SUBARU

1989

SERVICE MANUAL

1 GENERAL SECTION

2 ENGINE SECTION

3 TRANSMISSION AND DIFFERENTIAL SECTION

ABBREVIATION LIST

A/C	Air Conditioner
ACC	Accessory
A/C pulley	Air Conditioner compressor pulley
ALT pulley	Alternator pulley
API	American Petroleum Institute
Approx	Approximately
ASSY	Assembly
ASV	Air Suction Valve
AT	Automatic Transmission
ATF	Automatic Transmission Fluid
BILEV	Bi-level
BJ	Joint
BP	British Petroleum
BTDC	Before Top Dead Center
Calif.	California
Carb.	Carburetor
CP	Complete
C/P	Crankshaft Pulley
CTR	Center
CW	Curb Weight
DIFF	Differential
DOJ	Double Offset Joint
D/R	Dual-range
DSPD	Dry Single Plate Diaphragm
ECS	Electric Control System
FMVSS	Federal Motor Vehicle Safety Standards
FWD	Front wheel drive (2WD)
GVWR	Gross Vehicle Weight Rating
HI	High (Speed)
HP	Horse Power
IG-COIL	Ignition Coil
IG SWITCH	Ignition Switch
INT	Intermittent (Wiper)
I/P	Idler Pulley
LH	Left-hand
LO	Low (Speed)
LSD	Limited Slip Differential
MPFI	Multi Point Fuel Injection
MT	Manual Transmission
PCV	Positive Crankcase Ventilation
PHV	Pressure Holding Valve
P/N	Parts Number
P/S pulley	Power Steering oil pump pulley
RAD FAN	Radiator Fan
R-DEF	Rear Defogger
RH	Right-hand
SAE	Society of Automotive Engineers Inc.
SPFI	Single Point Fuel Injection
S/R	Single-range
TC	Torque Converter
TEMP GAUGE	Temperature Gauge
VGR	Variable Gear Ratio
VIN	Vehicle Identification Number
W/height control	With height control
W/P pulley	Water Pump pulley

SUBARU

1989

Page

4-DOOR SEDAN

ITEM				MODEL	FWD					
					DL	DL	GL	GL	GL-10	GL-10 TURBO
					SPFI 5MT	SPFI 3AT	SPFI 5MT	SPFI 3AT	SPFI 3AT	MPFI 3AT
Overall length				mm (in)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)
Overall width				mm (in)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height				mm (in)	1,334 (52.5)	1,334 (52.5)	1,334 (52.5)	1,334 (52.5)	1,334 (52.5)	1,334 (52.5)
Compart-ment	Leg room	Front Max.		mm (in)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)
		Rear Min.		mm (in)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)
	Head room	Front		mm (in)	954 (37.6)	954 (37.6)	954 (37.6)	954 (37.6)	954 (37.6)	954 (37.6)
		Rear		mm (in)	928 (36.5)	928 (36.5)	928 (36.5)	928 (36.5)	928 (36.5)	928 (36.5)
	Shoulder room			mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
Wheelbase				mm (in)	2,470 (97.2)	2,470 (97.2)	2,470 (97.2)	2,470 (97.2)	2,470 (97.2)	2,470 (97.2)
Tread	Front			mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
	Rear			mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance				mm (in)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)
Weight	Curb weight	For U.S.A.	Front	kg (lb)	*1 610 (1,345)	*1 626 (1,380)	*2 624 (1,375)	*2 637 (1,405)	*3 683 (1,505)	*3 707 (1,560)
			Rear	kg (lb)	*1 406 (895)	*1 408 (900)	*2 415 (915)	*2 420 (925)	*3 444 (980)	*3 456 (1,005)
			Total	kg (lb)	*1 1,016 (2,240)	*1 1,034 (2,280)	*2 1,039 (2,290)	*2 1,057 (2,330)	*3 1,127 (2,485)	*3 1,163 (2,565)
		For Canada	Front	kg (lb)	*1 610 (1,345)	*1 626 (1,380)	*1 621 (1,370)	*1 635 (1,400)	–	*3 703 (1,550)
			Rear	kg (lb)	*1 406 (895)	*1 408 (900)	*1 413 (910)	*1 417 (920)	–	*3 449 (990)
			Total	kg (lb)	*1 1,016 (2,240)	*1 1,034 (2,280)	*1 1,034 (2,280)	*1 1,052 (2,320)	–	*3 1,152 (2,540)
	Gross vehicle weight		Front	kg (lb)	844 (1,860)	844 (1,860)	844 (1,860)	844 (1,860)	862 (1,900)	862 (1,900)
			Rear	kg (lb)	712 (1,570)	712 (1,570)	712 (1,570)	712 (1,570)	730 (1,610)	730 (1,610)
			Total	kg (lb)	1,556 (3,430)	1,556 (3,430)	1,556 (3,430)	1,556 (3,430)	1,592 (3,510)	1,592 (3,510)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window, and auto door lock system is included in C.W.
*3: The weight of sunroof, air conditioner, power steering, power window, digital instrument panel, cruise control and auto door lock system is included in C.W.

4-DOOR SEDAN

ITEM				MODEL: 4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD Full time 4WD RX TURBO MPFI 5MT D/R	4WD Full time 4WD GL-10 TURBO MPFI 5MT S/R	4WD Full time 4WD GL-10 TURBO MPFI 4AT
Overall length mm (in)				4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)
Overall width mm (in)				1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height mm (in)				1,380 (54.3)	1,380 (54.3)	1,380 (54.3)	1,410 (55.5)	1,410 (55.5)
Compart-ment	Leg room		Front Max. mm (in)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)	1,060 (41.7)
			Rear Min. mm (in)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)
	Head room		Front mm (in)	954 (37.6)	954 (37.6)	954 (37.6)	954 (37.6)	954 (37.6)
			Rear mm (in)	928 (36.5)	928 (36.5)	928 (36.5)	928 (36.5)	928 (36.5)
	Shoulder room mm (in)			1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
Wheelbase mm (in)				2,465 (97.0)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)
Tread			Front mm (in)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)	1,420 (55.9)	1,420 (55.9)
			Rear mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance mm (in)				130 (5.1)	130 (5.1)	130 (5.1)	160 (6.3)	160 (6.3)
Weight	Curb weight	For U.S.A.	Front kg (lb)	*2 642 (1,415)	*2 646 (1,425)	*3 703 (1,550)	*4 712 (1,570)	*5 755 (1,665)
			Rear kg (lb)	*2 472 (1,040)	*2 474 (1,045)	*3 497 (1,095)	*4 515 (1,135)	*5 513 (1,130)
			Total kg (lb)	*2 1,114 (2,455)	*2 1,120 (2,470)	*3 1,200 (2,645)	*4 1,227 (2,705)	*5 1,268 (2,795)
		For Canada	Front kg (lb)	*1 640 (1,410)	*1 644 (1,420)	–	–	*5 755 (1,665)
			Rear kg (lb)	*1 469 (1,035)	*1 472 (1,040)	–	–	*5 513 (1,130)
			Total kg (lb)	*1 1,109 (2,445)	*1 1,116 (2,460)	–	–	*5 1,268 (2,795)
	Gross vehicle weight		Front kg (lb)	816 (1,800)	816 (1,800)	828 (1,825)	828 (1,825)	828 (1,825)
			Rear kg (lb)	753 (1,660)	753 (1,660)	782 (1,725)	782 (1,725)	782 (1,725)
			Total kg (lb)	1,569 (3,460)	1,569 (3,460)	1,610 (3,550)	1,610 (3,550)	1,610 (3,550)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window and auto door lock system is included in C.W.
*3: The weight of air conditioner, power steering, power window, auto door lock system, L.S.D. and RX package is included in C.W.
*4: The weight of sunroof, air conditioner, power steering, power window, digital instrument panel, cruise control, auto door lock system and L.S.D. is included in C.W.
*5: The weight of sunroof, air conditioner, power steering, power window, digital instrument panel, cruise control and auto door lock system is included in C.W.

4-DOOR SEDAN

ITEM	MODEL	FWD					
		DL	DL	GL	GL	GL-10	GL-10 TURBO
		SPFI 5MT	SPFI 3AT	SPFI 5MT	SPFI 3AT	SPFI 3AT	MPFI 3AT
Seating capacity	persons	5					
Engine type		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine					
		With Single-Point Fuel Injection					With Multi-Point Fuel Injection and Turbocharger
Valve arrangement		Overhead camshaft type					
Bore x stroke	mm (in)	92 x 67 (3.62 x 2.64)					
Displacement	cm³ (cu in)	1,781 (108.68)					
Compression ratio		9.5	9.5	9.5	9.5	9.5	7.7
Firing order		1-3-2-4					
Ignition timing at idling speed	BTDC/rpm*1	20°/700	20°/700	20°/700	20°/700	20°/700	20°/800
Idling speed at neutral, N or P position	rpm	700±100	700±100	700±100	700±100	700±100	800±100
Spark plug	Type and manufacturer	NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4					
Maximum output	HP/rpm	84/5,200					115/5,200
Maximum torque	N·m (kg-m, ft-lb)/rpm	137 (14.0, 101)/2,800					181 (18.5, 134)/2,800
Battery	Type	50D20R-MF	65D23R-MF	50D20R-MF	65D23R-MF	65D23R-MF	75D23R-MF
Battery	Reserve capacity (min.)	78	111	78	111	111	111
Battery	Cold cranking ampere (amp.)	306	420	306	420	420	490
Alternator		12V-60A					
Clutch type		DSPD	TC	DSPD	TC	TC	TC
Transmission type		*2	*3	*2	*3	*3	*3
Gear ratio	1st	3.636	2.821	3.636	2.821	2.821	2.821
Gear ratio	2nd	1.950	1.559	1.950	1.559	1.559	1.559
Gear ratio	3rd (Drive)	1.344	1.000	1.344	1.000	1.000	1.000
Gear ratio	4th	0.971	–	0.971	–	–	–
Gear ratio	5th	0.783	–	0.783	–	–	–
Gear ratio	Reverse	3.583	2.257	3.583	2.257	2.257	2.257
Auxiliary transmission gear ratio	High	–	–	–	–	–	–
Auxiliary transmission gear ratio	Low	–	–	–	–	–	–
Reduction gear (Front drive) — 1st reduction	Type of gear	–	Helical	–	Helical	Helical	Helical
Reduction gear (Front drive) — 1st reduction	Reduction gear ratio	–	0.976	–	0.976	0.976	0.976
Reduction gear (Front drive) — Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
Reduction gear (Front drive) — Final reduction	Reduction gear ratio	3.900	3.700	3.900	3.700	3.700	3.454

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum
*2: 5-forward speeds with synchromesh and 1-reverse
*3: Full automatic, 3-forward and 1-reverse

4-DOOR SEDAN

ITEM \ MODEL	4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD Full time 4WD RX TURBO MPFI 5MT D/R	4WD Full time 4WD GL-10 TURBO MPFI 5MT S/R	4WD Full time 4WD GL-10 TURBO MPFI 4AT
Seating capacity persons	5				
Engine type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine; With Single-Point Fuel Injection		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine; With Multi-Point Fuel Injection and Turbocharger		
Valve arrangement	Overhead camshaft type				
Bore x stroke mm (in)	92 x 67 (3.62 x 2.64)				
Displacement cm^3 (cu in)	1,781 (108.68)				
Compression ratio	9.5	9.5	7.7	7.7	7.7
Firing order	1-3-2-4				
Ignition timing at idling speed BTDC/rpm*1	20°/700	20°/700	20°/700	20°/700	20°/800
Idling speed at neutral, N or P position rpm	700±100	700±100	700±100	700±100	800±100
Spark plug — Type and manufacturer	NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4				
Maximum output HP/rpm	90/5,200		115/5,200		
Maximum torque N·m (kg-m, ft-lb)/rpm	137 (14.0, 101)/2,800		181 (18.5, 134)/2,800		
Battery — Type	50D20R-MF	65D23R-MF	50D20R-MF	50D20R-MF	75D23R-MF
Battery — Reserve capacity (min.)	78	111	78	78	111
Battery — Cold cranking ampere (amp.)	306	420	306	306	490
Alternator	12V-60A				
Clutch type	DSPD	TC	DSPD	DSPD	TC
Transmission type	*3	*2	*4	*5	*6
Gear ratio — 1st	3.545	2.821	3.545	3.545	2.785
Gear ratio — 2nd	1.947	1.559	2.111	2.111	1.545
Gear ratio — 3rd (Drive)	1.366	1.000	1.448	1.448	1.000
Gear ratio — 4th	0.972	–	1.088	1.088	0.694
Gear ratio — 5th	0.780	–	0.871	0.871	–
Gear ratio — Reverse	3.416	2.257	3.416	3.416	2.272
Auxiliary transmission gear ratio — High	1.000	–	1.000	–	–
Auxiliary transmission gear ratio — Low	1.592	–	1.196	–	–
Reduction gear (Front drive) — 1st reduction — Type of gear	–	Helical	–	–	Helical
Reduction gear (Front drive) — 1st reduction — Reduction gear ratio	–	0.974	–	–	1.000
Reduction gear (Front drive) — Final reduction — Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
Reduction gear (Front drive) — Final reduction — Reduction gear ratio	3.900	3.700	3.700	3.700	3.700

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum
*2: Full automatic, 3-forward and 1-reverse
*3: 5x2-forward speeds with synchromesh and 1-reverse (Dual range)
*4: 5x2-forward speeds with synchromesh and 1-reverse (Dual range) – with center differential
*5: 5-forward speeds with synchromesh and 1-reverse (Single range) – with center differential
*6: Full automatic, 4-forward and 1-reverse

4-DOOR SEDAN

ITEM		MODEL	FWD					
			DL	DL	GL	GL	GL-10	GL-10 TURBO
			SPFI 5MT	SPFI 3AT	SPFI 5MT	SPFI 3AT	SPFI 3AT	MPFI 3AT
Reduction gear (Rear drive)	Transfer reduction	Type of gear	–	–	–	–	–	–
		Reduction gear ratio	–	–	–	–	–	–
	Final reduction	Type of gear	–	–	–	–	–	–
		Reduction gear ratio	–	–	–	–	–	–
Steering system	Type		Rack and pinion					
	Turns, lock to lock		3.7					
	Minimum turning circle*1 m (ft)		At tire .... 9.6 (31.5) At bumper 10.6 (34.8)					
Suspension	Front		MacPherson strut type, Independent, Coil spring					
	Rear		Semi-trailing arm type, Independent, Coil spring					
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit					
	Front		Ventilated disc brake					
	Rear		Drum brake (Leading & trailing type)					Disc brake
	Parking brake		Mechanical on front brake					
Tire	Size		155SR13		175/70SR13		175/70HR13	
	Type		Steel belted radial, Tubeless					
Capacity	Fuel tank capacity ℓ (US gal., Imp gal.)		60 (15.9, 13.2)					
	Engine oil	Upper level ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)					
		Lower level ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)					
	Transmission gear oil ℓ (US qt, Imp qt)		2.6 (2.7, 2.3)	–	2.6 (2.7, 2.3)	–	–	–
	Automatic transmission fluid ℓ (US qt, Imp qt)		–	6.2±0.1 (6.6±0.1, 5.5±0.1)	–	6.2±0.1 (6.6±0.1, 5.5±0.1)	6.2±0.1 (6.6±0.1, 5.5±0.1)	6.2±0.1 (6.6±0.1, 5.5±0.1)
	AT differential gear oil ℓ (US qt, Imp qt)		–	1.2 (1.3, 1.1)	–	1.2 (1.3, 1.1)	1.2 (1.3, 1.1)	1.2 (1.3, 1.1)
	4WD rear differential gear oil ℓ (US qt, Imp qt)		–	–	–	–	–	–
	Power steering fluid ℓ (US qt, Imp qt)		0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant ℓ (US qt, Imp qt)		5.5 (5.8, 4.8)					6.0 (6.3, 5.3) *2 5.5 (5.8, 4.8)

*1: Curb to curb
*2: For CANADA

4-DOOR SEDAN

ITEM			4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	Full time 4WD RX TURBO MPFI 5MT D/R	Full time 4WD GL-10 TURBO MPFI 5MT S/R	Full time 4WD GL-10 TURBO MPFI 4AT
Reduction gear (Rear drive)	Transfer reduction	Type of gear	Helical	Helical	Helical	Helical	–
		Reduction gear ratio	1.000	0.948	1.000	1.000	–
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.900	3.700	3.700	3.700
Steering system	Type		Rack and pinion				
	Turns, lock to lock		3.7				
	Minimum turning circle*1 m (ft)		At tire .... 9.6 (31.5) At bumper ... 10.6 (34.8)				
Suspension	Front		MacPherson strut type, Independent, Coil spring			*2	
	Rear		Semi-trailing arm type, Independent, Coil spring			*3	
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit				
	Front		Ventilated disc brake				
	Rear		Drum brake (Leading & trailing type)		Disc brake		
	Parking brake		Mechanical on front brake				
Tire	Size		175/70SR13		185/70HR13		
	Type		Steel belted radial, Tubeless				
Capacity	Fuel tank capacity ℓ (US gal., Imp gal.)		60 (15.9, 13.2)				
	Engine oil	Upper level ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)				
		Lower level ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)				
	Transmission gear oil ℓ (US qt, Imp qt)		3.3 (3.5, 2.9)	–	3.5 (3.7, 3.1)	3.5 (3.7, 3.1)	–
	Automatic transmission fluid ℓ (US qt, Imp qt)		–	6.55±0.1 (6.9±0.1, 5.8±0.1)	–	–	9.5 (10.0, 8.4)
	AT differential gear oil ℓ (US pt, Imp pt)		–	1.2 (2.5, 2.1)	–	–	1.4 (3.0, 2.5)
	4WD rear differential gear oil ℓ (US qt, Imp qt)		0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)
	Power steering fluid ℓ (US qt, Imp qt)		0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant ℓ (US qt, Imp qt)		5.5 (5.8, 4.8)				6.0 (6.3, 5.3) *4 5.5 (5.8, 4.8)

*1: Curb to curb
*2: MacPherson strut type, Independent, Pneumatic suspension with height control
*3: Semi-trailing arm type, Independent, Pneumatic suspension with height control
*4: For CANADA

STATION WAGON

ITEM \ MODEL				FWD					
				DL	DL	GL	GL	GL-10	GL-10 TURBO
				SPFI 5MT	SPFI 3AT	SPFI 5MT	SPFI 3AT	SPFI 3AT	MPFI 3AT
Overall length			mm (in)	4,490 (176.8) *4 4,410 (173.6)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)
Overall width			mm (in)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height			mm (in)	1,345 (53.0)	1,345 (53.0)	1,345 (53.0)	1,345 (53.0)	1,345 (53.0)	1,345 (53.0)
Cargo space	Length	at 2 seats	mm (in)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)
		at 5 seats	mm (in)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)
	Width	at 2 seats	mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
		at 5 seats	mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
	Height		mm (in)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)
Wheelbase			mm (in)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)
Tread		Front	mm (in)	1,420 (55.9)	1,420 (55.9)	1,420 (55.9)	1,420 (55.9)	1,420 (55.9)	1,420 (55.9)
		Rear	mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance			mm (in)	140 (5.5)	140 (5.5)	140 (5.5)	140 (5.5)	140 (5.5)	140 (5.5)
Weight	Curb weight	For U.S.A.	Front kg (lb)	*1 608 (1,340) *4 585 (1,290)	*2 619 (1,365)	*2 615 (1,355)	*2 631 (1,390)	*3 676 (1,490)	*3 703 (1,550)
			Rear kg (lb)	*1 467 (1,030) *4 458 (1,010)	*1 474 (1,045)	*2 492 (1,085)	*2 494 (1,090)	*3 506 (1,115)	*3 515 (1,135)
			Total kg (lb)	*1 1,075 (2,370) *4 1,043 (2,300)	*1 1,093 (2,410)	*2 1,107 (2,440)	*2 1,125 (2,480)	*3 1,182 (2,605)	*3 1,218 (2,685)
		For Canada	Front kg (lb)	*1 608 (1,340)	*1 619 (1,365)	*1 612 (1,350)	*1 628 (1,385)	–	*3 703 (1,550)
			Rear kg (lb)	*1 467 (1,030)	*1 474 (1,045)	*1 488 (1,075)	*1 490 (1,080)	–	*3 515 (1,135)
			Total kg (lb)	*1 1,075 (2,370)	*1 1,093 (2,410)	*1 1,100 (2,425)	*1 1,118 (2,465)	–	*3 1,218 (2,685)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window and auto door lock system is included in C.W.
*3: The weight of sunroof, air conditioner, power steering, power window, digital instrument panel, cruise control and auto door lock system is included in C.W.
*4: For Puerto Rico model only

STATION WAGON

ITEM \ MODEL				4WD DL SPFI 5MT S/R	4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD GL TURBO MPFI 5MT S/R	Full time 4WD GL-10 TURBO MPFI 5MT S/R	Full time 4WD GL-10 TURBO MPFI 4AT
Overall length			mm (in)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)
Overall width			mm (in)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height			mm (in)	1,395 (54.9)	1,395 (54.9)	1,395 (54.9)	1,395 (54.9)	1,395 (54.9)	1,425 (56.1)
Cargo space	Length	at 2 seats	mm (in)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)
		at 5 seats	mm (in)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)
	Width	at 2 seats	mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
		at 5 seats	mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
	Height		mm (in)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)	895 (35.2)
Wheelbase			mm (in)	2,460 (96.9)	2,460 (96.9)	2,460 (96.9)	2,460 (96.9)	2,460 (96.9)	2,465 (97.0)
Tread	Front		mm (in)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)	1,420 (55.9)
	Rear		mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance			mm (in)	135 (5.3)	135 (5.3)	135 (5.3)	135 (5.3)	135 (5.3)	160 (6.3)
Weight	Curb weight	For U.S.A.	Front kg (lb)	*1 630 (1,390)	*2 646 (1,425)	*2 653 (1,440)	*3 687 (1,515)	*4 703 (1,550)	*5 750 (1,655)
			Rear kg (lb)	*1 524 (1,155)	*2 540 (1,190)	*2 540 (1,190)	*3 540 (1,190)	*4 563 (1,240)	*5 565 (1,245)
			Total kg (lb)	*1 1,154 (2,545)	*2 1,186 (2,615)	*2 1,193 (2,630)	*3 1,227 (2,705)	*4 1,266 (2,790)	*5 1,315 (2,900)
		For Canada	Front kg (lb)	*1 630 (1,390)	*1 644 (1,420)	*1 651 (1,435)	–	–	*5 750 (1,655)
			Rear kg (lb)	*1 524 (1,155)	*1 535 (1,180)	*1 535 (1,180)	–	–	*5 565 (1,245)
			Total kg (lb)	*1 1,154 (2,545)	*1 1,179 (2,600)	*1 1,186 (2,615)	–	–	*5 1,315 (2,900)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window and auto door lock system is included in C.W.
*3: The weight of air conditioner, power steering, power window and auto door lock system is included in C.W.
*4: The weight of sunroof, air conditioner, power steering, power window, digital instrument panel, cruise control, auto door lock and L.S.D. system is included in C.W.
*5: The weight of sunroof, air conditioner, power steering, power window, digital instrument panel, cruise control and auto door lock system is included in C.W.

STATION WAGON

ITEM \ MODEL			FWD					
			DL	DL	GL	GL	GL-10	GL-10 TURBO
			SPFI 5MT	SPFI 3AT	SPFI 5MT	SPFI 3AT	SPFI 3AT	MPFI 3AT
Weight	Gross vehicle weight	Front kg (lb)	816 (1,800)	816 (1,800)	844 (1,860)	844 (1,860)	857 (1,890)	857 (1,890)
		Rear kg (lb)	794 (1,750)	794 (1,750)	821 (1,810)	821 (1,810)	835 (1,840)	835 (1,840)
		Total kg (lb)	1,610 (3,550)	1,610 (3,550)	1,665 (3,670)	1,665 (3,670)	1,692 (3,730)	1,692 (3,730)
Seating capacity persons			5					
Engine type			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine With Single-Point Fuel Injection					With Multi-Point Fuel Injection and Turbocharger
Valve arrangement			Overhead camshaft type					
Bore x stroke mm (in)			92 x 67 (3.62 x 2.64)					
Displacement cm^3 (cu in)			1,781 (108.68)					
Compression ratio			9.5	9.5	9.5	9.5	9.5	7.7
Firing order			1-3-2-4					
Ignition timing at idling speed BTDC/rpm*1			20°/700	20°/700	20°/700	20°/700	20°/700	20°/800
Idling speed at neutral, N or P position rpm			700±100	700±100	700±100	700±100	700±100	800±100
Spark plug	Type and manufacturer		NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4					
Maximum output HP/rpm			90/5,200					115/5,200
Maximum torque N·m (kg-m, ft-lb)/rpm			137 (14.0, 101)/2,800					181 (18.5, 134)/2,800
Battery	Type		50D20R-MF	65D23R-MF	50D20R-MF	65D23R-MF	65D23R-MF	75D23R-MF
	Reserve capacity (min.)		78	111	78	111	111	111
	Cold cranking ampere (amp.)		306	420	306	420	420	490
Alternator			12V-60A					
Clutch type			DSPD	TC	DSPD	TC	TC	TC
Transmission type			*2	*3	*2	*3	*3	*3
Gear ratio	1st		3.636	2.821	3.636	2.821	2.821	2.821
	2nd		1.950	1.559	1.950	1.559	1.559	1.559
	3rd (Drive)		1.344	1.000	1.344	1.000	1.000	1.000
	4th		0.971	–	0.971	–	–	–
	5th		0.783	–	0.783	–	–	–
	Reverse		3.583	2.257	3.583	2.257	2.257	2.257
Auxiliary transmission gear ratio	High		–	–	–	–	–	–
	Low		–	–	–	–	–	–

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum
*2: 5-forward speeds with synchromesh and 1-reverse
*3: Full automatic, 3-forward and 1-reverse

STATION WAGON

ITEM \ MODEL			4WD					
			DL	GL	GL	GL TURBO	Full time 4WD GL-10 TURBO	Full time 4WD GL-10 TURBO
			SPFI 5MT S/R	SPFI 5MT D/R	MPFI 3AT	MPFI 5MT S/R	MPFI 5MT S/R	MPFI 4AT
Weight	Gross vehicle weight	Front kg (lb)	803 (1,770)	803 (1,770)	803 (1,770)	819 (1,805)	819 (1,805)	850 (1,875)
		Rear kg (lb)	859 (1,895)	859 (1,895)	859 (1,895)	877 (1,935)	877 (1,935)	880 (1,940)
		Total kg (lb)	1,662 (3,665)	1,662 (3,665)	1,662 (3,665)	1,696 (3,740)	1,696 (3,740)	1,730 (3,815)
Seating capacity persons			5					
Engine type			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine With Single-Point Fuel Injection			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine With Multi-Point Fuel Injection and Turbocharger		
Valve arrangement			Overhead camshaft type					
Bore x stroke mm (in)			92 x 67 (3.62 x 2.64)					
Displacement cm^3 (cu in)			1,781 (108.68)					
Compression ratio			9.5	9.5	9.5	7.7	7.7	7.7
Firing order			1-3-2-4					
Ignition timing at idling speed BTDC/rpm*1			20°/700	20°/700	20°/700	20°/700	20°/700	20°/800
Idling speed at neutral, N or P position rpm			700±100	700±100	700±100	700±100	700±100	800±100
Spark plug	Type and manufacturer		NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4					
Maximum output HP/rpm			90/5,200			115/5,200		
Maximum torque N·m (kg-m, ft-lb)/rpm			137 (14.0, 101)/2,800			181 (18.5, 134)/2,800		
Battery	Type		50D20R-MF	50D20R-MF	65D20R-MF	50D20R-MF	50D20R-MF	75D23R-MF
	Reserve capacity (min.)		78	78	111	78	78	111
	Cold cranking ampere (amp.)		306	306	420	306	306	490
Alternator			12V-60A					
Clutch type			DSPD	DSPD	TC	DSPD	DSPD	TC
Transmission type			*2	*4	*3	*2	*6	*5
Gear ratio	1st		3.545	3.545	2.821	3.545	3.545	2.785
	2nd		1.947	1.947	1.559	2.111	2.111	1.545
	3rd (Drive)		1.366	1.366	1.000	1.448	1.448	1.000
	4th		0.972	0.972	–	1.088	1.088	0.694
	5th		0.780	0.780	–	0.871	0.871	–
	Reverse		3.416	3.416	2.257	3.416	3.416	2.272
Auxiliary transmission gear ratio	High		–	1.000	–	–	–	–
	Low		–	1.592	–	–	–	–

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum
*2: 5-forward speeds with synchromesh and 1-reverse
*3: Full automatic, 3-forward and 1-reverse
*4: 5x2-forward speeds with synchromesh and 1-reverse (Dual range)
*5: Full automatic, 4-forward and 1-reverse
*6: 5-forward speeds with synchromesh and 1-reverse (Single range) — with center differential

STATION WAGON

ITEM			DL SPFI 5MT	DL SPFI 3AT	GL SPFI 5MT	GL SPFI 3AT	GL-10 SPFI 3AT	GL-10 TURBO MPFI 3AT
MODEL			FWD					
Reduction gear (Front drive)	1st reduction	Type of gear	—	Helical	—	Helical	Helical	Helical
		Reduction gear ratio	—	0.976	—	0.976	0.976	0.976
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.700	3.900	3.700	3.700	3.454
Reduction gear (Rear drive)	Transfer reduction	Type of gear	—	—	—	—	—	—
		Reduction gear ratio	—	—	—	—	—	—
	Final reduction	Type of gear	—	—	—	—	—	—
		Reduction gear ratio	—	—	—	—	—	—
Steering system	Type		Rack and pinion					
	Turns, lock to lock		3.7					
	Minimum turning circle*1	m (ft)	At tire .... 9.6 (31.5) At bumper.... 10.6 (34.8)					
Suspension	Front		MacPherson strut type, Independent, Coil spring					
	Rear		Semi-trailing arm type, Independent, Coil spring					
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit					
	Front		Ventilated disc brake					
	Rear		Drum brake (Leading & trailing type)					Disc brake
	Parking brake		Mechanical on front brake					
Tire	Size		155SR13		175/70SR13		175/70HR13	
	Type		Steel belted radial, Tubeless					
Capacity	Fuel tank capacity	ℓ (US gal., Imp gal.)	60 (15.9, 13.2)					
	Engine oil	Upper level ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)					
		Lower level ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)					
	Transmission gear oil	ℓ (US qt, Imp qt)	2.6 (2.7, 2.3)	—	2.6 (2.7, 2.3)	—	—	—
	Automatic transmission fluid	ℓ (US qt, Imp qt)	—	6.2±0.1 (6.6±0.1, 5.5±0.1)	—	6.2±0.1 (6.6±0.1, 5.5±0.1)	6.2±0.1 (6.6±0.1, 5.5±0.1)	6.2±0.1 (6.6±0.1, 5.5±0.1)
	AT differential gear oil	ℓ (US qt, Imp qt)	—	1.2 (1.3, 1.1)	—	1.2 (1.3, 1.1)	1.2 (1.3, 1.1)	1.2 (1.3, 1.1)
	4WD rear differential gear oil	ℓ (US qt, Imp qt)	—	—	—	—	—	—
	Power steering fluid	ℓ (US qt, Imp qt)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant	ℓ (US qt, Imp qt)	5.5 (5.8, 4.8)					6.0 (6.3, 5.3) *2 5.5 (5.8, 4.8)

*1: Curb to curb
*2: For CANADA

STATION WAGON

ITEM		MODEL	4WD					
			DL	GL	GL	GL TURBO	Full time 4WD GL-10 TURBO	Full time 4WD GL-10 TURBO
			SPFI 5MT S/R	SPFI 5MT D/R	SPFI 3AT	MPFI 5MT S/R	MPFI 5MT S/R	MPFI 4AT
Reduction gear (Rear drive)	Transfer reduction	Type of gear	Helical	Helical	Helical	Helical	Helical	–
		Reduction gear ratio	1.000	1.000	0.948	1.000	1.000	–
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.900	3.900	3.700	3.700	3.700
Reduction gear (Rear drive)	Transfer reduction	Type of gear	Helical	Helical	Helical	Helical	Helical	–
		Reduction gear ratio	1.000	1.000	0.948	1.000	1.000	–
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.900	3.900	3.700	3.700	3.700
Steering system	Type		Rack and pinion					
	Turns, lock to lock		3.7					
	Minimum turning circle*1	m (ft)	At tire .... 9.6 (31.5) At bumper ... 10.6 (34.8)					
Suspension	Front		MacPherson strut type, Independent, Coil spring					*2
	Rear		Semi-trailing arm type, Independent, Coil spring					*3
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit					
	Front		Ventilated disc brake					
	Rear		Drum brake (Leading & trailing type)			Disc brake		
	Parking brake		Mechanical on front brake					
Tire	Size		165SR13	185/70SR13		185/70HR13		
	Type		Steel belted radial, Tubeless					
Capacity	Fuel tank capacity	ℓ (US gal., Imp gal.)	60 (15.9, 13.2)					
	Engine oil Upper level	ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)					
	Engine oil Lower level	ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)					
	Transmission gear oil	ℓ (US qt, Imp qt)	3.3 (3.5, 2.9)	3.3 (3.5, 2.9)	–	3.3 (3.5, 2.9)	3.5 (3.7, 3.1)	–
	Automatic transmission fluid	ℓ (US qt, Imp qt)	–	–	6.55±0.1 (6.9±0.1, 5.8±0.1)	–	–	9.5 (10.0, 8.4)
	AT differential gear oil	ℓ (US pt, Imp pt)	–	–	1.2 (2.5, 2.1)	–	–	1.4 (3.0, 2.5)
	4WD rear differential gear oil	ℓ (US qt, Imp qt)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)
	Power steering fluid	ℓ (US qt, Imp qt)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant	ℓ (US qt, Imp qt)	5.5 (5.8, 4.8)					6.0 (6.3, 5.3) *2 5.5 (5.8, 4.8)

*1: Curb to curb
*2: MacPherson strut type, Independent, Pneumatic suspension with height control
*3: Semi-trailing arm type, Independent, Pneumatic suspension with height control
*4: For CANADA

3-DOOR

ITEM \ MODEL				FWD DL SPFI 5MT	FWD DL SPFI 3AT	FWD GL SPFI 5MT	FWD GL SPFI 3AT	4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD Full time 4WD RX TURBO MPFI 5MT D/R
Overall length mm (in)				4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)	4,435 (174.6)
Overall width mm (in)				1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height mm (in)				1,316 (51.8)	1,316 (51.8)	1,316 (51.8)	1,316 (51.8)	1,357 (53.4)	1,357 (53.4)	1,357 (53.4)
Compart-ment	Leg room	Front Max. mm (in)		1,073 (42.2)	1,073 (42.2)	1,073 (42.2)	1,073 (42.2)	1,073 (42.2)	1,073 (42.2)	1,073 (42.2)
		Rear Min. mm (in)		828 (32.6)	828 (32.6)	828 (32.6)	828 (32.6)	828 (32.6)	828 (32.6)	828 (32.6)
	Head room	Front mm (in)		955 (37.6)	955 (37.6)	955 (37.6)	955 (37.6)	955 (37.6)	955 (37.6)	955 (37.6)
		Rear mm (in)		909 (35.8)	909 (35.8)	909 (35.8)	909 (35.8)	909 (35.8)	909 (35.8)	909 (35.8)
	Shoulder room mm (in)			1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
Wheelbase mm (in)				2,470 (97.2)	2,470 (97.2)	2,470 (97.2)	2,470 (97.2)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)
Tread	Front mm (in)			1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)
	Rear mm (in)			1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance mm (in)				130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)
Weight	Curb weight	For U.S.A.	Front kg (lb)	*1 603 (1,330)	*1 619 (1,365)	*2 617 (1,360)	*2 633 (1,395)	*2 637 (1,405)	*2 644 (1,420)	*3 698 (1,540)
			Rear kg (lb)	*1 431 (950)	*1 433 (955)	*2 447 (985)	*2 449 (990)	*2 499 (1,100)	*2 501 (1,105)	*3 513 (1,130)
			Total kg (lb)	*1 1,034 (2,280)	*1 1,052 (2,320)	*2 1,064 (2,345)	*2 1,082 (2,385)	*2 1,136 (2,505)	*2 1,145 (2,525)	*3 1,211 (2,670)
		For Canada	Front kg (lb)	*1 603 (1,330)	*1 619 (1,365)	*1 614 (1,355)	*1 631 (1,390)	*1 635 (1,400)	*1 642 (1,415)	*3 698 (1,540)
			Rear kg (lb)	*1 431 (950)	*1 433 (955)	*1 447 (985)	*1 449 (990)	*1 499 (1,100)	*1 501 (1,105)	*3 513 (1,130)
			Total kg (lb)	*1 1,034 (2,280)	*1 1,052 (2,320)	*1 1,061 (2,340)	*1 1,080 (2,380)	*1 1,134 (2,500)	*1 1,143 (2,520)	*3 1,211 (2,670)
	Gross vehicle weight		Front kg (lb)	816 (1,800)	816 (1,800)	816 (1,800)	816 (1,800)	817 (1,800)	817 (1,800)	817 (1,800)
			Rear kg (lb)	735 (1,620)	735 (1,620)	735 (1,620)	735 (1,620)	780 (1,720)	780 (1,720)	780 (1,720)
			Total kg (lb)	1,551 (3,420)	1,551 (3,420)	1,551 (3,420)	1,551 (3,420)	1,597 (3,520)	1,597 (3,520)	1,597 (3,520)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window and auto door lock system is included in C.W.
*3: The weight of air conditioner, power steering, power window, auto door lock system, L.S.D. and RX package is included in C.W.

3-DOOR

MODEL / ITEM		FWD				4WD		
		DL	DL	GL	GL	GL	GL	Full time 4WD RX TURBO
		SPFI 5MT	SPFI 3AT	SPFI 5MT	SPFI 3AT	SPFI 5MT D/R	SPFI 3AT	MPFI 5MT D/R
Seating capacity persons		5						
Engine type		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine With Single-Point Fuel Injection						With Multi-Point Fuel Injection and Turbo-charger
Valve arrangement		Overhead camshaft type						
Bore x stroke mm (in)		92 x 67 (3.62 x 2.64)						
Displacement cm^3 (cu in)		1,781 (108.68)						
Compression ratio		9.5	9.5	9.5	9.5	9.5	9.5	7.7
Firing order		1-3-2-4						
Ignition timing at idling speed BTDC/rpm*1		20°/700	20°/700	20°/700	20°/700	20°/700	20°/700	20°/700
Idling speed at neutral, N or P position rpm		700±100	700±100	700±100	700±100	700±100	700±100	700±100
Spark plug	Type and manufacturer	NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4						
Maximum output HP/rpm		90/5,200				90/5,200		115/5,200
Maximum torque N-m (kg-m, ft-lb)/rpm		137 (14.0, 101)/2,800				137 (14.0, 101)/2,800		181 (18.5, 134) /2,800
Battery	Type	50D20R-MF	65D23R-MF	50D20R-MF	65D23R-MF	50D20R-MF	65D23R-MF	50D20R-MF
	Reserve capacity (min.)	78	111	78	111	78	111	78
	Cold cranking ampere (amp.)	306	420	306	420	306	420	306
Alternator		12V-60A						
Clutch type		DSPD	TC	DSPD	TC	DSPD	TC	DSPD
Transmission type		*2	*3	*2	*3	*4	*3	*5
Gear ratio	1st	3.636	2.821	3.636	2.821	3.545	2.821	3.545
	2nd	1.950	1.559	1.950	1.559	1.947	1.559	2.111
	3rd	1.344	1.000	1.344	1.000	1.366	1.000	1.448
	4th	0.971	–	0.971	–	0.972	–	1.088
	5th	0.783	–	0.783	–	0.780	–	0.871
	Reverse	3.583	2.257	3.583	2.257	3.416	2.257	3.416
Auxiliary transmission gear ratio	High	–	–	–	–	1.000	–	1.000
	Low	–	–	–	–	1.592	–	1.196

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum
*2: 5-forward speeds with synchromesh and 1-reverse
*3: Full automatic, 3-forward and 1-reverse
*4: 5x2-forward speeds with synchromesh and 1-reverse (Dual-range)
*5: 5x2-forward speeds with synchromesh and 1-reverse (Dual-range) — with center differential

3-DOOR

ITEM			FWD DL SPFI 5MT	FWD DL SPFI 3AT	FWD GL SPFI 5MT	FWD GL SPFI 3AT	4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD Full time 4WD RX TURBO MPFI 5MT D/R
Reduction gear (Front drive)	1st reduction	Type of gear	–	Helical	–	Helical	–	Helical	–
		Reduction gear ratio	–	0.976	–	0.976	–	0.976	–
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.700	3.900	3.700	3.900	3.700	3.700
Reduction gear (Rear drive)	Transfer reduction	Type of gear	–	–	–	–	Helical	Helical	Helical
		Reduction gear ratio	–	–	–	–	1.000	0.948	1.000
	Final reduction	Type of gear	–	–	–	–	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	–	–	–	–	3.900	3.900	3.700
Steering system	Type		Rack and pinion						
	Turns, lock to lock		3.7						
	Minimum turning circle*1 m (ft)		At tire .... 9.6 (31.5) At bumper ... 10.6 (34.8)						
Suspension	Front		MacPherson strut type, Independent, Coil spring						
	Rear		Semi-trailing arm type, Independent, Coil spring						
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit						
	Front		Ventilated disc brake						
	Rear		Drum brake (Leading & trailing type)				Drum brake (Leading & trailing type)		Disc brake
	Parking brake		Mechanical on front brake						
Tire	Size		155SR13		175/70SR13		175/70SR13		185/70HR13
	Type		Steel belted radial, Tubeless						
Capacity	Fuel tank capacity ℓ (US gal., Imp gal.)		60 (15.9, 13.2)						
	Engine oil	Upper level ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)						
		Lower level ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)						
	Transmission gear oil ℓ (US qt, Imp qt)		2.6 (2.7, 2.3)	–	2.6 (2.7, 2.3)	–	3.3 (3.5, 2.9)	–	3.5 (3.7, 3.1)
	Automatic transmission fluid ℓ (US qt, Imp qt)		–	6.2±0.1 (6.6±0.1, 5.5±0.1)	–	6.2±0.1 (6.6±0.1, 5.5±0.1)	–	6.55±0.1 (6.9±0.1, 5.8±0.1)	–
	AT differential gear oil ℓ (US qt, Imp qt)		–	1.2 (1.3, 1.1)	–	1.2 (1.3, 1.1)	–	1.2 (1.3, 1.1)	–
	4WD rear differential gear oil ℓ (US qt, Imp qt)		–	–	–	–	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)
	Power steering fluid ℓ (US qt, Imp qt)		0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant ℓ (US qt, Imp qt)		About 5.5 (5.8, 4.8)						

*1: Curb to curb

TOURING WAGON

MODEL / ITEM				FWD			
				GL	GL	GL-10	GL-10 TURBO
				SPFI 5MT	SPFI 3AT	SPFI 3AT	FPFI 3AT
Overall length			mm (in)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)
Overall width			mm (in)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height			mm (in)	1,385 (54.5)	1,385 (54.5)	1,385 (54.5)	1,385 (54.5)
Cargo space	Length	at 2 sets	mm (in)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)
		at 5 sets	mm (in)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)
	Width	at 2 sets	mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
		at 5 sets	mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
	Height		mm (in)	935 (36.8)	935 (36.8)	935 (36.8)	935 (36.8)
Wheelbase			mm (in)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)	2,465 (97.0)
Tread		Front	mm (in)	1,420 (55.9)	1,420 (55.9)	1,420 (55.9)	1,420 (55.9)
		Rear	mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance			mm (in)	140 (5.5)	140 (5.5)	140 (5.5)	140 (5.5)
Weight	Curb weight	For U.S.A.	Front kg (lb)	*2 615 (1,355)	*2 630 (1,390)	*3 667 (1,470)	*3 689 (1,520)
			Rear kg (lb)	*2 494 (1,090)	*2 497 (1,095)	*3 496 (1,095)	*3 499 (1,100)
			Total kg (lb)	*2 1,109 (2,445)	*2 1,127 (2,485)	*3 1,163 (2,565)	*3 1,188 (2,620)
		For Canada	Front kg (lb)	*1 612 (1,350)	*1 628 (1,385)	–	*3 689 (1,520)
			Rear kg (lb)	*1 490 (1,080)	*1 492 (1,085)	–	*3 499 (1,100)
			Total kg (lb)	* 1,102 (2,430)	*1 1,120 (2,470)	–	*3 1,188 (2,620)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window and auto door lock system is included in C.W.
*3: The weight of air conditioner, power steering, power window, digital instrument panel, cruise control and auto door lock system is included in C.W.

TOURING WAGON

ITEM \ MODEL					4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD GL TURBO MPFI 5MT S/R	Full time 4WD GL-10 TURBO MPFI 5MT S/R	Full time 4WD GL-10 TURBO MPFI 4AT
Overall length				mm (in)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)	4,490 (176.8)
Overall width				mm (in)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)	1,660 (65.4)
Overall height				mm (in)	1,435 (56.5)	1,435 (56.5)	1,435 (56.5)	1,435 (56.5)	1,465 (56.5)
Cargo space	Length	at 2 sets		mm (in)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)	1,645 (64.8)
Cargo space	Length	at 5 sets		mm (in)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)	805 (31.7)
Cargo space	Width	at 2 sets		mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
Cargo space	Width	at 5 sets		mm (in)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)	1,360 (53.5)
Cargo space	Height			mm (in)	935 (36.8)	935 (36.8)	935 (36.8)	935 (36.8)	935 (36.8)
Wheelbase				mm (in)	2,460 (96.9)	2,460 (96.9)	2,460 (96.9)	2,460 (96.9)	2,465 (97.0)
Tread	Front			mm (in)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)	1,410 (55.5)	1,420 (55.9)
Tread	Rear			mm (in)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)	1,425 (56.1)
Minimum road clearance				mm (in)	135 (5.3)	135 (5.3)	135 (5.3)	135 (5.3)	160 (6.3)
Weight	Curb weight	For U.S.A.	Front	kg (lb)	*2 646 (1,425)	*2 653 (1,440)	*3 687 (1,515)	*4 694 (1,530)	*5 744 (1,640)
Weight	Curb weight	For U.S.A.	Rear	kg (lb)	*2 542 (1,195)	*2 542 (1,195)	*3 542 (1,195)	*4 553 (1,220)	*5 556 (1,225)
Weight	Curb weight	For U.S.A.	Total	kg (lb)	*2 1,188 (2,620)	*2 1,195 (2,635)	*3 1,229 (2,710)	*4 1,247 (2,750)	*5 1,300 (2,865)
Weight	Curb weight	For Canada	Front	kg (lb)	*1 644 (1,420)	*1 651 (1,435)	–	–	*5 744 (1,640)
Weight	Curb weight	For Canada	Rear	kg (lb)	*1 538 (1,185)	*1 537 (1,185)	–	–	*5 556 (1,225)
Weight	Curb weight	For Canada	Total	kg (lb)	*1 1,182 (2,605)	*1 1,188 (2,620)	–	–	*5 1,300 (2,865)

*1: The weight of power steering is included in C.W.
*2: The weight of power steering, power window and auto door lock system is included in C.W.
*3: The weight of air conditioner, power steering, power window and auto door lock system is included in C.W.
*4: The weight of air conditioner, power steering, power window, digital instrument panel, cruise control, auto door lock and L.S.D. system is included in C.W.
*5: The weight of air conditioner, power steering, power window, digital instrument panel, cruise control and auto door lock system is included in C.W.

TOURING WAGON

ITEM / MODEL			FWD GL SPFI 5MT	FWD GL SPFI 3AT	FWD GL-10 SPFI 3AT	FWD GL-10 TURBO MPFI 3AT
Weight	Gross vehicle weight	Front kg (lb)	844 (1,860)	844 (1,860)	857 (1,890)	857 (1,890)
		Rear kg (lb)	821 (1,810)	821 (1,810)	835 (1,840)	835 (1,840)
		Total kg (lb)	1,665 (3,670)	1,665 (3,670)	1,692 (3,730)	1,692 (3,730)
Seating capacity		persons	5			
Engine type			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gaoline engine With Sngle-Point Fuel Injection			With Multi-Point Fuel Injection and Turbocharger
Valve arrangement			Overhead camshaft type			
Bore x stroke		mm (in)	92 x 67 (3.62 x 2.64)			
Displacement		cm^3 (cu in)	1,781 (108.68)			
Compression ratio			9.5	9.5	9.5	7.7
Firing order			1-3-2-4			
Ignition timing at idling speed		BTDC/rpm*1	20°/700	20°/700	20°/700	20°/800
Idling speed at neutral, N or P position		rpm	700±100	700±100	700±100	800±100
Spark plug	Type and manufacturer		NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4			
Maximum output		HP/rpm	90/5,200			115/5,200
Maximum torque		N·m (kg-m, ft-lb)/rpm	137 (14.0, 101)/2,800			181 (18.5, 134)/2,800
Battery	Type		50D20R-MF	65D23R-MF	65D23R-MF	75D23R-MF
	Reserve capacity	(min.)	78	111	111	111
	Cold cranking ampere	(amp.)	306	420	420	490
Alternator			12V-60A			
Clutch type			DSPD	TC	TC	TC
Transmission type			*2	*3	*3	*3
Gear ratio	1st		3.636	2.821	2.821	2.821
	2nd		1.950	1.559	1.559	1.559
	3rd (Drive)		1.344	1.000	1.000	1.000
	4th		0.971	–	–	–
	5th		0.783	–	–	–
	Reverse		3.583	2.257	2.257	2.257
Auxiliary transmission gear ratio	High		–	–	–	–
	Low		–	–	–	–

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum
*2: 5-forward speeds with synchromesh and 1-reverse
*3: Full automatic, 3-forward and 1-reverse

TOURING WAGON

ITEM \ MODEL			4WD				
			GL	GL	GL TURBO	Full time 4WD GL-10 TURBO	Full time 4WD GL-10 TURBO
			SPFI 5MT D/R	MPFI 3AT	MPFI 5MT S/R	MPFI 5MT S/R	MPFI 4AT
Weight	Gross vehicle weight	Front kg (lb)	803 (1,770)	803 (1,770)	819 (1,805)	819 (1,805)	850 (1,875)
		Rear kg (lb)	859 (1,895)	859 (1,895)	877 (1,935)	877 (1,935)	880 (1,940)
		Total kg (lb)	1,662 (3,665)	1,662 (3,665)	1,696 (3,740)	1,696 (3,740)	1,730 (3,815)
Seating capacity		persons	5				
Engine type			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine				
			With Single-Point Fuel Injection		With Multi-Point Fuel Injection and Turbocharger		
Valve arrangement			Overhead camshaft type				
Bore x stroke		mm (in)	92 x 67 (3.62 x 2.64)				
Displacement		cm^3 (cu in)	1,781 (108.68)				
Compression ratio			9.5	9.5	7.7	7.7	7.7
Firing order			1-3-2-4				
Ignition timing at idling speed		BTDC/rpm*1	20°/700	20°/700	20°C/700	20°/700	20°/800
Filing speed at neutral, N or P position		rpm	700±100	700±100	700±100	700±100	800±100
Spark plug	Type and manufacturer		NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) Nippondenso: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) Champion: RN9YC-4				
Maximum output		HP/rpm	90/5,200		115/5,200		
Maximum torque		N·m (kg-m, ft-lb)/rpm	137 (14.0, 101)/2,800		181 (18.5, 134)/2,800		
Battery	Type		50D20R-MF	65D20R-MF	50D20R-MF	50D20R-MF	75D23R-MF
	Reserve capacity	(min.)	78	111	78	78	111
	Cold cranking ampere	(amp.)	306	420	306	306	490
Alternator			12V-60A				
Clutch type			DSPD	TC	DSPD	DSPD	TC
Transmission type			*4	*3	*2	*6	*5
Gear ratio	1st		3.545	2.821	3.545	3.545	2.785
	2nd		1.947	1.559	2.111	2.111	1.545
	3rd (Drive)		1.366	1.000	1.448	1.448	1.000
	4th		0.972	—	1.088	1.088	0.694
	5th		0.780	—	0.871	0.871	—
	Reverse		3.416	2.257	3.416	3.416	2.272
Auxiliary transmission gear ratio	High		1.000	—	—	—	—
	Low		1.592	—	—	—	—

DSPD: Dry Single Plate Diaphragm
TC : Torque Converter

*1: Without vacuum

*2: 5-forward speeds with synchromesh and 1-reverse
*3: Full automatic, 3-forward and 1-reverse
*4: 5x2-forward speeds with synchromesh and 1-reverse (Dual range)
*5: Full automatic, 4-forward and 1-reverse
*6: 5-forward speeds with synchromesh and 1-reverse (Single range) — with center differential

TOURING WAGON

ITEM / MODEL			FWD GL SPFI 5MT	FWD GL SPFI 3AT	FWD GL-10 SPFI 3AT	FWD GL-10 TURBO MPFI 3AT
Reduction gear (Front drive)	1st reduction	Type of gear	–	Helical	Helical	Helical
		Reduction gear ratio	–	0.976	0.976	0.976
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.700	3.700	3.454
Reduction gear (Rear drive)	Transfer reduction	Type of gear	–	–	–	–
		Reduction gear ratio	–	–	–	–
	Final reduction	Type of gear	–	–	–	–
		Reduction gear ratio	–	–	–	–
Steering system	Type		Rack and pinion			
	Turns, lock to lock		3.7			
	Minimum turning circle*1 m (ft)		At tire .... 9.6 (31.5) At bumper 10.6 (34.8)			
Suspension	Front		MacPherson strut type, Independent, Coil spring			
	Rear		Semi-trailing arm type, Independent, Coil spring			
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit			
	Front		Ventilated disc brake			
	Rear		Drum brake (Leading & trailing type)			Disc brake
	Parking brake		Mechanical on front brake			
Tire	Size		175/70SR13		175/70HR13	
	Type		Steel belted radial, Tubeless			
Capacity	Fuel tank capacity ℓ (US gal., Imp gal.)		60 (15.9, 13.2)			
	Engine oil	Upper level ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)			
		Lower level ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)			
	Transmission gear oil ℓ (US qt, Imp qt)		2.6 (2.7, 2.3)	–	–	–
	Automatic transmission fluid ℓ (US qt, Imp qt)		–	6.2±0.1 (6.6±0.1, 5.5±0.1)	6.2±0.1 (6.6±0.1, 5.5±0.1)	6.2±0.1 (6.6±0.1, 5.5±0.1)
	AT differential gear oil ℓ (US qt, Imp qt)		–	1.2 (1.3, 1.1)	1.2 (1.3, 1.1)	1.2 (1.3, 1.1)
	4WD rear differential gear oil ℓ (US qt, Imp qt)		–	–	–	–
	Power steering fluid ℓ (US qt, Imp qt)		0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant ℓ (US qt, Imp qt)		5.5 (5.8, 4.8)			6.0 (6.3, 5.3) *2 5.5 (5.8, 4.8)

*1: Curb to curb
*2: For CANADA

TOURING WAGON

ITEM			MODEL 4WD GL SPFI 5MT D/R	4WD GL SPFI 3AT	4WD GL TURBO MPFI 5MT S/R	4WD Full time 4WD GL-10 TURBO MPFI 5MT S/R	4WD Full time 4WD GL-10 TURBO MPFI 4AT
Reduction gear (Front drive)	1st reduction	Type of gear	–	Helical	–	–	Helical
		Reduction gear ratio	–	0.976	–	–	1.000
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.700	3.700	3.700	3.700
Reduction gear (Rear drive)	Transfer reduction	Type of gear	Helical	Helical	Helical	Helical	–
		Reduction gear ratio	1.000	0.948	1.000	1.000	–
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Reduction gear ratio	3.900	3.900	3.700	3.700	3.700
Steering system	Type		Rack and pinion				
	Turns, lock to lock		3.7				
	Minimum turning circle*1	m (ft)	At tire .... 9.6 (31.5) At bumper 10.6 (34.8)				
Suspension	Front		MacPherson strut type, Independent, Coil spring				*2
	Rear		Semi-trailing arm type, Independent, Coil spring				*3
Brake	Service brake system		Dual circuit hydraulic with vacuum suspended power unit				
	Front		Ventilated disc brake				
	Rear		Drum brake (Leading & trailing type)		Disc brake		
	Parking brake		Mechanical on front brake				
Tire	Size		185/70SR13		185/70HR13		
	Type		Steel belted radial, Tubeless				
Capacity	Fuel tank capacity	ℓ (US gal., Imp gal.)	60 (15.9, 13.2)				
	Engine oil Upper level	ℓ (US qt, Imp qt)	4.0 (4.2, 3.5)				
	Engine oil Lower level	ℓ (US qt, Imp qt)	3.0 (3.2, 2.6)				
	Transmission gear oil	ℓ (US qt, Imp qt)	3.3 (3.5, 2.9)	–	3.3 (3.5, 2.9)	3.5 (3.7, 3.1)	–
	Automatic transmission fluid	ℓ (US qt, Imp qt)	–	6.55±0.1 (6.9±0.1, 5.8±0.1)	–	–	9.5 (10.0, 8.4)
	AT differential gear oil	ℓ (US qt, Inp qt)	–	1.2 (1.3, 1.1)	–	–	1.4 (1.5, 1.2)
	4WD rear differential gear oil	ℓ (US qt, Imp qt)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)	0.8 (0.8, 0.7)
	Power steering fluid	ℓ (US qt, Imp qt)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)	0.7 (0.7, 0.6)
	Engine coolant	ℓ (US qt, Imp qt)	5.5 (5.8, 4.8)				6.0 (6.3, 5.3) *4 5.5 (5.8, 4.8)

*1: Curb to curb
*2: MacPherson strut type, Independent, Pneumatic suspension with height control
*3: Semi-trailing arm type, Independent, Pneumatic suspension with height control
*4: For CANADA

SUBARU

1989

Page

General Precautions

Precautions to take before starting service

1) Be sure to perform the jobs listed in the Periodic Maintenance Schedule.
2) When a vehicle is brought in for maintenance, carefully listen to the owner's explanations of the symptoms exhibited by the vehicle. List the problems in your notebook, and refer to them when trying to diagnose the trouble.
3) All jewelry should be removed. Suitable work clothes should be worn.
4) Be sure to wear goggles.
5) Use fender, floor and seat covers to prevent the vehicle from being scratched or damaged.
6) Never smoke while working.
7) 4WD models (Except full time 4WD)
When front wheels are jacked up, or placed on test rollers (= chassis dynamometer) for operation, be sure to set "4WD switch" to "OFF" for both AT and MT Single range and select lever to "FWD" for MT Dual range.
On MT Single range, in addition, disconnect harness connector for 4WD solenoid valve inside engine compartment.
On AT, in addition, disconnect harness connector for transfer solenoid inside engine compartment.

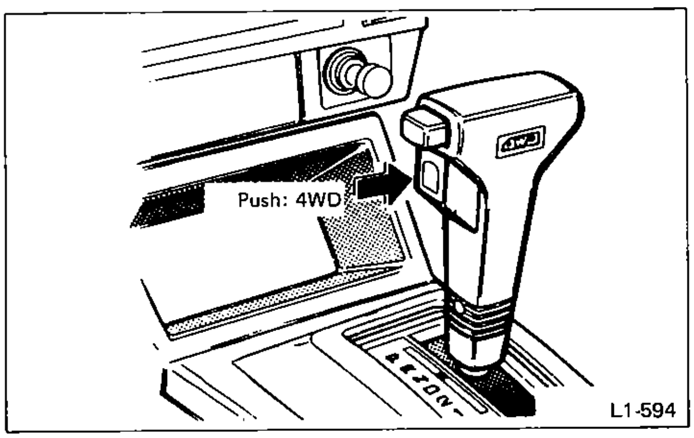


Fig. 1

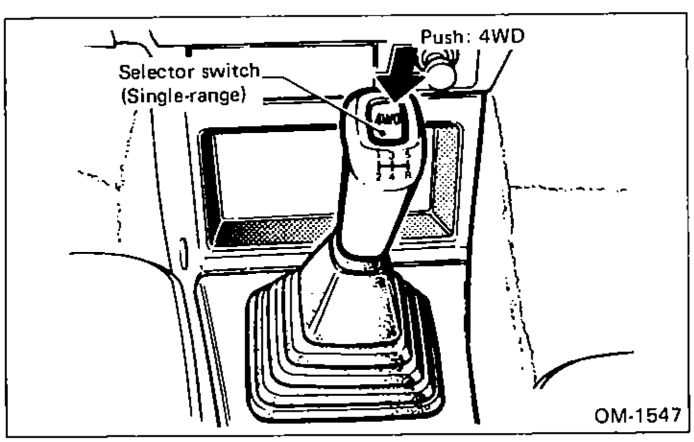


Fig. 2

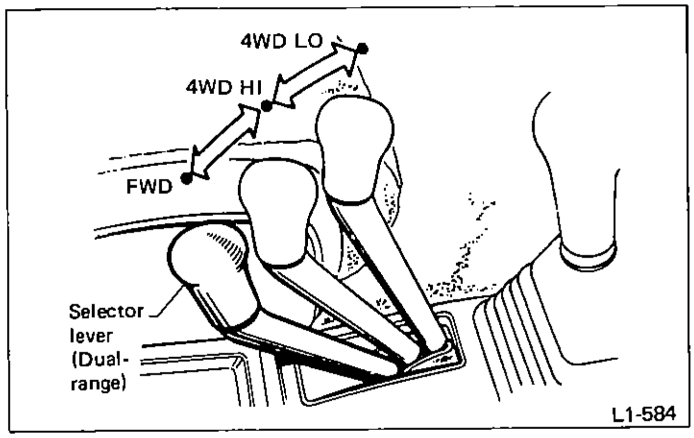


Fig. 3

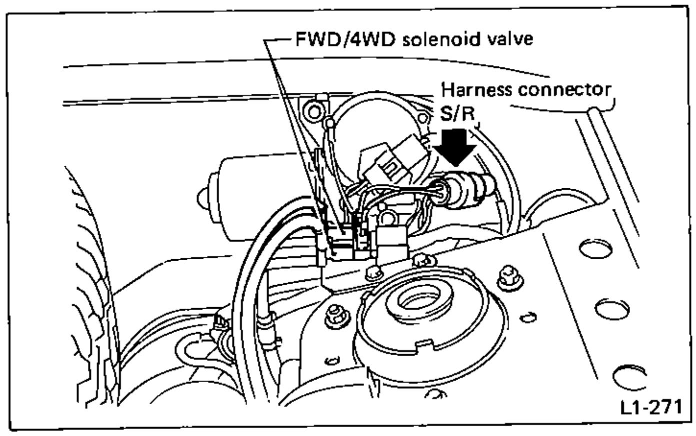


Fig. 4

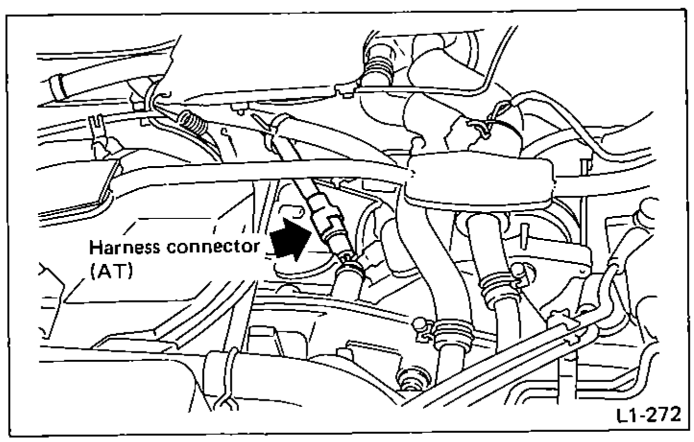


Fig. 5

8) Pneumatic suspension models w/height control
These models are provided with height control mechanisms. Be sure to return the height control to "Normal" position (low) and support the vehicle with a jack before getting under it for servicing, etc. To check any system, other than electrical, under the vehicle, disconnect cables from battery in advance.

9) Before installing underfloor bolts (include the rear differential filler plug) coated with bituminous wax, remove old wax and re-coat with new wax.

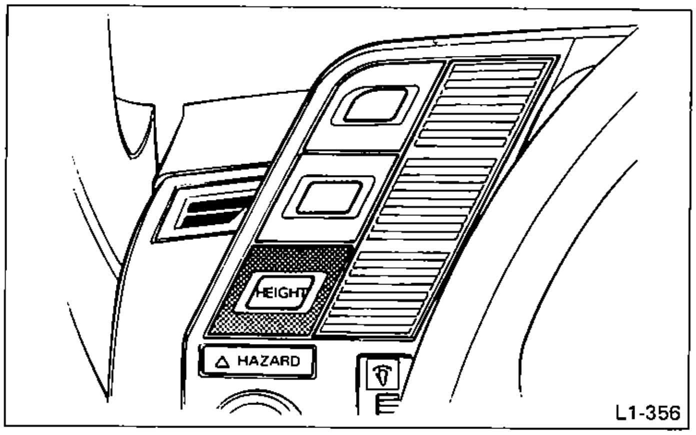


Fig. 6

Precautions while working

1) When jacking up the vehicle, be sure to use safety stands.
2) When jacking up the front or rear end of the car body, be sure to chock the tires remaining in contact with the ground.
3) Keep the parking brake applied when working on the vehicle. Set the shift lever to REVERSE, when the parking brake cannot be applied, such as when the brakes are being worked on.
4) Keep the ignition key turned "OFF" if at all possible.
5) Be cautious while working when the ignition key is "ON"; if the temperature in the engine compartment increases, the cooling fan can start to operate.
6) While the engine is in operation, properly ventilate the workshop.
7) While the engine is in operation, be aware of any moving parts, such as the cooling fan and the drive belt.
8) Keep your hands off any metal parts such as the radiator, exhaust manifold, exhaust pipe, and muffler, to prevent burning yourself.
9) When servicing the electrical system or the fuel system, disconnect the ground cable from the battery.
10) When disassembling, arrange the parts in the order that they were disassembled.
11) When removing a wiring connector, do not pull the wire unit but remove the connector unit by holding it.
12) When removing a hose or tube, remove the clip first. Then, pull the hose or tube while holding its end fitting.
13) Replace the gasket, O-ring, snap ring, lock washer, etc. with new ones.
14) When tightening a bolt or nut, tighten it to the specified torque.
15) When performing work requiring special tools, be sure to use the designated ones.
16) After completing the work, make certain that the hoses, tubes and wiring harnesses are securely connected.
17) After completing the work, be sure to wash the vehicle.

Precautions in handling a full time 4WD vehicle

MT

● Speedometer test

Generally, when testing the speedometer of a full-time 4WD vehicle, even if the engine is running at a relatively slow speed, releasing the clutch abruptly may still cause the vehicle to jump off of the test machine. Be especially careful to avoid this.

1) Testing Methods

(1) Jack-up Method

The usual speedometer tester is used and the rear wheels are tested with the front wheels raised off the ground and the center differential locked.

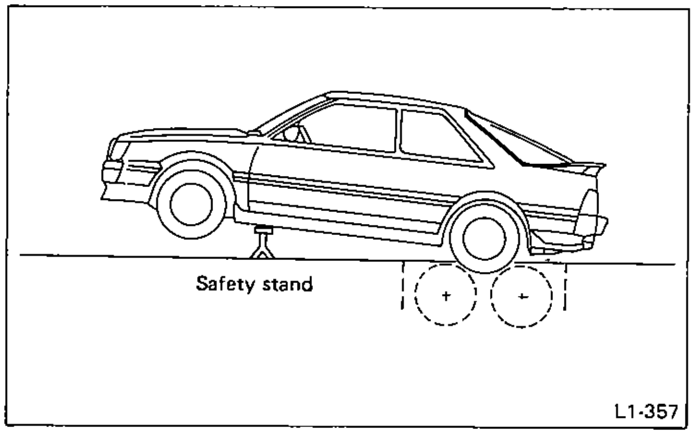


Fig. 7

(2) Adapter Method

An adapter is installed between the vehicle's speedometer and cable, and testing is done using the usual speedometer tester with the center differential operating. The vehicle's speedometer will then indicate 1/2 actual wheel speed. Therefore, an adapter which doubles the speed is necessary.

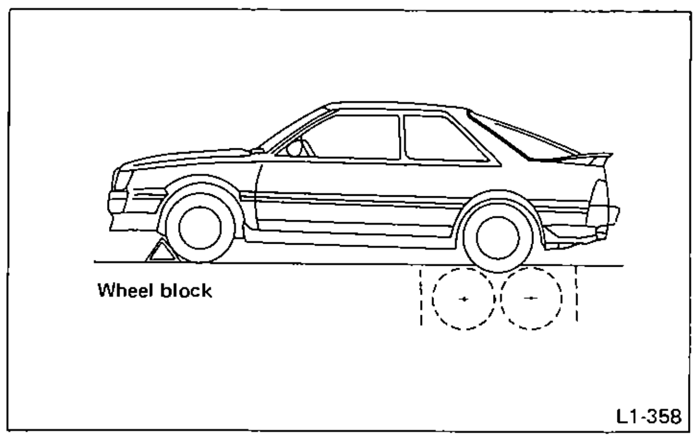


Fig. 8

Use the adapter method only when the jack-up method cannot be employed at the service garage.

2) Testing Procedures

(1) Jack-up Method

① Equipment

- Speedometer tester 1
- Garage jack 1
- Safety stand 2

② Precautions

- Test the speedometer using the rear wheels. (Vehicle stability is better than with the front wheels.)

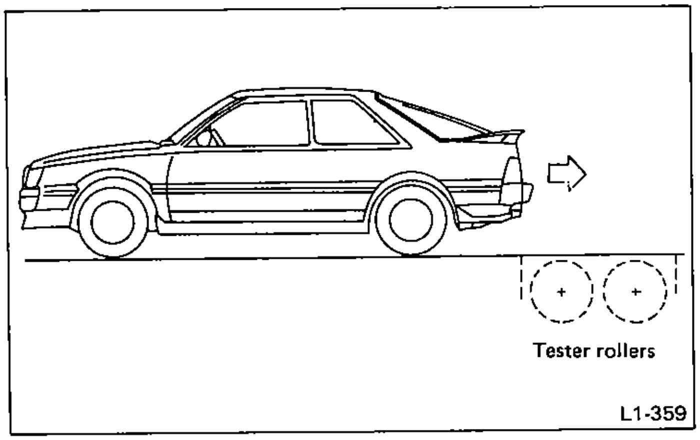


Fig. 9

- Place the garage jack and safety stands in their proper positions.
  Also, in order to prevent the vehicle from slipping due to vibration, do not place any wooden blocks or similar items between the safety stands and the vehicle.

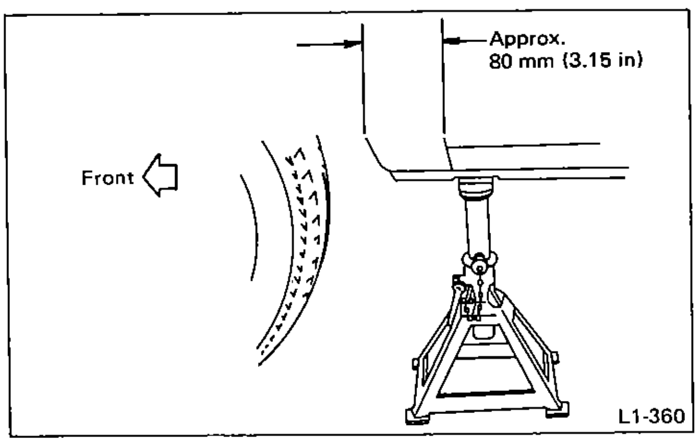


Fig. 10

- Since the front wheels will also be rotating, do not place anything near them. Also, make sure that nobody goes in front of the vehicle.
- With the center differential locked, confirm that the differential lock indicator light is lit.

If the differential lock switch is in the "ON" position, but the differential lock indicator light is not on, rock the vehicle slightly forward or backward to lock the differential.

Operate the differential lock switch before setting the speedometer tester. Never operate the differential lock switch while the vehicle is on the free rollers. (There is a chance that the vehicle may jump off the rollers.)

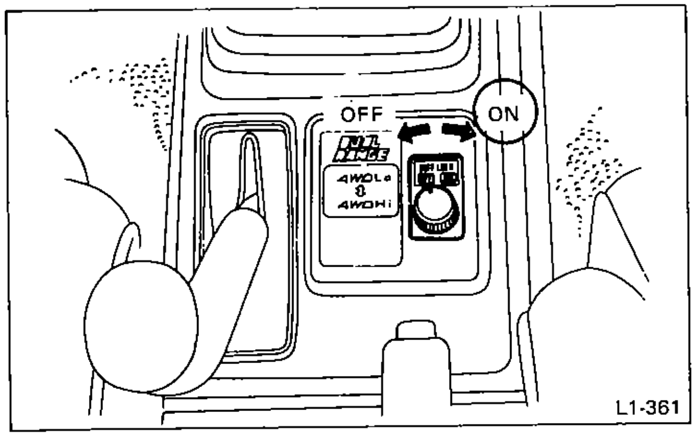


Fig. 11

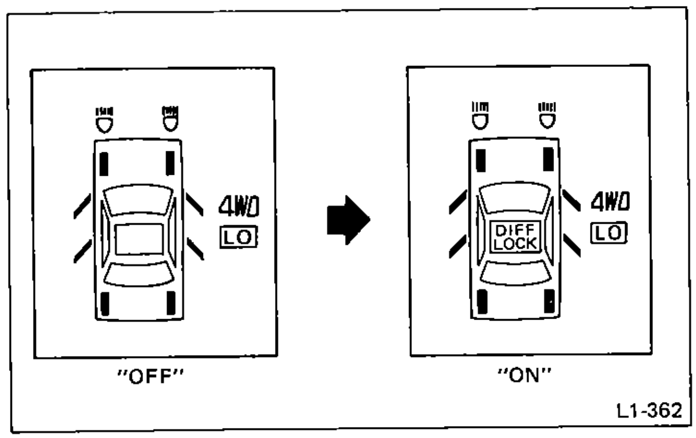


Fig. 12

- For safety, start in second gear. Never make any abrupt speed changes or maneuvers during the test.

(2) Adapter Method

① Equipment

- Speedometer tester 1
- Wheel blocks 2
- ADAPTER (499827100) 1

Since the speedometer detector is on the engine side of the center differential, if the front wheels are locked, the vehicle's speedometer will only indicate 1/2 the speed of the rear wheels. Thus an adapter which doubles the speed is necessary.

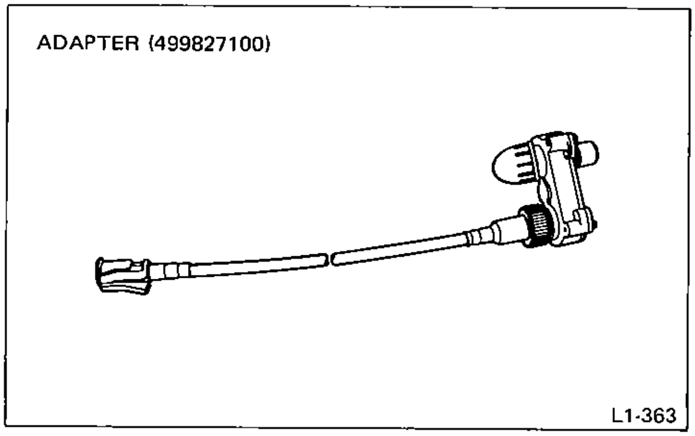


Fig. 13

② Precautions

- Do the testing with the differential lock cancelled. Confirmation that the differential lock is cancelled can be done with the differential lock indicator light, but for this test, confirm with actual driving, that there is no braking phenomenon when turning sharp corners at low speed.

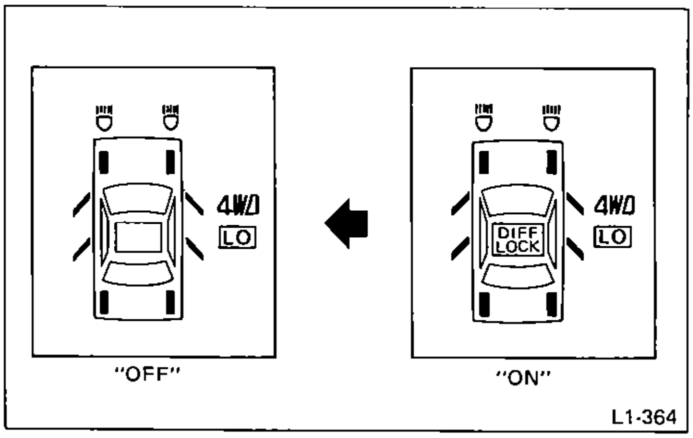


Fig. 14

- Since the vehicle speedometer indicates 1/2 the actual speed of the rotating wheels, be certain to install an ADAPTER (499827100).

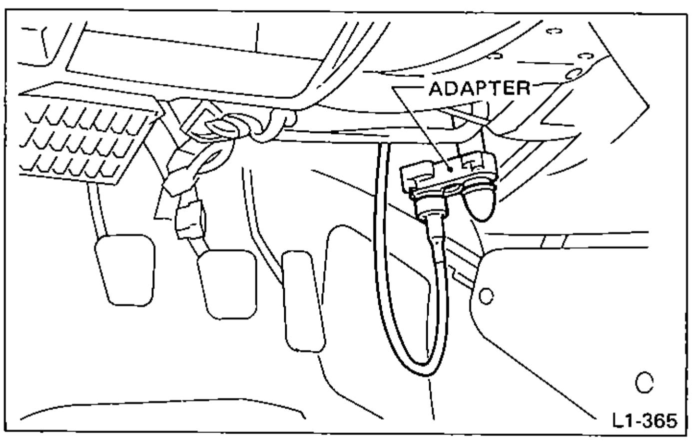


Fig. 15

- Do the test with the rear wheels on the speedometer tester rollers.

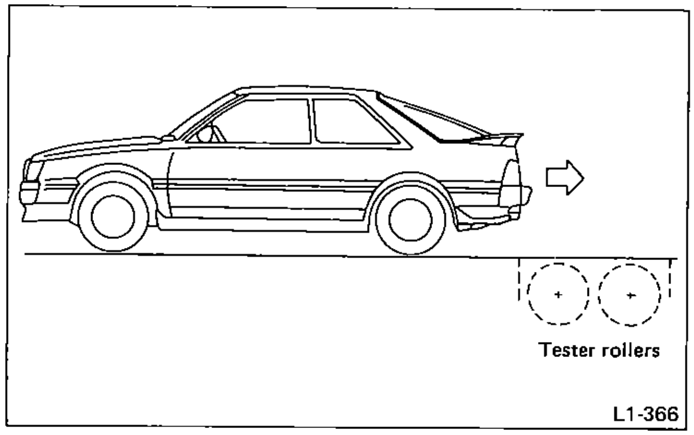


Fig. 16

- In order to prevent the vehicle from jumping off the tester, be certain to apply the parking brake and place wheel blocks in front of the front wheels. Also, make sure that nobody goes in front of the vehicle.

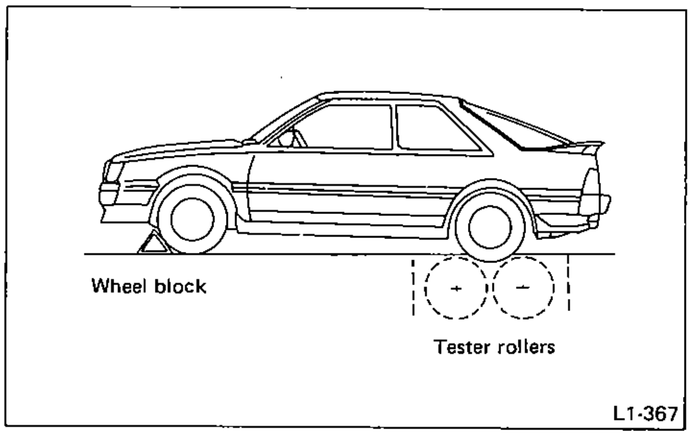


Fig. 17

- For safety, start in second gear. Never make any abrupt speed changes or maneuvers during the test.
- The center differential will be rotating faster than normal. Check the transmission oil which also serves as the center differential oil and add if oil level is low.
- Keep maximum speed below 50 km/h (31 MPH) and for less than 1 minute.

③ Adapter Installation Procedures

a. Remove the trim panel (D) below the driver's side instrument panel.

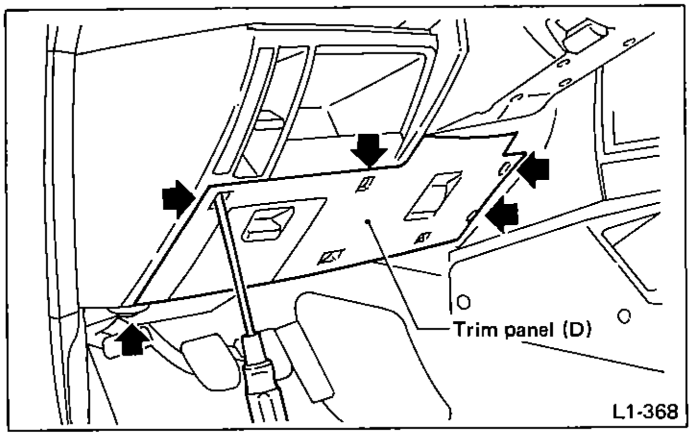


Fig. 18

b. Disconnect the speedometer cable from the speedometer.
c. Connect the speedometer cable to the ADAPTER gear box.

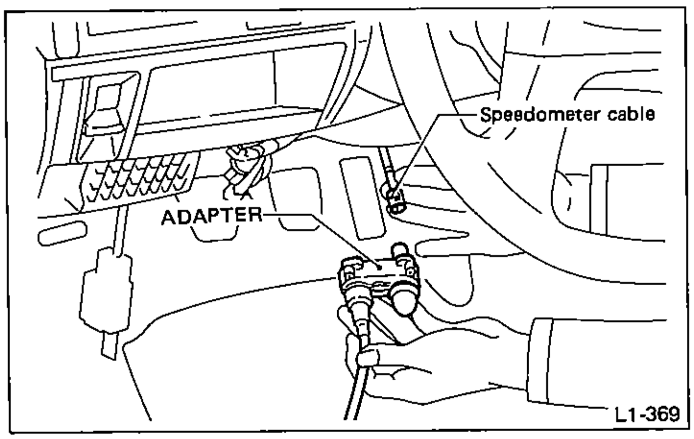


Fig. 19

d. Connect the speedometer to the ADAPTER speedometer cable.

Place the cable so that it does not get in the way when pressing down the Accelerator pedal.

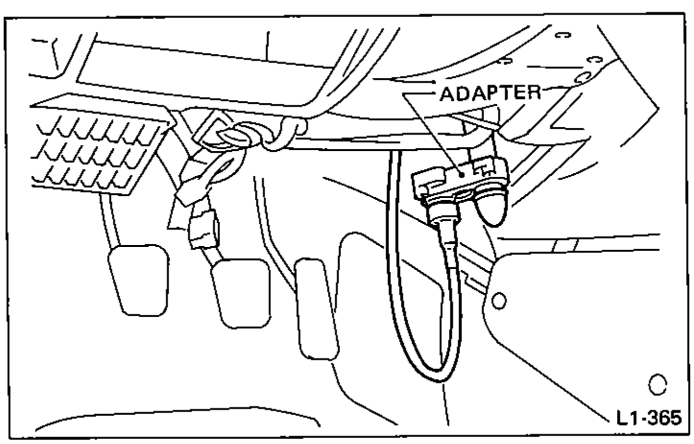


Fig. 20

● Brake Test
When using the brake tester, do so with the differential lock cancelled. Turn the differential lock switch off and make sure that the differential lock indicator light ("DIFF LOCK") has gone off.

● Chassis Dynamometer Test
The propeller shaft must be removed and the vehicle made into front wheel drive. To undo the propeller shaft, do not disconnect the front propeller shaft ASSY. Only disconnect the rear propeller shaft ASSY and lock the center differential.

When reconnecting the front and rear propeller shaft ASSY's, align the matching marks very carefully.

● Tire Balance Test (On-car-machine)
For safety when doing the tire balance testing, disconnect the propeller shaft and keep the center differential locked. Also, do not drive the tires with the engine, but use the on-car-machine to rotate the tires and do the balance testing.

a. In doing the testing, be sure to jack up both the left and right sides and put wheel blocks behind the tires contacting the ground.
b. Make sure that the transmission is in neutral gear position.

● Towing
If the following conditions cannot be met, raise and support all four wheels to move the vehicle.

a. Before towing, check transmission oil and differential oil levels and top up to the specified level if necessary.
b. The ignition switch should be in the "ACC" position while the vehicle is being towed.
c. Never use the tie down tabs for towing.
d. Remember that brake booster and power steering will not work when the engine is "OFF". You will have to use greater effort for the brake pedal and steering wheel.

1) Rope Towing

① Turn the differential lock switch to the "OFF" position and make sure that the differential lock indicator light ("DIFF LOCK") has gone off. (Confirmation of differential lock cancellation.)

② When the vehicle has a large air spoiler skirt on it, wrap the tow rope with a rag to prevent the rope from scratching the air spoiler.

Tow the vehicle with the engine off.

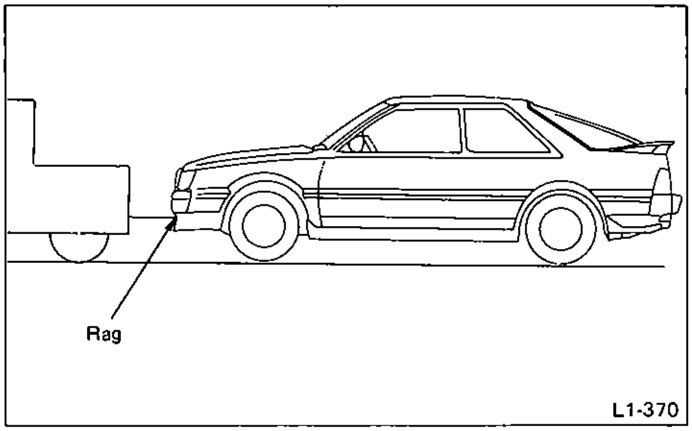


Fig. 21

● Differential Lock Cancelling Method

1) Under normal circumstances, start the engine, turn the differential lock switch off and, with the tires pointed straight, move the vehicle either forward or backward.

2) If the engine cannot be started, such as with a dead battery or when the vacuum actuator is not working, raise the front (or rear) wheels and move the differential lock lever, on the right side of the transmission, towards the rear of the vehicle.

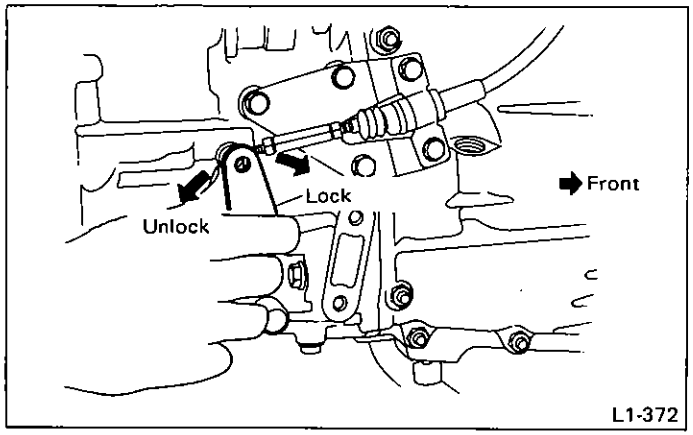


Fig. 23

2) Towing with Front Wheels Raised

① Turn the differential lock switch to the "OFF" position and make sure that the differential lock indicator light ("DIFF LOCK") has gone off. (Confirmation of differential lock cancellation.)

② The center differential will be rotating faster than normal. Check the transmission oil which also serves as the center differential oil and add if oil level is low.

Tow at less than 30 km/h (19 MPH).

③ Do not tow for more than 50 km (31 miles).

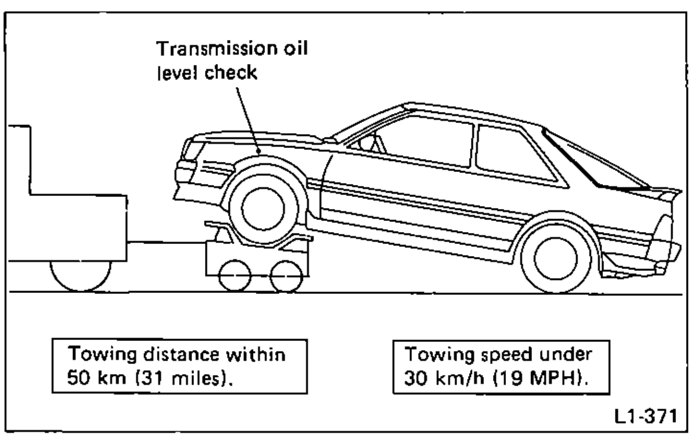


Fig. 22

AT

● Before checking or servicing the car with the front wheels raised or on rollers (brake tester, chassis dynamometer, etc.), always set the car in the FWD mode.

To set the car in the FWD mode, disconnect the 4WD circuit by inserting a fuse in the FWD connector inside the engine compartment. Also chock the rear wheels firmly. If the car is left in the 4WD mode, it will surge abruptly when the wheels turn, possibly damaging the transfer clutch.

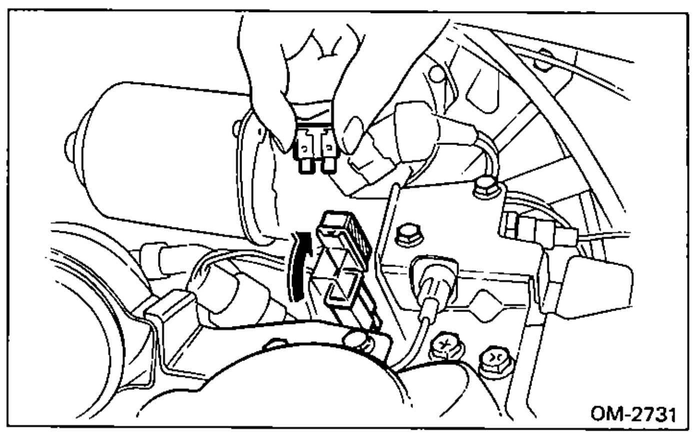


Fig. 24

- Also ensure that the FWD pilot light is on.

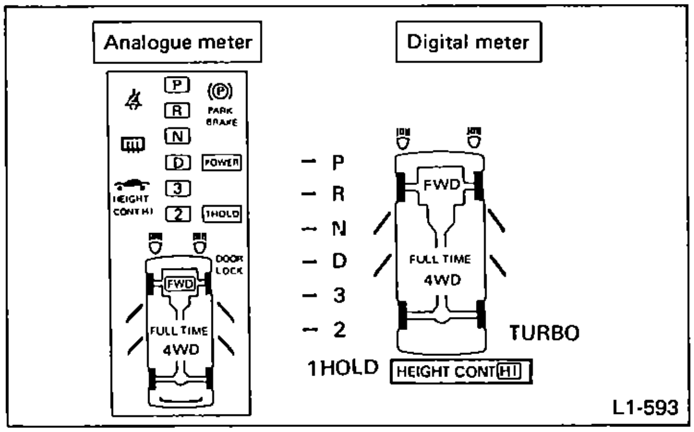


Fig. 25

- Towing

If the following conditions cannot be met, raise and support all four wheels to move the vehicle.

a. Before towing, check transmission oil and differential oil levels and top up to the specified level if necessary.
b. The ignition switch should be in the "ACC" position while the vehicle is being towed.
c. Never use the tie down tabs for towing.
d. Remember that brake booster and power steering will not work when the engine is "OFF". You will have to use greater effort for the brake pedal and steering wheel.

Rope towing

① Place the selector lever is "N" position and put a spare fuse inside the FWD connector.
② Tow at less than 30 km/h (19 MPH).
③ Do not tow for more than 10 km (6 miles).

Vehicle Identification Numbers (V.I.N.)

1. Applicable V.I.N. in This Manual

- 1800 cc Engine

4-DOOR SEDAN	DL	(SPFI, 5MT)	J	F	1	A	C	4	2	B	X	J	B	200001 and after
	DL	(SPFI, 3AT)	J	F	1	A	C	4	2	B	X	J	C	
	GL	(SPFI, 5MT)	J	F	1	A	C	4	3	B	X	J	B	
	GL	(SPFI, 3AT)	J	F	1	A	C	4	3	B	X	J	C	
	GL	(SPFI, 3AT with passive belt)	J	F	1	A	C	4	3	2	X	J	C	
	GL-10	(SPFI, 3AT)	J	F	1	A	C	4	4	B	X	J	C	
	GL-10	(SPFI, 3AT with passive belt)	J	F	1	A	C	4	4	2	X	J	C	
	GL-10 TURBO	(MPFI, 5MT)	J	F	1	A	C	4	5	B	X	J	B	
	*GL-10 TURBO	(MPFI, 3AT)	J	F	1	A	C	4	5	B	X	J	C	
	GL-10 TURBO	(MPFI, 3AT with passive belt)	J	F	1	A	C	4	5	2	X	J	C	
	4WD GL	(SPFI, 5MT Dual-range)	J	F	2	A	C	5	3	B	X	J	E	
	4WD GL	(SPFI, 3AT)	J	F	2	A	C	5	3	B	X	J	F	
	FULL TIME 4WD RX TURBO	(MPFI, 5MT Dual-range)	J	F	2	A	C	5	6	B	X	J	G	
	FULL TIME 4WD GL-10 TURBO	(MPFI, 5MT Single-range)	J	F	2	A	C	7	5	B	X	J	G	
	FULL TIME 4WD GL-10 TURBO	(MPFI, 4AT)	J	F	2	A	C	7	5	B	X	J	H	
STATION WAGON	DL	(SPFI, 5MT)	J	F	1	A	N	4	2	B	X	J	B	400001 and after
	DL	(SPFI, 3AT)	J	F	1	A	N	4	2	B	X	J	C	
	GL	(SPFI, 5MT)	J	F	1	A	N	4	3	B	X	J	B	
	GL	(SPFI, 3AT)	J	F	1	A	N	4	3	B	X	J	C	
	GL	(SPFI, 3AT with passive belt)	J	F	1	A	N	4	3	2	X	J	C	
	GL-10	(SPFI, 3AT)	J	F	1	A	N	4	4	B	X	J	C	
	GL-10	(SPFI, 3AT with passive belt)	J	F	1	A	N	4	4	2	X	J	C	
	GL-10 TURBO	(MPFI, 5MT)	J	F	1	A	N	4	5	B	X	J	B	
	*GL-10 TURBO	(MPFI, 3AT)	J	F	1	A	N	4	5	B	X	J	C	
	GL-10 TURBO	(MPFI, 3AT with passive belt)	J	F	1	A	N	4	5	2	X	J	C	
	4WD DL	(SPFI, 5MT Single-range)	J	F	2	A	N	5	2	B	X	J	D	
	4WD GL	(SPFI, 5MT Dual-range)	J	F	2	A	N	5	3	B	X	J	E	
	4WD GL	(SPFI, 3AT)	J	F	2	A	N	5	3	B	X	J	F	
	4WD GL TURBO	(MPFI, 5MT Single-range)	J	F	2	A	N	5	7	B	X	J	D	
	FULL TIME 4WD GL-10 TURBO	(MPFI, 5MT Single-range)	J	F	2	A	N	5	5	B	X	J	G	
	FULL TIME 4WD GL-10 TURBO	(MPFI, 4AT)	J	F	2	A	N	7	5	B	X	J	H	

*: Canada model

TOURING WAGON	GL (SPFI, 5MT)	J	F	1	A	K	4	3	B	X	K	B	002001 and after
	GL (SPFI, 3AT)	J	F	1	A	K	4	3	B	X	K	C	
	GL-10 (SPFI, 3AT)	J	F	1	A	K	4	4	B	X	K	C	
	GL-10 TURBO (MPFI, 3AT)	J	F	1	A	K	4	5	B	X	K	C	
	4WD GL (SPFI, 5MT, Dual-range)	J	F	2	A	K	5	3	B	X	K	E	
	4WD GL (SPFI, 3AT)	J	F	2	A	K	5	3	B	X	K	F	
	4WD GL TURBO (MPFI, 5MT, Single-range)	J	F	2	A	K	5	7	B	X	K	D	
	FULL TIME 4WD GL-10 TURBO (MPFI, 5MT Single-range)	J	F	2	A	K	5	5	B	X	K	G	
	FULL TIME 4WD GL-10 TURBO (MPFI, 4AT)	J	F	2	A	K	7	5	B	X	K	H	
3-DOOR	DL (SPFI, 5MT)	J	F	1	A	G	4	2	B	X	J	B	800001 and after
	DL (SPFI, 3AT)	J	F	1	A	G	4	2	B	X	J	C	
	GL (SPFI, 5MT)	J	F	1	A	G	4	3	B	X	J	B	
	GL (SPFI, 3AT)	J	F	1	A	G	4	3	B	X	J	C	
	4WD-GL (SPFI, 5MT Dual-range)	J	F	2	A	G	5	3	B	X	J	E	
	4WD-GL (SPFI, 3AT)	J	F	2	A	G	5	3	B	X	J	F	
	FULL TIME 4WD RX TURBO (MPFI, 5MT Dual-range)	J	F	2	A	G	5	6	B	X	J	G	

2. The Meaning of V.I.N.

Maker identifier

Vehicle attribute

Vehicle identification

J F 1 A C 4 2 B X K B 2 0 0 0 0 1

Sequential number

200001 and after	:	4-Door Sedan
400001 and after	:	Station Wagon
002001 and after	:	Touring Wagon
800001 and after	:	3-Door

Plant of manufacture and transmission type

- B : Gunma manufacture – 5MT
- C : Gunma manufacture – AT
- D : Gunma manufacture – 4WD 5MT
- E : Gunma manufacture – 4WD, Dual-range
- F : Gunma manufacture – 4WD AT
- G : Gunma manufacture – Full time 4WD MT
- H : Gunma manufacture – Full time 4WD AT

Model year

- K : 1989

Check digit

0 thru 9 and X, varies

Weight class and restraint type

- B : 3,001 to 4,000 lb GVWR without passive restraint
- 2 : 3,001 to 4,000 lb GVWR with passive restraint

GVWR: Gross Vehicle Weight Rating

Model

- 2 : DL model
- 3 : GL model
- 4 : GL-10 model
- 5 : GL-10 TURBO model
- 6 : RX TURBO model
- 7 : GL TURBO model

Series and engine type

- 4 : 1800cc engine
- 5 : 1800cc engine 4WD
  (except model equipped with air suspension)
- 7 : 1800 cc engine 4WD
  (model equipped with air suspension)

Body type

- C : 4-Door Sedan
- G : 3-Door
- N : Station Wagon
- K : Touring Wagon

Line

- A : Fuji SUBARU L line

Type of vehicle

- 1 : Passenger car
- 2 : Multipurpose passenger vehicle

Manufacturer and make

Fuji Heavy Industries Ltd. SUBARU

Identification Number and Label Locations

1. Vehicle Identification Number

The vehicle identification number is stamped on the bulkhead panel of the engine compartment.

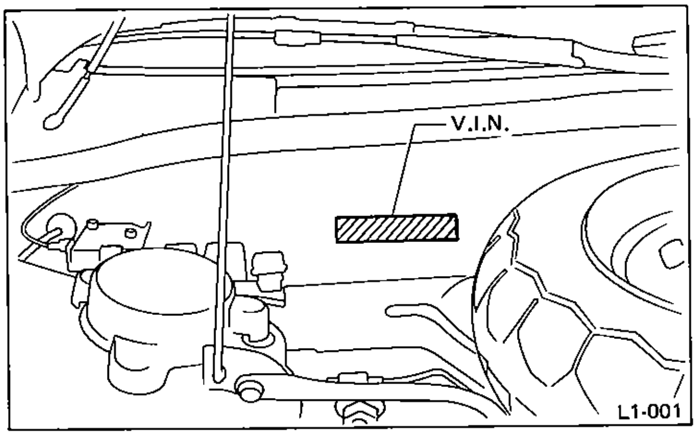


Fig. 26

2. Engine Serial Number

The engine serial number is stamped on the right side of the crankcase at the front.

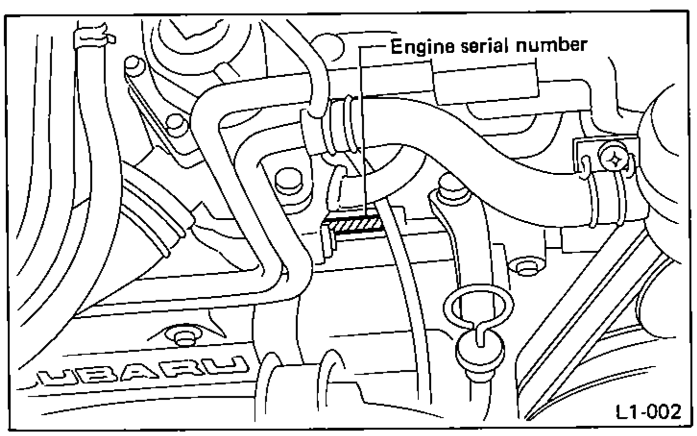


Fig. 27

3. Transmission Serial Number

The transmission number label is stuck on the upper surface of main case (MT) or converter housing (AT).

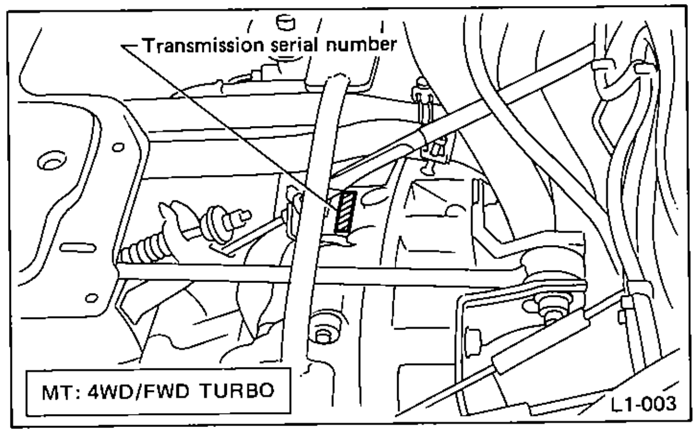


Fig. 28

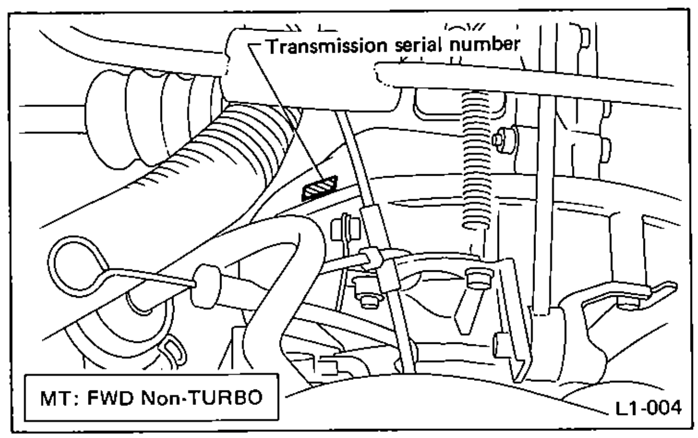


Fig. 29

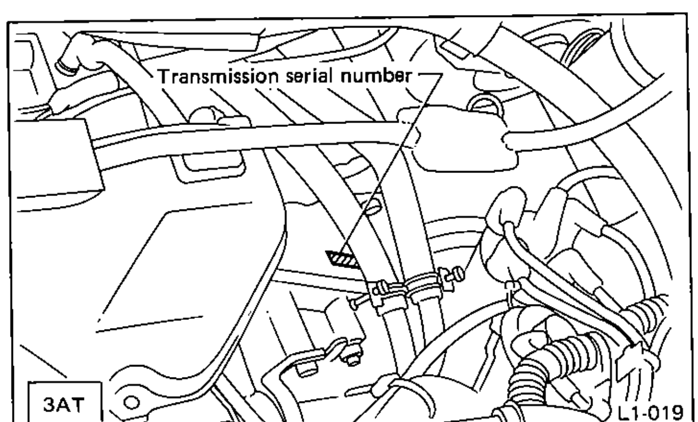


Fig. 30

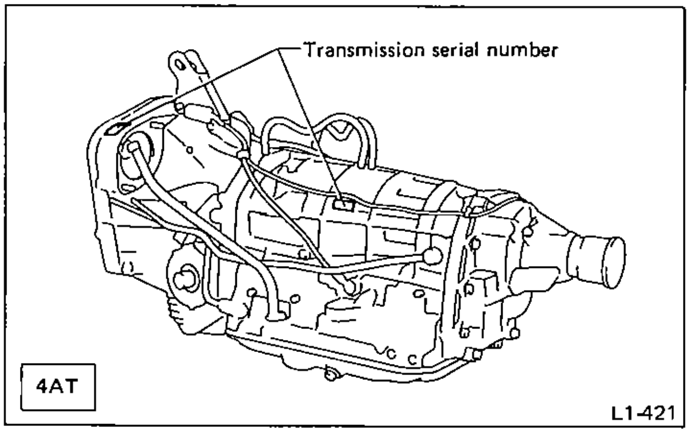


Fig. 31

Engine, transmission and vehicle identification numbers are used for factory communications such as Technical information, Service bulletins and other information.

4. Safety Certification Plate

Safety certification plate is stuck near the driver's side door striker.

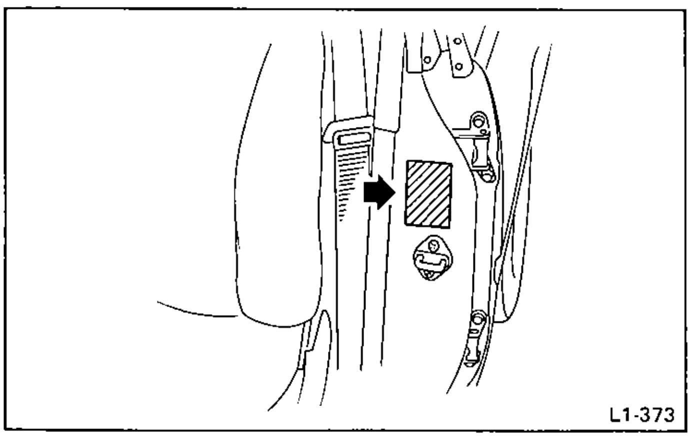


Fig. 32

5. Vehicle Emission Control Information Labels

Vehicle emission control information labels are stuck under the engine hood.

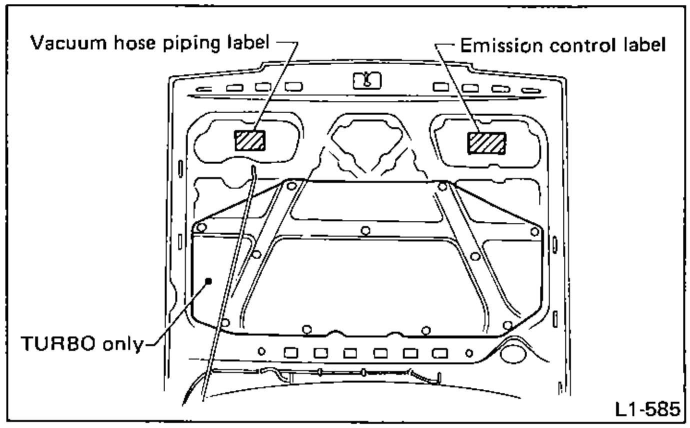


Fig. 33

6. Vehicle Identification Number Plate

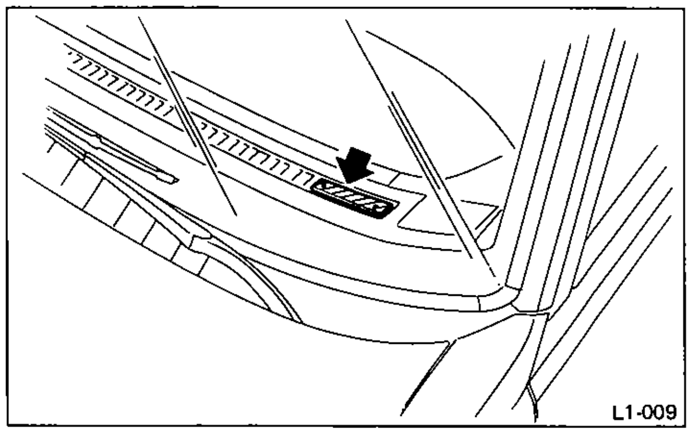


Fig. 34

7. Color Code Label

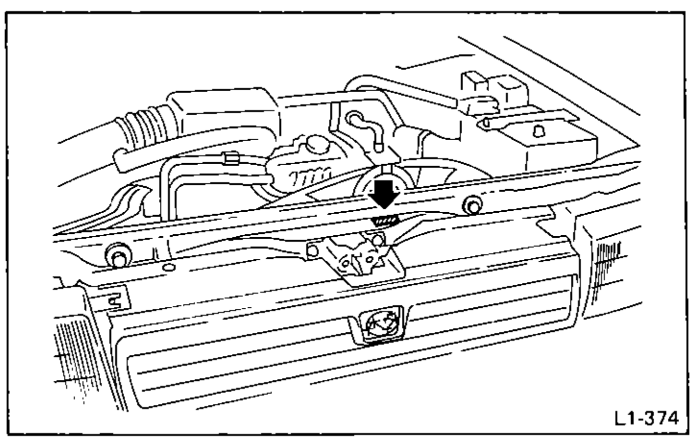


Fig. 35

Recommended Fuel, Lubricants, Sealants and Adhesives

1. Fuel

The SUBARU engine is designed to use only unleaded gasoline with an octane rating of 87 AKI or higher. [This octane rating is the average of the Research Octane and Motor Octane numbers and is commonly referred to as the Anti-Knock Index (AKI).] Use of fuels containing proper detergents is recommended for good performance and emission control. The neck of the fuel filler pipe is designed to accept only an unleaded gasoline filler nozzle. Under no circumstances should leaded gasoline be used since it will damage the emission control system and may impair driveability and fuel economy.

2. Fuels Containing Alcohol

Some gasoline blends sold at service stations contain alcohol or other oxygenates even though that fact may not be fully disclosed. If you are not sure whether there is alcohol present in the fuel, ask your service station operator. Do not use such fuels unless the gasoline/alcohol blend is suitable for your vehicle as explained below:

- The fuel should be unleaded and have an octane rating no lower than that recommended above.
- Never use fuel containing more than 10% ethanol (ethyl or grain alcohol).
- Methanol (methyl or wood alcohol) is sometimes mixed with unleaded gasoline. Methanol can be used in your vehicle ONLY if it does not exceed 5% of the fuel mixture AND it is accompanied by sufficient quantities of the proper cosolvents and corrosion inhibitors required to prevent fuel system damage. Otherwise, fuel containing methanol should not be used.
- Unleaded fuel blends which contain no more than 15% MTBE (methyl tertiary butyl ether) or other oxygenates and which are approved by the Environmental Protection Agency may be used.
- You should avoid using fuels mixed with alcohol or other oxygenates on an exclusive basis. If driving problems such as engine stalling or hard starting result when such fuels are used, immediately discontinue their use and switch back to unleaded gasoline that does not contain alcohol or other oxygenates.

Take care not to spill fuel during refueling. Fuels containing alcohol may cause paint damage.

Lubricants	Recommended	Application	Equivalent
• Grease	FX clutch grease (P/N 000040901)	Splines of transmission main shaft.	——
	Molylex No. 2 (P/N 723223010)	BJ and DOJ joints of axle shafts.	——
	PBC (P/N 003607000)	Stopper plugs of the front disc brake caliper.	——
	Silicone KS64 (P/N 003606010)	Brake caliper body (Piston, spindle adjuster O-ring), battery terminals, distributor, hood latch, etc.	——
	Silicolube G-30M (P/N 004404002)	Control cables and carburetor linkages subject to cold weather, water-pump impeller, door latch, striker, battery terminals, etc.	——
	Dow Corning Molykote No. 7439 (P/N 725191460)	Contacting surfaces of drum brake shoes and shoe clearance adjuster.	——
	Niglube RX-2 (P/N 003606000)	Disc brake caliper (lever, connecting link and spindle head).	——
	Valiant grease M-2 (P/N 003608001)	Steering gearbox (Both manual and power steering)	——
	SUNLIGHT 2 (P/N 003602010)	Steering shaft bearing, bushing for gear shift system, etc.	——
• Spray lubricants	SUBARU CRC (P/N 004301003)	TURBO unit and O_2 sensor.	——

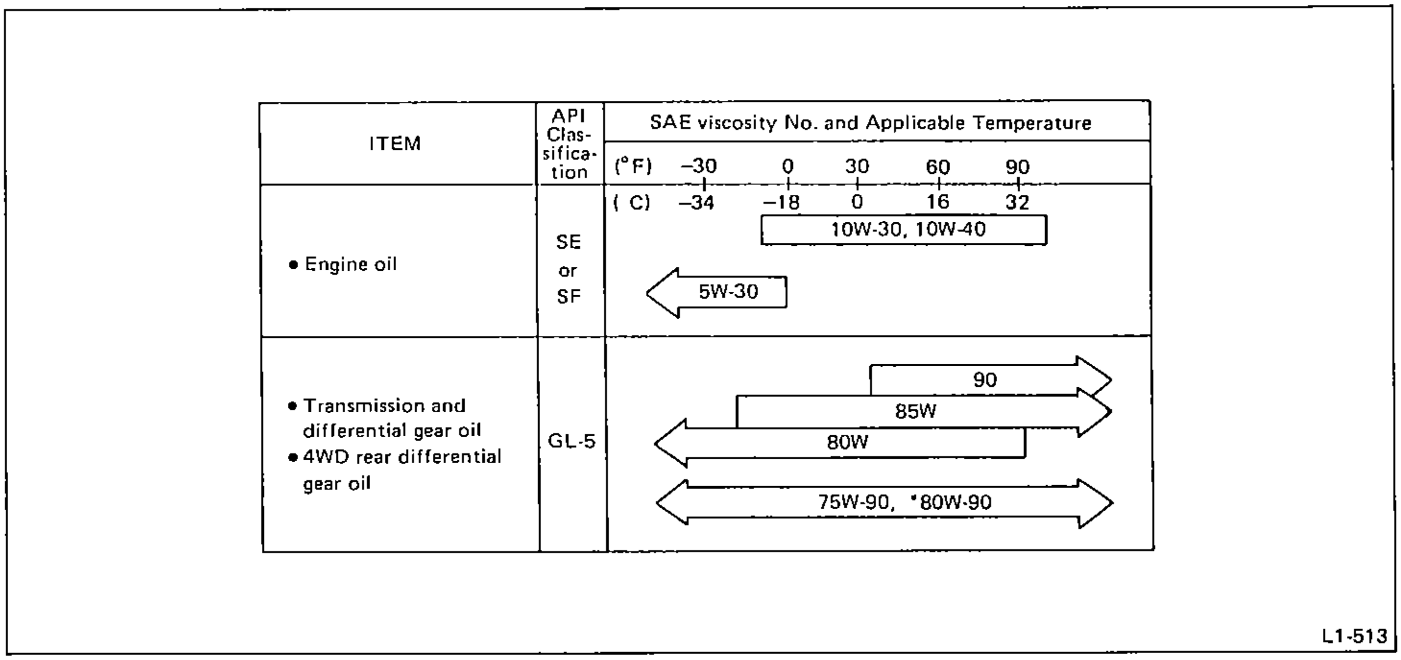


Fig. 36

a. Each oil manufacturer has its base oil and additives. Thus, do not mix two or more brands. (Except engine oil)
b. When replenishing oil, it does not matter if the oil to be added is a different brand from that in the engine, however, use oil having the API classification and SAE viscosity No. designated by SUBARU.
c. SAE 5W-30 is not recommended for sustained high speed driving.
d. If vehicle is used in desert areas or areas with very·high temperatures or for other heavy duty applications, the following viscosity oils may be used:

30, 40, 10W-50, 20W-40, 20W-50

e. * For differential gear oil (AT)

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	1.074	1.069	1.063	1.057	-36°C (-33°F)

* It is recommended that distilled water be used.

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

3. Sealants and Adhesives

	Recommended	Application	Equivalent
Sealant	Three Bond 1105 (P/N 004403010)	Mating surfaces of transmission cases, plugs, etc. Periphery of water pump mechanical seal.	Dow Corning's No. 7038
	Three Bond 1215 (P/N 004403007)	Flywheel bolts, mating surface of flywheel housing, crank case and cam case.	Dow Corning's No. 7038
	Starcalking B-33A (P/N 000018901)	Sealing against water and dust entry through weatherstrips, grommets, etc.	Butyl Rubber Sealant
Adhesive	Cemedine 5430L	Weatherstrips and other rubber parts, plastics and textiles except soft vinyl parts.	3M's EC-1770 EC-1368
	Cemedine 540	Soft vinyl parts, and other parts subject to gasoline, grease or oil. e.g. trim leather, gear shift boot, door inner remote cover, etc.	3M's EC-776 EC-847 EC-1022 (Spray Type)
	Cemedine 3000	Bonding metals, glass, plastic and rubber parts. Repairing slightly torn weather-strips, etc.	Armstrong's Eastman 910
	Essex Chemical Corp's Urethane E	Windshield to body panel.	——

Tightening Torque of Standard Bolts and Nuts

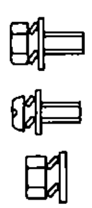
(1) ENGINE & TRANSMISSION

Unit: N·m (kg-m, ft-lb)

Dia. x Pitch (mm)	5T	7T	9T	10T
4 x 0.75	1.0 – 1.5 (0.105 – 0.155, 0.8 – 1.1)	1.5 – 2.0 (0.155 – 0.205, 1.1 – 1.5)	2.5 – 3.0 (0.255 – 0.305, 1.8 – 2.2)	3.0 – 3.5 (0.305 – 0.355, 2.2 – 2.6)
5 x 0.9	2.5 – 3.0 (0.255 – 0.305, 1.8 – 2.2)	2.9 – 3.9 (0.30 – 0.40, 2.2 – 2.9)	4.9 – 5.9 (0.50 – 0.60, 3.6 – 4.3)	5.4 – 6.4 (0.55 – 0.65, 4.0 – 4.7)
6 x 1.0	4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)	5.9 – 6.9 (0.60 – 0.70, 4.3 – 5.1)	9.4 – 10.8 (0.955 – 1.105, 6.9 – 8.0)	10 – 12 (1.0 – 1.2, 7 – 9)
8 x 1.25	12 – 14 (1.2 – 1.4, 9 – 10)	14.2 – 17.2 (1.45 – 1.75, 10.5 – 12.7)	23 – 26 (2.3 – 2.7, 17 – 20)	25 – 28 (2.5 – 2.9, 18 – 21)
10 x 1.25	25 – 28 (2.5 – 2.9, 18 – 21)	30 – 36 (3.1 – 3.7, 22 – 27)	46 – 54 (4.7 – 5.5, 34 – 40)	49.5 – 58.4 (5.05 – 5.95, 36.5 – 43.0)
12 x 1.5	41 – 49 (4.2 – 5.0, 30 – 36)	53 – 63 (5.4 – 6.4, 39 – 46)	84 – 98 (8.6 – 10.0, 62 – 72)	88 – 106 (9.0 – 10.8, 65 – 78)
14 x 1.6	71 – 84 (7.2 – 8.6, 52 – 62)	88 – 106 (9.0 – 10.8, 65 – 78)	139 – 165 (14.2 – 16.8, 103 – 122)	147 – 175 (15.0 – 17.8, 108 – 129)

(2) BODY

Unit: N·m (kg-m, ft-lb)

	Dia. (mm)	4T	7T	9T
 TC-002 *Fig. 37*	4	1.7 – 2.6 (0.17 – 0.27, 1.2 – 2.0)		
	5	2.9 – 5.9 (0.30 – 0.60, 2.2 – 4.3)		
	6	5.4 – 9.3 (0.55 – 0.95, 4.0 – 6.9)		
	8	12.7 – 22.6 (1.30 – 2.30, 9.4 – 16.6)	22.6 – 42.2 (2.30 – 4.30, 16.6 – 31.1)	31.4 – 51.0 (3.20 – 5.20, 23.1 – 37.6)
	10	27.5 – 47.1 (2.80 – 4.80, 20.3 – 34.7)	51.0 – 86.3 (5.20 – 8.80, 37.6 – 63.7)	62.8 – 107.9 (6.40 – 11.00, 46.3 – 79.6)
	12	52.0 – 85.3 (5.30 – 8.70, 38.3 – 62.9)	88.3 – 156.9 (9.00 – 16.00, 65.1 – 115.7)	117.7 – 196.1 (12.00 – 20.00, 86.8 – 144.7)
 TC-003 *Fig. 38* Including bolt or nut with washer or spring washer only	4	1.2 – 2.2 (0.12 – 0.22, 0.9 – 1.6)		
	5	2.5 – 4.4 (0.25 – 0.45, 1.8 – 3.3)		
	6	4.4 – 7.4 (0.45 – 0.75, 3.3 – 5.4)		
	8	9.8 – 17.7 (1.00 – 1.80, 7.2 – 13.0)	17.7 – 31.4 (1.80 – 3.20, 13.0 – 23.1)	23.5 – 39.2 (2.40 – 4.00, 17.4 – 28.9)
	10	22.6 – 36.3 (2.30 – 3.70, 16.6 – 26.8)	37.3 – 66.7 (3.80 – 6.80, 27.5 – 49.2)	48.1 – 83.4 (4.90 – 8.50, 35.4 – 61.5)
	12	39.2 – 64.7 (4.00 – 6.60, 28.9 – 47.7)	68.6 – 117.7 (7.00 – 12.00, 50.6 – 86.8)	88.3 – 147.1 (9.00 – 15.00, 65.1 – 108.5)

The mark is embossed on the bolt head as follows:

4T —— 4 9T —— 9
5T —— 5 10T —— 10
7T —— 7

Lifting, Towing and Tie-down Points

Be sure to lift, tow and tie-down the vehicle at the designated positions.

1. Garage Jack

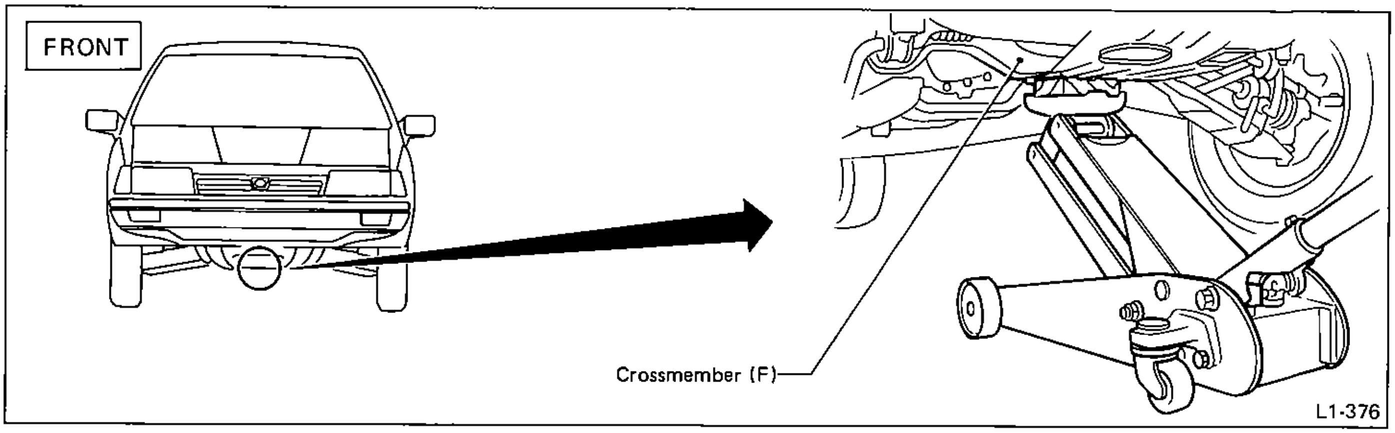


Fig. 39

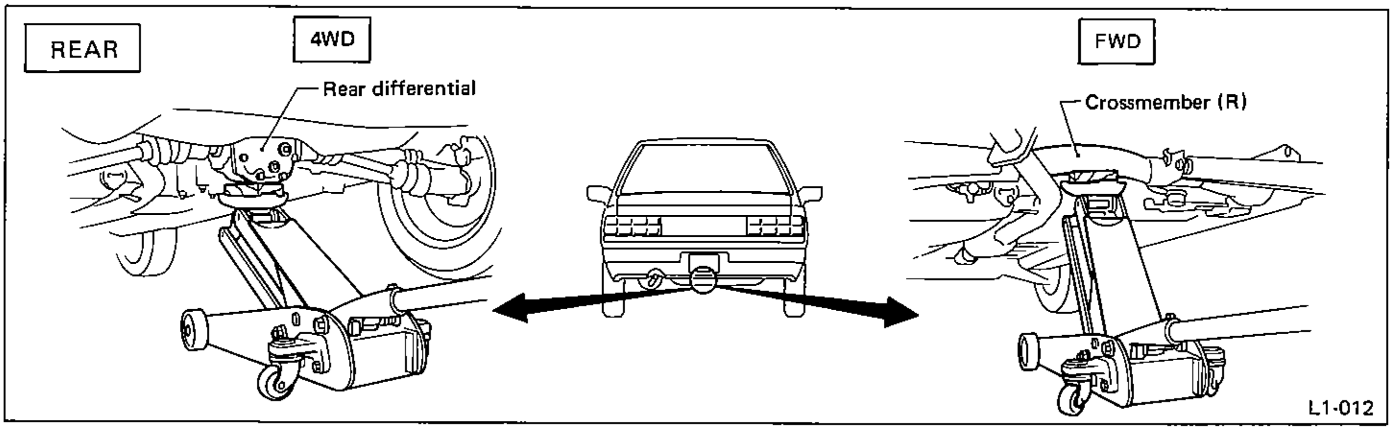


Fig. 40

a. When jacking up the vehicle, place chocks to hold wheels.
b. After jacking up the vehicle with garage jack, be sure to support the vehicle with safety stands for safety.

2. Pantograph Jack

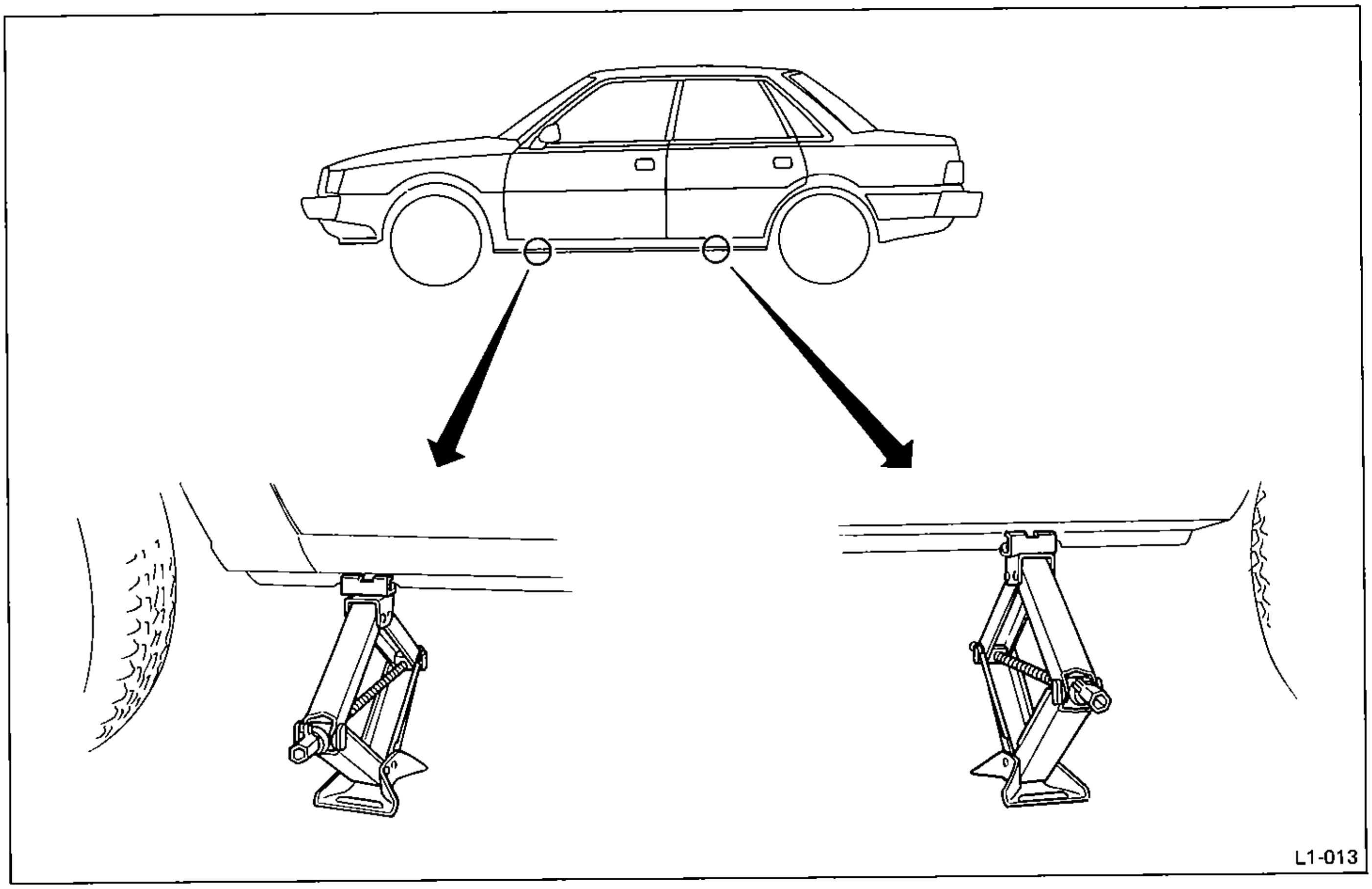


Fig. 41

a. Never get under the vehicle while it is supported only by the jack. Always use safety stands to support body when you have to get under the car.
b. Block the wheels diagonally by wheel chocks.
c. Make sure the jack is set at the correct position on the flange of side sill.
d. Be careful not to set the jack at the air flap portion.

3. Safety Stand

Be sure to lift vehicle at the same four positions as those of pantograph jack.

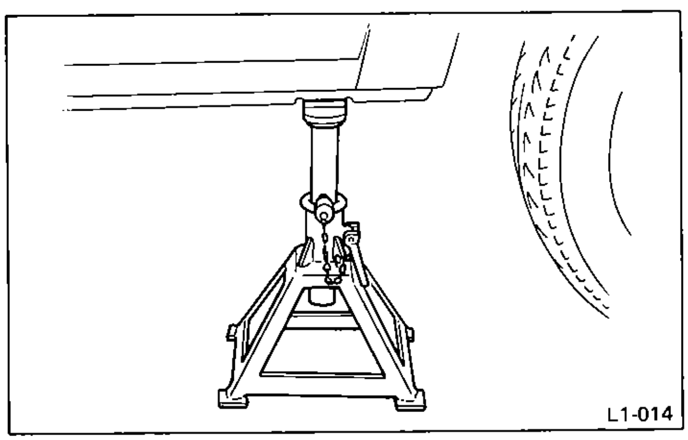


Fig. 42

4. Lift

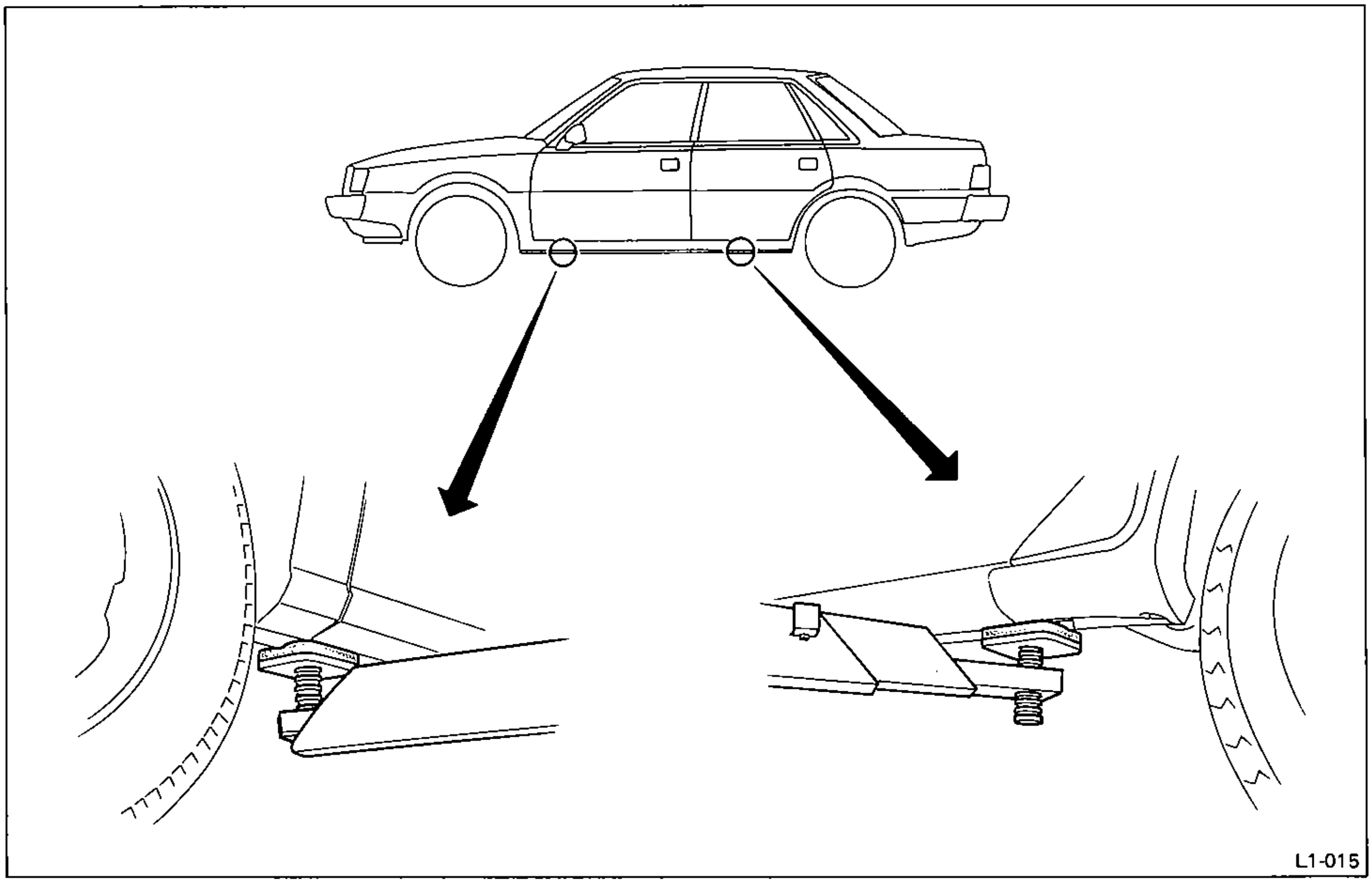


Fig. 43

a. Be sure to lift vehicle at the same four positions as those of pantograph jack.
b. Be careful not to set the lift at the air flap portion.

5. Towing and Tie-down Hooks

Avoid towing another car with front towing hooks.

Front

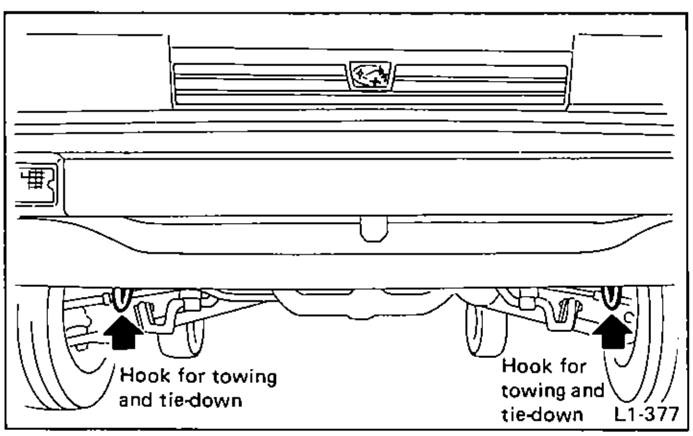


Fig. 44

Rear

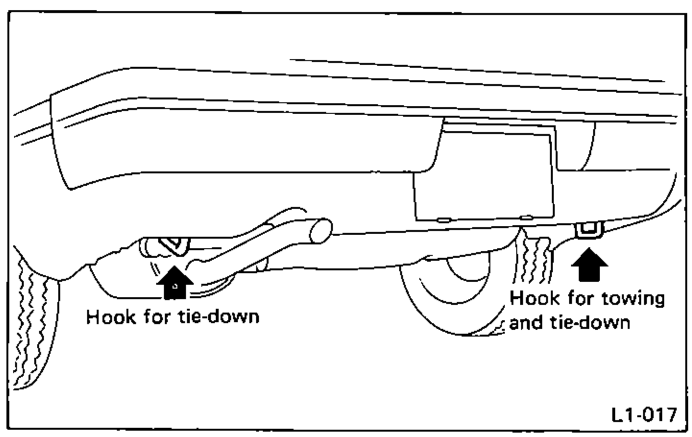


Fig. 45

SUBARU

1989

SCHEDULE OF INSPECTION AND MAINTENANCE SERVICES

Continue periodic maintenance beyond 96,000 km (60,000 miles) or 60 months by returning to the first column of the maintenance schedule and adding 96,000 km (60,000 miles) or 60 months to the column headings.

Symbols used:
- R : Replace
- I : Inspect, and then adjust, correct or replace if necessary.
- P : Perform
- (I) or (P) : Recommended service for safe vehicle operation

MAINTENANCE ITEM			MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								REMARKS
		Months	7.5	15	22.5	30	37.5	45	52.5	60	
		x 1,000 km	12	24	36	48	60	72	84	96	
		x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60	
1	Drive belt(s) [Except camshaft] (Inspect drive belt tension)					I				R	
2	Camshaft drive belt									R	
3	Engine oil		R	R	R	R	R	R	R	R	See NOTE 1
4	Engine oil filter	Non-TURBO vehicle	R*	R		R		R		R	
		TURBO vehicle	R	R	R	R	R	R	R	R	
5	Replace engine coolant and inspect cooling system, hoses and connections					(P)				P	
6	Replace fuel filter and inspect fuel system, line and connections					(P)				P	See NOTE 2 & 6
7	Air filter elements (Air cleaner)					R				R	
8	Spark plug					R				R	
9	Transmission/Differential (Front & Rear) Lubricants (Gear oil)					I					See NOTE 3
10	Automatic transmission fluid					I					See NOTE 4
11	Brake fluid					R				R	See NOTE 5
12	Disc brake pad and disc/Front and rear axle boots and axle shaft joint portions.			I		I		I		I	See NOTE 6
13	Brake lining and drum					I				I	See NOTE 6
14	Inspect brake line and check operation of parking and service brake system			P		P		P		P	See NOTE 6
15	Clutch and hill-holder system			I		I		I		I	
16	Steering and suspension			I		I		I		I	See NOTE 6
17	Grease on front and rear wheel bearings									(I)	

***: Only at first 12,000 km (7,500 miles) or 7.5 months whichever occurs first.**

NOTES:

1) When the vehicle is used under severe driving conditions such as those mentioned below*, the engine oil should be changed more often.

2) When the vehicle is used in extremely cold or hot weather areas, contamination of the filter may occur and filter replacement should be performed as necessary.

3) When the vehicle is frequently operated under severe conditions, replacement should be performed every 48,000 km (30,000 miles).

4) When the vehicle is frequently operated under severe conditions, replacement should be performed every 24,000 km (15,000 miles).

5) When the vehicle is used in high humidity areas or in mountainous areas, change the brake fluid every 24,000 km (15,000 miles) or 15 months, whichever occurs first.

6) When the vehicle is used under severe driving conditions such as those mentioned below*, inspection should be performed every 12,000 km (7,500 miles) or 7.5 months, whichever occurs first.

*** Examples of severe driving conditions:**

(1) Repeated short distance driving (Item 3, 12 and 13 only)
(2) Driving on rough and/or muddy roads (Item 12, 13 and 16 only)
(3) Driving in dusty conditions
(4) Driving in extremely cold weather (Item 3 and 16 only)
(5) Driving in areas where roads salts or other corrosive materials are used. (Item 6, 12, 13, 14 and 16 only)
(6) Living in coastal areas (Item 6, 12, 13, 14 and 16 only)

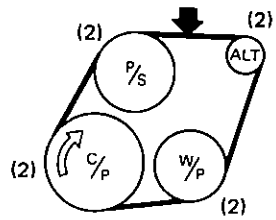
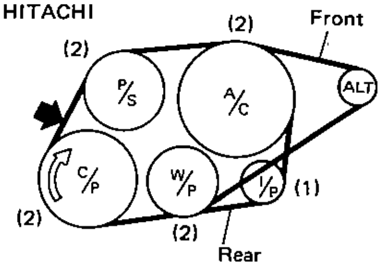
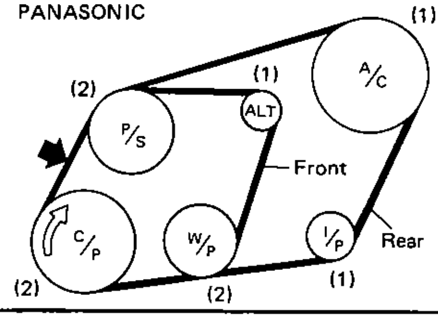
1 Drive Belt(s) [Except Camshaft] (Inspect drive belt tension)

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				I				R

INSPECTION

1) Replace belts, if cracks, fraying or wear is found.

2) Check drive belt tension and adjust it if necessary by changing alternator installing position and/or idler pulley installing position.

Type	Pulley arrangement	Tension mm (in)/98 N (10 kg, 22 lb)	
		New belt	Existing belt
Power steering equipped model		7 – 9 *1 (0.28 – 0.35)	9 – 11 (0.35 – 0.43)
Power steering and air conditioner equipped model	HITACHI  PANASONIC 	7.5 – 8.5 *2 (0.295 – 0.335)	

L1-595

Figures in parentheses refer to the number of grooves in pulleys.

C/P : Crankshaft pulley
W/P : Water pump pulley
ALT : Alternator pulley
P/S : Power steering oil pump pulley
A/C : Air conditioner compressor pulley
I/P : Idler pulley

Fig. 1

***1 Replace two belts simultaneously if the above fault is found on one of the two belts.**

***2 When replacing belt with a new one, adjust its tension to the specification and then readjust it to the same specification after running engine for 5 minutes in consideration of its initial expansion.**

REPLACEMENT

[A] Alternator drive belt(s)

On vehicles equipped with HITACHI air conditioner, remove pulser before replacing belt. After installing new belt, be sure to install the pulser to the original position.

1) Loosen alternator mounting bolts and remove belt(s).

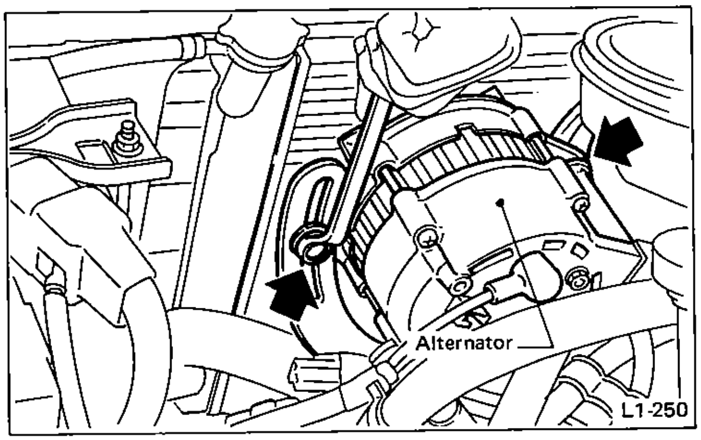


Fig. 2

2) Install new belt(s) and tighten alternator installing bolts as to obtain the specified belt tension shown in the above table.
3) Wipe off any oil or water on belts and pulleys.

[B] Rear side belt (not driving alternator)

On vehicles equipped with HITACHI air conditioner, remove pulser before replacing belt, and install the pulser after completion of replacement.

1) Loosen bolt and special nut, securing idler pulley then remove belt.

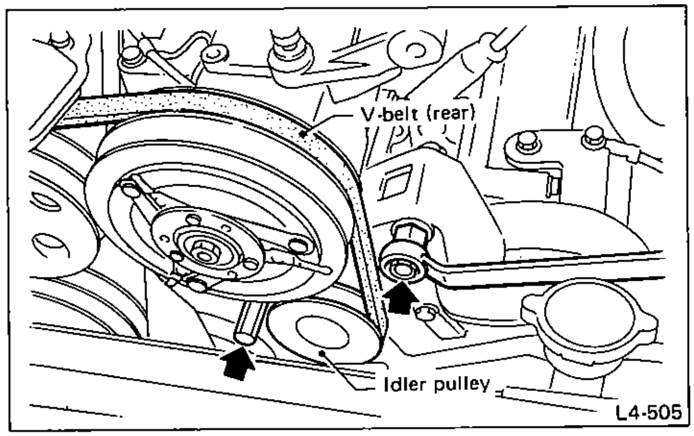


Fig. 3

2) Attach new belt and apply proper tension to belt as shown above.

2 Camshaft Drive Belt

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
								R

REPLACEMENT

a. Before replacing timing belts, remove radiator fan.
b. Timing belts should be replaced when engine is cold.
c. Be extremely careful not to allow nuts, washers, and other foreign matters to enter belt cover.

REMOVAL

1) Loosen water pump pulley nut until it can be turned with fingers.
2) Loosen two alternator mounting bolts.
3) Detach V-belts.
4) Disconnect harness for oil pressure switch or oil pressure gauge.
5) Remove crankshaft pulley:
Loosen crank pulley bolt, and remove pulley.

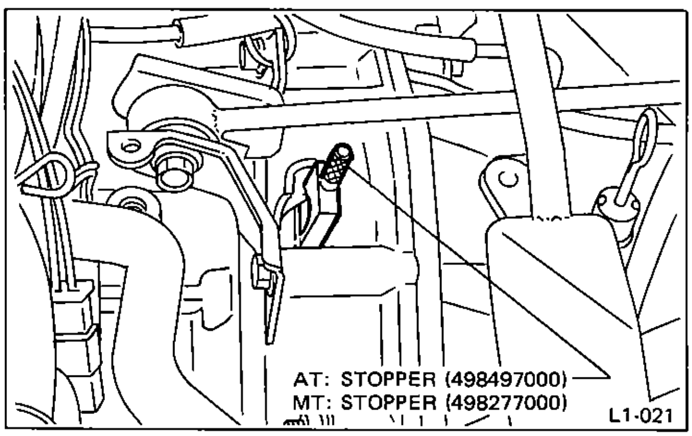


Fig. 4

6) Remove water pump pulley and pulley cover by loosening four 6 mm nuts.
7) Remove level gauge guide together with level gauge by loosening one 8 mm bolt.
8) Remove belt cover plate CP by loosening three 6 mm bolts. (For TURBO equipped models only)
9) Remove right-hand and left-hand belt covers by loosening eight 6 mm bolts.
10) Remove front belt cover by loosening eight 6 mm bolts.
11) Remove timing belts:
(1) Loosen bolts securing tensioner on the side of #1 and #3 cylinders, and move tensioner upward completely. Then temporarily tighten bolts.
Use special tool "TENSIONER WRENCH" (499007000) to move up #2 and #4 side tensioner.
(2) Detach timing belt on the side of #1 and #3 cylinders.
(3) Remove crankshaft sprocket CP.
(4) Detach timing belt on the side of #2 and #4 cylinders.

Put arrow mark to indicate the direction in which belts move before detaching belts.

INSTALLATION

Loosen the upper bolts ⓐ and ⓒ by 1/2 turn in advance.

1) Install timing belts:
(1) Align center line of three lines scribed on flywheel with timing mark on flywheel housing by moving flywheel.
(2) Align timing mark scribed on left-hand camshaft sprocket with notch on belt cover.

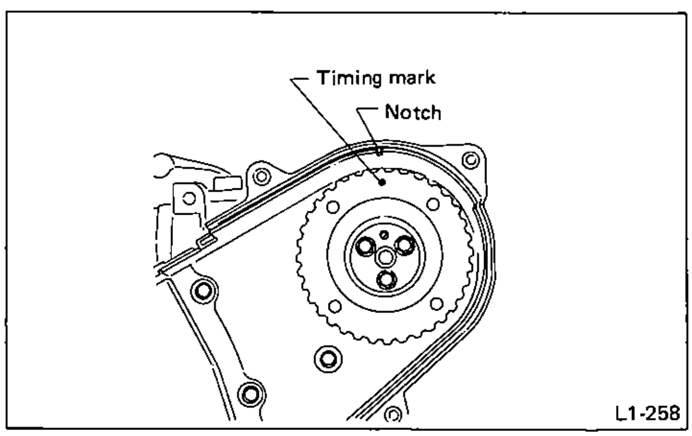


Fig. 5

(3) Attach No. 2 timing belt to crankshaft sprocket, oil pump sprocket, idler CP, and camshaft sprocket in sequence. Be careful not to slacken belt.
(4) Adjust tension of belt by loosening tensioner bolt ⓓ by 1/2 turn.

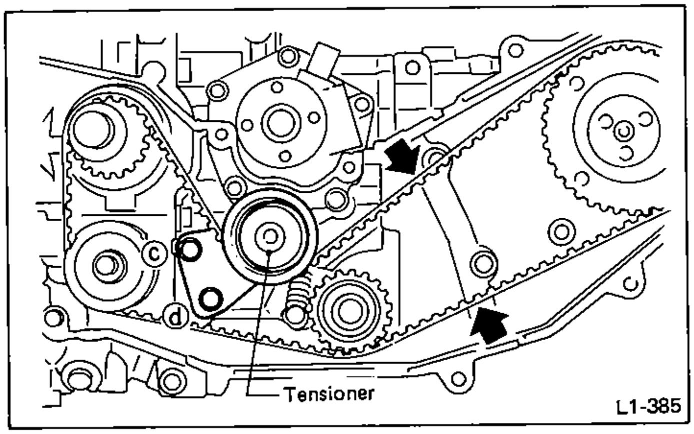


Fig. 6

(5) Push timing belt with finger and ensure tensioner moves smoothly.
(6) Using special tool "BELT TENSION WRENCH CP" (499437000), apply the specified torque counterclockwise to camshaft sprocket. Under this state, temporarily tighten tensioner bolt ⓓ and then temporarily tighten bolt ⓒ.

Specified timing belt tension and torque to be applied to camshaft sprocket

Belt tension:
147 – 245 N (15 – 25 kg, 33 – 55 lb)
Torque to be applied to camshaft sprocket:
24 – 25 N·m (2.4 – 2.6 kg-m, 17 – 19 ft-lb)

When specified belt tension is applied to timing belt, notch of special tool "BELT TENSION WRENCH CP" will be aligned with belt cover notch. Timing under tensioned state can be ascertained by this method.

(7) Sequentially tighten bolts ⓓ and ⓒ to the specified torque.

Tightening torque:
17.2 – 20.1 N·m
(1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

(8) Be sure the three lines on flywheel and timing mark on camshaft sprocket are respectively positioned as specified in steps (1) and (2) above.
(9) Rotate crankshaft clockwise one turn and align center line of scribed three lines on flywheel with timing mark on flywheel housing.
(10) Install crankshaft sprocket CP.
(11) Align timing mark of right-hand camshaft sprocket with notch on belt cover.
(12) Attach timing belt to crankshaft sprocket and camshaft sprocket. Be careful not to slacken belt.
(13) Loosen tensioner bolt ⓑ 1/2 turn, and apply tension to timing belt.
(14) Push timing belt with finger to ensure smooth movement of tensioner.
(15) Using special tool "BELT TENSION WRENCH CP" (499437000), apply the specified torque counterclockwise to camshaft sprocket. Under this state, temporarily tighten tensioner bolt ⓑ and then temporarily tighten bolt ⓐ.

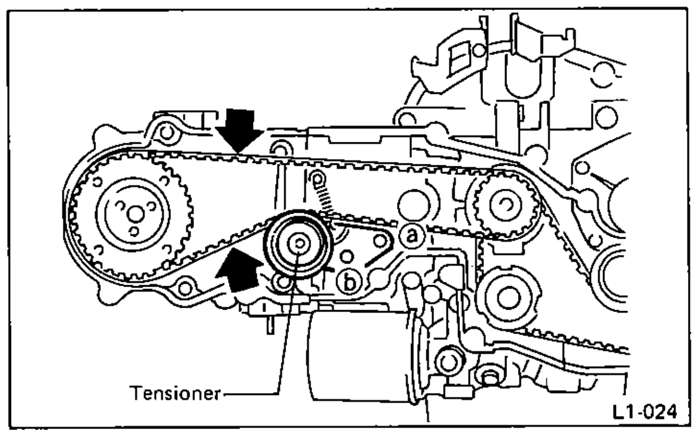


Fig. 7

(16) Sequentially tighten bolts ⓑ and ⓐ to the specified torque.

Tightening torque:
17.2 – 20.1 N·m
(1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

(17) Be sure the three lines on flywheel and timing mark on camshaft sprocket are respectively positioned as specified in steps (11) and (12) above.
2) Install front belt cover:
Attach front and rear belt cover sealings, and timing belt cover plug to front belt cover. Install it to cylinder block.

Be sure that no foreign matter such as nut, washer, etc. is left inside the belt cover.

3) Install crank pulley:
Lock crank pulley using special tool "FLYWHEEL STOPPER CP" (for AT) or "DRIVE PLATE STOPPER" (for MT) and tighten crank pulley bolt.

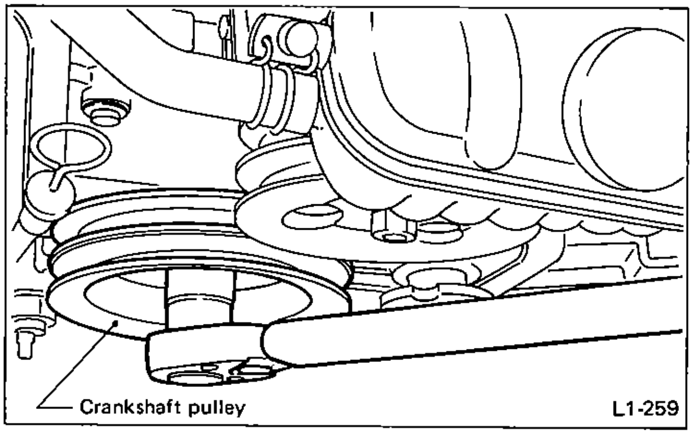


Fig. 8

Tightening torque:
89 – 107 N·m (9.1 – 10.9 kg-m, 66 – 79 ft-lb)

4) Install water pump pulley:
Assemble water pump pulley and pulley cover, and temporarily tighten bolts.
5) Install oil level No. 2 guide ASSY and oil level gauge CP. Coat O-ring with engine oil when installing.
6) Install right-hand and left-hand belt covers. Then install belt cover plate CP (TURBO equipped models only).
7) Install V-belts.
8) Tighten water pump pulley bolt to the specified torque.

Tightening torque:
9.1 – 10.5 N·m (0.93 – 1.07 kg-m, 6.7 – 7.7 ft-lb)

9) Connect harness to oil pressure switch or oil pressure gauge and clamp harness to level gauge guide.

3 Engine Oil

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
	R	R	R	R	R	R	R	R

REPLACEMENT

1) Drain engine oil by loosening engine oil drain plug.

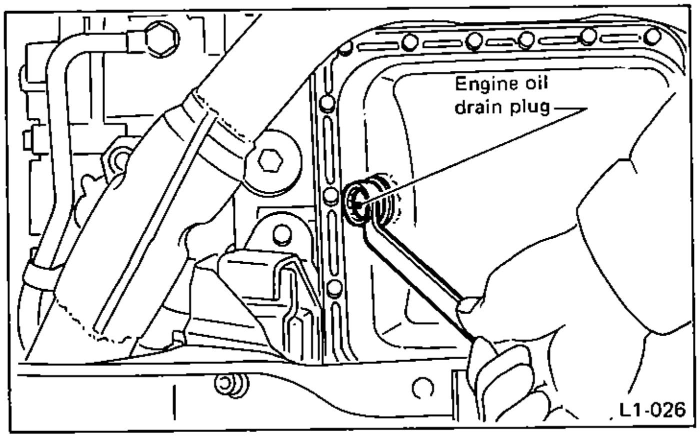


Fig. 9

2) Open engine oil filler cap for quick draining of the engine oil.

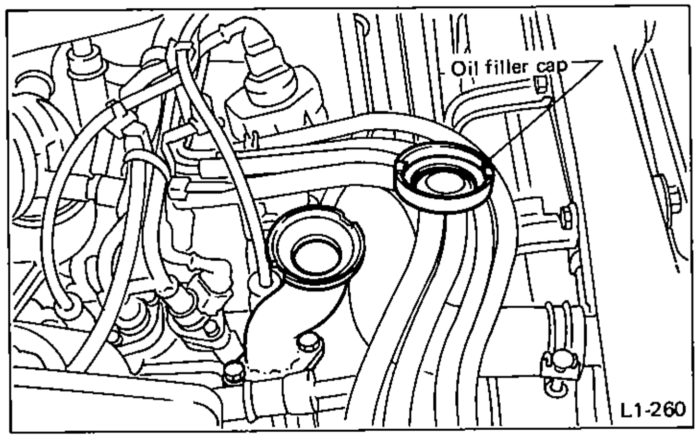


Fig. 10

3) Tighten engine oil drain plug after draining engine oil.

Tightening torque:
25 N·m (2.5 kg-m, 18 ft-lb)

4) Fill engine oil through filler pipe up to upper point on level gauge. Make sure that vehicle is placed level when checking oil level. Use engine oil of proper quality and viscosity, selected in accordance with the table below.

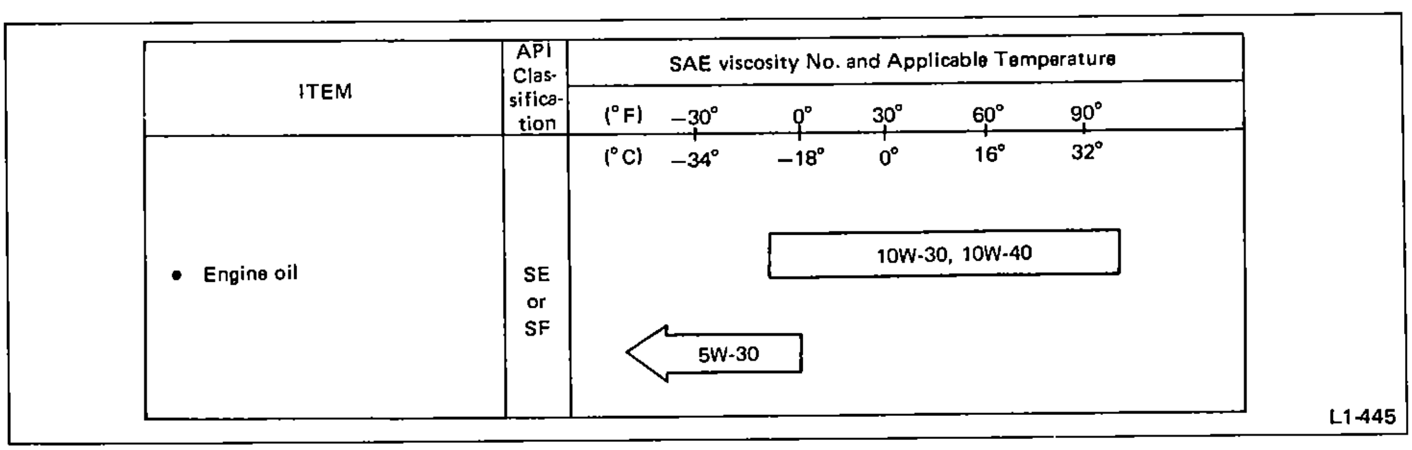


Fig. 11

The proper viscosity helps car get good cold and hot starting by reducing viscous friction and thus increasing cranking speed.

a. When replenishing oil, it does not matter if the oil to be added is a different brand from that in the engine, however, use oil having the API classification and SAE viscosity No. designated by SUBARU.
b. SAE 5W-30 is not recommended for sustained high speed driving.
c. If vehicle is used in desert areas or areas with very high temperatures or for other heavy duty applications, the following viscosity oils may be used:

30, 40, 10W-50, 20W-40, 20W-50

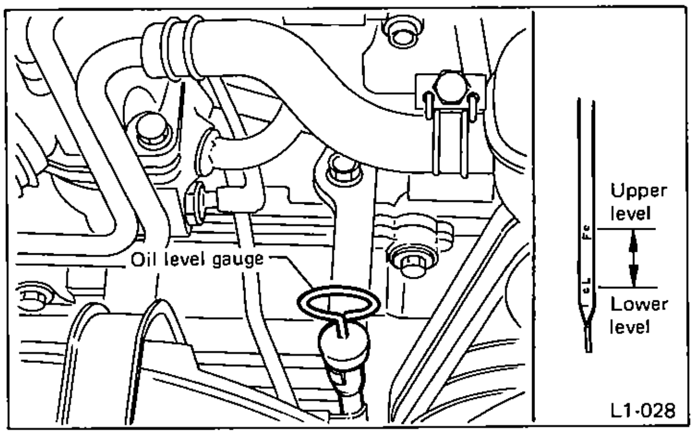


Fig. 12

Engine oil capacity:
Upper level
4.0 ℓ (4.2 US qt, 3.5 Imp qt)
Lower level
3.0 ℓ (3.2 US qt, 2.6 Imp qt)

5) Close engine oil filler cap.
6) Start engine and warm it up for a time.
7) After stopping the engine, recheck the oil level. If necessary, add oil up to the upper point on level gauge.

4 Engine Oil Filter

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
Non-TURBO vehicle		R		R		R		R
TURBO vehicle	R	R	R	R	R	R	R	R

REPLACEMENT

1) Remove oil filter with an oil filter wrench.
2) Get a new oil filter and apply a thin coat of engine oil to the seal rubber.
3) Install oil filter by turning it with hand, being careful not to damage seal rubber.
4) Tighten more approximately two thirds turn after the seal rubber contacts the oil pump case. Do not tighten excessively, or oil may leak.
5) After installing oil filter, run engine and make sure that no oil is leaking around seal rubber.

The filter element and filter case are permanently joined; therefore, interior cleaning is not necessary.

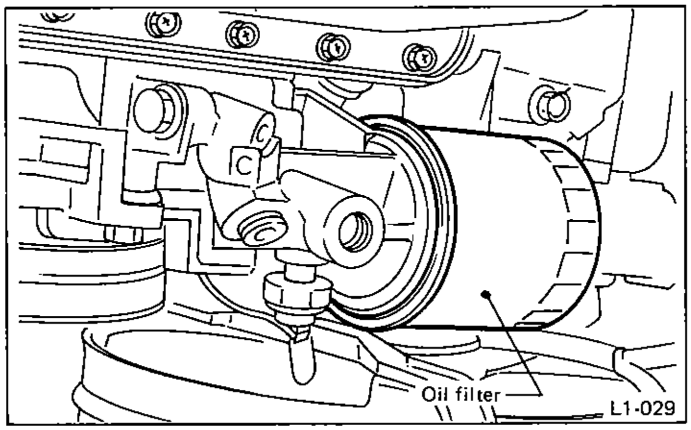


Fig. 13

5 Replace Engine Coolant and Inspect Cooling System, Hoses and Connections

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				(P)				P

REPLACEMENT

1) Pull out the end of drain tube to the underside of body from between undercover and skirt.

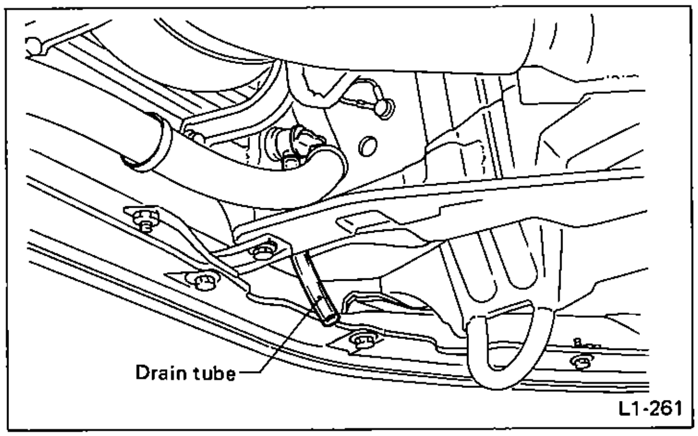


Fig. 14

2) Place a container under drain tube, and loosen drain plug.
3) Loosen radiator cap to drain coolant.
4) Drain coolant from reserve tank.
Be sure to remove fusible link case from reserve tank in advance when removing reserve tank from body.

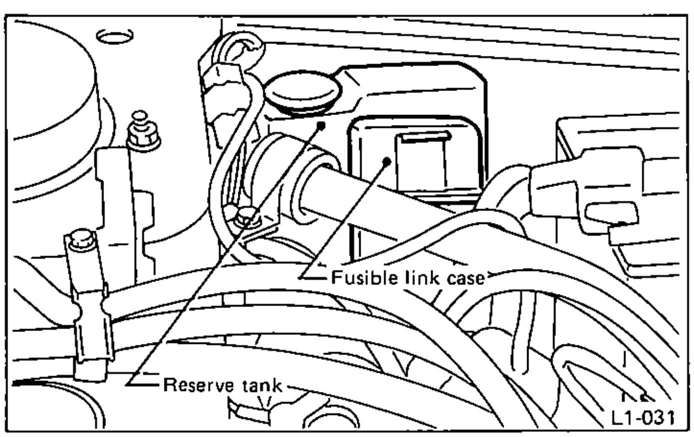


Fig. 15

5) Remove two drain plugs on engine side, and drain coolant.

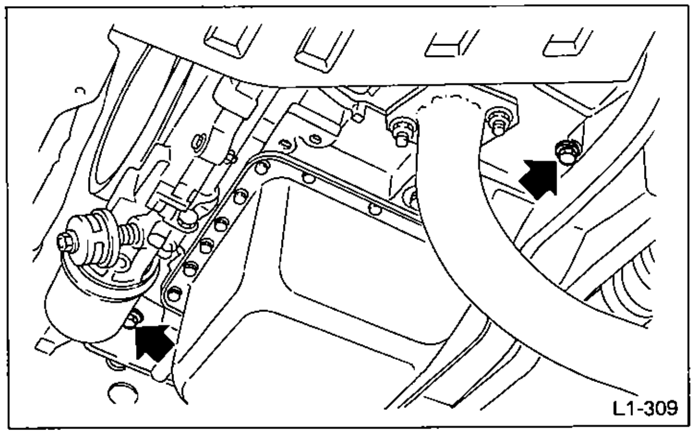


Fig. 16

6) Securely tighten engine side drain plugs.
7) Tighten radiator drain plug securely. (Drain tube may face downward.)
8) Install reserve tank to original position.
9) Carefully pour prepared coolant from radiator filler port to neck of filler, then pour into reserve tank up to "FULL" level.

Coolant capacity (Pour up to "FULL" level):
Except TURBO AT:
Approx. 5.5 ℓ (5.8 US qt, 4.8 Imp qt)
TURBO AT:
Approx. 6.0 ℓ (6.3 US qt, 5.3 Imp qt)

The SUBARU Genuine Coolant containing anti-freeze and anti-rust agents is especially made for SUBARU engine, which has an aluminum crankcase. Always use SUBARU Genuine Coolant, since other coolant may cause corrosion.

10) Securely install radiator cap.
11) Run engine for more than five minutes at 2,000 to 3,000 rpm. (Run engine until radiator becomes hot in order to purge air trapped in cooling system.)
12) Stop engine and wait until coolant temperature lowers. Then open radiator cap to check coolant level and add coolant up to radiator filler neck. Next, add coolant into reserve tank up to "FULL" level.

The radiator is of the pressurized type. Do not attempt to open the radiator cap immediately after the engine has been stopped.

13) After adding coolant, securely install radiator and reserve tank caps.

RELATIONSHIP OF SUBARU COOLANT CONCENTRATION AND FREEZING TEMPERATURE

The concentration and safe operating temerature of the SUBARU coolant is shown in the following diagram. Measuring the temperature and specific gravity of the coolant will provide this information.

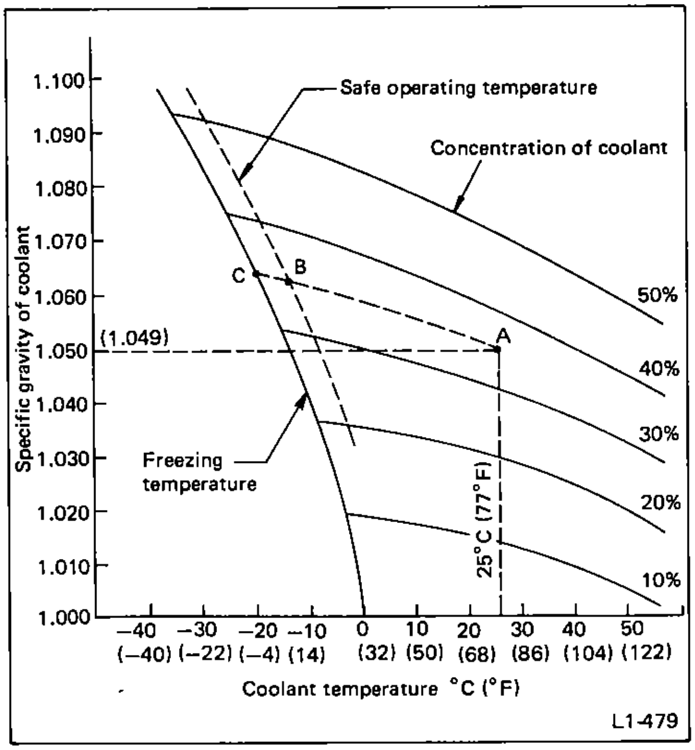


Fig. 17

[Example]

If the coolant temperature is 25°C (77°F) and its specific gravity is 1.049, the concentration is 35% (point A), the safe operating temperature is −14°C (7°F) (point B), and the freezing temperature is −20°C (−4°F) (point C).

PROCEDURE TO ADJUST THE CONCENTRATION OF THE COOLANT

To adjust the concentration of the coolant according to temperature, find the proper fluid concentration in the above diagram and replace the necessary amount of coolant with an undiluted solution of SUBARU genuine coolant (concentration 50%).

The amount of coolant that should be replaced can be determined using the following diagram.

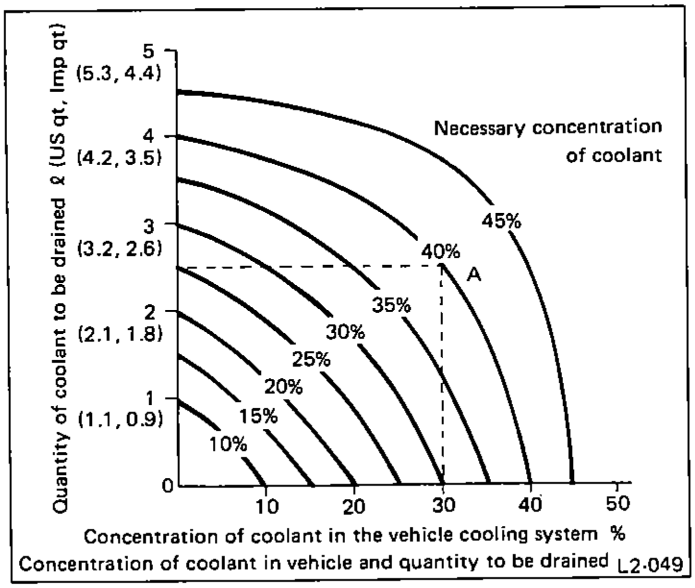


Fig. 18

[Example]

Assume that the coolant concentration must be increased from 30% to 40%. Find point A, where the 30% line of coolant concentration intersects with the 40% curve of the necessary concentration of the necessary coolant concentration, and read the scale on the vertical axis of the graph at height A. The quantity of coolant to be drained is 2.5 liters (2.6 US qt, 2.2 Imp qt). Drain 2.5 liters (2.6 US qt, 2.2 Imp qt) of coolant from the cooling system and add 2.5 liters (2.6 US qt, 2.2 Imp qt) of the undiluted solution of SUBARU coolant.

If a coolant concentration of 50% is needed, drain all the coolant and refill with the undiluted solution only.

INSPECTION

1) Check the radiator reserve tank and hoses for damage or clogging.
2) Check the hose connections for leakage.
3) Check the valve, spring and packing in the cap for damage.
4) 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.

Cap relief pressure:
88 kPa (0.9 kg/cm², 13 psi)

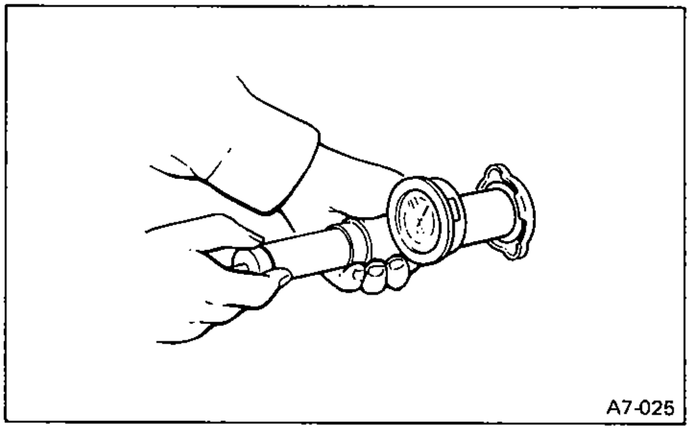


Fig. 19

5) Check the radiator for 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.

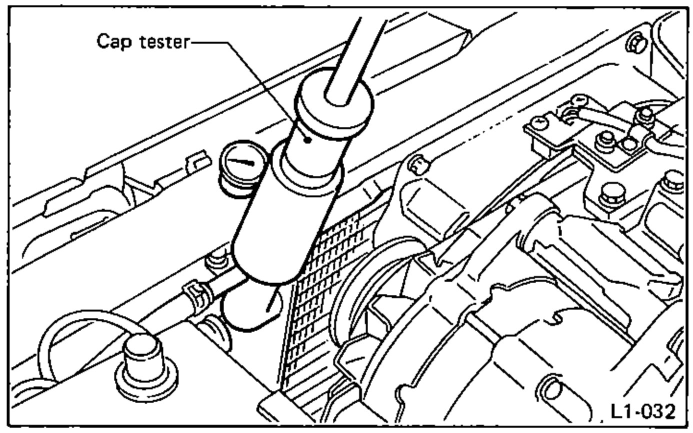


Fig. 20

6) If the coolant temperature exceeds 86.5 to 89.5°C (188 to 193°F) while radiator is not so hot, check thermostat.
7) If thermostat does not open at 86.5 to 89.5°C (188 to 193°F), replace it with a new one.
8) If electric fan does not operate with coolant temperature above 93 to 97°C (199 to 207°F), check thermoswitch or fan motor.

6 Replace Fuel Filter and Inspect Fuel System, Line and Connections

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				(P)				P

REPLACEMENT

a. Before starting the job, be sure to carry out the following.
- **Place "No fire" signs near the working area.**
- **Disconnect ground cable from battery.**

b. Be careful not to spill fuel on the floor.

1) Removal

(1) Before removing the hose, filter, pump, etc., be sure to release the fuel pressure, as follows:
- Disconnect the wiring connector of the fuel pump.
- Crank the engine for more than five seconds.
  If the engine starts, let the engine run until it stops.
- After turning IG switch OFF, connect the wiring connector of the fuel pump.

(2) Loosen the screw of the hose clamp and pull off the hose from the filter.

(3) Remove the filter from the holder.

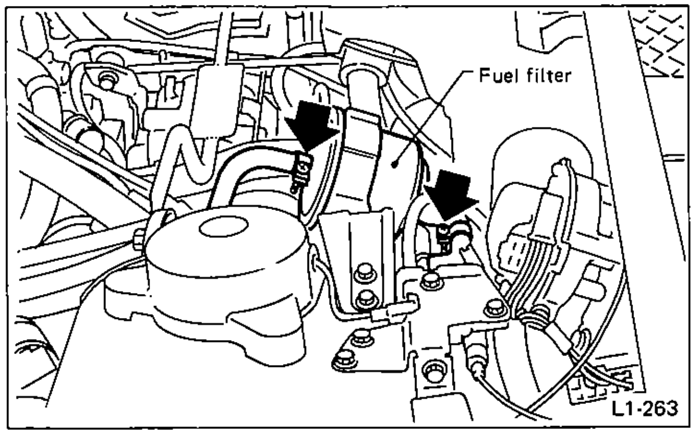


Fig. 1

2) Installation

(1) Install the filter to the holder.

(2) Connect the hose as illustrated below:

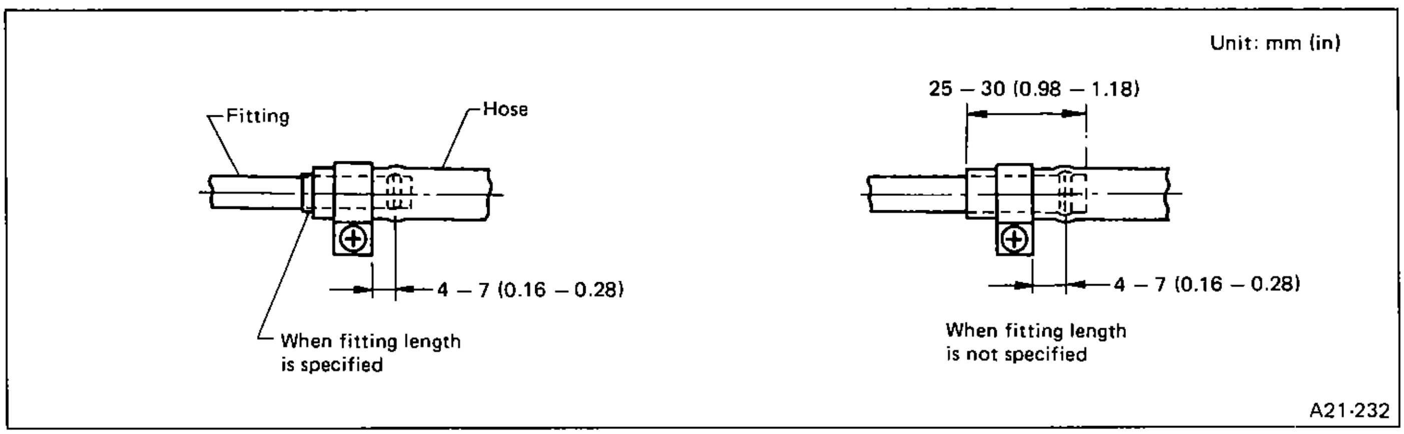


Fig. 2

(3) Tighten the hose clamp screw to the specified torque.

Tightening torque:
1.0 – 1.5 N·m (0.1 – 0.15 kg-m, 0.7 – 1.1 ft-lb)

(4) If the hose is damaged at the clamping portion, replace the hose with a new one.

(5) If the hose clamp is too deformed, replace with a new one.

(6) Fit the hose to the filter, then install the filter to the holder. Correct the hose position by removing any twist so that it will not interfere with the filter body or washer tank, before tightening the screw of the hose clamp.

INSPECTION

FUEL PIPING AND CONNECTIONS

Check fuel tank, piping and connections for leakage, scratches, swelling and corrosion.

SPFI

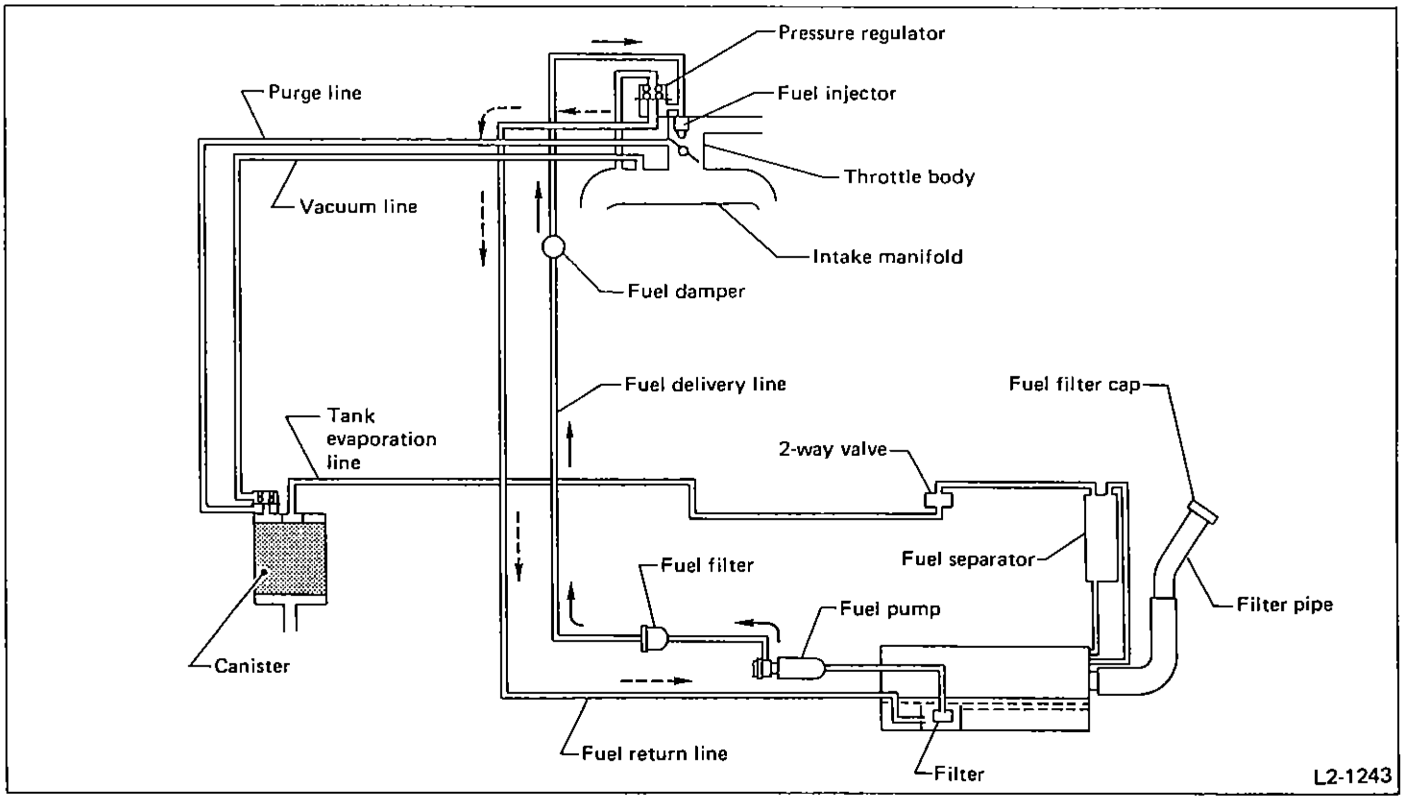


Fig. 23

MPFI (TURBO)

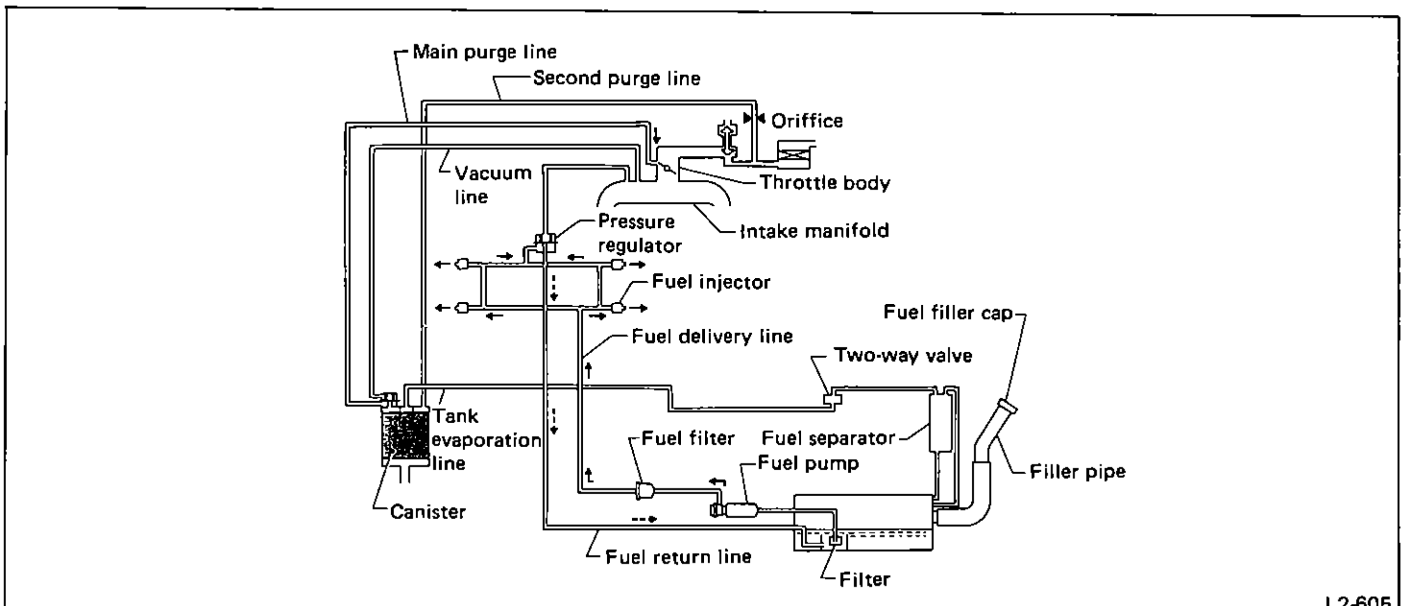


Fig. 24

2) Two-way valve

(1) Check for air passage with slight resistance due to the valve by blowing air into the nipple on the side marked with letters "To engine".

(2) Repeat the same step on the other nipple.

(3) Check for the valve case with no crack. If cracked, replace it with new one.

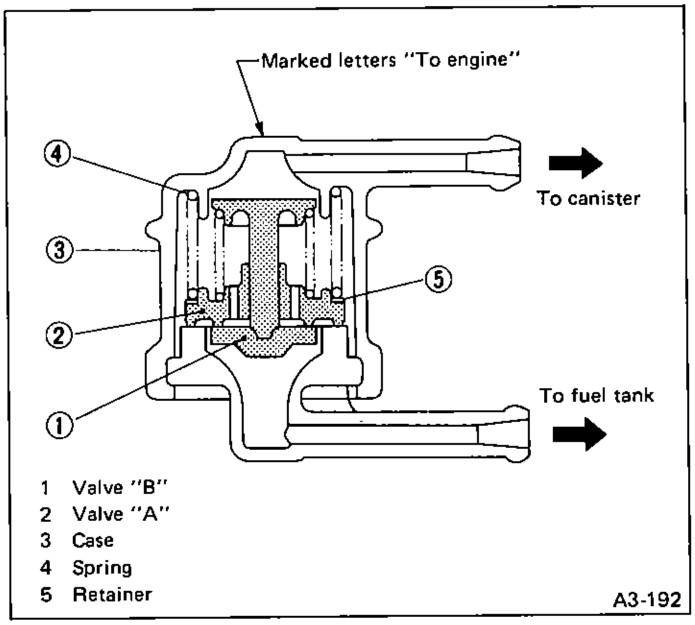


Fig. 25

3) Purge line and canister

(1) Disconnect the vacuum hose. Orally blow air through the hose to ensure that air does not leak.

(2) Disconnect the purge hose or first purge hose (TURBO vehicle). Orally blow air through the hose to ensure that air flows.

(3) Disconnect the evaporation hose from the fuel tank side. Orally blow air through the hose to ensure that air flows.

Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.

(4) Disconnect the second purge hose from the air intake boots. Orally blow air through the hose to ensure that there is an air flow with a slight resistance (TURBO vehicle).

Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.

(5) Check the exterior of the canister to ensure that it is not cracked or scratched.

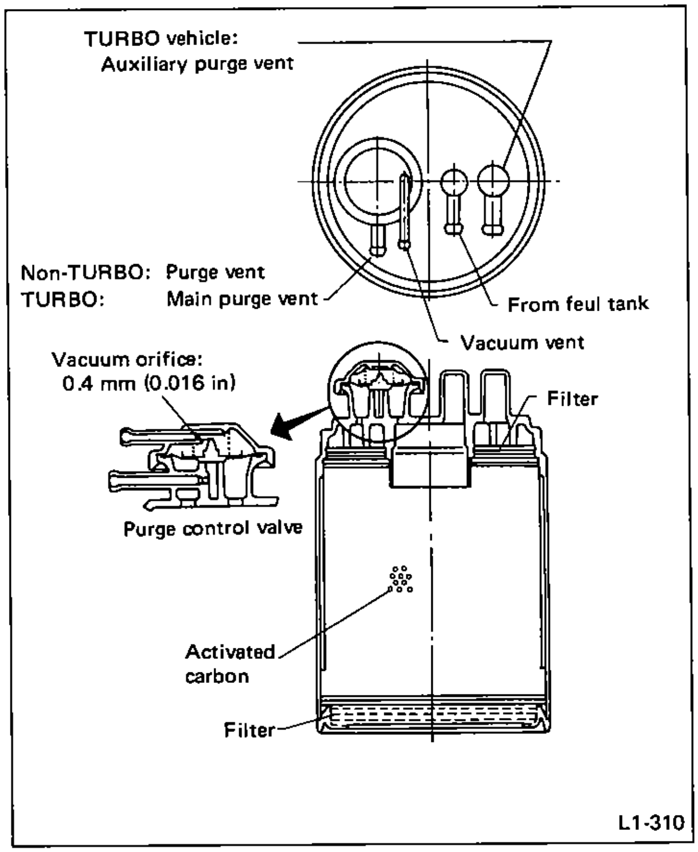


Fig. 26

7 Air Filter Elements (Air cleaner)

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				R				R

REPLACEMENT

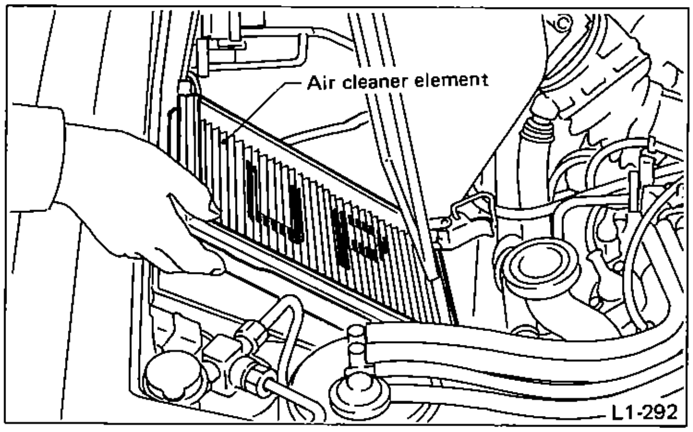


Fig. 27

a. **Do not attempt to clean the air cleaner element.**
The filter paper of the element is wetted with a special non-inflammable slow-evaporating viscous liquid. It is resistant to cold weather and has a long service life. Dirt adhering to this filter paper forms porous laminations with the viscous liquid, which function as a filtration layer to reduce dust penetration into the filter paper. If this filter paper is cleaned, the filtration layer thus formed will be lost along with the viscous liquid.

b. **Under extremely dusty conditions, replace it more frequently.**

8 Spark Plug

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				R				R

REPLACEMENT

Recommended spark plugs
NGK: BPR6ES-11
(or BPR5ES-11, BPR7ES-11)
Nippondenso: W20EPR-U11
(or W16EPR-11, W22EPR-U11)
Champion: RN9YC-4

Spark plug gap
1.0 – 1.1 mm (0.039 – 0.043 in)

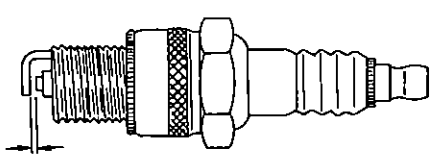


Fig. 28

When installing spark plugs on cylinder head, tighten to the specified torque.

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

Be sure to place the gasket between the cylinder head and spark plug.

9 Transmission/ Differential (Front and rear) Lubricants (Gear oil)

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				I				

INSPECTION

MANUAL TRANSMISSION

Inspect the transmission gear oil level. If the oil level is at the lower point or below, add some oil through the oil level gauge hole up to the upper point of gauge.

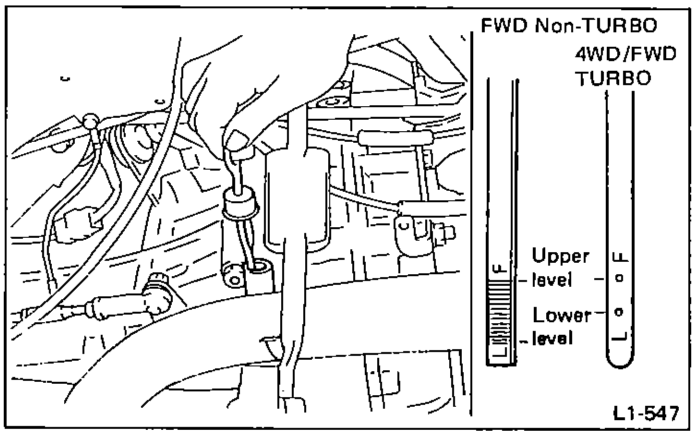


Fig. 29

FRONT DIFFERENTIAL (Automatic Transmission)

Oil level should be maintained between two points on the level gauge. If the oil level is at lower point or below, add some oil up to upper point.

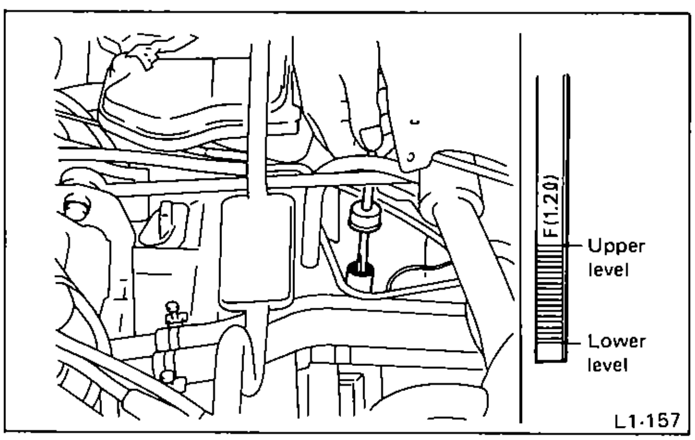


Fig. 30

REAR DIFFERENTIAL (4WD Vehicle)

Remove plug of filler hole and check the oil level. Oil level should be maintained fully to the filler hole.
If the oil level is below the mouth of filler hole, add some oil up to the mouth.

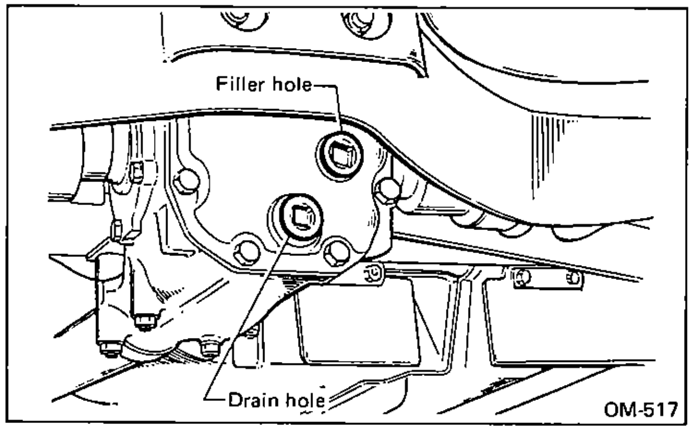


Fig. 31

Recommended oil

ITEM	API Classification	SAE Viscosity No. and Applicable Temperature
		(°F) −30 0 30 60 90
		(°C) −34 −18 0 16 32
• Transmission and differential gear oil • 4WD rear differential gear oil	GL-5	90 85W 80W 75W-90, *80W-90

a. Each oil manufacturer has its base oil and additives. Thus, do not mix two or more brands.
b. *For differential gear oil (AT)

10 Automatic Transmission Fluid

INSPECTION

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
FWD vehicle				I				
4WD vehicle				R				R

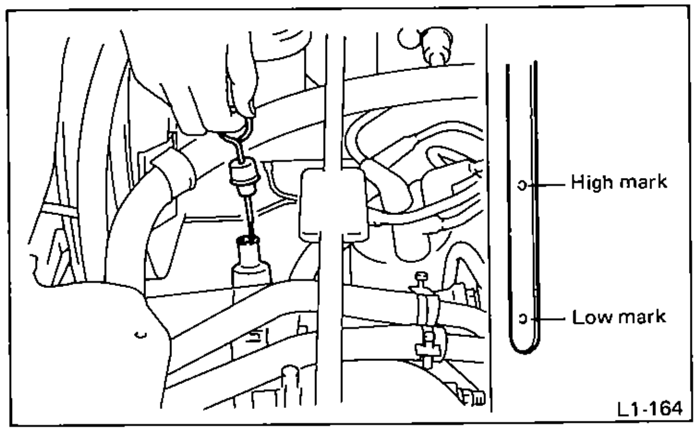


Fig. 33

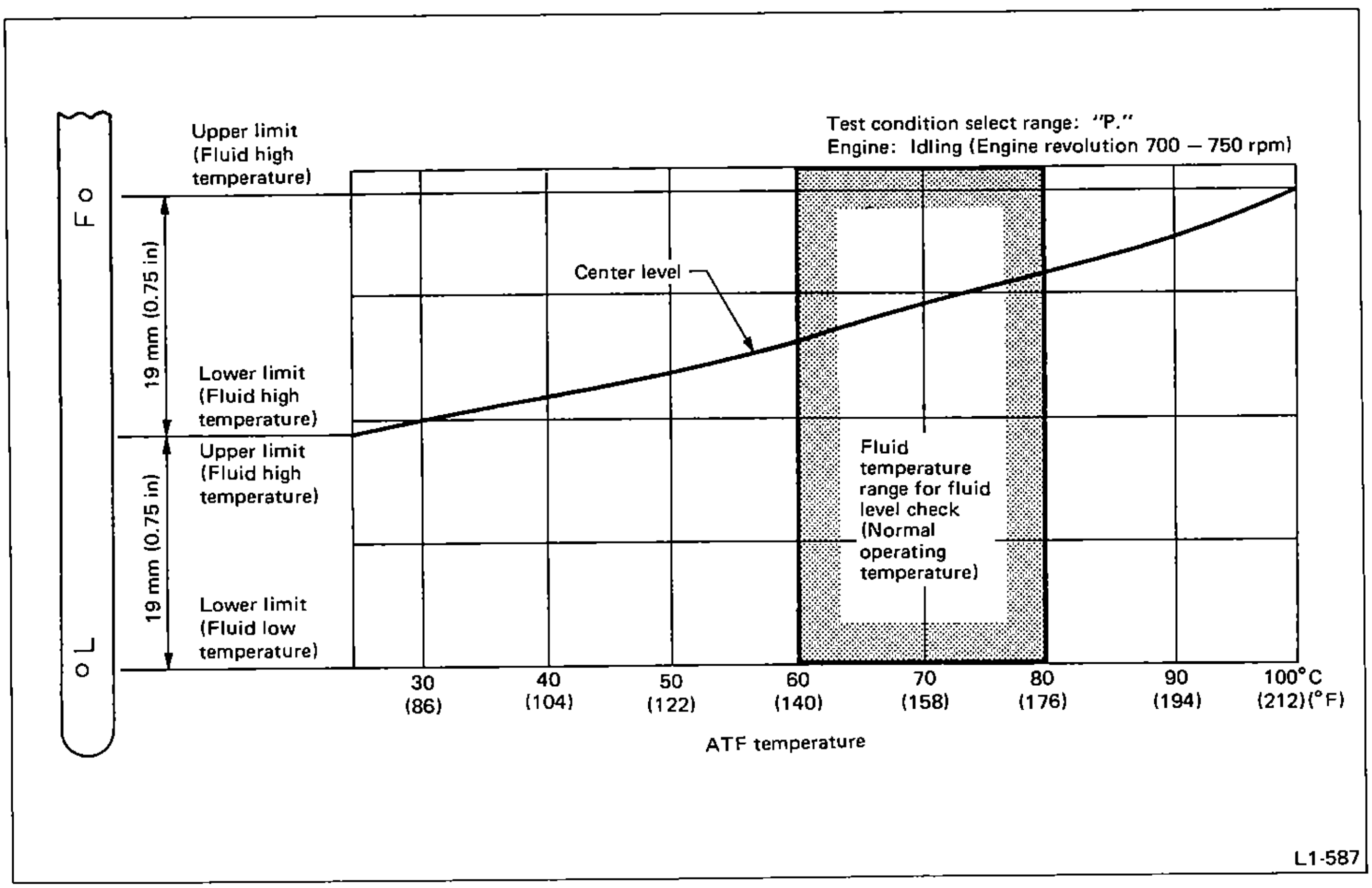


Fig. 32

INSPECTION

1) Drive vehicle several km (miles) to bring automatic transmission fluid (ATF) up to normal operating temperature. Normal operating temperature is 60 to 80°C (140 to 176°F).
2) Park vehicle on a level surface.
3) After selecting all positions, place selector lever in "P" position and run engine on at idling speed.
4) Remove level gauge and wipe it clean.
5) Reinsert the level gauge all the way.
6) Remove it again and note reading. If the fluid level is below the center between high and low marks, add recommended ATF until the fluid level is within the specified range (above the center between high and low marks). When transmission is hot, the level should be above the center of upper and lower marks, and when it is cold, the level should be below the center of these two marks.
ATF level gauge hole also serves as fluid filler.

NOTE:
Do not fill the fluid above upper point of level gauge.

Recommended automatic transmission fluid (ATF Dexron II)

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				I				

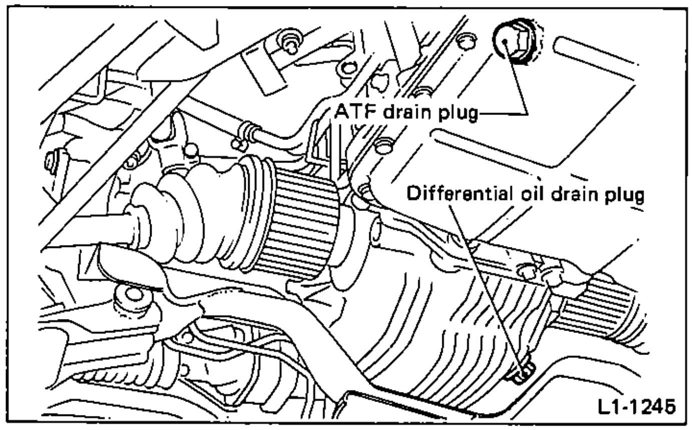


Fig. 4 4AT

REPLACEMENT

1) Drain fluid by removing drain plug after allowing the engine to cool for 3 to 4 hours.

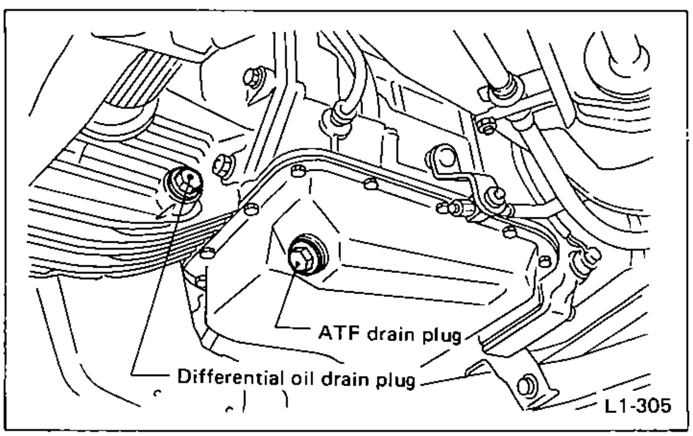


Fig. 3 3AT

2) Reinstall drain plug after draining fluid, and tighten it to the specified torque.

Tightening torque:
25 N·m (2.5 kg-m, 18 ft-lb)

a. Be sure to place a gasket between oil pan and drain plug.
b. Replace the gasket with new one.

3) Fill ATF through the fluid level gauge hole.

Oil capacity:
FWD 3AT:
6.2 ℓ (6.6 US qt, 5.5 Imp qt)
4WD 3AT:
6.55 ℓ (6.9 US qt, 5.8 Imp qt)
4WD 4AT:
9.5 ℓ (10.0 US qt, 8.4 Imp qt)

When replacing ATF, the normal refilling capacity is about 2.5 to 3.0 ℓ (2.6 to 3.2 US qt, 2.2 to 2.6 Imp qt) (except 4WD 4AT), 6.5 to 7 ℓ (6.9 to 7.4 US qt, 5.7 to 6.2 Imp qt) (4WD 4AT).

4) Run the vehicle until the ATF temperature rises to 60 to 80°C (140 to 176°F) and then check the ATF level.

11 Brake Fluid

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				R				R

REPLACEMENT

1) Either jack up the front end of vehicle and place a safety stand under it, or drive vehicle onto the pit and then jack up the front end.
2) Remove both left and right front wheels.
3) Remove filler cap from brake fluid tank.
Install one end of a vinyl tube onto the air bleeder of front brake and insert the other end of the tube into a container to collect the brake fluid.
To drain fluid into container, open the air bleeder and repeatedly depress and release the brake pedal until a small amount of fluid remains in the reservoir tank.
Then tighten the bleeder screw.

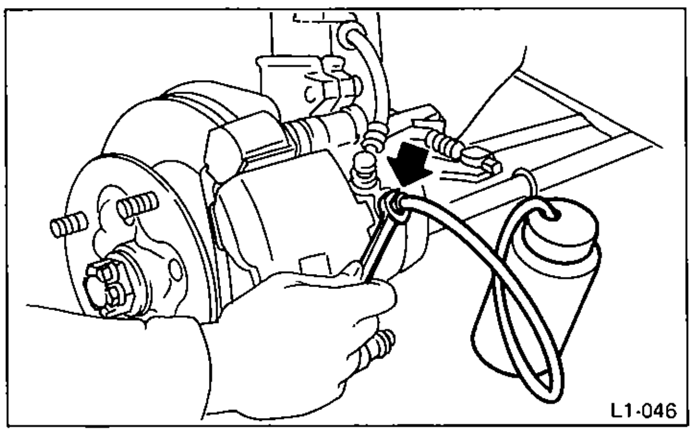


Fig. 35

a. The brake piping consists of a dual system, cross design. The piping on the primary side connects the right front brake and the rear left brake and the piping on the secondary side connects the left front brake and rear right brake.
b. For convenience and safety, it is advisable to have two men working.
c. Be careful not to spill brake fluid onto the painted surface.
d. Discard the drained brake fluid and do not reuse it.

4) Refill reservoir tank with recommended brake fluid.

Recommended brake fluid:
FMVSS No. 116, fresh DOT3 or DOT4 brake fluid

a. Avoid mixing different brands of brake fluid to prevent degrading the quality of the fluid.
b. Be careful not to allow dirt or dust to get into the reservoir tank.
c. Use fresh DOT3 or DOT4 brake fluid when replacing or refilling the fluid.
d. Always check to be sure a small amount of brake fluid is in the tank while changing brake fluid.
e. The amount of brake fluid required is approximately 270 mℓ (9.1 US fl oz, 9.5 Imp fl oz) for total brake system.
f. Bleed air according to illustrated sequence.

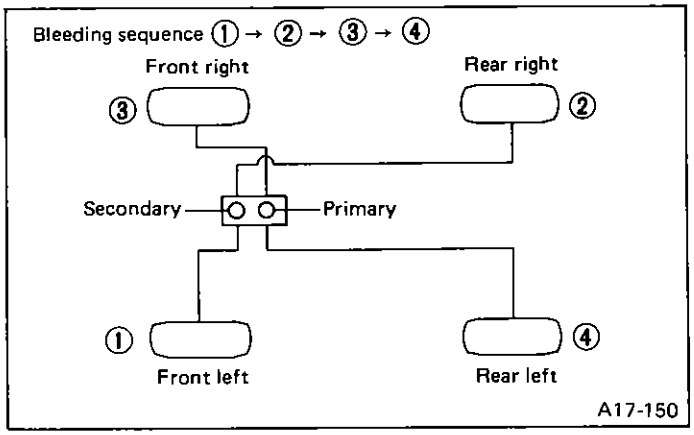


Fig. 36

5) Instruct your co-worker to depress the brake pedal slowly two or three times and then hold it depressed.
6) Loosen bleeder screw approximately 1/4 turn until a small amount of brake fluid drains into container, and then quickly tighten screw.
7) Repeat steps 5) and 6) above until there are no air bubbles in drained brake fluid and new fluid flows through vinyl tube.

Add brake fluid as necessary while performing the air bleed operation, in order to prevent the tank from running short of brake fluid.

8) After completing the bleeding operation, hold brake pedal depressed and tighten screw and install bleeder cap.

Tightening torque (Bleeder screw):
7 – 9 N·m (0.7 – 0.9 kg-m, 5.1 – 6.5 ft-lb)

9) Bleed air from each wheel cylinder using the same procedures as described in steps 5) through 8) above.

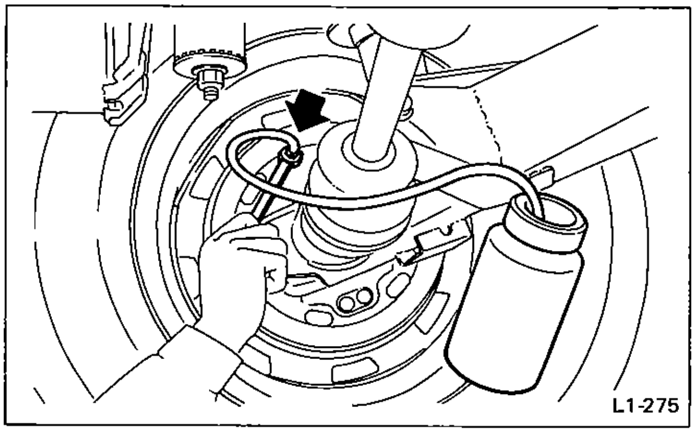


Fig. 37

10) Depress brake pedal with a force of approximately 294 N (30 kg, 66 lb) and hold it there for approximately 20 seconds. At this time check pedal to see if it shows any unusual movement.

Visually inspect bleeder screws and brake pipe joints to make sure that there is no fluid leakage.

11) Install wheels, and drive car for a short distance between 2 to 3 km (1 to 2 miles) to make sure that brakes are operating properly.

12 Disc Brake Pad and Disc/Front and Rear Axle Boots and Axle Shaft Joint Portions

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
		I		I		I		I

INSPECTION

[A] Disc Brake Pad and Disc (Front and Rear)

1) Jack up vehicle and support with rigid racks. Then remove wheels.

2) Visually check pad thickness through inspection hole of disc brake assembly. Replace pad if necessary.

FRONT

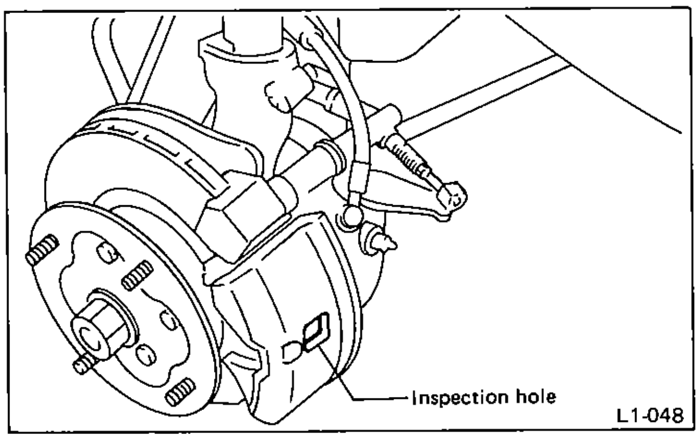


Fig. 38

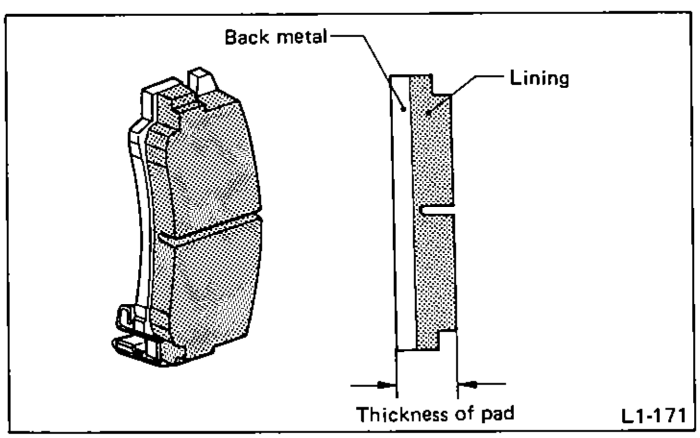


Fig. 39

REAR

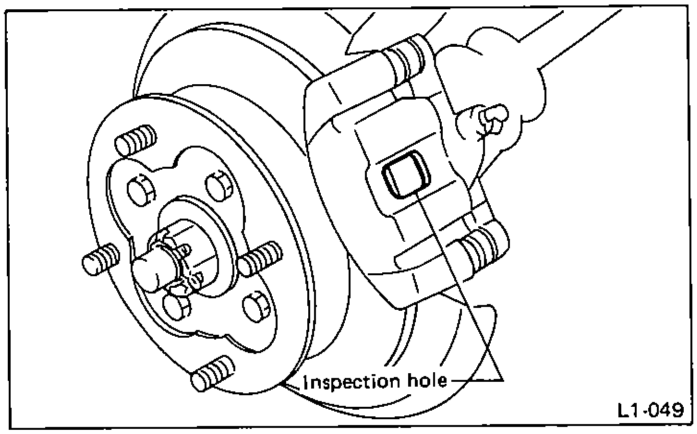


Fig. 40

Pad thickness including back metal mm (in)		
	Front	Rear
Standard	18 (0.709)	15 (0.591)
Wear limit	7.5 (0.295)	6.5 (0.256)
Wear limit (exclude back metal)	1.5 (0.059)	1.5 (0.059)

a. When replacing a pad, always replace the pads for both the left and right wheels at the same time. Also replace pad clips if they are twisted or worn.
b. The clip incorporated with pad is also used as a warning device for worn pads. When wear occurs on the pad to such an extent that the clip comes into contact with the rotor, unusual noise (squeak) is produced. If such a noise is noticed, replace the pads.

3) Disc rotor

Check for wear and damage, and correct or replace if abnormal.

Brake disc thickness mm (in)		
	Front	Rear
Standard	18 (0.709)	10 (0.394)
Wear limit	16 (0.630)	8.5 (0.335)

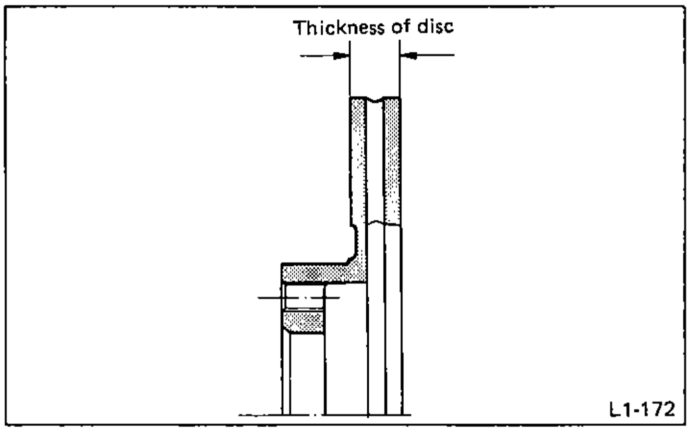


Fig. 41

Disc rotor runout:
Limit: 0.10 mm (0.0039 in)

Measure the disc rotor runout at a point less than 5 mm (0.20 in) from the outer periphery of the rotor.

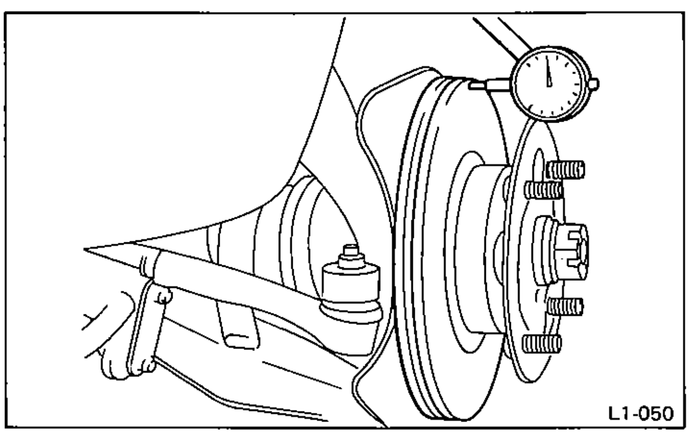


Fig. 42

[B] Front and Rear Axle Boots

Inspect front and rear axle boots for deformation, damage or failure. If faulty, replace them with new ones.

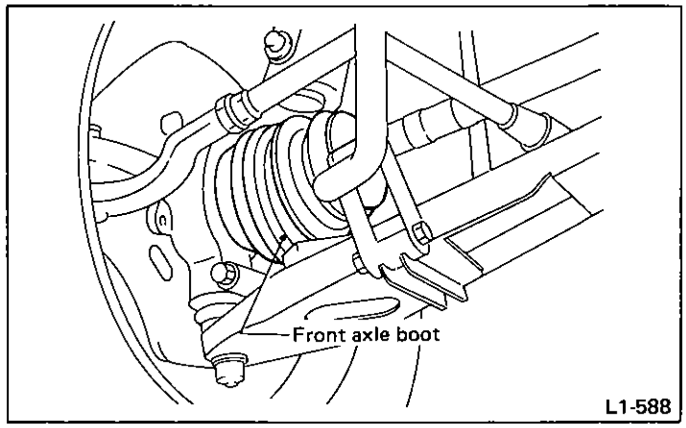


Fig. 43

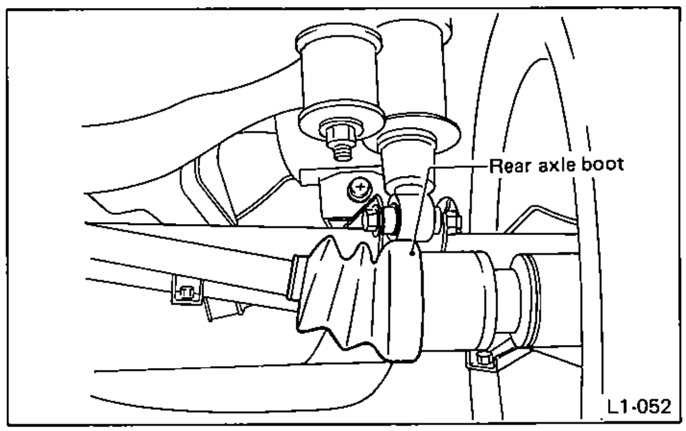


Fig. 44

13 Brake Lining and Drum

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
				I				I

INSPECTION

Inspect brake linings and drums of both sides of the rear brake at the same time by removing brake drums.

1) Inspect brake shoes for damage or deformities and check brake linings for wear.

Always replace both leading and trailing brake shoes for the left and right wheels at the same time.

Brake lining thickness excluding back metal:
Standard:
4.5 mm (0.177 in)
Wear limit:
1.5 mm (0.059 in)

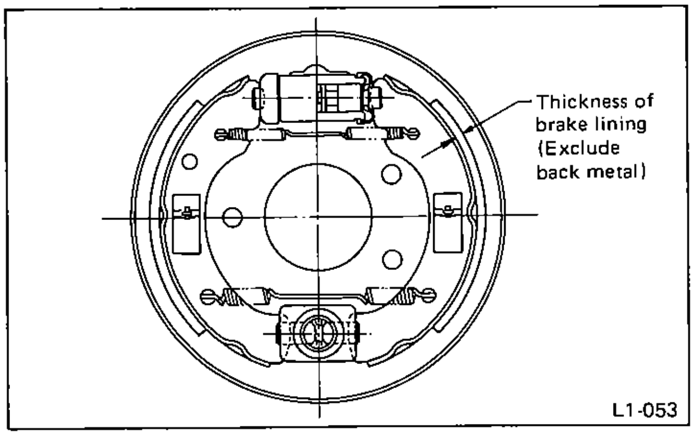


Fig. 45

2) Check brake drum for wear, dents or other damage.
If the inside surface of brake drum is streaked, correct the surface with emery cloth (#200 or more). If it is unevenly worn, taperingly streaked, or the outside surface of brake drum is damaged, correct or replace it.

Brake drum inside diameter:
Standard:
180 mm (7.09 in)
Wear limit:
182 mm (7.17 in)

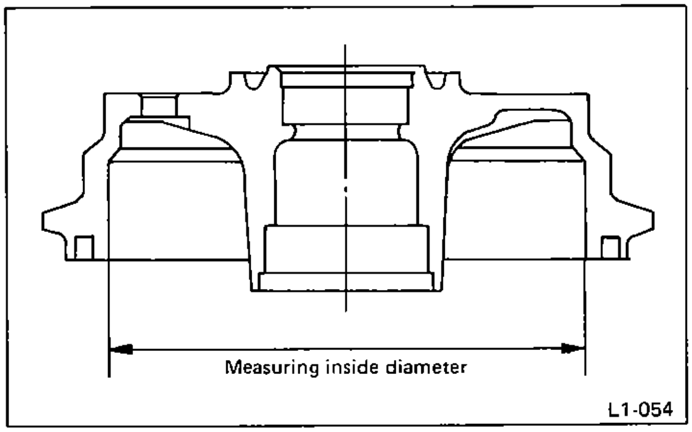


Fig. 46

3) If the deformation or wear of back plate, shoe, etc. are notable, replace them.
4) When the shoe return spring tension is excessively weakened, replace it, taking care to identify upper and lower springs.
5) If grease has leaked from brake drum, replace oil seal or drum.
6) If drum bearing is abnormal or loose, replace it.

14 Inspect Brake Line and Check Operation of Parking and Service Brake System

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
		P		P		P		P

INSPECTION

BRAKE LINE

1) Check scratches, swelling and/or traces of fluid leakage on brake hoses or pipe joints.

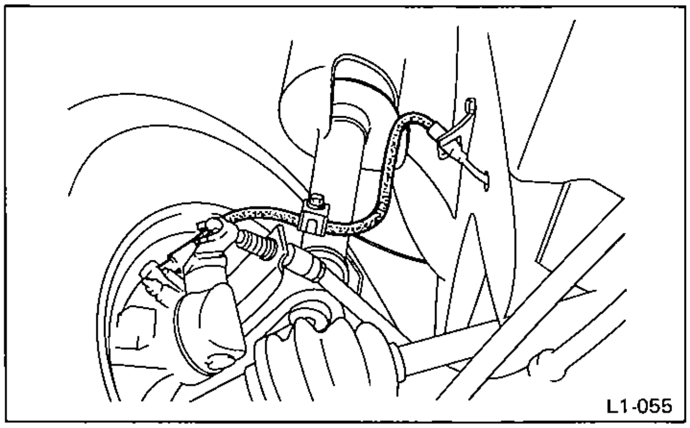


Fig. 47

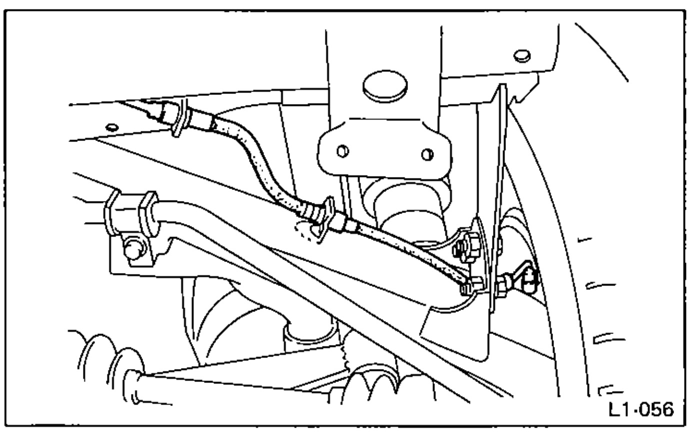


Fig. 48

2) Check the possibility of adjacent parts interfering with brake pipes/hoses during driving, and loose connections/clamps.
3) Check any trace of fluid leakage, scratches, etc. on master cylinder, wheel cylinder, pressure control valve and hill-holder.

When the brake fluid level in the reservoir tank is lower than the specified limit, the brake fluid warning light on the instrument panel will come on.

CHECKING

[A] Service Brake

1) Check the free play of brake pedal with a force of less than 10 N (1 kg, 2 lb).

Brake pedal free play:
0.5 – 2.5 mm (0.020 – 0.098 in)

If the free play is out of specifications above, adjust the brake pedal as follows:

(1) Be sure engine is off. (No vacuum is applied to brake booster.)
(2) There should be play between brake booster clevis and pin at brake pedal installing portion.
(Depress brake pedal pad with a force of less than 10 N [1 kg 2 lb] to a stroke of 0.5 to 2.5 mm [0.020 to 0.098 in].

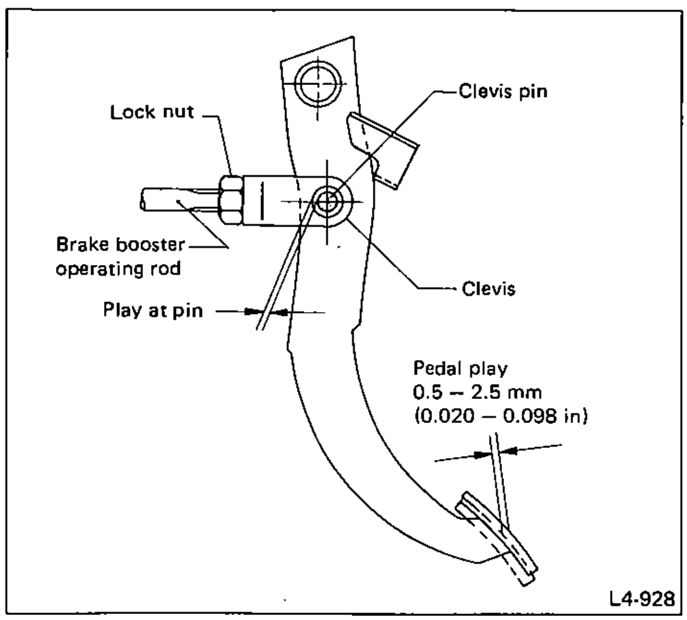


Fig. 49

(3) Depress the surface of brake pad by hand.
(4) If there is no free play between clevis pin and clevis, loosen lock nut for operating rod and adjust operating rod by turning in the direction that shortens it.

a. Make sure that the stop lamp operates normally.
b. After adjustment, make sure there is no brake dragging.

2) Adjust lining clearances of rear drum brake as follows. [FWD only]

(1) Jack up vehicle to release tires and wheels slightly from the ground.
(2) Tighten adjusting screw on back side of rear brake drum fully until tire and wheel ceases to rotate.
(3) Turn back adjusting screw by 180° and lining clearance will be 0.1 to 0.15 mm (0.004 to 0.0059 in).
(4) Be sure to rotate tire and wheel lightly by hand.
(5) Adjust lining clearance of another side rear brake with the same manner.

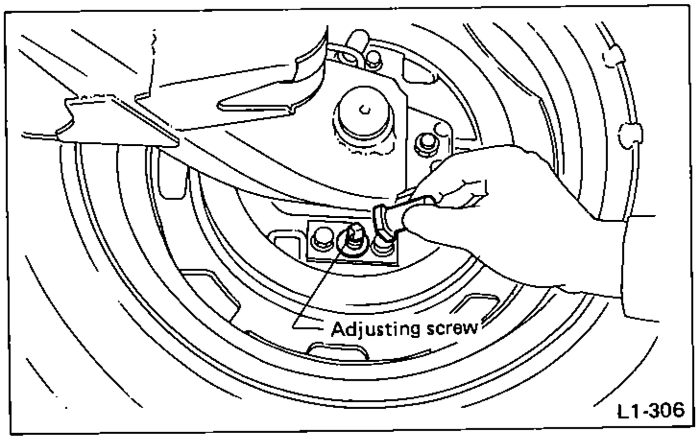


Fig. 50

3) Measure the distance between brake pedal and floor when the pedal is depressed with a force of approximately 294 N (30 kg, 66 lb).

Brake pedal reserve distance:
More than 67 mm (2.64 in)/294 N (30 kg, 66 lb)

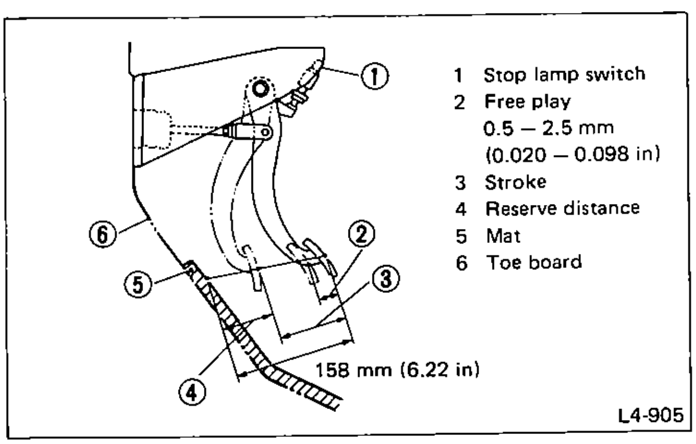


Fig. 51

4) Check to see if air is in the hydraulic brake line by the feel of the pedal operation. If air appears to exist in the line, bleed it from the system.

5) Check for even operation of all brakes, using a brake tester or by driving the vehicle for a short distance on a straight road.

[B] Parking Brake

1) After confirming the proper operation of brake pedal, pull parking brake lever with a force of approximately 245 N (25 kg, 55 lb) to make sure lever still has a short length of stroke to go.

Parking brake lever stroke: (With engine on)
Standard:
3 – 4 notches/245 N (25 kg, 55 lb)
Torque (Adjuster lock nut):
4.4 – 7.4 N·m (0.45 – 0.75 kg-m, 3.3 – 5.4 ft-lb)

2) If the parking brake lever pull is not within the above specifications, adjust it as follows:

(1) Pull parking brake lever forcibly three to five times.
(2) Loosen the lock nut and change the setting of adjuster until the play at point A is 0 to 0.5 mm (0 to 0.020 in).

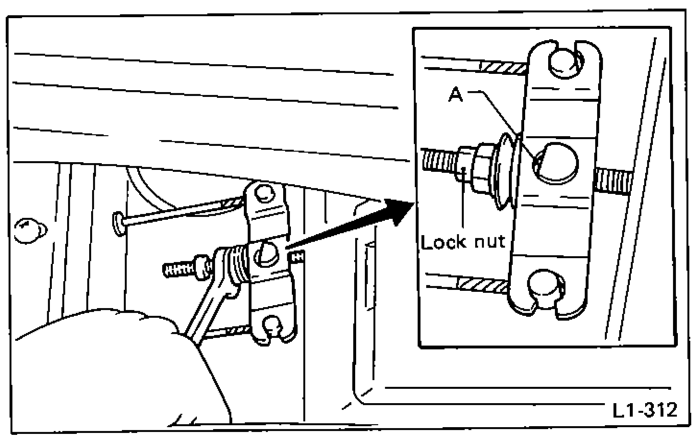


Fig. 52

(3) Make sure that vehicle stops on uphill road properly by operating parking lever.

[C] Brake Servo System

1) With the engine off, depress the brake pedal several times applying the same pedal force: Make sure the travel distance should not change.

2) With the brake pedal depressed, start the engine: Make sure the pedal should move slightly toward the floor.

3) With the brake pedal depressed, stop the engine and keep the pedal depressed for 30 seconds: Make sure the pedal height should not change.

4) Check valve is built into vacuum hose. Disconnect vacuum hose to inspect function of check valve.
Blow air into vacuum hose from its brake booster side end: Air must flow out of engine side end of hose. Next blow air into hose from engine side: Air should not flow out of hose.
Replace both check valve and vacuum hose if check valve is faulty. Engine side of vacuum hose is indicated by marking "E" as shown.

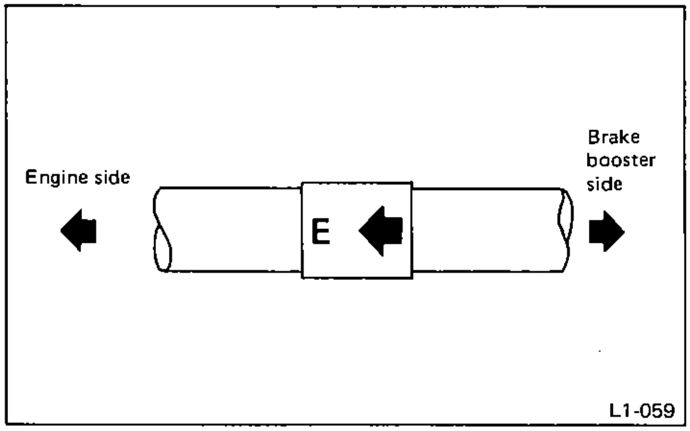


Fig. 53

5) Check vacuum hose for cracks or other damage.

When installing the vacuum hose on the engine and brake booster, do not use soapy water or lubricating oil on their connections.

6) Check vacuum hose to make sure it is tight and secure.

15 Clutch and Hill-holder System

INSPECTION AND ADJUSTMENT

1. Inspect the clutch free play and check the hill holder operation.
If it is out of the specified value, adjust it by turning adjusting nut on engine side end of clutch cable at release fork.
1) Clutch free play
(1) Remove the spare tire.
(2) Position a screwdriver as shown, and move it back to rotate the lever in the direction indicated by the arrow. This is necessary to remove hill holder load from the release lever to determine accurate clutch free play.

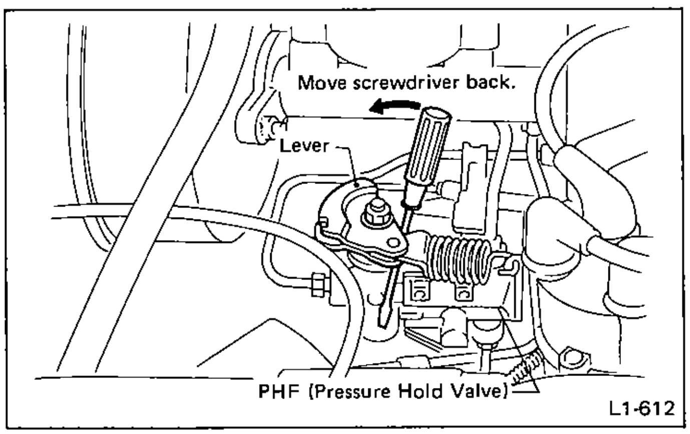


Fig. 9

(3) Lightly move the clutch lever with your hand to check free play.

Standard of free play:
At clutch pedal:
10 – 20 mm (0.39 – 0.79 in)
At center of cable on clutch release fork:
FWD Non-TURBO: 2 – 3 mm (0.08 – 0.12 in)
4WD/FWD TURBO: 3 – 4 mm (0.12 – 0.16 in)

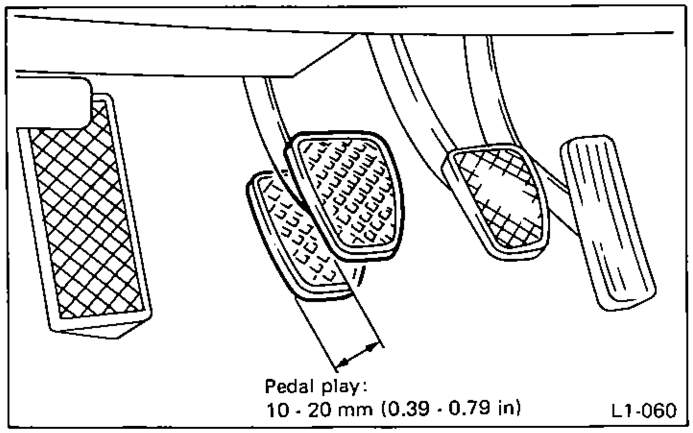


Fig. 54

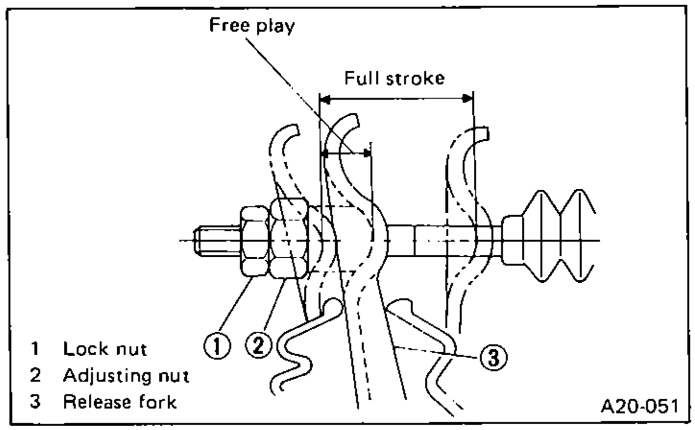


Fig. 55

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
		I		I		I		I

Tightening torque (Adjusting nut on release fork):
5.4 – 9.3 N·m (0.55 – 0.95 kg-m, 4.0 – 6.9 ft-lb)

a. When replacing clutch cable with new one and/or making free play adjustment of clutch pedal, make adjustment of hill-holder system without fail as follows.
b. After replacing clutch cable and/or pressure hold valve (PHV) cable with new one, depress clutch pedal about thirty (30) times as a running-in operation prior to this adjustment.

2) Confirm stopping and starting performance by activating hill-holder on an uphill road of 3° or higher inclination.
(1) If vehicle does not stop;
Tighten adjusting nut of PHV cable.

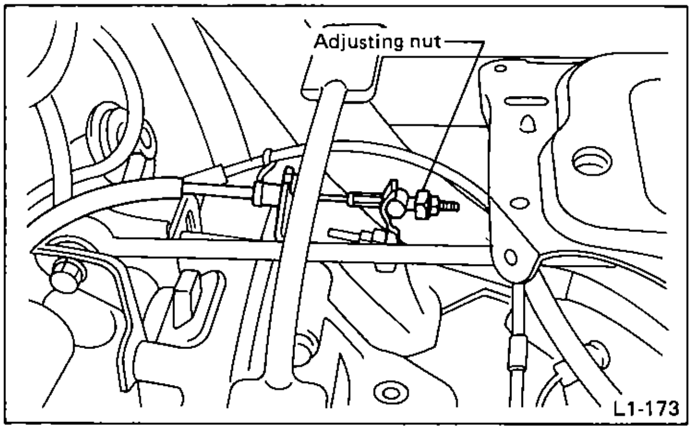


Fig. 56

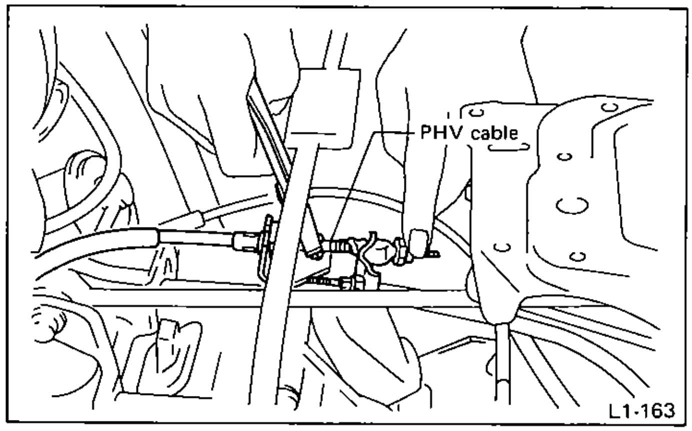


Fig. 57

(2) If vehicle does not start properly;

- Case A – When hill-holder is released later than engagement of clutch (engine tends to stall):
  Loosen adjusting nut gradually until smooth starting is enabled.
- Case B – When hill-holder is released earlier than engagement of clutch (vehicle slips down slightly):
  Tighten adjusting nut so that hill-holder is released later than engagement of clutch (status in Case A). Then make adjustment the same as in Case A.

a. Whenever turning adjusting nut, prevent PHV cable from revolving as following illustration.

b. Replace pressure hold valve (PHV), return spring of PHV or PHV cable with new one, if they are defective and/or damaged.

16 Steering and Suspension

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
		I		I		I		I

INSPECTION

STEERING WHEEL

1) Set steering wheel in a straight-ahead position, and check wheel spokes to make sure they are correctly set in their specified positions.
2) Lightly turn steering wheel to the left and right to determine the point where front wheels start to move.
Measure the distance of the movement of steering wheel at the outer periphery of wheel.

Steering wheel free play:
0 – 25 mm (0 – 0.98 in)

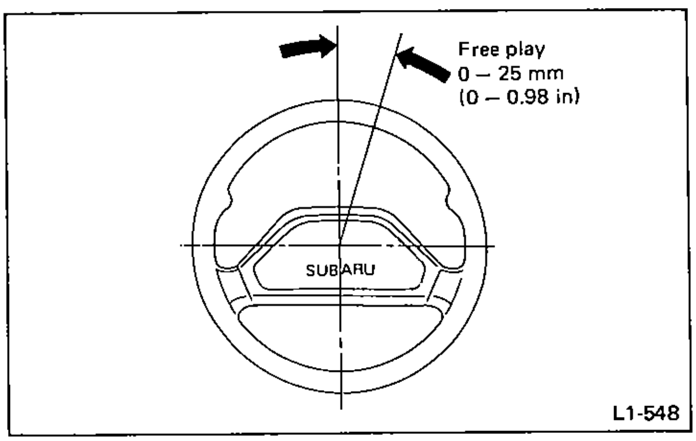


Fig. 58

3) Move steering wheel vertically toward the shaft to ascertain if there is play in that direction.

Maximum permissible play:
0.5 mm (0.020 in)

4) Drive vehicle and check the following items during operation.
(1) Steering force ....
The effort required for steering should be smooth and even at all points, and should not vary.
(2) Pull to one side ....
Steering wheel should not be pulled to either side while driving on a level surface.
(3) Wheel runout ....
Steering wheel should not show any sign of runout.
(4) Return factor ....
Steering wheel should return to its original position after it has been turned and then released.

STEERING SHAFT JOINT

1) When steering wheel free play is excessive, disconnect universal joint of steering shaft and check it for any play and yawing torque (at the point of the crossing direction). Also inspect for any damage to sealing or worn serrations.

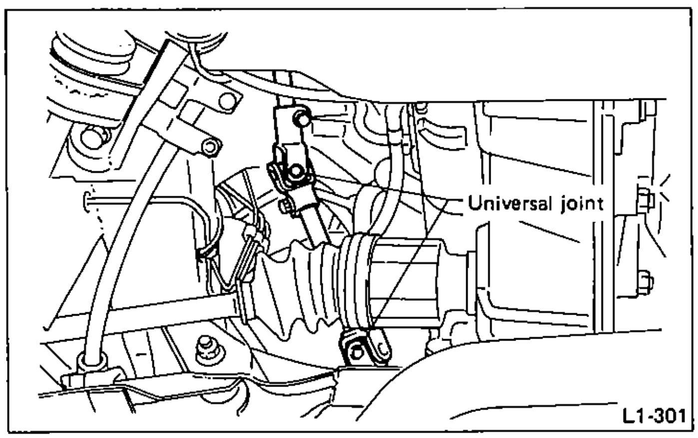


Fig. 59

If the joint is loose, retighten the mounting bolts to the specified torque.

Tightening torque:
21 – 26 N·m (2.1 – 2.7 kg-m, 15 – 20 ft-lb)

GEARBOX

1) With wheels placed on a level surface, turn steering wheel 90° in both the left and right directions.
While wheel is being rotated, reach under vehicle and check for looseness in gearbox.

Tightening torque:
47 – 71 N·m (4.8 – 7.2 kg-m, 35 – 52 ft-lb)

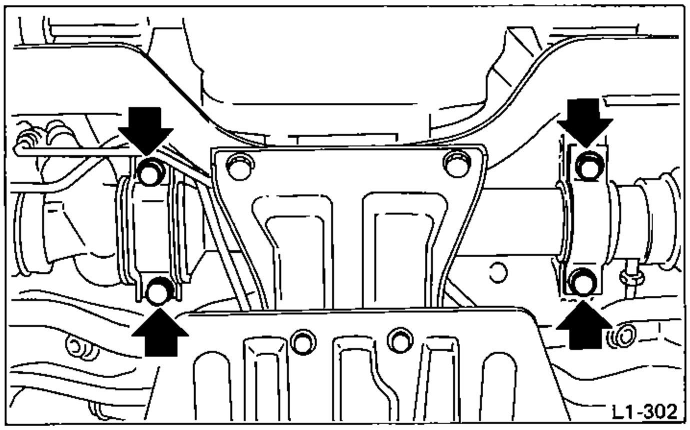


Fig. 60

2) Check boot for damage, cracks or deterioration.

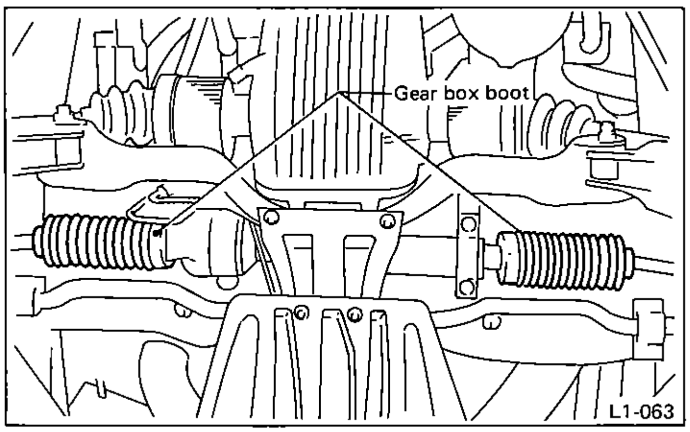


Fig. 61

3) With vehicle on a level surface, quickly turn steering wheel to the left and right.
While steering wheel is being rotated, check the gear backlash. If any unusual noise is noticed, adjust the gear backlash as follows:

(1) Loosen gearbox mounting clamps, and slightly lower gear box.

(2) Loosen lock nut by using SPANNER (926230000) and tighten adjusting screw fully.

SPANNER (926230000) can be also used for manual steering.

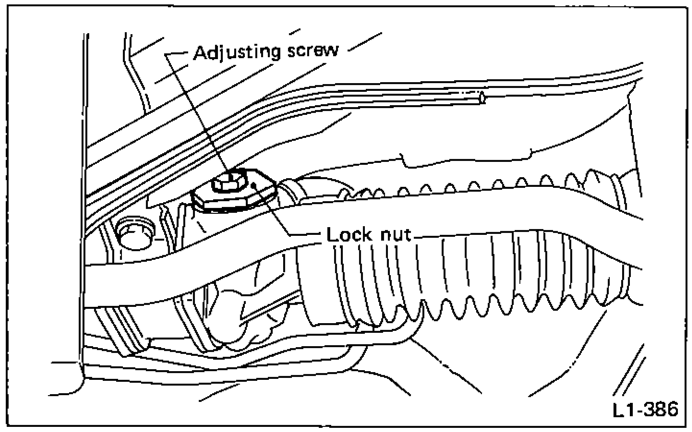


Fig. 62

(3) From that position, turn back adjusting screw 15° and then tighten lock nut securely.

Tightening torque:
29 – 49 N·m (3.0 – 5.0 kg-m, 22 – 36 ft-lb)

Hold the adjusting screw with a wrench to prevent it from turning while tightening the lock nut.

TIE-ROD

1) Check tie-rod and tie-rod ends for bends, scratches or other damage.
2) Check connections of knuckle ball joints for play, inspect for damage on dust seals, and check the free play of ball studs.
3) Make sure that the cotter pin is installed correctly in the castle nut of the tie-rod end.

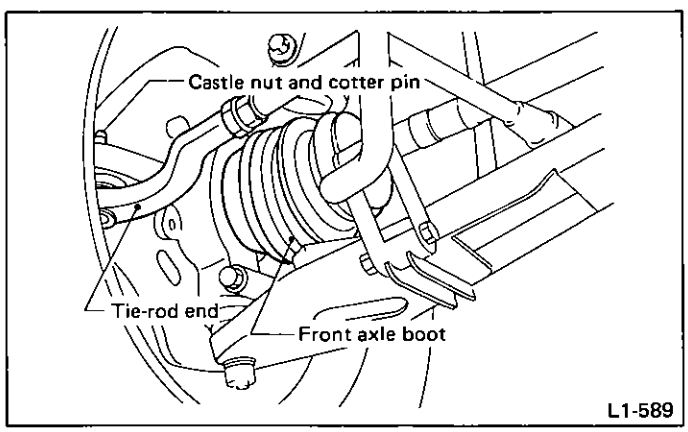


Fig. 63

POWER STEERING FLUID LEVEL

1) Place vehicle with engine "off" on the flat and level surface.

2) Check the fluid level by removing filler cap of oil pump.
(1) Check at temperature 21°C (70°F) of fluid temperature.

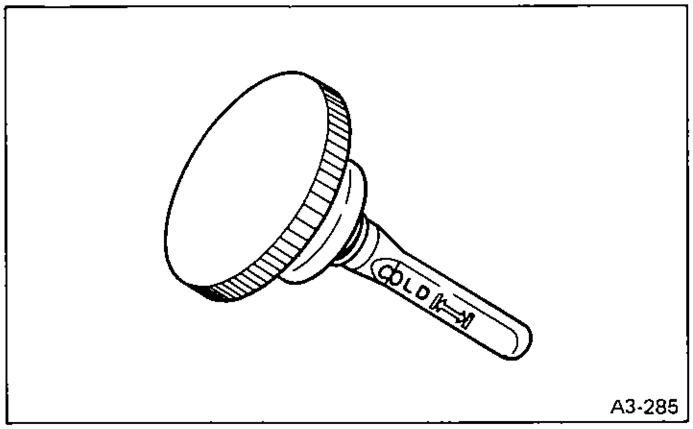


Fig. 64

(2) Check at temperature 60°C (140°F) of fluid temperature.

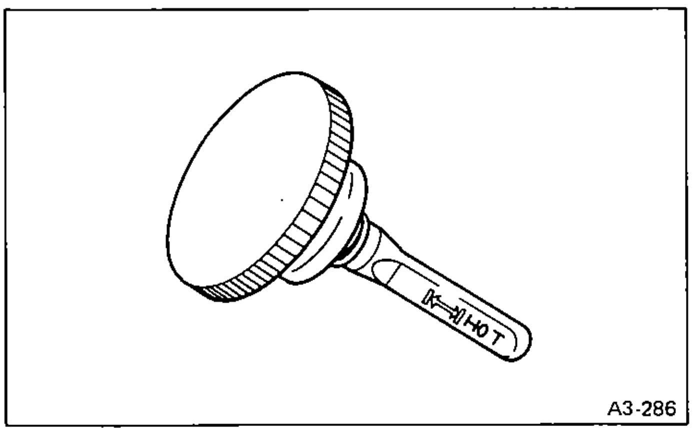


Fig. 65

3) Fluid level should be maintained in the each specified range on the indicator of filler cap.
If fluid level is at lower point or below, add fluid to keep the level in the specified range of indicator.
If fluid level is at upper point or above, drain fluid to keep the level in the specified range of indicator by using a syringe or the like.

Recommended fluid	Manufacturer
ATF Dexron II	B.P.
	CALTEX
	CASTROL
	MOBIL
	SHELL
	TEXACO

Fluid capacity:
0.7 ℓ (1.5 US pt, 1.2 Imp pt)

POWER STEERING FLUID FOR LEAKS

Inspect the underside of oil pump and gearbox for power steering system, hoses, piping and their couplings for fluid leaks.
If fluid leaks are found, correct them by retightening their fitting bolts (or nuts) and/or replacing their parts.

a. Wipe the leakage fluid off after correcting fluid leaks, or a wrong diagnosis is taken later.
b. Also pay attention to clearances between hoses (or pipings) and other parts when inspecting fluid leaks.

HOSES OF OIL PUMP FOR DAMAGES

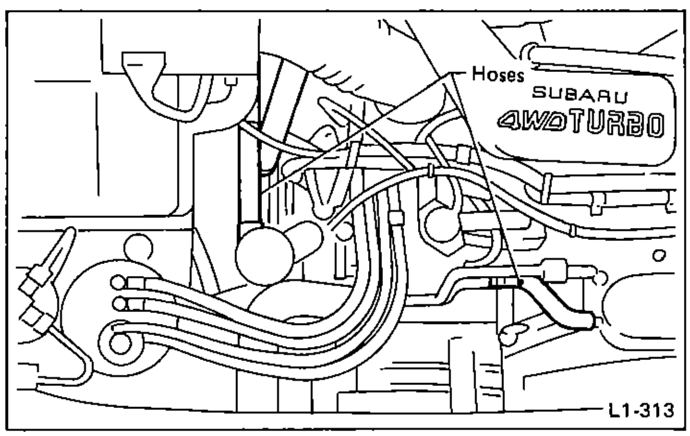


Fig. 66

Check pressure hose and return hose of oil pump for crack, swell or damage. Replace hose with new one if necessary.

Prevent hoses from revolving and/or turning when installing hoses.

POWER STEERING PIPES FOR DAMAGE

Check power steering pipes for corrosion and damage.
Replace pipes with new ones if necessary.

GEARBOX BOOTS

Inspect both sides of gearbox boots as follows, and correct the defects if necessary.

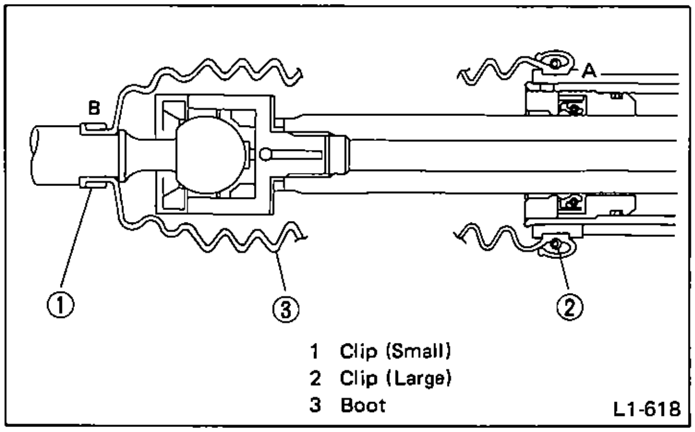


Fig. 28

1) A and B position of gearbox boot are fitted correspondingly in A and B grooves of gearbox and the rod.
2) Clips are fitted outside of A and B positions of boot.
3) Boot does not have crack, hole.

Rotate B position of gearbox boot against twist of it produced by adjustment of toe-in, etc.

FITTING BOLTS AND NUTS

Inspect fitting bolts and nuts of oil pump and bracket for looseness, and retighten them if necessary.

Inspect and/or retighten them when engine is cold.

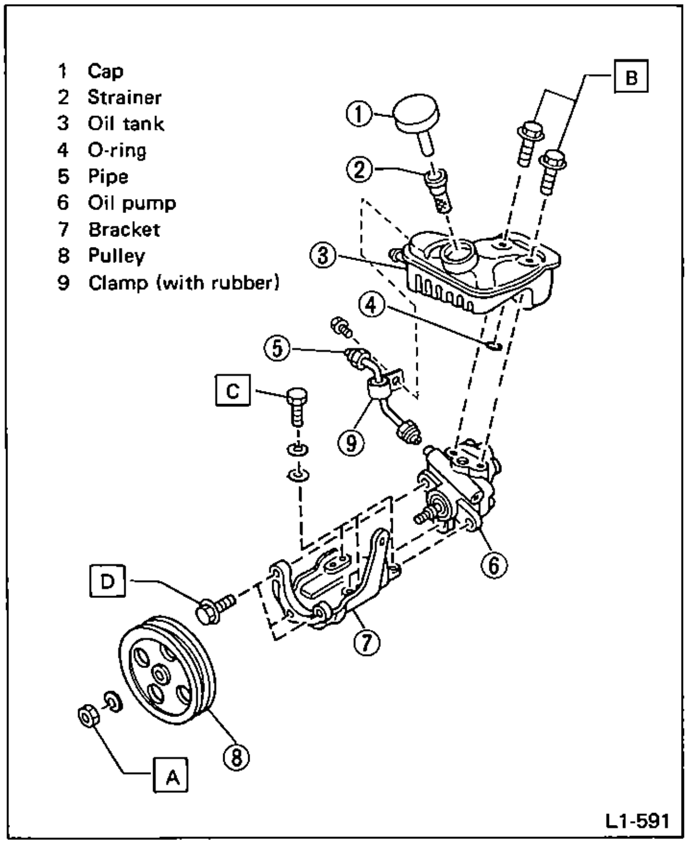


Fig. 68

Tightening torque:
Nut A (one):
42 – 62 N·m (4.3 – 6.3 kg-m, 31 – 46 ft-lb)
Bolt B (two):
20 – 29 N·m (2.0 – 3.0 kg-m, 14 – 22 ft-lb)
Bolt C (three):
18 – 22 N·m (1.8 – 2.2 kg-m, 13 – 16 ft-lb)
Bolt D (three):
29 – 49 N·m (3.0 – 5.0 kg-m, 22 – 36 ft-lb)

SUSPENSION SYSTEM

Care should be taken not to apply paint, undercoating agent, anti-corrosive wax, etc. to the following parts of air-suspension equipped models while refinishing the undercarriage.
(1) Diaphragm and rolling surfaces
(2) Air suspension compressor and dryer assembly

1) Play of front ball joint ...... Inspect every 24,000 km (15,000 miles) or 15 months, whichever occurs first.

(1) Jack up vehicle until front wheels are off ground as instructed in "Pre-Delivery Inspection."

(2) Next, grasp bottom of tire and move it in and out. If relative movement is observed between brake disc cover and end of transverse link, ball joint may be excessively worn.

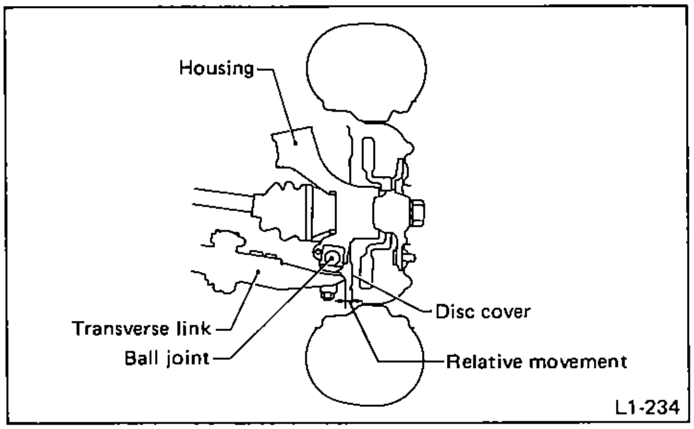


Fig. 69

(3) Next, grasp end of transverse link and move it up and down. Relative movement between housing and transverse link boss indicates ball joint may be excessively worn.

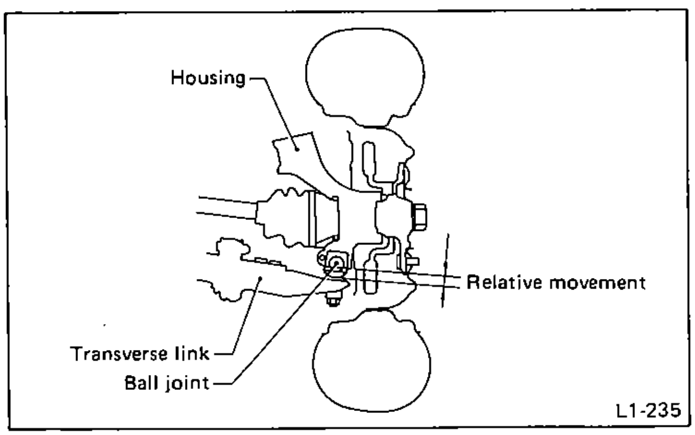


Fig. 70

(4) If relative movement is observed in tests (2) and (3) above, remove and inspect ball joint according to chapter 4-1. If looseness exceeds standard, replace ball joint.

2) Damage of dust seal ...... Inspect every 24,000 km (15,000 miles) or 15 months, whichever occurs first.
Visually inspect ball joint dust seal. If it is damaged, remove ball joint as instructed in chapter 4-1 and measure looseness of ball joint.

(1) When looseness exceeds standard value, replace ball joint.

(2) When looseness is less than standard value, wipe off old grease, apply the proper amount [about 3 g (0.11 oz)] of designated grease (SUNLIGHT 2, P/N 003602010), and install a new dust seal.

When transverse link ball joint has been removed or replaced, check toe-in (or side slip) of front wheel.
If front wheel toe-in (or side slip) is not at specified value, adjust according to chapter 4-1 so that toe-in conforms to service standard.

3) Wheel alignment and ground clearance ...... Inspect every 48,000 km (30,000 miles) or 30 months, whichever occurs first.

(1) Unload cargoes and set vehicle in curb weight (empty) condition.

(2) Then, check ground clearance of front and rear suspensions to ensure that they are within specified values.

(Adjusting procedure)

When ground clearance is out of standard, visually inspect following components and replace deformed parts.

- Suspensions components [Front: strut assembly, cross-member, transverse link, etc. Rear: shock absorber, inner arm, outer arm, etc.]
- Body parts to which suspensions are installed.

When no components are deformed, adjust ground clearance by replacing coil spring in the suspension whose ground clearance is out of standard.

(3) Check alignment of front suspension to ensure that following items conform to standard values provided in chapters 4-1 and 4-3.

- Toe-in (or side slip)
- Camber angle
- Caster angle
- Turning angle of tire

(Adjusting procedure) — Front suspension alignment

(a) Camber and caster angles are not adjustable. When camber or caster angle does not conform to standard value, visually inspect following components and replace deformed parts.

- Suspension components [Strut assembly, crossmember, transverse link, etc.]
- Body parts to which suspensions are installed.

(b) When toe-in (or side slip) is out of standard value, adjust by the method described in chapter 4-1 so that it conforms to service standard.

(c) When right-and-left turning angles of tire are out of standard, adjust to standard value by method described in chapter 4-3.

(4) Check alignment of rear suspension to ensure that following items are within standard values.

- Toe-in (or side slip)
- Camber angle

(Adjusting procedure) — Rear suspension alignment

When toe (or side slip) or camber angle does not conform to standard value, visually inspect parts listed below. If deformation is observed, replace damaged parts.

- Suspension components [Shock absorber, inner arm, outer arm, crossmember, etc.]
- Body parts to which suspensions are installed.

When no components are deformed, adjust alignment as instructed below so that it conforms to service standard.

Toe

(a) Jack up rear of vehicle as shown in "Pre-Delivery Inspection," and remove rear wheels.
(b) Loosen outer arm mounting bolts.

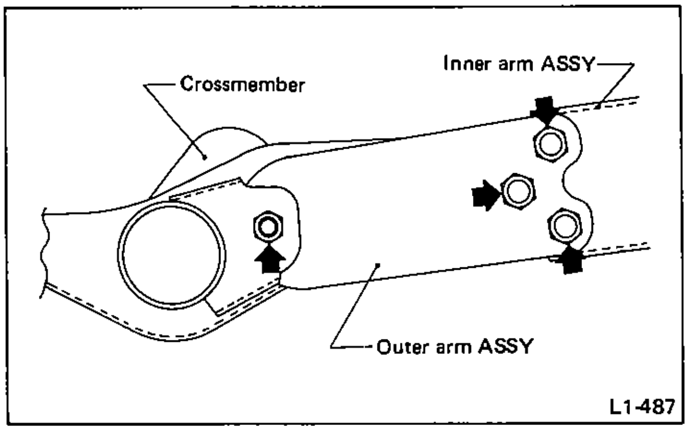


Fig. 71

(c) When toe-in (or side slip) is excessive, tighten outer arm mounting bolts shown above while pulling end of spindle towards rear of vehicle (in direction of arrow see below). When toe-out (or side slip) is excessive, tighten outer arm mounting bolts while pushing end of spindle toward front of vehicle (in opposite direction of arrow see below).

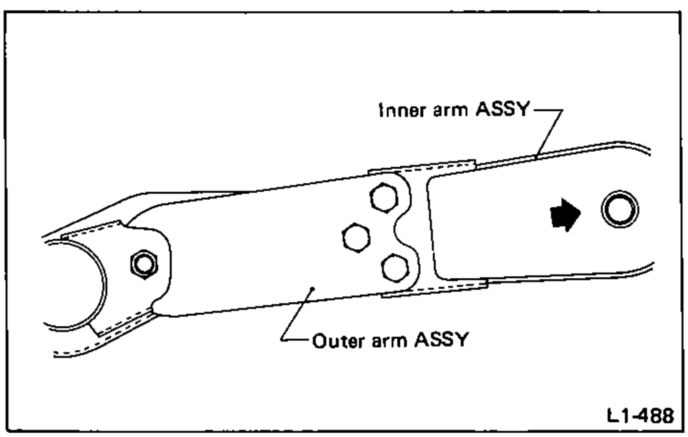


Fig. 72

(d) Adjust toe within service standard by repeating steps in 2) and 3) above for for both right and left wheels.

Camber angle

(a) Jack up rear of vehicle as shown in "Pre-Delivery Inspection," and remove wheel whose camber angle is out of standard.
(b) Remove bolt linking lower end of shock absorber to inner arm.
(c) Then, loosen outer arm mounting bolts.
(d) If camber angle is excessive in ⊕ direction, use a piece of wood as a lever and change relative angle between inner arm and outer arm so that angle θ formed by inner arm and outer arm centerlines (See below.) increases. Then, tighten outer arm mounting bolts.

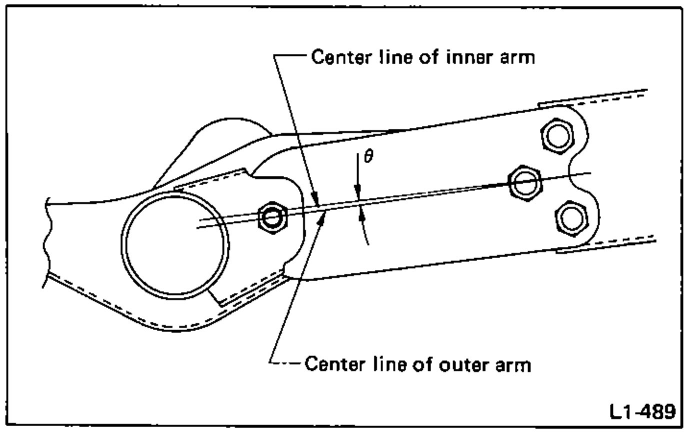


Fig. 73

(e) If camber angle is excessive in ⊖ direction, use a piece of wood as a lever and change relative angle between inner and outer arms so that angle θ formed by inner arm and outer arm centerlines decreases. Then, tighten outer arm mounting bolts.
(f) Adjust camber angle to conform to service standard by repeating steps 4) and 5) above.

a. Adjusting toe (or side slip) results in a change in camber angle, while adjusting camber angle causes a change of toe (or side slip). Therefore, when either is adjusted, always check that the other remains within service standard.
b. After both toe (or side slip) and camber angle have been adjusted within service standard, be sure to tighten bolts to torque specified in chapter 4-1..

4) Oil leakage of shock absorber . . . . . . Inspect every 48,000 km (30,000 miles) or 30 months, whichever occurs first.
Remove tire and visually inspect shock absorber for oil leakage as instructed in chapter 4-1. Replace shock absorber if oil leaks excessively.
5) Tightness of bolts and nuts . . . . Inspect every 48,000 km (30,000 miles) or 30 months, whichever occurs first.

Check bolts shown below for looseness. Retighten bolts to specified torque. Further, check that cotter pin in place as shown below. If not, install new cotter pin.

FRONT

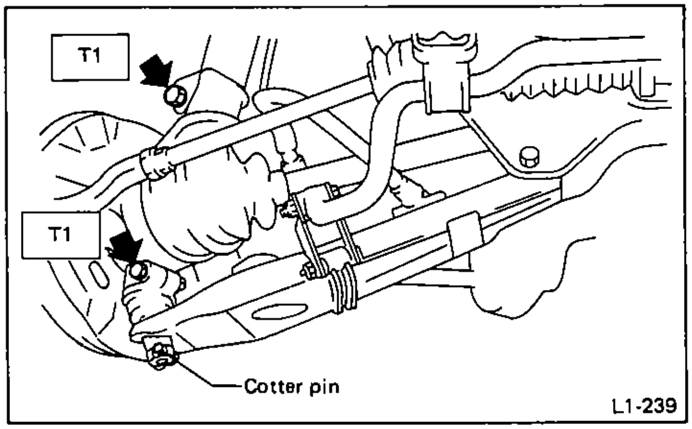


Fig. 35

REAR

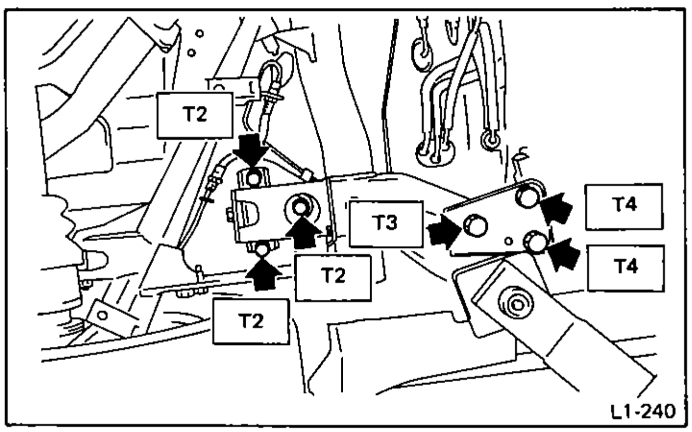


Fig. 36

Tightening torque N·m (kg-m, ft-lb)
T1: 38 – 50 (3.9 – 5.1, 28 – 37)
T2: 88 – 103 (9.0 – 10.5, 65 – 76)
T3: 118 – 147 (12.0 – 15.0, 87 – 108)
T4: 74 – 88 (7.5 – 9.0, 54 – 65)

6) Dirt on and damage to rolling diaphragm of air suspension ...... Inspect every 24,000 km (15,000 miles) or 15 months, whichever occurs first.

(1) After loosening wheel nuts, jack up vehicle until all four wheels are off ground according to instructions in "Pre-Delivery Inspection." Remove tires.

(2) Visually inspect rolling diaphragm. If dirty, remove dirt from diaphragm. Be careful not to damage diaphragms.

(3) Visually inspect rolling diaphragm. Replace air suspension ASSY if damaged. However, replacement is not required if only fine scratches on diaphragm surface caused by sand. These do not present a problem.

(4) Visually inspect rolling diaphragm for rust. If rusty, remove rust and touch up.

When touching up diaphragm, be careful paint does not adhere to diaphragm. (Lower jack after touch-up paint has dried completely.)

7) Damage to suspension parts
Check the following parts and the fastening portion of the car body for deformity or excessive rusting which impairs the suspension. Replace faulty parts. If minor rust formation, pitting, etc. are noted, remove rust and apply remedial anti-corrosion measures.

(1) Front suspension
- Transverse link
- Crossmember
- Strut (including air suspension)
- Leading rod
- Leading rod bracket

(2) Rear suspension
- Crossmember
- Inner arm
- Outer arm
- Bracket
- Shock absorber (including air suspension)

17 Grease on Front and Rear Wheel Bearings

MAINTENANCE INTERVAL [Number of months or km (miles), whichever occurs first]								
Months	7.5	15	22.5	30	37.5	45	52.5	60
x 1,000 km	12	24	36	48	60	72	84	96
x 1,000 miles	7.5	15	22.5	30	37.5	45	52.5	60
								(I)

INSPECTION

Inspect the condition and the amount of front and rear wheel bearing grease as follows:

FRONT WHEEL BEARING

1) Apply parking brake.
2) Raise front wheel with a jack, and remove wheel. Remove cotter pin from axle shaft and remover castle nut.
3) Remove bolts which secure disc rotor to front wheel hub, and remove hub.
4) Remove oil seal from housing, and check the condition of bearing grease.

a. If either the grease appears to be white or if only a small amount of grease remains, remove the bearing from the housing, clean it, and pack it with grease.
b. Discard the old seal and install a new one.

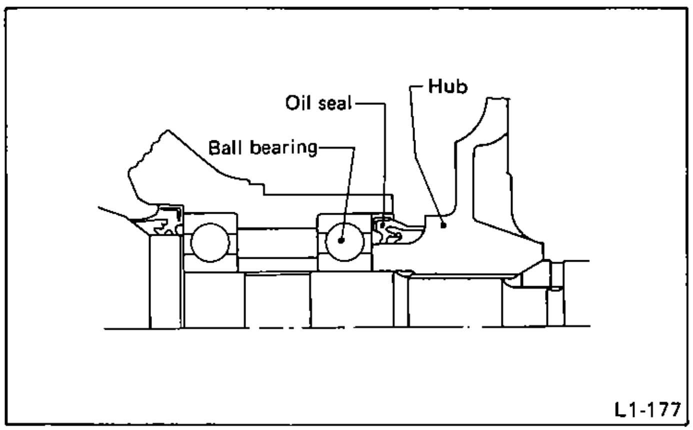


Fig. 76

5) Installation is in the reverse order of removal.

Tightening torque (Castle nut):
196 N·m (20 kg-m, 145 ft-lb)

After tightening the castle nut to the specified torque, tighten additionally in one sixth (1/6) turn until both holes of bolt and castle nut align each other.

Tightening torque (Hub to disc rotor bolts):
44 – 58 N·m (4.5 – 5.9 kg-m, 33 – 43 ft-lb)

REAR WHEEL BEARING [FWD vehicle]

1) Apply parking brake, and loosen rear wheel nuts.
2) Jack up vehicle, support it with safety stands (rigid racks) and remove rear tires and wheels.
3) Pry brake drum cap by screwdriver off drum.
4) Flatten lock washer and loosen axle nut, then remove lock washer, lock plate and brake drum so as not to drop inner race of outer taper roller bearing.
Outer bearing, outer race of inner bearing and oil seal can be removed together with drum.
5) Check condition of bearing grease.

a. If either the grease appears to be white or if only a small amount of grease remains, remove the bearing from the housing, clean it, and pack it with grease.
b. Discard the old seal and install a new one.

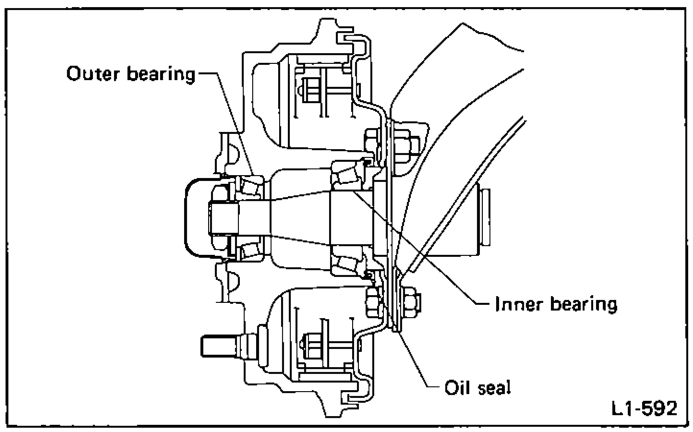


Fig. 77

6) Apply approximately 4 g (0.14 oz) of grease to inner bearing and 3 g (0.11 oz) to outer bearing.
Fill the hub of drum with approximately 30 g (1.06 oz) of grease.
7) Install drum, inner race of outer bearing, lock plate, lock washer and axle nut in this order onto the spindle.

Be sure to use new lock plate and new lock washer without fail.

REAR WHEEL BEARING [4WD vehicle]

1) Apply parking brake.
2) Remove rear wheel cap and cotter pin, and loosen castle nut and wheel nuts.
3) Detach shock absorber from inner trailing arm.
4) Loosen locking bolts of crossmember outer bushing.
5) Jack up vehicle, support it with safety stand (rigid racks) and remove rear tires and wheels.
6) Remove castle nut and brake drum.
7) Drive out spring pins of inner and outer D.O.J. by using a steel rod of 6 mm diameter.
8) Remove outer D.O.J. from spindle of trailing arm with trailing arm lowered fully.
9) Remove rear exhaust pipe, muffler and exhaust cover in that order.
10) Disconnect brake pipe from brake hose.

Fit air breather cap onto end of brake hose to prevent brake fluid from pouring out.

11) Remove brake assembly from trailing arm.
12) Remove bolt holding inner bushing of inner trailing arm.
13) Remove three bolts, and take out inner arm.
14) Vise inner arm, and straighten staked portion of housing, then remove ring nut by using HOUSING NUT WRENCH (925550000).
15) Extract spindle inwardly by tapping it from outside with a plastic hammer.
16) Remove oil seal.
17) Check condition of bearing grease.

a. If either the grease appears to be white or if only a small amount of grease remains, remove the bearing from the housing, clean it, and pack it with grease.
b. Discard the old seal and install a new one.

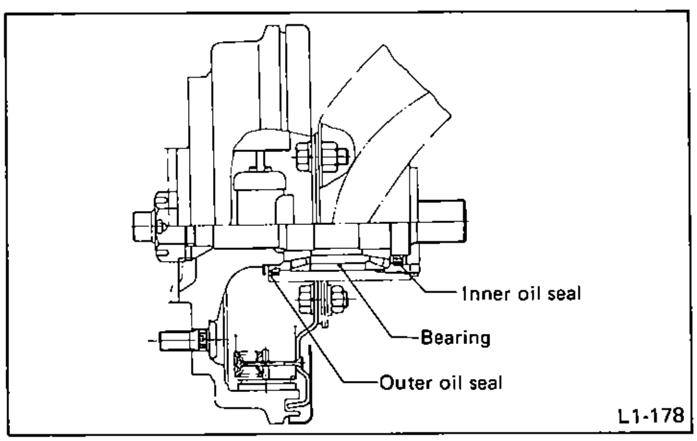


Fig. 78

18) Apply grease of 20 to 30 g (0.71 to 1.06 oz) to bearing outer race in housing.
19) Insert spindle from inside, and press inner race of outer bearing from outside by using a pipe of 35 mm (1.38 in) in inner diameter while tapping it with a hammer.

Apply grease sufficiently on the inner and outer bearing area.

20) Install ring nut to housing.

Tightening torque:
172 – 221 N·m (17.5 – 22.5 kg-m, 127 – 163 ft-lb)

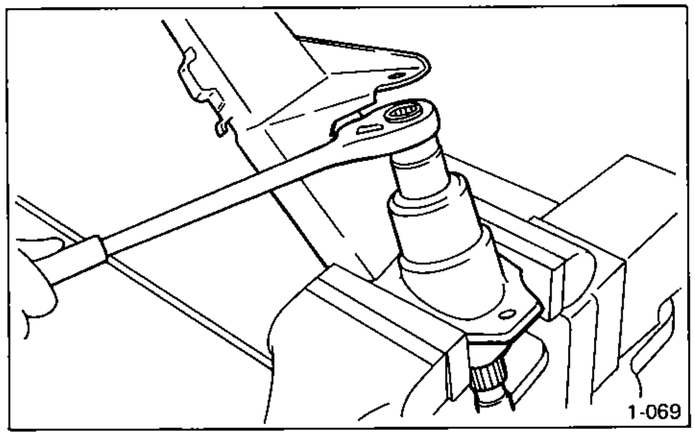


Fig. 79

21) Lock the ring nut by staking a point on the housing surface facing the ring nut groove.

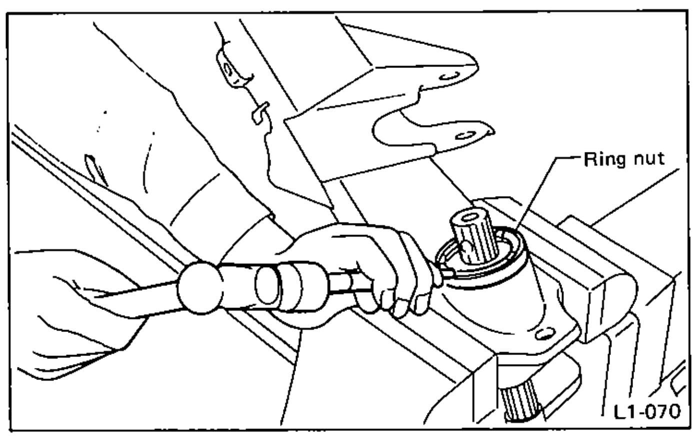


Fig. 80

22) Install outer oil seal by using OIL SEAL INSTALLER (925530000).

Be sure to renew the oil seal.

23) Install inner oil seal by using OIL SEAL INSTALLER (Special tool).

Be sure to renew the oil seal.

24) Mount inner arm to vehicle body.

Tightening torque:
Inner bush bolt:
74 – 93 N·m (7.5 – 9.5 kg-m, 54 – 69 ft-lb)
Inner and outer arms connecting bolts:
118 – 147 N·m
(12.0 – 15.0 kg-m, 87 – 108 ft-lb)

25) Install rear brake assembly to inner arm, and connect brake pipes etc.

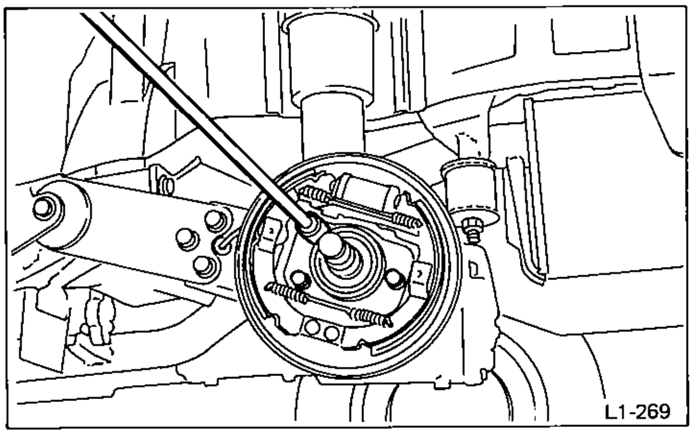


Fig. 81

Tightening torque (Back plate):
46 – 58 N·m (4.7 – 5.9 kg-m, 34 – 43 ft-lb)

26) Connect brake hose and brake pipe.

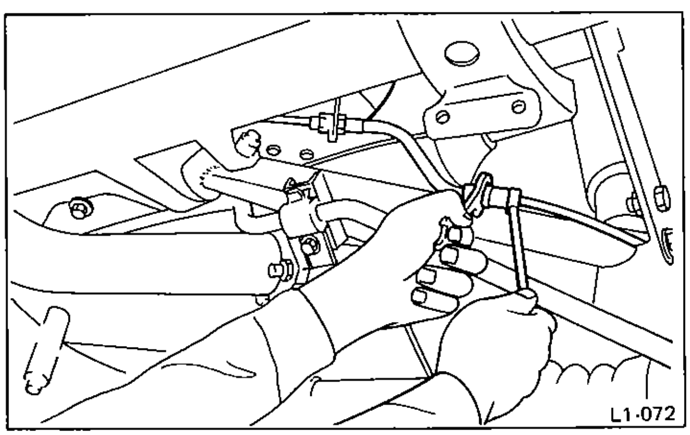


Fig. 82

27) Temporarily fit brake drum, center piece, washer spring and castle nut to spindle in this order.

a. Play on spindle is not a fault when mounting brake drum.
b. Don't confuse orientation of washer spring.

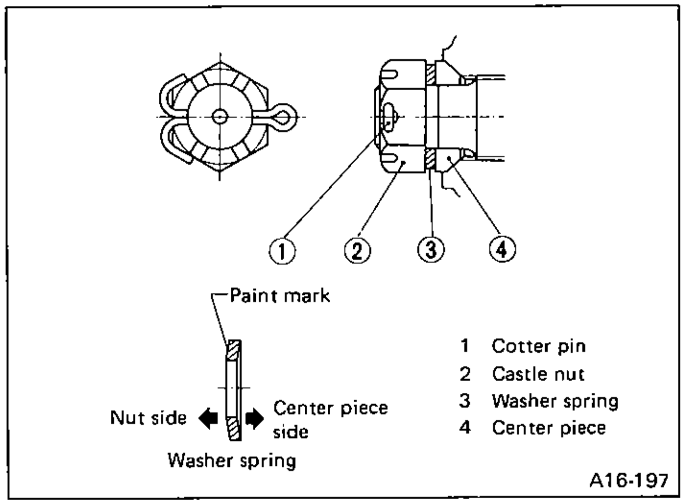


Fig. 83

28) Bleed brake system.

a. Before bleeding brake system, check pedal play and brake fluid level in reserve tank.
b. Bleed air from four wheels without fail.

29) Tighten castle nut, insert cotter pin and bend it firmly with foot brake applied to lock the wheel and axle.

Tightening torque:
196 N·m (20 kg-m, 145 ft-lb)

After tightening castle nut to the specified torque tighten further within 30° to align holes on nut and spindle.

30) Install packing to rear spindle, and mount D.O.J. on rear drive shaft onto spindle with trailing arm lowered all the way.

When mounting, mate the spline teeth properly so that the D.O.J. and spindle spring pin hole will align.

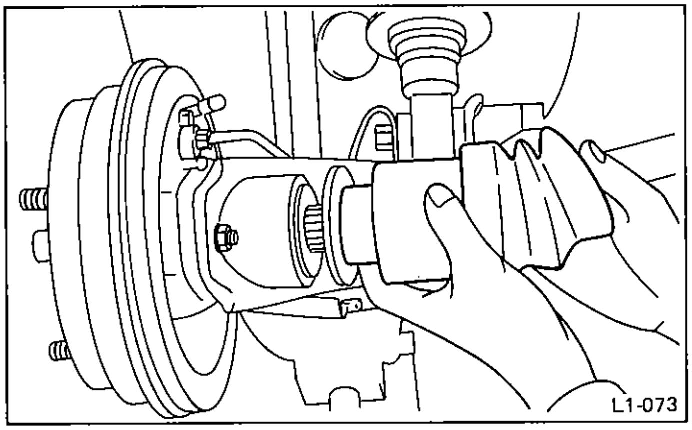


Fig. 84

31) Drive spring pins into D.O.J.

a. Before driving in the spring pin, confirm alignment of the holes.
b. Be sure to renew the spring pin to be driven in.

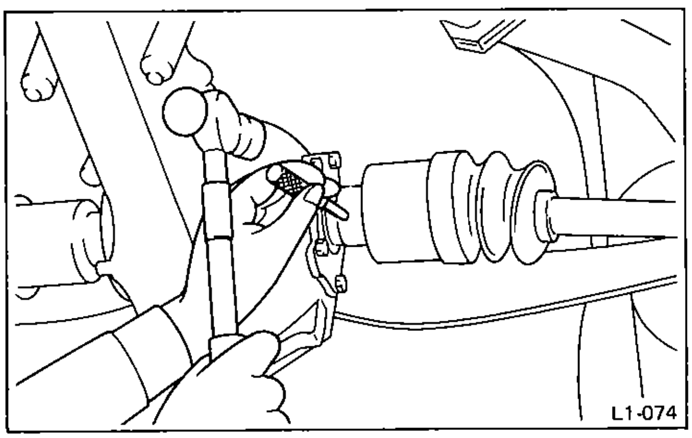


Fig. 85

32) Install wheels, outer arms, etc.
33) Lower vehicle on the ground, and install lower end of shock absorber.

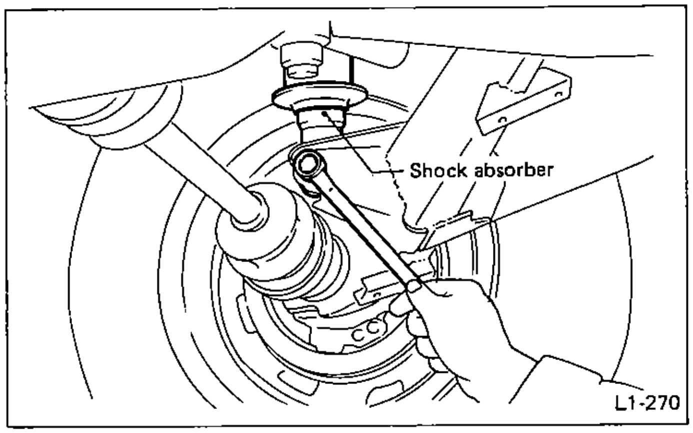


Fig. 86

Tightening torque:
88 – 118 N·m (9 – 12 kg-m, 65 – 87 ft-lb)

34) Check and adjust rear vehicle height and rear wheel alignment.
35) Tighten outer arm lock bolts.

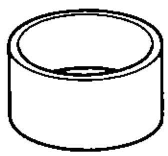
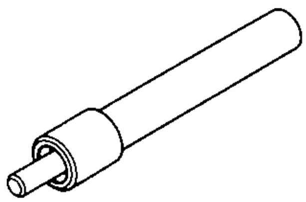
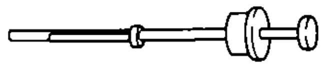
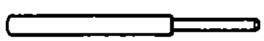
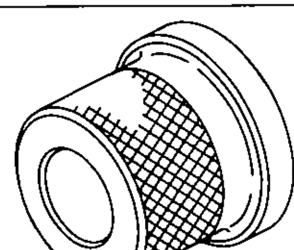
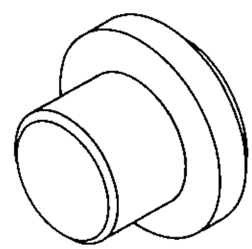
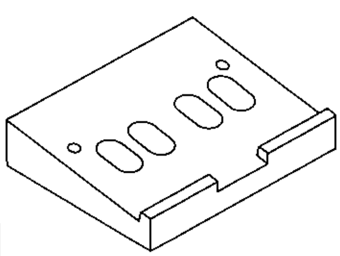
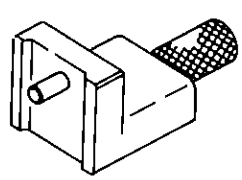
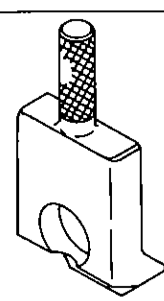
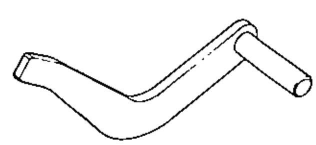
For vehicle with disc brakes, inspect in the same manner as with drum brakes.

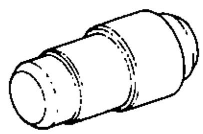
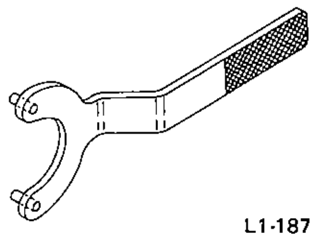
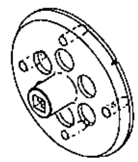
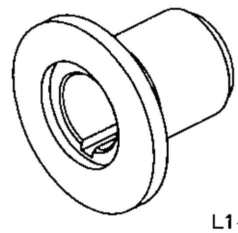
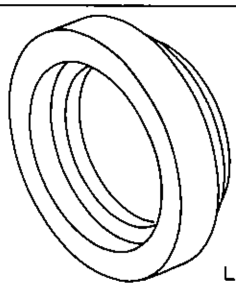
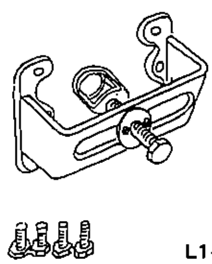
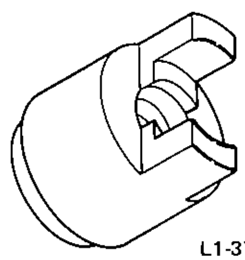
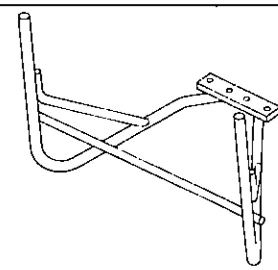
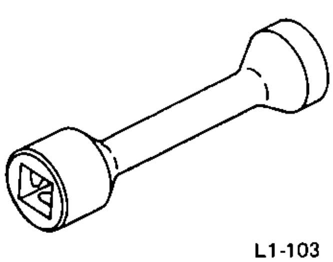
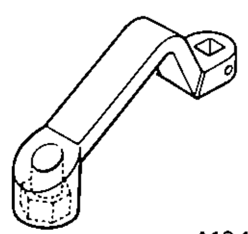
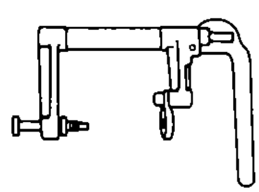
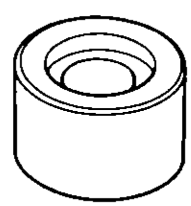
SUBARU

1989

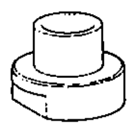
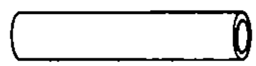
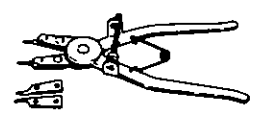
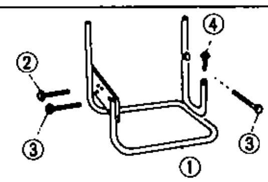
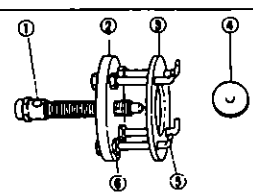
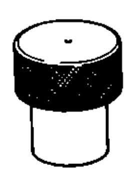
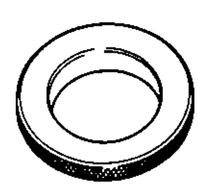
Page

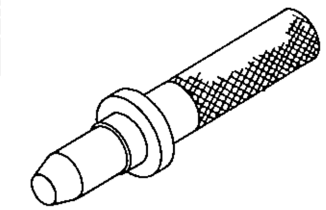
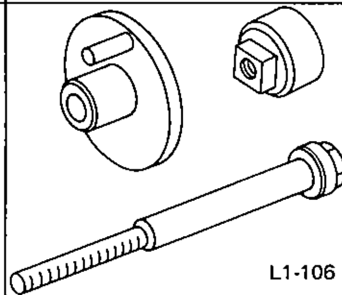
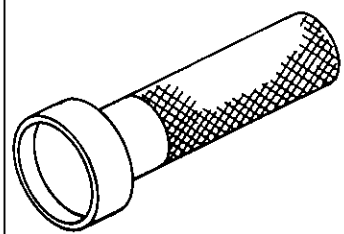
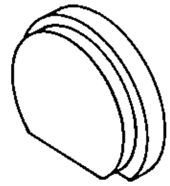
Engine Tools

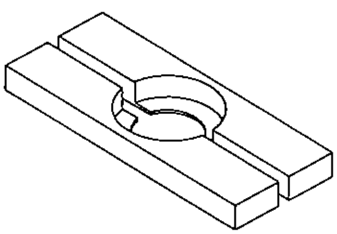
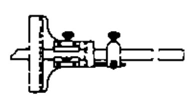
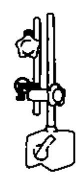
398744300	398852100	399094310	399284300
PISTON GUIDE	OIL SEAL INSTALLER	PISTON PIN REMOVER ASSY	PISTON PIN GUIDE
Used to install piston in cylinder.	For press-fitting of intake and exhaust valve guide oil seals.	Used to remove piston pins by inserting this tool through crank-case plug holes.	Used to install piston pin in piston and connecting rod.
 A5-155	 ST-054	 A5-143	 A5-156
399762103	399762104	498027000	498037000
VALVE GUIDE REMOVER	VALVE GUIDE REAMER	CAMSHAFT HOLDER	INSTALLER
For removing of valve guide.	For reaming of valve guide.	Used to hold camshaft when press-fitting distributor gear to camshaft.	Used to install camshaft oil seal.
 A5-147	 A5-150	 L1-092	 L1-093
498267100	498277000	498497000	499007000
CYLINDER HEAD TABLE	FLYWHEEL STOPPER CP	DRIVE PLATE STOPPER	TENSIONER WRENCH
For replacing of valve guide.	Used to stop rotation of flywheel when loosening and tightening crankshaft pulley bolt, etc. Manual transmission vehicle	Used to stop rotation of drive plate when loosening and tightening crankshaft pulley bolt, etc. Automatic transmission vehicle	Used to hold up tensioner No. 2 when reducing timing belt tension.
 L1-094	 L1-095	 L1-096	 L1-276

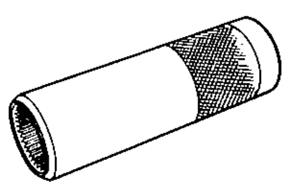
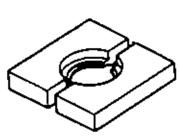
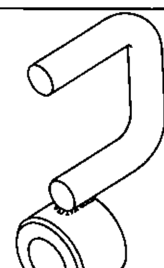
499037000	499207000	499437000	499567000
REMOVER & REPLACER	CAMSHAFT SPROCKET WRENCH	BELT TENSION WRENCH CP	INSTALLER
Connecting rod bushing	Used to remove and install camshaft sprocket.	When installing timing belt, used to apply the specified torque to camshaft pulley so as to get the specified belt tension.	Used to install crankcase front oil seal.
 A5-389	 L1-187	 L1-188	 L1-100
499587000	499717100	499717900	499817000
INSTALLER	REMOVER SET	INSTALLER	Engine stand
Used to install crankcase rear oil.	Used to remove and install valve spring.	Used to install intake and exhaust valve oil seal.	Stand used for engine disassembly and ASSY. Two pieces are needed.
 L1-101	 L1-378	 L1-379	 L1-102
499987200	499990110	899724100	899768603
SOCKET WRENCH (17)	SOCKET	VALVE SPRING PRESS ASSY	VALVE GUIDE ADJUSTER
For retightening cylinder head.	Oxygen (O_2) sensor.	Used to remove and install valve spring.	Used to install intake and exhaust valve guides.
 L1-103	 A10-133	 A5-149	 A5-149

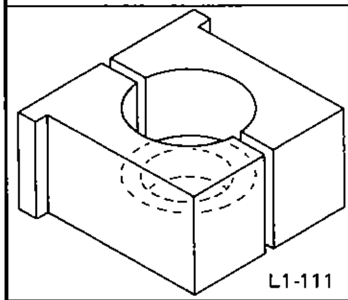
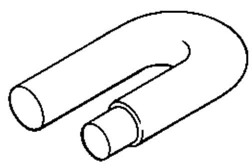
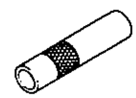
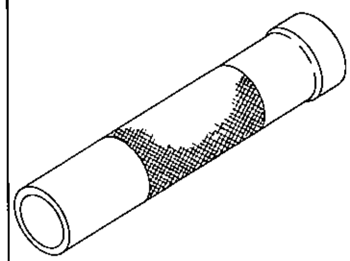
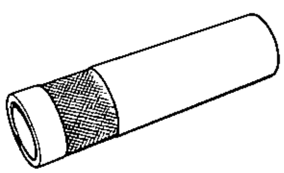
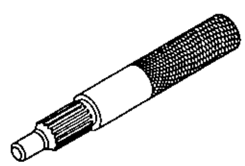
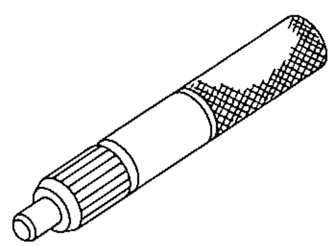
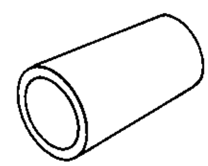
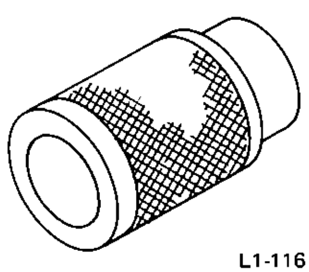
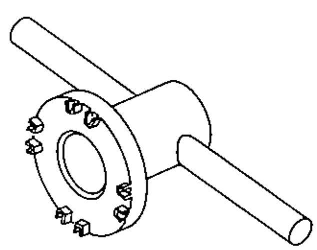
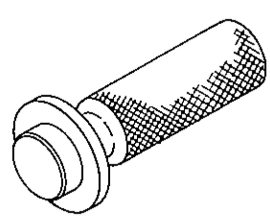
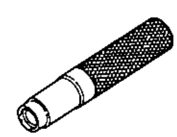
Manual Transmission and Differential Tools

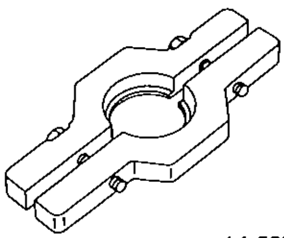
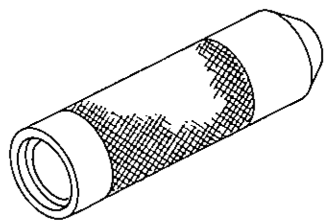
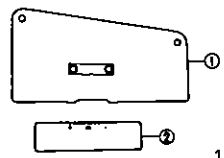
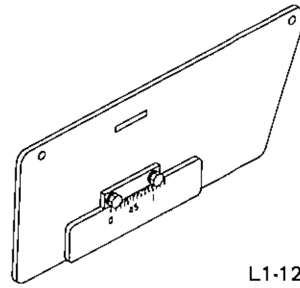
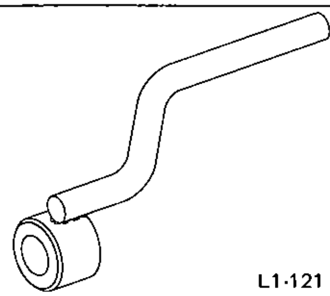
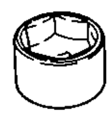
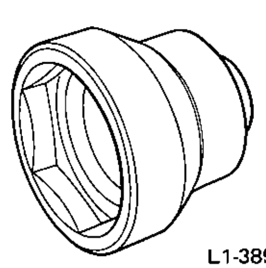
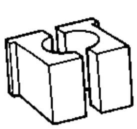
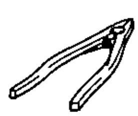
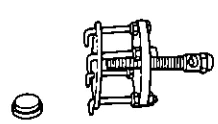
398405200	398507703	398663600	398791600
STAND	DUMMY COLLAR	PLIERS	REMOVER II
Rear drive shaft. 4WD	Oil seal of input shaft holder. 4WD Dual-range	Input shaft snap ring. 4WD Dual-range	Straight pin (Transfer shifter fork).
 ST-144	 A14-082	 A13-205	 A12-174
398791700	399295120	399411700	399513600
REMOVER II	STAND SET	INSTALLER	INSTALLER
Spring pin (5-speed)	Transmission main case.	Reverse shifter rail arm.	Extension rear oil seal. 4WD
 A12-174	 1 STAND CP (399935120) 2 BOLT (016510600)...10x60mm 3 BOLT (016510700)...10x70mm 4 BOLT (016510400)...10x40mm ST-169	 A12-170	 A13-196
399520105	399527700	399780104	399790110
SEAT	PULLER SET	WEIGHT	INSTALLER
Roller bearing (Differential). FWD Non-TURBO	Roller bearing (Differential). FWD TURBO · 4WD	Preload on roller bearing.	Roller bearing, (Differential) Axle shaft oil seal. FWD Non-TURBO
 A12-171	 1 BOLT (899521412) 2 PULLER (399527702) 3 HOLDER (399527703) 4 ADAPTER (398497701) 5 BOLT (899520107) 6 NUT (021008000) A14-075	 A12-172	 A12-175

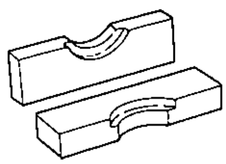
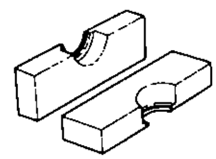
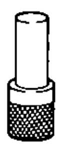
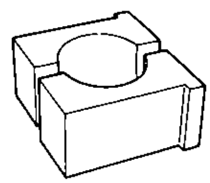
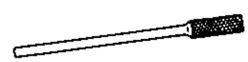
498057000	498057100	498057200	498067000
OIL SEAL INSTALLER	INSTALLER	OIL SEAL INSTALLER	TRANSFER RACE PRESS
Transfer case oil seal. 4WD	Transfer front oil seal. 4WD Dual-range	Transfer rear oil seal. 4WD Dual-range	Transfer race. 4WD
 L1-105	 L1-106	 L1-107	 L1-108

498077000	498147000	498247001	498247100
5TH DRIVE GEAR REMOVER	DEPTH GAUGE	MAGNET BASE	DIAL GAUGE
5th driven gear. FWD TURBO · 4WD	Main shaft axial end play adjustment	Backlash between side gear and pinion, Hypoid gear backlash.	Backlash between side gear and pinion, Hypoid gear backlash.
 L1-109	 ST-146	 ST-156	 ST-157

498427000	498517000	498787000	498787100
STOPPER	REPLACER	STOPPER	MAIN SHAFT STOPPER
For securing the drive pinion shaft ASSY and driven gear ASSY when removing the drive pinion shaft ASSY lock nut (18 x 13.5).	Drive pinion thrust plate and needle bearing race. FWD Non-TURBO	Transmission main shaft. FWD Non-TURBO	Transmission main shaft. FWD TURBO · 4WD
 L1-388	 ST-151	 A12-173	 L1-110

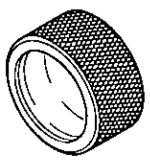
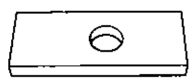
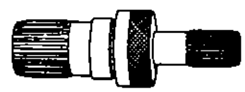
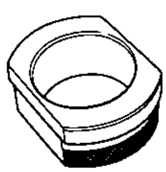
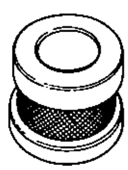
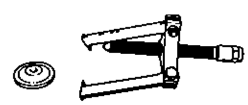
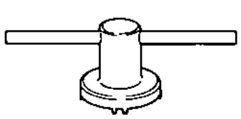
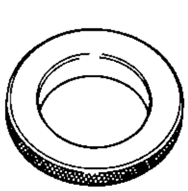
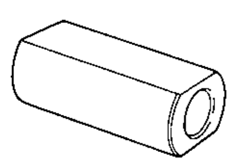
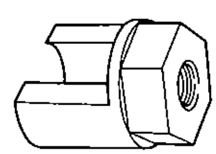
498937000	499267200	499277000	499277100
TRANSMISSION HOLDER	STOPPER PIN	INSTALLER	BUSH 1–2 INSTALLER
Transmission main shaft lock nut. FWD TURBO · 4WD	Transfer case and fork high-low rod. 4WD Dual-range	Drive pinion. FWD Non-TURBO	1st driven gear thrust plate. 1st–2nd driven gear bush. FWD TURBO · 4WD
 L1-111	 L1-277	 A12-296	 L1-113
499277200	499747000	499747100	499757001
INSTALLER	GUIDE	CLUTCH DISC GUIDE	SNAP RING GUIDE
For press fitting the 2nd driven gear, roller bearings, & 5th driven gear onto the driven shaft.	Clutch disc. FWD Non-TURBO	Clutch disc. FWD TURBO · 4WD	Snap ring (OUT 25) 4WD Dual-range
 L1-391	 ST-170	 L1-114	 L1-115
499757002	499787000	499797000	499827000
SNAP RING PRESS	WRENCH ASSY	OIL SEAL INSTALLER	PRESS
Snap ring (OUT 25) Ball bearing (25 x 62 x 17) 4WD Dual-range	Differential side retainer.	Differential side retainer oil seal. FWD TURBO · 4WD	Oil seal (Speedometer).
 L1-116	 L1-117	 L1-118	 ST-147

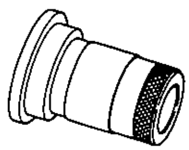
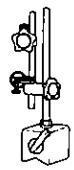
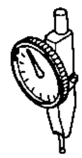
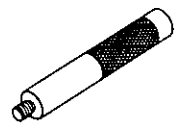
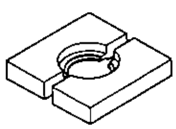
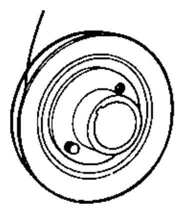
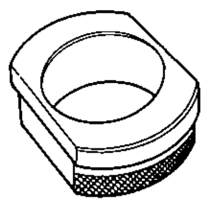
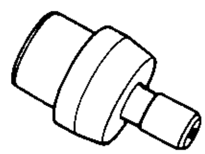
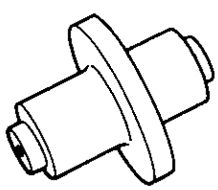
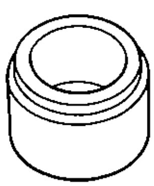
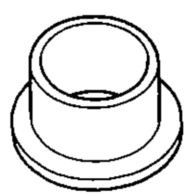
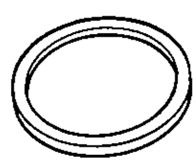
499857000	499877000	499917100	499917500
REMOVER ASSY	RACE 4–5 INSTALLER	GAUGE ASSY 2	DRIVE PINION GAUGE ASSY
To remove the driven gear ASSY 5th gear.	Needle bearing 4th and 5th races. Transmission main shaft rear ball bearing. FWD TURBO · 4WD	Drive pinion shim. FWD Non-TURBO	Drive pinion shim adjustment. FWD TURBO · 4WD
 L1-569	 L1-119	 A12-188	 L1-120
499927000	499927100	499987003	499987300
HANDLE	HANDLE	SOCKET WRENCH (35)	SOCKET WRENCH (50)
Transmission main shaft. FWD Non-TURBO	Transmission main shaft. FWD TURBO · 4WD	Drive pinion lock nut Main shaft lock nut (4WD)	To remove the driven gear ASSY lock nut.
 A12-189	 L1-121	 A12-191	 L1-389
898938600	899474100	899524100	899580100
HOLDER	EXPANDER	PULLER SET	INSTALLER
Transmission main shaft. FWD Non-TURBO	Snap ring (Transmission main shaft) 4WD Dual-range	Roller bearing (Differential) FWD Non-TURBO	Transmission main shaft. Drive pinion, Ball bearing (Rear drive shaft)
 A12-176	 A12-178	 A5-142	 A12-179

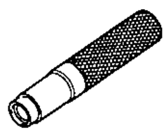
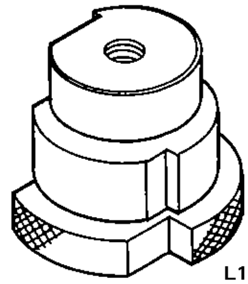
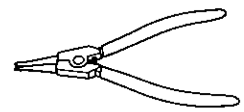
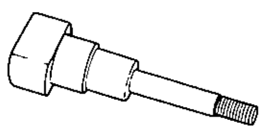
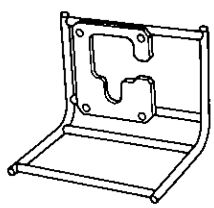
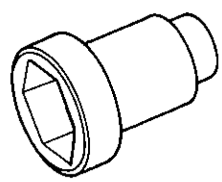
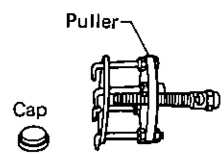
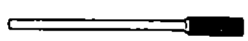
899714110	899754110	899754112	899858600
RETAINER	PRESS ASSY	PRESS	RETAINER II
Transmission main shaft, Drive pinion, Rear drive shaft.	Transmission main shaft, Needle bearing (transfer case), Rear drive shaft 4WD	Clutch release bearing holder. FWD Non-TURBO	Transmission main shaft, Drive pinion. FWD Non-TURBO
 A12-181	 A12-182	 A11-025	 A12-183
899864100	899874100	899884100	899904100
REMOVER	INSTALLER	HOLDER	REMOVER
Transmission main shaft, Drive pinion.	Transmission main shaft, Drive pinion, Transfer drive gear bushing.	Drive pinion, Rear drive shaft, Extension ASSY	Straight pin (Differential).
 A12-184	 A12-185	 A12-186	 A12-187
899988608			
SOCKET WRENCH (27)			
Transmission main shaft (FWD) Rear drive shaft (4WD)			
 A12-191			

Automatic Transmission and Differential Tools

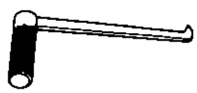
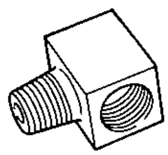
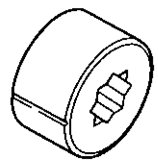
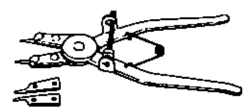
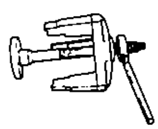
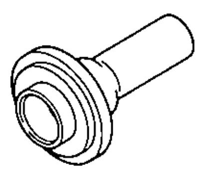
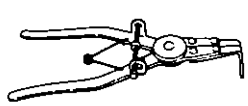
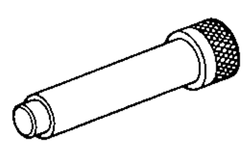
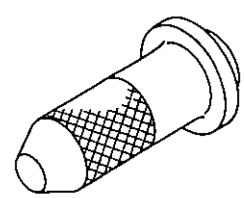
1. Special Tools for Differential

398437700	398643600	398653600	398781600
DRIFT	GAUGE	SHAFT	STOPPER
Drive pinion front bearing cup.	Low & reverse brake, total endplay, oil pump, drive pinion height.	Drive pinion and reduction drive gear.	Reduction drive gear.
 A14-046	 A13-211	 A13-192	 A12-173
398833600	399513600	399520105	399703600
GUIDE	INSTALLER	SEAT	PULLER
Needle bearing.	Drive pinion rear bearing cup.	Roller bearing (Differential)	Axle shaft bearing cup.
 A13-194	 A13-196	 A12-171	 A13-186
399780111	399790110	399913601	399913603
WRENCH	INSTALLER	MASTER	HOLDER
Axle shaft oil seal holder.	Roller bearing (Differential) Axle shaft oil seal.	Drive pinion.	Drive pinion.
 A12-168	 A12-175	 A13-190	 A13-189

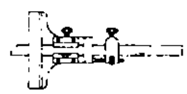
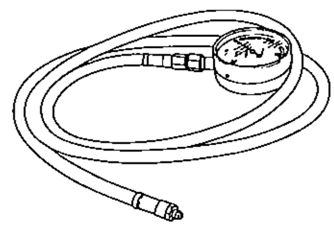
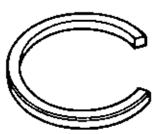
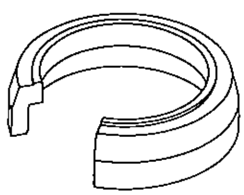
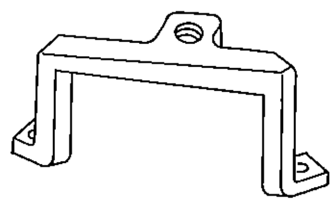
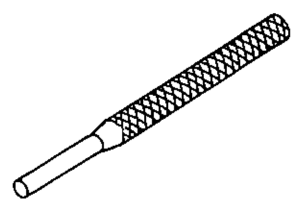
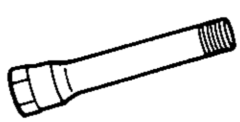
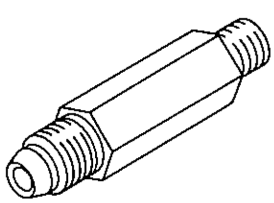
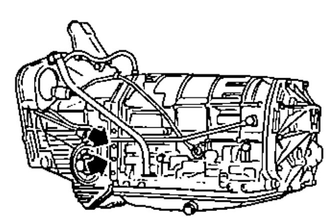
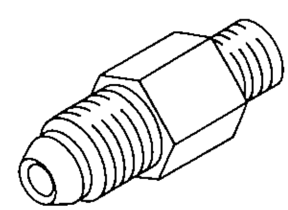
399913604	498247001	498247100	498477000
SPACER	MAGNET BASE	DIAL GAUGE	HANDLE
Drive pinion.	Backlash of gears.	Backlash of gears.	Bearing cup, needle bearing, drive pinion front bearing retainer and impeller bushing.
 A13-187	 ST-156	 ST-157	 ST-150
498517000	498567000	498807000	498847000
REPLACER	PULLEY	BEARING GUIDE	OIL SEAL GUIDE
Drive pinion front bearing core.	Preload check.	Needle bearing.	Oil seal holder
 ST-151	 A13-513	 A13-512	 A13-515
499247000	499247100	499247200	499267100
INSTALLER	OIL SEAL INSTALLER	INSTALLER	SPACER
Drive pinion oil seal 4WD	Oil seal holder.	Final reduction case.	Oil seal holder.
 A13-518	 A13-514	 A13-517	 A13-516

499427000	499827000	499867000	499897000
INSTALLER	PRESS	REMOVER	PLIERS
Drive pinion front bearing cup, axle shaft bearing cup and thrust bearing retainer.	Speedometer shaft oil seal.	Needle bearing at reduction drive gear.	Snap ring.
 A14-079	 ST-147	 L1-146	 A13-519
499917400	499937000	499987100	899524100
MASTER 2	DIFFERENTIAL STAND	SOCKET WRENCH (35)	PULLER SET
Drive pinion.	Final reduction section.	Drive pinion.	Roller bearing (Differential)
 A13-510	 A13-509	 A13-511	 A5-142
899580100	899904100	899924100	
INSTALLER	REMOVER	HANDLE	
Drive pinion.	Differential case.	Reduction drive gear.	
 A12-179	 A12-187	 A12-189	

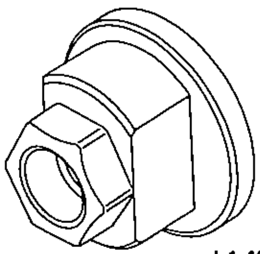
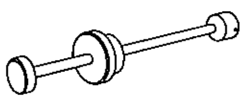
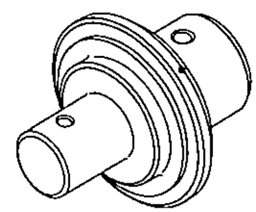
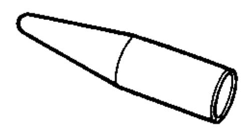
2. Special Tools for Transmission and Extension

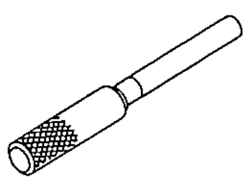
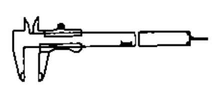
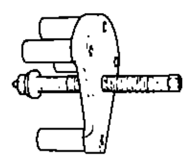
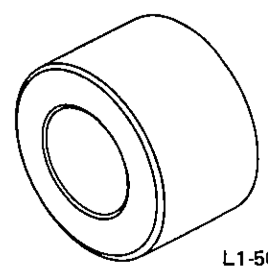
398308700	398534800	398603610	398663600
PULLER	ADAPTER 2	SOCKET	PLIER
Transmission case oil seal	Line pressure	Brake band	Governor valve
 A13-215	 A13-203	 A13-209	 A13-205
398673600	398863600	399248700	399543600
COMPRESSOR	INSTALLER 2	INSTALLER 2	INSTALLER
Reverse clutch, forward clutch and low & reverse brake	Needle bearing on oil pump carrier	Transmission case oil seal	Needle bearing and bushing on oil pump housing
 A13-208	 A13-213	 A13-216	 A13-212
399793600	399893600	399903600	* 498057300
INSTALLER	PLIER	REMOVER 2	INSTALLER
Final reduction case	Reverse clutch, forward clutch and low & reverse brake	Needle bearing and bushing on oil pump carrier	Extension oil seal 4AT
 A13-214	 A13-207	 A13-217	 L1-603

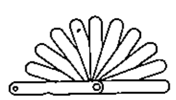
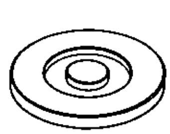
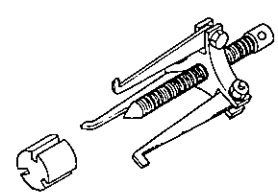
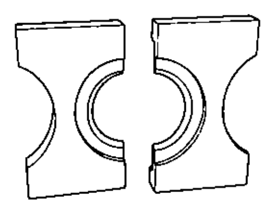
*Newly adopted tool

498107000	498147000	* 498575400	498597000
REPLACER	DEPTH GAUGE	OIL PRESSURE GAUGE ASSY	SOCKET WRENCH (7)
Impeller bushing on converter housing	Low & reverse brake	Oil pressure 3AT, 4AT	Plug
 ST-155	 ST-146	 J1-257	 A13-520
498627000	498627100	*498677010	498797000
SEAT	SEAT	COMPRESSOR	REMOVER
Center support snap ring	Used to hold overrunning clutch piston retainer (return spring) when installing snap ring 4AT	Band servo piston 4AT	Pin for bush of oil pump shaft
 A13-210	 L1-502	 L1-627	 L1-574
498897000	* 498897200		* 498897300
ADAPTER	ADAPTER CP		ADAPTER
Used when measuring the line pressure	*1: Reverse clutch pressure and line pressure on oil pump housing 4AT	*1: Used when measuring oil pressure at the following two points.	Oil pressure 3AT
 A13-521	 L1-604	 L1-606	 L1-605

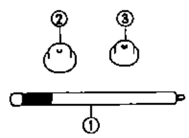
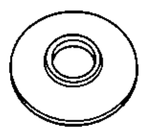
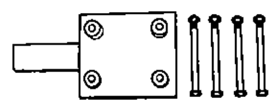
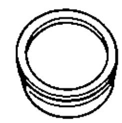
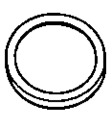
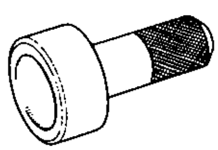
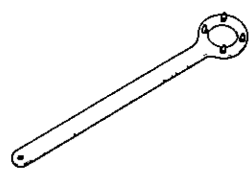
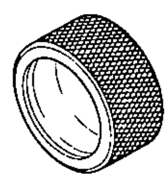
*: Newly adopted tool

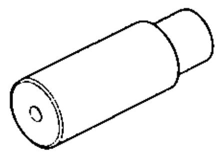
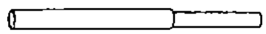
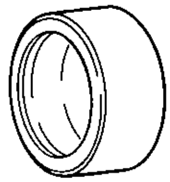
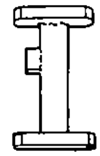
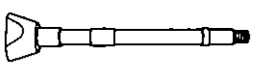
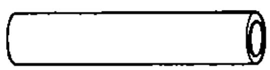
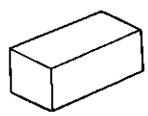
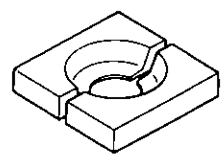
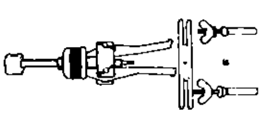
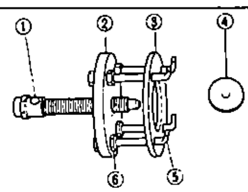
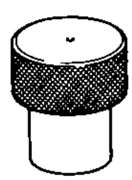
498937100	499095500	499247300	499257100
HOLDER	REMOVER ASSY	INSTALLER	OIL SEAL GUIDE
• Used to tighten/loosen M30 lock nut for drive pinion • Used when measuring tooth contact pattern 4AT	• Used to extract axle drive shaft from differential ASSY • Used with INSTALLER (499247300) 4AT	Drive pinion oil seal 4AT	Drive pinion oil seal 4WD
 L1-498	 L1-499	 L1-500	 A13-522

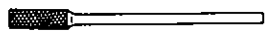
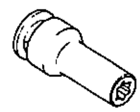
499267300	499337000	499527000	499577000
STOPPER PIN	VERNIER CALLIPER	PULLER SET	GAUGE
Used to align range selector lever/inhibitor switch 4AT	Vacuum diaphragm rod selection	Final reduction case	Transfer end play 4AT
 L1-508	 ST-158	 A13-338	 L1-509

499667000	499687100	499707200	499717000
THICKNESS GAUGE	BASE	PULLER ASSY	REMOVER
Forward clutch, reverse clutch, low & reverse brake and oil pump etc.	Low & reverse brake	Needle bearing of extension case 4WD	Rear shaft bearing 4WD
 ST-159	 ST-160	 L1-380	 A13-524

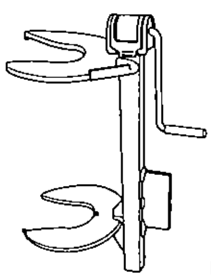
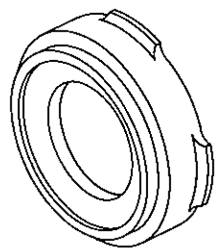
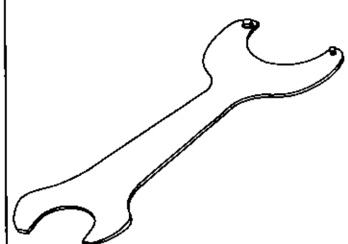
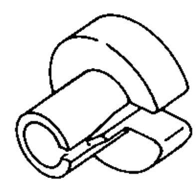
Rear Wheel Drive System (4WD Models) Tools

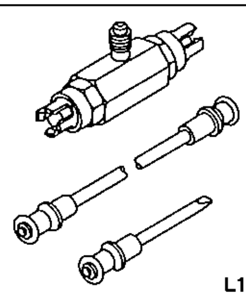
397471600	398177700	398217700	398227700
HANDLE & DRIFT KIT	INSTALLER	ATTACHMENT SET	WEIGHT
Front and rear bearing cup.	Rear bearing cone.	Differential case.	Side bearing.
 1 HANDLE (398477701) 2 DRIFT (398477702) 3 DRIFT 2 (398477703) ST-143	 A14-085	 A14-084	 A14-087
398237700	398417700	398427700	398437700
GAUGE	DRIFT	FLANGE WRENCH	DRIFT
Side bearing.	Oil seal.	Companion Flange	Oil seal.
 A14-086	 A14-045	 A14-043	 A14-046

398457700	398467700	398487700	398507701
ATTACHMENT	DRIFT	DRIFT	GAUGE
Side bearing retainer.	Drive pinion, Pilot bearing, Front bearing cone.	Side bearing cone.	Pinion height adjustment.
 A14-047	 A14-049	 A14-088	 A14-080
398507702	398507703	398507704	398517700
DUMMY SHAFT	DUMMY COLLAR	BLOCK	REPLACER
Pinion height and Preload adjustment.	Pinion height and Preload adjustment.	Pinion height and Preload adjustment.	Rear bearing cone.
 A14-081	 A14-082	 A14-083	 A14-076
398527700	399527700	399780104	899580100
PULLEY ASSY	PULLER SET	WEIGHT	INSTALLER
Oil seal, Side bearing cup.	Side bearing cone.	Front bearing cone, Pilot bearing, Companion flange.	Front bearing cone, Pilot bearing.
 A14-044	 1 BOLT(899521412) 2 PULLER(399527702) 3 HOLDER(399527703) 4 ADAPTER(398497701) 5 BOLT(899520107) 6 NUT(021008000) A14-075	 A12-172	 A12-179

899874100	899904100	925560000
INSTALLER	STRAIGHT PIN REMOVER	WRENCH
Companion flange.	Differential pinion shaft lock pin.	Differential spindle set bolt.
 A12-185	 A12-187	 ST-032

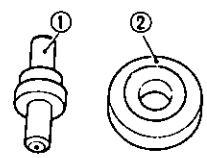
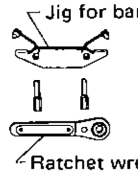
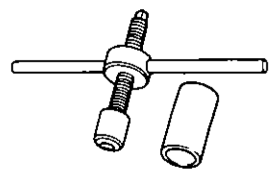
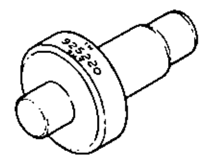
Suspension Tools

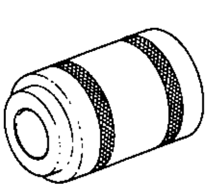
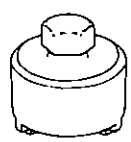
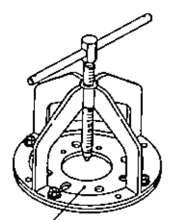
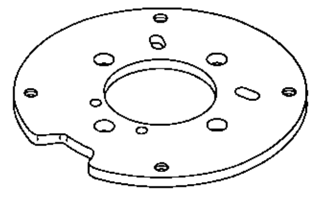
926110000	926500000	926510000	926520000
COIL SPRING COMPRESSOR	ADAPTER	SPANNER	AIR PIPE REMOVER
Used to remove and install coil spring. Except Air Suspension	Camber & caster gauge. All models	Used to disassemble and assemble front strut ASSY or front air suspension ASSY. All models	Used to disconnect air pipe from joint. For Air Suspension
 E1-076	 L1-122	 L1-123	 L1-124

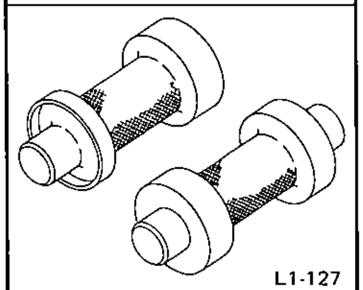
*926940000
3-WAY JOINT ASSY
Used as an adapter for gauge manifold of air conditioning system to measure pressure.
 L1-434

*Newly adopted tool

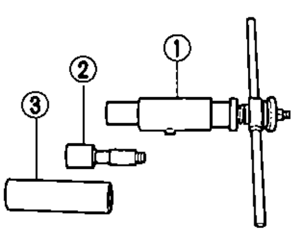
Wheels and Axles Tools

921130000	925091000	925130000 *1	925220000
INSTALLER	BAND TIGHTENING TOOL	INSTALLER	INSTALLER
Brake Drum Bearing (Outer) FWD	D.O.J. Boot B.J. Boot	Housing	Brake Drum Bearing (Inner) FWD
 1 Shank 2 Base A16-052	 A15-171	 A16-047	 A16-151

925530000	925550000	926470000 *2	926480000 *2
INSTALLER	WRENCH	AXLE SHAFT PULLER	AXLE SHAFT PULLER PLATE
Oil Seal 4WD	Rear Axle Ring Nut 4WD	Used to remove front axle shaft or brake drum.	Same as plate 2 included in AXLE SHAFT PULLER (926470000). Available as spare parts.
 A16-154	 A16-053	 L1-125	 L1-126

926490000
INSTALLER
Used to install bearing and oil seal into front housing.
 L1-127

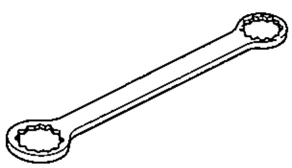
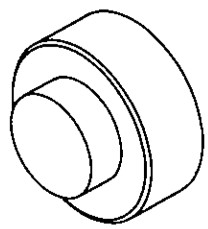
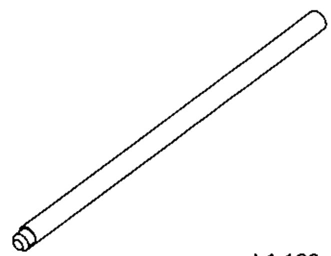
*1 AXLE SHAFT INSTALLER (922431000) can be used instead of this INSTALLER (925130000).

922431000
AXLE SHAFT INSTALLER
Used to install front axle shaft into housing. If necessary, use a 41 mm wrench to prevent rotation of installer body.
 ST-361

*2 Former PULLER (921122000) can be used instead of PULLER (926470000) by replacing its plate 2 with PLATE (926480000)

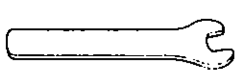
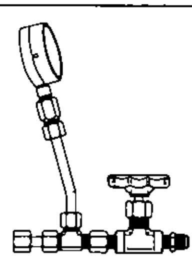
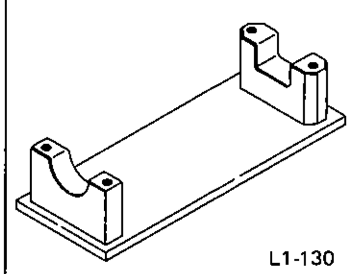
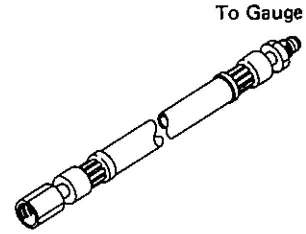
Steering System Tools

1. Manual Steering

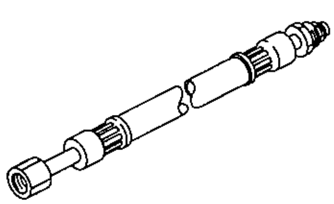
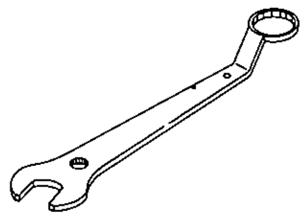
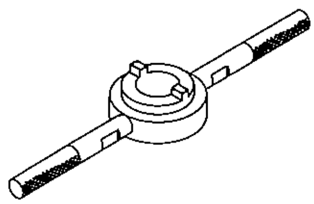
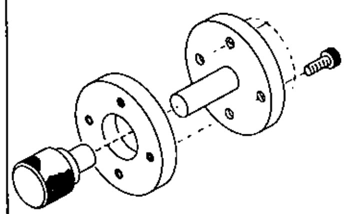
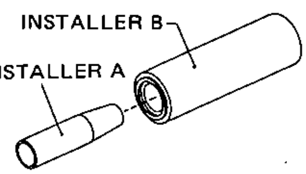
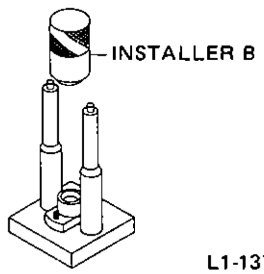
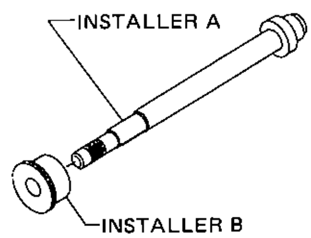
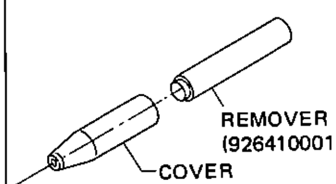
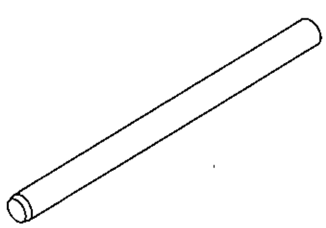
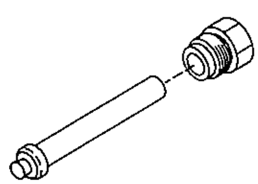
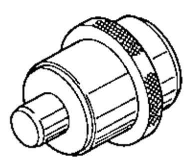
925640000 *3	926530000	926540000
SPANNER	BUSH A INSTALLER	BUSH A REMOVER
Big end: Used to loosen and tighten the lock nut when adjusting gear backlash of steering gearbox.	Used to install bush A into steering gearbox unit.	Used to remove bush A from VGR (Variable Gear Ratio) steering gearbox unit. For VGR steering gearbox
 A3-167	 L1-128	 L1-129

*3 SPANNER (926230000) for power steering can be used instead of this tool.

2. Power Steering

925700000	925711000 *4	926200000	926210000
WRENCH	PRESSURE GAUGE	STAND	ADAPTER A
Used to remove and install tie-rod. Apply this tool to rack.	Oil pump.	Used when inspection characteristic of gearbox ASSY and disassembling it. Vise this tool and secure gearbox ASSY using gearbox clamps.	Used with PRESSURE GAUGE.
 A18-233	 ST-175	 L1-130	 L1-131

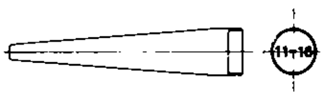
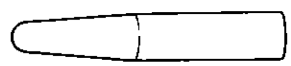
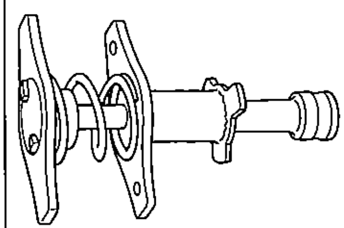
*4 Interchangeable with former PRESSURE GAUGE (925710000).

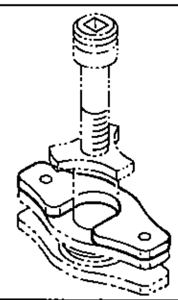
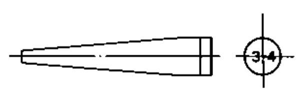
926220000	926230000	926340000	926350000
ADAPTER B	SPANNER	WRENCH	INSTALLER
Used with PRESSURE GAUGE.	For the lock nut when adjusting backlash of gearbox. Removal and installation of tie-rod. Measurement of rotating resistance of gear box ASSY.	Used to remove and install circlip which secures rack stopper.	Used to install oil seal into valve housing.
 To Gauge L1-132	 L1-133	 L1-279	 L1-135
926360000	926370000	926380000	*926390001
INSTALLER	INSTALLER	INSTALLER	COVER & REMOVER ASSY
Oil seal valve ASSY.	Ball bearing of valve ASSY.	Oil seal and back-up washer of rack housing.	Left side of rack.
 L1-136	 L1-137	 L1-280	 L1-396
926400000	*926410001	926420000	926790000
GUIDE	REMOVER	PLUG	INSTALLER
Right side of rack when installing rack bush.	Oil seal and back-up washer of rack housing.	When oil leaks from pinion side of gearbox ASSY, remove pipe B from valve housing, attach this tool and check oil leaking points.	Oil seal and shaft of oil pump.
 L1-140	 L1-141	 L1-142	 L4-1004

* **(1) General precautions**
- **To avoid deforming COVER tube, reinsert REMOVER into COVER after use.**
- **Do not handle the COVER by its tube section.**
- **Do not apply force to tube section.**
- **Always insert REMOVER into COVER while holding the lower end (inlet side) of the tube section.**

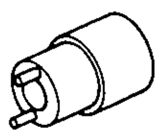
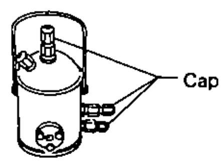
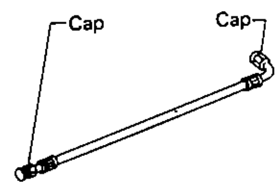
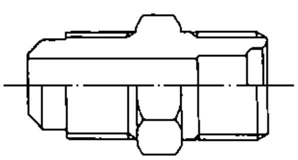
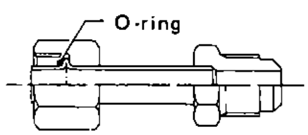
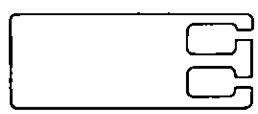
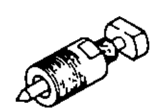
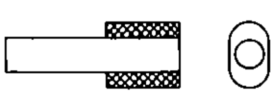
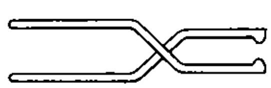
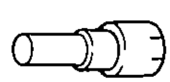
(2) Storing instructions
- **The tube section of COVER is transparent. Ensure that REMOVER is fully inserted into COVER.**
- **Always store COVER & REMOVER ASSY in a cool, dark place.**
- **Place COVER & REMOVER ASSY on a flat surface. Do not stand it on end.**

Brakes Tools

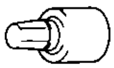
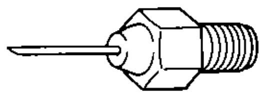
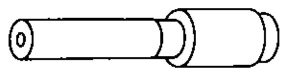
925460000	925471000	925600000	926430000
WHEEL CYLINDER 11/16" ADAPTER	DISC BRAKE CYLINDER PULLER	O-RING ADAPTER	DISC BRAKE PISTON WRENCH
Installing cup onto piston of rear drum brake wheel cylinder (size 11/16 in).	Pressing cone spring (front disc brake).	Installing spindle O-ring (front disc brake).	Used with SPACER (926440000) to rotate front disc brake piston.
 A17-163	 ST-148	 A17-160	 L1-143

926440000	926460000
SPACER	WHEEL CYLINDER 3/4" ADAPTER
Used as a set with WRENCH (926430000). Attach this tool to WRENCH using two 6-mm dia. bolts (length: less than 15 mm).	Installing cup onto piston of rear drum brake wheel cylinder (size 3/4 in).
 L1-144	 L1-145

Air Conditioning System Tools

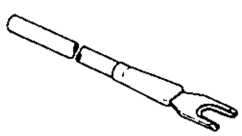
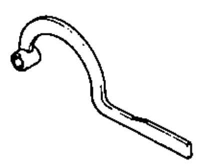
925770000 *5	925790000 *5	925800000 *6	925820000 *6
CLUTCH TIGHTENER	HUB NUT TIGHTENER	OIL SEPARATOR	FLEXIBLE HOSE
For holding clutch hub.	For tightening hub nut.	For withdrawing oil from refrigeration system.	(Used with OIL SEPARATOR)
 A26-045	 A26-047	 ST-176	 ST-178
925840000 *6	925850000 *6	926120000 *5	926130000 *5
DOUBLE UNION	CONNECTOR PIPE	SHAFT SEAL INSTALLER	CLUTCH ARMATURE REMOVER
(Used with OIL SEPARATOR)	(Used with OIL SEPARATOR)	For removing and installing shaft seal.	For clutch disassembly.
 ST-179	 ST-180	 L4-541	 A26-046
926140000 *5	926150000 *5	926160000 *5	926170000 *5
SHAFT ROTATOR	COVER PLATE REMOVER	HEXAGON SOCKET (8 mm)	FRONT COVER TIGHTENER
For assemble and rotation checking.	For cover plate removal.	For elbow removal and installation.	For shell removal and installation.
 L4-542	 L4-543	 L4-544	 L4-545

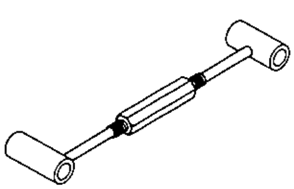
*5 For HITACHI A/C.
*6 Oil Separator Kit is composed of Oil Separator, Flexible Hose, Double Union and Connector Pipe and these are for both HITACHI and PANASONIC A/C.

926180000 *5	926190000 *5	926620000 *7
HEXAGON SOCKET (10 mm)	INJECTOR NEEDLE	PULLER
For cover end (R) removal and installation.	For discharging and charging gas.	For pressing pulley into compressor front plate boss.
 L4-546	 L4-547	 L4-627

*5 For HITACHI A/C.
*7 For PANASONIC A/C.

Body Tools

499827100	925580000	925610000	926661000 *8
ADAPTER ASSY	PULLER	WRENCH	REMOVER
For connection between speedometer and speedometer cable when checking speedometer, with rear wheels on free rollers.	Trim clip.	Door hinge.	Used to remove and install trunk torsion bar.
 L1-392	 ST-035	 ST-166	 L1-282

926610000
ENGINE SUPPORT ASSY
For supporting engine.
 L1-511

*8 This tool is for 4-Door Sedan.
Former REMOVER (926660000) is only for 4-Door Sedan.

EMISSION CONTROL SYSTEM AND VACUUM FITTING

2-1

SUBARU

1989

Page

System Application

There are three emission control systems which are as follows:
1) Crankcase emission control system
2) Exhaust emission control system
3) Evaporative emission control system

ITEM \ MODEL			SPFI			MPFI TURBO		
			U.S.A.		Canada	U.S.A.		Canada
			California	49-state		California	49-state	
Crankcase emission control system			●	●	●	●	●	●
Exhaust emission control system	Ignition control system		●	●	●	●	●	●
	EGR system		●	●	●	–	–	–
	Catalyst	Front (Three-way catalyst)	●	●	●	●	●	●
		Rear	●	●	●	●	●	●
Evaporative emission control system			●	●	●	●	●	●

a. Specifications for each system may differ depending on the destination area.
b. Abbreviation used EGR : Exhaust Gas Recirculation

General Precautions

1) Know the importance of periodic maintenance services.
   (1) Every service item in the periodic maintenance schedule must be performed.
   (2)Failing to do even one item can cause the engine to run poorly and increase exhaust emissions.
2) Determine if you have an engine or emission system problem.
   (1) Engine problems are usually not caused by the emission control systems.
   (2) When troubleshooting, always check the engine and the ignition system first.
3) Check hose and wiring connections first.
The most frequent cause of problems is simply a bad connection in the wiring or vacuum hoses. Always make sure that connections are secure and correct.
4) Avoid coasting with the ignition turned off and prolonged engine braking.
5) Do not damage parts.
   (1) To disconnect vacuum hoses, pull on the end, not the middle of the hose.
   (2) To pull apart electrical connectors, pull on the connector itself, not the wire.
   (3) Be careful not to drop electrical parts, such as sensors, or relays.
   If they are dropped on a hard floor, they should be replaced and not reused.
   (4) When steam cleaning an engine, protect the distributor, coil, air cleaner, carburetor from water.
   (5) When checking continuity at the wire connector, the test bar should be inserted carefully to prevent terminals from bending.
6) Use SUBARU genuine parts.
7) Record how hoses are connected before disconnecting.
   (1) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
   (2) After completing a job, double check to see that the vacuum hoses are properly connected. See the "Vacuum connections label" under the hood.

Schematic Drawing

SPFI

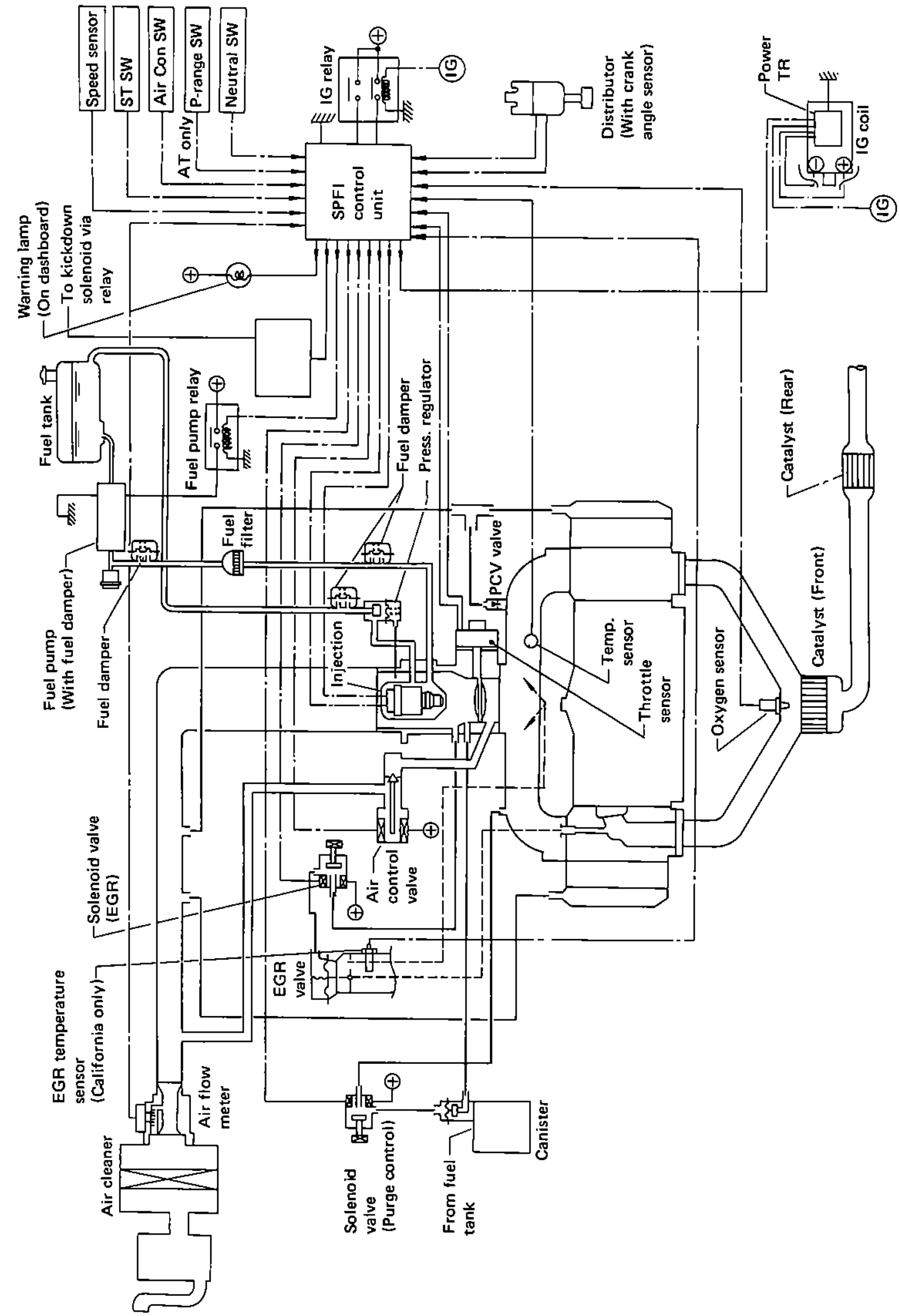


Fig. 1

L2-1679

MPFI TURBO

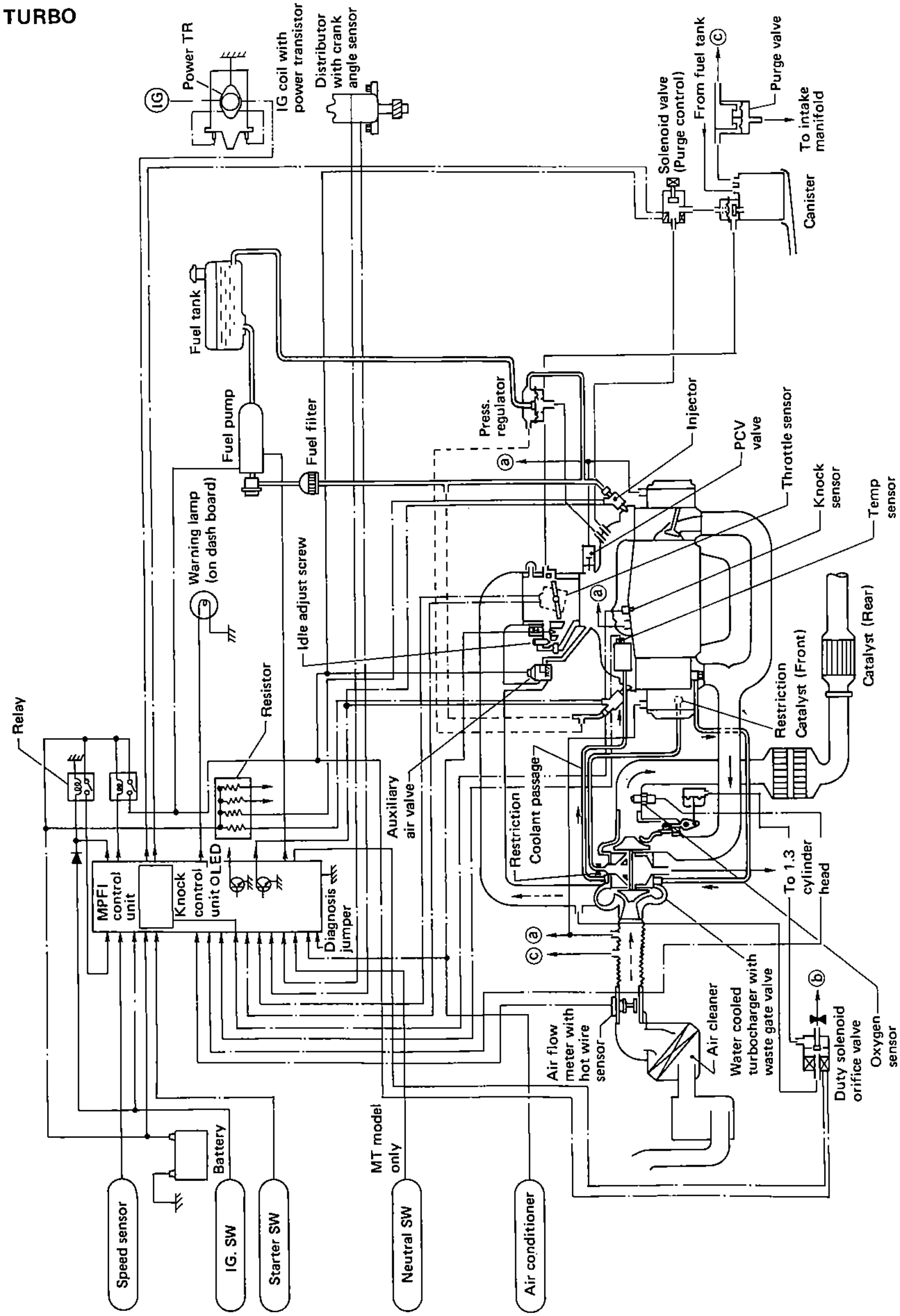


Fig. 2

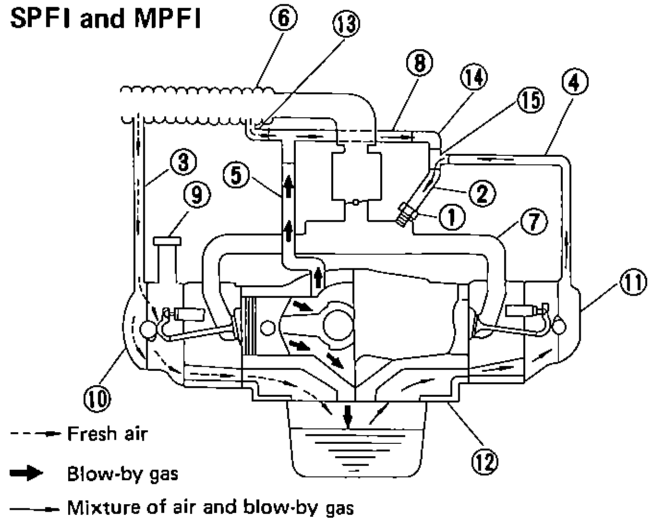
L2-1680

Crankcase Emission Control System

DESCRIPTION

The positive crankcase ventilation (PCV) system is employed to prevent air pollution which will be caused by blow-by gas being emitted from the crankcase.
The system consists of a sealed oil filler cap, rocker covers with an emission outlet and fresh air inlet, connecting hoses, PCV valve and an air cleaner.
At the part throttle, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose of rocker cover on #2 – #4 side, connecting hose of crank case (MPFI only) and PCV valve by the strong vacuum of the intake manifold. Under this condition, the fresh air is introduced into the crankcase through connecting hose of rocker cover on #1 – #3 side, and drawn to the intake manifold through PCV valve together with the blow-by gas.
At the wide open throttle, a part of blow-by gas flows into the air cleaner through the connecting hose of rocker cover on #1 – #3 side and is drawn to the carburetor or throttle chamber, because under this condition, the intake manifold vacuum is not so strong as to introduce all blow-by gases increasing with engine speed directly through the PCV valve.
Under the special operating condition, such as steep right turn driving, engine oil sometimes blows up into connecting hose of rocker cover on #2 – #4 side and flows into the intake manifold by the force of the vacuum.
However, in this case, the connecting hose between air cleaner case or intake duct and connecting hose of rocker cover on #2 – #4 side reduces the vacuum to prevent this.

SPFI and MPFI



1	PCV valve	8	Connector
2	PCV hose	9	Oil filler cap
3	Blow-by hose (RH)	10	Rocker cover (RH)
4	Blow-by hose (LH)	11	Rocker cover (LH)
5	Blow-by hose (CTR) [MPFI only]	12	Crank case
6	Intake duct	13	Connecting hose
7	Intake manifold	14	Connecting hose
		15	Connector

L1-039

Fig. 3

INSPECTION

1) Check the positive crankcase ventilation hoses and connections for leaks and clogging. The hoses may be cleared with compressed air.
2) Check the oil filler cap to insure that the gasket is not damaged and the cap fits firmly on the filler cap end.
3) Check the PCV valve as the following procedure.
   (1) Disconnect the hose from the PCV valve.
   (2) With a finger attaching top of the valve, then lightly open and close the throttle valve (increase and decrease the engine speed a little).
   (3) The valve is in good condition if a vacuum is felt by the finger. If not, replace the valve.
   (4) The valve alone may be checked by shaking it. It is normal when you hear it move. Replace it if it fails to move.

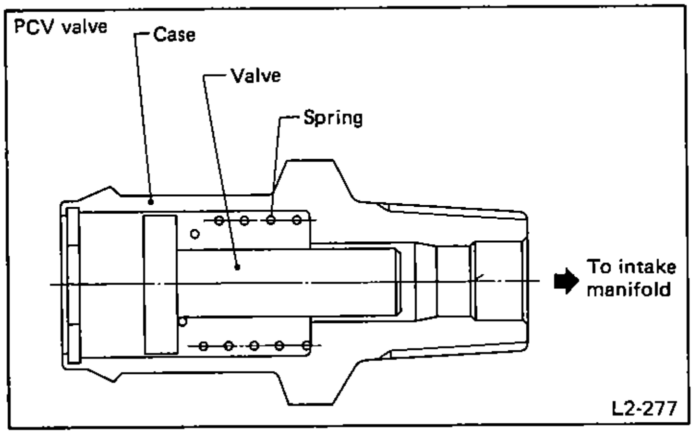


Fig. 4

Ignition Control System

SPFI AND MPFI

The ignition system is composed of a battery, an ignition coil, a distributor, spark plugs, a control unit and wires.
The crank angle sensor built-in distributor detects the reference crank angle and the positioned crank angle. Electronic signal of both angles is transmitted to control unit which is used in common by fuel injection system.
The control unit calculates the spark advance angle and determines the spark timing.
The electronic signal of spark timing determined by control unit is transmitted to the power transistor where it makes the primary circuit to ignition coil, whereby high voltage current is generated in the secondary circuit.
The high voltage of secondary circuit is distributed to the spark plug of each cylinder and discharged there.
The spark advance angle is calculated from the following three factors.

1) Engine speed compensation.
2) Advance when starting the engine.
3) Advance in all driving conditions except starting the engine, after engine speed exceeds the present value.

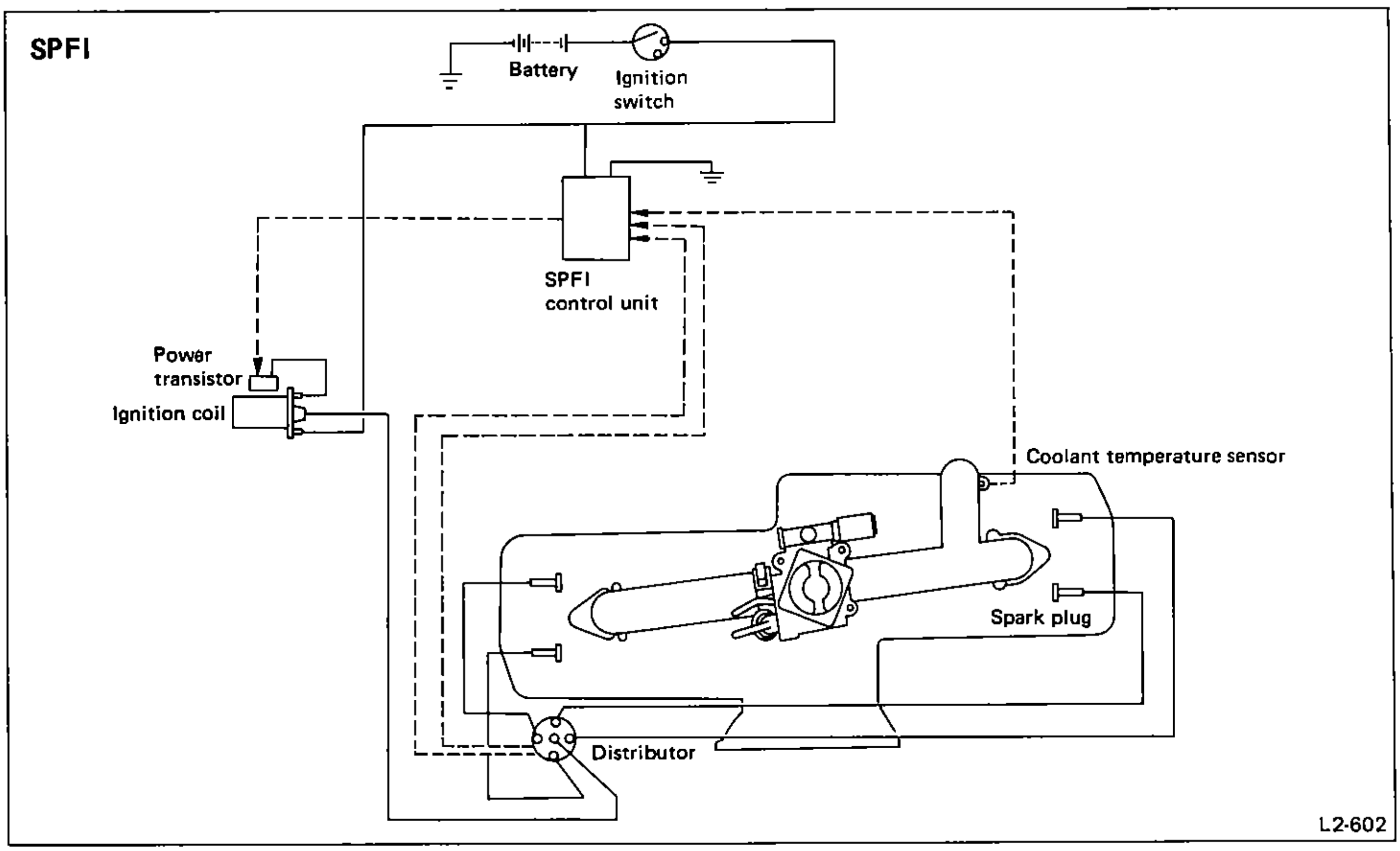


Fig. 5

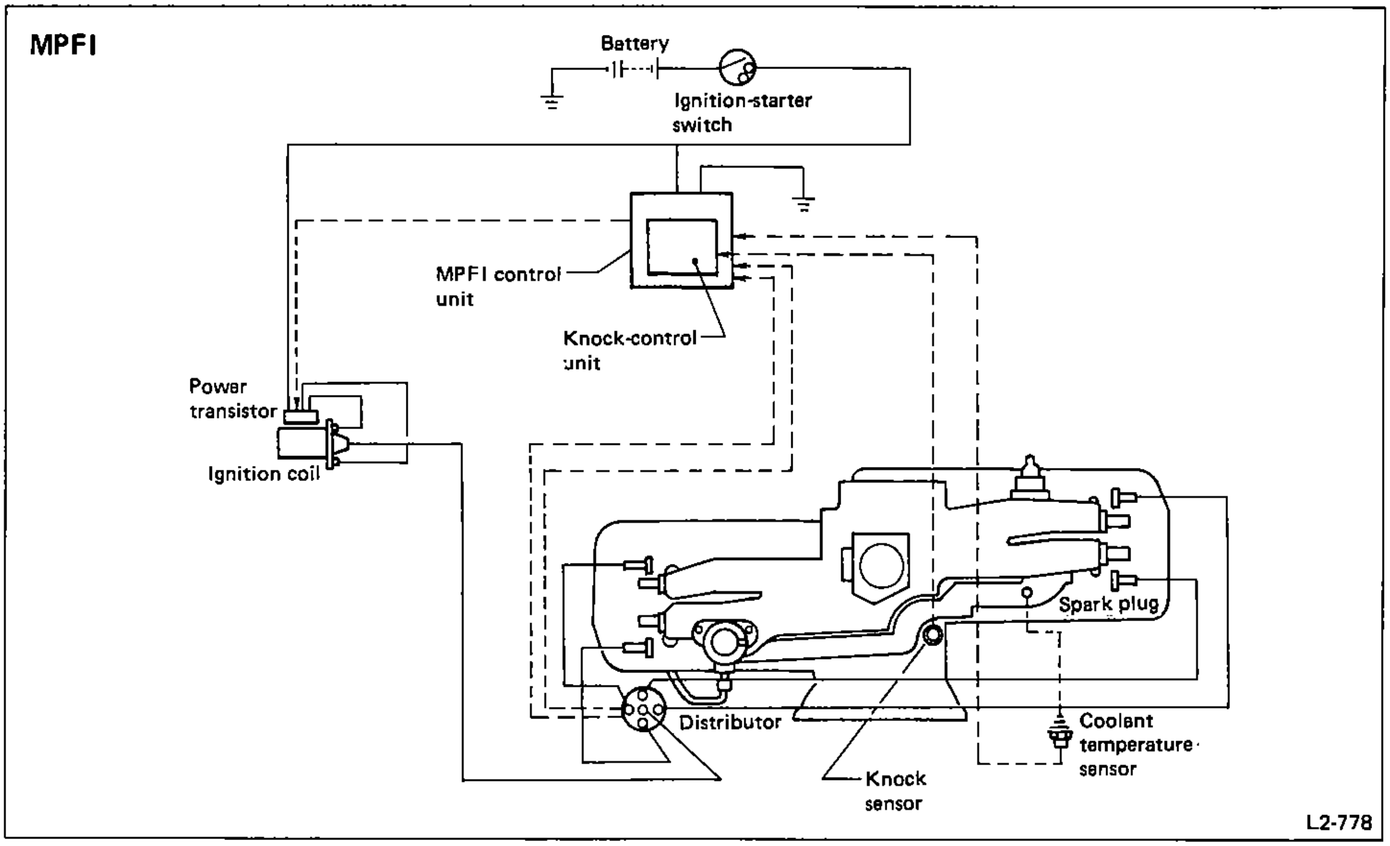

MPFI
Battery
Ignition-starter switch
MPFI control unit
Knock-control unit
Power transistor
Ignition coil
Spark plug
Distributor
Coolant temperature sensor
Knock sensor
L2-778

Fig. 6

EGR System

DESCRIPTION

Exhaust gas recirculation (EGR) system is aiming at reduction of NOx by reducing the top combustion temperature in cylinders through recirculating a part of exhaust gas into cylinders. The EGR valve opens in response to the engine driving conditions and a part of exhaust gas flows into cylinders through the intake manifold.

The vacuum signal to control the EGP valve is picked up from the port near the slightly upstream portion of throttle valve.

SPFI

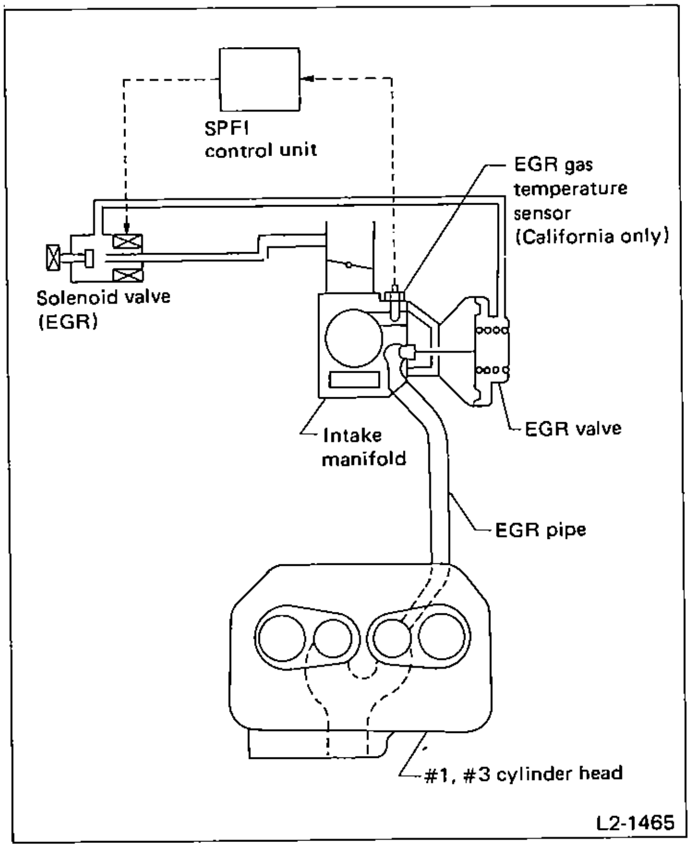


Fig. 7

MPFI [TURBO] (Except California model)

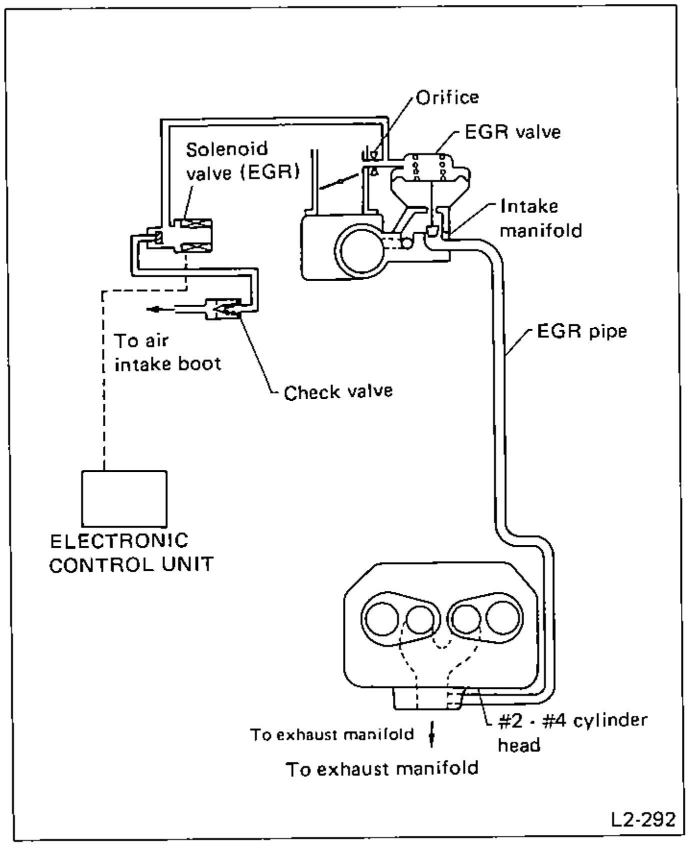


Fig. 8

INSPECTION

EGR valve and EGR flow passages (Vacuum and exhaust gas)

Engine warming up.

↓

Viewing through opening in EGR valve body, check if valve shaft moves when engine is revved up to 3,000 ~ 3,500 rpm under no load condition. During this test EGR solenoid valve should be removed from SPFI models.

- No → Check if EGR valve moves when vacuum [about -26.7 kPa (-200 mmHg, -7.87 inHg)] is applied to EGR valve by hand vacuum pump.
  - No → Remove EGR valve, and clean or replace the EGR valve. (Refer to a. EGR valve cleaning.)
  - Yes → Check and repair vacuum passage to EGR valve.
- Yes → Both EGR valve and vacuum passage to EGR valve are normal.

↓

Either engine rough idling or engine stall occurs when vacuum [about -26.7 kPa (-200 mmHg, -7.87 inHg)] is applied to EGR valve by hand vacuum pump.

- No → Clean or replace exhaust gas passage parts. (Refer to b. Exhaust gas passage cleaning.)
- Yes → EGR system OK.

EGR valve cleaning

Do not wash valve ASSY in solvents or degreaser as permanent damage to valve diaphragm may result.

1) Hold the valve ASSY in hand, then tap lightly on the sides and end of the valve with a small plastic hammer to remove the exhaust deposits from the valve seat. Empty loose particles.

Do not put in a vise.

2) With a wire wheel or deposit cleaning tool, buff the exhaust deposits from the mounting surface and around the valve.
3) Depress the valve diaphragm and look at the valve seating area through the valve outlet for cleanliness. If valve and/or seat are not completely clean, repeat Step 1).
4) Look for exhaust deposits in the valve outlet. Remove built-up deposite with a screwdriver.
5) Blow out small particles and dust remaining with air hose.
6) Check EGR valve operation by applying -26.7 kPa (-200 mmHg, -7.87 inHg) vacuum with hand vacuum pump. If valve does not open completely, replace EGR valve with a new part.

When reassembling EGR valve, replace EGR valve gasket with a new one.

Exhaust gas passage cleaning

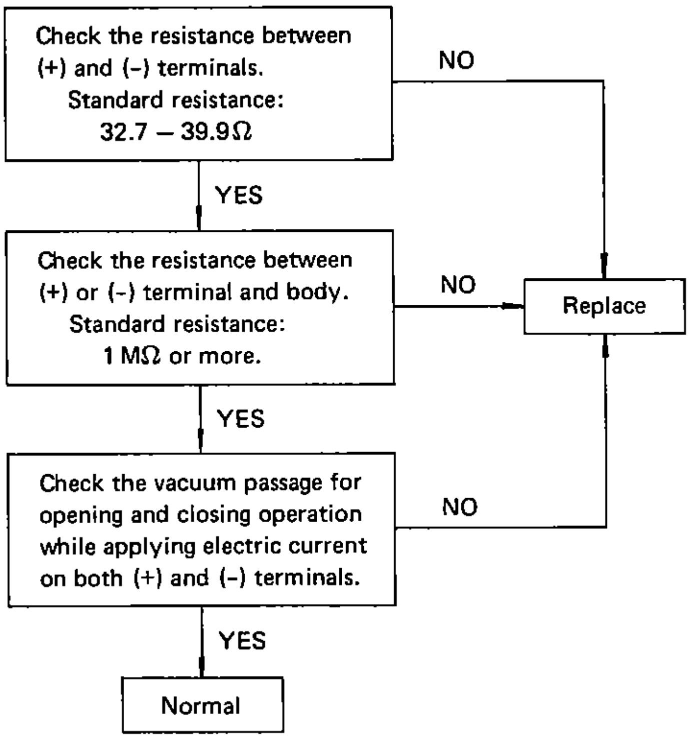
1) Inspect EGR gas inlet to intake manifold for presence of deposits. Remove any deposits present with a hooked awl taking care to minimize the amount of material falling into the intake manifold.

Do not use an electric drill.

2) Remove all deposit material using a vacuuming device.
3) Examine EGR Gas Inlet for exhaust deposits. If excess deposits present (more than 5 to 10% blockage of the passage), remove EGR pipe. Tap lightly on the sides of the EGR pipe with a small plastic hammer to loosen exhaust deposits. Remove loose exhaust deposits by blowing through EGR pipe using compressed air. Reassemble EGR pipe.

4) Inspect and clean EGR valve as required (See a. EGR valve cleaning).

EGR solenoid valve



[MPFI TURBO]

Usually (when the current is OFF), the plunger is forced upwards by the spring force to close the passage between Ⓐ and Ⓑ.
When the current is ON in the solenoid, the plunger is attached downwards to open the passage between Ⓐ and Ⓑ.

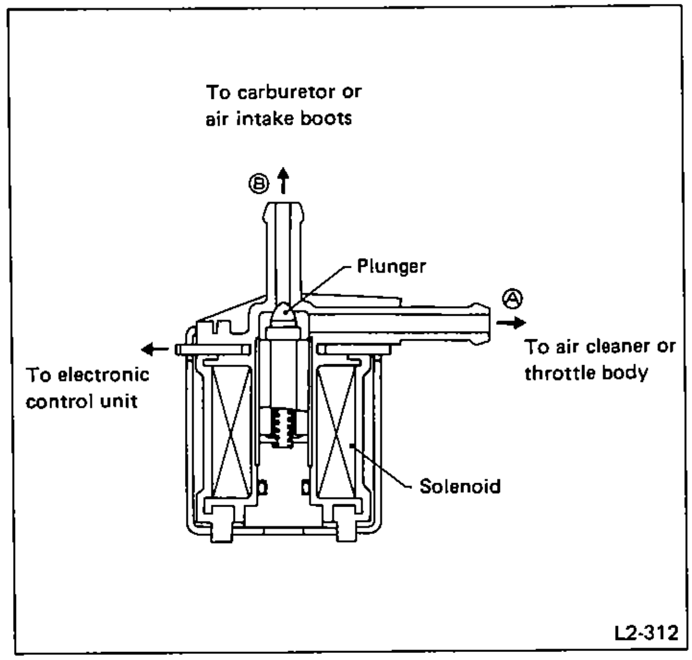


Fig. 10

[SPFI]

Usually (when the current is OFF), the plunger is forced upwards by the spring force to close the passage between Ⓐ and Ⓑ, and to open the passage between Ⓑ and Ⓒ.
When the current is ON in the solenoid, the plunger is attracted downwards to open the passage between Ⓐ and Ⓑ, and to close the passage between Ⓑ and Ⓒ.

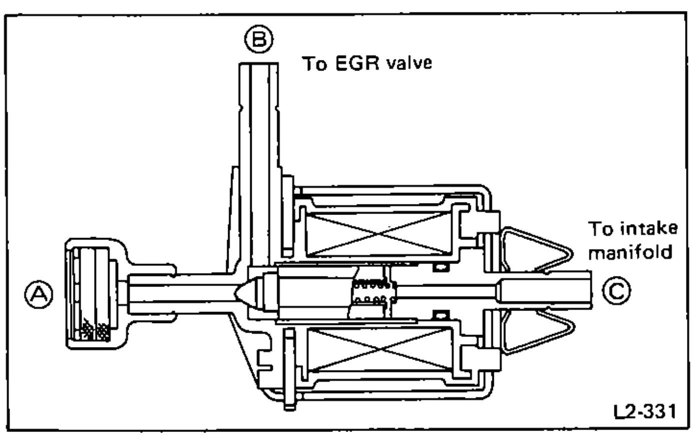


Fig. 9

Check valve [MPFI TURBO]

1) Confirm that there is no air flow from the EGR solenoid valve side to the air intake boots side.

2) Confirm that there is air flow from the air intake boots side to the EGR solenoid valve side.

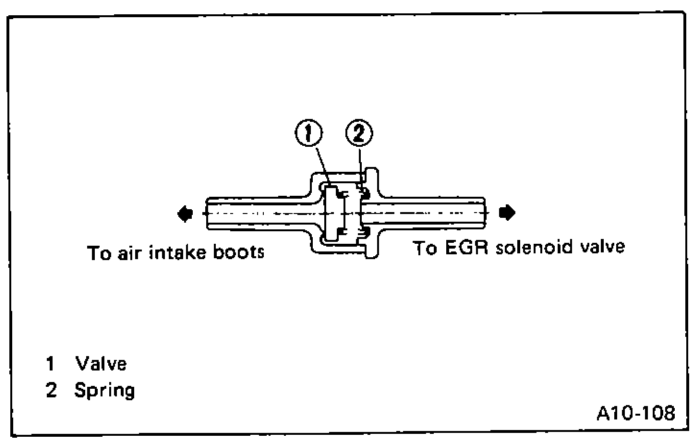


Fig. 11

Three-way Catalyst [Front Catalyst]

The basic material of three-way catalyst is platinum (Pt) and rhodium (Rh), and a thin film of their mixture is applied onto honeycomb or porous ceramics of an oval shape (carrier). To avoid damaging the catalyst, only unleaded gasoline should be used.

The catalyst is used to reduce HC, CO and NOx in exhaust gases, and permits simultaneous oxidation and reduction. To obtain an excellent purification efficiency on all components HC, CO and NOx, a balance should be kept among the concentrations of the components. These concentrations vary with the air-fuel ratio.

The air-fuel ratio needs to be controlled to a value within the very narrow range covering around the theoretical (stoichiometric) air-fuel ratio to purify the components efficiently.

Evaporative Emission Control System

DESCRIPTION

The evaporative emission control system is employed to prevent evaporative fuel from being discharged into ambient atmosphere. This system includes a canister, a two-way valve, a fuel separator, their connecting lines etc.

Gasoline vapor evaporated from the fuel in the fuel tank is introduced into the canister located in the engine compartment through the evaporation line, and is absorbed on activated carbon in it. A two-way valve and a fuel separator are also incorporated on the tank vapor line.

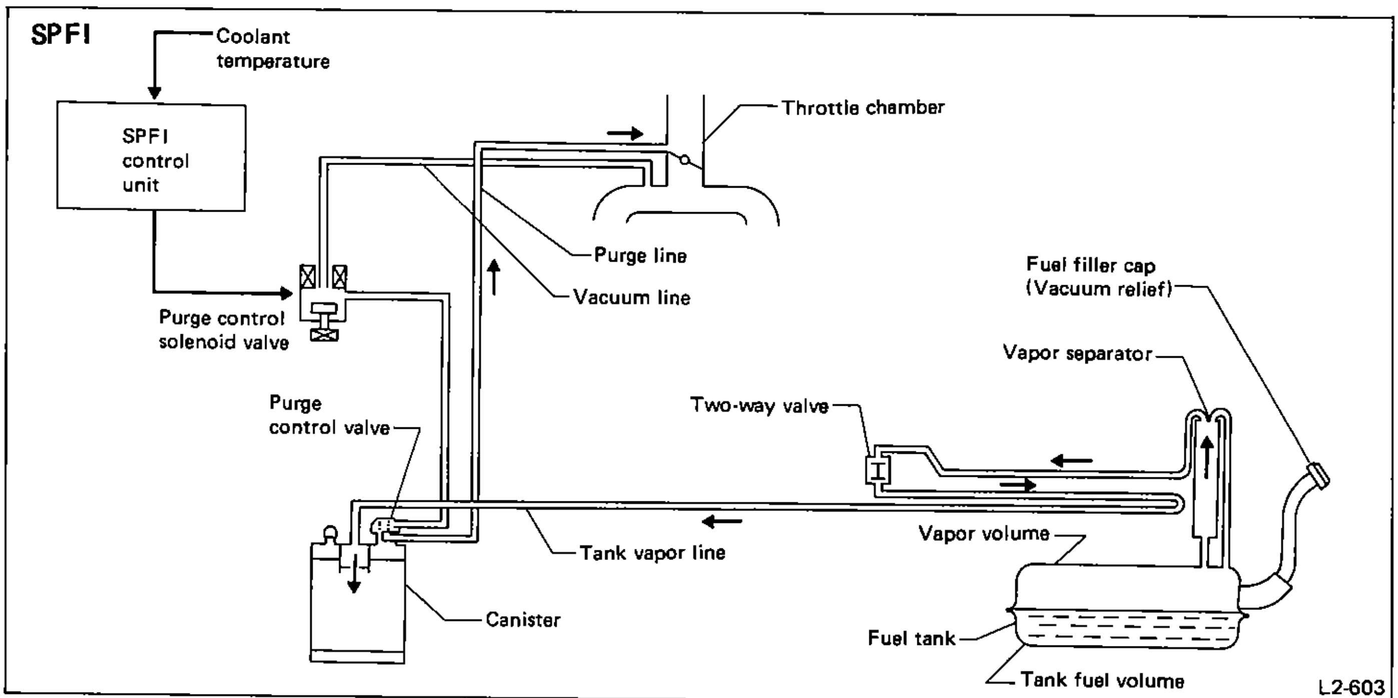


Fig. 12

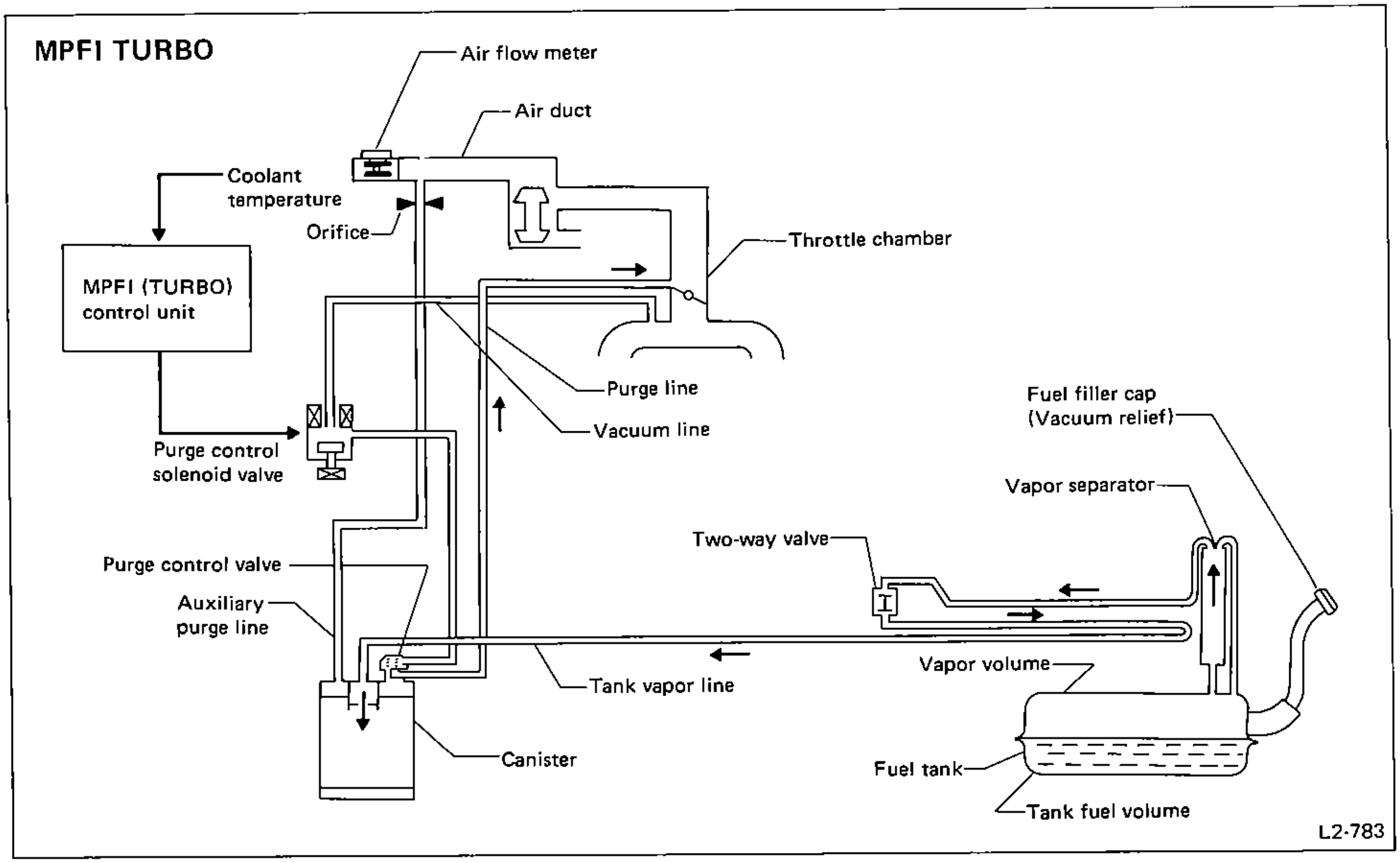


Fig. 13

CANISTER

SPFI and MPFI TURBO

The purge control valve on the canister is controlled by the intake manifold vacuum. When the purge control valve is opened, the absorbed vapor is introduced from the canister into the throttle body.

In case of TURBO, when the engine is either at super-charging or not running, the purge control valve is closed by the return spring.

Second purge line connects the canister and air intake boots. When the engine is running, the absorbed vapor is purged out by the vacuum in the air intake boots.

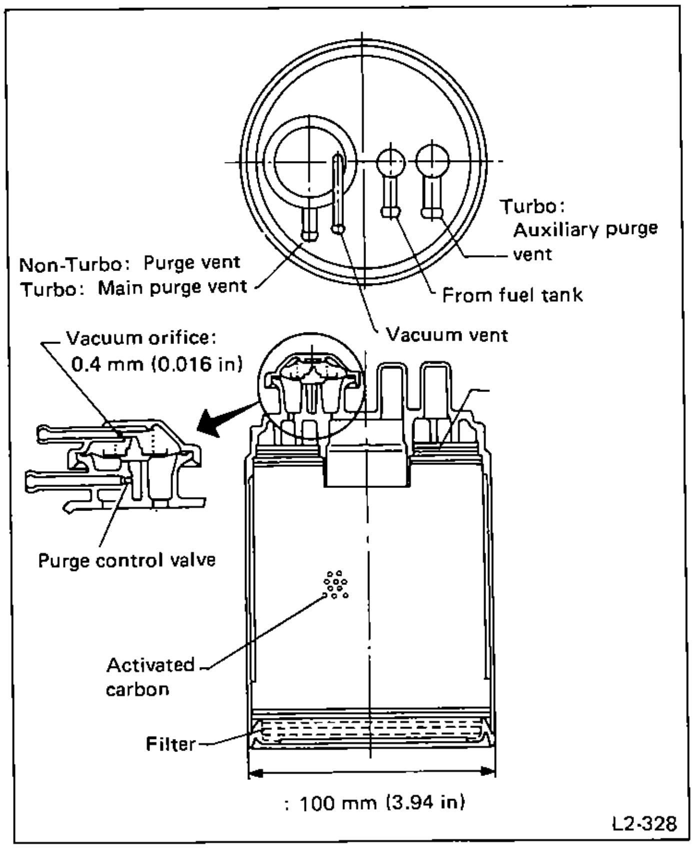


Fig. 14

TWO-WAY VALVE

The two-way valve is located in the fuel vapor line and functions to control the pressure in the fuel tank.
When the fuel tank pressure is positive above a certain point, the valve A is open to permit the fuel vapor to the canister, and when the fuel tank pressure is negative below a certain point, the valve B is open to introduce fresh air into the fuel tank.

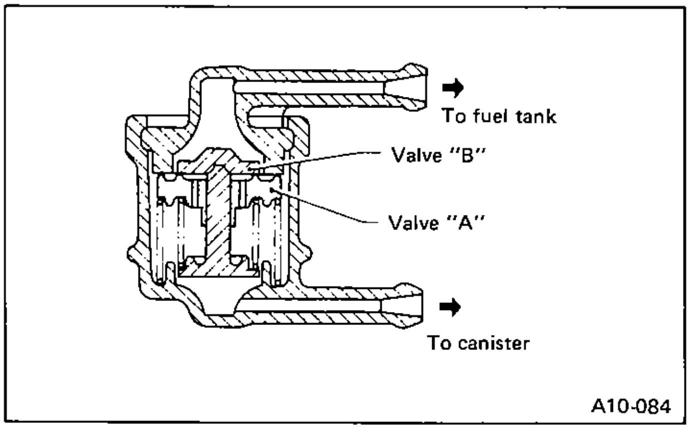


Fig. 15

FUEL SEPARATOR

The fuel separator is to prevent liquid fuel from flowing into the canister in case of abrupt cornering, etc.

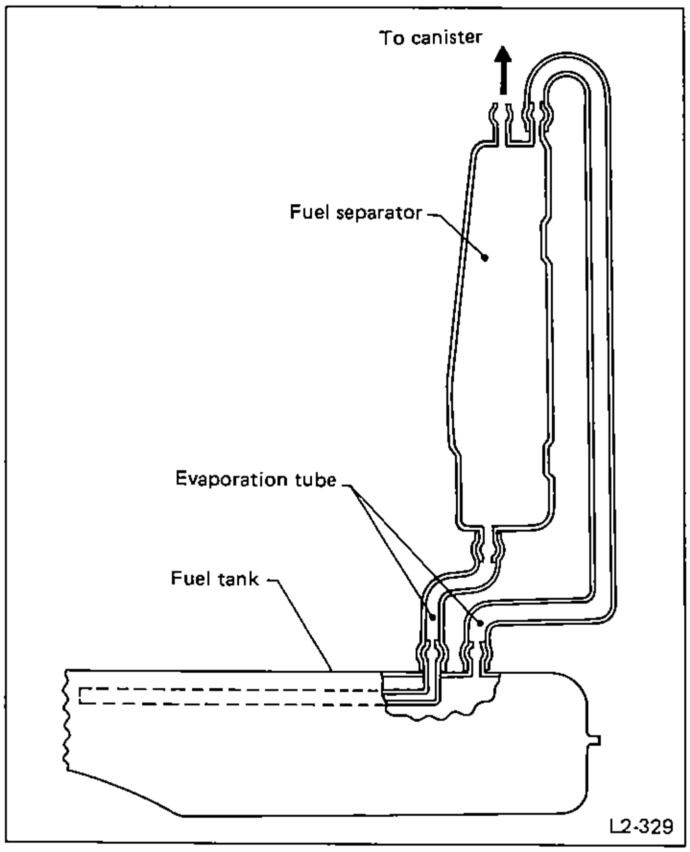


Fig. 16

FUEL CAP

The relief valve is adopted to prevent the development of vacuum in the fuel tank which may occur in case of trouble in the fuel vapor line.
In normal condition, the filler pipe is sealed at Ⓐ and at the packing pressed against the filler pipe end. As vacuum develops in the fuel tank, atmospheric pressure forces the spring down to open the valve; consequently air is led into the fuel tank controlling the inside pressure.

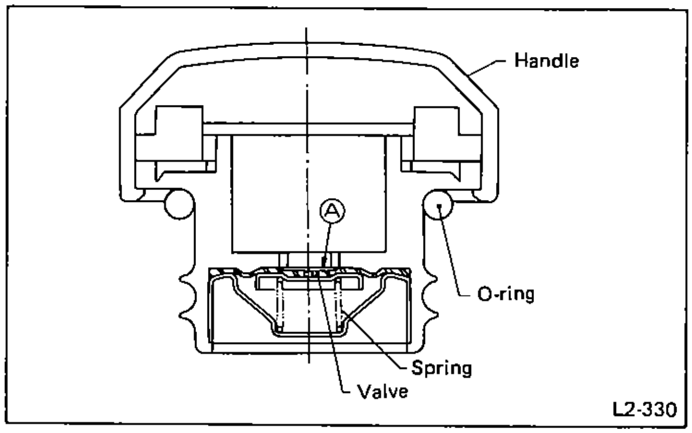


Fig. 17

INSPECTION

FUEL PIPING

Check fuel piping and connections for leakage.

EVAPORATIVE EMISSION SYSTEM

Evaporation line from fuel tank to canister

1) Remove fuel filler cap.
2) Disconnect evaporation line at evaporation pipe CP.
3) Check for unobstructed evaporation line on fuel tank side except for a little resistance due to 2-way valve by blowing air into hose.
4) Check for unobstructed evaporation line on canister side with no resistance by blowing air into hose.

Two-way valve

1) Check for air passage with slight resistance due to the valve by blowing air into the nipple on the side marked with letters "To engine".
2) Repeat the same step on the other nipple.
3) Check for the valve case with no crack. If cracked, replace it with new one.

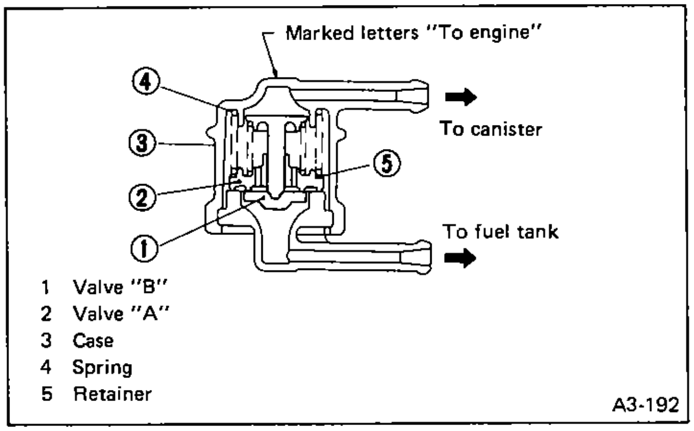


Fig. 18

Purge line and canister

1) Disconnect the vacuum hose. Orally blow air through the hose to ensure that air does not leak.

2) Disconnect the purge hose or first purge hose (TURBO). Orally blow air through the hose to ensure that air does not leak.

3) Disconnect the evaporation hose from the fuel tank side. Orally blow air through the hose to ensure that air flows.

Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.

4) Disconnect the second purge hose from the air intake boots. Orally blow air through the hose to ensure that there is an air flow with a slight resistance (TURBO).

Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.

5) Check the exterior of the canister to ensure that it is not cracked or scratched.

Vacuum Fitting

SPFI Model

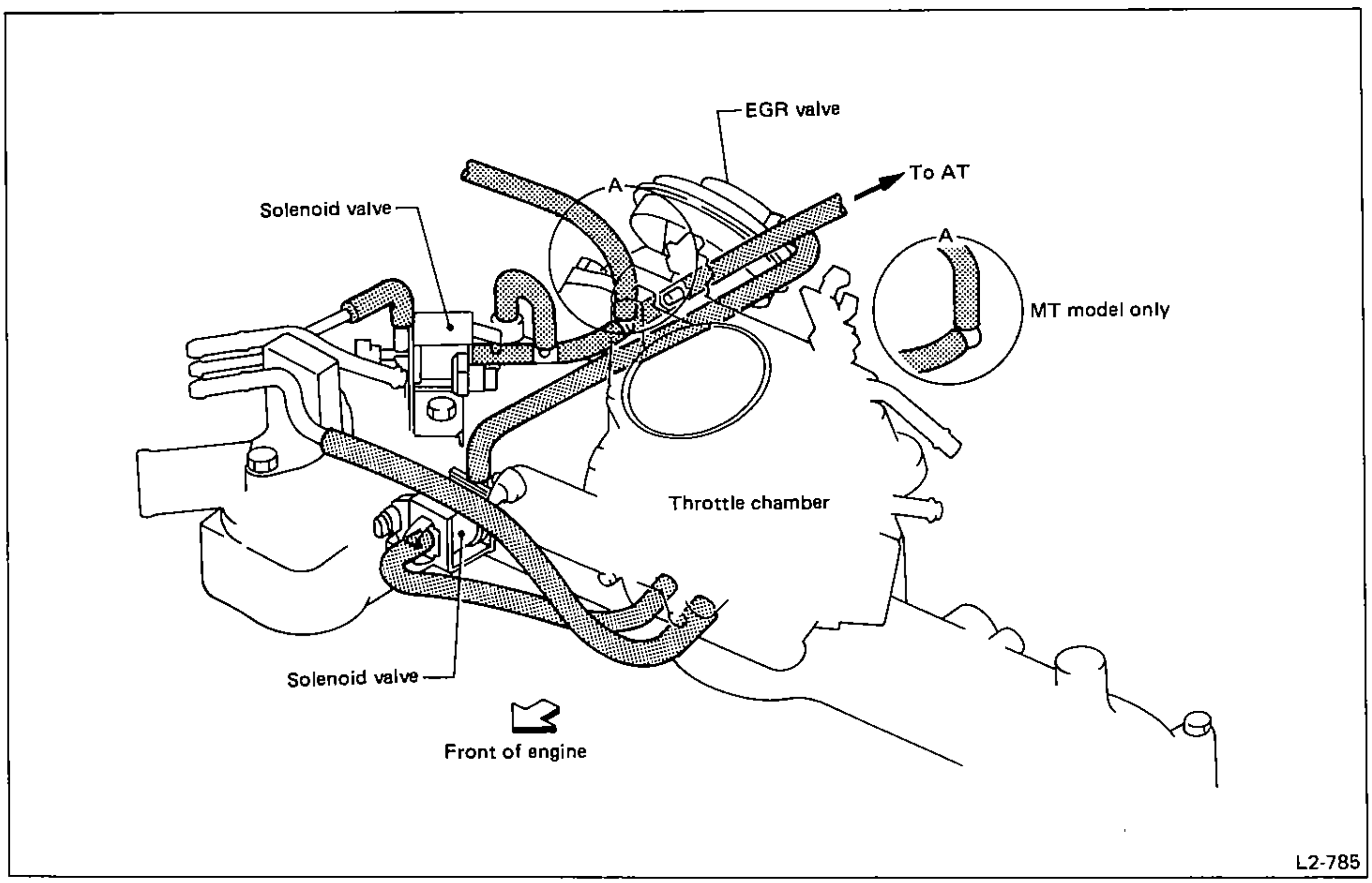


Fig. 19

MPFI TURBO Model [49-state]

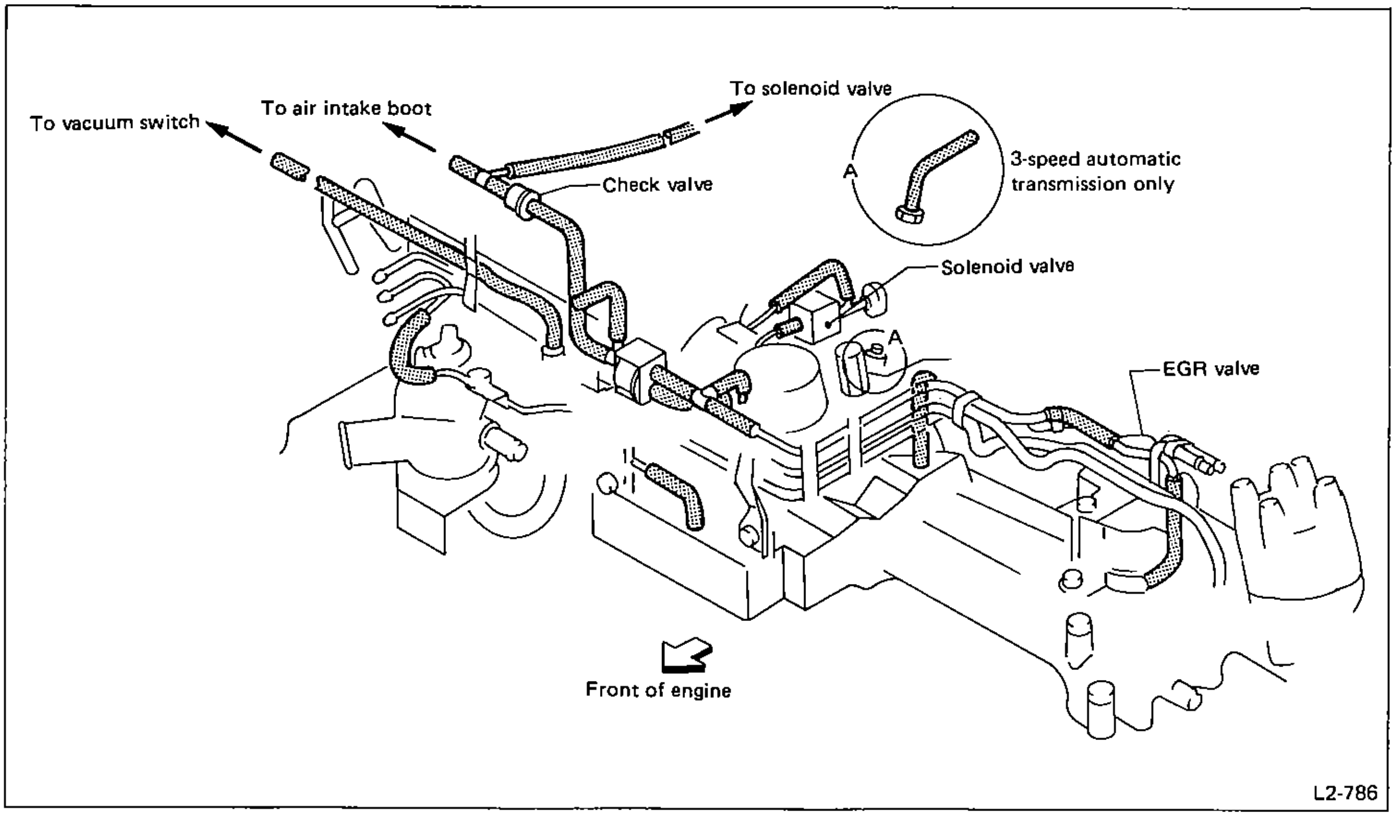


Fig. 20

MPFI TURBO [California]

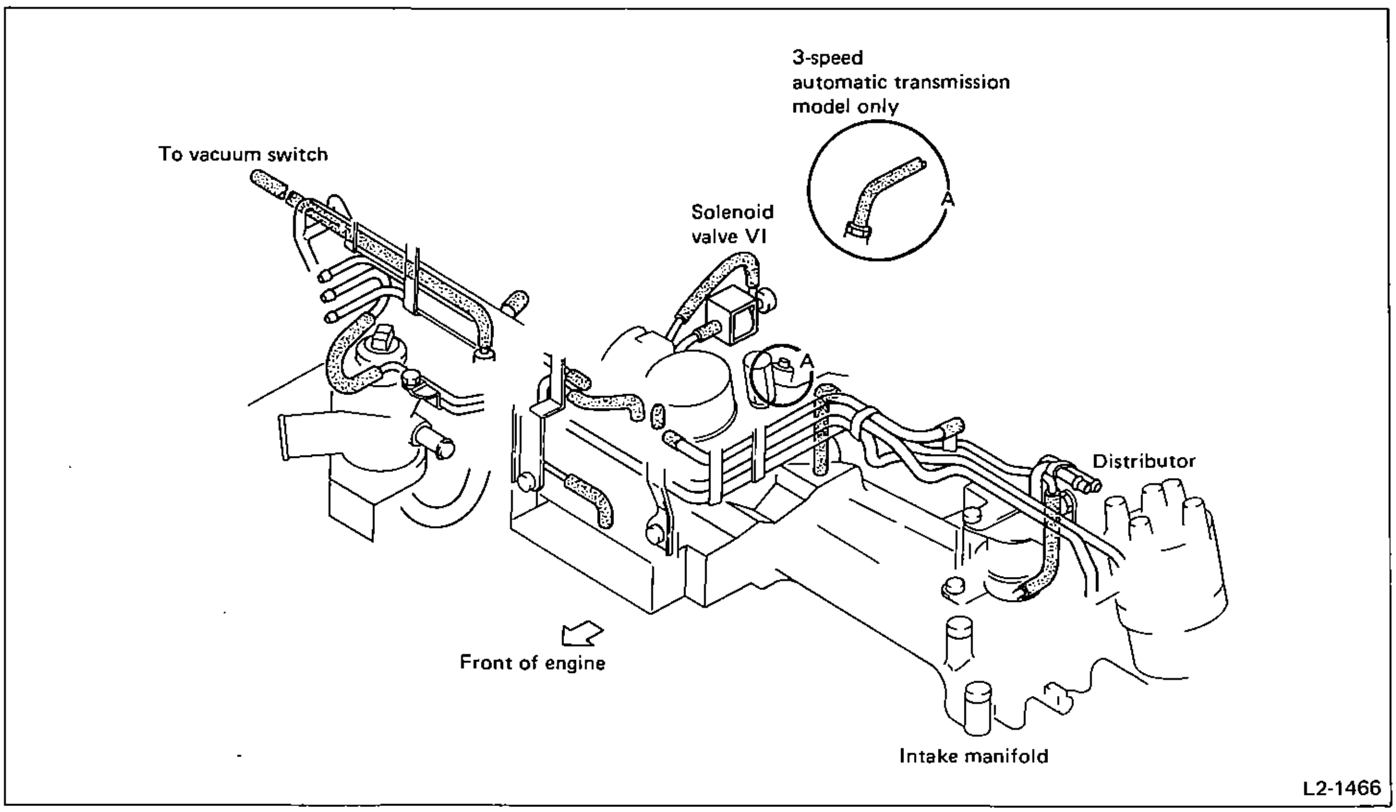


Fig. 21

SUBARU

1989

Page

This chapter describes major inspection and service procedures for the engine mounted on the body. For procedures not found in this chapter, refer to the service procedure section in the applicable chapter.

Ignition Timing

INSPECTION AND ADJUSTMENT

BEFORE CHECKING AND ADJUSTING IGNITION TIMING

1) Warm up the engine.
2) (1) Confirm that the idle switch is ON. (Refer to "Chapter 2-7".)
   (2) Connect the test mode connector.

a. The CHECK ENGINE light will come on. This does not indicate a problem.
b. Ignition timing must not be adjusted and cannot be checked while the idle switch is off or the test mode connector is disconnected.

CHECKING IGNITION TIMING

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.

[BTDC/rpm]

SPFI	MT AT	20°/700* 20°/700*
MPFI TURBO	MT AT	20°/700* 20°/800*

* **Ignition timing can be set when the test mode connector is connected and the idle switch is turned ON, regardless of engine rpm. Do not check ignition timing while the connector is disconnected and the switch is OFF.**

ADJUSTING IGNITION TIMING

1) Loosen the 6-mm bolts 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.

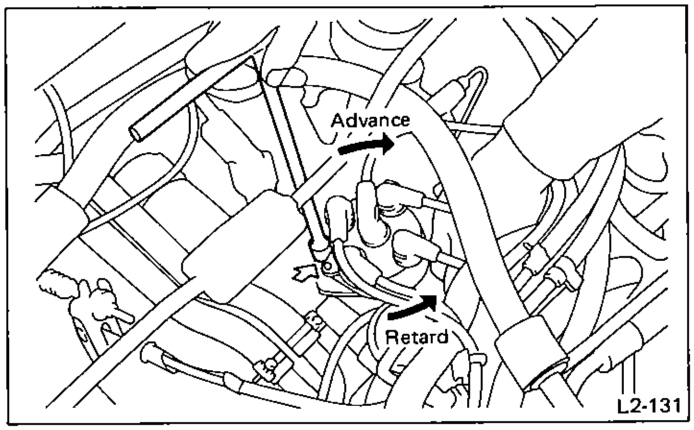


Fig. 1

AFTER CHECKING AND ADJUSTING

Be sure to disconnect the test mode connector.

Engine Compression

MEASUREMENT

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.

On MPFI model, disconnect the harness connectors for injectors.
On SPFI model, disconnect the harness connector for injector.

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.

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.

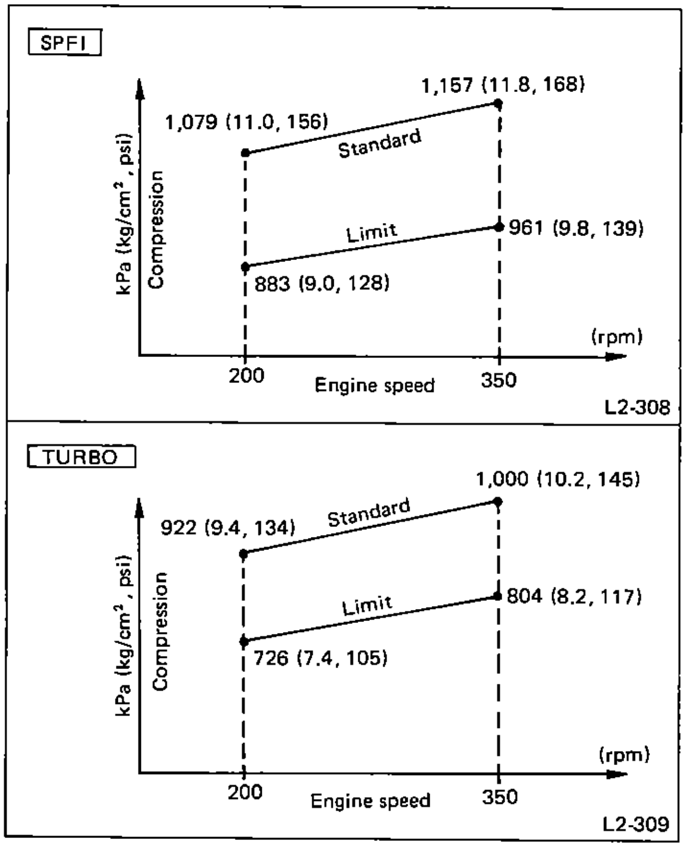


Fig. 2

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

Intake Manifold Vacuum

MEASUREMENT

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 throttle chamber 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 drops suddenly and intermittently from normal position.	Sticky valves.
5. 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.
6. Needle vibrates above and below normal position in narrow range.	Defective ignition system or throttle chamber idle adjustment (MPFI).

Engine Idle Speed and Idle Mixture

INSPECTION AND ADJUSTMENT

ENGINE IDLE SPEED

a. Make sure that the ignition timing is 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 O_2 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 throttle body after disconnecting it.

MPFI

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)	MT	700 ± 100
	AT	800 ± 100
CO contents (%)		0.1, max
HC contents (ppm)		200, max

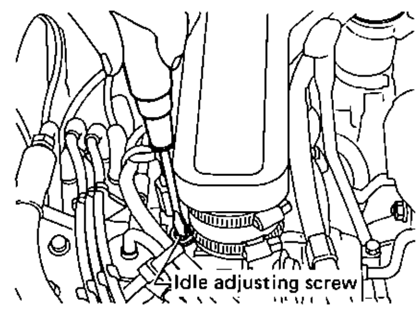


Fig. 3

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

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

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

Troubleshooting

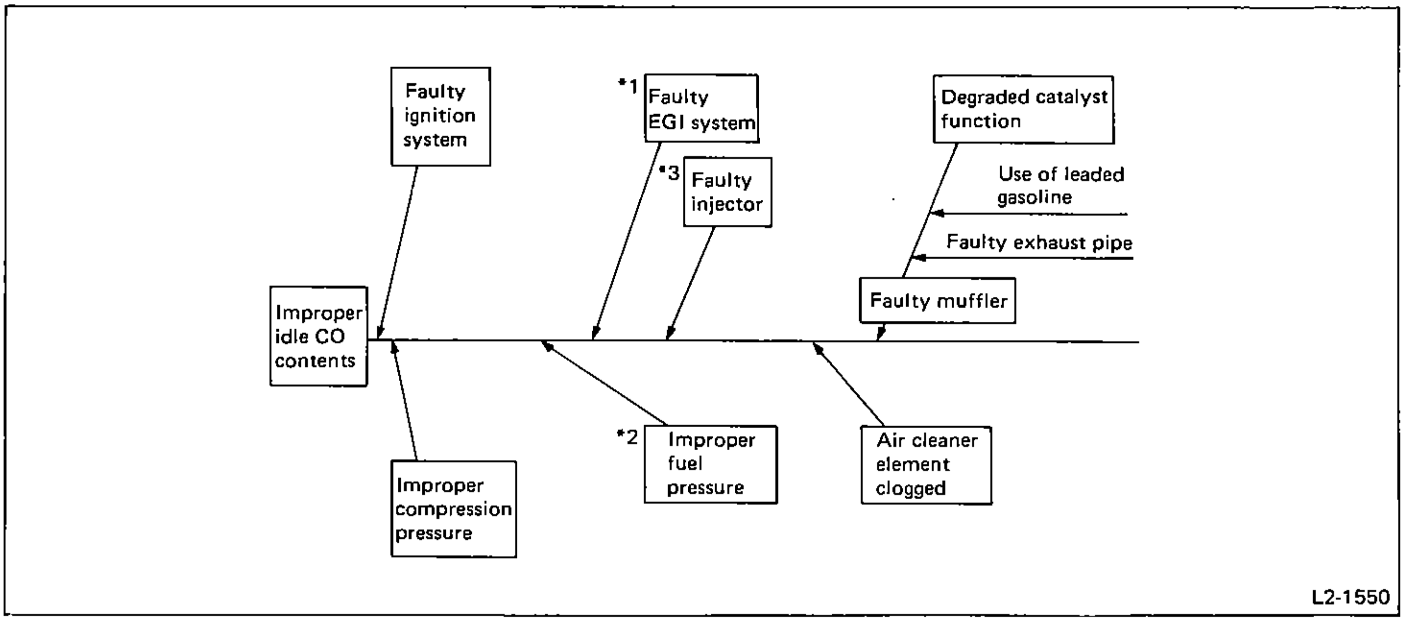


Fig. 4

*1: Check the EGI system.
Connect a jumper wire and check to see if the CHECK ENGINE light 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/cm^2, 28 psi) to see if air leaks at the nozzle tip. If air leaks, replace the injector.
b: The injector is faulty.

SPFI

Refer to Chapter 2-7 "Throttle Chamber Assembly".

ENGINE IDLE MIXTURE

This adjustment is not recommended.

Oxygen (O_2) Sensor

REPLACEMENT

Oxygen (O_2) 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.

REMOVAL

1) Disconnect O_2 sensor cord.
2) Apply SUBARU CRC (004301003) or its equivalent to threaded portion of oxygen (O_2) sensor, and leave it for one minute or more.
3) Loosen oxygen (O_2) sensor by turning it 10 to 40 degrees with special tool (SOCKET: 499990110) and wrench.

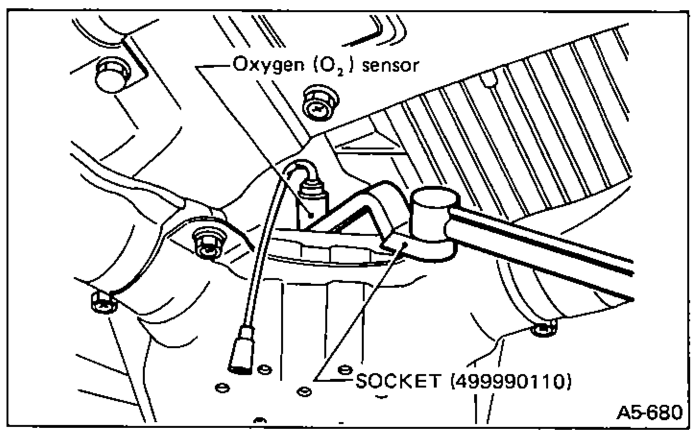


Fig. 5

4) Apply SUBARU CRC (004301003) to threaded portion of oxygen (O_2) sensor again, and leave it for one minute or more.
5) Remove oxygen (O_2) sensor by using socket and wrench.

When removing, do not force oxygen (O_2) sensor especially when exhaust pipe is cold; otherwise it will damage the exhaust pipe.

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 (O_2) sensor to make the next removal easier.

Never apply anti-seize compound to protector of oxygen (O_2) sensor.

2) By using socket and torque wrench, install oxygen (O_2) 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 (O_2) sensor cord.

Turbocharger System

INSPECTION

INSPECTING THE TURBOCHARGER SYSTEM PIPING FOR DAMAGE AND INSTALLATION

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

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 63.7 to 73.6 kPa (0.65 to 0.75 kg/cm^2, 9.2 to 10.7 psi) to the inspection hose to see if the waste gate link operates.

The waste gate control diaphragm may break if excessive pressure is applied. Before applying the air pressure, check that it is between 63.7 to 73.6 kPa (0.65 to 0.75 kg/cm^2, 9.2 to 10.7 psi) with a pressure gauge.

Cooling System

INSPECTION

SYSTEM COMPONENTS

Repair or replace parts which are found faulty.

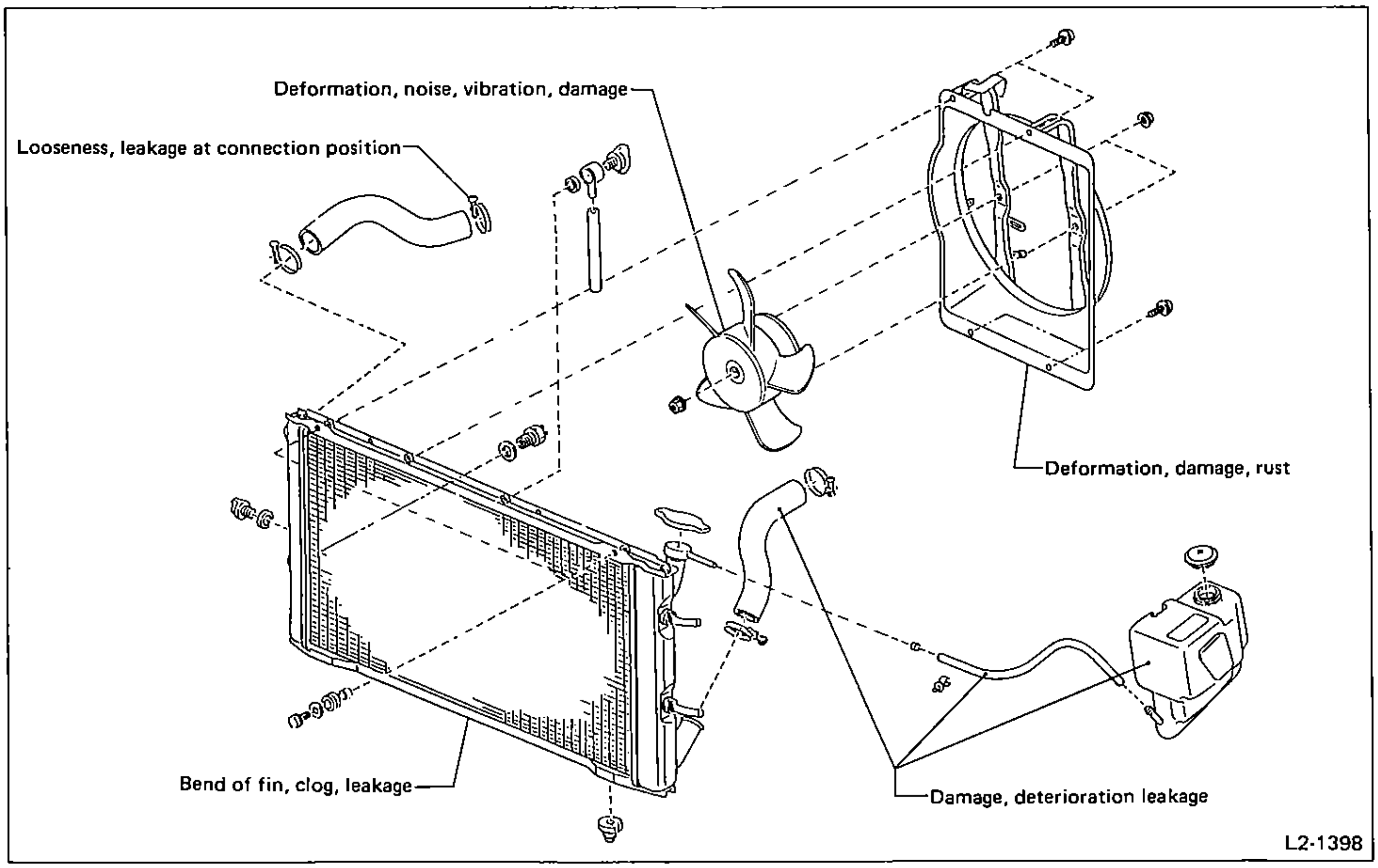


Fig. 6

RADIATOR CAP OPENING PRESSURE

1) Attach radiator cap to tester.
2) Increase pressure until tester gauge pointer stops. Radiator cap is functioning properly if it holds the service limit pressure for five to six seconds.

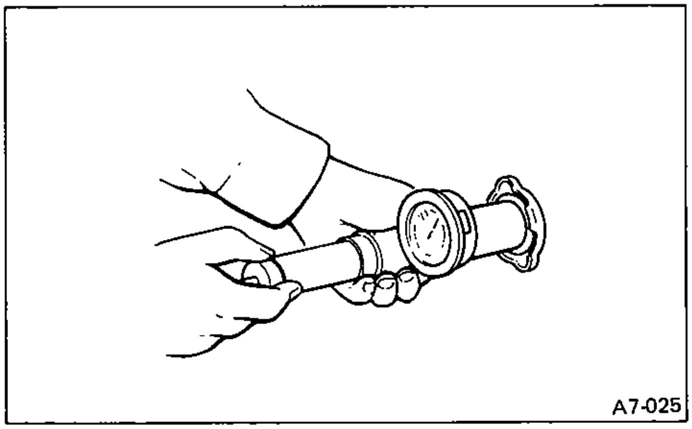


Fig. 7

Standard pressure:
78 – 98 kPa (0.8 – 1.0 kg/cm^2, 11 – 14 psi)
Service limit pressure:
69 kPa (0.7 kg/cm^2, 10 psi)

Be sure to remove foreign matter and rust from the cap in advance; otherwise, results of pressure test will be incorrect.

WATER LEAKAGE FROM RADIATOR

1) Remove radiator cap, top off radiator, and attach tester to radiator in place of cap.
2) Apply a pressure of 157 kPa (1.6 kg/cm^2, 23 psi) to radiator to check if:
(1) Water leaks at/around radiator.
(2) Water leaks at/around hoses or connections.

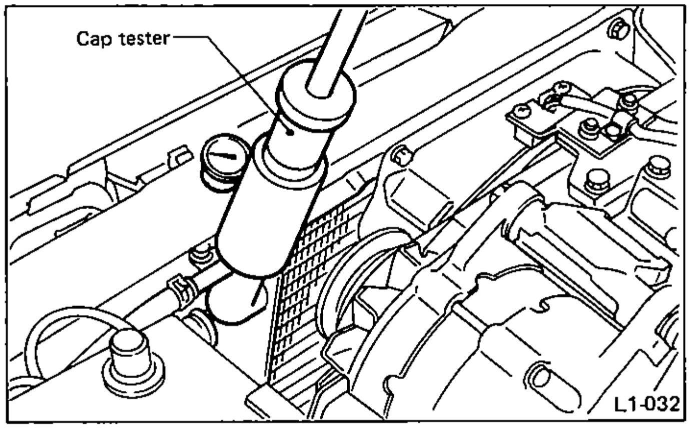


Fig. 8

a. Engine should be off.
b. Wipe water from check points in advance.
c. Be careful to prevent cooling water from spurting out when removing tester.
d. Be careful also not to deform filler neck of radiator when installing or removing tester.

COOLANT

1) Check coolant level.
When the engine is cool, check and add coolant on reserve tank side.
Be careful not to confuse the reserve tank cap which is green and the window washer cap which is blue.
(1) If coolant level is close to the "LOW" mark, add genuine SUBARU Coolant up to the "FULL" mark.
(2) If reserve tank is empty, check coolant level in radiator and first add coolant up to filler necks in radiator. Then, perform step (1).
(3) Replace caps.

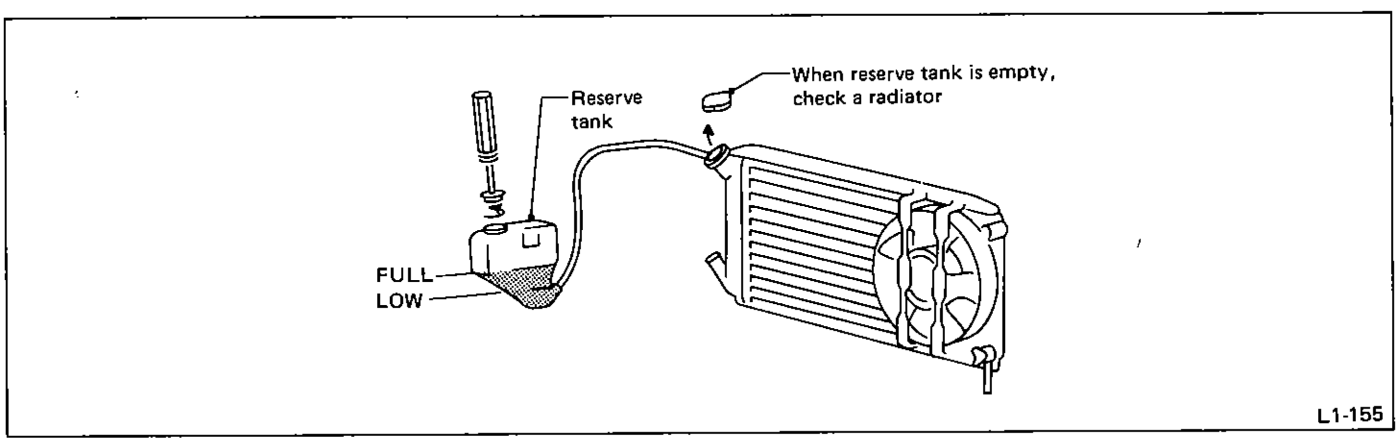


Fig. 9

2) Replacement work.
Refer to 1-5 "Periodic Maintenance Services".

High Tension Cords

INSPECTION

Check for:
1) Damage to cords, deformation, burning or rust formation of terminals.
2) Resistance values of cords.

Unit: [kΩ]

	MPFI & TURBO	SPFI
Distributor cord	2.43 – 5.67	2.43 – 5.67
#1 cord	9.48 – 22.13	8.38 – 19.56
#2 cord	2.99 – 6.97	2.99 – 6.97
#3 cord	9.58 – 22.36	7.90 – 18.44
#4 cord	2.41 – 5.62	2.41 – 5.62

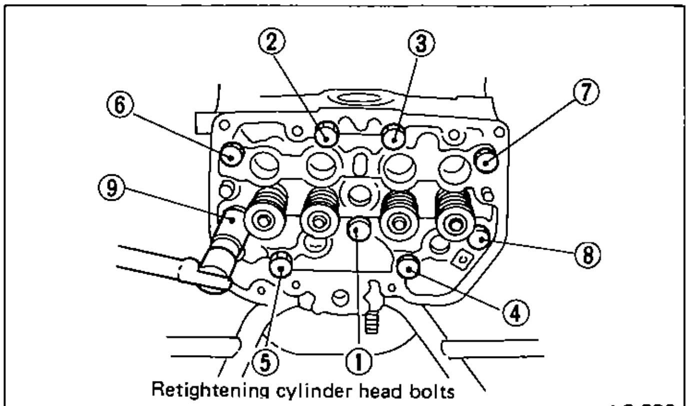


Fig. 10

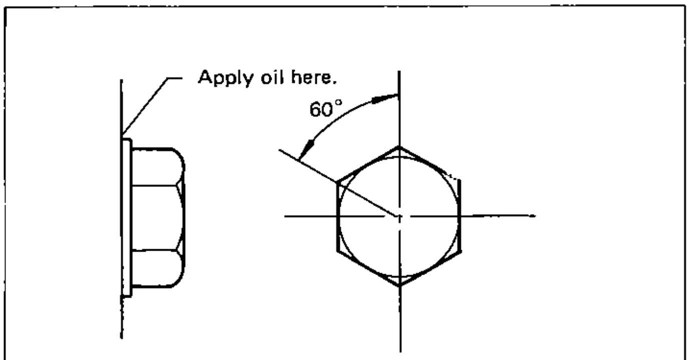


Fig. 11

Cylinder Head Bolts

RETORQUING

After completing engine ASSY and mounting engine on car, be sure to retighten cylinder head bolts.
1) Warm up engine.
2) After engine has cooled down, remove right and left valve rocker covers.
3) Loosen intake manifold (No. 1 and No. 3 cylinders side) mounting bolts (three) by 60°. Do not loosen mounting bolts of manifold for No. 2 and No. 4 cylinders.

Do not loosen the mounting bolts more than 90°, or water. may leak.

4) Loosen bolt at position ① in Figure, and apply oil to the thread. Repeat "loosen and tighten" operation four to five times within the 60° range for a better fit, then tighten bolt to the specified torque.

Specified torque:
64 N·m (6.5 kg-m, 47 ft-lb)

Tool Part No.	Tool Part Name
499987200	Socket wrench (17)

5) Similarly, retighten each bolt in the sequence from ② to ⑨ as shown in Figure.
Finally, retighten bolt ① to the specified torque without loosening.
6) After retightening right and left cylinder head bolts, tighten six mounting bolts of intake manifolds (No. 1 and No. 3) (No. 2 and No. 4).

Oil Pump Assembly

REMOVAL

1) Open the front hood.
2) Disconnect the ground cable from the battery.
3) Position the lift arm and raise the vehicle with a jack.

4) Remove the underguard, (4WD).
5) Remove the left and right undercovers.
6) Remove the belt cover plate, (TURBO).

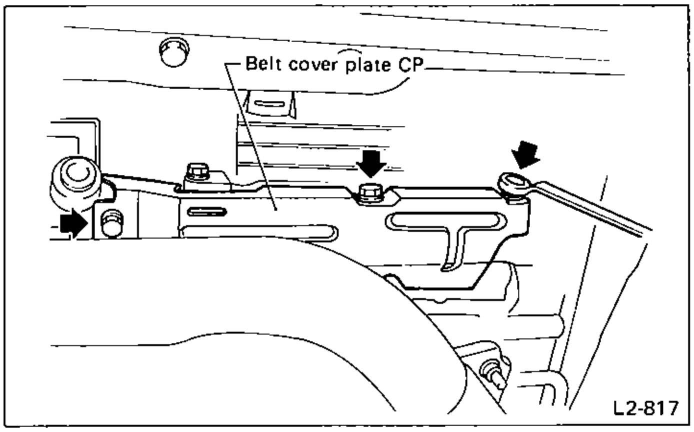


Fig. 12

7) Remove the bolts from the lower side of the radiator fan shroud.

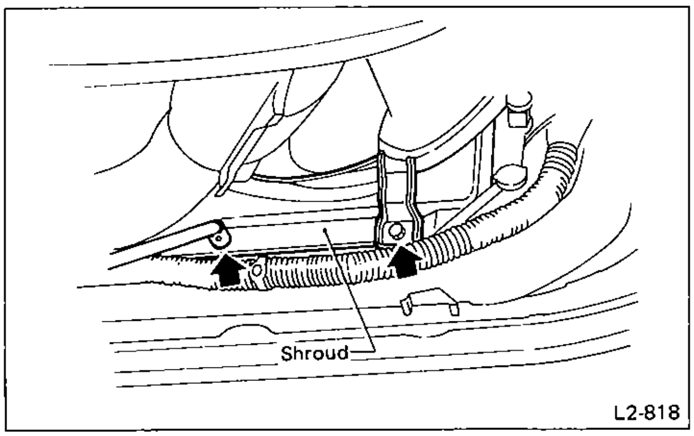


Fig. 13

8) Remove the bolts from the lower side of the air conditioner shroud, (A/C).
9) Lower the vehicle.
10) Remove the radiator fan shroud.
  (1) Disconnect the fan motor connector.
  (2) Remove the bolts from the upper side of the shroud.

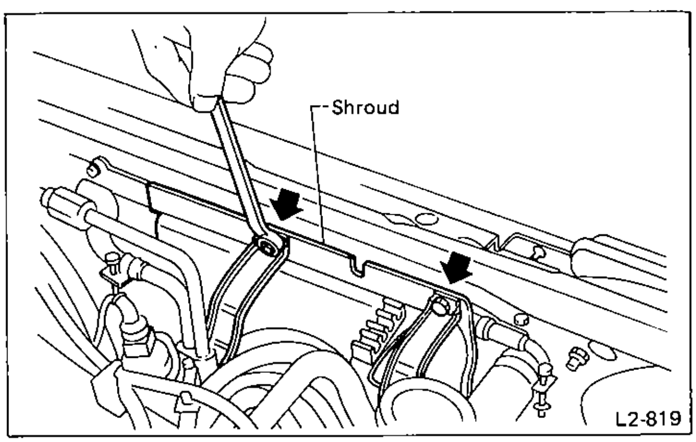


Fig. 14

  (3) Remove the canister hoses from their clamp.
  (4) Remove the radiator fan shroud.
11) Remove the air conditioner shroud, (A/C).

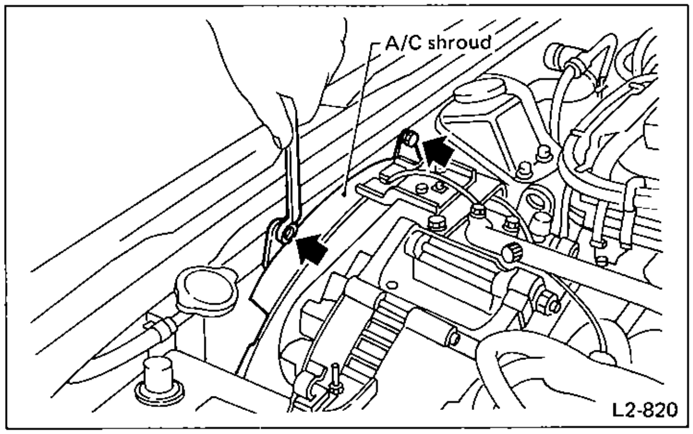


Fig. 15

12) Remove the pulser ASSY, (A/C).

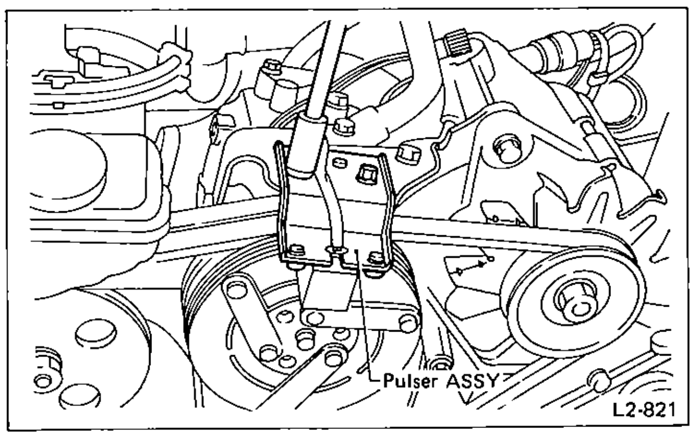


Fig. 16

13) Remove the engine slip fan ASSY, (A/C).
14) Remove the battery, (A/C).
15) Remove the alternator and V-belt.

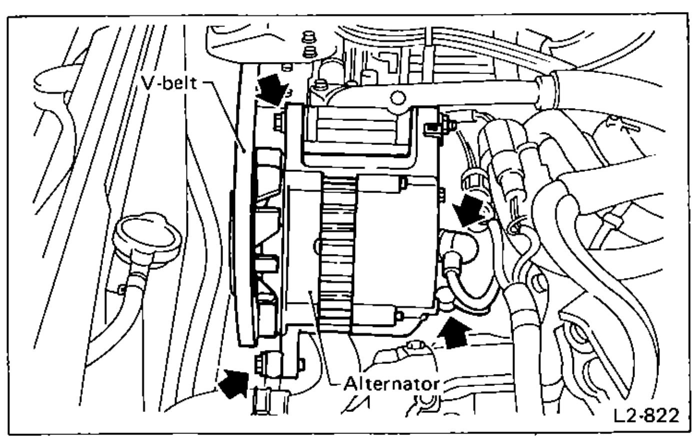


Fig. 17

16) Remove the oil level gauge guide and disconnect the oil pressure gauge harness.
17) Loosen the idler pulley and remove the belt. Then remove the pulley, (A/C).

Temporarily tighten the pulley nut to prevent the shaft from dropping.

18) Remove the compressor. Place a cloth on the battery bracket and position the compressor on the cloth, (A/C).

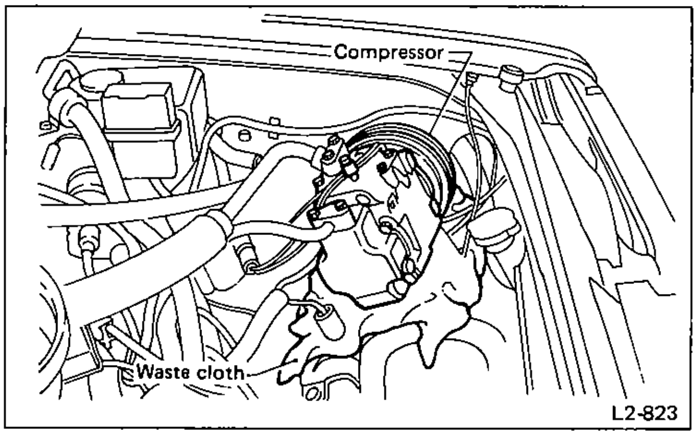


Fig. 18

19) Remove the water pump pulley.
20) Attach the STOPPER [498277000 (MT)/498497000 (AT)] to flywheel or torque converter to prevent it from turning. Remove the crank pulley.

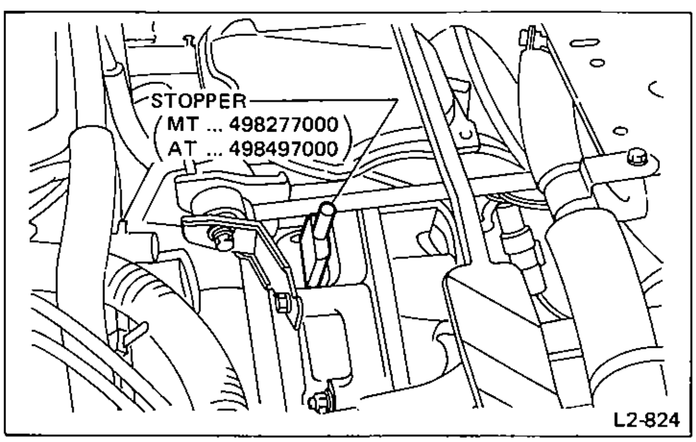


Fig. 19

21) Remove the LH, RH and FR belt covers, in that order.

22) Remove the right timing belt.

Draw an arrow on the left and right belts with a piece of chalk to indicate the direction of advance.

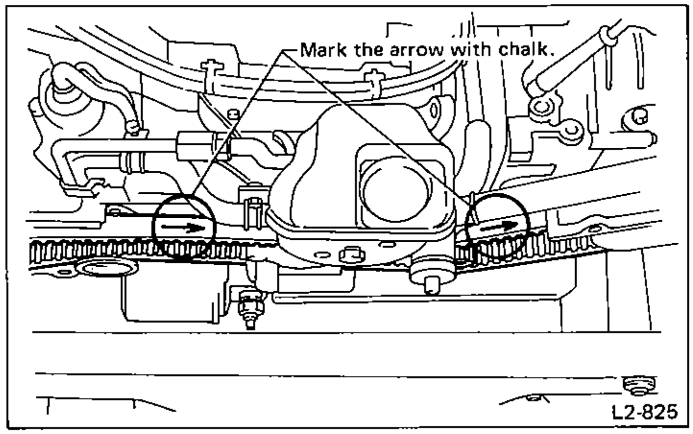


Fig. 20

(1) Loosen the two bolts which secure the tensioner. Move the tensioner in the direction which loosens it and temporarily tighten the bolts.

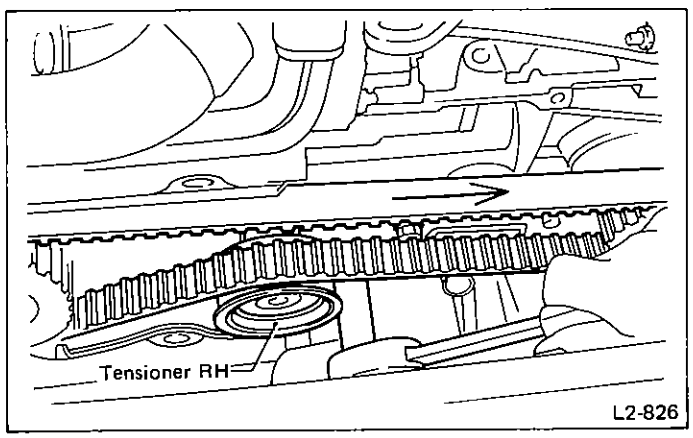


Fig. 21

(2) Remove the right timing belt.
23) Remove the crankshaft sprocket.
24) Remove the left timing belt.
(1) Loosen the two bolts which secure the tensioner. Move the tensioner in the direction which loosens it and temporarily tighten the bolts.

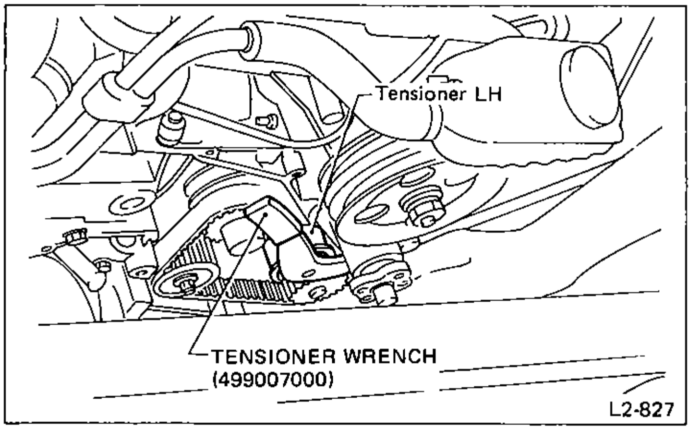


Fig. 22

Be careful not to scratch the crankshaft with a tensioner wrench.

(2) Remove the left timing belt.
25) Remove the belt idler.

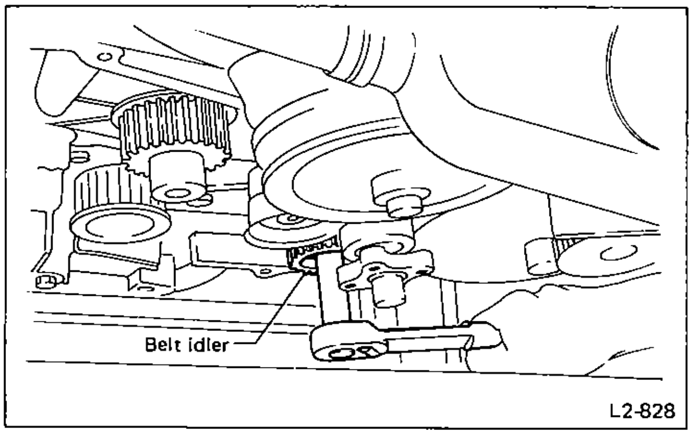


Fig. 23

26) Using the CAMSHAFT SPROCKET WRENCH (499207000), remove the left camshaft sprocket.
27) Remove the belt cover No. 2 (LH) and the belt cover (RR).
28) Remove the oil pump ASSY.

REINSTALLATION

1) Install the oil pump ASSY.

Replace the gasket with a new one.

2) Install the belt cover (RR) and the belt cover No. 2 (LH).
3) Install the camshaft sprocket on the right and left camshafts. Lock the camshaft using the CAMSHAFT SPROCKET WRENCH (499207000).
4) Install the belt idler.
5) Install the timing belt. (Refer to Chapter "2-3.")
6) Install the belt cover (FR) on the cylinder block.
Install the belt cover seals (FR and RR) and the timing cover plug on the belt cover (FR) in advance.

Before installing the belt cover (FR), check that there are no bolts, washers, etc. left in the cover.

7) Install the crank pulley.
Lock the crank pulley using the STOPPER [49827700 (MT)/ 498497000 (AT)].

Tightening torque:
93 – 103 N·m (9.5 – 10.5 kg-m, 69 – 76 ft-lb)

Apply a coat of engine oil to the crank pulley bolts before installation.

8) Install the left and right belt covers.
9) Install the oil level gauge guide.
10) Install the water pump pulley.
11) Install the air conditioner compressor and bracket, (A/C).
12) Position the V-belt and install the idler pulley. Adjust belt tension, (A/C).
13) Install the engine slip fan assembly, (A/C).
14) Install the alternator and V-belt, then adjust belt tension.
15) Install the upper radiator fan shroud and connect the connector.
16) Fasten the canister hose, etc. to the clamps.
17) Install the timing hole plug.
18) Raise the vehicle.
19) Install the lower radiator fan shroud.
20) Install the belt cover plate, (TURBO).
21) Lower the vehicle.
22) Install the battery, (A/C).
23) Connect the ground cable to the battery.
24) Start the engine.
25) Add engine oil to the oil pan.
26) Close the front hood and release the lift arm.

Water Pump Assembly

REMOVAL

1) Open the front hood.
2) Disconnect the ground cable from the battery.
3) Drain the coolant completely.
4) Disconnect the radiator outlet hose.

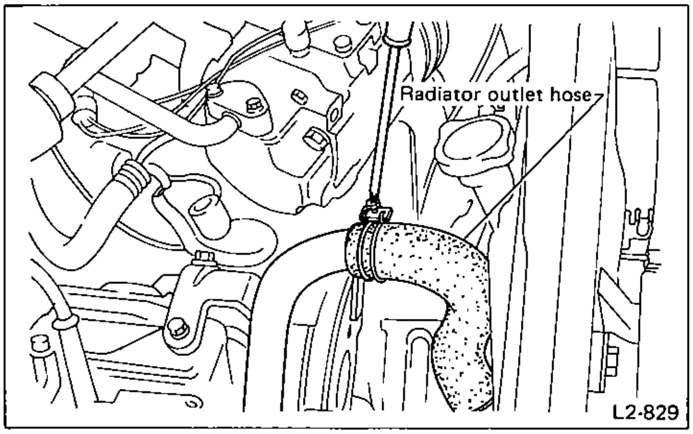


Fig. 24

5) Remove the alternator and V-belt.
6) Disconnect the water by-pass hose from the pipe.

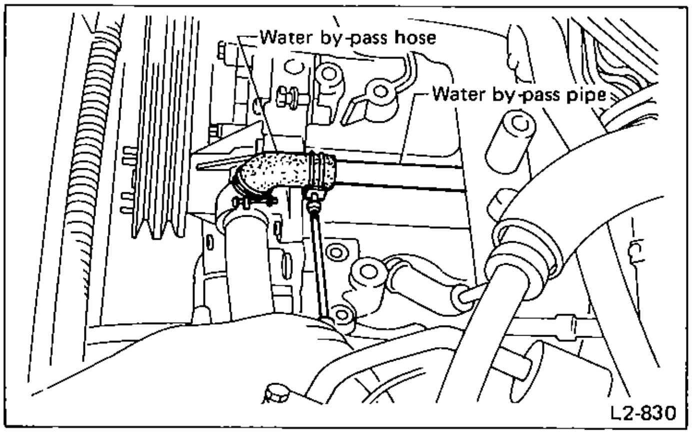


Fig. 25

7) Unfasten clips which secure the oil pressure switch harness.
8) Remove the oil level gauge guide.
9) Remove the water pump pulley.
10) Using the stopper, remove the crank pulley.
11) Set the lift arm and raise the vehicle.
12) Remove the belt cover plate, (TURBO).
13) Lower the vehicle.
14) Disconnect the water pipe.

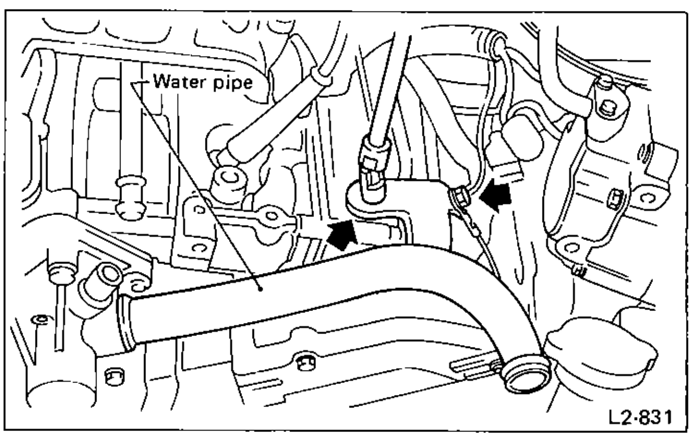


Fig. 26

15) Remove the LH, RH and FR belt covers, in that order.
16) Remove the water pump ASSY.

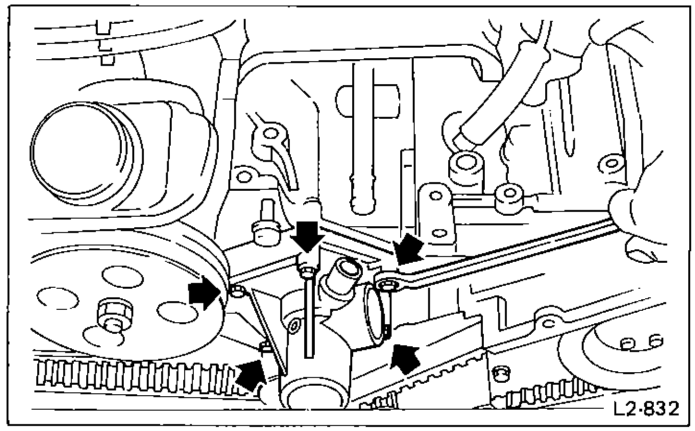


Fig. 27

REINSTALLATION

1) Install the water pump ASSY.

Replace the gasket with a new one.

2) Install the FR, RH and LH belt covers.
3) Connect the water pipe.
4) Raise the vehicle.
5) Install the belt cover plate.
6) Lower the vehicle.
7) Install the crank pulley.
8) Install the water pump pulley.
9) Install the oil level gauge guide.
10) Clamp the oil pressure switch harness clip.
11) Connect the water bypass hose to the pipe.
12) Install the alternator and V-belt.
13) Connect the radiator outlet hose.
14) Add coolant in the radiator.
15) Connect the ground cable to the battery.
16) Start the engine and check the coolant level.
17) Close the front hood and release the lift arm.

SUBARU

1989

MECHANISM AND FUNCTION

General

The SUBARU 1800 4-Door sedan, station wagon and 3-Door house a horizontally-opposed 4-cylinder, 4-stroke cycle, liquid cooled OHC gasoline engine. This well-balanced engine, adopting a horizontally opposed piston arrangement, is made of an aluminium alloy, and is light weight and compact in construction. This engine also adopts the OHC (Over-Head Camshaft) system, hydraulic lash adjuster, fuel injection system, and turbocharger, attaining easier maintenances servicing, and reliability as well as low fuel consumption, low noise and powerful performance.

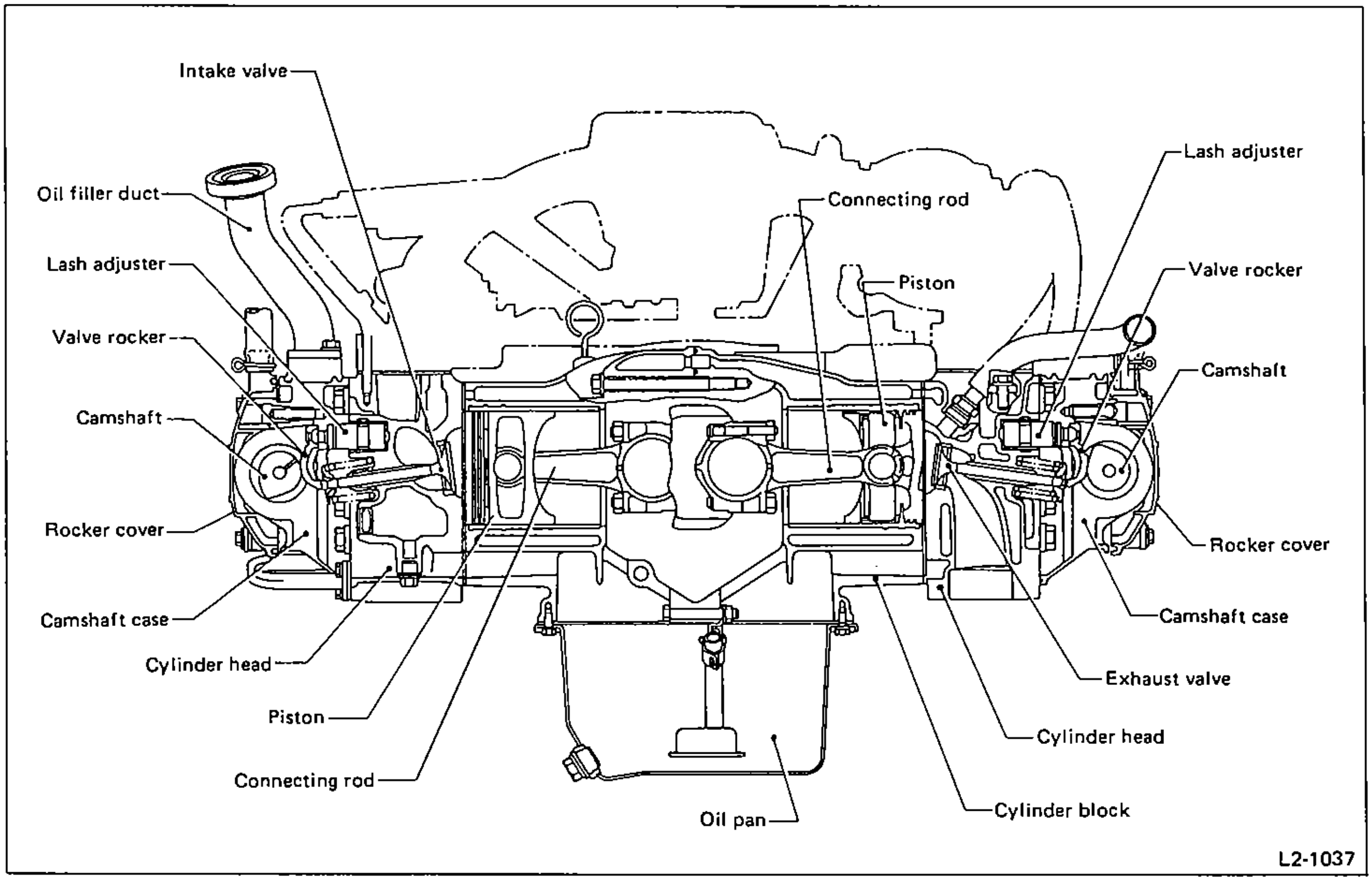


Fig. 1

CYLINDER BLOCK

1) The cylinder block, made of an aluminium alloy, is light weight and provides good heat conduction, and is divided into two portions, left-side half and right-side half, due to the adoption of a horizontally opposed piston arrangement.
2) The rotor housing for the oil pump is built into the cylinder block in order to reduce the total length of the engine.
3) The cylinder liner is a cast and dry type.

CYLINDER HEAD

1) The cylinder head, made of an aluminium alloy, forms a part of the bath-tub type combustion chamber which features higher combustion efficiency.
2) The intake and exhaust ports are laid out so as to minimize resistance for the intake air and exhaust gases, and they improve suction and discharge efficiencies.

HEAD GASKET

1) The cylinder head gaskets are provided with wire rings at the bore sections in order to increase pressure- and heat-resistant properties as well as an effective seal.
2) The oil passage is provided with an O-ring to improve sealing.
3) The head gasket for the TURBO model uses a carbon sheet, and for the other model a silicon-coated asbestos.

CAMSHAFT CASE

1) The camshaft case holds the camshaft, and is an aluminium die-casting.
2) The oil relief valve for the hydraulic lash adjuster is built into the cam case.
The oil filler duct is mounted on the right-hand camshaft case, and the distributor on the left-hand camshaft case.
3) The camshaft case has a groove all around the cylinder head mating surface, and fluid packing is filled into this groove for sealing.

ROCKER COVER

1) The rocker cover is a light-weight and compact aluminium die-casting.
2) This rocker cover adopts a float-supporting system with a rubber ring type gasket and an oil seal washer to reduce the noise level.

CRANKSHAFT

The crankshaft is made from special wrought iron which provides sturdiness. All corners of the journals are processed with "deep roll" treatment.
The horizontally opposed engine configuration provides greater strength against bending and torsional stresses while reducing the total length of the crankshaft.

PISTON AND PISTON RING

1) The piston is cast from aluminum alloy which features a small thermal expansion rate. Its top land is provided with valve relief and its skirt section has an elliptical, tapered design to provide heat- and wear-resistance.
The shaped piston and short piston pin effectively reduce the weight of the piston ASSY.
2) Three piston rings are used for each piston — two compression rings and one oil ring.
These piston rings have small wall thickness to reduce weight and oil consumption.

OIL PAN

The oil pan incorporates a double-layer baffle plate to stabilize the oil surface, and also improves rigidity along with reducing noise.

Valve Mechanism

The valve mechanism adopts a timing belt driven over-head camshaft (OHC) type. This OHC features reduced inertia mass of the valve mechanism, and superior valve follow-up performance from low to high engine speeds. The valve mechanism is provided with the hydraulic lash adjusters for maintenance-free and noiseless valve operation.

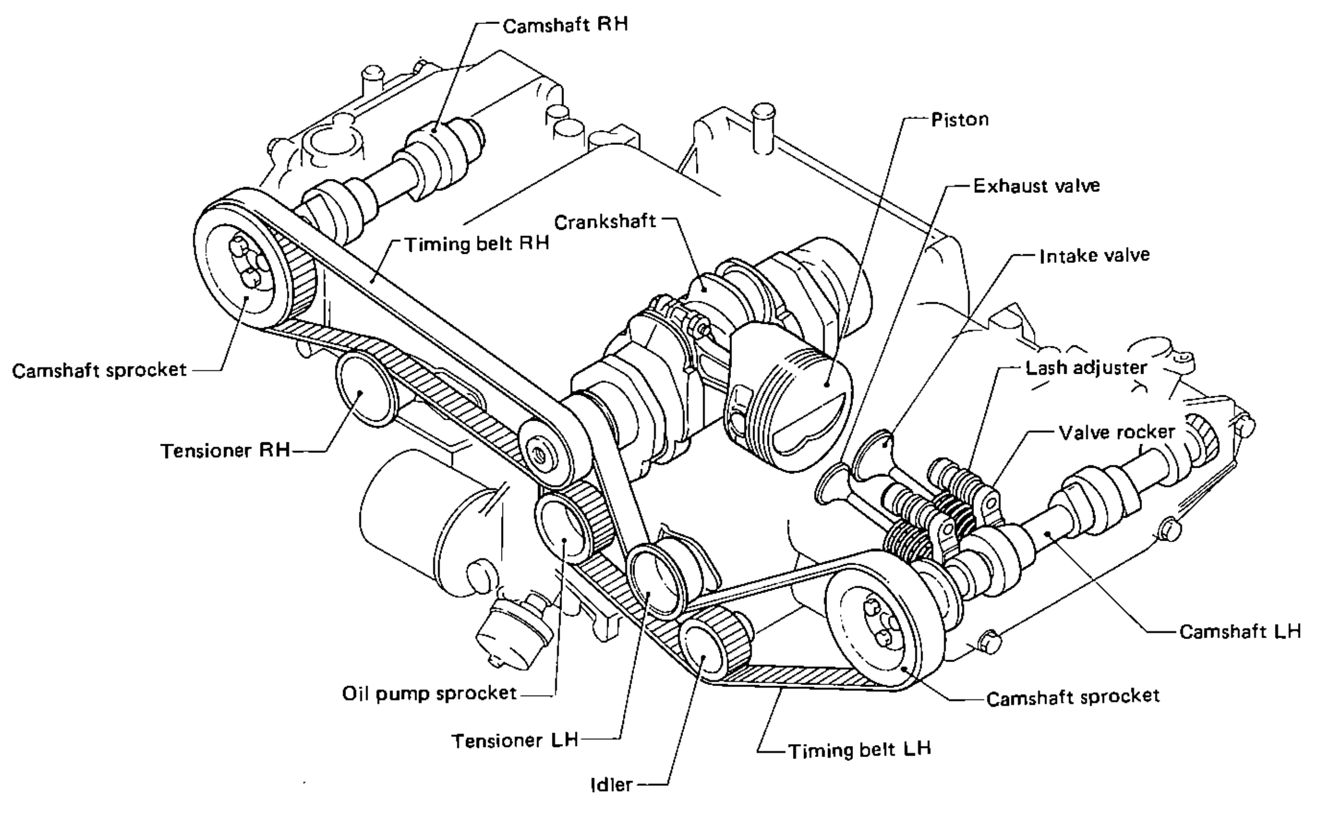


Fig. 2

CAMSHAFT

1) The camshafts are made of special cast iron, and are completely treated with Lubrite except for the bearing portions to improve initial fitting to the rocker arms. The cam rubbed surface is chilled to increase wear-resistance.
2) The cam profile is specially designed for this OHC type, and features higher output and less fuel consumption.
3) The cam base circle has an oil hole for lubricating the rocker arm. The distributor drive gear is mounted on the left-hand camshaft.

VALVE ROCKER AND VALVE LASH ADJUSTER

1) The rocker arms are special steel forgings having great strength and rigidity. Each arm is fitted with a sintered metal tip to improve wear resistance.
2) The hydraulic valve lash adjuster eliminates the need for valve clearance adjustment.
3) The rocker arms and valve lash adjusters are common between intake and exhaust valves.

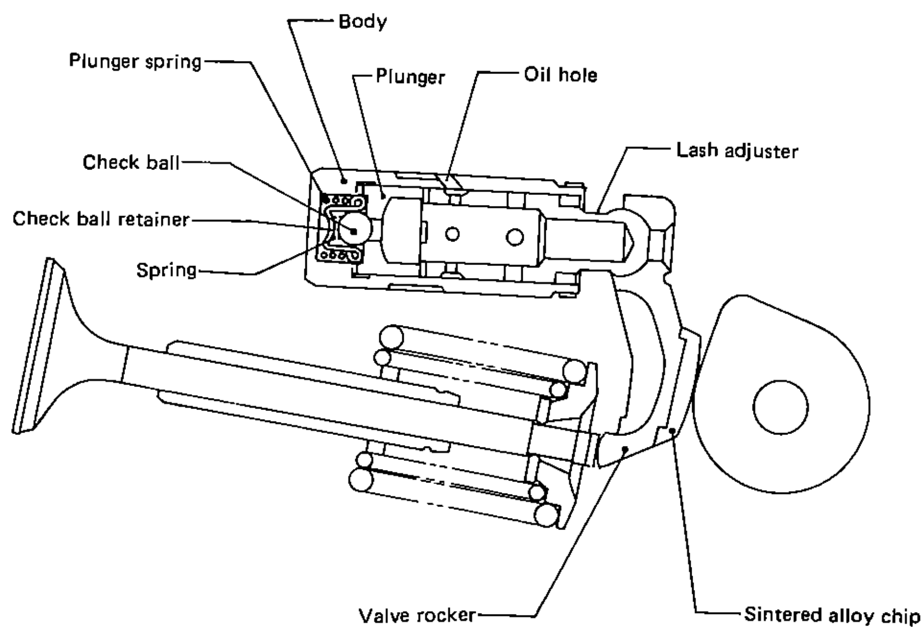


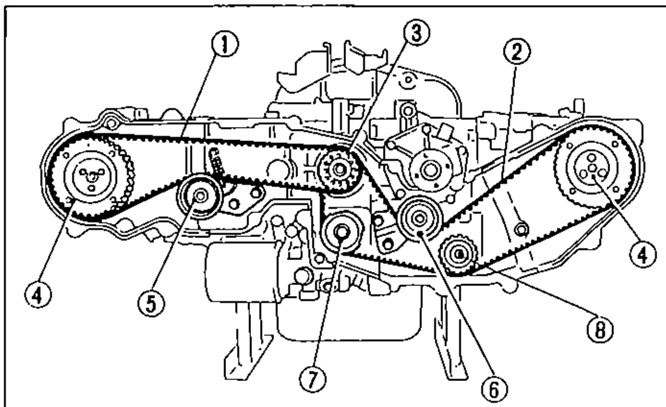
Fig. 3

VALVE AND VALVE SPRING

1) The valve has a small valve stem diameter [7 mm (0.28 in) dia.] to reduce the valve weight. The variable pitch valve spring is adopted to improve valve follow-up performance at high engine speeds.
2) The valve has a large valve head diameter to increase engine output.

TIMING BELT, TENSIONER AND SPROCKET

1) Two timing belts drive the left and right-hand camshafts. The timing belt is composed of a core featuring great strength and less elongation, canvas (tooth face portion) having superior wear resistance, and highly heat-resistant rubber.
2) The timing belt has special round teeth featuring positive engagement with sprocket teeth and smooth and low-noise operation. The crankshaft sprockets, oil pump sprocket and idler are made of sintered alloy.
3) The camshaft sprockets are made of sheet metal, and are common between right and left.
4) A grease-sealed type ball bearing is used in the tensioner. The tensioner spring gives the timing belt an initial tension which is adjustable by loosening the tensioner mounting bolt.



1	Timing belt RH	5	Tensioner RH
2	Timing belt LH	6	Tensioner LH
3	Crankshaft sprocket	7	Oil pump sprocket
4	Camshaft sprocket	8	Idler

L2-996

Fig. 4

TIMING BELT COVER

1) The resin-mold timing belt cover, consisting of six pieces, is used to protect the timing belt against dust and water.
2) Each of the left-hand and right-hand side covers has an access hole for belt tensioner adjustment.

SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

			SPFI	MPFI TURBO
ENGINE	Type		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
	Valve arrangement		Over-head camshaft type	
	Bore x Stroke mm (in)		92 x 67 (3.62 x 2.64)	
	Piston displacement cm^3 (cc, cu in)		1,781 (1,781, 108.68)	
	Compression ratio		9.5	7.7
	Compression pressure (at 350 rpm) kPa (kg/cm^2, psi)		1,157 (11.8, 168)	1,000 (10.2, 145)
	Number of piston rings		Pressure ring: 2, Oil ring: 1	
	Intake valve timing	Opening	10° BTDC	14° BTDC
		Closing	54° ABDC	56° ABDC
	Exhaust valve timing	Opening	49° BBDC	56° BBDC
		Closing	15° ATDC	14° ATDC
	Idling speed (At neutral (on N) or P position) rpm		MT: 700 ± 100 AT: 700 ± 100	MT: 700 ± 100 AT: 800 ± 100
	Firing order		1 → 3 → 2 → 4	
	Ignition timing BTDC/rpm		MT: 20°/700 AT: 20°/700	MT: 20°/700 AT: 20°/800

SERVICE DATA

Cylinder head	Surface warpage limit				0.05 mm	(0.0020 in)
	Surface grinding limit				0.3 mm	(0.012 in)
	Standard height				90.6 mm	(3.567 in)
Valve set	Refacing angle				90°	
	Wear limit				0.5 mm	(0.020 in)
	Contacting width			Intake	1.2 – 1.8 mm	(0.047 – 0.071 in)
				Exhaust	1.5 – 2.0 mm	(0.059 – 0.079 in)
Valve guide	Inner diameter				7.000 – 7.015 mm	(0.2756 – 0.2762 in)
	Protrusion above head				17.5 – 18.5 mm	(0.689 – 0.728 in)
Valve stem	Head edge thickness	Non-TURBO		STD	1.3 mm	(0.051 in)
				Limit	0.8 mm	(0.031 in)
		TURBO	Intake	STD	1.3 mm	(0.051 in)
				Limit	0.8 mm	(0.031 in)
			Exhaust	STD	1.8 mm	(0.071 in)
				Limit	1.3 mm	(0.051 in)
	Stem diameter			Intake	6.950 – 6.965 mm	(0.2736 – 0.2742 in)
				Exhaust	6.945 – 6.960 mm	(0.2734 – 0.2740 in)
	Stem oil clearance	STD		Intake	0.035 – 0.065 mm	(0.0014 – 0.0026 in)
				Exhaust	0.040 – 0.070 mm	(0.0016 – 0.0028 in)
		Limit			0.15 mm	(0.0059 in)
	Overall length	Non-TURBO			107.58 mm	(4.2354 in)
		TURBO		Intake	107.58 mm	(4.2354 in)
				Exhaust	108.1 mm	(4.256 in)
Valve spring	Free length			Outer spring	50.7 mm	(1.996 in)
				Inner spring	50.3 mm	(1.980 in)
	Squareness			Outer spring	2.2 mm	(0.087 in)
				Inner spring	2.2 mm	(0.087 in)
	Tension/spring height			Outer spring	203.0 – 238.3 N (20.7 – 24.3 kg, 45.6 – 53.6 lb)/ 41.5 mm (1.634 in) 502.1 – 576.7 N (51.2 – 58.8 kg, 112.9 – 129.7 lb)/ 31.5 mm (1.240 in)	
				Inner spring	88.3 – 101.0 N (9.0 – 10.3 kg, 19.8 – 22.7 lb)/ 38.5 mm (1.516 in) 201.0 – 230.5 N (20.5 – 23.5 kg, 45.2 – 51.8 lb)/ 28.5 mm (1.122 in)	

STD: Standard

Valve lash adjuster	Outer diameter		21.380 – 21.393 mm	(0.8417 – 0.8422 in)
	Cylinder head adjuster hole I.D.		21.413 – 21.470 mm	(0.8430 – 0.8453 in)
	Adjuster-to-hole clearance	STD	0.020 – 0.090 mm	(0.0008 – 0.0035 in)
		Limit	0.1 mm	(0.004 in)
Cylinder block	Surface warpage limit (mating with cylinder head)		0.05 mm	(0.0020 in)
	Surface grinding limit		0.4 mm	(0.016 in)
	Metal housing I.D.		59.000 – 59.018 mm	(2.3228 – 2.3235 in)
	Oil seal hole I.D.	Front and center	59.000 – 59.030 mm	(2.3228 – 2.3240 in)
		Rear	93.000 – 93.035 mm	(3.6614 – 3.6628 in)
	Cylinder bore	STD	91.985 – 92.015 mm	(3.6214 – 3.6226 in)
		Taper limit	0.050 mm	(0.0020 in)
		Out-of-roundness limit	0.050 mm	(0.0020 in)
	Piston clearance	Non-TURBO STD	0.015 – 0.035 mm	(0.0006 – 0.0014 in)
		Limit	0.060 mm	(0.0024 in)
		TURBO STD	0.010 – 0.030 mm	(0.0004 – 0.0012 in)
		Limit	0.050 mm	(0.0020 in)
		Enlarging (boring) limit	0.3 mm	(0.012 in)
Piston	Outer diameter STD	Non-TURBO	91.970 – 91.980 mm	(3.6209 – 3.6213 in)
		TURBO	91.975 – 91.985 mm	(3.6211 – 3.6214 in)
	0.25 mm (0.0098 in) OS	Non-TURBO	92.220 – 92.230 mm	(3.6583 – 3.6311 in)
		TURBO	92.225 – 92.235 mm	(3.6585 – 3.6589 in)
	0.50 mm (0.0197 in) OS	Non-TURBO	92.470 – 92.480 mm	(3.6405 – 3.6409 in)
		TURBO	92.475 – 92.485 mm	(3.6407 – 3.6411 in)
	Standard inner diameter of piston pin hole		20.999 – 21.009 mm	(0.8267 – 0.8271 in)
Piston pin	Outer diameter		20.994 – 21.000 mm	(0.8265 – 0.8268 in)
	Standard clearance between piston pin and hole in piston		0.001 – 0.015 mm	(0.00004 – 0.00059 in)
	Degree of fit		Piston pin must be fitted into position with thumb at 20°C (68°F).	
	Standard clearance between piston pin and hole in connecting rod		0 – 0.022 mm	(0 – 0.0009 in)
Piston ring	Width	Top ring	1.17 – 1.19 mm	(0.0461 – 0.0469 in)
		Second ring	1.47 – 1.49 mm	(0.0579 – 0.0587 in)
		Oil ring	Combination ring	
	Radial wall thickness	Top ring	3.2 – 3.4 mm	(0.126 – 0.134 in)
		Second ring	3.6 – 3.8 mm	(0.142 – 0.150 in)
		Oil ring	Combination ring	
	Piston ring gap	Top & Second ring STD	0.2 – 0.35 mm	(0.0079 – 0.0138 in)
		Limit	1.5 mm	(0.059 in)
		Oil ring STD	0.3 – 0.9 mm	(0.012 – 0.035 in)
		Limit	2.0 mm	(0.079 in)
	Clearance between piston ring and piston ring groove	Top ring STD	0.040 – 0.080 mm	(0.0016 – 0.0031 in)
		Limit	0.15 mm	(0.0059 in)
		Second ring STD	0.030 – 0.070 mm	(0.0012 – 0.0028 in)
		Limit	0.15 mm	(0.0059 in)
		Oil ring STD	0 mm	(0 in)
		Limit	0 mm	(0 in)

STD: Standard **OS: Oversize**

Connecting rod	Distance between big end and small end hole			116.95 – 117.05 mm (4.6043 – 4.6083 in)
	Crank pin bore diameter			48.000 – 48.019 mm (1.8898 – 1.8905 in)
	Piston pin bore diameter			21.000 – 21.016 mm (0.8268 – 0.8274 in)
	Width at big end			19.35 – 19.43 mm (0.7618 – 0.7650 in)
	Side clearance		STD	0.070 – 0.330 mm (0.0028 – 0.0130 in)
			Limit	0.4 mm (0.016 in)
	Bend twist per 100 mm (3.94 in) in length		Limit	0.10 mm (0.0039 in)
Connecting rod bearing	Thickness at center portion		STD	1.485 – 1.490 mm (0.0585 – 0.0587 in)
			0.03 mm (0.0012 in) US	1.500 – 1.505 mm (0.0591 – 0.0593 in)
			0.05 mm (0.0020 in) US	1.510 – 1.515 mm (0.0594 – 0.0596 in)
			0.25 mm (0.0098 in) US	1.610 – 1.615 mm (0.0634 – 0.0636 in)
	Oil clearance		STD	0.010 – 0.054 mm (0.0004 – 0.0021 in)
			Limit	0.10 mm (0.0039 in)
Crankshaft	Bend limit			0.035 mm (0.0014 in)
	Thrust clearance		STD	0.010 – 0.095 mm (0.0004 – 0.0037 in)
			Limit	0.30 mm (0.0118 in)
	Crank journal outer diameter	Front	STD	54.957 – 54.972 mm (2.1637 – 2.1642 in)
			0.03 mm (0.0012 in) US	54.927 – 54.942 mm (2.1625 – 2.1631 in)
			0.05 mm (0.0020 in) US	54.907 – 54.922 mm (2.1617 – 2.1623 in)
			0.25 mm (0.0098 in) US	54.707 – 54.722 mm (2.1538 – 2.1544 in)
		Center	STD	54.954 – 54.970 mm (2.1635 – 2.1642 in)
			0.03 mm (0.0012 in) US	54.924 – 54.940 mm (2.1624 – 2.1630 in)
			0.05 mm (0.0020 in) US	54.904 – 54.920 mm (2.1616 – 2.1622 in)
			0.25 mm (0.0098 in) US	54.704 – 54.720 mm (2.1537 – 2.1543 in)
		Rear	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)
	Width at center portion			25.970 – 26.015 mm (1.0224 – 1.0242 in)
	Oil clearance	Front & Rear	STD	0.003 – 0.036 mm (0.0001 – 0.0014 in)
			Limit	0.055 mm (0.0022 in)
		Center	STD	0.008 – 0.027 mm (0.0003 – 0.0011 in)
			Limit	0.045 mm (0.0018 in)
	Out-of roundness			0.030 mm (0.0012 in) or less
	Grinding limit			0.250 mm (0.0098 in)
	Crankpin outer diameter		STD	44.995 – 45.010 mm (1.7715 – 1.7720 in)
			0.03 mm (0.0012 in) US	44.965 – 44.980 mm (1.7703 – 1.7709 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)
	Width			19.50 – 19.68 mm (0.7677 – 0.7748 in)
	Oil clearance		STD	0.010 – 0.054 mm (0.0004 – 0.0021 in)
			Limit	0.10 mm (0.0039 in)
	Out-of roundness			0.030 mm (0.0012 in) or less
	Grinding limit			0.250 mm (0.0098 in)

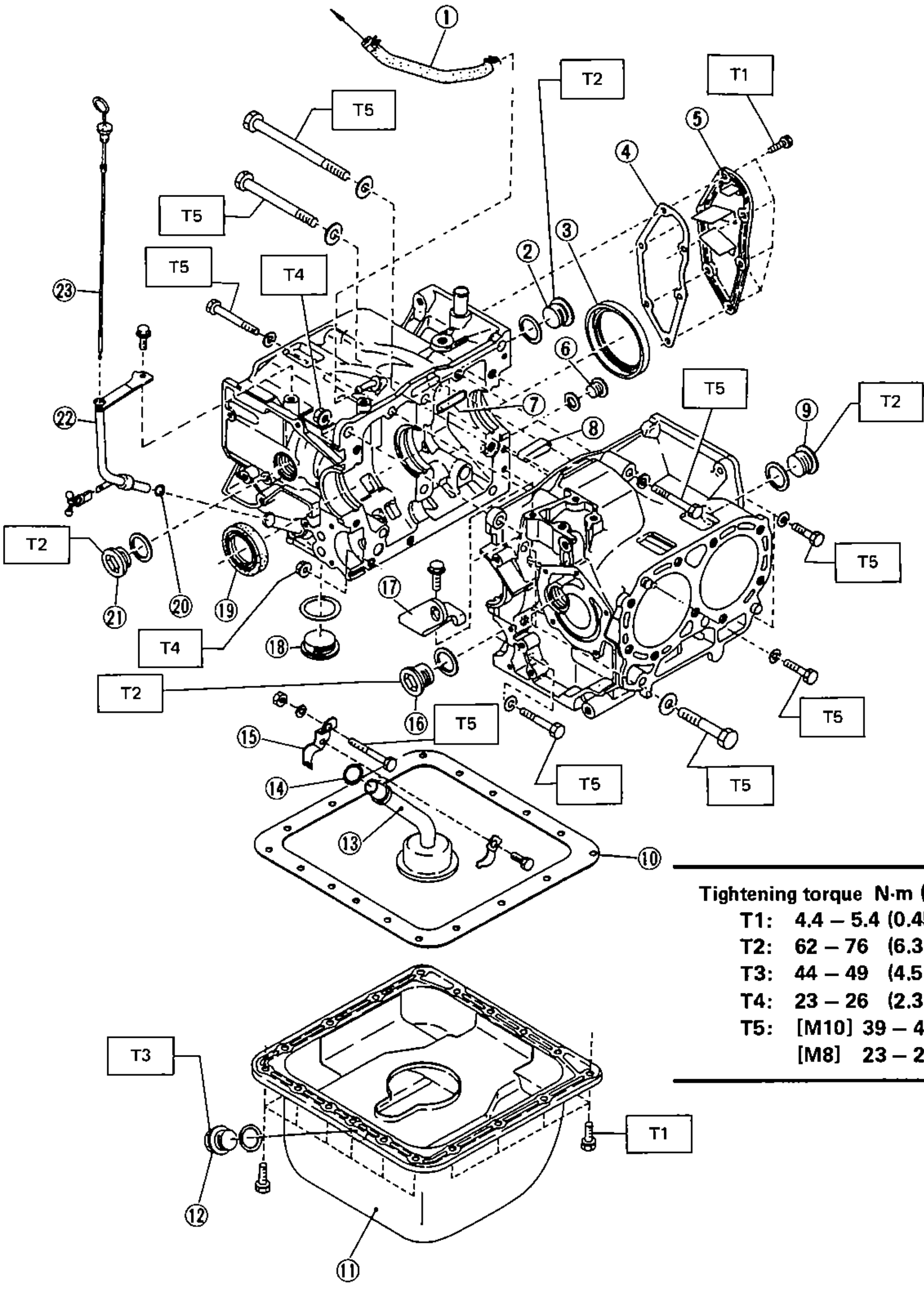
STD: Standard **OS: Oversize** **US: Undersize**

Crankshaft bearing	Thickness	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	2.019 – 2.022 mm	(0.0795 – 0.0796 in)
			0.03 mm (0.0012 in) US	2.034 – 2.037 mm	(0.0801 – 0.0802 in)
			0.05 mm (0.0020 in) US	2.044 – 2.047 mm	(0.0805 – 0.0806 in)
			0.25 mm (0.0098 in) US	2.144 – 2.147 mm	(0.0844 – 0.0845 in)
	Width	Center	STD	25.920 – 25.960 mm	(1.0205 – 1.0220 in)
Camshaft	Bend limit			0.025 mm	(0.0010 in)
	Thrust clearance			0.030 – 0.260 mm	(0.0012 – 0.0102 in)
	Cam lobe height		STD	39.75 – 39.85 mm	(1.5650 – 1.5689 in)
			Wear limit	0.15 mm	(0.0059 in)
	Cam journal outer diameter	Front		37.964 – 37.980 mm	(1.4946 – 1.4953 in)
		Center		48.464 – 48.480 mm	(1.9080 – 1.9087 in)
		Rear		47.964 – 47.980 mm	(1.8883 – 1.8890 in)
		LH distributor		38.964 – 38.980 mm	(1.5340 – 1.5346 in)
	Oil clearance		STD	0.020 – 0.054 mm	(0.0008 – 0.0021 in)
			Limit	0.070 mm	(0.0028 in)
Camshaft case	Camshaft journal inner diameter	Front		38.000 – 38.018 mm	(1.4961 – 1.4968 in)
		Center		48.500 – 48.518 mm	(1.9094 – 1.9102 in)
		Rear		48.000 – 48.018 mm	(1.8898 – 1.8905 in)
		Distributor		39.000 – 39.018 mm	(1.5354 – 1.5361 in)
	Camshaft support depth of spigot			19.00 – 19.08 mm	(0.7480 – 0.7512 in)
Camshaft support	I.D.			38.000 – 38.018 mm	(1.4961 – 1.4968 in)
	O.D.			57.971 – 59.990 mm	(2.2823 – 2.3618 in)
	Height of spigot			14.95 – 15.00 mm	(0.5886 – 0.5906 in)

STD: Standard **US: Undersize**

COMPONENT PARTS

Cylinder Block and Oil Pan



1 Air bleed hose
2 Service hole plug
3 Oil seal (Rear)
4 Oil separator cover gasket
5 Oil separator cover
6 Main gallery plug
7 Cylinder block O-ring
8 Back-up ring
9 Service hole plug
10 Oil pan gasket
11 Oil pan
12 Oil drain plug
13 Oil strainer
14 O-ring
15 Oil strainer stay
16 Service hole plug
17 Front engine hanger
18 Cylinder block plug
19 Oil seal (Front)
20 O-ring
21 Service hole plug
22 Oil level gauge guide
23 Oil level gauge

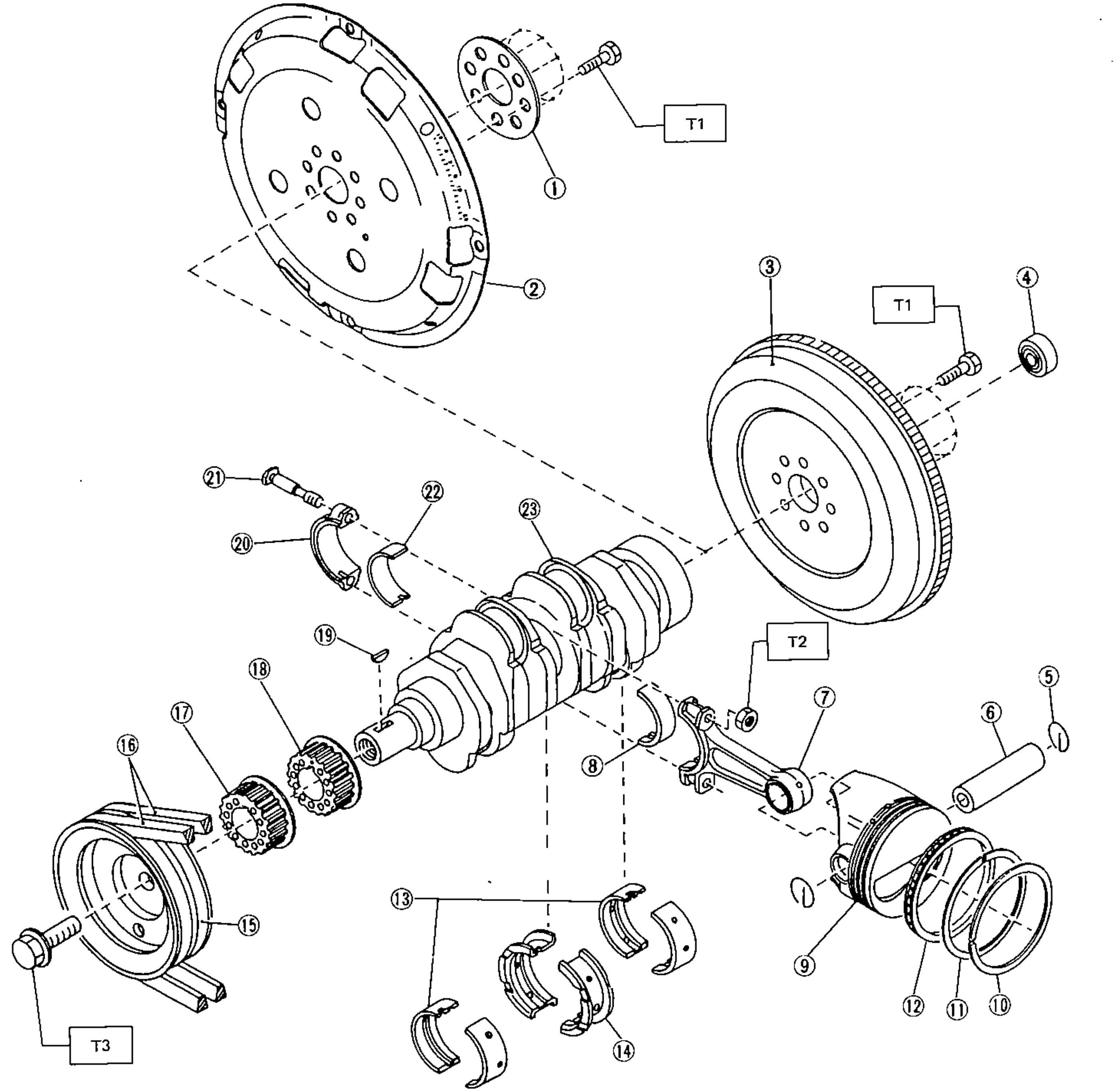
Tightening torque N·m (kg-m, ft-lb)

T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T2: 62 – 76 (6.3 – 7.7, 46 – 56)
T3: 44 – 49 (4.5 – 5.0, 33 – 36)
T4: 23 – 26 (2.3 – 2.7, 17 – 20)
T5: [M10] 39 – 47 (4.0 – 4.8, 29 – 35)
[M8] 23 – 26 (2.3 – 2.7, 17 – 20)

Fig. 5

L2-573

Crankshaft and Piston



1 Reinforcement
2 Drive plate
3 Flywheel
4 Ball bearing
5 Circlip
6 Piston pin
7 Connecting rod
8 Connecting rod bearing
9 Piston
10 Top ring
11 Second ring
12 Oil ring
13 Crankshaft bearing (Front and rear)
14 Crankshaft bearing (Center)
15 Crankshaft pulley
16 V-velt
17 Crankshaft sprocket CP
18 Crankshaft sprocket No. 2
19 Woodruff key
20 Connecting rod cap
21 Connecting rod cap bolt
22 Connecting rod bearing
23 Crankshaft

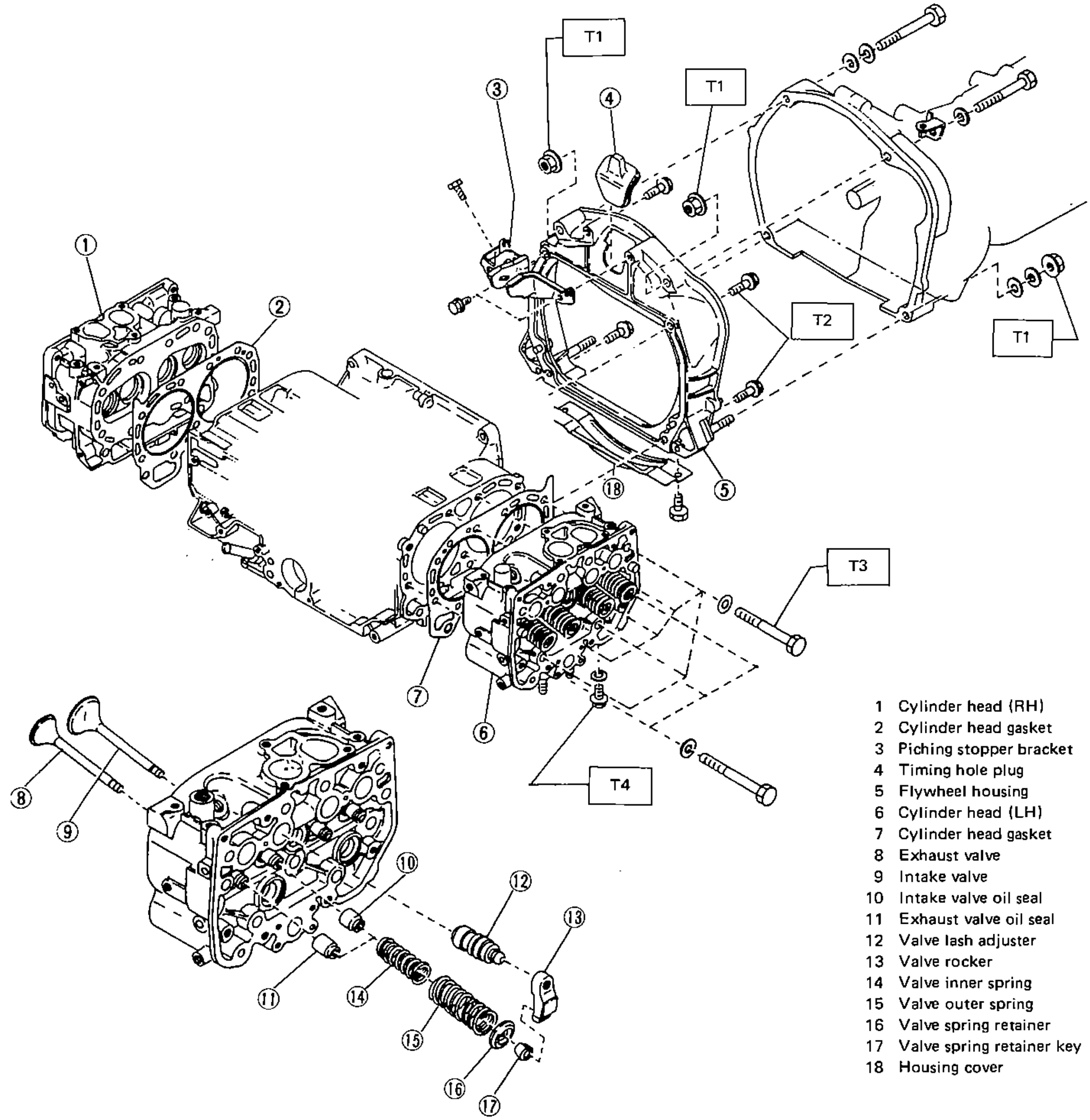
Tightening torque N·m (kg-m, ft-lb)

T1:	**69 – 75 (7.0 – 7.6, 51 – 55)**
T2:	**39 – 42 (4.0 – 4.3, 29 – 31)**
T3:	**89 – 107 (9.1 – 10.9, 66 – 79)**

Fig. 6

L2-137

Cylinder Head and Flywheel Housing



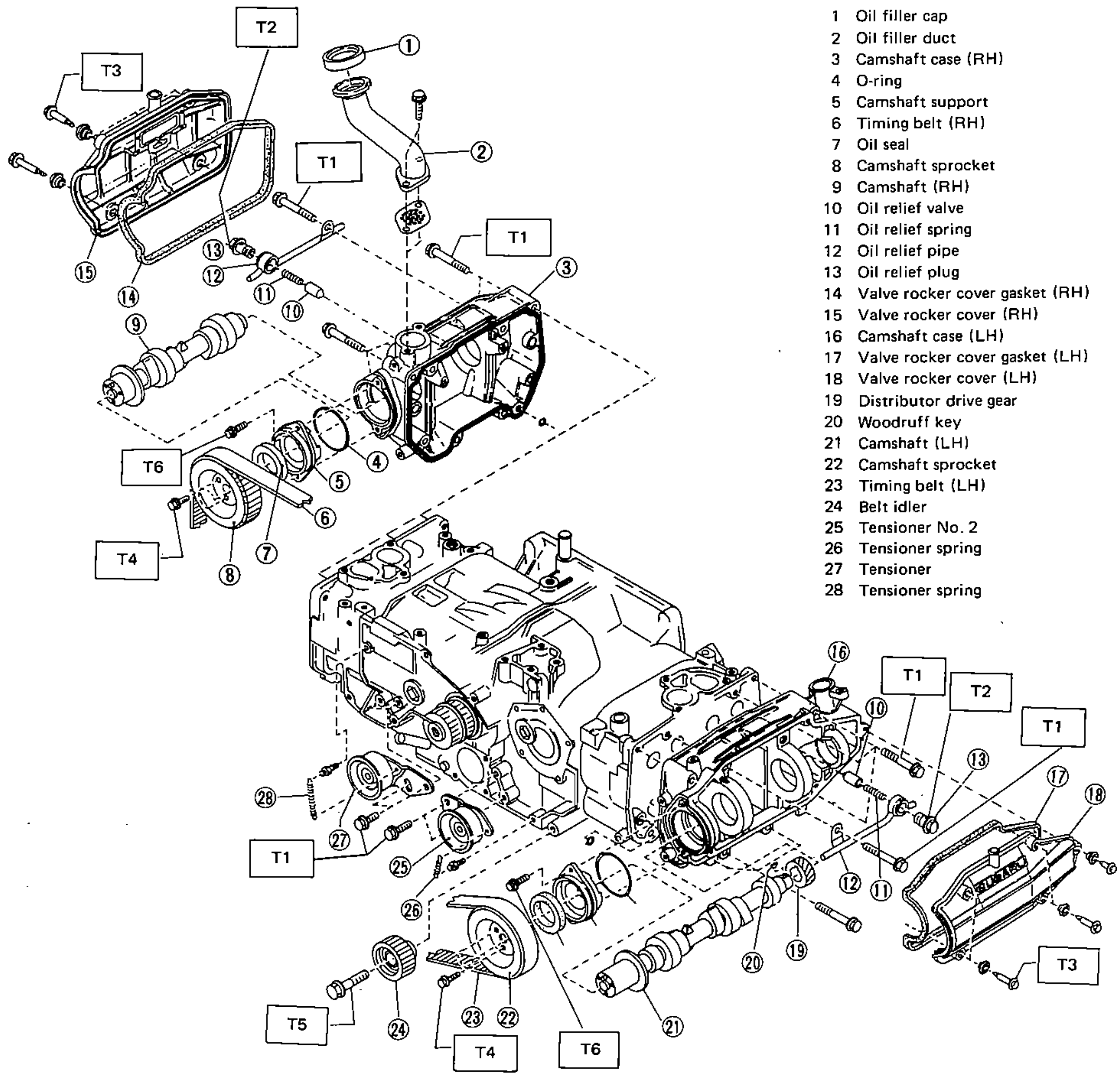
1 Cylinder head (RH)
2 Cylinder head gasket
3 Piching stopper bracket
4 Timing hole plug
5 Flywheel housing
6 Cylinder head (LH)
7 Cylinder head gasket
8 Exhaust valve
9 Intake valve
10 Intake valve oil seal
11 Exhaust valve oil seal
12 Valve lash adjuster
13 Valve rocker
14 Valve inner spring
15 Valve outer spring
16 Valve spring retainer
17 Valve spring retainer key
18 Housing cover

Tightening torque N·m (kg-m, ft-lb)
T1: 46 – 54 (4.7 – 5.5, 34 – 40)
T2: 34 – 40 (3.5 – 4.1, 25 – 30)
T3: 60 – 68 (6.1 – 6.9, 44 – 50)
T4: 22 – 27 (2.2 – 2.8, 16 – 20)

Fig. 7

L2-574

Camshaft and Timing Belt



1 Oil filler cap
2 Oil filler duct
3 Camshaft case (RH)
4 O-ring
5 Camshaft support
6 Timing belt (RH)
7 Oil seal
8 Camshaft sprocket
9 Camshaft (RH)
10 Oil relief valve
11 Oil relief spring
12 Oil relief pipe
13 Oil relief plug
14 Valve rocker cover gasket (RH)
15 Valve rocker cover (RH)
16 Camshaft case (LH)
17 Valve rocker cover gasket (LH)
18 Valve rocker cover (LH)
19 Distributor drive gear
20 Woodruff key
21 Camshaft (LH)
22 Camshaft sprocket
23 Timing belt (LH)
24 Belt idler
25 Tensioner No. 2
26 Tensioner spring
27 Tensioner
28 Tensioner spring

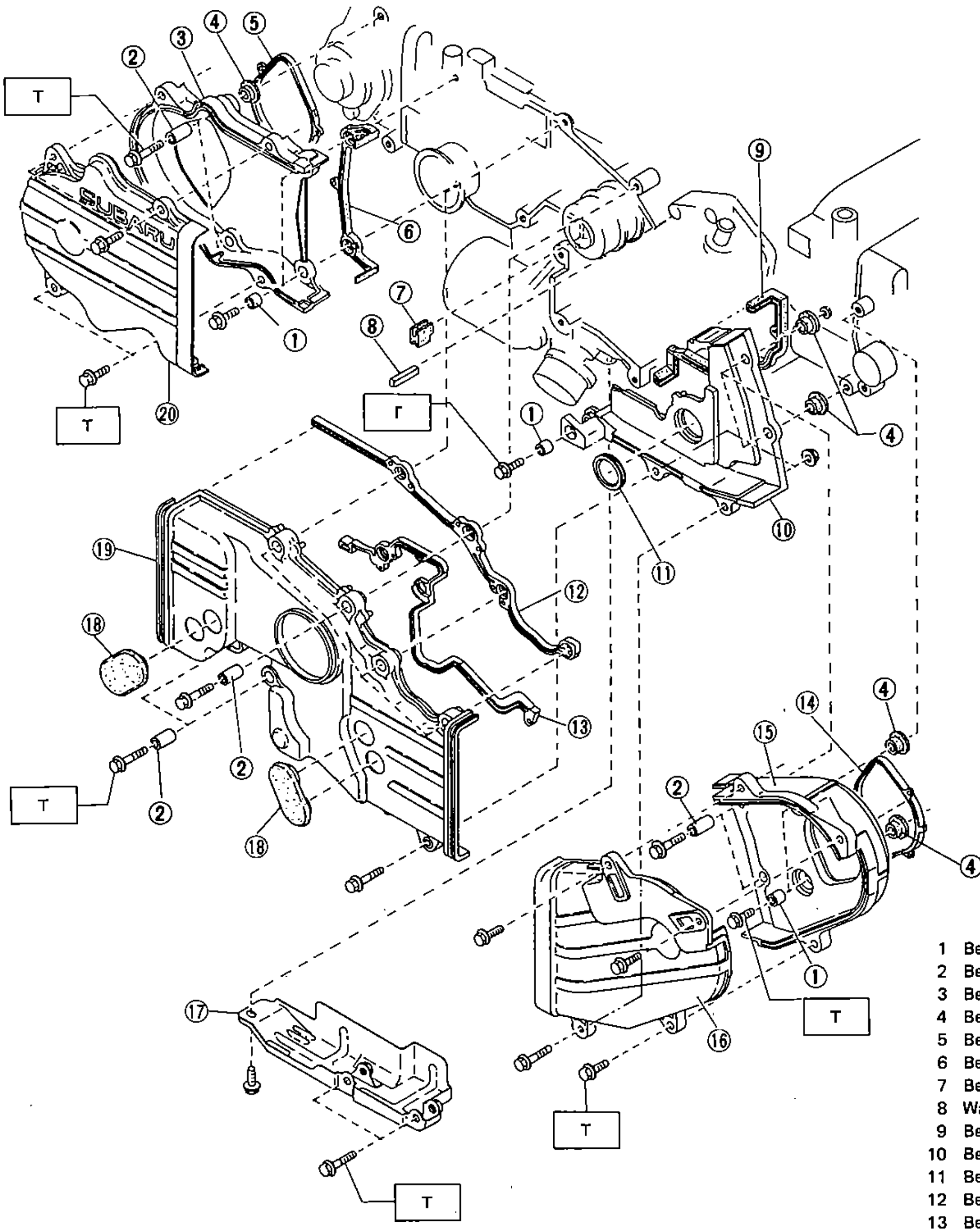
Tightening torque N·m (kg-m, ft-lb)

T1:	**17.2 – 20.1**	**(1.75 – 2.05, 12.7 – 14.8)**
T2:	**23 – 26**	**(2.3 – 2.7, 17 – 20)**
T3:	**4.4 – 5.4**	**(0.45 – 0.55, 3.3 – 4.0)**
T4:	**9.1 – 10.5**	**(0.93 – 1.07, 6.7 – 7.7)**
T5:	**39 – 47**	**(4.0 – 4.8, 29 – 35)**
T6:	**6 – 7**	**(0.6 – 0.7, 4.3 – 5.1)**

L2-575

Fig. 8

Belt Cover



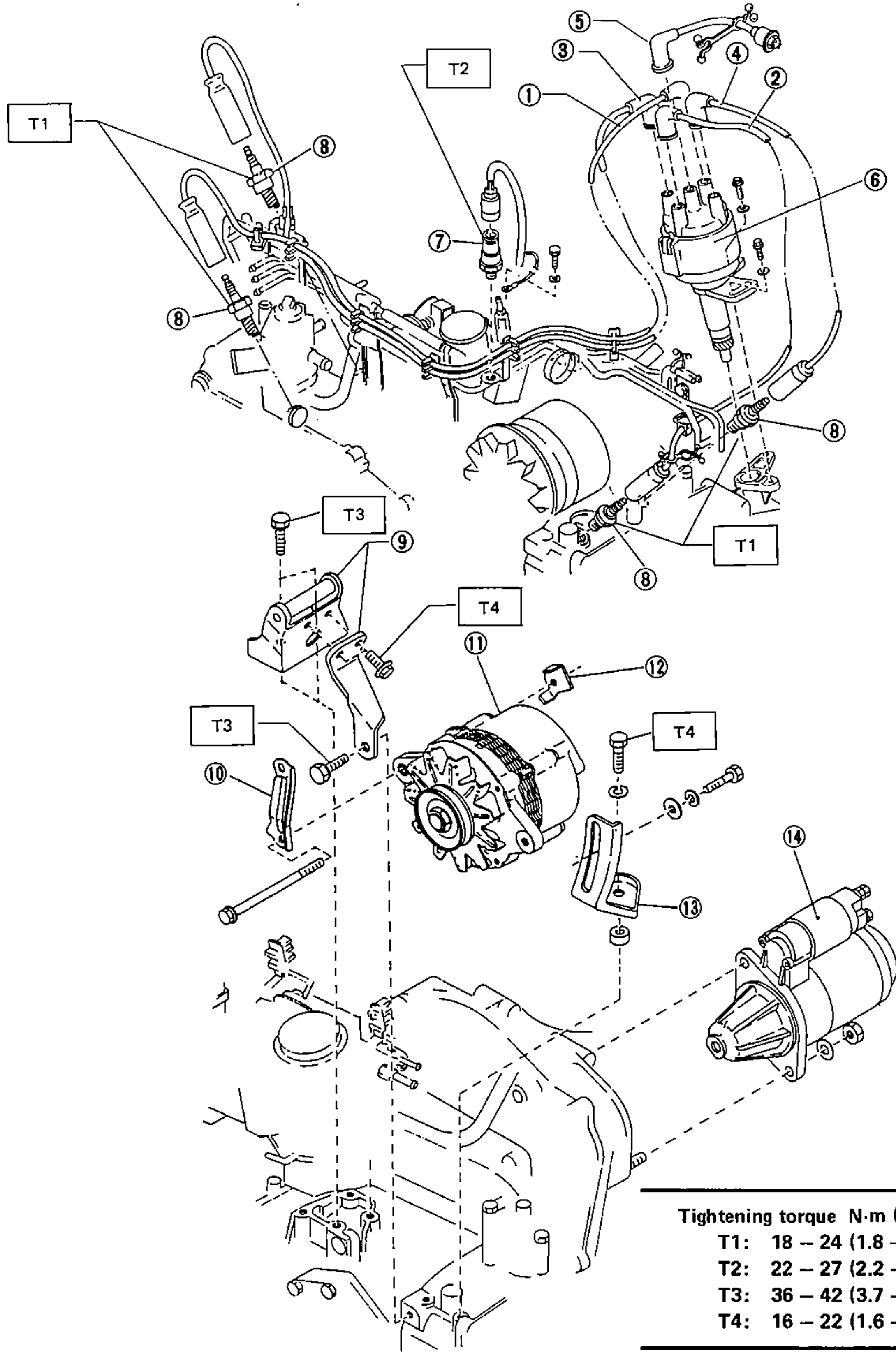
1 Belt cover spacer
2 Belt cover spacer No. 2
3 Belt cover No. 2 (RH)
4 Belt cover mount
5 Belt cover seal No. 2 (RH)
6 Belt cover seal (RH)
7 Belt cover seal No. 3 (LH)
8 Water pump seal
9 Belt cover seal (LH)
10 Belt cover (RR)
11 Belt cover seal No. 4 (LH)
12 Belt cover seal (FR)
13 Belt cover seal (RR)
14 Belt cover seal No. 2 (LH)
15 Belt cover No. 2 (LH)
16 Belt cover (LH)
17 Belt cover plate
18 Belt cover plug
19 Belt cover (FR)
20 Belt cover (RH)

Tightening torque N·m (kg-m, ft-lb)
T: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)

Fig. 9

L2-576

Electrical Equipment



1 Spark plug cord 1
2 Spark plug cord 2
3 Spark plug cord 3
4 Spark plug cord 4
5 Distributor cord
6 Distributor
7 Knock sensor (TURBO)
8 Spark plug
9 Alternator bracket
10 Cord stay
11 Alternator
12 Nut plate
13 Adjusting bar
14 Starter

Tightening torque N·m (kg-m, ft-lb)

T1: 18 – 24 (1.8 – 2.4, 13 – 17)
T2: 22 – 27 (2.2 – 2.8, 16 – 20)
T3: 36 – 42 (3.7 – 4.3, 27 – 31)
T4: 16 – 22 (1.6 – 2.2, 12 – 16)

Fig. 10

L2-790

SERVICE PROCEDURE

General Precautions

- Before disassembling Non-TURBO engine, install ENGINE STAND 499817000 x 2. On TURBO models, disconnect air duct, turbo cooling hose, turbocharger and front exhaust pipe from the engine before installing ENGINE STAND.
- All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to ASSY.
- Be careful not to let oil, grease or coolant contact the timing belt and clutch disc.
- All removed parts, if to be reused, should be reinstalled in the original positions and directions.
- Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
- Bolts, nuts and washers should be replaced with new ones as required.
- Even if necessary inspections have been made in advance, proceed with ASSY work while making rechecks.

Timing Belt and Belt Cover

REMOVAL

1) Loosen water pump pulley mounting nuts or bolts.
2) Loosen two alternator mounting bolts, and detach V-belt. [Except air conditioner equipped model]
3) Remove water pump pulley and pulley cover.
4) Disconnect lead from oil pressure switch.
5) Remove oil level gauge guide together with gauge.
6) Remove crankshaft pulley. To lock crankshaft, use FLYWHEEL STOPPER [manual transmission model] or DRIVE PLATE STOPPER [automatic transmission model].

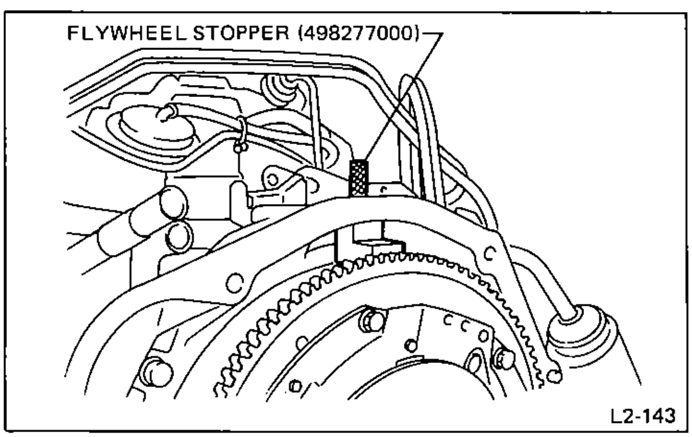


Fig. 11

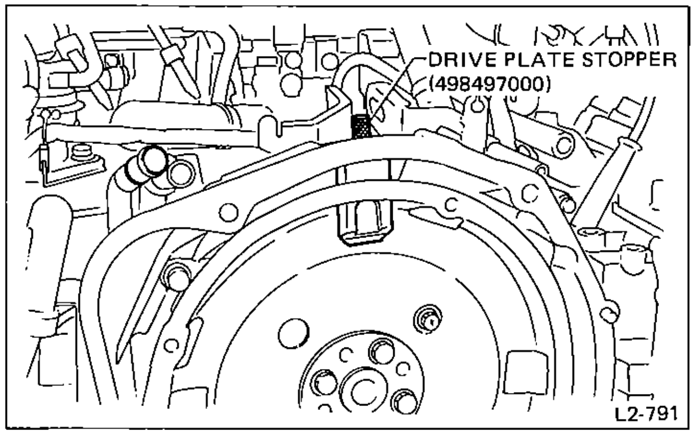


Fig. 12

7) Remove belt cover plate. [TURBO model]
8) Remove belt covers LH, RH and FR.
9) Removing timing belt
   (1) Loosen tensioner mounting bolts on #1 cylinder by 1/2 turn.
   (2) With tensioner fully turned to slacken belt, tighten mounting bolts.

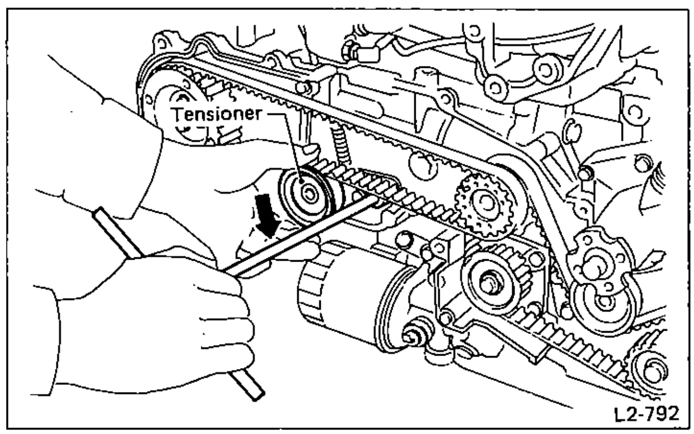


Fig. 13

   (3) Mark rotating direction of timing belt, then remove belt.
   (4) Loosen tensioner No. 2 mounting bolts on #2 cylinder by 1/2 turn.
   (5) With tensioner fully rotated to slacken belt by using TENSIONER WRENCH, tighten tensioner mounting bolts.

Cover TENSIONER WRENCH clamping tips with a rubber hose or waste cloth to prevent crankshaft or pulley from being damaged.

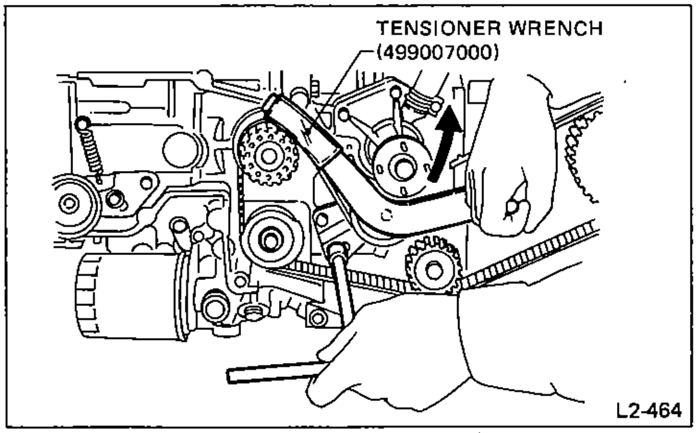


Fig. 14

(6) Remove crankshaft sprocket.
(7) Remove timing belt after marking rotating direction of belt.
(8) Remove crankshaft sprocket No. 2.

10) Remove tensioner and tensioner No. 2 together with tensioner spring.
11) Remove belt idler.
12) Remove camshaft sprockets by using CAMSHAFT SPROCKET WRENCH.

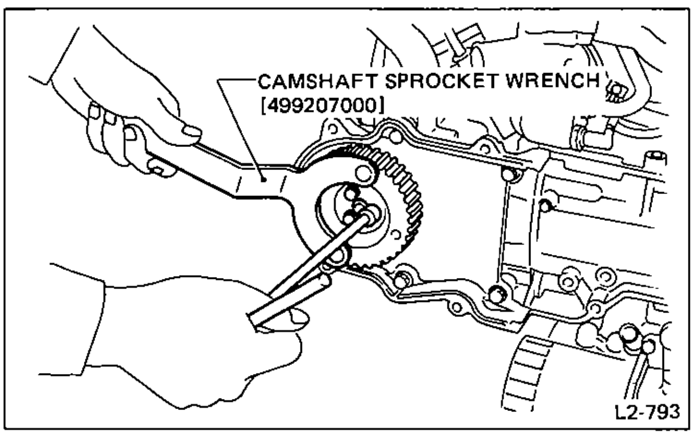


Fig. 15

13) Remove right-hand belt cover No. 2, left-hand belt cover No. 2 and belt cover RR.

a. Be careful not to let oil, grease or coolant contact the belt. Remove quickly and thoroughly if this happens.
b. Do not bend the belt sharply. [The bending radius must be greater than 60 mm (2.36 in).]
c. When replacing belt, be sure to replace both belts as a matched set.

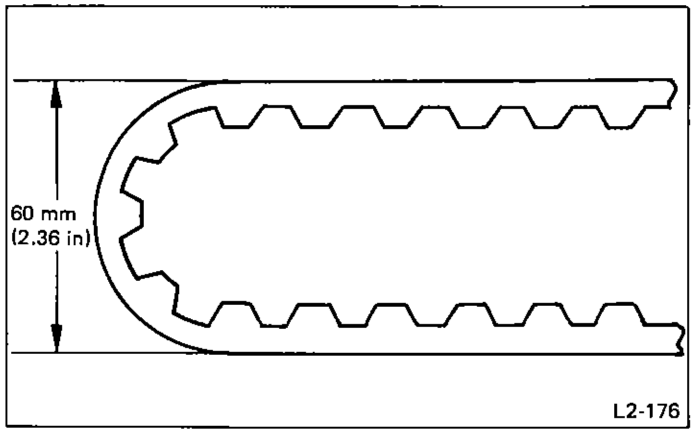


Fig. 16

INSPECTION

TIMING BELT

1) Check timing belt teeth for breaks, cracks, and wear. If any fault is found, replace belt.
2) Check the condition of back side of belt; if any crack is found, replace belt.

TIMING BELT TENSIONER

1) Check tensioner roller for smooth rotation. Replace roller if noise or excessive play is noted.
2) Measure the out-of-squareness of tensioner roller H. If it exceeds 0.5 mm (0.020 in), replace roller.

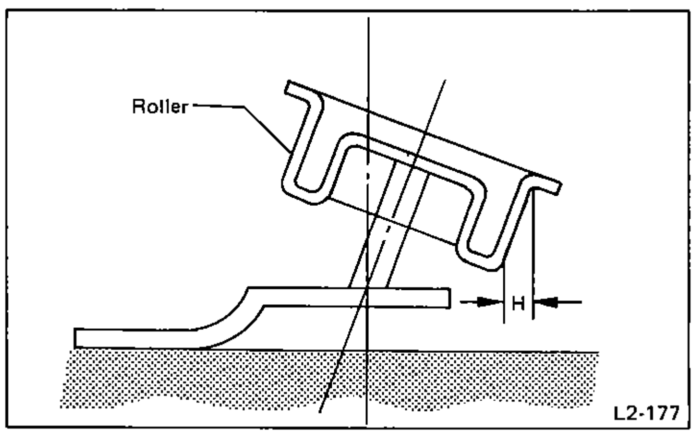


Fig. 17

BELT IDLER

Check idler for smooth rotation. Replace if noise or excessive play is noted.

SERVICE PROCEDURE

Timing Belt and Belt Cover

INSTALLATION

1) Install belt cover seal LH No. 3 to cylinder block.
2) Install belt cover LH seal, belt cover No. 4 LH seal, and belt cover mount to belt cover RR, then install to cylinder block.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

3) Install belt cover No. 2 LH seal and belt cover mounts to belt cover No. 2 LH, then install to cylinder head and camshaft case.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

4) Install belt cover RH seal, belt cover No. 2 RH seal, and belt cover mounts to belt cover No. 2 RH, then install to cylinder head and camshaft case.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

5) Install camshaft sprockets to right and left camshafts. To lock camshaft, use CAMSHAFT SPROCKET WRENCH. Tighten bolts gradually in two or three steps until the specified torque is attained.

Tightening torque:
9.1 – 10.5 N·m (0.93 – 1.07 kg-m, 6.7 – 7.7 ft-lb)

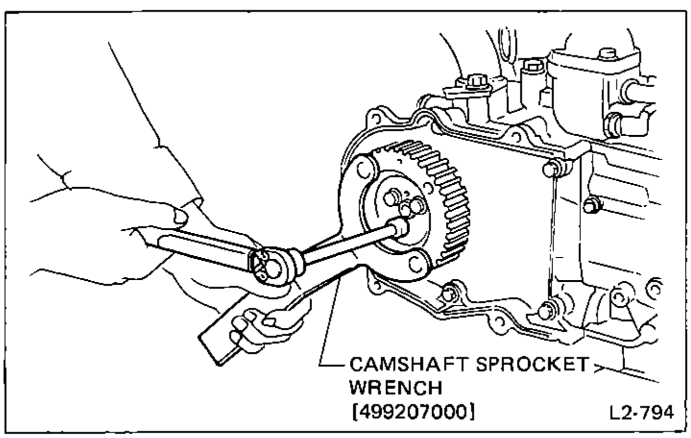


Fig. 1

6) Installing tensioner
(1) Attach tensioner spring to tensioner, then install to cylinder block RH. Tighten bolts temporarily by hand.
(2) Attach tensioner spring to bolt, tighten bolt ⓐ, and then loosen 1/2 turn.
(3) Push down tensioner until it stops, then tighten temporarily bolt ⓑ.

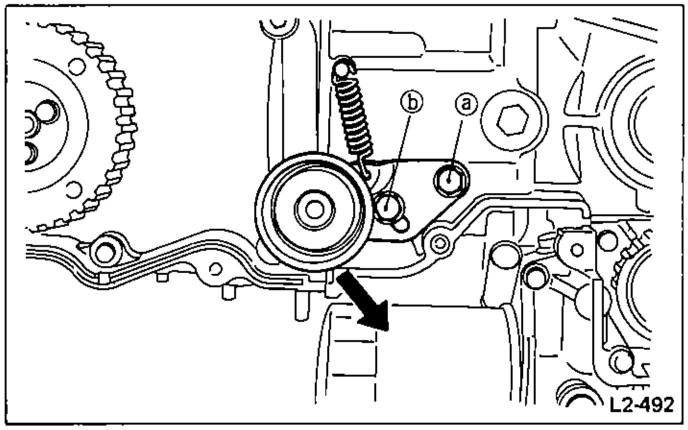


Fig. 2

7) Installing tensioner No. 2
(1) Attach tensioner spring to tensioner No. 2, then install the tensioner No. 2 to cylinder block LH. Tighten bolts temporarily by hand.
(2) Attach tensioner spring to bolt, tighten bolt ⓒ, then loosen 1/2 turn.
(3) Raise tensioner No. 2 using TENSIONER WRENCH (499007000) until it stops, then tighten bolt ⓓ temporarily.

Cover the tip of tensioner wrench with a rubber hose or waste cloth to prevent crankshaft or pulley from being damaged.

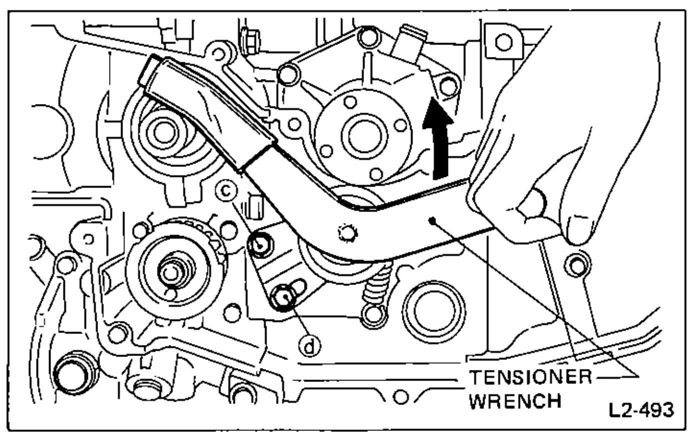


Fig. 3

8) Install belt idler to cylinder block, using care not to turn over seal.

Tightening torque:
39 – 47 N·m (4.0 – 4.8 kg-m, 29 – 35 ft-lb)

9) Install timing belt.

(1) Install sprocket No. 2 and sprocket to crankshaft.

Sprocket No. 2 can be identified by the absence of dowel pin.

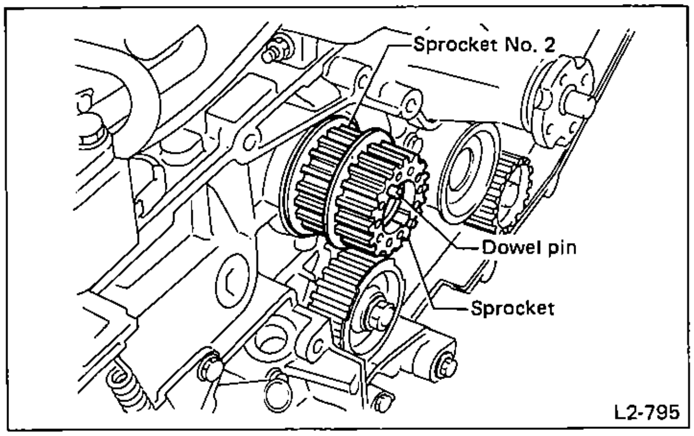


Fig. 4

(2) Install crankshaft pulley to crankshaft, and tighten bolt temporarily.

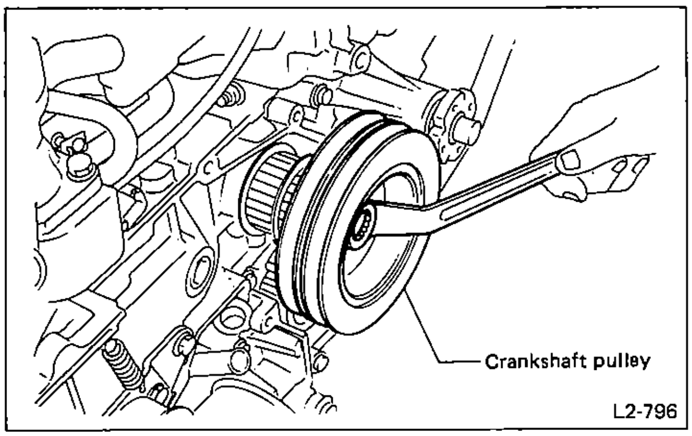


Fig. 5

(3) Align the center of three lines scribed on the flywheel with timing mark on flywheel housing.

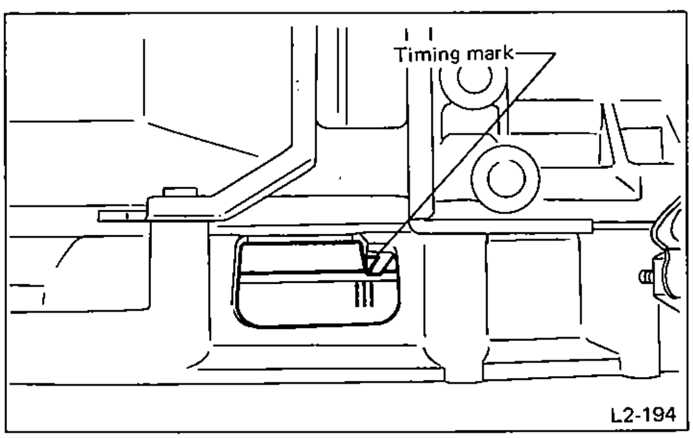


Fig. 6

(4) Align timing mark on camshaft sprocket LH with notch in belt cover.

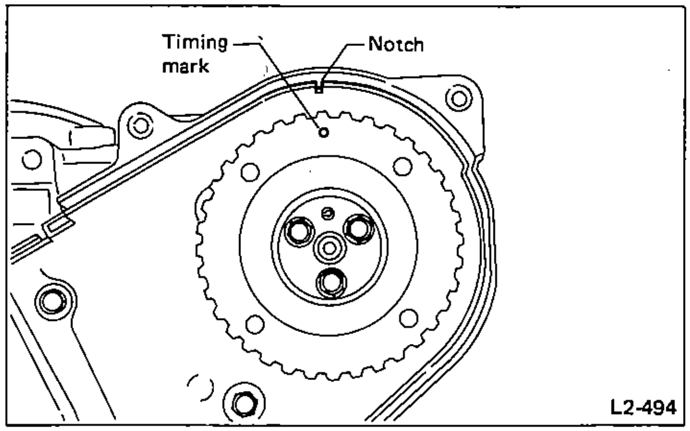


Fig. 7

(5) Attach timing belt No. 2 to crankshaft sprocket No. 2, oil pump sprocket, belt idler, camshaft sprocket, in that order, avoiding downward slackening of the belt.

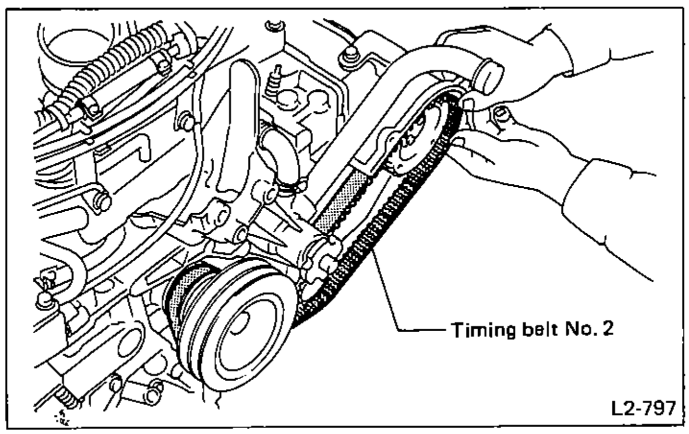


Fig. 8

(6) Loosen tensioner No. 2 tightening bolt ⓓ by 1/2 turn to apply tension to belt.

(7) Push timing belt by hand to ensure smooth movement of tensioner.

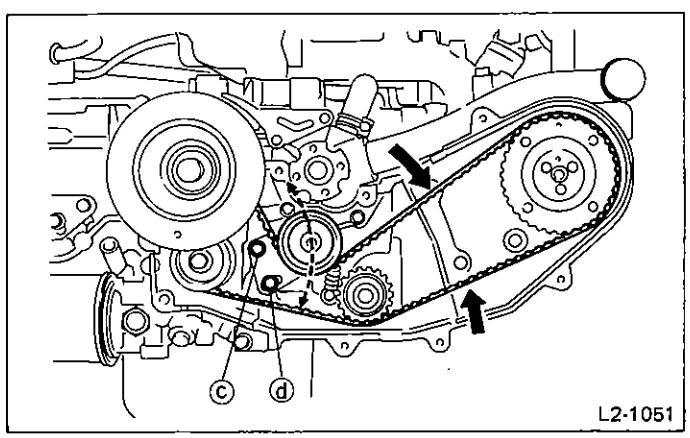


Fig. 9

(8) Apply the specified torque to camshaft sprocket in counterclockwise direction using BELT TENSION WRENCH. While applying torque, tighten tensioner No. 2 bolt ⓓ temporarily, then tighten bolt ⓒ temporarily.

a. When torquing sprocket, be extremely careful not to apply excessive force to it. Excessive belt tension will greatly reduce belt life.
When the left side of belt is too loose, gear noise will be emitted from around distributor. Use a torque wrench when adjusting belt tension.
b. Set belt to specified tension only when engine is cold (room temperature).

Head gasket	Belt	Torque to cam sprocket N·m (kg-m, ft-lb)	
		Right side	Left side (No. 2)
New	New	25 (2.5, 18)	34 (3.5, 25)
Old	New		25 (2.5, 18)
New	Old		
Old	Old		

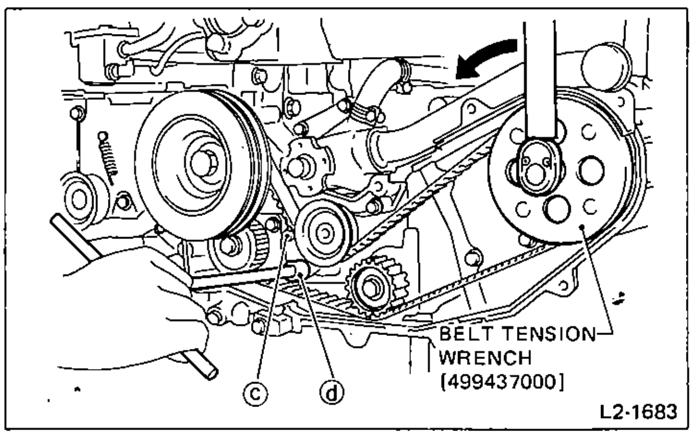


Fig. 10

(9) Tighten bolt ⓓ and bolt ⓒ, in that order, to the specified torque.
If gear noise is emitted from the vicinity of distributor after positioning a loose belt, observe above precautions and readjust belt tension.

Tightening torque:
17.2 – 20.1 N·m (1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

(10) Ascertain that flywheel timing mark and camshaft sprocket LH timing mark are in their normal positions.
(11) Turn crankshaft one turn clockwise from the position where timing belt No. 2 was installed, and align the center of three lines scribed on the flywheel with timing mark on flywheel housing.

(12) Align timing mark on camshaft sprocket RH with the notch in belt cover.

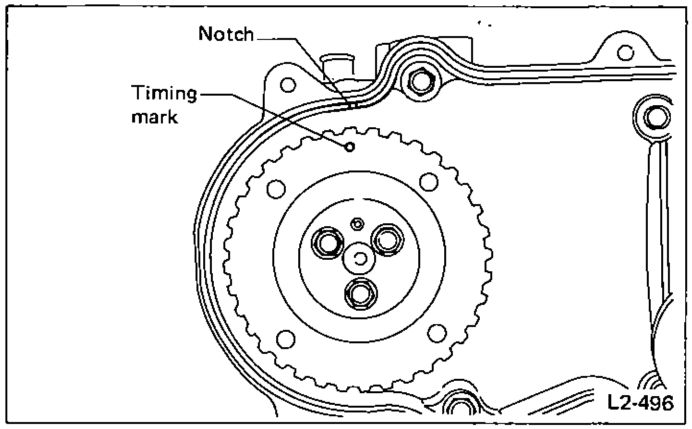


Fig. 11

(13) Attach timing belt to crankshaft sprocket and camshaft sprocket, avoiding slackening of belt on the upper side.

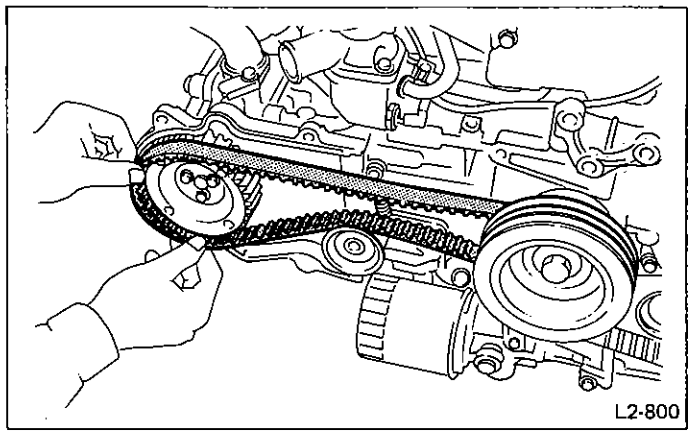


Fig. 12

(14) Loosen tensioner bolt ⓑ 1/2 turn to apply tension to belt.
(15) Push timing belt by hand to ensure smooth tensioner movement.

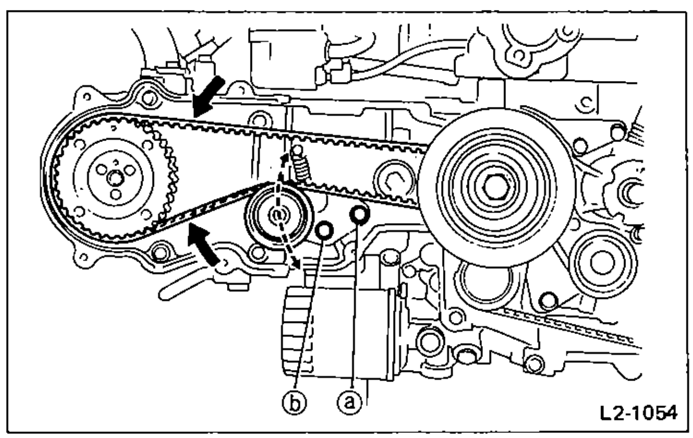


Fig. 13

(16) Apply the specified torque (same as camshaft sprocket LH) to camshaft sprocket RH in counterclockwise direction using BELT TENSION WRENCH. While applying torque, tighten tensioner No. 2 bolt ⓑ temporarily, then tighten bolt ⓐ temporarily.

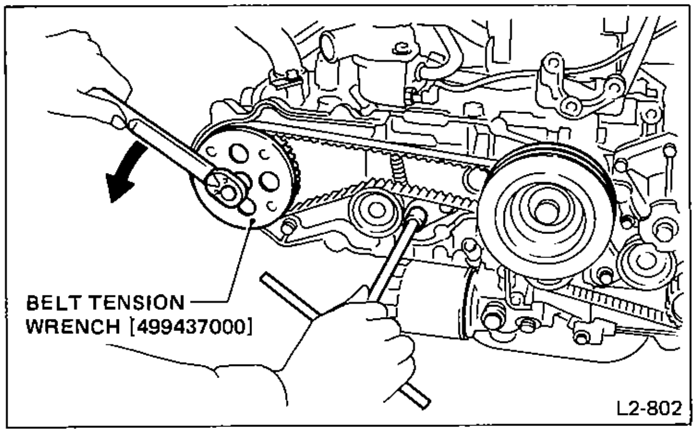


Fig. 31

(17) Tighten bolt ⓑ and bolt ⓐ, in that order, to the specified torque.

Tightening torque:
17.2 – 20.1 N·m (1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

(18) Make sure that flywheel timing mark and camshaft sprocket RH timing mark are in their normal positions.
(19) Remove crankshaft pulley.

Do not remove sprocket with crankshaft pulley.

10) Install belt cover FR seal, belt cover RR seal, and belt cover plug to belt cover FR, then install belt cover FR to cylinder block.

Before installing belt cover, ensure that no foreign matter such as nut or washer is in it.

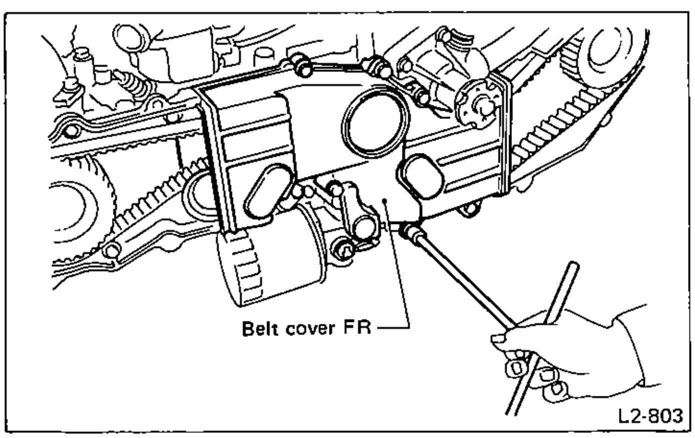


Fig. 32

11) Install belt covers LH and RH.
12) Install belt cover plate. [TURBO model]
13) Install crank pulley to crankshaft using FLYWHEEL STOPPER (498277000) [manual transmission model] or DRIVE PLATE STOPPER (498497000) [automatic transmission model] to lock crankshaft.

Tightening torque:
89 – 107 N·m (9.1 – 10.9 kg-m, 66 – 79 ft-lb)

14) Install water pump pulley and pulley cover to water pump ASSY, and tighten nuts temporarily.
15) Install oil level gauge and gauge guide. Apply engine oil to O-ring beforehand.
16) Connect lead to oil pressure switch.
17) Install V-belt and apply proper tension to the belt.
18) Tighten water pump pulley mounting nuts or bolts to the specified torque.

Tightening torque:
9.1 – 10.5 N·m (0.93 – 1.07 kg-m, 6.7 – 7.7 ft-lb)

Camshaft and Valve Rocker

REMOVAL

1) Removing distributor
   (1) Disconnect spark plug cords from distributor.
   (2) Remove distributor by removing mounting bolts.
2) Remove timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
3) Remove water pipe.
4) Remove oil filler duct.
5) Remove PCV hoses from rocker cover.
6) Remove EGR pipe cover, pipe clamps and EGR pipe. [TURBO model]

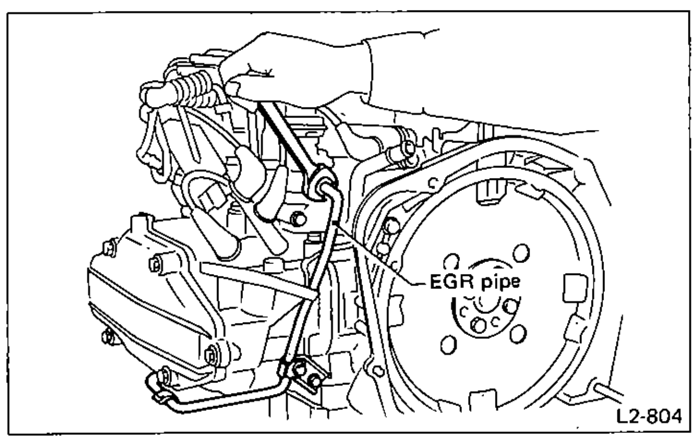


Fig. 33

7) Remove valve rocker covers and gaskets.
8) Remove camshaft cases, camshaft support, and camshaft as a unit.

When removing camshaft case, valve rockers may come off. To prevent them from being damaged, be sure to place waste cloth or rubber mat under cylinder head.

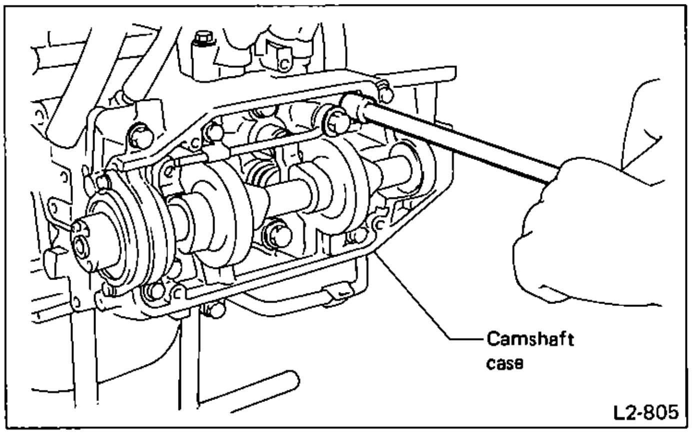


Fig. 34

9) Remove valve lash adjusters from cylinder head.

a. Do not lay down removed adjusters; keep them erect.
b. Retain removed valve rockers and adjusters in the order of their removal so that they can be reinstalled correctly.

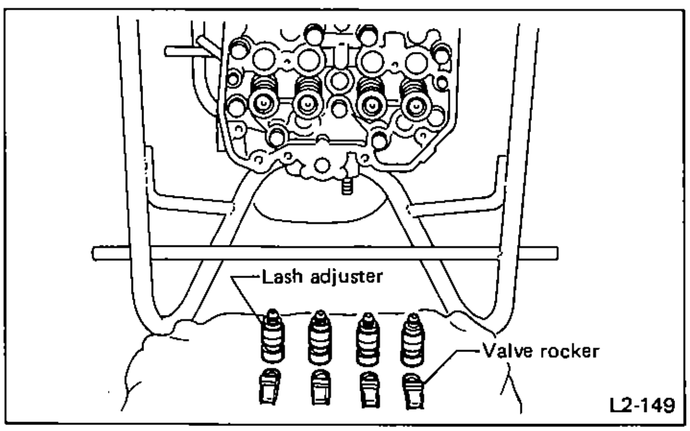


Fig. 35

DISASSEMBLY

1) Remove camshaft support.
2) Remove camshaft.

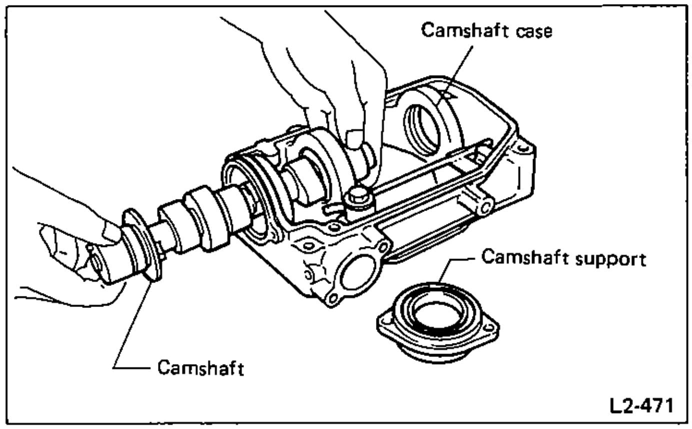


Fig. 36

3) Remove oil relief plug, then remove oil relief pipe, relief valve spring, and relief valve.

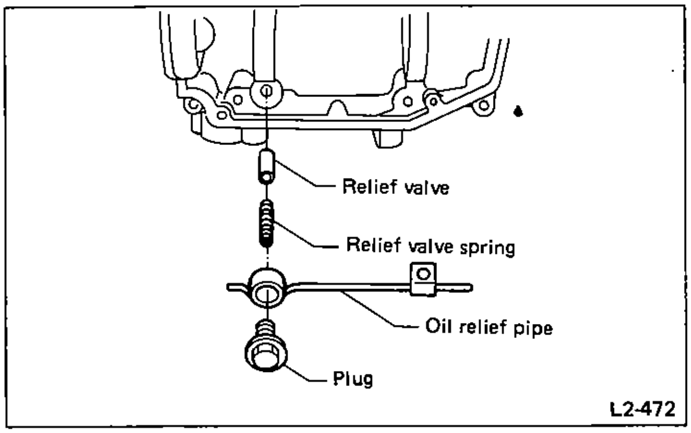


Fig. 37

INSPECTION

CAMSHAFT

1) Measure the bend, and repair or replace if necessary.

Limit:
0.025 mm (0.0010 in)

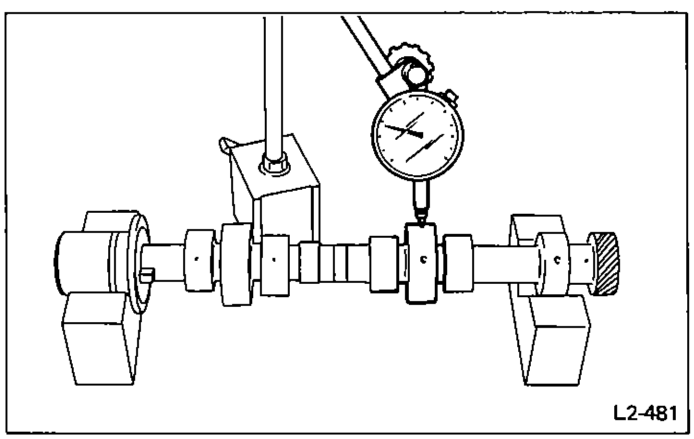


Fig. 38

2) Check journal for damage and wear. Replace if faulty.

Item		Front	Center	Rear	LH distributor
Cam case journal hole I.D.		38.000 – 38.018 mm (1.4961 – 1.4968 in)	48.500 – 48.518 mm (1.9094 – 1.9102 in)	48.000 – 48.018 mm (1.8898 – 1.8905 in)	39.000 – 39.018 mm (1.5354 – 1.5361 in)
Camshaft journal O.D.		37.964 – 37.980 mm (1.4946 – 1.4953 in)	48.464 – 48.480 mm (1.9080 – 1.9087 in)	47.964 – 47.980 mm (1.8883 – 1.8890 in)	38.964 – 38.980 mm (1.5340 – 1.5346 in)
Clearance at journal	Standard	0.020 – 0.054 mm (0.0008 – 0.0021 in)			
	Limit	0.070 mm (0.0028 in)			

3) Check cam face condition; remove minor faults by grinding with oil stone. Measure the cam height H; replace if the limit has been exceeded.

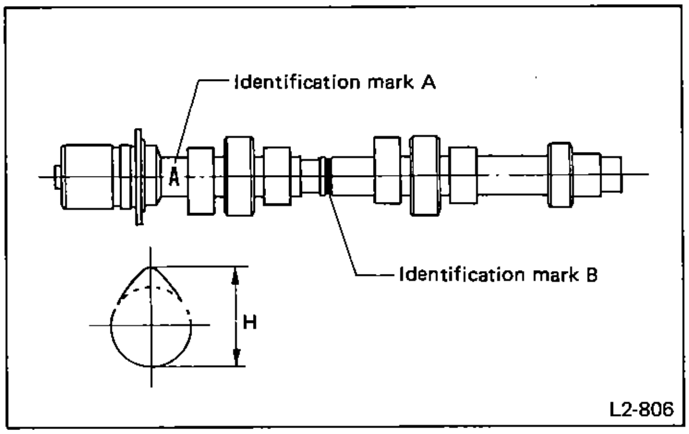


Fig. 39

	Marking groove A	Marking groove B	Height H	Wear limit
SPFI	A	0	39.75 – 39.85 mm (1.5650 – 1.5689 in)	0.15 mm (0.0059 in)
MPFI TURBO	A	1		

4) Measure backlash between distributor drive gear and distributor driven gear. If the limit is exceeded, replace distributor drive gear.

Backlash:
Standard
0.015 – 0.126 mm (0.0006 – 0.0050 in)
Limit
0.180 mm (0.0071 in)

5) Replace gear using a press and CAMSHAFT HOLDER (498027000).

VALVE ROCKER

If cam or valve contact surface of valve rocker is worn or dented, repair by removing the minimum necessary amount. If worn heavily, replace valve rocker.

VALVE LASH ADJUSTER

1) With adjuster set in vertical position, push adjuster pivot quick and hard by hand.
If pivot is depressed more than 0.5 mm (0.020 in), put adjuster in a container filled with light oil, and move plunger up and down until the depression is less than 0.5 mm (0.020 in).

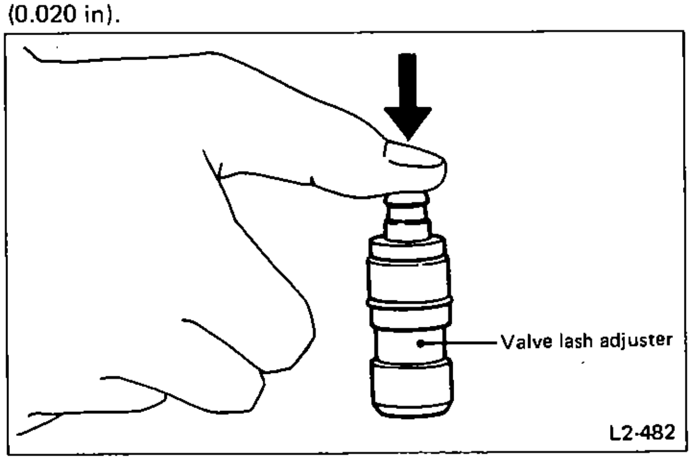


Fig. 40

2) If pivot is depressed more than 0.5 mm (0.020 in) even after repeating the above procedure, replace adjuster.

The new adjuster is provided with a pin which must be removed before using.

ASSEMBLY

1) Press-fit oil seal into camshaft support by using INSTALLER (498037000), then attach O-ring.
2) Install oil relief valve, relief valve spring, oil relief pipe, and oil relief plug to camshaft case.

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

3) Install woodruff key to camshaft, then press-fit distributor drive gear by using CAMSHAFT HOLDER (498027000).
4) Insert camshaft into camshaft case, and install camshaft support.

Tightening torque:
5.9 – 6.9 N·m (0.60 – 0.70 kg-m, 4.3 – 5.1 ft-lb)

INSTALLATION

1) Insert valve lash adjusters into cylinder head.

Be sure to insert each valve lash adjuster to its original position.

2) Apply grease to spherical surface and sliding surface of each valve rocker, then secure valve rockers to the respective valve adjusters and valves.

Be sure to apply grease; otherwise, valve rocker will drop off.

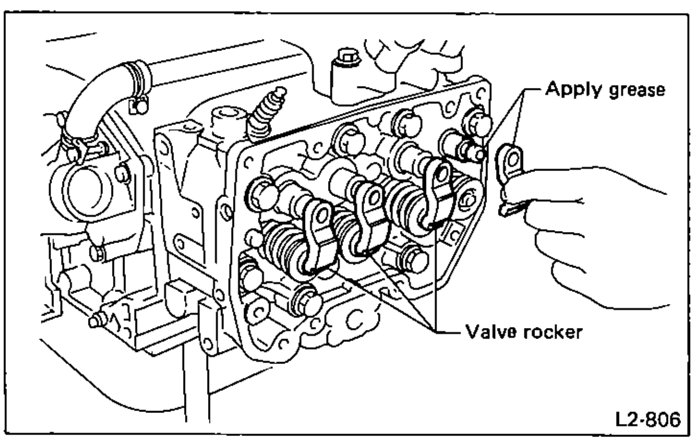


Fig. 41

3) Install O-ring to camshaft case by setting camshaft so that camshaft straight pin is oriented as shown.

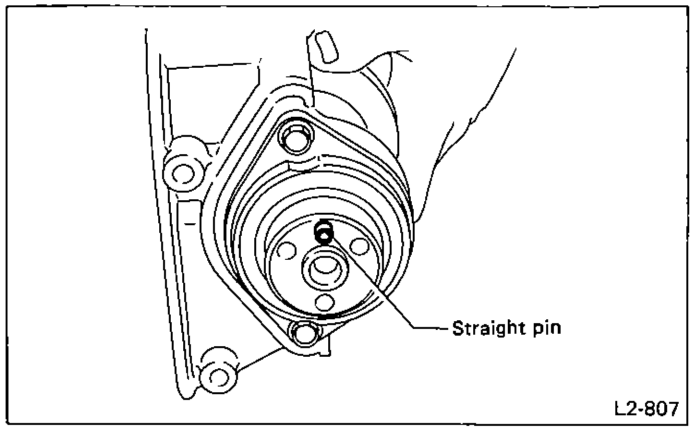


Fig. 42

4) Apply fluid packing (Three-bond 1215, or equivalent) to groove of each camshaft case, then install to cylinder head.

After installing, abundantly apply engine oil to sliding surfaces of cam and valve rocker.

Tightening torque:
17.2 – 20.1 N·m (1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

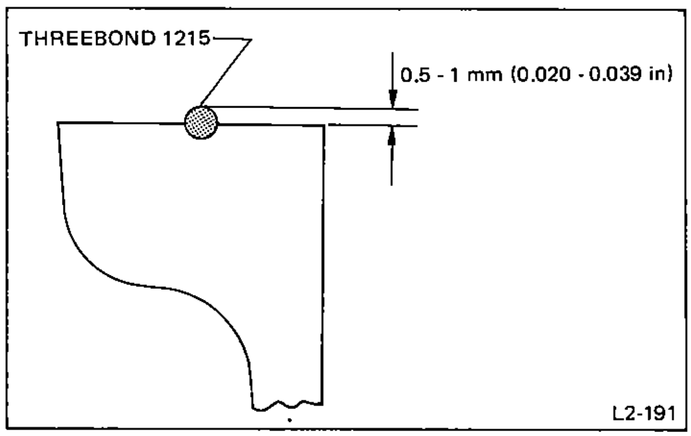


Fig. 43

5) Attach gaskets to valve rocker covers, and install the covers to camshaft cases with rocker cover washers and bolts.

Be extremely careful not to cause oil to leak from mating faces of valve rocker cover and camshaft case.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

6) Install PCV hoses.
7) Install EGR pipe, pipe clamps and EGR pipe cover. [TURBO model]

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

8) Install oil filler duct.
9) Install water pipe.
10) Install timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
11) Install distributor, proceeding as follows:
(1) Bring #1 cylinder piston to its top dead center on compression stroke. Set camshaft sprocket to the position shown in Figure.

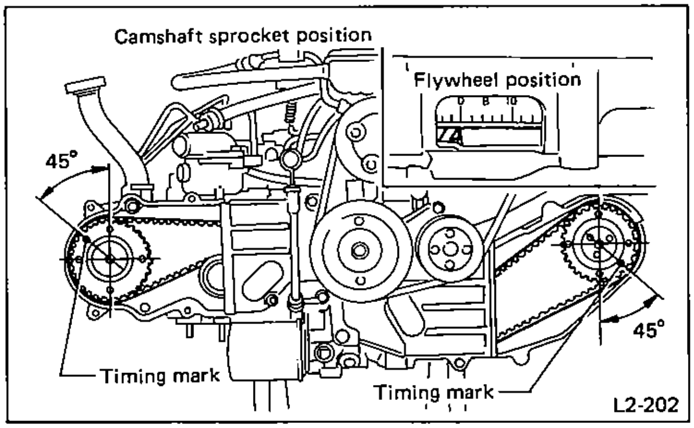


Fig. 44

(2) Align distributor housing match mark with pinion gear match mark to set #1 cylinder at igniting position.

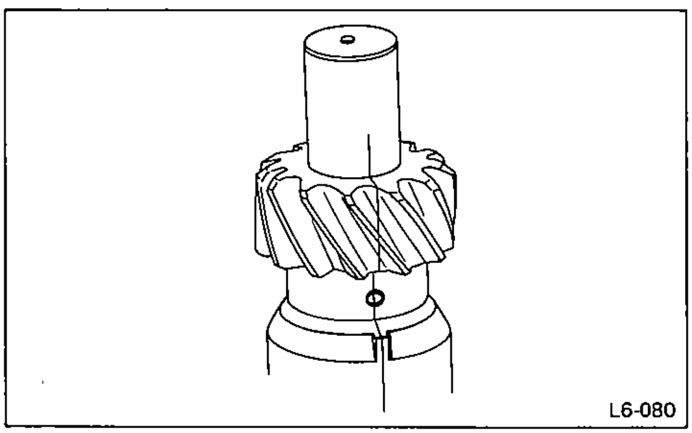


Fig. 45

(3) Install distributor to camshaft case.
(4) Connect lead wires.
(5) Install plug cord and high-tension cord.
12) Install right and left belt covers.

Cylinder Head

REMOVAL

1) Remove timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
2) Remove turbo cooling pipe together with union screws and gaskets from cylinder head. [TURBO model]

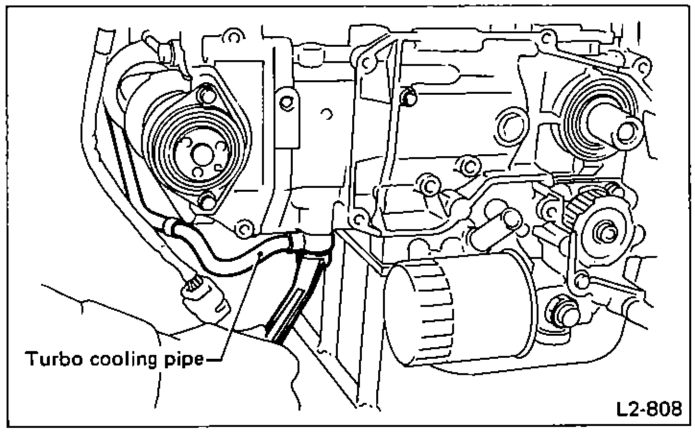


Fig. 46

3) Remove camshaft cases, lash adjuster and related parts. (Refer to "Camshaft and Valve Rocker".)
4) Remove plug attaching EGR pipe to cylinder head. [Except TURBO model]
5) Remove bolt attaching alternator bracket to cylinder head. [Except air conditioner model]
6) Remove bolt attaching adjusting bar to cylinder head. [Except air conditioner model]
7) Remove bolts attaching intake manifold to cylinder head, and then lift intake manifold from cylinder head.

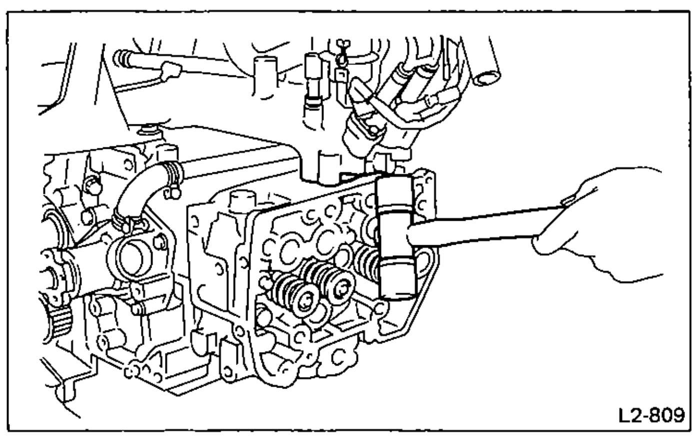


Fig. 47

8) Remove bolt attaching water by-pass pipe bracket to cylinder head.

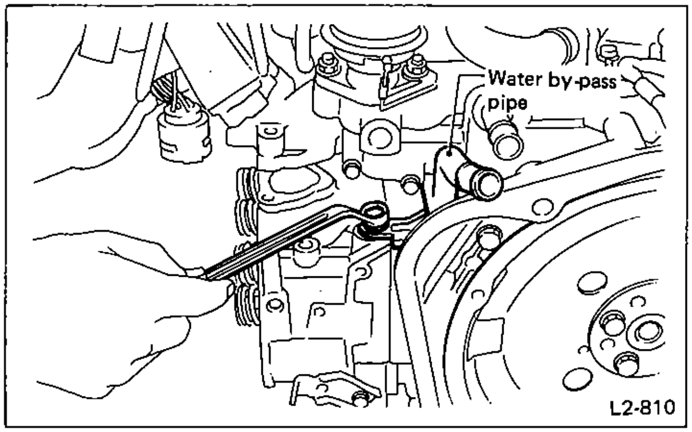


Fig. 48

9) Remove spark plugs.
10) Remove cylinder heads and gaskets from cylinder block.
11) Using VALVE SPRING PRESS ASSY (899724100), compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

a. Mark each valve to prevent confusion.
b. Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.

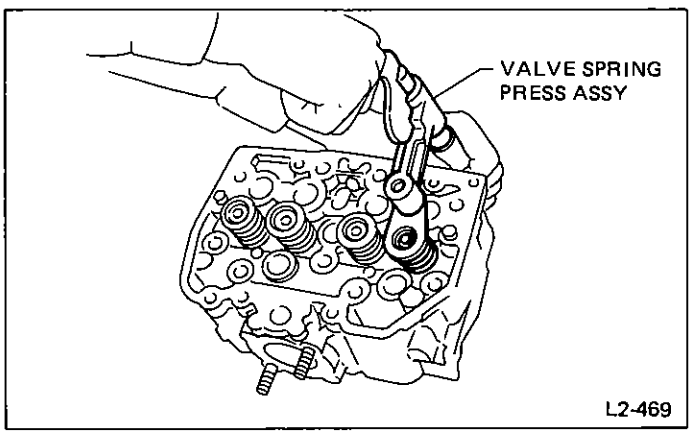


Fig. 49

INSPECTION

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.

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

Warping limit:
0.05 mm (0.0020 in)
Grinding limit:
0.3 mm (0.012 in)
Standard height of cylinder head:
90.6 mm (3.567 in)

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

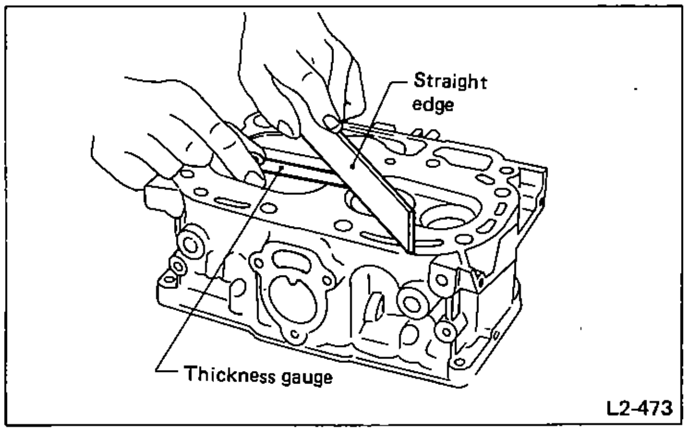


Fig. 50

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

W:
Intake
1.2 – 1.8 mm (0.047 – 0.071 in)
Exhaust
1.5 – 2.0 mm (0.059 – 0.079 in)
Wear limit of valve seat (measured in direction of valve axis):
0.5 mm (0.020 in) for both intake and exhaust valves

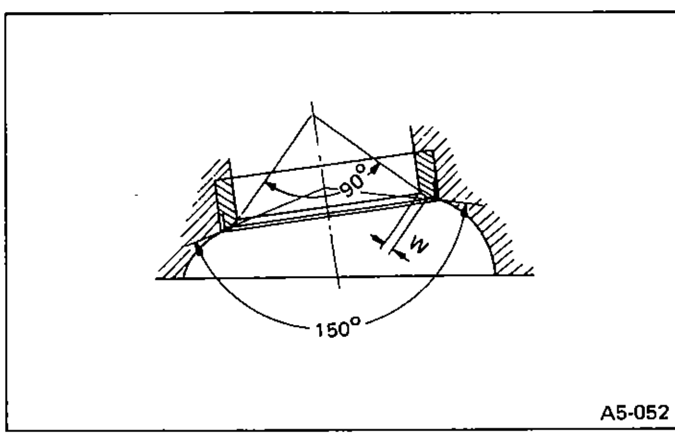


Fig. 51

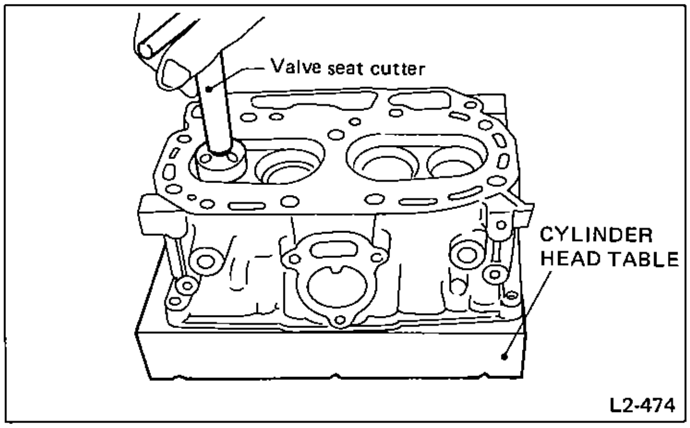


Fig. 52

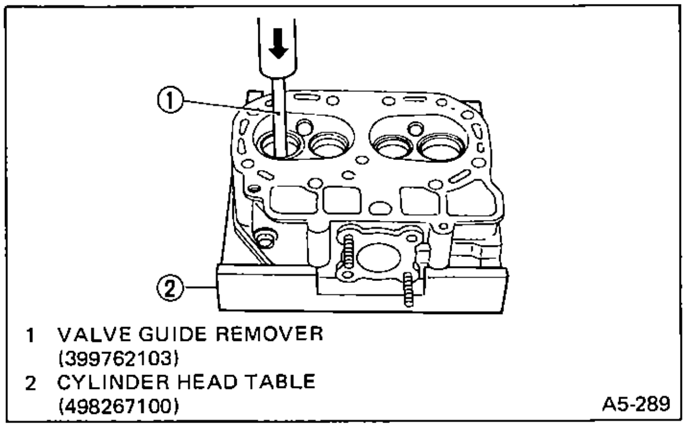


Fig. 53

VALVE GUIDE

1) 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.

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		0.15 mm (0.0059 in)
Standard inside diameter of valve guide		7.000 – 7.015 mm (0.2756 – 0.2762 in)
Standard diameter of valve stem	Intake	6.950 – 6.965 mm (0.2736 – 0.2742 in)
	Exhaust	6.945 – 6.960 mm (0.2734 – 0.2740 in)

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

(1) Place cylinder head on CYLINDER HEAD TABLE with the combustion chamber upward so that valve guides enter the holes in CYLINDER HEAD TABLE.

(2) Insert VALVE GUIDE REMOVER into valve guide and press it down to remove valve guide.

(3) Turn cylinder head upside down and place VALVE GUIDE ADJUSTER as shown in the figure.

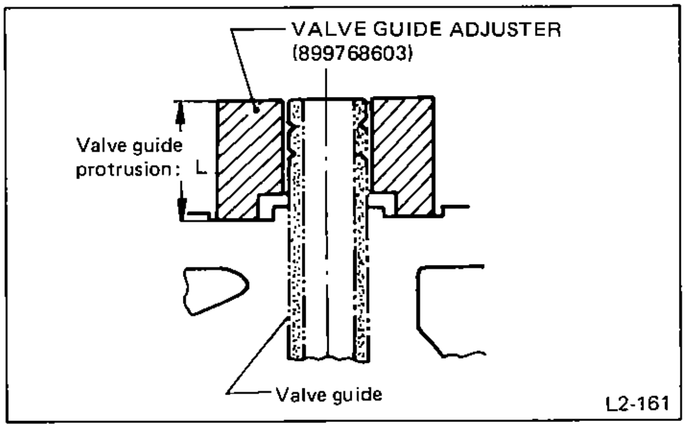


Fig. 54

(4) 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.

(5) Put new valve guide, coated with sufficient oil, in cylinder, and insert VALVE GUIDE REMOVER into valve guide. Press in until the valve guide upper end is flush with the upper surface of VALVE GUIDE ADJUSTER.

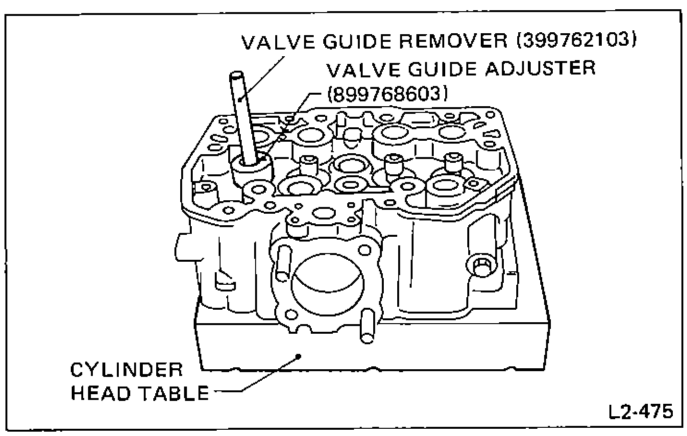


Fig. 55

(6) Check the valve guide protrusion.

Valve guide protrusion: L
17.5 – 18.5 mm (0.689 – 0.728 in)

(7) Ream the inside of valve guide with VALVE GUIDE REAMER (399762104). 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.

a. Apply engine oil to the reamer when reaming.
b. If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
c. 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.

(8) Recheck the contact condition between valve and valve seat after replacing valve guide.

INTAKE AND EXHAUST 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.

a. Apply engine oil to oil seal before force-fitting.
b. Differentiate between intake valve oil seal and exhaust valve oil seal by noting their difference in height.

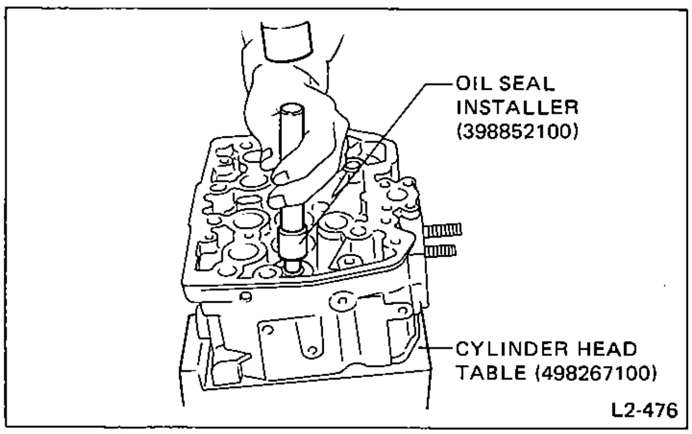


Fig. 56

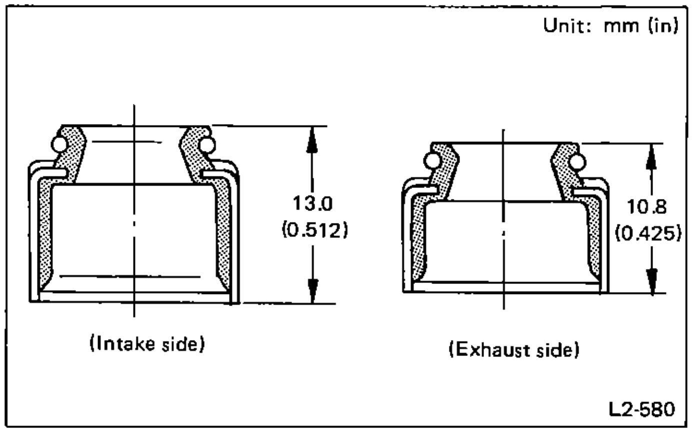


Fig. 57

INSTALLATION

1) Install the oil seals to the valve guides using OIL SEAL INSTALLER.

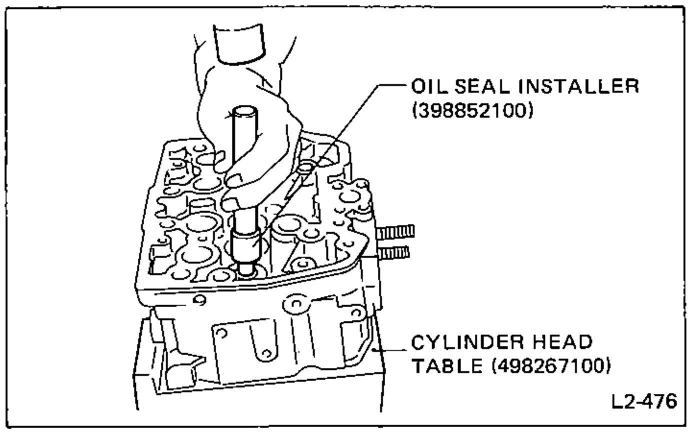


Fig. 58

2) Coat the stem of each valve with engine oil and insert the valve into the valve guide. Attach the valve springs and retainer. Then compress the valve springs using VALVE SPRING PRESS and fit the valve spring retainer key.

a. After installing, tap the valve spring retainers lightly with a wooden hammer for better seating.
b. When inserting the valve into the valve guide, use special care not to damage the oil seal lip.
c. Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

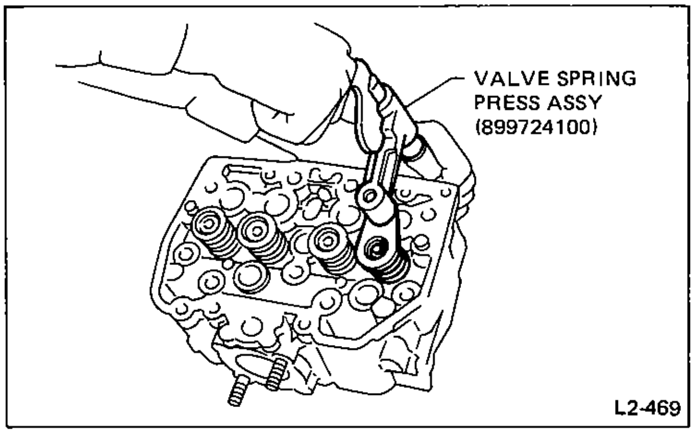


Fig. 59

3) Install cylinder heads to cylinder block with new gaskets.

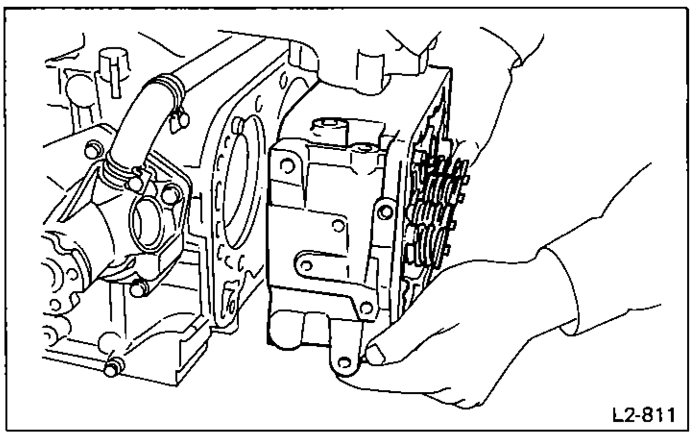


Fig. 60

When tightening 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)

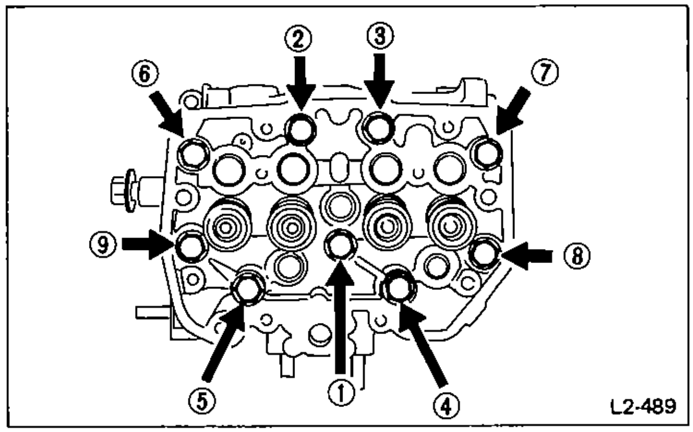


Fig. 61

4) Install spark plugs.

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

5) Install bolt attaching water by-pass pipe bracket to cylinder head.
6) Install bolts attaching intake manifold to cylinder head.

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

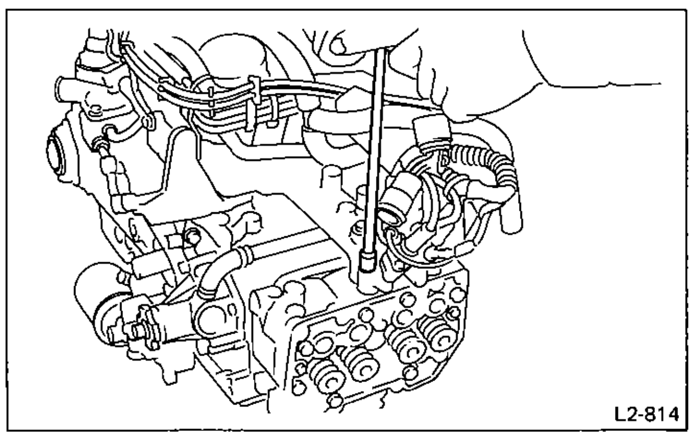


Fig. 62

7) Install plug attaching EGR pipe to cylinder head. [Except TURBO model]

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

8) Install TURBO cooling pipe together with union screws and gaskets to cylinder head. [TURBO model]

Tightening torque:
21.1 – 24.0 N·m (2.15 – 2.45 kg-m, 15.6 – 17.7 ft-lb)

9) Install bolt attaching adjusting bar to cylinder head.

Tightening torque:
16 – 22 N·m (1.6 – 2.2 kg-m, 12 – 16 ft-lb)

10) Install bolts attaching alternator bracket to cylinder head.

Tightening torque:
36 – 42 N·m (3.7 – 4.3 kg-m, 27 – 31 ft-lb)

11) Install camshaft cases, lash adjustor and related parts. (Refer to "Camshaft and Valve Rocker".)
12) Install timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)

After completing engine ASSY and mounting engine on car, be sure to retighten cylinder head bolts.
(Refer to "2-2 ON-CAR SERVICES".)

Valve and Valve Spring

REMOVAL

1) Remove cylinder head from engine ASSY.
(Refer to "Cylinder Head".)
2) Using VALVE SPRING PRESS ASSY, compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

a. Mark each valve to prevent confusion.
b. Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.

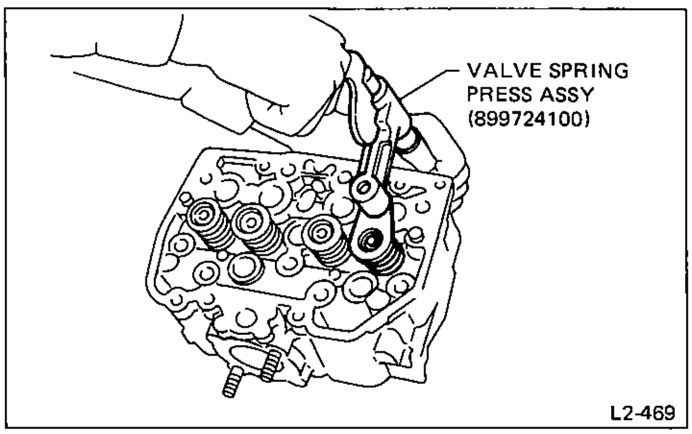


Fig. 63

INSPECTION

INTAKE AND EXHAUST VALVE

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:
TURBO Intake & Non-TURBO
Standard
1.3 mm (0.051 in)
Limit
0.8 mm (0.031 in)
TURBO Exhaust
Standard
1.8 mm (0.071 in)
Limit
1.3 mm (0.051 in)
Valve overall length:
TURBO Intake & Non-TURBO
107.58 mm (4.235 in)
TURBO Exhaust
108.1 mm (4.256 in)

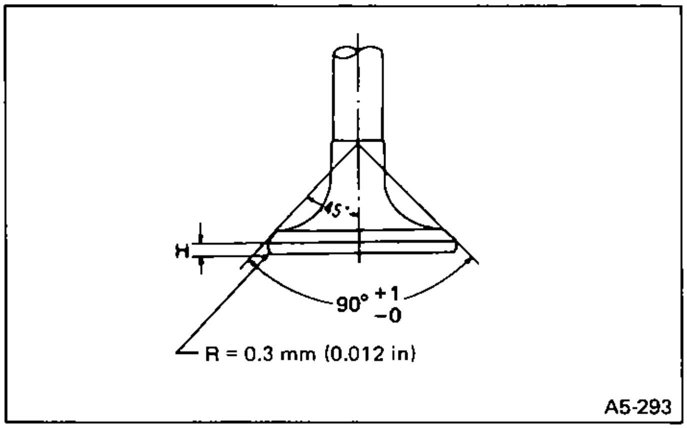


Fig. 64

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. [Intake valve only]

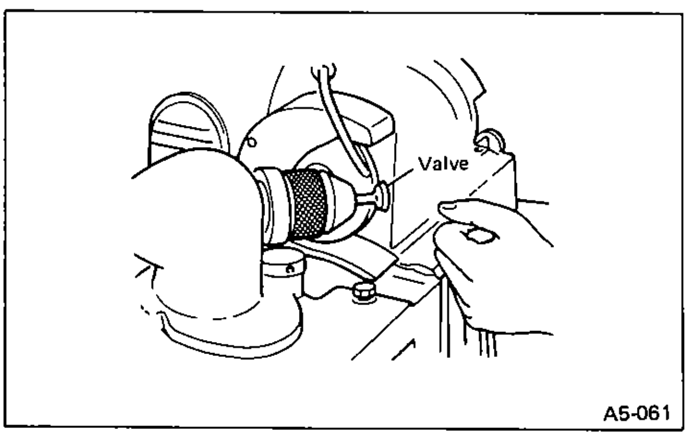


Fig. 65

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

VALVE SPRINGS

1) Check valve springs for damage, free length, and tension. Replace valve spring if it is not to the specifications presented below.
2) 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.

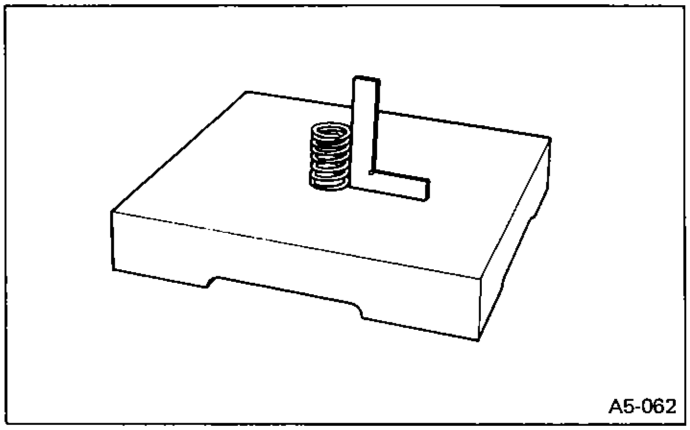


Fig. 66

	Outer spring	Inner spring
Free length	50.7 mm (1.996 in)	50.3 mm (1.980 in)
Tension/ spring height	203.0 – 238.3 N (20.7 – 24.3 kg, 45.6 – 53.6 lb)/ 41.5 mm (1.634 in)	88.3 – 101.0 N (9.0 – 10.3 kg, 19.8 – 22.7 lb)/ 38.5 mm (1.516 in)
	502.1 – 576.7 N (51.2 – 58.8 kg, 112.9 – 129.7 lb)/ 31.5 mm (1.240 in)	201.0 – 230.5 N (20.5 – 23.5 kg, 45.2 – 51.8 lb)/ 28.5 mm (1.122 in)
Squareness	2.2 mm (0.087 in)	2.2 mm (0.087 in)

ASSEMBLY

Coat the stem of each valve with engine oil and insert the valve into the valve guide. Attach the valve springs and retainer. Then compress the valve springs using VALVE SPRING PRESS (899724100) and fit the valve spring retainer key.

a. After installing, tap the valve spring retainers lightly with a wooden hammer for better seating.
b. When inserting the valve into the valve guide, use special care not to damage the oil seal lip.
c. Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

Cylinder Block

REMOVAL

1) Remove distributor and plug cord.

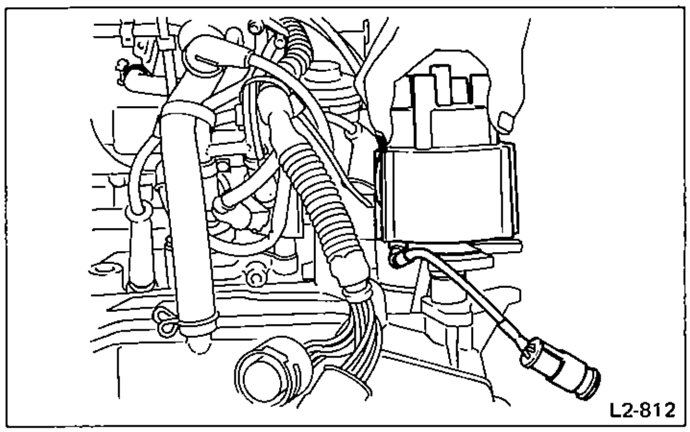


Fig. 67

2) Loosen water pump pulley mounting nuts or bolts.
3) Remove alternator and V-belt. [Except air conditioner equipped model]
4) Remove EGR pipe cover and EGR pipe.
5) Removal of intake manifold ASSY
   (1) Remove hoses and tubes from cylinder block side.
   (2) Disconnect each harness.
   (3) Remove intake manifold ASSY from engine.
6) Remove power steering oil pump bracket from cylinder block. [Power steering model]
7) Remove alternator brackets and adjusting bar. [All except air-conditioner models]
8) Remove knock sensor. [TURBO model]
9) Remove air bleed hose.
10) Remove oil filler duct.
11) Remove water pipe.
12) Remove crankshaft pulley. To lock crankshaft, use FLYWHEEL STOPPER (498277000) [manual transmission model] or DRIVE PLATE STOPPER (498497000) [automatic transmission model].

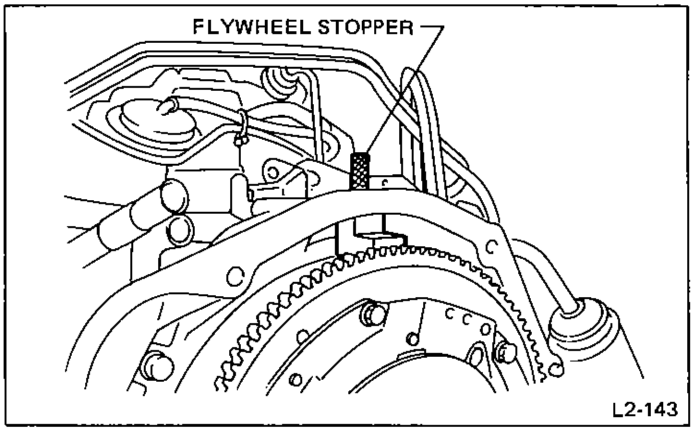


Fig. 68

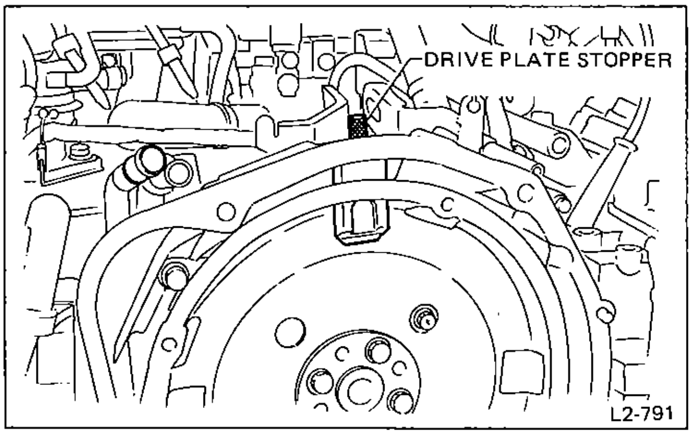


Fig. 69

13) Remove water pump pulley and pulley cover.
14) Remove oil level gauge guide together with gauge.
15) Remove timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
16) Remove water pump together with hose and pipe.
17) Remove oil pump by aligning notch in oil pump pulley with bolt position, then remove pump outer rotor from cylinder block.

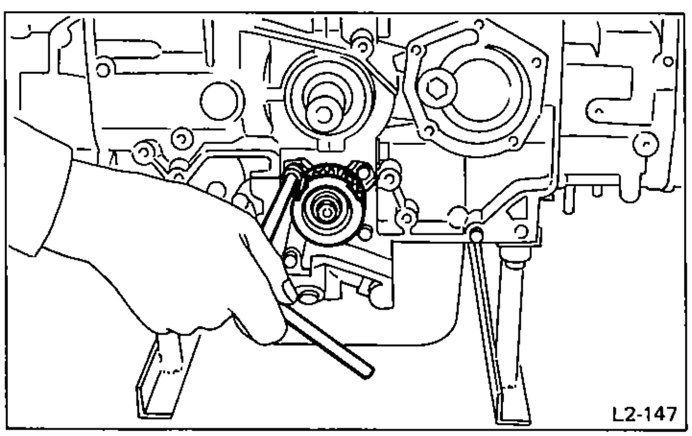


Fig. 70

18) Removing clutch cover and clutch disc. [All except automatic transmission model]

Be careful not to let oil, grease or coolant contact the clutch disc.

19) Remove flywheel [manual transmission model] or drive plate [automatic transmission model], and take out flywheel housing with housing cover. To lock crankshaft, use FLYWHEEL STOPPER (498277000) or DRIVE PLATE STOPPER (498497000).
20) Remove camshaft, valve rocker and related parts. (Refer to "Camshaft and Valve Rocker".)
21) Remove TURBO cooling pipe together with union screws and gaskets from cylinder head. [TURBO model]
22) Remove cylinder heads and gaskets.
23) Remove oil pan.
24) Remove oil strainer and strainer stays.

DISASSEMBLY

1) Remove oil separator cover.
2) Remove service hole plugs from cylinder block using hexagon wrench (14 mm).
3) Rotate crankshaft to bring #1 and #2 pistons to TDC position.
4) Remove piston circlip through service hole of #1 and #2 cylinders.

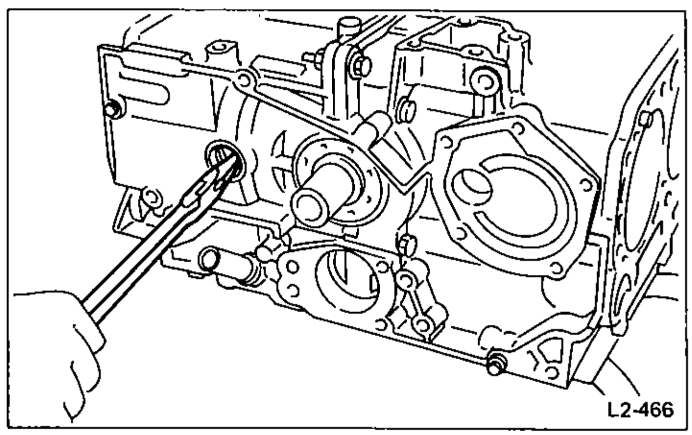


Fig. 71

5) Draw out piston pin from #1 and #2 pistons using PISTON PIN REMOVER (399094310).

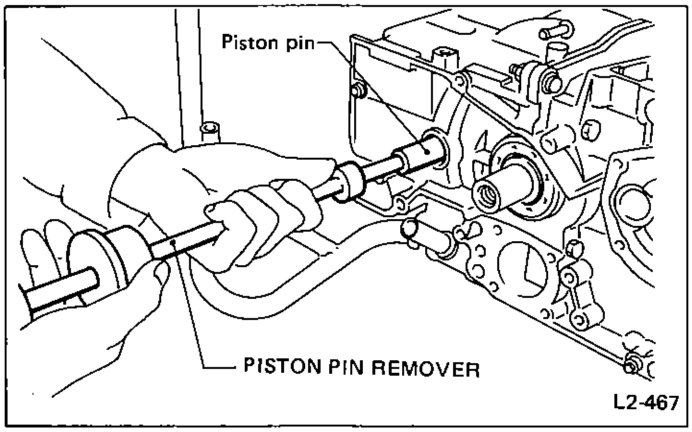


Fig. 72

6) Similarly remove piston pins from #3 and #4 pistons.

Be careful not to confuse original combination of piston, piston pin and cylinder.

7) Remove all of cylinder block connecting bolts except one 10-mm bolt under center journal. Loosen this 10-mm bolt until it can be turned by hand. (Cylinder block connecting bolts: six 10-mm bolts and six 8-mm bolts.)
8) Set up cylinder block so that #1 and #3 cylinders are on the upper side, then separate left-hand and right-hand cylinder blocks.

When separating cylinder block, do not allow the connecting rod to fall and damage the cylinder block.

9) Remove coolant passage O-ring and back-up ring from left-hand cylinder block.

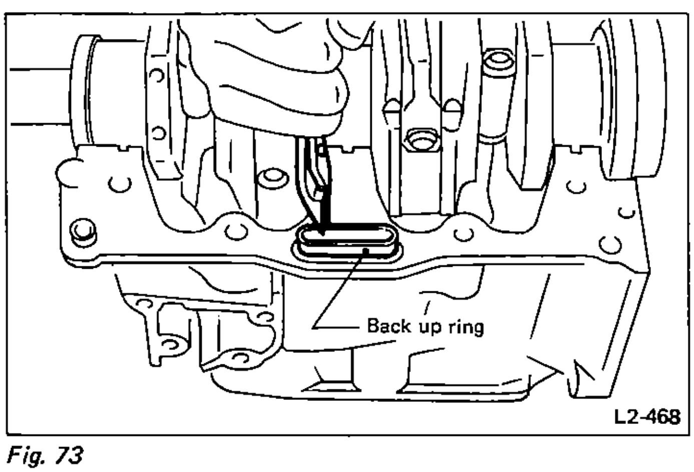


Fig. 73

10) Remove front oil seal and rear oil seal from crankshaft.
11) Remove crankshaft together with connecting rod from cylinder block.

12) Draw out each piston from cylinder block using wooden bar or hammer handle.

Do not confuse combination of piston and cylinder.

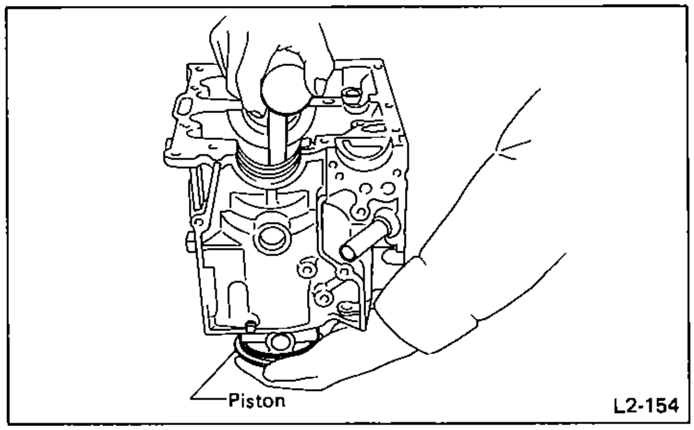


Fig. 74

13) Remove crankshaft bearings from cylinder block using hammer handle.

a. Do not confuse combination of crankshaft bearings. Press bearing at the end opposite to locking lip.
b. Do not confuse combination of crankshaft bearings.

INSPECTION

CYLINDER BLOCK

Check cylinder block 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) 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)
Grinding limit:
0.4 mm (0.016 in)

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.

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

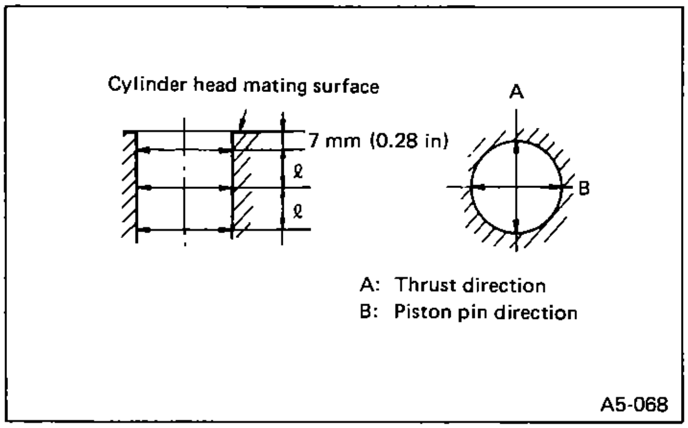


Fig. 75

ℓ:
1800 cc
33.5 mm (1.319 in)

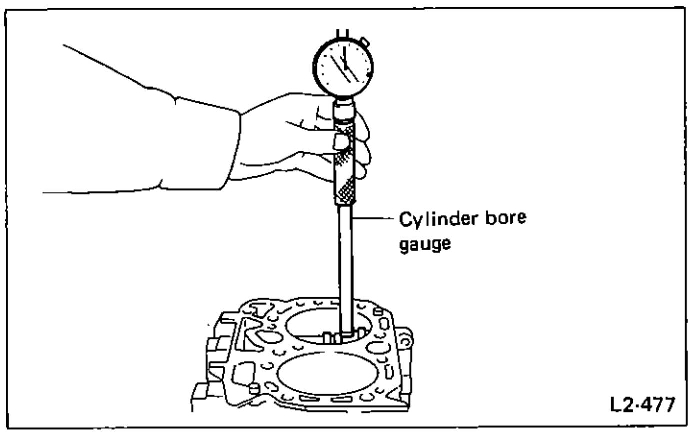


Fig. 76

Cylinder bore			
Standard diameter			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)	Non-TURBO	Standard	0.015 – 0.035 mm (0.0006 – 0.0014 in)
		Limit	0.060 mm (0.0024 in)
	TURBO	Standard	0.010 – 0.030 mm (0.0004 – 0.0012 in)
		Limit	0.050 mm (0.0020 in)

2) Boring and honing
(1) 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, rebore it to use an oversize piston.

When any of the cylinders needs reboring, 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.

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

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

Piston outer diameter:
Standard
Non-TURBO
91.970 – 91.980 mm (3.6209 – 3.6213 in)
TURBO
91.975 – 91.985 mm (3.6211 – 3.6214 in)
0.25 mm (0.0098 in) oversize
Non-TURBO
92.220 – 92.230 mm (3.6307 – 3.6311 in)
TURBO
92.225 – 92.235 mm (3.6309 – 3.6313 in)
0.50 mm (0.0197 in) oversize
Non-TURBO
92.470 – 92.480 mm (3.6405 – 3.6409 in)
TURBO
92.475 – 92.485 mm (3.6407 – 3.6411 in)

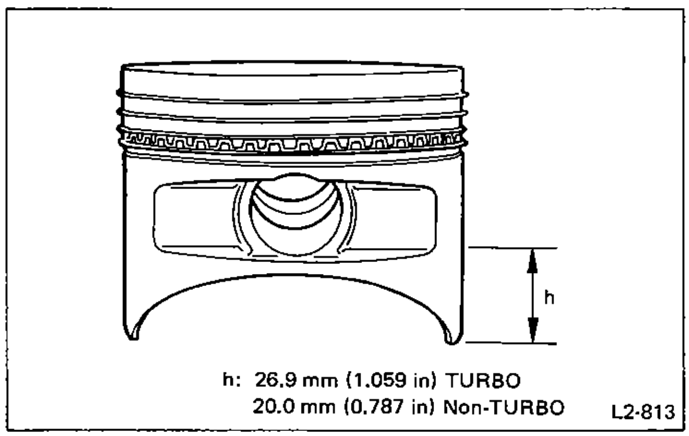


Fig. 77

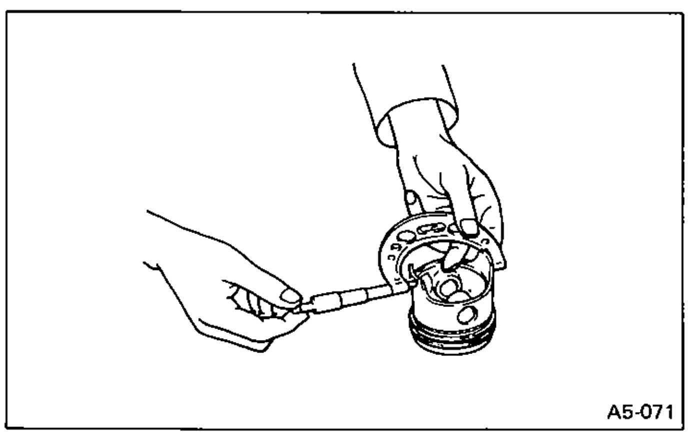


Fig. 78

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

Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

Enlarging limit of cylinder inner diameter:
0.30 mm (0.0118 in)

(4) Inspect the cylinder bore for taper, out-of-roundness, and diameter differences.

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

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

ASSEMBLY

1) Install ENGINE STANDS (499817000) to cylinder blocks. When installing ENGINE STANDS, fit bolts to the holes marked with "R" on the #1 and #3 cylinder sides, and to the holes marked with "L" on the #2 and #4 cylinder sides.
2) Install crankshaft bearings to cylinder blocks.
3) Install crankshaft to left-hand cylinder block.
4) Fit O-ring and back-up ring to coolant passage of left-hand cylinder block.
5) Apply fluid packing (Three-bond 1215, or equivalent) to mating surface of cylinder block.

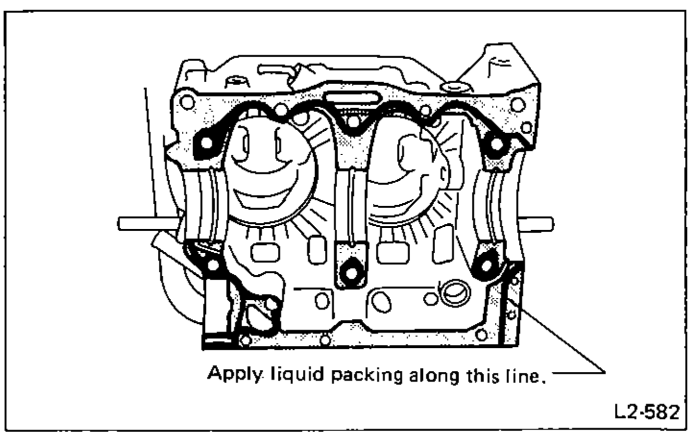


Fig. 79

6) With left-hand cylinder block facing down, install right-hand cylinder block. After tightening bolts temporarily, lay cylinder block down, then tighten bolts to the specified torque.

Make sure O-ring is fitted correctly in groove.

Tightening torque:
10 mm bolt
39 – 47 N·m (4.0 – 4.8 kg-m, 29 – 35 ft-lb)
8 mm bolt
23 – 26 N·m (2.3 – 2.7 kg-m, 17 – 20 ft-lb)

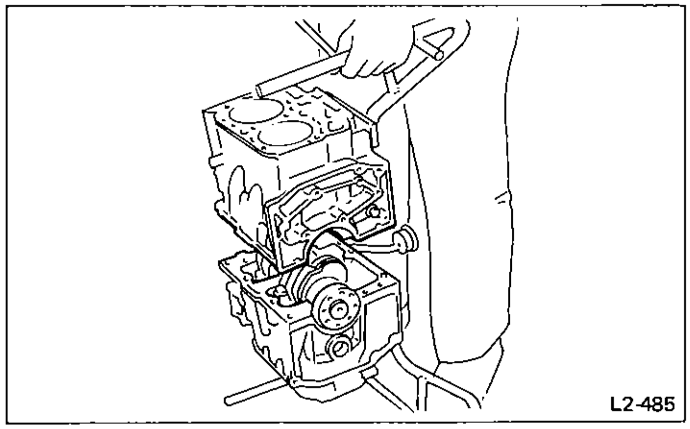


Fig. 80

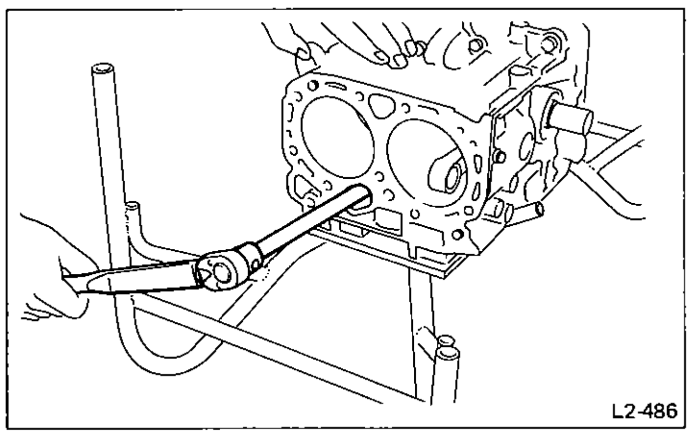


Fig. 81

7) Check thrust clearance of crankshaft.

Thrust clearance:
Standard
0.010 – 0.095 mm (0.0004 – 0.0037 in)
Limit
0.3 mm (0.012 in)

8) Position the gaps of the piston rings and oil ring as shown in the figure.

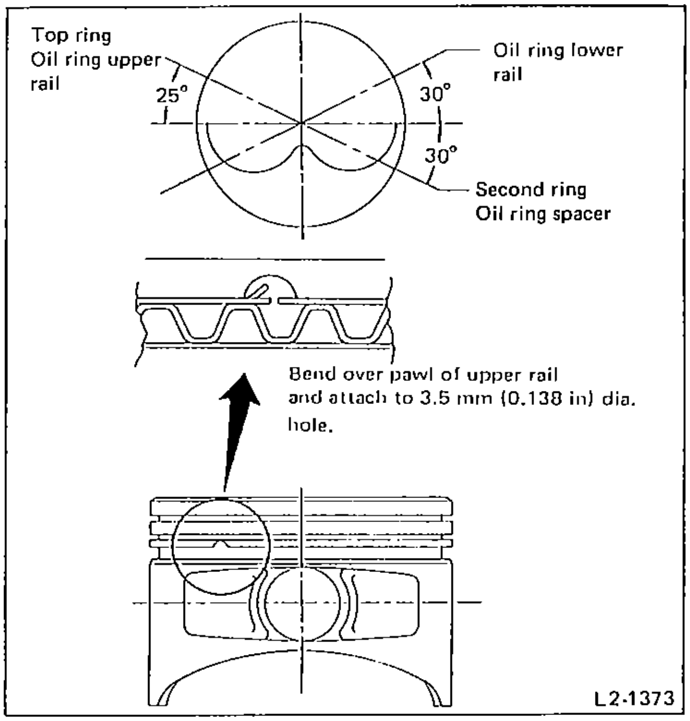


Fig. 82

9) Install pistons in cylinder as follows.

(1) Apply oil to the circumference of piston and the inner surface of cylinder.

(2) With the #3 and #4 cylinders facing downwards, turn crankshaft until the #1 and #2 connecting rod comes to the bottom dead center. Then insert the #1 and #2 piston into cylinder by using PISTON GUIDE (398744300).

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

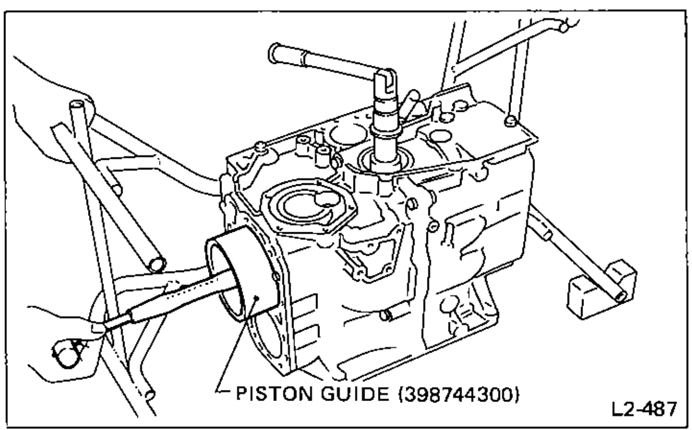


Fig. 83

(3) Install piston pin and circlip through the service hole after aligning the service hole, piston pin hole, and connecting rod small end with PISTON PIN GUIDE (399284300).

Circlip must be installed in correct direction with its end facing out.

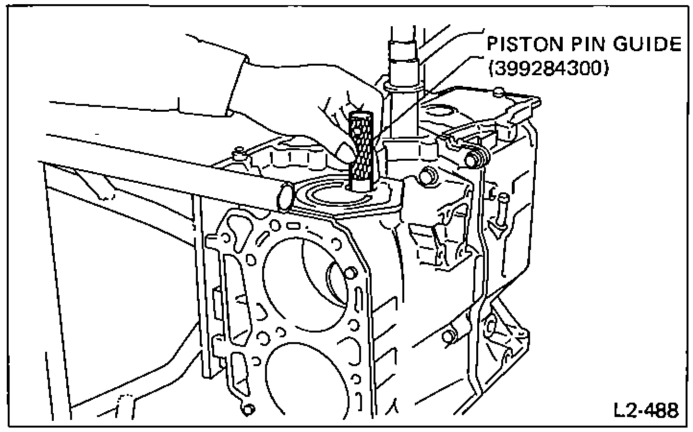


Fig. 84

(4) With #1 and #2 cylinders facing down, turn crankshaft until #3 and #4 piston connecting rods are at the bottom dead center position. Similarly to #1 and #2 cylinders, install pistons, piston pins, and circlips to #3 and #4 connecting rods.

Install crankshaft bolt to turn crankshaft.

(5) Turn crankshaft, and check whether pistons are assembled correctly.

10) Apply fluid packing (Fuji-bond C, or equivalent) to plugs, and tighten it with aluminium gasket placed in between.

Tightening torque:
62 –76 N·m (6.3 – 7.7 kg-m, 46 – 56 ft-lb)

11) Install rear oil seal to cylinder block using INSTALLER (499587000).

Coat oil seal lips with grease.
Coat the outside surface of oil seal with engine oil.

Max. allowable out-of-squareness of oil seal:
0.3 mm (0.012 in)

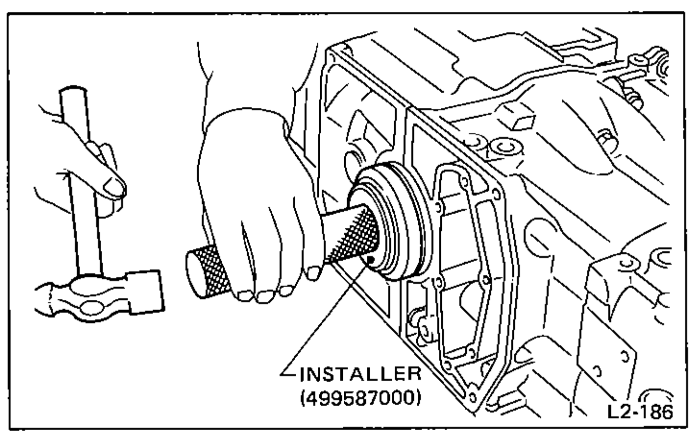


Fig. 85

12) Install oil separator cover with gasket placed in between.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

13) Install front oil seal to cylinder block using OIL SEAL INSTALLER (499567000).

Coat the outside surface of oil seal with engine oil, and oil seal lip with grease. Force-fit oil seal squarely into position.

Max. allowable out-of-squareness of oil seal:
0.2 mm (0.008 in)

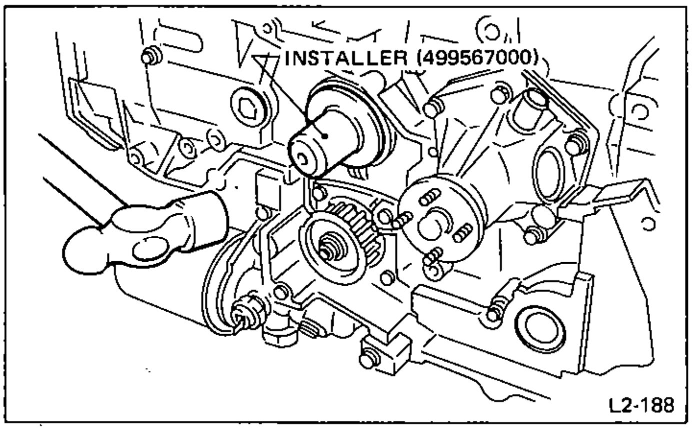


Fig. 86

INSTALLATION

1) Secure oil strainer to cylinder block with oil strainer stays.
2) Install oil pan.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

3) Install cylinder heads to cylinder blocks with gaskets placed between.
When tightening 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)

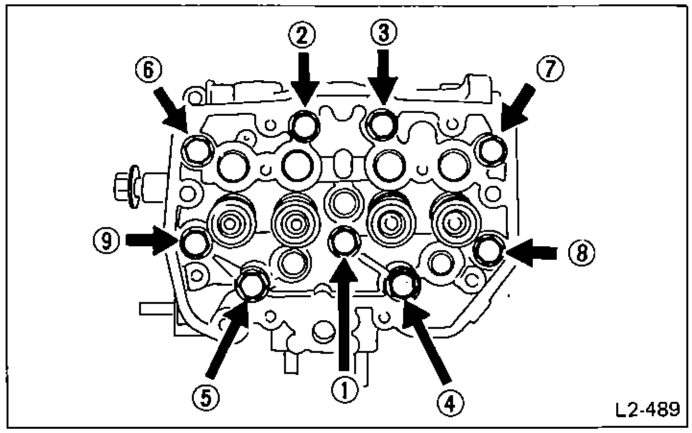


Fig. 87

4) Install TURBO cooling pipe together with union screws and gaskets to cylinder head.

Tightening torque:
21.1 – 24.0 N·m (2.15 – 2.45 kg-m, 15.6 – 17.7 ft-lb)

5) Install flywheel housing with housing cover and pitching stopper bracket.

Tightening torque:
34 – 40 N·m (3.5 – 4.1 kg-m, 25 – 30 ft-lb)

6) Install flywheel to crankshaft using FLYWHEEL STOPPER (498277000) for locking crankshaft. [Manual transmission model]

Tightening torque:
69 – 75 N·m (7.0 – 7.6 kg-m, 51 – 55 ft-lb)

7) Install drive plate and reinforcement using DRIVE PLATE STOPPER (498497000) for locking crankshaft. [Automatic transmission model]

Tightening torque:
69 – 75 N·m (7.0 – 7.6 kg-m, 51 – 55 ft-lb)

8) Position the clutch cover so that the "•" marks on the flywheel and clutch cover are spaced 120° or more.
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. [Manual transmission model]

Tightening torque:
16 N·m (1.6 kg-m, 12 ft-lb)

9) Install seal to water pump, then install the water pump to cylinder block with gasket placed between.

2) Position the gaps of the piston rings and oil ring as shown in the figure.

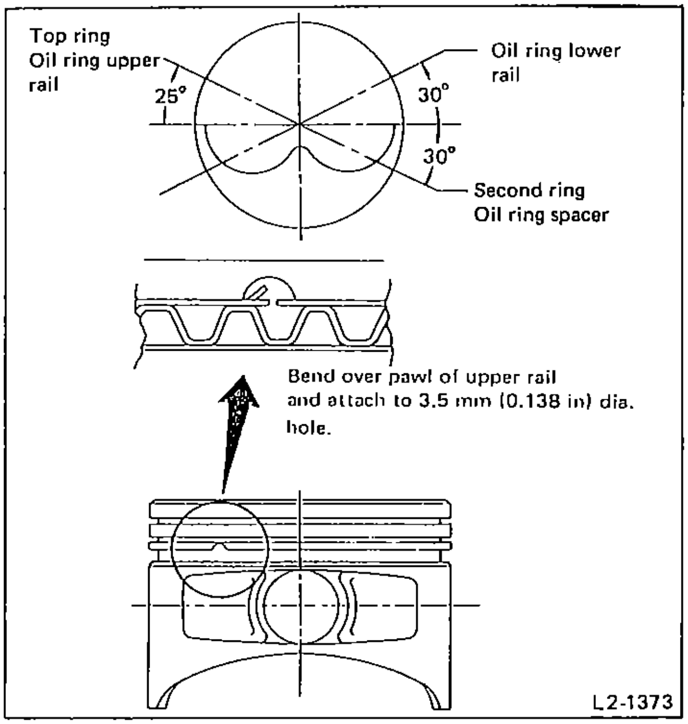


Fig. 109

3) Install circlip to piston.
The circlip must be fitted to the end that faces inside of crankcase when piston is inserted.

Circlip must be installed in correct direction with its end facing out.

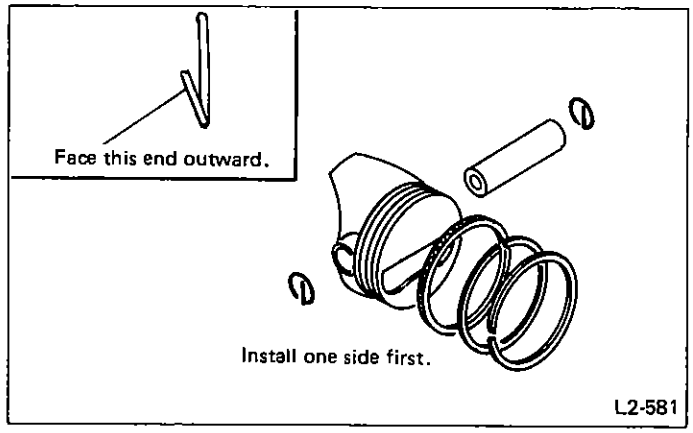


Fig. 110

TROUBLESHOOTING

Engine Trouble in General

Symbols shown in the chart refer to the possibility of reason for the trouble in order ("Very often" to "Rarely")
◎ – Very often
○ – Sometimes
Δ – Rarely

No.	TROUBLE	
1	Engine will not start.	Starter does not turn.
2		Initial combustion does not occur.
3		Initial combustion occurs.
4		Engine stalls after initial combustion.
5	Rough idle and engine stall.	
6	Low output, hesitation and poor acceleration.	
7	Surging.	
8	Engine does not return to idle.	
9	Dieseling (Run-on).	
10	Afterburning in exhaust system.	
11	Knocking.	
12	Excessive engine oil consumption.	
13	Excessive fuel consumption.	

TROUBLE No. 1	2	3	4	5	6	7	8	9	10	11	12	13	POSSIBLE CAUSE
													STARTER
○													● Defective battery-to-starter harness.
Δ													● Defective starter switch.
Δ													● Defective inhibitor switch.
○	Δ												● Defective starter.
													BATTERY
◎													● Poor terminal connection.
◎													● Run-down battery.
○													● Defective charging system.
	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎		◎	SPFI SYSTEM (See Chap. 2-7.)
	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎		◎	MPFI SYSTEM (See Chap. 2-7.)
													IGNITION SYSTEM
	○	○	○	◎	◎	◎	◎	◎	◎	◎		◎	● Incorrect ignition timing.
	○	◎		○	○	○			Δ			Δ	● Disconnection of spark plug cord.
	○			Δ	◎	○	○		◎	○			● Defective distributor.
	○			Δ	○	○							● Defective ignition coil.
	○			Δ	Δ	Δ							● Defective cord or wiring.
	○	○		Δ	○	Δ			○				● Leakage of spark plug cord.
		○		○	○	○			◎				● Defective spark plug.
	○	○	○	◎	○	◎	Δ		○	○			● Incorrect cam timing.
1	2	3	4	5	6	7	8	9	10	11	12	13	

1	2	3	4	5	6	7	8	9	10	11	12	13	POSSIBLE CAUSE
													INTAKE SYSTEM
		○	○	◎	○	○	◎	○	○			◎	• Improper idle adjustment.
			○	◎	◎	◎			Δ	◎			• Loosened or cracked intake boot.
			○	◎	◎	◎			Δ	◎			• Loosened or cracked intake duct.
			Δ	◎	◎	◎			Δ	◎	◎		• Loosened or cracked blow-by hose.
			Δ	◎	○	◎	◎		○	◎			• Loosened or cracked vacuum hose.
			Δ	○	○	○				◎			• Defective air cleaner gasket.
		○	○	○	○	○				◎			• Defective intake manifold gasket.
		○	○	○	○	○				◎			• Defective throttle body gasket.
				Δ	○	○			○	○	○		• Defective PCV valve.
				○	○	○			Δ	○	Δ		• Loosened oil filler cap.
			Δ	Δ	◎	○				○		◎	• Dirty air cleaner element.
													FUEL LINE
	◎	Δ		Δ	○	○							• Defective fuel pump.
		Δ	Δ	Δ	○	○							• Clogged fuel line.
	○	○	○	○	Δ	Δ							• Lack of or insufficient fuel.
													BELT
	○	○	○										• Defective.
	○	○	○	Δ	○	○			○	○		○	• Defective timing.
													FRICTION
Δ													• Seizure of crankshaft and connecting-rod bearing.
Δ													• Seized camshaft.
Δ													• Seized or stuck piston and cylinder.
													COMPRESSION
	Δ	Δ	Δ	○	○	○			○	Δ		○	• Incorrect valve clearance.
	Δ	Δ	Δ	○	○	Δ			Δ			Δ	• Loosened spark plugs or defective gasket.
	Δ	Δ	Δ	○	○	Δ			Δ			Δ	• Loosened cylinder head nuts or defective gasket.
	Δ	Δ	Δ	○	○	Δ			○			○	• Improper valve seating.
	Δ	Δ	Δ	Δ	Δ	Δ			Δ		◎	Δ	• Defective valve stem.
	○	○	○	○	○	Δ			Δ			Δ	• Worn or broken valve spring.
	Δ	Δ	Δ	○	Δ	Δ			Δ		◎	○	• Worn or stuck piston rings, cylinder and piston.
	○	○	○	◎	◎	◎			◎	○		○	• Incorrect valve timing.
	○	○	○	○	○	○							• Improper engine oil (low viscosity).
1	2	3	4	5	6	7	8	9	10	11	12	13	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													LUBRICATION SYSTEM
				○	○				△			△	• Incorrect oil pressure.
											○		• Loosened oil pump attaching bolts and defective gasket.
											○		• Defective oil filter seal.
											○		• Defective crankshaft oil seal.
				△							○		• Defective rocker cover gasket.
											○		• Loosened oil drain plug or defective gasket.
											○		• Loosened oil pan fitting bolts or defective oil pan.
													COOLING SYSTEM
				△	△	○		○		◎			• Overheating.
					△				△			△	• Over cooling.
													TURBOCHARGER
				△	◎	◎						○	• Malfunction of turbocharger.
					◎	◎				◎		○	• Malfunction of waste gate valve.
											○		• Defective oil pipe and hose.
													OTHERS
				○	◎	◎			○	◎		○	• Malfunction of EGR System. (See Chap. 2-1)
				◎	◎	△			△				• Malfunction of Evaporative Emission Control System. (See Chap. 2-1)
				○			◎						• Stuck or damaged throttle valve.
				△			○					○	• Dashpot out of adjustment.
				△			○	○				○	• Accelerator cable out of adjustment.
				○			○	○				○	• FICD out of adjustment.
				○			○						• Malfunction of FICD.
1	2	3	4	5	6	7	8	9	10	11	12	13	

Engine Noise

In case of 1800 cc OHC engine, valve lash adjuster may make clicking noise once engine starts. It is normal if clicking noise ceases after a few seconds.
If clicking noise continues after several seconds, check engine oil level and add oil if necessary. Then allow engine to idle for 10 to 20 minutes while maintaining engine speed at 1,500 to 2,000 rpm.

Type of sound	Condition	Possible cause
Regular clicking sound.	Sound increases as engine speed increases.	Valve mechanism is defective • Broken lash adjuster. • Worn valve rocker. • Worn camshaft. • Broken valve spring. • Worn valve lifter hole.
Heavy and dull metallic knock.	Oil pressure is low.	• Worn crankshaft main bearing. • Worn connecting rod bearing (big end).
	Oil pressure is normal.	• Loose flywheel mounting bolts. • Damaged engine mounting.
High-pitched metallic knock. (Engine knocking)	Sound is noticeable when accelerating with an overload.	• Ignition timing advanced. • Accumulation of carbon inside combustion chamber. • Wrong spark plug. • Improper gasoline.
Metallic knock when engine speed is medium (1,000 to 2,000 rpm).	Sound is reduced when spark plug in noisy cylinder is shortened out.	• Worn crankshaft main bearing. • Worn bearing at crankshaft end of connecting rod.
Knocking sound when engine is operating under idling speed and engine is warm.	Sound is reduced when spark plug in noisy cylinder is shortened out.	• Worn cylinder liner and piston ring. • Broken or stuck piston ring. • Worn piston pin and hole at piston end of connecting rod.
	Sound is not reduced if each spark plug is shortened out in turn.	• Unusually worn valve lifter. • Worn cam gear. • Worn camshaft journal bore in crankcase.
Squeaky sound.		• Insufficient alternator lubrication.
Rubbing sound.		• Defective alternator brush and rotor contact.

Type of sound	Condition	Possible cause
Gear scream when starting engine.		• Defective ignition starter switch. • Worn gear and starter pinion.
Sound like polishing glass with a dry cloth.		• Loose drive belt. • Defective water pump shaft.
Hissing sound.		• Loss of compression. • Air leakage in air intake system, hoses, connections or manifolds.
Timing belt noise.		• Loose timing belt. • Belt contacting case/adjacent part.
Distributor gear noise.		• Worn gear.

ENGINE LUBRICATION SYSTEM

2-4

SUBARU

1989

Page

MECHANISM AND FUNCTION

General

The engine lubrication system is a fully-pressurized full-flow filter type. The lubricating oil is pressurized by a trochoid oil pump with a built-in oil relief valve and oil bypass valve*. This oil pump is driven by the crankshaft at a speed ratio of 1:1 through a timing belt.

If the filtering capacity of the oil filter deteriorates, oil is sent directly to the main gallery through the oil bypass valve. If the oil pressure rises in the oil circuit, excess oil is returned to the oil pump through the oil relief valve.

*: The oil bypass valve is non-disassembling type.

Lubrication Lines

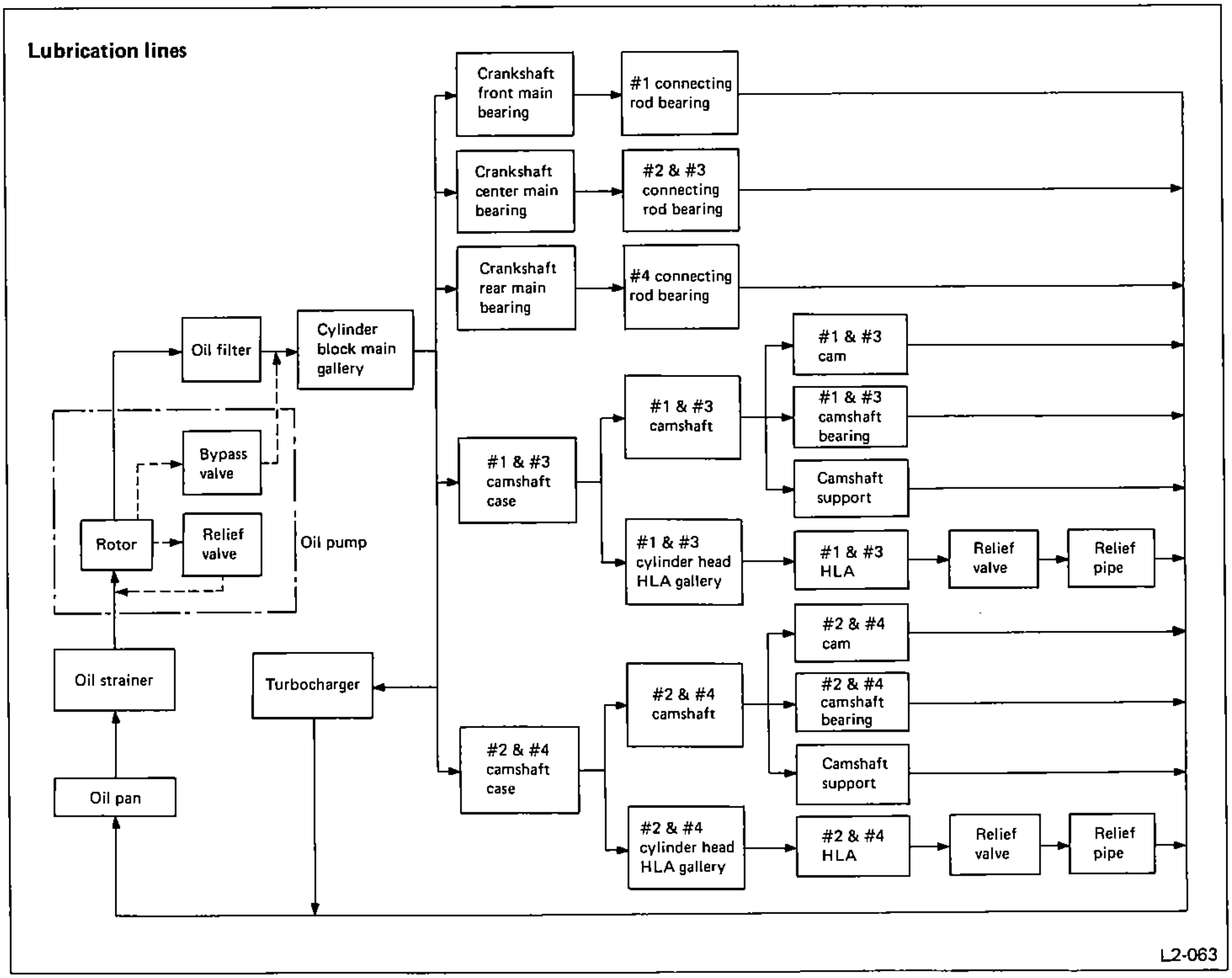


Fig. 1

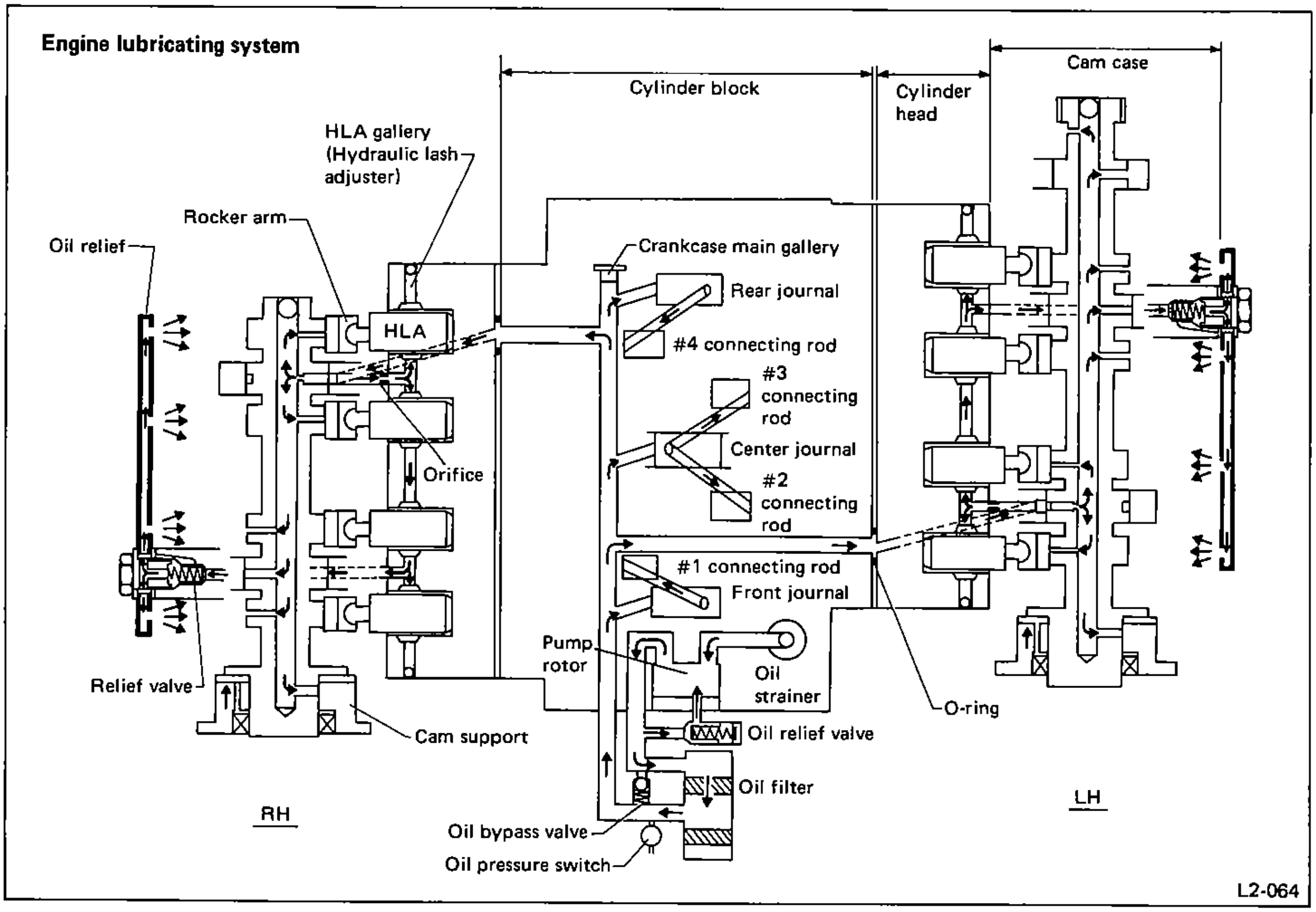


Fig. 2

Oil Pump

The oil pump is a small pump which sucks lubricant from the oil pan, and pressurizes it to send it to each section subjected to friction.
The trochoid pump consists of a pump casing with one lube oil inlet and one outlet, and an inner and outer rotor.

The inner rotor has four projections and the outer rotor has five depressions. As the inner rotor rotates inside the outer rotor, the clearance between the two rotors constantly varies. The oil is pumped in accordance with this clearance change. The trochoid pump is small and features a simple construction which experiences fewer problems.

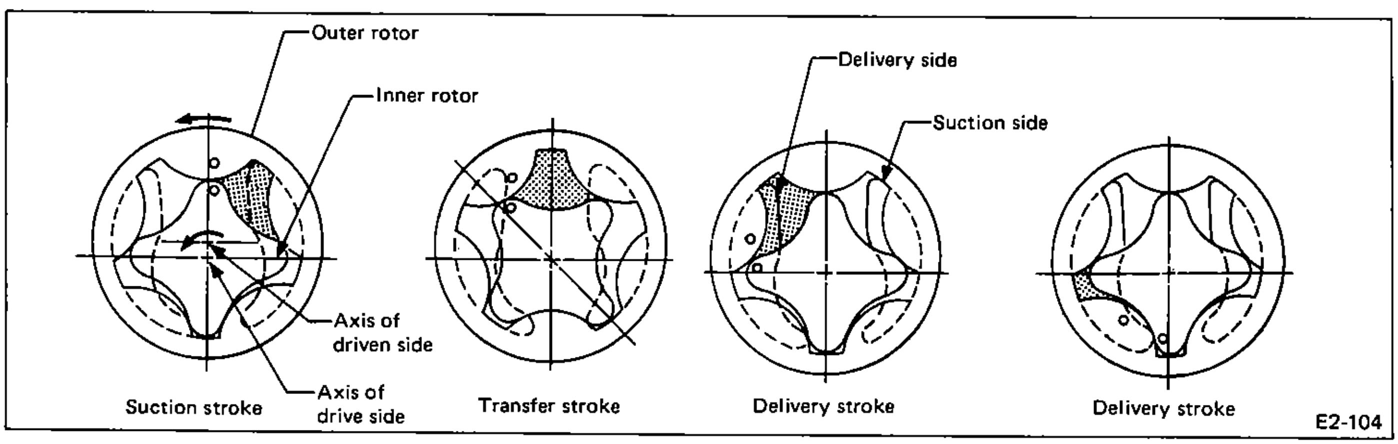
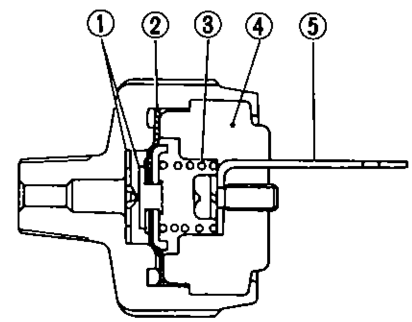


Fig. 3

Oil Pressure Switch

The oil pressure switch is attached to the oil pump case. It monitors the oil pressure and turns on or off the oil pressure indicator light in the combination meter.
The oil pressure switch consists of a diaphragm, which is operated by oil pressure, a set of contacts, which are opened or closed by diaphragm movement, and a spring, which determines when the contacts open depending on the oil pressure. It is enclosed by a housing similar in design to a hexagonal nut molded with phenol resin and a terminal.



1 Contacts
2 Diaphragm
3 Spring
4 Molded portion
5 Terminal

A6-011

Fig. 4

Oil Pressure Gauge

Construction

GAUGE SECTION

Gauge section consists of a bimetal, pointer and scale plate. Bimetal is wound with heat wire. Pointer moves in response to bending of bimetal.

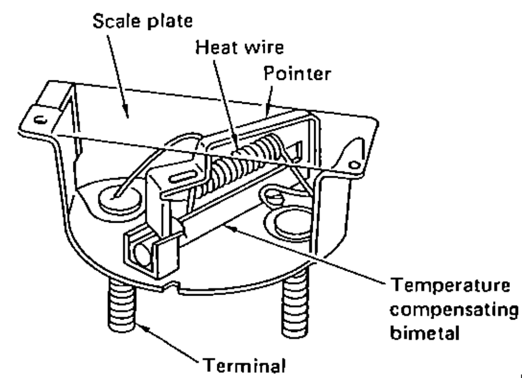


Fig. 5

SENDER SECTION

This section consists of a diaphragm, point arm, contact points and a heat-wire-wound bimetal. Diaphragm is displaced by oil pressure and the point arm conveys diaphragm displacement to contacts.
It is completely enclosed by a cover equipped with a positive terminal.

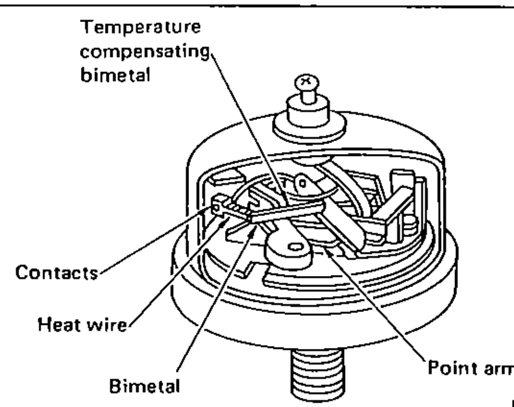


Fig. 6

Operation

1) When no oil pressure is applied, contact points open slightly.
2) When oil pressure is low:
   (1) Point arm is held by diaphragm and lightly contacts contact point of bimetal.

(2) When ignition switch is turned ON, current flows through gauge section and heat wire of sender section. Because of low point contact pressure, heat generated by low current allows bimetal to bend so that contact points open.
(3) Contact points (on sender side) open rapidly. Since temperature of bimetal (on gauge side) does not increase, bimetal hardly bends and the pointer does not move.

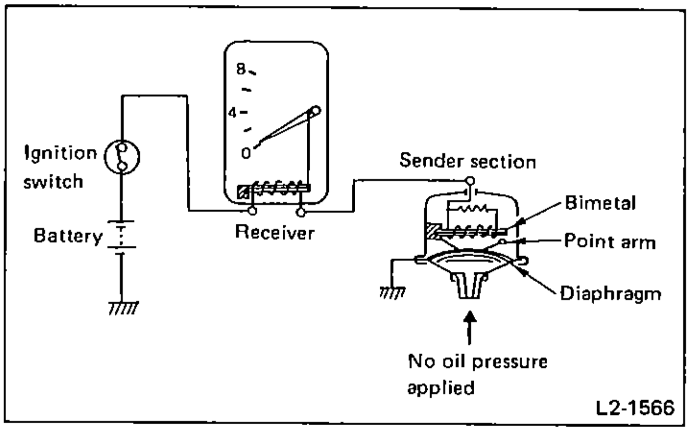


Fig. 7

3) When oil pressure is applied:
(1) Diaphragm expands in response to oil pressure so that it pushes up point arm forcefully. Point arm then contacts contact point (on the bimetal side).
(2) At this point, when ignition switch is turned ON to open contact point, bimetal bends considerably. In other words, current flows for a long period of time.
(3) However, after current flows through heat wire for a certain period of time (until bimetal reaches a certain temperature), point will open to interrupt current flow. As bimetal cools, contact point closes again.
(4) Thus, contact point closes and opens in response to temperature of bimetal. That is, temperature in relation to oil pressure. In other words, bimetal maintains a certain temperature in response to oil pressure.
(5) Similar to bimetal of sender section, bimetal of gauge section bends as its temperature increases. This causes gauge pointer to deflect.

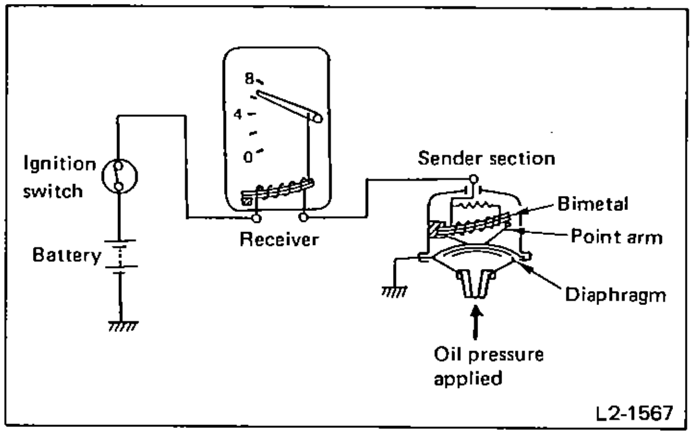


Fig. 8

Operating precautions

1) Do not apply battery voltage directly to gauge or sender section. Otherwise, heat wire may burn or bimetal twist.
2) Connect terminals firmly.
If an erroneous indication is noted, check wiring for grounding, terminal for looseness, and gauge for operation.
3) Do not ground or short midpoint of wiring. Otherwise, problems similar to those indicated in 1) above may occur.
4) Do not drop gauge/sender section and do not allow it to strike adjacent parts.

SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

Lubrication method			Forced feed, full flow filtration, splash type
Oil pump	Pump type		Trochoid type
	Discharge performance I	Discharge — Pressure	2.0ℓ/min (0.5 US gal/min, 0.4 Imp gal/min) — 98 kPa (1.0 kg/cm^2, 14 psi)
		Speed	550 rpm
		Oil temperature	75 – 85°C (167 – 185°F)
	Discharge performance II	Discharge — Pressure	31.2ℓ/min (8.2 US gal/min, 6.9 Imp gal/min) — 294 kPa (3.0 kg/cm^2, 43 psi)
		Speed	5000 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)
Oil filter		Type	Paper, cartridge type
		Filtration area	0.137 m^2 (1.47 sq ft)
Engine oil capacity		Upper level	4.0ℓ (4.2 US qt, 3.5 Imp qt)
		Lower level	3.0ℓ (3.2 US qt, 2.6 Imp qt)
Oil pressure switch		Type	Immersed contact point type
		Voltage	12V
		Warning light	12V – 3.4W or less
		Pressure at which switch closes	14.7 – 24.5 kPa (0.15 – 0.25 kg/cm^2, 2.1 – 3.6 psi)
		Pressure at which switch opens	14.7 – 24.5 kPa (0.15 – 0.25 kg/cm^2, 2.1 – 3.6 psi)
		Proof pressure	981 kPa (10 kg/cm^2, 142 psi) or more
Oil pressure gauge		Type	Bimetal type
		Voltage	12V
		Pressure range	0 – 785 kPa (0 – 8 kg/cm^2, 0 – 114 psi)

SERVICE DATA

Oil pump	Inner rotor outer diameter		35.65 – 35.70 mm	(1.4035 – 1.4055 in)
	Outer rotor outer diameter		49.95 – 50.00 mm	(1.9665 – 1.9685 in)
	Inner and outer rotor height	A	13.89 – 13.91 mm	(0.5468 – 0.5476 in)
		B	13.90 – 13.92 mm	(0.5472 – 0.5480 in)
		C	13.91 – 13.93 mm	(0.5476 – 0.5484 in)
	Height of oil pump case projection		7.97 – 8.00 mm	(0.3138 – 0.3150 in)
	Rotor housing depth		21.96 – 22.04 mm	(0.8646 – 0.8677 in)
	Side clearance between inner or outer rotor and crankcase.	STD	0.05 – 0.16 mm	(0.0020 – 0.0063 in)
		Limit	0.18 mm	(0.0071 in)
	Case clearance between outer rotor and crankcase.	STD	0.10 – 0.18 mm	(0.0039 – 0.0071 in)
		Limit	0.22 mm	(0.0087 in)
	Relief valve spring	Free length	47.1 mm	(1.854 in)
		Installed length	33.5 mm	(1.319 in)
		Load when installed	3.88 – 4.28 kg	(8.56 – 9.44 lb)

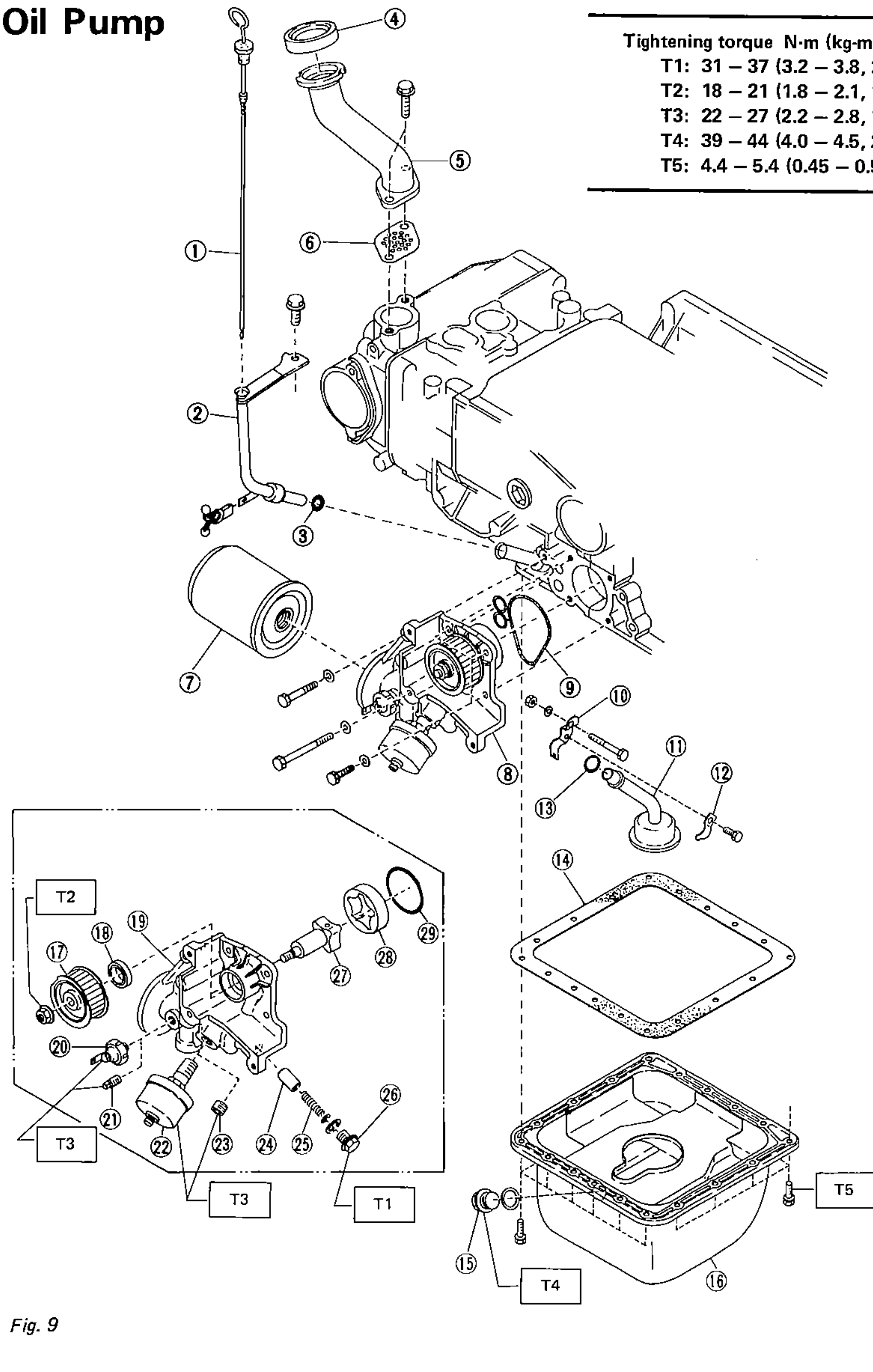
Reference pressure with oil pump equipped on the engine is as follows:

Condition	Oil temperature	100°C (212°F)	
	Cooling fan	OFF	
	Engine oil	10W – 30 (SAE)	
	Engine speed	2,000 rpm	4,000 rpm
Pressure on engine		98 – 177 kPa (1.0 – 1.8 kg/cm^2, 14 – 26 psi)	235 – 314 kPa (2.4 – 3.2 kg/cm^2, 34 – 46 psi)

COMPONENT PARTS

Oil Pump

Tightening torque N·m (kg-m, ft-lb)
T1: 31 – 37 (3.2 – 3.8, 23 – 27)
T2: 18 – 21 (1.8 – 2.1, 13 – 15)
T3: 22 – 27 (2.2 – 2.8, 16 – 20)
T4: 39 – 44 (4.0 – 4.5, 29 – 33)
T5: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)



1 Oil level gauge
2 Oil level gauge guide
3 O-ring
4 Oil filler cap
5 Oil filler duct
6 Gasket
7 Oil filter
8 Oil pump ASSY
9 Gasket
10 Oil strainer stay
11 Oil strainer
12 Oil strainer stay 2
13 O-ring
14 Gasket
15 Plug
16 Oil pan
17 Oil pump pulley
18 Oil seal
19 Oil pump case
20 Oil pressure switch
21 Plug
22 Oil pressure gauge
23 Plug
24 Oil relief valve
25 Oil relief valve spring
26 Plug
27 Oil pump inner rotor
28 Oil pump outer rotor
29 O-ring

Fig. 9

L2-572

SERVICE PROCEDURE

Oil Pump

REMOVAL

1) Drain engine oil.
2) Remove belt covers and camshaft drive belts. (See Section 2-3 "Engine".)

Before removing camshaft drive belts, be sure to loosen oil pump pulley mounting nut.

3) Remove oil pump mounting bolts, and detach oil pump together with oil filter from cylinder block.

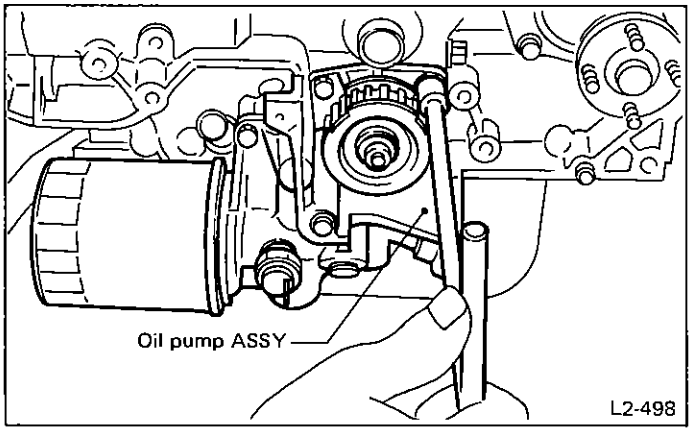


Fig. 10

4) Remove oil pump outer rotor from cylinder block.

DISASSEMBLY

1) Remove oil filter from oil pump.
2) Remove O-ring.
3) Remove oil pressure gauge or oil pressure switch.
4) Remove oil pump pulley, and draw out oil pump inner rotor.
5) Remove oil bypass valve plug, and take out spring and ball.
6) Remove oil relief valve plug, and take out spring and ball.

INSPECTION

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

INNER ROTOR

Check the outside diameter of the inner rotor shaft portion, and replace it if worn or damaged.

Outside diameter of inner rotor shaft portion:
35.65 – 35.70 mm (1.4035 – 1.4055 in)

OUTER ROTOR

Check the outer rotor, and replace if worn or damaged.

Outside diameter of outer rotor:
49.95 – 50.00 mm (1.9665 – 1.9685 in)

OIL PUMP CASE CLEARANCE

Measure the clearance between the outer rotor and the cylinder block rotor housing.
If the clearance exceeds the limit, replace the rotor.

Case clearance:
Standard
0.10 – 0.18 mm (0.0039 – 0.0071 in)
Limit
0.22 mm (0.0087 in)

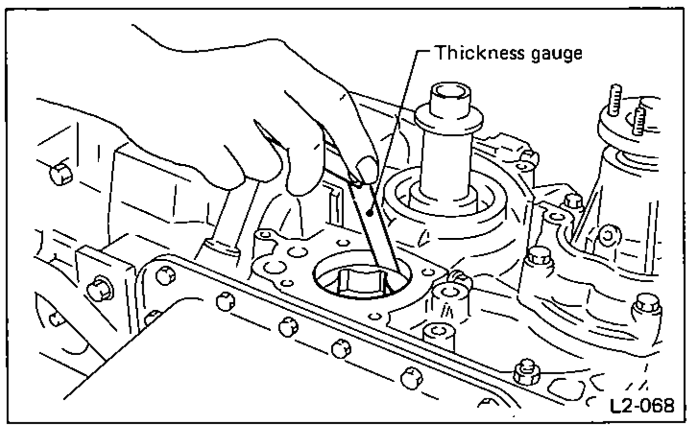


Fig. 11

OIL PUMP SIDE CLEARANCE

1) Measure total height of case projection (H1) plus oil pump inner and outer rotors (H2).

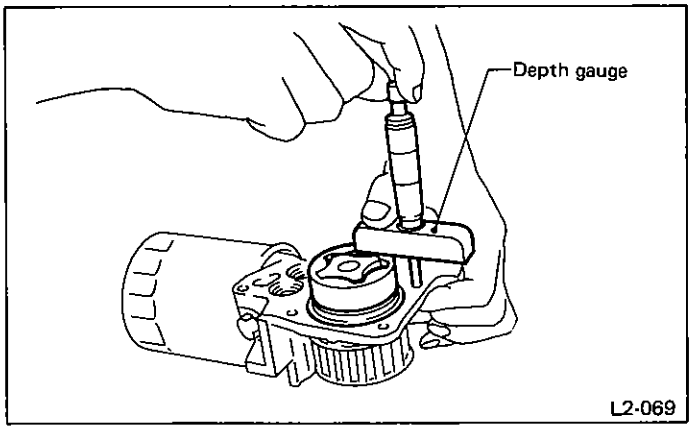


Fig. 12

2) Measure depth (L) of rotor housing bore in cylinder block.

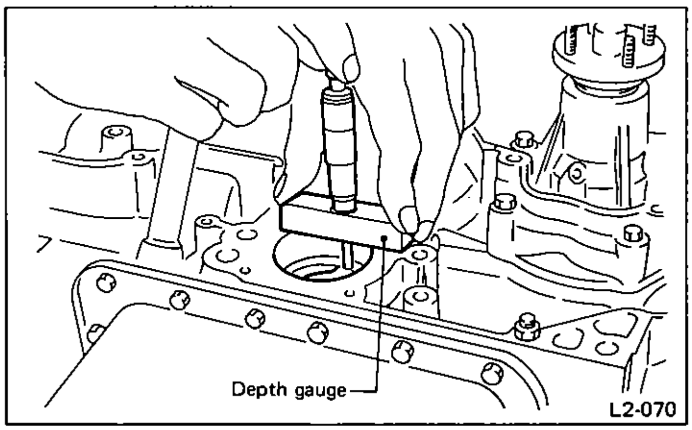


Fig. 13

3) Calculate side clearance (C) using the following equation:

$$C = L - (H1 + H2)$$

4) If side clearance value (C) is larger than "Limit" shown below, replace pump inner and outer rotors with the suitable ones selected from following table.

Side clearance: C
Standard
0.05 – 0.16 mm (0.0020 – 0.0063 in)
Limit
0.18 mm (0.0071 in)

Inner and Outer Rotor	
Marking	Height (H2)
A	13.89 – 13.91 mm (0.5468 – 0.5476 in)
B	13.90 – 13.92 mm (0.5472 – 0.5480 in)
C	13.91 – 13.93 mm (0.5476 – 0.5484 in)

Height of case projection: H1
7.97 – 8.00 mm (0.3138 – 0.3150 in)
Depth of rotor housing: L
21.96 – 22.04 mm (0.8646 – 0.8677 in)

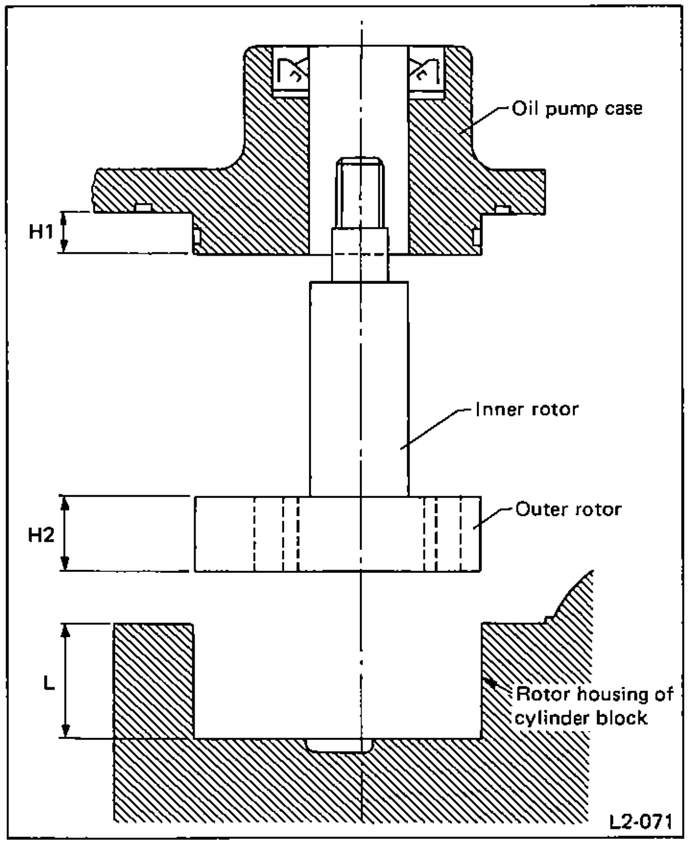


Fig. 14

OIL RELIEF VALVE

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
3.88 – 4.28 kg (8.555 – 9.437 lb)

OIL PUMP CASE

Check the oil pump case for worn shaft hole, clogged oil passage, worn rotor chamber, cracks, and other faults.

OIL SEAL

Check the oil seal lips for deformation, hardening, wear, etc. and replace if defective.

ASSEMBLY AND INSTALLATION

Assembly and installation is in the reverse order of removal procedure.

Observe the following:

1) Replace the O-ring and gaskets with a new one.

2) Coat rubber seal of oil filter with engine oil before installing the oil filter.

3) Tighten oil filter an extra 2/3 turn after rubber seal contacts pump case. Do not tighten excessively.

TROUBLESHOOTING

Before troubleshooting, make sure that the engine oil level is correct and no oil leakage exists.

Trouble	Possible cause		Corrective action
1. Warning light remains on.	1) Oil pressure switch failure	Cracked diaphragm	Replace.
		Oil leakage within switch	Replace.
	2) Low oil pressure	Clogged oil filter	Replace.
		Malfunction of oil by-pass valve	Clean or replace.
		Malfunction of oil relief valve	Clean or replace.
		Clogged oil passage	Clean.
		Excessive tip clearance and side clearance of oil pump rotor and gear	Replace.
		Clogged oil strainer or broken pipe	Clean or replace.
	3) No oil pressure	Insufficient engine oil	Replenish.
		Broken pipe of oil strainer	Replace.
		Stuck oil pump drive gear and rotor	Replace.
2. Warning light does not go on.	1) Burnt-out bulb		Replace.
	2) Poor contact of switch contact points		Replace.
	3) Disconnection of wiring		Repair.
3. Warning light flickers momentarily.	1) Poor contact at terminals		Repair.
	2) Defective wiring harness		Repair.
	3) Low oil pressure		Check for the same possible causes as listed in 1.–2)
4. Oil pressure gauge indication is erroneous.	1) Poor contact at terminals		Repair.
	2) Deformed bimetal		Replace.
	3) Binding of needle pointer		Repair.
	4) Contaminated points		Replace.
	5) Low oil pressure		Check for the same possible causes as listed in 1.–2)
5. Oil pressure gauge does not deflect.	1) Needle pointer out of place		Repair.
	2) Heat wire disconnection		Replace.
	3) Disconnection of wiring		Repair.
	4) Cracked senser diaphragm		Replace.
	5) Low oil pressure		Check for the same possible causes as listed in 1.–2)

ENGINE COOLING SYSTEM

2-5

SUBARU

1989

Page

MECHANISM AND FUNCTION

General

The engine cooling system consists of a cross-flow radiator which features high heat-dissipation performance, an electric motor fan, a water pump, a thermostat, and a thermometer. The reserve tank is designed to eliminate the need for replenishing coolant.

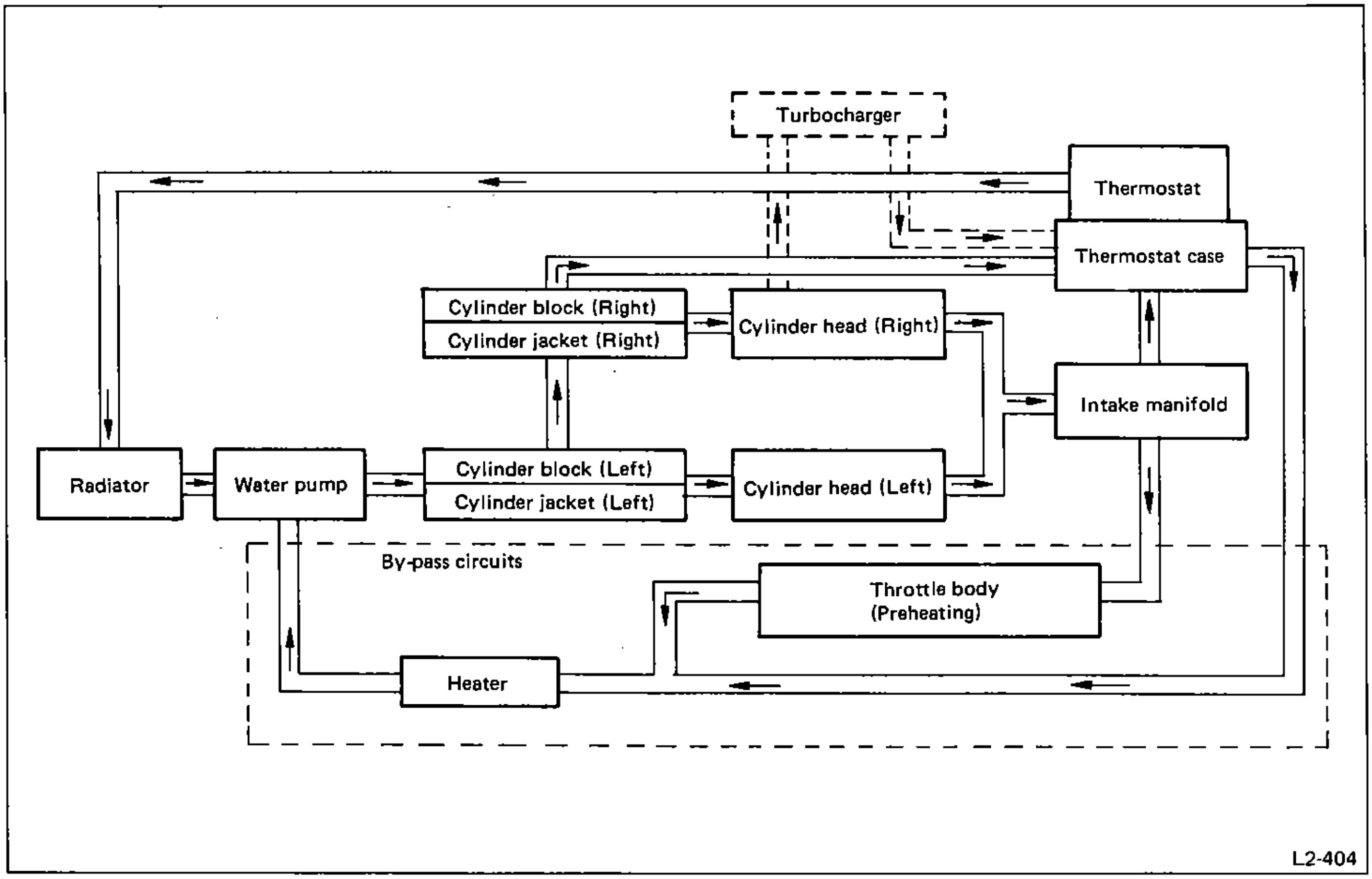


Fig. 1

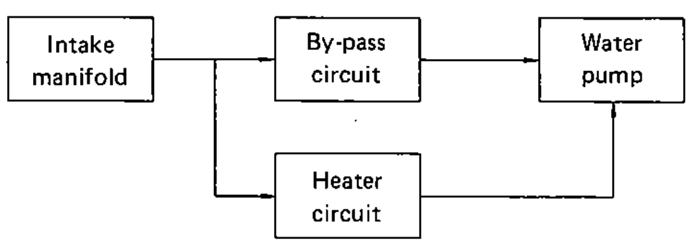
Cooling Lines

This cooling system operates in three steps depending on the temperature of the coolant flowing through the cooling circuit.

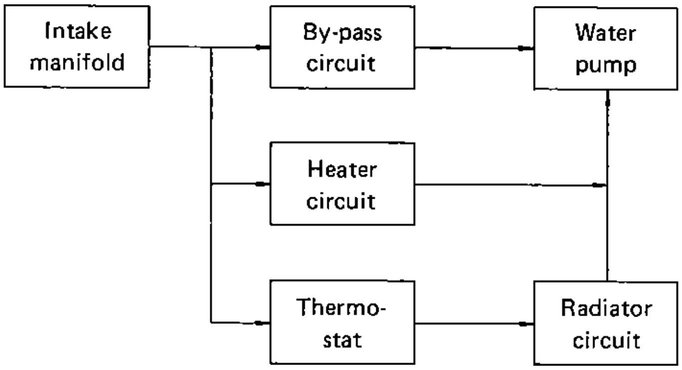
1) 1st step ... With thermostat closed

At coolant temperature of below 88°C (190°F), the thermostat remains closed and the coolant flows through the bypass and heater circuits.

This permits the engine to warm up quickly.



2) 2nd step ... With thermostat opened
When the coolant temperature is above 88°C (190°F), the thermostat opens and the coolant flows through the radiator where it is cooled.



3) 3rd step ... With electric cooling fan operating
When the coolant temperature rises above 95°C (203°F), the thermoswitch is turned on and the electric cooling fan rotates.

Thermostat

The thermostat is powered to open the valve by a totally-enclosed wax pellet which expands with increased temperature. It provides the sure open-close operation of the valve and features high durability.

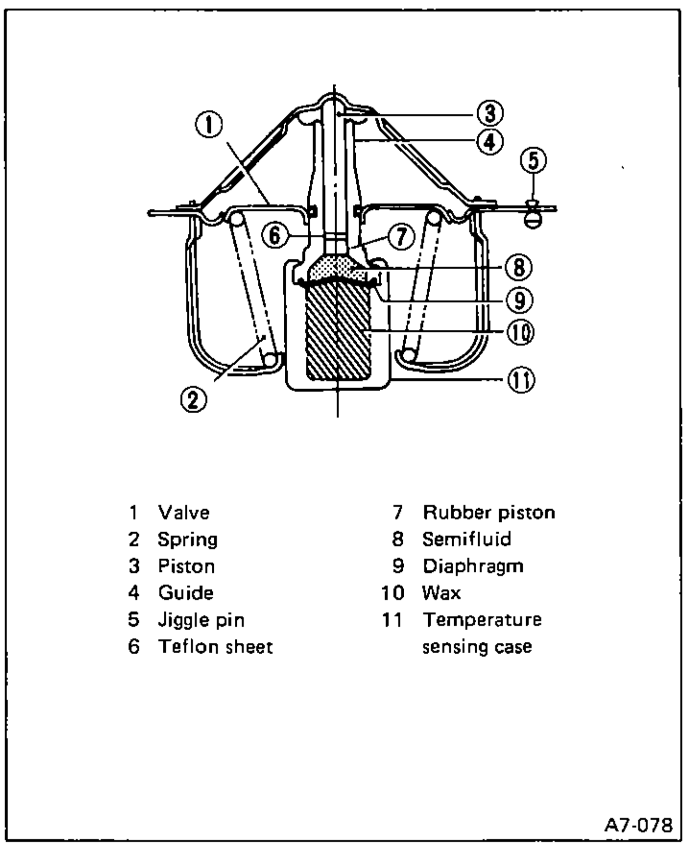


Fig. 2

Thermometer

The thermometer is installed on the intake manifold and monitors the temperature of the coolant in the engine to activate the temperature gauge in the combination meter. The thermometer includes a thermistor, lead wire, spring, terminal plate and resin body, completely sealed by a threaded case which is integral with a hexagon nut.

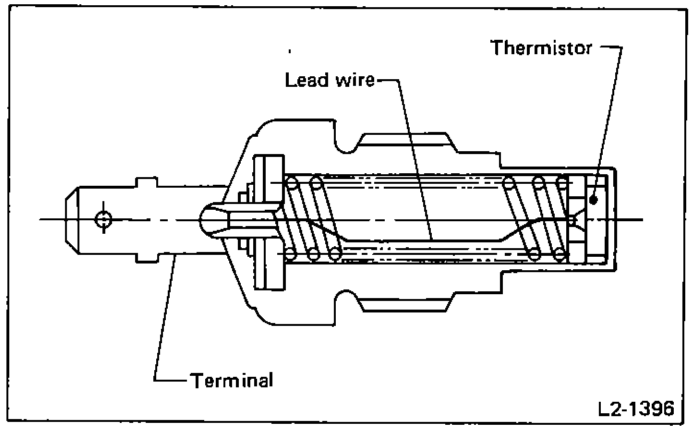


Fig. 3

SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

Total coolant capacity and radiation capacity are changed as follows:

Total coolant capacity	Non-TURBO, TURBO MT and TURBO AT (Canada)		5.5 ℓ (5.8 US qt, 4.8 Imp qt)
	TURBO AT (Except Canada)		6.0 ℓ (6.3 US qt, 5.3 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 (13.2 US gal, 11.0 Imp gal)/min 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		66 mm (2.60 in)
	Number of impeller vanes		5
	Pump pulley diameter		90 mm (3.54 in)
Thermostat	Type		Wax pellet type
	Starts to open		86.5 – 89.5°C (188 – 193°F)
	Fully opens		100°C (212°F)
	Valve lift		8.5 mm (0.335 in)
	Valve bore		31 mm (1.22 in)
Thermoswitch	Type		Bimetal type
	Operation temperature		ON: 93 – 97°C (199 – 207°F) Differential: 5 – 9°C (9 – 16°F)
Electric fan	Motor	Non-TURBO and TURBO MT	120 W or less
		TURBO AT	140 W or less
	Fan dia.		280 mm (11.02 in)

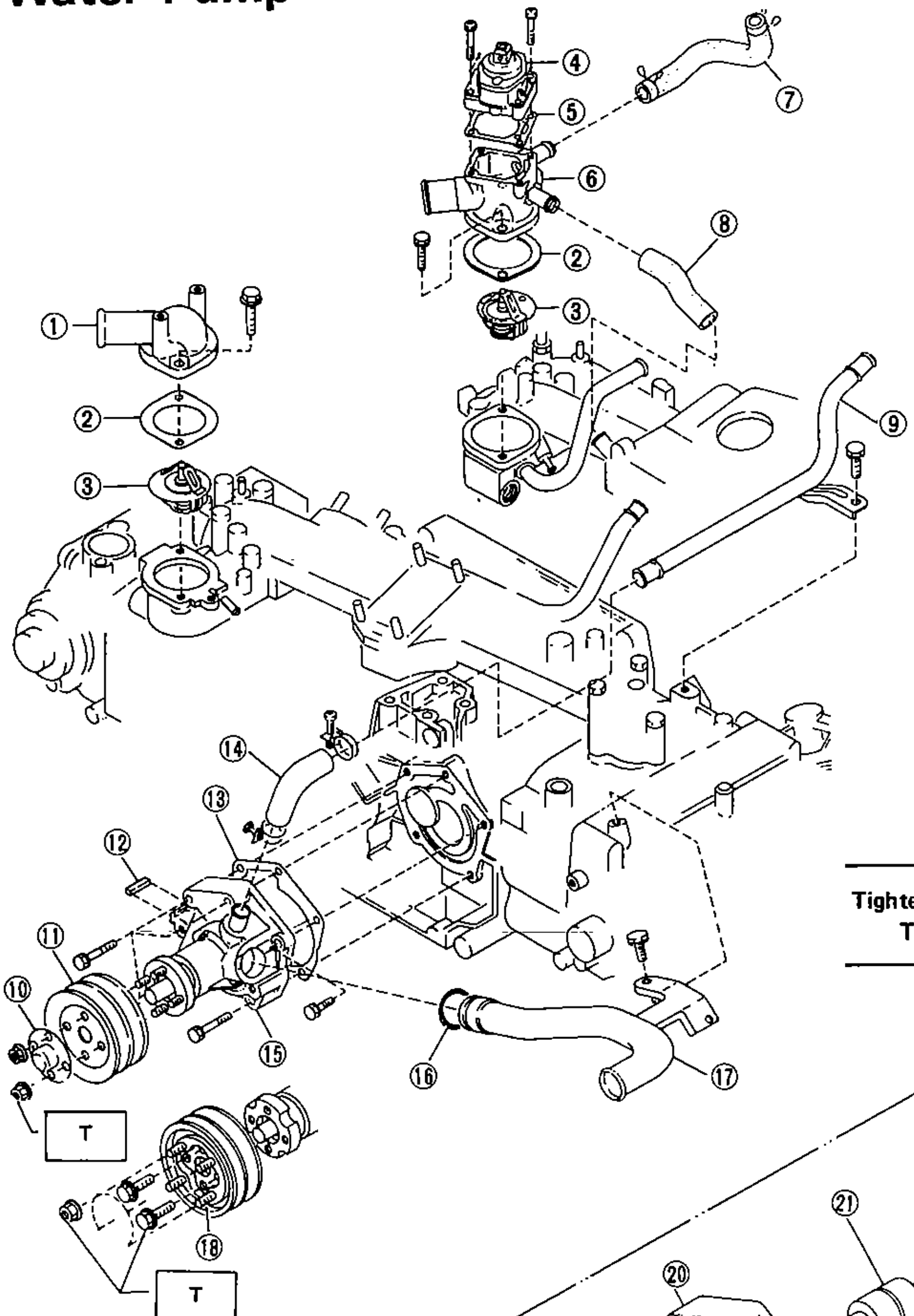
Radiator	Type				Cross flow, pressure type
	Radiation capacity	Non-TURBO	MT (Except 4WD dual-range)		40.007 kW (34,400 kcal/h, 136,499 BTU/h)
			AT and 4WD dual-range		45.822 kW (39,400 kcal/h, 156,339 BTU/h)
		TURBO	MT		47.683 kW (41,000 kcal/h, 162,688 BTU/h)
			AT	Except Canada	56.522 kW (48,600 kcal/h, 192,845 BTU/h)
				Canada	47.683 kW (41,000 kcal/h, 162,688 BTU/h)
	Core dimensions	Non-TURBO and TURBO MT			645 x 322 x 16 mm (25.39 x 12.68 x 0.63 in)
		TURBO AT			645 x 322 x 32 mm (25.39 x 12.68 x 1.26 in)
	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
Reserve tank	Capacity				1.2ℓ (2.5 US pt, 2.1 Imp pt)

SERVICE DATA

Water pump	Clearance between impeller and case		0.5 – 0.9 mm (0.020 – 0.035 in)
	Distance between pulley attaching surface of hub and pump case surface, which mates with gasket	A/C equipped model	103.6 – 104.2 mm (4.08 – 4.10 in)
		A/C not equipped model	109.7 – 110.1 mm (4.32 – 4.33 in)

COMPONENT PARTS

Water Pump



1 Thermostat cover [SPFI]
2 Gasket
3 Thermostat
4 Auxiliary air valve [MPFI]
5 Gasket
6 Thermostat cover [MPFI]
7 Hose (to air intake duct)
8 Hose (to intake manifold)
9 Water by-pass pipe
10 Pulley cover
11 Water pump pulley [A/C not-equipped model]
12 Seal
13 Gasket
14 Water by-pass hose
15 Water pump ASSY
16 O-ring
17 Water pipe
18 Water pump pulley [A/C equipped model]
19 Water pump hub
20 Water pump case
21 Water pump shaft
22 Water pump mechanical seal
23 Water pump plate
24 Water pump impeller
25 Water pump clip

Tightening torque: N·m (kg-m, ft-lb)
T: 9.1 – 10.5 (0.93 – 1.07, 6.7 – 7.7)

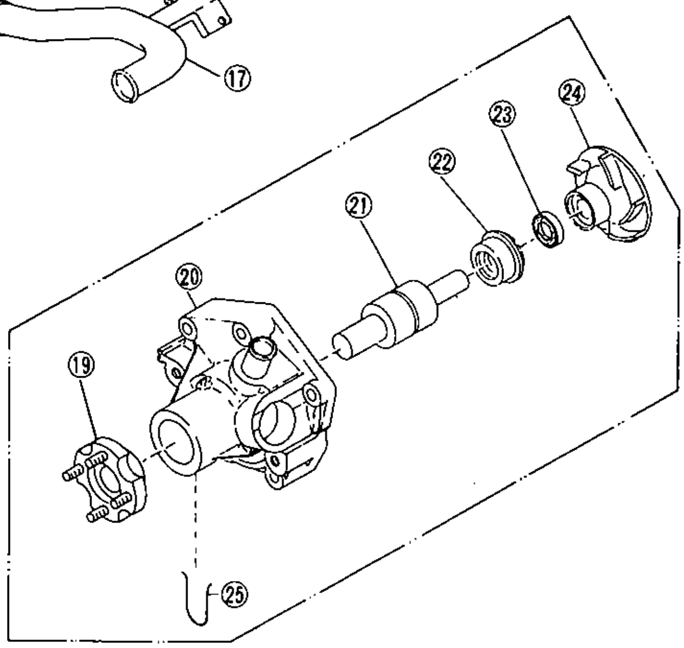
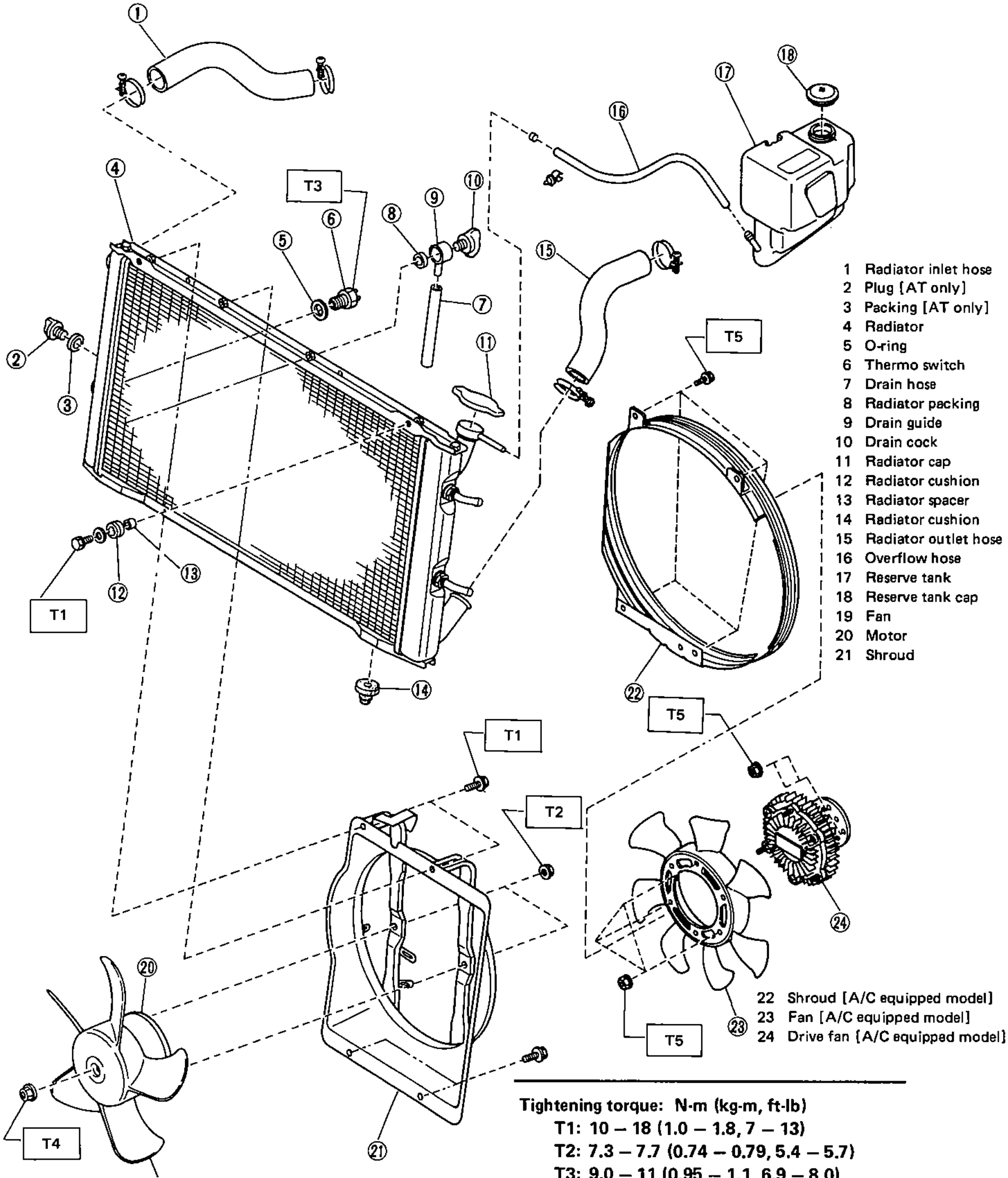


Fig. 4

L2-1551

Radiator and Cooling Fan



Tightening torque: N·m (kg-m, ft-lb)

T1: 10 – 18 (1.0 – 1.8, 7 – 13)
T2: 7.3 – 7.7 (0.74 – 0.79, 5.4 – 5.7)
T3: 9.0 – 11 (0.95 – 1.1, 6.9 – 8.0)
T4: 3.5 – 5.5 (0.36 – 0.56, 2.6 – 4.1)
T5: 5.5 – 9.5 (0.56 – 0.97, 4.1 – 7.0)

Fig. 5

L2-1397

SERVICE PROCEDURE

Water Pump

REMOVAL

1) Drain coolant and disconnect the radiator outlet hose and water by-pass hose from the water pump.
2) Loosen pulley nuts so that they can be turned by hand.
3) Loosen alternator ASSY mounting bolts and remove drive belt.
4) Remove front belt cover. Refer to 2-3 "Engine Disassembly" for procedures.

Be careful not to spill coolant on drive belt. If spilled, wipe clean immediately.

DISASSEMBLY

a. Do not disassemble water pump unless absolutely necessary. It is advisable to replace water pump ASSY.
b. In case of disassembling water pump, be sure to check "runout" of water pump hub after assembling. If it is outside specifications, replace water pump ASSY.

1) Remove water pump pulley.
2) Insert a screwdriver into the slit in water pump case and lift end of water pump clip.

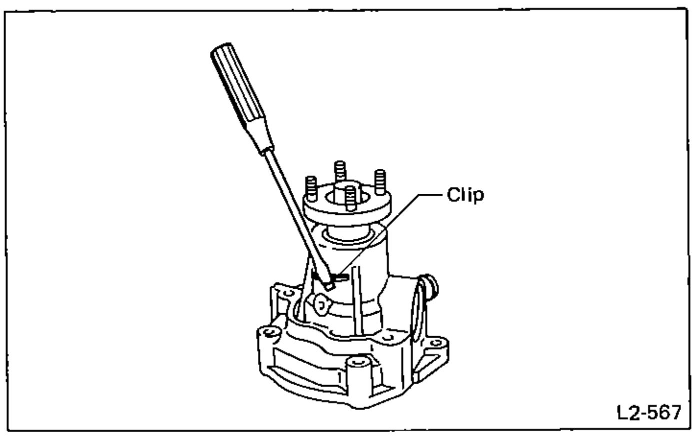


Fig. 6

3) Extract water pump clip with pliers.
4) Using a press, drive hub from water pump ASSY.

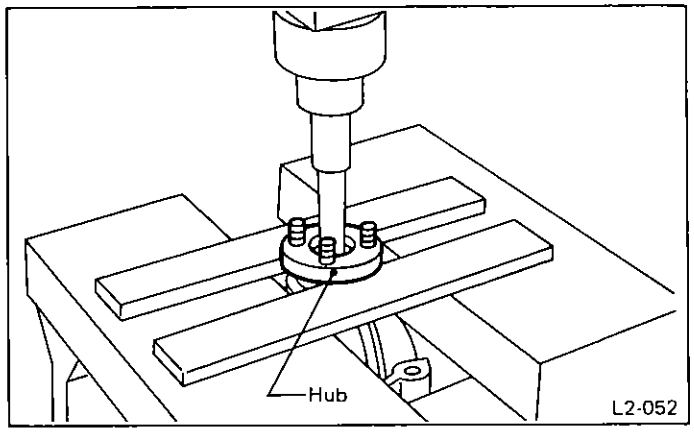


Fig. 7

5) Remove shaft, impeller, and mechanical seal from water pump case as a unit.

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

6) Remove impeller from shaft with a press.

INSPECTION

1) Clean all the disassembled parts thoroughly.
2) Inspect the pump shaft for wear, damage, and operation.
3) Inspect the impeller surface that contacts the mechanical seal for wear and damage.
4) Inspect the mechanical seal and plate for wear, crack and damage.
5) Inspect the other parts for crack, wear and damage, and replace if defective.

ASSEMBLY

1) Heat water pump case to a temperature of 80 to 100°C, (176 to 212°F), and press shaft into bore in water pump case. Do not press any section other than outer race.

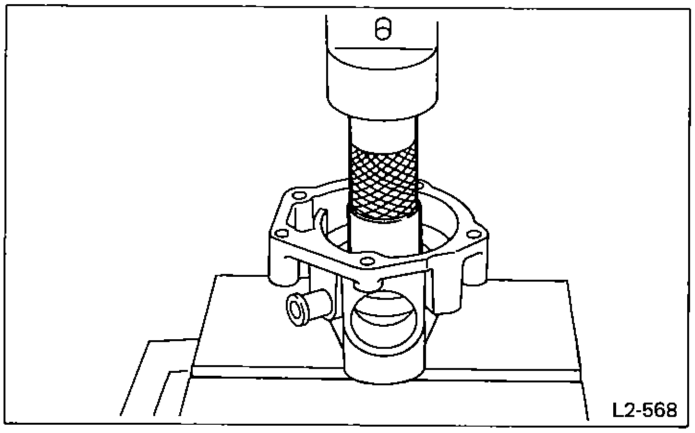


Fig. 8

2) **Be sure to install a new mechanical seal.**
Press the seal into the pump case with the carbon washer of the seal facing the impeller.
3) Apply coolant on the sliding surface between mechanical seal and impeller.
With a thin coat of oil on the shaft surface, install the impeller onto the pump shaft with a press.

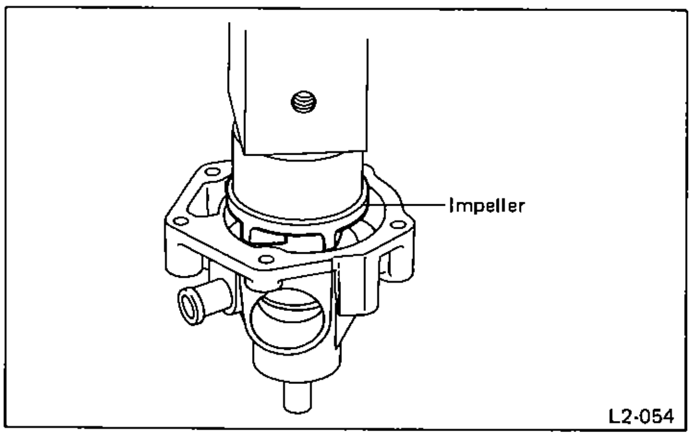


Fig. 9

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

Clearance between impeller and pump case:
0.5 – 0.9 mm (0.020 – 0.035 in)

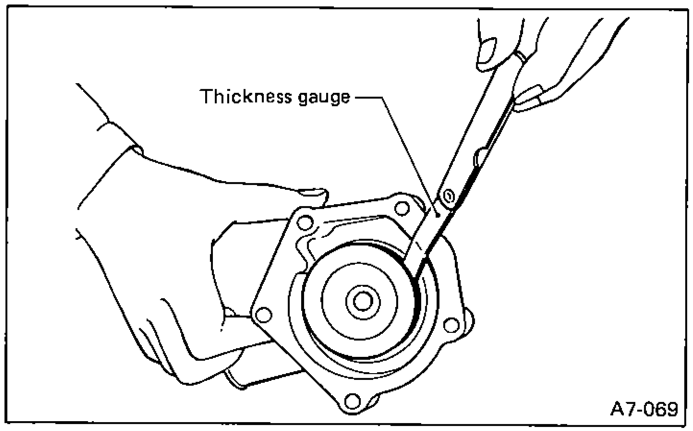


Fig. 10

5) Before pressing, apply oil on the pump shaft.
Support the impeller side of the pump shaft end and install the hub by using a press until the distance "L" between the pump case surface, which mates with the gasket, and the pulley attaching surface of the hub becomes specified value.

After pressing water pump hub into place, measure "runout". If it exceeds 0.05 mm (0.0020 in), replace water pump ASSY.

"L":
A/C equipped model
103.6 – 104.2 mm (4.08 – 4.10 in)
A/C not-equipped model
109.7 – 110.1 mm (4.32 – 4.33 in)

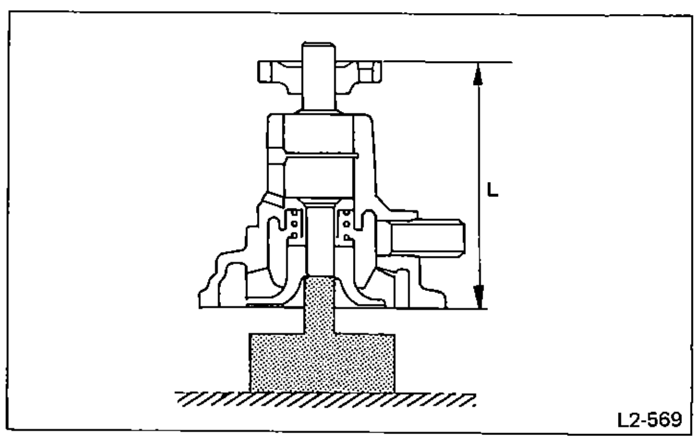


Fig. 11

6) Looking through slit in water pump case, ensure that groove on water pump case is aligned with groove on outer surface of shaft.
Insert water pump clip into grooves and drive it into place with a plastic hammer.

Be careful not to deform the clip.

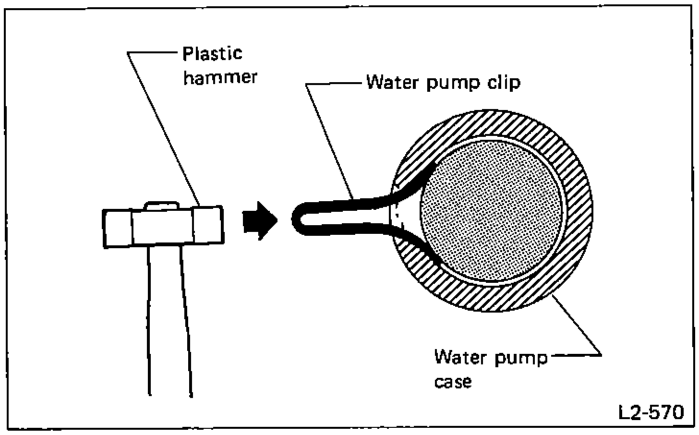


Fig. 12

7) Rotate water pump shaft by hand. It should turn smoothly without emitting noise.

INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:
1) Replace the gasket with a new one.
2) After reinstalling the water pump, adjust the drive belt tension and run the engine to make sure that neither water leakage nor abnormal noise exists.

Thermostat

REMOVAL AND INSTALLATION

1) Remove the thermostat case cover and gasket, and pull out the thermostat.
2) Install the thermostat in the intake manifold, and install the thermostat cover together with a gasket.

a. When reinstalling the thermostat, use a new gasket.
b. The thermostat must be installed with the jiggle pin upward.

INSPECTION

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.

Starts to open:
86.5 – 89.5°C (188 – 193°F)
Fully opens:
100°C (212°F)

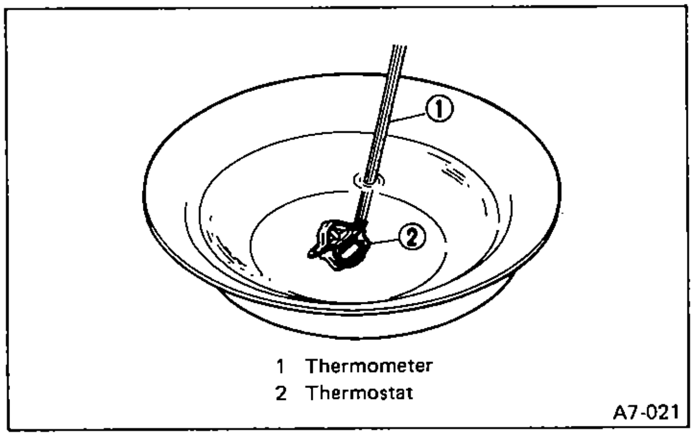


Fig. 13

Thermometer

INSPECTION

1) To test the thermometer, connect the gauge section and the sensor unit in series.
2) The thermometer performance data are shown below.

Temperature	Resistance
[120°C (248°F)]	14.9 – 17.3Ω
100°C (212°F)	26.2 – 29.3Ω
80°C (176°F)	47.5 – 56.8Ω
[50°C (122°F)]	133.9 – 178.9Ω

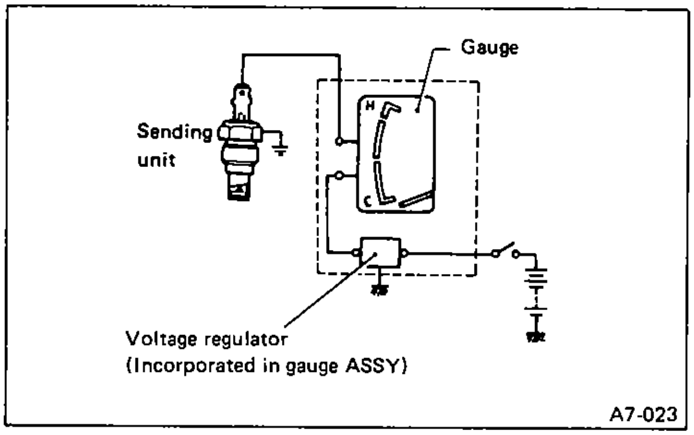


Fig. 14

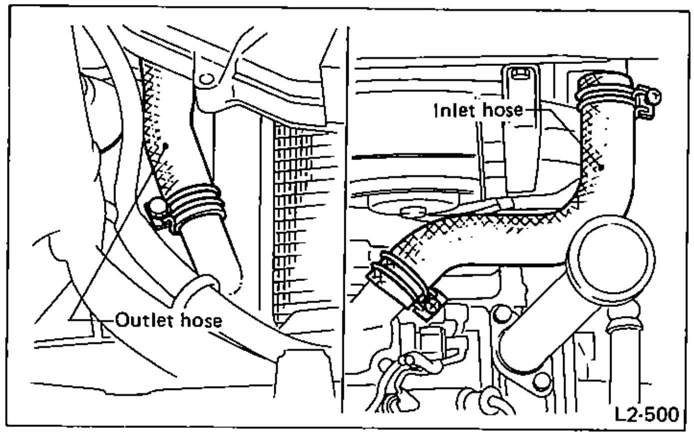


Fig. 15

4) Disconnect oil cooler's inlet and outlet hoses at radiator location (A/T model).

Catch both coolant and oil remained in the hoses into containers.

5) Disconnect lead wire connector from fan motor.
6) Disconnect main harness connector from thermoswitch.

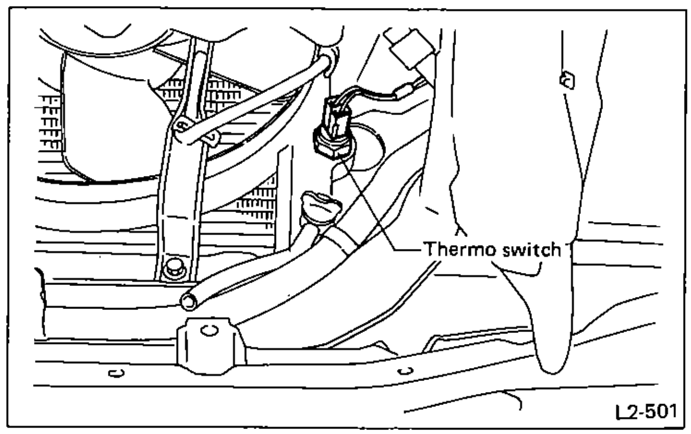


Fig. 16

7) Remove two radiator mounting bolts.

8) Lift radiator up and away from vehicle with radiator cap facing up to prevent remaining coolant from spilling.

PRECAUTIONS FOR HANDLING

1) When testing, do not apply battery voltage directly to the temperature gauge or sensor unit, because these two parts are designed to be connected in series.
If the battery voltage is applied to only one of them, the heating wire on gauge or thermistor may be damaged.
2) Connect the wire firmly to the terminals. When the gauge reading is abnormal, inspect not only the gauge but also the grounding wire or the terminal for loose connections.
3) Use care not to short or ground the terminals or wirings, otherwise troubles described in 1) may occur.
4) Use care not to drop or strike either the gauge or unit, since these are precision products.
5) Make sure that the gauge needle indicates C when the ignition switch is not turned on.

Radiator

REMOVAL

1) Drain coolant.
2) Disconnect ground cable from battery terminal.
3) Loosen hose clamps and disconnect both inlet and outlet hoses from radiator.

INSPECTION

Check all removed parts and replace if defective.
1) A clogged radiator should be cleaned.
2) A deteriorated hose should be replaced.
3) Check the valve opening pressure of the pressure cap with a cap tester. If the pressure is out of specification, replace the cap ASSY.

Cap valve opening pressure:
Positive pressure side
78.5 to 98.1 kPa
(0.8 to 1.0 kg/cm^2, 11.4 to 14.2 psi)
Negative pressure side
−4.9 to −9.8 kPa
(−0.05 to −0.1 kg/cm^2, −0.7 to −1.4 psi)

INSTALLATION

1) Attach radiator mounting cushions to pins on the lower side of radiator.

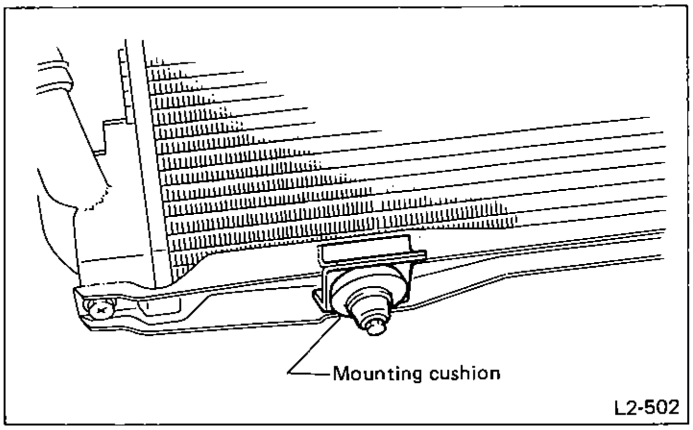


Fig. 17

2) Fit cushions, on lower side of radiator, into holes on body side and install radiator.

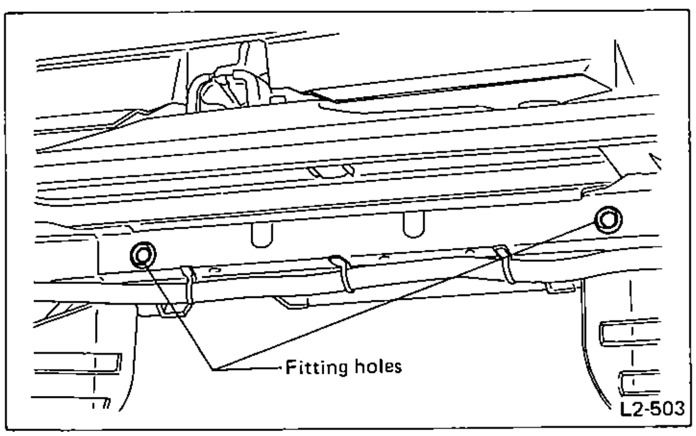


Fig. 18

3) Tighten two radiator mounting bolts.
4) Connect main harness connector to thermoswitch.
5) Connect lead wire connector to fan motor.
6) Connect both inlet and outlet hoses to radiator with marked sides facing up and tighten with hose clamps.

Be careful not to twist hoses.

7) Connect both inlet and outlet hoses to radiator's oil cooler and tighten with hose clamps (A/T model).
8) Pour coolant into radiator.
9) Connect ground cable to battery terminal.

Cooling Fan and Fan Motor

REMOVAL

1) Disconnect ground cable from battery terminal.
2) Disconnect lead wire connector from fan motor and remove harness from shroud.
3) Remove bolts holding shroud to radiator and detach shroud.

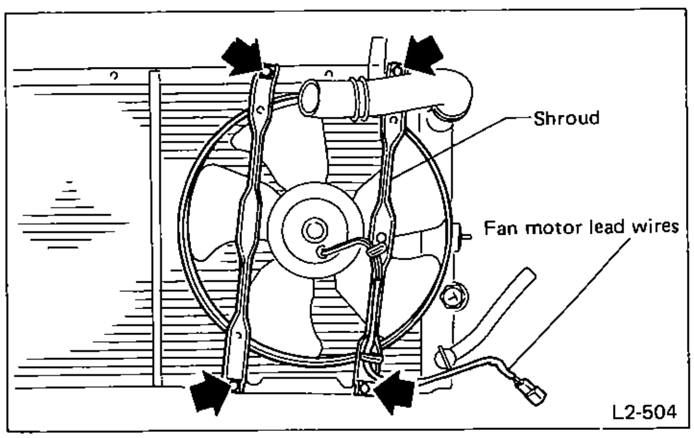


Fig. 19

4) Remove fan motor mounting nuts and detach fan motor from shroud.
5) Remove cooling fan mounting nuts and detach cooling fan from fan motor.

INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:

1) Before installing cooling fan motor, apply a coat of sealant to threads and tighten nuts.
2) Make sure cooling fan does not come into contact with shroud when installed.
3) After installation, make sure there is no unusual noise or vibration when fan is rotated.

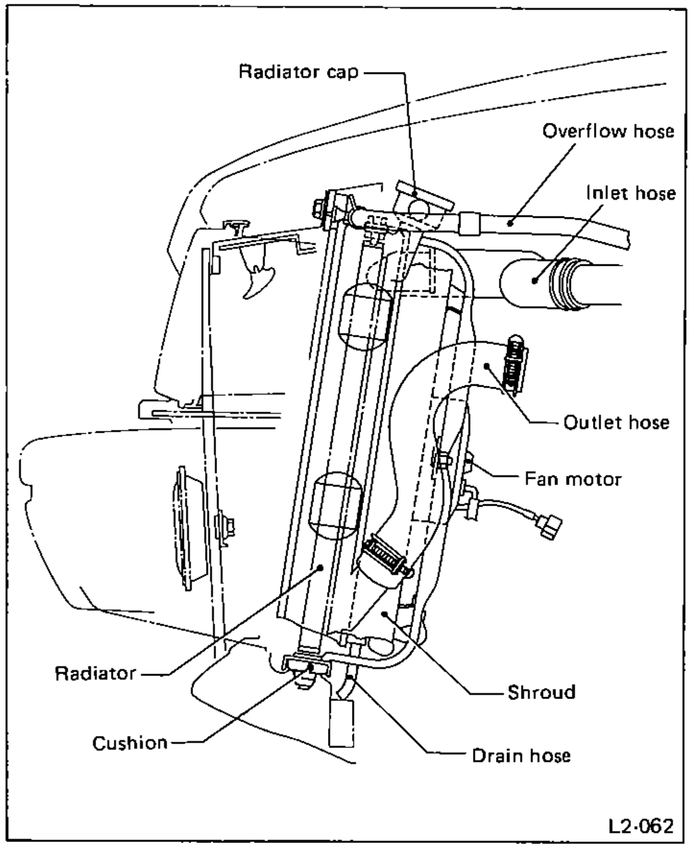


Fig. 20

TROUBLESHOOTING

Trouble	Possible cause	Corrective action
Over-heating	a. Insufficient coolant.	Replenish coolant, inspect for leakage, and repair.
	b. Loose drive belt.	Adjust drive belt tension.
	c. Oil on drive belt.	Replace.
	d. Malfunction of thermostat.	Replace.
	e. Malfunction of water pump.	Repair or replace.
	f. Clogged coolant passage.	Clean.
	g. Improper ignition timing.	Adjust.
	h. Clogged or leaking radiator.	Clean or repair, or replace.
	i. Improper engine oil.	Replace.
	j. Air-fuel mixture too thin.	Inspect and repair fuel system.
	k. Excessive back pressure in exhaust system.	Clean or replace.
	l. Insufficient clearance between piston and cylinder.	Adjust or replace.
	m. Slipping clutch.	Repair or replace.
	n. Dragging brake.	Adjust.
	o. Improper transmission oil.	Replace.
	p. Defective thermostat.	Replace.
	q. Malfunction of electric fan.	Replace thermoswitch or motor.
Over-cooling	a. Atmospheric temperature extremely low.	Partly cover radiator front area.
	b. Defective thermostat.	Replace.
Coolant leaks	a. Loosened or damaged connecting units on hoses.	Repair or replace.
	b. Leakage from water pump.	Repair or replace.
	c. Leakage from intake manifold.	Repair or replace.
	d. Leakage around cylinder head gasket.	Retighten cylinder head nuts or replace gasket.
	e. Damaged or cracked cylinder head and crankcase.	Repair or replace.
	f. Damaged or cracked thermostat case.	Repair or replace.
	g. Leakage from radiator.	Repair or replace.
Noise	a. Defective drive belt.	Replace.
	b. Defective electric fan.	Replace.
	c. Defective water pump bearing.	Replace.
	d. Defective water pump mechanical seal.	Replace.

SUBARU

1989

Single Point Fuel Injection System

MECHANISM AND FUNCTION

General

For conventional carburetors, the SPFI system substitutes a throttle chamber containing one fuel injector. It electronically controls the amount of fuel injection from the fuel injector and supplies the optimum mixture to suit all operating conditions of the engine.

The features of this SPFI system are as follows:

1) The reduction in the number of components results in easy servicing.

2) More precise control of the air-fuel mixture can be achieved by using an increased number of input signals transmitting engine operating conditions to the control unit.

3) The adoption of a hot wire type air flowmeter not only eliminates the need for high-altitude compensation, but also improves driving performance at high altitudes.

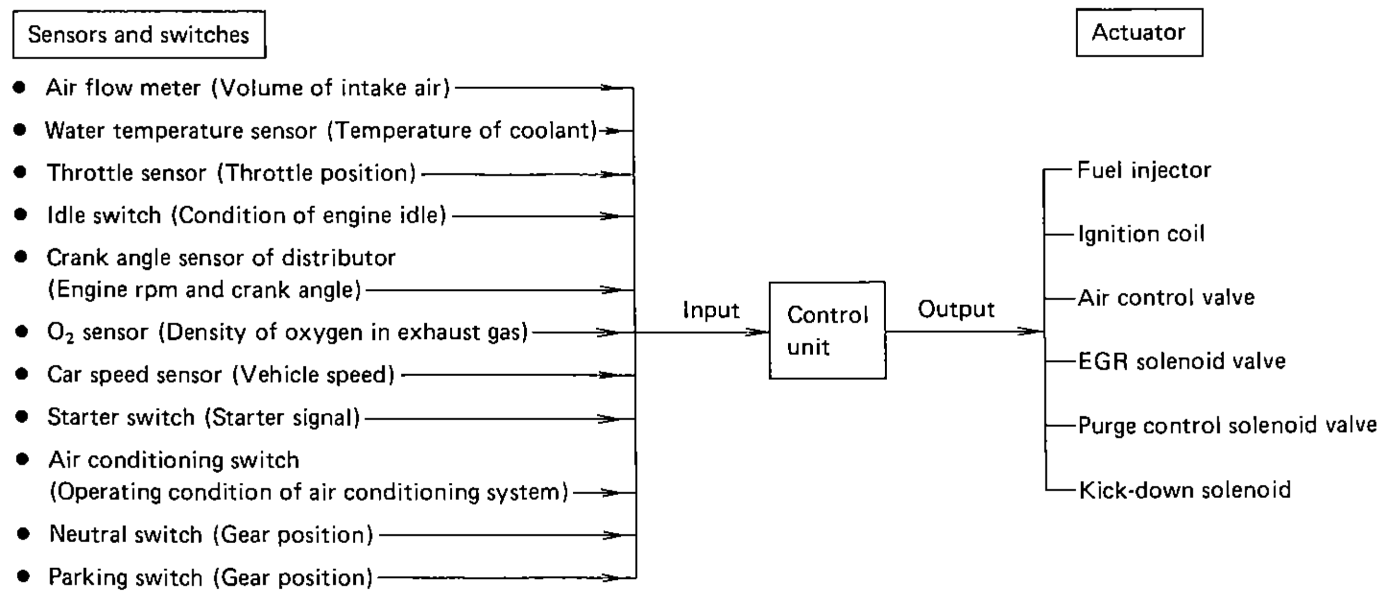
4) The air control valve automatically regulates the idle speed to the set value under various conditions.

5) The ignition timing is electrically controlled, thereby allowing the use of complicated spark advances characteristics.

6) The aging of the air flow meter and fuel injector is automatically corrected so that they maintain their original performance.

7) Trouble diagnosis can easily be accomplished by the built-in self-diagnosis function.

FLOW OF INPUT AND OUTPUT SIGNALS



Air Flow Meter

The SPFI system employs a hot-wire type air flow meter.
This air flow meter converts the amount of air taken into the engine into an electric signal by utilizing the heat transfer phenomenon between the incoming air and a heating resistor (hot wire) located in the air intake.
The features of this flow meter type are as follows:

1) High-altitude compensation is made automatically.
2) Quick response.
3) There are no moving parts.
4) It is compact.

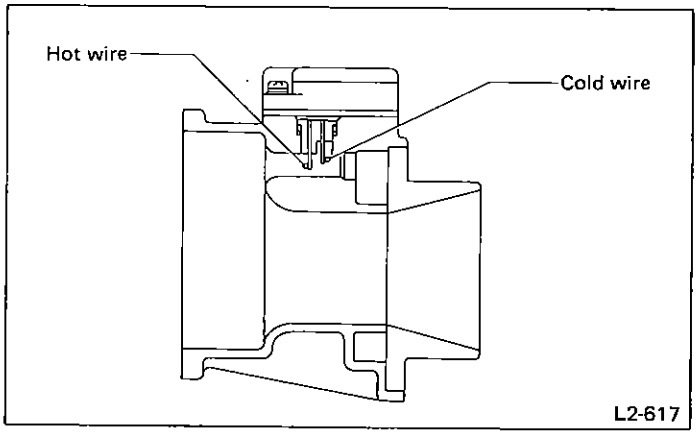


Fig. 1

PRINCIPLE OF OPERATION

The cold wire detects the temperature of inflowing air. Electric current flows in the hot wire so that the temperature difference between the hot and cold wires may be kept constant.
Then, the following relationship exists:

$$I^2R = (a + b\sqrt{PU})\,(T_H - T_C)$$

T_H:	Hot wire temperature	I :	Hot wire current
T_C:	Cold wire temperature	R :	Hot wire resistance
U :	Velocity of flow	a :	Constant
P :	Inflowing air density	b :	Constant

And it becomes as follows:

$$E \propto f\,(Q^{\frac{1}{4}})$$

E : Hot wire voltage
Q : Air flow (kg/h)

That is, the mass flow of inflowing air can be calculated by reading the voltage of the hot wire.

Throttle Chamber ASSY

The throttle chamber ASSY of the SPFI system contains an injector, throttle sensor, air control valve and pressure regulator that are combined in a body.
This throttle chamber ASSY is a single-bore, down-draft type equipped with an injector in the intake passage of the throttle valve. It consists of the following systems:

1) Fuel system
2) By-pass air control system
3) Throttle sensor system

FUEL SYSTEM

Fuel is fed from the fuel inlet pipe ① and injected from the injector ④. Also, fuel flows around the injector to cool it.
The pressure regulator ③ regulates fuel pressure and returns un-injected fuel to the fuel tank through the fuel return pipe ②.
The injector is operated by a signal from the SPFI control unit, based on engine speed and load.

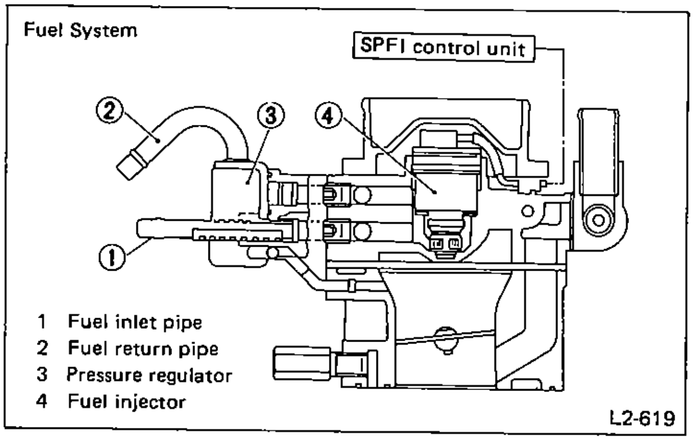


Fig. 2

BY-PASS AIR CONTROL SYSTEM

An air passage by-passing the throttle valve is provided to route air directly into the lower course of the throttle valve. The air control valve ① is located in the middle of this air passage and provides controls the amounts of air at engine starting, idle speed, etc.

The air control valve is driven by signals from the SPFI control unit and regulates the opening of the by-pass to maintain idle speed at the set value.

Using the air control valve, the system can provide the following functions:

1) Improved warm-up performance
2) Compensation of idle speed according to altitude
3) Compensation of idle speed with the air conditioner in operation
4) Compensation for idle speed fluctuation with aging

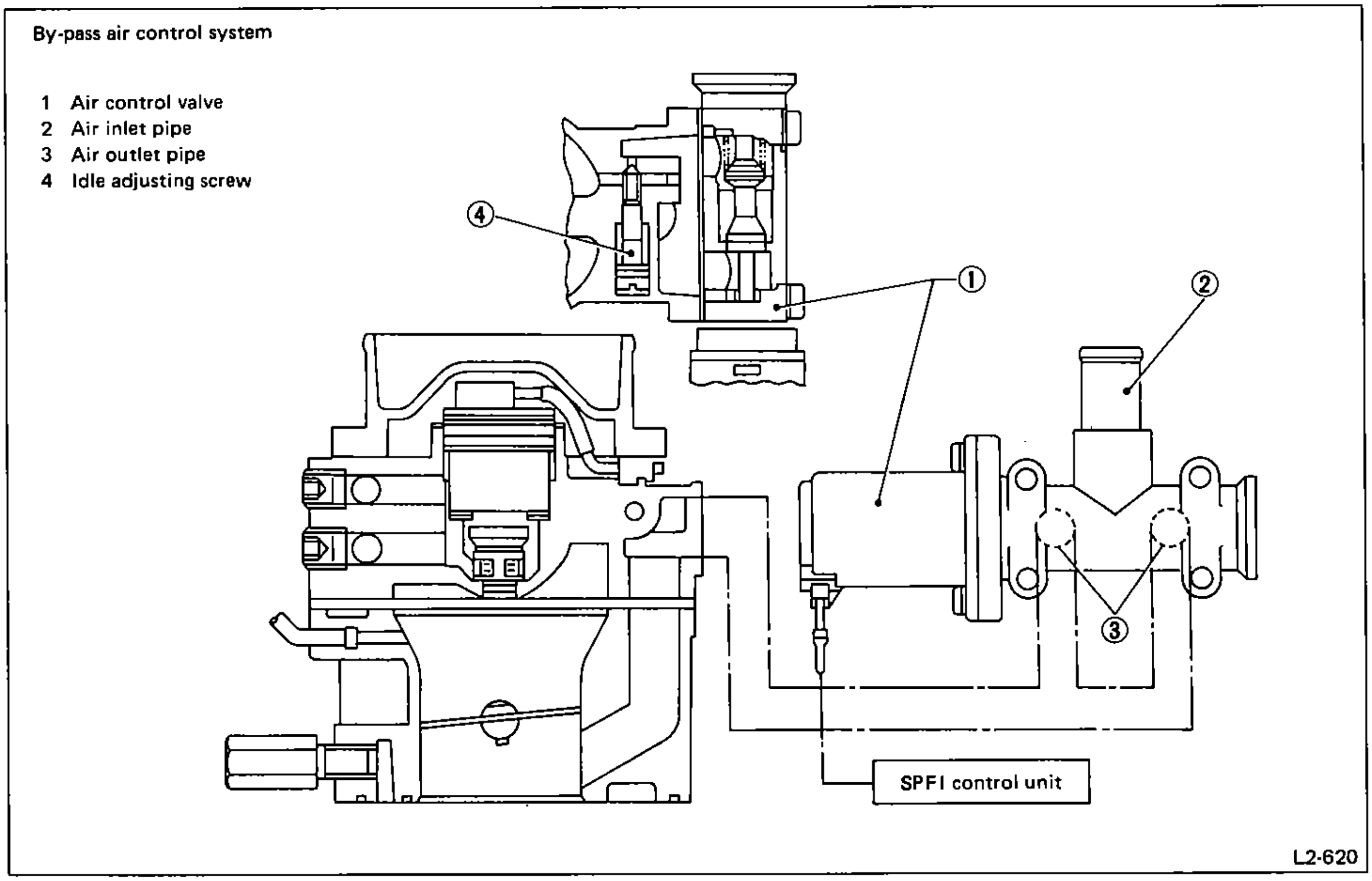


Fig. 3

THROTTLE SENSOR SYSTEM

A throttle position sensor is provided with a potentiometer and idle switch interlocked with the throttle valve shaft is utilized.
This throttle position sensor sends the SPFI control unit a potentiometer output signal corresponding to the opening of the throttle valve and an idle switch signal that turns ON only when the throttle is opened nearly to the idle position.
Using these signals, the SPFI control unit precisely controls the air-fuel ratio during acceleration and deceleration as well as idling.

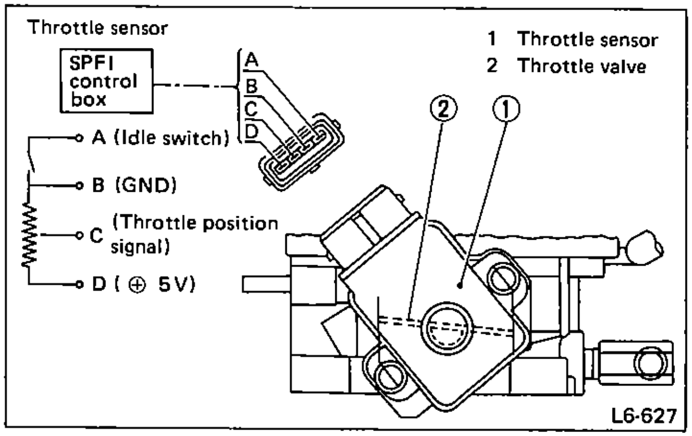


Fig. 4

Ignition System

The ignition system consists of a distributor containing a photoelectric crank-angle sensor, an ignition coil equipped with a power transistor, and the SPFI control unit. The crank-angle signal and reference signal detected by the photoelectric crank-angle sensor are sent to the SPFI control unit.
The SPFI control unit determines the optimum ignition timing from these signals and other engine operating parameters, and transmits an ignition signal to the ignition coil igniter.
The igniter amplifies this ignition signal and causes the primary current to flow intermittently in the ignition coil. Because of its accurate electric control, the system permits setting complicated spark-advance characteristics that cannot be realized in the mechanical type.

For further details of the distributor and ignition coil, refer to subsection 6-1, "ENGINE ELECTRICAL SYSTEM".

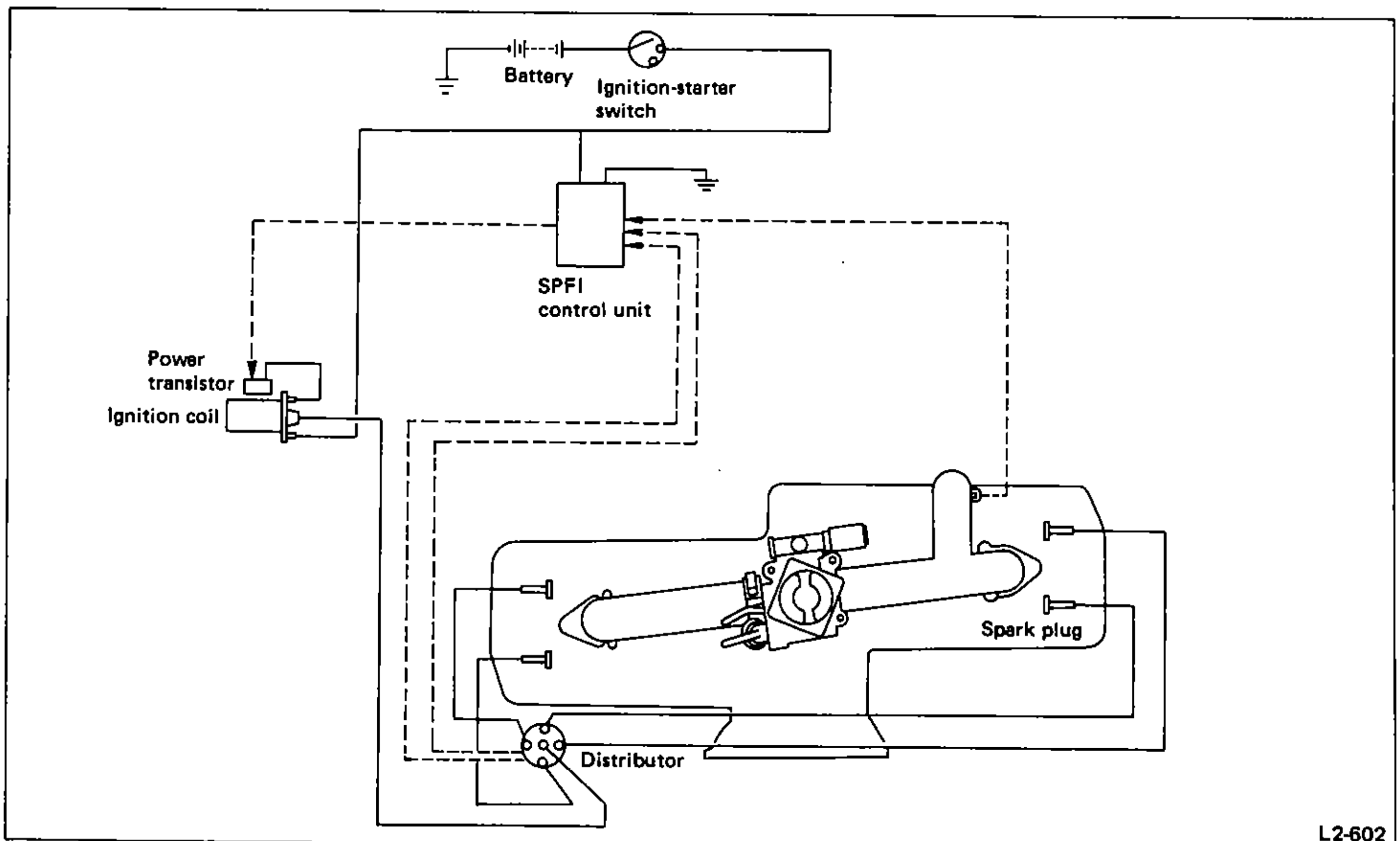


Fig. 5

Air-Fuel Ratio Learning Control System

This system has been developed to stabilize the quality of the hot-wire type air flow meter and fuel injector and to maintain their original performance by correcting their qualitative variation and aging.

By learning the feedback control amount of the O_2 sensor, the system controls the SPFI control unit to automatically set a coefficient of correction; thereby, the fuel injector always achieves fuel injection under the optimum condition.

O_2 Sensor

The O_2 sensor is mounted on the center exhaust pipe between the turbocharger and the rear exhaust pipe. It is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas hardly contains oxygen.

Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio.

The O_2 sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The hexagon screw on the outside is grounded to the exhaust pipe, and the inside is connected to the SPFI control unit through the harness.

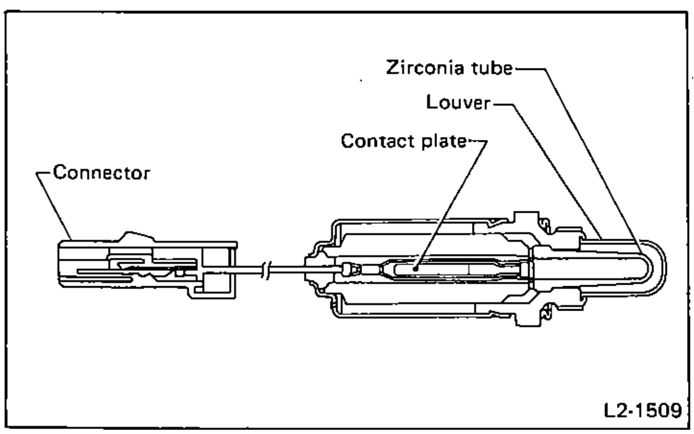


Fig. 6

When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results in very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in small difference in the oxygen concentration. The electromotive force is very small.

The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the MPFI control unit, the air-fuel ratio of the supplied mixture can be determined easily. The O_2 sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperatures of approximately 300 to 400°C (572 to 752°F).

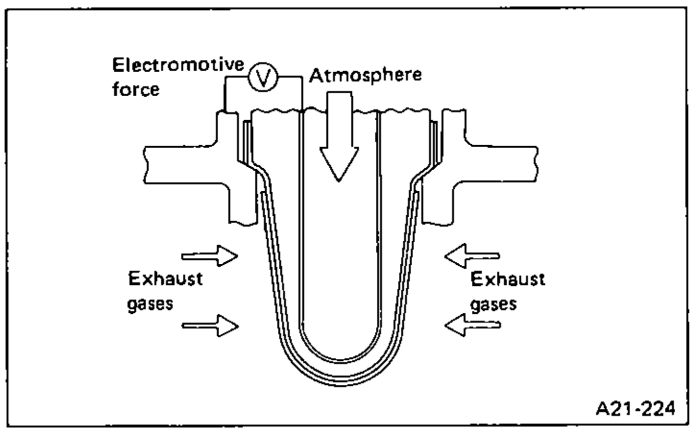


Fig. 7

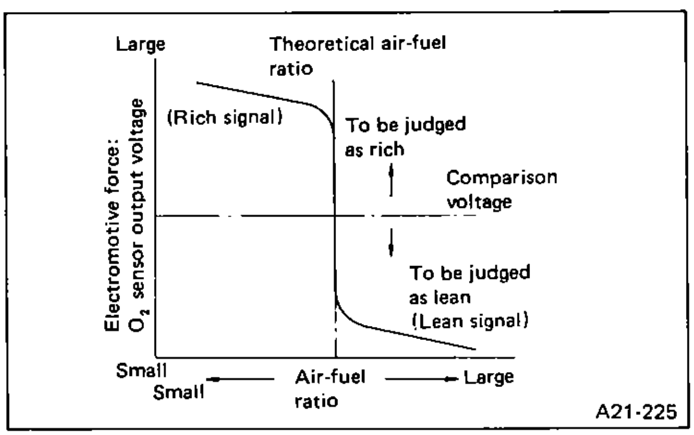


Fig. 8

Coolant Thermosensor

The coolant thermosensor is located on the thermocasing of the intake manifold. Its thermistor changes resistance with respect to temperature. A water temperature signal converted into resistance is transmitted to the control unit to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.

Kick-Down Control System

(AT model only)

KICK-DOWN CONTROL

A throttle sensor is used in place of the previous kick-down switch. It transmits a signal to the control unit to set the throttle valve to a specified position. When the throttle valve is in that position, the kick-down control relay turns on.

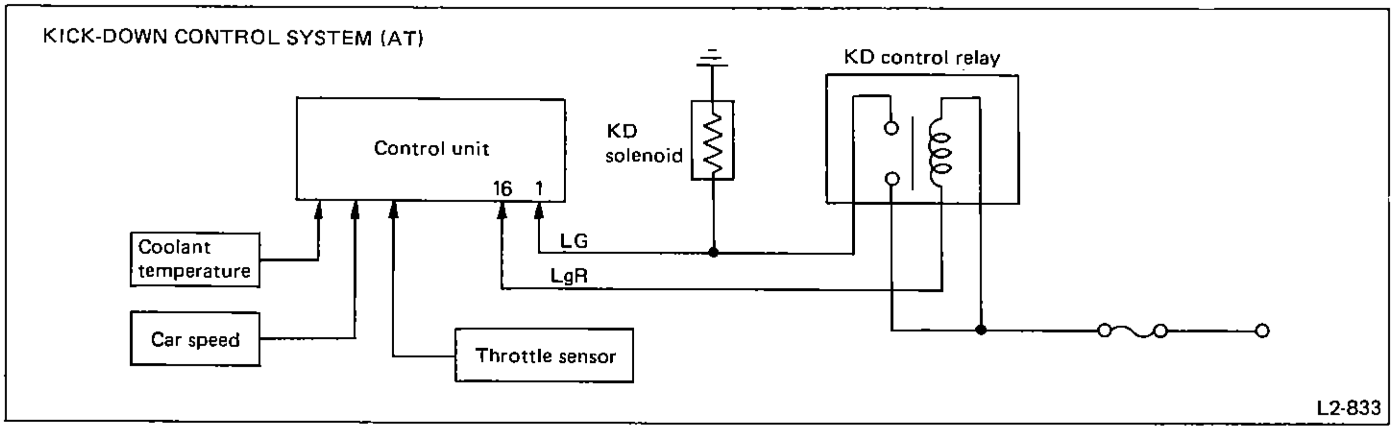


Fig. 9

EGR Gas Temperature Sensor

(California model only)

The EGR gas temperature sensor is located in the EGR gas passage on the intake manifold. An EGR gas temperature signal converted into resistance is transmitted to the control unit for EGR system diagnosis.

SCHEMATIC DRAWING OF SPFI SYSTEM

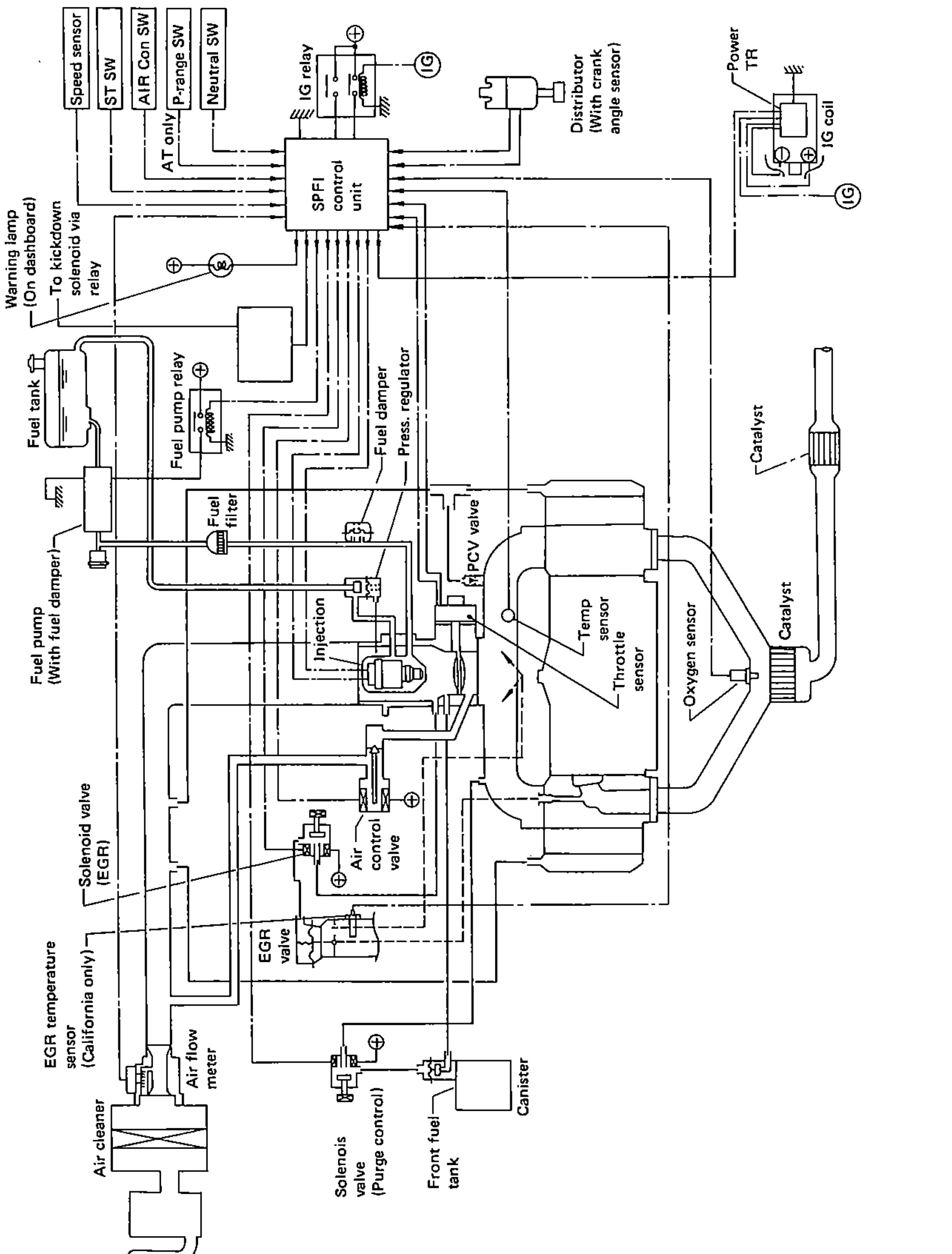
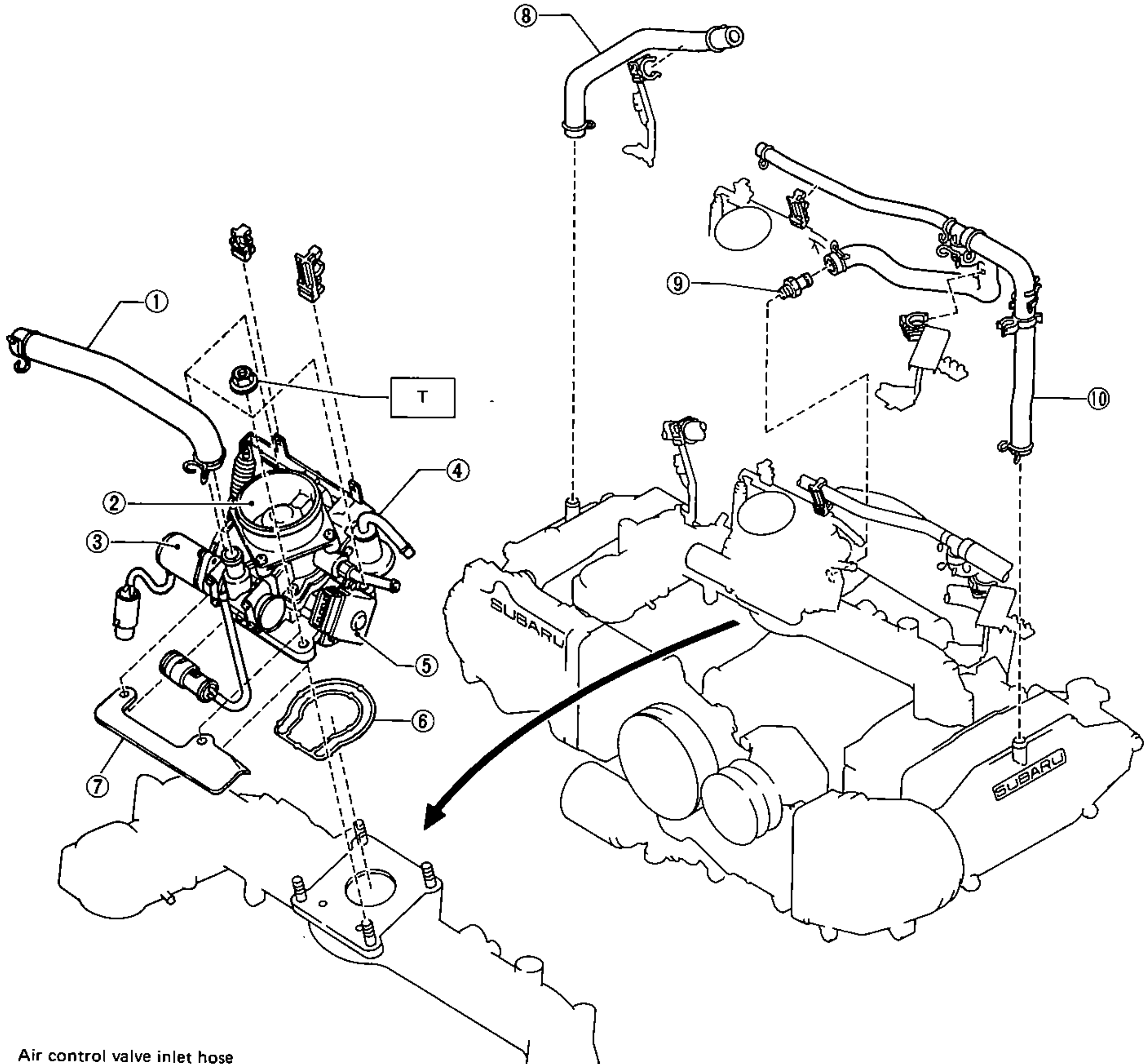


Fig. 10

L2-1463

COMPONENT PARTS

Throttle Chamber



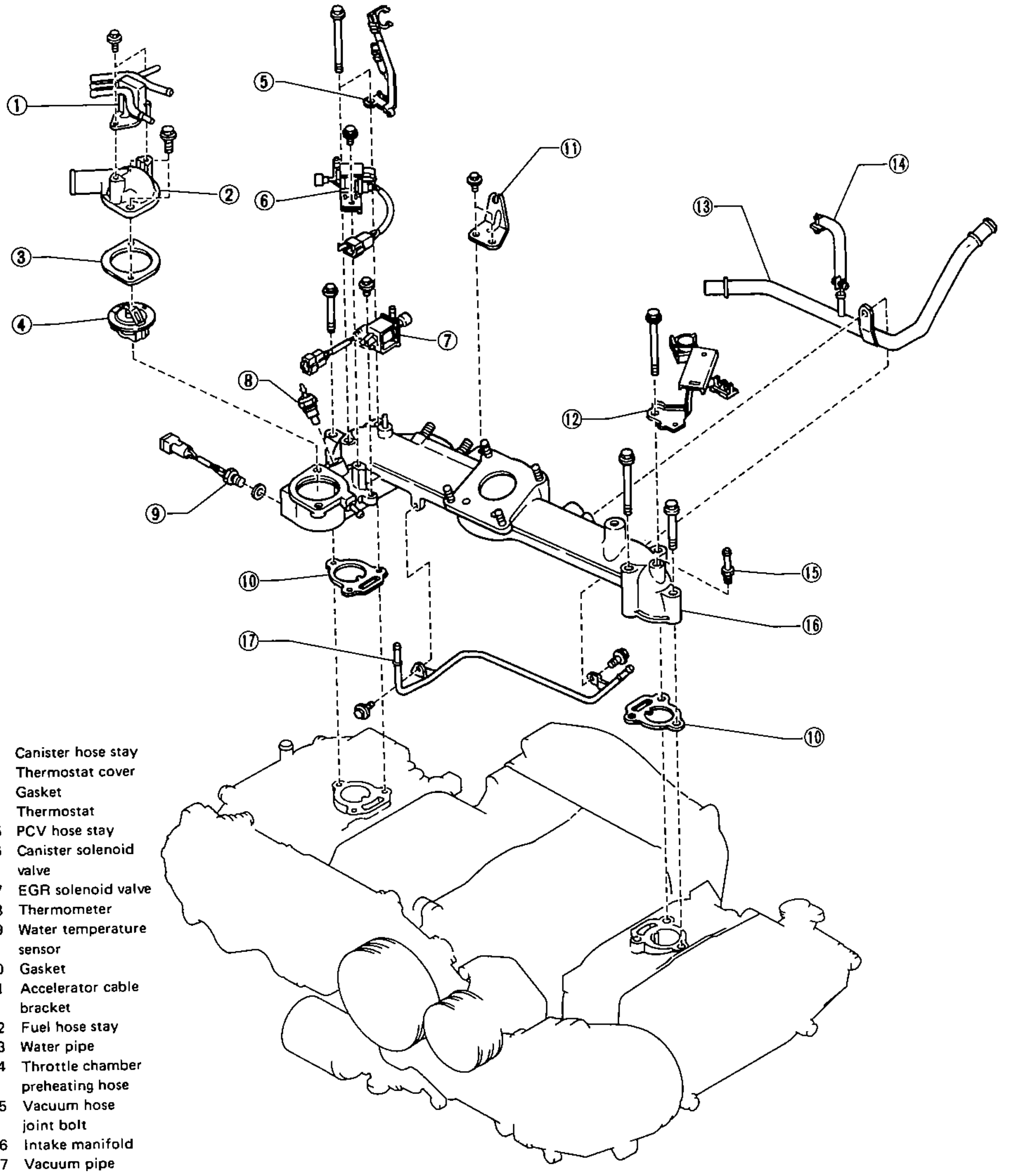
1 Air control valve inlet hose
2 Throttle chamber ASSY
3 Air control valve
4 Pressure regulator
5 Throttle sensor
6 Gasket
7 Plate
8 PCV hose
9 PCV valve
10 PCV hose

Tightening torque N·m (kg-m, ft-lb):
T: 18 – 21 (1.8 – 2.1, 13 – 15)

Fig. 11

L2-834

Intake Manifold

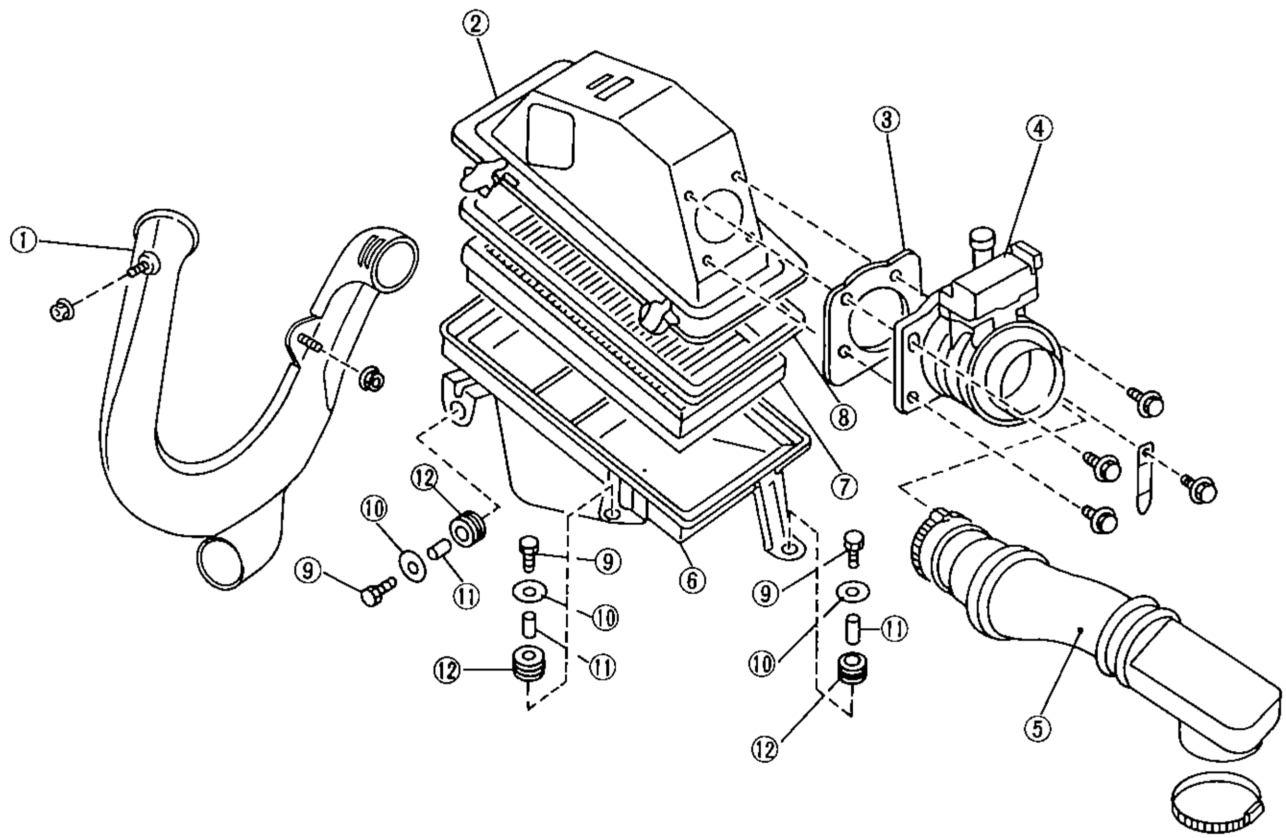


1 Canister hose stay
2 Thermostat cover
3 Gasket
4 Thermostat
5 PCV hose stay
6 Canister solenoid valve
7 EGR solenoid valve
8 Thermometer
9 Water temperature sensor
10 Gasket
11 Accelerator cable bracket
12 Fuel hose stay
13 Water pipe
14 Throttle chamber preheating hose
15 Vacuum hose joint bolt
16 Intake manifold
17 Vacuum pipe

L2-623

Fig. 12

Air Intake System



1 Air intake duct
2 Upper case
3 Gasket
4 Air flow meter ASSY
5 Air intake boot
6 Lower case
7 Air cleaner element
8 Gasket
9 Bolt
10 Washer
11 Spacer
12 Grommet

L2-836

Fig. 13

SERVICE PROCEDURE

Precautions in Servicing

1) Never connect the battery in reverse polarity.
- The SPFI control unit will be destroyed instantly.
- The fuel injector and other part will be damaged in just a few minutes more.

2) Do not disconnect the battery terminals while the engine is running.
- A large counter electromotive force will be generated in the alternator, and this voltage may damage the electronic parts such as SPFI control unit, etc.

3) Before disconnecting the connectors of each sensor and the SPFI control unit, be sure to turn off the ignition switch.
- Otherwise, the SPFI control unit may be damaged.

4) The connectors to each sensor in the engine compartment and the harness connectors on the engine side and body side are all designed to be waterproof. However, it is still necessary to take care not to allow water to get into the connectors when washing the vehicle, or when servicing the vehicle on a rainy day.

5) Every SPFI-related part is a precision part. Do not drop them.

6) Observe the following cautions when installing a radio in SPFI equipped models.
   a. The antenna must be kept as far apart as possible from the control unit.
   (The SPFI control unit is located under the steering column, inside of the instrument panel lower trim panel.)
   b. The antenna feeder must be placed as far apart as possible from the SPFI control unit and SPFI harness.
   c. Carefully adjust the antenna for correct matching.
   d. When mounting a large power type radio, pay special attention to items a. thru c. above.
- Incorrect installation of the radio may affect the operation of the SPFI control unit.

7) Before disconnecting the fuel hose, disconnect the fuel pump connector and crank the engine for more than five seconds to release pressure in the fuel system. If engine starts during this operation, run it until it stops.

8) Do not disassemble components other than those mentioned in the manual.

9) The coolant thermosensor is identical to that in the MPFI system. Refer to item "MPFI system".

Air Flow Meter

INSPECTION

1) Check for leaks or damage in the connection between the air intake boot and air flow meter. Repair any defect noted.

2) Remove the connectors from the air flow meter, the air intake boot, and the air flow meter for the air cleaner case in the order stated.

3) Check the exterior of the air flow meter for damage.

4) Check for foreign matter, water, or oil in the air passages, especially in the by-pass. If any abnormality is noticed, replace the air flow sensor.

5) If no defect is found in the visual checks above, conduct the following inspections.

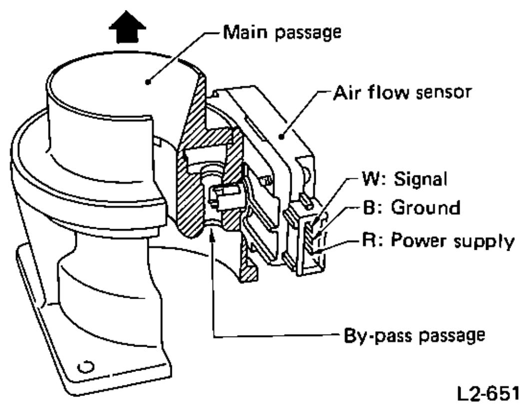


Fig. 14

Be careful not to short-circuit the power source.

(1) Turn the ignition switch OFF.
(2) Install the air flow meter on the air cleaner.
(3) Disconnect a connector from the air flow meter and remove the rubber cover from the connector.

Conduct the following checks by attaching the tester check pins to the connector terminals on the side from which the rubber cover has been removed.

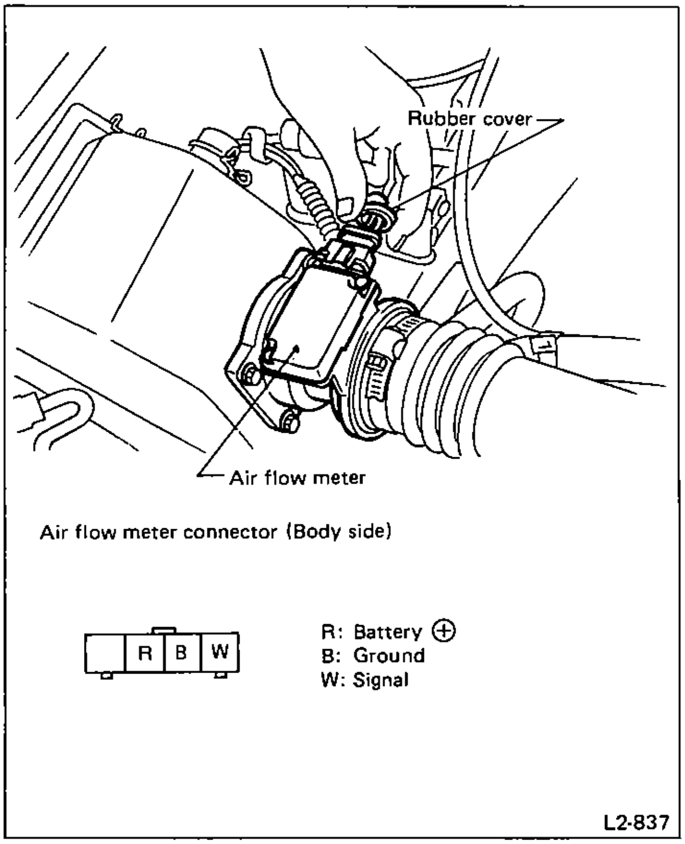


Fig. 15

(4) Measure resistance between the body and ground terminal (B).

Specified resistance:
10Ω, max.

If resistance is greater than 10 ohms, check the harness and internal circuits of the control unit for discontinuity.

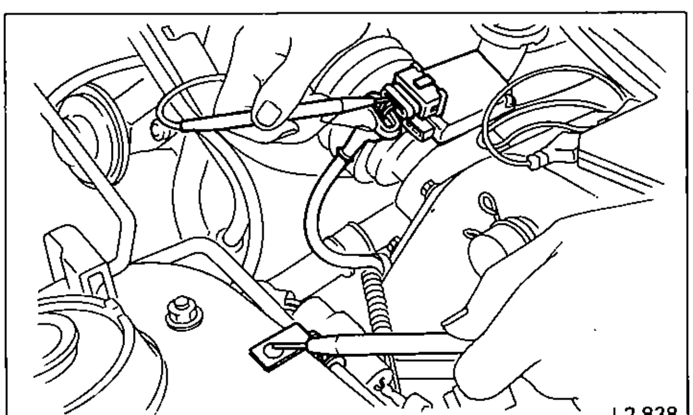


Fig. 16

(5) Turn the ignition switch ON (with the engine off).

(6) Measure voltage across power terminal (R) and the body.

Specified voltage:
10V, min.

If voltage is outside specifications, check the power line (battery, fuse, control unit, harness connector, etc.).

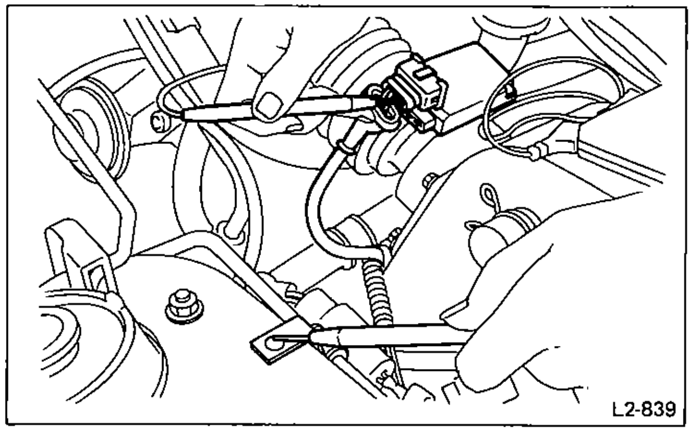


Fig. 17

(7) Connect the connector to air flow meter.

(8) Attach the positive lead ⊕ of the tester to signal terminal (W) and the negative lead ⊖ to ground terminal (B) and measure voltage across the two terminals.

Specified voltage:
0.1 – 0.5V

If voltage is not within the specified range, replace the air flow meter.

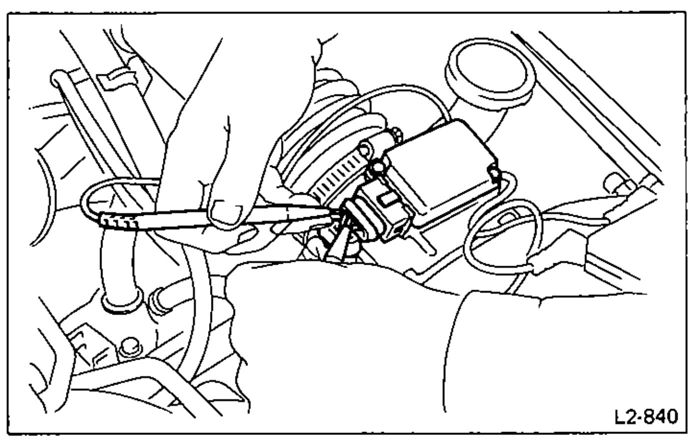


Fig. 18

(9) Remove the upper section of the air cleaner.

(10) Blow air from the air cleaner side to check if voltage across terminals (W) and (B) is higher than that measured in step (7) above.

If not, replace the air flow meter.

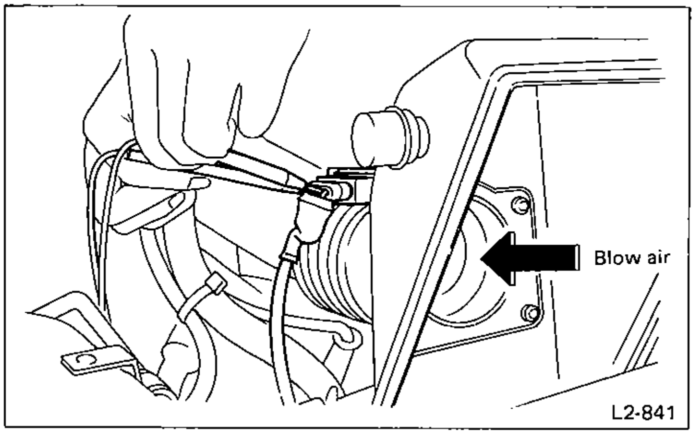


Fig. 19

Throttle Chamber ASSY

INSPECTION AND ADJUSTMENT

IGNITION TIMING

1) Warm up the engine.
2) Turn the ignition switch OFF.
3) Disconnect the connector of the throttle sensor.
4) Ensure that the resistance between the throttle sensor terminals Ⓐ and Ⓑ is 0Ω when the accelerator pedal is released.

If it is ∞Ω, adjust idle contact by referring to the following subsection, "THROTTLE SENSOR".

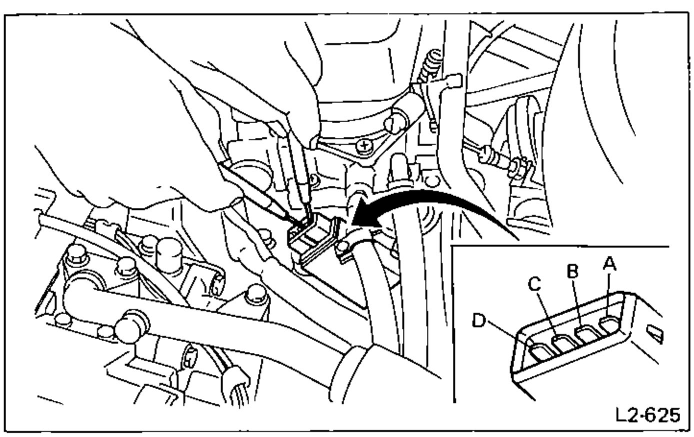


Fig. 20

5) Connect the connector of the throttle sensor.
6) Connect the test mode connector.
7) Start the engine and run it at idle speed. Do not depress the accelerator pedal.
8) Check and adjust ignition timing.

Specified ignition timing:
20° BTDC

The specified ignition timing can be obtained regardless of engine speed when the engine is idling without depressing the accelerator pedal.

9) Stop the engine.
10) Disconnect the test mode connector.

IDLE SPEED

1) Disconnect air control valve harness at throttle chamber ASSY.
2) Adjust idling speed to 550±50 rpm by turning in or out IAS.

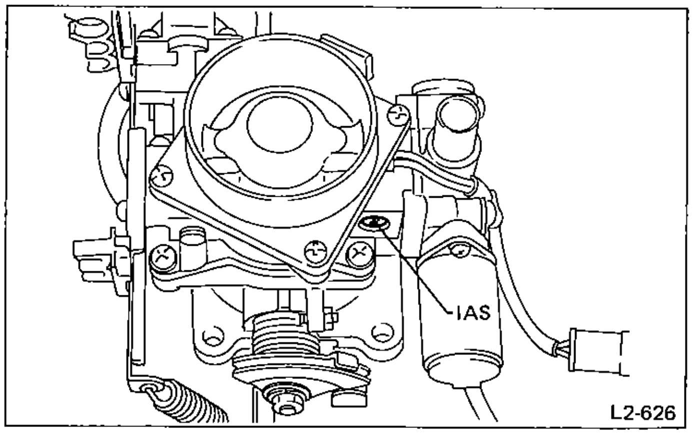


Fig. 21

3) Reconnect air control valve harness, and ensure engine idles at 700±100 rpm.
4) If engine idling speed is less than 600 rpm, the connector has faulty contact or the harness is broken.

THROTTLE SENSOR

Idle contact

Insert a thickness gauge between the stopper screw of the throttle chamber and stopper, and check for continuity between Ⓐ and Ⓑ.

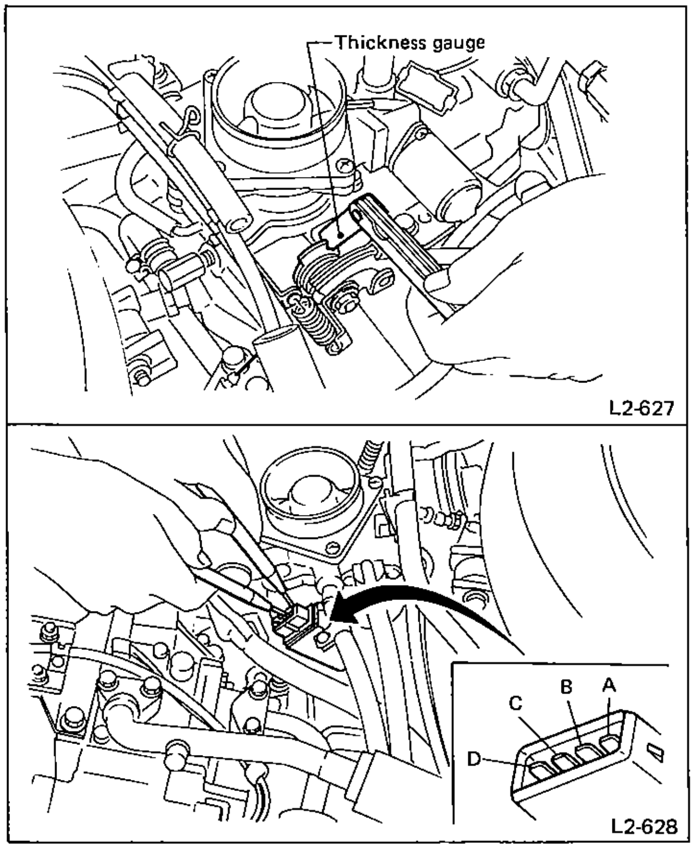


Fig. 22

1) Make sure that Ⓐ and Ⓑ are conducting when the throttle is closed fully.
2) Make sure that Ⓐ and Ⓑ are not conducting when the throttle is open fully.
3) Make sure that Ⓐ and Ⓑ are conducting when the thickness of gauge is 0.31 mm (0.0122 in) [this corresponds to throttle opening of 1.0°].
4) Make sure that Ⓐ and Ⓑ are not conducting when the thickness of gauge is 0.79 mm (0.0311 in) [this corresponds to throttle opening of 2.5°].
5) If the above standard is not satisfied, loosen the screws (two) securing the throttle sensor to the throttle chamber, and turn the throttle sensor main body until the correct adjustment is obtained.

If it can not be obtained, replace the throttle sensor with a new one.

Throttle opening signal

Checking resistance between Ⓑ and Ⓓ and between Ⓑ and Ⓒ (changes with the opening of the throttle valve).
1) Check that a resistance of 3.5 to 6.5 kΩ exists between Ⓑ and Ⓓ.
2) Check that resistance between Ⓑ and Ⓒ is less than 1 kΩ with the throttle valve fully closed and greater than 2.4 kΩ with the valve fully opened (about 80% of the resistance between Ⓑ and Ⓓ).
3) Check that resistance between Ⓑ and Ⓒ increases continuously when the throttle valve is moved from the fully closed to the fully opened position.
4) Check that resistance between Ⓑ and Ⓒ decreases continuously when the throttle valve is moved from the fully opened to the fully closed position.

If any defect is found in the above checks, replace the throttle sensor with a new one.

FUEL INJECTOR

Using a stethoscope or long-type screwdriver, make sure of operating noise (clicking sound) of the injector.
If the operating noise cannot be heard on the injector;
1) Check resistance of the injector on the control side.
 (1) Turn the ignition switch OFF (engine off).
 (2) Disconnect the connector from the control unit.
 (3) Measure resistance between terminal 43 (RW) and terminal 48 (RB) of the harness connector.

Specified resistance:
0.5 – 2Ω

a. Attach the check pin of the tester to the terminals from the rear of the connector. Use clips of hairpins if necessary to attach the check pin to the terminals.
b. If resistance is outside the specified range, check the following:

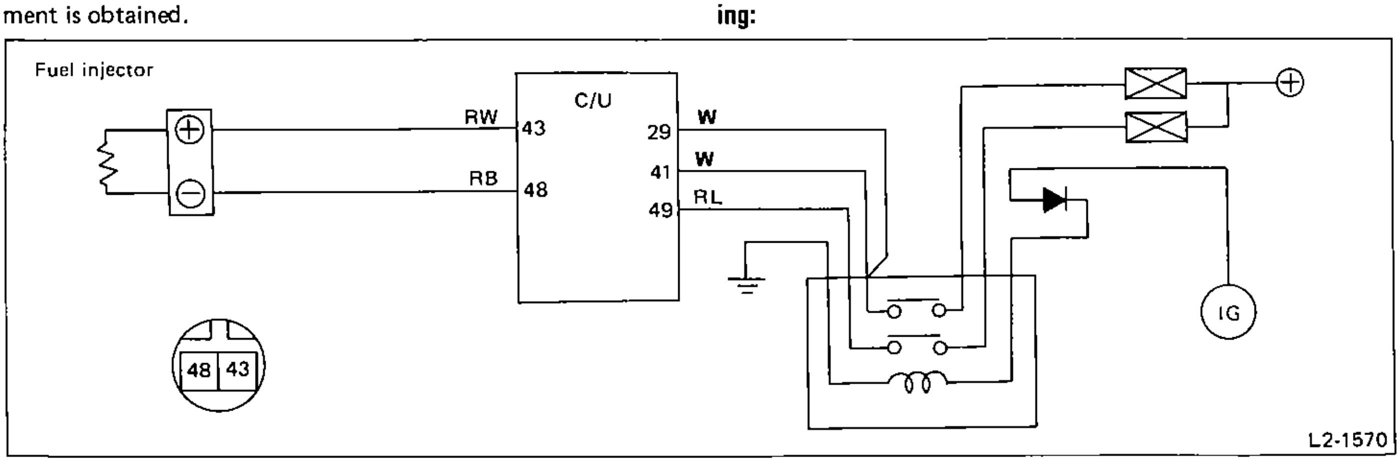


Fig. 23

2) Check the injector for discontinuity.
(1) Disconnect the connector from the injector.
(2) Measure resistance between the terminals of the connector on the injector side.

Specified resistance:
0.5 – 2Ω

If resistance is outside the specified range, replace the injector.

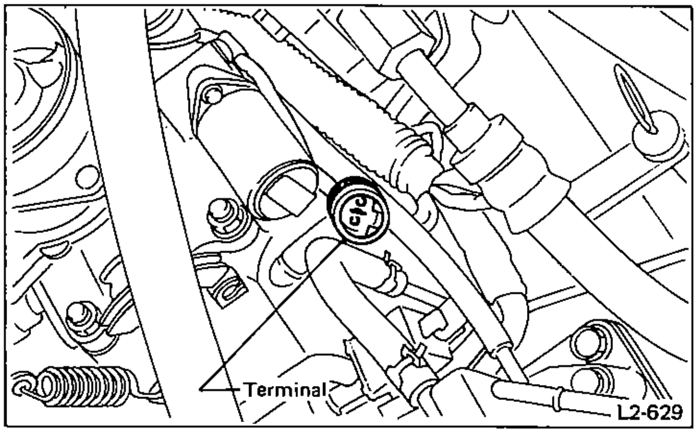


Fig. 24

3) Check the injector for insulation.
Measure resistance between each terminal of the connector on the injector side and the body.

Specified insulation resistance:
1 MΩ, min.

a. If insulation resistance is less than the specified value, replace the injector.
b. If the value measured in step 1) above is outside the 0.5 to 2Ω range (although the values measured in 2) and 3) are within specifications), check the harness for discontinuity and the connector for poor connection.

AIR CONTROL VALVE

1) Disconnect the connector to the air control valve while the engine is idling. At this time, check that engine speed drops.
2) Check that the engine resumes original speed when the connector is connected.

Disconnecting the connector causes a big change in rpm when the engine is cold. However, when the engine is warm, it causes a smaller change or almost no change.

3) When the engine shows no change in speed in the above check, inspect the following.
(1) Stop the engine and disconnect the connector from the air control valve.
(2) Turn the ignition switch ON (engine off).
(3) Measure voltage across the body and power terminal (BW) of the air control valve connector (body side).

Specified voltage:
10V, min.

If voltage is less than the specified value, check the harness.

(4) Turn the ignition switch OFF (engine off).
(5) Measure resistance between each terminal of the connector on the air control valve side.

Specified resistance:
7.3 – 13Ω [at –20 to 80°C (–4 to 176°F)]

If resistance is outside the specified range, replace the air control valve.

(6) Measure insulation resistance between the body and each terminal of the connector on the air control valve side.

Specified insulation resistance:
1 MΩ, min.

If insulation resistance is less than the specified value, replace the air control valve.

(7) Connect the air control valve connector.
(8) Disconnect the connector from the control unit.
(9) Turn the ignition switch ON (engine off).
(10) Measure voltage across the body and terminal 45 (GR) of the control unit connector.

Specified voltage:
10V, min.

If voltage is less than the specified value, check the harness between the air control valve and the control unit.

(11) Turn the ignition switch OFF (engine off).
(12) Connect the connector to the control unit.
(13) Monitor the voltage across the body and terminal 45 (GR) of the control unit connector.
Turn the ignition switch ON (engine off).

Specified voltage:
1 V, max. (for approximately one minute after ignition turns ON)
10 V, min. (one minute after ignition turns ON)

If voltage is not within the specified range, the problem is either poor contact of the terminal or faulty control unit.

(14) Turn the ignition switch OFF (engine off).
(15) Disconnect the air control valve hose.
(16) Turn the ignition switch ON (engine off).
(17) Look through the open end of the pipe (from which the air control valve hose is disconnected) to make sure the valve moves from the fully-closed position to the fully-open position one minute after the ignition switch is turned ON.

If the valve does not operate properly, replace the air control valve.

PRESSURE REGULATOR

The pressure regulator adjusts the fuel pressure to 147 kPa (1.5 kg/cm^2, 21 psi) compared to the throttle vore pressure of throttle chamber.

a. Before disconnecting the fuel hose, first disconnect the fuel pump connector and crank the engine (more than five seconds) to release the pressure in the fuel system. If the engine is started by this cranking, run it until it stops.
b. Be sure to clamp the hose at the connecting portion.

1) Disconnect the fuel hose at the fuel delivery pipe of throttle chamber and install a fuel pressure gauge.
2) Measure the fuel pressure when the engine is at idle speed.

Standard:
137 – 167 kPa (1.4 – 1.7 kg/cm^2, 20 – 24 psi)

DISASSEMBLY

FUEL INJECTOR

1) Remove injector cap and gasket.

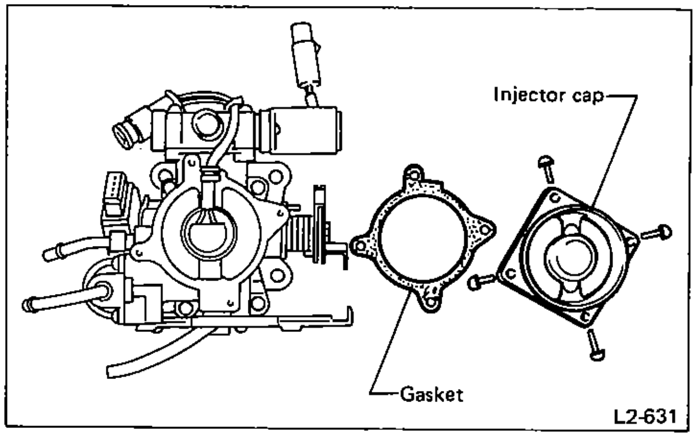


Fig. 25

2) Hold the injector using a pliers, then pull out the injector from chamber ASSY.

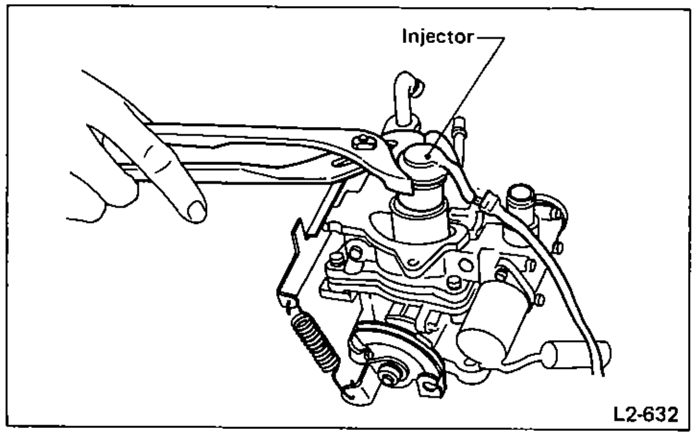


Fig. 26

3) Remove the injector and O-ring from the chamber ASSY.

Be careful not to damage the nozzle on the point of the injector.

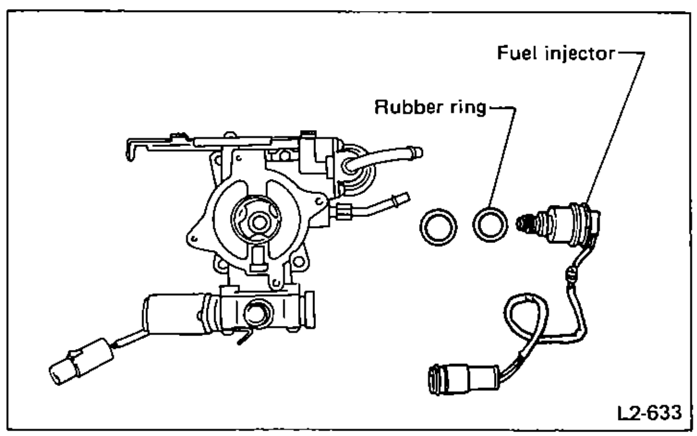


Fig. 27

AIR CONTROL VALVE

1) Remove the injector lead wire from the clamp.
2) Remove the air control valve, gasket and lead wire from the venturi chamber.

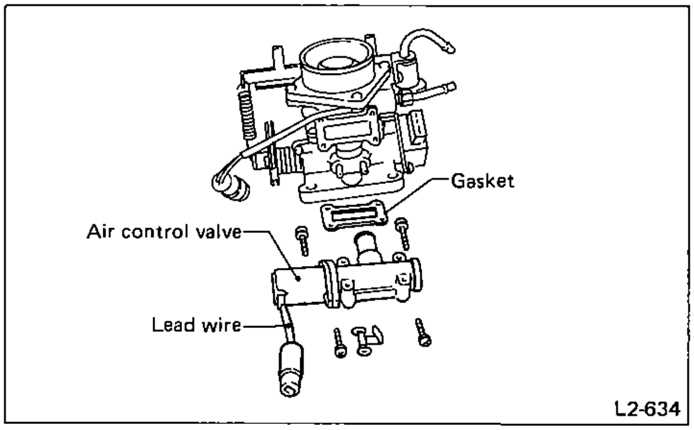


Fig. 28

THROTTLE SENSOR

1) Remove the two screws securing the throttle sensor to the throttle chamber.
2) Remove the throttle sensor by pulling it in the axial direction of the throttle shaft.

Pay attention to the O-ring attached to the throttle sensor mounting face of the throttle chamber.

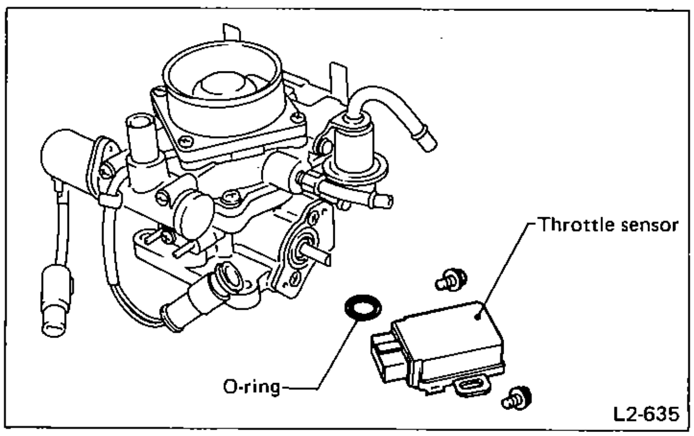


Fig. 29

PRESSURE REGULATOR

1) Remove the two screws securing the pressure regulator to the venturi chamber.
2) Pull the pressure regulator to remove.

Pay attention to the O-ring attached to the pressure regulator mounting face of the venturi chamber.

THROTTLE DRUM

1) Remove the throttle return spring from the spring lever.
2) Remove the nut first and then the washer and spring lever from the throttle shaft.
3) Remove the throttle drum from the throttle shaft.

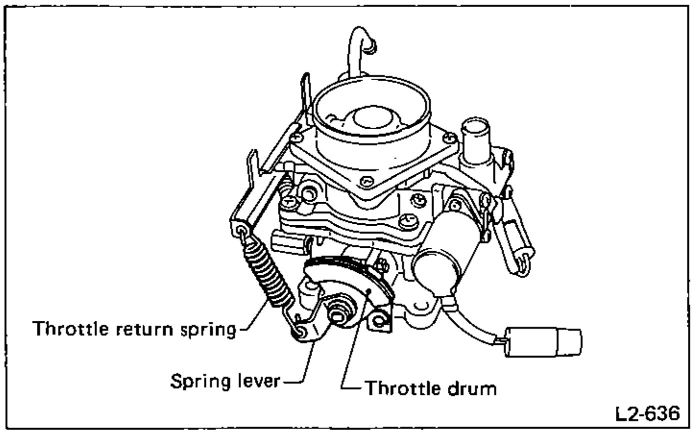


Fig. 30

ASSEMBLY

Assembly is in the reverse order of disassembly procedure.

Coolant Thermosensor

INSPECTION

Put the thermosensor in water of various temperatures and measure the resistance between terminals using a circuit tester.

Water temperature °C (°F)	Resistance value
−10 (14)	7 − 11.5 kΩ
20 (68)	2 − 3 kΩ
50 (122)	700 − 1,000 Ω

If the resistance value is too much out of these ranges, replace the thermosensor with a new one.

Air Intake System

INSTALLATION

Insert the air intake boot until it securely bottoms against the throttle chamber.
Make sure the throttle chamber screw is positioned in the center of the cutout section of the boot when the boot is installed.

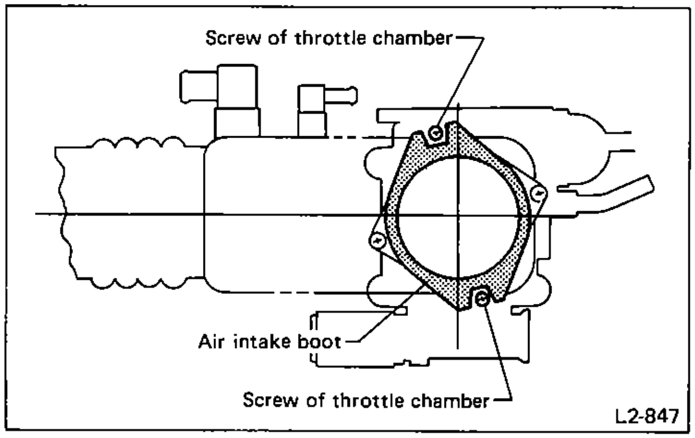


Fig. 31

TROUBLESHOOTING

General Troubleshooting Table

*: The CHECK ENGINE light blinks.
*1: The CHECK ENGINE light blinks when contact is resumed during inspection (although poor contact is present in the D-check).
*2: The CHECK ENGINE light lights when abnormality is detected in the D-check mode if the idle switch persistently remains off with the accelerator pedal released.
*3: The CHECK ENGINE light lights when the specified performance characteristics are unusual with the throttle valve in the slightly-opened position.

Symbols shown in the table refer to the degree of possibility of the reason for the trouble ("Very often" to "Rarely").
◎ : Very often
○ : Sometimes
△ : Rarely
☆ : Occurs only in extremely low temperatures

TROUBLE		
1	Engine will not start.	No initial combustion
2		Initial combustion occur.
3		Engine stalls after initial combustion.
4	Rough idle and engine stall.	
5	Inability to drive at constant speed	
6	Inability to accelerate and decelerate	
7	Engine does not return to idle.	
8	Afterburning in exhaust system	
9	Knocking	
10	Excessive fuel consumption	
11	Inability to "kick-down" and upshift	
U	CHECK ENGINE light operation	U-check mode & read memory mode
D		D-check mode

TROUBLE No.											CHECK ENGINE light		POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	U	D	
													AIR FLOW METER
		☆	◎				△	△	○		ON	ON	● Connector not connected
		△	◎	◎	◎		◎	○	△		ON	*1	● Poor contact of terminal
		☆	◎				△	○	△		ON	ON	● Short circuit
		☆	◎				△	△	○		ON	ON	● Discontinuity of wiring harness
		○	○	○	○		△	◎	○		OFF	*	● Performance characteristics unusual
													COOLANT THERMOSENSOR
	☆	○	☆		○		○	○	○		ON	ON	● Connector not connected
	△	△	◎	○	○	△	◎	◎	○		ON	*1	● Poor contact of terminal
	☆	○	☆		○		○	○	○		ON	ON	● Short circuit
	☆	○	☆		○		○	◎	○		ON	ON	● Discontinuity of wiring harness
	☆	○	○	△	○	○	◎	◎	◎		OFF	*	● Performance characteristics unusual
													IDLE SWITCH OF THROTTLE SENSOR
			◎	○	◎	◎	◎				ON	ON	● Connector not connected
			◎	○		◎	◎				ON	*1	● Poor contact of terminal
			◎	◎	△		◎				ON	ON	● Short circuit
			◎		△	◎	◎				ON	ON	● Discontinuity of wiring harness
			◎			◎	◎				OFF	*2	● Improper adjustment
1	2	3	4	5	6	7	8	9	10	11	U	D	

TROUBLE No.											CHECK ENGINE light		POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	U	D	
													THROTTLE SENSOR
				◎	◎		◎			○	ON	*1	● Poor contact of terminal
Δ			◎		◎		◎			◎	ON	ON	● Short circuit
			Δ		◎		◎			◎	ON	ON	● Discontinuity of wiring harness
	○	○	Δ	○	◎		◎			◎	OFF	*3	● Performance characteristics unusual
													PRESSURE REGULATOR
								Δ			OFF	*	● Sensing hose cracked or disconnected
	Δ				○		○		◎		OFF	*	● Fuel pressure too high
○	○	○	◎	◎	◎		◎				OFF	*	● Fuel pressure too low
													FUEL INJECTOR
○											ON	ON	● Connector not connected
	○	○	◎	◎	◎		○				ON	*1	● Poor contact of terminal
○											ON	ON	● Short circuit
○											ON	ON	● Discontinuity of wiring harness
	○	○	◎	◎	◎		◎		◎		OFF	*	● Performance characteristics unusual
	○	○	○	○	○						OFF	*	● Clogged filter
○	Δ										OFF	*	● Stuck open
			○				○		○		OFF	*	● Slight leakage from seat
													AIR CONTROL VALVE
	○	Δ	◎								ON	ON	● Connector not connected
	Δ	○	◎								ON	*1	● Poor contact of terminal
			○				○				ON	ON	● Short circuit
	○	Δ	◎								ON	ON	● Discontinuity of wiring harness
			◎			◎					OFF	*	● IAS improperly adjusted
						◎					OFF	*	● Stuck open
	○	○	◎								OFF	*	● Stuck closed
													CRANK ANGLE SENSOR
◎											ON	ON	● Connector not connected
	○	○	◎	◎	◎		○	○			ON	*1	● Poor contact of terminal
◎											ON	ON	● Short circuit
◎											ON	ON	● Discontinuity of wiring harness
													POWER TRANSISTOR OF IGNITION COIL
◎											OFF	*	● Connector not connected
	○	○	◎	◎	◎		○	Δ			OFF	*	● Poor contact of terminal
◎											OFF	*	● Short circuit
◎											OFF	*	● Discontinuity of wiring harness
1	2	3	4	5	6	7	8	9	10	11	U	D	

Self-diagnosis System

General

The self-diagnosis system detects and indicates a fault in various inputs and outputs of the complex electronic control. The warning lamp (CHECK ENGINE light) on the instrument panel indicates occurrence of a fault or trouble, and also the light emitting diode (LED) in the control unit indicates a trouble code.
Further, against such a failure of sensors as may disable the drive, the fail-safe function is provided to ensure the minimal driveability.

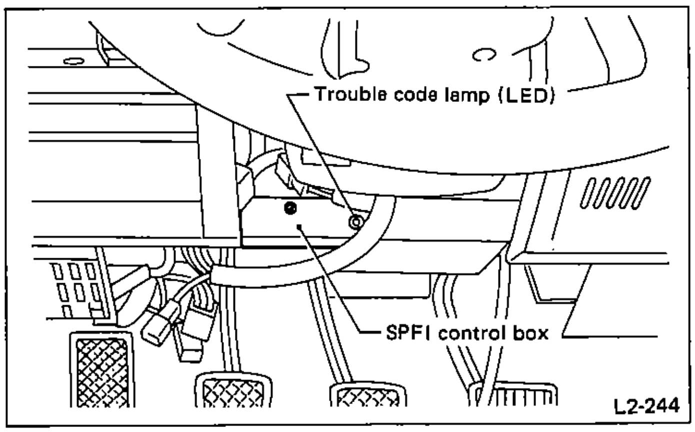


Fig. 32

SELF-DIAGNOSIS FUNCTION

The SPFI control unit executes the computational processing on the input information received from various sensors and produces the output information for driving the fuel injector, fuel pump, etc.
Along with this computational processing, it reads out all the input/output information to examine matching with the predetermined levels (proper values or ranges). If a predetermined level is not satisfied, i.e., a fault is found, the warning lamp is signaled to a driver. In this fashion, the self-diagnosis function is performed.

FAIL-SAFE FUNCTION

For the part which has been judged faulty in the self-diagnosis, the SPFI control unit generates the associated pseudo signal (only when convertible to electric signal) and carries out the computational processing. In this fashion, the fail-safe function is performed.

Function of Self-Diagnosis

The self-diagnosis function has four modes: U-check mode, Read memory mode, D-check mode and Clear memory mode. Two connectors (Read memory and Test mode) and two lamps (CHECK ENGINE light and O_2 monitor) are used. The connectors are for mode selection and the lamps monitor the type of problem.

RELATIONSHIP BETWEEN MODES AND CONNECTORS

Mode	Engine	Read memory connector	Test mode connector
U-check	Ignition ON	DISCONNECT	DISCONNECT
Read memory	Ignition ON	CONNECT	DISCONNECT
D-check	Ignition ON	DISCONNECT	CONNECT
Clear meory .	Ignition ON (engine on)	CONNECT	CONNECT

U-CHECK MODE

The U-check is a user-oriented mode in which only the SPFI components necessary for start-up and drive are diagnosed. On occurrence of a fault, the warning lamp (CHECK ENGINE light) is lighted to indicate to the user that the dealer's inspection is necessary. The diagnosis of other parts which do not give significant adverse effect to start-up and drive are excluded from this mode in order to avoid unnecessary uneasiness to be taken by the user.

READ MEMORY MODE

This mode is used by the dealer to read the problems which have occurred in the past (even when the vehicle is brought in with the monitor lamps off). It is most effective in detecting poor contact or connections of connectors, harnesses, etc.

D-CHECK MODE

This mode is used by the dealer to check the entire SPFI system and detect faulty parts.

CLEAR MEMORY MODE

This mode is used by the dealer to clear the trouble code from the memory after the affected part is repaired.

Basic Operation of Self-diagnosis System

NO TROUBLE

O : CONNECT X : DISCONNECT

Engine	Read memory connector	Test mode connector	CHECK ENGINE light	O_2 monitor lamp	Remarks
ON	X	X	OFF	O_2 monitor	
ON	O	X	OFF	O_2 monitor	
*ON	X	O	** OFF → Blink	OFF	Vehicle specification code is outputted when CHECK ENGINE light is OFF.
*ON	O	O	OFF → Blink	OFF	All memory stored in control unit is cleared after CHECK ENGINE light blinks.
OFF (Ignition switch ON)	O	X	ON	Vehicle specification code	Before starting the engine, the self-diagnosis system assumes the engine to be in a NO TROUBLE condition.
OFF (Ignition switch ON)	X	X	ON	Vehicle specification code	
OFF (Ignition switch ON)	X	O	ON	Vehicle specification code	
OFF (Ignition switch ON)	O	O	ON	Vehicle specification code	

TROUBLE

Engine	Read memory connector	Test mode connector	CHECK ENGINE light	O_2 monitor lamp	Remarks
ON	X	X	ON	Trouble code	
ON	O	X	ON	Trouble code (memory)	
*ON	X	O	** OFF → ON	Trouble code	Vehicle specification code is outputted when CHECK ENGINE light is OFF.
*ON	O	O	OFF → ON	Trouble code	
OFF (Ignition switch ON)	O	X	ON	Trouble code (memory)	
STALL (Ignition switch ON)	X	X	ON	Trouble code	
STALL (Ignition switch ON)	X	O	ON	Trouble code	
STALL (Ignition switch ON)	O	O	ON	Trouble code	

***: Ignition timing is set to 20° BTDC (when the engine is on, test mode connector is connected, and idle switch is ON).**
****: CHECK ENGINE light remains off until engine is operated at speed greater than 2,000 rpm for at least 40 seconds.**

List of Trouble Codes

Trouble code	Item	Page
11	Crank angle sensor (No reference pulse)	p49
12	Starter switch (Continuously in ON or OFF position while cranking)	p51
13	Crank angle sensor (No position pulse)	p52
14	Fuel injector (Abnormal injector output)	p54
21	Water temperature sensor (Open or shorted circuit)	p55
23	Air flow meter (Open or shorted circuit)	p56
24	Air control valve (Open or shorted circuit)	p57
31	Throttle sensor (Open or shorted circuit)	p58
32	O_2 sensor (Abnormal sensor signal)	p59
33	Car-speed sensor (No signal is present during operation)	p60
34	EGR solenoid valve (Solenoid switch continuously in ON or OFF position, or *clogged EGR line)	p61
35	Purge control solenoid valve (Solenoid switch continuously in ON or OFF position)	p62
42	Idle switch (Abnormal idle switch signal in relation to throttle sensor output)	p63
45	Kick-down control relay (Continuously in ON or OFF position)	p64
51	Neutral switch (Continuously in ON position)	p65 or p66
*55	EGR gas temperature sensor (Open or short circuit)	p67
61	Parking switch (Continuously in ON position)	p68

***: California model only**

List of Specification Codes

Specification codes	Specification
05	MT, Federal and Canada
06	MT, Cal
07	AT, Federal and Canada
08	AT, Cal

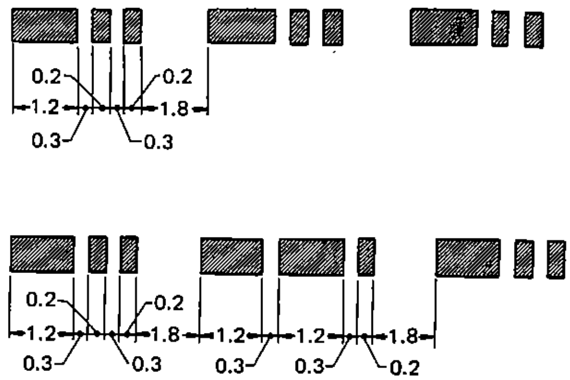
How to Read Trouble Codes (Flashing)

The O_2 monitor lamp flashes the code corresponding to the faulty part.
The long segment (1.2 sec on) indicates a "ten", and the short segment (0.2 sec on) signifies a "one".

Example:

When only one part has failed:
Flashing code 12
(unit: second)

When two or more parts have failed:
Flashing codes 12 and 21
(unit: second)



L2-848

Fig. 33

SPFI System Layout

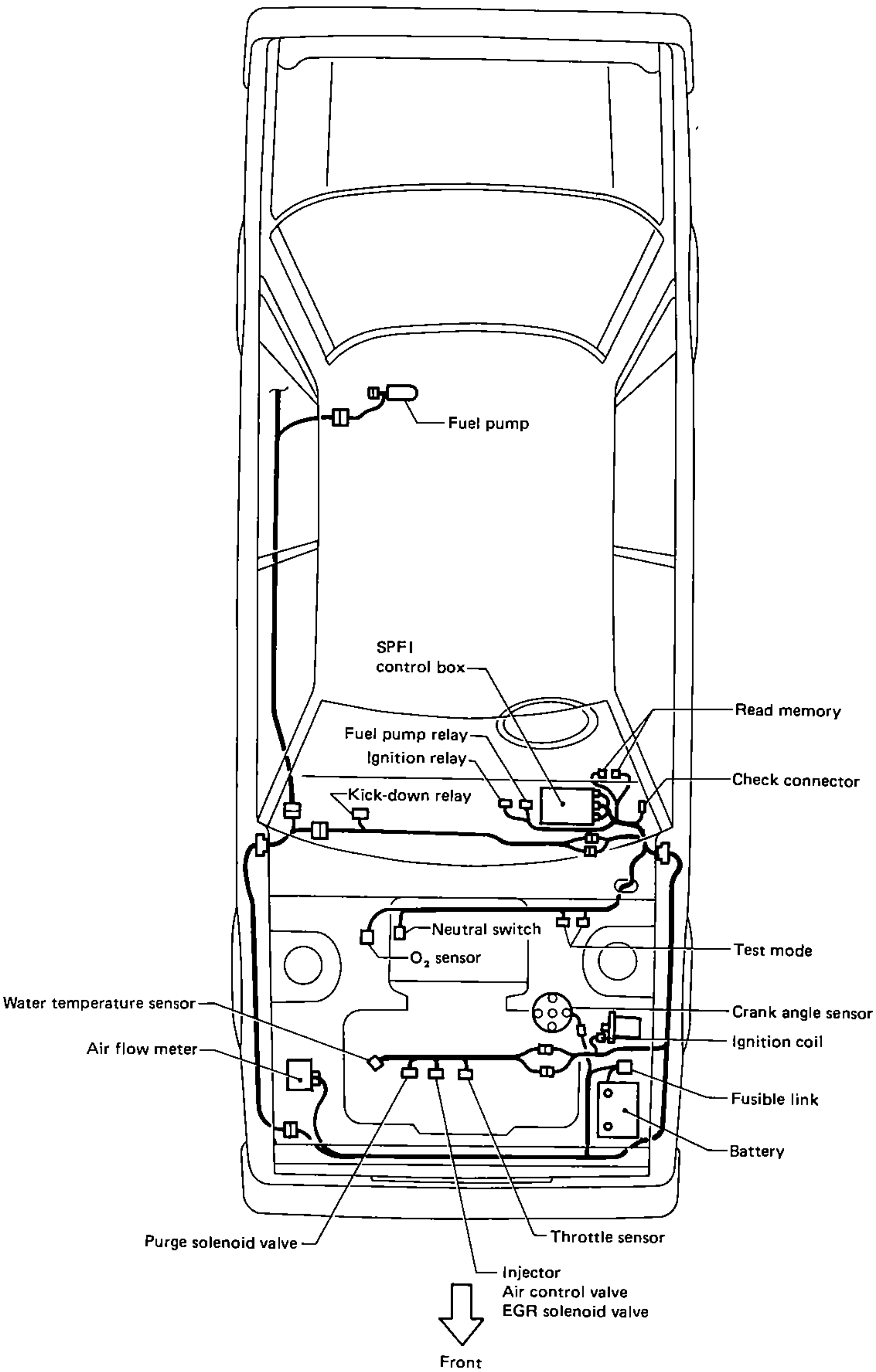


Fig. 35

L2-850

Connector Terminal

CONTROL UNIT CONNECTOR

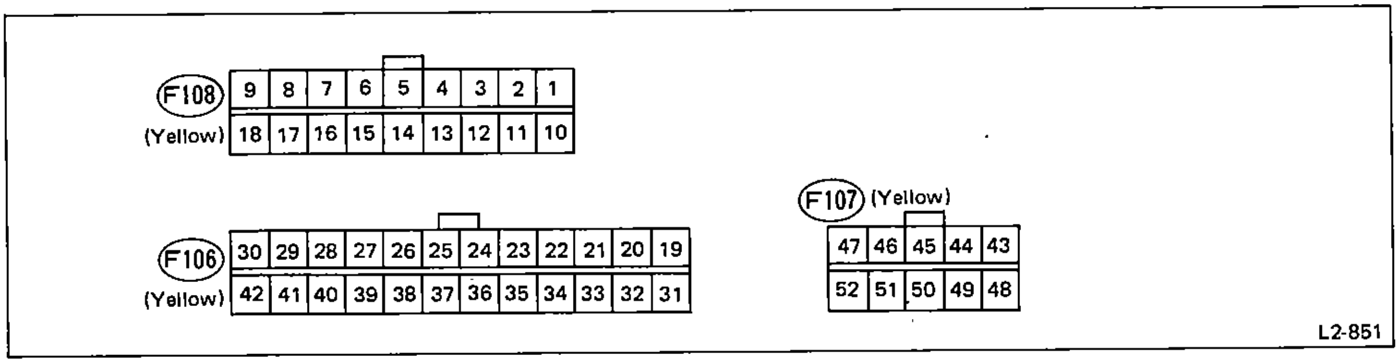


Fig. 36

1	LG	Kick-down control	27	BW	Power (input)
2	RL	CHECK ENGINE light	28	GW	Self-shutoff signal
3	R	Test 4	29	W	Power (input)
4	LR	EGR solenoid (control)	30	BR	GND
5	GL	Purge control solenoid	31	Br	Test mode connector (used at line end only)
6	LY	Air conditioner signal	32	BR	Test mode connector (used at line end only)
7	–	———	33	Lg	49-state/Cal identification
8	W	Air flow meter (signal)	34	SA	O_2 sensor
9	B	Air flow meter (GND)	35	B	GND
10	Y	Line end cord output	36	WR	EGR monitor
11	L	Line end cord output	37	LgR	Test mode connector (used at line end only)
12	RL	Line end cord output	38	RL	Ignition switch
13	YR	Inhibitor switch (AT models only)	39	LgW	Clear memory
14	YG	Neutral switch	40	–	———
15	YL	Parking switch (AT models only)	41	W	Power (input)
16	LgR	Kick-down monitor	42	BR	GND
17	R	Air flow meter power (output)	43	RW	Injector ⊕
18	LgY	Starter switch	44	BR	GND
19	GB	Crank angle sensor power (output)	45	GR	Air control valve
20	GY	Crank angle sensor signal (reference)	46	GY	A/C control
21	BW	Crank angle sensor signal (position)	47	LB	Fuel pump
22	YG	Car-speed sensor	48	RB	Injector ⊖
23	WB	Water temperature sensor	49	RL	Power (input)
24	LG	Idle switch	50	BY	GND
25	W	Throttle sensor (signal)	51	B	GND
26	R	Throttle sensor power (output)	52	WY	Ignition control

Intermediate connector I (body side) . . . (F41)

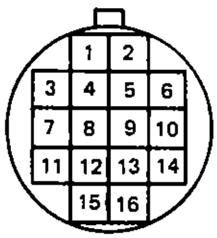


Fig. 37

1	BR	Ground
2	YB	Oil pressure (to combination meter)
3	–	———
4	YG	Thermometer (to combination meter)
5	B	Injector ⊖
6	B	Shield
7	LG	Idle switch
8	–	———
9	R	Throttle sensor (power)
10	W	Injector ⊕
11	BY	Ground
12	W	Throttle sensor (signal)
13	B	Ground
14	B	Ground
15	RL	Power supply
16	BR	Ground

Intermediate connector II (body side) . . . (F42) (Black)

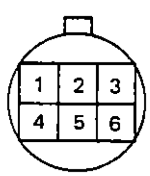
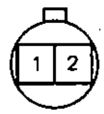


Fig. 38

1	GR	Air control valve (control)
2	Lg	Identification of specifications
3	GL	Purge solenoid (control)
4	WR	EGR gas temperature sensor
5	LR	EGR solenoid (control)
6	WB	Water temperature signal

Air control valve connector . . . (E10) (Black)

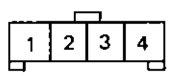


L2-854

Fig. 39

1	W	Air control valve control
2	BW	IG power supply

Air flow meter connector . . . (F20) (Black)

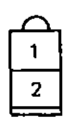


L2-855

Fig. 40

1	–	———
2	R	Air flow meter power supply
3	B	Ground
4	W	Air flow meter signal

Purge solenoid valve connector . . . (E13) (Black)



L2-856

Fig. 41

1	GL	Canistor solenoid valve control
2	BW	IG power supply

Crank angle sensor connector . . . (F93)

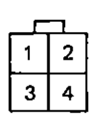
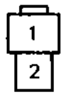


Fig. 42

L2-1511

1	GB	Power supply
2	GY	Ref. sign
3	BW	Pos. sign
4	B	Ground

EGR solenoid valve connector . . . (E11)

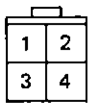


L2-858

Fig. 43

1	LR	EGR solenoid valve control
2	BW	IG power supply

Fuel pump relay connector . . . (F78) (Blue)

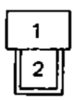


L2-859

Fig. 44

1	BW	IG power supply
2	BW	IG power supply
3	LB	Fuel pump control
4	LW	Fuel pump

Ignition coil connector . . . (F43) (Black)

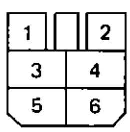


L2-1571

Fig. 45

1	BW	IG power supply
2	WY	Ignition coil control

Ignition relay connector . . . (F79) (Brown)



L2-861

Fig. 46

1	GW	Self shutoff control
2	B	Ground
3	R	Battery ⊕
4	BW	Battery ⊕
5	RL	(Injector) power supply
6	W	SPFI control unit power supply

Injector connector . . . (E9) (Black)

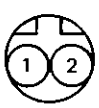
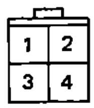


Fig. 47

L2-862

1	RB	Injector ⊖
2	RW	Injector ⊕

KD relay connector . . . (i48)



L2-859

Fig. 48

1	BW	IG power supply
2	BW	IG power supply
3	LG	SPFI C/U (for KD control)
4	L	KD solenoid

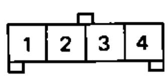
Neutral switch connector (MT) . . . (F56)

L2-854

Fig. 49

1	BR	Ground
2	YG	Neutral signal

Throttle sensor connector . . . (E8) (Black)



L2-865

Fig. 50

1	R	Battery ⊕
2	G	Throttle position signal
3	B	Ground
4	LG	Idle switch signal

Water temperature sensor . . . (E12) (Black)

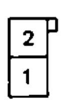


Fig. 51

L2-1572

1	BR	Ground
2	WB	Water temperature signal

EGR gas temperature sensor . . . (F34)

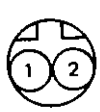


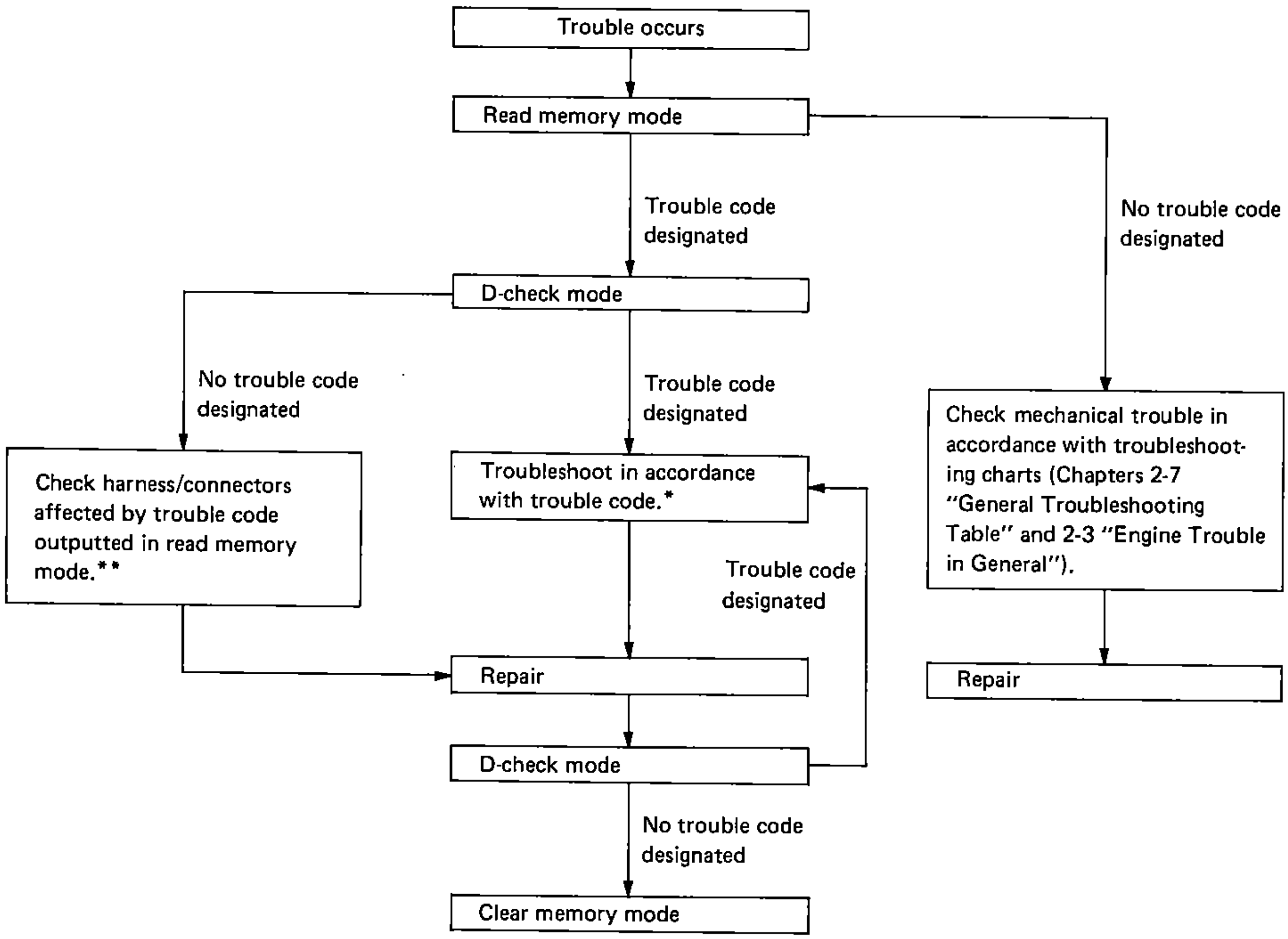
Fig. 52

L2-862

1	WR	EGR gas temperature signal
2	B	Ground

Troubleshooting Chart for Self-diagnosis System

Basic Troubleshooting Procedures



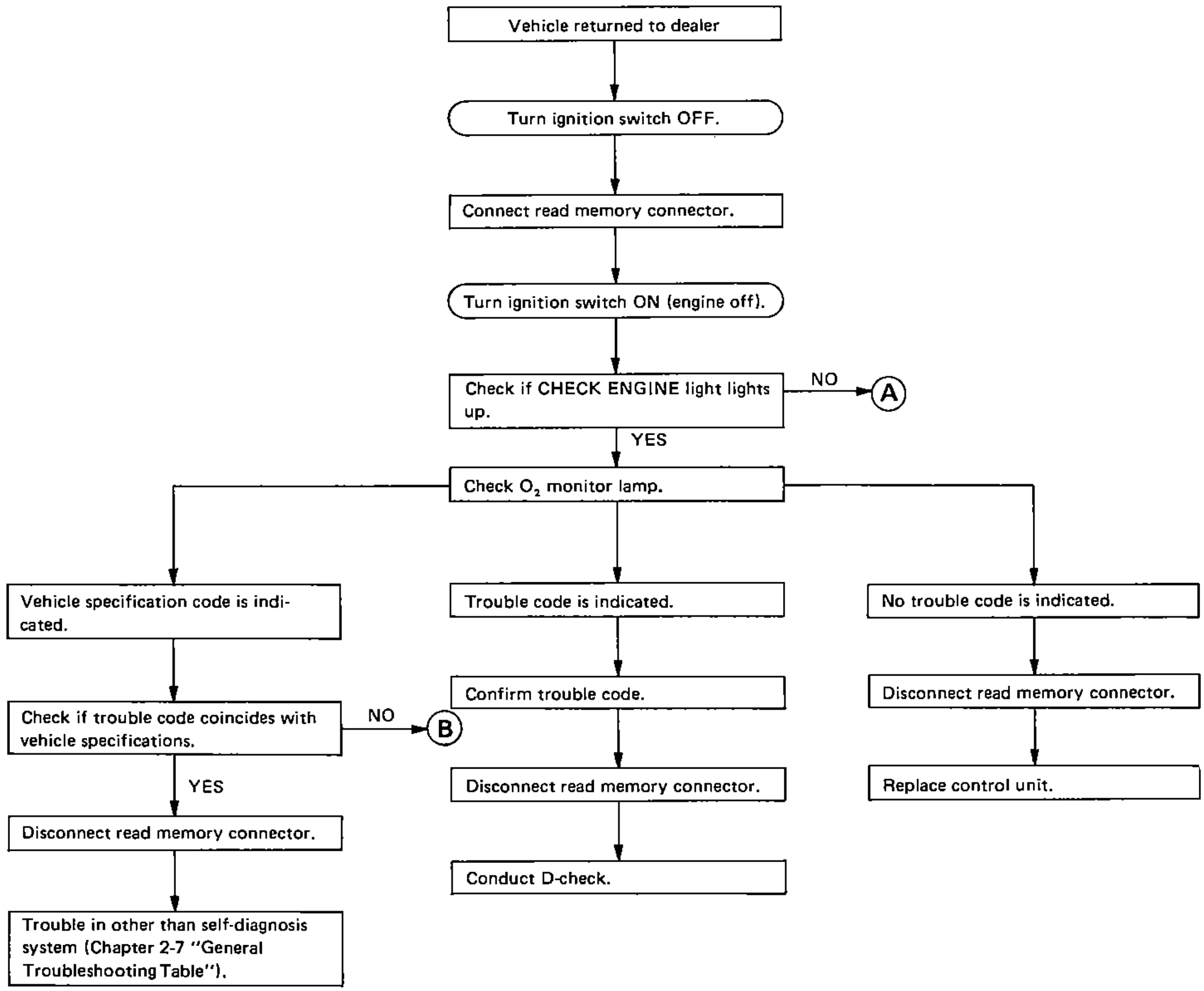
*: When more than one trouble code is outputted, begin troubleshooting with the smallest trouble code number and proceed to the next higher code.
After correcting each problem, conduct the D-check and ensure that the corresponding trouble code no longer appears.

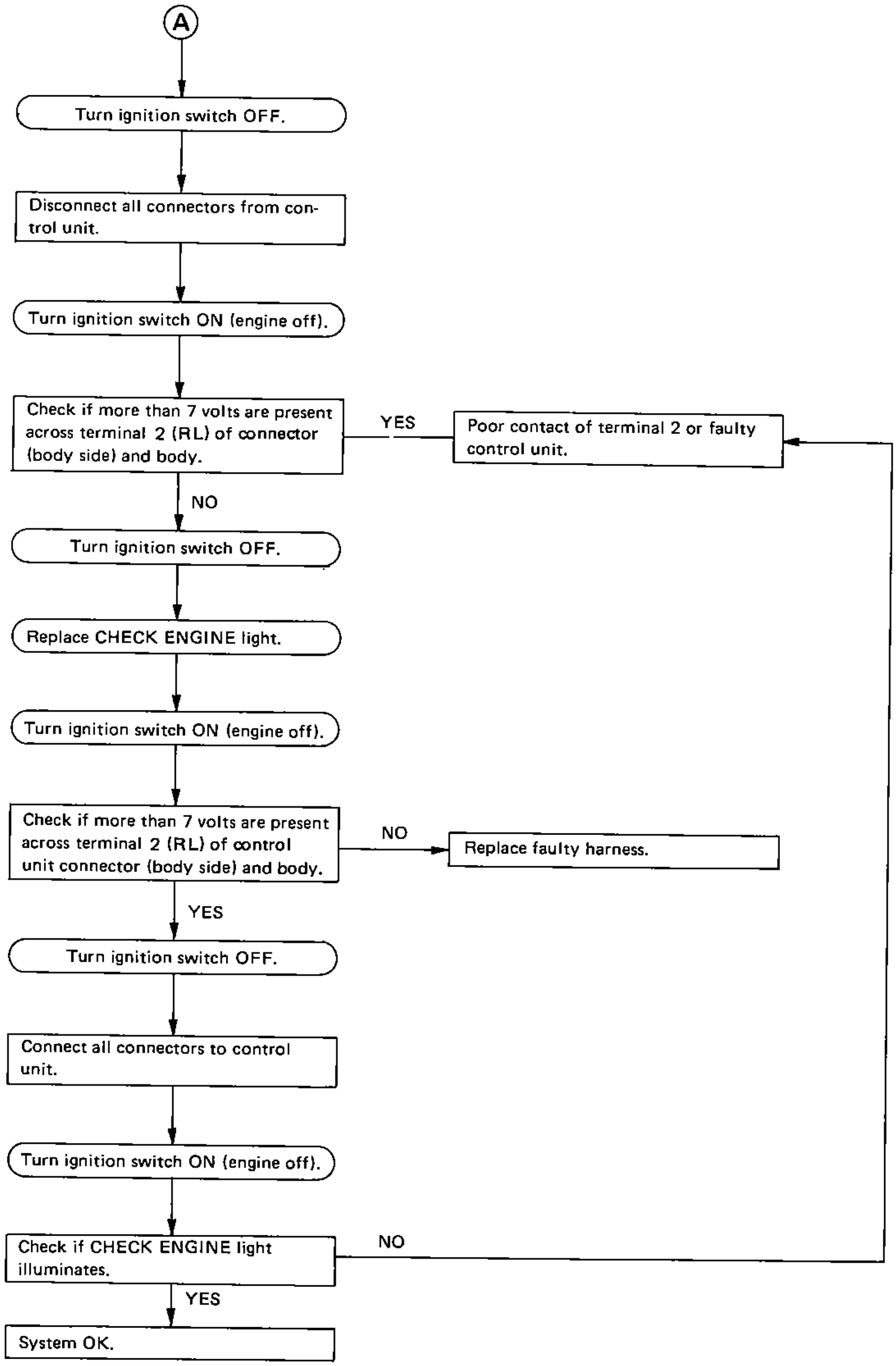
**: When more than one trouble code is outputted, check all related harness connectors, starting with that corresponding to the smallest trouble code number and proceeding to the next higher code.

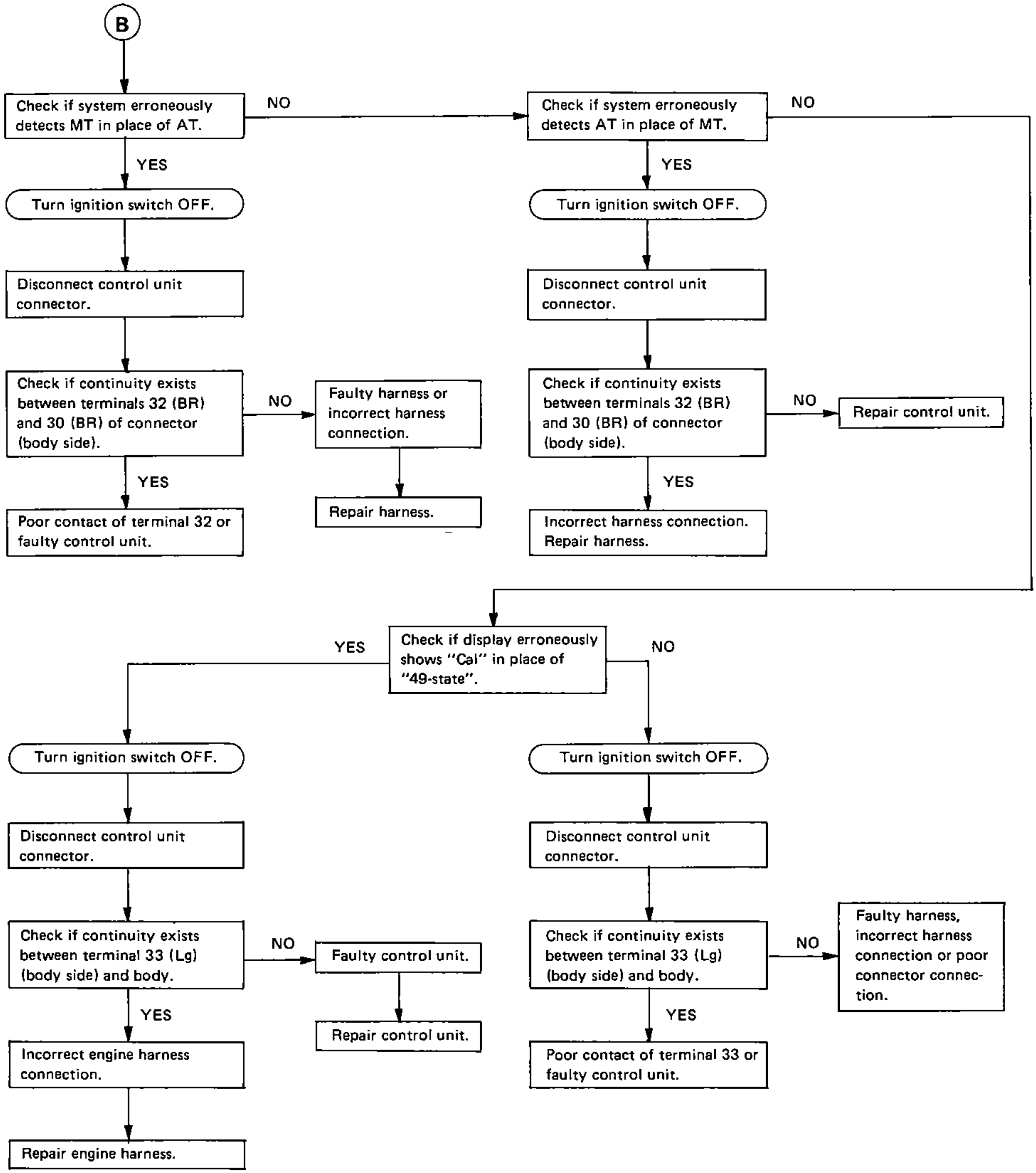
a. Check the connector while it is connected unless specified otherwise.
b. Be sure to check again from the beginning in order to prevent secondary trouble caused by repair work.
c. When checking with the vacuum hose disconnected from the vacuum switch at E/G on, be sure to plug the hose.

READ MEMORY MODE

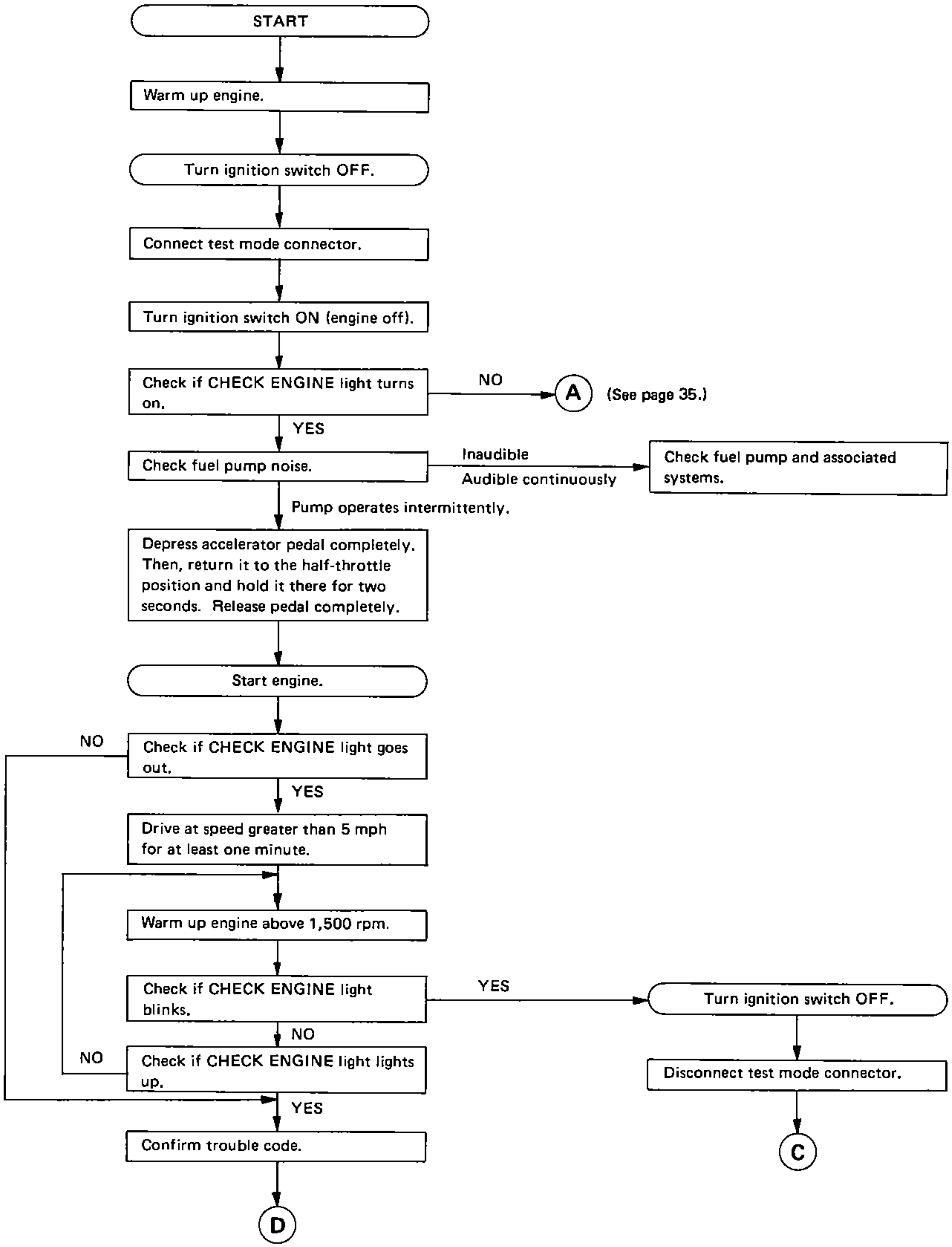
WHEN VEHICLE IS RETURNED TO DEALER BECAUSE CHECK ENGINE LIGHT LIGHTS UP

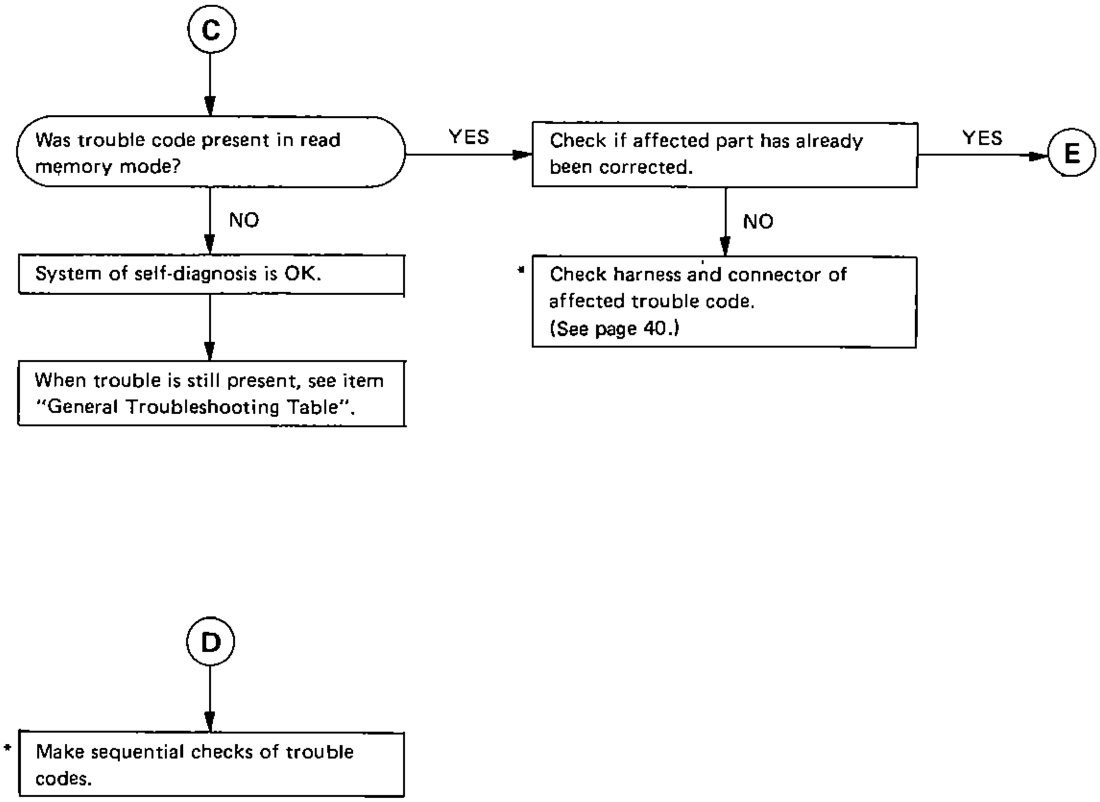



A
Turn ignition switch OFF.
Disconnect all connectors from control unit.
Turn ignition switch ON (engine off).
Check if more than 7 volts are present across terminal 2 (RL) of connector (body side) and body.
YES
Poor contact of terminal 2 or faulty control unit.
NO
Turn ignition switch OFF.
Replace CHECK ENGINE light.
Turn ignition switch ON (engine off).
Check if more than 7 volts are present across terminal 2 (RL) of control unit connector (body side) and body.
NO
Replace faulty harness.
YES
Turn ignition switch OFF.
Connect all connectors to control unit.
Turn ignition switch ON (engine off).
Check if CHECK ENGINE light illuminates.
NO
YES
System OK.


B
Check if system erroneously detects MT in place of AT.
NO
YES
Turn ignition switch OFF.
Disconnect control unit connector.
Check if continuity exists between terminals 32 (BR) and 30 (BR) of connector (body side).
NO
Faulty harness or incorrect harness connection.
Repair harness.
YES
Poor contact of terminal 32 or faulty control unit.
Check if system erroneously detects AT in place of MT.
NO
YES
Turn ignition switch OFF.
Disconnect control unit connector.
Check if continuity exists between terminals 32 (BR) and 30 (BR) of connector (body side).
NO
Repair control unit.
YES
Incorrect harness connection. Repair harness.
Check if display erroneously shows "Cal" in place of "49-state".
YES
NO
Turn ignition switch OFF.
Disconnect control unit connector.
Check if continuity exists between terminal 33 (Lg) (body side) and body.
NO
Faulty control unit.
Repair control unit.
YES
Incorrect engine harness connection.
Repair engine harness.
Turn ignition switch OFF.
Disconnect control unit connector.
Check if continuity exists between terminal 33 (Lg) (body side) and body.
NO
Faulty harness, incorrect harness connection or poor connector connection.
YES
Poor contact of terminal 33 or faulty control unit.

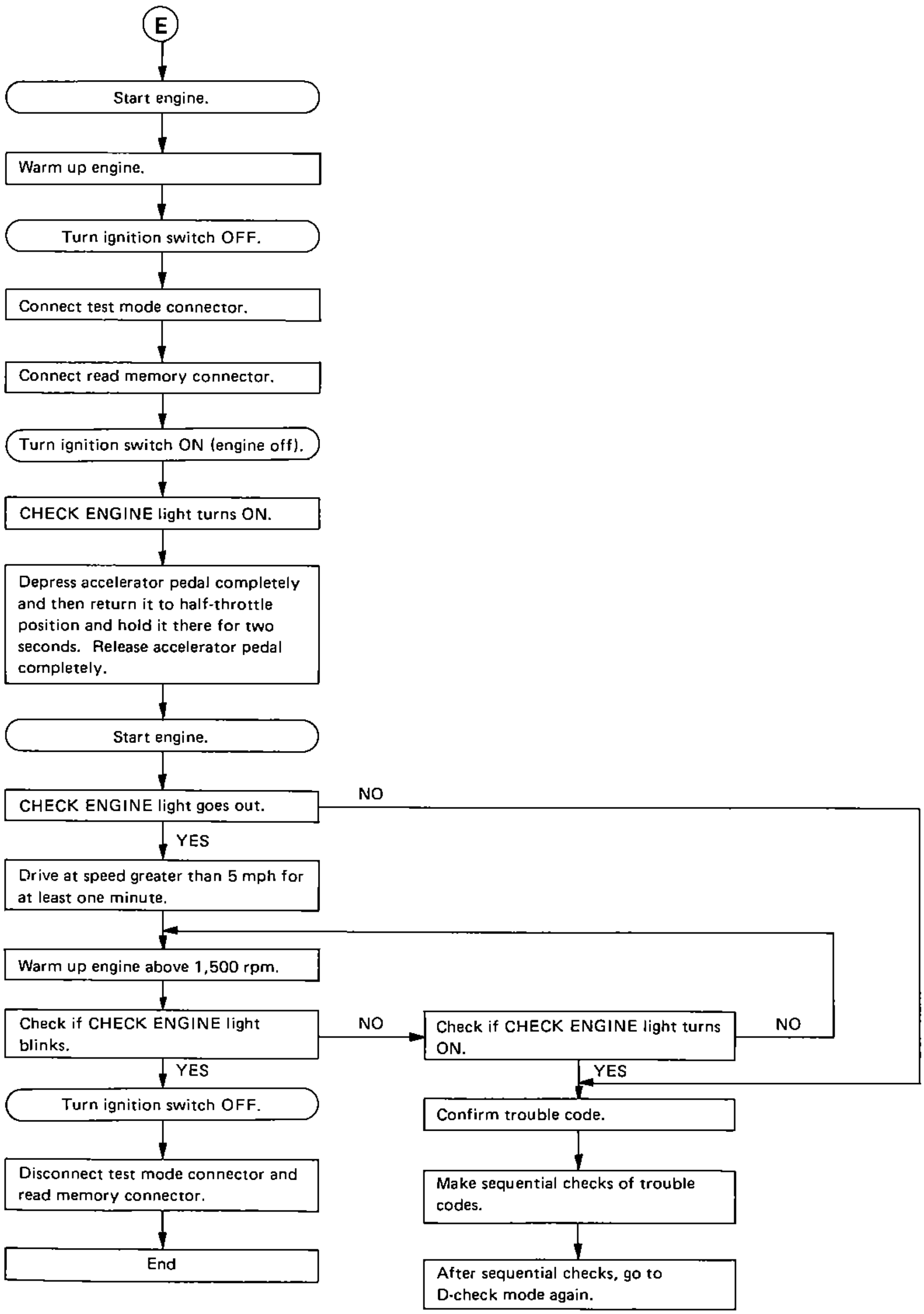
D-CHECK MODE


START
Warm up engine.
Turn ignition switch OFF.
Connect test mode connector.
Turn ignition switch ON (engine off).
Check if CHECK ENGINE light turns on.
NO
A
(See page 35.)
YES
Check fuel pump noise.
Inaudible
Audible continuously
Check fuel pump and associated systems.
Pump operates intermittently.
Depress accelerator pedal completely. Then, return it to the half-throttle position and hold it there for two seconds. Release pedal completely.
Start engine.
NO
Check if CHECK ENGINE light goes out.
YES
Drive at speed greater than 5 mph for at least one minute.
Warm up engine above 1,500 rpm.
Check if CHECK ENGINE light blinks.
YES
Turn ignition switch OFF.
Disconnect test mode connector.
C
NO
NO
Check if CHECK ENGINE light lights up.
YES
Confirm trouble code.
D



***: When more than one trouble code is outputted, sequentially check the trouble codes, starting with the smallest code number. After correcting each trouble, reconduct D-check and make sure the corresponding trouble code is no longer present.**

CLEAR MEMORY MODE



Checking Harnesses and Connectors Related to Trouble Codes

When a trouble code is outputted in the read memory mode but not in the D-check mode, check the affected harness and connector terminal as described below.

CHECKING TERMINALS OF CONTROL UNIT CONNECTOR (BODY SIDE)

1) When terminals are not locked securely, insert into connectors until they lock.

2) When terminals are considered to be open:
(1) Method of judging "OK" and "Faulty":
a. Pull out the terminal from the connector (body side).
b. Insert this terminal (female) into the terminal (male) of the connector (control unit).
c. Check "pull" force required to disconnect the female terminal from the male terminal.
If the terminal is loose, it is considered to be faulty.
(2) When terminals are faulty:
Pinch the terminal using a pair of nose pliers. If the terminal is still loose, replace it or the harness ASSY.

SYMPTOMS RESULTING FROM POOR CONTACT OF CONTROL UNIT CONNECTOR TERMINALS AND RELATED TROUBLE CODES

Terminal No.	Lead color	Trouble code	Symptom affected by poor terminal contact	At instantaneous poor contact
1	LG	45	Kick-down no longer occurs.	Shocks occur during kick-down.
2	RL	—	When ignition is ON (engine off), O_2 sensor monitor lamp remains off.	No shocks occur.
3	R	—	When ignition is ON (engine on), O_2 sensor monitor lamp remains off.	No shocks occur.
4	LR	34	EGR solenoid fails to operate.	Shocks rarely occur.
5	GL	35	Purge control solenoid fails to operate.	Shocks rarely occur.
6	LY	—	Idle speed does not increase when air conditioning system turns on.	Idle speed decreases slightly when air conditioning system turns on.
8	W	23	Shock is felt at instantaneous poor contact.	
9	B	23	Same as above.	
14	YG	51	Idle speed is erroneous.	
15	YL	61	Same as above.	
16	LgR	45	Shock is not felt.	
17	R	23	Shock is felt at instantaneous poor contact.	
18	LgY	12	Starter does not start. When instantaneous poor contact occurs shock is rarely felt.	
19	GB	11	Engine stalls. Shock is felt and tachometer indication goes down.	
20	GY	11	Same as above.	
21	BW	13	Same as above.	

Terminal No.	Lead color	Trouble code	Symptom affected by poor terminal contact
22	YG	33	Shock is not felt.
23	WB	21	While engine is cold, idle speed is erroneous and shock is felt.
24	LG	42	While idling engine, speed is erroneous.
25	W	31	Shock is rarely felt and acceleration is poor.
26	R	31	Same as above.
28	GW	–	Restarting ability is poor and shock is not felt.
29	W	–	Shock is not felt.
30	BR	–	Same as above.
31	Br	–	Same as above.
32	BR	–	Same as above.
33	Lg	–	Same as above.
34	SA	–	Same as above.
35	B	–	Same as above.
36	WR	34	Same as above.
38	RL	–	Same as above.
39	LgW	–	Same as above.
41	W	–	Same as above.
42	BR	–	Same as above.
43	RW	14	Engine stalls and shock is felt.
44	BR	14	Same as above.
45	GR	24	Engine speed decreases.
46	GY	–	Air conditioning system does not turn off though the throttle valve is opened fully.
47	LB	–	Engine lacks power, engine stalls, shock is felt.
48	RB	14	Engine stalls and shock is felt.
49	RL	–	Slight shock is felt at instantaneous poor contact.
51	B	34	Speed decreases and engine stalls. Shock is felt.
52	WY	–	Engine misfires. When engine stops, shock is felt and tachometer indication goes down.

Troubleshooting for Engine Starting Failure

1. GROUND & CONTROL UNIT POWER SUPPLY

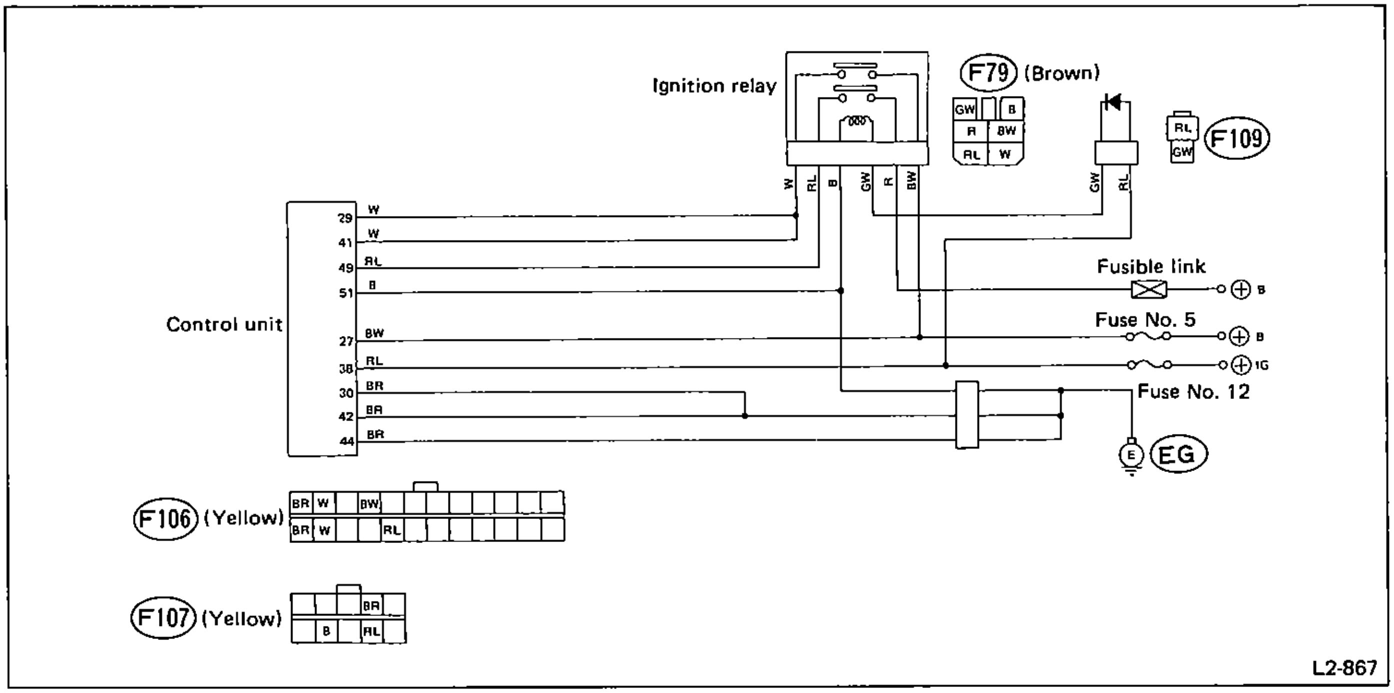


Fig. 53

- Turn ignition switch OFF.
- Disconnect control unit connector.
- Check if resistance is less than 10 Ω between body and terminals 30 (BR), 42 (BR), 44 (BR) and 51 (B) of connector (body side), respectively.
  - NO → Check if right intake manifold ground terminal is grounded properly.
    - YES → Tighten bolts.
    - NO → Check if connector between body harness and engine harness is disconnected.
      - YES → Connect properly.
      - NO → Repair harness.
  - YES → Turn ignition switch ON (engine off).
- Check if at least 10V DC is present across body and terminals 29 (W), 41 (W), 27 (BW) and 49 (RL) of connector (body side).
  - NO → Check battery terminals, fuse, ignition relay and ignition switch.
    - OK → Repair harness.
  - YES → Power supply and grounding circuits are OK.
- → 2

2. IGNITION CONTROL SYSTEM

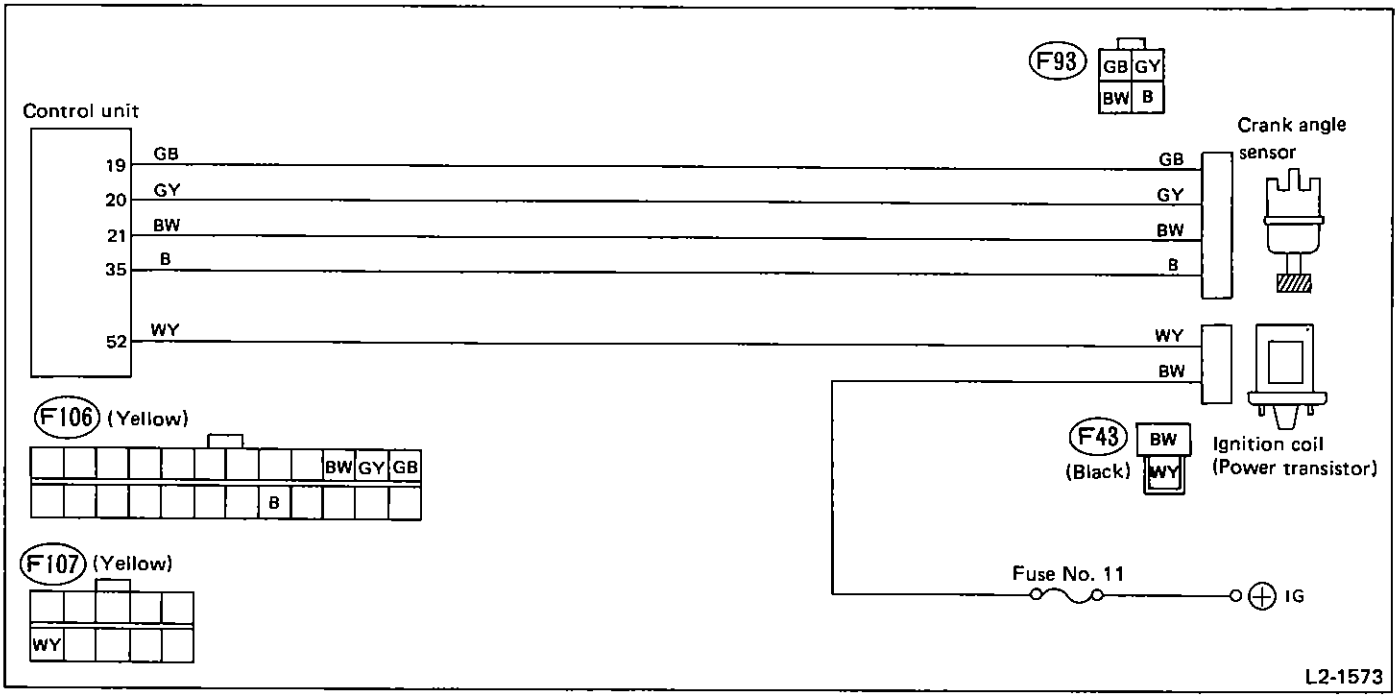


Fig. 54

2

↓

Turn ignition switch OFF (engine off).

↓

Connect control unit connector.

↓

Disconnect injector connector.

↓

Crank engine and check with timing light if ignition occurs.

YES → Ignition circuit is OK. → **3**

NO ↓

Disconnect crank angle sensor connector of distributor.

↓

2-1

2-1

Turn ignition switch ON (engine off).

Check if voltage across body and terminal (GB) of crank angle sensor connector (body side) is greater than 10V.

- NO → Check if voltage across body and terminal 19 (GB) of control unit connector is greater than 10V.
  - NO → Replace control unit.
  - YES → Repair harness.
- YES ↓

Check if voltage across body and terminal (BW) is greater than 4V.

- NO → Check if voltage across body and terminal 21 (BW) of control unit connector is greater than 4V.
  - NO → Replace control unit.
  - YES → Repair harness.
- YES ↓

Check if voltage across body and terminal (GY) is greater than 4V.

- NO → Check if voltage across body and terminal 20 (GY) of control unit connector is greater than 4V.
  - NO → Replace control unit.
  - YES → Repair harness.
- YES ↓

Connect crank angle sensor connector.

Disconnect 2-pole connector from ignition coil power transistor.

2-2

2-2

Turn ignition switch ON (engine off).

Check if monitor voltage repeats to become 0 V and 5 V when crankshaft is turned slowly (do not crank with starter) while monitoring voltage between control unit position signal terminal No. 21 (BW) and car body.

- NO → Replace crank angle sensor.
- YES ↓

Check if monitor voltage repeats to become 0 V and 5 V when crankshaft is turned by starter while monitoring voltage between control unit reference signal terminal No. 20 (GY) and car body.

- NO → Replace crank angle sensor.
- YES ↓

Connect 2-pole connector at IG coil power transistor.

Connect injector connector.

Turn ignition switch ON (engine off).

Check voltage between 2-pole connector power terminal (GY) at IG coil power transistor and car body is greater than 10.

- NO → Repair open harness.
- YES ↓

Check voltage between IG coil (−) terminal and car body is greater than 10 V.

- NO → Replace IG coil.
- YES ↓

Disconnect 2-pole connector at IG coil power transistor.

Check if voltage varies synchronously with engine revolutions when cranking while monitoring voltage between 2-pole connector signal terminal (WY) at IG coil power transistor and car body.

- YES → Replace IG coil.
- NO ↓

Repair harness or replace control unit.

3. FUEL PUMP (F/P) CIRCUIT

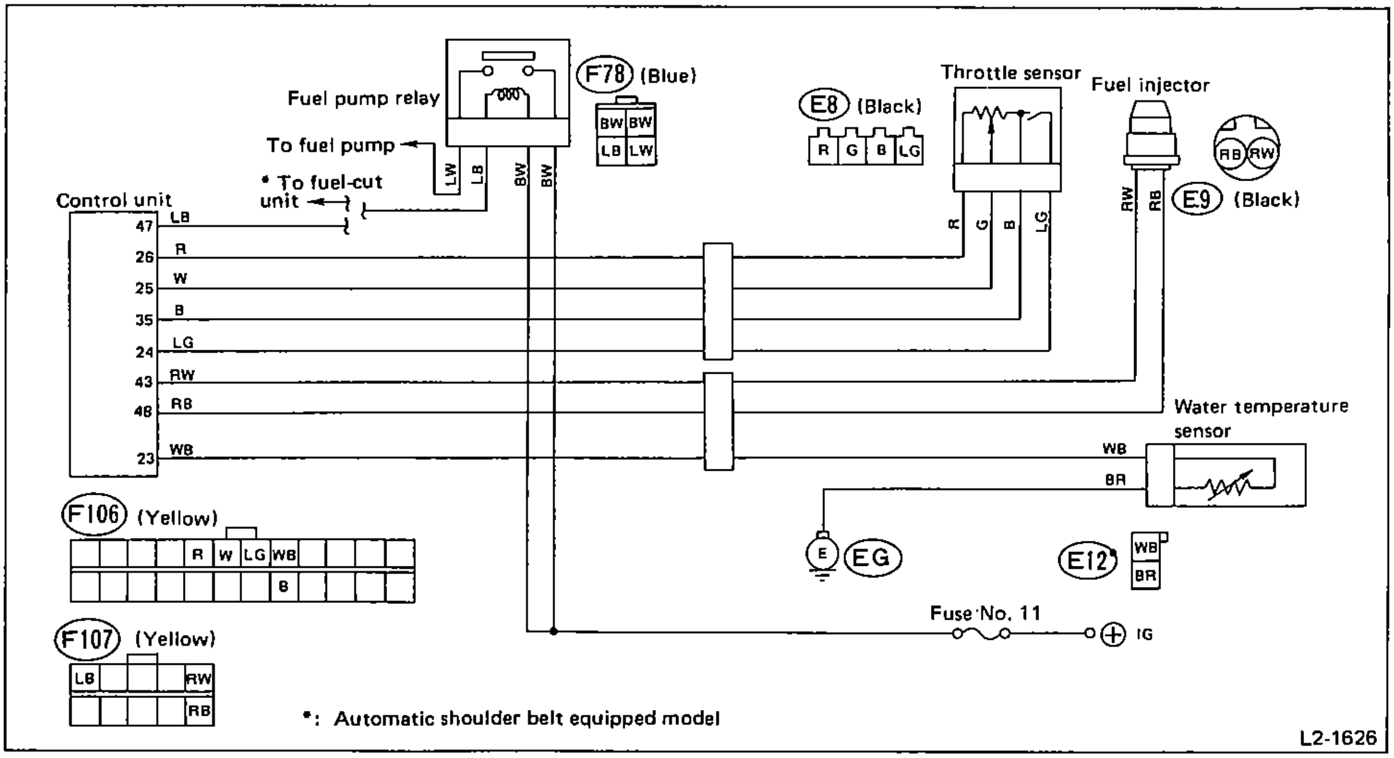


Fig. 55

3

1. Connect injector connector.
2. Disconnect 2-pole connector at IG coil power transistor.
3. Remove air-intake duct from throttle chamber.
4. Crank engine and visually check if fuel is injected.
   - YES → **3-1**
   - NO (Be careful on fire.) → Install upper duct.
5. Does fuel pump operate while cranking?
   - NO → **3-2**
   - YES → Is there any fuel?
6. Is there any fuel?
   - NO → Add fuel.
   - YES → Does injector operate while cranking?
7. Does injector operate while cranking? (Check by listening to operating noise.)
   - YES → Repair clogged fuel piping.
   - NO → Disconnect injector connector.
8. Check if resistance is less than 2 Ω between the two connector terminals on injector side.
   - NO → Replace injector.
   - YES → Check if resistance between each terminal of connector on injector side and car body is greater than 1 MΩ.
9. Check if resistance between each terminal of connector on injector side and car body is greater than 1 MΩ.
   - NO → Replace injector.
   - YES → Replace control unit.

3-1

Install air intake duct.

Connect 2-pole connector to ignition coil power transistor.

Turn ignition switch OFF.

Disconnect control unit connector.

Check if resistance between terminals 26 (R) and 35 (B) of connector (body side) is 3.5 – 6.5 Ω.
Check if resistance between terminals 25 (W) and 35 (B) is less than 1 kΩ when throttle is closed fully and greater than 2.4 kΩ when throttle is open fully.

- NO → Disconnect throttle sensor connector.
  - Check if resistance between terminals (B) and (D) of connector on sensor side is 3.5 – 6.5 kΩ. Also check if resistance between terminals (B) and (C) is less than 1 kΩ when throttle is closed fully and greater than 2.4 kΩ when throttle is opened fully.
    - YES → Repair harness.
    - NO → Replace throttle sensor.
- YES → Check if resistance between body and terminal 23 (WB) of connector (body side) is between 100 Ω and 20 kΩ.
  - NO → Disconnect water temperature sensor connector.
    - Check if resistance between terminals of connector (water temperature sensor side) is between 100 Ω and 200 kΩ.
      - YES → Repair harness. → Replace water temperature sensor.
      - NO → Replace water temperature sensor.
  - YES → Turn ignition switch ON.
    - Check if fuel pressure is between 137 – 167 kPa (1.4 – 1.7 kg/cm², 20 – 24 psi).
      - NO → Replace pressure regulator.
      - YES → Replace control unit.

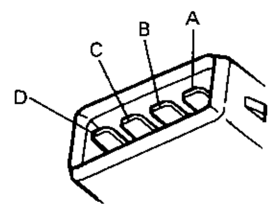
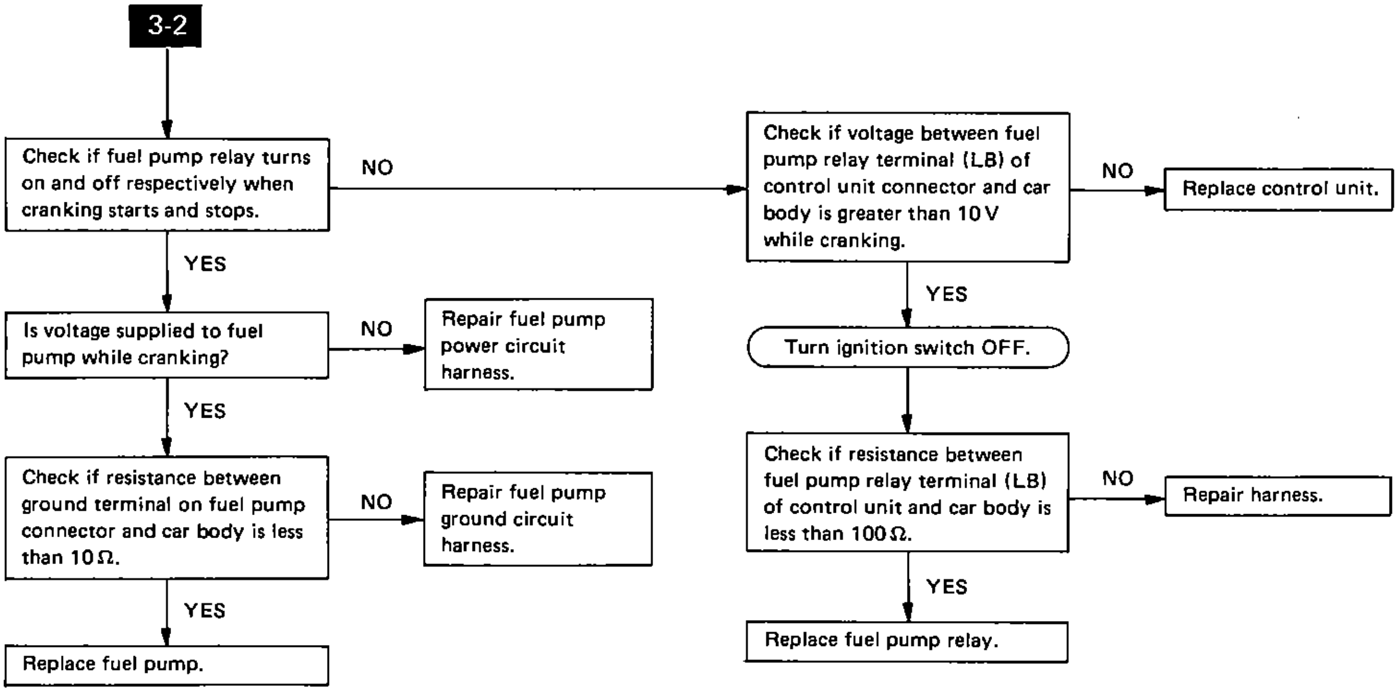


Fig. 56 L2-870


3-2
Check if fuel pump relay turns on and off respectively when cranking starts and stops.
NO
YES
Is voltage supplied to fuel pump while cranking?
NO
Repair fuel pump power circuit harness.
YES
Check if resistance between ground terminal on fuel pump connector and car body is less than 10 Ω.
NO
Repair fuel pump ground circuit harness.
YES
Replace fuel pump.
Check if voltage between fuel pump relay terminal (LB) of control unit connector and car body is greater than 10 V while cranking.
NO
Replace control unit.
YES
Turn ignition switch OFF.
Check if resistance between fuel pump relay terminal (LB) of control unit and car body is less than 100 Ω.
NO
Repair harness.
YES
Replace fuel pump relay.

TROUBLE CODE (11): CRANK ANGLE SENSOR

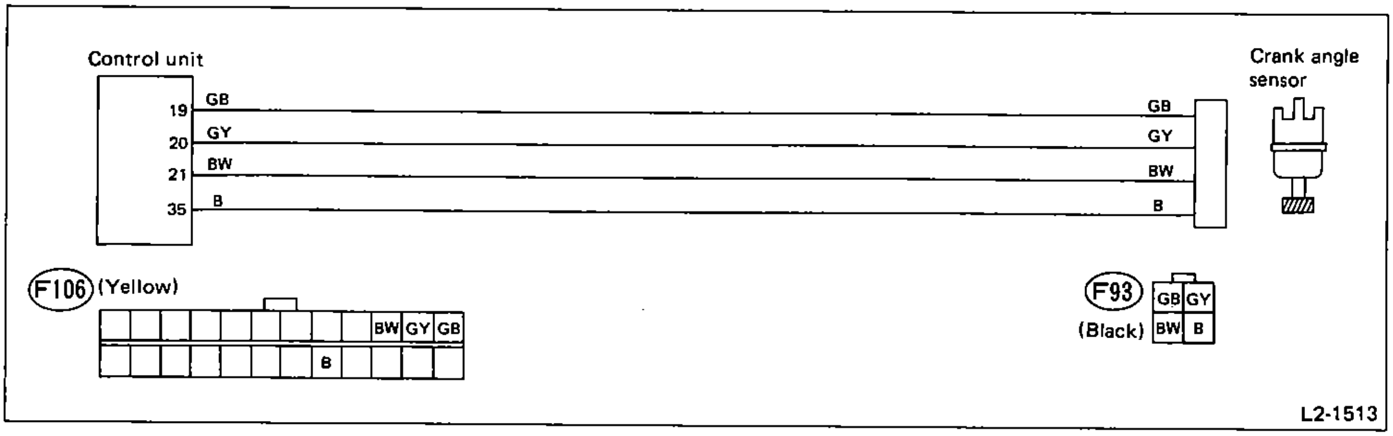


Fig. 57

Check if trouble code is outputted in D-check mode.
- NO → Check terminals of control unit connector. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).

Disconnect test mode connector.

Check if engine starts.
- YES → Check terminals (19), (20) and (35) of control unit connector for poor contact. (See page 40.)
- NO ↓

Turn ignition switch OFF.

Disconnect crank angle sensor connector.

Turn ignition switch ON (engine off).

Check if voltage across terminal (BW) of crank angle sensor connector (body side) and the body is greater than 4 V.
- NO → 11-1
- YES ↓

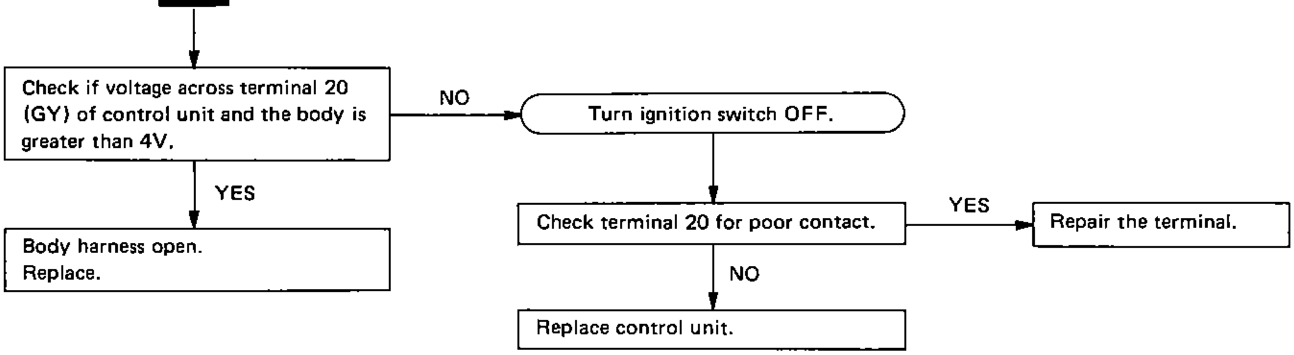
Check if voltage across terminal (GB) or connector (body side) and the body is greater than 10 V.
- NO → 11-2
- YES ↓

Check if continuity exists between terminal (B) of connector (body side) and the body.
- NO → 11-3
- YES ↓

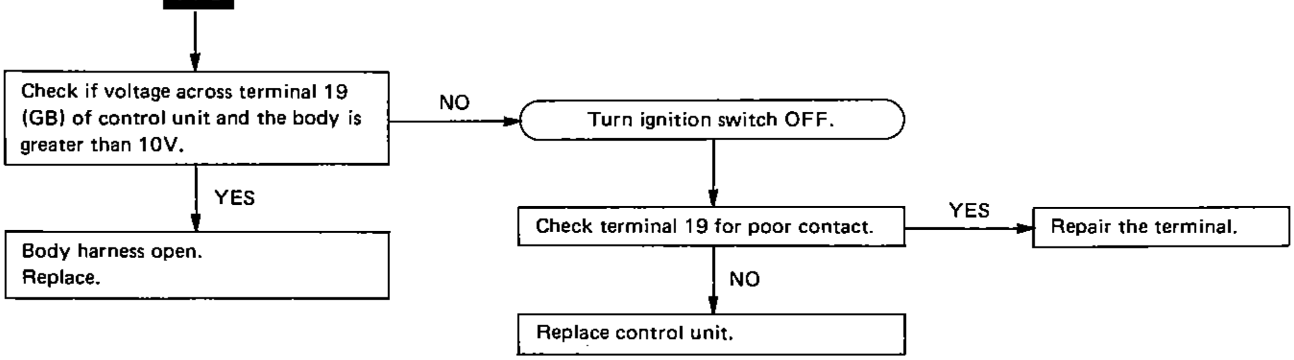
Check if female terminal of connector (body side) is open.
- YES → Repair terminal or replace body harness.
- NO ↓

Replace crank angle sensor.

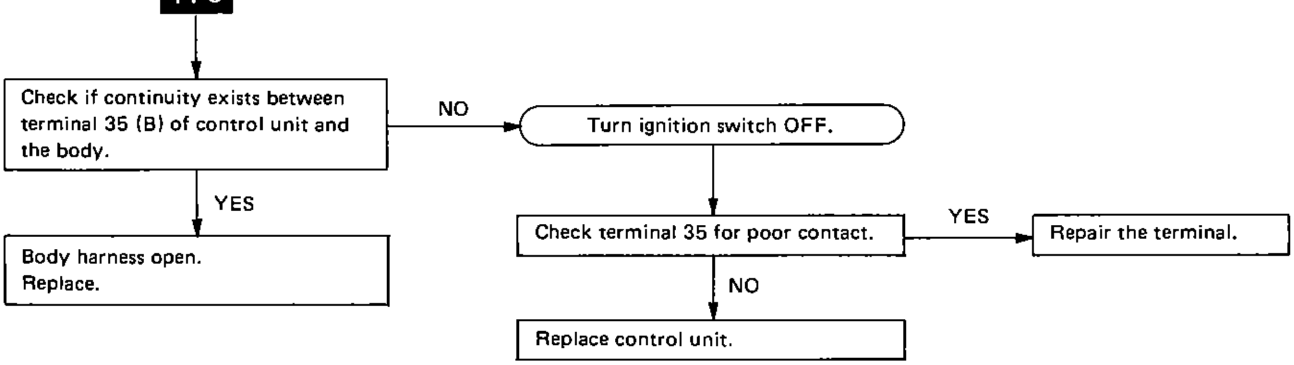
11-1


Check if voltage across terminal 20 (GY) of control unit and the body is greater than 4V.
NO
Turn ignition switch OFF.
YES
Body harness open. Replace.
Check terminal 20 for poor contact.
YES
Repair the terminal.
NO
Replace control unit.

11-2


Check if voltage across terminal 19 (GB) of control unit and the body is greater than 10V.
NO
Turn ignition switch OFF.
YES
Body harness open. Replace.
Check terminal 19 for poor contact.
YES
Repair the terminal.
NO
Replace control unit.

11-3


Check if continuity exists between terminal 35 (B) of control unit and the body.
NO
Turn ignition switch OFF.
YES
Body harness open. Replace.
Check terminal 35 for poor contact.
YES
Repair the terminal.
NO
Replace control unit.

TROUBLE CODE (12): STARTER SWITCH

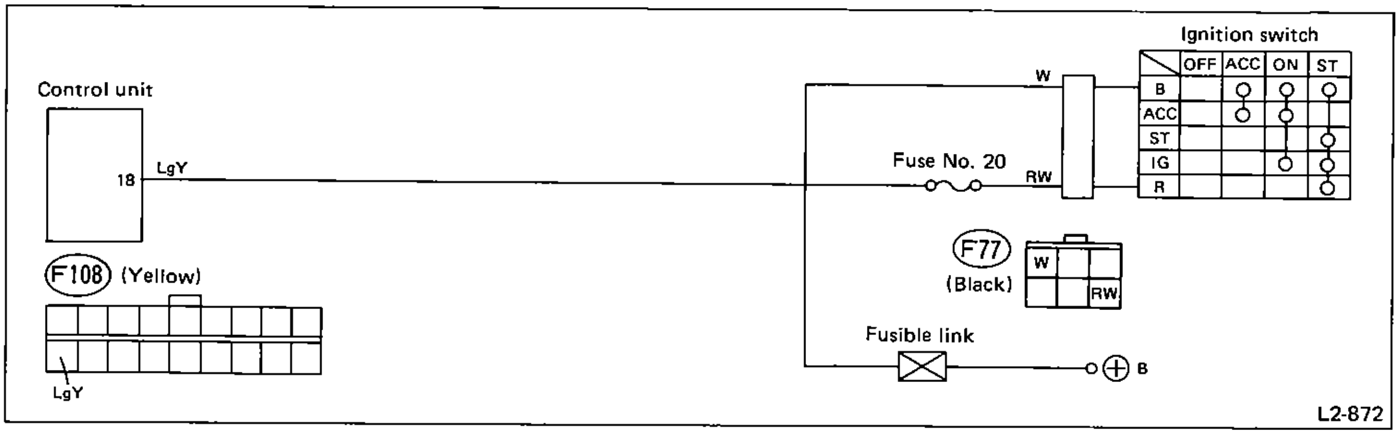


Fig. 58

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40.)
  - YES ↓
- Turn ignition switch OFF (engine off).
- Disconnect test mode connector.
- Turn ignition switch ON (engine off).
- Check if voltage across terminal 18 (LgY) of control unit and the body is less than 2 V.
  - NO → Turn ignition switch OFF. → Disconnect ignition switch connector. → Turn ignition switch ON (engine off). → Check if voltage across terminal 18 (LgY) of control unit and the body is less than 2 V.
    - YES → Repair harness.
    - NO → Replace ignition switch.
  - YES ↓
- Disconnect crank angle sensor connector.
- Turn ignition switch ON.
- Check if voltage across terminal 18 (LgY) of control unit and the body is greater than 4 V.
  - YES → Replace control unit.
  - NO → Turn ignition switch OFF. → Check if fuse blows.
    - YES → Replace fuse.
    - NO → Check if voltage across ignition switch terminal (R) and terminal 18 (LgY) of control unit is less than 10 V.
      - NO → Repair harness.
      - YES → Replace ignition switch.

TROUBLE CODE (13): CRANK ANGLE SENSOR

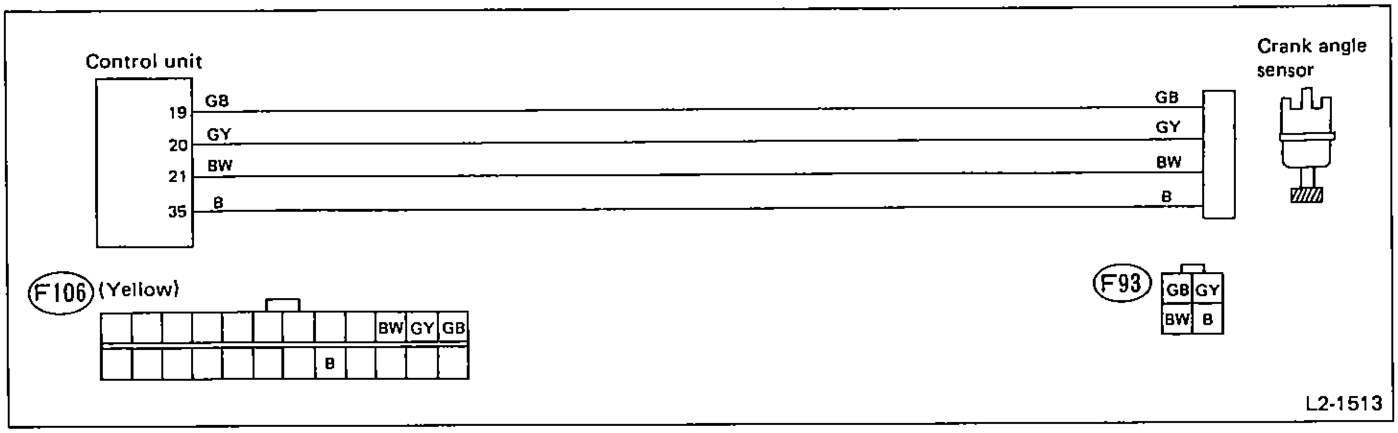


Fig. 59

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40.)
  - YES ↓
- Turn ignition switch OFF (engine off).
- Disconnect test mode connector.
- Check if engine starts.
  - YES → Check terminals (19), (21) and (35) of control unit connector for poor contact. (See page 40.)
  - NO ↓
- Turn ignition switch OFF.
- Disconnect crank angle sensor connector.
- Turn ignition switch ON (engine off).
- Check if voltage across terminal (BW) of crank angle sensor connector (body side) and the body is greater than 4 V.
  - NO → **13-1**
  - YES ↓
- Check if voltage across terminal (GB) of connector (body side) and the body is greater than 10V.
  - NO → **13-2**
  - YES ↓
- Check if continuity exists between terminal (B) of connector (body side) and the body.
  - NO → **13-3**
  - YES ↓
- Check if the female terminal of connector (body side) is open.
  - YES → Repair terminal or replace body harness.
  - NO ↓
- Replace crank angle sensor.

13-1

Check if voltage across terminal 21 (BW) of control unit and the body is greater than 4V.

- YES → Body harness open. Replace.
- NO → Turn ignition switch OFF. → Check terminal (21) for poor contact.
  - YES → Repair terminal.
  - NO → Replace control unit.

13-2

Check if voltage across terminal 19 (GB) of control unit and the body is greater than 10V.

- YES → Body harness open. Replace.
- NO → Turn ignition switch OFF. → Check terminal 19 for poor contact.
  - YES → Repair terminal.
  - NO → Replace control unit.

13-3

Check if continuity exists between terminal 35 (B) of control unit and the body.

- YES → Body harness open. Replace.
- NO → Turn ignition switch OFF. → Check terminal 35 for poor contact.
  - YES → Repair terminal.
  - NO → Replace control unit.

TROUBLE CODE (14): FUEL INJECTOR

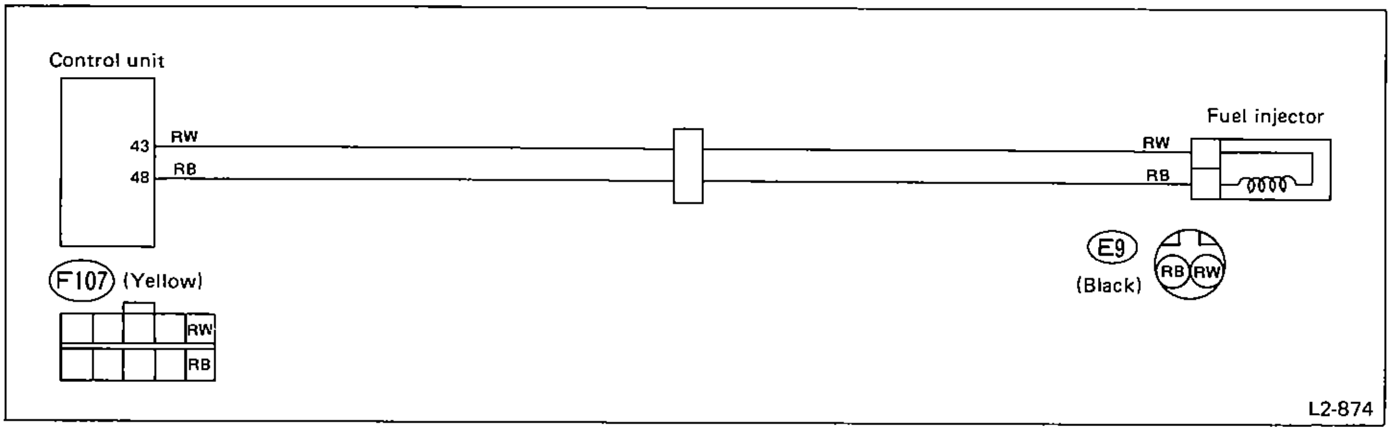


Fig. 60

Check if trouble code is outputted in D-check mode.
- NO → Check terminals of control unit. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).

↓

Disconnect test mode connector.

↓

Disconnect control unit connector.

↓

Check if resistance between terminals 43 (RW) and 48 (RB) of control unit connector (body side) is 0.5 – 2 Ω.
- YES → Check if terminals 43 and 48 are open or disconnected.
  - YES → Repair terminal or harness. → Check if resistance between terminals of injector connector (injector side) is 0.5 – 2 Ω.
  - NO → Replace control unit.
- NO → Disconnect fuel injector connector.
  ↓
  Check if resistance between terminals of injector connector (injector side) is 0.5 – 2 Ω.
  - NO → Replace fuel injector.
  - YES → Check if resistance between each terminal and body is greater than 1 MΩ.
    - NO → Replace fuel injector.
    - YES → Repair harness.

TROUBLE CODE (21): WATER TEMPERATURE SENSOR

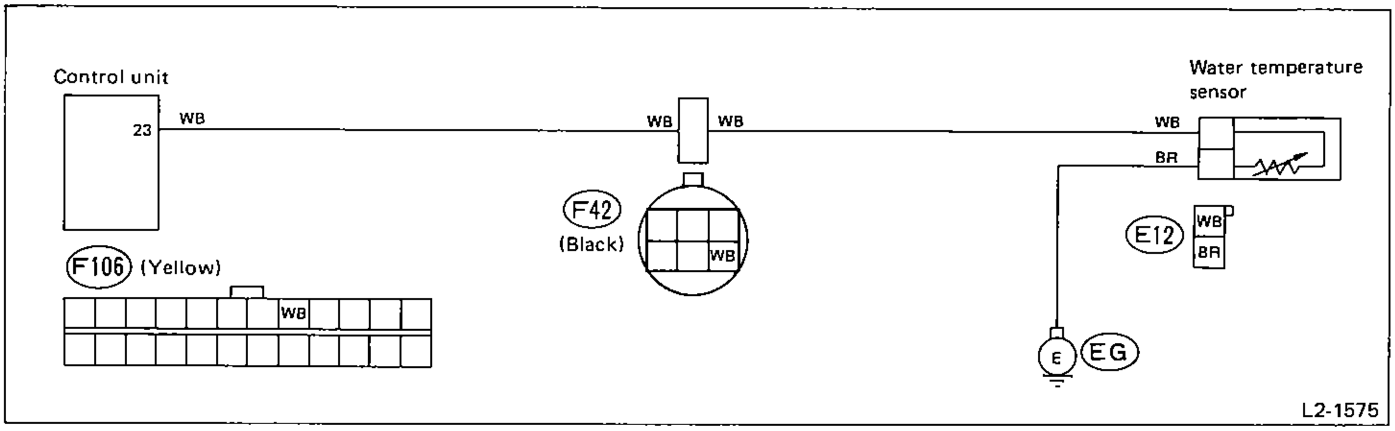


Fig. 61

Check if trouble code is outputted in D-check mode.
- NO → Check terminals of control unit. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).

↓

Disconnect test mode connector.

↓

Disconnect control unit connector.

↓

Check if resistance between terminal 23 (WB) of control unit connector (body side) is 100 Ω – 20 kΩ.
- NO → Disconnect water temperature sensor.
- YES ↓

Check female terminal 23 for poor contact.
- YES → Repair terminal or harness.
- NO ↓

Replace control unit.

Disconnect water temperature sensor.

↓

Check if resistance between terminals on sensor side is 100 Ω – 20 kΩ.
- NO → Replace water temperature sensor.
- YES ↓

Check if continuity exists between terminal (BR) of connector (body side) and body.
- NO → Repair engine harness.
- YES ↓

Connect water temperature sensor.

↓

Disconnect engine-to-body intermediate connector.

↓

Check if resistance between terminal (WB) of connector (engine side) and body is 100 Ω – 20 kΩ.
- NO → Repair engine harness.
- YES ↓

Repair body harness.

TROUBLE CODE (23): AIR FLOW METER

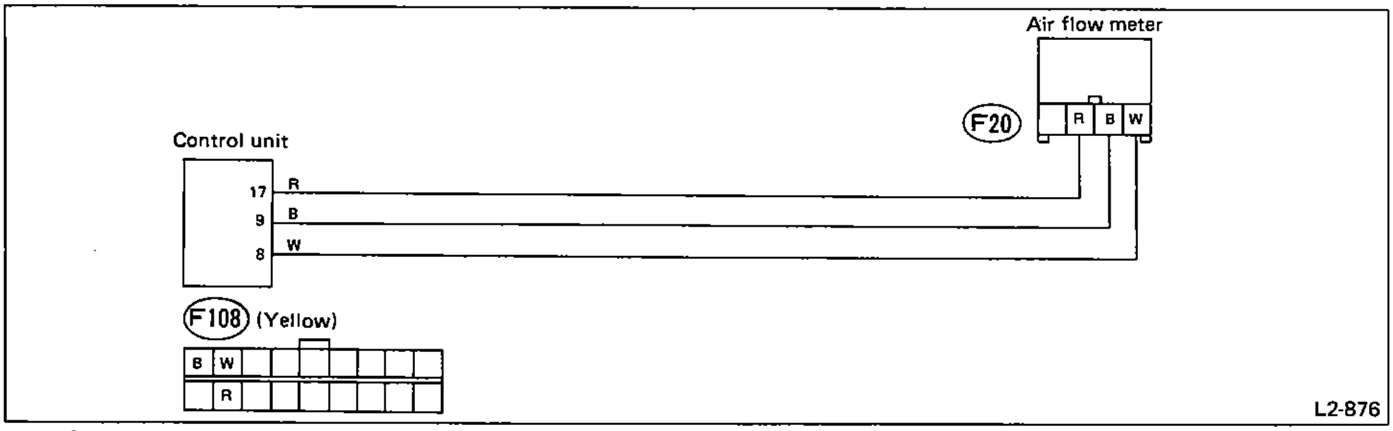


Fig. 62

*** Attach the tester check pin to the connector terminals on the side from which the rubber cover has been removed.**

Check if trouble code is outputted in D-check mode.
- NO → Check terminals of control unit. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).

↓

Disconnect test mode connector.

↓

Disconnect connector from air flow meter and remove rubber cover from connector.

↓

* Check if resistance between terminal (B) of connector and body is less than 10 Ω.
- NO → Check if resistance between terminal 9 (B) of control unit connector and body is less than 10 Ω (with control unit connector connected).
  - YES → Repair harness.
  - NO ↓ Disconnect control unit connector.
    ↓ Check if terminal 9 of control unit connector (body side) is open or disconnected.
    - YES → Repair terminal or harness.
    - NO ↓ Replace control unit.
- YES ↓

Turn ignition switch ON (engine off).

↓

* Check if voltage across terminal (R) of connector and body is greater than 10 V.
- NO → Check if voltage across terminal 17 (R) of control unit connector and body is greater than 10 V (with control unit connector connected).
  - YES ↓ Repair harness.
  - NO ↓ Turn ignition switch OFF (engine off).
    ↓ Disconnect control unit connector.
    ↓ Check if terminal 17 of connector (body side) is open or disconnected.
    - YES ↓ Repair terminal or harness.
- YES ↓

Connect connector to air flow meter.

↓

* Check if voltage across terminals (W) and (B) of connector is 0.1 – 0.5 V.
- NO → Replace air flow meter.
- YES ↓

Remove upper side of air cleaner and air flow meter as a unit.

↓

Blow air into air flow meter from air cleaner side to check if voltage across terminals (W) and (B) increases.
- NO → Replace air flow meter.
- YES ↓

Check if voltage across terminal No. 8 (W) of control unit connector and body is 0.1 – 0.5 V.
- NO → Repair harness.
- YES ↓

Replace control unit.

TROUBLE CODE (24): AIR CONTROL VALVE

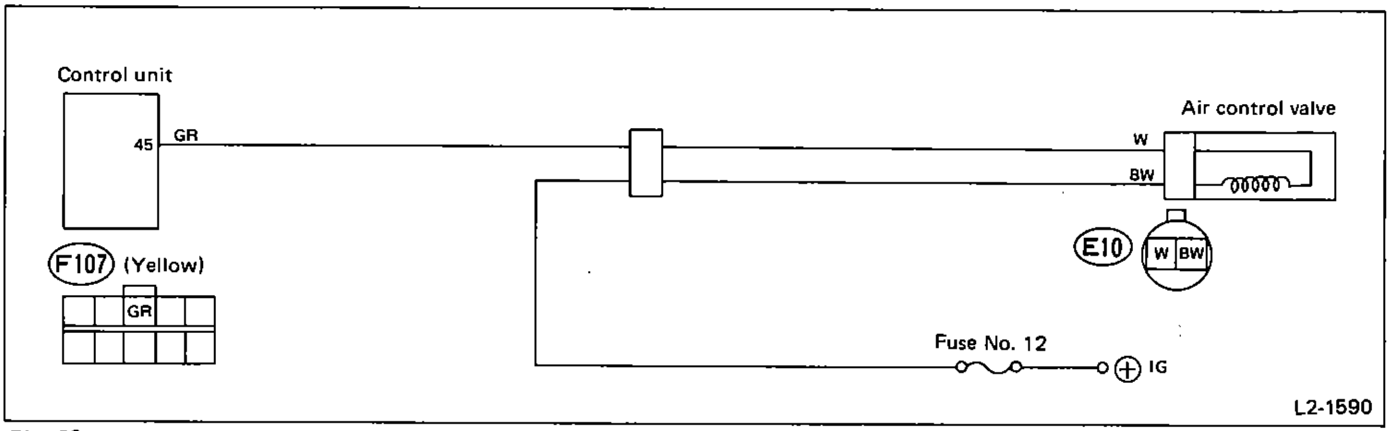


Fig. 63

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40.)
  - YES ↓
- Turn ignition switch OFF (engine off).
- Disconnect test mode connector.
- Monitor voltage across air control valve terminal (W) of control unit connector and body.
- Turn ignition switch ON (engine off).
- Check if monitor voltage remains below 1 V for approximately 1 minute after ignition switch is turned on.
  - NO → Disconnect control unit connector.
    - Check if terminal (W) of control unit connector (body side) is open or disconnected.
      - YES → Repair terminal or harness.
      - NO → Replace control unit.
  - YES ↓
- Check if monitor voltage exceeds 10 V about 1 minute after turning ignition switch on.
  - YES → Replace control unit.
  - NO → Disconnect air control valve connector.
    - Is voltage between power terminal (BW) of air control valve connector (body side) and car body greater than 10 V?
      - NO → Repair harness.
      - YES ↓
    - Is resistance across air control valve connector (valve side) less than 100 Ω?
      - NO → Replace air control valve.
      - YES ↓
    - Is resistance between one terminal of air control valve connector (valve side) and car body greater than 1 MΩ?
      - NO → Replace air control valve.
      - YES ↓
    - Disconnect control unit connector (10-pole).
    - Connect air control valve connector.
    - Check if resistance between air valve terminal (W) of control unit and body is less than 100 Ω.
      - NO → Replace control unit.
      - YES → Repair harness.

TROUBLE CODE (31): THROTTLE SENSOR

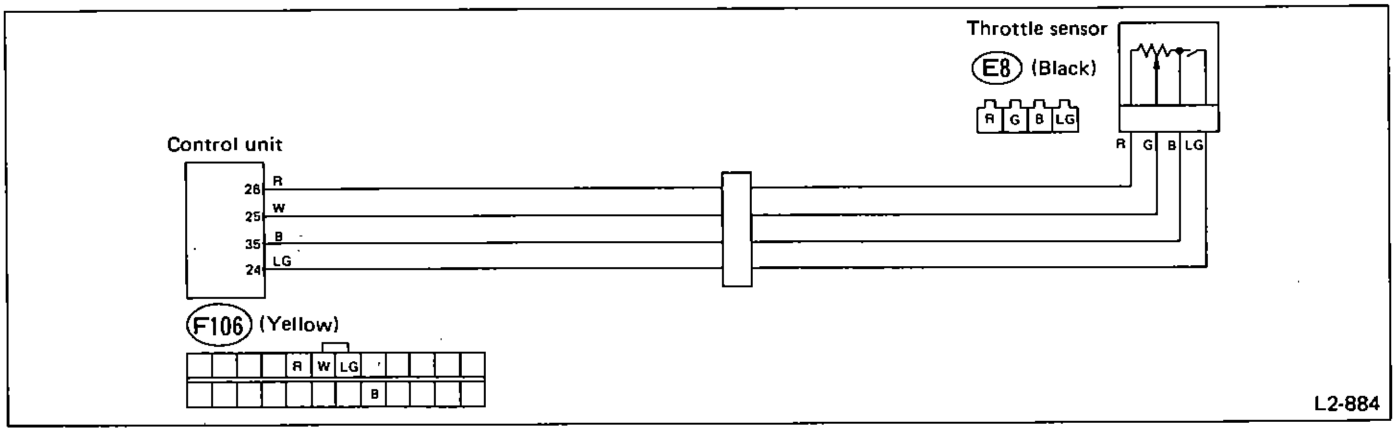


Fig. 64

1. Check if trouble code is outputted in D-check mode.
   - NO → Check control unit terminals. (See page 40.)
   - YES ↓
2. Turn ignition switch OFF (engine off).
3. Disconnect test mode connector.
4. Disconnect control unit connector.
5. Check if resistance between terminals 26 (R) and 35 (B) of control unit connector is 3.5 – 6.5 kΩ.
   - NO → Disconnect throttle sensor connector. → Check if resistance between terminals B and D is 3.5 – 6.5 kΩ.
     - NO → Replace throttle sensor.
     - YES → Repair harness.
   - YES ↓
6. Check if resistance between terminals 25 (W) and 35 (B) is less than 1 kΩ (when throttle is fully closed) and greater than 2.4 kΩ (when throttle is fully open).
   - NO → Disconnect throttle sensor connector. → Check if resistance between terminals B and C is less than 1 kΩ (when throttle is fully closed) and greater than 2.4 Ω (when throttle is fully open).
     - YES → Repair harness.
     - NO → Replace throttle sensor.
   - YES ↓
7. Check if terminals 25, 26 and 35 are open or disconnected.
   - NO → Replace control unit.
   - YES → Repair terminal or harness.

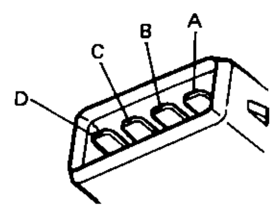


Fig. 65 L2-870

TROUBLE CODE (32): O_2 SENSOR

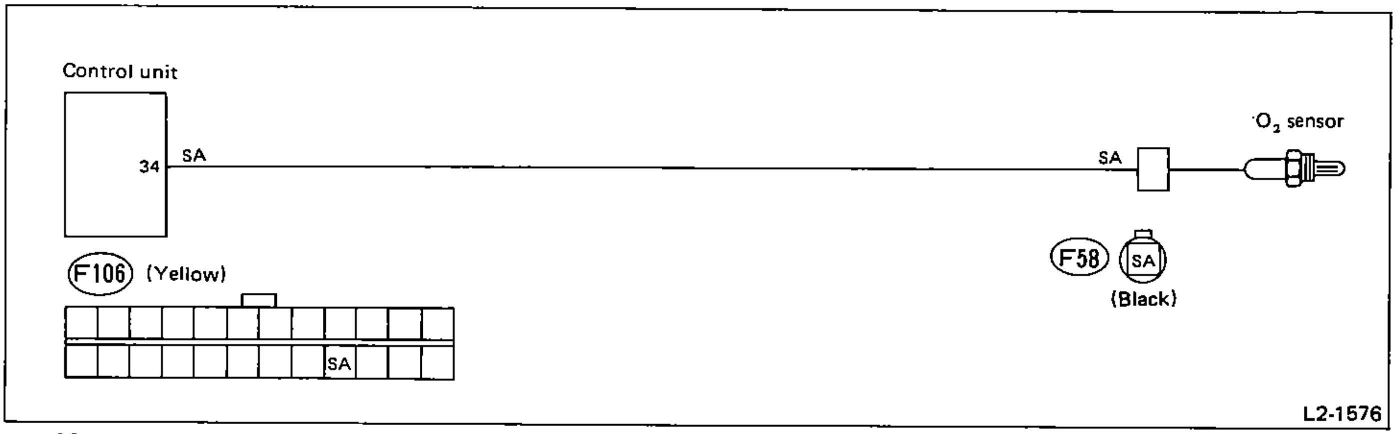


Fig. 66

Check if trouble code is outputted in D-check mode.

NO → Check terminals of control unit. (See page 40.)

YES ↓

Turn ignition switch OFF (engine off).

↓

Disconnect test mode connector.

↓

Turn ignition switch ON (engine off).

↓

Disconnect O_2 sensor connector.

↓

Is voltage between O_2 sensor connector and car body greater than 0.1 V?

YES → Replace O_2 sensor.

NO ↓

Check if voltage between control unit connector (24-pole) O_2 sensor signal terminal (SA) and car body is greater than 0.1 V.

NO → Replace control unit.

YES ↓

Repair harness.

TROUBLE CODE (33): SPEED SENSOR

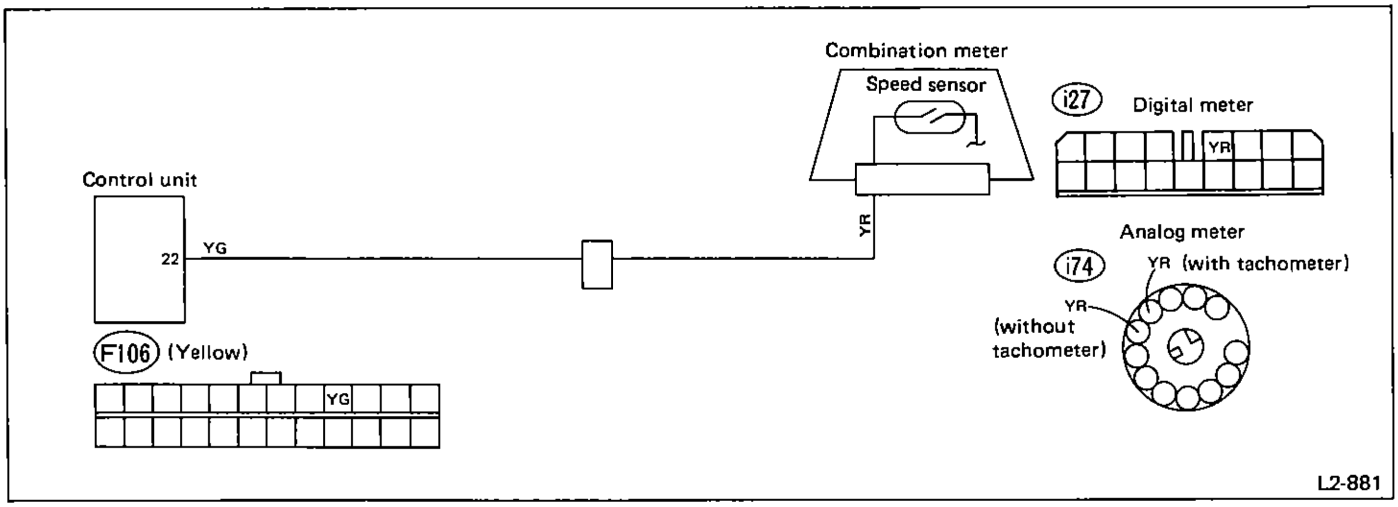


Fig. 3

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40)
  - YES ↓
- Turn ignition switch OFF (engine off).
- Disconnect test mode connector.
- Turn ignition switch ON (engine on).
- Check if voltage fluctuates above and below 2 V by slowly moving the car while monitoring voltage across speed signal terminal (YG) of control unit and body.
  - YES → Replace control unit.
  - NO ↓
- Is voltage between speed signal terminal (YG) of control unit and car body greater than 2 V?
  - YES ↓
    - Disconnect combination meter.
    - Is voltage between combination meter connector car speed signal terminal (YR) and car body greater than 2 V?
      - YES → Replace speedometer for analog meter or computer/body ASSY for digital meter.
      - NO → Repair harness.
  - NO →
    - Turn ignition switch OFF (engine off).
    - Disconnect combination meter.
    - Is resistance between speed signal terminal (YG) of control unit and car body less than 10 Ω.
      - NO → Replace speedometer for analog meter or computer/body ASSY for digital meter.
      - YES → Repair harness.

TROUBLE CODE (34): EGR SOLENOID VALVE

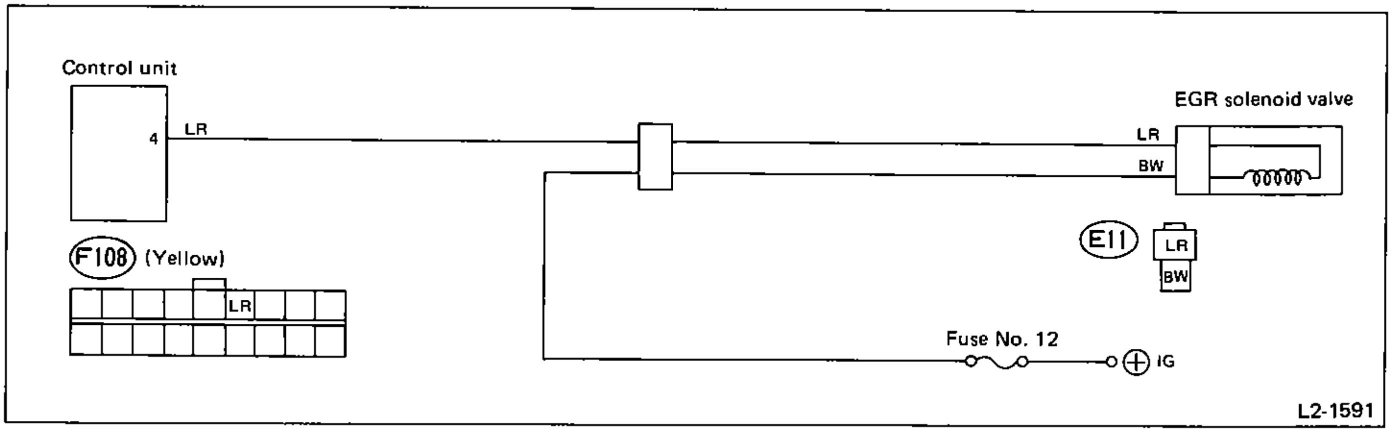
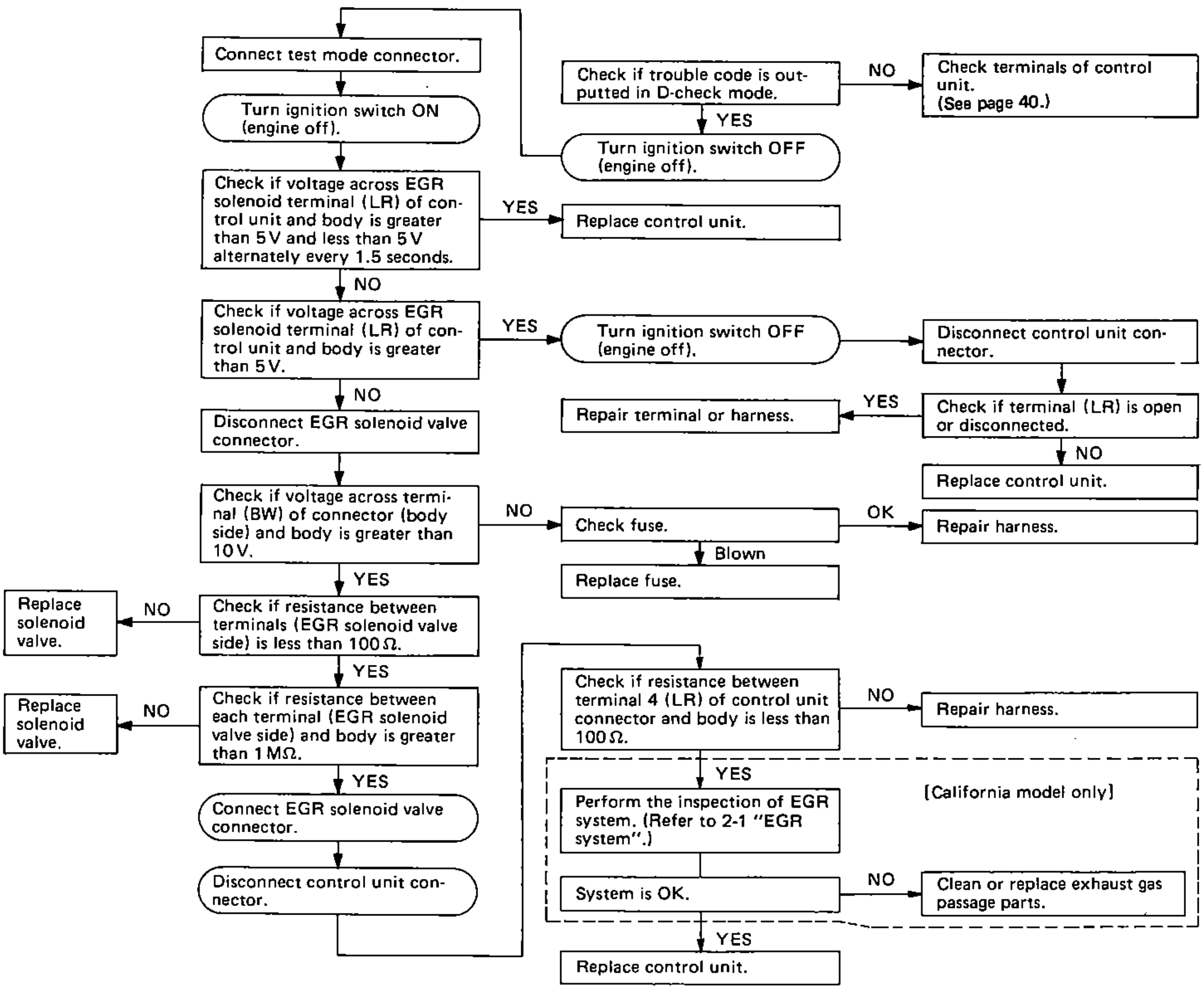


Fig. 68



TROUBLE CODE (35): PURGE CONTROL SOLENOID VALVE

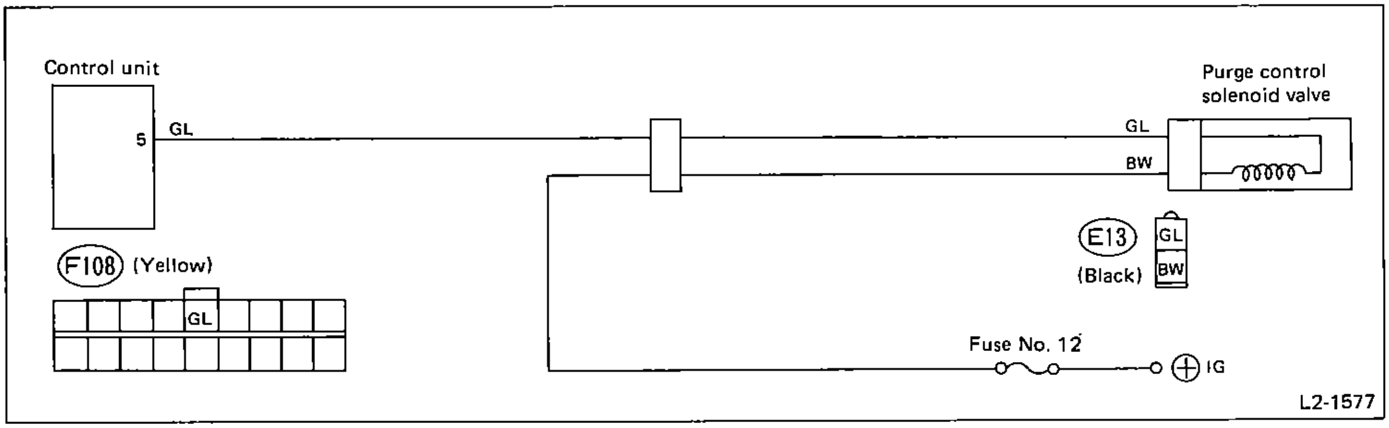
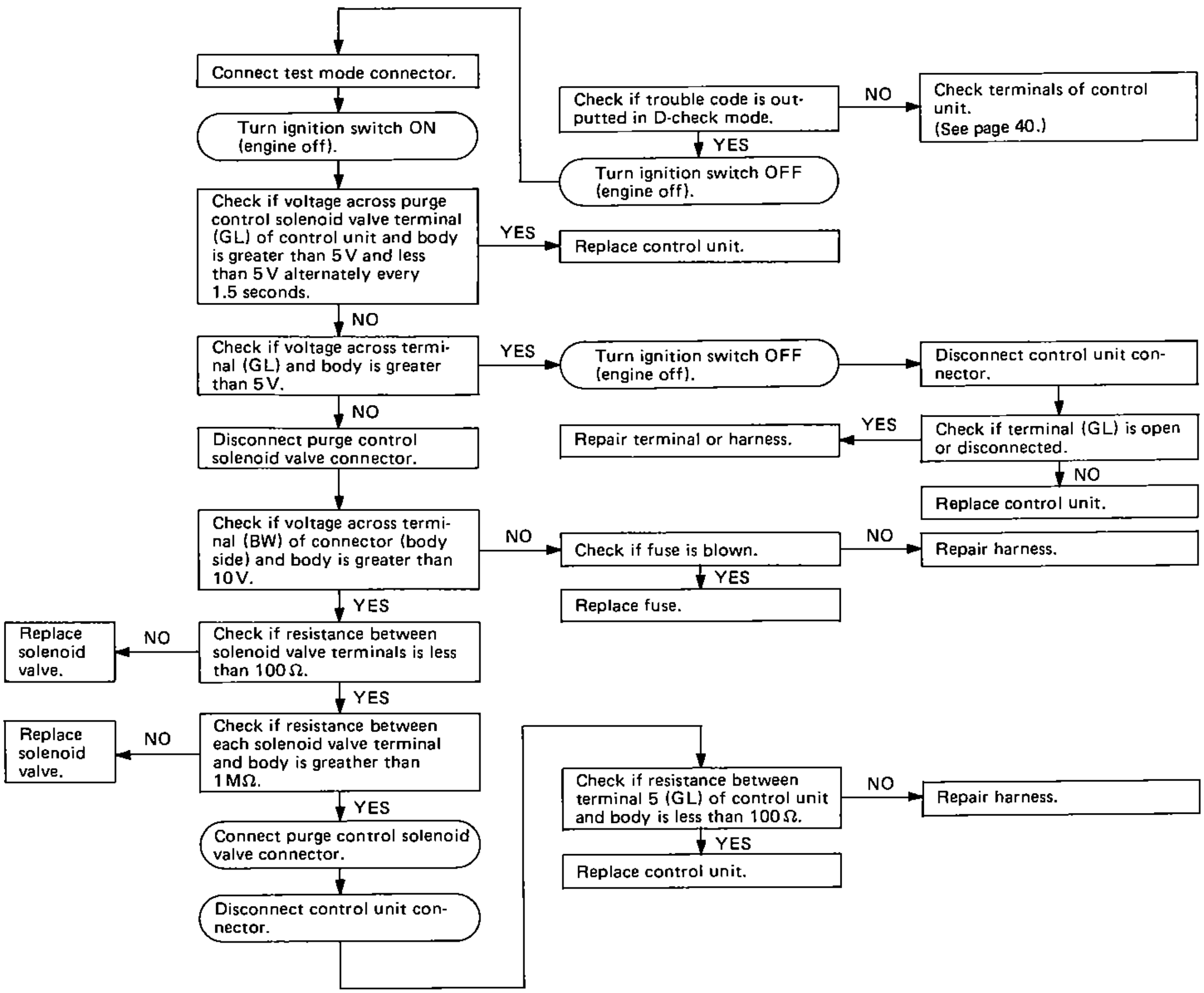


Fig. 69



TROUBLE CODE (42): IDLE SWITCH

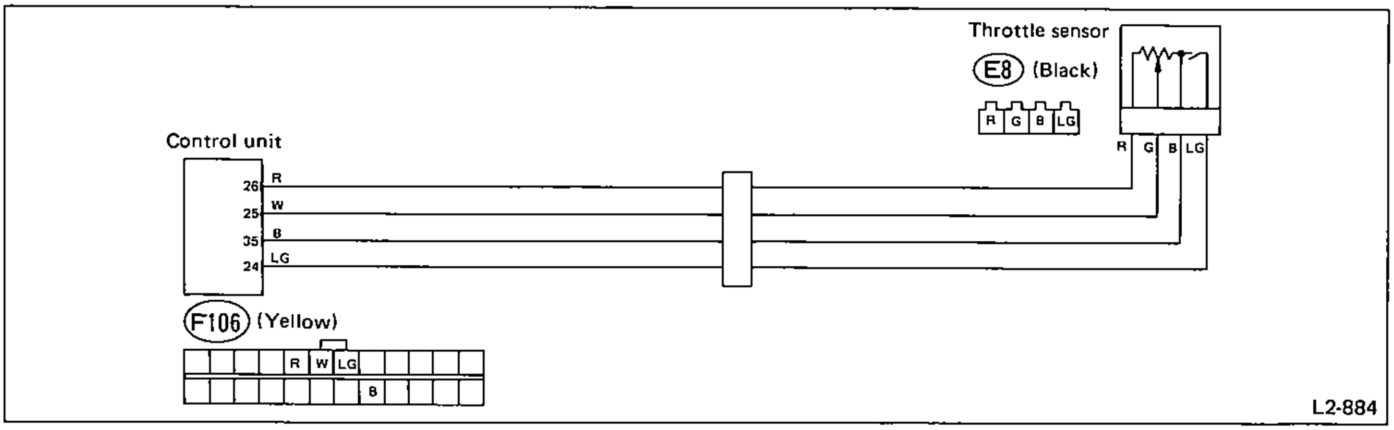


Fig. 70

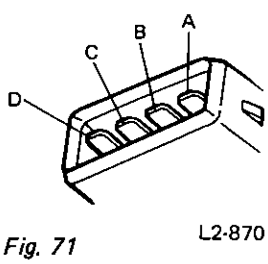


Fig. 71

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40.)
  - YES → Turn ignition switch OFF (engine off). → Disconnect test mode connector. → Disconnect control unit connector.
- Check if continuity exists between terminals 24 (LG) and 35 (B) of connector (body side) when accelerator pedal is released and does not exist when accelerator pedal is depressed.
  - YES → Check if terminals 24 and 35 are open or disconnected.
    - NO → Replace control unit.
    - YES → Repair terminal or harness.
  - NO → Disconnect throttle sensor connector.
- Check if continuity exists between terminals A and B of connector (throttle sensor side) when accelerator pedal is released.
  - NO → Adjust throttle sensor as outlined under "Idle contact" on page 14. → Check if continuity exists when accelerator pedal is released.
    - NO → Replace throttle sensor.
    - YES → Check if there is no continuity when accelerator pedal is depressed.
  - YES → Check if there is no continuity when accelerator pedal is depressed.
- Check if there is no continuity when accelerator pedal is depressed.
  - NO → Replace throttle sensor.
  - YES → Repair harness.

TROUBLE CODE (45): KICK-DOWN CONTROL RELAY

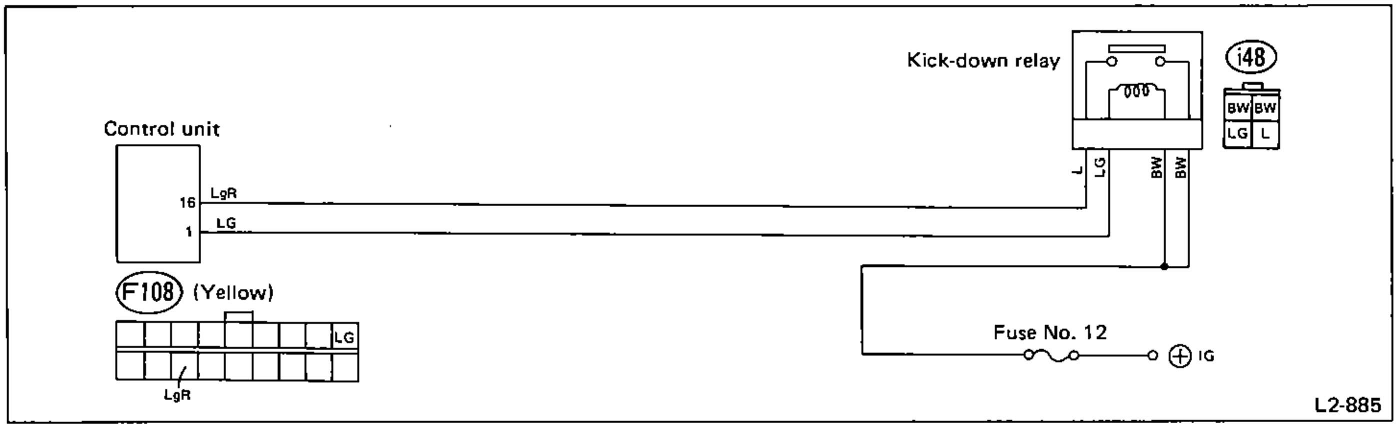


Fig. 72

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40.)
  - YES → Turn ignition switch OFF (engine off). → Connect test mode connector. → Turn ignition switch ON (engine off). → Disconnect control unit connector. → Check if voltage across terminal 1 (LG) of connector (body side) and body is greater than 10 V.
- Check if voltage across terminal 1 (LG) of connector (body side) and body is greater than 10 V.
  - NO → Disconnect kick-down relay connector. → Check if voltage across terminal (BW) of connector (body side) and body is greater than 10 V.
    - NO → Repair harness from ignition switch to relay.
    - YES → Check if continuity exists between terminals (BW) and (LG) of relay and their corresponding terminals.
      - NO → Replace relay.
      - YES → Repair harness from relay to control unit.
  - YES → Connect control unit connector. → Check if voltage across terminal 1 (LG) and body is less than 1 V.
    - NO → Disconnect control unit connector. Check if terminal 1 is open or disconnected.
      - NO → Replace control unit.
      - YES → Repair terminal or harness.
    - YES → Check if relay operates properly when ignition switch is repeatedly turned ON and OFF.
      - NO → Replace relay.
      - YES → Disconnect kick-down relay connector. → Check if continuity exists between terminal (L) of connector (body side) and body.
        - NO → Repair harness.
        - YES → Disconnect control unit connector. → Check if continuity exists between terminal 16 (LgR) of connector (body side) and body.
          - NO → Repair harness.
          - YES → Check if terminal 16 is open or disconnected.
            - YES → Repair terminal or harness.
            - NO → Replace control unit.

TROUBLE CODE (51): NEUTRAL SWITCH [MT]

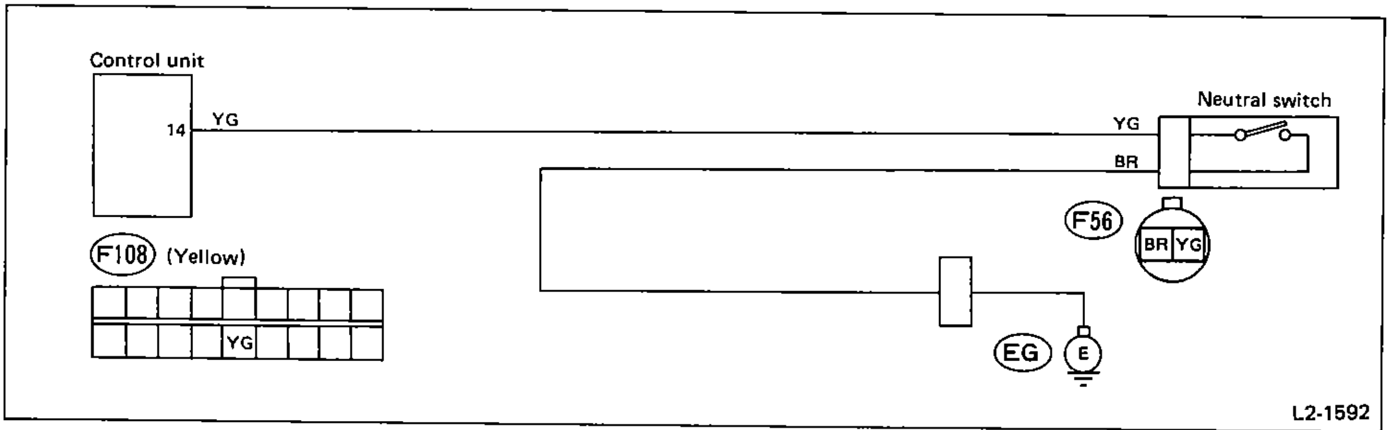


Fig. 73

Check if trouble code is outputted in D-check mode.

- NO → Check terminals of control unit. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).

↓

Disconnect test mode connector.

↓

Disconnect control unit connector.

↓

Check if continuity exists between terminal 14 (YG) of control unit connector (body side) and body when switch is in each position except Neutral.

- NO → Replace control unit.
- YES ↓

Connect control unit connector.

↓

Disconnect neutral switch connector.

↓

Check if resistance between body connector terminal (YG) and body is greater than 1 MΩ.

- NO → Repair harness.
- YES ↓

Replace neutral switch.

TROUBLE CODE (51): NEUTRAL SWITCH [AT]

Fig. 74

Check if trouble code is outputted in D-check mode.
- NO → Check terminals of control unit. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).
↓
Disconnect test mode connector.
↓
Disconnect control unit connector.
↓

Check if continuity exists between terminal 14 (YG) and body when select lever is in each position except Neutral.
- NO → Replace control unit.
- YES ↓

Disconnect position switch connector.
↓

Check if continuity exists between terminal (YG) of position switch connector and body when select lever is in each position except Neutral.
- NO → Repair harness.
- YES ↓

Replace position switch.

TROUBLE CODE (55): EGR GAS TEMPERATURE SENSOR [California model only]

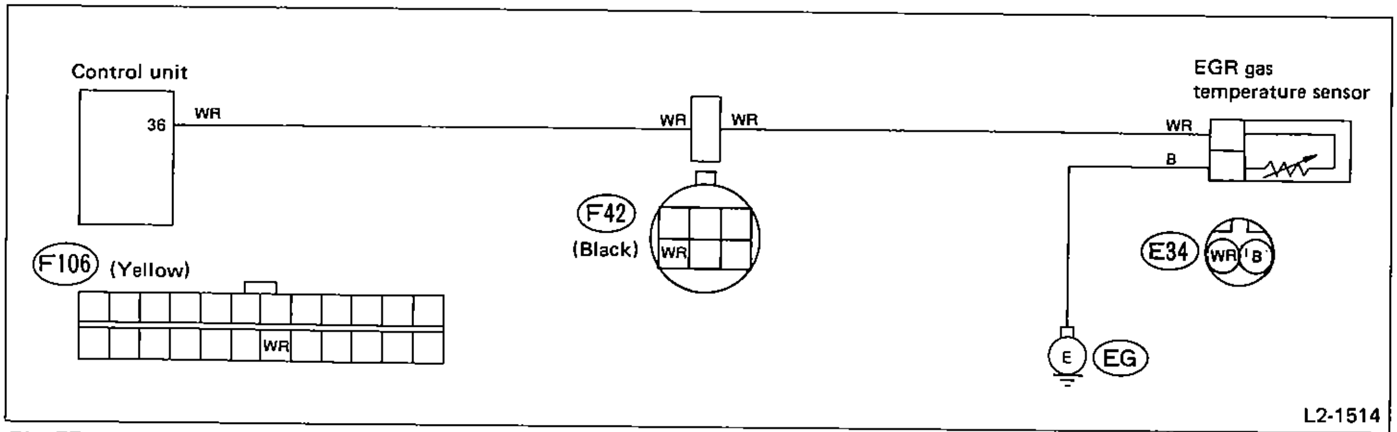


Fig. 75

- Check if trouble code is outputted in D-check mode.
  - NO → Check terminals of control unit. (See page 40.)
  - YES → Turn ignition switch OFF (engine off).
- Disconnect test mode connector.
- Disconnect control unit connector.
- Check if resistance between terminal 36 (WR) of control unit connector (body side) is above 250 Ω and continuity exists.
  - YES → Check female terminal 36 for poor contact.
    - YES → Repair terminal or harness.
    - NO → Replace control unit.
  - NO → Disconnect EGR gas temperature sensor.
- Check if resistance between terminals on sensor side is above 250 Ω and continuity exists.
  - NO → Replace EGR gas temperature sensor.
  - YES → Check if continuity exists between terminal (BR) of connector (body side) and body.
    - NO → Repair engine harness.
    - YES → Connect EGR gas temperature sensor.
- Disconnect engine-to-body intermediate connector.
- Check if resistance between terminal (WR) of connector (engine side) and body is above 250 Ω and continuity exists.
  - NO → Repair engine harness.
  - YES → Repair body harness.

TROUBLE CODE (61): PARKING SWITCH [AT]

Fig. 76

Check if trouble code is outputted in D-check mode.
- NO → Check terminals of control unit. (See page 40.)
- YES ↓

Turn ignition switch OFF (engine off).

↓

Disconnect test mode connector.

↓

Disconnect control unit connector.

↓

Check if continuity exists between terminal 15 (YL) and body when select lever is in each position except "P".
- NO → Replace control unit.
- YES ↓

Disconnect position switch connector.

↓

Check if continuity exists between terminal (YL) of position switch connector and body when select lever is in each position except "P".
- NO → Repair harness.
- YES ↓

Replace position switch.

Troubleshooting Table for Throttle Chamber

1. Fuel leakage	
1) Damaged O-ring in fuel injector	Replace O-ring
2) Damaged O-ring in pressure regulator	Replace O-ring
3) Damaged gasket or loose screws	Replace gasket or tighten screws
4) Pressure regulator vacuum sensing hose out of place or cracked	Install or replace hose
2. No fuel is injected	
When fuel injector drive signal is normal and fuel pump and fuel line are in good condition	
1) Lead wire broken or improperly contacting in fuel injector	Replace fuel injector ASSY
2) Fuel injector seized	Repair cause of seizure and replace fuel injector ASSY
3) Pressure regulator regulating pressure too low	Replace pressure regulator ASSY
3. Excessive fuel consumption	
When fuel line (especially return circuit) is normal and both control system and ignition system are in good condition	
1) Pressure regulator regulating pressure too high	Replace pressure regulator ASSY
2) Fuel leaks	Refer to "Fuel leakage" in item 1 above
3) Throttle sensor improperly adjusted or abnormal output signal	Adjust or replace throttle sensor
4. Rough idle	
When fuel pump, fuel line, control system, ignition system and resistance are normal	
1) Damaged gasket or screws loose	Replace gasket or tighten screws
2) Pressure regulator vacuum sensing hose out of place or cracked	Install or replace hose
3) Improperly set or malfunctioning idle switch	Adjust or replace throttle sensor
4) Lead wire broken or improperly contacting in air control valve	Replace air control valve ASSY
5) Foreign matter in air control valve metering unit or contamination	Remove foreign matter or replace air control valve ASSY
6) Fuel injector nozzle tip contaminated or deformed	Clean or replace injector ASSY
7) Fuel injector filter clogged	Replace injector
8) Pressure regulator regulating pressure too low or unstable	Replace pressure regulator ASSY
9) Throttle chamber throttle valve orifice clogged	Clean

5. Engine lacks power and/or high-speed performance	
When fuel pump, fuel line, control system, ignition system and intake system are in good condition	
1) Pressure regulator regulating pressure too low	Replace pressure regulator ASSY
2) Fuel injector filter clogged	Replace fuel injector
3) Throttle sensor out of adjustment or abnormal output signal	Adjust or replace throttle sensor
4) Gasket damaged or screws loose	Replace gasket or tighten screws
5) Pressure regulator vacuum sensing hose out of place or cracked	Install or replace hose

6. Hesitation and/or insufficient acceleration performance	
When fuel pump, fuel line, control system, ignition system and intake system are in good condition	
1) Throttle sensor output signal abnormal	Replace throttle sensor ASSY
2) Pressure regulator regulating pressure too low	Replace pressure regulator ASSY
3) Fuel injector filter clogged	Replace fuel injector
4) Damaged gasket or screws loose	Replace gasket or tighten screws
5) Pressure regulator vacuum sensing hose out of place or cracked	Install or replace hose

7. Hard starting in cold weather	
When fuel pump, fuel line, control system and ignition system are in good condition	
1) Lead wire broken or improperly contacting in air control valve	Replace air control valve ASSY
2) Foreign matter caught in air control valve metering unit or contamination	Remove foreign matter or replace air control valve ASSY
3) Fuel injector filter clogged	Replace fuel injector
4) Pressure regulator regulating pressure too low	Replace pressure regulator ASSY
5) Throttle chamber throttle valve orifice clogged	Clean

Multi Point Fuel Injection System

MECHANISM AND FUNCTION

General

The Multi Point Fuel Injection (MPFI) system is a system that supplies the optimum air-fuel mixture to the engine for all the various operating conditions through the use of the latest electronic technology.
With this system fuel, which is pressurized at a constant pressure, is injected into the intake air passage of the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where the electro-magnetic injection valve (fuel injector) opens only for a short period of time, depending on the quantity of air required for one cycle of operation. In actual operation, the injection quantity is determined by the duration of an electric pulse applied to the fuel injector and this permits simple, yet highly precise metering of the fuel.
Further, all the operating conditions of the engine are converted into electric signals, and this results in additional features of the system, such as large improved adaptability, easier addition of compensating element, etc. The MPFI system also has the following features:

1) Reduced emission of harmful exhaust gases.
2) Reduced in fuel consumption.
3) Increased engine output.
4) Superior acceleration and deceleration.
5) Superior startability and warm-up performance in cold weather since compensation is made for coolant and intake air temperature.
6) Good matching with turbocharger.

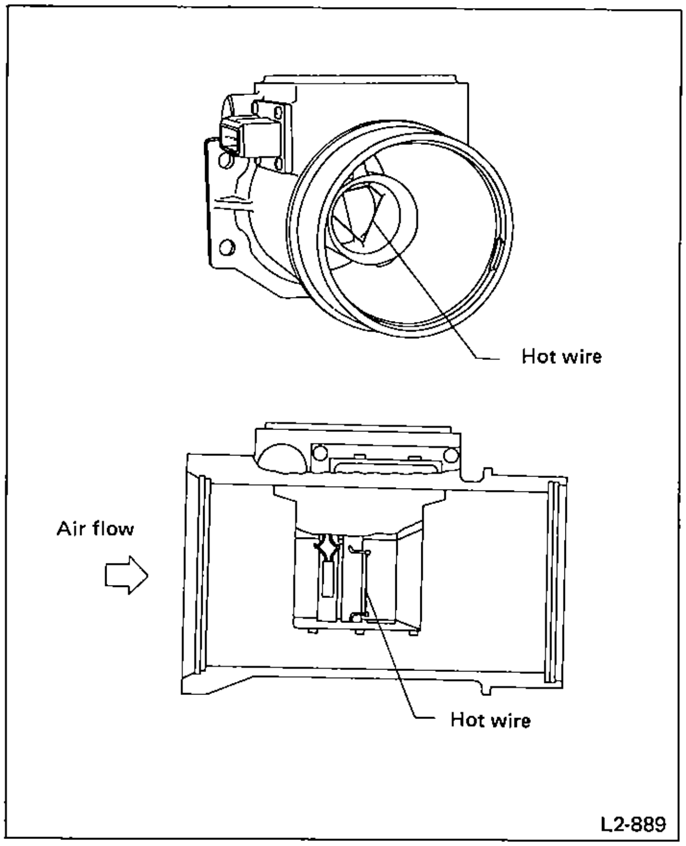


Fig. 77

Air Flow Meter

The MPFI TURBO system employs a hot-wire type air flow meter.
This air flow meter converts the amount of air taken into the engine into an electric signal by utilizing the heat transfer phenomenon between the incoming air and a heating resistor (hot wire) located in the air intake.
The features of this flow meter type are as follows:

1) High-altitude compensation is made automatically.
2) Quick response.
3) There are no moving parts.
4) It is compact.

Throttle Body

In response to the depressing stroke of the throttle pedal, the throttle body opens/closes its valve to regulate the air volume to be taken in the combustion chamber. Negative pressure (positive pressure at supercharging) generated according to the opening of the throttle valve is applied to the pressure ports for EGR control and canister purge. This pressure is used for controlling EGR valve and canister purge.
During idling, the throttle valve is almost fully closed and the air flow through the body is less than that passing through the carburetor. More than half of the air necessary for idling is supplied to the intake manifold via the idle bypass passage.
Turning the idle adjust screw on the idle bypass passage can change the air flow to adjust the number of revolutions in idling. Further, to prevent the number of revolutions from decreasing while the air conditioner is turned on, the fast idle bypass passage is provided which has the valve operated by the fast idle solenoid.

The fast idle engine rpm can be adjusted by turning the fast idle adjusting screw.

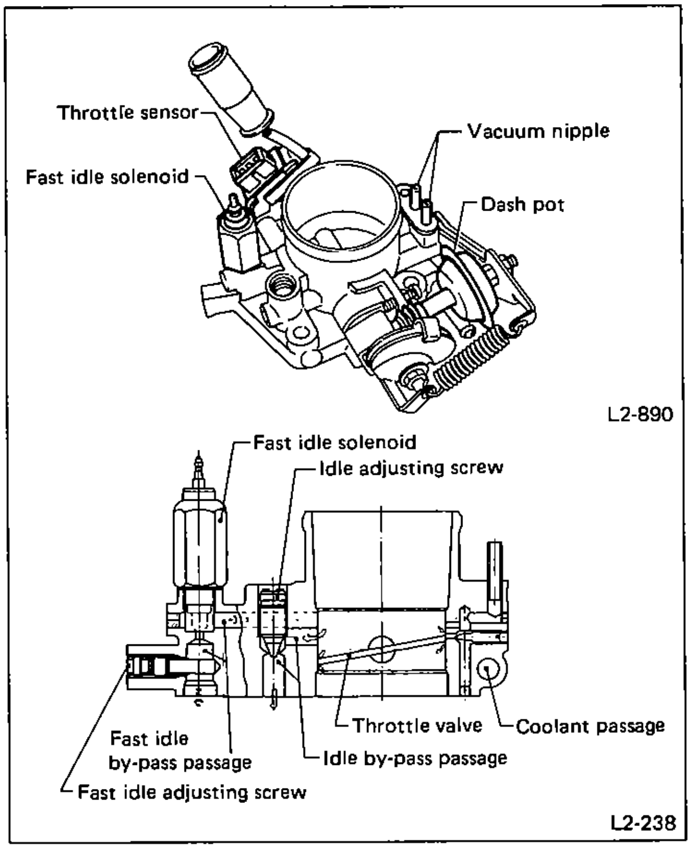


Fig. 78

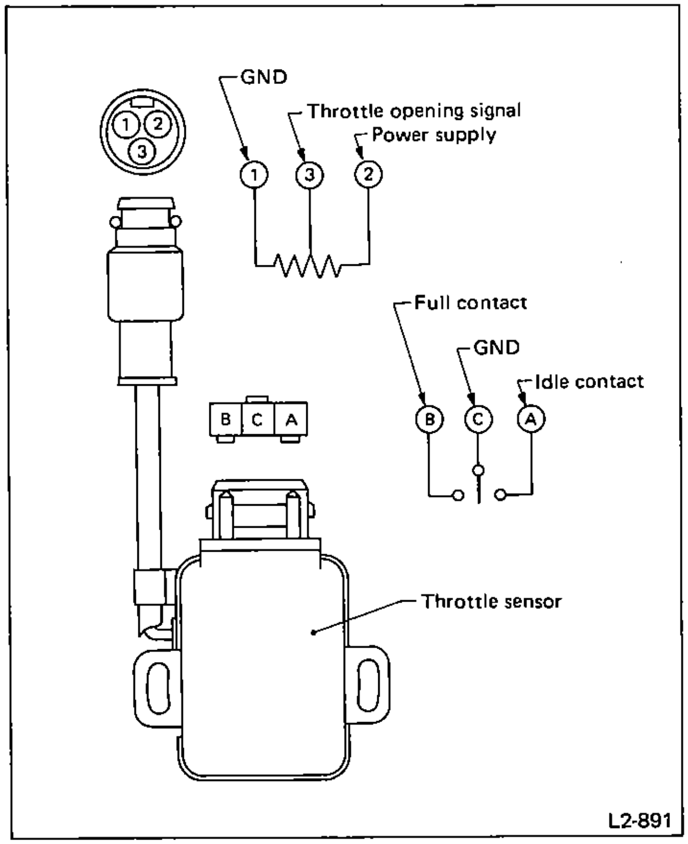


Fig. 79

THROTTLE SENSOR SYSTEM

A throttle position sensor is provided with a potentiometer and idle switch interlocked with the throttle valve shaft is utilized.
This throttle position sensor sends the MPFI control unit a potentiometer output signal corresponding to the opening of the throttle valve and an idle switch signal that turns ON only when the throttle is opened nearly to the idle position.
Using these signals, the MPFI control unit precisely controls the air-fuel ratio during acceleration and deceleration as well as idling.

Ignition System

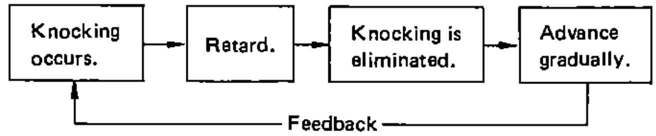
The ignition system is composed of a battery, an ignition coil, a distributor, spark plugs, knock sensor, MFFI control unit and wires.
The crank angle sensor built-in distributor detects the reference crank angle and the positioned crank angle. Electronic signal of both angles is transmitted to MPFI control unit which is used in common by fuel injection system.
The MPFI control unit calculates the spark advance angle and determines the spark timing.
The electronic signal of spark timing determined by control unit is transmitted to the power transistor where it makes the primary circuit to ignition coil, whereby high voltage current is generated in the secondary circuit.
The high voltage of secondary circuit is distributed to the spark plug of each cylinder and discharged there.

UNDER NORMAL OPERATING CONDITIONS

The spark advance angle is calculated from the following three factors.
1) Engine speed compensation.
2) Advance when starting the engine.
3) Advance in all driving conditions except starting the engine, after engine speed exceeds the preset value.

WHEN KNOCKING OCCURS

A signal is transmitted from the knock sensor to the MPFI control unit. The MPFI control unit then retards spark timing to prevent engine knocking.



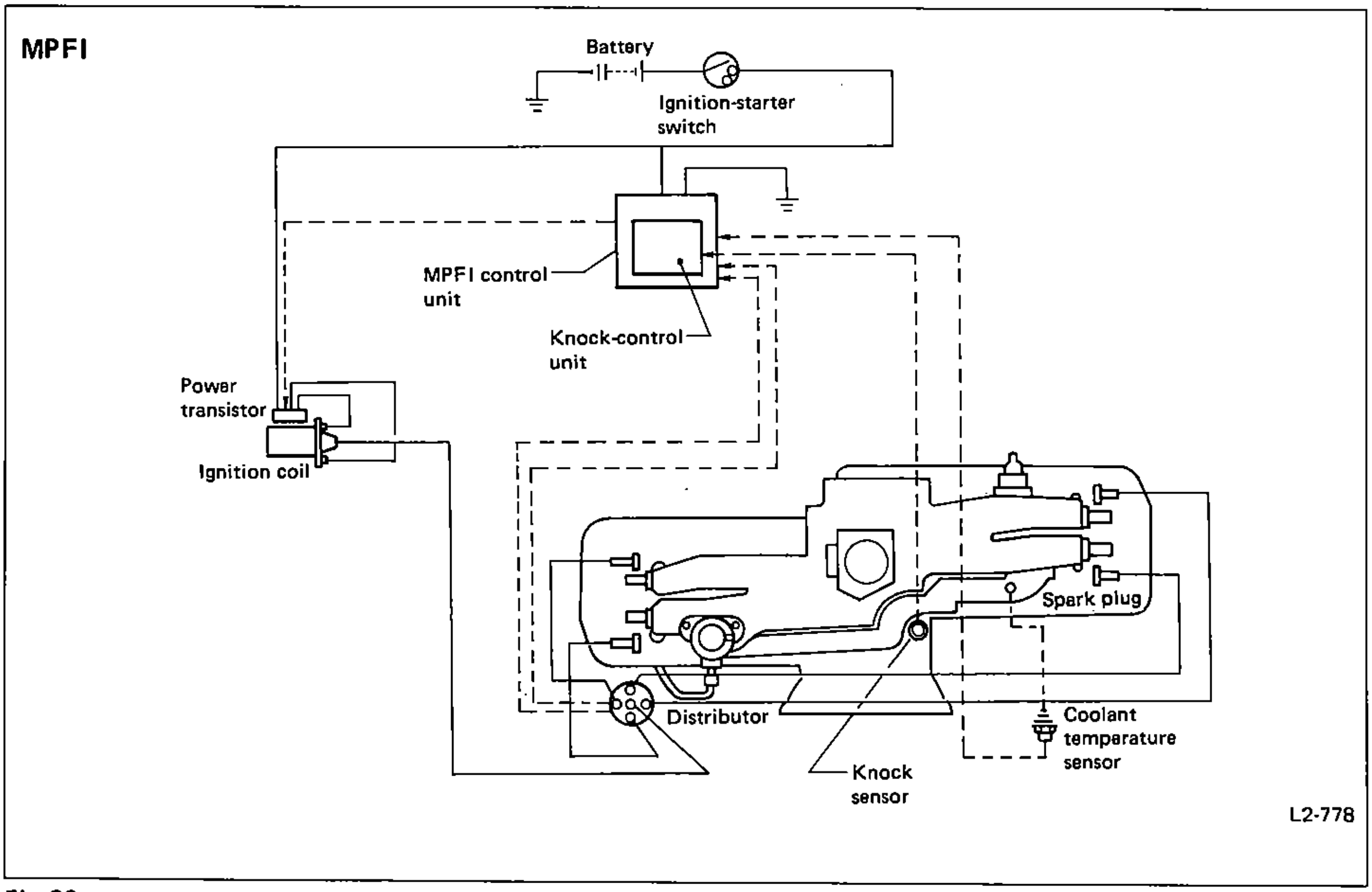


Fig. 80

KNOCK SENSOR

The knock sensor is installed on the cylinder block, and senses knocking signals from each cylinder.
This knock sensor is a piezo-electric type which converts knocking vibrations into electric signals.
It consists of a piezo-electric element, weight, and case.
If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.

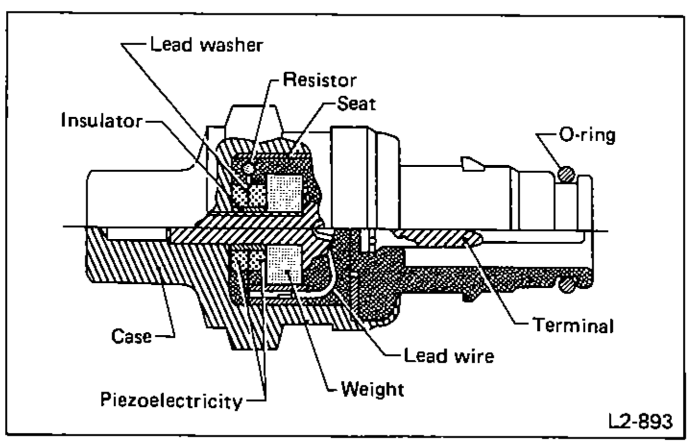


Fig. 81

Air-Fuel Ratio Learning Control System

This system has been developed to stabilize the quality of the hot-wire type air flow meter and fuel injector and to maintain their original performance by correcting their qualitative variation and aging.
By learning the feedback control amount of the O_2 sensor, the system controls the control unit to automatically set a coefficient of correction; thereby, the fuel injector always achieves fuel injection under the optimum condition.

O_2 Sensor

The O_2 sensor is mounted on the center exhaust pipe between the turbocharger and the rear exhaust pipe. It is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas hardly contains oxygen.
Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio.
The O_2 sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The hexagon screw on the outside is grounded to the exhaust pipe, and the inside is connected to the MPFI control unit through the harness.

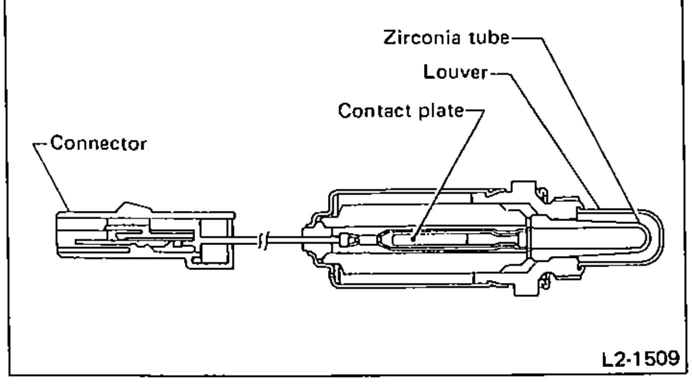
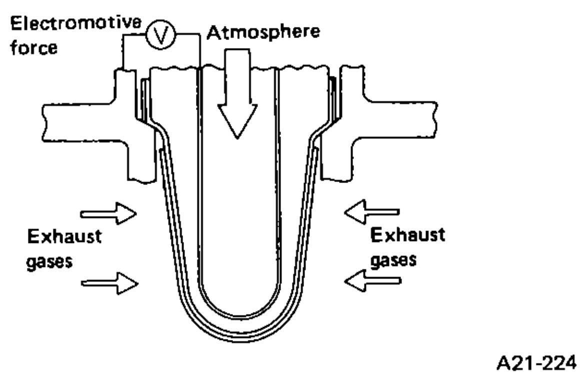


Fig. 82

When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results in very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.
When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in small difference in the oxygen concentration. The electromotive force is very small.
The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the MPFI control unit, the air-fuel ratio of the supplied mixture can be determined easily. The O_2 sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperatures of approximately 300 to 400°C (572 to 752°F).
On California models, a ceramic heater is used to improve performance at low temperatures.



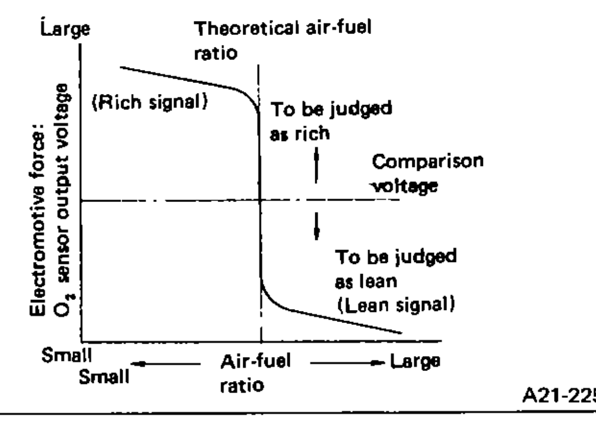


Fig. 83

Fuel Injector

The fuel injector injects fuel according to the valve open signal received from the MPFI control unit.
The nozzle is attached on the top of the fuel injector. The needle valve is lifted by the solenoid coil through the plunger on arrival of the valve open signal.
Since the injection opening, the lifted level of needle valve and the regulator-controlled fuel pressure are kept constant, the amount of fuel to be injected can be controlled only by the valve open signal from the MPFI control unit.

At the fuel inlet of the injector, the filter is mounted to prevent dust from entering.

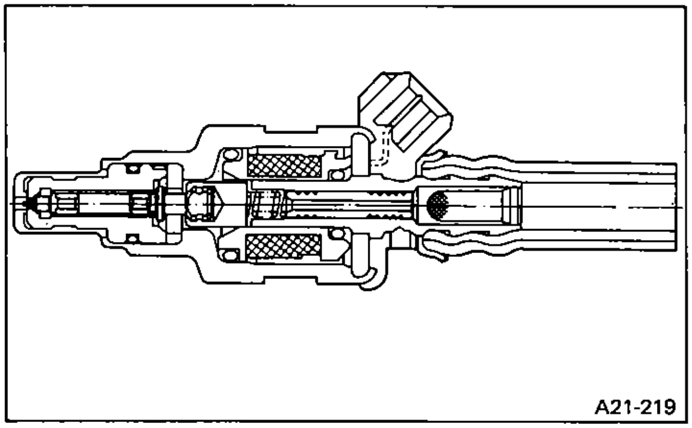


Fig. 84

Auxiliary Air Valve

The auxiliary air valve is used to increase air flow when the engine is started up at a low temperature and the following warmup is performed. It consists of the coiled bimetal, the bimetal-operated shutter valve, and the electric heater element for bimetal. The passing air flow (at start-up) is increased as the temperature becomes lower. After start-up of the engine, the heating is performed by the heater to which current is supplied from the fuel pump relay circuit. Thereby, the shutter valve turns gradually to decrease the air flow. After a certain elapsed time, the shutter valve is closed.

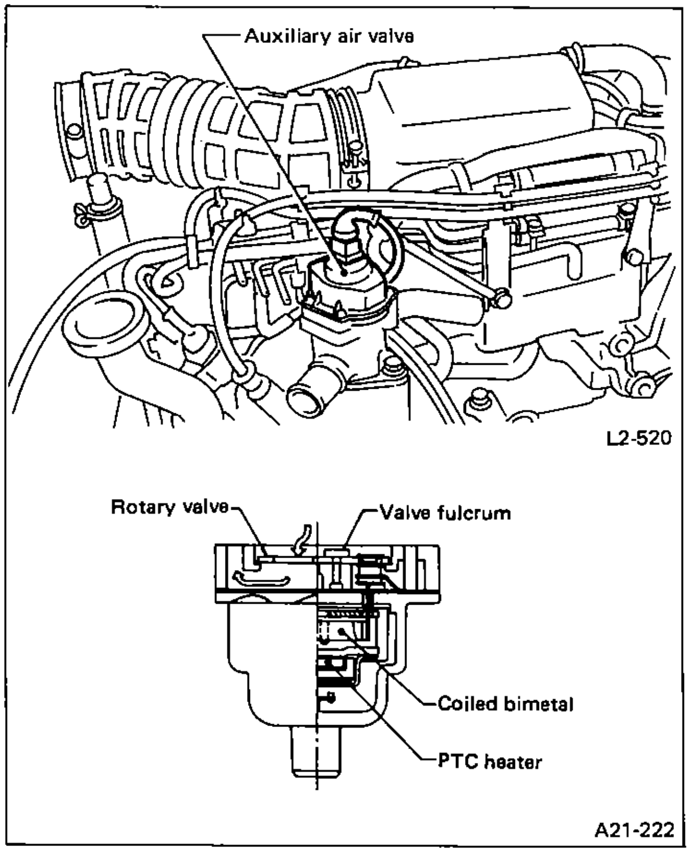


Fig. 85

Coolant Thermosensor

The coolant thermosensor is equipped on the waterpipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature.
To the MPFI control unit, the thermosensor sends the coolant temperature signal which is decisive for the fuel volume to be injected.

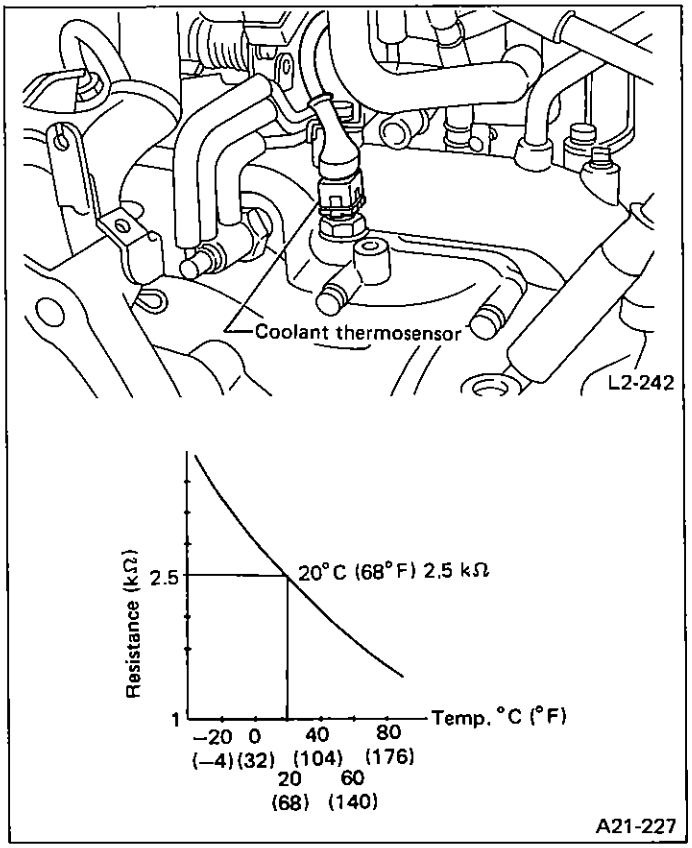


Fig. 86

Pressure Switch

Two positive pressure switches, which are combinations of a pressure withstanding diaphragm and microswitch, are mounted in front of the body strut mount. One switch operates when the intake manifold pressure reaches +6.7 kPa (+50 mmHg, +1.97 inHg) causing the TURBO indicator lamp to illuminate indicating that the turbocharger has begun its supercharging operation. At the same time, it also transmits the heavy load signal to the MPFI control box for cancelling the air-fuel ratio feedback control. The other switch operates at a pressure of +62.7 kPa (+470 mmHg, +18.50 inHg) for cutting off fuel when an abnormal rise in supercharging pressure occurs, due to a failed turbocharger waste gate or other fault, thereby preventing damage to the engine.

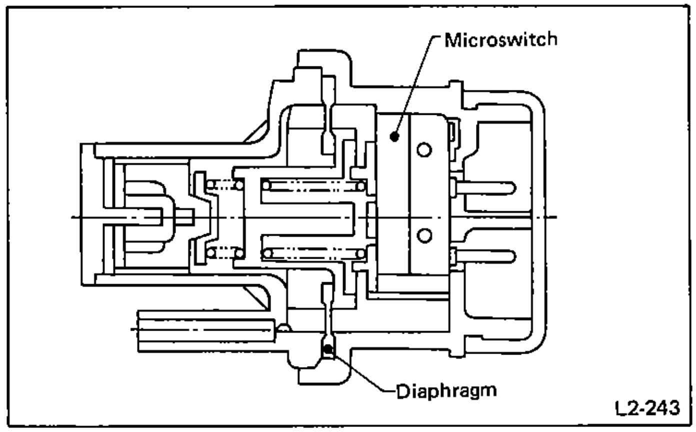


Fig. 87

Pressure Regulator

The pressure regulator is divided into the fuel chamber and the spring chamber by the diaphragm as illustrated below. Fuel is fed to the fuel chamber through the fuel inlet connected with the injector. A difference in pressure between the fuel chamber and the spring chamber connected with the intake manifold causes the diaphragm to be pushed down, and fuel is fed back to the fuel tank through the return line.

By returning fuel so as to balance the above pressure difference and the spring force, the fuel pressure is kept at a constant level 250.1 kPa (2.55 kg/cm^2, 36.3 psi) against the intake manifold pressure.

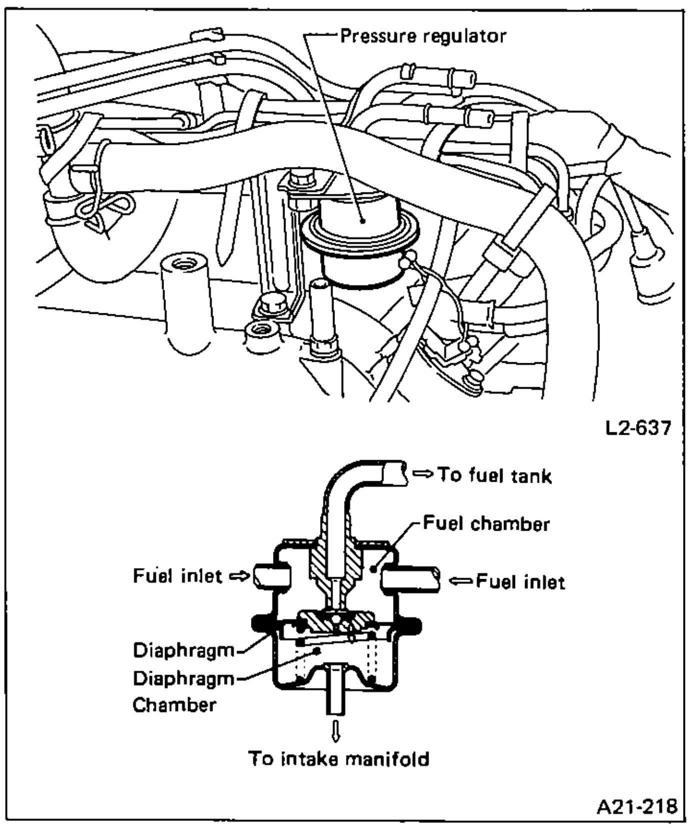


Fig. 88

Turbocharger System

General

The turbocharger performs supercharging with use of the wasted energy in the high temperature exhaust gas. It provides the following features:

- Less power loss with use of the exhaust gas energy.
- Light in weight and compact in size for better adaptability.
- Better matching with the engine load.
- Easy and efficient adjustment of the supercharge pressure by bypassing through the exhaust gas passage.

The turbocharger system for recent passenger cars places emphasis on low speed rather than high speed. More specifically, its supercharging performance is designed to be effective even at low engine speed with larger torque for enhancing both the fuel efficiency and power output. (In contrast, the conventional turbocharger is effective only at high engine speed.) The turbocharging effective at low engine speed minimizes a drawback of the conventional system which must take a certain time before the supercharging becomes effective through acceleration from low speed.

In the engineering of this turbocharger system, particular consideration has been given to the above performance. With the optimum turbocharger design and the suitable tuning of intake and exhaust systems, it is capable of providing powerful torque even at low speed, quick response and superb operability.

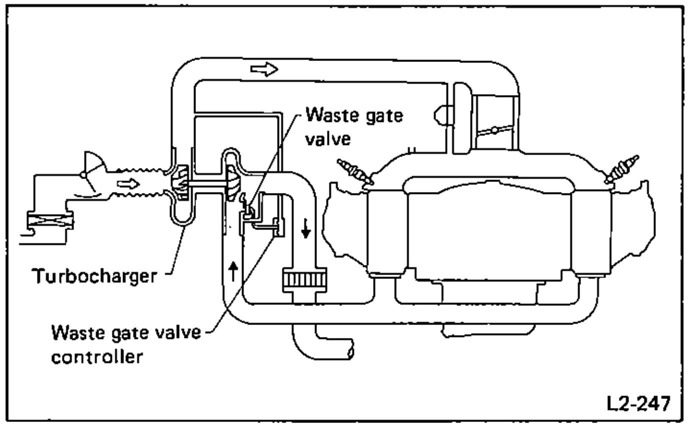


Fig. 89

While the supercharging pressure is lower than the predetermined level, the waste gate valve is closed so that all the exhaust gas is carried through the turbine.

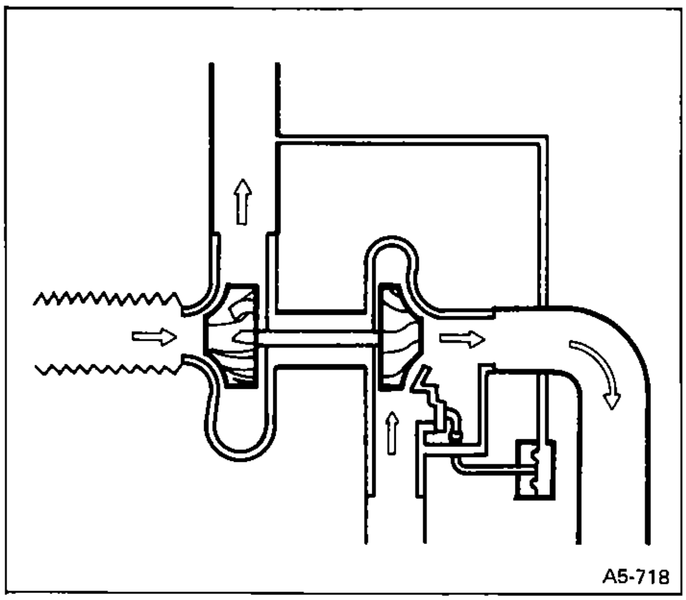


Fig. 90

Regulation of Supercharging Pressure

BASIC FUNCTION OF THE WASTE GATE VALVE

As the engine speed increases with the opening of the throttle valve, the amount of exhaust gas increases. This leads to increase in the rotational speed of turbine (approx. 20,000 to 120,000 rpm), the supercharging pressure and the output.

However, excessive supercharging pressure may cause occurrence of the knocking and heavier thermal load on such a part as piston. In the worst case, the engine may be damaged or broken. To prevent this, the waste gate valve and its controller are equipped. By sensing the supercharging pressure, the waste gate valve restricts it below a predetermined level.

When it reaches the predetermined level, the waste gate controller lets the supercharging pressure to press the diaphragm, causing the linked waste gate valve to open.

With the waste gate-valve opened, a part of the exhaust gas is allowed to flow into the exhaust gas pipe by bypassing the turbine.

This decreases the turbine rotating energy to keep the supercharging pressure constant.

It means $P_2 - P_1$ = constant

P_1: Atmospheric pressure

P_2: Supercharging pressure

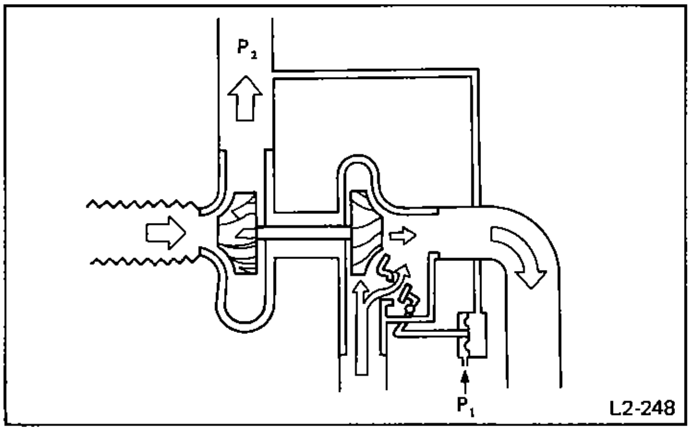


Fig. 91

Max P_2 = const (Absolute pressure 152.0 – 154.6 kPa (1,140 – 1,160 mmHg, 44.88 – 45.67 inHg)

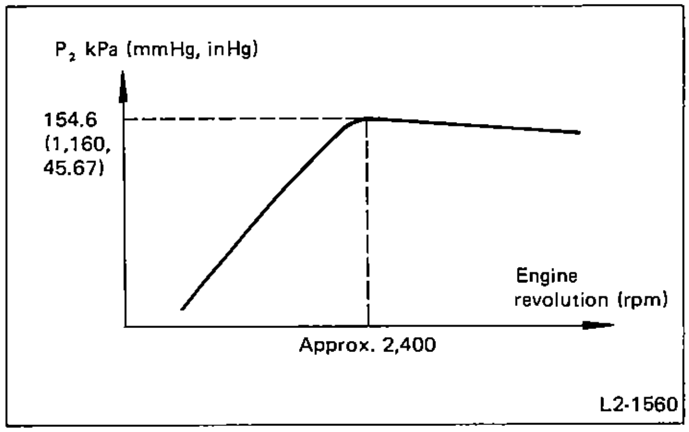


Fig. 93

CONCEPT OF THE WASTE GATE VALVE CONTROL

The higher the altitude, the lower the atmospheric pressure (P_1) and supercharging pressure (P_2). The duty solenoid valve acts as a control to maintain maximum supercharging pressure (P_2) under absolute pressure.

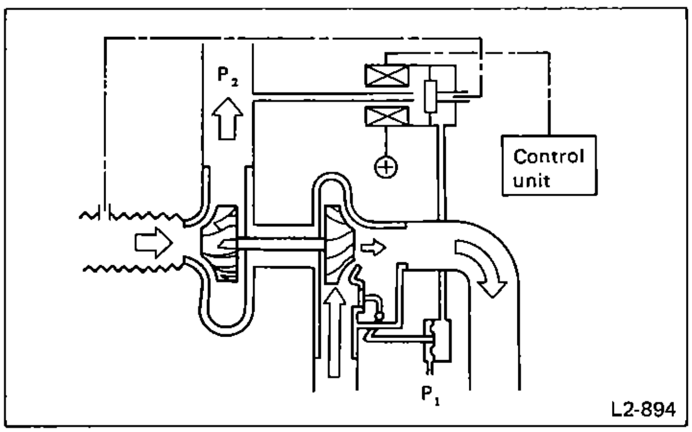


Fig. 92

Lubrication of Turbocharger

The turbocharger is lubricated by the engine oil branched out from the oil pump. Since the turbocharger turbine and the compressor shaft reach a maximum of several hundred thousand revolutions per minute, the full-floating type bearings are used to form desirable lubrication films on their inside and outside during running.

Further the oil supplied to the turbocharger also plays an important role of cooling the heat from exhaust gas in the turbine not to propagate to the bearings.

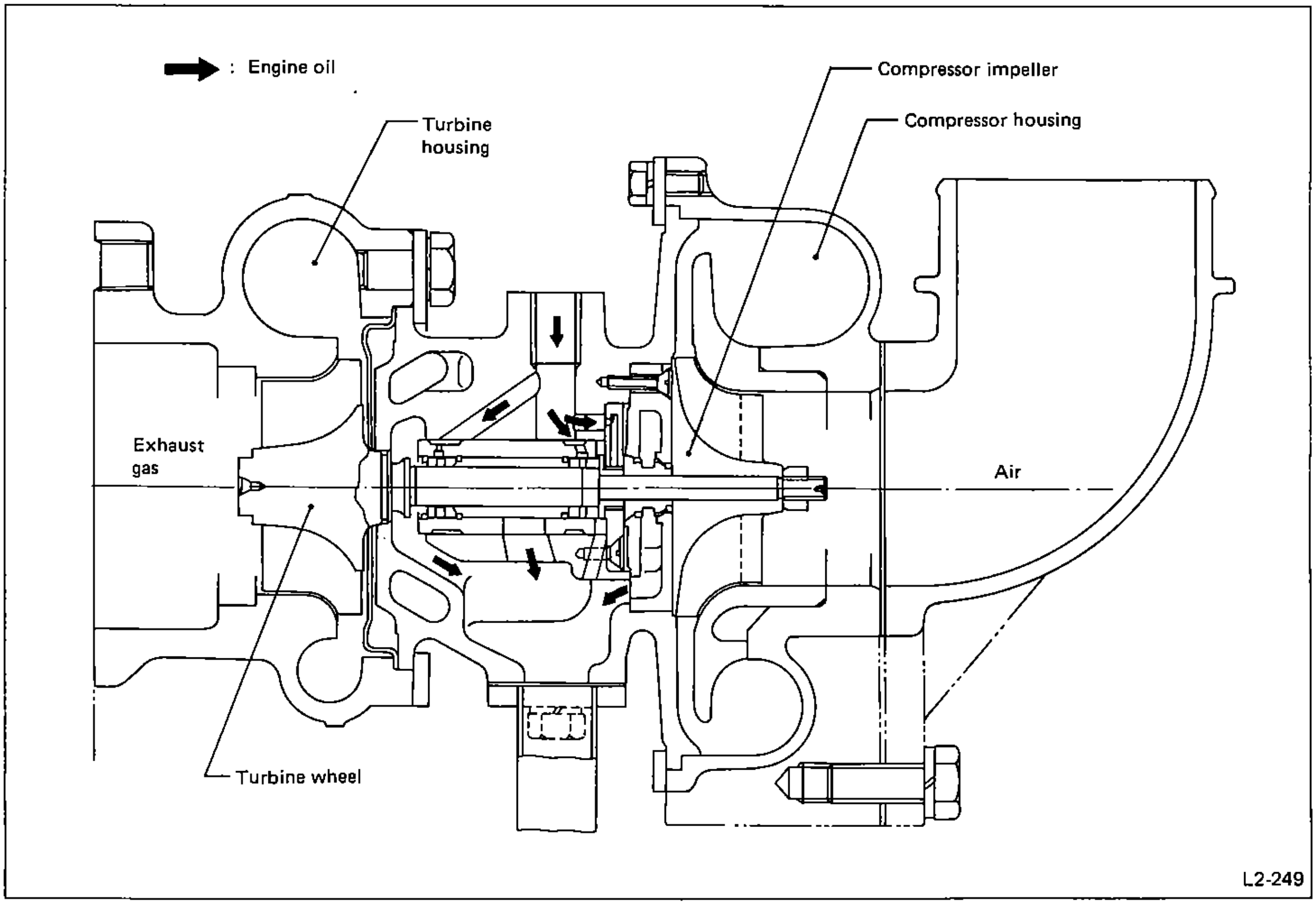


Fig. 94

Cooling of Turbocharger

The turbocharger is water cooled for higher reliability and durability. The coolant from the coolant drain hose under the engine cylinder head is led to the coolant passage, through a pipe, provided in the turbocharger bearing housing. After cooling the bearing housing, the coolant is led into the thermostat case in the intake manifold through a pipe.

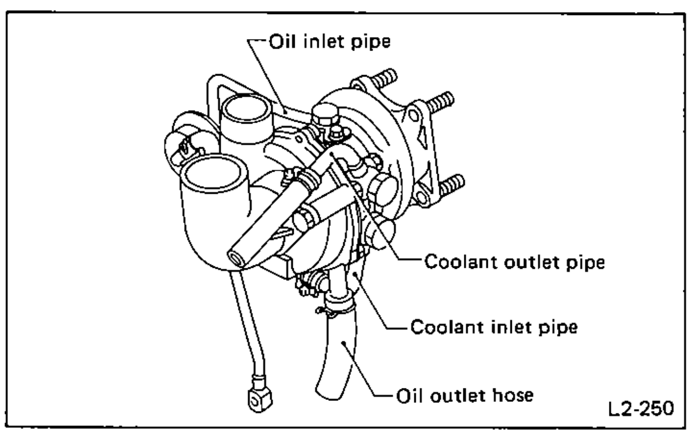


Fig. 95

Multi Point Fuel Injection System

SCHEMATIC DRAWING OF MPFI SYSTEM

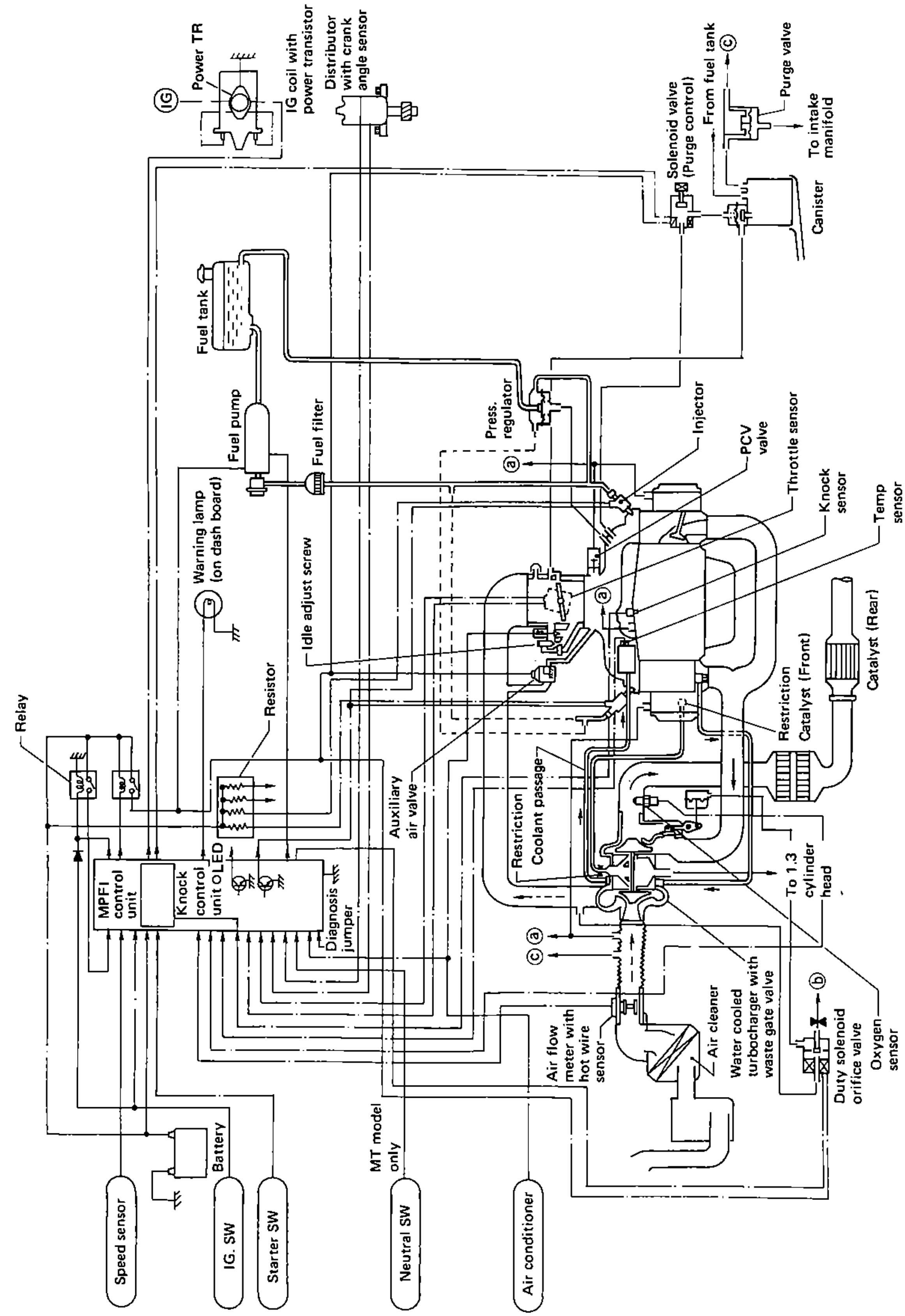
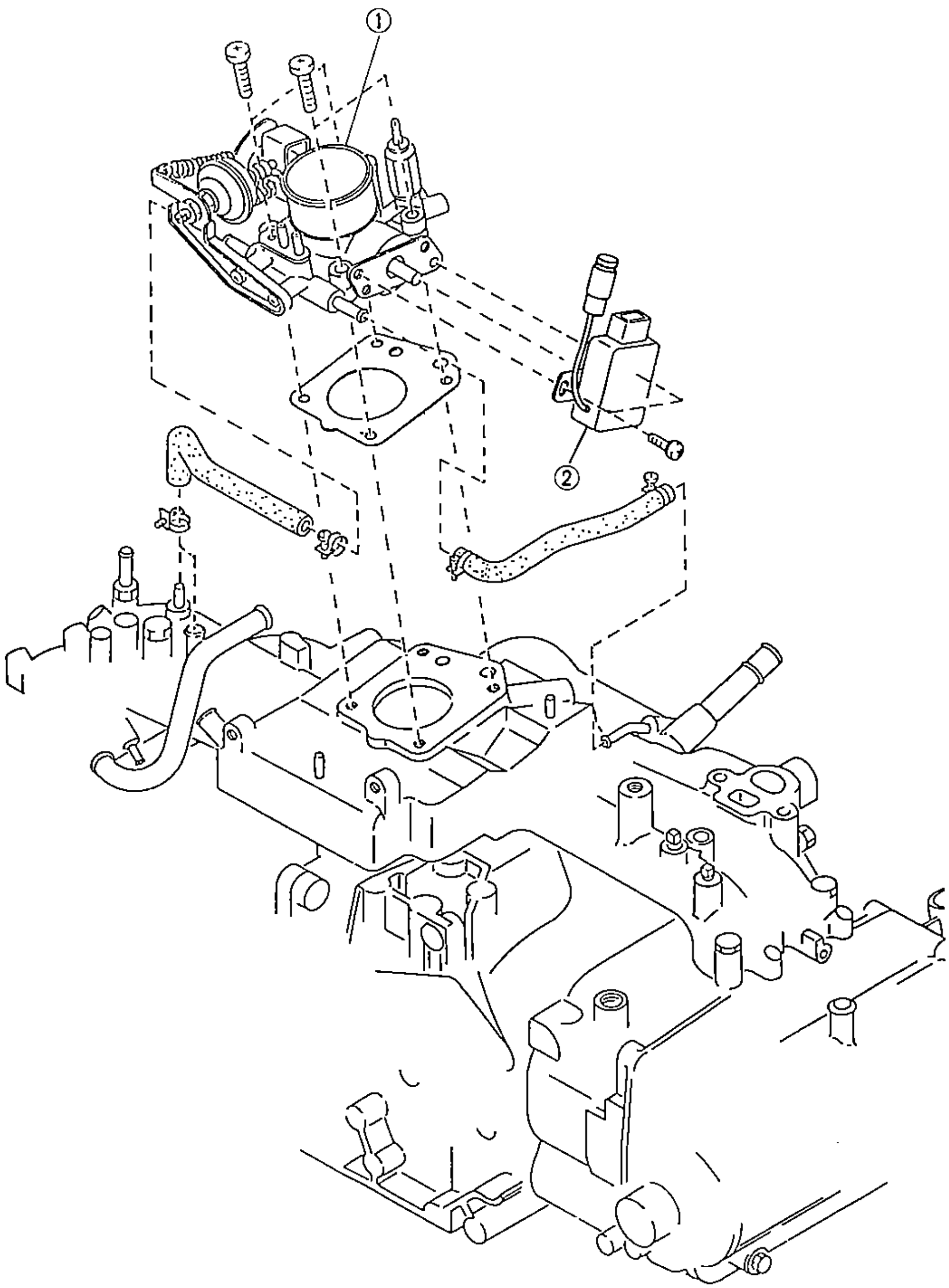


Fig. 4

L2-1680

COMPONENT PARTS

Throttle Body



1 Throttle body
2 Throttle switch

Fig. 5

L2-1685

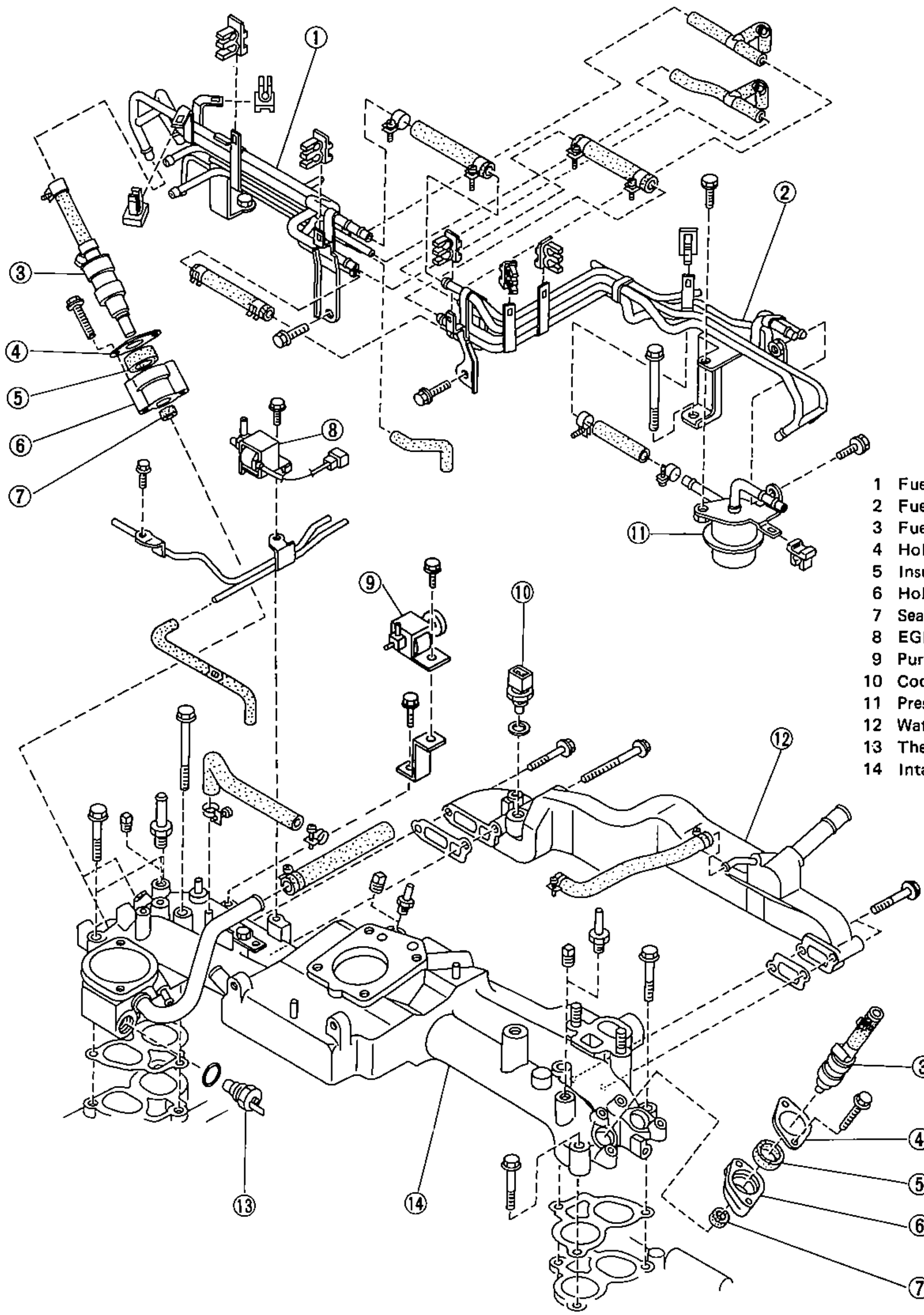
TROUBLESHOOTING

Self-diagnosis System

List of Trouble Codes

Trouble code	Item	See page
11	Crank angle sensor (No reference pulse)	p128
12	Starter switch (Continuously in ON position or continuously in OFF position while cranking)	p130
13	Crank angle sensor (No position pulse)	p131
14	Fuel injectors #1 and #2 (Abnormal injector output)	p133
15	Fuel injectors #3 and #4 (Abnormal injector output)	p134
21	Water temperature sensor (Open or shorted circuit)	p135
22	Knock sensor (Open or shorted circuit)	p136
23	Air flow meter (Open or shorted circuit)	p137
31	Throttle sensor (Open or shorted circuit)	p138
32	O_2 sensor (Abnormal sensor signal)	p139
33	Car-speed sensor (No signal is present during operation)	p141
35	Purge control solenoid valve (Solenoid switch continuously in ON or OFF position)	p143
41	System too lean	p144
42	Idle switch (Abnormal idle switch signal in relation to throttle sensor output)	p145
44	Duty solenoid valve (Waste gate control)	p147
51	Neutral switch (Continuously in ON position)	p146

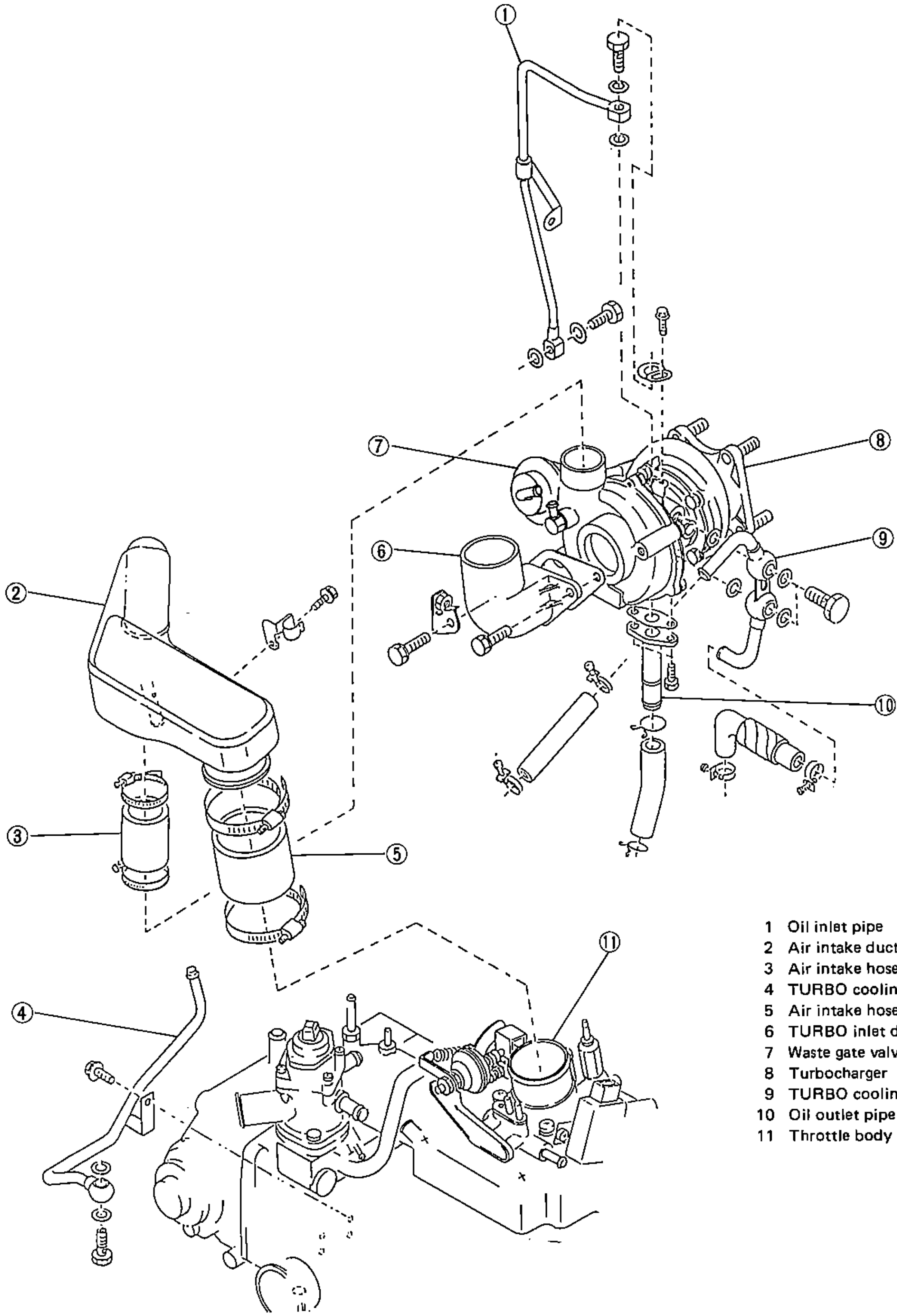
Intake Manifold



1 Fuel pipe ASSY RH
2 Fuel pipe ASSY LH
3 Fuel injector
4 Holder plate
5 Insulator
6 Holder
7 Seal
8 EGR solenoid valve
9 Purge control solenoid valve
10 Coolant thermosensor
11 Pressure regulator
12 Water pipe
13 Thermometer
14 Intake manifold

Fig. 98

Turbocharger

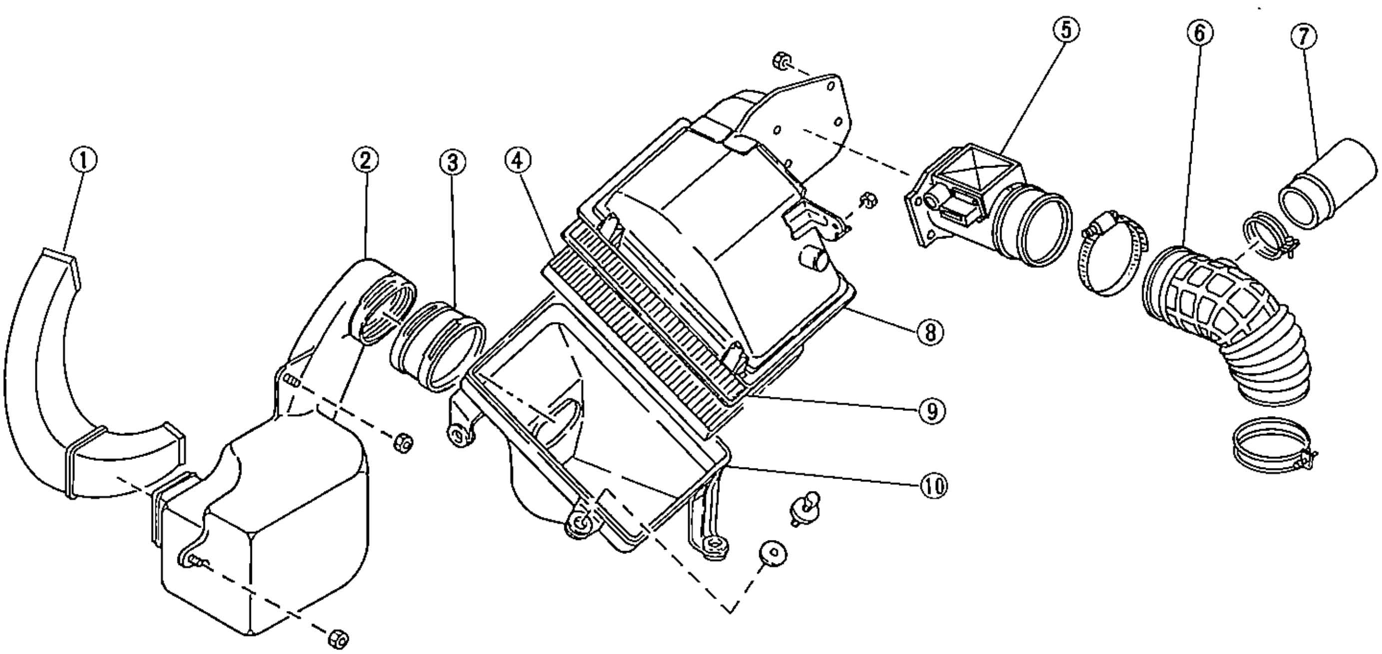


1 Oil inlet pipe
2 Air intake duct
3 Air intake hose
4 TURBO cooling inlet pipe
5 Air intake hose
6 TURBO inlet duct
7 Waste gate valve controller
8 Turbocharger
9 TURBO cooling pipe
10 Oil outlet pipe
11 Throttle body

Fig. 99

L2-899

Air Intake System



1 Chamber duct 1
2 Chamber
3 Chamber duct 2
4 Air cleaner element
5 Air flow meter ASSY
6 Air intake boot
7 Duct B
8 Upper case
9 Gasket
10 Lower case

L2-900

Fig. 100

SERVICE PROCEDURE

Precautions in Servicing

1) Never connect the battery in reverse polarity.
- The MPFI control unit will be destroyed instantly.
- The fuel injector and other part will be damaged in just a few minutes more.

2) Do not disconnect the battery terminals while the engine is running.
- A large counter electromotive force will be generated in the alternator, and this voltage may damage the electronic parts such as MPFI control unit, etc.

3) Before disconnecting the connectors of each sensor and the MPFI control unit, be sure to turn off the ignition switch.
- Otherwise, the MPFI control unit may be damaged.

4) The connectors to each sensor in the engine compartment and the harness connectors on the engine side and body side are all designed to be waterproof. However, it is still necessary to take care not to allow water to get into the connectors when washing the vehicle, or when servicing the vehicle on a rainy day.

5) Every MPFI-related part is a precision part. Do not drop them.

6) Observe the following cautions when installing a radio in MPFI equipped models.

a. The antenna must be kept as far apart as possible from the control unit.
(The MPFI control unit is located under the steering column, inside of the instrument panel lower trim panel.)
b. The antenna feeder must be placed as far apart as possible from the MPFI control unit and MPFI harness.
c. Carefully adjust the antenna for correct matching.
d. When mounting a large power type radio, pay special attention to items a. thru c. above.

- Incorrect installation of the radio may affect the operation of the MPFI control unit.

7) Before disconnecting the fuel hose, disconnect the fuel pump connector and crank the engine for more than five seconds to release pressure in the fuel system. If engine starts during this operation, run it until it stops.

4) Check for foreign matter, water, or oil in the air passages, especially in the by-pass. If any abnormality is noticed, replace the air flow sensor.

5) If no defect is found in the visual checks above, conduct the following inspections.

(1) Turn the ignition switch OFF (engine off).
(2) Attach the air flow meter to the air cleaner.
(3) Disconnect the air flow meter, and remove the rubber cover from the connector.
Conduct the following checks by attaching the tester check pins to the connector terminals on the side from which the rubber cover has been removed.

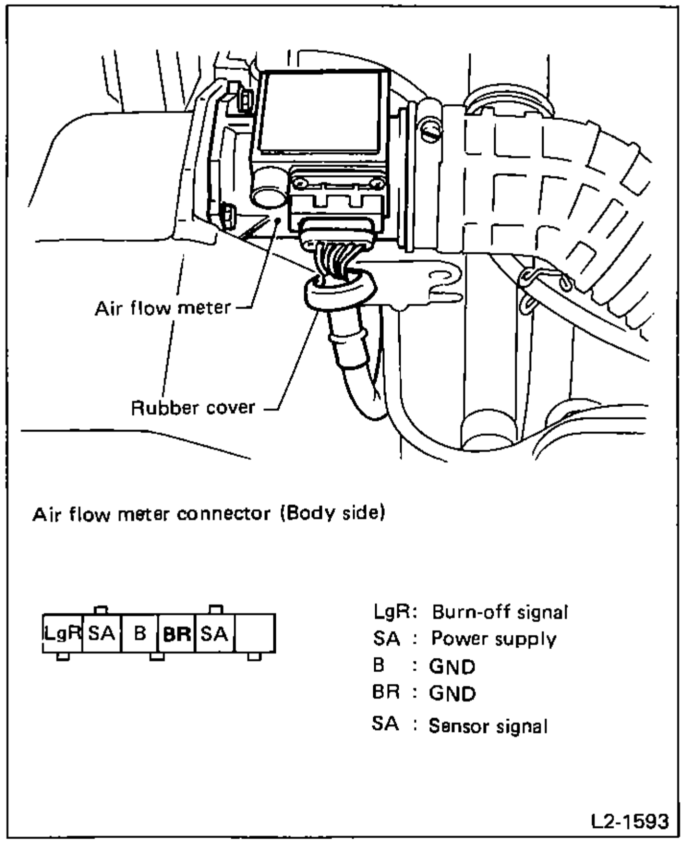


Fig. 101

Air Flow Meter

INSPECTION

1) Check for leaks or damage in the connection between the air intake boot and air flow meter. Repair any defect noted.

2) Remove the connectors from the air flow meter, the air intake boot, and the air flow meter for the air cleaner case in the order stated.

3) Check the exterior of the air flow meter for damage.

(4) Measure resistance between the body and ground terminals (B) and (BR).

Specified resistance:
10Ω, max.

If resistance is greater than 10Ω, check the harness and internal circuits of the control unit for discontinuity, and the ground terminal on the intake manifold for poor contact.

(5) Turn the ignition switch ON (engine off).

(6) Connect the air flow meter connector.
(7) Measure voltage across power terminal (SA) and the body.

Specified voltage:
10 V, min.

If voltage is outside specifications, check the condition of the parts (battery, fuse, control unit harness, connector, etc.) in the power line.
(8) Attach the positive lead of a tester to signal terminal (SA) and the negative lead to the ground terminal (BR). Measure the voltage across the two terminals.

Specified voltage:
1 – 2V

If voltage is outside specifications, replace the air flow meter.

(9) Remove the air flow meter from the air cleaner. (The air intake boot need not be removed.)
(10) Blow air from the air cleaner side to check if voltage across terminals (SA) and (B) is greater than that measured in step (7) above. If not, replace the air flow meter.
(11) Install the air flow meter on the air cleaner.
(12) Start the engine.
(13) Warm up the engine until the coolant temperature reaches approximately 80°C (176°F).
(14) Drive at speed greater than 24 km/h (15 MPH) for at least one minute.
(15) Race engine above, 2,000 rpm.
(16) While idling the engine, monitor voltage across terminal (LgR) of the air flow meter connector and the body. (0 V under normal operating conditions is OK.)
(17) Turn the ignition switch OFF. Check if 12 volts are present across the terminal (LgR) and the body for one second shortly after the ignition switch has been turned OFF. If not, check the harness from the control unit to the air flow meter for discontinuity.

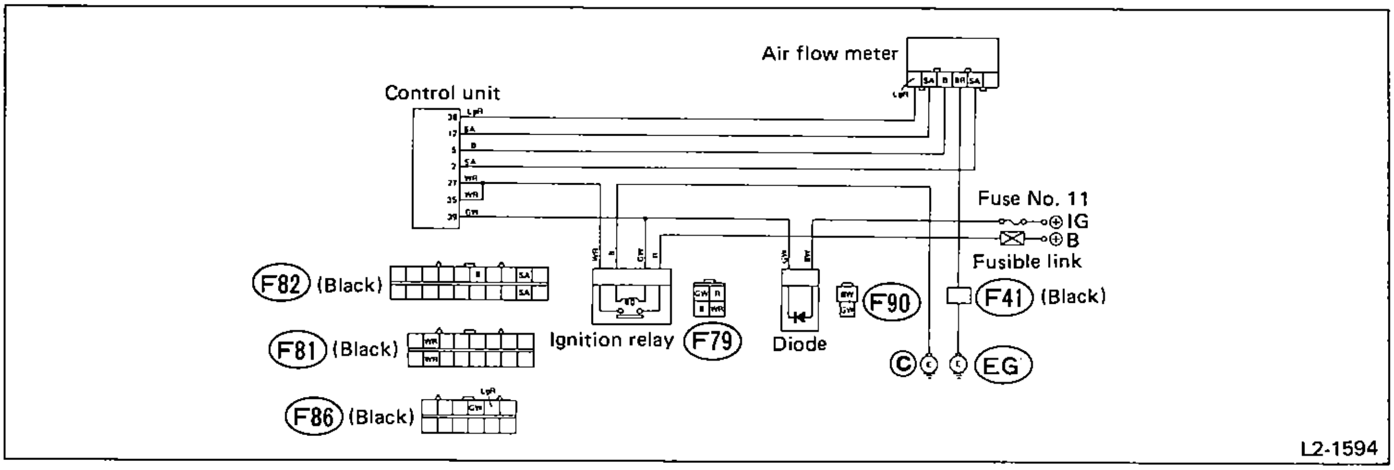


Fig. 102

Throttle Body

INSPECTION AND ADJUSTMENT

THROTTLE SENSOR

Idle contact

Insert a thickness gauge between the stopper screw of the throttle body and the stopper (portion Ⓖ), and check for continuity between (Ⓐ and Ⓒ).

1) Make sure that Ⓐ and Ⓒ are conducting when the throttle is closed fully.
2) Make sure that Ⓐ and Ⓒ are conducting when the thickness of gauge is 0.55 mm (0.0217 in) (this corresponds to throttle opening of 1.5°).
3) Make sure that Ⓐ and Ⓒ are not conducting when the thickness is 0.92 mm (0.0362 in) (this corresponds to a throttle opening of 2.5°).
4) If the above standards are not satisfied, loosen the screws (two) securing the throttle switch to the throttle body, and turn the throttle switch main body until the correct adjustment is obtained.

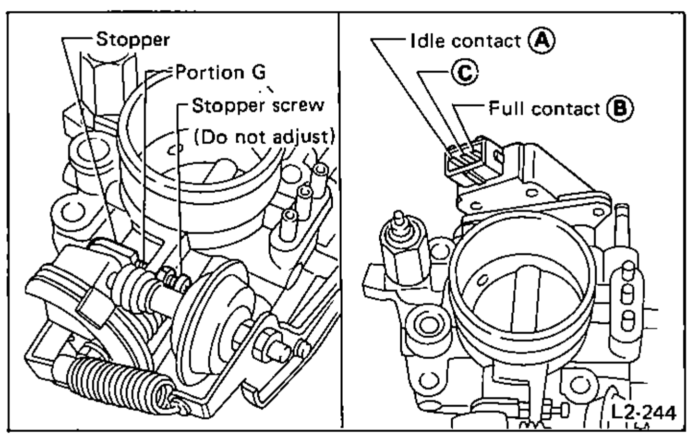


Fig. 103

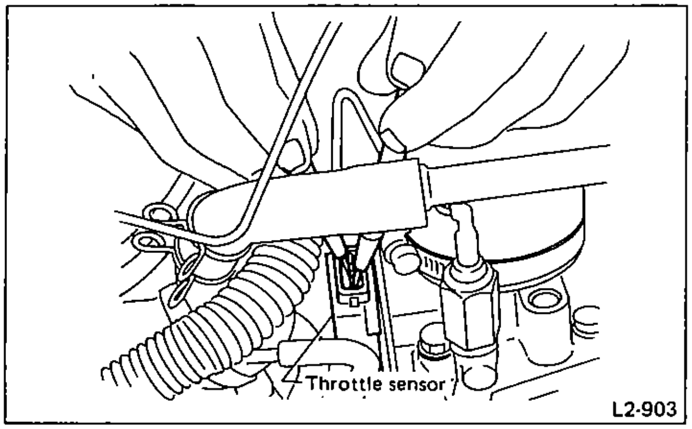


Fig. 104

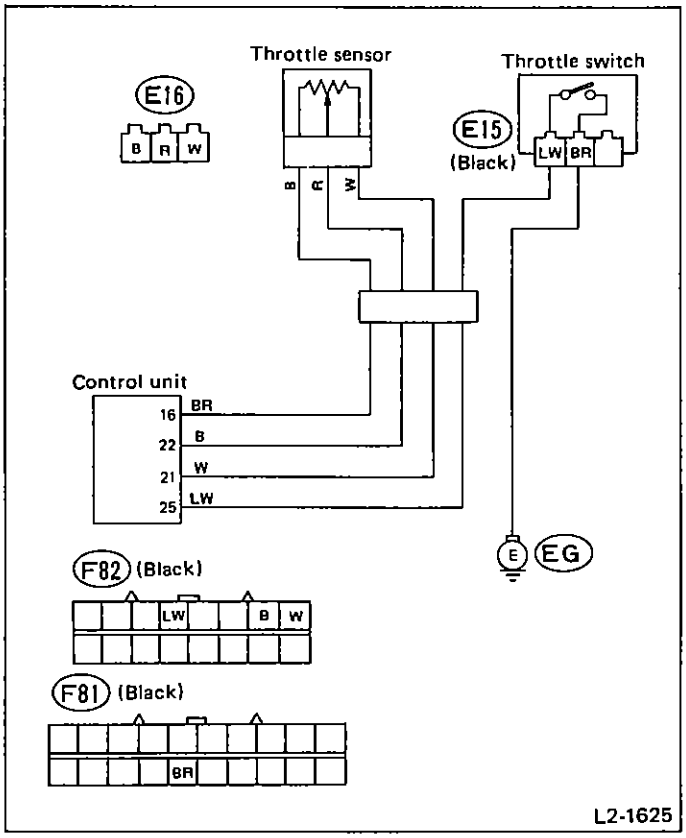


Fig. 105

Throttle opening signal

1) Measure resistance between terminals ① and ③.

Specified resistance:
6 – 18 kΩ

If resistance is outside specifications, replace the sensor.

2) Measure resistance between terminals ① and ②.

Specified resistance:
5.8 – 17.8 kΩ (Throttle closed)
1.5 – 5.1 kΩ (Throttle open)

Ensure that resistance changes smoothly between the fully-closed and fully-opened throttle positions. If resistance is outside specifications, replace the sensor.

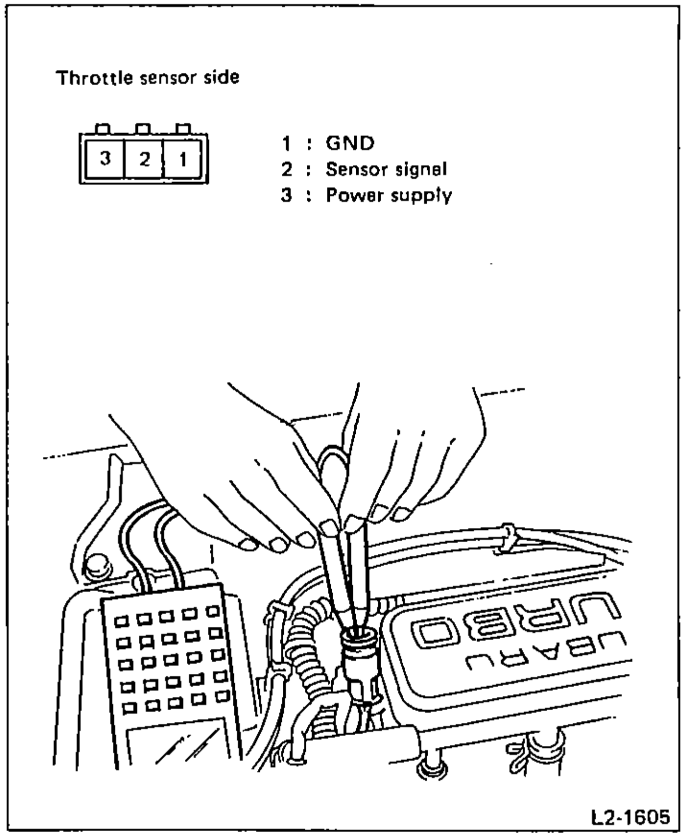


Fig. 106

DASH POT

1) Warm-up the engine sufficiently, and check that the idle speed is as specified.
2) Under the non-loaded state, turn the throttle lever by hand and increase engine speed until the end of the dash pot is off the throttle cam.
3) Gradually return the throttle lever, and read the engine rpm when the throttle cam contacts the end of the dash pot.

Engine rpm	2,800 – 3,400

4) If the engine rpm is not within this range, loosen the lock nut of the dash pot, and turn the dash pot until this specification is satisfied. After adjustment, tighten the lock nut securely.
5) After adjustment, race the engine and make sure the idle speed returns correctly to the idle speed as the throttle is released.

Fuel Injector and Resistor

INSPECTION

Using a stethoscope or a long-type screwdriver, make sure of operating noise (clicking sound) of each injector.
If this operating noise cannot be heard on any injector;
1) Disconnect the control unit connector (F80).
Measure voltage across the body and terminals 49 (W), 50 (W), 51 (WR) and 52 (WR) of control unit connector (body side), respectively.

Specified voltage:
12 V [Circuits ① through ⑦ in figure are all OK.]

If voltage is below 10 V in any line, the affected harness from the battery to the control unit through the resistor and injector is broken or shorted.
2) Disconnect each fuel injector connector.
Measure resistance between the terminals of each connector.

Specified resistance:
2 – 3 Ω [Circuit ⑤ is OK.]

If resistance is greater than 1 MΩ, the affected harness is broken. If 0 Ω, the harness is shorted. Replace the injector.
3) Measure voltage across power terminals RW, RB, R and RL (engine harness side) and the body.

Specified voltage:
12 V [Circuits ① through ④ are OK.]

If voltage is less than 10 V, the harness from the battery to the injector through the resistor is discontinued or shorted.
4) Disconnect the connector (F92) from the resistor.
Measure resistance between terminals W and B of the resistor.

Specified resistance:
5.8 – 6.5 Ω [Circuit ② is OK.]

If resistance is outside specifications, replace the resistor.
5) Measure voltage across terminal 5 (R) of body harness connector and the body.

Specified voltage:
12 V [Circuit ① is OK.]

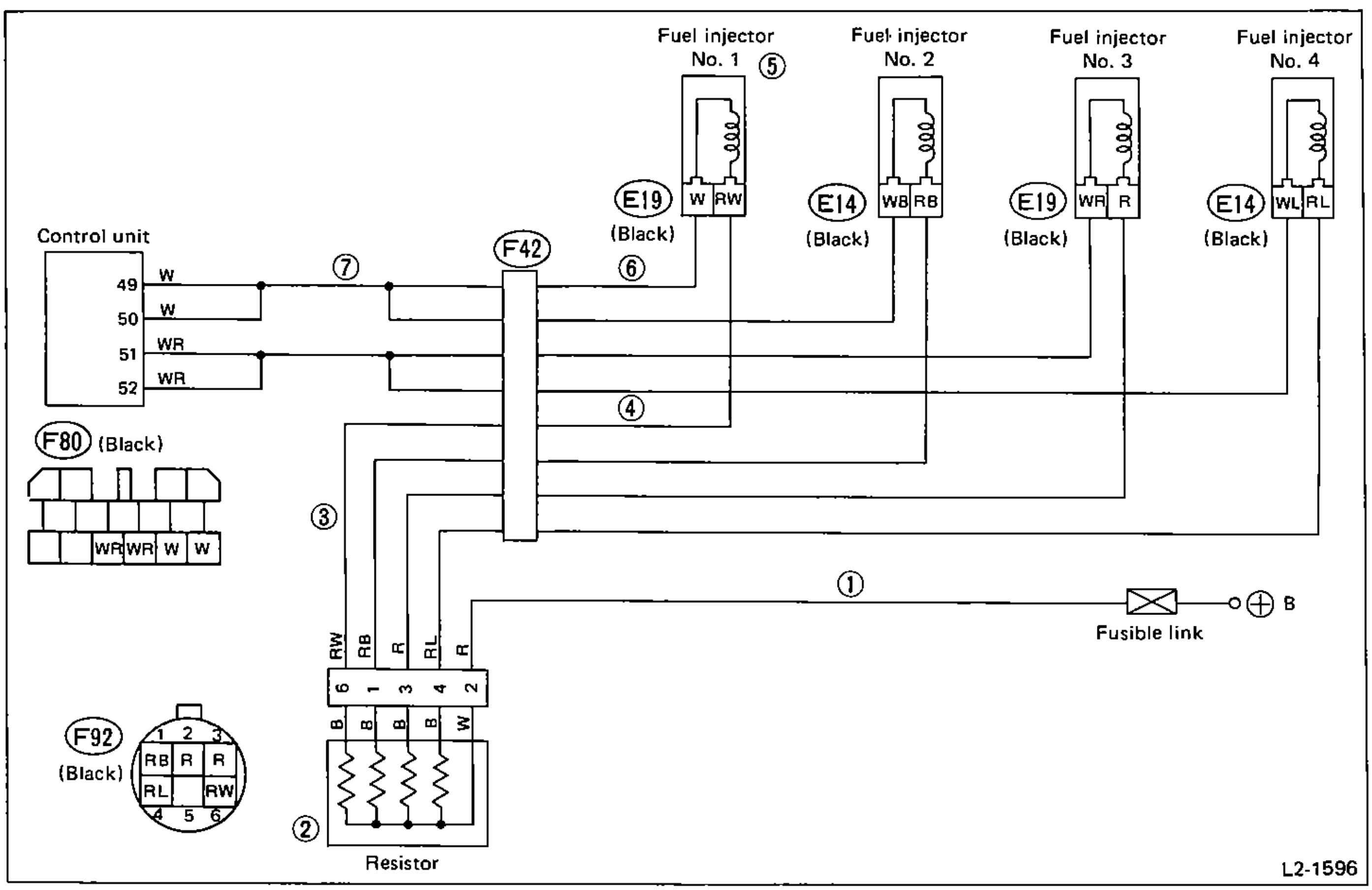


Fig. 107

Auxiliary Air Valve

INSPECTION

1) Pinch the hose connecting the air intake duct and auxiliary air valve and observe how the engine speed changes.

State of engine	Engine speed
When engine is cold	Engine idle speed drops as the hose is pinched.
When engine is hot	Reduction in engine speed is within 100 rpm.

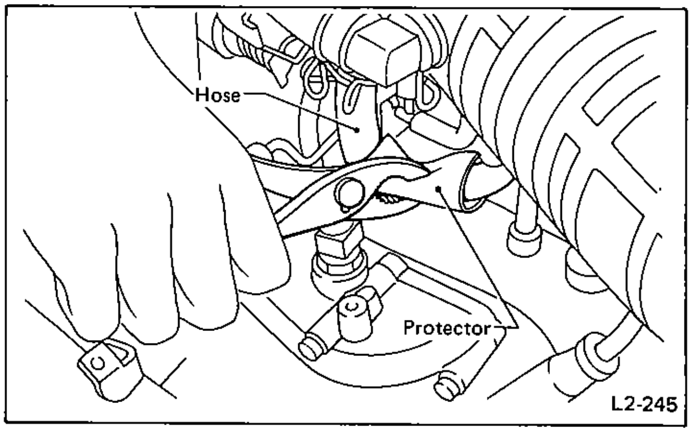


Fig. 108

When pinching the hose, cover it with a rubber plate or the like for protection.

2) As the engine is started, the auxiliary air valve is heated by the built-in heater and its shutter valve closes gradually. This causes the engine rpm to be lowered gradually until the specified idling rpm is reached.
If the engine speed will not drop to the idling rpm smoothly, the heater circuit or the heater power supply circuit may be faulty. In this case, perform the following checks;

(1) Check the resistance value of the auxiliary air valve.
Disconnect the connector of the auxiliary air valve and measure the resistance between the two terminals, using a circuit tester.

Resistance value must be other than zero (0) and infinity (∞).

If the resistance is zero (0) or infinity (∞), replace the auxiliary air valve with a new one.

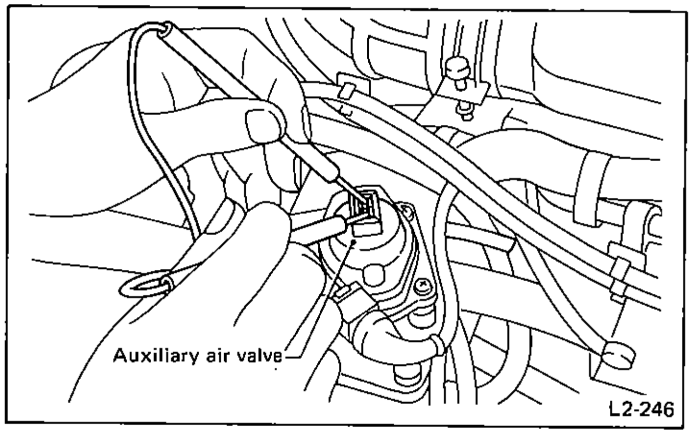


Fig. 109

(2) Check source voltage.
Disconnect the connector of the auxiliary air valve, and check voltage on the harness side.

Voltage (when engine is running):
Over 12V

If the voltage is 0V or lower than 12V, check the harness and connector for condition.

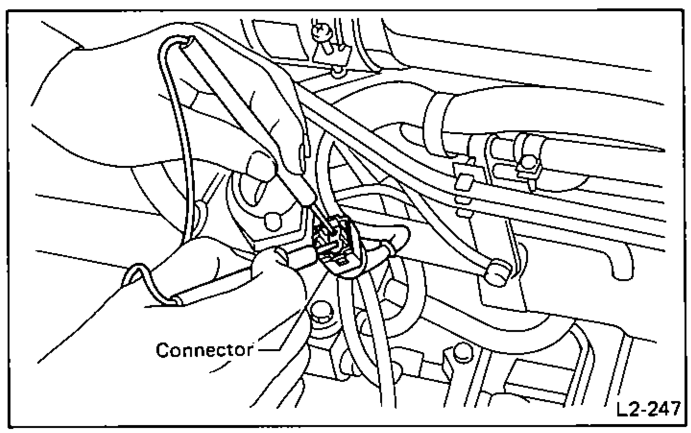


Fig. 110

3) If item 2) above is normal but only item 1) is faulty, the cause may be as follows:

	Cause of trouble	Symptom	Remedy
1	Sticking of shutter valve of auxiliary air valve. (Sticking in closed direction)	• Engine stalls easily when engine is cold.	Replace auxiliary air valve.
2	Sticking of shutter valve of auxiliary air valve. (Sticking in open direction)	• Engine rpm does not lower smoothly during warm-up operation. • Engine rpm remains high.	
3	Clogged air passage.	Same as ①	Check air passage, such as hose, etc. and clean.

Coolant Thermosensor

INSPECTION

Put the thermosensor in water of various temperatures and measure the resistance between terminals using a circuit tester.
If the resistance value is too much out of these ranges, replace the thermosensor with a new one.

Water temperature °C (°F)	Resistance value
−10 (14)	7 – 11.5 kΩ
20 (68)	2 – 3 kΩ
50 (122)	700 – 1,000Ω

Pressure Regulator

The pressure regulator adjusts the fuel pressure to 250.1 kPa (2.55 kg/cm^2, 36.3 psi) compared to the intake manifold pressure.

INSPECTION

Disconnect the fuel hose at the pressure regulator connecting portion and install a fuel gauge.

a. Before disconnecting the fuel hose, first disconnect the fuel pump connector and crank the engine (more than five seconds) to release the pressure in the fuel system. If the engine is started by this cranking, run it until it stops.
b. Be sure to clamp the hose at the connecting portion.

1) When checking with the engine running
(1) Measure the fuel pressure when the engine is at idle speed.

Standard:
177 – 206 kPa (1.8 - 2.1 kg/cm^2, 26 – 30 psi)

(2) Race the engine, and make sure the fuel pressure increases correspondingly.

2) When checking with the engine stopped
Set the diagnosis jumper for checking the MPFI system to ON, and then turn ON the key switch. This will cause the fuel pump to operate intermittently. Measure the fuel pressure in this state.

Standard:
Fuel pump ON
Approx. 255 kPa (2.6 kg/cm^2, 37 psi)
Fuel pump OFF
Approx. 226 kPa (2.3 kg/cm^2, 33 psi)

Turbocharger System

TROUBLE DIAGNOSIS

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

1) Excessively high supercharging pressure:
   - Engine knocking
2) Excessively low supercharging pressure:
   - Lack of engine power
   - Poor acceleration performance
   - Considerable fuel consumption
3) Oil leak from turbocharger:
   - Excessive oil consumption
   - White exhaust smoke

(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 MPFI control system.)

Phenomenon	Judgement
Supercharging pressure is in the 49.3 to 57.3 kPa (370 to 430 mmHg, 14.57 to 16.93 inHg) range.	Normal
Supercharging pressure exceeds the 57.3 kPa (430 mmHg, 16.93 inHg) upper limit.	
(1) Cracked or disconnected waste gate valve control rubber hoses	Replace or connect rubber hose.
(2) Inoperative and closed waste gate valve	Replace turbocharger.
Supercharging pressure is below the 49.3 kPa (370 mmHg, 14.57 inHg) lower limit.	Faulty turbocharger. ↓ Replace turbocharger.

INSPECTION

WASTE GATE VALVE

1) Check connecting hose between waste gate valve, turbocharger and duty solenoid valve for looseness or disconnection, as well as cracks and damage.
2) Disconnect the waste gate valve control connecting hose from actuator, and connect checking rubber hose.
Plug the disconnected rubber hose.
3) Apply air pressure [59 to 69 kPa (0.6 to 0.7 kg/cm^2, 9 to 10 psi)] to the checking rubber hose, and see whether the waste gate valve link operates or not.

Excessive pressure may cause damage to the waste gate valve control diaphragm. Be sure to check that the pressure is 59 to 69 kPa (0.6 to 0.7 kg/cm^2, 9 to 10 psi) with a pressure gauge before applying.

SUPERCHARGING PRESSURE

1) Disconnect the duty solenoid connector.
2) 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.
3) 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.

DUTY SOLENOID VALVE (WASTE GATE CONTROL)

1) Disconnect the duty solenoid connector.
2) Measure resistance between the terminals of connector (solenoid side).

Specified resistance:
17 – 21Ω [at 20°C (68°F)]

If resistance is outside specifications, replace the solenoid.
3) Measure resistance between each terminal of solenoid connector and the body.

Specified resistance:
1 MΩ, min.

If resistance is outside specifications, replace the solenoid.

TURBOCHARGER

Oil leakage from the exhaust gas side (turbine side)

Remove the center exhaust pipe and examine the turbocharger from the exhaust gas side.
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.)

Oil leakage from the inlet side (blower side)

1) The turbocharger is not necessarily leaking oil when oil is present on the blower side. The oil is likely to have come from oil mists contained in the blowby gases flow in the inlet system.
2) 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)

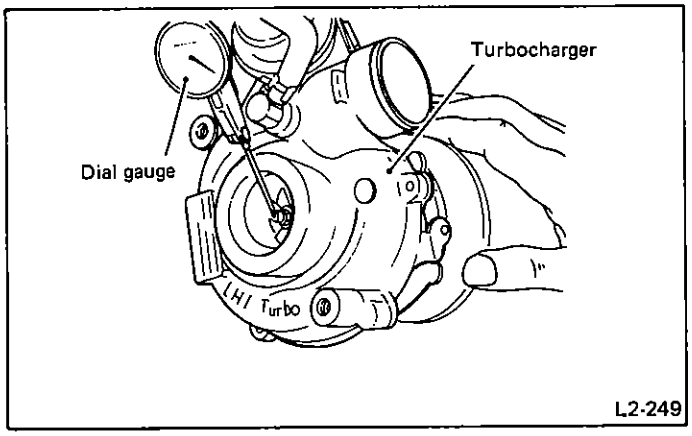


Fig. 111

b. Radial rattling:
0.17 mm (0.0067 in) when the turbine side and blower side of the shaft are moved circumferentialy at the same time.

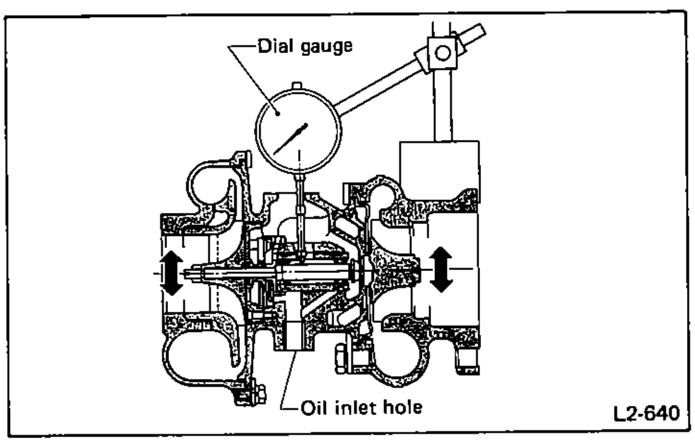


Fig. 112

If anything unusual is found, replace the turbocharger.

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 turbocharger 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 operation.

Oil leakage from the connection of the oil delivery pipe

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)

Coolant leakage from connection of the cooling pipe

Visually check the connection between turbocharger and cooling pipe, between engine cylinder head and cooling pipe, and the hose clamped area for leakage of coolant. If leakage is detected, replace the washer at the union screw, and tighten the screw to the specified torque. Check the hose for cracks and damage at the clamped area before tightening the clamp. If the hose is faulty, replace with a new one.

Tightening torque:
22 – 25 N·m
(2.2 – 2.5 kg-m, 16 – 18 ft-lb)

Air Intake System

Air Cleaner Assembly

REMOVAL AND INSTALLATION

1) Disconnect connector from air flow meter.
2) Remove engine harness from clip.
3) Loosen hose clamps securing air intake boot, and remove air intake boot connecting with air flow meter.
4) Remove bolts, and detach the air cleaner ASSY from chamber.
5) Move air cleaner ASSY toward engine, and take it out from body.

Installation is in the reverse order of removal procedure.

Chamber Assembly

REMOVAL AND INSTALLATION

1) Remove mud guard.
2) Remove washer tank.
3) Remove nuts, and remove chamber ASSY from body.

Installation is in the reverse order of removal procedure.

TURBO Cover

REMOVAL AND INSTALLATION

1) Remove TURBO cover A.
2) Remove one bolt securing TURBO cover B to center exhaust pipe.
3) Remove turbocharger.
4) Remove TURBO cover B from front exhaust pipe.

Installation is in the reverse order of removal procedure.

TROUBLESHOOTING

General Troubleshooting Table

*: The CHECK ENGINE light blinks.
*1: The CHECK ENGINE light blinks when contact is resumed during inspection (although poor contact is present in the D-check).
*2: The CHECK ENGINE light lights when the mixture is leaner than that specified and does not light (U-check) or blink (D-check) when the mixture is richer.
*3: The CHECK ENGINE light lights when abnormality is detected in the D-check mode if the idle switch persistently remains off with the accelerator pedal released.

Symbols shown in the table refer to the degree of possibility of the reason for the trouble ("Very often" to "Rarely").

◎ : Very often
○ : Sometimes
△ : Rarely
☆ : Occurs only in extremely low temperatures

	TROUBLE	
1	Engine will not start	No initial combustion
2		Initial combustion occurs.
3		Engine stalls after initial combustion.
4	Rough idle and engine stall	
5	Inability to drive at constant speed	
6	Inability to accelerate and decelerate	
7	Engine does not return to idle.	
8	Afterburning in exhaust system	
9	Knocking	
10	Excessive fuel consumption	
11		
U	CHECK ENGINE light operation	U-check mode & read memory mode
D		D-check mode

TROUBLE No.											CHECK ENGINE light		POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10		U	D	
													AIR FLOW METER
		☆	◎				△	△	○		ON	ON	• Connector not connected
		△	◎	◎	◎		◎	○	△		ON	*1	• Poor contact of terminal
		☆	◎				△	○	△		ON	ON	• Short circuit
		☆	◎				△	△	○		ON	ON	• Discontinuity of wiring harness
		○	○	○	○		△	◎	○		*2	*2	• Performance characteristics unusual
													COOLANT THERMOSENSOR
	☆	○	☆		○		○	○	○		ON	ON	• Connector not connected
	△	△	◎	○	○		◎	△	○		ON	*1	• Poor contact of terminal
	☆	○	☆		○		○	○	○		ON	ON	• Short circuit
	☆	○	☆		○		○	○	○		ON	ON	• Discontinuity of wiring harness
	☆	○	☆		○		◎	◎	◎		*2	*2	• Performance characteristics unusual
													IDLE SWITCH OF THROTTLE SENSOR
				○	◎		◎				OFF	ON	• Connector not connected
				○			○				ON	*1	• Poor contact of terminal
				○	△		○				ON	ON	• Short circuit
					△		○				OFF	ON	• Discontinuity of wiring harness
							○				OFF	*3	• Improper adjustment
1	2	3	4	5	6	7	8	9	10		U	D	

TROUBLE No.											CHECK ENGINE light		POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10		U	D	
													THROTTLE SENSOR
					◎		◎				ON	ON	● Connector not connected
				◎	◎		◎				ON	*1	● Poor contact of terminal
Δ					◎		◎				ON	ON	● Short circuit
					◎		◎				ON	ON	● Discontinuity of wiring harness
	○	○	Δ	○	◎		◎				OFF	*	● Performance characteristics unusual
													PRESSURE REGULATOR
	○	○	◎	◎	◎	○		Δ			*2	*2	● Sensing hose not connected
	Δ				○		○		◎		OFF	*	● Fuel pressure too high
○	○	○	◎	◎	◎		◎				*2	*2	● Fuel pressure too low
													FUEL INJECTOR
	◎	◎	○	○	○		○	○			ON	*1	● Connector not connected
	○	○	○	◎	◎		○				ON	ON	● Poor contact of terminal
	◎	◎	○	○	○		○				ON	ON	● Short circuit
	◎	◎	○	○	○		○	○			ON	ON	● Discontinuity of wiring harness
	Δ	○	○	Δ	○		○	Δ	○		*2	*2	● Performance characteristics unusual
	Δ	○	Δ	Δ	○		○	Δ			*2	*2	● Clogged filter
	Δ	○	○	○	○		○	Δ			*2	*2	● Clogged nozzle
○											OFF	*	● Stuck open
			○				○		○		OFF	*	● Slight leakage from seat
													CRANK ANGLE SENSOR
◎											ON	ON	● Connector disconnected
	○	○	◎	◎	◎		○	○			ON	*1	● Poor contact of terminal
◎											ON	ON	● Short circuit
◎											ON	ON	● Discontinuity of wiring harness
													POWER TRANSISTOR OF IGNITION COIL
◎											OFF	*	● Connector not connected
	○	○	◎	◎	◎		○				OFF	*	● Poor contact of terminal
◎											OFF	*	● Short circuit
◎											OFF	*	● Discontinuity of wiring harness
													AIR REGULATOR
						◎					OFF	*	● Connector not connected
	○	◎	○								OFF	*	● Short circuit
						◎					OFF	*	● Discontinuity of wiring harness
													KNOCK SENSOR
								◎			ON	ON	● Connector not connected
				○	○						ON	ON	● Short circuit
								◎			ON	ON	● Discontinuity of wiring harness
													DUTY SOLENOID
					Δ						OFF	*	● Connector disconnected
											OFF	*	● Poor contact of terminal
								○			OFF	*	● Short circuit
					Δ						OFF	*	● Discontinuity of wiring harness
			○	○	○	○	○	○			OFF	*	● Disconnected or cracked hose
1	2	3	4	5	6	7	8	9	10		U	D	

TROUBLE No.											CHECK ENGINE light		POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10		U	D	
													ENGINE GROUNDING
○											ON		● Disconnected engine grounding terminal at intake manifold
◎	◎	○	◎	◎	◎						ON	*1	● Poor contact of engine grounding terminal
○											ON		● Discontinuity of wiring harness for engine grounding

Self-diagnosis System

General

The self-diagnosis system detects and indicates a fault in various inputs and outputs of the complex electronic control. The warning lamp (CHECK ENGINE light) on the instrument panel indicates occurrence of a fault or trouble, and also the light emitting diode (LED) in the control unit indicates a trouble code.
Further, against such a failure of sensors as may disable the drive, the fail-safe function is provided to ensure the minimal driveability.

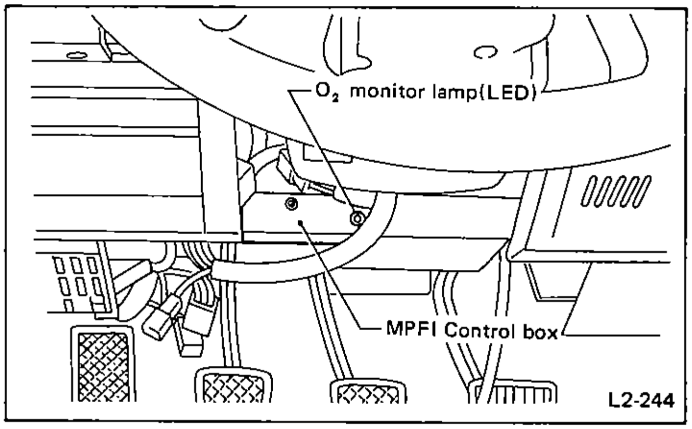


Fig. 113

SELF-DIAGNOSIS FUNCTION

The MPFI control unit executes the computational processing on the input information received from various sensors and produces the output information for driving the fuel injector, fuel pump, etc.
Along with this computational processing, it reads out all the input/output information to examine matching with the predetermined levels (proper values or ranges). If a predetermined level is not satisfied, i.e., a fault is found, the warning lamp is signaled to a driver. In this fashion, the self-diagnosis function is performed.

FAIL-SAFE FUNCTION

For the part which has been judged faulty in the self-diagnosis, the MPFI control unit generates the associated pseudo signal (only when convertible to electric signal) and carries out the computational processing. In this fashion, the fail-safe function is performed.

Function of Self-diagnosis

The self-diagnosis function has four modes: U-check mode, Read memory mode, D-check mode and Clear memory mode. Two connectors (Read memory and Test mode) and two lamps (CHECK ENGINE light and O_2 monitor) are used. The connectors are for mode selection and the lamps monitor the type of problem.

RELATIONSHIP BETWEEN MODES AND CONNECTORS

Mode	Engine	Read memory connector	Test mode connector
U-check	Ignition ON	DISCONNECT	DISCONNECT
Read memory	Ignition ON	CONNECT	DISCONNECT
D-check	Ignition ON	DISCONNECT	CONNECT
Clear memory	Ignition ON (engine on)	CONNECT	CONNECT

U-CHECK MODE

The U-check is a user-oriented mode in which only the MPFI components necessary for start-up and drive are diagnosed. On occurrence of a fault, the warning lamp (CHECK ENGINE light) is lighted to indicate to the user that the dealer's inspection is necessary. The diagnosis of other parts which do not give significant adverse effect to start-up and drive are excluded from this mode in order to avoid unnecessary uneasiness to be taken by the user.

READ MEMORY MODE

This mode is used by the dealer to read past problems (even when the vehicle's monitor lamps are off). It is most effective in detecting poor contact or loose connections of connectors, harnesses, etc.

D-CHECK MODE

This mode is used by the dealer to check the entire MPFI system and detect faulty parts.

CLEAR MEMORY MODE

This mode is used by the dealer to clear the trouble code from the memory after the affected part is repaired.

Basic Operation of Self-diagnosis System

NO TROUBLE

O : CONNECT X : DISCONNECT

Engine	Read memory connector	Test mode connector	CHECK ENGINE light	O_2 monitor lamp	Remarks
ON	X	X	OFF	O_2 monitor	
ON	O	X	OFF	O_2 monitor	
*ON	X	O	** OFF → Blink	OFF	Vehicle specification code is outputted when CHECK ENGINE light is OFF.
*ON	O	O	OFF → Blink	OFF	All memory stored in control unit is cleared after CHECK ENGINE light blinks.
OFF (Ignition switch ON)	O	X	ON	Vehicle specification code	Before starting the engine, the self-diagnosis system assumes the engine to be in NO TROUBLE condition.
OFF (Ignition switch ON)	X	X	ON	Vehicle specification code	
OFF (Ignition switch ON)	X	O	ON	Vehicle specification code	
OFF (Ignition switch ON)	O	O	ON	Vehicle specification code	

TROUBLE

Engine	Read memory connector	Test mode connector	CHECK ENGINE light	O_2 monitor lamp	Remarks
ON	X	X	ON	Trouble code	
ON	O	X	ON	Trouble code (memory)	
*ON	X	O	** OFF → ON	Trouble code	Vehicle specification code is outputted when CHECK ENGINE light is OFF.
*ON	O	O	** OFF → ON	Trouble code	
OFF (Ignition switch ON)	O	X	ON	Trouble code (memory)	
STALL (Ignition switch ON)	X	X	ON	Trouble code	
STALL (Ignition switch ON)	X	O	ON	Trouble code	
STALL (Ignition switch ON)	O	O	ON	Trouble code	

***: Ignition timing is set to 20° BTDC (when the engine is on, test mode connector is connected, and idle switch is ON).**
****: CHECK ENGINE light remains off until engine is operated at speed greater than 2,000 rpm for at least 40 seconds.**

List of Trouble Codes

Trouble code	Item	See page
11	Crank angle sensor (No reference pulse)	p128
12	Starter switch (Continuously in ON position or continuously in OFF position while cranking)	p130
13	Crank angle sensor (No position pulse)	p131
14	Fuel injectors #1 and #2 (Abnormal injector output)	p133
15	Fuel injectors #3 and #4 (Abnormal injector output)	p134
21	Water temperature sensor (Open or shorted circuit)	p135
22	Knock sensor (Open or shorted circuit)	p136
23	Air flow meter (Open or shorted circuit)	p137
31	Throttle sensor (Open or shorted circuit)	p138
32	O_2 sensor (Abnormal sensor signal)	p139
33	Car-speed sensor (No signal is present during operation)	p141
*34	EGR solenoid valve (Solenoid switch continuously in ON or OFF position)	p142
35	Purge control solenoid valve (Solenoid switch continuously in ON or OFF position)	p143
41	System too lean	p144
42	Idle switch (Abnormal idle switch signal in relation to throttle sensor output)	p145
44	Duty solenoid valve (Waste gate control)	p147
51	Neutral switch (Continuously in ON position)	p146

***: Except California model**

List of Specification Codes

Specification codes	Specification
01	MT, 49-state and Canada
02	MT, California
03	AT, 49-state and Canada
04	AT, California

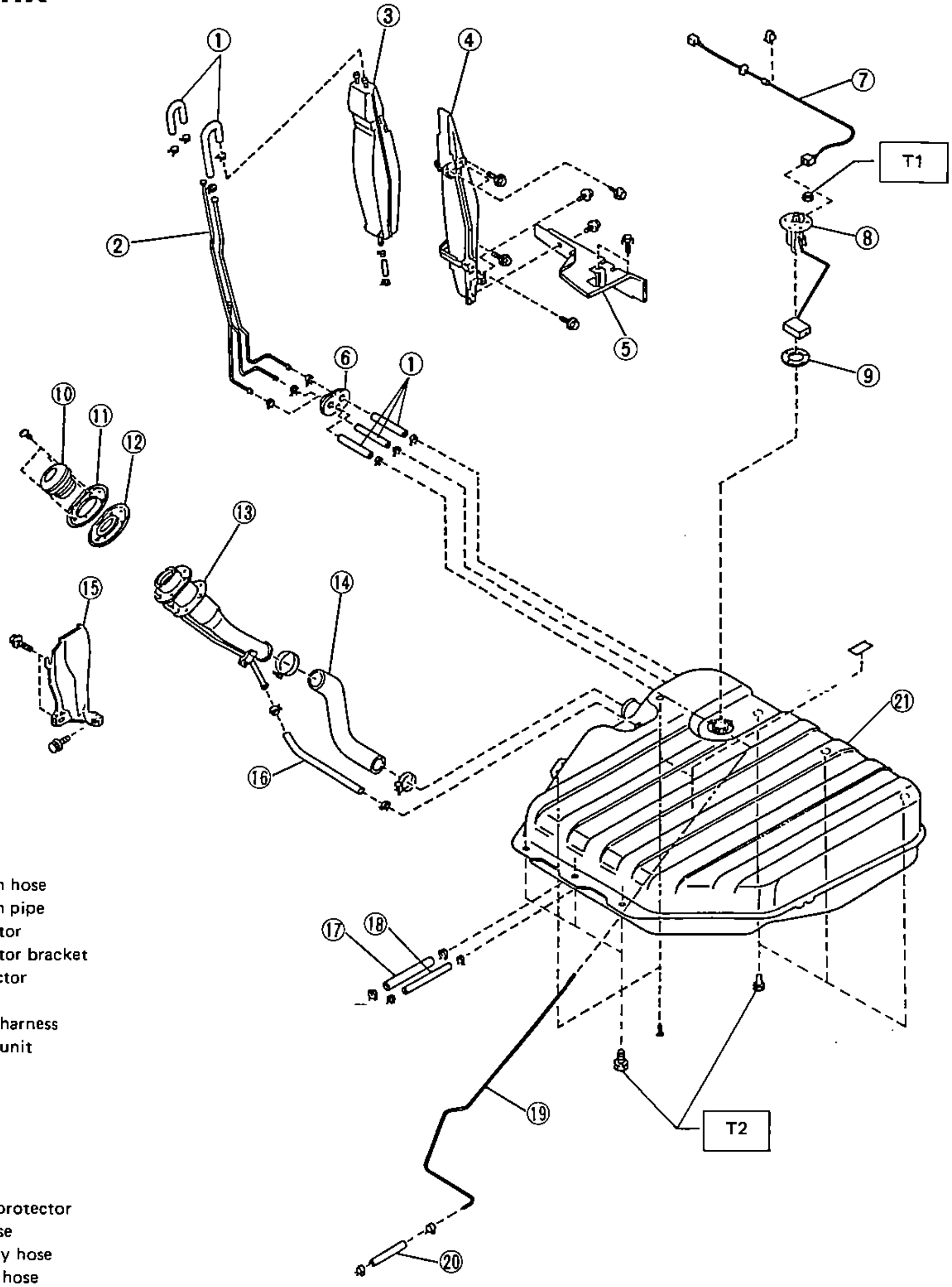
SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

Item		MPFI model	SPFI model
Fuel tank	Capacity	60ℓ (15.9 US gal, 13.2 Imp gal)	
	Location	Under rear floor	
Fuel pump	Type	Electromagnetic pin roller	
	Discharge pressure	422 – 490 kPa (4.3 – 5.0 kg/cm², 61 – 71 psi)	245 – 343 kPa (2.5 – 3.5 kg/cm², 36 – 50 psi)
	Discharge flow	95ℓ (25.1 US gal, 20.9 Imp gal)/H min. [12 V at 299.1 kPa (3.05 kg/cm², 43.4 psi)]	80ℓ (21.1 US gal, 17.6 Imp gal)/H min. [12 V at 147 kPa (1.5 kg/cm², 21 psi)]
Fuel filter		Cartridge type	
Fuel separator	Capacity	1,250 mℓ (42.3 US fl oz, 44.0 Imp fl oz)	

COMPONENT PARTS

Fuel Tank



1 Evaporation hose
2 Evaporation pipe
3 Fuel separator
4 Fuel separator bracket
5 Hose protector
6 Grommet
7 Fuel meter harness
8 Fuel meter unit
9 Gasket
10 Filler cap
11 Ring
12 Packing
13 Filler pipe
14 Filler hose
15 Filler hose protector
16 Air-vent hose
17 Fuel delivery hose
18 Fuel return hose
19 Evaporation pipe
20 Evaporation hose
21 Fuel tank

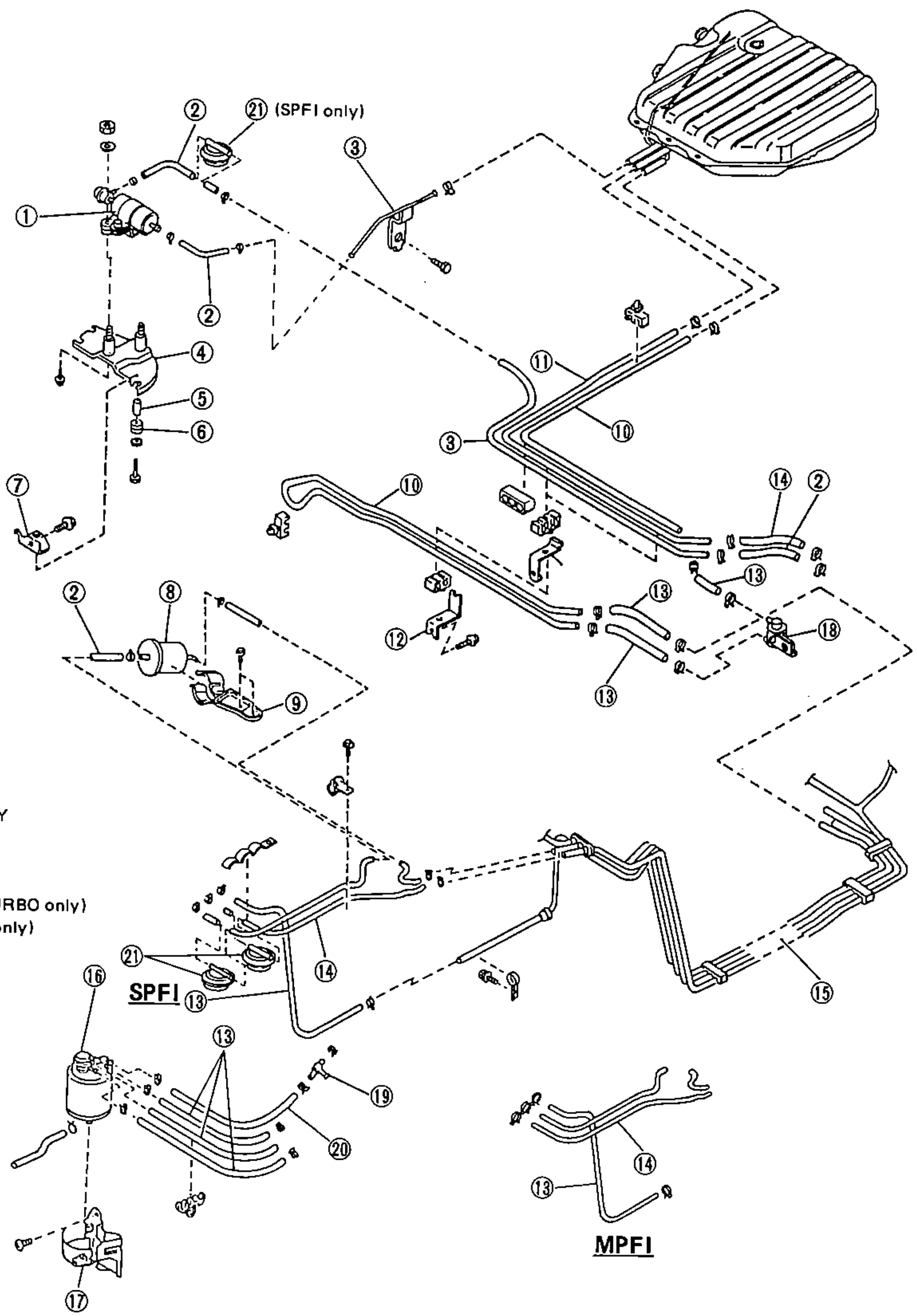
Tightening torque N·m (kg-m, ft-lb)
T1: 1.8 - 3.1 (0.18 - 0.32, 1.3 - 2.3)
T2: 13 - 23 (1.3 - 2.3, 9 - 17)

Fig. 3

L2-606

COMPONENT PARTS

Fuel Lines



1 Fuel pump
2 Fuel delivery hose
3 Fuel delivery pipe
4 Pump bracket
5 Spacer
6 Cushion
7 Pump bracket
8 Fuel filter
9 Filter bracket
10 Evaporation pipe
11 Fuel return pipe
12 Pipe stay
13 Evaporation tube
14 Fuel return hose
15 Fuel center pipe ASSY
16 Canister
17 Canister bracket
18 2-way valve
19 Evaporation tube (TURBO only)
20 Purge pipe (TURBO only)
21 Fuel damper

Fig. 3

L2-1691

SERVICE PROCEDURE

a. Before starting the job, be sure to carry out the following.
1) Place "No fire" signs near the working area.
2) Disconnect ground cable from battery.
b. Be careful not to spill fuel on the floor.

Fuel Tank

REMOVAL

1) Remove muffler and rear differential ASSY. (4WD model only)
2) Remove fuel filler cap and drain fuel from fuel tank.
3) Remove fuel filler pipe protector.

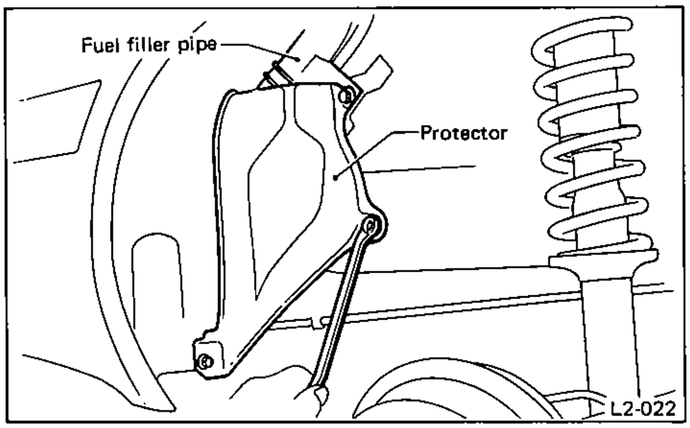


Fig. 5

4) Remove clamp and disconnect fuel filler hose from fuel filler pipe.
5) Remove clamp and disconnect air vent hose from fuel filler pipe.
6) Loosen clips and disconnect delivery hose, return hose and evaporation tube from fuel tank.
7) While holding fuel tank, remove six mounting bolts from fuel tank and dismount it.

a. Two men are required to perform step 7) above.
b. Have a helper support fuel tank, as shown in the figure, when disconnecting fuel meter harness or evaporation tube.

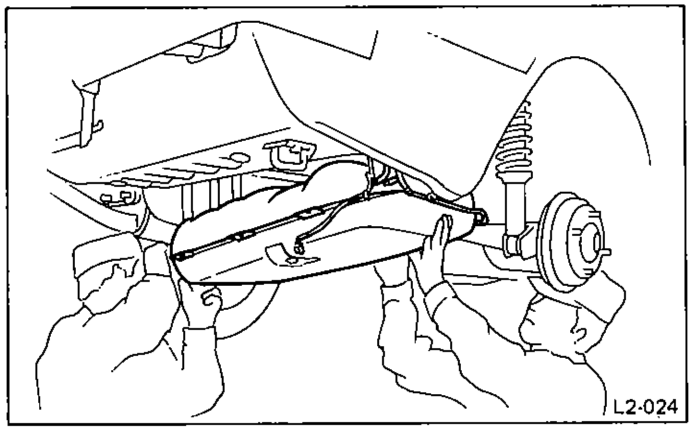


Fig. 6

8) Disconnect harness connector from fuel meter unit.
9) Loosen clips, disconnect evaporation tube, and dismount fuel tank.

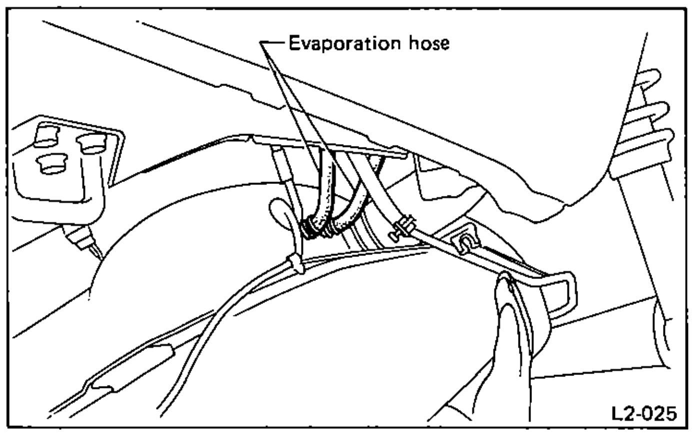


Fig. 7

INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:
1) When installing fuel tank, have a helper hold fuel tank while connecting hoses, tubes and harness connector.
2) Before tightening fuel tank mounting bolts, make sure hoses, harnesses, etc. are not caught between fuel tank and car body.

3) Install hose and tube holddown clips at positions indicated in the figure.

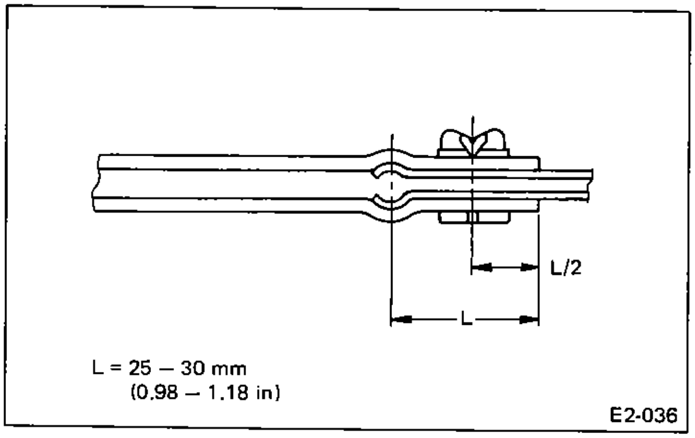


Fig. 8

Fuel Meter Unit

REMOVAL

1) Remove floor mat from luggage compartment.
2) Remove access hole lid.
3) Disconnect harness connector from fuel meter unit.

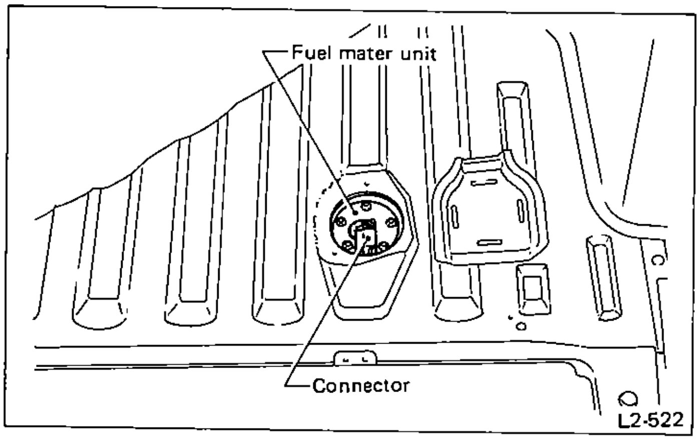


Fig. 9

4) Remove five nuts and detach fuel meter unit.

INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:

(1) Discard old packing (85025GA030) after removal. Replace with new packing.
(2) Ensure sealing portion is free from fuel or foreign particles before installation.
(Wipe tank mounting holes, packing, etc. clean with a cloth.)
(3) Tighten nuts in numerical sequence shown below, to specified torque.

Tightening torque:
1.8 – 3.1 N·m (18 – 32 kg-cm, 16 – 28 in-lb)

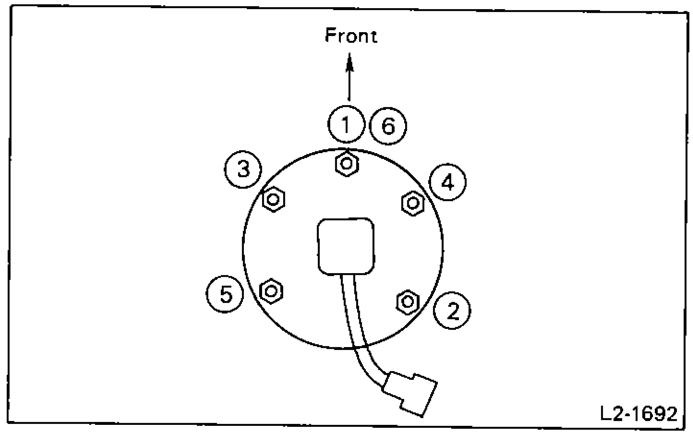


Fig. 5

(4) Apply a sealant to the edge of access hole lid before installation.

Fuel Filler Pipe

REMOVAL

1) Completely drain fuel from fuel tank.
2) Remove right rear tire.
3) Open fuel filler flap and remove filler cap.
4) Remove three screws holding packing in place.
5) Remove fuel filler pipe protector.
6) Remove clips and disconnect fuel filler hose and air vent hose from fuel filler pipe.

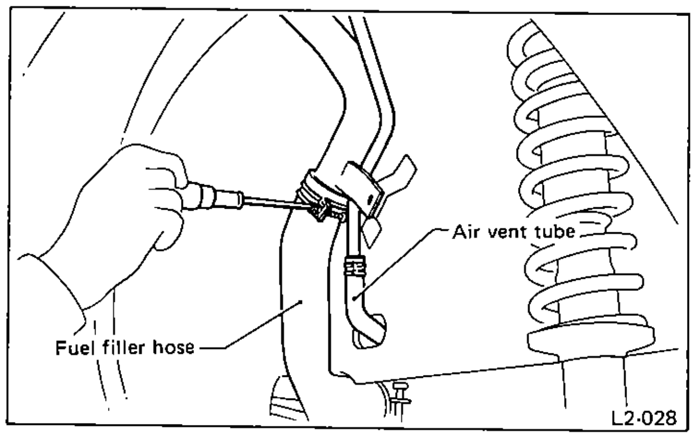


Fig. 10

SERVICE PROCEDURE

7) Disconnect fuel filler pipe from underside of car.

INSTALLATION

1) Hold fuel filler flap open.
2) Insert fuel filler pipe into hole in fuel saucer from the inner side of apron. Align holes in fuel filler pipe neck and packing and tighten screws.

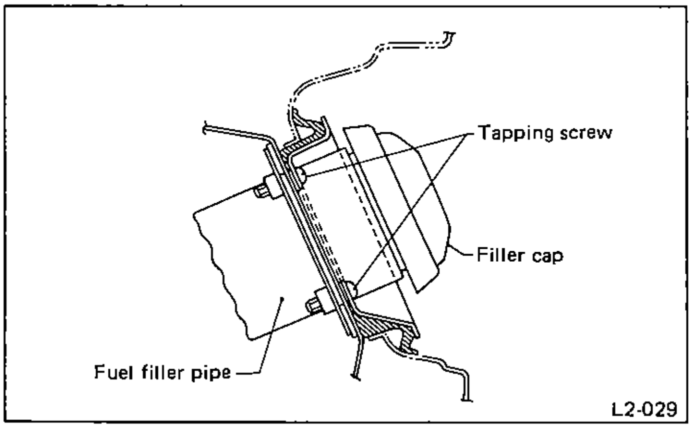


Fig. 11

3) If edges of rubber packing are folded toward the inside, straighten it with a standard screwdriver.
4) Insert fuel filler hose approximately 25 to 30 mm (0.98 to 1.18 in) over the lower end of fuel filler pipe and tighten clamps. Do not allow clips to touch protector and air vent pipe.
5) Insert air vent hose approximately 25 to 30 mm (0.98 to 1.18 in) into the lower end of air vent pipe and tighten with clips, as shown in figure.

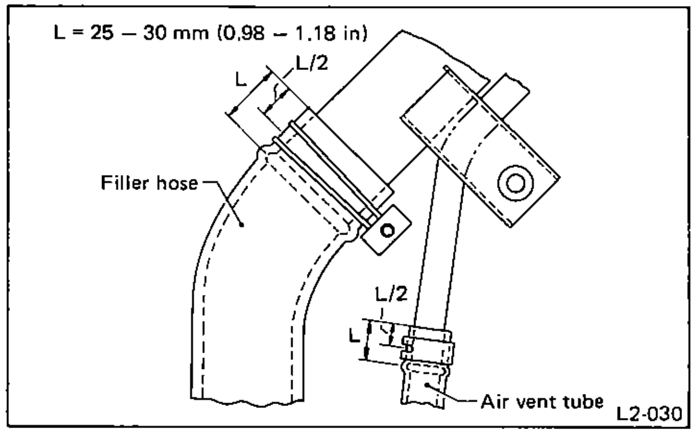


Fig. 12

6) Install protector together with fuel filler pipe. Check to be sure clamp for filler hose and clip for air vent hose do not touch apron.

Fuel Separator

REMOVAL

1) Remove right trim from luggage compartment.
2) Remove hose protector.
3) Remove fuel separator and bracket as a unit. Be sure not to scratch the inner side of car body.
4) Disconnect evaporation tube from pipe held to bracket.

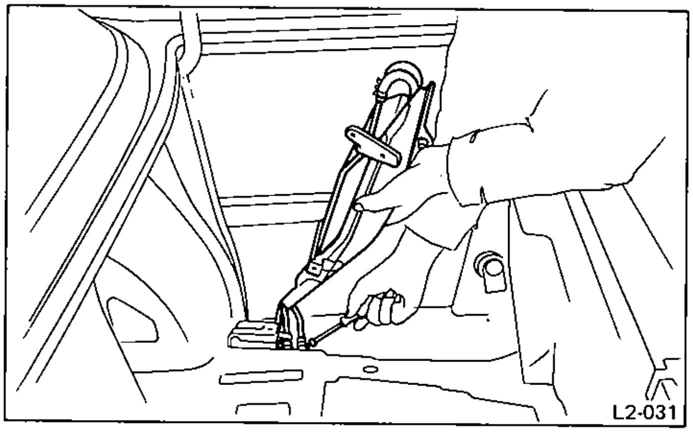


Fig. 13

5) Remove fuel separator from bracket.
6) Disconnect tube from fuel separator.

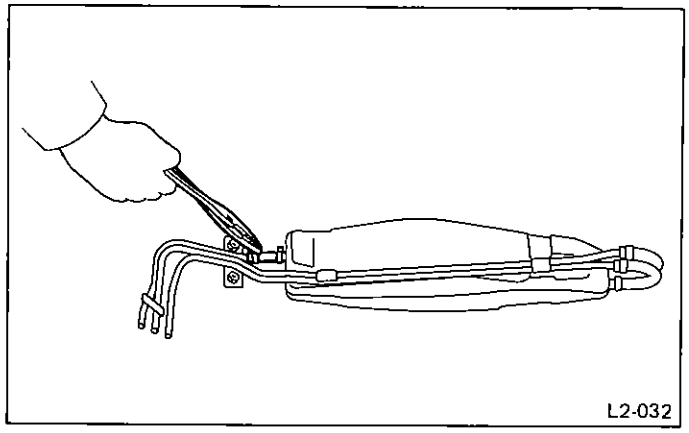


Fig. 14

INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:

1) When connecting tube between fuel separator and pipe, insert until it butts up against nipple on the separator side, and insert the other end up to the marked position on the pipe side.
2) Install fuel separator on bracket such that the pipe can run through the hollowed section of separator.

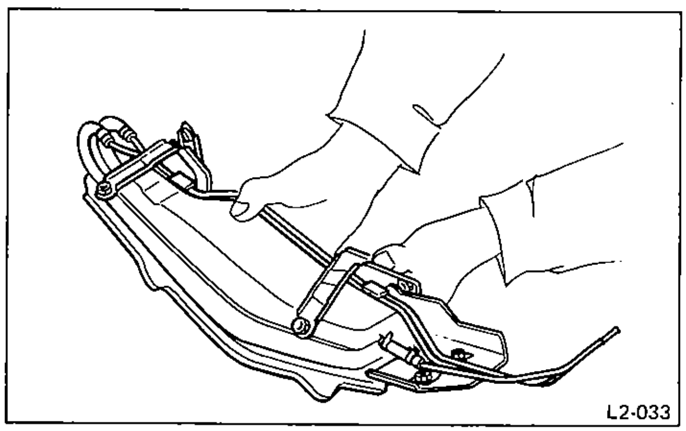


Fig. 15

3) Be sure to insert evaporation tube approximately 15 to 20 mm (0.59 to 0.79 in) into pipe on bracket. Install clips in a direction which does not touch other tubes.

Fuel Filter

REMOVAL

1) The fuel system is pressurized. Before removing the hose, filter, pump, etc., be sure to release the fuel pressure, as follows:

(1) Disconnect the wiring connector of the fuel pump.

(2) Crank the engine for more than five seconds.

If the engine starts, let the engine run until it stops.

(3) After turning IG switch to OFF, connect the wiring connector of the fuel pump.

2) Loosen the screw of the hose clamp and pull off the hose from the filter.

3) Remove the filter from the holder.

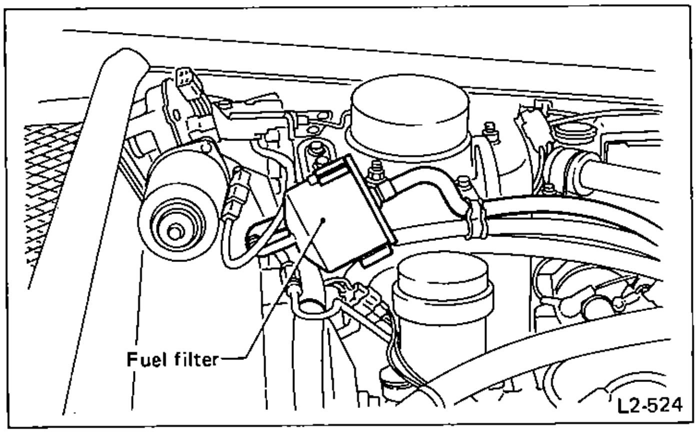


Fig. 16

INSPECTION

1) Check the inside of the filter for dirt and water sediment.

2) If the filter is clogged or cracked, or if the replacement interval has been reached, replace the filter.

3) If water is found in the filter, shake the filter with its inlet port facing down, to expel the water.

INSTALLATION

1) Connect the hose as illustrated below:

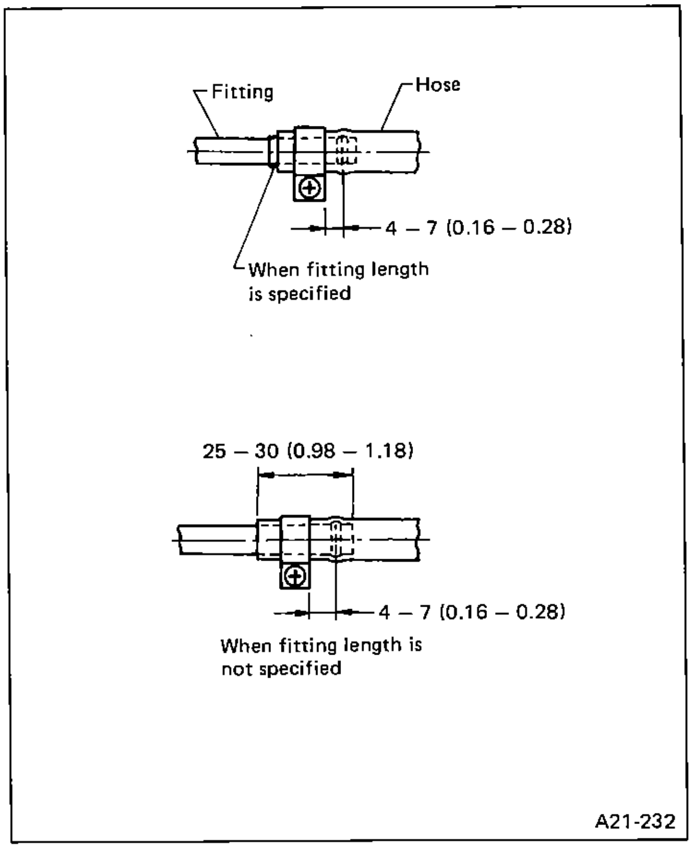


Fig. 17

2) Tighten the hose clamp screw to the specified torque.

Tighting torque:
1.0 - 1.5 N·m (0.1 - 0.15 kg-m, 0.7 - 1.1 ft-lb)

3) If the hose is damaged at the clamping portion, replace the hose with a new one.

4) If the hose clamp is too deformed, replace with a new one.

5) Fit the hose to the filter, then install the filter to the holder. Correct the hose position by removing any twist so that it will not interfere with the filter body or washer tank, before tightening the screw of the hose clamp.

Fuel Pump

REMOVAL

1) Release the pressure of the fuel system.

Refer to "REMOVAL 1)" in Fuel Filter for MPFI & SPFI MODELS.

2) Keep the pump harness connector disconnected.
3) Jack up the vehicle.
4) Clamp the middle portion of the thick hose connecting the pipe (coupling) and pump. Prevent the fuel from flowing out of the fuel tank.

Do not bend the hose sharply; otherwise, it may be damaged.

5) Loosen the hose clamp, and disconnect the hose.
6) Remove three pump bracket mounting bolts, and remove the pump together with the pump damper.

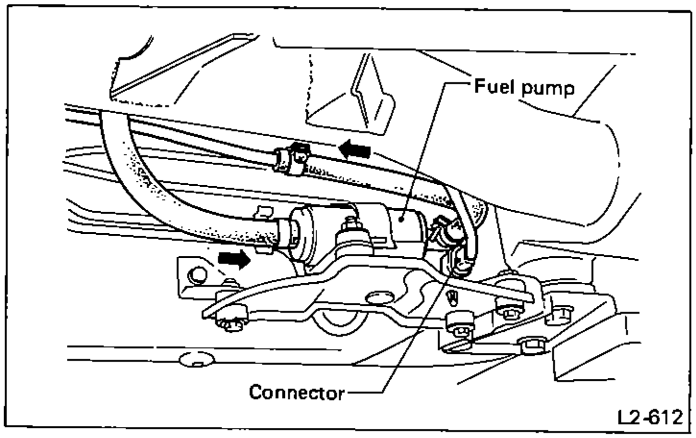


Fig. 18

INSPECTION

1) Connect the leads to the harness connector, and apply a 12-volt power supply to check whether the pump operates.

a. Keep the battery apart from the pump as far as possible.
b. Be sure to turn the 12 V supply ON and OFF on the battery side.
c. Do not run the pump for a long time under non-loaded condition.

INSTALLATION

1) If the pump and damper have been removed from the pump bracket, tighten the mounting bolts to the specified torque.
2) Install the hose using the same procedure as that explained in "Fuel Filter"
3) Install the pump bracket in position to the vehicle body, and secure it with bolts.

Use care not to drop the spacer of the cushion rubber.

4) Install the hose.
5) Connect the pump harness connector.
6) Run the pump and check for fuel leaks.

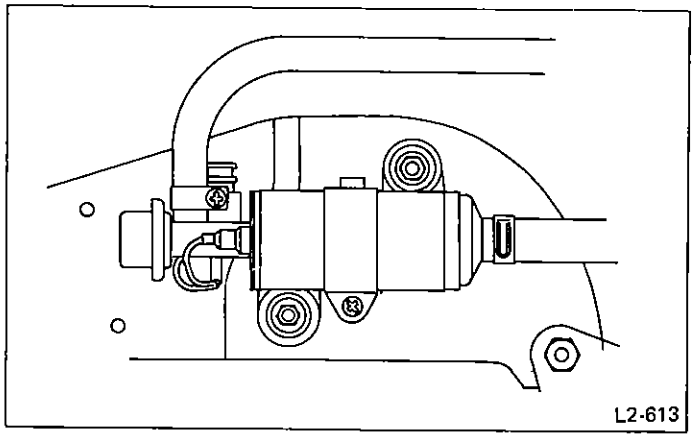


Fig. 19

Fuel Delivery, Return and Evaporation Lines

REMOVAL

1) Under body floor, detach fuel delivery hoses, return hoses, evaporation tubes and 2-way valve.

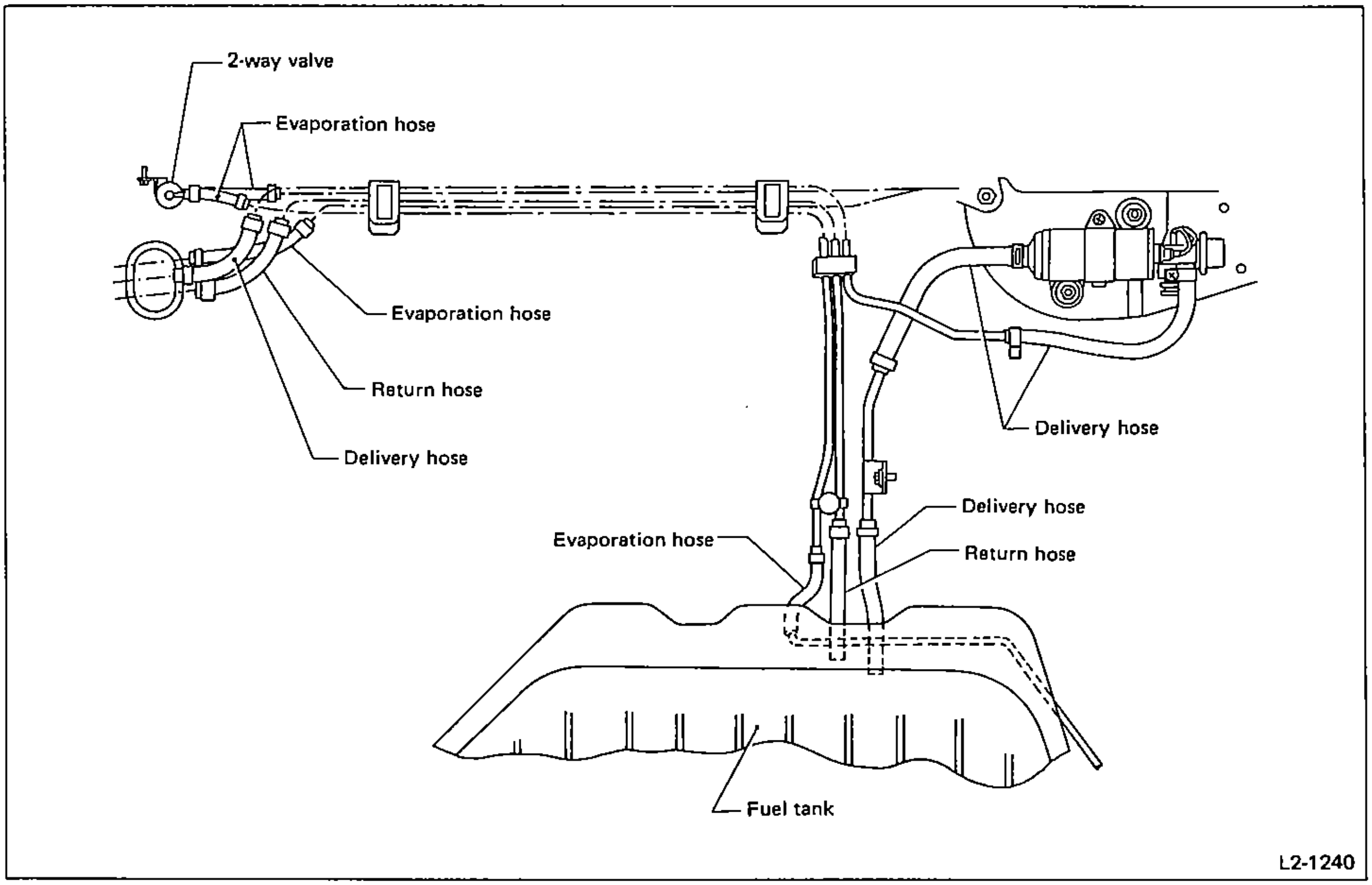


Fig. 20

2) In engine compartment, detach fuel delivery hoses, return hoses, evaporation tubes and canister.

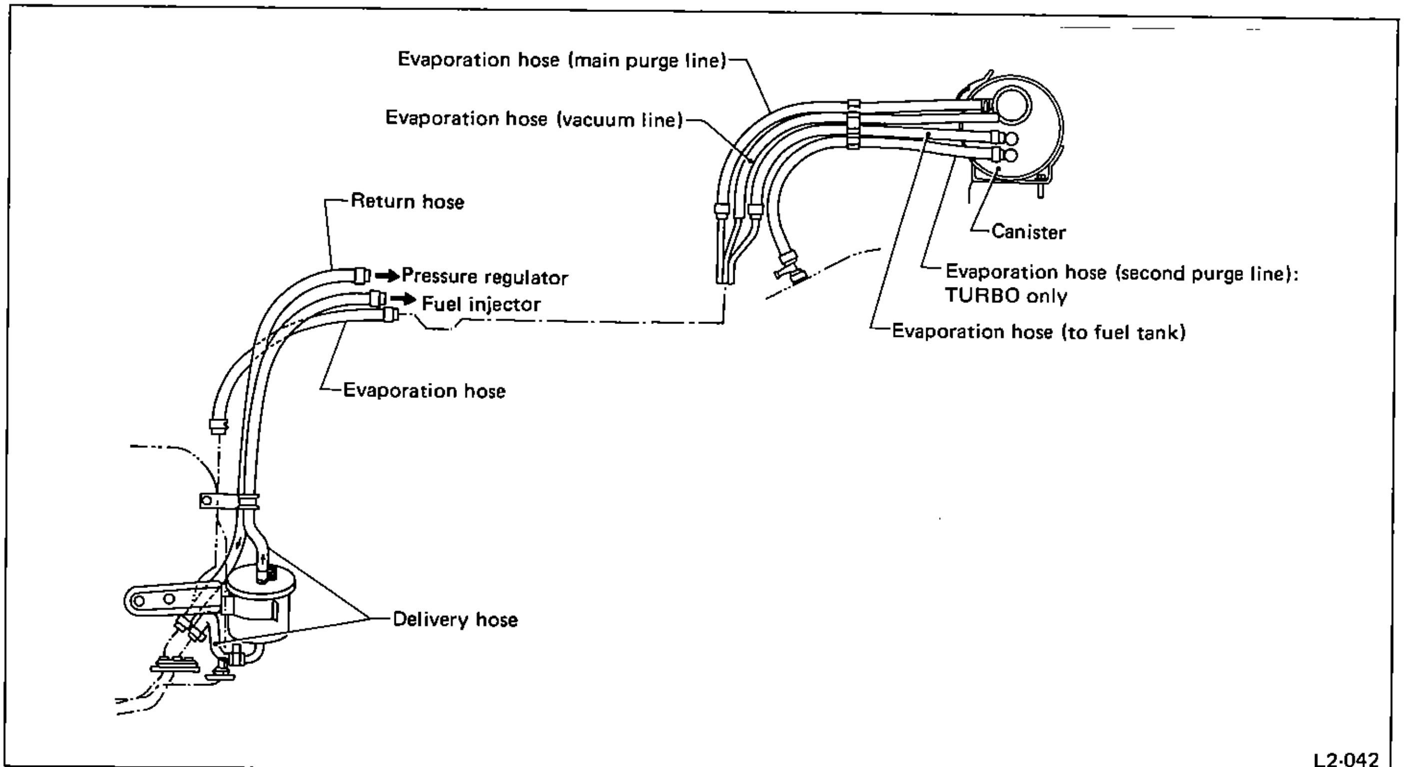


Fig. 21

INSTALLATION

Install in the reverse order of removal.

1) Connect delivery hose to delivery pipe with an overlap of 25 to 30 mm (0.98 to 1.18 in).

2) Connect delivery hoses and fuel return hose to fuel tank, fuel pump and fuel filter until they reach the base of each pipe.

3) Insert evaporation tube into evaporation pipe by approx. 15 mm (0.59 in) and position a clip with approx. 8 mm (0.31 in) from hose end.

4) When installing 2-way valve, install it with its "TO ENGINE" mark facing downward.

5) Be sure to inspect hoses and their connections for any leakage of fuel.

SUBARU

1989

SERVICE MANUAL

6 ELECTRICAL SECTION

ABBREVIATION LIST

A/C pulley	Air Conditioner Pulley
A/D converter	Analog/Digital converter
ALT	Alternator
A/S	Air Suspension
ASSY	Assembly
ASV	Air Suction Valve
AT	Automatic Transmission
ATF	Automatic Transmission Fluid
AVG speed	Engine Average speed
BAT	Battery
Cal	California
CP	Complete
C/P	Crankshaft Pulley
DIFF. LOCK	Differential Lock
ECC	Electronically Controlled Carburetor
ECM	Electronic Control Module
ECS	Electric Control System
ECU	Electronic Control Unit
E/G	Engine
EGR	Exhaust Gas Recirculation
ETR	Electronic Tuning Radio
FCV	Float Chamber Ventilation
FICD	Fast Idle Control Device
FLT	Fluorescent
GND	Ground
IC	Integrated Circuit
IGN	Ignition
INT	Intermittent
I/P	Idler Pulley
LCD	Liquide-Crystal Display
LED	Light Emitting Diode
LH	Left-Hand
LSI	Large Scale Integrated Circuit
MPFI	Multi Point Fuel Injection
MT	Manual Transmission
OD	Outer Diameter
P/S pulley	Power Steering Pulley
REV sensor	Revolution sensor
RH	Right-Hand
SPFI	Single Point Fuel Injection
S/r	Single-range
SW	Switch
VLC	Vacuum Line Control
W/P pulley	Water Pump Pulley

SUBARU

1989

SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

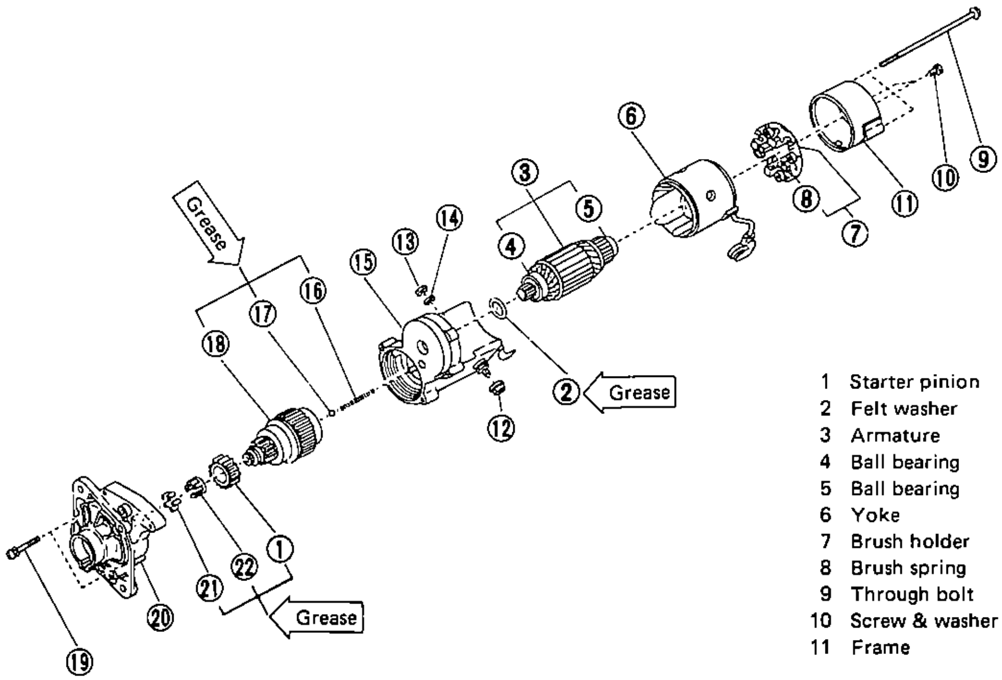
Item			Designation	
Starter	Type		Reduction type	
	Model		[MT] 028000-8581	[AT] 028000-9800
	Manufacturer		NIPPONDENSO	
	Voltage and Output		12V – 1.0 kW	12V – 1.4 kW
	Direction of rotation		Counterclockwise (when observed from pinion)	
	Number of pinion teeth		9	
	No-load characteristics	Voltage	11.5V	11V
		Current	90 A or less	
		Rotating speed	3,000 rpm or more	4,000 rpm or more
	Load characteristics	Voltage	8V	8V
		Current	230A or less	370A or less
		Torque	6.4 N·m (0.65 kg-m, 4.7 ft-lb)	14 N·m (1.4 kg-m, 10 ft-lb)
		Rotating speed	1,180 rpm or more	880 rpm or more
	Lock characteristics	Voltage	2.5V	5V
		Current	300A or less	735A or less
		Torque	7 N·m (0.7 kg-m, 5.1 ft-lb) or more	27 N·m (2.8 kg-m, 20 ft-lb) or more
Alternator	Type		Rotating-field three-phase type, Voltage regulator built-in type	
	Model		LR160-137 or LR160-138	
	Regulator type		TR1Z-56 (IC)	
	Manufacturer		HITACHI	
	Voltage and Output		12V – 60A	
	Polarity on ground side		Negative	
	Rotating direction		Clockwise (when observed from pulley side)	
	Armature connection		3-phase Y-type	
	Rectifying system		Full wave rectification by six self-contained silicone diodes	
	Revolution speed at 13.5 V 20°C (68°F)		1,000 rpm or less	
	Output current		1,250 rpm – 18A or more 2,500 rpm – 49A or more 5,000 rpm – 58A or more	
	Regulated voltage		14.1 – 14.8V [20°C (68°F)]	

	Item		Designation
Distributor	Type		Breakerless type with control unit
	Model		D4P84-03
	Manufacturer		HITACHI
	Firing order		1-3-2-4
	Rotating direction		Counterclockwise
	Cap insulation resistance		More than 50 MΩ
	Rotor head insulation resistance		More than 50 MΩ
Ignition coil	Type		E12-113
	Manufacturer		HITACHI
	Primary coil resistance	Ω	0.84 – 1.02
	Secondary coil resistance	Ω	8,000 – 12,000
	Insulation resistance between primary terminal and case		More than 10 MΩ
Spark plug	Type and Manufacturer		BPR6ES-11 (or BPR5ES-11, BPR7ES-11) . . . . . . NGK W20EPR-U11 (or W16EPR-U11, W22EPR-U11) . . . Nippondenso RN9YC-4 . . . . Champion
	Thread size	mm	14, P = 1.25
	Sperk gap	mm (in)	1.0 – 1.1 (0.039 – 0.043)

COMPONENT PARTS

Starter

MT: 028000-8581

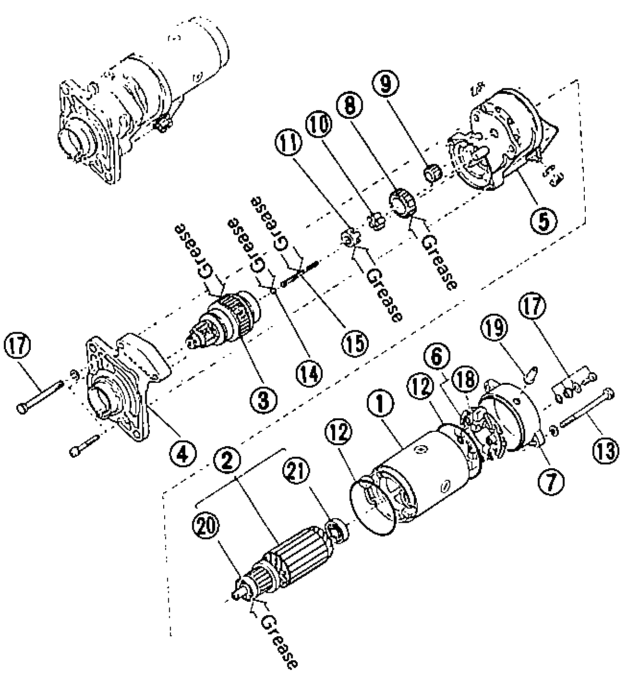


1	Starter pinion	12	Nut
2	Felt washer	13	Nut
3	Armature	14	Spring washer
4	Ball bearing	15	Magnet switch
5	Ball bearing	16	Spring
6	Yoke	17	Steel ball
7	Brush holder	18	Overrunning clutch
8	Brush spring	19	Screw & washer
9	Through bolt	20	Starter housing
10	Screw & washer	21	Clutch roller
11	Frame	22	Retainer

A25-761

Fig. 1

AT: 028000-9800



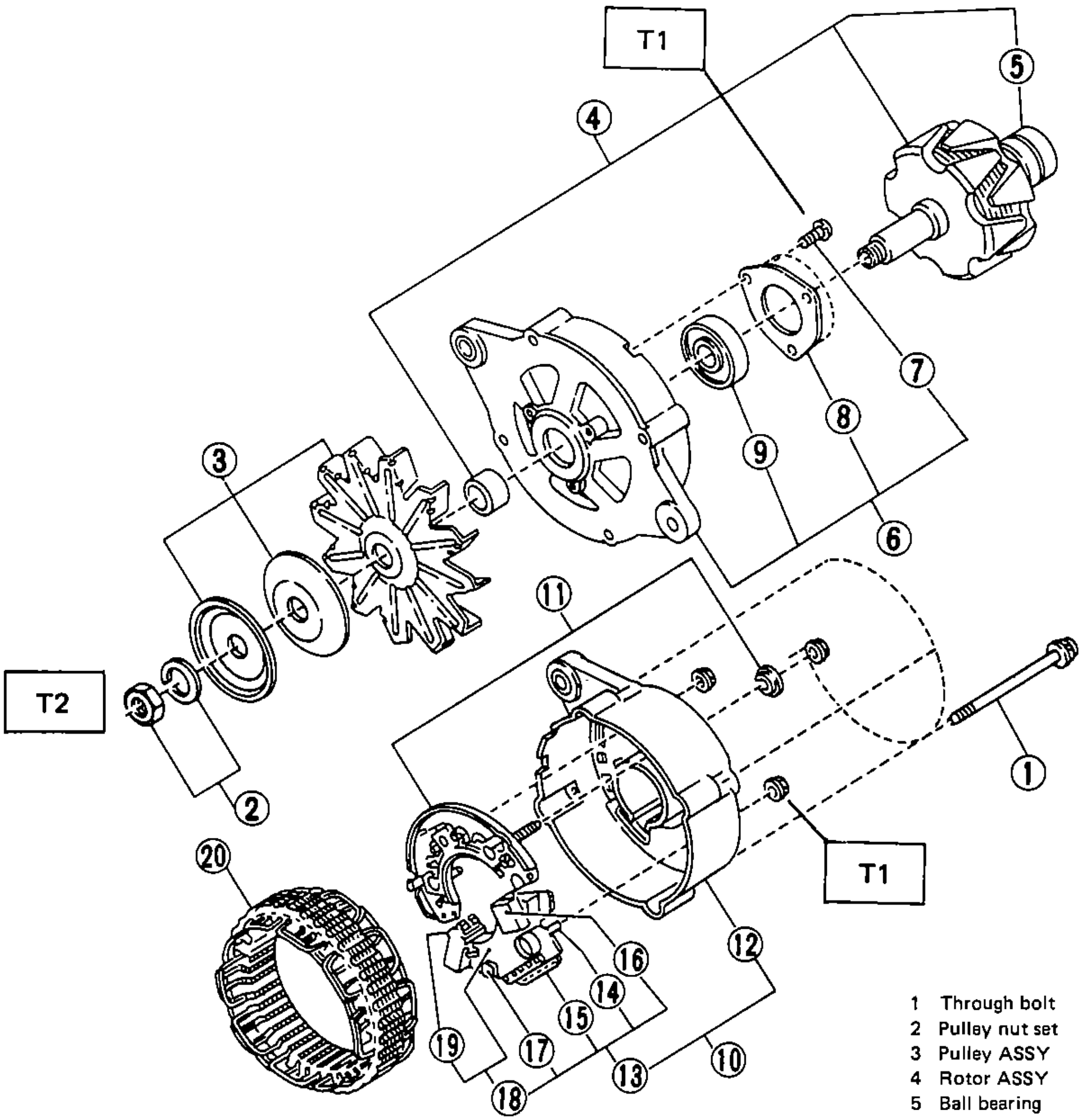
1 Yoke
2 Armature
3 Overrunning clutch
4 Starter housing
5 Magnet switch
6 Brush holder
7 End frame
8 Starter pinion
9 Idle pinion
10 Clutch roller
11 Retainer
12 O-ring
13 Through bolt
14 Steel ball
15 Spring
16 O-ring screw
17 Screw & washer
18 Brush spring
19 Cover
20 Ball bearing
21 Ball bearing

L6-004

Fig. 2

Alternator

LR160-137, LR160-138



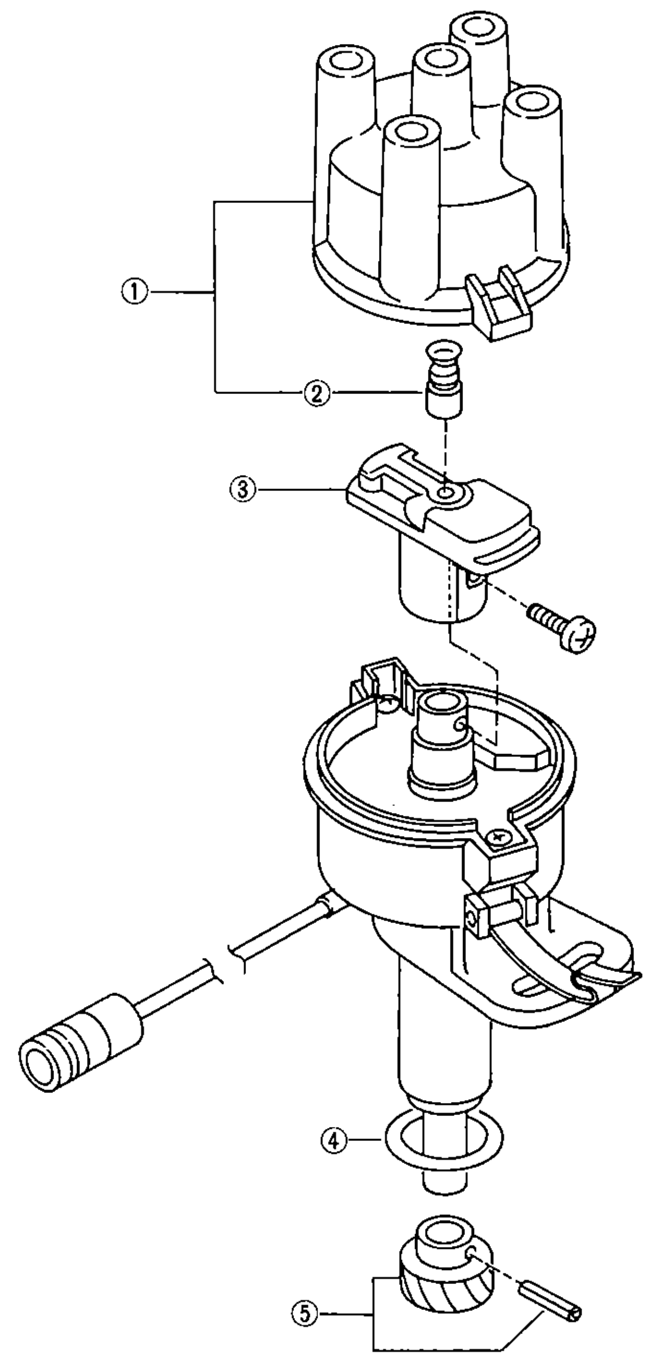
1 Through bolt
2 Pulley nut set
3 Pulley ASSY
4 Rotor ASSY
5 Ball bearing
6 Front cover ASSY
7 Bolt
8 Retainer
9 Ball bearing
10 Rear cover ASSY
11 Diode ASSY
12 Rear cover
13 Brush & IC regulator ASSY
14 Bolt
15 IC regulator
16 Condenser
17 Bolt
18 Brush ASSY
19 Brush
20 Stator

Tightening torque N·m (kg-m, ft-lb)
T1: 3.1 – 3.9 (0.32 – 0.40, 2.3 – 2.9)
T2: 39 – 59 (4.0 – 6.0, 29 – 43)

Fig. 3

A9-414

Distributor



1 Cap ASSY
2 Carbon point
3 Rotor head
4 O-ring
5 Pinion set

Fig. 4

L6-1673

SERVICE PROCEDURE

Starter

MT (028000-8581)

TEST

MAGNETIC SWITCH OPERATION

a. The following magnetic switch tests should be performed with specified voltage applied.
b. Each test should be conducted within 3 to 5 seconds. Power to be furnished should be one-half the rated voltage.

1) Checking pull-in coil
Connect a lead wire between negative (-) terminal of battery and terminal C of magnetic switch body. Then connect a lead wire between positive (+) terminal of battery and terminal 50. Pinion gear should spring out when the positive lead wire is connected.

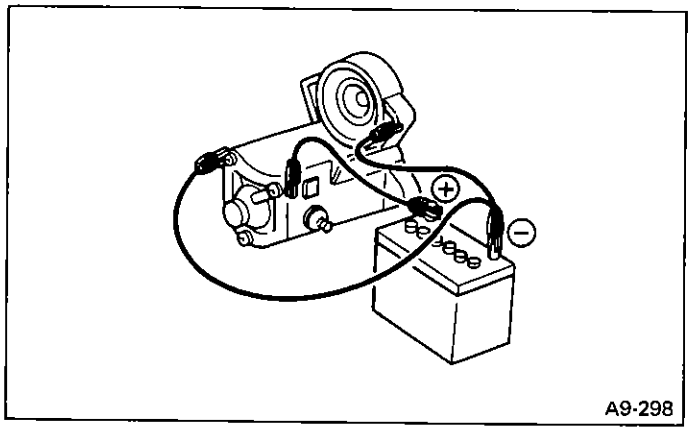


Fig. 5

2) Checking hold-in coil
In the same wiring connections as in 1) "Checking pull-in coil" above, disconnect the lead wire from terminal C to see if pinion gear remains sprung out. If not, hold-in coil is malfunctioning.

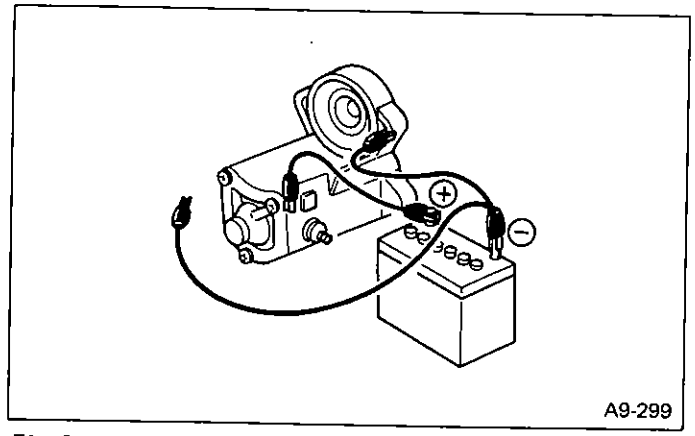


Fig. 6

PERFORMANCE TEST

The starter should be submitted to performance tests whenever it has been overhauled, to assure its satisfactory performance when installed on the engine.
Three performance tests, no-load test, load test, and lock test, are presented here; however, if the load test and lock test cannot be performed, carry out at least the no-load test.
For these performance tests, use the circuit shown in figure.
1) No-load test
With switch on, adjust the variable resistance to obtain 11.5 V (reduction type), take the ammeter reading and measure the starter speed. Compare these values with the specifications. values with the specifications. (See specifications.)
2) Load test
Apply the specified braking torque to starter. The condition is satisfactory if the current draw and starter speed are within specifications. (See specifications.)
3) Lock test
With starter stalled, or not rotating, measure the torque developed and current draw when the voltage is adjusted to the specified voltage. (See specifications.)

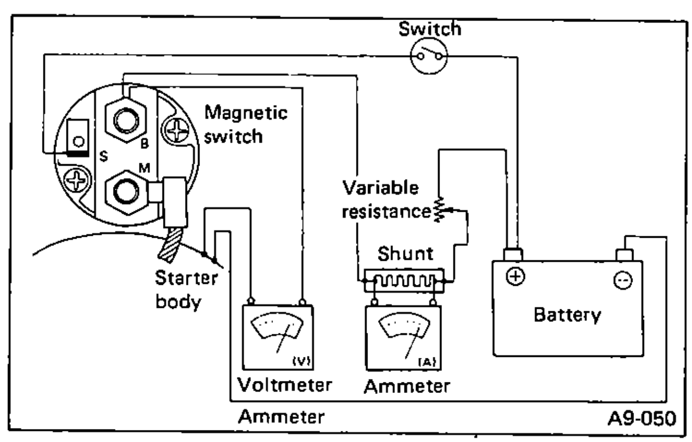


Fig. 7

DISASSEMBLY

1) Disconnect lead wiring from magnet switch.
2) Remove screws, bolts, etc.
- Two through bolts
- Two screws from starter housing
- Two screws and rear frame
3) Separate starter housing from magnet switch.
4) Separate yoke from magnet switch.
5) Using long-nose pliers, take off brushes, and pull out brush holder from armature.

Be careful not to scratch brushes, bearing and commutator.

6) Separate armature from yoke.

Be careful not to damage bearings.

7) Separate pinion and overrunning clutch.

a. Magnetic switch should be replaced as a subassembly.
b. Never loosen contact (terminal) bolt.

INSPECTION

ARMATURE

1) Check commutator for any sign of burns or rough surfaces or stepped wear. If wear is of a minor nature, correct it by using sandpaper.
2) Run-out test
Check the commutator run-out and replace if it exceeds the limit.

Commutator run-out:
Standard
0.02 mm (0.0008 in)
Service limit
Less than 0.05 mm (0.0020 in)

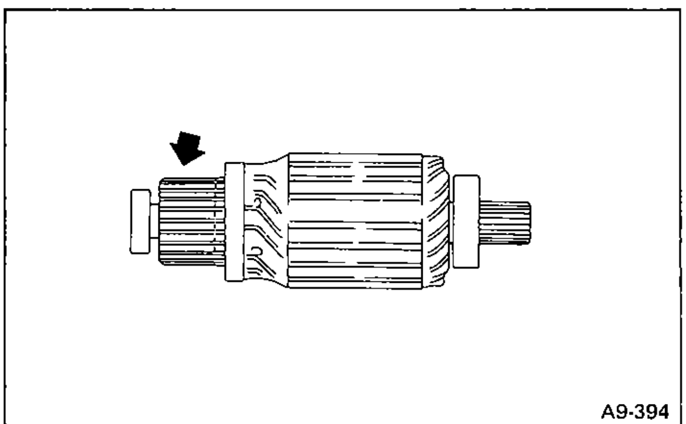


Fig. 8

3) Depth of segment mica
Check the depth of segment mica.

Depth of segment mica
Standard
0.5 – 0.8 mm (0.020 – 0.031 in)
Service limit
0.2 mm (0.008 in)

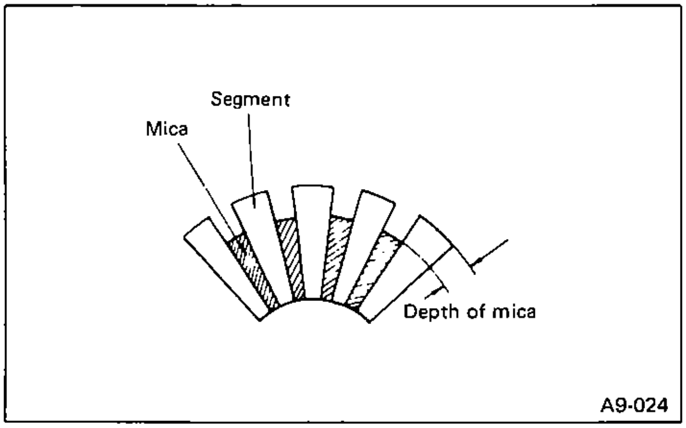


Fig. 9

4) Armature short circuit test
Check armature for short circuit by placing it on growler tester. Hold a hacksaw blade against armature core while slowly rotating armature. A short-circuited armature will cause the blade to vibrate and to be attracted to core. If the hacksaw blade is attracted or vibrates, the armature, which is short-circuited, must be replaced or repaired.

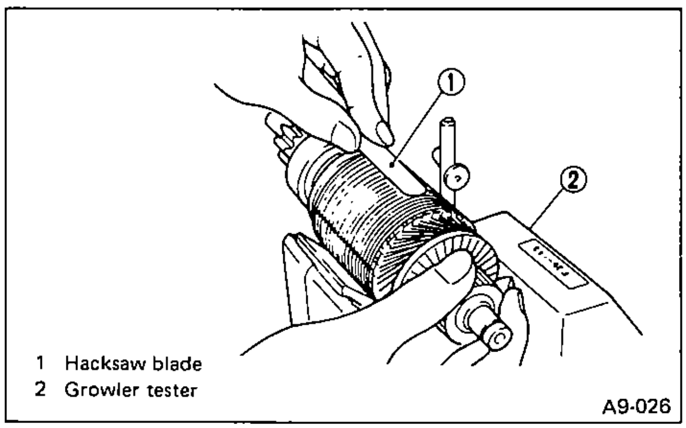


Fig. 10

5) Armature ground test
Using circuit tester, touch one probe to the commutator segment and the other to armature core. There should be no continuity. If there is a continuity, armature is grounded. Replace armature if it is grounded.

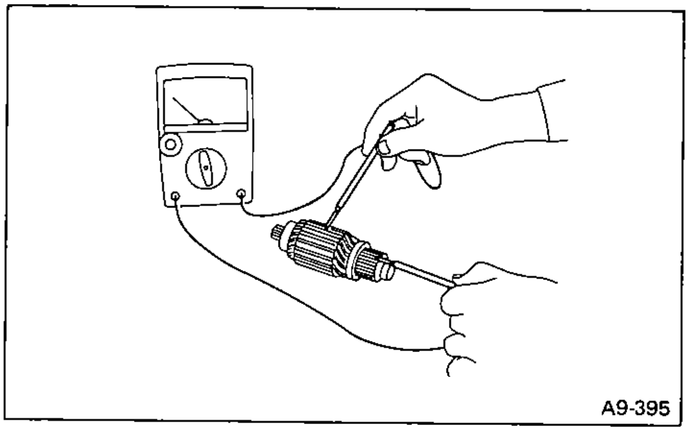


Fig. 11

6) Armature continuity test
Using circuit tester, touch two probes to segments. There should be continuity at any test points. Replace if it is open-circuited.

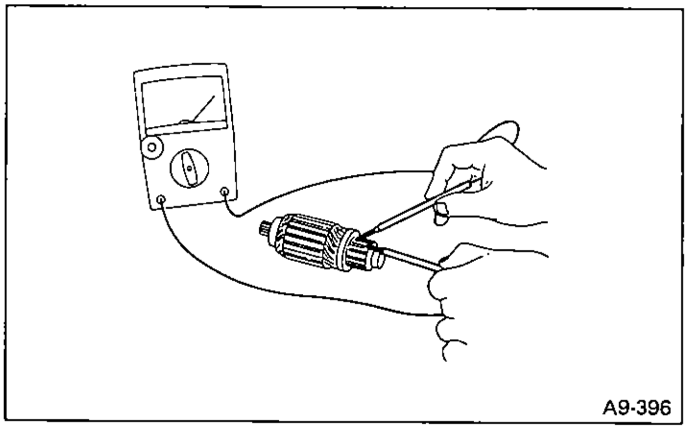


Fig. 12

YOKE

1) Field coil ground test
Using circuit tester, touch one probe to field coil end or brush and the other to the bare surface of yoke body. There should be no continuity. If there is continuity, field coil is grounded. Be sure to repair if it is grounded.

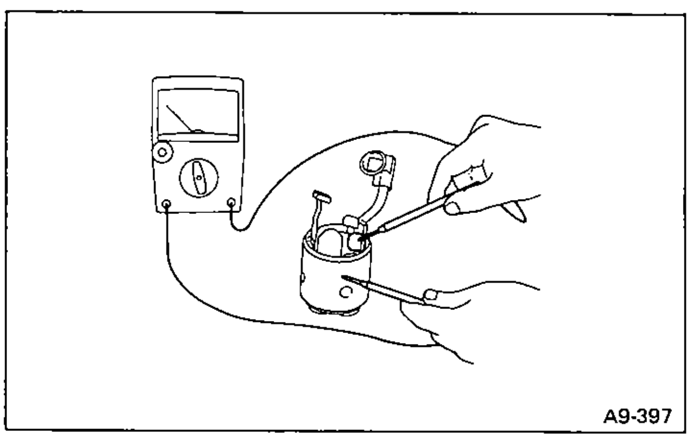


Fig. 13

2) Field coil continuity test
Using circuit tester, touch one probe to "C" terminal lead wire and the other to brush. There should be continuity. If there is no continuity, field coil is defective.

If field coil is defective, yoke ASSY must be replaced.

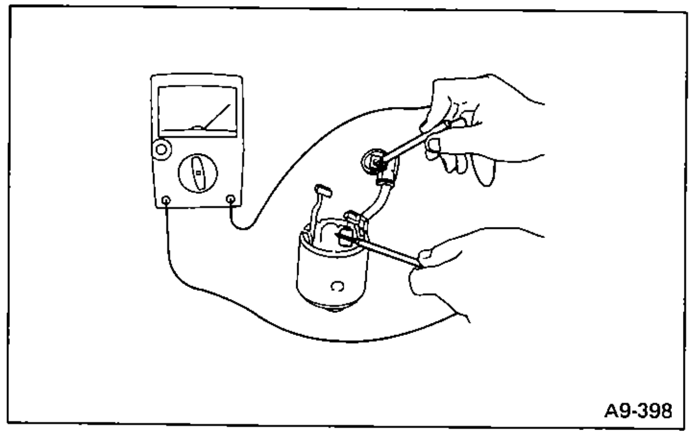


Fig. 14

BRUSH AND BRUSH HOLDER

1) Brush length
Measure the brush length and replace if it exceeds the service limit.

Brush length:
Standard
14 mm (0.55 in)
Service limit
9 mm (0.35 in)

a. If brushes are worn, replace them as entire yoke ASSY or entire brush holder ASSY.
b. Correct the contact surface of each brush after sandpaper (No. 300 or higher) has been wrapped around the commutator.

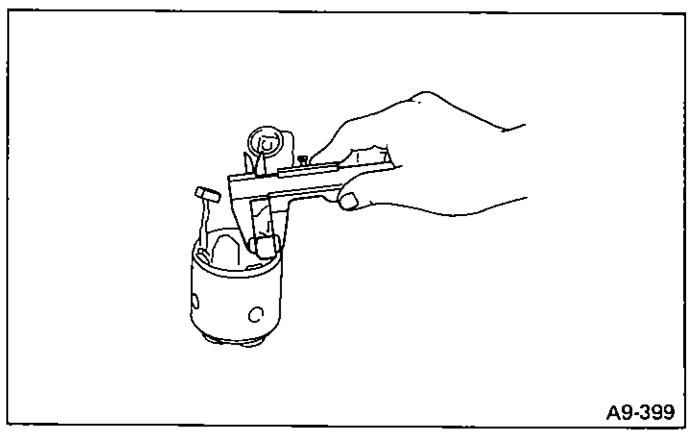


Fig. 15

2) Brush holder insulation test
Using circuit tester, check brush holder insulation. Touch one probe to holder plate and the other to positive brush holder. There should be no continuity.

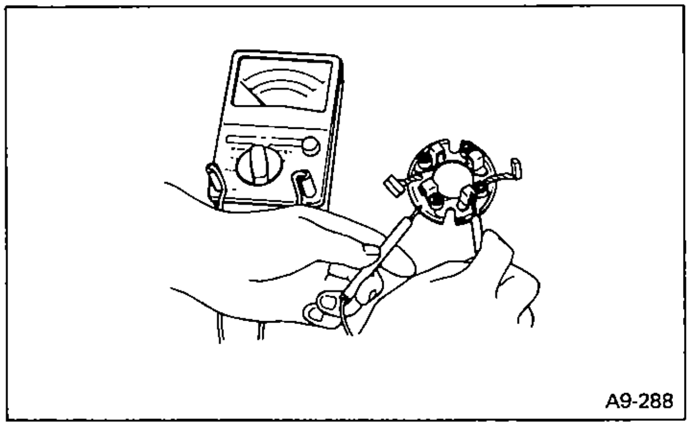


Fig. 16

OVERRUNNING CLUTCH

Inspect teeth of pinion for wear and damage. Replace it if damaged. Rotate pinion in direction of rotation (clockwise). It should rotate smoothly. But in opposite direction, it should be locked.

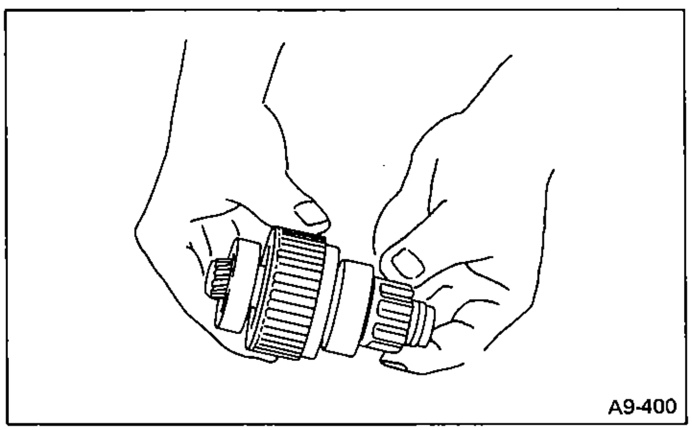


Fig. 17

BEARING

Check bearings for wear and damage. If bearings are noisy during operation, they should be replaced.

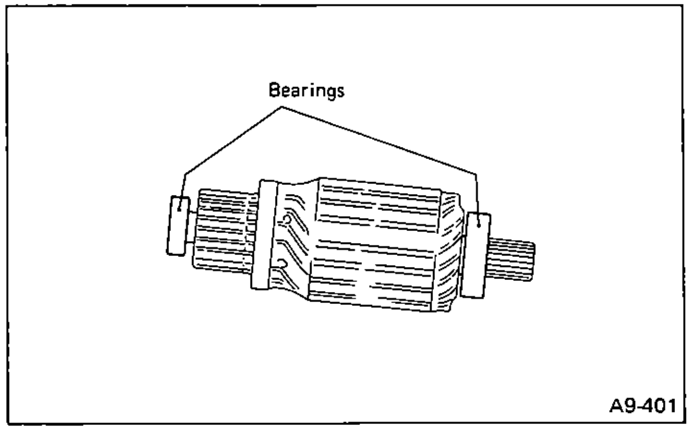


Fig. 18

ASSEMBLY

1) Before assembling, completely clean oil or dust off the surfaces of both commutator and brushes.
2) Apply a sufficient amount of grease to parts where necessary.
3) Assemble starter pinion and starter housing.
4) Assemble overrunning clutch and starter housing.

Do not forget to assemble steel ball and return spring.

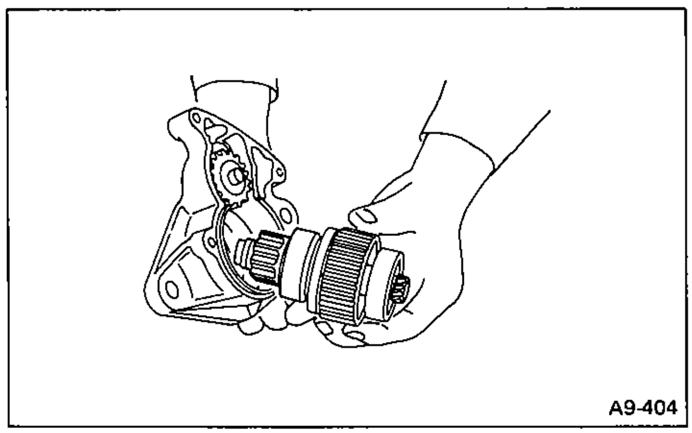


Fig. 19

5) Assemble brush holder and armature.

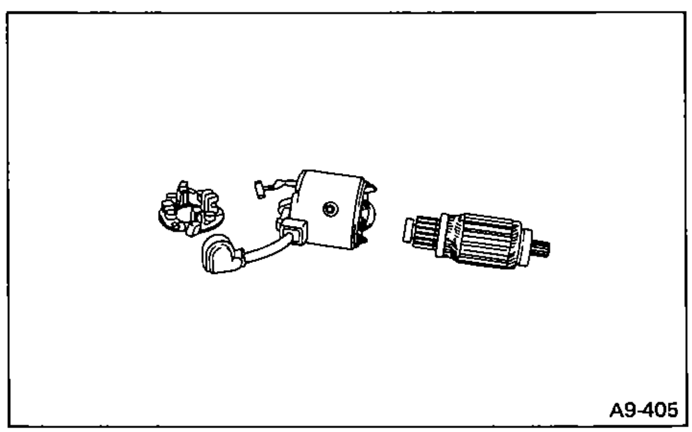


Fig. 20

6) Assemble brushes by using a long-nose pliers.

Take care not to damage nor to get oil on brushes.

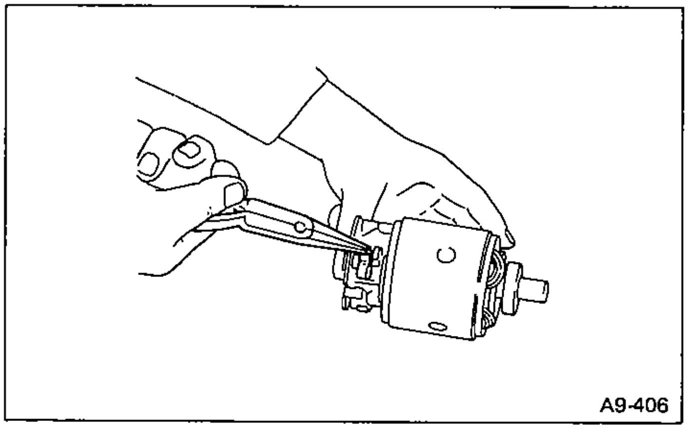


Fig. 21

7) Assemble rear frame and yoke.
8) Assemble yoke and magnet switch.
9) Assemble starter housing and magnet switch.

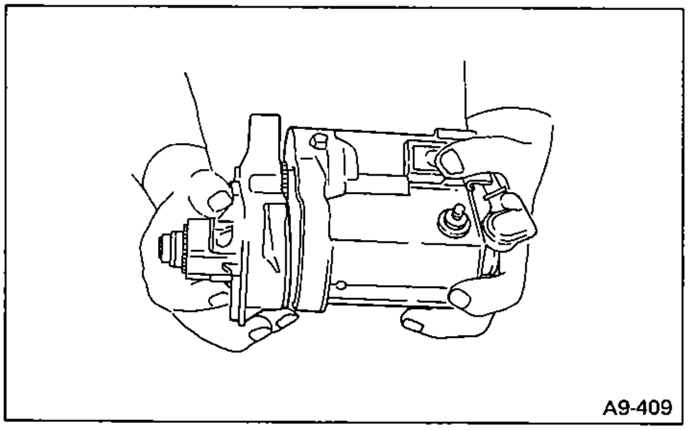


Fig. 22

10) Tighten two screws in rear frame.

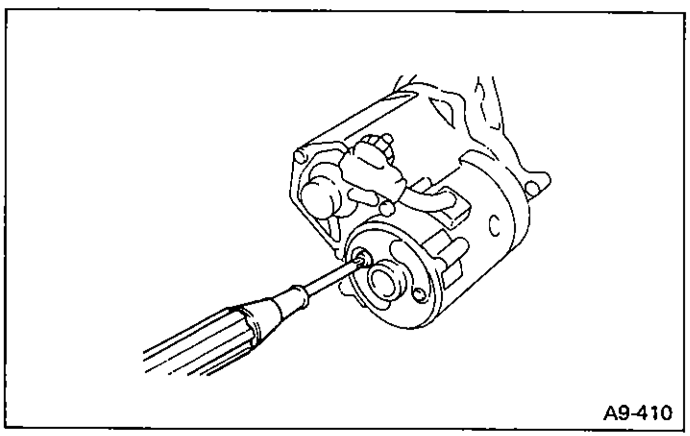


Fig. 23

11) Tighten two screws in starter housing.

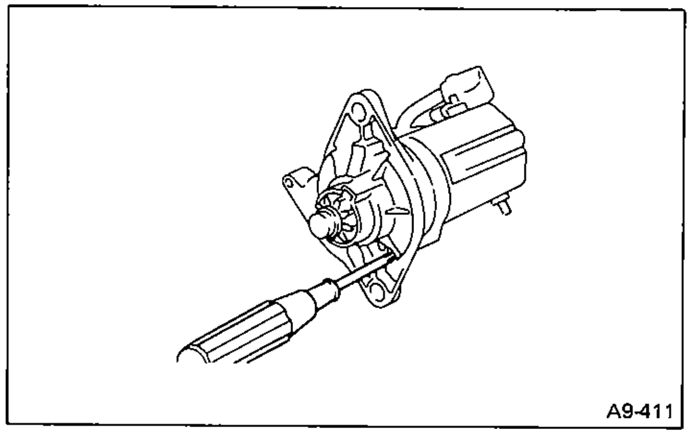


Fig. 24

12) Tighten two through bolts in yoke.

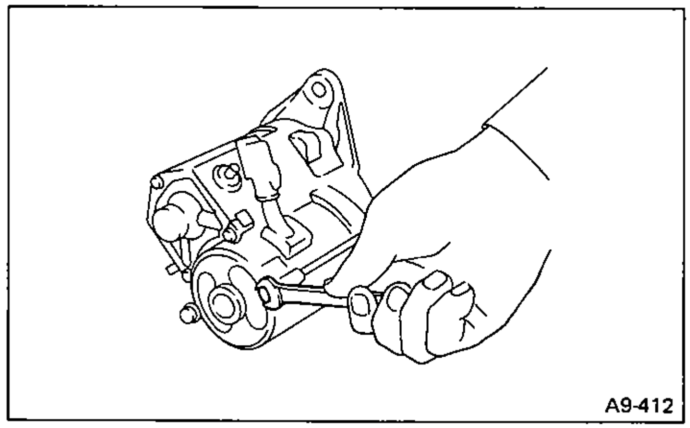


Fig. 25

13) Connect lead wire to magnet switch.

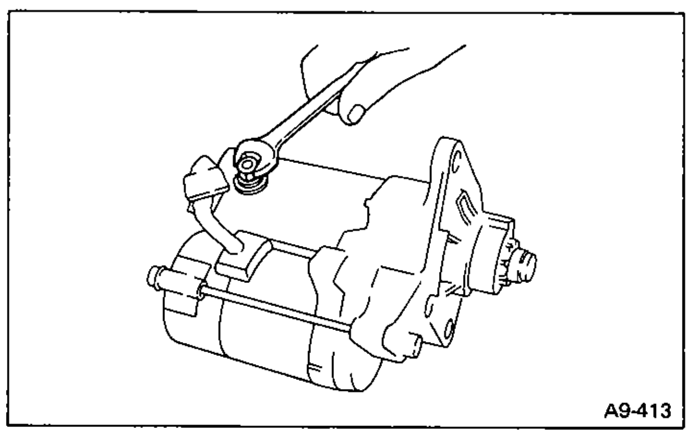


Fig. 26

AT (028000-9800)

TEST

MAGNETIC SWITCH

Be sure to complete each test within a few seconds.

1) Pull-in test
Connect two battery negative leads onto magnetic switch body and terminal C respectively. Then connect battery positive lead onto terminal 50. Pinion should extend when lead connections are made.

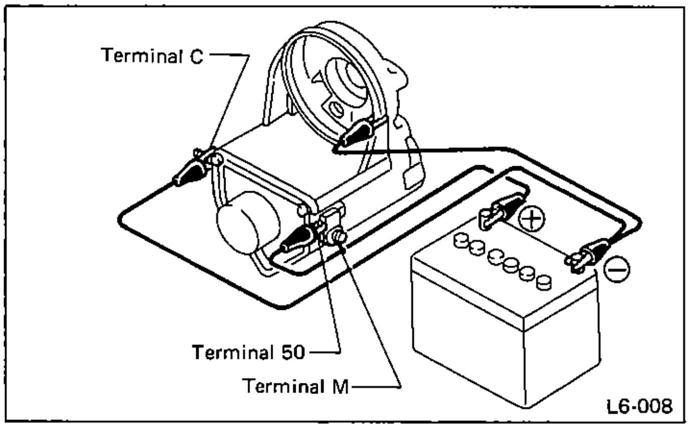


Fig. 27

2) Holding-in test
Disconnect lead from terminal C with pinion extended. Pinion should be held in the extended position.

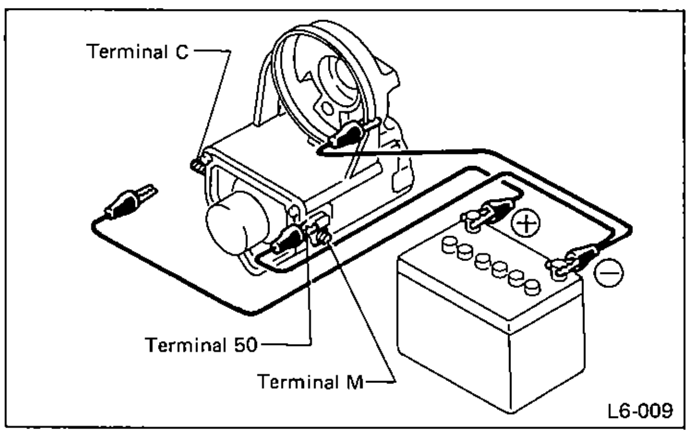


Fig. 28

3) Return test
Connect two battery negative leads onto terminal 50 and onto switch body respectively. Then connect battery positive lead onto terminal C. Next, disconnect lead from terminal 50. Pinion should return immediately.

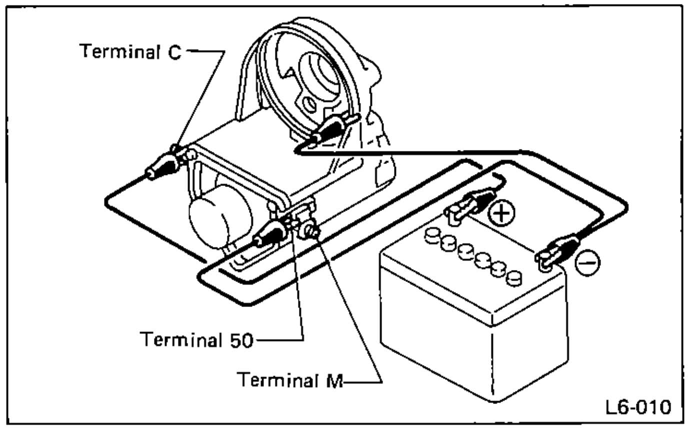


Fig. 29

PERFORMANCE TEST

The starter is required to produce a large torque and high rotating speed, but these starter characteristics vary with the capacity of the battery. It is therefore important to use a battery with the specified capacity whenever testing the starter.
The starter should be checked for the following three items.

1. No-load test: Measure the maximum rotating speed and current under a no-load state.
2. Load test: Measure the magnitude of current needed to generate the specified torque and rotating speed.
3. Stall test: Measure the torque and current when the armature is locked.

1) No-load test
Run single starter under no-load state, and measure its rotating speed, voltage, and current, using the specified battery. Measured values must meet the following standards:

No-load test (Standard):
Voltage/Current
11V/90A max.
Rotating speed
4,000 rpm min.

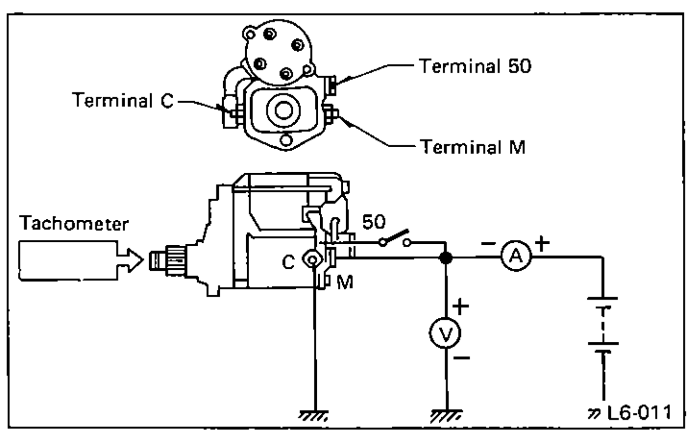


Fig. 30

2) Load test (For reference)
Perform this test to check maximum output of starter. Use test bench which is able to apply load (brake) to starter. Measure torque value and rotating speed under the specified voltage and current conditions while controlling braking force applied to starter.

Change engagement position of overrunning clutch and make sure it is not slipping.

Load test (Standard):
Voltage/Load
8V/14 N·m (1.4 kg-m, 10 ft-lb)
Current/Speed
370A max./880 rpm min.

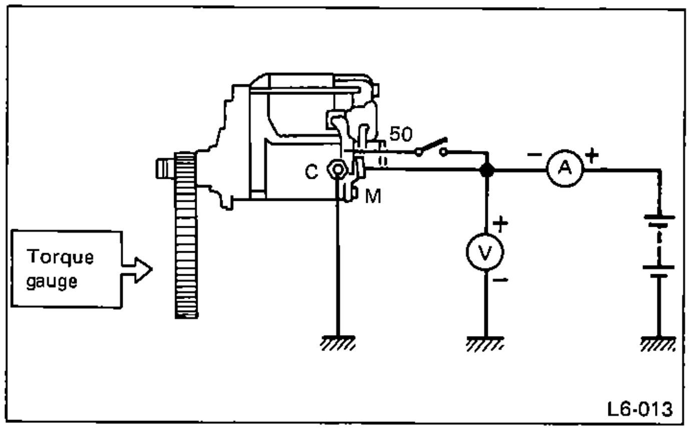


Fig. 32

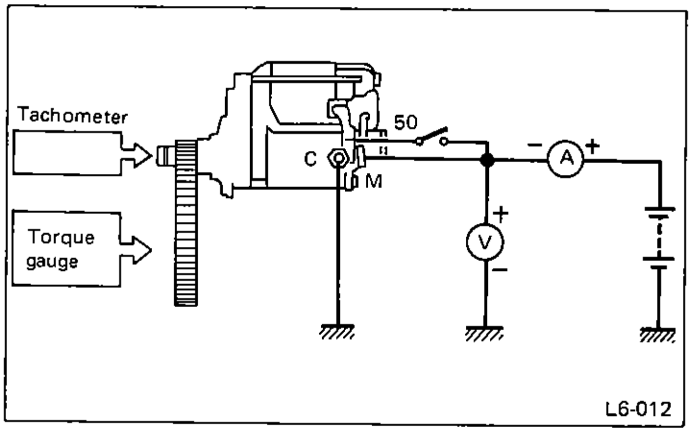


Fig. 31

Low rotating speed or excessive current during no-load test may be attributable to high rotating resistance of starter due to improper assembling.
Small current and no torque during stall test may be attributable to excessive contact resistance between brush and commutator; whereas, normal current and insufficient torque may be attributable to shorted commutator or poor insulation.
Starter can be considered normal if it passes no-load and stall tests; therefore, load test may be omitted.

3) Stall test
Using the same test equipment used for load test, apply brake to lock starter armature. Then measure voltage, current, and torque values.
Measured values must meet the following standard.

Stall test (Standard):
Voltage/Current
5V/735A max.
Torque
27 N·m (2.8 kg-m, 20 ft-lb) min.

DISASSEMBLY

1) Disconnect lead wire from magnetic switch.

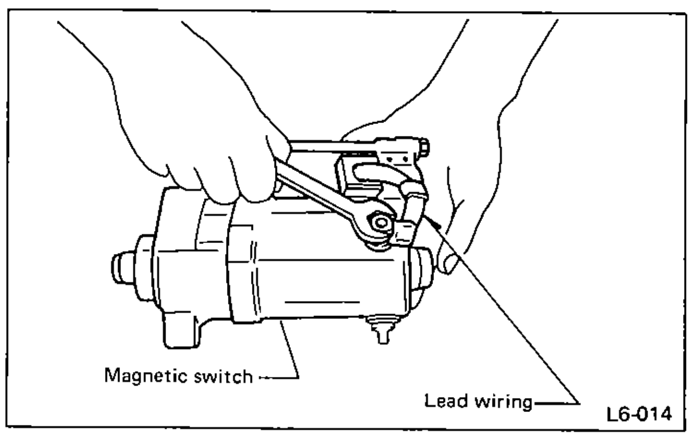


Fig. 33

2) Remove through-bolts from end frame.

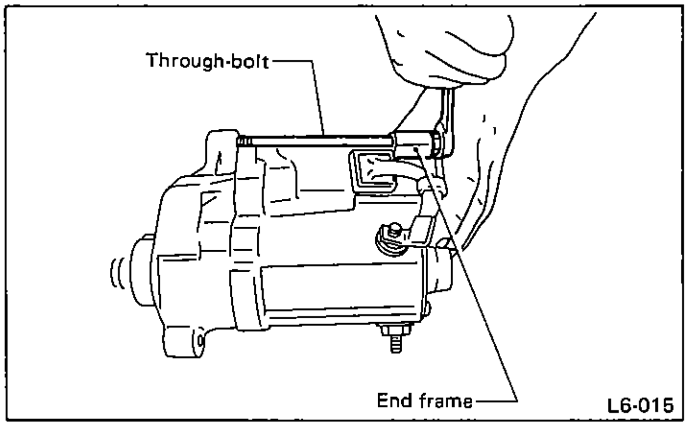


Fig. 34

3) Remove yoke from magnetic switch.

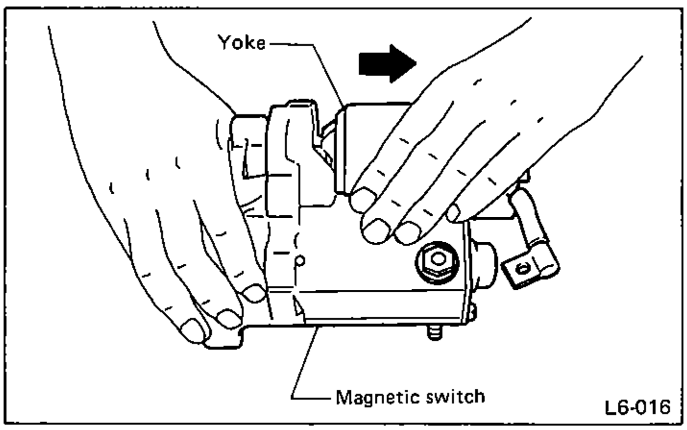


Fig. 35

4) Remove screws securing end frame to brush holder.

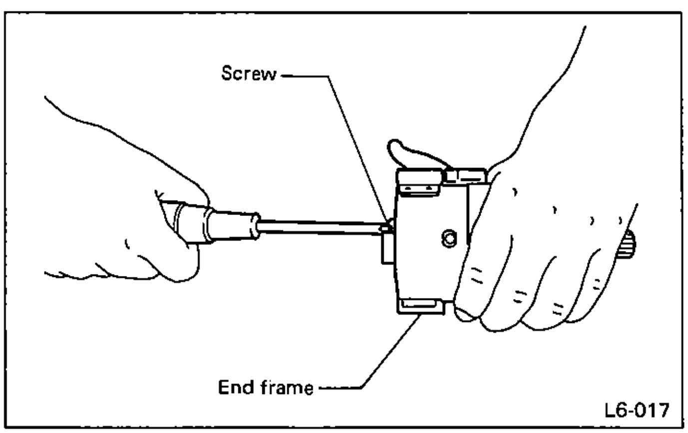


Fig. 36

5) Separate yoke from end frame.

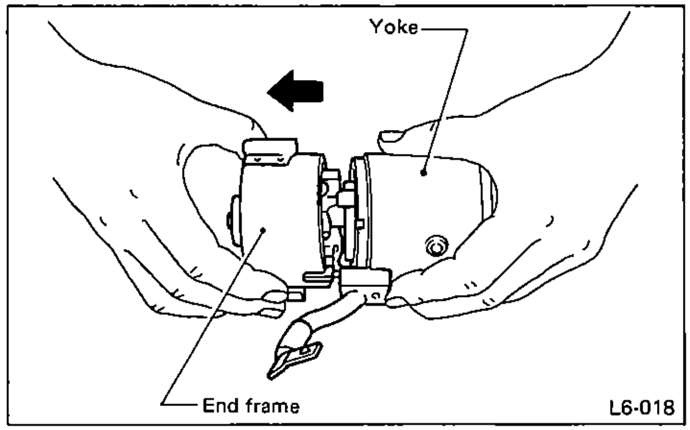


Fig. 37

6) Remove brush by lifting up positive (+) side brush spring using long-nose pliers.

Be careful not to damage brush and commutator.

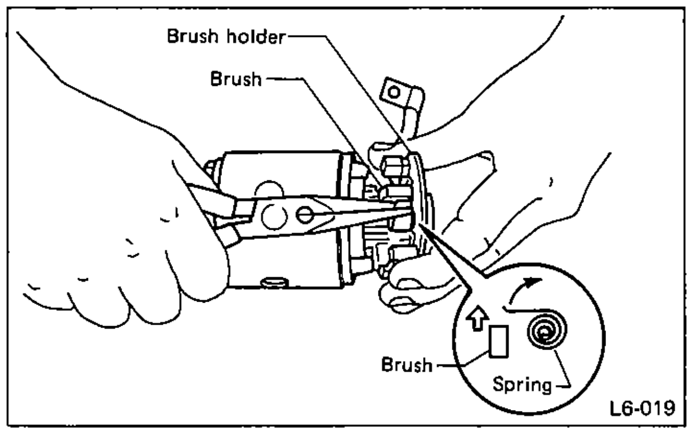


Fig. 38

7) Remove armature from yoke.

Be careful not to drop armature.

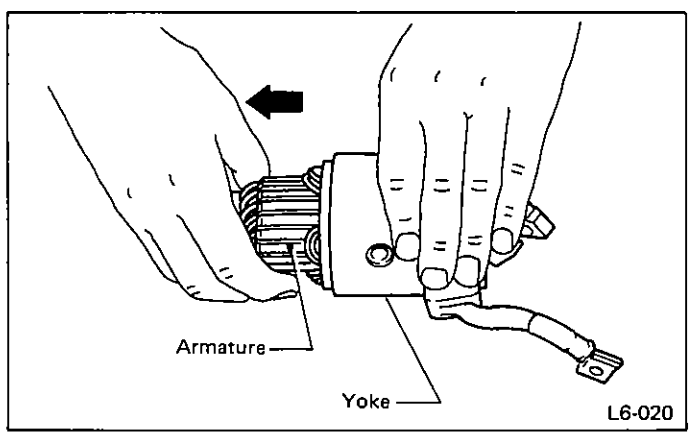


Fig. 39

8) Remove screws securing magnetic switch to housing.

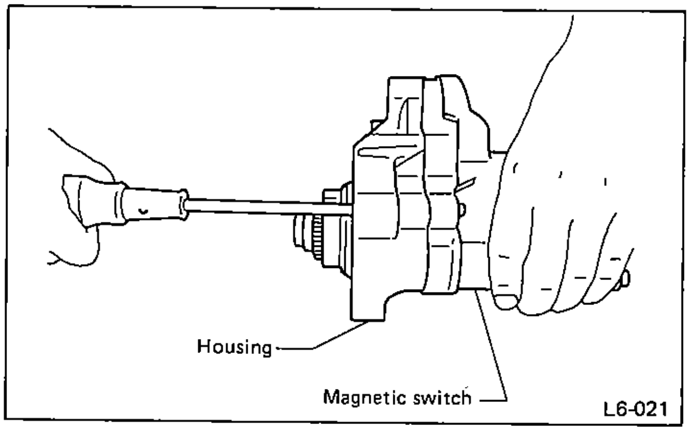


Fig. 40

Remove housing from magnetic switch.

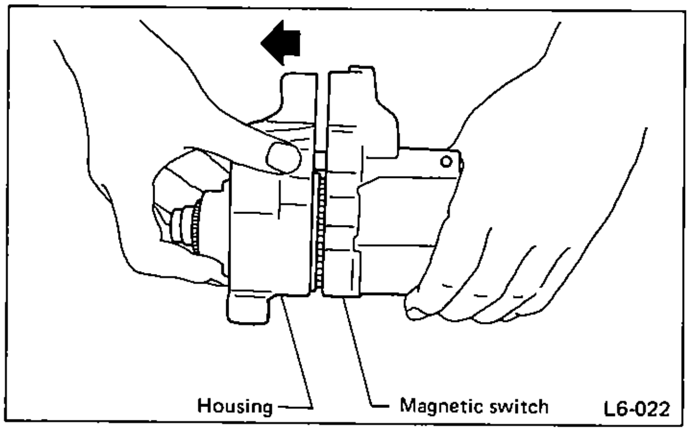


Fig. 41

9) Remove clutch from housing.

If pinion is placed on the outside of housing, first remove snap ring then take out clutch.
For removal of snap ring, see step 10).

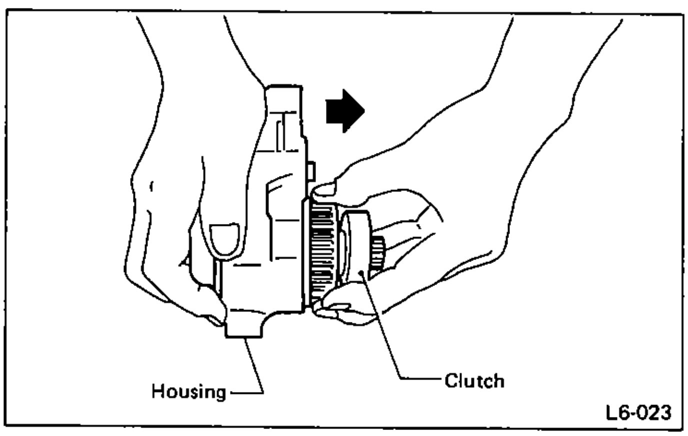


Fig. 42

10) Removal of snap ring (Models with pinion set on outside of housing).

(1) Press down housing to push out pinion.

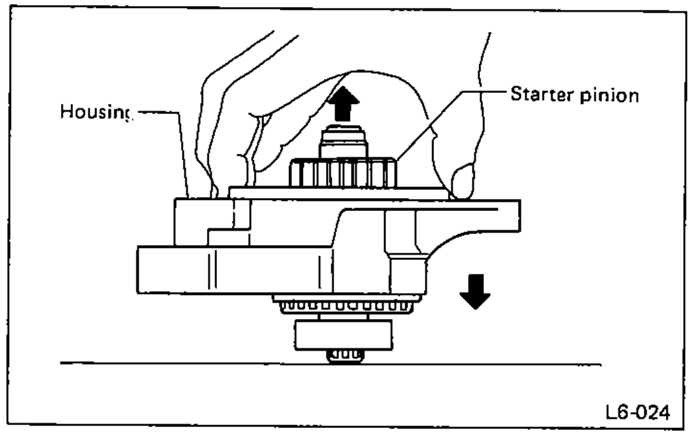


Fig. 43

(2) Press down pinion stop collar using jig as shown, until snap ring comes out.

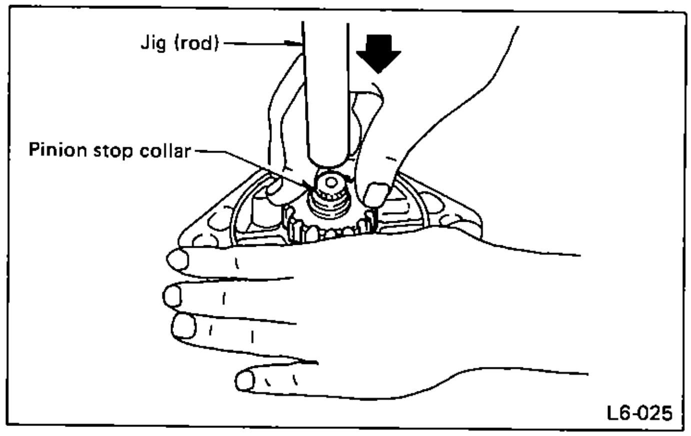


Fig. 44

(3) Remove snap ring using circlip pliers.
Remove pinion from clutch shaft, then take out clutch from housing.

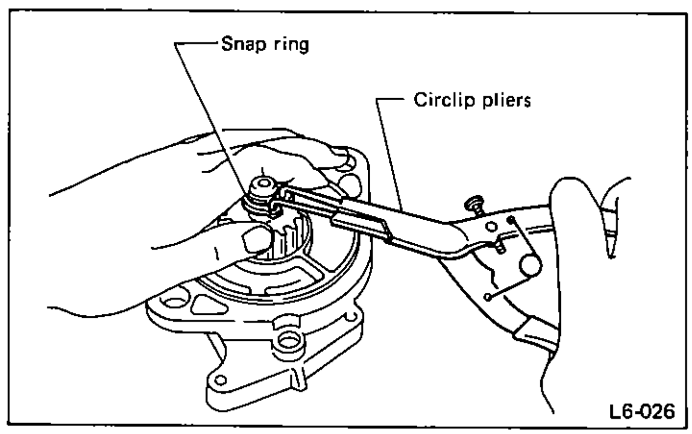


Fig. 45

11) Take out steel ball from clutch.

Be careful not to lose steel ball.

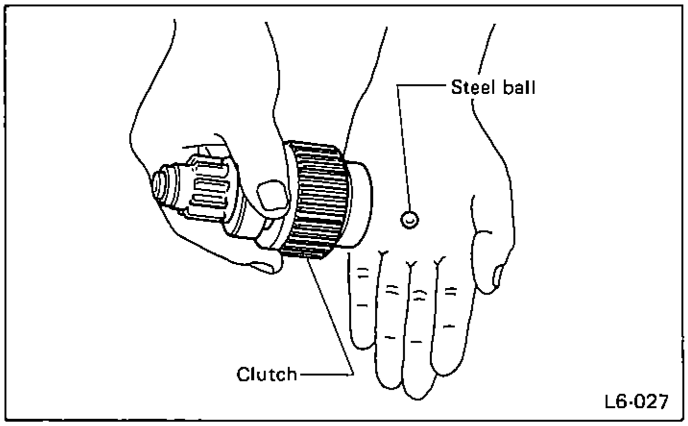


Fig. 46

12) Remove idle gear from housing.

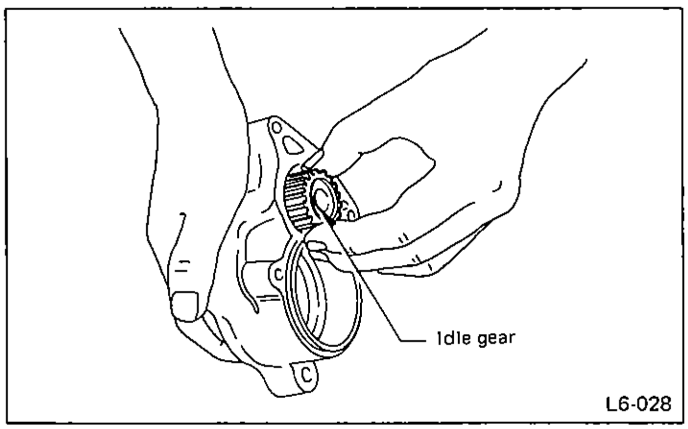


Fig. 47

13) Remove retainer and roller from housing.

Be careful not to drop retainer and roller.

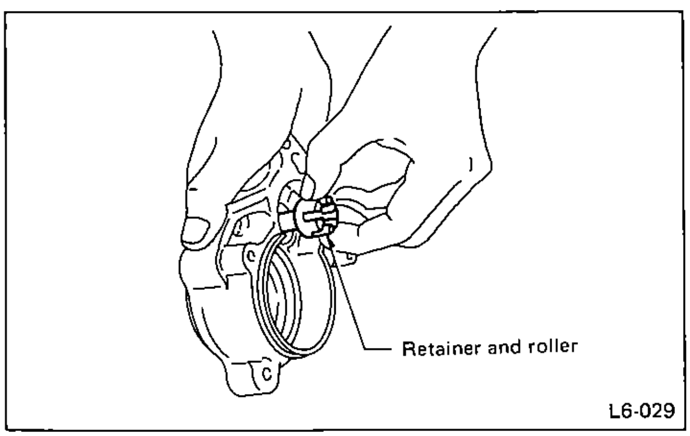


Fig. 48

14) Remove coil spring from magnetic switch.

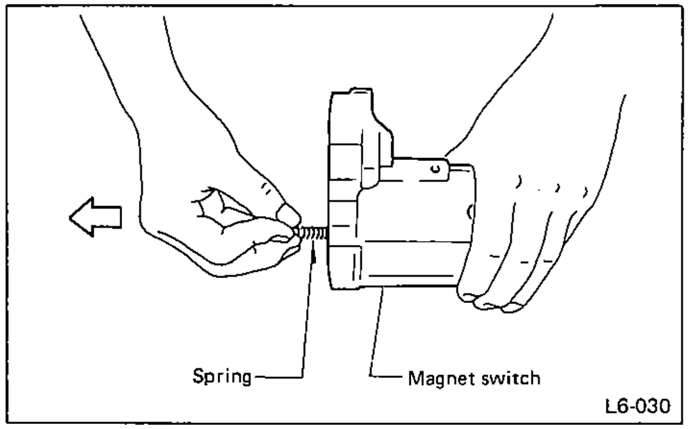


Fig. 49

INSPECTION AND REPAIR

ARMATURE

1) Layer test

Check armature coil for shortcircuit between layers by using armature tester.

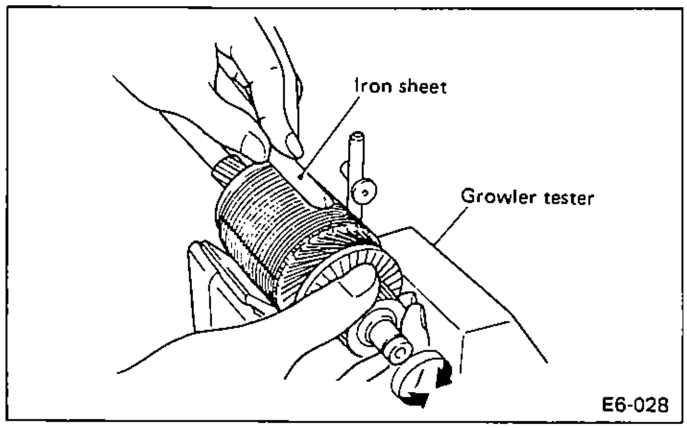


Fig. 50

If any shortcircuit exists in armature coil, circulating current is generated by alternating flux of armature tester, and the affected portion of the armature core is magnetized.

If an iron piece is brought close to that portion, it will vibrate, locating the shortcircuit.

Before performing the test, thoroughly remove carbon powder, etc. from around the commutator.

2) Insulation test

Check insulation between commutator and armature core using 500V megger.

Insulation resistance should be 0.1 MΩ or larger.

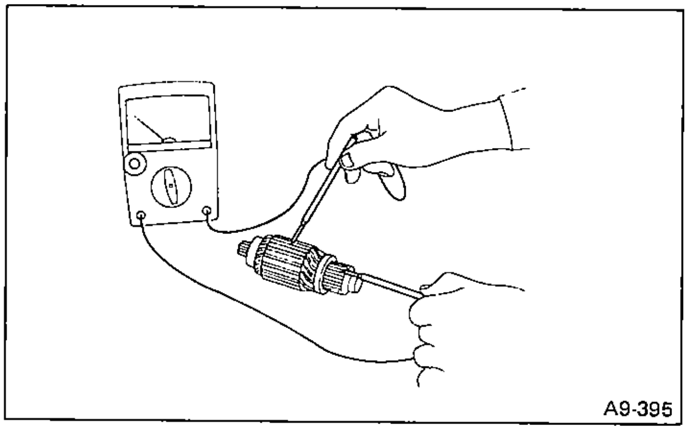


Fig. 51

3) Check commutator for out of roundness.
Use dial gauge to check that commutator is round. Repair commutator using lathe if uneven wear is found.
[If difference between maximum diameter and minimum diameter exceeds 0.05 mm (0.0020 in), repair commutator until the difference is less than 0.02 mm (0.0008 in).]

Be sure to perform this check after checking armature shaft for bend.

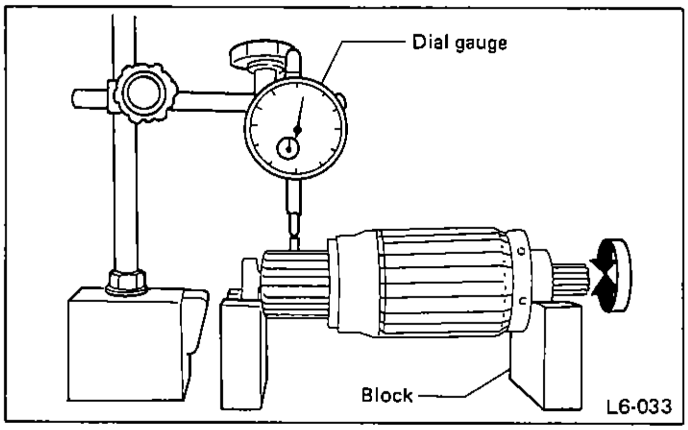


Fig. 52

If commutator surface is rough, polish with fine grain sand paper (#300); if burnt excessively, correct by cutting with a lathe.
In repairing commutator with lathe, do not reduce commutator O.D. by more than 1 mm (0.04 in) from its original (standard) value. Excessive cutting will hamper commutator durability.
After repairing, polish finished surface with sand paper.

Commutator O.D.:
Standard value
30 mm (1.18 in)
Service limit
29 mm (1.14 in)

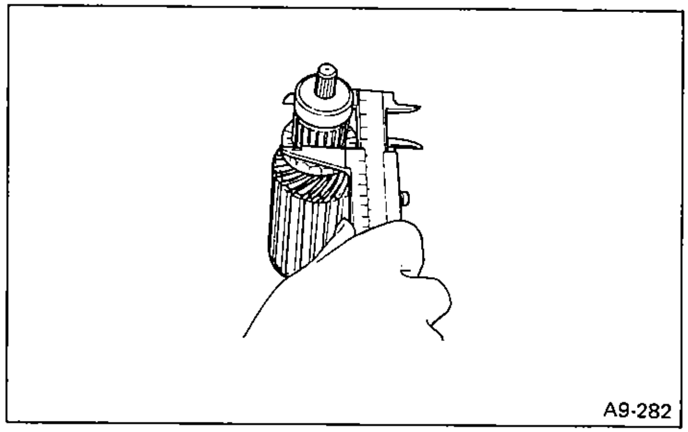


Fig. 53

4) Under-cutting of commutator
If commutator segments wear and mica insulation between segments stand higher than segment face, proper rectification is hampered. To avoid this, undercut insulator to a depth of 0.5 to 0.8 mm (0.020 to 0.031 in) if the depth below segment surface is reduced to less than 0.2 mm (0.008 in)

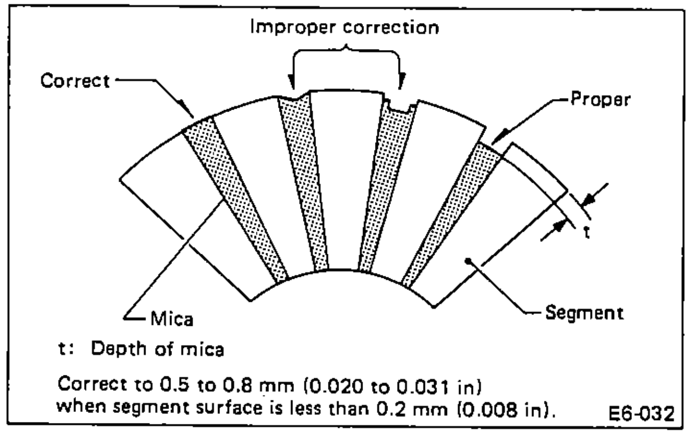


Fig. 54

YOKE

1) Testing field coil for open circuit
Check field coil for continuity using circuit tester. Continuity should exist.

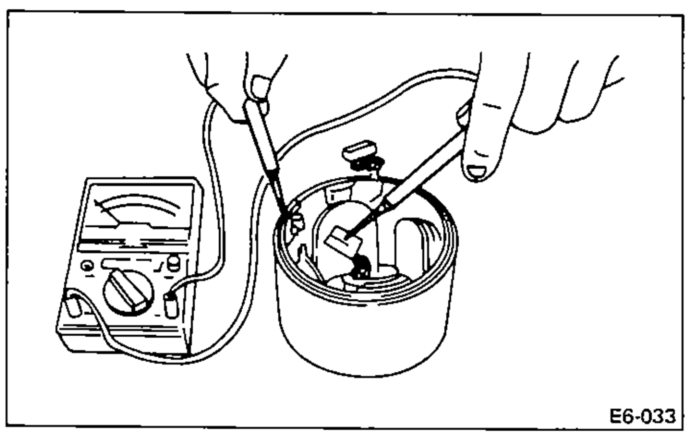


Fig. 55

2) Checking carbon brush
If carbon brush length has been reduced by more than 1/3 the original length, or if brush contact area has been reduced largely due to brush breakage, replace carbon brush.

Brush length:
Standard value
15 mm (0.59 in)
Service limit
10 mm (0.39 in)

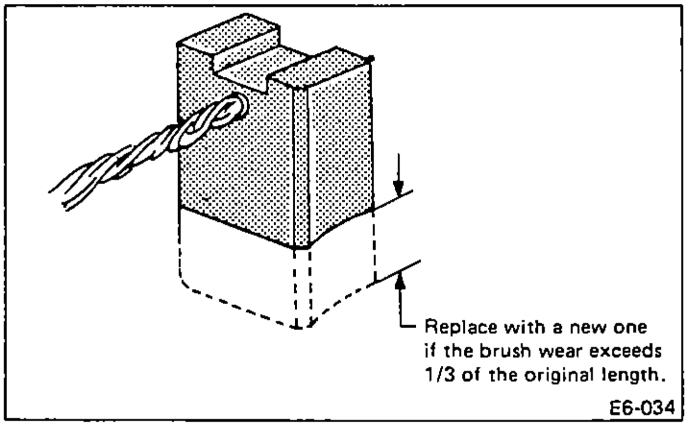


Fig. 56

BRUSH HOLDER

Measure insulation resistance of brush holder using Megger. Insulation resistance should be 0.1 MΩ or over.

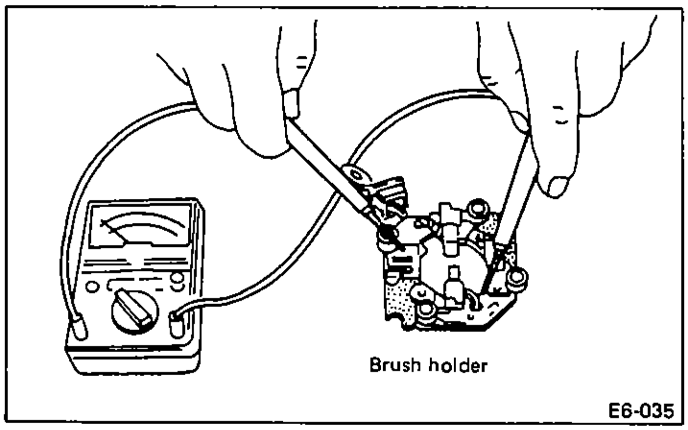


Fig. 57

CLUTCH

Check that pinion can be rotated in normal direction only.
Check pinion gear for wear, damage, rusting, or binding during rotation.

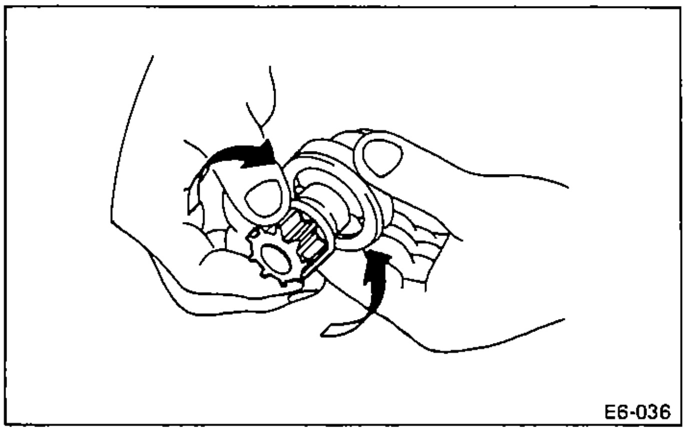


Fig. 58

Bearing

1) Inspection
(1) Rotate bearing by hand; no binding should exist.
(2) Rotate bearing rapidly; no abnormal noise should be heard.

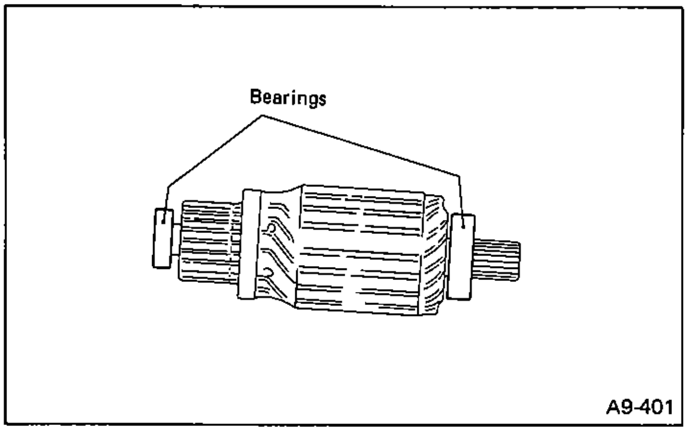


Fig. 59

2) Replacement
Pull out bearing using a jig as shown in Figure.

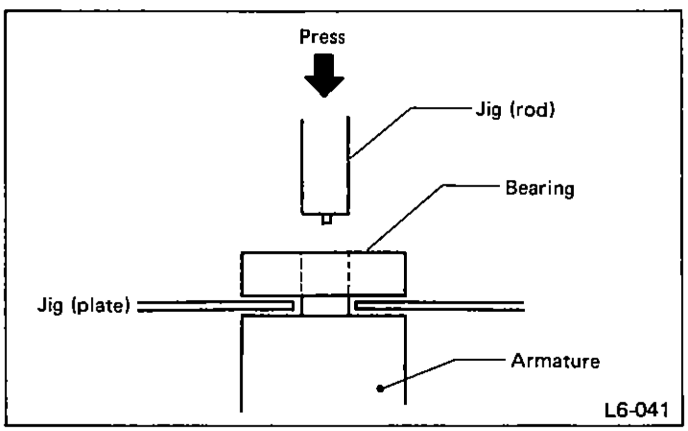


Fig. 60

ASSEMBLY

Assembly is in the reverse order of disassembly procedures. Observe the following:

1) Before assembling, lubricate disassembled parts at the points shown in the figure below.

Grease	
ESSO BEACON 325 SCHELL ALVANIA GREASE RA	or equivalent

2) Assembling magnetic switch, clutch, and housing
To assemble, first install clutch to mágnetic switch, then install idle gear, and finally install clutch.

a. Do not forget to install steel ball and coil spring to clutch.
b. Attach bearing to idle gear beforehand.

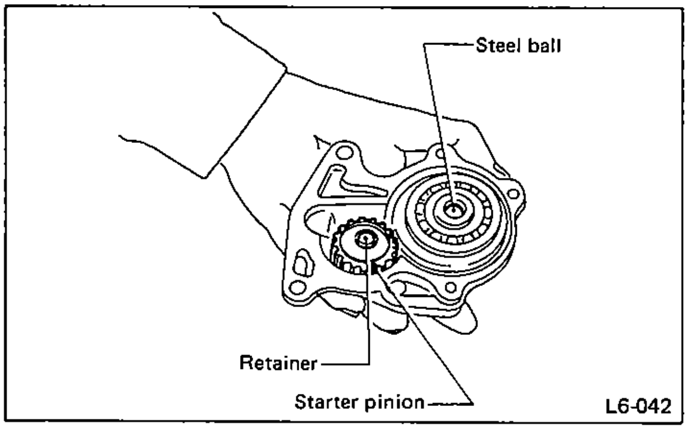


Fig. 61

3) Installing armature to yoke

Do not forget to put felt washer on armature shaft bearing.

4) Installing brushes
Assemble brush holder to yoke as shown, then assemble two yoke-side brushes to brush holder.

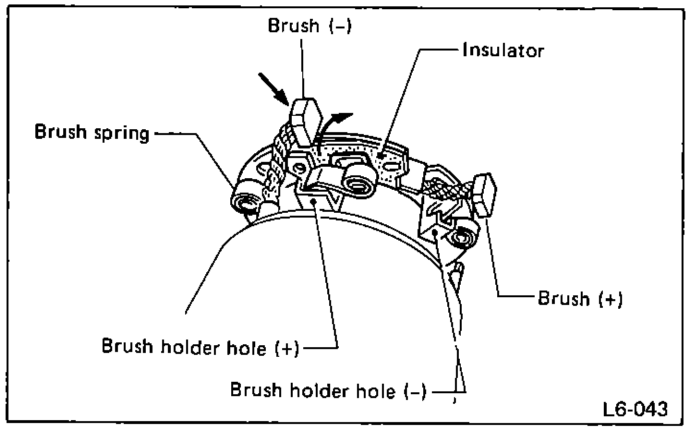


Fig. 62

5) Installing end frame
When assembling end frame to yoke, align notched portion of end frame with lead wire grommet.

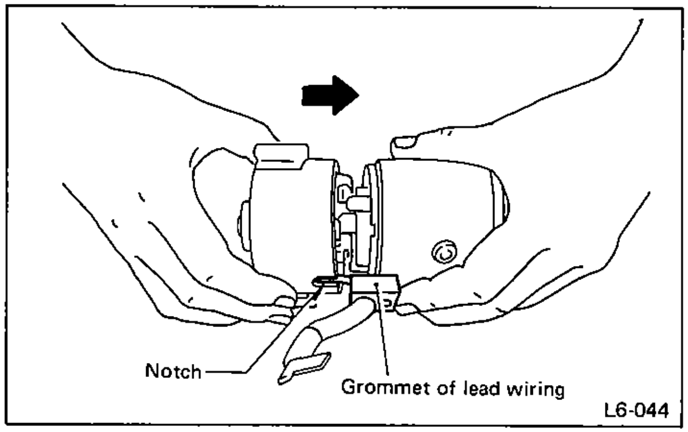


Fig. 63

6) Installing yoke
When installing yoke to magnetic switch, align notch of yoke with protrusion of magnetic switch.

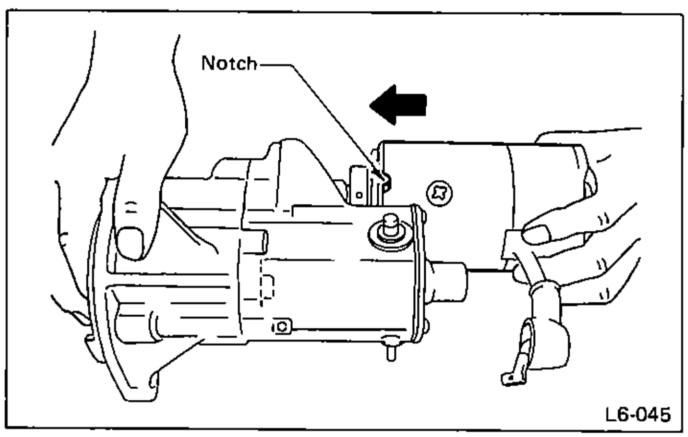


Fig. 64

Alternator

(LR160-137 and LR160-138)

TEST

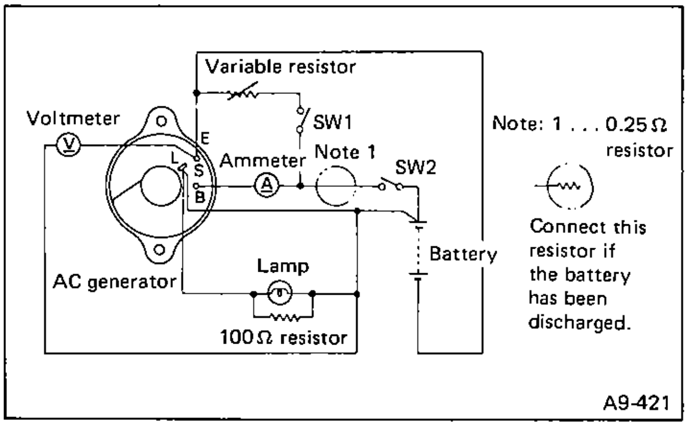


Fig. 65

GENERATOR SPEED AT 13.5V

1) Open switch SW_1, and close switch SW_2. Gradually raise generator speed, and read the speed when the voltage is 13.5V.
2) The generator is normal if it turns at 900 rpm when the voltage is 13.5V.

MEASUREMENT OF REGULATING VOLTAGE

Open switch SW_1 and close SW_2. Turn the generator at 5,000 rpm. The regulator is normal if the voltage is within 14.1 - 14.8 V with a fully charged battery.

MEASUREMENT OF OUTPUT CURRENT

1) With the variable resistor set to the minimum resistance position, close switches SW_1 and SW_2 in order to turn the generator.
2) Raise generator speed while keeping the voltage constant by adjusting the variable resistor. Measure the current at 1,250 rpm, 2,500 rpm and 5,000 rpm.

1,250 rpm	18A or more
2,500 rpm	49A or more
5,000 rpm	58A or more

DISASSEMBLY

1) Remove through bolts from alternator. Detach front cover with rotor from rear cover with stator by lightly tapping on front cover with a plastic hammer.

2) Hold rotor with a vise and remove pulley nut.

When holding rotor with vise, insert aluminum plates on the contact surfaces of the vise to prevent rotor from damage.

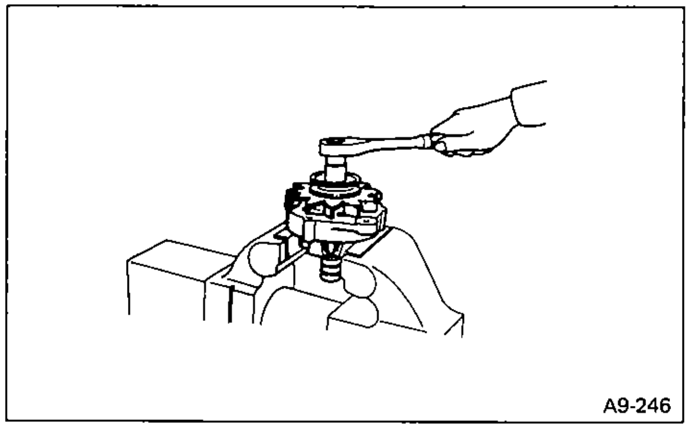


Fig. 66

3) Rotor from front cover.
4) Three screws from front cover and then retainer and ball bearing.
5) Separate stator with diode ASSY and brush ASSY from rear cover by removing nuts on rear cover.
6) Disconnect diode ASSY, brush ASSY and IC regulator all together from stator coil lead wires by using soldering iron.

Melting should be done quickly not to damage diodes and IC regulator.

7) Disconnect diode ASSY from brush and IC regulator by removing 3 mm (0.12 in) dia. rivet and by unsoldering L-terminal.
8) To replace IC regulator, first unsolder regulator terminals, and then remove two bolts.

Do not remove these bolts except when replacing IC regulator.

INSPECTION AND REPAIR

ROTOR

1) Inspect slip rings for contamination or any roughness of the sliding surface.
Clean or polish with #500 to #600 emery paper if defective.

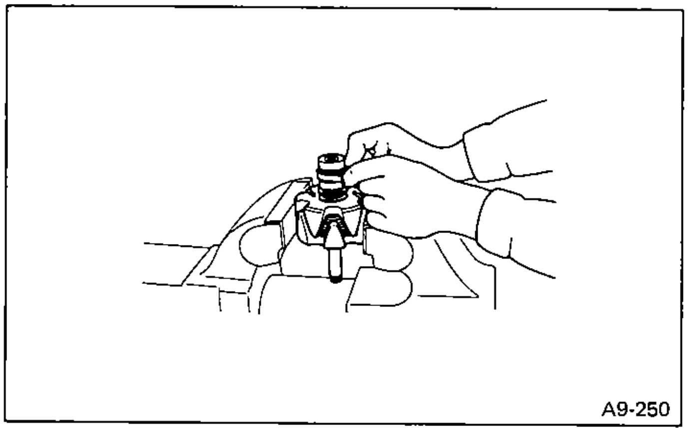


Fig. 67

2) Broken wire test
Inspect rotor coil for continuing between slip rings.
If there is no continuity, it is broken.
Replace rotor ASSY.

Resistance of rotor coil:
4 – 5Ω

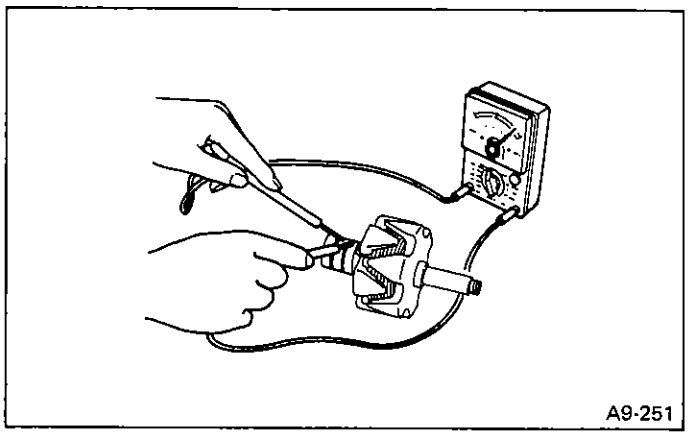


Fig. 68

3) Insulation test
Inspect continuity between slip ring and rotor core. If continuity exists, replace rotor ASSY because rotor coil or slip ring is broken.

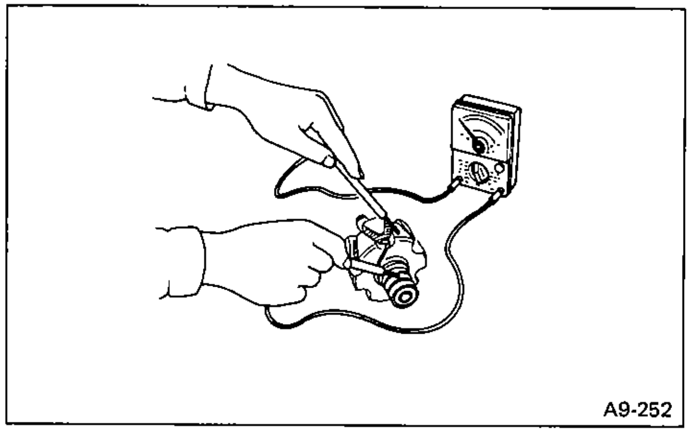


Fig. 69

4) Check ball bearing and replace if defective.

STATOR

1) Broken wire test
Inspect stator coil for continuity between its terminals.
When there is no continuity between individual terminals, cable is broken.
Replace stator ASSY.

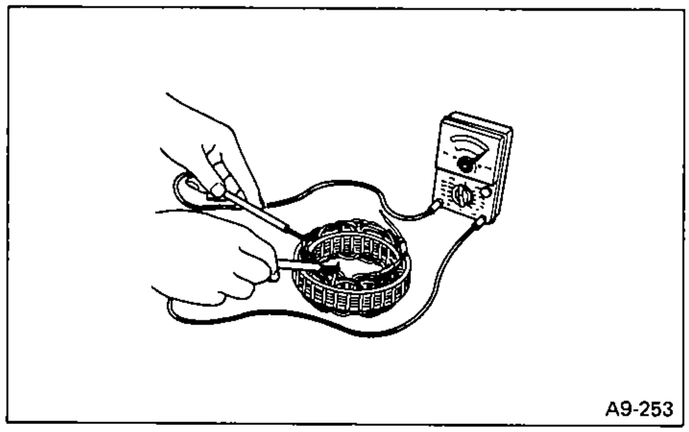


Fig. 70

2) Insulation test
Inspect stator coil for continuity between stator core and each terminal. If there is continuity, stator coil is grounded.

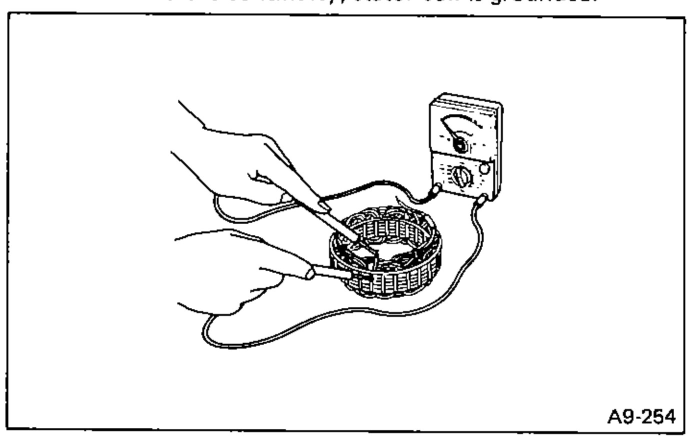


Fig. 71

BRUSH

1) Inspect the movement of brush and if the movement is not smooth, check brush holder and clean it.
Check brush for wear. If it is worn out to less than specified limit, replace brush ASSY.

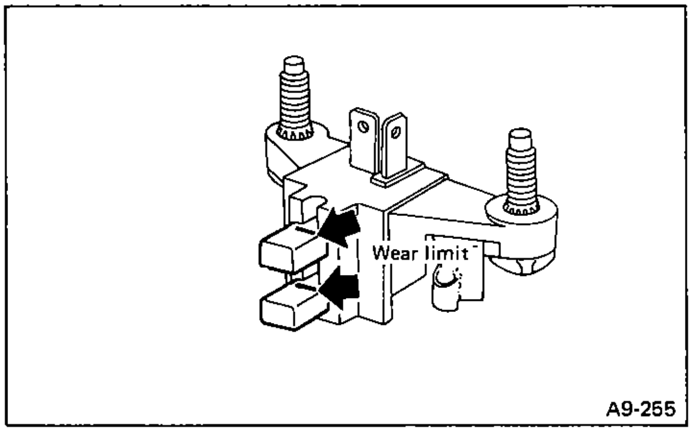


Fig. 72

2) With brush protruded approximately 2 mm (0.08 in) from brush holder, measure brush spring pressure with a spring balance.
Normally the pressure of a new brush spring is 2.501 to 3.383 N (255 to 345 g, 8.99 to 12.17 oz). When brush is worn, pressure decreases approximately 0.196 N (20 g, 0.71 oz) per 1 mm (0.04 in) wear.

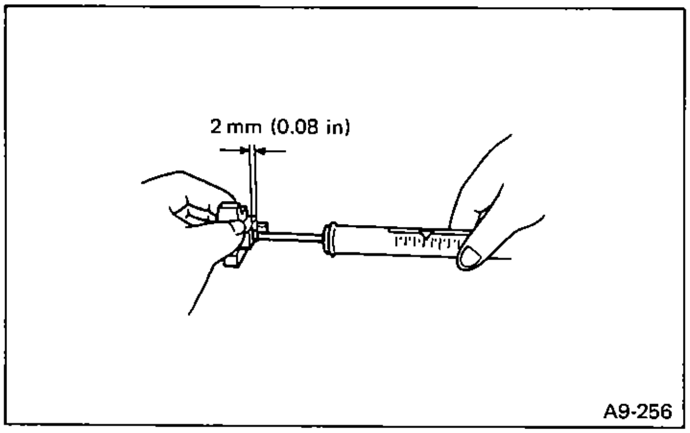


Fig. 73

DIODE ASSEMBLY

Perform the continuity test on diodes in both directions, using an ohmmeter.
A total of six diodes are used, there are mounted on the positive (+) plate, and other three are on the negative (-) plate.
The continuity test should be performed on each diode between the terminal and plate.

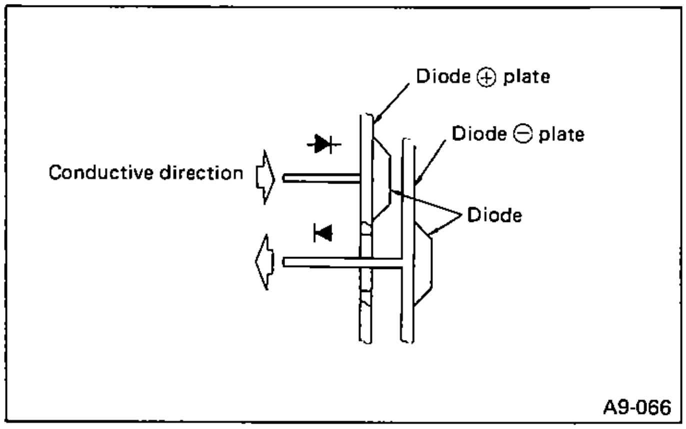


Fig. 74

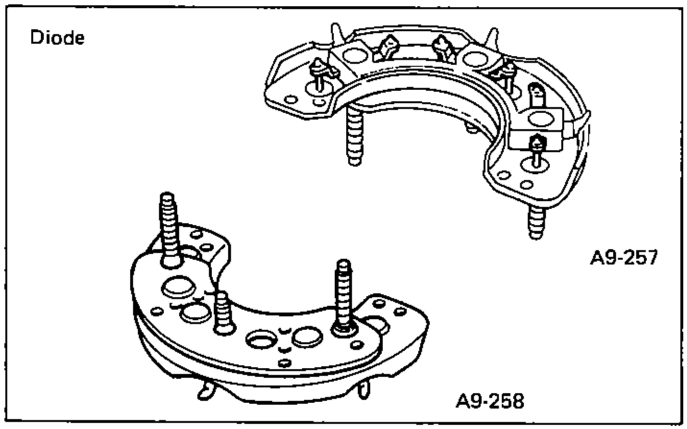
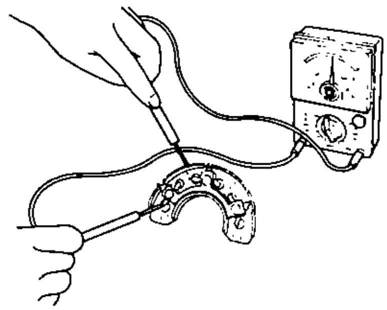


Fig. 75

Diodes installed on (+) plate are positive diodes which allow current flowing from terminal to (+) plate only.
Diodes installed on (-) plate are negative diodes which allow current flowing from (-) plate to terminal only. If each current flows in the same direction only, diode is in good condition.
If current flows toward both positive and negative directions, diode is short circuited. In this case, replace diode ASSY.

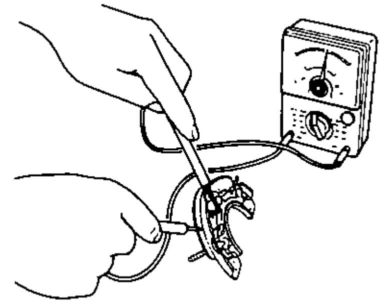
Never use a high tension insulation tester, such as a meggar as it will damage diodes with its high tension.

Normal conditions of continuity are shown in the following table.



Positive diode A9-259

Fig. 76



Negative diode A9-260

Fig. 77

		Connect (+) terminal of tester and ;		
		Diode (+) plate	Diode (-) plate	Diode (+) terminal
Connect (-) terminal of tester and ;	Diode (+) plate		Nonconduction	Nonconduction
	Diode (-) plate	Conduction		Conduction
	Diode (-) terminal	Conduction	Nonconduction	

IC REGULATOR

1) Prepare the following measuring apparatus:

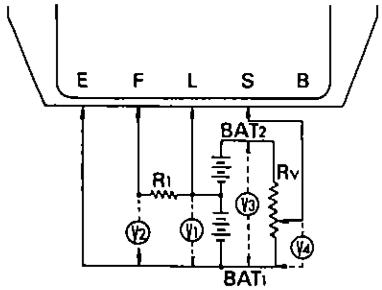
(1) Resistor (R_1)
10 Ω, 3 W (one)

(2) Variable resistor (R_V)
0 to 300 Ω, 3 W (one)

(3) Battery (BAT_1, BAT_2)
12 V (two)

(4) DC voltmeter (Ⓥ1, Ⓥ2, Ⓥ3, Ⓥ4)
0 to 30 V (one)

2) Connect the above-listed apparatus as shown in figure below, and perform checks in the following sequence;



A9-415

Fig. 78

(1) Check V_1 (voltage of battery 1).
Battery 1 is normal if 10 V to 13 V is indicated.

(2) Check V_2 (voltage between terminals F and E) with terminal S disconnected. IC regulator is normal if the voltage is below 2.0 V. If a voltage of 2.0 V or higher is indicated, the regulator is faulty and should be replaced.

(3) Check V_3 (total voltage of batteries 1 and 2). Both batteries are normal if 20 V to 26 V is measured.

(4) Measure V_2 (voltage between terminals F and E) while slowly increasing the resistance of variable resistor, starting from 0. Check whether the voltage of V_2 changes from below 2.0 V to 10 V – 13 V of V_3 (that is, the voltage of battery 1). If no change occurs, regulator is faulty and must be replaced.

(5) Measure V_4 (voltage between center tap of variable resistor and terminal E). With variable resistor Rv fixed, check V_4 to see whether it is within the specified range. If V_4 is in the specified range, regulator is normal. If not, regulator is faulty and must be replaced.

Specified voltage range:
14.1 - 14.8 V

(6) Connect measuring apparatus as shown in figure below, and measure V_4 (voltage between terminals B and E). Perform check in the same manner as in steps (4) and (5) above. If a voltage 0.5 V to 2.0 V higher than V_4 is measured, regulator is normal. In other cases, replace regulator.

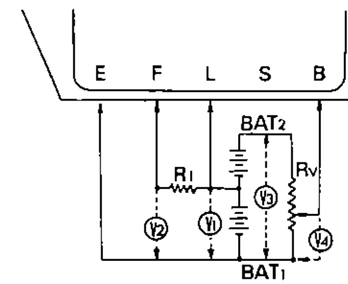


Fig. 79

ASSEMBLY

1) Assembling brush and IC regulator
(1) Soldering brush
Set brush in position and solder leads.

Use care not to allow melted solder to flow over lead wire.

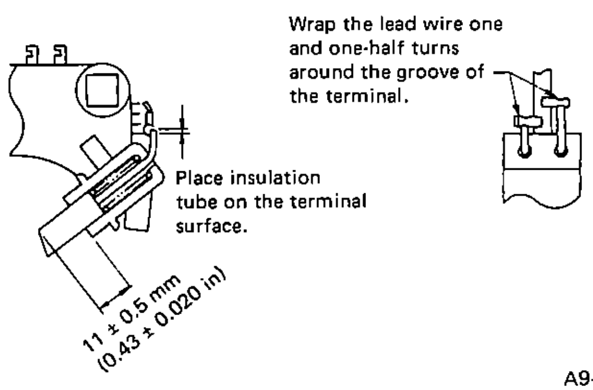
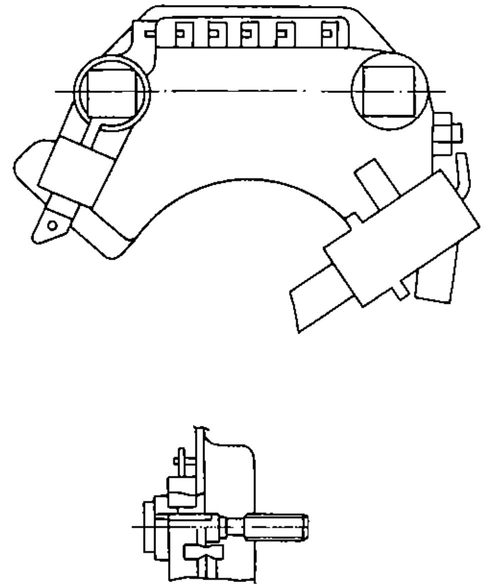


Fig. 80

(2) Assembling IC regulator
Place IC regulator on brush holder, and force-fit a 5 mm bolt. Be sure to set the bushing and connecting plate.

The output terminal is grounded and the battery will be short-circuited if the bushing is not installed.



Notes:
1. Force-fitting pressure:
981 N (100 kg, 221 lb)
2. Be sure to force-fit perpendicularly.

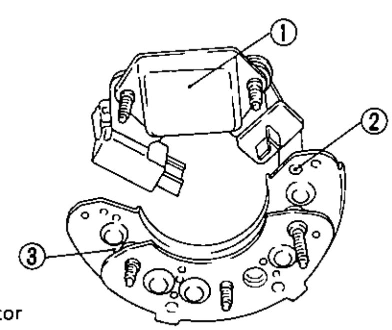
A9-418

Fig. 81

2) Connecting brush & IC regulator ASSY and diode.
(1) Joining by riveting
Insert a 3 mm (0.12 in) dia. rivet, and caulk rivet using caulking tool.

Caulking pressure:
4,904 N (500 kg, 1,103 lb)

(2) Connecting brush and diode
Insert brush terminal into diode terminal which has been warmed by soldering iron, and caulk both terminals. Then solder these terminals.



1 IC regulator
2 Rivet
3 Diode

A9-419

Fig. 82

3) Connect each stator coil lead wire to diode ASSY and brush terminals by soldering.

Soldering should be done quickly not to damage diodes.

4) Install and tighten diode ASSY and brush ASSY to rear cover by nuts.

Tightening torque:
3.1 – 3.9 N·m (0.32 – 0.40 kg-m, 2.3 – 2.9 ft-lb)

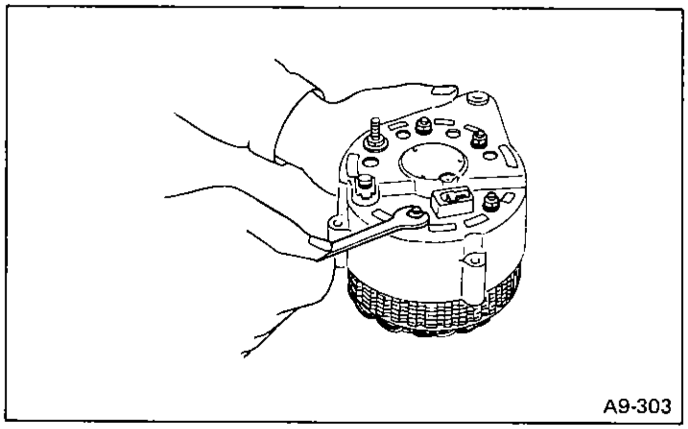


Fig. 83

5) After installing bearing into front cover, install bearing retainer on it by tightening screws.

Tightening torque:
3.1 – 3.9 N·m (0.32 – 0.40 kg-m, 2.3 – 2.9 ft-lb)

6) Install rotor ASSY into front cover.
7) Hold rotor with a vise and install spacer, fan, pulley, spring washer and pulley nut.
Tighten pulley nut to the specified torque.

Tightening torque:
39 – 59 N·m (4.0 – 6.0 kg-m, 29 – 43 ft-lb)

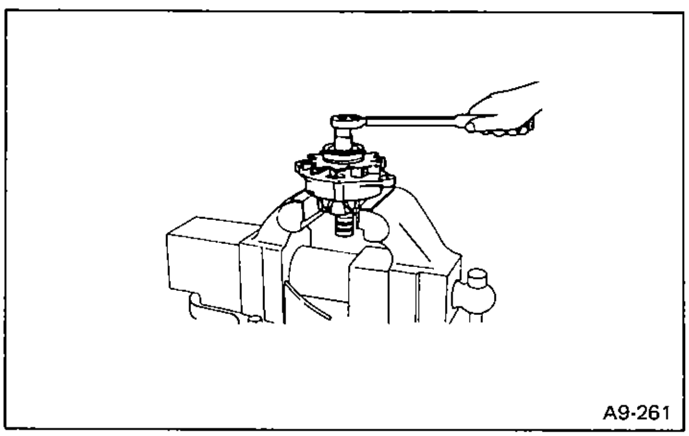


Fig. 84

When holding rotor with a vise, insert aluminum plates between the vise and rotor to prevent rotor from damage.
When pulley is tightened, make sure that deflection of V-groove is less than 0.3 mm (0.012 in).

8) Push brush up with finger and retain brush by inserting a pin, about 2 mm (0.08 in) dia, into brush lift hole from the outside of rear cover.

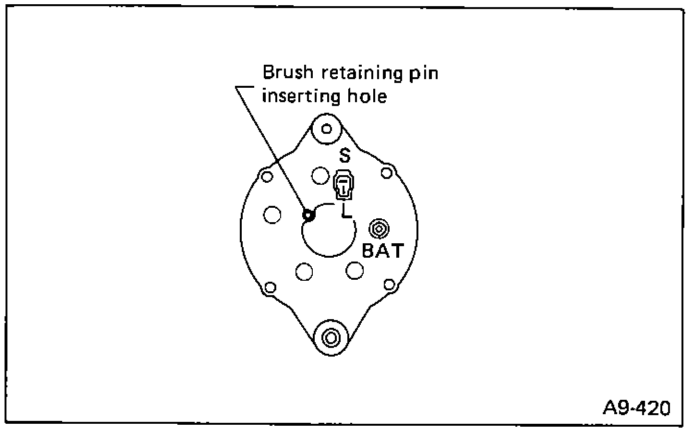


Fig. 85

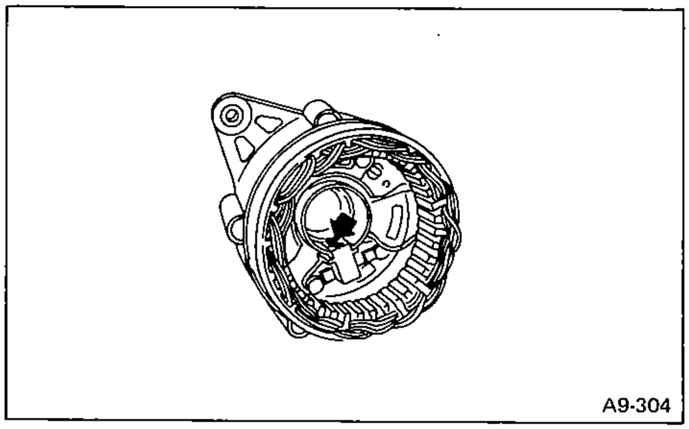


Fig. 86

9) Assemble front and rear parts of alternator and tighten through bolts.

Tightening torque:
3.1 – 5.4 N·m (0.32 – 0.55 kg-m, 2.3 – 4.0 ft-lb)

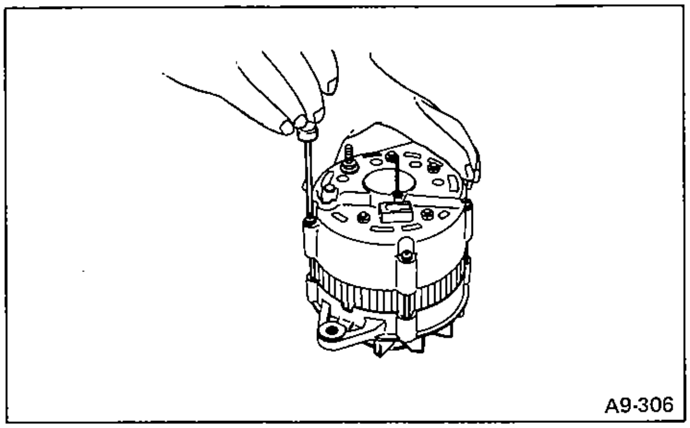


Fig. 87

10) After assembling alternator, pull up the brush holding pin by pushing toward center of hole.

Be careful not to damage the slip ring sliding surface by pulling pin.

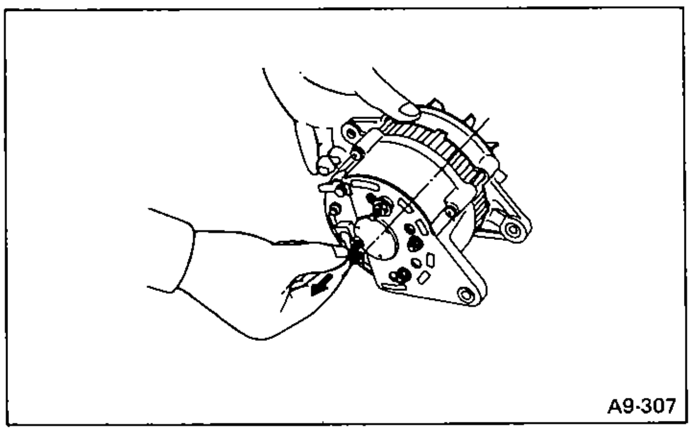


Fig. 88

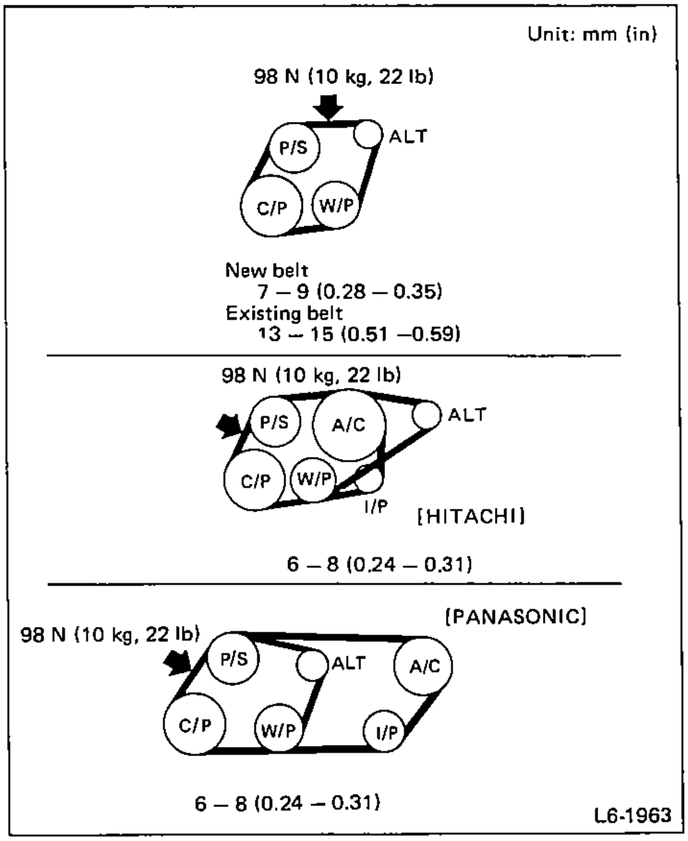


Fig. 89

4) Connect lead wires to alternator.

a. Be careful not to connect individual terminals erroneously.
b. Pay careful attention to battery polarity so that it may not be reversed by wrong connection. If polarities are reversed, battery will be shorted by diode, excessive current will flow, and diodes or wire harness may be damaged.

INSTALLATION

1) Install alternator to bracket on engine with bolts and tighten bolts lightly.
2) After installing drive belt, pull belt by moving alternator and tighten installing bolts.
3) Check belt tension as shown figure.

Distributor

DESCRIPTION

This distributor is equipped with a photoelectric crank-angle sensor which transmits a crank-angle signal and a cylinder-identification signal to the fuel injection control unit.

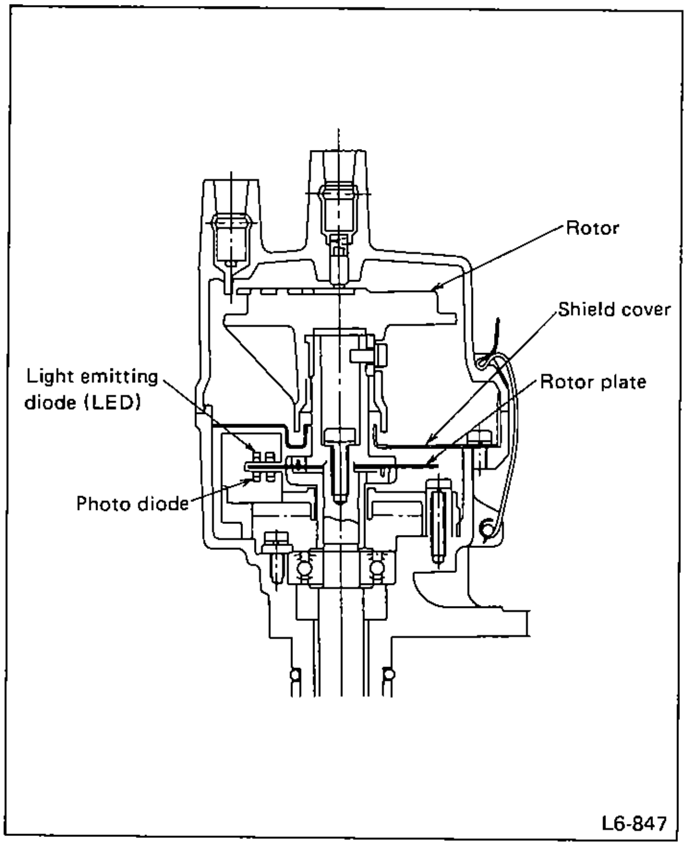


Fig. 90

A signal processing unit, which is built into the distributor housing, consists of LED and a photodiode. The rotor plate, located between the LED and the photodiode, is secured to the rotor shaft.
The rotor plate has four slits along its periphery through which 90° signals (in terms of distributor angle) are transmitted for cylinder detection. In addition, there are three hundred and sixty slits through which 1° signals (in terms of distributor angle) are transmitted for crank-angle detection. Directly above the rotor plate is the LED and below it is the photodiode.
When the ignition switch is turned "ON", the LED emits light to the photodiode. The rotor plate turns as the engine starts. The light emitted from the LED is then repeatedly interrupted and transmitted through the slits by rotation of the rotor plate. The "on-off" light signals (for cylinder detection and crank-angle detection) are then converted into output signals which are transmitted to the fuel injection control unit.
The fuel injection control unit determines optimum ignition timing in response to these output signals and engine operating conditions and transmits an ignition signal to the ignition coil. This type of distributor is not equipped with a centrifugal advance angle and a vacuum advance angle device.

DISASSEMBLY

1) Detach cap and dust cover as a unit.
2) Remove carbon point from cap.
3) Remove rotor head securing screw and detach rotor head from rotor shaft.
4) Remove O-ring from housing.
5) Drive roll pin out of shaft and pinion.
6) Remove pinion from shaft.

Further disassembly of parts is prohibited.

INSPECTION

1) Carbon point
Measure the length of carbon point in cap. Replace if it is less than service limit.

Standard length:
12 mm (0.47 in)
Service limit:
10 mm (0.39 in)

2) Cap and rotor head
Measure insulation resistance using a megger. Replace if it is less than the specified value.

Insulation resistance:
More than 50 MΩ

ASSEMBLY

ASSY is in the reverse order of disassembly. Observe the following:
1) Use new roll pin when installing pinion.
2) Install pinion so that its alignment mark is aligned with the mark on the housing when the cutout section of rotor shaft faces the 1st cylinder mark on the cap.

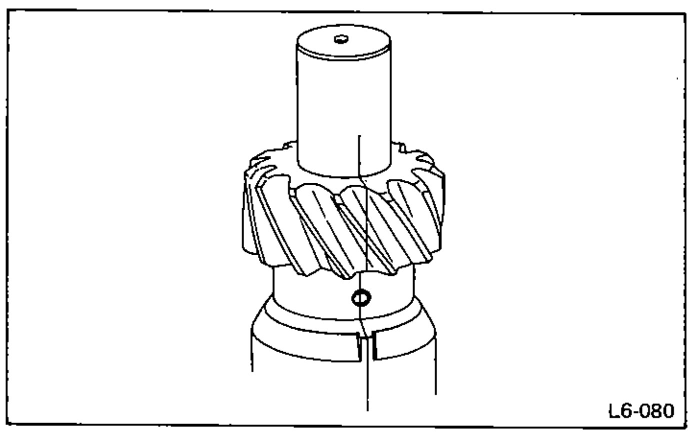


Fig. 91

Ignition Coil

DESCRIPTION

The E12-113 ignition coil is equipped with a power transistor igniter. The power transistor amplifies the ignition signal transmitted from the fuel injection control unit. The amplified signal is used to make and break the current flowing through the primary winding of the ignition coil.

REMOVAL AND INSTALLATION

1) Disconnect battery negative (–) terminals.
2) Disconnect wires from ignition coil.
3) Remove ignition coil.
4) To install, reverse the order of removal.

Be sure to connect wires to their proper positions. Failure to do so will damage unit.

INSPECTION

Using accurate tester, inspect the following items, and replace if defective.

1) Primary resistance
2) Secondary coil resistance

If the resistance is extremely low, this indicates the presence of a short-circuit.

3) Insulation between primary terminal and case: 10 MΩ or more.
4) If engine does not run due to faulty ignition system, check ignition system as follows:

Check for cracked distributor rotor or cap and corroded terminals.

Visually inspect high tension wire for condition. Check spark plugs and adjust gaps as necessary. Replace spark plug which is not suitable for further use.

If the above checks cannot correct the problem, check entire ignition system with oscilloscope or circuit tester in accordance with the troubleshooting charts. (See chapter 6-3)

Spark Plug

DESCRIPTION

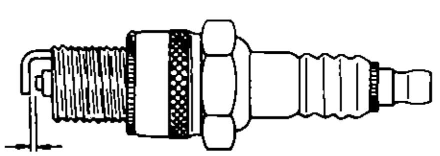


Fig. 92

The spark plugs are project type, having 14 mm (0.551 in) threads and 1.0 to 1.1 mm (0.039 to 0.043 in) gap.

All spark plugs installed on an engine, must be of the same heat range.

Applicable model	Spark plug
MPFI	NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) NIPPONDENSO: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) CHAMPION: RN9YC-4
SPFI	NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) NIPPONDENSO: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) CHAMPION: RN9YC-4

All spark plugs installed on an engine, must be of the same heat range.

Spark plug
NGK: BPR6ES-11 (or BPR5ES-11, BPR7ES-11) NIPPONDENSO: W20EPR-U11 (or W16EPR-U11, W22EPR-U11) CHAMPION: RN9YC-4

REMOVAL AND INSTALLATION

1) Remove spark plug cords by pulling boot, not cord itself.
2) Remove spark plugs.
3) When installing spark plugs on cylinder head, use spark plug wrench.

Tightening torque (Spark plug):
20 – 29 N·m (2 – 3 kg-m, 14 – 22 ft-lb)

The above torque should be only applied to new spark plugs without oil on their threads.
In case their threads are lubricated, the torque should be reduced by approximately 1/3 of the specified torque in order to avoid their over-stressing.

4) Connect spark plug cords.

INSPECTION

Check electrodes and inner and outer porcelain of plugs, noting the type of deposits and the degree of electrode erosion.

1) Normal
Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range.

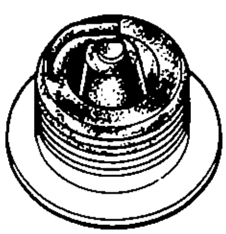

A9-164

Fig. 93

2) Carbon fouled
Dry fluffy carbon deposits on insulator and electrode are mostly caused by slow speed driving in city, weak ignition, too rich fuel mixture, dirty air cleaner, etc.
It is advisable to replace with plugs having hotter heat range.

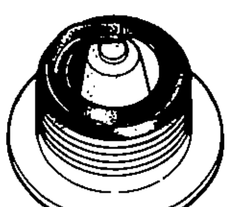

A9-165

Fig. 94

3) Oil fouled
Wet black deposits show excessive oil entrance into combustion chamber through worn rings and pistons or excessive clearance between valve guides and stems. If same condition remains after repair, use a hotter plug.

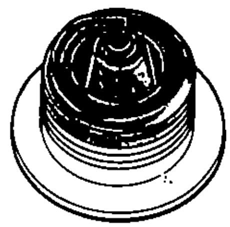

A9-166

Fig. 95

4) Overheating
White or light gray insulator with black or gray brown spots and bluish burnt electrodes indicate engine overheating. Moreover, the appearance results from incorrect ignition timing, loose spark plugs, wrong selection of fuel, hotter range plug, etc. It is advisable to replace with plugs having colder heat range.

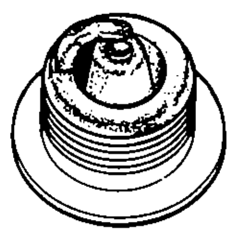

A9-167

Fig. 96

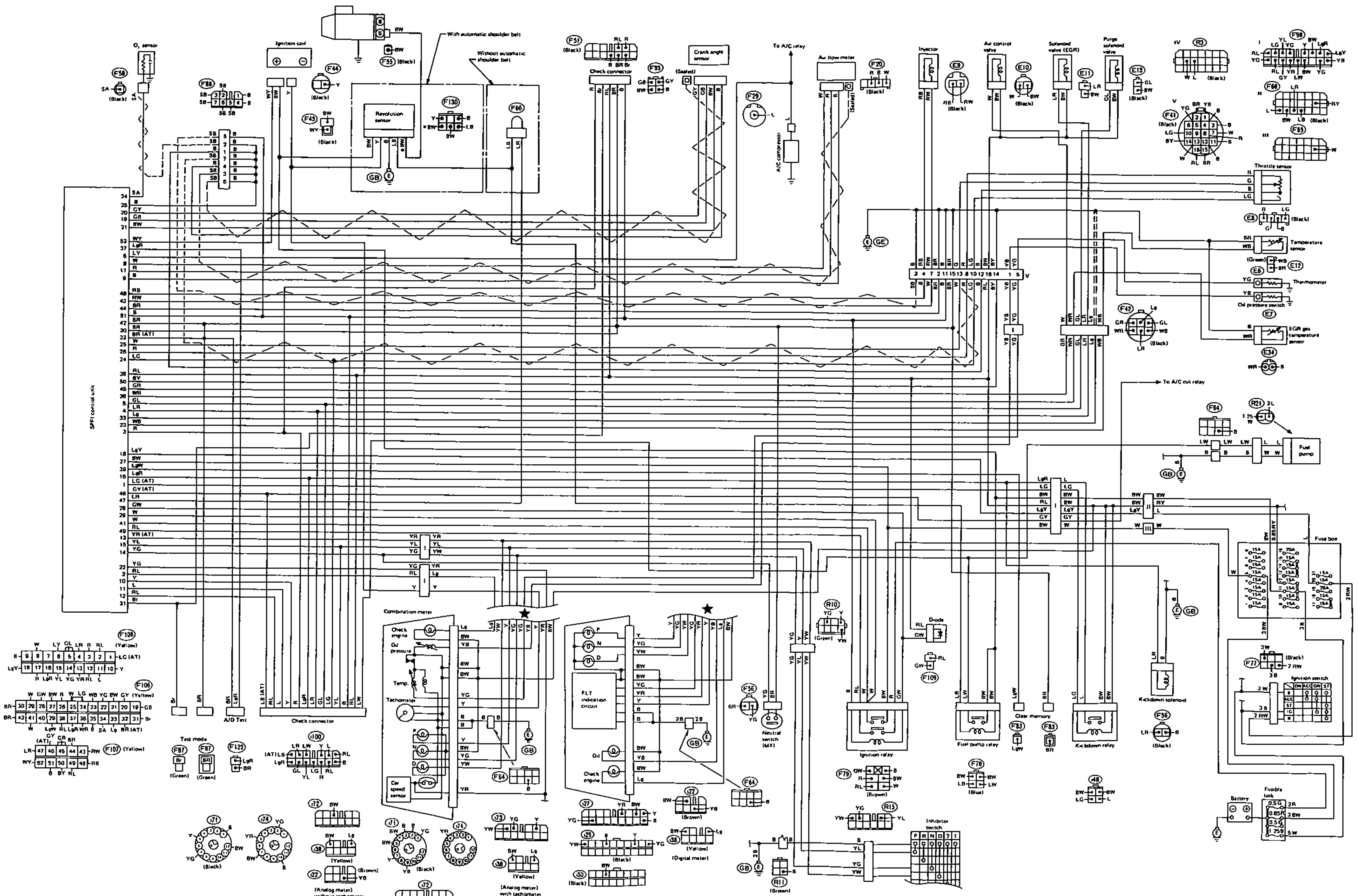
CLEANING AND REGAPPING

Clean spark plugs in a sand blast type cleaner.
Avoid excessive blasting. Clean and remove carbon or oxide deposits, but do not wear away porcelain.
If deposits are too stubborn, discard plugs.
After cleaning spark plugs, recondition firing surface of electrodes with file. Then correct the spark plug gap to 1.0 to 1.1 mm (0.039 to 0.043 in) using a gap gauge.

Diagram of SPFI System

For 1 US model 4-Door FWD GL and GL-10

2 US model Station Wagon FWD GL and GL-10



L6-2029

Fig. 2

Self-diagnosis System

Diagram of SPFI System

For 1 All CANADA model
2 US model 3-Door
3 US model 4-Door FWD DL and all 4WD
4 US model Station Wagon FWD DL and all 4WD

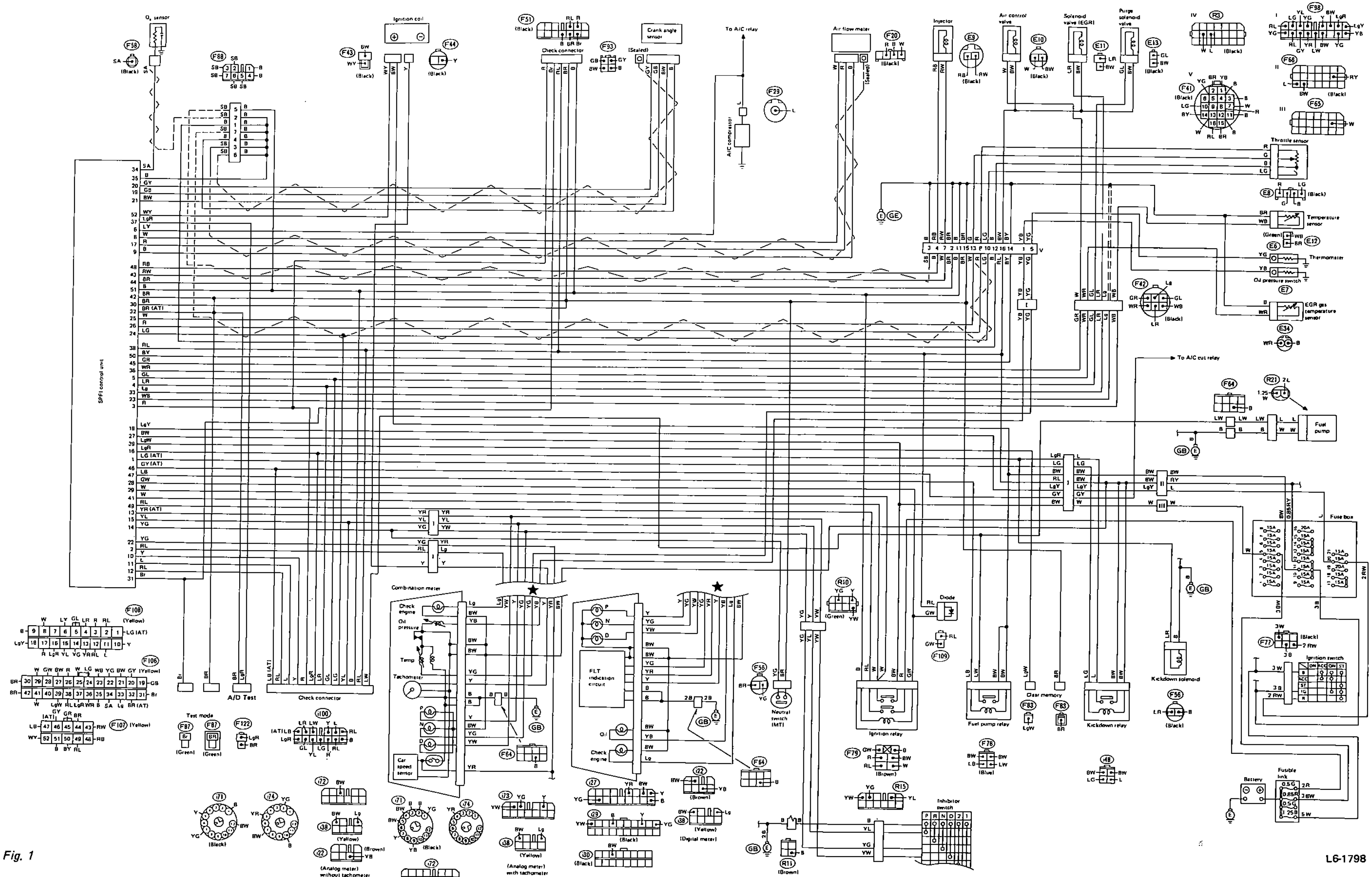


Fig. 1

L6-1798

Diagram of MPFI System (With automatic shoulder belt)

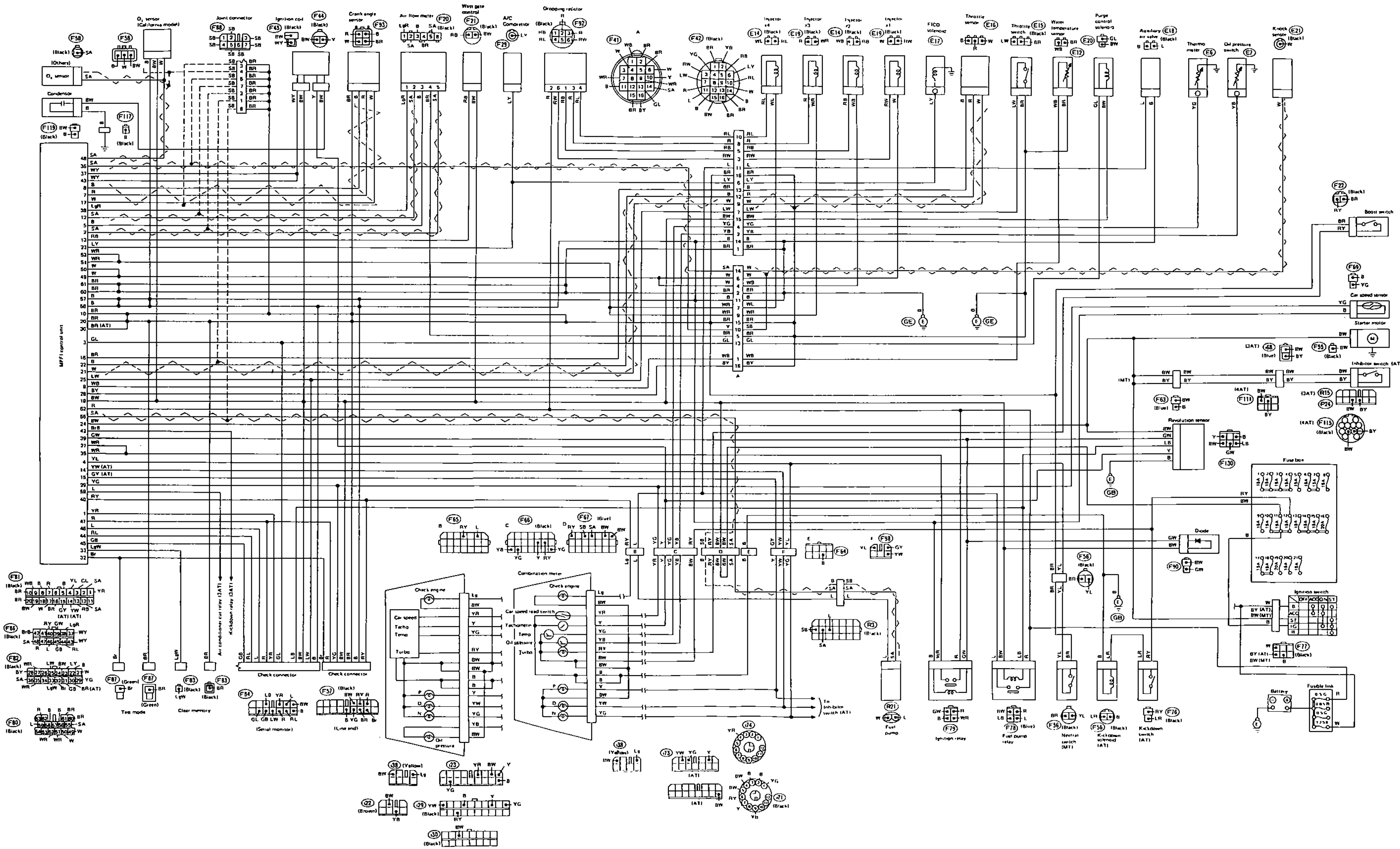


Fig. 7

L6-2028

Diagram of MPFI System (With automatic shoulder belt)

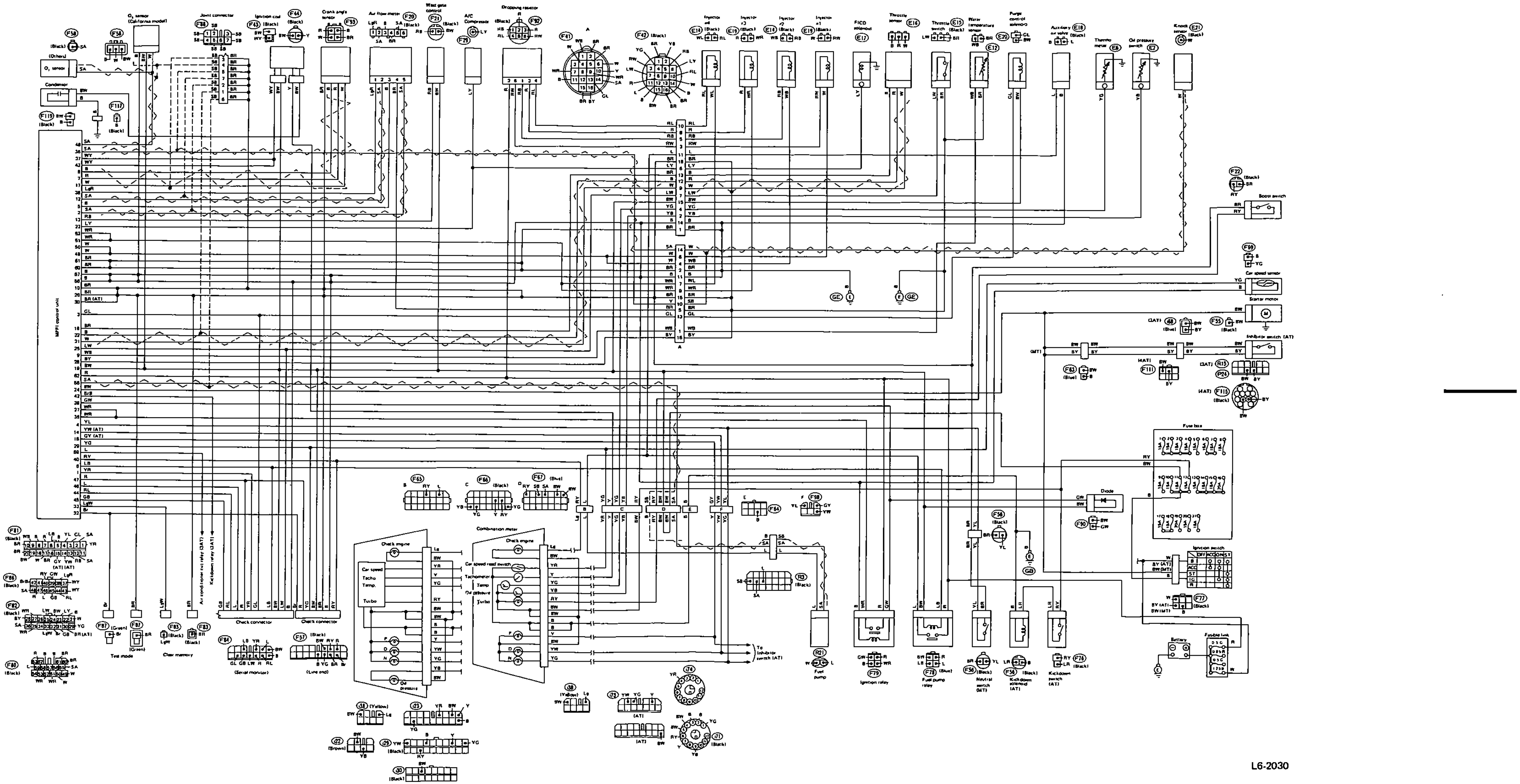


Fig. 6

Engine Electrical System

MPFI (Without Automatic Shoulder Belt)

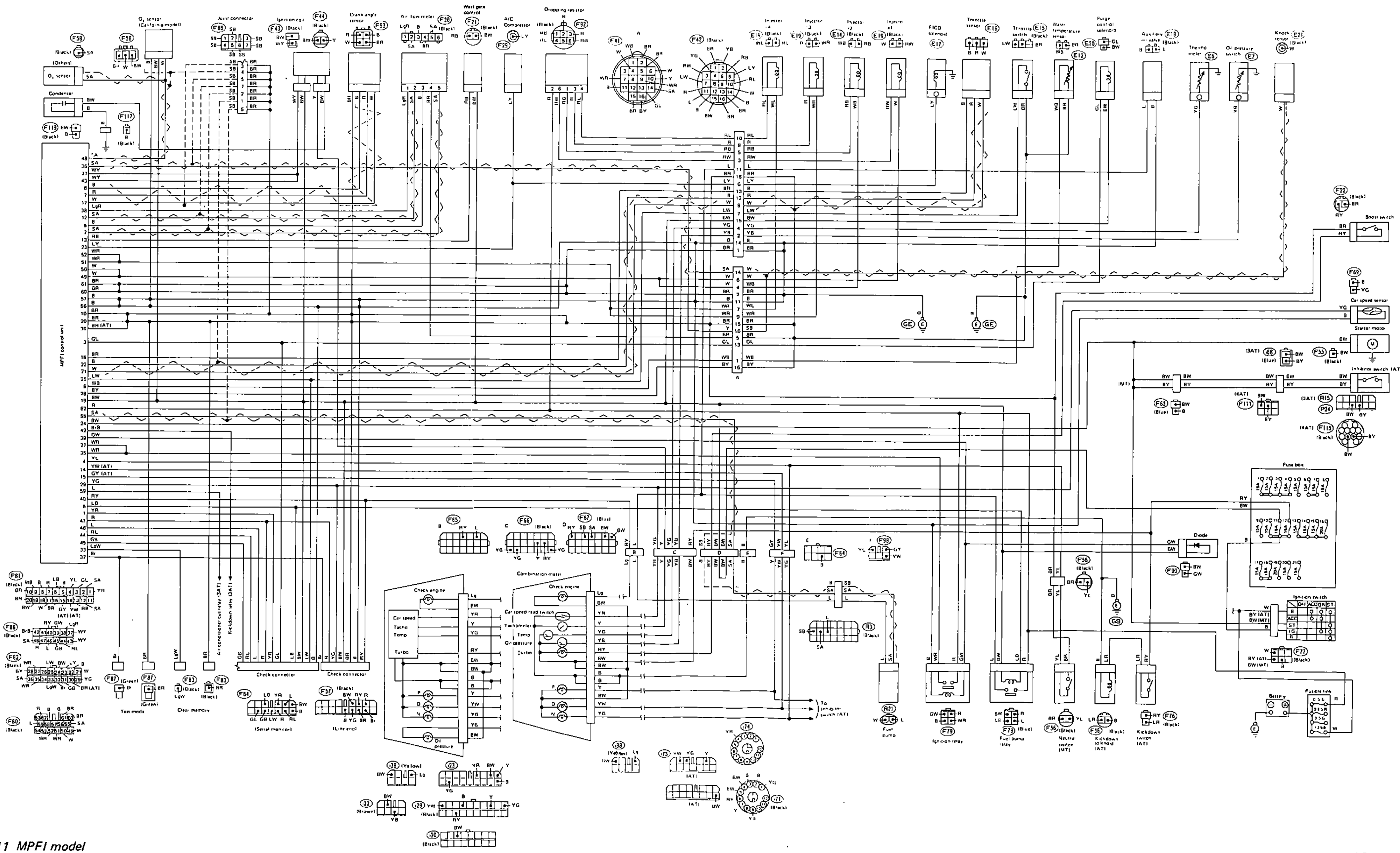


Fig. 11 MPFI model

L6-2030

MPFI (With Automatic Shoulder Belt)

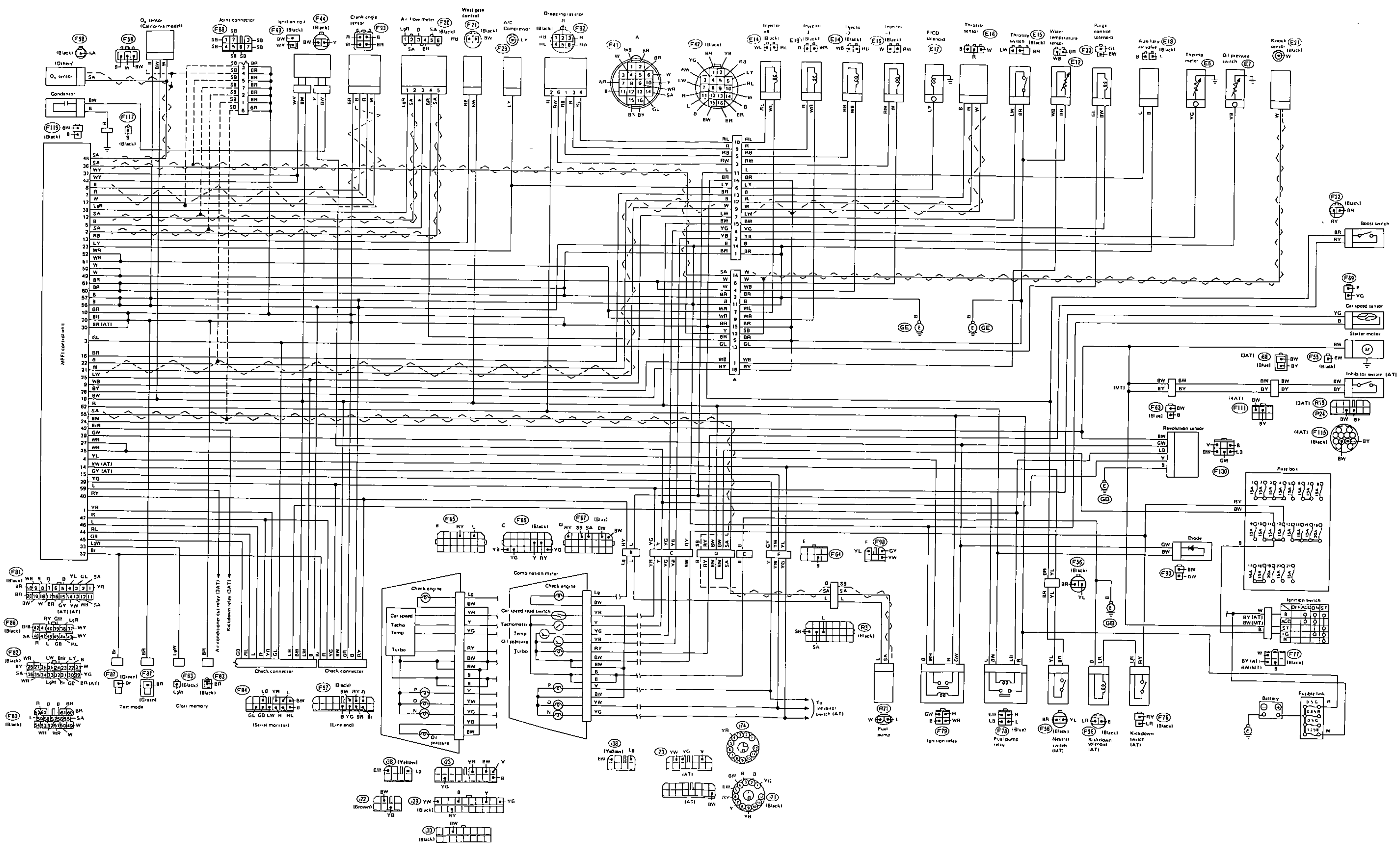


Fig. 12 MPFI model

L6-2028

SPFI
- ALL CANADA MODEL
- U.S. MODEL 3-DOOR
- U.S. MODEL 4-DOOR FWD DL & ALL 4WD
- U.S. MODEL STATION WAGON FWD DL & ALL 4WD

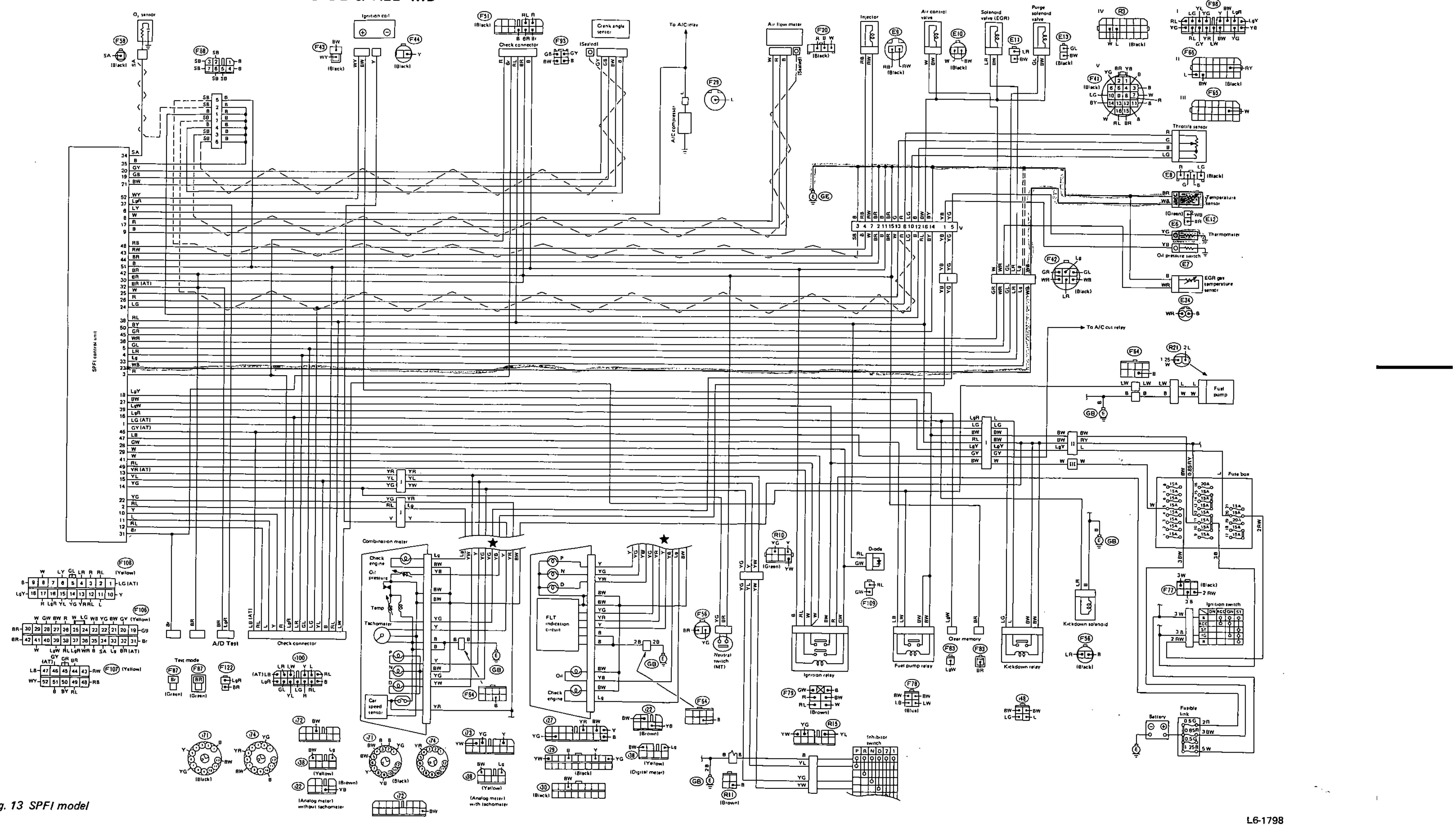


Fig. 13 SPFI model

SPFI • U.S. MODEL 4-DOOR FWD GL & GL-10
• U.S. MODEL STATION WAGON FWD GL & GL-10

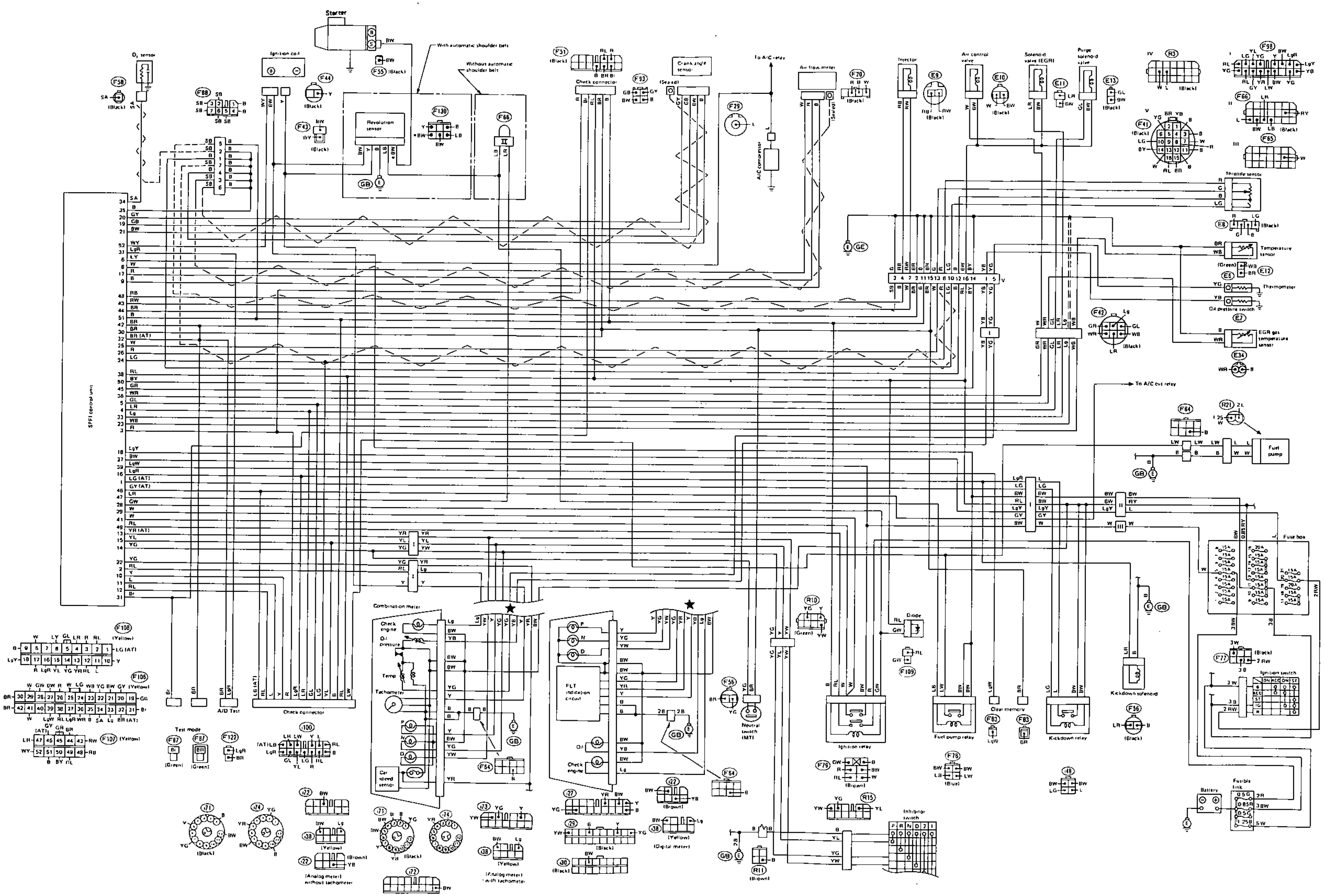


Fig. 14 SPFI model

L6-2029