump case pressure kpa (kg/cm^2)	Boost pressure kpa (kg/cm^2)	Reference
750	Below 0.5		73.3 (0.75)	
1600	(2.2 ± 0.4)		73.3 (0.75)	
1900	4.5 ± 0.2	618 ± 20 (6.3 ± 0.2)	73.3 (0.75)	Base
2300	$7.0^{+0.4}_{-0.3}$		73.3 (0.75)	

Timer Performance Diagram



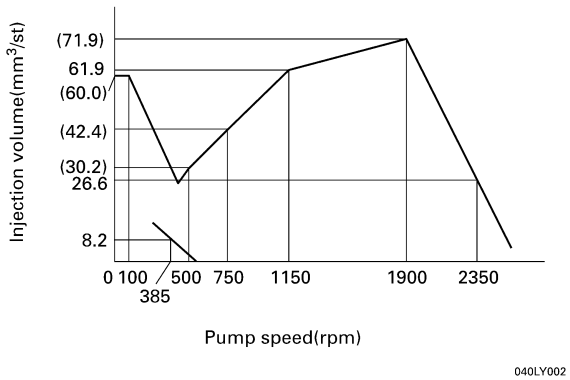
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine: 4JA1T

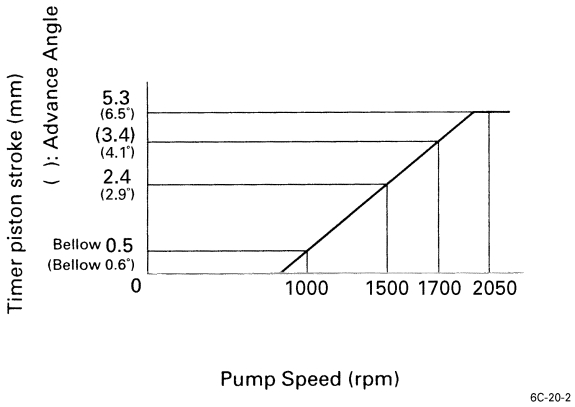
Identification Numbers: 104746-6501 (ISUZU Part Number 8971884490)

Test Fuel: Standard Diesel Fuel SAE J967D (or ISO 4113)

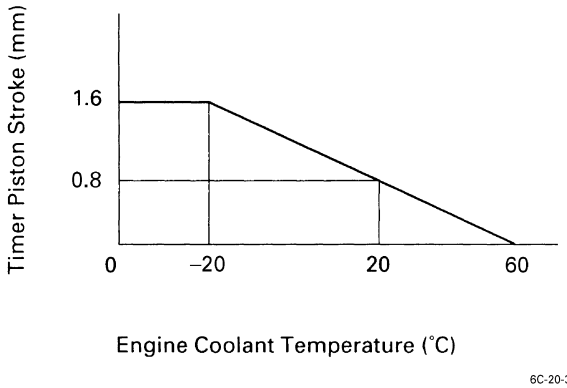
Governor Adjustment



Timer Performance Diagram



Cold Advancer Performance Diagram



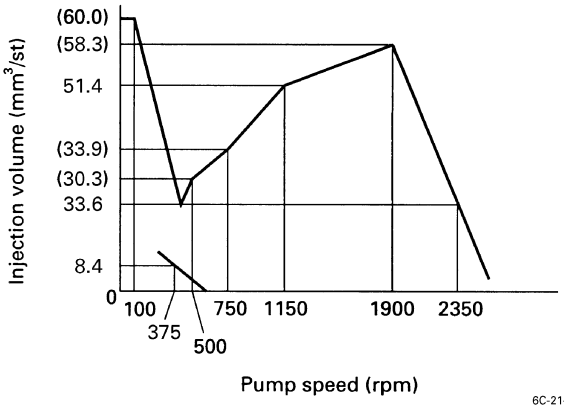
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine: 4JA1

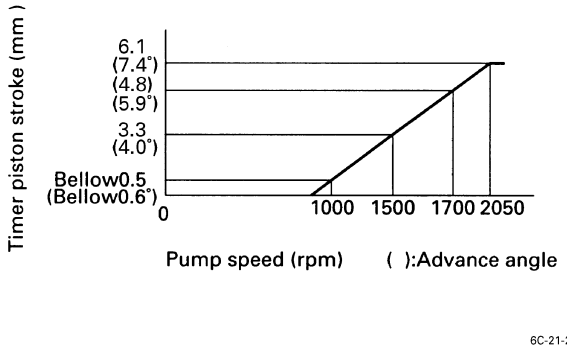
Identification Numbers: 104746-6192

Test Fuel: Standard Diesel Fuel SAE J967D (or ISO 4113)

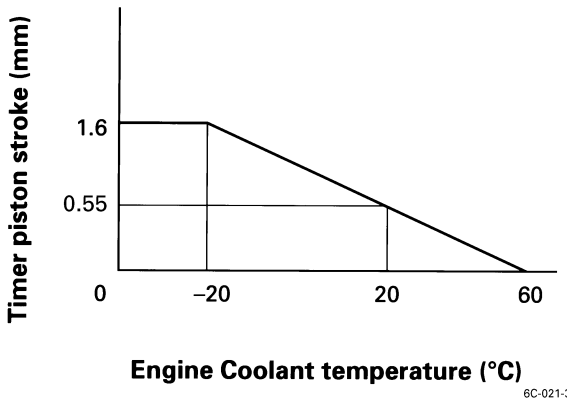
Governor Adjustment



Timer Performance Diagram



Cold Advancer Performance Diagram



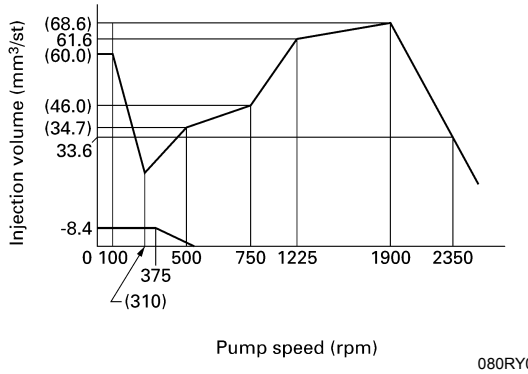
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine: 4JA1L For SOUTH AFRICA only

Identification Numbers: 104746-6501 (ISUZU Part Number 8972176381)

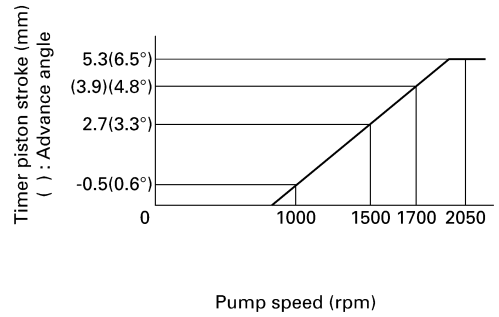
Test Fuel: Standard Diesel Fuel SAE J967D (or ISO 4113)

Governor Adjustment



080RY00004

Timer Performance Diagram



080RY00005

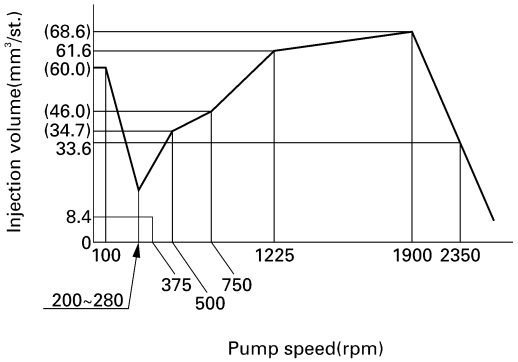
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine: 4JA1L For ARGENTINA only

Identification Numbers: 104746-6450 (ISUZU Part Number 8971881880)

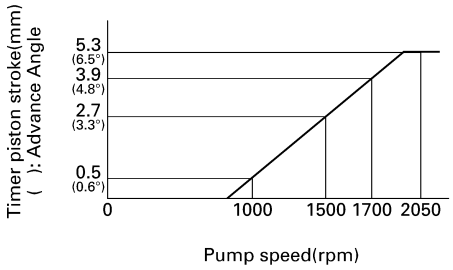
Test Fuel: Standard Diesel Fuel SAE J967D (or ISO 4113)

Governor Adjustment



080RY00006

Timer Performance Diagram



080RY00007

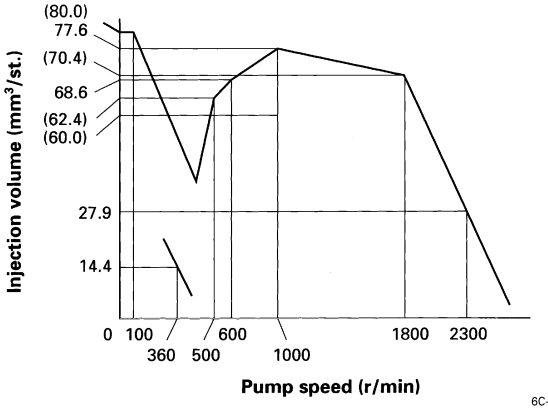
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine: 4JG2T

Identification Numbers: 104741-5862

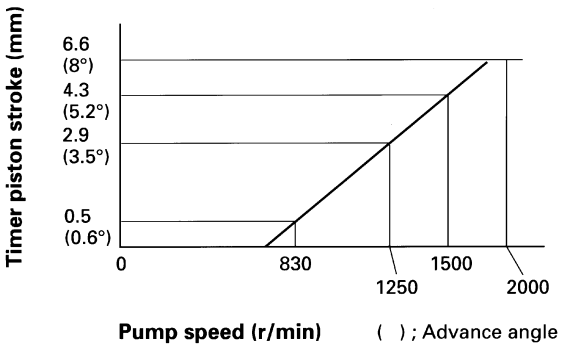
Test Fuel: Standard Diesel Fuel SAE J967D (or ISO 4113)

Governor Adjustment



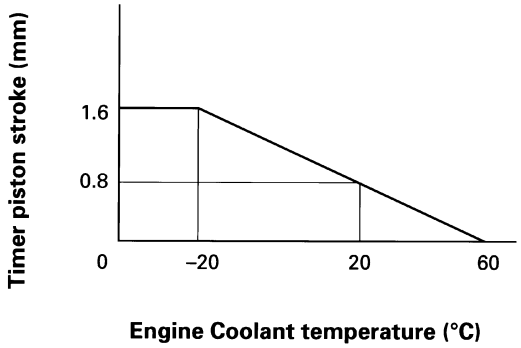
6C-22-1

Timer Performance Diagram



6C-22-2

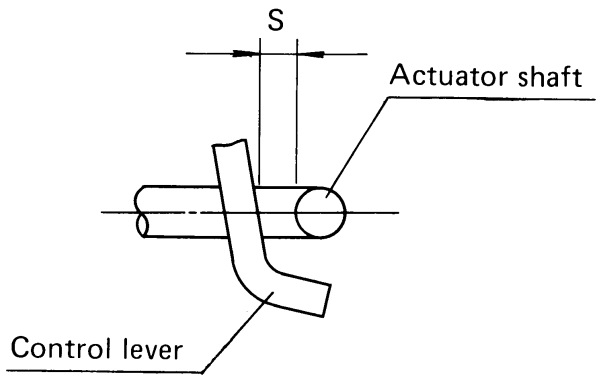
Cold Advancer Performance Diagram



6C-22-3

Vacuum Fast Idle Control Device (V-FICD) Adjustment

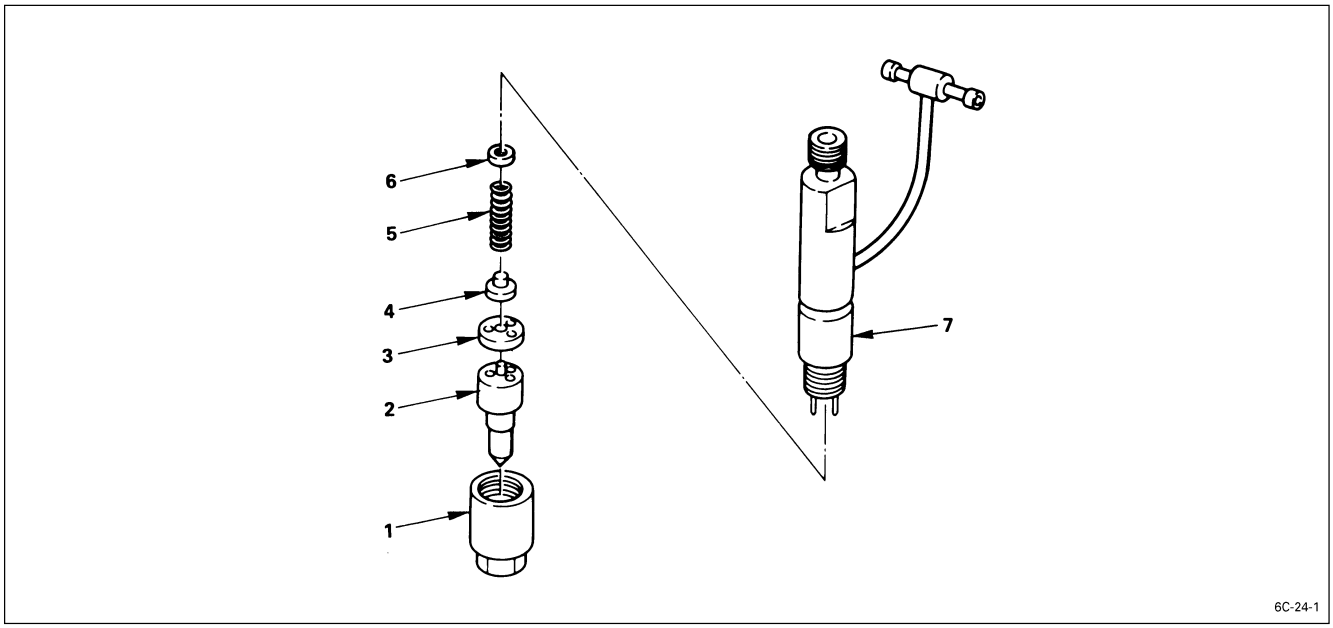
1. Set the bracket clearance “S” to 1.5 ± 0.5 mm (0.06 ± 0.02 in).
2. Apply 400 mmHg negative pressure to the inside of the actuator.
   Check that the actuator shaft moves one complete stroke.



6C-23

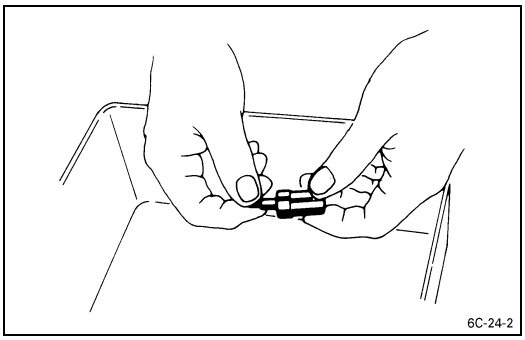
INJECTION NOZZLE

DISASSEMBLY



Disassembly Steps

1. Retaining nut
▲ 2. Injection nozzle
3. Spacer
4. Spring seat
5. Spring
6. Adjusting shim
7. Nozzle holder



Important Operations

2. Injection nozzle

1) Remove the nozzle assemblies from the nozzle holders.

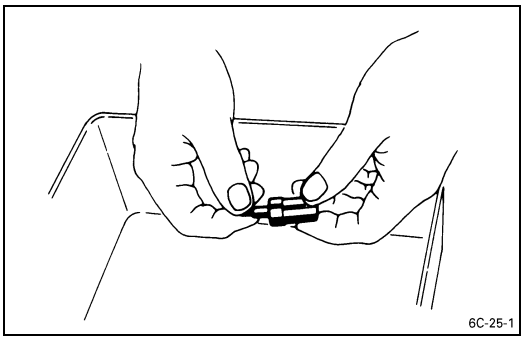
   Tag the nozzle assemblies and the nozzle holders to ensure that they are reinstalled in their original positions.

   The nozzle assembly and nozzle holder combinations must not be interchanged.

2) Immerse the injection nozzles in a tool tray filled with clean diesel oil to protect them from dust.

INSPECTION AND REPAIR

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



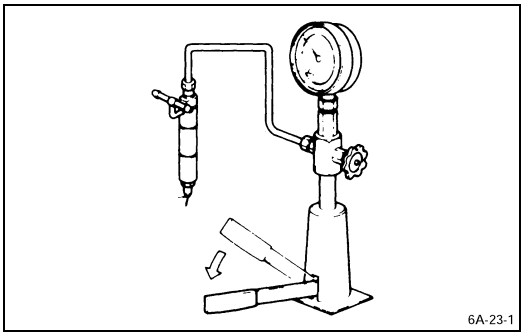
Injection Nozzle Needle Inspection

1. Remove the nozzle needle from the nozzle body.
2. Carefully wash the nozzle needle and the nozzle body in clean diesel fuel.
3. Check that the nozzle needle moves smoothly inside the injection nozzle body.
   If the nozzle needle does not move smoothly, it must be replaced.

Nozzle Body and Needle Valve Inspection

Check the nozzle body and the needle valve for damage and deformation.

The nozzle and body assembly must be replaced if either of these two conditions are discovered during inspection.



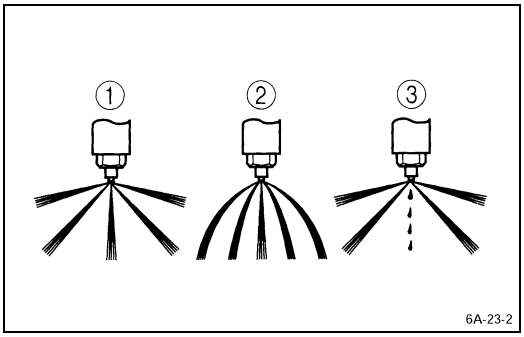
Injection Nozzle Inspection

Use a nozzle tester to check the injection nozzle opening pressure and the spray condition.

If the opening pressure is above or below the specified value, the injection nozzle must be replaced or adjusted.

Injection Nozzle Opening Pressure kg/cm^2 (psi/kPa)

4JA1T, 4JA1, 4JB1T	185 (2,631/18,1)
4JB1T For ARGENTINA and MALAYSIA only.	220 (3,128/21,575)



If the spray condition is bad, the injection nozzle must be replaced or repaired.

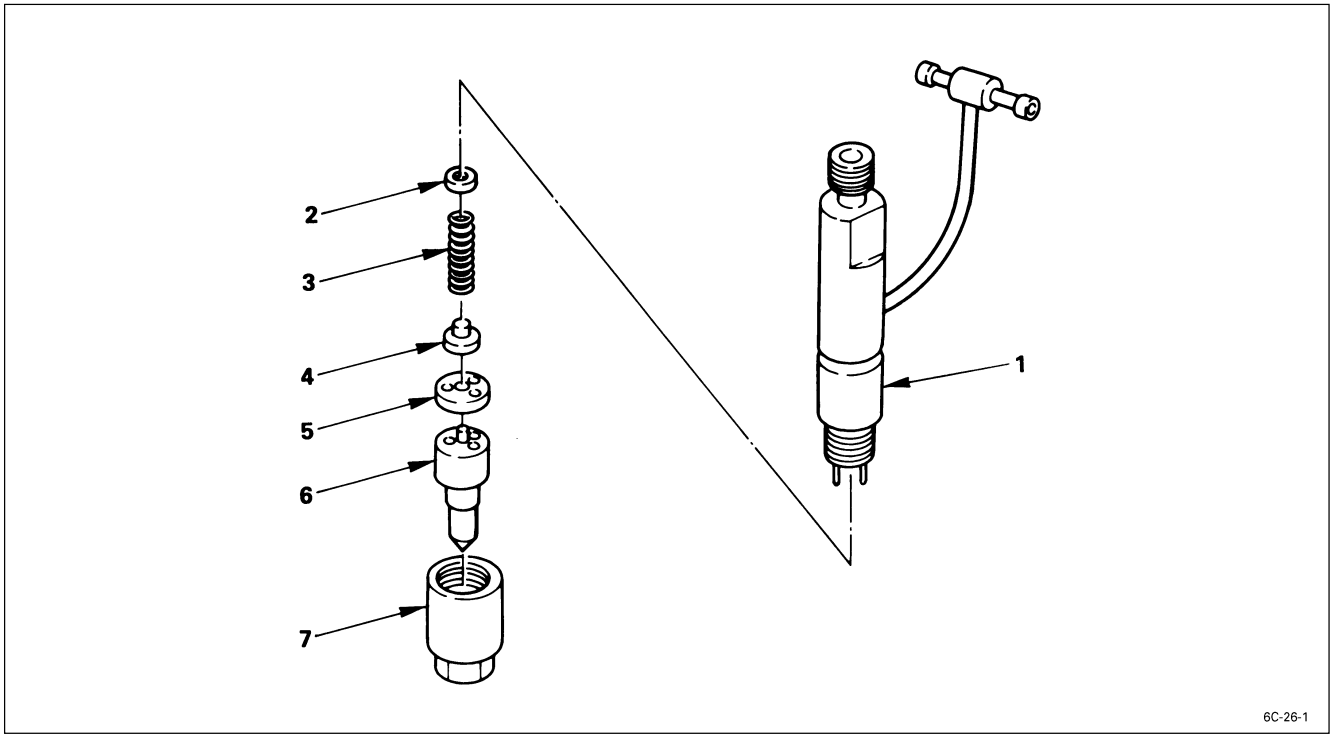
Spray Condition

① Correct

② Incorrect (Restrictions in orifice)

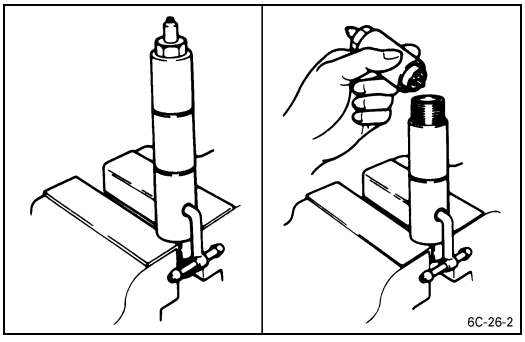
③ Incorrect (Dripping)

REASSEMBLY



Reassembly Steps

1. Nozzle holder
2. Adjusting shim
3. Spring
4. Spring seat
5. Spacer
6. Injection nozzle
7. ▲ Retaining nut

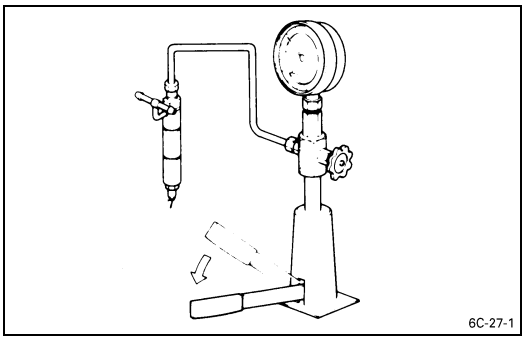


Important Operations

7. Retaining Nut

Tighten the retaining nut to the specified torque.

Retaining Nut Torque	kg·m (lb.ft/N·m)
3.5 ± 0.5 (25.3 ± 3.6/34.3 ± 4.9)	



Injection Nozzle Adjustment

The fuel injection starting pressure adjustment of this injection nozzle is done by rereplacing or decreasing or increasing the number of shims installed.

1) Attach the injection nozzle holder to the injection nozzle tester.
2) Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

   If the injection nozzle does not open at the specified pressure, install or remove the appropriate number of ajusting shims to adjust it.

Nozzle Opening Pressure kg/cm^2 (psi/MPa)
185 (2,631/18.1)

Adjusting Shim Availability	rnm(in)
Range	0.50 – 1.50 (0.02 – 0.06)
Increment	0.025 (0.001)
Total No. of Shims	41

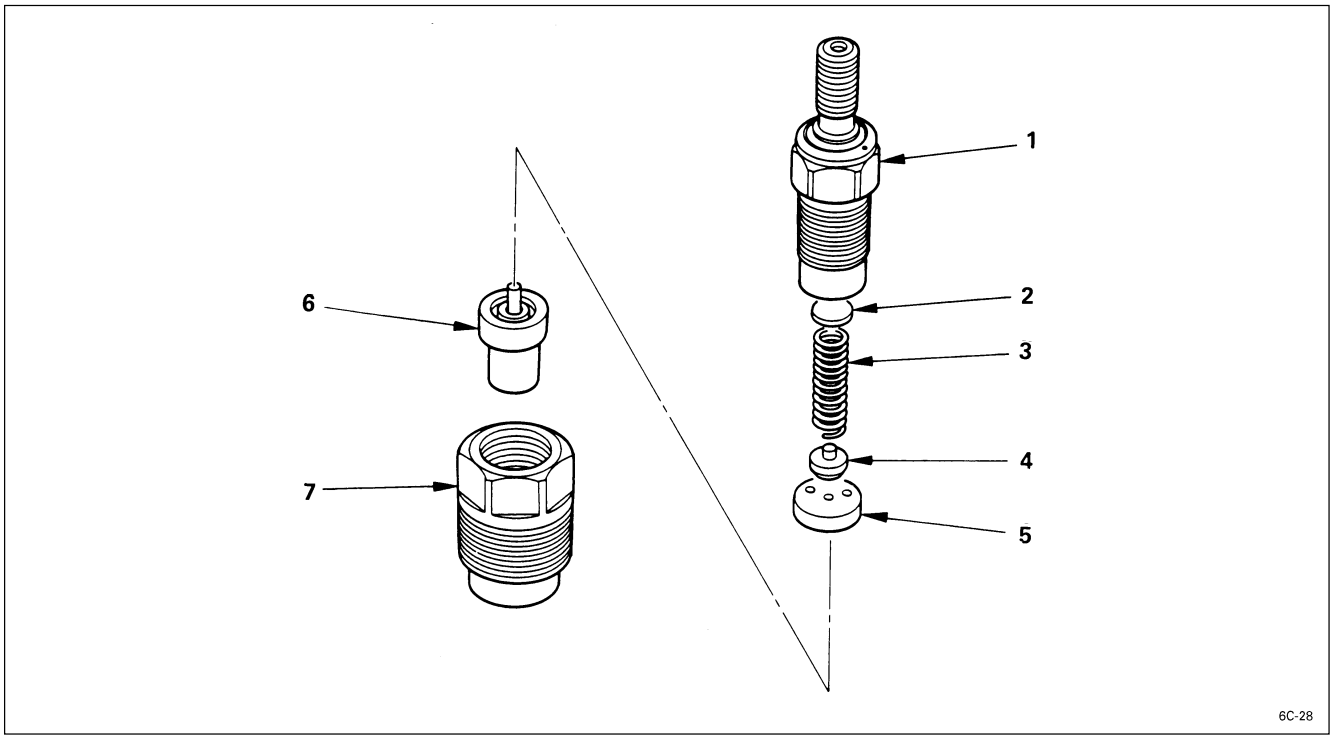
Removing or installing one shim will increase or decrease the nozzle opening pressure approximately 3.77 kg/cm^3 (53.6 psi/369.46 kPa).

WARNING:

TEST FLUID FROM THE INJECTION NOZZLE TESTER 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.

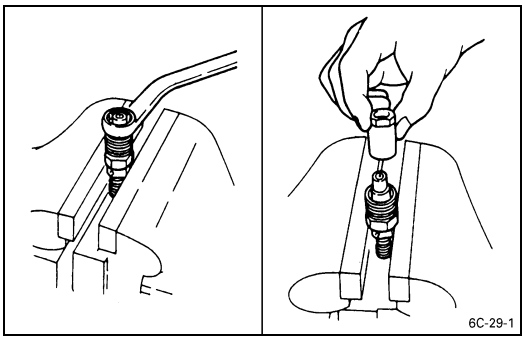
INJECTION NOZZLE
(For 4JG2T Engine)

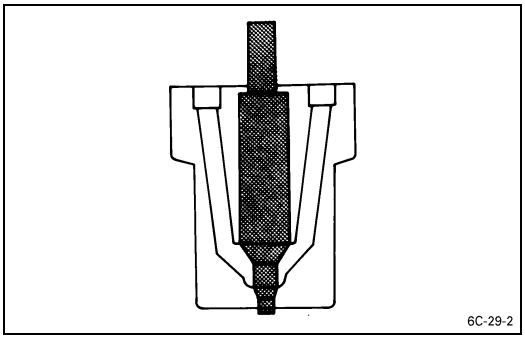
DISASSEMBLY



Disassembly Steps

▲ 1. Nozzle holder body
2. Adjusting shim
3. Spring
4. Push rod
5. Distance piece
▲ 6. Nozzle assembly
7. Retained nut





Important Operations

1. Nozzle holder body

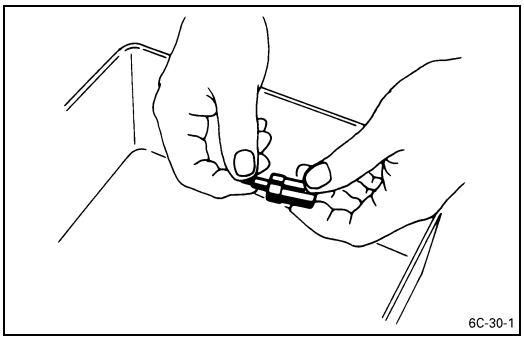
Clamp the nozzle holder in a vise and remove the retaining nut.

6. Nozzle assembly

Keep nozzle assembly removed from the holder body separated to maintain proper needle valve and body combinations.

INSPECTION AND REPAIR

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



Injection nozzle needle seizure inspection

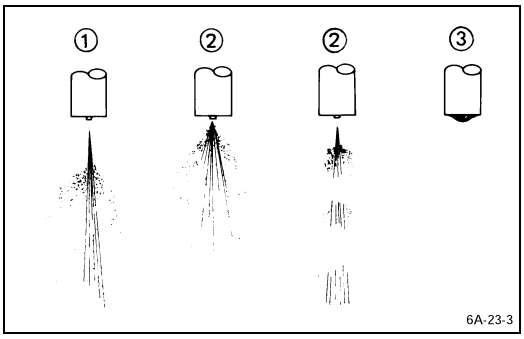
1) Remove the injection nozzle needle from the injection nozzle body.
2) Carefully wash the injection nozzle needle and the injection nozzle body in clean diesel fuel.
3) Check that the injection needle valve moves smoothly inside the injection nozzle body.

   If the injection needle valve does not move smoothly, it must be replaced.

Injection nozzle body and injection needle inspection

Check the injection nozzle body and the injection needle valve for damage and deformation.

The injection nozzle assembly must be replaced if either of these two conditions are discovered during inspection.



Injection Nozzle Inspection

Use a nozzle tester to check the injection nozzle opening pressure and the spray condition.

If the opening pressure is above or below the specified value, the injection nozzle must be replaced or adjusted.

Injection Nozzle Opening Pressure kg/cm^2 (psi/MPa)

4JG2T	150 (2,133/14.7)

If the spray condition is bad, the injection nozzle must be replaced or repaired.

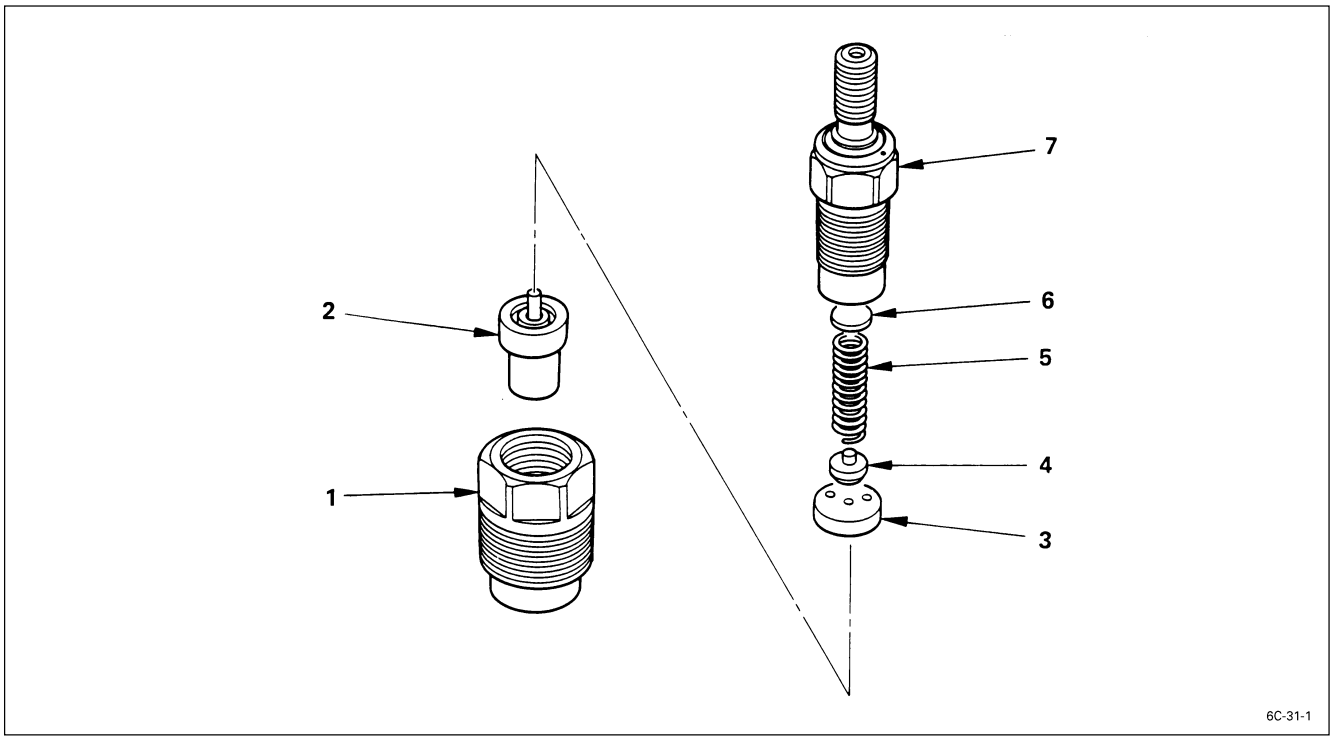
Spray Condition

① Correct

② Incorrect (Restrictions in orifice)

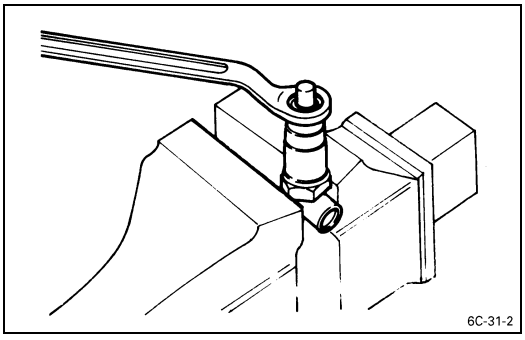
③ Incorrect (Dripping)

REASSEMBLY



Reassembly Steps

1. Retaining nut
2. Nozzle
3. Distance piece
4. Push rod
5. Spring
6. Adjusting shim
▲ 7. Nozzle holder body



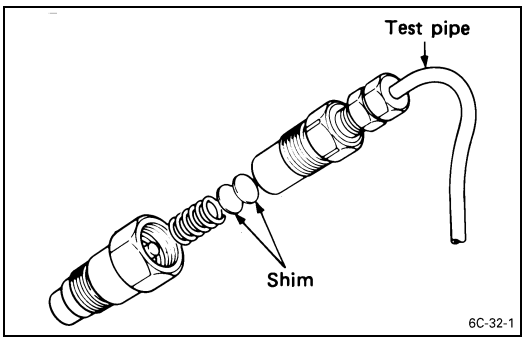
Important Operations

7. Nozzle holder body

Torque	3.0 – 5.0
kg·m (lb.ft/N·m)	(21.7 – 36.2/29.4 – 49.0)

INSPECTION AND ADJUSTMENT (AFTER DISASSEMBLY)

Adjustment of nozzle opening pressure, inspection for leakage and spray condition should be explained.



Adjustment of nozzle opening pressure

Install injection nozzle and nozzle holder assembly to nozzle tester.

Adjust the nozzle opening pressure by setting pressure adjusting shim until desired pressure is obtained.

Check nozzle openinig pressure by pumping tester lever once per second.

Nozzle opening pressure can be changed by:

1. Change of adjusting shim thickness at the rate of 4.8 kg/cm2 (68.3 psi/470.9 kpa) every thickness change of adjusting shim by 0.04 mm (0.0016 in.).
2. Adding one 0.05 mm shim to increase 6 kg/cm^2 (85.3 psi/588.6 kpa).

Nozzle opening pressure of injection nozzles:

150 kg/cm^2 (2,133 psi/14.7 MPa)

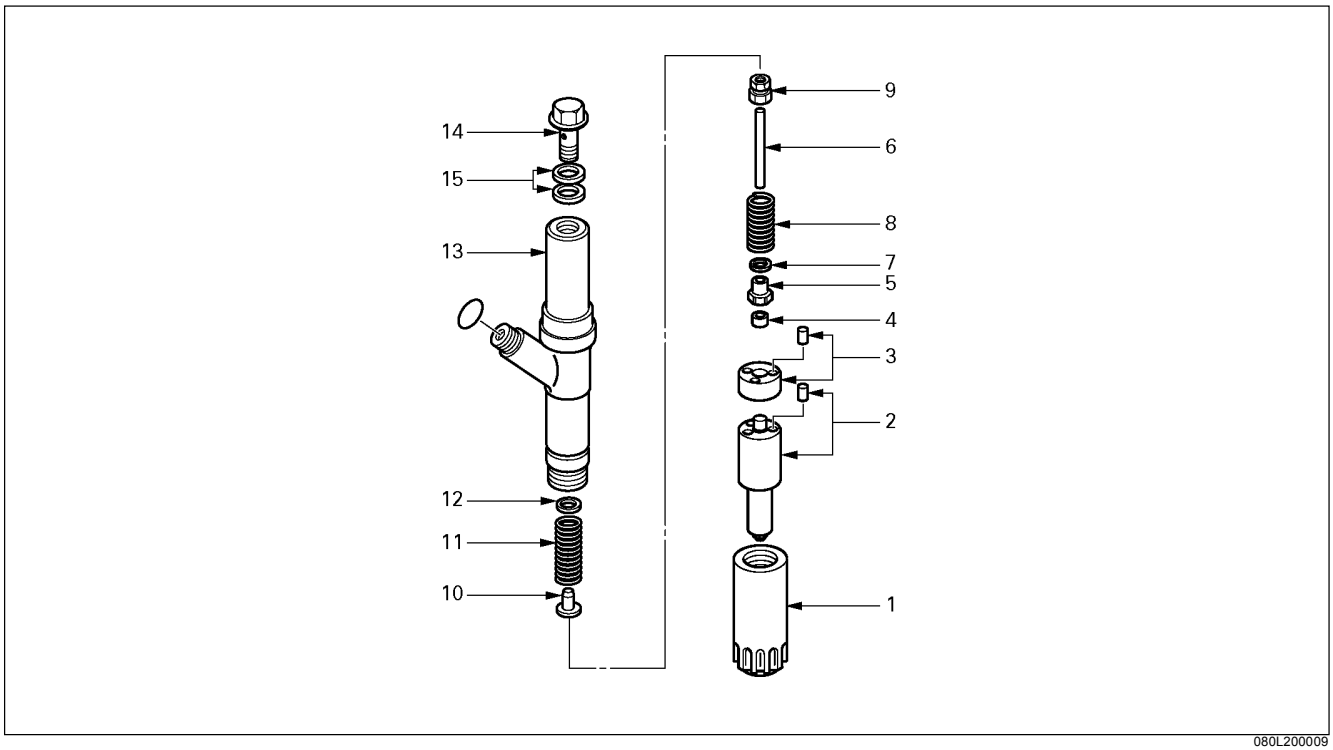
Adjusting shims used for injection nozzle assembly.

Adjusting Shim Available mm (in)

SHIM THICKNESS	IDENTIFICATION MARK ON SHIM
0.50 (0.0197)	50
0.54 (0.0213)	54
↓	↓
0.94 (0.0370)	94
0.98 (0.0386)	98
1.00 (0.0394)	00
0.05 (0.0020)	NONE

INJECTION NOZZLE
(For 4JA1TC, 4JH1TC Engine)

DISASSEMBLY



080L200009

Disassembly Steps

1. Retaining nut
2. Nozzle & pin
3. Spacer & pin
4. Lift Piece
5. Spring seat
6. Push rod
7. Shim (Second nozzle opening pressure adjustment)
8. Second spring
9. Collar
10. Spring seat
11. First spring
12. Shim (First nozzle opening pressure adjustment)
13. Nozzle holder body
14. Eye bolt
15. Gasket

Important Operations

The two-spring nozzle holder has been developed to reduce NOx (Nitrogen Oxides) and particulates from direct injection diesel enigne exhaust.

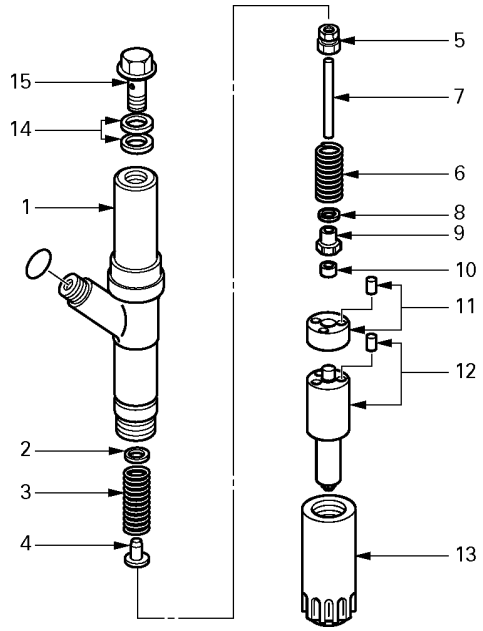
Before disassembly remove carbon deposit from nozzle and nozzle holder using a wire brush and wash the outside nozzle holder assembly.

Caution:

Do not touch nozzle holes with the wire brush during cleaning it.

Disassemble the nozzle holder assembly to numerical order.

REASSEMBLY



080L200010

Reassembly Steps

1. Nozzle holder body
2. Shim (First opening pressure adjustment)
3. First spring
4. Spring seat
5. Collar
6. Second spring
7. Push rod
8. Shim (Second opening pressure adjustment)
9. Spring seat
10. Lift Piece
11. Spacer & pin
12. Nozzle & pin
13. Retaining nut
14. Gasket
15. Eye bolt

Important Operations

The nozzle holder is adjusted as the components are reassembled in the sequence above.

As adjustment of the two-spring nozzle holder is made in hundredths of a millimeter, clean the parts thoroughly in light oil to completely remove any dirt or foreign matter.

REASSEMBLY AND ADJUSTMENT PROCEDURE

1 First nozzle opening pressure adjustment

Adjust the first nozzle opening pressure using the shim.

2 Full needle valve lift confirmation

Confirm the full needle valve lift in accordance with the closed method.

3 Pre-lift confirmation

Confirm pre-lift in accordance with the closed method.

CAUTION:
If not as specified, replace the nozzle assembly, lift piece, pins and spacer using the nozzle service kit.

4 Second nozzle opening pressure confirmation

Confirm the second nozzle opening pressure in accordance with the closed method.

5 Second nozzle opening pressure adjustment

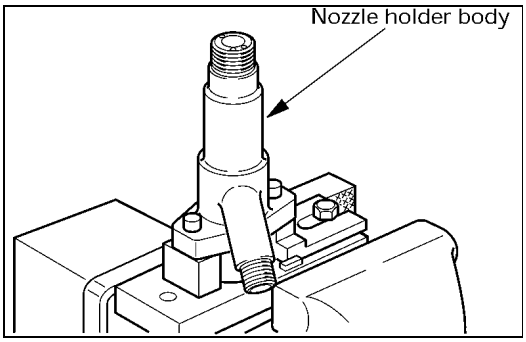
Adjust the second nozzle opening pressure using the shim.

6 Final inspection

Confirm the condition of the fuel spray with the nozzle and nozzle holder assembled.

First nozzle opening pressure adjustment

Nozzle needle valve full-lift	0.25 mm (0.0098 in)
Nozzle needle valve pre-lift	0.04 mm(0.0016 in) at 204 kg/cm^2 (2901 psi, 20,000 kpa)
Nozzle pressure 1st Stage	4JA1TC : 199—209 kg/cm^2 (2830—2972 psi, 19.5—20.5 Mpa)
	4JH1TC : 204—214 kg/cm^2 (2901—3043 psi, 20.0—21.0 Mpa)
2nd Stage	4JA1TC : 347—362 kg/cm^2 (4934—5148 psi, 34.0—35.5 Mpa)
	4JH1TC : 350—365 kg/cm^2 (4977—5190 psi, 34.3—35.8 Mpa)
	at lift 0.09 mm (0.0035 in) = (pre lift + 0.05 mm (0.0020 in))

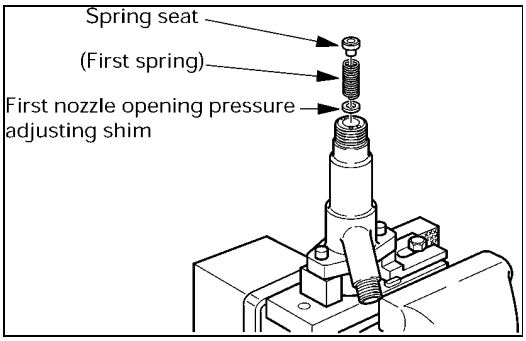


040MV015.tif

Injection Nozzle Adjustment

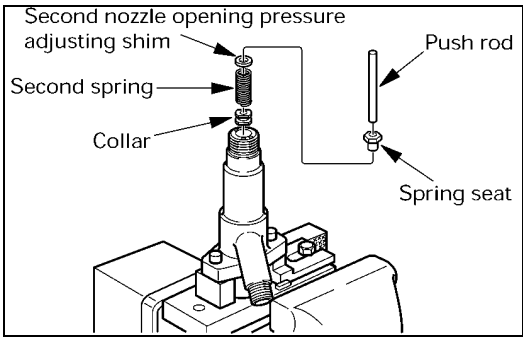
First nozzle opening pressure adjustment

1.Claim the nozzle holder in a vise.



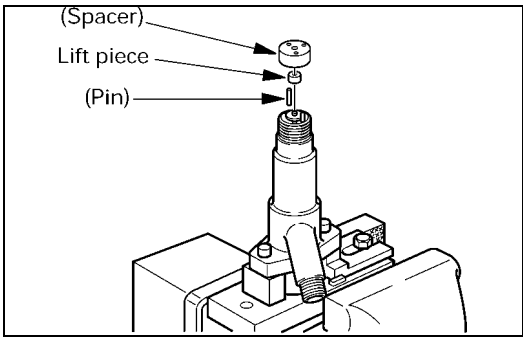
040MV016.tif

2. Install the shim, first spring and spring seat in the nozzle holder.



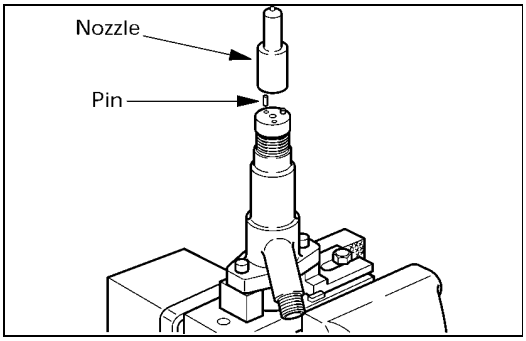
040MV017.tif

3. Install the collar, second spring, shim, spring seat and pushrod in the nozzle holder.



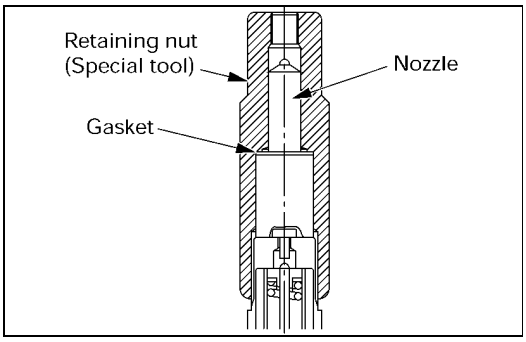
040MV018.tif

4. Install the pins, lift piece and spacer in the nozzle holder.



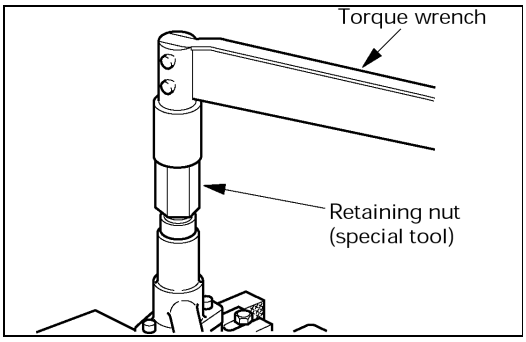
040MV019.tif

5. Install the pins in the spacer.
6. Install the nozzle on the spacer.



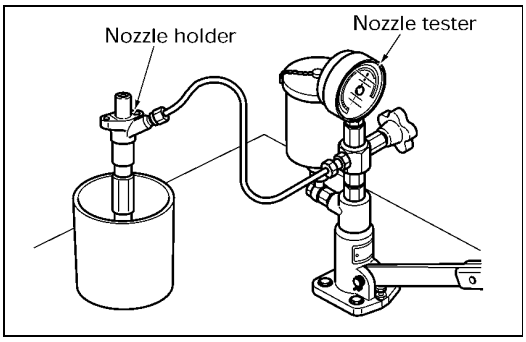
040MV010.tif

7. Hand-tighten the adjustment retaining nut together with the gasket to the nozzle holder.
   Retaining nut: 157892-3200 (Bosch AS)
   Gasket: 157892-5100 (Bosch AS)
   (Bosch AS = Bosch Automotive Systems Corporation)



040MV014-1.tif

8. Tighten the adjustment retaining nut to the specified torque.
   Torque: 5.1 kg·m (36.9 lb·ft/50 N·m)

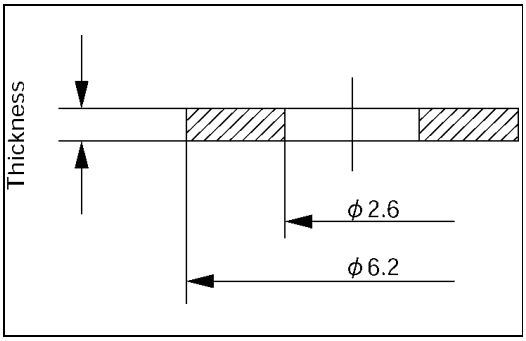


040MV030.tif

9. Set the nozzle holder to the nozzle tester.
10. Operate the nozzle tester and measure the first nozzle opening pressure.
11. If the first nozzle opening pressure is not as specified, disassemble the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

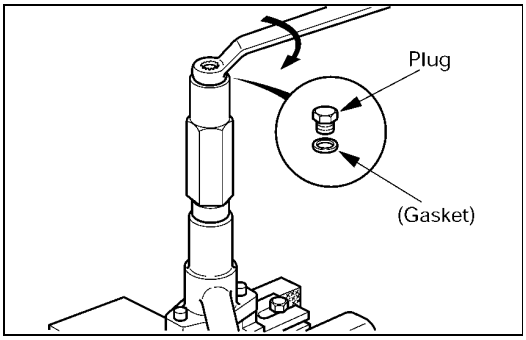
- **Use a micrometer to measure shim thickness.**
- **Use some combination of 3 adjusting shims to adjust the pressure.**



040LX010.tif

- First nozzle opening pressure adjusting shims

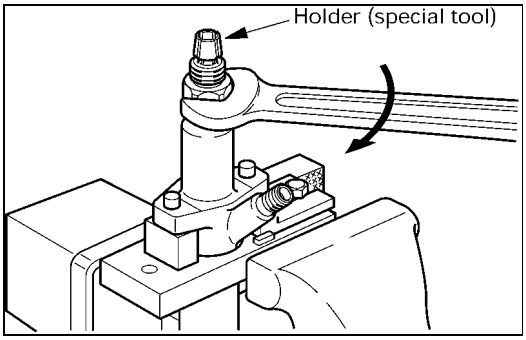
Parts No. (ISUZU)	Thickness (mm)
115349-0420	0.40
115349-0430	0.50
115349-0440	0.52
115349-0450	0.54
115349-0460	0.56
115349-0470	0.58
115349-0480	0.60
115349-0490	0.70



040MV013.tif

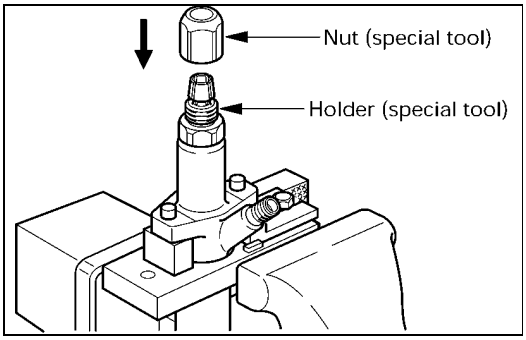
Full needle valve lift confirmation

1. Install the gasket and plug on the adjustment retaining nut.
   Gasket: 026508-1140 (Bosch AS)
   894227-6020 (ISUZU)
   Plug: 157892-1600 (Bosch AS)



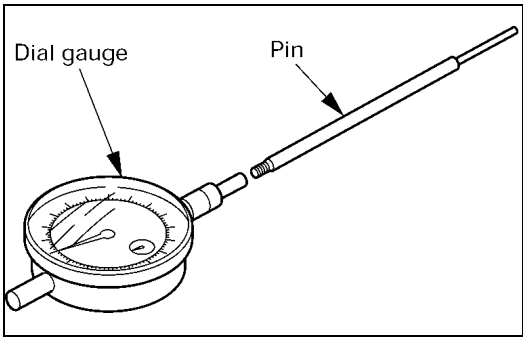
040MV012.tif

2. Position the nozzle holder with the nozzle facing down and install the dial gauge holder on the nozzle holder.
   Dial gauge holder: 157892-5000 (Bosch AS)



040MV011.tif

3. Install the nut on the dial gauge holder.
   Nut: 157892-1000 (Bosch AS)

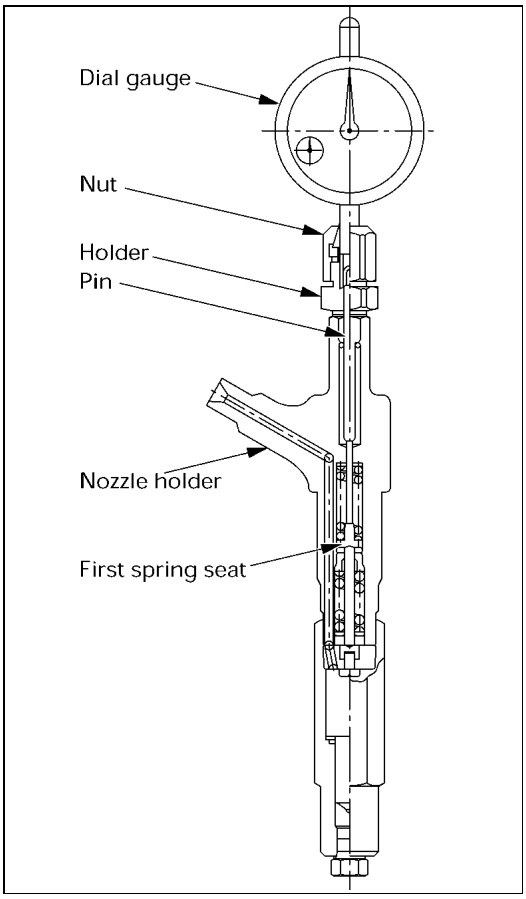


040MV029.tif

4. Install the pin to the dial gauge.

Note:
The lengths of the pins do not include the threaded portions.

Pin (liter=100 mm):	157892-5200 (Bosch AS)
Dial gauge:	157954-3800 (Bosch AS)
	185317-0150 (ISUZU)

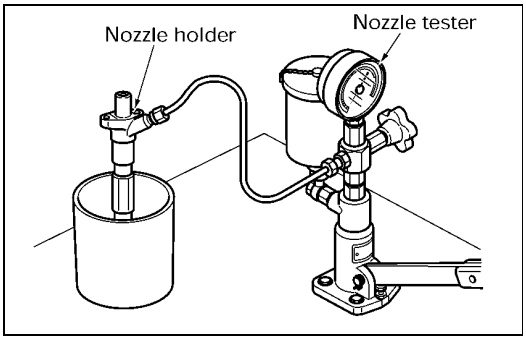


040MV009.tif

5. Secure the dial gauge to the nozzle holder using the nut so that the pin contacts the tip of the first spring seat.

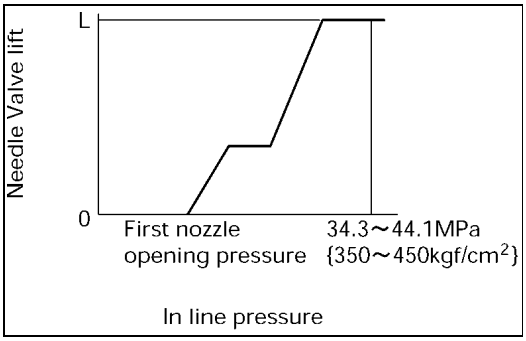
CAUTION:

- **Secure the dial gauge so that a stroke of 2 mm can be measured.**
- **Do not over-tighten the nut as the dial gauge shaft may jam. (Confirm from the dial gauge that the shaft moves smoothly.)**



040MV030.tif

6. Set the nozzle holder to the nozzle tester and put needle to zero on the dial gauge.
7. Operate the nozzle tester to bleed any air from inside the retaining nut and to confirm that no fuel leaks.



040MV008.tif

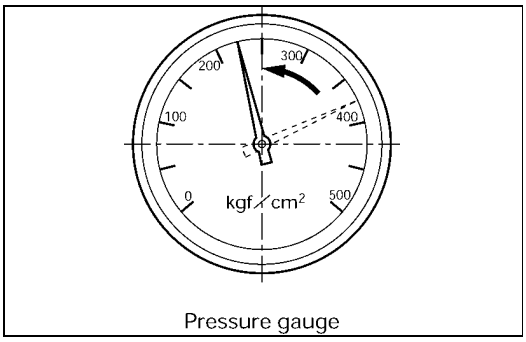
8. Operate the nozzle tester and increase the in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift.
   Record full lift 'L'. (Read dial gauge)

Nozzle Full Lift mm (in)

0.25 ± 0.02 (0.0098 ± 0.00008)

Note:

The above operation is used to determine whether the nozzle seat is worn and whether the nozzle assembly is in good condition.



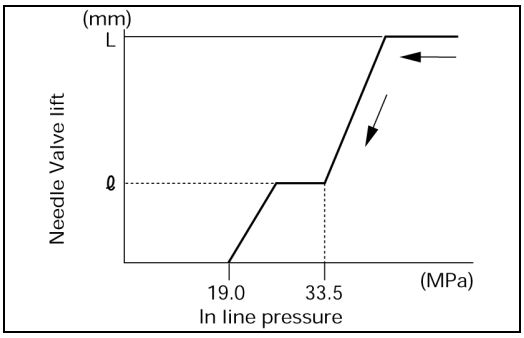
040MV007.tif

Pre-lift confirmation

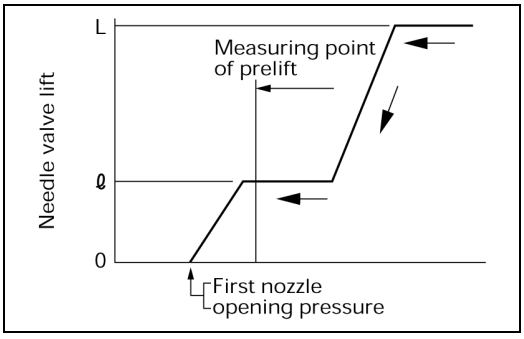
1. With the needle valve at full lift, release the nozzle tester handle.

Note:

The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.



040M100004



040H100007

2. Read the needle valve lift 'liter' from the dial gauge indication (once the needle valve has descended when the second spring has stopped operating). Refer to the pre-lift measuring point for 'liter'.

Pre-lift measuring point:

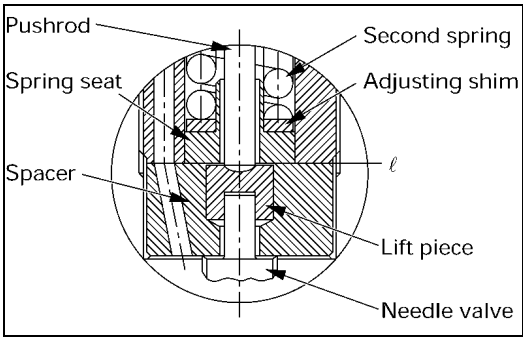
Read the dial gauge at first nozzle opening pressure +approx 1 MPa (10 kg/cm^2).

Pre-lift mm

Pressure kg/cm^2 (psi/kpa)	Lift mm (in)
204 (2,901/20,000)	0.04 (0.0016)

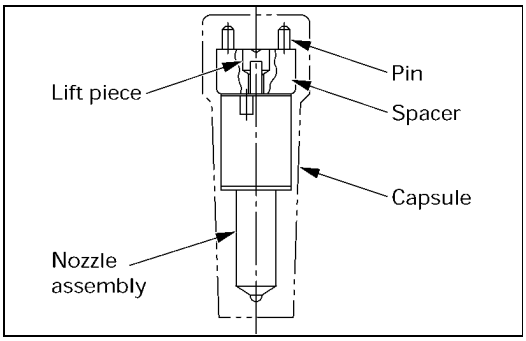
Note:

This point can be found while the pressure is decreasing.



040MV005.tif

3. Confirm that pre-lift 'liter' is as specified.

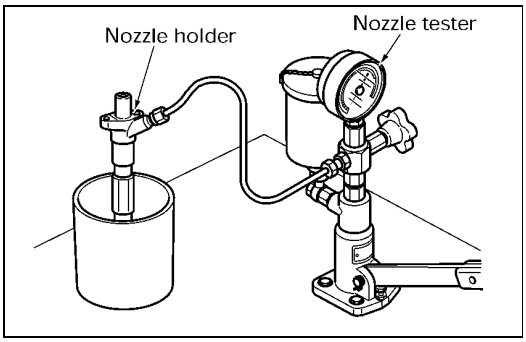


040MV031.tif

4. If pre-lift is not as specified, replace the pins, lift piece, spacer and nozzle assembly as a set with the service kit.

Service kit

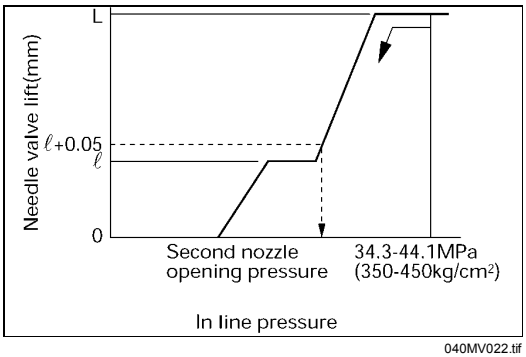
105017-2990 (Bosch AS)
897302-3070 (ISUZU)



040MV030.tif

Second nozzle opening pressure confirmation

1. After pre-lift confirmation, operate the nozzle tester to increase in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift.

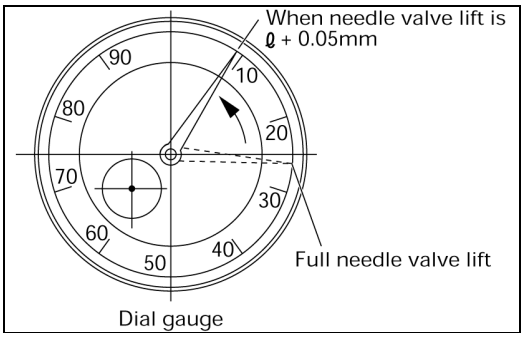


040MV022.tif

2. Release the nozzle tester handle so that in-line pressure decreases.

   Note:

   The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.

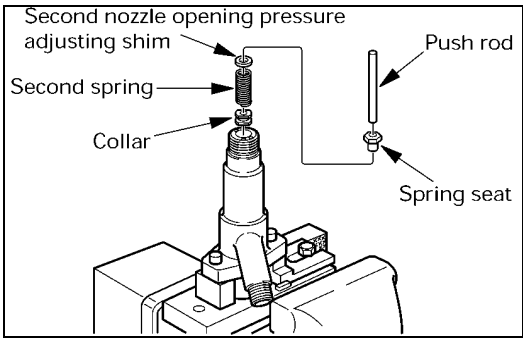


040M100006

3. Then, read the pressure gauge indication (second nozzle opening pressure) the instant that the dial gauge indicates the specified needle valve lift (usually pre-lift liter + 0.05 mm).

Second Nozzle Opening Pressure

	Lift mm (in)	Pressure kg/cm^2 (psi/Mpa)
4JA1TC	0.09 (0.0035)	347 – 362 (4934—5148/34.0—35.5)
4JH1TC		350 – 365 (4977—5190/34.3—35.8)



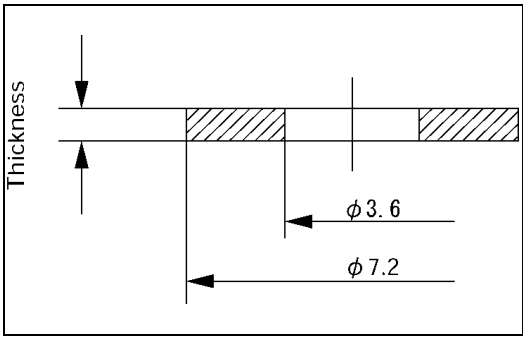
040MV017.tif

Second nozzle opening pressure adjustment

If the second nozzle opening pressure is not as specified, disassemble the nozzle from the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

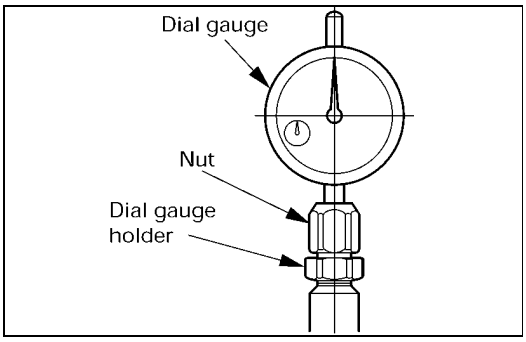
- **Because the second opening pressure changes when the first opening pressure changes, the second opening pressure must be adjusted when the first opening pressure changes.**
- **Use a micrometer to measure shim thickness.**
- **Use some combination of 3 adjusting shims to adjust the pressure.**



040LX009.tif

- Second nozzle opening pressure adjusting shims

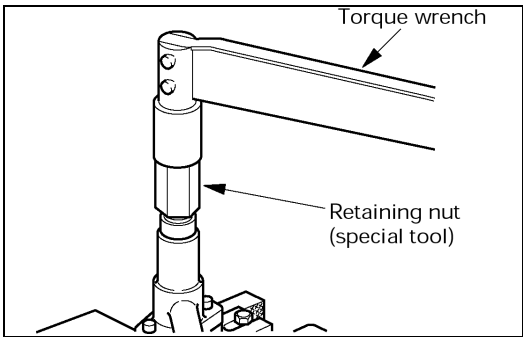
Part No. (ISUZU)	Thickness (mm)	Part No. (ISUZU)	Thickness (mm)
897116-0290	0.10	897116-0380	0.53
897116-0320	0.20	897116-0390	0.54
897116-0330	0.30	897116-0400	0.55
897116-0340	0.40	897116-0410	0.56
897116-0350	0.50	897116-0420	0.57
897116-0360	0.51	897116-0430	0.58
897116-0370	0.52	897116-0440	0.59



040MV028.tif

Final inspection

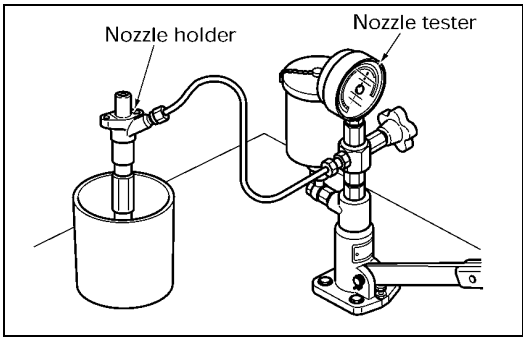
1. Remove the dial gauge, nut and dial gauge holder.



040MV014-1.tif

2. Remove the adjustment retaining nut and gasket.
3. Install the original retaining nut, confirm that the pins are inserted fully into the nozzle, and then hand-tighten the retaining nut. Then, tighten the original retaining nut to the specified torque.

   Torque: 7.0 kg·m (50.6 lb·ft/69 N·m)



040MV030.tif

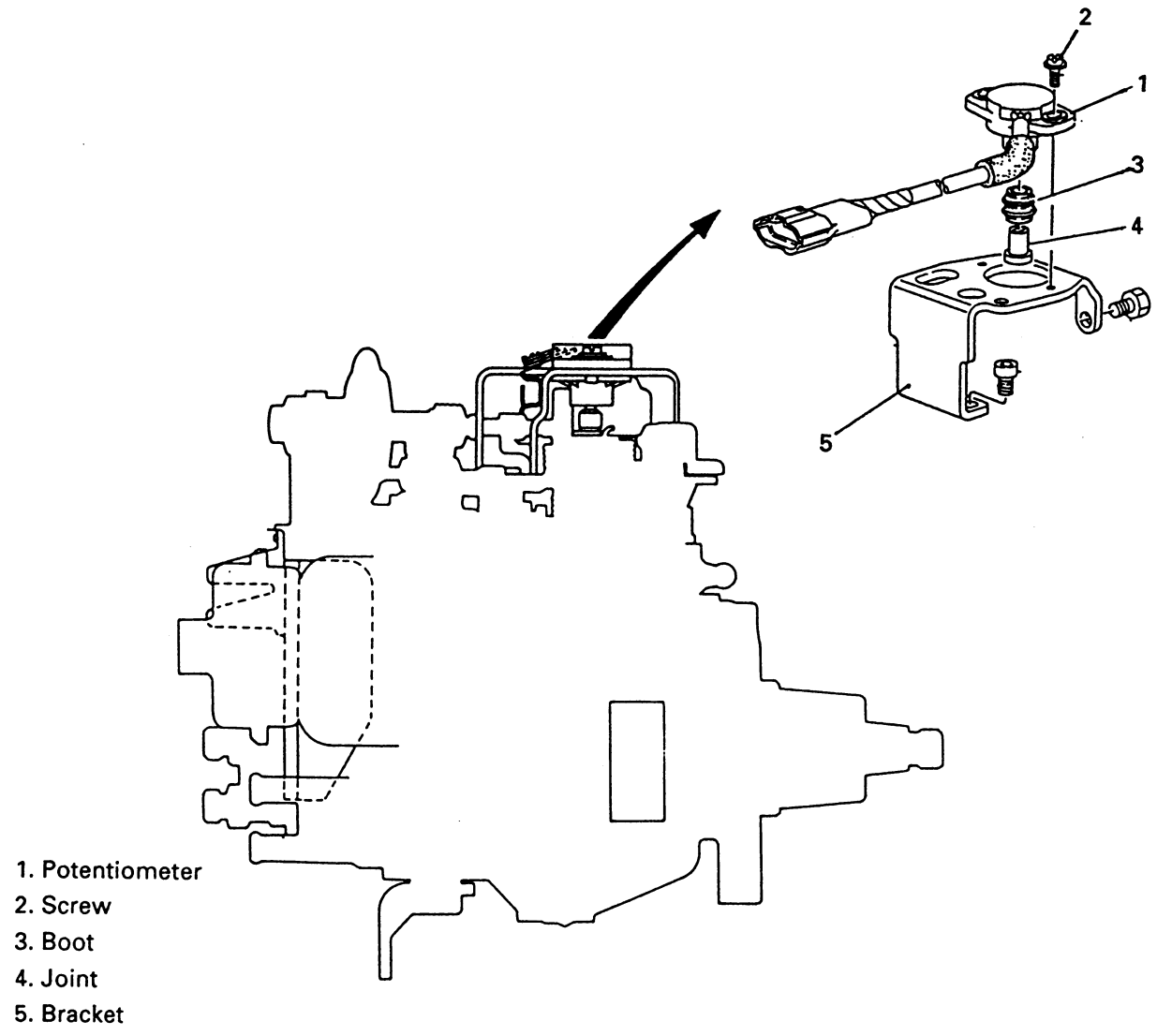
4. Set the nozzle holder to the nozzle tester and check first nozzle opening pressure, spray condition, seat oil tightness and each part for oil leaks.
5. When replacing the nozzle, replace the nozzle, lift piece, pins and spacer as a set with the nozzle service kit.

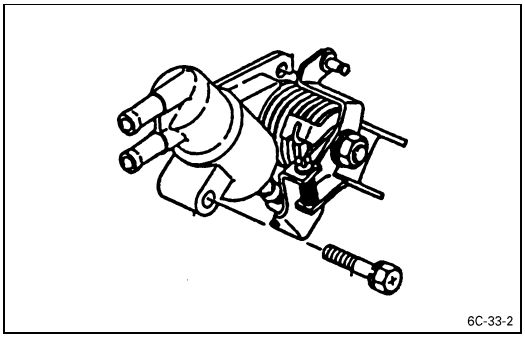
CAUTION:

Pre-lift will not be as specified if only the nozzle is replaced.

ADJUSTMENT PROCEDURE FOR POTENTIOMETER

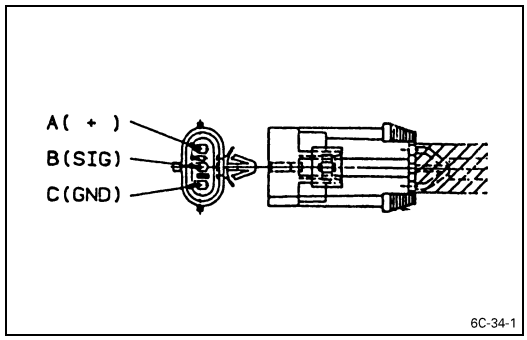
Development view of Potentiometer





1. Advance Assembly (CSD)

Remove the advance assembly from the injection pump assembly.



2. Digital Volt Meter and DC Constant Voltage Power Supply.

1) Connect digital volt meter to B and C connector on wire harness from potentiometer.
2) Connect DC constant voltage power supply to A (for positive electricity) and C (for negative electricity) connector on wire harness from potentiometer.
3) Supply DC 10V to between A and C connector.
4) Measure the output voltage from potentiometer at idling position on the fuel control lever.

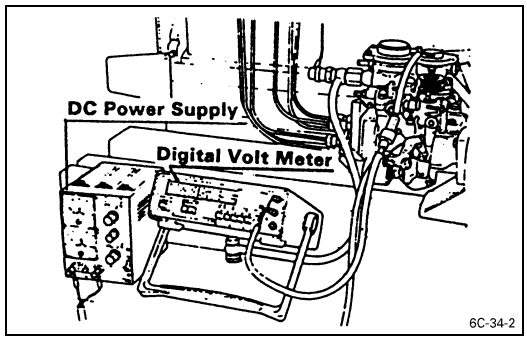
Idling Position Output Voltage — Volt

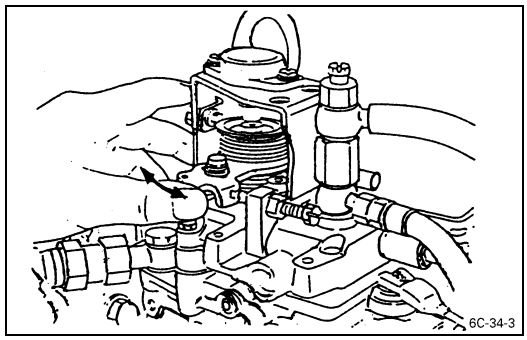
	Until 99 Model	From 00 Model
4JA1T	1.62 ± 0.45	2.12 ± 0.45
4JG2T	1.41 ± 0.45	1.41 ± 0.45

5) Measure the output voltage from potentiometer at full load position on the fuel control lever.

Full Load Position Output Voltage — Volt

	Until 99 Model	From 00 Model
4JA1T	7.7 ± 0.45	4.1 ± 0.03
4JG2T	-	3.65 ± 0.03

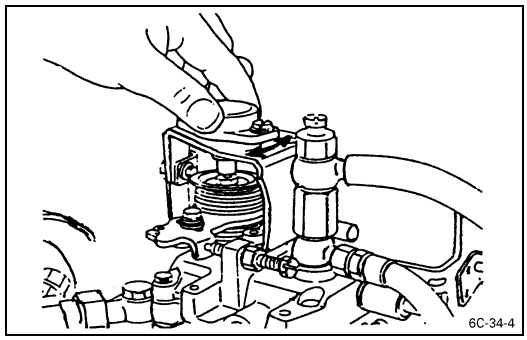


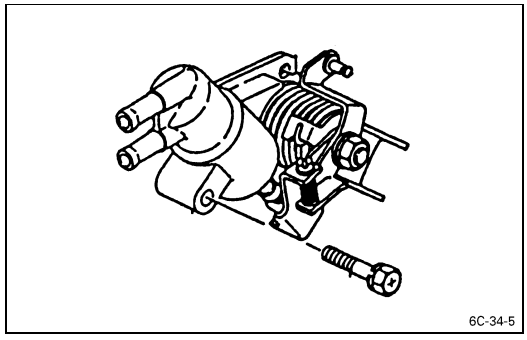


3. Adjustment of Output Voltage from Potentiometer

If the Measuring value is without standard above, readjust setting position of the potentiometer as below.

1) Loose the potentiometer fixing bolts.
2) Keep fuel control lever on idling position then move the potentiometer until reading the output voltage within standard.
3) Same time read the output voltage with full load position on the control lever.
4) Make sure that fuel control lever return to idling position by return spring.





5) Fix the advance assembly to the injection pump assembly.

Note:

If can not be readjusted potentiometer output voltage, recommend to contact Zexel or Bosch argent near your garage.

SECTION 6D
ENGINE ELECTRICAL

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- Removal and Installation ..... 6D -10
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Starter Motor ..... 6D -26
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- Inspection and Repair ..... 6D -30
- Reassembly ..... 6D -35

Pre-heating System ..... 6D -38
- Inspection and Repair ..... 6D -38

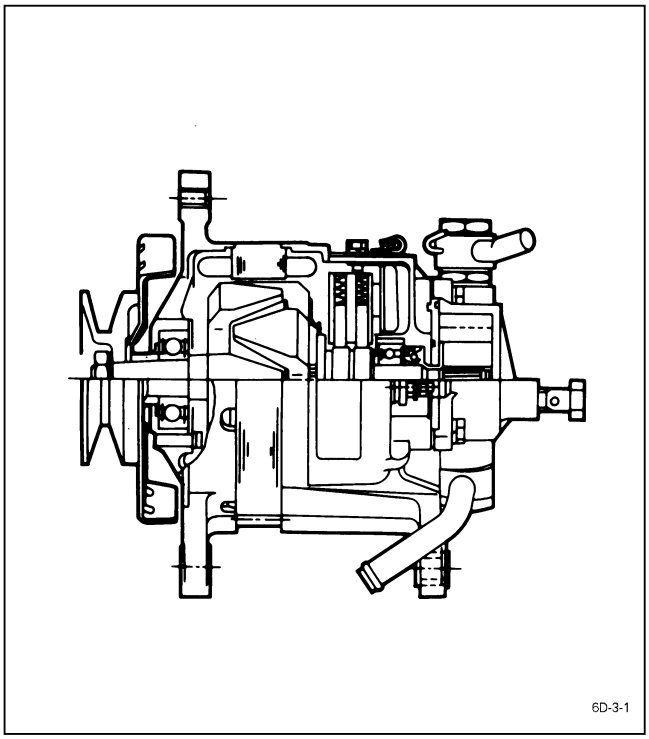
Troubleshooting ..... 6D -41
QOSII Preheating System ..... 6D -51
QOSII System Troubleshooting ..... 6D -54

MAIN DATA AND SPECIFICATIONS

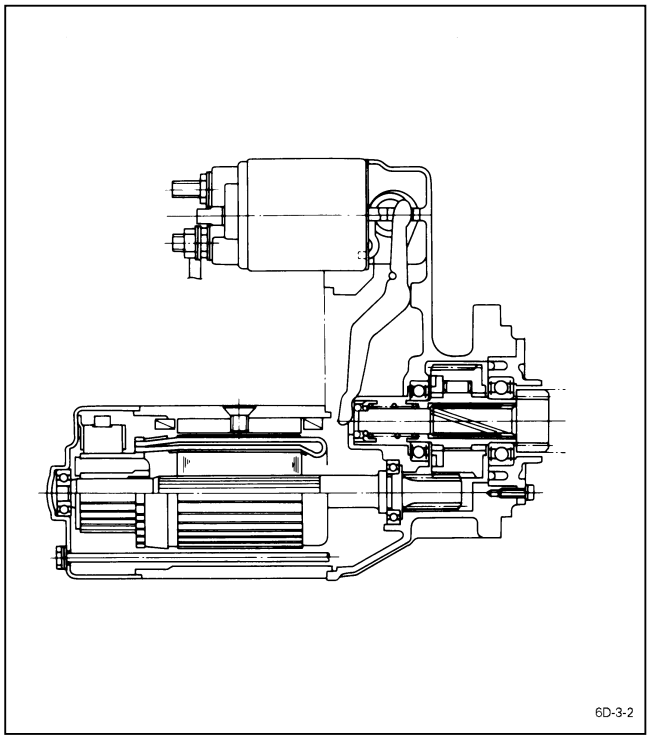
Item		Description					
		4JA1TC, 4JH1TC		4JA1, 4JA1T (L), 4JB1T			4JG2T
		General	Option	General	Option		General
Generator							
Type		AC brush with IC regulator and vacuum pump					
Voltage	V	12					
Drive and rotation		V-belt, clockwise viewed from the drive pulley					
Ground polarity		Negative					
Maximum output	A	60 at 5,000 rpm	80 at 5,000 rpm	40 at 5,000 rpm	50 at 5,000 rpm	80 at 5,000 rpm	60 at 6,000 rpm
Engine speed ratio	to 1	1.77		1.85			1.77
Maximum speed	rpm	11,000		11,000	11,000	9,500	11,000
Starter Motor							
Type		Solenoid controlled					
Rated voltage	V	12					
Rated output	kW	2.3					2.8
Load characteristics							
Terminal voltage	V	8.76					
Load current	A	300					
Vacuum Pump							
Delivery volume	cm^3/rev	30					50
500 mmHg build up time		35 seconds or less at 1,000 rpm					21 seconds or less at 1,000 rpm
		7~10 seconds or less at 5,000 rpm					
Maximum vacuum		680 mmHg or more at 5,000 rpm		650 mmHg or more at 5,000 rpm			
Weight	kg(lb)	0.65 (1.43)		0.9 (1.99)	1.2 (2.6)		

GENERAL DESCRIPTION

GENERATOR



STARTER MOTOR

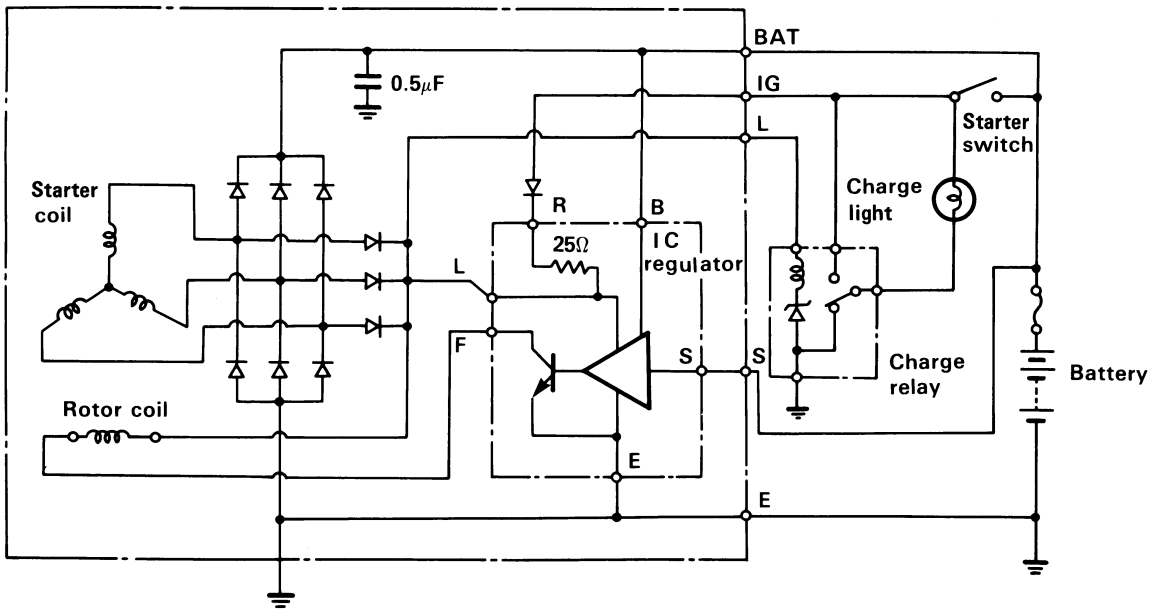


The basic charging system is the IC integral regulator charging system. The internal components are connected electrically as shown in charging circuit diagram.

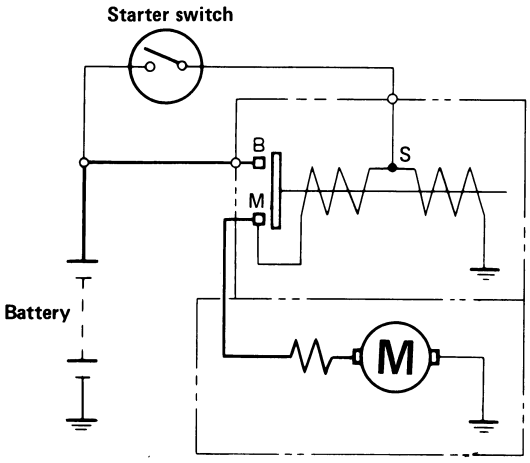
The generator features a solid state regulator that is mounted inside the generator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The generator voltage setting cannot be adjusted.

The starter motor circuit is composed of a 4-pole 4-brush type direct current series motor, starter switch with safety lock, etc. The starter motor circuit utilizes negative ground polarity.

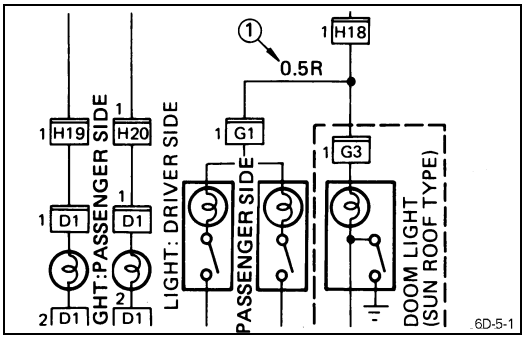
CHARGING CIRCUIT DIAGRAM



STARTING CIRCUIT DIAGRAM



WIRE CODING

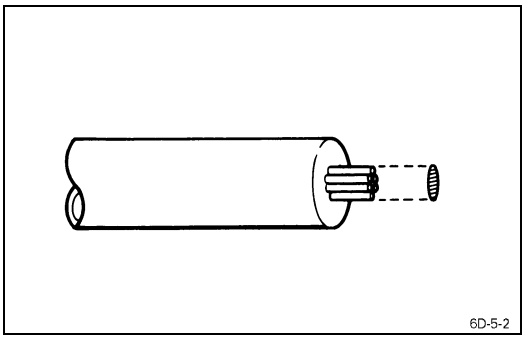


DESCRIPTION

Codes used in the circuit diagram represent wire size and color ①.

Example: 0.5 R

- Wire color (Red)
- Wire size (0.5 mm^2)



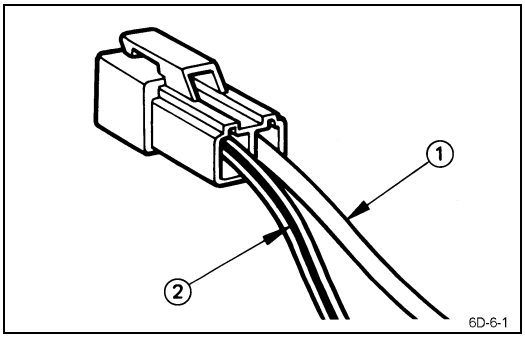
WIRE SIZE

Wire size is specified with the metric gauge system.

The metric gauge system gives the wire size in cross-sectional area measured in square millimeters.

WIRE SIZE SPECIFICATIONS

Wire size		Number of wires/ Wire diameter mm (in.)	Resistance at normal room temperature of 20°C (68°F) Ω/m (Ω/ft.)	Maximum allowable current A
mm^2	AWG			
0.5	20	7/0.32 (0.013)	0.03250 (0.00991)	11.3
0.85	18	11/0.32 (0.013)	0.02050 (0.00625)	14.8
1.25	16	16/0.32 (0.013)	0.01410 (0.00430)	18.8
2	14	26/0.32 (0.013)	0.00867 (0.00264)	25.4
3	12	41/0.32 (0.013)	0.00550 (0.00168)	34.2
5	10	65/0.32 (0.013)	0.00347 (0.00106)	45.9
8	8	50/0.45 (0.018)	0.00228 (0.00070)	59.8
15	6	84/0.45 (0.018)	0.00136 (0.00042)	82.8
20	4	41/0.80 (0.031)	0.00087 (0.00027)	110.9
30	2	70/0.80 (0.031)	0.00051 (0.00016)	147.0



WIRE COLOR

All wires have color-coded insulation.

Wires belonging to a system's main harness will have a single color ①.

Wires belonging to a system's sub-circuits will have a colored stripe ②.

Striped wires use the following code to show wire size and colors.

Example: 0.5 G R

- Wire size (0.5 mm^2)
- Green (Base color)
- Red (Stripe color)

Abbreviations are used to indicate wire color within a circuit diagram.

Refer to the following table.

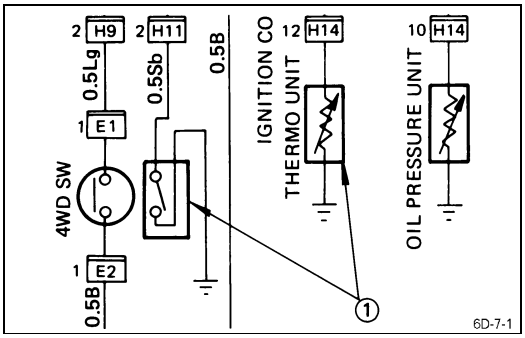
WIRE COLOR-CODING

Color-coding	Meaning	Circuits
B	Black	Starter circuit and grounding circuit
W	White	Charging circuit
R	Red	Lighting circuit
G	Green	Signal circuit
Y	Yellow	Instrument circuit
L	Blue	Wiper circuit
O	Orange	Other circuits
Br	Brown	
Lg	Light green	
Gy	Grey	
P	Pink	
Sb	Sky blue	
V	Violet	

SYMBOLS AND ABBREVIATIONS

DESCRIPTION

The symbols and abbreviations used in the circuit diagram make the diagram easier to read and understand.

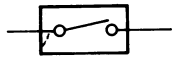
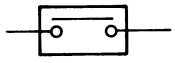
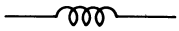


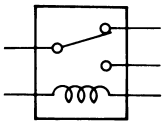
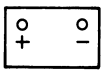
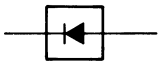
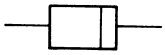
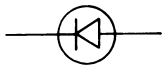
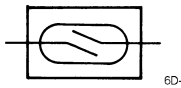
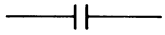
SYMBOLS

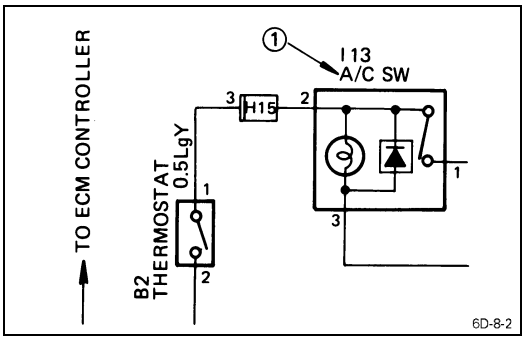
The illustration at the left shows a typical symbol ① used in circuit diagrams.

Refer to the following table.

SYMBOL AND MEANING

Symbol	Meaning	Symbol	Meaning
 6D-7-2a	Fuse	 6D-7-2f	Single filament bulb
 6D-7-2b	Main fuse	 6D-7-2g	Double filament bulb
 6D-7-2c	Fusible link wire	 6D-7-2h	Motor
 6D-7-2d	Switch	 6D-7-2i	Variable resistor
 6D-7-2e	Switch	 6D-7-2j	Coil (Inductor)

Symbol	Meaning	Symbol	Meaning
 6D-8-1a	Contact wiring	 6D-8-1g	Relay **Note:** **Relay contact shown in the wiring diagram indicates condition before actuation.**
 6D-8-1b	Battery		
 6D-8-1c	Diode	 6D-8-1h	Connector
 6D-8-1d	Electronic part	 6D-8-1i	Light emitting diode
6D-8-1e	Resistor	 6D-8-1j	Reed switch
 6D-8-1f	Speaker	 6D-8-1k	Condenser



ABBREVIATIONS

The illustration at the left shows a typical abbreviation ① used in circuit diagrams.

These same abbreviations may also appear in the next.

Refer to the following table.

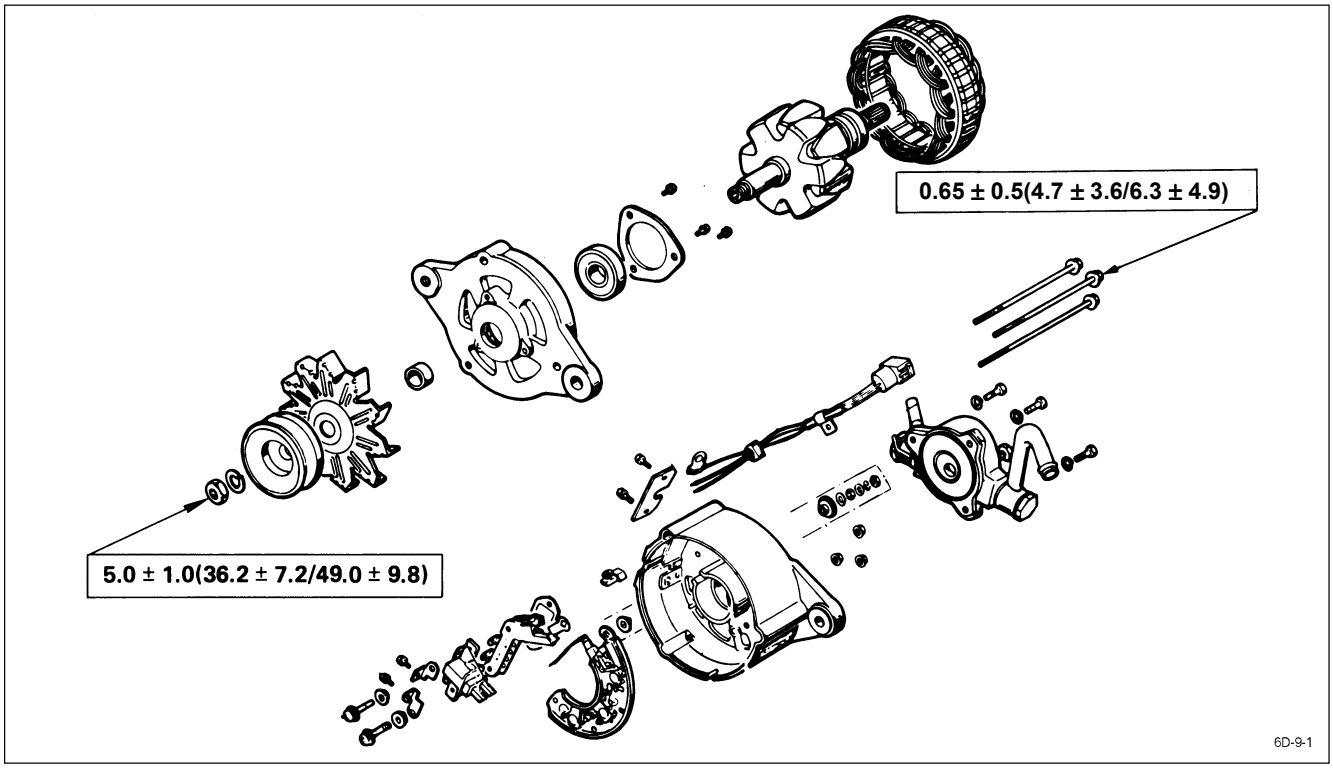
ABBREVIATION AND MEANING

Abbreviation	Meaning	Abbreviation	Meaning
RH	Right-hand side	STD	Standard equipment
LH	Left-hand side	OPT	Optional equipment
SW	Switch	W/	With
M/T	Manual transmission	WO/	Without
A/T	Automatic transmission	OD	Overdrive
FT	Front	ACC	Accessories
RR	Rear	A/C	Air conditioner
FLW	Fusible link wire	ATF	Automatic transmission fluid
TEMP	Temperature	VSV	Vacuum switching valve
ECM	Electronic control module		

TORQUE SPECIFICATIONS

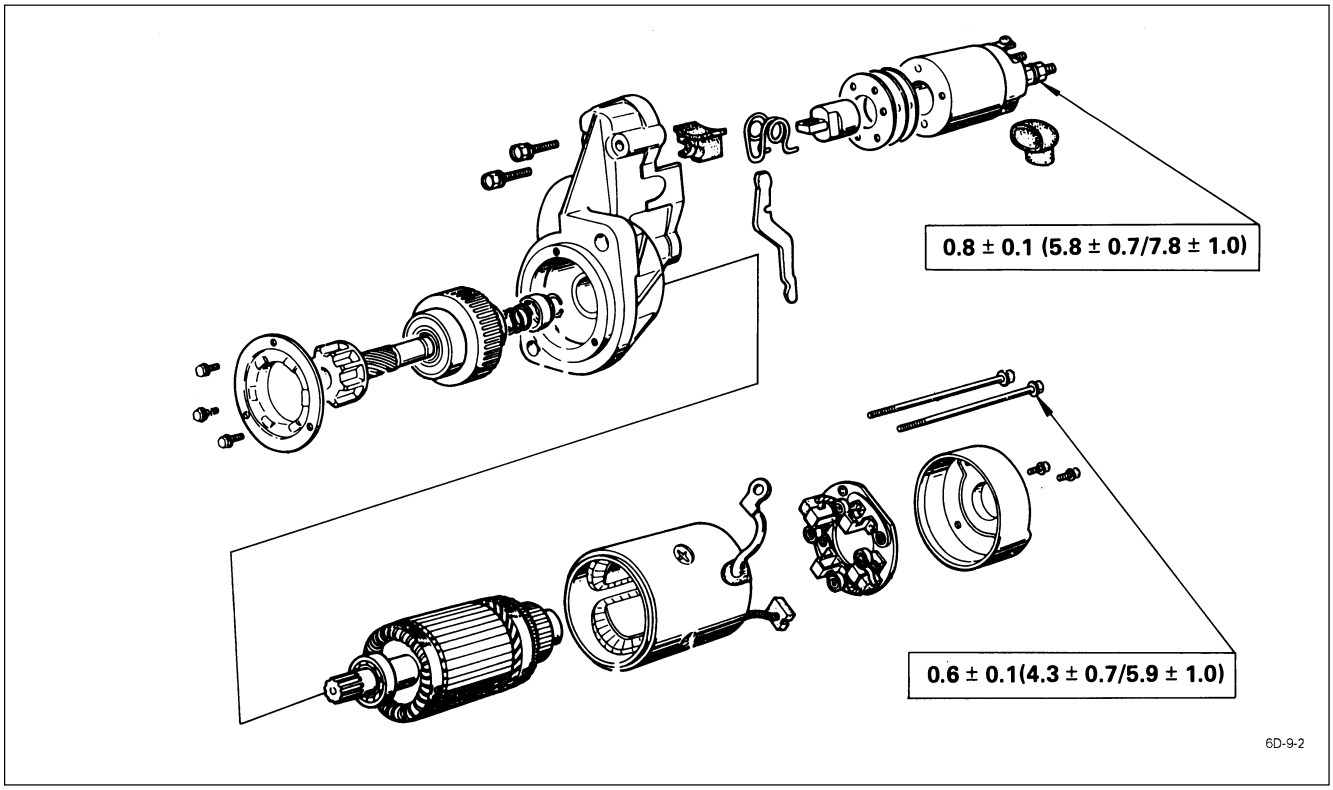
GENERATOR

kg·m(ft. lbs/N·m)



STARTER MOTOR

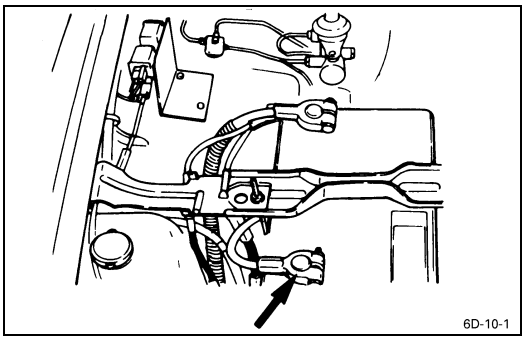
kg·m(ft. lbs/N·m)



GENERATOR

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.



Important Operations-Removal

Cooling Fan Belt

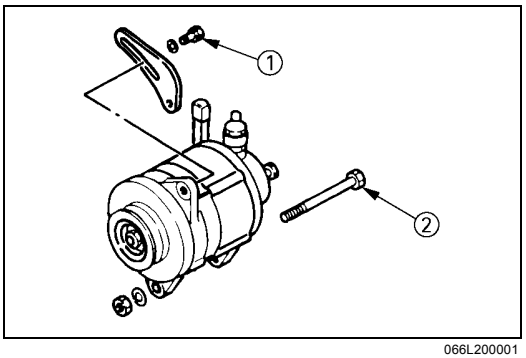
1) Disconnect the battery cables at the battery terminals.
2) Loosen and remove the fan belt adjusting plate bolts.
3) Remove the fan belt from the generator drive pulley.

Generator

Remove the generator bolt and the generator from the bracket.

Important Operations-Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

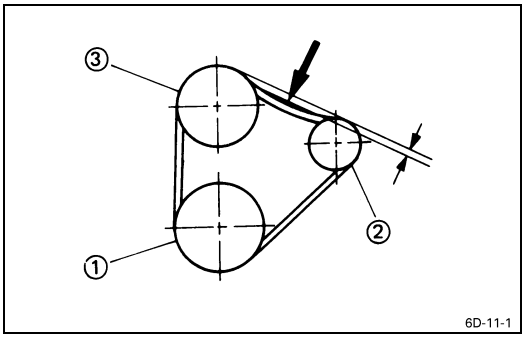


066L200001

Generator

1) Install the generator to the bracket.
2) Tighten the generator bolt to the specified torque.

Generator Bolt Torque	kg·m (lb·ft/N·m)
①	1.9 ± 0.5 (13.7 ± 3.6/18.6 ± 4.9)
②	4.1 ± 0.6 (29.6 ± 4.3/40.2 ± 5.9)



Cooling Fan Belt

1) Hold the generator toward the engine.
2) Install the fan belt to the three pulleys.
   (1) Crankshaft pulley
   (2) Water pump pulley
   (3) Generator pulley

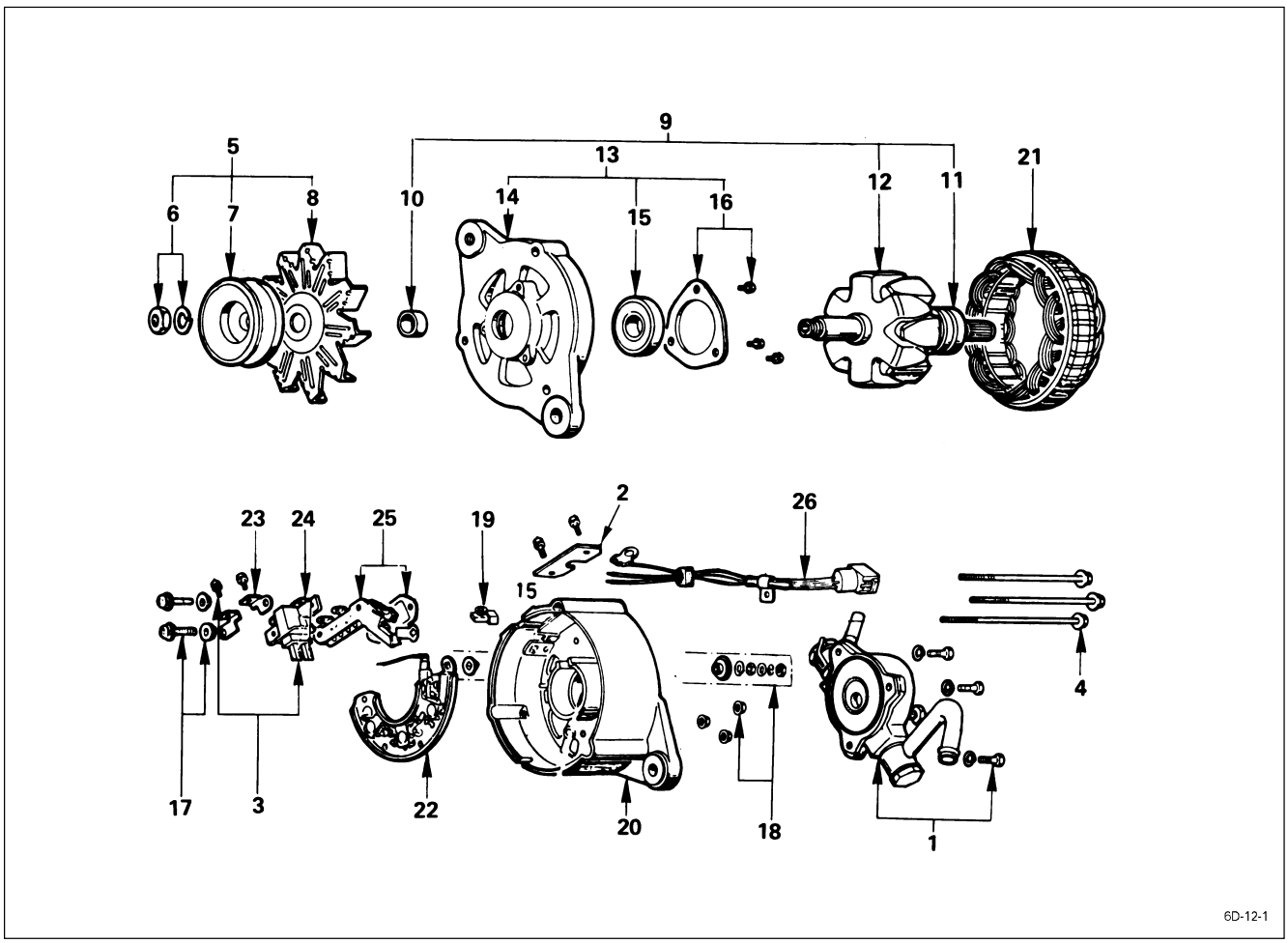
3) Adjust the fan belt tension
   (1) Use a bar to pull the generator away from the engine as far as possible.
   (2) Use your hand to apply a pressure of 10 kg (22 lb/98N) to the area of the fan belt indicated by the arrow in the illustration.
   There should be from 8 – 12 mm (0.3 – 0.5 in) of belt deflection.

4) Tighten the adjusting plate bolts to the specified torque.

Pulley Nut Torque	kg·m (lb·ft/N·m)
1.9 ± 0.5 (13.7 ± 3.6/18.3 ± 4.9)	

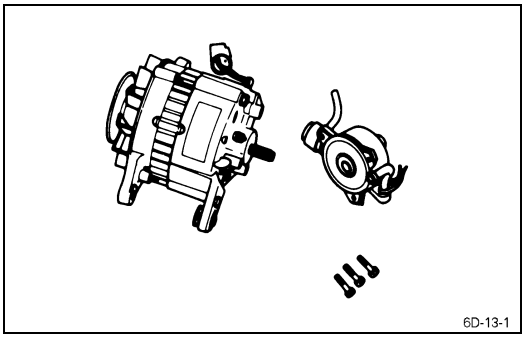
5) Reconnect the battery cable to the battery.

DISASSEMBLY



Disassembly Steps

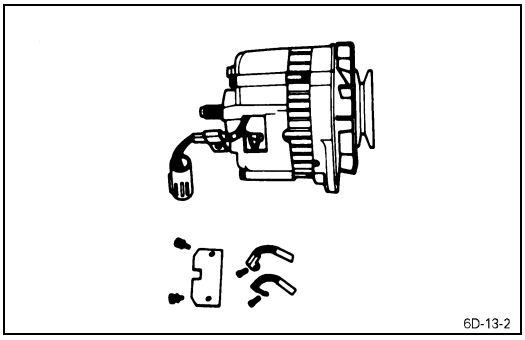
- ▲ 1. Vacuum pump
- ▲ 2. Cover
- ▲ 3. Brush
- ▲ 4. Through bolt
- ▲ 5. Pulley assembly
- 6. Pulley nut
- 7. Pulley
- 8. Fan
- ▲ 9. Rotor assembly
- 10. Spacer
- 11. Ball bearing
- 12. Rotor
- ▲ 13. Front cover assembly
- 14. Front cover
- 15. Ball bearing
- 16. Bearing retainer
- 17. Screw
- ▲ 18. Terminal bolt and nut
- 19. Condenser
- ▲ 20. Rear cover
- ▲ 21. Stator
- ▲ 22. Diode
- 23. Holder plate
- 24. Brush holder
- ▲ 25. IC regulator assembly
- 26. Lead wire


6D-13-1

Important Operations

1. Vacuum Pump

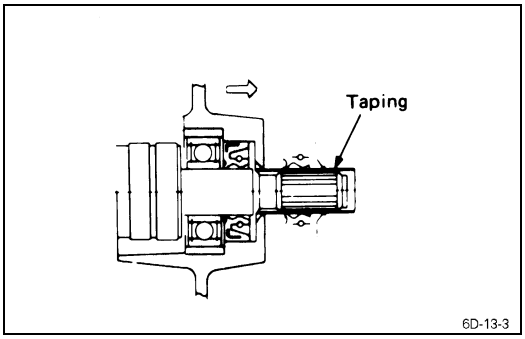
1) Loosen the vacuum pump fixing bolts.
2) Support the vacuum pump center plate.
3) Carefully remove the vacuum pump.


6D-13-2

2. Cover

3. Brush

1) Remove the cover.
2) Remove the brush fixing bolts.
3) Remove the brushes from the brush holder.

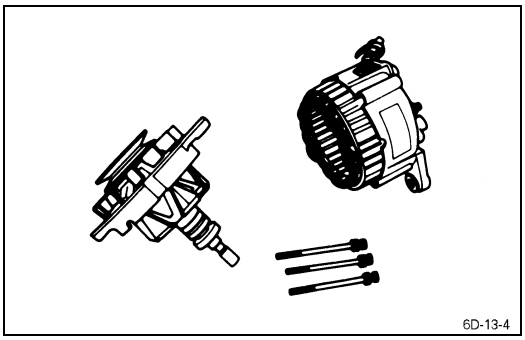


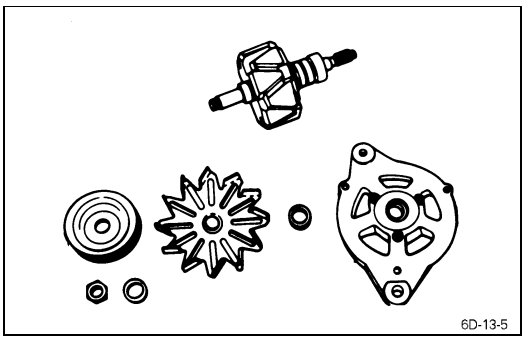
6D-13-3

4. Through Bolt

9. Rotor Assembly

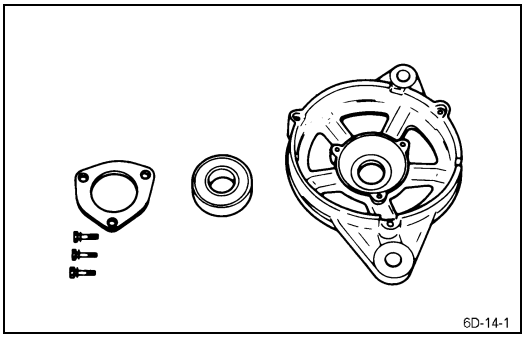
1) Loosen the through bolts.
2) Remove the rotor and front cover assembly from the stator and rear cover assembly.
   Do not allow the stator to separate from the rear cover.
   Take care not to damage the oil seal.
3) Tape the rotor splines to protect them from damage.


6D-13-4


6D-13-5

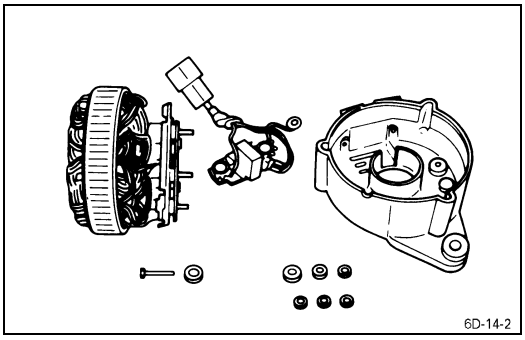
5. Pulley Assembly

1) Carefully clamp the rotor assembly in a vise.
2) Loosen the pulley nut.
3) Remove the pulley and the front cover from the rotor.



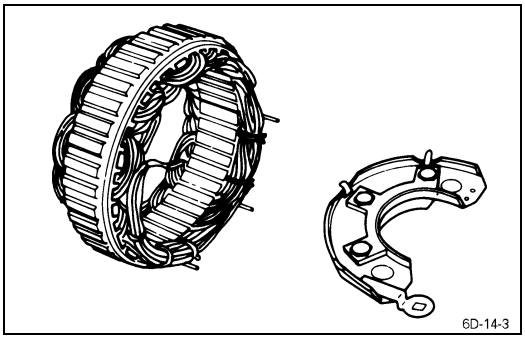
13. Front Cover Assembly

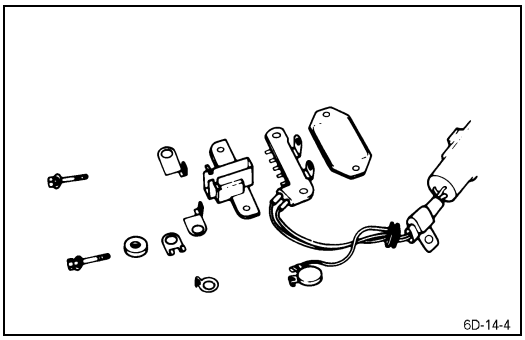
1. Remove the front cover bearing retainer screws.
2. Remove the bearing.



18. Terminal Nut and Bolt
20. Rear Cover
21. Stator
22. Diode

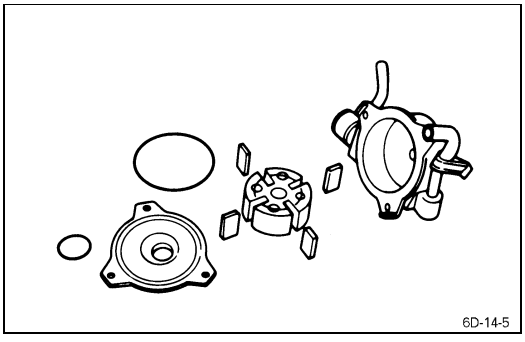
1) Loosen the terminal nuts and bolts.
2) Remove the insulators and the washers.
3) Remove the stator together with the diodes.
4) Disconnect the stator coil leads between each diode and the N-terminal by melting the solder connection. Hold the lead wire between the solder and the diode with a pair of long nose pliers.
   This will prevent heat transfer and resultant damage to the diode.





25. IC Regulator Assembly

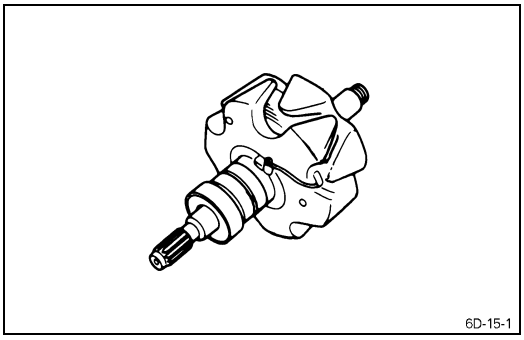
1) Melt away the solder from the IC regulator holder plate terminal.
2) Remove the IC regulator assembly.



Remove the center plate, rotor and vane in the vacuum pump.

INSPECTION AND REPAIR

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


6D-15-1

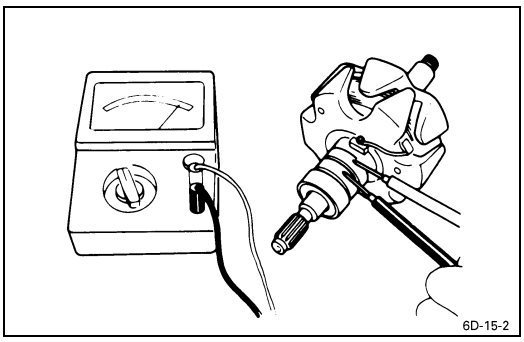
ROTOR ASSEMBLY

1. Inspect the slip ring faces for dirt and pitting.
   Wipe away any dirt with a clean cloth soaked in alcohol.
2. Measure the slip ring diameter.

Slip Ring Diameter mm (in)

Standard	Limit
31.6 (1.245)	30.6 (1.183)

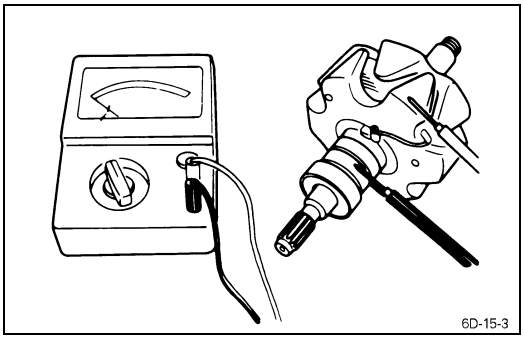
If the slip ring diameter is less than the specified limit, the slip rings must be replaced.


6D-15-2

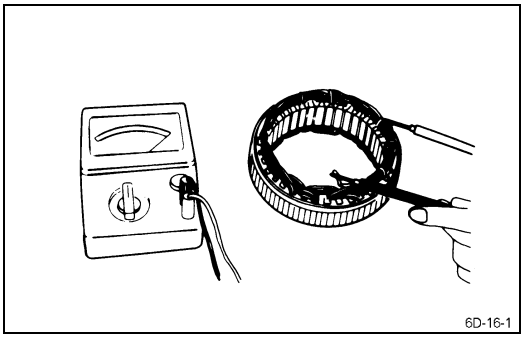
3. Measure the rotor coil resistance.

Rotor Coil Resistance at 20°C (68°F) ohms

Standard	4.2


6D-15-3

4. Check for continuity between the slip rings and the rotor core or shaft.
   If there is continuity, the entire rotor assmbly must be replaced.

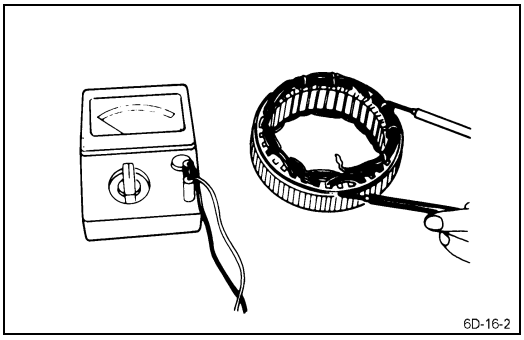


STATOR COIL ASSEMBLY

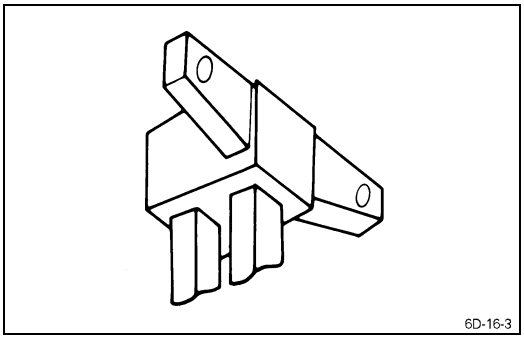
1. Check for continuity across the stator coils.
   If there is no continuity, the stator coils must be replaced.

Resistance Between The Terminal “N” and the Coil Ends (Reference) ohms

Standard	0.1



2. Check for continuity between each stator coils and the stator core.
   If there is continuity, the stator coils must be replaced.



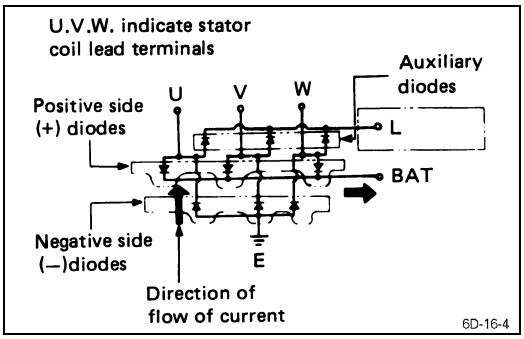
BRUSH

Each brush has a line to indicate whether or not the brush is serviceable.

If the line is not visible, the brush must be replaced.

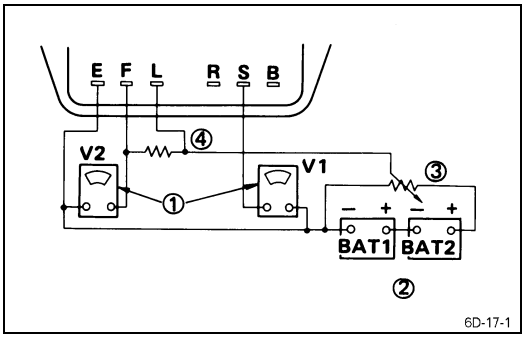
Brush Length (Reference) mm (in)

Standard	Limit
20 (0.8)	6 (0.2)



DIODE

1. Check for continuity between the battery and each of the three stator coil lead terminals.
   If there is continuity, the diode is normal.
   If there is no continuity, the diode must be replaced.
2. Reverse the polarity of the test probes.
   If there is no continuity, the diode is normal.
   If there is continuity, the diode must be replaced.



IC REGULATOR

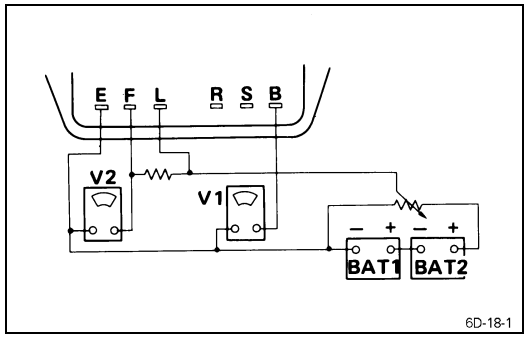
The IC regulator may be tested with either a circuit tester or a pair of standard voltmeters.

Refer to the illustration.

(1) Circuit tester (or voltmeter) range is from 0 to 50 volts in 0.5 volt increments.
(2) Two 12-volt batteries are required.
(3) Note the variable resistor.
(4) This resistor is rated at 100 watts or 3 ohms.

Testing the IC Regulator

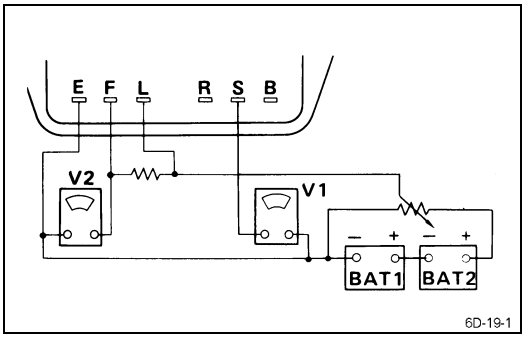
Refer to the wiring diagram in the illustration when testing the IC regulator.



1. Connect the batteries in series.
2. Measure the battery power (Voltage).

Battery Power	V
20 – 26	

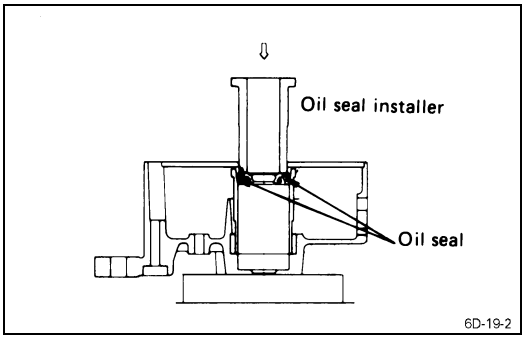
3. Connect the circuit tester (or voltmeter V2) as shown in the illustration.
4. Set the variable resistor (3) to zero.
5. Slowly increase the resistance of the variable resistor toward the build-up point.
   Measure the voltage between E and F.
   As long as the resistance is below the build-up point, the voltage reading should be stable and less than two volts.
   When the resistance exceeds the build-up point, the voltage reading should be two volts or greater.
   If the voltage does not exceed two volts after reaching the build-up point, the IC regulator must be replaced.
6. Return the variable resistor to zero.
7. Connect the circuit tester (or voltmeter V1) as shown in the illustration.
8. Measure the voltage at terminals S, L, and E.
9. Slowly increase the resistance of the variable resistor.
   Note the point at which the voltage quickly builds up to between 2 and 6 volts.
   This will indicate the point at which the voltage regulator begins to function.
   If the measured voltage is outside the specified range, the voltage regulator must be replaced.



10. Repeat Steps 3 through 5 to measure the voltage between terminals B, L, and E.
    Refer to the illustration.
    The regulator voltage should be between 0.5 and 3 volts higher than the measured voltage.
    If the regulator voltage is outside this range, the voltage regulator must be replaced.

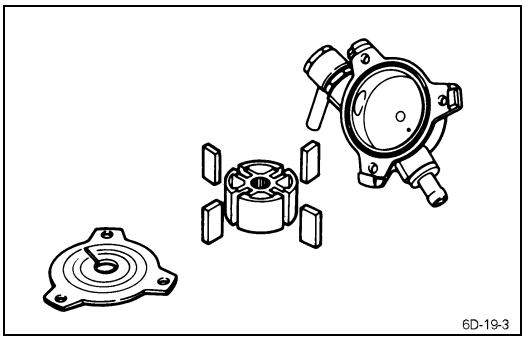
Oil Seal

Check the rear cover oil seal bore for oil leakage.



Oil Seal Replacement

1. Use a screwdriver to remove the oil seal from the rear cover side.
   Take care not to damage the oil seal bore.
2. Discard the used oil seal.
3. Use the oil seal installer to install the new oil seal.



Vacuum Pump

Vacuum Pump Disassembly

1. Remove the center plate from the vacuum pump housing.
2. Remove the vacuum pump rotor and the vanes from the housing.

Inspection

Vacuum Pump Housing and Center Plate

Inspect the vacuum pump housing and the center plate for excessive wear, abrasion, and scoring.

If any of these conditions are present, the vacuum pump housing and center plate must be replaced.

Vane

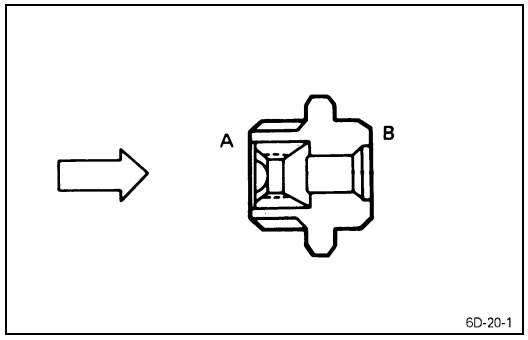
Inspect the vanes for excessive wear and damage.

Replace all four vanes if either of these conditions are present.

Never replace only one vane.

Rotor

1. Inspect the rotor for excessive wear, abrasion, and scoring.
   Pay particular attention to the internal spline.
   Replace the rotor if any of these conditions are present.
2. Inspect the generator rotor shaft splines for backlash.
   Replace the rotor if backlash is present.



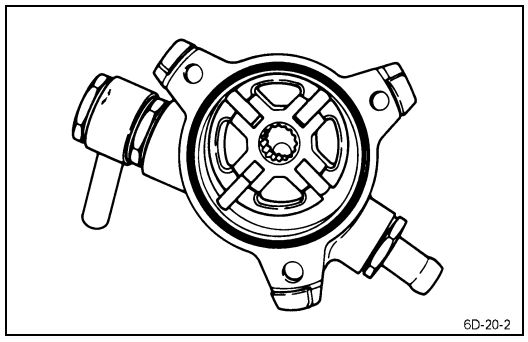
Check Value

1. Carefully force the valve from the “B” side as shown in the illustration.
   The valve must move smoothly.
   If it does not, the check valve must be replaced.
2. Apply compressed air to the “A” side.

Air Pressure	kg/cm^2(psi/kPa)
1-5 (14 – 71/98 - 490)	

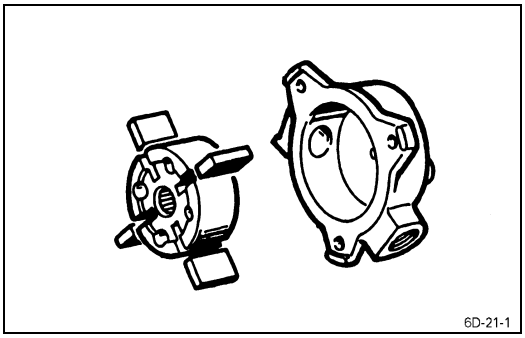
Check for air leakage from the check valve.

If there is air leakage, the valve must be replaced.

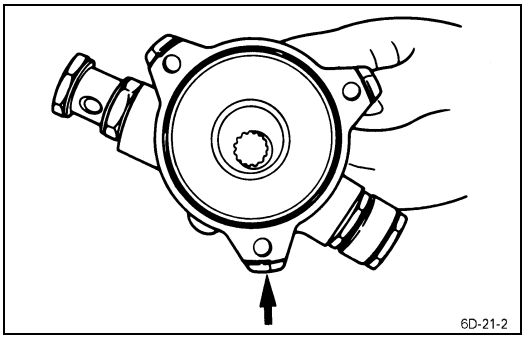


Vacuum Pump Reassembly

1. Install the vanes to the rotor slits.
   The rounded side of the vanes must be facing the rotor housing.

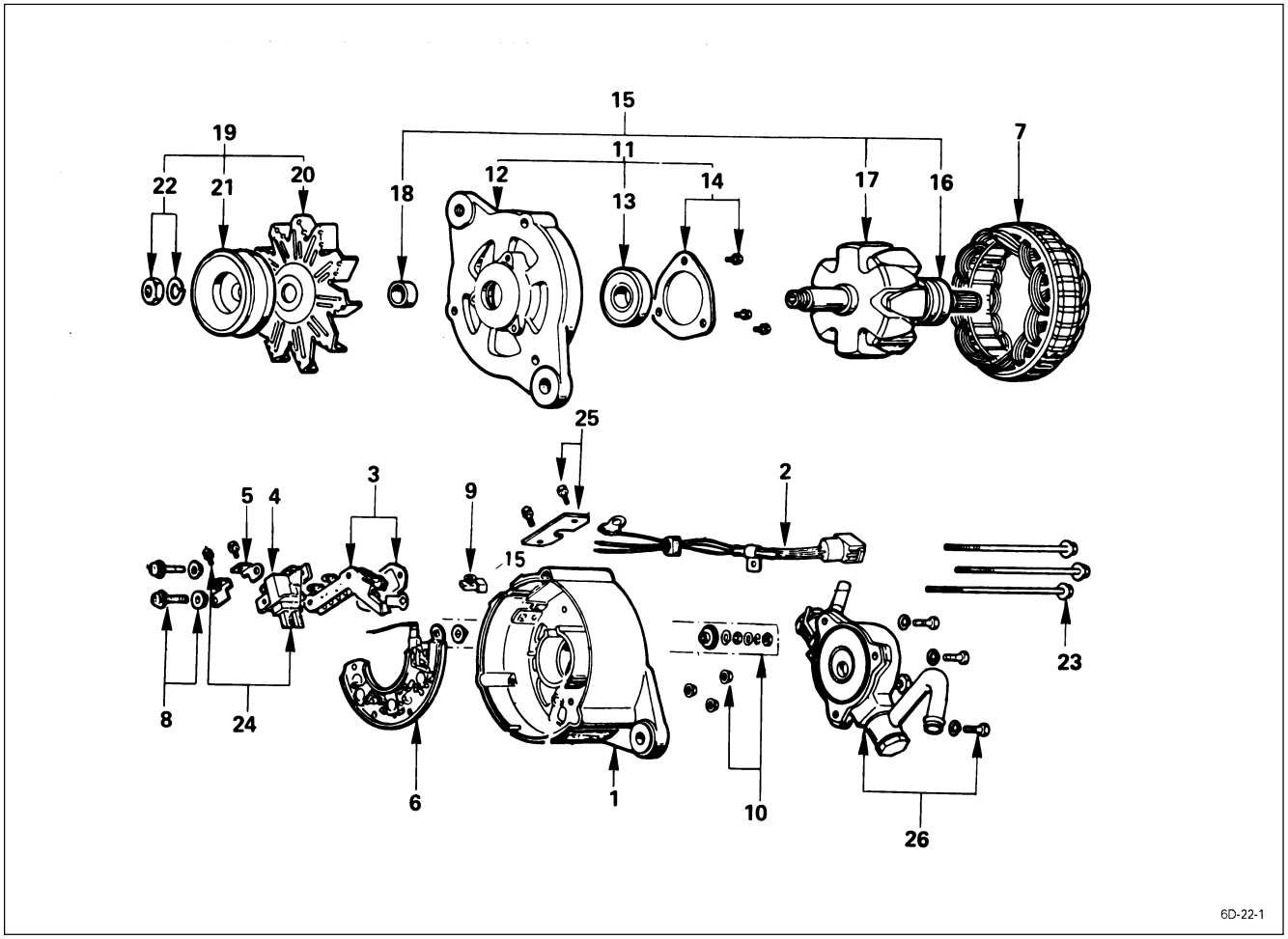

6D-21-1

2. Install the rotor with the concave side facing the center plate.


6D-21-2

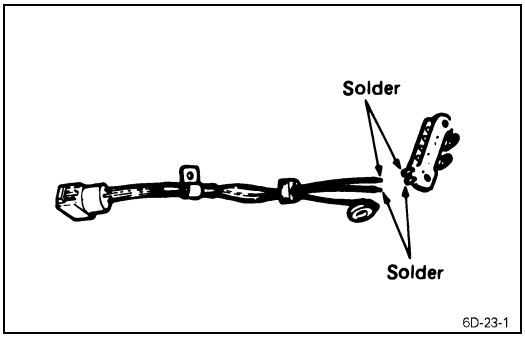
3. Install the center plate to the rotor housing.
   Be sure to use a new O-ring.

REASSEMBLY



Reassembly Steps

1. Rear cover
2. ▲ Lead wire
3. ▲ IC regulator assembly
4. Brush holder
5. Holder plate
6. ▲ Diode
7. ▲ Stator
8. Screw
9. Condenser
10. Terminal bolt and nut
11. Front cover assembly
12. Front cover
13. Ball bearing
14. Bearing retainer
15. ▲ Rotor assembly
16. Ball bearing
17. Rotor
18. Spacer
19. ▲ Pulley assembly
20. Fan
21. Pulley
22. Nut and washer
23. ▲ Through bolt
24. ▲ Brush
25. ▲ Cover
26. ▲ Vacuum pump

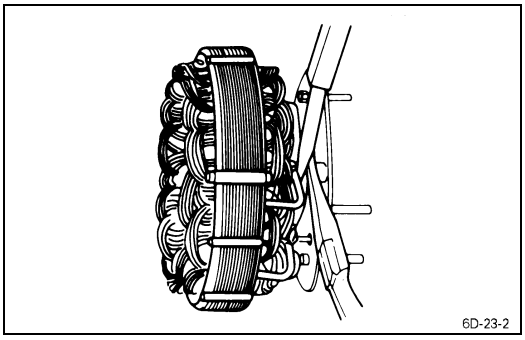


Important Operations

2. Lead Wire

3. IC Regulator

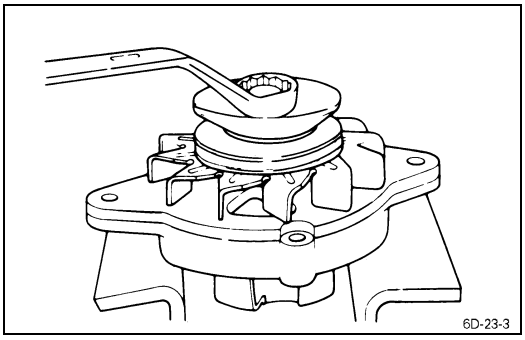
Solder the IC regulator lead wires.



6. Diode

7. Stator

Use a pair of long-nose plier to connect the stator coil leads and the diode leads.
Finish the work as quickly as possible to prevent the diode from heat transferred by the soldering.

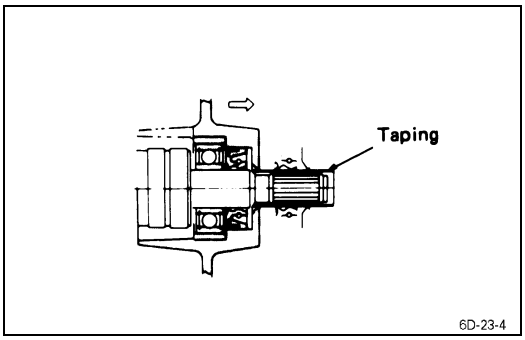


15. Rotor Assembly

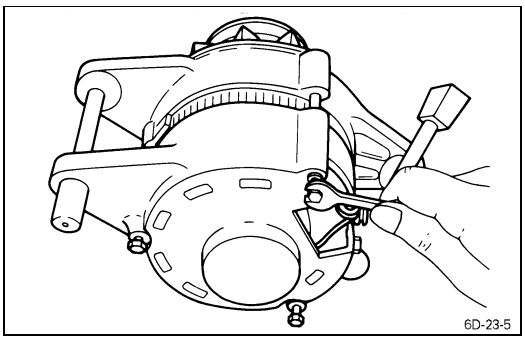
19. Pulley Assembly

Clamp the rotor in a vise and install the pulley nut.

Pulley Nut Torque	kg·m(lb·ft)
5.0 ± 1.0 (36.2 ± 7.2/49.0 ± 9.8)	



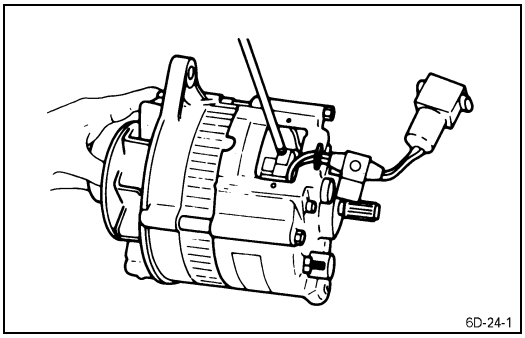
Remove the tape from the splines.



23. Through Bolt

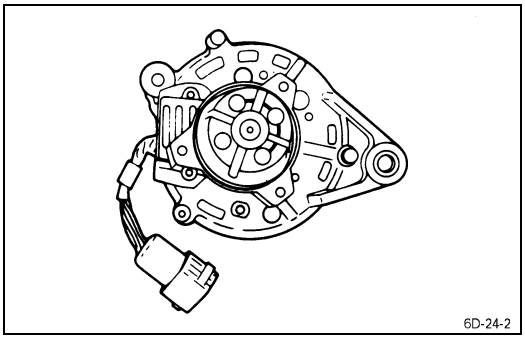
1. Place a pilot bar into the through bolt hole to align the front cover and the rear cover.
2. Install the through bolts and tighten them to the specified torque.

Through Bolt Torque	kg·m(lb·ft)
0.65 ± 0.5 (4.7 ± 3.6/6.3 ± 4.9)	


6D-24-1

24. Brush

Install the brush into the brush holders.


6D-24-2

25. Cover

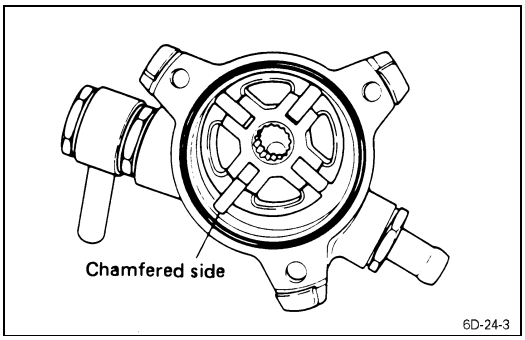
Install the brush cover and tighten the cover bolts to the specified torque.

Brush Cover Bolt Torque	kg·m(lb·ft)
0.35 ± 0.5 (2.5 ± 3.6/3.4 ± 5.0)	

26. Vaccum Pump

Position the rotor, with the serrated boss turned up, on the center plate and housing.

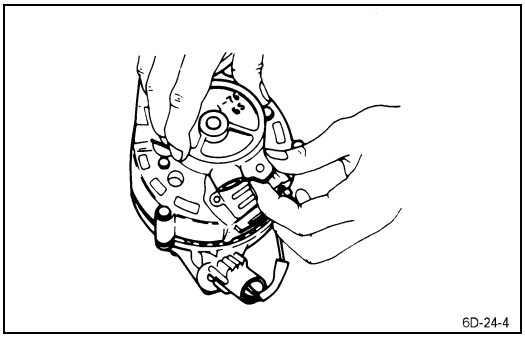
Align the holes in the center plate and the rotor.



6D-24-3

Install vanes into slits in rotor.

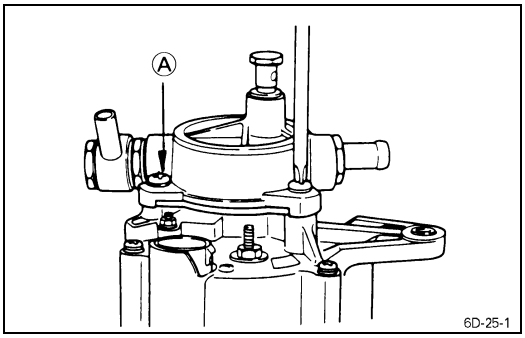
The vanes should be installed with the chamfered side facing outward.


6D-24-4

Install the vacuum pump housing.

Make sure that the O-ring is not projecting beyond the slots of the center plate.

Take care so that no scratching takes place on the vane resulted by contact with the housing.



Install the housing in the generator and fix it with the three bolts.

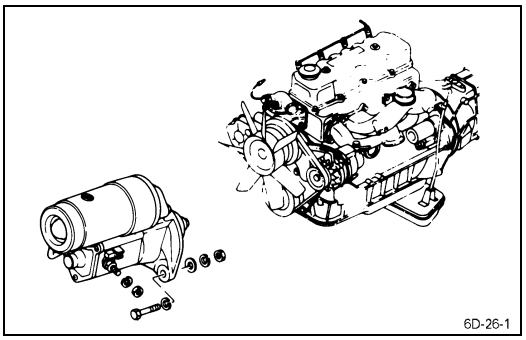
Supply engine oil (5cc or so) from the oil port and check that the generator pulley can be turned smoothly with your hand.

Generator Housing Bolt Torque	kg·m(lb·ft)
0.65 ± 0.5 (4.7 ± 3.6/6.3 ± 4.9)	

STARTER MOTOR

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.



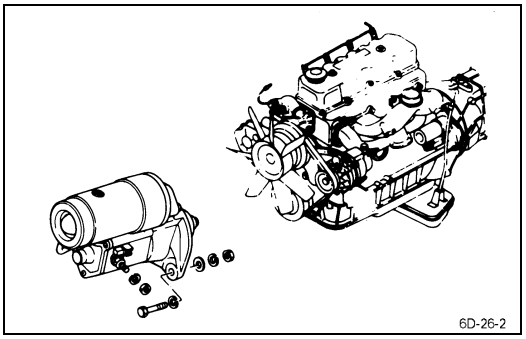
Important Operations - Removal

Starter Motor

1) Disconnect the battery cable and the ground cable at the battery terminals.
2) Disconnect the magnetic switch cable at the terminal bolts.
3) Disconnect the battery cable at the starter motor and the ground cable at the cylinder body.
4) Remove the starter motor from the engine.

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.



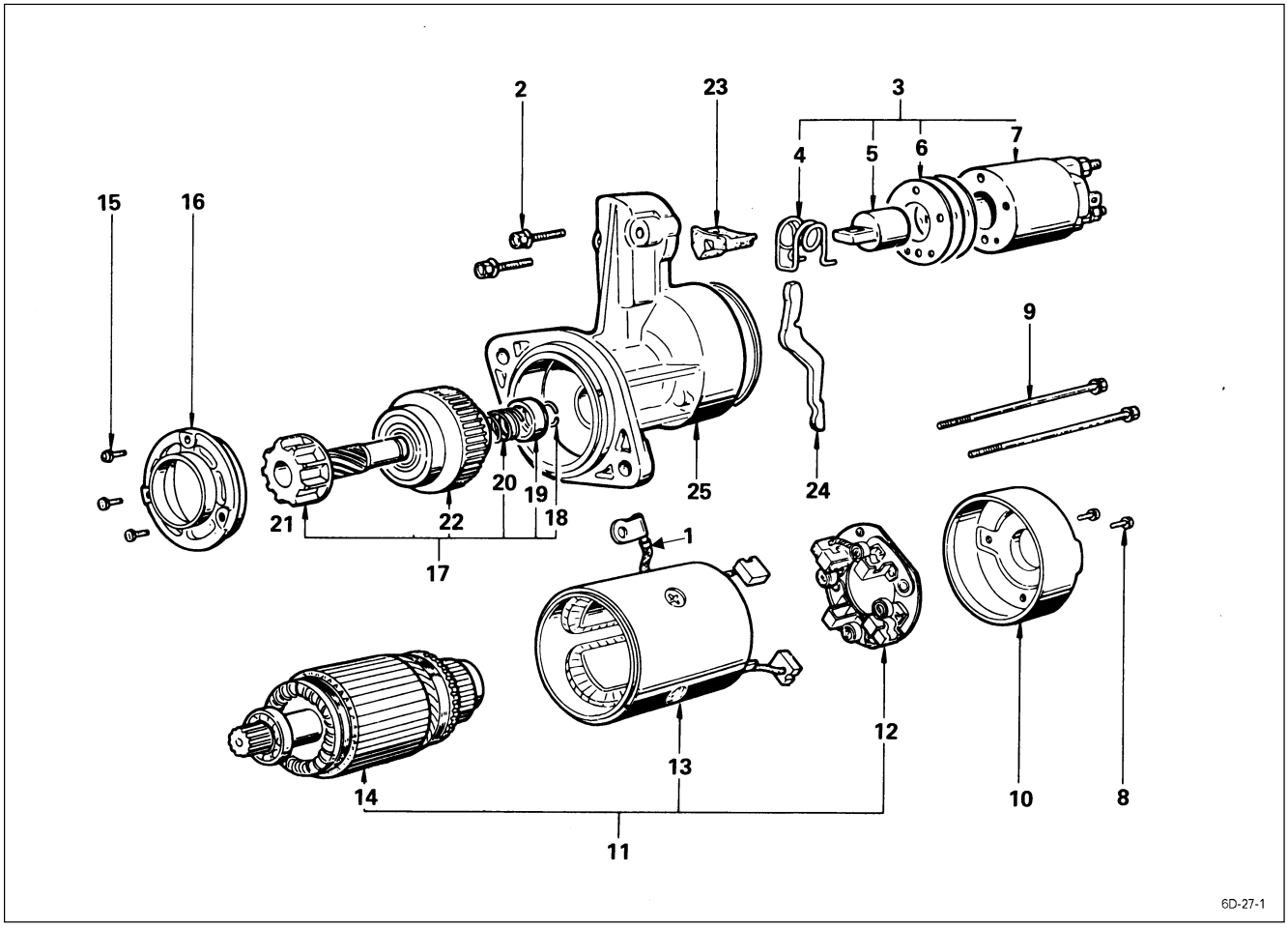
Starter Motor

1) Install the starter motor to the rear plate.
2) Tighten the starter motor bolts to the specified torque.

Starter Motor Bolt Torque	kg·m(lb·ft/N·m)
	7 ± 1 (50.6 ± 7.2/68.7 ± 9.8)

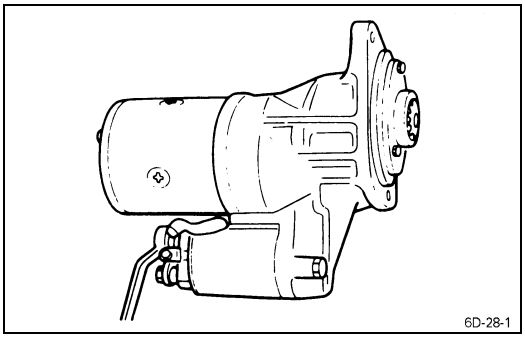
3) Reconnect the battery cable at the starter motor and the ground cable at the cylinder body.
4) Reconnect the battery cable and the ground cable at the battery terminals.

DISASSEMBLY



Disassembly Steps

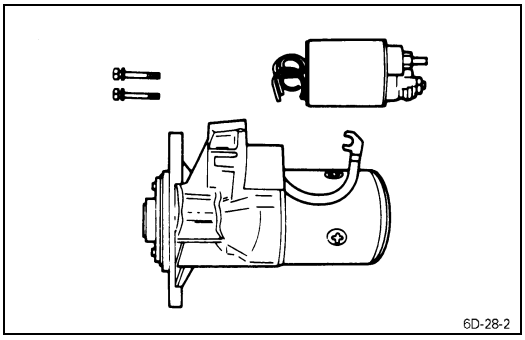
- ▲ 1. Lead wire
- 2. Bolt
- ▲ 3. Magnetic switch assembly
- 4. Torsion spring
- 5. Plunger
- 6. Adjusting shims
- 7. Magnetic switch
- ▲ 8. Screw
- ▲ 9. Through bolt
- ▲ 10. Rear cover
- ▲ 11. Motor assembly
- ▲ 12. Brush holder
- ▲ 13. Yoke
- ▲ 14. Armature
- 15. Screw
- ▲ 16. Bearing retainer
- ▲ 17. Pinion assembly
- 18. Pinion stopper clip
- 19. Pinion stopper
- 20. Return spring
- 21. Pinion shaft
- 22. Clutch
- ▲ 23. Dust cover
- ▲ 24. Shift lever
- ▲ 25. Gear case



Important Operations

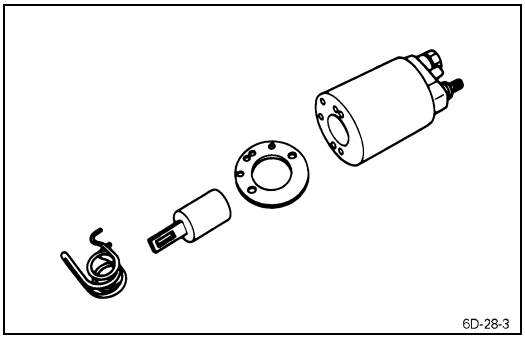
1. Lead Wire

Disconnect the lead wire at the magnetic switch.

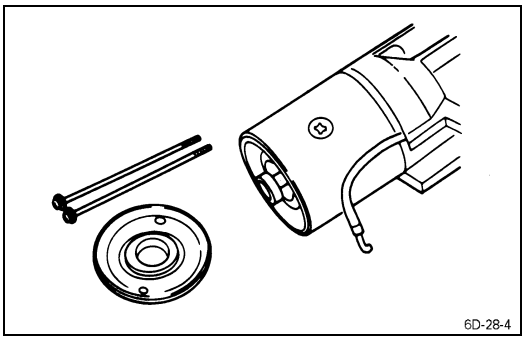


3. Magnetic Switch Assembly

Remove the magnetic switch bolts, then remove the switch from the shift lever.



Remove the torsion spring from the magnetic switch.

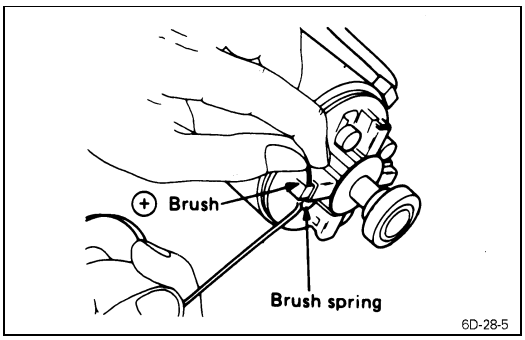


8. Screw

9. Through Bolt

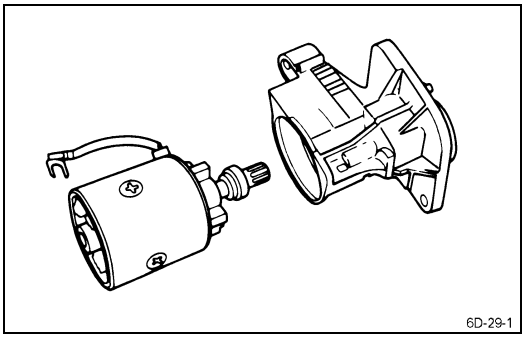
10. Rear Cover

Remove the through bolts, then remove the rear cover.



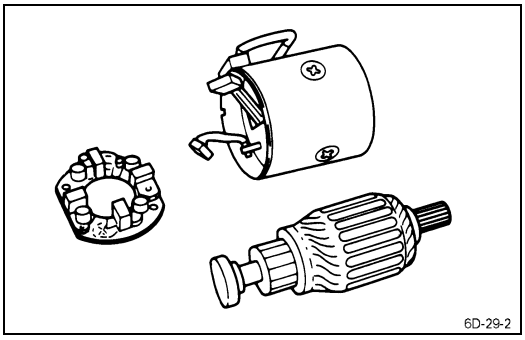
11. Motor Assembly

Remove the four brushes from the brush holders.



Remove the yoke along with the armature and the brush holder from the gear case.

Remove the brushes and commutator carefully so as not to allow them in contact with the adjacent parts.

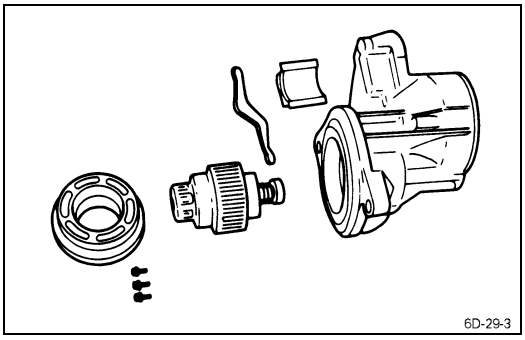


12. Brush Holder

13. Yoke

14. Armature

Remove the brush holder and pull out the armature assembly free from the yoke.



16. Bearing Retainer

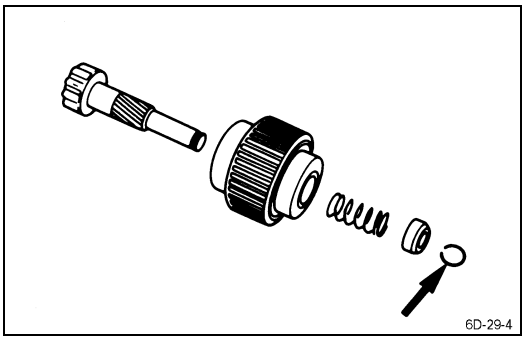
17. Pinion Assembly

23. Dust Cover

24. Shift Lever

25. Gear Case

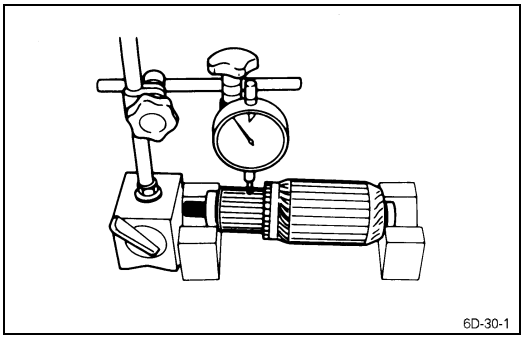
1. Remove the bearing retainer.
2. Remove the pinion from the gear case.



3. Use a screwdriver to remove the stopper clip. Then disassemble the pinion assembly.

INSPECTION AND REPAIR

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

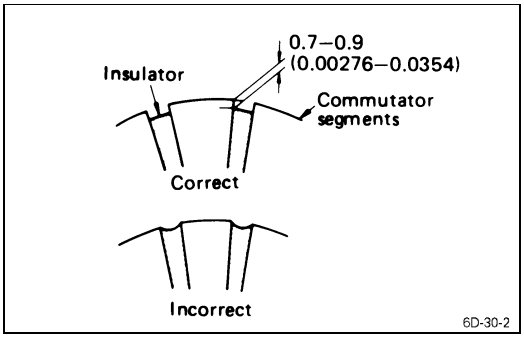


ARMATURE

1. Measure the commutator run-out.
   Replace the commutator if the measured run-out exceeds the specified limit.

Commutator Run-Out mm (in)

Standard	Limit
0.02 (0.001)	0.05 (0.002)



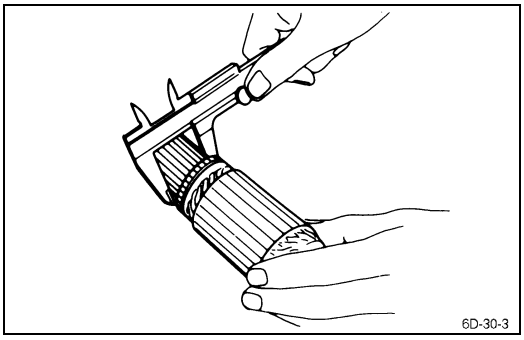
2. Check the commutator mica segments for excessive wear.
3. Measure the mica segment depth.

Mica Segment Depth mm (in)

Standard	Limit
0.7 – 0.9 (0.028 – 0.035)	0.2 (0.01)

If the mica segment depth is less than the standard but more than the limit, the commutator may be reground.

If the mica segment depth is less than the limit, the commutator must be replaced.

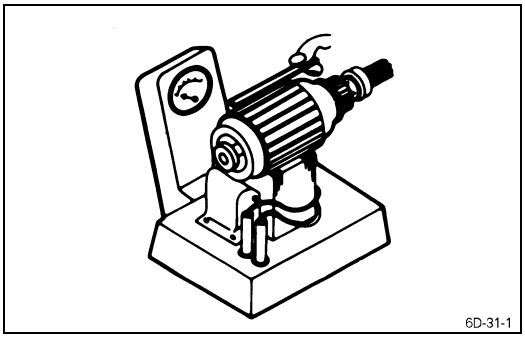


4. Measure the commutator outside diameter.

Commutator Outside Diameter mm (in)

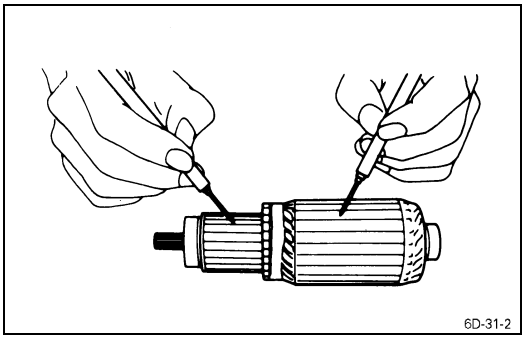
Standard	Limit
35 (1.4)	34 (1.3)

If the measured outside diameter is less than the specified limit, the commutator must be replaced.



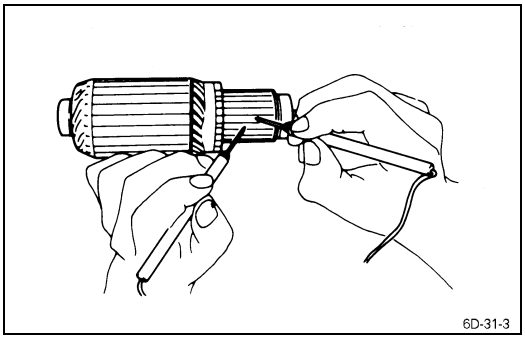
5. Test the armature for short circuiting.
   a. Place the armature in a growler tester.
   b. Hold a hacksaw blade against the armature core.

   If the armature has a short circuit, the hacksaw blade will vibrate.
   Replace the armature if there is a short circuit.



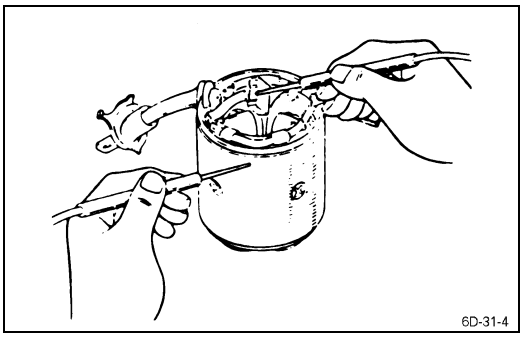
6. Use a circuit tester to check the armature for grounding.
   1) Hold one probe of the circuit tester against the commutator segment.
   2) Hold the other circuit tester probe against the armature core.

   If the circuit tester indicates continuity, the armature is grounded.
   The armature must be replaced.



7. Use the circuit tester to check the armature for continuity.
   1) Hold the circuit tester probes against two armature core segments.
   2) Repear Step 1 at different segments of the armature core.

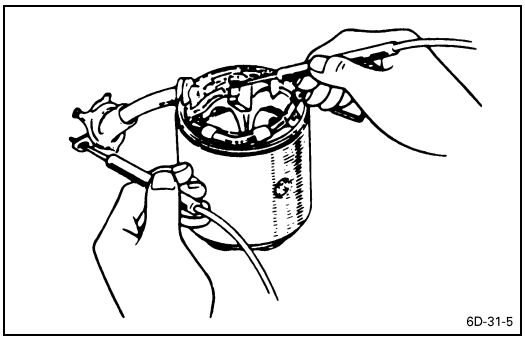
   There should be continuity between all segments of the armature core.
   If there is not, the armature must be replaced.



YOKE

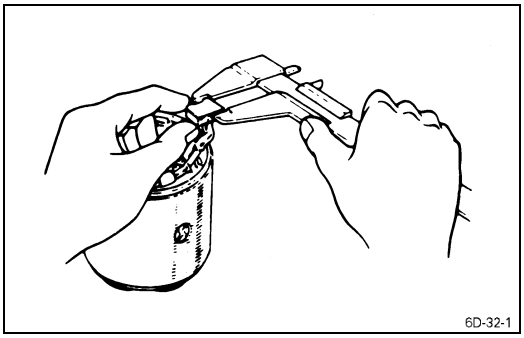
1. Use a circuit tester to check the field winding ground.
   1) Hold one circuit tester probe against the field winding end or brush.
   2) Hold the other circuit tester probe against the bare surface of the yoke body.

   There should be no continuity.
   If there is continuity, the field coil is grounded.
   The yoke must be replaced.



2. Use the circuit tester to check the field winding continuity.
   1) Hold one circuit tester probe against the “C” terminal lead wire.
   2) Hold the other circuit tester probe against the field winding brush.

   There should be continuity.
   If there is no continuity, the yoke must be replaced.

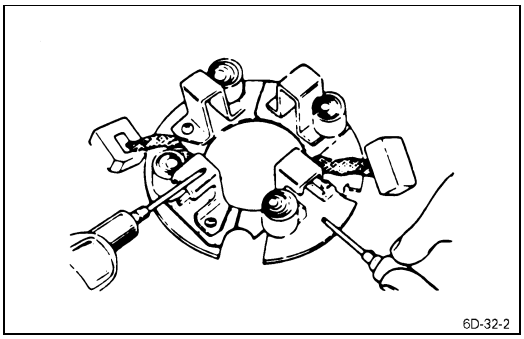


BRUSH AND BRUSH HOLDER

1. Use a vernier caliper to measure the brush length (four brushes).
   Replace the brushes as a set if one or more of the brush lengths is less than the specified limit.

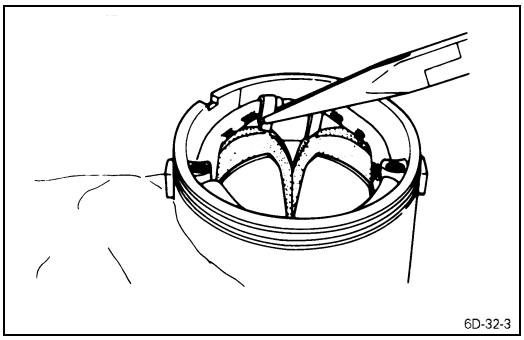
Brush Length mm (in)

Standard	Limit
14.5 (0.57)	9.5 (0.37)

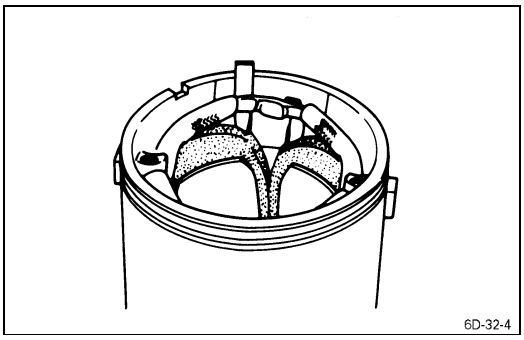


2. Use a circuit tester to check the brush holder insulation.
   Touch one probe to the holder plate and the other probe to the positive brush holder.
   There should be no continuity.

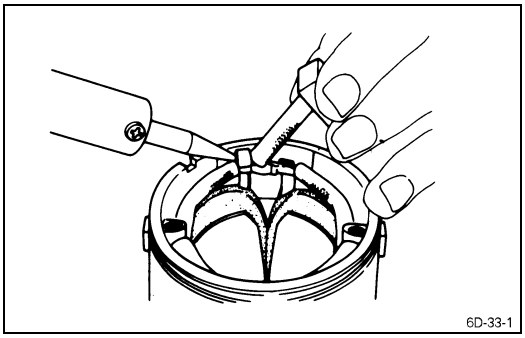
3. Inspect the brushes for excessive wear.
   If the negative brushes have excessive wear, the entire brush holder assembly must be replaced.
   If the positive brushes have excessive wear, only the brushes must be replaced.



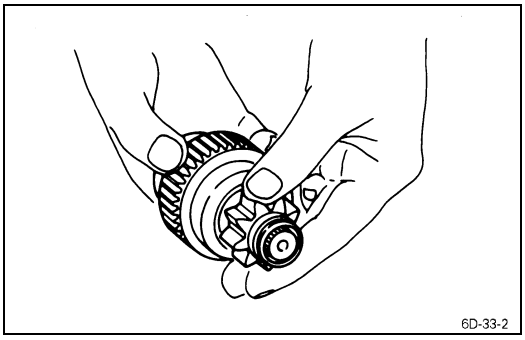
   1) Use a pair of side cutters to cut the lead wire from the brush.
   2) File away any foreign material clinging to the edge of the lead wire.
   3) Remove the brushes from the brush holder.
   4) Install the new brushes.



   5) Straighten the bent portion of the clip.
   6) File away any foreign material clinging to the clip surface.

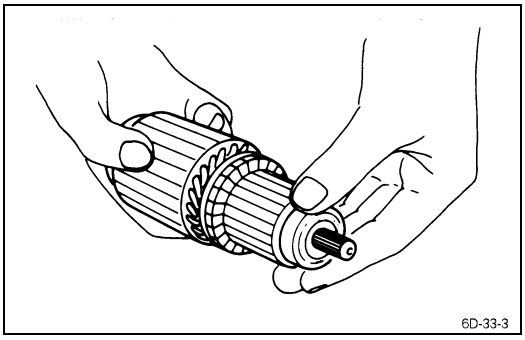


7) Place the lead wire in the clip.
8) Bend the clip shut.
9) Solder the brush lead.
10) Repeat the procedure for each of the brushes.



OVERRUNNING CLUTCH

1. Inspect the overrunning clutch gear teeth for excessive wear and damage.
   Replace the overrunning clutch if necessary.
2. Rotate the pinion clockwise.
   It should turn smoothly.
3. Try to rotate the pinion in the opposite direction.
   The pinion should lock.



BEARING

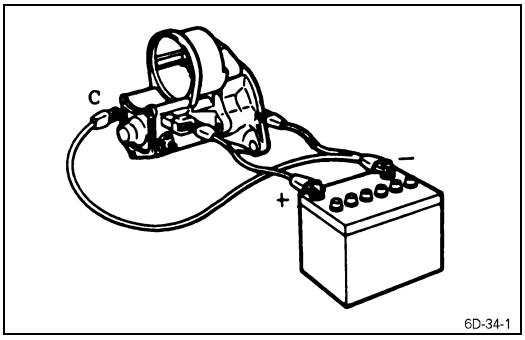
Inspect the bearings for excessive wear and damage.
Replace the bearings if necessary.

MAGNETIC SWITCH

The following tests must be performed with the starter motor fully assembled.

The yoke lead wire must be disconnected from the “C” terminal.

To prevent coil burning, complete each test as quickly as possible (within three to five seconds).

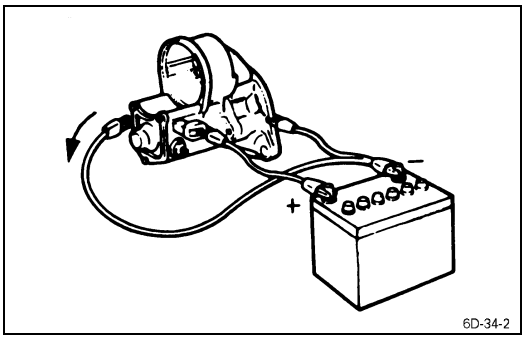


6D-34-1

Temporarily connect the solenoid switch between the clutch and the housing and run the following test. Complete each test within three to five seconds.

1. **Pull-in Test**

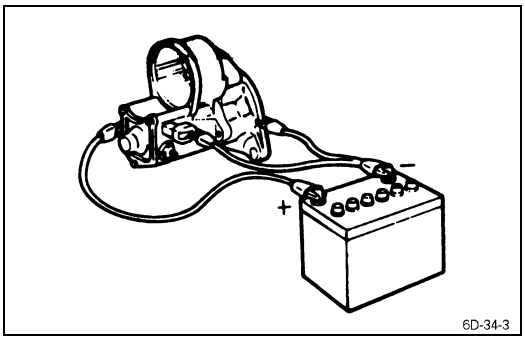
   Connect the battery negative terminal with the solenoid switch body and the C terminal. When current is applied to the 50 terminal from the battery positive terminal, the pinion should flutter.



6D-34-2

2. **Hold-in Maintenance Test**

   Disconnect the lead at the C terminal. The pinion should continue to flutter.



6D-34-3

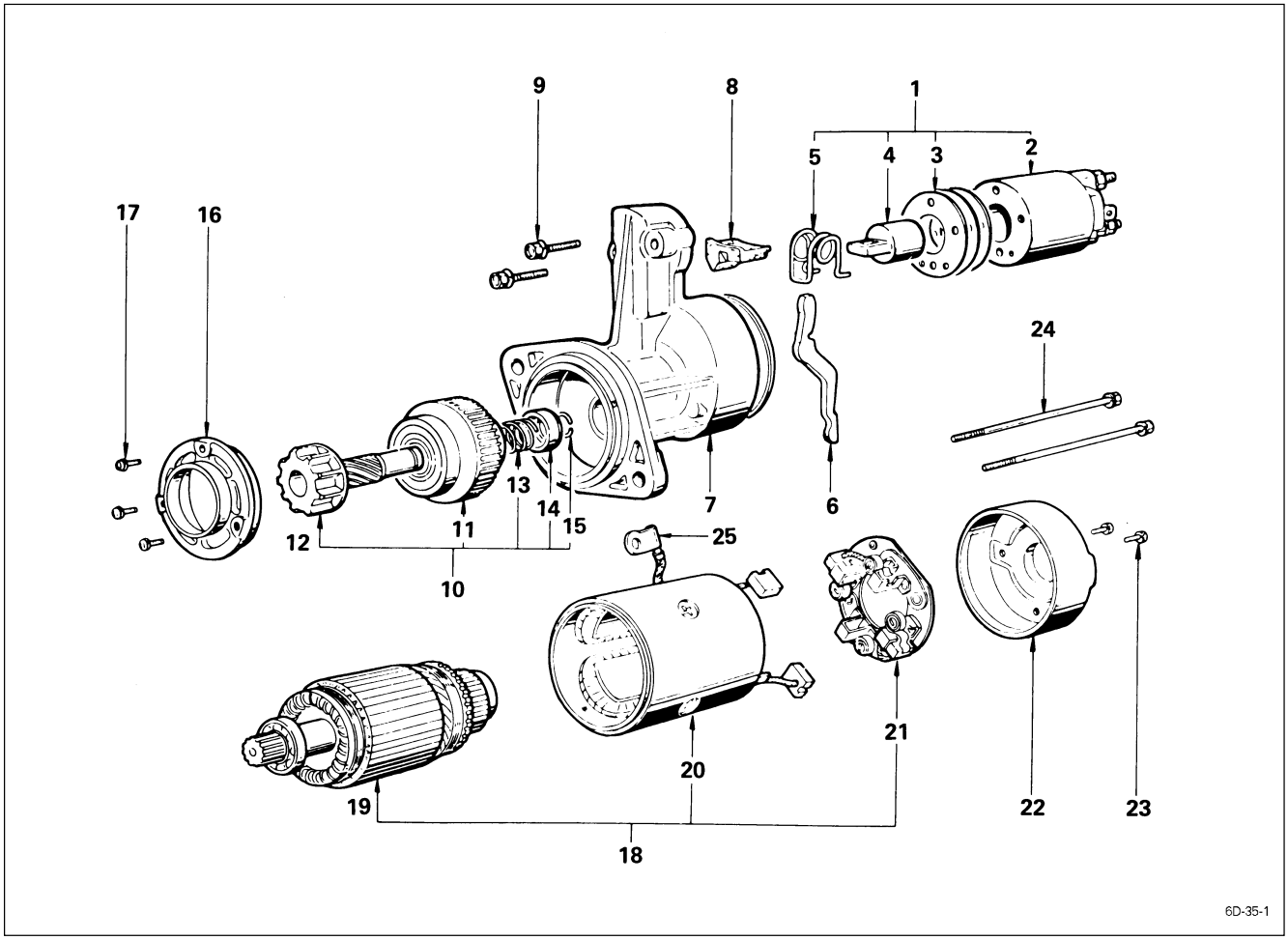
3. **Return Test**

   Connect the battery negative leads to the starter body and the 50 terminal.

   Connect the battery positive lead at the C terminal.

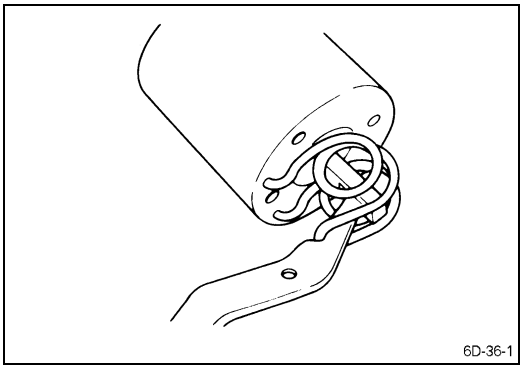
   The pinion should return to its home position.

REASSEMBLY



Reassembly Steps

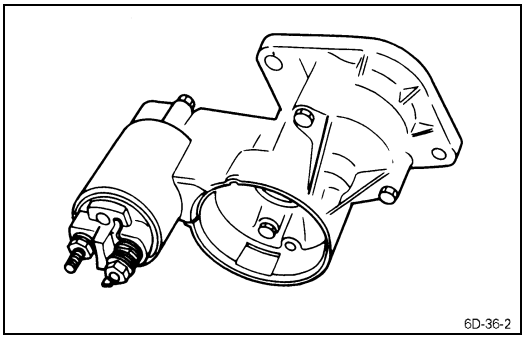
- ▲ 1. Magnetic switch assembly
- 2. Magnetic switch
- 3. Adjusting shims
- 4. Plunger
- 5. Torsion spring
- 6. Shift lever
- ▲ 7. Gear case
- ▲ 8. Dust cover
- 9. Bolt
- ▲ 10. Pinion assembly
- 11. Clutch
- 12. Pinion shaft
- 13. Rerurn spring
- 14. Pinion stopper
- 15. Pinion stopper clip
- 16. Bearing retainer
- 17. Screw
- 18. Motor assembly
- 19. Armature
- 20. Yoke
- ▲ 21. Brush holder
- 22. Rear cover
- 23. Screw
- ▲ 24. Through bolt
- ▲ 25. Lead wire



Important Operations

1. Magnetic Switch Assembly

1. Attach the torsion spring to the hole in the magnetic switch as illustrated.
2. Insert the shift lever into the plunger hole of the magnetic switch.

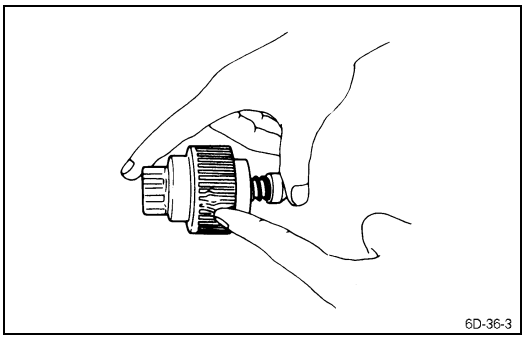


7. Gear Case

8. Dust Cover

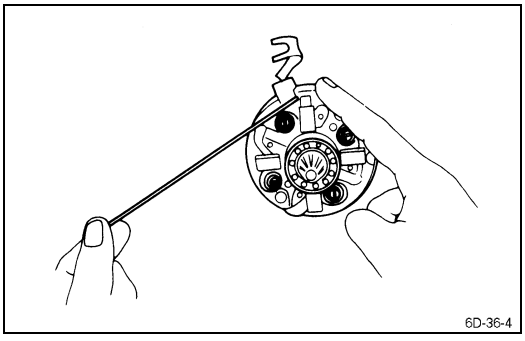
1. Install the magnetic switch assembly in the gear case.
2. Install the dust cover.

Dust Cover Bolt Torque	kg·m(lb·ft/N·m)
0.75 ± 0.5 (5.4 ± 3.6/7.4 ± 5)	



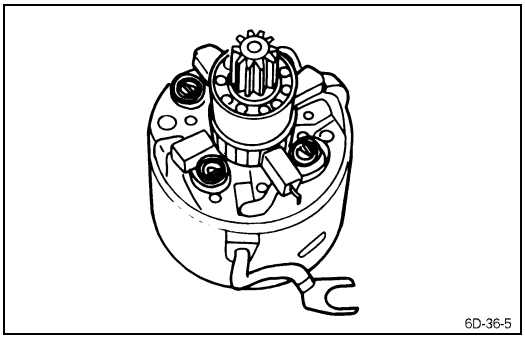
10. Pinion Assembly

Apply a coat of grease to the reduction gear and install the pinion assembly to the armature shaft.

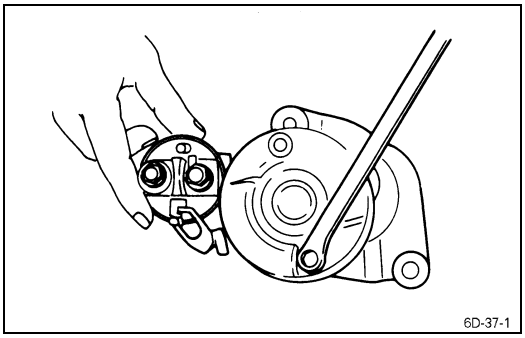


21. Brush Holders

1. Install the brushes into the brush holder with raising the spring end of the brush spring.
   Take care not to damage the commutator face.



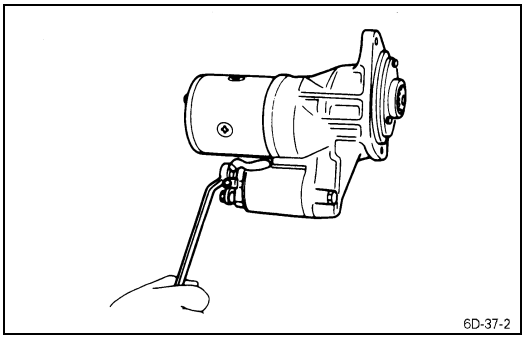
2. Install the brush holder with aligning the peripheries of the yoke and the brush holder.



24. Through Bolt

Install the through bolts in the rear cover and tighten them to the specified torque.

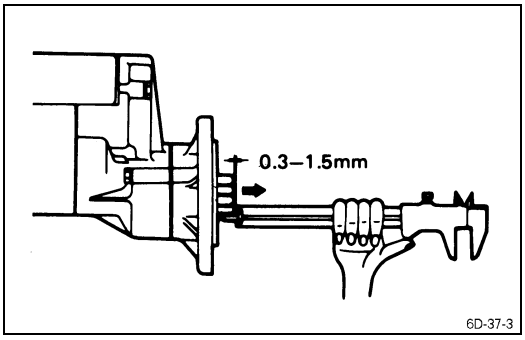
Through Bolt Torque	kg·m(lb·ft/N·m)
0.6 ± 0.1 (4.3 ± 0.7/5.9 ± 1.0)	



25. Lead Wire

Connect the lead wire in the magnetic switch and tighten the terminal nut to the specified torque.

Lead Wire Terminal Nut Torque	kg·m(lb·ft)
0.8 ± 0.1 (5.8 ± 0.7/7.8 ± 1.0)	

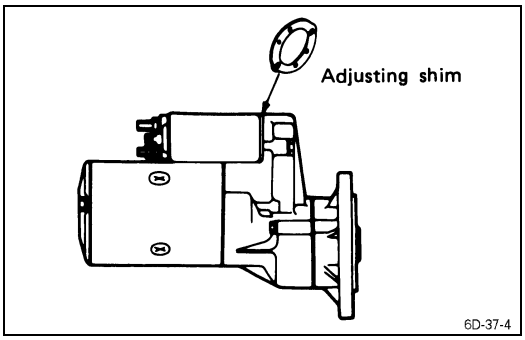


Inspection After Assembly

Use a vernier caliper to measure the pinion shaft thrust play.

The pinion shaft thrust play is equal to the pinion shaft end and pinion stopper clearance.

Pinion Shaft Thrust Play	mm (in)
0.3 - 1.5 (0.01 – 0.06)	



In a case where the pinion gap outside the specified value;

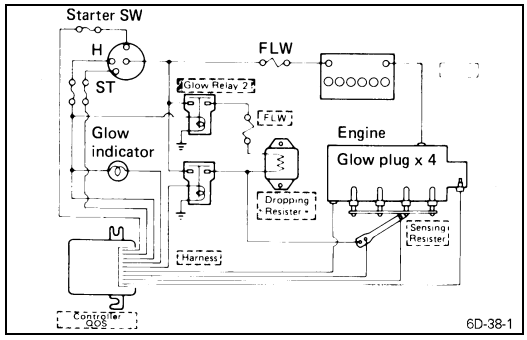
Make an adjustment using a shim(s).

Adjusting shims are available in 0.5 mm and 0.8 mm (0.02 and 0.03 in.) sizes.

PRE-HEATING SYSTEM

INSPECTION AND REPAIR

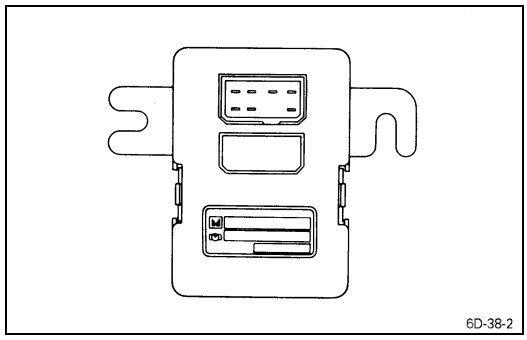
Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



SYSTEM CIRCUIT

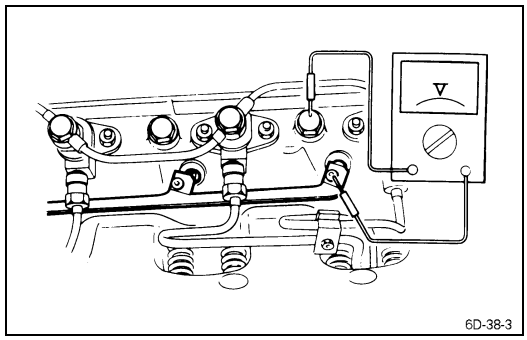
Visual Check

Check the main fuses and the glow indicator for damage. Replace the part(s) if required.



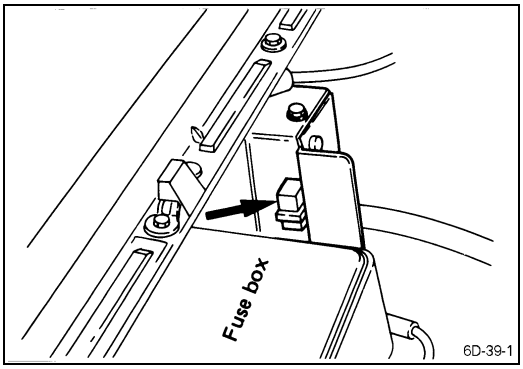
GLOW TIMER

The glow timer is initially activated by the starter switch. Thereafter, signals from the thermoswitch reach the glow timer to control the glow plug relay operation time.
The thermoswitch and timer unit also act to protect the battery in the event the starter key is engaged for an excessively long time.



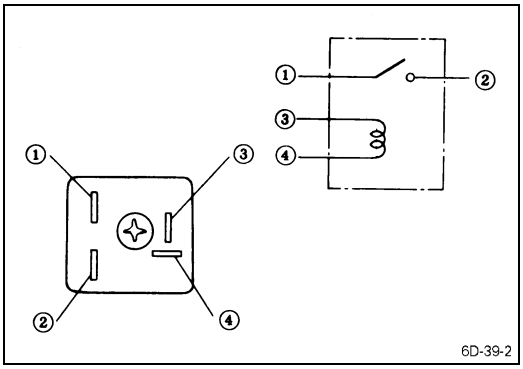
Glow Timer Operation

1. Disconnect the lead wires at the thermoswitch.
2. Connect a voltmeter between the glow plug and ground.
3. Turn the starter switch from “OFF” to “ON”.
   The engine must be stopped.
4. Note the time the glow indicator remains on.
   If the glow indicator remains on for approximately 1~6 seconds (4JG2T Engine model) or 3.5 seconds (4JA1, 4JB1T Engine model), the glow timer “ON” time is normal.
   If the glow indicator does not remain on for approximately 1~6 seconds or 3.5 seconds, trouble in the glow timer or, the glow relay, is indicated.
5. Return the starter switch to “OFF”.



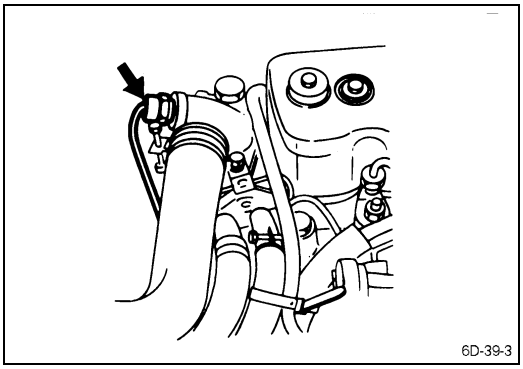
GLOW RELAY

The glow relay is located near the fuse box in the engine compartment.



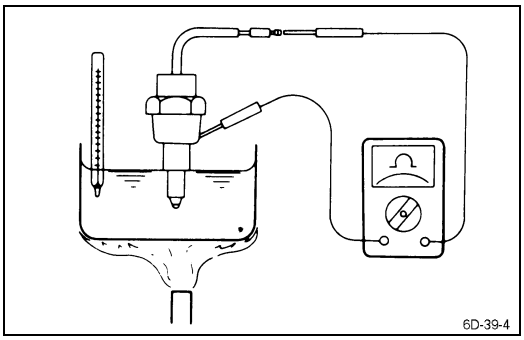
Use an ohmmeter to measure the resistance between terminals No. 3 and No. 4.
If the measured value is outside the specified range, the glow relay must be replaced.

Glow Relay Resistnace	Ohms
10 - 15	



THERMO SWITCH/THERMO SENSOR

The thermo switch or thermo sensor are located on the water outlet pipe.



Use a circuit tester to check the thermo switch for continuity.

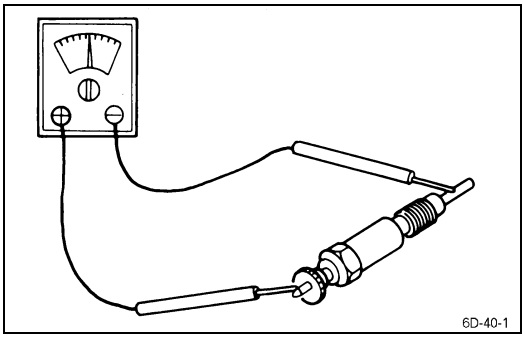
- **Thermo switch (4JA1, 4JB1T engine)**

OFF → ON : 7 - 13°C (44.6 – 55.4°F)	
ON → OFF : Below 3°C (37.4°F)	

- **Thermo sensor (4JG2T engine)**

Thermo Sensor Resistance K-Ohm

Temperature °C (°F)	Resistance	Temperature °C (°F)	Resistance
-15 (5)	12.00	40 (104)	1.10
0 (32)	6.00	60 (140)	0.60
10 (50)	3.60	80 (176)	0.30
20 (68)	2.45		



GLOW PLUG

Use a circuit tester to test the glow plugs for continuity.
Check each of the glow plugs for continuity.

TROUBLESHOOTING (For Charging and Starting system)

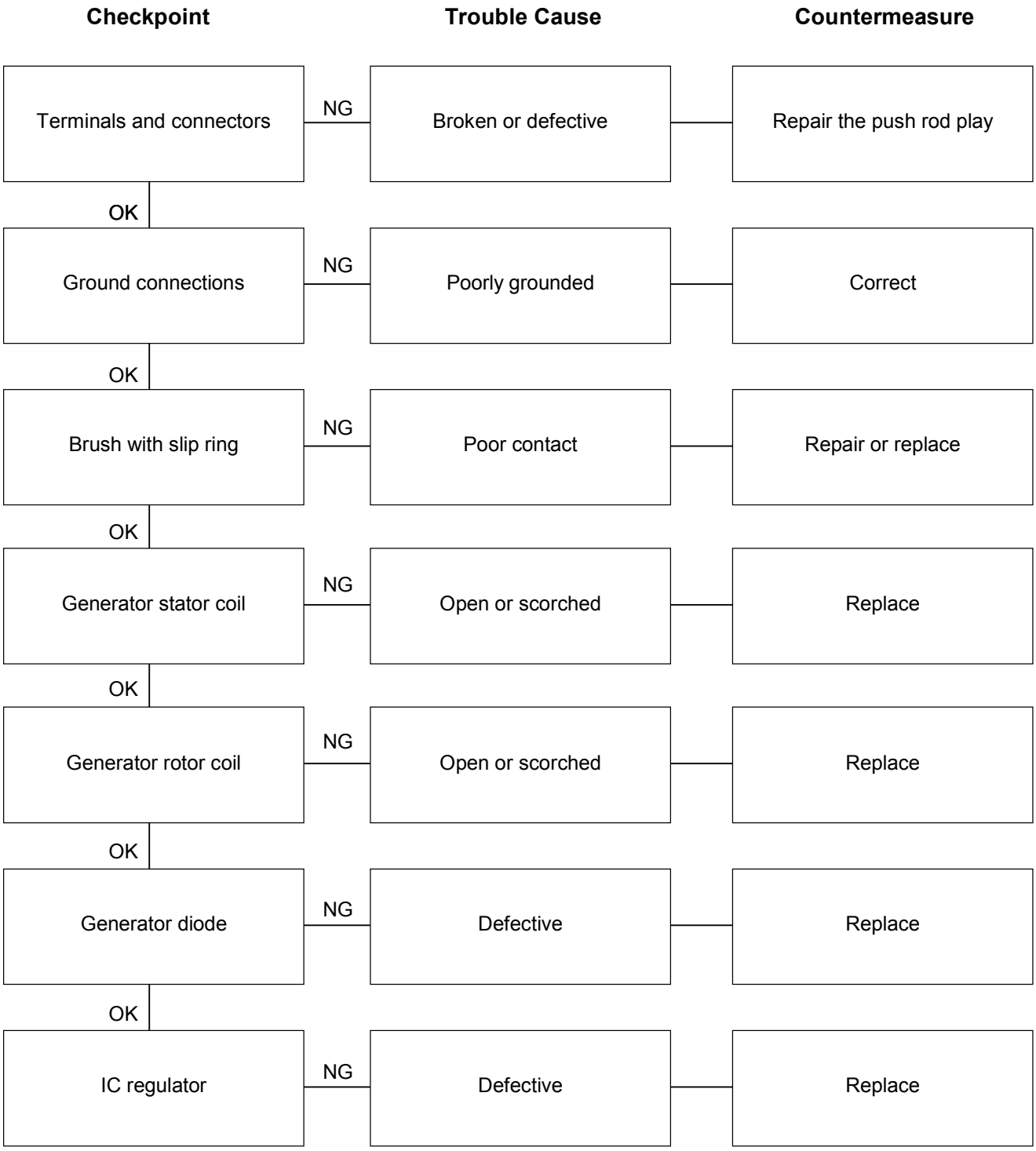
Refer to this Section to quickly diagnose and repair electrical problems.
Each troubleshooting chart has three headings arranged from left to right.
(1) Checkpoint (2) Trouble Cause (3) Countermeasure
This Section is divided into two Sub-Sections:

I. Battery Charging and Noise Problems
   1. No Charging
   2. Overcharging
   3. Undercharging
   4. Unstable Charging Current
   5. Noise

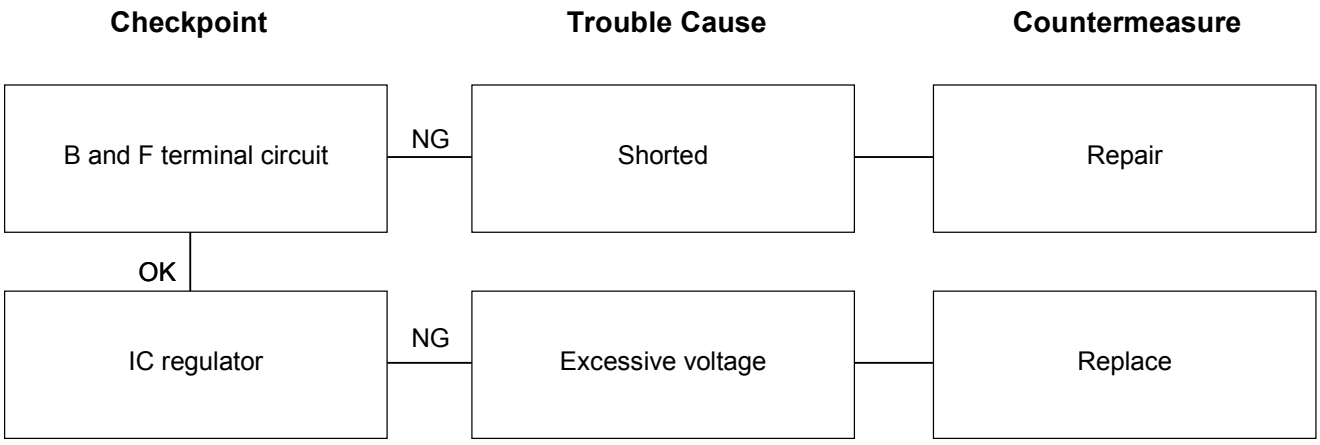
II. Hard Starting
   1. Pinion Does Not Engage The Ring Gear When The Starter Switch Is Turned On
   2. Pinion Engages The Ring Gear But The Engine Does Not Turn Over
   3. Incorrect Pinion And Ring Gear Engagement
   4. Starter Continues To Run After The Starter Switch Is Turned Off
   5. Excessive Commutator Sparking

I. BATTERY CHARGING AND NOISE PROBLEMS

1. NO CHARGING



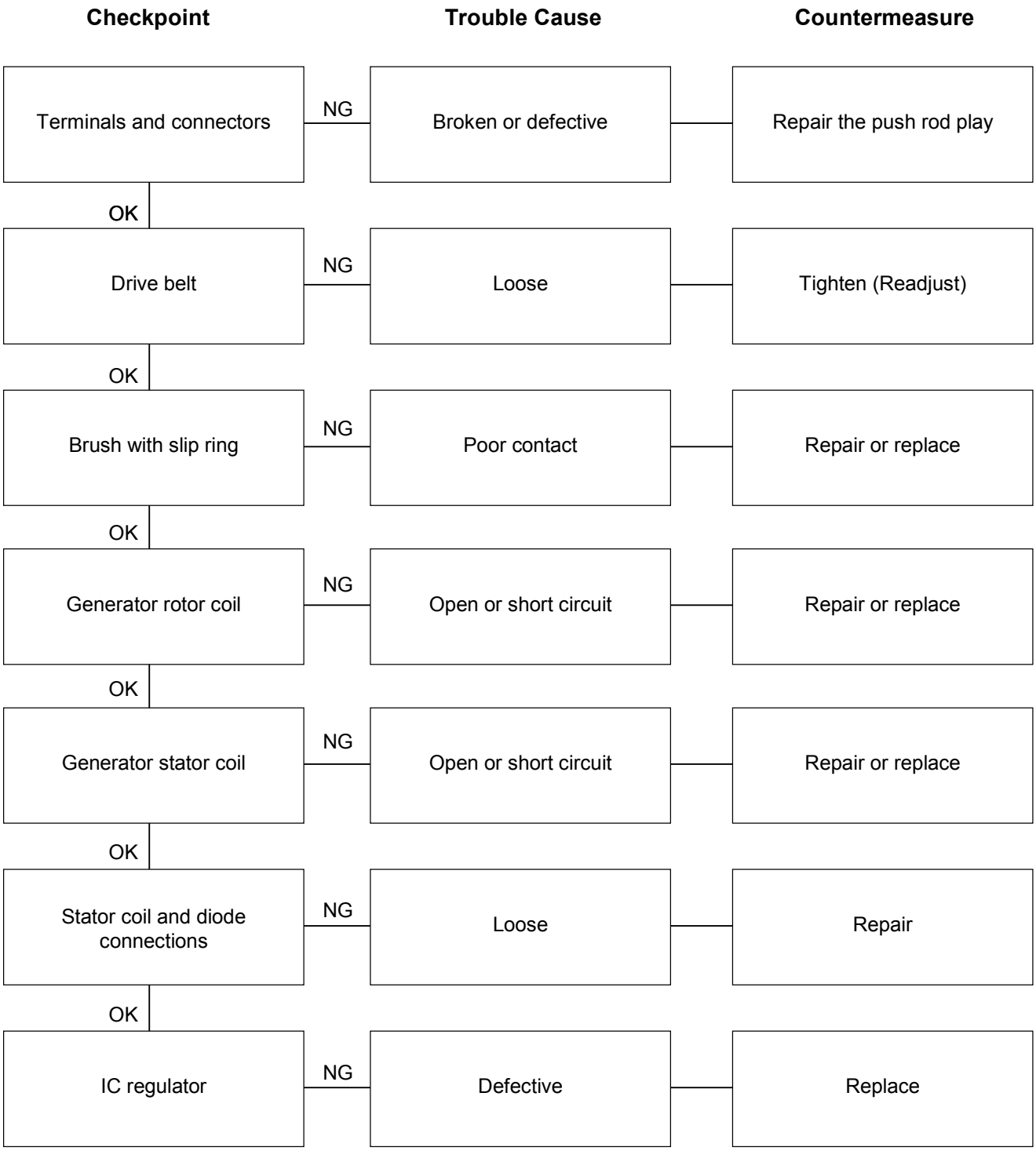
2. OVERCHARGING



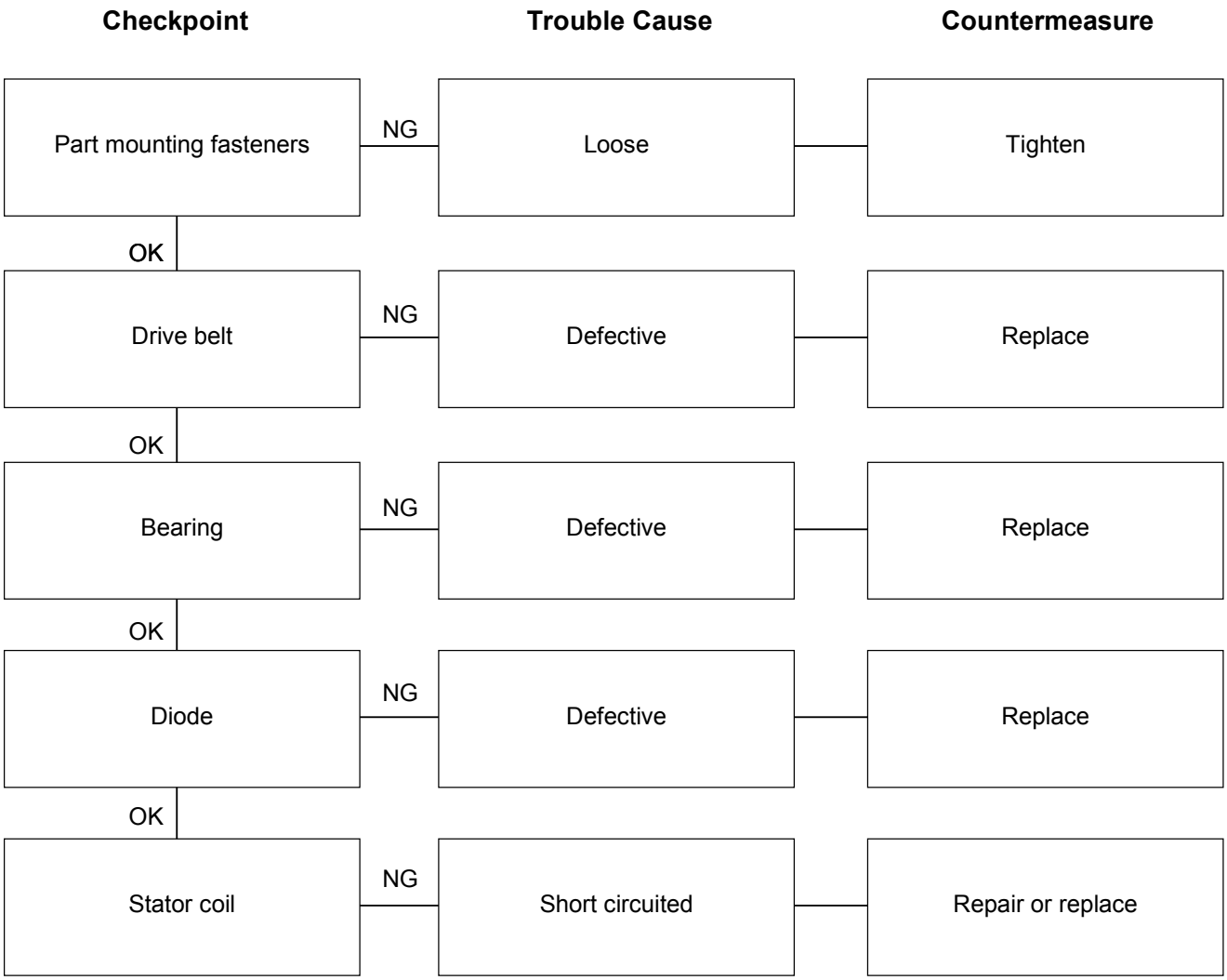
3. UNDERCHARGING

Checkpoint		Trouble Cause	Countermeasure
Battery terminals	NG	Loosely connected	Retighten
OK			
Drive belt	NG	Slippage	Adjust or replace
OK			
Brush and slip ring contact	NG	Intermittent	Replace or repair the brush holder assembly
OK			
Generator rotor coil	NG	Short circuit	Repair or replace
OK			
Generator stator coil	NG	Short or open circuit	Repair or replace
OK			
Generator diode	NG	Defective	Replace
OK			
IC regulator	NG	Insufficient voltage	Replace
OK			
Electrical load	NG	Excessive	Use a higher capacity alternator or reduce the accessory load

4. UNSTABLE CHARGING CURRENT

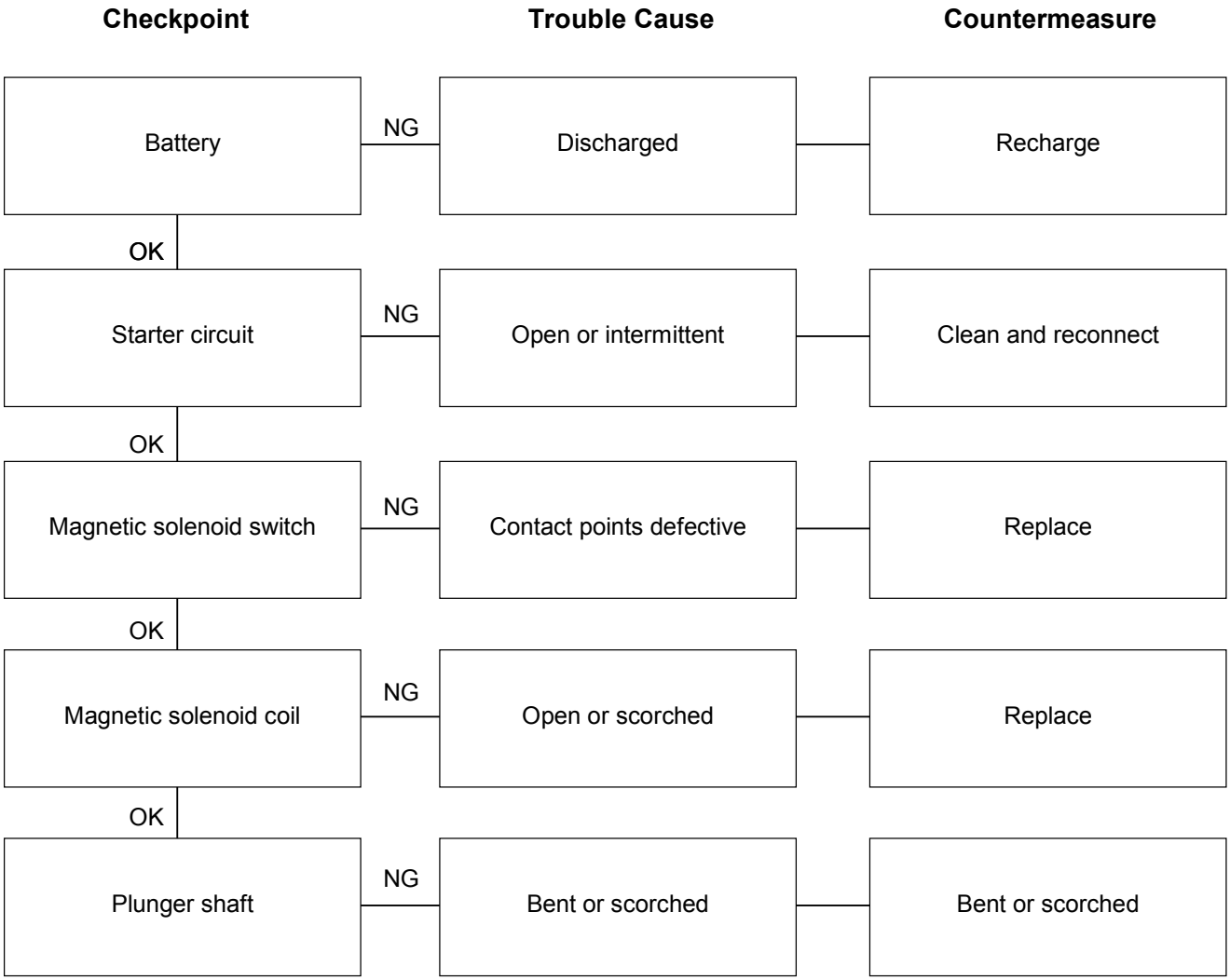


5. NOISE

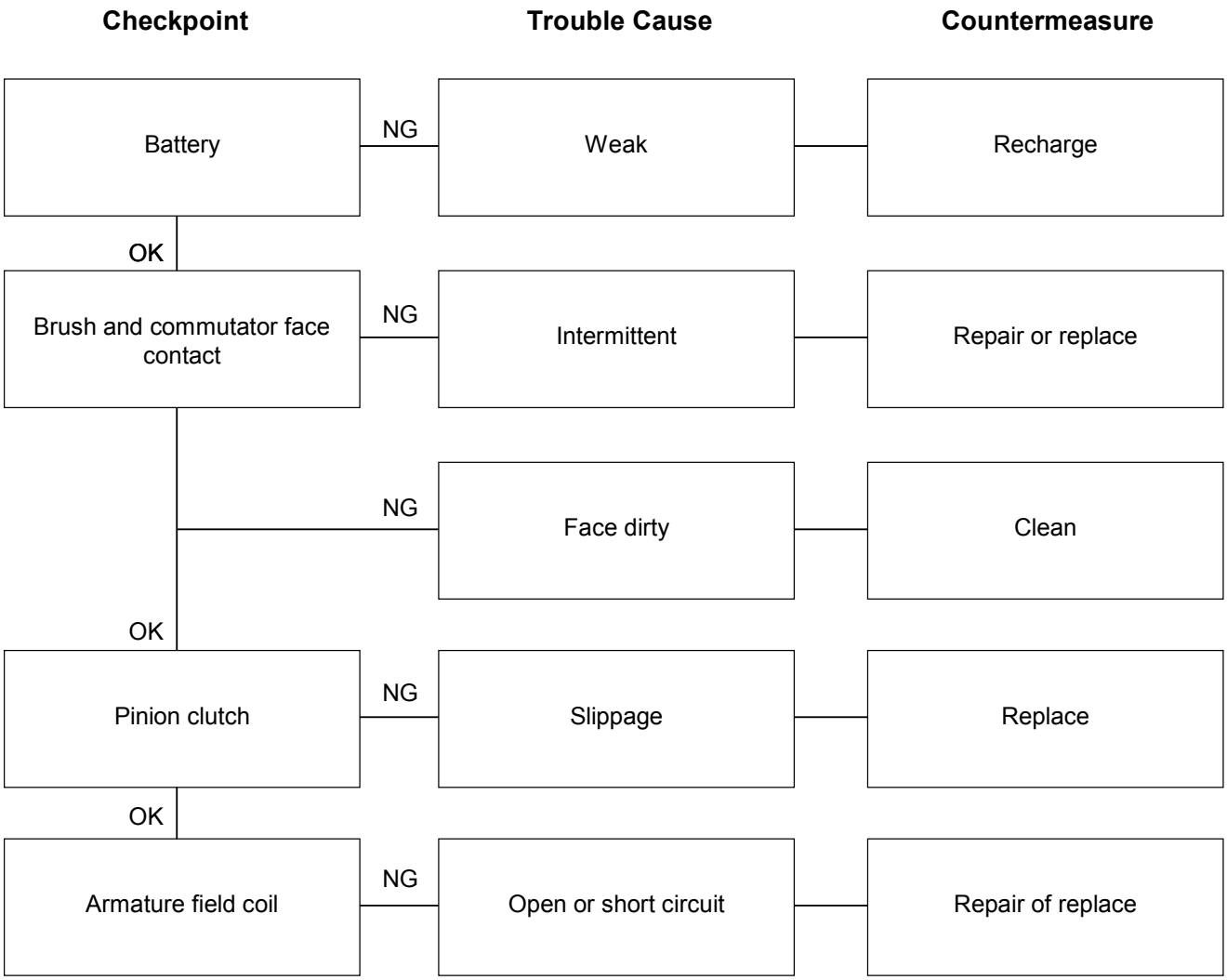

Checkpoint
Trouble Cause
Countermeasure
Part mounting fasteners
NG
Loose
Tighten
OK
Drive belt
NG
Defective
Replace
OK
Bearing
NG
Defective
Replace
OK
Diode
NG
Defective
Replace
OK
Stator coil
NG
Short circuited
Repair or replace

II. HARD STARTING

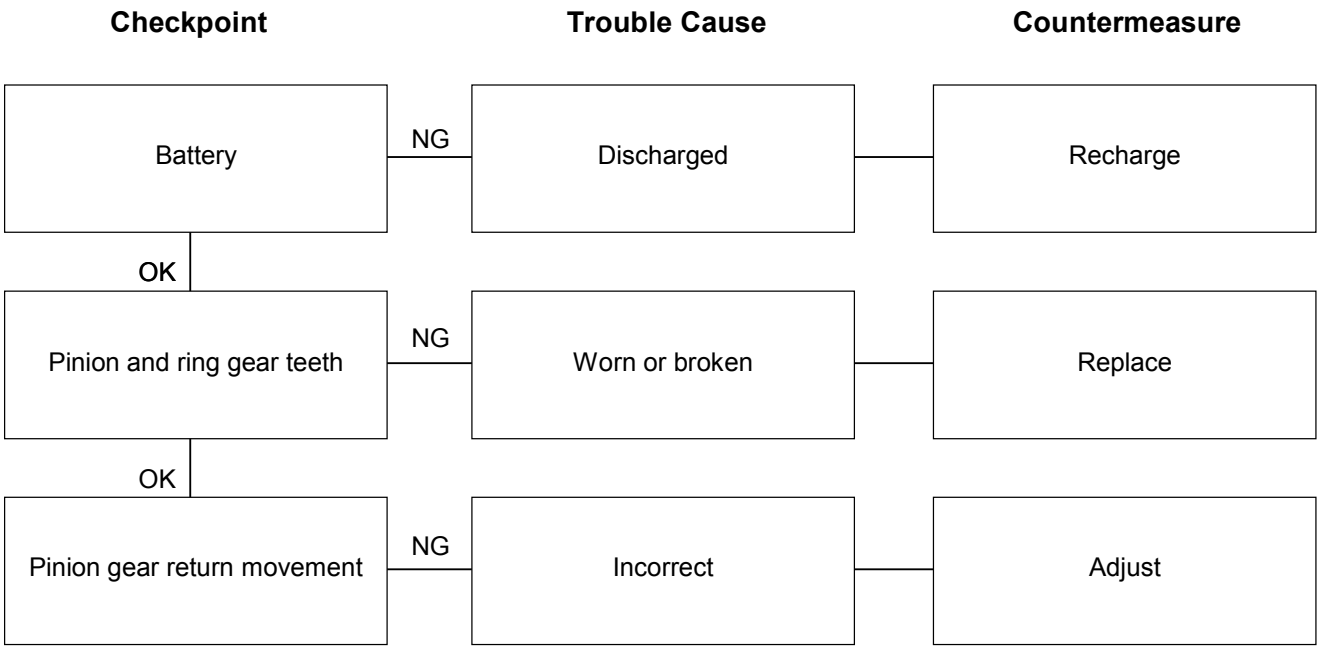
1. PINION DOES NOT ENGAGE THE RING GEAR WHEN THE STARTER SWITCH IS TURNED ON



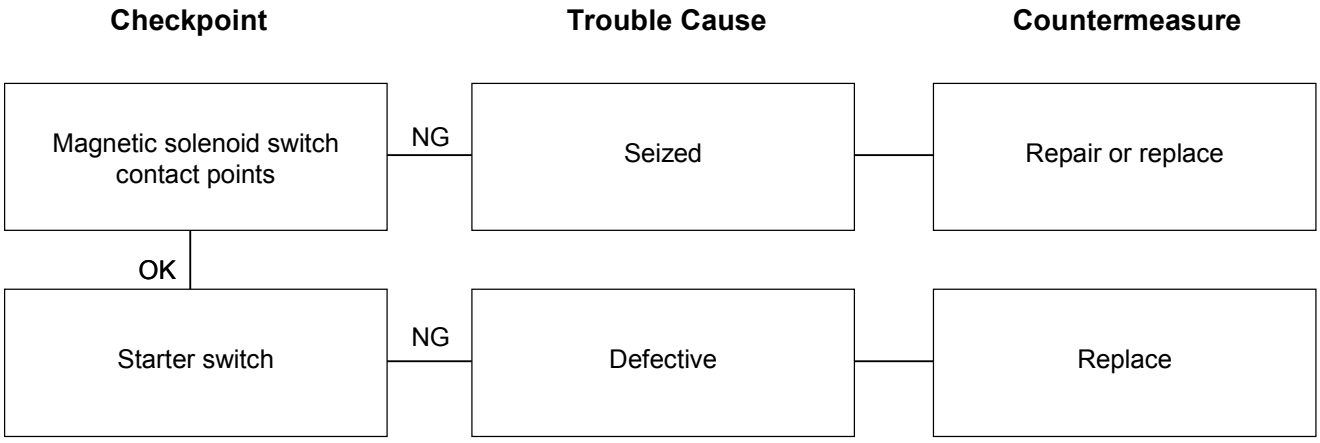
2. PINION ENGAGES THE RING GEAR BUT THE ENGINE DOES NOT TURN OVER



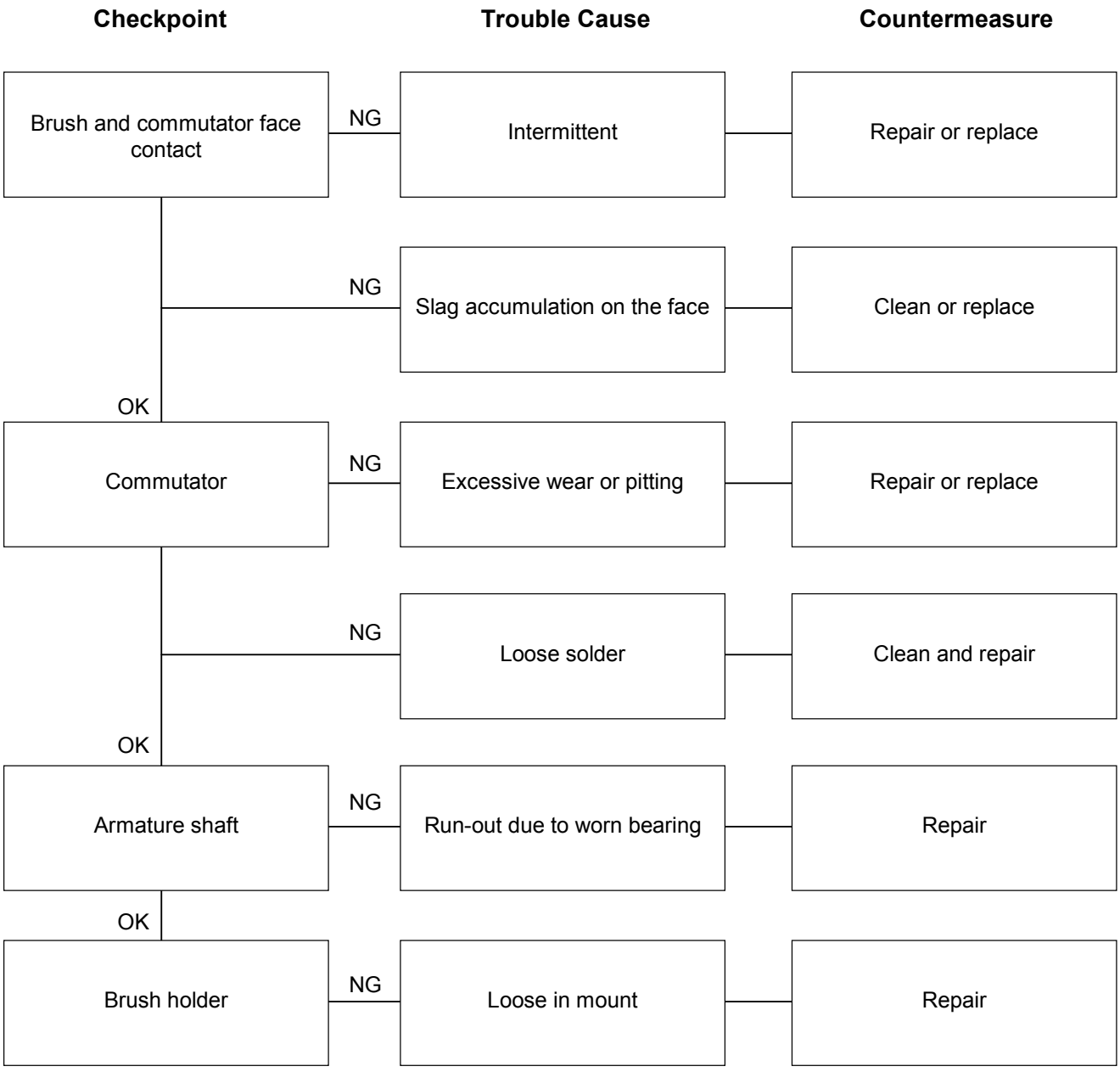
3. INCORRECT PINION AND RING GEAR ENGAGEMENT



4. STARTER CONTINUES TO RUN AFTER THE STARTER SWITCH IS TURNED OFF



5. EXCESSIVE COMMUTATOR SPARKING



QOS II PREHEATING SYSTEM

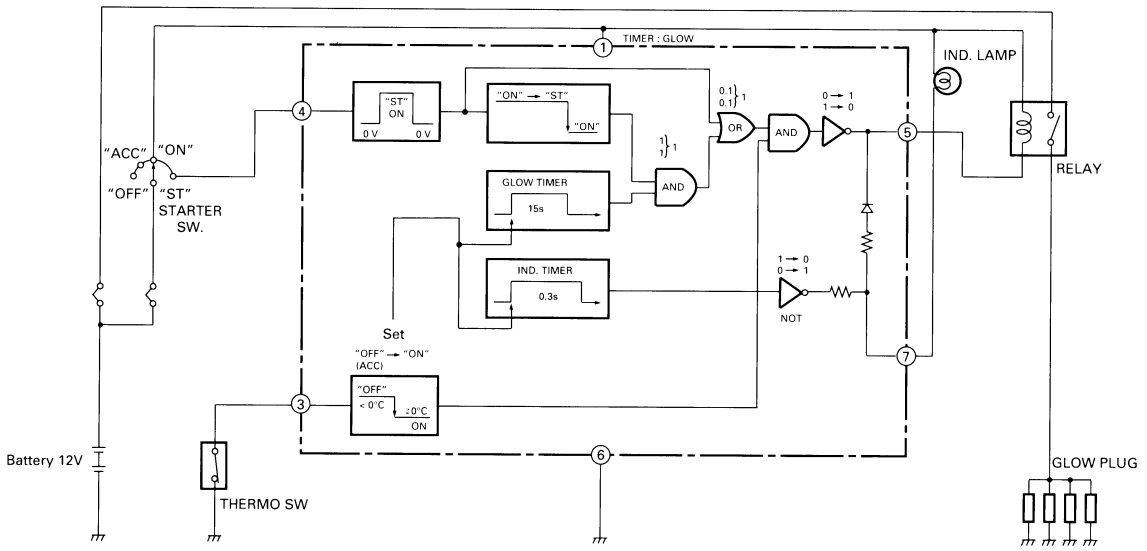
GENERAL DESCRIPTION

QOS II preheating system features a quick-on glow plug with thermometer control of the glowing time and the afterglow time function.

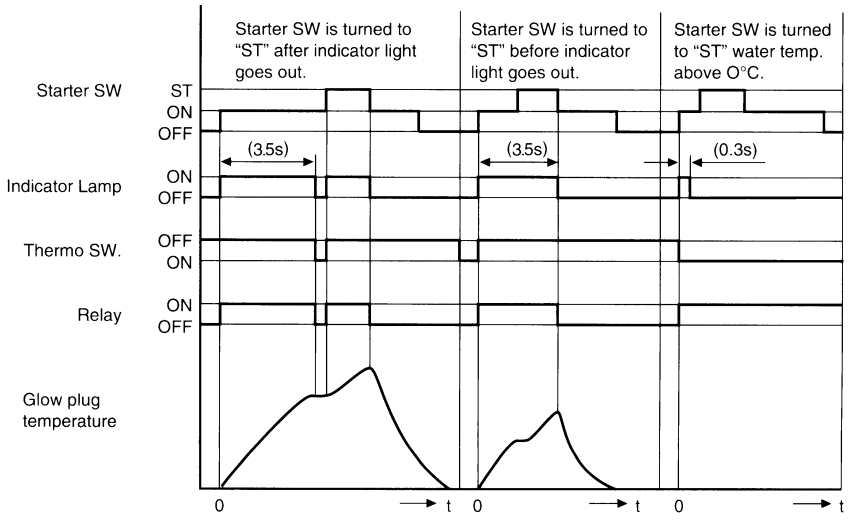
The system consists of a controller, indicator lamp, thermoswitch, relay, and glow plug (4pcs).

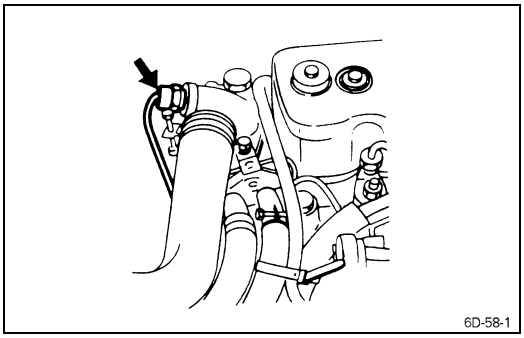
With the employment of the thermoswitch, the glow time changes according to the engine coolant temperature, thus allowing optimum starting conditions to be obtained.

SYSTEM DIAGRAM



QOS II Timing Chart

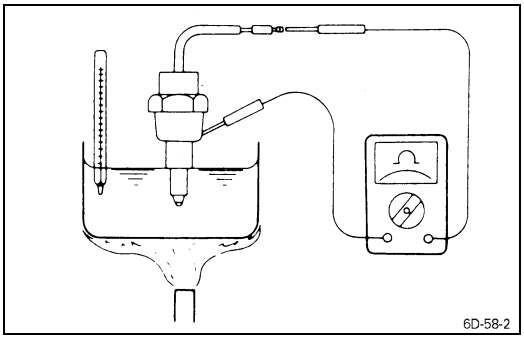




Inspection on QOS II System Operation

THERMO SWITCH

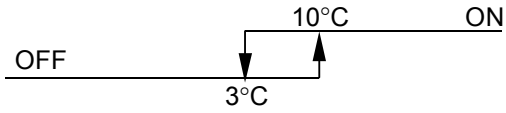
The thermo switch is located on the water outlet pipe.



Use a circuit tester to check the thermo switch for continuity.

Thermo sensor (4JA1, 4JA1T, 4JG2T engine)

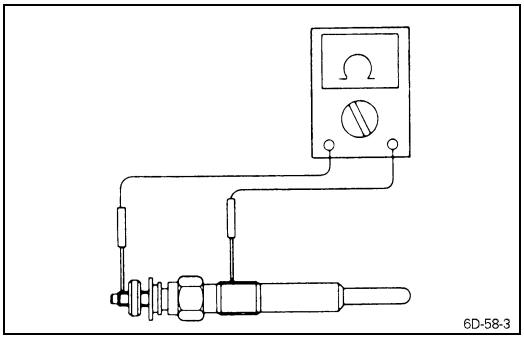
OFF	→	ON : 7 - 13°C (44.6 – 55.4°F)
ON	→	OFF : Below 3°C (37.4°F)



Thermo sensor (4JG2T engine)

Thermo Sensor Resistance K-Ohm

Temperature °C (°F)	Resistance	Temperature °C (°F)	Resistance
-15 (5)	12.00	40 (104)	1.10
0 (32)	6.00	60 (140)	0.60
10 (50)	3.60	80 (176)	0.30
20 (68)	2.45		



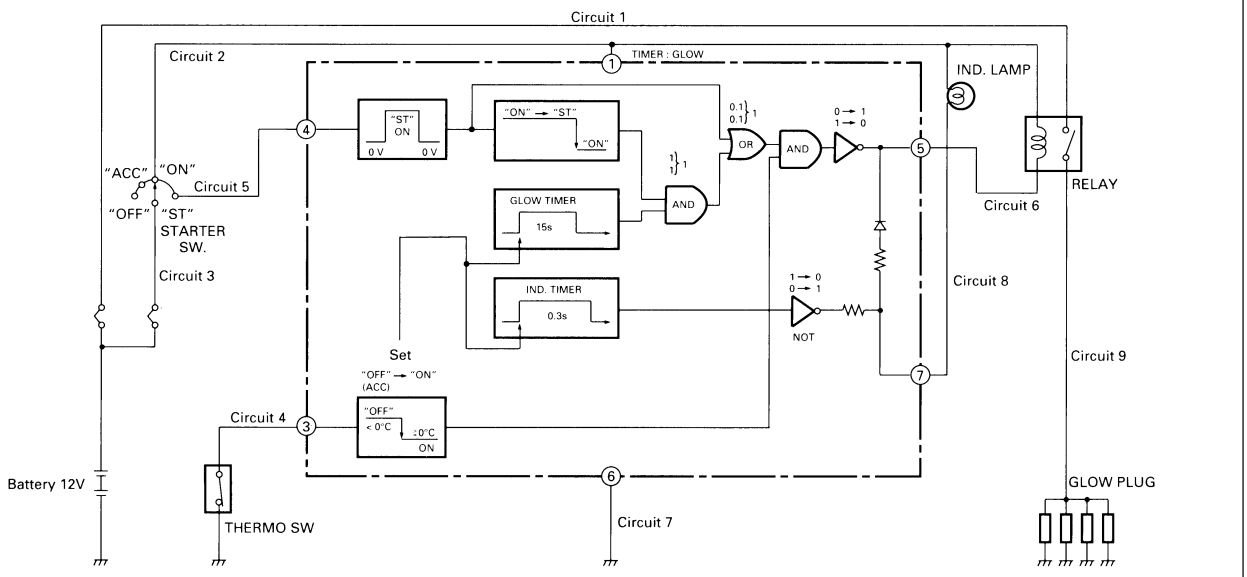
GLOW PLUG

Use a circuit tester to test the glow glugs for continuity.

Glow plug Resistance (Reference) Ohms

Quick on start model	Approximately 0.9

QOS II SYSTEM TROUBLESHOOTING



1) Problems when the water temperature of the engine is 0°C or below.

Condition	Cause	Circuit
Glow plug relay will not be lit.	Bad connection of FLW between battery and starter.	3
	Bad connection or disconnection of starter SW circuit	
	Bad connection or disconnection of Fuse No . 8 — Malfunction of other circuits occurred simultaneously.	2
	Bad starter switch.	
	Bad connection of glow plug relay terminal.	1
	Disconnection of glow plug relay excitation coil.	
	Disconnection of circuit between glow plug relay and timer.	6
	Bad glow relay. (The main contact does not pass electricity.)	
	Bad connection of timer.	
	Bad timer.	
	Bad earth circuit of timer.	7
	Bad thermoswitch. (It remains ON even in water temperature below 0°C.)	
	Earth short-circuiting of thermo SW.	7

Condition	Cause	Circuit
Through glow plug relay turns ON, preheating is not done.	Bad connection of FLW between battery and glow relay.	1
	Bad connection or disconnection in preheating circuit of glow relay main contact terminal connector.	
	Bad connection between plug connector and preheating circuit	9
Glow plug relay turns ON, but does not go OFF.	Bad timer.	
	Bad timer. Short circuiting in circuit or earth between 5 terminal and glow relay.	6
	Bad glow relay.	
Indication lamp is not lit.	Bad timer.	
	Burning-out of light bulb.	8

Note: Circuit No. in rectangle is shown in the previous pre-heating chart.

2) Problems when the time water temperature of the engine is 0°C or above.

Condition	Cause	Circuit
Indicator lamp is not lit	Bad timer	
	Burning-out of bulb.	8
Turn glow relay ON.	Bad thermoswitch or disconnection of thermo SW circuit. (Indicator will light up for 3.5 seconds.)	4
	Bad timer.	
	Bad timer. Short-circuiting in circuit or earth between terminal 5 and glow relay.	

Note: Circuit No. in rectangle is shown in the previous pre-heating chart.

3) Burning-out of glow plug

When only one line is burned out, it has no effect on the start up of the engine. Even if one line is burned out, judging from the characteristics of the glow plug, the impressed voltage will change only slightly. Therefore, no judgment can be made by normal testing while the glow plug is installed. In order to check for disconnections and burn-outs, the glow plugs will have to be removed from the connectors and checked one by one for continuity.

ENGINE WARMING-UP SYSTEM

GENERAL DESCRIPTION

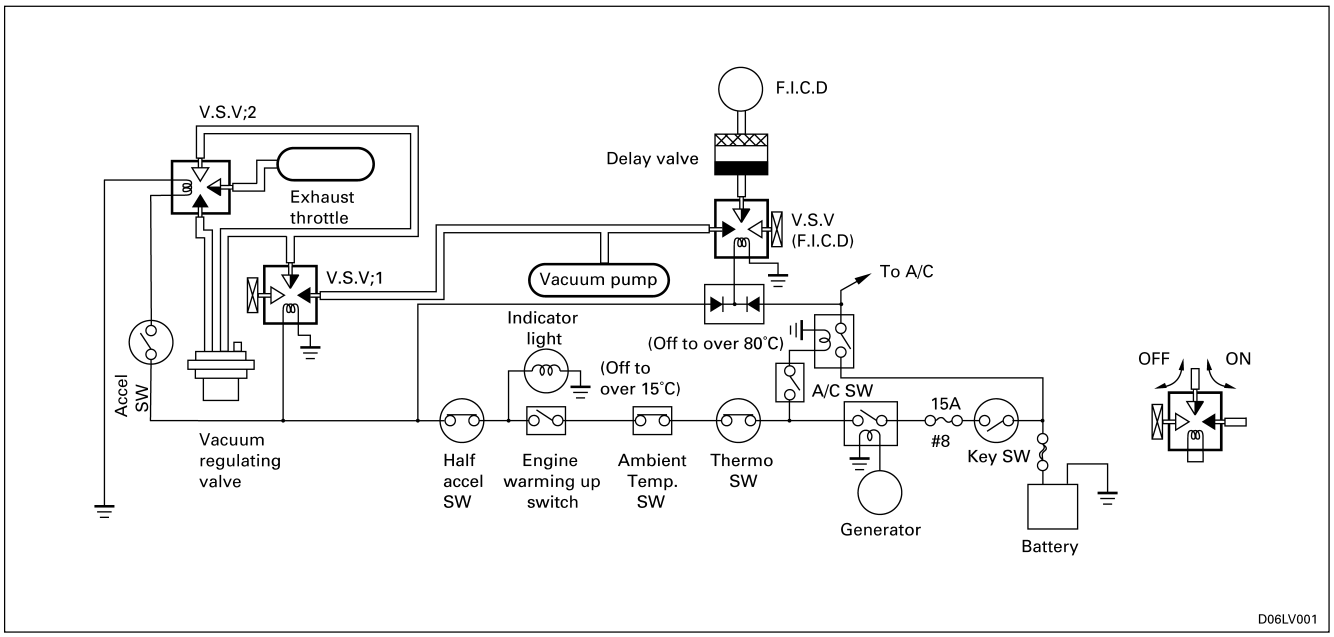
The engine warm-up system is a device which changes the openning of the throttle valve for intake in accordance with the engine rpm, controls the amount of the intake air, and changes the air ratio which is supplied to the cylinder. The device is also provided with such functions as to measure the amount of heat capacity, to close the exhaust throttle valve to raise the exhaust pressure, and to accelerate the rise in compression and temperature, and the increase of fuel.

Operation of each device when warming-up switch is ON position.

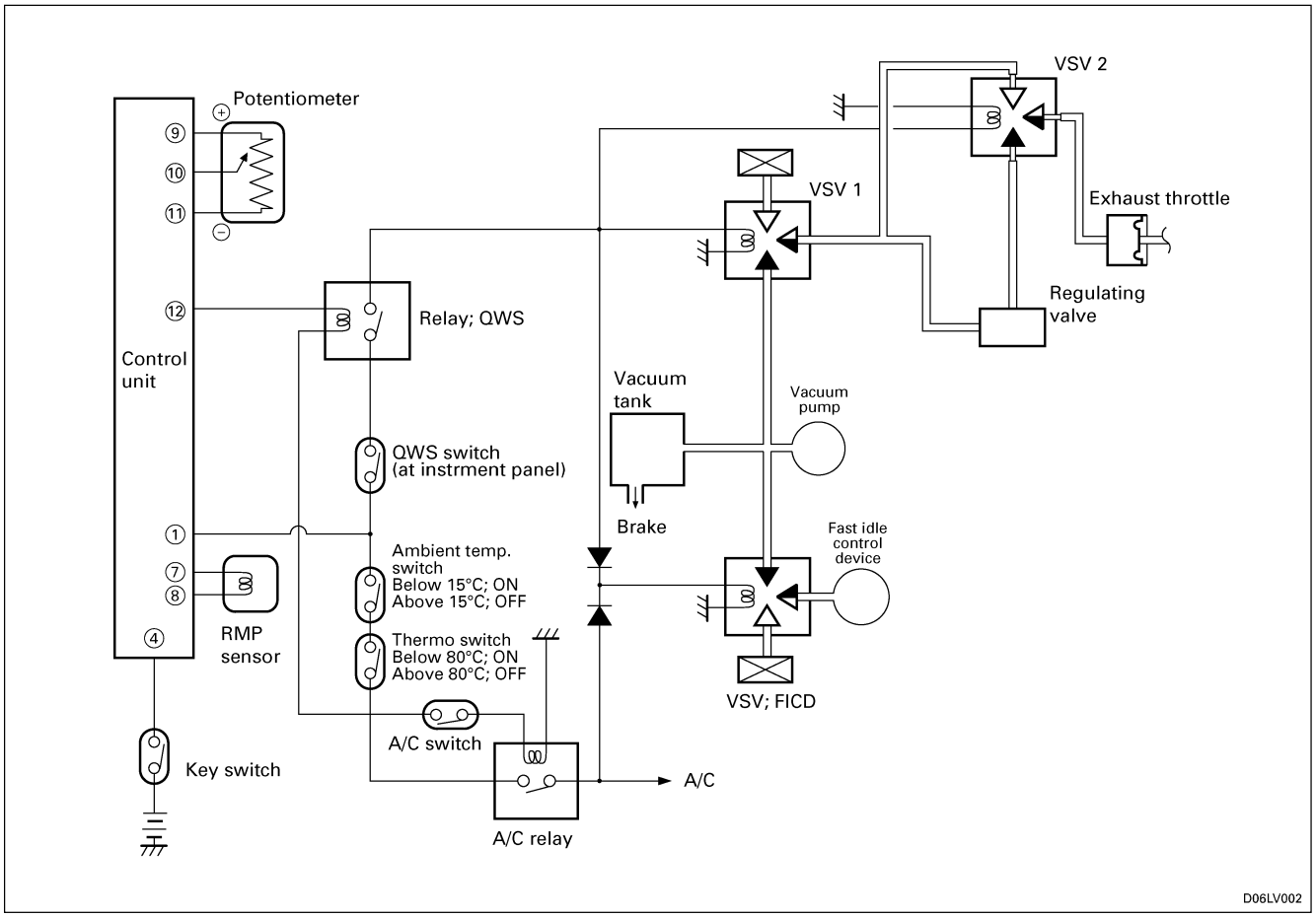
Temp. sw. Ambient sw. Half sw. (only 4JA1)	Accel sw.	Vacuum switching valve			EXH. valve	Intake valve	FICD
		1	2	FICD.			
One of above sw. OFF	-	OFF	OFF	OFF	Open	Open	NOT Working
All of above sw. ON	OFF	ON	OFF	ON	Full Close	Close	Working
	ON	ON	ON	ON	Half Close	Close	Working

ENGINE WARMING-UP SYSTEM CIRCUIT

Type A



Type B



TROUBLE SHOOTING

QUICK CHART FOR CHECK POINT

ENGINE WARMING-UP

When this system is out of order, checking as follows.

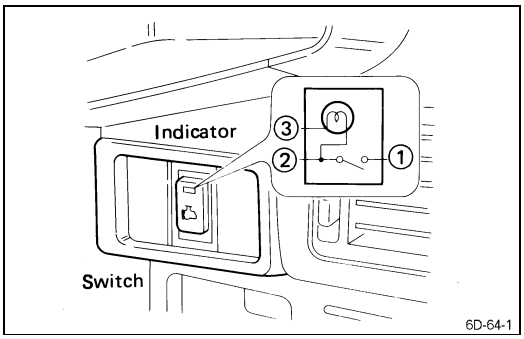
Checking parts / Trouble mode	Switch					ENG. Warming up Indicator	VSV		FICD	Throttle		Cable harness
	Engine warming up	Thermo	Ambient temperature	Accel	Half Accel (only 4JA1)		1	2		INT	EXH	
The indicator light does not light when switch is ON position.	O	O	O			O						
The system does not operate	O	O	O	O	O		O	O	O	O	O	O

Abbreviation

V.S.V. ; Vacuum switching valve
FICD ; Fast idle control device
INT ; Intake
EX ; Exhaust

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

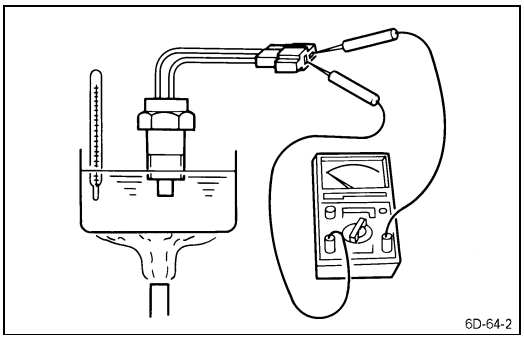


Engine Warming Up Switch

1. Inspect the switch continuity by following table.

Terminal / SW position	①	②	③
ON	O	O	O
OFF		O	O

2. Make sure the indicator light turns on, when the engine warming up switch is “ON” with engine running.

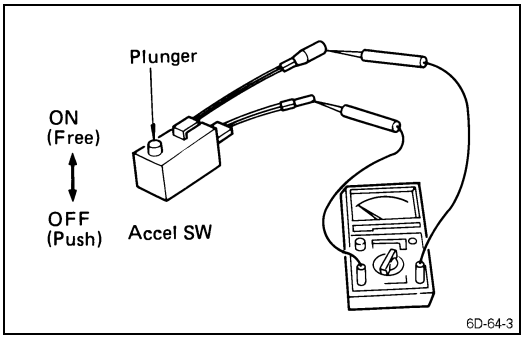


Thermo Switch/Ambient Temp. Switch

1. Submerge end of switch in water.
2. Connect circuit tester to the connector terminals.
3. Use a burner to heat the water.
4. Check the continuity test across.

Operating temperature

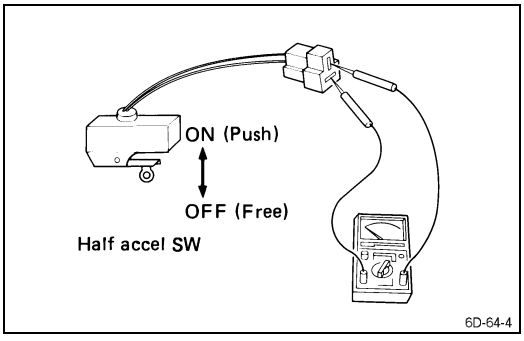
	Thermo	Ambient temp.
OFF → ON	73°C or less	8°C or less
ON → OFF	About 80°C	About 15°C



Accel Switch

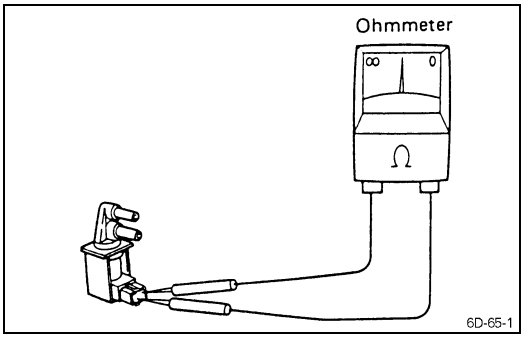
Half accel switch (only 4JA1T)

1. Connect a circuit tester to the connector terminals.
2. Check the Continuity test across.



Operating

	Position	
	Free	Push
Accel switch	Continuity	Not continuity
Half accel switch	Not continuity	Continuity

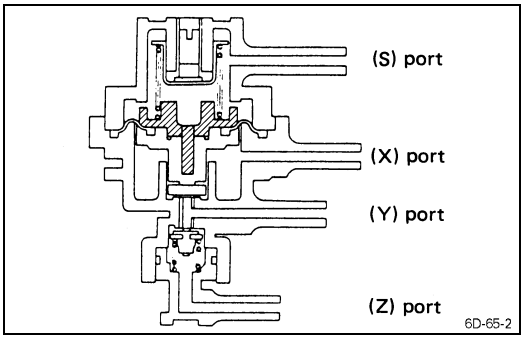


Vacuum switch valve (VSV)

Use a circuit tester to measure the V.S.V. resistance.

V.S.V. Resistance	at 20°C
Approx. 40Ω	

If the resistance is not within specification replace it.



Vacuum Control Valve

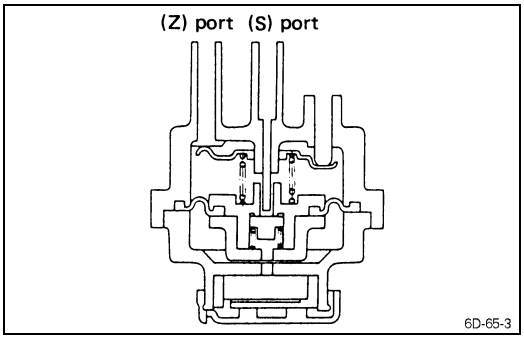
Check the control valve operating pressure.

1. Make sure that port (X) is open to the atmosphere (no obstructions).
2. Apply a constant pressure of – 500 mmHg to port (Z).
3. Apply a pressure of – 155 mmHg to port (S).
   Measure the valve operating pressure at port (Y).

Valve Operating Pressure	mmHg
Standard reading	0 to – 100

4. Apply a pressure of – 75 mmHg to port (S).
   Measure the valve operating pressure at port (Y).

Valve Operating Pressure	mmHg
Standard reading	– 400 to – 500

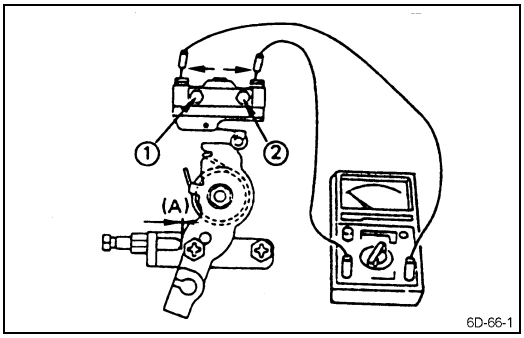


Vacuum Regulator Valve

Check the vacuum regulator valve operating pressure.

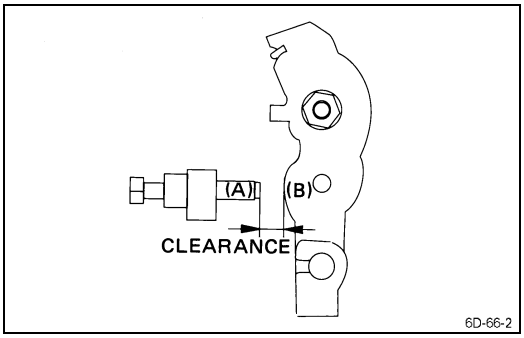
1. Apply a pressure of – 450 mmHg (– 17.7 Hg) to port (S).
   Measure the regulator pressure at port (Z).

Regulator Operating Pressure	mmHg (Hg)
Standard reading	– 235 to – 265 (– 9.3 to – 10.4)



Half Accel. Switch Adjustment (only 4JA1T)

1. Insert a feeler gauge of 6 mm thickness between the idle adjust screw end and control lever (A).
2. Loosen each bolts (① & ②).
3. Set the circuit tester to micro-switch harness.
4. Find out the just continuity from OFF to ON position with moving the micro-switch in the direction of the arrow.
5. Tigten each bolts (① & ②).



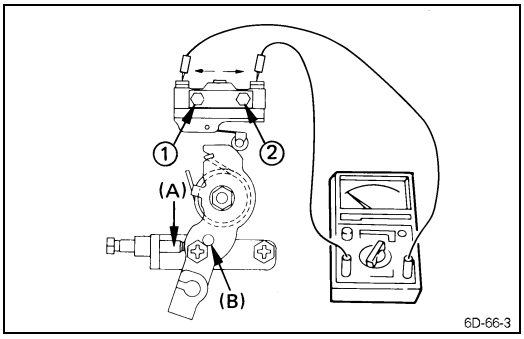
Half Accel. Switch (on the vehicle)

Inspection

1. Connect a circuit tester to the half accel. switch connector terminals.
2. Operate control lever slowly to a point where continuity is switched over from “ON” to “OFF”. Then measure the clearance between the idle stopper bolt (A) and control lever (B).

Standard clearance mm (in)	5.0 - 7.8 (0.2 - 0.3)

If the clearance is out of the range, the switch must be adjusted.



Adjustment

1. Insert a feeler gauge of specified thickness between the idle stopper bolt (A) and control lever (B).

Adjustment clearance mm (in)	5.0 (0.2)

2. Loosen two switch bolts.
3. Connect a circuit tester to the switch connector terminals.
4. Moving the switch in directions indicated by arrows. Check to make sure of the point where continuity is cut.
5. Tighten the two bolts ① & ②.

MEMO

SECTION 6E

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

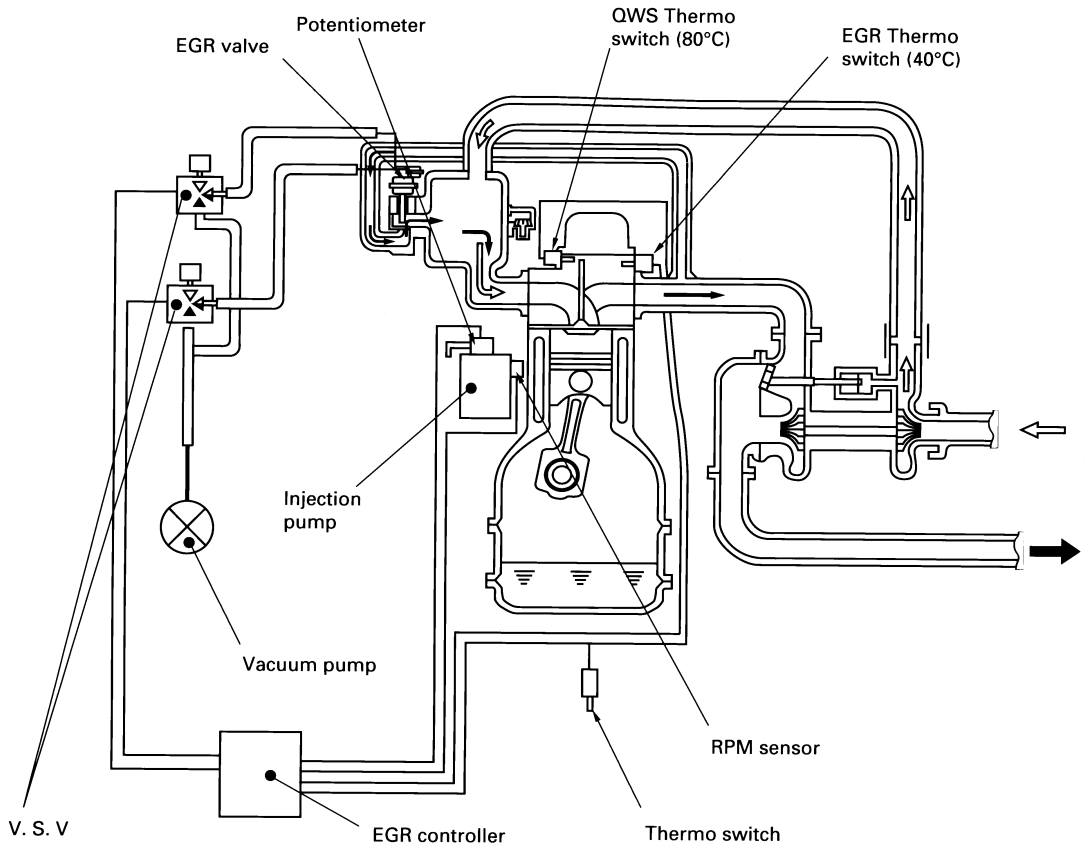
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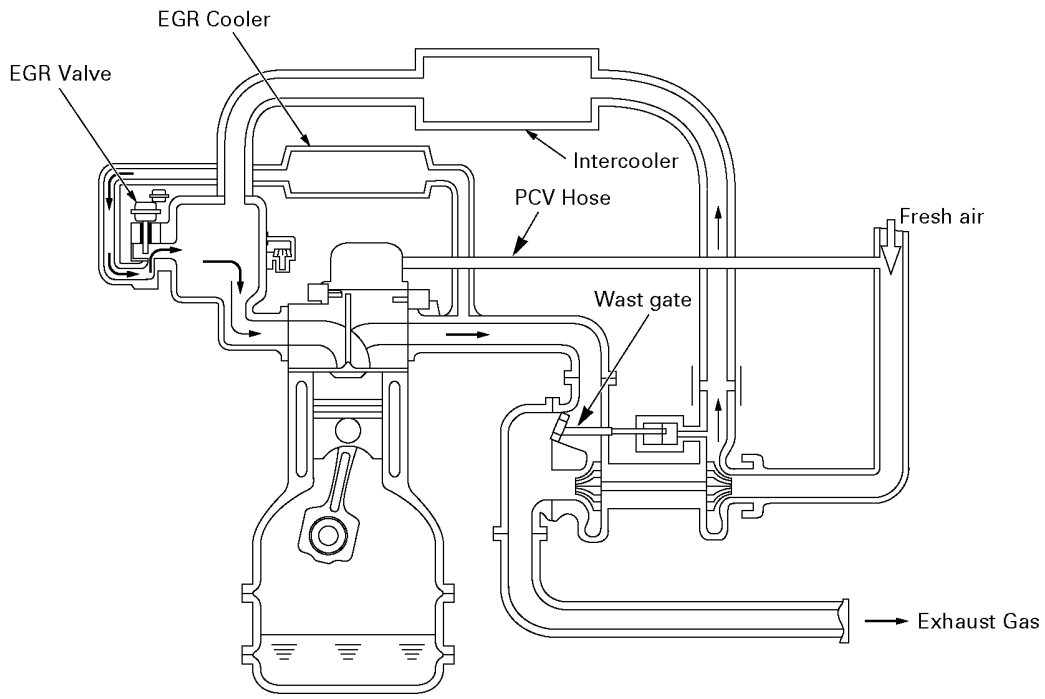
General Description..... 6E -2
EGR System Diagram..... 6E -4
EGR System Operation ..... 6E -4
Inspection..... 6E -5
EGR Cooler..... 6E -6

GENERAL DESCRIPTION

Except 4JA1TC Engine



4JA1TC

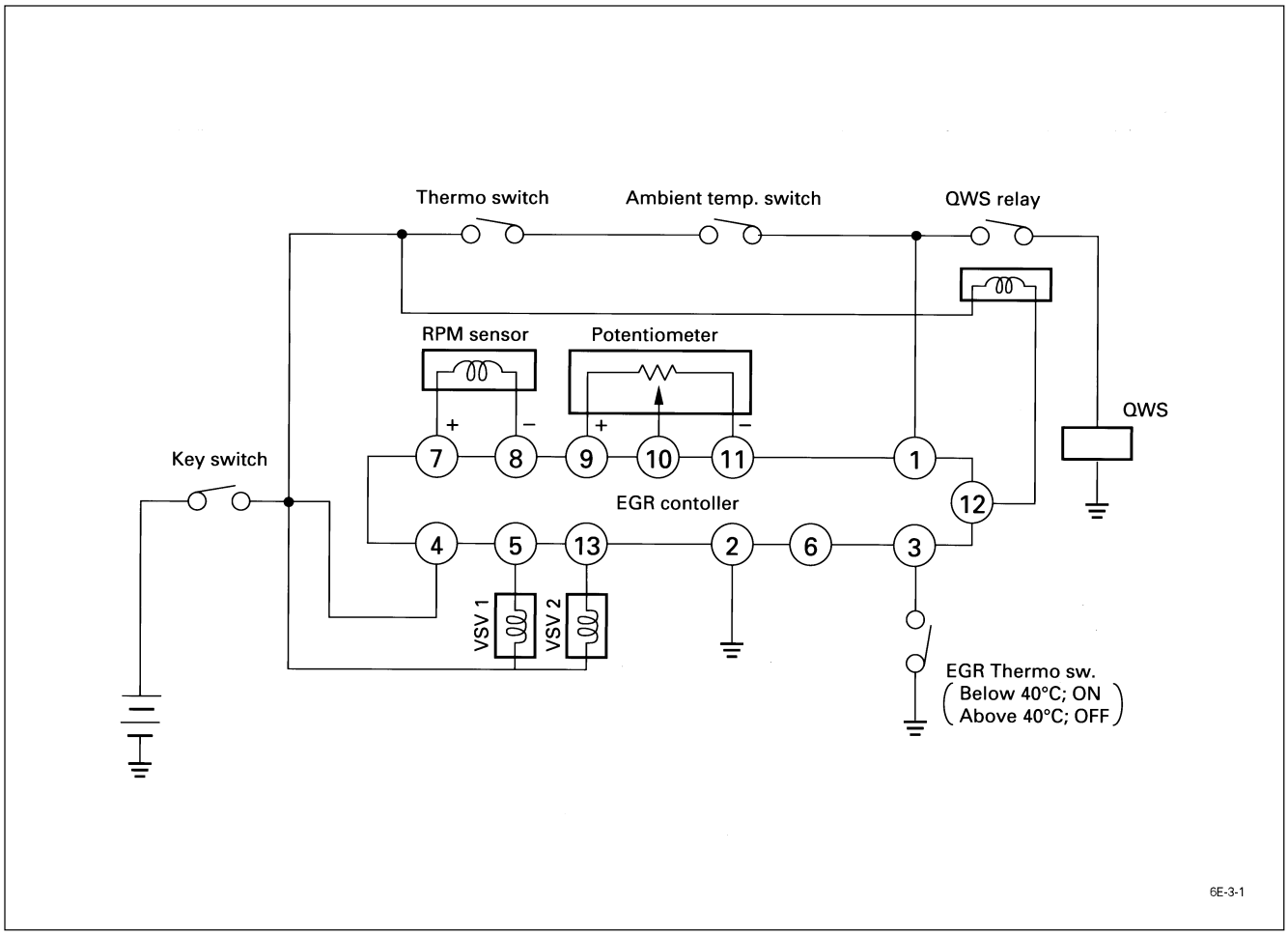


C06H200001

This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifllld.
The two EGR values are controlled by tow VSV controlled by EGR controller according to signals from various snsors.

The amount of EGR depends on the number of engine rotations and the opening of the accelerator. Also, EGR may fail to operate at some water temperature ranges of the engine.
The 4JA1TC engines is intercooler and EGR cooler equipped.

EGR SYSTEM DIAGRAM (Except 4JA1TC Engine)



EGR SYSTEM OPERATION

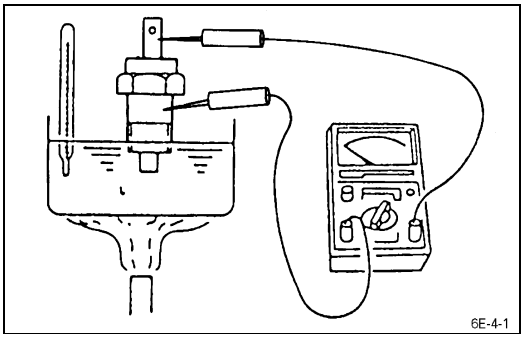
Inspect EGR valve motion visually while changing engine RPM under no load condition after warming-up.

- **Inspection point (Engine RPM)**

RPM	Idling	2000	2750	3250
Engine Front Side VSV-1	ON	ON	ON	OFF
Engine Rear Side VSV-2	ON	ON	OFF	OFF

ON means VSV should receive signal to move EGR valve.
OFF means VSV shouldn't receive signal to move EGR valve.

INSPECTION



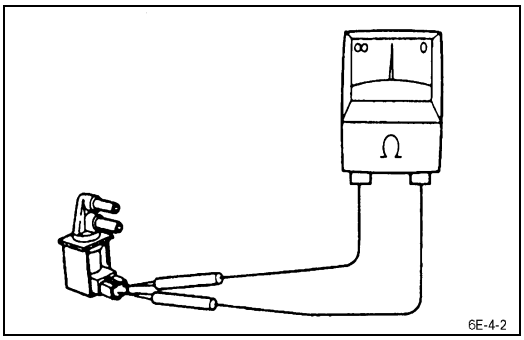
Thermo Switch

1. Submerge end of switch in water.
2. Connect circuit tester to the connector terminals.
3. Use a burner to heat the water.
4. Check the continuity test across.

Operating temperature

	Thermo sw. No.2	Thermo sw. No.1
OFF → ON	Over 73°C	Over 30°C
ON → OFF	76°C ~ 84°C	36°C ~ 44°C

If there is no continuity, replace the switch.

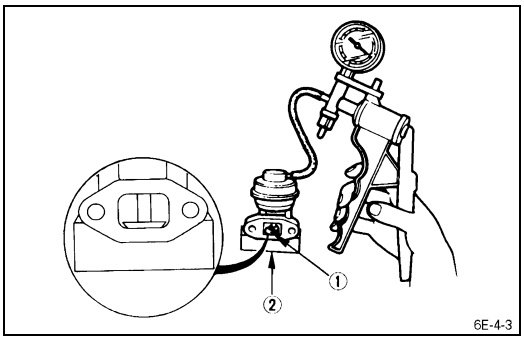


Vacuum switch valve (VSV)

Use a circuit tester to measure the V.S.V. resistance.

V.S.V Resistance	Ω at 20°C
35 ~ 45	

If the resistance is not within specification, replace it.

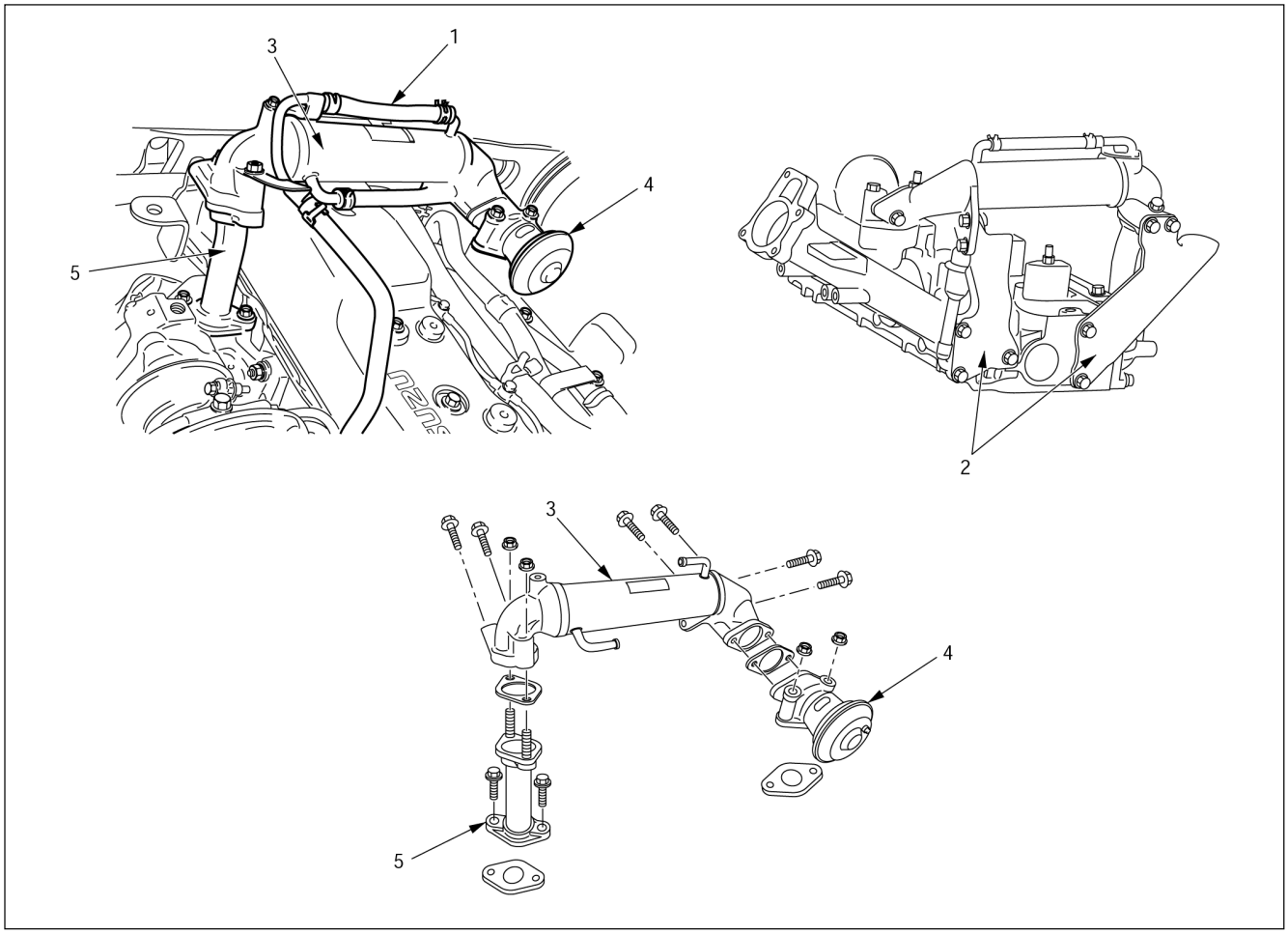


EGR Valve

Apply Vacuum to the EGR Valve, check to see the Valve

Apply Vacuum	
Less then 120 mmHg	Not operation
More than 180 mmHg	Operation

EGR COOLER (For 4JA1TC Engine)



057L200024

Removal Steps

Preparation:

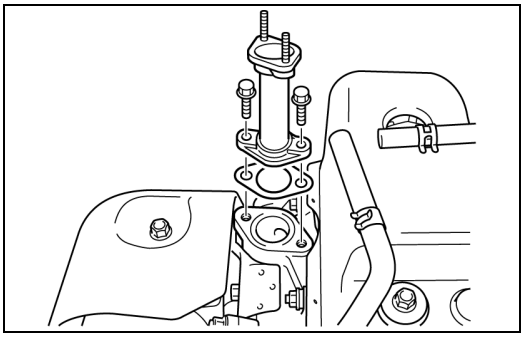
- Disconnect battery ground cable
- Drain coolant
- Remove the intercooler

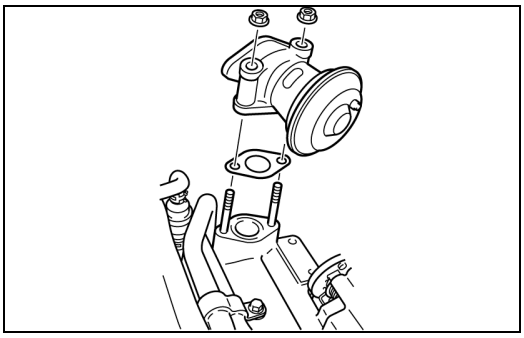
1. Water hose
2. EGR cooler bracket
3. EGR cooler ASM
4. EGR valve
5. EGR pipe

Installation Steps

To install, follow the removal procedure in reverse order.

- ▲ 5. EGR pipe
- ▲ 4. EGR valve
- ▲ 3. EGR cooler ASM
- ▲ 2. EGR cooler bracket
- ▲ 1. Water hose


057L200022


057L200021

Installation Steps

5. EGR Pipe

Install the EGR pipe to the Exhaust manifold and tighten the EGR pipe bolt with EGR pipe gasket to the specified torque.

EGR Pipe Bolt Torque	kg·m (lb·ft/N·m)
2.4 ± 0.5 (17.4 ± 3.6/23.5 ± 5)	

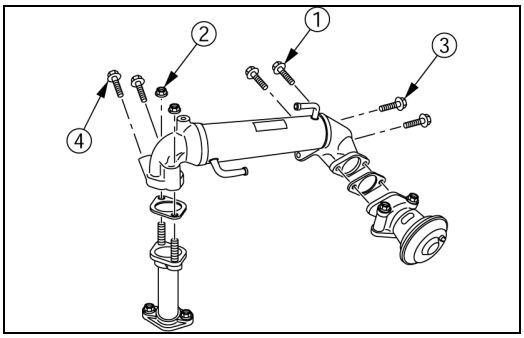
4. EGR Valve

Install the EGR valve to the intake manifold and tighten the EGR valve nut with EGR valve gasket to the specified torque.

EGR Valve Nut Torque	kg·m (lb·ft/N·m)
2.4 ± 0.5 (17.4 ± 3.6/23.5 ± 5)	

3. EGR Cooler ASM

Temporarily install the EGR cooler assembly.



057L200023

2. EGR Cooler Bracket

1) Temporarily install the EGR cooler bracket Hand-tighten each of the bolts.
2) Fintal tighten the bolts in the order shown in the illustration (①②③④).

①② Torque	kg·m (lb·ft/N·m)
2.4 ± 0.5 (17.4 ± 3.6/23.5 ± 5)	

③④ Torque	kg·m (lb·ft/N·m)
1.9 ± 0.5 (14 ± 3.6/19 ± 5)	

1. Water Hose

Connect the water hose to the EGR cooler ASM.

Note:

- **Take care not to scratch the installation surfaces.**
- **Do not allow dirt to adhere to the installation surfaces.**

SECTION 6F
EXHAUST SYSTEM

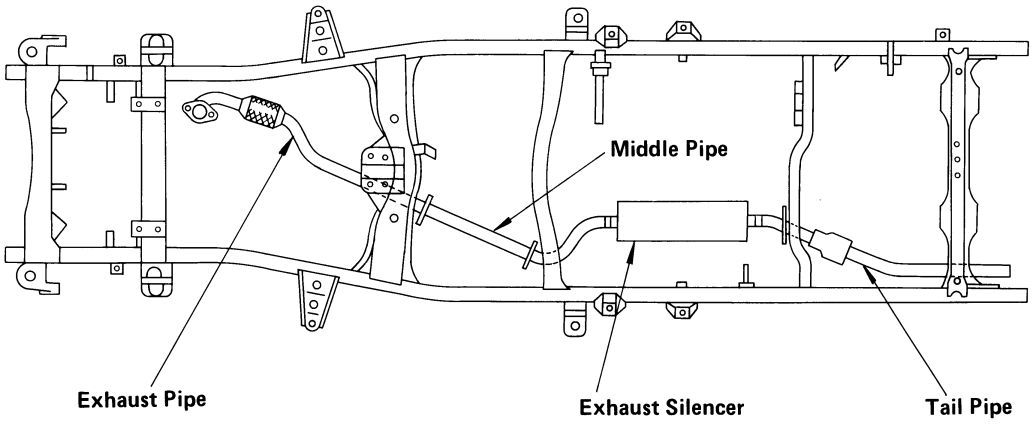
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Inspection and Repair ..... 6F -15
Special Tools..... 6F -17
IHI Service Network ..... 6F -18

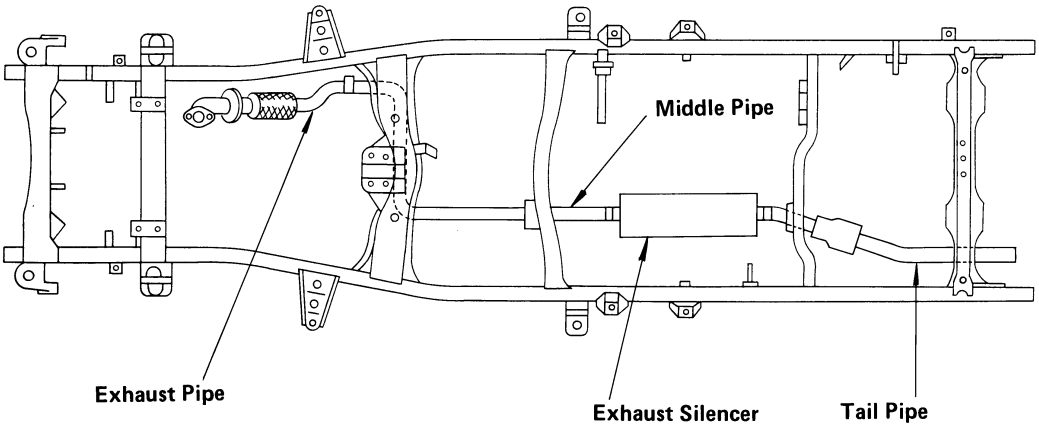
GENERAL DESCRIPTION

FOR 4 x 2



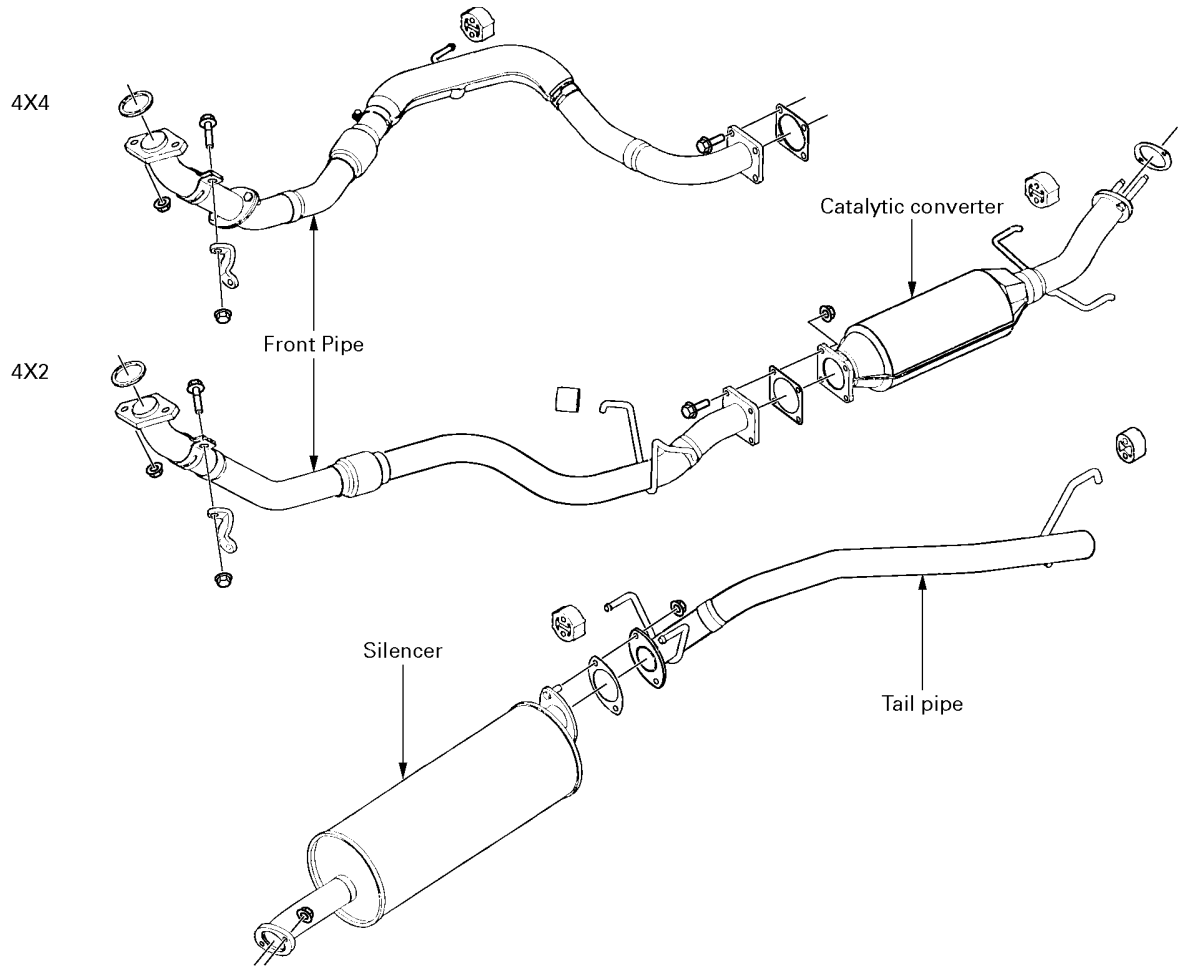
6F-3-1

FOR 4 x 4



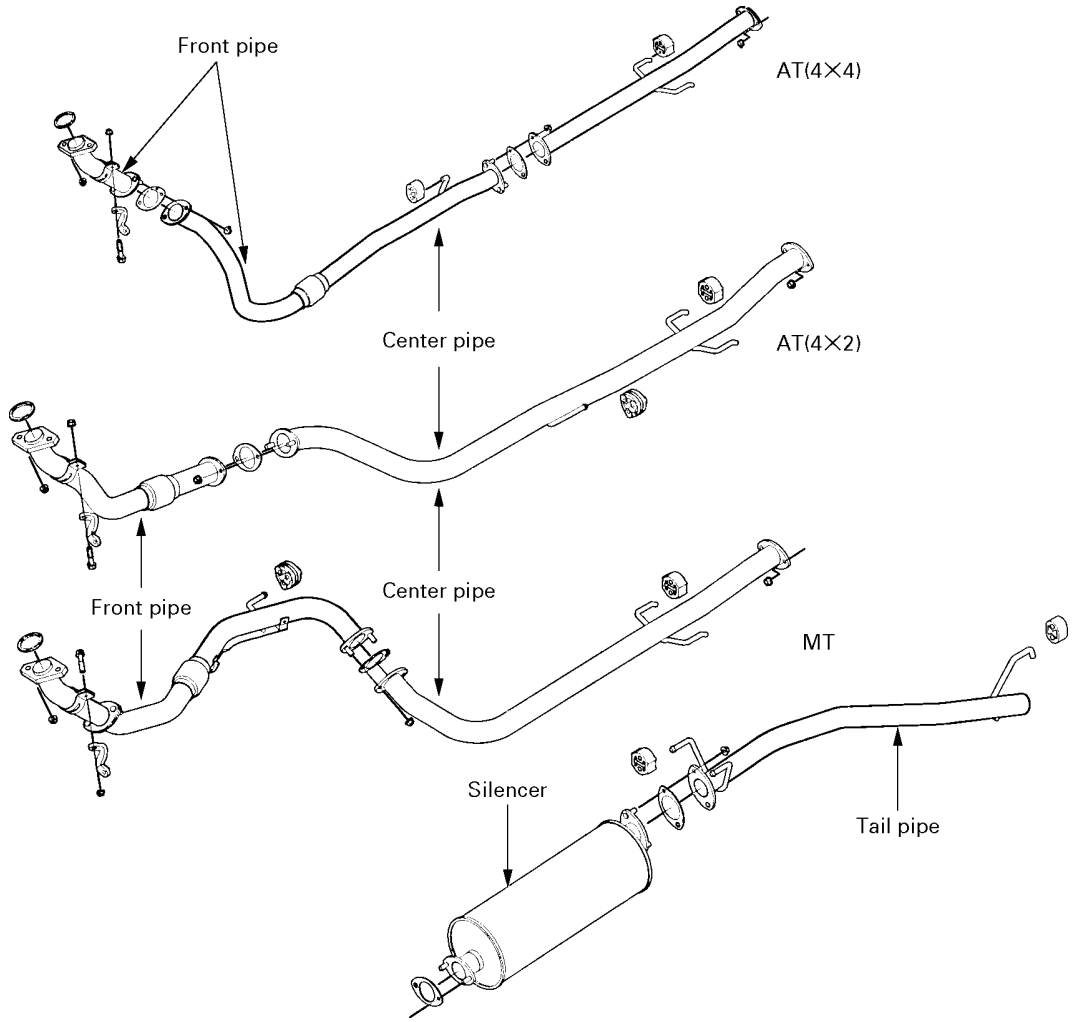
6F-3-2

4JA1TC



150L200004

4JH1TC

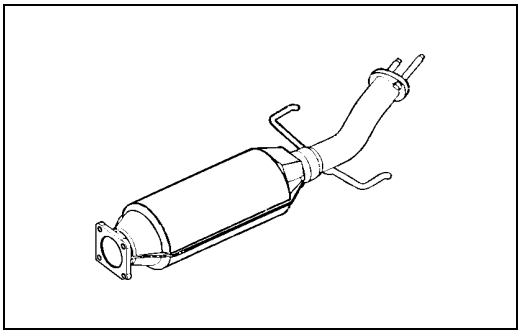


150L200007

The exhaust system consists of a front exhaust pipe, a catalytic converter, a silencer and a tail pipe.

When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may be an indication of a problem in one of these areas. Any faulty areas should be corrected immediately.



150L200005.tif

OXIDIZING CATALYTIC CONVERTER

The oxidizing catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

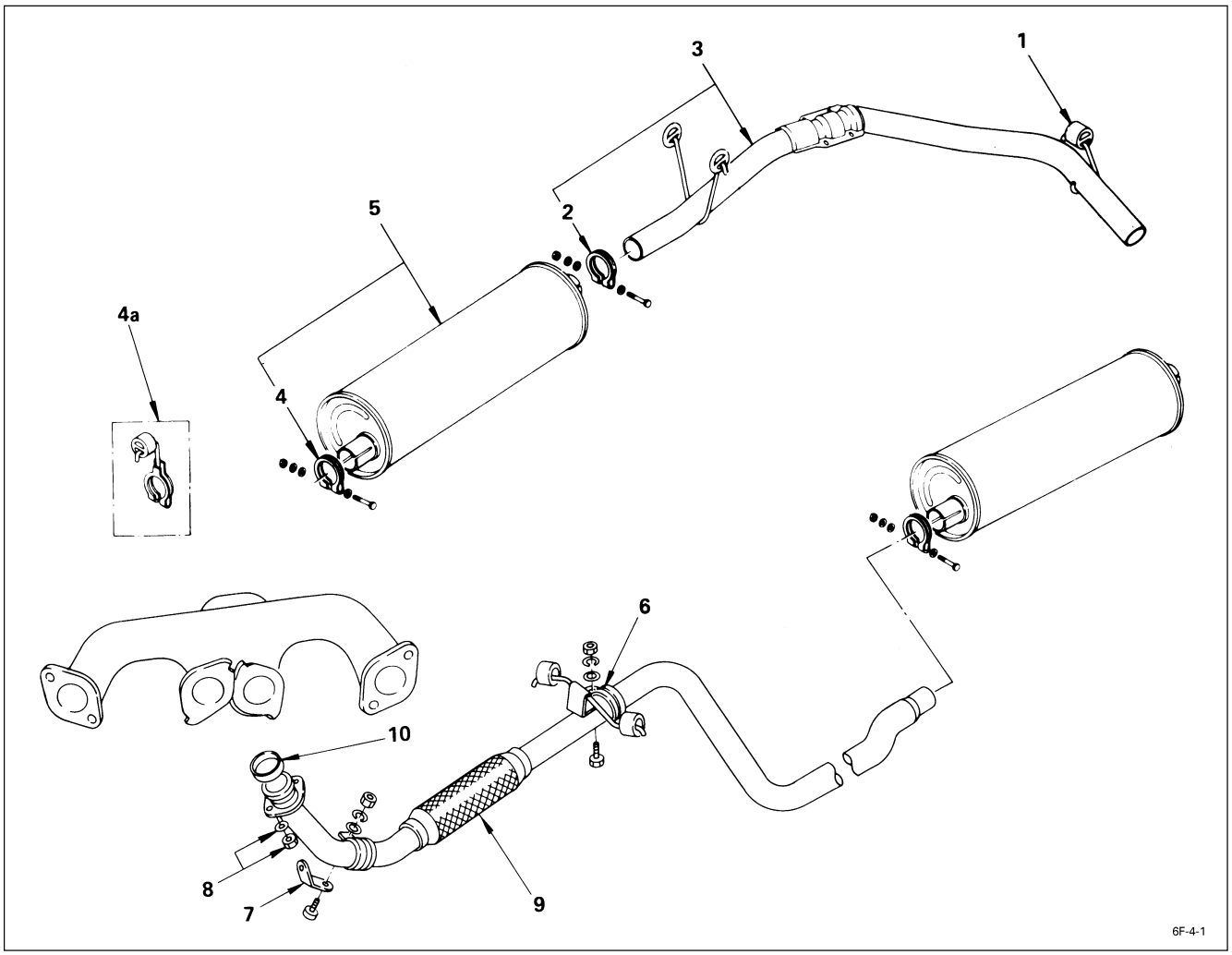
Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.

A dual bed monolith catalytic converter is used in combination with oxidizing catalytic converter.

GASKET

The gasket must be replaced whenever a new exhaust pipe, muffler or catalytic converter is installed.

REMOVAL AND INSTALLATION



Removal Steps

1. Rear hanger clamp
2. Silencer rear clamp
3. Rear exhaust pipe
4. Silencer front clamp
4a. Silencer front clamp (For long wheel base)
5. Exhaust silencer
6. Front hanger clamp
7. Exhaust front bracket
8. Exhaust pipe nut and washer
9. Front exhaust pipe
10. Exhaust pipe gasket

Installation Steps

10. Exhaust pipe gasket
9. Front exhaust pipe
▲ 8. Exhaust pipe nut and washer
7. Exhaust front bracket
6. Front hanger clamp
▲ 5. Exhaust silencer
4. Silencer front clamp
4a. Silencer front clamp (For long wheel base)
3. Rear exhaust pipe
2. Silencer rear clamp
1. Rear hanger clamp

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

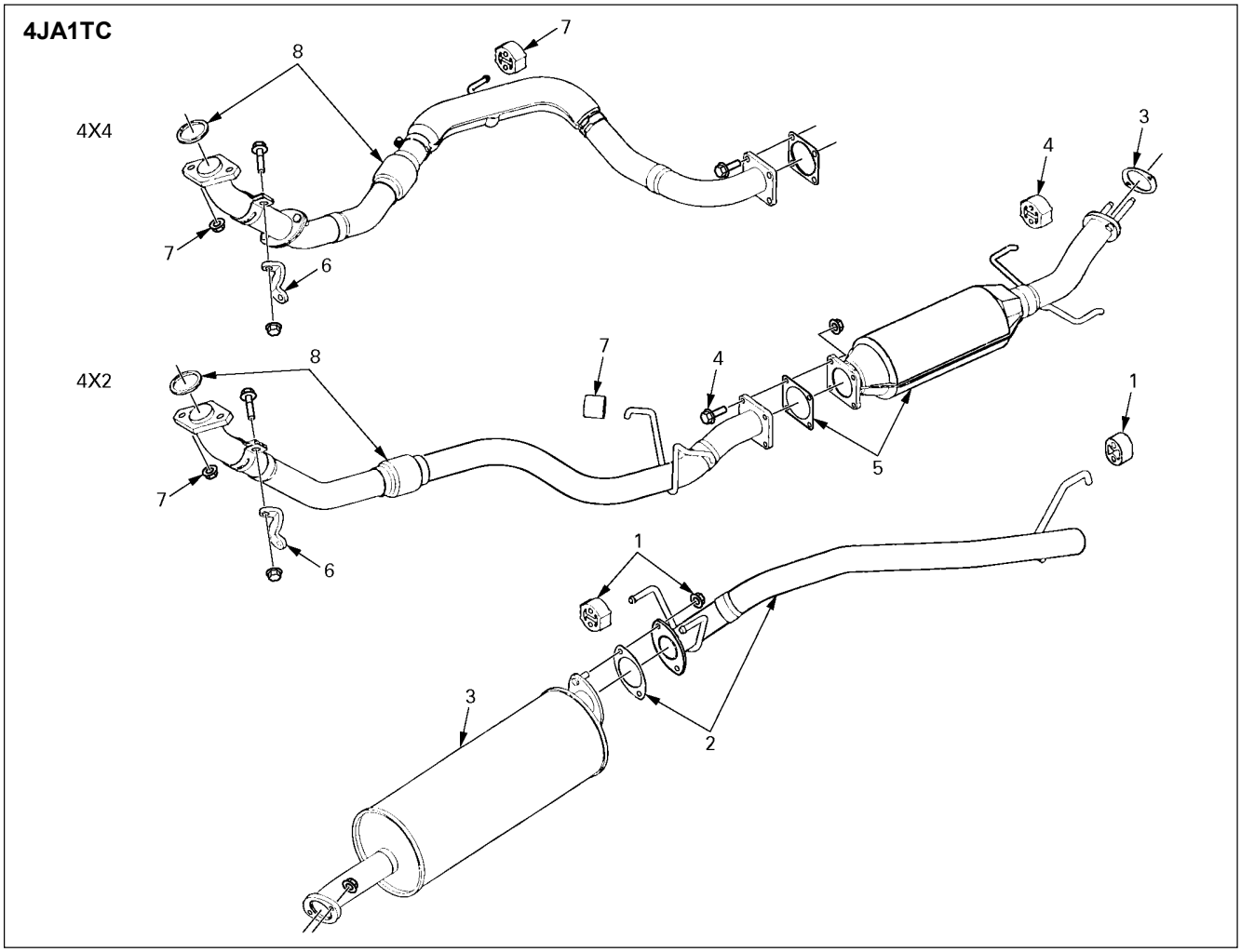
8. Exhaust Pipe Nut and Washer

Connect the exhaust pipe to the exhaust manifold.

Torque	kg·m (lb·ft/N·m)
	6.8 ± 0.5 (49 ± 3.6/67 ± 5)

5. Exhaust Silencer

Apply muffler sealer to the joining portion of the pipes.



150L200006

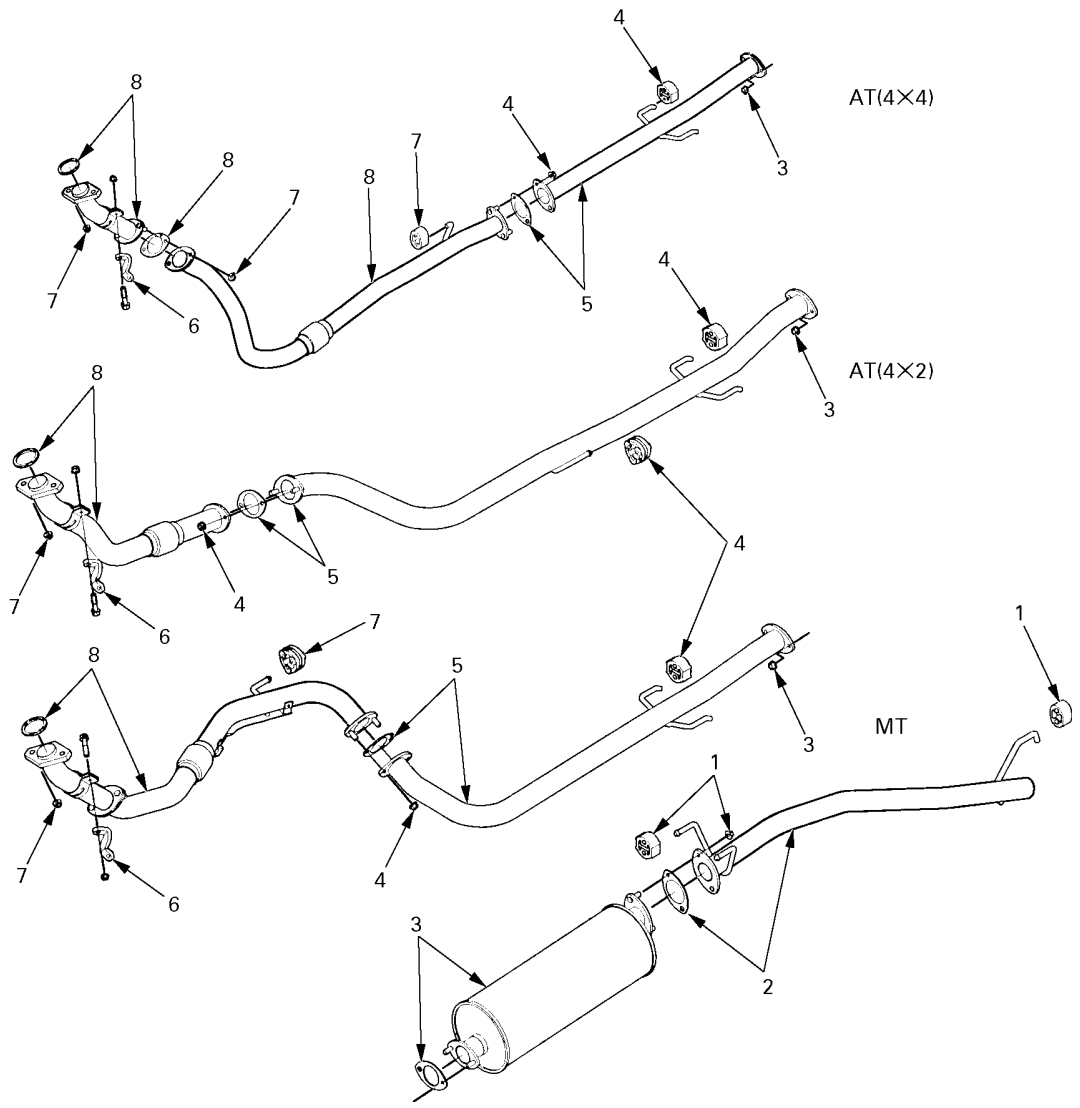
Removal Steps

1. Tail pipe hanger clamp and nuts
2. Tail pipe with gasket
3. Silencer with gasket
4. Oxidizing Catalytic converter hanger clamp and bolts
5. Oxidizing Catalytic converter with gasket
6. Front pipe BRKT
7. Front pipe hanger clamp and nuts
8. Front pipe with gasket

Installation Steps

- ▲ 8. Front pipe with gasket
- 7. Front pipe hanger clamp and nuts
- ▲ 6. Front pipe BRKT
- ▲ 5. Oxidizing Catalytic converter with gasket
- 4. Oxidizing Catalytic converter hanger clamp and bolts
- ▲ 3. Silencer with gasket
- ▲ 2. Tail pipe with gasket
- 1. Tail pipe hanger clamp and nuts

4JH1TC



150L200008

Removal Steps

1. Tail pipe hanger clamp and nuts
2. Tail pipe with gasket
3. Silencer with gasket and nuts
4. Center pipe hanger clamp and nuts
5. Center pipe with gasket
6. Front pipe BRKT
7. Front pipe hanger clamp and nuts
8. Front pipe with gasket

Installation Steps

- ▲ 8. Front pipe with gasket
- 7. Front pipe hanger clamp and nuts
- ▲ 6. Front pipe BRKT
- ▲ 5. Center pipe with gasket
- 4. Center pipe hanger clamp and nuts
- ▲ 3. Silencer with gasket
- ▲ 2. Tail pipe with gasket
- 1. Tail pipe hanger clamp and nuts

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

8. Front Pipe With Gasket

Connect the front pipe to the exhaust manifold.

Torque	kg·m(lb·ft/N·m)
6.8 ± 0.5 (49 ± 3.6/67 ± 5)	

6. Front Pipe BRKT

Tighten the fixing bolt to the specified torque.

Torque	kg·m(lb·ft/N·m)
Front pipe side 2.4 ± 0.5 (17 ± 3.6/23 ± 5)	
Transmission side 4.1 ± 1.0 (30 ± 7/40 ± 1)	

5. Oxidizing Catalytic Converter With Gasket (4JA1TC) Center Pipe With Gasket (4JH1TC)

Tighten the fixing nuts to the specified torque.

Torque	kg·m(lb·ft/N·m)
4.4 ± 1.3 (32 ± 9.4/43 ± 13)	

3. Silencer With Gasket

Tighten the fixing nuts to the specified torque.

Torque	kg·m(lb·ft/N·m)
4.4 ± 1.3 (32 ± 9.4/43 ± 13)	

2. Tail Pipe With Gasket

Tighten the fixing nuts to the specified torque.

Torque	kg·m(lb·ft/N·m)
4.4 ± 1.3 (32 ± 9.4/43 ± 13)	

- Connect battery ground cable.
- After assembling each part, start the engine to check for any leakage of gas at each connection.

INSPECTION AND REPAIR

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

Front Exhaust Pipe
Rear Exhaust Pipe
Exhaust Silencer

Check the pipes for corrosion, cracking, damage or misalignment and repair as required.

Check the rubber rings for deterioration or damage and repair as required.

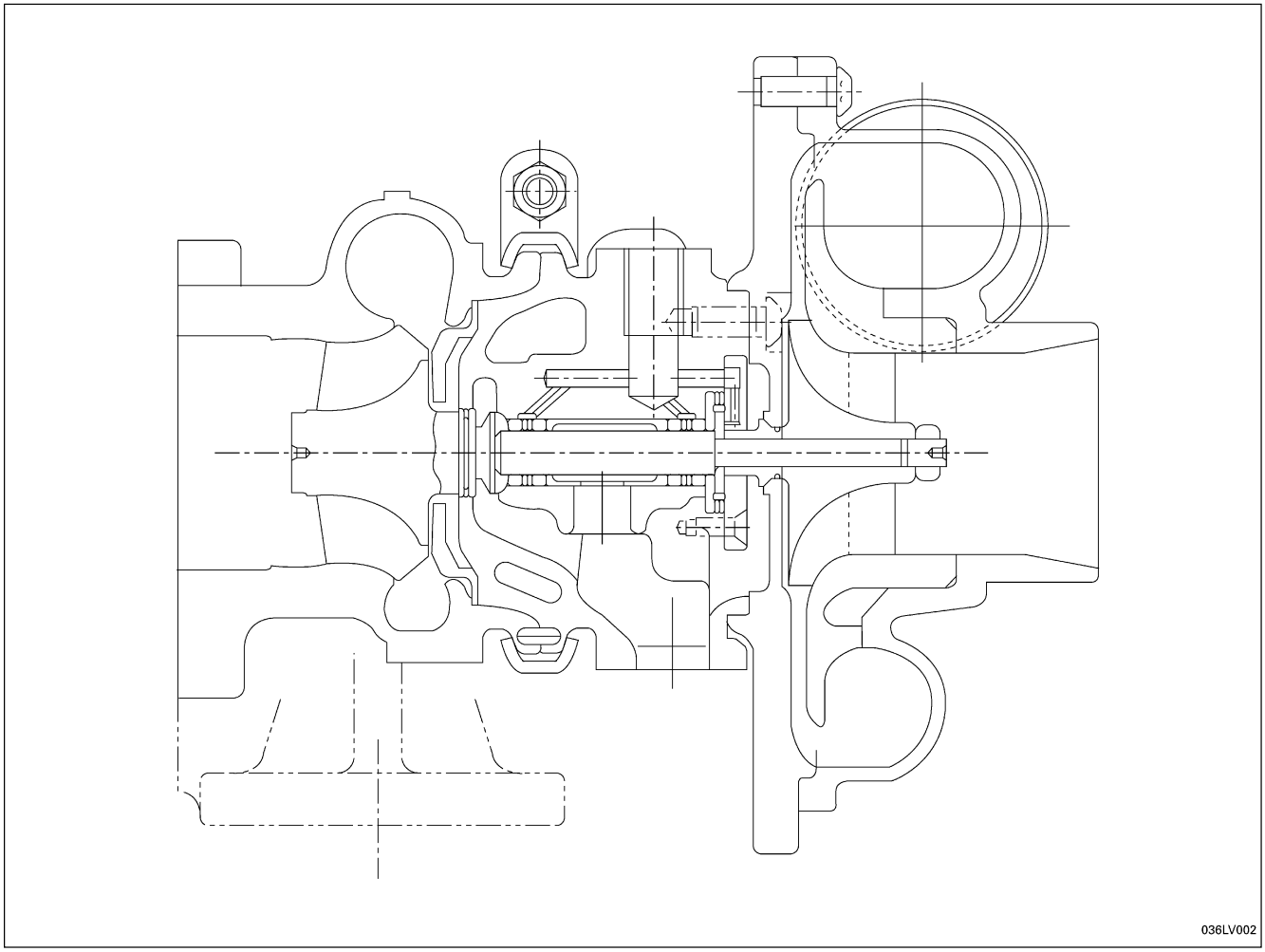
TURBOCHARGER

MAIN DATA AND SPECIFICATIONS

Engine model		4JA1T, 4JB1T, 4JA1TC	4JG2T	4JH1TC
Turbocharger model		IHI RHF 4H	IHI RHB 52W or RHF5H	RHF5H
Turbine type		Radial inflow		
Compressor type		Radial outflow		
Maximum permissible speed	rpm	180,000	172,000	180,000
Wastegate opening pressure	mmHg (inHg)	189 – 887		
Safety valve opening pressure	mmHg (inHg)	850 - 910		
Weight	kg (lb)	4.2 (9.3)	4.6 (10.1)	

IHI : Ishikawajima Harima Heavy Industries., Ltd.

GENERAL DESCRIPTION



The turbocharger internal mechanism consists of the turbine wheel, the compressor wheel, and the radial brarings. These parts are supported by the bearing housing.

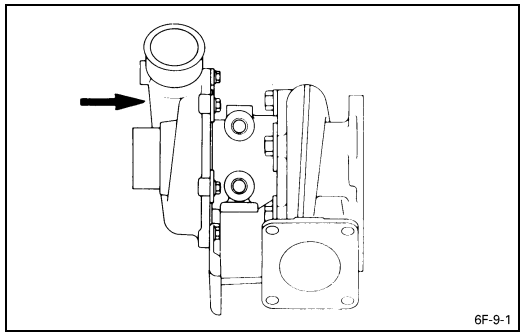
The turbocharger external mechanism consists of the compressor housing air intake port and the turbine housing air exhaust port.

The turbocharger increases air intake efficiency. This results in increased engine power, reduced fuel consumption, and minimal engine noise.

The turbocharger operates at very high speeds and temperatures. Part materials have been carefully selected and machined to extremely high precision.

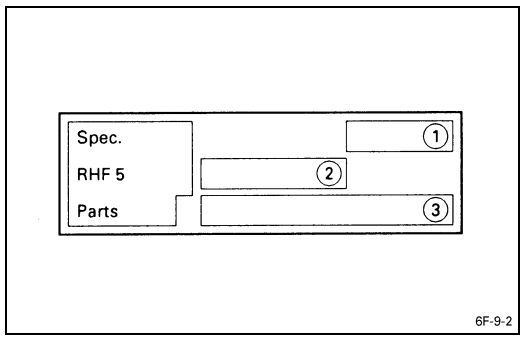
Turbocharger servicing requires great care and expertise.

If reduced performance is noted, check the engine for damage or wear. If there is no apparent engine damage or wear, trouble with the turbocharger is indicated.



IDENTIFICATION OF UNIT

The turbocharger nameplate gives the date of manufacture and other important information required to identify the unit when service inquiries are made.



The turbocharger nameplate has the following information stamped on it.

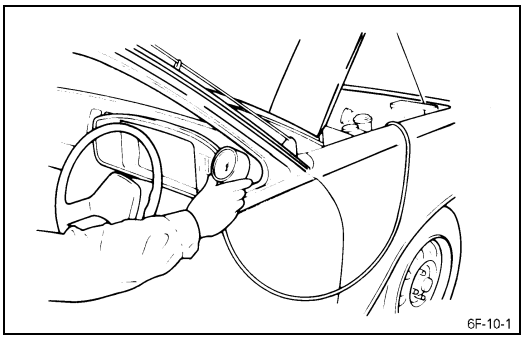
① Turbo Specification Number, Production Year and Month

② Production Date, Daily Serial Number

③ ISUZU Parts Number

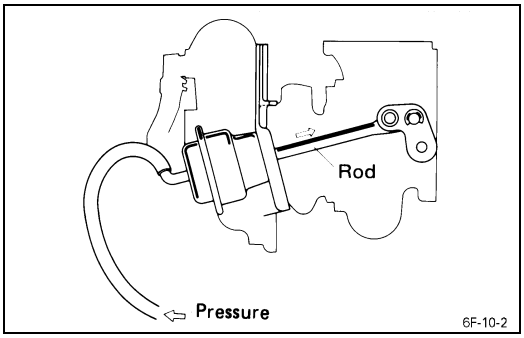
INSPECTION AND REPAIR

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



Turbocharger pressure check

(1) Remove the pressure switch connecting hose from intake duct.
(2) Connect the pressure gauge.
(3) Start the engine and gradually increase the engine speed (the vehicle must be stationary with no load applied to the engine).
(4) Check to see that turbocharger pressure rises to approximately 300 mmHg.
Pressure Gauge : 5-8840-0075-0

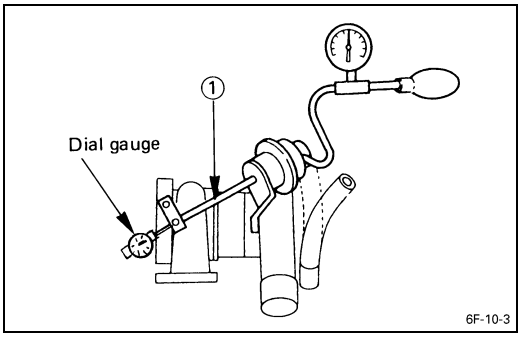


Waste gate operation check

(1) Remove the hose between the waste gate and the intake pipe.
(2) Connect the pressure gauge.
(3) Check to see that the rod begins to move when a pressure of approximately 665 mmHg is applied to the waste gate.

Note:

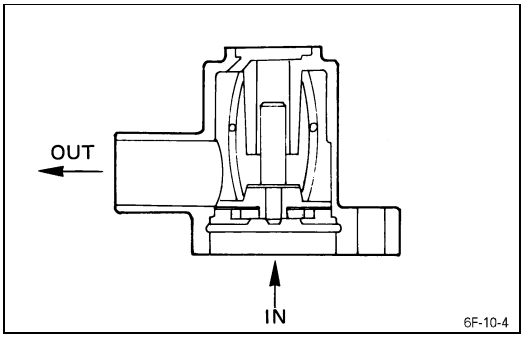
Do not apply a pressure greater than 1 kg/cm^2 to the wastegate during this check.



Unit Inspection (Remove Turbo. from engine)

Check to see the pressure required to move the control rod ① 2 mm is within the limits shown below.

Control Rod ① Operating Pressure	Approx. 860 mmHg

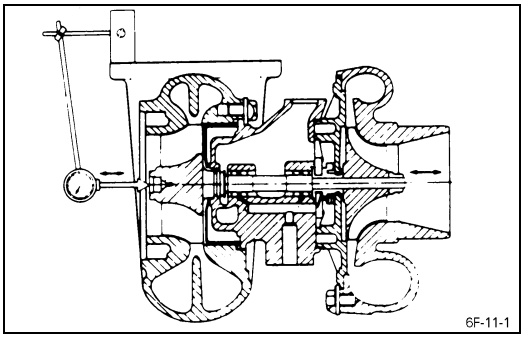


Safety valve check

Operate the valve with your hand to check its operation. Check the valve seal are for excessive wear or damage.

Contact the “ISUZU MOTORS LIMITED” Dealer service department or “IHI SERVICE FACILITY” for major repairs and maintenance.

Important wheel shaft end play and bearing clearance standards and limits are included below for your reference.

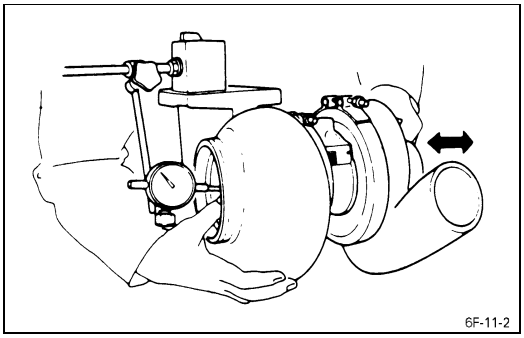


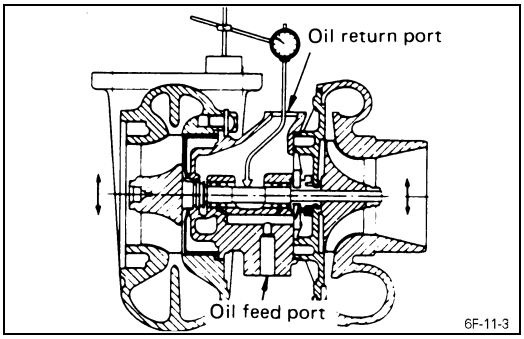
Wheel Shaft End Play

Use a dial indicator to measure the wheel shaft end play. Apply a force of 1.2 kg (2.6 lb/11.8N) alternately to the compressor wheel end and the turbine wheel end.

Wheel Shaft End Play mm (in)

Standard	Limit
0.03 - 0.06 (0.001 - 0.002)	0.09 (0.004)



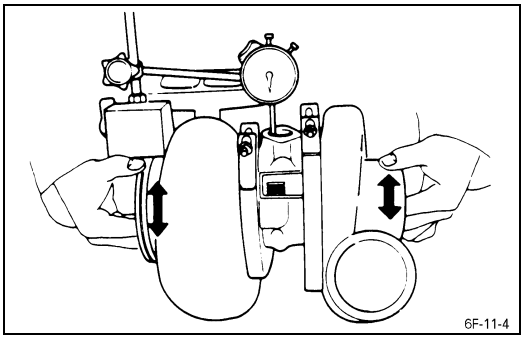


Wheel Shaft and Bearing Clearance

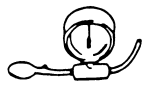
Use a dial indicator to measure the wheel shaft and bearing clearance.

Wheel Shaft and Bearing Clearance mm (in)

Standard	Limit
0.056 - 0.127 (0.0022 - 0.0050)	0.127 (0.0050)



SPECIAL TOOLS

ILLUSTRATION	TOOL NUMBER	TOOL NAME
 6F-12-1	5-8840-0070-0	Pressure Gauge

IHI SERVICE NETWORK

For inquiries relating to turbochargers, please contact your ISUZU distributor or the nearest IHI Turbocharger Service Facility.

HEADQUARTERS

ISHIKAWAJIMA HARIMA HEAVY INDUSTRIES CO., LTD.(IHI)

General Machinery Division
Tokyo Chuo Building 1-6-2 Marunouchi Chiyoda-ku
Tokyo 100-0005 JAPAN
TEL: 81-(3)-3286-2405 to 2407 (3 lines)
FAX: 81-(3)-3286-2430

CHINA

IHI BEIJING OFFICE

Room 705, China World Trade Center, No. 1 Jian Guo Men Wai Avenue
Beijing, People's Republic of CHINA
TEL: 86-(1)-505-4997, 0408
FAX: 86-(1)-505-4350
TLX: 210343 IHIPK CN

TAIWAN

IHI TAIPEI OFFICE

Room 1202, Chia Hsin Building, No. 96 Chung Shan
North Road, Section 2, Taipei, TAIWAN
TEL: 886-(2)-542-5520, 5521, 5523
FAX: 886-(2)-542-4362
TLX: 11320 IHICO

THAILAND

IHI BANGKOK OFFICE

8th Floor, Thaniya Building, 62 Silom Road, Bangkok, THAILAND
TEL: 66-(2)-236-3490, 7356, 9099
FAX: 66-(2)-236-7340
TLX: 82375 IHICO TH

MALAYSIA

IHI KUALA LUMPUR OFFICE

Letter Box No. 52, 22nd Floor, UBN Tower,
10 Jin. P. Ramlee 50250 Kuala Lumpur, MALAYSIA
TEL: 60-(3)-232-1255, 1271
FAX: 60-(3)-232-1418
TLX: IHI KLMA 20257

INDONESIA

IHI JAKARTA OFFICE

9th Floor, Skyline Building JI. M. H. Thamrin, No. 9, Jakarta, INDONESIA
TEL: 62-(21)-32-2147, 390-2211
FAX: 62-(21)-32-3273
TLX: 44175 IHIJKT

MEMO

TF4JE-WE-9712

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

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