

CHAPTER 3

ENGINE

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SUBARU

ENGINE

3-1. Specifications and Service Data

1. Entire Engine Specifications

		Non-TURBO				TURBO
		1600	1800		1800	
			MT		AT	AT
		Non-4WD	4WD	Non-4WD	4WD	4WD
Type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine					
Valve arrangement	Overhead type					
Bore x Stroke	mm (in)	92 x 60 (3.62 x 2.36)		92 x 67 (3.62 x 2.64)		
Piston displacement	cm ³ (cc, cu in)	1,595 (1,595, 97.33)		1,781 (1,781, 108.68)		
Compression ratio		9.0		8.7		7.7
Compression pressure	kPa (kg/cm ² , psi) (at 350 rpm)	1.206 (12.3, 175)		1,177 (12.0, 171)		1,079 (11.0, 156)
Number of piston rings	Pressure ring: 2, Oil ring: 1					
Intake valve timing	Opening	20° BTDC				16° BTDC
	Closing	60° ABDC		64° ABDC		68° ABDC
Exhaust valve timing	Opening	60° BBDC		64° BBDC		68° BBDC
	Closing	20° ATDC				
Valve clearances (when engine is cold)	Intake	0.25 (0.010)		0 (0)		
	Exhaust	0.35 (0.014)		0 (0)		
Idling speed (At neutral (or N) or P position)	rpm	650 ± 100 (4-speed) 700 ± 100 (5-speed)		700 ± 100		800 ± 100
Engine dimensions	mm (in)	419 (16.50)		422 (16.61)		411 (16.18)
	Length	701 (27.60)		712 (28.03)		736 (28.98)
	Width	607 (23.90)				594 (23.39)
Height						
Weight of engine without transmission (Oil and coolant are included)	kg (lb)	*1: 104 (229) *2: 101 (223)	*1: 108 (238) *2: 104 (229) *3: 104 (229)	*2: 104 (229) *4: 104 (229)	*1: 99 (218) *2: 95 (209) *3: 95 (209)	*2: 95 (209) *4: 95 (209) 107 (236)
Air cleaner element	Viscous type					
Emission control system		*1 ① ② ③ ④ *2 ① ② ③ ④	*1 ① ② ③ ④ *2 ① ② ③ ④ *3 ② ③ ④	*2 ① ② ③ ④ *4 ② ③ ④	*1 ① ② ③ ④ *2 ① ② ③ ④ *3 ② ③ ④	*2 ① ② ③ ④ *4 ② ③ ④ *2 ① ① *4 ① ③
Firing order	1 - 3 - 2 - 4					
Ignition timing		BTDC 8°/650 rpm (4-speed) BTDC 8°/700 rpm (5-speed)	BTDC 8°/700 rpm		BTDC 8°/800 rpm	
						BTDC 15°/800 rpm

*1: 49-State California *3: Canada *4: 49-State and Canada
①: Three-way catalyst ②: Oxidation catalyst ③: EGR ④: AI

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2. Lubrication System Specifications

		SUBARU 1800	SUBARU 1600	
Lubrication method		Forced feed, full flow filtration, splash type		
Oil pump	Pump type		Trochoid type	
	Discharge performance I	Discharge – Pressure	4.0ℓ/min (4.2 US qt/min, 3.5 Imp qt/min) or more – 343 kPa (3.5 kg/cm ² , 50 psi)	3.0ℓ/min (3.2 US qt/min, 2.6 Imp qt/min) or more – 245 kPa (2.5 kg/cm ² , 36 psi)
		Speed	500 rpm	
		Oil temperature	75 – 85°C (167 – 185°F)	
	Discharge performance II	Discharge – Pressure	21.0ℓ/min (22.2 US qt/min, 18.5 Imp qt/min) or more – 392 kPa (4.0 kg/cm ² , 57 psi)	15.0ℓ/min (15.9 US qt/min, 13.2 Imp qt/min) or more – 392 kPa (4.0 kg/cm ² , 57 psi)
		Speed	2,500 rpm	
		Oil temperature	75 – 85°C (167 – 185°F)	
	Oil relief valve	Pressure at which valve starts to open	392 – 441 kPa (4.0 – 4.5 kg/cm ² , 57 – 64 psi)	
Oil by-pass valve	Pressure at which valve starts to open	147 kPa (1.5 kg/cm ² , 21 psi)	98 kPa (1.0 kg/cm ² , 14 psi)	
Oil filter	Type	Paper, cartridge type		
	Filtration area	0.15 m ² (1.6 sq ft)		
Engine oil capacity	Upper level	4.0ℓ (4.2 US qt, 3.5 Imp qt)	3.5ℓ (3.7 US qt, 3.1 Imp qt)	
	Lower level	3.0ℓ (3.2 US qt, 2.6 Imp qt)	2.5ℓ (2.6 US qt, 2.2 Imp qt)	

3. Engine Oil Flow Diagram

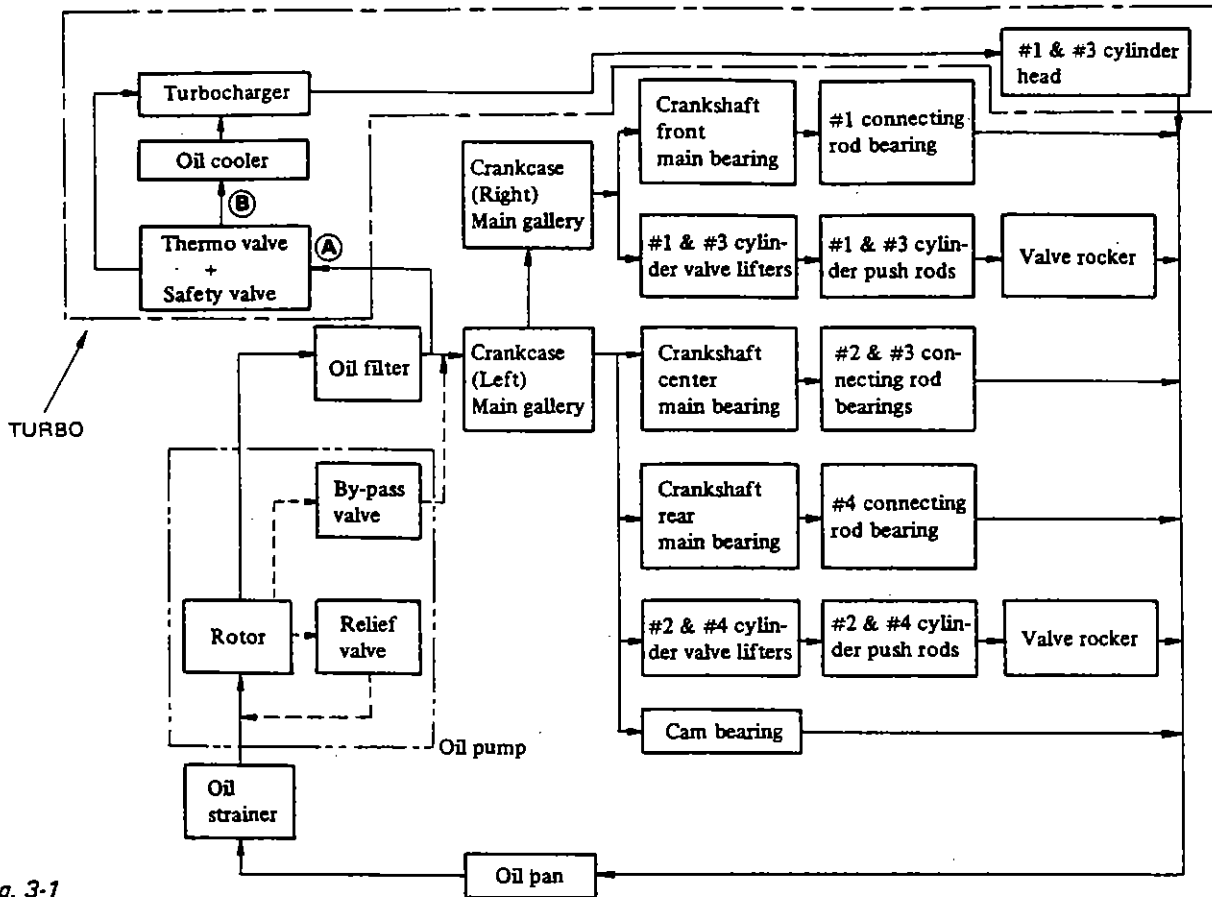


Fig. 3-1

A5-789

4. Engine Oil Cooling System

1) Specifications of Oil Cooler

- Core size : 200 x 55 x 32 mm (7.87 x 2.17 x 1.26 in)
 - Core pitch : 2 mm (0.08 in)
 - Fins : Corrugated fin type
 - Radiation capacity : 2.326 kW (2,000 kcal/h, 7,936 BTU/h)
- at
- Oil flow : 10 l/min (2.6 US gal/min, 2.2 Imp gal/min)
 - Wind velocity : 8 m/sec (26 ft/sec)
 - Temperature difference between oil and air : 75°C (167°F)
 - Oil temperature : 110°C (230°F)

2) Component Parts

Tightening torque: N·m (kg·cm, in·lb)	
T1:	29.4 ± 4.9 (300 ± 50, 260 ± 43)
T2:	34.3 ± 4.9 (350 ± 50, 304 ± 43)
T3:	7.4 ± 2.0 (75 ± 20, 65 ± 17)
T4:	2.5 ± 0.5 (25 ± 5, 21.7 ± 4.3)

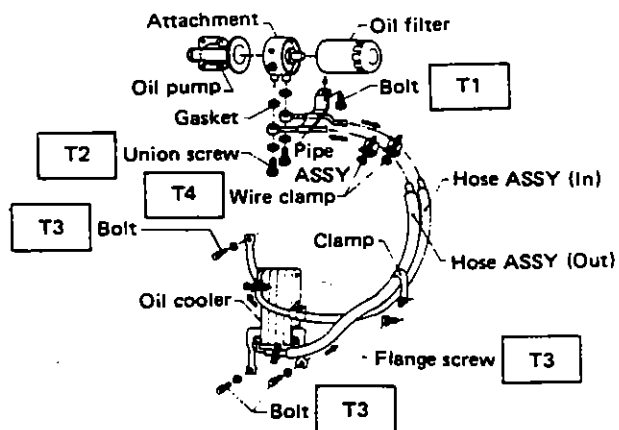


Fig. 3-2

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4) Description

Engine oil passing through the filter is branched before it is supplied.

When the temperature of engine oil is lower than a certain value, the thermo valve opens the circuit allowing engine oil to lubricate the working parts of the turbocharger and return to the engine.

When the temperature of engine oil reaches a certain value, the thermo valve closes. At this point, the engine oil pass through the oil cooler to lubricate the working parts of the turbocharger, returning to the engine.

Although the temperature of engine oil rises to operate the cooler, if a pressure difference between (A) and (B) is higher than the certain value, the safety valve will open. At this point, engine oil bypasses the cooler and is supplied to the turbocharger.

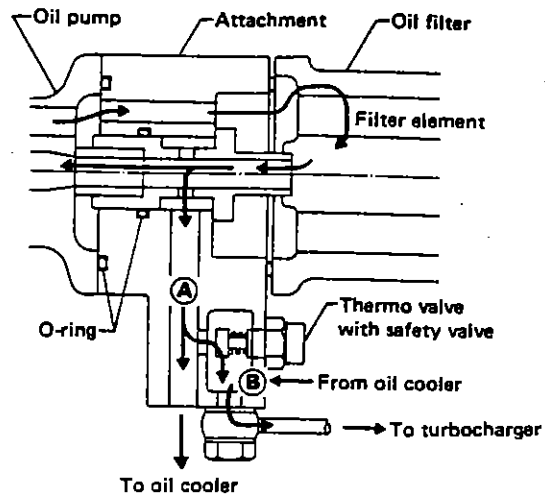


Fig. 3-3

A5-781

Thermo valve characteristics	Valve lifting amount is 5 mm (0.20 in) at 67 – 73°C (153 – 163°F)
Safety valve characteristics	Starts operating at oil temperature of 100°C (212°F) and at pressure difference of 226 kPa (2.3 kg/cm ² , 33 psi)

5) Inspection of Thermo Valve

Checking method

Measure dimension A shown in figure on the right when thermo valve reaches room temperature.

Next, dip thermo valve in hot water [67 – 73°C (153 – 163°F)] and, while holding it, measure dimension A. Check the difference between the two measurements above to make sure it is approximately 5 mm (0.20 in). If it is too different, replace thermo valve.

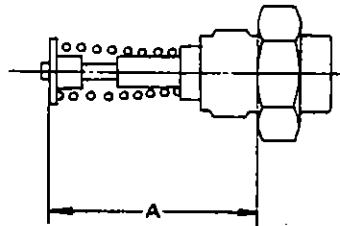


Fig. 3-4

A5-782

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5. Cooling System Specifications

		Non-TURBO		TURBO
		1600	1800	1800
Cooling system		Electric fan + Forced cooling water circulation system		
Total coolant capacity		5.3ℓ (5.6 US qt, 4.7 Imp qt)		5.5ℓ (5.8 US qt, 4.8 Imp qt)
Water pump	Type	Centrifugal impeller type		
	Discharge performance I	Discharge	7ℓ/min (7.4 US qt/min, 6.2 Imp qt/min) or more	
		Pump speed – total water head	1,000 rpm – 0.29 m Aq (0.95 ft Aq)	
		Water temperature	75 – 85°C (167 – 185°F)	
	Discharge performance II	Discharge	50ℓ/min (13.2 US gal, 11.0 Imp gal) or more	
		Pump speed – total water head	4,000 rpm – 5.0 m Aq (16.4 ft Aq)	
		Water temperature	75 – 85°C (167 – 185°F)	
	Impeller diameter	64 mm (2.52 in)		
Number of impeller vanes	5			
Pump pulley diameter	84 mm (3.31 in)	90 mm (3.54 in)		
Thermostat	Type	Wax pellet type		
	Starts to open	88 ± 1.5°C (190 ± 3°F)		
	Fully opens	100°C (212°F)		
	Valve lift	8 mm (0.31 in)		
	Valve bore	31 mm (1.22 in)		
Thermo valve	Type	Wax pellet type		–
	Fully closes	27 ± 2°C (81 ± 3.6°F)		–
	Fully opens	25 ± 2°C (77 ± 3.6°F)		–
Thermo-switch	ON	95 ± 2°C (203 ± 3.6°F)		
	OFF	91 ± 2°C (196 ± 3.6°F)		
Electric fan	Motor	120 W or less		
	Fan dia.	280 mm (11.02 in)		
Radiator	Type	Cross flow, pressure type		
	Total radiation area	4.82 m ² (51.9 sq ft)	AT & 4WD-AT: 7.83 m ² (84.3 sq ft) 4WD: 7.29 m ² (78.4 sq ft) Others: 5.90 m ² (63.5 sq ft)	7.83 m ² (84.3 sq ft)
	Radiation capacity	31.7 kW (455 kcal/min, 1,805 BTU/min)	AT & 4WD-AT: 47.3 kW (678 kcal/min, 2,690 BTU/min) 4WD: 42.9 kW (615 kcal/min, 2,440 BTU/min) Others: 37.8 kW (542 kcal/min, 2,151 BTU/min)	47.3 kW (678 kcal/min, 2,690 BTU/min)
	at	<ul style="list-style-type: none"> • Water flow: 45ℓ/min (11.9 US gal/min, 9.9 Imp gal/min) • Temperature difference between coolant and ambient atmosphere: 65°C (149°F) • Air velocity: 8 m/sec (26 ft/sec) 		
	Core dimensions	mm (in)	SUBARU 1800 AT & 4WD-AT: 625 × 334 × 32 (24.61 × 13.15 × 1.26) Others: 580 × 334 × 32 (22.83 × 13.15 × 1.26)	625 × 334 × 32 (24.61 × 13.15 × 1.26)
	Radiator capacity	1.9ℓ (2.0 US qt, 1.7 Imp qt)		
	Pressure range in which cap valve is open	Above 88 ± 10 kPa (0.9 ± 0.1 kg/cm ² , 13 ± 1.4 psi) Below -4.9 to -10 kPa (-0.05 to -0.1 kg/cm ² , -0.7 to -1.4 psi)		
Fins	Corrugated fin type			

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6. Coolant

It is recommended to use "SUBARU genuine coolant" when replacing or refilling the engine coolant.

SUBARU COOLANT
(net 18 liter)
Parts No. 000016218

This coolant is anti-freeze, anti-corrosive ethylene glycol coolant, and is especially made for SUBARU vehicle.

NOTE:

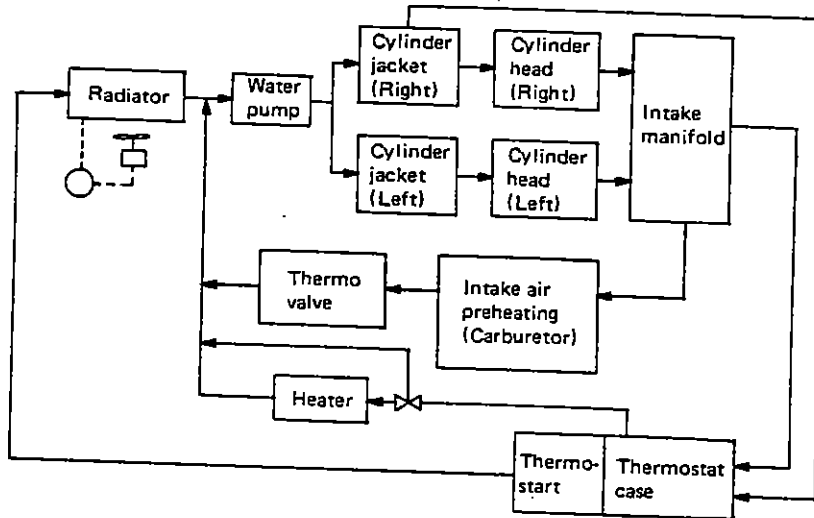
- Avoid using any coolant or only water other than this designated type to prevent corrosion.
- SUBARU's engine is aluminum alloy, and so special care is necessary.

SUBARU Coolant specifications are as follows:

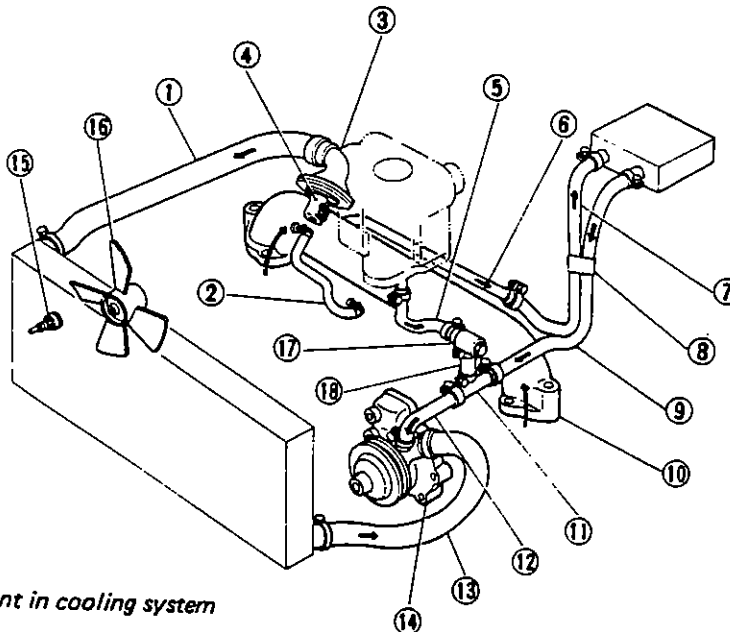
Coolant Specifications							
Lowest atmospheric anticipated temperature	SUBARU coolant-to-water ratio (Volume) %	Specific gravity					Freezing point
		at 10°C (50°F)	at 20°C (68°F)	at 30°C (86°F)	at 40°C (104°F)	at 50°C (122°F)	
Above -30°C (-22°F)	50 - 50	1.078	1.072	1.067	1.058	1.055	-36°C (-33°F)

* It is recommended that distilled water be used.

7. Coolant Flow Diagram



A5-658



- Radiator inlet hose
- Water by-pass hose
- Thermostat cover
- Thermostat
- Water by-pass hose
- Water by-pass pipe
- Water by-pass pipe
- 3-way cock
- Water by-pass hose
- Intake manifold
- Water by-pass pipe
- Water by-pass hose
- Radiator outlet hose
- Water pump
- Thermo switch
- Electric fan
- Thermo valve
- Water by-pass hose

Fig. 3-5 Flow of coolant in cooling system

A5

The operation of the cooling system is as follows:

1) Cooling with thermostat closed
When the coolant temperature is under the specified degrees, coolant flows only through the by-pass passage. This limited coolant circulation reduces cooling action, thus shortening engine warm-up time.

By-pass passage:

a. Intake manifold → Carburetor → Thermo valve → Water by-pass base and pipe → Water pump
When the environmental temperature around thermo valve exceeds the specified degrees, the coolant passage from carburetor to water by-pass pipe is shut off by means of thermo valve so that the fuel in carburetor is not heated.

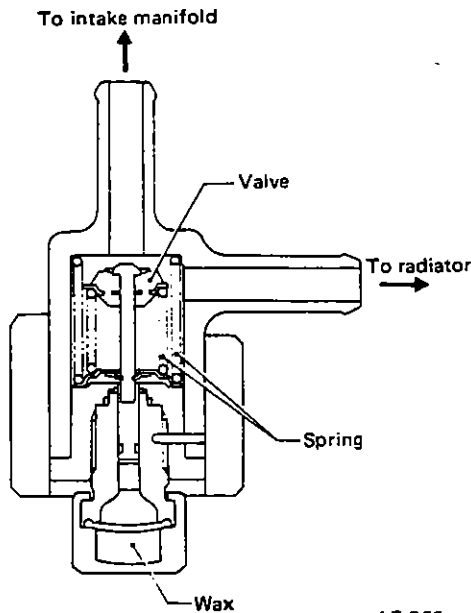
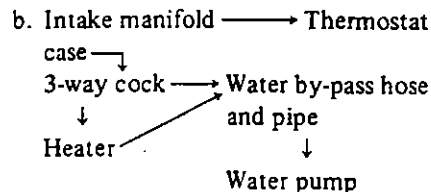


Fig. 3-6 Cross section of thermo valve



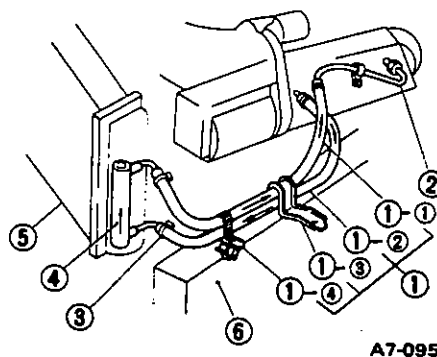
2) Cooling with thermostat open
When the coolant temperature exceeds the specified degrees, thermostat begins to open and coolant flows through radiator and by-pass passage, increasing the cooling function.
3) Cooling with electric fan in operation
When the coolant temperature exceeds the specified degrees, the thermo-switch turns on to operate the electric fan.

8. Automatic Transmission Fluid Cooling System

Automatic transmission fluid cooling system (SUBARU 1800 AT & 4WD-AT)	Radiation capacity	1.570 kW (1,350 kcal/h, 5,357 BTU/h)
		at <ul style="list-style-type: none"> • Oil flow: 6ℓ/min (1.6 US gal/min, 1.3 Imp gal/min) • Water flow: 20ℓ/min (5.3 US gal/min, 4.4 Imp gal/min) • Temperature difference between water inlet and oil inlet: 30°C (86°F)

The fluid cooling system of automatic transmission consists of a cooler built in radiator, pipes and hoses to circulate fluid between torque converter and cooler.

Heated fluid circulating through torque converter returns to cooler and is cooled by coolant, thereby being maintained at an adequate temperature.



- 1 Hose assembly
- 1-1 Outlet hose
- 1-2 Inlet hose
- 1-3 Clamp
- 1-4 Clip
- 2 Pipe complete
- 3 Hose clamp
- 4 Cooler
- 5 Radiator
- 6 Side frame

Fig. 3-7 Component parts of automatic transmission fluid cooling system

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9. Service Data

Cylinder head	Head surface warpage		Limit	0.05 mm	(0.0020 in)		
	Head surface grinding		Limit	0.5 mm	(0.020 in)		
	Standard height	1600			89.6 mm	(3.528 in)	
		1800			90.6 mm	(3.567 in)	
	Valve seat	Refacing angle			90°, 150°		
		Contacting width		Intake	0.7 – 1.3 mm	(0.028 – 0.051 in)	
				Exhaust	1.0 – 1.8 mm	(0.039 – 0.071 in)	
	Valve guide	Wear limit			0.5 mm	(0.020 in)	
		Inner diameter			8.000 – 8.015 mm	(0.3150 – 0.3156 in)	
		Protrusion		Intake	17.5 – 18.5 mm	(0.689 – 0.728 in)	
			Exhaust	22.5 – 23.5 mm	(0.886 – 0.925 in)		
Valve	Valve overall length	Intake		109.5 mm	(4.31 in)		
		Exhaust		109.3 mm	(4.30 in)		
	Valve head edge thickness	Intake	STD		1.5 mm	(0.059 in)	
			Limit		0.5 mm	(0.020 in)	
			Exhaust	STD		1.3 mm	(0.051 in)
	Stem diameter	Intake	Limit		0.8 mm	(0.031 in)	
			Exhaust		7.950 – 7.965 mm	(0.3130 – 0.3136 in)	
			Exhaust		7.945 – 7.960 mm	(0.3128 – 0.3134 in)	
	Stem oil clearance	Intake	STD		0.035 – 0.065 mm	(0.0014 – 0.0026 in)	
			Limit		0.15 mm	(0.0059 in)	
Exhaust		STD		0.040 – 0.070 mm	(0.0016 – 0.0028 in)		
		Limit		0.15 mm	(0.0059 in)		
Valve spring	● With solid valve lifter	Free length	Outer spring	45.3 mm	(1.783 in)		
			Inner spring	48.8 mm	(1.921 in)		
	Tension/spring height		Outer spring		146.1 – 169.7 N/39.5 mm	(14.9 – 17.3 kg/39.5 mm, 32.9 – 38.1 lb/1.555 in)	
					500.2 – 568.8 N/30.5 mm	(51.0 – 58.0 kg/30.5 mm, 112.5 – 127.9 lb/1.201 in)	
				Inner spring	84.3 – 98.1 N/37.5 mm	(8.6 – 10.0 kg/37.5 mm, 19.0 – 22.1 lb/1.476 in)	
				185.4 – 214.8 N/28.5 mm	(18.9 – 21.9 kg/28.5 mm, 41.7 – 48.3 lb/1.122 in)		
			Squareness	Outer spring		2.0 mm or less	(0.079 in or less)
					Inner spring	2.1 mm or less	(0.083 in or less)
	● With hydraulic valve lifter	Free length	Outer spring		48.5 mm	(1.909 in)	
			Inner spring		53.0 mm	(2.087 in)	

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Valve spring (continued)	Tension/spring height	Outer spring	228.5 – 261.8 N/39.5 mm (23.3 – 26.7 kg/39.5 mm, 51.4 – 58.9 lb/1.555 in) 518.8 – 599.2 N/32.0 mm (52.9 – 61.1 kg/32.0 mm, 116.6 – 134.7 lb/1.260 in)
		Inner spring	115.7 – 133.4 N/37.5 mm (11.8 – 13.6 kg/37.5 mm, 26.0 – 30.0 lb/1.476 in) 201.0 – 230.5 N/30.0 mm (20.5 – 23.5 kg/30.0 mm, 45.2 – 51.8 lb/1.181 in)
	Squareness	Outer spring	2.1 mm or less (0.083 in or less)
		Inner spring	2.3 mm or less (0.091 in or less)
Valve rocker	Inner diameter of rocker arm		18.016 – 18.034 mm (0.7093 – 0.7100 in)
	Outer diameter of rocker shaft		17.982 – 18.003 mm (0.7080 – 0.7088 in)
	Rocker arm to rocker shaft clearance		0.013 – 0.052 mm (0.0005 – 0.0020 in)
Valve lifter	• Solid valve lifter		
	Lifter hole inner diameter of crankcase		21.000 – 21.021 mm (0.8268 – 0.8276 in)
	Outer diameter of lifter		20.949 – 20.970 mm (0.8248 – 0.8256 in)
	Lifter to lifter hole clearance	STD	0.030 – 0.072 mm (0.0012 – 0.0028 in)
		Limit	0.100 mm (0.0039 in)
	• Hydraulic valve lifter		
	Lifter hole inner diameter of crankcase		20.988 – 21.040 mm (0.8263 – 0.8283 in)
	Outer diameter of lifter		20.950 – 20.968 mm (0.8248 – 0.8255 in)
	Lifter to lifter hole clearance	STD	0.020 – 0.090 mm (0.0008 – 0.0035 in)
		Limit	0.100 mm (0.0039 in)
Push rod	Overall length	1600 (Knurling: 2)	219 – 219.4 mm (8.62 – 8.64 in)
		1800 with solid valve lifter (Knurling: 1)	230.7 – 231.1 mm (9.08 – 9.10 in)
		1800 with hydraulic valve lifter (Knurling: nothing) (Steel tube)	231.7 – 232.2 mm (9.12 – 9.14 in)
	Deflection at center		0.4 mm (0.016 in) or less
Crankcase	Cylinder bore	Diameter	91.985 – 92.015 mm (3.6214 – 3.6226 in)
	(Both 1800 and 1600)	Taper	STD 0.015 mm (0.0006 in)
			Limit 0.050 mm (0.0020 in)
		Out of roundness	STD 0.010 mm (0.0004 in)
			Limit 0.050 mm (0.0020 in)
		Cylinder to piston clearance	STD 0.010 – 0.040 mm (0.0004 – 0.0016 in)
			Limit 0.060 mm (0.0024 in)
		Enlarging limit of cylinder inner diameter	0.50 mm (0.0197 in)
		Inner diameter difference limit between cylinders	0.05 mm (0.0020 in)
		Case surface warpage (mating with head)	Limit 0.05 mm (0.0020 in)
	Protrusion of stud bolt from mating surface	1800	91.5 – 93.5 mm (3.602 – 3.681 in)
		1600	90.5 – 92.5 mm (3.563 – 3.642 in)

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Piston and Piston pin	Piston outer diameter		STD	91.960 – 91.990 mm (3.6205 – 3.6216 in)	
			0.25 mm (0.0098 in) OS	92.210 – 92.240 mm (3.6303 – 3.6315 in)	
			0.50 mm (0.0197 in) OS	92.460 – 92.490 mm (3.6402 – 3.6413 in)	
	Piston pin hole inner diameter of piston			20.999 – 21.009 mm (0.8267 – 0.8271 in)	
	Piston pin outer diameter			20.992 – 21.000 mm (0.8265 – 0.8268 in)	
Piston pin to hole in piston clearance			0.004 – 0.010 mm (0.0002 – 0.0004 in)		
Piston ring	Piston ring gap	Top ring	STD	0.20 – 0.35 mm (0.0079 – 0.0138 in)	
			Limit	1.0 mm (0.039 in)	
	Second ring		STD	0.20 – 0.35 mm (0.0079 – 0.0138 in)	
			Limit	1.0 mm (0.039 in)	
	Oil ring rail		STD	0.20 – 0.90 mm (0.0079 – 0.0354 in)	
			Limit	1.5 mm (0.059 in)	
	Piston ring to piston ring groove clearance	Top ring	STD	0.04 – 0.08 mm (0.0016 – 0.0031 in)	
			Limit	0.15 mm (0.0059 in)	
Second ring		STD	0.03 – 0.07 mm (0.0012 – 0.0028 in)		
		Limit	0.15 mm (0.0059 in)		
	Oil ring		0		
Connecting rod	Distance between big end and small end hole		1800	116.95 – 117.05 mm (4.6043 – 4.6083 in)	
			1600	109.95 – 110.05 mm (4.3287 – 4.3327 in)	
	Bend or twist per 100 mm (3.94 in) in length		Limit	0.10 mm (0.0039 in)	
	Thrust clearance		STD	0.070 – 0.330 mm (0.0028 – 0.0130 in)	
			Limit	0.40 mm (0.0157 in)	
Piston pin to bushing clearance			0 – 0.022 mm (0 – 0.0009 in)		
Bushing bore			21.000 – 21.016 mm (0.8268 – 0.8274 in)		
Connecting rod bearing	Thickness at center		STD	1.477 – 1.485 mm (0.0581 – 0.0585 in)	
			0.05 mm (0.0020 in) US	1.505 – 1.510 mm (0.0593 – 0.0594 in)	
			0.25 mm (0.0098 in) US	1.605 – 1.610 mm (0.0632 – 0.0634 in)	
Crankshaft	Bend limit			0.035 mm (0.0014 in)	
	Crankpin and crank journal	Out-of-roundness		0.03 mm or less (0.0012 in or less)	
			Taper limit		0.07 mm (0.0028 in)
			Grinding limit		0.25 mm (0.0098 in)
			Thrust clearance	STD	0.01 – 0.095 mm (0.0004 – 0.0037 in)
			Limit	0.30 mm (0.0118 in)	
	Crank journal outer diameter	1800	STD	54.955 – 54.970 mm (2.1636 – 2.1642 in)	
			0.03 mm (0.0012 in) US	54.925 – 54.940 mm (2.1624 – 2.1630 in)	
			0.05 mm (0.0020 in) US	54.905 – 54.920 mm (2.1616 – 2.1622 in)	
			0.25 mm (0.0098 in) US	54.705 – 54.720 mm (2.1537 – 2.1543 in)	
			1600	Front & rear	STD
				0.03 mm (0.0012 in) US	49.927 – 49.940 mm (1.9656 – 1.9661 in)
				0.05 mm (0.0020 in) US	49.907 – 49.920 mm (1.9648 – 1.9654 in)
				0.25 mm (0.0098 in) US	49.707 – 49.720 mm (1.9570 – 1.9575 in)
		Center		STD	49.970 – 49.982 mm (1.9673 – 1.9678 in)
		0.03 mm (0.0012 in) US	49.940 – 49.952 mm (1.9661 – 1.9666 in)		
		0.05 mm (0.0020 in) US	49.920 – 49.932 mm (1.9654 – 1.9658 in)		
		0.25 mm (0.0098 in) US	49.720 – 49.732 mm (1.9575 – 1.9579 in)		

ENGINE

Crankshaft (continued)	Crank journal oil clearance	1800	Front & rear	STD	0.010 – 0.030 mm (0.0004 – 0.0012 in)		
				Limit	0.055 mm (0.0022 in)		
			Center	STD	0.010 – 0.025 mm (0.0004 – 0.0010 in)		
			Limit	0.045 mm (0.0018 in)			
		1600	Front & rear	STD	0.010 – 0.035 mm (0.0004 – 0.0014 in)		
			Limit	0.055 mm (0.0022 in)			
			Center	STD	0.010 – 0.030 mm (0.0004 – 0.0012 in)		
			Limit	0.045 mm (0.0018 in)			
	Crankpin outer diameter			STD	44.995 – 45.010 mm (1.7715 – 1.7720 in)		
				0.05 mm (0.0020 in) US	44.945 – 44.960 mm (1.7695 – 1.7701 in)		
			0.25 mm (0.0098 in) US	44.745 – 44.760 mm (1.7616 – 1.7622 in)			
Crankpin oil clearance			STD	0.020 – 0.070 mm (0.0008 – 0.0028 in)			
			Limit	0.1 mm (0.0039 in)			
Crankshaft bearing	Thickness at center	1800	Front & rear	STD	2.015 – 2.019 mm (0.0793 – 0.0795 in)		
				0.03 mm (0.0012 in) US	2.030 – 2.034 mm (0.0799 – 0.0801 in)		
				0.05 mm (0.0020 in) US	2.040 – 2.044 mm (0.0803 – 0.0805 in)		
				0.25 mm (0.0098 in) US	2.140 – 2.144 mm (0.0843 – 0.0844 in)		
				Center	STD	2.015 – 2.028 mm (0.0793 – 0.0798 in)	
				0.03 mm (0.0012 in) US	2.030 – 2.043 mm (0.0799 – 0.0804 in)		
				0.05 mm (0.0020 in) US	2.040 – 2.053 mm (0.0803 – 0.0808 in)		
				0.25 mm (0.0098 in) US	2.140 – 2.153 mm (0.0843 – 0.0848 in)		
			1600	Front & rear	STD	2.001 – 2.008 mm (0.0788 – 0.0791 in)	
					0.03 mm (0.0012 in) US	2.017 – 2.030 mm (0.0794 – 0.0799 in)	
					0.05 mm (0.0020 in) US	2.022 – 2.035 mm (0.0796 – 0.0801 in)	
					0.25 mm (0.0098 in) US	2.122 – 2.135 mm (0.0835 – 0.0841 in)	
					Center	STD	2.003 – 2.015 mm (0.0789 – 0.0793 in)
					0.03 mm (0.0012 in) US	2.017 – 2.030 mm (0.0794 – 0.0799 in)	
					0.05 mm (0.0020 in) US	2.022 – 2.035 mm (0.0796 – 0.0801 in)	
					0.25 mm (0.0098 in) US	2.122 – 2.135 mm (0.0835 – 0.0841 in)	
Camshaft	Cam lobe height			STD	*1: 32.24 – 32.34 mm (1.2693 – 1.2732 in)		
				Wear limit	*2: 35.90 – 36.00 mm (1.4134 – 1.4173 in)		
	Bend limit					0.15 mm (0.0059 in)	
						0.05 mm (0.0020 in)	
	Thrust clearance				STD	0.020 – 0.090 mm (0.0008 – 0.0035 in)	
					Limit	0.20 mm (0.0079 in)	
	Camshaft journal outer diameter	1600	Front & center			25.959 – 25.975 mm (1.0220 – 1.0226 in)	
						1800	31.959 – 31.975 mm (1.2582 – 1.2589 in)
1800		Rear				35.959 – 35.975 mm (1.4157 – 1.4163 in)	
Camshaft journal to cam bore clearance				STD	0.025 – 0.059 mm (0.0010 – 0.0023 in)		
				Limit	0.100 mm (0.0039 in)		
Camshaft gear	Run out			Limit	0.25 mm (0.0098 in)		
	Crankshaft gear to cam gear backlash			STD	0.010 – 0.050 mm (0.0004 – 0.0020 in)		
					Limit	0.10 mm (0.0039 in)	

*1: With solid valve lifter

*2: With hydraulic valve lifter

ENGINE

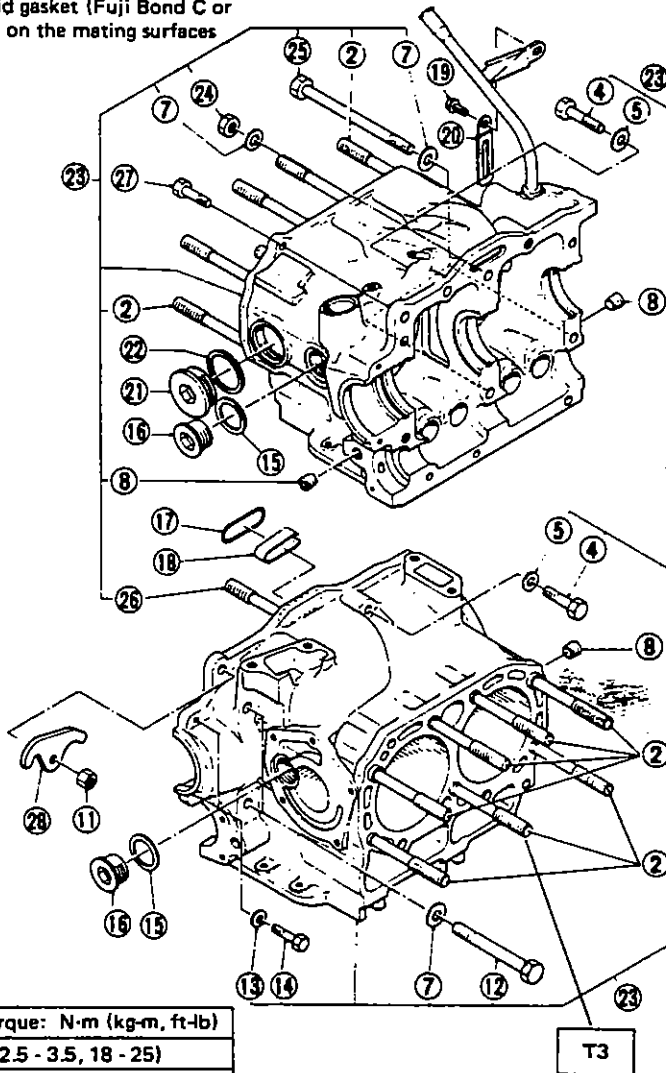
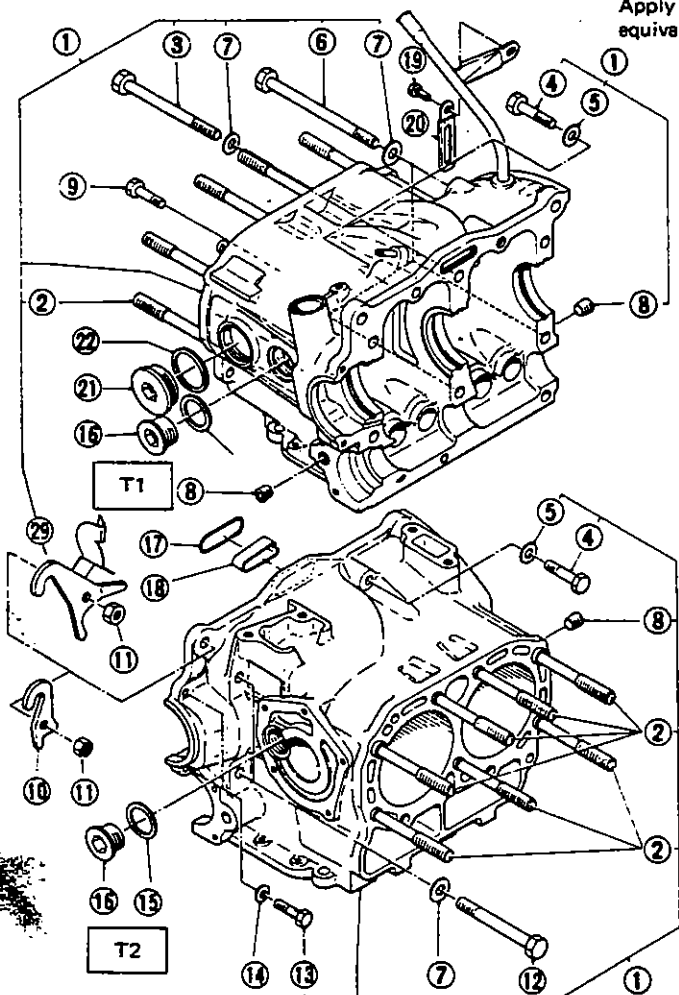
Oil pump	Drive gear outer diameter		29.70 – 29.74 mm	(1.1693 – 1.1709 in)	
	Rotor outer diameter		40.53 – 40.56 mm	(1.5957 – 1.5968 in)	
	Drive gear to rotor tip clearance	STD	0.02 – 0.12 mm	(0.0008 – 0.0047 in)	
		Limit	0.2 mm	(0.008 in)	
	Rotor to case and gear to case axial clearance	STD	0.03 – 0.13 mm	(0.0012 – 0.0051 in)	
		Limit	0.2 mm	(0.008 in)	
	Rotor to case radial clearance	STD	0.15 – 0.21 mm	(0.0059 – 0.0083 in)	
		Limit	0.25 mm	(0.0098 in)	
	Relief valve spring	Free length	47.1 mm	(1.854 in)	
		Installed length	33.5 mm	(1.319 in)	
		Load when installed	38.05 – 41.97 N (3.88 – 4.28 kg, 8.56 – 9.44 lb)		
	By-pass valve spring	Free length	1600	40.7 mm	(1.602 in)
			1800	37.1 mm	(1.461 in)
		Installed length	1600	31.1 mm	(1.224 in)
			1800	25.1 mm	(0.988 in)
Load when installed		1600	3.580 – 3.972 N (0.365 – 0.405 kg, 0.805 – 0.893 lb)		
		1800	5.178 – 6.159 N (0.528 – 0.628 kg, 1.164 – 1.385 lb)		
Oil filter filtration area			0.15 m ²	(1.6 sq ft)	

3-2. Component Parts

1. Crankcase

Thread size	Torque
10 mm	39 - 47 N·m (4.0 - 4.8 kg·m, 29 - 35 ft·lb)
8 mm	23 - 26 N·m (2.3 - 2.7 kg·m, 17 - 20 ft·lb)
6 mm	4.4 - 5.4 N·m (0.45 - 0.55 kg·m, 3.3 - 4.0 ft·lb)

Apply liquid gasket (Fuji Bond C or equivalent) on the mating surfaces



● Apply liquid gasket (Fuji Bond C or equivalent) on the thread

Tightening torque: N·m (kg·m, ft·lb)
T1: 25 - 34 (2.5 - 3.5, 18 - 25)
T2: 62 - 76 (6.3 - 7.7, 46 - 56)
T3: 34 - 44 (3.5 - 4.5, 25 - 33)

- | | |
|--|--|
| 1 Crankcase assembly | 15 Gasket (26.2 x 31.5 x 1 mm) |
| 2 Stud bolt | 16 Crankcase plug |
| 3 Bolt (10 x 108 x 28 mm) | 17 Crankcase O-ring |
| 4 Bolt | 18 Back up ring |
| 5 Washer | 19 Bolt & washer (6 x 13 x 13 mm) |
| 6 Bolt (10 x 145 x 28 mm) | 20 Clip |
| 7 Washer (10.5 x 18 x 2 mm) | 21 Crankcase plug |
| 8 Main gallery plug | 22 Gasket (36.2 x 44 x 1 mm) |
| 9 Bolt | 23 Crankcase assembly |
| 10 Crankcase front hanger (Hitachi carburetor) | 24 Nut (10 x 8 mm) |
| 11 Nut | 25 Bolt (10 x 135 x 28 mm) |
| 12 Bolt (10 x 70 x 28 mm) | 26 Stud bolt (10 x 120 x 26 mm) |
| 13 Bolt | 27 Bolt |
| 14 Washer | 28 Crankcase front hanger |
| | 29 Crankcase front hanger (C-W carburetor) |

Fig. 3-8 Crankcase

2. Cylinder Heads

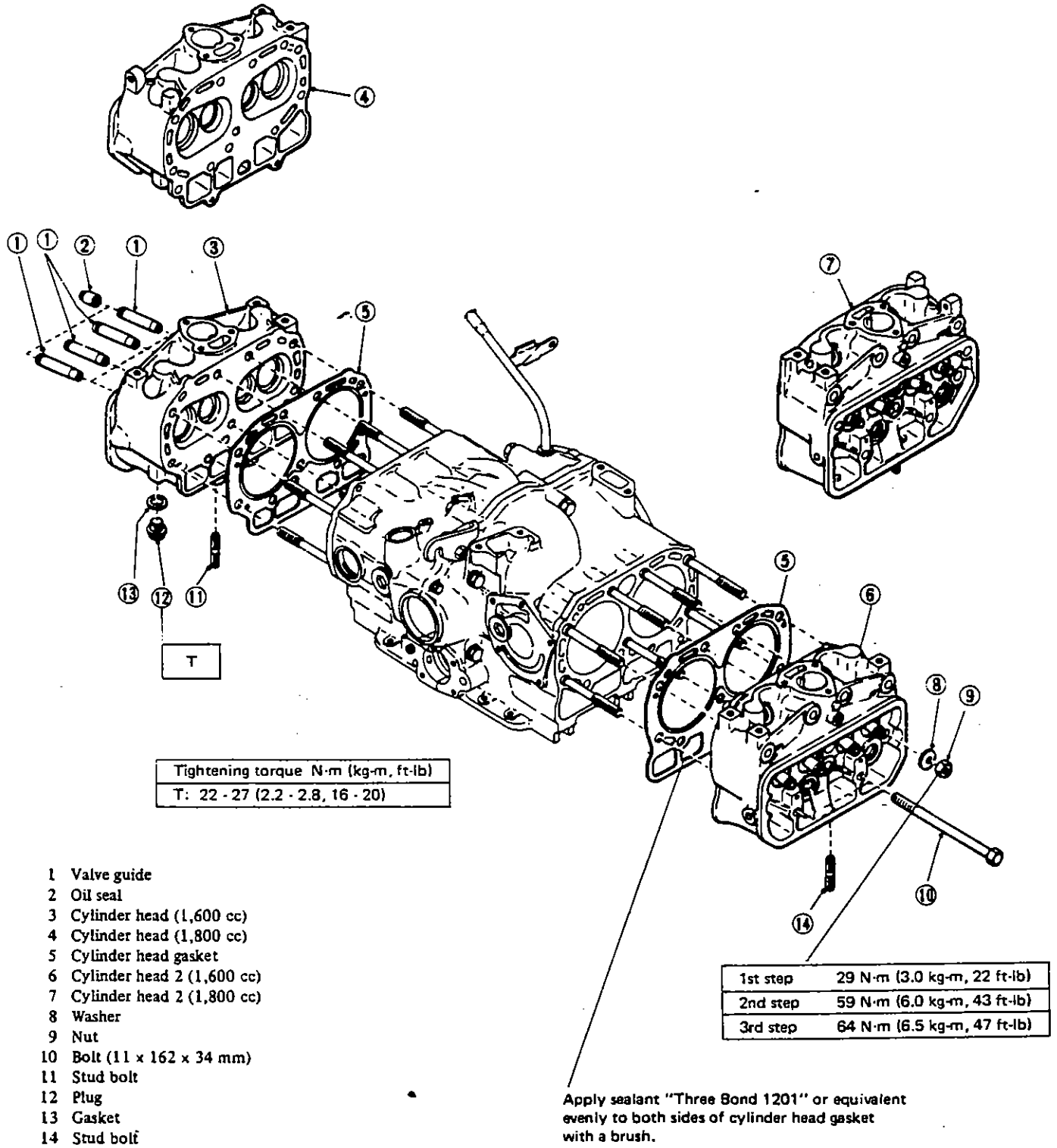
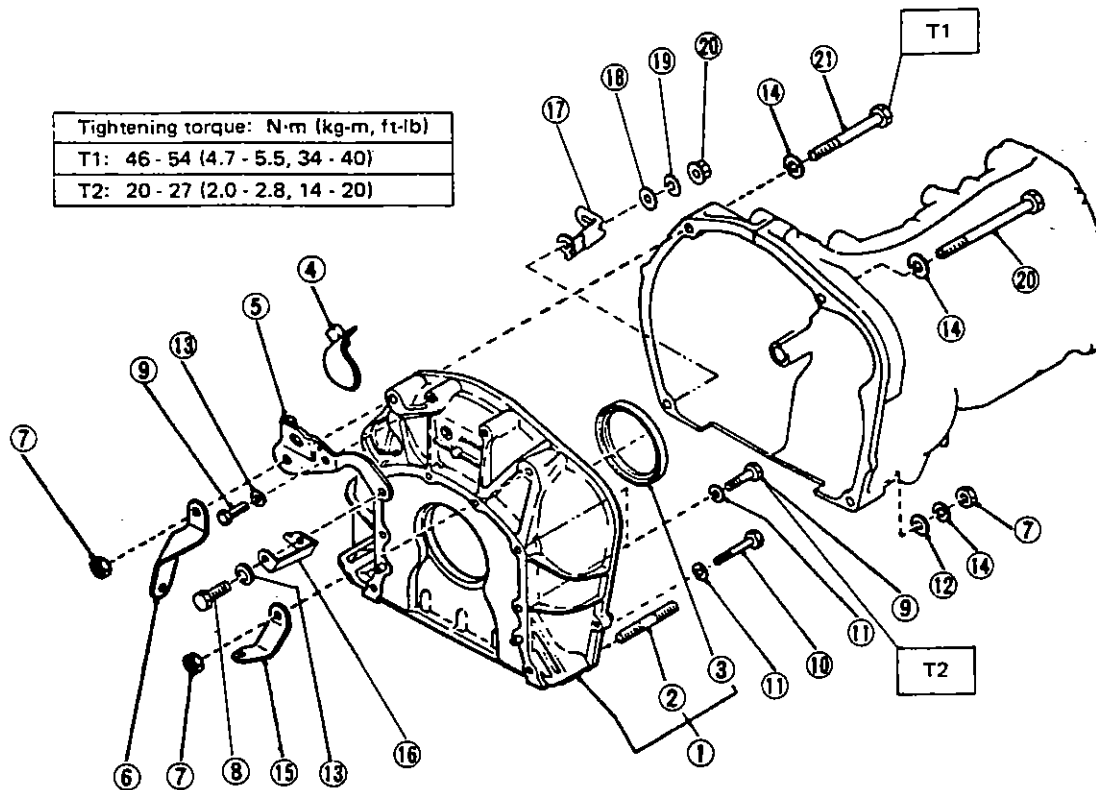


Fig. 3-9 Cylinder heads

3. Flywheel Housing and Fittings



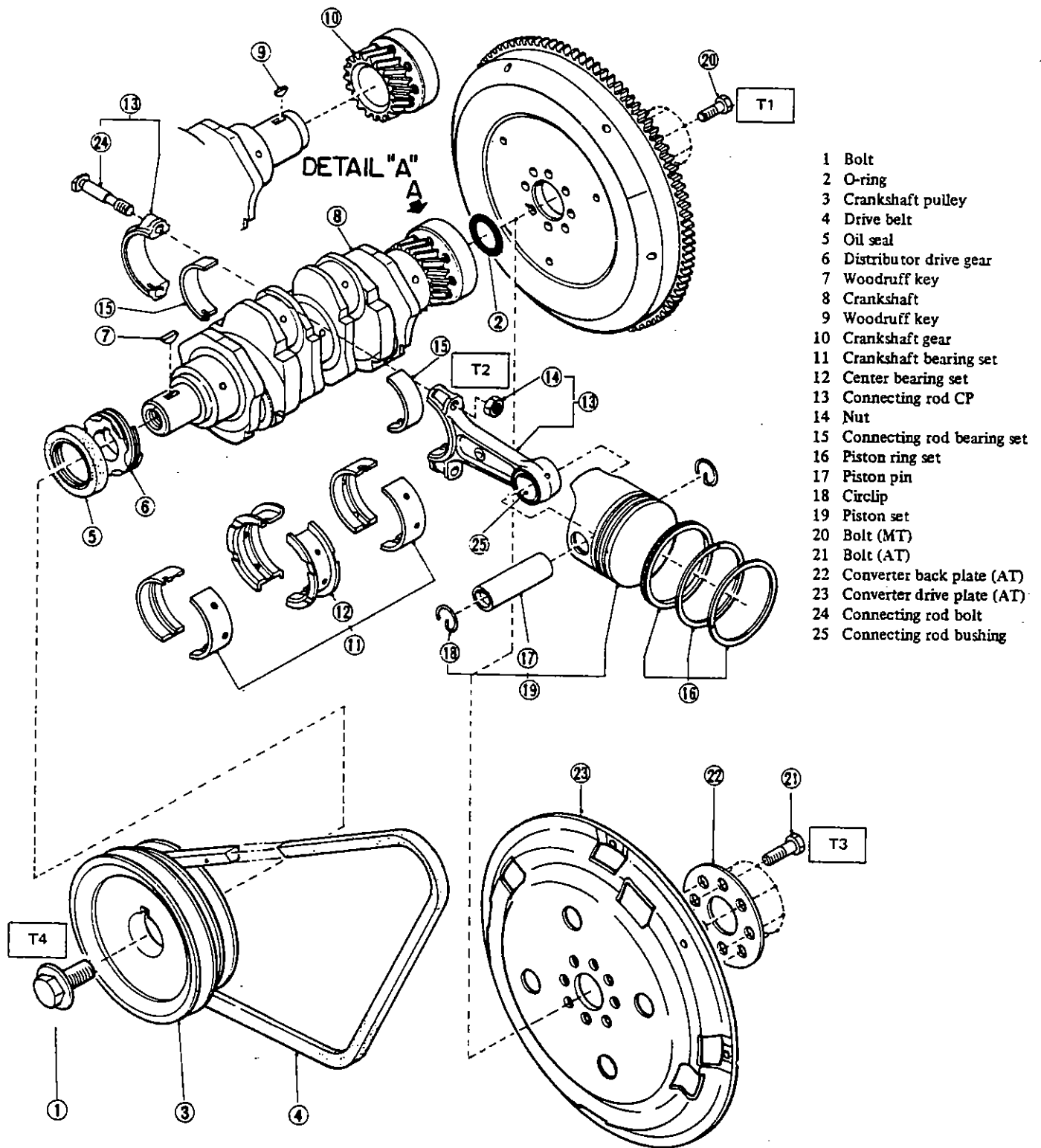
Coat with liquid gasket (Three Bond 1215 or equivalent) on mating surface and dry the coated surface for 5 to 10 minutes before installation.

- | | | |
|-------------------------------|------------------|--|
| 1 Flywheel housing CP | 8 Bolt | 15 Stiffener 2 |
| 2 Stud | 9 Bolt | 16 Accelerator cable bracket
(C-W carburetor) |
| 3 Oil seal (70 x 87 x 8.5 mm) | 10 Bolt | 17 Clip |
| 4 Timing hole plug | 11 Washer | 18 Washer |
| 5 Crankcase rear hanger | 12 Washer | 19 Spring washer |
| 6 Stiffener | 13 Spring washer | 20 Nut |
| 7 Nut | 14 Spring washer | 21 Bolt |

Fig. 3-10 Flywheel housing and fittings

A5-791

4. Crankshaft and Related Parts



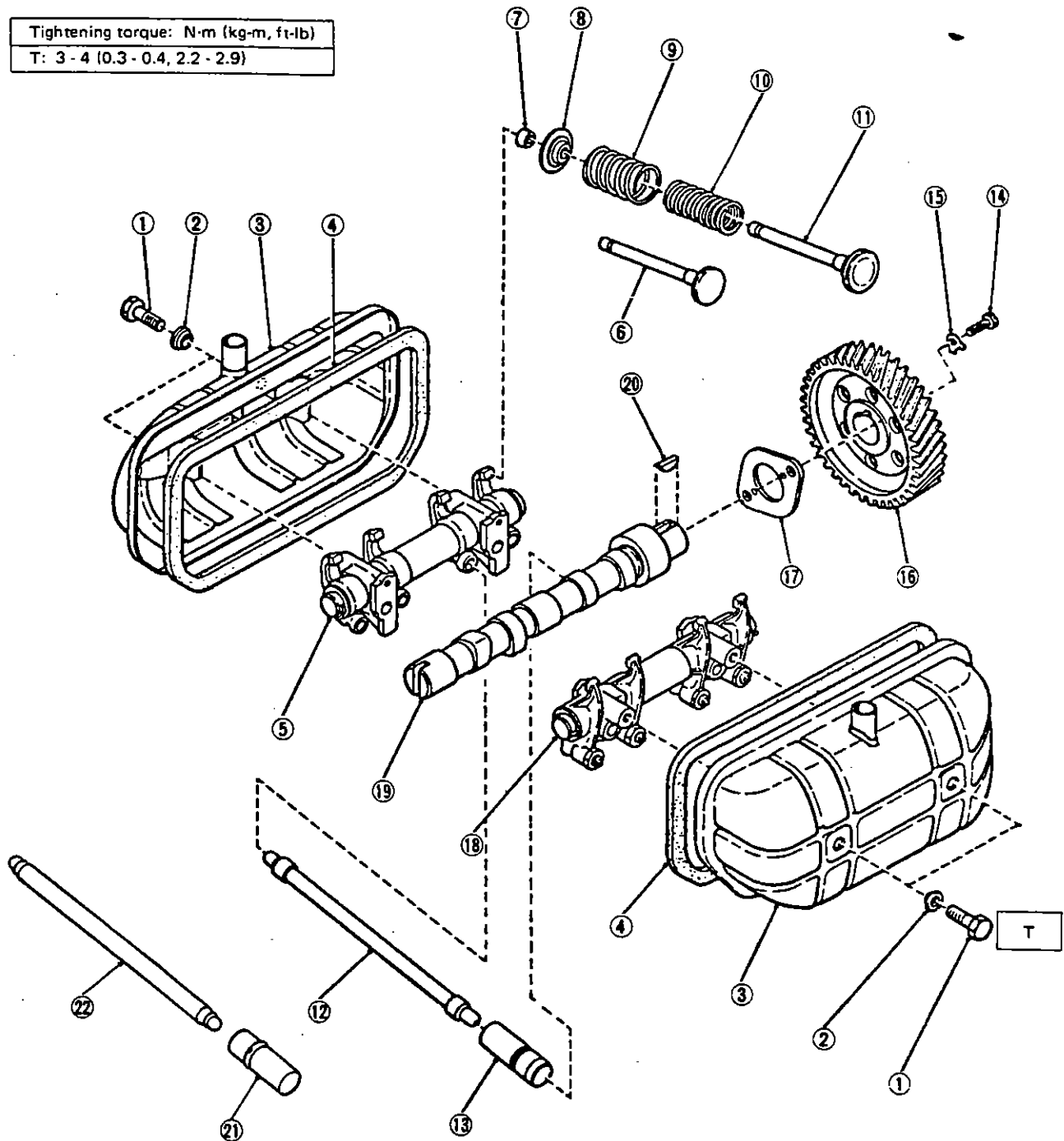
- Apply engine oil on the thread.
- Apply liquid gasket (Three Bond 1215 or equivalent) on the flange seat.

Tightening torque: N·m (kg·m, ft·lb)	
T1:	41 - 45 (4.2 - 4.6, 30 - 33)
T2:	39 - 42 (4.0 - 4.3, 29 - 31)
T3:	49 - 53 (5.0 - 5.4, 36 - 39)
T4:	64 - 74 (6.5 - 7.5, 47 - 54)

Fig. 3-11 Crankshaft and related parts

5. Valve System

Tightening torque: N-m (kg-m, ft-lb)
T: 3 - 4 (0.3 - 0.4, 2.2 - 2.9)



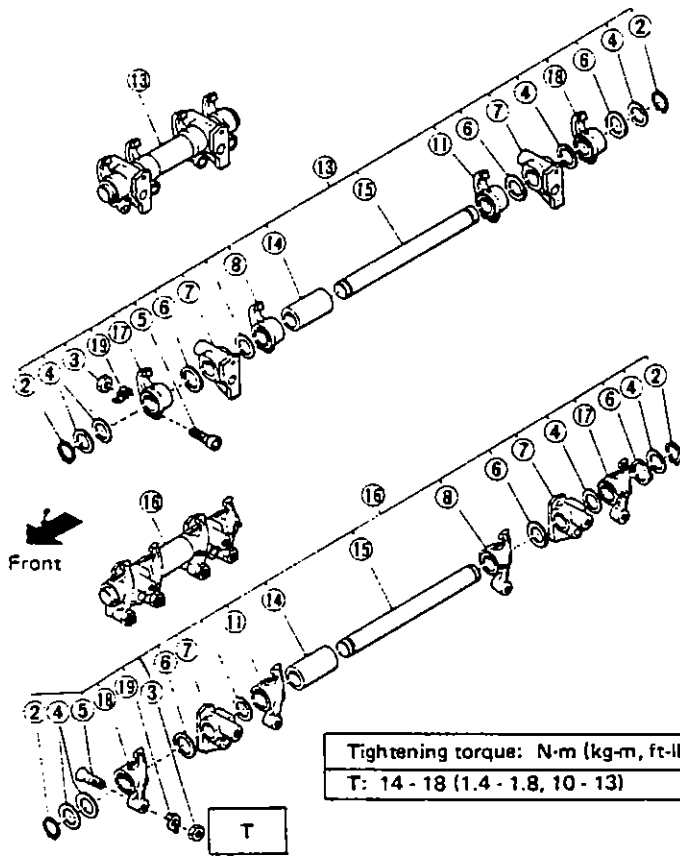
- | | | |
|----------------------------------|-------------------|--|
| 1 Bolt | 9 Valve spring | 16 Camshaft gear |
| 2 Valve rocker cover seal washer | 10 Valve spring 2 | 17 Camshaft plate |
| 3 Valve rocker cover | 11 Intake valve | 18 Valve rocker ASSY |
| 4 Valve rocker cover gasket | 12 Valve push rod | 19 Camshaft |
| 5 Valve rocker ASSY (R.H.) | 13 Valve lifter | 20 Woodruff key |
| 6 Exhaust valve | 14 Bolt | 21 Hydraulic valve lifter |
| 7 Valve spring retainer key | 15 Lock washer | 22 Push rod (for hydraulic valve lifter) |
| 8 Valve spring retainer | | |

Fig. 3-12 Valve system

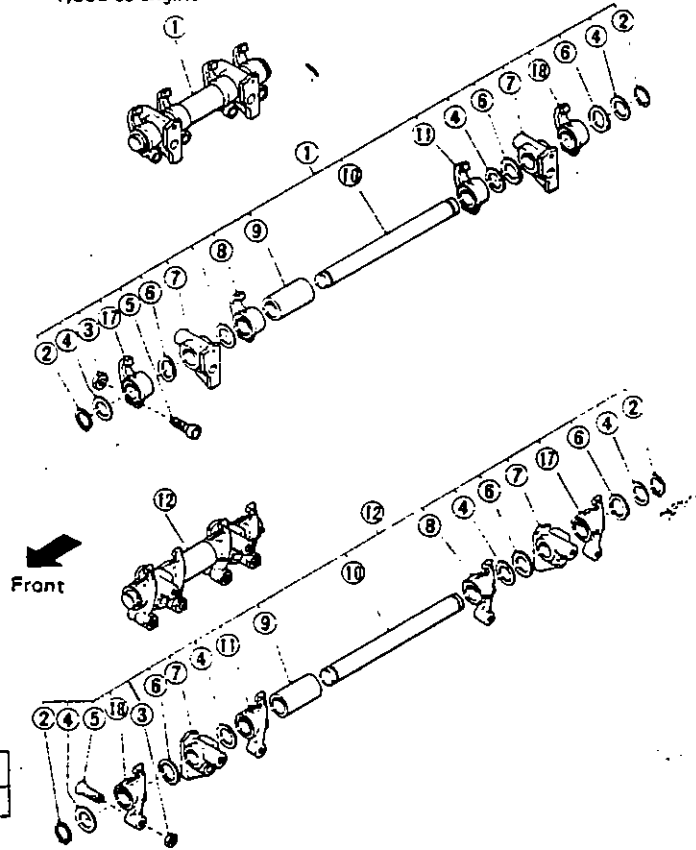
ENGINE

6. Valve Rocker

1,800 cc engine



1,600 cc engine



Tightening torque: N·m (kg·m, ft·lb)

T: 14 - 18 (1.4 - 1.8, 10 - 13)

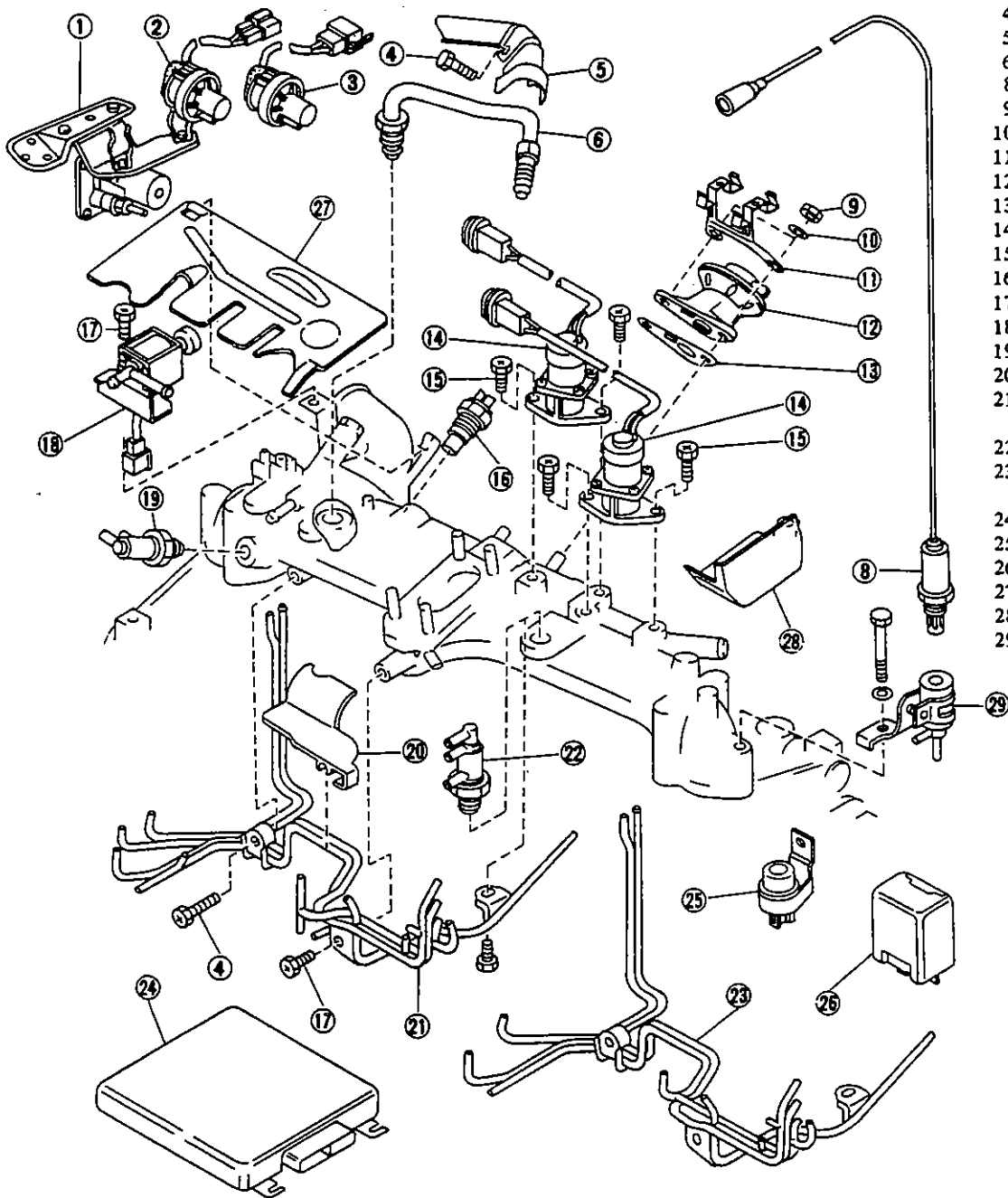
- | | |
|------------------------------|--|
| 1 Valve rocker ASSY (R.H.) | 11 Valve rocker arm CP 2 |
| 2 Snap ring | 12 Valve rocker ASSY (L.H.) |
| 3 Nut | 13 Valve rocker ASSY (R.H.) |
| 4 Washer | 14 Rocker shaft spacer |
| 5 Valve rocker screw | 15 Valve rocker shaft |
| 6 Rocker shaft spring washer | 16 Valve rocker ASSY (L.H.) |
| 7 Rocker shaft supporter | 17 Valve rocker arm |
| 8 Valve rocker arm CP | 18 Valve rocker arm 2 |
| 9 Rocker shaft spacer | 19 Lock washer (only for hydraulic valve lifter) |
| 10 Valve rocker shaft | |

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Fig. 3-13 Valve rocker

7. Emission Control Equipment

1) Hitachi Carburetor Type (1) (California and 49-state non-4WD)



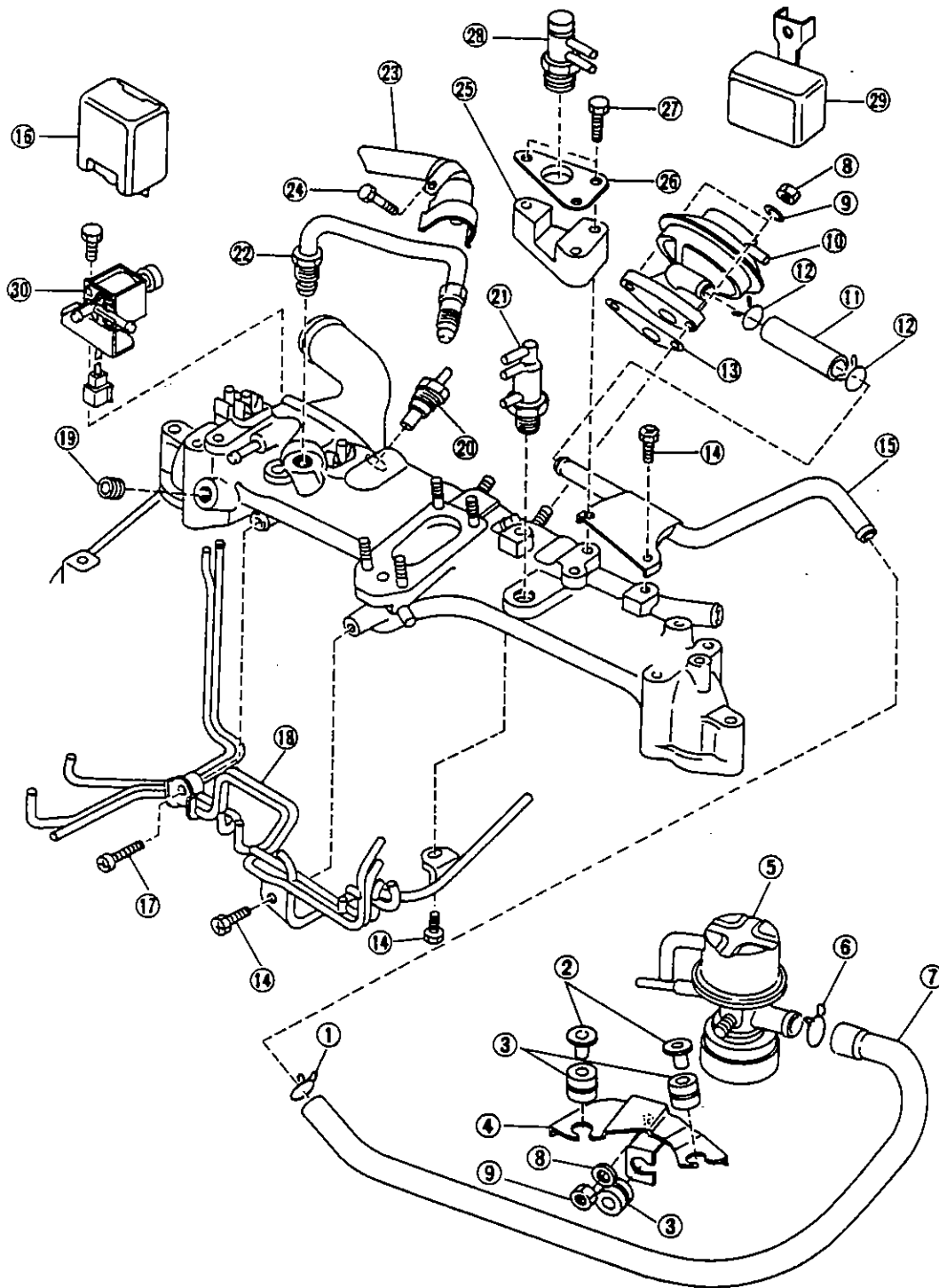
- 1 Altitude compensator (49-state non-4WD)
- 2 Vacuum switch I
- 3 Vacuum switch II
- 4 Bolt & washer
- 5 EGR pipe cover
- 6 EGR pipe
- 8 Oxygen sensor
- 9 Nut
- 10 Washer
- 11 Clamp
- 12 EGR valve
- 13 Gasket
- 14 Duty solenoid valve
- 15 Bolt & washer
- 16 Thermo sensor
- 17 Bolt & washer
- 18 Solenoid valve I
- 19 Thermo vacuum valve II
- 20 Carburetor protector 3
- 21 Vacuum pipe CP (Except 4WD and AT)
- 22 Thermo vacuum valve I
- 23 Vacuum pipe CP (4WD and AT)
- 24 Electronic control module
- 25 Ignition relay
- 26 Revolution sensor
- 27 Carburetor protector
- 28 Carburetor protector 2
- 29 Solenoid valve II (49-State only)

Fig. 3-14-1

A5-792

ENGINE

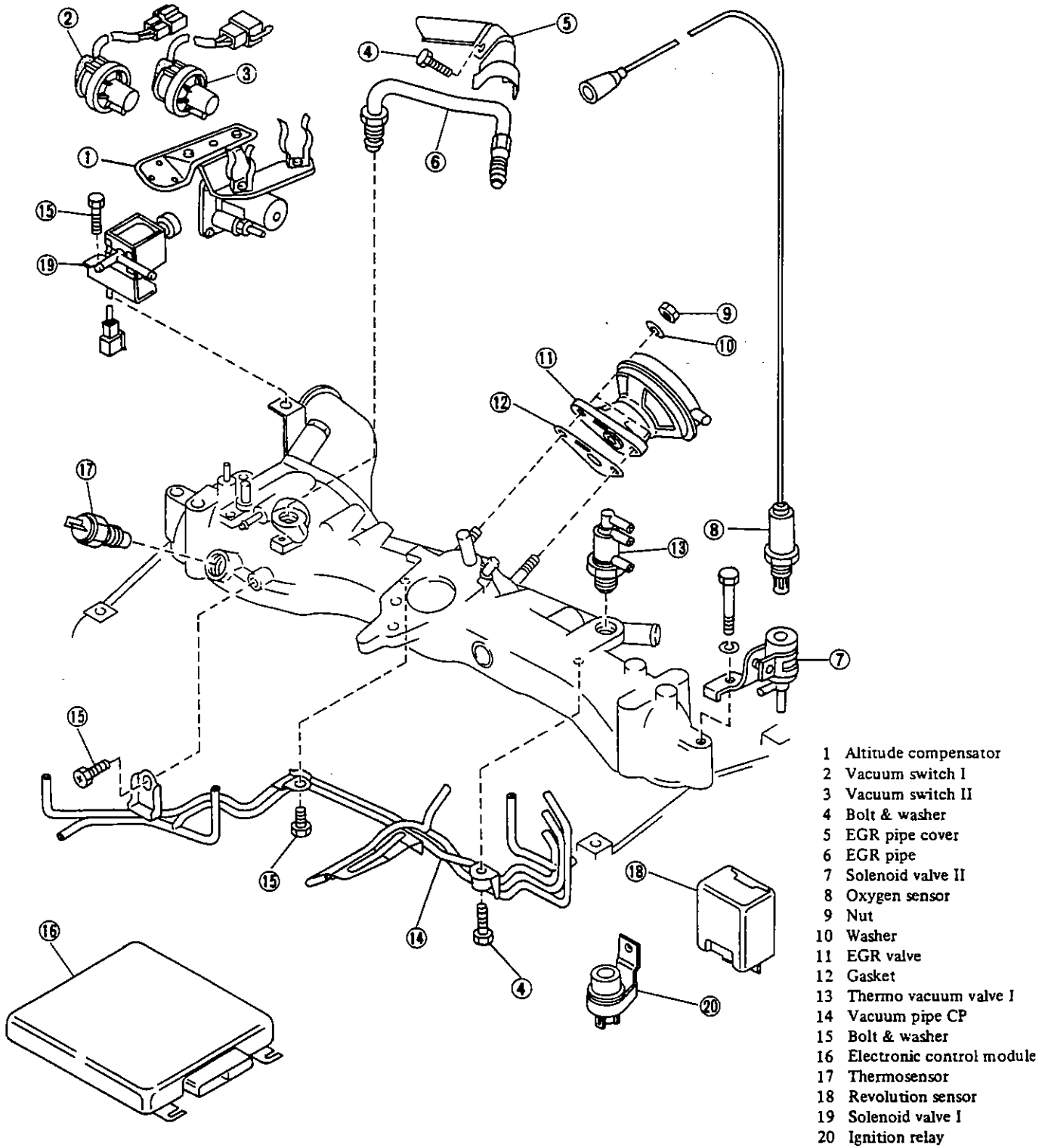
2) Hitachi Carburetor Type (2) (Canada and 49-state 4WD)



- 1 Hose clamp
- 2 Bush
- 3 Grommet
- 4 Bracket
- 5 Anti-after burning valve
- 6 Hose clamp
- 7 Hose
- 8 Nut
- 9 Spring washer
- 10 EGR valve ASSY
- 11 Hose
- 12 Hose clamp
- 13 Gasket
- 14 Bolt & washer
- 15 Pipe
- 16 Revolution sensor
- 17 Bolt & washer
- 18 Vacuum pipe CP
- 19 Plug
- 20 Thermometer CP
- 21 Temperature valve ASSY
- 22 EGR pipe CP
- 23 EGR pipe cover
- 24 Bolt & washer
- 25 Insulator
- 26 Bracket
- 27 Bolt & washer
- 28 Temperature valve ASSY
- 29 Revolution sensor
- 30 Solenoid valve I

Fig. 3-14-2

3) C-W Carburetor Type

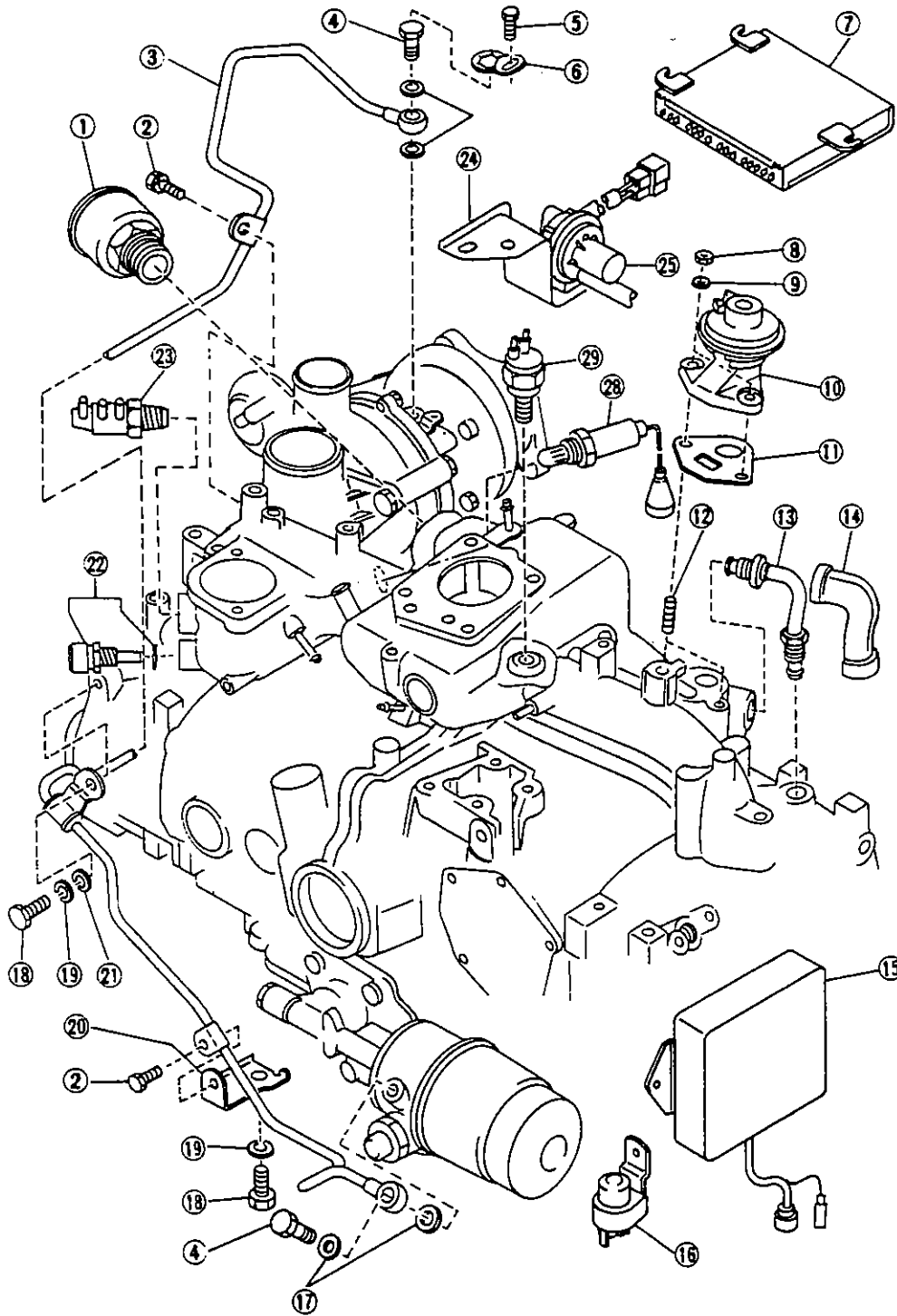


- 1 Altitude compensator
- 2 Vacuum switch I
- 3 Vacuum switch II
- 4 Bolt & washer
- 5 EGR pipe cover
- 6 EGR pipe
- 7 Solenoid valve II
- 8 Oxygen sensor
- 9 Nut
- 10 Washer
- 11 EGR valve
- 12 Gasket
- 13 Thermo vacuum valve I
- 14 Vacuum pipe CP
- 15 Bolt & washer
- 16 Electronic control module
- 17 Thermosensor
- 18 Revolution sensor
- 19 Solenoid valve I
- 20 Ignition relay

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Fig. 3-15 Emission control equipment (C-W carburetor type)

4) EGI-TURBO Engine System (1)



- 1 Air relief valve ASSY
- 2 Bolt and washer
- 3 Oil delivery pipe CP
- 4 Union screw
- 5 Bolt
- 6 Union screw lock plate
- 7 Fuel injection control unit
- 8 Nut
- 9 Spring washer
- 10 EGR valve ASSY
- 11 EGR valve gasket
- 12 Stud
- 13 EGR pipe CP
- 14 EGR pipe cover
- 15 Knock control unit
- 16 Relay ASSY
- 17 Gasket
- 18 Bolt
- 19 Spring washer
- 20 Oil pipe stay
- 21 Washer
- 22 Temperature sensor ASSY
- 23 Thermo vacuum valve
- 24 Bracket
- 25 Pressure switch
- 28 O₂ sensor
- 29 Knock sensor

Fig. 3-16

5) EGI-TURBO Engine System (2)

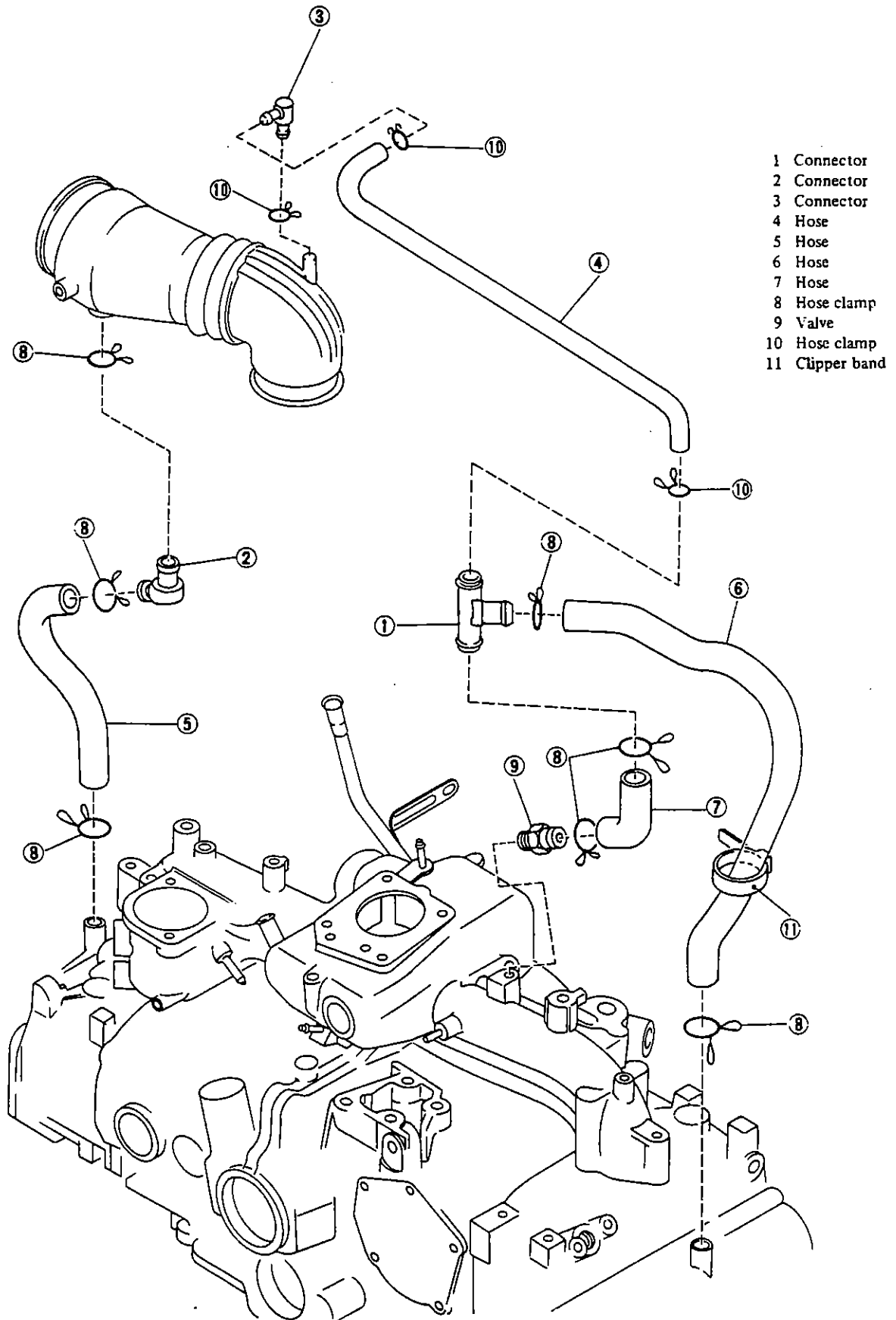
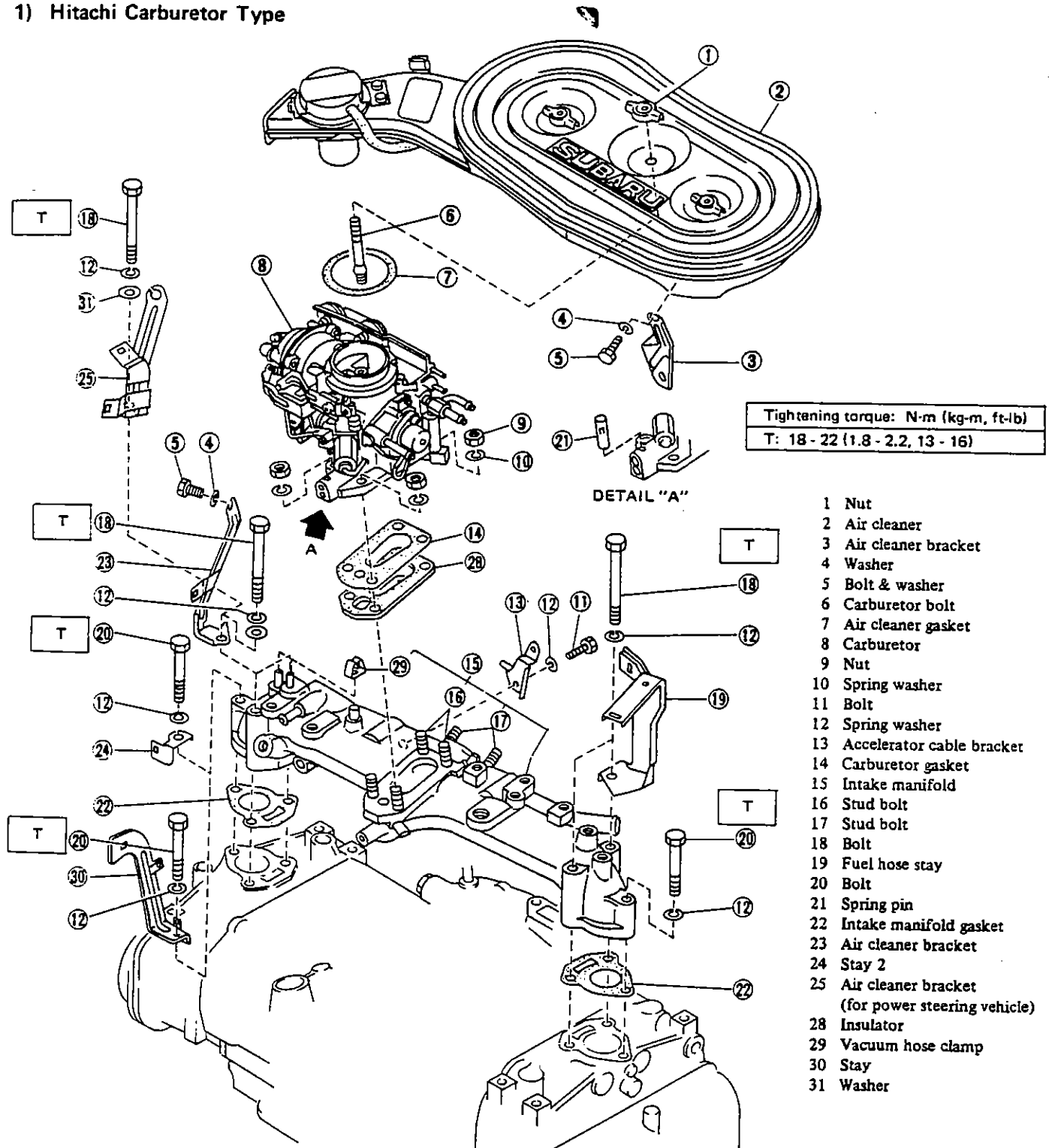


Fig. 3-17

ENGINE

8. Intake Manifold

1) Hitachi Carburetor Type

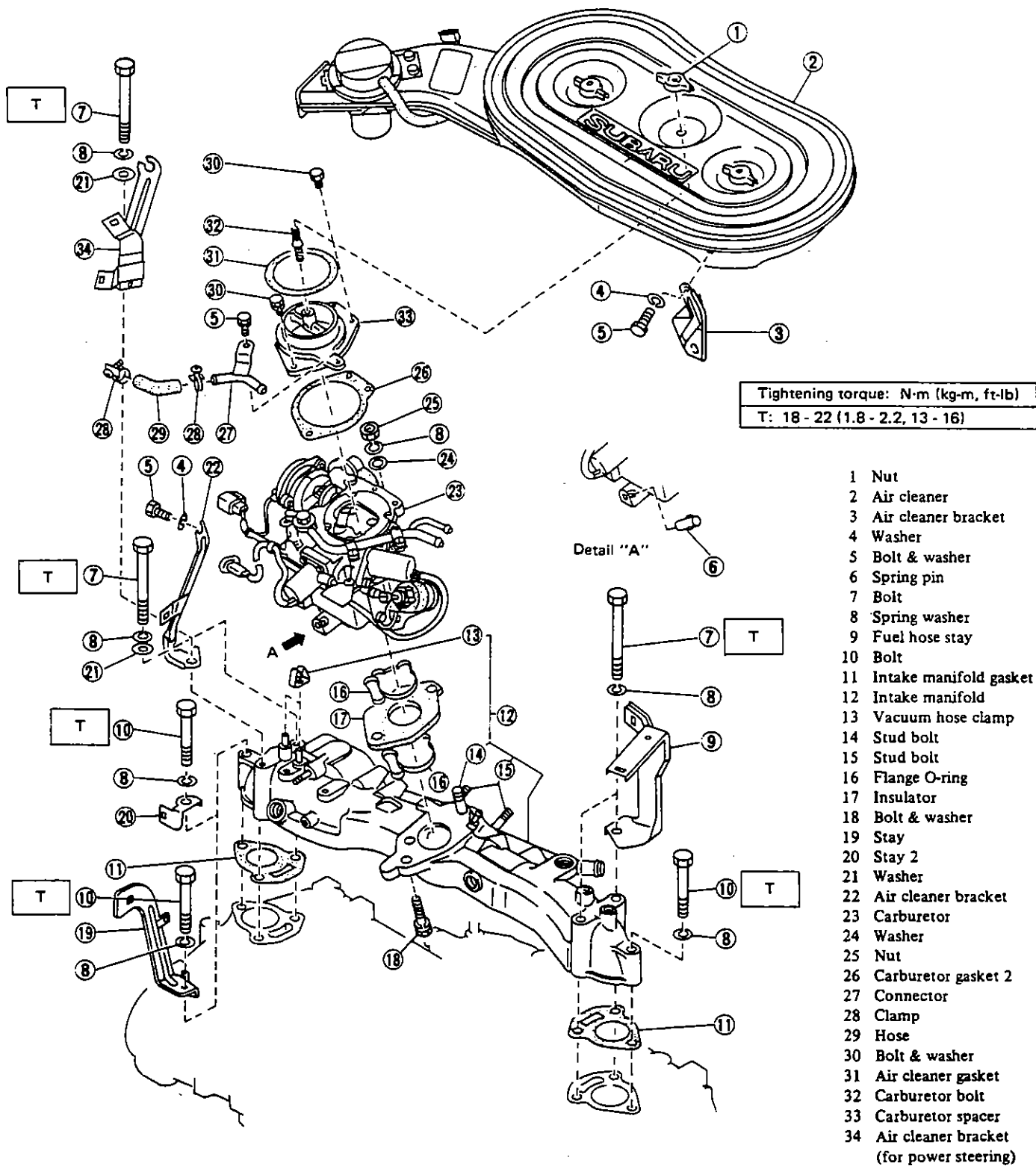


Tightening torque: N·m (kg·m, ft·lb)
 T: 18 - 22 (1.8 - 2.2, 13 - 16)

- 1 Nut
- 2 Air cleaner
- 3 Air cleaner bracket
- 4 Washer
- 5 Bolt & washer
- 6 Carburetor bolt
- 7 Air cleaner gasket
- 8 Carburetor
- 9 Nut
- 10 Spring washer
- 11 Bolt
- 12 Spring washer
- 13 Accelerator cable bracket
- 14 Carburetor gasket
- 15 Intake manifold
- 16 Stud bolt
- 17 Stud bolt
- 18 Bolt
- 19 Fuel hose stay
- 20 Bolt
- 21 Spring pin
- 22 Intake manifold gasket
- 23 Air cleaner bracket
- 24 Stay 2
- 25 Air cleaner bracket (for power steering vehicle)
- 28 Insulator
- 29 Vacuum hose clamp
- 30 Stay
- 31 Washer

Fig. 3-18 Intake manifold (Hitachi carburetor type)

2) C-W Carburetor Type



A5-596

Fig. 3-19 Intake manifold (C-W carburetor type)

ENGINE

3) EGI-TURBO Engine System (1)

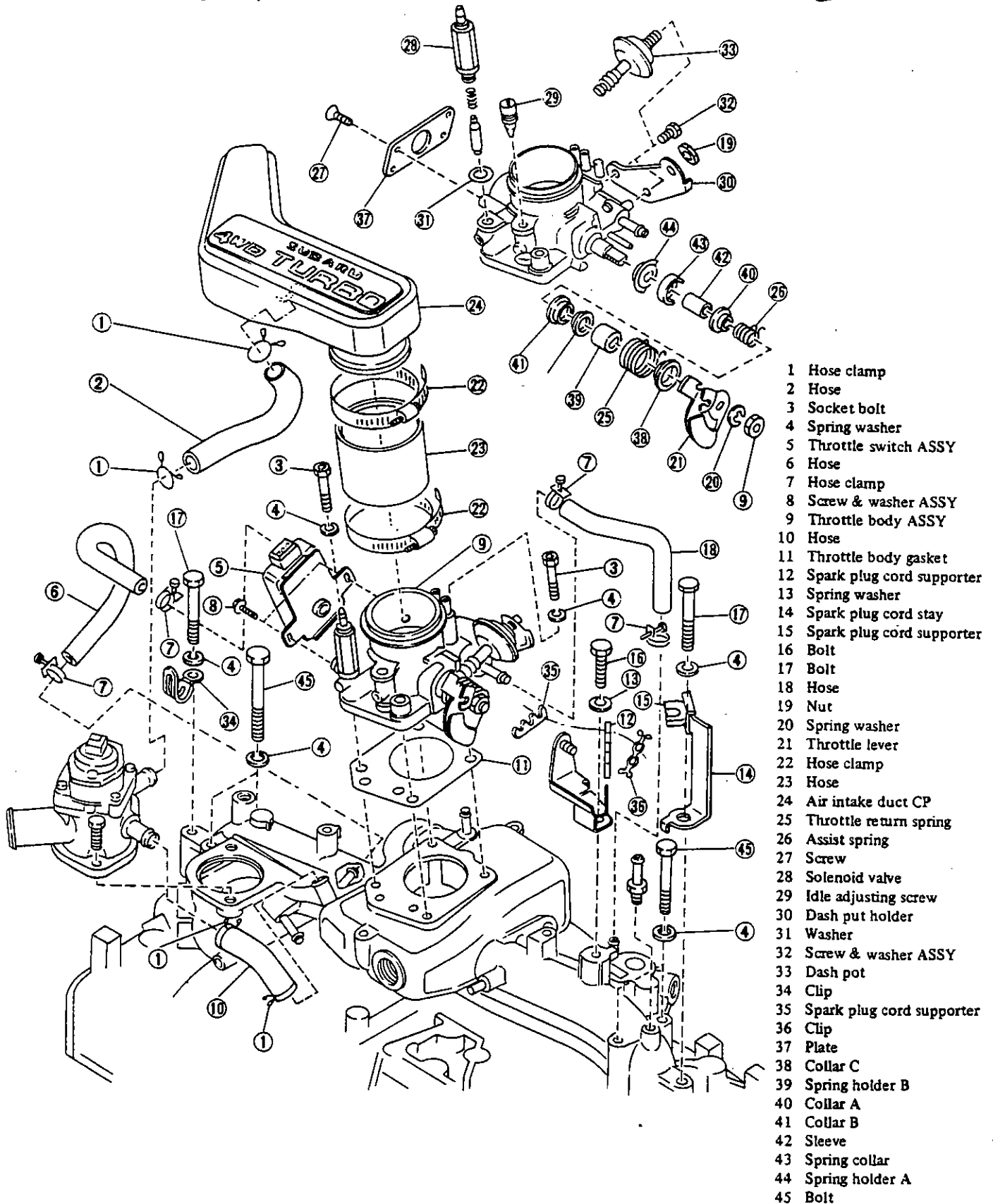


Fig. 3-20

4) EGI-TURBO Engine System (2)

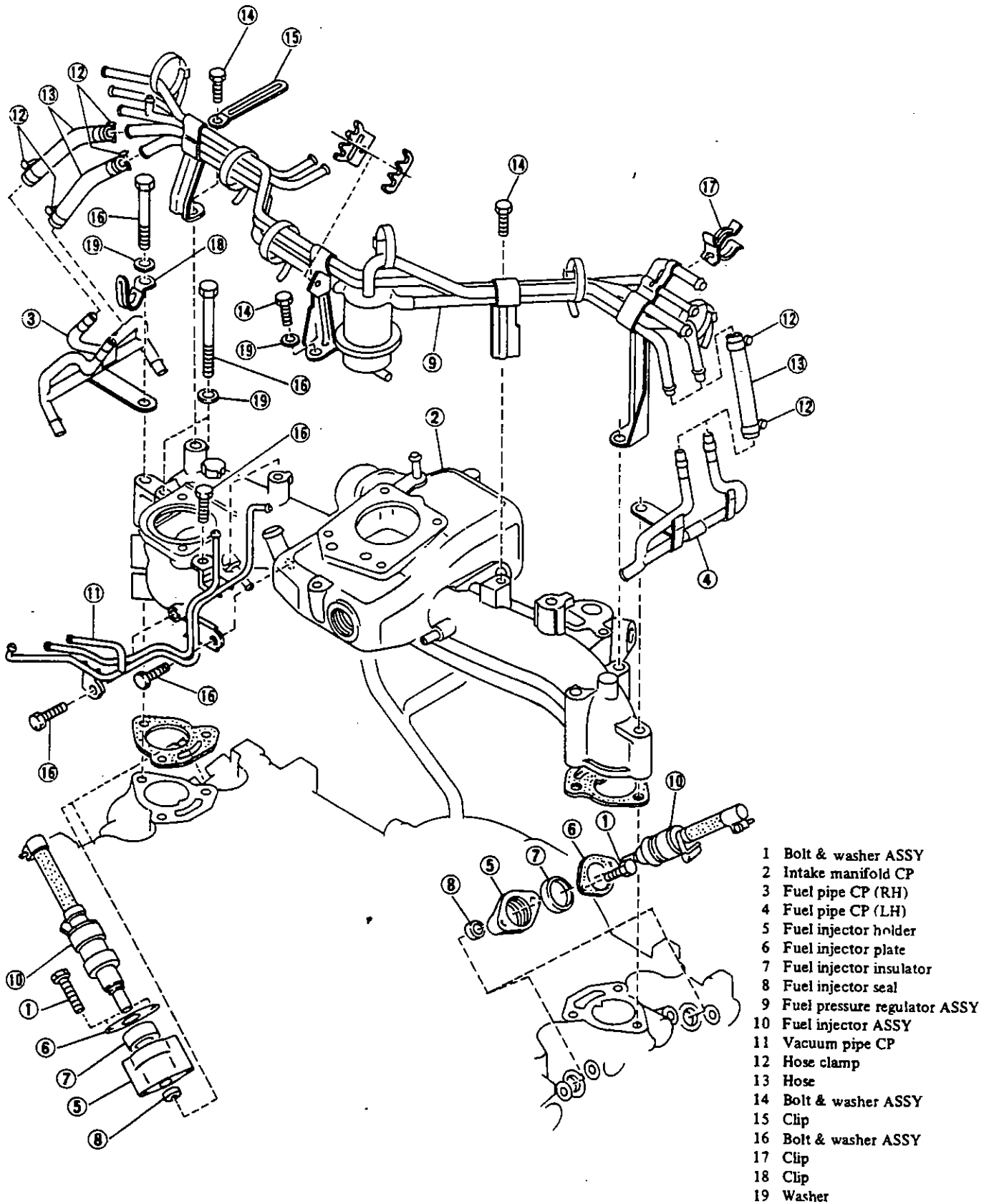
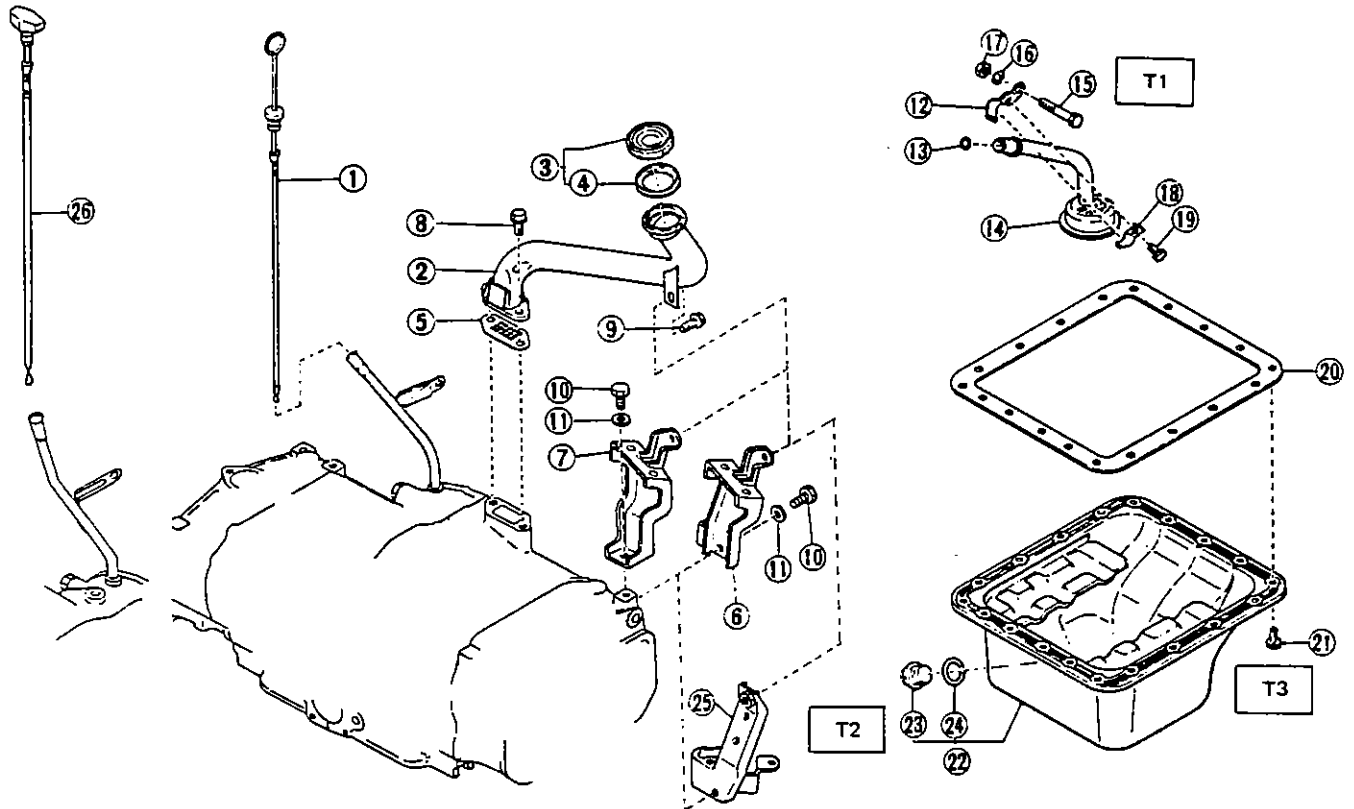


Fig. 3-21

9. Oil Pan, Oil Filler Duct and Fittings



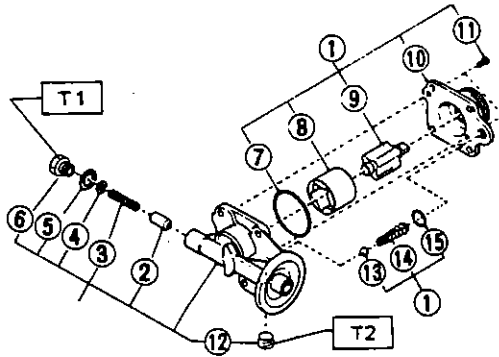
Tightening torque: N·m (kg·m, ft·lb)
T1: 23 - 26 (2.3 - 2.7, 17 - 20)
T2: 22 - 27 (2.2 - 2.8, 16 - 20)
T3: 4.4 - 5.4 (0.45 - 0.55, 3.3 - 4.0)

- | | |
|---|---------------------------------|
| 1 Oil level gauge | 12 Oil strainer stay |
| 2 Oil filler duct | 13 O-ring |
| 3 Oil filler cap CP | 14 Oil strainer |
| 4 Gasket | 15 Bolt |
| 5 Air breather duct gasket | 16 Spring washer |
| 6 Oil filler duct stay
(SUBARU 1800) | 17 Nut |
| 7 Oil filler duct stay
(SUBARU 1600) | 18 Oil strainer stay 2 |
| 8 Bolt and washer | 19 Bolt & washer |
| 9 Bolt and washer | 20 Oil pan gasket |
| 10 Bolt | 21 Bolt & washer |
| 11 Spring washer | 22 Oil pan CP |
| | 23 Plug |
| | 24 Gasket |
| | 25 Oil filler duct stay (TURBO) |
| | 26 Oil level gauge (TURBO) |

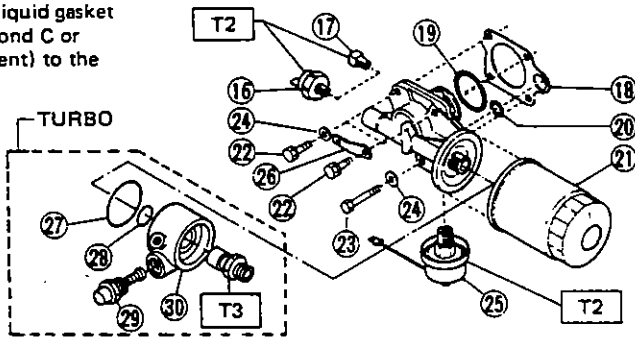
Fig. 3-22

10. Oil Pump

(1800 cc engine)



* Apply liquid gasket (Fuji Bond C or equivalent) to the thread.

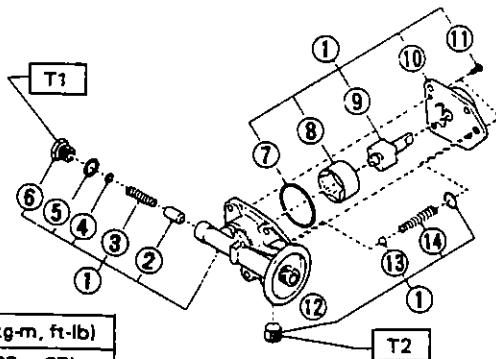


* Apply a thin coat of oil to the seal rubber.

Tightening torque N·m (kg·m, ft·lb)
T1: 31 - 37 (3.2 - 3.8, 23 - 27)
T2: 22 - 27 (2.2 - 2.8, 16 - 20)
T3: 29 (3.0, 22)

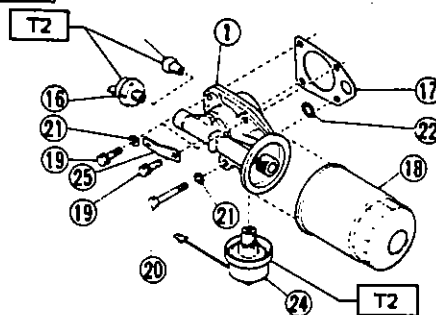
- 1 Oil pump assembly
- 2 Oil relief valve
- 3 Relief valve spring
- 4 Washer
- 5 Washer
- 6 Plug
- 7 O-ring
- 8 Oil pump rotor
- 9 Oil pump drive gear
- 10 Oil pump body holder
- 11 Pan head screw
- 12 Plug (Models without pressure gauge)
- 13 Ball
- 14 By-pass valve spring
- 15 O-ring
- 16 Oil pressure switch (Models without pressure gauge)
- 17 Plug (1/8") (Models with pressure gauge)
- 18 Oil pump body gasket
- 19 O-ring
- 20 O-ring
- 21 Oil filter
- 22 Bolt
- 23 Bolt
- 24 Washer
- 25 Oil pressure gauge (Models with pressure gauge)
- 26 Stay
- 27 O-ring
- 28 O-ring
- 29 Thermo valve
- 30 Attachment
- 31 Connector

(1600 cc engine)



Tightening torque N·m (kg·m, ft·lb)
T1: 31 - 37 (3.2 - 3.8, 23 - 27)
T2: 22 - 27 (2.2 - 2.8, 16 - 20)

* Apply liquid gasket (Fuji Bond C or equivalent) to the thread.



* Apply a thin coat of oil to the seal rubber.

- 1 Oil pump assembly
- 2 Oil relief valve
- 3 Relief valve spring
- 4 Washer
- 5 Washer
- 6 Plug
- 7 O-ring
- 8 Oil pump rotor
- 9 Oil pump drive gear
- 10 Oil pump body holder
- 11 Pan head screw
- 12 Plug (Models without pressure gauge)
- 13 Ball
- 14 By-pass valve spring
- 15 O-ring
- 16 Oil pressure switch (Models without pressure gauge)
- 17 Oil pump body gasket
- 18 Oil filter
- 19 Bolt
- 20 Bolt
- 21 Washer
- 22 O-ring
- 23 Plug (Models with pressure gauge)
- 24 Oil pressure gauge (Models with pressure gauge)
- 25 Stay

Fig. 3-23

11. Engine Cooling System

NOTE:

There are two manufacturers of fan ASSY. One is Hitachi and the other is Mitsuba. Each is exclusively composed, so there is no interchangeability between two manufacturers.

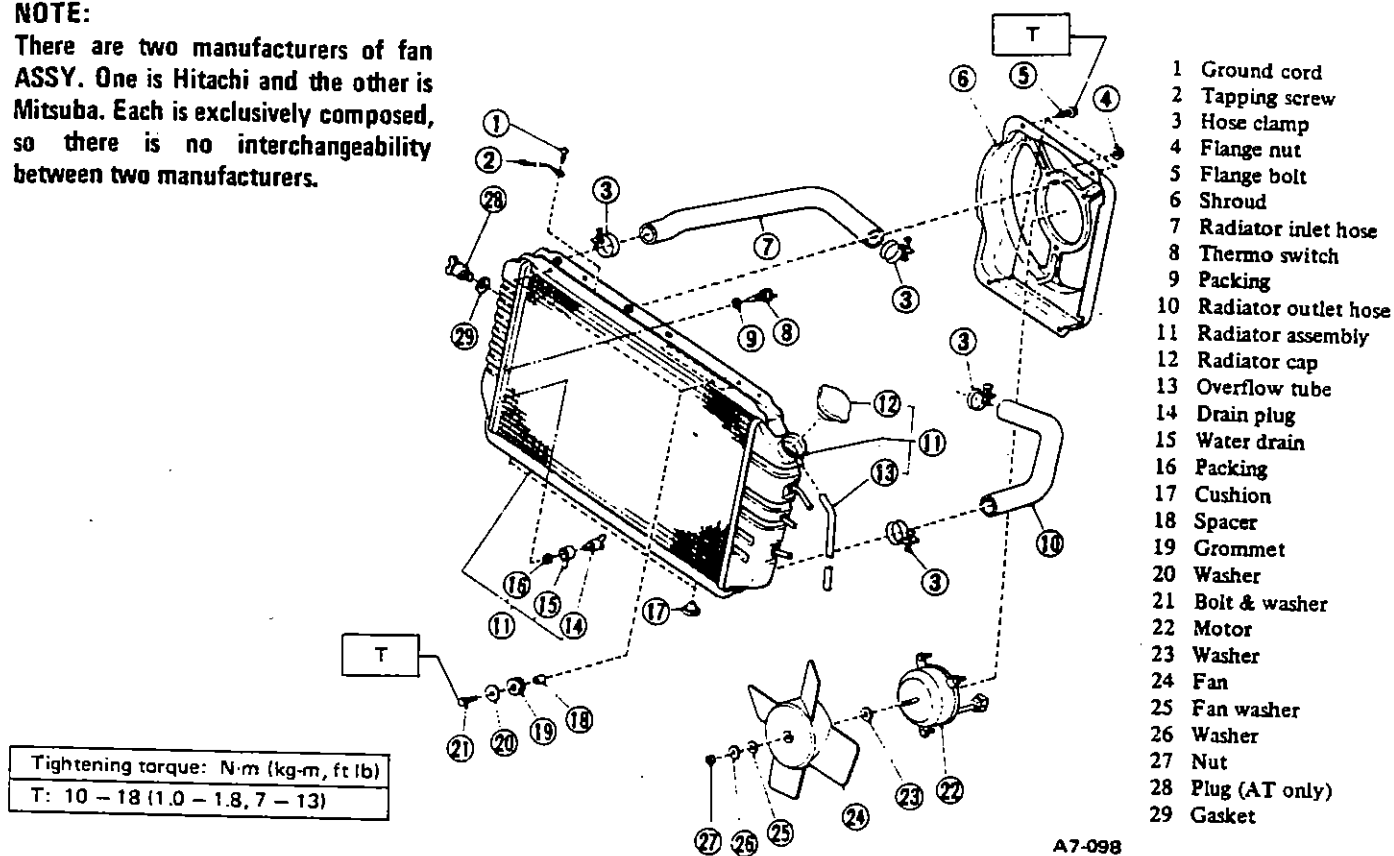


Fig. 3-24 Engine cooling system (Radiator ASSY and electric fan)

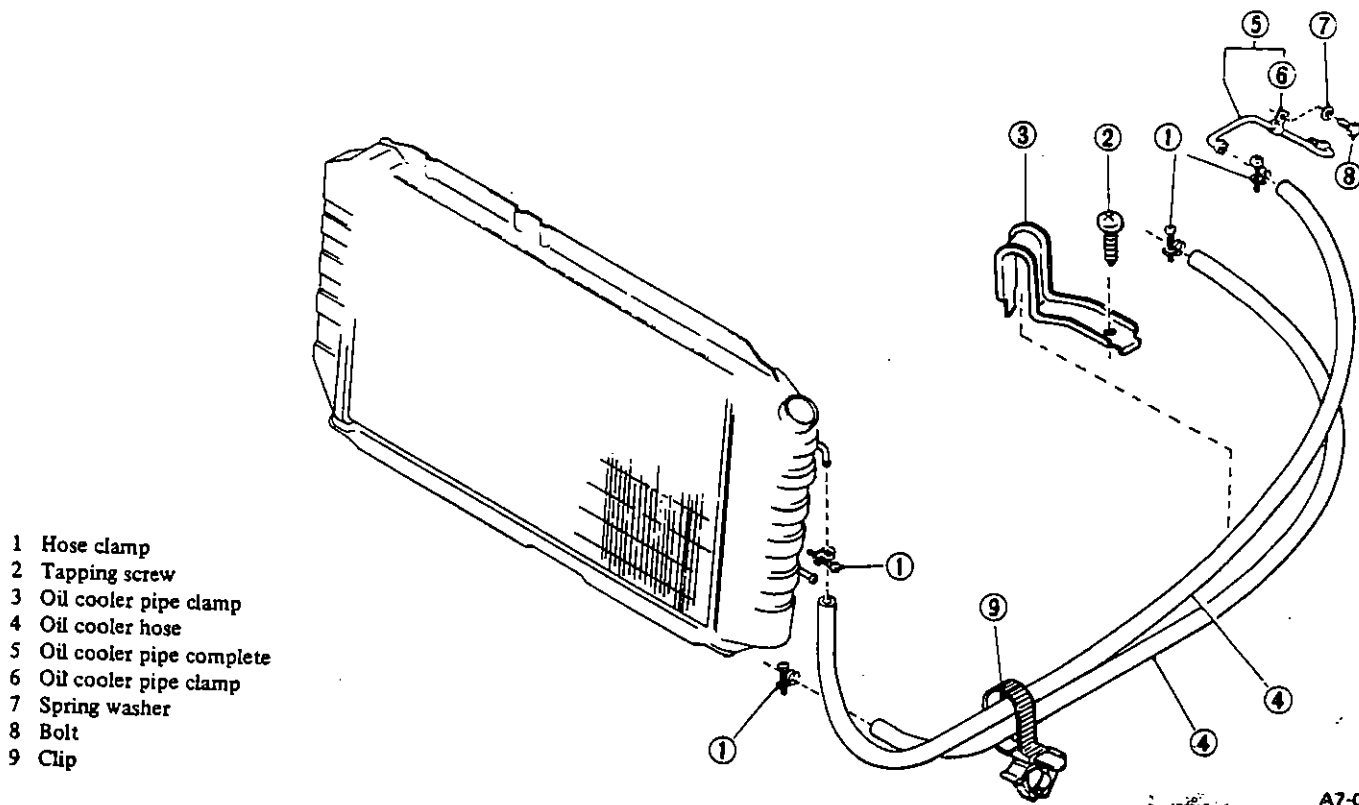


Fig. 3-25 Engine cooling system [Oil cooler (AT)]

12. Water Pump and Relative Fittings

1) Non-TURBO Vehicle

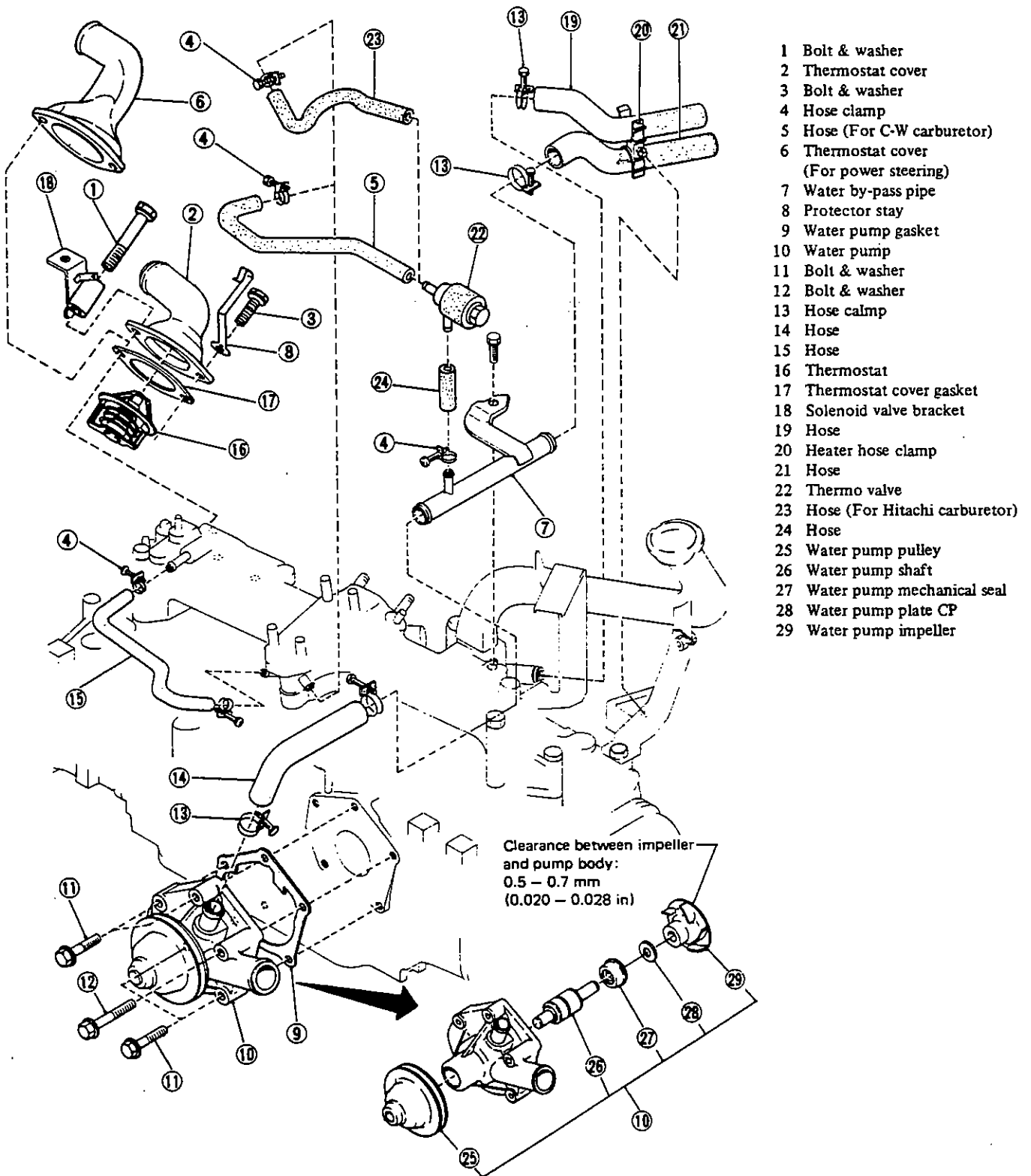
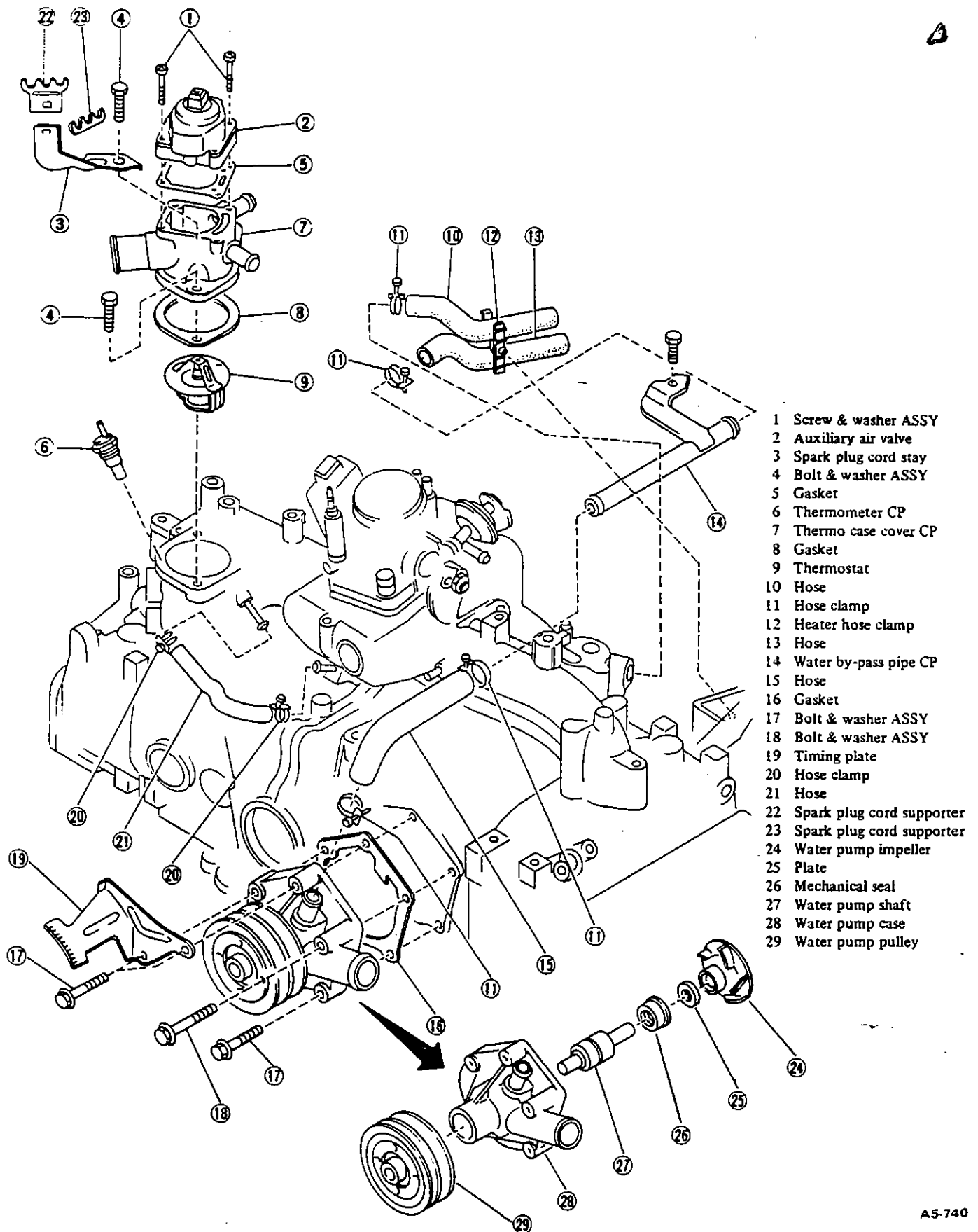


Fig. 3-26 Engine cooling system (Water pump and relative fittings)

ENGINE

2) TURBO Vehicle

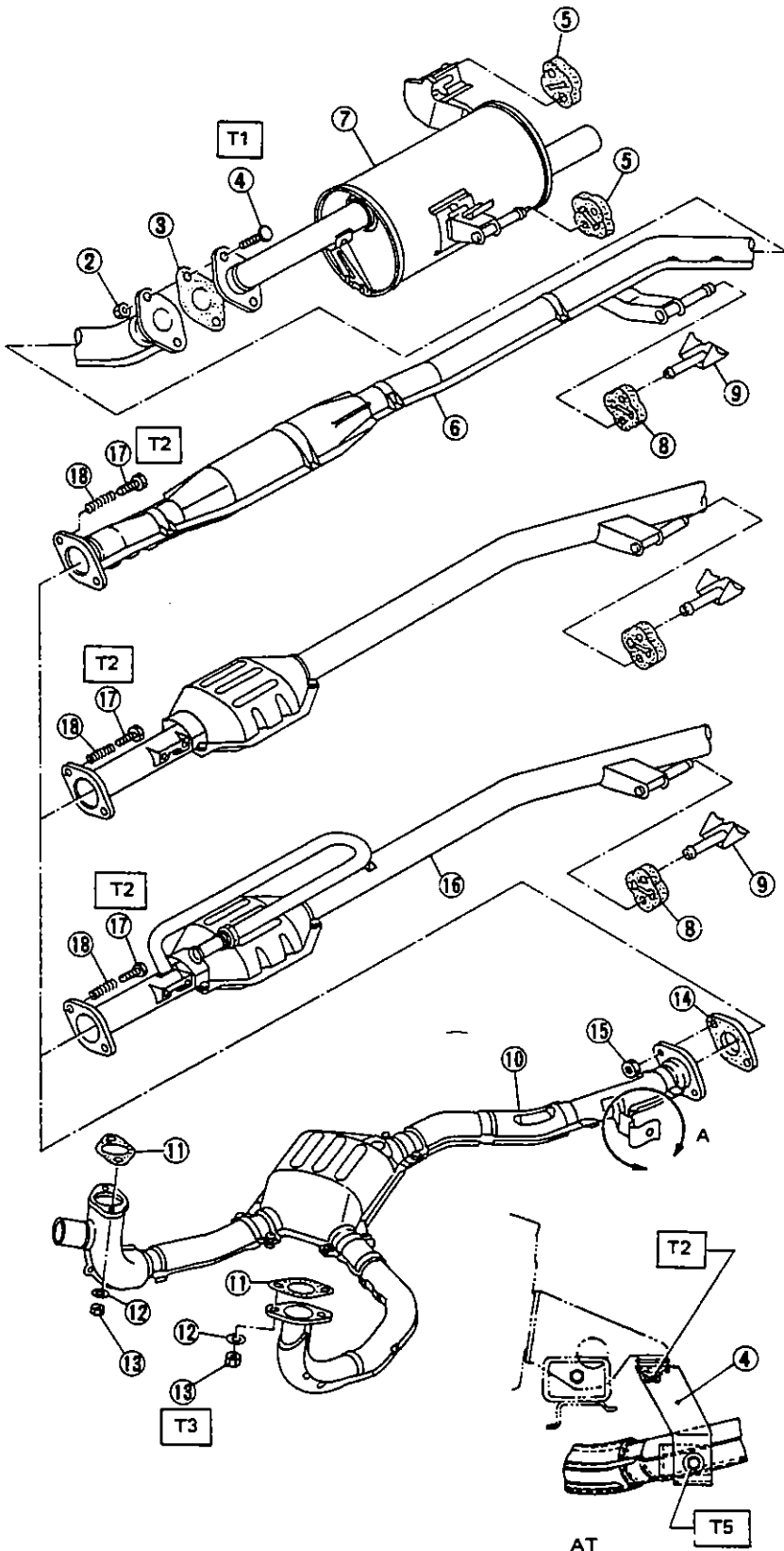


- 1 Screw & washer ASSY
- 2 Auxiliary air valve
- 3 Spark plug cord stay
- 4 Bolt & washer ASSY
- 5 Gasket
- 6 Thermometer CP
- 7 Thermo case cover CP
- 8 Gasket
- 9 Thermostat
- 10 Hose
- 11 Hose clamp
- 12 Heater hose clamp
- 13 Hose
- 14 Water by-pass pipe CP
- 15 Hose
- 16 Gasket
- 17 Bolt & washer ASSY
- 18 Bolt & washer ASSY
- 19 Timing plate
- 20 Hose clamp
- 21 Hose
- 22 Spark plug cord supporter
- 23 Spark plug cord supporter
- 24 Water pump impeller
- 25 Plate
- 26 Mechanical seal
- 27 Water pump shaft
- 28 Water pump case
- 29 Water pump pulley

Fig. 3-27

13. Exhaust System

1) Non-TURBO Vehicle



Tighten torque: N·m (kg-m, ft-lb)	
T1:	42 - 52 (4.3 - 5.3, 31 - 38)
T2:	10 - 18 (1.0 - 1.8, 7 - 13)
T3:	25 - 29 (2.6 - 3.0, 19 - 22)
T4:	14 - 22 (1.4 - 2.2, 10 - 16)
T5:	25 - 34 (2.5 - 3.5, 18 - 25)

- 1 Rear exhaust pipe ASSY (Canada and 49-state 4WD)
- 2 Self-lock nut
- 3 Exhaust gasket
- 4 Bolt
- 5 Exhaust cushion
- 6 Rear exhaust pipe ASSY (California)
- 7 Muffler ASSY
- 8 Exhaust cushion
- 9 Exhaust pipe hanger bracket
- 10 Front exhaust pipe ASSY
- 11 Gasket
- 12 Washer
- 13 Nut
- 14 Gasket
- 15 Self-lock nut
- 16 Rear exhaust pipe ASSY (49-state non-4WD)
- 17 Flange bolt
- 18 Spring

ENGINE

2) TURBO Vehicle

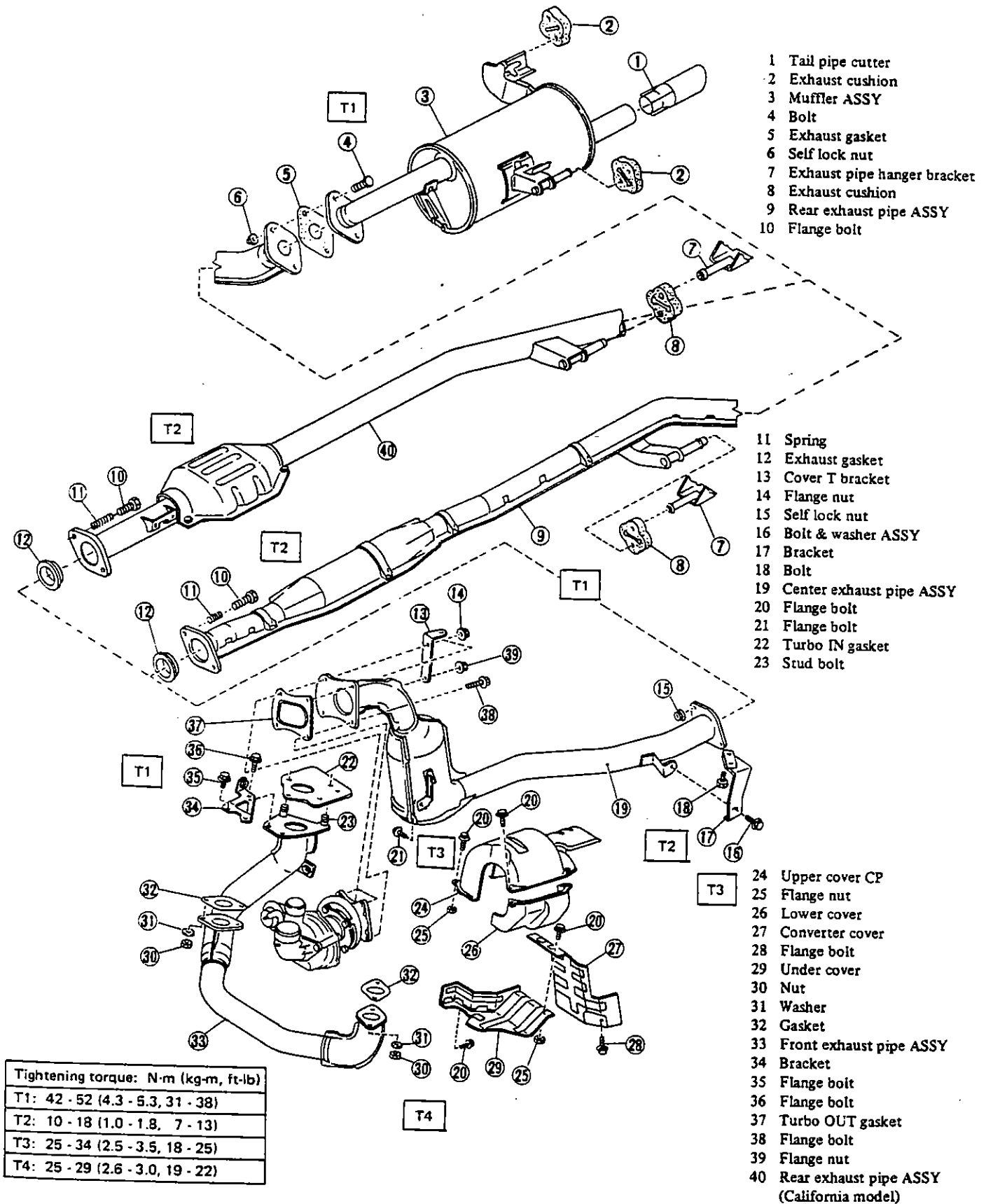


Fig. 3-29

14. Turbocharger

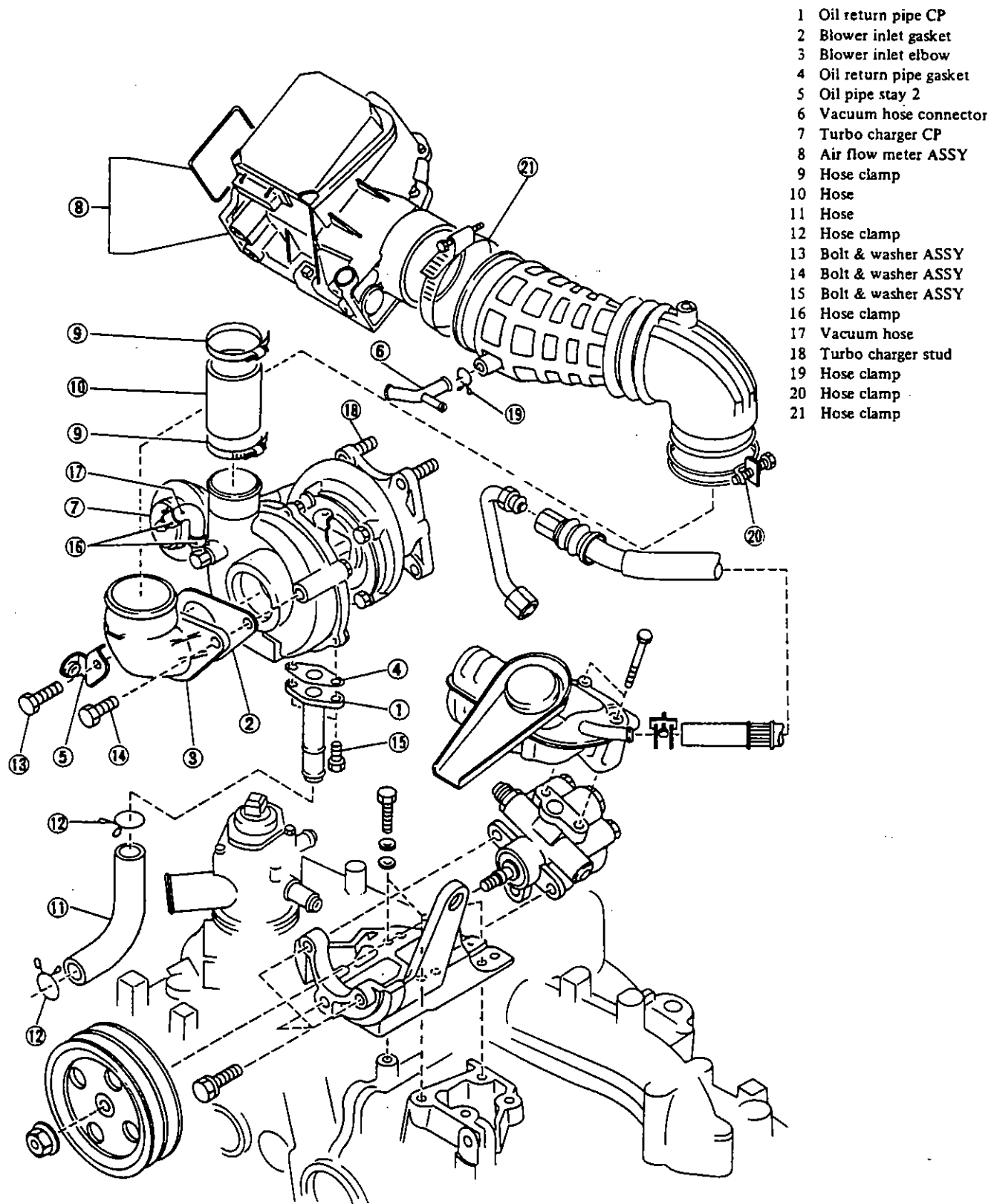


Fig. 3-30

3-3. On-car Services

Also after reassembling and remounting the engine, perform the following checks and adjustments.

NOTE:

- a. Upon completion of the engine adjustments, check the oil and coolant level. Add up the oil and coolant if necessary.
- b. Check to see if there is any leakage of the engine oil or coolant.
- c. Check the wiring cords, pipes, hoses, etc. for undesirable interference.
- d. If one or both of the cylinder heads are removed in engine disassembly, never fail to perform the retightening of the cylinder head nuts & bolts and intake manifold bolts and the adjustment of the valve clearances after the engine has been run for about 10 minutes and cooled down to ambient temperature.

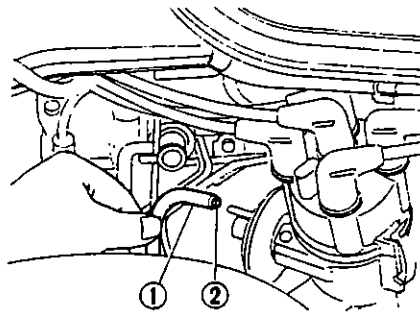
1. Ignition Timing

Perform inspection and/or adjustment of ignition timing according to the following procedures.

Ignition timing (BTDC)			
Without vacuum advance function, and with gear in neutral position (MT) or N or P position (AT), and lights off.			
Non-TURBO	1600	4-speed	$8 \pm 2^\circ/650$ rpm
		5-speed	$8 \pm 2^\circ/700$ rpm
	1800	MT	$8 \pm 2^\circ/700$ rpm
		AT	$8 \pm 2^\circ/800$ rpm
TURBO	1800	AT	$15 \pm 2^\circ/800$ rpm

1) Checking Ignition Timing

Before adjusting ignition timing, disconnect the pressure hose of advancer from the distributor to stop the vacuum advance function of the distributor, and, while checking ignition timing, plug the end of the pressure hose with small rod.

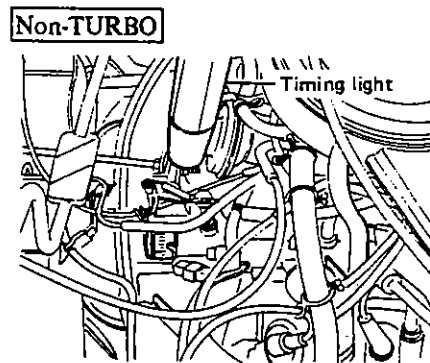


1 Vacuum hose
2 Rod
A5-507
Fig. 3-31 Plugging vacuum hose

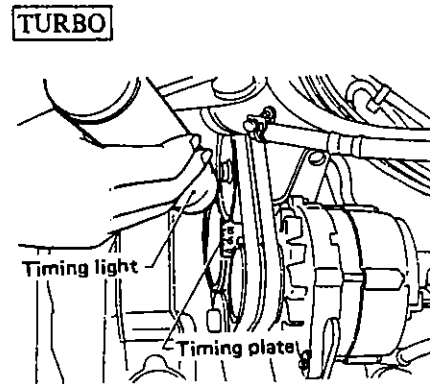
For TURBO vehicles, disconnect the black connector (2-pole connector) between distributor and knock control unit.

To check the ignition timing, connect a timing light to #1 cylinder spark plug cord, adjust the engine idle speed to the specification and illuminate the timing mark with the timing light.

If the timing is not correct, proceed to the next paragraph for adjustment.



Non-TURBO
Timing light
A5-377

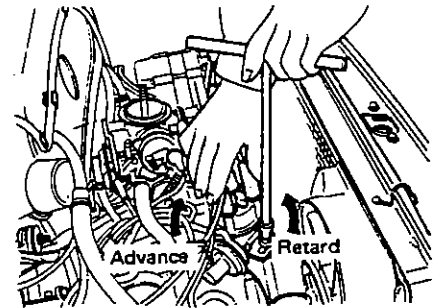


TURBO
Timing light
Timing plate
A5-743

Fig. 3-32 Checking ignition timing

2) Adjusting Ignition Timing

- 1) Loosen the 6 mm bolt on the mounting plate of the distributor.
- 2) Turn the distributor housing. The timing is advanced when the distributor housing is turned clockwise and is retarded when turned counterclockwise.
- 3) Tighten the bolt and make sure that the timing is correct.



A5-379
Fig. 3-33 Adjusting ignition timing

2. Engine Compression

- 1) After warming up the engine, turn off the ignition-starter switch.
- 2) Make sure that the battery is fully charged.
- 3) Remove all the spark plugs.
- 4) Fully open the throttle valve.
- 5) Check the starter motor for satisfactory performance and operation.
- 6) Crank the engine by means of the starter motor, and read the maximum value on the gauge when the pointer is steady.

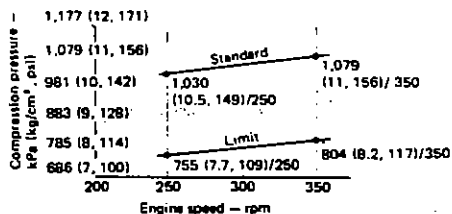
NOTE:

Hold the compression gauge tight against the spark plug hole.

- 7) Perform at least two measurements per cylinder, and make sure that the values are correct.

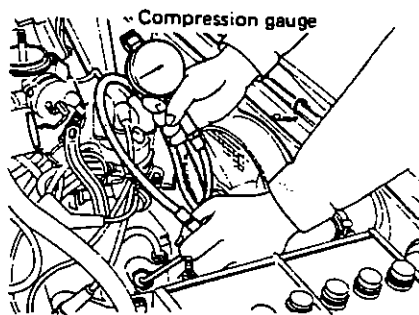
Non-TURBO			
Compression pressure - kPa (kg/cm ² , psi)	1,177 (12, 171)	Standard	1,079 (11, 156)
	1,079 (11, 156)		350
	981 (10, 142)	Limit	834 (9, 128)/250
	883 (9, 128)		883 (9, 128)/350
	785 (8, 114)		
	686 (7, 100)		
	200	250	300
	Engine speed - rpm		

TURBO



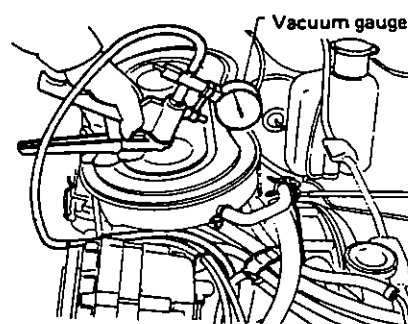
A5-744

Fig. 3-34 Compression pressure



A5-381

Fig. 3-35 Measuring compression



A5-382

Fig. 3-36 Measuring vacuum

Difference between cylinders	196 kPa (2.0 kg/cm ² , 28 psi) or less
------------------------------	---

3. Intake Manifold Vacuum

- 1) Warm up the engine.
- 2) Disconnect the vacuum hose and install the vacuum gauge to the hose fitting on the manifold.

- 3) Keep the engine at the idle speed and read the vacuum gauge indication. By observing the gauge needle movement, the internal condition of the engine can be diagnosed as described in Table below.

Diagnosis of engine condition by measurement of manifold vacuum	
Vacuum gauge indication	Possible engine condition
1. Needle is steady but lower than normal position. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket or carburetor gasket.
2. When engine speed is reduced slowly from higher speed, needle stops temporarily when it is lowering or becomes steady above normal position.	Back pressure too high, or exhaust muffler clogged.
3. Needle intermittently drops to position lower than normal position.	Leakage around cylinder.
4. Needle is steady but slightly lower than normal position.	Retarded ignition timing or insufficient valve clearances.
5. Needle is steady but slightly higher than normal position.	Advanced ignition timing.
6. Needle drops slightly and intermittently from normal position.	Leaking valves or irregular valve clearances.
7. Needle drops suddenly and intermittently from normal position.	Sticky valves.
8. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs.
9. Needle vibrates above and below normal position in narrow range.	Defective ignition system or incorrect carburetor idle adjustment.

4. Hot Air Control System

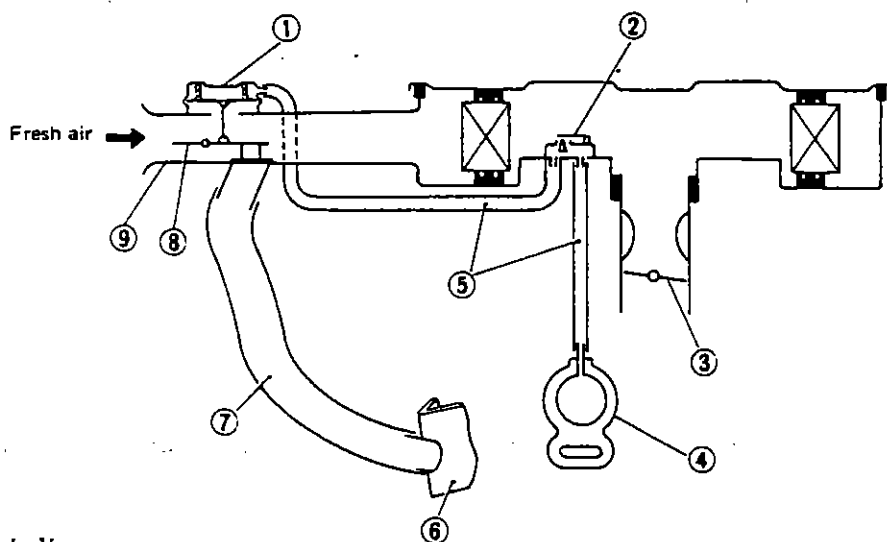
Inspect the hot air control system periodically as follows:

In warm weather, it is difficult to find out malfunction of the hot air control system. In cold weather, however, malfunction of the air control valve due to disconnection or deterioration of the vacuum hose between the intake manifold and vacuum motor and insufficient durability of the air

control valve will cause insufficient automatic control operation for intake air, and result in engine disorders:

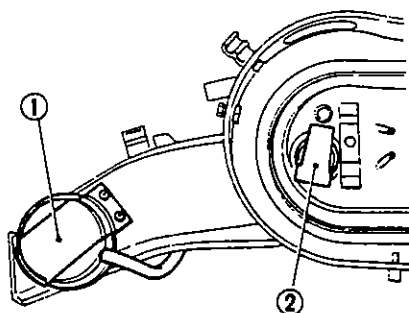
- 1) Stall or hesitation of engine operation,
- 2) Increase in fuel consumption, and
- 3) Lack of power.

These phenomena reveal malfunction of hot air control system. If these phenomena should occur, check the hot air control system for the following items before carrying out inspection of the carburetor.



- 1 Vacuum motor
- 2 Temperature sensor
- 3 Throttle valve
- 4 Intake manifold
- 5 Vacuum hose
- 6 Air stove
- 7 Air intake hose
- 8 Air control valve
- 9 Air horn (Snorkel tube)

A5-383



- 1 Vacuum motor
- 2 Temperature sensor

A5-508

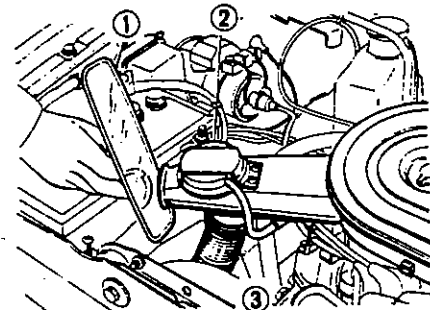
Fig. 3-37 Hot air control system

1) Vacuum Hoses

Check each hose for cracks and proper connections.

2) Vacuum Motor

1) With the engine stopped, place a mirror at the end of the air cleaner inlet pipe as shown in the figure, and check to see if the air control valve is in correct position.



- 1 Mirror
- 2 Vacuum motor
- 3 Air intake hose

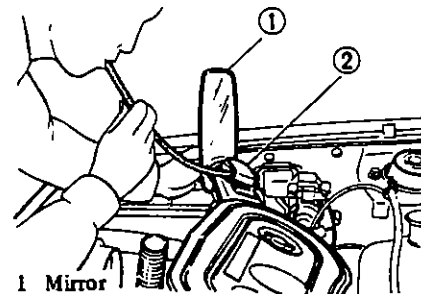
A5-385

Fig. 3-38 Inspecting valve position

The air control valve is in correct position if its under hood air inlet is open and hot air inlet is closed. Check the condition of the air control valve linkage.

2) Disconnect the vacuum motor inlet vacuum hose, and connect another hose to the inlet to apply vacuum to the vacuum motor. Vacuum can be applied by sucking at the hose end as shown in the figure.

Place a mirror at the end of the air cleaner inlet pipe, and check to see if the air control valve is in correct position.



- 1 Mirror
- 2 Vacuum motor

A5-386

Fig. 3-39 Inspecting valve position

Correct position of the air control valve is the reverse of that described in 1) above. The air control valve is in correct position if the under hood air inlet is closed, and the hot air inlet is open.

ENGINE

3) With the hot air inlet in open position, as described in 2), pinch the vacuum hose with fingers so that the air does not enter the vacuum motor. In this condition, check that the air control valve maintains the condition described in 2) for more than 30 seconds, and that the hot air inlet is open. If the diaphragm spring actuates the air control valve by its spring force to open the under hood air inlet within 30 seconds, replace the vacuum motor as an assembly since this may have resulted from air leak at the vacuum motor diaphragm.

3) Temperature Sensor

Check temperature sensor for proper function by proceeding as follows. Be sure to keep the engine cold before starting this test.

1) With the engine stopped, check the position of the air control valve. In this case, underhood air inlet should be open. Use a mirror for inspection as 2) - 1).

2) Start the engine and keep it idling. Immediately after engine starting, check the air control valve for correct position as described above. In this case, the correct position of the air control valve is the reverse of 2)-1); the under hood air inlet is closed, and the hot air inlet is open.

3) Check that the air control valve gradually moves to open the under hood air inlet as the engine warms up. When the environmental temperature around the temperature sensor is low, spend more time for engine warming up operation to facilitate smooth operation of the air control valve.

4) Rubber Plate

Check the rubber plate for stickiness.

5) Air Intake Hose

Check the air intake hose for damage and its connections for leaks.

Operation of air control valve and sensor valve

Under hood air temperature	Vacuum on vacuum motor diaphragm	Air control valve operation	Sensor valve operation
Below 38°C (100°F)	Below 5.3 kPa (40 mmHg, 1.57 inHg)	Cool air admission	Close
	Above 16.0 kPa (120 mmHg, 4.72 inHg)	Hot air admission	
38 - 53°C (100 - 127°F)	—————	Cool and hot air mixture admission	Open
Above 53°C (127°F)	—————	Cool air admission	Open

5. Engine Idle Speed and Idle Mixture

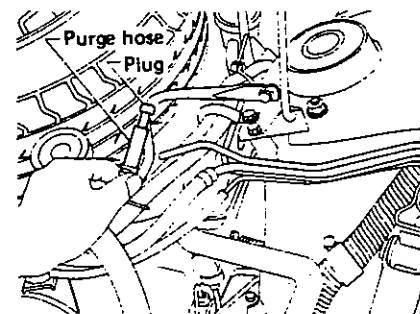
1. ENGINE IDLE SPEED

NOTE:

- a. Make sure that the ignition timing and valve clearances are correctly adjusted prior to this inspection.
- b. Set the gear position at "Neutral" for MT, or "P" or "N" for AT.
- c. Before inspecting the engine idle speed, ensure that:
 - (1) Vacuum hoses, blow-by hoses, rocker cover, oil filler cap, etc. which are connected to the

intake system, are tight and secure.

- (2) The engine has warmed up sufficiently and O₂ sensor has also been warmed up at an engine speed of 2,500 rpm for approximately one minute after engine warm-up.
- (3) Clog the purge hose to the intake manifold after disconnecting it.



A3-254

Fig. 3-40

ENGINE

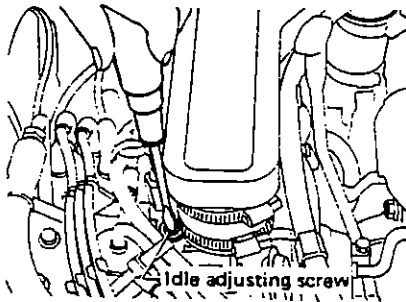
Non-TURBO vehicle

Engine idle speed (rpm)		
1600	4-speed	650 ± 100
	5-speed	700 ± 100
1800	MT	
	AT	800 ± 100

TURBO vehicle

- 1) Before inspection, ensure that the auxiliary air valve is completely closed.
- 2) Adjust the idle speed by using the idle adjusting screw located on the throttle body.

Idle speed (rpm)	800 ± 100
CO contents (%)	0.1, max.
HC contents (ppm)	200, max.



A3-282

Fig. 3-41

- 3) Inspecting the exhaust gas.
 - a. After adjusting both ignition timing and idling speed, check both the idle CO and HC contents in the exhaust gas.

NOTE:

The CO content adjusting screw of the air flow meter need not be adjusted as the air-fuel ratio is feedback controlled.

- b. If the CO and HC contents are outside specifications, check and correct the problem using the following chart as a guide.

● Troubleshooting

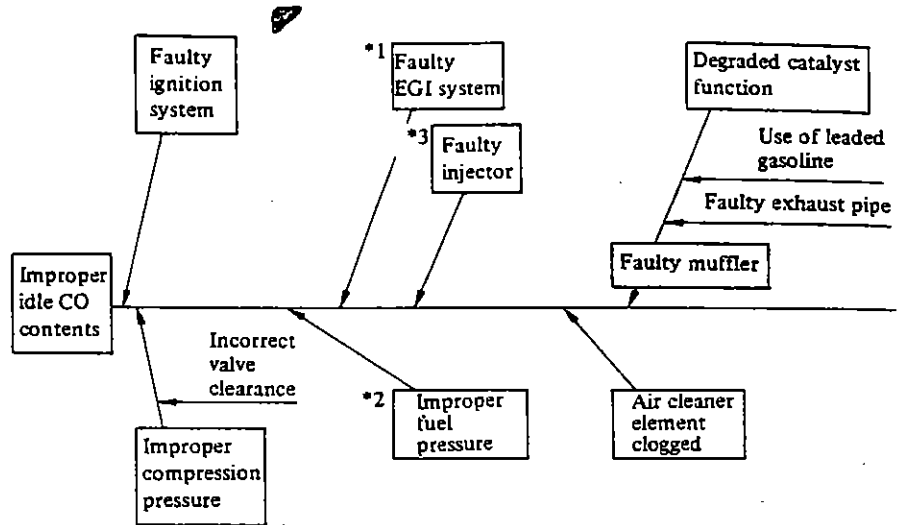


Fig. 3-42

A3-289

*1: Check the EGI system.

Connect a jumper wire and check to see if the ECS lamp flickers with the engine at idle. If it does, the EGI system is functioning properly.

*2: Check the fuel pressure.

*3: Check fuel injectors.

- a. Remove the fuel injector and direct air at a pressure of approximately 196 kPa (2 kg/cm², 28 psi) to see if air leaks at the nozzle tip. If air leaks, replace the injector.
- b. The injector is faulty.

2. ENGINE IDLE MIXTURE

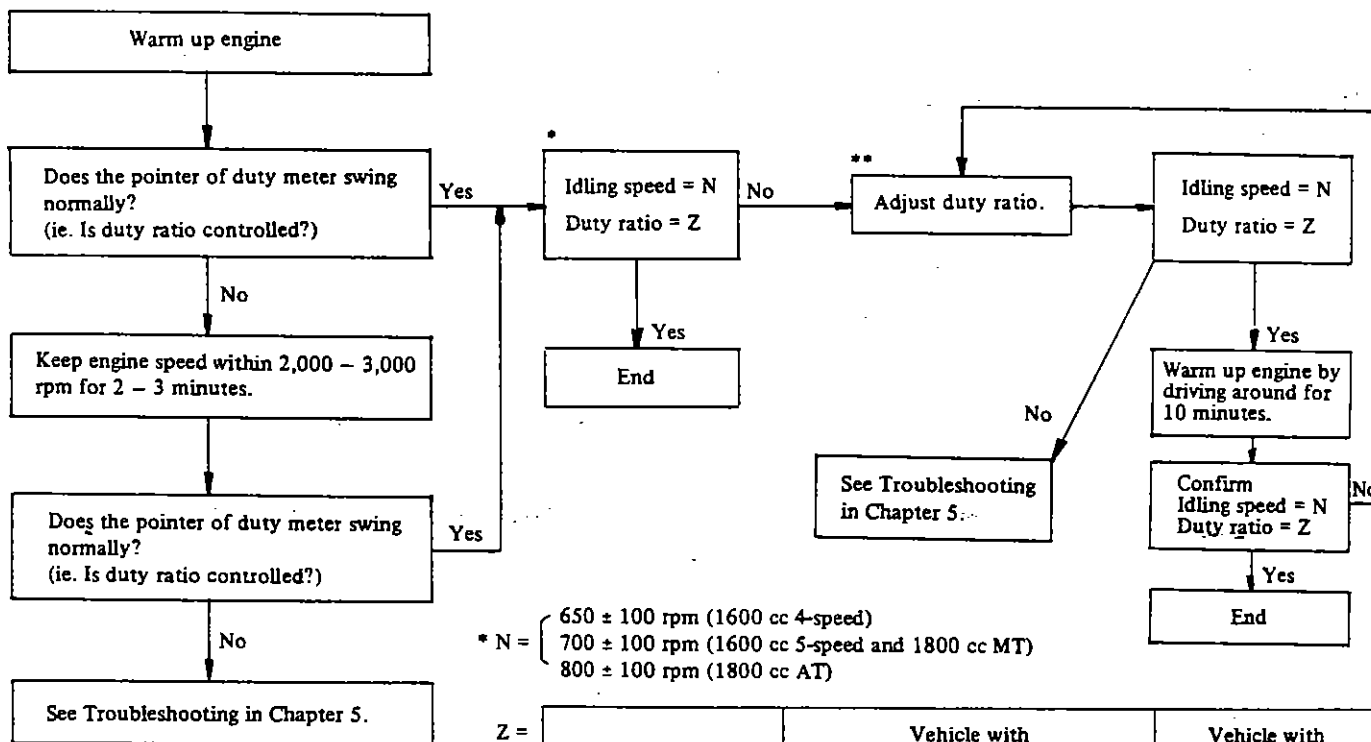
Non-TURBO

NOTE:

Perform the idle mixture adjustment only when dismantling carburetor from engine or disassembling carburetor. And after completion of adjustment, be sure to press spring pin into the hole in throttle chamber.

1) For 49-state Non-4WD and California

Perform the engine idle mixture adjustment according to the following diagram.



* N = { 650 ± 100 rpm (1600 cc 4-speed)
700 ± 100 rpm (1600 cc 5-speed and 1800 cc MT)
800 ± 100 rpm (1800 cc AT)

Z =

	Vehicle with HITACHI carburetor	Vehicle with C-W carburetor
Standard value	Duty ratio = Z <p>(Z is determined according to the altitude.)</p>	Z = 35% (31.5 deg) (Z is constant regardless of the altitude.)
Allowance	At adjusting	±5% (±4.5 deg)
	At checking	±20% (±18 deg)

NOTE:

- a. Perform the above adjustment on both main and slow duty solenoid valve by using check terminal.
- b. Adjustment method by using dwell meter is as follows.
 - (1) Set the range switch to 'four cycle - four cylinder'.
 - (2) Adjust the idle adjusting screw so that the needle points out according to the following calculation.

$$\text{Dwell (deg)} = \frac{90}{100} \times \text{Duty (\%)}$$

** Adjust idle adjusting screw so that duty meter indicates 35 ± 10%.

ENGINE

2) For 49-state 4WD and Canada

Adjust engine idle mixture as follows:

- 1) Start engine and warm up sufficiently.
- 2) Inspect idle speed and CO percentage in exhaust gas with secondary air.

		Other than AT	AT & 4WD-AT	1600 2-Door Hatch-back STD
Idle speed (rpm)		700 ±100	800 ±100	650 ±100
CO percentage (%)	Without secondary air	2.0 ±1.0	1.5 ±1.0	2.0 ±1.0
	With secondary air	0 - 0.4		

- 3) Disconnect air suction hose between air suction valve and secondary air cleaner.
- 4) Clog air suction pipe with rubber cap or the like.
- 5) Inspect idle speed and CO percentage in exhaust gas without secondary air.
- 6) If necessary, adjust idle speed and CO percentage in exhaust gas while clogging air suction pipe.
 - a. Adjust both throttle adjusting screw and idle mixture adjusting screw to obtain the specified idle speed and CO percentage without secondary air.
 - b. Remove the plug clogging air suction pipe, and connect the pipe to secondary air cleaner hose.
 - c. With secondary air, recheck that idle speed and CO percentage satisfy the specifications.

TURBO

This adjustment is not recommendable.

6. Radiator

Check radiator, hoses and their connections for damage, clogging or leakage.

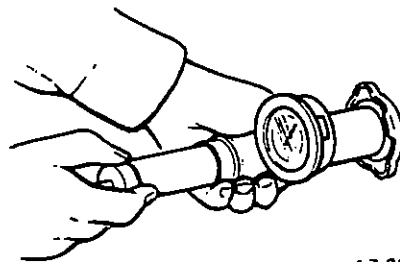
A. Testing of radiator cap

Check the valve, spring and packing in the cap for damage.

Check rubber seal on cap for tears, cracks or deterioration after cleaning it.

Install the cap on a tester and if cap does not hold or does not release the specified pressure, replace cap.

Standard pressure at which valve starts to open	88 kPa (0.9 kg/cm ² , 13 psi)
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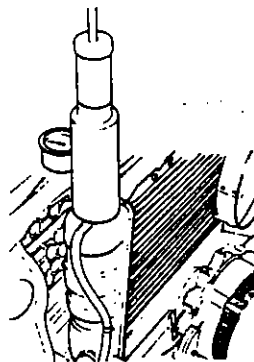
A7-025

Fig. 3-43 Testing the cap

B. Testing of radiator leakage

Inspect radiator for leakage using a cap tester and applying a pressure of 157 kPa (1.6 kg/cm², 23 psi).

If a leakage is detected, repair or replace the radiator.



A7-026

Fig. 3-44 Testing the radiator

7. Hydraulic Valve Lifter

1) Replacement

The hydraulic valve lifter can be replaced even when the engine is mounted on the vehicle as follows:

1) Disconnect both the blow-by and PCV hoses.

2) Remove the valve rocker cover.

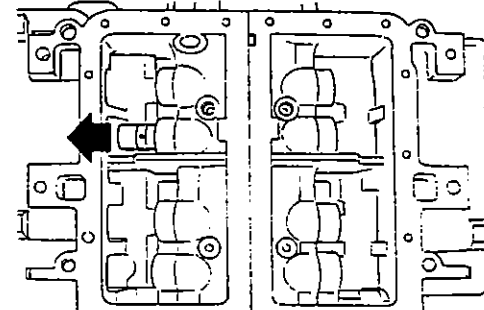
3) Using the special tool (Socket Wrench: 899988607), loosen the valve rocker ASSY and remove the push rod.

4) Raise the vehicle body with a jack and support it on a safety stand.

5) Remove the nuts which secure the front engine mounting and slightly raise the engine using a floor crane.

6) Remove the drain plug to drain the engine oil completely. Detach the oil pan.

7) Remove the hydraulic valve lifter. Use of a magnet facilitates removal.



A5-678

Fig. 3-45

8) The valve lifter can be installed in the reverse order.

2) Adjustment

1) Perform adjustment in cold condition [coolant temperature: 20 to 40°C (68 to 104°F)].

2) Retighten cylinder head nuts and bolts previously if necessary.

3) Adjust hydraulic valve lifter with the following procedures:

a. Perform adjustment in two (2) sequences.

Sequence (I) _____

Position #1 cylinder at TDC (compression), and adjust the valve lifters for intake and exhaust valves on #1 cylinder, for exhaust valve on #3 cylinder and for intake valve on #4 cylinder.

Sequence (II)

Position #2 cylinder at TDC (compression), and adjust all the others, i.e. for intake and exhaust valves on #2 cylinder, for intake valve on #3 cylinder and for exhaust valve on #4 cylinder.

- b. Raise up the bend of lock washer, loosen the lock nut, and then turn the valve rocker screw clockwise by approx. four (4) turns using Valve Clearance Adjuster 498767000.

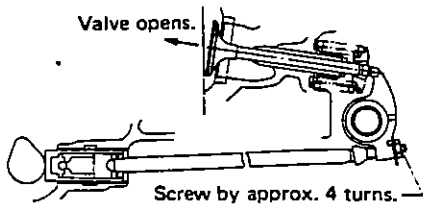


Fig. 3-46

A5-700

- c. Leave it with the valves opened for approx. 15 minutes.

Leave for approx. 15 minutes then pressure chamber volume becomes minimum.

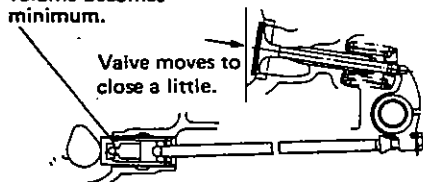


Fig. 3-47

A5-701

- d. Unscrew the valve rocker screw gradually. Then, the rocker arm stops moving due to the closing of valve. This condition is called "Zero Point".

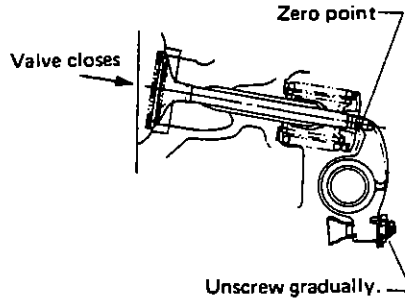


Fig. 3-48

A5-702

- e. Moreover, unscrew the valve rocker screw counterclockwise by 1.5 turns.

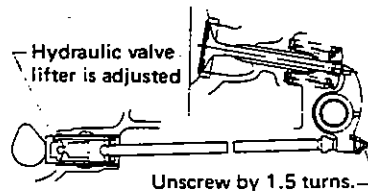


Fig. 3-49

A5-703

- f. Tighten the lock nut, and bend the lock washer.

8. Exhaust System

- 1) After installing the exhaust system, check all clearances to ensure that they exceed the specified values.
- 2) If a clearance is small at any particular point, loosen all connections, then readjust clearances by utilizing free play existing at each bolt location until correct clearances are obtained. Finally, tighten all connections to the specified value.

NOTE:

If muffler or exhaust pipe clearance is excessively small due to a deformed or broken exhaust cover, repair or replace the cover, and adjust the clearance correctly.

Non-TURBO

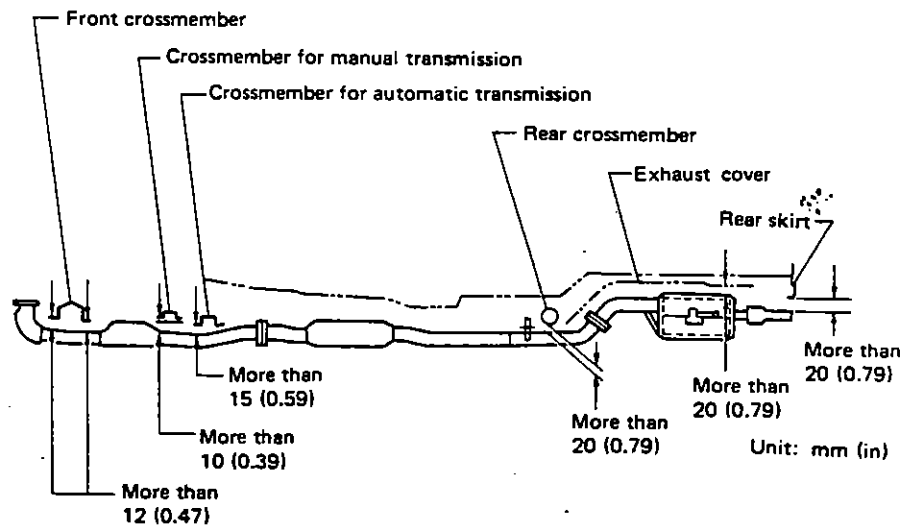
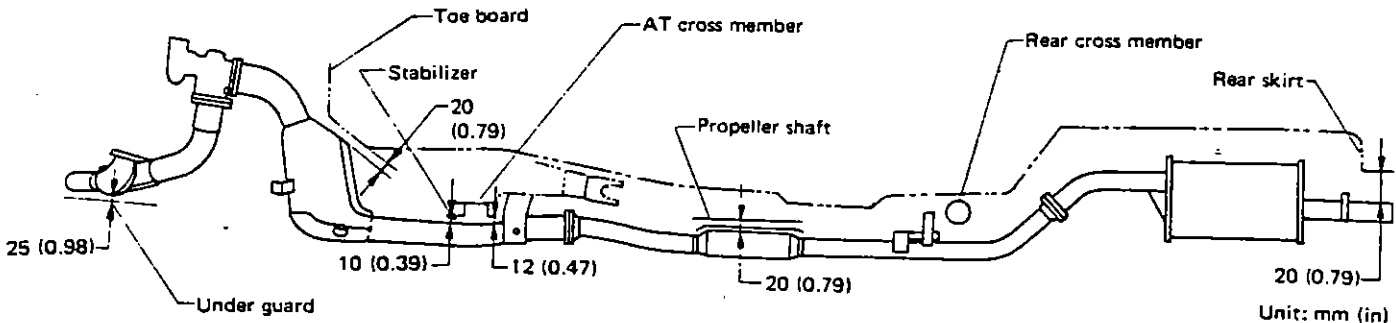


Fig. 3-50

A22-065

TURBO



A5-745

Fig. 3-51

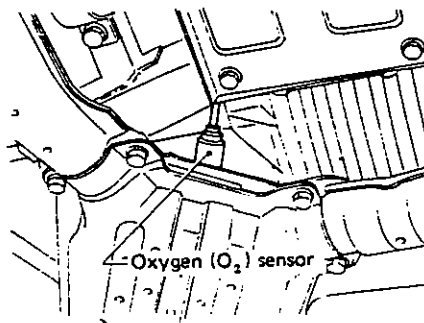
NOTE:

Observe the following precautions when removing and installing the front, center, and rear exhaust pipes.

- a. After a gasket is removed it must never be reused. Always use Subaru genuine parts for replacement. (When the center exhaust pipe is replaced, the gasket in the joint between the center and rear exhaust pipes should also be replaced. During ordinary servicing, this gasket should not be separated from the center exhaust pipe.)
- b. The bolts and nuts should be the specified genuine parts. Self-locking nuts cannot be reused.
- c. To loosen the bolts and nuts holding the turbocharger, first apply a lubricant such as CRC to them while the engine is cold.
- d. When installing the front exhaust pipe, ensure that the pipe is free of foreign matter and then join it to the turbocharger. (If foreign matter enters the turbocharger, it can cause damage to the impeller.)

9. Oxygen (O₂) Sensor

Oxygen (O₂) sensor is one of the important emission control parts. Therefore, replace it as follows only when it is damaged by external force, or if it seems to be out of order according to troubleshooting etc.

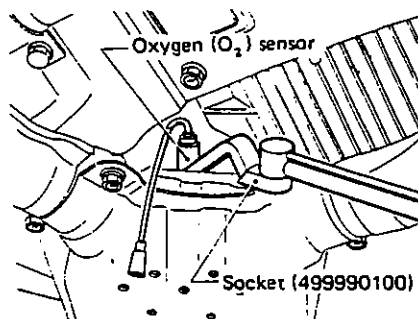


A5-679

Fig. 3-52

1) Removal

- 1) Disconnect O₂ sensor cord.
- 2) Apply SUBARU GUARD (000902821) or its equivalent to threaded portion of oxygen (O₂) sensor, and leave it for one minute or more.
- 3) Loosen oxygen (O₂) sensor by turning it 10 to 40 degrees with special tool (Socket: 499990100 for Non-TURBO or 926040000 for TURBO) and wrench.



A5-680

Fig. 3-53

- 4) Apply SUBARU GUARD (000902821) to threaded portion of oxygen (O₂) sensor again, and leave it for one minute or more.
- 5) Remove oxygen (O₂) sensor by using socket and wrench.

NOTE:

When removing, do not force oxygen (O₂) sensor especially when exhaust pipe is cold; otherwise it will damage the exhaust pipe.

2) Installation

- 1) Apply anti-seize compound ("SS-30" made by JET-LUBE Inc. in U.S.A. or its equivalent) only to threaded portion of oxygen (O₂) sensor to make the next removal easier.

NOTE:

Never apply anti-seize compound to protector of oxygen (O₂) sensor.

- 2) By using socket and torque wrench, install oxygen (O₂) sensor onto front exhaust pipe by tightening it to the specified torque.

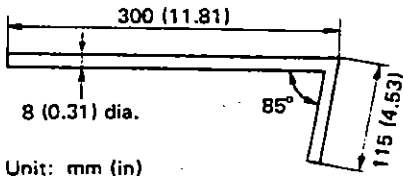
Torque [oxygen (O ₂) sensor]	25 - 34 N·m (2.5 - 3.5 kg·m, 18 - 25 ft·lb)
--	---

- 3) Securely connect oxygen (O₂) sensor cord.

10. Removal and Installation of Crank Pulley

1) Removal

- 1) Loosen the two bolts which secure the alternator ASSY and remove the V-belt.
- 2) Place the tool shown in the figure in the hole of the crank pulley to hold it stationary, loosen the bolt, and remove the crank pulley. (The above tool can be prepared by modifying a large screwdriver.)

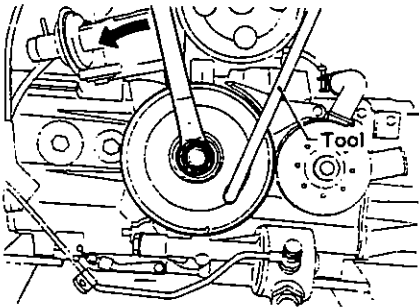


Unit: mm (in)

Fig. 3-54-1

A5-746

• When loosening



A5-747

Fig. 3-54-2

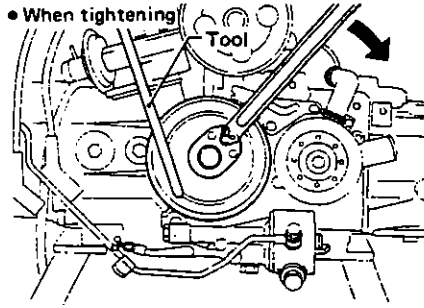


Fig. 3-55

A5-748

2) Installation

- 1) Insert the tool in the hole of the crank pulley to stop it from turning, and tighten the bolt.

Tightening torque	64 – 74 N·m (6.5 - 7.5 kg·m, 47 - 54 ft·lb)
-------------------	---

NOTE:

Apply Three Bond #1215 or the like to the bolt seat.

- 2) Install the V-belt.

Tension of V-belt	Without air conditioner 7 – 9 mm (0.28 – 0.35 in) /98 N (10 kg, 22 lb)
	With air conditioner 6 – 8 mm (0.24 – 0.31 in) /98 N (10 kg, 22 lb)

11. Turbocharger System Inspection

1) Inspecting the Turbocharger System Piping for Damage and Installation

Check the waste gate valve control rubber hose for disconnection, slackness, cracks and damage.

2) Inspecting the Function of the Supercharging Pressure Controller

- 1) Disconnect the waste gate valve control rubber hose at the actuator side and connect the inspection hose. Seal the disconnected hose with a blind plug.

- 2) Using an air gun, apply a pressure of 49 to 59 kPa (0.5 to 0.6 kg/cm², 7 to 9 psi) to the inspection hose to see if the waste gate link operates.

NOTE:

The waste gate control diaphragm may break if excessive pressure is applied. Before applying the air pressure, check that it is between 49 to 59 kPa (0.5 to 0.6 kg/cm², 7 to 9 psi) with a pressure gauge.

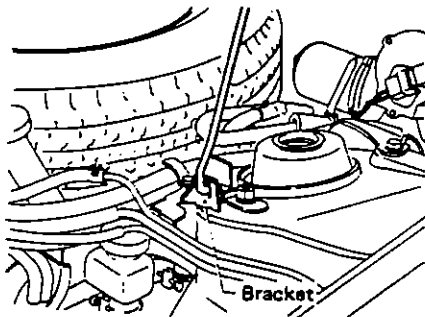
3-4. Dismounting and Remounting

1. Precautions

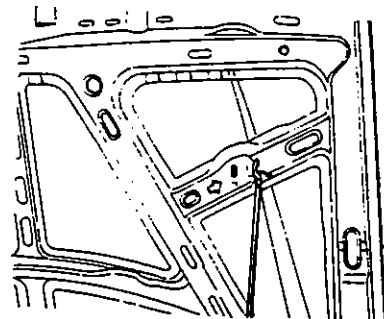
- 1) Perform the job at a place where a chain hoist or a floor crane is available. If possible, it is desirable to perform the job over a pit together with a chain hoist or a floor crane.
- 2) Be careful not to soil the vehicle interior (particularly windows and seats).
- 3) Be careful not to allow brake fluid and coolant to come in contact with the painted surfaces of the vehicle body. It is desirable to cover the fenders with covers during the work, if possible.

2. Dismounting

- 1) Open engine hood and set its stay in the correct position.



A1-063



A4-161

Fig. 3-56 Opening engine hood

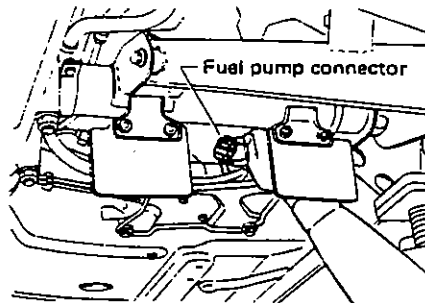
- 2) Detach spare tire.

NOTE:

Be careful not to damage adjacent parts.

- 3) Decrease the fuel pressure (TURBO).

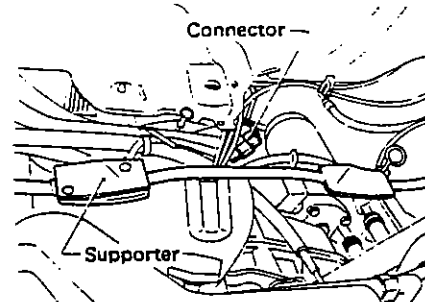
- a. Disconnect the fuel pump connector and stop its operation.
- b. Crank the engine for at least 5 seconds.
- c. If the engine starts, leave it unattended until it stalls.
- d. Connect the fuel pump connector.



A5-749

Fig. 3-57

- 4) Remove the battery \ominus terminal and ground cable.
- 5) Disconnect the air temperature sensor connector in the engine room (TURBO), and remove the spare tire supporter, or raise supporter upward (TURBO).



A5-750

Fig. 3-58

- 6) Disconnect hoses and electric wiring from air cleaner. Remove bolts and nuts, and take out air cleaner (Non-TURBO).

NOTE:

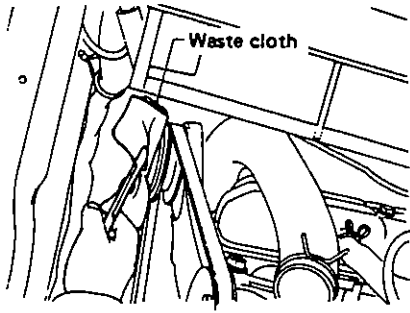
Plug the carburetor opening to prevent dirt or dust from entering carburetor.

- 7) Remove the fuel hoses and the evaporation hoses.

NOTE:

Gasoline remaining in delivery hose may flow out. Therefore receive this gasoline with an appropriate container.

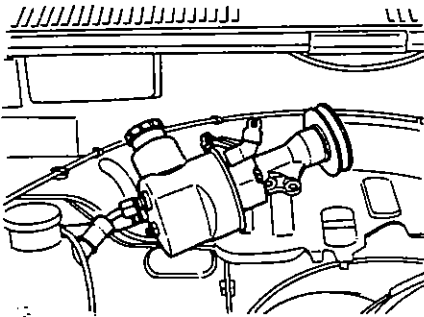
- 8) Remove vacuum hoses.
 - a. Cruise control
 - b. Master-Vac
 - c. Air intake shutter
 - d. Vacuum control diaphragm
 - e. Carburetor vent hose (Non-TURBO)
 - f. Purge hose (Non-TURBO)
- 9) Remove the harness, etc. (TURBO)
 - a. High-tension cord
 - b. Ignition cord connector
 - c. Alternator harness connector
 - d. Engine ground wire
 - e. Connector of concentration wires
 - f. EGI harness connector
 - g. Thermoswitch harness connector and electric fan harness connector
 - h. Condenser harness
 - i. Ignition coil harness cord (both \oplus and \ominus)
- 10) Disconnect electric wiring, hoses, etc. (Non-TURBO)
 - a. Engine wiring harness
 - b. High tension cords
 - c. Alternator wiring
 - d. Starter wirings
 - e. Vacuum switch hose(s)
- 11) Remove link ASSY.
- 12) Disconnect cables, pitching stopper, etc.
 - Accelerator cable
 - Clutch cable
 - PHV cable
 - Pitching stopper
- 13) Remove window washer tank (TURBO), and put it behind the RH strut tower.
- 14) Remove power steering pump (Non-TURBO). Remove oil pump ASSY and bracket as follows:
 - a. Detach idler cap with pliers with waste cloth around it in order not to damage it.



A4-194

Fig. 3-59 Removing cap

- b. Loosen lock bolts and adjust bolt of idler pulley, and then detach oil pump belt.
- c. Remove bolts and nut, and put oil pump ASSY on bulkhead.



A4-196

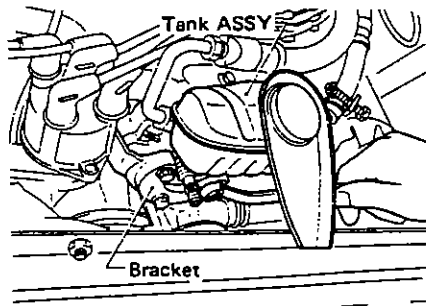
Fig. 3-60 Removing oil pump ASSY

NOTE:

- a. Be careful that the oil does not flow out.
- b. Be careful that the two oil hoses does not damage.
- d. Detach bracket.

15) Remove power steering pump (TURBO).

- a. Loosen the alternator adjustment bolt and lock bolt, then remove the V-belt.
- b. Remove the pump pulley and bolts holding the pump.



A5-752

Fig. 3-61

- c. Remove clamp D.
- d. Remove the stay for the engine oil filler pipe.

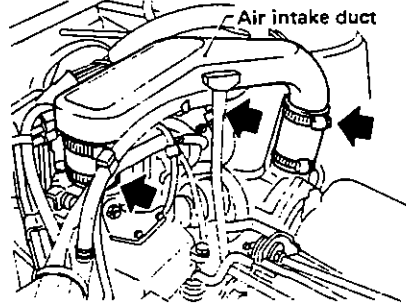
NOTE:

Place the power steering pump on the bulkhead.

16) Remove air duct (TURBO).

NOTE:

Cover the openings where air duct is installed to keep out dirt and dust after removal.



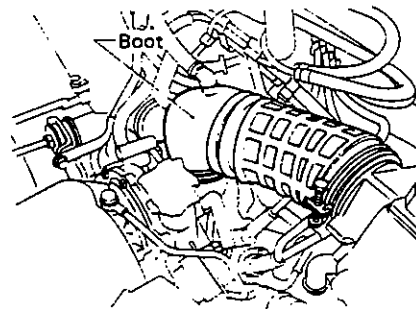
A5-753

Fig. 3-62

17) Remove air flowmeter boot (TURBO).

NOTE:

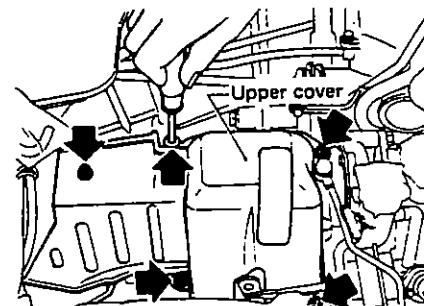
Cover the openings where air flowmeter boot is installed to keep out dirt and dust after removal.



A5-754

Fig. 3-63

18) Remove upper cover (TURBO)



A13-546

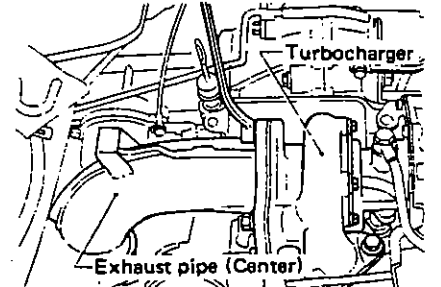
Fig. 3-64

19) Remove center exhaust pipe (TURBO).

NOTE:

See NOTE in 21).

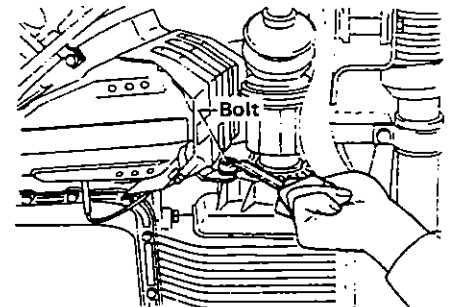
- a. Disconnect the thermo sensor connector.
- b. Separate the pipe from the turbocharger body.
- c. Remove the rear cover.



A13-533

Fig. 3-65

d. Remove the joint bolt with the transmission.



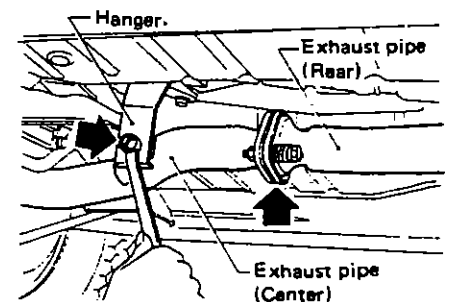
A5-755

Fig. 3-66

- e. Remove the center exhaust pipe from the rear exhaust pipe.
- f. Remove the hanger bolts (center exhaust pipe) and then the center exhaust pipe.

NOTE:

There is limited space around the pipe. Be careful not to damage the pipe during removal.



A13-532

Fig. 3-67

ENGINE

20) Remove the converter cover (TURBO).

The bolts need not be removed, only be loosened.

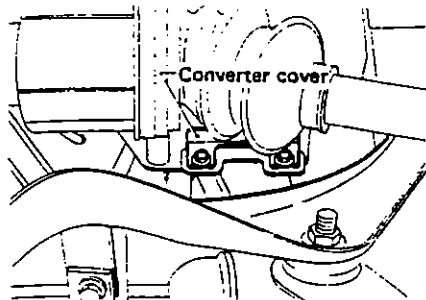


Fig. 3-68

A5-756

21) Remove the turbocharger body (TURBO).

NOTE:

a. Perform the removal of turbo unit after it has cooled off sufficiently.

b. Seizure prevention procedure:

1) Apply **SUBARU GUARD** (000902821) or the equivalent to threaded portion of bolts and nuts, and leave them for one minute or more.

2) Loosen bolts and nuts by turning them 10 to 40 degrees.

3) Apply **SUBARU GUARD** (000902821) or the equivalent to the threaded portion of bolts and nuts again, and leave them for one minute or more.

4) Remove bolts and nuts.

c. When stud bolt is pulled out, flange bolt (901000032) can be used instead.

a. Remove the oil pipe.

b. Remove the turbocharger body, lower cover and gasket. Disconnect the lubricating hose for the turbocharger.

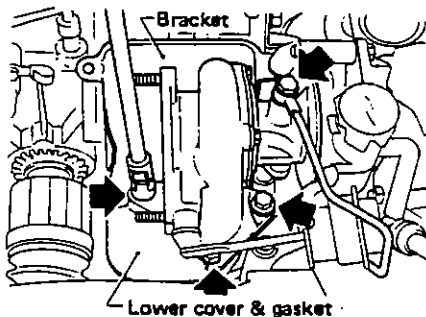


Fig. 3-69

A13-531

22) Disconnect the O₂ sensor connector (TURBO).

23) Remove the bolt connecting the torque converter to the drive plate.

24) Remove the bolts and nuts from the upper joint of the engine with the transmission.

NOTE:

The starter must not be removed.

25) Drain coolant

Install a commercially available vinyl hose [inner diameter of 8 to 9 mm (0.31 to 0.35 in) dia.] on the drain plug, and drain the coolant.

26) Remove the radiator ASSY

a. Disconnect the inlet and outlet radiator hoses from the radiator.

b. Disconnect the inlet and outlet oil cooler hoses from the radiator.

c. Remove the ground wire.

d. Remove the radiator.

NOTE:

Drain the remaining coolant into a container.

27) Disconnect oil cooler hoses (IN and OUT) from pipe ASSY (TURBO). Drain the oil into a container.

28) Disconnect heater hoses (IN and OUT) from the engine side.

NOTE:

Drain the remaining coolant into a container.

29) Separate front exhaust pipe from engine as follows (Non-TURBO):

a. Disconnect oxygen (O₂) sensor cord.

b. Remove nuts securing front exhaust pipe to the exhaust ports of engine.

c. Loosen bolt connecting front exhaust pipe to bracket of body.

30) Remove the front engine mount.

31) Remove the lower nuts joining the engine to the transmission.

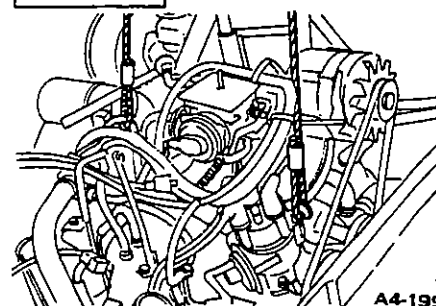
32) Lift up the engine with a wire rope.

NOTE:

a. Make sure that the lifting wire hook is securely attached to the hanger.

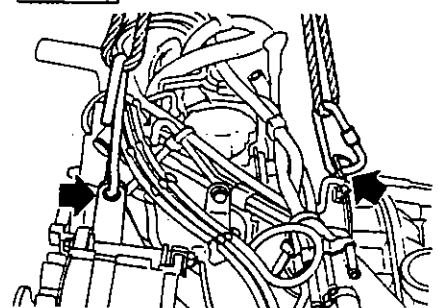
b. Take care so that a lifting wire does not damage the engine parts.

Non-TURBO



A4-199

TURBO



A5-757

Fig. 3-70

33) Remove the engine

a. Raise the engine to some height.

b. Raise the transmission to some height by using a jack.

c. Move the engine horizontally.

d. Pull the engine out of the engine room carefully.

3. Remounting

1) Position the engine in the engine compartment.

NOTE:

a. While engine is lowered, be careful to prevent engine from striking any adjacent parts or car body.

b. Apply grease to splines of mainshaft in advance (MT).

2) Connect the engine with transmission.

3) Install nuts and bolts to secure both units.

a. Temporarily tighten the upper bolts.

b. Remove the wire cable and jack.

c. Tighten the lower nuts securely.

d. Tighten the nuts that secure the engine mount.

Torque

20 - 24 N·m
(2.0 - 2.4 kg·m,
14 - 17 ft·lb)

- e. Tighten the upper bolts securely.
- 4) Connect the torque converter.
- a. Align the torque converter with the holes in the drive plate.
- b. Tighten all bolts – one bolt at a time.

Torque	23 – 26 N·m (2.3 – 2.7 kg·m, 17 – 20 ft·lb)
--------	---

NOTE:

Be careful not to drop any bolts into the torque converter housing.

- 5) Connect the O₂ sensor connector (TURBO).
- 6) Install the turbocharger (TURBO).
 - a. Place the lower cover and gasket onto the front exhaust pipe.
 - b. Attach the turbocharger while inserting its lubricating hose into place.
 - c. Connect the oil pipe.

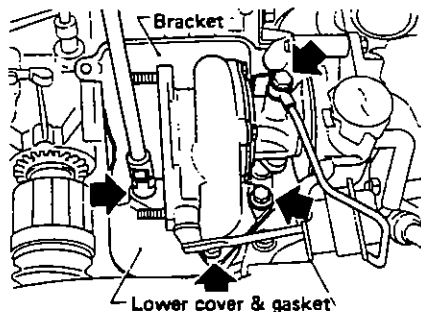


Fig. 3-71

A13-531

- 7) Install the converter cover (TURBO).
- 8) Install the center exhaust pipe (TURBO).
 - a. Put the gasket in between the turbocharger and center exhaust pipe.
 - b. Install the center exhaust pipe and temporarily tighten the hanger bolt (transmission bottom).
 - c. Temporarily tighten the joint of the turbocharger with the pipe.

NOTE:

Do not forget to install the cover bracket.

- d. Temporarily tighten the joint bolt with the transmission.

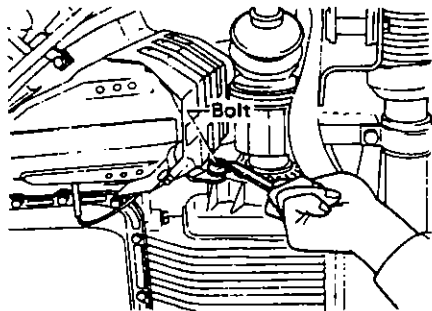


Fig. 3-72

A5-755

- e. Temporarily tighten the joint with the rear exhaust pipe.
- f. Tighten the joint with the turbocharger regularly.

NOTE:

- a. After wiping off oxide scale on the threaded portion of bolts and nuts which attach turbo unit to exhaust pipe, coat them with lubricants.
- b. Replace the gasket with a new one at every disassembly.

Tightening torque	25 – 34 N·m (2.5 – 3.5 kg·m, 18 – 25 ft·lb)
-------------------	---

- g. Tighten the joint bolt with the transmission regularly.

Tightening torque	25 – 34 N·m (2.5 – 3.5 kg·m, 18 – 25 ft·lb)
-------------------	---

- h. Tighten the hanger bolt regularly.

Tightening torque	10 – 18 N·m (1.0 – 1.8 kg·m, 7 – 13 ft·lb)
-------------------	--

- i. Tighten the joint with the rear exhaust pipe regularly.

Tightening torque	22 – 33 N·m (2.2 – 3.4 kg·m, 16 – 25 ft·lb)
-------------------	---

- j. Install the rear cover.
- k. Connect the thermo sensor connector.

Securely tighten engine mount cushion rubbers on the crossmember.

Torque	20 – 33 N·m (2.0 – 3.4 kg·m, 14 – 25 ft·lb)
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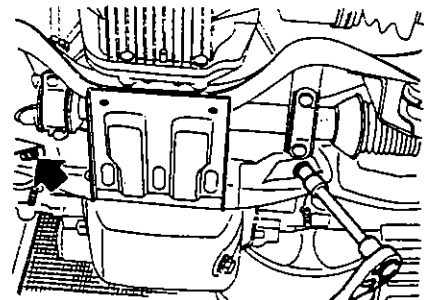


Fig. 3-73 Tightening cushion rubber nuts

A4-095

- 10) Connect front exhaust pipe to engine as follows (Non-TURBO).
 - a. Attach new gaskets to the engine exhaust ports, and temporarily tighten nuts.

NOTE:

Place the flat surface of the gasket to the engine exhaust port.

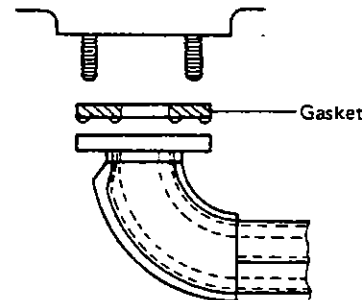


Fig. 3-74 Installing gasket

A22-031

- b. Tighten bolt at bracket of body.

Torque	25 – 34 N·m (2.5 – 3.5 kg·m, 18 – 25 ft·lb)
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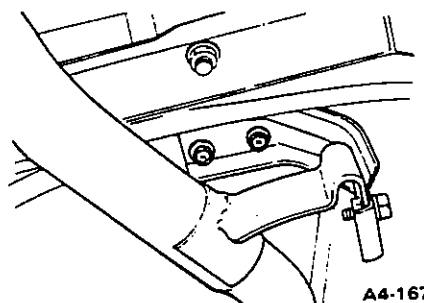


Fig. 3-75 Installing front exhaust pipe

A4-167

ENGINE

- c. Then tighten four nuts to the specified torque.

Torque	25 – 29 N·m (2.6 – 3.0 kg·m, 19 – 22 ft·lb)
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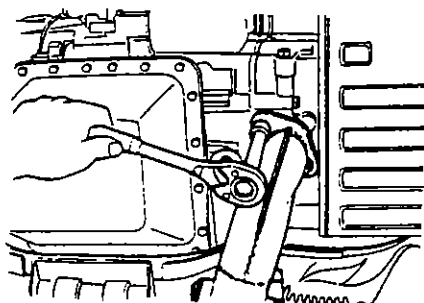


Fig. 3-76

A4-093

- d. Connect O₂ sensor cord.
- 11) Install pitching stopper as follows:
- Insert pitching stopper rod into the bracket on the engine side, and tighten it at the car body side.
 - Tighten the rear nut on pitching stopper on the engine side so that the specified clearance exists between rubber cushion and washer.

Specified clearance	
MT	0.8 – 1.2 mm (0.031 – 0.047 in)
AT	1.8 – 2.2 mm (0.071 – 0.087 in)

- c. Attach a wrench to the rear nut on pitching stopper of the engine side to prevent it from turning, and tighten the front nut securely.

Torque	10 – 18 N·m (1.0 – 1.8 kg·m, 7 – 13 ft·lb)
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NOTE:
Always make a precise adjustment of pitching stopper to prevent engine from vibrating during operation.

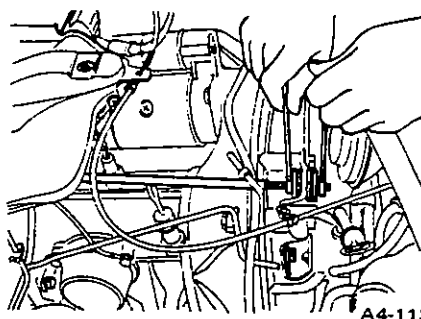


Fig. 3-77 Installing pitching stopper

- 12) Install the turbocharger upper cover (TURBO).

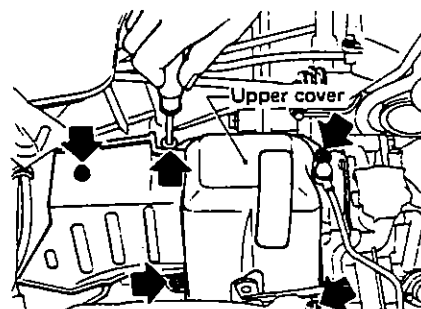
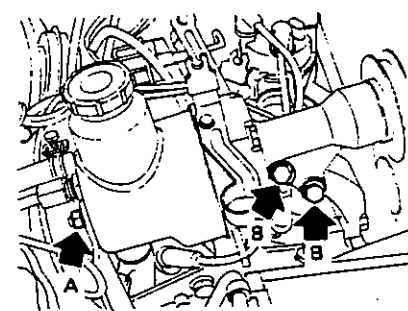


Fig. 3-78

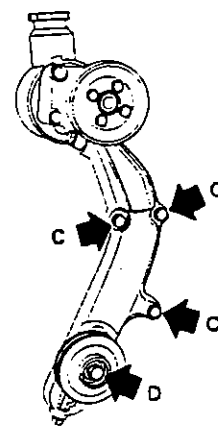
- 13) Install the inlet and outlet heater hoses.
- 14) Install power steering oil pump ASSY and oil pump belt. After adjusting the belt tension, tighten lock bolt and attach idler cap (Non-TURBO).

Belt tension	
15 – 20 mm (0.59 – 0.79 in)/ 98 N (10 kg, 22 lb)	

Torque	
Nut A (one)	44 – 54 N·m (4.5 – 5.5 kg·m, 33 – 40 ft·lb)
Bolt B (two)	44 – 54 N·m (4.5 – 5.5 kg·m, 33 – 40 ft·lb)
Bolt C (three)	25 – 34 N·m (2.5 – 3.5 kg·m, 18 – 25 ft·lb)
Bolt D (one)	20 – 29 N·m (2 – 3 kg·m, 14 – 22 ft·lb)



A3-201



A5-581

Fig. 3-79 Fitting bolts and nuts

- 15) Install the power steering pump (TURBO).
- Install the engine oil filler pipe stay.
 - Tighten the pump mounting bolts and install the pump pulley.

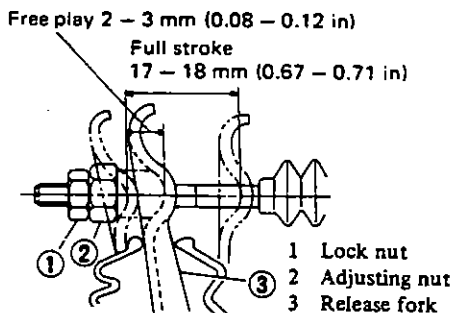
Tightening torque	
Pump mounting bolt:	25 – 34 N·m (2.5 – 3.5 kg·m, 18 – 25 ft·lb)
Pump pulley:	33 – 41 N·m (3.4 – 4.2 kg·m, 25 – 30 ft·lb)

- Install the clamp D.
- Install the V-belt and adjust its tension.

Belt tension		
With air conditioner	7.5 – 8.5 mm (0.295 – 0.335 in)/ 98 N (10 kg, 22 lb)	
Without air conditioner	7 – 9 mm (0.28 – 0.35 in)/ 98 N (10 kg, 22 lb)	

- 16) Attach supporter of spare wheel & tire (Non-TURBO).
- 17) Connect cables as before (Non-TURBO).

- a. Connect clutch cable to release fork with free play.



A20-051

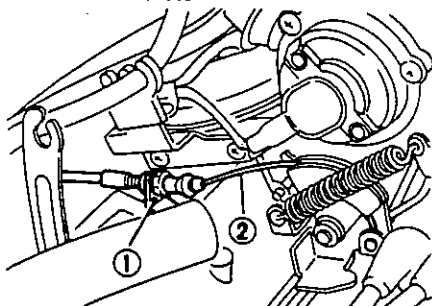
Fig. 3-80 Adjusting clutch release fork

- b. (Vehicle with Hill-holder) Connect P.C.V. cable, and adjust Hill-holder system.
c. Connect accelerator cable, and adjust its tension by adjusting nuts.

NOTE:

After making the accelerator cable adjustment, depress the accelerator pedal to ensure that the throttle valve fully opens.

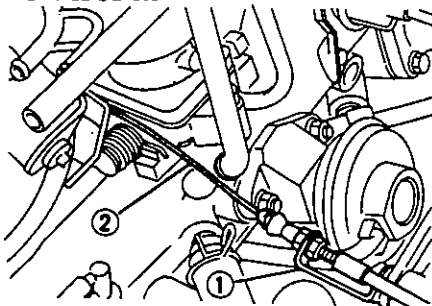
- Hitachi carburetor



- 1 Accelerator cable bracket
2 Accelerator cable

A4-247

- C-W carburetor



- 1 Accelerator cable bracket
2 Accelerator cable

A4-248

Fig. 3-81 Installing accelerator cable.

- 18) Install the accelerator cable (TURBO).

NOTE:

Check to see if the throttle valve can be opened completely by means of the cable.

- 19) Install the link ASSY.
a. Adjusting the accelerator pedal play
• Adjust so that there is a gap of 1 to 3 mm (0.04 to 0.12 in) between the pin and stopper.
• Adjust the accelerator cable end at the throttle body side.

Cable end play	0 - 2 mm (0 - 0.08 in)
----------------	---------------------------

- b. Adjusting the actuator play
• Adjust the cable end play, caused by slackness, so that it is 0 to 2 mm (0 to 0.08 in) on the actuator side.
20) Install the radiator ASSY.
a. Install the radiator.
b. Connect the oil cooler hose.
c. Install the radiator hoses.
d. Make the ground connection.
e. Connect thermostat and fan motor.
f. Connect inlet and outlet hoses to heater unit.
g. Pour coolant into the radiator.

NOTE:

Before installing the radiator, put hoses into it to facilitate the work.

- 21) Install the window washer tank (TURBO).

NOTE:

Install the motor harness securely.

- 22) Install the air flowmeter boot (TURBO).

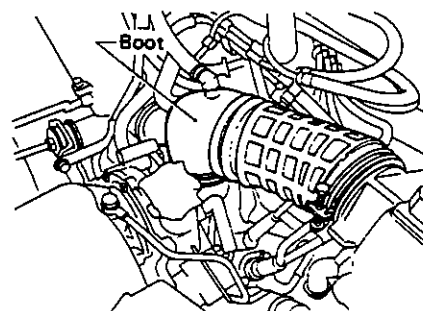


Fig. 3-82

A5-754

- 23) Install the air intake duct (TURBO).

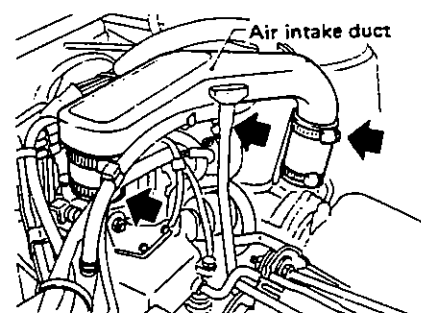
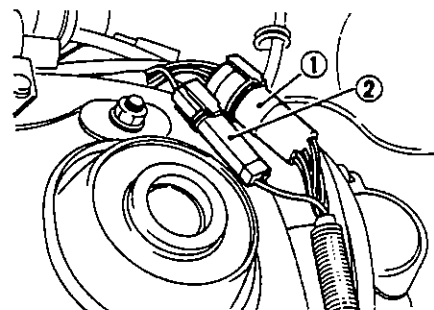


Fig. 3-83

A5-753

- 24) Install the harness, etc. (TURBO).
a. High-tension cord (from the ignition coil to the distributor).
b. Ignition cord connectors.
c. Alternator harness connector and ground wire.
d. Concentration-wire harness connector.
e. EGI harness connector.
f. Thermostat harness connector and electric fan harness connector.
g. Condenser ground.
h. Ignition coil cord harness (+ and - sides).
25) Connect electric wiring as before (Non-TURBO).
a. Two multiple connectors for engine wiring harness



- 1 Harness connector
2 Harness connector for auto-choke, and carburetor selection (C-W)

A4-245

Fig. 3-84

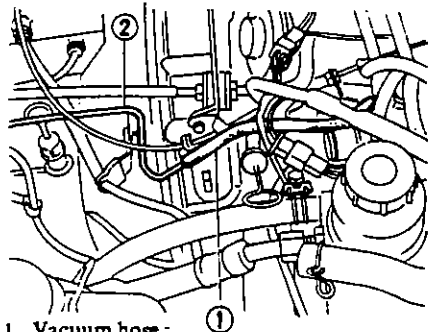
- b. High tension cords
c. Connectors for alternator

NOTE:

(Vehicle with power steering) Securely fit cord supporter onto blow-by hose paint marking and high tension cord.

26) Connect hoses as before (Non-TURBO).

- a. (AT) Vacuum hose to vacuum pipe for kick-down solenoid

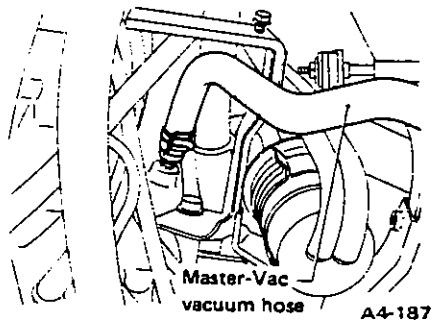


- 1 Vacuum hose
2 Vacuum pipe

A4-188

Fig. 3-85

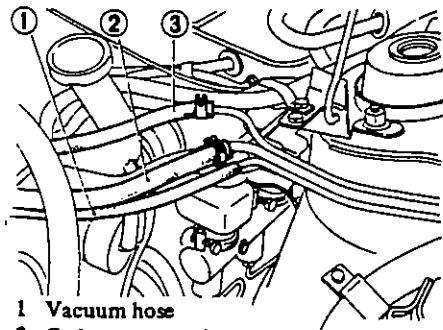
- b. Vacuum hose to intake manifold for brake booster (Master-vac)



Master-Vac vacuum hose
A4-187

Fig. 3-86 Connecting master-vac vacuum hose

- c. Vacuum hose, carburetor vent hose and purge hose to pipe complete

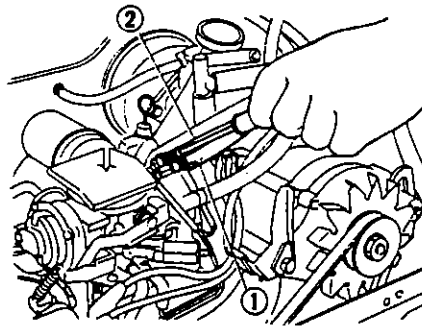


- 1 Vacuum hose
2 Carburetor vent hose
3 Purge hose

A4-186

Fig. 3-87 Connecting hoses

- d. Fuel delivery hose and fuel return hose to carburetor



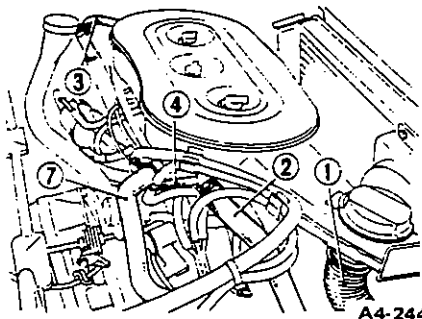
- 1 Fuel delivery hose
2 Fuel return hose

A4-185

Fig. 3-88 Connecting fuel hoses

27) Attach air cleaner onto carburetor and connect the following hoses (Non-TURBO).

- ① Air intake hose
- ② P.C.V. hose
- ③ P.C.V. vacuum hose
- ④ A.T.C. vacuum hose
- ⑤ Vacuum hose to thermo vacuum valve II (Hitachi carburetor) or thermo vacuum valve III (C-W carburetor)
- ⑥ Vacuum hose to thermo vacuum valve I
- ⑦ Hose to A.S.V.



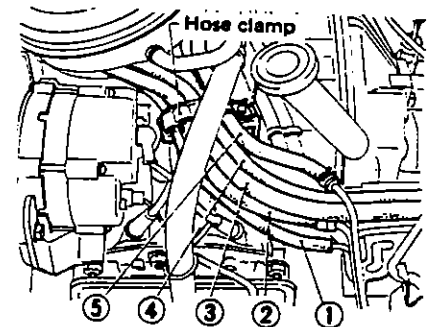
A4-244

Fig. 3-89 Connecting hoses

Then, tighten bolts and wing nuts securely.

28) Put hoses onto stay, and hold them with hose clamp (Non-TURBO).

- ① Vacuum hose
- ② Carburetor vent hose
- ③ Fuel delivery hose
- ④ Fuel return hose
- ⑤ Purge hose



A4-181

Fig. 3-90

29) Connect hoses (TURBO).

- a. Cruise control
- b. Master-Vac
- c. Air intake shutter
- d. Vacuum control diaphragm
- e. Fuel hose
- f. Canister evaporator hose

30) Install the spare tire support and make the air temperature sensor connection in the engine room (TURBO).

31) Connect the battery (-) terminal and ground cable.

32) Mount the spare tire and install the jack (TURBO).

33) Close the front hood.

4. Inspection and Test

1) Check both the engine oil and coolant levels to ensure that they are even with the specified marks. Start the engine and check for the condition of various parts. If necessary, take corrective action.

Check the exhaust pipe connection to make sure that there is no sign of gas leakage.

2) Stop the engine and allow it to rest for some length of time. Check the engine oil and coolant levels again. If the levels are below the specified marks, replenish as necessary.

NOTE:

The radiator is a high pressure type. Never open the radiator cap while the engine is hot. Doing so may burn your hand. Allow the engine to cool off before checking the coolant level.

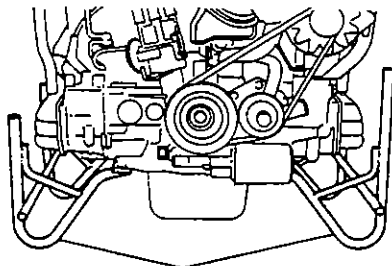
3-5. Removal

1. Non-TURBO Vehicle

1) Install Engine Stands (399814300 x 2) and drain the engine oil and coolant by removing engine oil drain plug and coolant drain plug. After draining, install plugs in place.

NOTE:

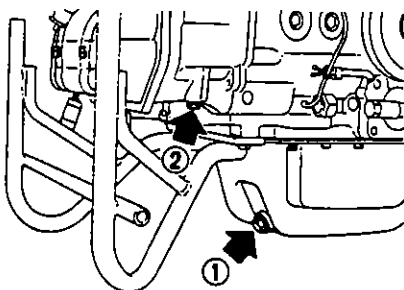
Take care not to allow oil or water to come in contact with the clutch cover or disc. (MT)



Engine Stand (399814300 x 2)

A5-472

Fig. 3-91 Installing engine stand



- 1 Oil drain plug
- 2 Coolant drain plug

A5-255

Fig. 3-92 Position of drain plugs

2) Carburetor protector. [For 49 States (except 4WD & 4WD-AT) and California]

3) Distributor.

- a. Disconnect vacuum hose from distributor.
- b. Unclamp distributor lead wire.
- c. Disconnect spark plug cords from spark plugs and cord supporters, and distributor cord from cord supporter.

d. Remove distributor and distributor plate.

4) Alternator with air cleaner bracket, spark plug cord stay and drive belt.

5) E.G.R. pipe cover.

6) ASV pipe and ASV.

7) Battery cable bracket and ASV bracket [vehicle without power steering for 49 States (except 4WD & 4WD-AT)] or oil pump bracket (vehicle with power steering).

8) Loosen the connectors of E.G.R. pipe at intake manifold and cylinder head.

9) Disconnect the wiring harness lead of oil pressure switch or oil pressure gauge.

10) Disconnect connecting hoses from rocker covers.

11) Unclamp heater hose.

12) Disconnect two water by-pass hoses and heater hose from intake manifold.

13) Intake manifold ASSY and E.G.R. pipe.

14) Generator bracket complete and generator bracket 3 as an ASSY, and bracket 2.

15) Oil filler duct and oil filler duct stay as an ASSY.

* Remove stiffener 2 at this time (4WD).

16) Pulley by tapping it lightly.

NOTE:

a. Insert a screwdriver or the like into a hole in the drive plate (AT) or the flywheel (MT) through the timing hole to prevent the crankshaft from turning.

b. Use Puller Set (899524100) in such a case of pulley fitted tightly.

17) Oil pump together with oil filter.

18) Water pump, hose, pipe complete and by-pass hose as an ASSY and another by-pass hose.

19) Clutch cover and clutch disc.

NOTE:

a. Insert a screwdriver or the like into a hole in the flywheel through the timing hole to prevent the flywheel from turning.

b. Take care not to allow oil or water to come in contact with the clutch disc.

20) Flywheel with O-ring (MT) or converter drive plate with back plate and O-ring (AT).

NOTE:

Insert a screwdriver or the like into a hole in the converter drive plate through the timing hole to prevent it from turning.

21) Invert engine.

22) Crankcase oil pan, oil pan gasket and transmission cover II (MT).

23) Invert engine.

24) Flywheel housing.

25) Spark plugs.

26) Valve rocker covers and gaskets.

27) After loosening valve rocker lock nuts and adjusting screws for other than hydraulic valve lifters, remove the valve rocker assemblies and valve push rods.

NOTE:

a. Never loosen valve rocker lock nuts and adjusting screws for hydraulic valve lifters.

b. If the push rods are to be reused, keep them in order, so that they are installed in the original positions.

28) Cylinder head attaching nuts.

NOTE:

Loosen nuts according to the sequence below.

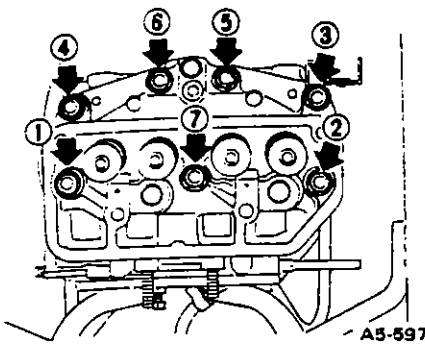


Fig. 3-93 Loosening sequence of cylinder head nuts

29) Cylinder heads and cylinder head gaskets.

30) Remove bolt and nut retaining oil strainer stay.

If necessary, drive out oil strainer together with stay as a unit.

NOTE:

a. Use a chisel when removing the oil strainer.

b. Never attempt to remove the strainer unless it is really necessary.

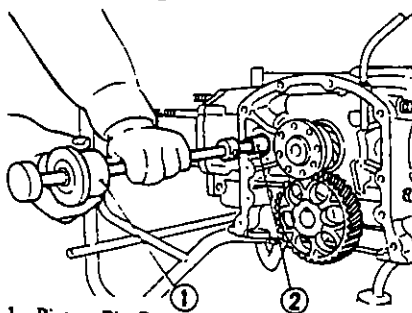
31) Piston pin circlip on the rear side of each #3 and #4 piston;

Set piston to its bottom dead center by turning crankshaft and insert long nose pliers through the rear service hole to reach circlip.

NOTE:

To turn the crankshaft with a wrench, install the crankshaft pulley bolt on the crankshaft front end.

32) Piston pins for #3 and #4 pistons, using Piston Pin Remover (399094310) inserted through the rear service hole.

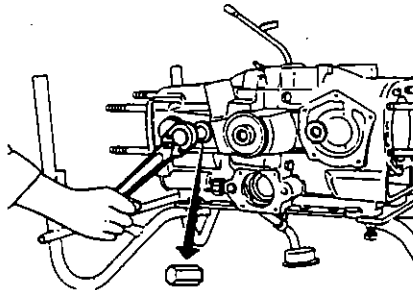


- 1 Piston Pin Remover (399094310)
- 2 Piston pin

A5-276

Fig. 3-94 Removing piston pin

33) Crankcase plugs from crankcase with an Allen wrench 14 mm (0.55 in) wide across flats.



Use this shape of wrench A5-277

Fig. 3-95 Removing crankcase plug

34) Piston pin circlips and piston pins for #1 and #2 pistons in the same way as before, but use the front service holes (crankcase plug holes) this time.

35) Straighten lockwashers for camshaft attaching bolts, working through the camshaft gear holes, and remove bolts.

36) Tilt crankcase, and take out hydraulic valve lifters.

NOTE:

Keep them in order so that they are not mixed up.

37) Separate crankcase by removing bolts and nuts with #1 and #3 cylinders facing upward.

NOTE:

a. Use Valve Lifter Clips (899804100) to prevent the lifters (other than hydraulic valve lifter) in the upper crankcase from dropping off.

b. Before separating the crankcase, pull the camshaft toward the rear so that it does not interfere with the crankcase.

c. Also remove the crankcase hanger (F) and stiffener (4WD).

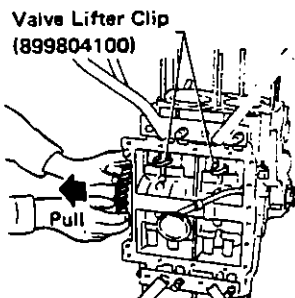


Fig. 3-96 Pulling camshaft A5-279

38) Oil seal at the front of crankcase, O-ring and back-up ring.

39) Oil seal at the front of crankcase, O-ring and back-up ring.

40) Crankshaft together with connecting rods, distributor gear and crankshaft gear as a unit.

41) Camshaft together with camshaft gear and camshaft plate.

42) Solid valve lifters and keep them in order, so that they can be reinstalled into their original holes.

43) Pistons from crankcase.

NOTE:

a. Keep the pistons and piston pins together for each cylinder so that they are not mixed up.

b. Make marks on the pistons so as not to change their installed positions.

44) Crankshaft bearings.

NOTE:

If the bearings are to be used again, do not mix them up.

45) Oil pressure switch (Vehicle without pressure gauge) or plug (Vehicle with pressure gauge).

46) Engine Stands (399814300 x 2) from the crankcase halves.

2. TURBO Vehicle

NOTE:

The condition of the engine before disassembly is as shown in the figure below.

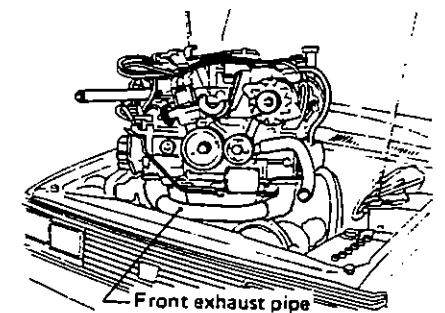


Fig. 3-97

A5-758

1) Removing the front exhaust pipe. Loosen the four nuts securing the front exhaust pipe to the cylinder head.

ENGINE

2) Removing the oil pipe stay.

Remove the bolt fitting the stay to the crankcase bottom (#1 and #3 sides).

3) Installing the engine stand.

Install the ENGINE STAND (399814300) to the engine ASSY.

4) Removing the distributor ASSY.

a. Remove the high-tension cords from the spark plugs and supporters.

b. Remove the lead wires. ... Clips in four places, ground terminal on the intake manifold (6 mm bolt) and knock sensor.

c. Disconnect the vacuum hose.

d. Remove the bolts holding the distributor ASSY, and pull it up.

5) Removing the alternator ASSY.

Remove the two bolts holding the alternator ASSY.

6) Removing the intake manifold ASSY.

a. Remove the oil pressure switch and injector lead wires.

b. Remove the air vent hose from the intake manifold side.

c. Remove the EGR cover (insertion type), and remove the EGR pipe plug at the cylinder head side.

d. Disconnect the blow-by hose.

e. Disconnect the fuel pipe from the injector.

(a) Loosen the hose clamps in four places.

(b) Remove the two bolts holding the fuel pipe (together with the intake manifold ASSY).

f. Disconnect the vacuum hose.

g. Remove the intake manifold ASSY by loosening the four bolts holding it.

7) Removing brackets.

a. Remove the alternator bracket 2.

b. Remove the alternator bracket.

c. Remove the pump bracket for the power steering.

8) Removing the knock sensor ASSY.
Use a 27 mm deep socket for removal.

NOTE:

a. Use of a shallow socket damages the terminals. Be sure to use the above deep socket.

b. Do not tilt or lay down the socket during removal.

9) Removing the fuel injector.

Use a Phillips-head screwdriver for removal.

10) Removing the oil filler duct CP.

Remove the two bolts holding the oil filler duct CP.

11) Removing oil pump with attachment & oil filter.

NOTE:

The operations that follow hereunder should be carried out by the same procedures used for Non-TURBO vehicles.

3-6. Disassembly

1. Intake Manifold Assembly

1. NON-TURBO VEHICLE

1) Hitachi Carburetor Type for 49-state Non-4WD and California

- 1) Disconnect wiring harness.
- 2) Remove vacuum hoses, hoses and related parts.
 - a. Thermostat cover, solenoid valve I and bracket, protector stay, gasket and thermostat.
 - b. Actuator ASSY (A/C only), clip and stay & clip.
 - c. E.G.R. valve, gasket and duty solenoid valve connector clamp.
 - d. Carburetor, two gaskets and an insulator.
 - e. P.C.V. hose.
 - f. Heater hose.
 - g. Duty solenoid valves (slow and main) and carburetor protector 2.
 - h. Vacuum pipe CP and carburetor protector 3.
 - i. Thermo vacuum valve III.
 - j. P.C.V. valve.
 - k. Thermo vacuum valve I.
 - l. Accelerator cable bracket.
 - m. Thermosensor.
 - n. Solenoid valve II (except for California).

2) Hitachi Carburetor Type for 49-state 4WD and Canada

- 1) Disconnect wiring harness.
- 2) Remove (vacuum) hoses and related parts.
 - a. Thermostat cover, stay, gasket and thermostat
 - b. Actuator ASSY (A/C only), clip and stay & clip
 - c. Thermo vacuum valve IV, bracket and insulator.
 - d. E.G.R. valve, gasket and AAV pipe & hose
 - e. Carburetor, two gasket and insulator
 - f. P.C.V. hose
 - g. Heater hose
 - h. Vacuum pipe
 - i. P.C.V. valve
 - j. Thermo vacuum valve I

- k. Accelerator cable bracket
- l. Thermosensor

3) C-W Carburetor Type

- 1) Disconnect wiring harness.
- 2) Remove vacuum hoses, hoses, and related parts.
 - a. Thermostat cover, gasket and thermostat.
 - b. Solenoid valve I.
 - c. Actuator ASSY (A/C only).
 - d. E.G.R. valve and gasket.
 - e. Carburetor, two gaskets and an insulator.
 - f. P.C.V. hose.
 - g. Heater hose.
 - h. Stay & clip.
 - i. Clip.
 - j. P.C.V. valve.
 - k. Thermo vacuum valve I.
 - l. Thermosensor.
 - m. Vacuum pipe CP.
 - n. Solenoid valve II.

2. TURBO VEHICLE

- 1) Remove the wiring harness from the intake manifold.
 - Auxiliary air valve
 - Throttle switch
 - FICD solenoid valve
 - Thermometer CP
 - Coolant thermosensor
 - Ground terminal ... Tightened along with the pressure regulator stay
- 2) Remove the pressure regulator.
- 3) Remove the following parts from the intake manifold and throttle body.
 - Each vacuum hose
 - Blow-by hose
 - Heater hose
 - Throttle body hot water preheat hose
 - EGR pipe
- 4) Remove the following parts from the intake manifold.
 - Throttle body ASSY ... Use a "Torx" wrench.
 - Auxiliary air valve
 - Thermostat cover, thermostat and hose
 - EGR valve
 - Thermo valve

- Thermometer CP
- Coolant thermosensor
- PCV valve
- Air relief valve ASSY
- Vacuum pipe CP

2. Valve Rocker Assembly

Disassemble valve rocker ASSY to each component part.

NOTE:

- a. Keep the disassembled parts in order.
- b. Never loosen rocker arm screws for hydraulic valve lifter. In addition, be sure not to mix rocker arms since their screws are adjusted with every cylinder.

3. Cylinder Head

- 1) Remove valves, springs, spring retainers, and retainer keys from cylinder head, by using Spring Press (899724100).

NOTE:

Put a mark on the individual valves, and be careful not to mix them up.

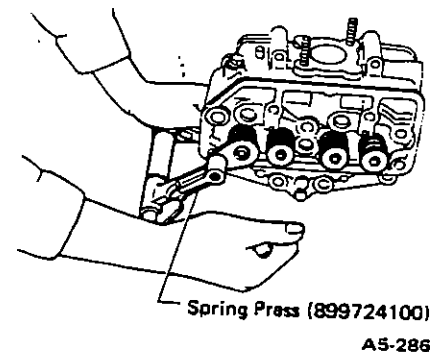


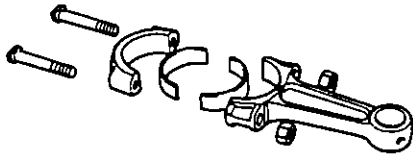
Fig. 3-98 Removing valve and spring

- 2) Remove spacer with gasket.

4. Crankshaft

Remove connecting rods from crankshaft by unscrewing connecting rod nuts.

Remove bearings from connecting rod.



A5-039

Fig. 3-99 Disassembled connecting rod

NOTE:

Arrange the disassembled parts in order and be careful not to mix them up.

5. Camshaft

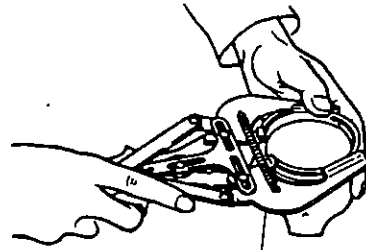
Remove cam gear from camshaft using Remover Set (899714110) and press. Then remove woodruff key and camshaft plate.

6. Piston

Remove piston rings with a piston ring expander. Also remove circlip.

NOTE:

Arrange the removed piston rings in order and be careful not to mix them up.



Piston ring expander
A5-038

Fig. 3-100 Removing piston rings

7. Oil Pump

Disassemble oil pump to each component part.

- a. Oil filter
- b. Two screws
- c. Oil pump body holder, drive gear, rotor and O-ring
- d. O-ring, by-pass valve spring and ball

- e. Oil pressure gauge or plug
- f. Relief valve plug, two washers, spring and relief valve

8. Water Pump

Disassemble water pump to each component part.

- a. Water pump pulley
- b. Water pump shaft

NOTE:

Do not press the shaft, or the bearings will be damaged. Press the bearing outer race.

- c. Impeller
- d. Mechanical seal

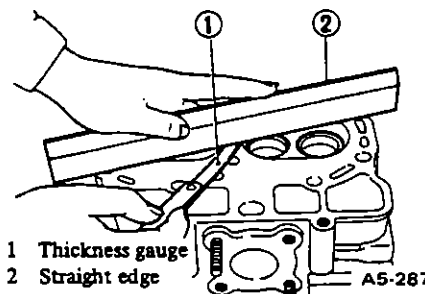
3-7. Inspection and Adjustment

1. Precautions

- 1) Before cleaning parts, make sure that no leakage exists in parts which carry coolant or oil.
- 2) Clean all parts carefully and make sure that adhering gaskets and other substances are removed.
- 3) Blow compressed air into the oil passages to make sure that they are not clogged.
- 4) When removing deposits such as carbon, be careful not to damage the part surface.
- 5) Arrange all relative parts in order, so that they are not mixed up.

If the warping exceeds 0.05 mm (0.0020 in), grind the surface with a surface grinder.

Warping limit	0.05mm (0.0020 in)	
Grinding limit	0.5mm (0.020 in)	
Standard height of cylinder head	1600 cc Engine	89.6 mm (3.528 in)
	1800 cc Engine	90.6 mm (3.567 in)



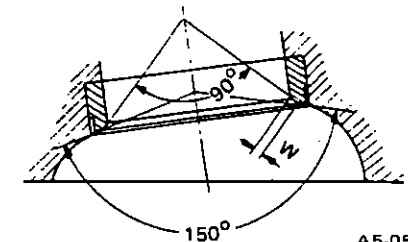
1 Thickness gauge
2 Straight edge
A5-287

Fig. 3-101 Measuring cylinder head for warping

NOTE:

Uneven torque for the cylinder head nuts can cause warping. When re-assembling, pay special attention to the torque so as to tighten evenly.

- 3) Inspect intake and exhaust valve seats, and correct the contact surfaces if they are defective or when valve guides are replaced.



A5-052

Fig. 3-102 Dimensions of intake and exhaust valve seats

2. Cylinder Head

- 1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect important areas by means of red check.
- 2) Measure the warping of the cylinder head surface that mates with crankcase by using a straight edge and thickness gauge.

W	Intake	0.7 - 1.3 mm (0.028 - 0.051 in)
	Exhaust	1.0 - 1.8 mm (0.039 - 0.071 in)
Wear limit of valve seat (measured in direction of valve axis)		0.5 mm (0.020 in) for both intake and exhaust valves

ENGINE

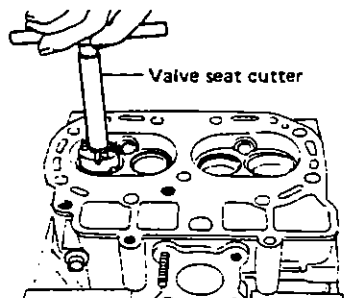
The correction procedure is as follows:

a. Precautions

(1) When valve seat correction is required, check intake and exhaust valve stems and valve guides for wear, and the springs for squareness, tension, etc. If defective, replace them before proceeding the valve seat correction work.

(2) When reconditioning valve and valve seat surfaces, remove intake valve oil seals. Install new oil seals with oil after completing the work.

b. Reface valve seat with valve seat cutters or grinders to the dimensions shown in the above figure.



A5-288

Fig. 3-103 Refacing valve seat with valve seat cutter

NOTE:

Refacing of the valve seat should be closely coordinated with the refacing of the valve face, so that the finished seat and valve face will be concentric and specified interference angle will be maintained.

- c. Apply a thin coat of Prussian blue or red lead to the contacting surface of valve to see the contacting condition of valve and valve seat.
- d. Rotate valve with light pressure. If the blue or red lead is transferred to the center of the valve seat surface, the contact is satisfactory.
- e. In case of improper contact, apply a small amount of grinding compound (about #400) on the valve surface and lap the valve and seat surface so that they obtain proper fit.

NOTE:

The above is important because the valve and seat must have a gastight fit.

- f. Clean valves and valve seats to remove chips.
- 4) Inspect exhaust pipe stud bolts installed on the cylinder head, and replace if defective.

Protrusion length of stud bolts
54 mm (2.13 in)

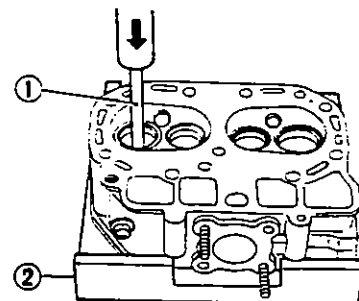
3. Valve Guide

Check the clearance between valve guide and stem. The clearance can be checked by measuring the outside diameter of valve stem and the inside diameter of valve guide with outside and inside micrometers respectively.

If the clearance between valve guide and stem exceeds the specification, replace guide as follows:

Specifications for valve stem and valve guide		
Standard clearance between valve guide and valve stem	Intake	0.035 – 0.065 mm (0.0014 – 0.0026 in)
	Exhaust	0.040 – 0.070 mm (0.0016 – 0.0028 in)
Limit of clearance between valve guide and valve stem	Intake	0.15 mm (0.0059 in)
	Exhaust	0.15 mm (0.0059 in)
Standard inside diameter of valve guide		8.000 – 8.015 mm (0.3150 – 0.3156 in)
Standard diameter of valve stem	Intake	7.950 – 7.965 mm (0.3130 – 0.3136 in)
	Exhaust	7.945 – 7.960 mm (0.3128 – 0.3134 in)

- a. Place cylinder head on Cylinder Head Table (399765101) with the combustion chamber upward so that valve guides enter the holes in Cylinder Head Table.
- b. Insert Valve Guide Remover (899764104) into valve guide and press it down to remove valve guide.

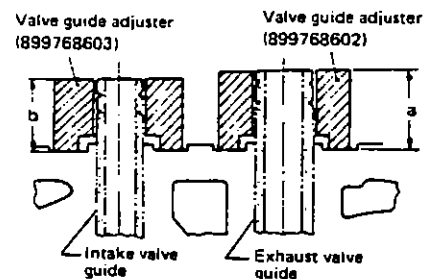


- 1 Valve Guide Remover (899764104)
- 2 Cylinder head table (399765101)

A5-289

Fig. 3-104 Removing valve guide

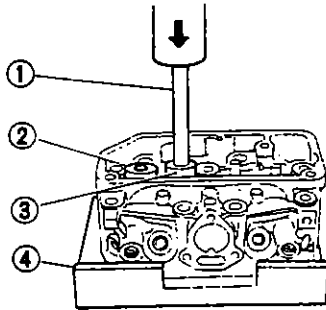
- c. Turn cylinder head upside down and place Valve Guide Adjuster (899768602 for exhaust valve guide, 899768603 for intake valve guide) as shown in the figure.



A5-055

Fig. 3-105 Valve guide adjusters

- d. Before installing new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.
- e. Put new valve guide, coated with sufficient oil, in cylinder, and insert Valve Guide Remover (899764104) into valve guide. Press in until the valve guide upper end is flush with the upper surface of Valve Guide Adjuster.



- 1 Valve Guide Remover (899764104)
- 2 Valve Guide Adjuster (899768603) A5-290
- 3 Valve Guide Adjuster (899768602)
- 4 Cylinder Head Table (399765101)

Fig. 3-106 Installing valve guide

f. Check the valve guide projection.

Valve guide projection	Intake (b)	17.5 – 18.5 mm (0.689 – 0.728 in)
	Exhaust (a)	22.5 – 23.5 mm (0.886 – 0.925 in)

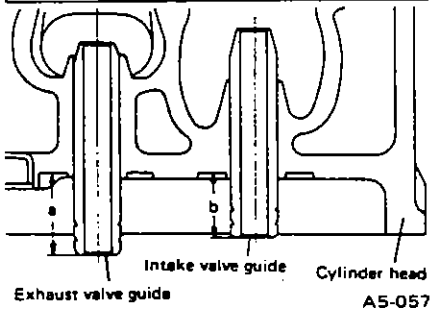


Fig. 3-107 Valve guide projection

g. Ream the inside of valve guide with Valve Guide Reamer (899764105). Gently rotate the reamer clockwise while pressing it lightly into valve guide, and return it also rotating clockwise. After reaming clean valve guide to remove chips.

NOTE:

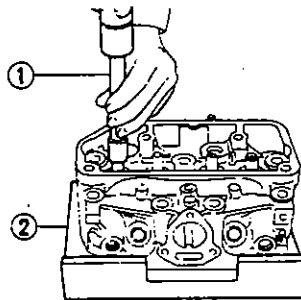
- a. The outside diameter of the reamer should be adjusted to 8.004 to 8.010 mm (0.3151 to 0.3154 in).
- b. Apply engine oil to the reamer when reaming.
- c. If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
- d. If the inner surface of the valve guide becomes lustrous and the reamer does not cut chips, use a new reamer or remedy the reamer.

h. Recheck the contact condition between valve and valve seat after replacing valve guide.

4. Intake Valve Oil Seal

Replace oil seal with new one, if lip is damaged or spring is out of place, or when the surfaces of intake valve and valve seat are reconditioned or intake valve guide is replaced.

Press in oil seal to the specified dimension indicated in the figure, using Oil Seal Installer (898858600).



- 1 Oil Seal Installer (898858600)
- 2 Cylinder Head Table (399765101) A5-291

Fig. 3-108 Installing oil seal

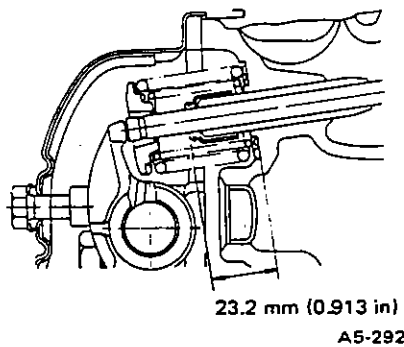


Fig. 3-109 Installed position of oil seal

NOTE:

Apply oil to the oil seal prior to pressing.

5. Intake and Exhaust Valves

1) Inspect the flange and stem of valve, and replace if damaged, worn, or deformed, or if "H" is less than the specified limit.

	H	
	Standard	Limit
Intake	1 mm (0.039 in)	0.5 mm (0.020 in)
Exhaust	1.3 mm (0.051 in)	0.8 mm (0.031 in)

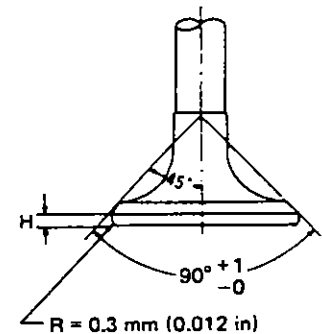
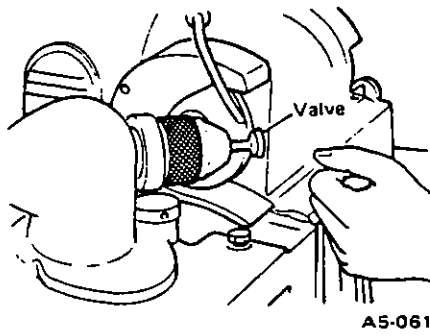


Fig. 3-110 Valve head dimensions

	Intake valve	Exhaust valve
Angle of valve surface that contacts valve seat	90° +1° -0	
Valve overall length	109 mm (4.29 in)	109.3 mm (4.30 in)

2) If the contact surface of valve is damaged, or if the stem end is recessed, correct with a valve refacer, grinding

as little as possible. The contact surface should be at right angle with the valve axis.



A5-061

Fig. 3-111 Grinding valve

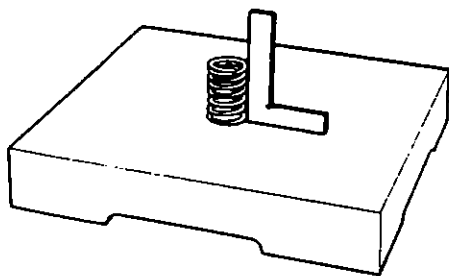
3) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. Also refer to 2. Cylinder Head 3) at this time. Install a new intake valve oil seal after lapping.

6. Valve Springs

Check valve springs for damage, free length, and tension. Replace valve spring if it is not to the specifications presented below.

NOTE:

To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.



A5-062

Fig. 3-112 Checking spring squareness

Specifications of valve spring with solid valve lifter		
	Outer spring	Inner spring
Free length	45.3 mm (1.783 in)	48.8 mm (1.921 in)
Tension/spring height	146.1 – 169.7 N (14.9 – 17.3 kg, 32.9 – 38.1 lb)/ 39.5 mm (1.555 in)	84.3 – 98.1 N (8.6 – 10.0 kg, 19.0 – 22.1 lb)/ 37.5 mm (1.476 in)
	500.2 – 568.8 N (51.0 – 58.0 kg, 112.5 – 127.9 lb)/ 30.5 mm (1.201 in)	185.4 – 214.8 N (18.9 – 21.9 kg, 41.7 – 48.3 lb)/ 28.5 mm (1.122 in)
Squareness	2.0 mm (0.079 in) or less	2.1 mm (0.083 in) or less

Specifications of valve spring with hydraulic valve lifter		
	Outer spring	Inner spring
Free length	48.5 mm (1.909 in)	53.0 mm (2.087 in)
Tension/spring height	228.5 – 261.8 N (23.3 – 26.7 kg, 51.4 – 58.9 lb)/ 39.5 mm (1.555 in)	115.7 – 133.4 N (11.8 – 13.6 kg, 26.0 – 30.0 lb)/ 37.5 mm (1.476 in)
	518.8 – 599.2 N (52.9 – 61.1 kg, 116.6 – 134.7 lb)/ 32.0 mm (1.260 in)	201.0 – 230.5 N (20.5 – 23.5 kg, 45.2 – 51.8 lb)/ 30.0 mm (1.181 in)
Squareness	2.1 mm (0.083 in) or less	2.3 mm (0.091 in) or less

7. Valve Rocker

1) Inspect the inner surface of valve rocker arm and the outer surface of rocker shaft for wear.

Replace valve rocker arm or shaft if defective.

2) If the rocker arm surface that contacts the stem head is noticeably worn, replace the rocker arm. If worn slightly in a stepped shape, use a valve refacer and correct the surface, grinding as little as possible.

Clearance between rocker arm and shaft	0.013 – 0.052 mm (0.0005 – 0.0020 in)
Inner diameter of rocker arm	18.016 – 18.034 mm (0.7093 – 0.7100 in)
Outer diameter of shaft	17.982 – 18.003 mm (0.7080 – 0.7088 in)

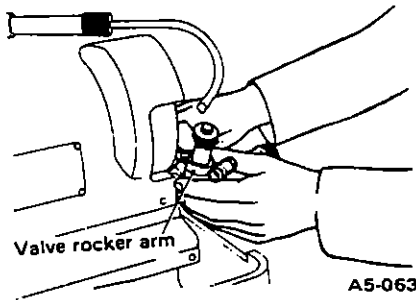


Fig. 3-113 Correcting valve rocker arm

3) Replace rocker shaft spring washers if worn excessively.

NOTE:

Be extremely careful to prevent any foreign matter from getting into the valve lifter as it is machined to a high degree of precision.

1) Measure the outer diameter of the valve lifter. If it is outside the specified value, replace it. Also check it for wear or damage and replace it as necessary.

2) Measure the bore diameter in the crankcase at the valve lifter location. If the clearance between the bore diameter and outer diameter of the lifter exceeds the specified limit, replace the lifter.

3) Forcibly insert the push rod seat with push rod to see if the seat moves into the valve body. If it does, check the following reasons and repair it as follows:

- Air is sucked into the pressure chamber.
- Plunger-to-body clearance is too large.
- Foreign matter and/or damage exists around check ball and plunger.

a. Remove the following parts in the order indicated.

- Clip
- Push rod seat
- Plunger
- Check ball, check ball spring and check ball retainer
- Plunger spring

NOTE:

a. Never mix up plunger, push rod seat and valve body among valve lifters.

b. Use a wire to facilitate removal of the plunger.

8. Valve Lifter

1) Solid Valve Lifter

Specifications for lifter and lifter hole		
Standard inner diameter of lifter hole		21.000 – 21.021 mm (0.8268 – 0.8276 in)
Standard outer diameter of lifter		20.949 – 20.970 mm (0.8248 – 0.8256 in)
Clearance between lifter and lifter hole	Standard	0.030 – 0.072 mm (0.0012 – 0.0028 in)
	Limit	0.100 mm (0.0039 in)

1) Check valve lifters for wear and damage, and replace or correct if defective.

2) Check the lifter holes in the crankcase for damage, etc., and correct or replace as necessary.

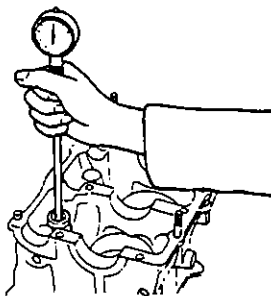


Fig. 3-114 Checking lifter hole

2) Hydraulic Valve Lifter

Hydraulic valve lifter and lifter hole		
Standard inner diameter of lifter hole		20.988 – 21.040 mm (0.8263 – 0.8283 in)
Standard outer diameter of lifter		20.950 – 20.968 mm (0.8248 – 0.8255 in)
Lifter to lifter hole clearance	Standard	0.020 – 0.090 mm (0.0008 – 0.0035 in)
	Limit	0.100 mm (0.0039 in)

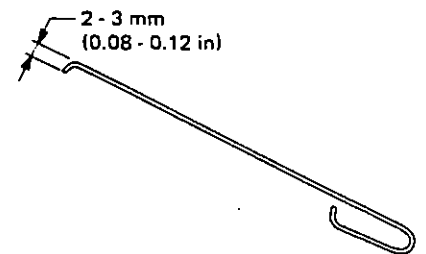


Fig. 3-115

- b. Clean all disassembled parts.
- c. Install the check ball, check ball spring and check ball retainer on the plunger, being careful not to tilt them.

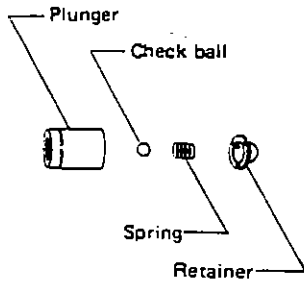


Fig. 3-116

A5-683

- d. Install the plunger spring in the valve body and fill the body with clean engine oil.
- e. Insert plunger into valve body and push check ball with drift pin [outer 3.2 mm (1/8 in) dia.] until the plunger comes into contact with the body while making an opening between the check ball and plunger.
- f. Insert a suitable pin into the oil hole in the body and remove the drift pin.

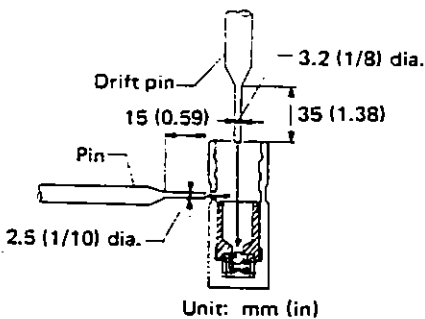


Fig. 3-117

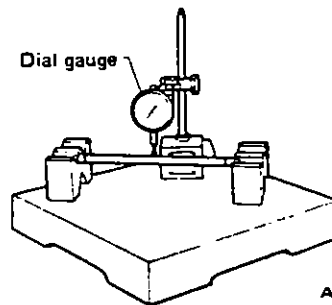
A5-684

- g. After refilling with clean engine oil, insert the push rod seat, install the clip in place and remove the pin.
- h. Again make sure that the push rod seat does not move into the valve body when forcibly pushing the seat with the push rod. If it does, replace the valve lifter with a new one.

9. Push Rod

- 1) Check for any sign of bending or damage, and replace if defective.
- 2) Check the oil hole in push rod for clogging and clean if necessary.

Deflection of center		0.4 mm (0.016 in) or less
Overall length	For 1600 (Knurling: 2)	219 – 219.4 mm (8.62 – 8.64 in)
	For 1800 with solid valve lifter (Knurling: 1)	230.7 – 231.1 mm (9.08 – 9.10 in)
	For 1800 with hydraulic valve lifter (Knurling: nothing)	231.7 – 232.2 mm (9.12 – 9.14 in)



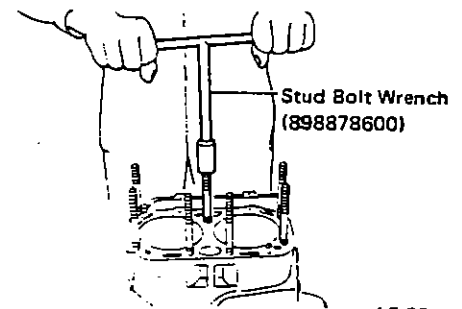
A5-065

Fig. 3-118 Checking push rod for bending

Use Stud Bolt Wrench (898878600) to screw the stud bolt into crankcase.

NOTE:

Coat the stud bolt threads with a torque-holding sealant (Loctite 270 or 271, or equivalent) before installation.



A5-294

Fig. 3-119 Installing cylinder head stud bolt

10. Crankcase

Check crankcase for the following items, and correct or replace if defective.

- 1) Check for cracks and damage visually. Especially, inspect important parts by means of red check.
- 2) Check the oil passages for clogging.
- 3) Check stud bolts on the crankcase for looseness. If any stud bolt is loose, correct or replace. If it is bent, correct so that the cylinder head can be installed smoothly.

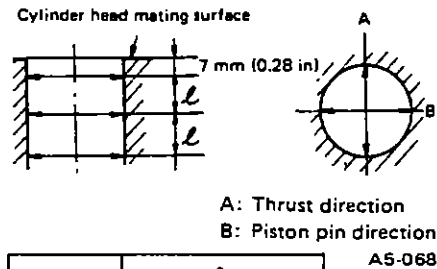
- 4) Inspect the crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

Warping limit	0.05 mm (0.0020 in)
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Stud Bolt		
	1,800 cc	1,600 cc
Length	91.5 – 93.5 mm (3.602 – 3.681 in)	90.5 – 92.5 mm (3.563 – 3.642 in)
Torque	34 – 44 N·m (3.5 – 4.5 kg·m, 25 – 33 ft·lb)	

11. Cylinder and Piston

1) Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in the figure, using a cylinder bore gauge.



	\varnothing
1,600 cc	30 mm (1.18 in)
1,800 cc	33.5 mm (1.319 in)

Fig. 3-120 Positions for cylinder bore measurement

NOTE:
Measurement should be performed at a temperature of 20°C (68°F).

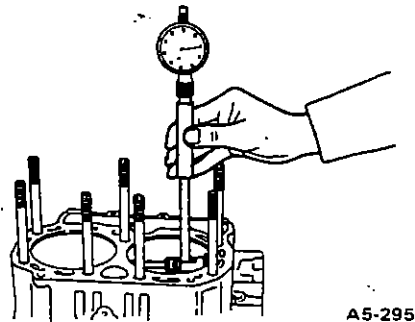


Fig. 3-121 Measuring cylinder bore

2) Boring and honing
a. If the value of taper, out-of-roundness, or cylinder-to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebores it to use an oversize piston.

NOTE:
When any of the cylinders needs rebor-ing, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.

b. Get four of the oversize pistons and measure the outer diameter of each piston at the height shown in the figure. (Thrust direction)

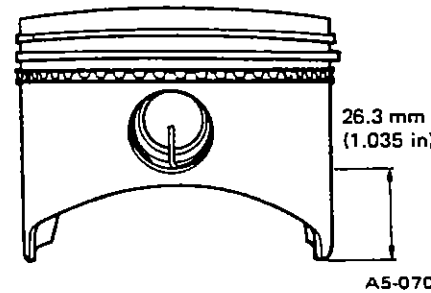


Fig. 3-122 Position for measuring piston diameter

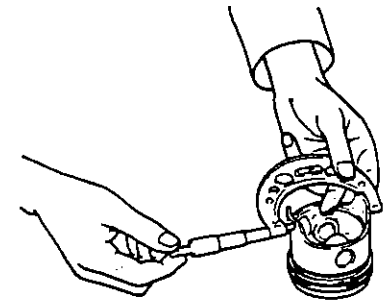


Fig. 3-123 Measuring piston diameter

Piston outer diameter	
Standard	91.960 – 91.990 mm (3.6205 – 3.6216 in)
0.25 mm (0.0098 in) oversize	92.210 – 92.240 mm (3.6303 – 3.6315 in)
0.50 mm (0.0197 in) oversize	92.460 – 92.490 mm (3.6402 – 3.6413 in)

NOTE:
Measurement should be performed at a temperature of 20°C (68°F).

c. If the cylinder inner diameter exceeds the following enlarging limit after boring and honing, replace the crankcase.

Enlarging limit of cylinder inner diameter	0.50 mm (0.0197 in)
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NOTE:
Immediately after rebor-ing, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

d. Inspect the cylinder bore for taper, out-of-roundness, and diameter differences.

Diameter difference between cylinders	0.050 mm (0.0020 in) or less
---------------------------------------	------------------------------

NOTE:
Measure the inner diameter of the cylinder when the temperature is 20°C (68°F).

Cylinder bore		
Standard diameter (Both 1800 and 1600)		91.985 – 92.015 mm (3.6214 – 3.6226 in)
Taper	Standard	0.015 mm (0.0006 in)
	Limit	0.050 mm (0.0020 in)
Out-of roundness	Standard	0.010 mm (0.0004 in)
	Limit	0.050 mm (0.0020 in)
Cylinder to piston clearance at 20°C (68°F)	Standard	0.010 – 0.040 mm (0.0004 – 0.0016 in)
	Limit	0.060 mm (0.0024 in)

12. Piston and Piston Pin

- 1) Check pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
- 2) Measure the piston-to-cylinder clearance at each cylinder as instructed in 11. Cylinder and Piston. If any of the clearances is not to specification, replace the piston or bore the cylinder to use an oversize piston.
- 3) Make sure that piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if defective.

Specifications for piston and piston pin	
Standard outer diameter of piston pin	20.992 to 21.000 mm (0.8265 to 0.8268 in)
Standard inner diameter of piston pin hole	20.999 to 21.009 mm (0.8267 to 0.8271 in)
Standard clearance between piston pin and hole in piston	0.004 to 0.010 mm (0.0002 to 0.0004 in)
Standard clearance between piston pin and hole in connecting rod	0.005 to 0.040 mm (0.0002 to 0.0016 in)

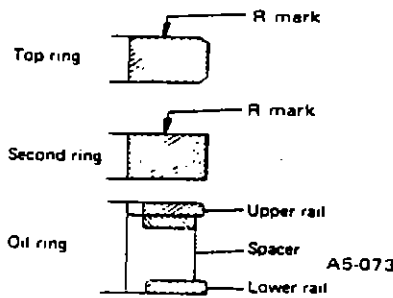


Fig. 3-125 Cross section of piston rings (Riken Piston Ring)

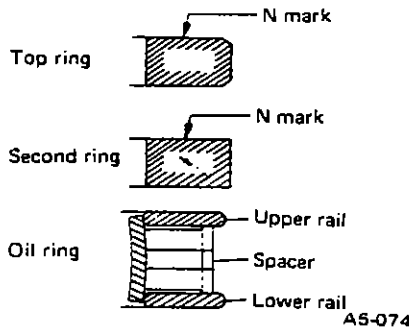


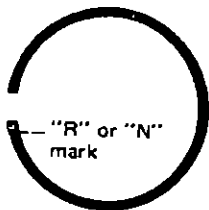
Fig. 3-126 Cross section of piston ring (Nippon Piston Ring)

13. Piston Ring

- 1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

NOTE:

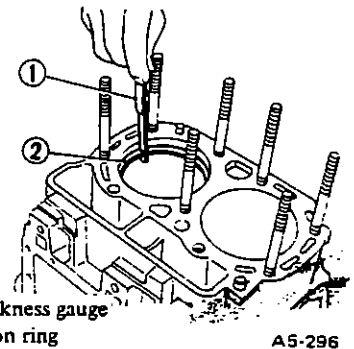
- a. "R" or "N" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.



A5-072

Fig. 3-124 Mark on piston ring

- b. The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful not to make misassembly.

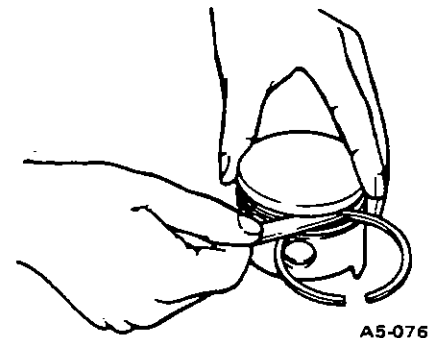


1 Thickness gauge
2 Piston ring
A5-296
Fig. 3-127 Measuring piston ring gap

- 3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

NOTE:

Before measuring the clearance, clean the piston ring groove and piston ring.



A5-076
Fig. 3-128 Measuring piston ring groove clearance

- 2) Squarely place piston ring in cylinder and measure the piston ring gap with a thickness gauge.

NOTE:

If the cylinder is not corrected or replaced one, measure the piston ring gap at the bottom of the cylinder, where the wear is little.

		Standard	Limit
Piston ring gap	Top ring	0.20 – 0.35 mm (0.0079 – 0.0138 in)	1.0 mm (0.039 in)
	Second ring	0.20 – 0.35 mm (0.0079 – 0.0138 in)	1.0 mm (0.039 in)
	Oil ring rail	0.20 – 0.90 mm (0.0079 – 0.0354 in)	1.5 mm (0.059 in)

ENGINE

		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.04 – 0.08 mm (0.0016 – 0.0031 in)	0.15 mm (0.0059 in)
	Second ring	0.03 – 0.07 mm (0.0012 – 0.0028 in)	0.15 mm (0.0059 in)
	Oil ring	0	0

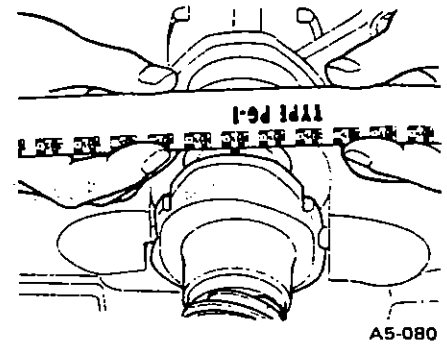
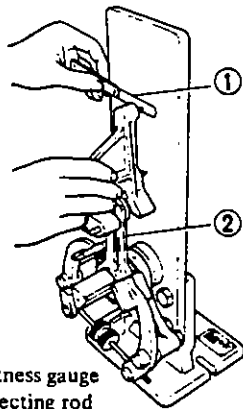


Fig. 3-131 Measuring connecting rod oil clearance

14. Connecting Rod

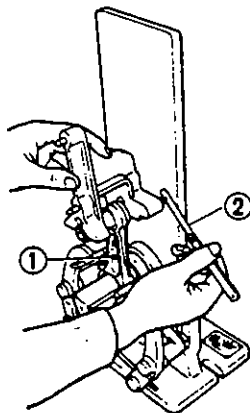
- 1) Replace connecting rod, if the large or small end thrust surface is damaged.
- 2) Check for bend or twist using a connecting rod aligner. Replace connecting rod if the bend or twist exceeds the limit.

Limit of bend or twist per 100 mm (3.94 in) in length	0.10 mm (0.0039 in)
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- 1 Thickness gauge
- 2 Connecting rod

A5-077



- 1 Connecting rod
- 2 Thickness gauge

Fig. 3-129 Measuring piston ring groove clearance

A5-078

- 3) Install connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). Replace connecting rod if the side clearance exceeds the specified limit.

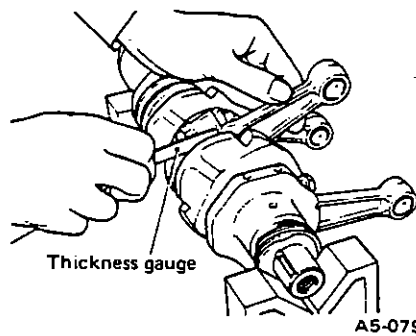


Fig. 3-130 Measuring side clearance

Connecting rod side clearance	
Standard	0.070 – 0.330 mm (0.0028 – 0.0130 in)
Limit	0.4 mm (0.016 in)

- 4) Inspect connecting rod bearing for scar, peeling, seizure, melting, wear, etc.
- 5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge according to the following procedure.

- a. Wipe off oil, dust, etc. on the surfaces to be measured.
- b. Cut the plastigauge to the width of the bearing, place it on the crankpin parallel with the crankshaft axis, and install connecting rod. Tighten connecting rod nuts to 41 N·m (4.2 kg·m, 30 ft·lb).

NOTE:

During this measurement, do not allow relative movement between the crankpin and connecting rod.

- c. Remove connecting rod and measure the width of the plastigauge with the scale printed on the plastigauge case.

If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary, and replace or recondition the crankshaft as necessary. (See the table below.)

- 6) Inspect bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

Standard clearance between piston pin and bushing in connecting rod	0 – 0.022 mm (0 – 0.0009 in)
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Connecting rod oil clearance	
Standard	0.020 – 0.070 mm (0.0008 – 0.0028 in)
Limit	0.10 mm (0.0039 in)

ENGINE

Replacement procedure is as follows.

- a. Remove bushing from connecting rod with Remover & Replacer (499037000) and press.
- b. Press bushing with Remover & Replacer (499037000) after applying oil on the periphery of bushing.

- c. Make two 3 mm (0.12 in) holes in bushing.
- d. Ream the inside of bushing.

Bushing bore	21.000 – 21.016 mm (0.8268 – 0.8274 in)
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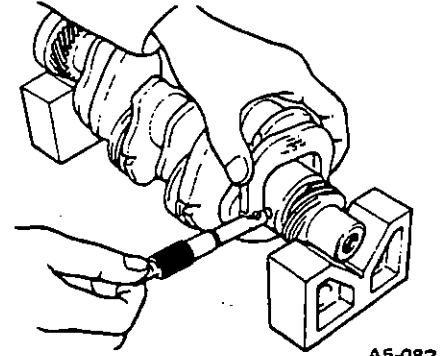
Distance between big end and small end hole	1800 cc	116.95 – 117.05 mm (4.6043 – 4.6083 in)
	1600 cc	109.95 – 110.05 mm (4.3287 – 4.3327 in)

- e. After completion of reaming, clean bushing to remove chips.

NOTE:

When measuring, place both the front and rear journals on blocks located on a surface plate, and apply a dial gauge to the center journal.

- 3) Inspect the crank journal and crankpin for wear. If not to specifications, replace bearing with an undersize one, and replace or recondition crankshaft as necessary. When grinding crank journal or crankpin, finish them to the specified dimensions according to the undersize bearing to be used. (See the table.)



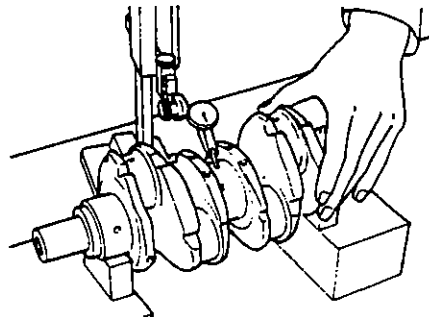
A5-082

Fig. 3-133 Checking wear of crank journal

15. Crankshaft and Crankshaft Bearing

- 1) Clean crankshaft completely and check for cracks by means of red check etc., and replace if defective.
- 2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

Crankshaft bend limit	0.035 mm (0.0014 in)
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A5-081

Fig. 3-132 Checking crankshaft bend

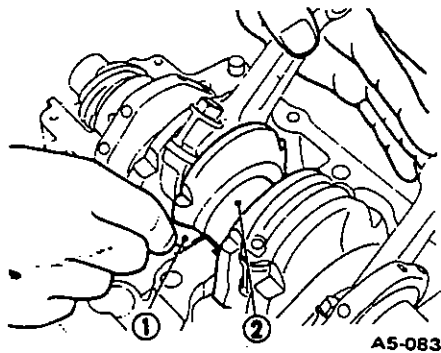
Crankpin and crank journal	
Out-of-roundness	0.03 mm (0.0012 in) or less
Taper limit	0.07 mm (0.0028 in)
Grinding limit	0.25 mm (0.0098 in)

Dimensions of crankpin, bearing and bearing bore			
Part Size	Crankpin diameter	Connecting rod bearing thickness at center	Connecting rod bearing bore diameter
Standard	44.995 – 45.010 mm (1.7715 – 1.7720 in)	1.477 – 1.485 mm (0.0581 – 0.0585 in)	48.000 – 48.019 mm (1.8898 – 1.8905 in)
0.05 mm (0.0020 in) undersize	44.945 – 44.960 mm (1.7695 – 1.7701 in)	1.505 – 1.510 mm (0.0593 – 0.0594 in)	
0.25 mm (0.0098 in) undersize	44.745 – 44.760 mm (1.7616 – 1.7622 in)	1.605 – 1.610 mm (0.0632 – 0.0634 in)	

Dimensions of crankpin, crank journal and bearing				
Bearing size	Crankpin outer diameter	Crank journal outer diameter		
		1,800 cc engine		1,600 cc engine
		Front, Center and Rear	Front and Rear	Center
Standard	44.995 – 45.010 mm (1.7715 – 1.7720 in)	54.955 – 54.970 mm (2.1636 – 2.1642 in)	49.957 – 49.970 mm (1.9668 – 1.9673 in)	49.970 – 49.982 mm (1.9673 – 1.9678 in)
0.03 mm (0.0012 in) undersize	—	54.925 – 54.940 mm (2.1624 – 2.1630 in)	49.927 – 49.940 mm (1.9656 – 1.9661 in)	49.940 – 49.952 mm (1.9661 – 1.9666 in)
0.05 mm (0.0020 in) undersize	44.945 – 44.960 mm (1.7695 – 1.7701 in)	54.905 – 54.920 mm (2.1616 – 2.1622 in)	49.907 – 49.920 mm (1.9648 – 1.9654 in)	49.920 – 49.932 mm (1.9654 – 1.9658 in)
0.25 mm (0.0098 in) undersize	44.745 – 44.760 mm (1.7616 – 1.7622 in)	54.705 – 54.720 mm (2.1537 – 2.1543 in)	49.707 – 49.720 mm (1.9570 – 1.9575 in)	49.720 – 49.732 mm (1.9575 – 1.9579 in)

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace bearing.

Crankshaft thrust clearance	
Standard	0.010 – 0.095 mm (0.0004 – 0.0037 in)
Limit	0.3 mm (0.0118 in)



1 Thickness gauge
2 Center bearing part

Fig. 3-134 Checking thrust clearance

5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.

6) Measure the oil clearance on each crankshaft bearing by means of plastigauge as follows:

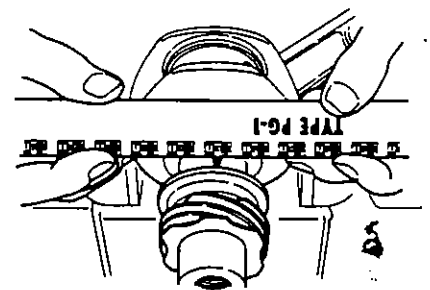
- Wipe off oil, dust, etc. on the surfaces to be measured.
- Install bearings in crankcase and set crankshaft in position.
- Cut the plastigauge to the bearing width and place it on journal parallel with the crankshaft axis. Be careful not to put it on the oil hole or groove. Bring together the crankcase halves and tighten bolts to the specified torque.

NOTE:

During the work, the crankshaft must not be turned nor the crankcase inverted.

Thread size	Torque
10 mm	39 – 47 N·m (4.0 – 4.8 kg·m, 29 – 35 ft·lb)
8 mm	23 – 26 N·m (2.3 – 2.7 kg·m, 17 – 20 ft·lb)
6 mm	4.4 – 5.4 N·m (0.45 – 0.55 kg·m, 3.3 – 4.0 ft·lb)

d. Remove all bolts and separate crankcase. Measure the plastigauge width with the scale printed on the plastigauge case.



A5-084

Fig. 3-135 Measuring oil clearance of crank journal

If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

ENGINE

- In case that the oil clearance of crankshaft bearings does not reach the limit and the engine knocking noise is generated, select under size bearings in suitable size to minimize the oil clearance within the standard range as shown in the following table "Crankshaft oil clearance".

NOTE:

- When selecting crankshaft bearings, the following combination can be made as well as using same size bearings for both right and left crankcase halves:

The following table summarizes the amounts of reduction in oil clearance for various combination of bearing halves.

- If you use undersize bearings, please confirm that the crankshaft can be turned smoothly by hand [at a torque of 15 N·m (1.5 kg·m, 11 ft·lb) or less], to prevent the bearings from seizing after assembling the crankcase just before installing the pistons.

Combination of crankshaft bearing

Crankshaft bearing size		Left side crankcase		
		Standard	0.03 mm (0.0012 in) undersize	0.05 mm (0.0020 in) undersize
Right side crankcase	Standard	0 mm (0 in)	0.015 mm (0.0006 in)	Not recommended
	0.03 mm (0.0012 in) undersize	0.015 mm (0.0006 in)	0.03 mm (0.0012 in)	0.04 mm (0.0016 in)
	0.05 mm (0.0020 in) undersize	Not recommended	0.04 mm (0.0016 in)	0.05 mm (0.0020 in)

Crankshaft oil clearance			
Engine		1,800 cc	1,600 cc
Standard	Center	0.010 – 0.025 mm (0.0004 – 0.0010 in)	0.010 – 0.030 mm (0.0004 – 0.0012 in)
	Front & Rear	0.010 – 0.030 mm (0.0004 – 0.0012 in)	0.010 – 0.035 mm (0.0004 – 0.0014 in)
Limit	Center	0.045 mm (0.0018 in)	
	Front & Rear	0.055 mm (0.0022 in)	

ENGINE

Dimensions of bearing				
Crankshaft bearing size	Thickness of bearing at center			
	1,800 cc engine		1,600 cc engine	
	Front & Rear	Center	Front & Rear	Center
Standard	2.015 – 2.019 mm (0.0793 – 0.0795 in)	2.015 – 2.028 mm (0.0793 – 0.0798 in)	2.001 – 2.008 mm (0.0788 – 0.0791 in)	2.003 – 2.015 mm (0.0789 – 0.0793 in)
0.03 mm (0.0012 in) undersize	2.030 – 2.034 mm (0.0799 – 0.0801 in)	2.030 – 2.043 mm (0.0799 – 0.0804 in)	2.017 – 2.030 mm (0.0794 – 0.0799 in)	2.017 – 2.030 mm (0.0794 – 0.0799 in)
0.05 mm (0.0020 in) undersize	2.040 – 2.044 mm (0.0803 – 0.0805 in)	2.040 – 2.053 mm (0.0803 – 0.0808 in)	2.022 – 2.035 mm (0.0796 – 0.0801 in)	2.022 – 2.035 mm (0.0796 – 0.0801 in)
0.25 mm (0.0098 in) undersize	2.140 – 2.144 mm (0.0843 – 0.0844 in)	2.140 – 2.153 mm (0.0843 – 0.0848 in)	2.122 – 2.135 mm (0.0835 – 0.0841 in)	2.122 – 2.135 mm (0.0835 – 0.0841 in)

7) Inspect the crankshaft gear teeth and the surface on which oil seal slides for wear, damage, etc., and replace if defective.

8) Inspect distributor drive gear for tooth surface damage, and proper fit of woodruff key, and replace if defective.

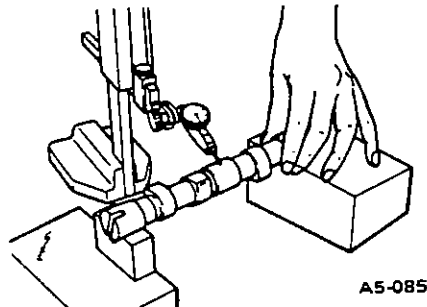
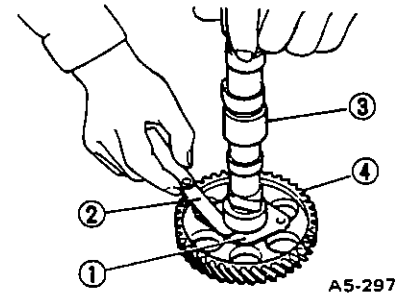


Fig. 3-136 Checking camshaft bend



1 Camshaft plate 3 Camshaft
2 Thickness gauge 4 Cam gear

Fig. 3-137 Measuring thrust clearance

16. Camshaft

1) Measure the camshaft bend, and correct or replace if it exceeds the limit.

NOTE:

When the camshaft is replaced, the valve filters also must be replaced.

Bend limit	0.05 mm (0.0020 in)
------------	---------------------

2) Measure the thrust clearance between camshaft and camshaft plate. If it exceeds the limit, remove cam gear and replace plate.

Camshaft thrust clearance	
Standard	0.020 – 0.090 mm (0.0008 – 0.0035 in)
Limit	0.2 mm (0.008 in)

3) Inspect the journals, and replace if damaged or worn.

4) Inspect the cam surface for damage, and measure the total height of the cam. Replace camshaft, if damaged noticeably or worn beyond the limit. If damaged only to a minor degree, grind and correct with an oil stone.

NOTE:

a. The cam lobe is provided with taper of 4 minutes to cause the valve lifter to rotate. Be sure to retain this taper.

ENGINE

Specifications of cam lobe height (intake and exhaust)		
Standard (Dimension "H")	With solid	32.24 – 32.34 mm (1.2693 – 1.2732 in)
	With solid	35.90 – 36.00 mm (1.4134 – 1.4173 in)
Wear limit		0.15 mm (0.0059 in)
Dimension "D"	With conventional valve lifter	27 mm (1.06 in)
	With hydraulic valve lifter	31 mm (1.22 in)

8) Measure the backlash between cam gear and crankshaft gear, by using Magnet Base (498247001) and Dial Gauge (498247100). Replace cam gear if the measurement exceeds the specified limit.

Backlash between crankshaft gear and cam gear	
Standard	0.010 – 0.050 mm (0.0004 – 0.0020 in)
Limit	0.10 mm (0.0039 in)

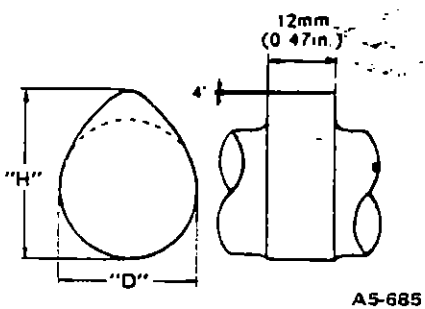


Fig. 3-138 Cam lobe shape

b. If a new cam is used, check its identification mark and groove.

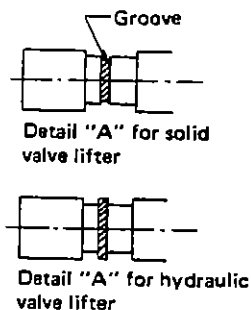
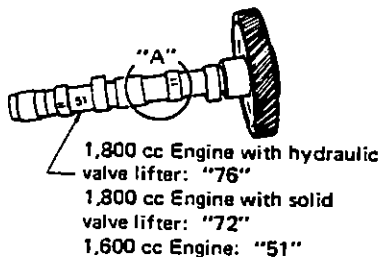


Fig. 3-139 Cam identification

c. Whenever the camshaft is replaced because of its abnormality, replace the valve lifters with new ones too.

5) Inspect the fit of woodruff key (5 x 6.5 x 20 mm) in the camshaft key groove and cam gear key groove, and if defective replace key or gear, or correct the key groove.

6) Inspect camshaft and cam gear contact surfaces for cracks or other damage, and the cam gear tooth surface for wear. Replace cam gear if defective.

7) Measure the cam gear run-out, and replace cam gear if the run-out exceeds the limit.

Limit of run-out	0.25 mm (0.0098 in)
------------------	---------------------

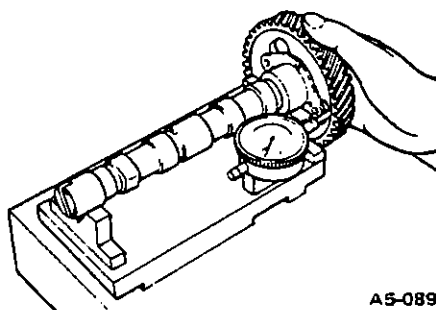
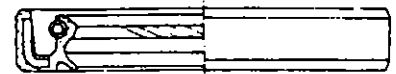


Fig. 3-140 Checking cam gear run-out

ENGINE

Standard inner diameter of camshaft journal bores	Front & Center	1,800 cc	32.000 – 32.018 mm (1.2598 – 1.2605 in)
		1,600 cc	26.000 – 26.018 mm (1.0236 – 1.0243 in)
	Rear	36.000 – 36.018 mm (1.4173 – 1.4180 in)	
Standard outer diameter of camshaft journal	Front & Center	1,800 cc	31.959 – 31.975 mm (1.2582 – 1.2589 in)
		1,600 cc	25.959 – 25.975 mm (1.0220 – 1.0226 in)
	Rear	35.959 – 35.975 mm (1.4157 – 1.4163 in)	
Clearance between camshaft journal and journal bore	Standard	0.025 – 0.059 mm (0.0010 – 0.0023 in)	
	Limit	0.100 mm (0.0039 in)	



A5-092

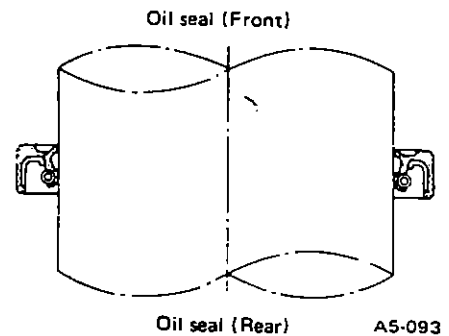
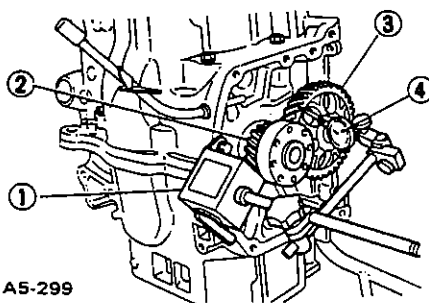


Fig. 3-143 Oil seal

NOTE:

The oil seal (Front) can be detached by separating the crankcase. Reinstallation is performed by using Oil Seal Installer (499067000).



A5-299

- | | |
|------------------------------|-----------------------------|
| 1 Magnet Base
(498247001) | 3 Cam gear |
| 2 Crankshaft gear | 4 Dial Gauge
(498247100) |

Fig. 3-141 Measure backlash

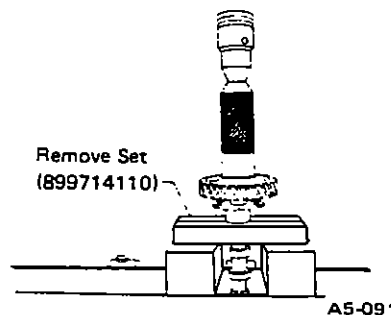


Fig. 3-142 Installing cam gear

17. Oil Seals

Inspect oil seal fitted in flywheel housing and the oil seal fitted at the crankshaft front end for lip wear, damage, hardening, etc., and replace if defective.

NOTE:

When replacing the cam gear, use Remover Set (899714110). Measure the thrust clearance as described in 2) after replacement, and adjust to the specification.

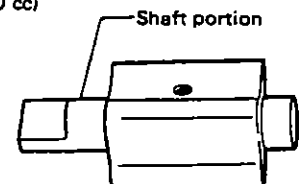
Oil seal	1,800 cc	1,600 cc
Front	38 x 59 x 9 mm (1.50 x 2.32 x 0.35 in)	38 x 55 x 9 mm (1.50 x 2.17 x 0.35 in)
Rear	76 x 93 x 10 mm (2.99 x 3.66 x 0.39 in)	70 x 87 x 8.5 mm (2.76 x 34.3 x 0.335 in)

18. Oil Pump

Wash the disassembled parts, check them for the following items, and repair or replace if defective.

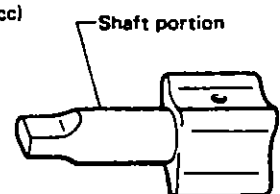
- 1) Oil pump drive gear and rotor
 - a. Check the outside diameter of the shaft portion, and replace oil pump drive gear if worn or damaged considerably.

(1800 cc)



A6-018

(1600 cc)



A6-004

Fig. 3-144

ENGINE

- b. Check both the gear and rotor and replace if worn or damaged considerably.

Outside diameter of drive gear	29.70 – 29.74 mm (1.1693 – 1.1709 in)
Outside diameter of rotor	40.53 – 40.56 mm (1.5957 – 1.5968 in)

- c. Tip clearance between pump drive gear and pump rotor
Measure the tip clearance and replace both the drive gear and rotor as a set if the clearance exceeds the limit.

Drive gear-to-rotor tip clearance	Stand-ard	0.02 – 0.12 mm (0.0008 – 0.0047 in)
	Limit	0.2 mm (0.008 in)

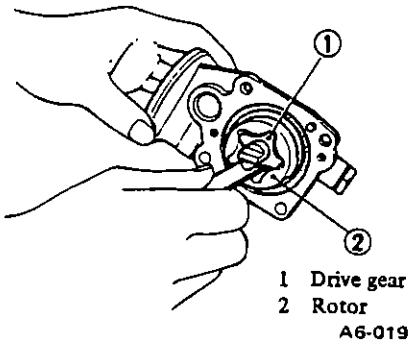
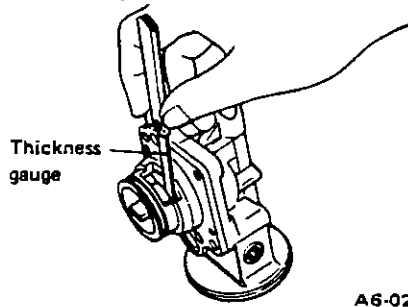


Fig. 3-145 Measuring drive gear-to-rotor clearance

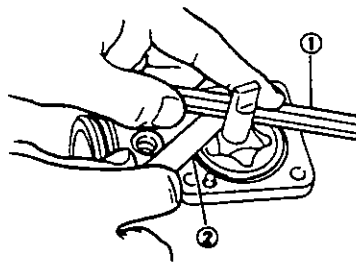
- d. Side clearance between pump case and pump rotor and between pump case and drive gear
Measure the side clearance and replace either the rotor or case as necessary if the clearance exceeds the limit.

Rotor-to-case and gear-to-case clearance	Stand-ard	0.03 – 0.13 mm (0.0012 – 0.0051 in)
	Limit	0.2 mm (0.008 in)

(1800 cc engine)



(1600 cc engine)



- 1 Straight edge
2 Thickness gauge

Fig. 3-146 Measuring rotor-to-case and gear-to-case clearance

- e. Radial clearance between pump rotor and pump case
Replace either the rotor or case as necessary if the clearance exceeds the limit.

Rotor-to-case radial clearance	Stand-ard	0.15 – 0.21 mm (0.0059 – 0.0083 in)
	Limit	0.25 mm (0.0098 in)

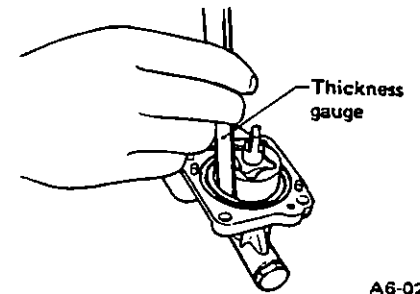
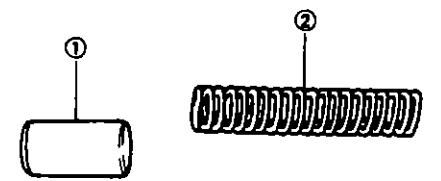


Fig. 3-147 Measuring rotor-to-case clearance

- 2) Oil relief valve and relief valve spring

Check the valve for fitting condition and damage, and the relief valve spring for damage and deterioration. Replace the parts if defective.

Relief valve spring	
Free length	47.1 mm (1.854 in)
Installed length	33.5 mm (1.319 in)
Load when installed	38.05 – 41.97 N (3.88 – 4.28 kg, 8.56 – 9.44 lb)



- 1 Oil relief valve
2 Relief valve spring

Fig. 3-148 Oil relief valve and spring

- 3) By-pass valve and spring
The checking method is as same as that of paragraph 2).

	By-pass valve spring	
	1,800 cc	1,600 cc
Free length	37.1 mm (1.461 in)	40.7 mm (1.602 in)
Installed length	25.1 mm (0.988 in)	31.1 mm (1.224 in)
Load when installed	5.178 – 6.159 N (0.528 – 0.628 kg, 1.164 – 1.385 lb)	3.580 – 3.972 N (0.365 – 0.405 kg, 0.805 – 0.893 lb)

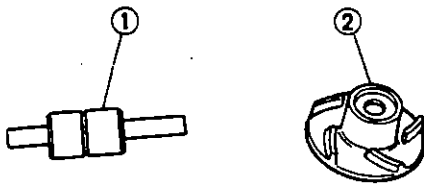
- 4) Oil pump holder
Check the pump shaft hole for wear, and other surfaces for damage.
- 5) Oil pump case
Check the oil pump case for clogged oil passage, worn rotor chamber, cracks, and other faults.

19. Water Pump

NOTE:

Clean all the disassembled parts thoroughly.

- 1) Inspect the pump shaft for wear, damage, and operation.



- 1 Water pump shaft
- 2 Water pump impeller

A7-063

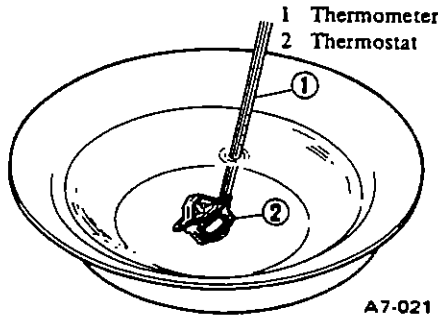
Fig. 3-149 Shaft and impeller

- 2) Inspect the impeller surface that contacts the mechanical seal for wear and damage.

- 3) Inspect the other parts for crack, wear and damage, and replace if defective.

20. Thermostat

Replace the thermostat if the valve does not close completely at an ambient temperature or if the following test shows unsatisfactory results. Immerse the thermostat and a thermometer in water. Raise water temperature gradually, and measure the temperature and valve lift when the valve begins to open and when the valve is fully opened. During the test, agitate the water for even temperature distribution. The measurement should be to the specification.



A7-021

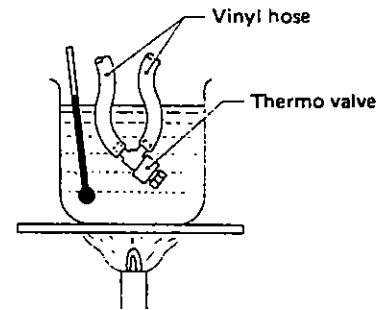
Fig. 3-150 Temperature test for thermostat

21. Thermo Valve

Connect vinyl tubes to output ports of thermo valve.

Soak the valve in cool water [approx. 10°C (50°F)] for some time, and then heat the water.

Blow air into the valve through one vinyl tube, and confirm that the valve opens or closes in response to the specified temperature. (Refer to page 3-5)



A5-687

Fig. 3-151

3-8. Assembly

1. Precautions

- 1) All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
- 2) Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to ASSY.
- 3) All removed parts, if to be reused, should be reinstalled in the original positions and directions.
- 4) Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
- 5) Bolts, nuts and washers should be replaced with new ones as required.

- 6) Even if necessary inspections have been made in advance, proceed with ASSY work while making rechecks.

NOTE:

In the following procedures, items with ★ mark should be rechecked.

2. Intake Manifold Assembly

1. NON-TURBO VEHICLE

1) Hitachi Carburetor Type

- 1) Install thermostat and thermostat cover with new gasket.

NOTE:

Install it with the jiggle pin upward.

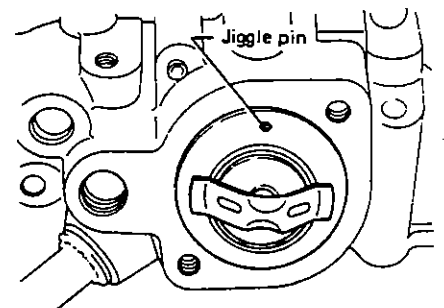


Fig. 3-152

A5-598

- 2) Install the following parts.
 - a. Thermo vacuum valve II.

Torque	23 - 26 N·m (2.3 - 2.7 kg-m, 17 - 20 ft-lb)
--------	---

ENGINE

NOTE:

- a. Apply liquid gasket (Three Bond 1201 -P/N 004403008, or equivalent) on the thread.
- b. Install thermo valve with its pipe outlet facing outside.
- b. Stay & clip, clip and actuator ASSY (A/C only).
- c. Solenoid valve I, bracket and protector stay.
- d. Thermosensor.

NOTE:

Be careful not to bend the terminal.

- e. Accelerator cable bracket.
- f. P.C.V. valve.

Torque	23 - 26 N-m (2.3 - 2.7 kg-m, 17 - 20 ft-lb)
--------	---

NOTE:

Apply liquid gasket (Fuji Bond C or equivalent) on the thread.

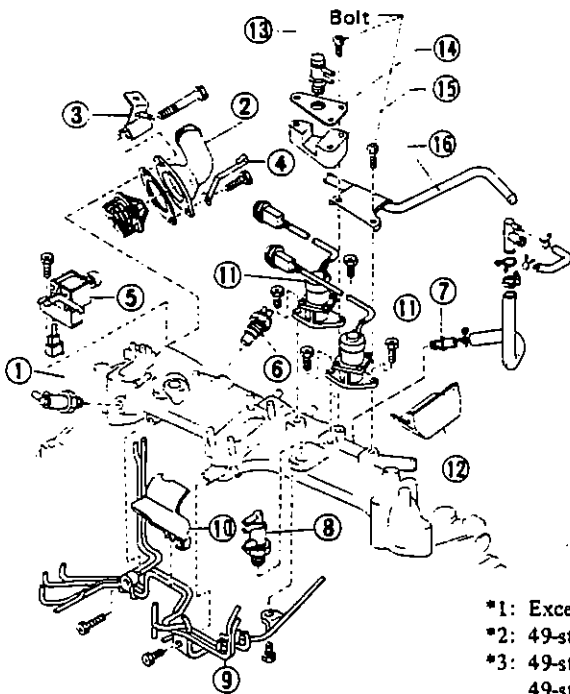
- g. Thermo vacuum valve I.

Torque	23 - 26 N-m (2.3 - 2.7 kg-m, 17 - 20 ft-lb)
--------	---

NOTE:

Install thermo valve with its pipe outlet facing forward.

- h. Vacuum pipe CP with carburetor protector 3, and vacuum hoses.
- i. Control air cleaner, P.C.V. hose, duty solenoid valves, carburetor protector 2 and hoses.
- j. Heater hose and purge hose.



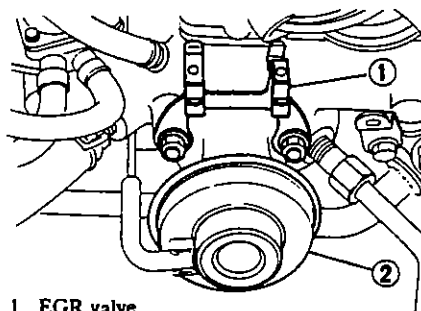
- 1 Thermo vacuum valve II*1
- 2 Thermostat cover
- 3 Solenoid valve bracket*3
- 4 Protector stay*1
- 5 Solenoid valve I*3
- 6 Thermosensor
- 7 PCV valve
- 8 Thermo vacuum valve I
- 9 Vacuum pipe CP
- 10 Carburetor protector 3*1
- 11 Duty solenoid valve*1
- 12 Carburetor protector 2*1
- 13 Thermo valve IV*2
- 14 Bracket*2
- 15 Insulator*2
- 16 Anti-afterburning pipe*2

- *1: Except 49-state 4WD and Canada
- *2: 49-state 4WD and Canada
- *3: 49-state non-4WD and California, 49-state 4WD, Canada AT and 4WD AT

Fig. 3-153

A5-803

- 3) Install carburetor with two gaskets and an insulator, and connect hoses.
- 4) Install E.G.R. valve with gasket and connector clamp, and connect hose.



- 1 EGR valve
- 2 Connector clamp

Fig. 3-154

A5-689

- 5) Attach electric wiring harness, connect electric connectors, and then clip harness.

2) C-W Carburetor Type

- 1) Install thermostat and thermostat cover with new gasket.

NOTE:

Install it with the jiggle pin upward.

- 2) Install the following parts.

- a. Stay & clip.
- b. Clip.
- c. Gasket, thermostat cover, solenoid valve I and bracket, and connect hose.
- d. Thermosensor.

NOTE:

Be careful not to bend the terminal.

- e. P.C.V. valve.

Torque	23 - 26 N-m (2.3 - 2.7 kg-m, 17 - 20 ft-lb)
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NOTE:

Apply liquid gasket (Fuji Bond C or its equivalent) on the thread.

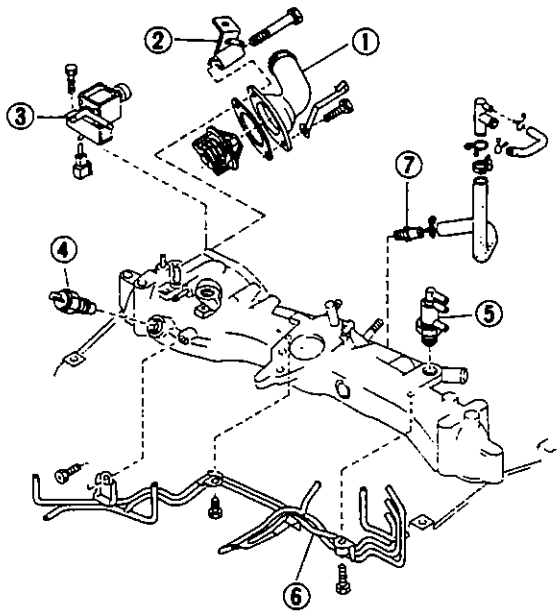
- f. Thermo vacuum valve I.

Torque	23 - 26 N-m (2.3 - 2.7 kg-m, 17 - 20 ft-lb)
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NOTE:

Install the valve with its pipe facing outside.

- g. Vacuum pipe CP and vacuum hoses.

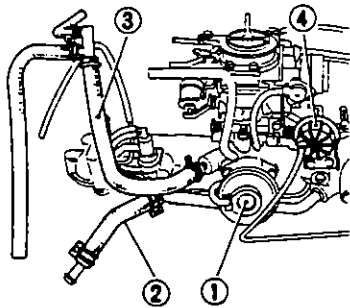


- 1 Thermostat cover
- 2 Solenoid valve bracket
- 3 Solenoid valve I
- 4 Thermosensor
- 5 Thermo vacuum valve I
- 6 Vacuum pipe CP
- 7 PCV valve

A5-804

Fig. 3-155

- 3) Install carburetor with two gaskets and an insulator, and connect hoses.
- 4) Install the following parts.
 - a. E.G.R valve with gasket, and hose.
 - b. Heater hose.
 - c. P.C.V. hose ASSY.
 - d. (A/C only) FICD actuator and hose.



- 1 Heater hose
- 2 EGR valve
- 3 PCV hose ASSY
- 4 Actuator (A/C only)

A5-691

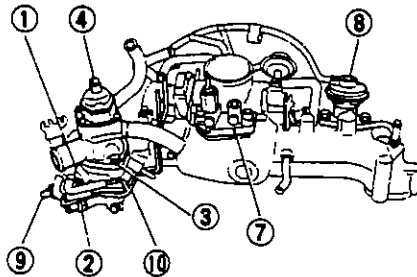
Fig. 3-156

- 5) Attach electric wiring harness, connect electric connectors, and then clip harness.

2. TURBO VEHICLE

- 1) Attach the following parts to the intake manifold:

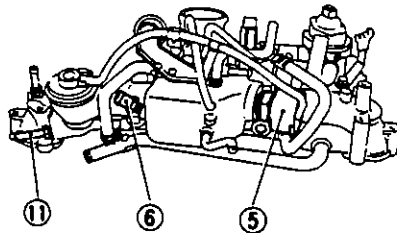
Front view



- 1 Thermometer CP
- 2 Coolant thermosensor
- 3 Thermostat cover and gasket
- 4 Auxiliary air valve and gasket
- 7 Throttle body and gasket
- 8 EGR valve and gasket
- 9 Thermo valve
- 10 Vacuum pipe CP

A5-759

Rear view



- 5 Air relief valve
- 6 PCV valve
- 11 EGR pipe

Fig. 3-157

A5-760

- Thermometer

Torque	25 ± 2 N·m (2.5 ± 0.2 kg·m, 18.1 ± 1.4 ft·lb)
--------	---

- Coolant thermosensor

Torque	25 ± 5 N·m (2.5 ± 0.5 kg·m, 18.1 ± 3.6 ft·lb)
--------	---

- Thermostat

- Thermostat cover and gasket

NOTE:

Also attach the spark plug cord stay and hose.

- Auxiliary air valve and gasket

- Air relief valve

Torque	69 – 98 N·m (7 – 10 kg·m, 51 – 72 ft·lb)
--------	--

NOTE:

Apply a coat of liquid packing to threaded areas.

- PCV valve

Torque	25 ± 2 N·m (2.5 ± 0.2 kg·m, 18.1 ± 1.4 ft·lb)
--------	---

NOTE:

Apply a coat of liquid packing to threaded areas.

- Throttle body and gasket

Torque	15.7 ± 1.5 N·m (1.6 ± 0.15 kg·m, 11.6 ± 1.1 ft·lb)
--------	--

- EGR valve and gasket

Torque	15.7 ± 1.5 N·m (1.6 ± 0.15 kg·m, 11.6 ± 1.1 ft·lb)
--------	--

- Thermo valve

Torque	25 ± 2 N·m (2.5 ± 0.2 kg·m, 18.1 ± 1.4 ft·lb)
--------	---

ENGINE

NOTE:

Always install the valve with its nipple facing 45-degree upward.

- Vacuum pipe
- EGR pipe
- 2) Connect the various hoses.
- Water preheating hose of throttle body

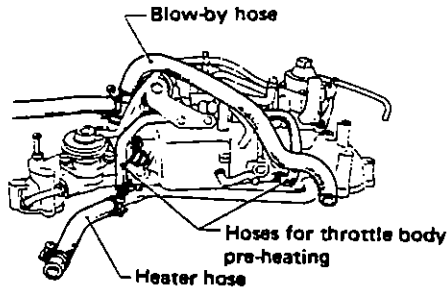


Fig. 3-158

A5-761

- Heater hose
- Blow-by hose.
- Vacuum hoses

NOTE:

Refer to the label for piping instructions or parts catalogue.

3) Installing the pressure regulator.

NOTE:

- a. Install the harness clip.
- b. Do not use bolt to fasten the stay together with the ground terminal.
- c. Connect hoses with pressure regulator.

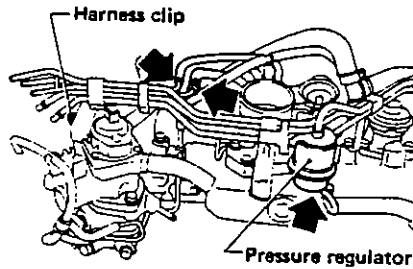


Fig. 3-159

A5-762

- 4) Connect the wiring harness.
 - Auxiliary air valve
 - Throttle switch
 - FICD solenoid valve
 - Thermometer
 - Coolant thermosensor
 - Ground terminal ... Tighten together with the pressure regulator stay.

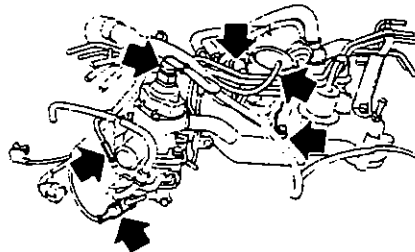


Fig. 3-160

A5-763

NOTE:

See Parts catalogue for the clip positions and clip band facings of the wiring harness.

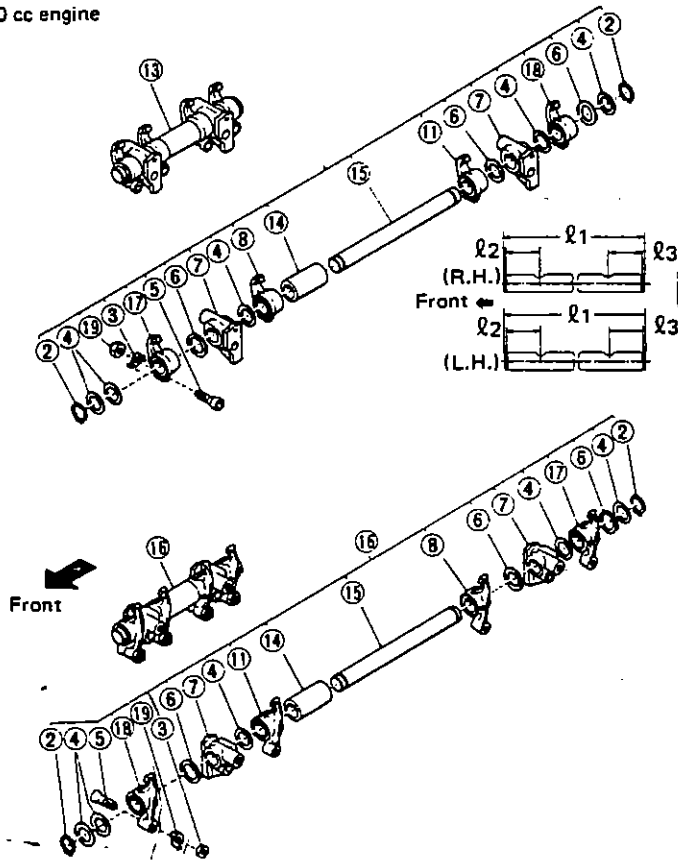
3. Valve Rocker Assembly

NOTE:

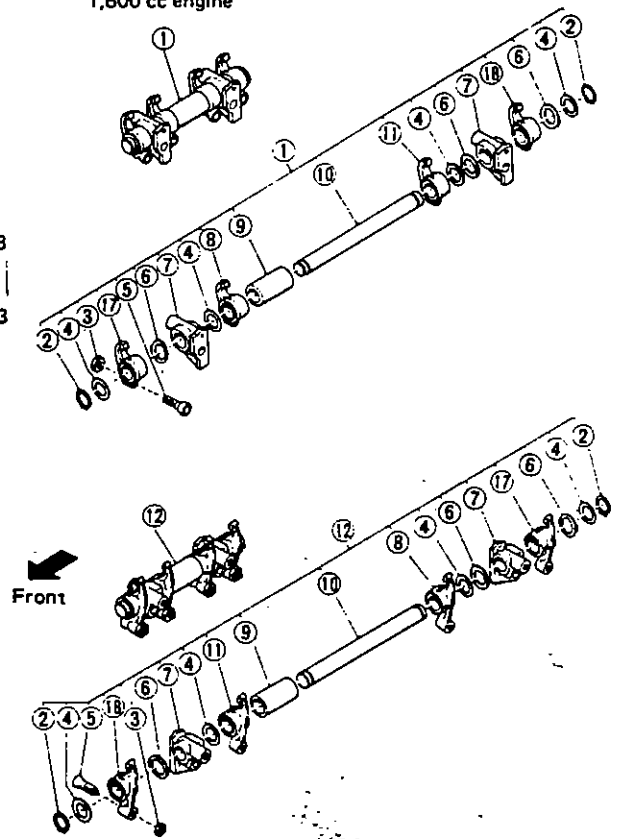
- a. Pay special attention to the direction of the rocker shaft, the position of the spring washers, the number of plain washers, the difference between the rocker arms, and the marks on the spacer.
- b. Before assembling, apply a generous amount of oil to the sliding surface of each part.

Valve rocker assembly		
	1,800 cc	1,600 cc
ℓ ₁	180.6 mm (7.11 in)	176.9 mm (6.96 in)
ℓ ₂	35.8 mm (1.409 in)	34.2 mm (1.346 in)
ℓ ₃	34.8 mm (1.370 in)	33.2 mm (1.307 in)
Mark on spacer (RH)	<u>RH</u>	RH
Mark on spacer (LH)	<u>LH</u>	LH

1,800 cc engine



1,600 cc engine



- 1 Valve rocker ASSY (R.H.)
- 2 Snap ring
- 3 Nut
- 4 Washer
- 5 Valve rocker screw
- 6 Rocker shaft spring washer
- 7 Rocker shaft supporter
- 8 Valve rocker arm CP
- 9 Rocker shaft spacer
- 10 Valve rocker shaft

- 11 Valve rocker arm CP 2
- 12 Valve rocker ASSY (L.H.)
- 13 Valve rocker ASSY (R.H.)
- 14 Rocker shaft spacer
- 15 Valve rocker shaft
- 16 Valve rocker
- 17 Valve rocker arm
- 18 Valve rocker arm 2
- 19 Lock washer (only for hydraulic valve lifter)

A5-692

Fig. 3-161 Assembling valve rocker parts

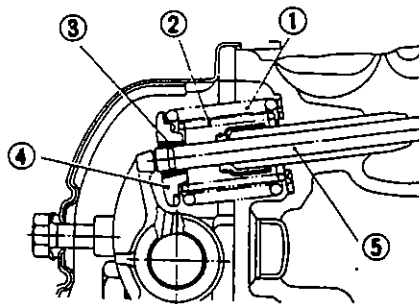
4. Cylinder Head

1) Press oil seal onto intake valve guide.

NOTE:

Apply oil to the oil seal prior to pressing.

2) Apply oil to stems of intake and exhaust valves prior to installation.
 3) Install intake and exhaust valves with inner and outer valve springs, valve spring retainers and retainer keys on cylinder head by using Valve Spring Press (899724100).



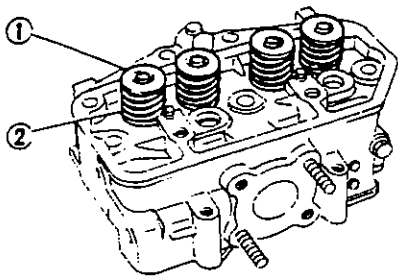
- 1 Outer valve spring
- 2 Inner valve spring
- 3 Retainer key
- 4 Valve spring retainer
- 5 Valve stem

A5-324

Fig. 3-162 Installing valve and related parts

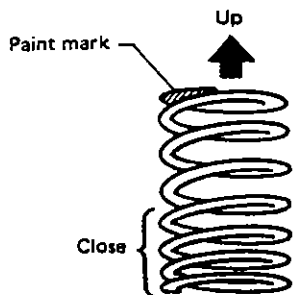
NOTE:

- a. Take care not to damage the lips of the intake valve oil seals when installing the intake valves.
- b. Place the inner and outer valve springs with the paint mark toward the valve spring retainer, or with the close coil side toward the cylinder head.
- c. After installing all the parts, tap the spring top lightly with a plastic hammer or the like to give better seating of the valve.



- 1 Valve spring retainer
- 2 Close coil side

A5-325



A5-326

Fig. 3-163 Installed direction of valve spring

4) Install spacer with gasket for air injection system.

Discrimination mark on spacer		
* For right-hand side (#1 & #3) cylinder head	1600 Engine	7
	1800 Engine	8
For left-hand side (#2 & #4) cylinder head		LH

* Only for 49-state (except 4WD & 4WD-AT)

5. Crankshaft

1) Install connecting rod bearings on connecting rods and connecting rod caps.

NOTE:

Apply oil to the surfaces of the connecting rod bearings.

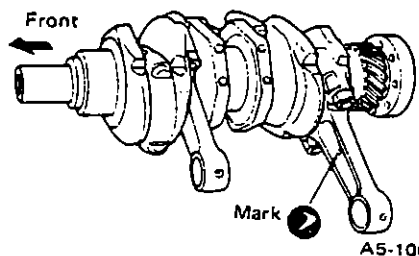
2) Install connecting rods and connecting rod caps on crankshaft with connecting rod bolts and nuts.

Torque (Connecting rod nut)	39 - 42 N·m (4.0 - 4.3 kg·m, 29 - 31 ft·lb) with oil on threads
-----------------------------	--

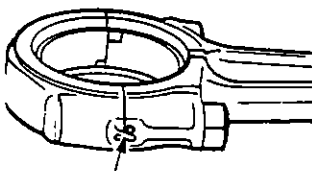
NOTE:

- a. Position each connecting rod with the side marked **7** facing forward.
- b. Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.
- c. When tightening the connecting rod nuts, apply oil on the threads.

* Side clearance and oil clearance



A5-100

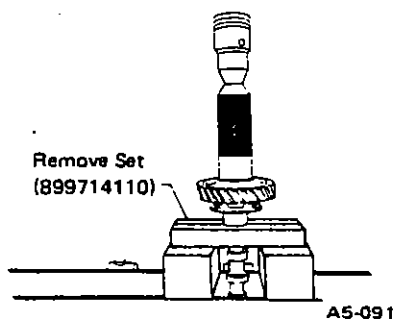


A5-101

Fig. 3-164 Installing connecting rods

6. Camshaft

Install woodruff key on camshaft. Place camshaft plate in position and install cam gear by using Remover Set (899714110).



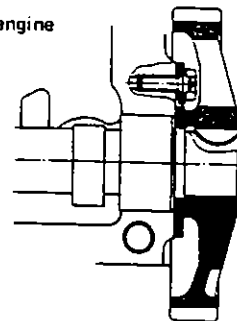
A5-091

Fig. 3-165 Installing cam gear

NOTE:

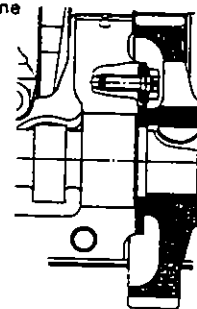
a. Pay attention to the assembling direction of camshaft plate and cam gear.

1,800 cc engine



A5-328

1,600 cc engine



A5-329

Fig. 3-166 Camshaft plate and cam gear

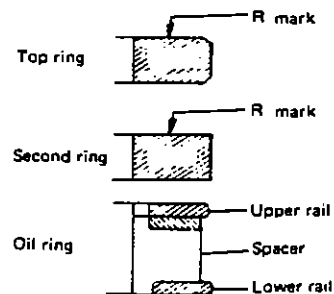
b. Place the camshaft journal on Remover Set (899714110) when pressing the cam gear.

* Thrust clearance

7. Piston

1) Install piston rings on pistons as follows.

Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.



A5-073

Fig. 3-167 Cross section of piston rings (Riken Piston Ring)

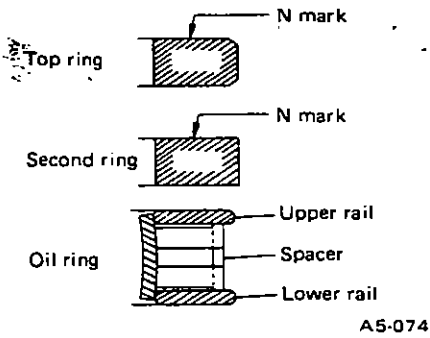


Fig. 3-168 Cross section of piston rings (Nippon Piston Ring)

NOTE:

- a. Position the gaps of the piston rings.

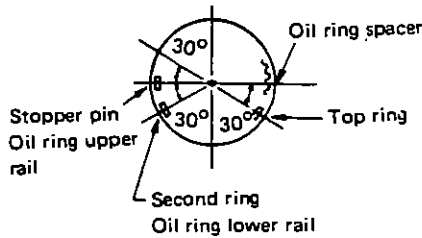
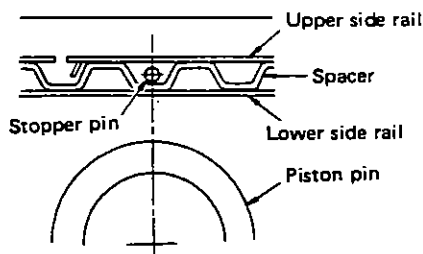


Fig. 3-169 Piston ring gap position

- b. Install oil ring as shown in the figure.

(Riken Piston Ring)



A5-331

(Nippon Piston Ring)

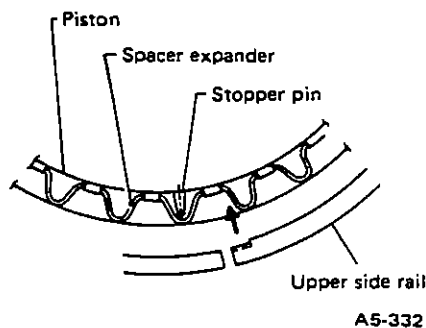


Fig. 3-170 Installation of oil ring

c. Position stopper pins.

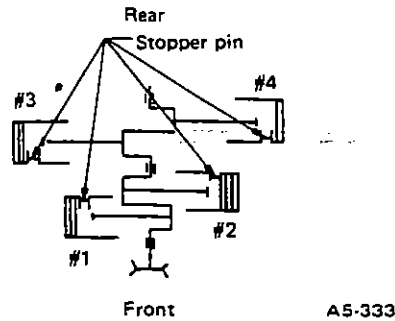


Fig. 3-171 Stopper pin position

- d. The top and second rings are provided with "R" or "N" mark as shown in Figs. 5-84 and 5-85. Be sure to install the rings with this mark facing upward.

★ Ring to groove clearance

- 2) Insert piston pin circlip into the stopper pin side of the piston.

NOTE:

- a. The installed circlip should be directed as shown in the figure.

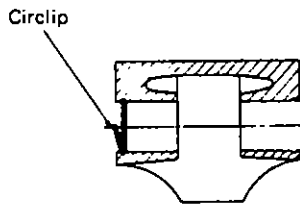


Fig. 3-172 Installed direction of circlip

- b. If the piston pin hole has burrs made by the circlip end during its removal, correct so that the piston pin can be inserted smoothly into the piston pin hole with fingers.

8. Oil Pump

NOTE:

Replace washers and O-rings with new ones.

- 1) Assemble oil relief valve, spring, two washers and plug in pump body.

- 2) Assemble ball, by-pass valve spring and O-ring in pump body.
- 3) Assemble oil pump rotor, drive gear, O-ring and pump body holder in pump body.
- 4) Install oil filter.

9. Water Pump

NOTE:

- a. Replace the mechanical seal with a new one.
- b. Apply liquid gasket where required.

- 1) Install the water pump shaft into pump body with a press.

NOTE:

- a. Before pressing, heat the pump body to 80 to 100°C (176 to 212°F).
- b. Do not press the shaft, or the bearings will be damaged. Press the bearing outer race.

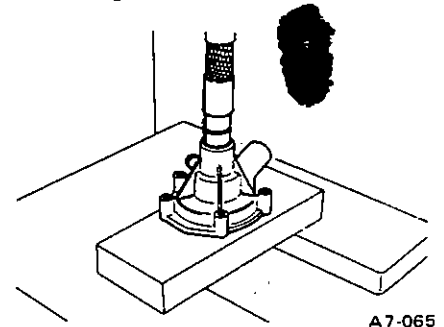


Fig. 3-173 Pressing water pump shaft

- 2) Apply liquid gasket (Fuji Bond D or equivalent) to the periphery of the mechanical seal and press the seal into the pump body with the carbon washer of the seal facing the impeller.
- 3) With a thin coat of oil on the shaft surface, install the impeller onto the pump shaft with a press.

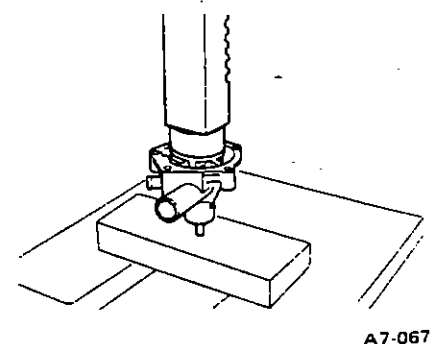


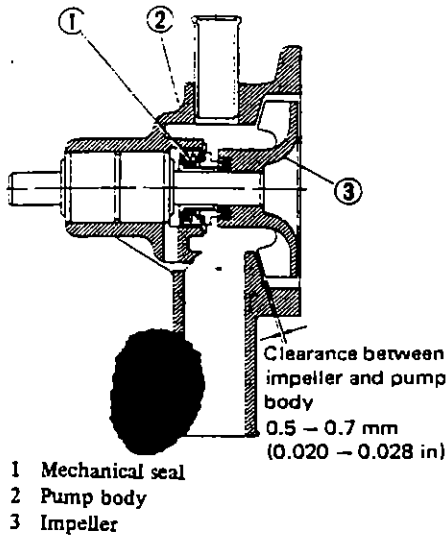
Fig. 3-174 Installing impeller

NOTE:

Apply coolant on the sliding surface between mechanical seal and impeller.

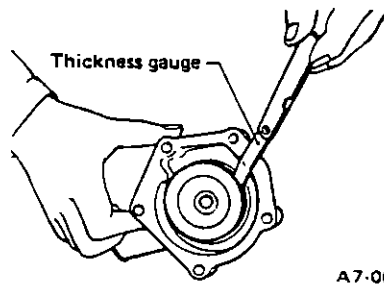
Check for the following clearance after installation and correct if defective.

Clearance between impeller and pump body	0.5 – 0.7 mm (0.020 – 0.028 in)
--	------------------------------------



A7-089

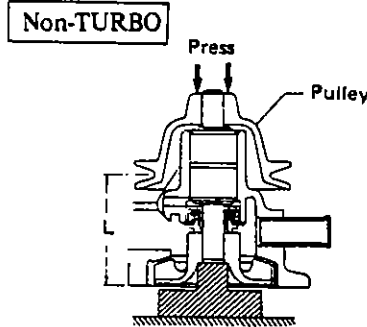
Fig. 3-175 Impeller clearances



A7-069

Fig. 3-176 Checking impeller-to-pump body clearance

4) Support the impeller side of the pump shaft end and install the pulley by using a press until the distance "L" between the pump body surface, which mates with the gasket, and the center of belt groove of the pulley becomes specified value.



A7-101

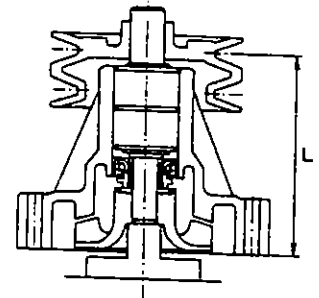
Fig. 3-177

L	
1800 cc Engine	1600 cc Engine
61.1 – 61.7 mm (2.406 – 2.429 in)	64.1 – 64.7 mm (2.524 – 2.547 in)

NOTE:

Before pressing, apply oil on the pump shaft.

TURBO



A5-767

Fig. 3-178

L	92.1 – 92.7 mm (3.626 – 3.650 in)
---	--------------------------------------

NOTE:

In the following procedures, items with * mark should be rechecked.

3-9. Installation

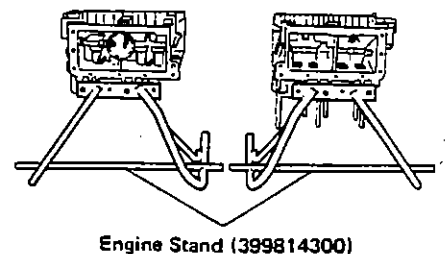
1. Precautions

- 1) All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons, cylinders and bearings.
- 2) Rotating parts and sliding parts such as the piston, cylinder, bearing and gear should be coated with oil prior to reinstallation.
- 3) All removed parts, if to be reused, should be reinstalled in the original positions and directions.
- 4) Oil seal lips should be coated with grease before reinstallation.
- 5) Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.

- 6) Bolts, nuts, washers, and cotter pins should be replaced with new ones as required.
- 7) Even if necessary inspections have been made in advance, proceed with reinstallation work while making rechecks.
- 8) If one or both of the cylinder heads are removed in engine disassembly, perform the retightening of the cylinder head nuts and intake manifold bolts and the adjustment of the valve clearances (except engine with hydraulic valve lifter) after the engine has been assembled, mounted on the car, run for about 10 minutes, and cooled down to ambient temperature.

2. Non-TURBO Vehicle

- 1) Install Engine Stand (399814300) to each crankcase half.



A5-335

Fig. 3-179 Installing engine stand

2) Install oil pressure switch (Vehicle without pressure gauge) or plug (Vehicle with pressure gauge) on crankcase. Before installation, apply liquid gasket (Fuji Bond C or equivalent) to the threads of pressure switch body or plug body.

Torque	22 – 27 N·m (2.2 – 2.8 kg·m, 16 – 20 ft·lb)
--------	---

3) Install crankshaft bearings on crankcase.

★ Oil passage.

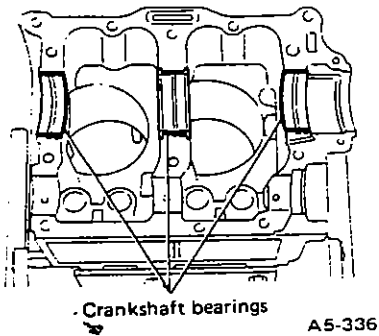


Fig. 3-180 Installing crankshaft bearings

4) Insert valve lifters into the lifter holes in crankcase and hold them on #1 and #3 cylinder side by using Valve Lifter Clip 899804100 (only for hydraulic valve lifter).

NOTE:

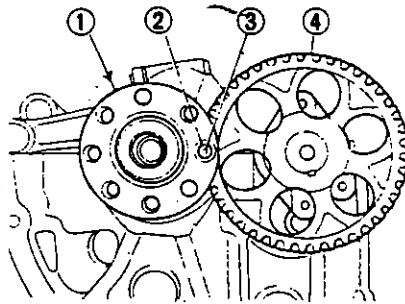
Apply oil to the valve lifters before installation.

5) Install crankshaft and camshaft on the crankcase half having #2 and #4 cylinders.

NOTE:

- a. Apply oil to the camshaft and crankshaft bearings before installation.
- b. One of the bolt holes in the crankshaft gear has a larger chamfer than others. Install the crankshaft so that the punch mark on the cam gear can be seen through this bolt hole in the crankshaft gear.
- c. Whenever the camshaft is replaced because of its abnormality, replace the valve lifters with new ones too.

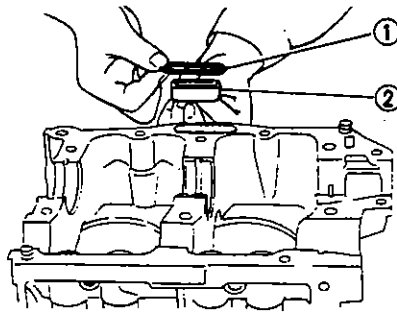
★ Oil clearance of crankshaft



- 1 Crankshaft gear
- 2 Large chamfer
- 3 Punch A5-337
- 4 Camshaft gear

Fig. 3-181 Aligning crankshaft and camshaft gears

6) Install O-ring and backup ring on the crankcase half having #2 and #4 cylinders.



- 1 O-ring
- 2 Backup ring

Fig. 3-182 Installing O-ring and backup ring

7) Apply liquid gasket (Fuji Bond C or equivalent) on the mating surface of crankcase.

NOTE:

Before applying liquid gasket, clean the mating surfaces of the crankcase so that they are free of oil, grease and dust by using thinner or the like.

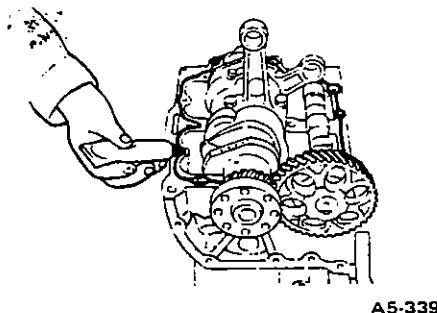


Fig. 3-183 Applying liquid gasket

8) Put Valve Lifter Clips (899804100) between valve lifters in the crankcase half having the #1 and #3 cylinders, to prevent lifters from dropping off (for solid valve lifter).

9) Bring together the crankcase halves and tighten the crankcase bolts and nut with a plain washer to the specified torques and in the specified sequence.

Torque for crankcase bolts and nut	
Thread size	Torque
10 mm 6	39 – 47 N·m (4.0 – 4.8 kg·m, 29 – 35 ft·lb)
8 mm 2	23 – 26 N·m (2.3 – 2.7 kg·m, 17 – 20 ft·lb)
6 mm 2	4.4 – 5.4 N·m (0.45 – 0.55 kg·m, 3.3 – 4.0 ft·lb)

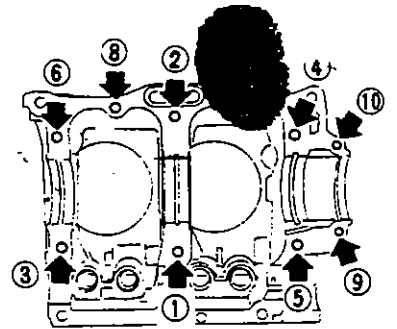


Fig. 3-184 Tightening sequence for crankcase bolts and nut

NOTE:

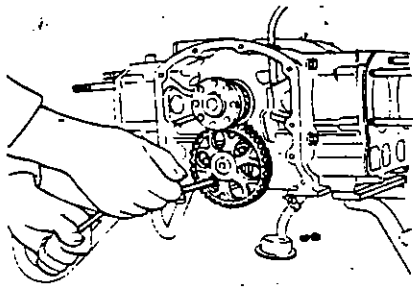
- a. Install the front hanger at this time.
- b. Pull cam gear fully.
- c. Make sure that the O-ring is installed exactly.
- d. Install stiffener (4WD) at this time temporarily.
- e. Take out Valve Lifter Clips (only for solid valve lifter).

10) Secure camshaft plate on crankcase with the two bolts and lock washers, working through the hole in cam gear.

NOTE:

Bend the lock washers to securely lock the bolts.

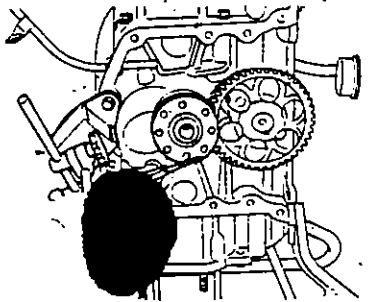
ENGINE



A5-278

Fig. 3-185 Installing camshaft plate

- ★ Backlash of cam gear
- ★ Thrust clearance of crankshaft



A5-342

Fig. 3-186 Checking crankshaft thrust clearance

NOTE:

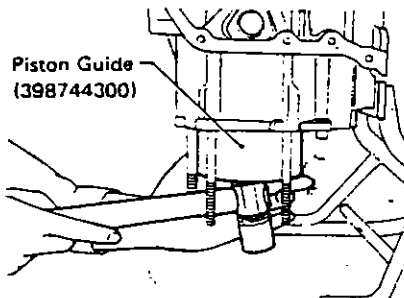
When measuring the backlash of cam gear and thrust clearance of crankshaft, use an appropriate plate as an attachment.

11) Install pistons in cylinder as follows.

- a. Apply oil to the circumference of piston and the inner surface of cylinder.
- b. With the #2 and #4 cylinders facing downwards, turn crankshaft until the #2 connecting rod comes to the bottom dead center. Then insert the #2 piston into cylinder by using Piston Guide (398744300).

NOTE:

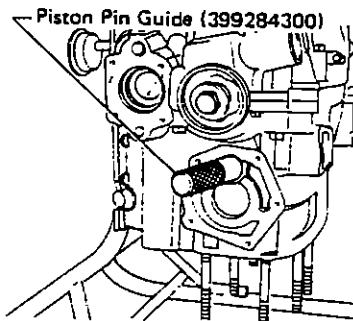
If any of the pistons are reused, be sure to direct them in the same way as before they were disassembled.



A5-343

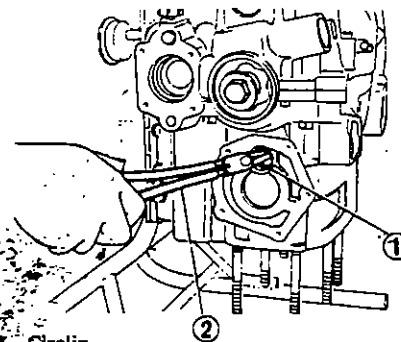
Fig. 3-187 Installing piston

c. Install piston pin and circlip through the front service hole after aligning the service hole, piston pin hole, and connecting rod small end with Piston Pin Guide (399284300).



A5-344

Fig. 3-188 Inserting piston pin



A5-345

Fig. 3-189 Installing circlip

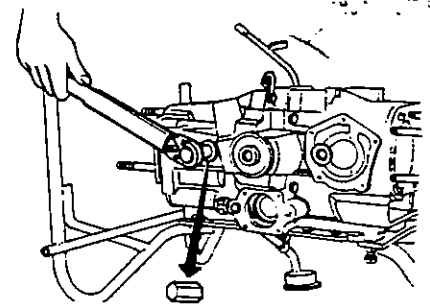
d. Install #4 piston, piston pin, circlip into cylinder in the same manner, but carry out this job from the flywheel housing side.

e. Turn the crankcase upside down so that #1 and #3 cylinder face downward and perform the same job as described in a) to b).

12) Bring crankcase to horizontal position and check whether piston pins are completely installed or not by turning crankshaft and watching piston movement.

13) Apply liquid gasket (Fuji Bond C or equivalent) on crankcase plugs and tighten them with aluminum gasket.

Torque (Crankcase plug)	62 - 76 N·m (6.3 - 7.7 kg·m, 46 - 56 ft·lb)
----------------------------	---



Use this shape of wrench

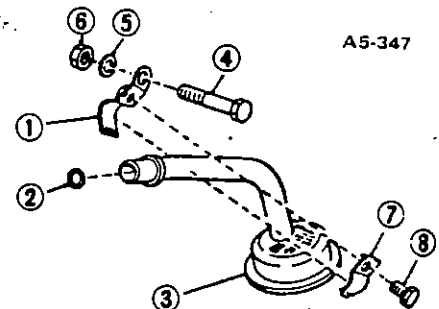
A5-346

Fig. 3-190 Installing crankcase plugs

14) If oil strainer has been removed, install it with a new O-ring by driving with an aluminum bar.

15) Install oil strainer stay with 8 mm bolt, nut and spring washer.

Torque (Oil strainer stay)	23 - 26 N·m (2.3 - 2.7 kg·m, 17 - 20 ft·lb)
-------------------------------	---



A5-347

- 1 Oil strainer stay
- 2 O-ring
- 3 Oil strainer
- 4 Bolt
- 5 Spring washer
- 6 Nut
- 7 Oil strainer stay 2
- 8 Bolt and washer

Fig. 3-191 Installing oil strainer stay

ENGINE

16) Install a new cylinder head gasket, #2 - #4 cylinder head, valve push rods and also valve rocker as follows.

a. Install a new cylinder head gasket.

NOTE:

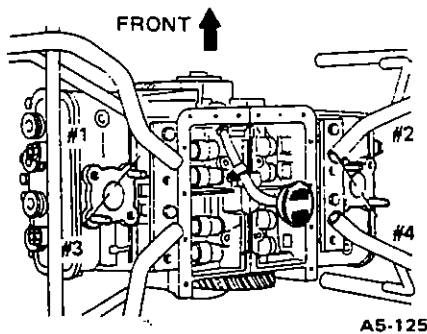
a. Before installing the cylinder head gasket, clean the mating surfaces of the cylinder head and crankcase so that they are free of oil, grease and dust by using thinner or the like.

b. Apply head gasket sealant **THREE BOND 1201 (004403008)** or **DOW CORNING #92-024** evenly to both sides of the new cylinder head gasket with a brush. Do not apply excessive sealant. Install the gasket on to the crankcase quickly after applying sealant.

b. Install #2 - #4 cylinder head.

NOTE:

The cylinder head installing direction is as in the figure.



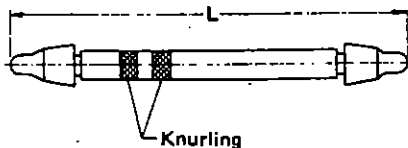
A5-125

Fig. 3-192 Installed position of cylinder heads

c. Take out Valve Lifter Clip 899804100 (for hydraulic valve lifter), and insert valve push rods in alignment with valve lifters.

NOTE:

Do not misuse the push rod.



A5-348

Fig. 3-193 Discrimination of push rod

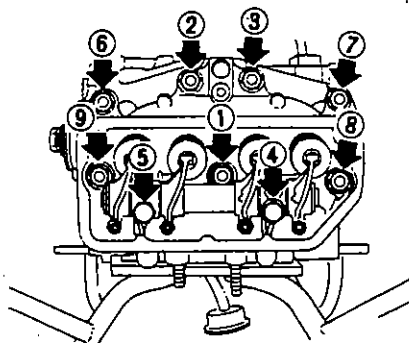
Number of Knurlings	
1600	2
1800 with solid valve lifter	1
1800 with hydraulic valve lifter	Nothing

d. Install valve rocker.

When tightening nuts and bolts, apply oil to the threads and tighten them in two or three successive steps until the final tightening is at the specified torque.

In each step, tighten them in the specified sequence.

1st step	29 N·m (3.0 kg·m, 22 ft·lb)
2nd step	59 N·m (6.0 kg·m, 43 ft·lb)
3rd (final) step	64 N·m (6.5 kg·m, 47 ft·lb)



A5-615

Fig. 3-194

NOTE:

- When tightening ①, ⑨ nuts, use Socket Wrench (499987006).
- After tightening all the cylinder head nuts and bolts, retighten the center nut ① to insure it is correctly torqued.
- Do not use washers in installing valve lifter.
- Make sure that the valve rocker is correctly assembled.

17) Install #1 - #3 cylinder head with a new gasket and push rods and valve rocker assembly (RH) in the same way as instructed in 16).

18) Press oil seal (Rear) into the flywheel housing if oil seal has been removed.

NOTE:

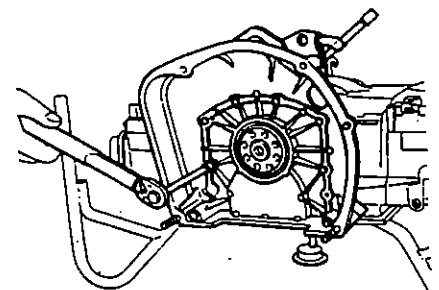
- Apply oil on the circumference of the oil seal prior to pressing.
- Oil seal dimensions.

1,800 cc 76 x 93 x 10 mm
(2.99 x 3.66 x 0.39 in)

1,600 cc 70 x 87 x 8.5 mm
(2.76 x 3.43 x 0.335 in)

19) Install flywheel housing to crankcase with the mating surface coated with liquid gasket [THREE BOND 1215 (P/N 004403007) or equivalent].

Torque	20 - 27 N·m (2.0 - 2.8 kg·m, 14 - 20 ft·lb)
--------	---



A5-350

Fig. 3-195 Installing flywheel housing

NOTE:

- Clean the mating surfaces of the flywheel housing and crankcase so that they are free of oil, grease and dust by using thinner or the like before applying liquid gasket.
- Be careful not to damage the oil seal lip and not to detach the spring when installing the flywheel housing.

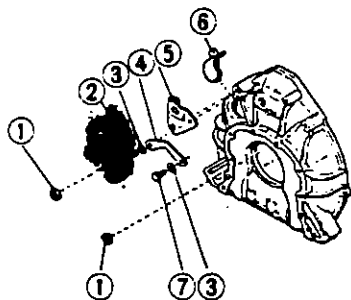
ENGINE

- c. When using **THREE BOND 1215**, dry the coated surface for 5 to 10 minutes before installation.
- d. Remove Valve Lifter Clips (899804100) before installing oil pan.

20) Install crankcase oil pan, oil pan gasket and transmission cover II (MT).

Torque (Oil pan)	4.4 – 5.4 N·m (0.45 – 0.55 kg·m, 3.3 – 4.0 ft·lb)
---------------------	---

(SUBARU 1600)



(SUBARU 1800)

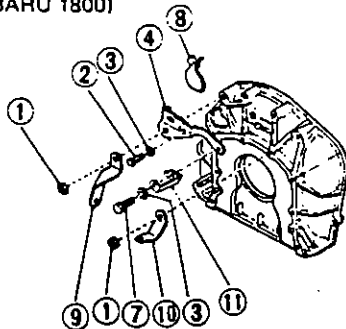
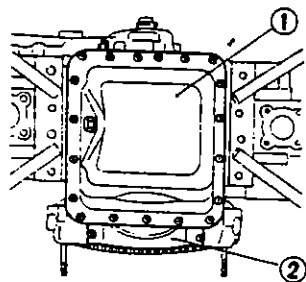


Fig. 3-197 Installing crankcase hanger

- 22) Install flywheel with O-ring (MT) or converter drive plate with back plate and O-ring (AT) on the crankshaft gear.

Apply liquid gasket [**THREE BOND 1215** (P/N 004403007)] to the threads of the bolts.

	AT	MT
Torque	49 – 53 N·m (5.0 – 5.4 kg·m, 36 – 39 ft·lb)	41 – 45 N·m (4.2 – 4.6 kg·m, 30 – 33 ft·lb)



- 1 Transmission cover II (MT)
- 2 Oil pan

A5-271

Fig. 3-196 Installing oil pan

- 21) Install pitching stopper bracket and crankcase rear hanger, if it has been removed, to flywheel housing. On C-W carburetor, install accelerator cable bracket with hanger.

NOTE:

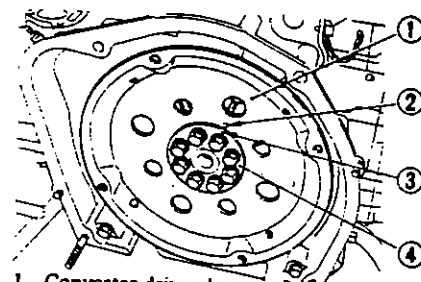
Do not misplace the washer.

- 1 Nut
- 2 Bolt
- 3 Spring washer
- 4 Crankcase rear hanger
- 5 Pitching stopper bracket
- 6 Timing hole hanger
- 7 Bolt
- 8 Timing hole hanger
- 9 Stiffener RH (4WD)
- 10 Stiffener LH (4WD)
- 11 Accelerator cable bracket (C-W carburetor)

A5-893

NOTE:

- a. The flywheel or drive plate and back plate can be installed only in one position since not all the bolt holes are positioned at equal intervals.
- b. When installing back plate, align the mark on back plate and the hole in drive plate. (AT)



- 1 Converter drive plate
- 2 Hole
- 3 Mark
- 4 Back plate

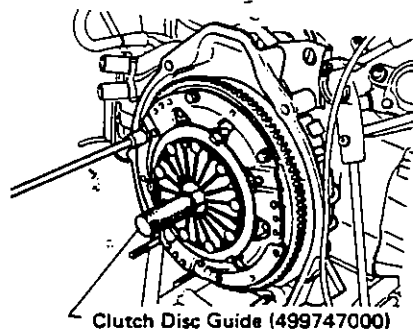
A5-353

Fig. 3-198 Installing drive plate and back plate (AT)

- c. When using **THREE BOND 1215**, dry the bolts coated with it for 5 to 10 minutes before screwing them in.

- 23) Install clutch disc and clutch cover with bolts and spring washers, aligning clutch disc with flywheel by inserting Clutch Disc Guide (499747000) into needle bearing fitted in flywheel. (MT)

Torque (Clutch cover)	16 N·m (1.6 kg·m, 12 ft·lb)
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A5-354

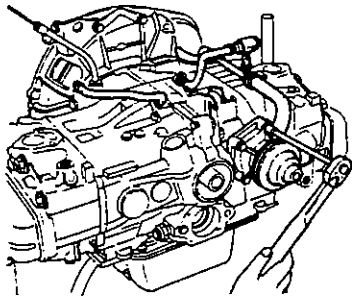
Fig. 3-199 Installing clutch cover

NOTE:

Position the clutch cover so that the "0" marks on the flywheel and clutch cover are spaced 120° or more.

- 24) Install water pump, hose, pipe compl. and heater hose as an assembly and install another hose.

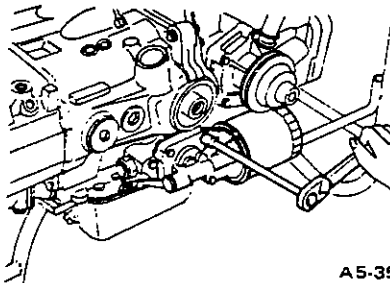
ENGINE



A5-694

Fig. 3-200 Installing water pump

25) After assembling oil filter and oil pump, install it with O-ring and oil pump gasket.



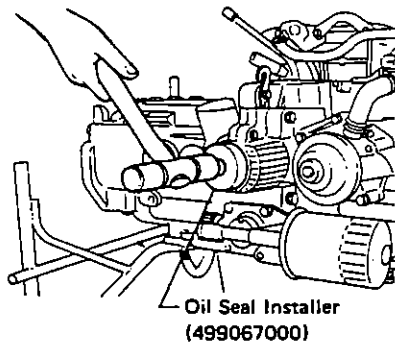
A5-356

Fig. 3-201 Installing oil pump

NOTE:

- a. Use new gaskets and O-rings.
- b. When installing, align the rotor shaft with the groove in the camshaft end.

26) Install oil seal (Front) on the crankshaft front end by using Oil Seal Installer (499067000).



A5-357

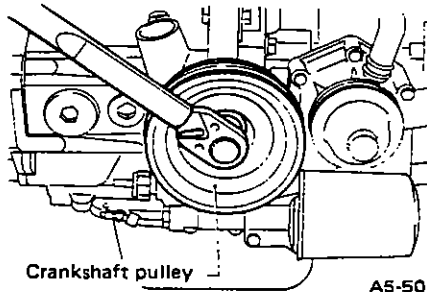
Fig. 3-202 Installing oil seal

27) Install crankshaft pulley on crankshaft with flange bolt.

Torque	64 – 74 N·m (6.5 – 7.5 kg·m, 47 – 54 ft·lb)
--------	---

NOTE:

- a. When tightening the bolt, insert a screw driver through the timing hole into the hole in the drive plate (AT) or flywheel (MT) to prevent the crankshaft from turning.

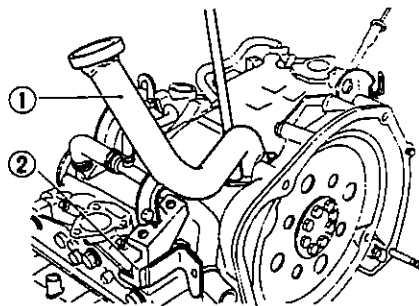


A5-502

Fig. 3-203 Installing crankshaft pulley

- b. Apply engine oil on the thread, and liquid gasket (THREE BOND 1215 or the equivalent) on the flange seat.
- c. Pulley dia. is as follows.
1600 cc: 109 mm (4.29 in)
1800 cc: 119 mm (4.69 in)

28) Install oil filler duct, oil filler duct stay and gasket on crankcase. On 4WD, install oil filler duct, stiffener 2, and gasket on crankcase.



- 1 Oil filler duct
- 2 Oil filler duct stay

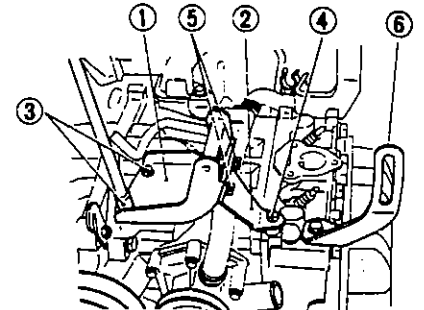
A5-695

Fig. 3-204 Installing oil filler duct

- 29) Install generator bracket compl., bracket 2 and bracket 3 as follows.
 - a. Temporarily connect bracket compl. ① and bracket 3, ② until the spring washer is deformed a little.
 - b. Install the sub-assembled bracket prepared in a onto the engine by tightening bolts ③ ④ temporarily.
 - c. At first tighten fully the two bolts ③ and after that tighten the bolt ④ to the specified torque.
 - d. Tighten fully the two bolts ⑤ to the specified torque.

- e. After loosening the bolt ④ by two turns or more, tighten it again to the specified torque.
- f. Temporarily install bracket 2. ⑥.

Torque	13 – 19 N·m (1.3 – 1.9 kg·m, 9 – 14 ft·lb)
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- 1 Bracket CP
- 2 Bracket 3
- 3 Bolts
- 4 Bolt
- 5 Bolts
- 6 Bracket 2

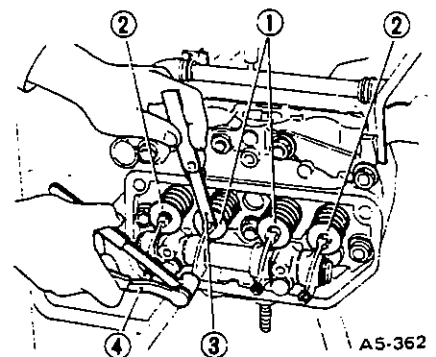
A5-696

Fig. 3-205 Installing generator brackets

NOTE:

Be sure to use the ⑨ bolt for the generator bracket 2. Others are ⑦ ones.

30) (Except engine with hydraulic valve lifter) Adjust the valve clearances.



- 1 Exhaust valves
- 2 Intake valves
- 3 Thickness gauge
- 4 Valve Clearance Adjuster (498767000)

Fig. 3-206 Adjusting valve clearance

Valve clearance (Cold)	
Intake	0.23 – 0.27 mm (0.009 – 0.011 in)
Exhaust	0.33 – 0.37 mm (0.013 – 0.015 in)

NOTE:

Use T.D.C. marking on pulley.

31) Install valve rocker covers with valve rocker cover gaskets, seal washers and bolts.

Torque	2.9 – 3.9 N·m (0.30 – 0.40 kg·m, 2.2 – 2.9 ft·lb)
--------	---

32) Install spark plugs with gaskets.

Torque	18 – 24 N·m (1.8 – 2.4 kg·m, 13 – 17 ft·lb)
--------	---

33) Install the intake manifold assembly prepared before as follows.

a. Install the intake manifold assembly with intake manifold gasket, air cleaner bracket, fuel hose stay, and EGR pipe. And connect water by-pass hoses.

Torque	18 – 22 N·m (1.8 – 2.2 kg·m, 13 – 16 ft·lb)
--------	---

NOTE:

Discrimination knurling for E.G.R. pipe.

Vehicle	Knurling
1600 cc	2
C-W carburetor type	3
Except the above	Nothing

b. Connect the harness lead to oil pressure gauge or oil pressure switch, and clip it.

c. Connect the P.C.V. hose to rocker cover and clip it at the upper portion.

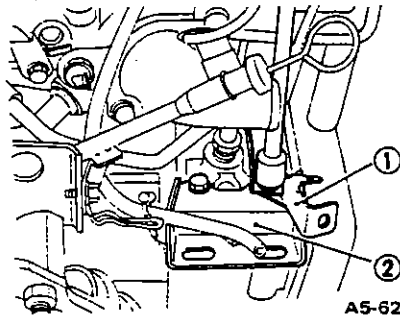
NOTE:

a. For further particulars of vacuum hose, wiring harness, water hose and P.C.V. hose, refer to label behind engine hood, and Parts Catalogue.

b. Be sure to connect E.C.M. (Electronic Control Module) earth at right front bolt.

34) Tighten E.G.R. pipe.

35) Install battery cable bracket and A.S.V. bracket [vehicle without power steering for Canada and 49-state (except 1600 cc)] or oil pump bracket (vehicle with power steering).



- 1 Battery cable bracket
- 2 A.S.V. bracket

Fig. 3-207

36) Install A.S.V. pipe and A.S.V.

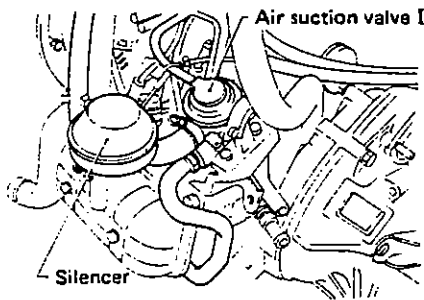


Fig. 3-208

37) Install E.G.R. pipe cover.

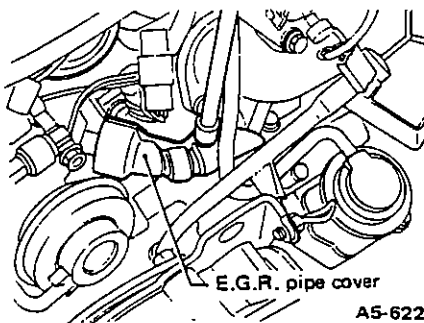


Fig. 3-209

38) Install alternator on the generator brackets with air cleaner bracket, spark plug cord stay and drive belt.

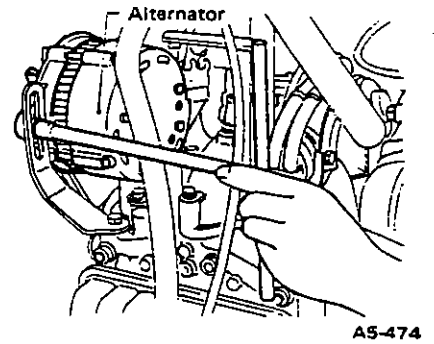


Fig. 3-210 Installing alternator with relative parts

NOTE:

- a. After aligning the air cleaner bracket and air cleaner, secure the bracket.
- b. Do not forget tightening fully the bolt for generator bracket 2.

Drive belt tension
13 – 14 mm (0.51 – 0.55 in)/ 98 N (10 kg, 22 lb)

When replacing with new one, the tension is 10 mm (0.39 in)/98 N (10 kg, 22 lb).

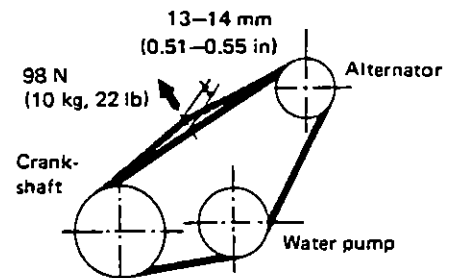


Fig. 3-211 Drive belt tension

39) Install distributor as follows.

a. Set #1 piston at its top dead center in the compression stroke.

b. Align the distributor matching marks.

ENGINE

- c. Install distributor plate on crankcase with bolt.

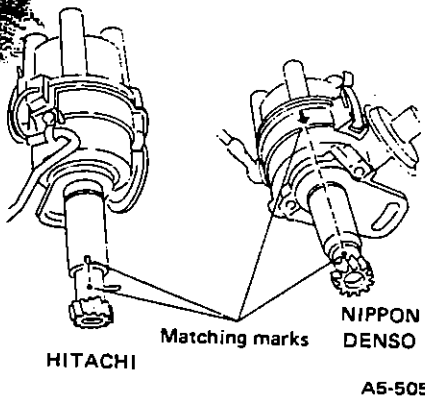


Fig. 3-212 Aligning distributor matching marks

- d. Apply oil to the circumference of distributor shaft and gear.
 e. Install distributor into crankcase taking care not to damage distributor gear and O-ring.

- f. Connect vacuum hoses to distributor.
 g. Clip the distributor lead wire.

NOTE:
 Be careful that the holes in the distributor plate and crankcase are correctly lined up.

- 40) Connect spark plug cords to spark plugs and cord supporters and distributor cord to cord supporter.
 41) Install oil level gauge if it has been removed.
 42) Install carburetor protector. [For 49 States (except 4WD & 4WD-AT) and California]
 43) Remove Engine Stands (399814300).

- a. Install pipe ④ to attachment ① with union screws ② and gaskets ③.

Torque	34 N·m (3.5 kg-m, 25 ft-lb)
--------	--------------------------------

- b. Set O-ring ⑤ in attachment ①. (Apply oil)
 c. Install connector ⑥ into attachment ①.
 d. Set O-ring ⑦ in attachment ①. (Apply oil)
 e. Assemble oil pump ⑮ and attachment ① by temporarily tightening connector ⑥.
 f. Install pipe ④ to crankcase by temporarily tightening bolt ⑧.
 g. Tighten connector ⑥ to the specified torque.

Torque	29 N·m (3 kg-m, 22 ft-lb)
--------	------------------------------

- h. Tighten bolt ⑧ to the specified torque.

Torque	26 N·m (2.7 kg-m, 20 ft-lb)
--------	--------------------------------

- i. Install oil filter ⑨.
 j. Install oil delivery pipe ⑪ with union screw ⑫ and gaskets ⑬.

Torque	16 N·m (1.6 kg-m, 12 ft-lb)
--------	--------------------------------

NOTE:
 Replace union screw and gasket with new ones.

- 29) Installing the injector

Tightening torque	1.03 – 1.52 N·m (0.105 – 0.155 kg-m, 0.76 – 1.12 ft-lb)
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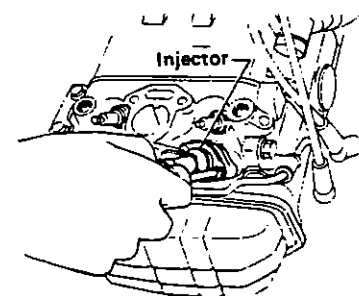


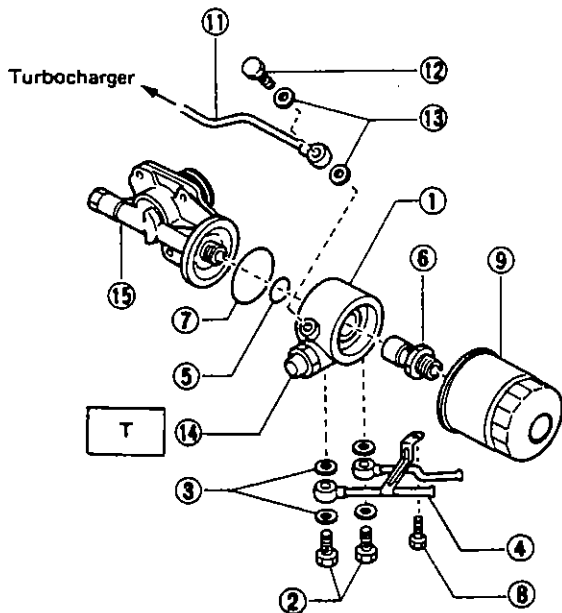
Fig. 3-214

A5-768

3. TURBO Vehicle

NOTE:
 The procedures for assembling the engine as far as 28) are the same as those for Non-TURBO vehicles except 25) installing the oil pump.

- 25) Install oil pump together with attachment and oil filter as follows:



- 1 Attachment
- 2 Union screw
- 3 Gasket
- 4 Pipe
- 5 O-ring
- 6 Connector
- 7 O-ring
- 8 Bolt & washer
- 11 Delivery pipe
- 12 Union screw
- 13 Gasket
- 14 Thermo valve
- 15 Oil pump

Tightening torque: N·m (kg-m, ft-lb)
T: 59 N·m (6 kg-m, 43 ft-lb)

Fig. 3-213

A5-788

ENGINE

- 30) Installing the knock sensor.
Use a 27 mm deep socket.

Tightening torque	22 – 27 N·m (2.2 – 2.8 kg·m, 16 – 20 ft·lb)
-------------------	---

NOTE:

Do not lay down the socket when tightening.

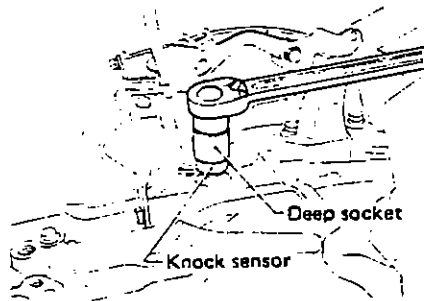


Fig. 3-215

A5-769

- 31) Installing the alternator bracket.

Tightening torque	30 – 36 N·m (3.1 – 3.7 kg·m, 22 – 27 ft·lb)
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- 32) Installing the power steering pump bracket.

Tightening torque	18 – 22 N·m (1.8 – 2.2 kg·m, 13 – 16 ft·lb)
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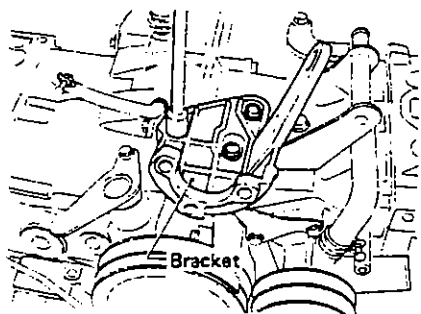


Fig. 3-216

A5-771

- 33) Installing the intake manifold.

- a. Use four longer bolts to install.

Tightening torque	18 – 22 N·m (1.8 – 2.2 kg·m, 13 – 16 ft·lb)
-------------------	---

- b. Install the fuel pipe to the injector.

NOTE:

Replace the fuel hose clamp with a new one.

- c. Tighten the fuel pipe along with the intake manifold.

Tightening torque	18 – 22 N·m (1.8 – 2.2 kg·m, 13 – 16 ft·lb)
-------------------	---

NOTE:

Mount the spark plug cord stays on sides #2 and #4.

- d. Tighten the EGR pipe plug.

Tightening torque	31 – 37 N·m (3.2 – 3.8 kg·m, 23 – 27 ft·lb)
-------------------	---

- e. Connect the air vent hose.
f. Connect the lead wires of the oil pressure switch and injector.

NOTE:

Clamp the lead wires after connecting them.

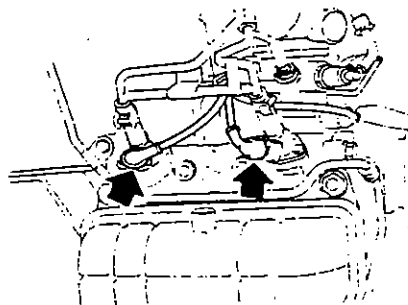


Fig. 3-217

A5-773

- g. Connect the blow-by hose and vacuum hose.

- h. Put the EGR pipe cover in place.

- 34) Installing the alternator.

Temporarily install the alternator ASSY to the bracket.

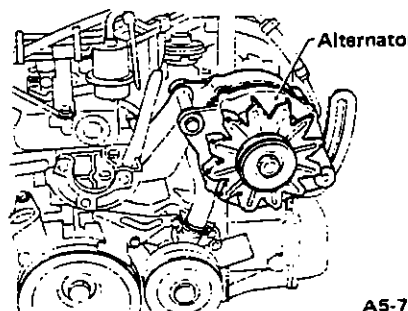


Fig. 3-218

A5-774

NOTE:

- a. If the alternator ASSY is hard to install, drive out the slide bush.

- b. The V-belt should be installed after the engine has been mounted on the vehicle.

- 35) Installing the distributor.

- a. Install the plate.

- b. Bring #1 cylinder to TDC on the compression stroke.

- c. Put #1 cylinder in an electrified state.

Adjust the notch to the punched mark on the pinion.

- d. Install the distributor and fix it to the plate with 6 mm bolt.

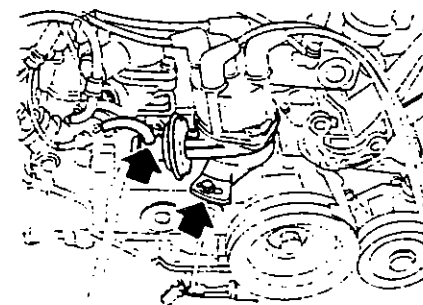


Fig. 3-219

A5-775

- e. Connect the vacuum hose.

- f. Connect the lead wires.

- Knock sensor
- Ground terminal

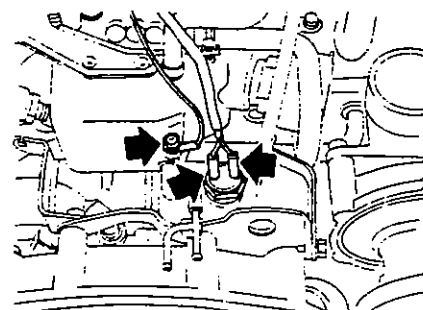


Fig. 3-220

A5-776

- g. Connect the plug cords and high-tension cord.

- 36) Removing the ENGINE STAND.

- 37) Installing the front exhaust pipe.

NOTE:

Before installation, ensure that the exhaust pipe is free of all foreign matter.

- 38) Install the oil pipe stay.

3-10. Troubleshooting

1. Turbocharger Trouble Diagnosis

If the turbocharger system fails, any of the following phenomena can occur.

- ① Excessively high supercharging pressure:
 - Engine knocking
 - Air is intermittently relieved from air relief valve.
- ② Excessively low supercharging pressure:
 - Lack a engine power
 - Poor acceleration performance
 - Considerable fuel consumption
- ③ Oil leak from turbocharger:
 - Excessive oil consumption
 - White exhaust smoke
 - (●: Phenomenon)

1) How to Diagnose ① and ②

(However, the phenomena ② can also result from other causes, such as air leakage from the intake system, exhaust system leakage or obstruction, incorrect ignition timing, malfunctioning knock control system, defects in the EGI control system.)

[Checking supercharging pressure]

- Disconnect the rubber hose from the pressure switch, and attach a branch connector. Lead the rubber hose into the passenger compartment, and connect it to the positive pressure gauge.
- After warming up the engine, make a test run. Read the supercharging pressure on the positive pressure gauge when the vehicle is running at approximately 2,400 rpm with a full-open throttle.
- At this time, check for air being intermittently relieved from the relief valve (This would be detectable by a loud, hissing sound).

[Judgment]

- The turbocharger is in normal condition if the supercharging pressure is in the range of 48.0 ± 4.0 kPa (360 ± 30 mmHg, 14.17 ± 1.18 in-

Hg) and the relief valve is not leaking air.

- The air relief valve is defective when the supercharging pressure is below the upper limit of 52.0 kPa (390 mmHg, 15.35 inHg) and air is being relieved from the relief valve. Replace the air relief valve.
- When the supercharging pressure exceeds the upper limit of 52.0 kPa (390 mmHg, 15.35 inHg).
 - Check the rubber hose that controls the waste gate valve for cracks and disconnection. Replace the rubber hose or correct the connection.
 - If the waste gate valve is not operating and remains closed, replace the turbocharger.
- When the supercharging pressure is below the lower limit of 44.0 kPa (330 mmHg, 12.99 inHg), the turbocharger is defective. Replace the turbocharger.

2) How to Diagnose ③

- Oil leaks from the exhaust gas side (turbine side)
 - Remove the center exhaust pipe and examine the turbocharger from the exhaust gas side. As shown in the figure on the right, if there are excessive carbon deposits on the turbine exhaust side, oil is leaking from the turbine. (In this case, oil may also be leaking from between the turbine chamber and bearing chamber.)

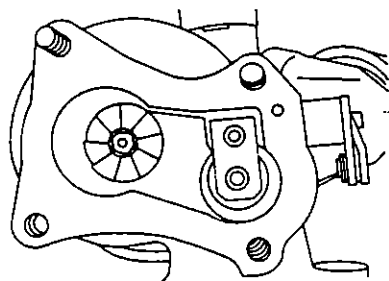


Fig. 3-221

AS-778

- Oil leaks from the inlet side (blower side)
 - The turbocharger is not neces-

sarily leaking oil when oil is present on the blower side. The oil is likely to have come from oil mists contained in the blow-by gases flow in the inlet system.

- When oil is leaking from the inlet system, it is accompanied by a rattle from the turbocharger shaft when it moves in an axial or radial direction. Remove the turbocharger from the engine and determine if the shaft rattles.

(Limit of rattling: Measure with a dial gauge.)

- a. Axial rattling: 0.09 mm (0.0035 in)
- b. Radial rattling: 0.17 mm (0.0067 in) when the turbine side and blower side of the shaft are moved circumferentially at the same time.

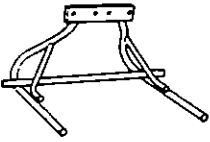
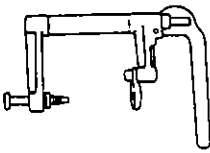
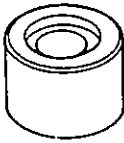
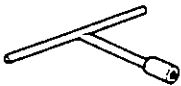
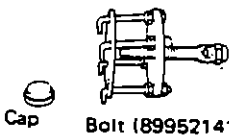



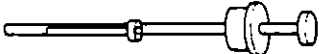
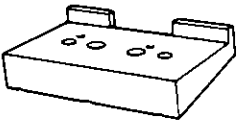





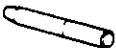
If anything unusual is found, replace the turbocharger.

NOTE:





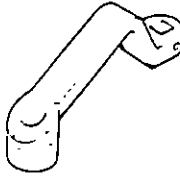
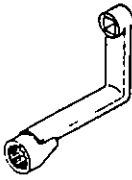
- a. The turbocharger proper cannot be disassembled or adjusted.
 - b. When removing and installing the turbocharger, do not allow dirt and dust to enter the inlet and outlet openings of the turbine and blower. Any foreign matter allowed to enter, will undoubtedly damage the turbine and blower blades as soon as the turbocharge goes into operation again.
 - c. Likewise, cover the open end of the front exhaust pipe. If foreign matter is allowed to enter, the turbine blades will be instantaneously destroyed when the turbocharger is put into operate.
- Visually inspect the connections of the oil delivery pipe with the turbocharger and oil pump. If oil is leaking, replace the washer of the union screw and tighten it to the specified tightening torque.

Tightening torque	14.7 – 17.7 N·m (1.50 – 1.80 kg·m, 10.8 – 13.0 ft·lb)
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3-11. Special Tools

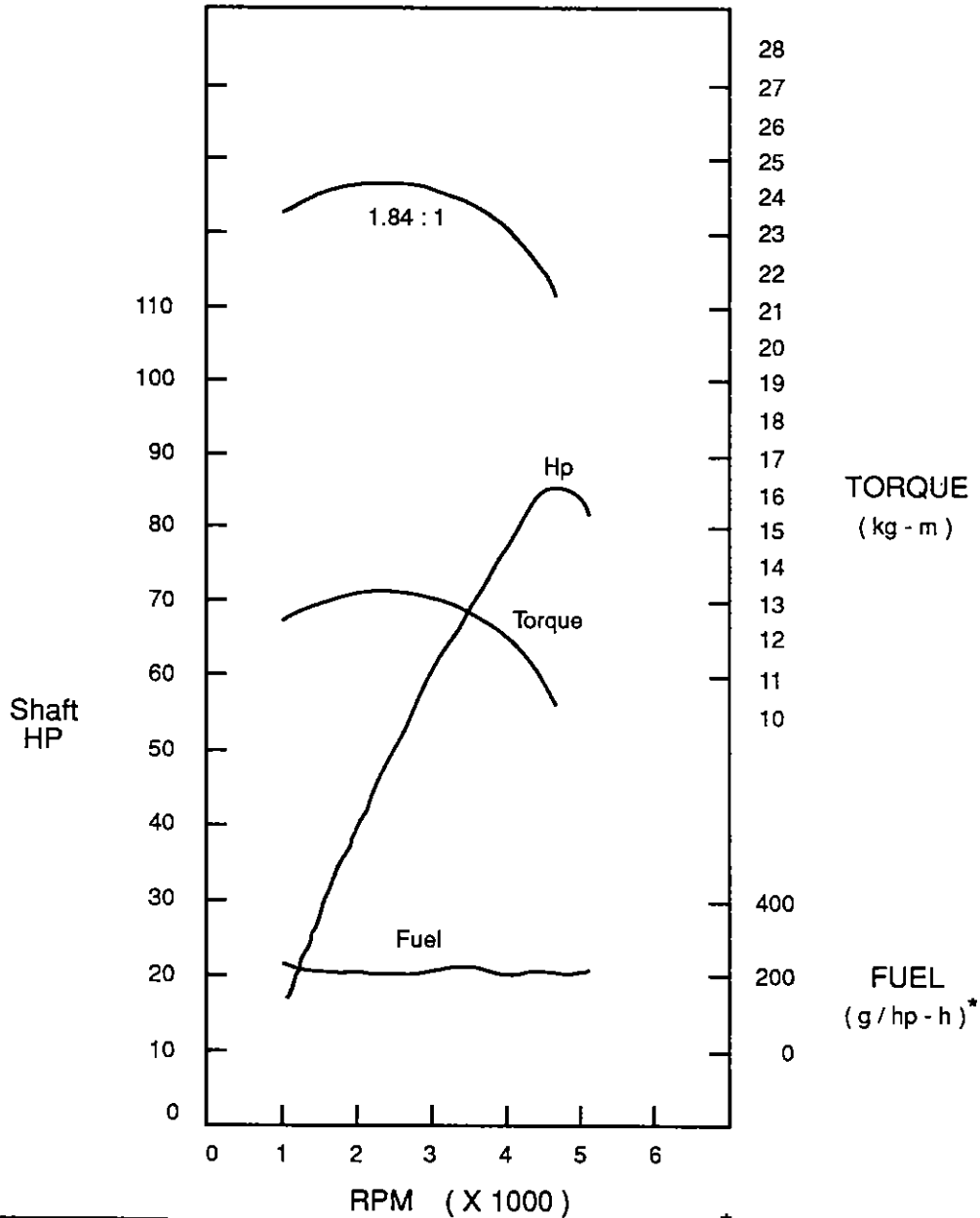
399814300	899724100	899768602	898878600
ENGINE STAND	SPRING PRESS	VALVE GUIDE ADJUSTER	STUD BOLT WRENCH
Crankcase	Valve spring	Exhaust valve guide	Crankcase stud bolt
			
<i>Fig. 3-222</i> A5-141	<i>Fig. 3-226</i> A5-145	<i>Fig. 3-230</i> A5-148	<i>Fig. 3-234</i> A5-152
899524100	899714110	899768603	499067000
PULLER SET	REMOVER SET	VALVE GUIDE ADJUSTER	OIL SEAL INSTALLER
Crankshaft pulley	Cam shaft	Intake valve guide	Oil seal (crankcase)
Puller (899521411)  Cap Bolt (899521412)			
<i>Fig. 3-223</i> A5-142	<i>Fig. 3-227</i> A12-181	<i>Fig. 3-231</i> A5-149	<i>Fig. 3-235</i> A5-388
399094310	399765101	899764105	398744300
PISTON PIN REMOVER	CYLINDER HEAD TABLE	VALVE GUIDE REAMER	PISTON GUIDE
Piston pin	Cylinder head	Valve guide	Piston
			
<i>Fig. 3-224</i> A5-143	<i>Fig. 3-228</i> A5-146	<i>Fig. 3-232</i> A5-150	<i>Fig. 3-236</i> A5-155
899804100	899764104	898858600	399284300
VALVE LIFTER CLIP	VALVE GUIDE REMOVER	OIL SEAL INSTALLER	PISTON PIN GUIDE
Valve lifter	Valve guide	Valve guide oil seal	Piston pin
			
<i>Fig. 3-225</i> A5-144	<i>Fig. 3-229</i> A5-147	<i>Fig. 3-233</i> A5-151	<i>Fig. 3-237</i> A5-156

ENGINE

499987006	499747000	498767000	499037000
SOCKET WRENCH	CLUTCH DISC GUIDE	VALVE CLEARANCE ADJUSTER	REMOVER & REPLACER
Cylinder head nuts	Clutch disc	Intake and exhaust valves	Connecting rod bushing
			
<i>Fig. 3-238</i> ST-030	<i>Fig. 3-239</i> A11-014	<i>Fig. 3-240</i> ST-029	<i>Fig. 3-241</i> A5-389
499990100	926040000		
SOCKET	SOCKET		
Oxygen (O ₂) sensor	O ₂ sensor (TURBO)		
			
<i>Fig. 3-242</i> A10-133	<i>Fig. 3-243</i> A10-214		

EA-81 STOCK ENGINE

Maximum Output 85 hp @ 4800 rpm
 Maximum Torque 13 kg - m @ 2400 rpm
 With 1.84 : 1 Reduction 24 kg - m @ 3500 rpm
 Minimum Fuel Consumption 205 g / hp - h



Useful conversions:
 1 kg - m = 7.24 ft-lbs
 1 lb = 454 g

Graph courtesy of:
 Dave Johnson
 REDUCTIONS
 Box 16, Grp. 15, RR 1
 Dugald, Manitoba
 CANADA R0E 0K0
 204.853.7998

* NOTE: the Fuel graph is 'normalized' to horsepower, so for example, to calculate expected fuel burn in Gal/hr, you need to convert grams of fuel to gallons, and then multiply by HP.

AirSoob: EA-81 Engine

Service Manual Excerpts
to assist you in ordering genuine Subaru parts,
these pages provided by

Courtesy Subaru
3155 Stevens Creek Blvd.
San Jose, CA 95117
408-984-2001 (ask for Subaru Parts)

Note: For those that want to order parts via UPS directly from Courtesy, any of the parts people are aware of our application and can assist you without knowing "what kinda car do you have". Just mention you are part of this group, the Soob-powered Airplane guys, tell them you have a parts manual in front of you, and they will understand. I was asked NOT to give out the parts manager's name, for fear you might only ask for him, but if there is any confusion about parts for our application, his name is Robert, and he is the Soob "god" there. But try to use whoever handles your call first, before bailing out to Robert.

Our motors are referred to by the Soob people as the "1800 Direct Drive Motor" or "1800 Pushrod Motor."