TABLE OF CONTENTS

1 GENERAL SECTION	1–1 Specifications 1–2 ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ 1–3 General Information 1–4 Pre-Delivery Inspection 1–5 Periodic Maintenance Services 1–6 Special Tools
2 ENGINE SECTION	2–1 Emission Control System and Vacuum Fitting 2–2 On-Car Services 2–3 Engine 2–4 Engine Lubrication System 2–5 Engine Cooling System 2–6 ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ 2–7 Fuel Injection System 2–8 Fuel System 2–9 Exhaust System 2–10 Clutch 2–11 Engine and Transmission Mounting System
3 TRANSMISSION AND DIFFERENTIAL SECTION	3–1 Manual Transmission and Differential 3–2 Automatic Transmission and Differential 3–3 Transmission Control System 3–4 AWD System
4 MECHANICAL COMPONENTS SECTION	4–1 Suspension 4–2 Wheels and Axles 4–3 Steering System 4–4 Brakes 4–5 Pedal System and Control Cables 4–6 Heater and Ventilator 4–7 Air Conditioning System
5 BODY SECTION	5–1 Body and Exterior 5–2 Doors and Windows 5–3 Seats, Seat Belts, and Interior 5–4 Instrument Panel 5–5 Supplemental Restraint System
6 ELECTRICAL SECTION	6–1 Engine Electrical System 6–2 Body Electrical System 6–3 Wiring Diagram and Trouble-shooting

S SPECIFICATIONS

4-DOOR SEDAN

ITEM \ MODEL	FWD			AWD				
	L		LS	L		LS	TURBO	
	5MT*1	4AT*1	4AT*2	5MT*3*5	4AT*4*5	4AT*2	5MT*2	4AT*2

1. DIMENSIONS

Overall length mm (in)	4,545 (178.9)								
Overall width mm (in)	1,690 (66.5)								
Overall height mm (in)	1,360 (53.5)								
Compartment	Leg room	Front Max. mm (in)	1,095 (43.1)						
		Rear Min. mm (in)	885 (34.8)						
	Head room	Front mm (in)	965 (38.0)	925 (36.4)	965 (38.0)	925 (36.4)	925 (36.4)	965 (38.0)	
		Rear mm (in)	915 (36.0)	910 (35.8)	910 (35.8)	910 (35.8)	910 (35.8)	915 (36.0)	
	Shoulder room	Front mm (in)	1,375 (54.1)						
		Rear mm (in)	1,365 (53.7)						
Wheelbase mm (in)	2,580 (101.6)								
Tread	Front mm (in)	1,465 (57.7)			1,460 (57.5)			1,465 (57.7)	
	Rear mm (in)	1,450 (57.1)							
Minimum road clearance mm (in)	140 (5.5)			120 (4.7)					

2. WEIGHT

Curb weight (C.W.)	Front kg (lb)	705 (1,555) 695 (1,535)*1	745 (1,640) 735 (1,620)*1	795 (1,745) 785 (1,725)*1	755 (1,665) 715 (1,580)*5	780 (1,725) 745 (1,640)*5	800 (1,775) 795 (1,755)*1	805 (1,780) 800 (1,760)*1	840 (1,855) 830 (1,835)*1
	Rear kg (lb)	540 (1,185) 530 (1,170)*1	545 (1,200) 540 (1,185)*1	565 (1,250) 560 (1,235)*1	600 (1,320) 595 (1,310)*5	605 (1,330) 600 (1,320)*5	625 (1,380) 620 (1,365)*1	615 (1,360) 610 (1,345)*1	620 (1,365) 615 (1,350)*1
	Total kg (lb)	1,245 (2,740) 1,225 (2,705)*1	1,290 (2,840) 1,275 (2,805)*1	1,360 (2,995) 1,345 (2,960)*1	1,355 (2,985) 1,310 (2,890)*5	1,385 (3,055) 1,345 (2,960)*5	1,430 (3,155) 1,415 (3,120)*1	1,425 (3,140) 1,410 (3,105)*1	1,460 (3,220) 1,445 (3,185)*1
Gross vehicle weight (G.V.W.)	Front kg (lb)	940 (2,065)			950 (2,095)				
	Rear kg (lb)	845 (1,865)			915 (2,015)				
	Total kg (lb)	1,785 (3,930)			1,865 (4,110)				

*1: Models for Canada
*2: The weight of the power door lock, power window, air conditioner, cruise control, ABS, cassette player and sunroof are included in the C.W.
*3: The weight of the power door lock, power window, air conditioner, cruise control and cassette player are included in the C.W.
*4: The weight of the power door lock, power window and air conditioner are included in the C.W.
*5: Models for Canada, the weight of the power door lock and power window are included in the C.W.

NOTE: When optional parts are installed, the weight indicated in the following table is added to Curb weight.

	Power door lock and power window	Air conditioner	Cruise control and cassette player	ABS	Sunroof	AIRBAG
Front kg (lb)	0 (0)	25 (55)	5 (10)	14 (30)	9 (20)	5 (10)
Rear kg (lb)	2 (5)	−2 (−5)	0 (0)	0 (0)	14 (30)	2 (5)
Total kg (lb)	2 (5)	23 (50)	5 (10)	14 (30)	23 (50)	7 (15)

MODEL	FWD			AWD				
	L		LS	L		LS	TURBO	
	5MT	4AT	4AT	5MT	4AT	4AT	5MT	4AT

3. ENGINE

Engine type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
Valve arrangement	Overhead camshaft type	
Bore × Stroke mm (in)	96.9 × 75 (3.815 × 2.95)	
Displacement cm^3 (cu in)	2,212 (134.98)	
Compression ratio	9.5	8.0
Firing order	1—3—2—4	
Idling speed at N or P position rpm	700± 100 (No load) 850± 50 (Air conditioner ON)	
Maximum output kW (PS)/rpm	130 at 5,400	160 at 5,600
Maximum torque N·m (kg-m, ft-lb)/rpm	186 (19.0, 137) at 4,400	245 (25.0, 181) at 2,800

4. ELECTRICAL

Ignition timing at idling speed BTDC/rpm		20° at 700	15° at 700
Spark plug	Type and manufacturer	NGK: BKR6E-11 NIPPONDENSO: K20EPR-V11 CHAMPION: RC7YC-4	
Alternator		12 V — 70 A	
Battery	Type	5MT: 55D23L-MF/4AT: 75D23L-MF	
	Reserve capacity min.	5MT: 99/4AT: 111	
	Cold cranking amperes amp.	5MT: 356/4AT: 490	

5. TRANSMISSION

Clutch type			DSPD	TC	TC	DSPD	TC	TC	DSPD	TC
Transmission type			*6	*7	*7	*8	*9	*9	*8	*9
Gear ratio	1st		3.545	2.785	2.785	3.545	3.027	3.027	3.545	2.785
	2nd		1.947	1.545	1.545	1.947	1.619	1.619	1.947	1.545
	3rd		1.366	1.000	1.000	1.366	1.000	1.000	1.366	1.000
	4th		0.972	0.694	0.694	0.972	0.694	0.694	0.972	0.694
	5th		0.738	—	—	0.783	—	—	0.783	—
	Reverse		3.416	2.272	2.272	3.416	2.272	2.272	3.416	2.272
Reduction gear (Front drive)	1st reduction	Type of gear	—	Helical	Helical	—	Helical	Helical	—	Helical
		Gear ratio	—	1.000	1.000	—	1.000	1.000	—	1.000
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Gear ratio	3.700	3.700	3.700	4.111	3.900	3.900	3.900	3.900
Reduction gear (Rear drive)	Transfer reduction	Type of gear	—			Helical	—	—	Helical	—
		Gear ratio	—			1.000	—	—	1.000	—
	Final reduction	Type of gear	—			Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Gear ratio	—			4.111	3.900	3.900	3.900	3.900

DSPD: Dry Single Plate Diaphragm
TC: Torque Converter
*6: 5-forward speeds with synchromesh and 1-reverse
*7: Electronically controlled fully-automatic, 4-forward speeds and 1-reverse
*8: 5-forward speeds with synchromesh and 1-reverse — with center differential and viscous coupling
*9: Electronically controlled fully-automatic, 4-forward speeds and 1-reverse — with hydraulically controlled transfer clutch

SPECIFICATIONS

[S0A6]

MODEL	FWD			AWD					
	L		LS	L		LS	TURBO	
:M	5MT	4AT	4AT	5MT	4AT	4AT	5MT	4AT
STEERING								
ype	Rack and pinion							
urns, lock to lock	3.3							
linimum turning circle m (ft)	Wall to wall ... 11.0 (36.1) Curb to curb ... 10.2 (33.5)							
. SUSPENSION								
Front	Macpherson strut type, Independent, Coil spring							
Rear	Dual link strut type, Independent, Coil spring							
. BRAKE								
Service brake system	Dual circuit hydraulic with vacuum suspended power unit							
Front	Ventilated disc brake						Ventilated disc brake	
Rear	Disc brake							
Parking brake	Mechanical on rear brakes							
9. TIRE								
Size	P185/70R14 87H						P195/60R15 87H	
Type	Steel belted radial, Tubeless							
10. CAPACITY								
Fuel tank ℓ (US gal, Imp gal)	60 (15.9, 13.2)							
Engine oil Upper level ℓ (US qt, Imp qt)	4.5 (4.8, 4.0)							
Engine oil Lower level ℓ (US qt, Imp qt)	3.5 (3.7, 3.1)							
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)	—	8.3 (8.8, 7.3)	8.3 (8.8, 7.3)	—	8.3 (8.8, 7.3)	8.3 (8.8, 7.3)	—	8.3 (8.8, 7.3)
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)	—	1.2 (1.3, 1.1)
AWD rear differential gear oil ℓ (US qt, Imp qt)	—			0.8 (0.8, 0.7)				
Power steering fluid ℓ (US qt, Imp qt)	0.7 (0.7, 0.6)							
Engine coolant ℓ (US qt, Imp qt)	5.9 (6.2, 5.2)						7.0 (7.4, 6.2)	

B: STATION WAGON

ITEM \ MODEL	FWD			AWD		
	L		LS	L		LS
	5MT	4AT	4AT*2	5MT	4AT	4AT*2

1. DIMENSIONS

Overall length mm (in)	4,620 (181.9)						
Overall width mm (in)	1,690 (66.5)						
Overall height mm (in)	1,390 (54.7)						1,430 (56.3)
Compartment — Leg room — Front Max. mm (in)	1,095 (43.1)						
Compartment — Leg room — Rear Min. mm (in)	890 (35.0)						
Compartment — Head room — Front mm (in)	975 (38.4)		940 (37.0)		975 (38.4)		940 (37.0)
Compartment — Head room — Rear mm (in)	960 (37.8)		925 (36.4)		960 (37.8)		925 (36.4)
Compartment — Shoulder room — Front mm (in)	1,375 (54.1)						
Compartment — Shoulder room — Rear mm (in)	1,365 (53.7)						
Cargo space — Length — with 2 seats mm (in)	1,685 (66.3)						
Cargo space — Length — with 5 seats mm (in)	860 (33.9)						
Cargo space — Width — with 2 seats mm (in)	1,365 (53.7)						
Cargo space — Width — with 5 seats mm (in)	1,365 (53.7)						
Cargo space — Height mm (in)	875 (34.4)						
Wheelbase mm (in)	2,580 (101.6)						
Tread — Front mm (in)	1,465 (57.7)				1,460 (57.5)		
Tread — Rear mm (in)	1,450 (57.1)						1,455 (57.3)
Minimum road clearance mm (in)	135 (5.3)				155 (6.1)		165 (6.5)

2. WEIGHT

Curb weight (C.W.) — Front kg (lb)	695 (1,535) 690 (1,515)*1	735 (1,620) 725 (1,600)*1	785 (1,725) 775 (1,705)*4	715 (1,580) 690 (1,515)*1	750 (1,650) 740 (1,630)*1	805 (1,770) 795 (1,750)*4
Curb weight (C.W.) — Rear kg (lb)	600 (1,325) 595 (1,315)*1	610 (1,340) 605 (1,330)*1	620 (1,370) 615 (1,355)*4	665 (1,460) 595 (1,315)*1	665 (1,470) 660 (1,460)*1	680 (1,505) 675 (1,490)*4
Curb weight (C.W.) — Total kg (lb)	1,295 (2,860) 1,285 (2,830)*1	1,345 (2,960) 1,330 (2,930)*1	1,405 (3,095) 1,390 (3,060)*4	1,380 (3,040) 1,285 (2,830)*1	1,415 (3,120) 1,400 (3,090)*1	1,485 (3,275) 1,470 (3,240)*4
Gross vehicle weight (G.V.W.) — Front kg (lb)	915 (2,015)			935 (2,065)		
Gross vehicle weight (G.V.W.) — Rear kg (lb)	960 (2,115)			990 (2,180)		
Gross vehicle weight (G.V.W.) — Total kg (lb)	1,875 (4,130)			1,925 (4,245)		

*1: Models for Canada, the weight of the power door lock and power window are included in the C.W.
*2: The weight of the power door lock, power window, air conditioner, cruise control, ABS, cassette player and sunroof are included in the C.W.
*3: The weight of the power window is included in the C.W.
*4: Models for Canada

NOTE: When optional parts are installed, the weight indicated in the following table is added to Curb weight.

	Power door lock and power window	Air conditioner	Cruise control and cassette player	ABS	Sunroof	AIRBAG
Front kg (lb)	0 (0)	25 (55)	5 (10)	14 (30)	9 (20)	5 (10)
Rear kg (lb)	2 (5)	– 2 (– 5)	0 (0)	0 (0)	14 (30)	2 (5)
Total kg (lb)	2 (5)	23 (50)	5 (10)	14 (30)	23 (50)	7 (15)

MODEL	FWD			AWD		
	L		LS	L		LS
	5MT	4AT	4AT	5MT	4AT	4AT
ENGINE						
Engine type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine					
Valve arrangement	Overhead camshaft type					
Bore × Stroke mm (in)	96.9 × 75 (3.815 × 2.95)					
Displacement cm^3 (cu in)	2,212 (134.98)					
Compression ratio	9.5					
Firing order	1—3—2—4					
Engine speed at N or P position rpm	700 ± 100 (No load) 850 ± 50 (Air conditioner ON)					
Maximum output kW (PS)/rpm	130 at 5,400					
Maximum torque N•m (kg-m, ft-lb)/rpm	186 (19.0, 137) at 4,400					
ELECTRICAL						
Ignition timing at idling speed BTDC/rpm	20° at 700					
Spark plug — Type and manufacturer	NGK: BKR6E-11 NIPPONDENSO: K20EPR-V11 CHAMPION: RC7YC-4					
Alternator	12 V — 70 A					
Battery — Type	5MT: 55D23L-MF/4AT: 75D23L-MF					
Battery — Reserve capacity min.	5MT: 99/4AT: 111					
Battery — Cold cranking amperes amp.	5MT: 356/4AT: 490					
TRANSMISSION						
Clutch type	DSPD	TC	TC	DSPD	TC	TC
Transmission type	*5	*6	*6	*7	*8	*8
Gear ratio — 1st	3.545	2.785	2.785	3.545	3.027	3.027
Gear ratio — 2nd	1.947	1.545	1.545	1.947	1.619	1.619
Gear ratio — 3rd	1.366	1.000	1.000	1.366	1.000	1.000
Gear ratio — 4th	0.972	0.694	0.694	0.972	0.694	0.694
Gear ratio — 5th	0.738	—	—	0.783	—	—
Gear ratio — Reverse	3.416	2.272	2.272	3.416	2.272	2.272
Reduction gear (Front drive) — 1st reduction — Type of gear	—	Helical	Helical	—	Helical	Helical
Reduction gear (Front drive) — 1st reduction — Gear ratio	—	1.000	1.000	—	1.000	1.000
Reduction gear (Front drive) — Final reduction — Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
Reduction gear (Front drive) — Final reduction — Gear ratio	3.700	3.700	3.700	4.111	3.900	3.900
Reduction gear (Rear drive) — Transfer reduction — Type of gear	—	—		Helical	—	—
Reduction gear (Rear drive) — Transfer reduction — Gear ratio	—	—		1.000	—	—
Reduction gear (Rear drive) — Final reduction — Type of gear	—	—		Hypoid	Hypoid	Hypoid
Reduction gear (Rear drive) — Final reduction — Gear ratio	—	—		4.111	3.900	3.900

DSPD: Dry Single Plate Diaphragm
TC: Torque Converter
*5: 5-forward speeds with synchromesh and 1-reverse
*6: Electronically controlled fully-automatic, 4-forward speeds and 1-reverse
*7: 5-forward speeds with synchromesh and 1-reverse — with center differential and viscous coupling
*8: Electronically controlled fully-automatic, 4-forward speeds and 1-reverse — with hydraulically controlled transfer clutch

ITEM \ MODEL	FWD			AWD		
	L		LS	L		LS
	5MT	4AT	4AT	5MT	4AT	4AT

6. STEERING

Type	Rack and pinion
Turns, lock to lock	3.3
Minimum turning circle m (ft)	Wall to wall ... 11.0 (36.1) Curb to curb ... 10.2 (33.5)

7. SUSPENSION

Front	Macpherson strut type, Independent	*9
	Coil spring	
Rear	Dual link strut type, Independent	*9
	Coil spring	

8. BRAKE

Service brake system	Dual circuit hydraulic with vacuum suspended power unit
Front	Ventilated disc brake
Rear	Disc brake
Parking brake	Mechanical on rear brakes

9. TIRE

Size	P185/70R14 87H
Type	Steel belted radial, Tubeless

10. CAPACITY

Fuel tank ℓ (US gal, Imp gal)		60 (15.9, 13.2)					
Engine oil	Upper level ℓ (US qt, Imp qt)	4.5 (4.8, 4.0)					
	Lower level ℓ (US qt, Imp qt)	3.5 (3.7, 3.1)					
Transmission gear oil ℓ (US qt, Imp qt)		3.3 (3.5, 2.9)	—	—	3.5 (3.7, 3.1)	—	—
Automatic transmission fluid ℓ (US qt, Imp qt)		—	8.3 (8.8, 7.3)	8.3 (8.8, 7.3)	—	8.3 (8.8, 7.3)	8.3 (8.8, 7.3)
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)
AWD rear differential gear oil ℓ (US qt, Imp qt)		—			0.8 (0.8, 0.7)		
Power steering fluid ℓ (US qt, Imp qt)		0.7 (0.7, 0.6)					
Engine coolant ℓ (US qt, Imp qt)		5.9 (6.2, 5.2)					

*9: Pneumatic suspension with height control

SUBARU®

1992

SERVICE MANUAL

FOREWORD

This service manual has been prepared to provide SUBARU service personnel with the necessary information and data for the correct maintenance and repair of SUBARU LEGACY.
This manual include the procedures for maintenance disassembling, reassembling, inspection and adjustment of components and trouble-shooting for guidance of both the fully qualified and the less-experienced mechanics.
Please peruse and utilize this manual fully to ensure complete repair work for satisfying our customers by keeping their vehicle in optimum condition. When replacement of parts during repair work is needed, be sure to use SUBARU genuine parts.
All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

FUJI HEAVY INDUSTRIES LTD.

All right reserved. This book may not be reproduced or copied, in whole or in part, without the written permission of
FUJI HEAVY INDUSTRIES LTD., TOKYO JAPAN.

SUBARU, and ⓯ are trademarks of
FUJI HEAVY INDUSTRIES LTD.

Copyright 1991 FUJI HEAVY INDUSTRIES LTD.

2 ENGINE SECTION

EMISSION CONTROL SYSTEM AND VACUUM FITTING 2-1
ON-CAR SERVICES 2-2
ENGINE 2-3
ENGINE LUBRICATION SYSTEM 2-4
ENGINE COOLING SYSTEM 2-5
★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ 2-6
FUEL INJECTION SYSTEM 2-7
FUEL SYSTEM 2-8
EXHAUST SYSTEM 2-9
CLUTCH 2-10
ENGINE AND TRANSMISSION MOUNTING SYSTEM 2-11

3 TRANSMISSION AND DIFFERENTIAL SECTION

MANUAL TRANSMISSION AND DIFFERENTIAL 3-1
AUTOMATIC TRANSMISSION AND DIFFERENTIAL 3-2
TRANSMISSION CONTROL SYSTEM 3-3
AWD SYSTEM 3-4

IMPORTANT SAFETY NOTICE

Providing appropriate service and repair is a matter of great importance in the serviceman's safety maintenance and safe operation, function and performance which the SUBARU vehicle possesses.

In case the replacement of parts or replenishment of consumables is required, genuine SUBARU parts whose parts numbers are designated or their equivalents must be utilized.

It must be made well known that the safety of the serviceman and the safe operation of the vehicle would be jeopardized if he used any service parts, consumables, special tools and work procedure manuals which are not approved or designated by SUBARU.

How to use this manual

1. GENERAL

- This Service Manual is divided into six volumes by section so that it can be used with ease at work. Refer to the Table of Contents, select and use the necessary section.

- Each chapter in the manual is basically made of the following five types of areas.

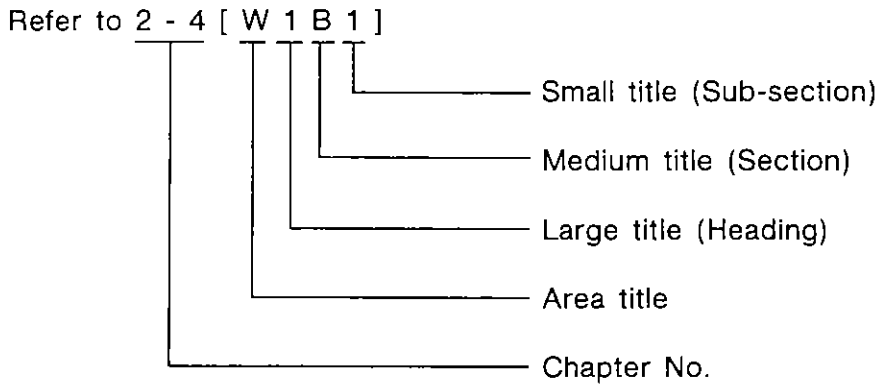
  M : Mechanism and function
  S : Specification and service data
  C : Component parts
  W : Service procedure
  (X : Service procedure)
  (Y : Service procedure)
  T : Troubleshooting

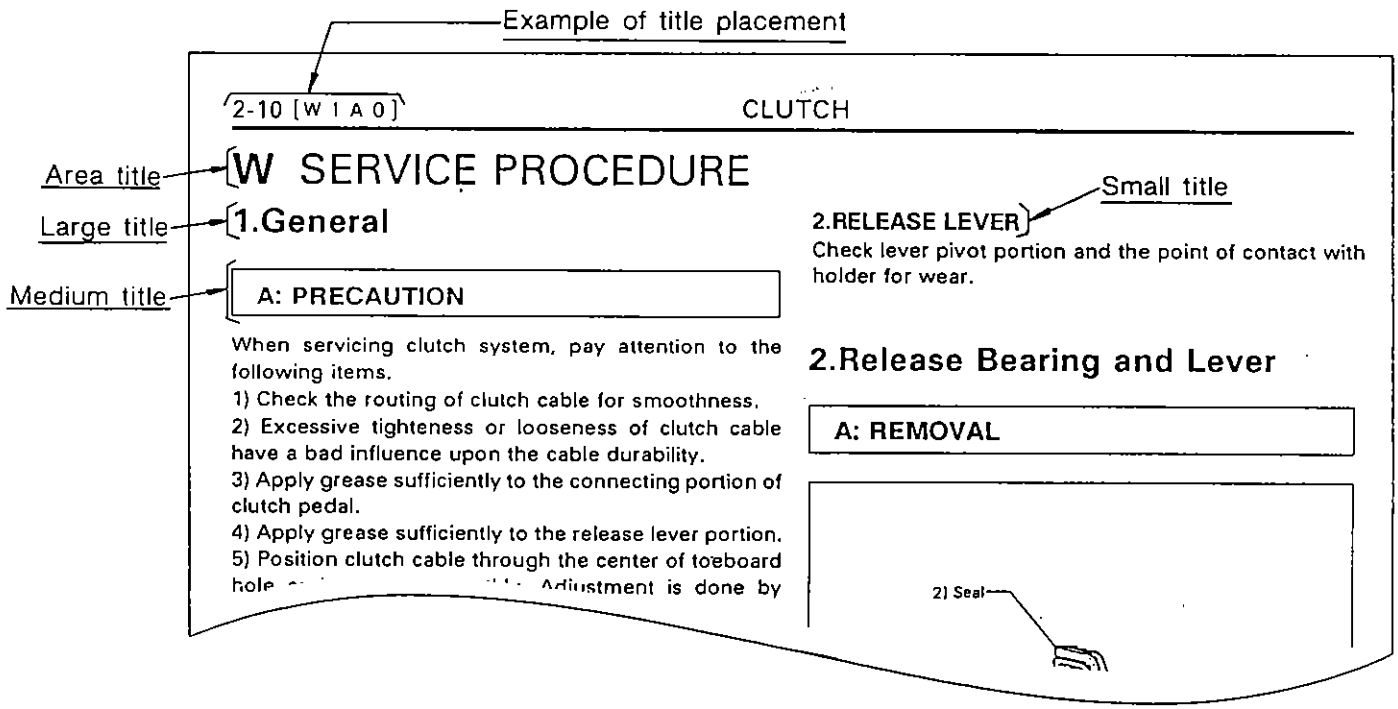
- The description of each area is provided with four types of titles different in size as shown below. The Title No. or Symbol prefixes each title in order that the construction of the article and the flow of explanation can be easily understood.

  [Example of each title]
  - Area title: W. SERVICE PROCEDURE (one of the five types of areas)
  - Large title (Heading): 1. Oil Pump (to denote the main item of explanation)
  - Medium title (Section): A. REMOVAL (to denote the type of work in principle)
  - Small title (Sub-section): 1. INNER ROTATOR (to denote a derivative item of explanation)

- The Title Index No. is indicated on the top left (or right) side of the page as the book is opened. This is useful for retrieving the necessary portion.

(Example of usage)





- In this manual, the following symbols are used.

: Should be lubricated with oil.

: Should be lubricated with grease.

: Sealing point

T : Tightening torque

SUBARU®

1992

SERVICE MANUAL

Page

1. System Application 2
2. Schematic Drawing 3
3. General Precautions 5
4. Crankcase Emission Control System 6
5. Three-way Catalyst 7
6. A/F Control System 7
7. Ignition Control System 8
8. Evaporative Emission Control System 9
9. Vacuum Fitting 11

1. System Application

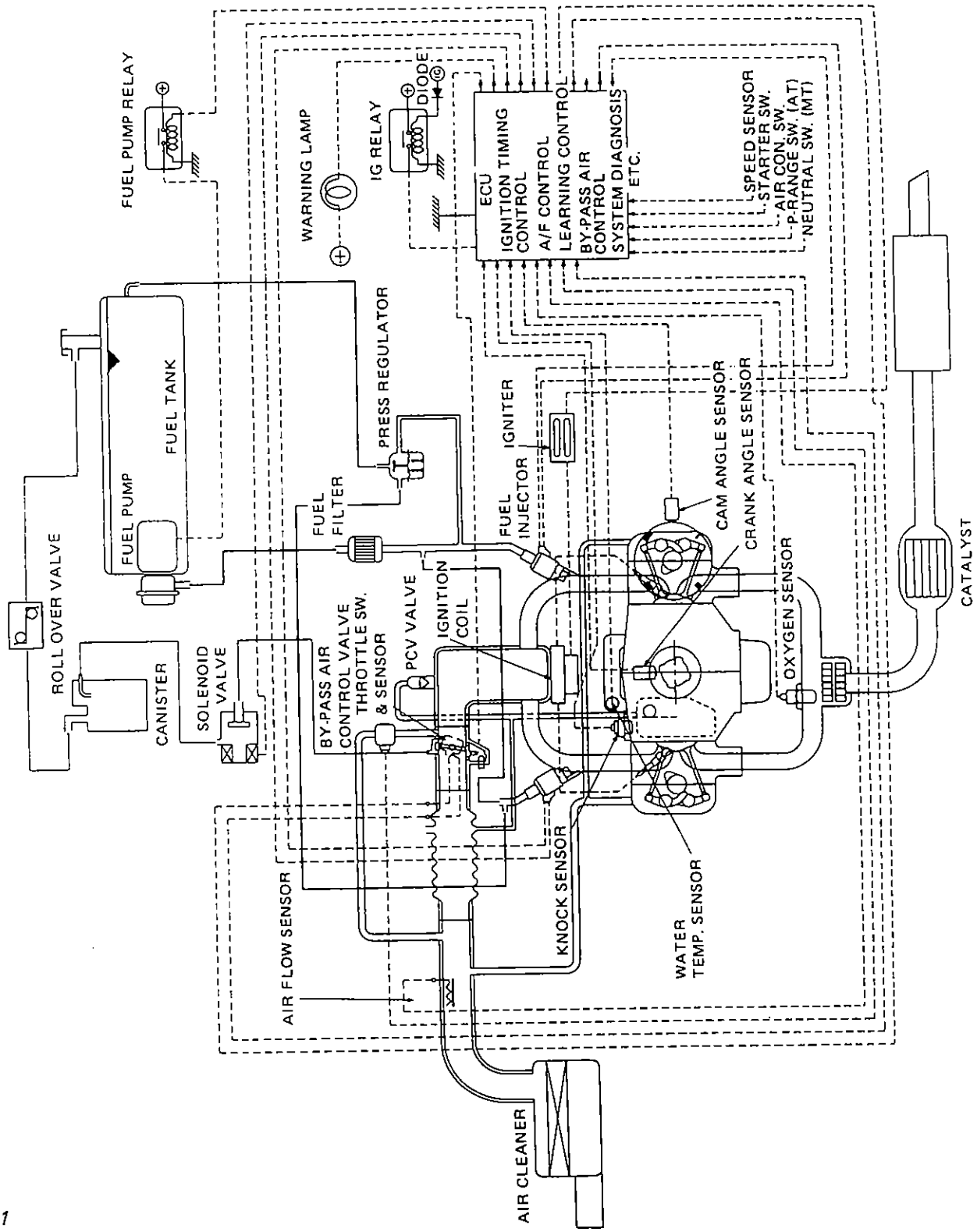
There are three emission control systems which are as follows:

1) [redacted]kcase emission control system
2) Ex...aust emission control system
   - Three-way catalyst system
   - A/F control system
   - Ignition control system
3) Evaporative emission control system

Item			Main components	Function
Crankcase emission control system			PCV valve	Draws blow-by gas into intake manifold from crankcase and burns it together with air-fuel mixture. Amount of blow-by gas to be drawn in is controlled by intake manifold vacuum pressure.
Exhaust emission control system	Catalyst system	Front	Three-way catalyst	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.
		Rear		
	A/F control system		ECU (Electronic Control Unit)	Receives input signals from various sensors, compares these signals with stored data, and emits a signal for optimal control of air-fuel mixture ratio.
			O_2 sensor	Detects density of oxygen contained in exhaust gases.
			Air flow sensor	Detects amount of intake air.
			Throttle sensor	Detects throttle valve position and idle-position signal.
	Ignition control system		ECU	Receives various signals, compares these signals with basic data stored in memory, and emits a signal for optimal control of ignition timing.
			Crank angle sensor	Detects engine's revolution speed.
			Cam angle sensor	Detects reference signal for combustion cylinder discrimination.
			Water temperature sensor	Emits a coolant temperature signal.
			Knock sensor	Detects a knock signal and sends to ECU.
[redacted]ive emission control system			Canister	Adsorbs evaporative gas which occurs in fuel tank when engine stops, and sends it to combustion chambers for a complete burn when engine is started. This prevents HC from being discharged into atmosphere.
			Purge control solenoid valve	Receives a signal from ECU and controls purge of evaporative gas adsorbed by canister.

2. Schematic Drawing

1. MPFI Non-TURBO model



B2-9

Fig. 1

2. MPFI TURBO model

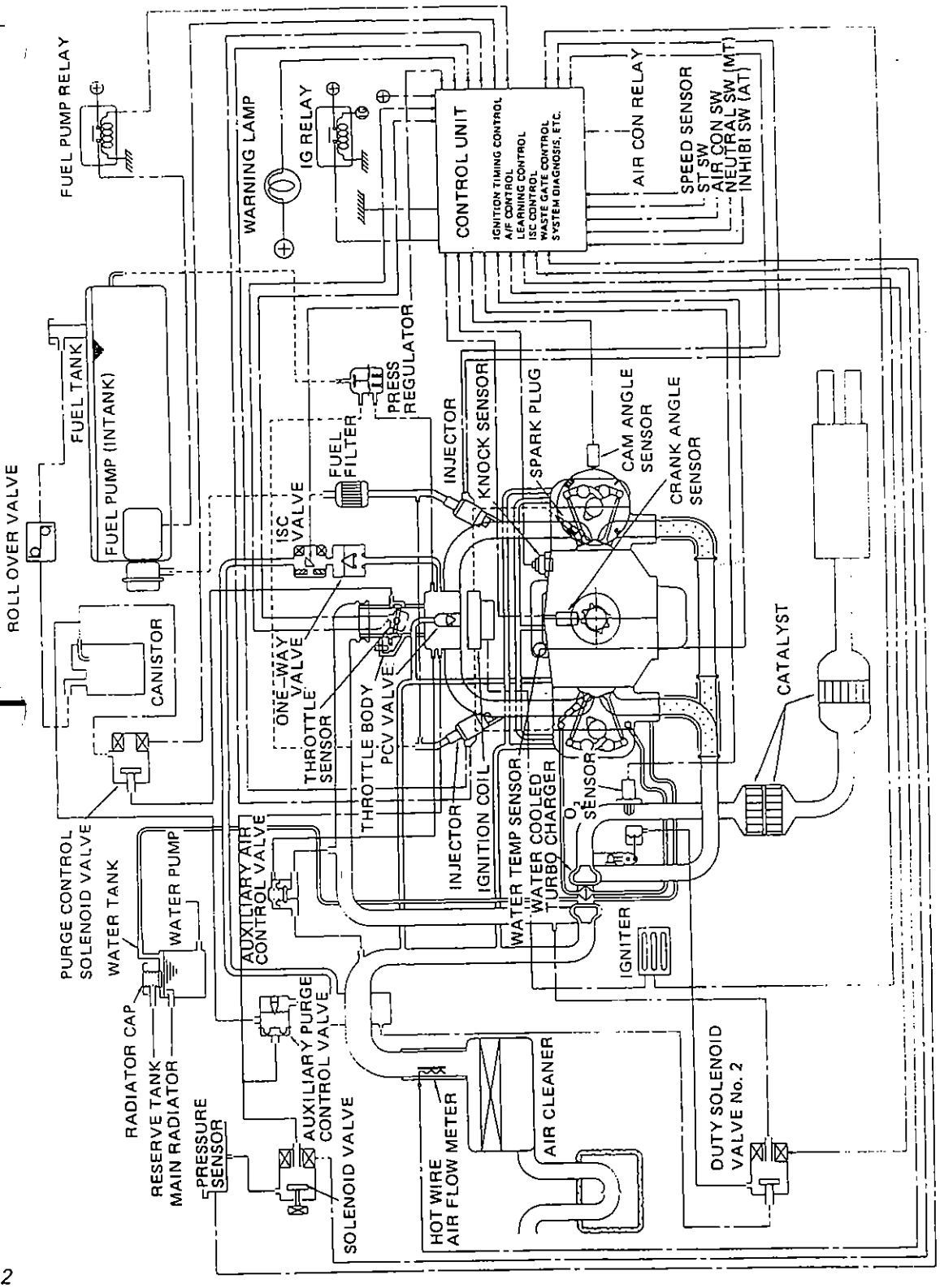


Fig. 2

3. 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 MPFI 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 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.

4. Crankcase Emission Control System

A: 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 fresh air inlet, connecting hoses, PCV valve and an air intake duct.
At the part throttle, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose of crank case 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.
At wide open throttle, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn to the 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.

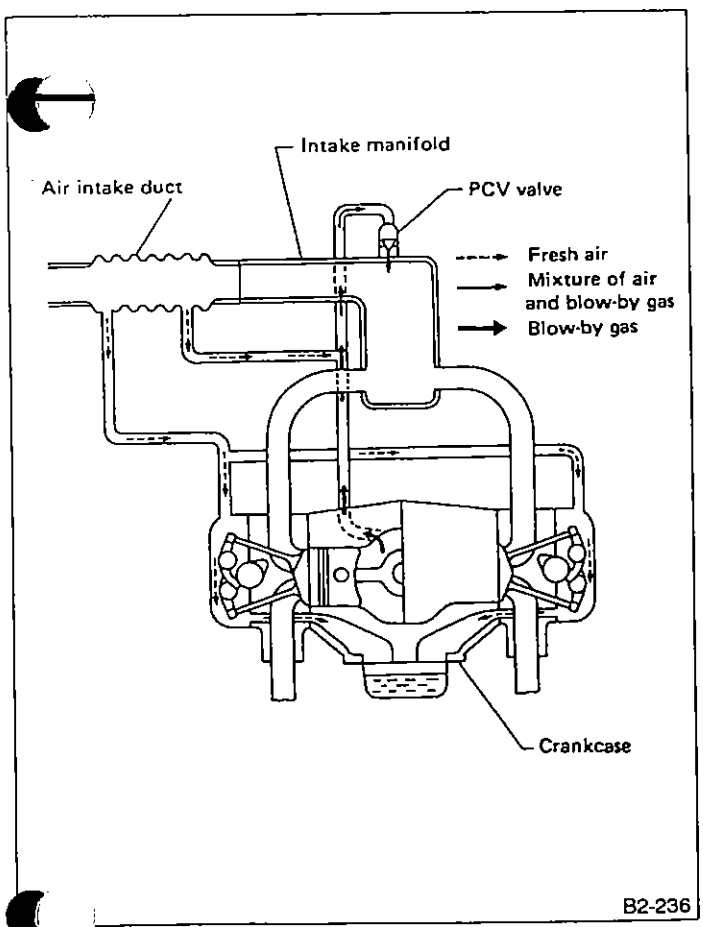


Fig. 3 Non-Turbo model

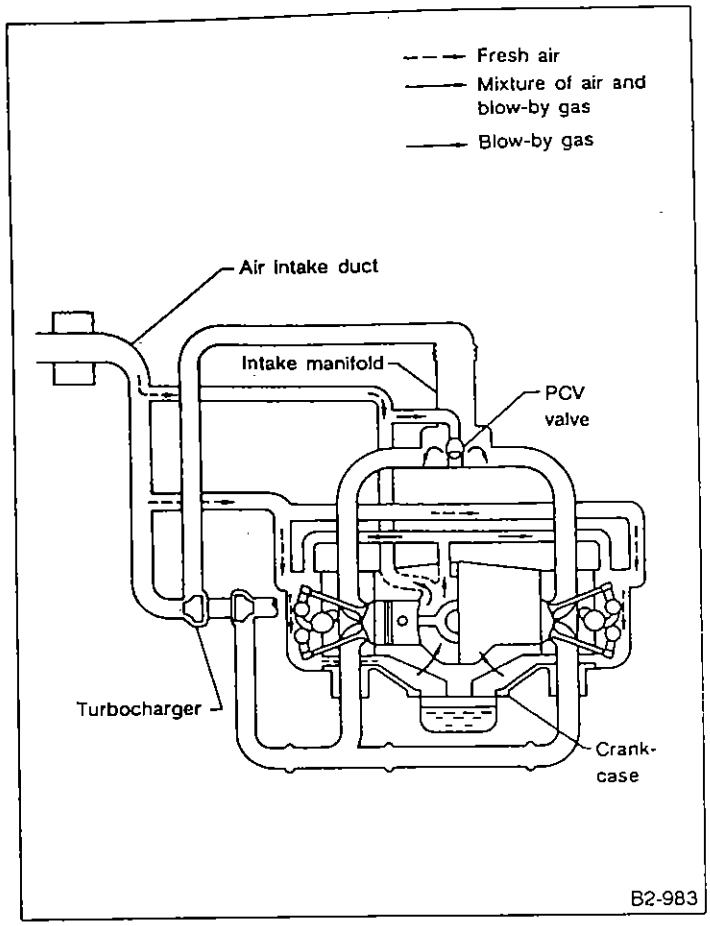


Fig. 4 Turbo model

B: 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.

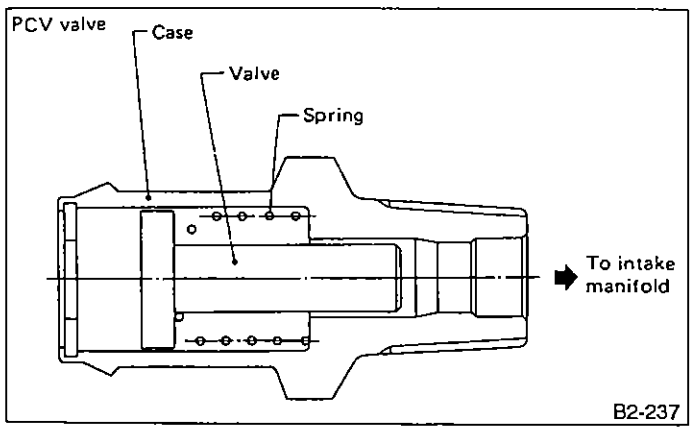


Fig. 5

5. Three-way 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.

6. A/F Control System

The air/fuel control system compensates for the basic amount of fuel injection in response to a signal sent from the O_2 sensor to provide proper feedback control of the mixture. Thus, the theoretical air-fuel ratio is maintained to provide effective operation of the three-way catalyst. The basic amount of fuel injection is preset according to engine speed and loads, as well as the amount of intake air.
This system also has a "learning" control function which stores the corrected data in relation to the basic amount of fuel injection in the memory map. A new air-fuel ratio correction is automatically added for quick response to the deviation of the air- fuel ratio. Thus, the air-fuel ratio is optimally maintained under various conditions while stabilizing exhaust gases, improving driving performance and compensating for changes in sensors' performance quality with elapse of time.
Refer to 2-7 "FUEL INJECTION SYSTEM".

7. Ignition Control System

The ignition control system is controlled by the ECU. The ECU determines the optimal ignition timing according to signals sent from various sensors (which monitor the operating conditions of the engine), and sends a signal to the igniters.

The ECU has a "learning" control function which provides superb transient characteristics for responsive ignition timing control.

Refer to 2-7 "FUEL INJECTION SYSTEM".

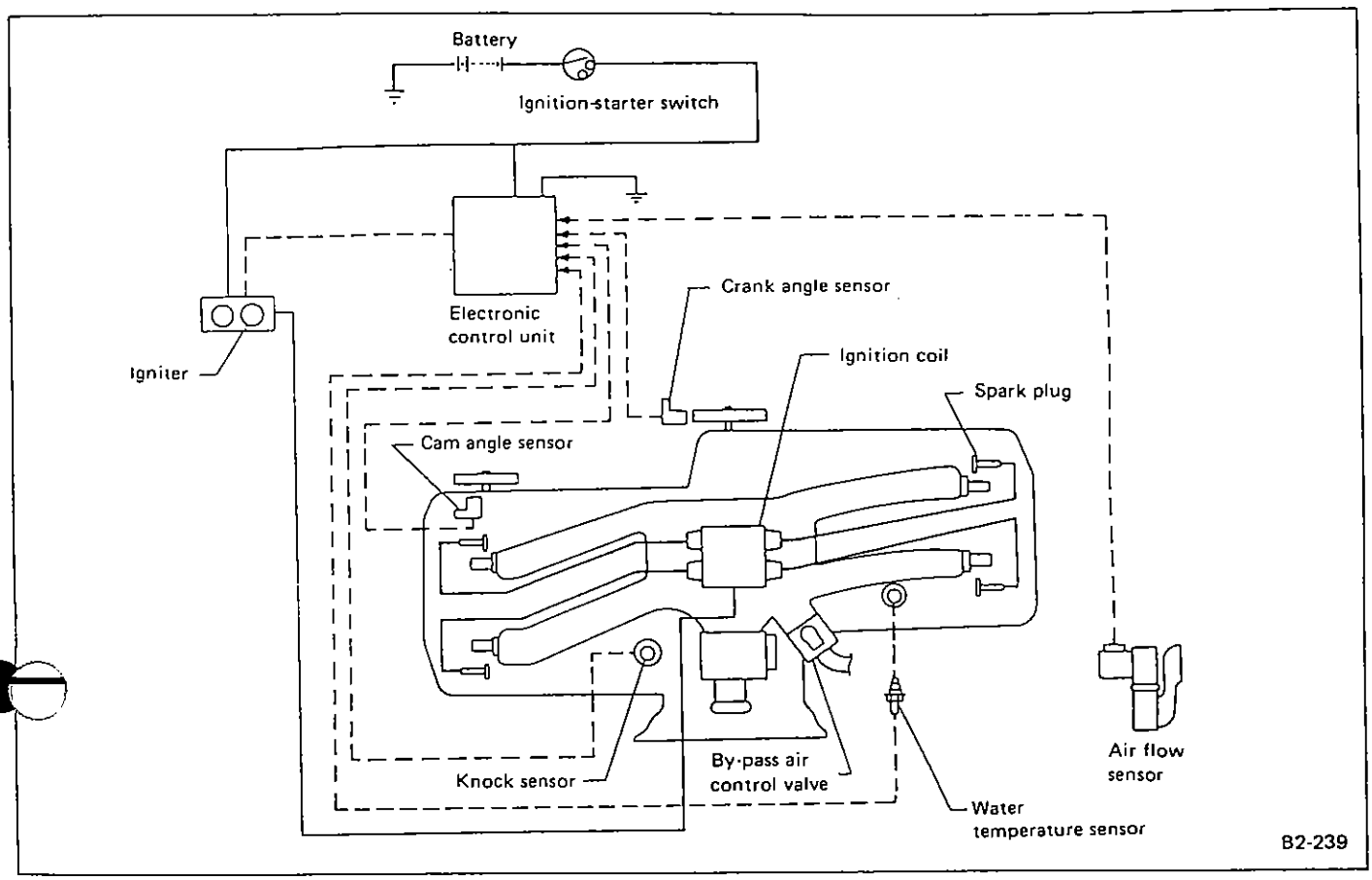


Fig. 6

8. Evaporative Emission Control System

A: DESCRIPTION

1. GENERAL

The evaporative emission control system is employed to prevent evaporative fuel from being discharged into ambient atmosphere. This system includes a canister, purge control solenoid 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 fuel separator is also incorporated on the tank fuel line.

The purge control solenoid valve is controlled by the ECU and provides optimal purge control according to the coolant temperature, engine speed and vehicle speed.

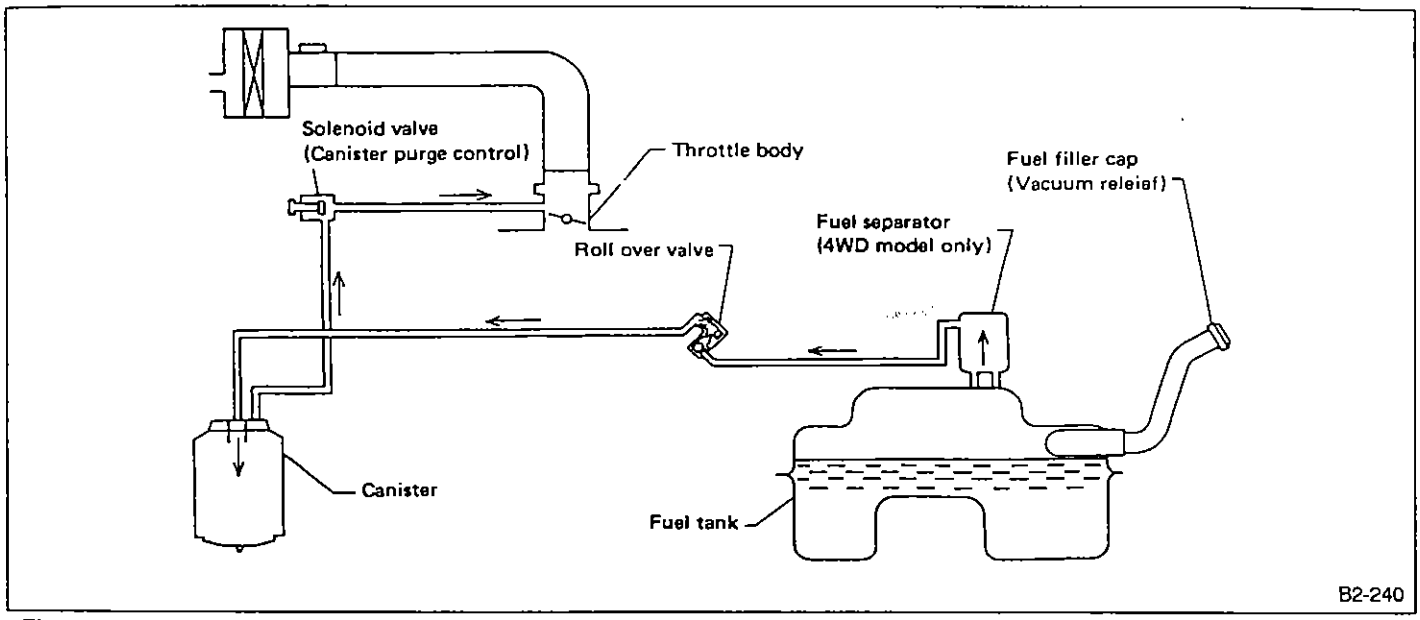


Fig. 7

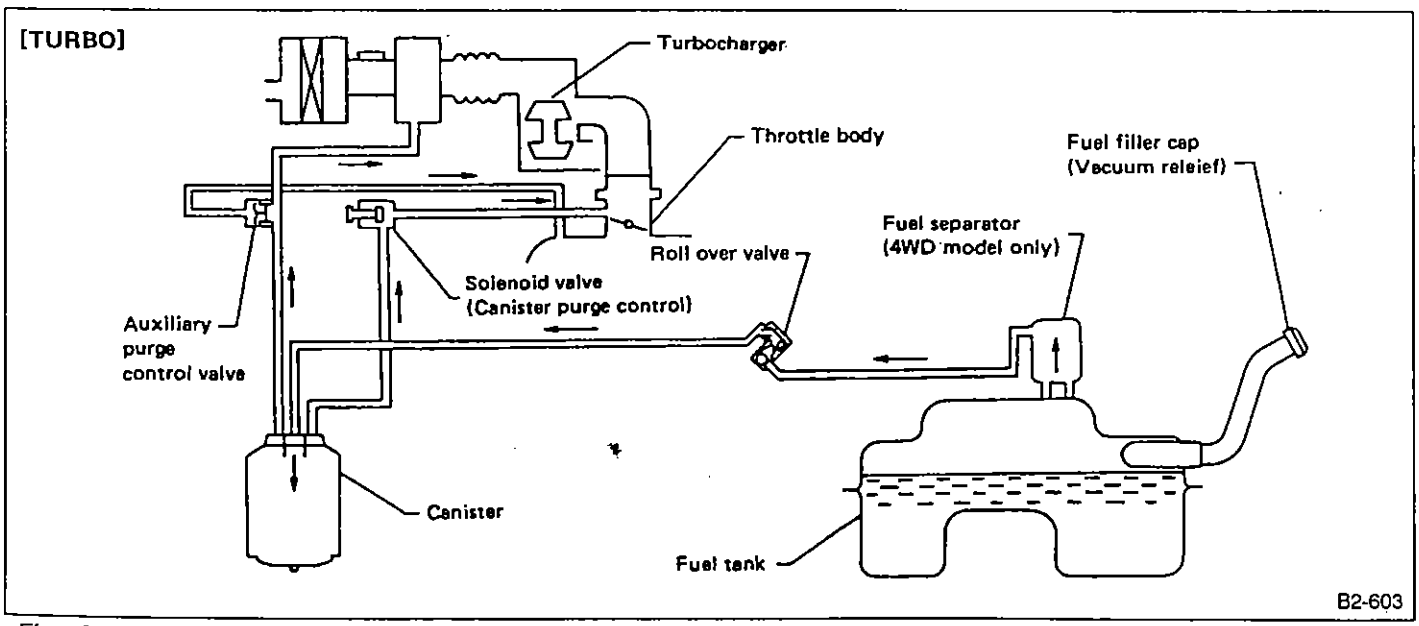


Fig. 8

2. FUEL SEPARATOR

The fuel separator is to prevent liquid fuel from flowing [illegible] canister in case of abrupt cornering, etc.

3. 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.

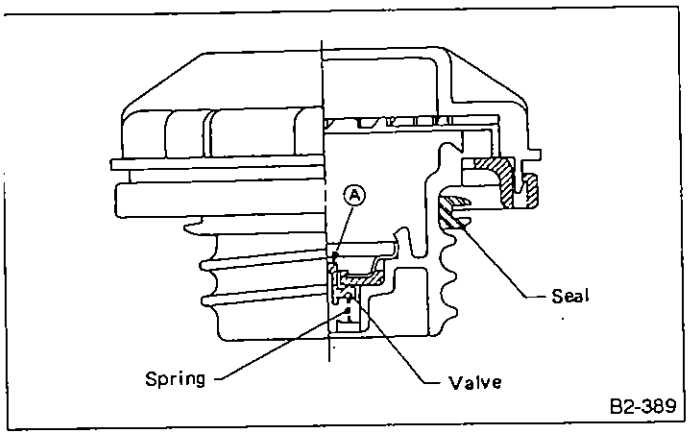


Fig. 9

B: INSPECTION

1) Remove fuel filler cap.
2) Disconnect evaporation hose from canister. Check for unobstructed evaporation line by blowing air into hose.
3) Disconnect purge hose from canister. Blow air through hose to ensure that air does not leak.
Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.
4) Check the exterior of the canister to ensure that it is not cracked or scratched.

9. Vacuum Fitting

1. Non-TURBO model

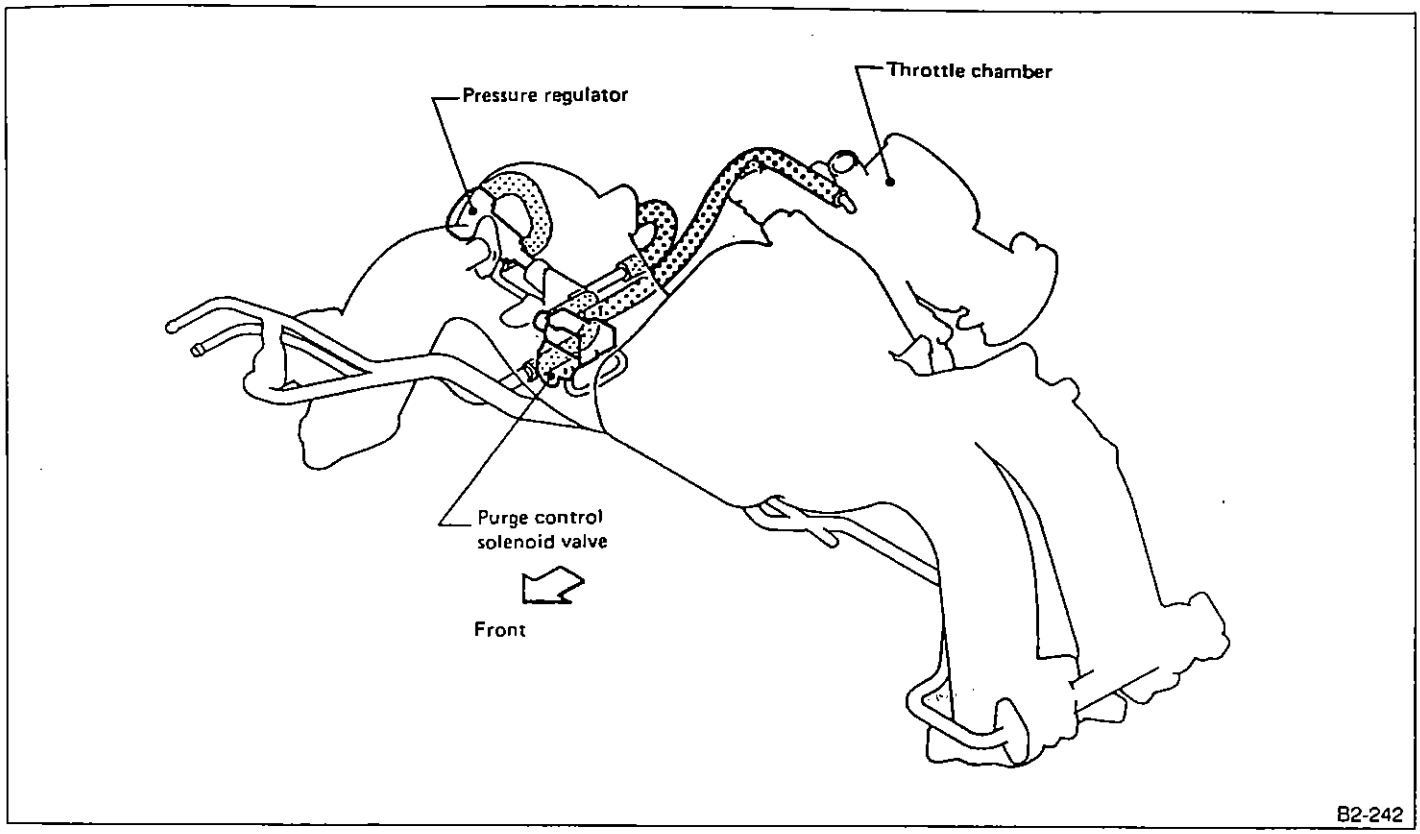


Fig. 10

2. TURBO model

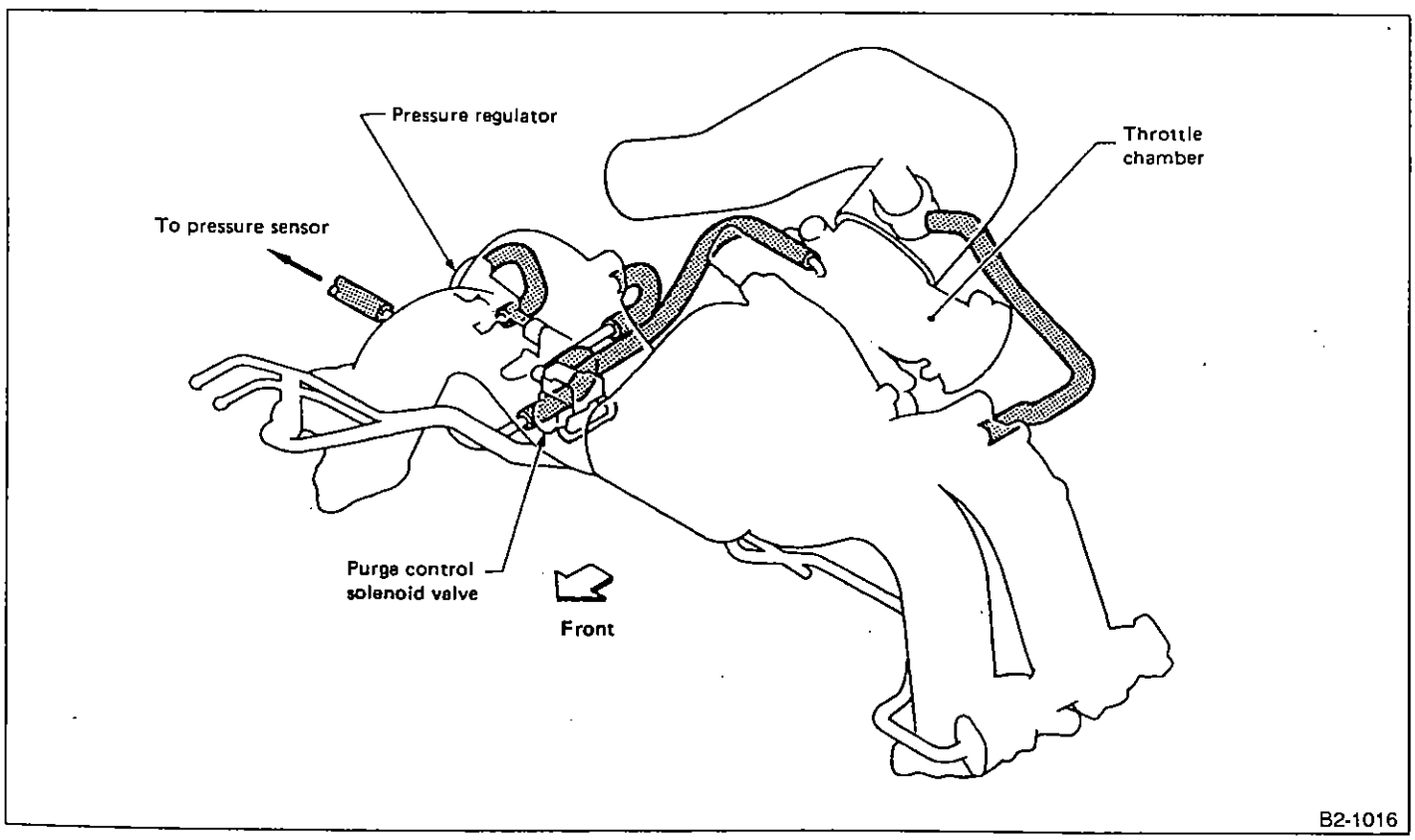


Fig. 11

SUBARU®

1992

SERVICE MANUAL

Page

1. Foreword 2
2. Ignition Timing 2
3. Engine Idle Speed 2
4. Engine Compression 3
5. Intake Manifold Vacuum 4
6. Hydraulic Lash Adjuster 5
7. Fuel Injector 6
8. Oxygen (O_2) Sensor 6

1. Foreword

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.

2. Ignition Timing

A: INSPECTION

1) Warm up the engine.
2) Confirm that the idle switch is ON.
3) To check the ignition timing, connect a timing light to #1 cylinder spark plug cord, and illuminate the timing mark with the timing light.
If the timing is not correct, check the ignition control system. (Refer to "2-7 Fuel Injection System".)

Ignition timing [BTDC/rpm]:
Non-TURBO*
20° ± 8°/700
TURBO
15° ± 8°/700

* To improve stability, ignition timing while engine is idling is also controlled. For this reason specified ignition timing range is increased somewhat, to ±8°.

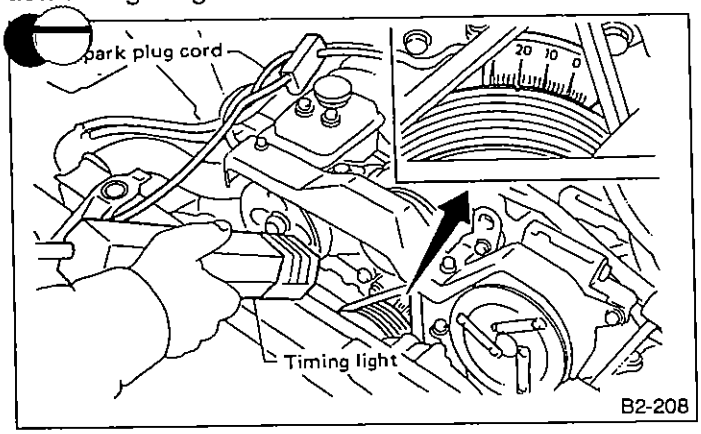


Fig. 1

3. Engine Idle Speed

A: INSPECTION

1) Before checking idle speed, check the following:
(1) Ensure that air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and that hoses are connected properly.
(2) Ensure that CHECK ENGINE light is off.
2) Warm up the engine.
3) Connect "Select Monitor" and measure engine rpm. (Function mode "F04")
a. When Select Monitor is not used, attach the pickup sensor on tachometer (Secondary pickup type) to #1 plug cord.
b. This ignition system provides simultaneous ignition for #1 and #2 plugs. It must be noted that some tachometers may register twice that of actual engine speed.

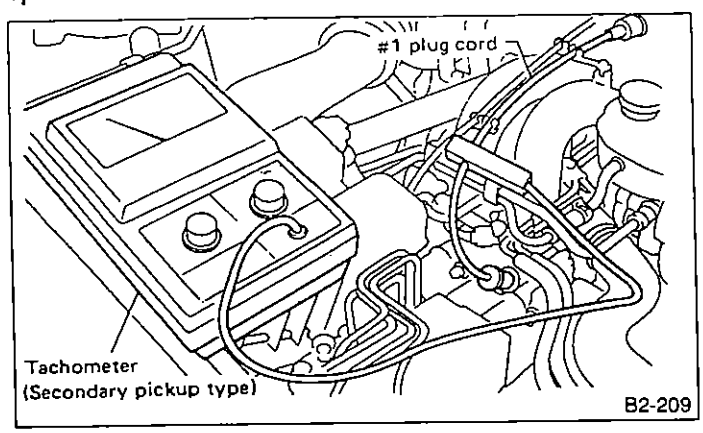


Fig. 2

4) Check idle speed when unloaded (with headlights, heater fan, rear defroster, radiator fan, air conditioner, etc. OFF).

Idle speed (No load and gears in neutral position):
700 ± 100 rpm

5) Check idle speed when loaded. (Turn air conditioner switch "ON" and operate compressor for at least one minute before measurement.)

Idle speed (A/C switch "ON"):
850 ± 50 rpm

If idle speed is outside specifications, refer to General Troubleshooting chart under "2-7 Fuel Injection System".

4. Engine Compression

A: 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.
4) Disconnect connectors from fuel injector.
5) Fully open the throttle valve.
6) Check the starter motor for satisfactory performance and operation.
7) 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.
8) Perform at least two measurements per cylinder, and make sure that the values are correct.

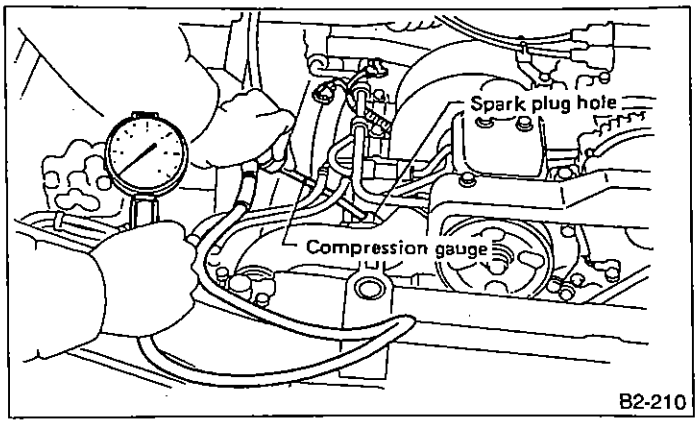


Fig. 3

Compression (200 — 300 rpm and fully open throttle):
- **Non TURBO**
  - **Standard**
    - **1,079 — 1,275 kPa**
    - **(11.0 — 13.0 kg/cm², 156 — 185 psi)**
  - **Limit**
    - **883 kPa (9.0 kg/cm², 128 psi)**
  - **Difference between cylinders**
    - **196 kPa (2.0 kg/cm², 28 psi)**
- **TURBO**
  - **Standard**
    - **981 — 1,177 kPa**
    - **(10.0 — 12.0 kg/cm², 142 — 171 psi)**
  - **Limit**
    - **785 kPa (8.0 kg/cm², 114 psi)**
  - **Difference between cylinders**
    - **196 kPa (2.0 kg/cm², 28 psi)**

i. Intake Manifold Vacuum

EASUREMENT

) Warm up the engine.
) Disconnect the vacuum hose and install the vacuum jauge to the hose fitting on the manifold.
:) Keep the engine at the idle speed and read the 'acuum gauge indication.
3y observing the gauge needle movement, the internal :ondition of the engine can be diagnosed as described n Table below.

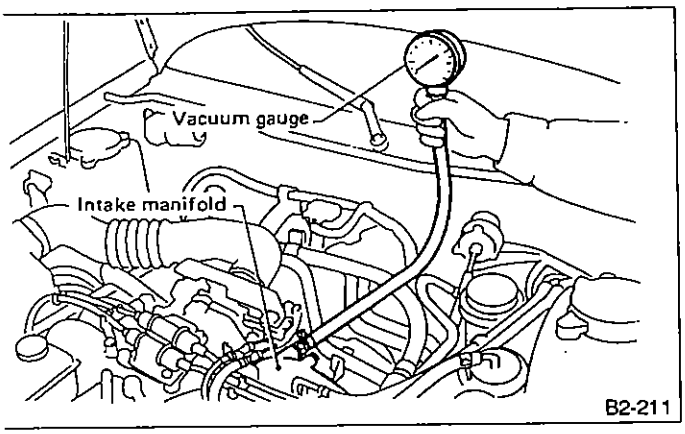


Fig. 4

Vacuum pressure (at idling, A/C "OFF"):
Non-TURBO
More than —66.7 kPa
(—500 mmHg, —19.69 inHg)
TURBO
More than —65.3 kPa
(—490 mmHg, —19.29 inHg)

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 .

5. Hydraulic Lash Adjuster

A: INSPECTION

1) Disconnect blow-by hose.
2) Remove plug cap.
3) Disconnect connectors from fuel injectors.

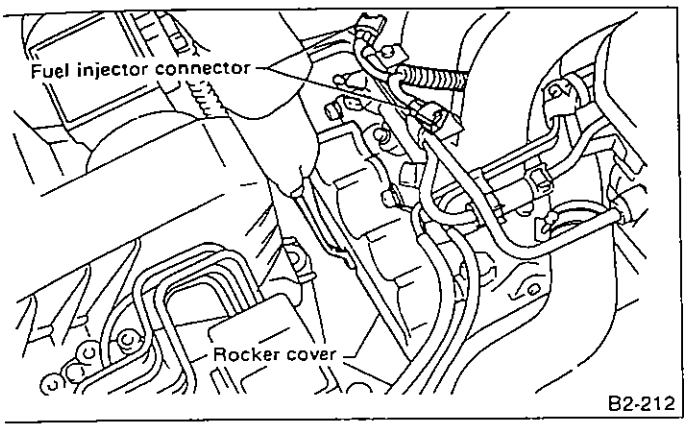


Fig. 5

4) Remove left and right rocker covers.
Before removing left rocker cover, disconnect engine harness connector, battery cables and alternator cable.
5) Manually push valve rocker (at lash adjuster location) to check that there is no air in it.
When air is in lash adjuster, valve rocker moves when pushed with fingers.

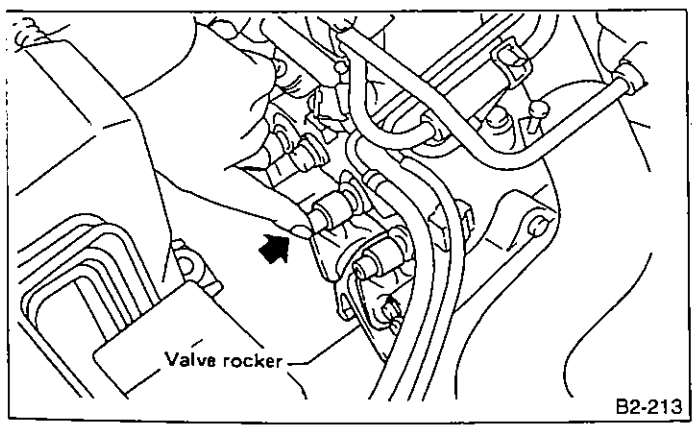


Fig. 6

6) If air is in lash adjuster, remove valve rocker ASSY from engine and bleed air completely. B: BLEEDING AIR FROM VALVE LASH ADJUSTER
1) Remove valve rocker ASSY.

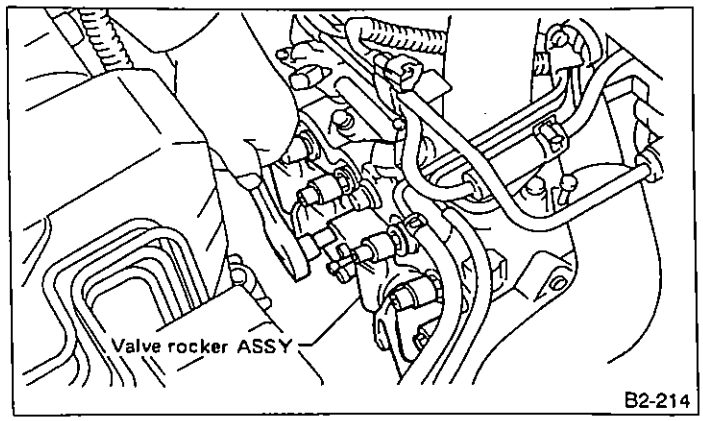


Fig. 7

2) Manually remove lash adjusters where air is trapped.
If lash adjuster is difficult to remove manually, use pliers. Be careful not to scratch lash adjuster.
3) Insert lash adjuster into OIL SEAL GUIDE as shown, and fill OIL SEAL GUIDE with engine oil.
Using a 2 mm (0.08 in) dia rod, push check ball in.

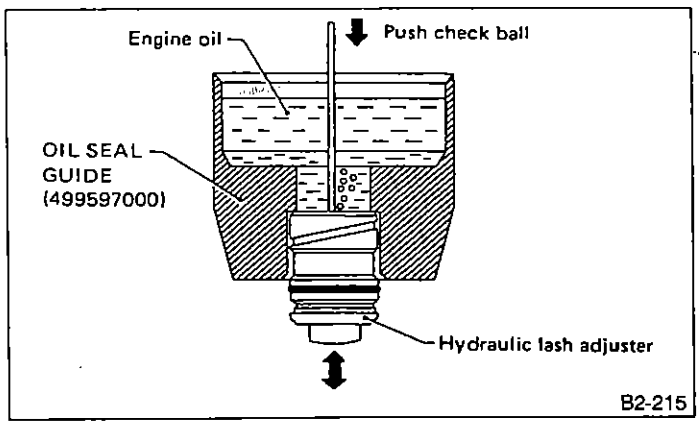
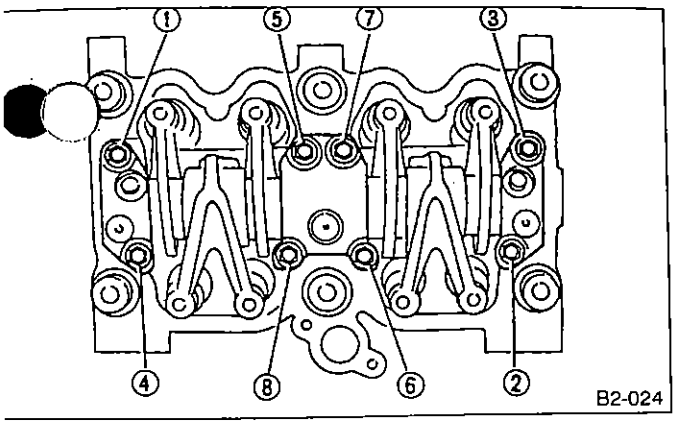


Fig. 8

4) With check ball pushed in, push plunger at an interval of one second.
5) Move plunger up and down until air bubbles are no longer emitted from lash adjuster.
6) Remove the rod. Push plunger to ensure that air is completely bled out.
If plunger does not properly lock (when pushed), replace lash adjuster with a new one.
7) Fill rocker arm's oil reservoir with engine oil and install lash adjuster.
Do not rotate lash adjuster during installation.
8) Temporarily and equally tighten bolts ①through ④.
Do not allow dowel pin to catch valve rocker ASSY.



ig. 9

) Tighten bolts ⑤through ⑧to specified torque.
0) Tighten bolts ①through ④to specified torque.
1) Install rocker covers.
2) Connect harness connectors, hoses, etc. to their positions.

7. Fuel Injector

A: REMOVAL AND INSTALLATION

1) Fuel pressure elimination
(1) Disconnect fuel pump connector.
(2) Start engine.
(3) Run engine until it stalls.
(4) After it stalls, crank starter for approximately 5 seconds and turn ignition switch to "OFF".
2) Remove spark plug caps.
3) Disconnect connector from fuel injector.
4) Remove fuel injector cover.

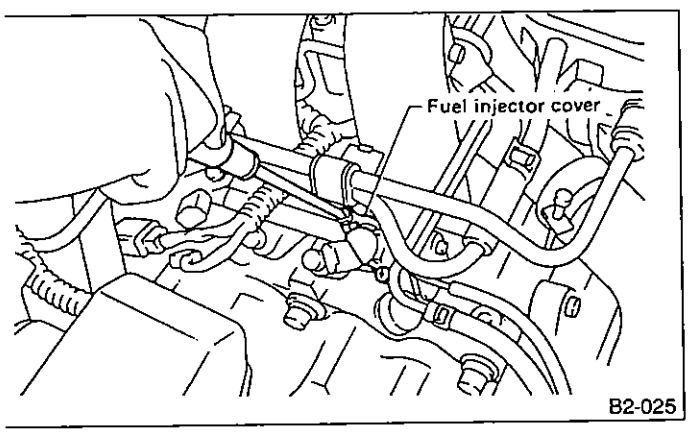


Fig. 10

5) Extract while turning fuel injectors.

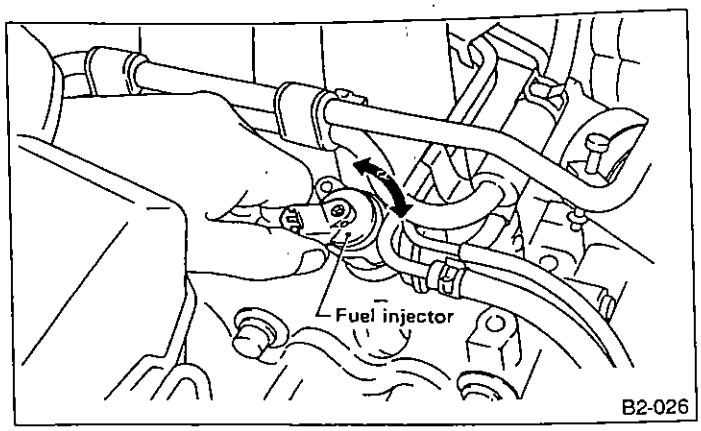


Fig. 11

a. Do not attempt to pry injectors with a screwdriver or similar tool. Do not pinch injector pin with pliers.
b. Be careful not to damage O-ring.
c. If injector is difficult to remove with your hand, remove injector and fuel pipe as a unit, and push injector out from the back side.
6) To install, reverse order of removal procedures.

8. Oxygen (O_2) Sensor

A: REMOVAL

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.

1. Non-TURBO MODEL

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.

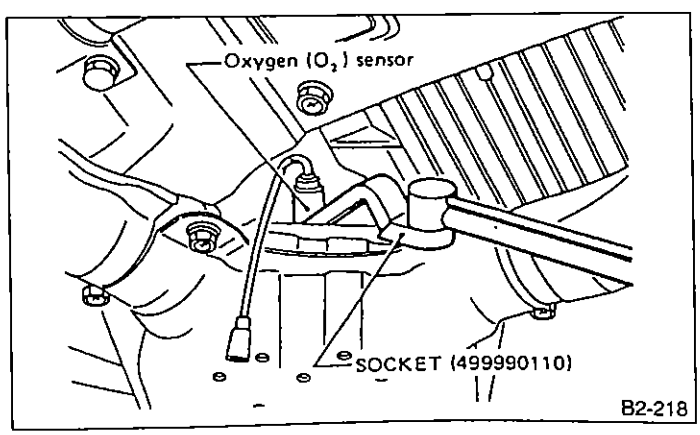


Fig. 12

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 (499990110) and wrench.
When removing, do not force oxygen (O_2) sensor especially when exhaust pipe is cold; otherwise it will damage the exhaust pipe.

2. TURBO MODEL

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.

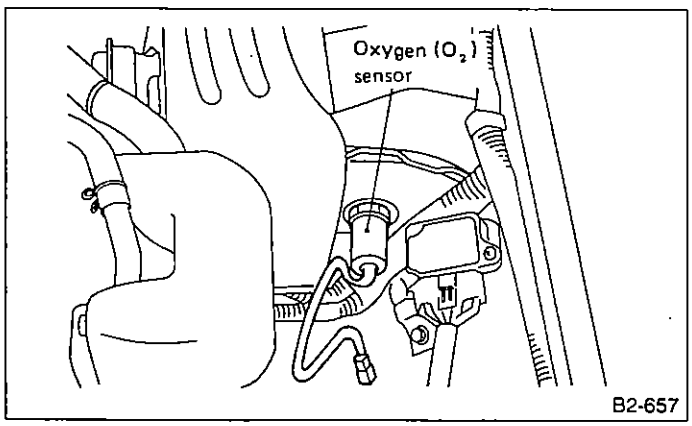


Fig. 13

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

B: INSTALLATION

1. Non-TURBO MODEL

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 (499990110) 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.

2. TURBO MODEL

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) Install oxygen (O_2) sensor onto center exhaust pipe by tightening it to the specified torque.

Tightening 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.

SUBARU®

1992

SERVICE MANUAL

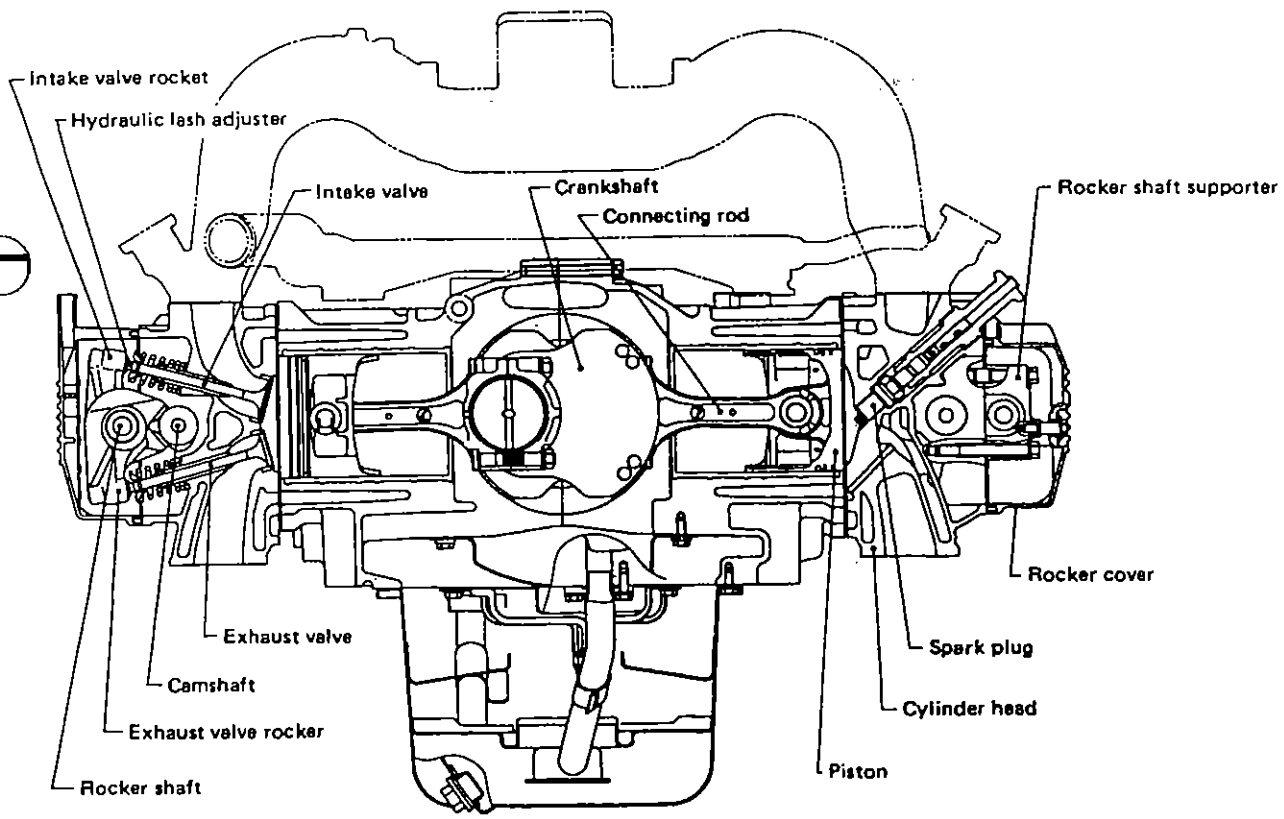
		Page
M	MECHANISM AND FUNCTION	2
	1. General	2
	2. Timing Belt	3
	3. Belt Tension Adjuster	3
	4. Belt Cover	4
	5. Valve Rocker ASSY	4
	6. Hydraulic Lash Adjuster	5
	7. Cam Shaft	5
	8. Cylinder Head	6
	9. Cylinder Block	6
	10. Crankshaft	7
	11. Piston	7
S	SPECIFICATIONS AND SERVICE DATA	8
	A: SPECIFICATIONS	8
	B: SERVICE DATA	9
C	COMPONENT PARTS	13
	1. Timing Belt	13
	2. Cylinder Head and Camshaft	14
	3. Cylinder Head and Valve ASSY	15
	4. Cylinder Block	16
	5. Crankshaft and Piston	18
W	SERVICE PROCEDURE	19
	1. General Precautions	19
	2. Timing Belt	21
	3. Valve Rocker ASSY	33
	4. Camshaft	33
	5. Cylinder Head	41
	6. Cylinder Block	44
T	TROUBLESHOOTING	61
	1. Engine Trouble in General	61
	2. Engine Noise	61

M MECHANISM AND FUNCTION

1. General

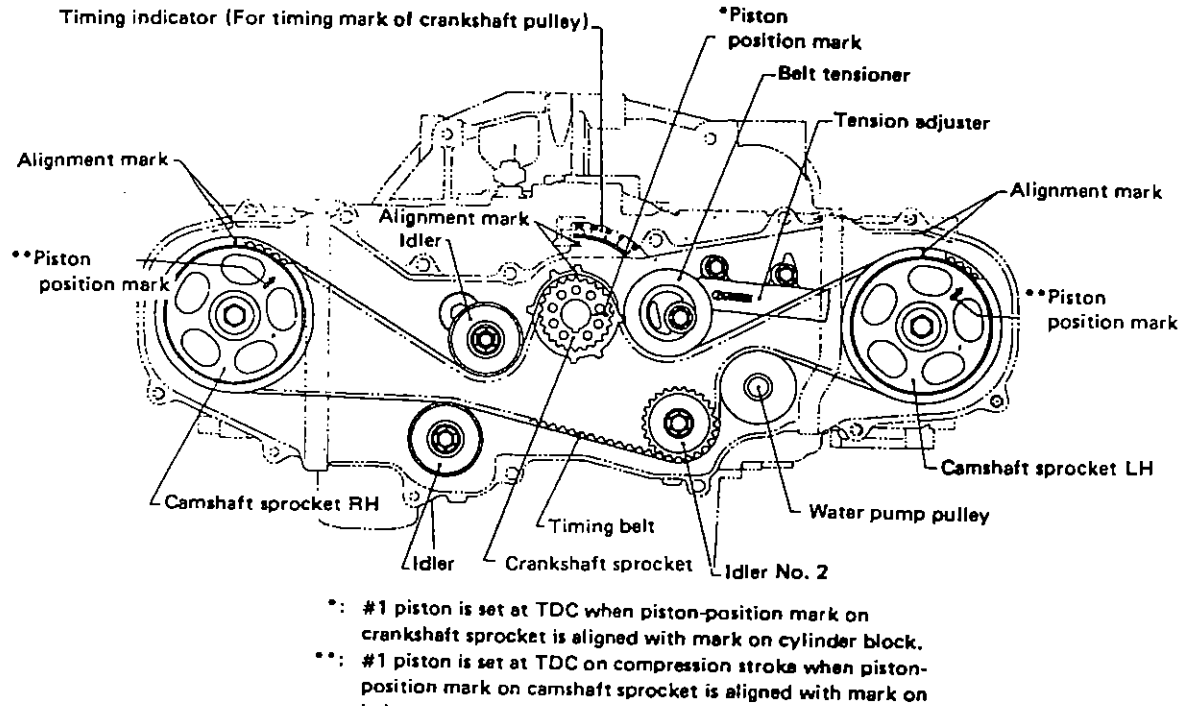
The Subaru 2200cc engine is made from aluminum alloy and is horizontally opposed. It is a 4-stroke cycle, water-cooled, SOHC 16-valve engine. The fuel system utilizes an MPFI (multiple fuel injection) design.
A summary of the major construction and function features is as follows:

- The cylinder head is a center-plug type that utilizes pentroof combustion chambers. The four-valve design is provided with two intake valves and two exhaust valves per cylinder. The intake and exhaust ports are arranged in a cross-flow design.
- The valve rocker arm has a built-in hydraulic lash adjuster which eliminates the need for valve clearance adjustment.
- A single timing belt drives two camshafts on the left and right banks and the oil pump on the right bank. Belt tension is automatically adjusted to eliminate maintenance.
- The crankshaft is supported by five bearings to provide high rigidity and strength.
- The cylinder block is made from aluminum die cast which is integrated with cast-iron cylinder liners.



2. Timing Belt

A single timing belt drives two camshafts (one in the left bank and one in the right bank). The back of the belt also drives the water pump.
The timing belt teeth have a specially designed round profile to provide quiet operation. The timing belt is composed of a strong and inflexible core wire, a wear-resistant canvas and heat- resistant rubber material.
A hydraulic belt-tension adjuster constantly maintains specified belt tension to properly drive the camshafts, as well as to provide a "maintenance-free" advantage.



*: #1 piston is set at TDC when piston-position mark on crankshaft sprocket is aligned with mark on cylinder block.
**: #1 piston is set at TDC on compression stroke when piston-position mark on camshaft sprocket is aligned with mark on belt cover.

B2-077

Fig. 2

3. Belt Tension Adjuster

The belt tension adjuster provides a constant value of tension for the timing belt. Proper belt tension is maintained using a rod to push the tension pulley. The location of the tensioner pulley shaft center is offset in relation to the center of the pulley's outside diameter.
The tensioner adjuster rod provides a rotary movement for the tensioner pulley by both tension of the spring housed in the adjuster.

1) Belt tension action

The tensioner adjuster rod is moved to the left by the force of the main spring. This causes silicon oil (which is held to constant pressure by compression-spring tension inside the reservoir chamber) to push the check ball so that silicon oil flows into the oil-pressure chamber.
The momentum which forces the adjuster rod out acts upon the tensioner arm so that the pulley is turned counterclockwise. Thus, timing belt tension is properly maintained.

2) Balance to belt tension

When the timing belt reaction force is balanced by the main spring tension (to push the adjuster rod), the arm is held stationary to maintain constant belt tension.
When the timing belt reaction force increases to such an extent that the belt will be too tight, a small quantity of oil in the oil-pressure chamber gradually returns to the reservoir chamber via the adjuster body-to-rod clearance. This return of oil continually moves the rod until the reaction force of the timing belt balances with main spring force and oil pressure inside the oil-pressure chamber. Thus, belt tension is constantly maintained.

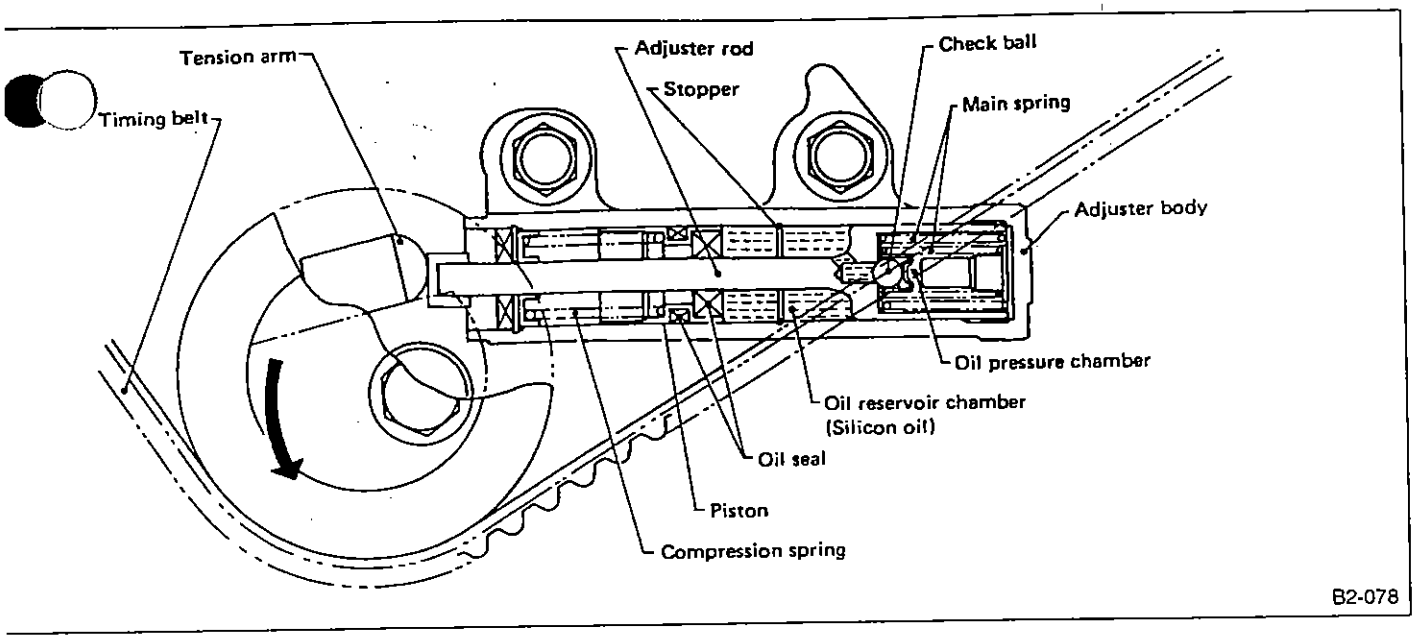


Fig. 3

4. Belt Cover

The belt cover is made of synthetic resin molding which is lightweight and heat resistant. It has a totally enclosed design that utilizes rubber packing at the mating surface of the cylinder block. This eliminates the chance of dust and water from entering the interior.

A floating design is utilized by placing rubber mounting between the cylinder block and belt cover to prevent the transmission of noise and vibration.

The front belt cover has a graduated line for ignition-timing confirmation.

5. Valve Rocker ASSY

A metal bushing is press-fitted to the rocker arm at the rocker shaft location and a sintered alloy chip casting is used at the frictional surface of the cam.

The valve side of the rocker arm is provided with a hydraulic lash adjuster to maintain a "zero" valve clearance, as well as to provide quiet operation and eliminate valve clearance adjustment.

The rocker arm on the exhaust valve side has a "Y"-letter design and operates two exhaust valves.

The rocker shaft has an oil passage in it. Each shaft end is provided with a built-in relief valve.

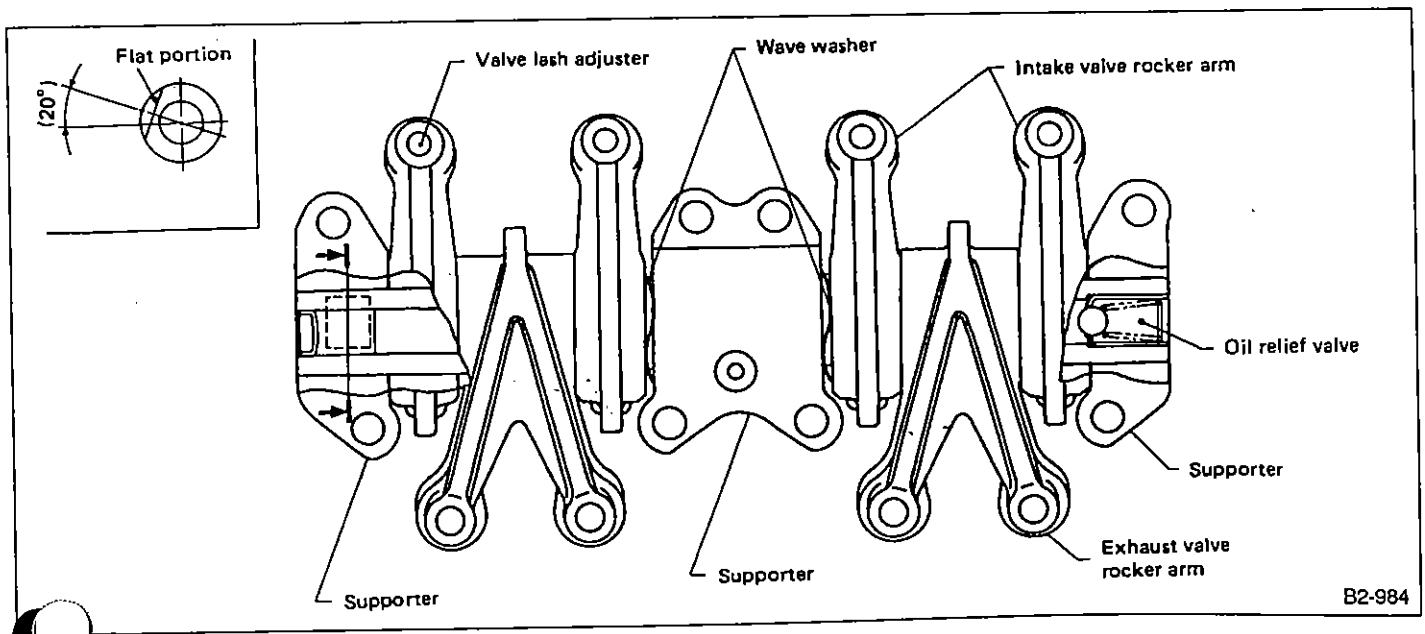


Fig. 4

6. Hydraulic Lash Adjuster

The hydraulic lash adjuster is built into each rocker arm on the valve side. A total of sixteen lash adjusters are employed.

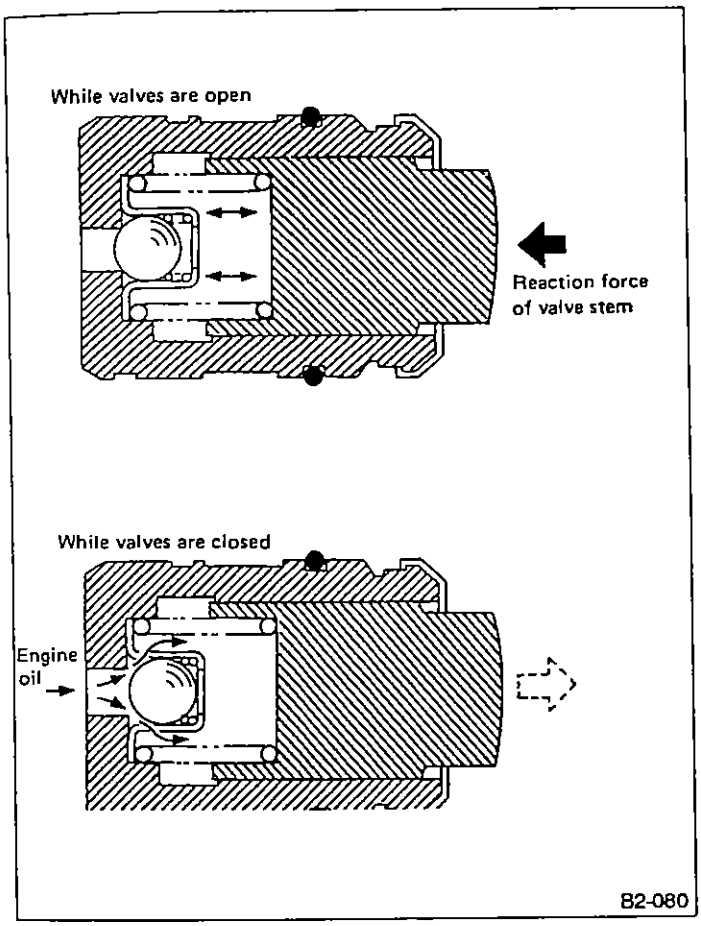


Fig. 5

7. Cam Shaft

The cam nose part is finished with "chill" treatment to increase wear resistance and anti-scuffing property. The right- hand camshaft is supported by three journals inside the cylinder head while the left-hand camshaft is supported by four journals. The flanges of these camshafts are also supported by the camshaft support ends to receive thrust force.

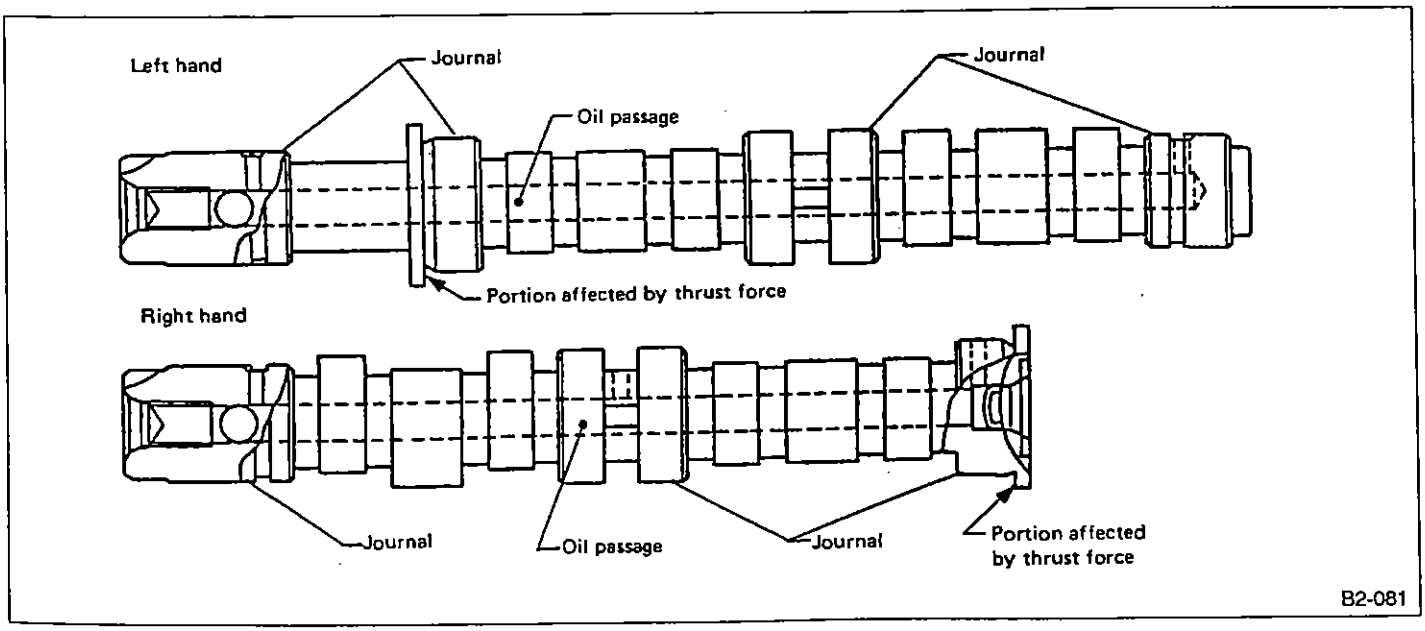
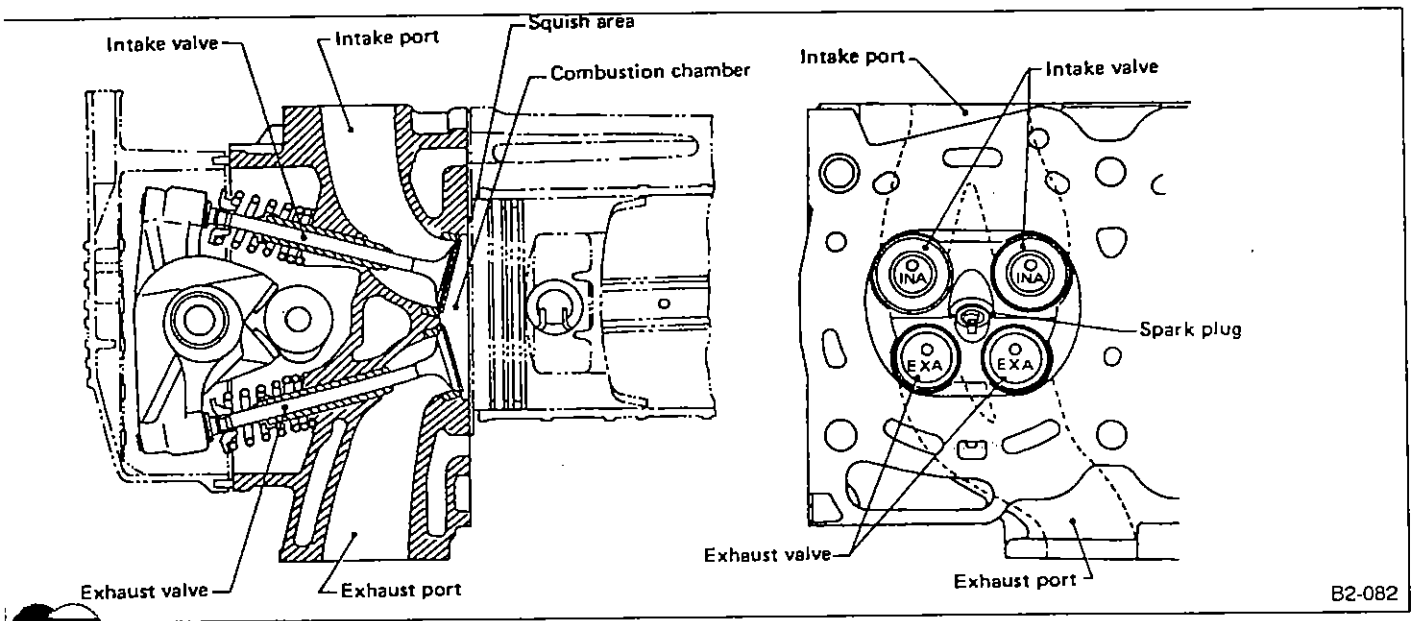


Fig. 6

3. Cylinder Head

Combustion chambers in the cylinder head are compact squish area for increased combustion efficiency.
Four valves (two intake and two exhaust), which are arranged in a cross-flow design, are used per cylinder.
The cylinder head gasket is made from carbon material (not asbestos). Its core is metal provided with metal hooks to increase resistance to both heat and wear.
The inner side of grommets used in the cylinder bore are reinforced with wire to withstand both high combustion pressure and temperature.
The cylinder head of the turbocharged engine utilizes the same basic design as that described above, except that pipes to lubricate and cool the turbocharger are provided.

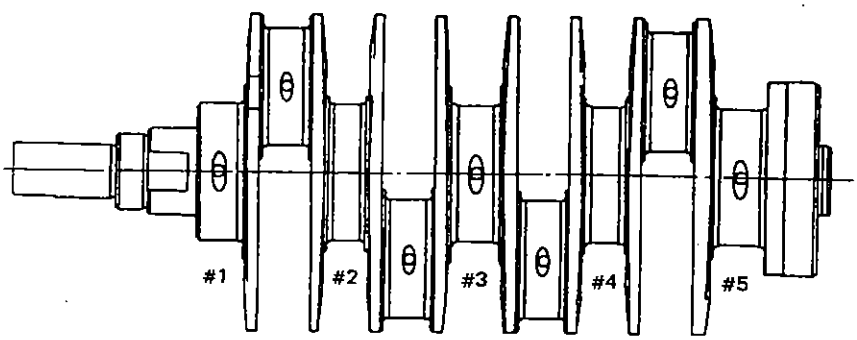


9. Cylinder Block

The cylinder block is made from aluminum die casting. The cylinder perimeter has an open-deck design which is lightweight, highly rigid and has superb cooling efficiency.
The cylinder block of the turbocharged engine is a closed deck type to increase rigidity.
The cylinder liners are made from cast iron and are dry types which are totally cast with aluminum cylinder block. Five main journal block designs are employed to increase stiffness and quiet operation. The oil pump is located in the front center of the cylinder block and the water pump is located at the front of the right-cylinder bank. At the rear of the right-cylinder block is a separator which eliminates oil mist contained in the blow-by gas.

10. Crankshaft

The crankshaft is supported by five bearings to provide high rigidity and strength. The corners of the crankshaft journals and webs, as well as the crank pins and webs, are finished with fillet-roll work to increase stiffness. The five crankshaft bearings are made from aluminum alloy and the No. 3 bearing is provided with a flanged metal to receive thrust force.



B2-084

Fig. 8

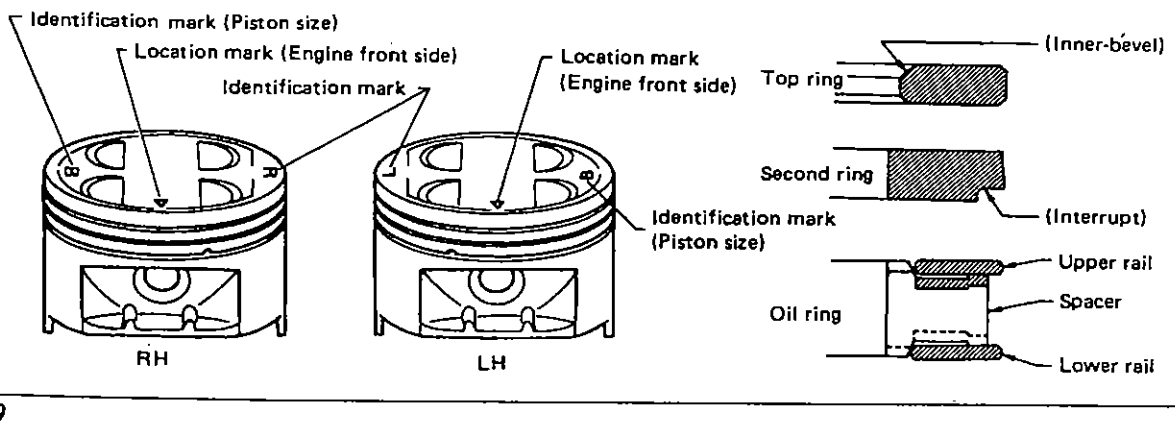
11. Piston

The piston skirt has a "slipper" design to reduce weight and sliding. The oil control ring groove utilizes a slit design.

The piston pin is located in an offset position. The Nos. 1 and 3 pistons are offset in the lower direction while the Nos. 2 and 4 pistons are offset in the upper direction.

The piston head is recessed for both the intake and exhaust valves. It also has symbols used to identify the location and the direction of installation.

Three piston rings are used for each piston-two compression rings and one oil ring. The top piston ring has an inner-bevel design and the second piston ring has an interrupt design to reduce oil consumption.



B2-991

Fig. 9

S SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

			Non-TURBO	TURBO
ENGINE	Type		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
	Valve arrangement		Belt driven, single over-head camshaft, 4-valve/cylinder	
	Bore x Stroke	mm (in)	96.9 x 75 (3.815 x 2.95)	
	Piston displacement	cm^3 (cc, cu in)	2,212 (2,212, 134.98)	
	Compression ratio		9.5	8.0
	Compression pressure (at 200 - 300 rpm)	kPa (kg/cm^2, psi)	1,079 — 1,275 (11.0 — 13.0, 156 — 185)	981 — 1,177 (10.0 — 12.0, 142 — 171)
	Number of piston rings		Pressure ring: 2, Oil ring: 1	
	Intake valve timing	Opening	4° BTDC	6° BTDC
		Closing	52° ABDC	52° ABDC
	Exhaust valve timing	Opening	48° BBDC	42° BBDC
		Closing	12° ATDC	10° ATDC
	Idling speed [At neutral (on N) or position]	rpm	700± 100 (No load) 850± 50 (A/C switch ON)	
	Firing order		1 → 3 → 2 → 4	
	Ignition timing	BTDC/rpm	AT: 20°± 8°/700 MT: 20°± 2°/700	15°± 8°/700

B: SERVICE DATA

elt ension djuster	Protrusion of adjuster rod					15.4 — 16.4 mm	(0.606 — 0.646 in)
	Spacer O.D.					16 mm	(0.63 in)
	Tensioner bush I.D.					16.16 mm	(0.6362 in)
elt ten- ioner	Clearance between spacer and bush				STD	0.117 — 0.180 mm	(0.0046 — 0.0071 in)
					Limit	0.230 mm	(0.0091 in)
	Side clearance of spacer				STD	0.37 — 0.54 mm	(0.0146 — 0.0213 in)
					Limit	0.8 mm	(0.031 in)
Valve ocker arm	Clearance between shaft and arm				STD	0.020 — 0.081 mm	(0.0008 — 0.0032 in)
					Limit	0.10 mm	(0.0039 in)
Camshaft	Bend limit					0.025 mm	(0.0010 in)
	Thrust clearance				STD	0.030 — 0.260 mm	(0.0012 — 0.0102 in)
					Limit	0.35 mm	(0.0138 in)
	Cam lobe height			Non-Turbo	STD	32.364 — 32.464 mm	(1.2742 — 1.2781 in)
					Limit	32.11 mm	(1.2642 in)
				Turbo	STD	32.286 — 32.386 mm	(1.2711 — 1.2750 in)
					Limit	32.04 mm	(1.2614 in)
	Camshaft journal OD	RH	Front	LH	Rear	31.935 — 31.950 mm	(1.2573 — 1.2579 in)
			Center		Center	37.435 — 37.450 mm	(1.4738 — 1.4744 in)
			Rear		Front	37.935 — 37.950 mm	(1.4935 — 1.4941 in)
	Camshaft journal hole ID	RH	Front	LH	Rear	32.005 — 32.025 mm	(1.2600 - - 1.2608 in)
			Center		Center	37.505 — 37.525 mm	(1.4766 — 1.4774 in)
			Rear		Front	38.005 — 38.025 mm	(1.4963 — 1.4970 in)
	Oil clearance				STD	0.055 — 0.090 mm	(0.0022 — 0.0035 in)
					Limit	0.10 mm	(0.0039 in)
Cylinder head	Surface warpage limit					0.05 mm	(0.0020 in)
	Surface grinding limit					0.1 mm	(0.004 in)
	Standard height					98.3 mm	(3.870 in)
Valve set	Refacing angle					90°	
	Contacting width			Intake	STD	0.7 mm	(0.028 in)
					Limit	1.4 mm	(0.055 in)
				Exhaust	STD	1.0 mm	(0.039 in)
					Limit	1.8 mm	(0.071 in)
Valve guide	Inner diameter					6.000 — 6.012 mm	(0.2362 — 0.2367 in)
	Protrusion above head					17.5 — 18.0 mm	(0.689 — 0.709 in)
Valve	Head edge thickness			Intake	STD	1.0 mm	(0.039 in)
					Limit	0.8 mm	(0.031 in)
				Exhaust	STD	1.2 mm	(0.047 in)
					Limit	0.8 mm	(0.031 in)
	Stem diameter				Intake	5.950 — 5.965 mm	(0.2343 — 0.2348 in)
					Exhaust	5.945 — 5.960 mm	(0.2341 — 0.2346 in)
	Stem oil clearance			STD	Intake	0.035 — 0.062 mm	(0.0014 — 0.0024 in)
					Exhaust	0.040 — 0.067 mm	(0.0016 — 0.0026 in)
				Limit	-	0.15 mm	(0.0059 in)
	Overall length				Intake	101.0 mm	(3.976 in)
					Exhaust	101.2 mm	(3.984 in)

STD: Standard ID: Inner diameter OD: Outer diameter

	Free length				46.16 mm	(1.8173 in)
	Squareness				2.5°, 2.0 mm	(0.079 in)
	Tension/spring height				190.3 — 219.7 N (19.4 — 22.4 kg, 42.8 — 49.4 lb)/37.0 mm (1.457 in) 401.1 — 461.9 N (40.9 — 47.1 kg, 90.2 — 103.9 lb)/29.2 mm (1.150 in)	
ylinder lock	Surface warpage limit (mating with cylinder head)				0.05 mm	(0.0020 in)
	Surface grinding limit				0.1 mm	(0.004 in)
	Cylinder bore	STD	A		96.905 — 96.915 mm	(3.8151 — 3.8155 in)
			B		96.895 — 96.905 mm	(3.8148 — 3.8151 in)
			C		96.885 — 96.895 mm	(3.8144 — 3.8148 in)
	Taper			STD	0.015 mm	(0.0006 in)
				Limit	0.050 mm	(0.0020 in)
	Out-of-roundness			STD	0.010 mm	(0.0004 in)
				Limit	0.050 mm	(0.0020 in)
	Piston clearance			STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
				Limit	0.060 mm	(0.0024 in)
	Enlarging (boring) limit				0.5 mm	(0.020 in)
iston	Outer diameter	STD	A		96.885 — 96.895 mm	(3.8144 — 3.8148 in)
			B		96.875 — 96.885 mm	(3.8140 — 3.8144 in)
			C		96.865 — 96.875 mm	(3.8136 — 3.8140 in)
		0.25 mm (0.0098 in) OS			97.125 — 97.135 mm	(3.8238 — 3.8242 in)
		0.50 mm (0.0197 in) OS			97.375 — 97.385 mm	(3.8337 — 3.8340 in)
	Standard inner diameter of piston pin hole				23.000 — 23.006 mm	(0.9055 — 0.9057 in)
	Outer diameter				22.994 — 23.000 mm	(0.9053 — 0.9055 in)
	Standard clearance between piston pin and hole in piston				0.004 — 0.008 mm	(0.0002 — 0.0003 in)
	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).	
Piston ring	Piston ring gap	Top ring	Non-TURBO	STD	0.20 — 0.35 mm	(0.0079 — 0.0138 in)
				Limit	1.0 mm	(0.039 in)
			TURBO	STD	0.20 — 0.25 mm	(0.0079 — 0.0098 in)
				Limit	0.9 mm	(0.035 in)
		Second ring		STD	0.37 — 0.52 mm	(0.0146 — 0.0205 in)
				Limit	1.0 mm	(0.039 in)
		Oil ring		STD	0.20 — 0.70 mm	(0.0079 — 0.0276 in)
				Limit	1.5 mm	(0.059 in)
	Clearance between piston ring and piston ring groove	Top ring		STD	0.040 — 0.080mm	(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)
Connecting rod	Bend twist per 100 mm (3.94 in) in length			Limit	0.10 mm	(0.0039 in)
	Side clearance			STD	0.070 — 0.330 mm	(0.0028 — 0.0130 in)
				Limit	0.4 mm	(0.016 in)

Connecting rod bearing	Oil clearance	Non-TURBO	STD	0.0158 — 0.0438 mm	(0.0006 — 0.0017 in)
			Limit	0.05 mm	(0.0020 in)
		TURBO	STD	0.0258 — 0.0538 mm	(0.0010 — 0.0021 in)
			Limit	0.06 mm	(0.0024 in)
	Thickness at center portion	Non-TURBO	STD	1.492 — 1.501 mm	(0.0587 — 0.0591 in)
			0.03 mm (0.0012 in) US	1.510 — 1.513 mm	(0.0594 — 0.0596 in)
			0.05 mm (0.0020 in) US	1.520 — 1.523 mm	(0.0598 — 0.0600 in)
			0.25 mm (0.0098 in) US	1.620 — 1.623 mm	(0.0638 — 0.0639 in)
		TURBO	STD	1.487 — 1.496 mm	(0.0585 — 0.0589 in)
			0.03 mm (0.0012 in) US	1.505 — 1.508 mm	(0.0593 — 0.0594 in)
			0.05 mm (0.0020 in) US	1.515 — 1.518 mm	(0.0596 — 0.0598 in)
			0.25 mm (0.0098 in) US	1.615 — 1.618 mm	(0.0636 — 0.0637 in)
Connecting rod bushing	Clearance between piston pin and bushing		STD	0 — 0.022 mm	(0 - 0.0009 in)
			Limit	0.030 mm	(0.0012 in)

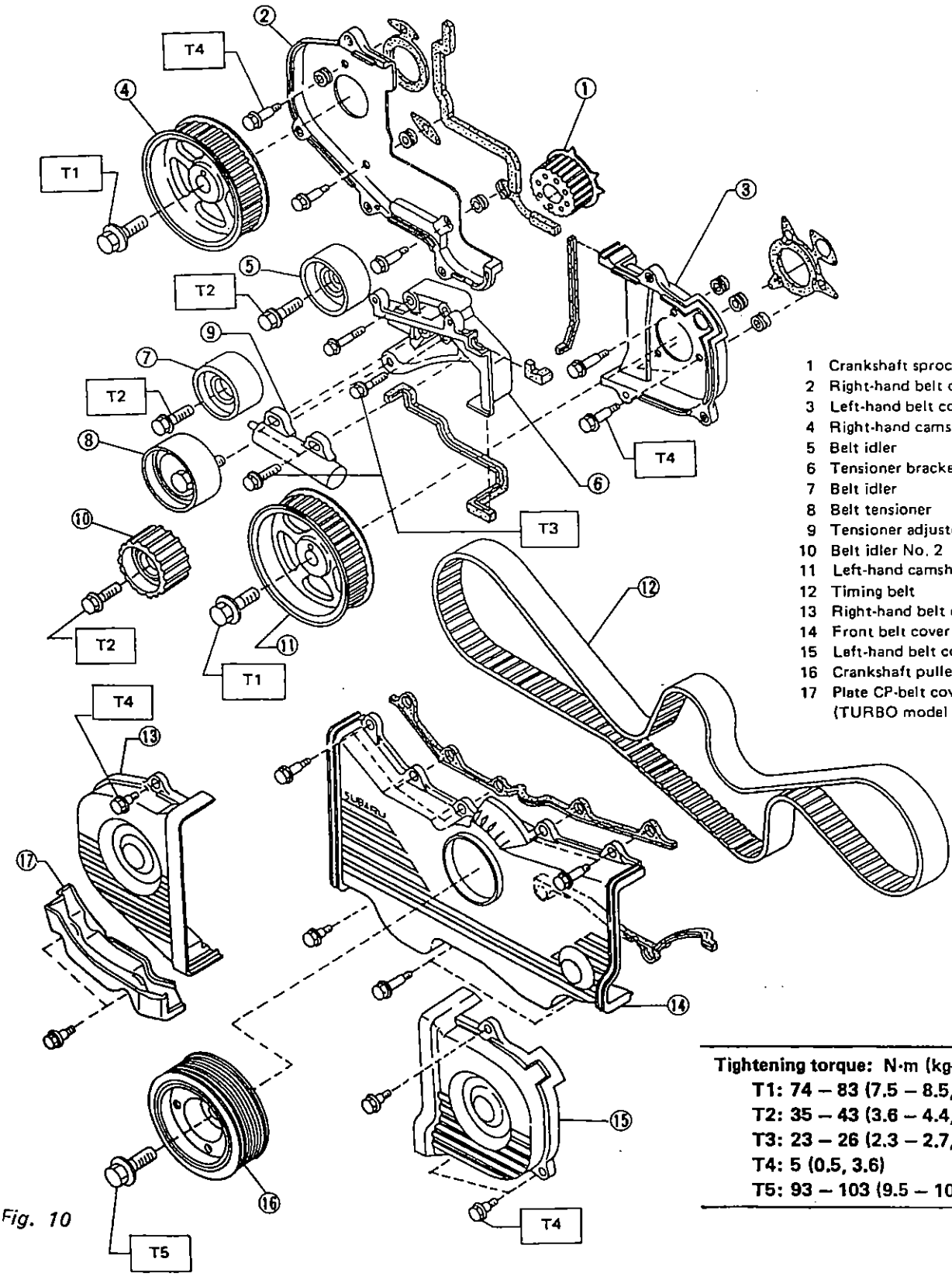
STD: Standard OS: Oversize

	Bend limit			0.035 mm	(0.0014 in)
	Crankpin and crank journal	Out-of-roundness		0.030 mm (0.0012 in) or less	
		Grinding limit		0.250 mm	(0.0098 in)
Crankshaft	Crankpin outer diameter		STD	51.984 — 52.000 mm	(2.0466 — 2.0472 in)
			0.03 mm (0.0012 in) US	51.954 — 51.970 mm	(2.0454 — 2.0461 in)
			0.05 mm (0.0020 in) US	51.934 — 51.950 mm	(2.0446 — 2.0453 in)
			0.25 mm (0.0098 in) US	51.734 — 51.750 mm	(2.0368 — 2.0374 in)
	Crank journal outer diameter		STD	59.984 — 60.000 mm	(2.3616 — 2.3622 in)
			0.03 mm (0.0012 in) US	59.954 — 59.970 mm	(2.3604 — 2.3610 in)
			0.05 mm (0.0020 in) US	59.934 — 59.950 mm	(2.3596 — 2.3602 in)
			0.25 mm (0.0098 in) US	59.734 — 59.750 mm	(2.3517 — 2.3524 in)
	Thrust clearance		STD	0.030 — 0.115 mm	(0.0012 — 0.0045 in)
			Limit	0.25 mm	(0.0098 in)
	Oil clearance	#1, #5	STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.040 mm	(0.0016 in)
		#2, #3, #4	STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.035 mm	(0.0014 in)
Crankshaft bearing	Crankshaft bearing thickness	#1, #5	STD	1.998 — 2.011 mm	(0.0787 — 0.0792 in)
			0.03 mm (0.0012 in) US	2.017 — 2.020 mm	(0.0794 — 0.0795 in)
			0.05 mm (0.0020 in) US	2.027 — 2.030 mm	(0.0798 — 0.0799 in)
			0.25 mm (0.0098 in) US	2.127 — 2.130 mm	(0.0837 — 0.0839 in)
		#2, #3, #4	STD	2.000 — 2.013 mm	(0.0787 — 0.0793 in)
			0.03 mm (0.0012 in) US	2.019 — 2.022 mm	(0.0795 — 0.0796 in)
			0.05 mm (0.0020 in) US	2.029 — 2.032 mm	(0.0799 — 0.0800 in)
			0.25 mm (0.0098 in) US	2.129 — 2.132 mm	(0.0838 — 0.0839 in)

STD: Standard US: Under Size

C COMPONENT PARTS

1. Timing Belt



1 Crankshaft sprocket
2 Right-hand belt cover No. 2
3 Left-hand belt cover No. 2
4 Right-hand camshaft sprocket
5 Belt idler
6 Tensioner bracket
7 Belt idler
8 Belt tensioner
9 Tensioner adjuster
10 Belt idler No. 2
11 Left-hand camshaft sprocket
12 Timing belt
13 Right-hand belt cover
14 Front belt cover
15 Left-hand belt cover
16 Crankshaft pulley
17 Plate CP-belt cover (TURBO model only)

Tightening torque: N·m (kg-m, ft-lb)
T1: 74 – 83 (7.5 – 8.5, 54 – 61)
T2: 35 – 43 (3.6 – 4.4, 26 – 32)
T3: 23 – 26 (2.3 – 2.7, 17 – 20)
T4: 5 (0.5, 3.6)
T5: 93 – 103 (9.5 – 10.5, 69 – 76)

Fig. 10

B2-935

Cylinder Head and Camshaft

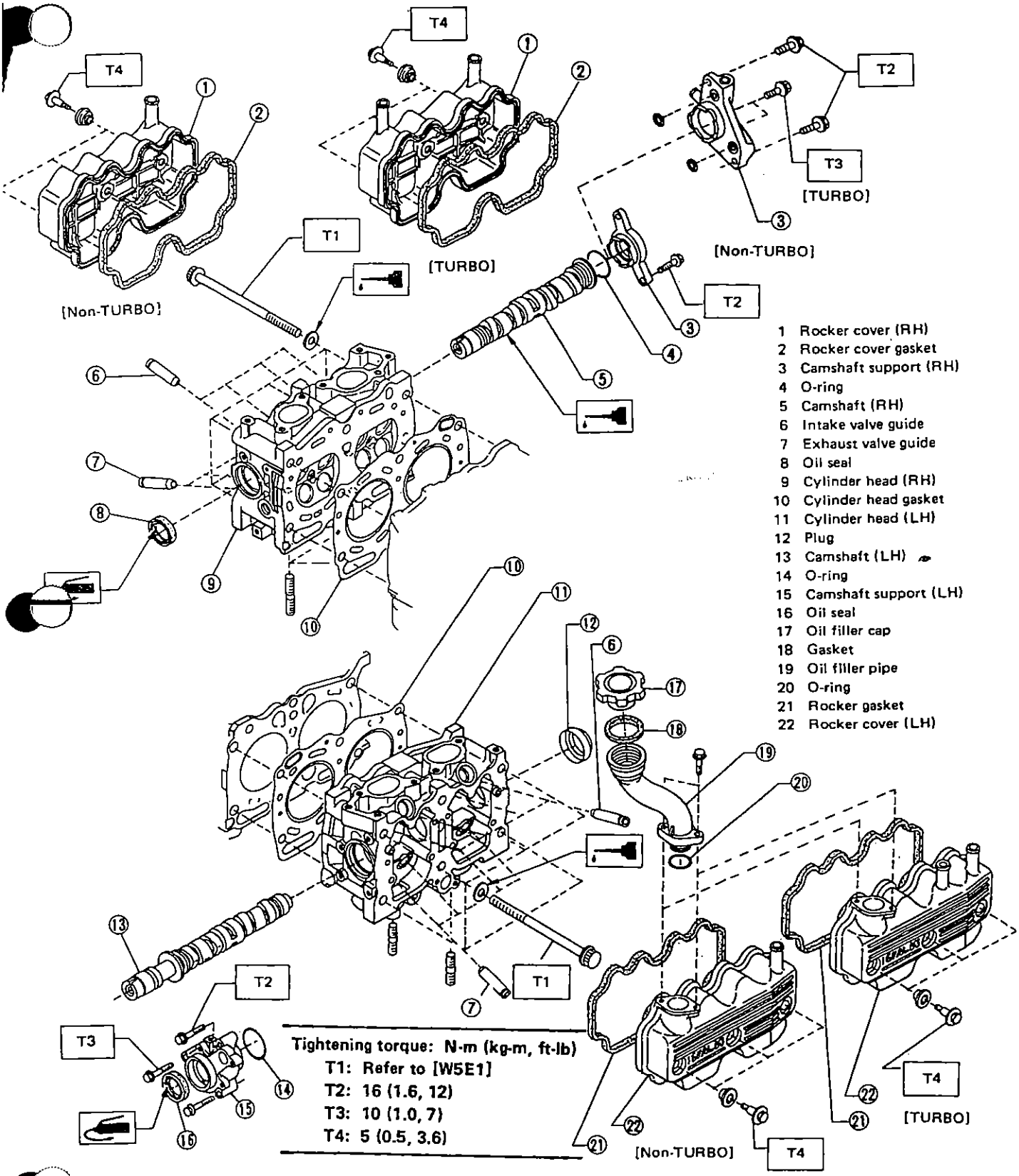
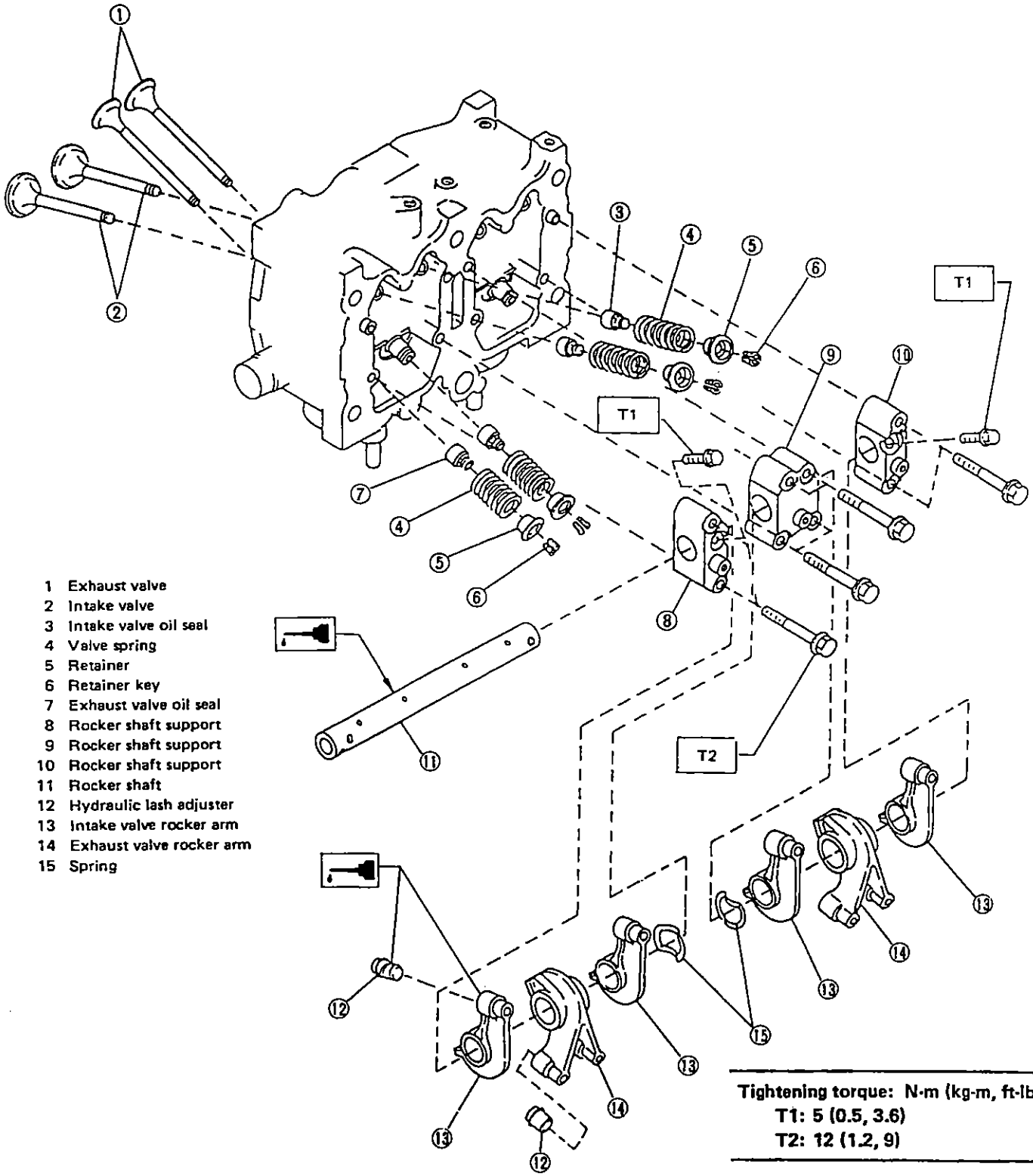


Fig. 11

3. Cylinder Head and Valve ASSY



1 Exhaust valve
2 Intake valve
3 Intake valve oil seal
4 Valve spring
5 Retainer
6 Retainer key
7 Exhaust valve oil seal
8 Rocker shaft support
9 Rocker shaft support
10 Rocker shaft support
11 Rocker shaft
12 Hydraulic lash adjuster
13 Intake valve rocker arm
14 Exhaust valve rocker arm
15 Spring

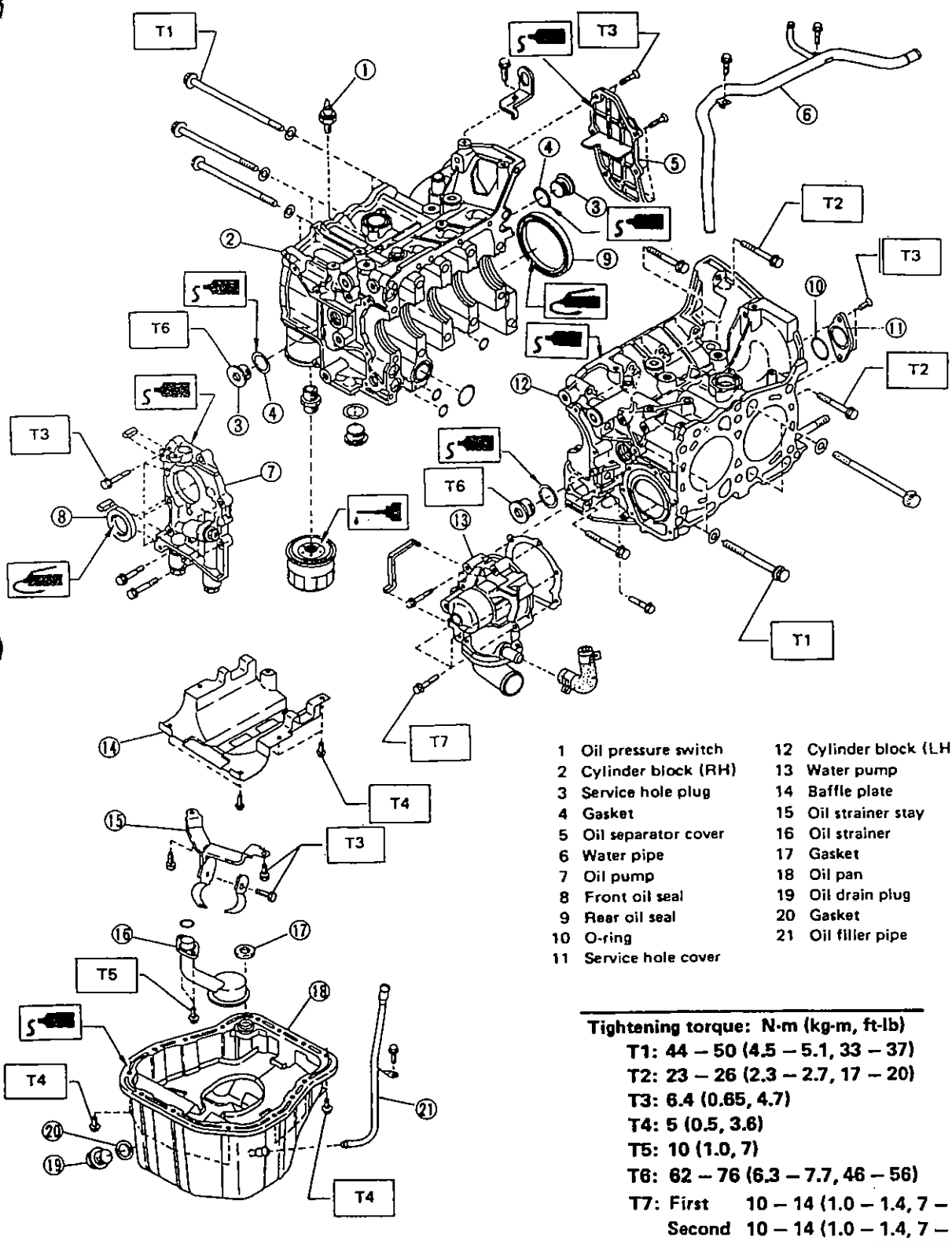
Tightening torque: N·m (kg-m, ft-lb)
T1: 5 (0.5, 3.6)
T2: 12 (1.2, 9)

B2-309

Fig. 12

1. Cylinder Block

Non-TURBO MODEL



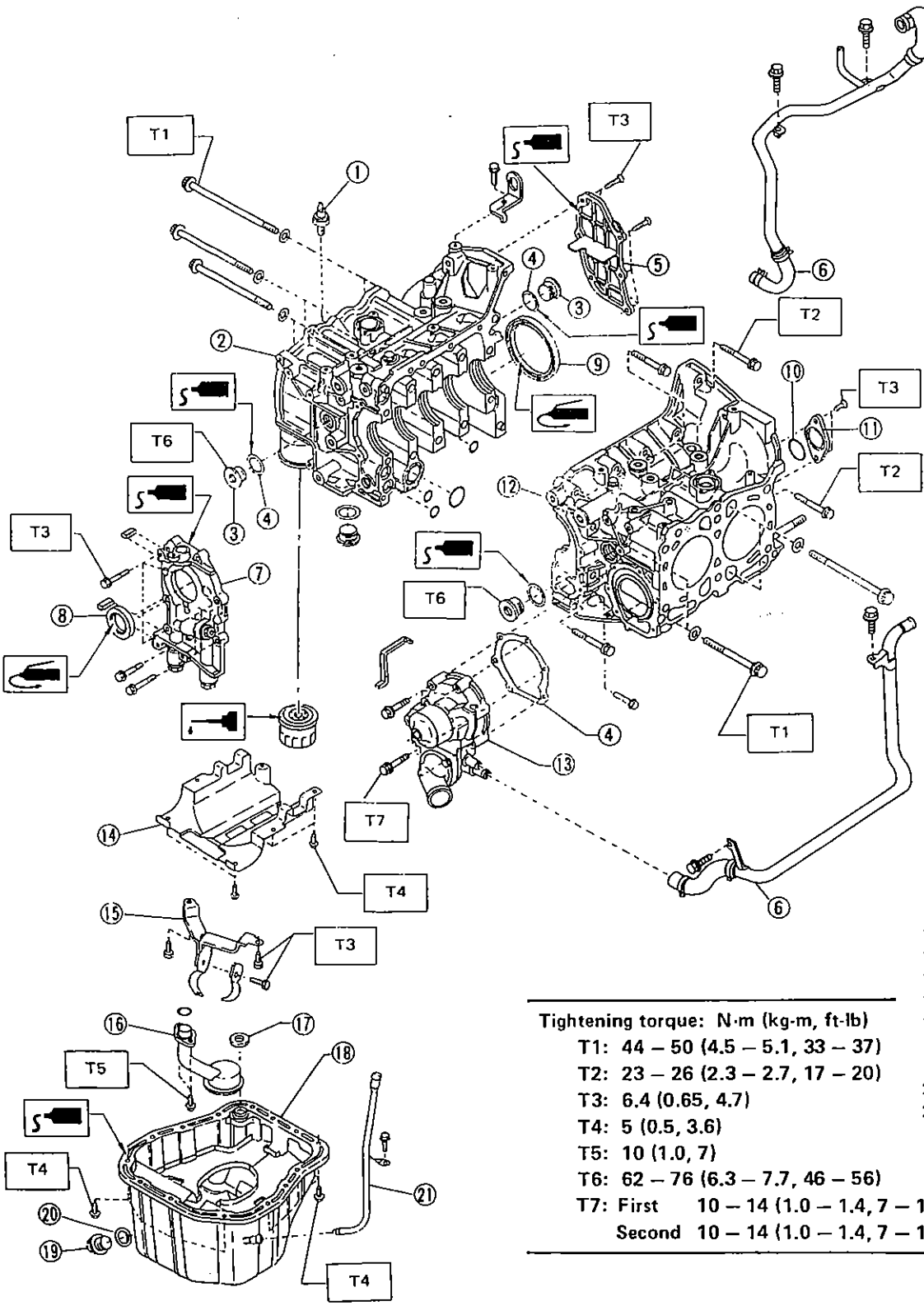
1 Oil pressure switch
2 Cylinder block (RH)
3 Service hole plug
4 Gasket
5 Oil separator cover
6 Water pipe
7 Oil pump
8 Front oil seal
9 Rear oil seal
10 O-ring
11 Service hole cover
12 Cylinder block (LH)
13 Water pump
14 Baffle plate
15 Oil strainer stay
16 Oil strainer
17 Gasket
18 Oil pan
19 Oil drain plug
20 Gasket
21 Oil filler pipe

Tightening torque: N·m (kg-m, ft-lb)
T1: 44 – 50 (4.5 – 5.1, 33 – 37)
T2: 23 – 26 (2.3 – 2.7, 17 – 20)
T3: 6.4 (0.65, 4.7)
T4: 5 (0.5, 3.6)
T5: 10 (1.0, 7)
T6: 62 – 76 (6.3 – 7.7, 46 – 56)
T7: First 10 – 14 (1.0 – 1.4, 7 – 10)
Second 10 – 14 (1.0 – 1.4, 7 – 10)

B2-089

Fig. 13

2. TURBO MODEL



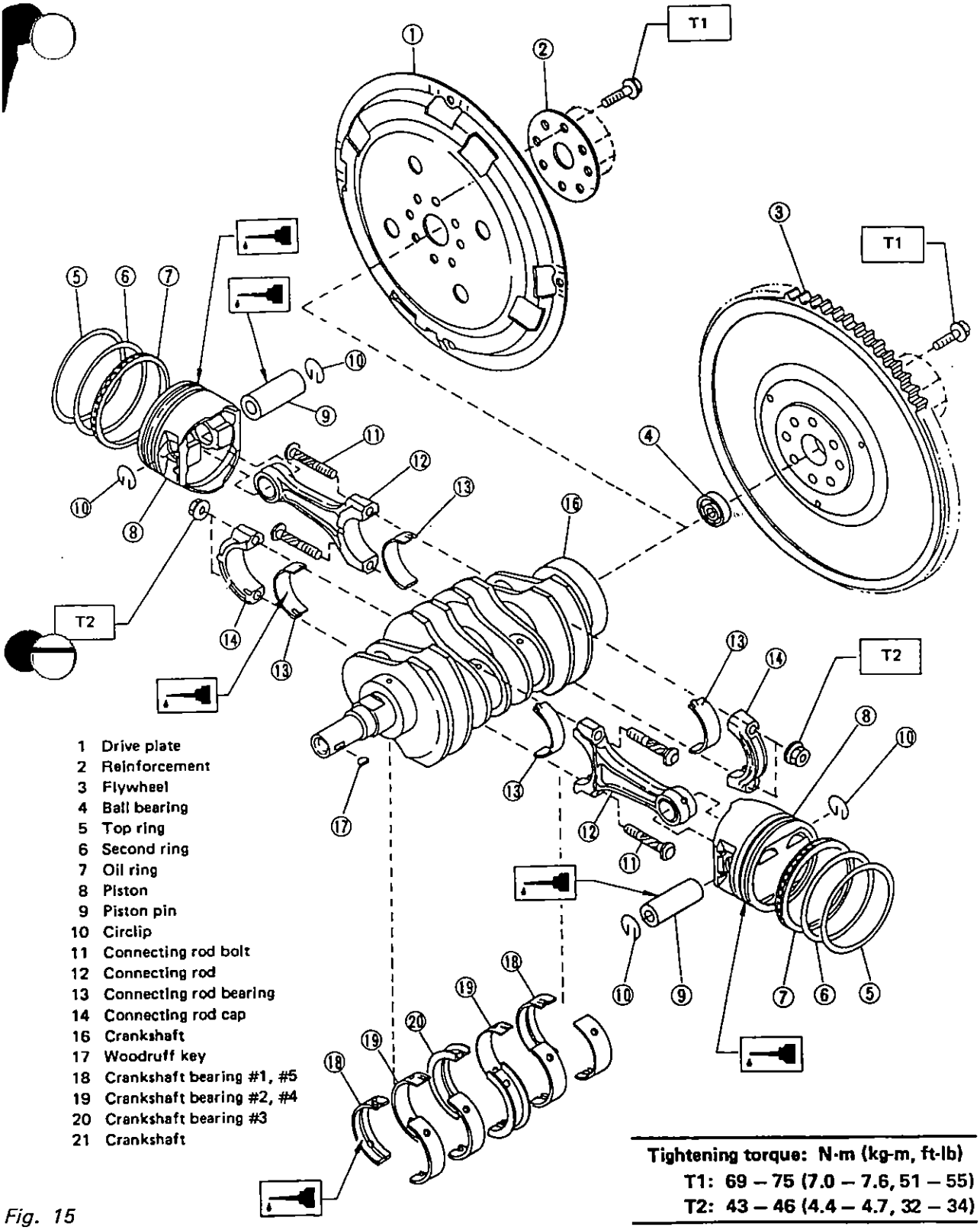
1 Oil pressure switch
2 Cylinder block (RH)
3 Service hole plug
4 Gasket
5 Oil separator cover
6 Water pipe
7 Oil pump
8 Front oil seal
9 Rear oil seal
10 O-ring
11 Service hole cover
12 Cylinder block (LH)
13 Water pump
14 Baffle plate
15 Oil strainer stay
16 Oil strainer
17 Gasket
18 Oil pan
19 Oil drain plug
20 Gasket
21 Oil filler pipe

Tightening torque: N·m (kg-m, ft-lb)
T1: 44 – 50 (4.5 – 5.1, 33 – 37)
T2: 23 – 26 (2.3 – 2.7, 17 – 20)
T3: 6.4 (0.65, 4.7)
T4: 5 (0.5, 3.6)
T5: 10 (1.0, 7)
T6: 62 – 76 (6.3 – 7.7, 46 – 56)
T7: First 10 – 14 (1.0 – 1.4, 7 – 10)
Second 10 – 14 (1.0 – 1.4, 7 – 10)

B2-1027

Fig. 14

Crankshaft and Piston



1 Drive plate
2 Reinforcement
3 Flywheel
4 Ball bearing
5 Top ring
6 Second ring
7 Oil ring
8 Piston
9 Piston pin
10 Circlip
11 Connecting rod bolt
12 Connecting rod
13 Connecting rod bearing
14 Connecting rod cap
16 Crankshaft
17 Woodruff key
18 Crankshaft bearing #1, #5
19 Crankshaft bearing #2, #4
20 Crankshaft bearing #3
21 Crankshaft

Tightening torque: N·m (kg-m, ft-lb)
T1: 69 – 75 (7.0 – 7.6, 51 – 55)
T2: 43 – 46 (4.4 – 4.7, 32 – 34)

B2-090

Fig. 15

W SERVICE PROCEDURE

1. General Precautions

1) Before disassembling engine, place it on ENGINE STAND.
On turbocharged engine, remove exhaust manifolds, turbo joint pipe and turbocharger before placing it on ENGINE STAND.

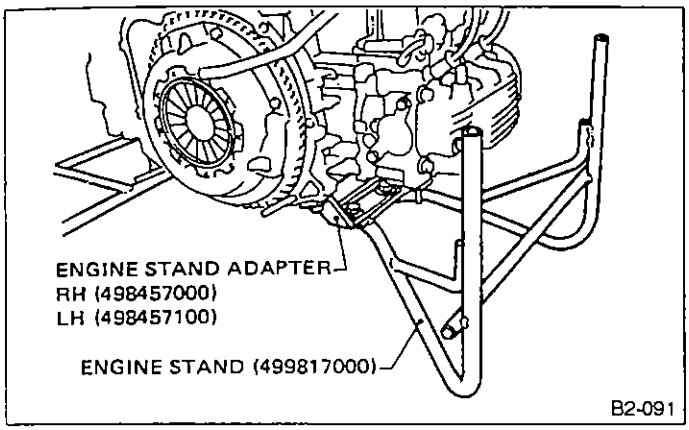


Fig. 16

2) All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
3) Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
4) Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
5) All removed parts, if to be reused, should be reinstalled in the original positions and directions.
6) Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
7) Bolts, nuts and washers should be replaced with new ones as required.
8) Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.

. Timing Belt

EMOVAL

CRANKSHAFT PULLEY AND BELT COVER

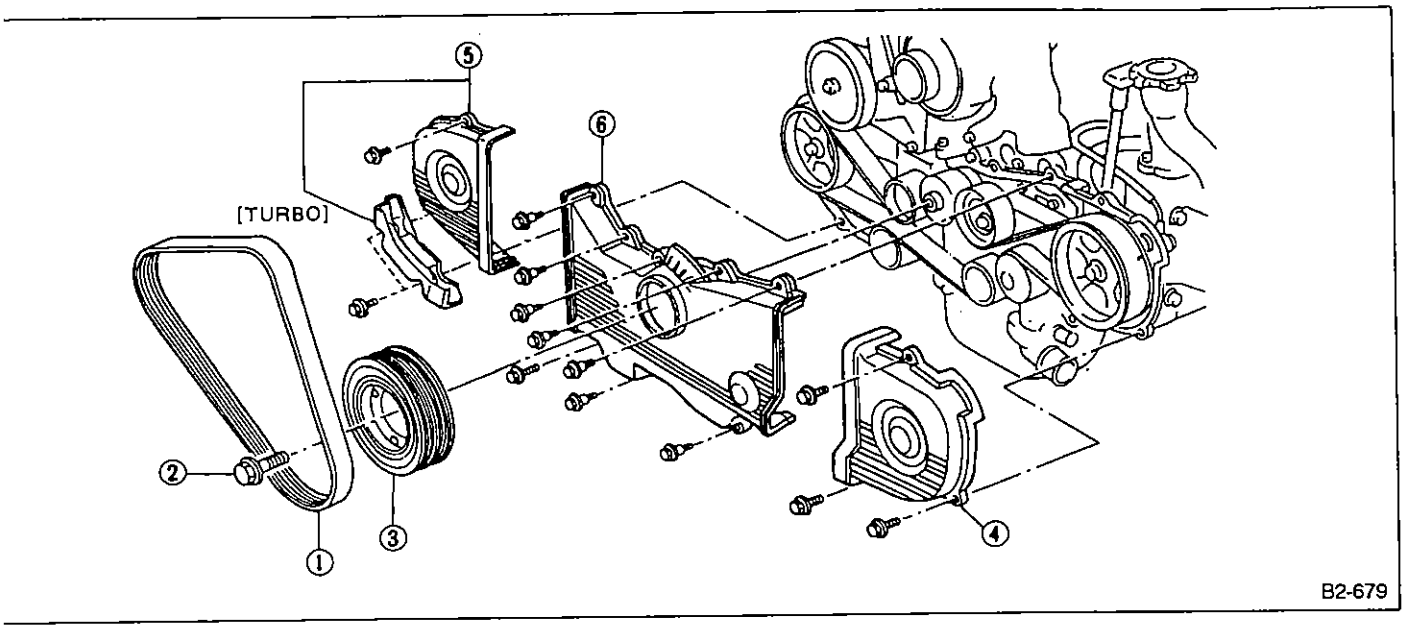


Fig. 17

ove V-belt.
ove pulley bolt. To lock crankshaft, use Special Tool.

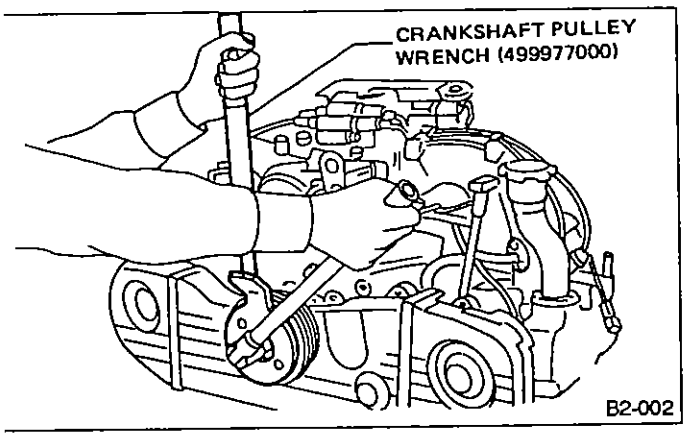


Fig. 18

3) Remove crankshaft pulley.
4) Remove left-hand belt cover.
5) Remove right-hand belt cover and plate CP-belt cover (TURBO model).
6) Remove front belt cover.

. TIMING BELT

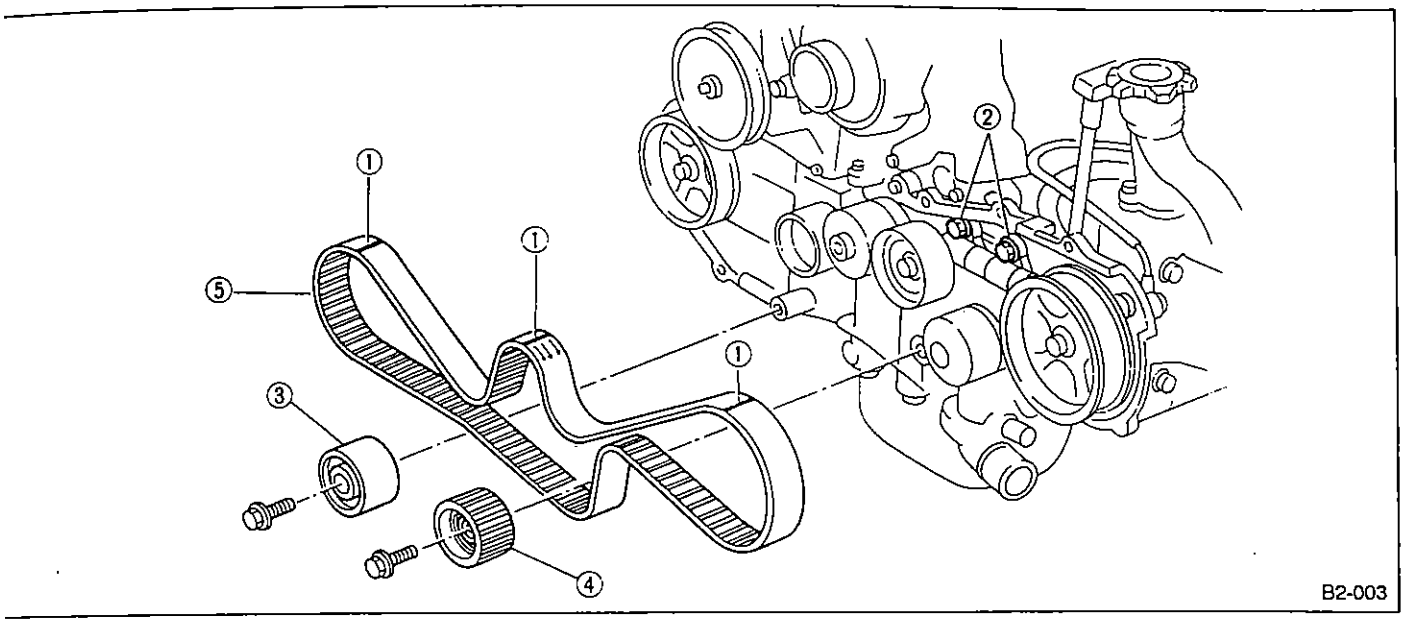


Fig. 19

) If alignment mark and/or arrow mark (which indicates rotation direction) on timing belt fade away, put ıew marks before removing timing belt as follows:

(1) Turn crankshaft, and align alignment marks on crankshaft sprocket, and left and right camshaft sprockets with notches of belt cover and cylinder block.

Special tool: CRANKSHAFT SOCKET (499987500)

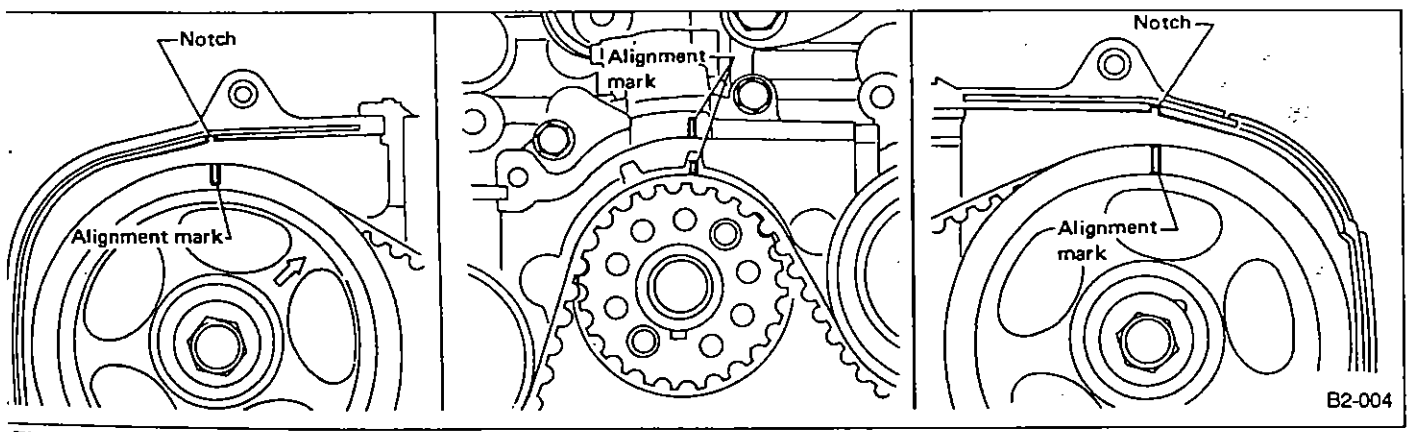


Fig. 20

(2) Using white paint, put alignment and/or arrow marks on timing belts in relation to the sprockets.

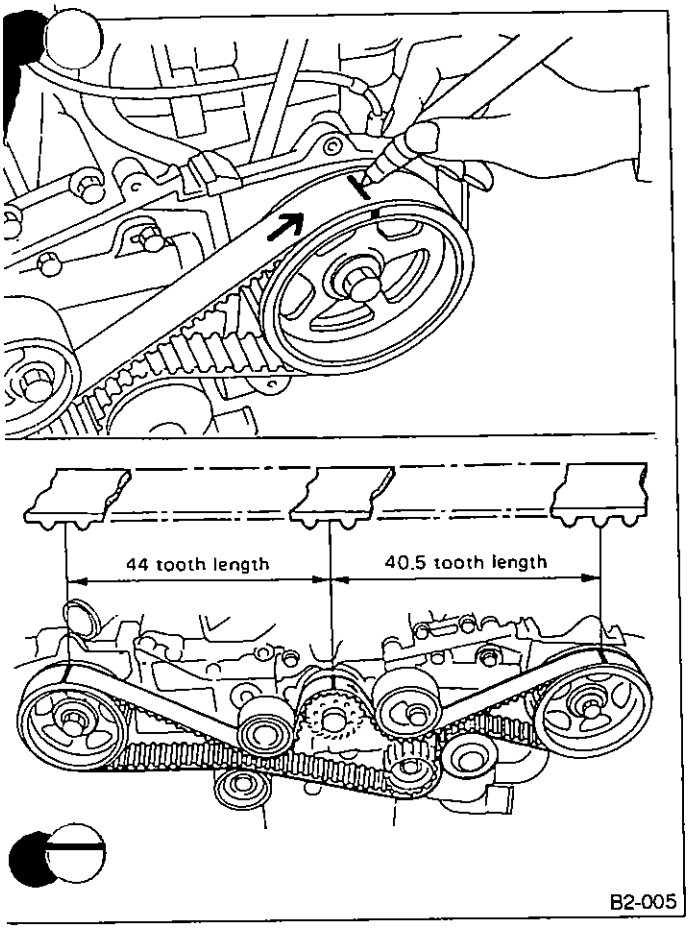


Fig. 21

2) Loosen tensioner adjuster mounting bolts.
3) Remove belt idler.
4) Remove belt idler No. 2
5) Remove timing belt.

. BELT TENSIONER AND IDLER

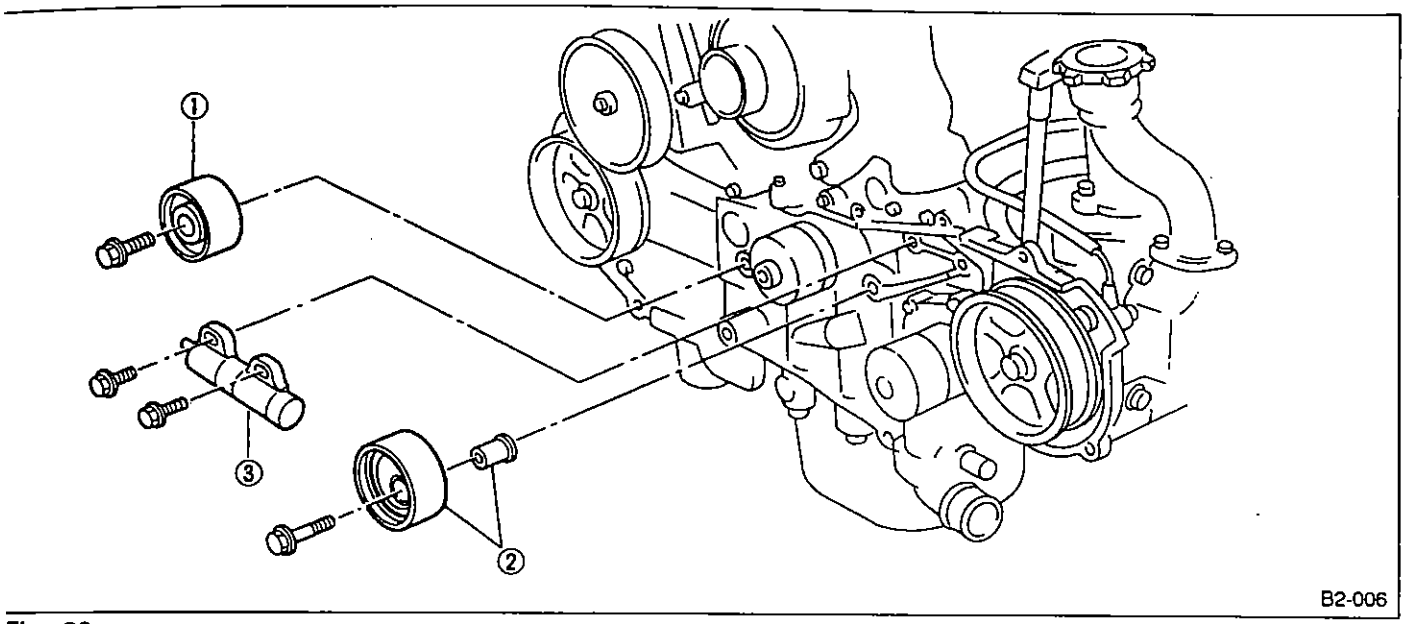


Fig. 22

) Remove belt idler.
) Remove belt tensioner and spacer.
) Remove belt tension adjuster.

4. SPROCKET

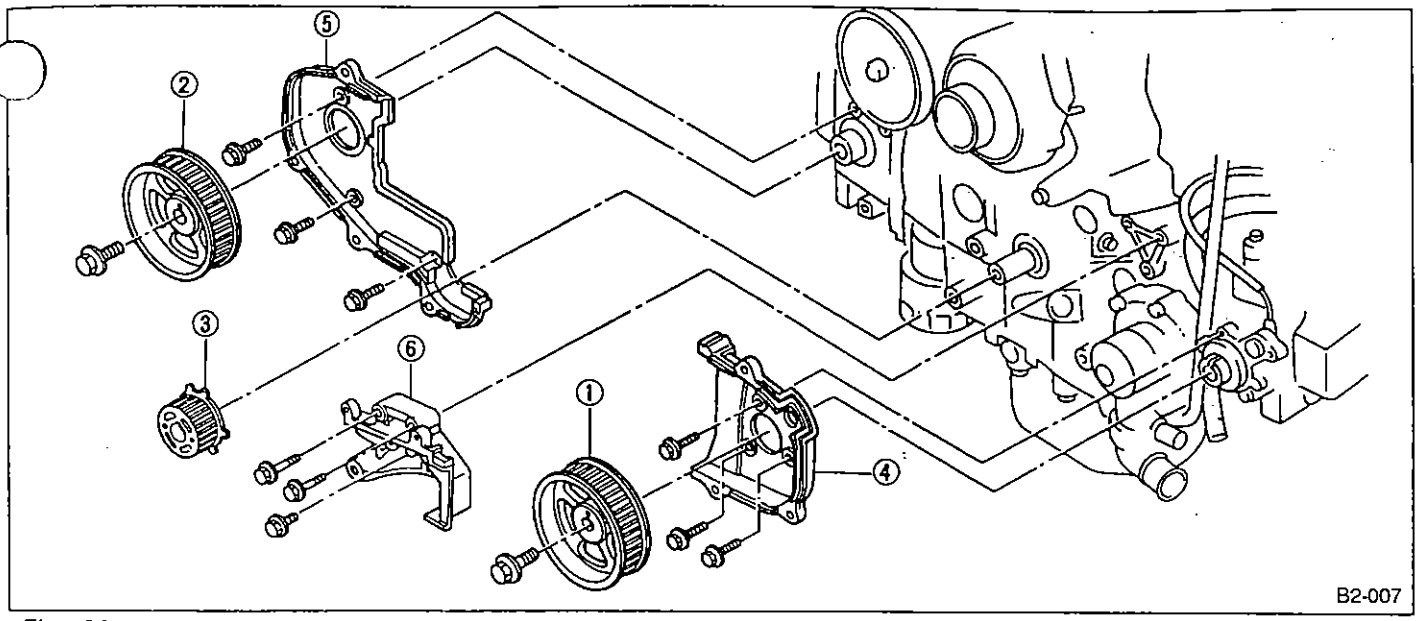


Fig. 23

1) Remove left-hand camshaft sprocket.

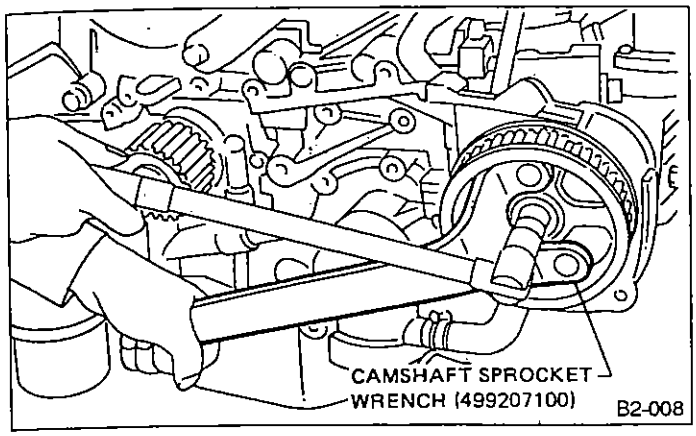


Fig. 24

2) Remove right-hand camshaft sprocket. To lock camshaft, use CAMSHAFT SPROCKET WRENCH.
3) Remove crankshaft sprocket.
4) Remove left-hand belt cover No. 2.
5) Remove right-hand belt cover No. 2.
6) Remove tensioner bracket.

B: INSPECTION

1. 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.
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).]

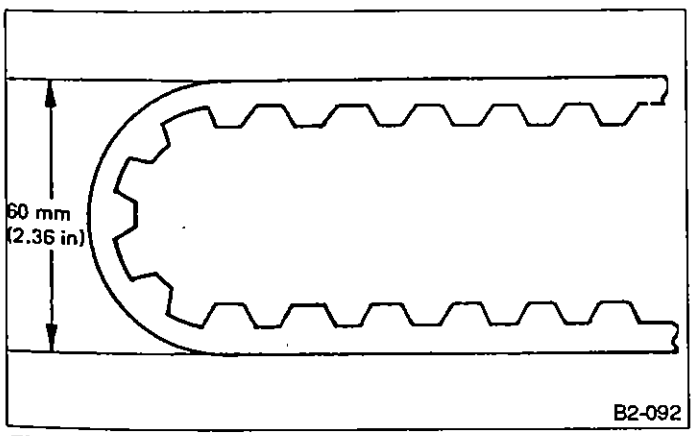


Fig. 25

2. BELT TENSION ADJUSTER

1) Visually check oil seals for leaks, and rod ends for abnormal wear or scratches. If necessary, replace faulty parts.
Slight traces of oil at rod' oil seal does not indicate a problem.
2) While holding tensioner with both hands, push the rod section against floor or wall with a force of 147 to 490 N (15 to 50 kg, 33 to 110 lb) to ensure that the rod section does not move. If it moves, replace tension adjuster with a new one.
3) Measure the extension of rod beyond the body. If it is not within specifications, replace with a new one.

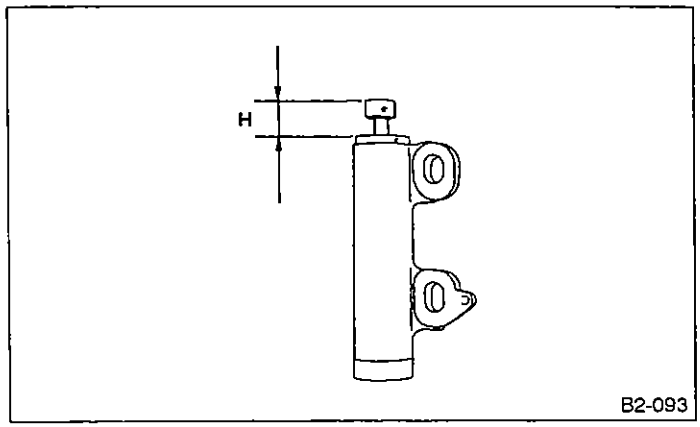


Fig. 26

Rod extension H:
15.4 — 16.4 mm (0.606 — 0.646 in)

3. BELT TENSIONER

1) Check mating surfaces of timing belt and contact point of tension adjuster rod for abnormal wear or scratches. Replace belt tensioner if faulty.
2) Check spacer and tensioner bushing for wear.

4. BELT IDLER

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

C: INSTALLATION

SPROCKET

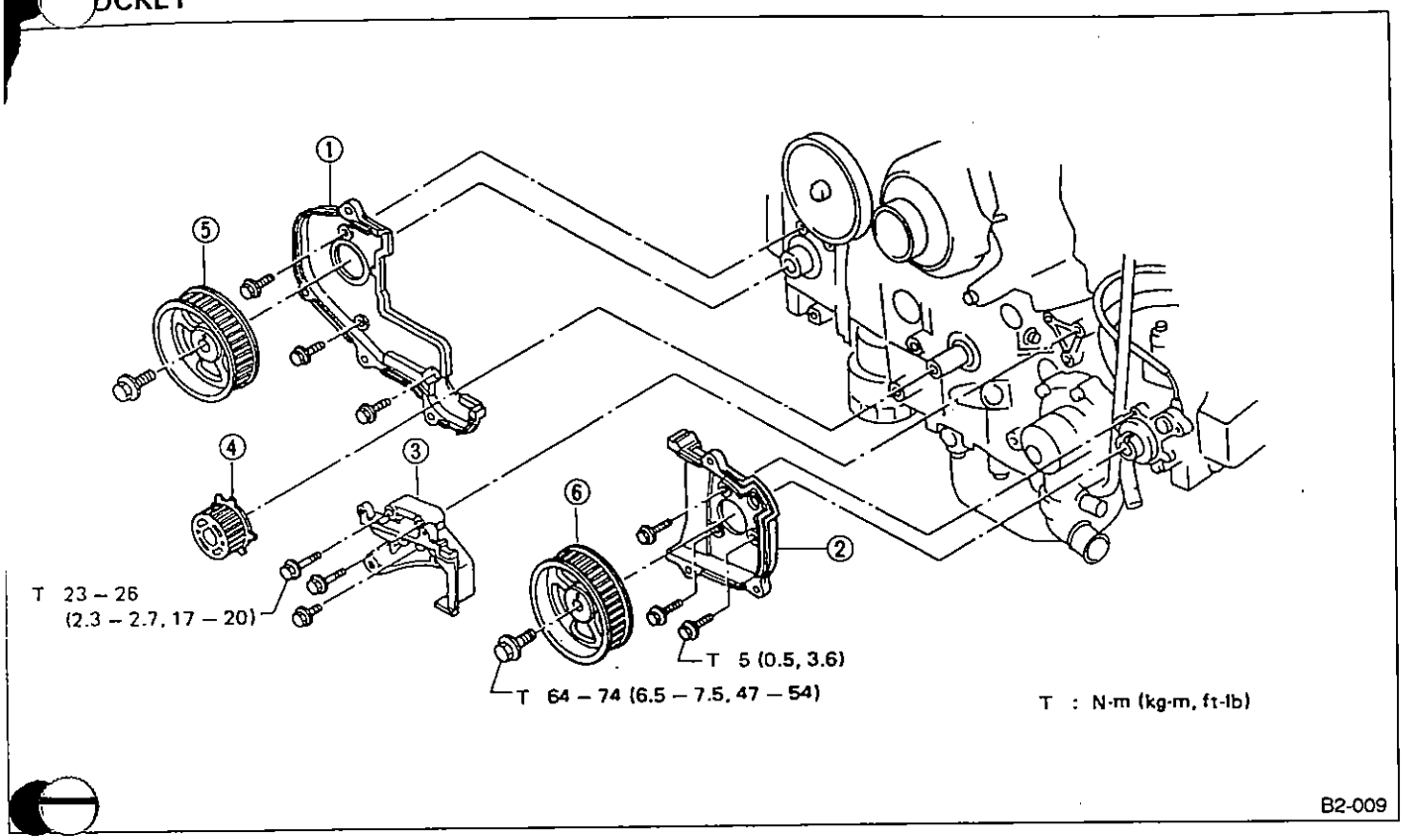


Fig. 27

1) Install right-hand belt cover No. 2.
2) Install left-hand belt cover No. 2.
3) Install tensioner bracket.
4) Install crankshaft sprocket.
5) Install right-hand camshaft sprocket.

To lock camshaft, use CAMSHAFT SPROCKET WRENCH.

6) Install left-hand camshaft sprocket.

Do not confuse left- and right-hand camshaft sprockets during installation. The left-hand camshaft sprocket is identified by a projection used to monitor cam angle sensor.

2. BELT TENSIONER AND IDLER

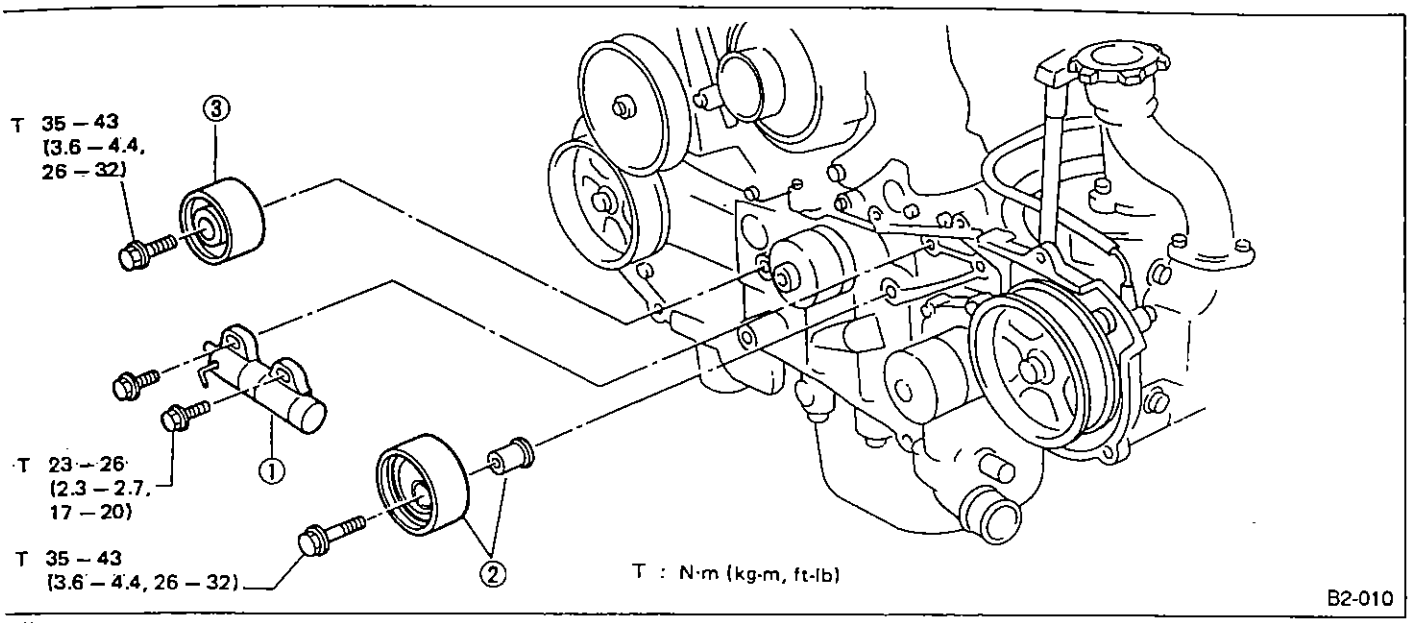


Fig. 28

1) Installation of belt tensioner adjuster.
   (1) Insert stopper pin 1.5 mm (0.059 in) dia. into place while pushing tension adjuster rod into body using a press.

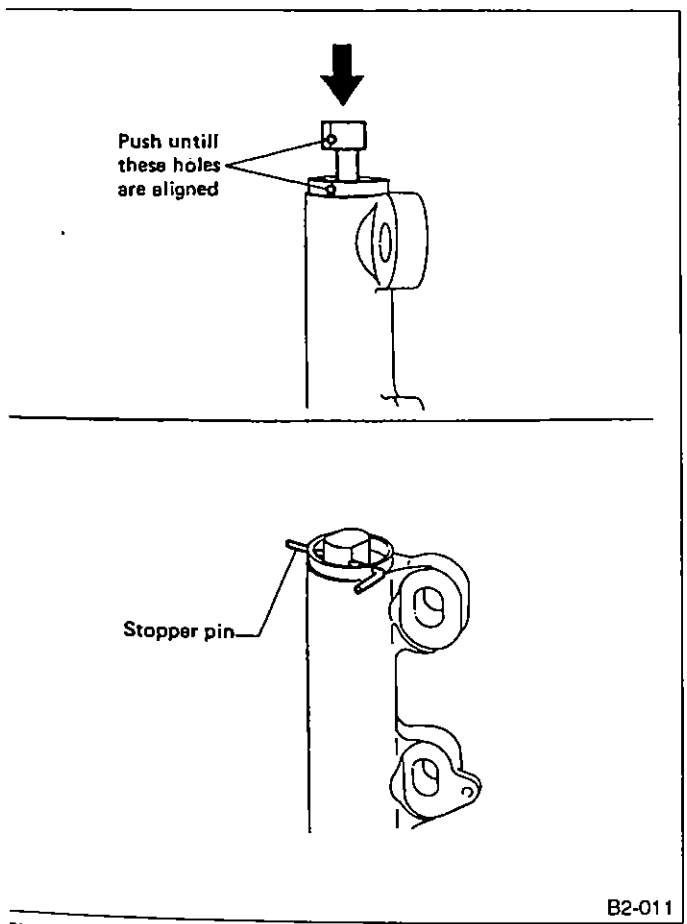


Fig. 29

2) Install belt tensioner.
3) Install belt idler.
a. Do not allow press pressure to exceed 9,807 N (1,000 kg, 2,205 lb).
b. Do not release press pressure until stopper pin is completely inserted.
c. Push tension adjuster rod vertically.
   (2) Temporarily tighten bolts while tension adjuster is pushed all the way to the right.

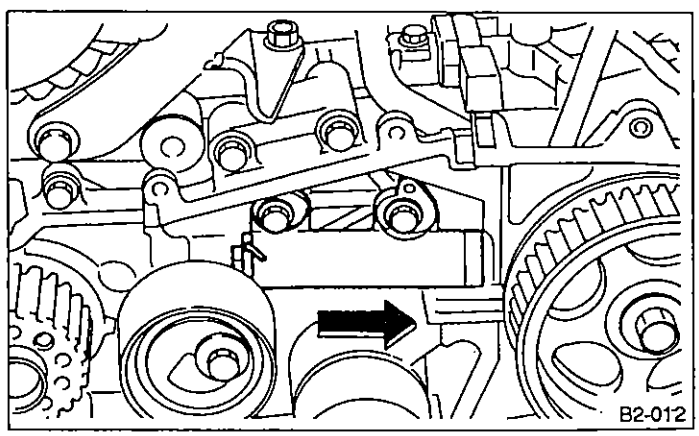


Fig. 30

3. TIMING BELT

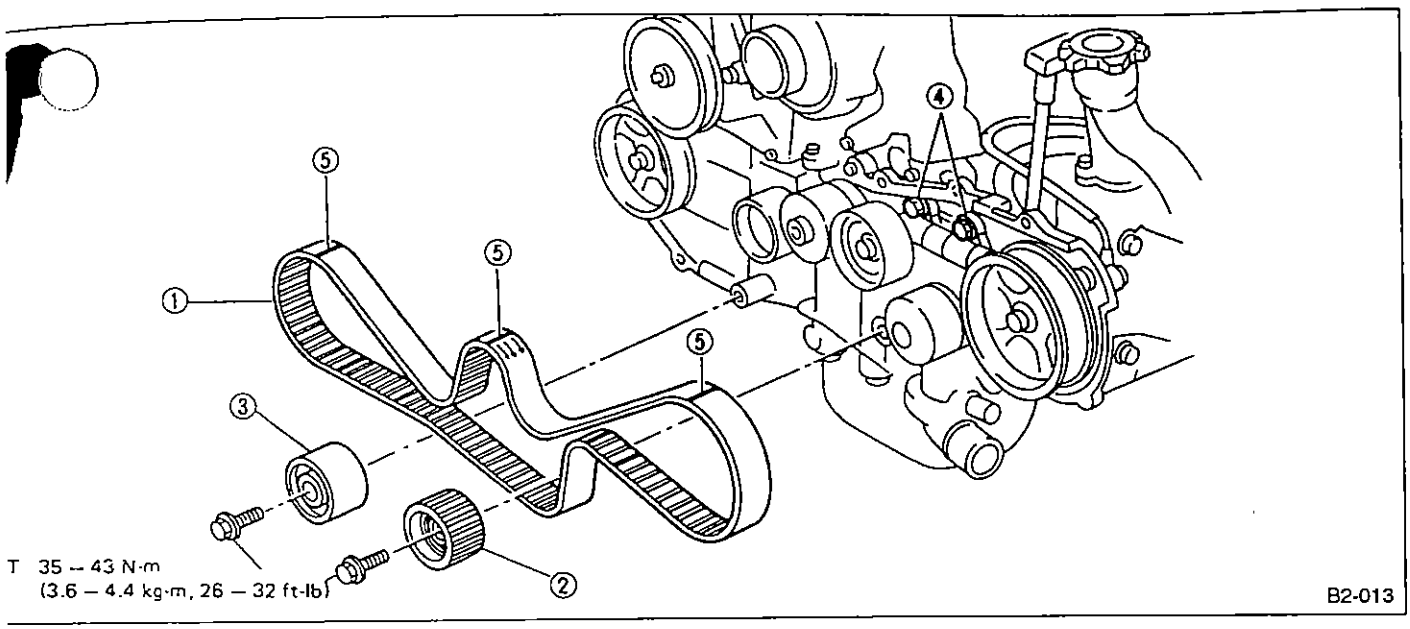


Fig. 31

1) Installation of timing belt.
   (1) Using SPROCKET WRENCH, turn sprockets so that their alignment marks come to top positions.

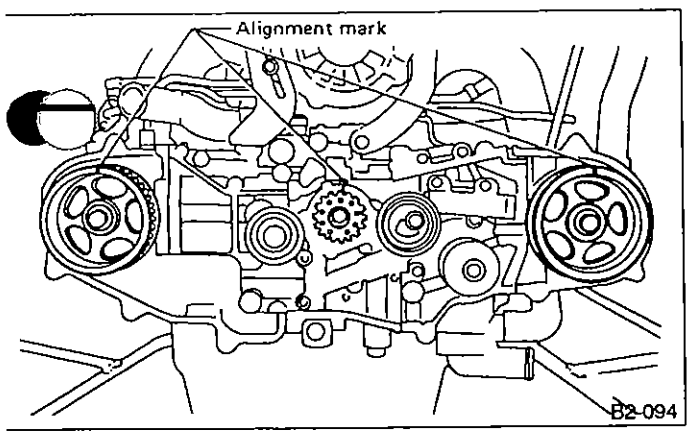


Fig. 32

   (2) While aligning alignment mark on timing belt with marks on sprockets, position timing belt properly.

Ensure belt's rotating direction is correct.

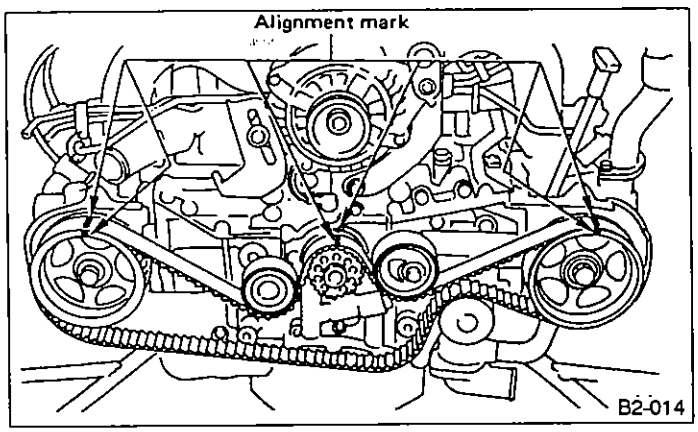


Fig. 33

2) Install belt idler No. 2.
3) Install belt idler.
4) Loosen tension adjuster attaching bolts and move adjuster all the way to the left. Tighten the bolts.

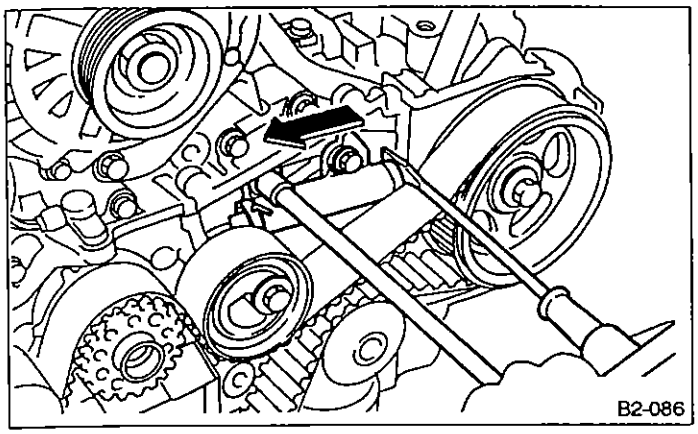


Fig. 34

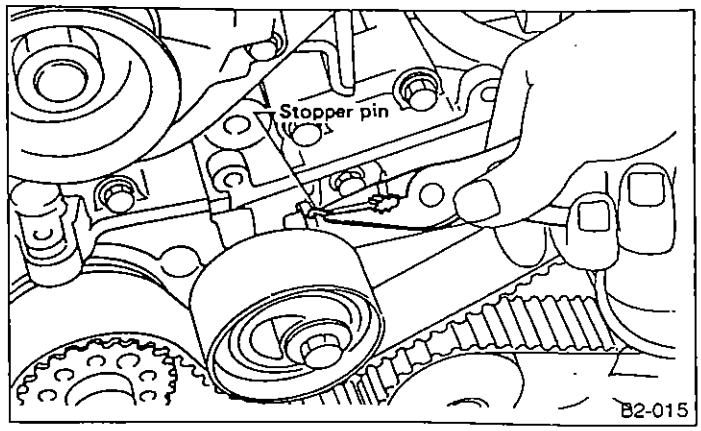


Fig. 35

5) After ensuring that the marks on timing belt and sprockets are aligned, remove stopper from tension adjuster.

After properly installing timing belt, remove rocker cover and ensure that the valve lash adjuster contains no air.

CRANKSHAFT PULLEY AND BELT COVER

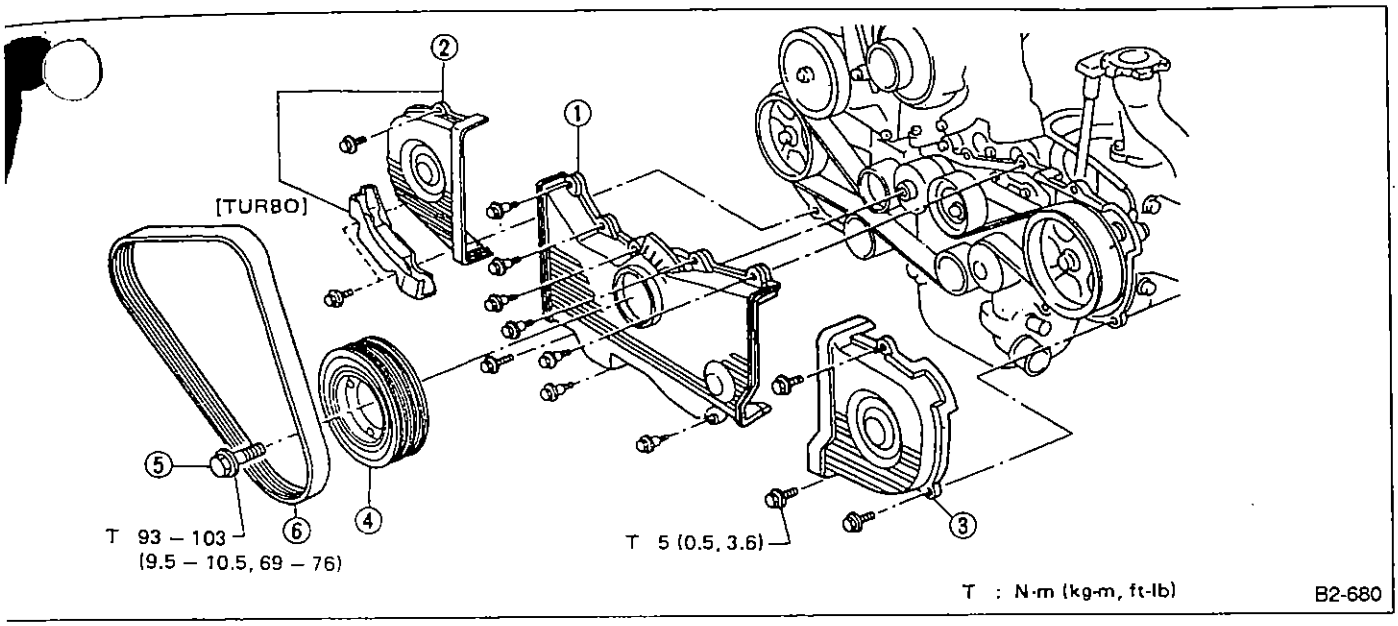


Fig. 36

) Install front belt cover.
) Install right-hand belt cover and plate CP-belt cover URBO).
) Install left-hand belt cover.

4) Install crankshaft pulley.
5) Install pulley bolt.
6) Install V-belt.

. Valve Rocker ASSY

A: REMOVAL

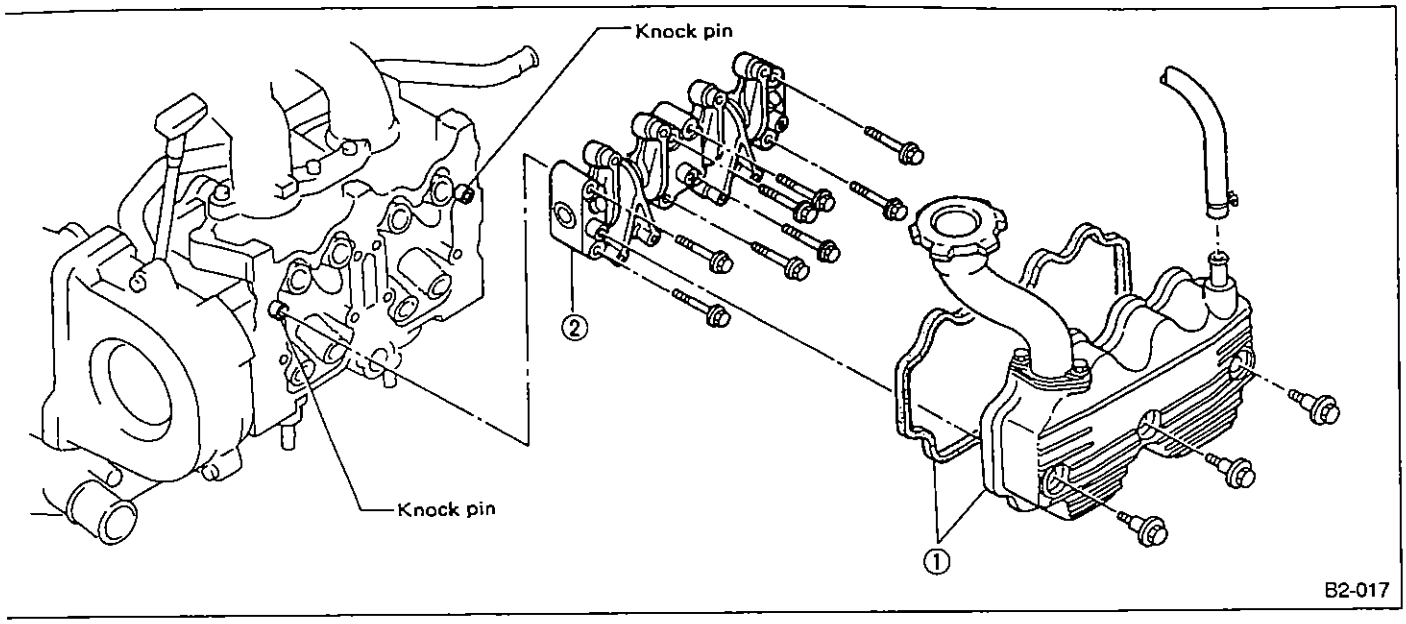


Fig. 37

) Disconnect PCV hose and remove rocker cover.
) Removal of valve rocker ASSY
(1) Remove bolts ②through ④in numerical sequence. See Figure.

.eave two or three threads of bolt ① engaged to retain 'alve rocker ASSY.

(2) Equally loosen bolts ⑤through ⑧all the way, being careful that dowel pin is not gouged.
(3) Remove valve rocker ASSY.

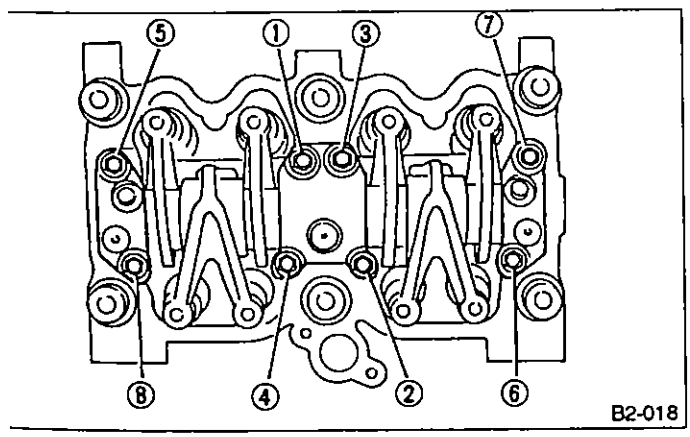


Fig. 38

Locate valve rocker ASSY with air vent (on rocker arm) facing upward or dip it in engine oil after removal. See Figure.

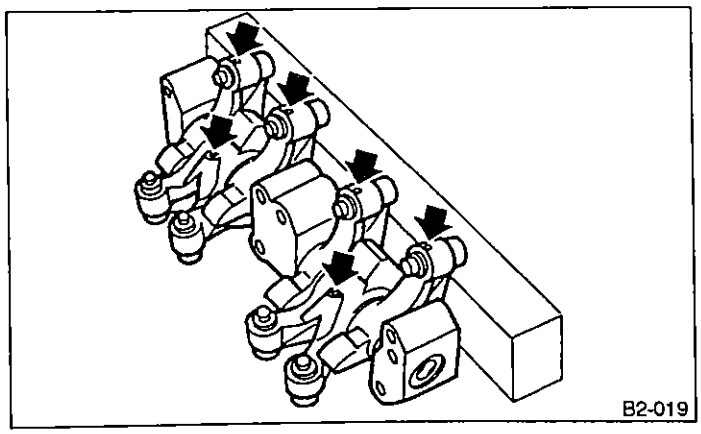


Fig. 39

B: DISASSEMBLY

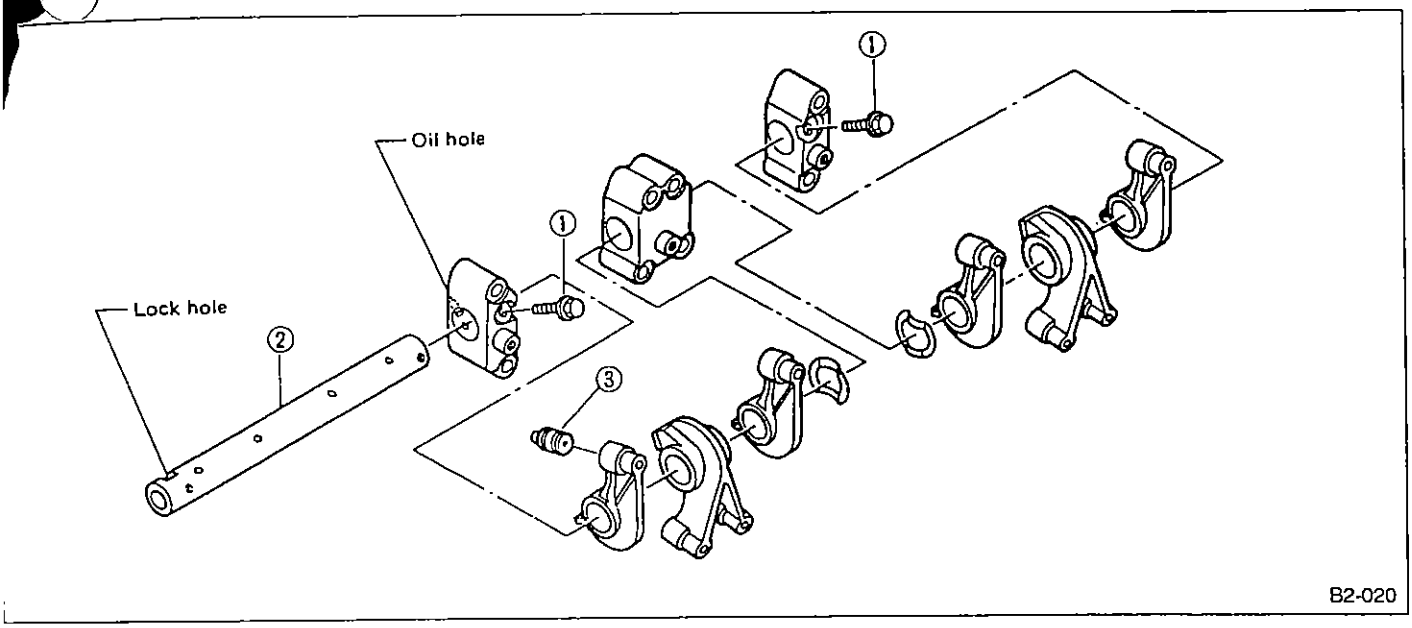


Fig. 40

1) Remove bolts which secure rocker shaft.
2) Extract rocker shaft. Remove valve rocker arms, springs and shaft supports from rocker shaft.
Arrange all removed parts in order so that they can be installed in their original positions.
Locate rocker arms with air vents facing upward.
3) Remove valve lash adjuster from valve rocker.
Do not remove valve lash adjuster unless it requires air bleeding or replacement.
If valve lash adjuster is hard to remove by hand, use pliers. Be careful not to scratch valve lash adjuster.
Dip lash adjuster in engine oil after removal.

C: INSPECTION

1. VALVE LASH ADJUSTER

1) Bleed air from valve lash adjuster as described below:
   (1) While dipping valve lash adjuster in engine oil, as shown in Figure, push check ball in using a 2 mm (0.08 in) dia. round bar.
   (2) With check ball pushed in, manually move plunger up and down at one-second intervals until air bubbles disappear.
   (3) After air bubbles disappear, remove round bar and quickly push plunger in to ensure it is locked. If plunger does not lock properly, replace valve lash adjuster.

Leave lash adjuster (after air is bled) in engine oil until it is ready for installation.

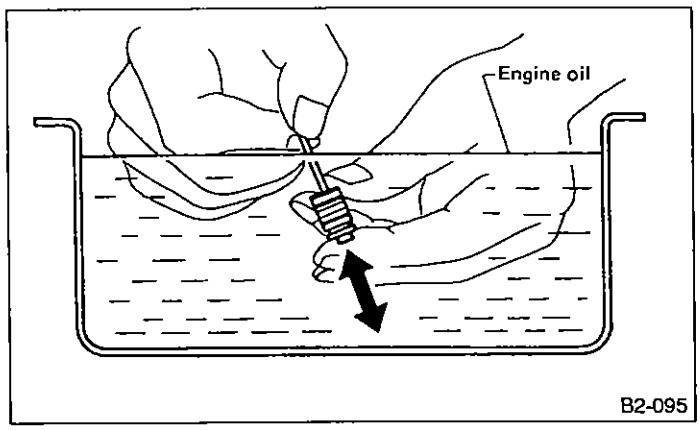


Fig. 41

2) Replace valve lash adjuster with a new one if valve contact surface is scratched.

2. VALVE ROCKER ARM

1) Measure inside diameter of valve rocker arm and outside diameter of valve rocker shaft, and determine the difference between the two (= oil clearance).

Clearance between arm and shaft:
Standard
0.020 — 0.081 mm (0.0008 — 0.0032 in)
Limit
0.10 mm (0.0039 in)

If oil clearance exceeds specifications, replace valve rocker arm or shaft.

Use the following table as a guide in determing a combination rocker shaft, rocker arm and support.

Rocker shaft	Rocker arm	Support
Mark A or (No mark)	Mark "—"	(No mark)
Mark B	Mark "+"	Mark B [Stamp 3mm dia.]

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

3. VALVE ROCKER SHAFT

Visually check oil relief valve of shaft end for any of the following abnormalities.

- Breaks in check ball body
- Foreign particles caught in valve spring
- Oil leaks at check ball

Repair or replace valve rocker shaft as necessary.

D: ASSEMBLY

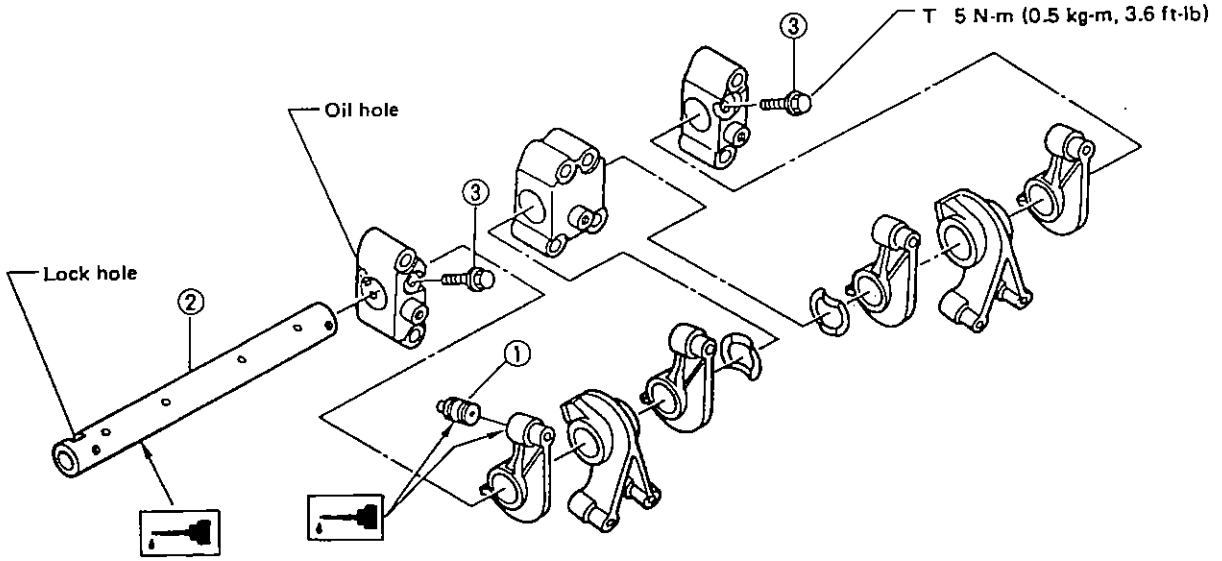


Fig. 42

1) After bleeding air from valve lash adjuster, position valve lash adjuster in valve rocker arm while dipping in engine oil. <Ref. to [W2C1]>

Fill rocker arm oil reservoir chamber with engine oil.

Install a new valve lash adjuster O-ring, being careful not to scratch it.

Do not attempt to rotate valve lash adjuster during installation.

2) Arrange valve rocker arms, springs and shaft supports in assembly order and insert valve rocker shaft. Ensure that cutout portion of rocker shaft faces oil holes in shaft supports.

Valve rocker arms, rocker shaft and shaft supports have identification marks. Ensure parts with same markings are properly assembled.

3) Install valve rocker shaft securing bolts while aligning shaft "lock" holes with bolts.

E: INSTALLATION

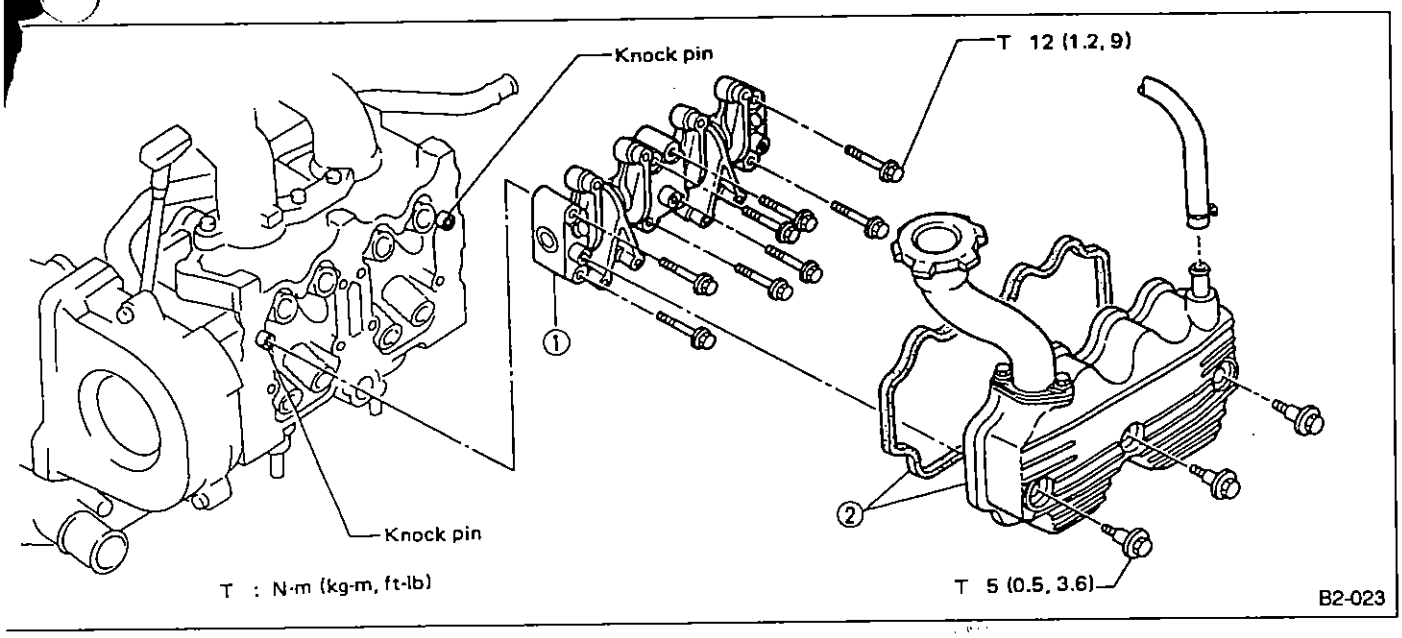


Fig. 43

) Installation of valve rocker ASSY
(1) Temporarily tighten bolts ①through ④equally (as shown in Figure. Do not allow valve rocker ASSY ge dowel pins.
(2) Tighten bolts ⑤through ⑧to specified torque.
(3) Tighten bolts ①through ④to specified torque.

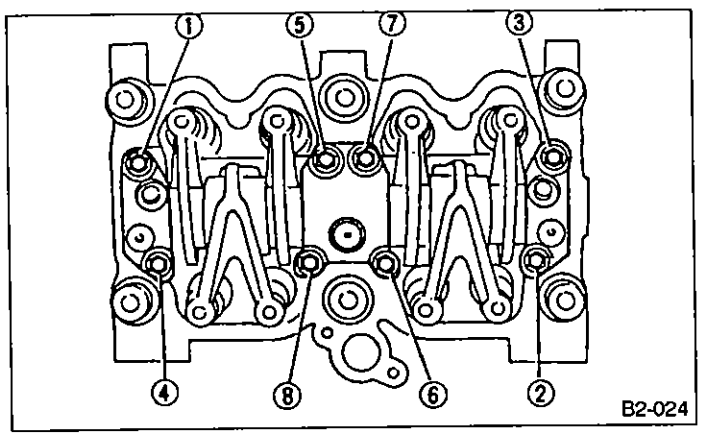


Fig. 44

2) Install rocker cover and connect PCV hose.

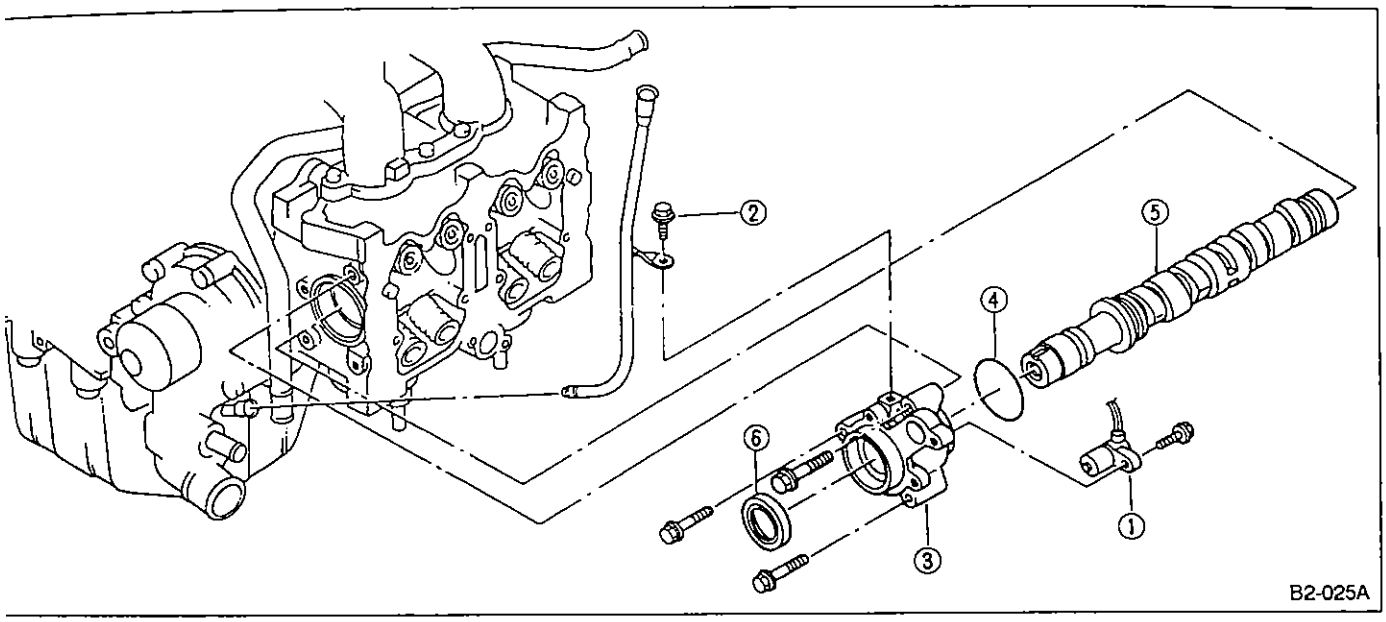
Camshaft

A: REMOVAL

1. RELATED PARTS

1) Remove timing belt, camshaft sprockets and related parts.
〈Ref. to 2. Timing Belt [W2A0].〉
2) Remove valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3A0].〉

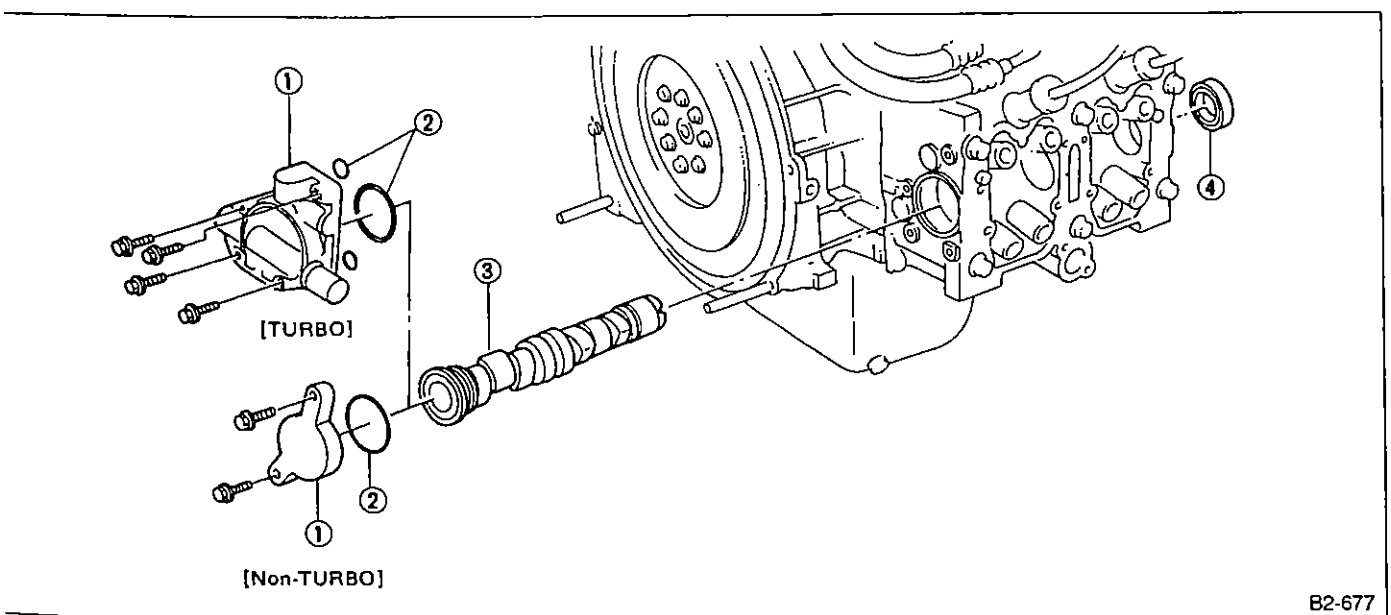
CAMSHAFT LH



ig. 45

Remove cam-angle sensor.
Remove oil level gauge guide attaching bolt.
Remove camshaft support LH.
Remove O-ring.
5) Remove camshaft LH.
6) Remove oil seal.
Do not remove oil seal unless necessary.

CAMSHAFT RH



ig. 46

1) Remove camshaft support RH.
2) Remove O-ring.
3) Remove camshaft.
4) Remove oil seal.
Do not remove oil seal unless necessary.

B: INSPECTION

1. CAMSHAFT

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

Limit:
0.025 mm (0.0010 in)

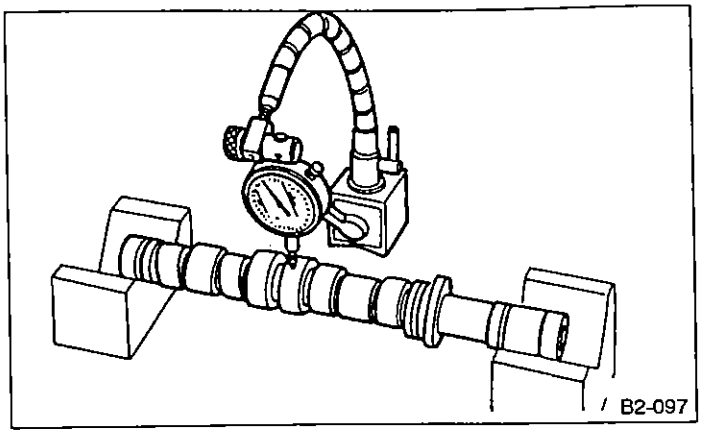


Fig. 47

2) Check journal for damage and wear. Replace if faulty.
3) Measure outside diameter of camshaft journal and inside diameter of cylinder head journal, and determine the difference between the two (= oil clearance). If oil clearance exceeds specifications, replace camshaft or cylinder head as necessary.

Unit: mm (in)

Item		Front	Center	Rear
	Right-hand camshaft	Front	Center	Rear
	Left-hand camshaft	Rear	Center	Front
Clearance at journal	Standard	0.055 — 0.090 (0.0022 — 0.0035)		
	Limit	0.10 (0.0039)		
Camshaft journal O.D.		31.935 — 31.950 (1.2573 — 1.2579)	37.435 — 37.450 (1.4738 — 1.4744)	37.935 — 37.950 (1.4935 — 1.4941)
Journal hole I.D.		32.005 — 32.025 (1.2600 — 1.2608)	37.505 — 37.525 (1.4766 — 1.4774)	38.005 — 38.025 (1.4963 — 1.4970)

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

Cam height: H
Standard
Non-TURBO
32.364 — 32.464 mm (1.2742 — 1.2781 in)
TURBO
32.286 — 32.386 mm (1.2711 — 1.2750 in)
Limit
Non-TURBO
32.11 mm (1.2642 in)
TURBO
32.04 mm (1.2614 in)

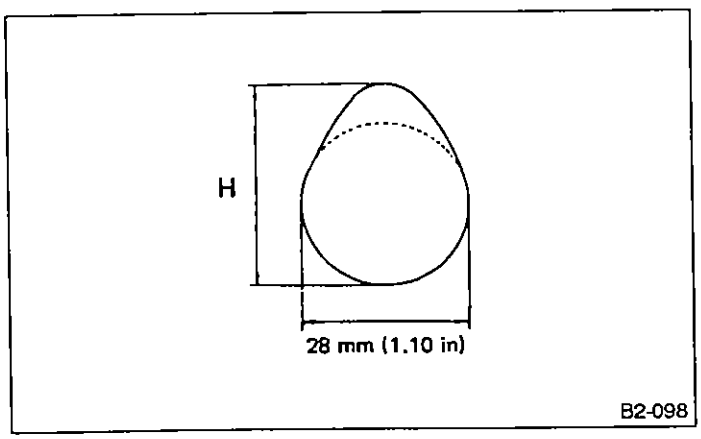


Fig. 48

2. CAMSHAFT SUPPORT

Measure the thrust clearance of camshaft with dial gauge. If the clearance exceeds the limit, replace camshaft support.

Standard:
0.03 — 0.26 mm (0.0012 — 0.0102 in)
Limit:
0.35 mm (0.0138 in)

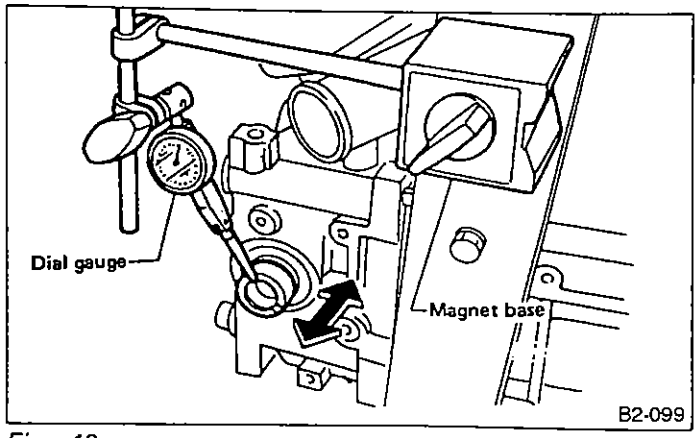


Fig. 49

C: INSTALLATION

SHAFT LH

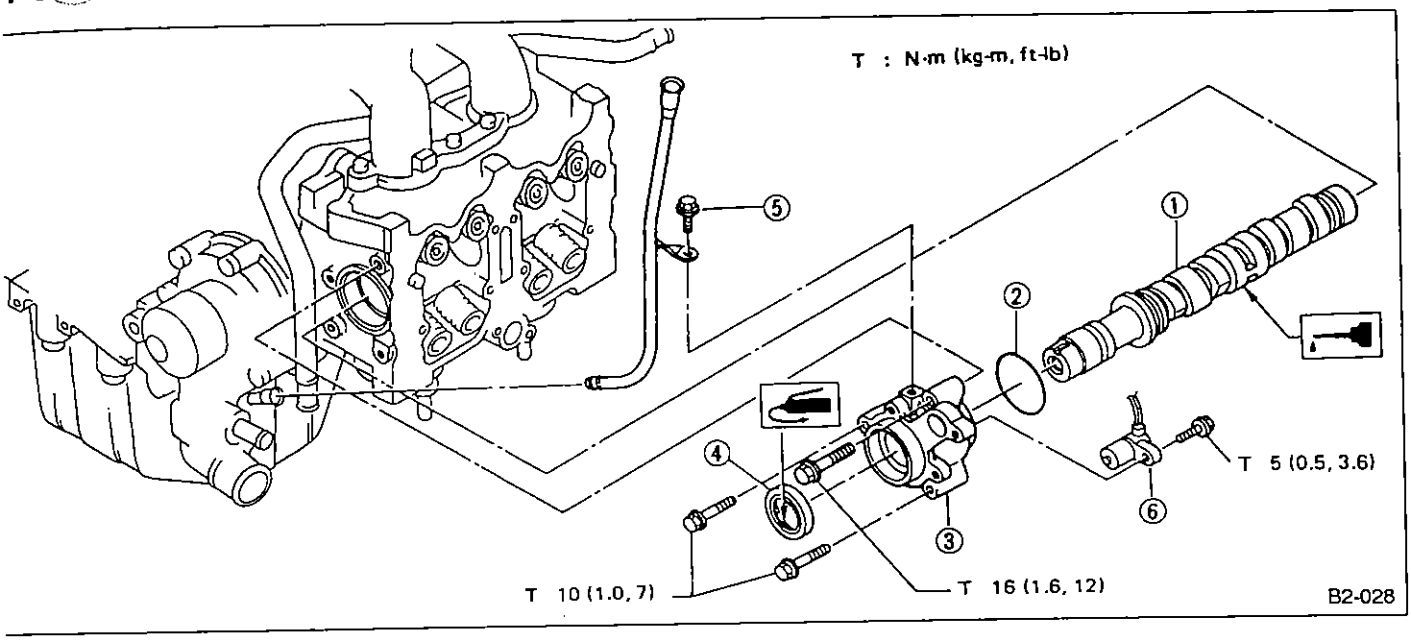


Fig. 50

1) Apply a coat of engine oil to camshaft journals and install camshaft LH.
2) Install O-ring to camshaft support.
3) Install camshaft support.
4) Apply a coat of grease to oil seal lips and install oil seal on camshaft support.
Use a new oil seal.

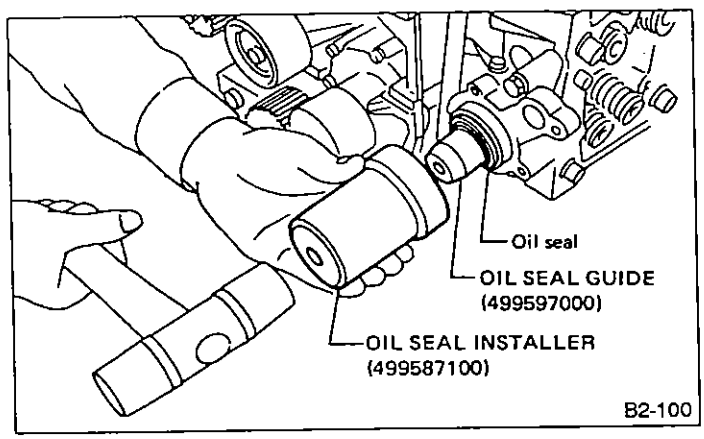


Fig. 51

5) Install oil level gauge guide bolt.
6) Install cam-angle sensor.

2. CAMSHAFT RH

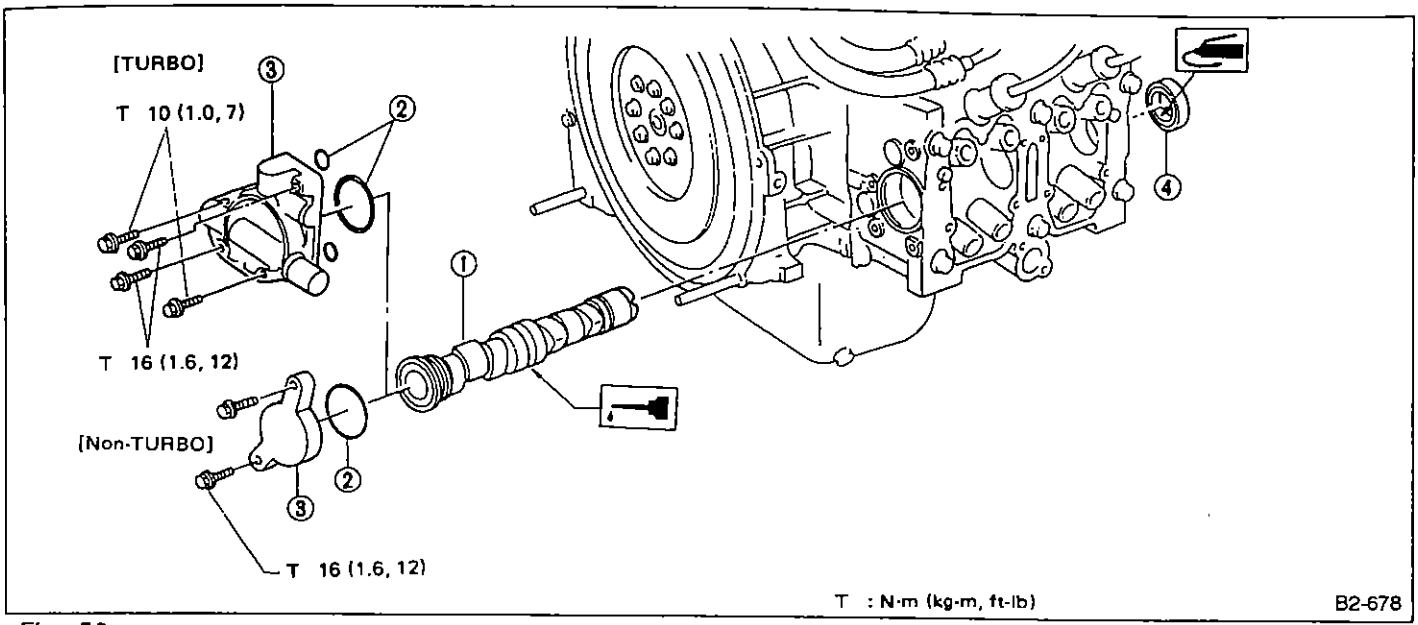


Fig. 52

1) Apply a coat of engine oil to camshaft journals and install camshaft RH.
2) Install O-ring to camshaft support.
3) Install camshaft support.
4) Install oil seal.

Use a new oil seal.

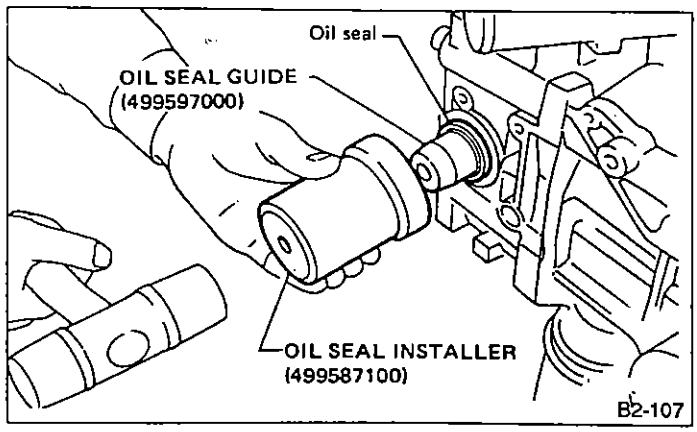


Fig. 53

3. RELATED PARTS

1) Install valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3E0].〉
2) Install timing belt, camshaft sprockets and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

5. Cylinder Head

REMOVAL

1. INTAKE MANIFOLD

1) Remove V-belt.
2) Remove power steering pump.
3) Remove alternator and bracket.
4) Remove cover.
5) Disconnect PCV hose.
6) Disconnect spark plug caps.
7) Remove Connector bracket attaching bolt.
8) Remove crank angle sensor and cam angle sensor.
9) Disconnect oil pressure switch connector.
10) Remove knock sensor.
11) Disconnect blow-by hose.
12) Remove intake manifold and gasket.
13) Remove water pipe.

2. CYLINDER HEAD

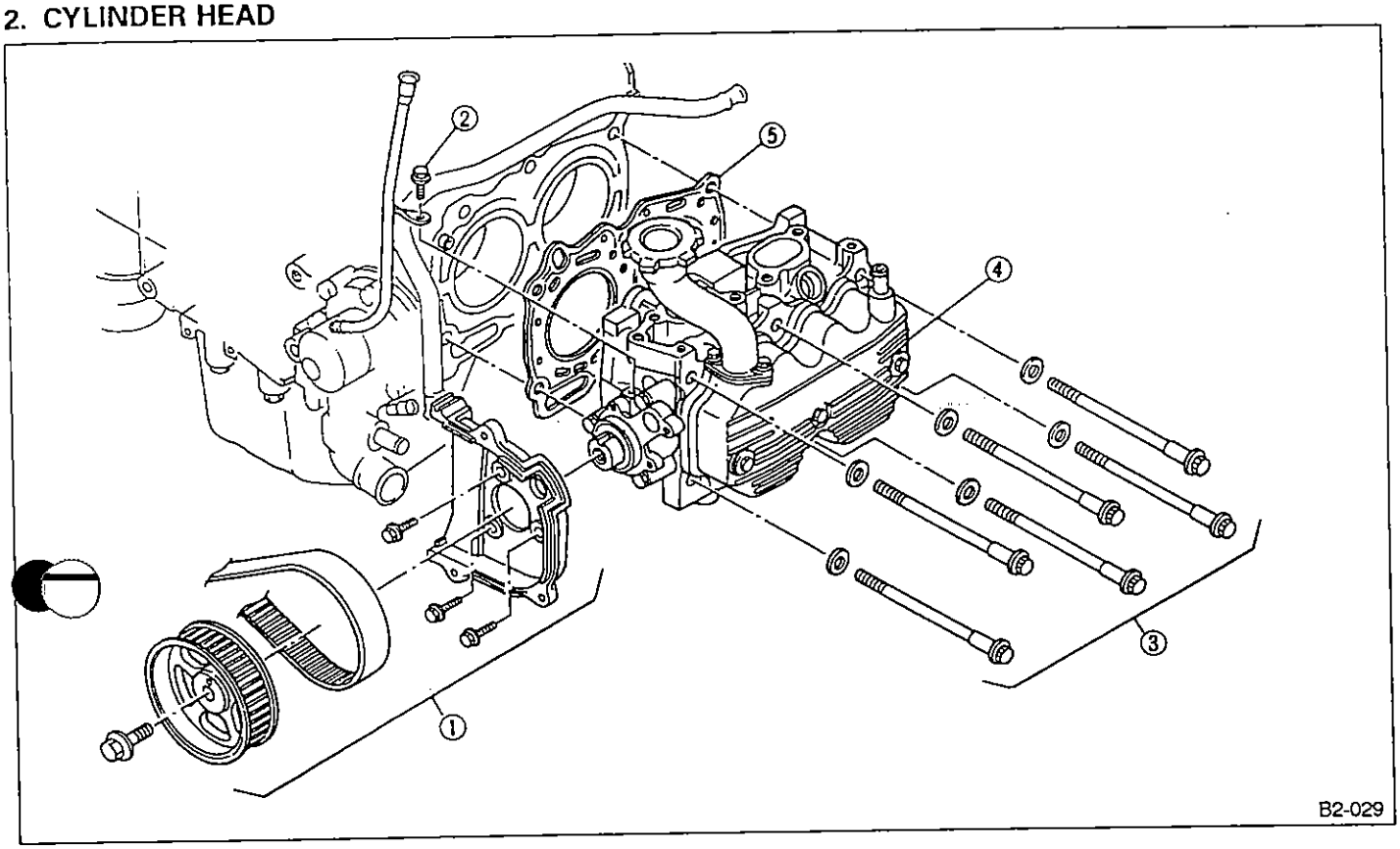


Fig. 54

1) Remove timing belt, camshaft sprocket and related parts.
(Ref. to 2. Timing Belt [W2A0].)
2) Remove oil level gauge guide attaching bolt (left hand only).
3) Remove cylinder head bolts in numerical sequence shown in Figure.
Leave bolts ① and ③ engaged by three or four threads to prevent cylinder head from falling.

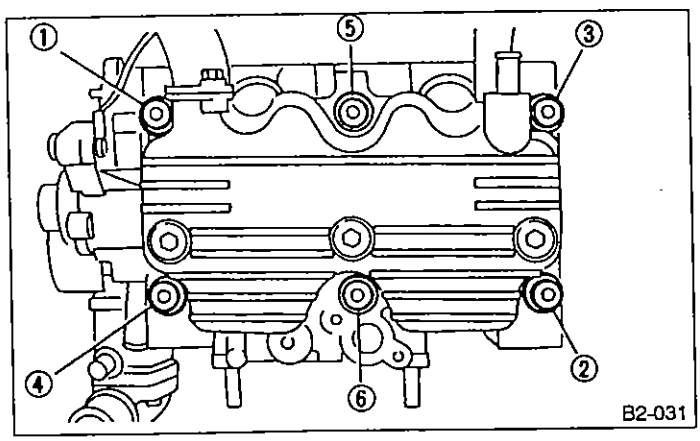


Fig. 55

4) While tapping cylinder head with a plastic hammer, separate it from cylinder block.
Remove bolts ① and ③ to remove cylinder head.
5) Remove cylinder head gasket.

6) Similarly, remove right-hand cylinder head.

B: DISASSEMBLY

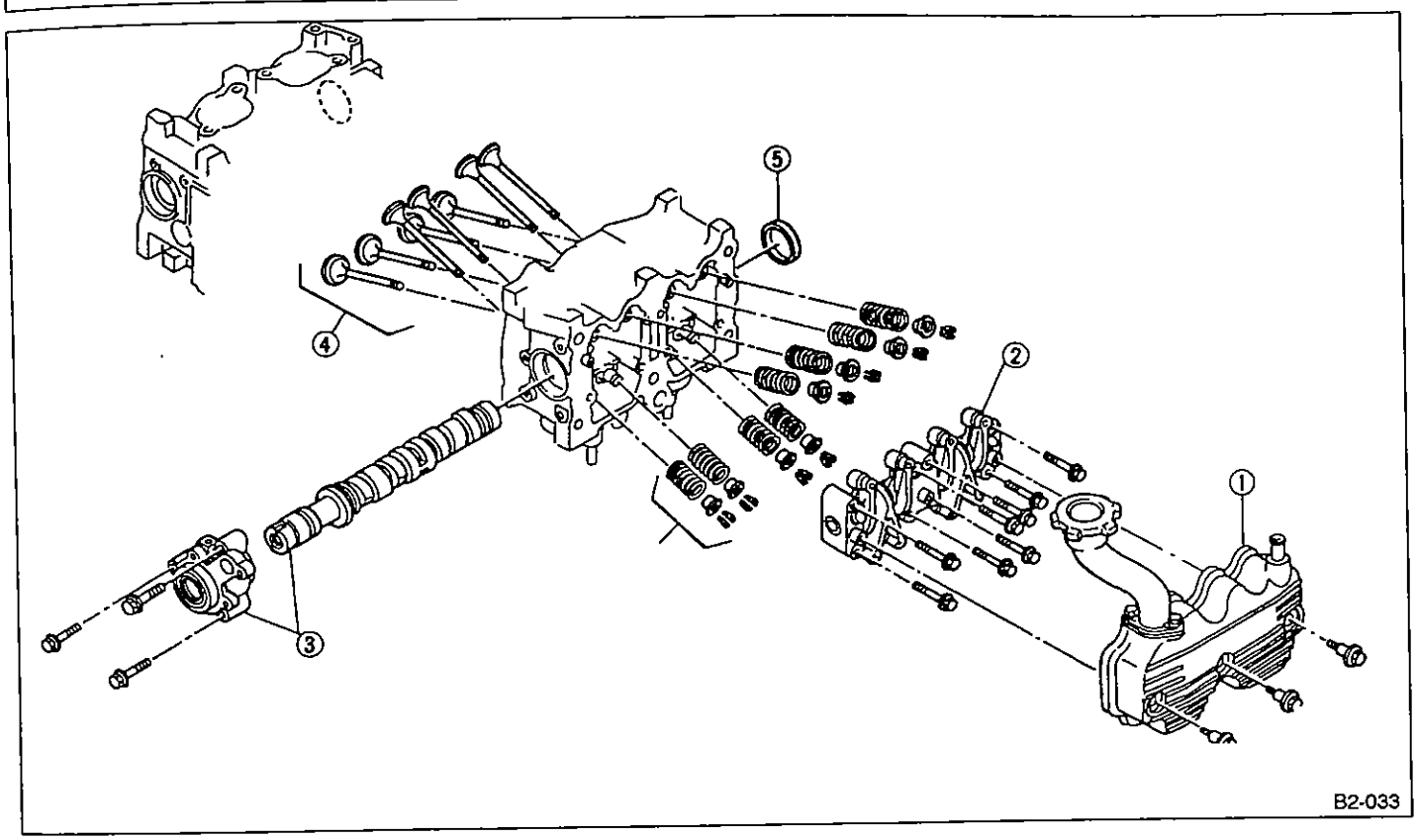


Fig. 56

1) Remove rocker cover.
2) Remove valve rocker ASSY.
⟨Ref. to 3. Valve Rocker ASSY [W3A0].⟩
3) Remove camshaft and support
⟨Ref. to 4. Camshaft [W4A0].⟩
4) 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.

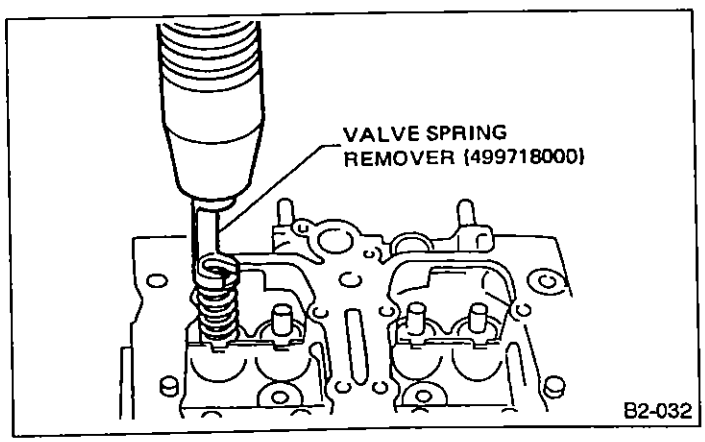


Fig. 57

5) Removal of plug (cylinder head LH).
Do not remove plug unless necessary.

C: INSPECTION

1. 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:
0.1 mm (0.004 in)
Standard height of cylinder head:
98.3 mm (3.870 in)

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

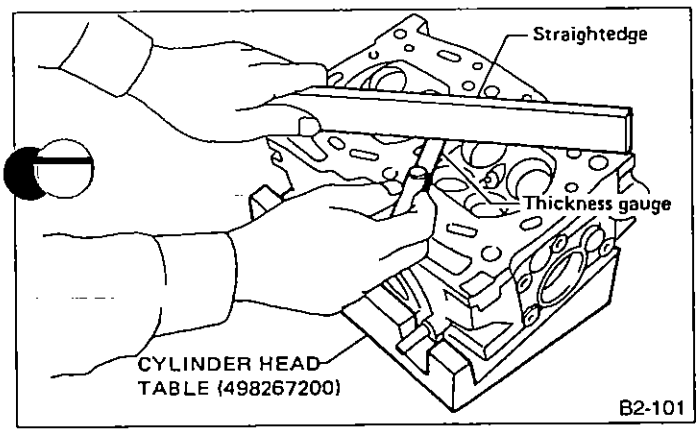


Fig. 58

2. VALVE SEAT

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
Standard
0.7 mm (0.028 in)
Limit
1.4 mm (0.055 in)
Exhaust
Standard
1.0 mm (0.039 in)
Limit
1.8 mm (0.071 in)

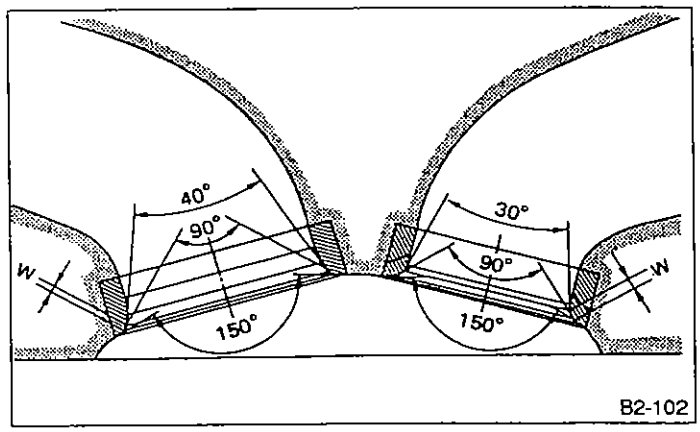


Fig. 59

3. 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.

Clearance between the valve guide and valve stem:
Standard
Intake
0.035 — 0.062 mm (0.0014 — 0.0024 in)
Exhaust
0.040 — 0.067 mm (0.0016 — 0.0026 in)
Limit
0.15 mm (0.0059 in)
Valve guide inner diameters:
6.00 — 6.012 mm (0.2362 — 0.2367 in)
Valve stem outer diameter:
Intake
5.950 — 5.965 mm (0.2343 — 0.2348 in)
Exhaust
5.945 — 5.960 mm (0.2341 — 0.2346 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.

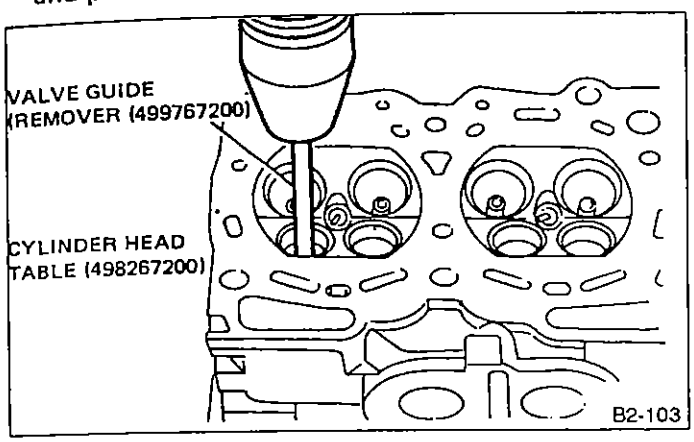


Fig. 60

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

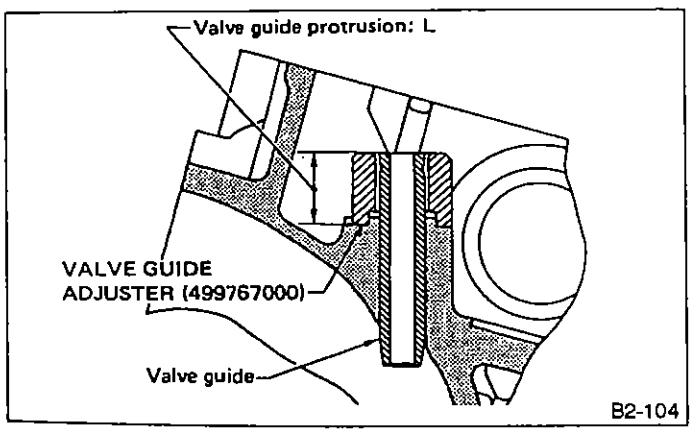


Fig. 61

(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.

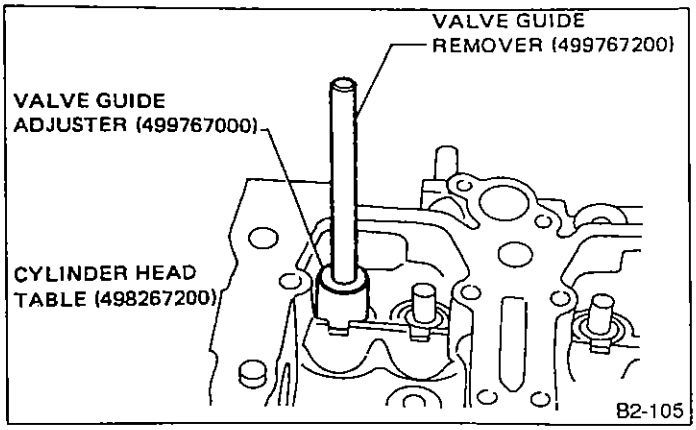


Fig. 62

(6) Check the valve guide protrusion.

Valve guide protrusion: L
17.5 — 18.0 mm (0.689 — 0.709 in)

(7) Ream the inside of valve guide with VALVE GUIDE REAMER (499767400). 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.

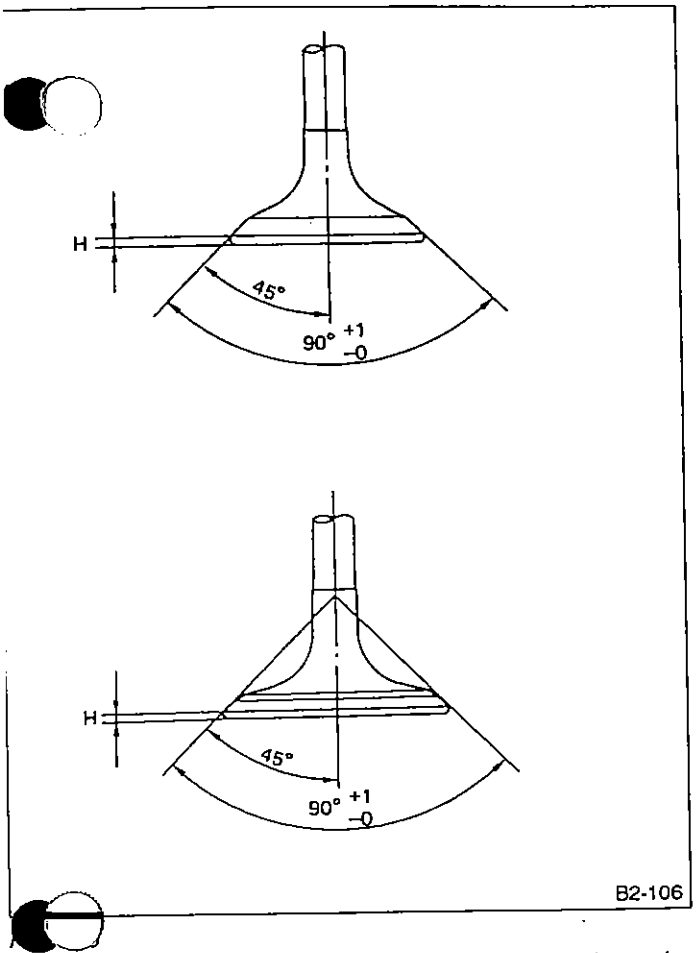
a. Apply engine oil to the reamer when reaming.
b. If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
c. If the inner surface of the valve guide becomes lustrous and the reamer does not chips, use a new reamer or remedy the reamer.

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

4. 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:
Intake
Standard
1.0 mm (0.039 in)
Limit
0.8 mm (0.031 in)
Exhaust
Standard
1.2 mm (0.047 in)
Limit
0.8 mm (0.031 in)
Valve overall length:
Intake 101.0 mm (3.976 in)
Exhaust 101.2 mm (3.984 in)



2) 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.

5. 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.

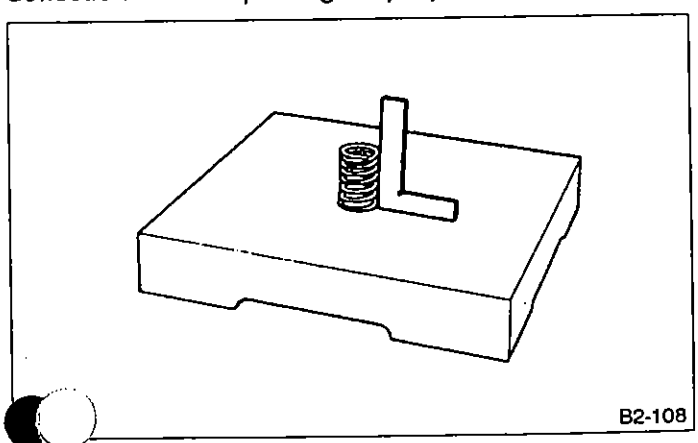


Fig. 64

	Valve spring
Free length	46.16 mm (1.8173 in)
Tension/spring height	190.3 — 219.7 N (19.4 — 22.4 kg, 42.8 — 49.4 lb)/ 37.0 mm (1.457 in)
	401.1 — 461.9 N (40.9 — 47.1 kg, 90.2 — 103.9 lb)/ 29.2 mm (1.150 in)
Squareness	2.5°, 2.0 mm (0.079 in)

6. INTAKE AND EXHAUST VALVE OIL SEAL

Replace oil seal with new one, if lip is damaged or spring 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 VALVE OIL SEAL GUIDE.

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 color.

Color of rubber part:
Intake [Black]
Exhaust [Brown]
Color of spring part:
Intake [White]
Exhaust [White]

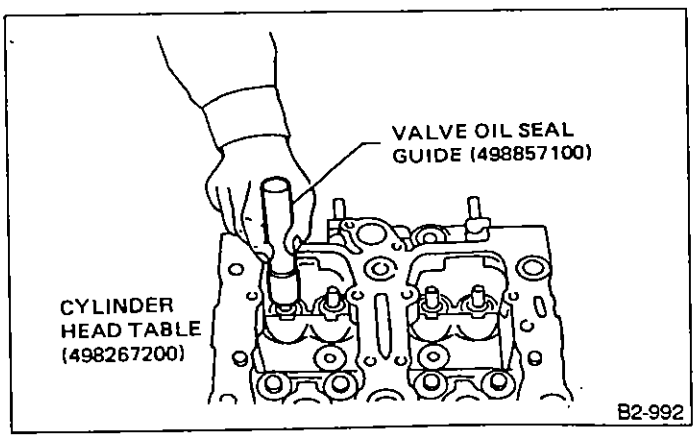


Fig. 65

D: ASSEMBLY

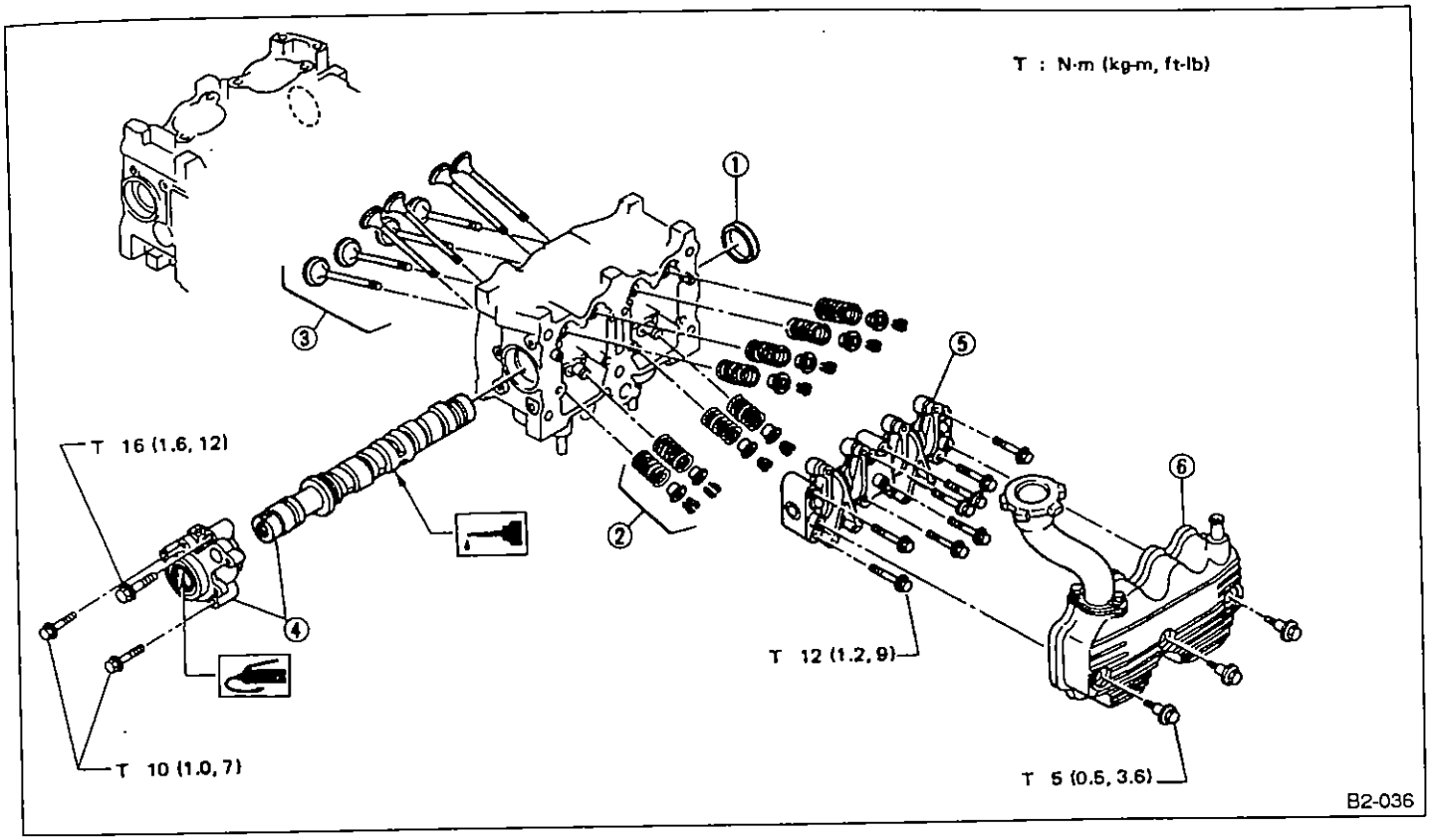


Fig. 66

1) Install plug (cylinder head LH).

Special tool:
OIL SEAL INSTALLER (499587100)

2) Installation of valve spring and valve.
(1) Coat stem of each valve with engine oil and insert valve into valve guide.

When inserting valve into valve guide, use special care not to damage the oil seal lip.

(2) Install valve spring and retainer.

Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

(3) Compress valve spring and fit valve spring retainer key.

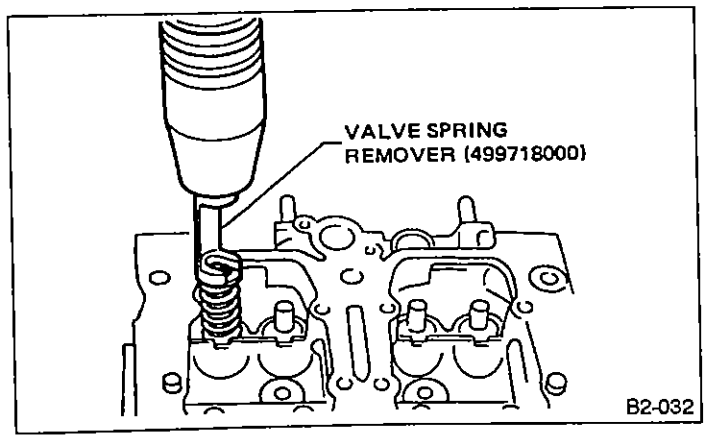


Fig. 67

(4) After installing, tap valve spring retainers lightly with wooden hammer for better seating.

3) Install camshaft and support.
〈Ref. to 4. Camshaft [W4C0].〉
4) Install valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3E0].〉
5) Install rocker cover.

E: INSTALLATION

NDER HEAD

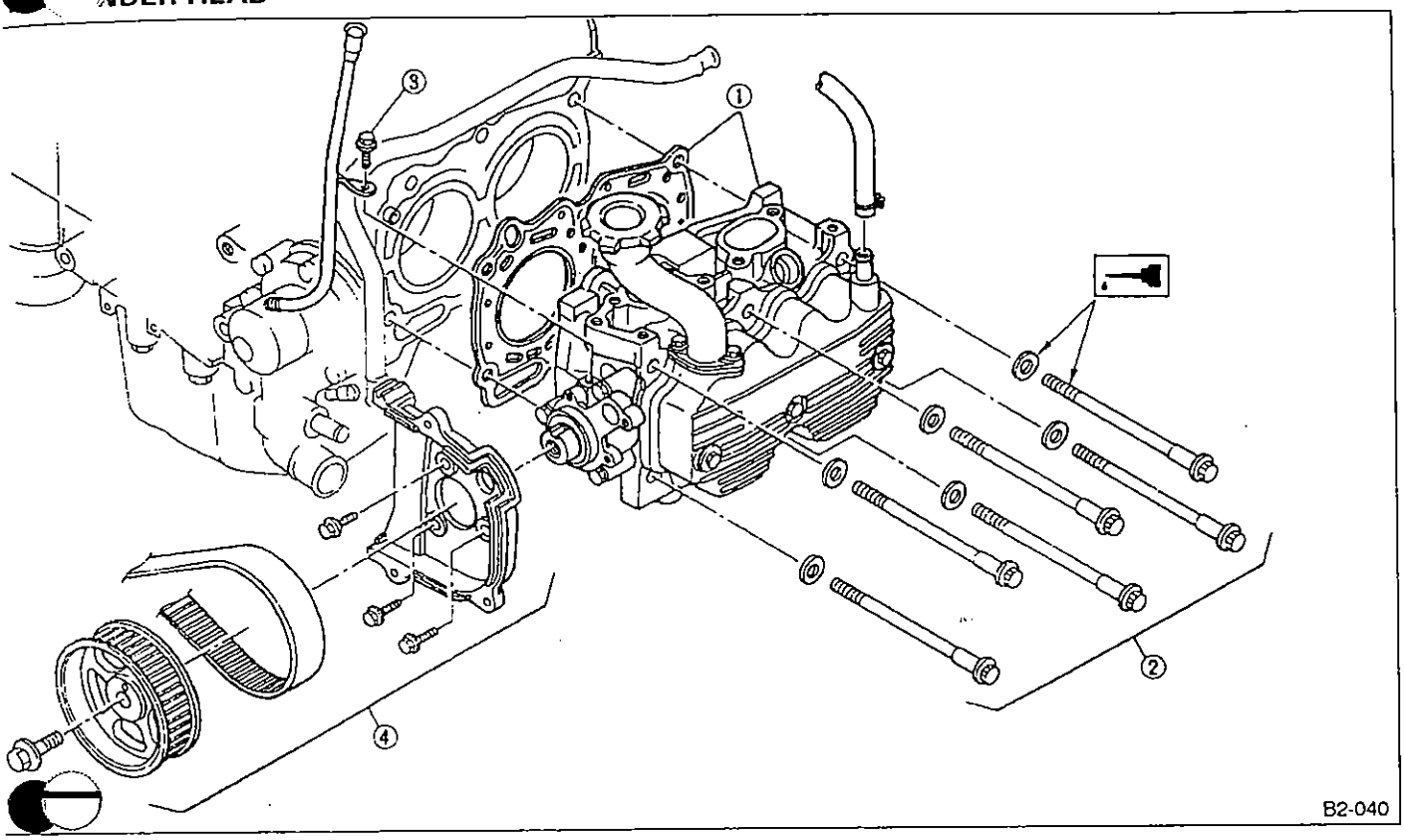


Fig. 68

1) Install cylinder head and gaskets on cylinder block.
Use new cylinder head gaskets.
2)Tighten cylinder head bolts.
(1) Apply a coat of engine oil to washers and bolt threads.
(2) Tighten all bolts to 29 N•m (3.0 kg-m, 22 ft-lb) in numerical order shown in Figure 29.
Then tighten all bolts to 69 N•m (7.0 kg-m, 51 ft-lb) in numerical order.
(3) Back off all bolts by 180° first; back them off by 180° again.
(4) Tighten bolts ① and ② for non-TURBO engines to 34 N•m (3.5 kg-m, 25 ft-lb) and those for TURBO engines to 36.8 N•m (3.75 kg-m, 27.1 ft-lb).
(5) Tighten bolts ③, ④, ⑤ and ⑥ for non-TURBO engines to 15 N•m (1.5 kg-m, 11 ft-lb) and those for TURBO engines to 20 N•m (2.0 kg-m, 14 ft-lb).
(6) Tighten all bolts by 80 to 90° in numerical sequence.
Do not tighten bolts more than 90°.
(7) Further tighten all bolts by 80 to 90° in numerical sequence.
Make sure that the total "re-tightening angle" [steps (6) and (7) above] do not exceed 180°.

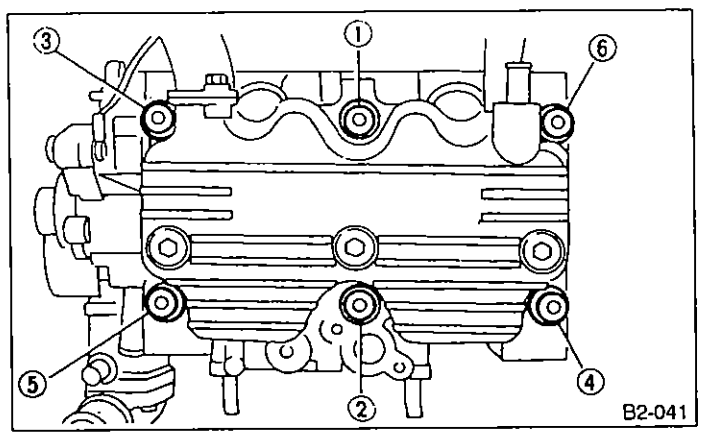


Fig. 69

3) Install oil level gauge guide attaching bolt (left hand only).
4) Install timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

2. INTAKE MANIFOLD

1) Install water pipe.

Use dry compressed air to remove foreign particles before installing sensors.

2) Install intake manifold.

Use dry compressed air to remove foreign particles before installing sensors.

3) Connect blow-by hose.
4) Install knock sensor.
5) Connect oil pressure switch connector.
6) Install crank angle sensor and cam angle sensor.

Use dry compressed air to remove foreign particles before installing sensors.

7) Install connector bracket attaching bolt.
8) Connect spark plug caps.
9) Connect PCV hose.
10) Install cover.
11) Install alternator and bracket.
12) Install power steering pump.
13) Install V-belt.
14) Remove ENGINE STAND.
15) Install exhaust manifolds and turbo joint pipe. (TURBO)
16) Install turbocharger. (TURBO)
17) Connect water hose, oil pipe and vacuum hose. (TURBO)

6. Cylinder Block

REMOVAL

1. RELATED PARTS

1) Remove timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2A0].〉
2) Remove intake manifold and cylinder head.
〈Ref. to 5. Cylinder Head [W5A0].〉

2. OIL PUMP AND WATER PUMP

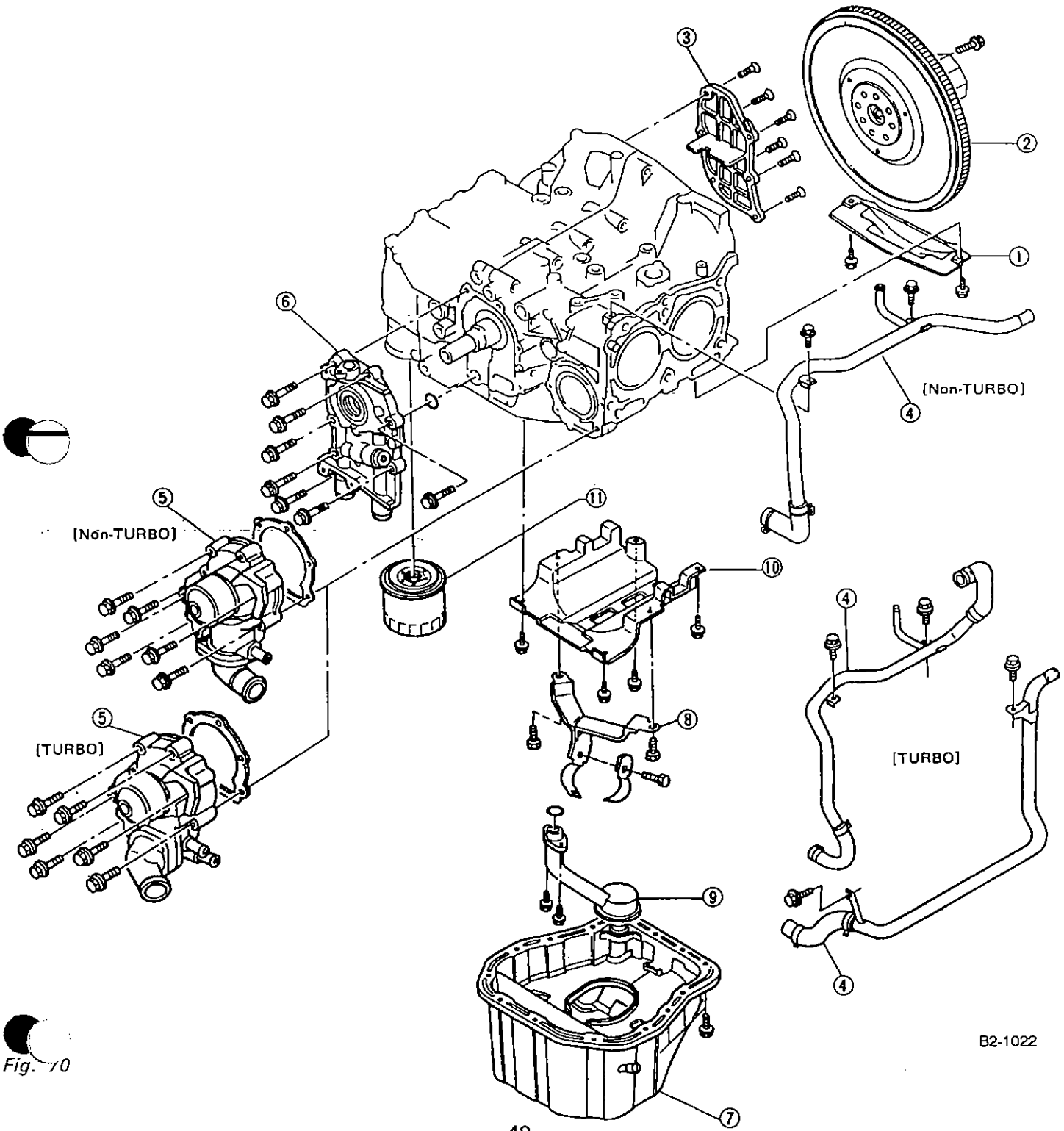


Fig. 70

1) Remove housing cover.
2) Remove flywheel or drive plate.

To lock crankshaft, use CRANKSHAFT STOPPER.

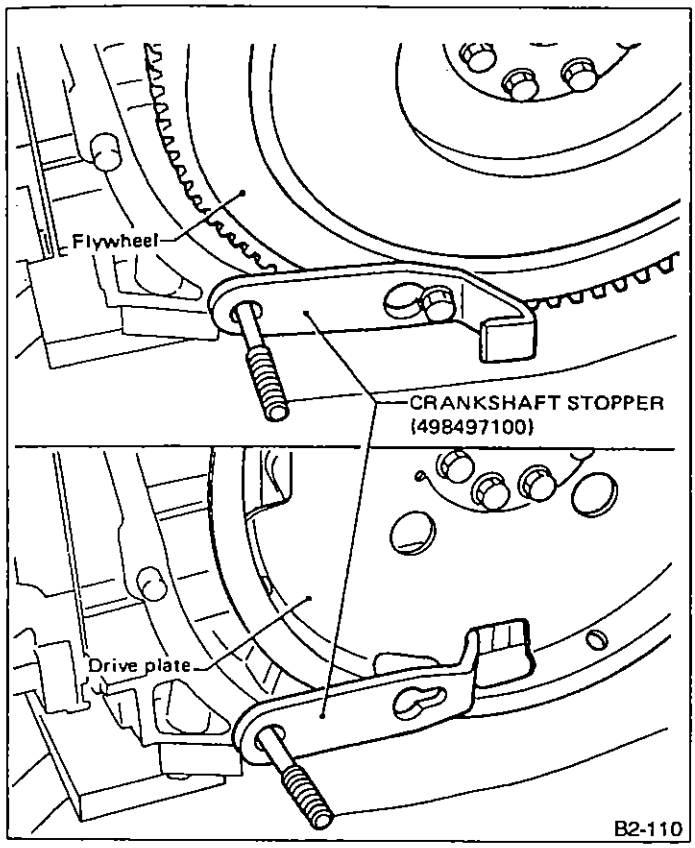


Fig. 71

3) Remove oil separator cover.
4) Remove water pipes.
5) Remove water pump.
6) Remove oil pump from cylinder block.

Use a standard screwdriver as shown in Figure when removing oil pump.

Be careful not to scratch the mating surface of cylinder block and oil pump.

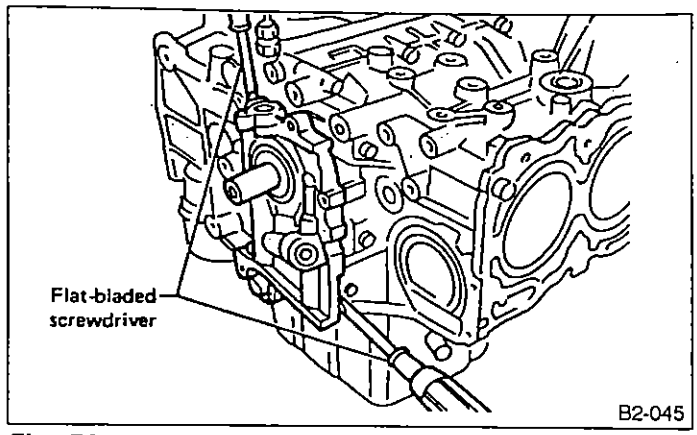


Fig. 72

7) Removal of oil pan.
   (1) Turn cylinder block with #2 and #4 piston sides facing upward.
   (2) Remove bolts which secure oil pan to cylinder block.
   (3) Insert a oil-pan cutter blade between cylinder block-to-oil pan clearance and remove oil pan.

Do not use a screwdriver or similar tool in place of oil-pan cutter blade.

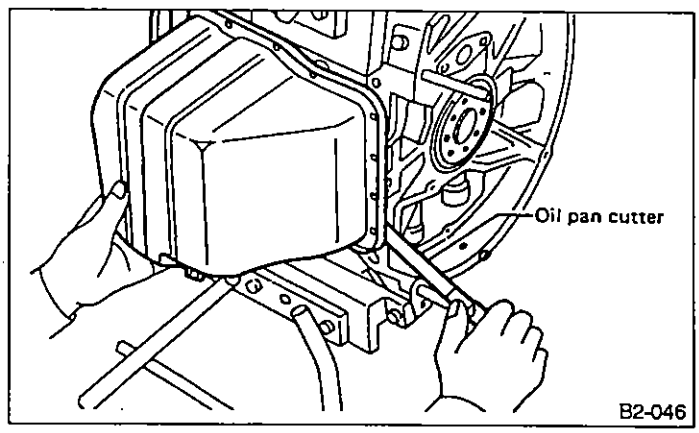


Fig. 73

8) Remove oil strainer stay.
9) Remove oil strainer.
10) Remove baffle plate.
11) Remove oil filter.

B: DISASSEMBLY

PISTON PIN AND CYLINDER BLOCK CONNECTING BOLT

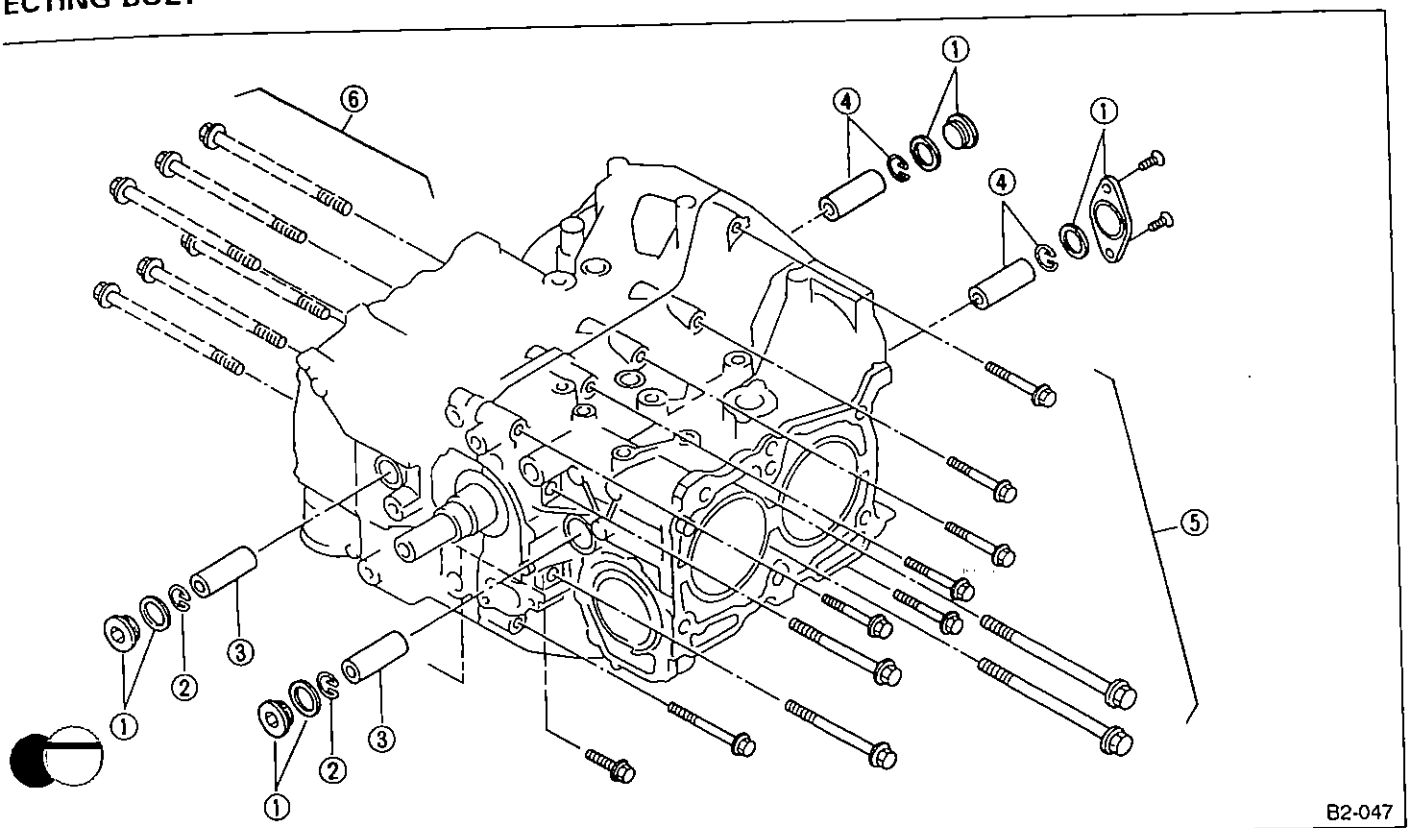


Fig. 74

1) Remove service hole cover and service hole plugs using hexagon wrench (14 mm).
2) Rotate crankshaft to bring #1 and #2 pistons to BDC position, then remove piston circlip through service hole of #1 and #2 cylinders.

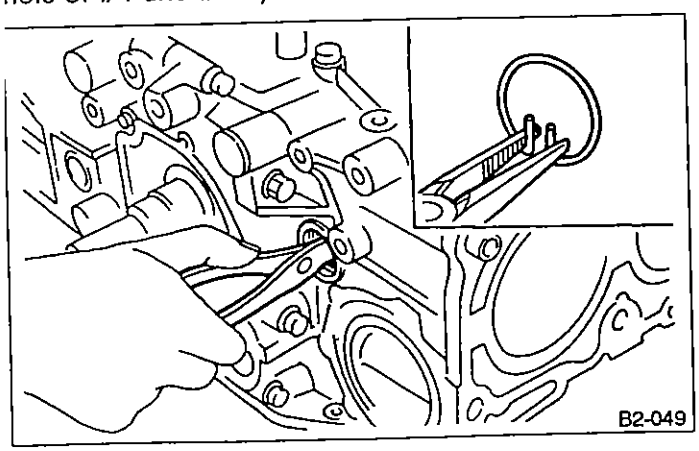


Fig. 75

3) Draw out piston pin from #1 and #2 pistons.

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

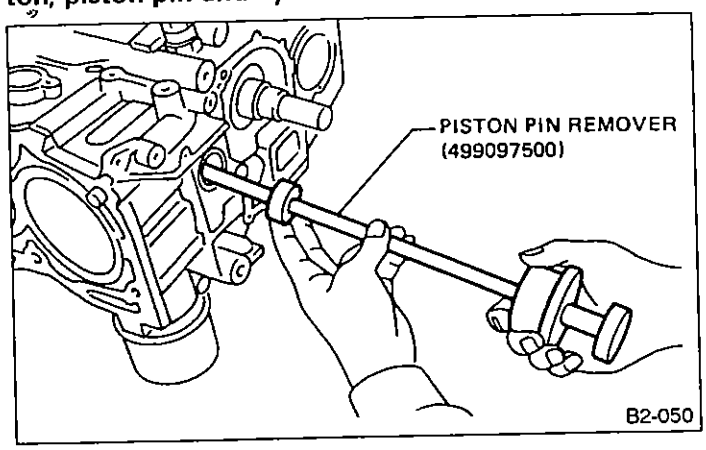


Fig. 76

4) Similarly remove piston pins from #3 and #4 pistons.
5) Remove bolts which connect cylinder block on the side of #2 and #4 cylinders.
6) Back off bolts which connect cylinder block on the side of #1 and #3 cylinders two or three turns.

2. CYLINDER BLOCK

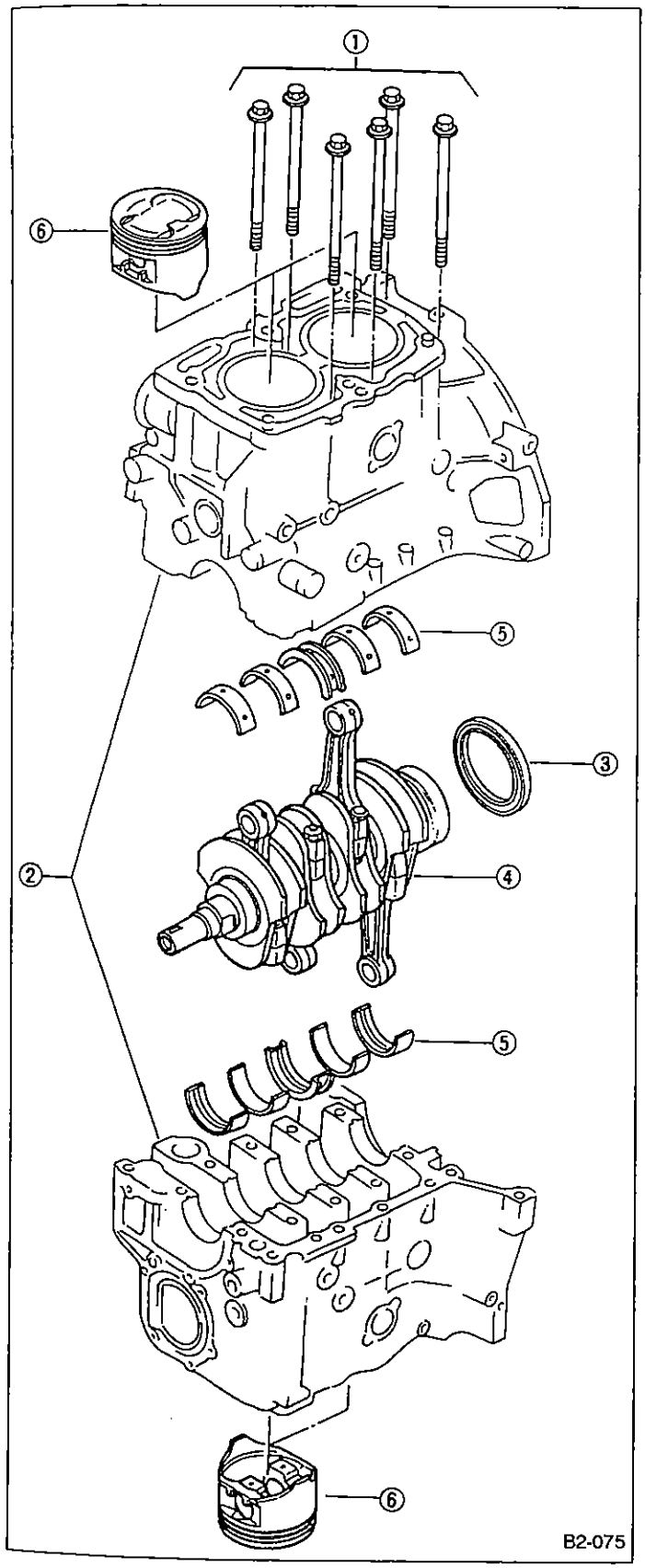


Fig. 77

1) Set up cylinder block so that #1 and #3 cylinders are on the upper side, then remove cylinder block connecting bolts.
2) 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.
3) Remove rear oil seal.
4) Remove crankshaft together with connecting rod.
5) Remove crankshaft bearings from cylinder block using hammer handle.
Do not confuse combination of crankshaft bearings. Press bearing at the end opposite to locking lip.
6) Draw out each piston from cylinder block using wooden bar or hammer handle.
Do not confuse combination of piston and cylinder.

3. CRANKSHAFT AND PISTON

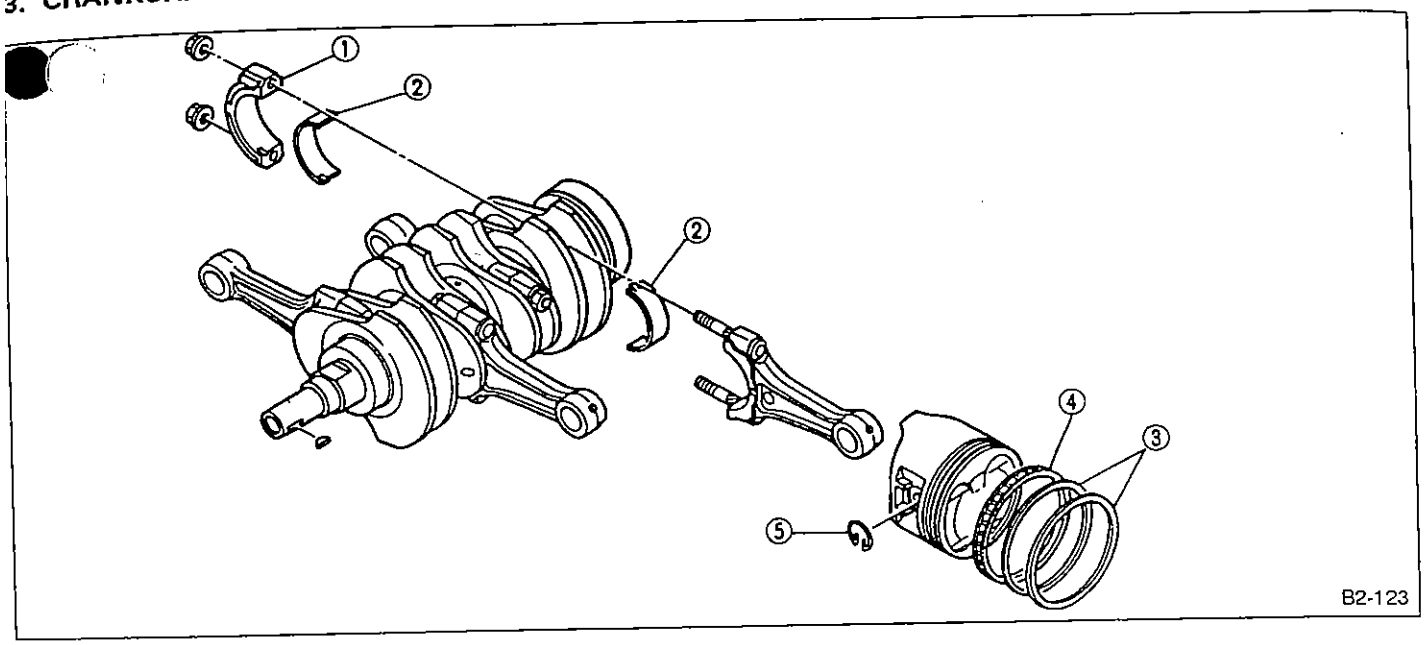


Fig. 78

1) Remove connecting rod cap.
2) Remove connecting rod bearing.

Arrange removed connecting rod, connecting rod cap and bearing in order to prevent confusion.

3) Remove the piston rings using the piston ring expander.
4) Remove the oil ring by hand.

Arrange the removed piston rings in good order to prevent confusion.

5) Remove circlip.

C: INSPECTION

1. CYLINDER BLOCK

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 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:
0.1 mm (0.004 in)

2. CYLINDER AND PISTON

1) The cylinder bore size is stamped on the cylinder block's front upper surface.
2) Standard sized pistons are classified into three grades, "A", "B" and "C". These grades should be used as a guideline in selecting a standard piston.

(2) When piston is to be replaced due to general or cylinder wear, determine a suitable sized piston by measuring the piston clearance.

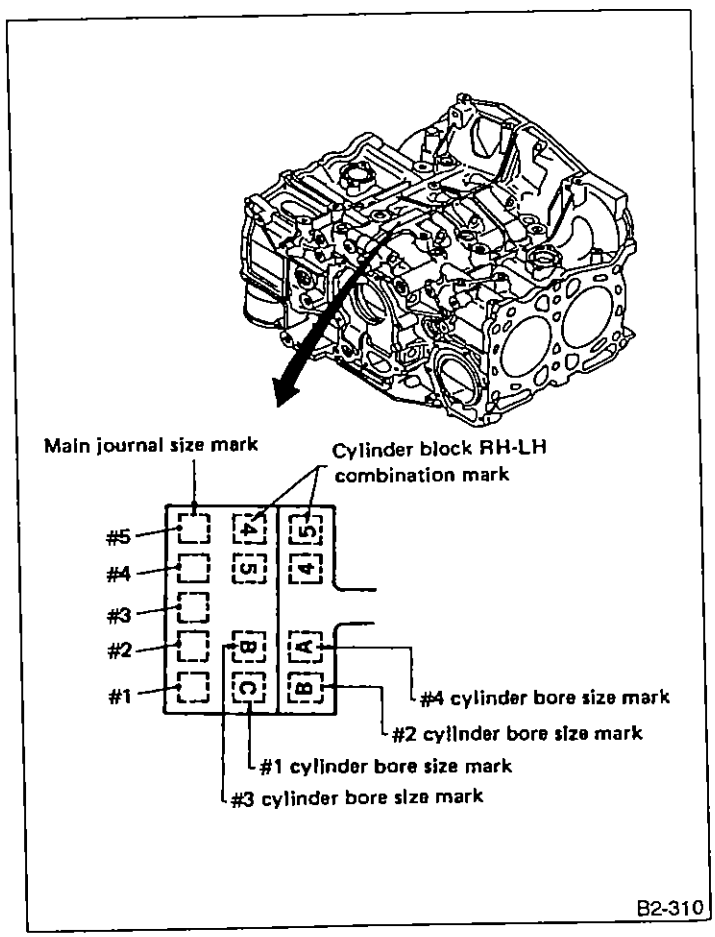


Fig. 79

(3) Proper combination of pistons and cylinders

Cylinder		Piston		Piston clearance 20°C (68° F)
Bore size symbol	Cylinder bore dia.	Piston grade symbol	Standard piston dia.	
A	96.905 — 96.915 mm (3.8151 — 3.8155 in)	A	96.885 — 96.895 mm (3.8144 — 3.8148 in)	0.01 — 0.03 mm (0.0004 — 0.0012 in)
B	96.895 —96.905 mm (3.8148 — 3.8151 in)	B	96.875 — 96.885 mm (3.8140 — 3.8144 in)	
C	96.885 — 96.895 mm (3.8144 — 3.8148 in)	C	96.865 — 96.875 mm (3.8136 — 3.8140 in)	

2) 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 20°C (68°F).

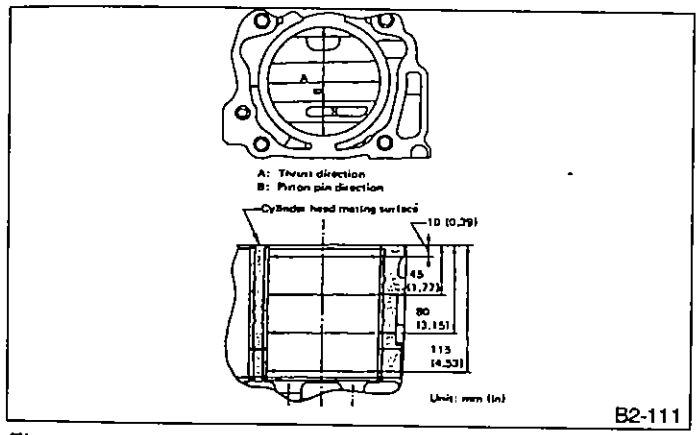


Fig. 80

Taper:
Standard
0.015 mm (0.0006 in)
Limit
0.050 mm (0.0020 in)
Out-of-roundness:
Standard
0.010 mm (0.0004 in)
Limit
0.050 mm (0.0020 in)
Cylinder to piston clearance at 20°C (68°F):
Standard
0.010 — 0.030 mm (0.0004 — 0.0012 in)
Limit
0.060 mm (0.0024 in)
Standard diameter:
A 96.905 — 96.915 mm (3.8151 — 3.8155 in)
B 96.895 — 96.905 mm (3.8148 — 3.8151 in)
C 96.885 — 96.895 mm (3.8144 — 3.8148 in)

3) 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
A 96.885 — 96.895 mm (3.8144 — 3.8148 in)
B 96.875 — 96.885 mm (3.8140 — 3.8144 in)
C 96.865 — 96.875 mm (3.8136 — 3.8140 in)
0.25 mm (0.0098 in) oversize
97.125 — 97.135 mm (3.8238 — 3.8242 in)
0.50 mm (0.0197 in) oversize
97.375 — 97.385 mm (3.8337 — 3.8340 in)

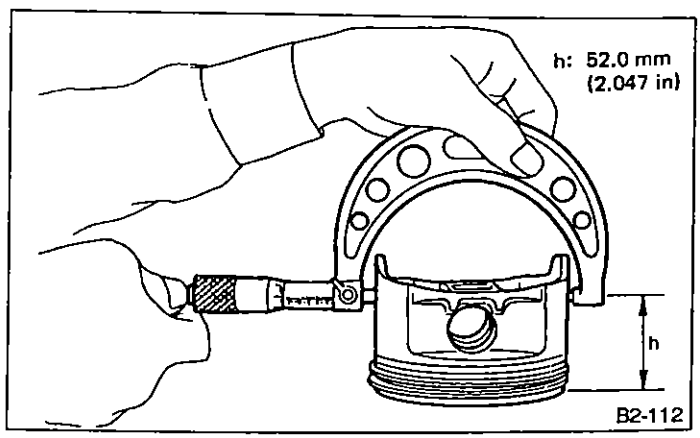


Fig. 81

(3) If the cylinder inner diameter exceeds the 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.

Limit of cylinder enlarging (boring):
0.5 mm (0.020 in)

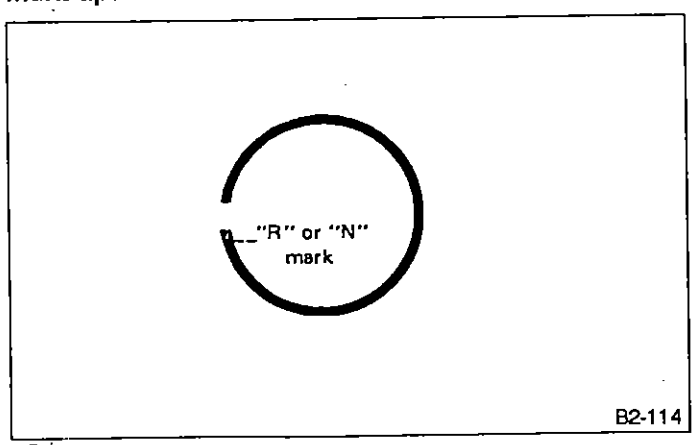
3. PISTON AND PISTON PIN

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

Standard clearance between piston pin and hole in piston:
0.001 — 0.013 mm (0.00004 — 0.00051 in)
Standard clearance between piston pin and hole in connecting rod:
0 — 0.022 mm (0 — 0.0009 in)

4. PISTON RING

1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.
"R" or "N" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.



The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful to assemble correctly.

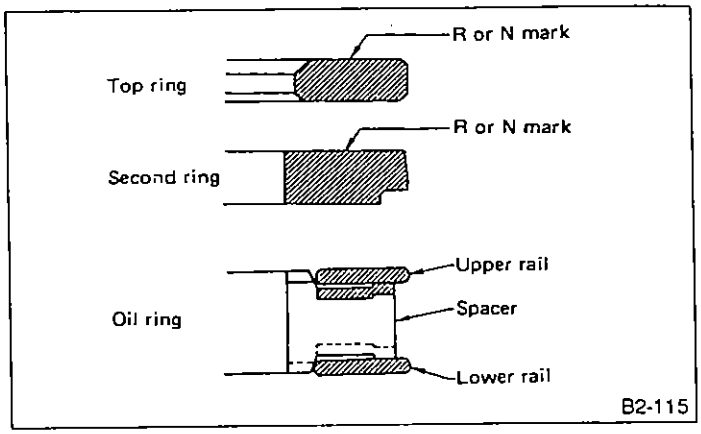


Fig. 83

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

Unit: mm (in)

		Standard		Limit
		Non-TURBO	TURBO	
Piston ring gap	Top ring	0.20 — 0.35 (0.0079 — 0.0138)	0.20 — 0.25 (0.0079 — 0.0098)	1.0 (0.039)
	Second ring	0.37 — 0.52 (0.0146 — 0.0205)		1.0 (0.039)
	Oil ring rail	0.20 — 0.70 (0.0076 — 0.0276)		1.5 (0.059)

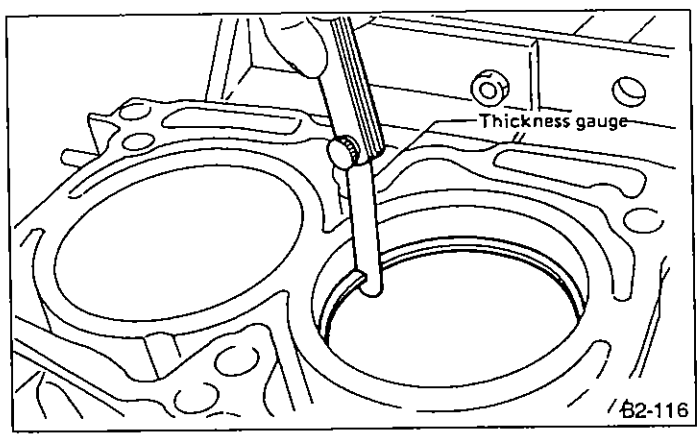


Fig. 84

3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.
Before measuring the clearance, clean the piston ring groove and piston ring.

Unit:mm (in)

		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.04 — 0.08 (0.0016 — 0.0031)	0.15 (0.0059)
	Second ring	0.03 — 0.07 (0.0012 — 0.0028)	0.15 (0.0059)

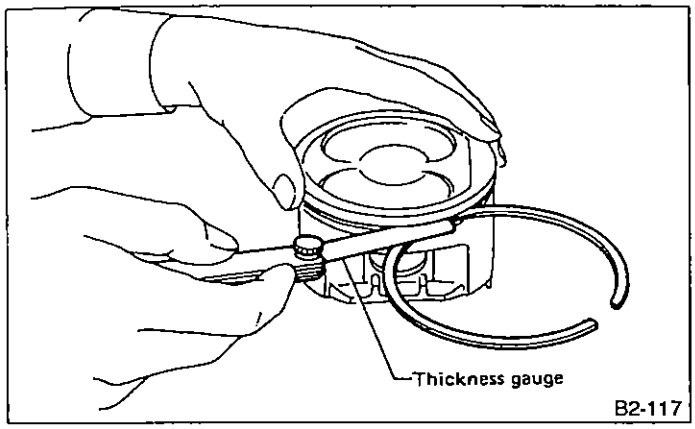


Fig. 85

5. CONNECTING ROD

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

Limit of bend or twist per 100 mm (3.94 in) in length:
0.10 mm (0.0039 in)

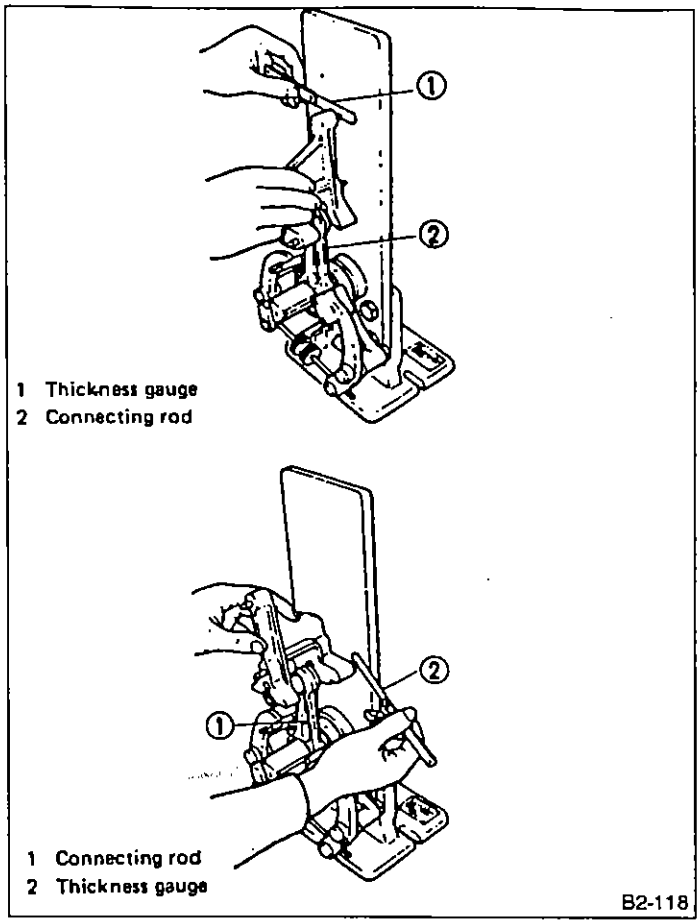


Fig. 86

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

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

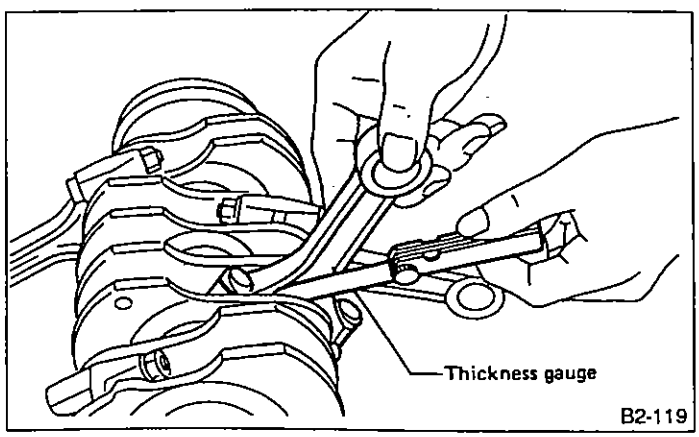


Fig. 87

i) Inspect connecting rod bearing for scar, peeling, eizure, melting, wear, etc.

ure the oil clearance on individual connecting od rings by means of plastigauge. If any oil clearnce is not within specification, replace the defective earing with a new one of standard size or undersize as ecessary, necessary. (See the table below.)

Connecting rod oil clearance:
Standard
Non-TURBO
0.0158 — 0.0438 mm (0.0006 — 0.0017 in)
TURBO
0.0258 — 0.0538 mm (0.0010— 0.0021 in)
Limit
Non-TURBO
0.05 mm (0.0020 in)
TURBO
0.06 mm (0.0024 in)

Unit: mm (in)

Bearing	Bearing size (Thickness at center)	Outer diameter of crank pin
Standard	1.492 — 1.501 (0.0587 — 0.0591)	51.984 — 52.000 (2.0466 — 2.0472)
0.03 (0.0012) undersize	1.510 — 1.513 (0.0594 — 0.0596)	51.954 — 51.970 (2.0454 — 2.0461)
(0.0020) undersize	1.520 — 1.523 (0.0598 — 0.0600)	51.934 — 51.950 (2.0446 — 2.0453)
0.25 (0.0098) undersize	1.620 — 1.623 (0.0638 — 0.0639)	51.734 — 51.750 (2.0368 — 2.0374)

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

Clearance between piston pin and bushing:
Standard
0 — 0.022 mm (0 — 0.0009 in)
Limit
0.030 mm (0.0012 in)

Replacement procedure is as follows.
(1) Remove bushing from connecting rod with REMOVER & REPLACER and press.
(2) Press bushing with REMOVER & REPLACER after applying oil on the periphery of bushing.

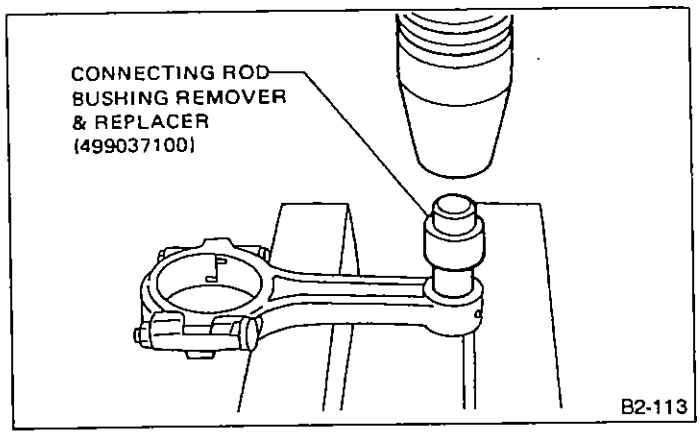


Fig. 88

(3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.
(4) After completion of reaming, clean bushing to remove chips.

6. CRANKSHAFT AND CRANKSHAFT BEARING

1) Clean crankshaft completely and check for cracks by means of red check etc., and replace if defective.
2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.
If a suitable V-block is not available, install #1 and #5 crankshaft bearing on cylinder block, position crankshaft on these bearings and measure crankshaft bend using a dial gauge.

Crankshaft bend limit:
0.035 mm (0.0014 in)

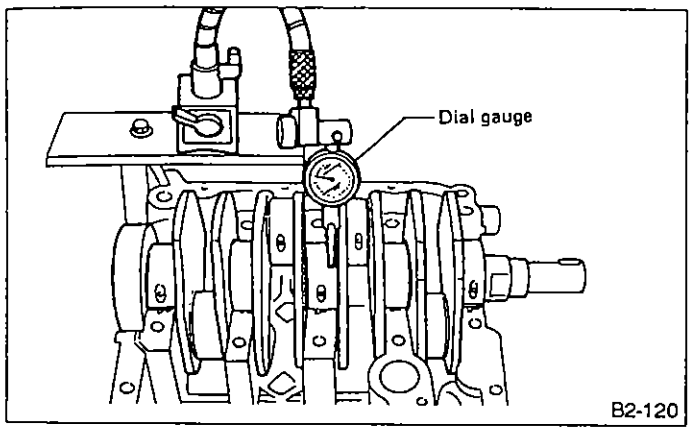


Fig. 89

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

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

Unit: mm (in)

		Crank journal			Crank pin O.D.
		#1, #5	#2, #4	#3	
Standard	Journal O.D.	59.984 — 60.000 (2.3616 — 2.3622)	59.984 — 60.000 (2.3616 — 2.3622)	59.984 — 60.000 (2.3616 — 2.3622)	51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.011 (0.0787 — 0.0792)	2.000 — 2.013 (0.0787 — 0.0793)	2.000 — 2.013 (0.0787 — 0.0793)	1.492 — 1.510 (0.0587 — 0.0594)
0.03 (0.0012) undersize	Journal O.D.	59.954 — 59.970 (2.3604 — 2.3610)	←	←	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	2.019 — 2.022 (0.0795 — 0.0796)	1.510 — 1.513 (0.0594 — 0.0596)
0.05 (0.0020) undersize	Journal O.D.	59.934 — 59.950 (2.3596 — 2.3602)	←	←	51.934 — 51.950 (2.0446 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	2.029 — 2.032 (0.0799 — 0.0800)	1.520 — 1.523 (0.0598 — 0.0600)
0.25 (0.0098) undersize	Journal O.D.	59.734 — 59.750 (2.3517 — 2.3524)	←	←	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.620 — 1.623 (0.0638 — 0.0639)

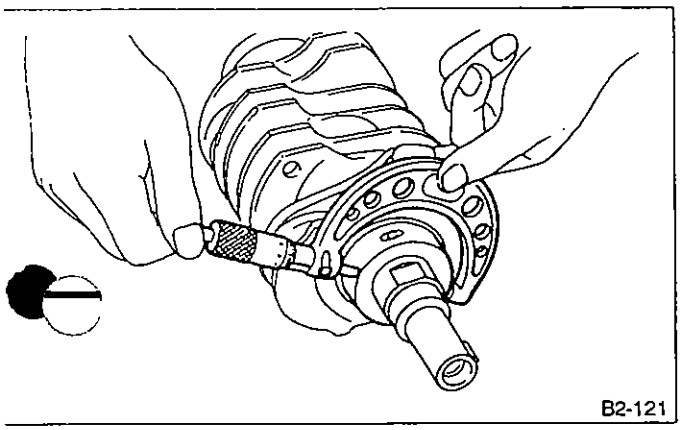


Fig. 90

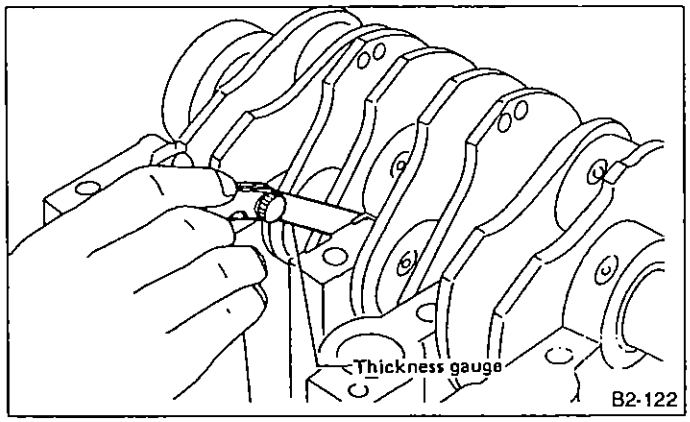


Fig. 91

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

Crankshaft thrust clearance:
Standard
0.030 — 0.115 mm (0.0012 — 0.0045 in)
Limit
0.25 mm (0.0098 in)

5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.
6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

Unit: mm (in)

Crankshaft oil clearance		
Standard	#1, #5	0.010 — 0.030 (0.0004 — 0.0012)
	#2, #3, #4	0.010 — 0.030 (0.0004 — 0.0012)
Limit	#1, #5	0.040 (0.0016)
	#2, #3, #4	0.035 (0.0014)

D: ASSEMBLY

1. CRANKSHAFT AND PISTON

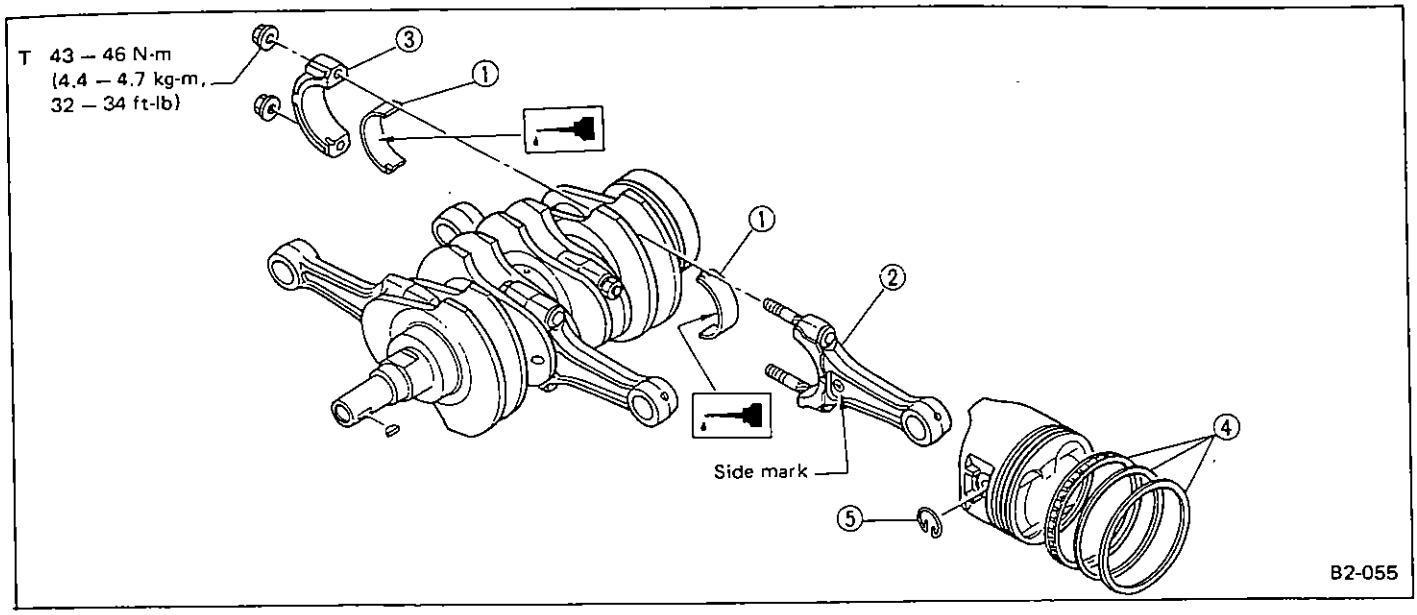


Fig. 92

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

Apply oil to the surfaces of the connecting rod bearings.

2) Install connecting rod on crankshaft.

Position each connecting rod with the side marked facing forward.

3) Install connecting rod cap with connecting rod nut.

Ensure the arrow on connecting rod cap faces the front during installation.

a. Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.

b. When tightening the connecting rod nuts, apply oil on the threads.

4) Installation of piston rings and oil ring.

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

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

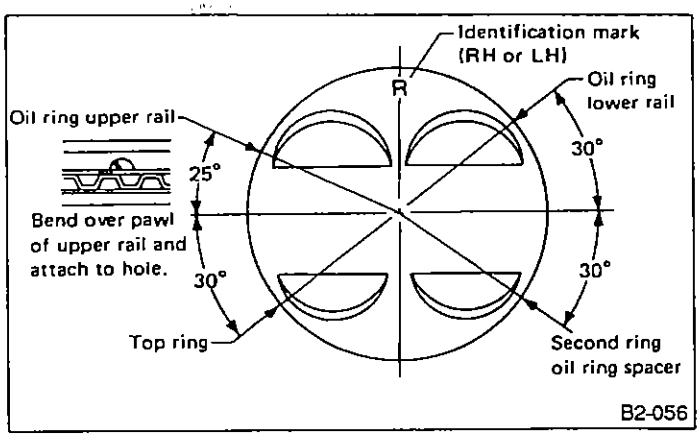


Fig. 93

5) Install circlip.

Install circlips in piston holes located opposite service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

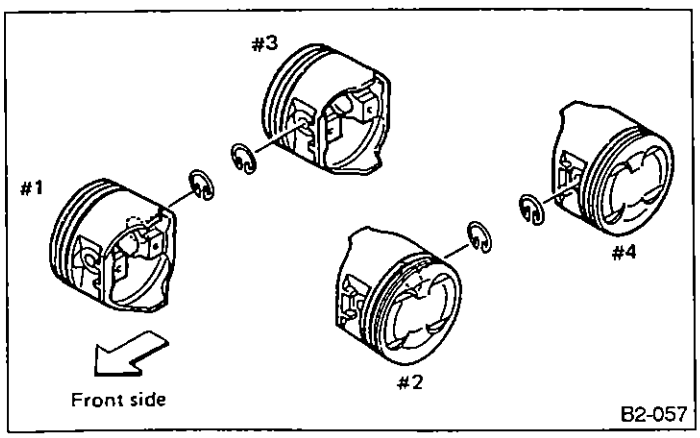


Fig. 94

2. CYLINDER BLOCK

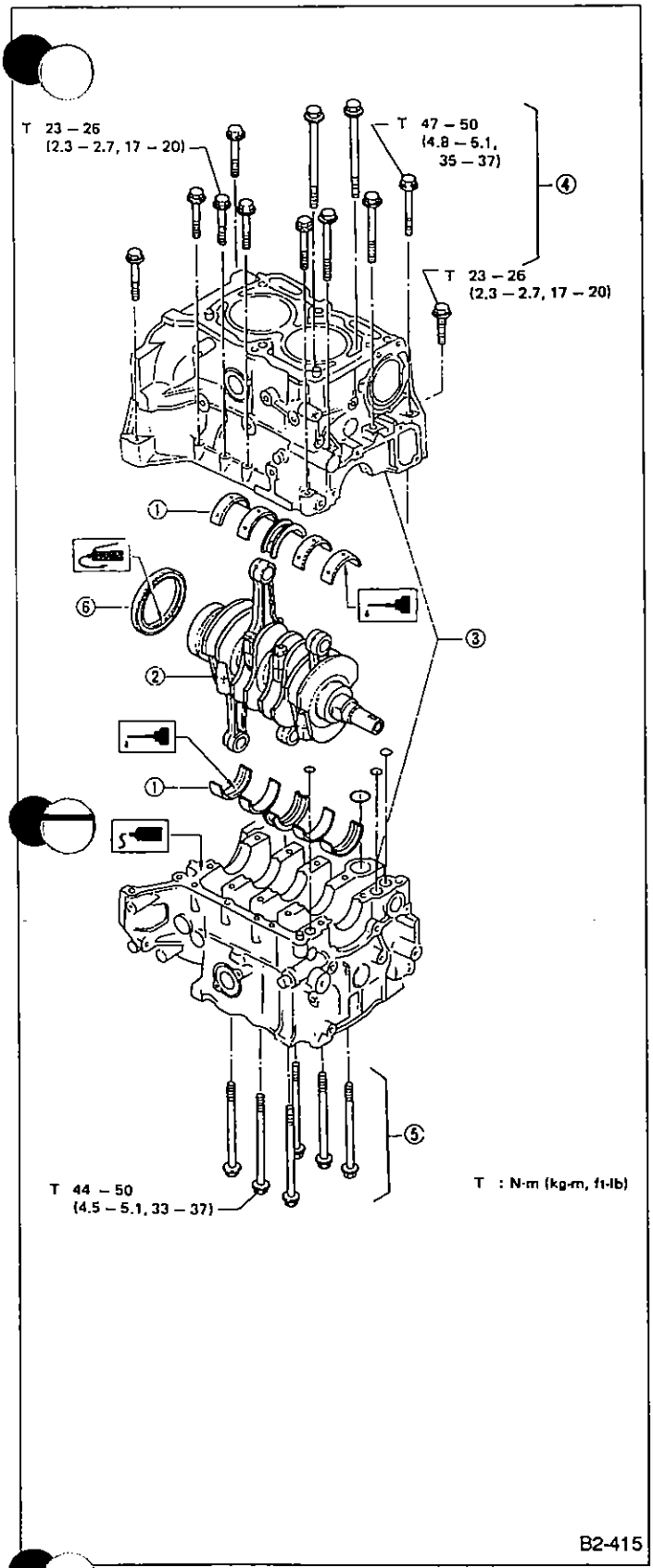


Fig. 95

1) Install ENGINE STAND to cylinder block, then install crankshaft bearings.

Remove oil the mating surface of bearing and cylinder block before installation. Also apply a coat of engine oil to crankshaft pins.

2) Position crankshaft on the #2 & #4 cylinder block.

3) Apply fluid packing to the mating surface of #1 & #3 cylinder block, and position it on #2 & #4 cylinder block.

Fluid packing:
Three-bond 1215 or equivalent

Do not allow fluid packing to jut into O-ring grooves, oil passages, bearing grooves, etc.

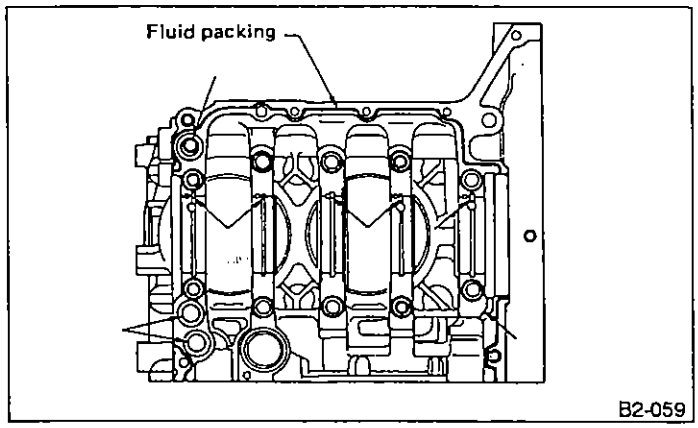


Fig. 96

4) Temporarily tighten #1 & #3 cylinder block side connecting bolts to 20 to 29 N•m (2 to 3 kg-m, 14 to 22 ft-lb).

5) Turn cylinder block so that it is horizontal. Tighten all cylinder block connecting bolts to specified torque, starting with bolts on the #1 & #3 cylinder block side.

6) Install rear oil seal.

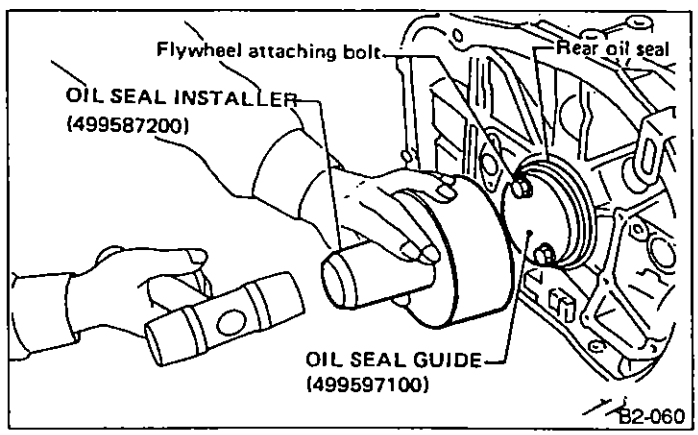


Fig. 97

3. PISTON AND PISTON PIN (#1 and #2)

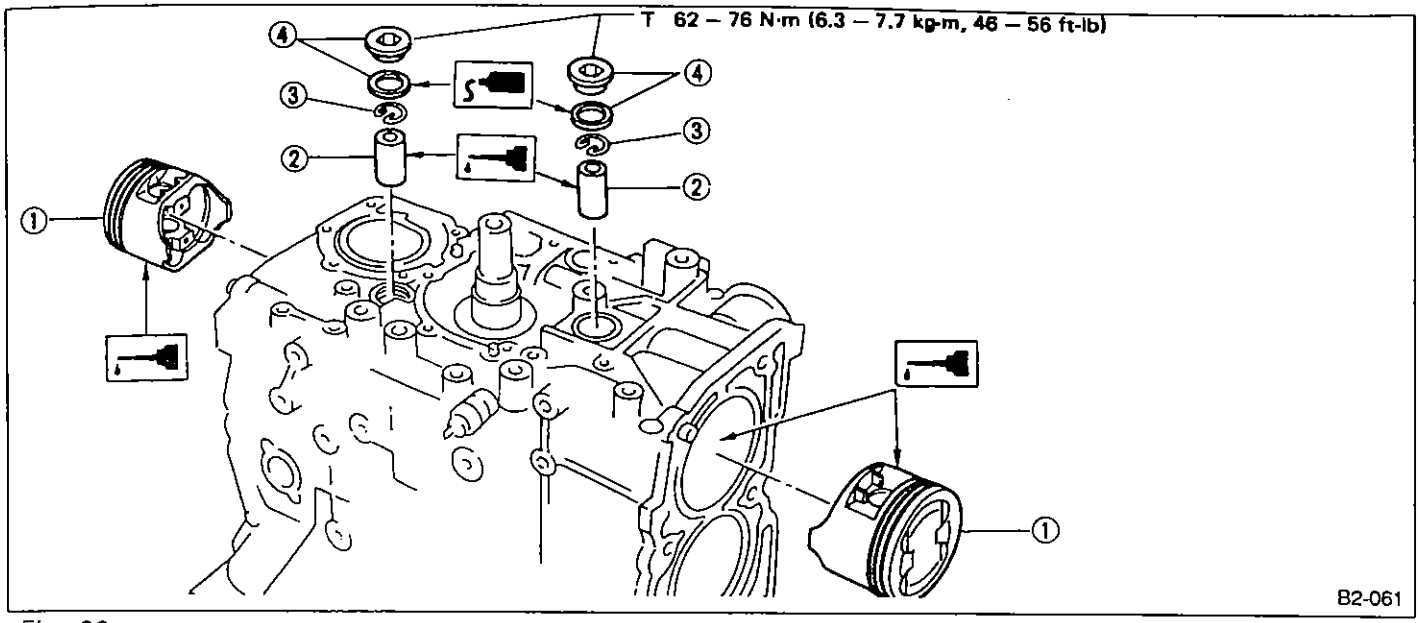


Fig. 98

1) Installing piston
   (1) Turn cylinder block so that #1 and #2 cylinders face upward.
   (2) Turn crankshaft so that #1 and #2 connecting rods are set at bottom dead center.
   (3) Apply a coat of engine oil to pistons and cylinders and insert pistons in their cylinders.

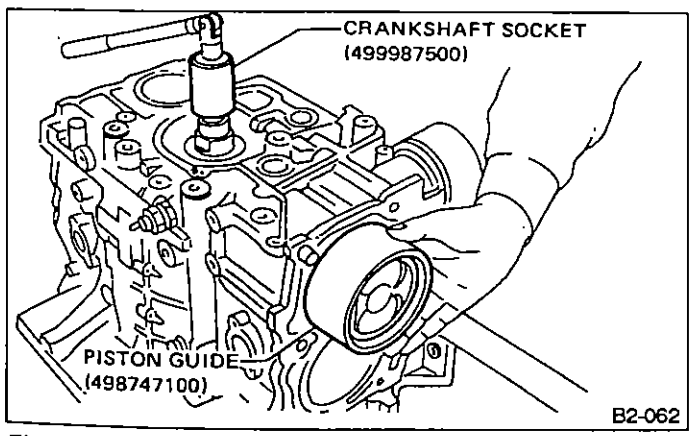


Fig. 99

2) Installing piston pin
   (1) Insert the PISTON PIN GUIDE into service hole to align piston pin hole with connecting rod small end.
Apply a coat of engine oil to PISTON PIN GUIDE before insertion.

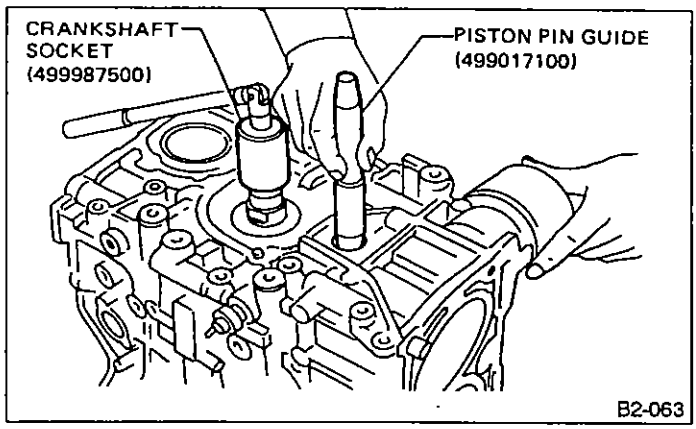


Fig. 100

   (2) Apply a coat of engine oil to piston pin and insert piston pin into piston and connecting rod through service hole.
   (3) Install circlip.

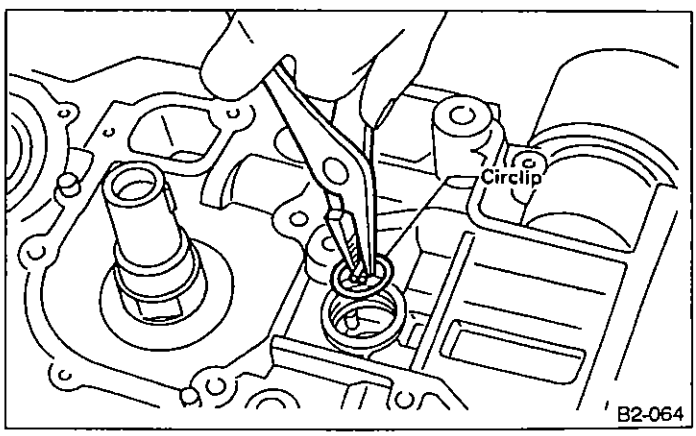


Fig. 101

(4) Install service hole plug and gasket.
Use a new gasket and apply a coat of fluid packing to ... before installation.

Fluid packing:
Three-bond 1105

4. PISTON AND PISTON PIN (#3 and #4)

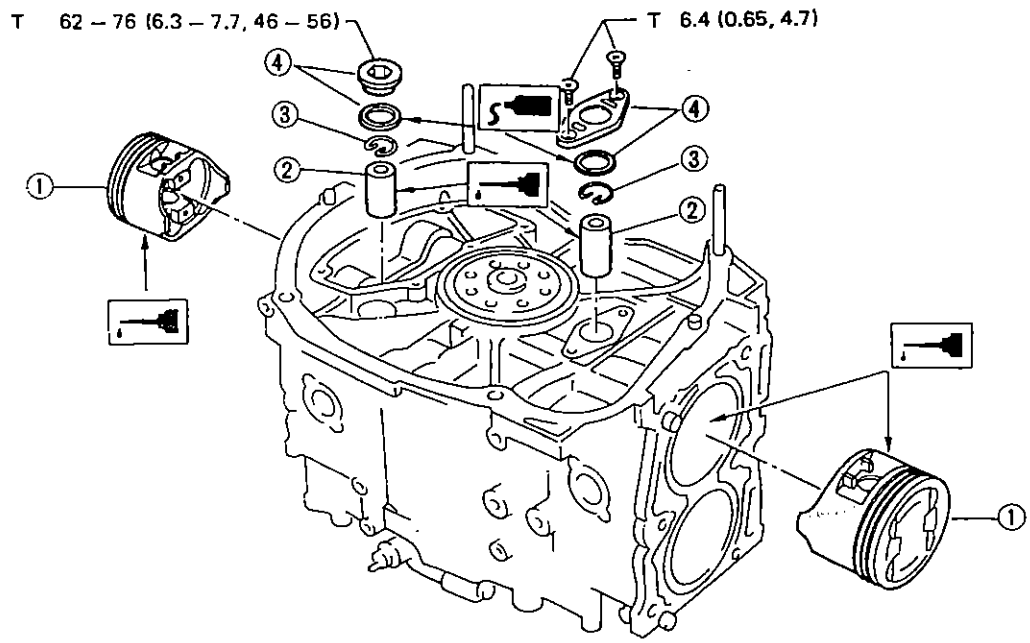


Fig. 102

Turn cylinder block so that #3 and #4 cylinders face upward. Using the same procedures as used for #1 and #2 cylinders, install pistons and piston pins.

E: INSTALLATION

1. OIL PUMP AND WATER PUMP

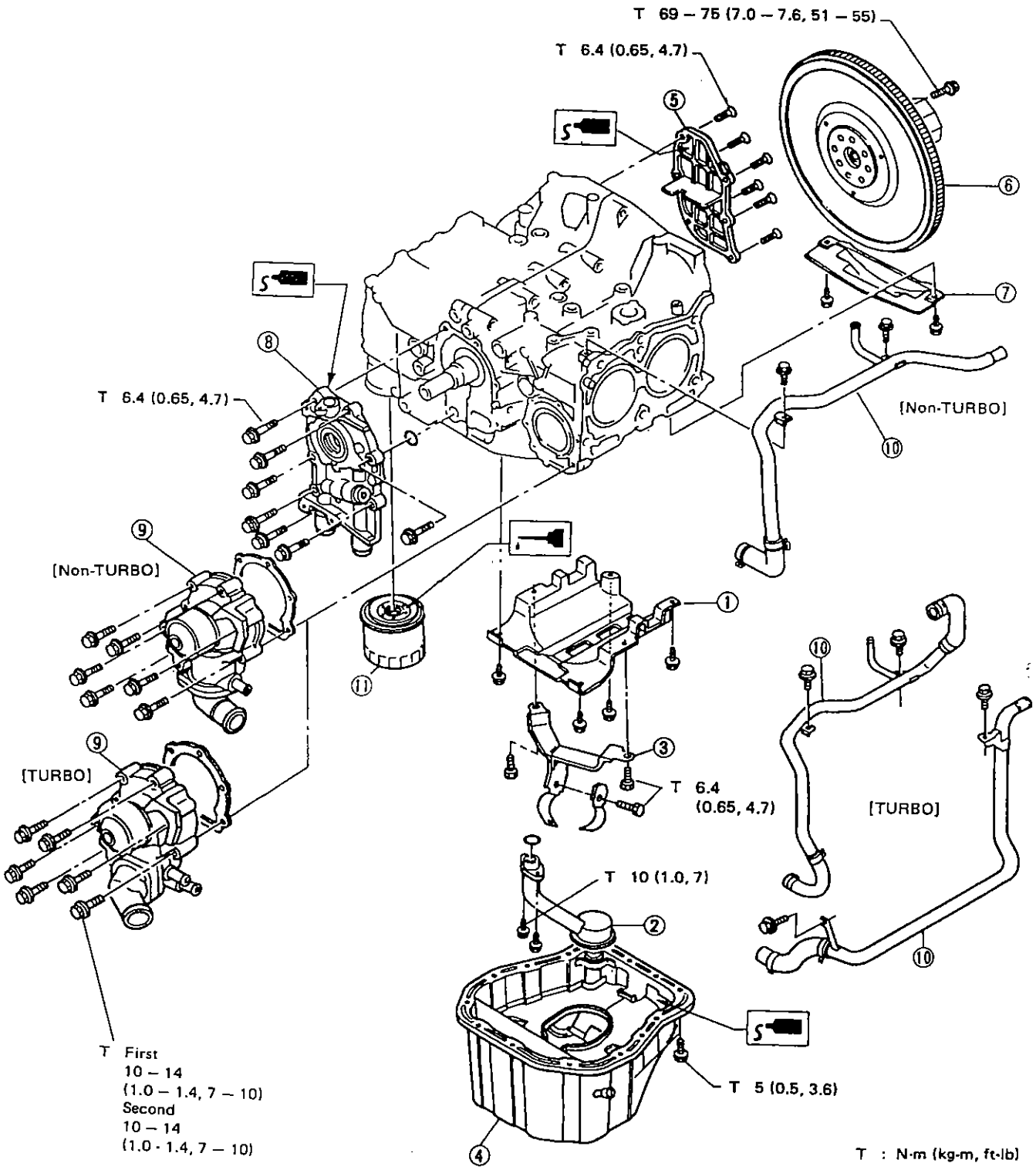
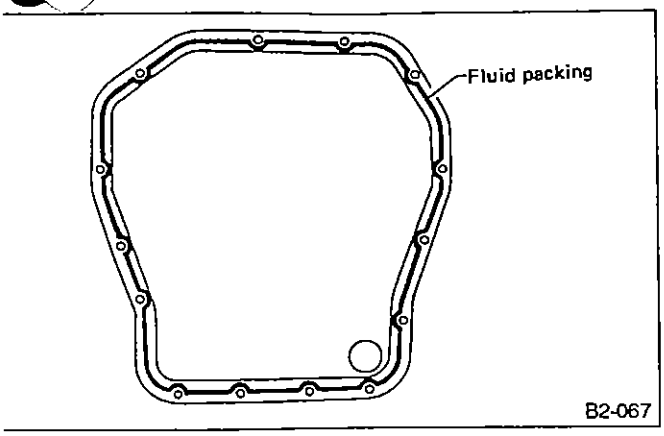


Fig. 103

1) Install baffle plate.
2) Install oil strainer and O-ring
3) Install oil strainer stay.
4) Apply fluid packing to matching surfaces and install oil pan.

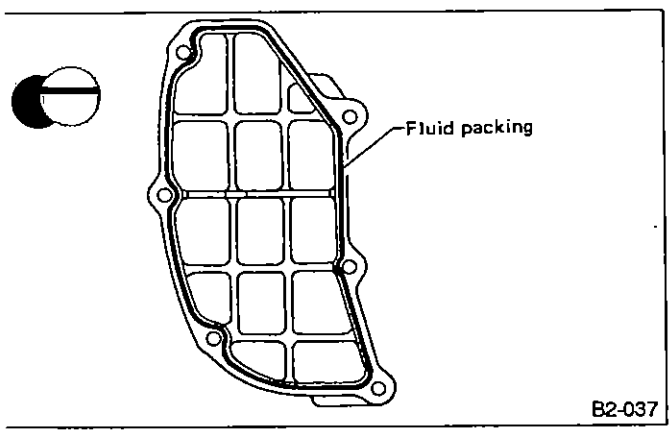
uid packing:
Three-bond 1207C or equivalent



g. 104

Apply fluid packing to matching surfaces and install
l separator cover.

uid packing:
Three-bond 1215 or equivalent



g. 105

) Install flywheel or drive plate.
) Install housing cover.
) Installation of oil pump.
(1) Discard front oil seal after removal. Replace with a new one.

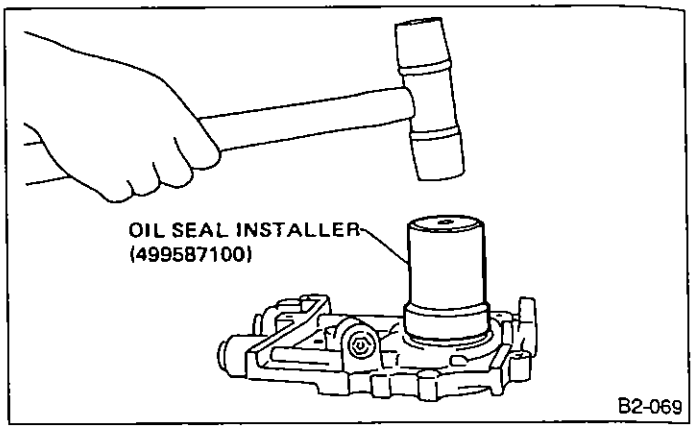


Fig. 106

(2) Apply fluid packing to matching surface of oil pump.

Fluid packing:
Three-bond 1215 or equivalent

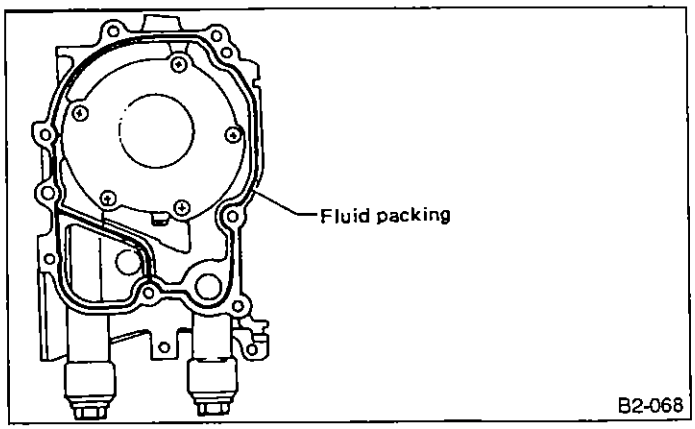


Fig. 107

(3) Install oil pump on cylinder block. Be careful not to damage oil seal during installation.

a. Do not forget to install O-ring and seal when installing oil pump.

b. Align flat surface of oil pump's inner rotor with crankshaft before installation.

9) Install water pump and gasket.
a. Be sure to use a new gasket.
b. When installing water pump, tighten bolts in two stages in numerical sequence as shown in figure.

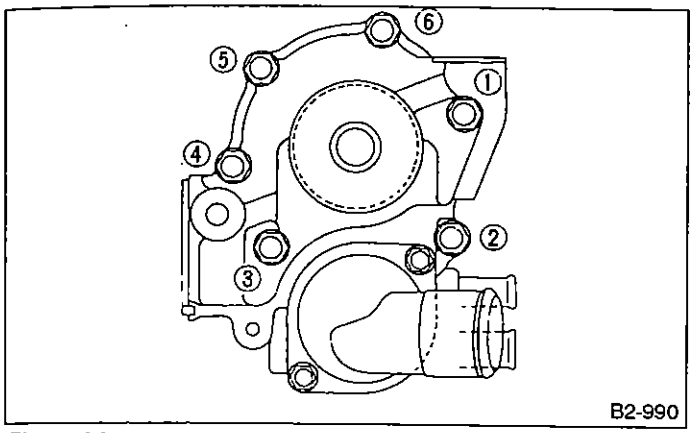


Fig. 108

10) Install water pipes.
11) Install oil filter.

2. RELATED PARTS

1) Install cylinder head and intake manifold.
〈Ref. to 5. Cylinder Head [W5E0].〉
2) Install timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

TROUBLESHOOTING

gine Trouble in General

Symbols shown in the chart refer to
he possibility of reason for
he trouble in order ("Very often" to "Rarely")
⊙— Very often
○— Sometimes
△— 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.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													STARTER
○													• Defective battery-to-starter harness.
△													• Defective starter switch.
△													• Defective inhibitor switch.
○	△												• Defective starter.
													BATTERY
⊙													• Poor terminal connection.
⊙													• Run-down battery.
○													• Defective charging system.
	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	MPFI SYSTEM (See Chap. 2-7.)
													IGNITION SYSTEM
	○	○	○	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	• Incorrect ignition timing.
	○	⊙		○	○	○			△			△	• Disconnection of spark plug cord.
	○			△	⊙	○	○		⊙	○			• Defective distributor.
	○			△	○	○							• Defective ignition coil.
	○			△	△	△							• Defective cord or wiring.
	○	○		△	○	△			○				• Leakage of spark plug cord.
		○		○	○	○			⊙				• Defective spark plug.
	○	○	○	⊙	○	⊙	△		○	○			• Incorrect cam timing.
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	
													INTAKE SYSTEM
		○	○	⊙	○	○	⊙	○	○			⊙	• Improper idle adjustment.
			○	⊙	⊙	⊙			△	⊙			• Loosened or cracked intake boot.
			○	⊙	⊙	⊙			△	⊙			• Loosened or cracked intake duct.
			△	⊙	⊙	⊙			△	⊙	⊙		• Loosened or cracked blow-by hose.
			△	⊙	○	⊙	⊙		○	⊙			• Loosened or cracked vacuum hose.
			△	○	○	○				⊙			• Defective air cleaner gasket.
		○	○	○	○	○				⊙			• Defective intake manifold gasket.
		○	○	○	○	○				⊙			• Defective throttle body gasket.
				△	○	○			○	○	○		• Defective PCV valve.
				○	○	○			△	○	△		• Loosened oil filler cap.
			△	△	⊙	○				○		⊙	• Dirty air cleaner element.
													FUEL LINE
	⊙	△		△	○	○							• Defective fuel pump.
		△	△	△	○	○							• Clogged fuel line.
	○	○	○	○	△	△							• Lack of or insufficient fuel.
													BELT
	○	○	○										• Defective.
	○	○	○	△	○	○			○	○		○	• Defective timing.
													FRICTION
△													• Seizure of crankshaft and connecting-rod bearing.
△													• Seized camshaft.
△													• Seized or stuck piston and cylinder.
													COMPRESSION
	△	△	△	○	○	○			○	△		○	• Incorrect valve clearance.
	△	△	△	○	○	△			△			△	• Loosened spark plugs or defective gasket.
	△	△	△	○	○	△			△			△	• Loosened cylinder head nuts or defective gasket.
	△	△	△	○	○	△			○			○	• Improper valve seating.
	△	△	△	△	△	△			△		⊙	△	• Defective valve stem.
	○	○	○	○	○	△			△			△	• Worn or broken valve spring.
	△	△	△	○	△	△			△		⊙	○	• 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
	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 Evaporative Emission Control System. (See Chap. 2-1.)
			○			⊙							• Stuck or damaged throttle valve.
			△			○	○				○		• Accelerator cable out of adjustment.
1	2	3	4	5	6	7	8	9	10	11	12	13	

2. Engine Noise

Valve lash adjusters may make clicking noise once engine starts. It is normal if clicking noise ceases after a few minutes.

If clicking noise continues after a few minutes, check engine oil level and add oil if necessary. Warm up engine for five minutes, then operate it at approximately 3,000 rpm for twenty minutes. If noise still exists, conduct troubleshooting procedures in accordance with the following table.

For MPFI system engines, do not disconnect spark plug cord while engine is running.

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 fuel injector connector of noisy cylinder is disconnected.	• 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 fuel injector connector of noisy cylinder is disconnected.	• 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 fuel injector connector is disconnected 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.

SUBARU®

1992

SERVICE MANUAL

Page

M MECHANISM AND FUNCTION 2
1. General 2
2. Lubrication Lines 3
3. Oil Pump 4
4. Oil Filter 5
5. Oil Pan & Oil Strainer 5
6. Oil Pressure Switch 5
S SPECIFICATIONS AND SERVICE DATA 6
C COMPONENT PARTS 7
1. Oil Pump 7
W SERVICE PROCEDURE 8
1. Oil Pump 8
T TROUBLESHOOTING 1

M MECHANISM AND FUNCTION

1. General

The lubrication system is a full-flow, filtering type. The oil pump utilizes a thin, large-diameter trochoid design to accommodate the high engine output. It is directly driven by the crankshaft.

Engine oil flow is regulated by the relief valve built into the oil pump. It is then delivered to the journal bearings, connecting rod bearings, etc., via the oil passage (on the lower right side of the cylinder block), oil filter, and the oil gallery (on the right of the cylinder block) to provide proper lubrication.

Engine oil is also fed under pressure to the cylinder head valve mechanism after the flow is regulated by the orifice provided in the oil gallery. The rocker shaft has a built-in relief valve on the end so proper oil pressure is delivered to the hydraulic lash adjusters.

The oil pan is provided with baffle plates to eliminate the effect of oil suction caused by oil level variations during operation.

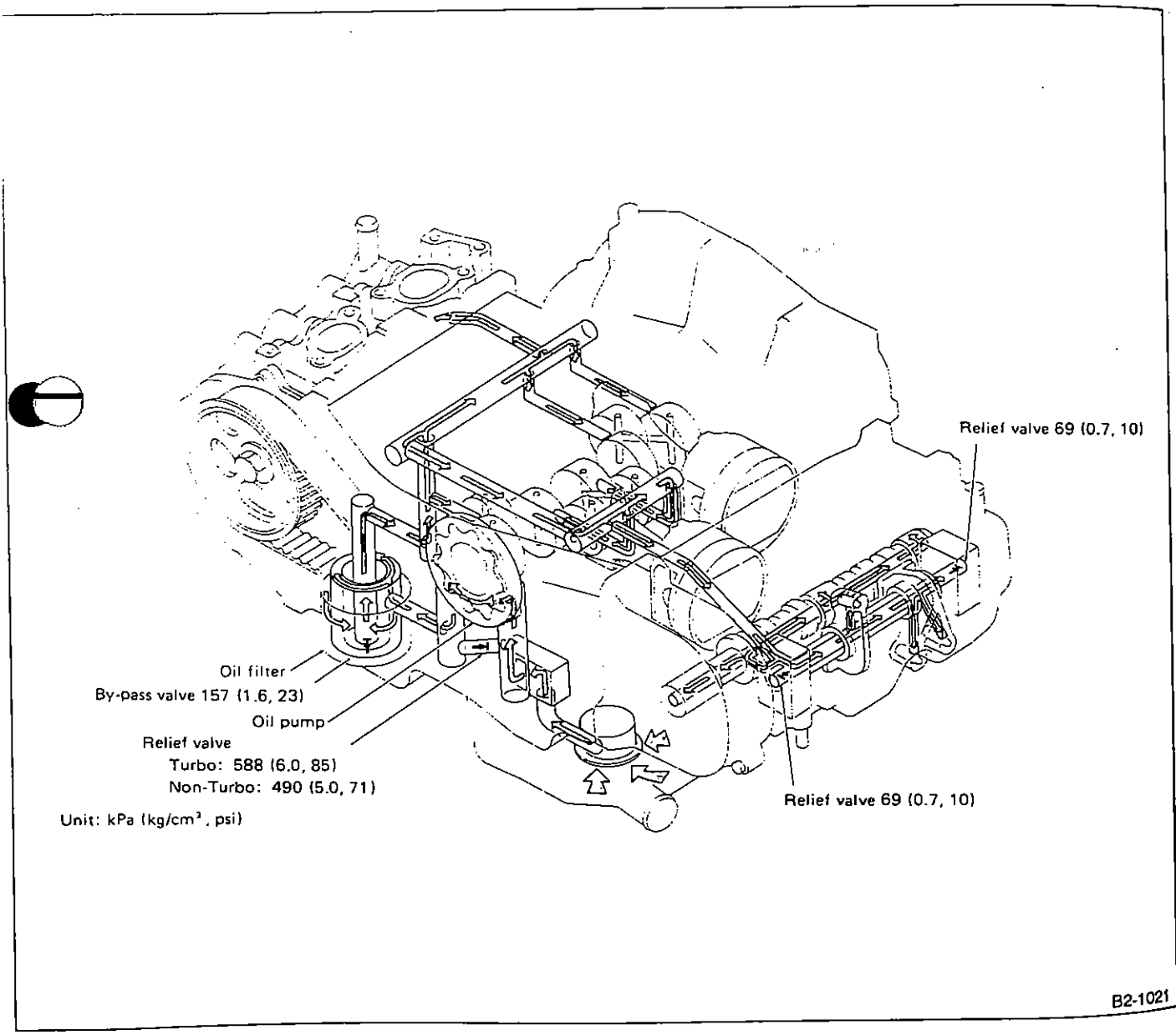


Fig. 1

2. Lubrication Lines

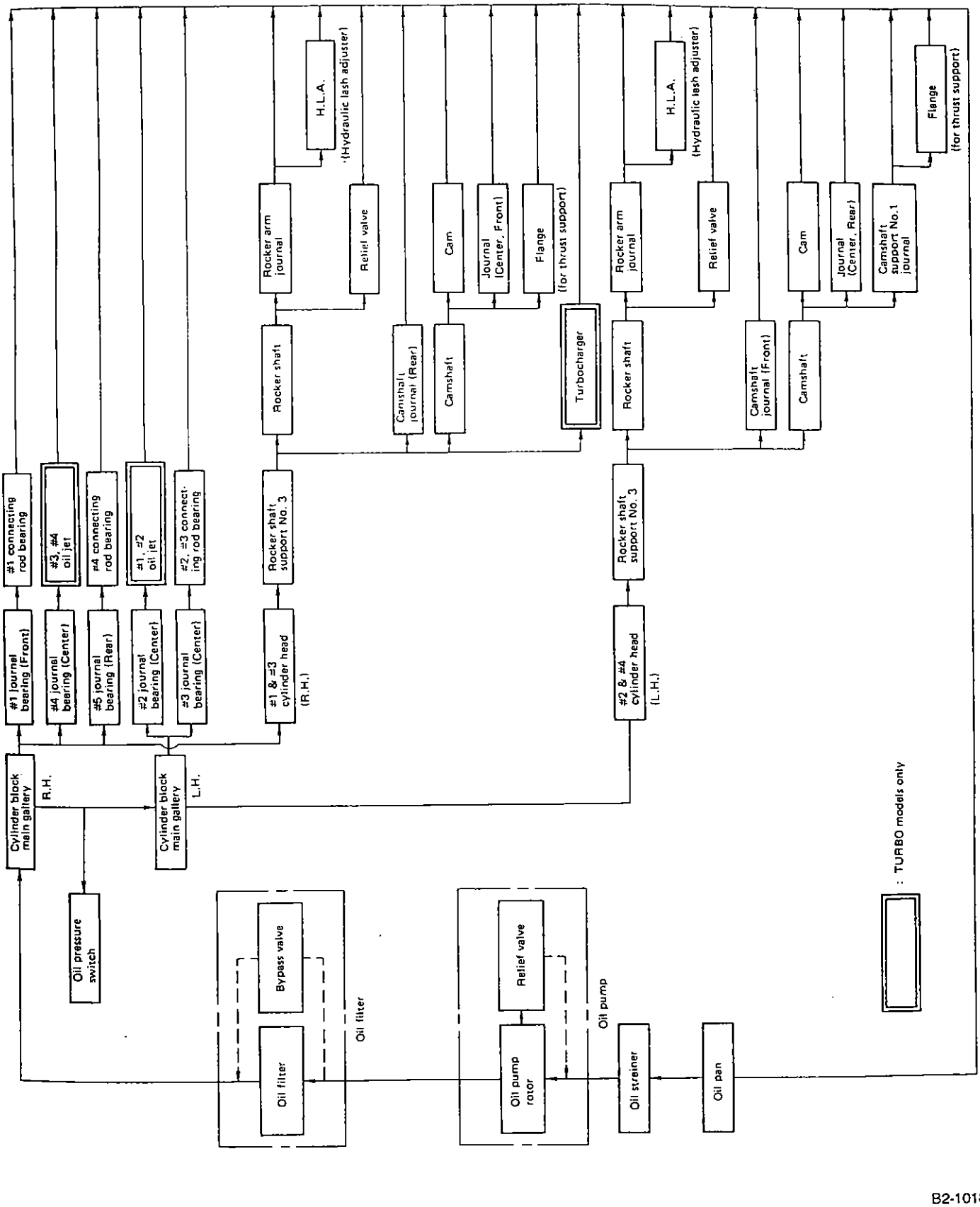
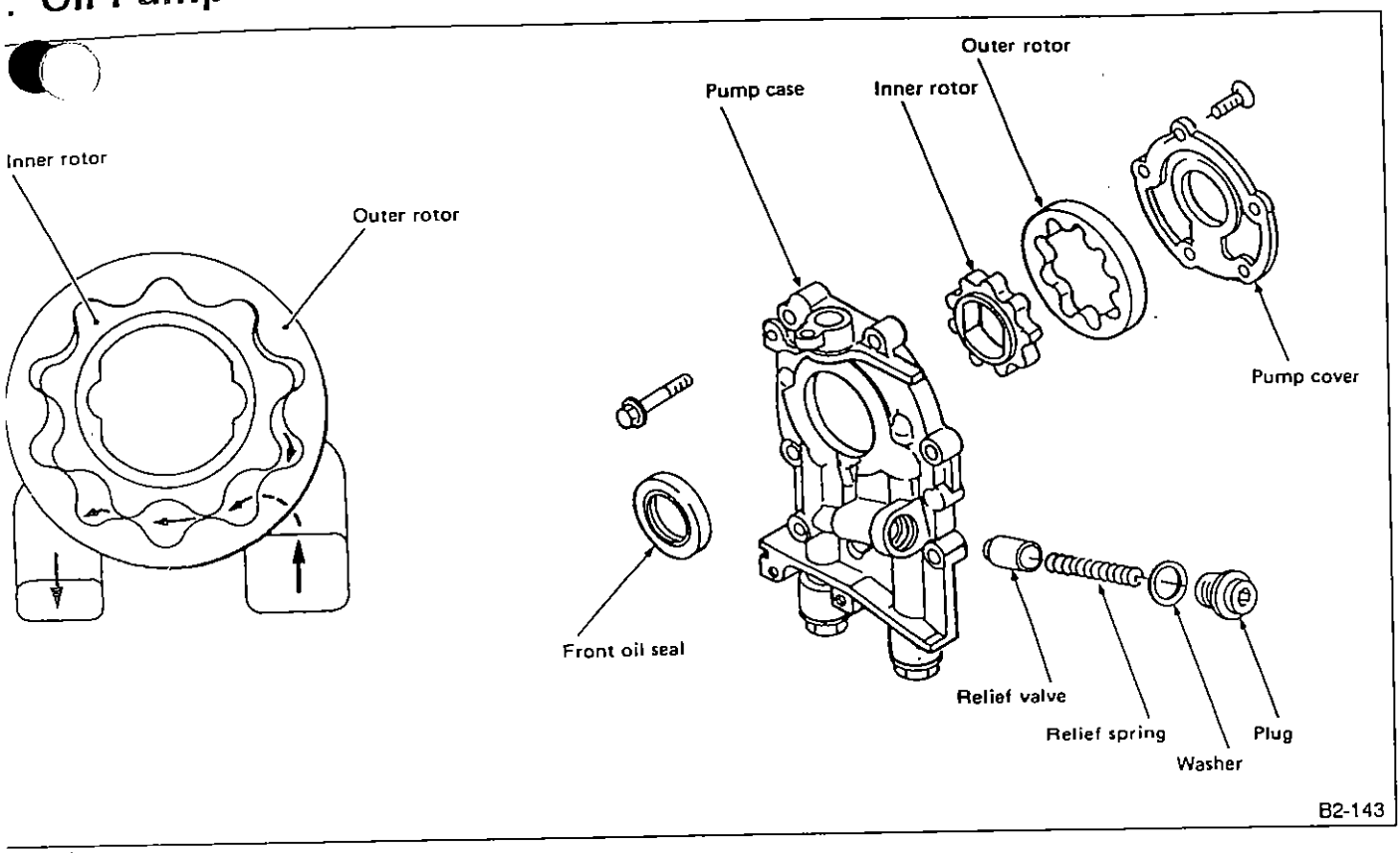


Fig. 2

. Oil Pump



The trochoid oil pump utilizes an internal oil circulation design which is accomplished by an inner rotor and outer rotor built into the pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the size of the space between the two rotors (because of the different number of teeth used on the rotors).

Engine oil is sucked into the large space created near the inlet side. It is then carried over to the discharge port and discharged due to it being gradually pressurized as the space carrying it becomes smaller. Oil pressure is regulated by the relief valve located on the discharge side. Excess oil is directly returned to the suction port.

4. Oil Filter

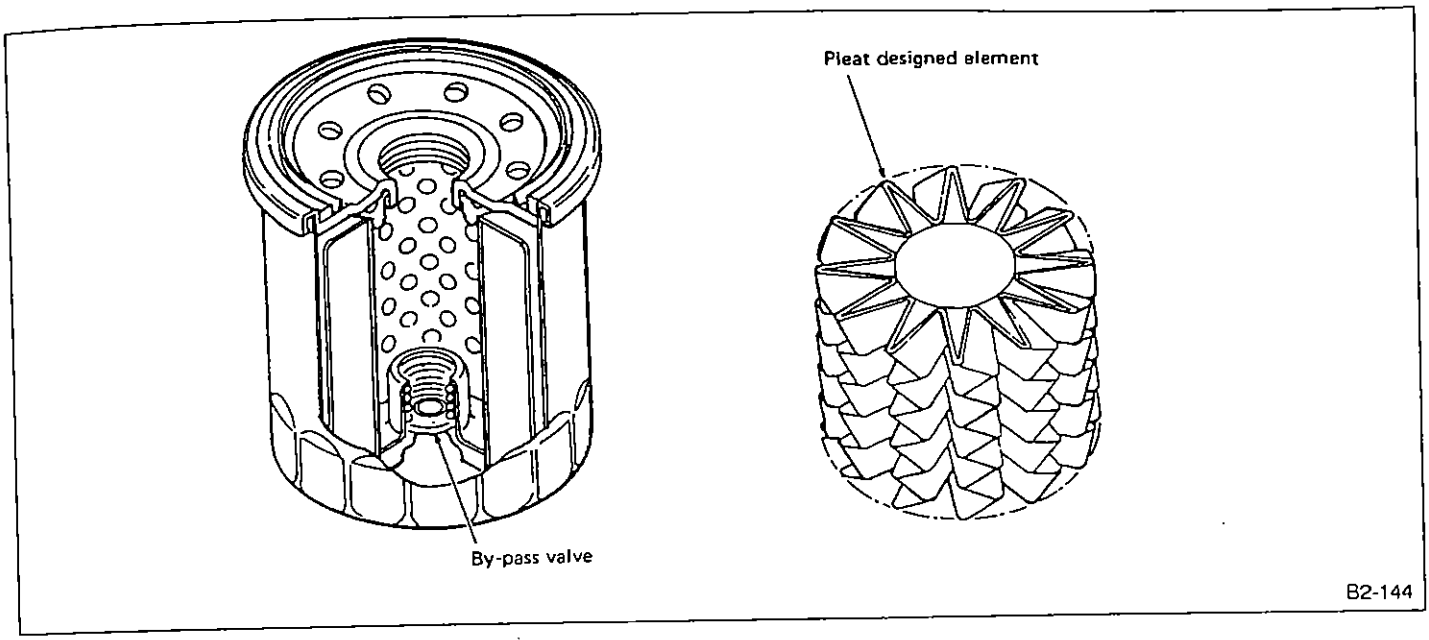


Fig. 4

The oil filter is a full-flow cartridge type that utilizes a paper element. It also has a built-in bypass valve. The filter element has a special pleat design to increase the effective filtering area.

5. Oil Pan & Oil Strainer

The oil pan is joined to the cylinder block via liquid gasket. The oil strainer is a metal net type and removes large foreign particles from the engine oil. It is located in the middle of the oil pan. The pipe from the strainer is connected to the suction port on the left side of the cylinder block.

Baffle plates are placed in the oil pan and the lower side of the cylinder block to stabilize the oil level and strengthen the oil pan.

6. Oil Pressure Switch

A: CONSTRUCTION

The oil pressure switch is located on the front right upper portion of the cylinder block. The purpose of this switch is to monitor the operation of the oil pump as well as the lubricating oil pressure when the engine is running.

B: FUNCTION

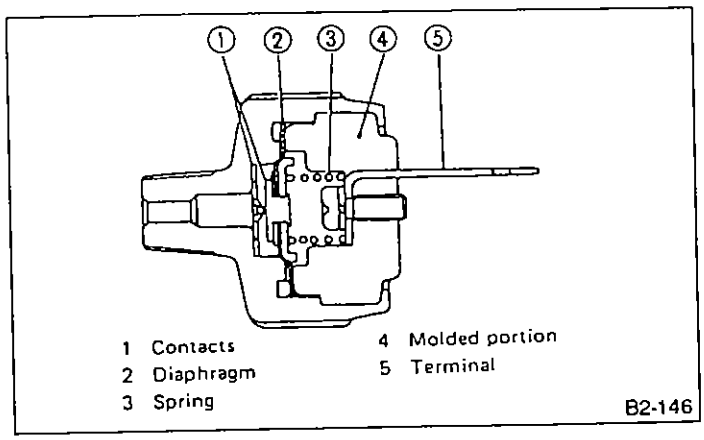


Fig. 5

1) When oil pressure does not build up (with ignition switch "ON"):
The diaphragm is pushed toward the cylinder block by spring force (equivalent to the specified oil pressure). This closes the contact point to illuminate the oil pilot lamp on the instrument panel.

2) When oil pressure reaches the specified value (after engine starts):
After oil pressure reaches the specified value of [14.7 kPa (0.15 kg/cm^2, 2.1 psi)], the diaphragm, pushed by oil pressure, overcomes the spring force. This opens the contact point to turn the oil pilot lamp off.

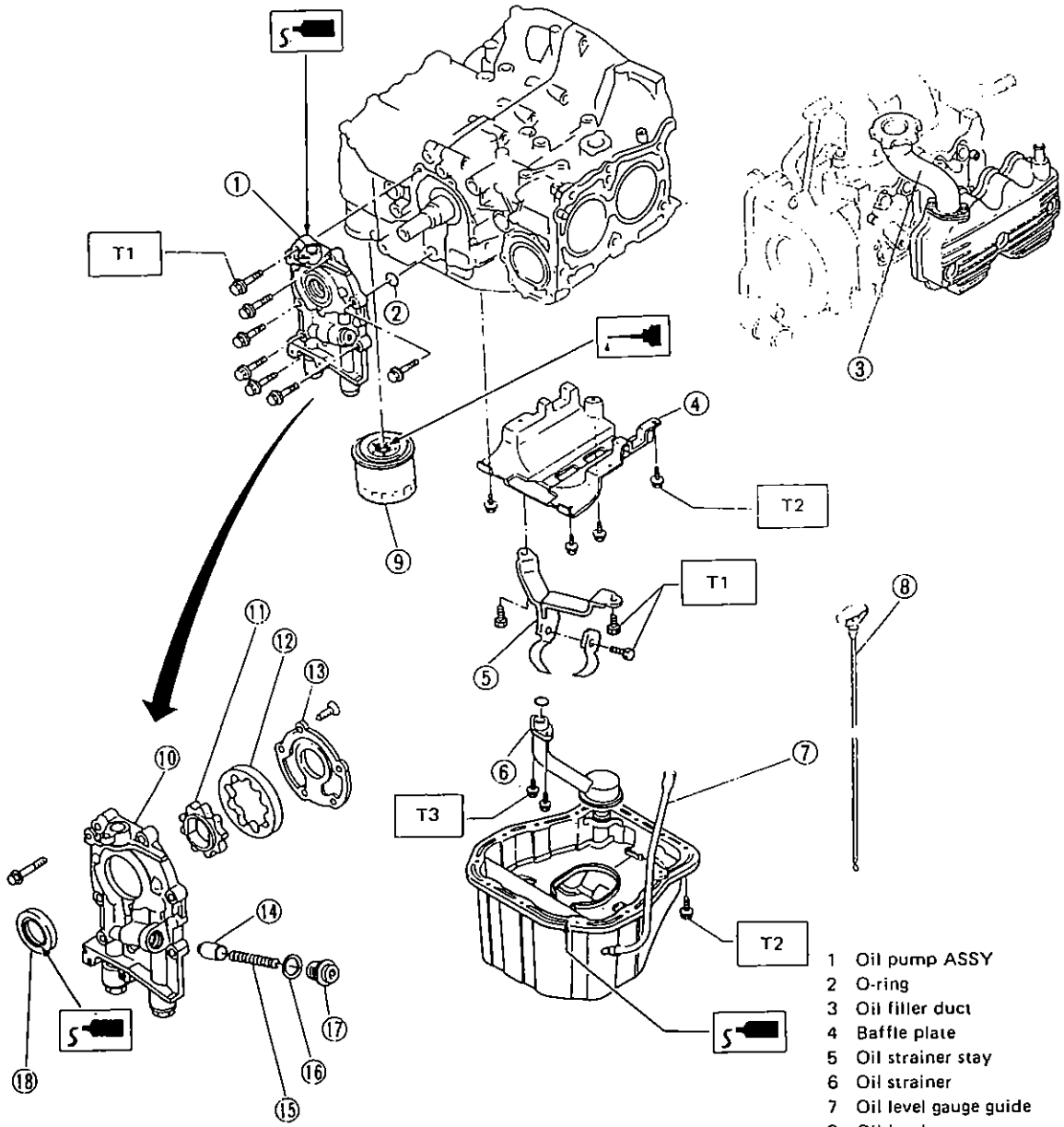
S SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

ITEM \ MODEL					Non-TURBO	TURBO
Lubrication method					Forced lubrication	
Oil pump	Pump type				Trochoid type	
	Number of teeth			Inner rotor	9	
				Outer rotor	10	
	Outer rotor diameter x thickness mm (in)				78 x 9 (3.07 x 0.35)	78 x 10 (3.07 x 0.39)
	Tip clearance between inner and outer rotor mm (in)			STD	0.04 — 0.14 (0.0016 — 0.0055)	
				LIM	0.18 (0.0071)	
	Side clearance between inner rotor and pump case mm (in)			STD	0.02 — 0.07 (0.0008 — 0.0028)	
				LIM	0.12 (0.0047)	
	Case clearance between outer rotor and pump case mm (in)			STD	0.10 — 0.175 (0.0039 — 0.0069)	
				LIM	0.20 (0.0079)	
	Capacity at 80°C (176°F)	600 rpm	Discharge	- pressure	98 kPa (1.0 kg/cm², 14 psi)	
				- quantity	4.2 ℓ (4.4 US qt, 3.7 Imp qt)/min.	4.6 ℓ (4.9 US qt, 4.0 Imp qt)/min.
		5,000 rpm	Discharge	- pressure	294 kPa (3.0 kg/cm², 43 psi)	
				- quantity	42.0 ℓ (11.10 US gal, 9.24 Imp gal)/min.	47.0 ℓ (12.42 US gal, 10.34 Imp gal)/min.
	Relief valve operation pressure				490 kPa (5.0 kg/cm², 71 psi)	588 kPa (6.0 kg/cm², 85 psi)
Oil filter	Type				Full-flow filter type	
	Filtration area				1,000 cm² (155 sq in)	
	By-pass valve opening pressure				156 kPa (1.6 kg/cm², 23 psi)	
	Outer diameter x width mm (in)				80 x 70 (3.15 x 2.76)	
	Oil filter to engine thread size				M 20 x 1.5	
Relief valve (on rocker shaft) operation pressure					69 kPa (0.7kg/cm², 10 psi)	
Oil pressure switch	Type				Immersed contact point type	
	Working voltage — wattage				12 V — 3.4 W or less	
	Warning light activation pressure				14.7 kPa (0.15 kg/cm², 2.1 psi)	
	Proof pressure				More than 981 kPa (10 kg/cm², 142 psi)	
Oil capacity (at replacement)					4.5 ℓ (4.8 US qt, 4.0 Imp qt)	

C COMPONENT PARTS

1. Oil Pump



Tightening torque: N·m (kg-m, ft-lb)
T1: 6.4 (0.65, 4.7)
T2: 5 (0.5, 3.6)
T3: 10 (1.0, 7)

1 Oil pump ASSY
2 O-ring
3 Oil filler duct
4 Baffle plate
5 Oil strainer stay
6 Oil strainer
7 Oil level gauge guide
8 Oil level gauge
9 Oil filter
10 Pump case
11 Inner rotor
12 Outer rotor
13 Pump cover
14 Relief valve
15 Relief spring
16 Washer
17 Plug
18 Front oil seal

B2-1019

Fig. 6

W SERVICE PROCEDURE

Oil Pump

A: REMOVAL

1) Drain engine oil
2) Drain coolant
3) Remove belt covers, drive belt and related parts. Refer to "2- 3 ENGINE")
4) Remove belt tensioner bracket.
5) Remove water pump.
6) Remove oil pump.

nsert a standard screwdriver as shown in Figure 8.

3e careful not to scratch mating surfaces of cylinder block and oil pump.

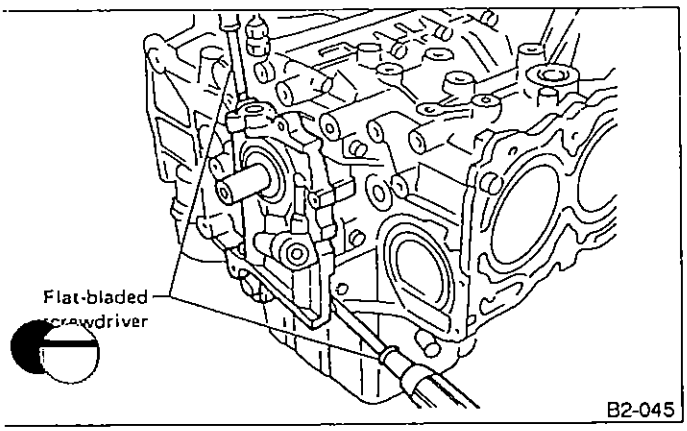


Fig. 7

B: DISASSEMBLY

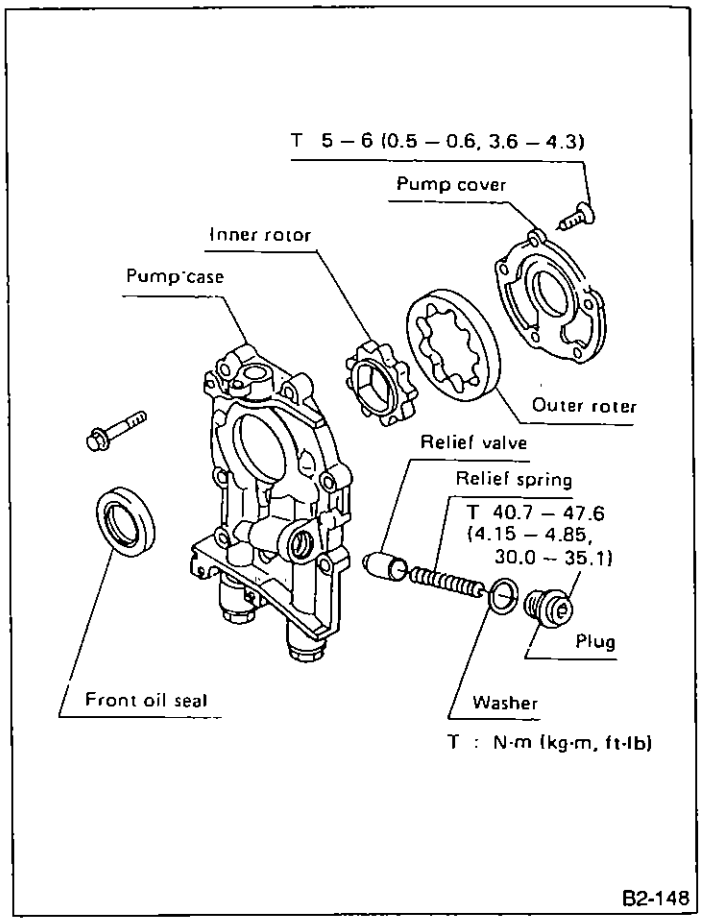


Fig. 8

Remove screws which secure oil pump cover and disassemble oil pump.

Inscribe alignment marks on inner and outer rotors so that they can be replaced in their original positions during reassembly.

Before removing relief valve, loosen plug when removing oil pump from cylinder block.

C: INSPECTION

1. TIP CLEARANCE

Measure the tip clearance of rotors. If the clearance exceeds the limit, replace rotors as a matched set.

Tip clearance:
Standard
0.04 — 0.14 mm (0.0016 — 0.0055 in)
Limit
0.18 mm (0.0071 in)

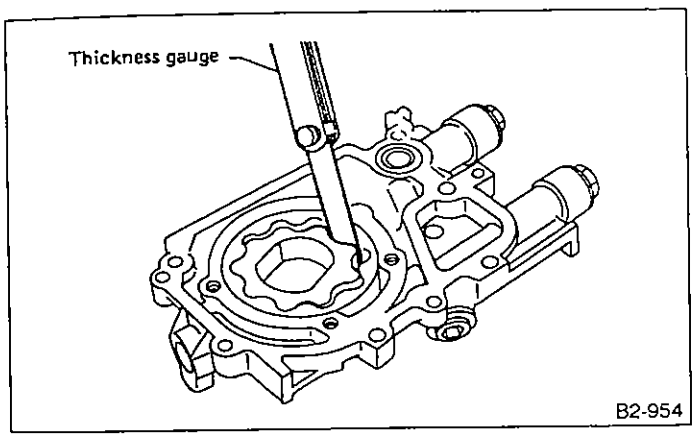


Fig. 9

2. 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 — 0.175 mm (0.0039 — 0.0069 in)
Limit
0.20 mm (0.0079 in)

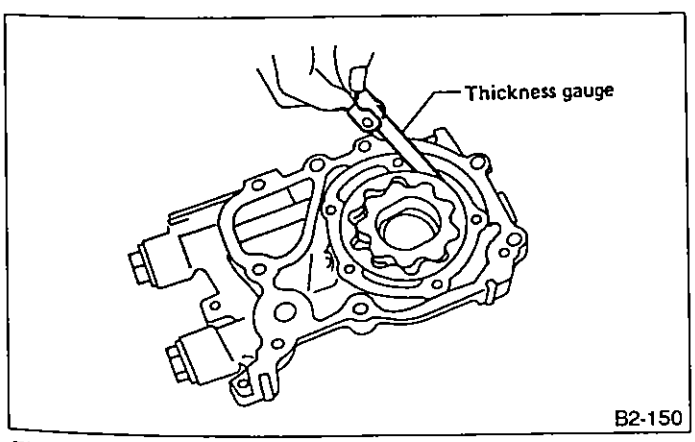


Fig. 10

3. SIDE CLEARANCE

Measure clearance between oil pump inner rotor and pump cover. If the clearance exceeds the limit, replace rotor or pump body.

Side clearance:
Standard
0.02 — 0.07 mm (0.0008 — 0.0028 in)
Limit
0.12 mm (0.0047 in)

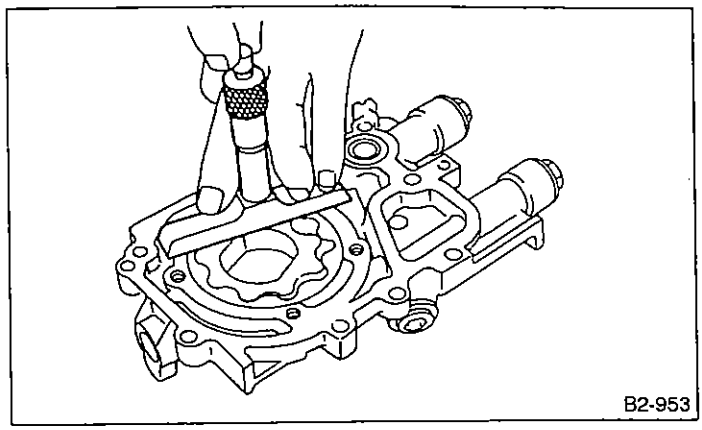


Fig. 11

4. 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:
Non-TURBO
Free length: 71.8 mm (2.827 in)
Installed length: 54.7 mm (2.154 in)
Load when installed: 77.08 N (7.86 kg, 17.33 lb)
TURBO
Free length: 73.7 mm (2.902 in)
Installed length: 54.7 mm (2.154 in)
Load when installed: 93.2 N (9.5 kg, 20.9 lb)

5. OIL PUMP CASE

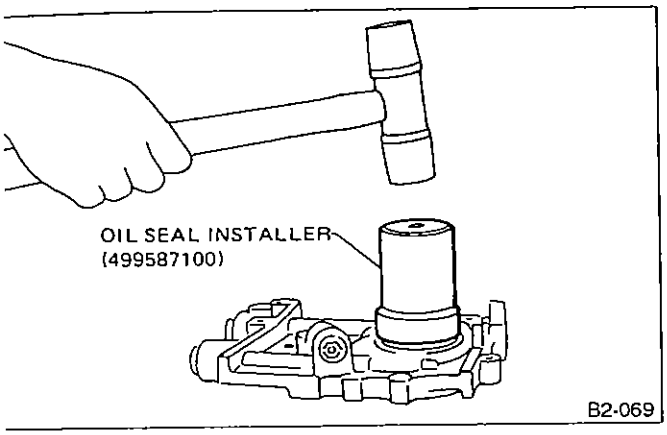
Check the oil pump case for worn shaft hole, clogged oil passage, worn rotor chamber, cracks, and other faults.

6. OIL SEAL

Check the oil seal lips for deformation, hardening, wear, etc. and replace if defective.

D: ASSEMBLY

Install front oil seal.
se a new oil seal.



g. 12

Install inner and outer rotors in their original positions.
Install oil relief valve and relief spring.
Install oil pump cover.

E: INSTALLATION

Installation is in the reverse order of removal.
Observe the following:
1) Apply fluid packing to matching surfaces of oil pump.

Fluid packing:
Three bond 1215 or equivalent

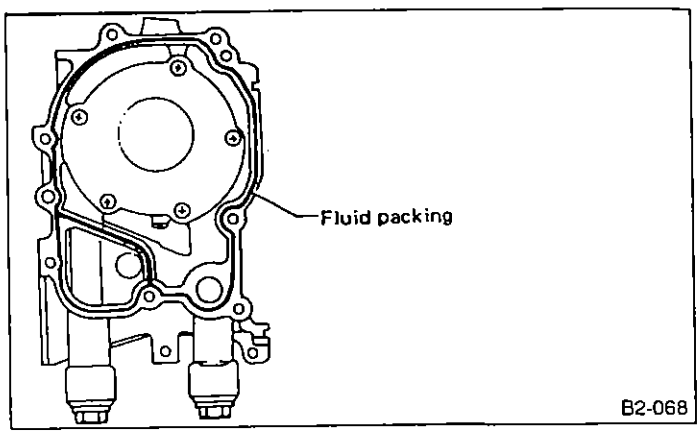


Fig. 13

2) Replace O-ring with a new one.
3) Be careful not to scratch oil seal when installing oil pump on cylinder block.
Apply liquid packing to oil pressure switch threads before installation.

T 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 or oil leakage within switch	Replace.
		Broken spring or seized contacts	Replace.
	2) Low oil pressure	Clogged oil filter	Replace.
		Malfunction of oil by-pass valve of oil filter	Clean or replace.
		Malfunction of oil relief valve of oil pump	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 rotor	Replace.
2. Warning light does not go on.	1) Burn-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)

SUBARU®

1992

SERVICE MANUAL

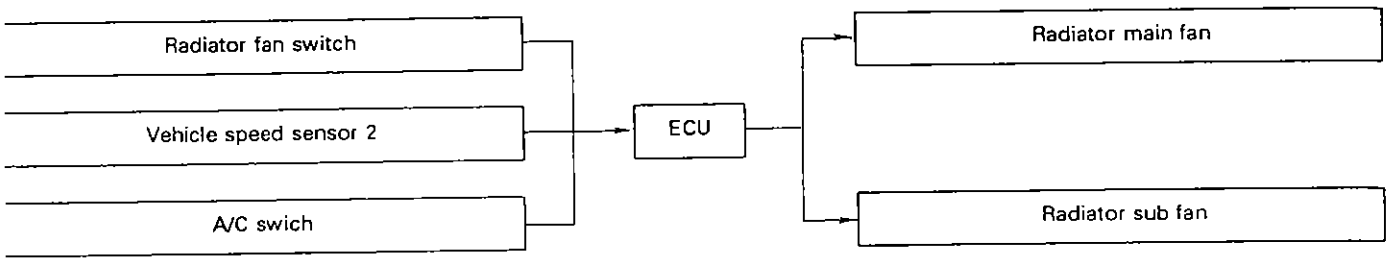
Pag
M MECHANISM AND FUNCTION .....
1. General .....
2. Cooling Lines .....
3. Water Pump .....
4. Mechanical Seal .....
5. Thermostat .....
6. Coolant Filler Tank .....
S SPECIFICATIONS AND SERVICE DATA .....
A: SPECIFICATIONS .....
B: SERVICE DATA .....
C COMPONENT PARTS .....
1. Water Pump .....
2. Radiator and Radiator Fan .....
3. Water Pipe .....
W SERVICE PROCEDURE .....
1. Water Pump .....
2. Thermostat .....
3. Radiator .....
4. Radiator Cap (Filler Tank Cap on Turbo Model) .....
5. Radiator Fan and Fan Motor .....
6. Coolant Filler Tank .....
T TROUBLESHOOTING .....

M MECHANISM AND FUNCTION

neral

he engine cooling system consists of a cross-flow idiator which features high heat-dissipation perfor-iance, an electric motor fan, a water pump, a thermo-:at, and a radiator fan switch. The reserve tank is esigned to eliminate the need for replenishing coolant.

On models without an air conditioner, the ECU sends an ON or OFF switch signal to the radiator fan in response to signals from the thermometer and speed sensor. On models with an air conditioner, the ECU sends ON or OFF, and Lo (low) or Hi (high) switch signals to the radiator main fan and sub fan in response to signals from the thermomerter, vehicle speed sensor 2 and A/C switch. (As to A/C fan, refer to chapter 4-7.)



2. Cooling Lines

. MPFI Non-TURBO MODEL

his cooling system operates in three steps depending n the temperature of the coolant flowing through the ooling circuit.

) 1st step ... With thermostat closed

nt temperature of below 76°C (169°F), the ther-remains closed and the coolant flows through he bypass and heater circuits.

his permits the engine to warm up quickly.

2) 2nd step ... With thermostat opened

When the coolant temperature is above 76 — 80°C (169 — 176°F), the thermostat opens and the coolant flows through the radiator where it is cooled.

3) 3rd step ... With radiator fan operating

When the coolant temperature rises above 95°C (203°F), the radiator fan switch is turned on and the radiator fan rotates.

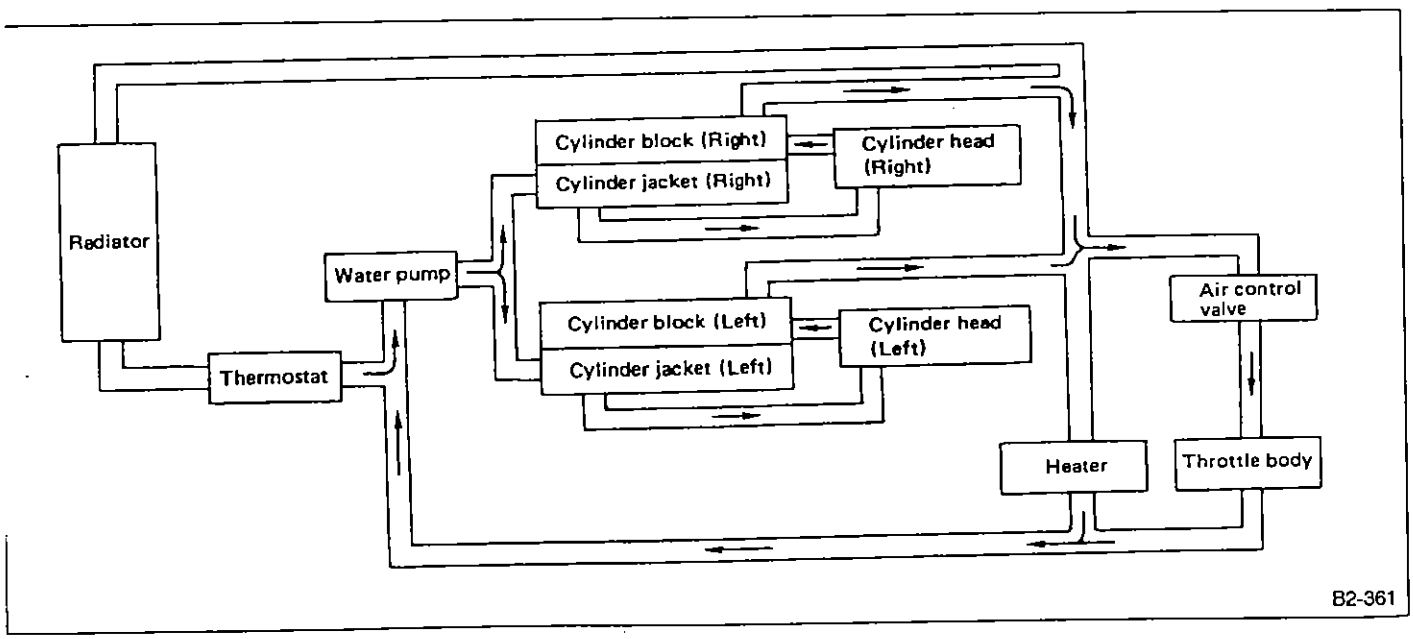


Fig. 1

2. TURBO MODEL

1) 1st step ... With thermostat closed
At coolant temperature of below 76°C (169°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 76 — 80°C (169 — 176°F), the thermostat opens and the coolant flows through the radiator where it is cooled.
3) 3rd step ... With radiator fan operating
When the coolant temperature rises above 95°C (203°F), the radiator fan switch is turned on and the radiator fan rotates.
4) When the engine is stopped after high-speed operations, vapor produced in the turbocharger cooling section is delivered from the coolant filler tank to the reservoir tank where it condenses back into water. Water is then absorbed by the coolant filler tank as the engine cools.

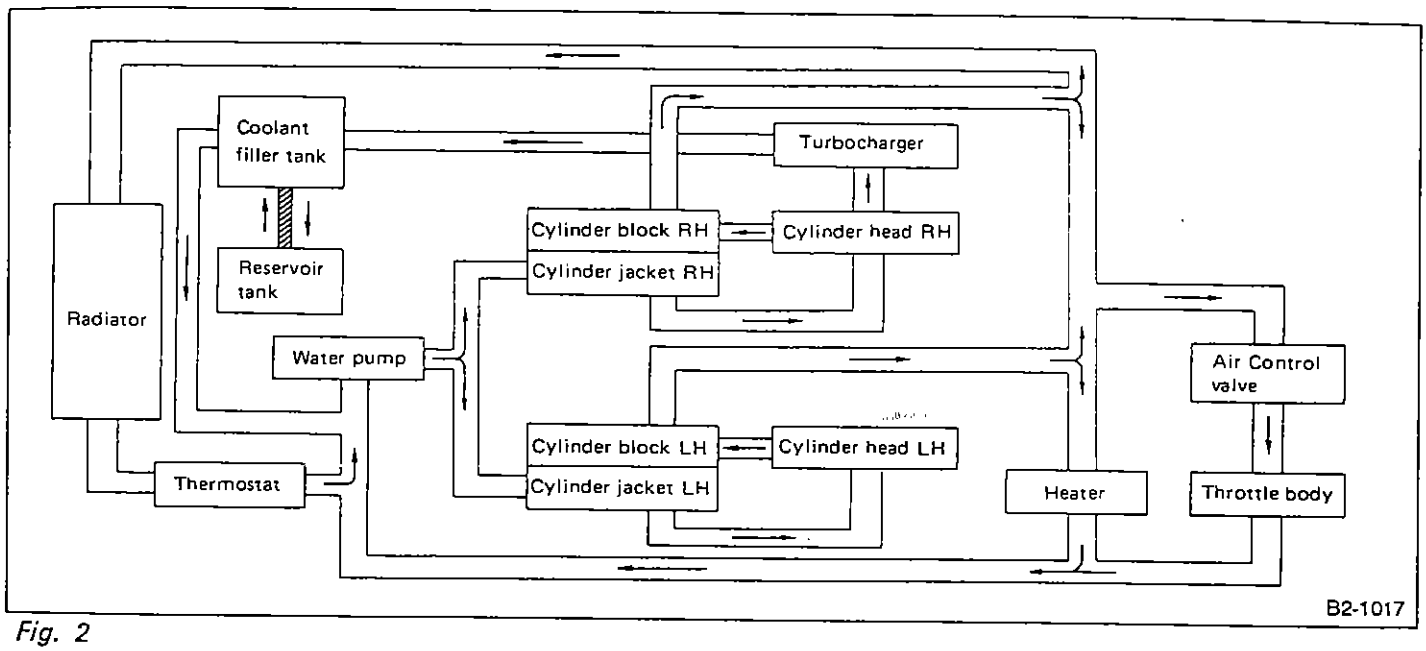


Fig. 2

3. Water Pump

The water pump is located on the left front portion of [illegible]ler block and is driven by the back of the timing belt. The thermostat is built into the water inlet located on the lower side of the water pump. When the impeller rotates, engine coolant is drawing into the water pump from the lower pipe (which is connected to the radiator hose) via the thermostat. It then flows along the perimeter of the impeller and is delivered to the engine's water passage.

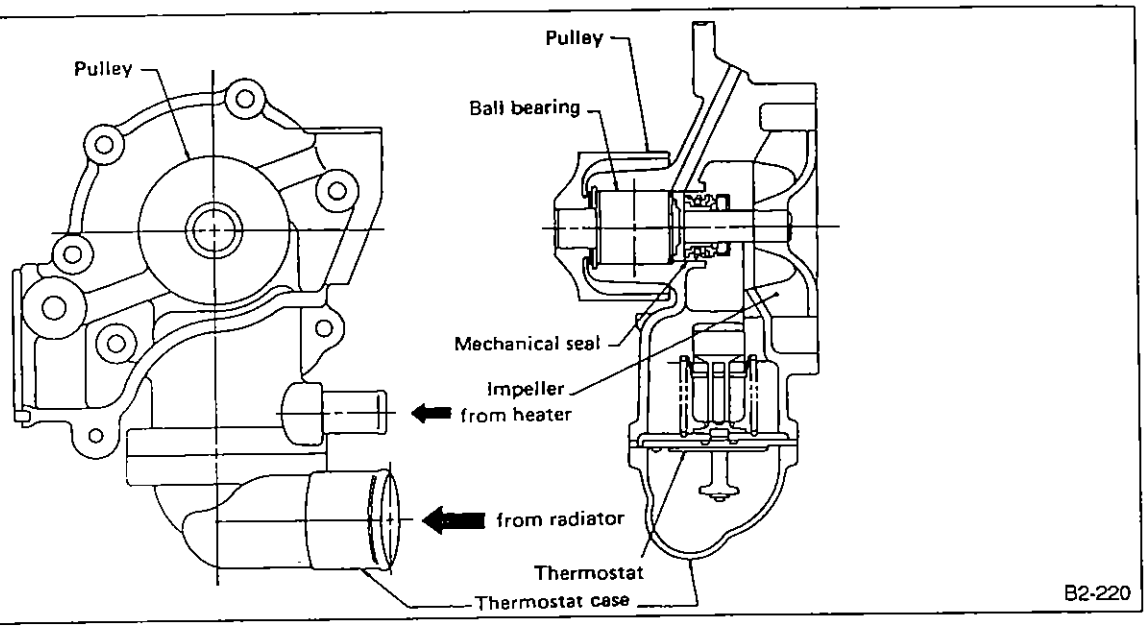


Fig. 3 MPFI Non-Turbo model

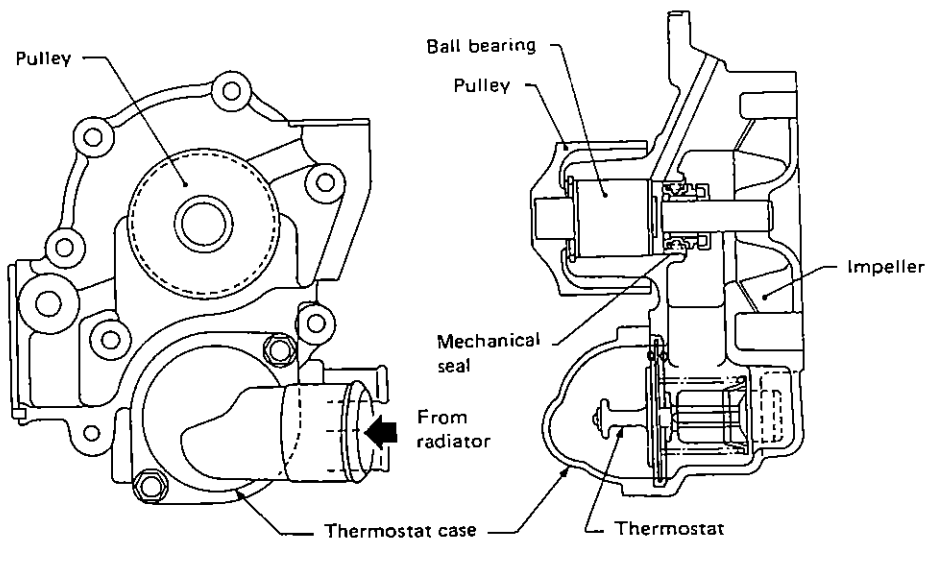


Fig. 4 MPFI Turbo model

4. Mechanical Seal

The mechanical seal has its seat pressed into the water pump shaft to form the seal and water pump as a single unit. With this design, the water pump cannot be disassembled.

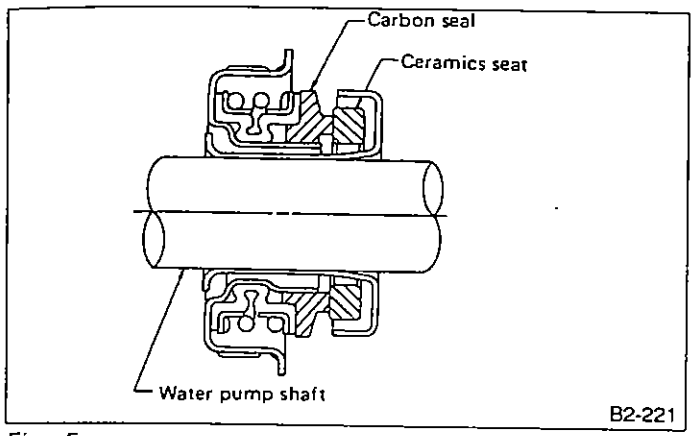


Fig. 5

5. 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.

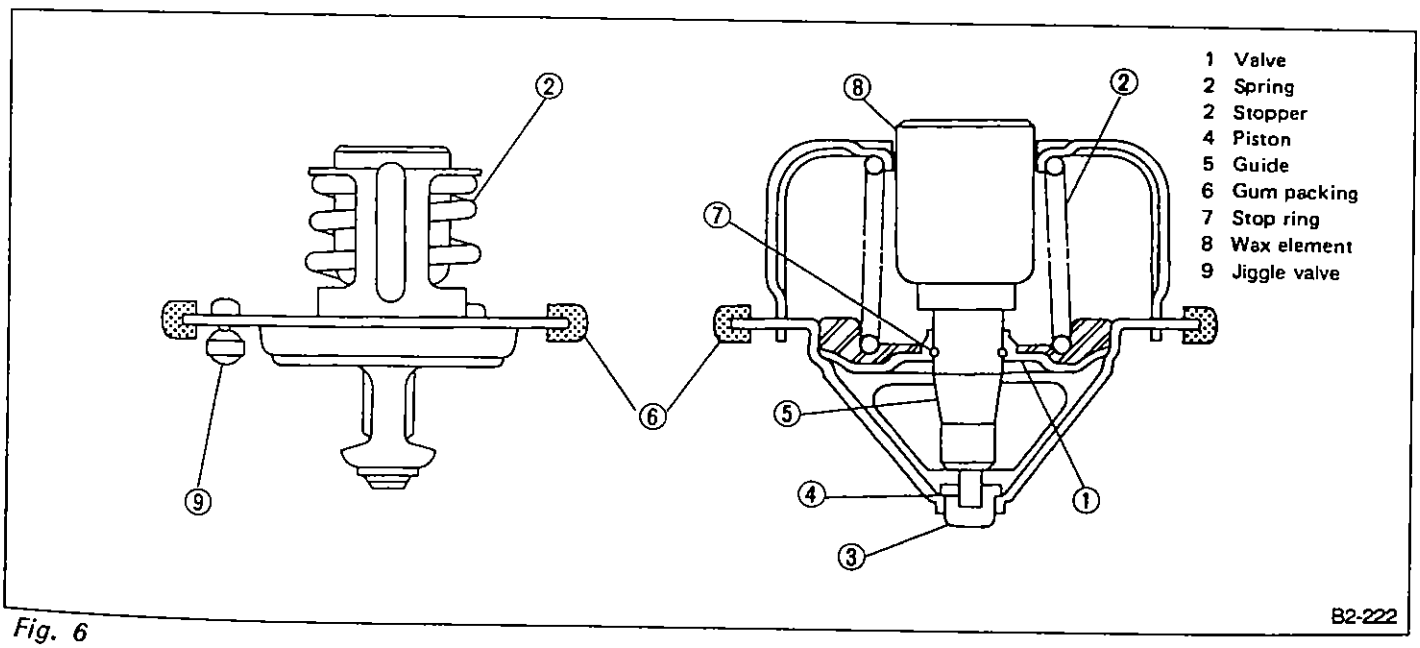


Fig. 6

6. Coolant Filler Tank

On TURBO models, the radiator is not equipped with a filler cap. The coolant filler tank, located above No. [illegible] cylinder, not only delivers coolant to the turbocharger, but also sends vapor produced in the turbocharger cooling section to the reservoir tank. This vapor condenses into water inside the reservoir tank and is then absorbed by the coolant filler tank.

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

ITEM \ MODEL			Non-TURBO	TURBO
Cooling system			Electric fan + Forced cooling water circulation system	
Total coolant capacity ℓ (US qt, Imp qt)		MT	6.4 (6.8, 5.6)	6.2 (6.6, 5.5)
		AT	6.35 (6.7, 5.6)	7.2 (7.6, 6.3)
Water pump	Type		Centrifugal impeller type	
	Discharge performance I	Discharge	20 ℓ (5.3 US gal, 4.4 Imp gal)/min.	
		Pump speed—total water head	760 rpm — 0.3 mAq (1.0 ftAq)	
		Water temperature	85°C (185°F)	
	Discharge performance II	Discharge	100 ℓ (26.4 US gal, 22.0 Imp gal)/min.	
		Pump speed—total water head	3,000 rpm — 5.0 mAq (16.4 ftAq)	
		Water temperature	85°C (185°F)	
	Discharge performance III	Discharge	200 ℓ (52.8 US gal, 44.0 Imp gal)/min.	
		Pump speed—total water head	6,000 rpm — 23.0 mAq (75.5 ftAq)	
		Water temperature	85°C (185°F)	
	Impeller diameter		76 mm (2.99 in)	
	Number of impeller vanes		8	
	Pump pulley diameter		60 mm (2.36 in)	
Thermostat	Type		Wax pellet type	
	Starts to open		76 — 80°C (169 — 176°F)	
	Fully opened		91°C (196°F)	
	Valve lift		9.0 mm (0.354 in) or more	
	Valve bore		35 mm (1.38 in)	
Radiator fan	Motor		120 W	140 W
	Fan dia.		340 mm (13.39 in), 350 mm (13.78 in)*	
Radiator	Type		Cross flow, pressure type	
	Core dimensions		670 x 361 x 16 mm (26.38 x 14.21 x 0.63 in)	670 x 394 x 25 mm (26.38 x 15.51 x 0.98 in)
	Pressure range in which cap valve is open		Above: 88± 10 kPa (0.9± 0.1 kg/cm^2, 12.8± 1.4 psi) Below: − 4.9 to − 9.8 kPa (− 0.05 to − 0.1 kg/cm^2, − 0.7 to − 1.4 psi)	
	Fins		Corrugated fin type	
Reservoir	Capacity		0.55 ℓ (0.6 US qt, 0.5 Imp qt)	

*: A/C equipped model

B: SERVICE DATA

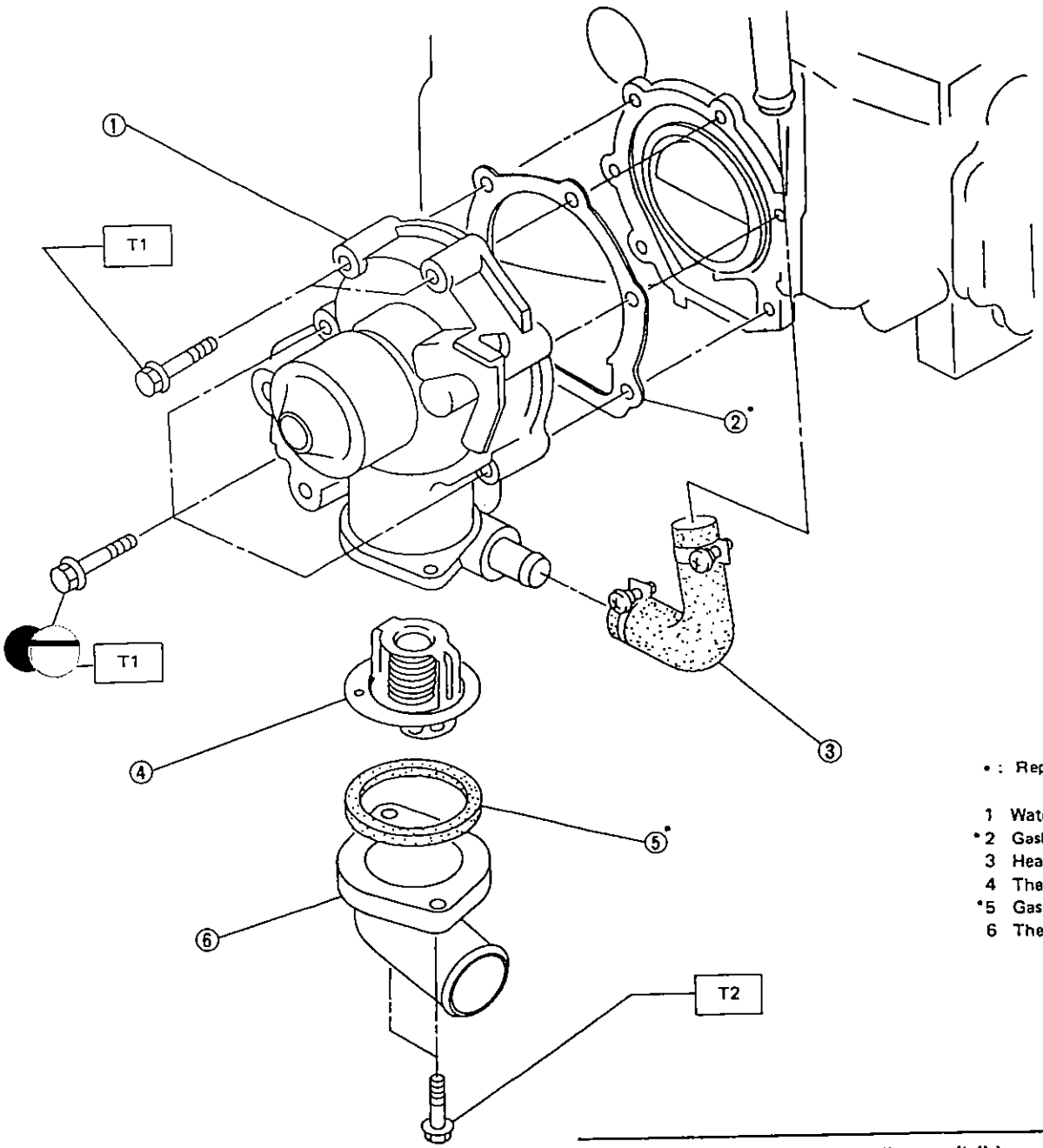
Unit: mm (in)

Water pump	Clearance between impeller and case	Standard 0.5 — 0.7 (0.020 — 0.028) Limit 1.0 (0.039)
	"Thrust" runout of impeller end	0.5 (0.020)

C COMPONENT PARTS

Water Pump

1. MFI Non-TURBO MODEL



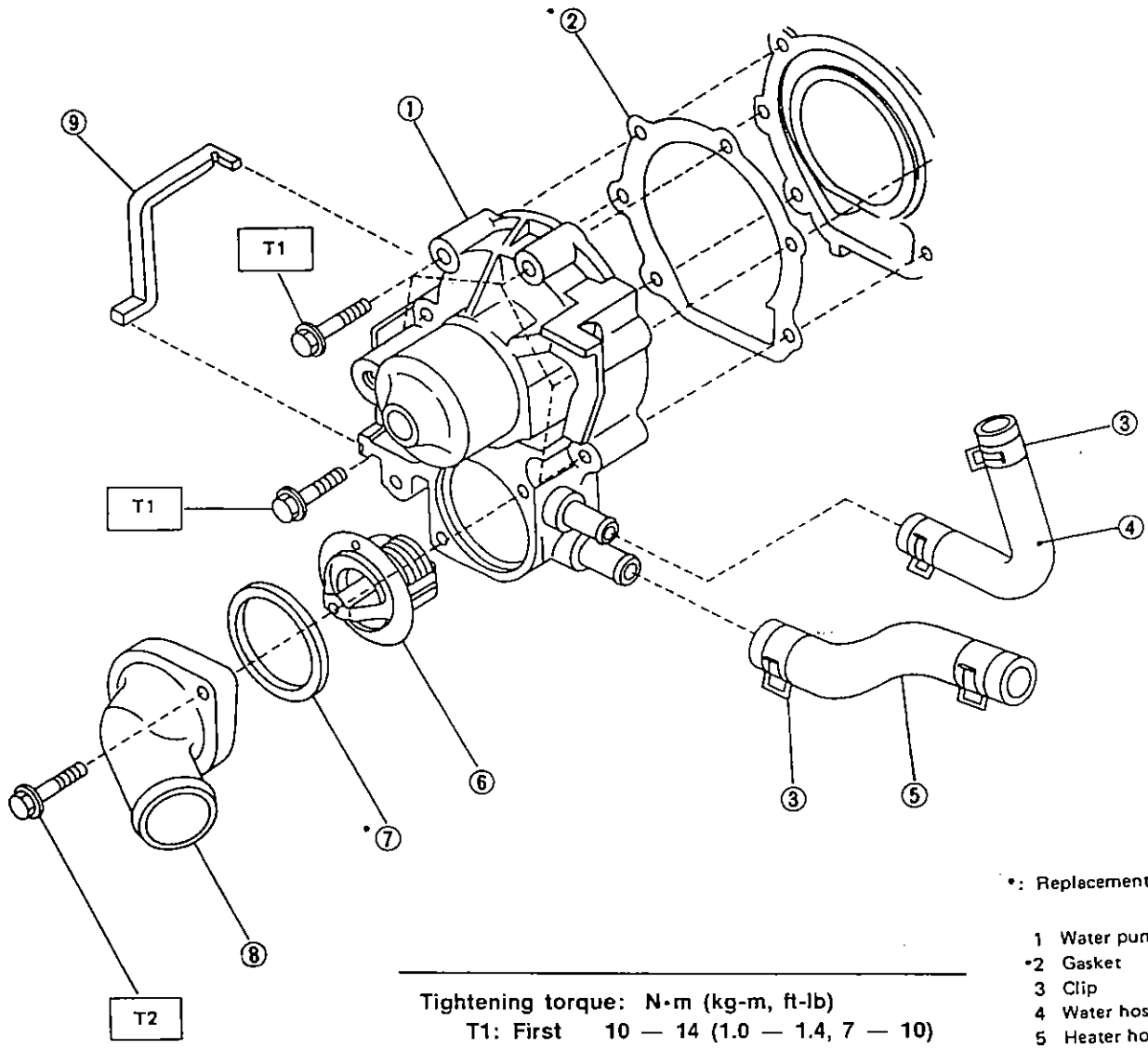
• : Replacement part

1 Water pump ASSY
•2 Gasket
3 Heater hose
4 Thermostat
•5 Gasket
6 Thermostat case

Tightening torque: N·m (kg-m, ft-lb)	
T1: First	10 — 14 (1.0 — 1.4, 7 — 10)
Second	10 — 14 (1.0 — 1.4, 7 — 10)
T2:	6 — 7 (0.6 — 0.7, 4.3 — 5.1)

B2-223

2. TURBO MODEL



Tightening torque: N·m (kg-m, ft-lb)
T1: First 10 — 14 (1.0 — 1.4, 7 — 10)
Second 10 — 14 (1.0 — 1.4, 7 — 10)
T2: 6 — 7 (0.6 — 0.7, 4.3 — 5.1)

•: Replacement part

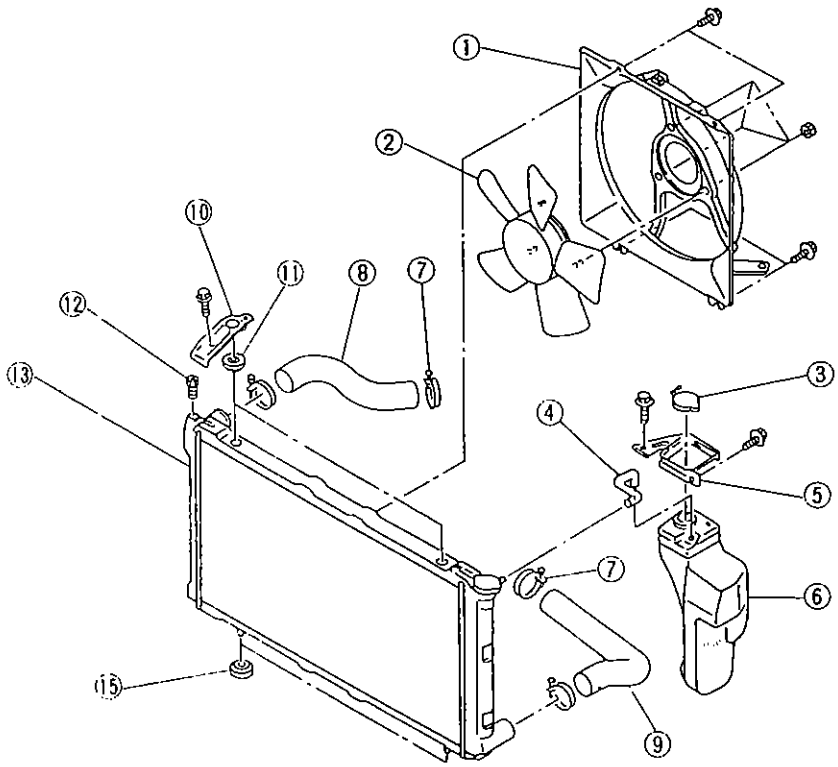
1 Water pump ASSY
•2 Gasket
3 Clip
4 Water hose
5 Heater hose
6 Thermostat
•7 Gasket
8 Thermostat case
9 Water pump seal

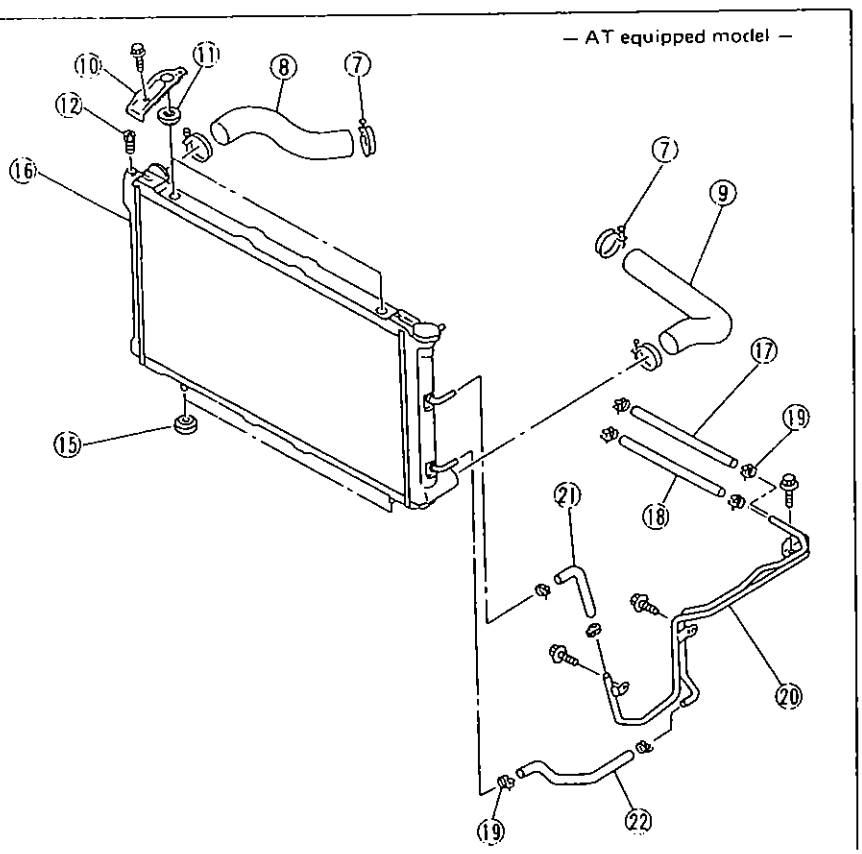
B2-974

Fig. 8

2. Radiator and Radiator Fan

MODEL Non-TURBO MODEL





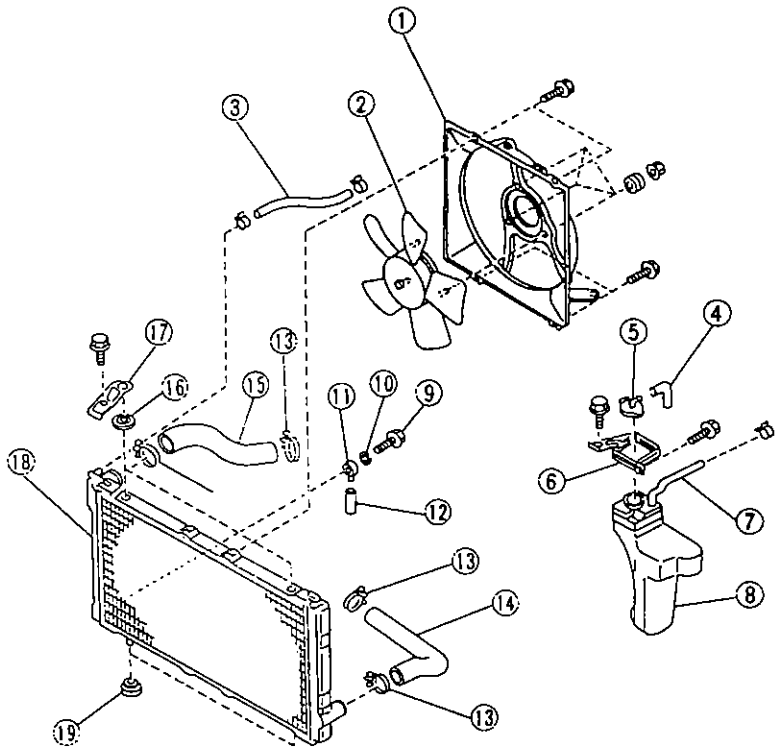
1 Shroud
2 Fan and motor
3 Reservoir tank cap
4 Overflow hose
5 Reservoir tank bracket
6 Reservoir tank
7 Hose clamp
8 Radiator inlet hose
9 Radiator outlet hose
10 Radiator bracket
11 Upper cushion
12 Air vent plug
13 Radiator
14 Radiator cover
15 Lower cushion

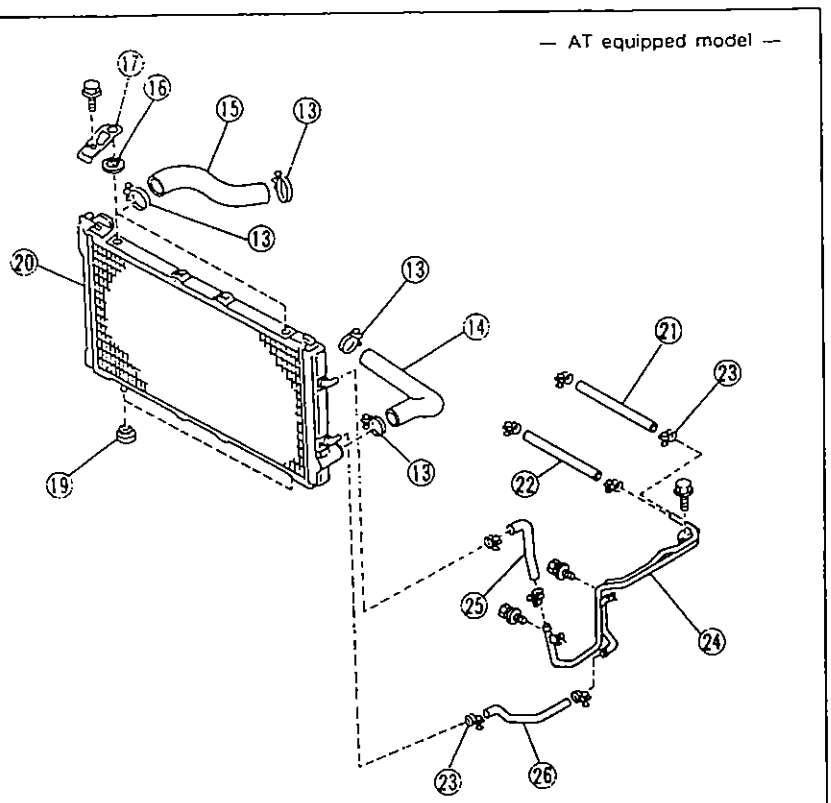
— AT equipped model —
16 Radiator
17 ATF inlet hose A
18 ATF outlet hose A
19 Hose clip
20 ATF pipe
21 ATF inlet hose B
22 ATF outlet hose B

B2-1018

Fig. 9

2. MPFI TURBO MODEL





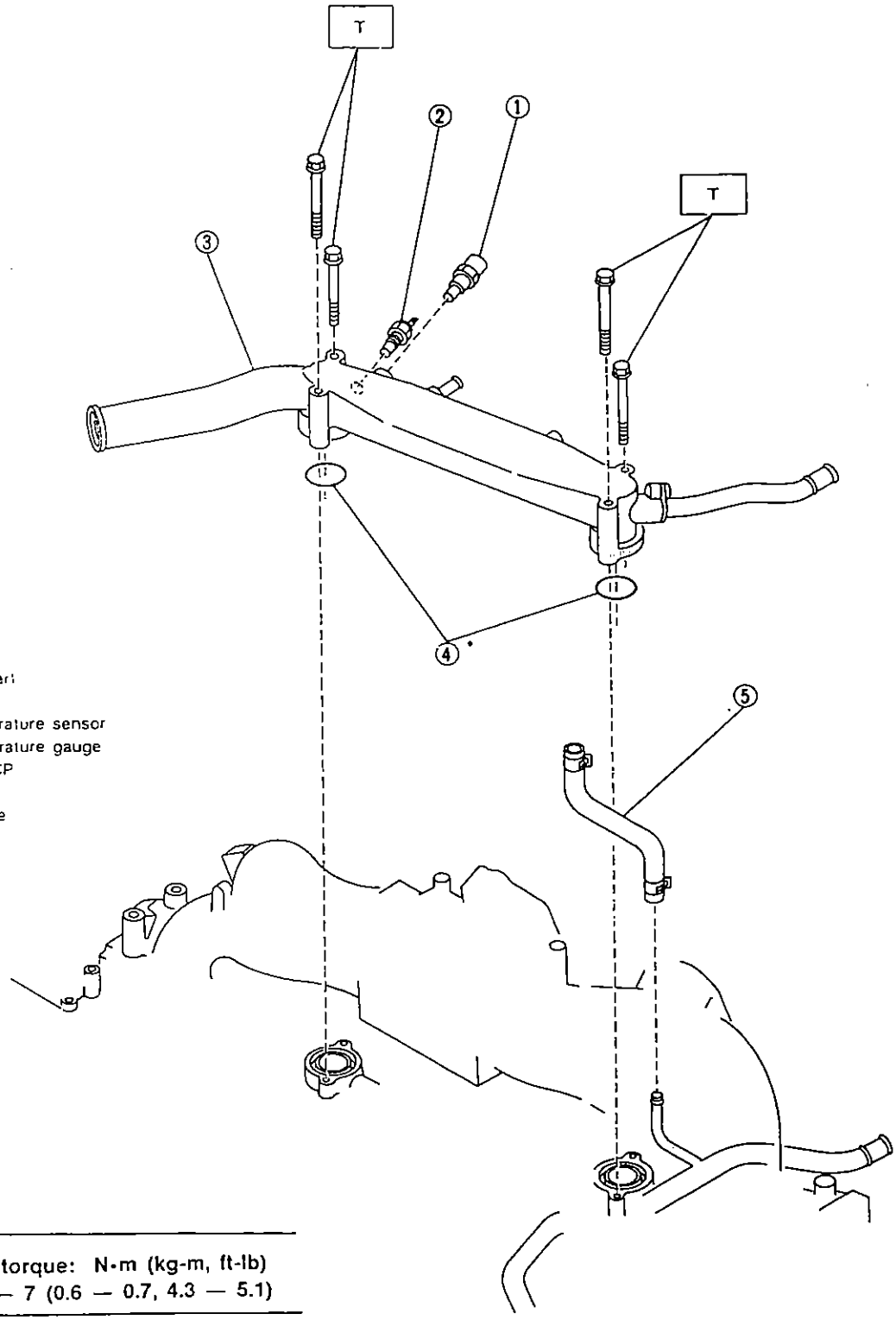
1 Shroud
2 Radiator main fan ASSY
3 Water hose (to filler tank)
4 Overflow hose A
5 Reservoir tank cap
6 Reservoir tank bracket
7 Overflow hose B
8 Reservoir tank
9 Drain cock
10 Packing
11 Drain guide
12 Drain tube
13 Hose clamp
14 Radiator outlet hose
15 Radiator inlet hose
16 Upper cushion
17 Radiator bracket
18 Radiator
19 Lower cushion
— AT equipped model —
20 Radiator
21 ATF inlet hose A
22 ATF outlet hose A
23 Hose clip
24 ATF pipe ASSY
25 ATF inlet hose B
26 ATF outlet hose B

B2-986

Fig. 10

3. Water Pipe

[ ] Non-TURBO MODEL



*: Replacement part

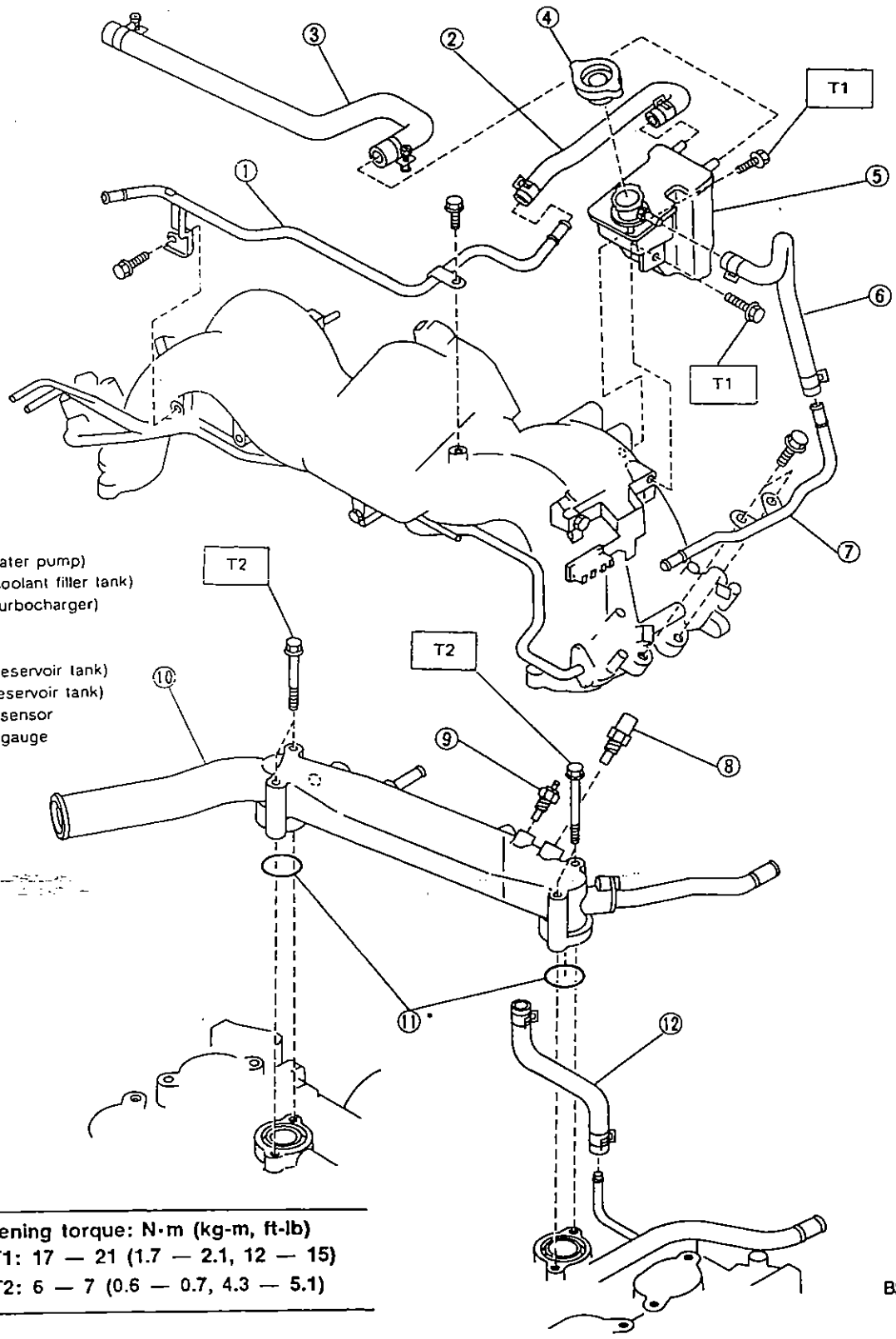
1 Water temperature sensor
2 Water temperature gauge
3 Water pipe CP
*4 O-ring
5 By-pass hose

Tightening torque: N·m (kg-m, ft-lb)
T : 6 — 7 (0.6 — 0.7, 4.3 — 5.1)

B2-987

Fig. 11

2. MPFI TURBO MODEL



*: Replacement part

1 Water pipe A (To water pump)
2 Water hose A (To coolant filler tank)
3 Water hose B (To turbocharger)
4 Tank cap
5 Coolant filler tank
6 Water hose C (To reservoir tank)
7 Water pipe C (To reservoir tank)
8 Water temperature sensor
9 Water temperature gauge
10 Water pipe CP
*11 O-ring
12 By-pass hose

Tightening torque: N·m (kg-m, ft-lb)
T1: 17 — 21 (1.7 — 2.1, 12 — 15)
T2: 6 — 7 (0.6 — 0.7, 4.3 — 5.1)

Fig. 12

W SERVICE PROCEDURE

1. Water Pump

A: 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.

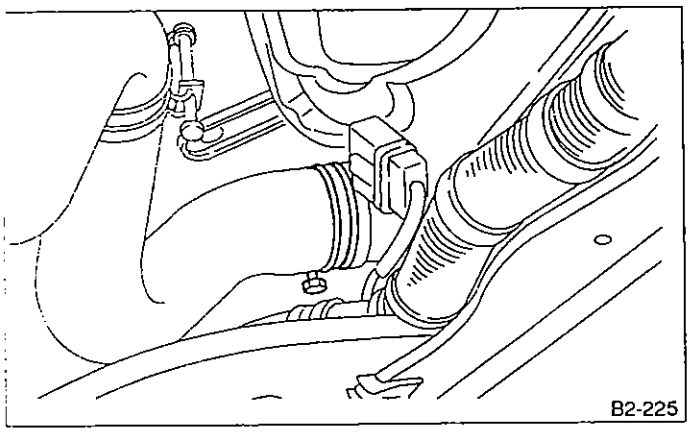


Fig. 13

5) Remove radiator fan motor ASSY.

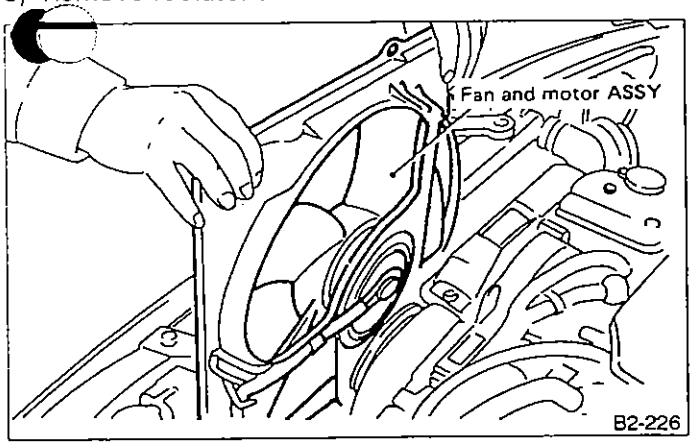


Fig. 14

6) Remove V-belt(s).
(Refer to "Chapter 1-5 section 1".)
7) Remove timing belt.
(Refer to "Chapter 1-5 section 2".)
8) Remove tensioner adjuster.
9) Remove cam angle sensor.
10) Remove left side camshaft pulley.

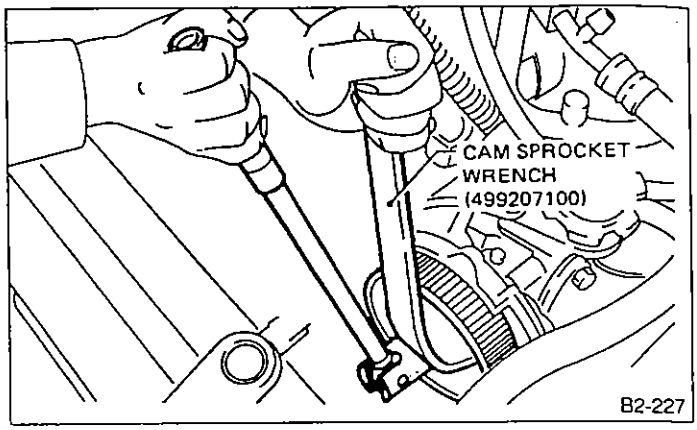


Fig. 15

11) Remove left side rear timing belt cover.

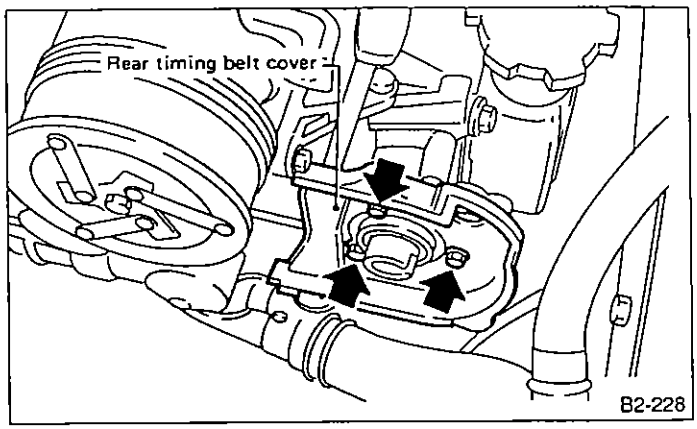


Fig. 16

12) Remove tensioner bracket.
13) Disconnect radiator hose and heater hose from water pump.
14) Remove water pump.

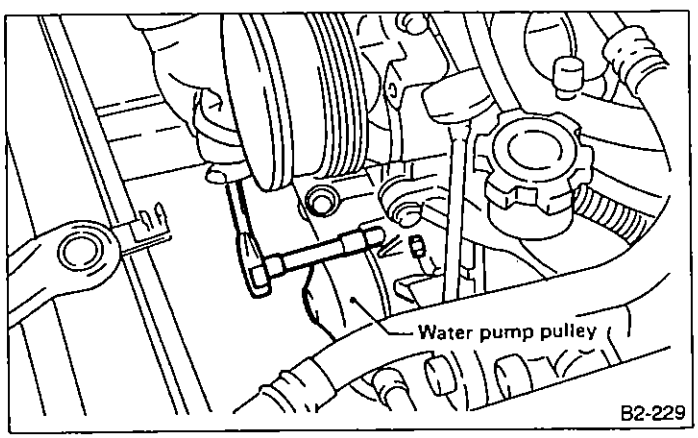


Fig. 17

B: INSPECTION

1) Check water pump bearing for smooth rotation.
2) Check water pump pulley for abnormalities.
3) Using a dial gauge, measure impeller runout in thrust direction while rotating the pulley.

"Thrust" runout limit:
0.5 mm (0.020 in)

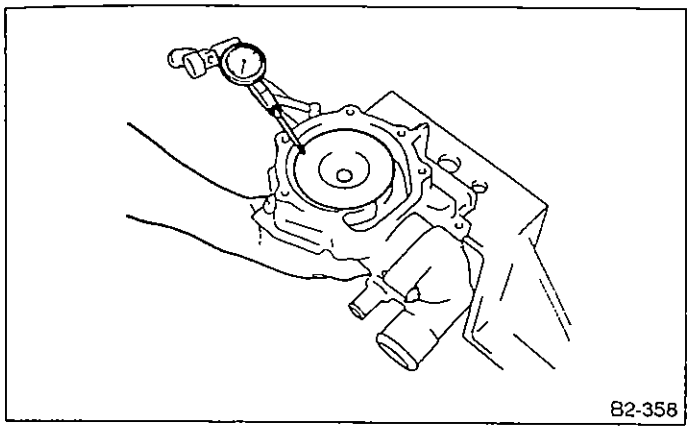


Fig. 18

4) Check clearance between impeller and pump case.

Clearance between impeller and pump case:
Standard
0.5 — 0.7 mm (0.020 — 0.028 in)
Limit
1.0 mm (0.039 in)

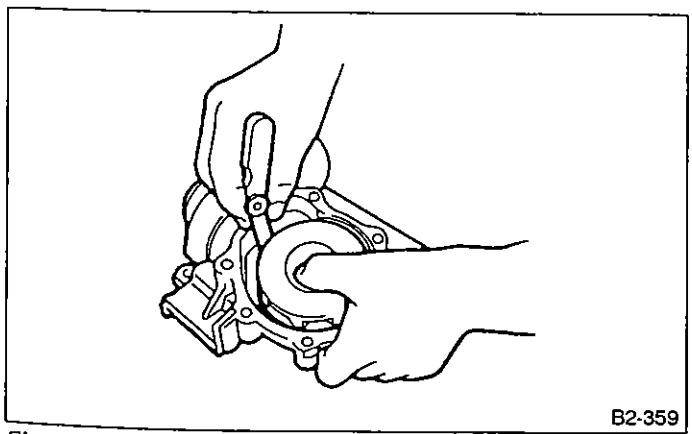


Fig. 19

5) After water pump installation, check pulley shaft for water leaks. If leaks are noted, replace water pump ASSY.

C: INSTALLATION

Installation is in the reverse order of removal.
a. Always use a new gasket.
b. When installing water pump, tighten bolts in two stages in numerical sequence as shown in figure.

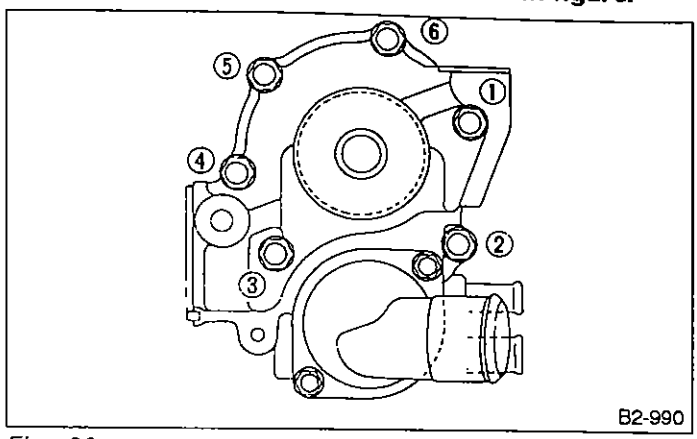


Fig. 20

c. After reinstalling the water pump, run the engine to make sure that neither water leakage nor abnormal noise exists.

2. Thermostat

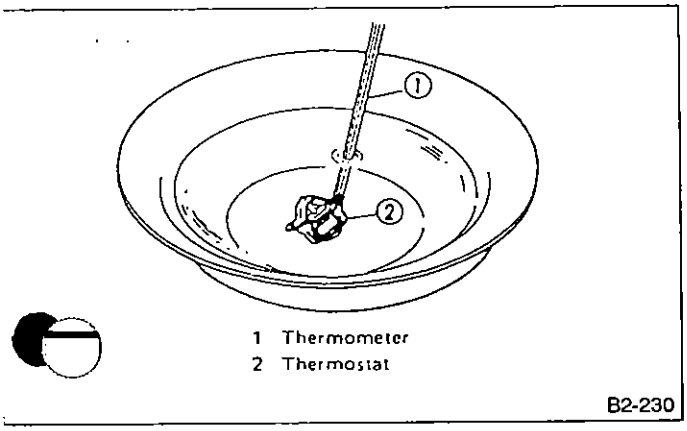
A: REMOVAL AND INSTALLATION

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.
c. In this time, set the jiggle pin of thermostat for front side.

B: INSPECTION

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:
76.0 — 80.0°C (169 — 176°F)
Fully opens:
91°C (196°F)



1 Thermometer
2 Thermostat

B2-230

Fig. 21

3. Radiator

A: ON CAR SERVICE

1) Remove radiator cap, top off radiator, and attach tester to radiator in place of cap.
On turbo model, check at coolant filler tank 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.

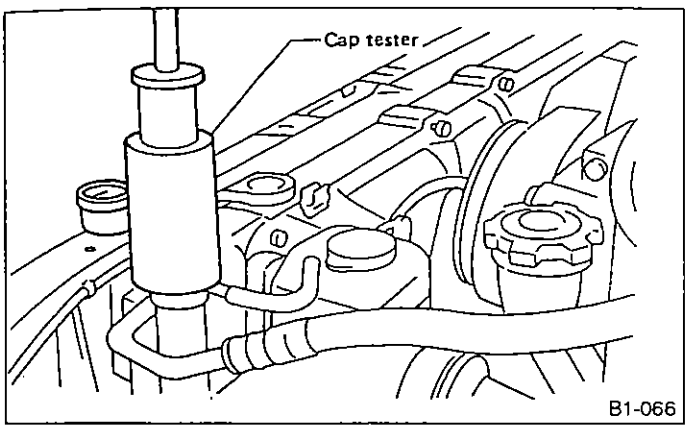


Fig. 22

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.

B: REMOVAL

1) Disconnect battery cables and remove battery from body.
2) Drain coolant.
3) Disconnect inlet and outlet hoses from engine.
Drain coolant into container.
4) Remove V-belt cover.

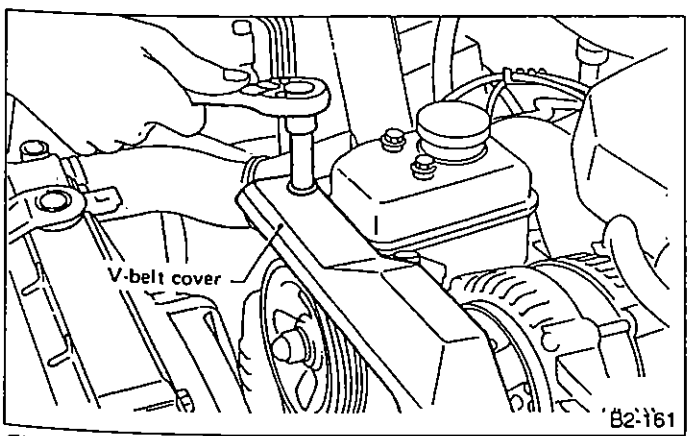


Fig. 23

5) Remove reservoir tank and over-flow hose.
6) Disconnect connectors of radiator main fan and sub fan motor.
7) Remove radiator brackets.

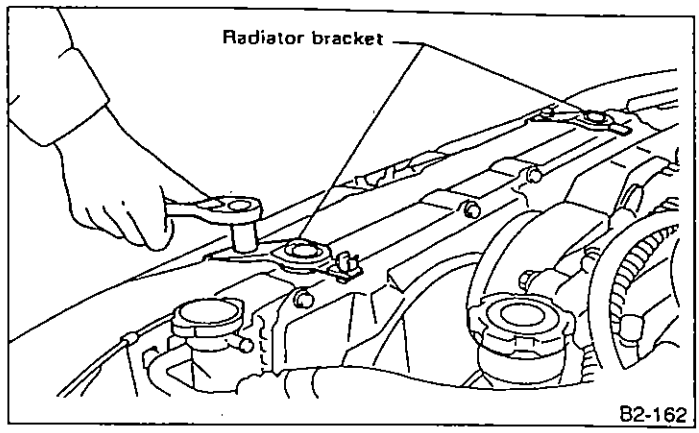


Fig. 24

8) While slightly lifting radiator, slide it to left.
9) Disconnect ATF cooler hoses from radiator.
Drain ATF into container.

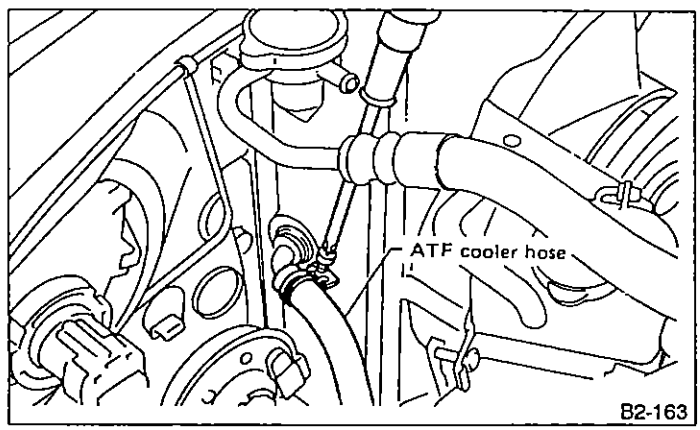


Fig. 25

10) Lift radiator up and away from vehicle.

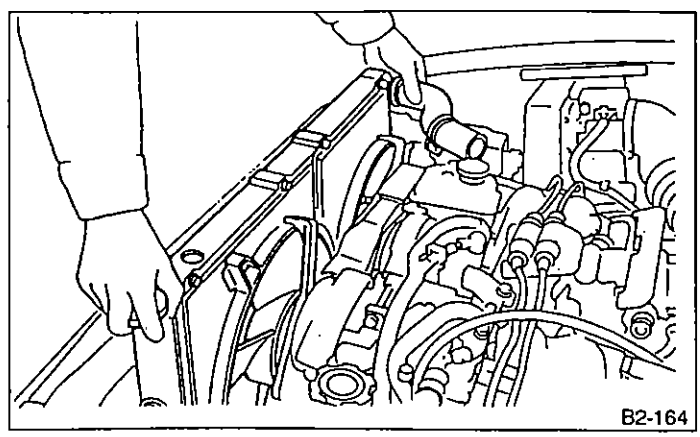


Fig. 26

C: INSTALLATION

) radiator mounting cushions to pins on the ower side of radiator.

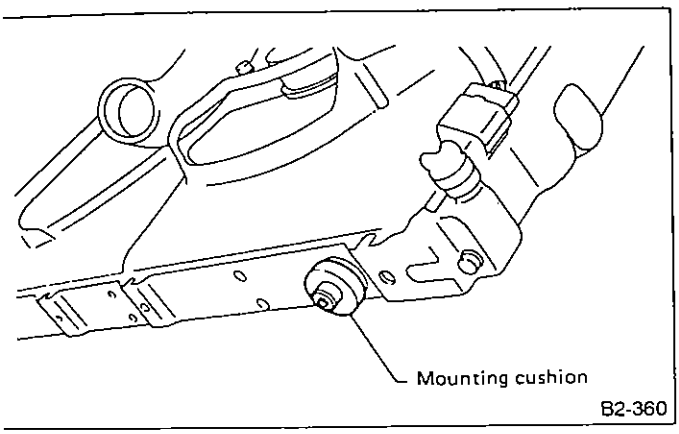


Fig. 27

2) Fit cushions, on lower side of radiator, into holes on body side and install radiator.

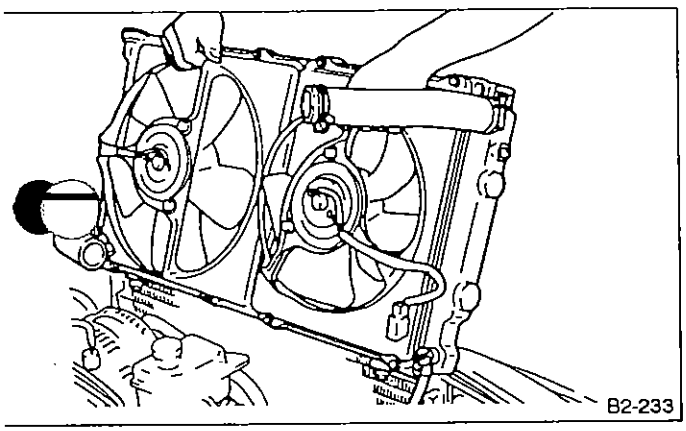


Fig. 28

3) Install radiator brackets and tighten bolts.
4) Connect radiator main fan motor and sub fan motor connectors.
5) Connect radiator hoses (inlet and outlet).
6) Install reservoir tank and over-flow hose.
7) Install V-belt.
8) Pour coolant.
   (1) Remove air vent plug on radiator. (Non-turbo model only)
   (2) Pour coolant into radiator up to filler neck position.

On turbo models, always pour coolant into coolant filler tank.

(3) Pour coolant into reservoir tank up to upper level.
(4) Attach radiator cap, air vent plug and reservoir tank cap properly.
(5) Warm up engine completely. (For more than 5 minutes at 2,000 to 3,000 rpm.)
(6) Stop engine and wait until temperature drops to a safe level.
(7) Remove air vent plug and radiator cap.
(8) If coolant level drops in radiator, add coolant to filler neck position.
(9) If coolant level drops from upper level of reservoir tank, add coolant to upper level.
(10) Attach radiator cap, air vent plug and reservoir tank cap properly.

9) Connect ground cable to battery terminal.

4. Radiator Cap (Filler Tank Cap on Turbo Model)

A: INSPECTION

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.

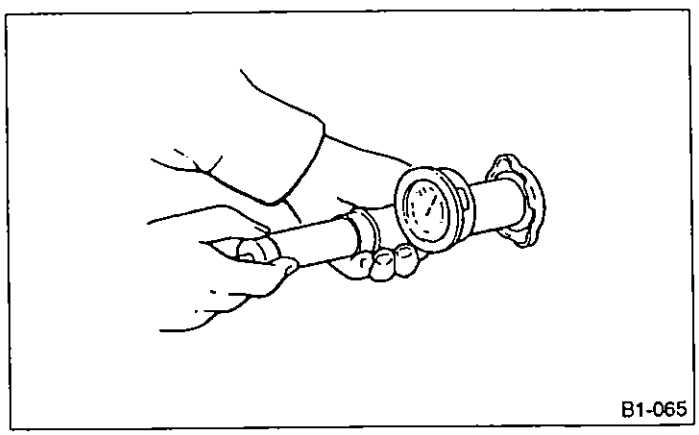


Fig. 29

Standard pressure:
78 — 98 kPa (0.8 — 1.0 kg/cm², 11 — 14 psi)
Service limit pressure:
69 kPa (0.7 kg/cm², 10 psi)

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

5. Radiator Fan and Fan Motor

A: REMOVAL

1) Disconnect ground cable from battery terminal.
2) Disconnect connector from fan motor.
3) Remove reservoir tank.
4) Loosen two bolts holding shroud to radiator underside.
5) Remove two bolts holding shroud to radiator upper side.
6) Remove radiator fan motor ASSY.

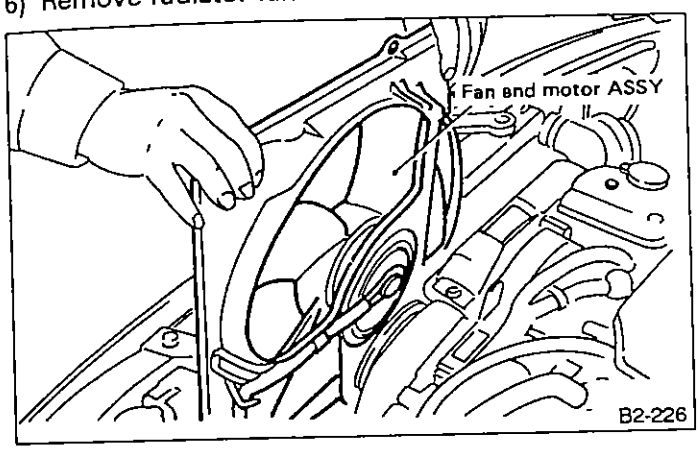


Fig. 30

7) Remove fan motor ASSY from shroud.

B: INSTALLATION

Installation is in the reverse order of removal procedures.
Observe the following:
1) Before installing radiator fan motor, apply a coat of sealant to threads and tighten nuts.
2) Make sure radiator 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.

6. Coolant Filler Tank

A: REMOVAL

1) Remove hoses from coolant filler tank.
2) Remove the two bolts, and remove coolant filler tank.

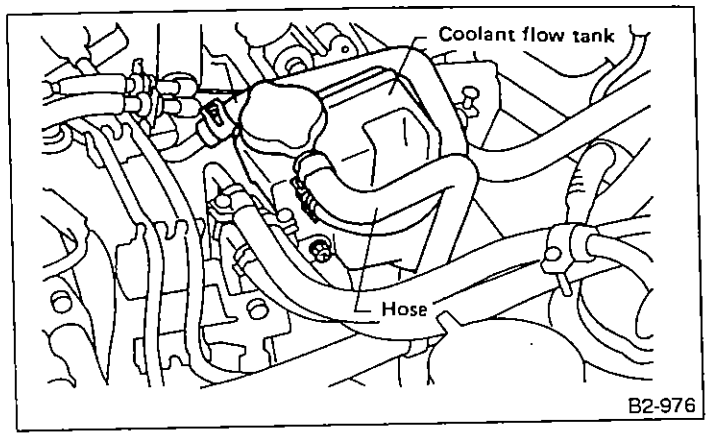


Fig. 31

B: INSTALLATION

Installation is in the reverse order of removal procedures.

T TROUBLESHOOTING

Trouble	Possible cause	Corrective action
Over-heating	a. Insufficient coolant.	Replenish coolant, inspect for leakage, and repair.
	b. Loose timing belt.	Repair or replace timing belt tensioner.
	c. Oil on drive belt.	Replace.
	d. Malfunction of thermostat.	Replace.
	e. Malfunction of water pump.	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.	Inspect radiator fan relay, water temperature sensor or motor, and replace there.
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.	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 radiator fan.	Replace.
	c. Defective water pump bearing.	Replace water pump.
	d. Defective water pump mechanical seal.	Replace water pump.

SUBARU®

1992

SERVICE MANUAL

Precaution for Supplemental Restraint System "Airbag"
The Supplemental Restraint System "Airbag" helps to reduce the risk or severity of injury to the driver in a frontal collision.
The Supplemental Restraint System consists of an airbag module (located in the center of the steering wheel), sensors, a control unit, warning light, wiring harness and spiral cable.
Information necessary to service the safety is included in the "5-5. SUPPLEMENTAL RESTRAINT SYSTEM" of this Service Manual.
WARNING:
- To avoid rendering the Airbag system inoperative, which could lead to personal injury or death in the event of a severe frontal collision, all maintenance must be performed by an authorized SUBARU dealer.
- Improper maintenance, including incorrect removal and installation of the Airbag system, can lead to personal injury caused by unintentional activation of the Airbag system.
- All Airbag system electrical wiring harnesses and connectors are covered with yellow outer insulation. Do not use electrical test equipment on any circuit related to the Supplemental Restraint System "Airbag".

		Page
M	MECHANISM AND FUNCTION	2
	1. General	2
	2. Air Line	4
	3. Fuel Line	6
	4. Sensor and Switch	9
	5. Control System	13
	6. Self-diagnosis System	24
	7. Turbocharger System	27
C	COMPONENT PARTS	30
	1. Intake Manifold	30
	2. Air Intake Duct and Throttle Body	32
	3. Air Cleaner	34
	4. Turbocharger Unit	35
W	SERVICE PROCEDURE	36
	1. Turbocharger System	36
T	TROUBLESHOOTING AIRBAG	39
	1. Supplemental Restraint System "Airbag"	39
	2. Precautions	39
	3. Pre-inspection	39
	4. Troubleshooting Chart for Self-diagnosis System	40
	5. Output Modes of Select Monitor	46
	6. Control Unit I/O Signal	48
	7. Troubleshooting for Engine Starting Failure	51
	8. Troubleshooting Chart with Trouble Code	60
	9. Troubleshooting Chart with Select Monitor	99
	10. General Troubleshooting Table	114

MECHANISM AND FUNCTION

neral

ne Multi Point Fuel Injection (MPFI) system is a system iat supplies the optimum air-fuel mixture to the engine r all the various operating conditions through the use f the latest electronic technology.

/ith this system fuel, which is pressurized at a constant ressure, is injected into the intake air passage of the ylinder head. The injection quantity of fuel is controlled y an intermittent injection system where the electro-iagnetic injection valve (fuel injector) opens only for a hort period of time, depending on the quantity of air equired for one cycle of operation. In actual operation, ne injection quantity is determined by the duration of n 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.

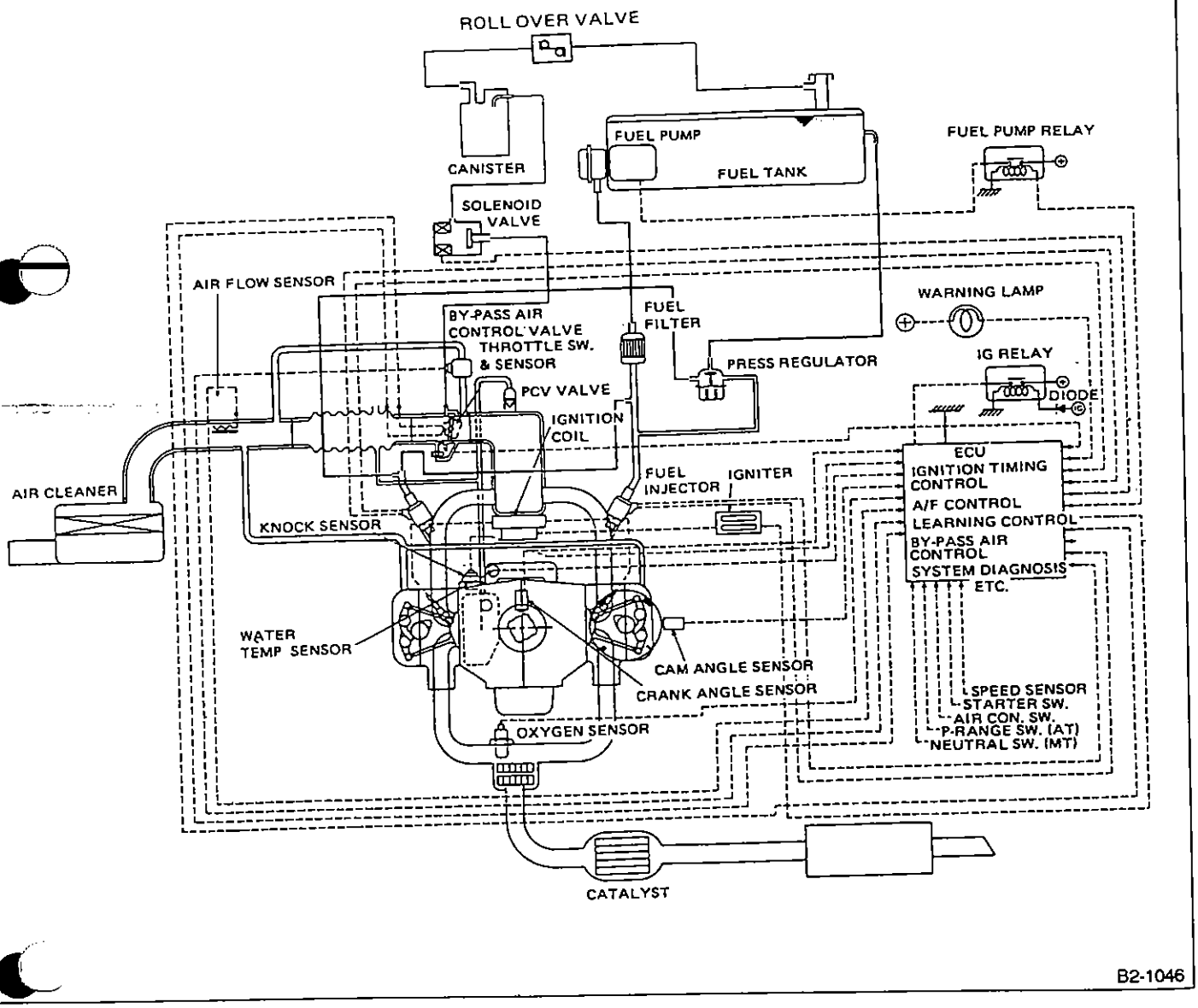
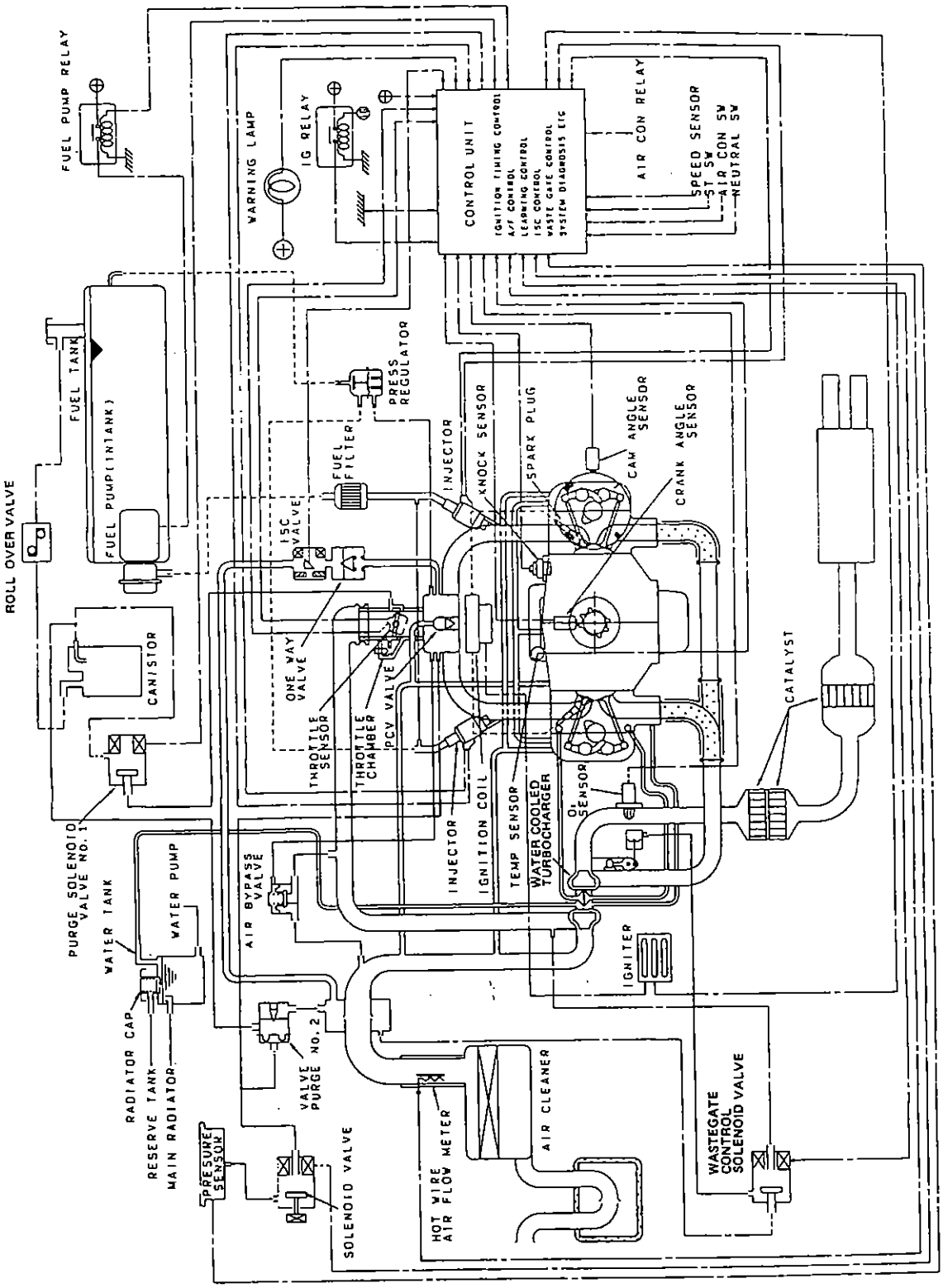


Fig. 1

[TURBO]



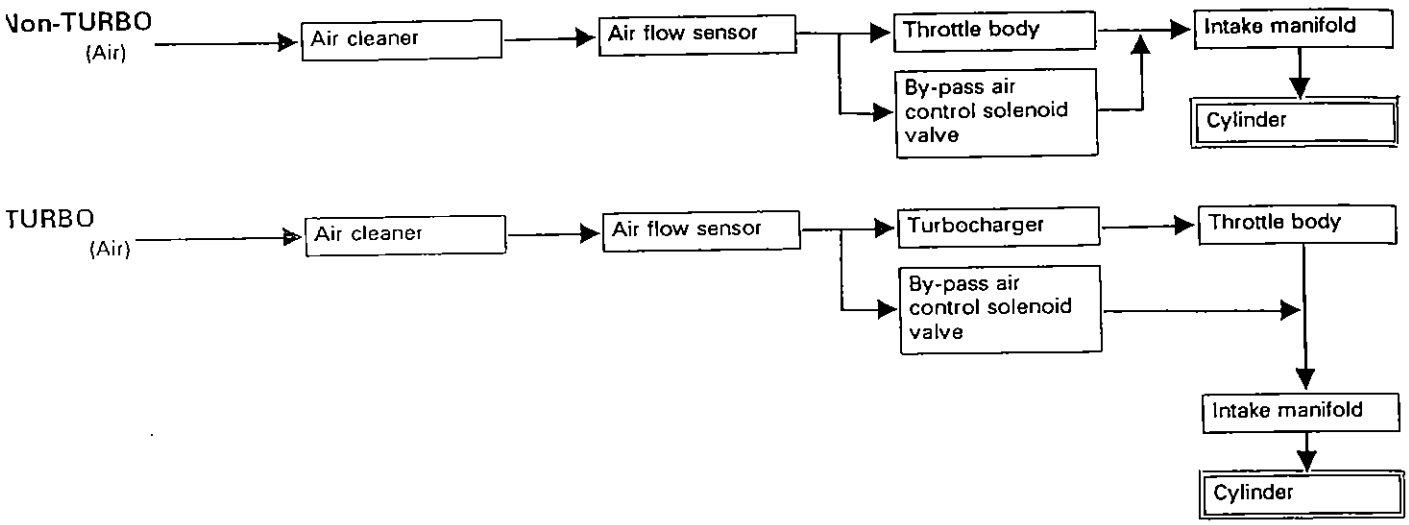
B2-1048

Fig. 2

2. Air Line

GENERAL

Air is drawn in and filtered by the air cleaner is metered and sent to the throttle body via the air intake boot. In a TURBO model, air is filtered by the air cleaner and metered by the air flow sensor. Air is then supercharged by the turbocharger, and sent to the throttle body via the air intake boot. From the throttle body, the air is regulated by the open-close operation of the throttle valve and is delivered to the intake manifold. It is then distributed to the respective cylinders to mix with fuel injected by the fuel injectors. Thus, the air-fuel mixture is delivered into the cylinder. Part of the air branched at the upstream of the throttle body is sent to the by-pass air control valve which regulates engine idle speed.



FLOW SENSOR

The EFI system employs a hot-film type (Non-TURBO) or hot-wire type (TURBO) air flow sensor.

These air flow sensors convert 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 film or hot wire) located in the air intake.

The features of these flow sensor types are as follows:

1) High-altitude compensation is made automatically.
2) Quick response.
3) There are no moving parts.
4) They are compact.

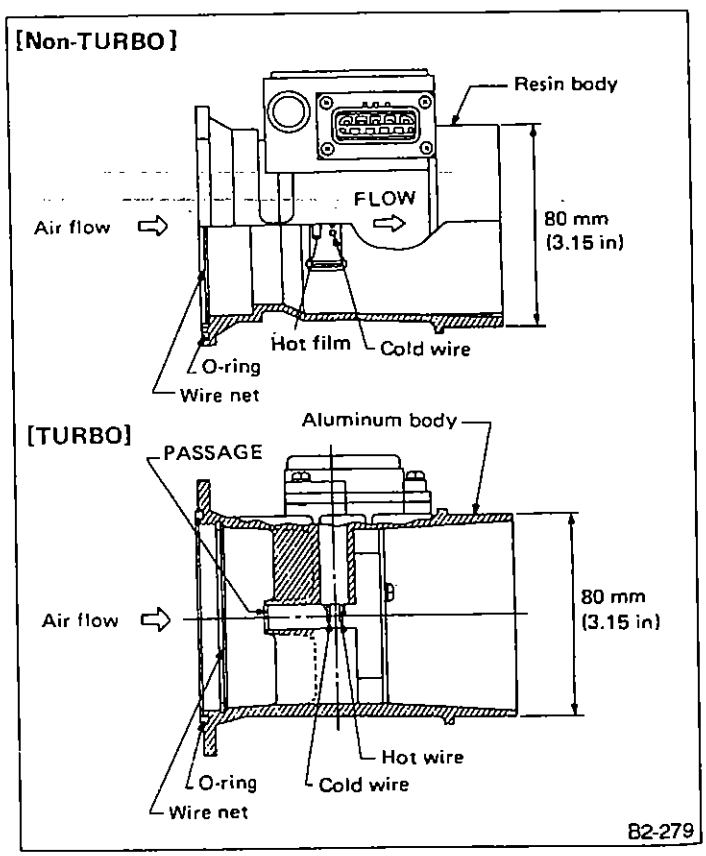


Fig. 3

3. 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.

During idling, the throttle valve is almost fully closed and the air flow through the throttle 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 by-pass air control valve. And the by-pass air control valve properly controls the number of revolutions in idling, so it does not need to be adjusted.

4. THROTTLE SENSOR

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.

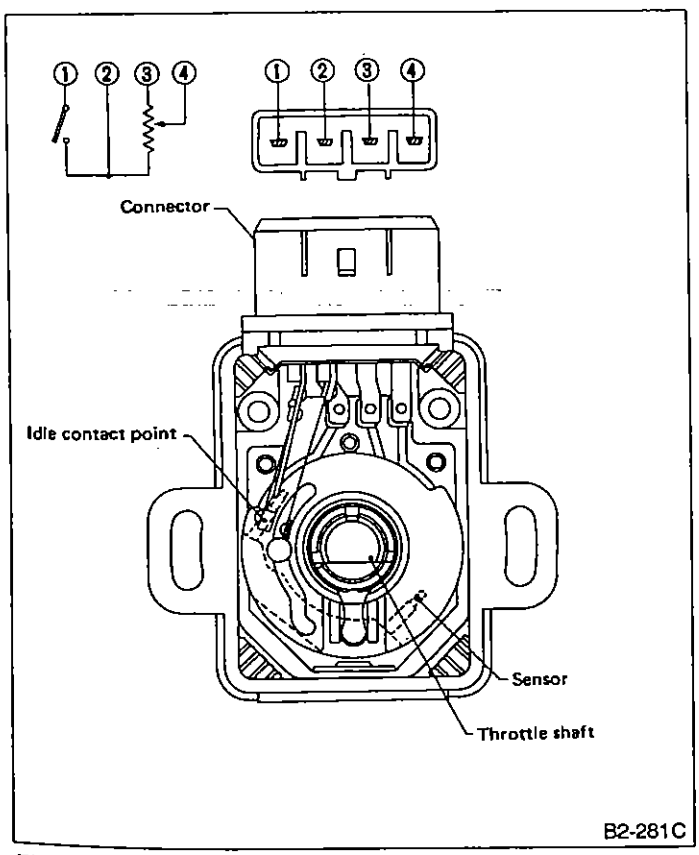


Fig. 4

5. BY-PASS AIR CONTROL SOLENOID VALVE

The by-pass air control solenoid valve consists of an air cut valve, duty control valve, intake air passage and a coolant passage.

The air cut valve contains a bimetallic substance which responds to coolant temperature, and a duty control valve which is operated by a signal sent from the ECU.

When the coolant temperature is low, the air cut valve is fully opened by the action of the bimetallic substance so that the air flow required for low coolant temperatures is maintained.

The ECU controls the duty control valve to bring the operating engine speed as close to preset idle speed as possible.

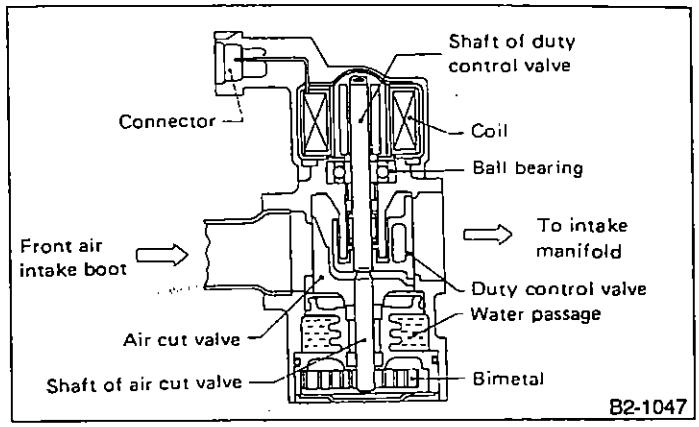


Fig. 5

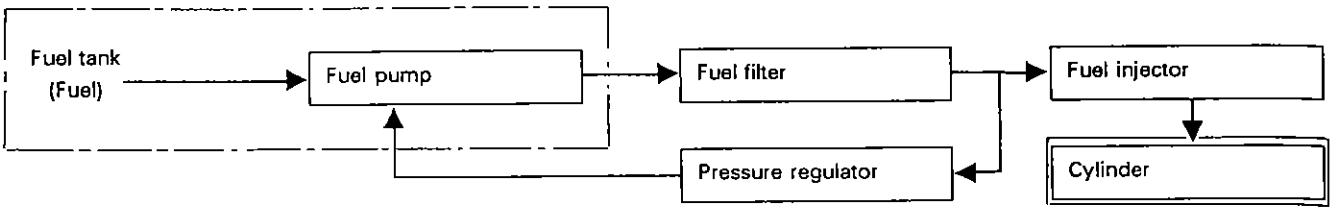
3. Fuel Line

GENERAL

Fuel is pressurized by the fuel pump built into the fuel tank and is delivered to fuel injectors by way of the fuel pipe and fuel filter. Fuel is regulated to the optimum pressure level by the pressure regulator on the way to the injectors.

From the injectors, fuel is injected into the intake manifold where it is mixed with intake air, and is then delivered to the respective cylinders.

Fuel injection timing and the amount of fuel injected is regulated by the ECU.



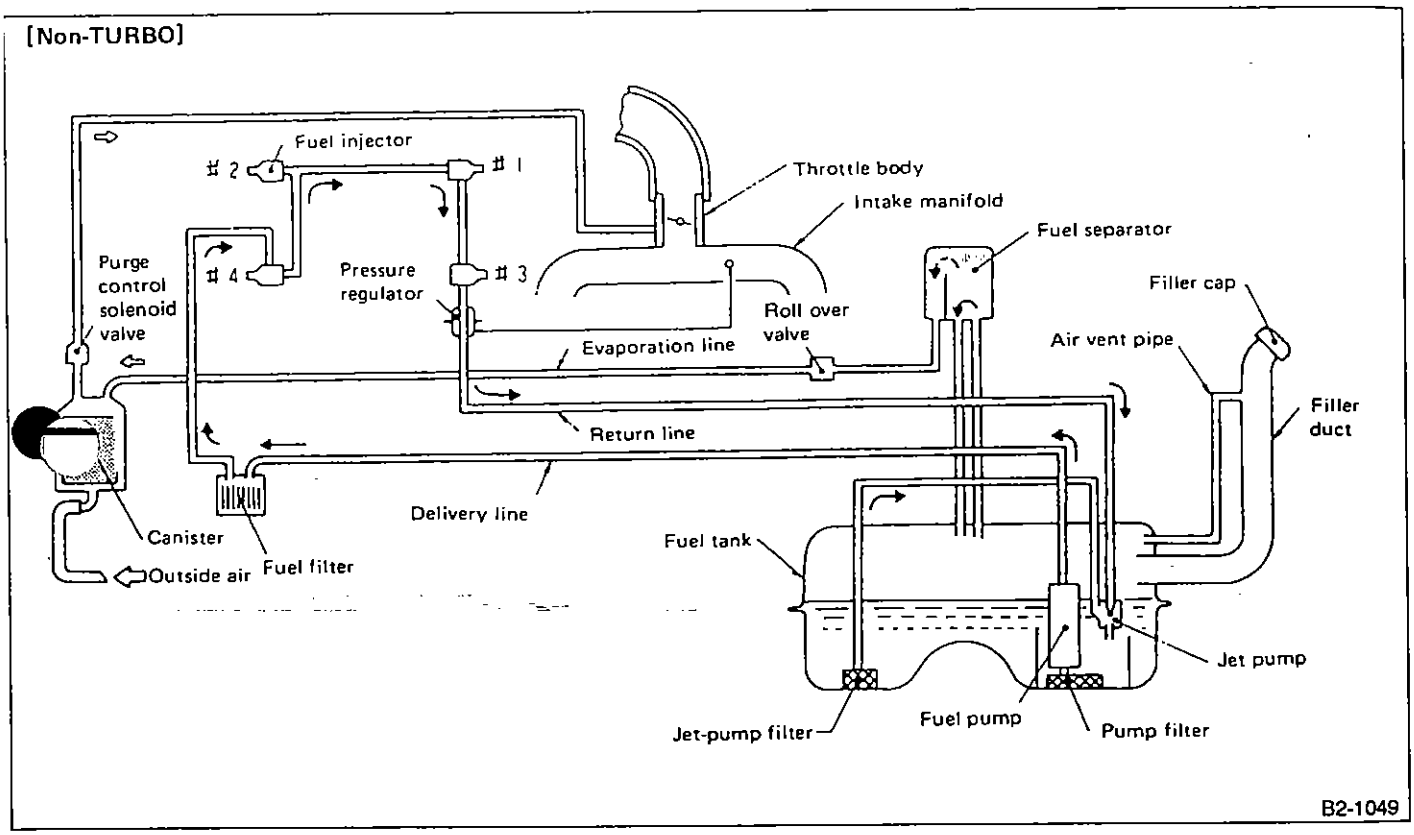


Fig. 6

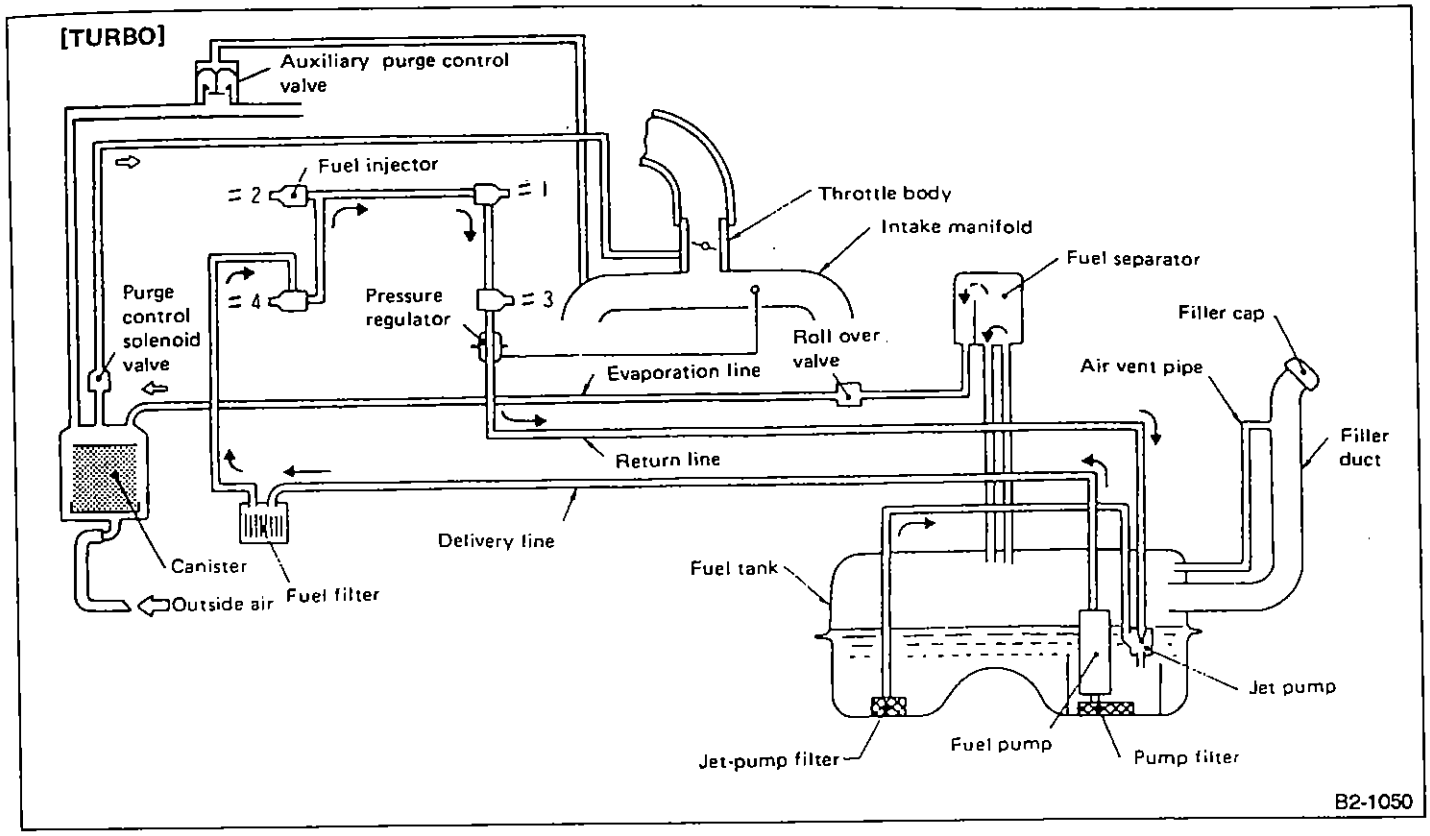
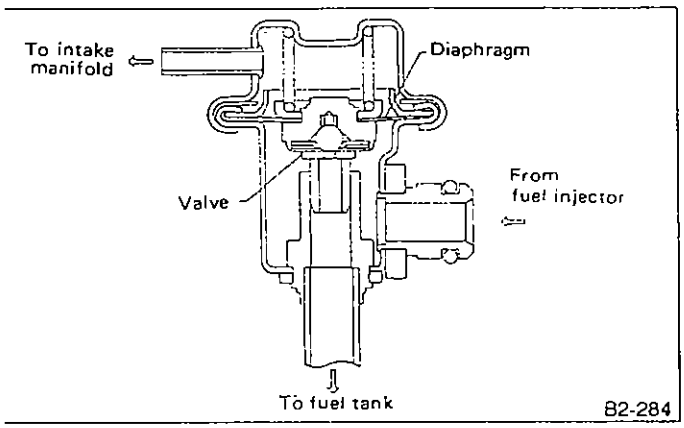

[TURBO]
Auxiliary purge control valve
Fuel injector
= 2
= 1
= 4
= 3
Throttle body
Intake manifold
Fuel separator
Purge control solenoid valve
Pressure regulator
Roll over valve
Filler cap
Air vent pipe
Evaporation line
Return line
Filler duct
Delivery line
Canister
Outside air
Fuel filter
Fuel tank
Jet pump
Jet-pump filter
Fuel pump
Pump filter
B2-1050

Fig. 7

2. PRESSURE REGULATOR

The pressure regulator is divided into the fuel chamber and 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.



3. FUEL INJECTOR

The MPFI system employs a gallery type (side-feed type) fuel injector.

The gallery type fuel injector is installed in the fuel pipe to allow cooling of the injector by the fuel.

The features of this type of fuel injector are as follows:

1) High heat resistance
2) Low driving noise
3) Easy to service
4) Small size

The fuel injector injects fuel according to the valve open signal received from the ECU.

The nozzle is attached on the top of the fuel injector. The needle valve (Non-TURBO) or ball valve (TURBO) is lifted by the solenoid coil through the plunger on arrival of the valve open signal.

Since the injection opening, the lifted level of 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 ECU.

The fuel injector of TURBO models is designed to inject a greater amount of fuel than that of Non-TURBO models, thus providing higher engine output.

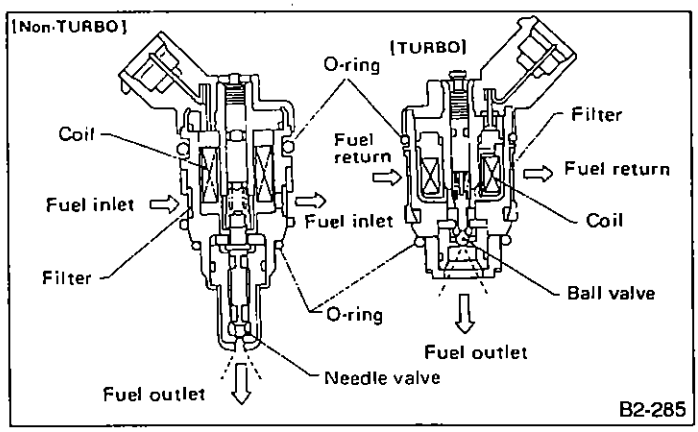


Fig. 9

4. Sensor and Switch

1. O_2 SENSOR

The O_2 sensor 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 contains hardly any 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 ECU through the harness.

A ceramic heater is employed to improve performance at low temperature.

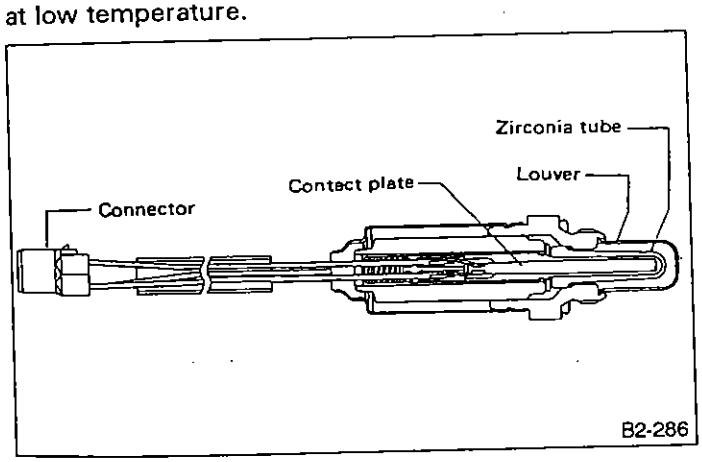


Fig. 10

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 is a 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 a 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 temperature of approximately 300 to 400°C (572 to 752°F).

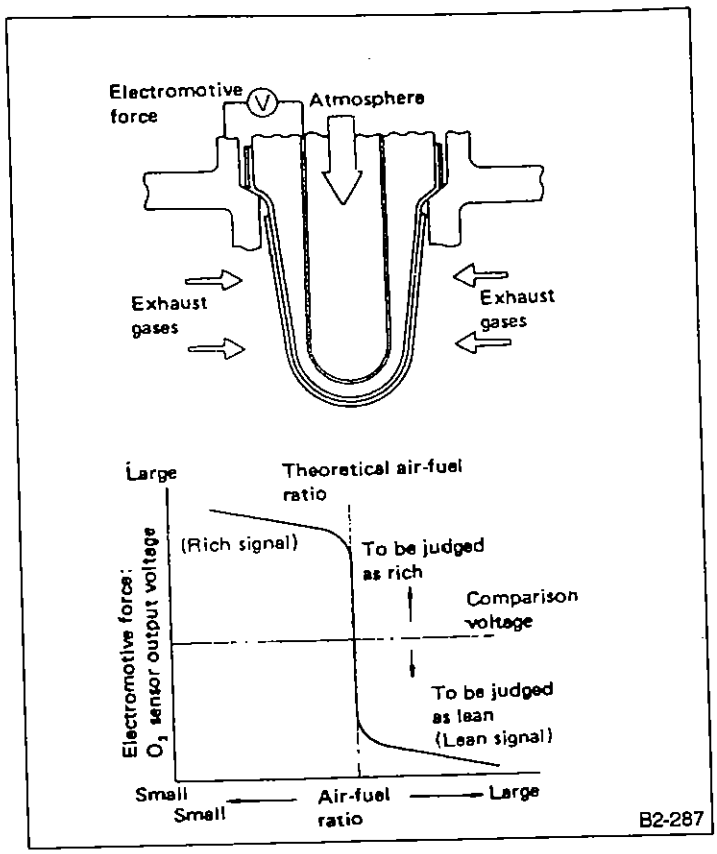


Fig. 11

2. WATER TEMPERATURE SENSOR

The water temperature sensor is located on the water pipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature. A water temperature signal converted into resistance is transmitted to the ECU to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.

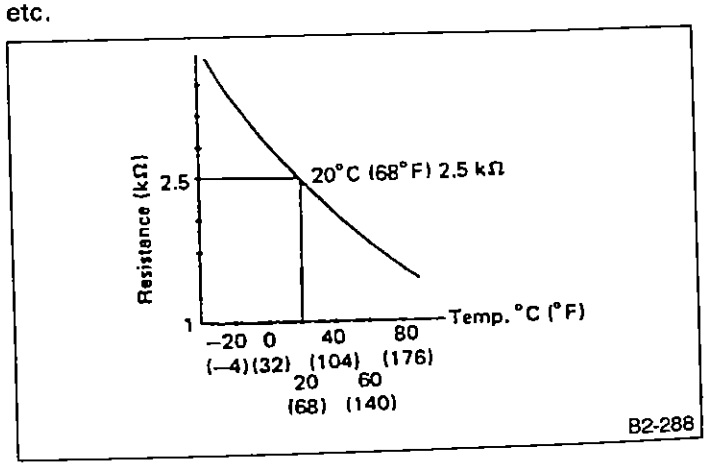


Fig. 12

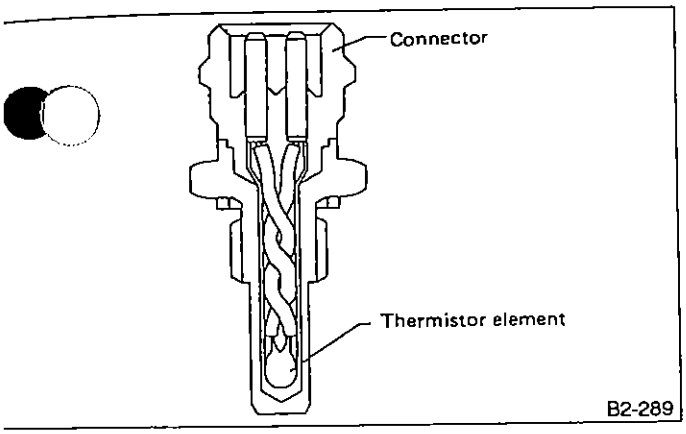


Fig. 13

3. 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.

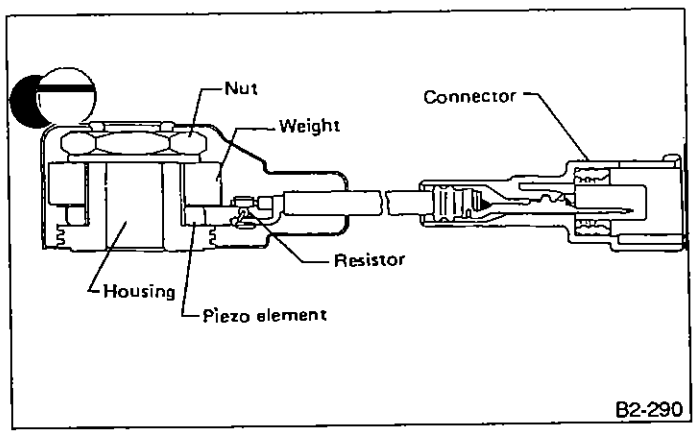


Fig. 14

4. CRANK ANGLE SENSOR

The crank angle sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crank angle position. It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crank sprocket (rotating together with the crankshaft) cross the crank angle sensor.

The crank angle sensor is a molded type which consists of a magnet, pick-ups, coil, terminals, etc.

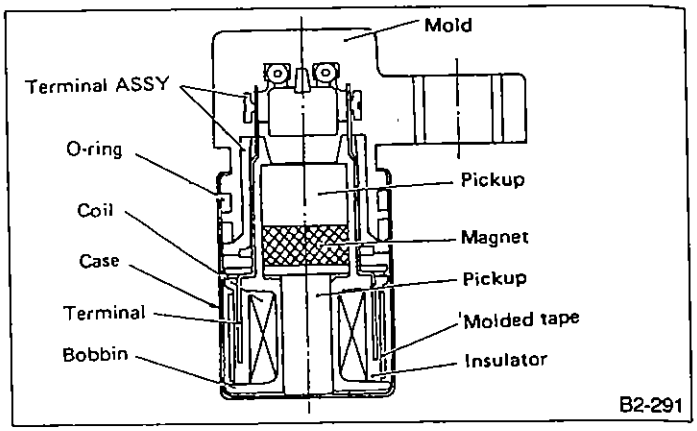


Fig. 15

Function

The crank sprocket is provided with six protrusions. Crank rotation causes these protrusions to cross the crank angle sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECU.

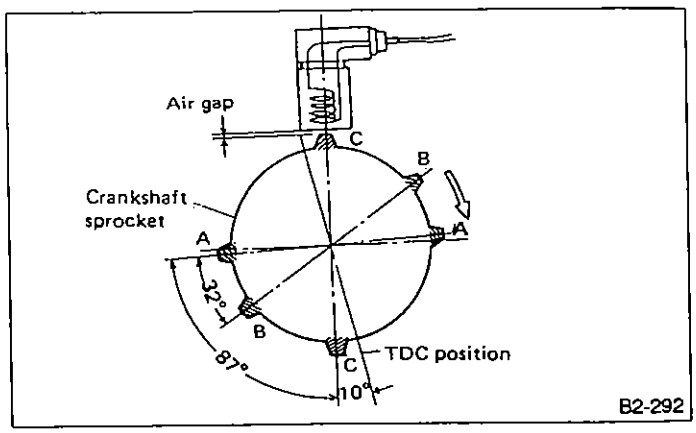


Fig. 16

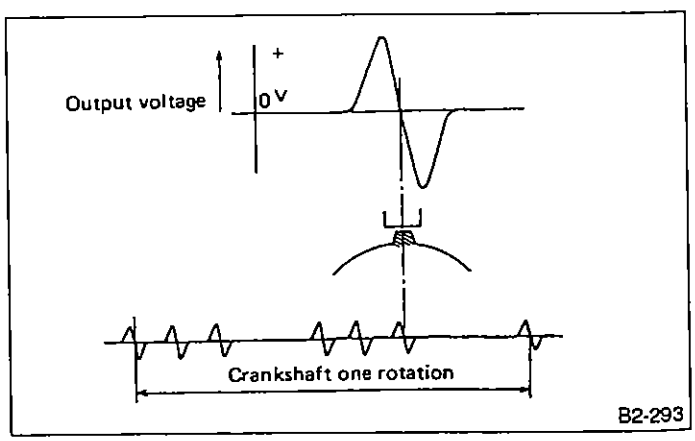


Fig. 17

5. CAM ANGLE SENSOR

The cam angle sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.

It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided on the back of the LH camshaft-drive sprocket cross the sensor.

Internal construction and the basic operating principle of the cam angle sensor are similar to those of the crank angle sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.

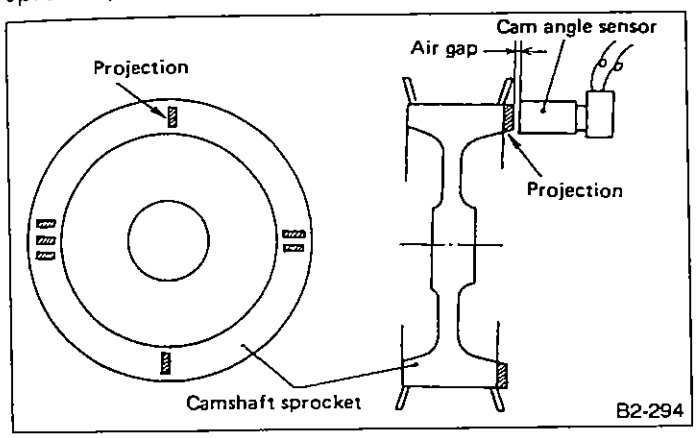


Fig. 18

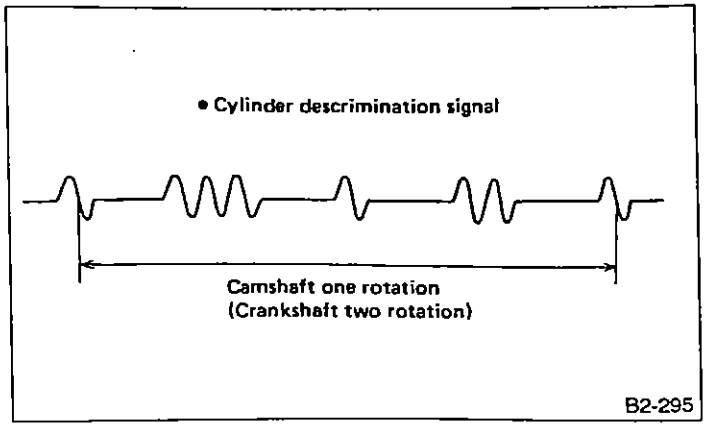


Fig. 19

6. VEHICLE SPEED SENSOR 2

The vehicle speed sensor 2 consists of a magnet rotor which is rotated by a speedometer cable and a reed switch. It is built into the combination meter.

One rotation of the magnet rotor turns the reed switch on and off four times to produce a digital signal. The digital signal is used as a vehicle speed signal which is transmitted to the ECU.

7. ATMOSPHERIC PRESSURE SENSOR (Non-TURBO)

The atmospheric pressure sensor is built into the ECU. It utilizes an "absolute" pressure sensor design. Its purpose is to detect the atmospheric pressure used to compensate for pressure at high altitudes and to maintain driving stability.

The signal from this sensor is also used for "shift control" of the automatic transmission at high altitudes.

. A/C (Air Conditioning) SWITCH AND RELAY

he A/C switch turns the A/C system on or off. The eration of the switch is transmitted to the ECU. he A/C cut relay breaks the current flow to the compressor, through the use of an output signal from the ECU, for a certain period of time when a "full-throttle" signal (emitted from the throttle sensor) enters the ECU while the compressor is operating. This prevents the degradation of acceleration performance and stabilizes driving performance.

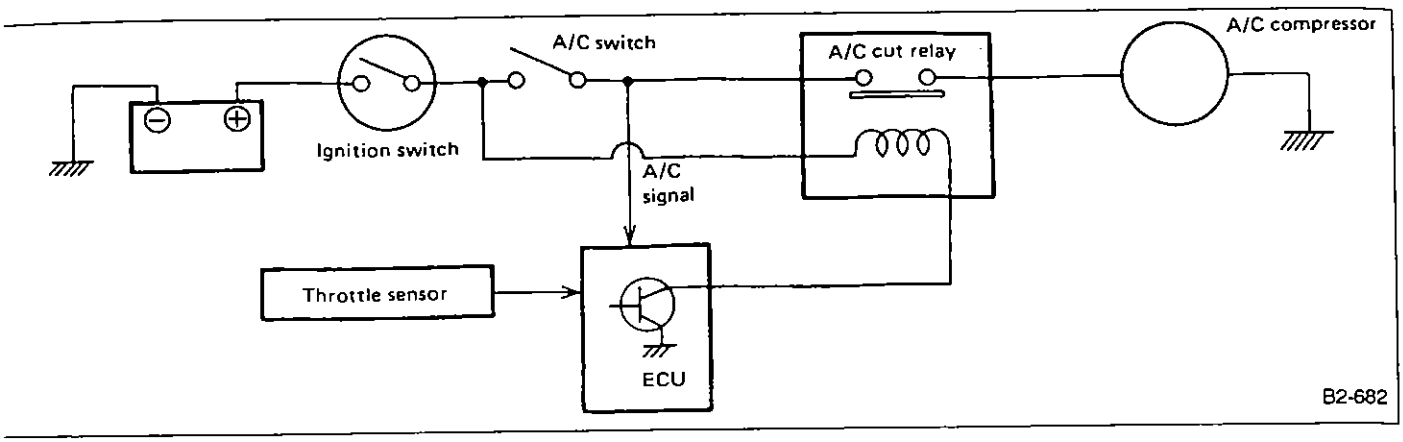


Fig. 20

9. PRESSURE SENSOR AND PRESSURE EXCHANGE SOLENOID VALVE (TURBO)

TURBO models have, in the inside of their engine compartment, a pressure sensor and a pressure exchange solenoid which switches pressure inlets so that the pressure sensor can detect both the atmospheric pressure and intake manifold pressure.

This selection of pressure inlet is performed by the pressure exchange solenoid valve according to the signal sent from the ECU. The output from the pressure sensor is entered into the ECU, which then sends out a signal for controlling the supercharging pressure to the wastegate control duty solenoid valve.

If supercharging pressure exceeds the preset value, the fuel is cut by the ECU.

5. Control System

1. GENERAL

The ECU receives signals sent from various sensors and switches to judge the engine operating condition and emits output signals to provide the optimum control and/or functioning of various systems.
Major items governed by the ECU are as follow:

- Fuel injection control
- Ignition system control
- By-pass air control (Idle speed control)
- Canister purge control
- Radiator fan control
- Fuel pump control
- Air conditioner cut control
- Self-diagnosis function
- Fail-safe function
- Wastegate control (TURBO)

2. INPUT AND OUTPUT SIGNALS

	Unit	Function	Non-TURBO	TURBO
Input signal	Air flow sensor	Detects the amount of intake air.	O	O
	Throttle sensor	Detects the throttle position.	O	O
	Idle switch	Detects a fully-closed throttle.	O	O
	O_2 sensor	Detects the density of O_2 in exhaust gases.	O	O
	Crank angle sensor	Detects engine speed.	O	O
	Cam angle sensor	Detects the relative cylinder positions.	O	O
	Water temperature sensor	Detects the coolant temperature.	O	O
	Knock sensor	Detects engine knocking.	O	O
	Vehicle speed sensor 2	Detects vehicle speed.	O	O
	Ignition switch	Detects ignition switch operation.	O	O
	Starter switch	Detects the condition of engine cranking	O	O
	Inhibitor switch (A/T)	Detects shift positions.	O	O
	A/C switch	Detects the ON-OFF operation of the A/C switch.	O	O
	Atmospheric pressure sensor	Detects atmospheric pressure.	O	
	Pressure sensor	Detects atmospheric pressure and intake manifold pressure.		O
Output signal	Fuel injector	Inject fuel.	O	O
	Ignition signal	Turns primary ignition current on or off.	O	O
	Fuel pump relay	Turns the fuel pump relay on or off.	O	O
	A/C control relay	Turns A/C control relay on or off.	O	O
	Radiator fan control relay	Turns radiator fan control relay on or off.	O	O
	By-pass air control solenoid valve	Adjusts the amount of by-pass air flowing through the throttle valve.	O	O
	Check engine light	Indicates trouble.	O	O
	Purge control solenoid valve	Controls the amount of canister purge through the throttle body.	O	O
	Pressure exchange solenoid valve	Switches pressure detection line between atmospheric pressure and intake manifold pressure.		O
	Wastegate control solenoid valve	Controls the supercharging pressure.		O

3. INPUT AND OUTPUT SIGNAL DIAGRAM

Non-TURBO]

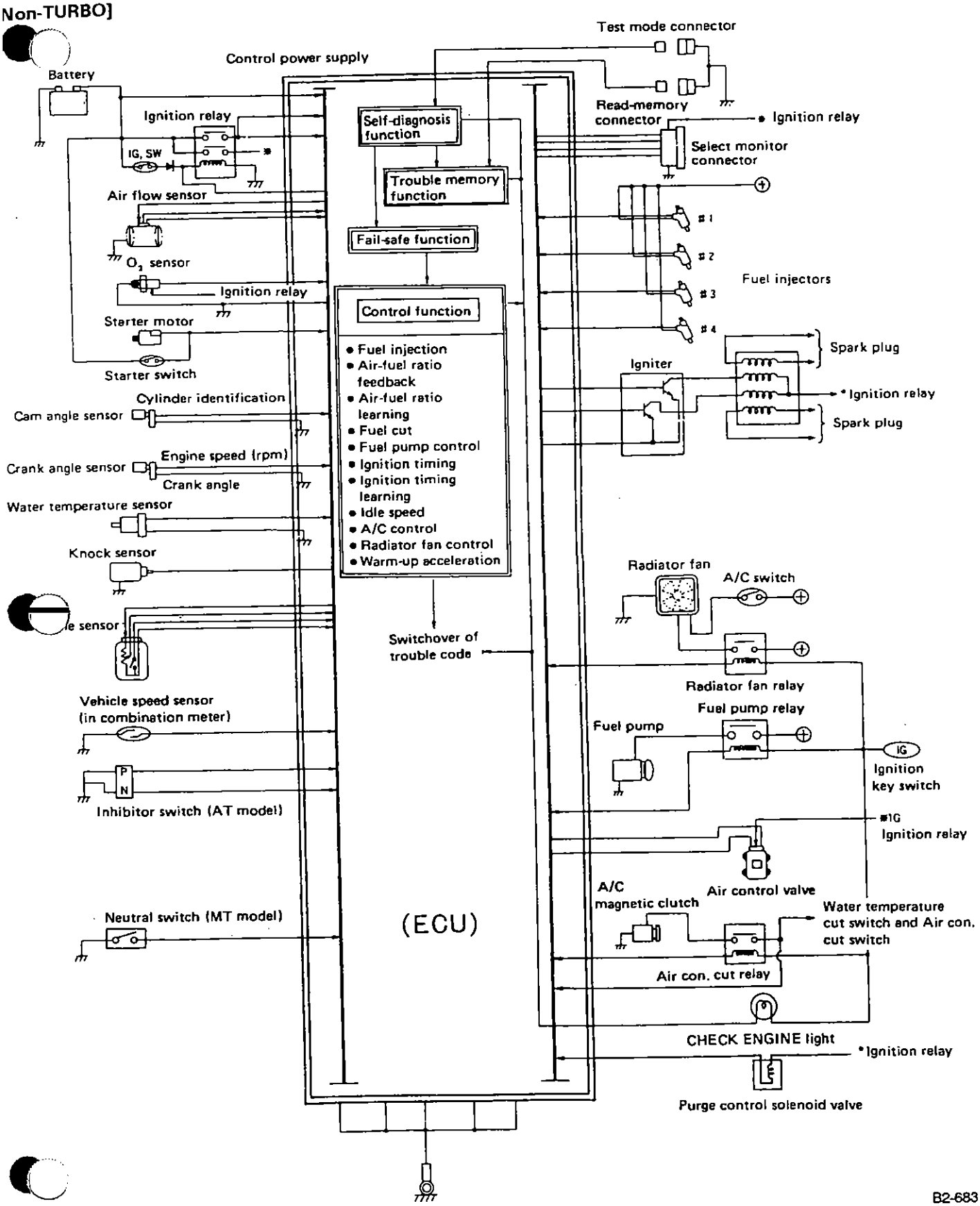


Fig. 21

[TURBO]

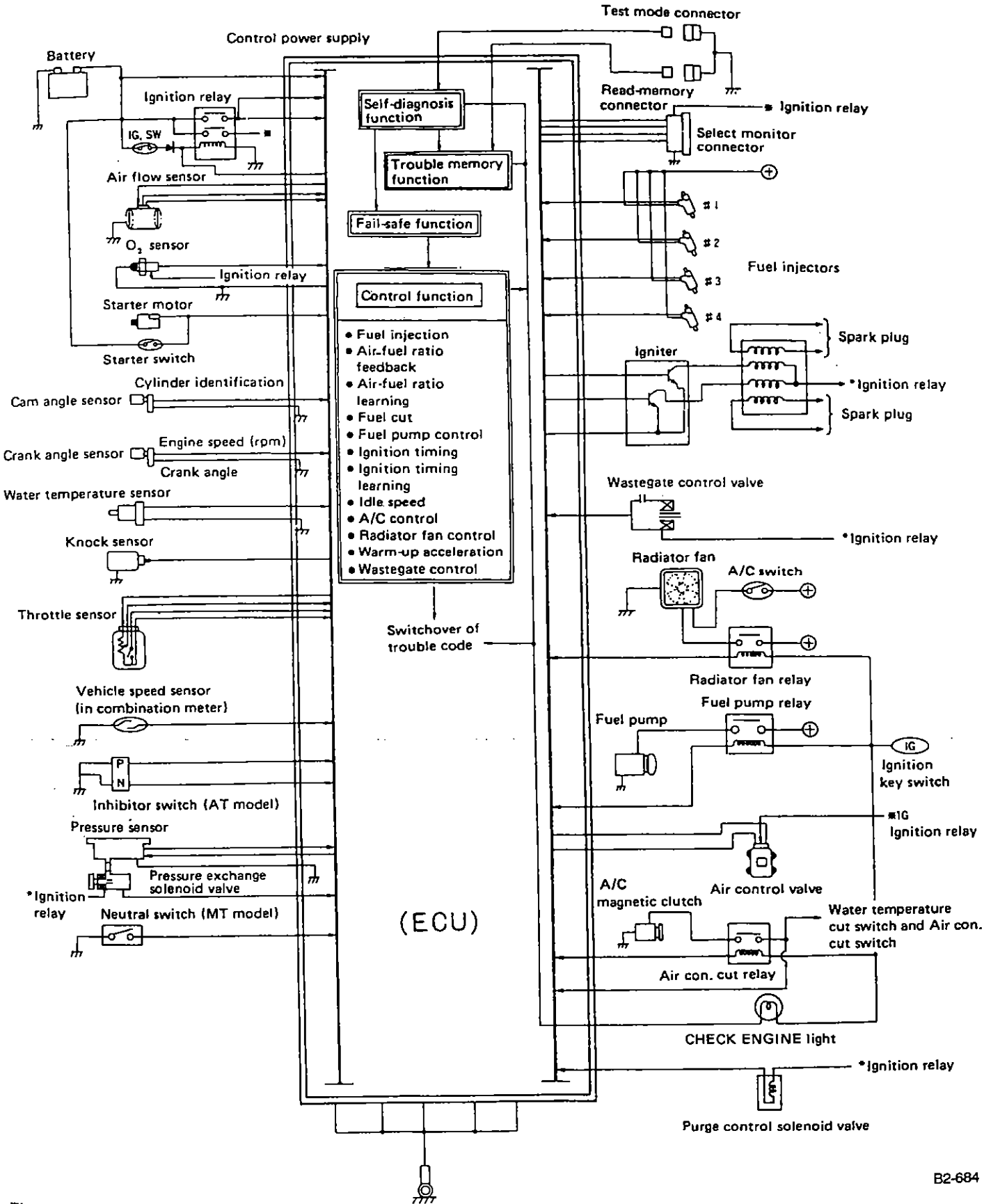

Test mode connector
Control power supply
Battery
Ignition relay
Self-diagnosis function
Read-memory connector
*Ignition relay
Select monitor connector
IG, SW
Trouble memory function
Air flow sensor
Fail-safe function
#1
#2
#3
#4
Fuel injectors
O2 sensor
Ignition relay
Control function
Starter motor
• Fuel injection
• Air-fuel ratio feedback
• Air-fuel ratio learning
• Fuel cut
• Fuel pump control
• Ignition timing
• Ignition timing learning
• Idle speed
• A/C control
• Radiator fan control
• Warm-up acceleration
• Wastegate control
Starter switch
Igniter
Spark plug
*Ignition relay
Spark plug
Cylinder identification
Cam angle sensor
Engine speed (rpm)
Crank angle sensor
Crank angle
Water temperature sensor
Wastegate control valve
*Ignition relay
Knock sensor
Radiator fan
A/C switch
Throttle sensor
Switchover of trouble code
Radiator fan relay
Vehicle speed sensor (in combination meter)
Fuel pump relay
Fuel pump
IG
Ignition key switch
P
N
Inhibitor switch (AT model)
*IG
Ignition relay
Pressure sensor
Air control valve
A/C magnetic clutch
Pressure exchange solenoid valve
*Ignition relay
Neutral switch (MT model)
(ECU)
Water temperature cut switch and Air con. cut switch
Air con. cut relay
CHECK ENGINE light
*Ignition relay
Purge control solenoid valve
B2-684

Fig. 22

1. FUEL INJECTION CONTROL

The ECU receives signals emitted from various sensors [illegible]rol the amount of fuel injected and the fuel [illegible] timing. Sequential fuel injection control is utilized over the entire engine operating range except during standing starts.

The amount of fuel injected by the injector valve is dependent upon the length of time it remains open. The optimum fuel injection timing is determined by transmitting a signal to the injector from the ECU according to varying engine operations. Feedback control is also accomplished by means of a learning control. As a result, the fuel injection control system is highly responsive and accurate in design and structure.

The sequential fuel injection system is designed so that fuel is injected at a specific time to provide maximum air intake efficiency for each cylinder. In other words, fuel injection is completed just before the intake valve begins to open.

1) Fuel injection characteristics

Fuel injection timing is basically expressed as indicated below:

(1) During engine starts:
Duration of fuel injection
= Duration of fuel injection during engine starts

(2) During normal operation:
[illegible]asic duration of fuel injection x correction factor + voltage correction time

- Basic duration of fuel injection ..... The basic length of time fuel is injected. This is determined by two factors—the amount of intake air detected by the air flow sensor and the engine speed (rpm) monitored by the crank angle sensor.
- Duration of fuel injection during engine starts ..... Determined according to the engine coolant temperature detected by a signal emitted from the water temperature sensor to improve starting ability.
- Voltage correction time ..... Compensates for the fuel injector's time lag affected by the battery voltage.

2) Correction coefficients

Correction coefficients are used to correct the basic duration of fuel injection so that the air-fuel ratio meets the requirements of varying engine operations.

These correction coefficients are classified as follows:

(1) Air-fuel ratio coefficient:
Allotted to provide the optimum air-fuel ratio in relation to engine speed and the basic amount of fuel [illegible]cted.

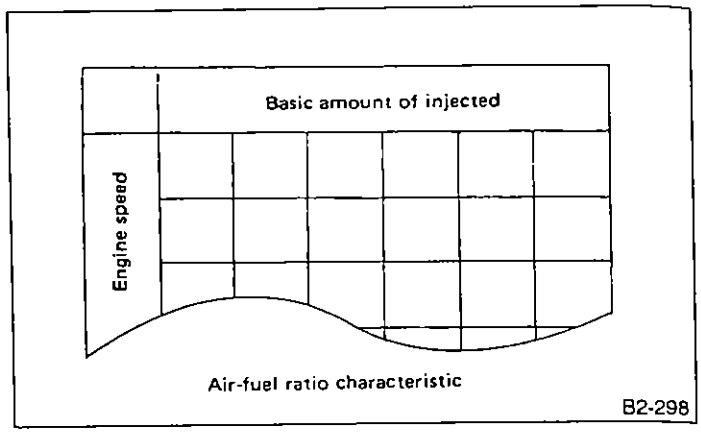


Fig. 23

(2) Start increment coefficient:
Increases the amount of fuel injected only when cranking the engine, which improves starting ability.

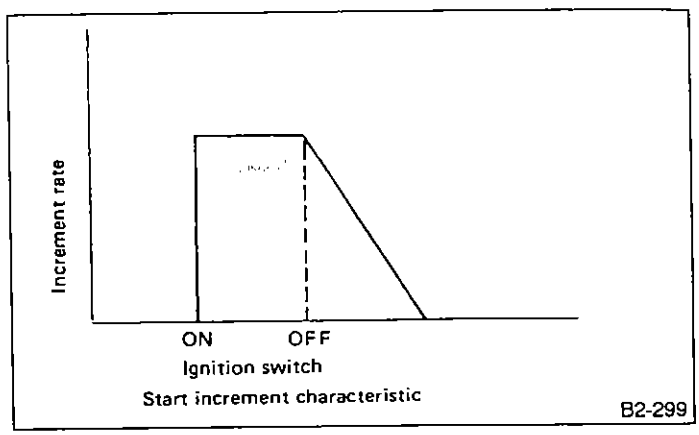


Fig. 24

(3) Water temperature increment coefficient:
Used to increase the amount of fuel injected in relation to a signal emitted from the water temperature sensor for easier starting of a cold engine. The lower the water temperature, the greater the increment rate.

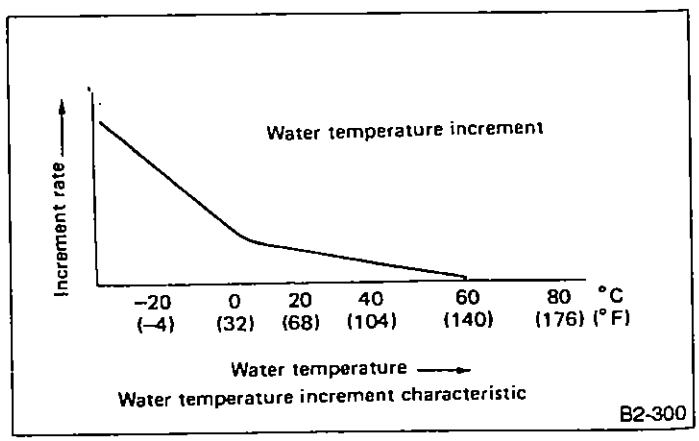


Fig. 25

(4) After-start increment coefficient:
Increases the amount of fuel injected for a certain period of time immediately after the engine starts to

stabilize engine operation.

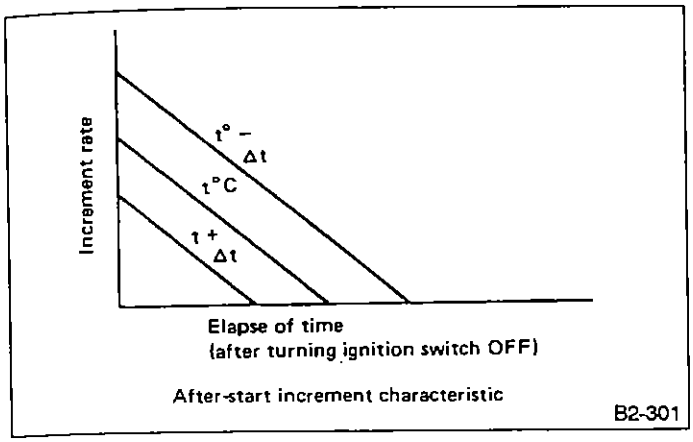


Fig. 26

(5) Full increment coefficient:
Increases the amount of fuel injected by a signal emitted from the throttle sensor in relation to a signal emitted from the air flow sensor.

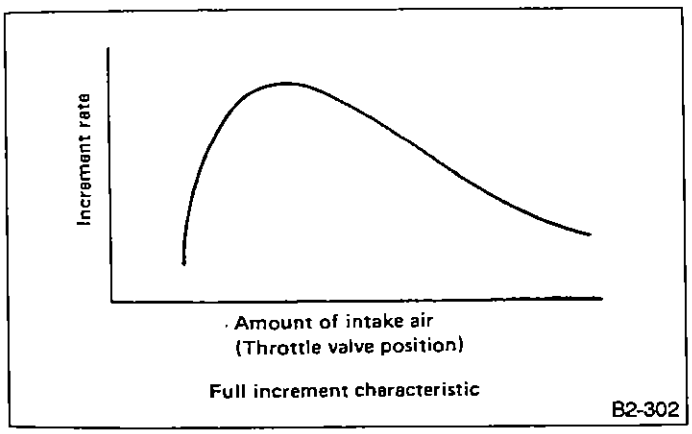


Fig. 27

(6) Acceleration increment coefficient:
Compensates for time lags of air flow measurement and/or fuel injection during acceleration to provide quick response.

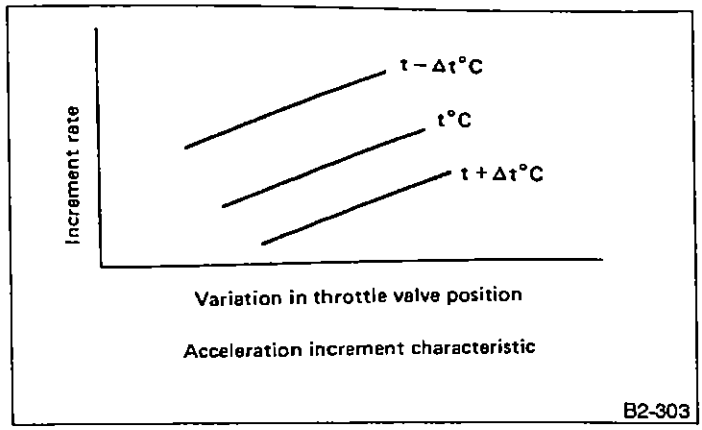


Fig. 28

3) Air-fuel ratio feedback coefficient "alpha"
This feedback coefficient utilizes the O_2 sensor's electromotive force (voltage) as a signal to be entered into the ECU. When low voltage is entered, the ECU judges it as a lean mixture, and when high voltage is entered, it is judged as a rich mixture. In other words, when the air-fuel ratio is richer than the theoretical air-fuel ratio, the amount of fuel injected is decreased. When it is leaner, the amount of fuel injected is increased. In this way, the air-fuel ratio is compensated so that it comes as close to the theoretical air-fuel ratio as possible on which the three-way catalyst acts most effectively. (CO, HC and NOx are also reduced when the air-fuel ratio is close to theoretical air-fuel ratio.)

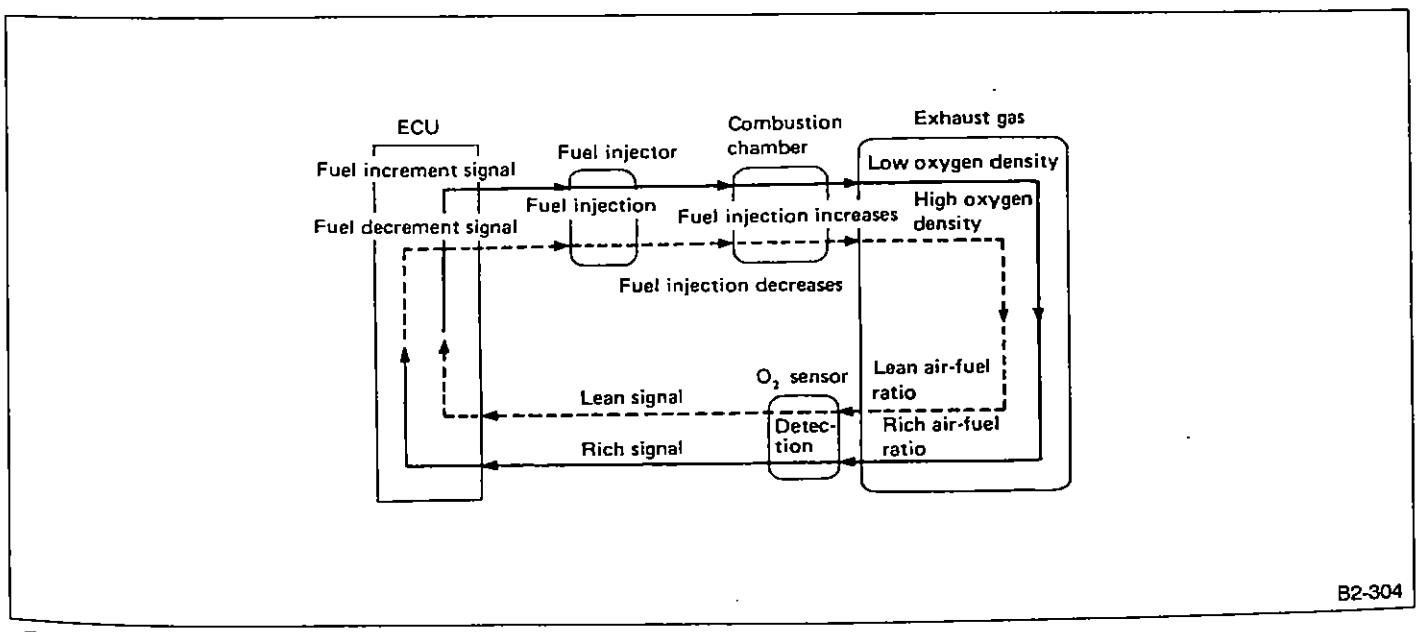


Fig. 29

Learning control system

a conventional air-fuel feedback control system, the [redacted]ount of fuel injected (according to engine [redacted]eed [redacted]d various loads) is stored in the memory. After e ECU receives a signal emitted from the O_2 sensor, e basic amount of fuel injected is corrected so that it is ose to the theoretical air-fuel ratio. This means that the eater the air-fuel ratio is corrected, the lesser the ntrol accuracy.

SUBARU engines, however, an air-fuel ratio learning ntrol system constantly memorizes the amount of rrection required in relation to the basic amount of el to be injected (the basic amount of fuel injected is etermined after several cycles of fuel injection), so that e correction affected by feedback control is mini-ized. Thus, quick response and accurate control of ariations in air-fuel ratio, sensors' and actuators' char-cteristics during operation, as well as in the air-fuel atio with the time of engine operation, are achieved. In ddition, accurate control contributes much to stability f exhaust gases and driving performance.

5. IGNITION SYSTEM CONTROL

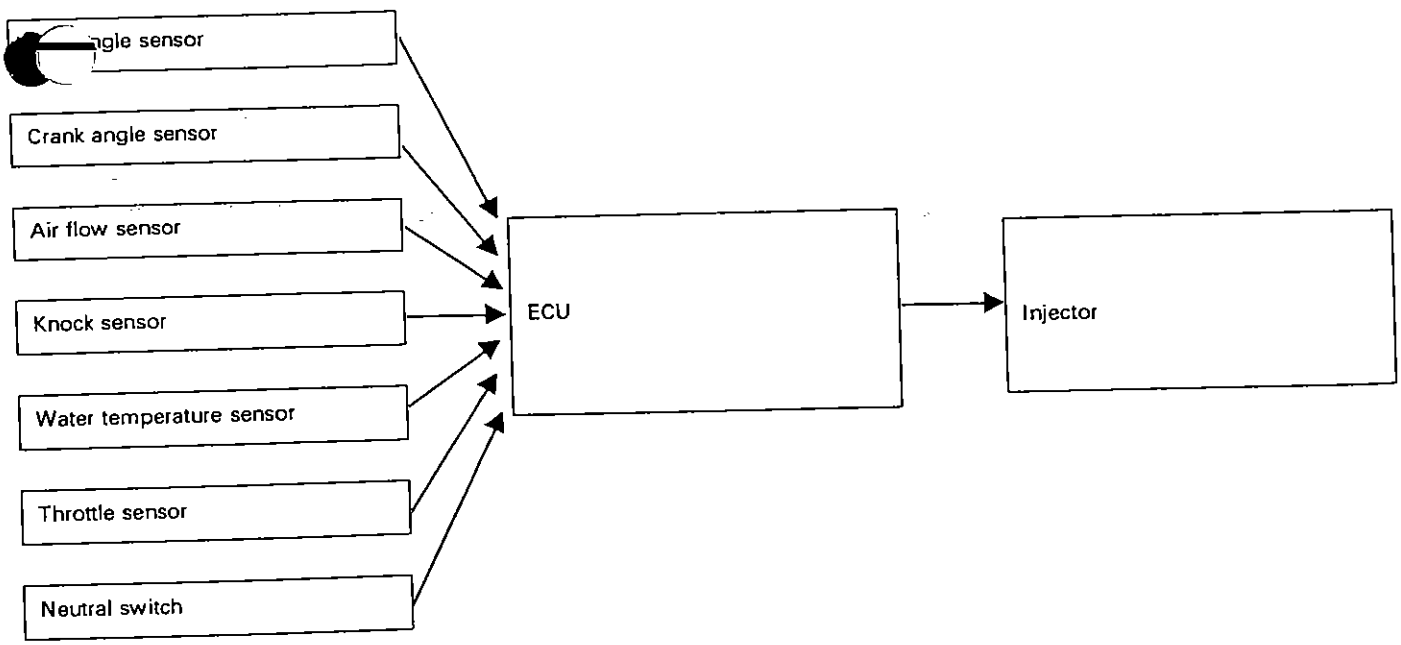
The ECU receives signals emitted from the air flow sensor, water temperature sensor, crank angle sensor, cam angle sensor, knock sensor, etc., to judge the operating condition of the engine. It then selects the optimum ignition timing stored in the memory and immediately transmits a primary current OFF signal to the ignitor to control the ignition timing.

While the ECU receives signals emitted from the knock sensor, it is controlled so that advanced ignition timing is maintained immediately before engine knock occurs. This system control type features a quick-to-response learning control method by which data stored in the ECU memory is processed in comparison with information emitted from various sensors and switches.

Thus, the ECU constantly provides the optimum ignition timing in relation to output, fuel consumption, exhaust gas, etc., according to various engine operating conditions, the octane rating of the fuel used, etc.

Two ignition coils are used - one for the #1 and #2 cylinders, and one for the #3 and #4 cylinders. A simultaneous ignition type is employed for #1 and #2 cylinders on one hand, and #3 and #4 cylinders on the other.

This eliminates the distributor and achieves maintenance-free operation.



• Ignition control under normal engine conditions
Between the 97° signal and the 65° signal, the ECU measures the engine revolutions, and by using this data it decides the dwell set timing and ignition timing according to the engine condition.

• Ignition control under starting conditions
Engine revolutions fluctuate at the starting condition, so the ECU cannot control the ignition timing. When such a condition exists, ignition timing is fixed at 10° BTDC by using the 10° signal.

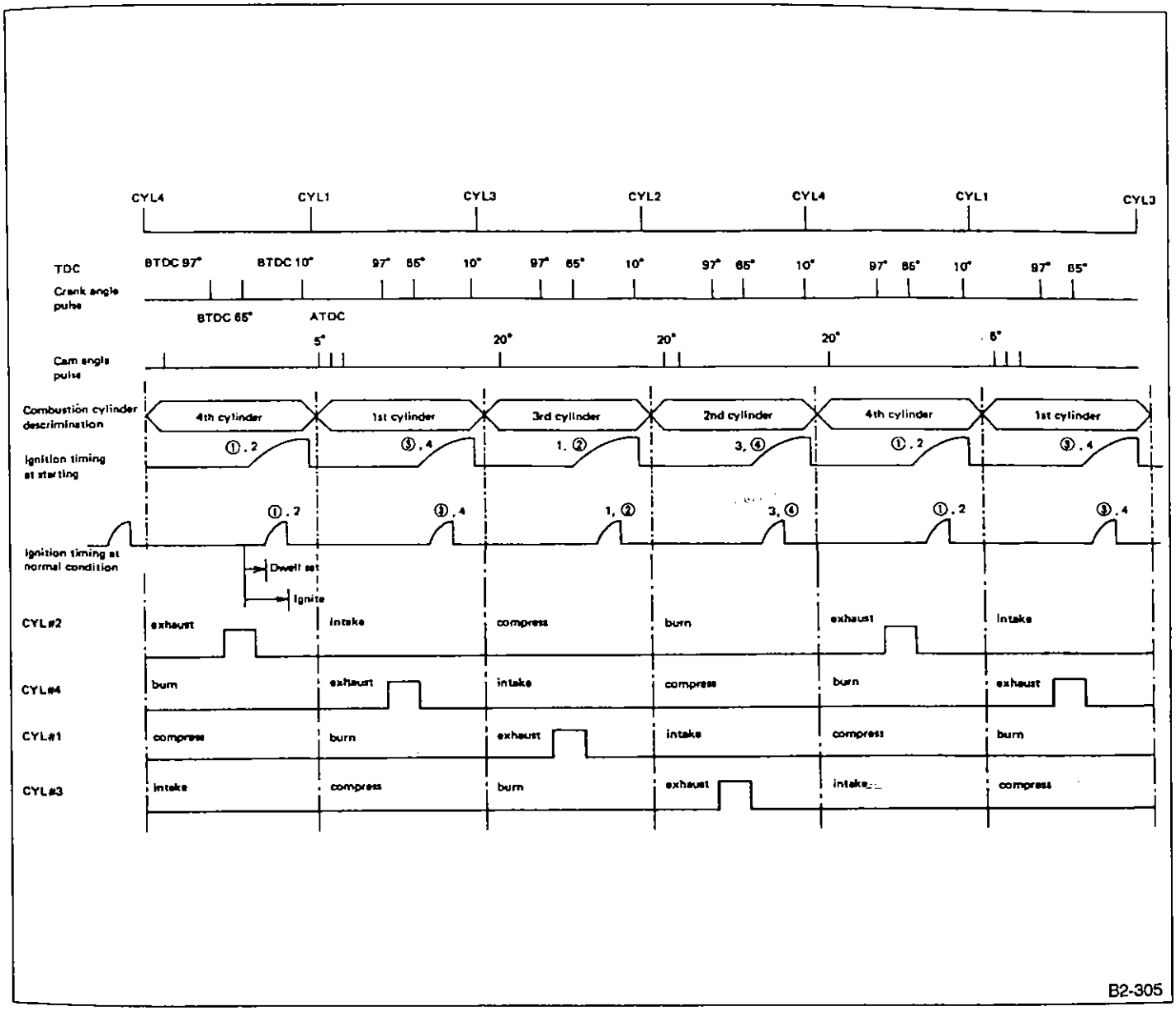


Fig. 30

6. BY-PASS AIR CONTROL (IDLE SPEED CONTROL)

ECU activates the by-pass air control valve in [illegible] to control the amount of by-pass air flowing through the throttle valve in relation to signals emitted from the crank angle sensor, cam angle sensor, water temperature sensor and A/C switch, so that the proper idle speed specified for each engine load is achieved.
The by-pass air control valve utilizes a duty solenoid design so that the amount of valve "lift" is determined by a certain operating frequency. For this reason, the by-pass air flow is regulated by controlling the duty ratio. The relationship between the duty ratio, valve lift and by-pass air flow is as follows:

Duty ratio (high) → Increases valve lift and by-pass air flow.

Bypass air control features the following advantages:

1. Compensation for engine speed under A/C (air condition-ing) system and electrical loads.
2. Increase in idle speed during early stage of warm-up period.
3. A dashpot function during the time the throttle valve is quickly closed.
4. Prevention of engine speed variations over time.

Diagram

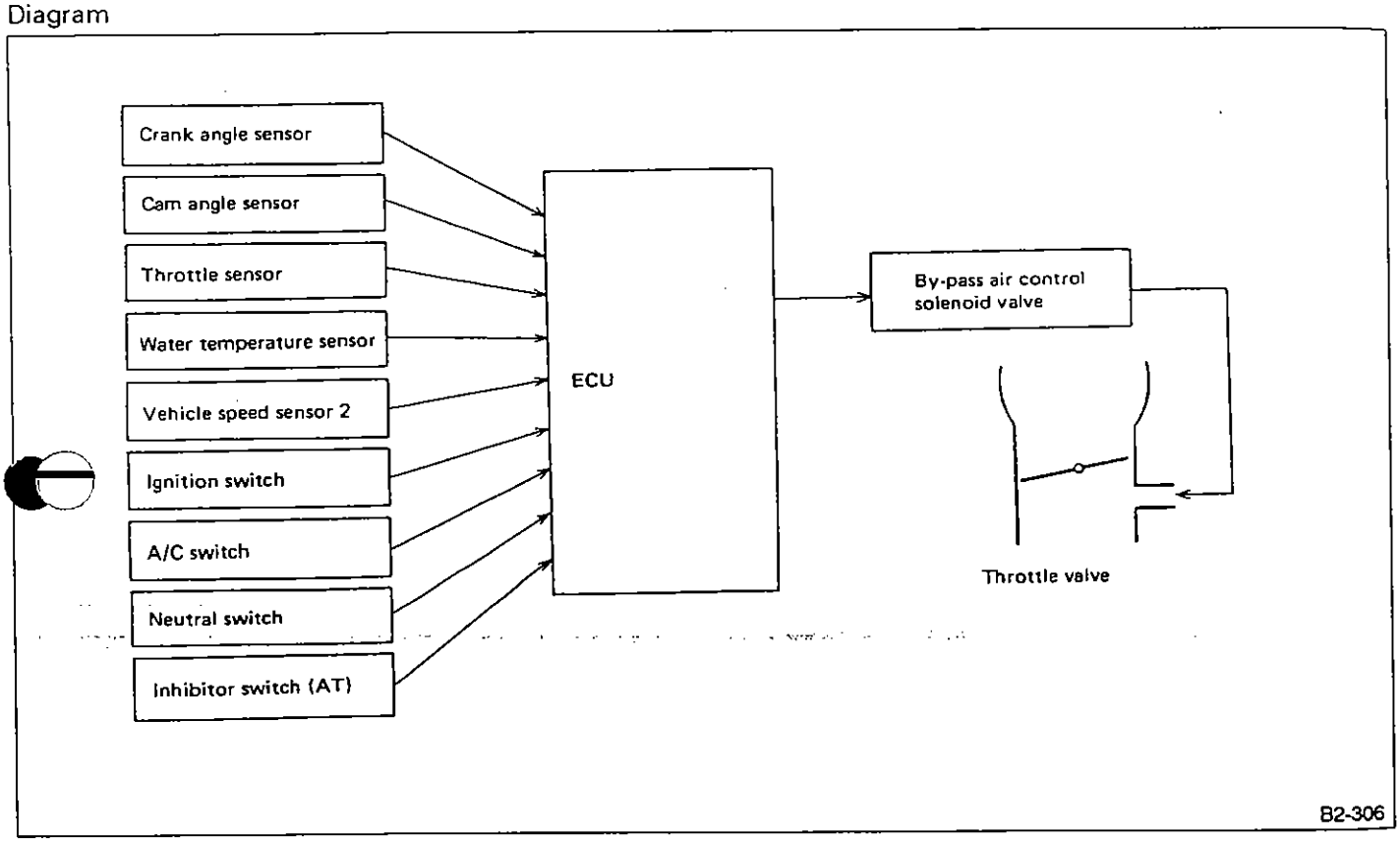


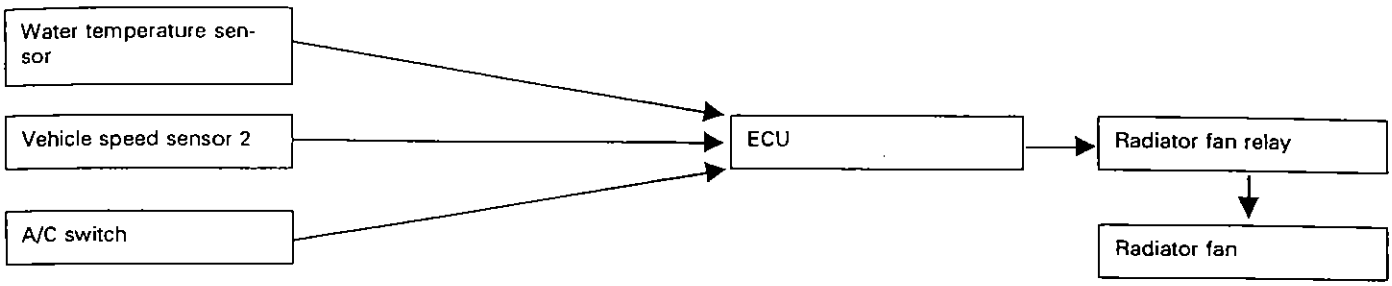
Fig. 31

7. CANISTER PURGE CONTROL

The ECU receives signals emitted from the water temperature sensor, vehicle speed sensor and crank angle sensor to control the purge control solenoid.
Canister purge takes place during operation of the vehicle except under certain conditions (during idle, etc.).
The purge line is connected to the throttle chamber to purge fuel evaporation gas from the canister according to the amount of intake air.

8. RADIATOR FAN CONTROL

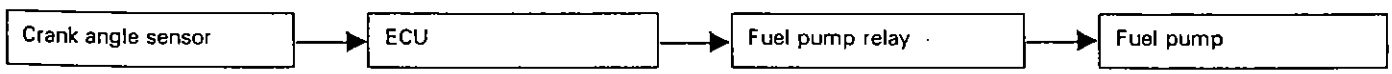
The ON-OFF control of the radiator fan (for models which are not equipped with an air conditioning system) is governed by the ECU which receives signals sent from the water temperature sensor and vehicle speed sensor. On models which are equipped with an air conditioning system, the ECU receives signals sent from the water temperature sensor, vehicle speed sensor and A/C switch. These signals simultaneously turn ON or OFF the main radiator fan and A/C sub fan as well as setting them at "HI" or "LO" speed.



9. FUEL PUMP CONTROL

The ECU receives a signal emitted from the crank angle sensor and turns the fuel pump relay ON or OFF to control fuel pump operation. To improve safety, the fuel pump will stop if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time (after ignition switch is turned ON)	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate



0. A/C CUT CONTROL

When the ECU receives a "full-open" signal emitted from the throttle sensor while the air conditioning system is operating, the A/C cut relay turns off for a certain period of time to stop the compressor. This prevents degradation of output during acceleration and stabilizes driveability.

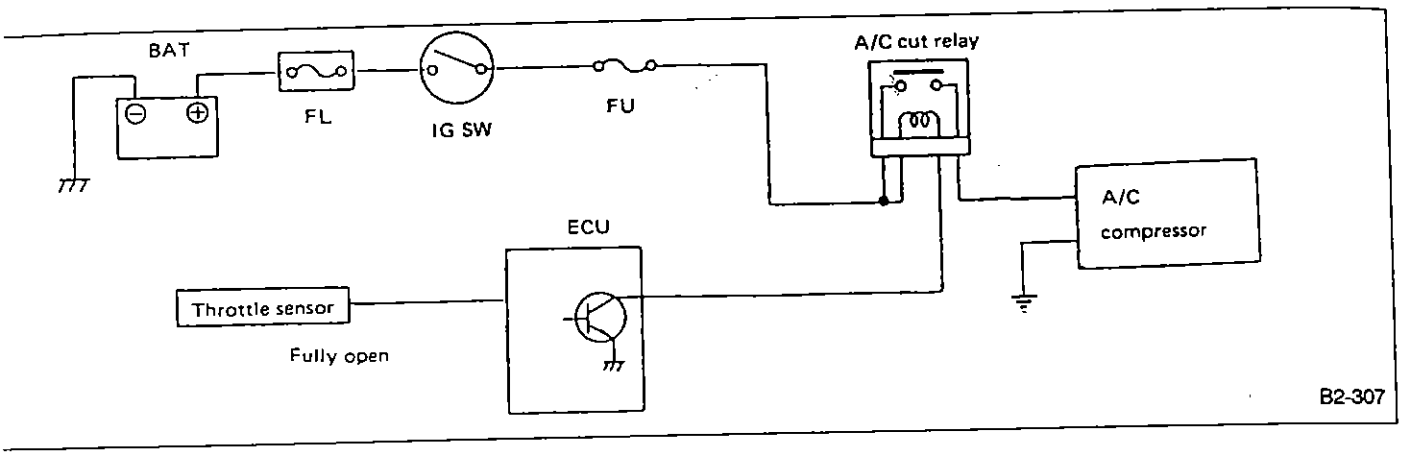
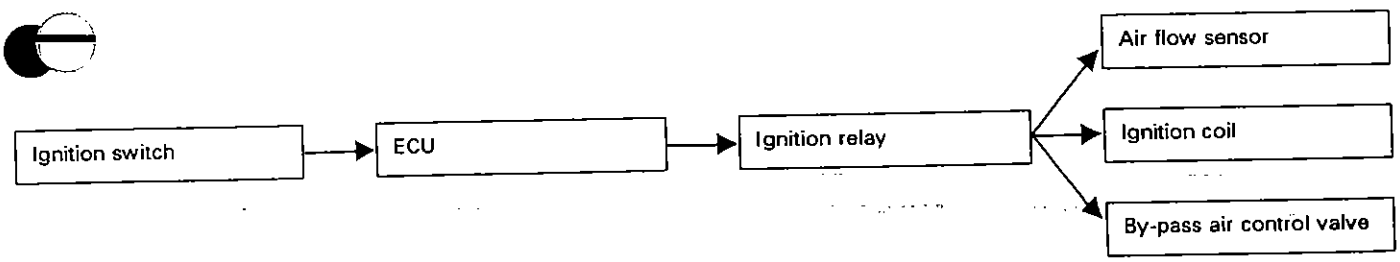


Fig. 32

11. POWER SUPPLY CONTROL

When the ECU receives an ON signal emitted from the ignition switch, current flows through the ignition relay. This turns the ignition relay ON so that power is supplied to the ignition coil, air flow sensor, by-pass air control valve, etc.

Power to the above parts is turned off five seconds after the ECU receives an OFF signal from the ignition switch. The fuel injectors stop fuel injection immediately after the ignition switch is turned OFF because the injection signal is cut off.



12. WASTEGATE CONTROL (TURBO)

The ECU computes the objective supercharging pressure according to the signals sent from the crank angle sensor, air flow sensor, throttle sensor, pressure sensor, and water temperature sensor. The ECU then sends a signal to the duty solenoid valve so as to attain the computed objective supercharging pressure.

The duty solenoid valve, according to the signal from the ECU, leaks out the pressure applied to the wastegate valve controller so that the supercharging pressure at which the wastegate valve opens reaches the objective level. By this method, engine performance in acceleration or in high altitude is compensated.

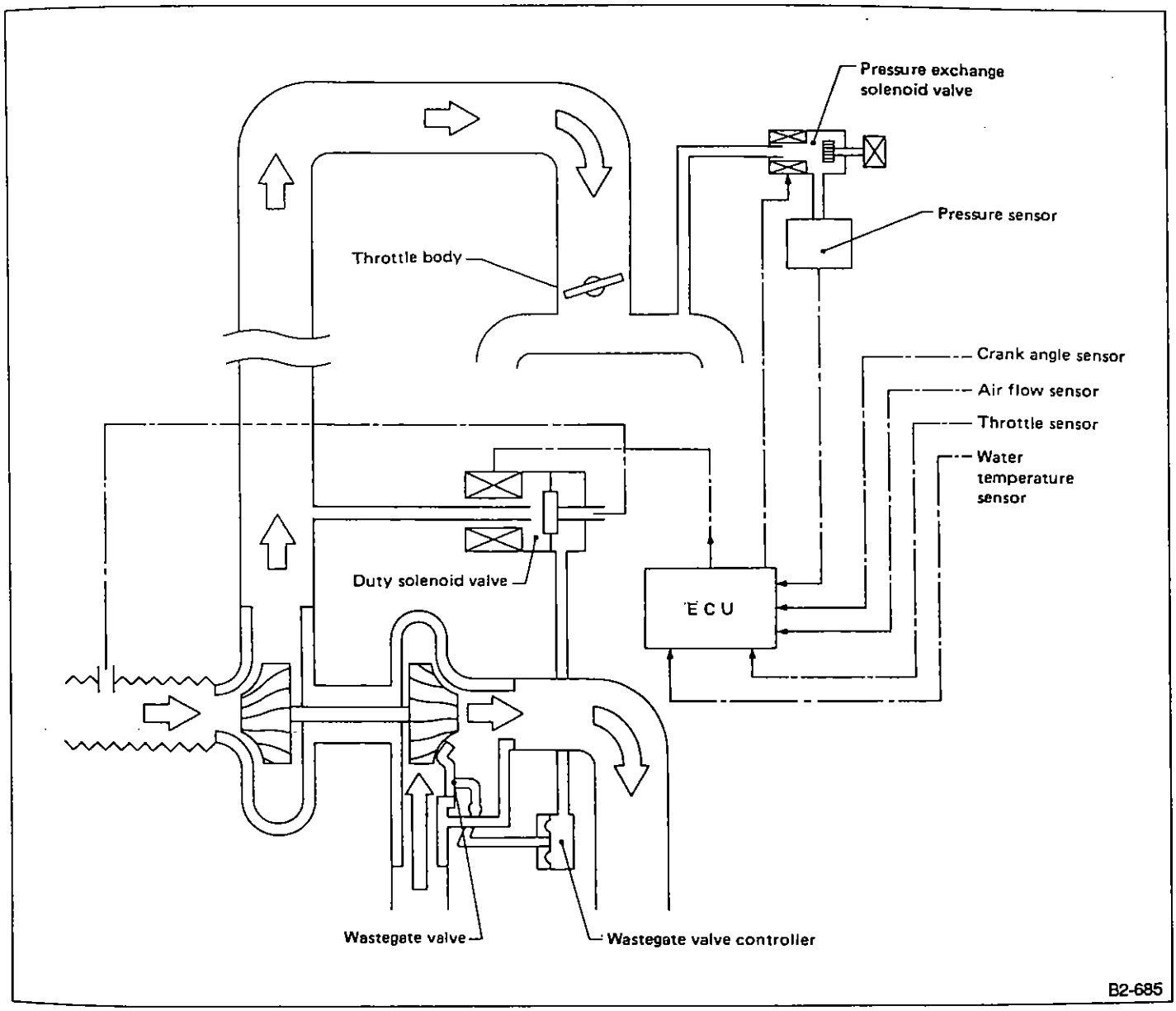


Fig. 33

5. Self-diagnosis System

GENERAL

The diagnosis system detects and indicates a fault in various inputs and outputs of the complex electronic control. The warning light (CHECK ENGINE light) on the instrument panel indicates occurrence of a fault or trouble.

Further, against such a failure or sensors as may disable the drive, the fail-safe function is provided to ensure the minimal driveability.

2. 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 a light (CHECK ENGINE light) are used. The connectors are for mode selection and the light monitors the type of problem.

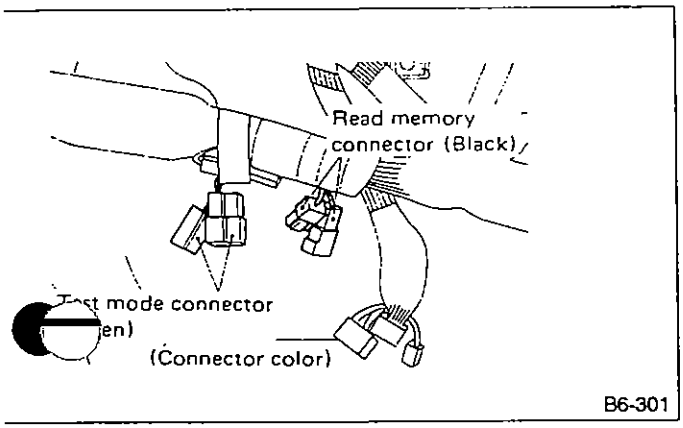


Fig. 34

Refer to C.6-3 [W0600] for the location of connectors.

- 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 (engine 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 light (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 lights 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.

3. BASIC OPERATION OF SELF-DIAGNOSIS SYSTEM

• No TROUBLE

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	X	X	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF
Read memory	O	X	Ignition switch ON (Engine OFF)	Blink
			Engine ON	ON
D-check	X	O	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*
Clear memory	O	O	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*

• TROUBLE

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	X	X	Ignition switch ON	ON
Read memory	O	X	Ignition switch ON	Trouble code (memory)
D-check	X	O	Engine ON	Trouble code**
Clear memory	O	O	Engine ON	Trouble code**

* When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, the check engine light blinks. However, when all check items check out "O.K.',' even before the 40 seconds is reached, the check engine light blinks.

** When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, a trouble code is emitted.

4. FAIL-SAFE FUNCTION

For the part which has been judged faulty in the self-diagnosis, the ECU 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.

5. TROUBLE CODES AND FAIL-SAFE OPERATION

Trouble code	Item	Contents of diagnosis	Fail- safe operation	Non-TURBO	TURBO
11	Crank angle sensor	No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor.	—	O	O
12	Starter switch	Abnormal signal emitted from starter switch.	Turns starter switch signal OFF.	O	O
13	Cam angle sensor	No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor.	—	O	O
14	Injector #1	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)	—	O	O
15	Injector #2		—	O	O
16	Injector #3		—	O	O
17	Injector #4		—	O	O
21	Water temperature sensor	Abnormal signal emitted from water temperature sensor.	Adjusts water to a specific temperature. Maintains radiator fan "ON" to prevent overheating.	O	O
22	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.	Sets in regular fuel map and retards ignition timing.	O	O
23	Air flow sensor	Abnormal voltage input entered from air flow sensor.	Controls the amount of fuel (injected) in relation to engine speed and throttle sensor position.	O	O
[illegible]	By-pass air control solenoid valve	Air control valve inoperative. (Abnormal signal produced in monitor circuit.)	Prevents abnormal engine speed using "fuel cut" in relation to engine speed, vehicle speed and throttle sensor position.	O	O
31	Throttle sensor	Abnormal voltage input entered from throttle sensor.	Sets throttle sensor's voltage output to a fixed value.	O	O
32	O_2 sensor	O_2 sensor inoperative.	—	O	O
33	Vehicle speed sensor 2	Abnormal voltage input entered from vehicle speed sensor.	Sets vehicle speed signal to a fixed value.	O	O
35	Purge control solenoid valve	Solenoid valve inoperative.	—	O	O
41	A/F learning control	Faulty learning control function.	—	O	O
42	Idle switch	Abnormal voltage input entered from idle switch.	Judges OFF operation.	O	O
44	Wastegate control solenoid valve	Solenoid valve inoperative.	—		O
45	Atmospheric pressure sensor	Faulty sensor.	Sets sensor to 760 mmHg.	O	
	Pressure sensor and pressure exchange solenoid valve	Faulty sensor or pressure exchange solenoid valve inoperative.	Prevents abnormal supercharging pressure using "fuel cut" in relation to engine load.		O
49	Air flow sensor	Use of improper air flow sensor.	—	O	O
51	Neutral switch	Abnormal signal entered from neutral switch.	—	O	O
51	Inhibitor switch	Abnormal signal entered from inhibitor switch.	—	O	O
52	Parking switch	Abnormal signal entered from parking switch.	—	O	O

7. Turbocharger System

1. GENERAL

The turbocharger performs supercharging with use of the wasted energy in the high temperature exhaust gas. It provides the following features:

1) Less power loss with use of the exhaust gas energy.
2) Light in weight and compact in size for better adaptability.
3) Better matching with the engine load.
4) 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.

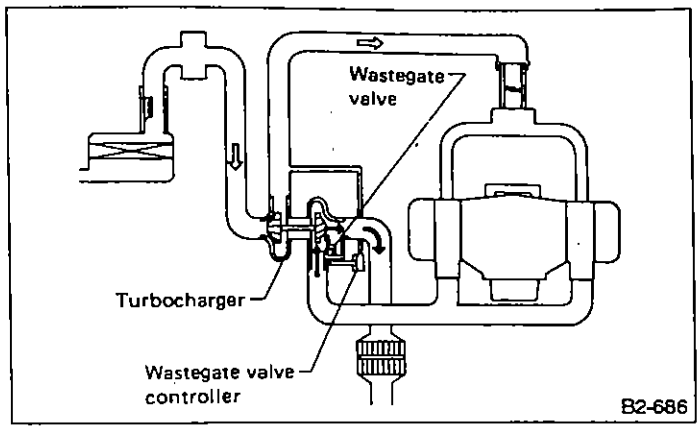


Fig. 35

While the supercharging pressure is lower than the predetermined level, the wastegate valve is closed so that all the exhaust gas is carried through the turbine.

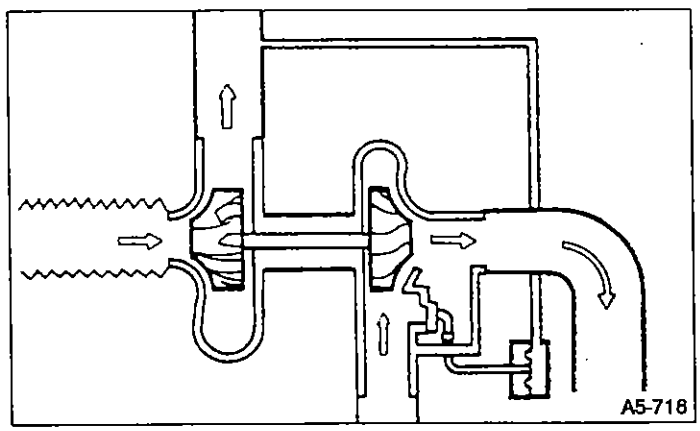


Fig. 36

2. REGULATION OF SUPERCHARGING PRESSURE

1) Basic function of the wastegate 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 wastegate valve and its controller are equipped. By sensing the supercharging pressure, the wastegate valve restricts it below a predetermined level.

hen it reaches the predetermined level, the wastegate ntroller lets the supercharging pressure to press the m, causing the linked wastegate valve to open. /astegate-valve opened, a part of the exhaust is is allowed to flow into the exhaust gas pipe by /passing the turbine.
his decreases the turbine rotating energy to keep the upercharging pressure constant.
means $P_2 - P_1$ = constant
P_1: Atmospheric pressure
P_2: Supercharging pressure

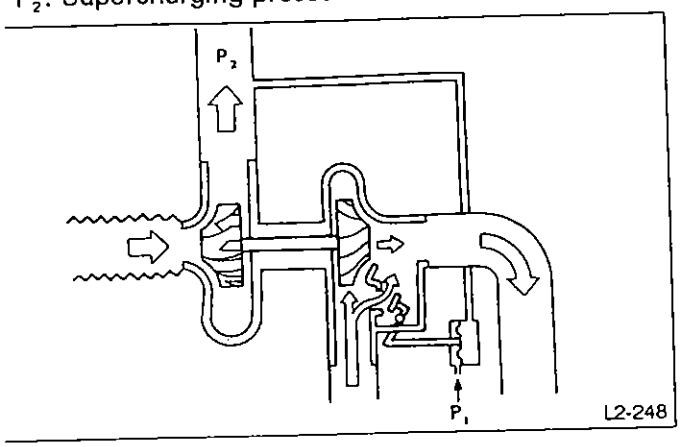


Fig. 37

2) Concept of the wastegate valve control

The higher the altitude, the lower the atmospheric (P1) and supercharging pressure (P_2). The duty solenoid valve acts as a control to maintain maximum supercharging pressure (P_2) under absolute pressure.

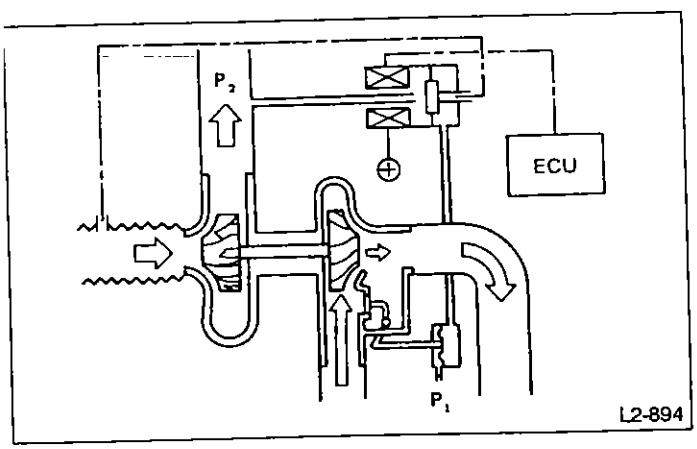


Fig. 38

Max. P_2 = const (Absolute pressure 161.3 kPa (1,210 mmHg, 47.64 inHg)

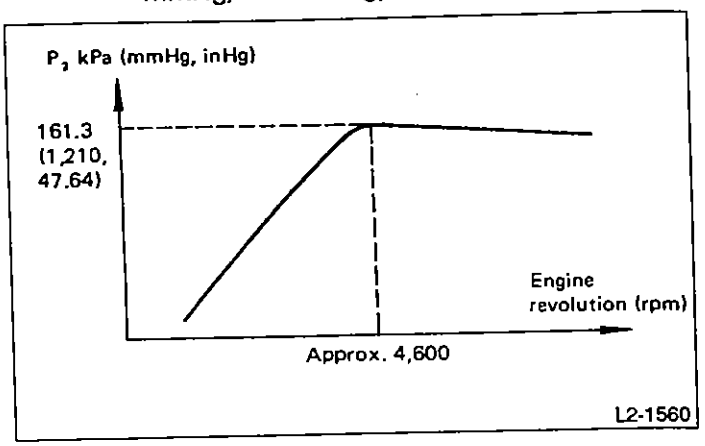


Fig. 39

3. 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.

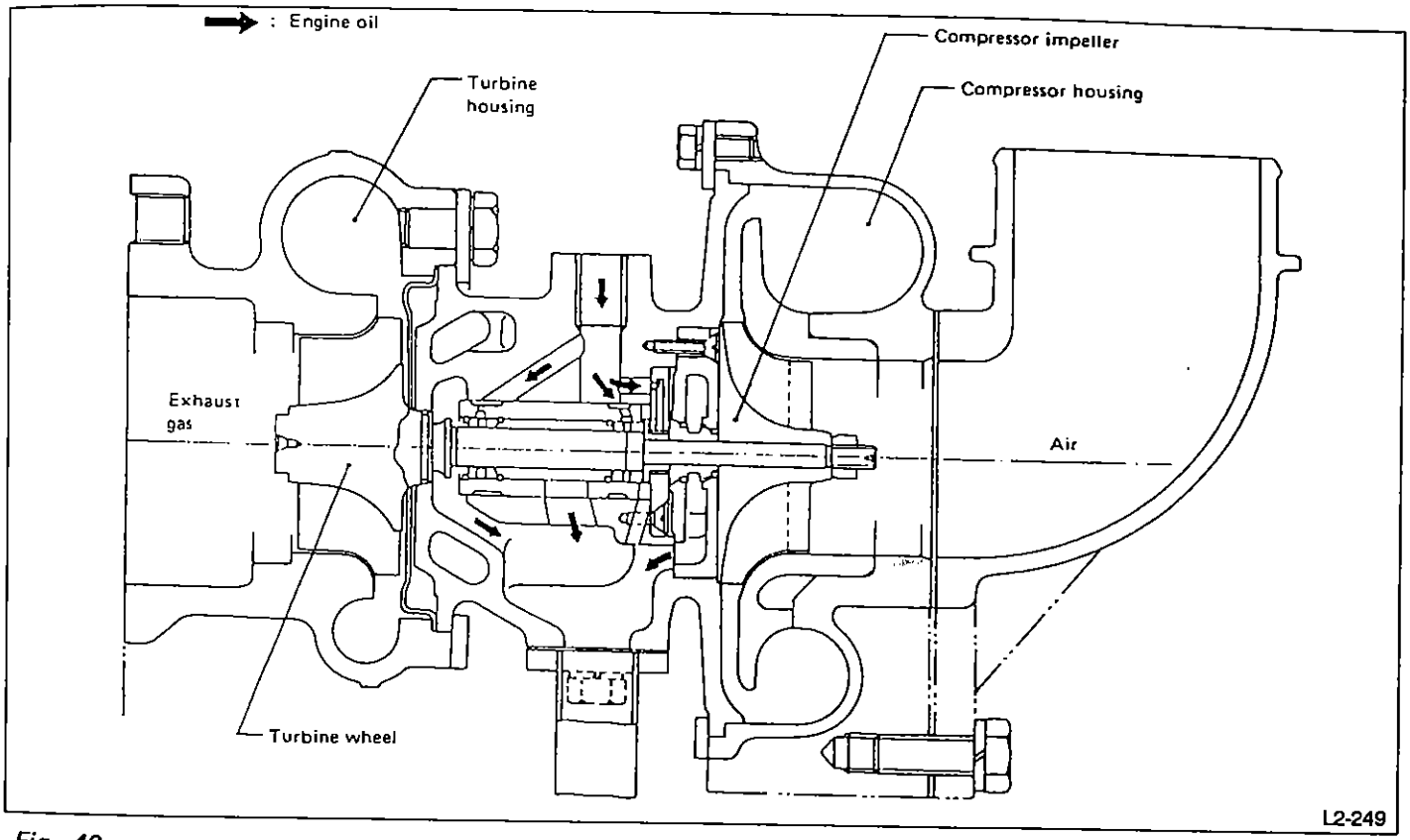


Fig. 40

4. 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 coolant filler tank through a pipe.

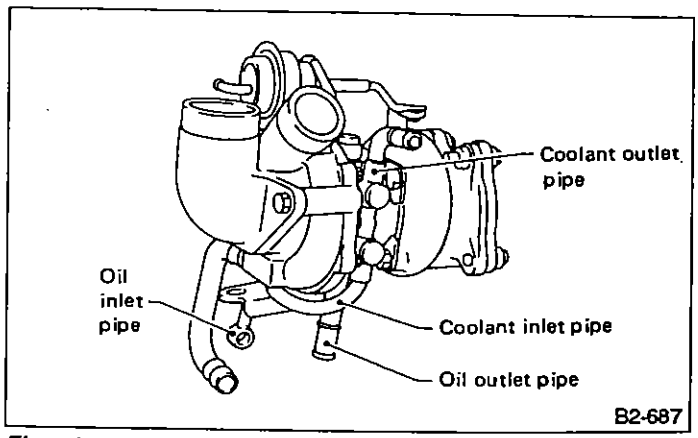
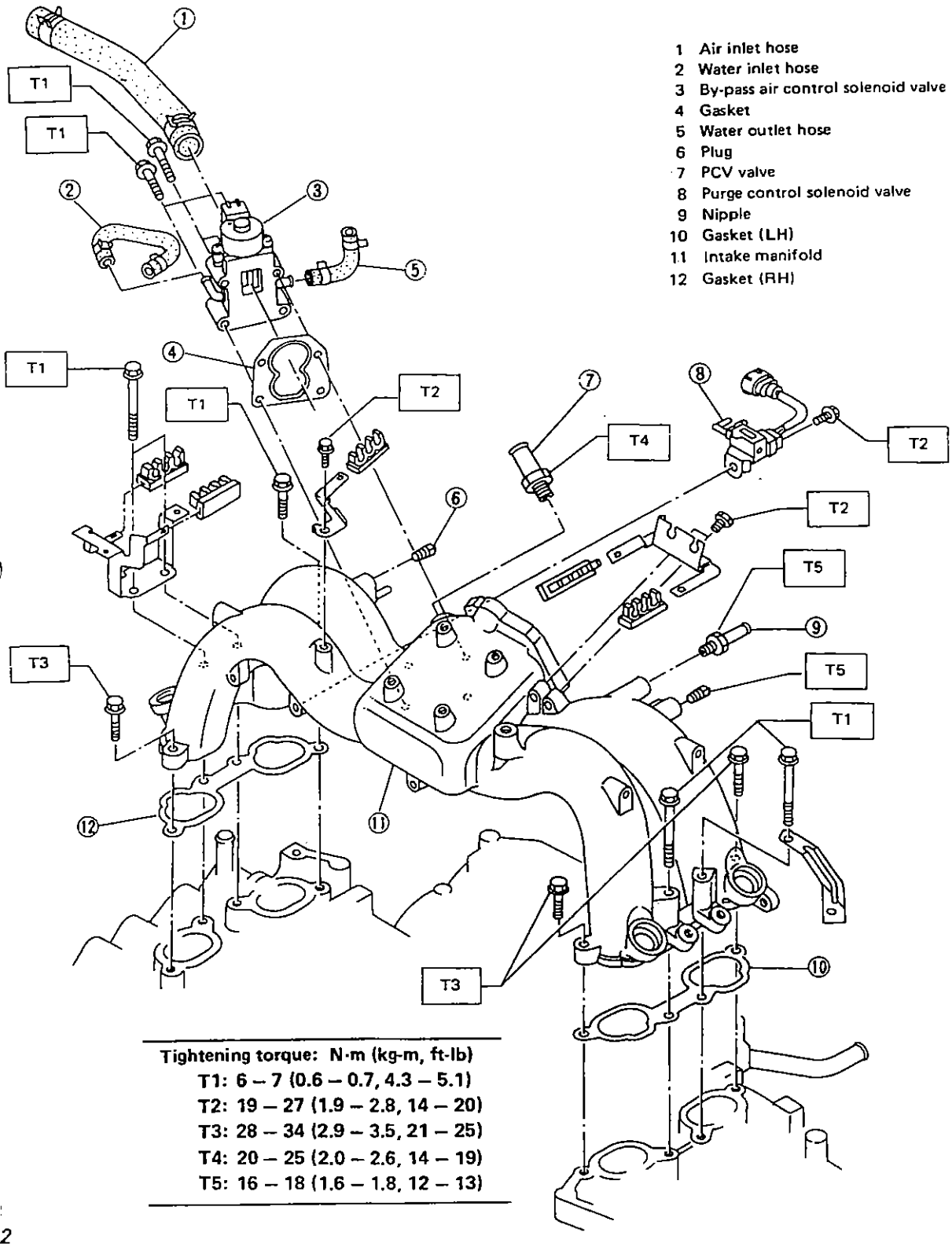


Fig. 41

C COMPONENT PARTS

ake Manifold

I. NON-TURBO MODEL



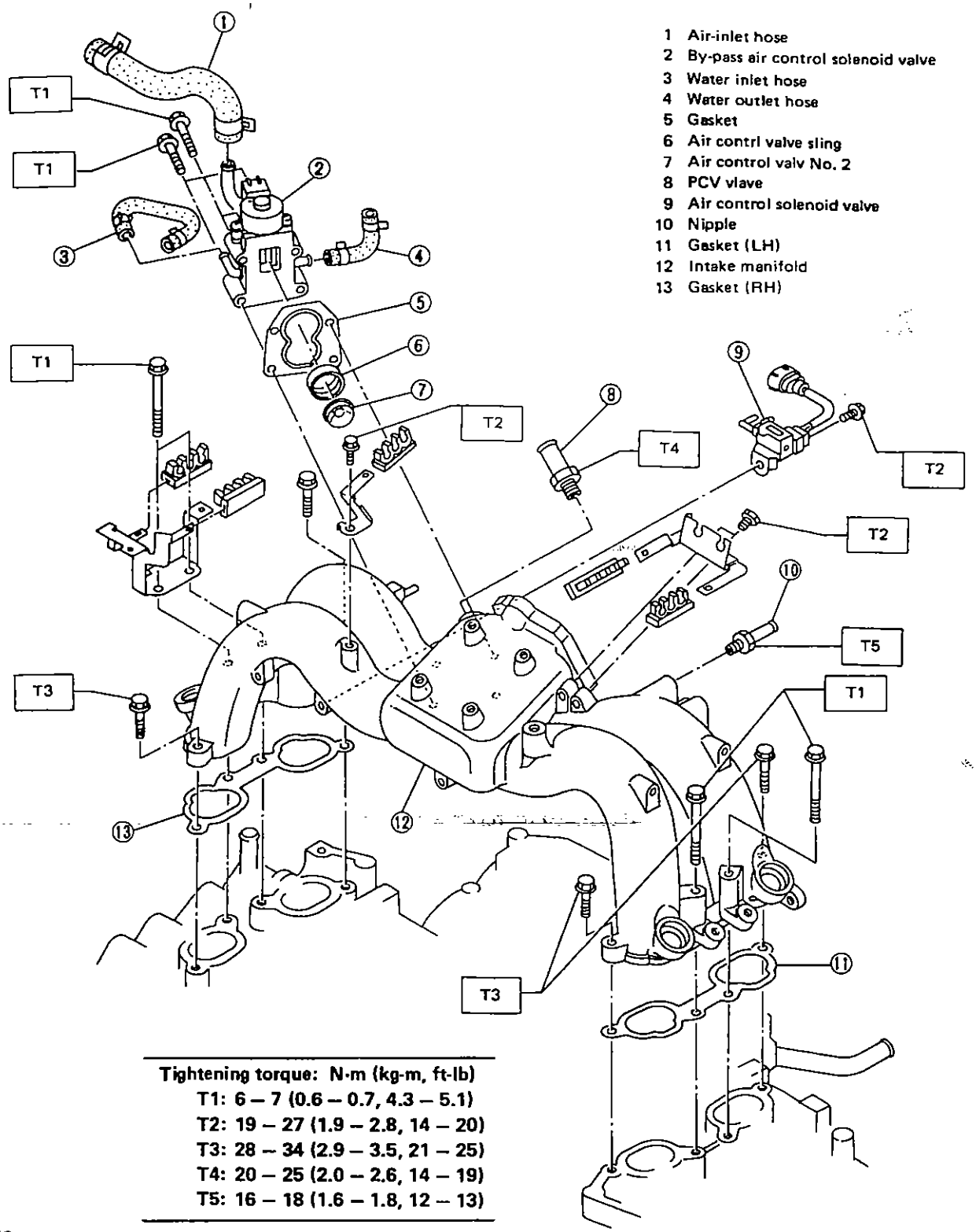
1 Air inlet hose
2 Water inlet hose
3 By-pass air control solenoid valve
4 Gasket
5 Water outlet hose
6 Plug
7 PCV valve
8 Purge control solenoid valve
9 Nipple
10 Gasket (LH)
11 Intake manifold
12 Gasket (RH)

Tightening torque: N·m (kg-m, ft-lb)
T1: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)
T2: 19 – 27 (1.9 – 2.8, 14 – 20)
T3: 28 – 34 (2.9 – 3.5, 21 – 25)
T4: 20 – 25 (2.0 – 2.6, 14 – 19)
T5: 16 – 18 (1.6 – 1.8, 12 – 13)

B2-1011

Fig. 42

2. TURBO MODEL

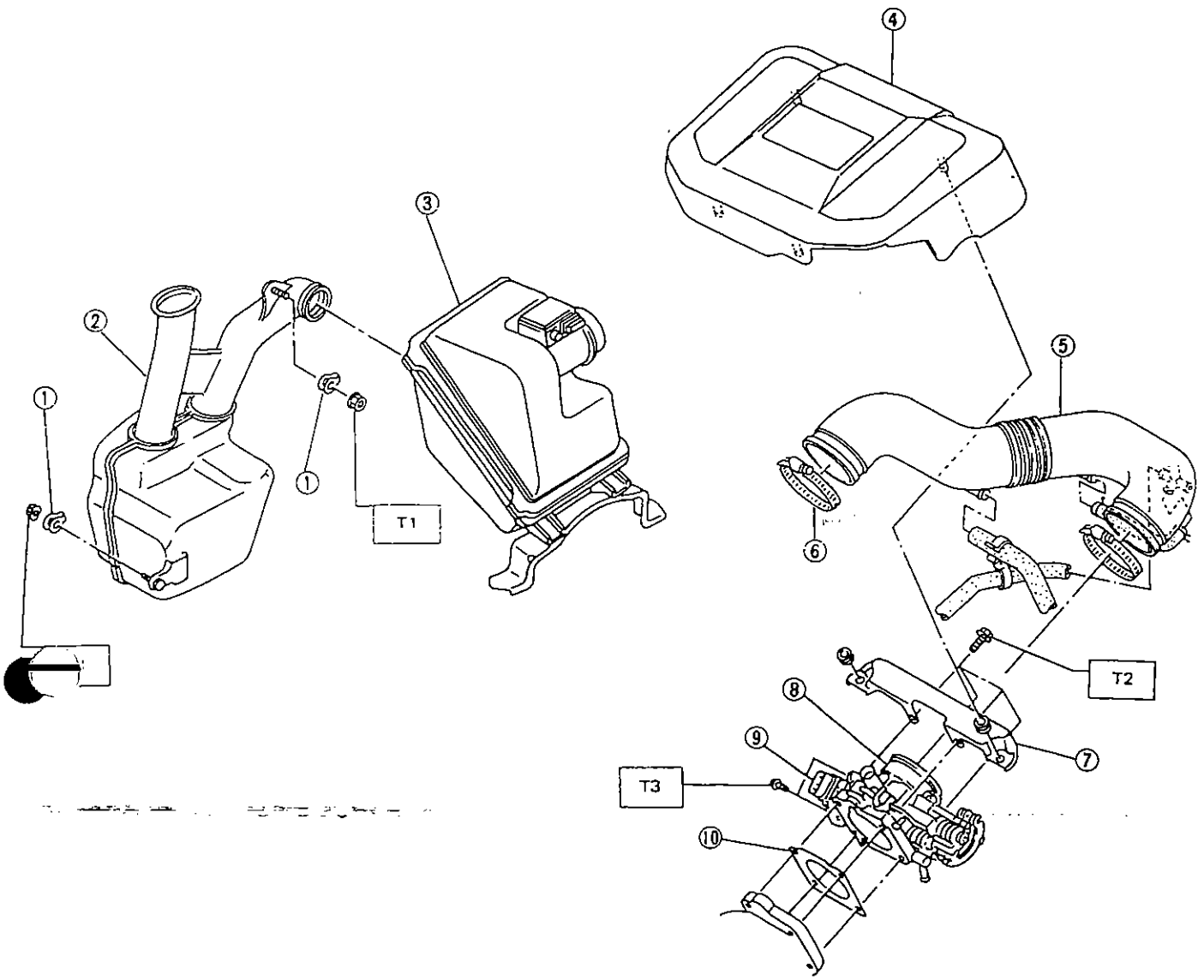


Tightening torque: N·m (kg-m, ft-lb)
T1: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)
T2: 19 – 27 (1.9 – 2.8, 14 – 20)
T3: 28 – 34 (2.9 – 3.5, 21 – 25)
T4: 20 – 25 (2.0 – 2.6, 14 – 19)
T5: 16 – 18 (1.6 – 1.8, 12 – 13)

Fig. 43

2. Air Intake Duct and Throttle Body

I-TURBO MODEL



Tightening torque: N·m (kg-m, ft-lb)
T1: 6.4 – 8.3 (0.65 – 0.85, 4.7 – 6.1)
T2: 19 – 23 (1.9 – 2.3, 14 – 17)
T3: 2 – 3 (0.2 – 0.3, 1.4 – 2.2)

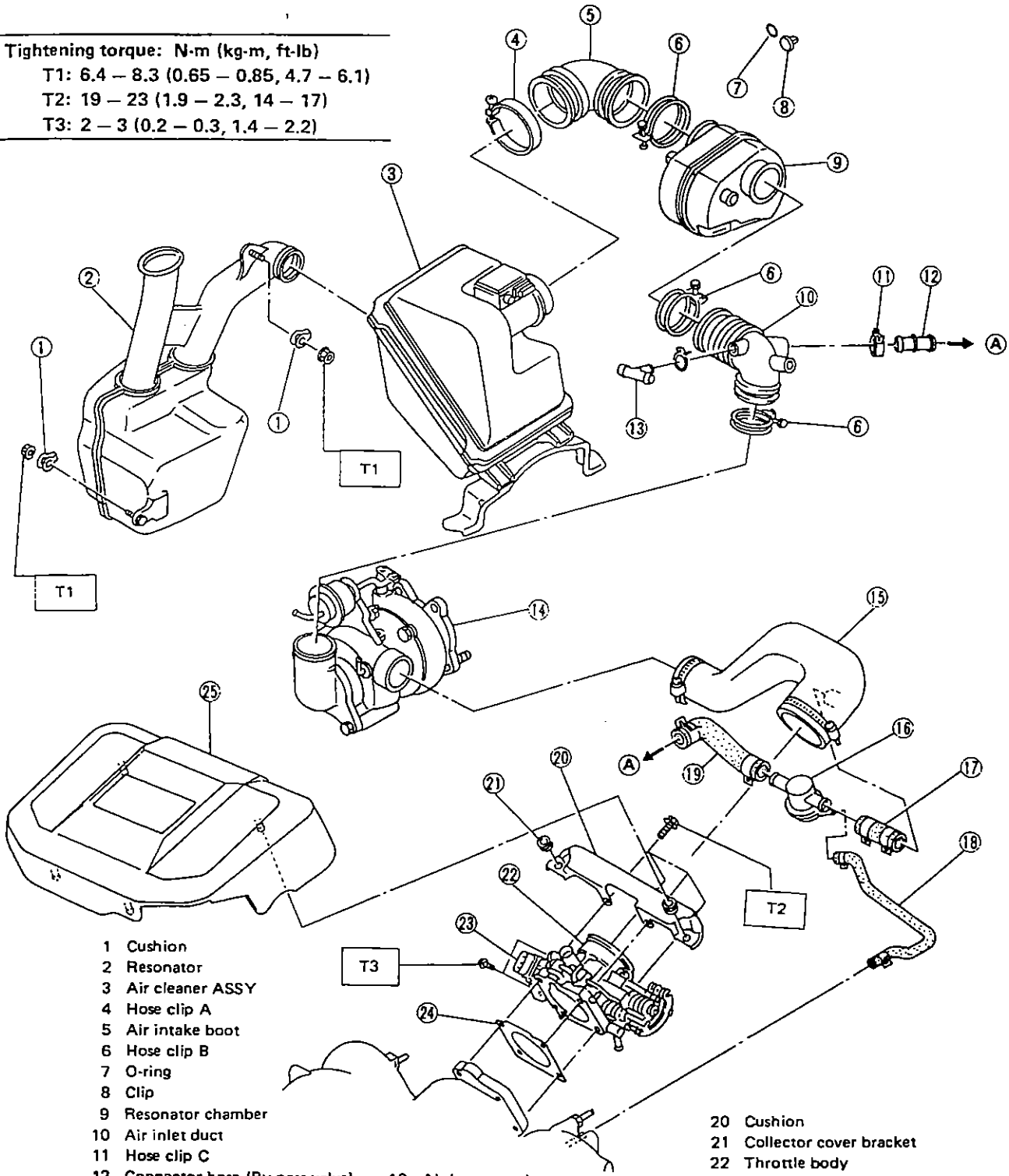
1 Cushion
2 Resonator
3 Air cleaner ASSY
4 Collector cover
5 Air intake boot
6 Clamp
7 Collector bracket
8 Throttle body
9 Throttle sensor
10 Gasket

B2-1013

Fig 44

2. TURBO MODEL

Tightening torque: N·m (kg-m, ft-lb)
T1: 6.4 – 8.3 (0.65 – 0.85, 4.7 – 6.1)
T2: 19 – 23 (1.9 – 2.3, 14 – 17)
T3: 2 – 3 (0.2 – 0.3, 1.4 – 2.2)

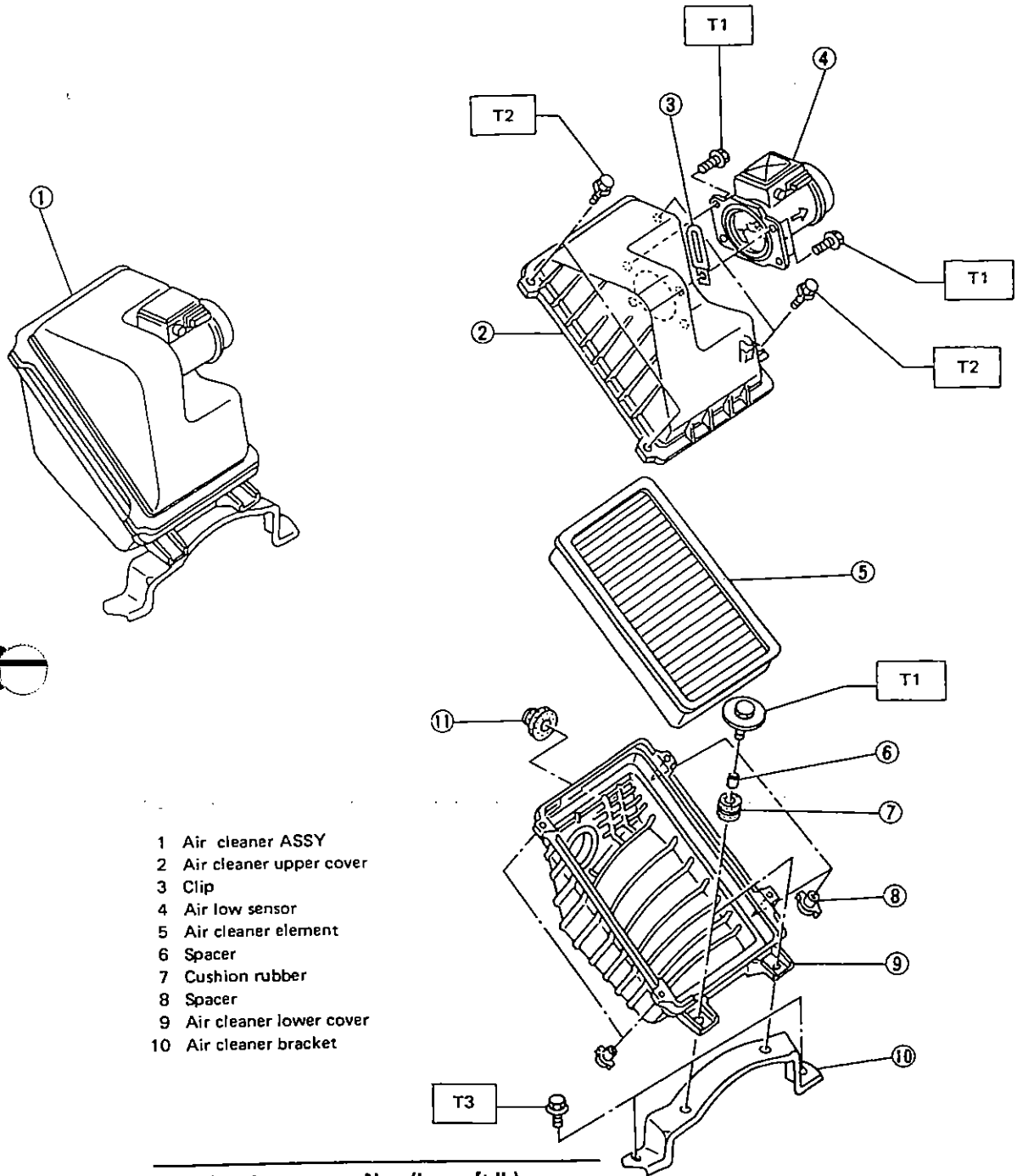


1 Cushion
2 Resonator
3 Air cleaner ASSY
4 Hose clip A
5 Air intake boot
6 Hose clip B
7 O-ring
8 Clip
9 Resonator chamber
10 Air inlet duct
11 Hose clip C
12 Connector hose (By-pass valve)
13 Connector hose (PCV valve)
14 Turbocharger unit
15 Air outlet duct
16 Air by-pass valve
17 Connector hose A (To intake duct)
18 By-pass valve vacuum hose
19 Connector hose B (To boot B)
20 Cushion
21 Collector cover bracket
22 Throttle body
23 Throttle sensor
24 Gasket
25 Collector cover

Fig. 45

B2-1014

3. Air Cleaner



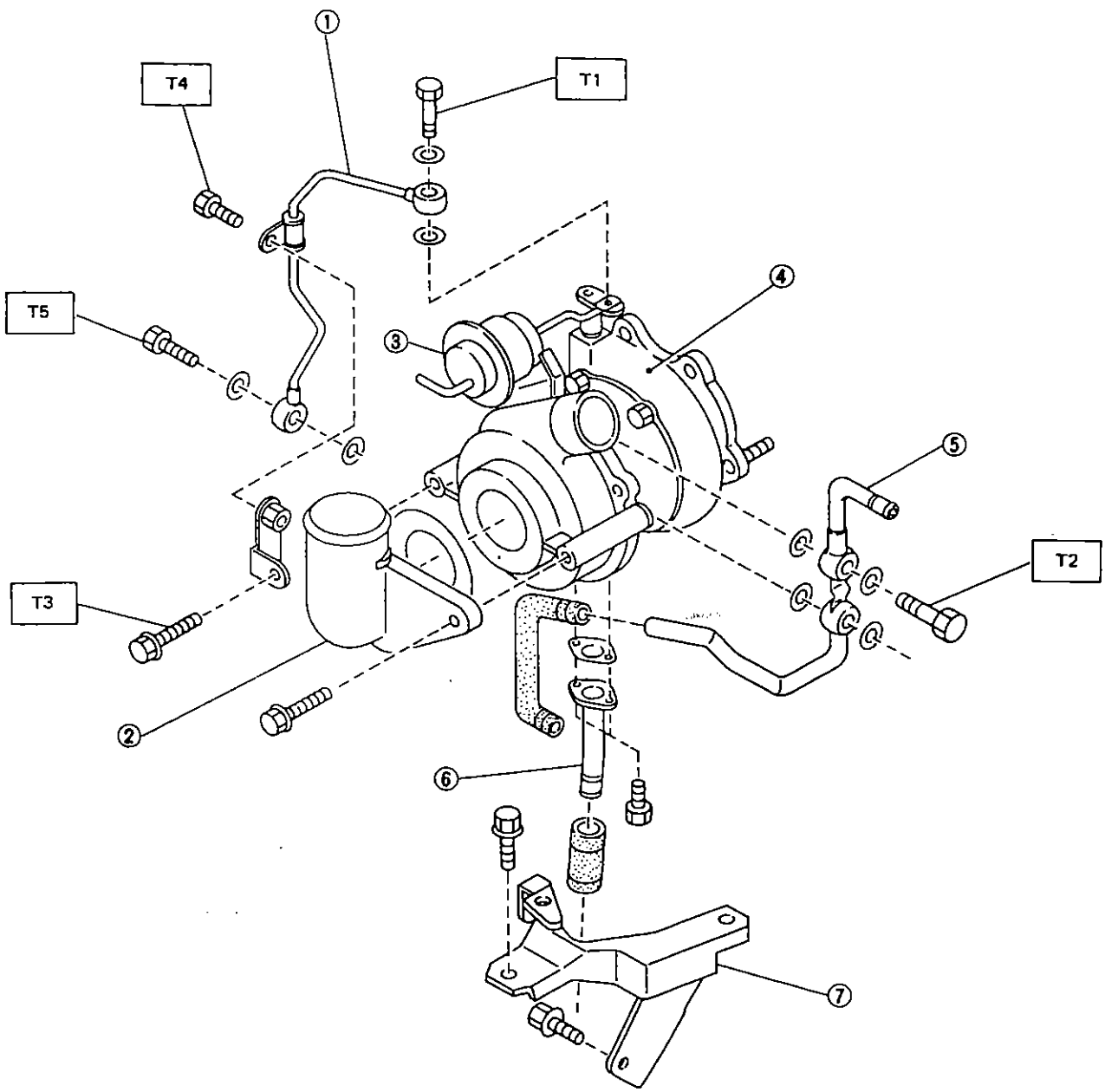
1 Air cleaner ASSY
2 Air cleaner upper cover
3 Clip
4 Air low sensor
5 Air cleaner element
6 Spacer
7 Cushion rubber
8 Spacer
9 Air cleaner lower cover
10 Air cleaner bracket

Tightening torque: N·m (kg-m, ft-lb)
T1: 4.4 – 7.4 (0.45 – 0.75, 3.3 – 5.4)
T2: 2.5 – 4.4 (0.25 – 0.45, 1.8 – 3.3)
T3: 27 – 37 (2.8 – 3.8, 20 - 27)

B2-1015

Fig. 46

4. Turbocharger Unit



1 Oil inlet pipe
2 TURBO inlet duct
3 Wastegate valve controller
4 Turbocharger
5 TURBO cooling pipe
6 Oil outlet pipe
7 Bracket

Tightening torque: N·m (kg-m, ft-lb)
T1: 14.7 – 17.7 (1.50 – 1.80, 10.8 – 13.0)
T2: 21.1 – 24.0 (2.15 – 2.45, 15.6 – 17.7)
T3: 22 – 24 (2.2 – 2.4, 16 – 17)
T4: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T5: 21.1 – 24.0 (2.15 – 2.45, 15.6 – 17.7)

B2-688

Fig. 47

W SERVICE PROCEDURE

1. Turbocharger System

A: TROUBLE DIAGNOSIS

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

1) Excessively high supercharging pressure:
   (1) Engine knocking
2) Excessively low supercharging pressure:
   (1) Lack of engine power
   (2) Poor acceleration performance
   (3) Considerable fuel consumption
3) Oil leak from turbocharger:
   (1) Excessive oil consumption
   (2) 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.)

B: REMOVAL AND INSPECTION

1. WASTEGATE VALVE

1) Check connecting hose between wastegate valve, turbocharger and duty solenoid valve for looseness or disconnection, as well as cracks and damage.
2) Disconnect the wastegate 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 wastegate valve link operates or not.

Excessive pressure may cause damage to the wastegate 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.

2. SUPERCHARGING PRESSURE

1) Disconnect rubber hose from pressure exchange solenoid valve and attach a branch connector. Lead the rubber hose into the passenger compartment, and connect it to the positive pressure gauge.
2) Disconnect two rubber hoses from duty solenoid valve and connect these hoses using a connector. Plug duty solenoid valve.
3) After warming up engine, make a test run. Read the supercharging pressure on the positive pressure gauge when the vehicle is running at approximately 4,600 rpm with fully open throttle.

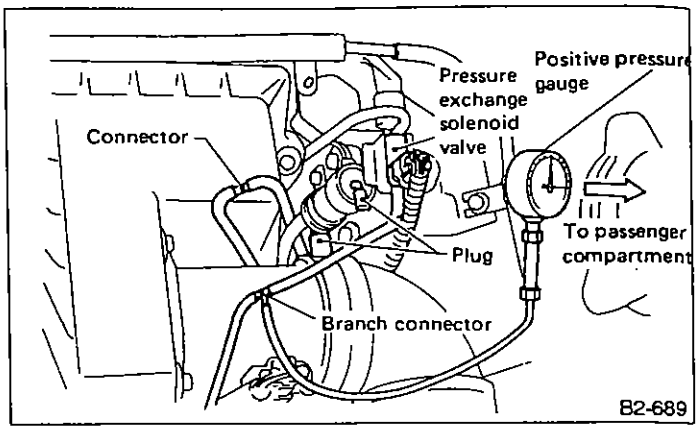


Fig. 48

Phenomenon	Judgement
Supercharging pressure is in the 42.7 to 50.7 kPa (320 to 380 mmHg, 12.60 to 14.96 inHg) range.	Normal
Supercharging pressure exceeds the 50.7 kPa (380 mmHg, 14.96 inHg) upper limit.	
(1) Cracked or disconnected wastegate valve control rubber hoses	Replace or connect rubber hose.
(2) Inoperative and closed wastegate valve	Replace turbocharger.
Supercharging pressure is below the 42.7 kPa (320 mmHg, 12.60 inHg) lower limit.	Faulty turbocharger. ↓ Replace turbocharger.

3. TURBOCHARGER

1) 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.)

2) 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) xp-37

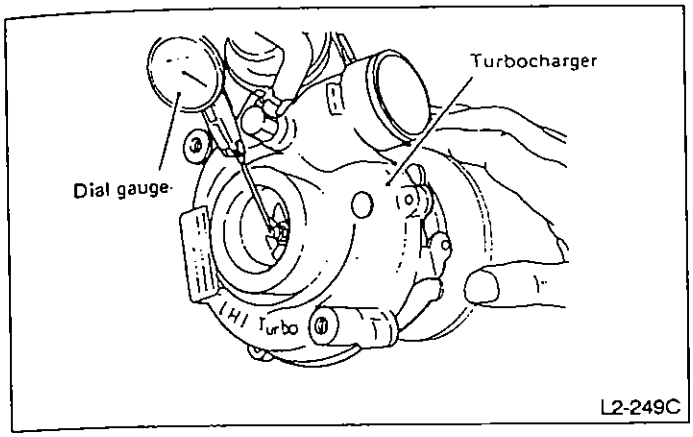


Fig. 49

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.

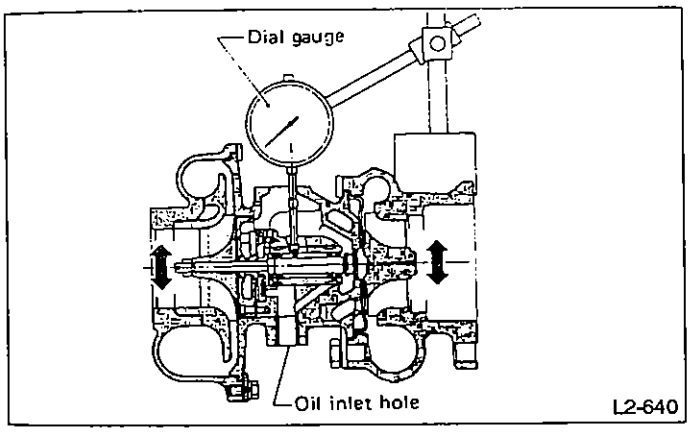


Fig. 50

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.
3) 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)

4) 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)

T TROUBLESHOOTING AIRBAG

1. Supplemental Restraint System "Airbag"

Airbag system wiring harness is routed near the MPFI control unit (ECU), main relay and fuel pump relay.

a. All Airbag system wiring harness and connectors are colored yellow. Do not use electrical test equipment on these circuit.

b. Be careful not to damage Airbag system wiring harness when servicing the MPFI control unit (ECU), main relay and fuel pump relay.

2. Precautions

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 electronic parts such as ECU (MPFI control unit), etc.

3) Before disconnecting the connectors of each sensor and the ECU, be sure the turn off the ignition switch.

4) Before removing ECU from the located position, disconnect two cables on battery.
- Otherwise, the ECU may be damaged.

5) 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.

6) Every MPFI-related part is a precision part. Do not drop them.

7) 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 ECU 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 ECU 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 ECU.

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.

3. Pre-inspection

Before troubleshooting, check the following items which might affect engine problems:

1. Power supply

1) Measure battery voltage and specific gravity of electrolyte.

Standard voltage: 12 V
Specific gravity: Above 1.260

2) Check the condition of the main and other fuses, and harnesses and connectors. Also check for proper grounding.

2. Caps and plugs

1) Check that the fuel cap is properly closed.
2) Check that the oil filler cap is properly closed.
3) Check that the oil level gauge is properly inserted.

3. Intake manifold vacuum pressure

1) After warming up the engine, measure intake manifold vacuum pressure while at idle.

Standard vacuum pressure:
Non-TURBO
More than – 66.7 kPa (– 500 mmHg, – 19.69 in Hg)
TURBO
More than – 65.3 kPa (– 490 mmHg, – 19.29 inHg)

Refer to C.2-2 [W5A0].

2) Unusual vacuum pressure occurs because of air leaks, fuel or engine problems. In such a case, engine idles roughly.

4. Fuel pressure

1) Release fuel pressure
Refer to C.2-8 [W1A0].
2) Connect fuel pressure gauge between fuel filter and hose, and measure fuel pressure at idling.
Refer to C.2-8 [W2A0].

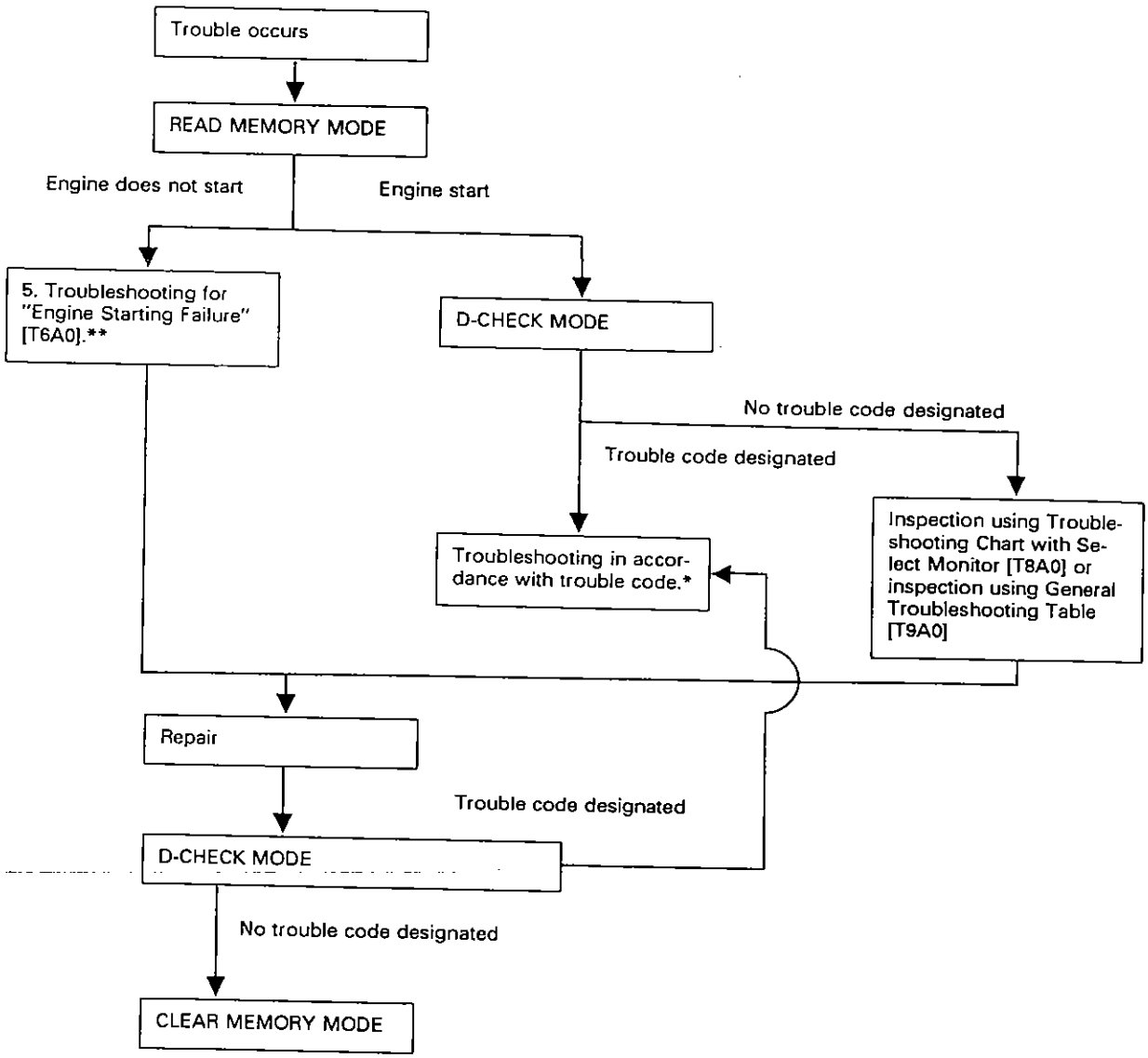
Fuel pressure:
177 — 206 kPa (1.8 — 2.1 kg/cm², 26 — 30 psi)

5. Engine grounding

Make sure the engine grounding terminal is properly connected to the engine.

4. Troubleshooting Chart for Self-diagnosis System

BASIC TROUBLESHOOTING PROCEDURE



*: 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 a trouble code is displayed in the read-memory mode, conduct troubleshooting measures which correspond with the 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 engine "ON", be sure to plug the hose.

B: LIST OF TROUBLE CODE

1. TROUBLE CODE

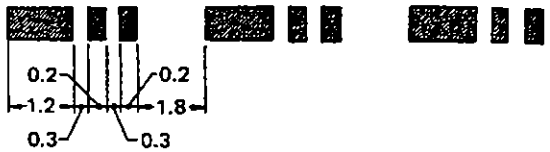
Trouble code	Item	Content of diagnosis	Non-TURBO	TURBO
11.	Crank angle sensor	No signal entered from crank angle sensor, but signal entered from cam angle sensor.	O	O
12.	Starter switch	Abnormal signal emitted from ignition switch.	O	O
13.	Cam angle sensor	No signal entered from cam angle sensor, but signal entered from crank angle sensor.	O	O
14.	Injector #1	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)	O	O
15.	Injector #2			
16.	Injector #3			
17.	Injector #4			
21.	Water temperature sensor	Abnormal signal emitted from water temperature sensor.	O	O
22.	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.	O	O
23.	Air flow sensor	Abnormal voltage input entered from air flow sensor.	O	O
24.	By-pass air control solenoid valve	By-pass air control sdenoid valve inoperative (Abnormal signal emitted from monitor circuit.)	O	O
31.	Throttle sensor	Abnormal voltage input entered from throttle sensor.	O	O
32.	O_2 sensor	O_2 sensor inoperative.	O	O
33.	Vehicle speed sensor 2	Abnormal voltage input entered from speed sensor.	O	O
35.	Purge control solenoid valve	Solenoid valve inoperative.	O	O
41.	AF (Air/fuel) learning control	Faulty learning control function.	O	O
42.	Idle switch	Abnormal voltage input entered from idle switch.	O	O
45.	Atmospheric pressure sensor	Faulty sensor.	O	
49.	Air flow sensor	Use of improper air flow sensor.	O	O
51.	Neutral switch (MT)	Abnormal signal entered from neutral switch.	O	O
51.	Inhibitor switch (AT)	Abnormal signal entered from inhibitor switch.	O	O
52.	Parking switch	Abnormal signal entered from parking switch.	O	O
44.	Wastegate control solenoid valve	Wastegate control solenoid valve inoperative.		O
45.	Pressure sensor and pressure exchange solenoid valve	Faulty sensor or pressure exchange solenoid valve inoperative.		O

2. HOW TO READ TROUBLE CODE (FLASHING)

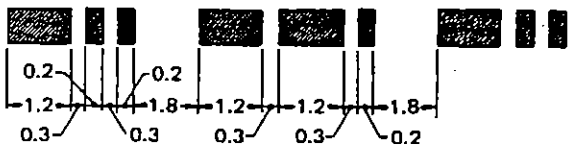
The CHECK ENGINE light flashes the code corresponding to the faulty part.
The long segment (1.2 sec on) indicates a "ten", and the short segment (0.2 sec on) signifies "one".

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)



B2-311

Fig. 51

C: READ MEMORY MODE

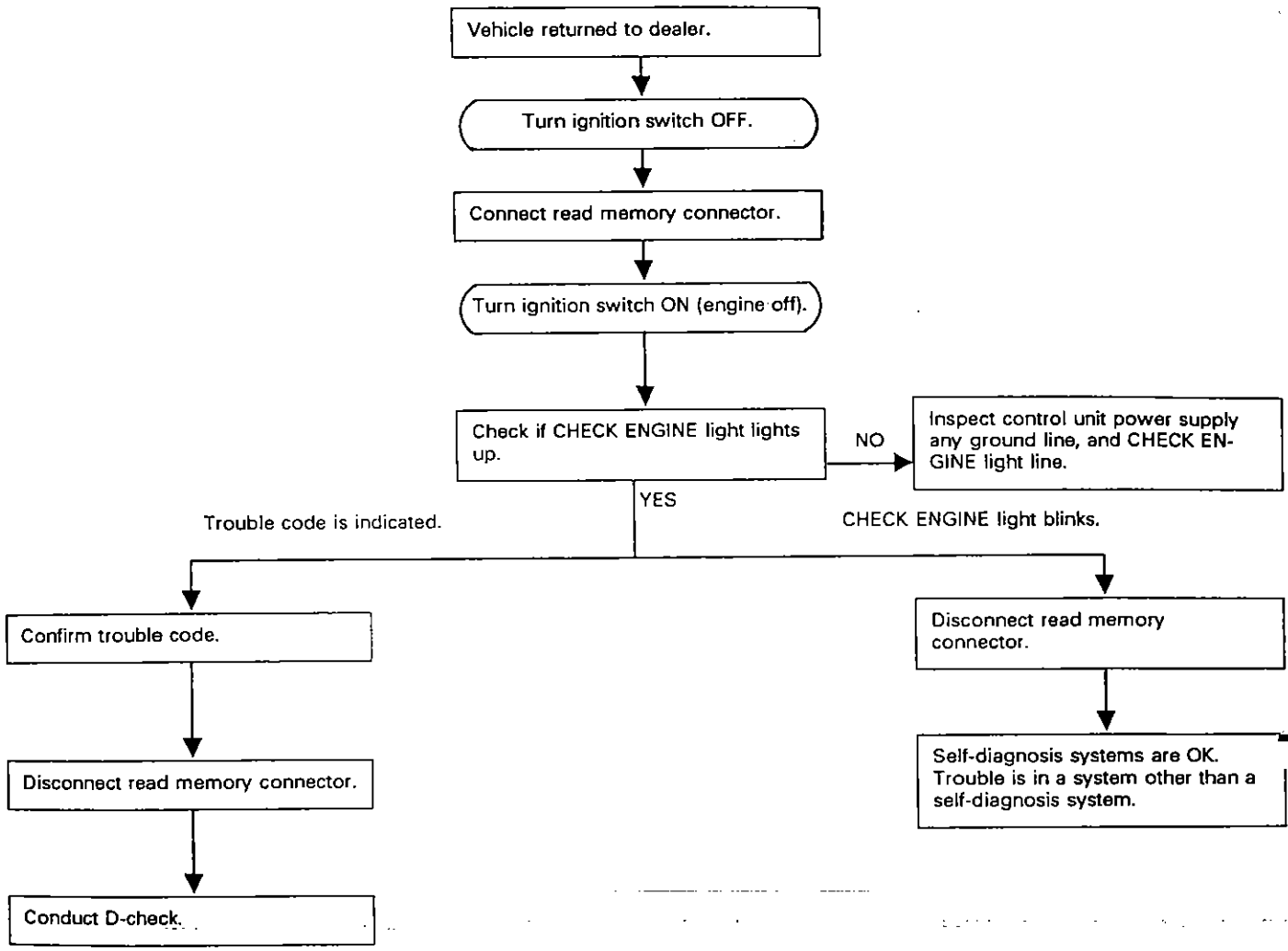


Fig. 52

D: D-CHECK MODE

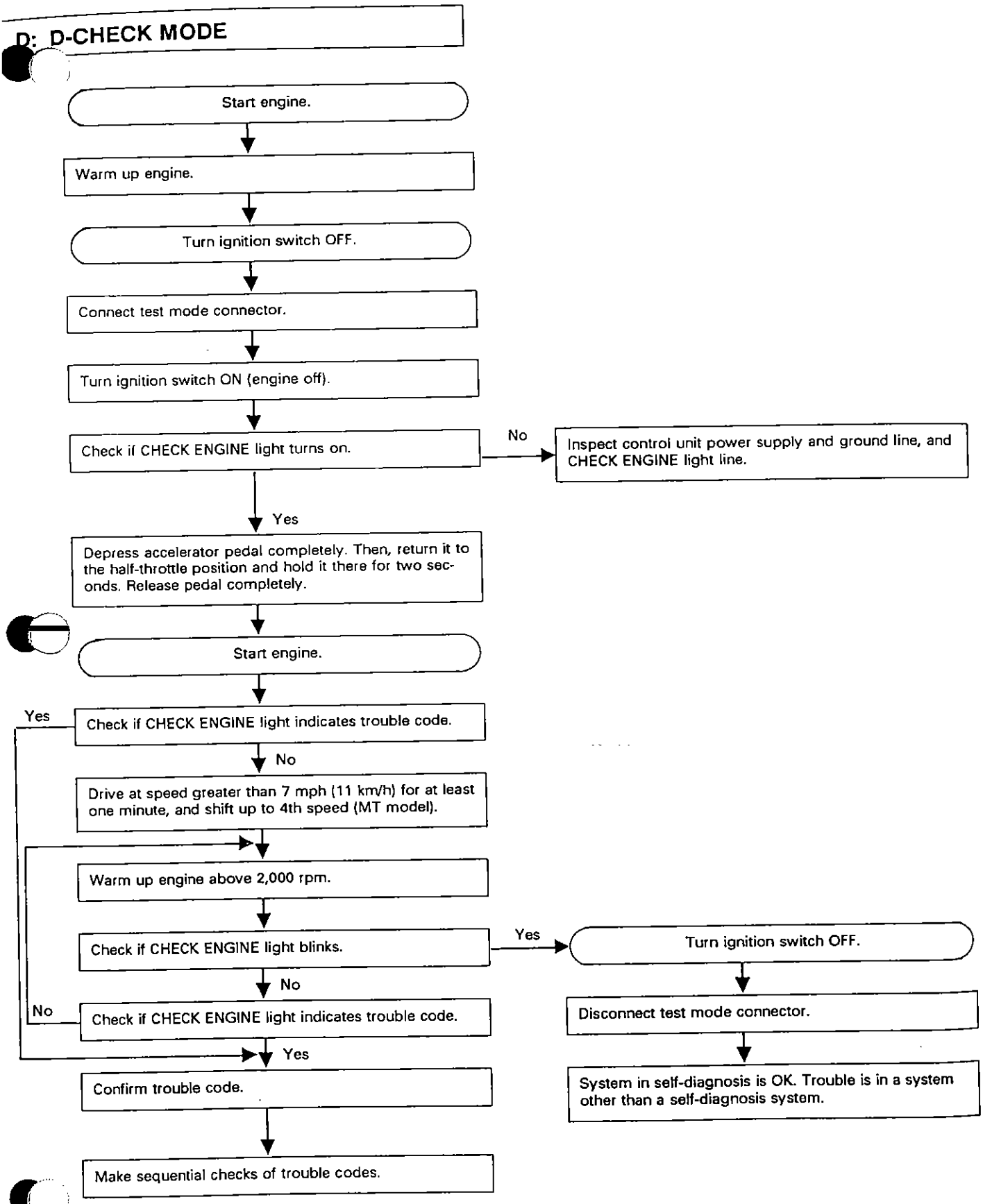


Fig. 53

E: CLEAR MEMORY MODE

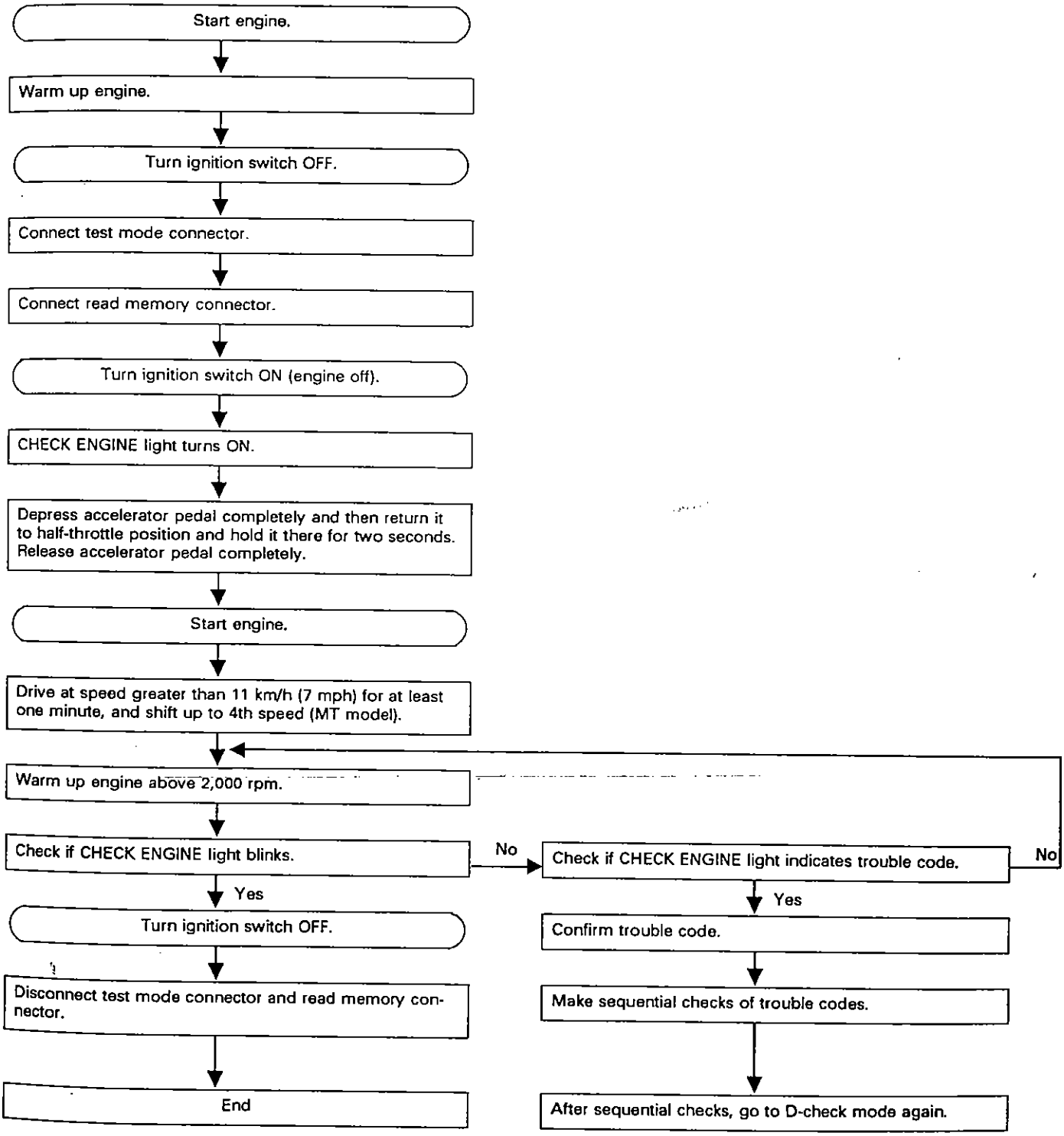


Fig. 54

5. Output Modes of Select Monitor

FUNCTION MODE

Applicable cartridge of select monitor: No. 498348800

MODE	Contents	Abbr.	Unit	Contents of display	Non-TURBO	TURBO
F00	PROM ID Number	YEAR	—	Model year of vehicle to which select monitor is connected	O	O
F01	Battery Voltage	VB	V	Battery voltage supplied to control unit	O	O
F02	Vehicle Speed Sensor	VSP	m/h	Vehicle speed inputted from vehicle speed sensor 2	O	O
F03	Vehicle Speed Sensor	VSP	km/h	Vehicle speed inputted from vehicle speed sensor 2	O	O
F04	Engine speed	EREV	rpm	Engine speed inputted from crank angle sensor	O	O
F05	Water Temp Sensor	TW	deg F	Coolant temperature inputted from water temperature sensor	O	O
F06	Water Temp Sensor	TW	deg C	Coolant temperature inputted from water temperature sensor	O	O
F07	Ignition Timing	ADVS	deg	Ignition timing determined by ECU in relation to signals sent from various sensors	O	O
F08	Air Flow Sensor	QA	V	Voltage inputted from air flow meter	O	O
F09	Load Data	LDATA	—	Engine load value determined by related sensor signals	O	O
F10	Throttle Sensor	THV	V	Voltage inputted from throttle position sensor	O	O
F11	Injector Pulse Width	TIM	mS	Duration of pulse flowing through injectors	O	O
F12	Air Control Valve	ISC	%	"Duty" ratio flowing through air control valve	O	O
F13	O_2 Sensor	O_2	V	Voltage outputted from O_2 sensor	O	O
F14	O_2 Max	O_2 max	V	Maximum voltage outputted from O_2 sensor	O	O
F15	O_2 Min	O_2 min	V	Minimum voltage outputted from O_2 sensor	O	O
F16	ALPHA	ALPHA	%	AF correction ratio determined in relation to signal outputted from O_2 sensor	O	O
F17	Knock Sensor	RTRD	deg	Ignition timing correction determined in relation to signal inputted from knock sensor	O	O
F19	Atmospheric Sensor	BARO.P	mmHg	—	O	
F18	Wastegate control	WGC	%	"Duty" ratio of wastegate control solenoid valve		O
F19	Atmospheric pressure	BARO.P	mmHg	Atmospheric pressure input from pressure sensor		O
F20	Manifold pressure	MANI.P	mmHg	Intake manifold pressure input from pressure sensor		O
FA0	ON ↔ OFF Signal	—	—	—	O	O
FA1	ON ↔ OFF Signal	—	—	—	O	O
FA3	ON ↔ OFF Signal	—	—	—	O	O
FB0	Trouble Code	DIAG	—	Trouble code in U- or D-check mode	O	O
FB1	Trouble Code	DIAG	—	Trouble code in read memory mode	O	O
FC0	Clear Memory	—	—	(Used to clear memory)	O	O

2. ON ↔ OFF SIGNAL LIST

MODE	LED No.	Contents	Display	LED "ON" requirements	Non-TURBO	TURBO
FA0	1	Ignition SW	IG	Ignition switch "ON"	O	O
	2	AT/MT discrimination	AT	AT models only	O	O
	3	Test Mode	UD	Test mode connector connected	O	O
	4	Read Memory	RM	Read-memory connector connected	O	O
	5	—	—	—		
	6	—	—	—		
	7	Neutral SW	NT	Neutral switch "ON"	O	O
	8	Parking SW	PK	Parking switch "ON" [AT]	O	O
	9	Fed./Cal. Discrimination	FC	49-state and Canada model only	O	O
	10	—	—	—		
FA1	1	Idle SW	ID	Idle switch "ON"	O	O
	2	A/C SW	AC	Air conditioner switch "ON"	O	O
	3	A/C Relay	AR	Air conditioner relay "ON"	O	O
	4	Radiator Fan	RF	Radiator fan in operation	O	O
	5	—	—	—		
	6	Fuel Pump Relay	FP	Fuel pump relay in operation	O	O
	7	Purge control solenoid valve	CN	Purge control solenoid valve	O	O
	8	Knock Sensor	KS	Engine knocks occur	O	O
	9	Pressure exchange solenoid valve	BR	Atmospheric pressure is being measured (solenoid "ON")		O
	10	—	—	—		
FA3	1	—	—	—		
	2	—	—	—		
	3	—	—	—		
	4	—	—	—		
	5	—	—	—		
	6	—	—	—		
	7	—	—	—		
	8	—	—	—		
	9	—	—	—		
	10	O_2 Monitor	O_2	A/F ratio is rich.	O	O

;. Control Unit I/O Signal

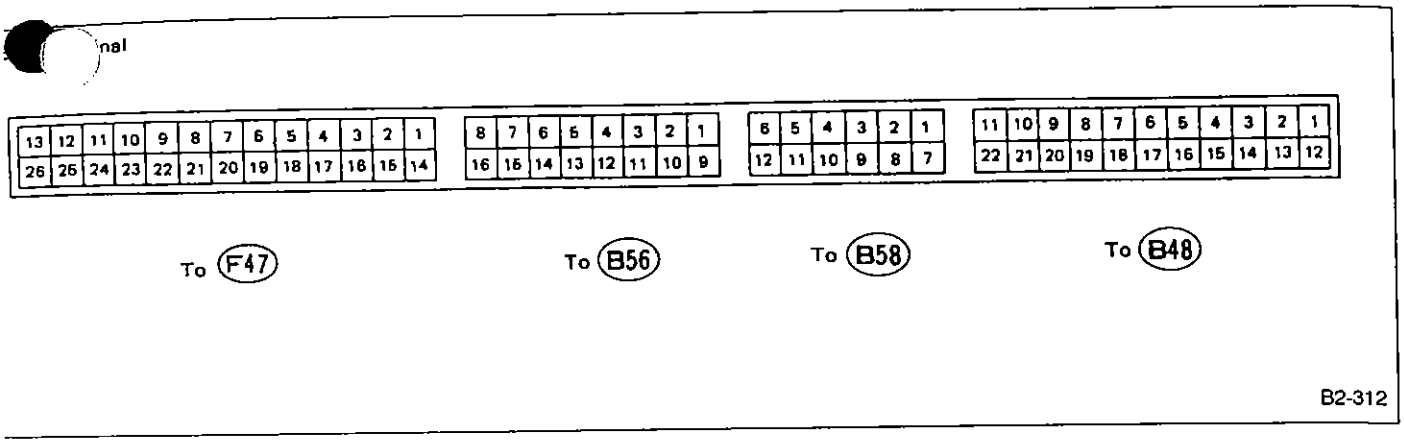


Fig. 55

Content			Connector No.	Terminal No.	Signal (V)			Note
					Ig SW		Engine ON (Idling)	
					OFF	ON (Engine OFF)		
Crank angle sensor	Non-TURBO	Signal (+)	B56	1	—	0	*	*Sensor output waveform
		Signal (−)	B56	2	—	0	0	
		Shield	B56	3	—	0	0	
	TURBO	Signal (+)	B58	4	—	0	*	*Sensor output waveform
		Signal (−)	B58	5	—	0	0	
		Shield	B58	6	—	0	0	
Cam angle sensor	Non-TURBO	Signal (+)	B58	4	—	0	*	*Sensor output waveform
		Signal (−)	B58	5	—	0	0	
		Shield	B58	6	—	0	0	
	TURBO	Signal (+)	B56	1	—	0	*	*Sensor output waveform
		Signal (−)	B56	2	—	0	0	
		Shield	B56	3	—	0	0	
Air flow sensor		Power supply	B48	8	—	10 - 13	13 - 14	—
		Signal	B48	9	—	0 - 0.3	0.8 - 1.2	—
		GND	B48	10	—	0	0	—
		Shield	B48	1•9	—	0	0	—
Throttle sensor		Signal	B58	2	—	Fully closed: 4.7 Fully opened: 1.6	Fully closed: 4.7 Fully opened: 1.6	—
		Power supply	B58	3	—	5	5	—
		GND	B58	1	—	0	0	—
		Shield	B58	7	—	0	0	—
O_2 sensor	Non-TURBO	Signal	B48	6	—	(AT) 0.6 (MT) 0	Rich mixture: 0.7 (AT), 1.0 (MT) Lean mixture: 0 (AT), 0.2 (MT)	
		Shield	B48	17	—	0	0	—
	TURBO	Signal	B48	6	—	0	Rich mixture: 1.0 Lean mixture: 0.2	
		Shield	B48	17	—	0	0	—
Knock sensor		Signal	B56	5	—	3 - 4	3 - 4	—
		Shield	B56	4	—	0	0	—
Water temperature sensor			B48	7	0	0.7 - 1.0	0.7 - 1.0	*After warm-up
Vehicle speed sensor			B58	11	—	0 or 5	0 or 5	"5" and "0" are repeatedly displayed when vehicle is driven.

Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Pressure sensor (TURBO only)	Signal	B48	4	—	10 - 13	2.4 ↔ 2.7	—
	Power supply	B48	3	—	5	5	—
	GND	B48	5	—	0	0	—
Idle switch		B56	6	—	ON:0, OFF:4.6	ON:0, OFF:4.6	—
49-state and Canada/ California identification		B56	11	—	—	—	49-state and Canada:12 California:0
Starter switch		B56	10	—	0	0	Cranking: 10 to 14
Air conditioner switch		B56	9	—	ON:10 - 13, OFF:0	ON:13 - 14, OFF:0	—
Ignition switch		B58	12	0	10 - 13	13 - 14	—
Neutral switch		B58	10	—	[AT] N Range: 0 Other: 8, min. [MT] N Position: 8, min. Other: 0	[AT] N Range: 0 Other: 8, min. [MT] N Position: 8, min. Other: 0	
Parking switch [AT]		B58	9	—	P Range: 0 Other: 8, min.	P Range: 0 Other: 8, min.	—
Test mode connector	Non-TURBO	B56	13	—	[AT] 10 - 13 [MT] 5	[AT] 13 - 14 [MT] 5	[AT] When connected: 0
	TURBO	B56	13	—	5	5	When connected: 0
Read memory connector	Non-TURBO	B56	12	—	[AT] 10 - 13 [MT] 5	[AT] 13 - 14 [MT] 5	[AT] When connected: 0
	TURBO	B56	12	—	5	5	When connected: 0
AT/MT identification	Non-TURBO	B48	20	—	[AT] 0 [MT] 5	[AT] 0 [MT] 5	—
	TURBO	B48	20	—	5	5	—
Back-up power supply		B48	15	10 - 13	10 - 13	13 - 14	—
Control unit power supply		B48	2	0	10 - 13	13 - 14	
		B48	13	0	10 - 13	13 - 14	—
Ignition control	Non-TURBO #1, #2	F47	10	—	[AT] 0.01 [MT] 0	—	—
	Non-TURBO #3, #4	F47	9	—	[AT] 0.01 [MT]0	—	—
	TURBO #1, #2	F47	10	—	0	—	—
	TURBO #3, #4	F47	9	—	0	—	—
Fuel injector	#1	F47	13	10 - 13	10 - 13	13 - 14	—
	#2	F47	12	10 - 13	10 - 13	13 - 14	—
	#3	F47	11	10 - 13	10 - 13	13 - 14	—
	#4	F47	26	10 - 13	10 - 13	13 - 14	—
By-pass air control solenoid valve	Non-TURBO OPEN end	F47	2	—	[AT] 7 [MT] 12 → *0	—	*1 min. after ignition switch ON.
	Non-TURBO CLOSE end	F47	1	—	[AT] 6 [MT] 0	—	—
	TURBO OPEN end	F47	2	—	0 → *12	—	*1 min. after ignition switch ON.
	TURBO CLOSE end	F47	1	—	12 → *0	—	
Fuel pump relay control		F47	23	—	ON: 0 OFF: 10 - 13	0	—
Air conditioner cut relay control		F47	22	—	ON: 0 Off: 10 - 13	ON: 0 OFF: 13 - 14	—
Radiator fan control		F47	17	—	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	—
Self-shutoff control		F47	5	—	10 - 13	13 - 14	—
Wastegate control (TURBO only)		F47	3	—	10 - 13	13 - 14	—
CHECK ENGINE light		F47	19	—	—	—	Light "ON": 1, max. Light "OFF": 10 - 14

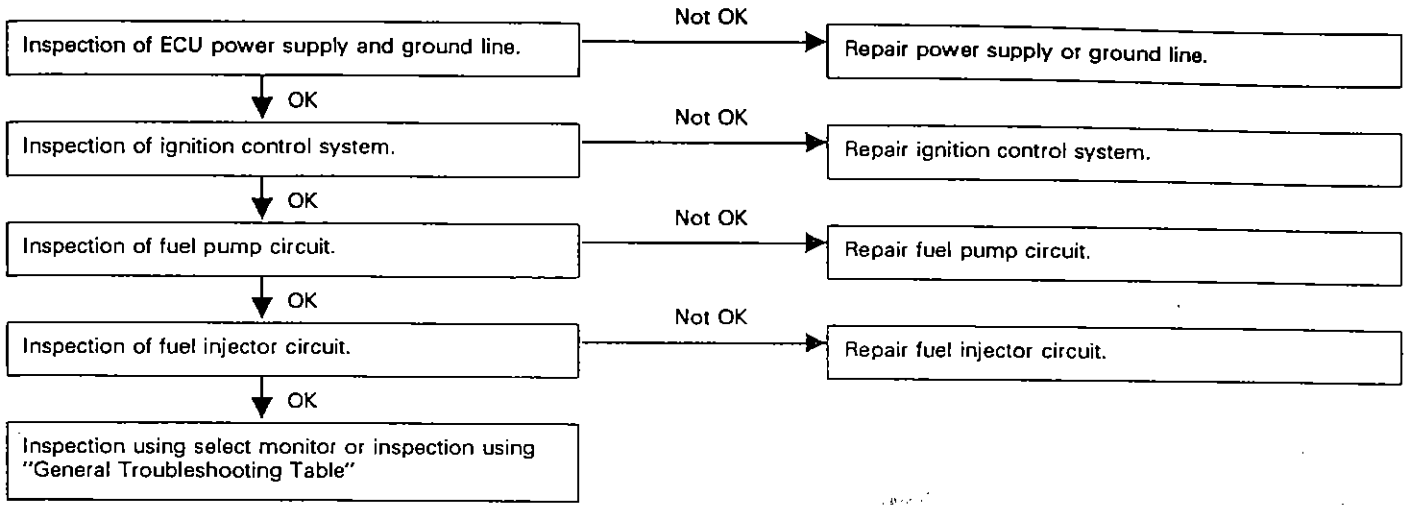
Content	Connector No.	Terminal No.	Signal (V)			Note
			Ig SW		Engine ON (Idling)	
			OFF	ON (Engine OFF)		
Pressure exchange solenoid valve (TURBO only)	F47	20	—	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	—
Engine tachometer output	B56	16	—	—	—	—
Purge control solenoid valve	F47	6	—	ON: 0 OFF: 10 - 13	ON: 0 OF: 13 - 14	—
Atmospheric pressure sensor (Non-TURBO only)	B48	16	—	—	—	—
GND (sensors)	B48	21	—	0	0	—
GND (injectors)	F47	24	—	0	0	—
	F47	25	—	0	0	—
GND (ignition system)	F47	15	—	0	0	—
GND (power supply)	F47	14	—	0	0	—
GND (control systems)	B48	11	—	0	0	—
	B48	22	—	0	0	—
Select Monitor Signal	B56	8	—	—	—	—
	B56	7	—	—	—	—

*: For manufacture

7. Troubleshooting for Engine Starting Failure

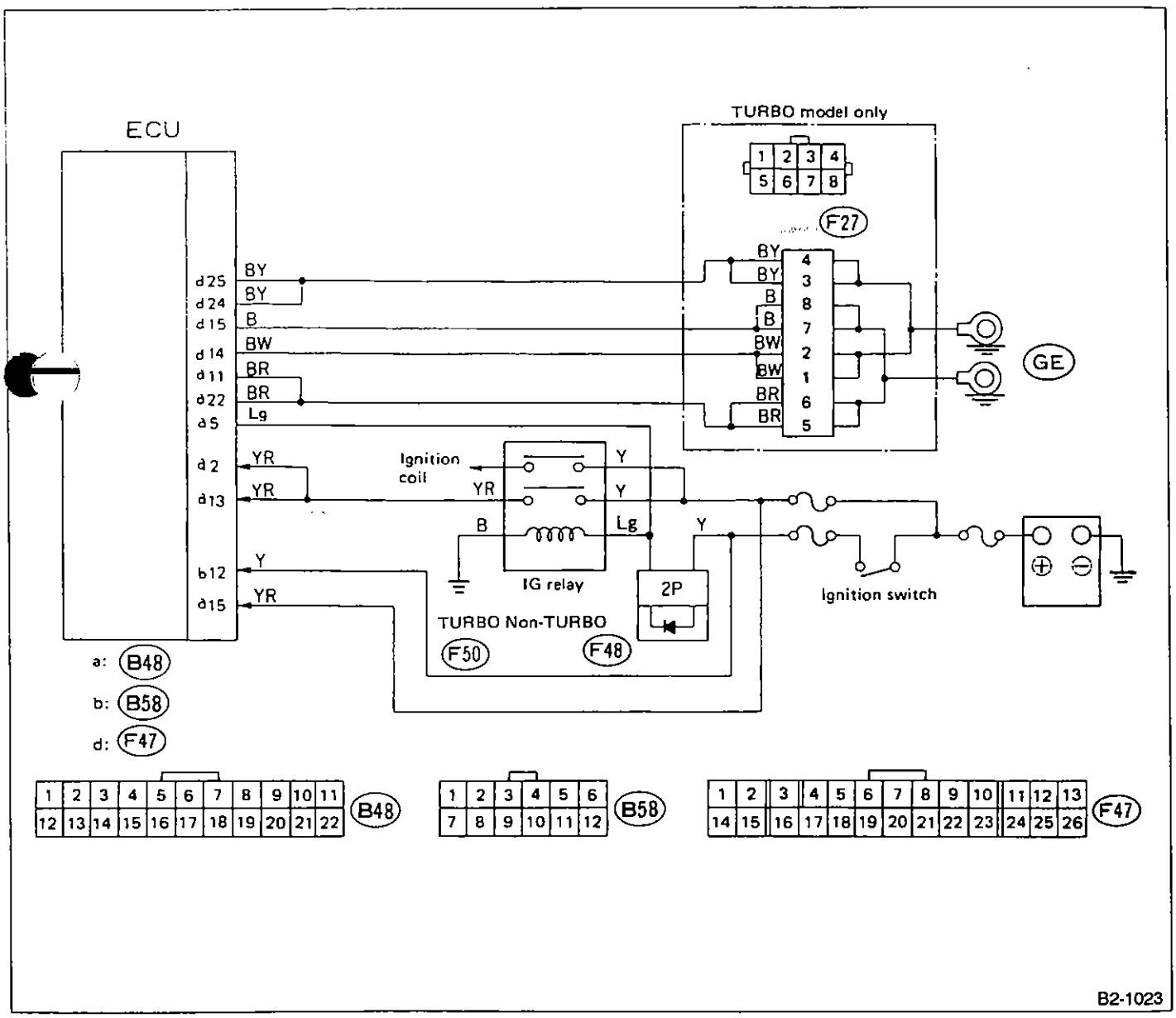
A: BASIC TROUBLESHOOTING CHART

When engine cranks but does not start, troubleshoot in accordance with the following chart.



B: CONTROL UNIT POWER SUPPLY AND GROUND LINE

1	Check voltage between ECU and body.	Not OK	Repair power harness/connector.
	▼ OK		
2	Check grounding circuit.	Not OK	Repair harness/connector.
	▼ OK		
	Check ignition system.		



1. Check voltage between ECU and body.

1) Turn the ignition switch to "ON."
2) Measure voltage between ECU connector terminals and body.

Connector & Terminal/Specified voltage:
(B58) No. 12 — Body/10 V, min.
(B48) No. 15 — Body/10 V, min.
(B48) No. 2 — Body/10 V, min.
(B48) No. 13 — Body/10 V, min.

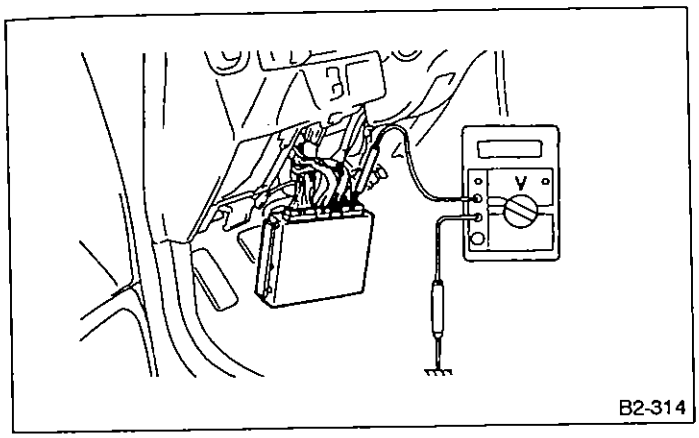


Fig. 57

2. Check grounding circuit.

1) Disconnect ECU connector.
2) Check continuity between ECU connector terminals and body.

Connector & Terminal/Specified resistance:
(F47) No. 24 — Body/0 Ω
(F47) No. 25 — Body/0 Ω
(F47) No. 14 — Body/0 Ω
(F47) No. 15 — Body/0 Ω
(B48) No. 11 — Body/0 Ω
(B48) No. 22 — Body/0 Ω

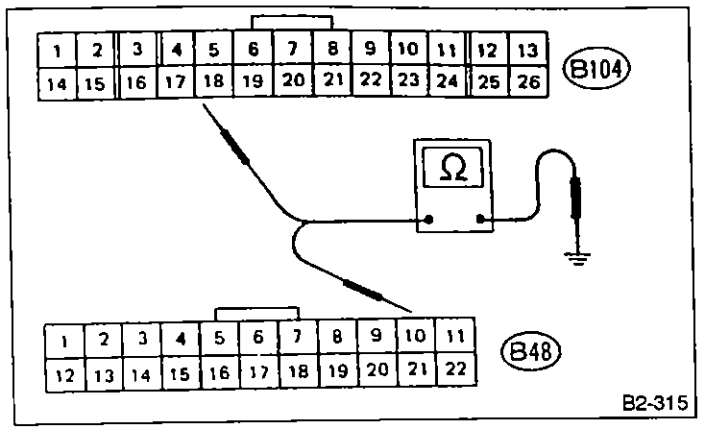


Fig. 58

C: IGNITION CONTROL SYSTEM

1. Check ignition system for sparks.
   - OK → Check fuel pump system.
   - Not OK ↓
2. Check voltage at ignition coil's positive (+) terminal.
   - Not OK → Repair power harness or connector.
   - OK ↓
3. Check condition of ignition coil.
   - Not OK → Replace ignition coil.
   - OK ↓
4. Check input signal at igniter.
   - Not OK → Poor igniter ground terminal contact. Replace igniter.
   - OK ↓
5. Check harness between ECU and igniter.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

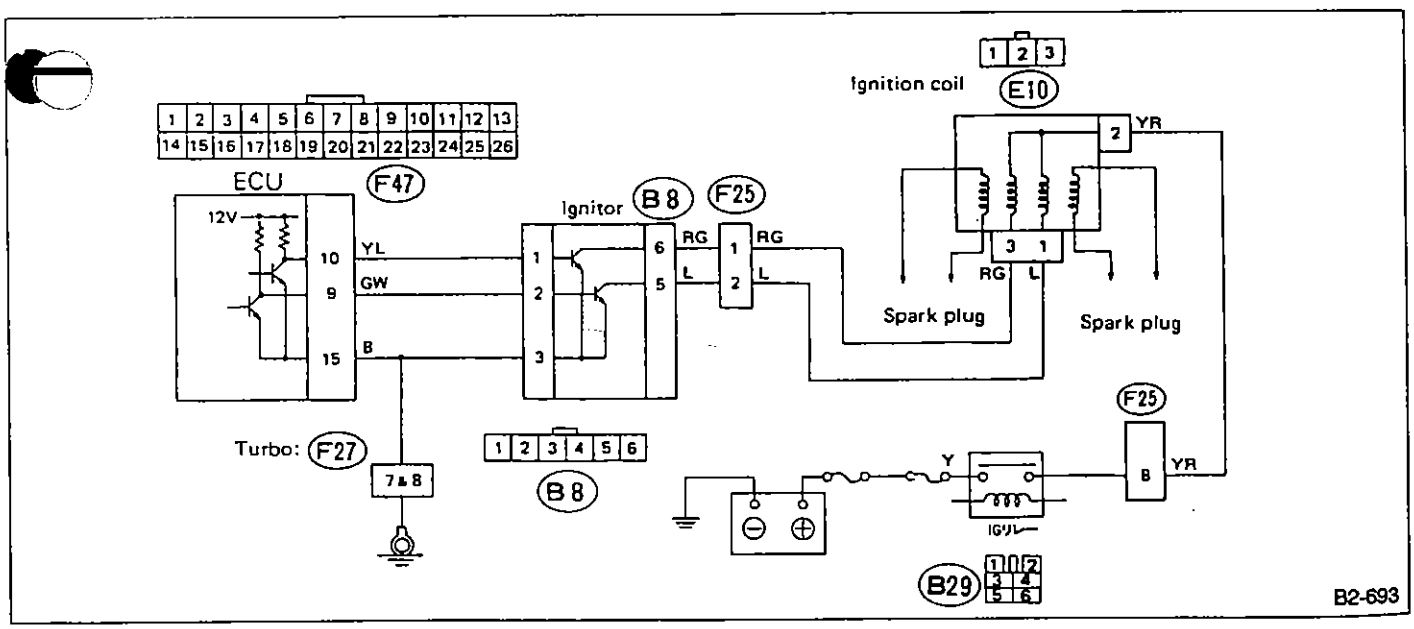


Fig. 59

1. Check ignition system for sparks.

1) Remove plug cord cap from each spark plug.
2) Install new spark plug on plug cord cap. (Do not remove spark plug from engine.)
3) Contact spark plug's thread portion on engine.
4) Crank engine to check that spark occurs at each plug.

2. Check voltage at ignition coil's positive (+) terminal.

1) Turn ignition switch to " ON."
2) Measure voltage between positive terminal of ignition coil connector and body.

Connector & Terminal/Specified voltage:
(E10) No. 2 — Body/10 V, min.

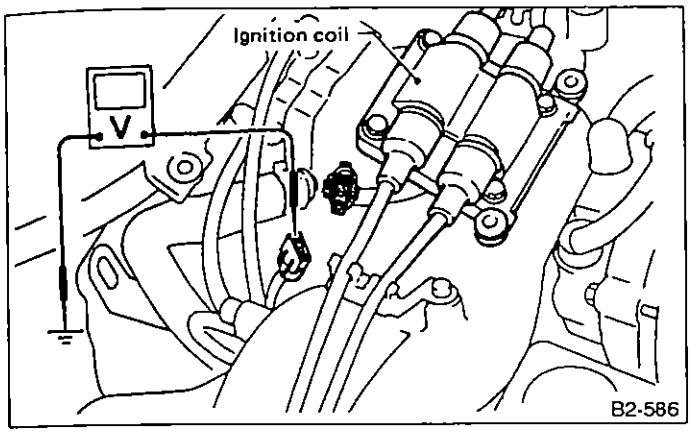


Fig. 60

3. Check condition of ignition coil.

1) Disconnect ignition coil connector.
2) Remove ignition coil from engine.
3) Measure resistance of ignition coil's primary and secondary windings.

• Primary side

Connector & Terminal/Specified resistance:
(E10) No. 2 — No. 1/0.7 Ω
(E10) No. 2 — No. 3/0.7 Ω

• Secondary side

Connector & Terminal/Specified resistance:
#1 — #2/13.8 kΩ(HITACHI), 21 kΩ(DIAMOND)
#3 — #4/13.8 kΩ(HITACHI), 21 kΩ(DIAMOND)

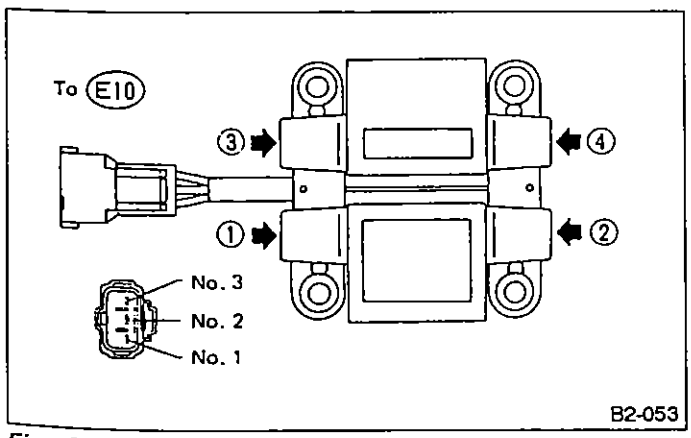


Fig. 61

4. Check input signal at igniter.

Check if voltage varies synchronously with engine revolution when cranking, while monitoring voltage between igniter connector and body.

Connector & Terminal
(B8) No. 1 — Body/0.1 V, min.
(B8) No.2 — Body/0.1 V, min.

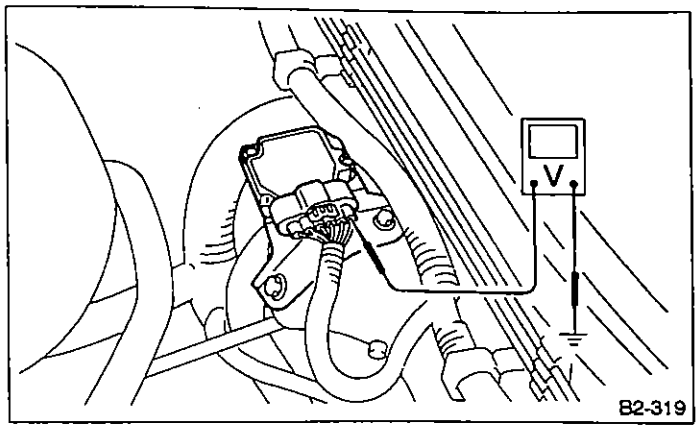


Fig. 62

5. Check harness between ECU and igniter.

1) Disconnect ECU connector and ignitor connector.
2) Check discontinuity between ECU- and igniter- connector terminals.

Connector & Terminal/Specified resistance:
(F47) No. 9 — (B8) No. 2/0 Ω
(F47) No. 10 — (B8) No. 1/0 Ω
(F47) No. 15 — (B8) No. 3/0 Ω
(B8) No. 3 — Body/0Ω

3) Measure resistance between connector terminals and body to check shortcircuit.

Connector & Terminal/Specified resistance:
(B8) No. 1 — Body/1 MΩ min.
(B8) No. 2 — Body/1 MΩ min.

D: FUEL PUMP CIRCUIT

1. Check operation of fuel pump in D-check mode.
   - OK → Check fuel injector system.
   - Not OK ↓
2. Check fuel pump relay.
   - Not OK → Replace fuel pump relay.
   - OK ↓
3. Check voltage between fuel pump relay and body.
   - Not OK → Repair power harness or connector.
   - OK ↓
4. Check voltage between ECU and body.
   - Not OK → Repair ECU terminal poor contact/grounding line. (Replace ECU)
   - OK ↓
5. Check terminal voltage of fuel pump.
   - Not OK → Repair harness/connector between fuel pump and relay.
   - OK ↓
6. Check fuel pump.
   - Not OK → Replace fuel pump.
   - OK ↓

fuel pump grounding circuit.

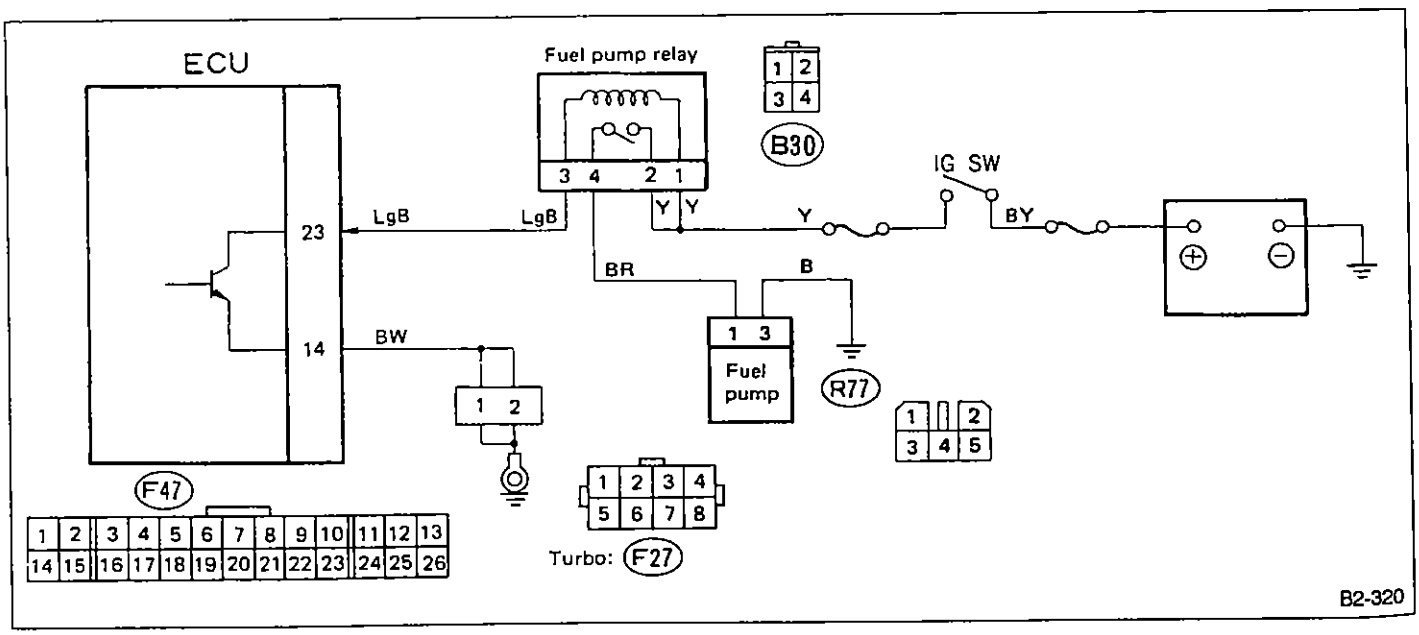


Fig. 63

1. Check operation of fuel pump in D-check mode.

1) Connect test-mode connector.
2) Turn ignition switch to "ON."
3) Check fuel pump for proper operation.

2. Check fuel pump relay.

1) Disconnect fuel pump relay connector and remove relay from bracket.
2) Measure resistance of relay coil.

Terminal/Specified resistance:
No. 1 — No. 3/70 Ω

3) Connect battery (12 volts) to fuel pump relay coil terminals and check continuity between switching terminals. (Relay must issue clicks).

Terminal/Specified resistance:
No. 2 — No. 4/0 Ω
(No. 1: Battery ⊕)
(No. 3: Battery ⊖)

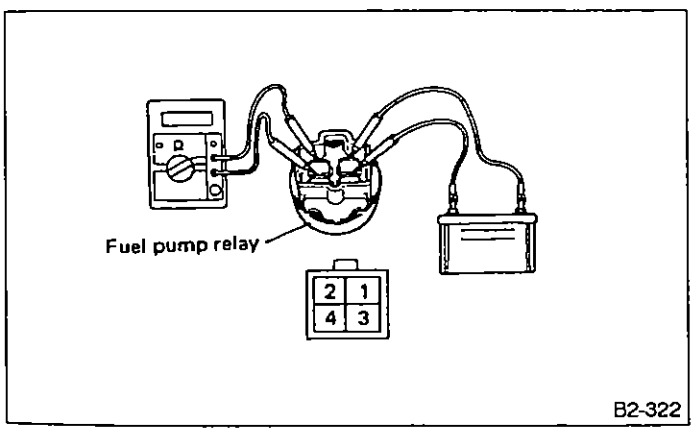


Fig. 64

3. Check voltage between fuel pump relay and body.

1) Turn ignition switch to "OFF," and remove fuel pump relay. (Do not disconnect connector.)
2) Measure voltage between fuel pump relay connector and body.

Connector & Terminal/Specified voltage:
(B30) No. 1 — Body/10 V, min.

4. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage when ignition switch is in "ON." Also measure voltage when cranking the engine.

Connector & Terminal/Specified voltage:
(F47) No. 23 — Body/
10 V, min. (Ignition ON)
0 V (when cranking the engine)

5. Check terminal voltage of fuel pump.

1) Remove access lid of fuel pump located in trunk compartment and remove fuel pump connector.
2) Measure voltage between connector and body while cranking the engine.

Connector & Terminal/Specified voltage:
(R77) No. 1 — Body/10 V, min.

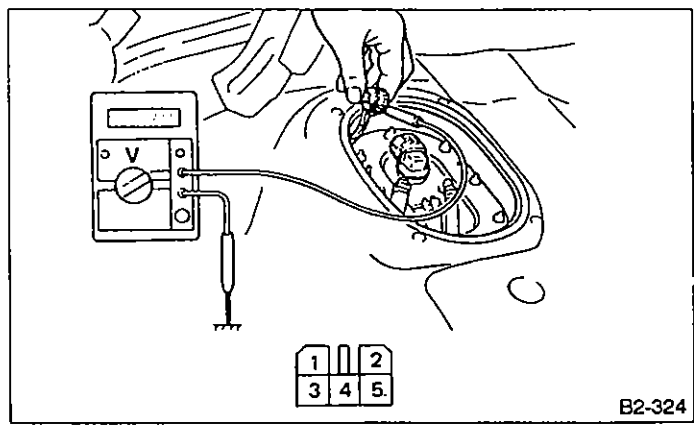


Fig. 65

6. Check fuel pump.

1) Disconnect fuel pump connector.
2) Connect 12-volt battery to proper fuel pump connector terminal and GND terminal to check fuel pump operation.

Terminal:
No. 1 → Battery ⊕
No. 3 → Battery ⊖

E: FUEL INJECTOR CIRCUIT

1. Check each fuel injector for operation.
   - OK → Check fuel pressure.
   - Not OK ↓
2. Check voltage at fuel injector's power terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check fuel injectors.
   - Not OK → Replace fuel injector.
   - OK ↓
4. Check voltage at each ECU terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
5. Check harness connector between ECU and body.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

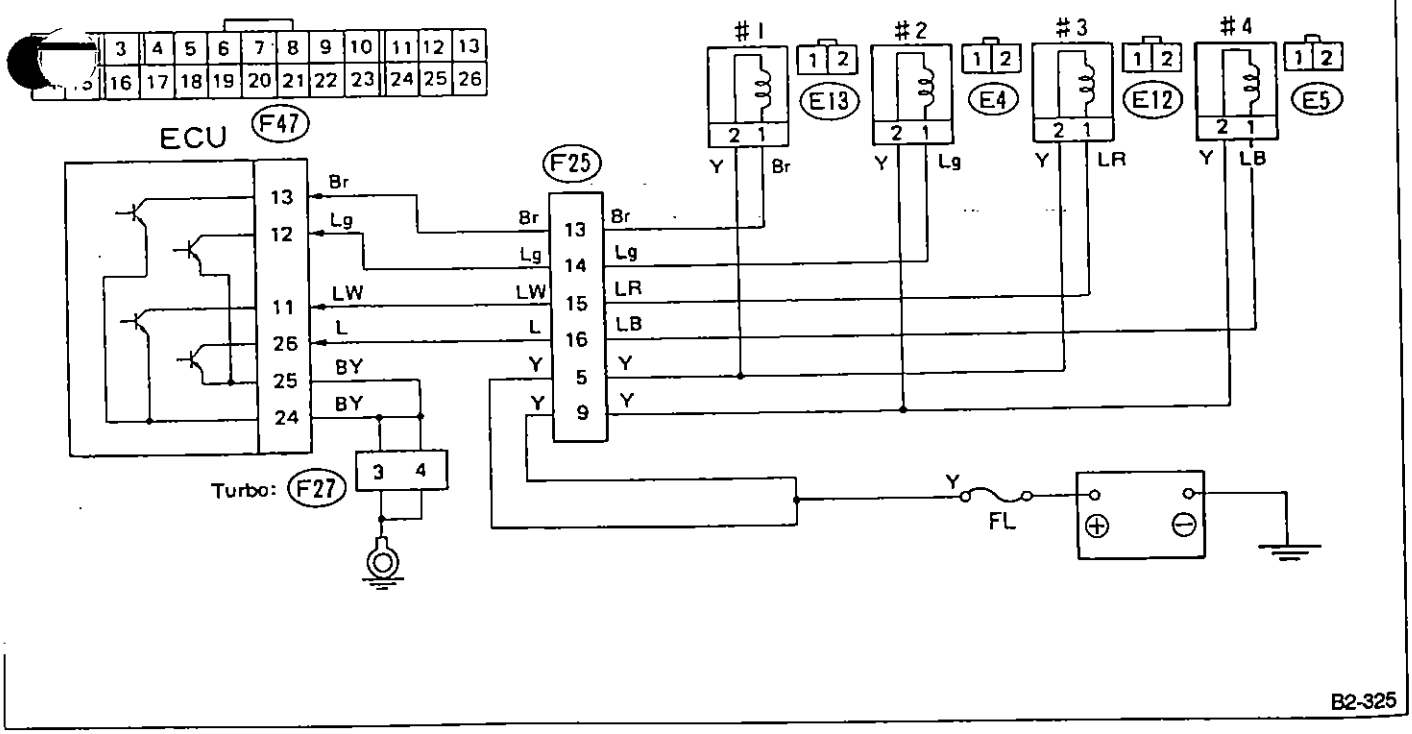


Fig. 66

1. Check each fuel injector for operation.

While cranking the engine, check that each fuel injector emits 'operating' sound. Use a sound scope or attach a screwdriver to injector for this check.

2. Check voltage at fuel injector power terminal.

1) Disconnect connector from injector.
2) Measure voltage between injector connector power terminal and body.

Connector & Terminal/Specified voltage:
- **(E12) No. 2 — Body/10 V, min.**
- **(E4) No. 2 — Body/10 V, min.**
- **(E13) No. 2 — Body/10 V, min.**
- **(E5) No. 2 — Body/10 V, min.**

3. Check fuel injectors.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistance:
- **11 — 12 Ω**

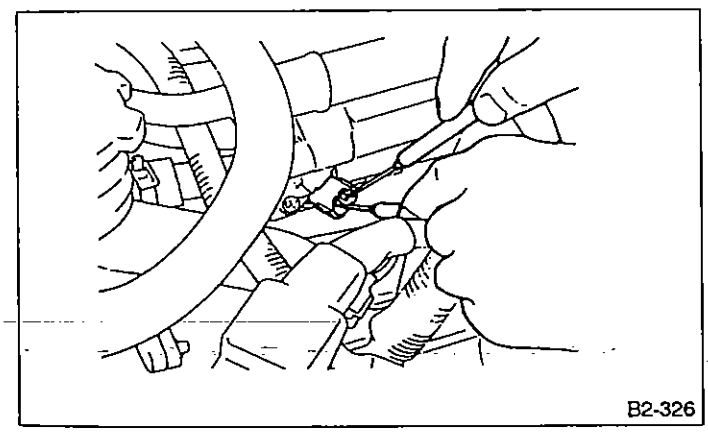


Fig. 67

4. Check voltage at each ECU terminal.

Measure voltage between each fuel injector terminal of ECU connector and body.
(Fuel injector connector is connected.)

Connector & Terminal/Specified voltage:
- **(F47) No. 11 — Body/10 V, min.**
- **(F47) No. 12 — Body/10 V, min.**
- **(F47) No. 13 — Body/10 V, min.**
- **(F47) No. 26 — Body/10 V, min.**

5. Check harness connector between ECU and body.

1) Disconnect connector from ECU.
2) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
- **(F47) No. 24 — Body/0 Ω**
- **(F47) No. 25 — Body/0 Ω**

Troubleshooting Chart with Trouble Code

)UBLE CODE (11) —CRANK ANGLE SENSOR—

ONTENT OF DIAGNOSIS:
o signal entered from crank angle sensor, but signal
:orresponding to at least one rotation of crank) entered
om cam angle sensor

TROUBLE SYMPTOM:
- Engine stall
- Restarting impossible

1. Check crank angle sensor.
   - Not OK → Replace crank angle sensor.
   - OK ↓
2. Check harness connector between ECU and crank angle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

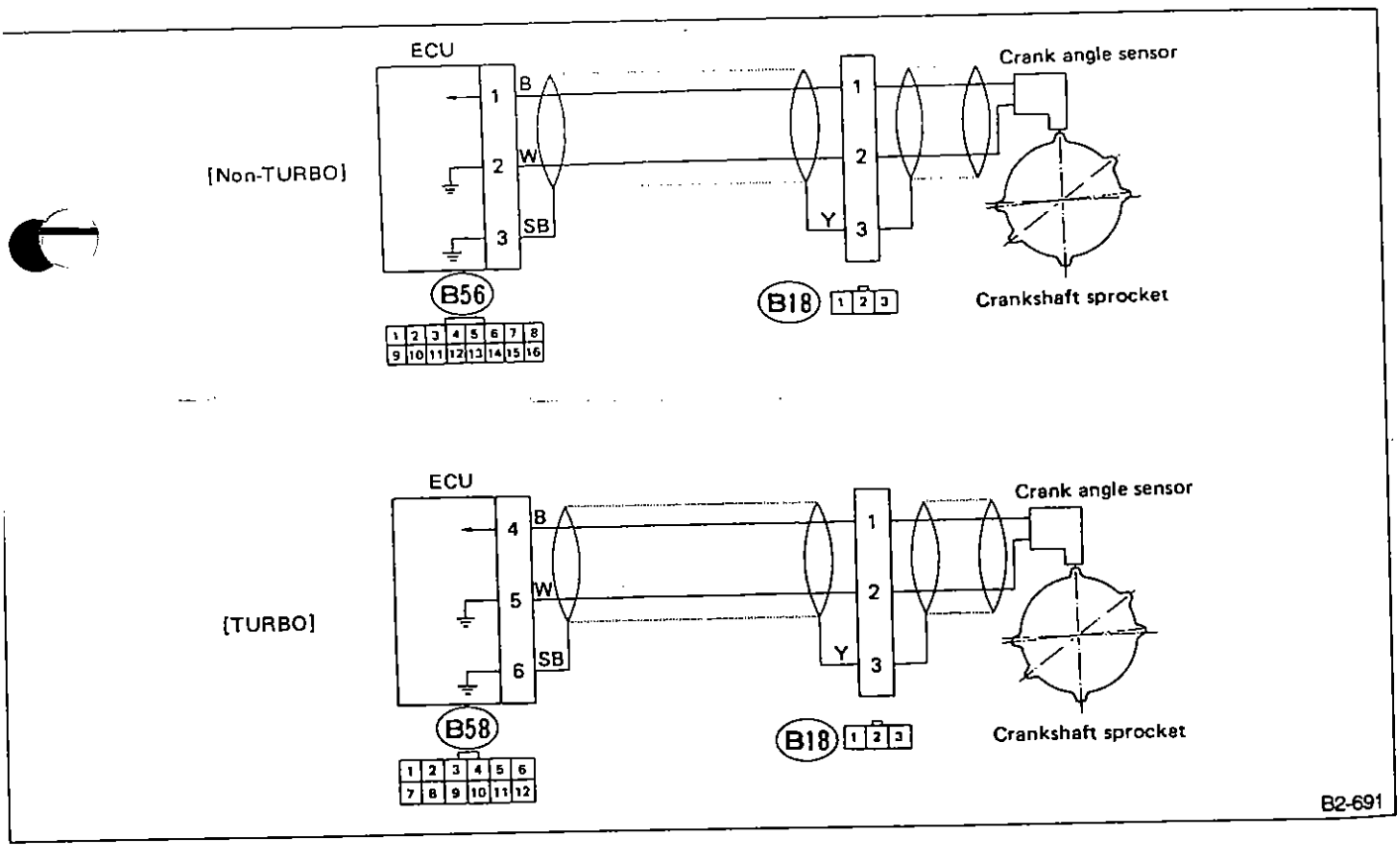


Fig. 68

1. Check crank angle sensor.

1) Disconnect crank angle sensor connector.

2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between crank angle sensor connector terminals (AC 0.1 V, min.).

Terminal:
No. 1 — No. 2

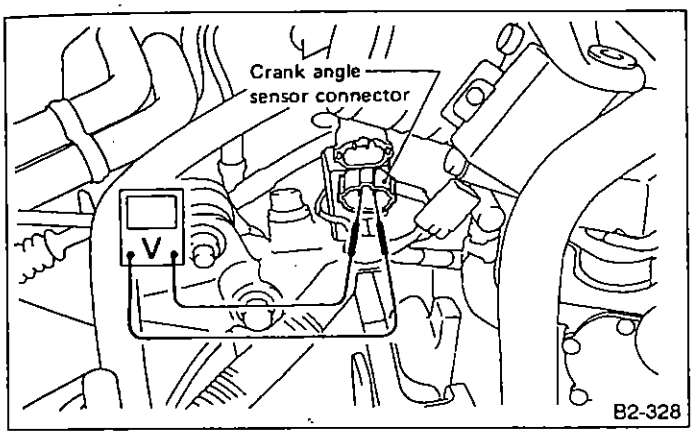


Fig. 69

2. Check harness connector between ECU and crank angle sensor.

1) Disconnect connectors from ECU and crank angle sensor.

2) Measure resistance between ECU connector and angle sensor connector.

Connector & Terminal/Specified resistance:
Non-TURBO
(B56) No. 1 — (B18) No. 1/0 Ω
(B56) No. 2 — (B18) No. 2/0 Ω
(B56) No. 3 — (B18) No. 3/1 Ω max.
TURBO
(B58) No. 4 — (B18) No. 1/0 Ω
(B58) No. 5 — (B18) No. 2/0 Ω
(B58) No. 6 — (B18) No. 3/1 Ω max.

3) Measure resistance between crank angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B18) No. 1 — Body/1 MΩ min.
(B18) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between crank angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B18) No. 3 — Body/1 Ω max.

5) Disconnect cam angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B17) No. 3 — Body/1 Ω max.

B: TROUBLE CODE (12) — STARTER SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from ignition starter switch

TROUBLE SYMPTOM:
Failure of engine to start

1. Check operation of starter motor.
   - Not OK → Repair starter motor circuit or replace starter motor.
   - OK ↓
2. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
3. Check harness connector between ECU and starter motor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

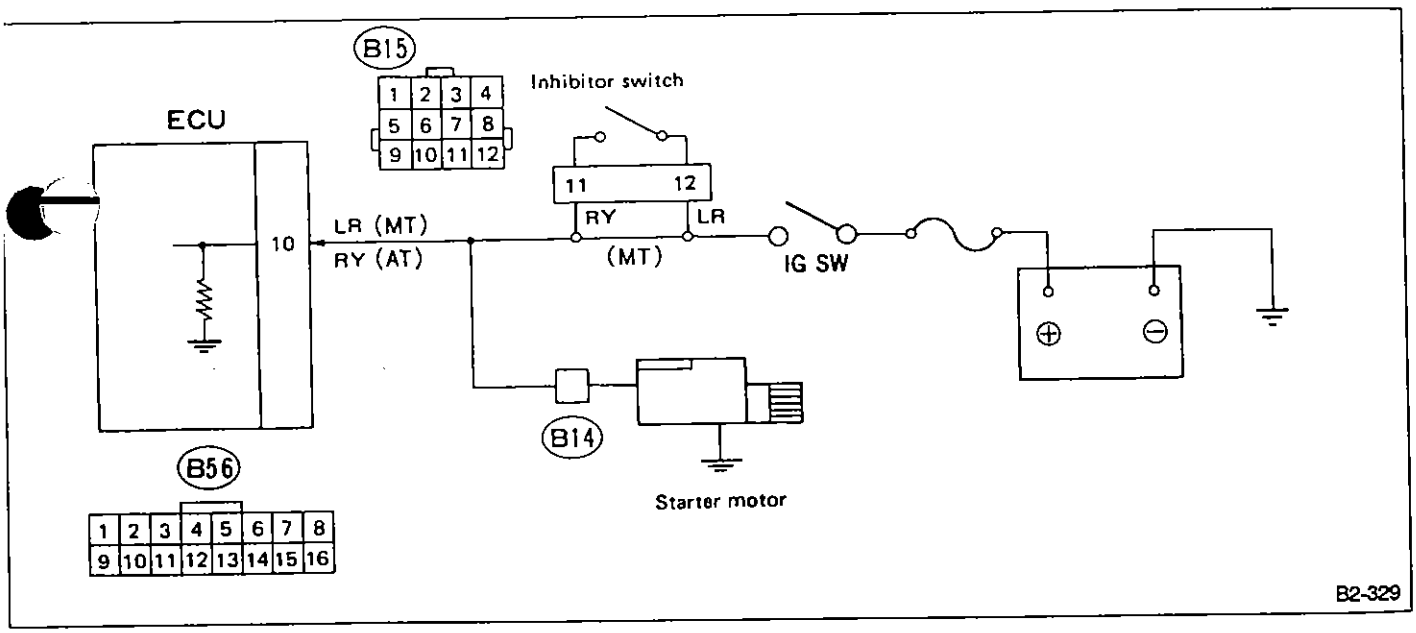


Fig. 70

1. Check operation of starter motor.
Turn ignition switch to "ST" to ensure that starter motor functions.

2. Measure voltage between ECU and body.
Measure voltage between ECU connector terminal and body while cranking the engine.

Connector & Terminal/Specified voltage:
(B56) No. 10 — Body/9 — 12 V

3. Check harness connector between ECU and starter motor.
1) Disconnect connectors from ECU and starter motor.
2) Measure resistance between ECU connector and starter motor connector.

Connector & Terminal/Specified resistance:
(B56) No. 10 — (B14) No. 1/0 Ω

3) Measure resistance between starter motor connector and body.

Connector & Terminal/Specified resistance:
(B14) No. 1 — Body/1 MΩ min.

C: TROUBLE CODE (13) — CAM ANGLE SENSOR —

CONTENT OF DIAGNOSIS:
No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor

TROUBLE SYMPTOM:
- Engine stall
- Failure of engine to start

1. Check cam angle sensor.
   - Not OK → Replace cam angle sensor.
   - OK ↓
2. Check harness connector between ECU and cam angle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

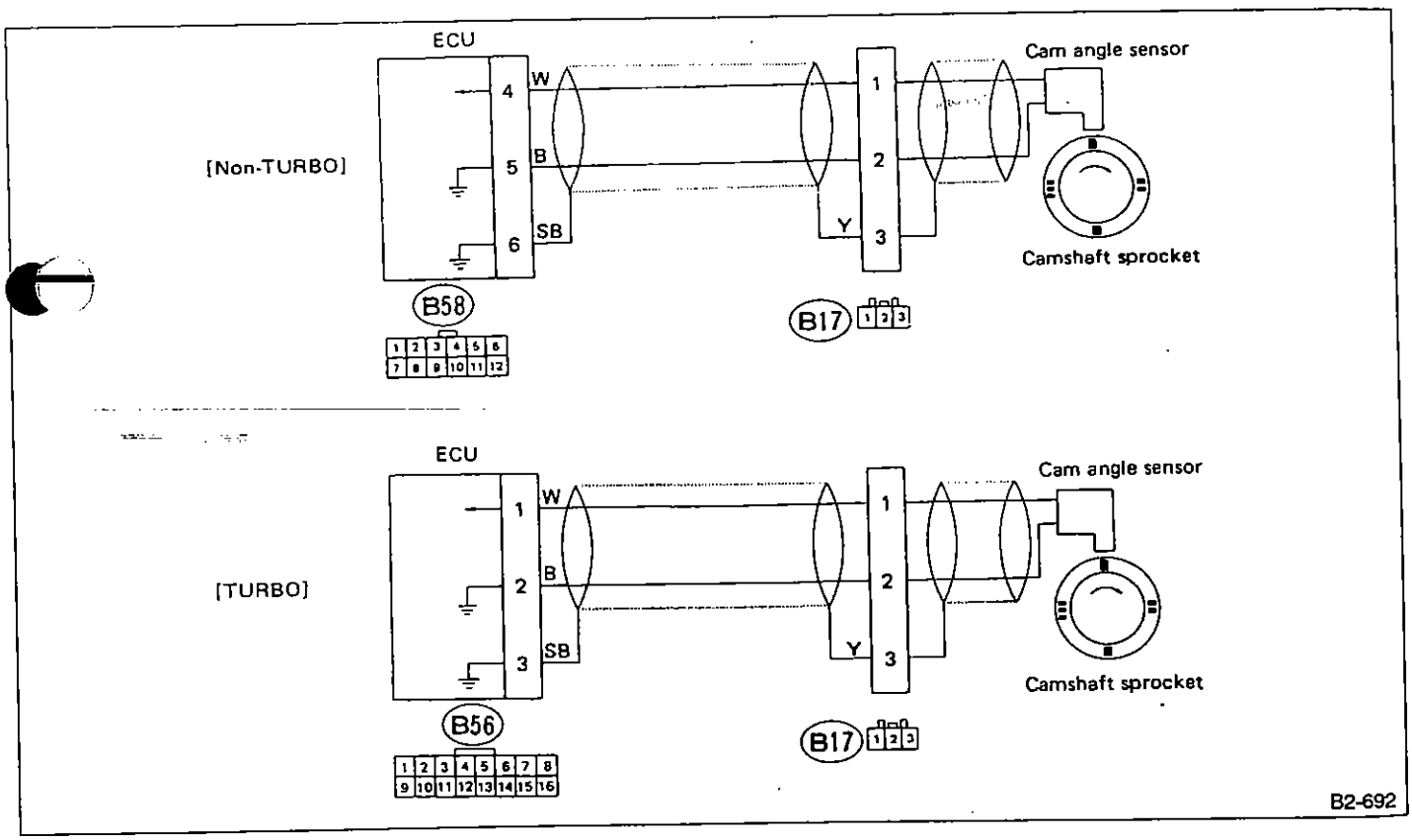


Fig. 71

1. Check cam angle sensor.

1) Disconnect cam angle sensor connector.

2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between cam angle sensor connector terminals (AC 0.1 V, min.).

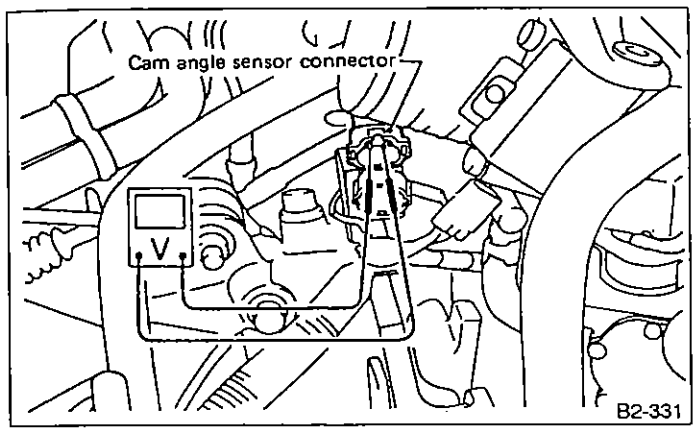


Fig. 72

2. Check harness connector between ECU and cam angle sensor.

1) Disconnect connectors from ECU and cam angle sensor.

2) Measure resistance between ECU connector and cam angle sensor connector.

Connector & Terminal/Specified resistance:
Non-TURBO
(B58) No. 4 — (B17) No. 1/0 Ω
(B58) No. 5 — (B17) No. 2/0 Ω
(B58) No. 6 — (B17) No. 3/1 Ω max.
TURBO
(B56) No. 1 — (B17) No. 1/0 Ω
(B56) No. 2 — (B17) No. 2/0 Ω
(B56) No. 3 — (B17) No. 3/1 Ω max.

3) Measure resistance between cam angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B17) No. 1 — Body/1 MΩ min.
(B17) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between cam angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B17) No. 3 — Body/1 Ω max.

5) Disconnect crank angle sensor connector and measure resistance between sealed terminal and body.

Connector &Terminal/Specified resistance:
(B18) No. 3 — Body/1 Ω max.

D: TROUBLE CODE (14, 15, 16, 17) — FUEL INJECTOR —

CONTENT OF DIAGNOSIS:
Fuel injector inoperative

TROUBLE SYMPTOM:
- Engine stall
- Erroneous idling
- Rough driving

1.	Check each fuel injector for operation.	OK	Check fuel pressure.
2.	Check voltage at fuel injector's power terminal .	Not OK	Repair harness/connector.
3.	Check fuel injectors.	Not OK	Replace fuel injector.
4.	Check voltage at each ECU terminal.	Not OK	Repair harness/connector.
5.	Check harness connector between ECU and body.	Not OK	Repair harness/connector.

OK → Repair ECU terminal poor contact. (Replace ECU.)

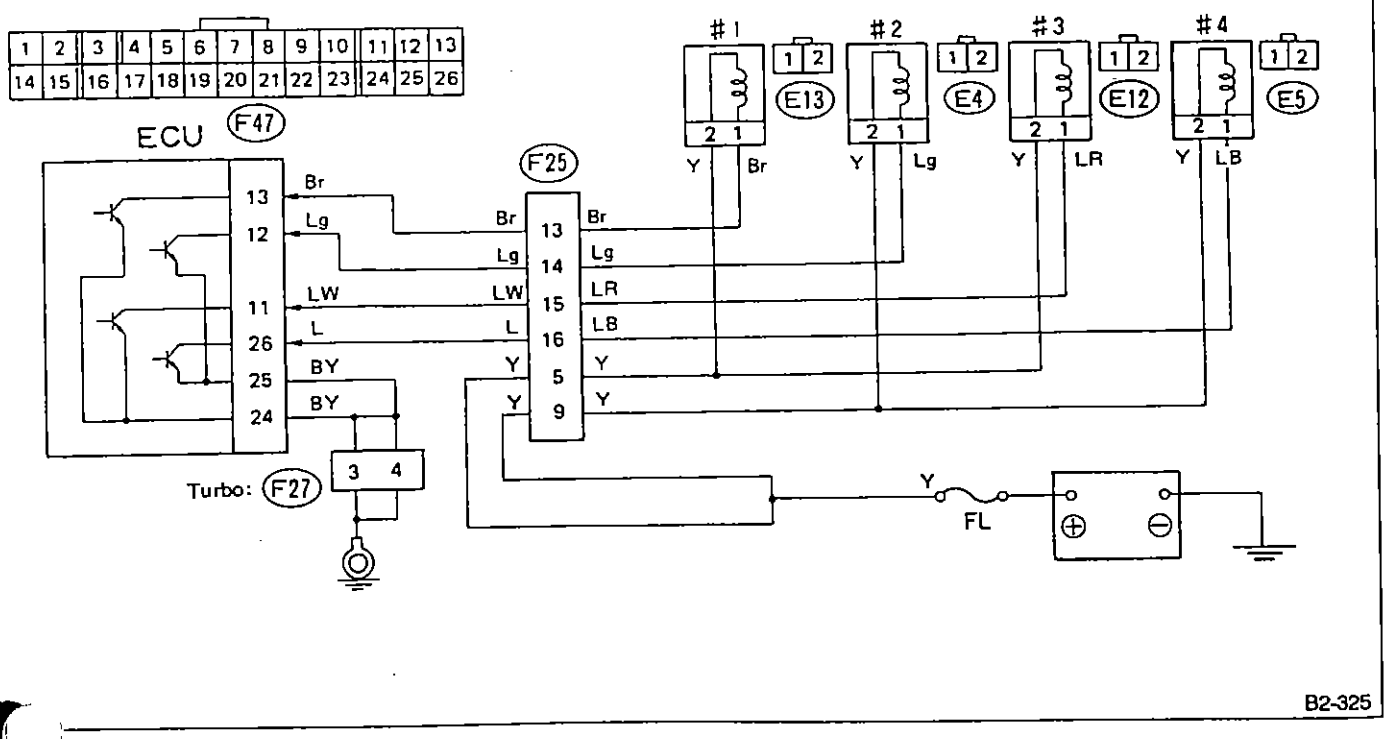


Fig. 73

1. Check each fuel injector for operation.
While cranking the engine, check that each fuel injector emits "operating" sound. Use a sound scope or attach a screwdriver to injector for this check.

2. Check voltage at fuel injector power terminal.
1) Disconnect connector from injector.
2) Measure voltage between injector connector power terminal and body.

Connector & Terminal/Specified voltage:
(E12) No. 2 — Body/10 V, min.
(E4) No. 2 — Body/10 V, min.
(E13) No. 2 — Body/10 V, min.
(E5) No. 2 — Body/10 V, min.

3. Check fuel injectors.
1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistance
11 — 12 Ω

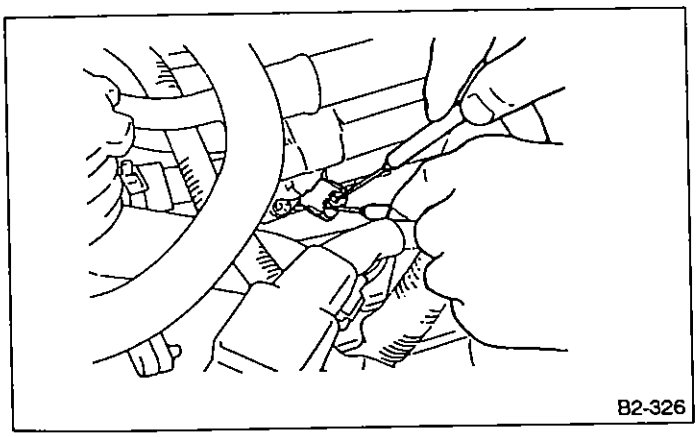


Fig. 74

4. Check voltage at each ECU terminal.
Measure voltage between each fuel injector terminal of ECU connector and body.
(Fuel injector connector is connected.)

Connector & Terminal/Specified voltage:
(F47) No. 11 — Body/10 V, min.
(F47) No. 12 — Body/10 V, min.
(F47) No. 13 — Body/10 V, min.
(F47) No. 26 — Body/10 V, min.

5. Check harness connector between ECU and body.
1) Disconnect connector from ECU.
2) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(F47) No. 24 — Body/0 Ω
(F47) No. 25 — Body/0 Ω

E: TROUBLE CODE (21) — WATER TEMPERATURE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from water temperature sensor

TROUBLE SYMPTOM:
- Hard to start
- Erroneous idling
- Poor driving performance

1. Check water temperature sensor.
   - Not OK → Replace water temperature sensor.
   - OK ↓
2. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
3. Check harness connector between ECU and water temperature sensor.
   - Not OK → Repair harness/connector .
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

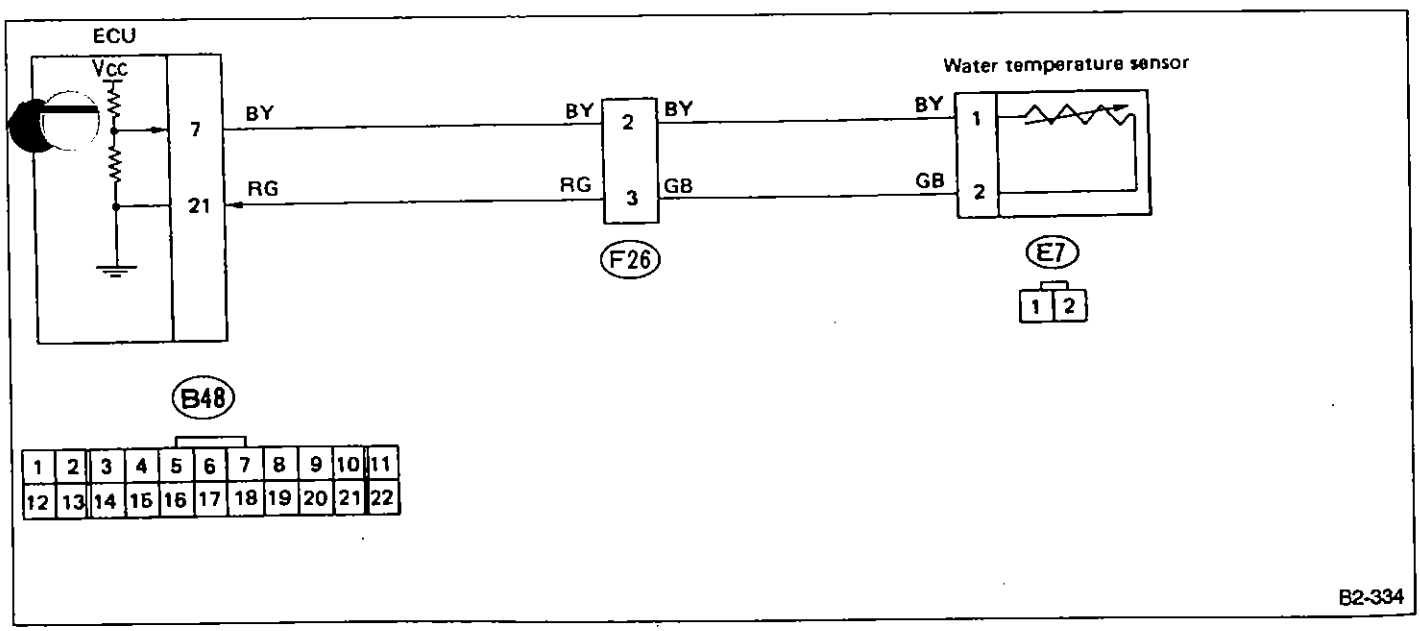


Fig. 75

1. Check water temperature sensor.

1) Disconnect connector from water temperature sensor.

2) Measure resistance between water temperature sensor terminals.

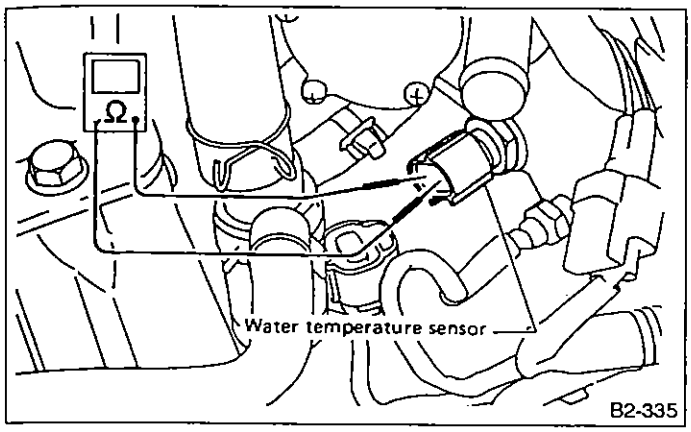


Fig. 76

Specified resistance:
2.0 — 3.0 kΩ [20°C (68°F)]
0.3 — 0.4 kΩ [80°C (176°F)]

2. Check voltage between ECU and body.

1) Turn ignition switch to "ON."

2) Measure voltage between ECU connector terminal and body. (Water temperature sensor connector is connected.)

Connector & Terminal/Specified voltage:
(B48) No. 7 — Body/0.6 — 4.5 V

3. Check harness connector between ECU and water temperature sensor.

1) Disconnect ECU connector and water temperature sensor connector.

2) Measure resistance between ECU connector and water temperature connector.

Connector & Terminal/Specified resistance:
(B48) No. 7 — (E7) No. 1/0 Ω
(B48) No. 21 — (E7) No. 2/0 Ω

3) Measure resistance between water temperature sensor connector and body after connector (i4) has been disconnected.

Connector & Terminal/Specified resistance:
(E7) No. 1 — Body/1 MΩ min.
(E7) No. 2 — Body/1 MΩ min.

F: TROUBLE CODE (22) — KNOCK SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage produced in knock sensor.

TROUBLE SYMPTOM:
Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check knock sensor.
   - Not OK → Replace knock sensor.
   - OK ↓
3. Check harness connector between ECU and knock sensor.
   - Not OK → Repair harness/connector .
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

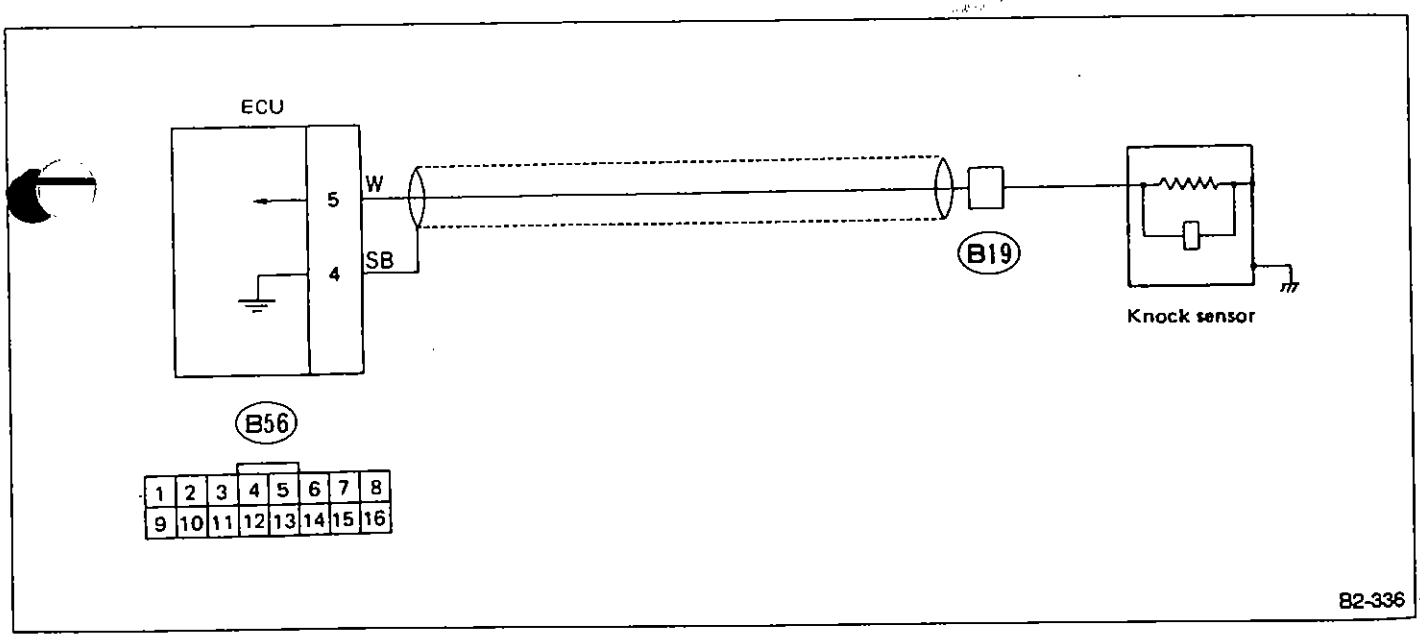


Fig. 77

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B56) No. 5 — Body/3 — 4 V

2. Check knock sensor.

1) Disconnect connector from knock sensor.
2) Measure resistance between knock sensor terminals and body.

Connector & Terminal/Specified resistance:
(B19) No. 1 — Body/Approx. 560 kΩ

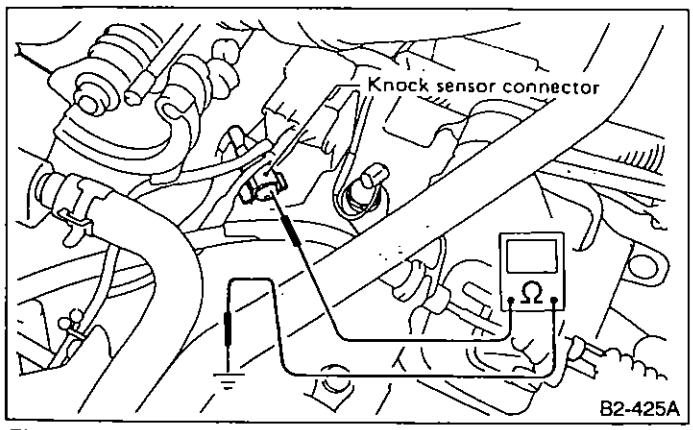


Fig. 78

3. Check harness connector between ECU and knock sensor.

1) Disconnect connectors from ECU and knock sensor
2) Measure resistance between ECU and knock sensor connectors.

Connector & Terminal/Specified resistance:
(B56) No. 5 — (B19) No. 1/0 Ω

3) Measure resistance between knock sensor connector and body.

Connector & Terminal/Specified resistance:
(B19) No. 1 — Body/1 MΩ min.

G: TROUBLE CODE (23) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from air flow sensor

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connectors between ECU and air flow sensor, and between air flow sensor and ground.
   - Not OK → Repair harness/connector.
   - OK ↓

Replace air flow sensor.

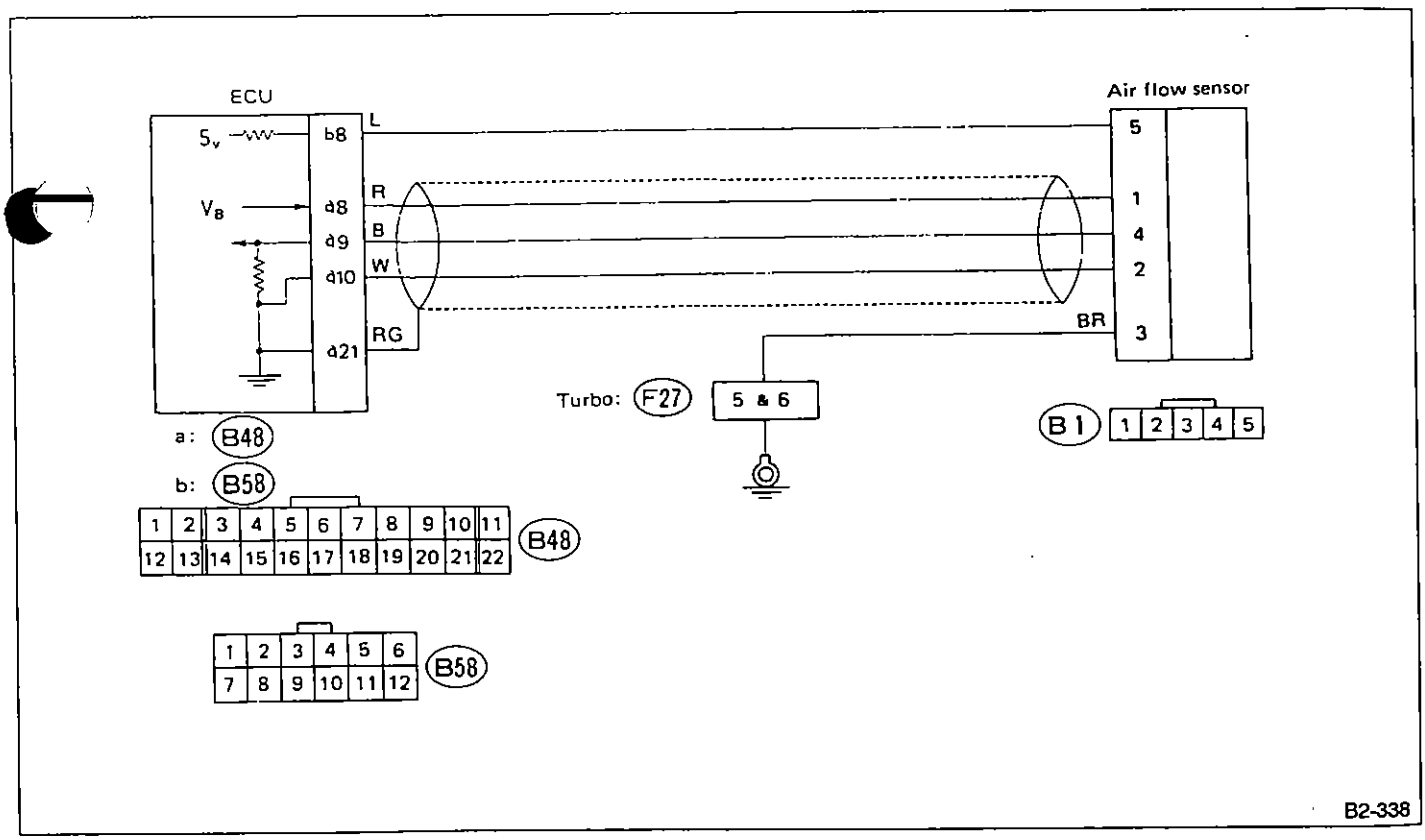


Fig. 79

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B48) No. 8 — Body/
10 — 13 V (Engine OFF)
13 — 14 V (Engine at idle)
(B48) No. 9 — Body/
0 — 0.3 V (Engine OFF)
0.8 — 1.2 V (Engine at idle)
(B48) No. 10 — Body/
0 V (Engine OFF)
0 V (Engine at idle)

2. Check harness connector between ECU and air flow sensor.

1) Disconnect ECU and air flow sensor connectors.
2) Measure resistance between ECU and air flow sensor connectors.

Connector & Terminal/Specified resistance:
(B48) No. 8 — (B1) No. 1/0 Ω
(B48) No. 9 — (B1) No. 4/0 Ω
(B48) No. 10 — (B1) No. 2/0 Ω

3. Measure resistance between air flow sensor connector and body.

Connector & Terminal/Specified resistance:
(B1) No. 1 — Body/1 MΩ min.
(B1) No. 4 — Body/1 MΩ min.
(B1) No. 2 — Body/1 MΩ min.
(B1) No. 3 — Body/0 Ω

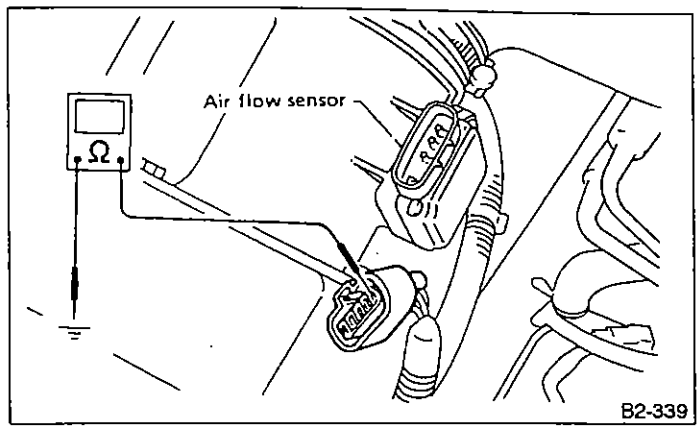


Fig. 80

H: TROUBLE CODE (24) — BY-PASS AIR CONTROL SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
Solenoid valve inoperative

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Engine breathing

1.	Check power voltage at by-pass air control solenoid valve.	Not OK	Repair harness connector/fusible link between by-pass air control solenoid valve and battery.
	↓ OK		
2.	Check by-pass air control solenoid valve.	Not OK	Replace solenoid valve.
	↓ OK		
3.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
	↓ Not OK		
4.	Check harness connector between ECU and air control valve.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

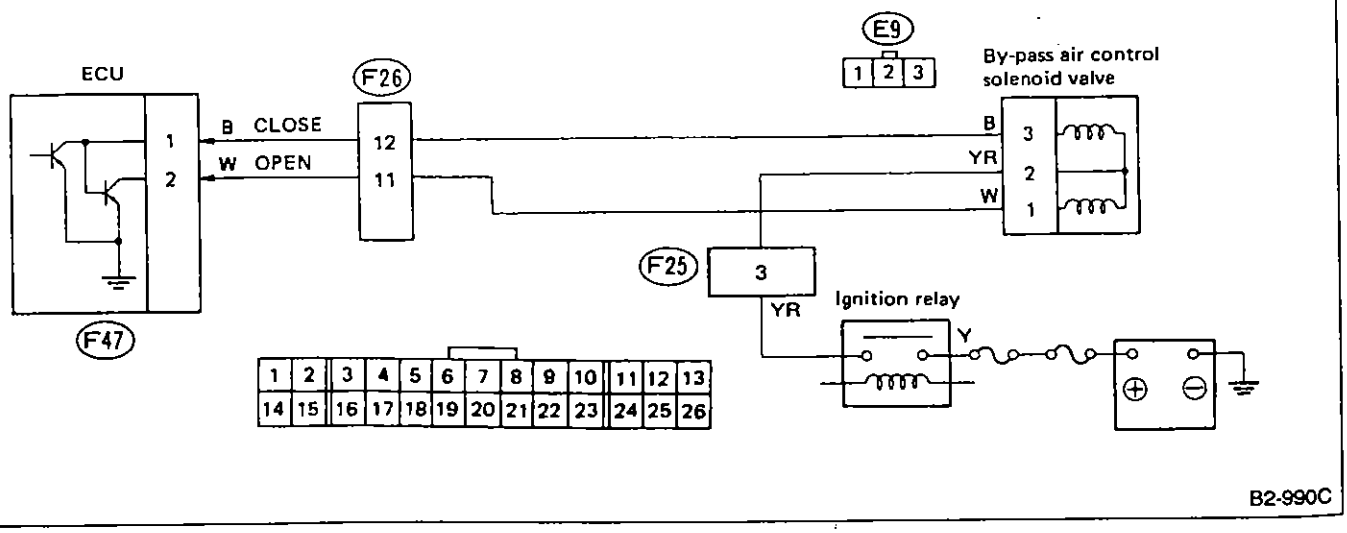


Fig. 81

1. Check power voltage by-pass air control solenoid valve.

1) Turn ignition switch to "ON."
2) Measure voltage between by-pass air control solenoid valve connector terminal and body.

Connector & Terminal/Specified voltage:
(E9) No. 2 — Body/10 V, min.

2. Check by-pass air control solenoid valve.

1) Disconnect connector from by-pass air control solenoid valve.
2) Measure resistance between solenoid valve terminals.

Connector & Terminal/Specified resistance:
Non-TURBO
No. 1 — No. 2/9 Ω
No. 2 — No. 3/9 Ω
TURBO
No. 1 — No. 2/9 Ω
No. 2 — No. 3/9 Ω

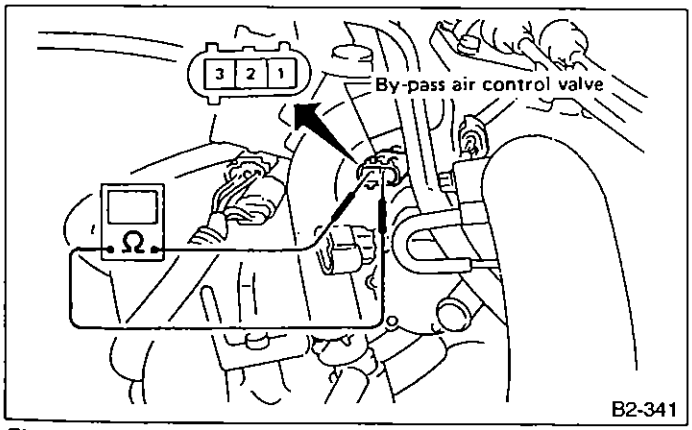


Fig. 82

3. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
Non-TURBO
(F47) No. 2 — Body/7 V
(F47) No. 1 — Body/6 V
TURBO
(F47) No. 2 — Body/0 V → 12 V*
(F47) No. 1 — Body/12 V → 0 V*

*: 1 min after ignition switch ON.

4. Check harness connector between ECU and by-pass air control solenoid valve.

1) Disconnect connectors from ECU and by-pass air control solenoid valve.
2) Measure resistance between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(F47) No. 2 — (E9) No. 1/0 Ω
(F47) No. 1 — (E9) No. 3/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 1 — Body/1 MΩ min.
(E9) No. 3 — Body/1 MΩ min.

I: TROUBLE CODE (31) — THROTTLE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from throttle sensor.

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact and harness. (Replace ECU.)
   - Not OK ↓
2. Check throttle sensor.
   - Not OK → Replace throttle sensor.
   - OK ↓
3. Check harness connector between ECU and throttle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

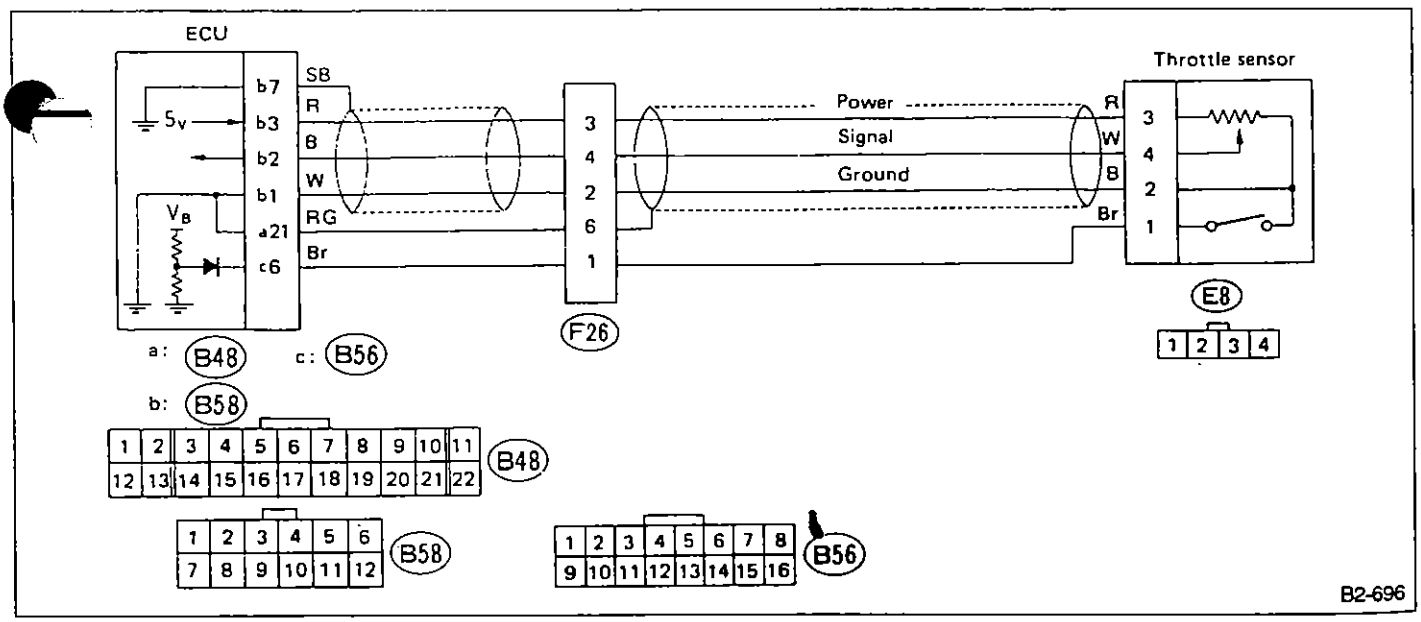


Fig. 83

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B58) No. 2 — Body/
4.4 — 4.8 V (Throttle is fully closed.)
0.7 — 1.6 V (Throttle is fully open.)
(Ensure voltage smoothly decreases as throttle valve changes from "closed" to "open".)
(B58) No. 3 — Body/5 V
(B58) No. 1 — Body/0 V

2. Check throttle sensor.

1) Disconnect connector from throttle sensor.
2) Measure resistance between throttle sensor terminals.

Connector & Terminal/Specified resistance:
No. 2 — No. 3/12 kΩ

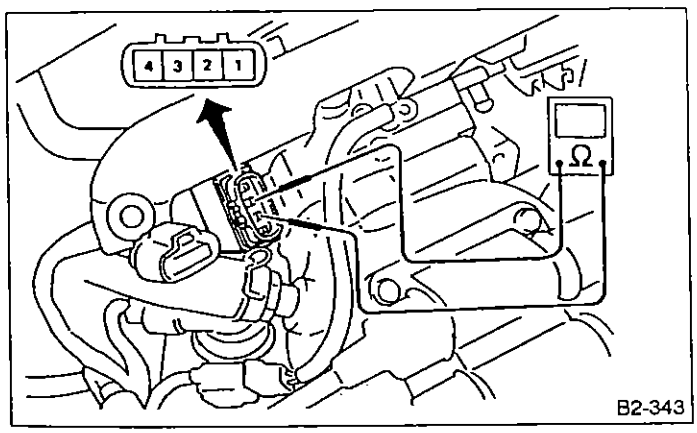


Fig. 84

3) Measure resistance between terminals while slowly opening throttle valve from the "closed" position.

Terminal/Specified resistance:
No. 2 — No. 4/ 10 — 12 kΩ (Throttle is fully closed.)
3 — 5 kΩ (Throttle is fully open.)
Ensure resistance increases in response to throttle valve opening.

3. Check harness connector between ECU and throttle sensor.

1) Disconnect connectors from ECU and throttle sensor.
2) Measure resistance between ECU connector and throttle sensor connectors.

Connector & Terminal/Specified resistance:
(B58) No. 1 — (E8) No. 2 /0 Ω
(B58) No. 2 — (E8) No. 4 /0 Ω
(B58) No. 3 — (E8) No. 3 /0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E8) No. 2 — Body/1 MΩ min.
(E8) No. 4 — Body/1 MΩ min.
(E8) No. 3 — Body/1 MΩ min.

J: TROUBLE CODE (32) — O_2 SENSOR —

CONTENT OF DIAGNOSIS:
O_2 sensor inoperative

TROUBLE SYMPTOM:
- Failure of engine to start
- Erroneous idling
- Poor driving performance
- Engine stall

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check O_2 sensor.
   - Not OK → Replace O_2 sensor.
   - OK ↓
3. Check harness connector between ECU and O_2 sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

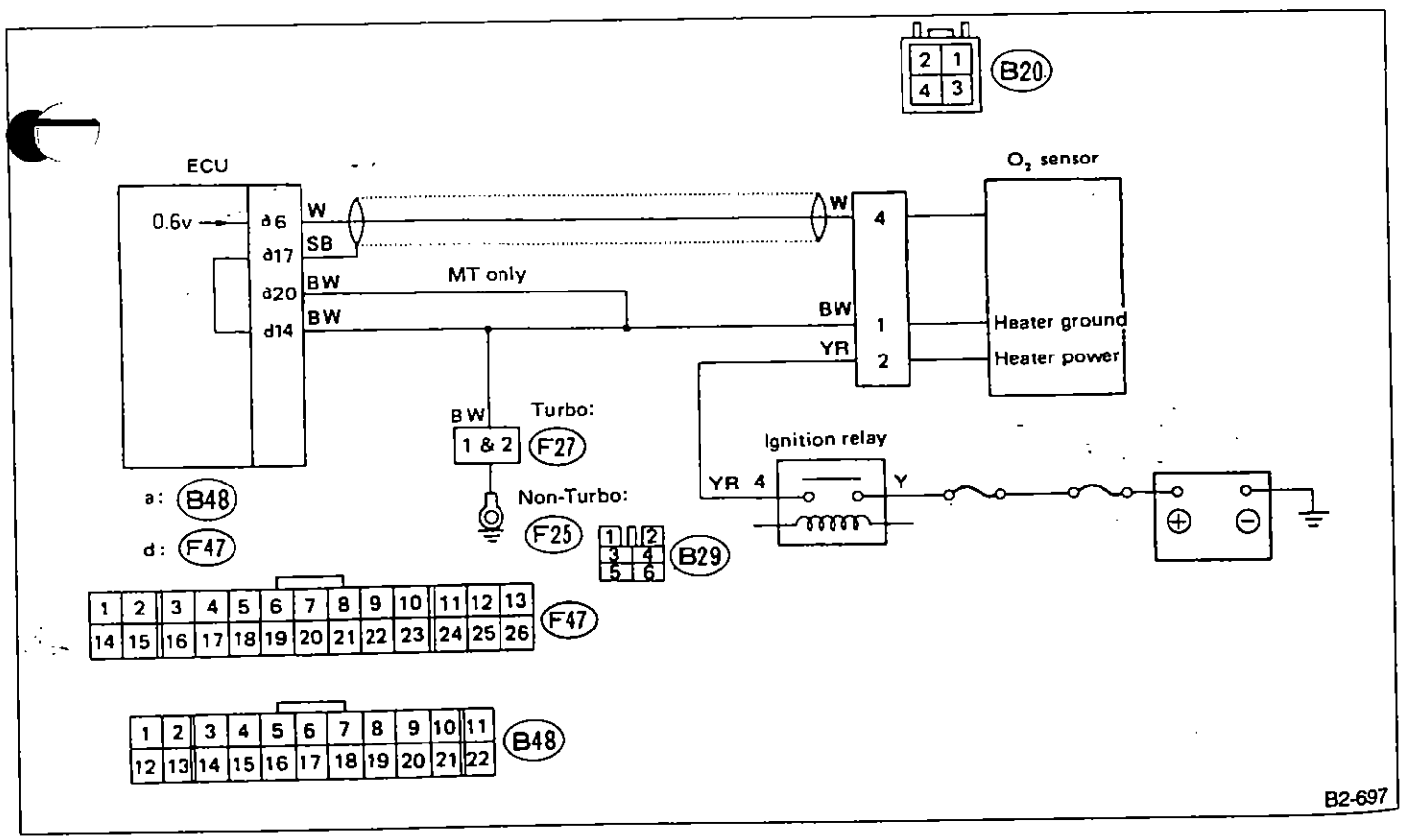


Fig. 85

1. Check voltage between ECU and body.
Measure voltage between ECU connector terminal and body while idling engine.

Connector & Terminal/Specified voltage:
(B48) No. 6 — Body/0.1 — 1.0 V

Problems in heater circuit causes O_2 sensor to deactivate.

2. Check O_2 sensor.
1) Idle engine.
2) Disconnect O_2 sensor connector.
3) Measure voltage between O_2 sensor terminal and body.

Connector & Terminal/Specified voltage:
No. 4 — Body/0.1 — 1.0 V

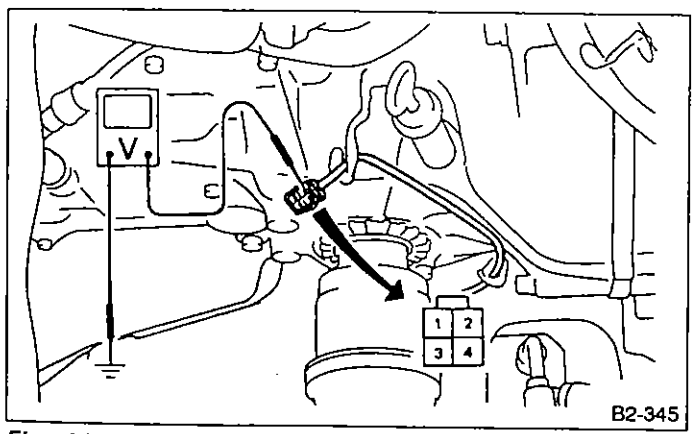


Fig. 86

3. Check harness connector between ECU and O_2 sensor.
1) Disconnect connectors from ECU and O_2 sensor.
2) Measure resistance between ECU connector and O_2 sensor connector.

Connector & Terminal/Specified resistance:
(B48) No.6 — (B20) No. 4/0 Ω

3) Measure resistance between O_2 sensor connector and body.

Connector & Terminal/Specified resistance:
(B20) No. 4 — Body /1 MΩ min.

C: TROUBLE CODE (33) — VEHICLE SPEED SENSOR 2 —

ONTENT OF DIAGNOSIS:
bnormal voltage input entered from vehicle speed sen-
or 2

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connector between ECU and vehicle speed sensor 2.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check vehicle speed sensor 2.
   - Not OK → Replace combination meter.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

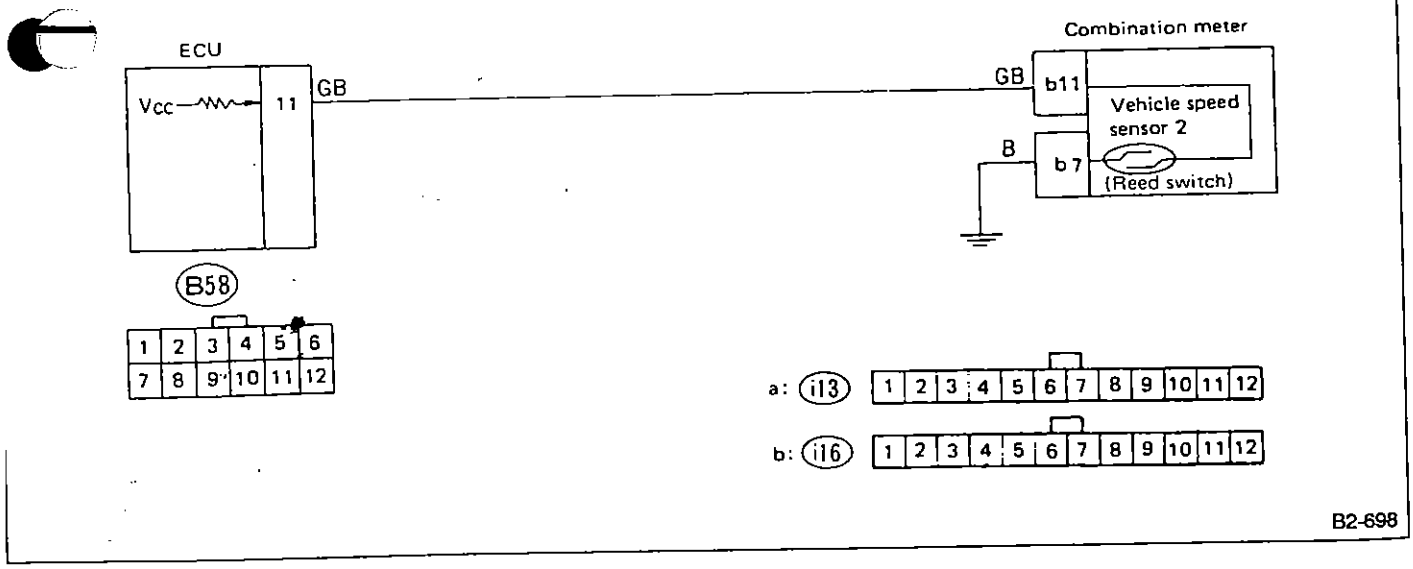


Fig. 87

1. Check voltage between ECU and body.

1) Raise vehicle and support with safety stands.
Ensure all four wheels are off the ground (AWD model).
2) Measure voltage between ECU connector terminal and body while slowly driving wheels.

Connector & Terminal/Specified voltage:
(B58) No. 11 — Body/0 ↔ 5 V

2. Check harness connector between ECU and vehicle speed sensor 2.

1) Remove connector from ECU and combination meter.
2) Measure resistance between ECU connector and combination meter connector.

Connector & Terminal/Specified resistance:
(B58) No. 11 — (i16) No. 11/0 Ω

3) Measure resistance between combination meter connector and body.

Connector & Terminal/Specified resistance:
(i16) No. 11 — Body/1 MΩ min.
(i16) No. 7 — body/ 0 Ω

3. Check vehicle speed sensor 2.

1) Remove combination meter.
2) Disconnect connectors from combination meter.
3) Insert a screwdriver into portion occupied by meter cable and rotate rotor.
4) Check that resistance across combination meter terminals deflects four times per gear rotation.

Connector & Terminal/Specified resistance:
(i16) No. 11 — (i16) No. 7/0 ↔ 1 MΩ min

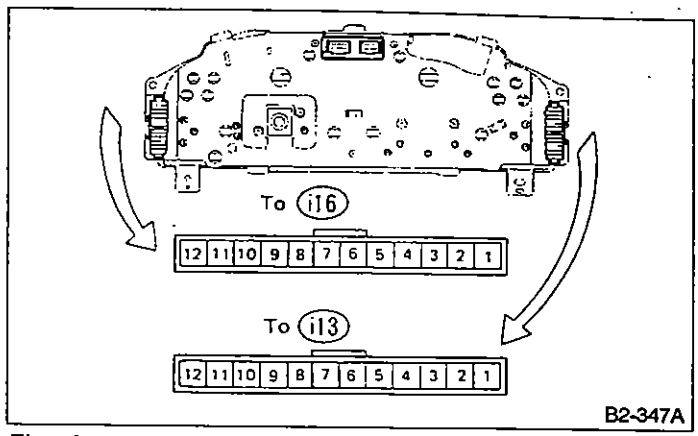


Fig. 88

L: TROUBLE CODE (35) — PURGE CONTROL SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
Solenoid valve inoperative

TROUBLE SYMPTOM:
- Erroneous idling

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check purge control solenoid valve.
   - Not OK → Replace purge control solenoid valve.
   - OK ↓
3. Check harness connector between ECU and purge control solenoid valve.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact.
(Replace ECU.)

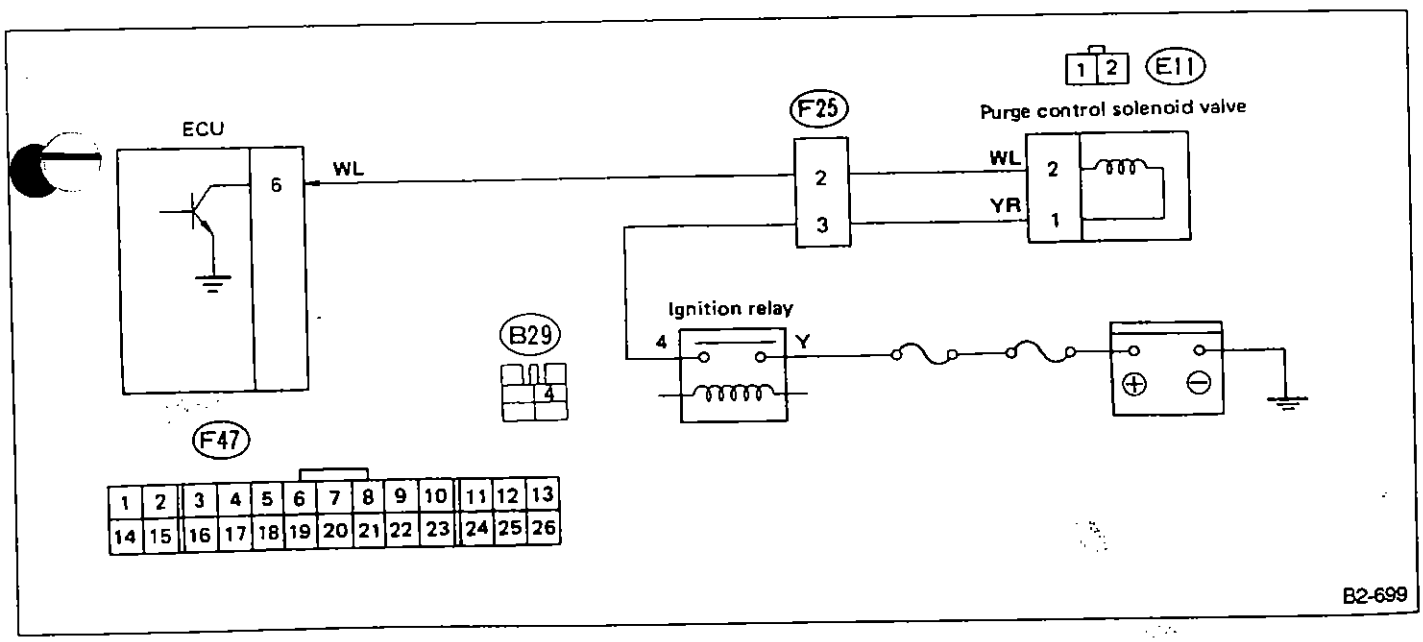


Fig. 89

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON" with engine OFF.
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
F47 No. 6 — Body/10 — 13 V

2. Check purge control solenoid valve.

1) Disconnect connector from solenoid valve.
2) Measure resistance between solenoid valve terminals.

Specified resistance:
36 Ω [at 20°C (68°F)]

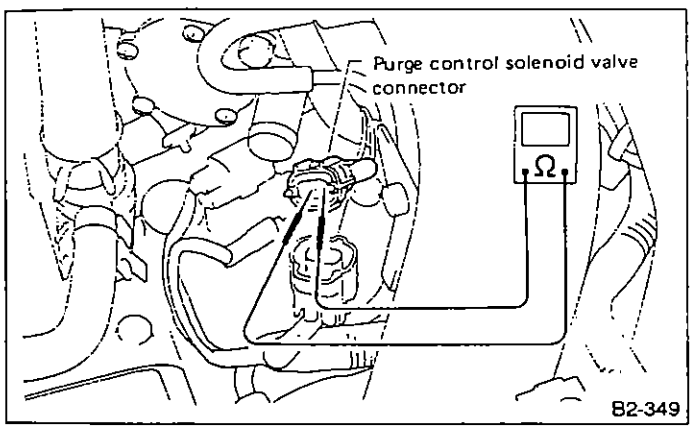


Fig. 90

3. Check harness connector between ECU and purge control solenoid valve.

1) Disconnect connectors from ECU and solenoid valve.
2) Measure resistance between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(F47) No. 6 — (E11) No. 2/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E11) No. 2 — Body/1 MΩ min.

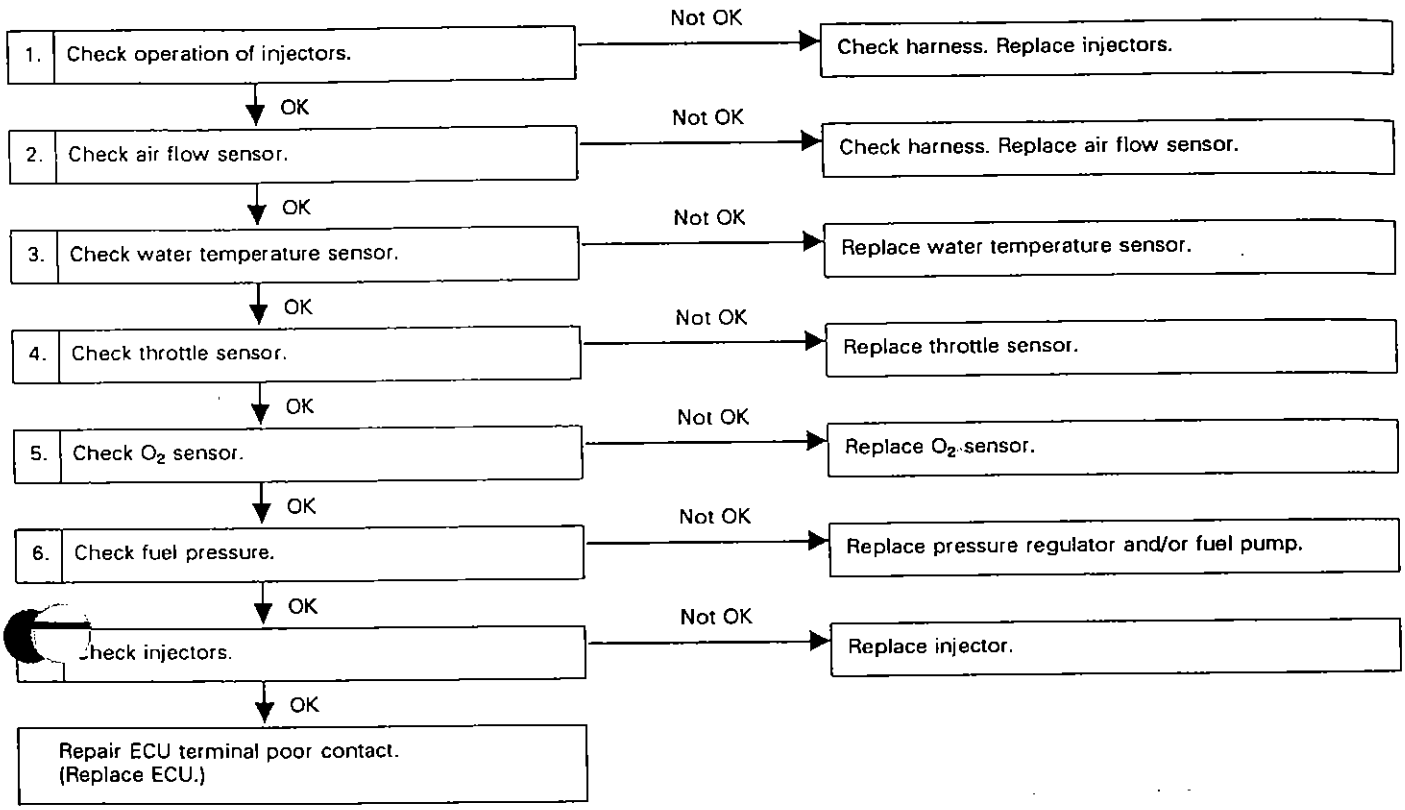
4) Disconnect ground and positive terminals from battery in that order.
5) Measure resistance between solenoid valve connector and battery's positive terminal.

Connector & Terminal/Specified resistance:
(E11) No. 1 — (+) terminal/0 Ω

M: TROUBLE CODE (41) — AIR-FUEL RATIO CONTROL SYSTEM —

CONTENT OF DIAGNOSIS:
Faulty learning control system

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall



N: TROUBLE CODE (42) — IDLE SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from idle switch

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check idle switch.
   - Not OK → Adjust idle switch. (Replace idle switch.)
   - OK ↓
3. Check harness connector between ECU and idle switch.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

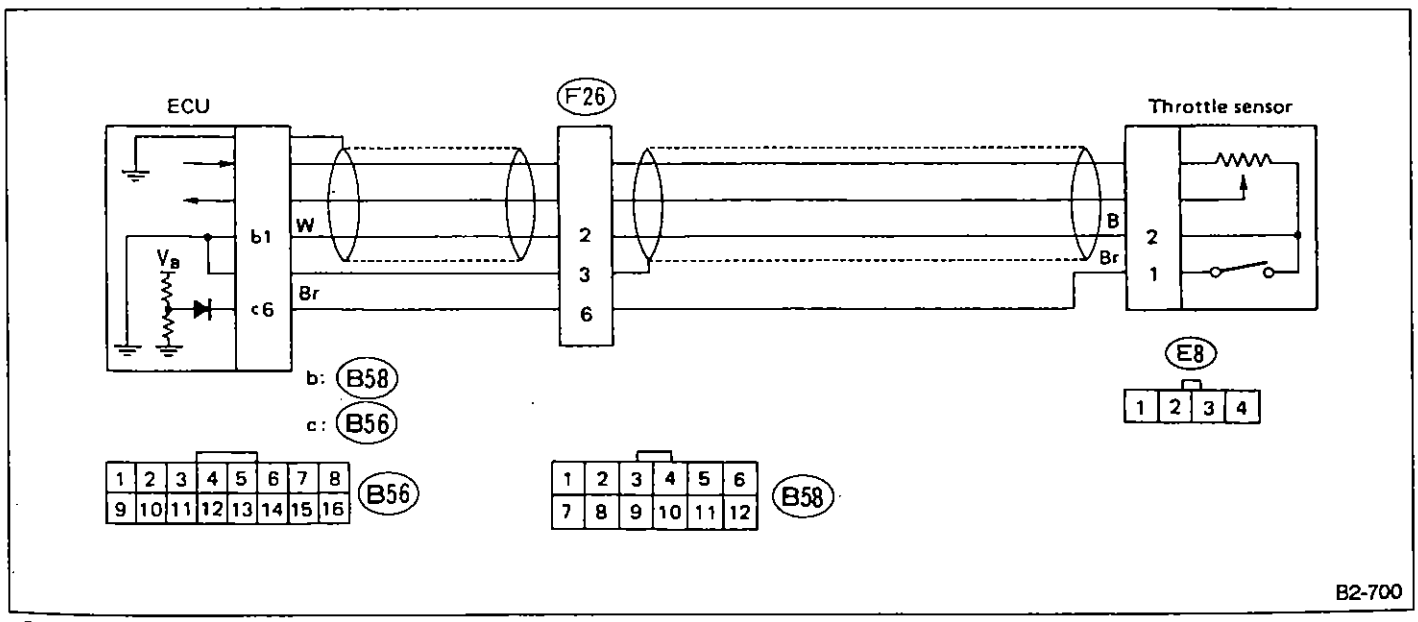


Fig. 91

Check voltage between ECU and body.

Turn ignition switch to "ON."

[redacted] ire voltage between ECU connector terminal [redacted]

onnector & Terminal/Specified voltage:
(B56) No. 6 — Body/ 0 V (Throttle is fully closed.)
Approx. 5 V (Throttle is open.)

. Check idle switch.

) Disconnect connector from throttle sensor.
) Check continuity between throttle sensor idle switch erminals.

erminal/Specified resistance:
No. 1 — No. 2 /0 Ω (Throttle is fully closed.)
1 MΩ min. (Throttle is fully open.)

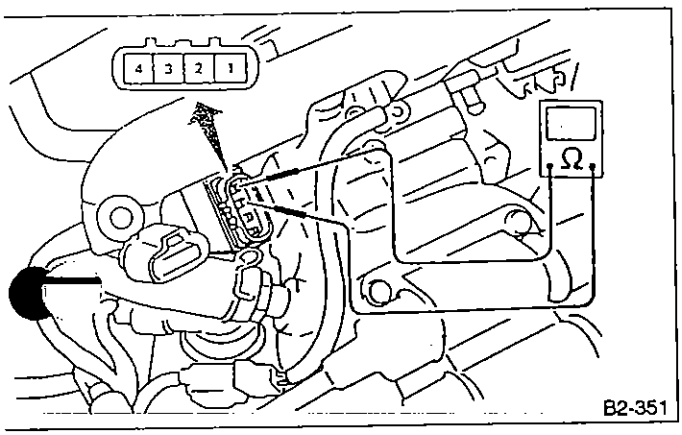


Fig. 92

3) If resistance is outside specifications, adjust idle switch as follows (Before replacement of throttle sensor):
Insert a thickness gauge between the stopper screw of the throttle body and the stopper (Portion G), and check for continuity between terminal No. 1 and No. 2.
(1) Make sure that No.1 and No. 2 are conducting when the throttle is closed fully.
(2) Make sure that No. 1 and No. 2 are conducting when the thickness gauge is 0.7 mm (0.028 in).
(3) Make sure that No. 1 and No. 2 are not conducting when the thickness gauge is 0.9 mm (0.035 in).
(4) If the above standards are not satisfied, loosen the screws (two) securing the throttle sensor to the throttle body, and turn the throttle sensor main body until the correct adjustment is obtained.

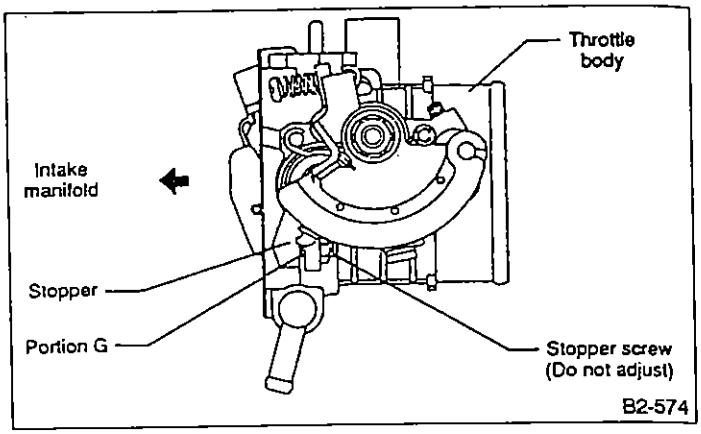


Fig. 93

3. Check harness connector between ECU and idle switch.

1) Disconnect connectors from ECU and throttle sensor.
2) Measure resistance between ECU connector and throttle sensor connector.

Connector & Terminal/Specified resistance:
(B56) No. 6 — (E8) No. 1/0 Ω
(B58) No. 1 — (E8) No. 2/0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E8) No. 1 — Body/1 MΩ min.
No. 2 — Body/1 MΩ min.

O: TROUBLE CODE (45) — ATMOSPHERIC PRESSURE SENSOR [Non-TURBO] —

CONTENT OF DIAGNOSIS:
Faulty atmospheric pressure sensor inside ECU

TROUBLE SYMPTOM:
- Erroneous idling
- Failure of engine to start

When trouble code 45 appears on display, replace ECU.

P: TROUBLE CODE (49) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Use of improper air flow sensor

TROUBLE SYMPTOM:
- Erroneous idling
- Failure of engine to start

When trouble code 49 appears on display, check the specifications of air flow sensor and ECU. Replace air flow sensor (or ECU) with one of a proper type.
- Non-TURBO model : Hot film type air flow sensor (JECS)
- TURBO model : Hot wire type air flow sensor (HITACHI)

Q: TROUBLE CODE (51) — NEUTRAL SWITCH (MT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from neutral switch

TROUBLE SYMPTOM:
Erroneous idling

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check neutral switch.
   - Not OK → Replace neutral switch.
   - OK ↓
3. Check harness connector between ECU and neutral switch.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal. Repair contact. (Replace ECU.)

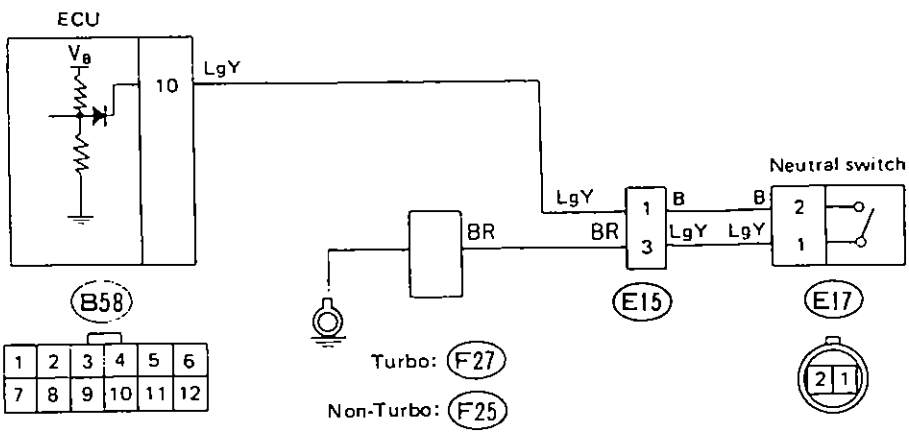


Fig. 94

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B58) No. 10 — Body/Approx. 8 V, min. (Neutral position)
0 V (Other than neutral position)

2. Check neutral switch.

1) Disconnect transmission connectors.
2) Measure resistance between neutral switch terminals while shifting shift lever from Neutral to any other position.

Connector & Terminal / Specified resistance:
(E15) No. 1 — No. 3 / 1 MΩ min. (Neutral position)
0 Ω (Other than neutral position)

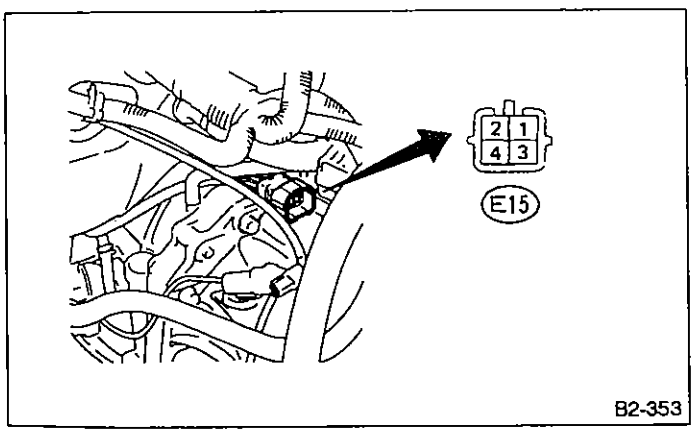


Fig. 95

3. Check harness connector between ECU and neutral switch.

1) Disconnect connectors from ECU and neutral switch.
2) Measure resistance between ECU connector and neutral switch connector.

Connector & Terminal/Specified resistance:
(B58) No. 10 — (E17) No. 2/0 Ω

3) Measure resistance between neutral switch connector and body.

Connector & Terminal/Specified resistance:
(E17) No. 1 — Body/1 MΩ min.
(E17) No. 2 — Body/0 Ω

R: TROUBLE CODE (51) — INHIBITOR SWITCH (AT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from inhibitor switch

TROUBLE SYMPTOM:
Erroneous idling

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check inhibitor switch.
   - Not OK → Adjust inhibitor switch Neutral position.
   - OK ↓
3. Check harness connector between ECU and inhibitor switch.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

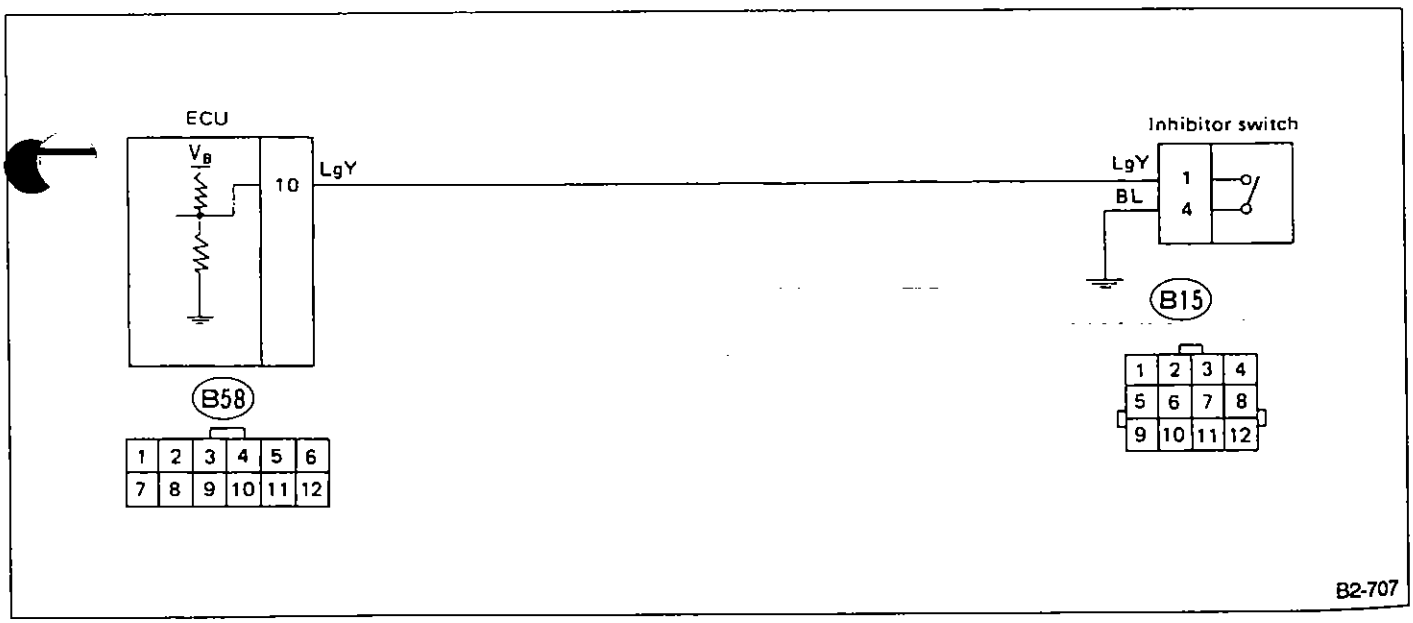


Fig. 96

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B58) No. 10 — Body/0 V (N Range)
8 V, min. (Other than N Range)

2. Check inhibitor switch.

1) Disconnect transmission connectors.
2) Measure resistance between inhibitor switch terminals while shifting select lever from Neutral to any other position.

Connector & Terminal/Specified resistance:
(E18) No. 1 — No. 4/ 0 Ω (N Range)
1 MΩ min. (Other than N Range)

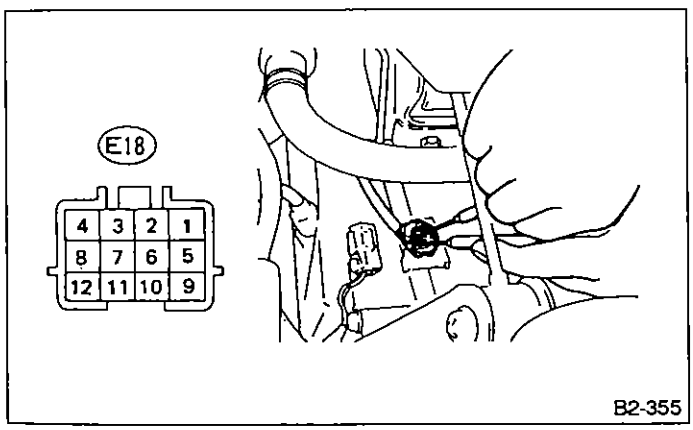


Fig. 97

3. Check harness connector between ECU and inhibitor switch.

1) Disconnect connectors from ECU and inhibitor switch.
2) Measure resistance between ECU connector and inhibitor switch connector.

Connector & Terminal/Specified resistance:
(B58) No. 10 — (B15) No. 1/0 Ω

3) Measure resistance between inhibitor switch connector and body.

Connector & Terminal/Specified resistance:
(B15) No. 1 — Body/1 MΩ min.
(B15) No. 4 — Body/0 Ω

S: TROUBLE CODE (52) — PARKING SWITCH (AT) —

:ONTENT OF DIAGNOSIS:
\bnormal signal entered from parking switch

TROUBLE SYMPTOM:
- Erroneous idling
- Poor warm-up performance with select lever in "P"

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check inhibitor switch.
   - Not OK → Replace inhibitor switch or adjust inhibitor switch Neutral position.
   - OK ↓
3. Check harness connectors between ECU and inhibitor switch, and between inhibitor switch and GND.
   - Not OK → Repair harness connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

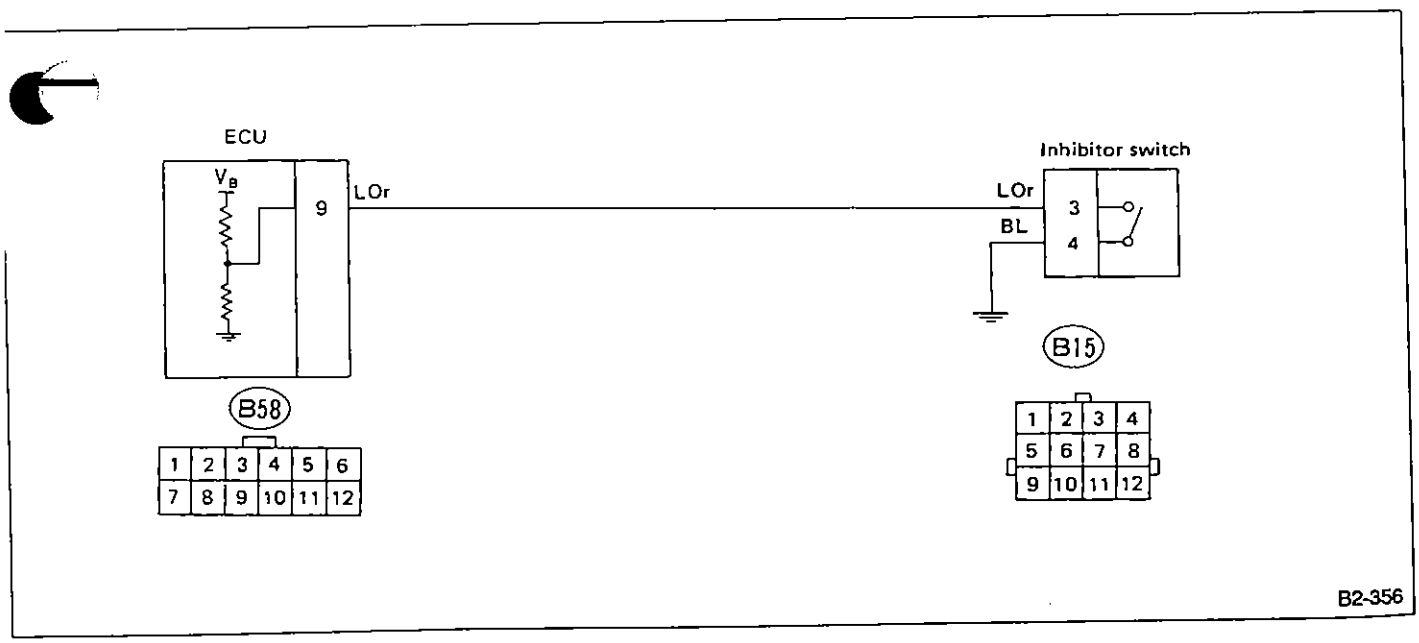


Fig. 98

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON."
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B58) No. 9 — Body/Approx. 0 V (P Range)
8 V, min. (Other than P Range)

2. Check inhibitor switch.

1) Disconnect connector from inhibitor switch.
2) Measure resistance between inhibitor switch terminals while shifting select lever from Neutral to any other position.

Connector & Terminal/Specified resistance:
(E18) No. 3 — No. 4/ 0 Ω(P Range)
1 MΩ, min. (Other than P Range)

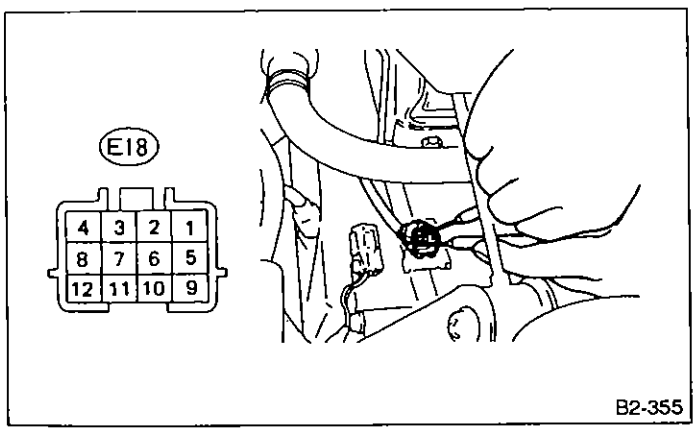


Fig. 99

3. Check harness connector between ECU and inhibitor switch.

1) Disconnect connectors from ECU and inhibitor switch.
2) Measure resistance between ECU connector and inhibitor switch connector.

Connector & Terminal/Specified resistance:
(B58) No. 9 — (B15) No. 3/0 Ω

3) Measure resistance between inhibitor switch connector and body.

Connector & Terminal/Specified resistance:
(B15) No. 3 — Body/1 MΩ, min.
(B15) No. 4 — Body/0 Ω

T: TROUBLE CODE (44) — WASTEGATE CONTROL SOLENOID VALVE [TURBO] —

CONTENT OF DIAGNOSIS:
Wastegate control solenoid valve inoperative.

TROUBLE SYMPTOM:
Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check wastegate control solenoid valve.
   - Not OK → Replace solenoid valve.
   - OK ↓
3. Check harness connector between ECU and solenoid valve.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact.
(Replace ECU.)

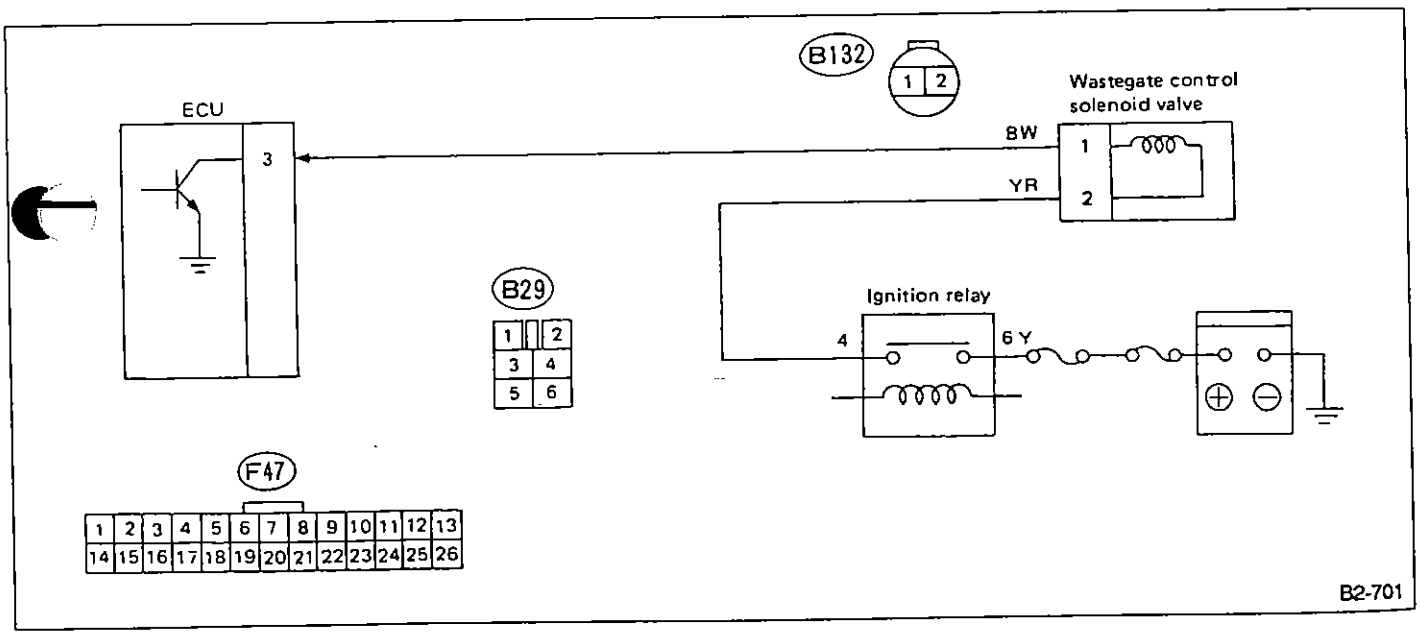


Fig. 100

1. Check voltage between ECU and body.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(F47) No. 3 — Body/10 V, min.

2. Check wastegate control solenoid valve.

1) Disconnect connector from wastegate control solenoid valve.
2) Measure resistance between wastegate control solenoid valve terminals.

Terminal/Specified resistance:
No. 1 — No. 2/20 Ω

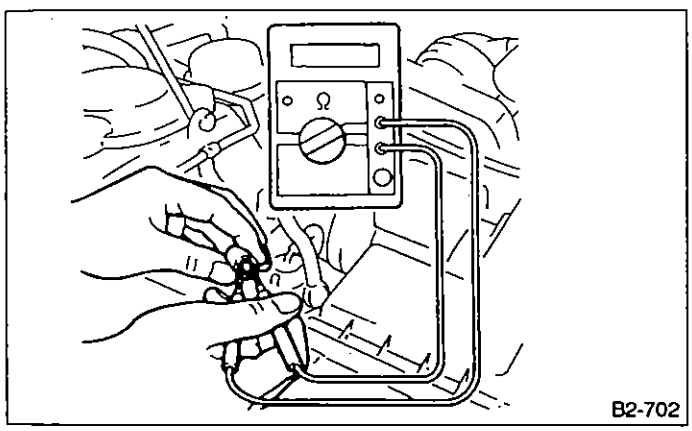


Fig. 101

3. Check harness connector between ECU and wastegate control solenoid valve.

1) Disconnect connector from ECU and wastegate control solenoid valve.
2) Check continuity between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(F47) No. 3 — (B132) No. 1/0 Ω

3) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(F47) No. 3 — Body/1 MΩ min.

4) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(B132) No. 1 — Body/1 MΩ min.

5) Disconnect connector from solenoid valve and ignition relay.
6) Measure resistance between solenoid valve connector and ignition relay connector.

Connector & Terminal/Specified resistance:
(B132) No. 2 — (B29) No. 4/0 Ω

U: TROUBLE CODE (45) — PRESSURE SENSOR, PRESSURE EXCHANGE SOLENOID VALVE [TURBO] —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from pressure sensor
Solenoid valve inoperative

TROUBLE SYMPTOM:
Poor driving performance

1. Check rubber hose between pressure sensor and pressure exchange solenoid valve, and between pressure exchange solenoid valve and intake manifold.
   - Not OK → Repair rubber hose.
   - OK ↓
2. Check pressure sensor.
   - Not OK → Replace pressure sensor.
   - OK ↓
3. Check pressure exchange solenoid valve.
   - Not OK → Replace pressure exchange solenoid valve.
   - OK ↓
4. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
5. Check harness connector between ECU and pressure sensor.
   - Not OK → Repair harness/connector.
   - OK ↓
6. Check harness connector between ECU and pressure exchange solenoid valve.
   - Not OK → Repair harness/connector.
   - OK ↓
7. Check harness connector between pressure exchange solenoid valve and battery.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

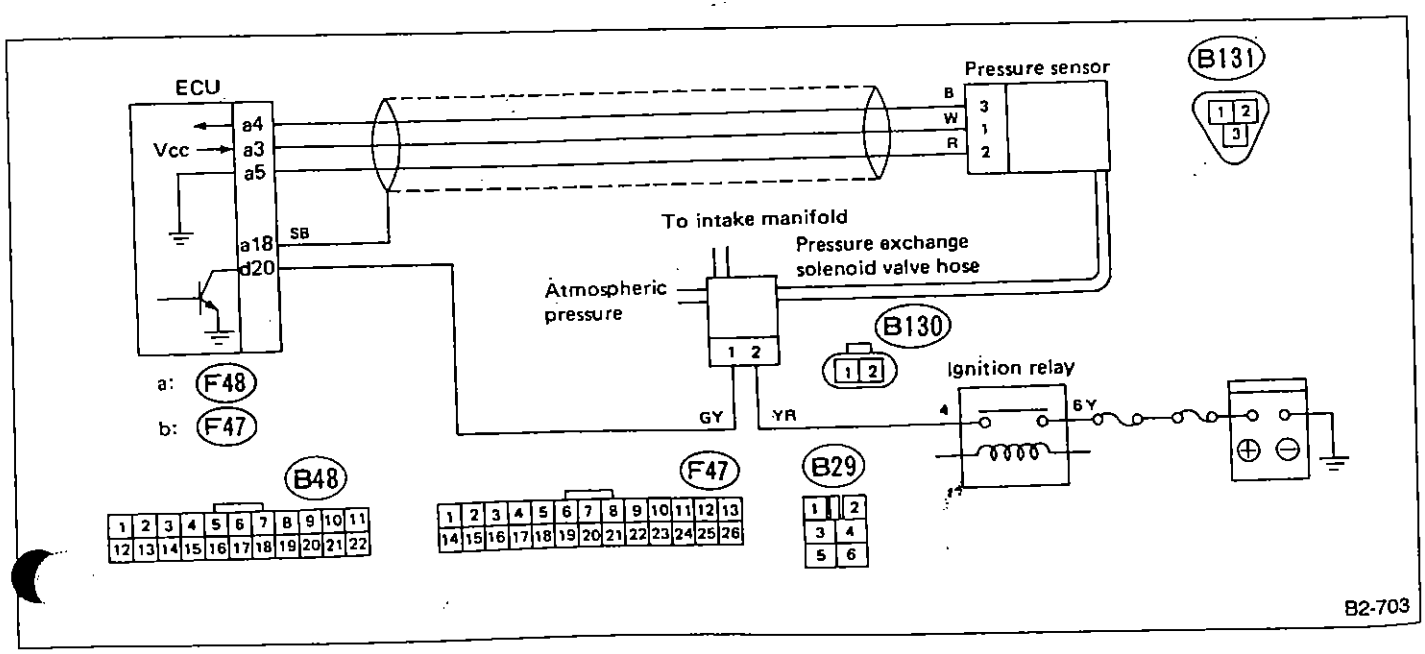


Fig. 102

1. Check rubber hose between pressure sensor and pressure exchange solenoid valve, and between pressure exchange solenoid valve and intake manifold.

1) Visually check the connection between pressure sensor and rubber hose, between pressure exchange solenoid valve and rubber hose, and between intake manifold and rubber hose.
2) Check rubber hose for cracks and damage.

2. Check pressure sensor.

1) Disconnect connector from pressure sensor.
2) Apply 5-volt voltage across terminals No. 1 and No. 2, then connect terminal No. 1 to positive side and terminal No. 2 to negative side.
3) Install vacuum pump to hose fitting on pressure sensor.
4) Measure voltage across terminals when pressure is applied to pressure sensor.

Connector & Terminal/Specified voltage:
(B131) No. 2 — No. 3/3.1 V at 26.7 kPa (200 mmHg, 7.87 inHg)
2.6 V at 0 kPa (0 mmHg, 0 inHg)
2.1 V at – 26.7 kPa (– 200 mmHg, – 7.87 inHg)

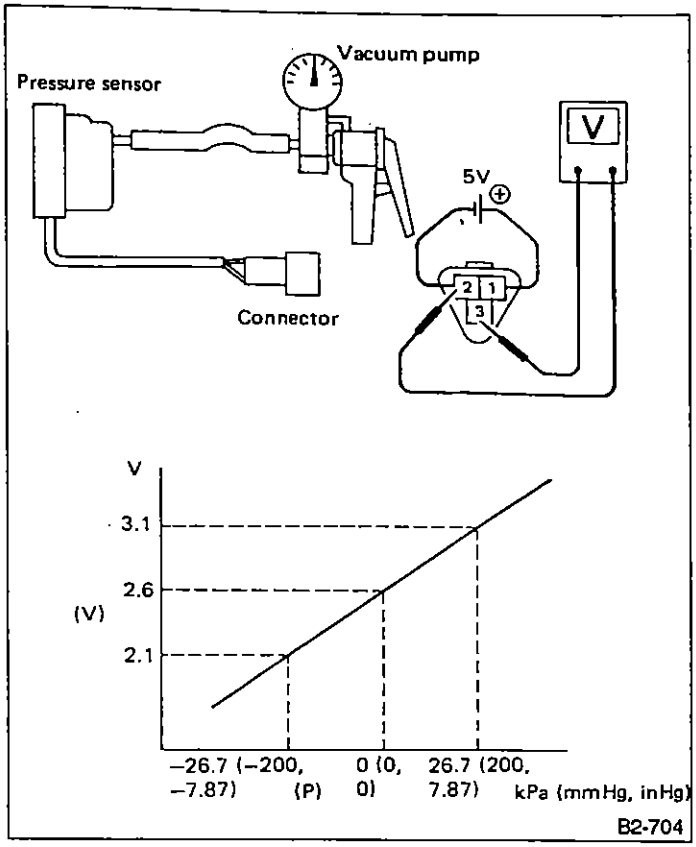


Fig. 103

3. Check pressure exchange solenoid valve.

1) Disconnect connector from pressure exchange solenoid valve.
2) Measure resistance across terminals.

Connector & Terminal/Specified resistance:
(B130) No. 1 — No. 2/37 ↔ 48 Ω

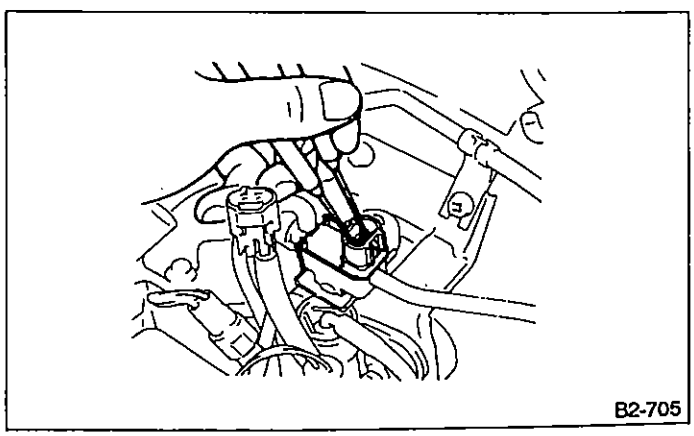


Fig. 104

. Check voltage between ECU and body.

) Connect connector and rubber hose to pressure

[redacted]ect connectors to pressure exchange solenoid alve.

) Turn ignition switch to "ON".

) Measure voltage between ECU connector terminal nd body.

:onnector & Terminal/Specified voltage:
(B48) No. 3 — Body/5 V
(B48) No. 4 — Body/2.4 — 2.7 V
(B48) No. 5 — Body/0 V
(F47) No. 20 — Body/0 V or 10 — 13 V

i. Check harness connector between ECU and pressure sensor.

:) Disconnect connectors from ECU and pressure sen-ior.

2) Measure resistance between ECU connector and pressure sensor connector.

Connector & Terminal/Specified resistance:
(B48) No. 3 — (B131) No. 1/0 Ω
(B48) No. 4 — (B131) No. 3/0 Ω
(B48) No. 5 — (B131) No. 2/0 Ω

[redacted]sure resistance between ECU connector terminal and body.

Connector & Terminal/Specified resistance:
(B48) No. 3 — Body/1 MΩ min.
(B48) No. 4 — Body/1 MΩ min.
(B48) No. 5 — Body/1 MΩ min.

6. Check harness connector between ECU and pressure exchange solenoid valve.

1) Disconnect connectors from ECU and pressure exchange solenoid valve.

2) Measure resistance between ECU connector and pressure exchange solenoid valve connector.

Connector & Terminal/Specified resistance:
(F47) No. 20 — (B130) No. 1/0 Ω

3) Measure resistance between ECU connector terminal and body.

Connector & Terminal/Specified resistance:
(F47) No. 20 — Body/1 MΩ min.

7. Check harness connector between pressure exchange solenoid valve and battery.

1) Disconnect connectors from pressure exchange solenoid valve and ignition relay.

2) Measure resistance between pressure exchange solenoid valve connector and ignition relay connector.

Connector & Terminal/Specified resistance:
(B29) No. 4 — (B130) No. 2/0 Ω

9. Troubleshooting Chart with Select Monitor

BASIC TROUBLESHOOTING CHART

If no trouble codes appear in the Read Memory, U-Check or D-check mode (although problems have occurred or are occurring), measure performance characteristics of sensors, actuators, etc., in the "F" mode (select-monitor function), and compare with the "basic data" to determine the cause of problems.

Applicable cartridge of select monitor: No. 498348800 (TURBO and Non-TURBO)

Problem occurs No trouble codes appear in Read Memory, U-Check or D-check mode.

↓

Measure each item in "F" mode (select-monitor function).

↓

Refer to "General Troubleshooting Table" [T900] for inspection order.

↓

Compare measured value with "specified data." Determine item which is outside "specified data".

↓

* Check sensor or actuator corresponding with item outside "specified data."

↓

*When item is not constantly outside "specified data," problem may be due to poor harness contact. Disconnect or connect affected sensor/actuator connector or shake its harness to check if trouble code appears.

A: MODE F01 — Battery voltage (VB) —

CONDITION:
(1) Ignition switch "ON"
(2) Idling after warm-up

SPECIFIED DATA:
10 — 13 V (Ignition switch ON, engine OFF)
13 — 14 V (Engine at idle)

- Probable cause (item outside specified data)

1.	Battery	Check battery voltage and electrolyte's specific gravity.
2.	Charging system	• Check regulating voltage. (under no load) • Check alternator.

B: MODE F02 — Vehicle speed signal (VSP) —

CONDITION:
Raise vehicle until all wheels are off ground, and support with safety stands. Operate vehicle at constant speed.

SPECIFICATION DATA:
Compare speedometer with monitor indications. Probable cause (if indications are different)

- Probable cause (item outside specified data)

1.	Vehicle speed sensor 2	Check if sensor is in operation. (Refer to [T7KO].) ↓ OK Replace ECU.

F03 = Vehicle speed signal: Vehicle speed is indicated in kilometer per hour (km/h).

C: MODE F04 — Engine speed (EREV) —

CONDITION:
Operate engine at constant speed.

SPECIFIED DATA:
Compare engine speeds indicated on engine tester monitor.

- Probable cause (if outside specified data)

1. Cam angle sensor
2. Crank angle sensor

→ Check cam angle sensor output signal. (Refer to [T7C0])
↓ OK
Check crank angle sensor output signal.
↓ OK
Replace ECU.

D: MODE F06 — Water temperature sensor signal (TW) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
80 — 95 deg C

- Probable cause (if outside specified data)

1. Water temperature sensor

→ Check water temperature sensor. (Refer to [T7E0].)
↓ OK
Replace ECU.

F05 = Water temperature signal (TW): To be indicated in "deg F".

E: MODE F07 — Ignition timing —

CONDITION:
(1) While idling after warm-up
(2) Gear in neutral position

SPECIFIED DATA:
12 deg — 28 deg (Non-TURBO model)

9 deg — 21 deg (TURBO model, Neutral SW OFF)
15 deg (TURBO model, Neutral SW ON)

- Probable cause (if items outside specified data)

1.	L Data (specified amount of fuel injection)	Check "F09" mode (engine under loads).
		↓ OK
2.	Air flow sensor	Check "F08" mode (air flow signal)
		↓ OK
3.	Throttle sensor	Check throttle sensor. (Refer to [T7I0].)
		↓ OK
4.	Knock sensor	Check knock sensor. (Refer to [T7F0].)
		↓ OK
5.	Idle switch	Check idle switch. (Refer to [T7N0].)
		↓ OK
		Replace ECU.

F: MODE F08 — Air flow signal (QA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.8 — 1.2 V

• Probable cause (if outside specified data)

1. Air flow sensor

→ Compare air flow sensor signal voltage with specified data QA.
(QA voltage equals air flow sensor signal voltage.)

Not OK → Replace air flow sensor.

OK → Replace ECU.

G: MODE F09 — Engine under loads (L DATA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
15 — 20 (Non-TURBO)
30 — 50 (TURBO)

• Probable cause (if outside specified data)

1. Air flow sensor → Check "F08" mode.
2. Engine speed (rpm) → Check "F04" mode.
3. Cam angle sensor → Check cam angle sensor. (Refer to [T7C0].)
4. Crank angle sensor → Check crank angle sensor. (Refer to [T7A0].)

→ Replace ECU.

H: MODE F10 — Throttle sensor signal

CONDITION:
Check while changing from "fully-closed" to "fully-open" throttle valve.

SPECIFIED DATA:
4.7 V → 1.6 V
*Engine throttle change must be smooth.

- Probable cause (if outside specified data)

1.	Throttle sensor	Check throttle sensor. (Refer to [T7I0].) ↓ OK Replace ECU.

I: MODE F11 — Fuel injection duration (TIM)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
3.0 — 3.7 ms (Non-TURBO)
2.0 — 3.5 ms (TURBO)

• Probable cause (if outside specified data)

1.	Engine under load (L DATA)	Check "F09" mode.
2.	Correction coefficient of air-fuel ratio (ALPHA)	Check "F16" mode.
3.	Water temperature sensor	Check "F06" mode .
4.	O_2 sensor	Check "F13" mode.
5.	Idle switch	Check idle switch. (Refer to [T7M0].)
6.	Vehicle speed sensor 2	Check "F03" mode .
7.	Air flow sensor	Check "F08" mode .
8.	By-pass air control solenoid valve	Check "F12" mode .
9.	Battery voltage	Check "F01" mode.

OK

J: MODE F12 — By-pass air control solenoid valve (ISC)

CONDITIONS:
(1) Idling after warm-up
(2) Air conditioner 'OFF'
(3) Radiator fan 'OFF'
(4) Battery voltage: Greater than 13 volts
(5) Sea level (Not height altitudes)

SPECIFIED DATA:
25 — 40 % (Non-TURBO)
30 — 45% (TURBO)

- Probable cause (if outside specified data)

1.	Water temperature sensor	Check "F06" mode.
		↓ OK
2.	Idle switch	Check idle switch. (Refer to [T7M0].)
		↓ OK
3.	Neutral switch	Check neutral switch. (Refer to [T7P0].)
		↓ OK
4.	Parking switch	Check parking switch. (Refer to [T7R0].)
		↓ OK
		Replace ECU.

K: MODE F13 — O_2 sensor (O_2)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0 — 1.0 V

- Probable cause (if outside specified data)

1.	Duration of fuel injection (TIM)	Check "F11" mode.
		↓ OK
2.	O_2 sensor	Check O_2 sensor. (Refer to [T7J0].)
		↓ OK
		Replace ECU.

L: MODE F14 — Maximum O_2 sensor signal voltage (O_2 Max.)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.7 — 1.0 V

- Probable cause (if outside specified data)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   OK
   Replace ECU.

M: MODE F15 — Minimum O_2 sensor signal voltage (O_2 Min.)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0 — 0.2 V

- Probable cause (if outside date)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   OK
   Replace ECU.

N: MODE F16 — Correction coefficient of air-fuel ratio (ALPHA)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
— 1.6 to + 1.6

- Probable cause (if outside specified data)

1.	O_2 sensor	Check "F13" mode. → OK
2.	Air flow sensor	Check "F08" mode. → OK
3.	Injector	Check "F11" mode. → OK
		Replace ECU.

O: MODE F17 — Correction value of ignition timing (RTRD)

CONDITION:

SPECIFIED DATA:
— 10 to + 10 deg

- Probable cause (if outside specified data)

1.	Knock sensor	Check knock sensor. (Refer to [T7F0].) → OK
		Replace ECU.

P: MODE F19 — Atmospheric pressure (BARO. P) [Non-TURBO]

CONDITION:
Ground surface (not high altitudes)

SPECIFIED DATA:
*760 mmHg

*"—9 to 10 mmHg" changes at an altitude of 100 meters.

- Probable cause (if outside specified data)

1.	Atmospheric sensor	Replace ECU.

Q: MODE F18 — Wastegate control duty (WGC) [TURBO] —

CONDITION:
When engine is running

SPECIFIED DATA:
*16% (at 6,000 rpm) — 70% (at idle)

*Not high altitudes

• Probable cause (if outside specified data)

1. Atmospheric pressure or Intake manifold pressure → Check "F19" mode.
   OK ↓
   Check "F20" mode.
   OK ↓
2. Throttle sensor → Check "F10" mode.
   OK ↓
   Replace ECU.

R: MODE F19 — Atmospheric pressure (BARO. P) [TURBO] —

CONDITION:
Sea level surface (not high altitudes)
Engine at idle

SPECIFIED DATA:
*760 mmHg

*"– 9 to 10 mmHg" changes at an altitude of 100 meters.

• Probable cause (if outside specified data)

1. Pressure sensor → Check pressure sensor. (Refer to [T7T0].)
   OK ↓
2. Pressure exchange solenoid valve → Check pressure exchange solenoid valve. (Refer to [T7T0].)
   OK ↓
   Replace ECU.

S: MODE F20 — Intake manifold pressure (MANI. P) [TURBO] —

CONDITION:
After warming up, engine at idle

SPECIFIED DATA:
– 400 to – 550 mmHg

• Probable cause (if outside specified data)

1.	Pressure sensor	Check pressure sensor. (Refer to [T7T0].)
2.	Pressure exchange solenoid valve	Check pressure exchange solenoid valve. (Refer to [T7T0].)

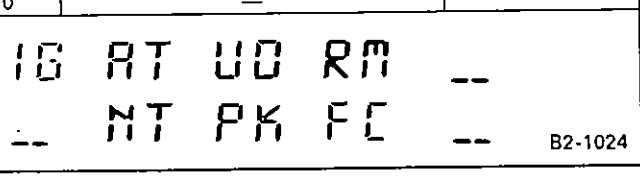
OK

OK

Replace ECU.

T: MODE FA0 — ON ↔ OFF SIGNAL —

Description		
LED No.	Signal name	Presentation
1	Ignition switch	IG
2	AT/MT discrimination	AT
3	Test mode	UD
4	Read memory	RM
5	—	—
6	—	—
7	Neutral switch	NT
8	Parking position switch	PK
9	Fed./Cal. discrimination	FC
10	—	—



B2-1024

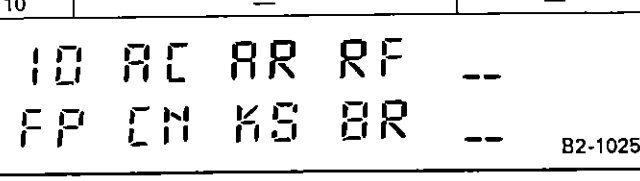
Requirement for LED "ON"

1. Ignition switch is turned to "ON".
2. Vehicle is AT model.
3. Test mode connector is connected.
4. Read memory connector is connected.
7. Selector lever is in "N" position on AT model, or gear shift lever is in neutral position on MT model.
8. Selector lever is in "P" position [AT model].
9. 49-states and Canada model

Fig. 105

U: MODE FA1 — ON ↔ OFF SIGNAL —

Description		
	Signal name	Presentation
1	Idle switch	ID
2	A/C switch	AC
3	A/C relay	AR
4	Radiator fan	RF
5	—	—
6	Fuel pump relay	FP
7	Purge control solenoid valve	CN
8	Knock sensor	KS
9	Pressure exchange solenoid valve	BR
10	—	—



B2-1025

Requirement for LED "ON"

1. Throttle valve is fully closed.
2. A/C switch is turned to "ON".
3. A/C relay is in "ON".
4. Radiator fan is in operation.
6. Fuel pump relay is in operation.
7. Purge control solenoid valve is in operation.
8. Engine knocks occur.
9. Atmospheric pressure is being measured. (solenoid valve is in operation.)

Fig. 106

V: MODE FA3 — ON ↔ OFF SIGNAL —

Description			Requirement for LED "ON"
LED No.	Signal name	Presentation	
1	—	—	10. A/F ratio is rich
2	—	—	
3	—	—	
4	—	—	
5	—	—	
6	—	—	
7	—	—	
8	—	—	
9	—	—	
10	O_2 monitor	O2	

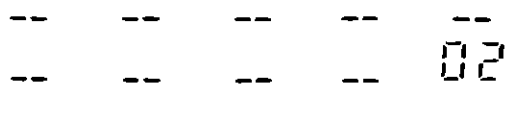


Fig. 107

0. General Troubleshooting Table

riority of "parts to check" is shown by figures (1, 2, 3, ... 14).

Symptom	Parts to check	ECU power supply	Air flow sensor	Water temperature sensor	Idle switch	Throttle sensor	Fuel pump	Pressure regulator	Fuel injector	Igniter (power transistor)	Ignition coil	Spark plug	Knock sensor	Cam angle sensor	Crank angle sensor	By-pass air control solenoid valve	O_2 sensor	Waste-gate control solenoid valve
Failure of engine to start	Initial combustion does not occur.	1	10	11			5	6	7	2	3	4		8	9			
	Initial combustion occurs.	1		10			2	3	4	5	6	7		8	9	11		
	Engine stalls after initial combustion.	1	2	7		8	4	5	6	11	12	13		9	10	3		
	Rough idling	1	3	12	8	7	4	5	6	9	10	11		13	14	2	15	16
	Hard to drive at constant speed	1	4	6	8	7	3	2	9	12	13	14		10	11		5	15
	Poor acceleration/ deceleration	1	2	6	7	8	3	4	5	13	14	15	9	11	12	10	10	2
	Poor return to idle			3	2											1		
	Backfire			3	4	5		6	7					2	1			
	Knocking		1	2				4	5				3		6			7
	Excessive fuel consumption		3	4				1	2									
	Shocks while driving	1	8						7	4	5	6		2	3			
	Poor engine revving		2	3	4	5		1										
Remarks		Include engine grounding circuit.														Check hoses.		Check hoses.

SUBARU®

1992

SERVICE MANUAL

		Page
M	MECHANISM AND FUNCTION	2
	1. Fuel Lines	2
	2. Fuel Tank	5
	3. Fuel Pump	6
	4. Jet Pump (4WD model only)	7
	5. Fuel Filter	8
	6. Roll Over Valve	9
S	SPECIFICATIONS AND SERVICE DATA	10
C	COMPONENT PARTS	11
	1. Fuel Tank	11
	2. Fuel Lines	13
W	SERVICE PROCEDURE	15
	1. Precautions	15
	2. Fuel Tank	15
	3. Fuel Filler Pipe	17
	4. Fuel Filter	18
	5. Fuel Pump	19
	6. Fuel Meter Unit	19
	7. Fuel Meter Unit (4WD model only)	20
	8. Fuel Separator (4WD model only)	21
	9. Fuel Delivery, Return and Evaporation Lines	22
T	TROUBLESHOOTING	24

VI MECHANISM AND FUNCTION

1. Fuel Lines

The fuel lines consist of a delivery line, return line, and an evaporation line. The delivery line supplies fuel from the fuel tank to the intake manifold and consists of a pump filter, fuel pump and fuel filter. On 4WD models, a suction jet pump is used to prevent fuel from remaining in one of the two tank chambers.

The return line returns excess fuel to the fuel tank via the pressure regulator to maintain a constant level of fuel pressure.

The evaporation line consists of a roll-over valve (which is provided with a two-way valve), canister and check valve. On 4WD models, a fuel separator is additionally provided.

1. Non-TURBO MODEL

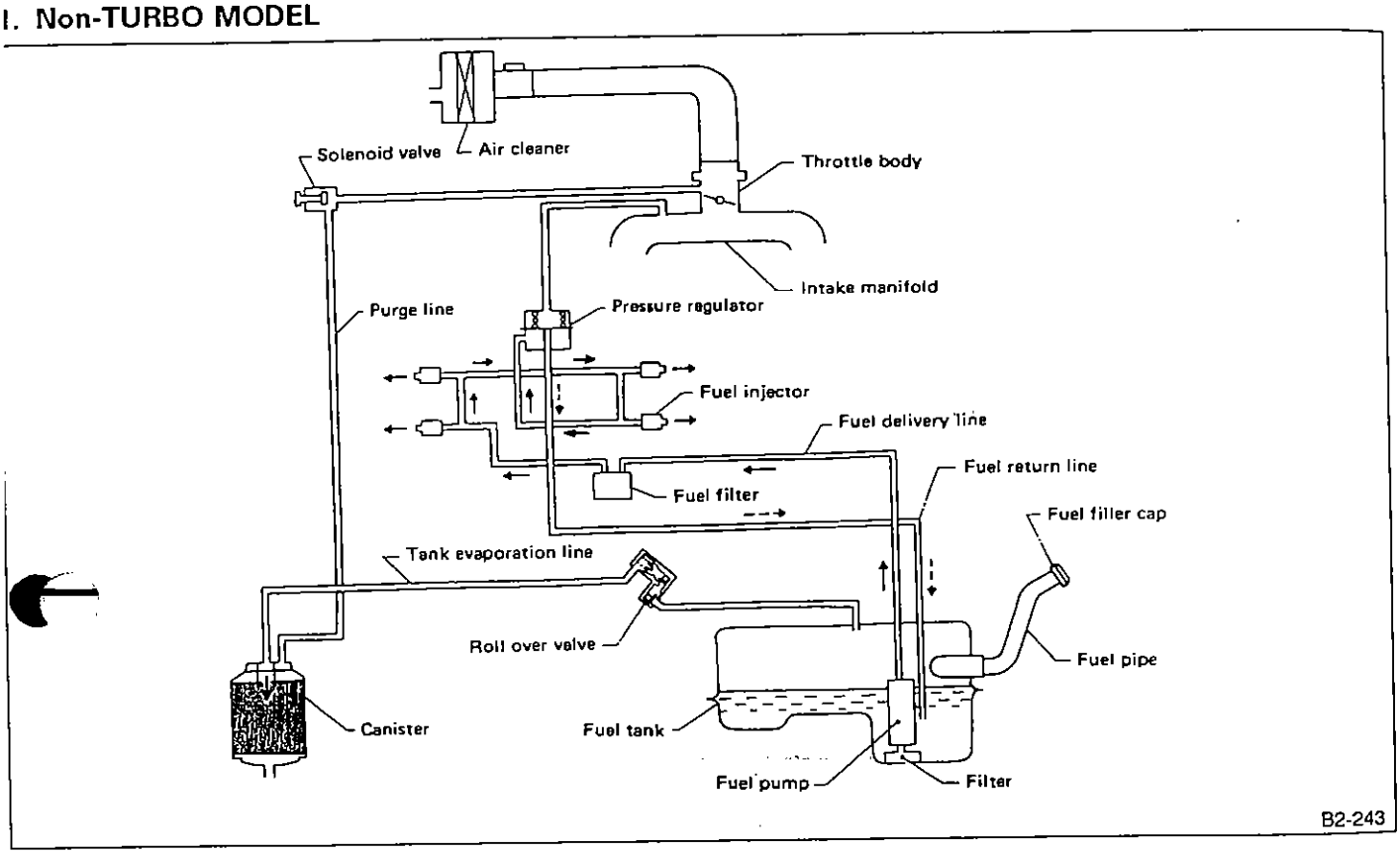


Fig. 1 FWD model

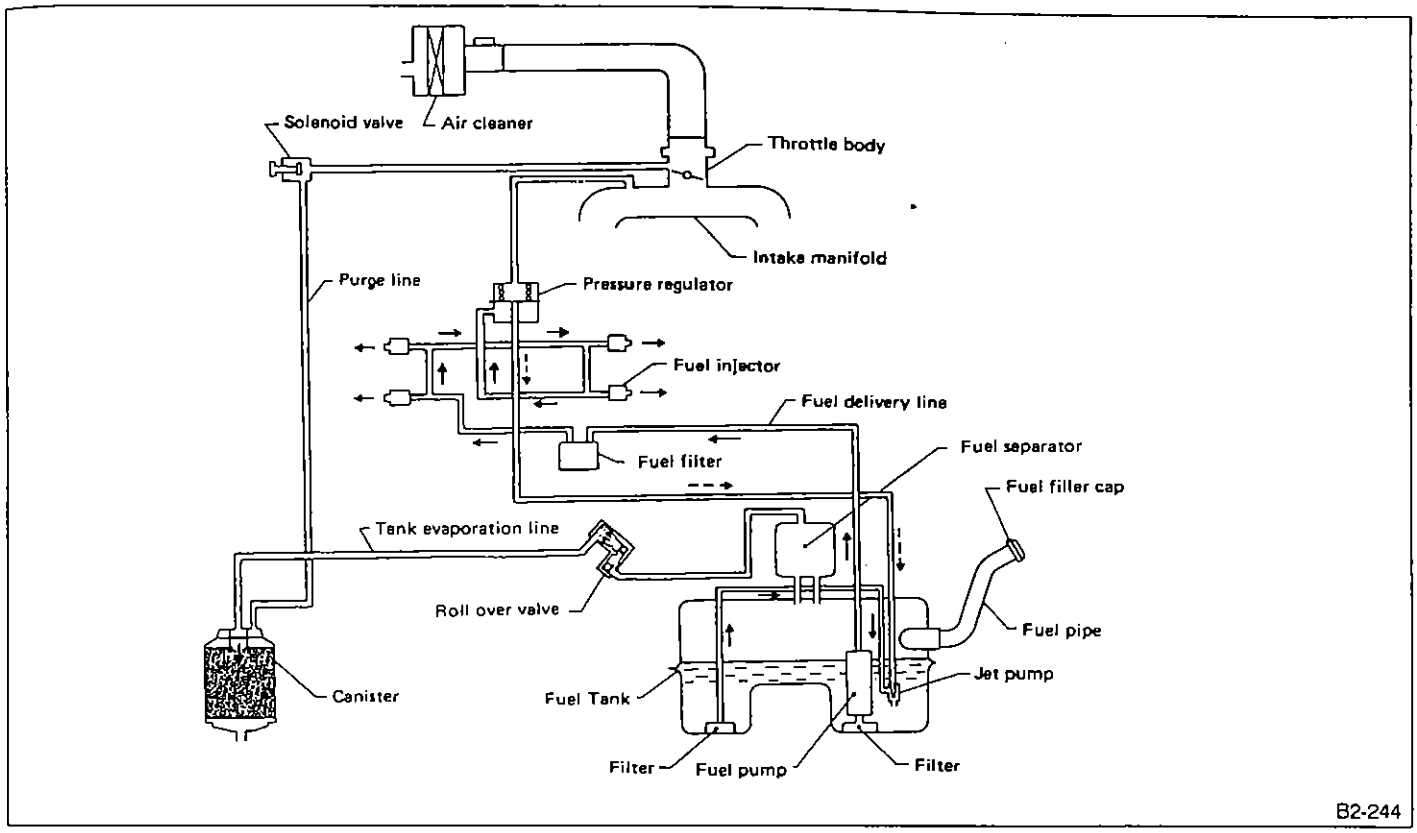


Fig. 2 4WD model

TURBO MODEL

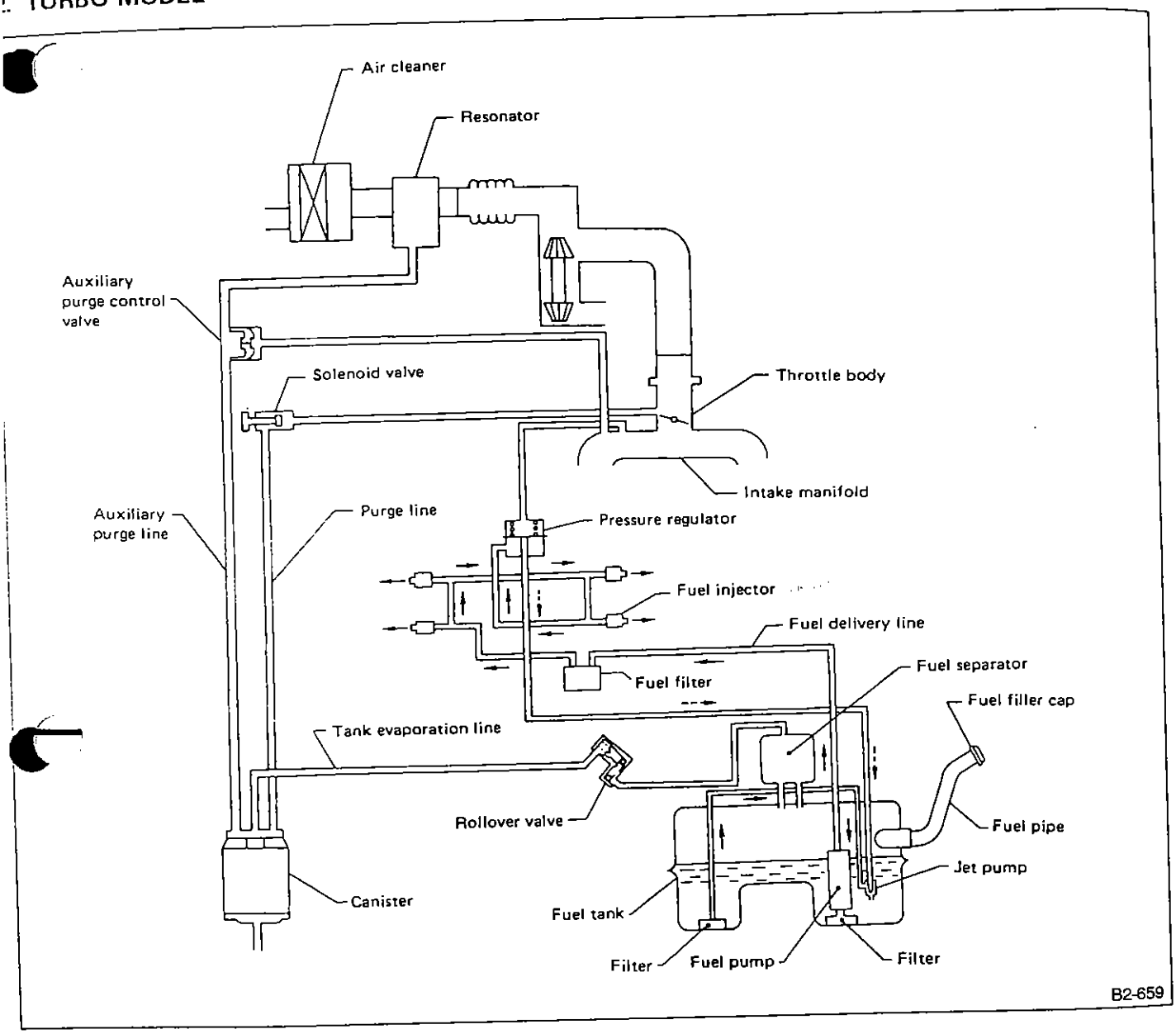


Fig. 3

SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

		MPFI Non-TURBO	MPFI TURBO
el tank	Capacity	60 ℓ (15.9 US gal, 13.2 Imp gal)	
	Location	Under rear seat	
el pump	Type	Impeller	
	Discharge pressure	250.1 kPa (2.55 kg/cm^2, 36.3 psi)	299.1 kPa (3.05 kg/cm^2, 43.4 psi)
	Discharge flow	More than 80 ℓ (21.1 US gal, 17.6 Imp gal)/h [12V at 250.1 kPa (2.55 kg/cm^2, 36.3 psi)]	More than 150 ℓ (39.6 US gal, 33.0 Imp gal)/h [12V at 299.1 kPa (3.05 kg/cm^2, 43.4 psi)]
el filter		Cartridge type	
el separator	Capacity	1.0 ℓ (1.1 US qt, 0.9 Imp qt)	

SUBARU®

1992

SERVICE MANUAL

		Page
S	SPECIFICATIONS AND SERVICE DATA	2
C	COMPONENT PARTS	4
	1. Starter	4
	2. Alternator	6
W	SERVICE PROCEDURE	7
	1. Starter	7
	2. Alternator	15
	3. Spark Plug	21
	4. Ignition Coil	23
	5. Spark Plug Cord	23
T	TROUBLESHOOTING	24
	1. Starter	24
	2. Alternator	25

S SPECIFICATIONS AND SERVICE DATA

SPECIFICATIONS

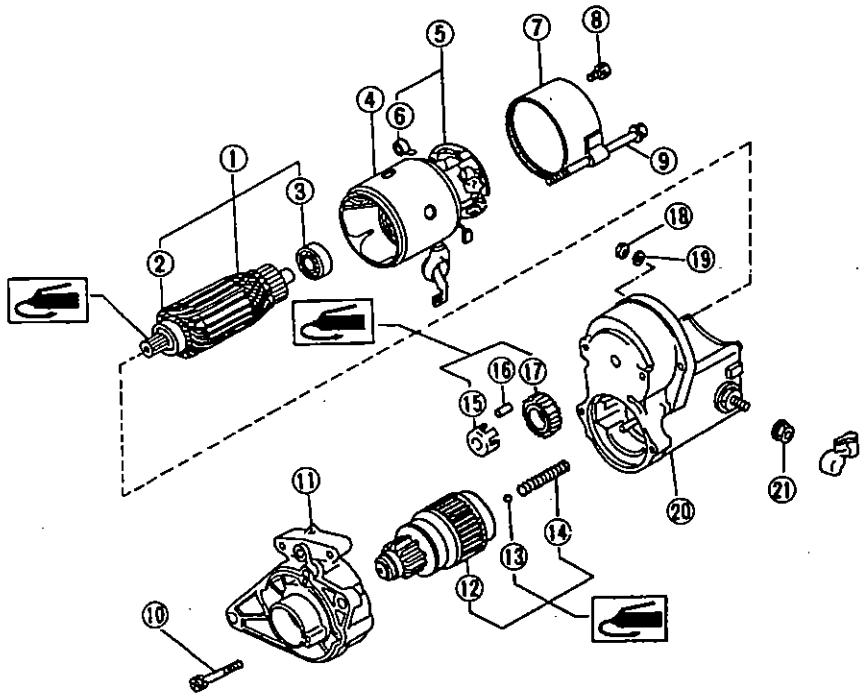
Item			Designation	
Starter	Type		Reduction type	
	Model		[MT] 128000-7190	[AT] 128000-7200
	Manufacturer		NIPPONDENSO	
	Voltage and Output		12 V — 1.0 kW	12 V — 1.4 kW
	Direction of rotation		Counterclockwise (when observed from pinion)	
	Number of pinion teeth		9	
	No-load characteristics	Voltage	11 V	
		Current	90 A or less	
		Rotating speed	3,000 rpm or more	3,350 rpm or more
	Load characteristics	Voltage	8 V	
		Current	280 A or less	370 A or less
		Torque	10 N•m (1.0 kg-m, 7 ft-lb)	14 N•m (1.4 kg-m, 10 ft-lb)
		Rotating speed	900 rpm or more	880 rpm or more
	Lock characteristics	Voltage	5 V	
		Current	800 A or loss	735 A or less
		Torque	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		LR170-732B	
	Regulator type		TR1Z-102	
	Manufacturer		HITACHI	
	Voltage and Output		12 V — 85 A	
	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		1,500 rpm — 33 A or more 3,000 rpm — 66 A or more 6,000 rpm — 80 A or more	
	Regulated voltage		14.1 — 14.7 V [20°C (68°F)]	

Item		Designation	
Ignition coil	Model	[MT] F-569-01R	[AT] CM12-100
	Manufacturer	DIAMOND	HITACHI
	Primary coil resistance	0.62 — 0.76 Ω	0.63 — 0.77 Ω
	Secondary coil resistance	17.9 — 24.5 kΩ	10.4 — 15.6 kΩ
	Insulation resistance between primary terminal and case	More than 50 MΩ	More than 10 MΩ
Spark plug	Type and Manufacturer	BKR6E-11 ..... NGK K20PR-U11 ..... Nippondenso RC7YC4 ..... Champion	
	Thread size mm	14, P = 1.25	
	Spark gap mm (in)	1.0 — 1.1 (0.039 — 0.043)	

C COMPONENT PARTS

1. Starter

1. MT: 128000-7190



1 Armature
2 Ball bearing
3 Ball bearing
4 Yoke
5 Brush holder
6 Brush spring
7 End frame
8 Screw & washer
9 Through bolt
10 Screw & washer
11 Starter housing
12 Overrunning clutch
13 Steel ball
14 Spring
15 Retainer
16 Roller
17 Starter pinion
18 Nut
19 Spring washer
20 Magnet switch
21 Nut

B6-675

Fig. 1

2. AT: 128000-7200

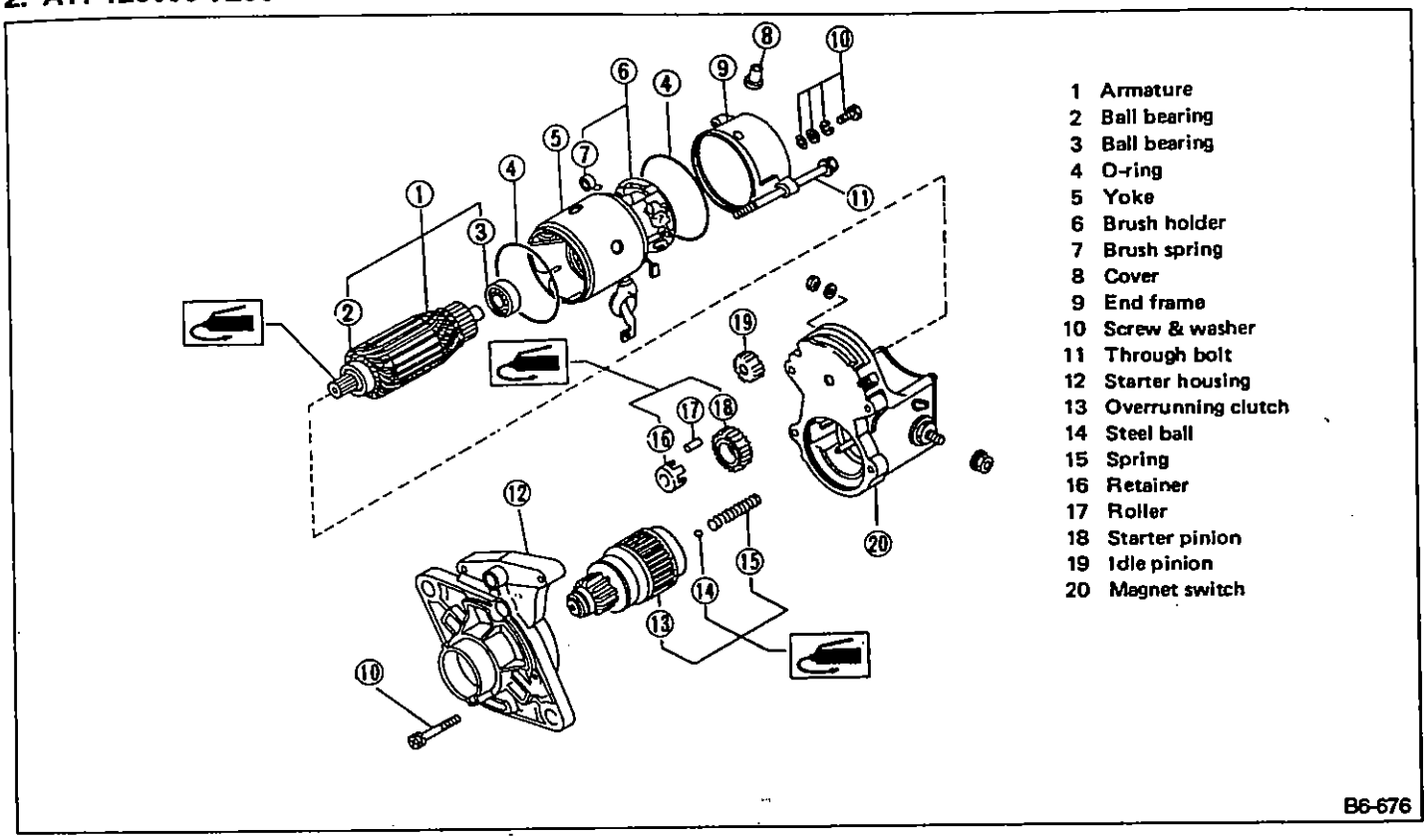
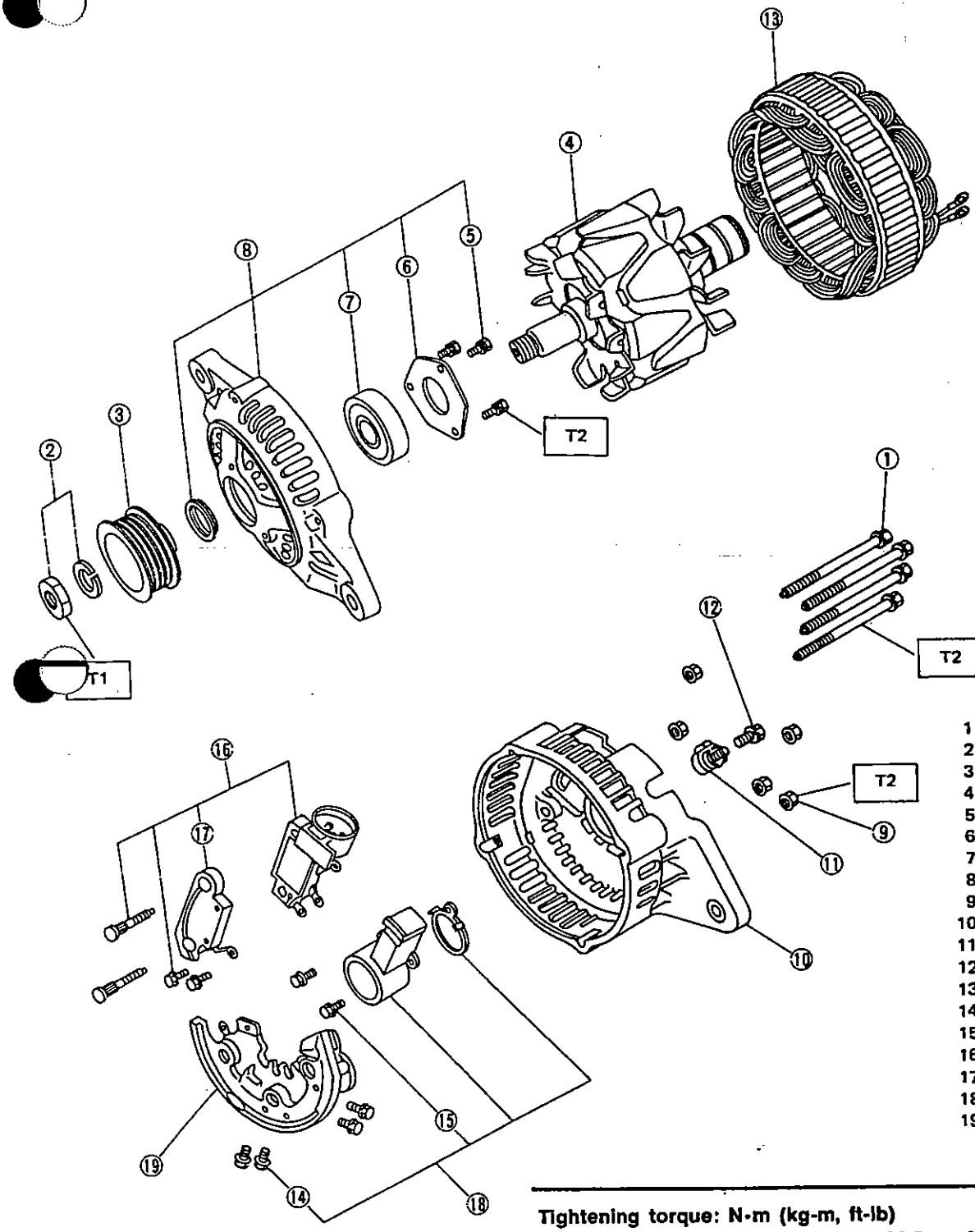


Fig. 2

2. Alternator



1 Through bolt
2 Pulley nut ASSY
3 Pulley
4 Rotor ASSY
5 Screw
6 Bearing retainer
7 Ball bearing
8 Front cover ASSY
9 Nut
10 Rear cover
11 BAT terminal bolt
12 Bolt
13 Stator
14 Bolt
15 Bolt
16 IC regulator ASSY
17 Condenser
18 Brush holder ASSY
19 Diode ASSY

Tightening torque: N·m (kg-m, ft-lb)
T1: 49.0 — 63.7 (5.00 — 6.50, 36.2 — 47.0)
T2: 3.1 — 3.9 (0.32 — 0.40, 2.3 — 2.9)

B6-030

Fig. 3

W SERVICE PROCEDURE

1. Starter

A: TEST

1. MAGNETIC SWITCH

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) 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.

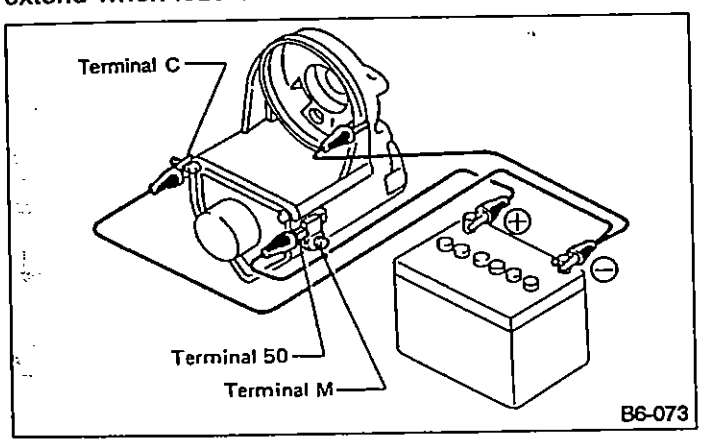


Fig. 4

2) Holding-in test

Disconnect lead from terminal C with pinion extended. Pinion should be held in the extended position.

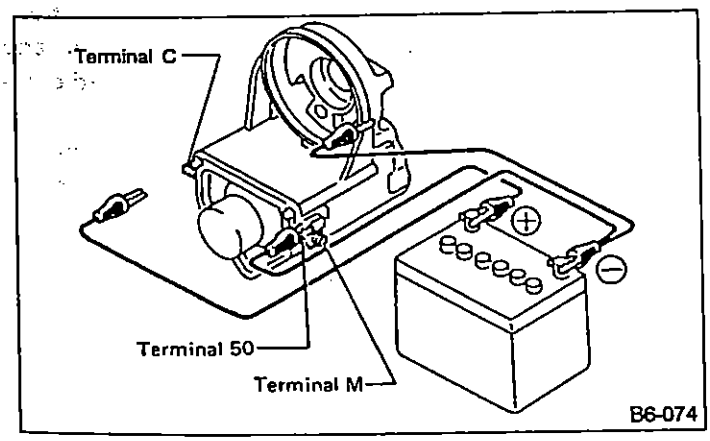


Fig. 5

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.

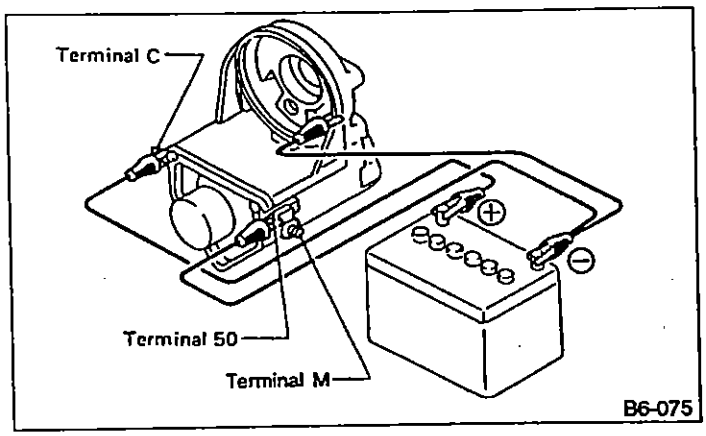


Fig. 6

2. 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
11 V/90 A max.
Rotating speed
MT: 3,000 rpm min.
AT: 3,350 rpm min.

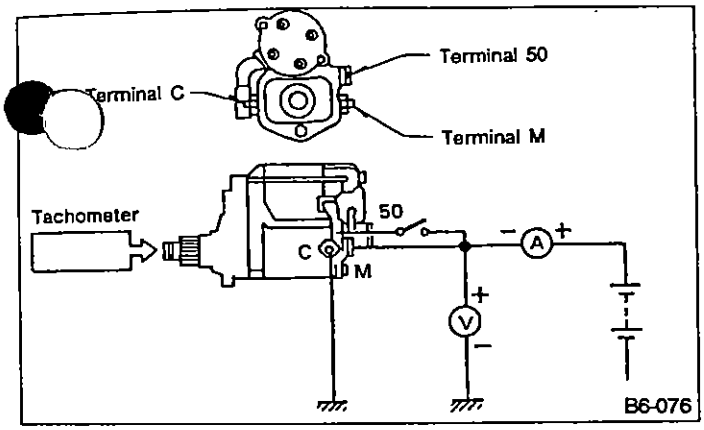


Fig. 7

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):

MT	**Voltage/Load**
	8 V/10 N•m (1.0 kg-m, 7 ft-lb)
	Current/Speed
	280 A max./900 rpm min.
	Voltage/Load
	8 V/14 N•m (1.4 kg-m, 10 ft-lb)
	Current/Speed
	370 A max./880 rpm min.

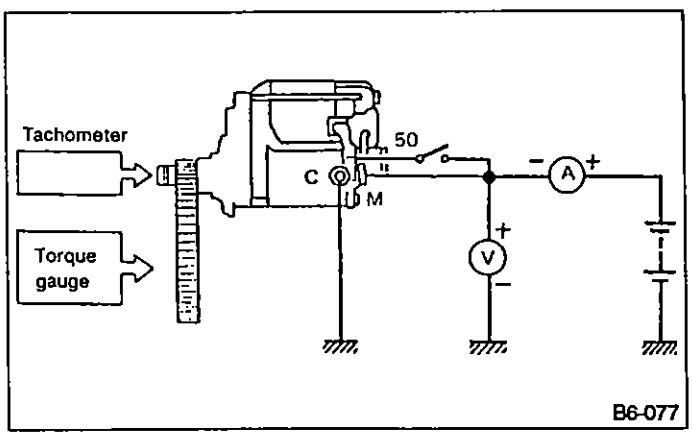


Fig. 8

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):

MT	**Voltage/Current**
	5 V/800A max.
	Torque
	27 N•m (2.8 kg-m, 20 ft-lb) min.
AT	**Voltage/Current**
	5 V/735 A max.
	Torque
	27 N•m (2.8 kg-m, 20 ft-lb) min.

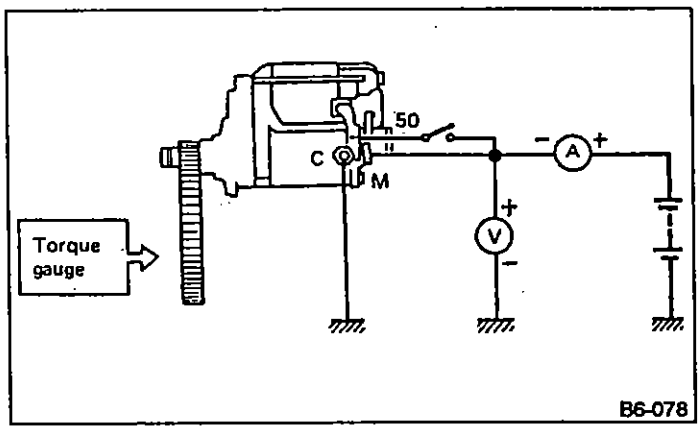


Fig. 9

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.

B: DISASSEMBLY

1) Disconnect lead wire from magnetic switch.

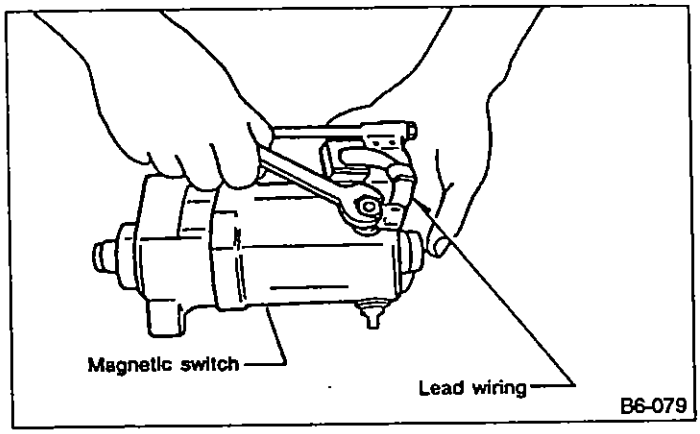


Fig. 10

2) Remove through-bolts from end frame.

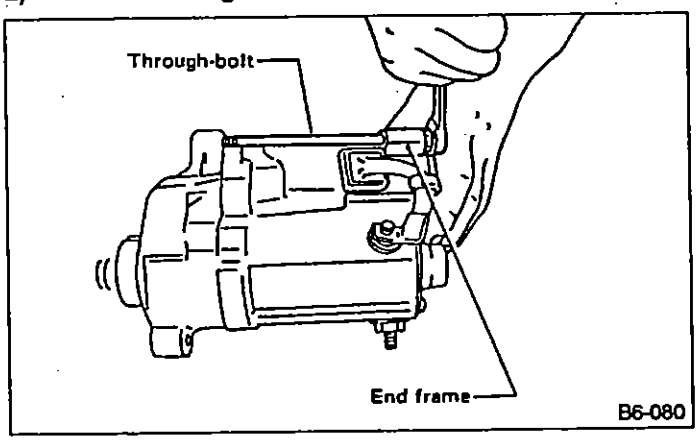


Fig. 11

3) Remove yoke from magnetic switch.

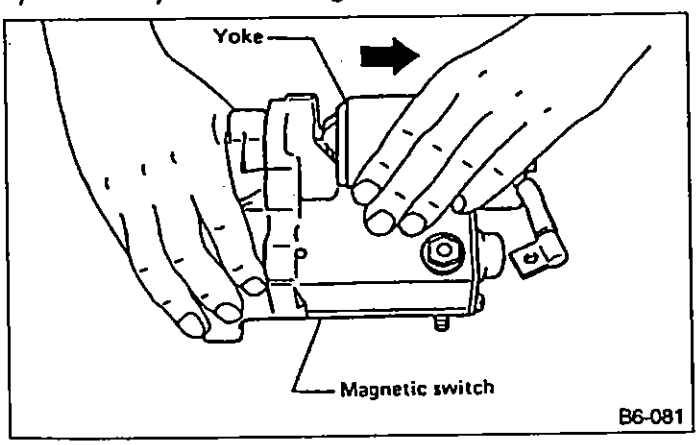


Fig. 12

4) Remove screws securing end frame to brush holder.

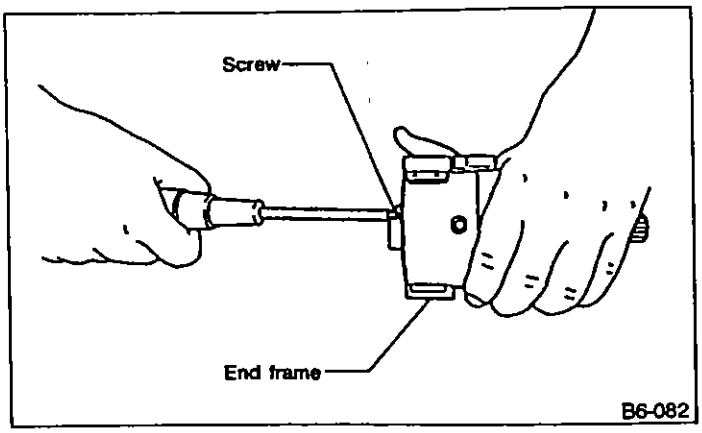


Fig. 13

5) Separate yoke from end frame.

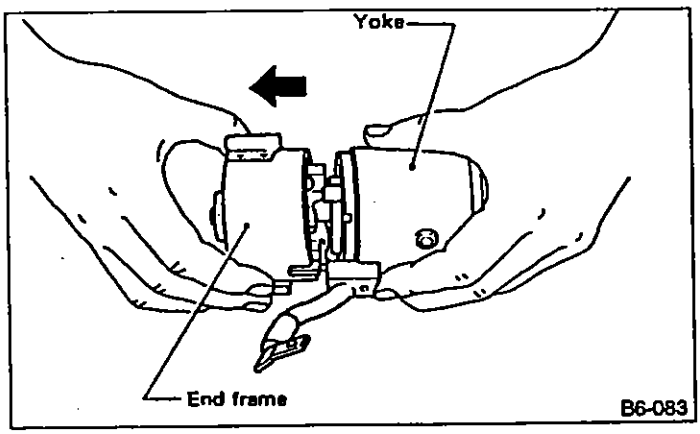


Fig. 14

6) Remove brush by lifting up positive (+) side brush spring using long-nose pliers.
Be careful not to damage brush and commutator.

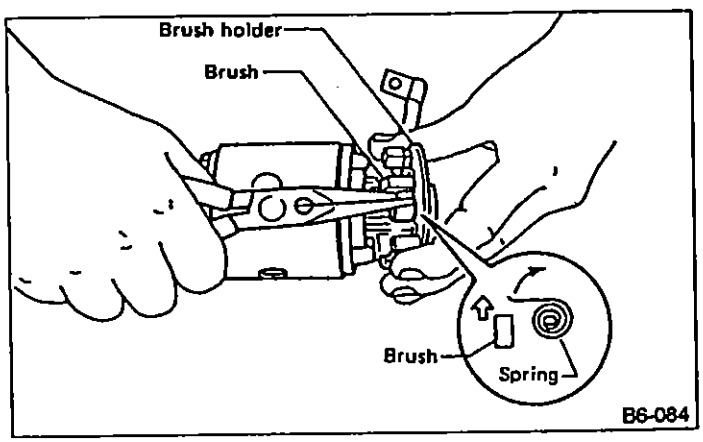


Fig. 15

7) Remove armature from yoke.
Be careful not to drop armature.

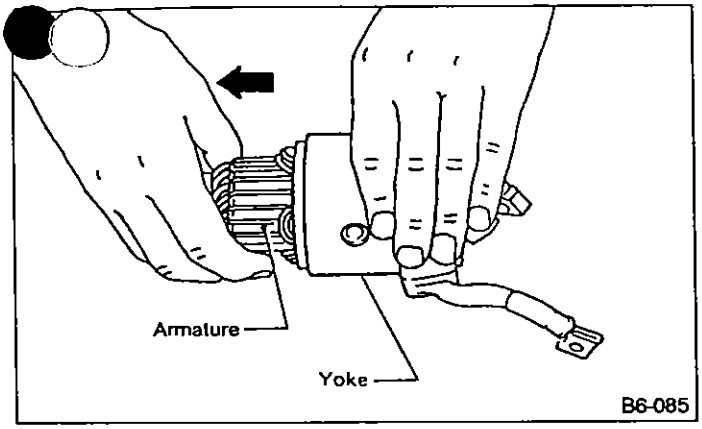


Fig. 16

8) Remove screws securing magnetic switch to housing.

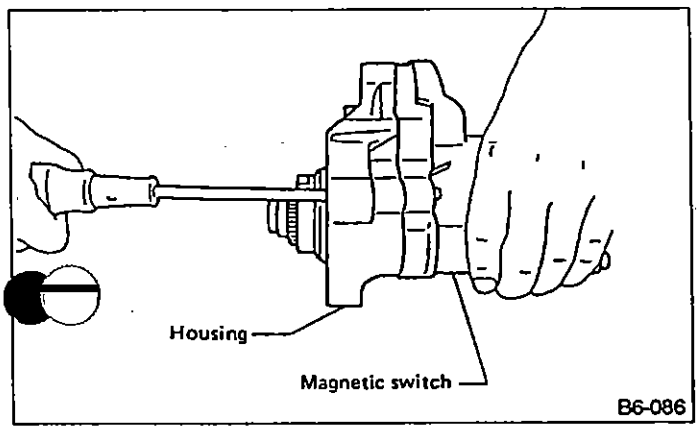


Fig. 17

Remove housing from magnetic switch.

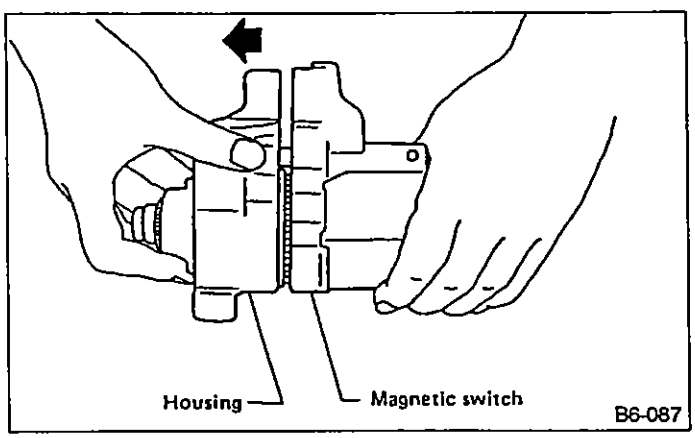


Fig. 18

9) Remove clutch from housing.

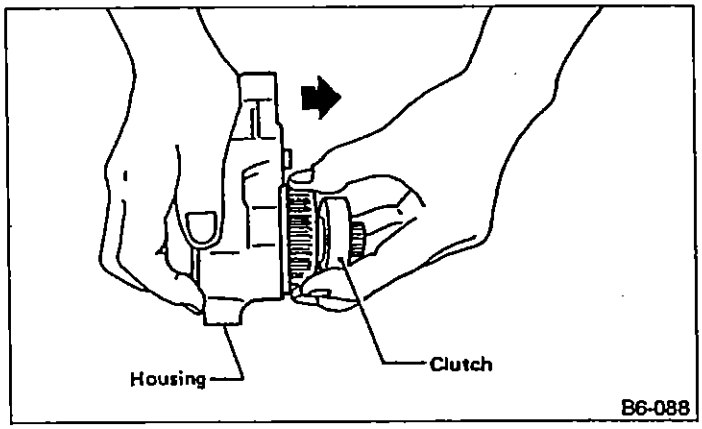


Fig. 19

10) Take out steel ball from clutch.
Be careful not to lose steel ball.

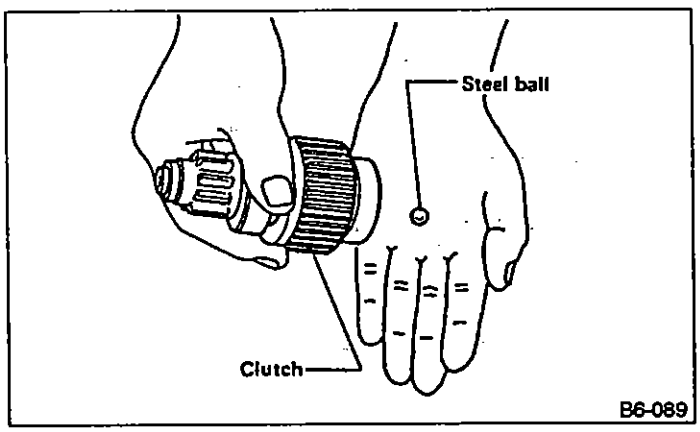


Fig. 20

11) Remove idle gear from housing.

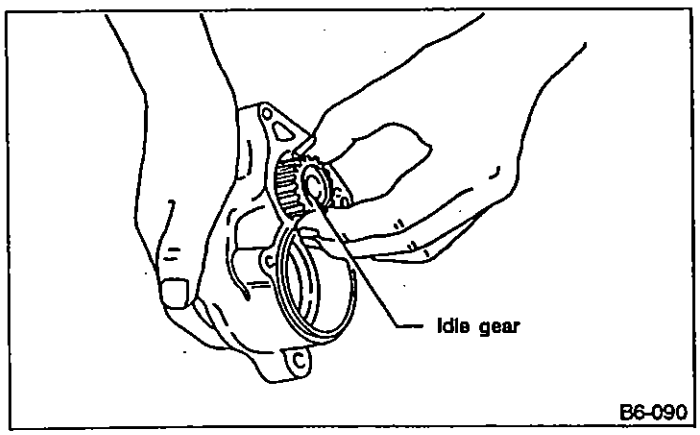


Fig. 21

12) Remove retainer and roller from housing.
Be careful not to drop retainer and roller.

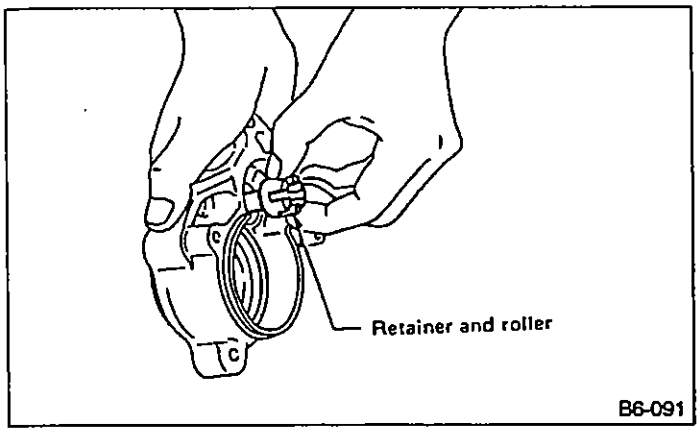


Fig. 22

13) Remove coil spring from magnetic switch.

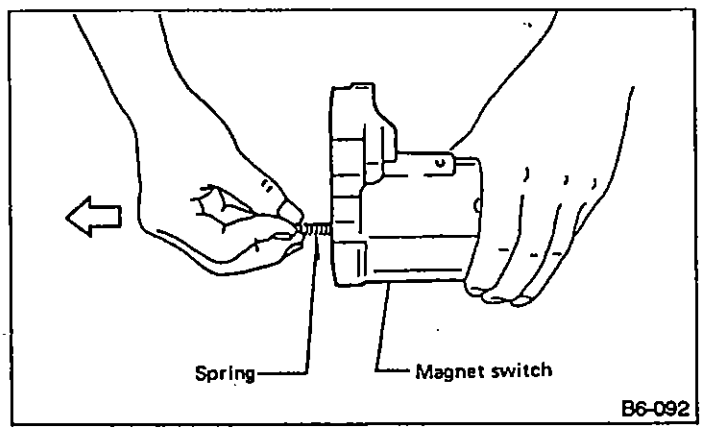


Fig. 23

C: INSPECTION AND REPAIR

1. ARMATURE

1) Layer test
Check armature coil for shortcircuit between layers by using growler tester.

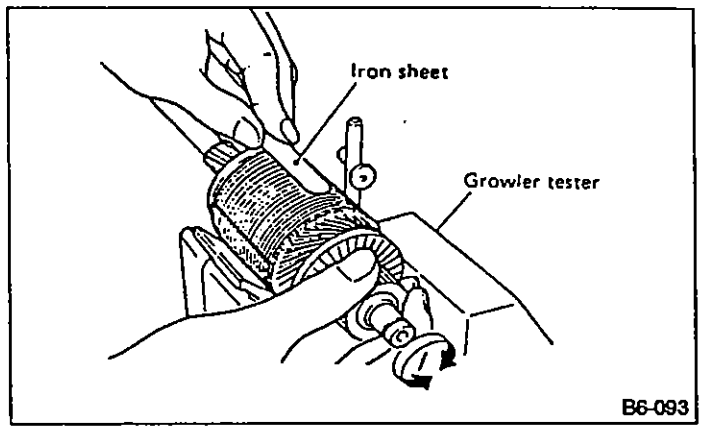


Fig. 24

If any shortcircuit exists in armature coil, circulating current is generated by alternating flux of growler 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 500 V megger.
Insulation resistance should be 0.1 MΩ or larger.

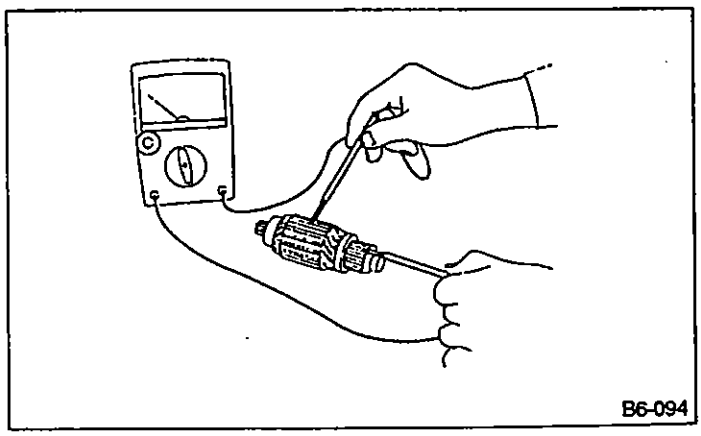


Fig. 25

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.

Out of roundness:
Standard
0.02 mm (0.0008 in) or less
Limit
0.05 mm (0.0020 in)

Be sure to perform this check after checking armature shaft for bend.

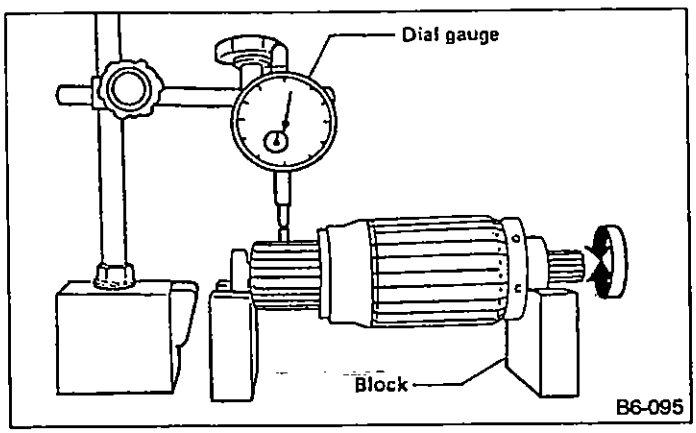


Fig. 26

If commutator surface is rough, polish with fine grain 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
30 mm (1.18 in)
Limit
29 mm (1.14 in)

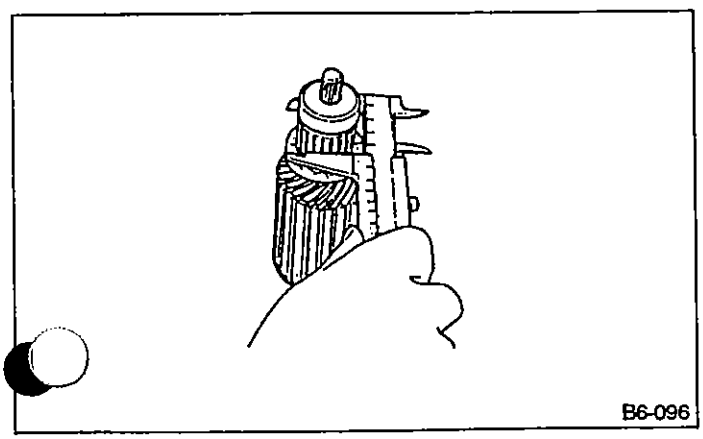


Fig. 27

4) Under-cutting of commutator
If commutator segments wear and mica insulation between segments stand higher than segment face, proper rectification is hampered.

Depth of mica:
Standard
0.5 — 0.8 mm (0.020 — 0.031 in)
Limit
0.2 mm (0.008 in)

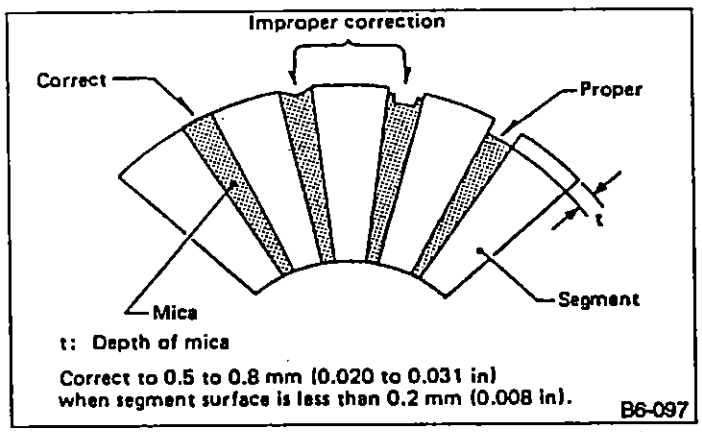


Fig. 28

2. BEARING

1) Inspection
(1) Rotate bearing by hand; no binding should exist.
(2) Rotate bearing rapidly; no abnormal noise should be heard.

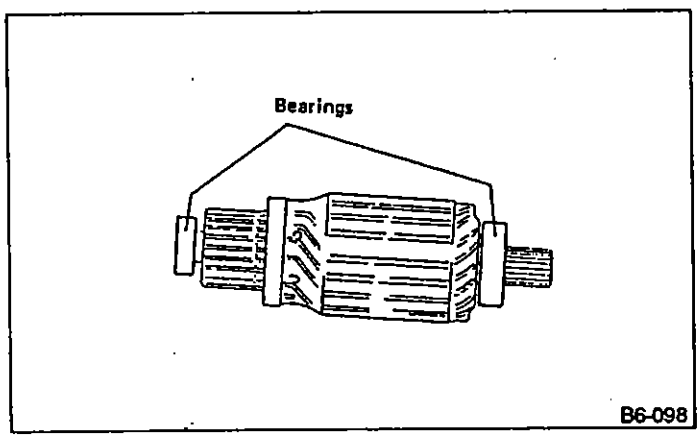


Fig. 29

2) Replacement
Pull out bearing using a jig as shown in Figure.

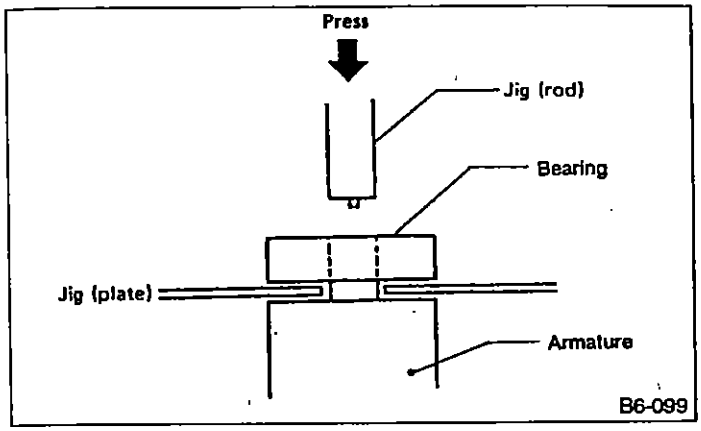


Fig. 30

3. YOKE

1) Testing field coil for open circuit
Check field coil for continuity using circuit tester. Continuity should exist.

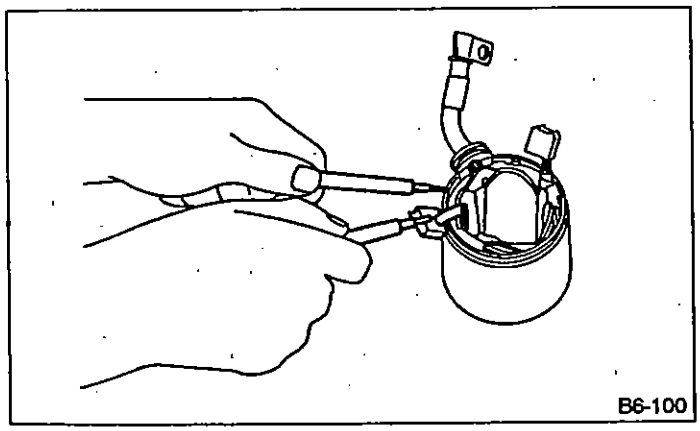


Fig. 31

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:
1.4 kW type (AT)
Standard 15 mm (0.59 in)
Limit 10 mm (0.39 in)
1.0 kW type (MT)
Standard 13 mm (0.51 in)
Limit 8.5 mm (0.335 in)

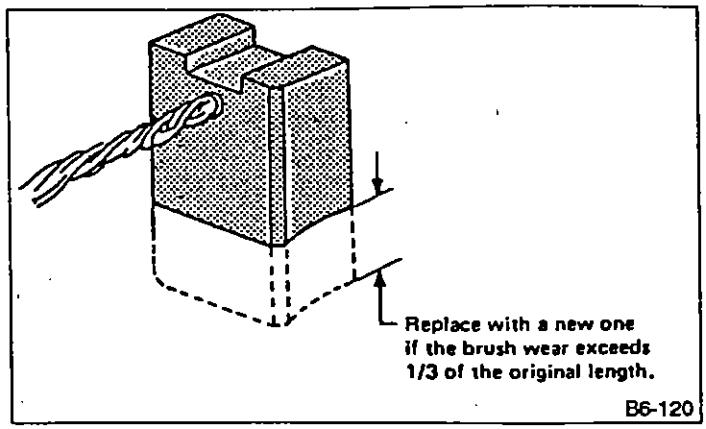


Fig. 32

4. BRUSH HOLDER

Measure insulation resistance of brush holder using Megger.

Insulation resistance:
0.1 MΩ or over

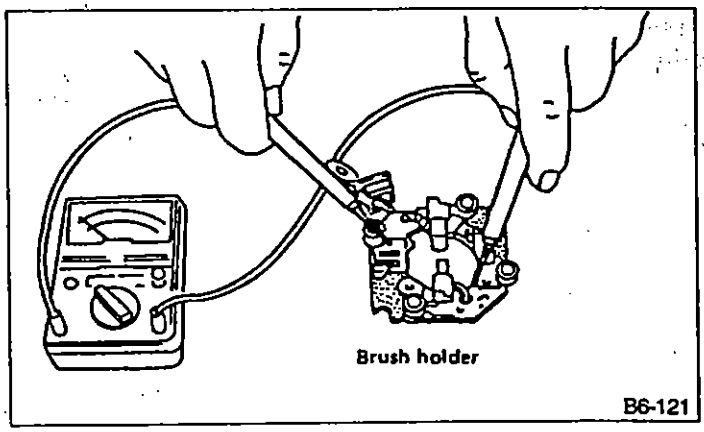


Fig. 33

5. CLUTCH

Check that pinion can be rotated in normal direction

pinion gear for wear, damage, rusting, or binding during rotation.

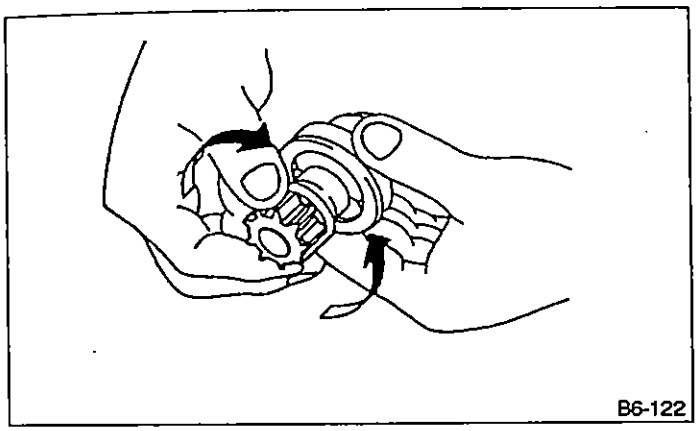


Fig. 34

D: ASSEMBLY

Assembly is in the reverse order of disassembly procedures. Observe the following:

1) Before assembling, lubricate disassembled parts at the points shown in Fig. 1 and Fig. 2.

ESSO BEACON 325 SCHELL ALVANIA GREASE RA	or equivalent

2) Assembling magnetic switch, clutch, and housing

To assemble, first install clutch to magnetic 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.

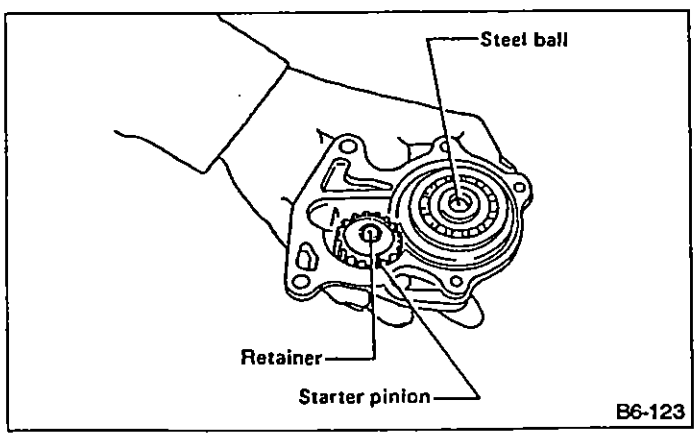


Fig. 35

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.

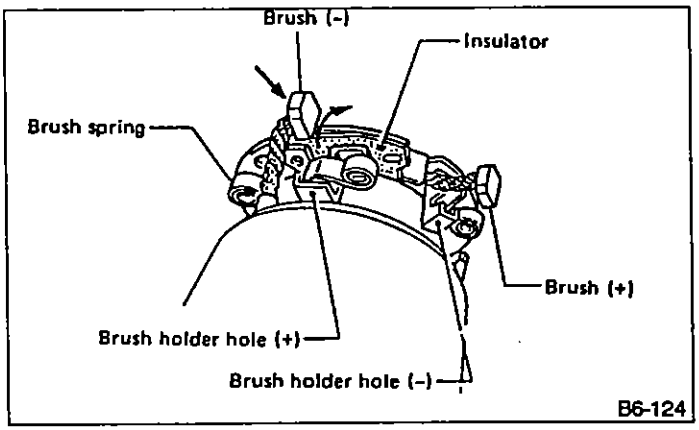


Fig. 36

5) Installing end frame

When assembling end frame to yoke, align notched portion of end frame with lead wire grommet.

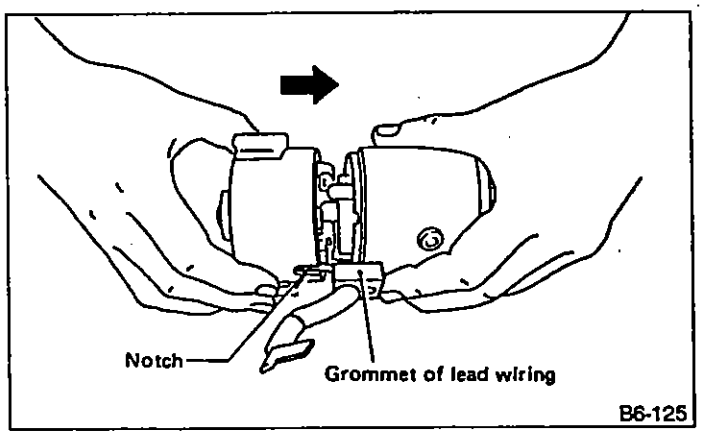


Fig. 37

i) Installing yoke
When installing yoke to magnetic switch, align notch of yoke with protrusion of magnetic switch.

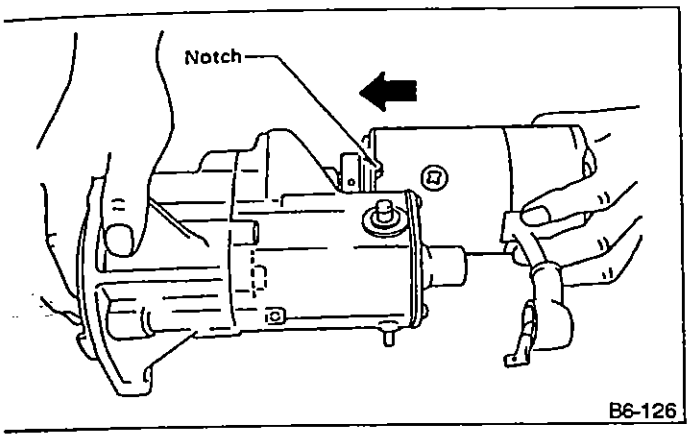


Fig. 38

2. Alternator

A: TEST

1. PRECAUTION

Prepare the following measuring equipment:
(1) DC voltmeter (V): 0 — 30 V
(2) DC ammeter (A): 0 — 100 A
(3) Variable resistor: 0 — 0.25 Ω, 1 kW
(4) Resistor: 0.25Ω, 25 W
(5) Switch (SW1 and SW2): 12 V
(6) Test lamp: 12 V, 1.4 W

- Connect test leads [of at least 8 mm² (0.012 sq in) in cross-sectional area and shorter than 2.5 m (8.2 ft)] in line "Y" (between alternator B terminal and battery positive terminal), and in line "Z" (between battery negative terminal and terminal E).
- Use switches SW1 and SW2 having as low a resistance as possible.

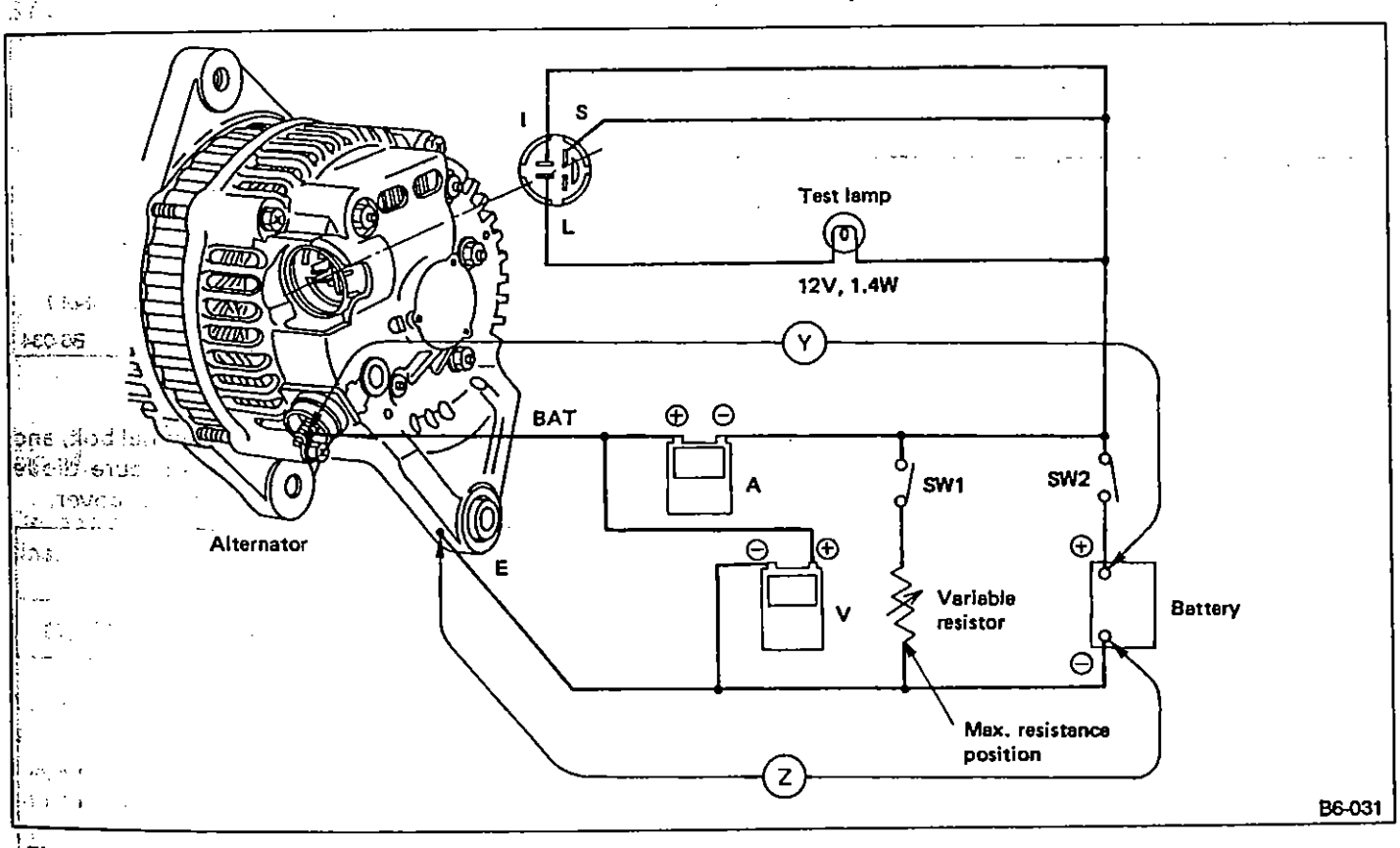


Fig. 39

2. REGULATING VOLTAGE MEASUREMENT

1) Open switch SW1 and close switch SW2.
2) Operate alternator at a rated speed of 6,000 rpm.
3) Measure regulating voltage (while operating at 6,000 rpm). If it is in the 14.1 to 14.7 V range, alternator is functioning properly.

3. OUTPUT CURRENT MEASUREMENT

1) Set variable resistor at minimum resistance position. Close both SW1 and SW2.
2) While adjusting variable resistor, increase alternator speed so that voltmeter registers 13.5 volts.
3) Measure output current values when alternator speeds reach 1,500, 3,000 and 6,000 rpm, respectively.

1,500 rpm	Greater than 33A
3,000 rpm	Greater than 66A
6,000 rpm	Greater than 80A

4. ALTERNATOR SPEED AT 13.5 V

1) Open switch SW1, and close switch SW2. Gradually raise alternator speed, and read the speed when the voltage is 13.5 V.
2) The alternator is normal if it is turning at less than 1,000 rpm when the voltage is 13.5 V.

DISASSEMBLY

1) Remove through screws from alternator. Detach front cover with rotor from rear cover with stator by lightly tapping on front cover with a plastic hammer.

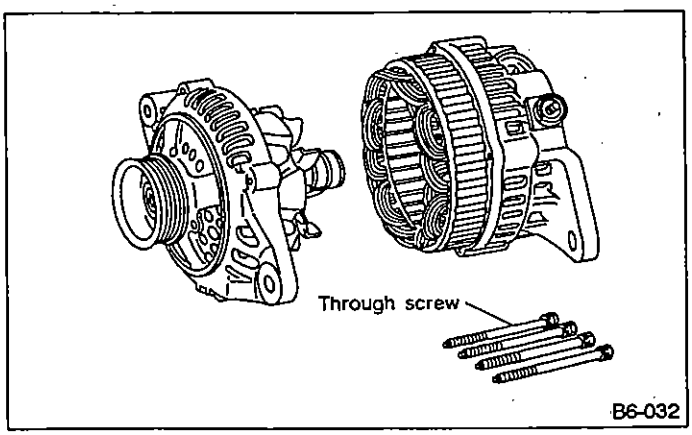


Fig. 40

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.

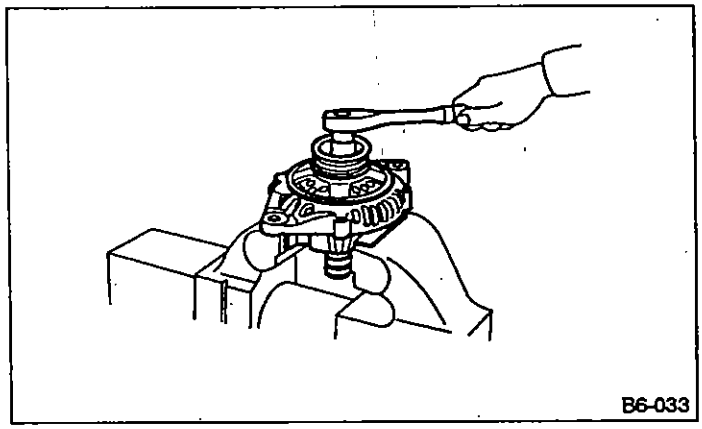


Fig. 41

3) Remove rotor from front cover.
4) Remove three screws from front cover and then bearing retainer and ball bearing.

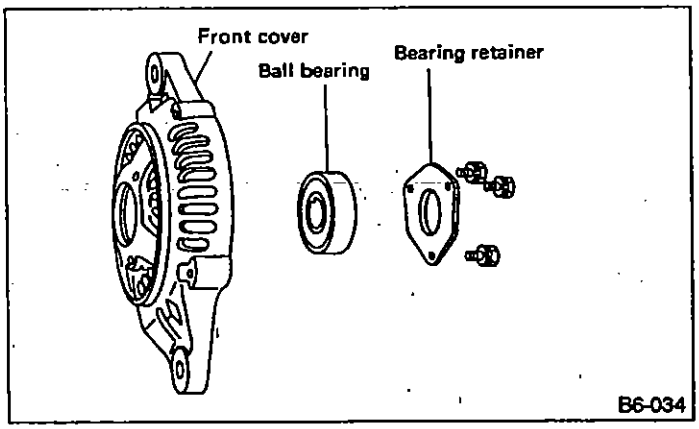


Fig. 42

5) Remove bolt which secure battery terminal bolt, and remove rear cover. Remove nuts which secure diode and IC regulator, and remove stator and rear cover.

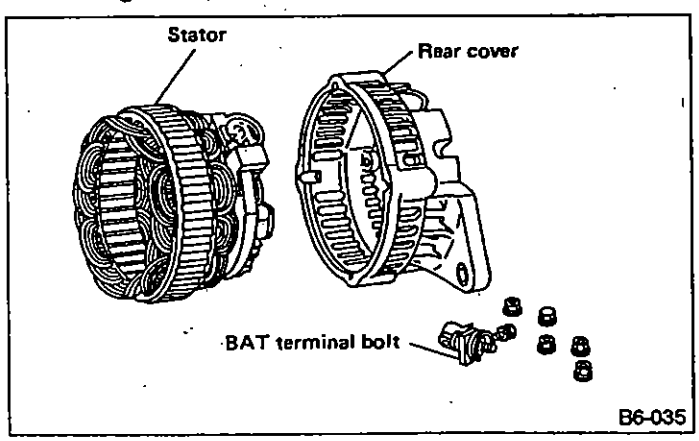


Fig. 43

6) Remove bolts which secure stator terminal to diode terminal, and remove stator.

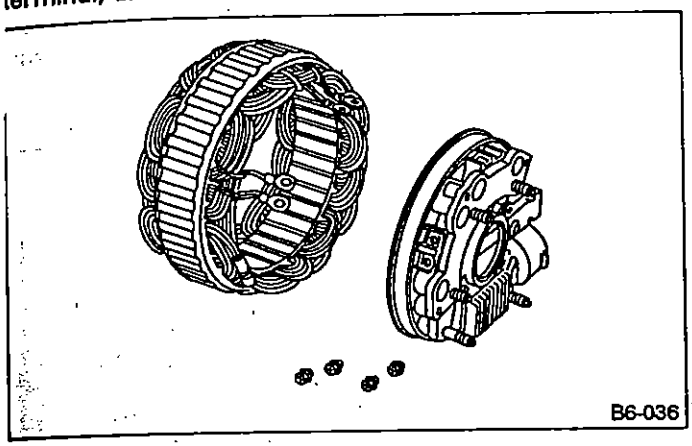


Fig. 44

7) Remove bolts which secure IC regulator ASSY, diode ASSY and brush holder, and separate these ASSY's.

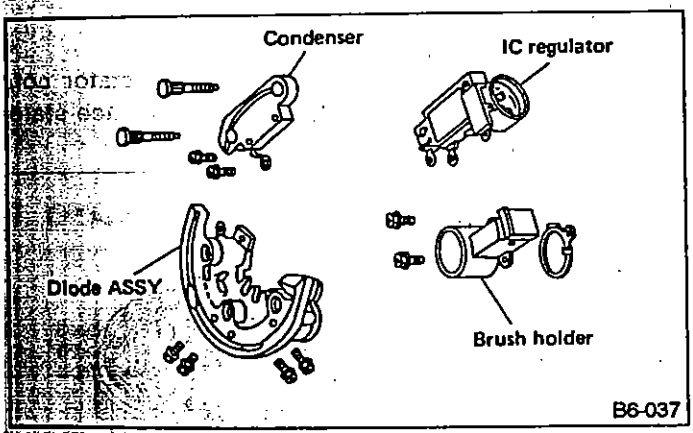


Fig. 45

Do not apply a shock or load to IC regulator cooling fins.

C: INSPECTION AND REPAIR

1. ROTOR

1) Slip ring surface

Inspect slip rings for contamination or any roughness of the sliding surface.

Clean or polish with #500 to #600 emery paper if defective.

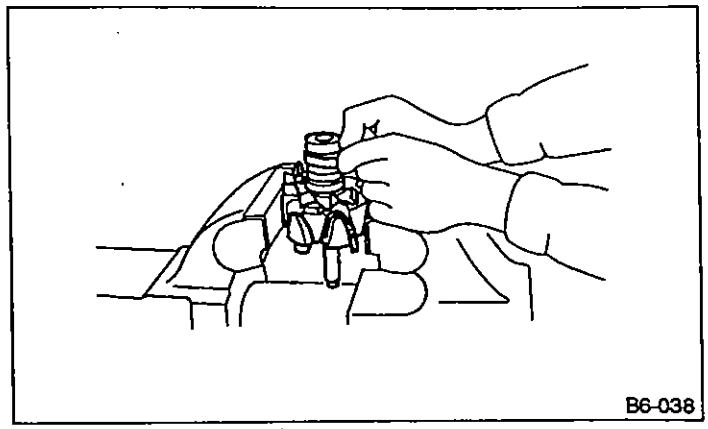


Fig. 46

2) Slip ring outside diameter

Measure slip ring outside diameter. If slip ring is worn, replace rotor ASSY.

Slip ring outside diameter:
Standard
27 mm (1.06 in)
Limit
26 mm (1.02 in)

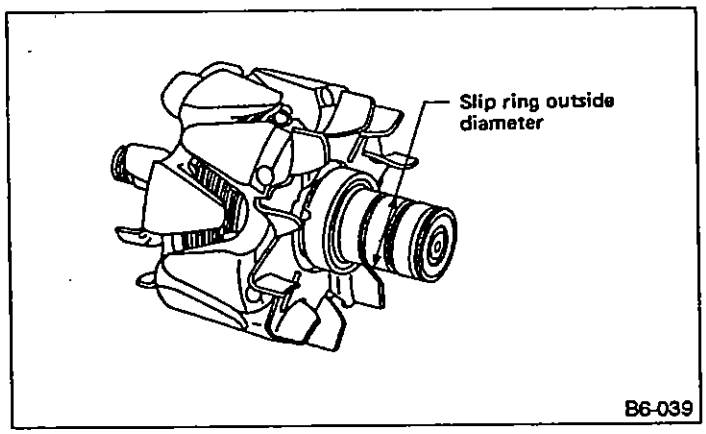


Fig. 47

3) Continuity test

Check continuity between slip rings. If continuity does not exist, replace rotor ASSY.

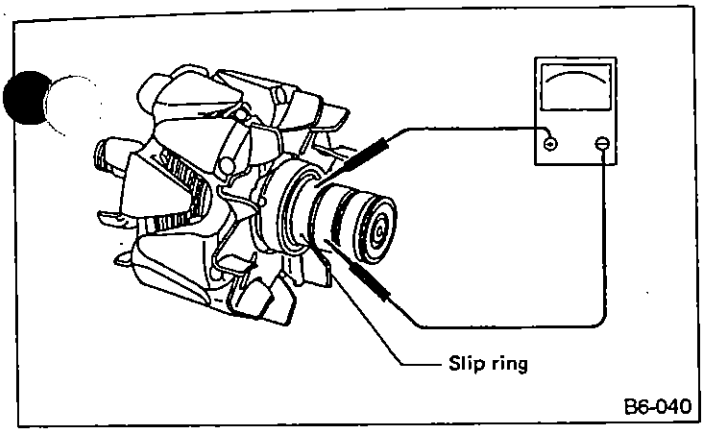


Fig. 48

4) Insulation test
Check continuity between slip ring and rotor core or shaft. If continuity exists, replace rotor ASSY.

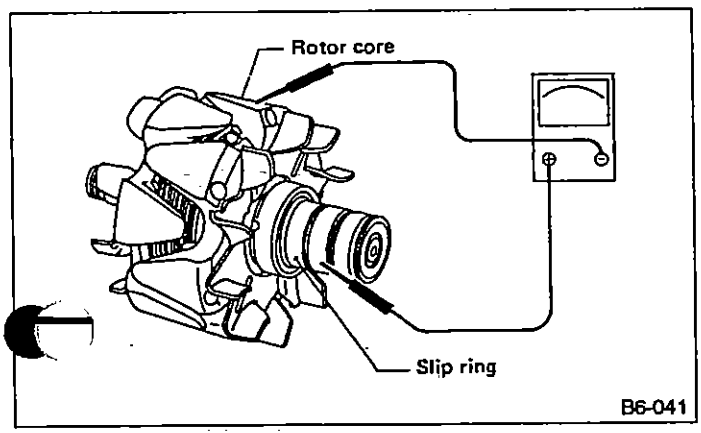


Fig. 49

5) Ball bearing
Check rear ball bearing. Replace it if it is noisy or if rotor does not turn smoothly.

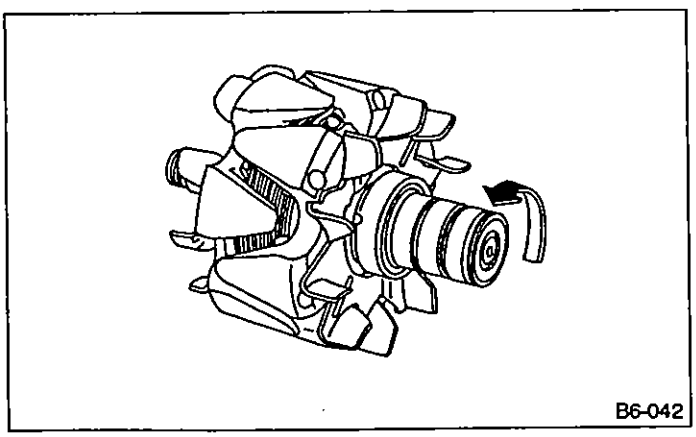


Fig. 50

2. STATOR

1) Continuity test
Inspect stator coil for continuity between its terminals. When there is no continuity between individual terminals, cable is broken.
Replace stator ASSY.

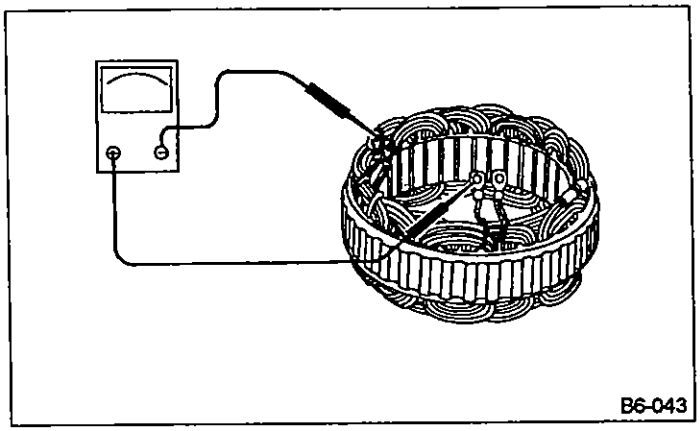


Fig. 51

2) Insulation test
Inspect stator coil for continuity between stator core and each terminal. If there is continuity, replace stator ASSY.

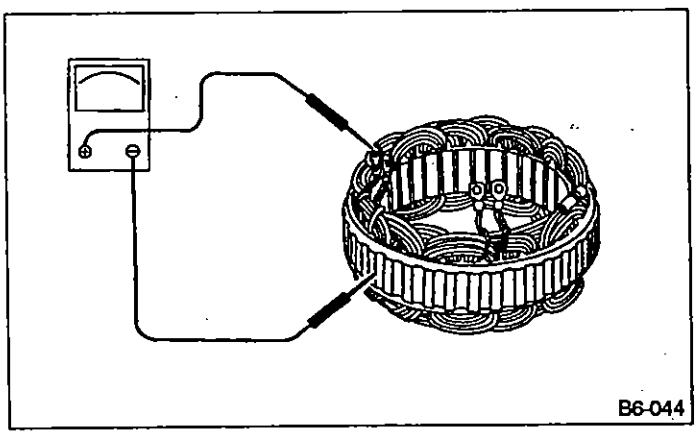


Fig. 52

3. BRUSH

Measure brush length. If brush is worn, replace brush holder ASSY.

Brush length (ℓ):
Standard
20.5 mm (0.807 in)
Limit
1.5 mm (0.059 in)

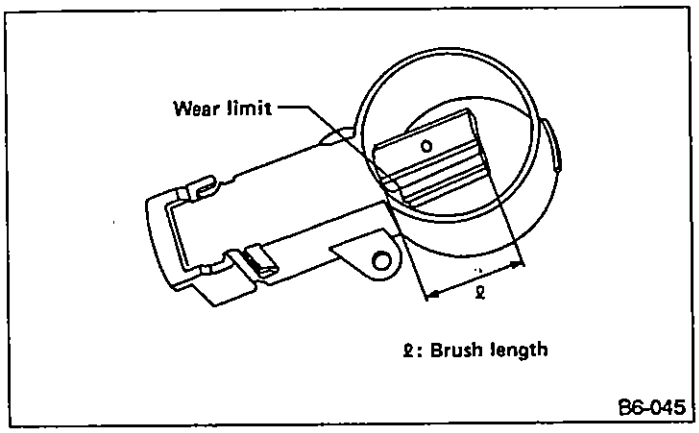


Fig. 53

4. DIODE ASSEMBLY

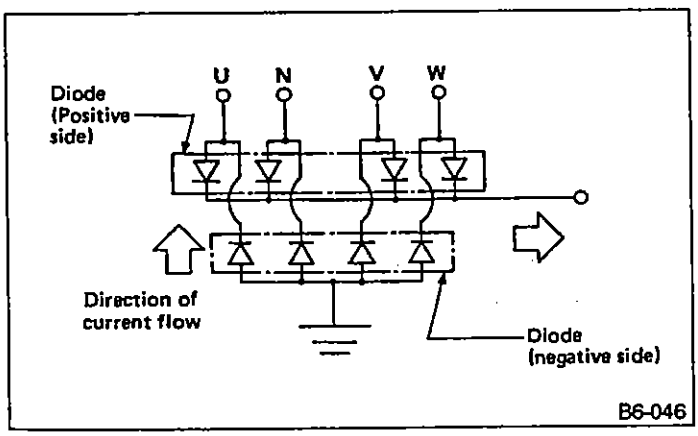


Fig. 54

The diode ASSY consists of eight diodes, four each being located on the positive and negative sides. The diode is necessary to restrict current flow to one direction.
Check all diodes, for continuity. If any diode is faulty, replace diode ASSY.
1) Diodes on "+" side

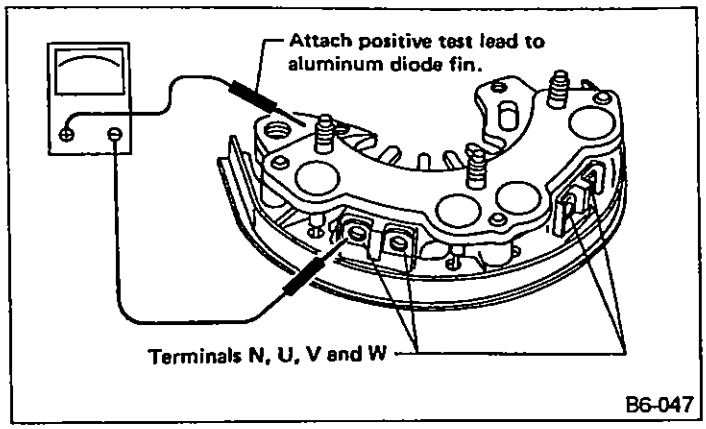


Fig. 55

Continuity of proper diodes on "+" side

BAT side / Terminal N, U, V and W	(+)	(−)
(+)	—	Continuity must not exist.
(−)	Continuity must exist.	—

2) Diodes on "−" side

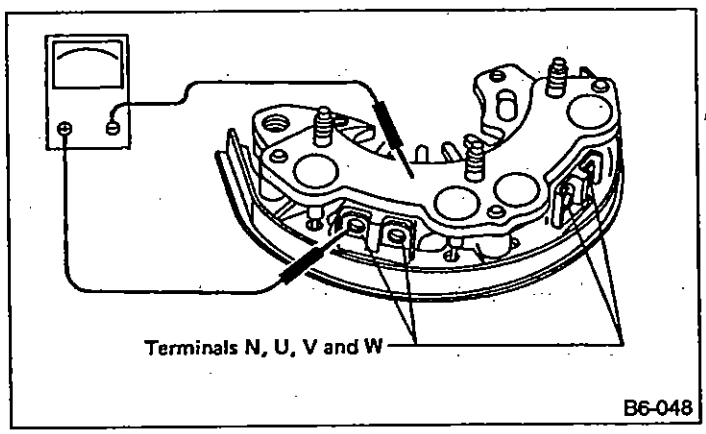


Fig. 56

Continuity of proper diodes on "−" side

"E" side / Terminal N, U, V and W	(+)	(−)
(+)	—	Continuity must exist.
(−)	Continuity must not exist.	—

Never use a high tension insulation tester, such as a meggar as it will damage diodes with its high tension.

5. IC REGULATOR

1) Prepare the following equipment:
   (1) Power supply: Variable 12 V DC
   (2) Lamp: L1 and L2, 12 V, 1.4 W, 2 each
   (3) Switch: SW1 and SW2, 12 V, 2 each
   (4) DC voltmeter (V): 0 — 50 V
2) Test procedure

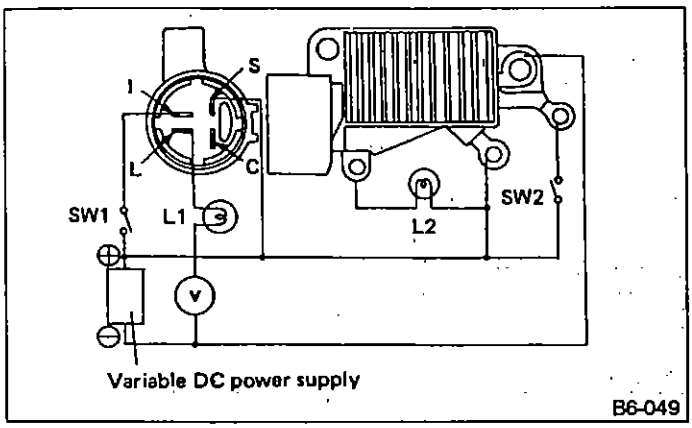


Fig. 57

(1) Open switches SW1 and SW2.
(2) Set variable DC power supply to 12 V.
(3) Close switch SW1 to check L1 and L2 lamp conditions.
(4) With switch SW1 closed, close switch SW2 to check L1 and L2.
(5) With both switches closed, gradually increase variable DC power supply. Check L1 and L2 lamp conditions when power supply reaches the specified voltage range.

Specified voltage range [at 25°C (77°F)]:
14.1 — 14.7 V

Step No.	Lamp L1	Lamp L2
(3)	ON (bright)	ON (dark)
(4)	OFF	ON (bright)
(5)	OFF	OFF

If any of the test results are not as indicated in the above table, replace IC regulator.

D: ASSEMBLY

To assemble, reverse order of disassembly procedures
a. Install a new ball bearing on rear of alternator.
b. Rear ball bearing has a ring placed in eccentric groove of the outer race. Part of this ring protrudes beyond the outer race. Before assembling the ring, rotate it so that the protrusion is reduced to a minimum. Replace rear cover if it is worn or damaged at bearing location.

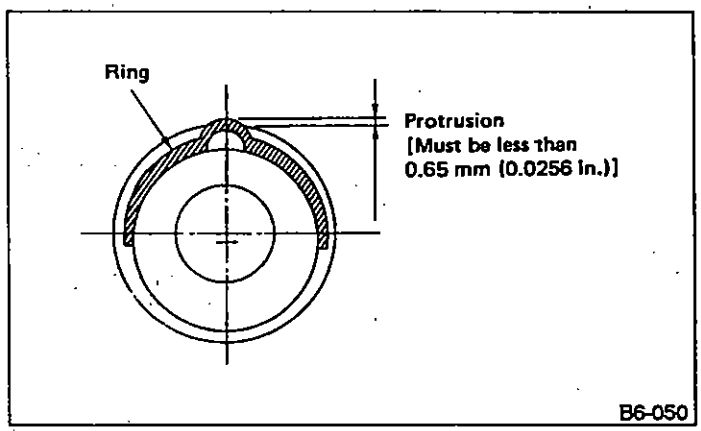
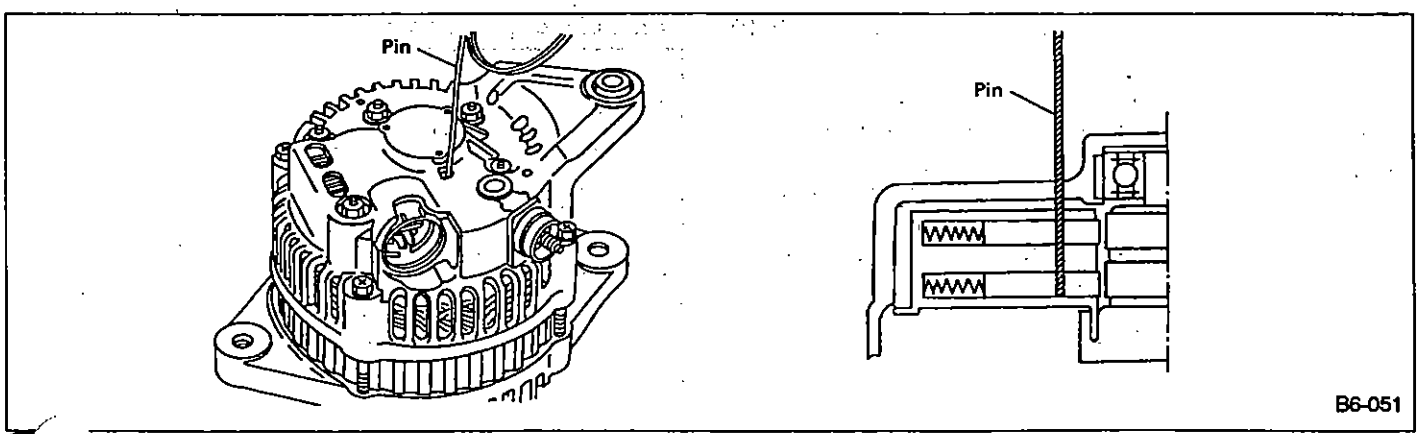


Fig. 58

c. When installing front and rear covers, insert pin from outside of rear cover. Insert brush into brush holder. After cover installation, remove the pin.



E: INSTALLATION

1) Install alternator to bracket on engine with bolts and tighten bolts lightly.
2) After installing drive belt, pull belt by moving alternator with adjusting bolt and tighten installing bolts.
3) Check belt tension.
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.

3. Spark Plug

A: DESCRIPTION

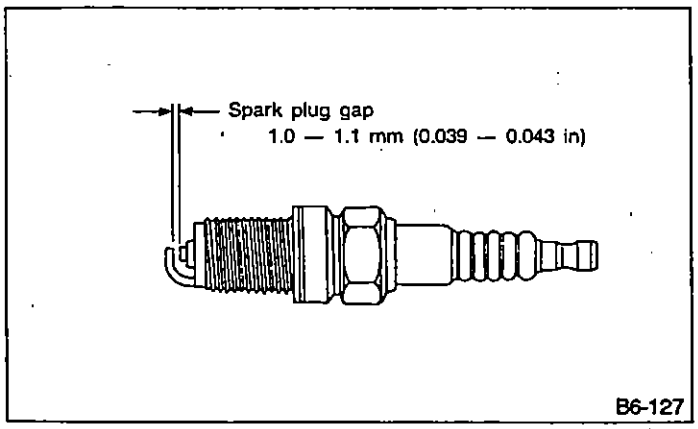


Fig. 60

The spark plugs are project type, having 14 mm (0.55 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.

Spark plug
NGK:
BKR6E-11
NIPPONDENSO:
K20PR-U11
CchampION:
RC7YC-4

B: 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.

C: INSPECTION

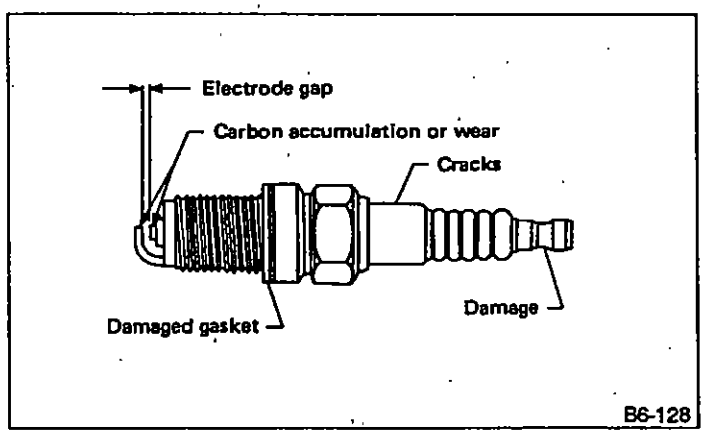


Fig. 61

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.

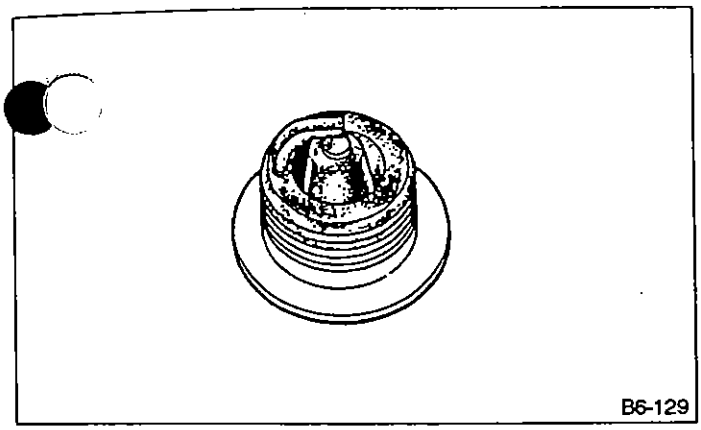


Fig. 62

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.

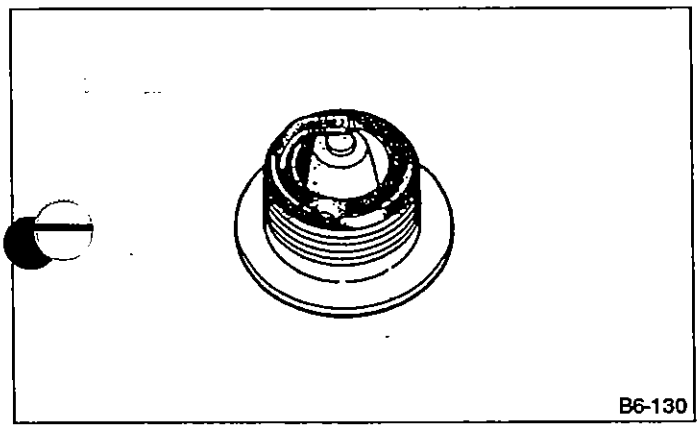


Fig. 63

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.

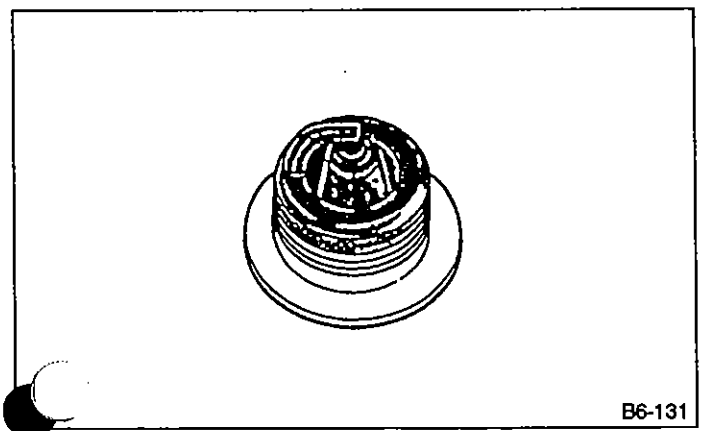


Fig. 64

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.

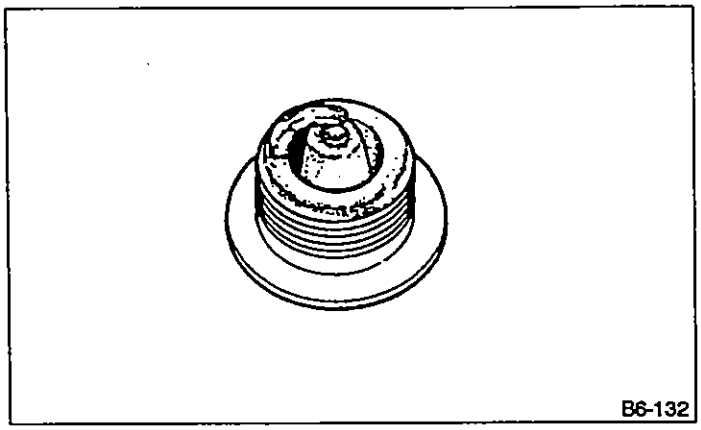


Fig. 65

D: 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.

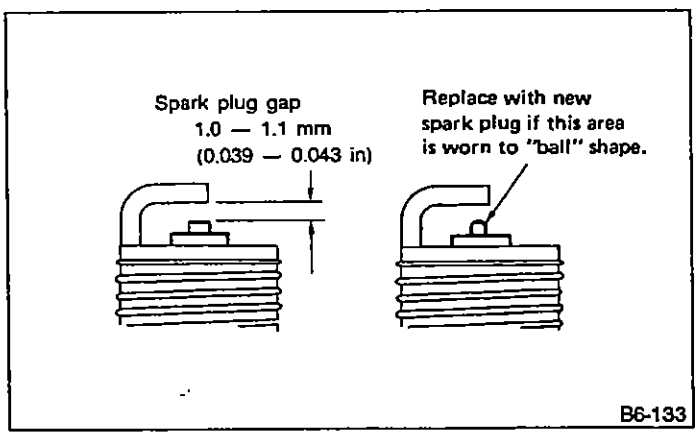


Fig. 66

4. Ignition Coil

A: REMOVAL AND INSTALLATION

1) Disconnect battery negative (−) terminals.
2) Remove intake manifold cover.
3) Disconnect wires from ignition coil.
4) Remove ignition coil.
5) To install, reverse the order of removal.

Be sure to connect wires to their proper positions. Failure to do so will damage unit.

B: 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.

Specified resistance:
[Primary side]
Between ① and ②
Between ③ and ④
(MT) 0.62 — 0.76 Ω
(AT) 0.63 — 0.77 Ω
[Secondary side]
Between terminal No. 1 and No. 2
Between terminal No. 3 and No. 2
(MT) 17.9 — 24.5 kΩ
(AT) 10.4 — 15.6 kΩ

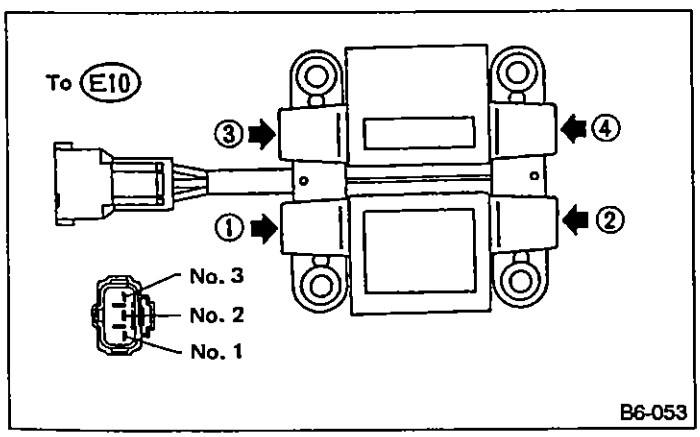


Fig. 67

3) Insulation between primary terminal and case: 10 MΩ or more.

5. Spark Plug Cord

A: INSPECTION

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

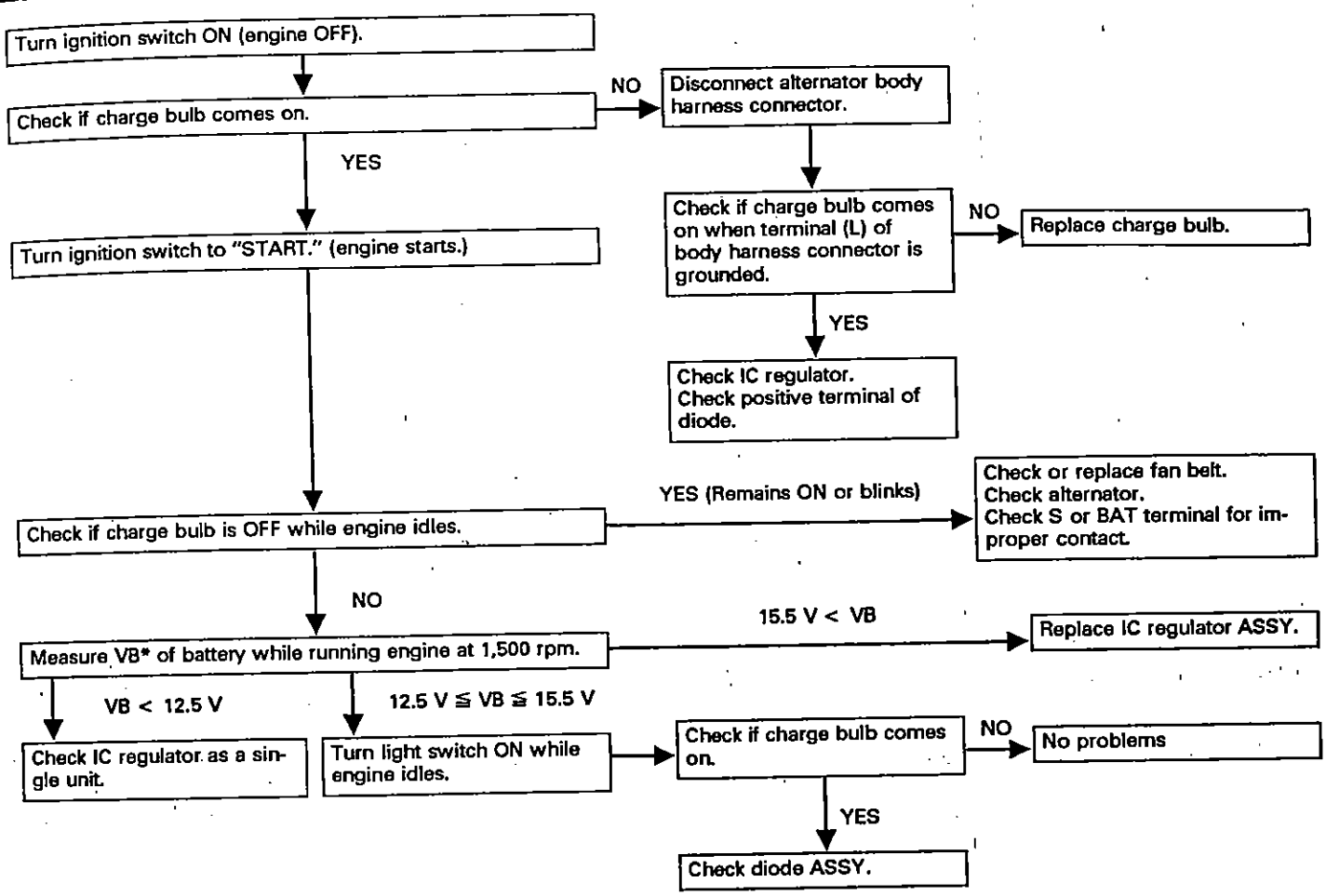
	Resistance value: kΩ	Length: mm (in)
#1 cord	4.95 — 11.56	540 (21.26)
#2 cord	4.86 — 11.33	550 (21.65)
#3 cord	4.95 — 11.56	540 (21.26)
#4 cord	5.24 — 12.23	600 (23.62)

T TROUBLESHOOTING

Starter

Trouble		Probable cause
Starter does not start.	Magnet switch does not operate (no clicks are heard).	Magnet switch poor contact or discontinuity of pull-in coil circuit Improper sliding of magnet switch plunger
	Magnet switch operates (clicks are issued).	Poor contact of magnet switch's main contact point
		Layer short of armature Contaminants on armature commutator High armature mica.
		Improper grounding of yoke field coil
		Insufficient carbon brush length
		Insufficient brush spring pressure
Starter starts but does not crank engine	Failure of pinion gear to engage ring gear	Worn pinion teeth
		Improper sliding of overrunning clutch
		Improper adjustment of stud bolt
	Clutch slippage	Faulty clutch roller spring
Starter starts but engine cranks too slowly.		Poor contact of magnet switch's main contact point
		Layer short of armature
		Discontinuity, burning or wear of armature commutator
		Poor grounding of yoke field coil
		Insufficient brush length
		Insufficient brush spring pressure
		Abnormal brush wear
Starter overruns		Magnet switch coil is a layer short.

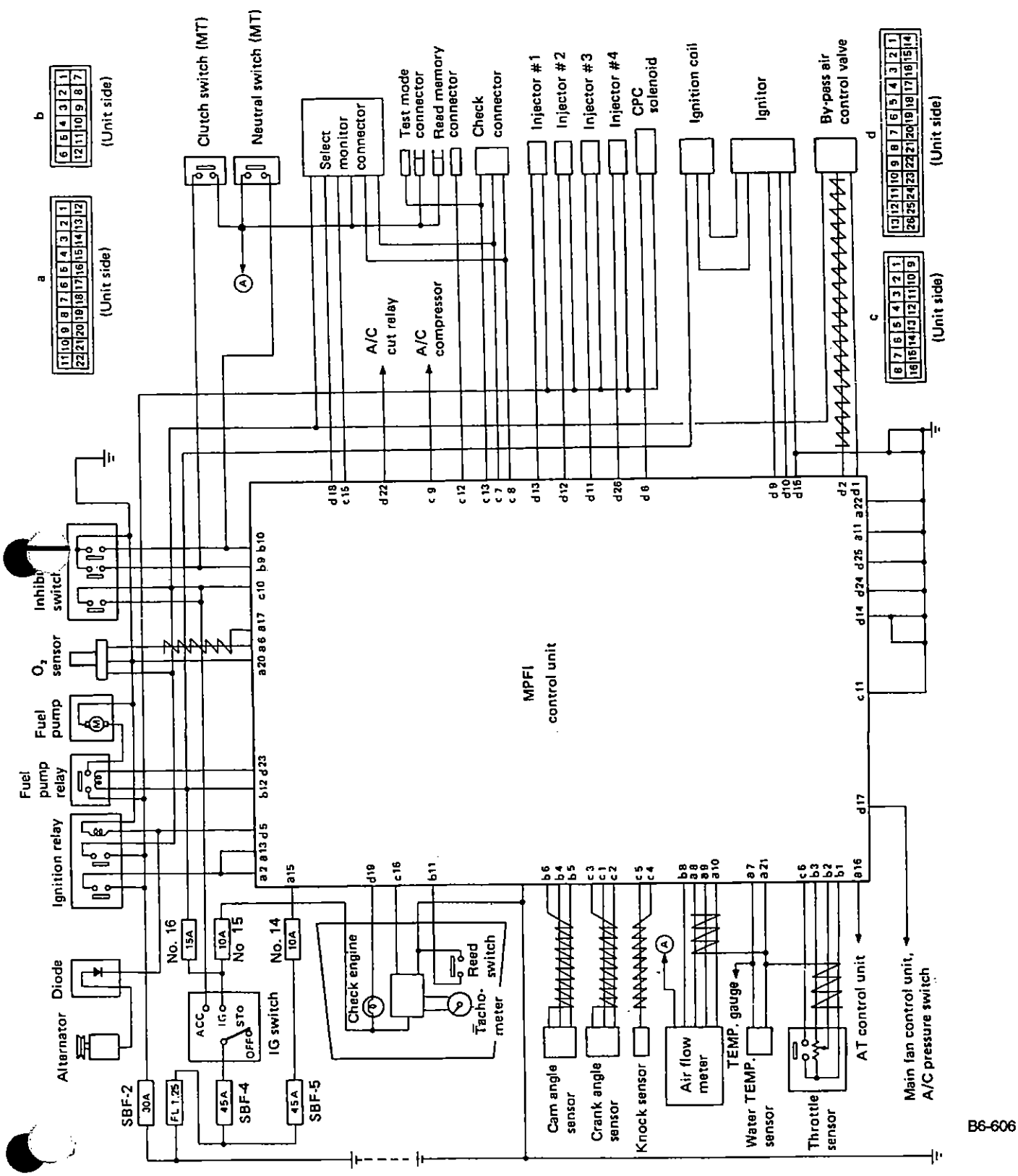
2. Alternator



*: Terminal voltage

4. Engine Electrical (MPFI)

SCHEMATIC



5. Radiator Fan

A: SCHEMATIC

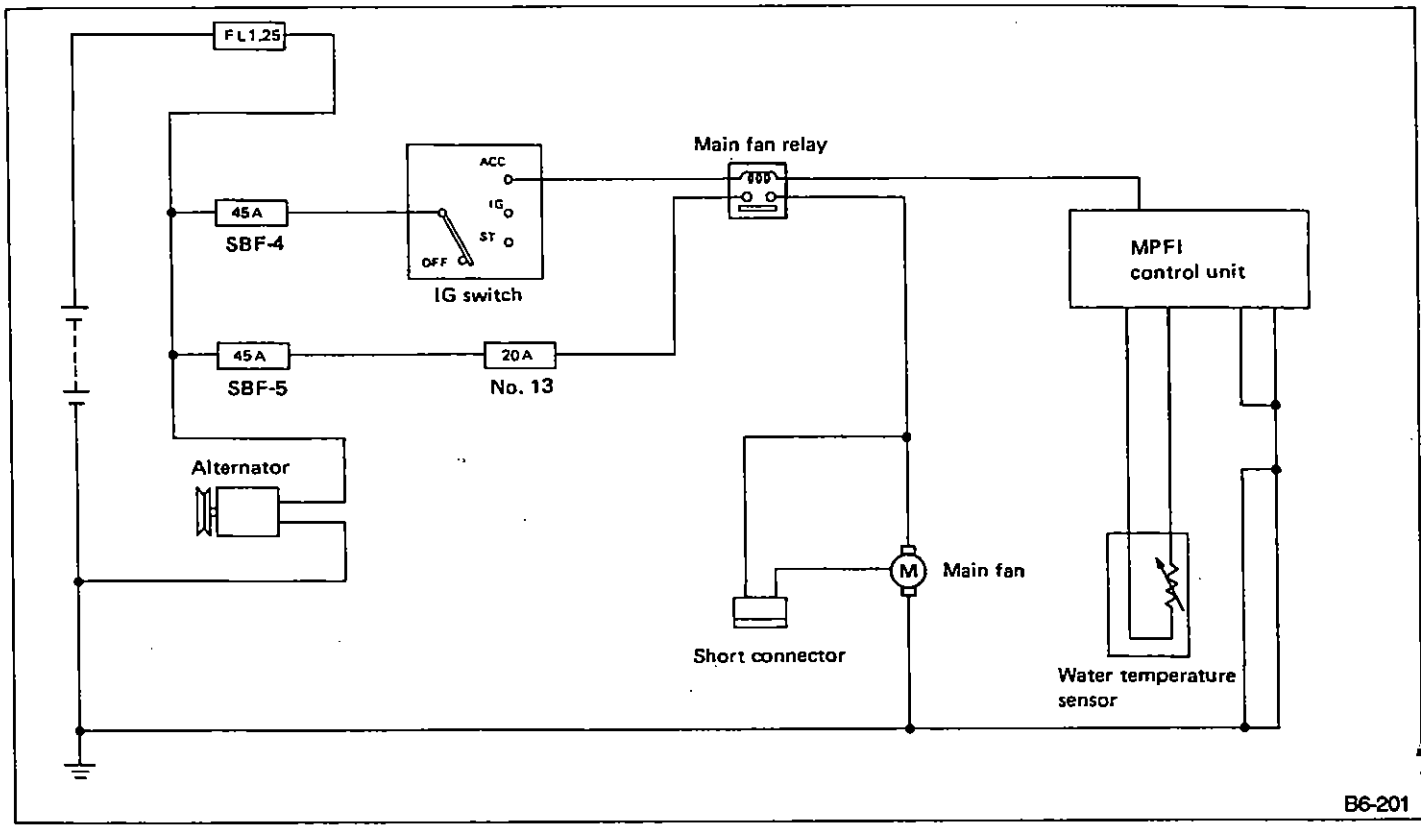


Fig. 16

6. Lighting AIRBAG

SCHEMATIC

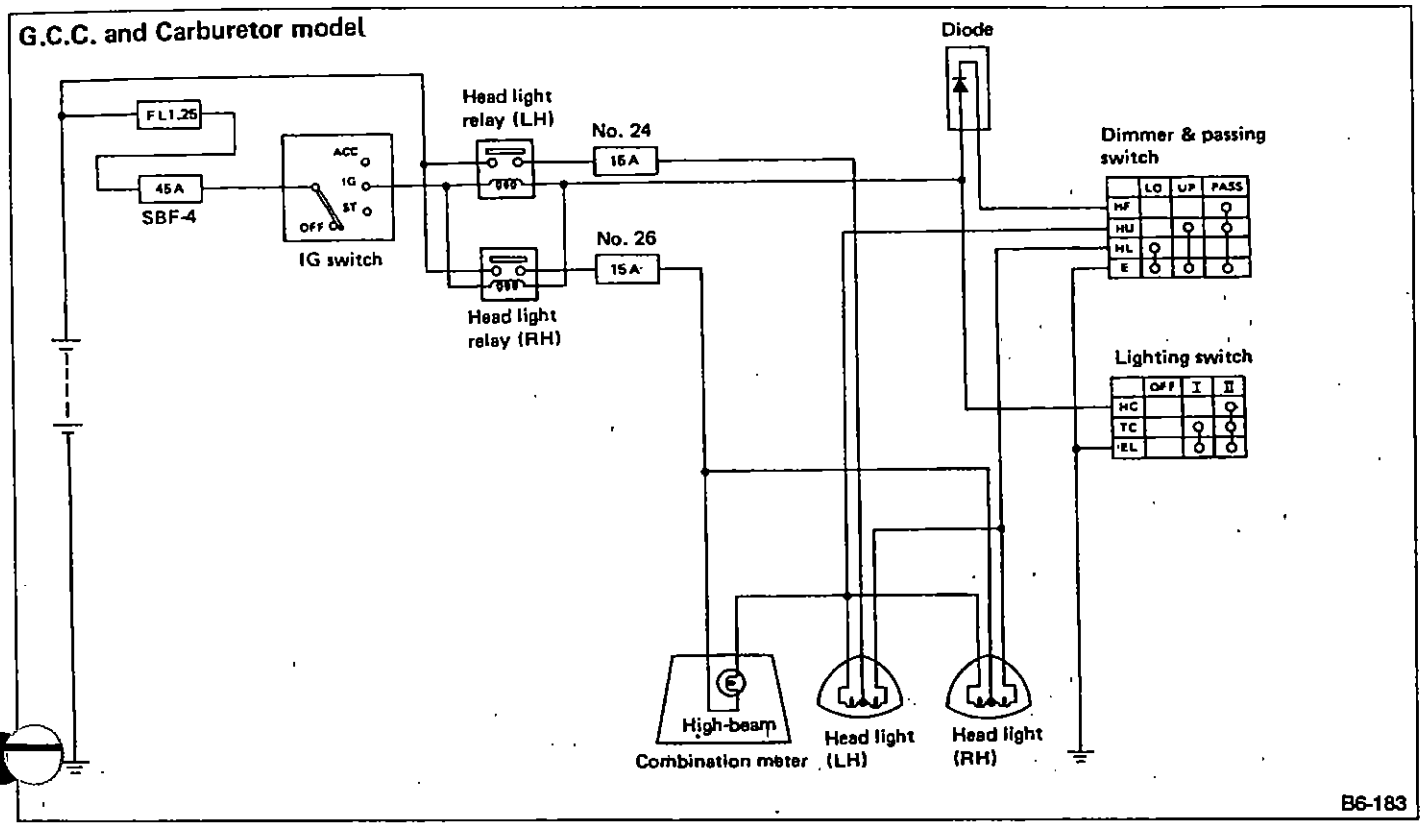


Fig. 17

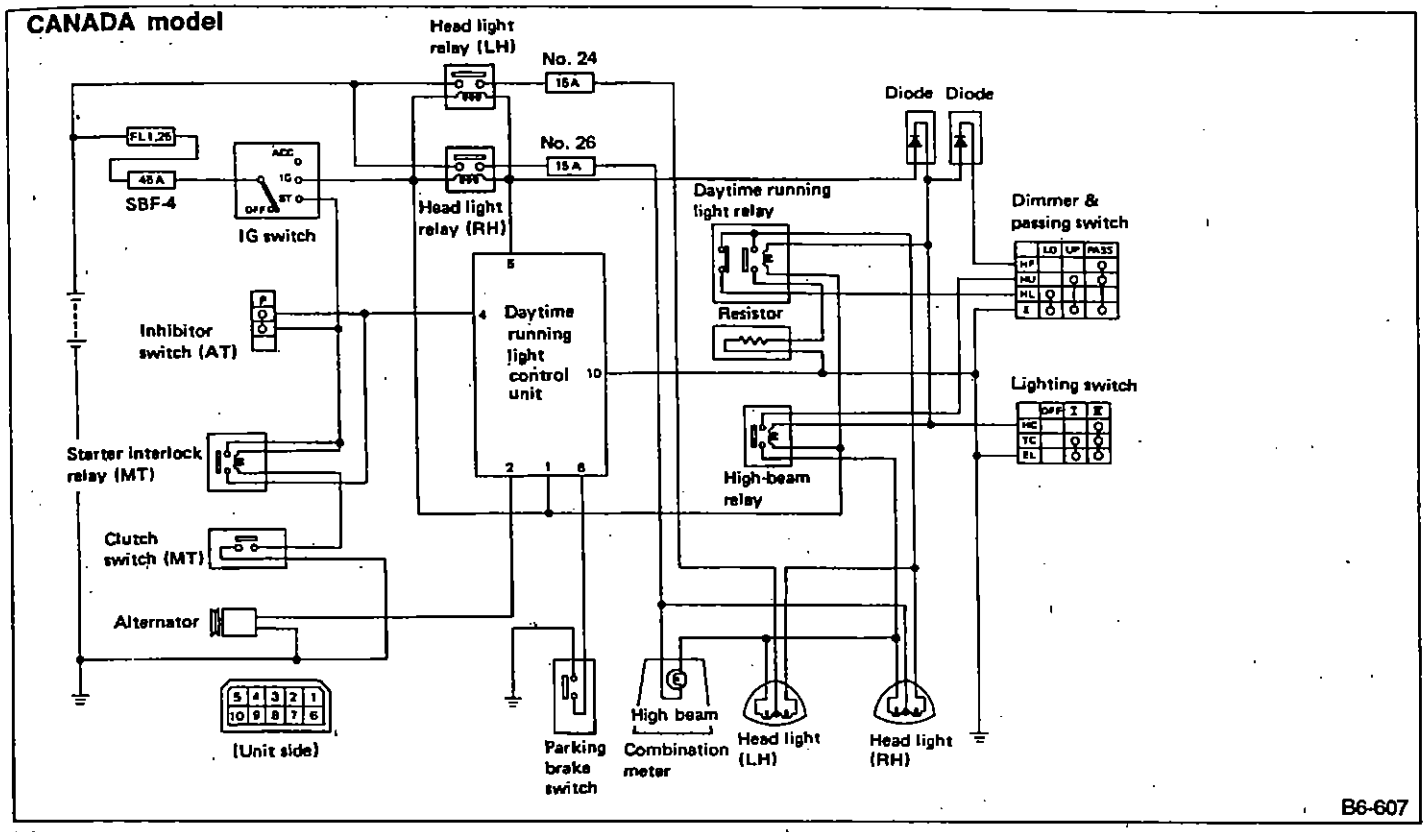

CANADA model
Head light relay (LH)
No. 24
15A
No. 26
15A
Head light relay (RH)
FL1.25
45A
SBF-4
IG switch
Inhibitor switch (AT)
Starter interlock relay (MT)
Clutch switch (MT)
Alternator
(Unit side)
Daytime running light control unit
Diode
Diode
Daytime running light relay
Resistor
Dimmer & passing switch
Lighting switch
High-beam relay
Parking brake switch
High beam
Combination meter
Head light (LH)
Head light (RH)
B6-607

Fig. 18

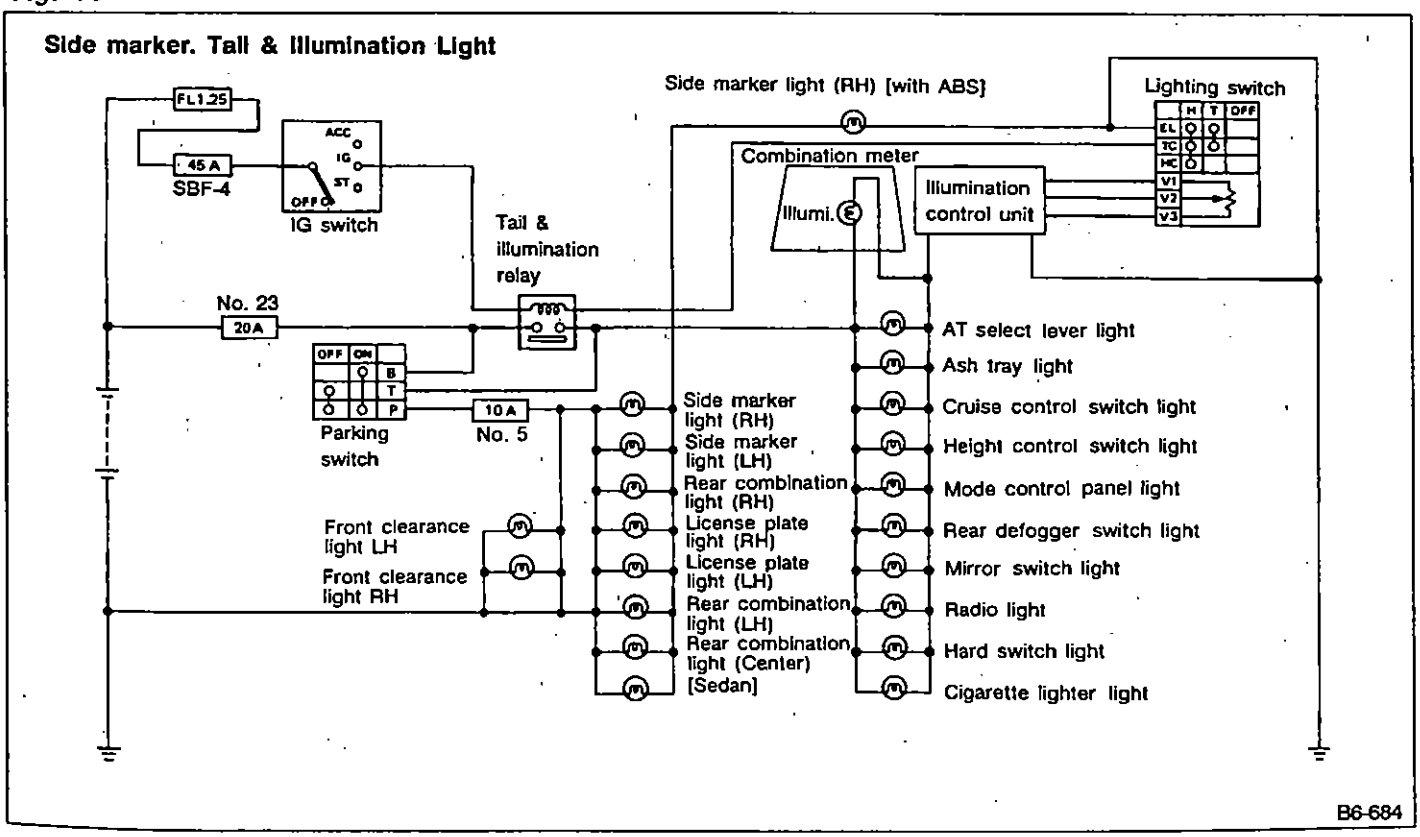
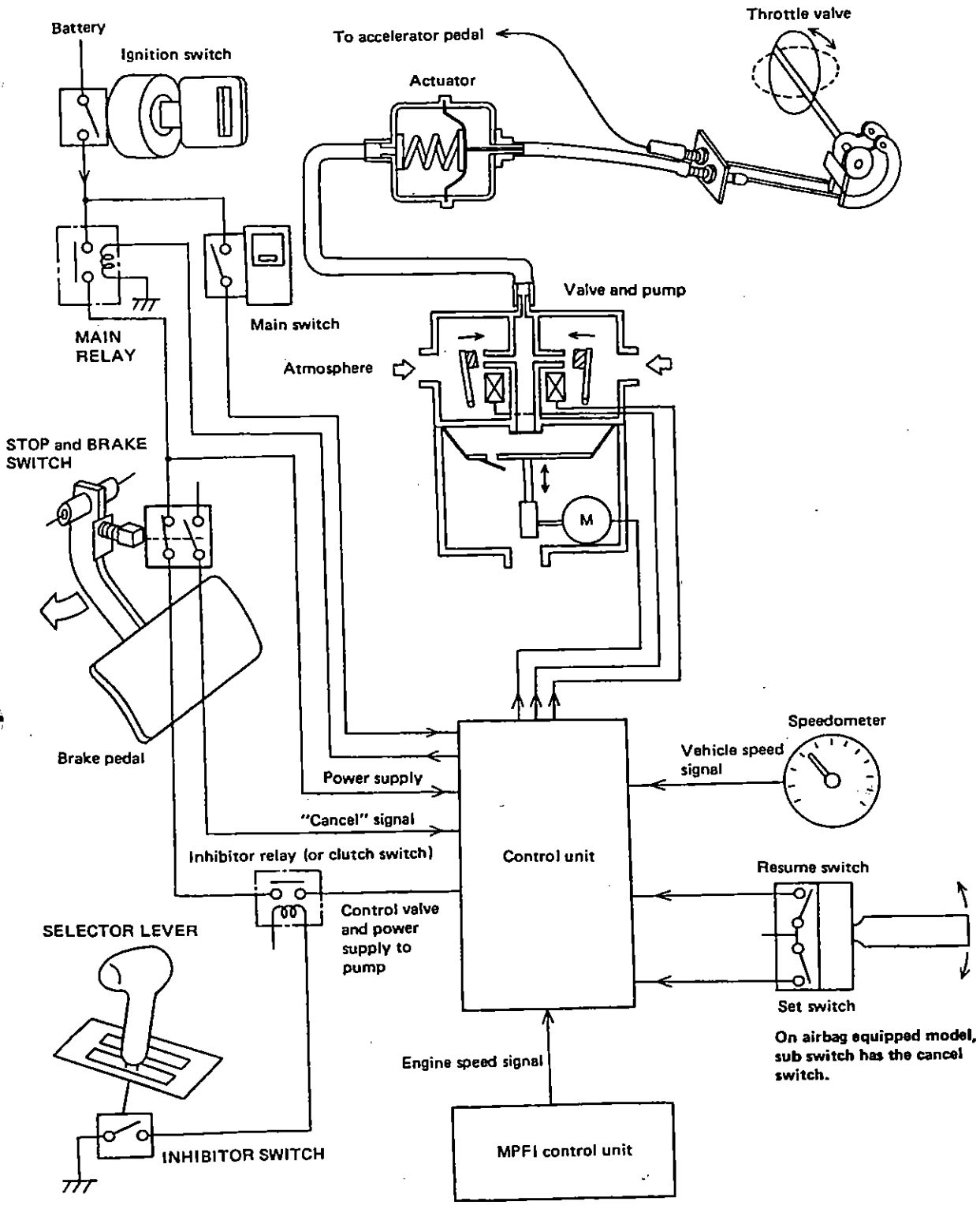

Side marker. Tail & Illumination Light
FL1.25
45A
SBF-4
IG switch
No. 23
20A
Parking switch
10A
No. 5
Tail & illumination relay
Side marker light (RH) [with ABS]
Lighting switch
Combination meter
Illumi.
Illumination control unit
Front clearance light LH
Front clearance light RH
Side marker light (RH)
Side marker light (LH)
Rear combination light (RH)
License plate light (RH)
License plate light (LH)
Rear combination light (LH)
Rear combination light (Center) [Sedan]
AT select lever light
Ash tray light
Cruise control switch light
Height control switch light
Mode control panel light
Rear defogger switch light
Mirror switch light
Radio light
Hard switch light
Cigarette lighter light
B6-684

Fig. 19



B6-162

Fig. 113

B: DESCRIPTION

1. CONTROL AND OPERATION

Constant speed control	When actual driving speed is higher than "set" speed, cruise control system intermittently opens vent valve and moves throttle valve toward the close position. This occurs while comparing actual driving speed with "set" speed. When actual driving speed is lower than "set" speed, the system intermittently activates vacuum pump to move throttle valve toward the "open" direction.
"Set" control	When SET/COAST switch is pressed with main switch ON while vehicle is being driven a specifieds greater than 40 km/h (25 MPH), current flows so that vent and safety valves close. This then causes vacuum pump to intermittently activate to set throttle valve at position corresponding with accelerator pedal depression. Thus, vehicle is being driven at constant speed.
Deceleration control	When SET/COASTS switch is turned ON while vehicle is cruising, vent valve intermittently opens, partially closing throttle valve. This causes the vehicle to decelerate. When the switch is turned OFF, vehicle speed is stored in memory and vehicle is constantly driven at that speed.
Acceleration control	When RESUME/ACCEL switch is turned ON while vehicle is cruising, vacuum pump intermittently activates to partially open throttle valve. This causes vehicle to accelerate. When the switch is turned OFF, vehicle speed is stored in memory and vehicle is constantly driven at that speed.
Resume control	When RESUME/ACCEL switch is turned ON after cruise control is released, vehicle speed returns to that speed which was stored in memory just before cruise control was released. However, this occurs only when vehicle is being driven at a speed greater than 30 km/h (19 MPH).
Manual cancel control	When any of the following signals are entered, vent valve and safety valve open to release cruising speed. (1) Stop light switch ON signal (Brake pedal depressed) (2) Brake switch OFF signal (Brake pedal depressed) (3) Clutch switch OFF signal (Clutch pedal depressed — MT) (4) Inhibitor switch ON signal (Selector lever set to "N" — AT) (5) CANCEL switch ON signal (Sub switch pulled — Airbag equipped model)
Low speed limit control	When vehicle speed drops below 30 km/h (19 MPH), cruise control is automatically cancelled. The memorized speed will also be cleared. Cruise control at speed lower than 40 km/h (25 MPH) cannot be effected.
Release valve control	When vehicle speed increases 10 km/h (6 MPH) greater than memorized speed while vehicle is cruising (downgrade, etc.) actuator's vent valve as well as safety valve are turned OFF (to open to atmospheric pressure) so that vehicle decelerates. When vehicle decelerates within 8 km/h (5 MPH) greater than the memorized speed, vent and safety valve are turned ON (to shut out atmospheric pressure) so that cruise control resumes.
Auto, cancel control	When any of the following signals are entered while vehicle is cruising, actuator's vent valve as well as safety valve are turned OFF (to shut out atmospheric pressure). This cancels cruise control. (a) When vehicle speed drops below low speed limit 30 km/h (19 MPH), (b) When actuator's vent valve, safety valve, vacuum pump motor or harness circuit is shorted, (c) When actuator's vent valve, safety valve, vacuum pump or harness circuit are discontinued, (d) When ON signals are simultaneously emitted from SET/COAST and RESUME/ACCEL switches, or (e) When a vehicle speed signal that implies speed variation of greater than ± 25 km/h (± 16 MPH) per second is entered.

Cruise control unit compares the actual car speed detected by feedback signals from speed sensor incorporated in speedometer with the speed set in the memory memorized when set switch was turned on. A signal is then transmitted according to the difference between the two speeds.

This signal is transmitted to solenoid valves of valve ASSY located in engine compartment. The movement of actuator operates throttle valve through accelerator pedal and cable, thereby keeping the car speed constant.

SUBARU®

1992

SERVICE MANUAL

Precaution for Supplemental Restraint System "Airbag"
The Supplemental Restraint System "Airbag" helps to reduce the risk or severity of injury to the driver in a frontal collision.
The Supplemental Restraint System consists of an airbag module (located in the center of the steering wheel), sensors, a control unit, warning light, wiring harness and spiral cable.
Information necessary to service the safety is included in the "5-5. SUPPLEMENTAL RESTRAINT SYSTEM" of this Service Manual.
WARNING:
- To avoid rendering the Airbag system inoperative, which could lead to personal injury or death in the event of a severe frontal collision, all maintenance must be performed by an authorized SUBARU dealer.
- Improper maintenance, including incorrect removal and installation of the Airbag system, can lead to personal injury caused by unintentional activation of the Airbag system.
- All Airbag system electrical wiring harnesses and connectors are covered with yellow outer insulation. Do not use electrical test equipment on any circuit related to the Supplemental Restraint System "Airbag".

		Page
1.	**General Description**	2
2.	**Working Precautions** AIRBAG	9
3.	**How to Use Wiring Diagram**	11
4.	**How to Use Super Multiple Junction (S.M.J.)**	12
5.	**Wiring Diagram and Troubleshooting**	14
	1. POWER SUPPLY ROUTING	14
	2. CHARGING	16
	3. STARTING	17
	4. ENGINE ELECTRICAL	18
	5. RADIATOR FAN	26
	6-1. LIGHTING (HEADLIGHT)	27
	6-2. LIGHTING (TAIL•ILLUMINATION•etc.)	30
	7. ROOM LIGHT AND DOOR SWITCH	32
	8. STOP LIGHT	38
	9. TURN SIGNAL AND HAZARD	39
	10. TRUNK ROOM LIGHT	40
	11. BACK-UP LIGHT	41
	12. A/T CONTROL	42
	13. A/T SHIFT LOCK	46
	14. AIR CONDITIONER	48
	15. WINDSHIELD WIPER AND WASHER	50
	16. REAR WIPER AND WASHER	51
	17. REAR WINDOW DEFOGGER	52
	18. PARKING BRAKE AND BRAKE FLUID LEVEL WARNING	53
	19. FUEL GAUGE	54
	20. COMBINATION METER	55
	21. OIL PRESSURE AND TEMPERATURE GAUGE	59
	22. POWER WINDOW	60
	23. CRUISE CONTROL	64
	24. DOOR LOCK	68
	25. HORN AND CIGARETTE LIGHTER	71
	26. SUNROOF•SPOT LIGHT AND VANITY MIRROR	72
	27. RADIO AND POWER ANTENNA	73
	28. MODE SELECTOR	75
	29. REMOTE CONTROL REARVIEW MIRROR	76
	30. PNEUMATIC (AIR) SUSPENSION	78
	31. AUTOMATIC SHOULDER BELT (SEAT BELT) AND KEY WARNING CHIME	80
	32. ABS	86
	33. AIRBAG	90
6.	**Electrical Unit Location**	91
7.	**Electrical Wiring Harness and Ground Point**	107

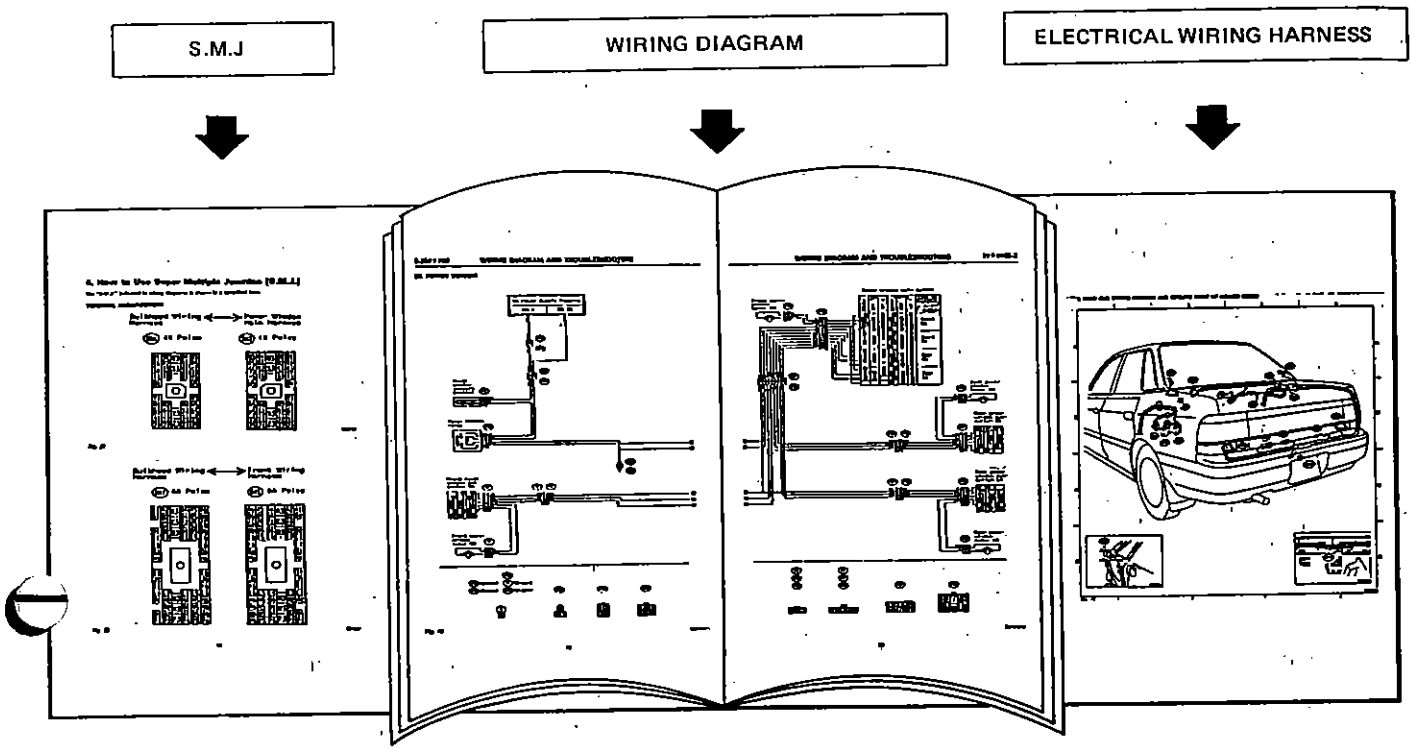
1. General Description

1. HOW TO USE THIS MANUAL

The description of the electrical system is divided into the charging system, starting system, etc.

1. First, open to the necessary electrical system section and wiring diagram.

2. Next, open the foldout page of the S.M.J. (super Multiple Junction) and that of the electrical wiring diagram. The S.M.J.'s terminal position is given, and by observing the electrical wiring harness' illustrations (front, instrument panel, etc.), the wiring diagram connector can be located.



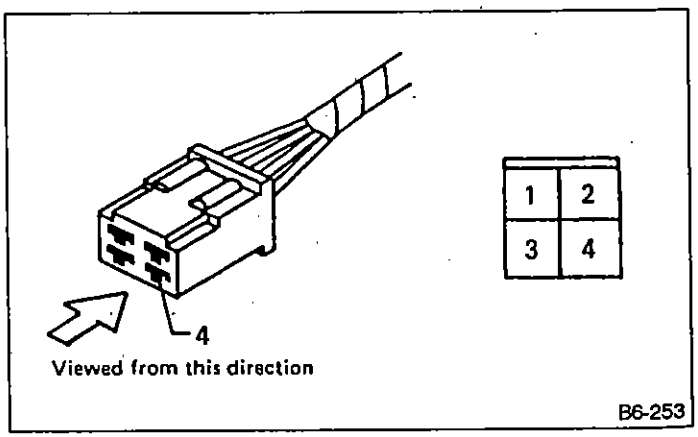
B6-240

Fig. 1

2. WIRING DIAGRAM

The wiring diagram of each system is illustrated so that you can understand the path through which the electric current flows from the battery. Sketches and codes are used in the diagrams. They should read as follows:

1) Each connector and its terminal position are indicated by a sketch of the connector in a disconnected state which is viewed from the front, as shown in figure.



B6-253

Fig. 2

2) The number of poles or pins, presence of a lock, and pin number of each terminal are indicated in the sketch of each connector.

In the sketch, the highest pole number refers to the number of poles which the connector has. For example, the sketch of the connector shown in Figure 3 indicates the connector has 9 poles.

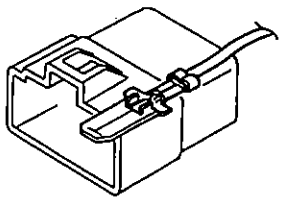
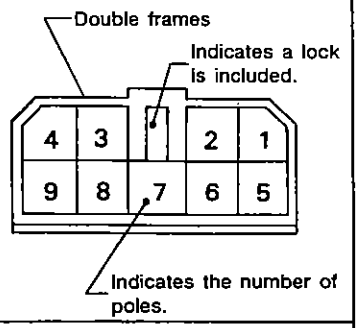
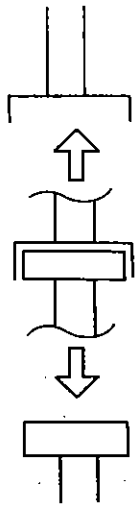
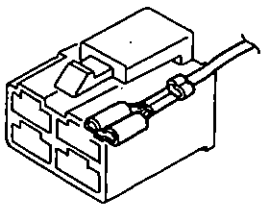
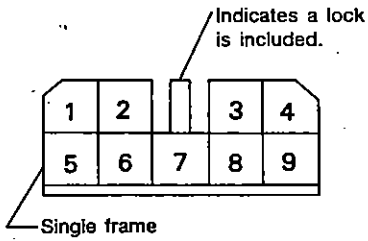
Connector used in vehicle	Connector shown in wiring diagram		
	Sketch	Symbol	Number of poles
			Numbered in order from upper right to lower left.
			Numbered in order from upper left to lower right.

Fig. 3

When one set of connectors is viewed from the front side, the pole numbers of one connector are symmetrical to those of the other. When these two connectors are connected as a unit, the poles which have the same number are joined.

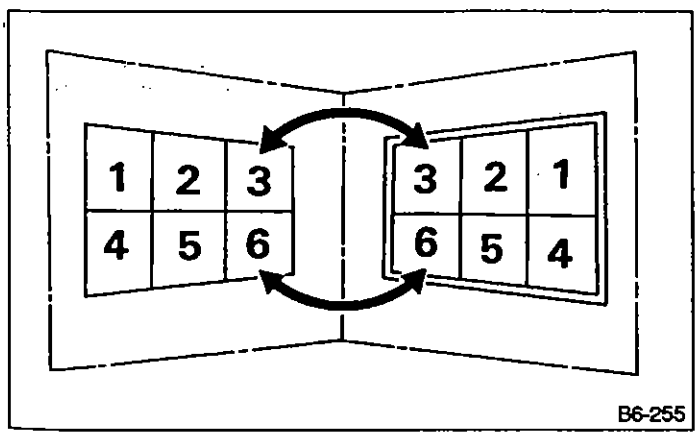


Fig. 4

3) Electrical wiring harness

The connectors are numbered along with the number of poles, external colors, and mating connections in the accompanying list.

4) The sketch of each connector in the wiring diagram usually shows the "A" side of the connector. The relationship between the wire color, terminal number and connector is described below.

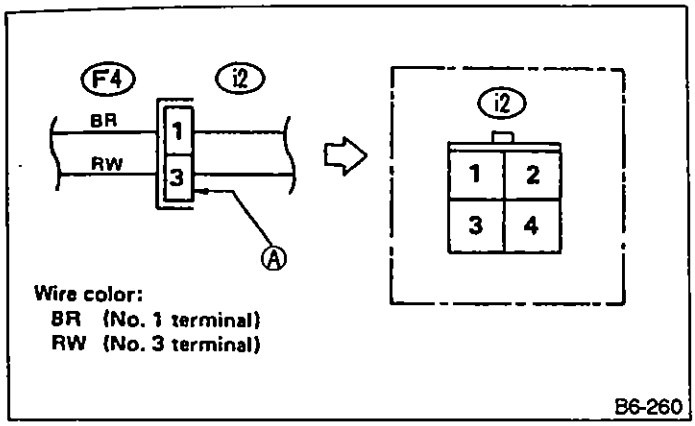


Fig. 5

c. A wire which runs in one direction from a connector terminal sometimes may have a different color from that which runs in the other direction from that terminal.

5) In wiring diagram, connectors which have no terminal number refer to one-pole types. Sketches of these connectors are omitted intentionally.

6) The following color codes are used to indicate the colors of the wires used.

Color code	Color
L	Blue
B	Black
Y	Yellow
G	Green
R	Red
W	White
Br	Brown
Lg	Light green
Gr	Gray
P	Pink
Or	Orange
Lb	Light Blue
SA	Sealed (Inner)
SB	Sealed (Outer)

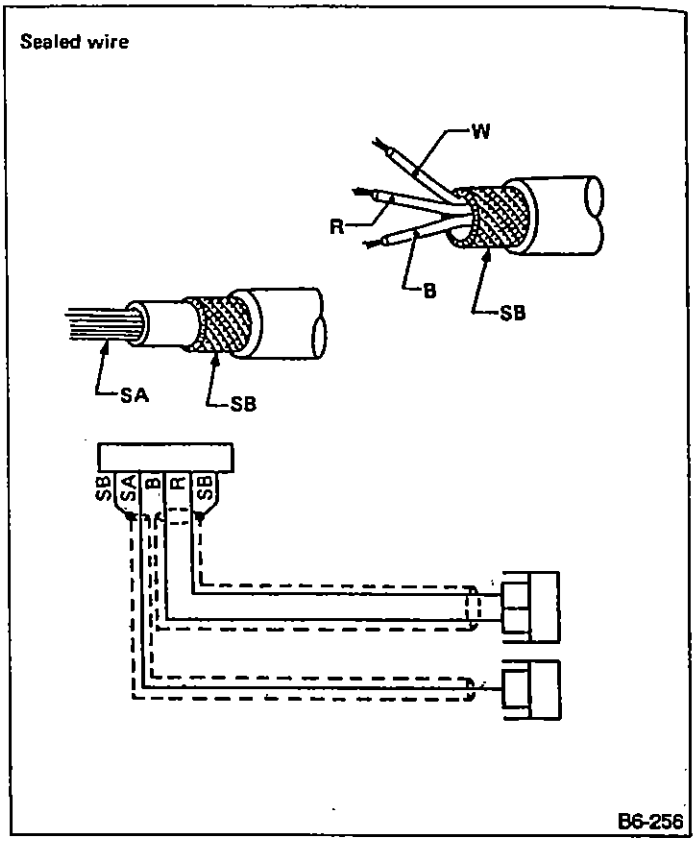


Fig. 6

7) The wire color code, which consists of two letters (or three letters including Br or Lg), indicates the standard color (base color of the wire covering) by its first letter and the stripe marking by its second letter.

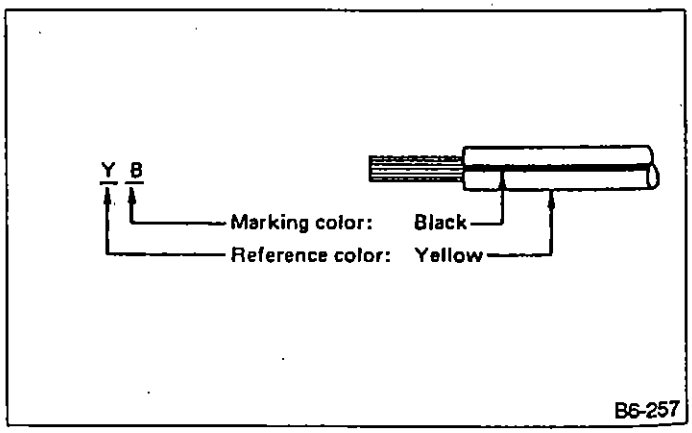


Fig. 7

8) The table below lists the nominal sectional areas and allowable currents of the wires.

Nominal sectional area mm^2	No. of strands/ strand diameter	Outside diameter of finished wiring mm	Allowable current Amps/ 40°C
0.3	7/0.26	1.8	7
0.5	7/0.32	2.2 (or 2.0)	12
0.75	30/0.18	2.6 (or 2.4)	16
0.85	11/0.32	2.4 (or 2.2)	16
1.25	16/0.32	2.7 (or 2.5)	21
2	26/0.32	3.1 (or 2.9)	28
3	41/0.32	3.8 (or 3.6)	38
5	65/0.32	4.6 (or 4.4)	51
8	50/0.45	5.5	67

a. The allowable current in the above table indicates the tolerable amperage of each wire at an ambient temperature of 40°C (104°F).

b. The allowable current changes with ambient temperature. Also, it changes if a bundle of more than two wires is used.

c. When replacing or repairing a wire, be sure to use the same size and type of the wire which was originally used.

9) Each unit is directly grounded to the body or indirectly groundes through a harness ground terminal. Different symbols are used in the wiring diagram to identify the two grounding systems.

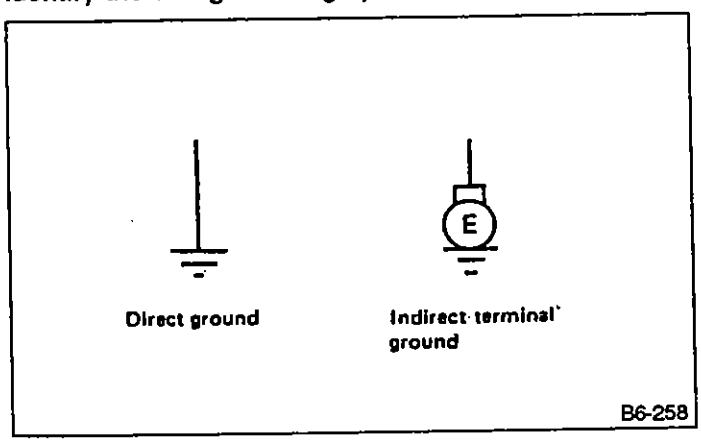


Fig. 8

The ground points shown in the wiring diagram refer to the following:

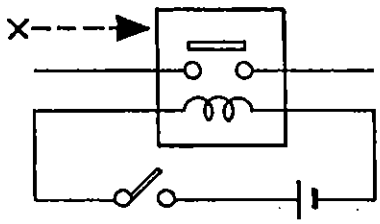
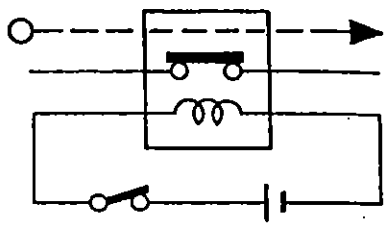
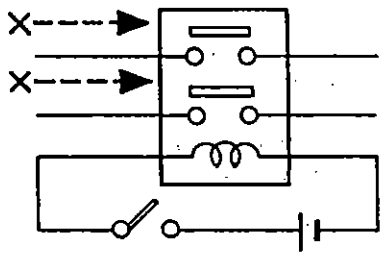
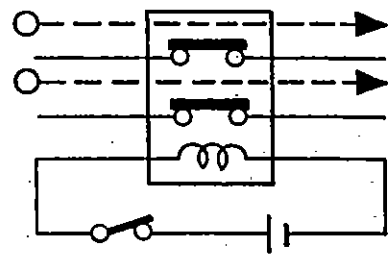
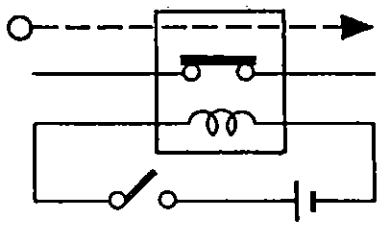
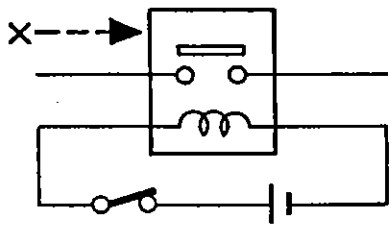
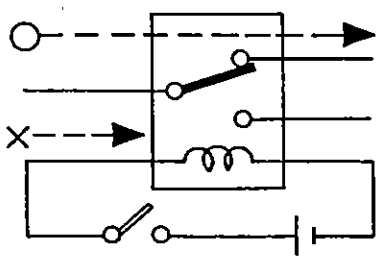
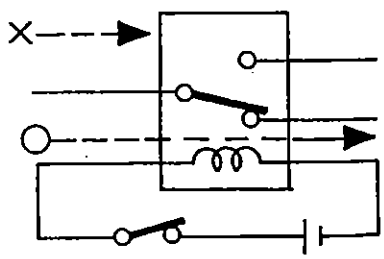
(GB) Body ground
(GE) Engine ground
(GR) Radio ground
(GD) Rear defogger ground

All wiring harnesses are provided with a ground point which should be securely connected.

10) Relays are ciassified as normally-open or normally-closed.

normally-closed relay has one or more contacts.

wiring diagram shows the relay mode when the energizing circuit is OFF.

Relay type		Energizing circuit OFF	Energizing circuit ON
Normally-open type	4-pole		
	6-pole		
Normally-closed type	4-pole		
Mixed type	5-pole		

B6-243

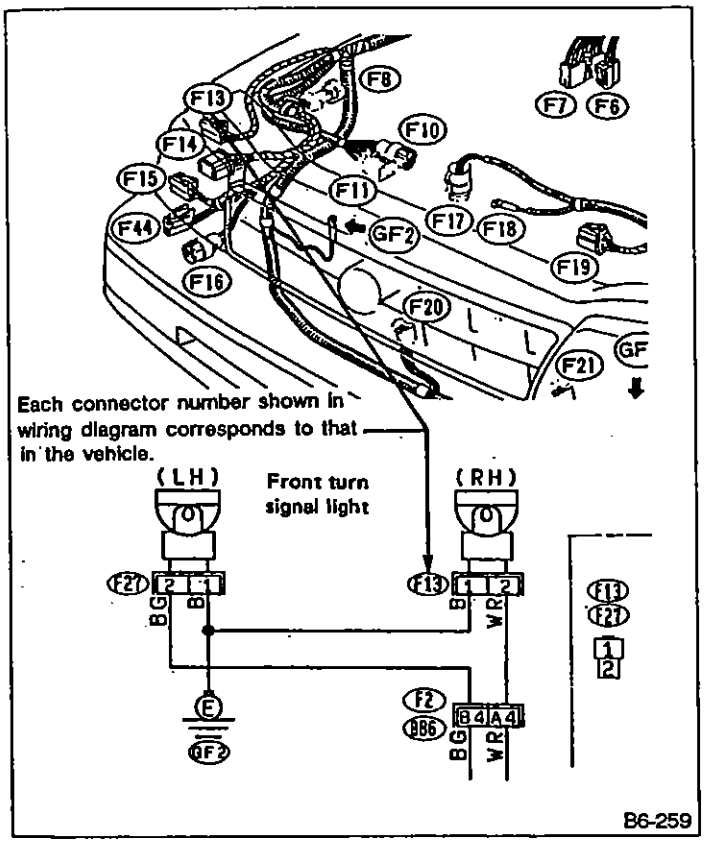
Fig. 9

Key to symbols:

○ →: Current flows.

X →: Current dose not flow.

11) Each connector number shown in the wiring diagram corresponds to that in the wiring harness. The location of each connector in the actual vehicle is determined by reading the first character of the connector (for example, a "F" for F8, "i" for i16, etc.) and the type of wiring harness.
The first character of each connector number refers to the area or system of the vehicle, as indicated in table below.



B6-259

Fig. 10

Symbol	Wiring harness & Cord
F	Front
E	Engine, transmission, etc.
B	Bulkhead
i	Instrument panel
R	Rear & Rear gate
P	Power window & door

3. TROUBLESHOOTING PROCEDURES

The most important purpose of troubleshooting is to determine which part is malfunctioning quickly, to save time and labor.

1. Identification of trouble symptom
Determine what the problem is based on the symptom.

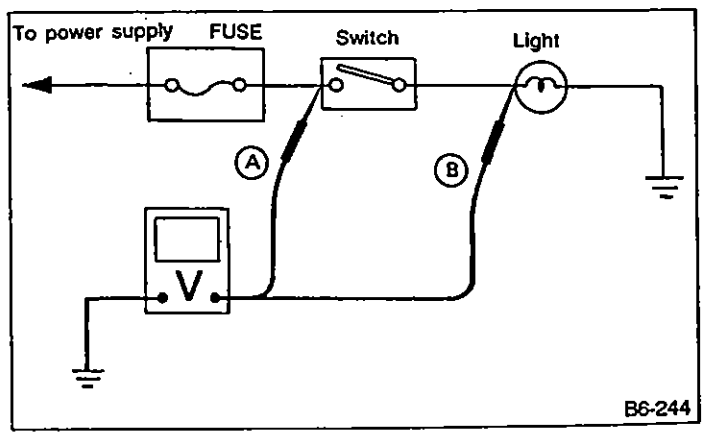
2. Probable cause of trouble
Look at the wiring diagram and check the system's circuit. Then check the switch, relay, fuse, ground, etc.

3. Location and repair of trouble
1) Using the troubleshooting narrow down the causes.
2) If necessary, use a voltmeter, ohmmeter, etc.
3) Before replacing certain component parts (switch, relay, etc.), check the power supply, ground, for open wiring harness, poor connectors, etc. If no problems are encountered, check the component parts.

4. Confirmation of system operation
After repairing, ensure that the system operates properly.

4. VOLTAGE MEASUREMENT

1) Using a voltmeter, connect the negative lead to a good ground point or negative battery terminal and the positive lead to the connector or component terminal.
2) Contact the positive probe of the voltmeter on connector (A).
The voltmeter will indicate a voltage.
3) Shift the positive probe to connector (B). The voltmeter will indicate no voltage.
With test setup held as it is, turn switch ON. The voltmeter will indicate a voltage and, at the same time, the light will come on.
4) The circuit is in good order. If a problem such as a lamp failing to light occurs, use the procedures outlined above to track down the malfunction.



B6-244

Fig. 11

5. CIRCUIT CONTINUITY CHECKS

1) Disconnect the battery terminal or connector so there is no voltage between the check points.
2) Contact the two leads of an ohmmeter to each of the check points.
If the circuit has diodes, reverse the two leads and check again.
2) Use an ohmmeter to check for diode continuity.
When contacting the negative lead to the diode positive side and the positive lead to the negative side, there should be continuity.
When contacting the two leads in reverse, there should be no continuity.

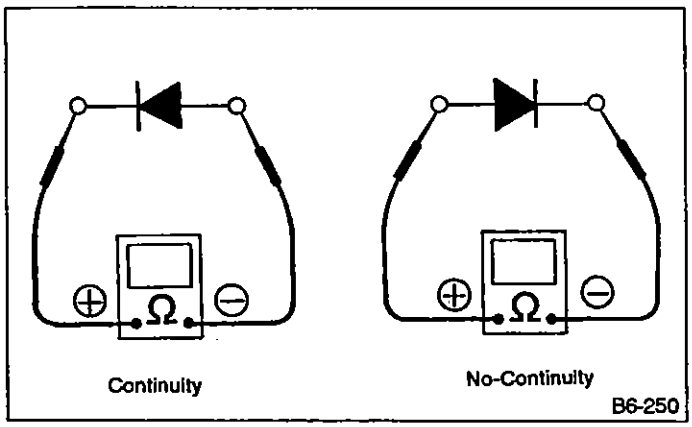


Fig. 12

Symbol "o—o" indicates that continuity exists between two points or terminals. For example, when a switch position is "3", continuity exists among terminals 1, 3 and 6, as shown in table below.

Terminal / Switch Position	1	2	3	4	5	6
OFF						
1	○				○	○
2	○			○		○
3	○		○			○
4	○	○				○

6. HOW TO DETERMINE AN OPEN CIRCUIT

1) Voltmeter Method
An open circuit is determined by measuring the voltage between respective connectors and ground using a voltmeter, starting with the connector closest to the power supply. The power supply must be turned ON so that current flows in the circuit. If voltage is not present between a particular connector and ground, the circuit between that connector and the previous connector is open.

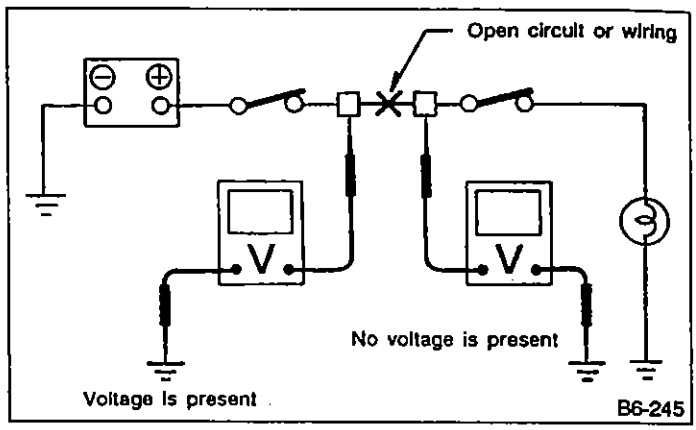


Fig. 13

2) Ohmmeter method
Disconnect all connectors affected, and check continuity in the wiring between adjacent connectors. When the ohmmeter indicates "infinite", the wiring is open.

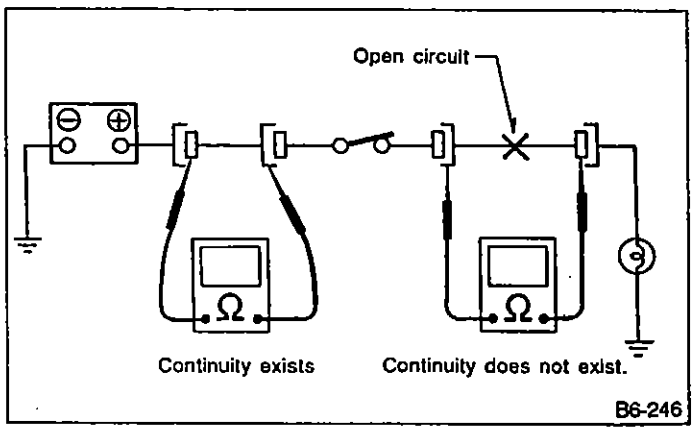


Fig. 14

7. HOW TO DETERMINE A SHORTCIRCUIT

1) Test lamp method

Connect a test lamp (rated at approximately 3 watts) in place of the blown fuse and allow current to flow through the circuit. Disconnect one connector at a time from the circuit, starting with the one located farthest from the power supply. If the test lamp goes out when a connector is disconnected, the wiring between that connection and the next connector (farther from the power supply) is shorted.

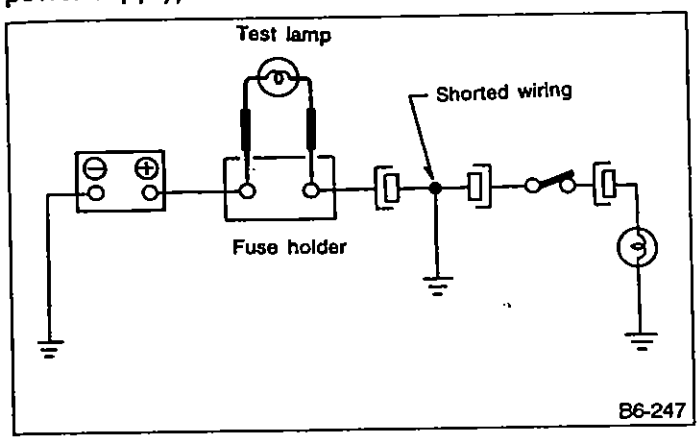


Fig. 15

2) Ohmmeter method

Disconnect all affected connectors, and check continuity between each connector and ground. When ohmmeter indicates continuity between a particular connector and ground, that connector is shorted.

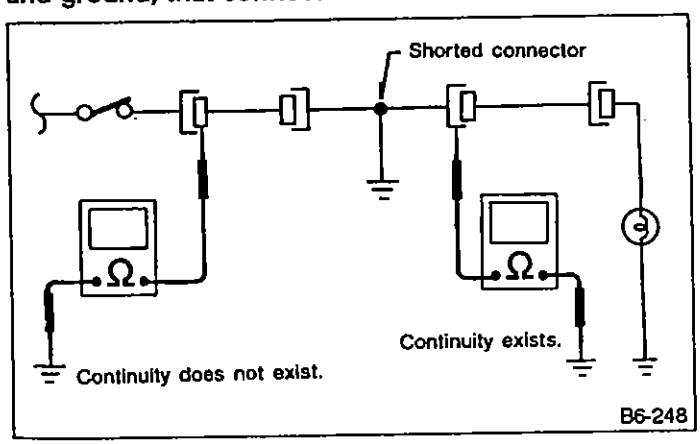


Fig. 16

2. Working Precautions AIRBAG

1. SUPPLEMENTAL RESTRAINT SYSTEM "AIRBAG"

Airbag system wiring harness is routed near other wiring harness.

1. All Airbag system wiring harness and connectors are colored yellow. Do not use electrical test equipment on these circuit.

2. Be careful not to damage Airbag system wiring harnesses.

2. PRECAUTIONS WHEN WORKING WITH THE PARTS MOUNTED ON THE VEHICLE

1) When working under a vehicle which is jacked up, always be sure to use safety stands.

2) The parking brake must always be applied during working. Also, in automatic transmission vehicles, keep the select lever set to the P (Parking) range.

3) Be sure the workshop is properly ventilated when running the engine. Further, be careful not to touch the belt or fan while the engine is operating.

4) Be careful not to touch hot metal parts, especially the radiator and exhaust system immediately after the engine has been shut off.

3. PRECAUTIONS IN TROUBLE DIAGNOSIS AND REPAIR OF ELECTRIC PARTS

1) The battery cable must be disconnected from the battery's (−) terminal, and the ignition switch must be set to the OFF position, unless otherwise required by the troubleshooting.

2) Securely fasten the wiring harness with clamps and slips so that the harness does not interfere with the body end parts or edges and bolts or screws.

3) When installing parts, be careful not to catch them on the wiring harness.

4) When disconnecting a connector, do not pull the wires, but pull while holding the connector body.

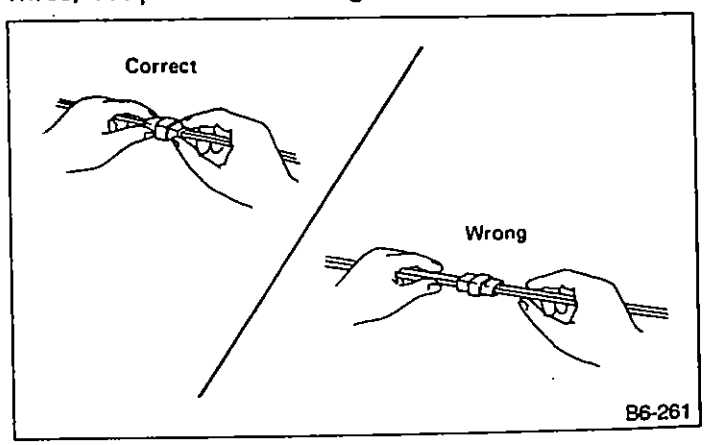


Fig. 17

5) Some connectors are provided with a lock. One type of such a connector is disconnected by pushing the lock, and the other, by moving the lock up. In either type the lock shape must be identified before attempting to disconnect the connector.
To connect, insert the connector until it snaps and confirm that it is tightly connected.

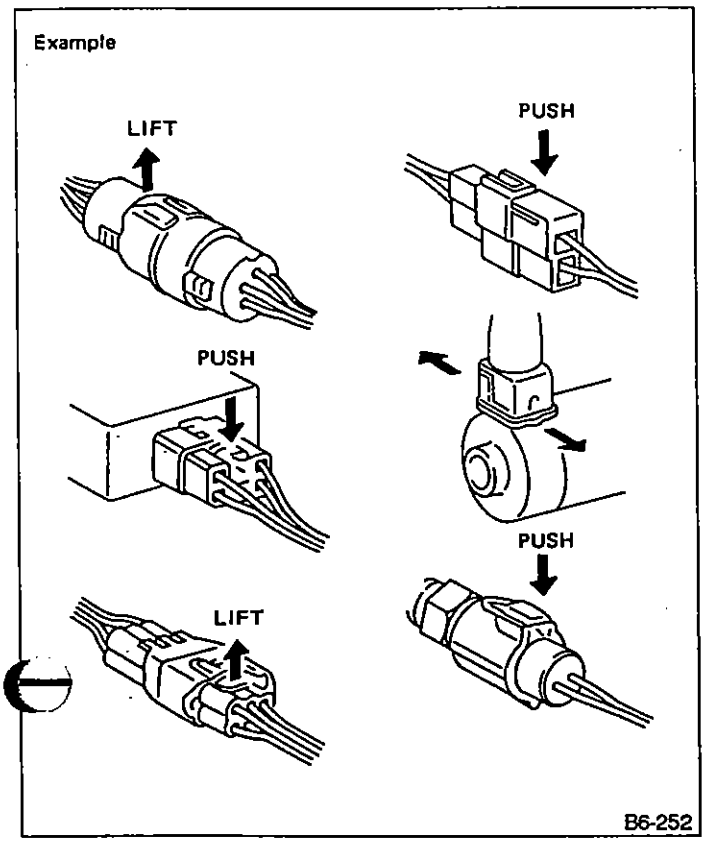


Fig. 18

6) When checking continuity between connector terminals, or measuring voltage across the terminal and ground, always contact tester probe(s) on terminals from the wiring connection side. If the probe is too thick to gain access to the terminal, use "mini" test leads.
To check water-proof connectors (which are not accessible from the wiring side), contact test probes on the terminal side being careful not to bend or damage the terminals.

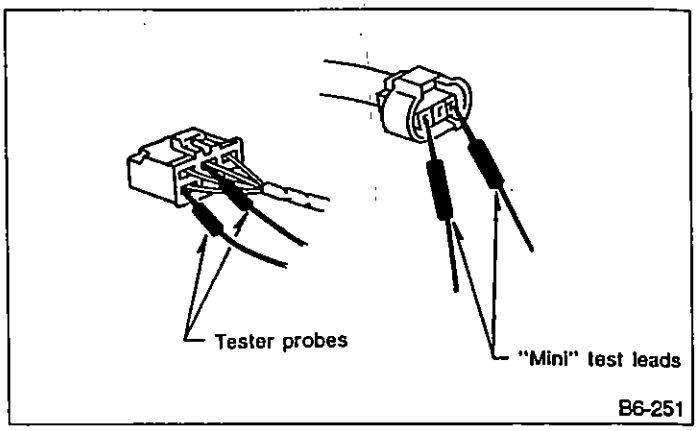


Fig. 19

7) Sensors, relays, electrical unit, etc., are sensitive to strong impacts.
Handle them with care so that they are not dropped or mishandled.

3. How to Use Wiring Diagram

RELAY

A symbol used to indicate a relay.

POWER SUPPLY ROUTING

A symbol is used to indicate the power supply in each wiring diagram.
"MB-5", "MB-6," etc., which are used as power-supply symbols throughout the text, correspond with those shown in the POWER SUPPLY ROUTING in the wiring diagram.
Accordingly, using the POWER SUPPLY ROUTING and wiring diagrams permits service personnel to understand the entire electrical arrangement of a system.

SYMBOLS OF WIRE CONNECTION AND CROSSING

Symbol — Refers to wires which are connected and branched at the "dot" point.

Symbol — Refers to wires which are crossed but not connected.

SYMBOLS AND ABBREVIATIONS

A number of symbols and abbreviations are used in each wiring diagram to easily identify parts or circuits.

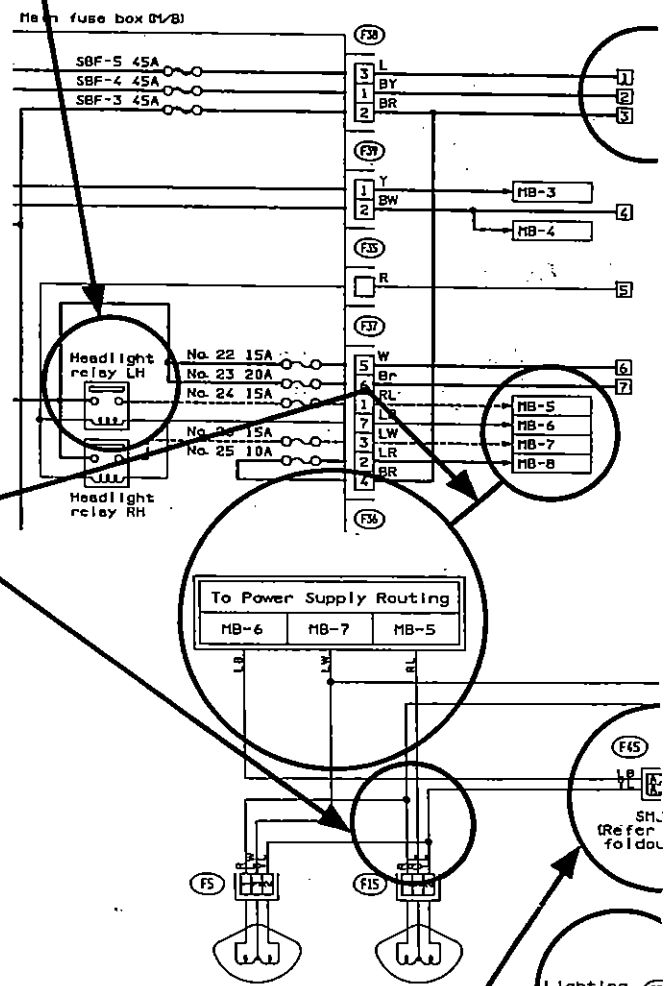


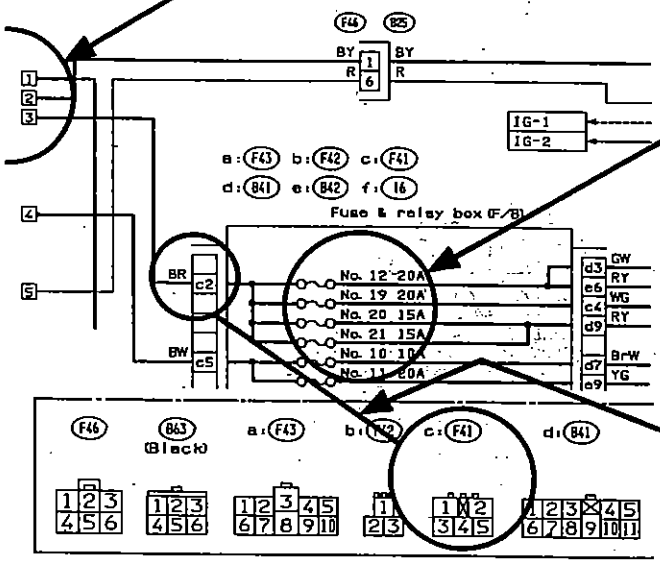
Fig. 20

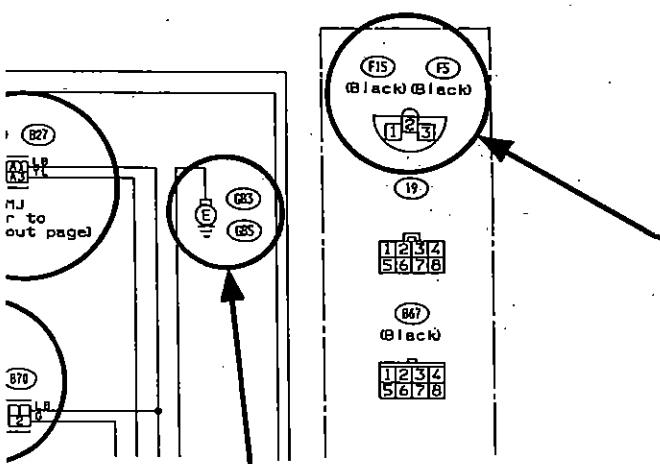
S.M.J.

A symbol is used to indicate the terminal arrangement of the super multiple junction. The S.M.J. is not shown in respective wiring diagrams but is indicated on the next page.

DIODE

A symbol is used to





WIRING CONNECTION

Some wiring diagrams are indicated in foldouts for convenience. Wiring destinations are indicated where necessary by corresponding symbols (as when two pages are needed for clear indication), as shown below.

FUSE NO. & RATING

The "FUSE NO. & RATING" corresponds with that used in the fuse box (main fuse box, fuse and joint box.)

CONNECTOR

1. Each connector is indicated by a symbol.
2. Each terminal number is indicated in the corresponding wiring diagram in an abbreviated form.
3. For example, terminal number "C2" refers to No. 2 terminal of connector (C:F41) shown in the connector sketch.

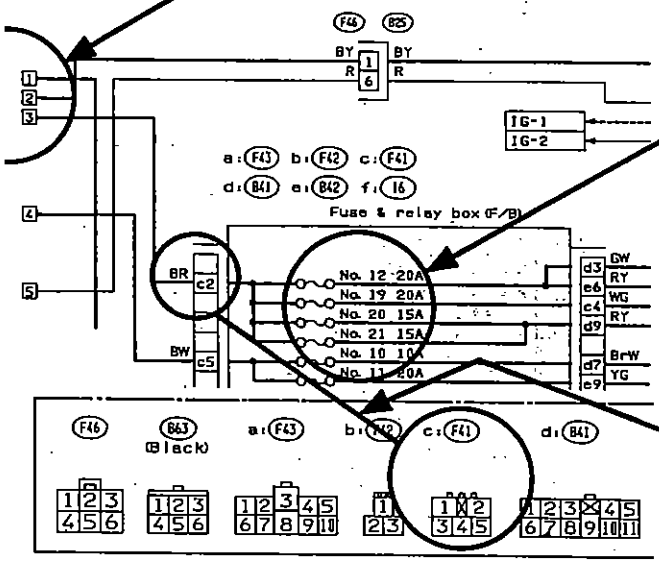
CONNECTOR SKETCH

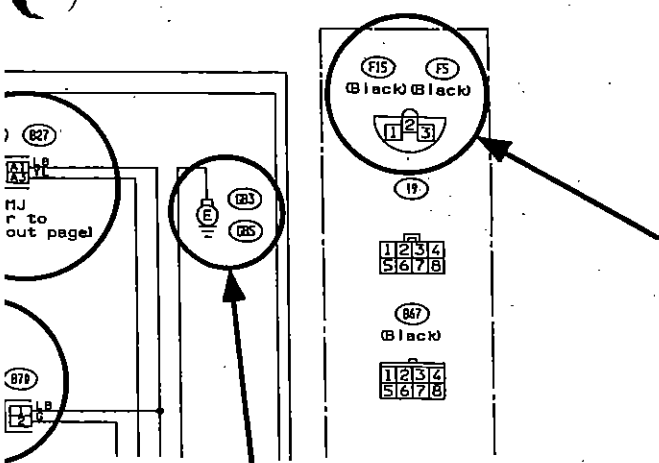
1. Each connector sketch clearly identifies the shape and color of a connector as well as terminal locations. Non-colored connectors are indicated in natural color.
2. When more than two types of connector number are indicated in a connector sketch, it means that the the same type connectors are used.

GROUND

Each grounding point can be located easily by referring to the corresponding wiring harness.

to indicate a diode.





B6-249

WIRING CONNECTION

Some wiring diagrams are indicated in foldouts for convenience. Wiring destinations are indicated where necessary by corresponding symbols (as when two pages are needed for clear indication), as shown below.

FUSE NO. & RATING

The "FUSE NO. & RATING" corresponds with that used in the fuse box (main fuse box, fuse and joint box.)

CONNECTOR

1. Each connector is indicated by a symbol.
2. Each terminal number is indicated in the corresponding wiring diagram in an abbreviated form.
3. For example, terminal number "C2" refers to No. 2 terminal of connector (C:F41) shown in the connector sketch.

CONNECTOR SKETCH

1. Each connector sketch clearly identifies the shape and color of a connector as well as terminal locations. Non-colored connectors are indicated in natural color.
2. When more than two types of connector number are indicated in a connector sketch, it means that the the same type connectors are used.

GROUND

Each grounding point can be located easily by referring to the corresponding wiring harness.

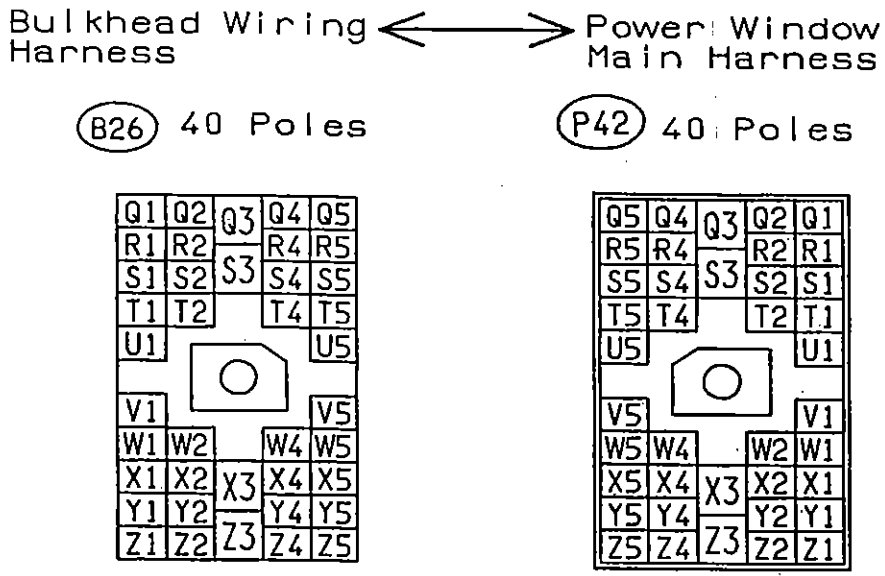
...icate a diode.

[0400]

4. How to Use Super Multiple Junction (S.M.J.)

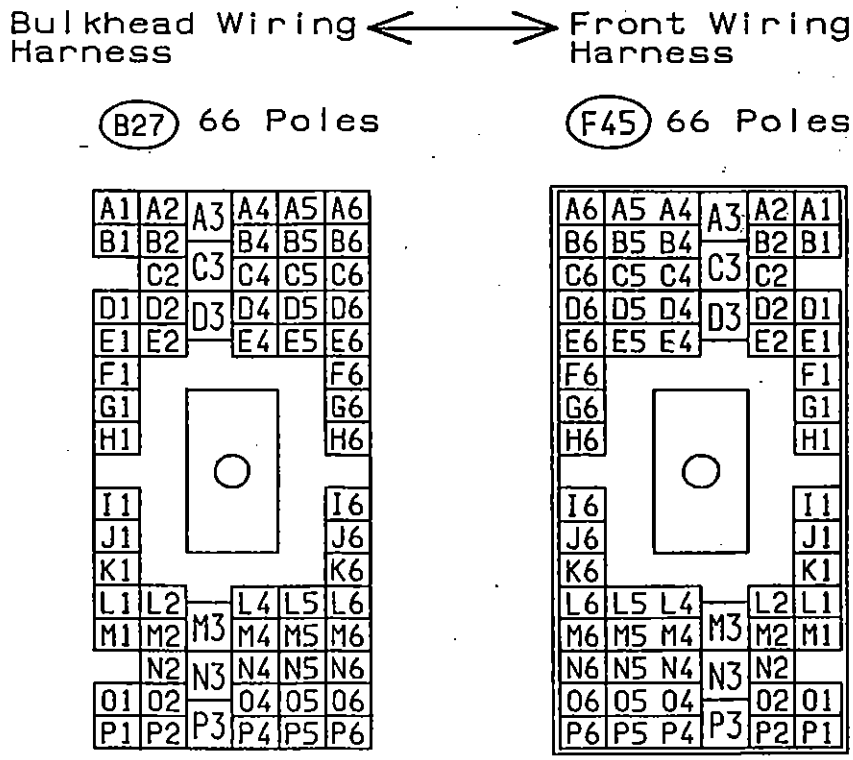
The "S.M.J." indicated in wiring diagrams is shown in a simplified from.

TERMINAL ARRANGEMENT



B6-238

Fig. 21



B6-239

Fig. 22

INSTALLATION

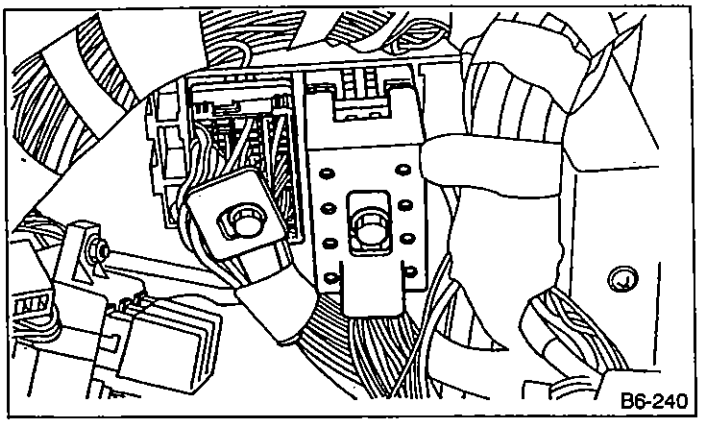


Fig. 23

Tightening torque:
4.4 — 7.4 N·m (45 — 75 kg-cm, 39 — 65 in-lb)

- **Align the cutout portion of one connector with that of other before tightening the connecting bolt.**
- **Do not tighten the bolt excessively since this may deform the connectors.**

EXPLANATION OF S.M.J. SHOWN IN THE WIRING DIAGRAM

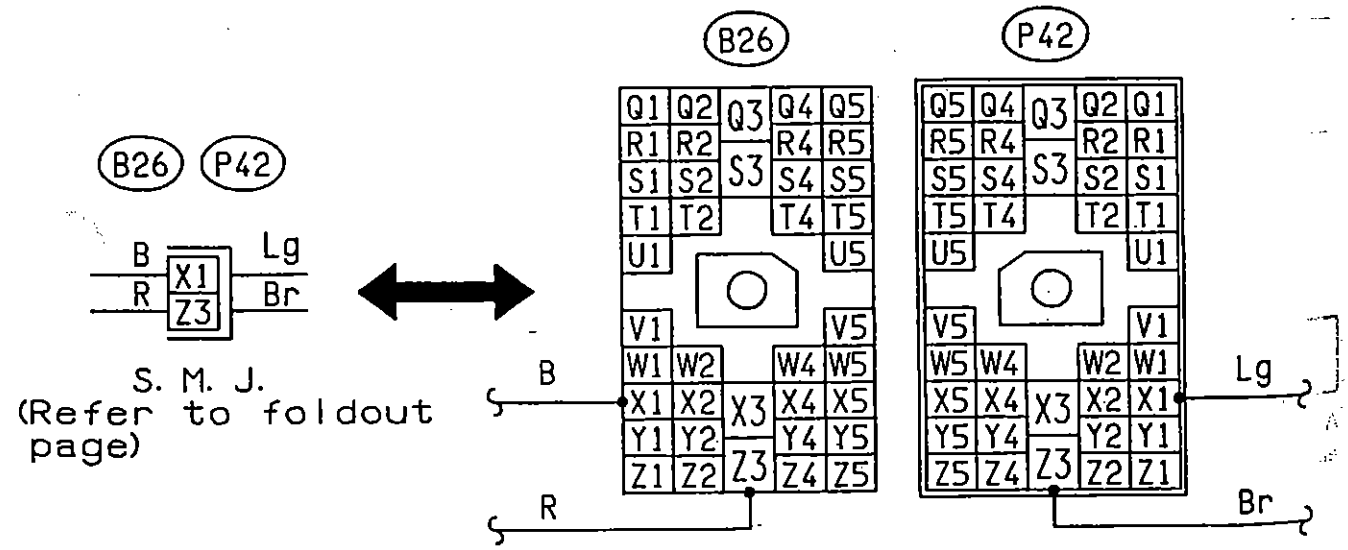
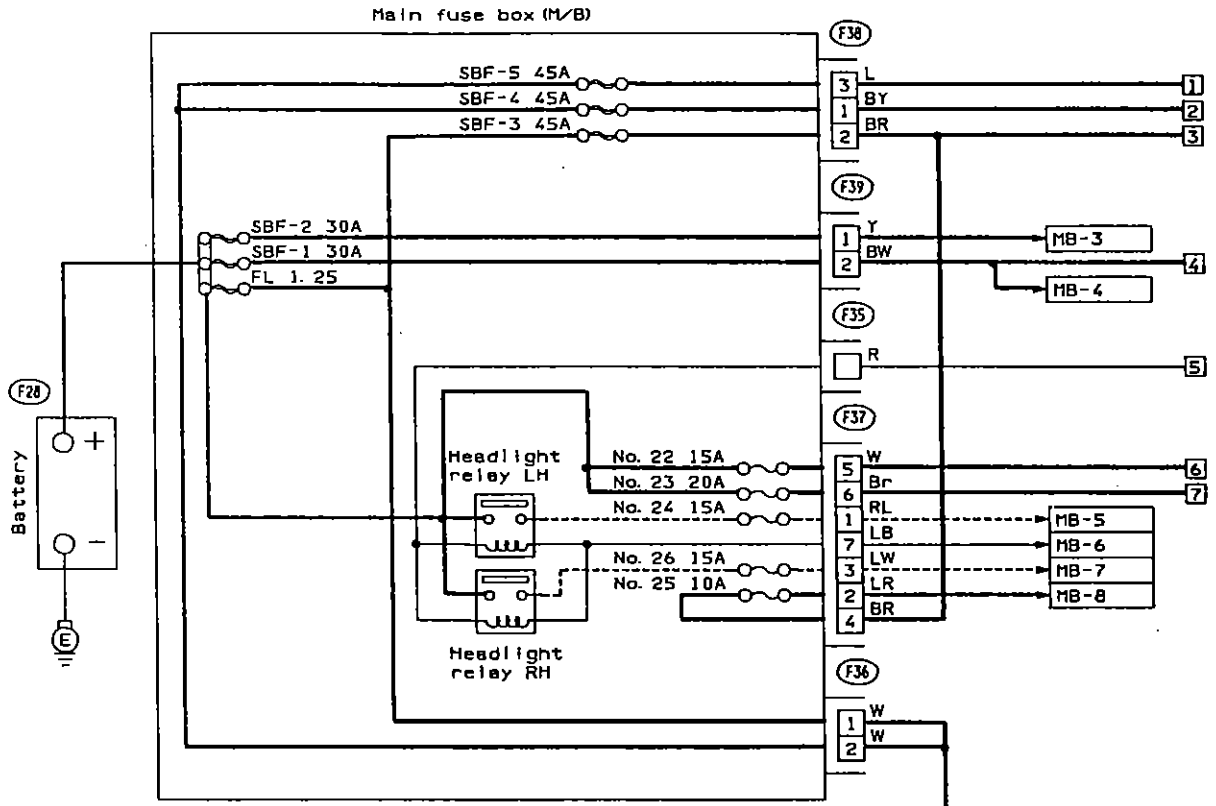


Fig. 24

5. Wiring Diagram and Troubleshooting

1. POWER SUPPLY ROUTING



FUSE LOCATION

(M/B)

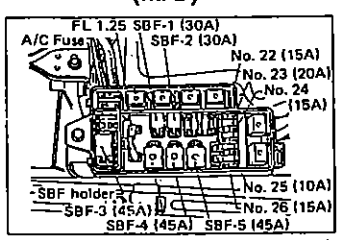


Fig. 25-1 B6-349

(F/B)

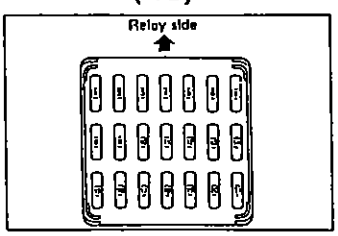
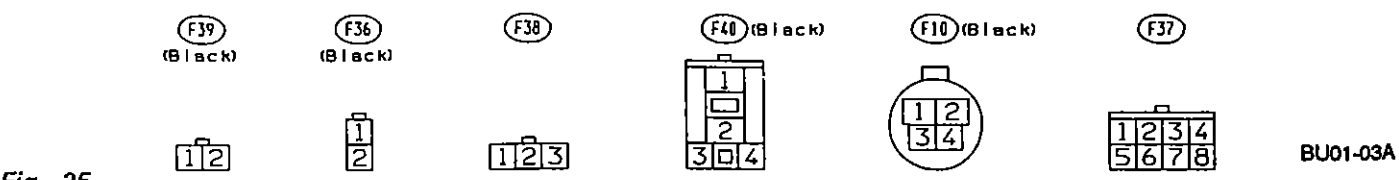
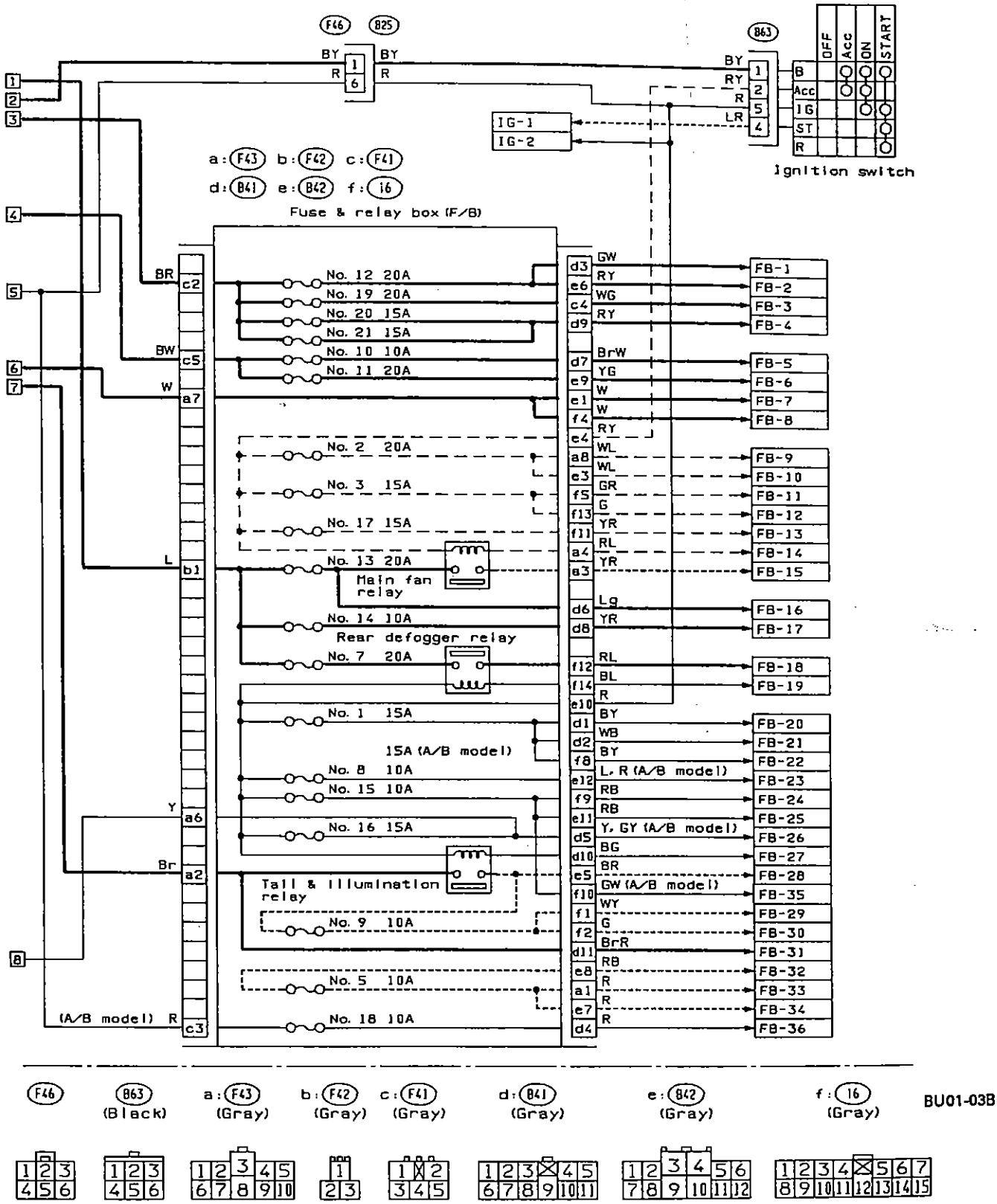


Fig. 25-2 B6-167



BU01-03A

Fig. 25


F46
B25
B63
BY
R
BY
RY
R
LR
IG-1
IG-2
OFF
Acc
ON
START
B
Acc
IG
ST
R
Ignition switch
a: F43 b: F42 c: F41
d: B41 e: B42 f: 16
Fuse & relay box (F/B)
BR
BW
W
L
Y
Br
(A/B model) R
No. 12 20A
No. 19 20A
No. 20 15A
No. 21 15A
No. 10 10A
No. 11 20A
No. 2 20A
No. 3 15A
No. 17 15A
No. 13 20A
Main fan relay
No. 14 10A
Rear defogger relay
No. 7 20A
No. 1 15A
15A (A/B model)
No. 8 10A
No. 15 10A
No. 16 15A
Tail & illumination relay
No. 9 10A
No. 5 10A
No. 18 10A
GW
RY
WG
RY
BrW
YG
W
W
RY
WL
WL
GR
G
YR
RL
YR
Lg
YR
RL
BL
R
BY
WB
BY
L, R (A/B model)
RB
RB
Y, GY (A/B model)
BG
BR
GW (A/B model)
WY
G
BrR
RB
R
R
R
FB-1
FB-2
FB-3
FB-4
FB-5
FB-6
FB-7
FB-8
FB-9
FB-10
FB-11
FB-12
FB-13
FB-14
FB-15
FB-16
FB-17
FB-18
FB-19
FB-20
FB-21
FB-22
FB-23
FB-24
FB-25
FB-26
FB-27
FB-28
FB-35
FB-29
FB-30
FB-31
FB-32
FB-33
FB-34
FB-36
F46
B63 (Black)
a: F43 (Gray)
b: F42 (Gray)
c: F41 (Gray)
d: B41 (Gray)
e: B42 (Gray)
f: 16 (Gray)
BU01-03B

2. CHARGING

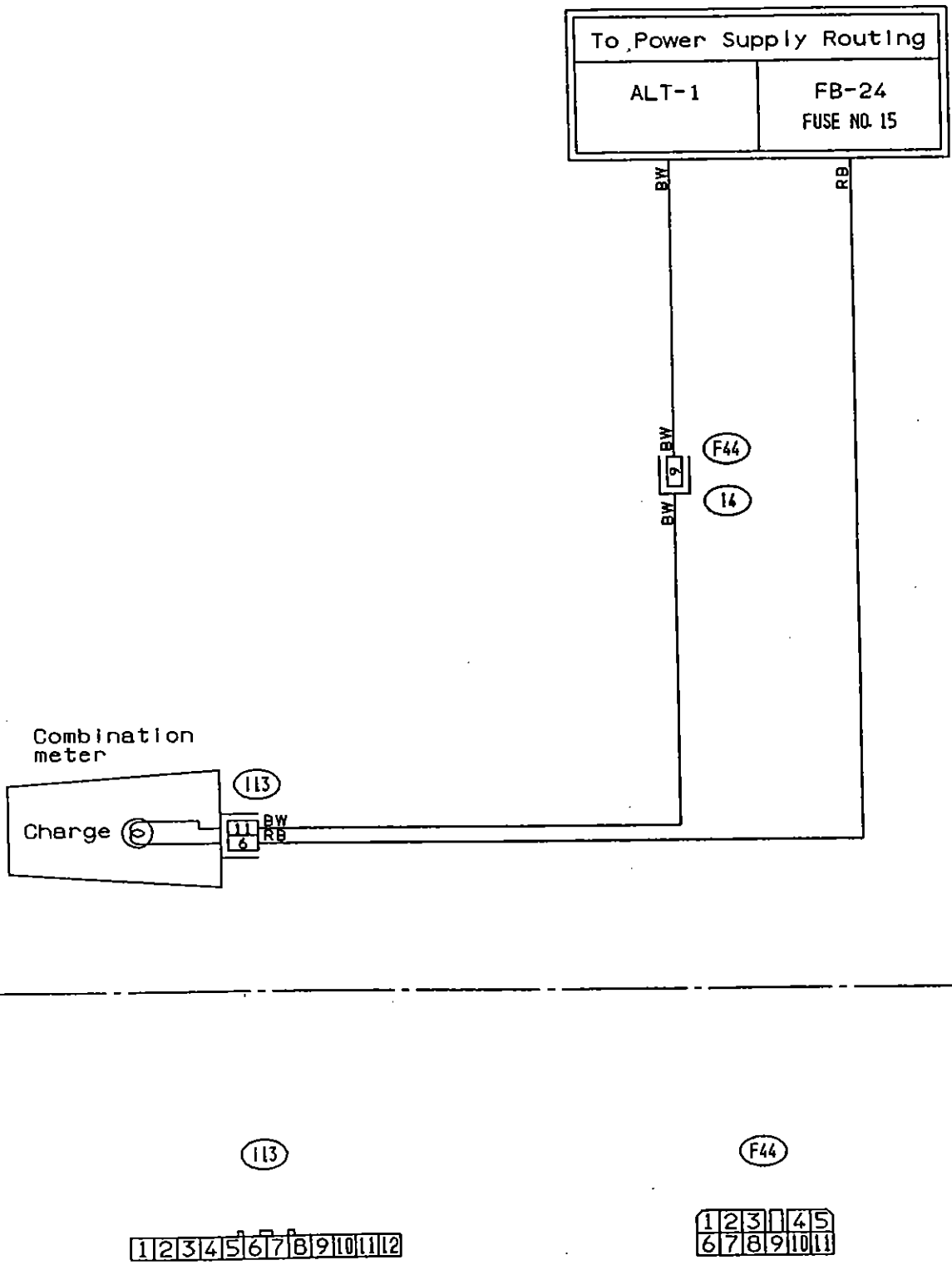
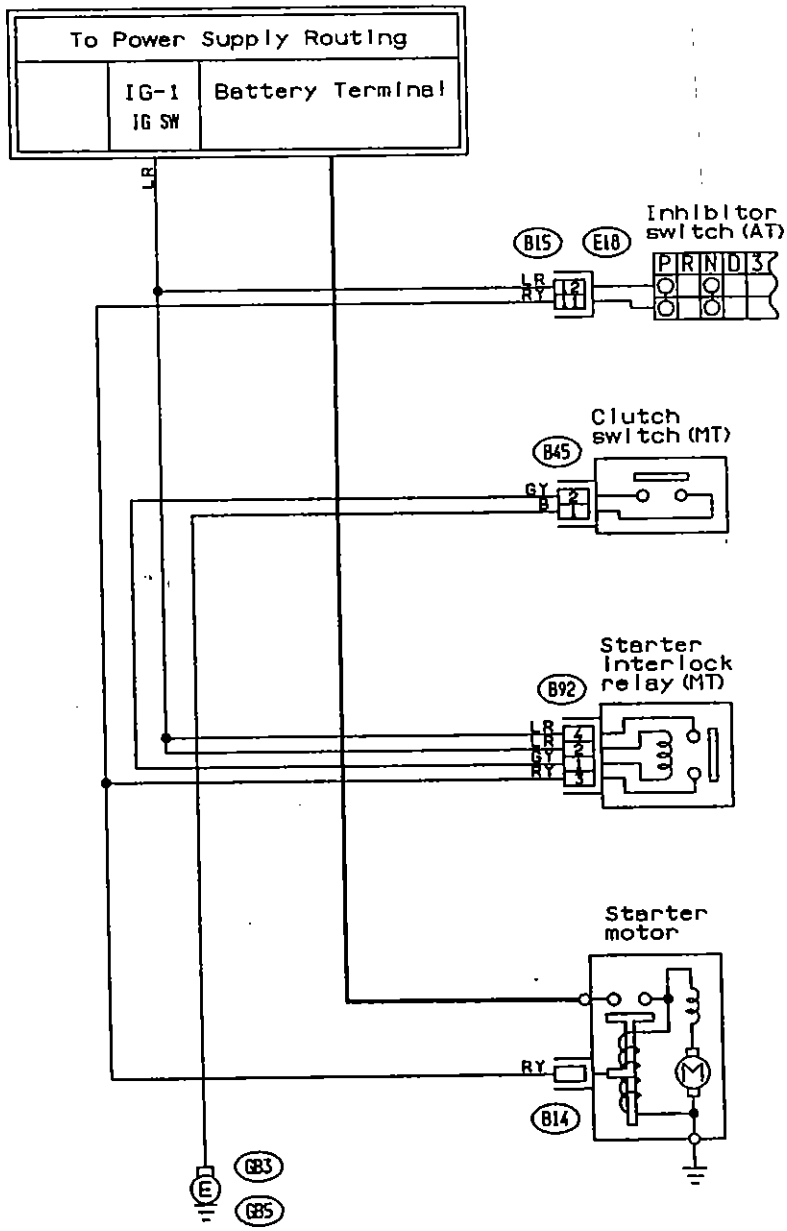
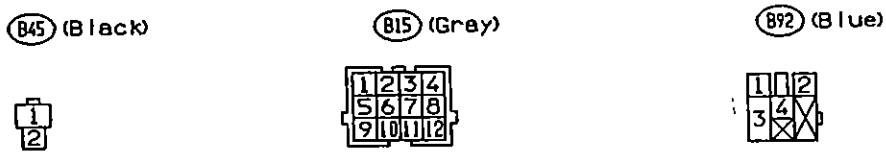


Fig. 26

3. STARTING



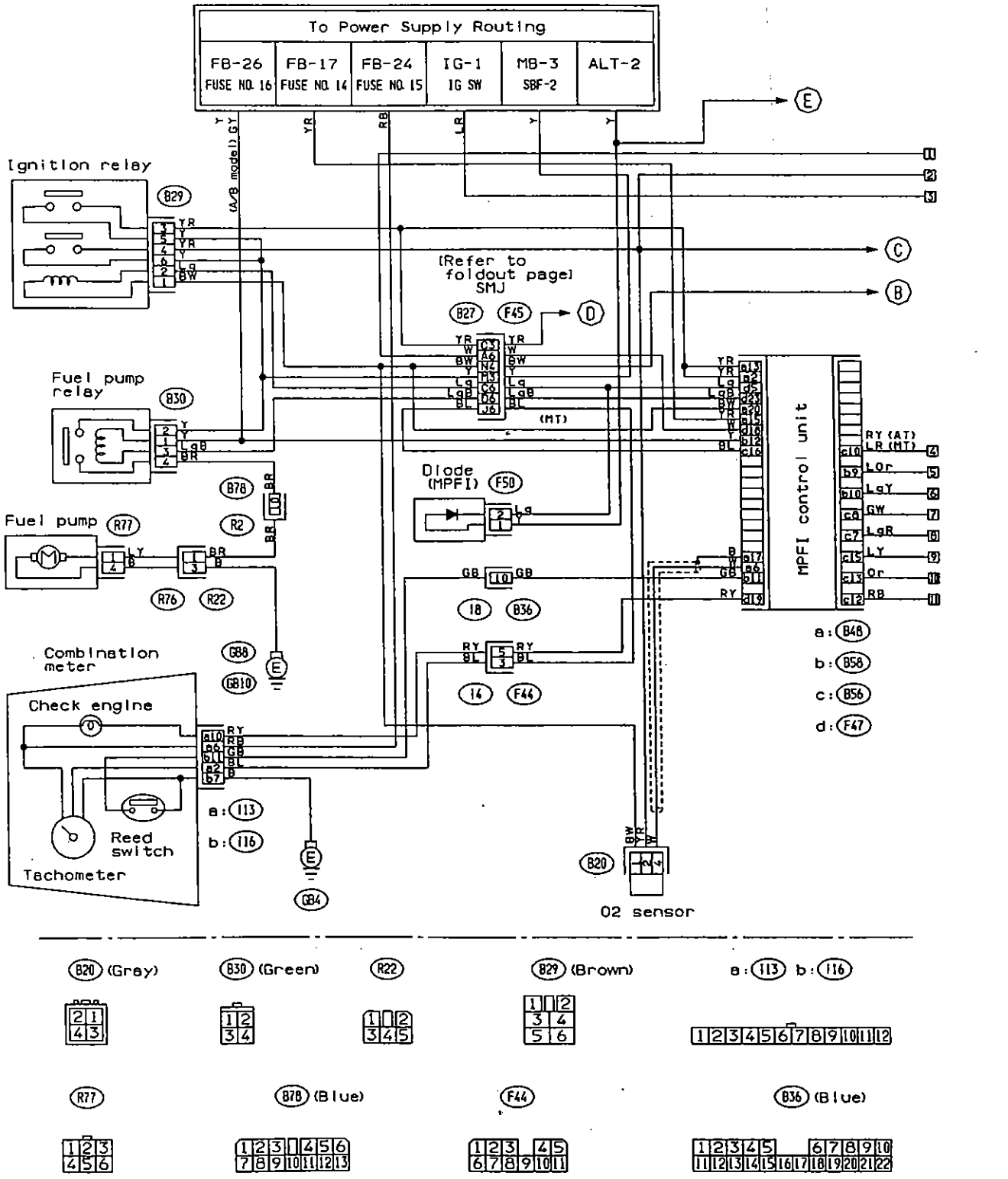


BU03-02

Fig. 27

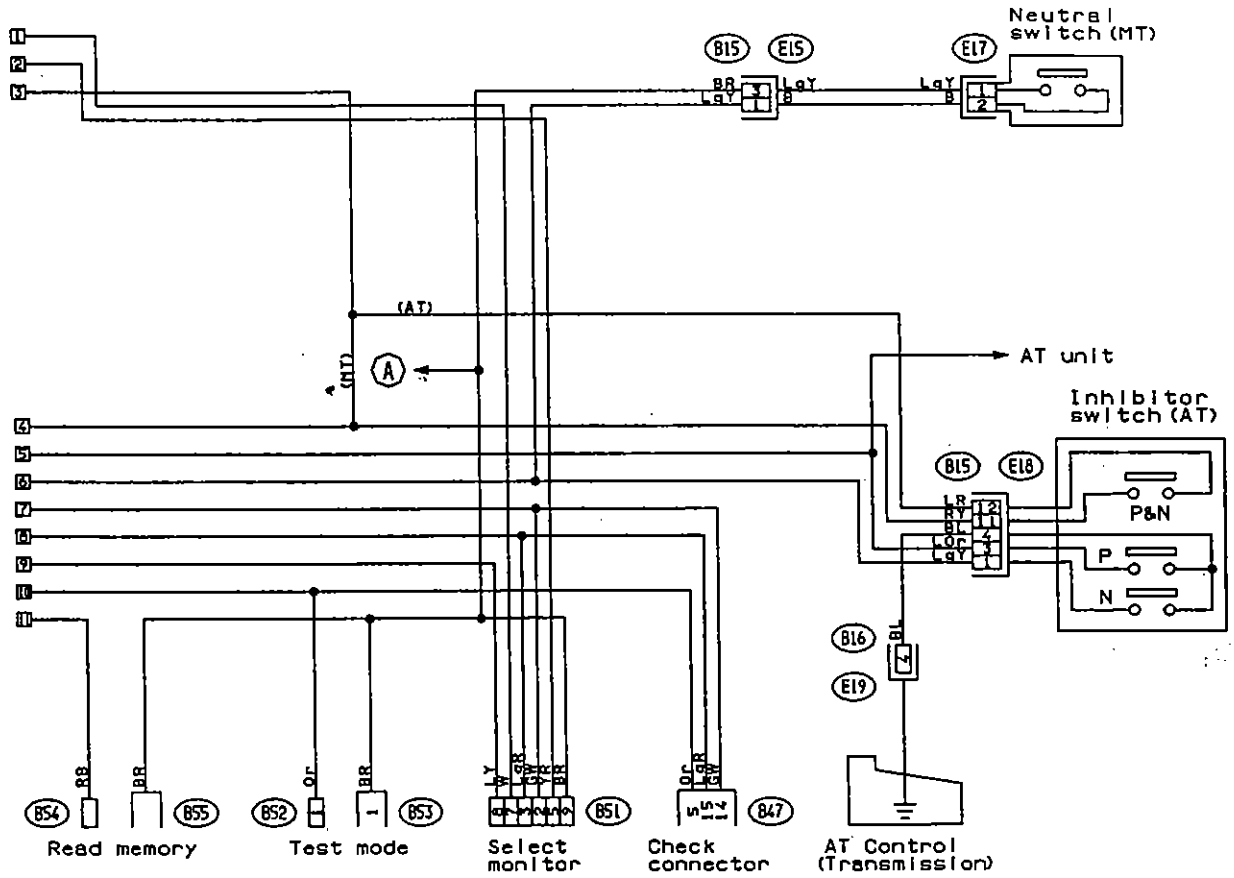
4. ENGINE ELECTRICAL

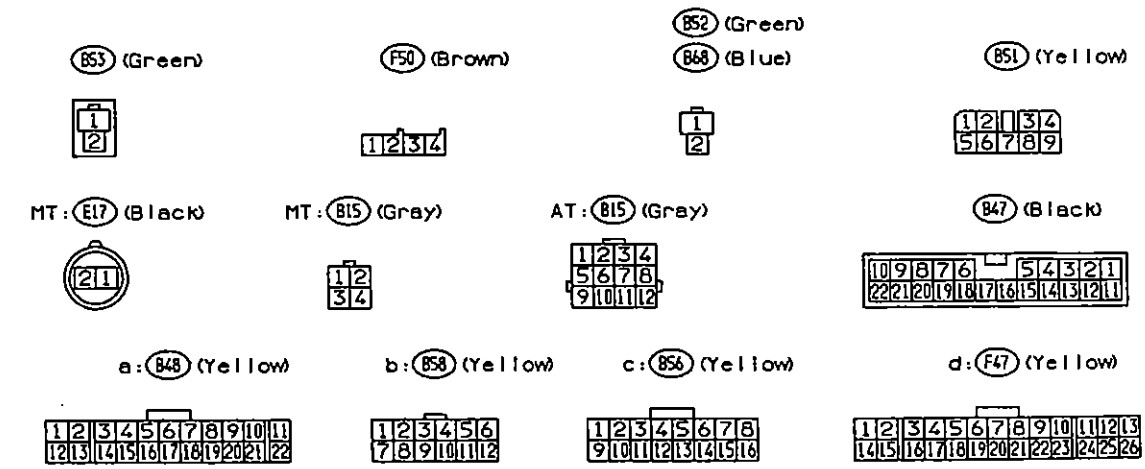
MPFI-Non-TURBO



BU10-04A

Fig. 28-1


Neutral switch (MT)
B15
E15
E17
(AT)
(MT)
A
AT unit
Inhibitor switch (AT)
B15
E18
P&N
P
N
B16
E19
B54
B55
B52
B53
B51
B47
Read memory
Test mode
Select monitor
Check connector
AT Control (Transmission)


B53 (Green)
F50 (Brown)
B52 (Green)
B68 (Blue)
B51 (Yellow)
MT : E17 (Black)
MT : B15 (Gray)
AT : B15 (Gray)
B47 (Black)
a : B48 (Yellow)
b : B58 (Yellow)
c : B56 (Yellow)
d : F47 (Yellow)

BU10-04B

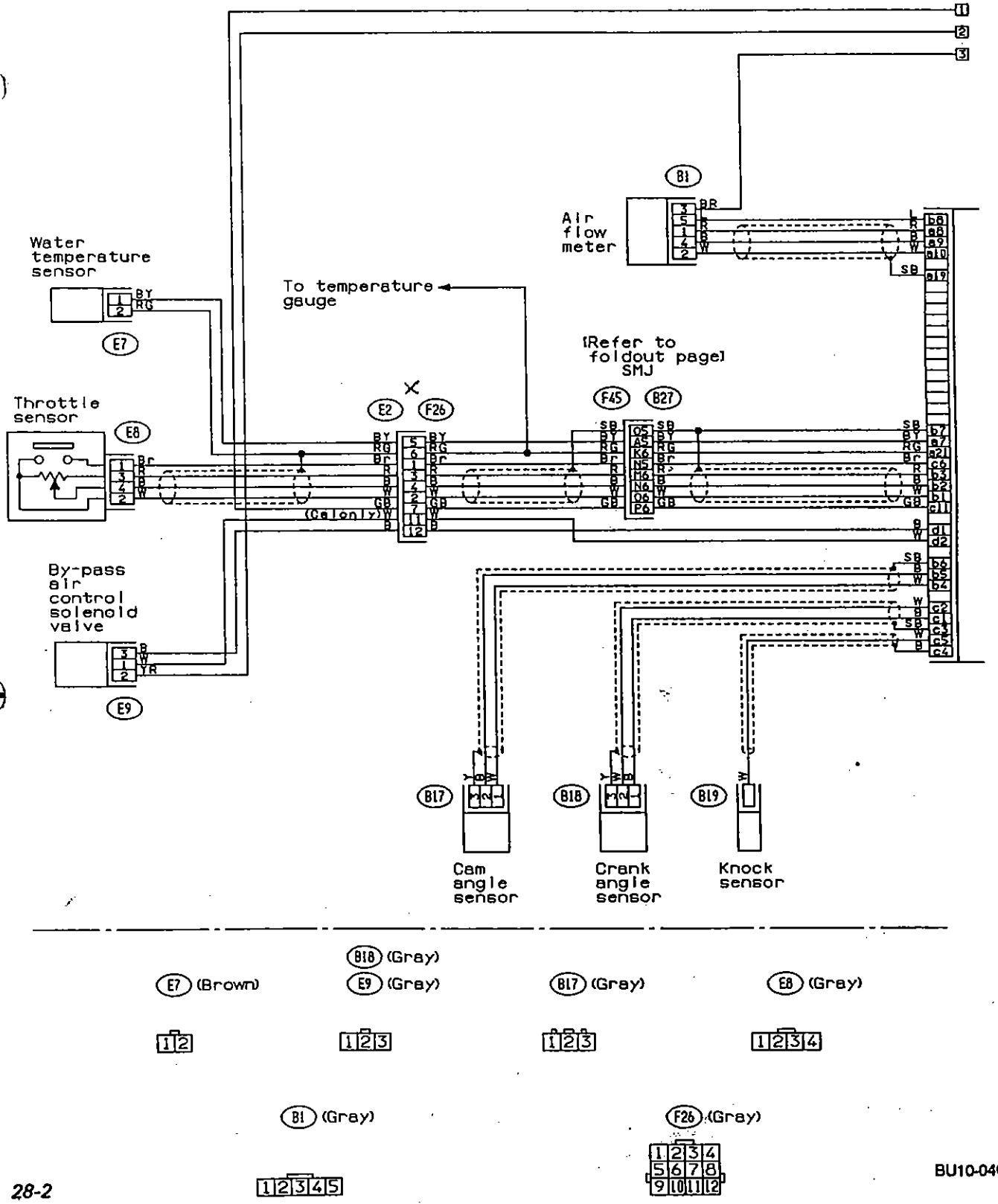
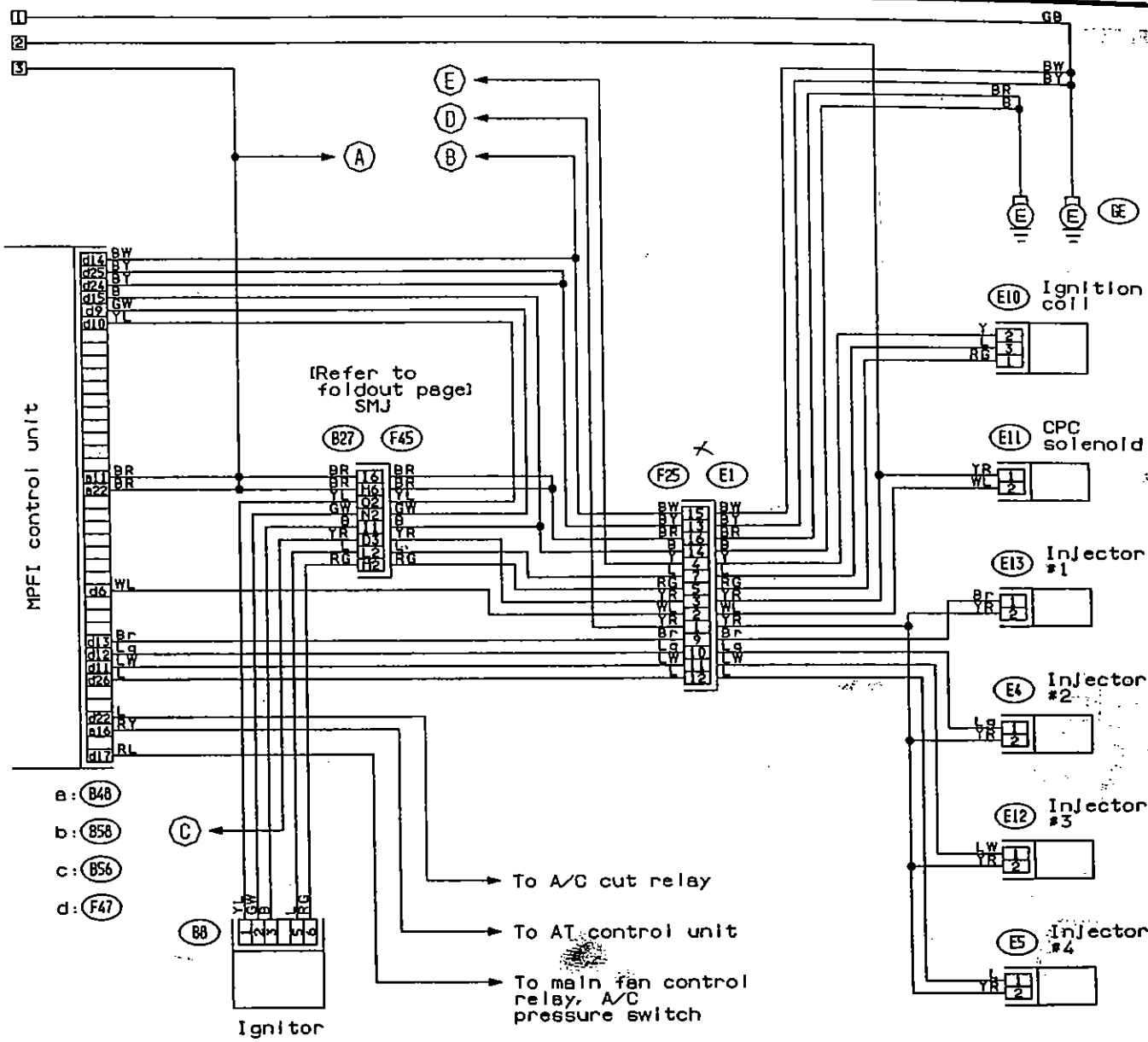
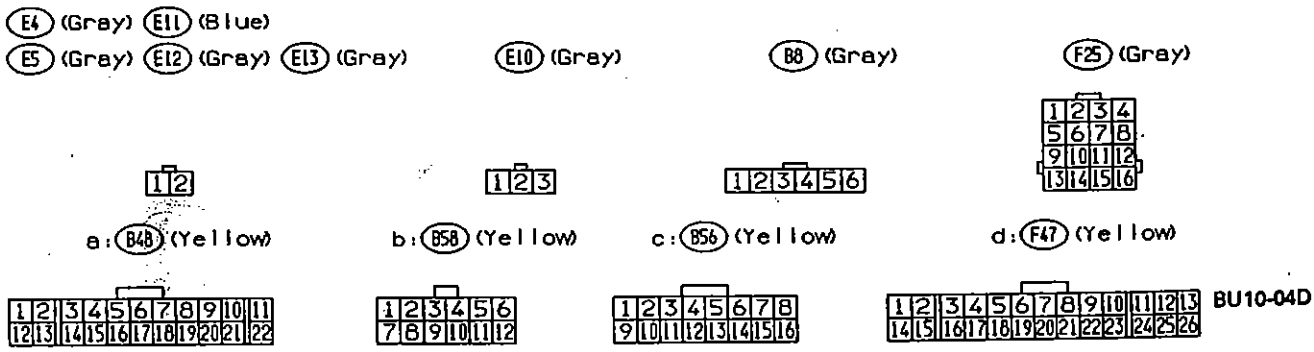

Water temperature sensor
E7
To temperature gauge
Air flow meter
B1
(Refer to foldout page) SMJ
F45
B27
Throttle sensor
E8
E2
F26
By-pass air control solenoid valve
E9
B17
B18
B19
Cam angle sensor
Crank angle sensor
Knock sensor
E7 (Brown)
B18 (Gray)
E9 (Gray)
B17 (Gray)
E8 (Gray)
B1 (Gray)
F26 (Gray)
BU10-04C

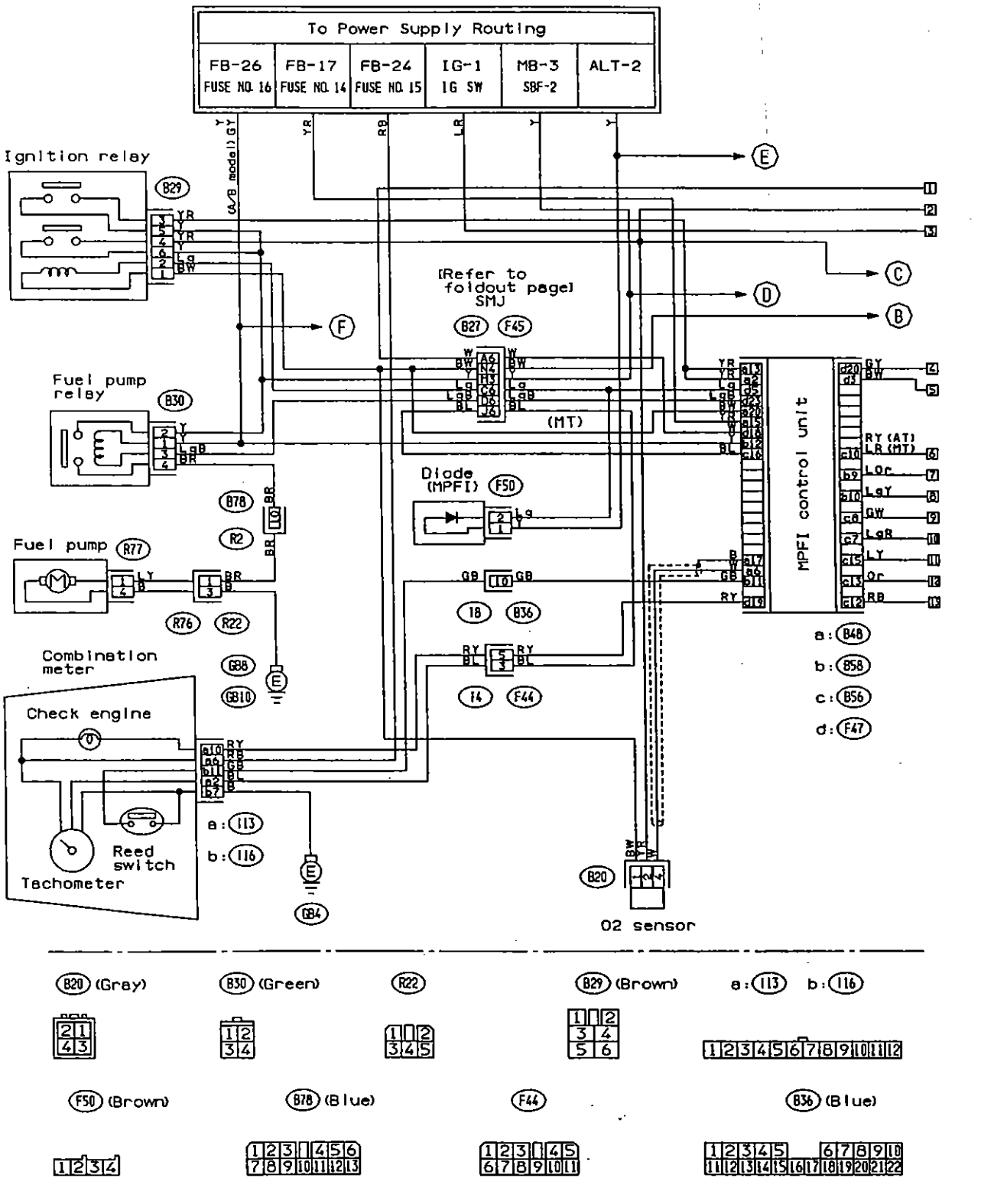
Fig. 28-2


MPFI control unit
(Refer to foldout page) SMJ
B27
F45
F25
E1
E10 Ignition coil
E11 CPC solenoid
E13 Injector #1
E4 Injector #2
E12 Injector #3
E5 Injector #4
E
D
B
A
C
a: B48
b: B58
c: B56
d: F47
B8
Ignitor
To A/C cut relay
To AT control unit
To main fan control relay, A/C pressure switch


E4 (Gray) E11 (Blue)
E5 (Gray) E12 (Gray) E13 (Gray)
E10 (Gray)
B8 (Gray)
F25 (Gray)
a: B48 (Yellow)
b: B58 (Yellow)
c: B56 (Yellow)
d: F47 (Yellow)

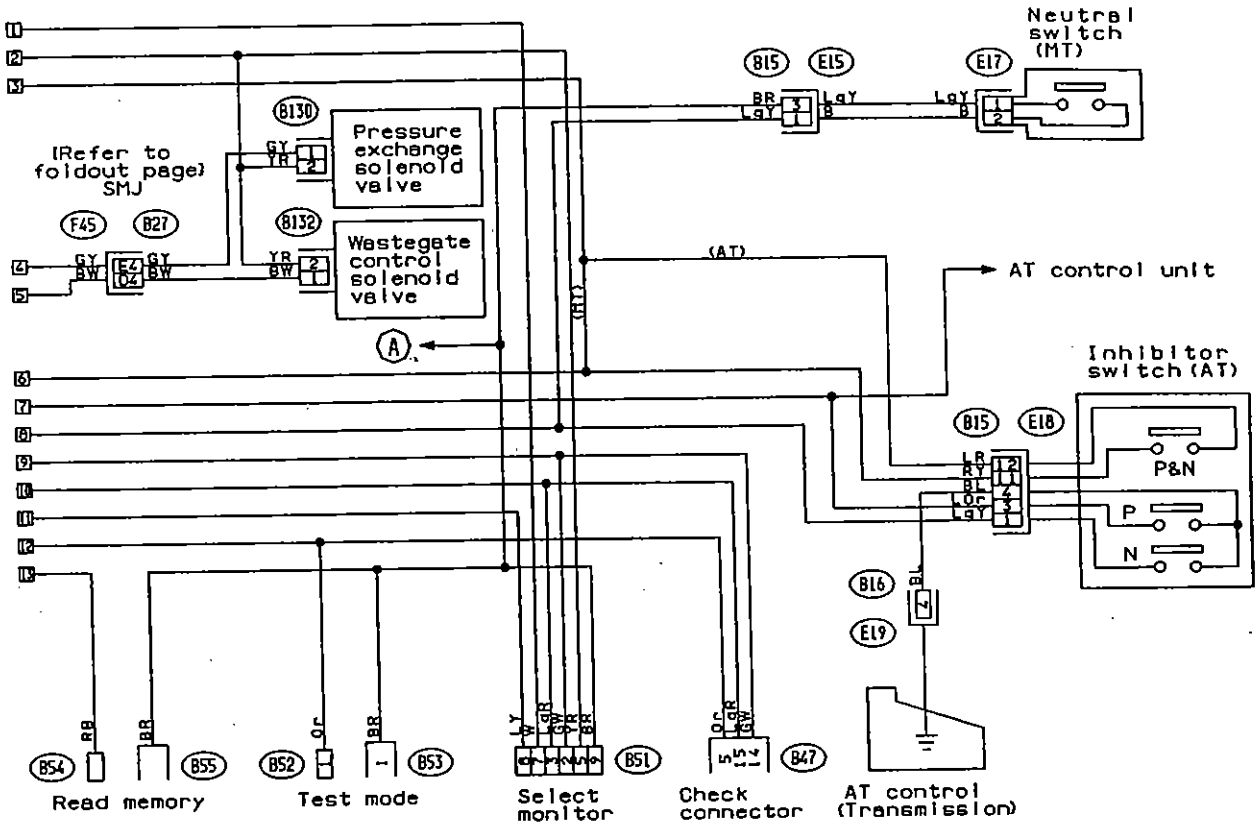
BU10-04D

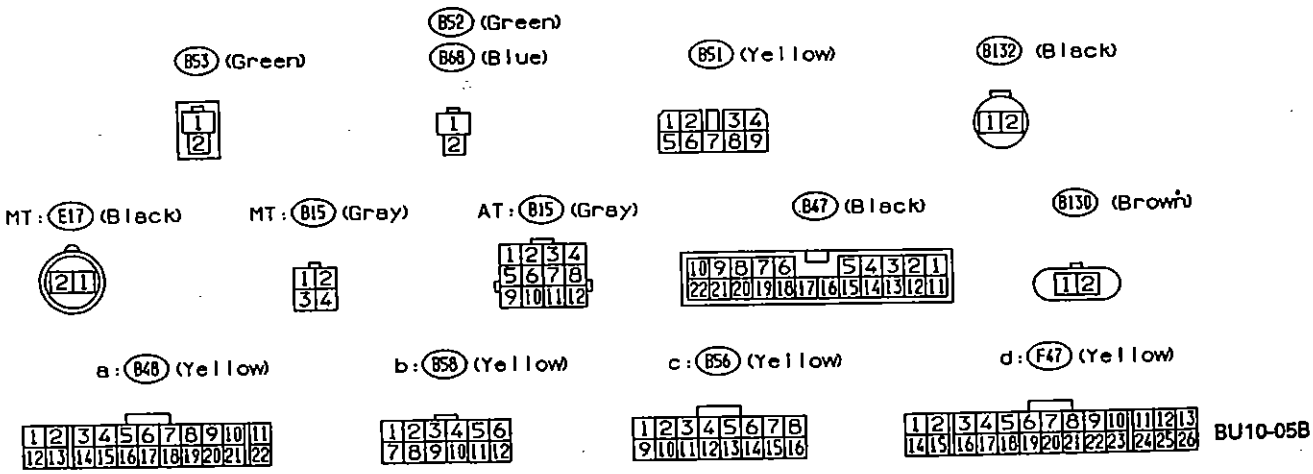
MPFI-TURBO



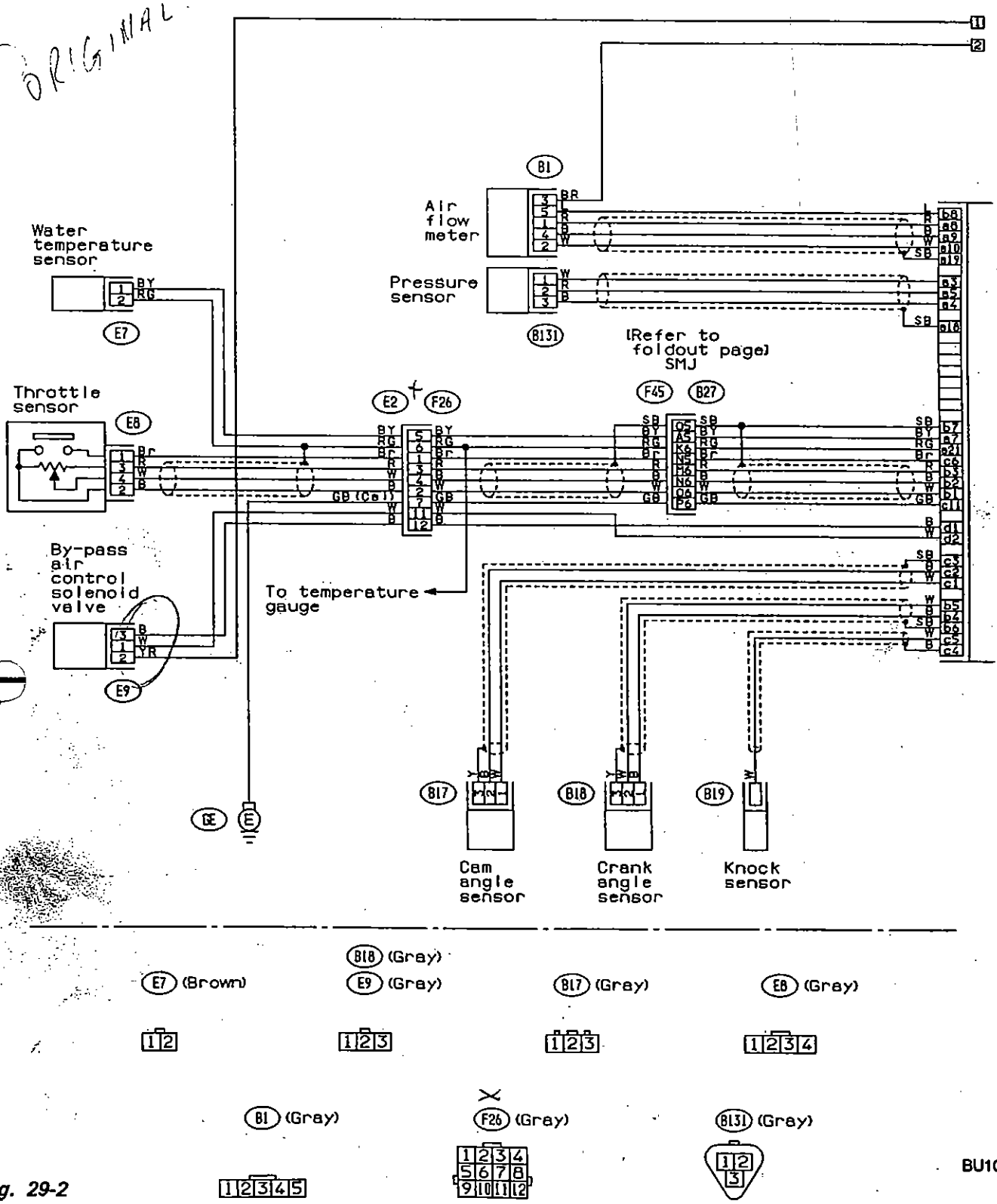
BU10-05A

Fig. 29-1


Neutral switch (MT)
B15
E15
E17
B130
Pressure exchange solenoid valve
(Refer to foldout page) SMJ
F45
B27
B132
Wastegate control solenoid valve
(AT)
AT control unit
(MT)
A
Inhibitor switch (AT)
B15
E18
P&N
P
N
B16
E19
B54
B55
B52
B53
B51
B47
Read memory
Test mode
Select monitor
Check connector
AT control (Transmission)

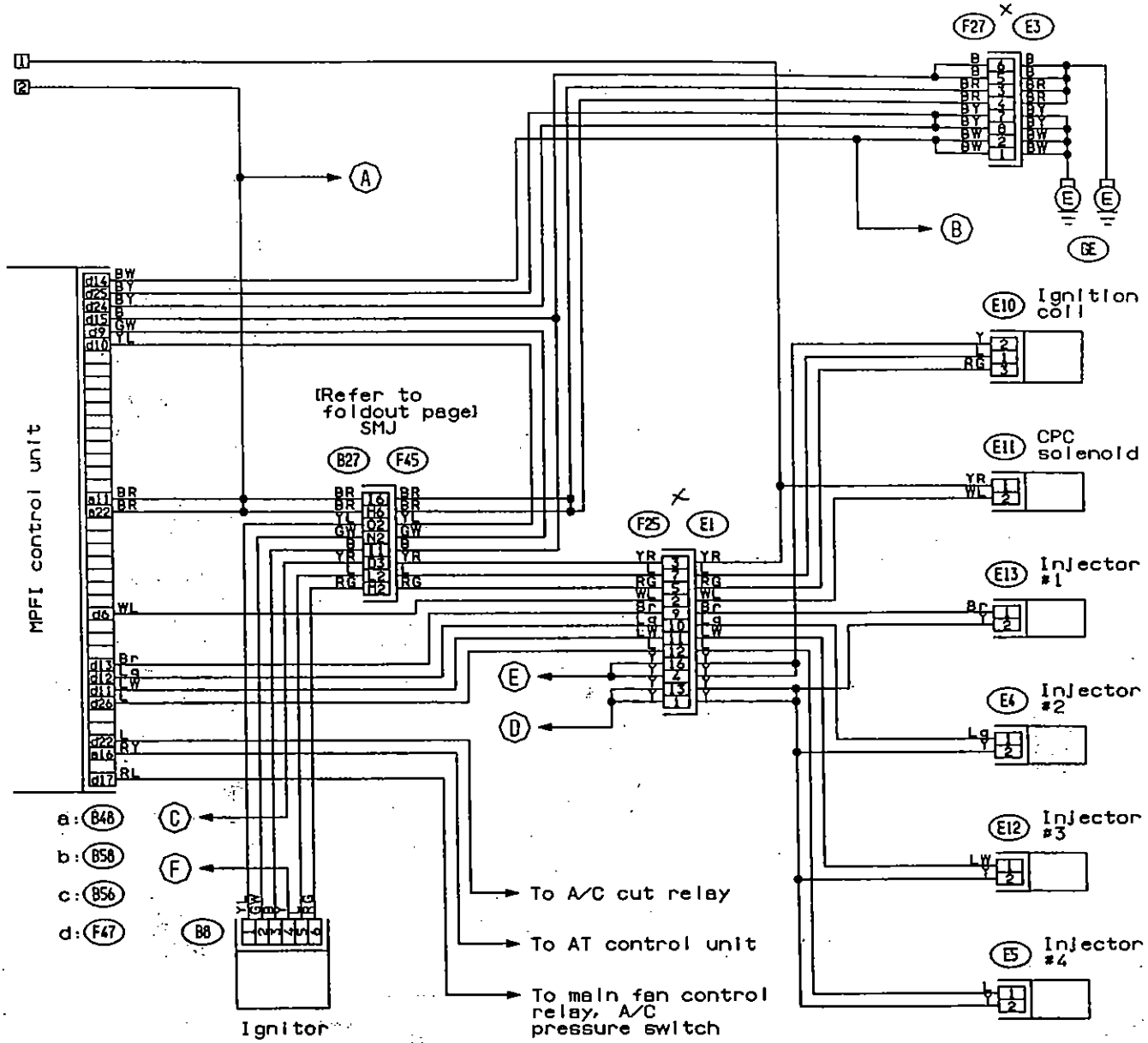

B53 (Green)
B52 (Green)
B68 (Blue)
B51 (Yellow)
B132 (Black)
MT: E17 (Black)
MT: B15 (Gray)
AT: B15 (Gray)
B47 (Black)
B130 (Brown)
a: B48 (Yellow)
b: B58 (Yellow)
c: B56 (Yellow)
d: F47 (Yellow)
BU10-05B

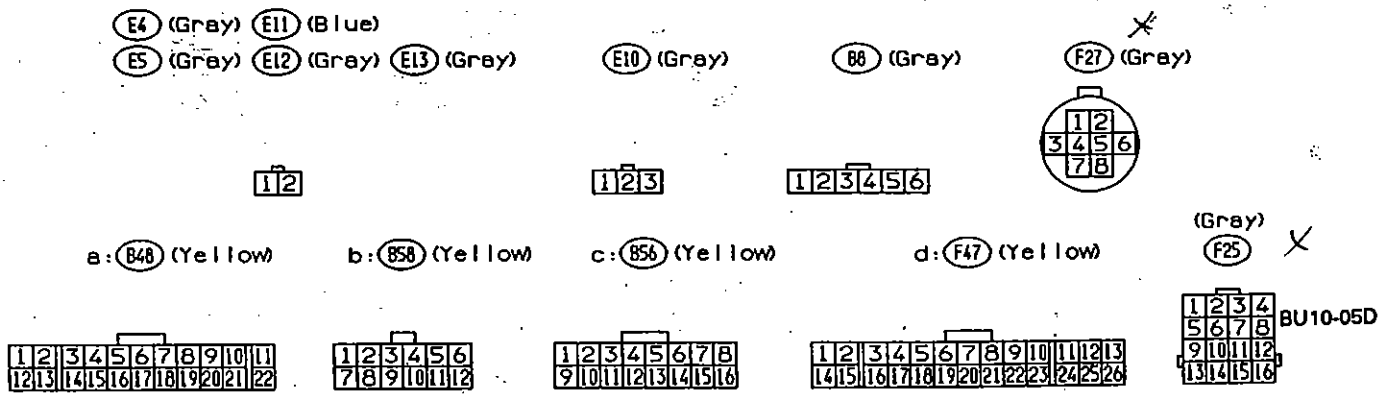
ORIGINAL



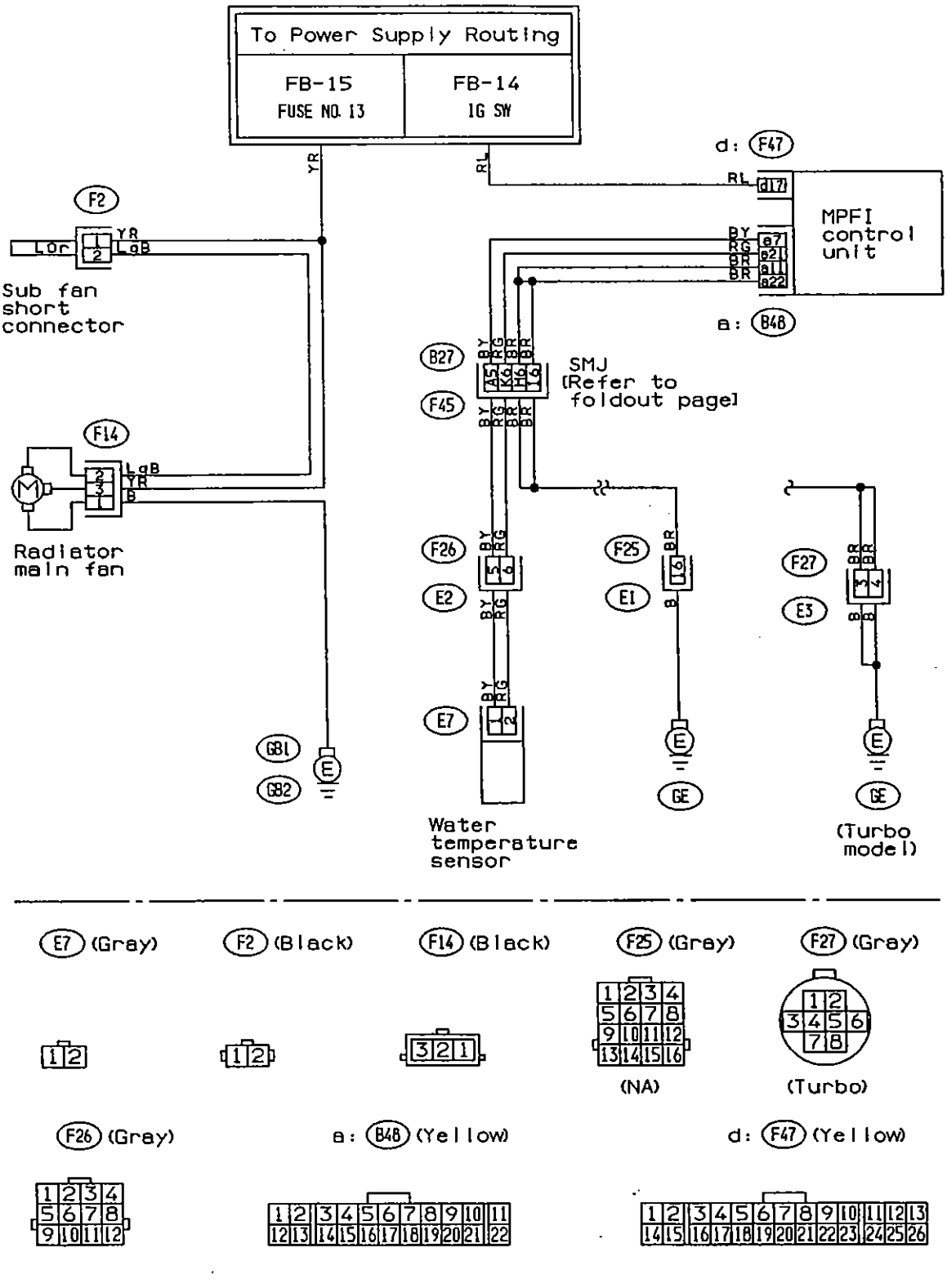
BU10-05C

Fig. 29-2


MPFI control unit
[Refer to foldout page] SMJ
B27
F45
F25
E1
F27
E3
E10 Ignition coil
E11 CPC solenoid
E13 Injector #1
E4 Injector #2
E12 Injector #3
E5 Injector #4
GE
a: B48
b: B58
c: B56
d: F47
B8
Ignitor
To A/C cut relay
To AT control unit
To main fan control relay, A/C pressure switch


E4 (Gray) E11 (Blue)
E5 (Gray) E12 (Gray) E13 (Gray)
E10 (Gray)
B8 (Gray)
F27 (Gray)
a: B48 (Yellow)
b: B58 (Yellow)
c: B56 (Yellow)
d: F47 (Yellow)
(Gray) F25
BU10-05D

5. RADIATOR FAN



BU14-03

Fig. 30

6-1. LIGHTING (HEADLIGHT)

U.S. MODEL

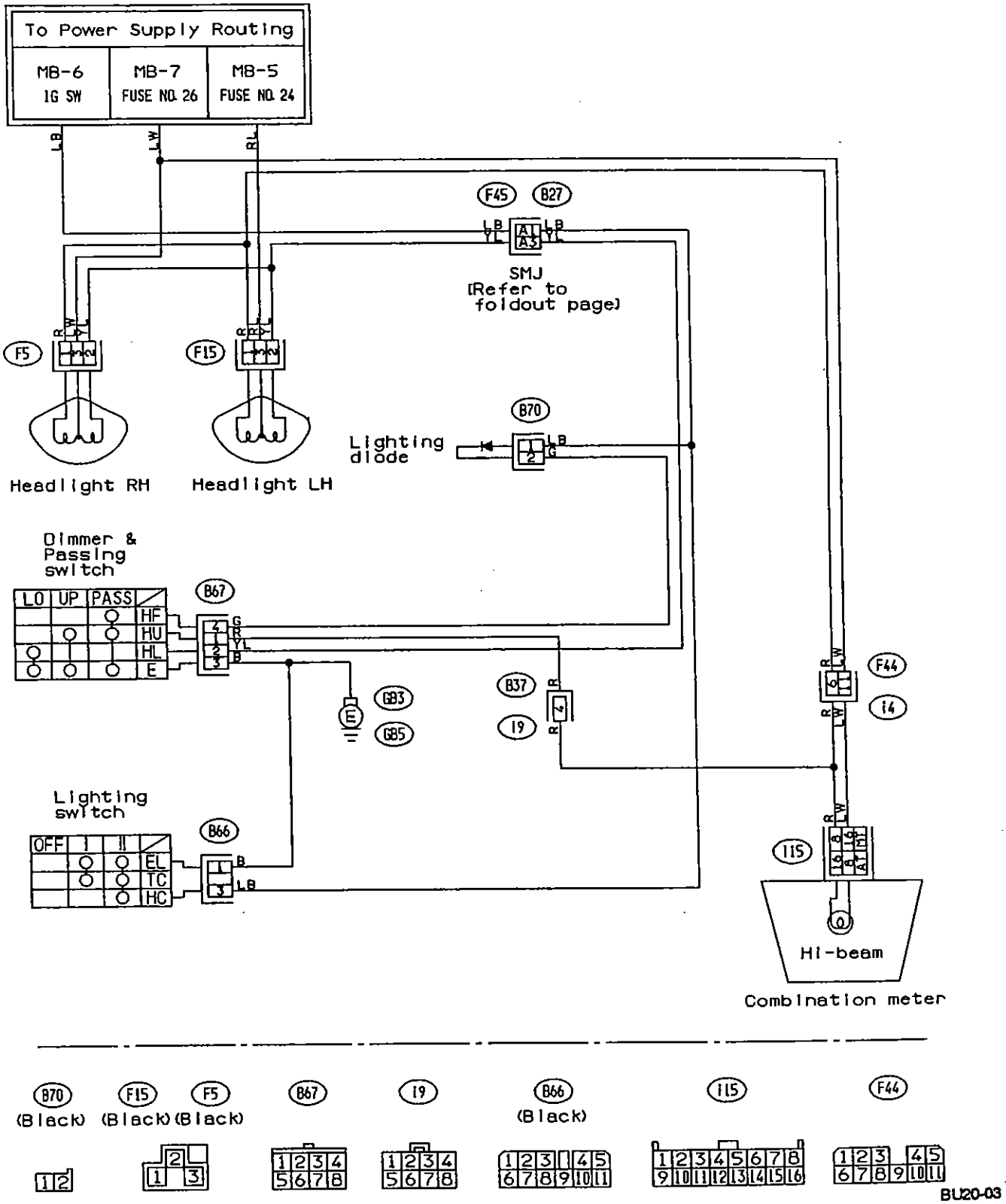
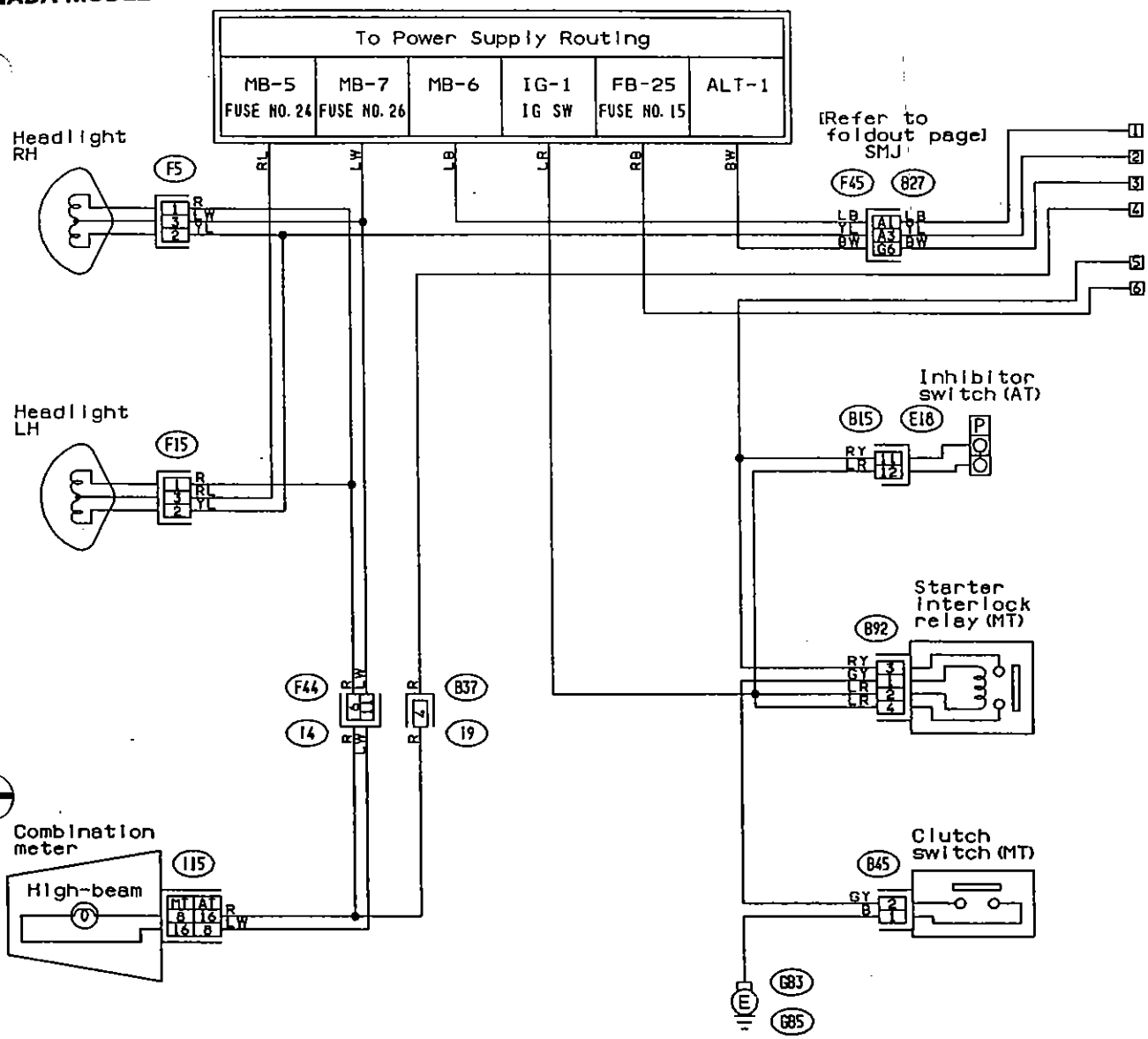
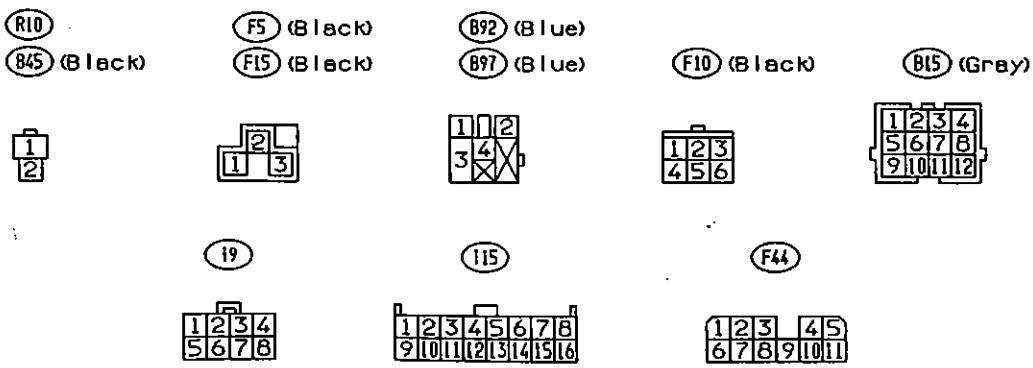


Fig. 31

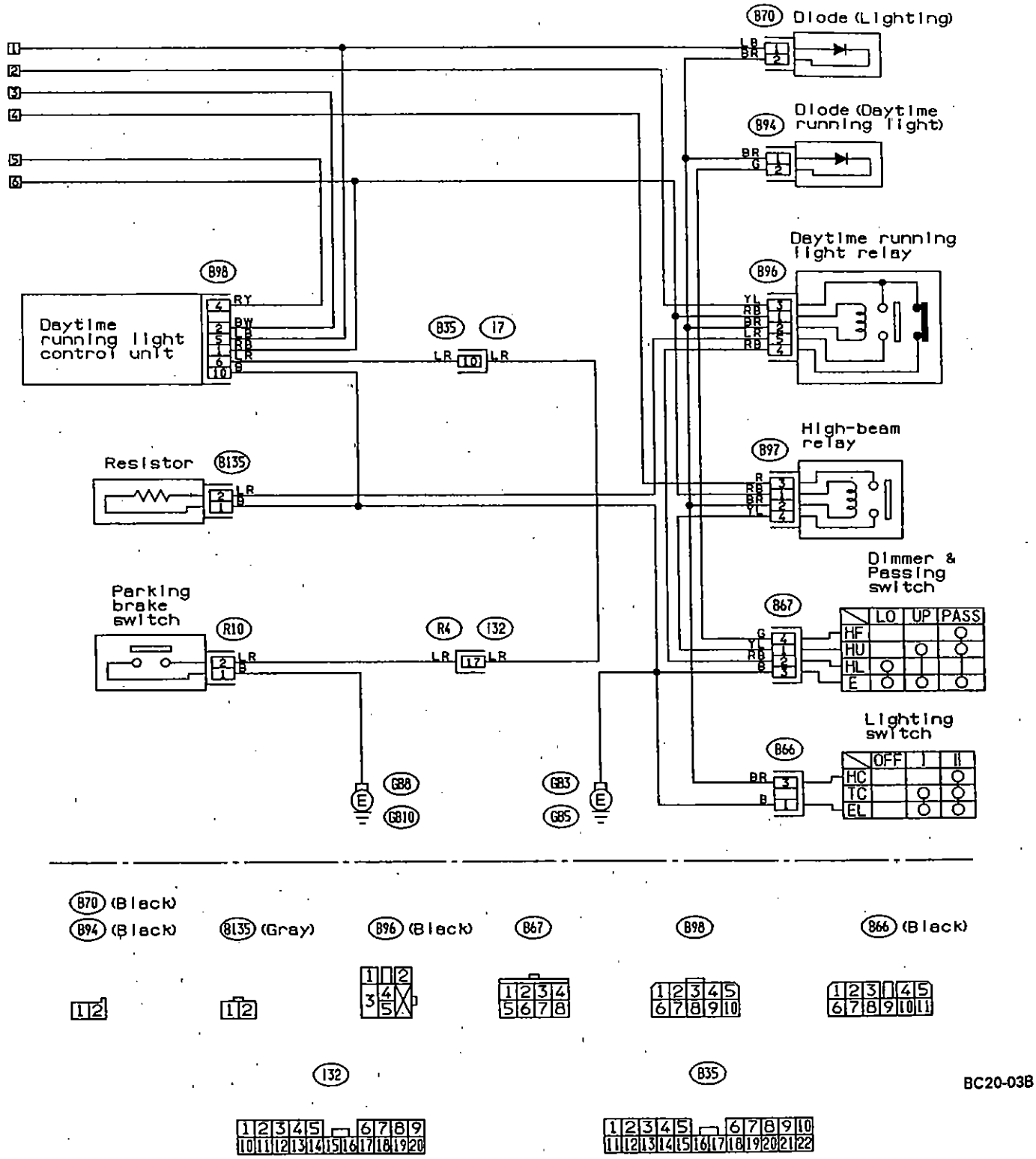
CANADA MODEL





BC20-03A

Fig. 32


B70 Diode (Lighting)
B94 Diode (Daytime running light)
Daytime running light relay
B96
B98
Daytime running light control unit
B35 17
Resistor B135
High-beam relay
B97
Dimmer & Passing switch
B67
LO UP PASS
HF
HU
HL
E
Parking brake switch
R10
R4 132
Lighting switch
B66
OFF I II
HC
TC
EL
G88
G810
G83
G85
B70 (Black)
B94 (Black)
B135 (Gray)
B96 (Black)
B67
B98
B66 (Black)
132
B35
BC20-03B

6-2. LIGHTING (TAIL•ILLUMINATION•etc.)

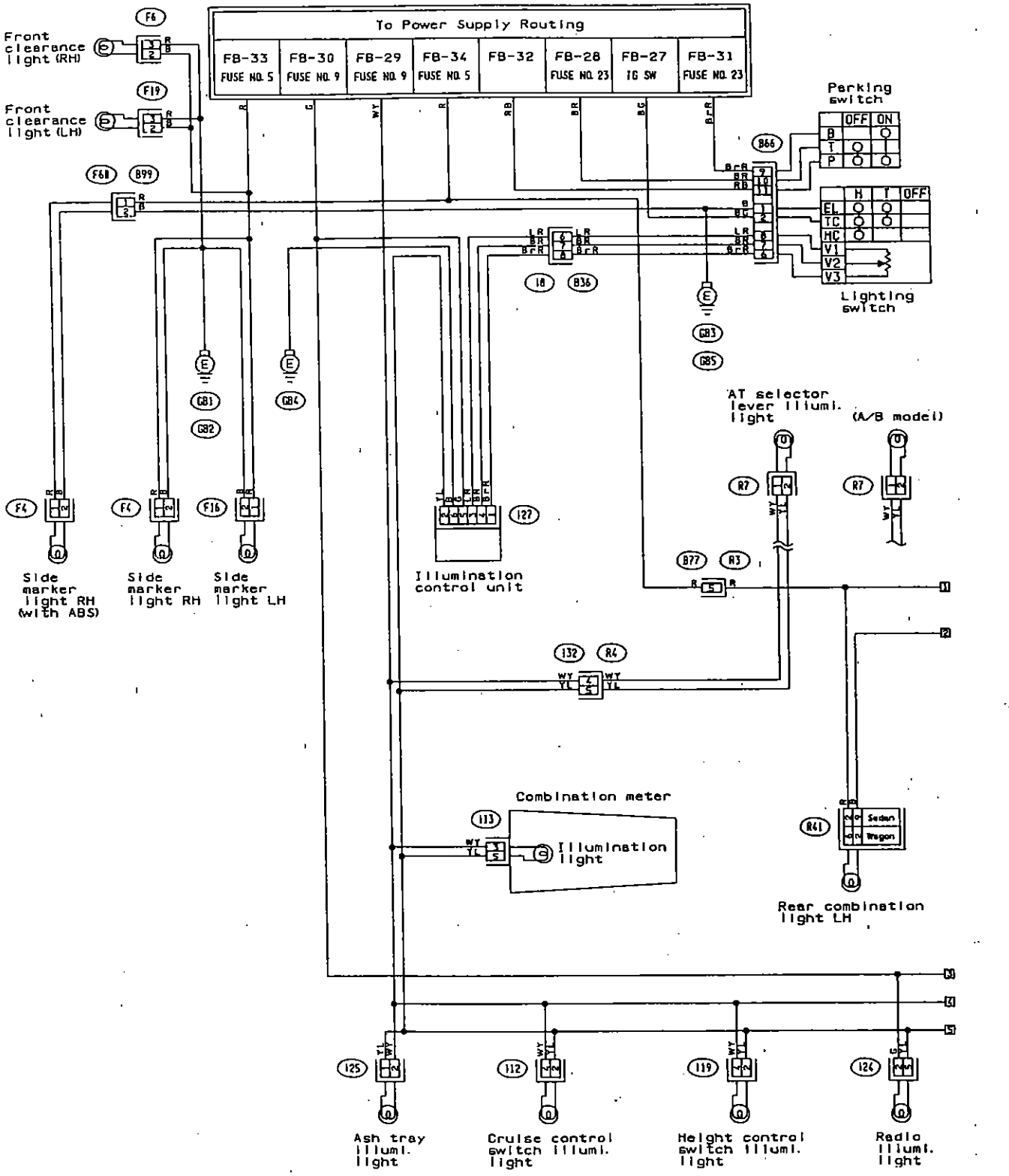
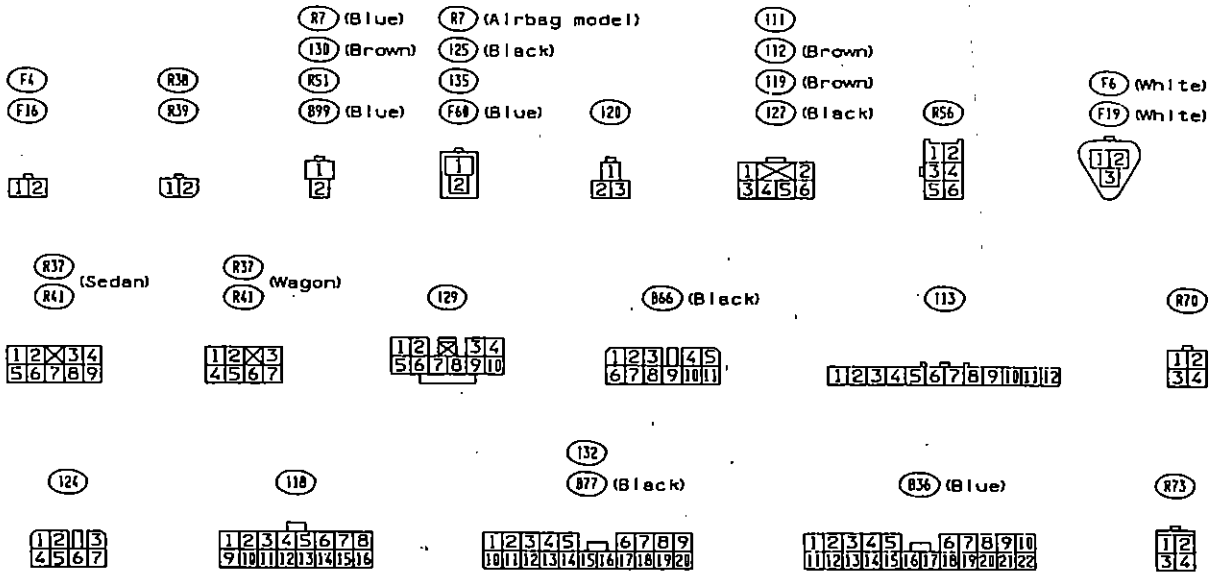
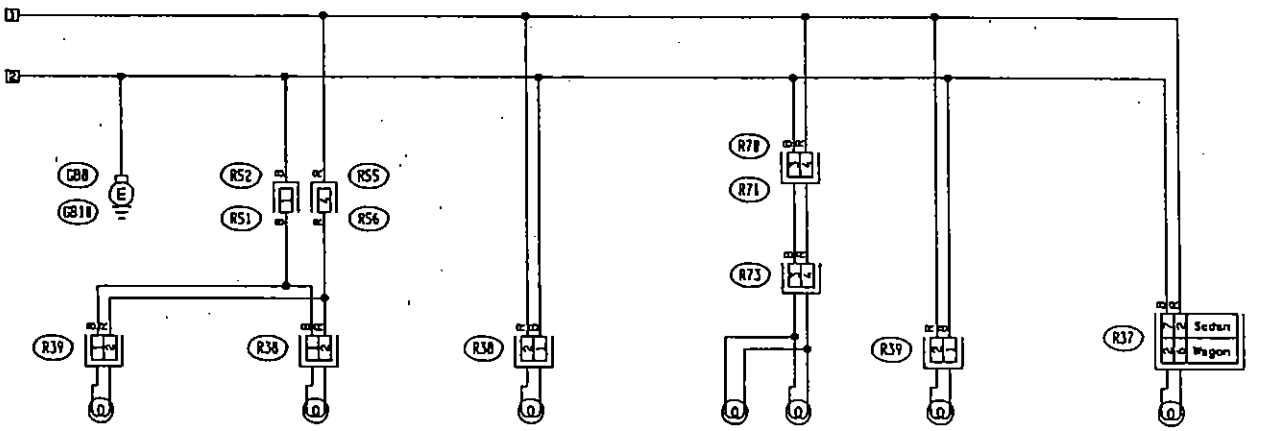
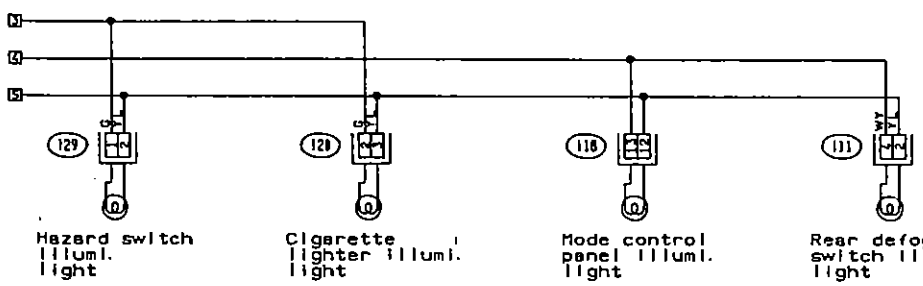


Fig. 33

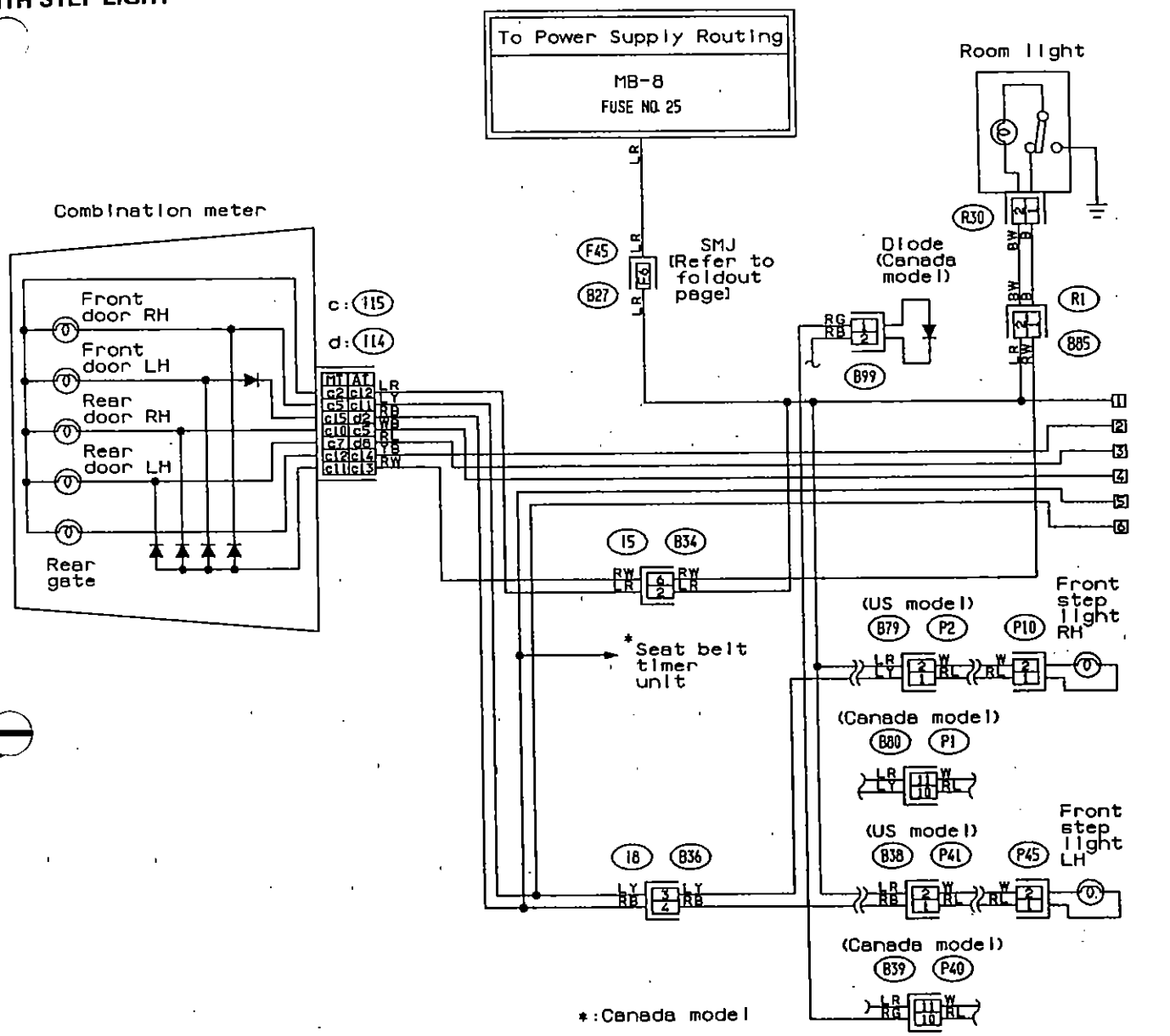

R7 (Blue)
R7 (Airbag model)
111
130 (Brown)
125 (Black)
112 (Brown)
F4
R38
R51
135
119 (Brown)
F6 (White)
F16
R39
B99 (Blue)
F68 (Blue)
120
127 (Black)
R56
F19 (White)
R37 (Sedan)
R37 (Wagon)
129
B66 (Black)
113
R70
R41
R41
132
124
118
B77 (Black)
B36 (Blue)
R73


GB8
GB18
R52
R51
R55
R56
R78
R71
R73
R39
R38
R38
R39
R37
Sedan
Wagon
License plate light LH (Wagon)
License plate light RH (Wagon)
License plate light LH (Sedan)
Rear finisher light (Sedan)
License plate light RH (Sedan)
Rear combination light RH


129
128
118
111
Hazard switch illuml. light
Cigarette lighter illuml. light
Mode control panel illuml. light
Rear defogger switch illuml. light

BU21-05B

7. ROOM LIGHT AND DOOR SWITCH WITH STEP LIGHT



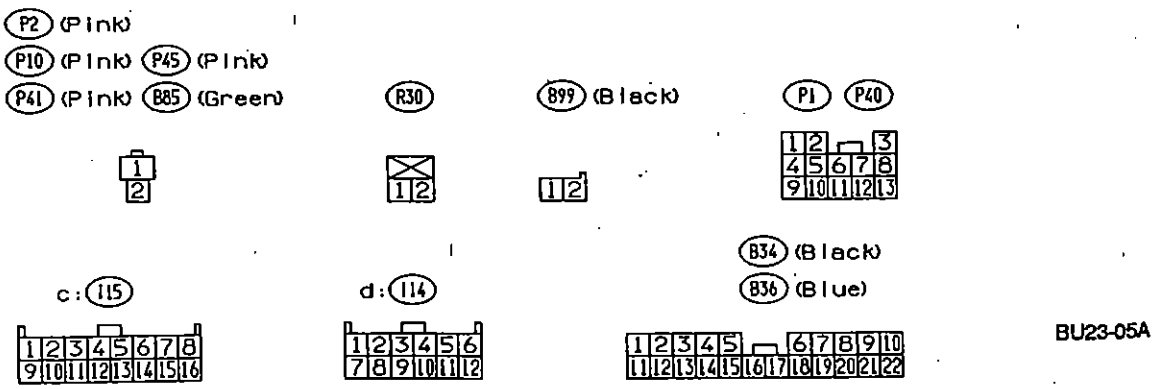
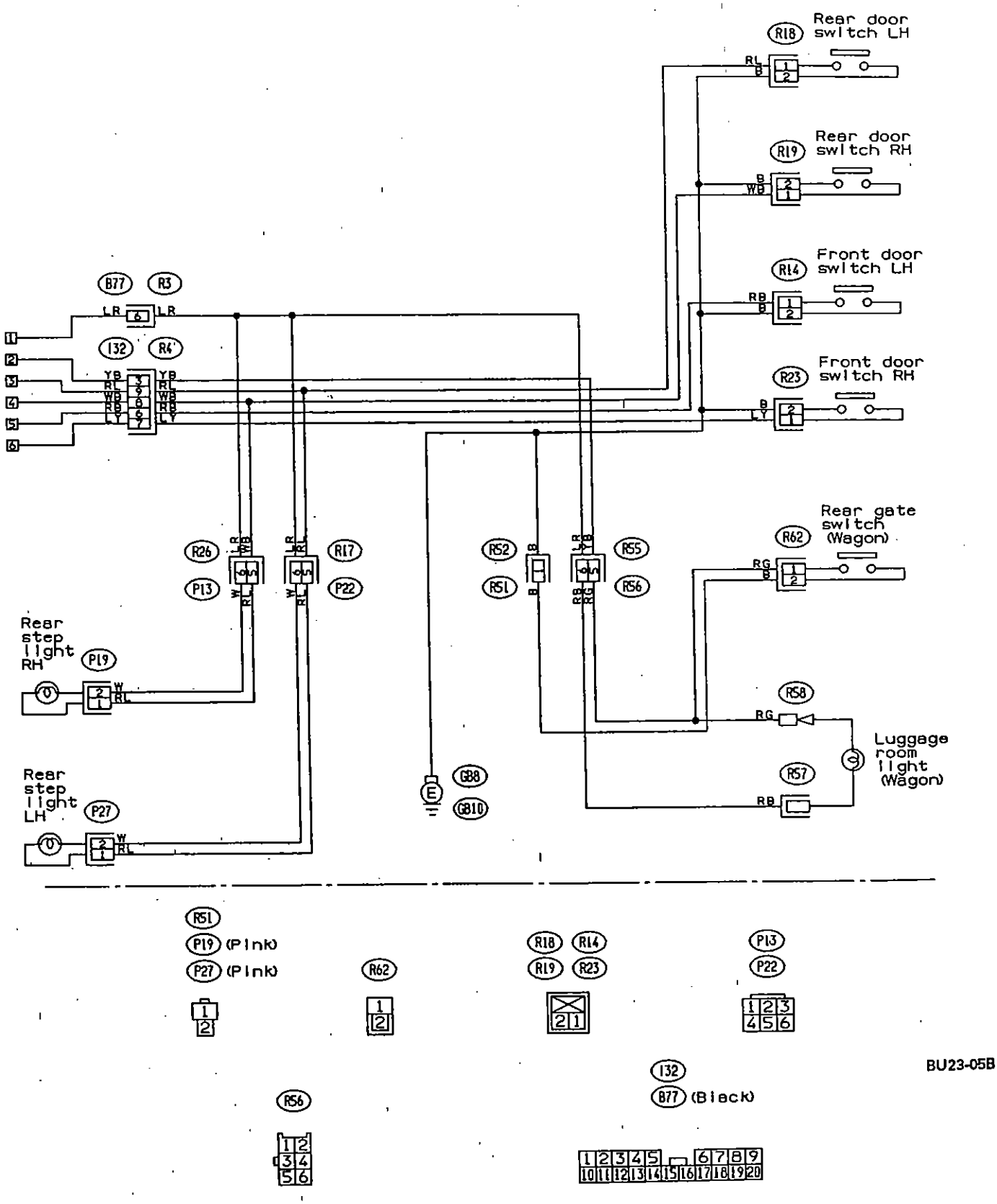
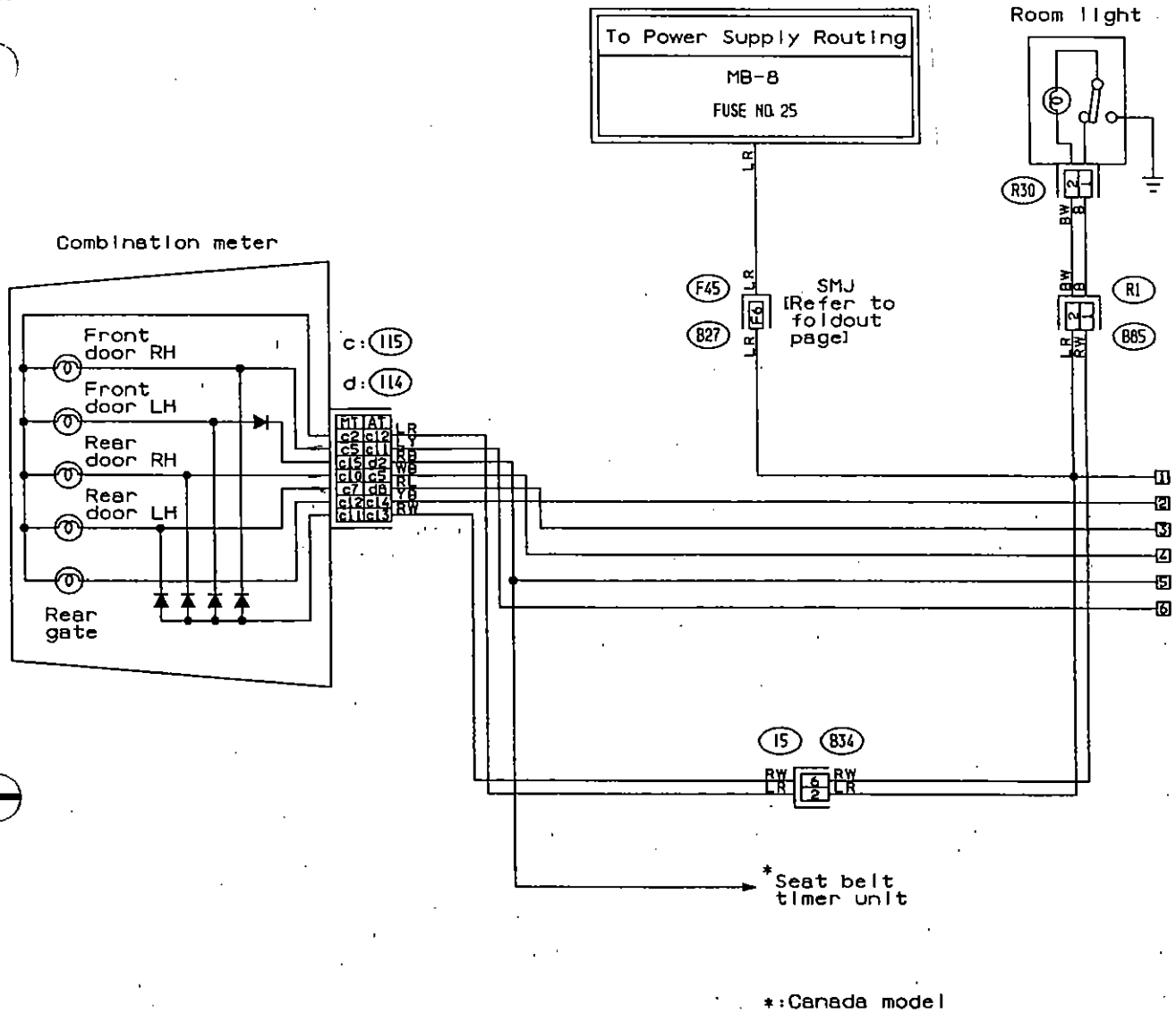


Fig. 34


Rear door switch LH
R18
Rear door switch RH
R19
Front door switch LH
R14
Front door switch RH
R23
B77
R3
132
R4
R26
P13
R17
P22
R52
R51
R55
R56
Rear gate switch (Wagon)
R62
Rear step light RH
P19
Rear step light LH
P27
R58
Luggage room light (Wagon)
R57
G38
G810
R51
P19 (Pink)
P27 (Pink)
R62
R18
R14
R19
R23
P13
P22
BU23-05B
132
B77 (Black)
R56

WITHOUT STEP LIGHT



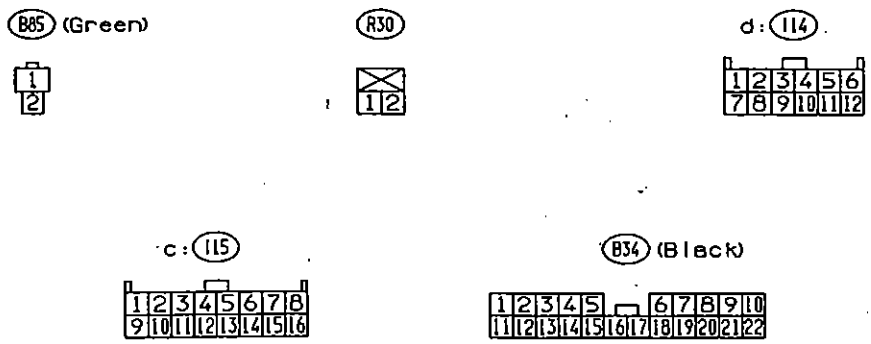
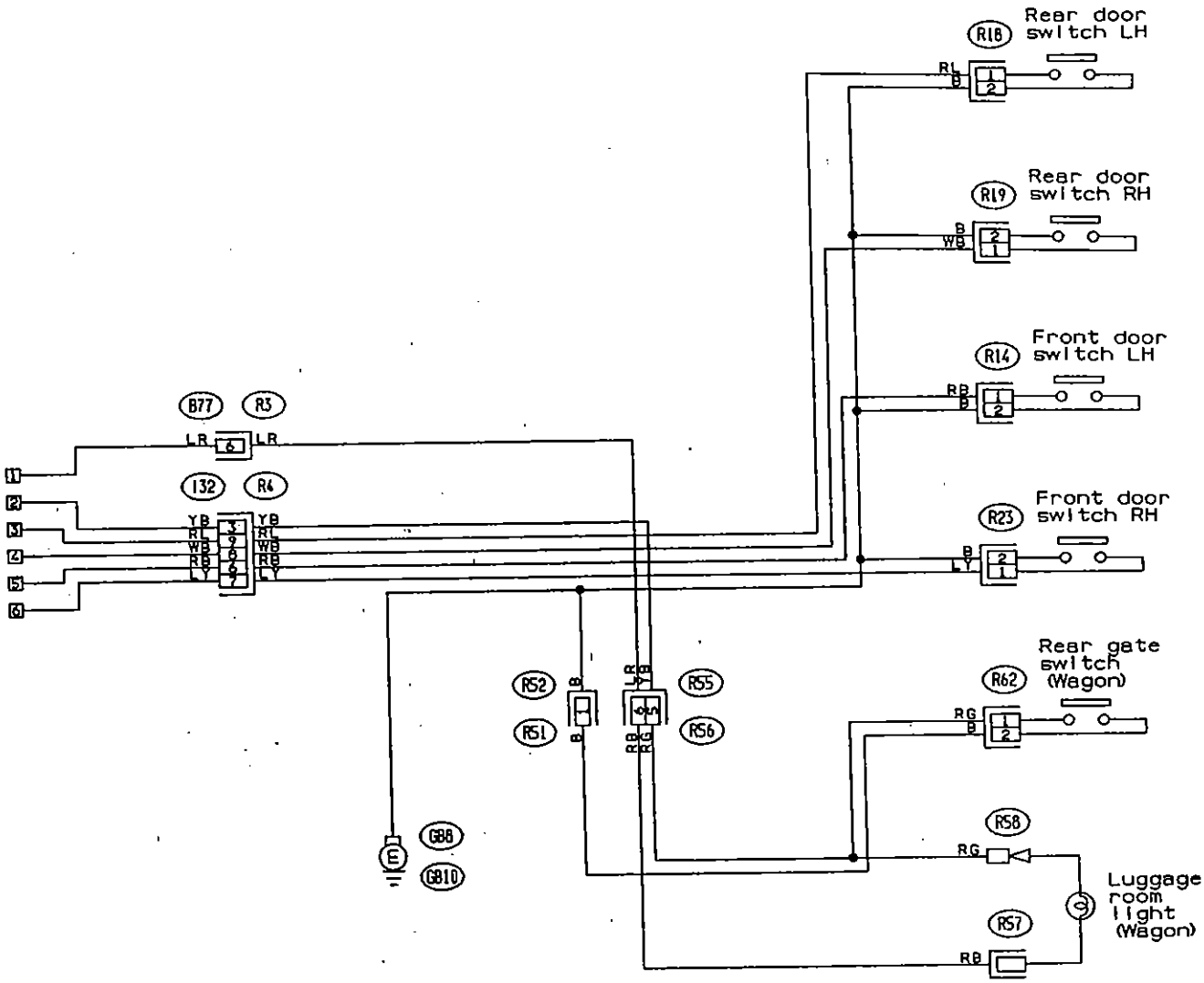
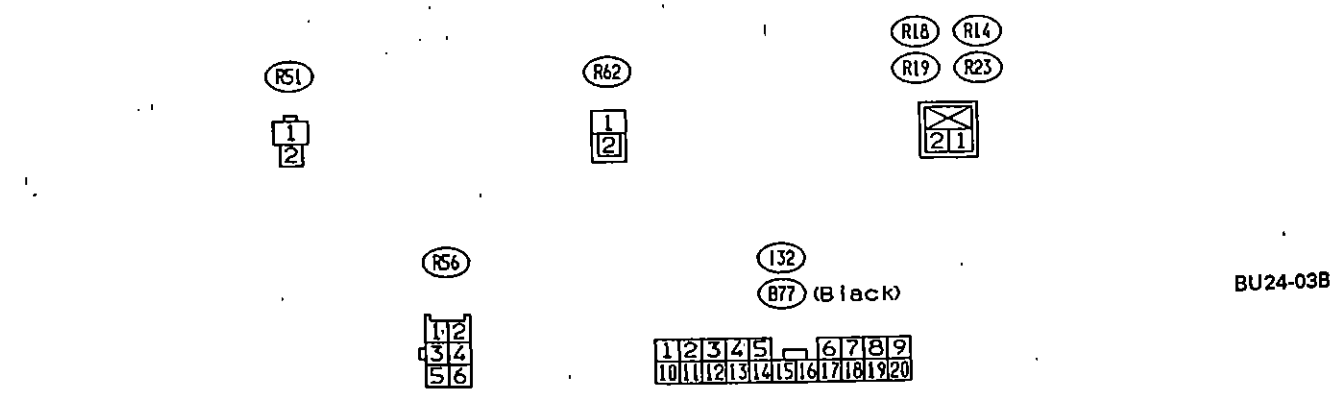


Fig. 35

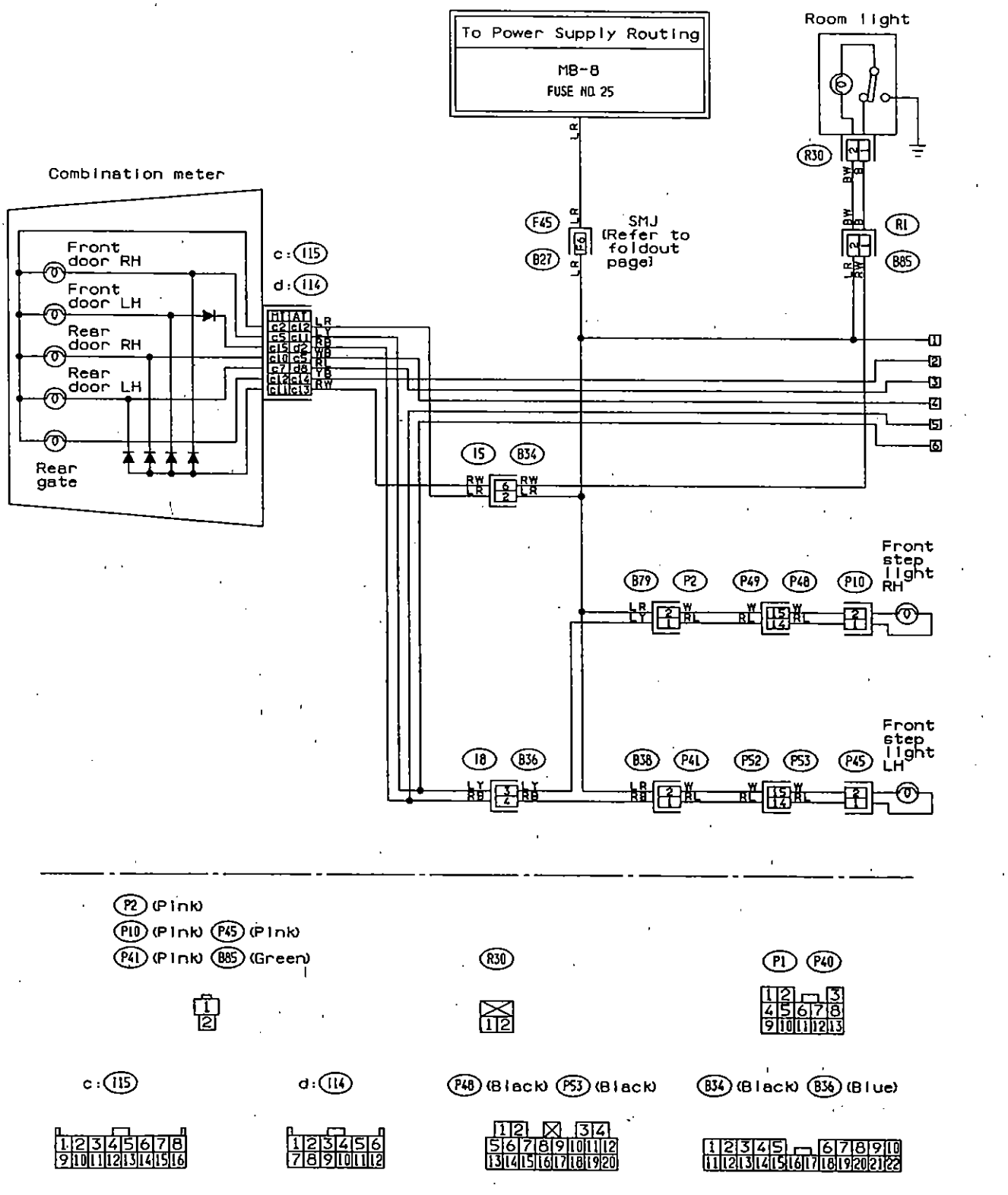
BU24-03A


R18
Rear door switch LH
R19
Rear door switch RH
R14
Front door switch LH
R23
Front door switch RH
B77
R3
132
R4
R52
R51
R55
R56
R62
Rear gate switch (Wagon)
GB8
GB10
R58
Luggage room light (Wagon)
R57


R51
R62
R18
R14
R19
R23
R56
132
B77 (Black)

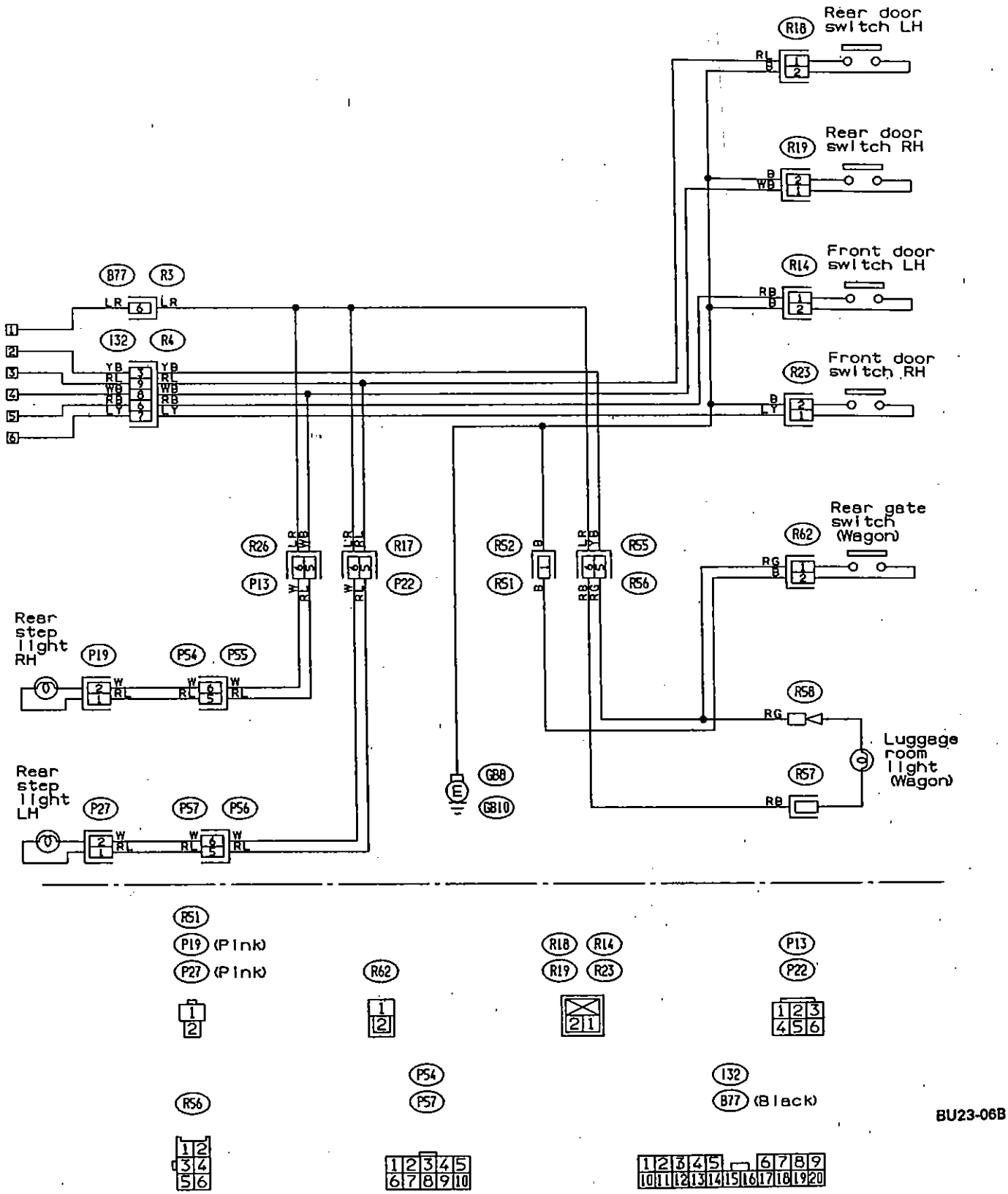
BU24-03B

S.I.A. MODEL



BU23-06A

Fig. 36


Rear door switch LH
R18
Rear door switch RH
R19
Front door switch LH
R14
Front door switch RH
R23
Rear gate switch (Wagon)
R62
B77
R3
132
R4
R26
P13
R17
P22
R52
R51
R55
R56
Rear step light RH
P19
P54
P55
Rear step light LH
P27
P57
P56
G88
G810
R58
R57
Luggage room light (Wagon)
R51
P19 (Pink)
P27 (Pink)
R62
R18
R14
R19
R23
P13
P22
R56
P54
P57
132
B77 (Black)
BU23-06B

8. STOP LIGHT

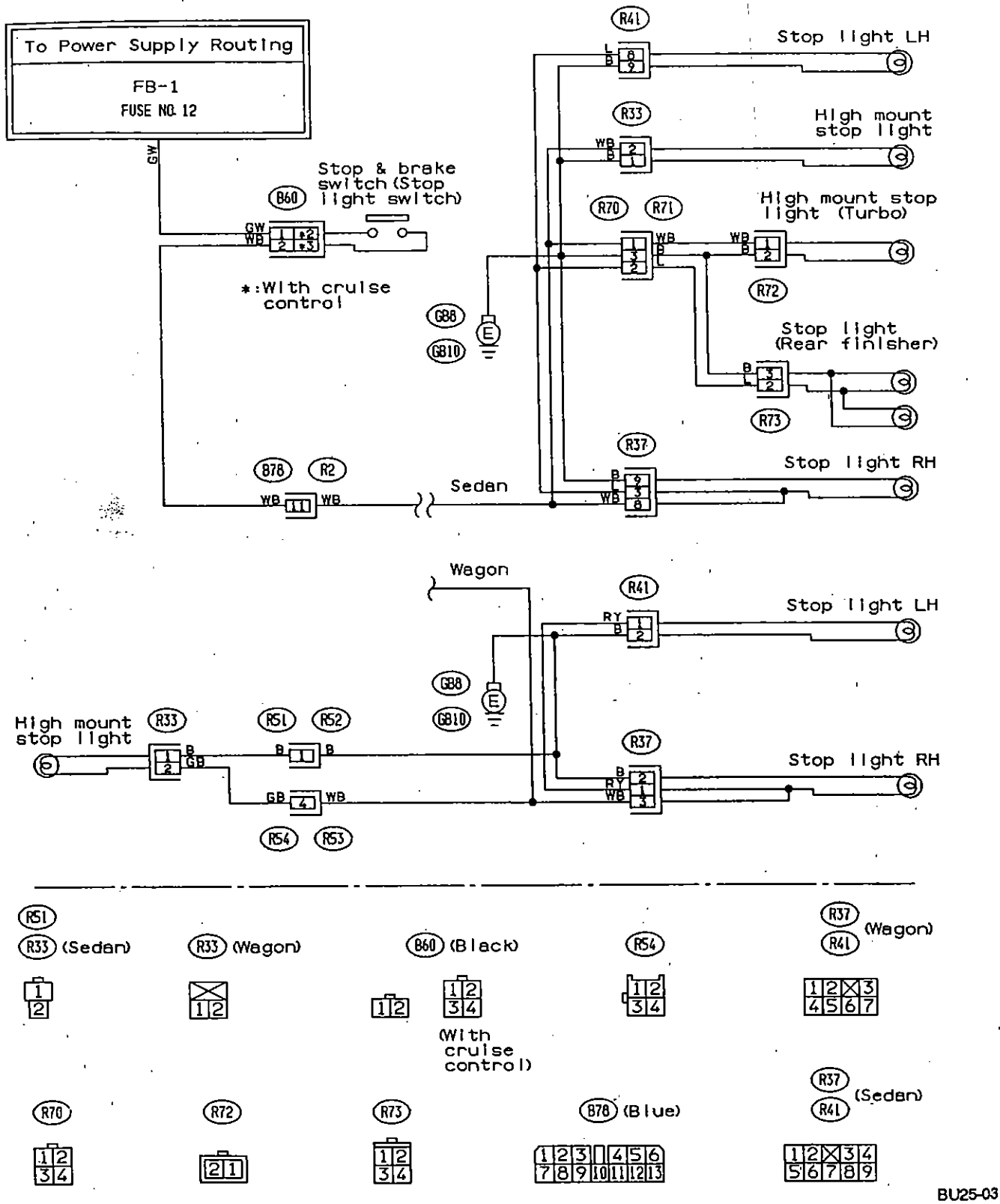


Fig. 37

9. TURN SIGNAL AND HAZARD

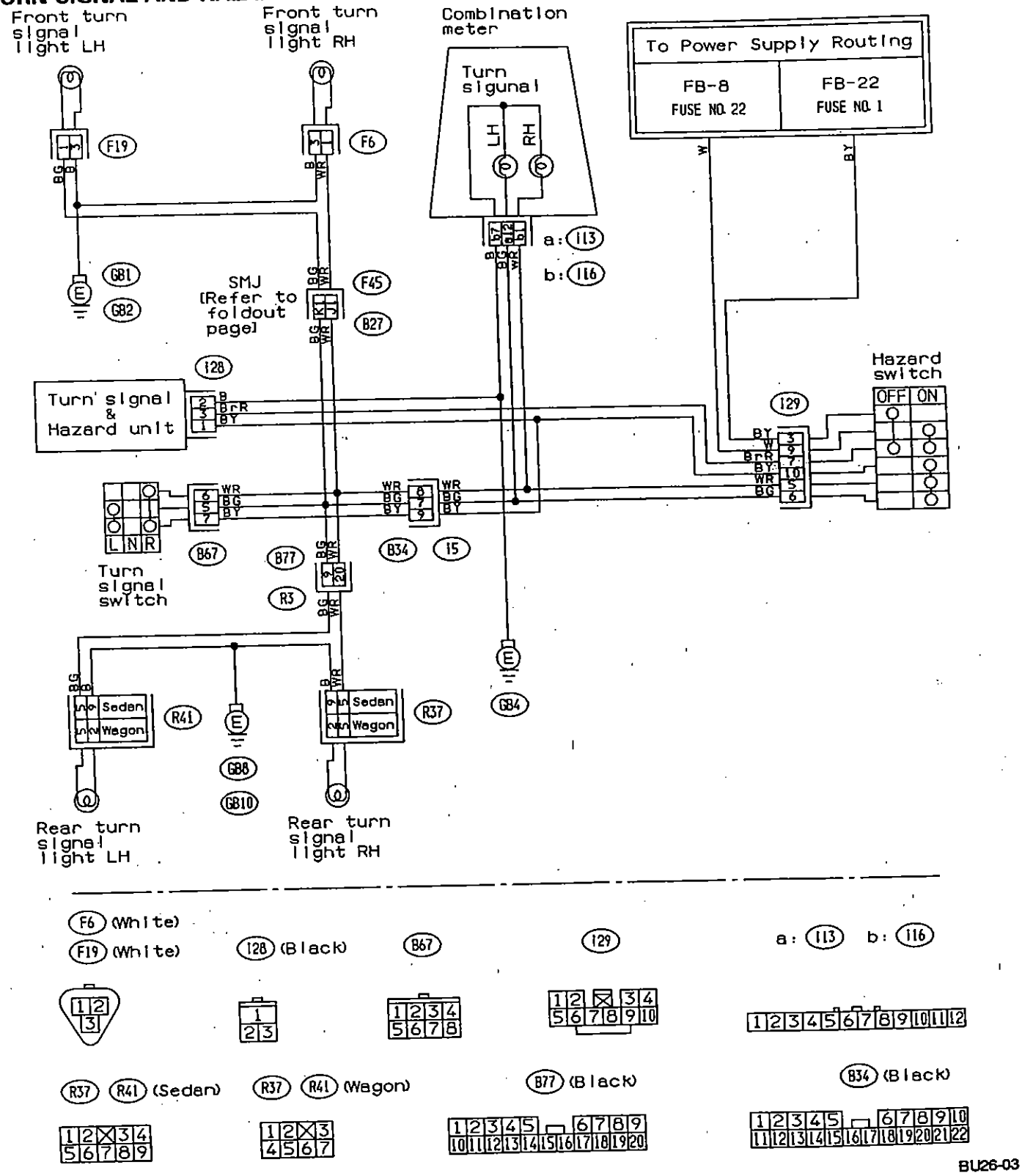
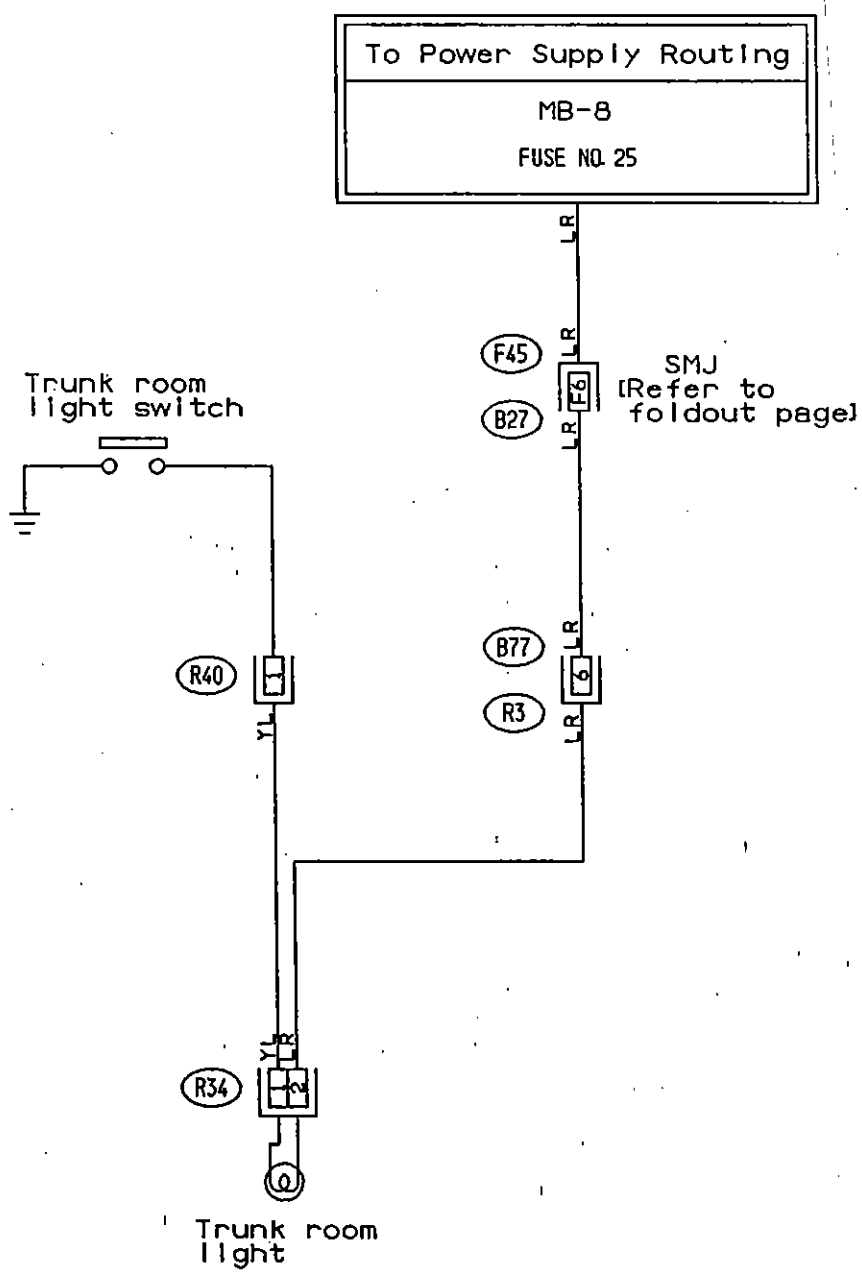


Fig. 38

10. TRUNK ROOM LIGHT



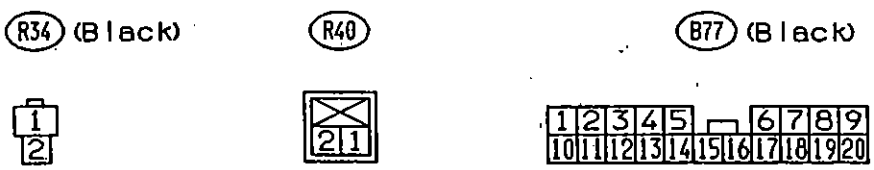


Fig. 39

11. BACK-UP LIGHT

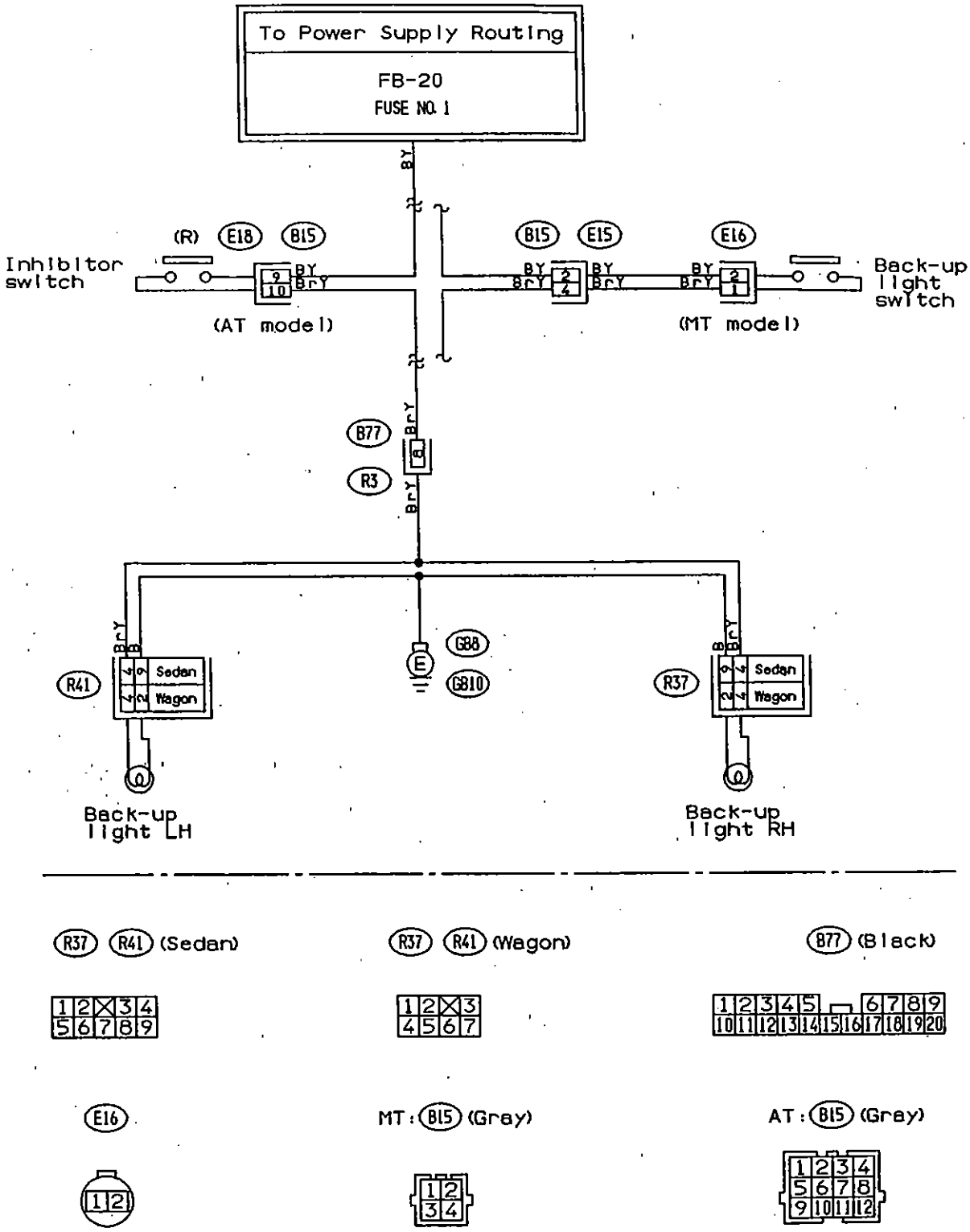
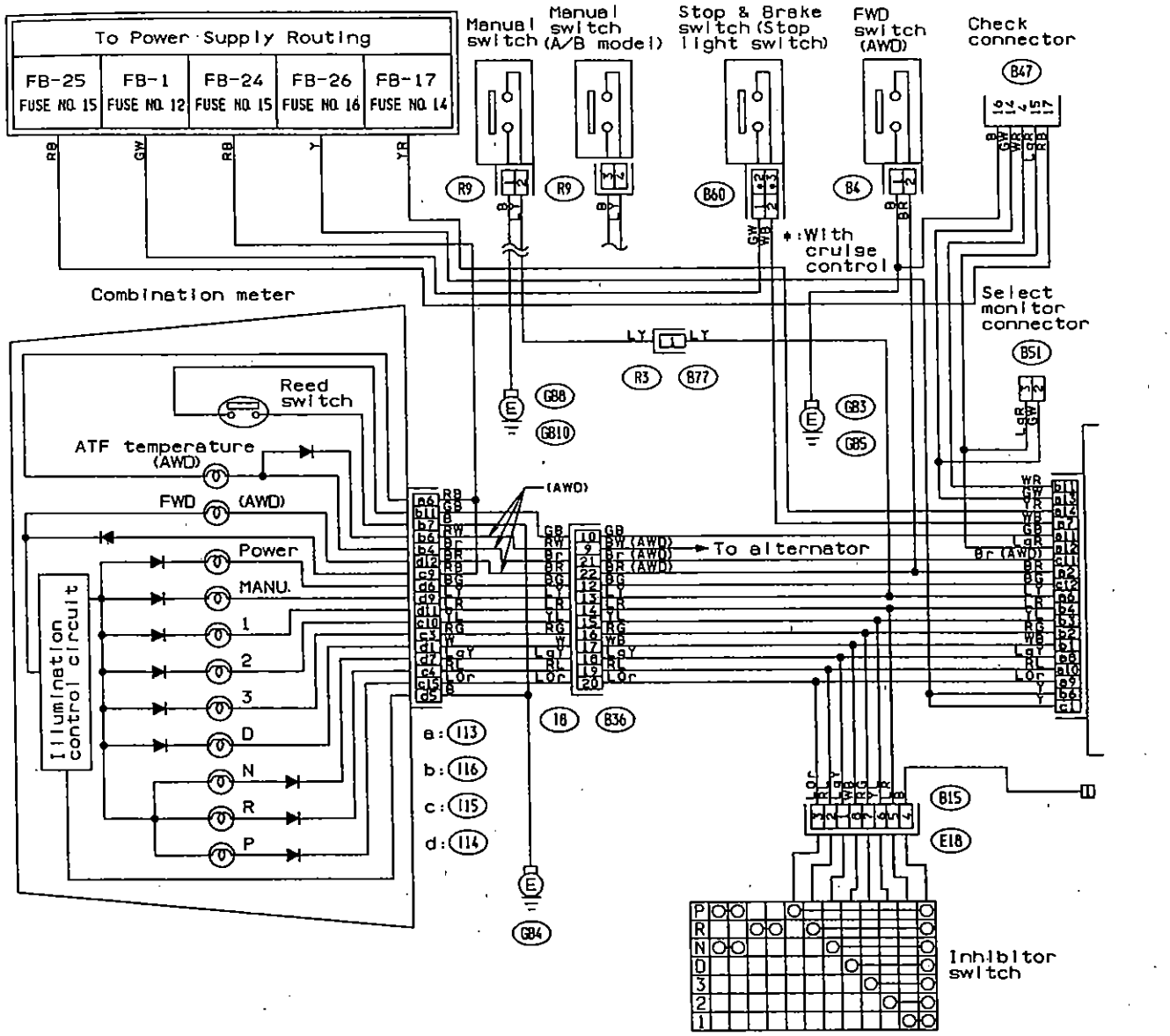
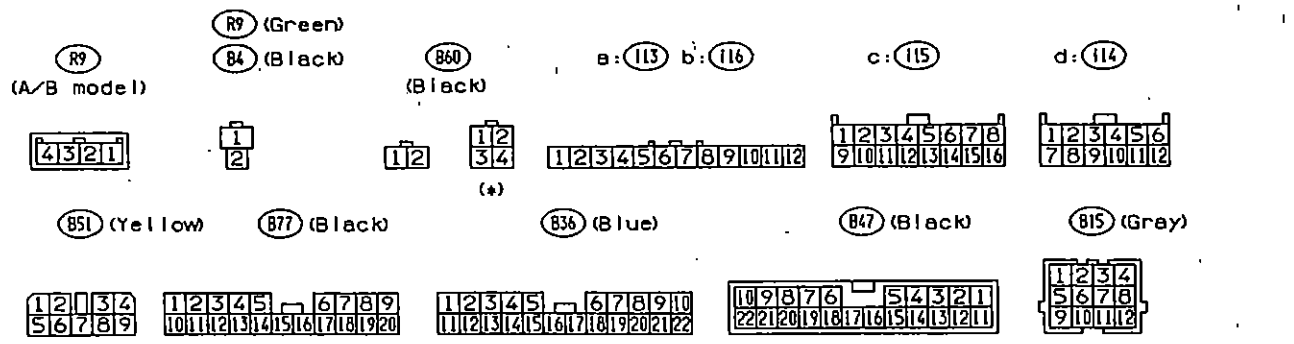


Fig. 40

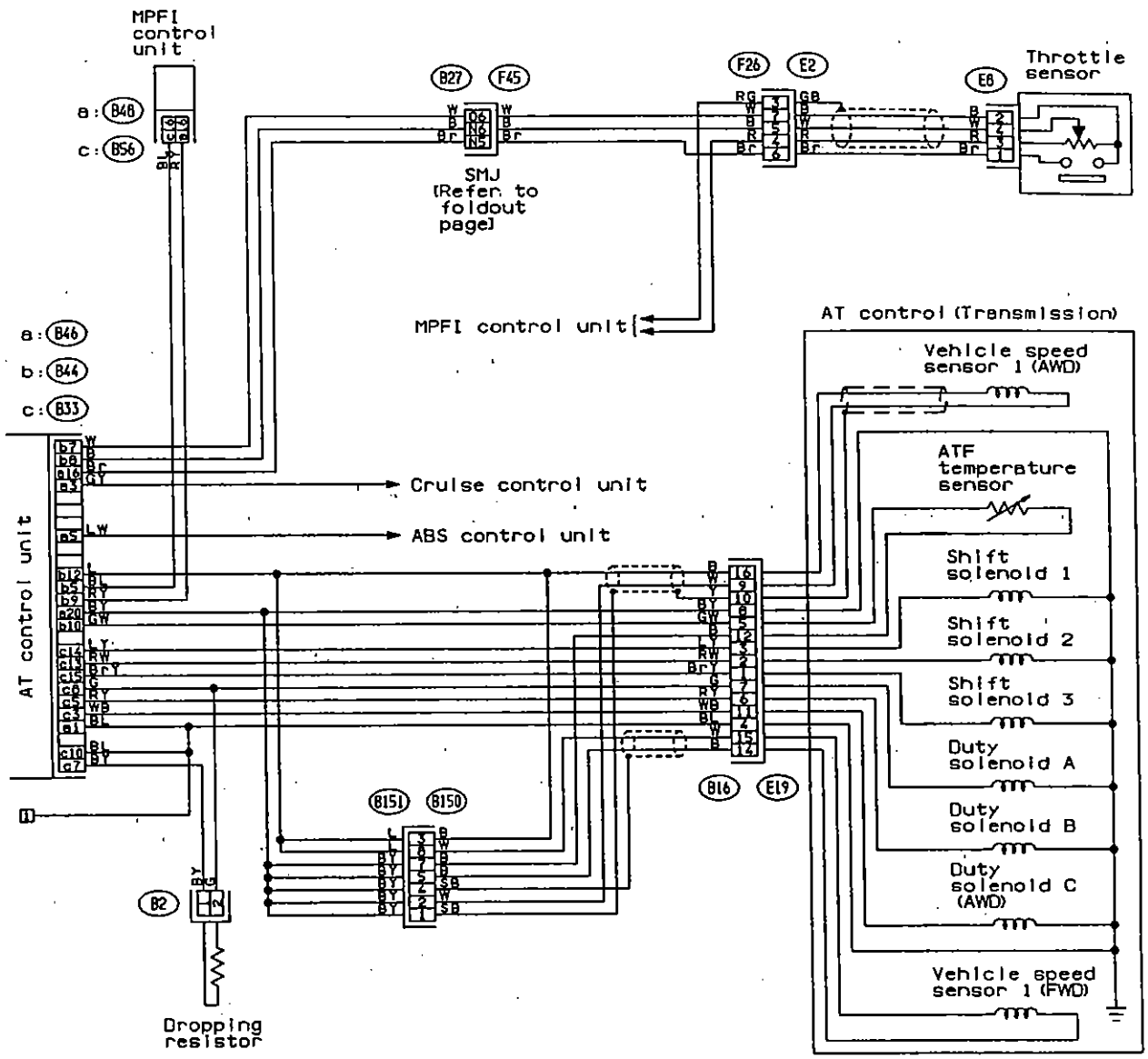
12. A/T CONTROL
NA (WITHOUT AIR SUSPENSION)

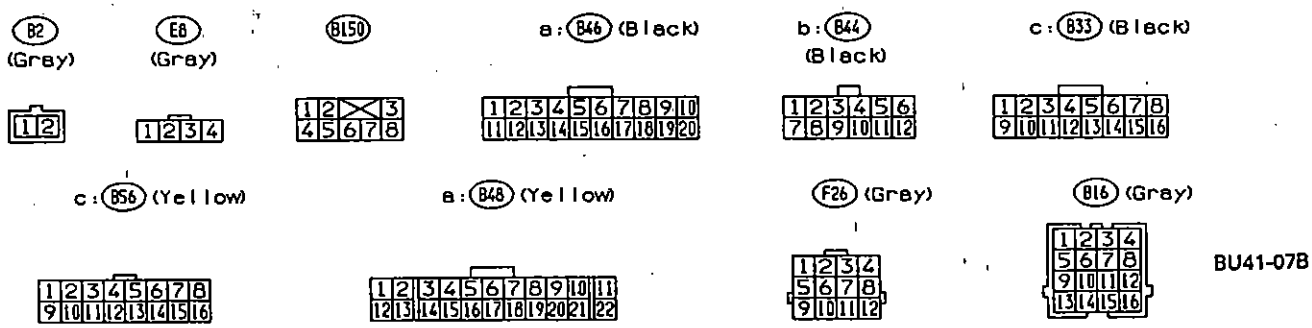




BU41-07A

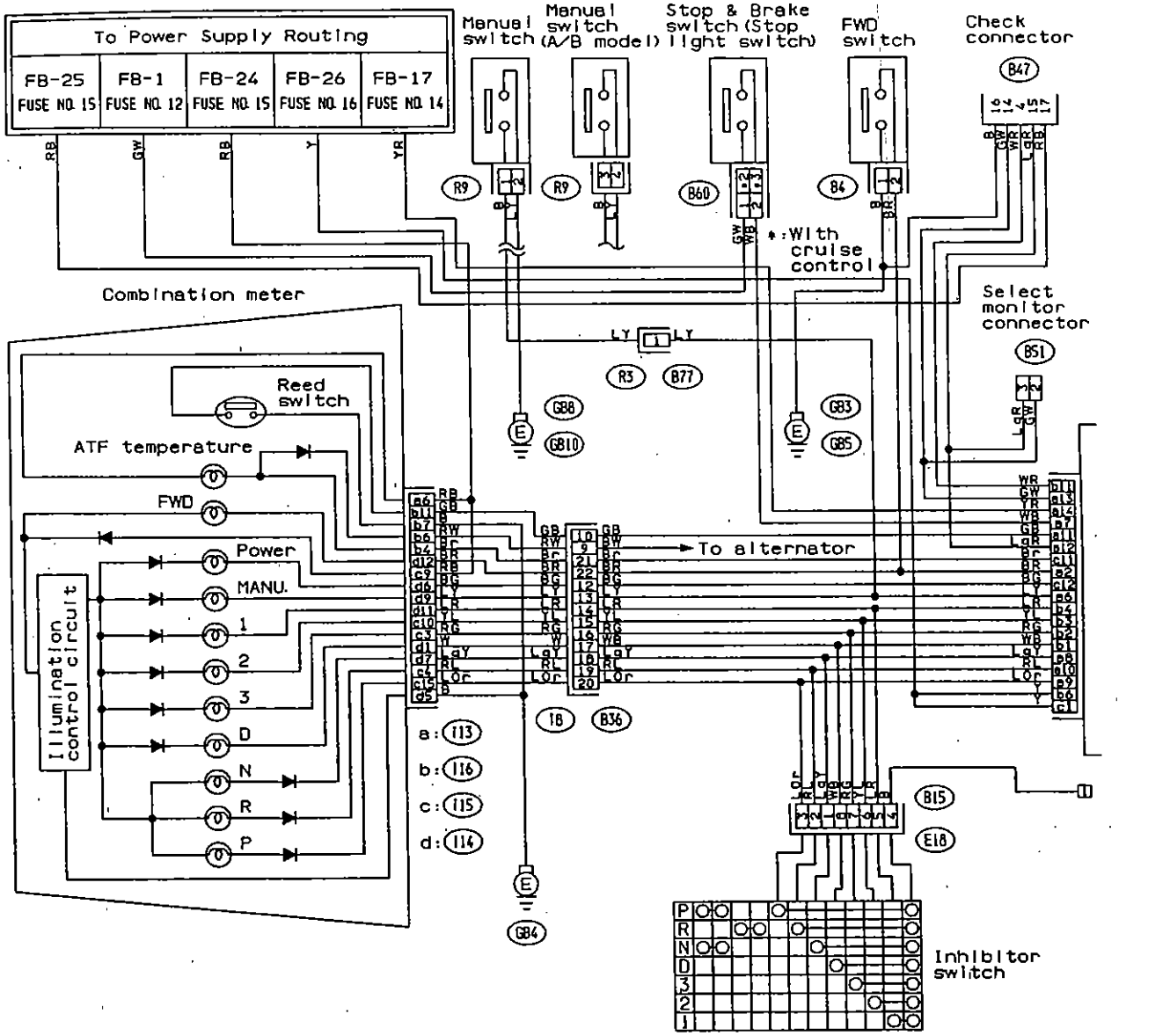
Fig. 41


MPFI control unit
a: B48
c: B56
B27
F45
SMJ (Refer to foldout page)
F26
E2
E8
Throttle sensor
MPFI control unit
AT control (Transmission)
a: B46
b: B44
c: B33
AT control unit
Cruise control unit
ABS control unit
Vehicle speed sensor 1 (AWD)
ATF temperature sensor
Shift solenoid 1
Shift solenoid 2
Shift solenoid 3
Duty solenoid A
Duty solenoid B
Duty solenoid C (AWD)
Vehicle speed sensor 1 (FWD)
B16
E19
B151
B150
B2
Dropping resistor


B2 (Gray)
E8 (Gray)
B150
a: B46 (Black)
b: B44 (Black)
c: B33 (Black)
c: B56 (Yellow)
a: B48 (Yellow)
F26 (Gray)
B16 (Gray)

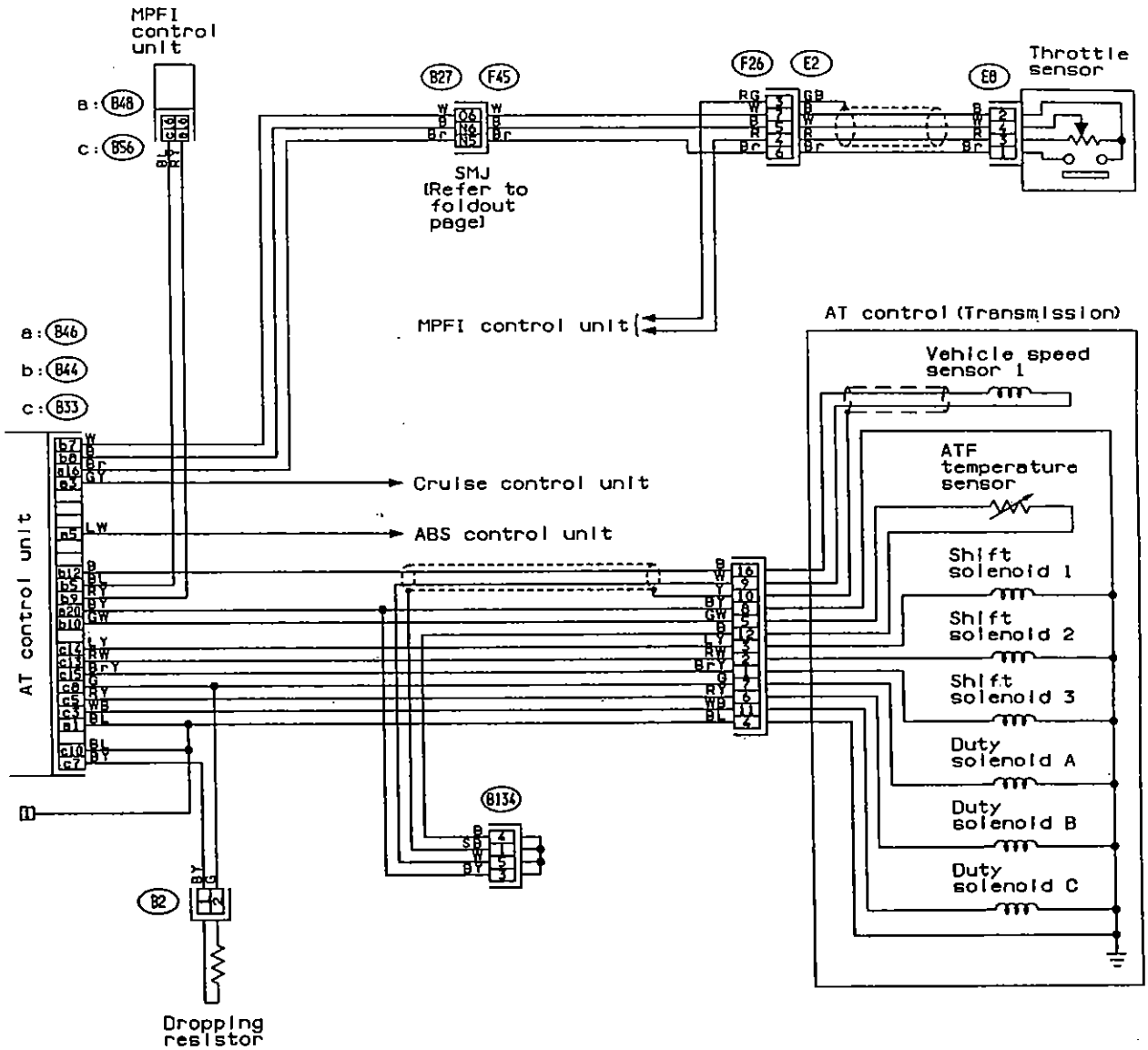
BU41-07B

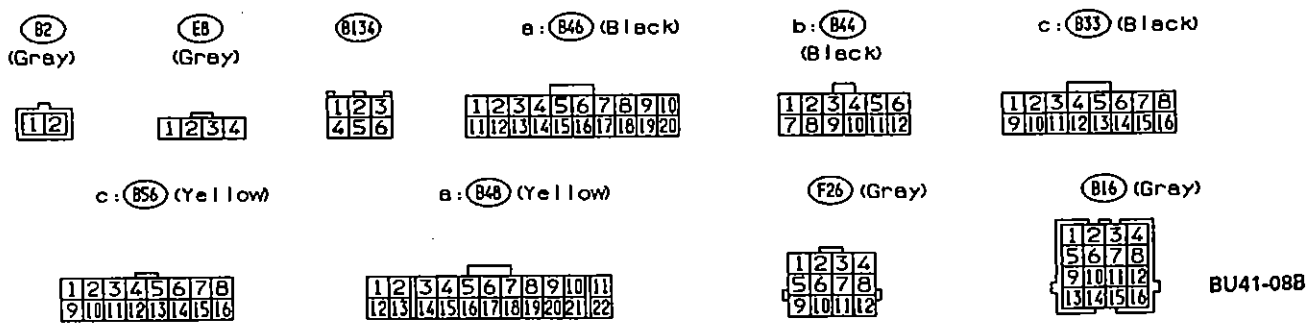
TURBO AND AIR SUSPENSION MODEL



BU41-08A

Fig. 42


MPFI control unit
a: B48
c: B56
B27
F45
SMJ (Refer to foldout page)
F26
E2
E8
Throttle sensor
MPFI control unit
AT control (Transmission)
Vehicle speed sensor 1
ATF temperature sensor
Shift solenoid 1
Shift solenoid 2
Shift solenoid 3
Duty solenoid A
Duty solenoid B
Duty solenoid C
a: B46
b: B44
c: B33
AT control unit
Cruise control unit
ABS control unit
B134
B2
Dropping resistor


B2 (Gray)
E8 (Gray)
B134
a: B46 (Black)
b: B44 (Black)
c: B33 (Black)
c: B56 (Yellow)
a: B48 (Yellow)
F26 (Gray)
B16 (Gray)

BU41-08B

13. A/T SHIFT LOCK

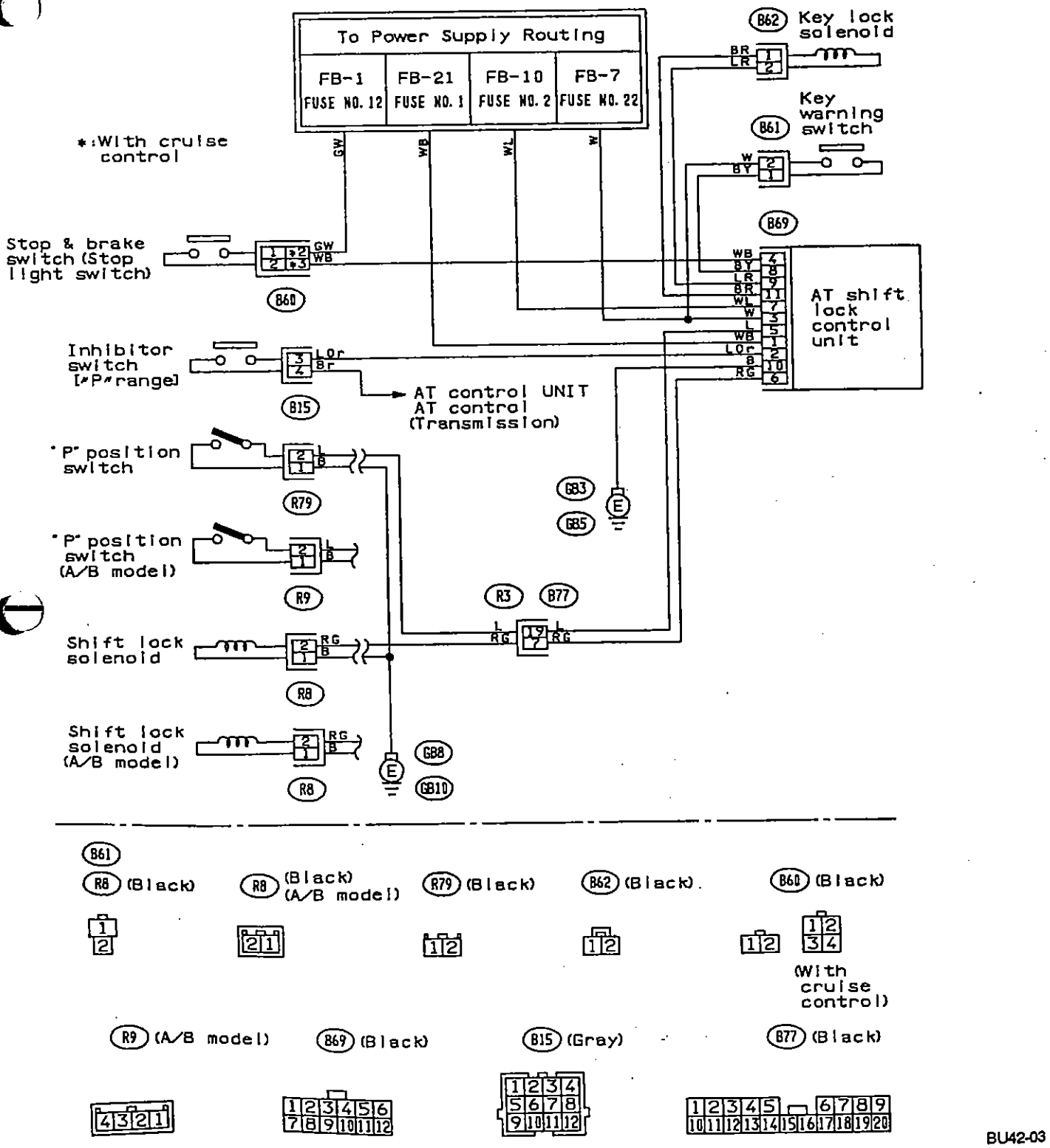
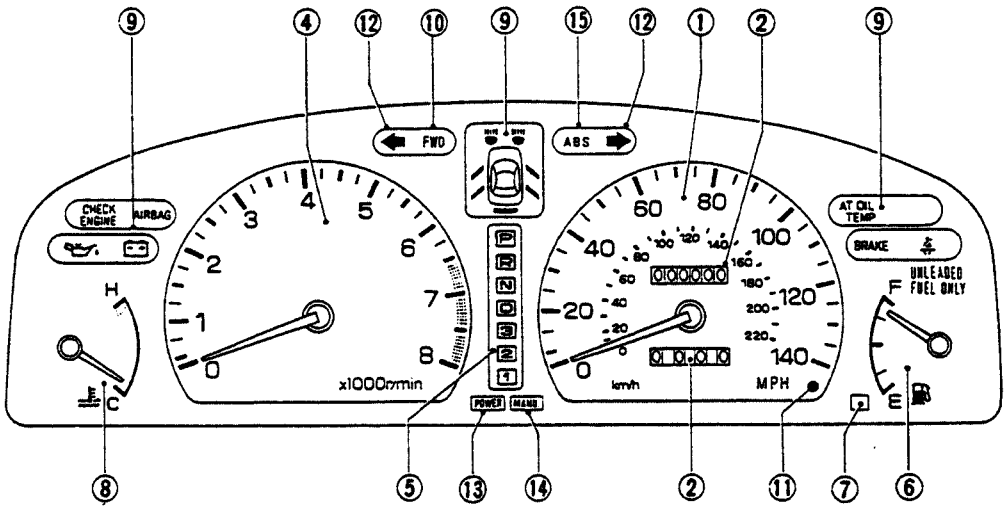
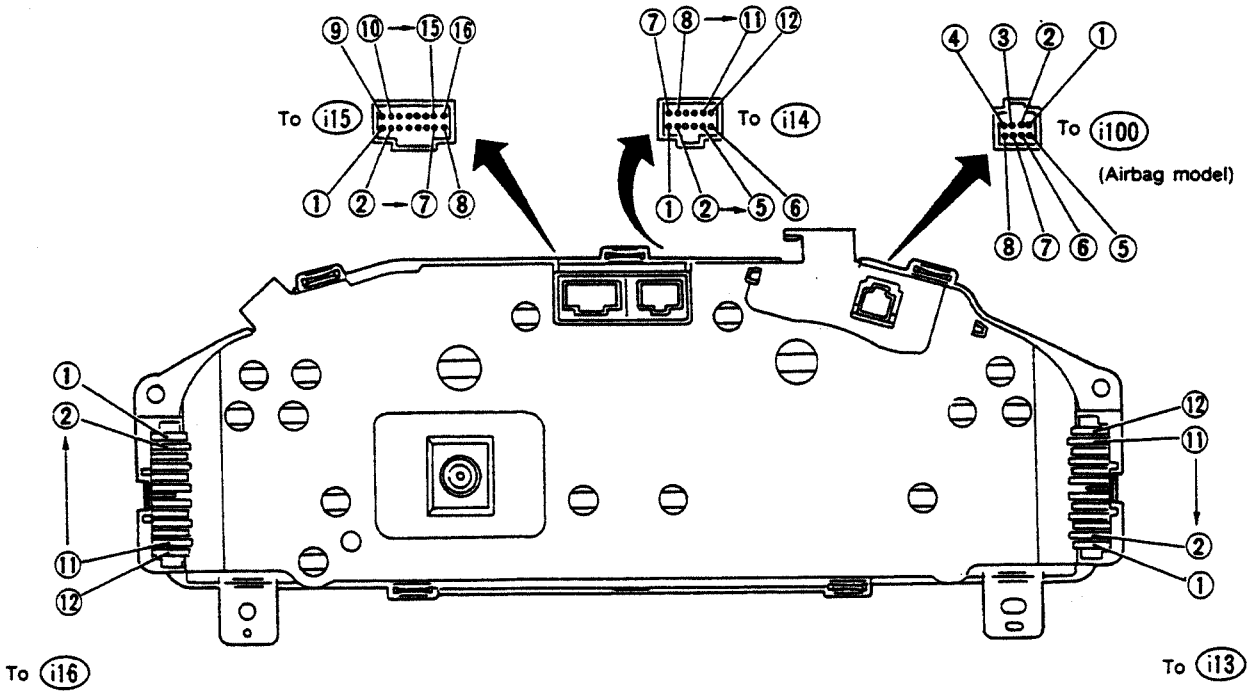


Fig. 43

20. COMBINATION METER



1 Speedometer
2 Odometer
3 Trip meter
4 Tachometer
5 Shift position indicator
6 Fuel gauge
7 Low fuel warning light
8 Temperature gauge
9 Warning and indicator light
10 FWD warning light
11 Reset button
12 Turn signal indicator light
13 Power indicator light
14 Manual indicator light
15 ABS warning light



B6-701

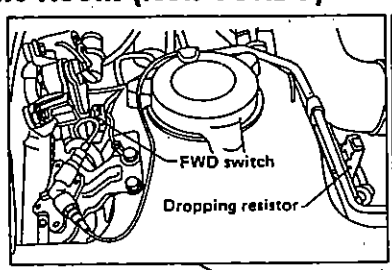
Fig. 50-1

4 SENSOR•VALVE•SOLENOID•ETC.

ABS G-sensor (Non-TURBO)	Fig.83-5
ABS G-sensor (TURBO)	Fig.84-5
A/S charge solenoid	Fig.83-6
A/S compressor	Fig.83-6
Blower motor resistor	Fig.86-3
By-pass air control valve	Fig.85-2
Cam angle sensor	Fig.85-5
CPC solenoid	Fig.85-1
Crank angle sensor	Fig.85-6
Cruise control pump (Non-TURBO)	Fig.83-5
Cruise control pump (TURBO)	Fig.84-5
Daytime running light resistor (Non-TURBO)	Fig.83-4
Dropping resistor (Non-TURBO)	Fig.84-4
Dropping resistor (TURBO)	Fig.84-4
Fuel gauge unit	Fig.86-1
Igniter (Non-TURBO)	Fig.83-1

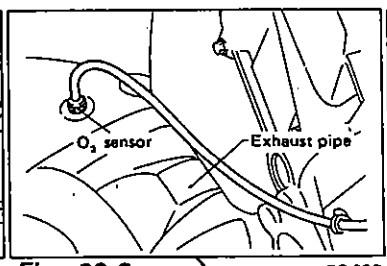
Igniter (TURBO)	Fig.84-1
Key-lock solenoid	Fig.86-5
Knock sensor	Fig.85-4
Mode actuator	Fig.86-4
Pressure exchange solenoid valve	Fig.84-3
Pressure sensor	Fig.84-3
P/W circuit breaker	Fig.86-6
O_2 sensor (Non-TURBO)	Fig.83-2
O_2 sensor (TURBO)	Fig.84-2
Shift-lock solenoid	Fig.86-2
Thermometer	Fig.85-2
Throttle sensor	Fig.85-3
Water temperature sensor	Fig.85-2
Waste gate control solenoid	Fig.84-3

(1) Engine Room (Non-TURBO)



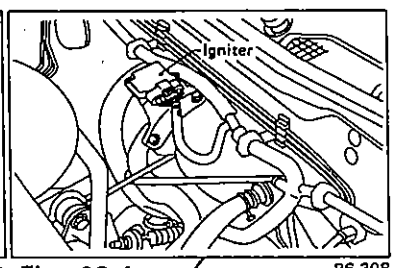
B6-305

Fig. 83-3



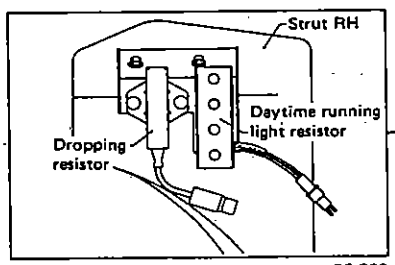
B6-337

Fig. 83-2



B6-308

Fig. 83-1



B6-329

Fig. 83-4

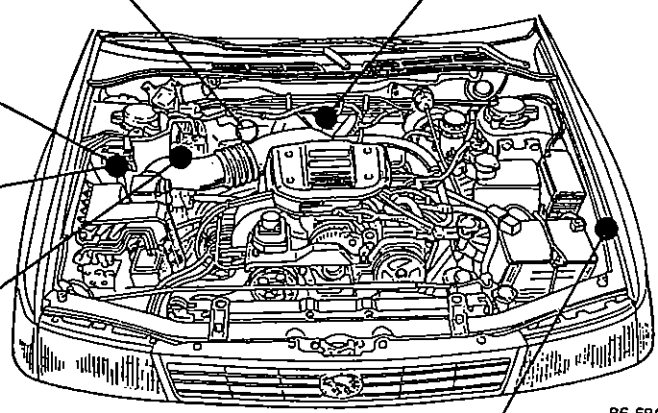
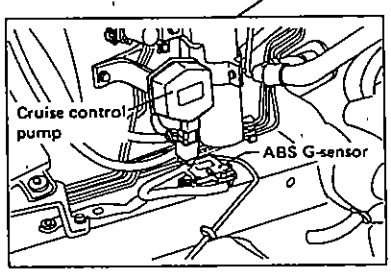
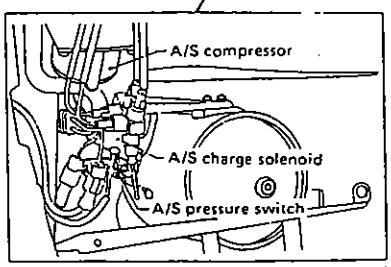

B6-680

Fig. 83



B6-307

Fig. 83-5



B6-315

Fig. 83-6

B6-680E

(2) Engine Room (TURBO)

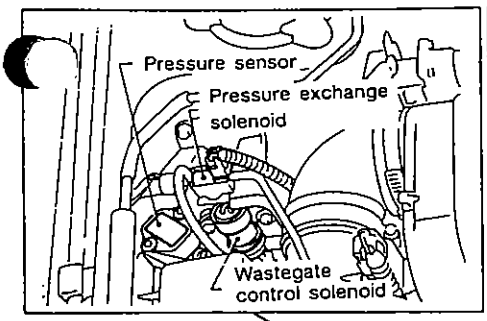


Fig. 84-3 B6-677

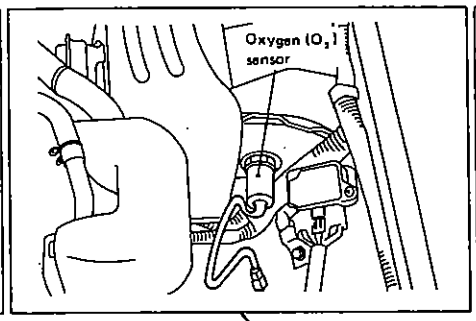


Fig. 84-2 B2-657

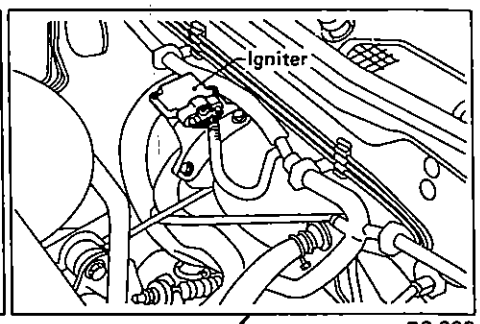


Fig. 84-1 B6-308

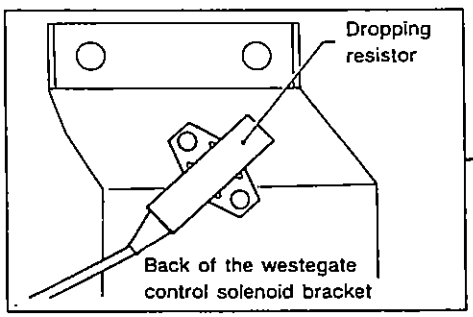
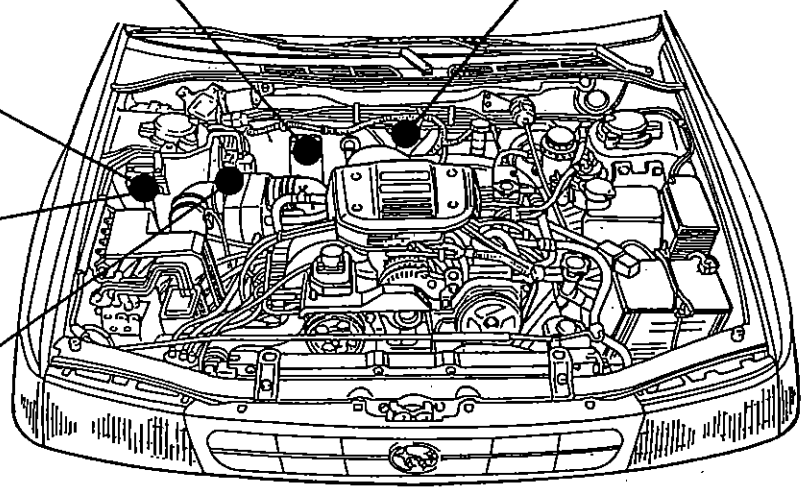


Fig. 84-4 B6-678



B6-679

Fig. 84

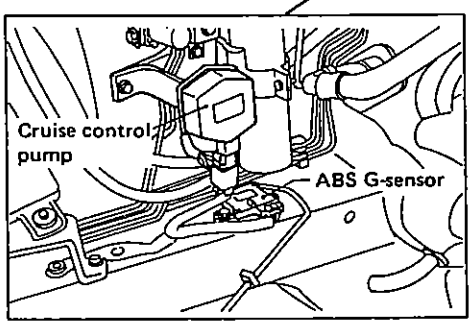


Fig. 84-5 B6-307

B6-679C

Fig. 84

(3) Engine

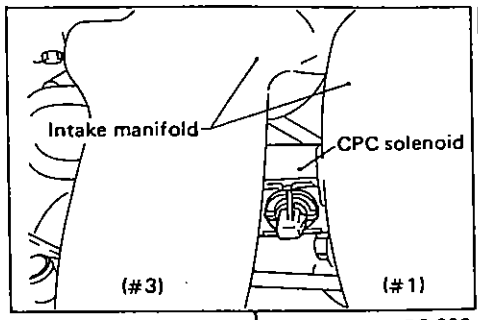


Fig. 85-1 B6-338

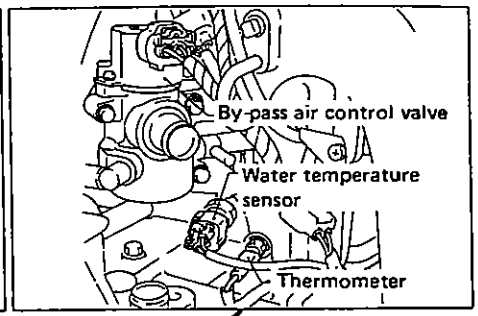


Fig. 85-2 B6-310

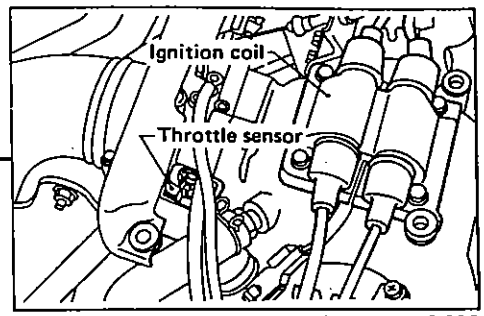


Fig. 85-3 B6-309

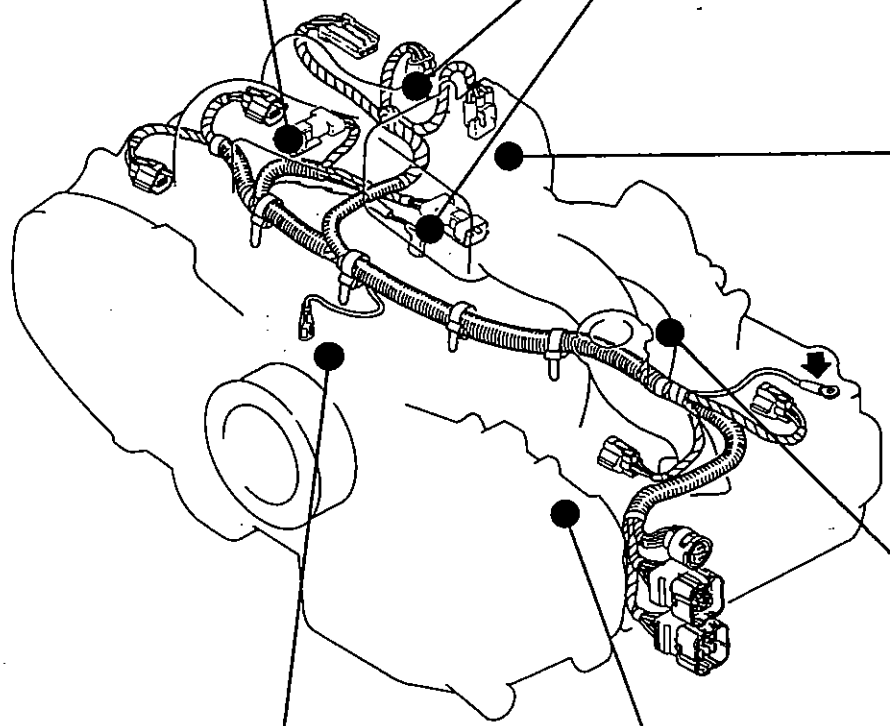


Fig. 85 B6-703

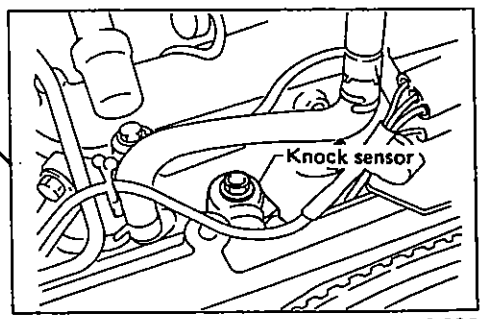


Fig. 85-4 B6-336

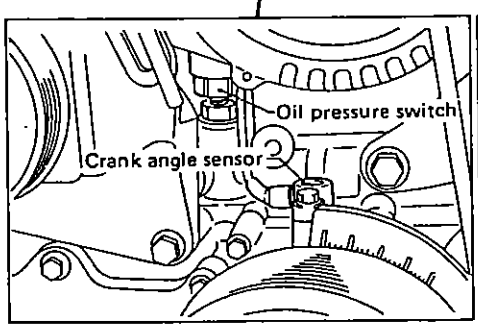


Fig. 85-6 B6-334

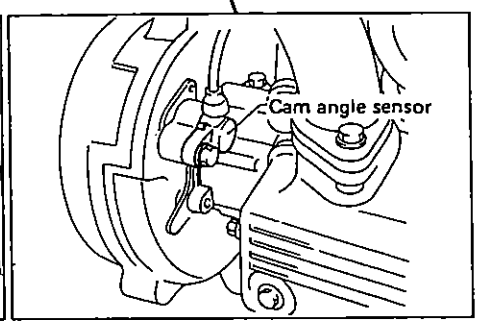


Fig. 85-5 B6-335

B6-703C

ector		Connecting to	
Color	Area	No.	Name
Gray	B—1		Air flow meter
Gray	B—2		Dropping resistor (AT)
Black	B—2		A/C pressure switch
Black	A—2		FWD switch (AT)
Gray	A—2		A/S front solenoid RH
Gray	A—2		A/S front sensor RH
	A—2		Wiper motor
Gray	A—3		Ignitor
Gray	B—3		Brake fluid level sensor
Black	A—3		A/S compressor relay
Gray	B—4		A/S front solenoid LH
Gray	B—3		A/S front sensor LH
Gray	B—3		ABS front sensor LH
Black	B—3		Starter (Magnet)
Gray	B—3	E18	Transmission (AT)
Gray	B—3	E15	Transmission cord (MT)
Gray	B—3	E19	Transmission (AT)
Gray	B—2		Cam angle sensor
Gray	B—2		Crank angle sensor
Gray	B—2		Knock sensor
Gray	B—2		O_2 sensor
Gray	B—2		Cruise control pump
Gray	B—2		ABS front sensor RH
Black	B—2		ABS G-sensor (MT)
Brown	B—2		Pressure exchange solenoid valve (Turbo model)
Gray	B—1		Pressure sensor (Turbo model)
Black	B—2		Wastegate control solenoid valve (Turbo model)
Gray	B—2		Daytime running light resistor (CANADA model)

2. BULKHEAD WIRING

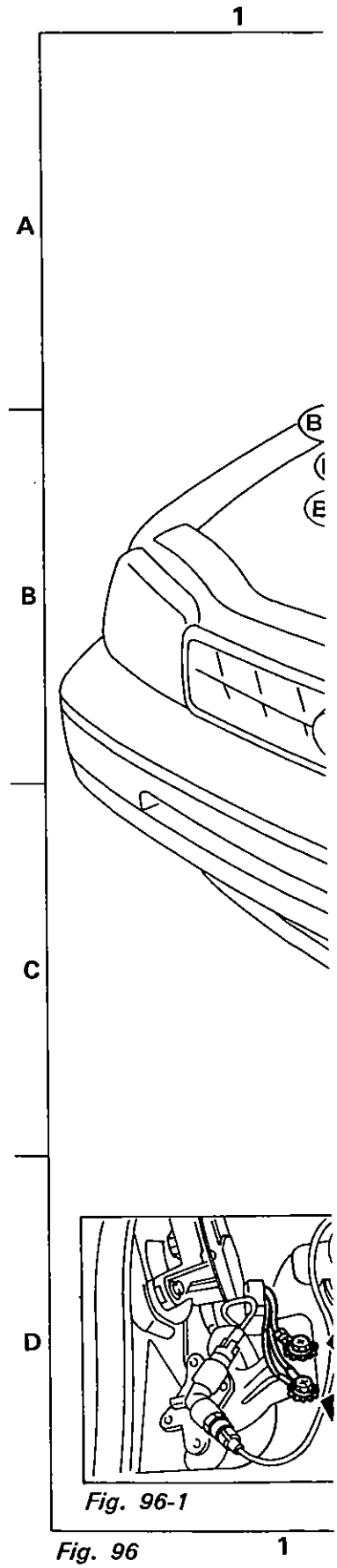


Fig. 96-1

Fig. 96 1

ARNESS AND GROUND POINT

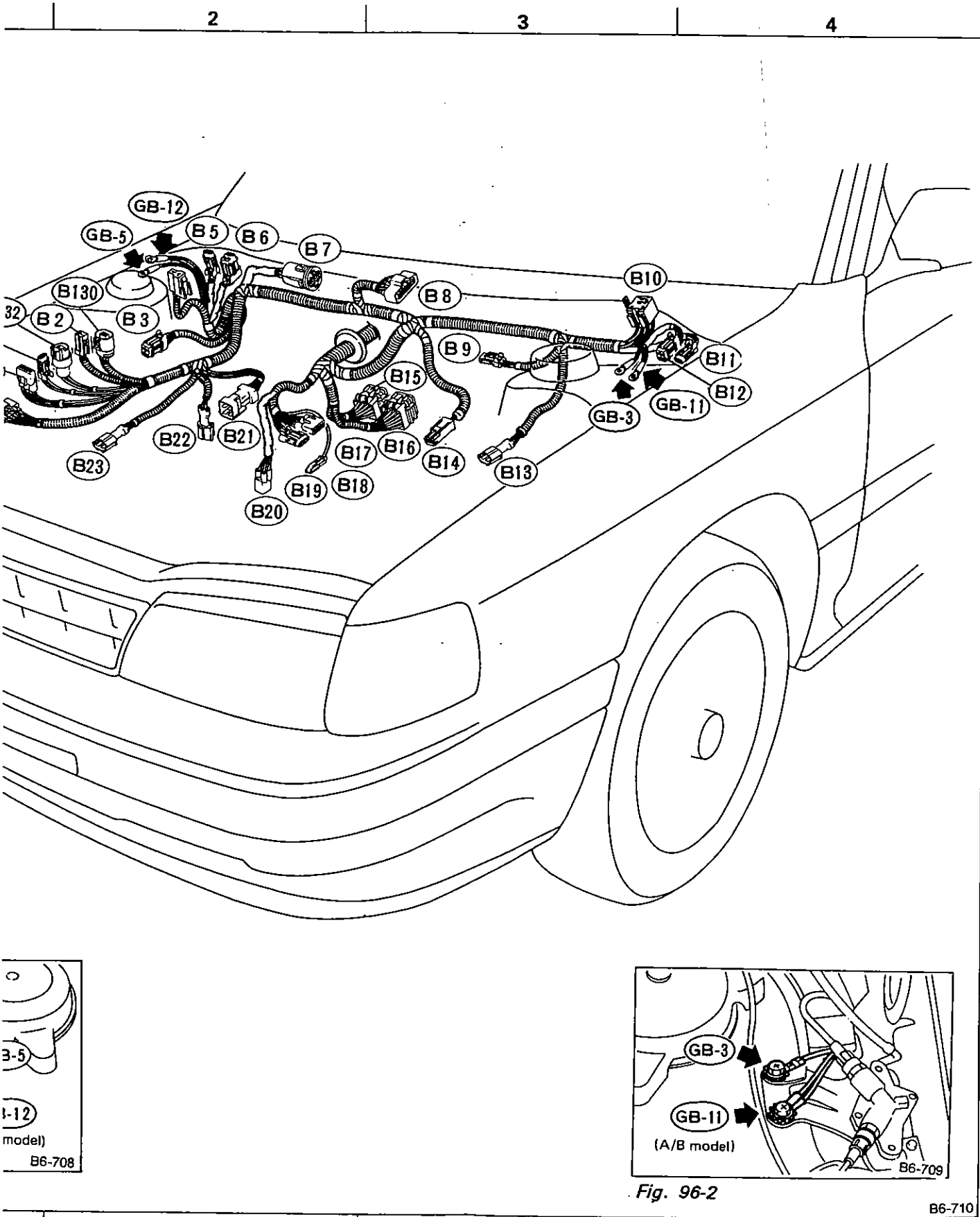


Fig. 96-2

Connector			Connecting to	
le	Color	Area	No.	Name
	Gray	C—3	F25	Front LH wiring harness
	Gray	B—3	F26	
	Gray	B—3	F27	Front LH wiring harness (Turbo model)
	Gray	B—3		Injector #2
	Gray	B—3		Injector #4
		A—2		Thermometer
	Brown	A—2		Water temperature sensor
	Gray	A—3		Throttle sensor
	Gray	A—2		By-pass air control valve
	Gray	A—2		Ignition coil
	Blue	A—2		CPC solenoid
	Gray	A—2		Injector #3
	Gray	A—2		Injector #1
	Black	B—2		Oil pressure switch

Connector			Connecting to	
ıle	Color	Area	No.	Name
	Gray	C—2	B15	Bulkhead wiring harness (MT)
		D—2		Back-up light switch (MT)
	Black	D—2		Neutral switch (MT)
2	Gray	D—3	B15	Bulkhead wiring harness (AT)
6	Gray	D—3	B16	

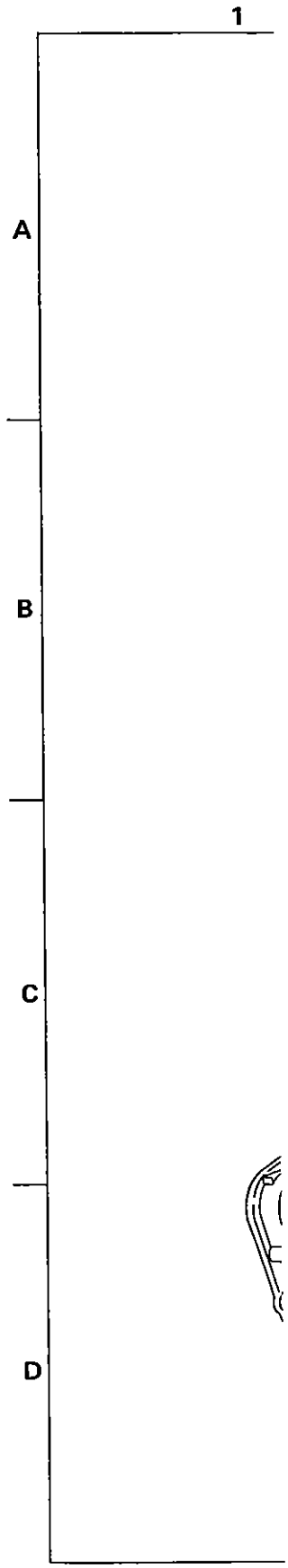


Fig. 97 1

SS • TRANSMISSION CORD AND GROUND POINT

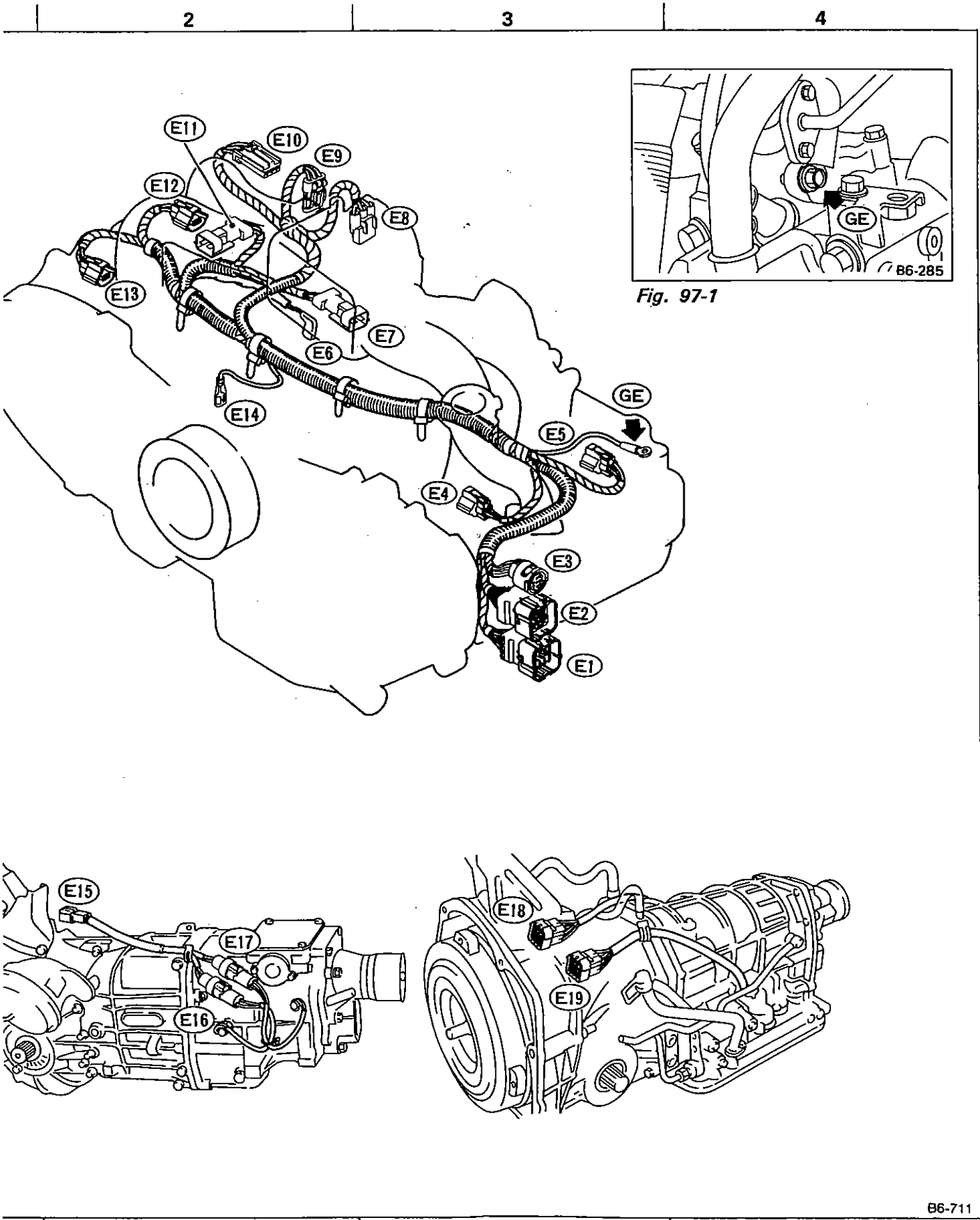


Fig. 97-1

Area	Connecting to No.	Name
		Automatic shoulder belt limit switch LH
B—2	·46	Front wiring harness
B—1	P42	Power window main harness (SMJ)
B—2	F45	Front wiring harness (SMJ)
B—1		Blower relay
B—1		Ignition relay
B—1		Fuel pump relay
B—1	R11	Sunroof cord
C—1		AT control unit
C—1	I5	Instrument panel wiring harness
C—1	I7	
C—1	I8	
C—1	I9	
C—1	P41	Front door cord LH
C—1	P40	
C—1	P39	Power window main harness
C—1		F/B
C—1		
C—1		AT control unit
B—2		Clutch switch (MT)
C—1		AT control unit
C—3		Check connector
C—2		MPFI control unit
B—3		Select monitor connector
C—2	B53	Test mode connector
C—2	B52	
C—2	B55	Read memory connector
C—2	B54	
C—2		MPFI control unit
C—2		MPFI control unit
B—	?57	Shield joint connector
		Stop and Brake switch (with cruise control)
B—2		Stop light switch
C—2		Key warning switch
C—2		Key lock solenoid
C—2		Ignition switch
C—2		Combination switch
C—2		Cruise control sub-switch
C—2		Combination switch
C—2		Combination switch (Lighting switch)
B—3		AT shift lock control unit
B—3		Diode (Lighting)
B—3		Evaporator thermoswitch
B—3		A/C cut relay
B—4		FRESH/RECIRC actuator
B—4		Blower motor resistor
B—4		Blower motor
C—4	R3	Rear wiring harness
C—4	R2	
B—4	P2	Front door cord RH
B—4	P1	

Connector No.	Pole	Color	Area	Connecting to No.	Name
B81	4		B—4		Cruise control unit
B82	20		B—4		
B83	4	White	B—4		Inhibitor relay (AT-cruise control)
B84	4	Black	B—4		Main relay (Cruise control)
B85	2	Green	B—4	R1	Room light cord
B86	3	Black	B—1		Horn relay
B87	2		A—4		Automatic shoulder belt limit switch RH
B88	2	Blue	B—2		Clutch switch (MT-cruise control)
B89	10	Brown	B—2		Mode actuator
B90	1		C—3		Diagnosis terminal (Ground)
B91	4	Black	C—3		Diagnosis connector
	6	Black	C—3		Diagnosis connector (Airbag model)
B92	4	Blue	B—3		Starter interlock relay (MT)
B93	2	Blue	B—3	I37	Instrument panel wiring harness
B94	2	Black	B—4		Diode (Daytime running light)
B95	2		B—4		Diode (AT-cruise control)
	4	Brown	B—4		Diode (AT-cruise control) (Canada model)
B96	5	Black	B—4		Daytime running light relay (Canada model)
B97	4	Blue	B—4		Daytime running light high beam relay (Canada model)
B98	10		B—4		Daytime running light control unit
B99	2	Blue	C—1		Diode (Seat belt) (Canada model)
B133	6		B—2		Shield joint connector (ABS)
B134	6		C—2		Shield joint connector (AT) (Turubo and air suspension model)
B140	7	Yellow	C—1	AB-1	Airbag harness
B150	8		C—2	B151	Shield joint connector (AT)
B151	8		C—2	B150	

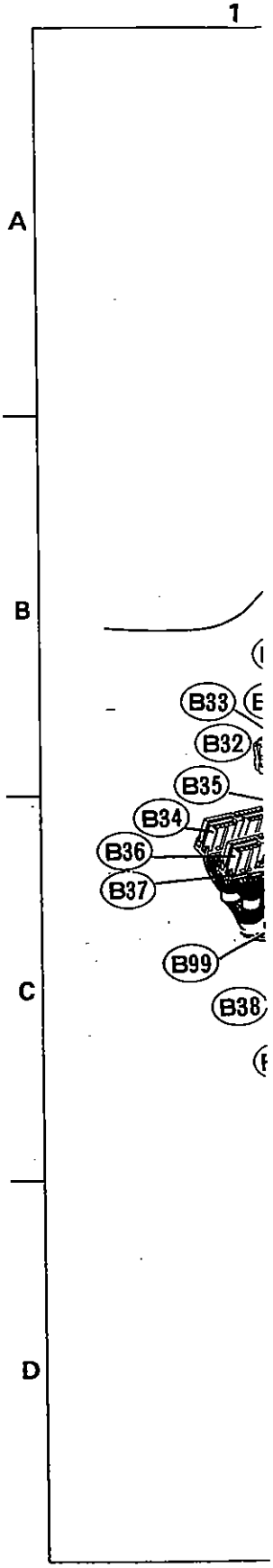
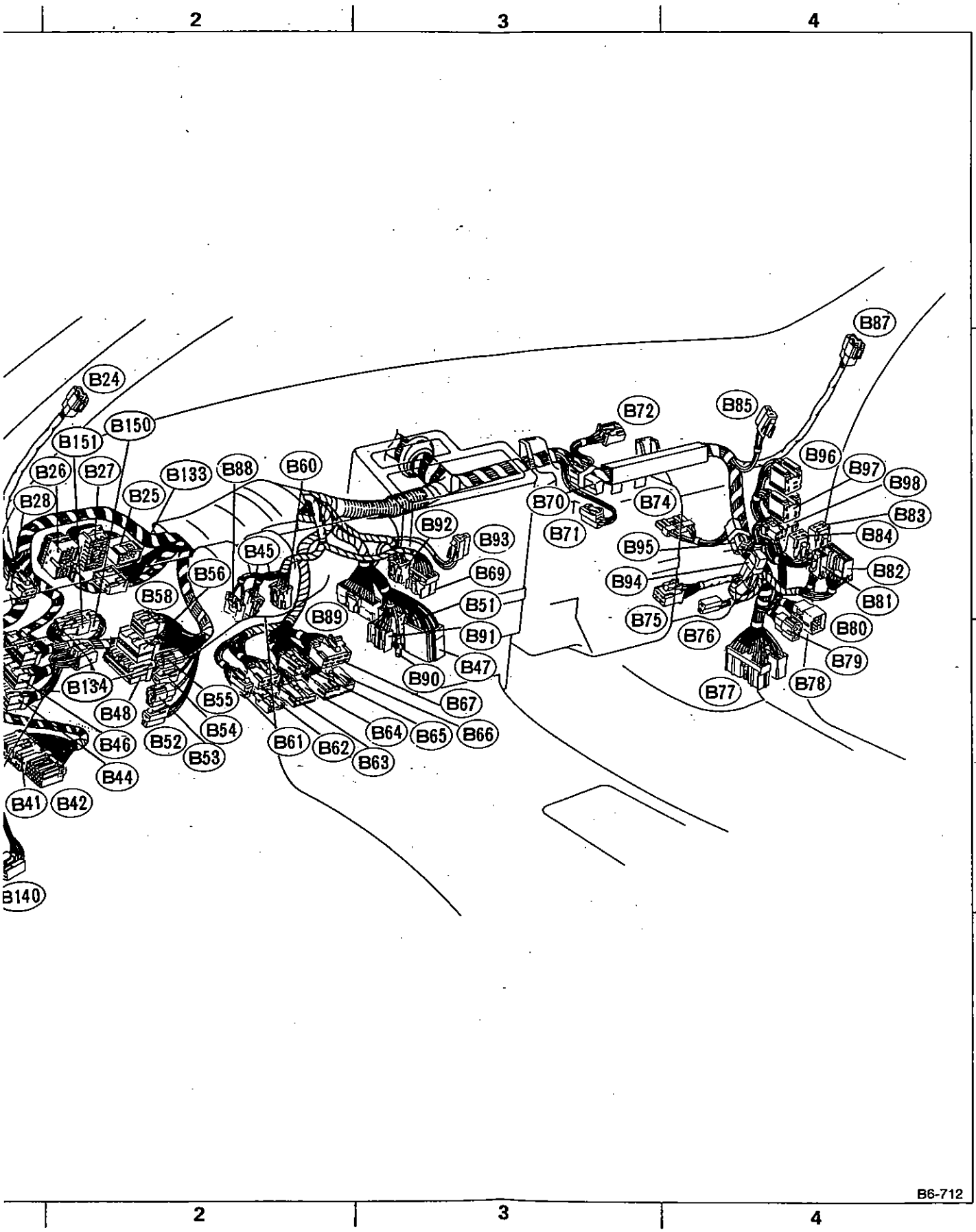
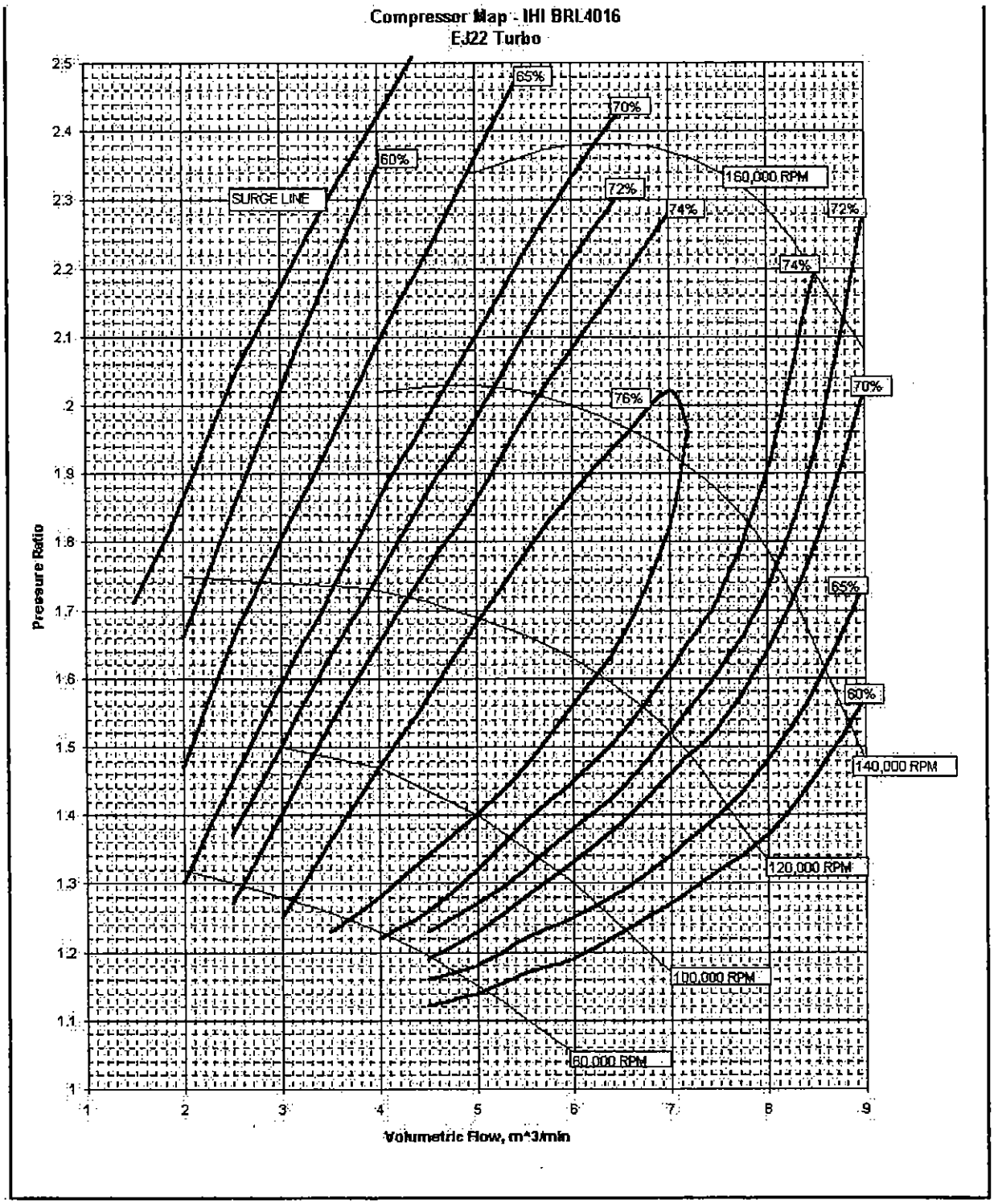


Fig. 98

RNESS


2
3
4
A
B
C
D
B87
B24
B150
B151
B72
B85
B96
B97
B98
B26
B27
B133
B88
B60
B28
B25
B70
B74
B83
B92
B71
B84
B93
B45
B95
B56
B69
B94
B82
B58
B51
B81
B89
B75
B80
B91
B76
B79
B47
B90
B78
B134
B67
B77
B55
B48
B54
B64
B65
B66
B46
B52
B61
B62
B53
B63
B44
B41
B42
B140
B6-712


Compressor Map - IHI BRL4016
EJ22 Turbo
Pressure Ratio
Volumetric Flow, m^3/min
SURGE LINE
65%
70%
60%
72%
74%
160,000 RPM
72%
74%
76%
70%
65%
60%
140,000 RPM
120,000 RPM
100,000 RPM
80,000 RPM
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
1
2
3
4
5
6
7
8
9