SUZUKI

SH410

SUPPLEMENTARY SERVICE MANUAL

USE THIS MANUAL WITH:
SH410 SERVICE MANUAL

99510M70F01-01E

SUZUKI
Caring for Customers
Part No. 99510M70F01-01E
December, 1996 (ENGLISH)

FOREWORD

This SUPPLEMENTARY SERVICE MANUAL is a supplement to SH410 SERVICE MANUAL.

Applicable Model:

SH410 vehicles equipped with Multiport Fuel Injection system and/or Automatic Transmission.

When servicing a vehicle equipped with these systems, consult this supplement first. And for any section, item or description not found in this supplement, refer to the above mentioned SERVICE MANUAL.

When replacing parts or servicing by disassembling, it is recommended to use SUZUKI genuine parts, tools and service materials (lubricants, sealants, etc.) as specified in each description.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. And used as the main subject of description is the vehicle of standard specifications among others. Therefore, note that illustrations may differ from the vehicle being actually serviced. The right is reserved to make changes at any time without notice.

SUZUKI MOTOR CORPORATION

OVERSEAS SERVICE DEPARTMENT

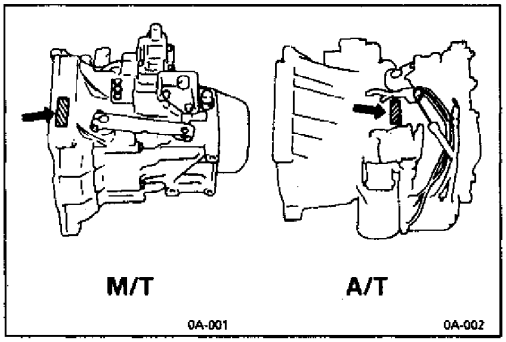
0A

SECTION 0A

GENERAL INFORMATION

NOTE:
For the descriptions (items) not found in this section of this manual, refer to the same section of the service manual mentioned in the FOREWORD of this manual.

CONTENTS



IDENTIFICATION INFORMATION

TRANSMISSION IDENTIFICATION NUMBER

The number is located on the transmission case.

ABBREVIATIONS MAY BE USED IN THIS MANUAL

A

ABS : Anti-lock Brake System
ATDC : After Top Dead Center
API : American Petroleum Institute
ATF : Automatic Transmission Fluid
ALR : Automatic Locking Retractor
AC : Alternating Current
A/T : Automatic Transmission
A/C : Air Conditioning
ABDC : After Bottom Dead Center
A/F : Air Fuel Mixture Ratio
A-ELR : Automatic-Emergency Locking Retractor

B

B + : Battery Positive Voltage
BTDC : Before Top Dead Center
BBDC : Before Bottom Dead Center

C

CKT : Circuit
CMP Sensor : Camshaft Position Sensor (Crank Angle Sensor, CAS)
CO : Carbon Monoxide
CPP Switch : Clutch Pedal Position Switch (Clutch Switch, Clutch Start Switch)
CPU : Central Processing Unit
CRS : Child Restraint System
CTP Switch : Closed Throttle Position Switch (Idle switch)

D

DC : Direct Current
DLC : Data Link Connector (Assembly Line Diag. Link, ALDL, Serial Data Link, SDL)
DOHC : Double Over Head Camshaft
DOJ : Double Offset Joint
DRL : Daytime Running Light
DTC : Diagnostic Trouble Code (Diagnostic Code)

E

EBCM: Electronic Brake Control Module, ABS Control Module
ECM : Engine Control Module
ECT Sensor : Engine Coolant Temperature Sensor (Water Temp. Sensor, WTS)
EGR : Exhaust Gas Recirculation
EGRT Sensor : EGR Temperature Sensor (Recirculated Exhaust Gas Temp. Sensor, REGTS)
EFE Heater : Early Fuel Evaporation Heater (Positive Temperature Coefficient, PTC Heater)
ELR : Emergency Locking Retractor
EVAP : Evaporative Emission
EVAP Canister :Evaporative Emission Canister (Chacoal Canister)

F

4WD : 4 Wheel Drive

G

GEN : Generator
GND : Ground

H

HC : Hydrocarbons
HO2S : Heated Oxygen Sensor

I

IAC Valve : Idle Air Control Valve (Idle Speed Control Solenoid Valve, ISC Solenoid Valve)
IAT Sensor : Intake Air Temperature Sensor (Air temperature Sensor, ATS)
ICM : Immobilizer Control Module
IG : Ignition
ISC Actuator : Idle Speed Control Actuator (Motor)

L

LH : Left Hand

M

MAF Sensor : Mass Air Flow Sensor (Air Flow Sensor, AFS, Air Flow Meter, AFM)

MAP Sensor : Manifold Absolute Pressure Sensor (Pressure Sensor, PS)

Max : Maximum

MFI : Multiport Fuel Injection (Multipoint Fuel Injection)

Min : Minimum

MIL : Malfunction Indicator Lamp ("CHECK ENGINE" Light)

M/T : Manual Transmission

N

NOx : Nitrogen Oxides

O

OBD : On-Board Diagnostic System (Self-Diagnosis Function)

OHC : Over Head Camshaft

O2S : Oxygen Sensor

P

PCM : Powertrain Control Module (ECM with TCM)

PNP : Park/Neutral Position

P/S : Power Steering

PSP Switch : Power Steering Pressure Switch (P/S Pressure Switch)

PCV : Positive Crankcase Ventilation

R

RH : Right Hand

S

SAE : Society of Automotive Engineers

SDM : Sensing and Diagnostic Module

SFI : Sequential Multiport Fuel Injection

SIR : Supplemental Inflatable Restraint

SOHC : Single Over Head Camshaft

T

TBI : Throttle Body Fuel Injection (Single-Point Fuel Injection, SPI)

TCC : Torque Converter Clutch

TCM : Transmission Control Module (A/T Controller, A/T Control Module)

TP Sensor : Throttle Position Sensor

TP Code : Transponder Code

TR Switch : Transmission Range Switch (Shift switch)

TVV : Thermal Vacuum Valve (Thermal Vacuum Switching Valve, TVSV, Bimetal Vacuum Switching Valve, BVSV)

TWC : Three Way Catalytic Converter (Three Way Catalyst)

2WD : 2 Wheel Drive

V

VIN : Vehicle Identification Number

VSS : Vehicle Speed Sensor

W

WU-TWC : Warm Up Three-Way Catalytic Converter

SECTION 0B

MAINTENANCE AND LUBRICATION

NOTE:
For the descriptions (items) not found in this section of this manual, refer to section 0B (fuel injection model) or Section 0B1 (carburetor model) of the service manual mentioned in the FOREWORD of this manual.

CONTENTS

MAINTENANCE SCHEDULE

NORMAL CONDITION SCHEDULE (FUEL INJECTION MODEL)

Interval: This interval should be judged by odometer reading or months, whichever comes first.	This table includes services as scheduled up to 80,000 km (48,000 miles) mileage. Beyond 80,000 km (48,000 miles), carry out the same services at the same intervals respectively.								
	Km (x 1,000)	10	20	30	40	50	60	70	80
	Miles (x 1,000)	6	12	18	24	30	36	42	48
	Months	6	12	18	24	30	36	42	48
1. ENGINE									
1-1. Drive belt (tension, damage)		—	—	—	I	—	—	—	R
1-2. Valve lash (clearance)		—	I	—	I	—	I	—	I
1-3. Camshaft timing belt		Inspect at 50,000 km (30,000 miles) and 150,000 km (90,000 miles). Replace every 100,000 km (60,000 miles).							
1-4. Engine oil and Engine oil filter	API Grade SE, SF, SG or SH	R	R	R	R	R	R	R	R
1-5. Cooling system, hoses and connections (leakage, damage)		—	I	—	I	—	I	—	I
1-6. Engine coolant		—	—	—	R	—	—	—	R
1-7. Exhaust pipes and mountings (leakage, damage, tightness)		—	I	—	I	—	I	—	I
1-8. Wiring harness and connections		—	—	—	I	—	—	—	I
2. IGNITION SYSTEM									
2-1. Spark plugs		—	—	—	R	—	—	—	R
2-2. Distributor cap and rotor (crack, wear)		—	—	—	I	—	—	—	I
2-3. Ignition wiring		—	—	—	—	—	—	—	R
3. FUEL SYSTEM									
3-1. Air cleaner filter element	Paved-road	—	—	—	R	—	—	—	R
	Dusty condition	Refer to "Severe Driving Condition" schedule.							
3-2 Fuel tank, cap & lines (Deterioration, leakage, damage)		—	—	—	I	—	—	—	I
		Replace fuel tank cap every 100,000 km (60,000 miles) or 60 months.							
3-3. Fuel filter		—	—	—	—	—	—	—	R
3-4. Engine idle speed		—	I	—	I	—	I	—	I
4. EMISSION CONTROL SYSTEM									
4-1. PCV (Positive Crankcase Ventilation) Valve		Inspect every 100,000 km (60,000 miles) or 60 months.							
4-2. EVAP canister		Inspect every 100,000 km (60,000 miles) or 60 months.							
5. BRAKE									
5-1. Brake discs and pads (thickness, wear, damage) Brake drums and shoes (wear, damage)		I	—	I	—	I	—	I	—
5-2. Brake hoses and pipes (leakage, damage, clamp)		I	—	I	—	I	—	I	—
5-3. Brake fluid		—	—	—	R	—	—	—	R
5-4. Brake lever and cable (damage, stroke, operation)		I	—	I	—	I	—	I	—
5-5. Brake pedal		—	I	—	I	—	I	—	I

Interval: This interval should be judged by odometer reading or months, whichever comes first.	This table includes services as scheduled up to 80,000 km (48,000 miles) mileage. Beyond 80,000 km (48,000 miles), carry out the same services at the same intervals respectively.								
	Km (x 1,000)	10	20	30	40	50	60	70	80
	Miles (x 1,000)	6	12	18	24	30	36	42	48
	Months	6	12	18	24	30	36	42	48
6. CHASSIS AND BODY									
6-1. Clutch (For manual transmission) pedal free travel		I	I	I	I	I	I	I	I
6-2. Tires/wheel discs (wear, damage, rotation)		I	I	I	I	I	I	I	I
6-3. Drive axle boots (breakage, damage)		I	I	I	I	I	I	I	I
6-4. Suspension system (Tightness, damage, rattle, breakage)		I	I	I	I	I	I	I	I
6-5. Steering system (tightness, damage, breakage, rattle)		I	I	I	I	I	I	I	I
6-6. Transmission oil (Manual) (leakage, level)		I	I	I	R	I	I	I	R
6-6-1. Automatic transmission	Fluid level	I	I	I	I	I	I	I	I
	Fluid change	Replace every 160,000 km (100,000 miles)							
	Fluid hose	—	—	—	—	—	R	—	—
6-7. Door hinges & gear shift control lever/shaft		I	I	I	I	I	I	I	I

NORMAL CONDITION SCHEDULE (CARBURETOR MODEL)

Interval: This interval should be judged by odometer reading or months, whichever comes first.	This table includes services as scheduled to 80,000 km (48,000 miles) mileage. Beyond 80,000 km (48,000 miles), carry out the same services at the same intervals respectively.								
	Km (x 1,000)	10	20	30	40	50	60	70	80
	Miles (x 1,000)	6	12	18	24	30	36	42	48
	Months	6	12	18	24	30	36	42	48
1. ENGINE									
1-1. Drive belt (tension, damage)		—	—	—	I	—	—	—	R
1-2. Valve lash (clearance)		—	I	—	I	—	I	—	I
1-3. Camshaft timing belt		Inspect at 50,000 km (30,000 miles) and 150,000 km (90,000 miles). Replace every 100,000 km (60,000 miles).							
1-4. Engine oil and Engine oil filter	API Grade SE, SF, SG or SH	R	R	R	R	R	R	R	R
1-5. Cooling system, hoses and connections (leakage, damage)		—	I	—	I	—	I	—	I
1-6. Engine coolant		—	—	—	R	—	—	—	R
1-7. Exhaust pipes and mountings (leakage, damage, tightness)		—	I	—	I	—	I	—	I
1-8. Wiring harness and connections		—	—	—	I	—	—	—	I
2. IGNITION SYSTEM									
2-1. Spark plugs	When unleaded fuel is used	—	R	—	R	—	R	—	R
	When leaded fuel is used	Refer to "Severe Driving Condition" Schedule.							
2-2. Distributor cap and rotor (crack, wear)		—	—	—	I	—	—	—	I
2-3. Ignition wiring		—	—	—	I	—	—	—	R
2-4. Ignition timing	Without TWC	—	—	—	I	—	—	—	I
	With TWC	—	I	—	I	—	I	—	I
2-5. Distributor advancer	Without TWC	—	—	—	I	—	—	—	I
	With TWC	—	I	—	I	—	I	—	I
3. FUEL SYSTEM									
3-1. Air cleaner filter element	Paved-road	—	—	—	R	—	—	—	R
	Dusty condition	Refer to "Severe Driving Condition" schedule.							
3-2 Fuel tank, cap & lines (Deterioration, leakage, damage)		—	—	—	I	—	—	—	I
		Replace fuel tank cap every 100,000 km (60,000 miles) or 60 months.							
3-3. Fuel filter		—	—	—	*R	—	—	—	R
3-4. Caburetor choke system		—	—	—	I	—	—	—	I
3-5. Engine idle speed & idle mixture		(I)	I	—	I	—	I	—	I

NOTES:

- *"R": Replace or change*
- *"I": Inspect and correct or replace if necessary*
- *Item 3-3 *R is a recommended maintenance item.*
- *Item 3-5 (I) is applicable only to the 10,000 km inspection.*

Interval: This interval should be judged by odometer reading or months, whichever comes first.	This table includes services as scheduled to 80,000 km (48,000 miles) mileage. Beyond 80,000 km (48,000 miles), carry out the same services at the same intervals respectively.								
	Km (x 1,000)	10	20	30	40	50	60	70	80
	Miles (x 1,000)	6	12	18	24	30	36	42	48
	Months	6	12	18	24	30	36	42	48
4. EMISSION CONTROL SYSTEM									
4-1. PCV (Positive Crankcase Ventilation) Vale		—	—	—	I	—	—	—	I
4-2. EVAP canister (if equipped)		—	I	—	I	—	I	—	I
4-3. Fuel cut system		—	I	—	I	—	I	—	I
5. BRAKE									
5-1. Brake discs and pads (thickness, wear, damage) Brake drums and shoes (wear, damage)		I	—	I	—	I	—	I	—
5-2. Brake hoses and pipes (leakage, damage, clamp)		I	—	I	—	I	—	I	—
5-3. Brake fluid		—	I	—	R	—	I	—	R
5-4. Brake lever and cable (damage, stroke, operation)		I	—	I	—	I	—	I	—
5-5. Brake pedal		—	I	—	I	—	I	—	I
6. CHASSIS AND BODY									
6-1. Clutch (For manual transmission) pedal free travel		I	I	I	I	I	I	I	I
6-2. Tires/wheel discs (wear, damage, rotation)		I	I	I	I	I	I	I	I
6-3. Drive axle boots (breakage, damage)		I	I	I	I	I	I	I	I
6-4. Suspension system (Tightness, damage, rattle, breakage)		I	I	I	I	I	I	I	I
6-5. Steering system (tightness, damage, breakage, rattle)		I	I	I	I	I	I	I	I
6-6. Transmission oil (Manual) (leakage, level)		I	I	I	R	I	I	I	R
6-6-1. Automatic transmission	Fluid level	I	I	I	I	I	I	I	I
	Fluid change	Replace every 160,000 km (100,000 miles)							
	Fluid hose	—	—	—	—	—	R	—	—
6-7. Door hinges & Gear shift control lever/shaft		I	I	I	I	I	I	I	I

NOTES:

"R": Replace or change

"I": Inspect and correct or replace if necessary

MAINTENANCE RECOMMENDED UNDER SEVERE DRIVING CONDITIONS

If the vehicle is usually used under the conditions corresponding to any severe condition code given below, it is recommended that applicable maintenance operation be performed at the particular interval as given in the chart below.

Severe condition code

A – Repeated short trips
B – Driving on rough and/or muddy roads
C – Driving on dusty roads
D – Driving in extremely cold weather and/or salted roads
E – Repeated short trips in extremely cold weather
F – Leaded fuel use (Carburetor model only)

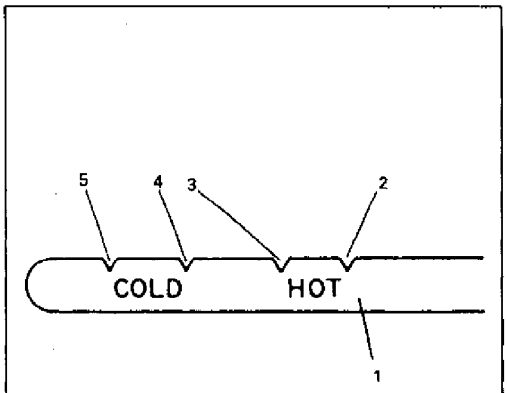
Severe Condition Code	Maintenance	Maintenance Operation	Maintenance Interval
– – C D – –	Drive belt	I	Every 20,000 km (12,000 miles) or 12 months
		R	Every 40,000 km (24,000 miles) or 24 months
A – C D E –	Engine oil and oil filter	R	Every 5,000 km (3,000 miles) or 3 months
– – – – – F	Spark plugs	R	Every 10,000 km (6,000 miles) or 6 months
– – C – – –	Air cleaner filter element *1	I	Every 2,500 km (1,500 miles)
		R	Every 40,000 km (24,000 miles) or 24 months
– – – D – –	Fuel tank, cap and lines	I	Every 20,000 km (12,000 miles) or 12 months
A B C – E –	Brake discs and pads Brake drums and shoes	I	Every 10,000 km (6,000 miles) or 6 months
– B – – E –	Automatic transmission fluid change	R	Every 20,000 km (12,000 miles) or 12 months
A B – D E –	Brake hoses and pipes	I	Every 10,000 km (6;000 miles) or 6 months
– B C D – –	Wheel bearings	I	Every 20,000 km (12,000 miles) or 12 months
– B – – E –	Manual transmission oil	R	Every 20,000 km (12,000 miles) or 12 months

**1 Inspect or replace more frequently if the vehicle is used under dusty conditions.*

NOTES:

"R": Replace or change

"I": Inspect and correct or replace if necessary



1. Oil level gauge
2. FULL HOT mark
3. LOW HOT mark
4. FULL COLD mark
5. LOW COLD mark

0B-001

MAINTENANCE SERVICE

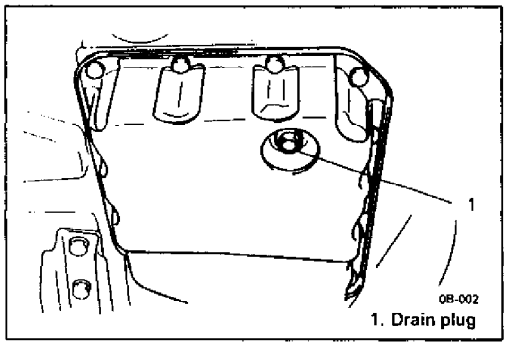
CHASSIS AND BODY

ITEM 6-6-1

Automatic Transmission

[Fluid level inspection]

1) Inspect transmission case for evidence of fluid leakage. Repair leaky point, if any.
2) Make sure that vehicle is placed level for fluid level check.
3) Check fluid level.
   For fluid level checking procedure, refer to ON-VEHICLE SERVICE in SECTION 7B and be sure to perform it under specified conditions. If fluid level is low, replenish specified fluid.



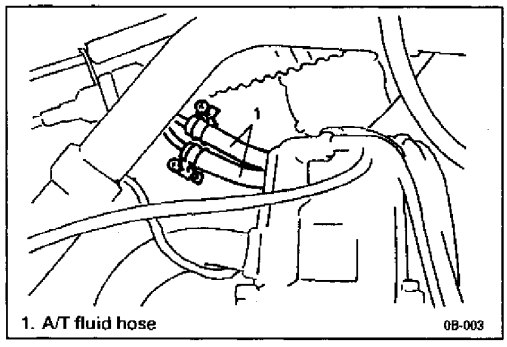
0B-002

1. Drain plug

[Fluid change]

1) Perform steps 1) and 2) of above Fluid Level inspection.
2) Change fluid. For its procedure, refer to ON-VEHICLE SERVICE in SECTION 7B.

CAUTION:
Use of specified fluid is absolutely necessary.



1. A/T fluid hose

0B-003

[Fluid cooler hose change]

Replace inlet and outlet hoses of cooler hose and their clamps. For replacement procedure, refer to ON-VEHICLE SERVICE in SECTION 7B.

FINAL INSPECTION

ROAD TEST

Carry out road test in safe place.

WARNING:
When carrying out following road tests, select a safe place where no man or no running car is seen so as to prevent any accident.

Gearshift or Selector Lever (Transmission)
Check gear shift or selector lever for smooth shifting to all positions and for good performance of transmission in any position.
With automatic transmission equipped car, also check that shift indicator indicates properly according to which position selector lever is shifted to.

CAUTION:
With automatic transmission equipped car, make sure that car is at complete stop when shifting selector lever to "P" range position.

OWNER INSPECTIONS AND SERVICES

BEFORE OPERATING YOUR VEHICLE
[INSIDE VEHICLE]
Automatic Transmission Shift Indicator and Park Mechanism Operation

- Move selector lever and check that indicator points to exact gear as chosen.
- Check the lock release button of the selector lever for proper and smooth operation.

RECOMMENDED FLUIDS AND LUBRICANTS

Engine oil	SE, SF, SG or SH
Engine coolant (Ethylene glycol base coolant)	"Antifreeze/Anticorrosion coolant"
Brake fluid	DOT3 or SAE J1703
Manual transmission oil	See oil chart on SECTION 7A
Automatic transmission fluid	Automatic transmission fluid DEXRON®-II, IIE, III or equivalent
Gear shift control lever and shaft	Water resistance chassis grease (SUZUKI SUPER GREASE A 99000-25010)
Door hinges	Engine oil
Hood latch assembly	Engine oil
Key lock cylinder	Spray lubricant

SECTION 1B

AIR CONDITIONING (OPTIONAL)

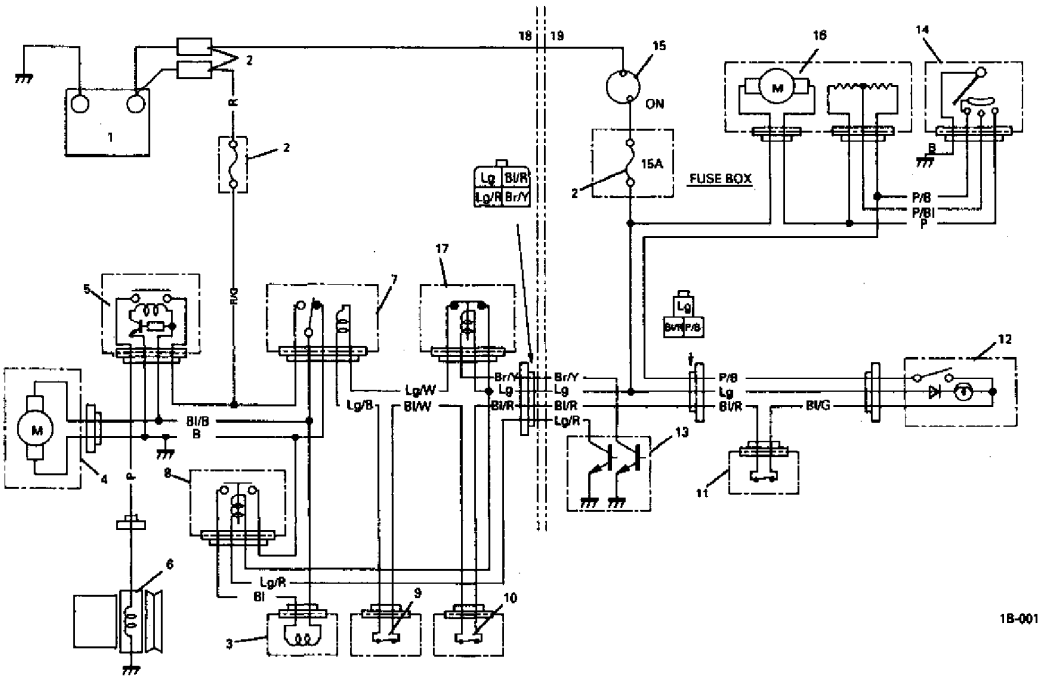
NOTE:
For the descriptions (items) not found in this section of this service manual, refer to the same section of service manual mentioned in the FOREWORD of this manual.

CONTENTS

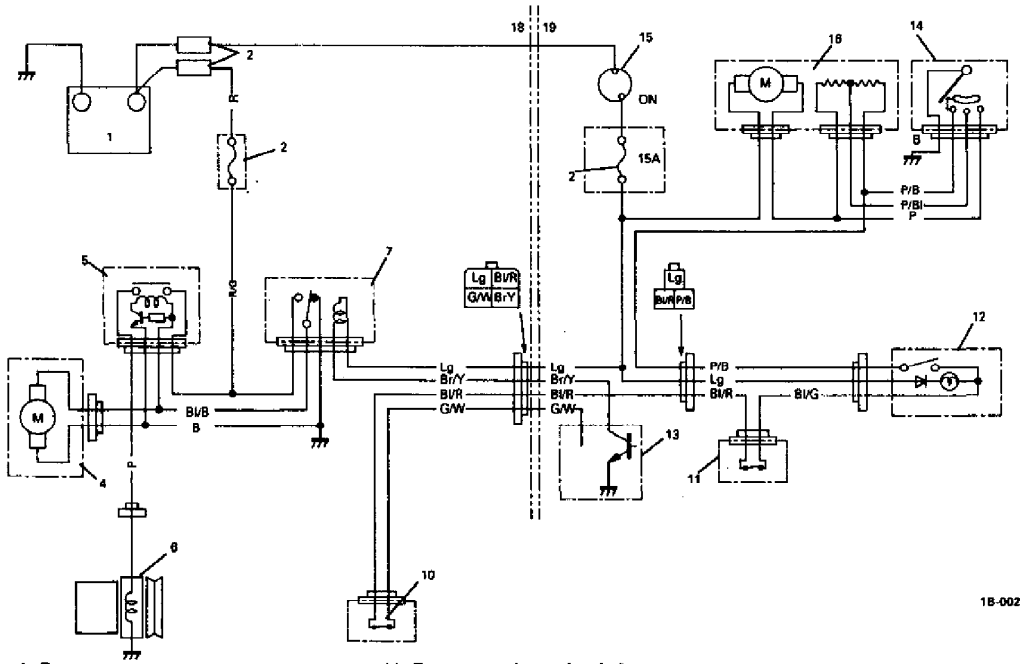
GENERAL DESCRIPTION

WIRING DIAGRAM

(A/T VEHICLE WITH CARBURETOR)



(FUEL INJECTION MODEL)



1. Battery
2. Fuse
3. A/C solenoid vacuum valve
4. Condenser fan motor
5. Compressor relay
6. Compressor magnetic clutch
7. A/C relay
8. A/C solenoid vacuum valve cut relay
9. Coolant (water) temp. switch
10. Dual pressure switch
11. Evaporator thermal switch
12. A/C switch
13. ECM (Fuel Injection model) or TCM (A/T vehicle with carburetor)
14. Fan switch
15. Ignition switch
16. Blower motor assy
17. A/C cut relay
18. Engine room
19. Passenger room

FUNCTION OF EACH CONTROL COMPONENT

**COMPRESSOR RELAY,
MAGNETIC CLUTCH,
EVAPORATOR THERMAL SWITCH,
COOLANT (WATER) TEMP SWITCH (CARBURETOR MODEL ONLY),
DUAL PRESSURE SWITCH AND
AIR CONDITIONING SOLENOID VACUUM VALVE (CARBURETOR MODEL ONLY)
Refer to same section of SH410 SERVICE MANUAL.**

A/C RELAY

A/C relay controls operation of the solenoid vacuum valve (carburetor model only), compressor relay and condenser fan motor according to the signals from the switches and/or controller (if equipped) which detect the state of the engine and driving conditions.
Main system control functions are as follows (at A/C switch ON).

- Idle speed control (idle-up for carburetor model only)
- Magnetic clutch delay control: 0.4 second delay after solenoid vacuum valve ON (for carburetor model) or after A/C ON signal inputted (for fuel injection model).
- A/C ON–OFF control:

– Dual Pressure Switch
High refrigerant pressure:

	R134a	R12
OFF	above 32 kg/cm^2 (455 psi)	above 27 kg/cm^2 (388 psi)
ON	below 26 kg/cm^2 (369 psi)	below 21 kg/cm^2 (299 psi)

Low refrigerant pressure:

	R134a	R12
OFF	below 2.0 kg/cm^2 (28.4 psi)	below 2.1 kg/cm^2 (29.9 psi)
ON	above 2.3 kg/cm^2 (32.7 psi)	above 2.4 kg/cm^2 (34.1 psi)

– Coolant (Water) Temp. Switch (Carburetor model) Engine Coolant temperature (in coolant inlet pipe)
above 104°C (219°F) ..... OFF
below 101°C (213°F) ..... ON
– Evaporater Thermal Switch
Evaporative temperature
below 1°C (33°F) ..... OFF
above 4.5°C (40°F) .... ON
– ECM (fuel injection model)
Refer to ECM item in this section.
– TCM (A/T Vehicle with Carburetor)
Refer to TCM item in this section.

ECM (FUEL INJECTION MODEL)

The A/C circuit outputs A/C signal to ECM when A/C ON conditions are satisfied on the A/C circuit side (The air conditioning system does not turn ON in this state). When ECM detects through the A/C signal that A/C ON conditions are satisfied on the A/C circuit side, it uses the A/C signal as one of the factors to output A/C ON signal and to control idle air control valve and fuel injection respectively.

- Engine coolant temperature:
  above 110°C (230°F) ..... OFF
  below 106°C (222°F) ..... ON
- While engine cranking with
  starter ON and after 2 seconds ..... OFF
  after above time ..... ON
- Engine speed:
  above 6900 r/min. ..... OFF
  below 6500 r/min ..... ON
  below 400 r/min. ..... OFF
  above 600 r/min. ..... ON
- Throttle valve opening (A/T vehicle)
  For 10 sec. after throttle valve
  opening exceeds 76°. ..... OFF

TCM (A/T VEHICLE WITH CARBURETOR)

TCM turn ON the A/C cut relay (turn OFF A/C) for 4sec. after throttle valve opening exceeds 56° and turn ON the A/C solenoid vacuum valve cut relay (turn OFF A/C solenoid vacuum valve) when engine speed exceeds 2,600 r/min.

A/C CUT RELAY (A/T VEHICLE WITH CARBURETOR)

A relay to turn OFF the A/C relay.

A/C SOLENOID VACUUM VALVE CUT RELAY (A/T VEHICLE WITH CARBURETOR)

A relay to turn OFF the A/C solenoid vacuum valve.

ON-VEHICLE SERVICE

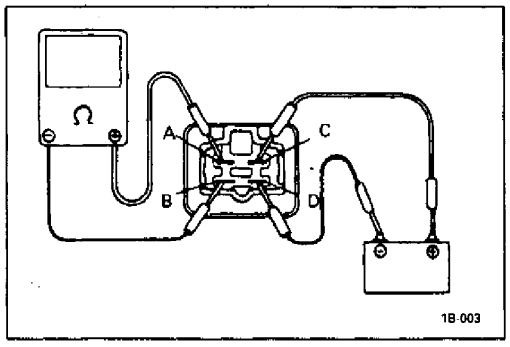
AIR CONDITIONING SOLENOID VACUUM VALVE (CARBURETOR MODEL ONLY)

Refer to same section of SH410 SERVICE MANUAL.

A/C CUT RELAY AND A/C SOLENOID VACUUM VALVE CUT RELAY (A/T VEHICLE WITH CARBURETOR)

INSPECTION

1) Disconnect negative cable at battery.
2) Remove relay after disconnecting its coupler.



3) Check continuity between terminals "A" and "B" in following condition.

Relay / Condition	A/C cut relay	A/C solenoid vacuum valve cut relay
Battery is connected to terminals "C" and "D"	Not continuity	Continuity
Battery is not connected to terminals "C" and "D"	Continuity	Not continuity

If found defective in above check, replace relay.

IDLE SPEED ADJUSTMENT WITH A/C ON (CARBURETOR MODEL ONLY)

M/T VEHICLE

Refer to same section of SH410 SERVICE MANUAL

A/T VEHICLE

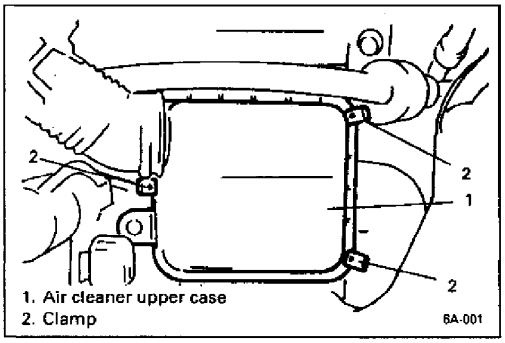
Refer to section 6D of this manual.

SECTION 6A

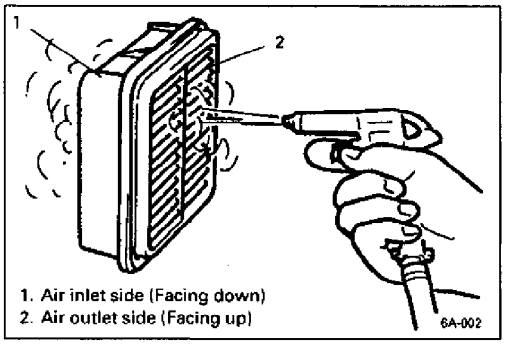
ENGINE MECHANICAL

NOTE:
For the descriptions (items) not found in this section of this service manual, refer to the same section of service manual mentioned in the FOREWORD of this manual.

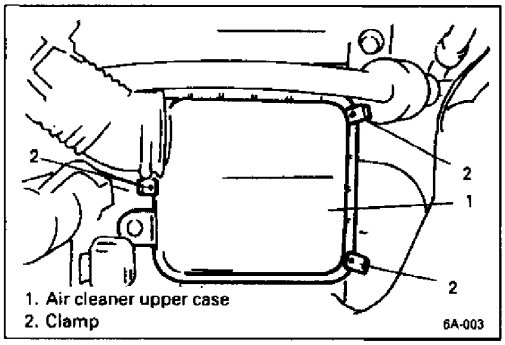
CONTENTS



1. Air cleaner upper case
2. Clamp
6A-001



1. Air inlet side (Facing down)
2. Air outlet side (Facing up)
6A-002



1. Air cleaner upper case
2. Clamp
6A-003

ON-VEHICLE SERVICE

AIR CLEANER ELEMENT

This air cleaner element is of dry type. Remember that it needs cleaning according to following procedure.

REMOVAL

1) Remove air cleaner upper case after removing clamps.
2) Remove air cleaner element.

INSPECTION

Check air cleaner element for dirt.

CLEANING

Blow off dust by compressed air from air outlet side of element.

INSTALLATION

1) Install air cleaner element to air cleaner case.
2) Install air cleaner upper case.

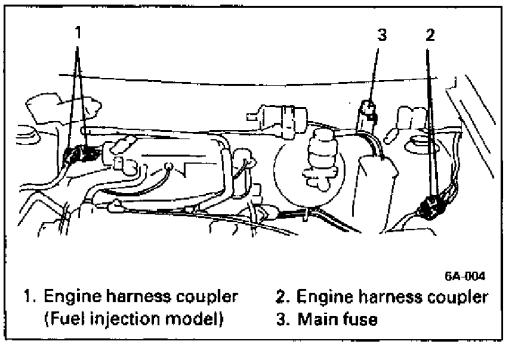
UNIT REPAIR OVERHAUL

ENGINE REMOVAL

1) Relieve fuel pressure according to FUEL PRESSURE RELIEF PROCEDURE described in SECTION 6.
2) Remove engine hood. (M/T)
3) Remove battery.
4) Remove battery tray. (M/T)
5) Drain cooling system referring to section 6B.

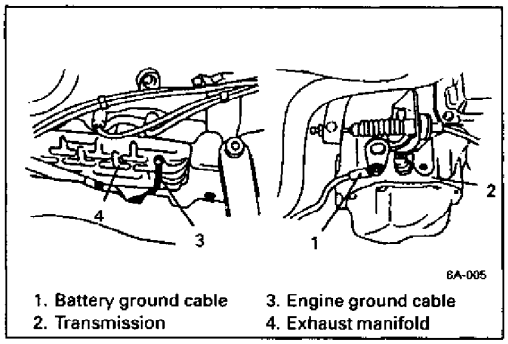
WARNING:
To help avoid danger of being burned, do not remove drain plug, radiator hose and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug, hose and cap are taken off too soon.

6) Remove radiator with cooling fan. Refer to Section 6B for removal.
7) Remove air cleaner outlet hose and air cleaner case. (Fuel injection model)
8) Remove air cleaner case, resonator, air intake hose and air intake pipe. (Carburetor model)
9) Remove EVAP canister. (If equipped)
10) Pull off ignition coil high-tension cord from ignition coil.
11) Disconnect heater inlet and outlet hoses.



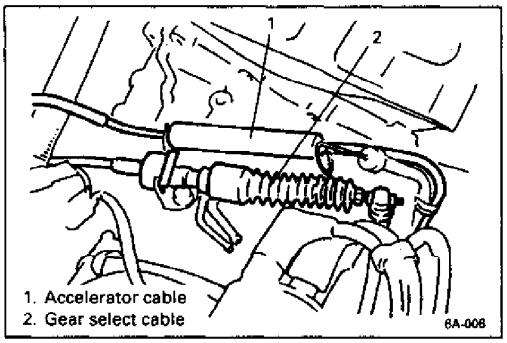
1. Engine harness coupler (Fuel injection model)
2. Engine harness coupler
3. Main fuse

12) Disconnect engine harness from main harness at couplers and release clamp. (Fuel injection model)
13) Disconnect engine harness from main harness at couplers.
14) Disconnect engine harness from main fuse.
15) Disconnect magnet clutch lead wire from A/C wire harness. (If equipped with A/C)



1. Battery ground cable
2. Transmission
3. Engine ground cable
4. Exhaust manifold

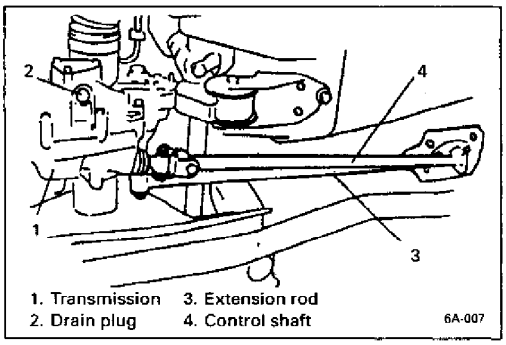
16) Disconnect negative battery cable from transmission case, and reinstall engine hook.
17) Disconnect engine ground cable from exhaust manifold.
18) Disconnect clutch cable from clutch release arm and transmission. (M/T)
19) Disconnect speedometer cable from transmission.



20) Disconnect gear select cable from transmission. (A/T)
21) Disconnect accelerator cable from transmission. (A/T)
22) Recover refrigerant from refrigeration system using recovery and recyling equipment. (If equipped with A/C)
23) Disconnect suction and discharge flexible hose from compressor. (If equipped with A/C)

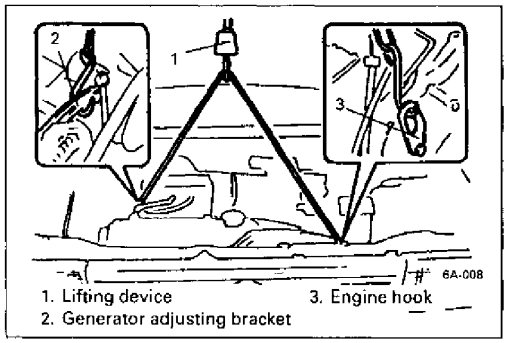
NOTE:
Cap open fittings immediately to keep moisture out of system.

24) Disconnect accelerator cable from throttle body (or carburetor).
25) Disconnect fuel feed hose from delivery pipe (or carburetor).
26) Disconnect fuel return hose from return pipe (or carburetor).



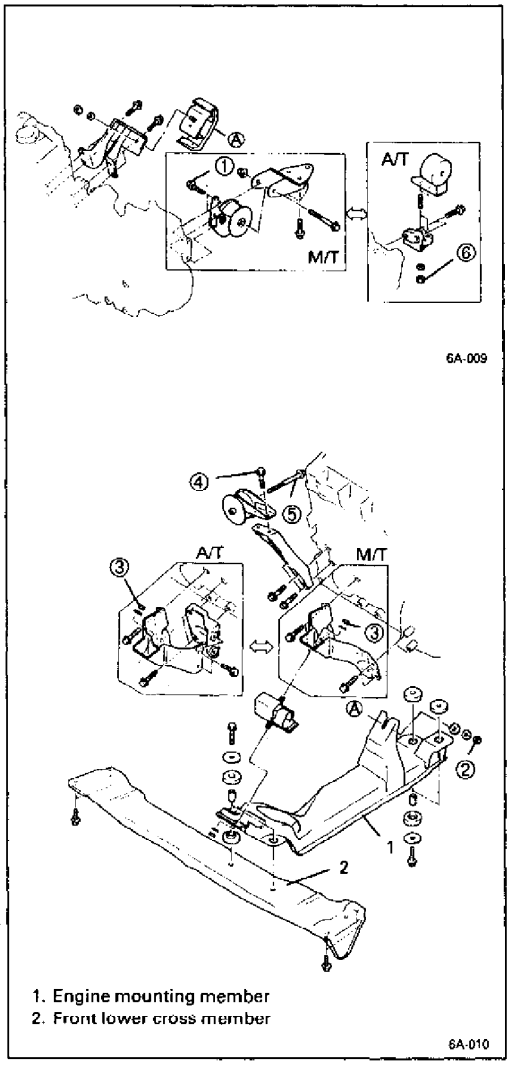
27) Hoist vehicle.
28) Drain engine oil, if necessary.
29) Drain transmission oil.
30) Remove exhaust center pipe.
31) Remove gear shift control shaft and extension rod from transmission. (M/T)
32) Remove stabilizer bar. (A/T)

33) Remove drive shafts (right and left) from differential side gears of transmission. Refer to Section 4 (DRIVE SHAFT) for procedure to disconnect drive shaft. For engine and transmission removal, it is not necessary to remove drive shaft from steering knuckle.

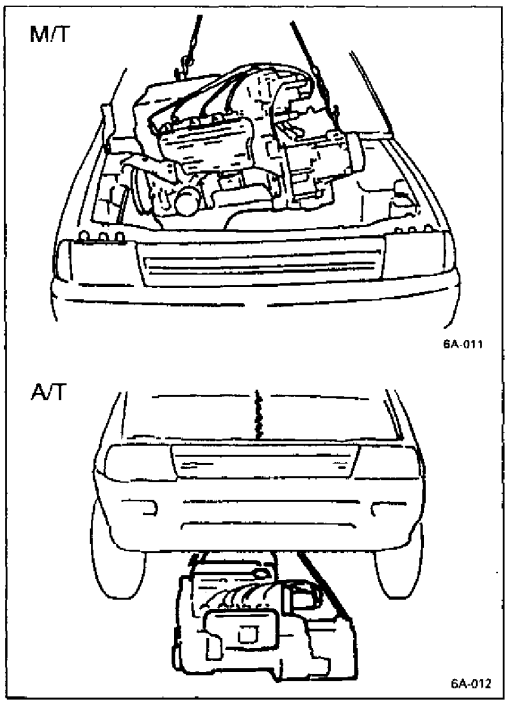


34) Lower vehicle.
35) Install lifting device as shown figure.

CAUTION:
Do not touch wire rope to any plastic parts (TP sensor, IAC valve, fuel injector etc.). Be careful not to bend or break engine component when removing and installing engine.

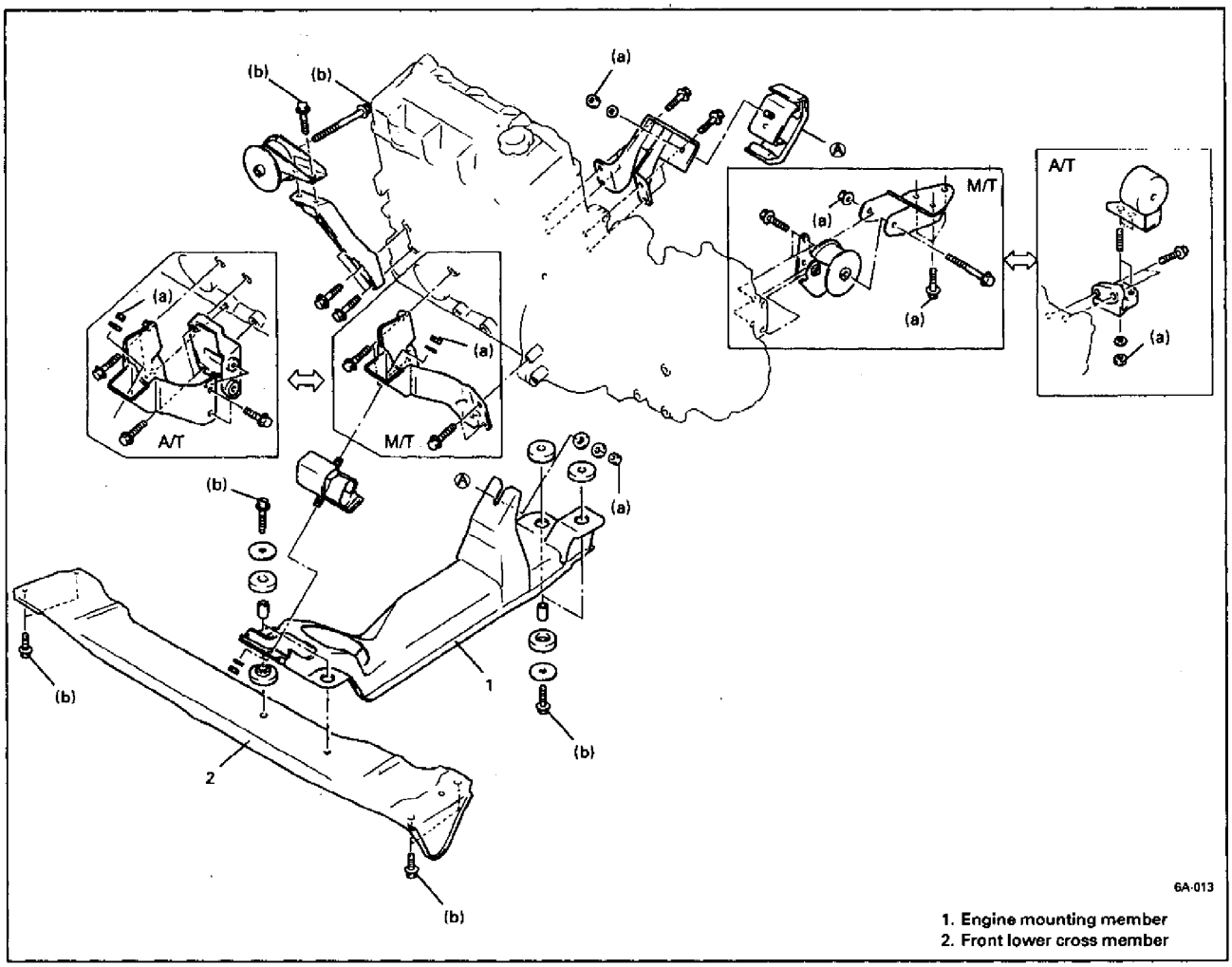


36) Remove rear torque stopper bolts ①. (M/T)
37) Remove engine rear mounting nut ②.
38) Remove engine front mounting nut ③.
39) Remove engine mounting member with engine front mounting and front lower cross member. (A/T)
40) Remove engine right bracket bolts ④, and loosen engine right mounting bolt ⑤. (M/T)
41) Remove engine left bracket nuts ⑥ and engine right bracket bolts ④. (A/T)



42) Before lifting engine with transmission, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transmission.
43) Hoist engine with M/T from body or lower engine with A/T from body.
44) Separate engine from transmission.

ENGINE INSTALLATION



1. Engine mounting member
2. Front lower cross member

Reverse removal procedures for installation noting the following points.

- Tighten bolts and nuts to specified torque.
  Tightening Torque
  (a): 40 N·m (4.0 kg-m, 29.0 lb-ft)
  (b): 55 N·m (5.5 kg-m, 40.0 lb-ft)
- Push in each drive shaft joint fully so that snap ring engages with differential gear.
  Use care not to damage oil seal lip when inserting.
- Clamp electric wire securely.
- Adjust accelerator cable paly, referring to Section 6E1.
- Adjust clutch pedal free travel, referring to Section 7C. (M/T)
- Adjust gear select cable and accelerator cable, referring to Section 7B. (A/T)
- Refill transmission with gear oil. (A/T fluid for A/T model), referring to Section 0B.
- Refill engine with engine oil, referring to Section 0B.
- Refill cooling system, referring to Section 6B.
- Evacuate and chage A/C system. (Vehicle with A/C)
- Upon completion of installation, verify that there is no fuel leakage, coolant leakage, transmission oil leakage or exhaust gas leakage at each connection.

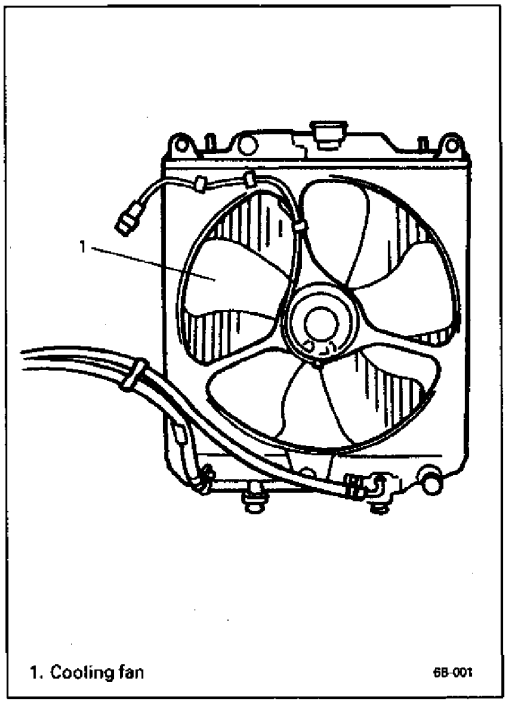
SECTION 6B

ENGINE COOLING

NOTE:
For the descriptions (items) not found in this section of this manual, refer to the same section of service manual mentioned in the FOREWORD of this manual.

6B

CONTENTS



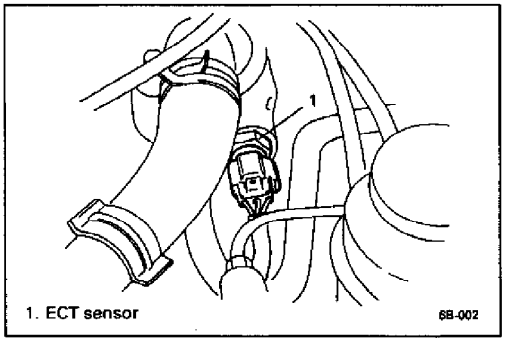
1. Cooling fan 6B-001

GENERAL DESCRIPTION

COOLING FAN (FOR FUEL INJECTION MODEL)

The cooling fan is driven by electric motor, and the motor is activated by ECM (and ECT sensor). For its details, refer to SECTION 6E1.

WARNING:
Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECM (and ECT sensor) with the ignition switch in the "ON" position.



1. ECT sensor 6B-002

COOLANT (WATER) TEMP. GAUGE (FOR FUEL INJECTION MODEL)

Coolant (water) temp. gauge is incorporated with engine coolant temperature sensor and installed to thermostat case.
This gauge activates a temp. meter gauge in the instrument cluster.

DIAGNOSIS

Condition	Possible Cause	Correction
Engine overheats	• Loose or braken water pump belt	Adjust or replace.
	• Not enough coolant	Check coolant level and add as necessary.
	• Faulty thermostat	Replace.
	• Faulty water pump	Replace.
	• Dirty or bent radiator fins	Clean or remedy.
	• Coolant leakage on cooling system	Repair
	• Defective cooling fan motor.	Check and replace as necessary.
	• Faulty fan motor control circuit	Refer to SECTION 6E1.
	• Plugged radiator	Check and replace radiator as necessary.
	• Faulty radiator cap	Replace.
	• Maladjusted ignition timing	Adjust.
	• Dragging brakes	Adjust brake.
	• Slipping clutch	Adjust or replace.

MAINTENANCE

COOLANT

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the overflow is collected in the reservoir tank. When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled at the factory with a quality coolant that is either 50/50 mixture of water and antifreeze/anticorrosion coolant (ethylene glycol base coolant) or 30% water and 70% antifreeze/anticorrosion coolant.

The 50/50 mixture coolant solution provides freezing protection to –36°C (–33°F), and the 30/70 mixture coolant solution provides freezing protection to –16°C (3°F).

- Maintain cooling system freeze protection at –36°C (–33°F) to ensure protection against corrosion and loss of coolant from boiling. This should be done even if freezing temperatures are not expected.
- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than –36°C (33°F).

NOTE:

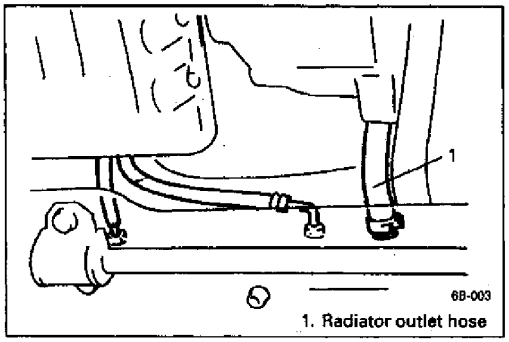
- **Alcohol or methanol base coolant or plain water alone should not be used in cooling system at any time as damage to cooling system could occur.**
- **Even in a market where no freezing temperature is anticipated, mixture of 70% water and 30% antifreeze/anticorrosion coolant (ethylene glycol base coolant) should be used for the purpose of corrosion protection and lubrication.**

ANTI-FREEZE PROPORTIONING CHART

			Vehicle with M/T		Vehicle with A/T	
ANTI-FREEZE PROPORTIONING CHART	Freezing temperature	°C	–16	–36	–16	–36
		°F	3	–33	3	–33
	Anti-freeze/Anti-corrosion coolant concentration	%	30	50	30	50
	Ratio of compound to cooling water	ltr.	1.20/2.80	2.00/2.00	1.14/2.66	1.90/1.90
		US pt.	2.56/5.92	4.23/4.23	2.41/5.62	4.01/4.01
		Imp pt.	2.11/4.93	3.52/3.52	2.01/4.68	3.34/3.34
	Engine radiator and heater		3.1 liter (6.6/5.5 US/Imp. pt.)		2.9 liter (6.1/5.1 US/Imp. pt.)	
	Reservoir tank		0.9 liter (1.9/1.6 US/Imp. pt.)			
	Total		4.0 liter (8.5/7.0 US/Imp. pt.)		3.8 liter (8.0/6.7 US/Imp. pt.)	

ON-VEHICLE SERVICE

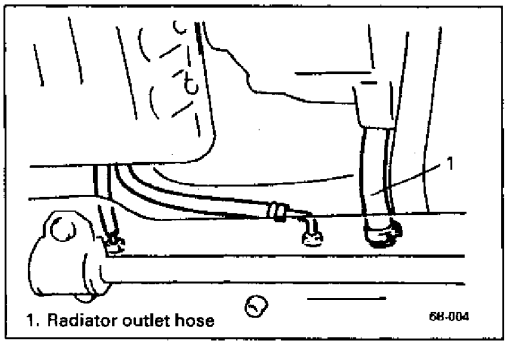
WARNING:
- **Check to make sure that engine coolant temperature is cold before removing any part of cooling system.**
- **Also be sure to disconnect negative cord from battery terminal before removing any part.**



1. Radiator outlet hose

COOLING SYSTEM DRAINING (A/T VEHICLE)

1) Remove radiator cap.
2) Disconnect radiator outlet hose from radiator to drain coolant.
3) After draining coolant, be sure to connect radiator outlet hose securely.
4) Fill cooling system. (Refer to item COOLANT of MAINTENANCE.)

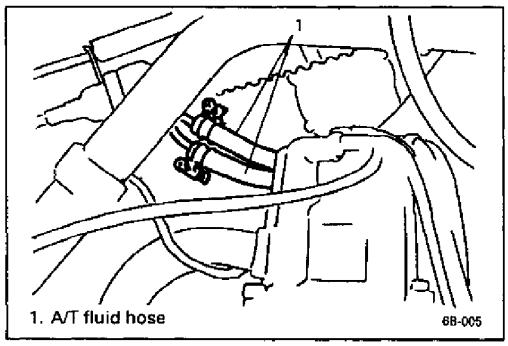


1. Radiator outlet hose

RADIATOR (A/T VEHICLE)

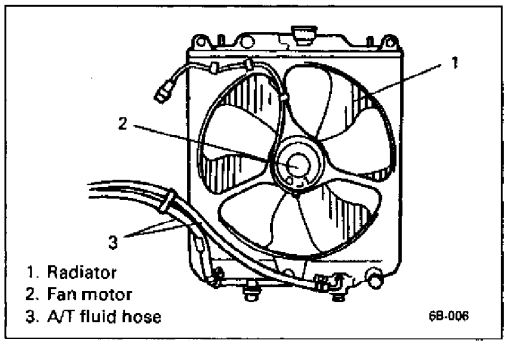
REMOVAL

1) Disconnect engative cable at battery.
2) Drain cooling system by disconnecting outlet hose from radiator.
3) Disconnect radiator inlet and reservoir tank hose from radiator.



1. A/T fluid hose

4) Disconnect 2A/T fluid hoses from A/T fluid pipes.
5) Disconnect radiator fan motor lead wire at coupler.



1. Radiator
2. Fan motor
3. A/T fluid hose

6) Remove radiator with A/T fluid hoses and cooling fan.

INSPECTION
Check radiator for leakage or damage. Straighten bent fins, if any.

CLEANING
Clean frontal area of radiator cores.

INSTALLATION
Reverse removal procedures.

NOTE:
- **Refill cooling system with proper coolant referring to COOLANT item of MAINTENANCE.**
- **With automatic transmission car, fill A/T fluid up to specified level. (For procedure to check A/T fluid and its level, refer to SECTION 7B.)**
- **After installation, check each joint for leakage.**

SECTION 6C

ENGINE FUEL

NOTE:
For the descriptions (items) not found in this section of this manual, refer to the same section of service manual mentioned in the FOREWORD of this manual.

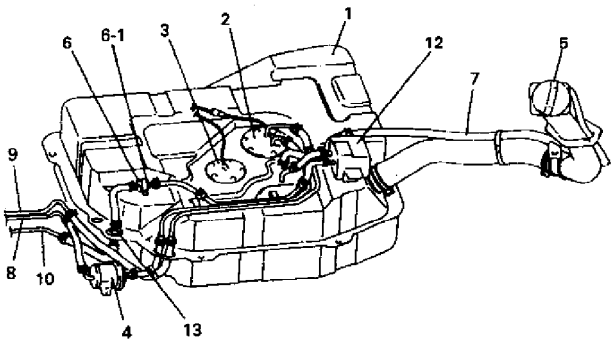
GENERAL DESCRIPTION

6C

FUEL SYSTEM

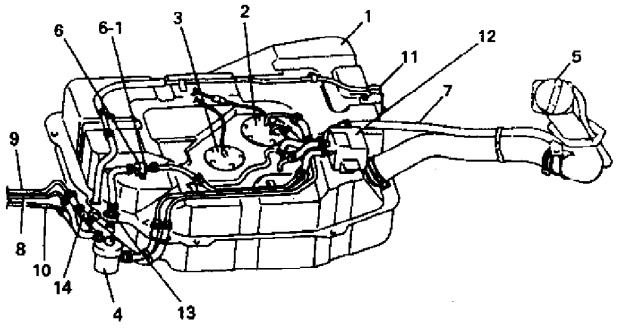
The main components of the fuel system are fuel tank, fuel pump, fuel filter and fuel level gauge and it includes three lines; fuel feed line, fuel return line and fuel vapor line.
For the details of fuel flow and fuel vapor flow for injection model, refer to "ELECTRONIC FUEL INJECTION SYSTEM" section.

For Fuel Injection model

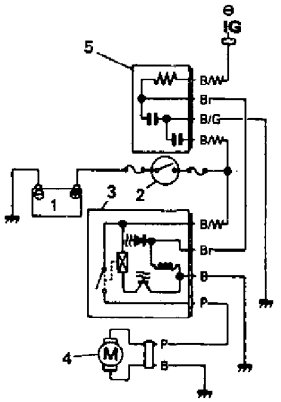


1. Fuel tank
2. Fuel pump
3. Fuel level gauge
4. Fuel filter
5. Fuel filler cap
6. Tank pressure control valve
6-1. Black nozzle
7. Breather hose

For Carburetor model



8. Fuel feed line
9. Fuel return line
10. Fuel vapor line (vehicle with EVAP canister)
11. Fuel breather vessel (vehicle without EVAP canister)
12. Liquid-vapor separator
13. Roll over valve
14. Fuel return check valve



1. Battery
2. Ignition switch
3. Fuel cotroller (M/T vehicle) or TCM (A/T vehicle)
4. Fuel pump
5. Noize supressor

B : Black
B/G : Black/Green
B/W : Black/White
Br : Brown
P : Pink

FUEL PUMP (For Carburetor model)

NOTE:
For fuel pump of Electronic Fuel Injection model, refer to SECTION 6E1.

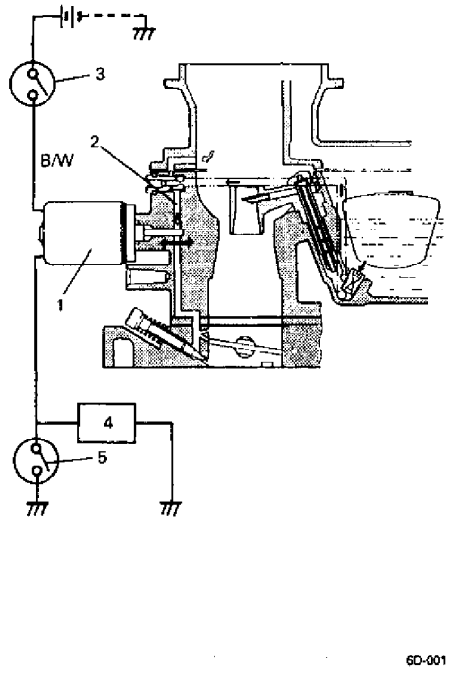
The fuel pump is a low pressure type electro-magnetic pump. It is installed in the fuel tank as outlined previously. Operation of the fuel pump by passing electric current to it for about 2 seconds after the ignition switch is turned ON or while the ignition signal is fed to the controller.

SECTION 6D

CARBURETOR

NOTE:
For the items not found in this section of this manual, refer to the same section of the Service Manual mentioned in the FOREWORD of this manual.

CONTENTS



1. Fuel cut solenoid valve
2. Slow mixture passage
3. Ignition switch
4. Fuel controller (TCM for A/T)
5. CTP switch (A/T) or vacuum switch (M/T, if equipped)

GENERAL DESCRIPTION

FUEL CUT SYSTEM

As shown in the figure, the fuel cut solenoid valve is provided in the primary slow system of the carburetor to open and close the fuel passage of the slow system.
As turning the ignition switch "OFF" cuts off the electric current to the solenoid, the solenoid closes the fuel passage. Thus this system contributes to preventing dieseling of the engine after the ignition switch is turned "OFF". Also, during the deceleration and provided that all below listed two conditions exist, the fuel cut solenoid valve operates to cut the fuel feed to the engine temporarily by closing the fuel passage when it received a signal from the controller and CTP switch (A/T) or vacuum switch (M/T, if equipped). Such operation of this system prevents the three-way catalyst from getting heated high and improves fuel economy.
Two conditions:

- The CTP switch is in "OFF" position. In other words, the primary throttle valve is closed (A/T).
  Or the vacuum switch is in "OFF" position. In other words, the engine vacuum is high (M/T).
- The engine revolution is more than 2,600 rpm.

ON VEHICLE SERVICE

A/C IDLE UP (A/T VEHICLE)

INSPECTION

1) Check to ensure that idle speed is within specification and maintain engine at that speed.
2) Turn ON A/C, if engine idle speed rises to specified idle speed below, that proves normal function of A/C idle up.

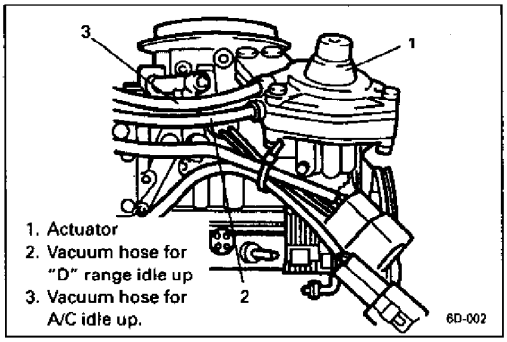
Engine idle speed when A/C is ON	1000 ± 50 r/min (rpm)

If found faulty, check following parts individually according to each procedure.

Solenoid Vacuum Valve

1) Make sure that A/C switch is OFF.
2) Disconnect solenoid vacuum valve vacuum hoses from intake manifold and actuator.
3) Turn ignition switch to "ON" position.
4) By blowing air into hose disconnected from actuator, make sure there is no continuity between these hoses.

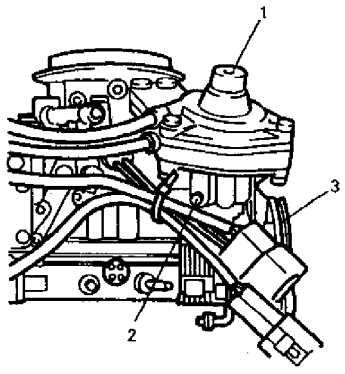
5) Turn ON A/C switch and blower fan switch, by blowing air into the hose disconnected from actuator, make sure there is continuity between hoses.



1. Actuator
2. Vacuum hose for "D" range idle up
3. Vacuum hose for A/C idle up.

Actuator

1) Disconnect vacuum hose for A/C idle up from solenoid vacuum valve.
2) Connect vacuum pump gauge to disconnected hose and apply – 50 cmHg vacuum to actuator.
3) In the state of 2), stop pumping. If actuator stays up, it is normal. If defective, replace.



1. A/C idle up adjusting screw
2. "D" range idle up adjusting screw
3. Throttle lever

6D-003

ADJUSTMENT

If solenoid vacuum valve, actuator, hose, wiring harness and battery capacity are normal and yet idle up speed is not attained, adjust as follows.

1) Check to be sure that
   - Engine idle speed with A/C OFF is as specified.
   - Parking brake is pulled fully and drive wheels are blocked
2) Engine idle speed with A/C ON should be within specification.
   If not within specification, adjust with A/C idle up adjusting screw.

"D" RANGE IDLE UP (A/T VEHICLE)

INSPECTION

1) Check to ensure that idle speed is within specification and maintain engine at that speed.
2) When selector lever is shifted to each of "R", "D", "2" and "L" range, if engine speed keeps at specified idle speed below, that proves normal function of "D" range idle up.

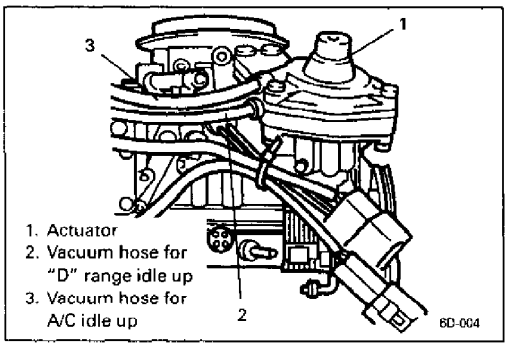
Engine idle speed when shift lever is shifted to "R", "D", "2" or "L" range	800 ± 50 r/min (rpm)

If found faulty, check following parts individually according to each procedure.

Solenoid Vacuum Valve

1) Make sure that selector lever is shifted to "P" range.
2) Disconnect solenoid vacuum valve vacuum hoses from intake manifold and actuator.
3) Turn ignition switch to "ON" position.
4) By blowing air into hose disconnected from actuator make sure that there is no continuity between these hoses. Then, shift selector lever to "N" range and also check to make sure that there is no continuity between these hoses.
5) Shift selector lever to "R" range, by blowing air into the hose disconnected from actuator, make sure that there is continuity between hoses. Also, with selector lever shifted to "D", "2" and "L" ranges check to make sure that there is continuity between these hoses in each range.

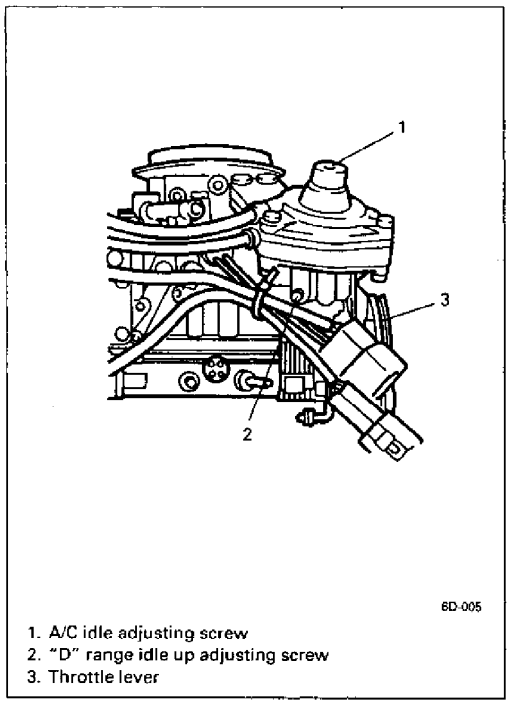
If found faulty in steps 4) and 5), replace hoses, wiring harness or solenoid vacuum valve.



1. Actuator
2. Vacuum hose for "D" range idle up
3. Vacuum hose for A/C idle up

Actuator

1) Disconnect vacuum hose for "D" range idle up from solenoid vacuum valve.
2) Connect vacuum pump gauge to disconnected hose and apply – 50 cmHg vacuum to actuator.
3) In the state of 2), stop pumping. If actuator stays up, it is normal. If defective, replace.

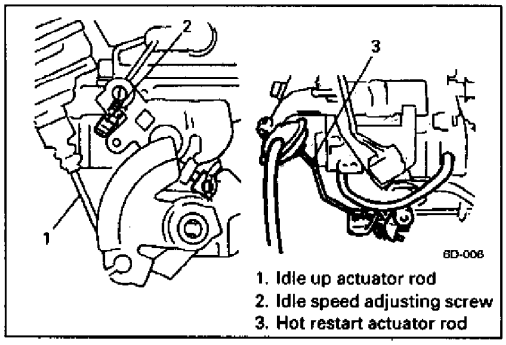


1. A/C idle adjusting screw
2. "D" range idle up adjusting screw
3. Throttle lever

ADJUSTMENT

If solenoid vacuum valve, actuator, hose, wiring harness and battery capacity are normal and yet idle up speed is not attained, adjust as follows.

1) Check to be sure that
   - Engine idle speed with selector lever shifted to "P" or "N" range is as specified.
   - Parking brake is pulled fully and drive wheels are blocked.
2) Engine speed with selector lever shifted to "D", "2", "L" or "R" range should be within specification.
   If not within specification, adjust with "D" range idle up adjusting screw.

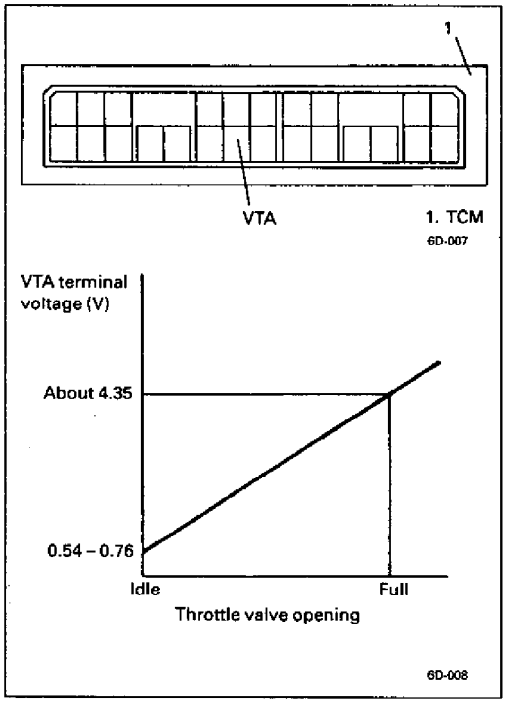


1. Idle up actuator rod
2. Idle speed adjusting screw
3. Hot restart actuator rod

THROTTLE POSITION (TP) SENSOR (A/T VEHICLE)

SYSTEM INSPECTION

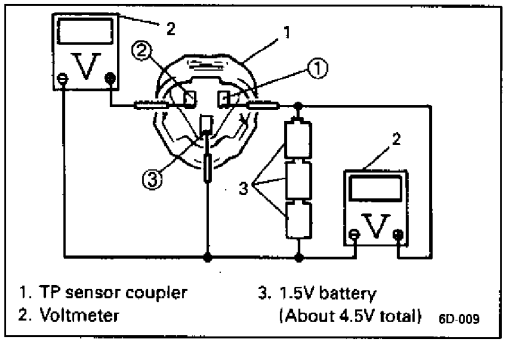
1) Remove TCM from body and connect TCM coupler to TCM.
2) Remove air clear case, disconnect actuator rods from throttle lever and loosen idle speed adjusting screw fully.



3) Check VTA terminal voltage with ignition switch ON.

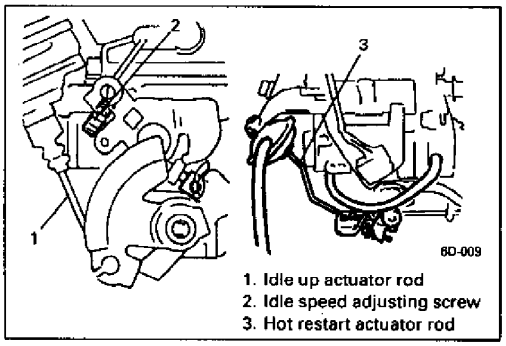
   VTA terminal voltage : 0.54 – 0.76 V

4) Open throttle vale gradually with ignition switch ON. Check VTA terminal voltage in above condition.
   It should be as shown figure.
   If not check TP sensor or its circuit.
5) After inspection connect actuator rods, adjust idle speed and idle mixture.



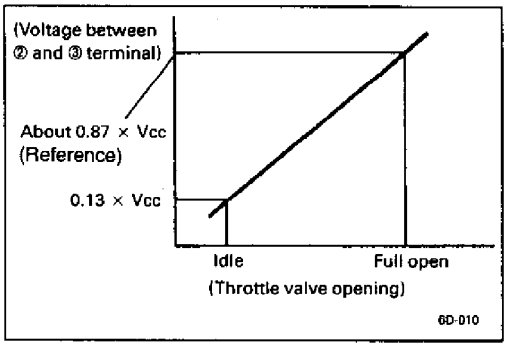
INSPECTION

1) Disconnect TP sensor coupler.
2) Arrange 3 new 1.5V batteries in series and connect its positive terminal to ① terminal and negative terminal to ③ terminal of TP sensor coupler. Then check voltage between ① and ③ terminal of TP sensor coupler.

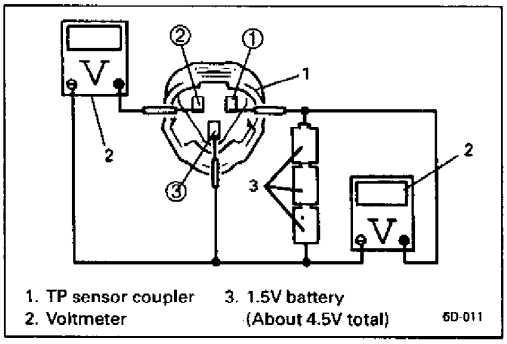


1. Idle up actuator rod
2. Idle speed adjusting screw
3. Hot restart actuator rod

3) Remove air cleaner case, disconnect actuator rods from throttle lever and loose idle speed adjusting screw fully. Then check voltage between ② and ③ terminal of TP sensor coupler.
   Standard voltage :0.13 × Voltage measured at step 2)
   (Reference :0.59V when voltage measured at step 2) is 4.5V)
   If not, adjust TP Sensor

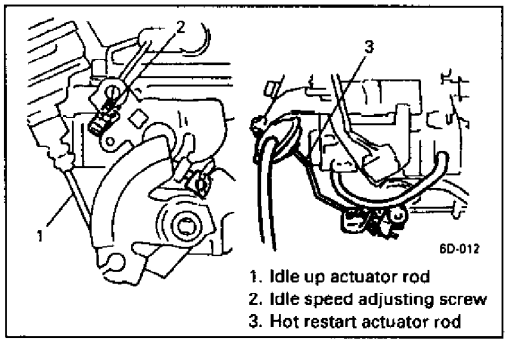


4) Open throttle valve gradually and check voltage between ② and ③ terminal of TP sensor coupler.
It should be as shown in figure.
If not, faulty TP sensor.

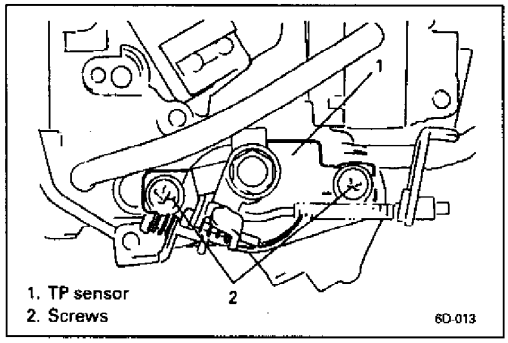


ADJUSTMENT

1) Disconnect TP sensor coupler
2) Arrange 3 new 1.5V batteries in series and connect its positive terminal to ① terminal and negative terminal to ③ terminal of TP sensor coupler. Then check voltage Vcc between ① and ③ terminal of TP sensor coupler.



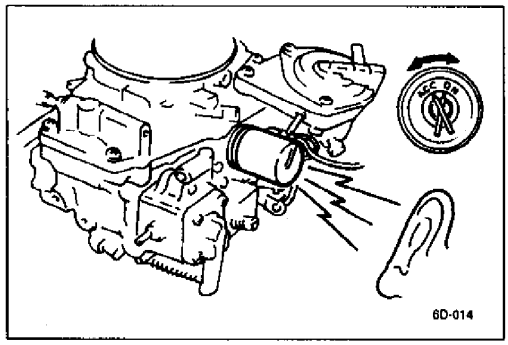
3) Remove air cleaner case, disconnect actuator rods from throttle lever and loose idle speed adjusting screw fully. Then check voltage between ② and ③ terminal of TP sensor coupler.



4) Turn TP sensor clockwise or counterclockwise and tighten TP sensor screws at a position where voltage as specified below is obtained.

Specified voltage : 0.13 × voltage measured at step 3)
(Reference : 0.59V when voltage measured at step 3) is 4.5V)

5) After adjustment connect actuator rods, adjust idle speed and idle mixture.

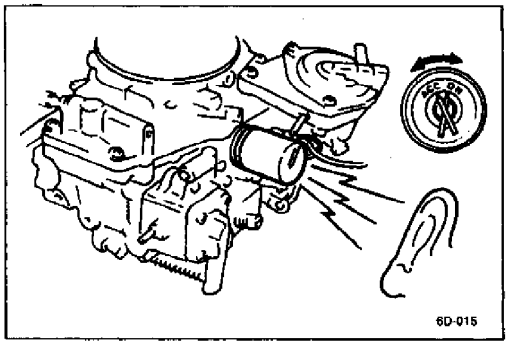


FUEL CUT SYSTEM

INSPECTION (M/T WITHOUT VACUUM SWITCH)

1) Check to ensure that carburetor fuel cut solenoid makes "clicking" sound when ignition switch key is turned "ON" and "OFF" (without starting engine).

If anything faulty was found, check connector for proper connection and also check by using a voltmeter if electric current is obtained at the coupler of solenoid lead wire when ignition key is turned "ON".
Correct or replace if defective.



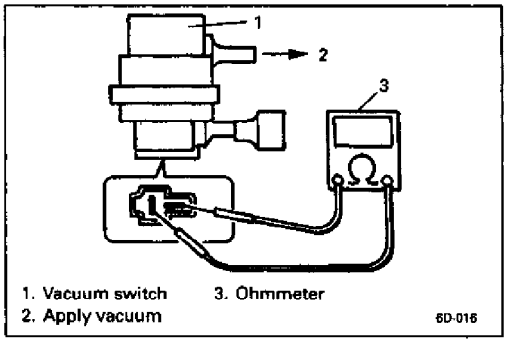
INSPECTION (M/T WITH VACUUM SWITCH)

1) Check to ensure that carburetor fuel cut solenoid makes "clicking" sound when ignition switch key is turned "ON" and "OFF" (without starting engine).

If anything faulty was found in this check, check connector for proper connection and also check by using voltmeter if electric current is obtained at "B/W" wire terminal of solenoid valve coupler when ignition key is turned "ON". Correct or replace if defective.

2) Increase engine speed to 3,000 – 3,500 r/min, Under this condition, check to be sure that engine speed changes when vacuum switch coupler is disconnected.

If found defective in above step 2), check vacuum switch.

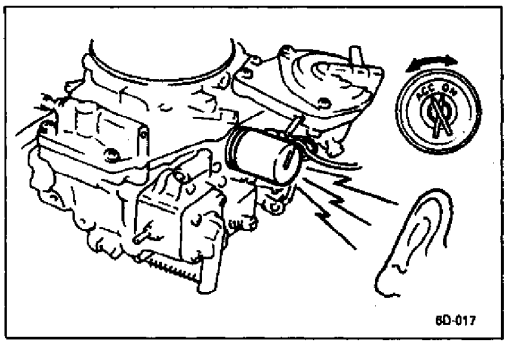


Vacuum Switch Inspection

1) Disconnect vacuum hose and lead wire from vacuum switch.
2) Connect vacuum pump gauge to vacuum switch, apply vacuum and check continuity between vacuum switch terminals.

Vacuum	– 570 mmHg or less	– 590 mmHg or more
Continuity	Continuity	Not continuity

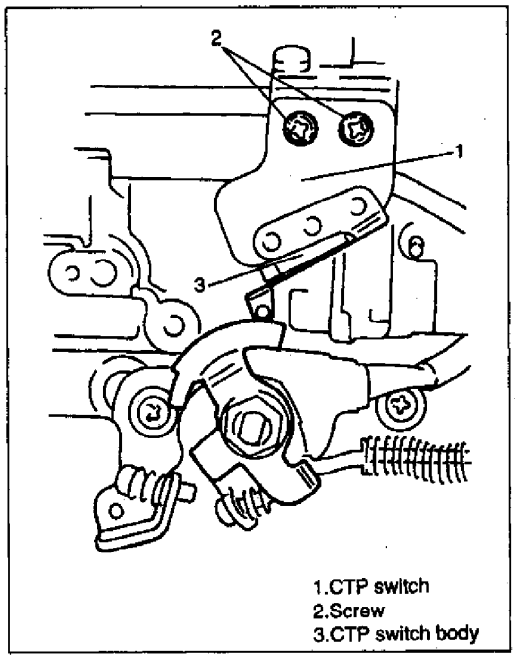
If found defective in above step 2), replace vacuum switch.



INSPECTION (A/T VEHICLE)

1) check to ensure that carburetor fuel cut solenoid makes "clicking" sound when ignition switch key is turned "ON" and "OFF" (without starting engine)
   If anything faulty was found, check connector for proper connection and also check by using a voltmeter if electric current is obtained at "B/W" wire terminal of solenoid valve coupler when ignition key is turned "ON".
   Correct or replace if defective.

2) Increase engine speed to 3,000 – 3,500 r/min. Under this condition, check to be sure that engine speed changes when CTP switch coupler is disconnected.
   If found defective in above step 2), check CTP switch.



Closed Throttle Position (CTP) Switch

Removal

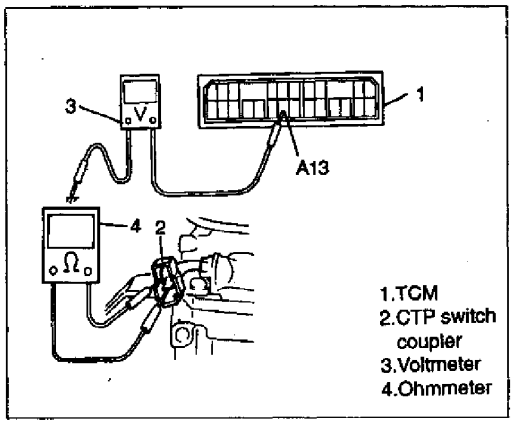
Remove CTP switch from carburetor by removing two screws.

Installation

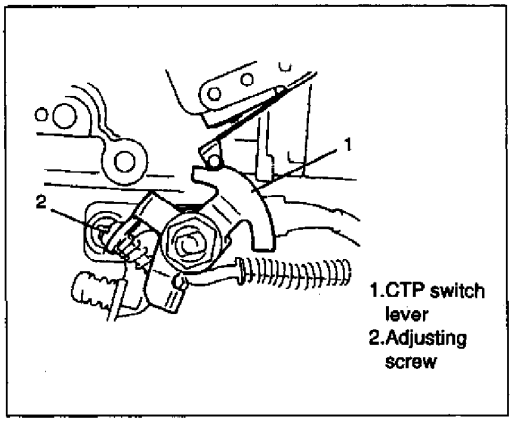
1) Install CTP switch to carburetor body and handtighten two screws.
2) Tighten two screws to the specified torque at the position where CTP switch is turned ON and hinge roller lever of CTP switch is free from contact with CTP switch body when throttle valve is opened fully.

   Tightening Torque

   (a) : 2.0 N·m (20 kg-cm)



3) Disconnect CTP Switch Coupler and remove TCM with ignition switch OFF.
4) Connect voltmeter and ohmmeter as shown in figure.



5) With ignition switch ON, adjust CTP switch lever by turning adjusting screw of lever so that CTP switch turns ON from OFF when TP sensor output voltage is at specified voltage.

   TP sensor output voltage when CTP switch is turned ON from OFF : 1.08 - 1.12 V

SECTION 6E1

ELECTRONIC FUEL INJECTION SYSTEM

(Multi-Port Fuel Injection System)

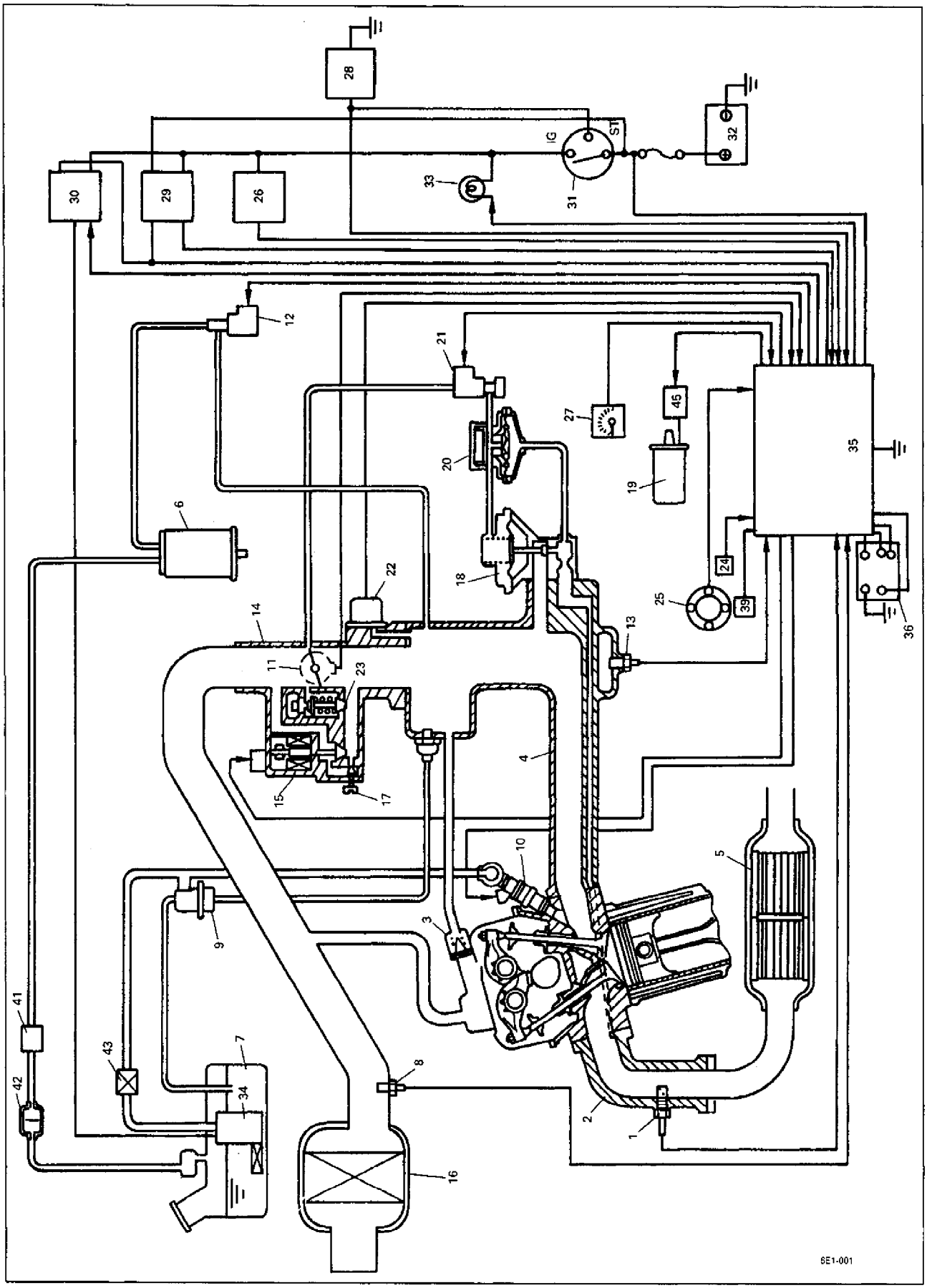
CONTENTS

GENERAL DESCRIPTION

The Electronic Fuel Injection system in this vehicle supplies the combustion chambers with air/fuel mixture of optimized ratio under widely varying driving conditions. It uses the multi-port fuel injection system which injects fuel into the each intake port of the cylinder head.

This system has 3 major sub–systems: air intake system, fuel delivery system and electronic control system. Air intake system includes air cleaner, throttle body, MAP sensor, IAC valve and intake manifold.
Fuel delivery system includes fuel pump, delivery pipe fuel pressure regulator, etc.. Electronic control system includes ECM, various sensors and controlled devices.
This section explains the system related to the electronic fuel injection as well as such functions of ECM as listed below.

- EGR system
- Evaporative emission control system
- Oxygen sensor heater control system
- Ignition control system
- Radiator fan control system
- A/C ON/OFF control system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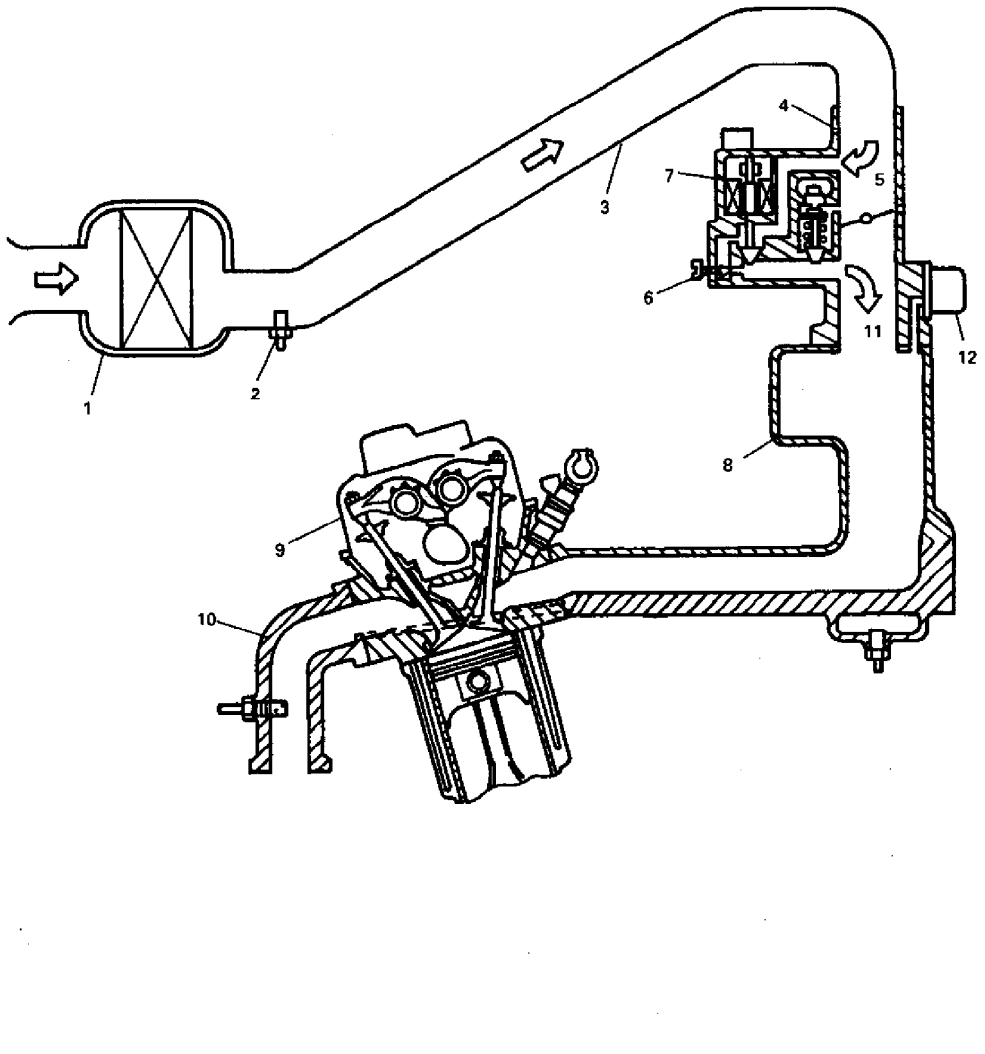
6E1-001

1. Heated oxygen sensor
2. Exhaust manifold
3. PCV valve
4. Intake manifold
5. Three way catalytic converter
6. EVAP canister
7. Fuel tank
8. IAT sensor
9. Fuel pressure regulator
10. Fuel injector
11. TP sensor
12. EVAP SP valve
13. ECT sensor
14. Throttle body
15. IAC valve
16. Air cleaner
17. Idle air adjusting screw
18. EGR valve
19. Ignition coil
20. EGR modulator
21. EGR SV valve (Blue)
22. MAP sensor
23. Fast idle air valve
24. Transmission range switch (A/T)
25. CMP sensor (in distributor)
26. Electric load (heater fan motor, lighting switch, rear defogger)
27. Vehicle speed sensor
28. Starter magnetic switch
29. Main relay
30. Fuel pump relay
31. Main switch
32. Battery
33. Malfunction indicator lamp ("CHECK ENGINE" light)
34. Fuel pump
35. ECM
36. Monitor coupler
37. Blank
38. Blank
39. Radiator fan motor relay
40. Blank
41. Fuel tank breather valve
42. TPC valve
43. Fuel filter
44. Blank
45. Ignitor

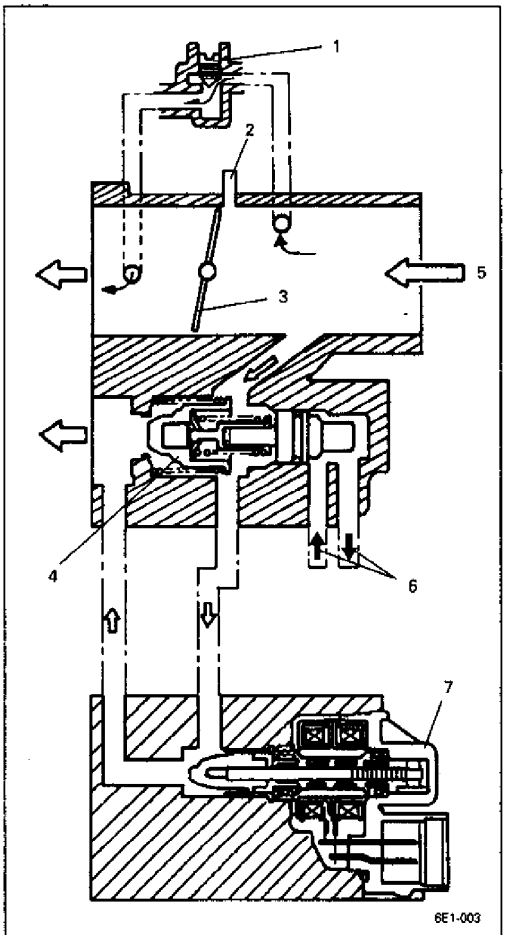
AIR INTAKE SYSTEM

The main components of the air intake system are air cleaner, air cleaner outlet hose, throttle body, idle air control valve and intake manifold. The air (by the amount corresponding to the throttle valve opening and engine speed) is filtered by the air cleaner, passes through the throttle body, is distributed by the intake manifold and finally drawn into each combustion chamber.

When the engine is idling, when it is cold or when the idle air control valve is opened according to the signal from ECM, the air bypasses the throttle valve through bypass passage which varies in each case and is finally drawn into the intake manifold.



1. Air cleaner
2. Intake air temperature sensor (IAT sensor)
3. Air cleaner outlet hose
4. Throttle body
5. Throttle valve
6. Idle air adjusting screw
7. Idle air control valve (IAC valve)
8. Intake manifold
9. Cylinder head
10. Exhaust manifold
11. Air flow
12. MAP sensor

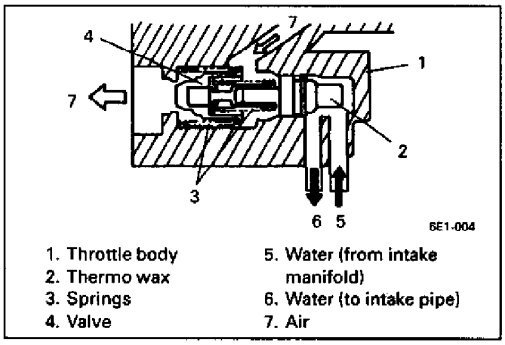


1. Idle speed adjusting screw
2. Vacuum passage
3. Throttle valve
4. Fast idle air valve
5. Air
6. Engine coolant
7. IAC valve

THROTTLE BODY

The throttle body consists of the main bore, air bypass passage, vacuum passage (for EGR system) and the following parts.

- Throttle valve which is interlocked with the accelerator pedal and controls the amount of the intake air
- Idle air adjusting screw which controls the amount of bypass air to adjust idle air control duty.
- TP sensor which detects the throttle valve opening and sends a signal to ECM
- Idle air control valve which supplies the bypass air depending on engine condition.
- Fast idle air valve which supplies the bypass air when engine is cold.

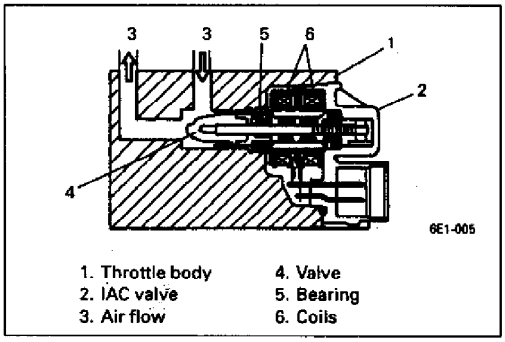


1. Throttle body
2. Thermo wax
3. Springs
4. Valve
5. Water (from intake manifold)
6. Water (to intake pipe)
7. Air

Fast Idle Air Valve

The fast idle air valve consists of thermo-wax, springs and valve.

When the engine is cold, it sends the air from the air cleaner to the intake manifold without letting it pass through the throttle valve to increase the engine speed, and thus the engine is warmed up.



1. Throttle body
2. IAC valve
3. Air flow
4. Valve
5. Bearing
6. Coils

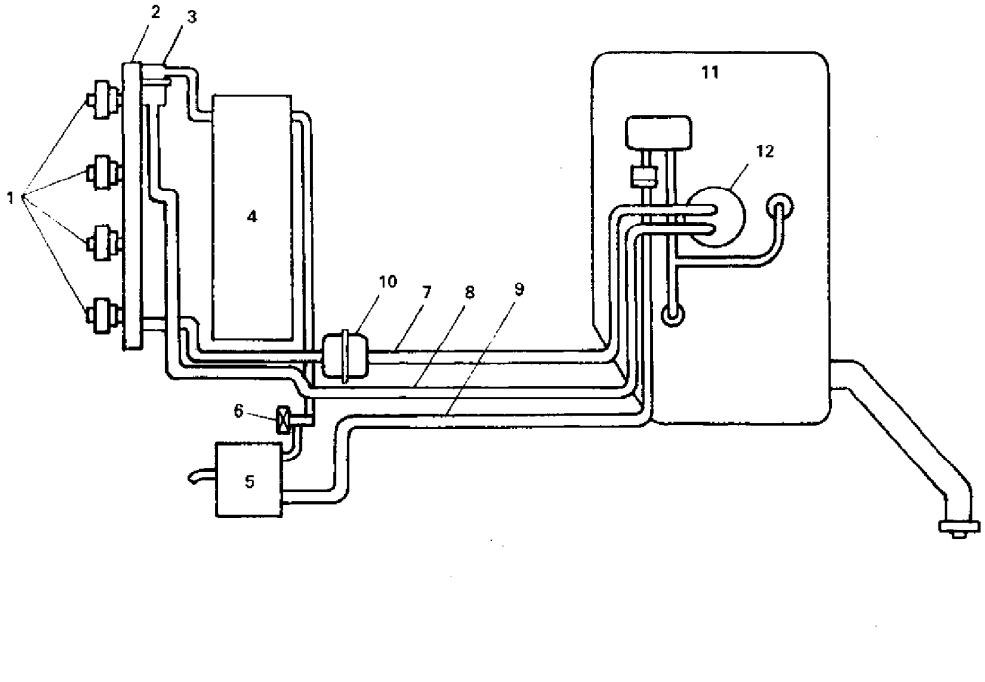
Idle Air Control Valve (IAC Valve)

The idle air control valve opens and closes air bypass passage according to the signal from ECM.

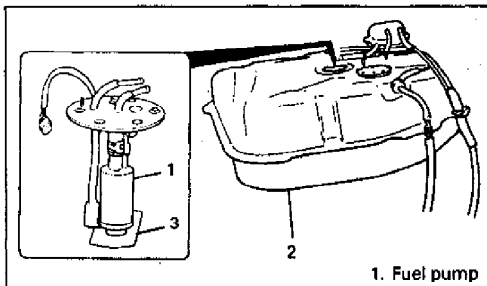
When it opens, the air is supplied to the intake manifold.

FUEL DELIVERY SYSTEM

The fuel delivery system consists of the fuel tank, fuel pump, fuel filter, fuel pressure regulator, delivery pipe and fuel injectors.
The fuel in the fuel tank is pumped up by the fuel pump, filtered by the fuel filter and fed under pressure to each injector through the delivery pipe.
As the fuel pressure applied to the injector (the fuel pressure in the fuel feed line) is always kept a certain amount higher than the pressure in the intake manifold by the fuel pressure regulator, the fuel is injected into the intake port of the cylinder head when the injector opens according to the injection signal from ECM.
The fuel relieved by the fuel pressure regulator returns through the fuel return line to the fuel tank.
For the structure and operation of the fuel tank and filter, refer to SECTION 6C "ENGINE FUEL".



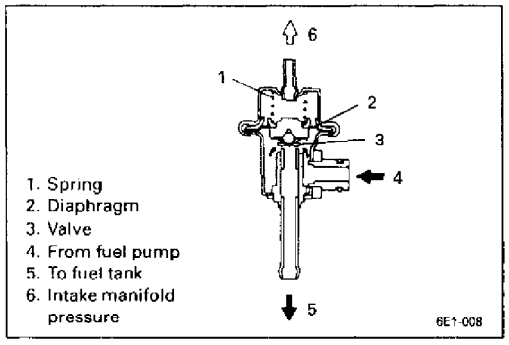
1. Fuel injector
2. Delivery pipe
3. Fuel pressure regulator
4. Intake manifold
5. EVAP canister
6. EVAP canister purge valve
7. Fuel feed line
8. Fuel return line
9. Fuel vapor line
10. Fuel filter
11. Fuel tank
12. Fuel pump



1. Fuel pump
2. Fuel tank
3. Filter

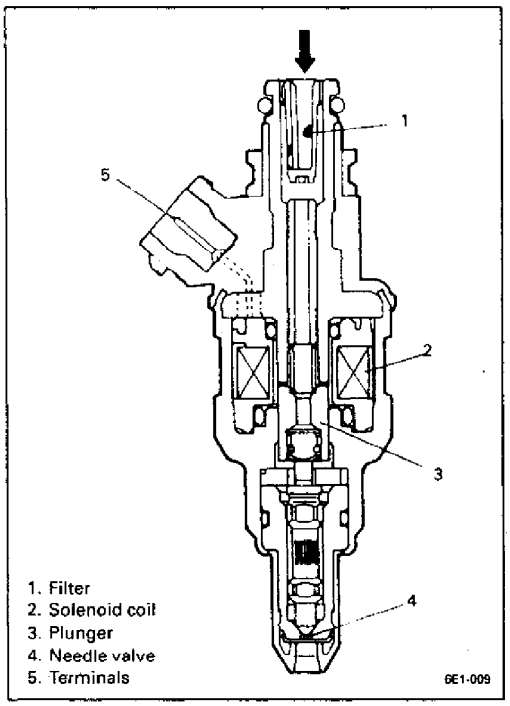
FUEL PUMP

The electric fuel pump located in the fuel tank consists of armature, magnet, impeller, brush, check valve, relief valve, etc.. The ECM controls its ON/OFF operation as described in item "Fuel Pump Control System".



FUEL PRESSURE REGULATOR

The fuel pressure regulator keeps the fuel pressure applied to the injector 2.55 kg/cm^2 (250 kPa) higher than that in the intake manifold at all times.



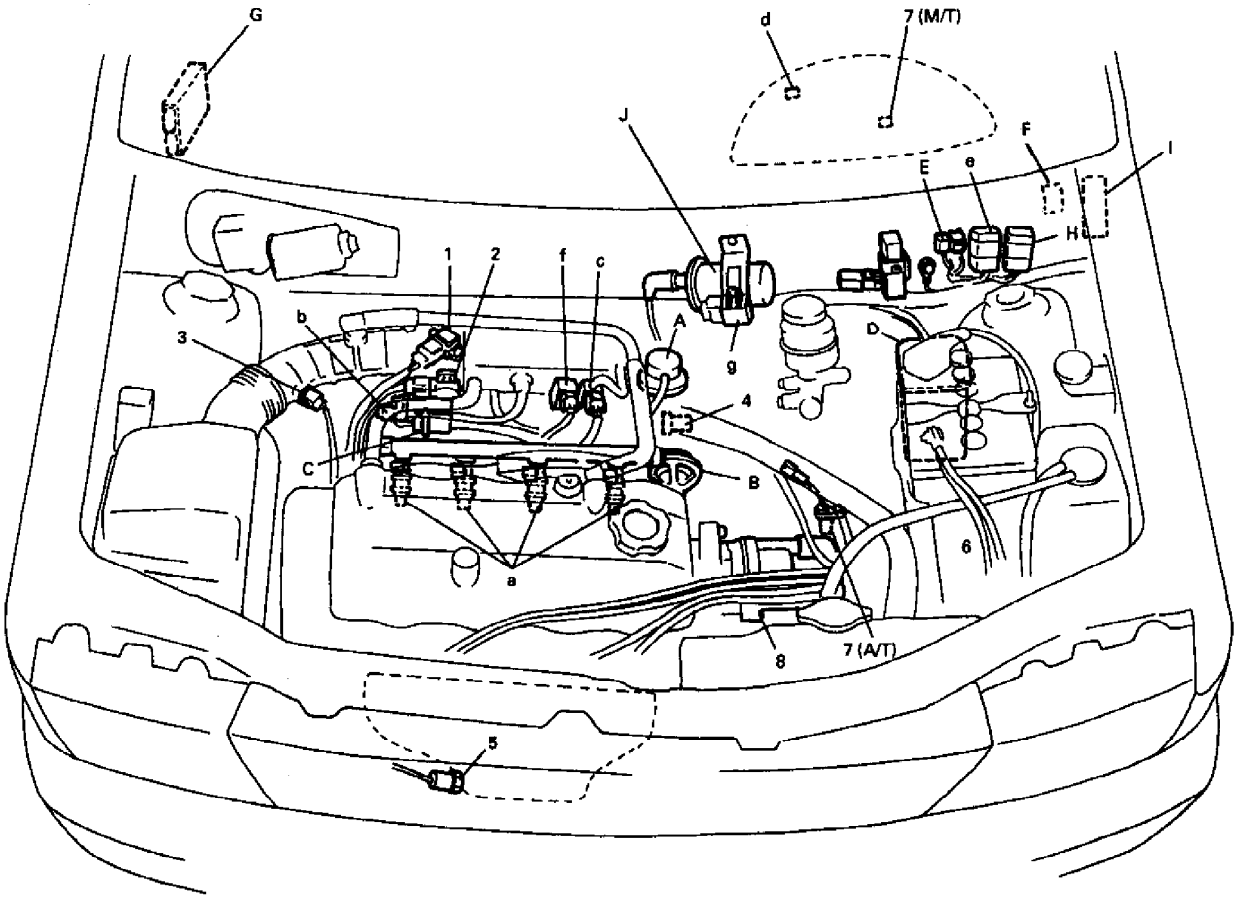
FUEL INJECTOR

There are 4 injectors (one for each cylinder), each of which is installed between the intake manifold and delivery pipe. It is an electromagnetic type injection nozzle which injects fuel into the intake port of the cylinder head according to the signal from ECM.

ELECTRONIC CONTROL SYSTEM

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices. Functionally, it is divided into the following sub systems:

- Fuel injection control system
- Heated oxygen sensor heater control system
- Idle air control system
- Fuel pump control system
- EGR system
- EVAP control system
- IC (Ignition Control) system

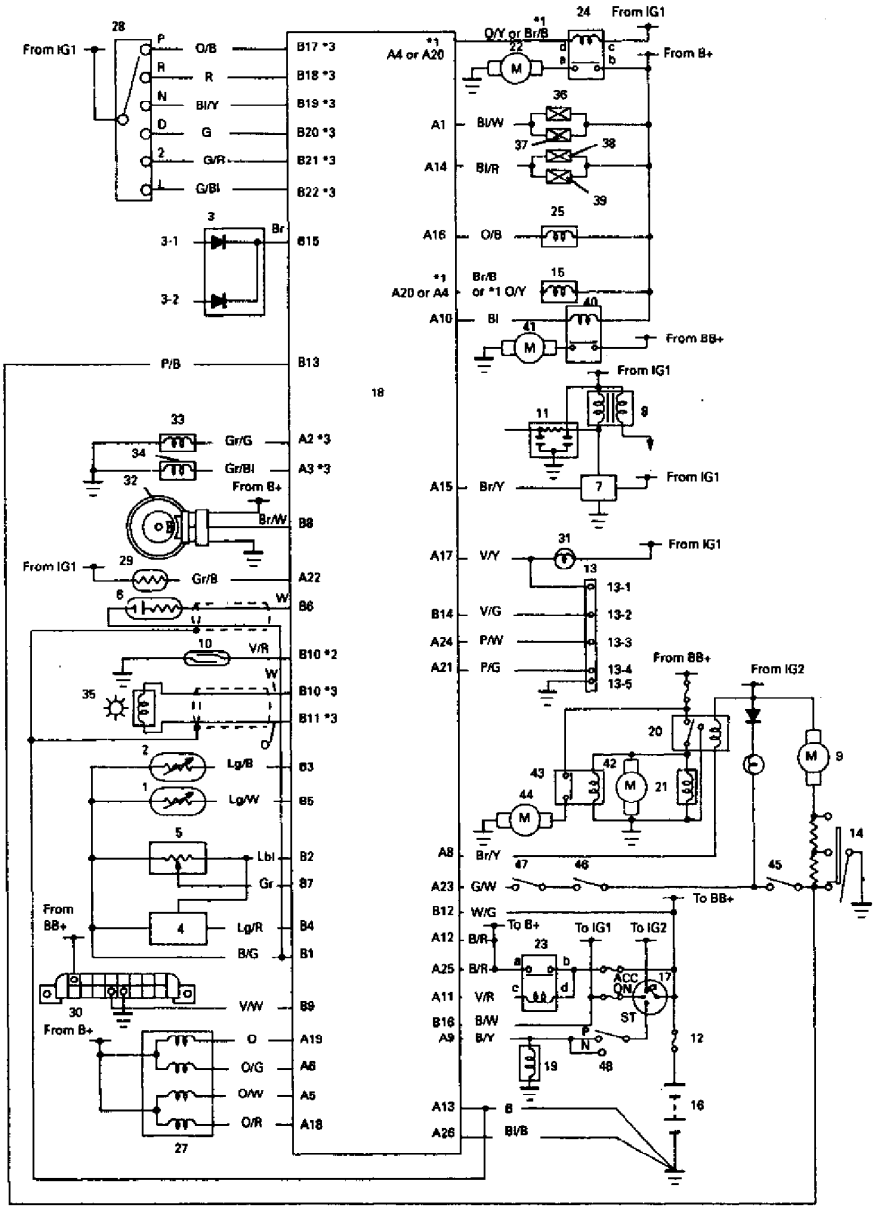


6E1-010

INFORMATION SENSORS
1. MAP sensor
2. TP sensor
3. IAT sensor
4. ECT sensor
5. Heated oxygen sensor
6. Battery
7. VSS
8. CMP sensor (in distributor)

CONTROLLED DEVICES
a :Injector
b :IAC valve
c :EGR Solenoid Vacuum valve (Blue)
d :Malfunction indicator lamp ("CHECK ENGINE" light)
e :Fuel pump relay
f :EVAP canister purge valve (Brown)
g :Ignitor

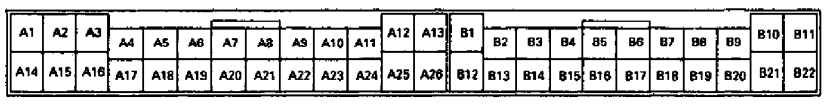
OTHERS
A :EGR pressure transducer
B :EGR valve
C :Fuel pressure regulator
D :EVAP canister
E :Monitor coupler
F :Immobilizer monitor coupler (if equipped)
G :ECM
H :Main relay
I :Data link connector
J :Ignition coil



6E1-011

TERMINAL ARRANGEMENT OF EACH COUPLER (VIEWED FROM HARNESS SIDE)

ECM



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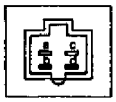
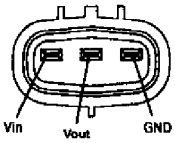
FUEL PUMP AND MAIN RELAY



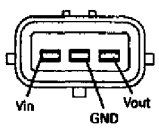
6E1-013

TP sensor



6E1-014

MAP sensor



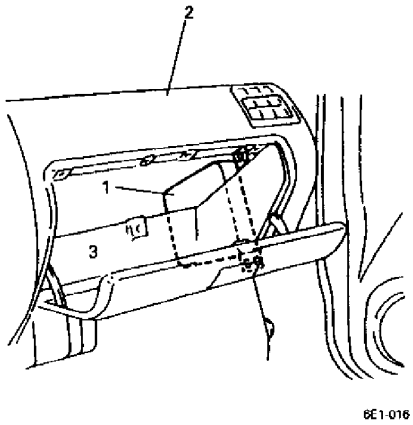
6E1-015

*1: Only vehicles with immobilizer control system
*2: Only vehicles with M/T
*3: Only vehicles with A/T

1. IAT sensor
2. ECT sensor
3. Electric load signal diode
3-1. To lighting switch
3-2. To rear window defogger
4. MAP sensor
5. TP sensor
6. Heated oxygen sensor
7. Ignitor
8. Ignition coil
9. Heater fan motor
10. VSS (M/T only)
11. Noise suppressor
12. Main fuse
13. Moniter coupler
13-1. Diag. check terminal
13-2. Diag. switch terminal
13-3. Test switch terminal
13-4. Duty check terminal
13-5. Ground terminal
14. Heater fan switch
15. EVAP canister purge valve
16. Battery
17. Main switch
18. ECM (M/T) or PCM (A/T)
19. Starter magnetic switch
20. Condenser fan motor relay (if equipped)
21. A/C Solenoid vacuum valve (if equipped)
22. Fuel pump
23. Main relay
24. Fuel pump relay
25. EGR Solenoid Vacuum valve
26. Blank
27. IAC valve
28. Transmission range switch (A/T only)
29. Oxygen sensor heater
30. Data link connector
31. Malfunction indicator lamp ("CHECK ENGINE" light)
32. CMP sensor (in distributor)
33. Shift solenoid 1 (A/T only)
34. Shift solenoid 2 (A/T only)
35. VSS (A/T only)
36. No.1 injector
37. No. 3 injector
38. No. 2 injector
39. No. 4 injector
40. Radiator fan control relay
41. Radiator fan motor
42. Condenser fan motor
43. Magnet clutch relay
44. Compressor
45. A/C switch
46. Evaporeter thermister
47. Dual pressure switch
48. Transmission range switch (A/T)

Wire color

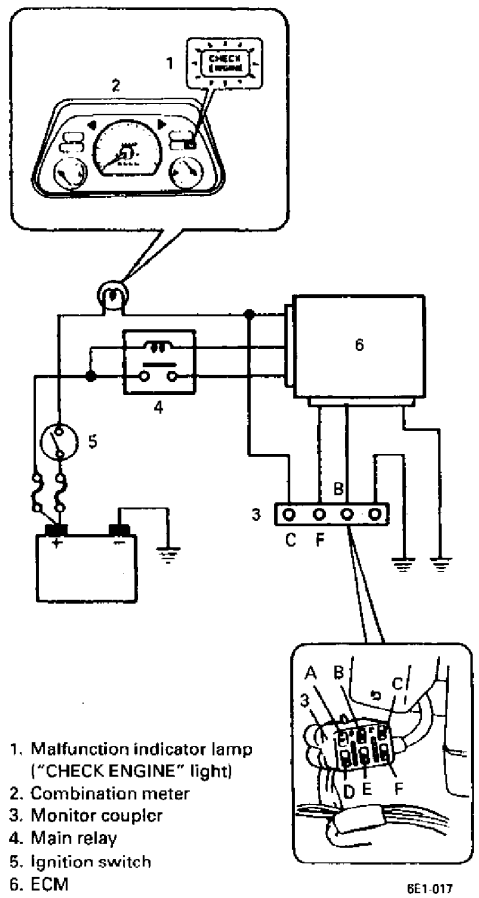
B	Black
B/Bl	Black/Blue
B/G	Black/Green
B/R	Black/Red
B/W	Black/White
B/Y	Black/Yellow
Bl	Blue
Bl/B	Blue/Black
Bl/R	Blue/Red
Bl/W	Blue/White
Bl/Y	Blue/Yellow
Br	Brown
Br/B	Brown/Black
Br/R	Brown/Red
Br/Y	Brown/Yellow
Br/W	Brown/White
G/R	Green/Red
G/Bl	Green/Blue
G/W	Green/White
Gr	Gray
Gr/G	Gray/Green
Gr/Bl	Gray/Blue
Gr/B	Gray/Black
Lbl	Lightblue
Lg/B	Lightgreen/Black
Lg/R	Lightgreen/Red
Lg/W	Lightgreen/White
Lg/Y	Lightgreen/Yellow
O	Orange
O/B	Orange/Black
O/G	Orange/Green
O/R	Orange/Red
O/W	Orange/White
O/Y	Orange/Yellow
P	Pink
P/B	Pink/Black
P/G	Pink/Green
P/W	Pink/White
R	Red
V/G	Violet/Green
V/R	Violet/Red
V/W	Violet/White
V/Y	Violet/Yellow
W	White
W/G	White/Green
Y/R	Yellow/Red



1. ECM
2. Instrument main panel
3. Glove box

Engine Control Module (ECM)

ECM is installed on dash side panel of passenger's side.
ECM is a precision unit consisting of one chip microcomputer, A/D (Analog/Digital) converter, I/O (Input/Output) unit and etc..
It is an essential part of the electronic control system, for its functions include not only such a major function as to control fuel injector, IAC valve, etc. but also on-board diagnostic system (self-diagnosis function), fail safe function and back-up function as described in the following section.



1. Malfunction indicator lamp ("CHECK ENGINE" light)
2. Combination meter
3. Monitor coupler
4. Main relay
5. Ignition switch
6. ECM
A: Blank
B: Diag. switch terminal
C: Diag. output terminal
D: Ground terminal
E: Test switch terminal
F: A/F duty output terminal

On-board diagnostic system (Self-diagnosis function)

ECM diagnoses troubles which may occur in the areas including the following parts when the ignition switch is ON or the engine is running, and indicates the result by turning on or flashing malfunction indicator lamp ("CHECK ENGINE" light).

- Heated oxygen sensors
- IAT sensor
- MAP sensor
- ECT sensor
- TP sensor
- Vehicle speed sensor
- Camshaft position sensor
- CPU (Central Processing Unit) of ECM

ECM and malfunction indicator lamp ("CHECK ENGINE" light) operate as follows.

- Malfunction indicator lamp ("CHECK ENGINE" light) lights when the ignition switch is turned ON (but the engine at stop) with the diagnosis switch terminal ungrounded regardless of the condition of Electronic Fuel Injection system. This is only to check the malfunction indicator lamp ("CHECK ENGINE" light) bulb and its circuit.
- If the above areas of Electronic Fuel Injection system is free from any trouble after the engine start (while engine is running), malfunction indicator lamp ("CHECK ENGINE" light) turns OFF.

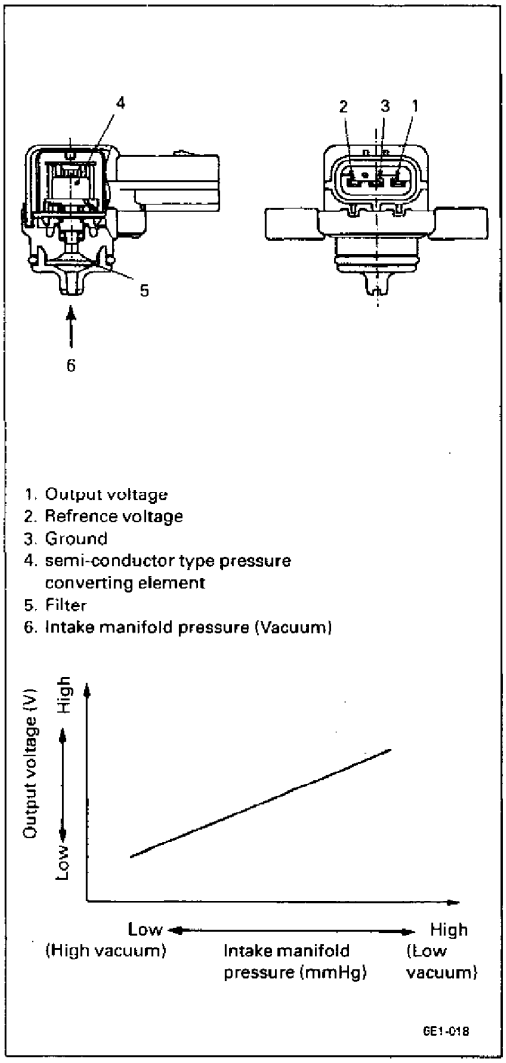
- When ECM detects a trouble which has occurred in the above areas, it makes malfunction indicator lamp ("CHECK ENGINE" light) turn ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the exact trouble area in ECM back-up memory.
  (The memory is kept as it is even if the trouble was only temporary and disappeared immediately. And it is not erased unless the power to ECM is shut off for 2 minuits or longer.) ECM also indicates trouble area in memory by means of flashing of malfunction indicator lamp ("CHECK ENGINE" light) at the time of inspection (i.e. when diagnosis switch terminal is grounded and ignition switch is turned ON).

  NOTE:
  - **Even when a trouble occurs in CMP sensor circuit (circuit open), ECM does not indicate it (or activate malfunction indicator lamp ("CHECK ENGINE" light)). And when that troubled circuit regains good condition, the memory of defective area will be erased automatically even if the power circuit to ECM is not opened as described above.**
  - **For on-board diagnostic system and fail-safe function of A/T related parts, refer to On-Board Diagnostic System in section 7B1.**

Fail-safe function

Even when a trouble has occurred in such areas of Electronic Fuel Injection system that include the following parts and a failure signal is sent to ECM, control over the injector, idle air control valve and other is maintained on the basis of the standard signals and/or back-up program prestored in the ECM while ignoring that failure signal and/or CPU. This function is called "fail-safe function". Thus, with this function, a certain level of engine performance is available even when some failure occurs in such areas so that disability in running is avoided.

- ECT sensor
- IAT sensor
- TP sensor
- MAP sensor
- CPU in ECM

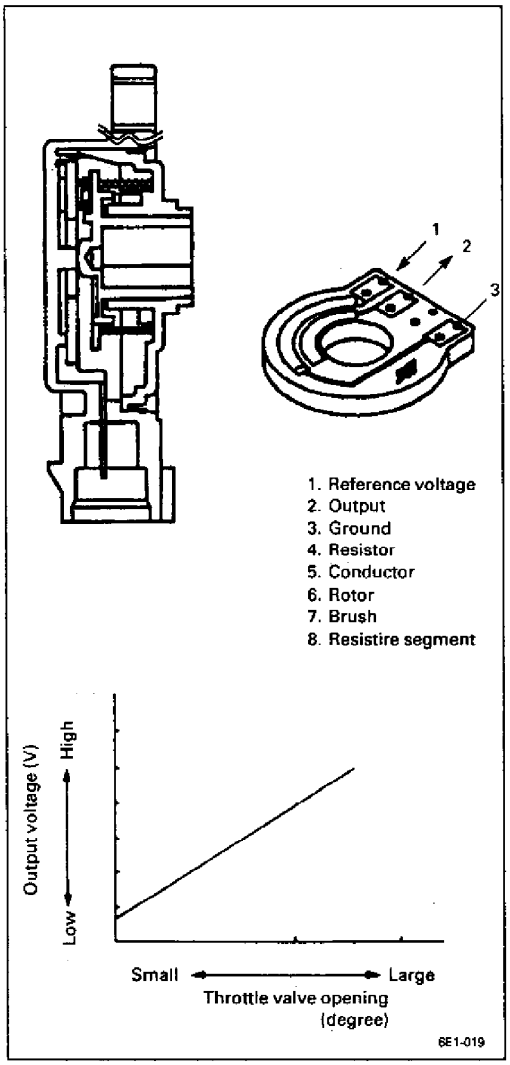


Manifold Absolute Pressure sensor (MAP Sensor)

This sensor senses pressure change in the intake manifold and converts it into voltage change. It consists of a semi-conductor type pressure converting element which converts a pressure change into an electrical change and an electronic circuit which amplifies and corrects the electric change. The ECM sends a 5-volt reference voltage to the MAP sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes.

By monitoring the sensor output voltage, ECM knows the manifold pressure (intake air volume).

ECM uses the voltage signal from the MAP sensor as one of the signals to control fuel injector, IAC valve and EGR Solenoid Vacuum valve.



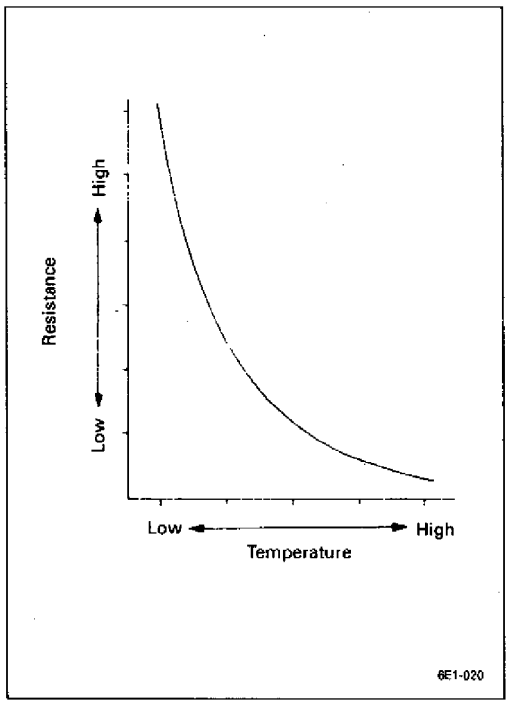
Throttle Position Sensor (TP Sensor)

The throttle position sensor consisting of a potentiometer is installed on the throttle body, and detects the throttle valve opening.

A5-volt reference voltage is applied to the sensor from ECM and as its brush moves over the print resistance according to the throttle valve opening, the output voltage varies accordingly.

By monitoring the sensor output voltage, ECM detects the throttle valve opening.

ECM uses the signal from TP sensor as one of the signals to control fuel injector, idle air control valve, ignition timing, EVAP canister purge valve and EGR solenoid vacuum valve.



Intake Air Temperature Sensor (IAT Sensor)

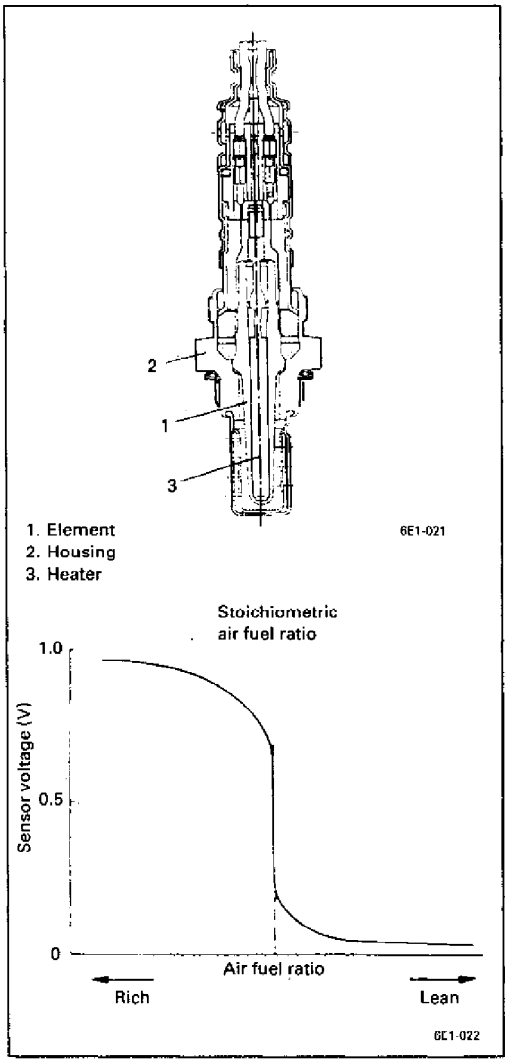
Located on the air cleaner outlet hose, this sensor constantly measures the temperature of the air entering there and converts a change in the air temperature into that in resistance through its thermistor. That is, as air temperature lowers, resistance increases and as it rises, resistance decreases. As air density of the intake air varies with variation in temperature, ECM, by monitoring the resistance, adjusts the amount of fuel injection according to the air temperature.

Engine Coolant Temperature Sensor (ECT Sensor)

Incorporated with coolant temp. gauge and installed to thermostat case, this sensor measures the temperature of the engine coolant and converts its change into that in resistance through the thermistor like the air temperature sensor.

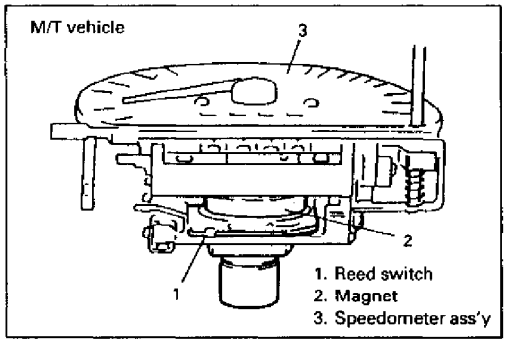
That is, as coolant temperature lowers, resistance increases and as it rises, resistance decreases.

By monitoring the resistance of the coolant temperature sensor, ECM detects the engine coolant temperature and that affects most systems under the control of ECM.



Heated Oxygen Sensor (HO_2S)

The oxygen sensor is installed on the exhaust manifold to detect the concentration of oxygen in the exhaust gases. The oxygen sensor heater promotes activation of the oxygen sensor.

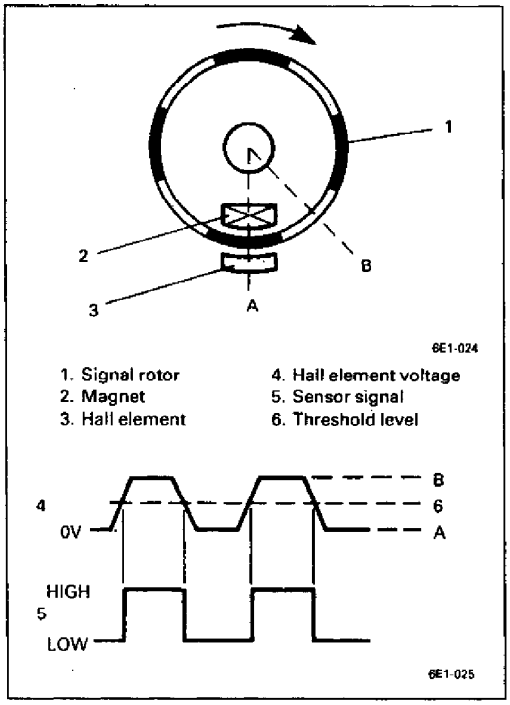


Vehicle Speed Sensor (VSS)

The VSS for M/T vehicle consisting of the reed switch and magnet is built in the speedometer. As the magnet turns with the speedometer cable, its magnetic force causes the reed switch to turn ON and OFF. Such ON/OFF frequency increases or decreases in proportion with the vehicle speed and is sent to ECM as pulse signals.
For VSS of A/T vehicle, refer to section 7B.
ECM uses it as one of the signals to control the fuel injector.

Engine Start Signal

This signal is sent from the engine starter circuit.
Receiving it, ECM judges whether the engine is cranking or not and uses it as one of the signals to control the fuel injector, IAC valve, ignition timing and fuel pump relay.



Camshaft Position Sensor (CMP sensor)

The CMP sensor located in the distributor consists of the signal generator (hall element and magnet) and signal rotor.

As the signal rotor turns, it causes the magnetic flux from the magnet to be applied to the hall element intermittently. The hall element generates the voltage in proportion with the magnetic flux as shown below. This voltage is waveshaped into the pulse signal (sensor signal) by the comparator.

This pulse signal (4 pulses/revolution) is sent to ECM where it is used to calculate the engine speed and also as one of the signals to control fuel injector and ignition timing.

Electric Load Signal

This signal sent from each circuit of head & small (or clearance) lights heater fan and rear window defogger.

ECM uses it as one of the factors for controlling idle air control valve operation.

Air-Conditioning Signal (For vehicle with A/C)

This signal is sent from the air-conditioning circuit.

The air-conditioning circuit sends this signal to ECM when A/C ON conditions are satisfied on the air-conditioning circuit side. (The air conditioner does not turn ON in this state.)

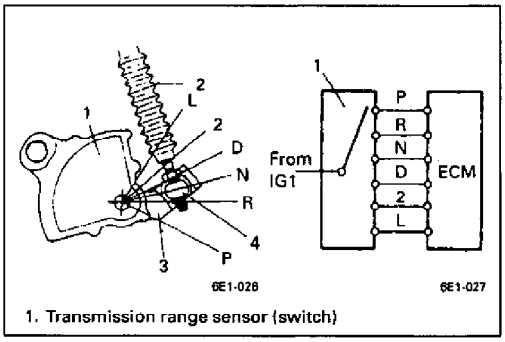
When ECM detects through the A/C signal that A/C ON conditions are satisfied on the air-conditioning circuit side, it uses the A/C signal as one of the factors to output A/C ON signal and to control injector.

Battery Voltage

The fuel injector is driven by its solenoid coil based upon the ECM output signal.

There is some delay called as "Ineffective injection time", which doesn't provide fuel, between ECM signal and valve action.

As the ineffective injection time depends on the battery voltage, ECM takes voltage information to compensate it in fuel injection time.



1. Transmission range sensor (switch)

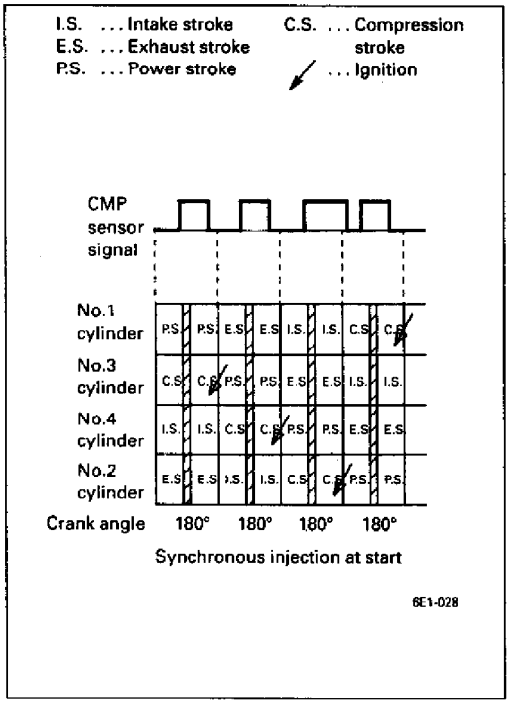
Transmission Range Sensor (switch) (A/T vehicle only).
This switch is installed on the automatic transmission. ECM detects transmission range by monitoring the ON/OFF signal from this switch and uses it as one of the signals to control the fuel injector, IAC valve and automatic transmission.

Diagnosis Switch Terminal
The diagnosis switch terminal is included in the monitor coupler in the engine room. When diagnosis switch terminal is grounded, a diagnosis signal is fed to ECM which then output diagnostic trouble code.

Test Switch Terminal
The test switch terminal is included in the monitor coupler. When this terminal is grounded, ECM sets the ignition timing to the initial ignition timing. When both test switch terminal and diagnosis switch terminal are grounded, ECM outputs A/F duty through the A/F duty check terminal.

FUEL INJECTION CONTROL SYSTEM

In this system, ECM controls the time (amount) and timing of the fuel injection from the fuel injector into the cylinder head intake port according to the signals from the various sensors so that suitable air/fuel mixture is supplied to the engine in each driving condition.



Synchronous injection at start

Injection Timing

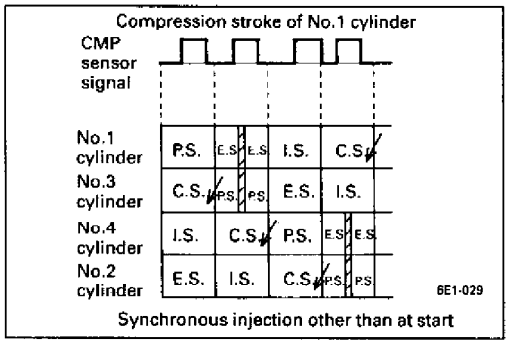
There are two types of injection timing. One is "synchronous injection" in which injection takes place at the same crank angle all the time and the other is "asynchronous injection" in which the fuel is injected according to sensor signals other than the CMP sensor signal.

Synchronous injection

At start

When the engine speed is lower than 600 r/min, all four injectors inject fuel simultaneously at every one signal (once every revolution of the engine.)

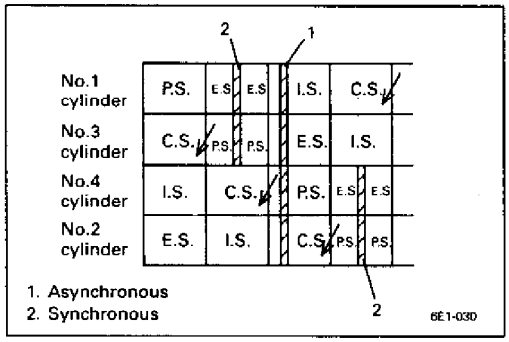
When the engine is started from its very cold state, however, the amount of fuel determined by the engine coolant temperature is divided and injected.



Synchronous injection other than at start

After engine start

After the engine started and the piston position of each cylinder was judged by ECM through the CMP sensor signal, two of four injectors (No.1 and No.3 cylinder injectors and No.2 and No.4 cylinder injectors) inject fuel simultaneously.



Asynchronous injection

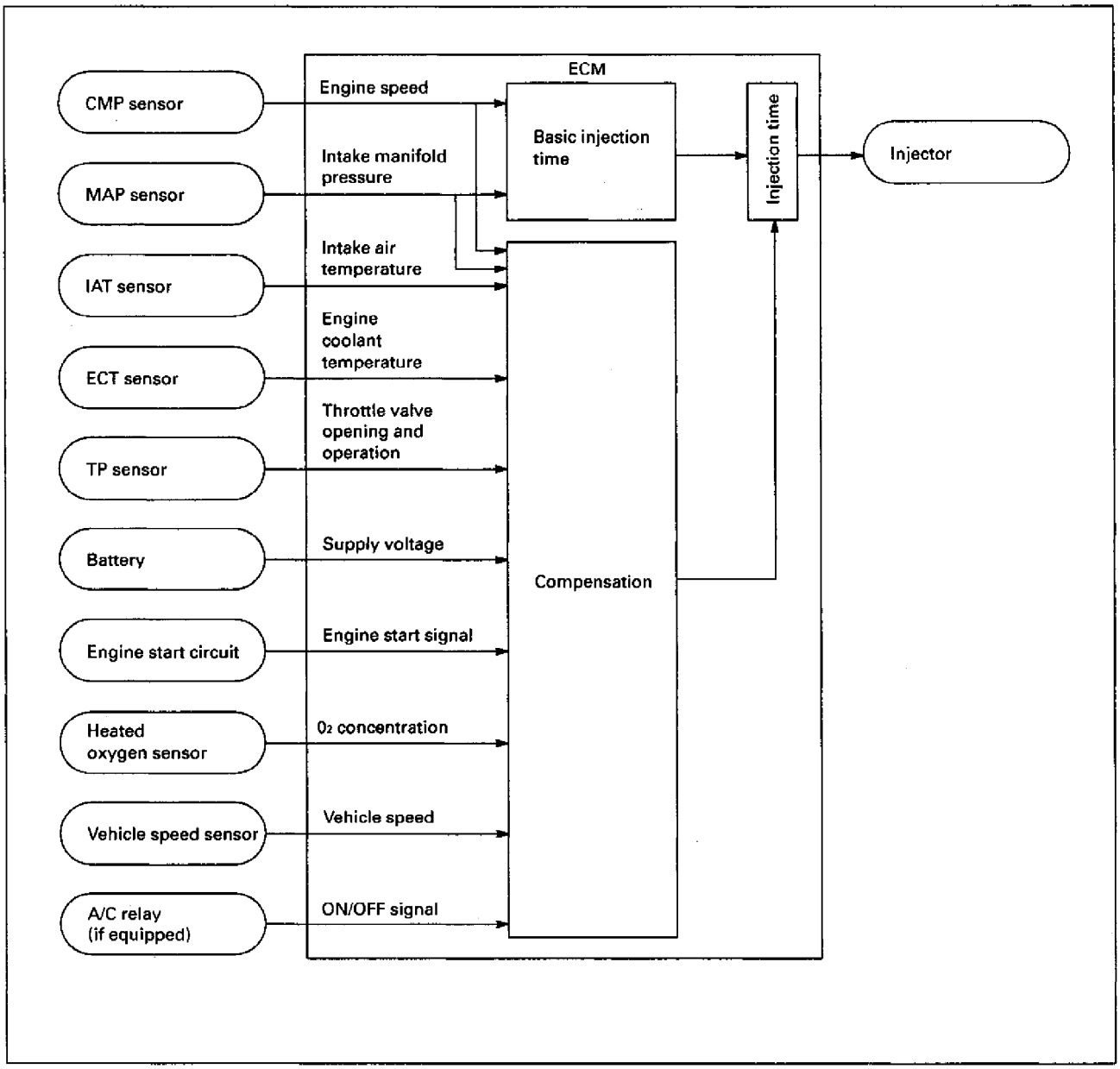
After the engine was started and both of the following conditions are satisfied, all injectors inject fuel regardless of the CMP sensor signal.

- When the throttle valve opens at a larger change rate than the specified value (when the throttle valve is opened quickly)

Asynchronous injection takes place immediately when above conditions are met.

Injection Time (amount of injection)

The factors to determine the injection time are the basic injection time which is calculated on the basis of the engine speed and the intake manifold pressure (amount of the intake air) and various compensations which are determined according to the signals from various sensors that detect the state of the engine and driving conditions.



Fuel cut

Fuel injection stops (with operation of the injector prevented) when decelerating (i.e. when the throttle valve is at idle position and the engine speed is high), so that unburned gas will not be exhausted and it starts again when above conditions are not met.

The fuel injection also stops when the engine speed exceeds about 6,600 r/min to prevent over-run which affects the engine adversely and it starts again when the engine speed reduces to less than about 6,300 r/min.

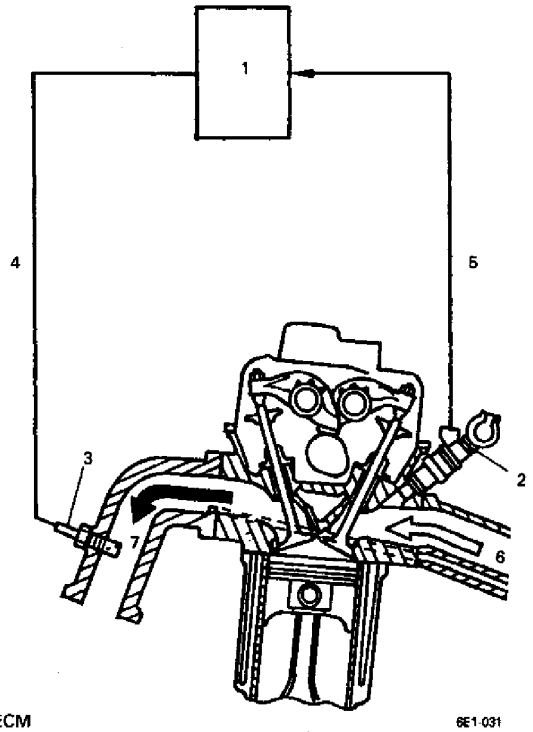
Air/fuel ratio feed back compensation (Closed loop system)

It is necessary to keep the air/fuel mixture close to the theoretical air/fuel ratio (14.7) to obtain efficient performance of the 3-way catalytic converter and high clarification rate of CO, HC and NOx in the exhaust gas. For that purpose, ECM operates as follows. It first compares the signal from the heated oxygen sensor with a specified reference voltage and if the signal is higher, it detects that the air/fuel ratio is richer than the theoretical air/fuel ratio and reduces fuel. On the other hand, if the signal is lower, it detects that the air/fuel ratio is leaner and increases fuel. By repeating these operations, it adjusts the air/fuel ratio closer to the theoretical air/fuel ratio.

1) When oxygen concentration in the exhaust gas is low, that is, when the air/fuel ratio is smaller than the theoretical air/fuel ratio (fuel is richer), electromotive force of the heated oxygen sensor increases and a rich signal is sent to ECM.
2) Upon receipt of the rich signal, ECM decreases the amount of fuel injection, which causes oxygen concentration in the exhaust gas to increase and electromotive force of the heated oxygen sensor to decrease. Then a lean signal is sent to ECM.
3) As ECM increases the amount of fuel injection according to the lean signal, oxygen concentration in the exhaust gas decreases and the situation is back to above 1).

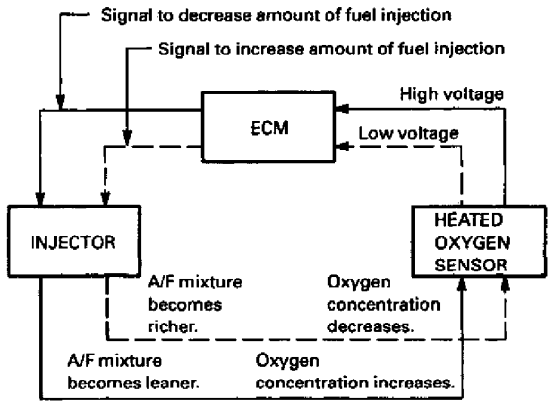
This control process, however, will not take place under any of the following conditions.

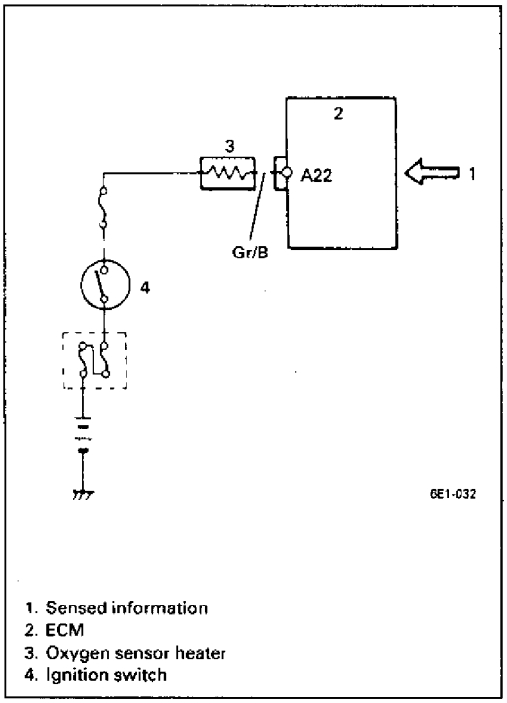
- At engine start and when fuel injection is increased after engine start
- When engine coolant temperature is low
- When highly loaded and fuel injection is increased
- At fuel cut
- When heated oxygen sensor is cold
- When engine is running at high speed



1. ECM
2. Injector
3. Heated oxygen sensor
4. Voltage signal
5. Injection signal
6. Air/fuel mixture
7. Exhaust gas

6E1-031

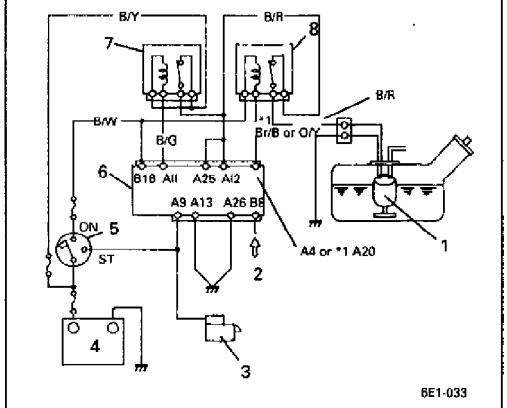




1. Sensed information
2. ECM
3. Oxygen sensor heater
4. Ignition switch

HEATED OXYGEN SENSOR HEATER CONTROL SYSTEM

This system controls operation (ON/OFF) of the heater which assists activation of the oxygen sensor. ECM turns the oxygen sensor heater ON (to allow the electric current to flow to the oxygen sensor heater) when the engine is running without high-load and high-speed condition.



*1: For vehicles with immobilizer control system

1. Fuel pump
2. From CMP sensor
3. Starter
4. Battery
5. Main switch
6. ECM
7. Main relay
8. Fuel pump relay

FUEL PUMP CONTROL SYSTEM

ECM controls ON/OFF operation of the fuel pump by turning it ON via the fuel pump relay under any of the following condition.

- For 3 seconds after ignition switch ON.
- While cranking engine (while engine start signal is inputted to ECM).
- While CMP sensor signal is inputted to ECM.

IDLE AIR CONTROL SYSTEM

This system controls the bypass air flow by means of ECM and idle air control valve (IAC valve) for the following four purposes.

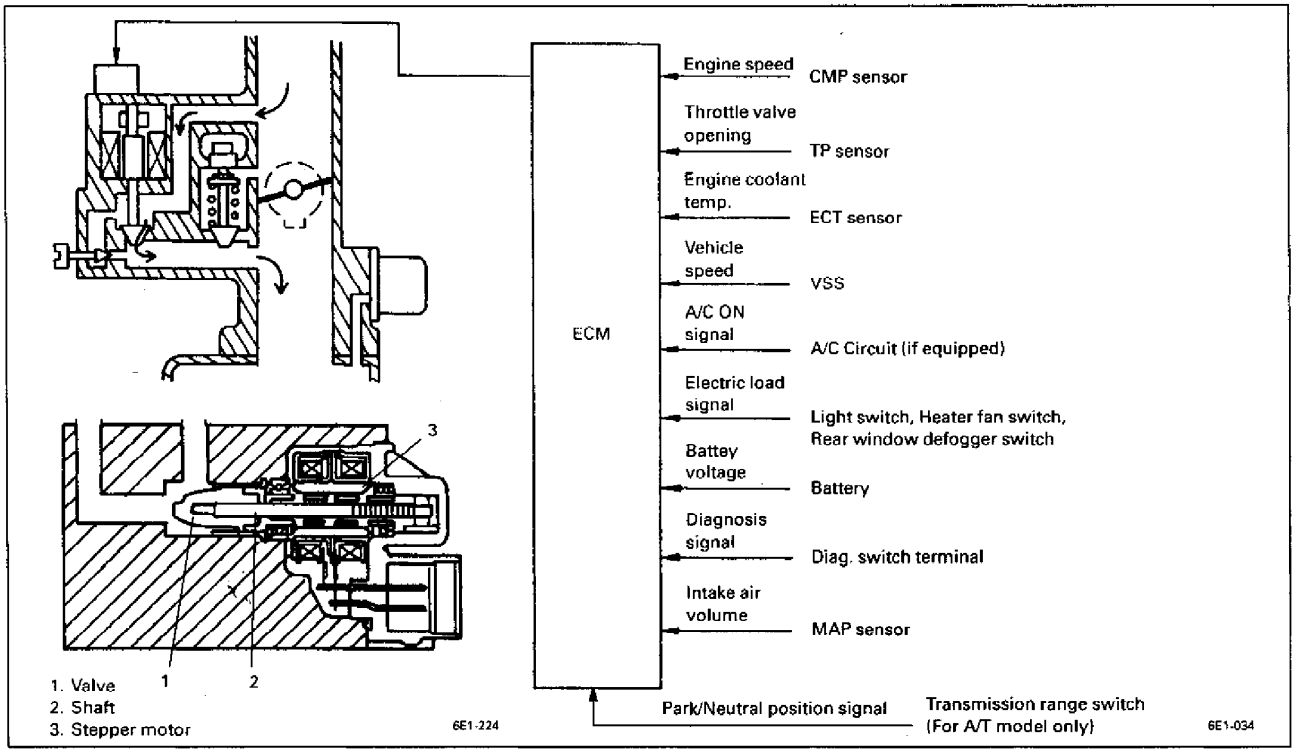
- To keep the engine idle speed as specified at all times.
  The engine idle speed can vary due to following reasons.
  * Load applied to engine (when electric load is applied, automatic transmission is shifted to "R", "D", "2', or "L" range, A/C is turned ON, etc.)
  * Variation in atmospheric pressure
  * Change in engine itself with passage of time
  * Other factors causing idle speed to change
- To improve starting performance of engine
- To compensate air/fuel mixture ratio when decelerating (Dash-pot effect)
- To improve driveability when while engine is warmed up.

Operation

The IAC valve opens and closes the bypass air passage according to signals from ECM.
When the IAC valve stepper motor receives "open" signal from ECM, it turns in the "open" direction according to the number of steps and pulls up the shaft which is in mesh with the worm of the stepper motor. As the valve installed to the shaft is pulled by this shaft, the IAC valve opens by the amount corresponding to the number of steps of the "open" signal from ECM.
To close the IAC valve, the stepper motor turns in the "close" direction according to the number of steps of the "close" signal from ECM and pushes out the shaft. In this way, the valve is closed by the spring force.
ECM detects the engine condition by using signals from various sensors and switches and controls the engine idle speed by turning the IAC valve stepper motor in "open" direction or in "close" direction.
When the vehicle is at a stop, the throttle valve is at the idle position and the engine is running, the engine speed is kept at a specified idle speed.

<M/T vehicle>	A/C OFF	A/C ON
Engine idle speed specification	800±50 r/min.	1,000±50 r/min.

<A/T vehicle>		A/C OFF	A/C ON
Engine idle speed specification	"P" or "N" range	800±50 r/min.	1,000±50 r/min.
	"R", "D", "2" or "L" range	900±50 r/min.	1,000±50 r/min.



EXHAUST GAS RECIRCULATION (EGR) SYSTEM

This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifold.

The EGR valve is controlled by EGR pressure transducer and EGR solenoid vacuum valve controlled by ECM according to signals from various sensors.

The diaphragm mounted in the EGR pressure transducer is operated by back pressure of the exhaust gas to open and close the valve. By this opening and closing action of the valve, the EGR pressure transducer controls the vacuum transmitted to the EGR valve.

Under a low load condition such as low speed driving, the exhaust pressure is low. In this state, the diaphragm in the EGR pressure transducer is pushed down by the spring force and the modulator valve opens to allow the air into the vacuum passage from the outside.

As a result, the vacuum transmitted to the EGR valve becomes smaller and so does the opening of the EGR valve.

Thus, less amount of exhaust gas is recirculated to the intake manifold.

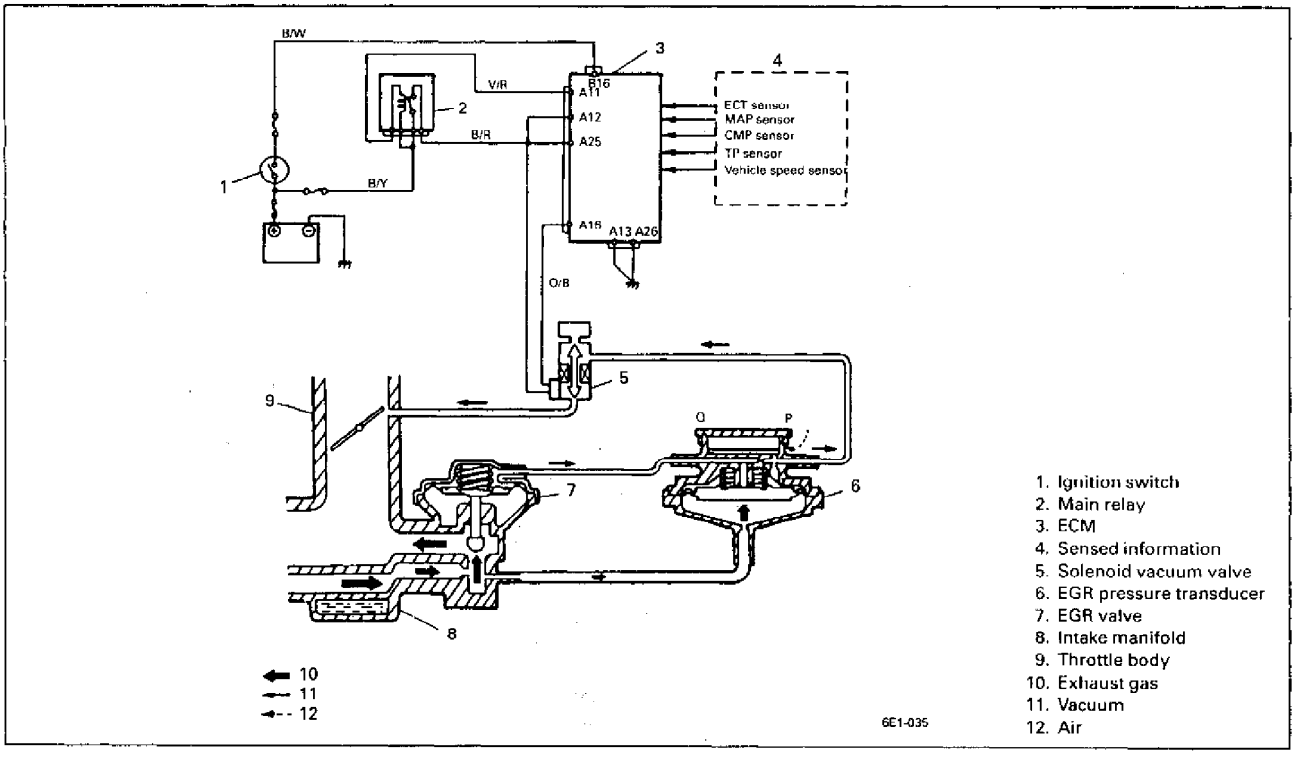
Under a high load condition such as high speed driving, on the other hand, the exhaust pressure is high. By the high exhaust pressure, the diaphragm in the pressure transducer is pushed up and closes its valve. As the air does not enter the vacuum passage in this state, the vacuum transmitted to the EGR valve grows larger and so does the opening of the EGR valve.

Thus, larger amount of exhaust gas is recirculated to the intake manifold.

Under any one of the following conditions, ECM closes the vacuum passage of solenoid vacuum valve. In this state, as the vacuum is not transmitted to the EGR valve, it remains closed.

- When engine coolant temperature is low
- When barometric pressure is low (at high altitude)
- When engine is running at high load
- When vehicle is stopped
- When engine is running at high speed

Other than the above, EGR valve opens and closes in accordance with the EGR pressure transducer operation.



EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM

An evaporative emission control system is used to prevent emission of fuel vapor.

The vapor generated in the fuel tank while driving or the engine at a stop passes through a tank pressure control valve and enters the EVAP canister where the charcoal absorbs and stores the fuel vapor.

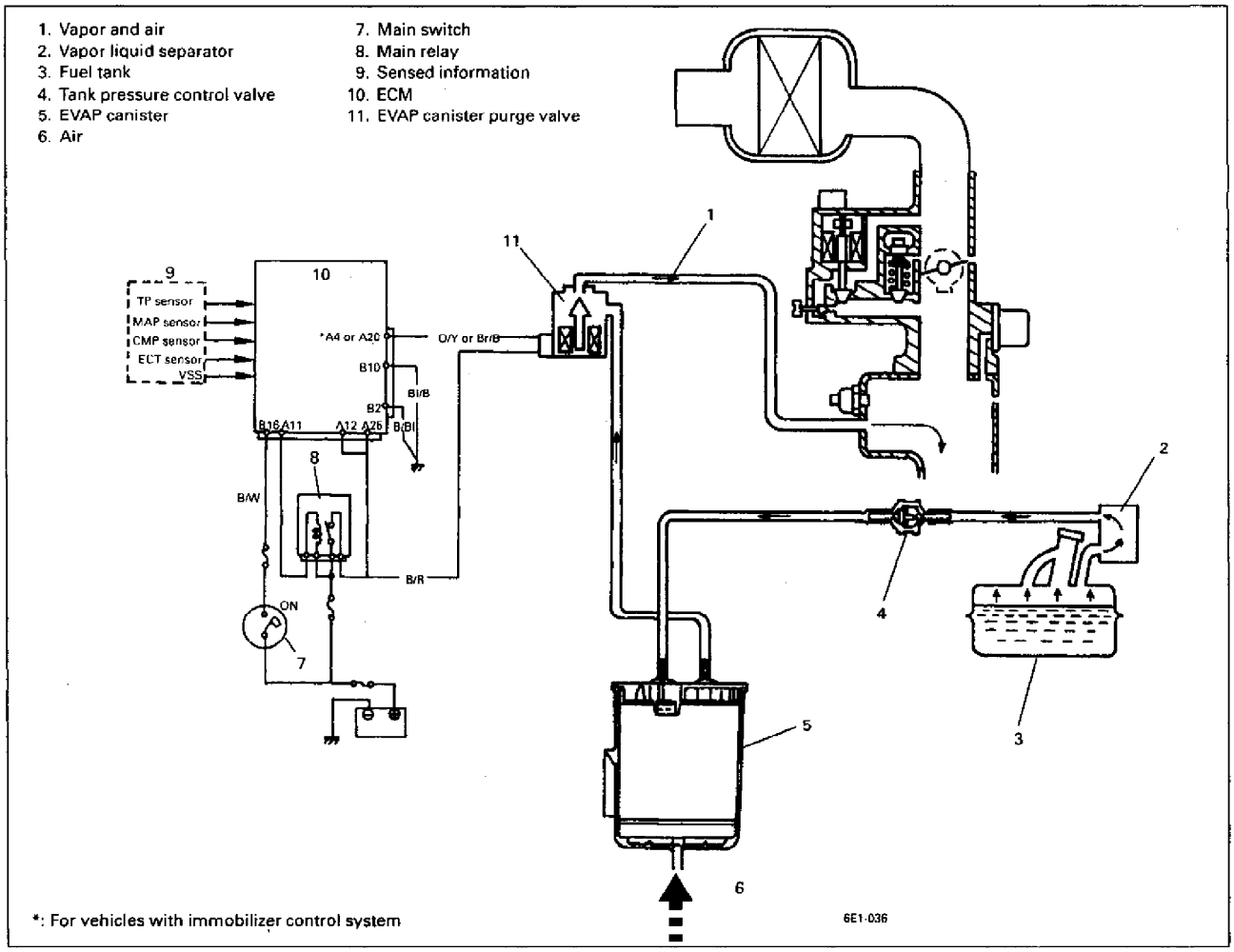
The EVAP canister purge valve is controlled by ECM according to signals from various sensors. Only when the following conditions are all satisfied, ECM opens vacuum passage of EVAP canister purge valve.

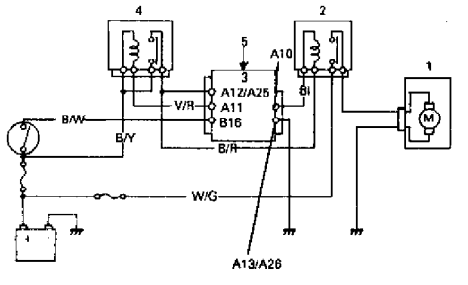
- When engine is normal operating temperature.
- When engine speed is higher than specified.
- When throttle valve opens wider than idle position
- When engine is running with the load higher than specified.
- When vehicle speed is higher than 14km/h (8.8 mile/h) (Or when test switch terminal is grounded and vehicle speed is higher than 1.4 km/h (0.88 mile/h).)

As a result, fuel vapor in the canister is sucked into intake manifold.

In this state, the canister is purged or cleaned by air drawn through the filter at the bottom of the canister.

The tank pressure control valve is provided to keep the pressure in the fuel tank constant. When the pressure in the fuel tank becomes positive and reaches its specified value, it opens the valve to let the vapor flow into the EVAP canister. On the other hand, when the pressure in the fuel tank becomes negative and reaches its specified value, it opens the valve to let the air flow into the fuel tank.





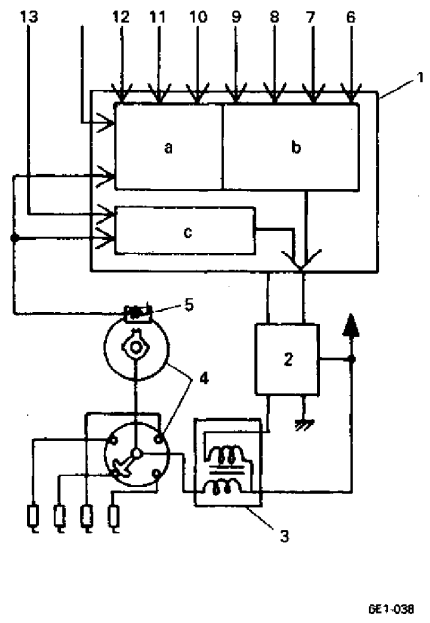
1. Radiator fan motor
2. Radiator fan control relay
3. ECM
4. Main relay
5. Engine coolant temp. (ECT sensor)

RADIATOR FAN CONTROL SYSTEM

This system controls operation (ON/OFF) of the radiator fan motor. Radiator fan motor is turned ON and OFF by its relay which ECM controls.

Radiator fan motor is turned ON/OFF under following engine coolant temp.

Radiator fan motor	Engine coolant temperature
OFF→ON	above 96 °C (205°F)
ON→OFF	below 90°C (194°F)



1. ECM
2. Ignitor
3. Ignition coil
4. Distributor
5. CMP sensor
6. TP sensor
7. ECT sensor
8. MAP sensor
9. Test switch terminal
10. Diag. switch terminal
11. Engine start switch
12. VSS
13. Battery voltage

IGNITION CONTROL (IC) SYSTEM

This system controls electronically the time of electric Current flow to ignition primary coil as well as ignition timing. ECM judges the engine condition by using signals from various sensors, selects the most suitable electric current flow time and ignition timing for that engine condition from among those prestored in its memory and sends an ignition signal to the igniter.

Control of this system includes three different types as follows.

a) Ignition timing control at engine start (initial ignition timing)
b) Ignition timing control after engine start
c) Electric current flow time control

Ignition Timing Control at Engine Start (Initial Ignition Timing)

To obtain better starting performance of the engine at the engine start (when the engine start switch turns ON.), IC system sets the ignition timing to the initial ignition timing (5° BTDC.)

Ignition Timing Control After Engine Start

The ignition timing after the engine start is determined as follows so that the spark occurs at the most suitable timing for each engine condition.

Ignition timing	=	Basic ignition timing	+	Various compensating advance

When the idle Switch is ON, the ignition timing is determined by adding basic ignition timing which varies according to the engine speed, compensating advance for idle speed stability and coolant temperature compensating advance.

When the idle switch is OFF, the ignition timing is determined by adding basic ignition timing which varies according to the engine speed and intake manifold pressure and the coolant temperature compensating advance etc.

- **Coolant temperature compensating advance**
  This compensation is added according to the signal from the engine coolant temperature sensor which detects the engine coolant temperature.
- **Compensating advance for idle speed stability**
  This compensation is carried out to stabilize the engine idle speed.

Electric Current Flow Time Control

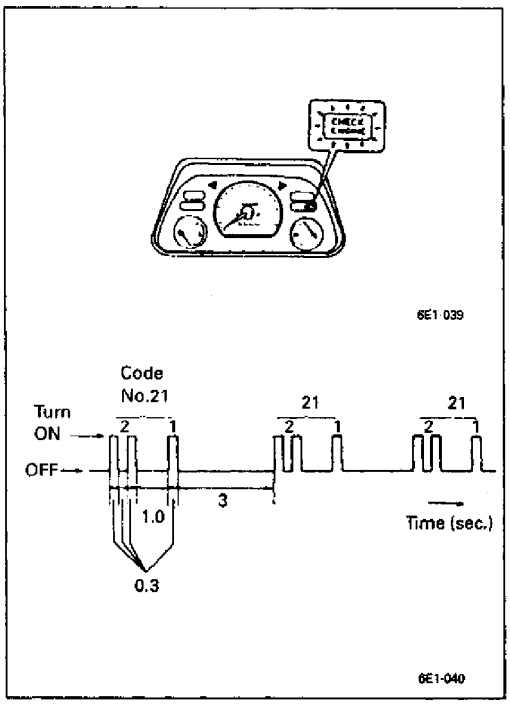
To stabilize the secondary voltage generated in the ignition coil to a proper level, ignition control system controls the time of primary current flow to the ignition coil.

NOTE:

The ignition timing is controlled by ECM as described above. Therefore, when checking or adjusting the ignition timing, the ignition timing must be fixed to the initial one by grounding the test switch terminal.

DIAGNOSIS

ECM has on-board diagnostic system (a system self-diagnosis function) as described previously (p. 6E1-13).
Investigate where the trouble is by referring to "DIAGNOSTIC FLOW CHART" and "DIAGNOSTIC TROUBLE CODE TABLE" on later pages.



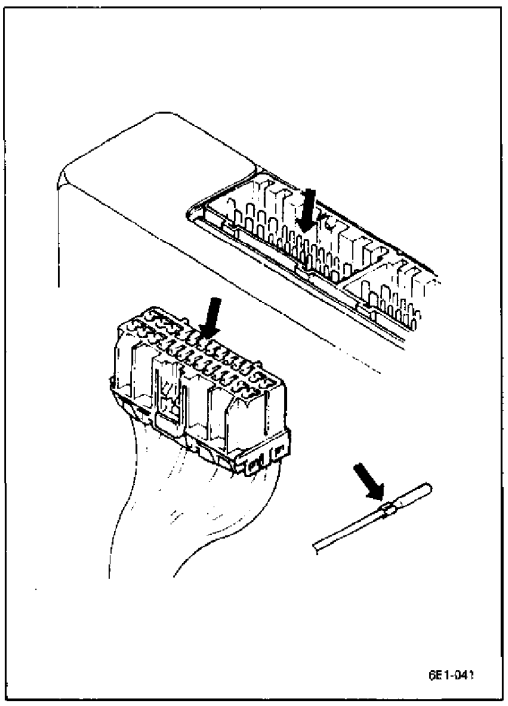
PRECAUTIONS IN DIAGNOSING TROUBLES
[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC TROUBLE CODE]

- Before identifying diagnostic trouble code indicated by malfunction indicator lamp ("CHECK ENGINE" light), don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine. Such disconnection will erase memorized trouble in ECM memory
- If abnormality or malfunction lies in two or more areas, malfunction indicator lamp ("CHECK ENGINE" light) indicates applicable codes three times each.
  And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.
- Take a note of diagnostic trouble code indicated first.

[INTERMITTENT TROUBLES]

- There are cases where malfunction indicator lamp ("CHECK ENGINE" light) indicates a diagnostic trouble code representing a trouble which occurred only temporarily and has gone. In such case, it may occur that good parts are replaced unnecessarily. To prevent such an accident, be sure to follow instructions given below when checking by using "Diagnostic Flow Chart".
  * When trouble can be identified, it is not an intermittent one:
    Check sensor (actuator), wires and each connection and if they are all in good condition, substitute a known-good ECM and recheck.

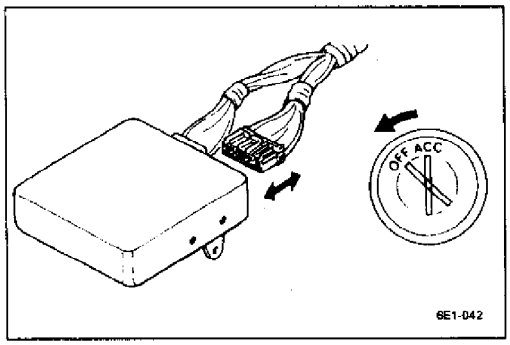
* When trouble can not be identified but malfunction indicator lamp ("CHECK ENGINE" light) indicates a trouble code:
  Diagnose trouble by using that code No. and if sensor (actuator), wires and each connection are all in good condition, erase diagnostic trouble code in ECM memory.
  Then conduct a test run and check what malfunction indicator lamp ("CHECK ENGINE" light) indicates. Only when it indicates trouble code again, substitute a known-good ECM and check again.
  If it indicates not trouble code but normal code No. 12, it means that an intermittent trouble did occur and has gone. In this case, check wires and connections carefully again.



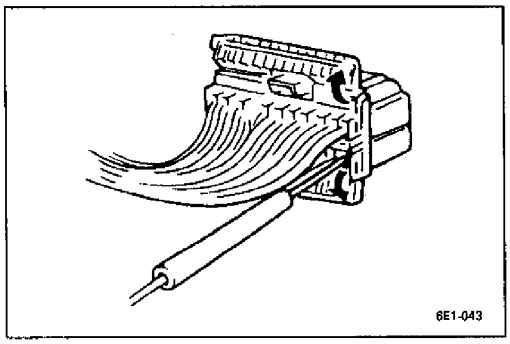
[NOTES ON SYSTEM CIRCUIT INSPECTION]

- Intermittent troubles
  Most intermittent problems are caused by faulty electrical connections or wiring.
  Perform careful check of suspect circuits for:
  - Poor mating of coupler halves, or terminals not fully seated in coupler body (backed out).
  - Improperly formed or damaged terminals. All coupler terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection.
- When there is a question "Are couplers connected properly?" in FLOW CHART, check male half of terminal for bend and female half for excessive opening, terminal for poor locking (looseness), corrosion, dust, etc.

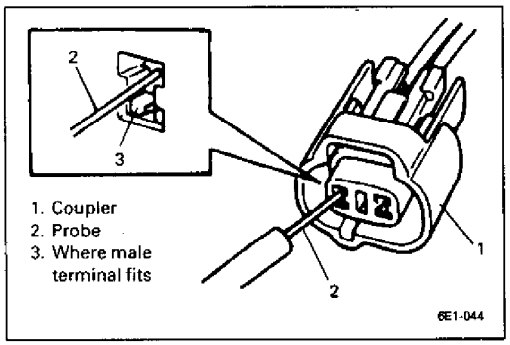
- Never connect any tester (voltmeter, ohmmeter, or whatever) to ECM when its coupler is disconnected. Attempt to do it may cause damage to ECM.
- Never connect an ohmmeter to ECM with its coupler connected to it. Attempt to do it may cause damage to ECM and sensors.
- Be sure to use a voltmeter with high impedance (MΩ/V minimum) or a digital type voltmeter. Any other voltmeter should not be used because accurate measurements are not obtained.



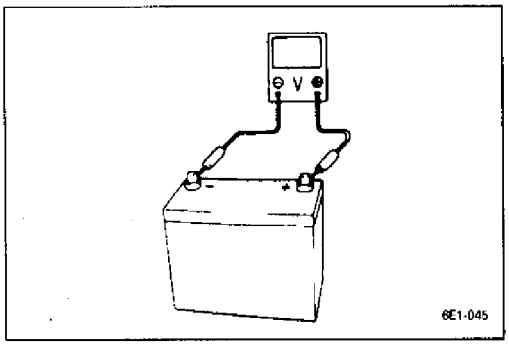
- When disconnecting and connecting coupler, make sure to turn ignition switch OFF, or ECM may get damaged.



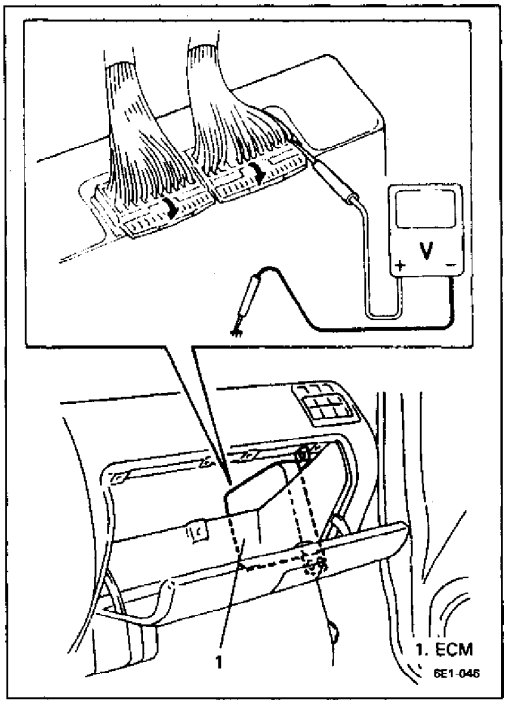
- When connecting a probe of ohmmeter, voltmeter, etc. to coupler terminal, be sure to connect it from wire harness side of coupler.



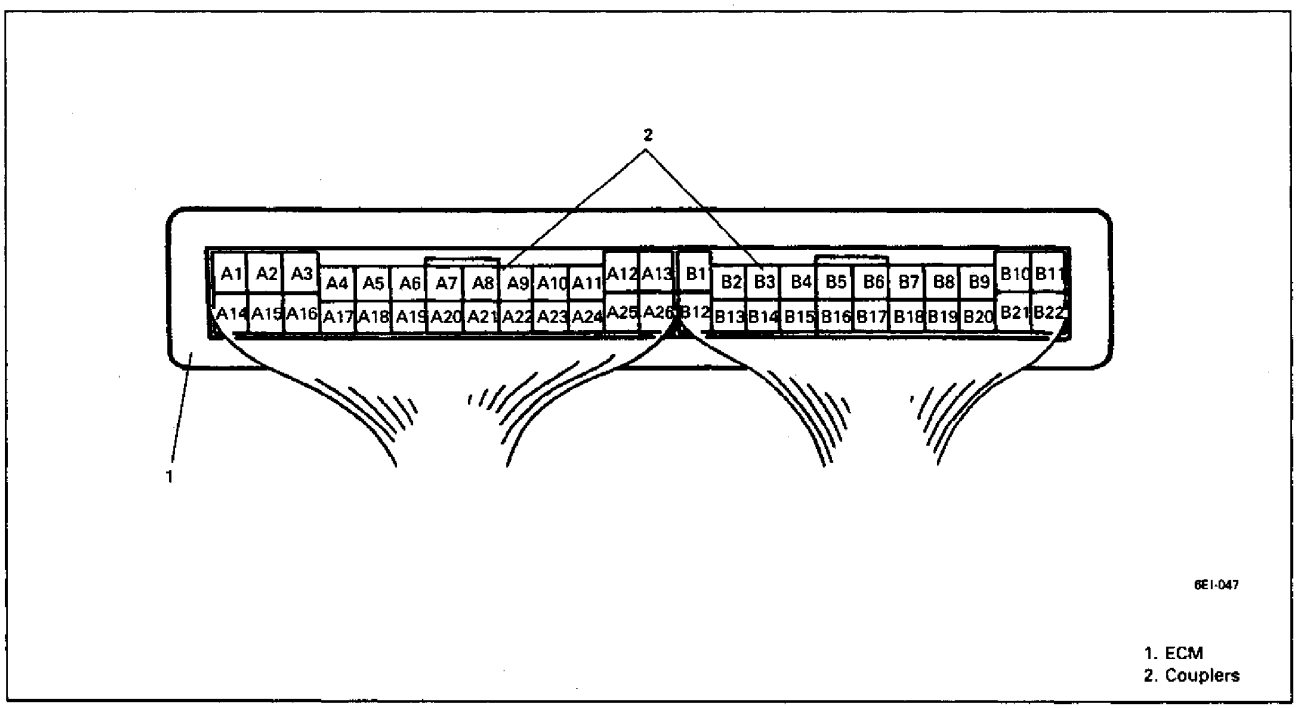
- When connecting meter probe from terminal side of coupler because it can't be connected from harness side, use extra care not to bend male terminal of coupler or force its female terminal open for connection.
  In case of such coupler as shown at the left, connect probe as shown to avoid opening female terminal.
  Never connect probe where male terminal is supposed to fit.



- Before measuring voltage at each terminal, check to make sure that battery voltage is 11V or higher. Such terminal voltage check at low battery voltage will lead to erroneous diagnosis.



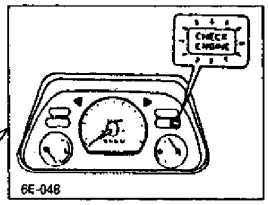
- When checking voltage at each terminal of the coupler which is connected to ECM, be sure to connect negative probe to body ground. Any other way is prohibited even by accident.
  Applying it improperly may cause the sensor or ECM to be shorted and damaged.



DIAGNOSTIC FLOW CHART

START

Does malfunction indicator lamp ("CHECK ENGINE" light) turn ON when ignition switch is turned ON (without starting engine.)?



NO (Remains OFF)

Does engine start?

YES

NO

Proceed to chart A-2. (Malfunction indicator lamp ("CHECK ENGINE" light) circuit check.)

Proceed to chart A-1. (ECM power and ground circuit check.)

No (Flashes)

Proceed to DIAGNOSIS of SECTION 8A.

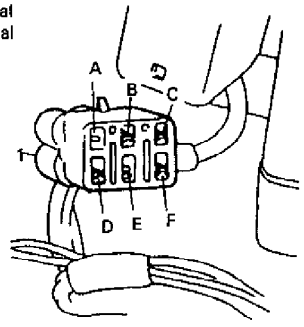
YES

Using service wire, ground "Diagnosis switch terminal" in monitor coupler and observe malfunction indicator lamp ("CHECK ENGINE" light).

NOTE:

If engine fails to start, crank it for 3 seconds and then while keeping ignition switch ON (Don't turn it OFF), using service wire, ground "Diagnosis switch terminal" in monitor coupler.

A: Blank
B: Diag. switch terminal
C: Diag. output terminal
D: Ground terminal
E: Test switch terminal
F: A/F duty output terminal



1. Monitor coupler

6E1-049

Remains ON

Proceed to chart A-3. (Malfunction indicator lamp ("CHECK ENGINE" light) circuit check.)

Flashes

Is diagnostic code No.12 indicated?

YES

Are engine basic parts described in SECTION 6 "ENGINE DIAGNOSIS" in good condition?

YES

Proceed to "TROUBLE DIAGNOSIS". Check Electronic Fuel Injection system parts that are not indicated by on-board diagnostic system (self-diagnosis function).

NO

Repair or replace

NO

Check and repair according to flow chart corresponding to that code No.

1. After repair, disconnect battery negative cable for longer than 20 sec. to erase diagnostic trouble code stored in ECM memory and reconnect it.
2. Start engine and warm it up to normal operating temperature.
3. Using service wire, ground "Diagnosis switch terminal" in monitor coupler and ignition switch turned ON, make sure that malfunction indicator lamp ("CHECK ENGINE" light) shows code No.12.
4. Disconnect service wire from monitor coupler.

Is trouble corrected?

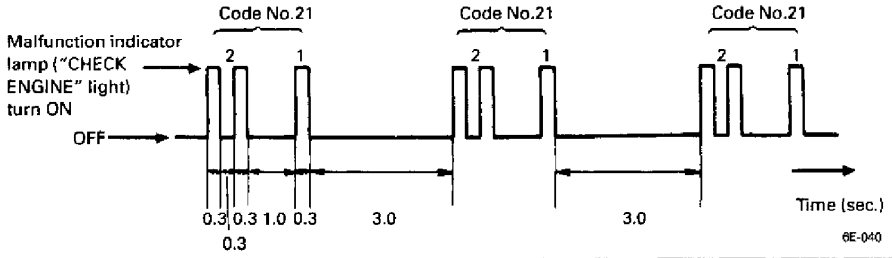
NO

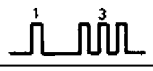
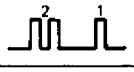
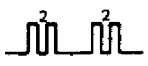
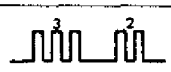
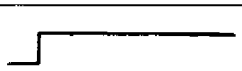
YES

END

DIAGNOSTIC TROUBLE CODE TABLE

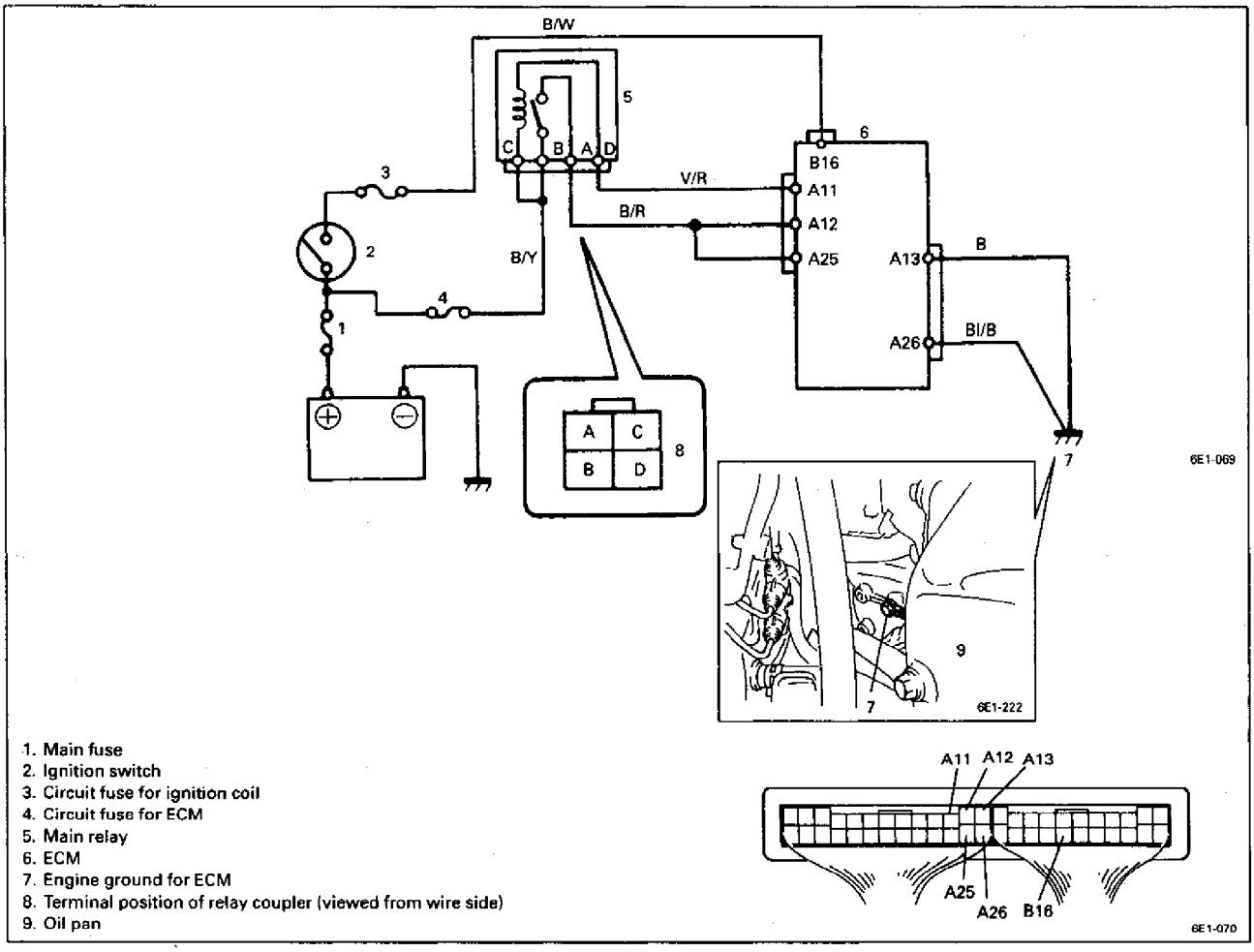
EXAMPLE: Throttle position sensor failure (Code No.21)



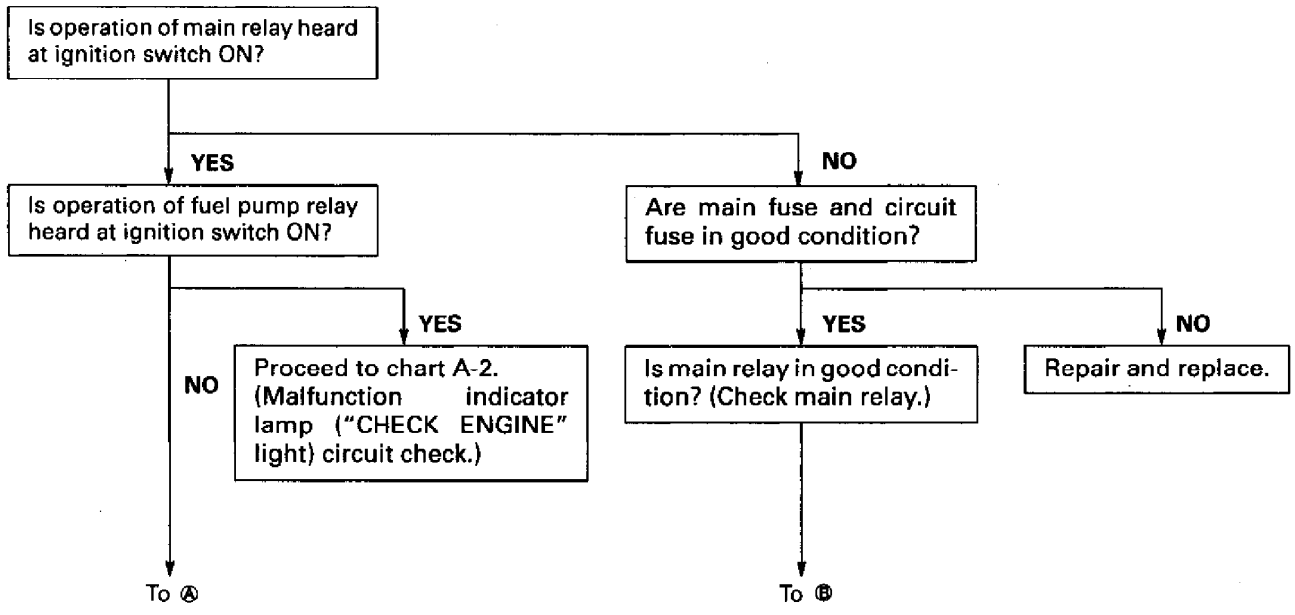
DIAGNOSTIC TROUBLE CODE NO.	DIAGNOSTIC TROUBLE CODE MODE	DIAGNOSTIC AREA	DIAGNOSIS
12	 6E1-051	Normal	This code appears when none of the other codes are identified.
13	 6E1-052	Oxygen sensor	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
14	 6E1-053	Engine coolant temperature sensor (ECT sensor)	
15	 6E1-054		
21	 6E1-055	Throttle position sensor (TP sensor)	
22	 6E1-056		
23	 6E1-057	Intake air temperature sensor (IAT sensor)	
25	 6E1-058		
24	 6E1-059	Vehicle speed sensor	
31	 6E1-060	Manifold absolute pressure sensor (MAP sensor)	
32	 6E1-061		
42	 6E1-062	CMP sensor	
61	 6E1-063	Shift solenoid No.1 (A/T)	Refer to SECTION 7B.
62	 6E1-064		
63	 6E1-065	Shift solenoid No.2 (A/T)	
64	 6E1-066		
72	 6E1-067	Transmission switch (A/T)	
ON	 6E1-068	ECM	ECM failure.

A-1 ECM POWER AND GROUND CIRCUIT CHECK

(MALFUNCTION INDICATOR LAMP ("CHECK ENGINE" LIGHT) DOESN'T LIGHT AT IGNITION SWITCH ON AND ENGINE DOESN'T START THOUGH IT IS CRANKED UP.)



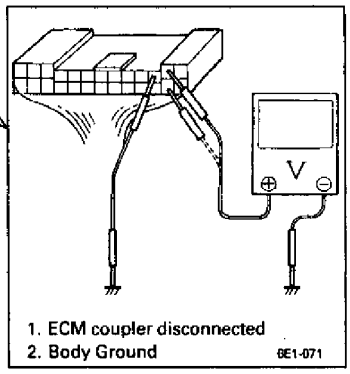
1. Main fuse
2. Ignition switch
3. Circuit fuse for ignition coil
4. Circuit fuse for ECM
5. Main relay
6. ECM
7. Engine ground for ECM
8. Terminal position of relay coupler (viewed from wire side)
9. Oil pan



From Ⓐ

NO

1. Turn ignition switch OFF, and then disconnect ECM couplers after 4 sec. or more.
2. Using service wire, ground A11 terminal.
3. Is battery voltage applied to A12 or A25 terminal at ignition switch ON?



1. ECM coupler disconnected
2. Body Ground

6E1-071

YES

- Poor A13 and A26 connection.
- "B" or "BI/B" wire open or
- Poor "B" or "BI/B" wire grounding.

If wire and connections are OK, substitute a known-good ECM and recheck.

NO

- "B/Y" wire open,
- Poor relay-to-coupler Connection or
- "B/R" wire open.

If wire and connection are OK, check main relay.

From Ⓑ

YES

Check voltage between B16 terminal and body ground with ignition switch ON.
Is it 10 – 14 V?

NO

Replace.

YES

- Poor relay-to-coupler connection,
- "B/Y" wire open,
- "V/R" wire open or
- Poor A11 connection or
- Poor engine ground.

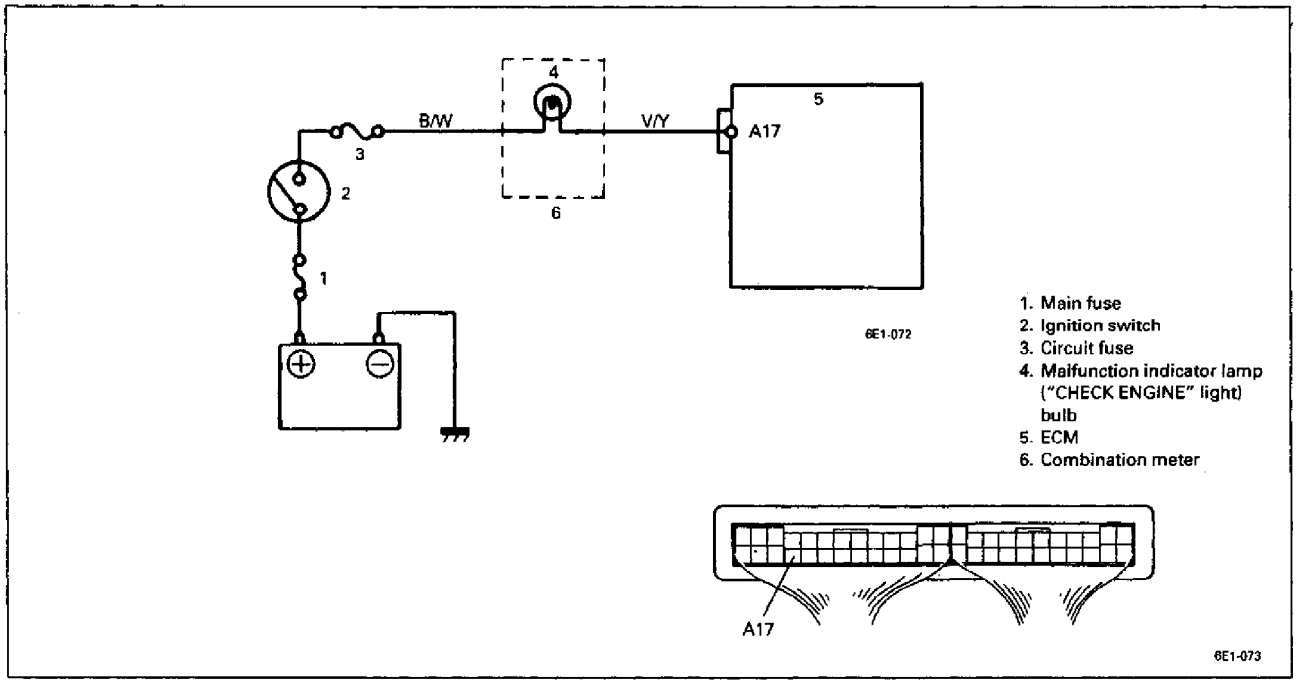
If all above are OK, substitute a known-good ECM and recheck.

NO

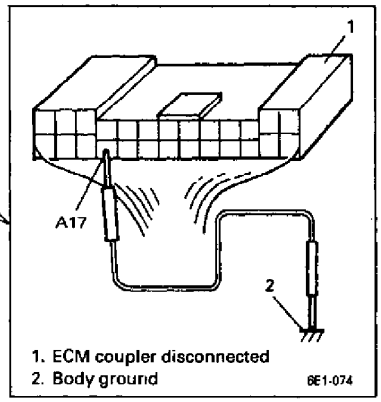
"B/W" wire open

A-2 MALFUNCTION INDICATOR LAMP ("CHECK ENGINE" LIGHT) CIRCUIT CHECK

(MALFUNCTION INDICATOR LAMP ("CHECK ENGINE" LIGHT) DOESN'T LIGHT AT IGNITION SWITCH ON THOUGH ENGINE STARTS.)



1. Turn ignition switch OFF, and then disconnect coupler from ECM after 4 sec. or more.
2. Body-ground terminal A17 in coupler disconnected.
3. Does malfunction indicator lamp ("CHECK ENGINE" light) turn ON at ignition switch ON?

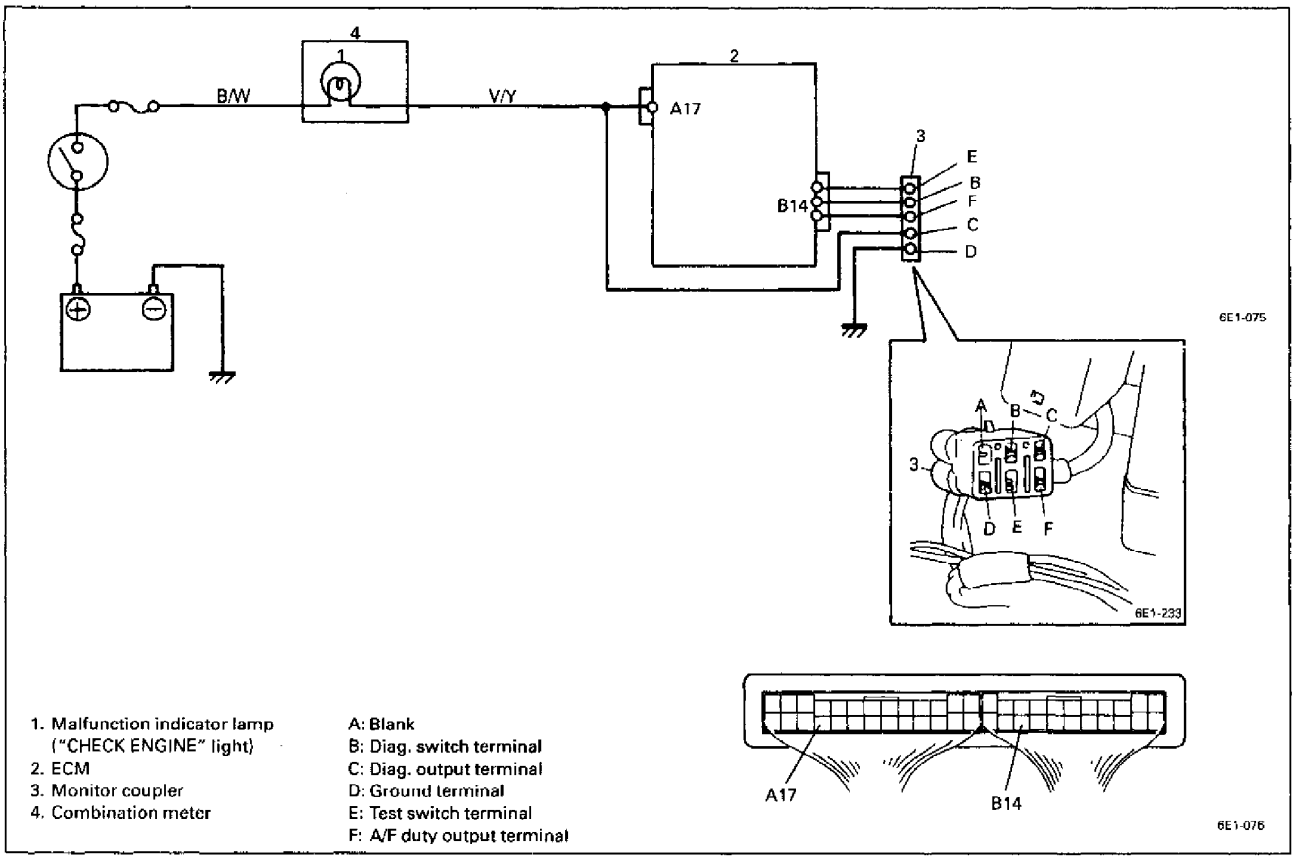


NO → Bulb burned out, "V/Y" wire circuit open or "Bl/W" wire circuit open.

YES → Poor A17 connection.
If connection is OK, substitute a known-good ECM and recheck.

A-3 MALFUNCTION INDICATOR LAMP ("CHECK ENGINE" LIGHT) CIRCUIT CHECK

MALFUNCTION INDICATOR LAMP ("CHECK ENGINE" LIGHT) DOESN'T FLASH OR JUST REMAINS ON EVEN WITH GROUNDING DIAGNOSIS SWITCH TERMINAL.)



1. Malfunction indicator lamp ("CHECK ENGINE" light)
2. ECM
3. Monitor coupler
4. Combination meter

A: Blank
B: Diag. switch terminal
C: Diag. output terminal
D: Ground terminal
E: Test switch terminal
F: A/F duty output terminal

1. Turn ignition switch OFF, and then disconnect ECM coupler after 4 sec. or more.
2. Does malfunction indicator lamp ("CHECK ENGINE" light) turn ON at ignition switch ON?

YES → Wire harness (Violet/Yellow) shorted to ground.

NO ↓

Are couplers connected to ECM properly?

NO → Poor connection.

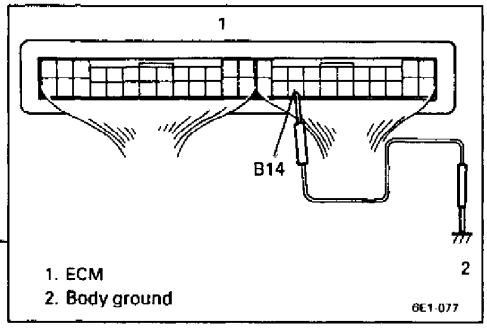
YES ↓

1. Ground terminal B14 with coupler connected to ECM.
2. Does malfunction indicator lamp ("CHECK ENGINE" light) flash at ignition switch ON?

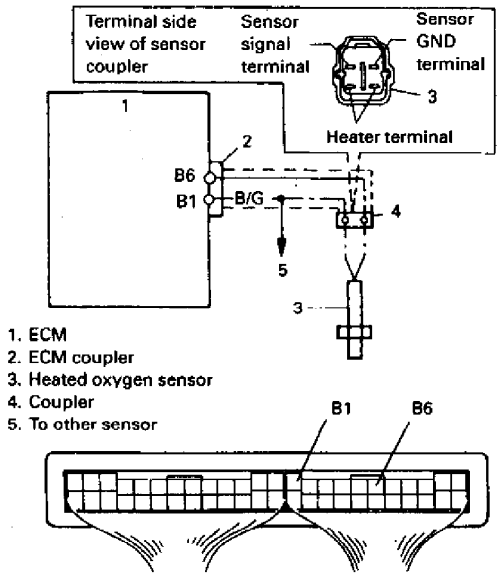
YES →
- Poor body grounding.
- Diagnosis ground circuit (B14 – ground) open.

NO ↓

Substitute a known-good ECM and recheck.



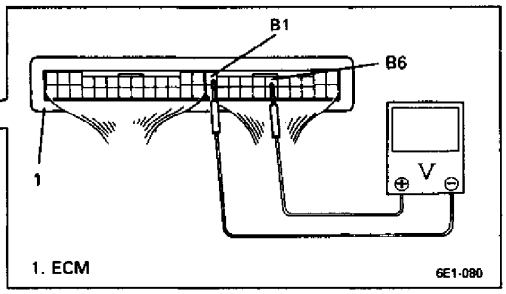
CODE NO.13 HEATED OXYGEN SENSOR CIRCUIT (SIGNAL VOLTAGE DOESN'T CHANGE)



NOTE:

- **Before diagnosing trouble according to flow chart given below, check to make sure that following system and parts other than Electronic Fuel Injection system are in good condition.**
  - **Air cleaner (clogged)**
  - **Vacuum leaks (air inhaling)**
  - **Spark plugs (contamination, gap)**
  - **High-tension cords (crack, deterioration)**
  - **Distributor rotor or cap (wear, crack)**
  - **Ignition timing**
  - **Engine compression**
  - **Any other system and parts which might affect A/F mixture or combustion.**
- **If code No. 13 and another code No. are indicated together, the latter has priority. Therefore, check and correct what is represented by that code No. first and then proceed to the following check.**
- **Be sure to use a voltmeter with high impedance (MΩ/V minimum) or digital type voltmeter for accurate measurement.**

1. Remove ECM and connect couplers to ECM.
2. Warm up engine to normal operating temperature.
3. Connect voltmeter between "B6" and "B1" terminals of ECM coupler.
4. Maintain engine speed at 2000 r/min. After 60 seconds, check voltmeter.



0 V

- Wire between sensor and ECM open.
- "B/G" wire open or
- Poor connection.

If wire and connection are OK, replace heated oxygen sensor and recheck.

Remains unchanged at below 0.45 V.

1. Maintain engine speed at 2,000 r/min. for 60 sec.
2. Check voltmeter while repeating racing engine.

Does it indicate 0.45 V or more even once?

NO

Replace heated oxygen sensor and recheck.

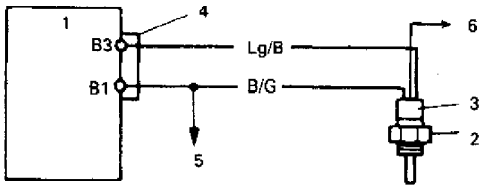
YES

Poor B6 connection or lean A/F mixture.

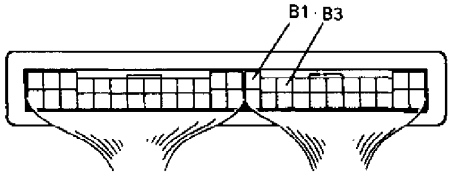
- Check MAP sensor, ECT sensor, IAT sensor fuel pressure and injectors.

If all above are OK, check ECM and its circuit referring to p. 6E1-65.

CODE NO.14 ECT SENSOR (ENGINE COOLANT TEMP. SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)



6E1-081

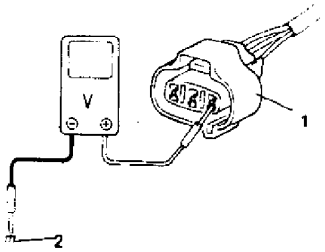


6E1-082

NOTE:
When Code Nos. 13, 14, 21 and 23 are indicated together, it is possible that "B/G" wire is open or B1 terminal connection is poor.

1. ECM
2. ECT sensor
3. Coupler
4. ECM coupler
5. To other sensors
6. To combination meter

1. Disconnect ECT sensor coupler with ignition switch OFF.
2. With ignition switch ON, check voltage at "Lg/B" wire terminals of ECT sensor coupler. Is it about 4 – 5 V?



6E1-083

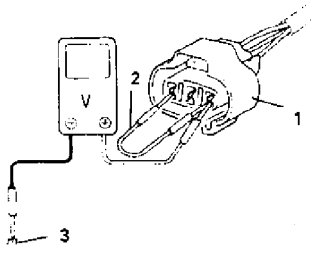
1. ECT sensor coupler disconnected
2. Engine ground

YES

1. Using service wire, connect ECT sensor coupler terminals.
2. Check voltage at "Lg/B" wire terminal of ECT sensor coupler with ignition switch ON. Is it below 0.15V?

NO

"Lg/B" wire open, poor B3 connection or "Lg/B" wire shorted to power circuit.
If wire and connection are OK, substitute a known-good ECM and recheck.



6E1-084

1. ECT sensor coupler disconnected
2. Service wire
3. Engine ground

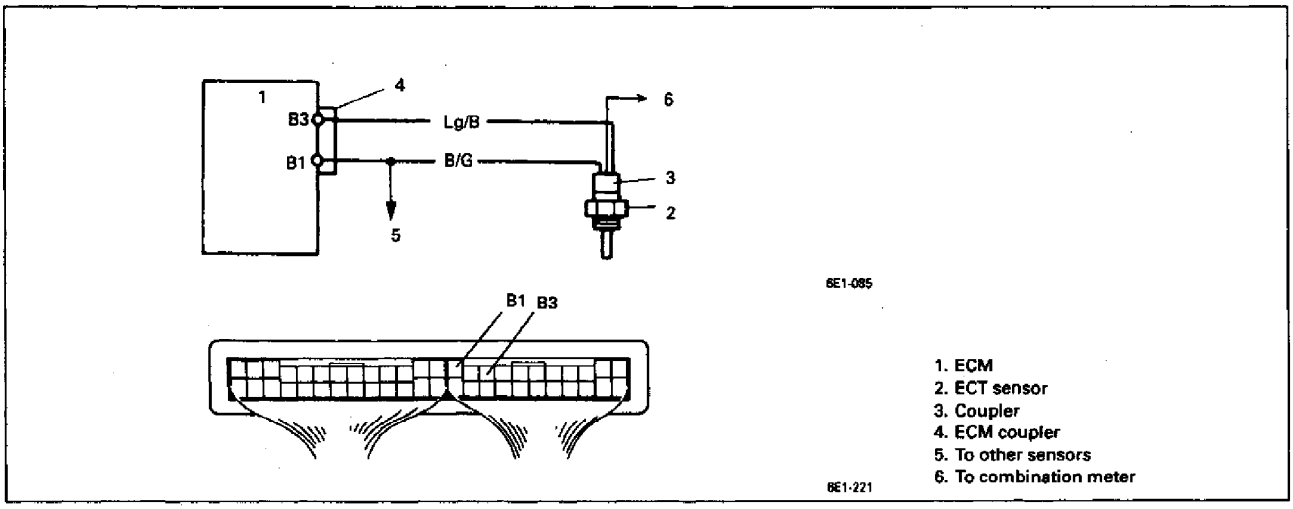
NO

"B/G" wire open or poor B1 connection.
If wire and connection are OK, substitute a known-good ECM and recheck.

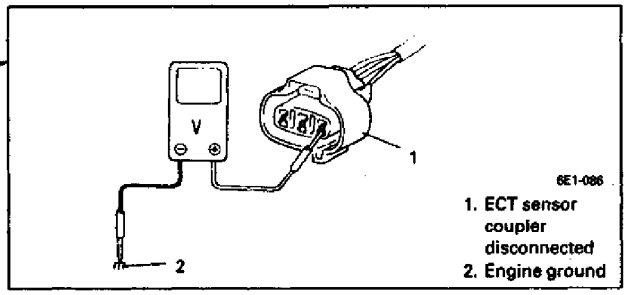
YES

Poor ECT sensor-to-coupler connection of faulty ECT sensor.
If connection and ECT sensor are OK, intermittent trouble or faulty ECM. Recheck referring to "Intermittent trouble" on p. 6E1-30.

CODE NO.15 ECT SENSOR (ENGINE COOLANT TEMP. SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED, SIGNAL VOLTAGE LOW)



1. Disconnect ECT sensor coupler with ignition switch OFF.
2. With ignition switch ON, is voltage applied to "Lg/B" wire terminal of ECT sensor coupler 4V or more?



YES

Check ECT sensor referring to p. 6E1-89. Is it in good condition?

NO

"Lg/B" wire shorted to "B/G" wire or ground circuit. If wire is OK, substitute a known-good ECM and recheck.

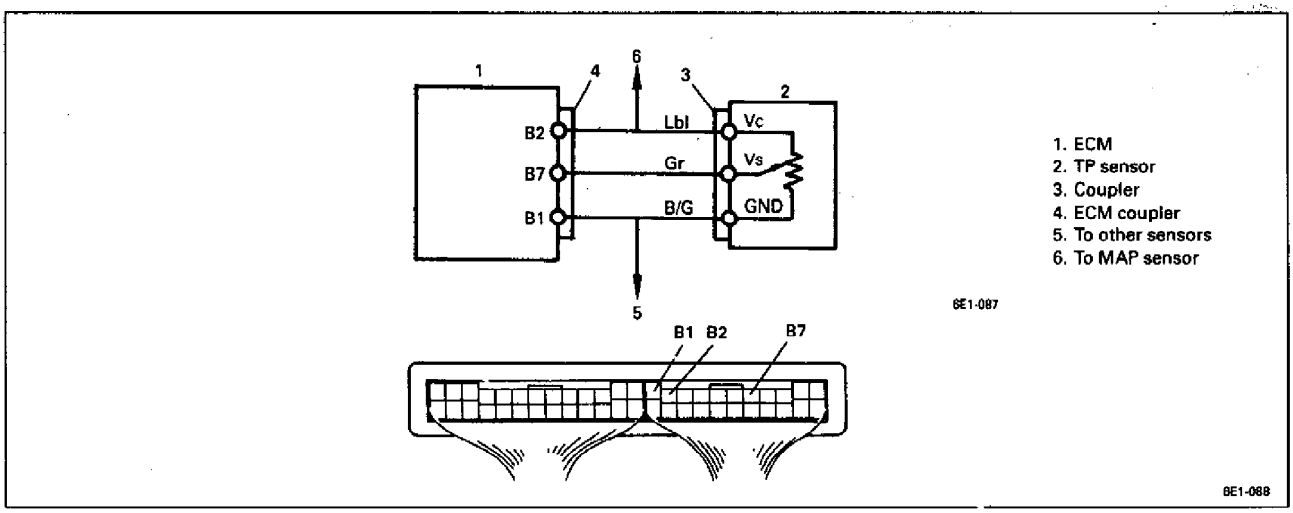
YES

Intermittent trouble or faulty ECM. Recheck referring to "Intermittent trouble" on p. 6E1-30.

NO

Faulty ECT sensor.

CODE NO.21 TP SENSOR (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH)



1. ECM
2. TP sensor
3. Coupler
4. ECM coupler
5. To other sensors
6. To MAP sensor

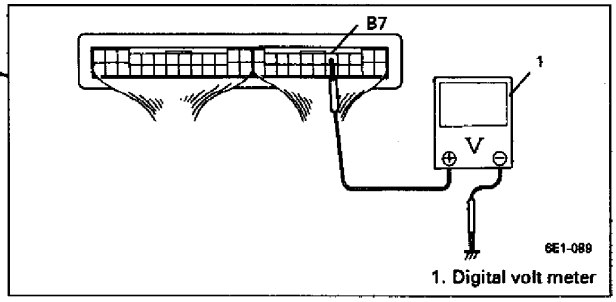
1. Disconnect TP sensor coupler with ignition switch OFF.
2. Check voltage between "Lbl" wire terminal and "B/G" wire terminal of disconnected TP sensor coupler with ignition switch ON.
3. Is it about 4.75 – 5.25V?

YES

1. Connect TP sensor coupler with ignition switch OFF.
2. Remove ECM and connect ECM couplers with ignition switch OFF.
3. Check voltage between B7 terminal and body ground with ignition switch ON.

NO

"B/G" with open, poor B1 connection, or "Lbl" wire shorted to power circuit.



1. Digital volt meter

B7 terminal voltage is:
0.80 ± 0.025 V (throttle valve is fully close)
4.2 ± 0.15 V (throttle valve is fully open)

Poor B7 connection.
If connection is OK, substitute a known good ECM and recheck.

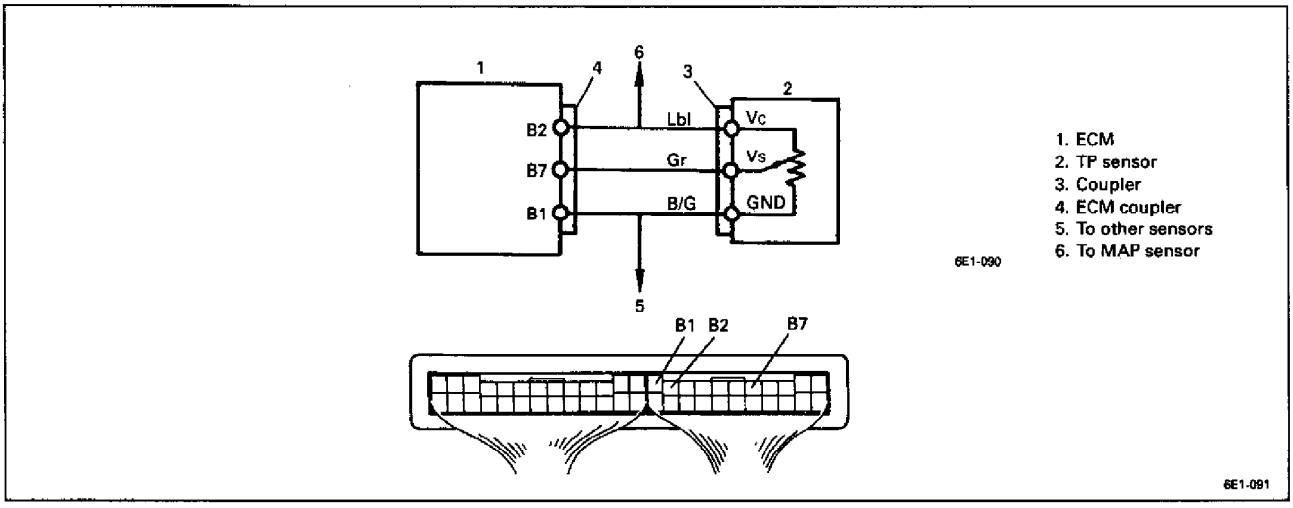
B7 terminal voltage is about 4.75 – 5.25 V.

"Gr" wire open or shorted to "Lbl" wire circuit or poor TP sensor coupler connection.

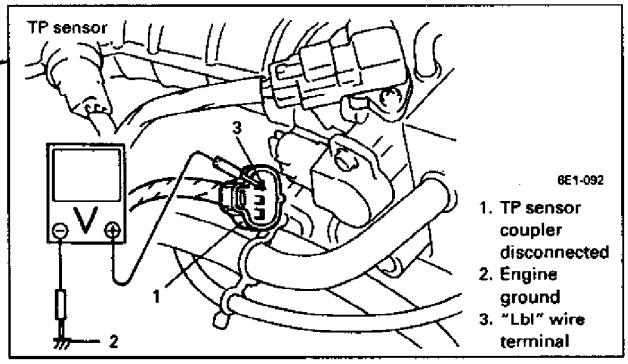
Other

Maladjusted TP sensor or faulty TP sensor.

CODE NO.22 TP SENSOR (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW)



1. Disconnect TP sensor coupler with ignition switch OFF.
2. With ignition switch ON, is voltage applied to "Lbl" wire terminal of TP sensor coupler about 4.75 – 5.25V?



YES

Check TP sensor referring to p. 6E1-86.
Is it in good condition?

YES

Intermittent trouble or faulty ECM.
Recheck referring to "Intermittent trouble" on p. 6E1-30.

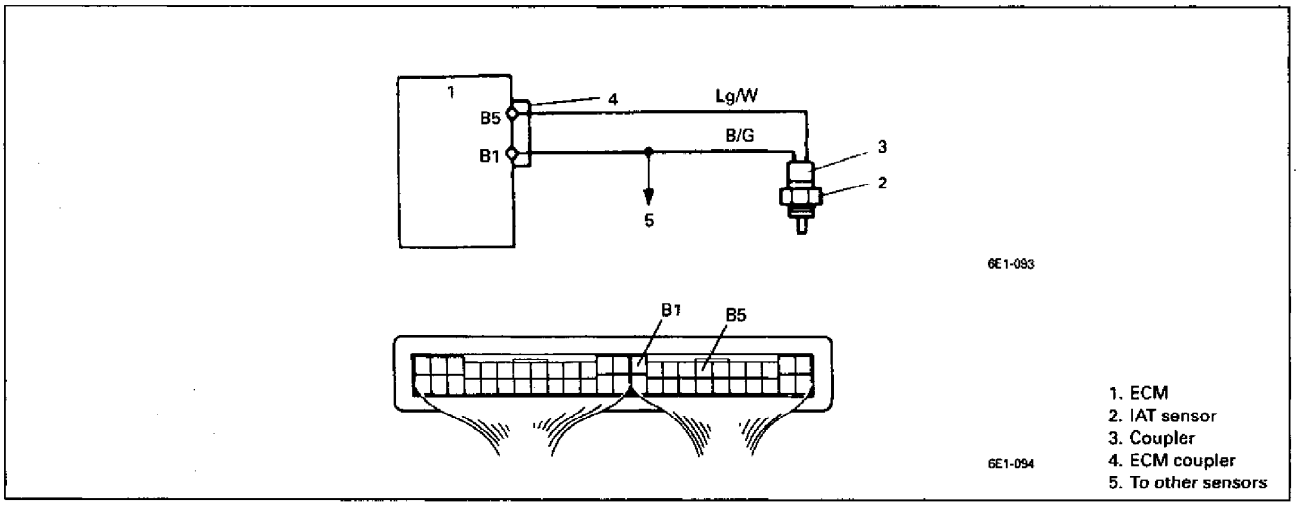
NO

"Lbl" wire open, "Lbl" wire shorted to ground circuit or "B/G" wire, or poor B2 connection.
If wire and connection are OK, substitute a known-good ECM and recheck.

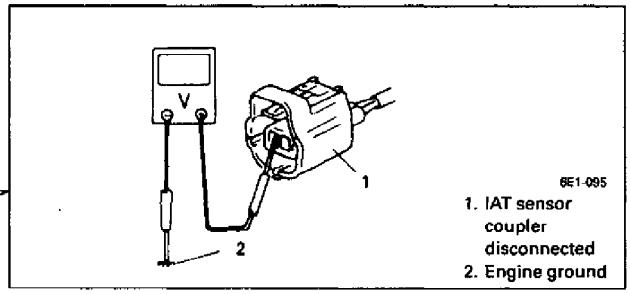
NO

Poor TP sensor coupler connection, "Gr" wire shorted to "B/G" or faulty TP sensor.

CODE NO.23 IAT (INTAKE AIR TEMP.) SENSOR CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)



1. Disconnect IAT sensor coupler with ignition switch OFF.
2. With ignition switch ON, check voltage at "Lg/W" wire terminal of IAT sensor coupler.
   Is it about 4 – 5 V?

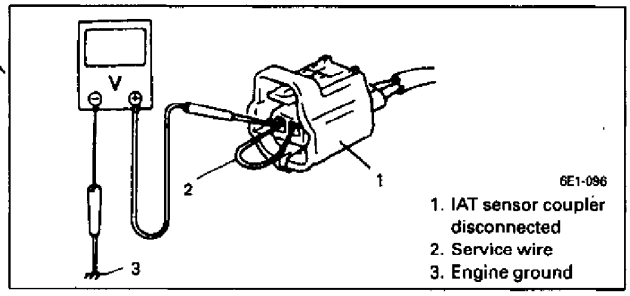


YES

1. Using service wire, connect IAT sensor coupler terminals.
2. Check voltage at "Lg/W" wire terminal of IAT sensor coupler with ignition switch ON.
   Is it below 0.15 V?

NO

"Lg/W" wire open, poor B5 connection or "Lg/W" wire shorted to power circuit.
If wire and connection are OK, substitute a known-good ECM and recheck.



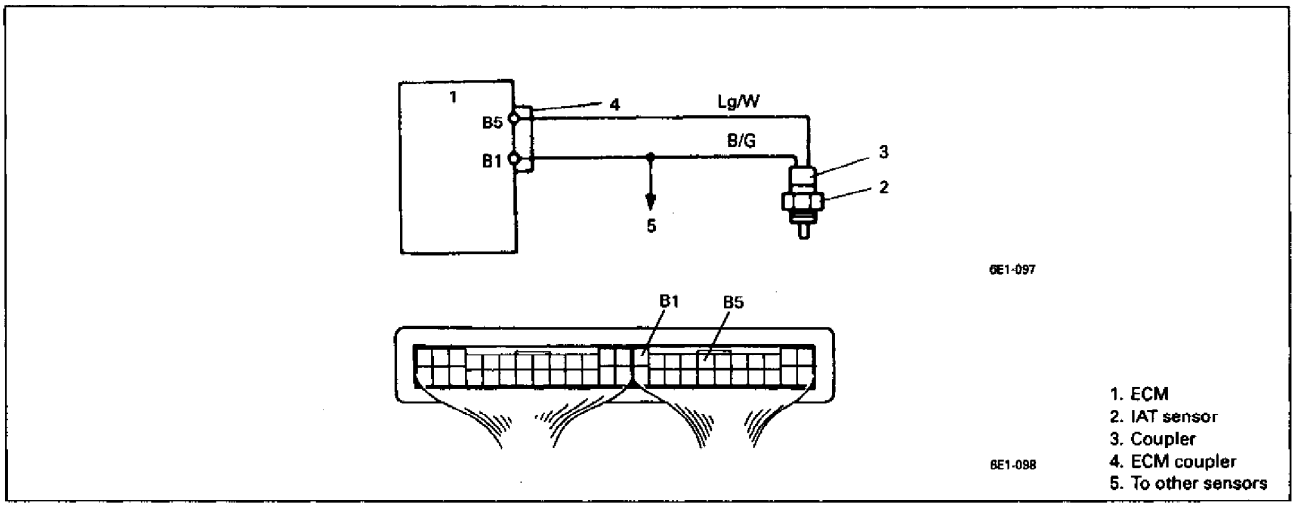
NO

"B/G" wire open or poor B1 connection.
If wire and connection are OK, faulty ECM.
Substitute a known-good ECM and recheck.

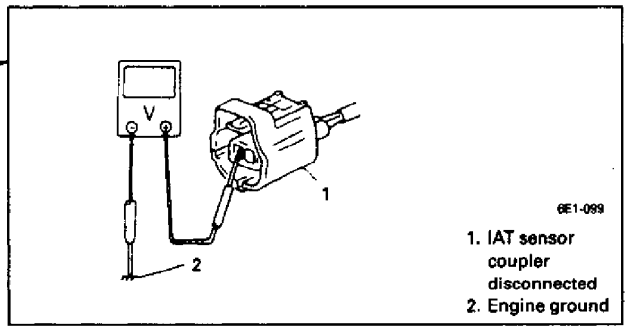
YES

Poor coupler connection of IAT sensor or faulty IAT sensor.
If connection and IAT sensor are OK, intermittent trouble or faulty ECM. Recheck referring to "Intermittent trouble" on p. 6E1-30.

CODE NO.25 IAT (INTAKE AIR TEMP.) SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED SIGNAL VOLTAGE LOW)



1. Disconnect IAT sensor coupler with ignition switch OFF.
2. With ignition switch ON, is voltage applied to "Lg/W" wire terminal of IAT sensor coupler 4 V or more?



YES

Check IAT sensor referring to next page. Is it in good condition?

NO

"Lg/W" wire shorted to "B/G" wire or ground circuit. If wire is OK, substitute a known-good ECM and recheck.

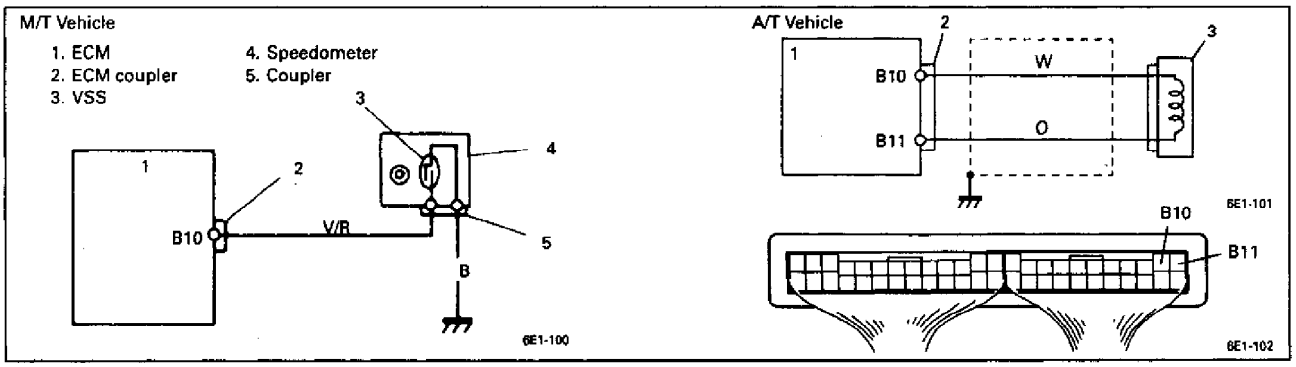
YES

Intermittent trouble or faulty ECM. Recheck referring to "Intermittent trouble" on p. 6E1-30.

NO

Faulty IAT sensor.

CODE NO.24 VSS (VEHICLE SPEED SENSOR) CIRCUIT (VSS SIGNAL NOT INPUTTED ALTHOUGH FUEL IS KEPT CUT FOR LONGER THAN 4 SECONDS (M/T VEHICLE)/OPEN CIRCUIT WHILE RUNNING (A/T VEHICLE))



M/T Vehicle

NOTE:

Be sure to turn OFF ignition switch for this check.

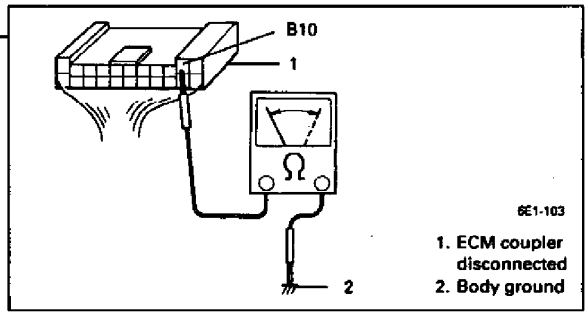
Does speedometer indicate vehicle speed?

NO

Check speedometer cable and gears for damage.

YES

1. Turn ignition switch OFF, and then disconnect ECM coupler after 4 sec. or more.
2. Connect ohmmeter between B10 terminal of ECM coupler and body ground.
3. Hoist front end of vehicle and lock front left tire.
4. Turn front right tire slowly. Does ohmmeter indicator deflect between 0 and ∞ a few times while tire is turned one revolution?



NO

Check VSS referring to p. 6E1-91.
Is it in good condition?

YES

Poor B10 connection. If connection is OK, intermittent trouble or faulty ECM.
Recheck referring to "Intermittent trouble" on p. 6E1-30.

YES

"V/R" wire open, "B" wire open, poor coupler-to-meter connection or poor "B" wire ground.

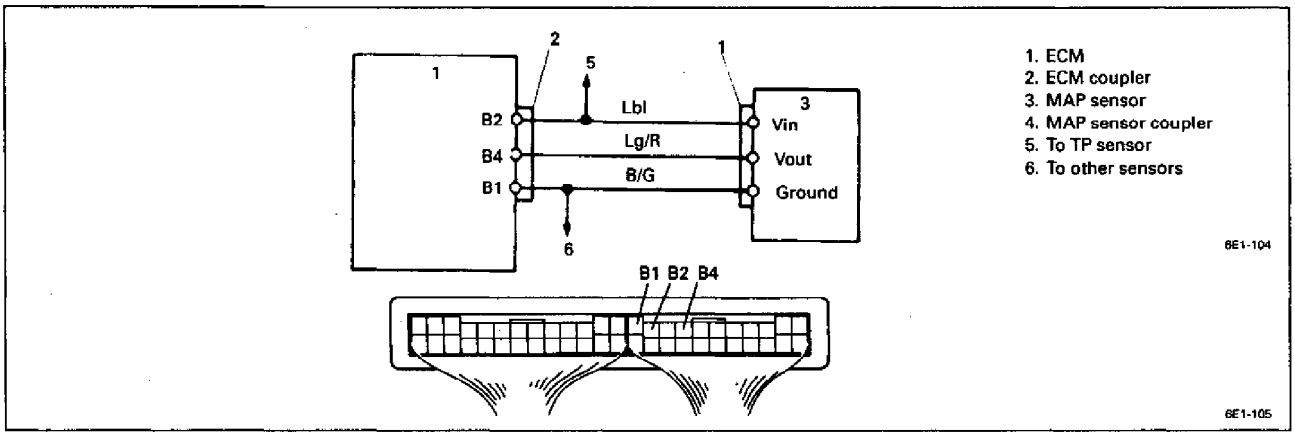
NO

Faulty VSS.

A/T Vehicle

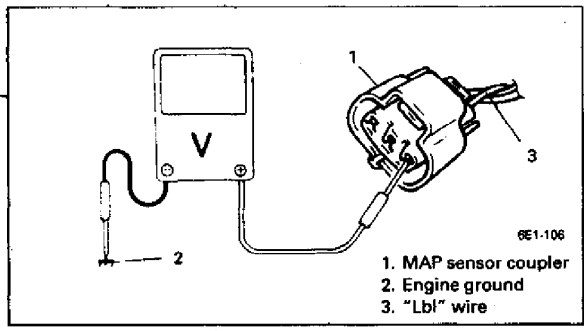
Refer to Vehicle Speed Sensor Checking Procedure in Section 7B.

CODE NO.31 MAP SENSOR (MANIFOLD ABSOLUTE PRESSURE SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW–LOW PRESSURE–HIGH VACUUM)



1. ECM
2. ECM coupler
3. MAP sensor
4. MAP sensor coupler
5. To TP sensor
6. To other sensors

1. Disconnect MAP sensor coupler with ignition switch OFF.
2. With ignition switch ON, is voltage applied to "Lbl" wire terminal of MAP sensor coupler about 4 – 5 V?



1. MAP sensor coupler
2. Engine ground
3. "Lbl" wire

YES

Check MAP sensor referring to p. 6E-84.
Is it in good condition?

NO

"Lbl" wire open, "Lbl" wire shorted to ground circuit or poor B2 connection.
If wire and connection are OK, substitute a known-good ECM and recheck.

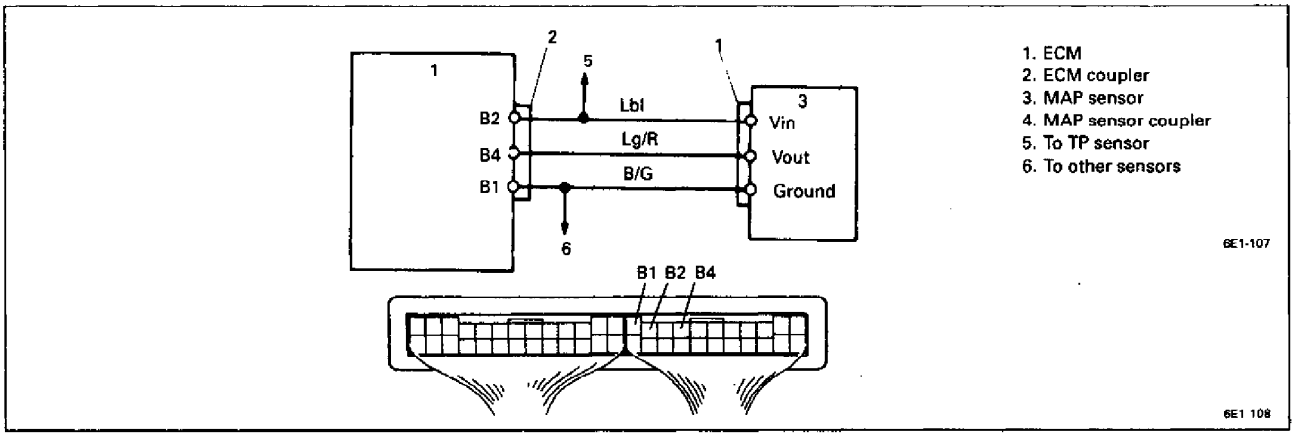
YES

"Lg/R" wire shorted to ground circuit.
If wire is OK, intermittent trouble or faulty ECM.
Recheck referring to "Intermittent trouble" on p. 6E1-30.

NO

Faulty MAP sensor.

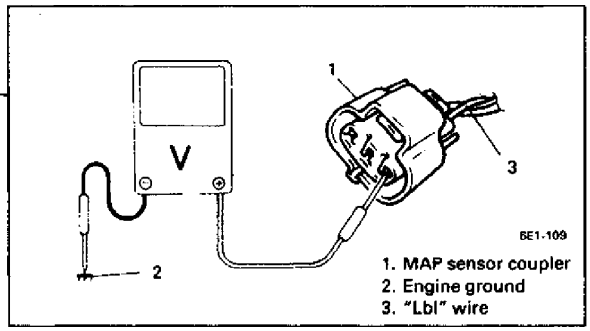
CODE NO.32 MAP SENSOR (MANIFOLD ABSOLUTE PRESSURE SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH–HIGH PRESSURE–LOW VACUUM)



1. ECM
2. ECM coupler
3. MAP sensor
4. MAP sensor coupler
5. To TP sensor
6. To other sensors

6E1-107

1. Disconnect MAP sensor coupler with ignition switch OFF.
2. With ignition switch ON, is voltage applied to "Lbl" wire terminal of MAP sensor coupler about 4 – 5 V?



1. MAP sensor coupler
2. Engine ground
3. "Lbl" wire

YES

Check MAP sensor referring to p. 6E1-84.
Is it in good condition?

NO

"Lbl" wire shorted to power circuit.
If wire is OK, substitute a known-good ECM and recheck.

NOTE:
When battery voltage is applied to "Lbl" wire, it is possible that MAP sensor is also faulty.

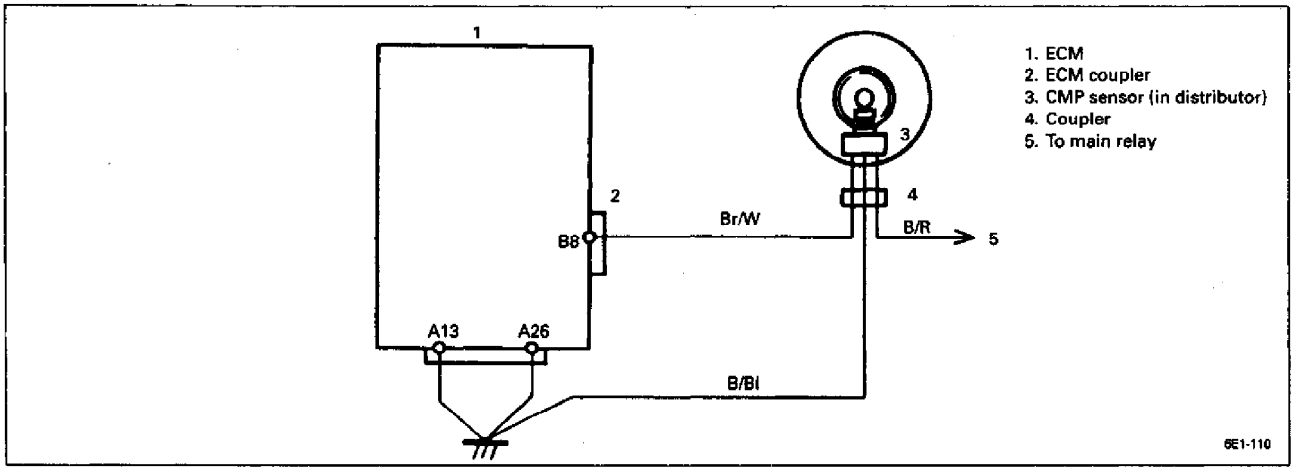
YES

"Lbl" wire shorted to "Lg/R" wire, "B/G wire open, poor B1 connection, "Lg/R" wire open, poor B4 connection or poor MAP sensor coupler connection.
If wires and connections are OK, intermittent trouble or faulty ECM.
Recheck referring to "Intermittent trouble" on p. 6E1-30.

NO

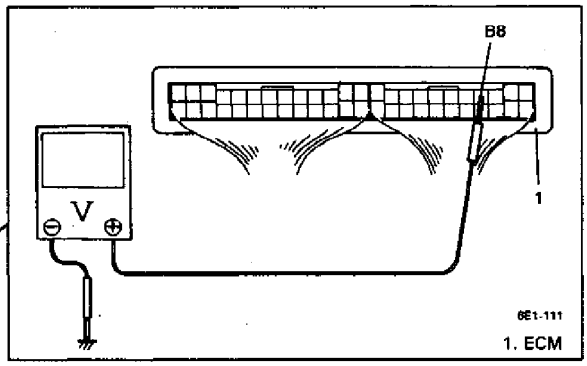
Faulty MAP sensor.

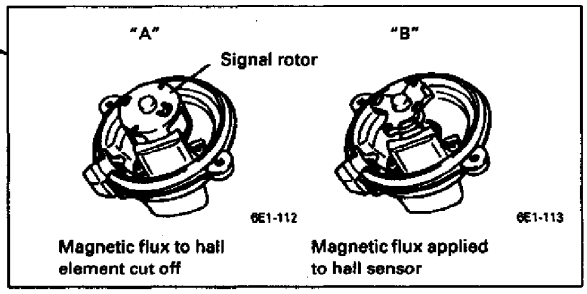
CODE NO 42 CAS (CRANK ANGLE SENSOR) CIRCUIT (SENSOR SIGNAL NOT INPUTTED FOR 3 SECONDS AT ENGINE CRANKING)



1. Remove ECM and connect couplers to ECM.
2. Remove distributor cap, rotor and shield cover.
3. With ignition switch ON, check voltage at B8 terminal with signal rotor inserted between hall element and magnet ("A") and without it ("B") respectively.

"A"	3 – 5 V
"B"	0 – 1 V
Is it in good condition?	





NO

- 3 – 5 V or more at both "A" and "B". → "Br/W" wire open, "B/Bl" circuit open, "B/R" circuit open or poor CMP sensor coupler connection. If wire and connection are OK, substitute a known-good CMP sensor and recheck.
- 0 – 1 V at both "A" and "B". → Poor B8 connection or "Br/W" wire short to ground. If wire and connection are OK, substitute a known-good CMP sensor and recheck.

YES

Substitute a known-good ECM and recheck.

TROUBLE DIAGNOSIS

This section describes trouble diagnosis of Electronic Fuel Injection system parts whose trouble is not indicated by the on-board diagnostic system (self-diagnosis function).

When diagnostic trouble code No.12 is indicated by the on-board diagnostic system (self-diagnosis function) and assuredly those engine basic parts as described in "ENGINE DIAGNOSIS" are all in good condition, check following Electronic Fuel Injection system parts which may be a possible cause for each symptom of the engine.

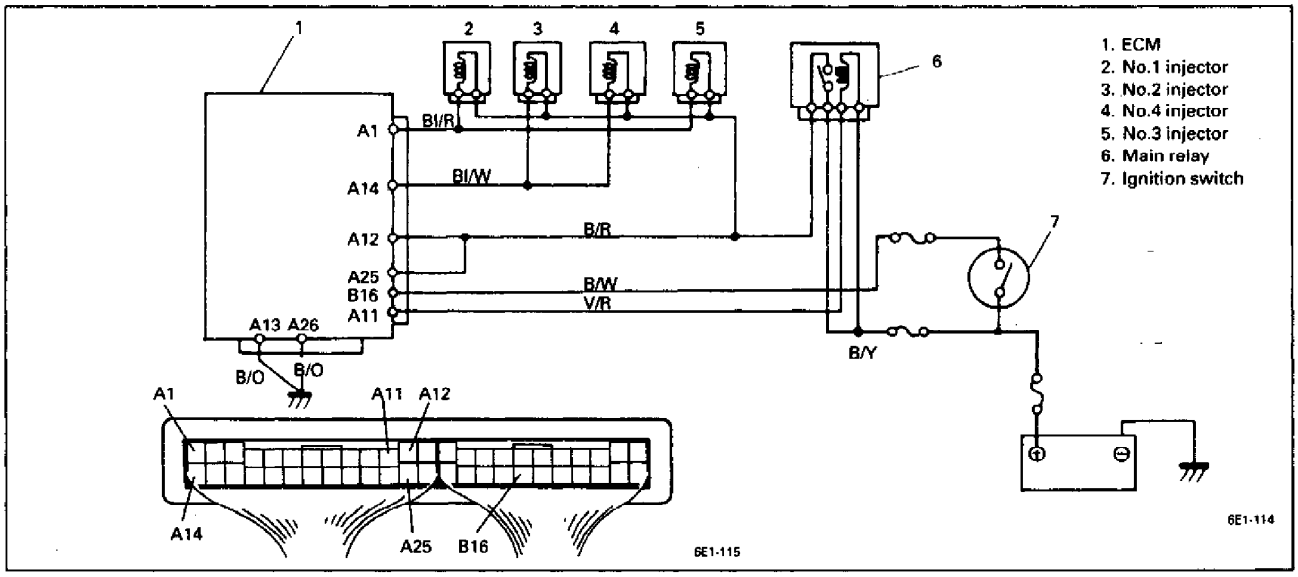
SYMPTOM	POSSIBLE CAUSE	INSPECTION
Hard or no starting (Engine cranks OK)	• Shortage of fuel in fuel tank	
	• Faulty fuel pump or its circuit open	Check if fuel pressure is felt at fuel return hose for 3 seconds after ignition switch ON. If not, advance to Diagnostic flow chart B-2
	• Injector or its circuit defective	Diagnostic flow chart B-1
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty fast idle air valve	
	• Open starter signal circuit	Check voltage at ECM coupler terminal A9 (refer to p. 6E1-65)
	• Faulty idle air control system	Diagnostic flow chart B-4
	• Poor performance of ECT sensor, IAT sensor or MAP sensor	See p. 6E1-89, 6E1-88 or 6E1-84
	• Faulty ECM	See p. 6E1-65
NOTE: • **If engine doesn't start at all, perform fuel injector and its circuit check first. (Advance to Diagnostic Flow Chart B-1.)** • **If engine is hard to start only when it is cold, check fast idle air valve first and then engine starter signal circuit.**		
Engine fails to idle	• Shortage of fuel in fuel tank	
	• Faulty idle air control system	Diagnostic flow chart B-4
	• Maladjusted idle air adjusting screw	See p. 6E1-71
	• Faulty fast idle air valve	
	• Faulty EGR system	Diagnostic flow chart B-5
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty injector	Check injector for resistance and injection condition and fuel leakage (Refer to p. 6E1-80)

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Engine fails to idle	• Poor performance ECT sensor, IAT sensor or MAP sensor • Faulty ECM	See p. 6E1-89, 6E1-88, 6E1-84 See p. 6E1-65
NOTE: **If engine fails to idle when it is cold, check fast idle air valve first.**		
Improper engine idle speed	• Maladjusted accelerator cable play • Clogged MAP sensor vacuum passage • Faulty idle air control system • Maladjusted idle air adjusting screw • Faulty fast idle air valve • Fuel pressure out of specification • Faulty injector • Poor performance of ECT sensor, IAT sensor or MAP sensor • Faulty ECM	See p. 6E1-71 Check vacuum passage Diagnostic flow chart B-4 See p. 6E1-71 Diagnostic flow chart B-3 Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E1-80) See p. 6E1-89, 6E1-88 or 6E1-84 See p. 6E1-65
Engine has no or poor power	• Clogged MAP sensor vacuum passage • Maladjusted accelerator cable play • Maladjusted installation angle of throttle position sensor • Fuel pressure out of specification (Low fuel pressure) • Faulty EGR system • Faulty injector • Poor performance of TP sensor, ECT sensor, IAT sensor or MAP sensor • Faulty ECM	Check vacuum passage and filter See p. 6E1-71 See p. 6E1-86 Diagnostic flow chart B-3 Diagnostic flow chart B-5 Check injector for resistance, injection condition and fuel leakage. (Refer to p. 6E1-80) See p. 6E1-86, 6E1-89, 6E1-88 or 6E1-84 See p. 6E1-65

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Engine hesitates when acceleration	• Clogged MAP sensor vacuum passage	Check vacuum passage
	• Defective throttle valve operation	Check throttle valve for smooth operation
	• Poor performance of TP sensor	See p. 6E1-86
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-5
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E1-80)
	• Poor performance of ECT sensor or MAP sensor	See p. 6E1-89, 6E1-84
	• Faulty ECM	See p. 6E1-65
Surges (Variation in vehicle speed is felt although acceleator pedal is not operated)	• Variable fuel pressure (Clogged fuel filter, faulty fuel pressure regulator, etc.)	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-5
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E1-80)
	• Poor performance of TP sensor, ECT sensor or MAP sensor	See p. 6E1-86, 6E1-89 or 6E1-84
	• Faulty ECM	See p. 6E1-65
Excessive detonation (Engine makes sharp metallic knocks that change with throttle opening)	• Low fuel pressure	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-5
	• Defective injector	Check injector for resistance, injection condition and fuel leakaqe (Refer to p. 6E1-80)
	• Poor performance of TP sensor, ECT sensor or MAP sensor	See p. 6E1-86, 6E1-89 or 6E1-84
	• Faulty ECM	See p. 6E1-65
Poor gasoline mileage	• High idle speed	Refer to item "Improper engine idle speed" previously
	• Fuel pressure out of specification or fuel leakage	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-5
	• Defective injector	Check injector for fuel leakage (See p. 6E1-80)
	• Poor performance of TP sensor, ECT sensor or MAP sensor	See p. 6E1-86, 6E1-89 or 6E1-84
	• Faulty ECM	See p. 6E1-65

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Excessive hydrocarbon (HC) emission (Rich or lean fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc.)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor.
	• Fuel leakage from injector	See p. 6E1-80
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Poor performance of ECT sensor, IAT sensor or MAP sensor	See p. 6E1-89, or 6E1-88 or 6E1-84
	• Faulty ECM	See p. 6E1-65
Excessive carbon monoxide (CO) emission (Rich fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc.)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor.
	• Fuel leakage from injector	See p. 6E1-80
	• Fuel pressure out of specification (High fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of ECT sensor, IAT sensor or MAP sensor	See p. 6E1-89, or 6E1-88 or 6E1-84
	• Faulty ECM	See p. 6E1-65
Excessive nitrogen oxides (NOx) emission (Lean fuel mixture)	• Improper ignition timing	See section 6F1
	• Lead contamination of catalytic converter	Check for adsence of filler neck restrictor.
	• Misrouted vacuum hoses	
	• Defective EGR system	Diagnostic flow chart B-5
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of ECT sensor, IAT sensor or MAP sensor	See p. 6E1-89, 6E1-88 or 6E1-84
	• Faulty ECM	See p. 6E1-65

B-1 FUEL INJECTOR CIRCUIT CHECK



Using sound scope, check each injector for operating sound at engine cranking.
Do all 4 injectors make operating sound?

NO

None of 4 injectors makes operating sound.
To ① on next page.

2 of 4 injectors make no operating sound.
To ② on next page.

One of 4 injectors makes no operating sound.

Check coupler connection of injector not making operating sound and injector itself (Refer to p. 6E1-80.)

YES

Fuel injector circuit is in good condition.

①

None of 4 injectors makes operating sound.

↓

Check power circuit for open or short.
Is it normal?

↓ YES

Check all 4 injectors for resistance respectively.
If resistance is OK, substitute a known-good ECM and recheck.

NO →

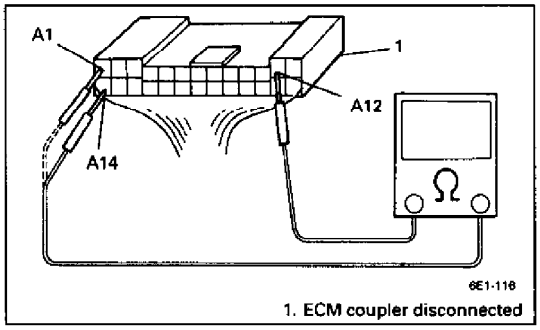
Power circuit open or short.

②

2 of 4 injectors make no operating sound.

↓

1. Turn ignition switch OFF, and then disconnect ECM couplers after 4 sec. or more.
2. Is resistance between A14 (or A11) and A12 6 – 9 Ω?



1. ECM coupler disconnected

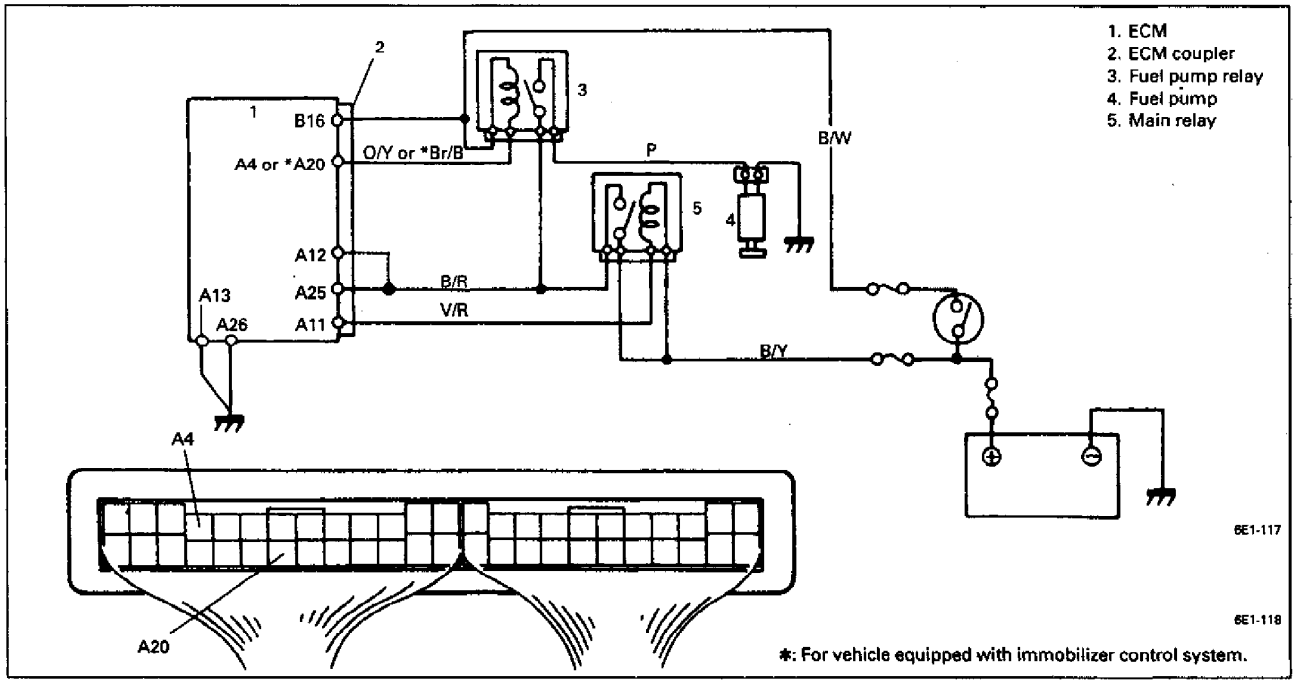
↓ YES

Poor A14 or A1 connection.
If connection is OK, substitute a known-good ECM and recheck.

NO →

"BI/R" or "BI/W" circuit open.

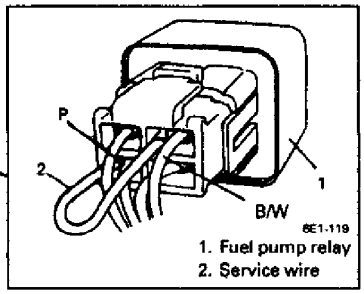
B-2 FUEL PUMP CIRCUIT CHECK



Is fuel pump heard to operate for 3 sec. after ignition switch ON?

NO

1. Turn OFF ignition switch.
2. Using service wire, connect "P" and "B/W" wire terminals.
3. Is fuel pump heard to operate at ignition switch ON?



1. Fuel pump relay
2. Service wire

YES

Fuel pump circuit in good condition.

YES

Check fuel pump relay referring to p. 6E1-93. Is it in good condition?

NO

"P" wire open, poor fuel pump coupler connection or faulty fuel pump.

YES

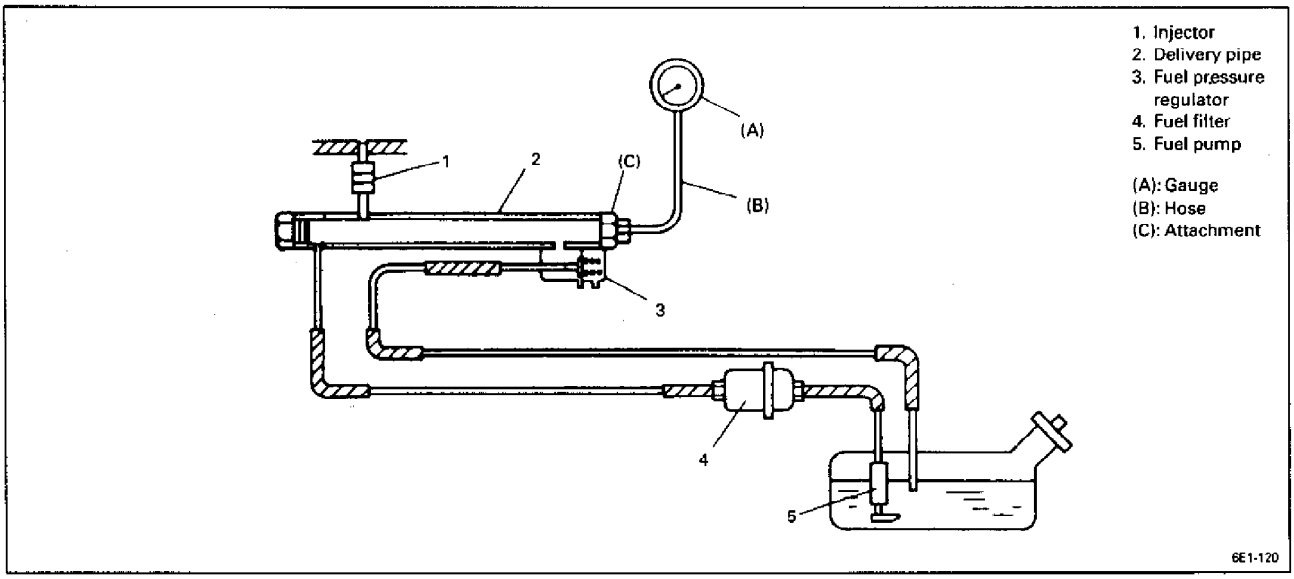
Poor relay coupler connection, "O/Y" or "Br/B" (Vehicle equipped with immobilizer control system) wire open or poor A4 or A20 (Vehicle equipped with immobilizer control system) connection.
If wire and connection are OK, substitute a known-good ECM and recheck.

NOTE:
Before substituting a known-good ECM, check to make sure that resistance of coil in relay is as specified.

NO

Faulty fuel pump relay.

B-3 FUEL PRESSURE CHECK



NOTE:
Before using following flow chart, check to make sure that battery voltage is higher than 11V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

1. Install fuel pressure gauge referring to p. 6E1-77.
2. Operate fuel pump according to procedure described on p. 6E1-77.
   Is fuel pressure then 2.3 – 2.7 kg/cm^2 (230 – 270 kPa, 32.7 – 38.4 psi)?
   Also, is 1.7 kg/cm^2 (170 kPa, 24.2 psi) or higher fuel pressure retained for 1 minute after fuel pump is stopped?

NO
- No pressure
  To ① on next page.
- Pressure within spec. but not retained
  To ② on next page.
- Low pressure
  To ③ on next page.
- High pressure
  To ④ on next page.

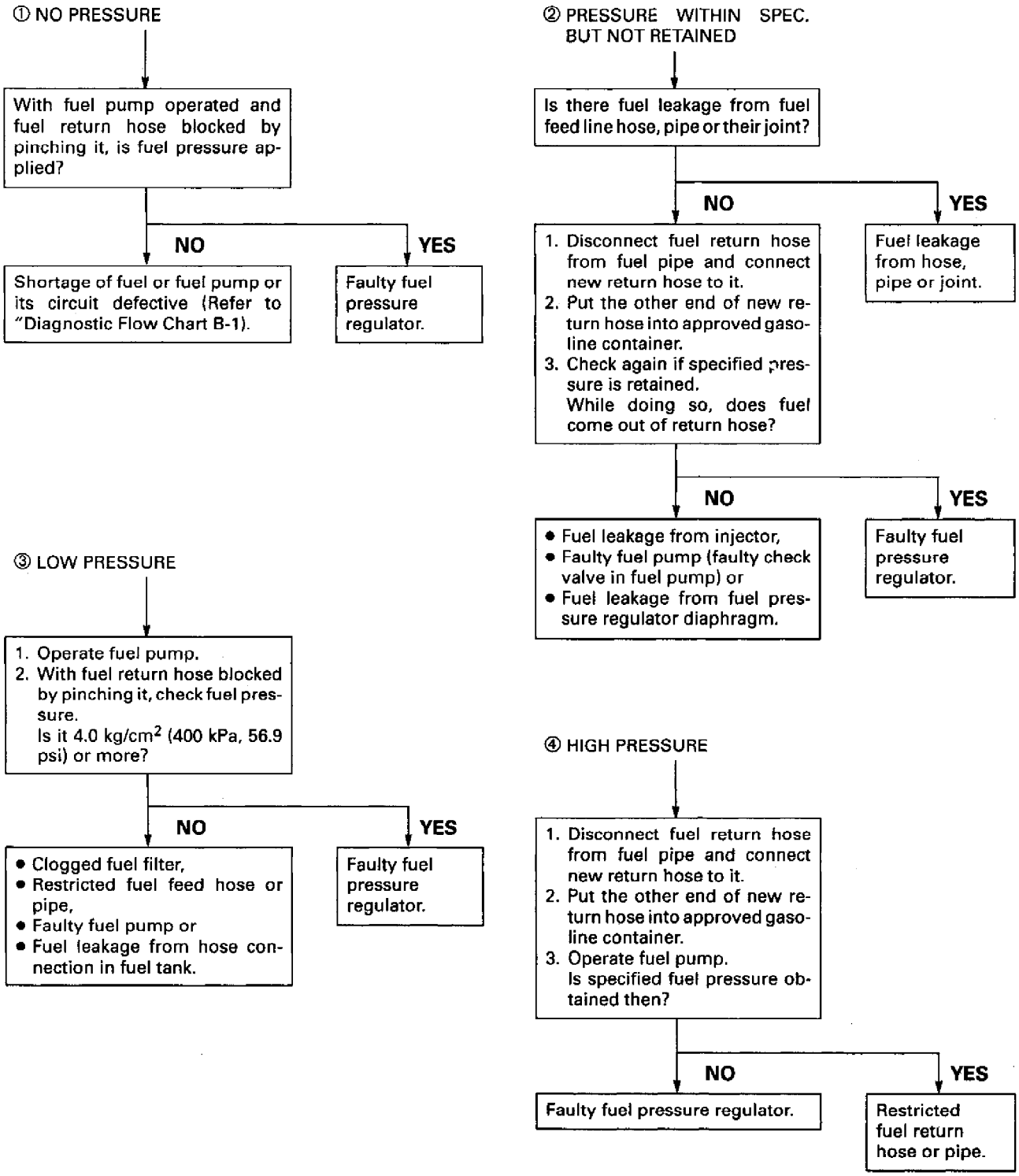
YES

1. Start engine and warm it up to normal operating temperature.
2. Keep it running at specified idle speed.
   Is fuel pressure then within 1.65 – 2.05 kg/cm^2 (165 – 205 kPa, 23.5 – 29.2 psi)?

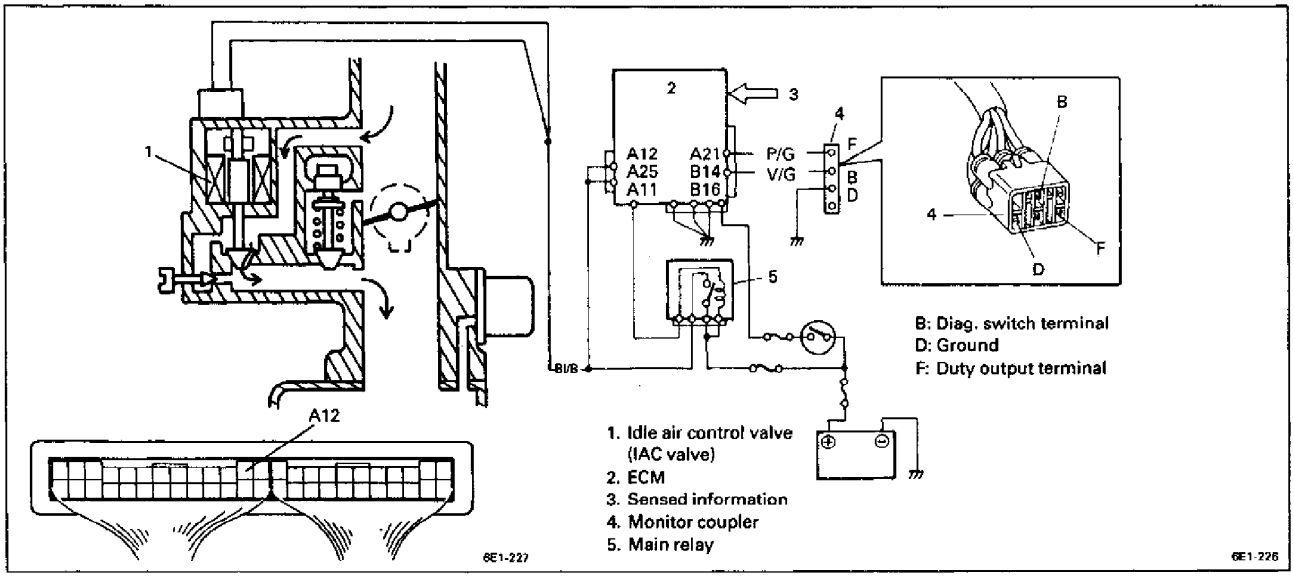
YES
Normal fuel pressure.

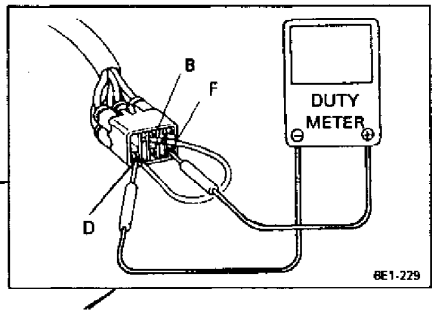
NO
- Clogged vacuum passage for fuel pressure regulator or
- Faulty fuel pressure regulator.

B-3 FUEL PRESSURE CHECK (continued)



B-4 IDLE AIR CONTROL SYSTEM CHECK





1. Warm up engine to normal operating temperature and keep it idling.
2. Using service wire, ground diagnosis switch terminal.
3. Is diagnostic trouble code No.12 indicated?

YES

1. Turn ignition switch OFF, and then ON after 4 sec. or more.
2. Check idle air control duty (IAC duty) and idle speed referring to p. 6E1-71.
   Are they within specification?

NO

Go back to "Diagnostic Flow Chart" on p. 6E1-34.

NO

High idle speed.
To ① on next page.

NO

Low idle speed.
To ② on next page.

YES

Idle speed is within specification but duty is not.
1. Adjust IAC duty to specification referring to p. 6E1-71.
2. Proceed to next step.

Is engine idle speed kept at 750 – 850 r/min even with headlights turned ON.

YES

System is in good condition.

NO

Proceed to system circuit check ③ on next page.

B-4 IDLE AIR CONTROL SYSTEM CHECK (continued)

① HIGH IDLE SPEED

Check IAC valve for its resistance and/or operation. (Refer to p. 6E1-76.)
Is it in good condition?

YES → Does duty meter indicate less than about 35% (or more than about 65% for OFF duty meter)?

NO → Faulty IAC valve.

NO → Substitute a known-good ECM and recheck.

YES → Adjust idle speed and duty referring to p. 6E1-71.
NOTE:
If not adjustable with idle air adjusting screw, check fast idle air valve for air leakage or "Lg/B" circuit for short.

② LOW IDLE SPEED

Check IAC valve for its resistance and/or operation. (Refer to p. 6E1-76.)
Is it in good condition?

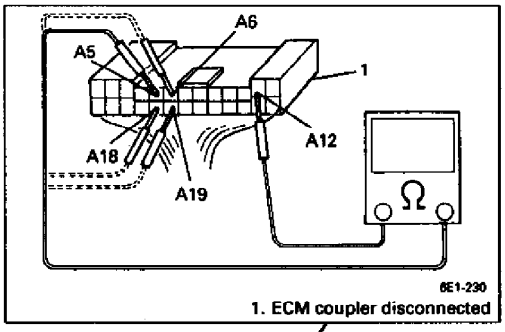
YES → Does duty meter indicate about 100% (about 0% for OFF duty meter)?

NO → Faulty IAC valve.

NO → Substitute a known-good ECM and recheck.

YES → Proceed to system circuit check ③.

③ SYSTEM CIRCUIT CHECK



1. ECM coupler disconnected

1. Turn ignition switch OFF, and then disconnect ECM couplers after 4 sec. or more.
2. Check resistance between following terminals of IAC valve in each pair.

A5 – A12 A6 – A12 A18 – A12 A19 – A12	28.8–31.2 Ω at 20°C (68°F)

Is it in good condition?

YES → Poor coupler connection. If connection is OK, substitute a known-good ECM and recheck.

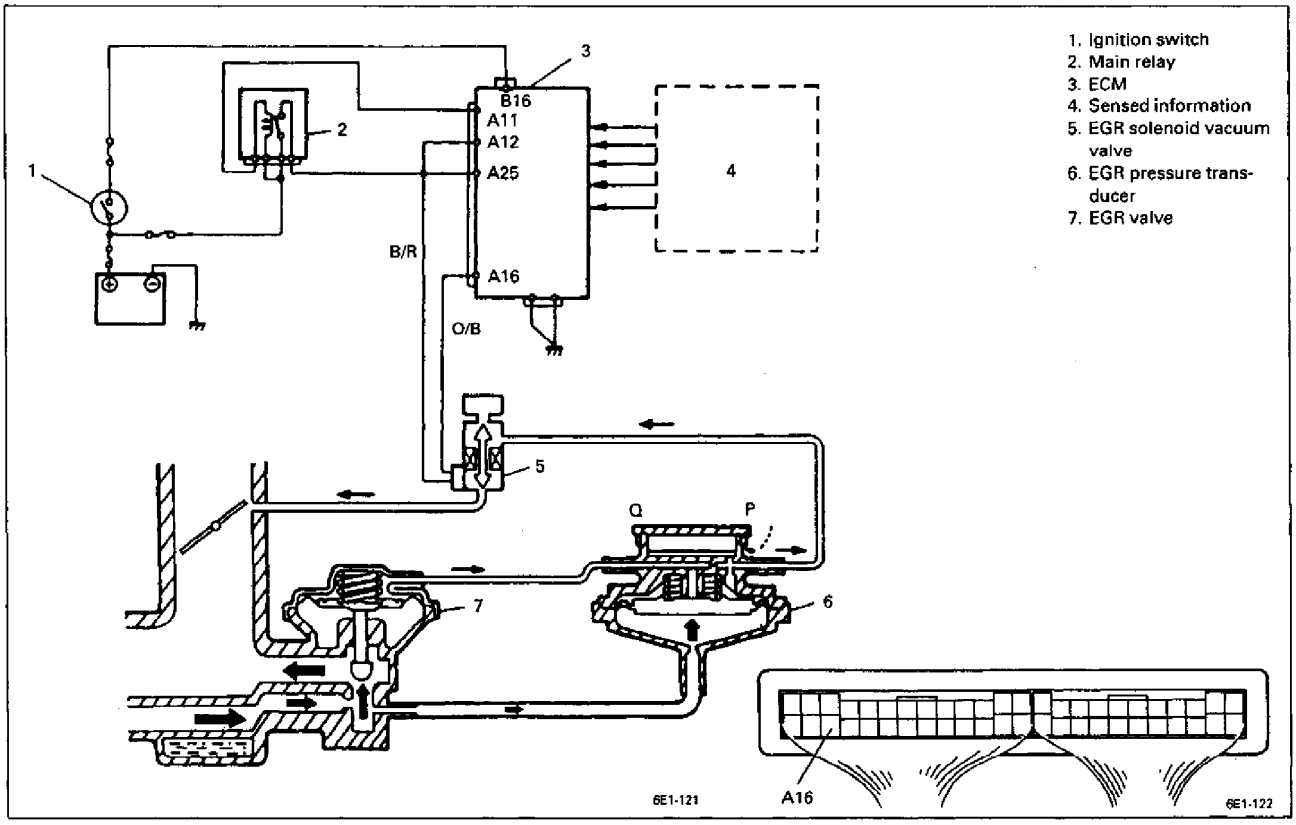
NO →
- Faulty IAC valve
- Poor coupler connection or
- Open wire harness

NOTE:
IAC duty can be checked by using analog type voltmeter with high impedance (MΩ/V minimum), although not accurate. IAC duty to voltage relation is as follows.

ON DUTY METER INDICATION	OFF DUTY METER INDICATION	VOLTMETER INDICATION
0 (%)	100 (%)	0 (V)
35	65	0.35 x V_B
50	50	0.5 x V_B
100	0	V_B

- **"OFF" DUTY METER" is such duty meter that indicates approx. 100% when terminal voltage is approx. "0V".**
- **"V_B" represents battery voltage while engine of vehicle being checked is running.**

B-5 EGR SYSTEM CHECK



Check EGR system referring to p. 6E1-94.
Is it in good condition?

NO

Check vacuum hose, EGR valve and EGR pressure transducer referring to p. 6E1-94.
Are they in good condition?

YES

Check EGR solenoid vacuum valve referring to p. 6E1-96.
Is it in good condition?

YES

- "O/B" wire open,
- "O/B" wire shorted to ground,
- Poor solenoid vacuum valve coupler connection
- Poor A16 connection or
- Poor performance of ECT sensor, TP sensor or MAP sensor

If wire, connection and sensors are OK, substitute a known-good ECM and recheck.

NO

Faulty solenoid vacuum valve.

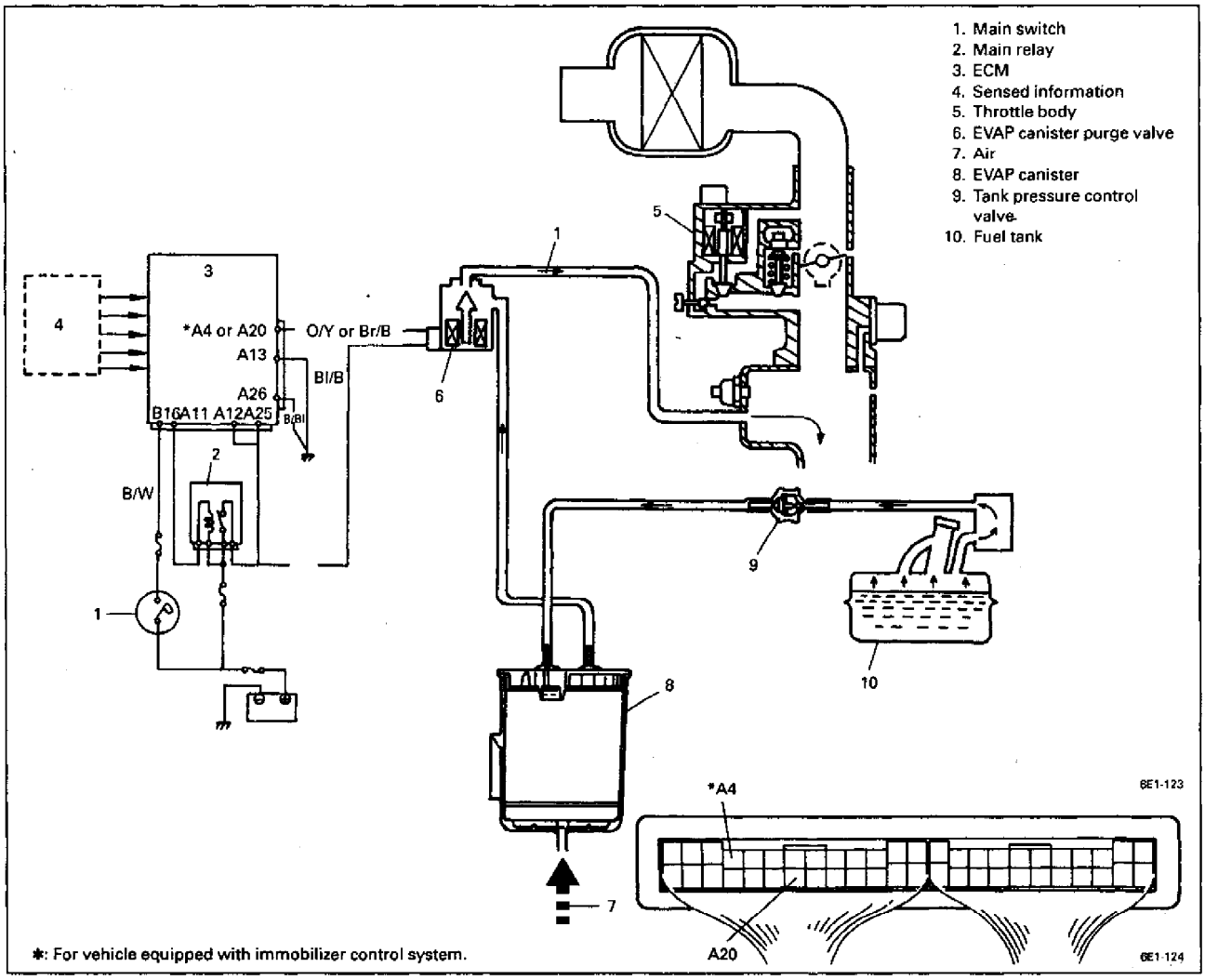
NO

- Vacuum hose misconnection, leakage, clog or deterioration,
- Faulty EGR valve or
- Faulty EGR pressure transducer.

YES

EGR system in good condition.

B-6 EVAPORATIVE EMISSION CONTROL SYSTEM CHECK



Check canister purge system for operation referring to p. 6E1-97.
Is it in good condition?

NO

Check vacuum passage, hoses and EVAP canister purge valve referring to p. 6E1-97.
Are they in good condition?

YES

- "Br/B" or "O/Y" wire open,
- "Br/B" or "O/Y" wire shorted to ground,
- Poor canister purge valve coupler connection,
- Poor A20 or A4 connection or
- Poor performance of ECT sensor, TP sensor, VSS or MAP sensor.

If wire, connection and sensor are OK, substitute a known-good ECM and recheck.

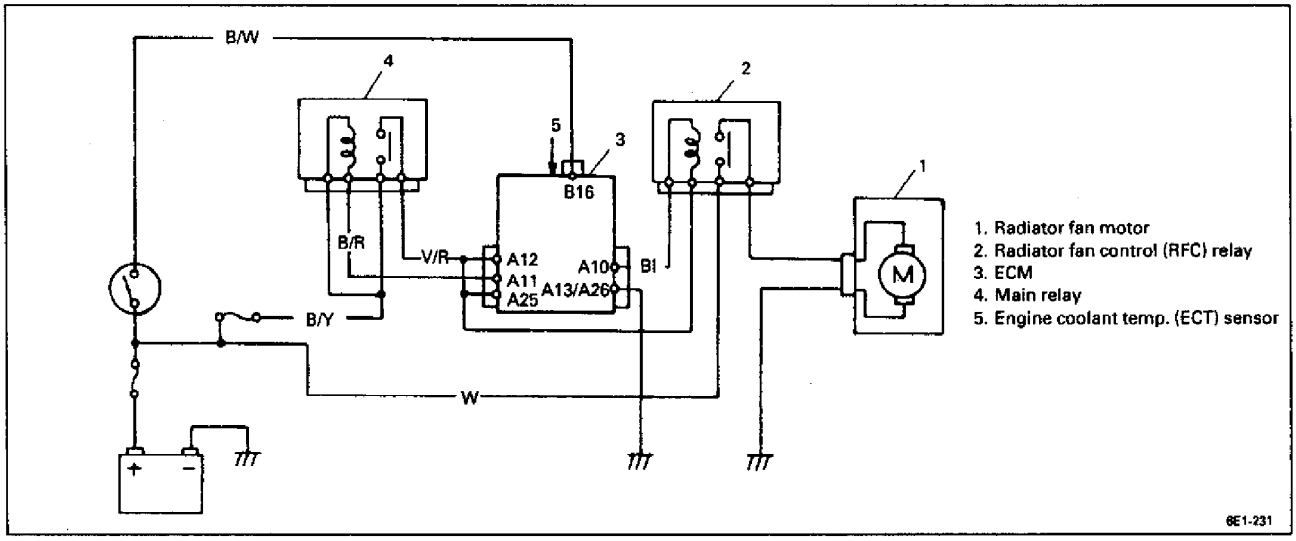
YES

- Canister purge system in good condition check EVAP canister, tank pressure control valve and fuel filler cap.

NO

- Vacuum passage clogged,
- Vacuum leakage or
- Faulty EVAP canister purge valve

B-7 RADIATOR FAN CONTROL SYSTEM CHECK

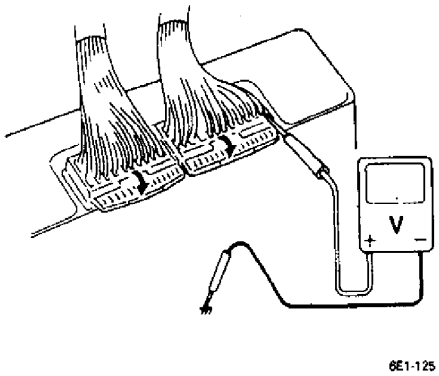


Check radiator fan control system referring to p. 6E1-100.
Is it in good condition?

YES → RFC system is in good condition.

NO → Check RFC relay referring to p. 6E1-100.
Is it in good condition?

- NO → Faulty RFC relay.
- YES → Check wire harnesses and connections for open or short.
Are they in good condition?
  - NO → • Wire open or short, • Poor connection.
  - YES → Poor performance of ECT sensor. If ECT sensor is OK, substitute a known-good ECM and recheck.



6E1-125

INSPECTION OF ECM AND ITS CIRCUITS

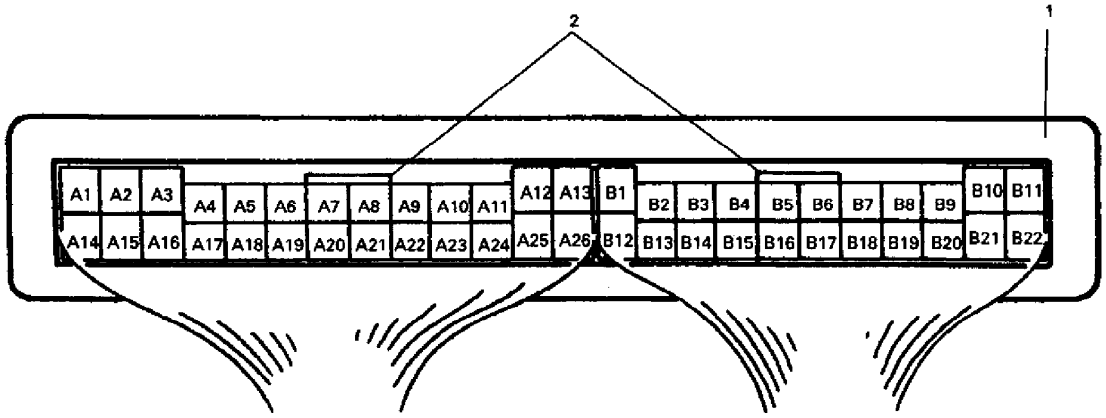
ECM and its circuits can be checked at ECM wiring couplers by measuring voltage and resistance.

CAUTION:
ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with couplers disconnected from it.

Voltage Check

1) Remove ECM from body referring to p. 6E1-83.
2) Connect ECM couplers to ECM.
3) Check voltage at each terminal of couplers connected.

NOTE:
As each terminal voltage is affected by the battery voltage, confirm that it is 11V or more when ignition switch is ON.



1. ECM
2. Coupler

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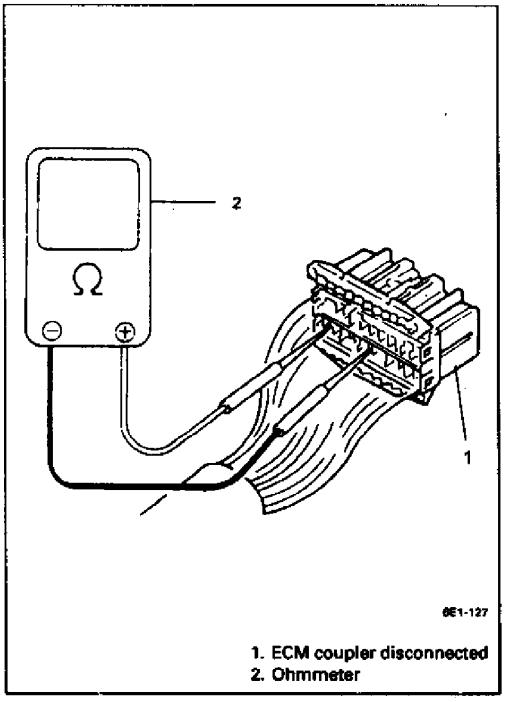
TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A1	Injector No.1 & No.3	10 – 14V	Ignition switch ON
A2	Shift solenoid 1 (A/T only)	0V	Ignition switch ON, selector lever at "P" range
		10 – 14V	Ignition switch ON, selector lever at "D" range
A3	Shift solenoid 2 (A/T only)	0V	Ignition switch ON, selector lever at "P" range
		10 – 14V	Ignition switch ON, selector lever at "D" range
A4	Fuel pump relay	0 – 1.0V	For 3 seconds after ignition switch ON
		10 – 14V	After the above time
	EVAP canister purge valve (Vehicles with immobilizer control system)	10 – 14V	Ignition switch ON
A5	IAC valve (Stepper motor coil 3)	0 – 1V	Ignition switch ON
A6	IAC valve (Stepper motor coil 2)	10 – 14V	Ignition switch ON
A7	Blank	———	———
A8	A/C cut signal (if equipped)	0 – 1V	While engine running and A/C OFF
		10 – 14V	While engine running and A/C ON
A9	Engine start switch (Engine start signal)	0V	Ignition switch ON
		6 – 12V	While engine cranking
A10	Radiator fan control relay	10 – 14V	Ignition switch ON When engine cooling fan OFF
		0 – 1V	Ignition switch ON When engine cooling fan ON
A11	Main relay	0 – 1V	Ignition switch ON
		10 – 14V	When over 4 sec. after ignition switch OFF
A12	Power source	10 – 14V	Ignition switch ON
A13	Ground	———	———
A14	Injector No.2 & No.4	10 – 14V	Ignition switch ON
A15	Ignition trigger signal	0 – 1V	Ignition switch ON
		0 – 3V	While engine cranking
A16	EGR solenoid vacuum valve	10 – 14V	Ignition switch ON
A17	Malfunction indicator lamp ("CHECK ENGINE" light)	0 – 1V	Ignition switch ON
		10 – 14V	When engine running
A18	IAC valve (Stepper motor coil 4)	10 – 14V	Ignition switch ON
A19	IAC valve (Stepper motor coil 1)	0 – 1V	Ignition switch ON
A20	EVAP canister valve	10 – 14V	Ignition switch ON
	Fuel pump relay (Vehicles with immobilizer control system)	0 – 1.0V	For 3 seconds after ignition switch ON
		10 – 14V	After the above time
A21	Duty output terminal	———	———
A22	Oxygen sensor heater	10 – 14V	Ignition switch ON
		0 – 1V	When over 120 sec. after engine started When specified idle speed.

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A23	A/C ON signal (if equipped)	10 – 14V	While engine running and A/C OFF
		0V	While engine running and A/C ON
A24	Test switch terminal	10 – 14V	Ignition switch ON
		0V	Ignition switch ON and test switch terminal grounded
A25	Power source	10 – 14V	Ignition switch ON
A26	Ground	———	———
B1	Ground for sensors	———	———
B2	Power source for sensors (MAP sensor and TP sensor)	4.75 – 5.25V	Ignition switch ON
B3	Engine coolant temp. sensor	0.5 – 0.9V	Ignition switch ON Coolant temp.: 80°C (176°F)
B4	MAP sensor	3.6 – 4.4V	Ignition switch ON Barometric pressure: 760 mmHg
B5	IAT sensor	2.2 – 3.0V	Ignition switch ON Sensor ambient temperature: 20°C (68°F)
B6	Oxygen sensor	Indicator deflection repeated between over and under 0.45V	While engine running at 2,000 r/min for 1 minute or longer after warmed up
B7	TP sensor	0.775 – 0.825V	Ignition switch ON Throttle valve at idle position
		4.05 – 4.35V	Ignition switch ON Throttle valve at full open position
B8	Camshaft position sensor	Indicator deflection repeated between 0V and about 5V	Ignition switch ON, Crankshaft turned slowly
B9	Data link connector (Serial data terminal)	4 – 5V	When over 3 sec. after ignition switch ON
B10	Vehicle speed sensor (M/T)	Indicator deflection repeated between 0V and 4 – 5V	Ignition switch ON Front right tire turned slowly with front left tire locked
	Vehicle speed sensor (+) (A/T)	Indicator deflection repeated between over and under 0V	Ignition switch ON Front right tire turned slowly with front left tire locked
B11	Vehicle speed sensor (–) (A/T)	Indicator deflection repeated between over and under 0V	Ignition switch ON Front right tire turned slowly with front left tire locked
B12	Power source for back-up circuit	10 – 14V	Ignition switch OFF and ON
B13	Electric load signal (–)	0V	Ignition switch ON Heater fan switch ON
		10 – 14V	Ignition switch ON
B14	Diagnosis switch terminal	10 – 14V	Ignition switch ON
		0V	Ignition switch ON Diag. switch terminal grounded (with service wire connected to diag. switch terminal and ground terminal.)

TERMINAL	CIRCUIT		NORMAL VOLTAGE	CONDITION	
B15	Electric load signal (+)		10 – 14V	Ignition switch ON Small light or rear defogger turned ON	
			0V	Ignition switch ON	
B16	Ignition signal		10 – 14V	Ignition switch ON	
			about 0V	Ignition switch OFF	
B17	Transmission range switch (A/T only)	"P" range	10 – 14V	Ignition switch ON	Selector lever at "P" range
B18		"R" range			Selector lever at "R" range
B19		"N" range			Selector lever at "N" range
B20		"D" range			Selector lever at "D" range
B21		"2" range			Selector lever at "2" range
B22		"L" range			Selector lever at "L" range



1. ECM coupler disconnected
2. Ohmmeter

RESISTANCE CHECK

1) Turn ignition switch OFF, and then disconnect ECM couplers after 4 sec. or more.

> **CAUTION:**
> **Never touch terminals of ECM itself or connect voltmeter or ohmmeter.**

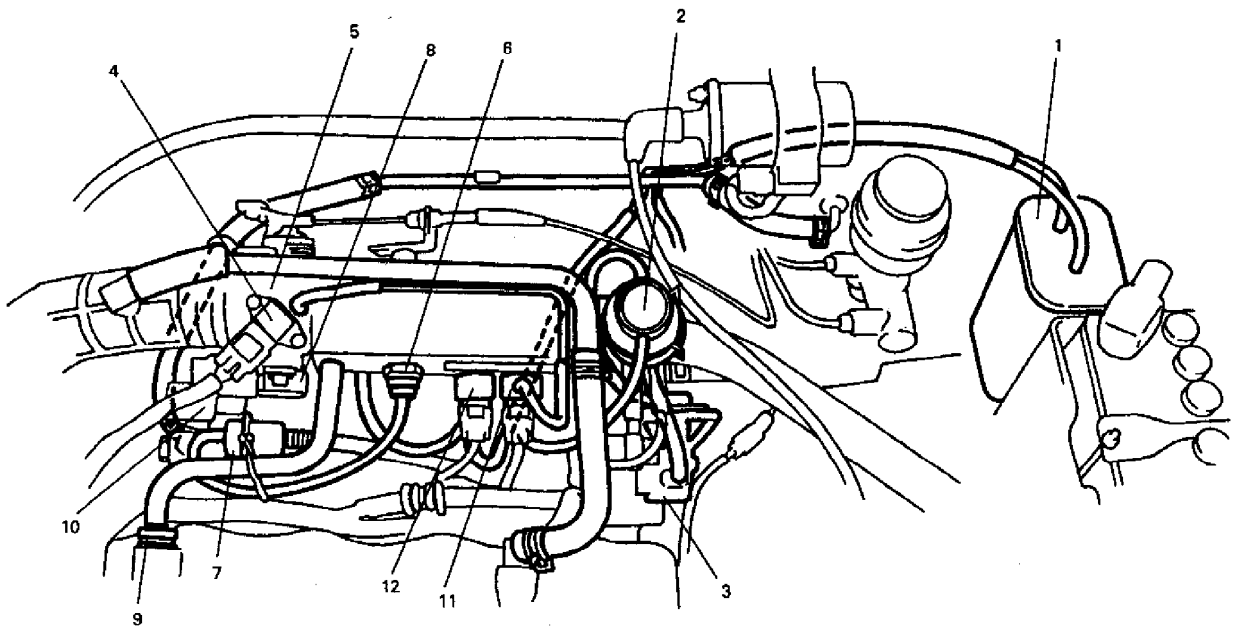
2) Check resistance between each pair of terminals disconnected couplers as listed in following table.

> **CAUTION:**
> - **Be sure to connect ohmmeter probe from wire harness side of coupler.**
> - **Be sure to turn OFF ignition switch for this check.**
> - **Resistance in below table represents that when parts temperature is 20°C (68°F).**

TERMINALS	CIRCUIT	NORMAL RESISTANCE	CONDITION
A2 – Body ground	Shift solenoid 1	22 – 28Ω	———
A3 – Body ground	Shift solenoid 2	17 – 21Ω	———
A4/*A20 – B16	Fuel pump relay	56 – 84Ω	———
A5 – A12/A25	IAC valve (Stepper motor coil 3)	28.8–31.2 Ω at 20°C (68°F)	———
A6 – A12/A25	IAC valve (Stepper motor coil 2)	28.8–31.2 Ω at 20°C (68°F)	———
A10 – A12/A25	Radiator fan control relay	82 – 101Ω	———
A11 – B12	Main relay	56 – 84Ω	———
A1 – A12/A25	Injector No.1 & No.3	6 – 9Ω	———
A14 – A12/A25	Injector No.2 & No.4	6 – 9Ω	———
A16 – A12/A25	EGR solenoid vacuum valve	33 – 39Ω	———
A18 – A12/A25	IAC valve (Stepper motor coil 4)	28.8–31.2 Ω at 20°C (68°F)	———
A19 – A12/A25	IAC valve (Stepper motor coil 1)	28.8–31.2 Ω at 20°C (68°F)	———
A20/*A4 – A12/A25	EVAP canister purge valve	33 – 39Ω	———
A21 – Body ground	Duty check terminal	∞ (infinity)	———
A22 – B16	Oxygen sensor heater	10 – 16Ω	Sensor ambient temp. 20°C (68°F)
A24 – Body ground	Test switch terminal	∞ (infinity)	———
B3 – B1	ECT sensor	0.29 – 0.35Ω	Engine coolant temp. 80°C (176°F)
B5 – B1	IAT sensor	2.28 – 2.87Ω	Sensor ambient temp. 20°C (68°F)
B7 – B1	TP sensor	0.3 – 2kΩ	Throttle valve at idle position
		2 – 6.5kΩ	Throttle valve at full open position
B14 – Body ground	Diagnosis switch terminal	∞ (infinity)	———

*: Only vehicles with immobilizer control system

ON-VEHICLE SERVICE

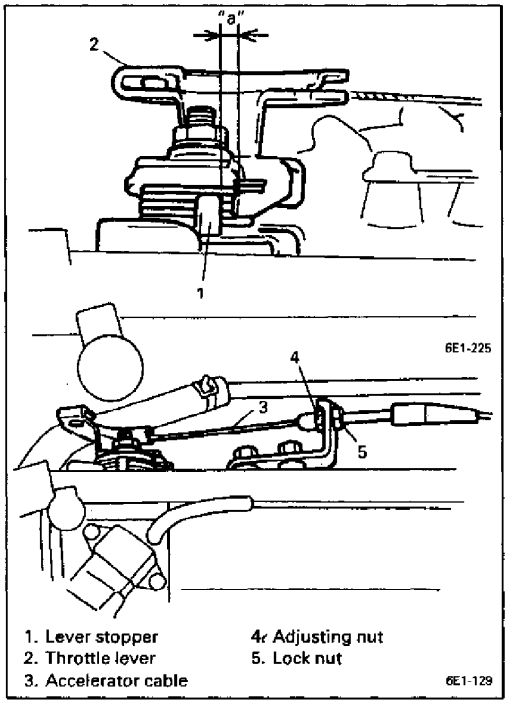


1. EVAP canister
2. EGR pressure transducer
3. EGR valve
4. MAP sensor
5. Throttle body
6. Gas filter
7. Fuel pressure regulator
8. TP sensor
9. PCV valve
10. IAC valve
11. EGR solenoid vacuum valve
12. EVAP canister purge valve

6E1-128

GENERAL

When hoses are disconnected and system components are removed for service, reinstall components properly, and route and connect hoses correctly after service. Refer to figure on prervious page for proper routing of hoses.



1. Lever stopper
2. Throttle lever
3. Accelerator cable
4. Adjusting nut
5. Lock nut

6E1-129

ACCELERATOR CABLE ADJUSTMENT

1) With accelerator pedal depressed fully, check clearance between throttle lever and lever stopper (throttle body) which should be within following specification.

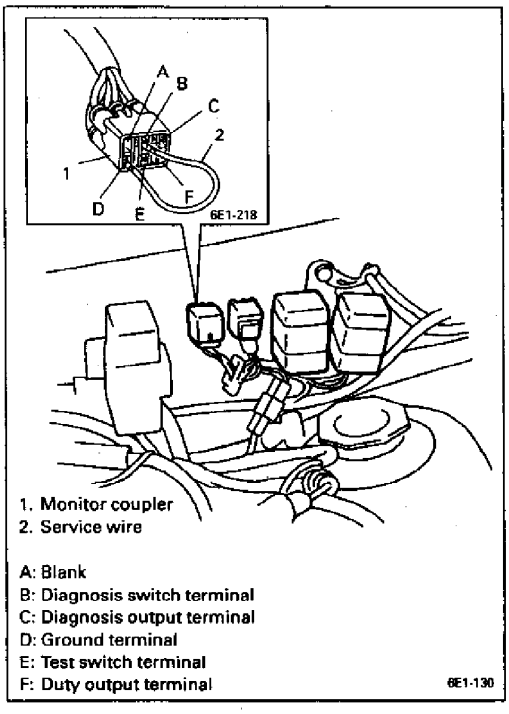
Clearance "a" : 0.5 – 2.0 mm (0.02 – 0.07 in.)
(With pedal depressed fully)

If measured value is out of specification, adjust it to specification with cable adjusting nut.

IDLE SPEED/IDLE AIR CONTROL (IAC) DUTY ADJUSTMENT

Before idle speed/IAC duty check and adjustment, make sure of the following.

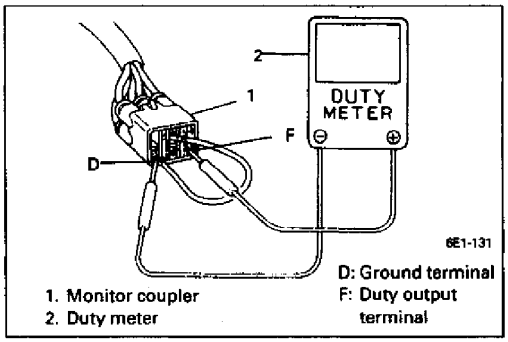
- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked and adjusted according to maintenance schedule.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, A/C, etc.) are out of service.
- Air cleaner has been properly installed and is in good condition.



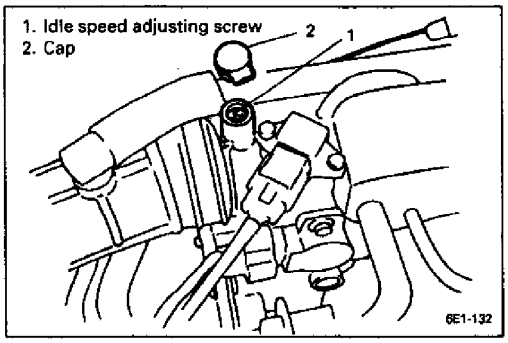
After above items are all confirmed, check idle speed and IAC duty as follows.

NOTE:
Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T vehicle), and set parking brake and block drive wheels.

1) Warm up engine to normal operating temperature.
2) Using service wire, ground diagnosis switch terminal in monitor coupler and make sure that malfunction indicator lamp ("CHECK ENGINE" light) indicate diagnostic trouble code No.12.
   The monitor coupler is located beside relays (main and fuel pump).



3) Stop engine and connect duty meter between duty output terminal and ground terminal of monitor coupler.
4) Set tachometer.



5) Start engine and warm it up completely.
6) Check IAC duty and idle speed. If duty and/or idle speed is out of specifications, adjust it by turning idle speed adjusting screw.

ENGINE IDLE SPEED AND IAC DUTY	
Engine idle speed	800 ± 50 r/min.
IAC duty at specified idle speed	50% (7V when battery voltage is 14V)

NOTE:
IAC duty can be checked by using analog type voltmeter.
IAC duty to voltage relation is as follows.

ON DUTY METER INDICATION (%)	OFF DUTY METER INDICATION (%)	VOLTMETER INDICATION (V)
0	100	0
50	50	0.5 x V_B
100	0	V_B

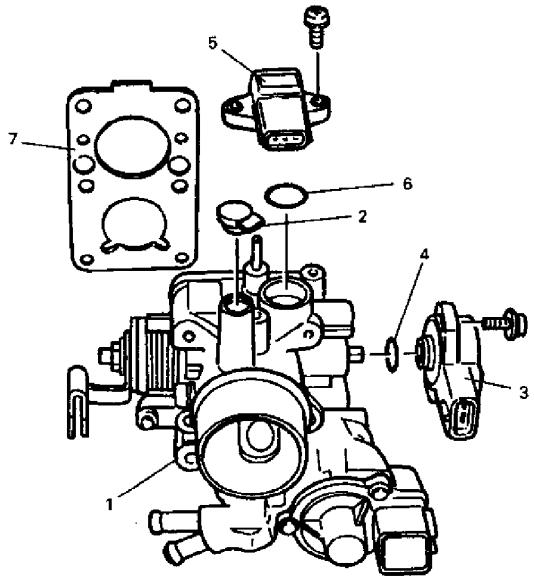
- **"OFF DUTY METER" is such duty meter that indicates approx. 100% when terminal voltage is approx. "0V".**
- **"V_B" represents battery voltage while engine of vehicle being checked is running.**

If duty remains unchanged or is not outputed even when adjusting screw is turned, check duty output terminal circuit, A/C signal circuit, "D" range signal circuit (A/T) and ECT sensor performance.

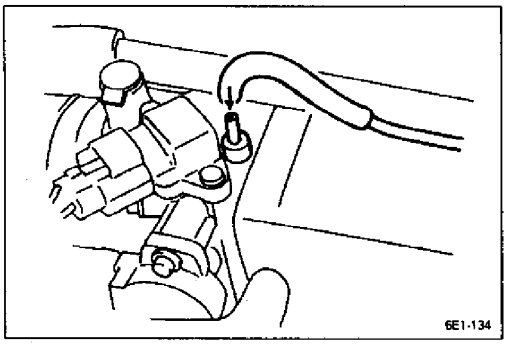
7) Upon completion of adjustment, install adjusting screw cap to throttle body.
8) Remove service wire from monitor coupler.
9) Install cap to monitor coupler.
10) Check that specified engine idle speed is obtained with A/C ON if vehicle is equipped with A/C.
    Refer to p. 6E1-24 for specified idle speed.
    If not, check A/C ON signal circuit and IAC valve.

AIR INTAKE SYSTEM

THROTTLE BODY

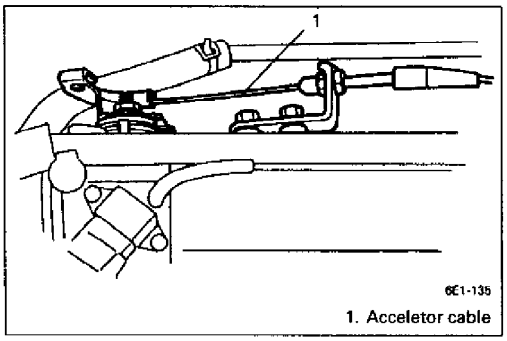


1. Throttle body
2. Cap
3. TP sensor
4. O-ring (TP sensor)
5. MAP sensor
6. O-ring (MAP sensor)
7. Gasket



On-Vehicle Inspection

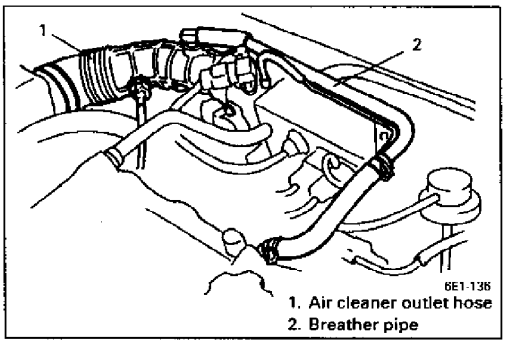
- Check that throttle valve lever moves smoothly.
- Vacuum passage inspection.
  With finger placed against vacuum nozzle, increase engine speed a little and check that vacuum is applied.



1. Acceletor cable

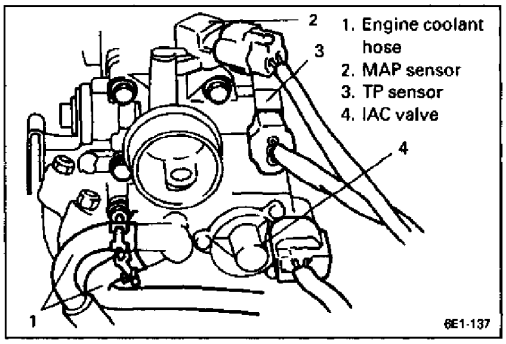
Removal

1) Turn ignition switch OFF, and then disconnect negative cable at battery after 4 sec. or more.
2) Drain cooling system.
3) Disconnect accelerator cable from throttle body.

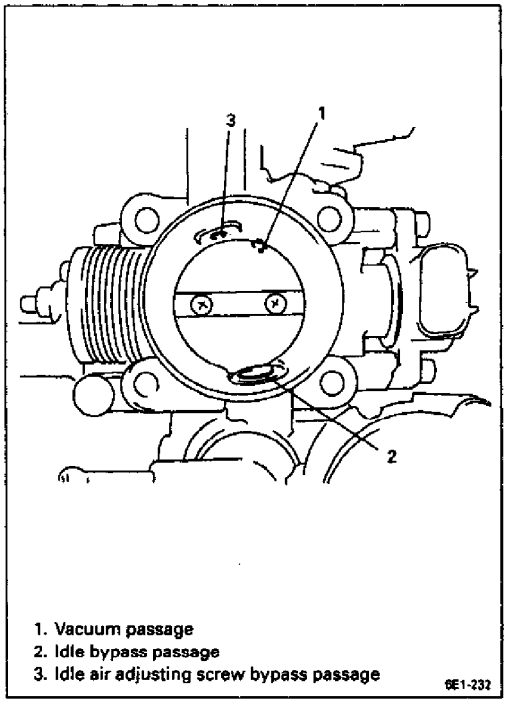


1. Air cleaner outlet hose
2. Breather pipe

4) Remove air cleaner outlet hose from throttle body.
5) Disconnect vacuum hose from throttle body.
6) Remove breather pipe.



7) Disconnect electric coupler from MAP sensor, TP sensor and IAC valve.
8) Disconnect engine coolant hoses from throttle body.
9) Remove throttle body from surge tank (intake manifold).

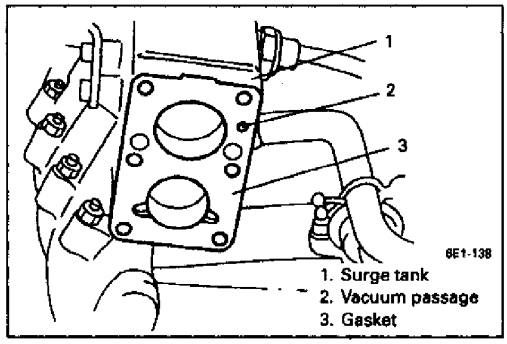


Cleaning

Remove MAP sensor from throttle body, and then clean each passages of throttle body by blowing compressed air.

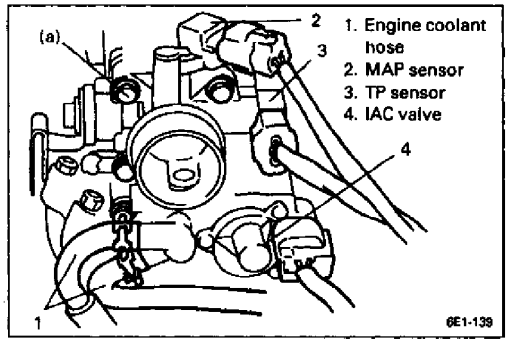
NOTE:

- **MAP sensor, TP sensor, IAC valve or other components containing rubber must not be placed in a solvent or cleane bath. A chemical reaction will cause these parts to swel harden or get distorted.**
- **Don't put drills or wires into passage for cleaning. It cause damages in passages.**



Installation

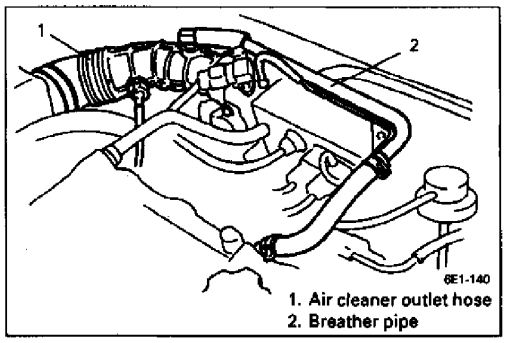
1) Clean mating surfaces and install throttle body gasket to surge tank (Intake manifold.).
Use new gasket.



2) Install throttle body to surge tank.
Tighten bolts to specified torque.

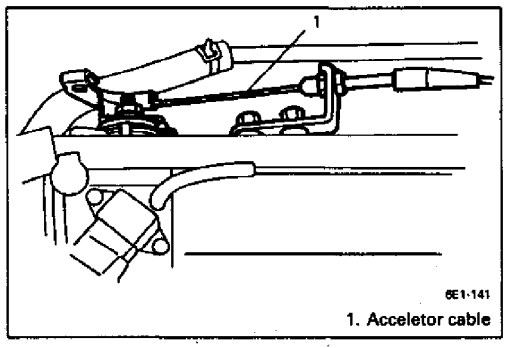
Tightening Torque
(a): 10 N·m (1.0 kg-m, 7.2 lb-ft)

3) Connect engine coolant hoses.
4) Connect coupler to MAP sensor, TP sensor and IAC valve securely.



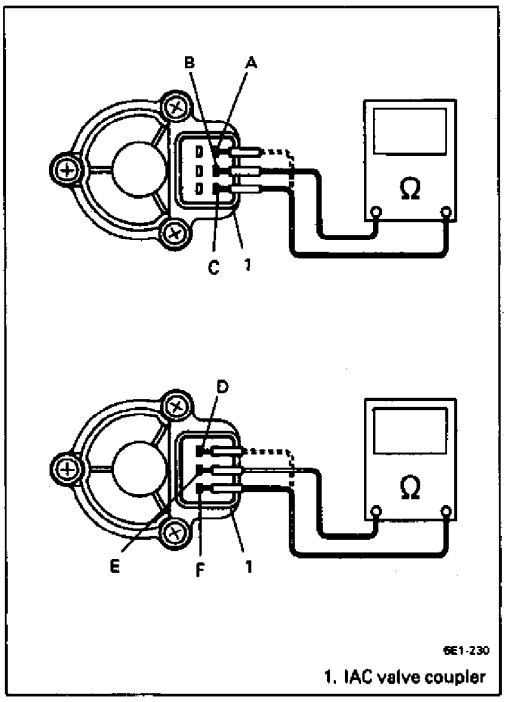
1. Air cleaner outlet hose
2. Breather pipe

5) Install breather pipe.
6) Connect vacuum hose to throttle body.
7) Install air cleaner outlet hose.



1. Acceletor cable

8) Connect accelerator cable and adjust cable play to specification.
9) Refill cooling system.
10) Connect negative cable at battery.



1. IAC valve coupler

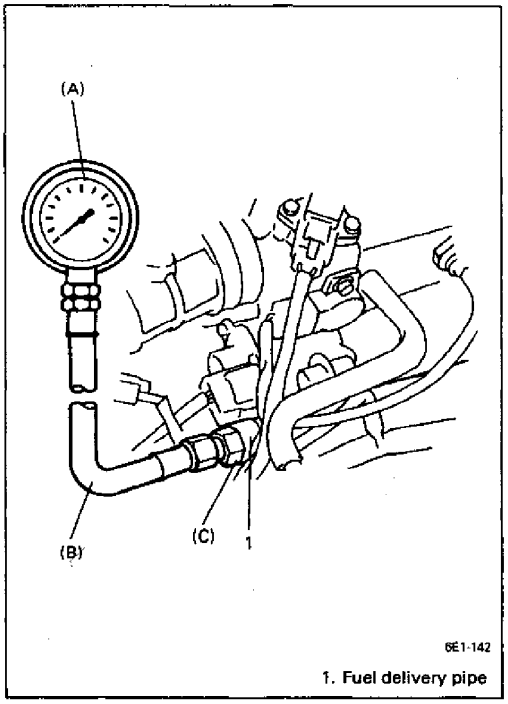
IDLE AIR CONTROL VALVE (IAC VALVE)

On-Vehicle Inspection

1) Turn ignition switch "OFF", and then disconnect IAC valve coupler after 4 sec. or more.
2) Check resistance between following terminals of IAC valve in each pair.

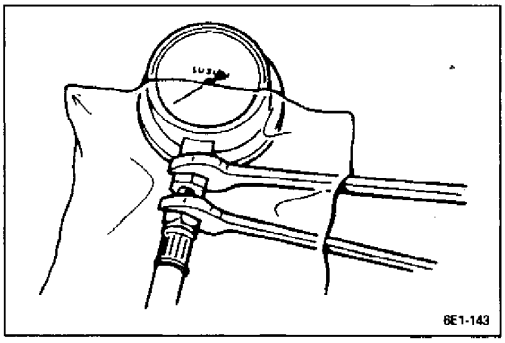
Terminal	Standard resistance
A – B C – B F – E D – E	28.8–31.2 Ω at 20°C (68°F)

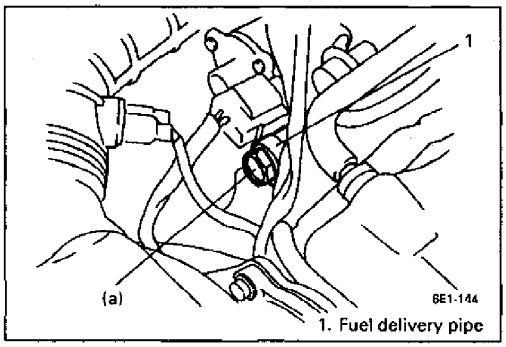
If found faulty, replace throttle body.



1. Fuel delivery pipe

CONDITION	FUEL PRESSURE
With fuel pump operating and engine stopped	230 – 270 kPa 2.3 – 2.7kg/cm^2 32.7 – 38.4 psi
At specified idle speed	165 – 205 kPa 1.65 – 2.05kg/cm^2 23.5 – 29.2 psi
With 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	over 170 kPa 1.7 kg/cm^2 24.2 psi





1. Fuel delivery pipe

FUEL DELIVERY SYSTEM

FUEL PRESSURE INSPECTION

1) Relieve fuel pressure in fuel feed line according to procedure described in Section 6.
2) Using backup wrench, loosen plug bolt on fuel delivery pipe and remove it. Connect special tools (fuel pressure gauge) to delivery pipe.

CAUTION:
A small amount of fuel may be released when plug bolt is loosened. Place container under the bolt or cover bolt hole with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place that cloth in an approved container.

Special Tool
(A): 09912-58441
(B): 09912-58431
(C): 09919-46010

3) Check that battery voltage is above 11V.
4) Turn ignition switch ON to operate fuel pump and after 3 seconds turn it OFF. Repeat this 3 or 4 times and then check fuel pressure.
5) Start engine.
6) Measure fuel pressure at idling.

   If measured pressure doesn't satisfy specification, refer to "Diagnostic Flow Chart B-3" and check each possibly defective part. Replace if found defective.

7) After checking fuel pressure, remove fuel pressure gauge.

CAUTION:
As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place fuel container under joint.**
- **Cover joint with rag and loosen joint nut slowly to release fuel pressure gradually.**

8) Install plug bolt to fuel delivery pipe.
   Use new gasket.
   Tighten it to specified torque, using backup wrench.

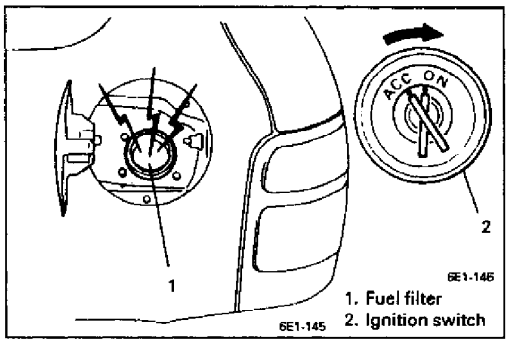
   Tightening Torque
   (a): 30 N·m (3.0 kg-m, 21.7 lb-ft)

9) With engine "OFF" and ignition switch "ON", check for fuel leaks.

FUEL PUMP

On-Vehicle Inspection

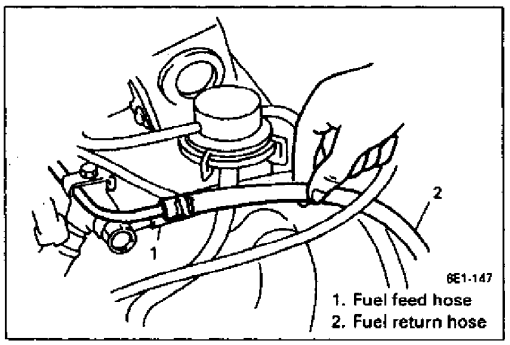
CAUTION:
When fuel filler cap is removed in any procedure, work must be done in a well-ventilated area, keep away from any open flames and without smoking.



1. Fuel filter
2. Ignition switch

1) Remove filler cap and turn ON ignition switch. Then fuel pump operating sound should be heard from fuel filler for about 3 seconds and stop. Be sure to reinstall fuel filler cap after checking.

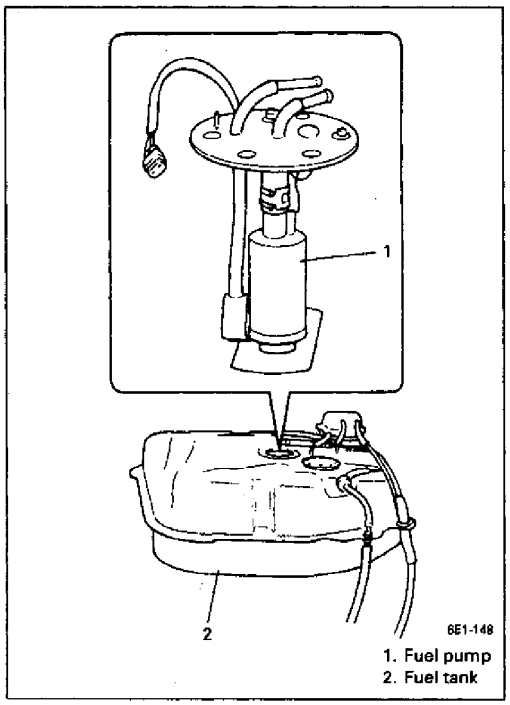
   If above check result is not satisfactory, advance to "Diagnostic Flow Chart B-1".



1. Fuel feed hose
2. Fuel return hose

2) Fuel pressure should be felt at fuel return hose for 3 seconds after ignition switch ON.

   If fuel pressure is not felt, advance to "Diagnostic Flow Chart B-3".



1. Fuel pump
2. Fuel tank

Removal

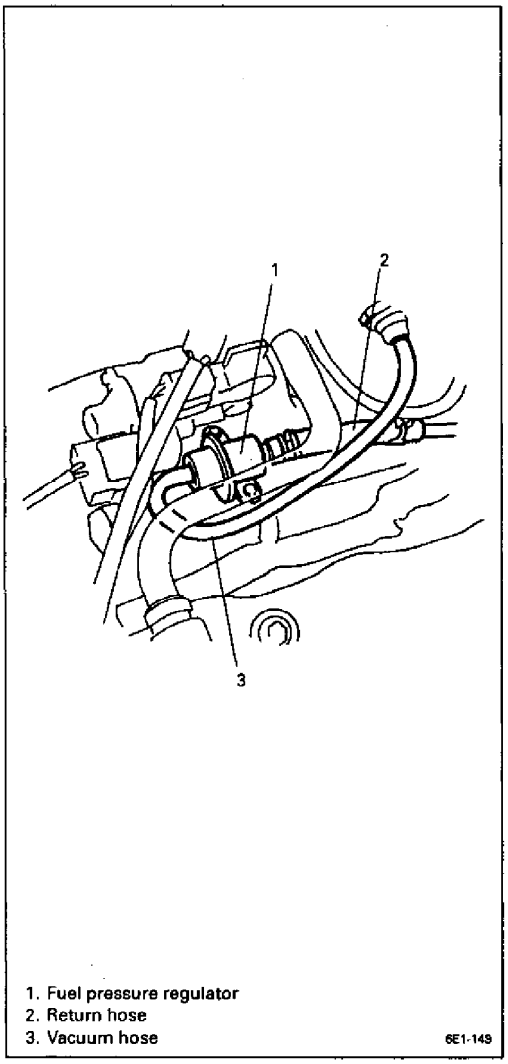
Remove fuel tank from body according to procedure described in Section 6C and remove fuel pump from fuel tank.

Inspection

Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

Installation

1) Install fuel pump to its backet.
2) Install fuel pump to fuel tank and then install fuel tank to body according to procedure described in Section 6C.



1. Fuel pressure regulator
2. Return hose
3. Vacuum hose

6E1-149

FUEL PRESSURE REGULATOR

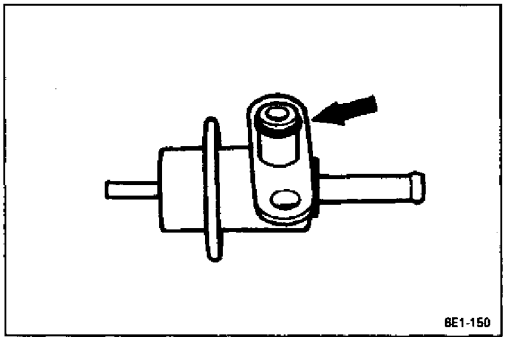
Removal

1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect battery negative cable from battery.
3) Remove PCV valve hose.
4) Disconnect vacuum hose from fuel pressure regulator.
5) Disconnect fuel return hose from fuel pressure regulator.

> **CAUTION:**
> **A small amount of fuel may be released when hose is disconnected. Cover hose to be disconnected with a shop cloth.**

6) Remove fuel pressure regulator.

> **CAUTION:**
> **A small amount of fuel may be released when it is from delivery pipe.**
> **Place a shop cloth under delivery pipe so that released fuel is absorbed in it.**

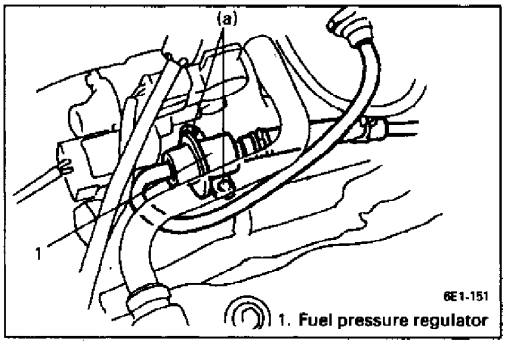


6E1-150

Installation

For installation, reverse removal procedure and note following precautions.

- Use new O-ring.
- Apply thin coat of spindle oil or gasoline to O-ring to facilitate installation.



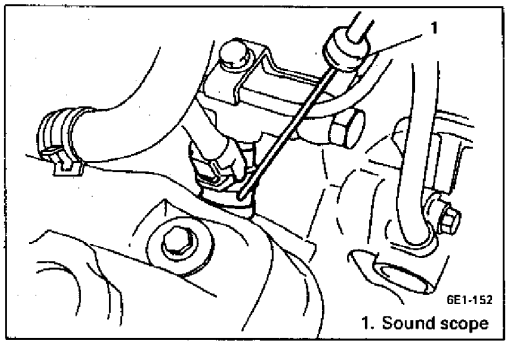
6E1-151

1. Fuel pressure regulator

- Tighten fuel pressure regulator bolts to specified torque.

Tightening Torque
(a): 10 N·m (1.0 kg-m, 7.2 lb-ft)

- With engine "OFF" and ignition switch "ON", check for fuel leaks around fuel line connection.

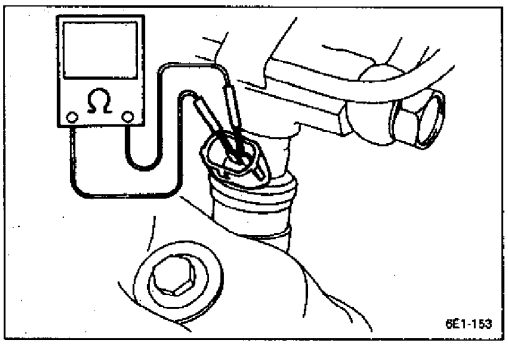


1. Sound scope

FUEL INJECTOR

On-Vehicle Inspection

1) Using sound scope or such, check operating sound of injector when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector.



2) Disconnect coupler from injector, connect ohmmeter between terminals of injector and check resistance.

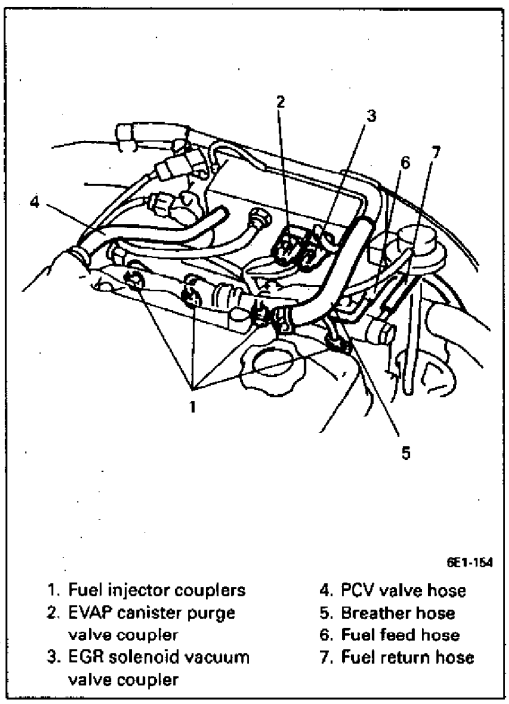
   Resistance of injector: 13.5 – 14.1 Ω at 20°C (68°F)

   If resistance is out of specification, replace.
3) Connect coupler to injector securely.

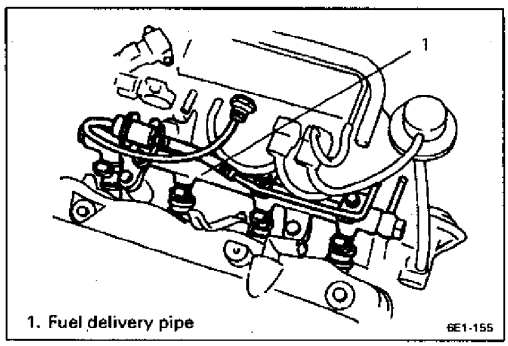
Removal

1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect battery negative cable at battery.
3) Remove PCV valve hose and breather hose.
4) Disconnect EVAP canister purge valve coupler, EGR solenoid vacuum valve coupler and fuel injector couplers.
5) Disconnect fuel feed hose and return hose from fuel delivery pipe.

> **CAUTION:**
> **A small amount of fuel may be released when hoses is disconnected. Cover them to be disconnected with a shop cloth.**



1. Fuel injector couplers
2. EVAP canister purge valve coupler
3. EGR solenoid vacuum valve coupler
4. PCV valve hose
5. Breather hose
6. Fuel feed hose
7. Fuel return hose

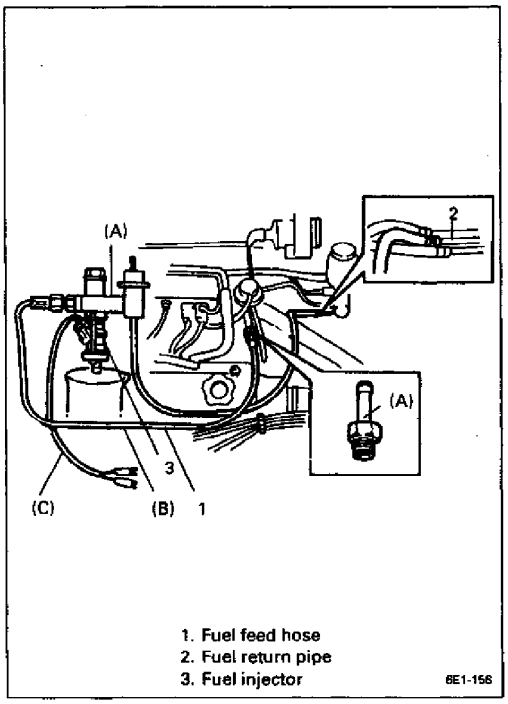


1. Fuel delivery pipe

6) Disconnect vacuum hose from fuel pressure regulator.
7) Remove fuel delivery pipe bolts.
8) Remove fuel injector(s).

Inspection

WARNING:
As fuel is injected in this inspection, perform in a well ventilated area and away from open flames.
Use special care to prevent sparking when connecting and disconnecting test lead to and from battery.



1. Fuel feed hose
2. Fuel return pipe
3. Fuel injector

6E1-156

1) Install injector and fuel pressure regulator to special tool (injector checking tool).

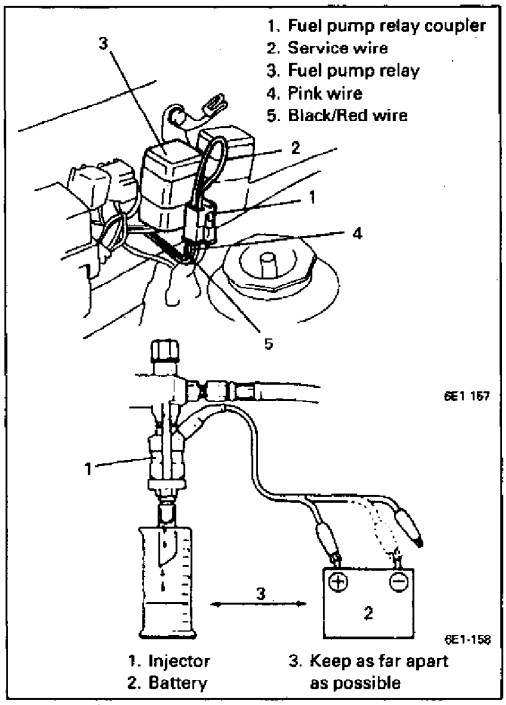
Special Tool
(A): 09912-58421

2) Connect special tools (hoses and attachment) to fuel feed hose and return pipe of vehicle.

Special Tool
(B): 09912-58431

3) Connect special tool (test lead) to injector.

Special Tool
(C): 09930-88530

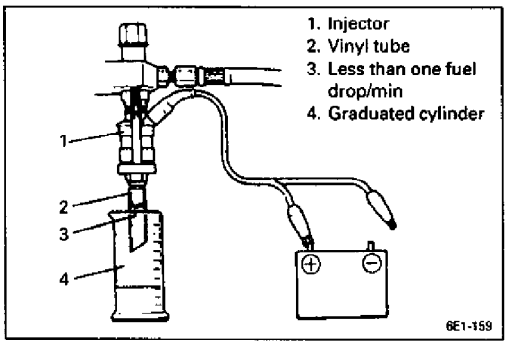


4) Install suitable vinyl tube onto injector nozzle to prevent fuel from splashing out when injecting.
5) Put graduated cylinder under injector as shown.
6) Disconnect coupler from fuel pump relay.
7) To operate fuel pump and apply fuel pressure to injector, using wire, connect Black/Red and Pink wire harness terminals of fuel pump relay coupler.

CAUTION:
Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

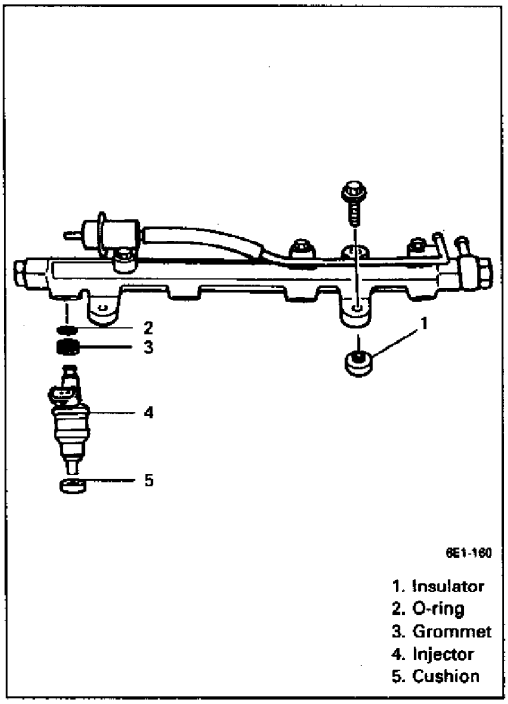
8) Apply battery voltage to injector for 15 seconds and measure injected fuel volume with graduated cylinder. Test each injector two or three times.
If not within specification, replace injector.

Injected fuel volume:
31 – 41 cc/15 sec. (1.05/1.09 – 1.39/1.44 US/Imp. oz/15 sec.)



9) Check fuel leakage from injector nozzle. Do not operate injector for this check (but fuel pump should be at work). If fuel leaks more than following specifications, replace.

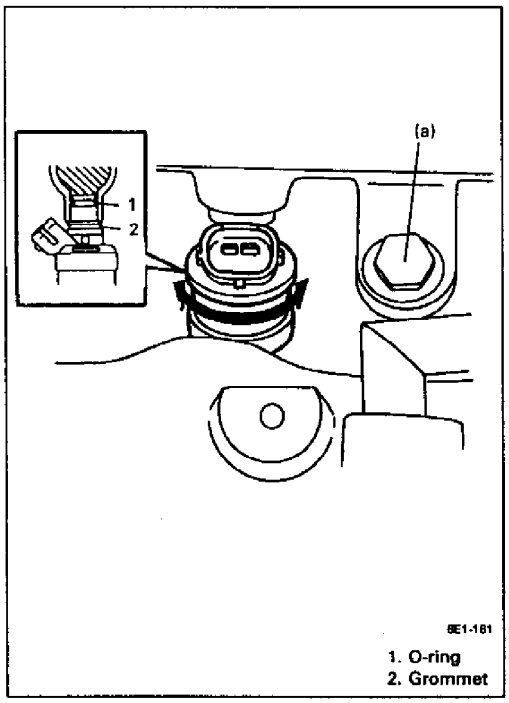
Fuel leakage: Less than 1 drop/min.



Installation

For installation, reverse removal procedure and note following precautions.

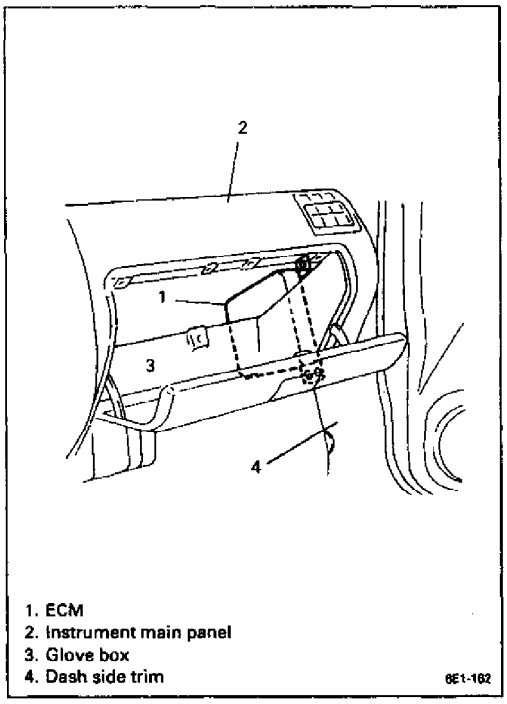
- Replace injector O-ring with new one using care not to damage it.
- Check if cushion is scored or damaged, If it is, replace with new one.



- Apply thin coat of fuel to O-rings and then install injectors into delivery pipe and intake manifold.
  Make sure that injectors rotate smoothly. If not, probable cause is incorrect installation of O-ring. Replace O-ring with new one.
- Tighten delivery pipe bolts and make sure that injectors rotate smoothly.

Tightening Torque
(a): 30 N·m (3.0 kg-m, 21.7 lb-ft)

- With engine "OFF" and ignition switch "ON", check for fuel leaks around fuel line connection.



1. ECM
2. Instrument main panel
3. Glove box
4. Dash side trim

6E1-162

ELECTRONIC CONTROL SYSTEM

ENGINE CONTROL MODULE (ECM)

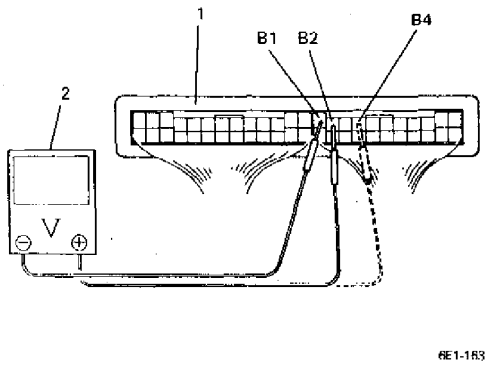
CAUTION:
As ECM consists of precision parts, be careful not to expose it to excessive shock.

Removal

1) Turn ignition OFF, and then disconnect battery negative cable from battery after 4 sec. or more.
2) Remove glove box upper cover and dash side trim.
3) Disconnect couplers from ECM while releasing coupler lock.
4) Remove ECM from vehicle.

Installation

1) Install ECM.
2) Connect couplers to ECM securely.
3) Install glove box upper cover and dash side trim.
4) Connect battery negative cable to battery.



1. ECM
2. Digital type voltmeter

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP SENSOR)

Output Voltage Check

1) Remove ECM, referring to ECM removal on p. 6E1-83.
2) With coupler connected to ECM, connect digital type voltmeter and check that ECM supply voltage. 4.75 – 5.25V is applied to coupler terminal B2.
3) Check output voltage at coupler terminal B4.
   Note that it varies with atmosheric pressure and altitude. Also, start engine, if it can, and check if output voltage varies.

Output voltage (ECM supply voltage 4.75–5.25V)

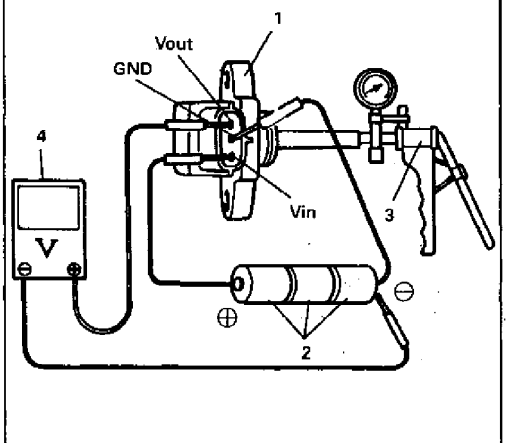
ALTITUDE		BAROMETRIC PRESSURE	OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(V)
0	0	760	3.6 – 4.4
1 000	305	733	3.5 – 4.2
2 000	610	707	3.4 – 4.1
3 000	914	682	3.2 – 4.0
4 000	1 219	658	3.1 – 3.8
5 000	1 524	634	3.0 – 3.7
6 000	1 829	611	2.9 – 3.6
7 000	2 133	589	2.8 – 3.4
8 000	2 438	567	2.7 – 3.3
9 000	2 743	546	2.6 – 3.2
10 000	3 048	526	2.5 – 3.1

NOTE:
Note that atmospheric pressure varies depending on weather conditions as well as altitude.
Take that into consideration when performing above check.

If check result is not satisfactory in previous step 2 or 3, check MAP sensor and its circuit according to Code No.31 or 32 Diagnostic Flow Chart.

NOTE:
If output voltage does not vary when engine is started, it is possible that vacuum passage is clogged.
Clean them.
Another possibility is that filter in MAP sensor is clogged from freezing. If it is suspected, leave it at room temperature (20°C, 68°F) for a while and recheck.

4) Upon completion of checking, install ECM.



1. MAP sensor
2. 1.5V Battery (4.5V in total)
3. Vacuum pump
4. Digital type voltmeter

MAP Sensor Individual Check

1) Disconnect battery negative cable at battery.
2) Disconnect MAP sensor coupler.
3) Remove MAP sensor.
4) Arrange 3 new 1.5V batteries in series and connect its positive terminal to "Vin" terminal of coupler and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground".
   Also, check if voltage reduces when vacuum is applied up to 40 cmHg by using vacuum pump.

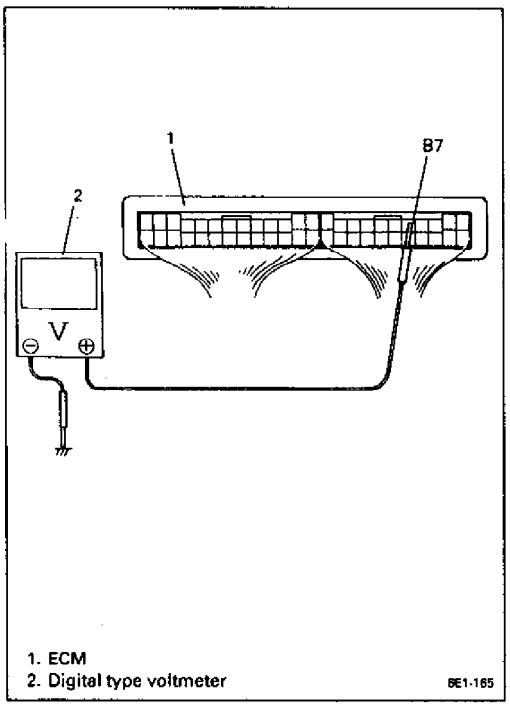
CAUTION:
As connection to wrong terminal will cause damage to MAP sensor, make absolutely sure to connect properly as shown below.

Output voltage (Vin voltage 4.5V)

ALTITUDE		BAROMETRIC PRESSURE	OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(V)
0	0	760	3.4 – 3.8
1 000	305	733	3.3 – 3.7
2 000	610	707	3.1 – 3.6
3 000	914	682	3.0 – 3.5
4 000	1 219	658	2.9 – 3.3
5 000	1 524	634	2.8 – 3.2
6 000	1 829	611	2.7 – 3.1
7 000	2 133	589	2.6 – 3.0
8 000	2 438	567	2.5 – 2.9
9 000	2 743	546	2.4 – 2.8
10 000	3 048	526	2.3 – 2.7

If check result is not satisfactory, replace MAP sensor.

5) Install MAP sensor.
   Check O-ring for damage and replace if necessary.
6) Connect MAP sensor coupler securely.



1. ECM
2. Digital type voltmeter

6E1-165

THROTTLE POSITION SENSOR (TP SENSOR)

Inspection

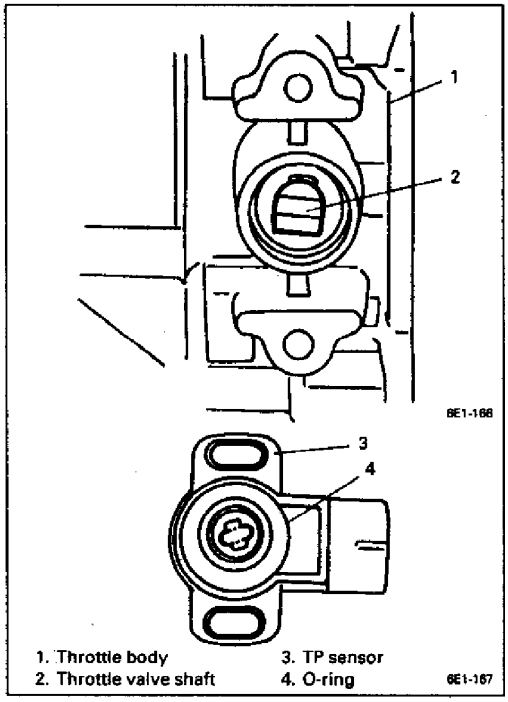
1) Remove ECM as previously outlined.
2) Using voltmeter check voltage at "B7" terminal under following each condition.

   When throttle is fully close : 0.80 ± 0.025 V
   When throttle is fully open : 4.2 ± 0.15 V

   If measured voltage is out of above specified range, diagnose trouble by referring to "Diagnostic Flow Chart for Diag. Trouble Code No."21" or "22".
   Also, check that voltage varies according to throttle valve opening linearly. If not, it is possible that TP sensor has failed. Replace.
3) Upon completion of checking, install ECM.

Removal

1) Disconnect battery negative cable at battery.
2) Disconnect coupler from TP sensor.
3) Remove TP sensor from throttle body.

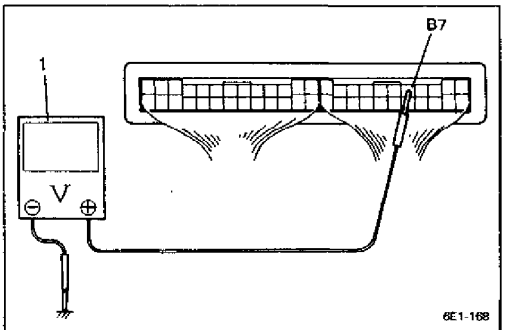


1. Throttle body
2. Throttle valve shaft
3. TP sensor
4. O-ring

6E1-167

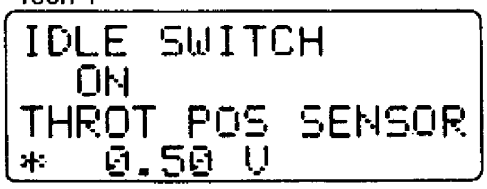
Installation

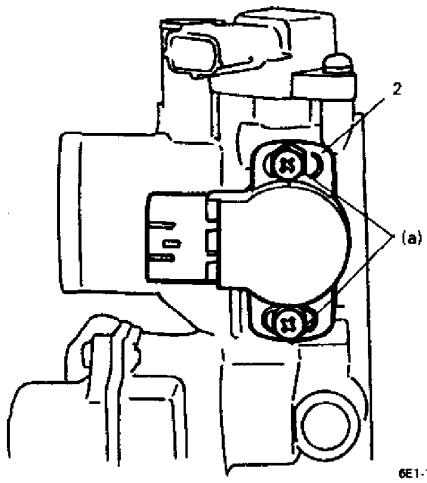
1) Install TP sensor to throttle valve shaft as the figure so as to be aligned to throttle valve shaft.
   Check O-ring for damage and replace if necessary.
2) Hand-tighten TP sensor bolts.
3) Connect coupler to TP sensor securely.
4) Connect battery negative cable to battery.
5) Adjust installation angle of TP sensor according to procedure described in item "Adjustment".



Voltmeter

Tech 1





1. Digital type voltmeter
2. TP sensor

Adjustment

1) Loosen TP sensor bolts.
2) Remove ECM as previously outlined and with couplers connected to ECM, connect digital type voltmeter as shown.
3) Turn TP sensor clockwise or counterclockwise and tighten TP sensor bolt at a position where voltage as specified below is obtained at coupler terminal B7.

NOTE:
If tech 1 and cartridge are available, it is not necessary to remove ECM. Make an adjustment by using tech 1 while observing TP sensor voltage.

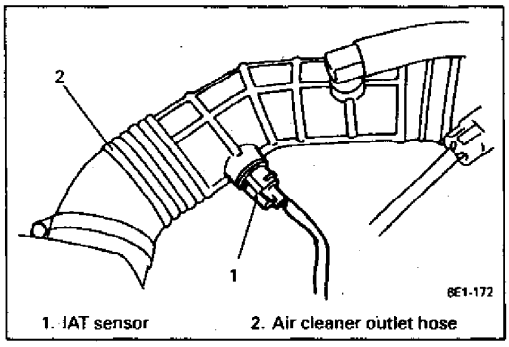
TP sensor voltage when throttle is fully close :
0.80 ± 0.025 V

Tightening Torque
(a): 3.5 N·m (0.35kg-m, 2.5 lb-ft)

4) Check to make sure that TP sensor voltage is as shown below when throttle is fully open.

TP sensor voltage when throttle is fully open :
4.2 ± 0.15 V

5) Install ECM.

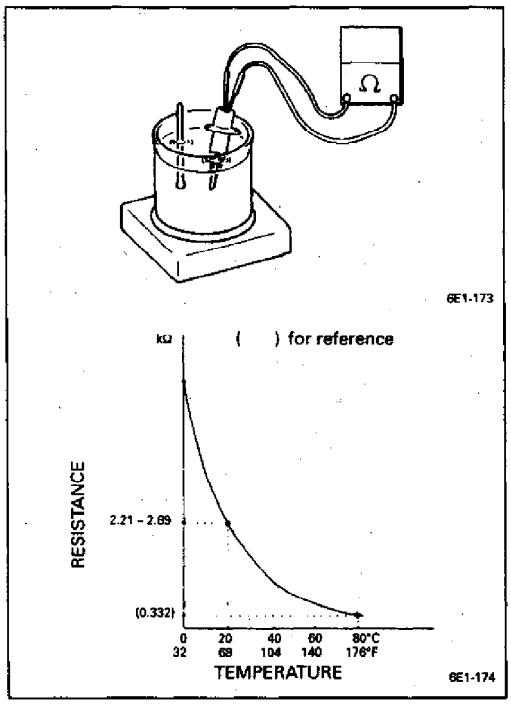


1. IAT sensor 2. Air cleaner outlet hose

INTAKE AIR TEMPERATURE SENSOR (IAT SENSOR)

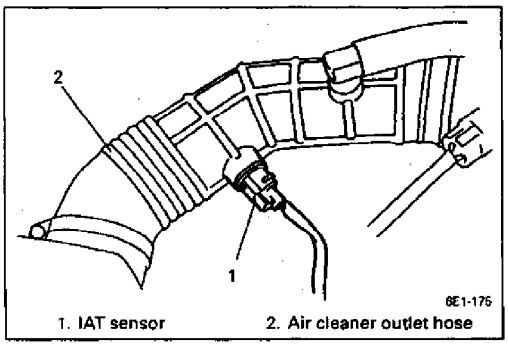
Removal

1) Disconnect battery negative cable at battery.
2) Disconnect coupler from IAT sensor.
3) Remove IAT sensor from air cleaner outlet hose.



Inspection

Immerse temperature sensing part of IAT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance doesn't show such characteristic as shown in left figure, replace IAT sensor.

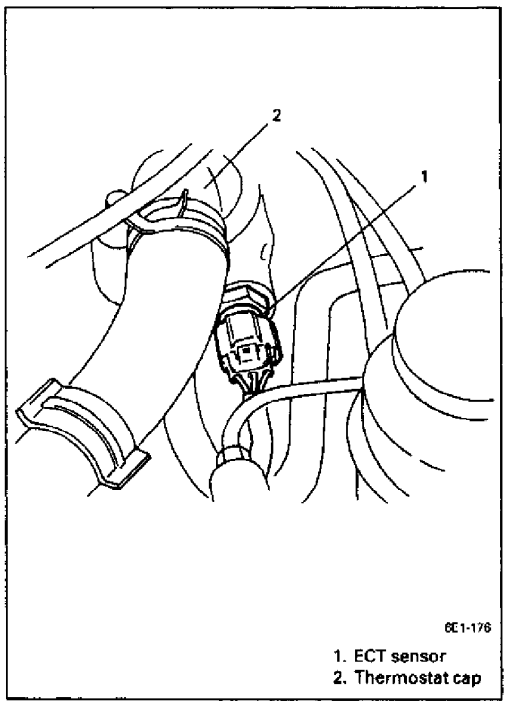


1. IAT sensor 2. Air cleaner outlet hose

Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of IAT sensor and air cleaner outlet hose.
- Connect IAT sensor coupler securely.



1. ECT sensor
2. Thermostat cap

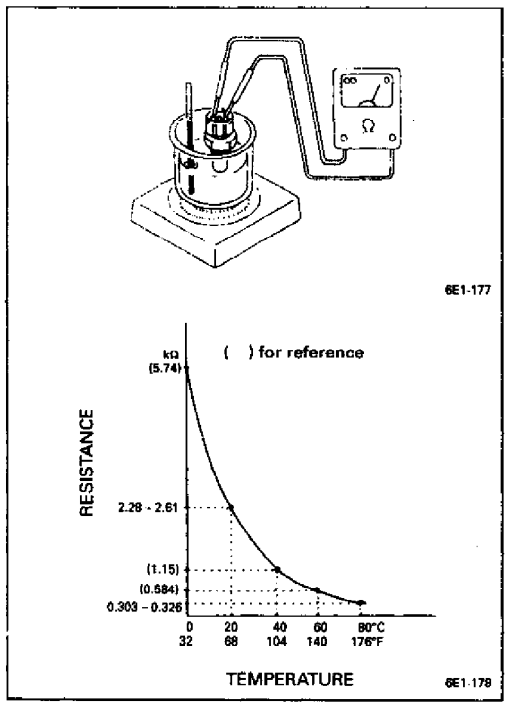
ENGINE COOLANT TEMPERATURE SENSOR (ECT SENSOR)

Removal

1) Disconnect battery negative cable at battery.
2) Drain coolant referring to Section 6B.

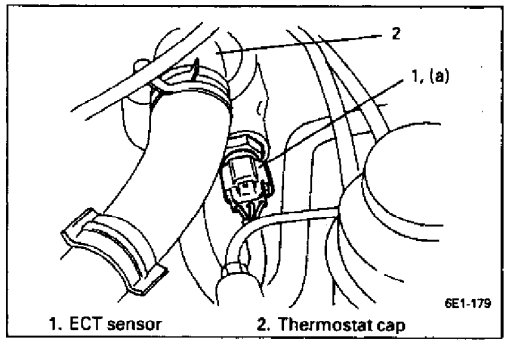
> **WARNING:**
> **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.**
> **Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.**

3) Disconnect coupler from ECT sensor.
4) Remove ECT sensor from in take manifold.



Inspection

Immerse temperature sensing part of ECT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance doesn't show such characteristic as shown in left figure, replace ECT sensor.



1. ECT sensor
2. Thermostat cap

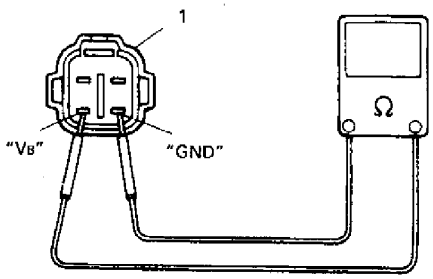
Installation

Reverse removal procedure noting the following

- Clean mating surfaces of ECT sensor and intake manifold.
- Check O-ring for damage and replace if necessary.
- Tighten ECT sensor to specified torque.

Tightening Torque
(a): 15 N·m (1.5 kg-m, 11.0 lb-ft)

- Connect coupler to ECT sensor securely.
- Refill coolant referring to Section 6B.



6E1-180
1. Viewed from terminal side

HEATED OXYGEN SENSOR

Oxygen Sensor Heater Inspection

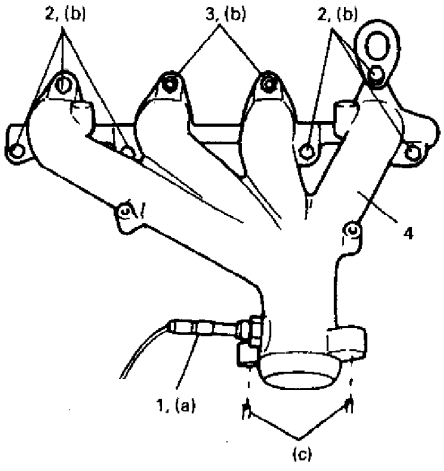
1) Disconnect sensor coupler.
2) Using ohmmeter, measure resistance between terminals "V_B" and "GND" of sensor coupler.

NOTE:
Temperature of sensor affects resistance value largely. Make sure that sensor heater is at correct temperature.

Resistance of oxygen sensor heater:
11.7 – 14.3 Ω at 20°C, 68°F

If found faulty, replace oxygen sensor.

3) Connect sensor coupler securely.



6E1-181
1. Heated oxygen sensor
2. Bolt
3. Nut
4. Exhaust manifold

Removal

WARNING:
To avoid danger of being burned, do not touch exhaust system when system is hot. Heated oxygen sensor removal should be performed when system is cool.

1) Disconnect negative cable from battery.
2) Disconnect coupler of heated oxygen sensor.
3) Remove exhaust manifold with heated oxygen sensor referring to Section 6A.
4) Remove heated oxygen sensor from exhaust manifold.

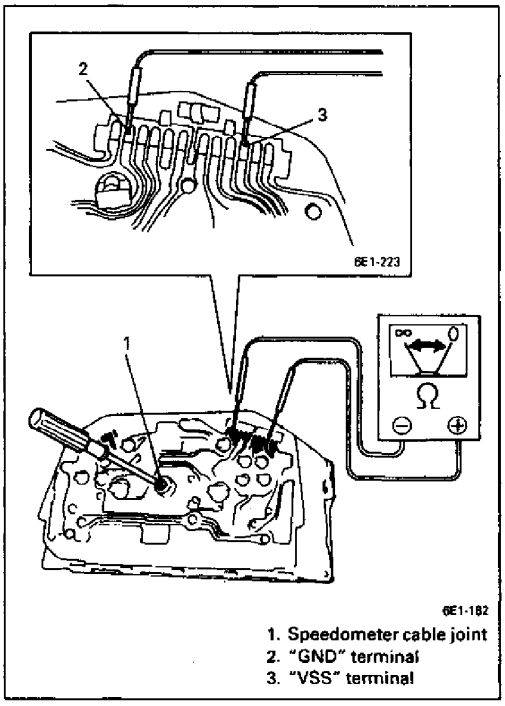
Installation

Reverse removal procedure noting the following.

- Tighten heated oxygen sensor, exhaust manifold bolts & nuts and exhaust pipe bolts to specified torque.

Tightening Torque
(a): 40 N·m (4.0 kg-m, 29.0 lb-ft)
(b): 23 N·m (2.3 kg-m, 17.0 lb-ft)
(c): 45 N·m (4.5 kg-m, 32.5 lb-ft)

- Connect coupler of heated oxygen sensor and clamp wire harness securely.
- After installing heated oxygen sensor, start engine and check that no exhaust gas leakage exists.

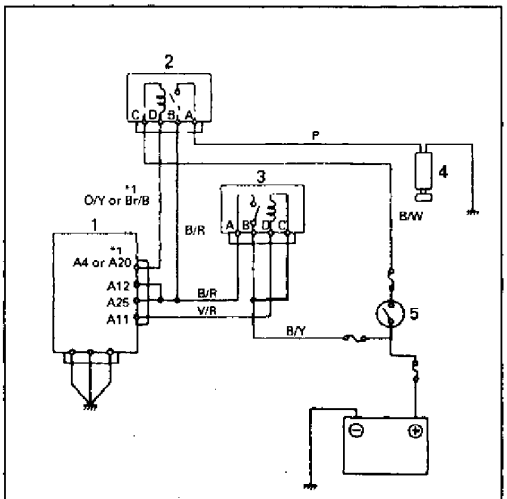


1. Speedometer cable joint
2. "GND" terminal
3. "VSS" terminal

VEHICLE SPEED SENSOR (VSS) <ONLY VEHICLE WITH M/T>

Inspection

1) Disconnect negative cable at battery.
2) Remove steering column upper cover.
3) Remove combination meter from instrument panel.
4) Connect ohmmeter between "VSS" terminal and "GND" terminal of combination meter and turn cable joint of speedometer with a screwdriver. Ohmmeter indicator should move back and forth between continuity and ∞ (infinity) 4 times while cable joint is turned one full revolution.
   Replace speedometer if check result is not satisfactory.
5) Install combination meter to instrument panel.
6) Install steering column upper cover.
7) Connect negative cable to battery.



1. ECM
2. Fuel pump relay
3. Main relay
4. Fuel pump
5. Ignition switch

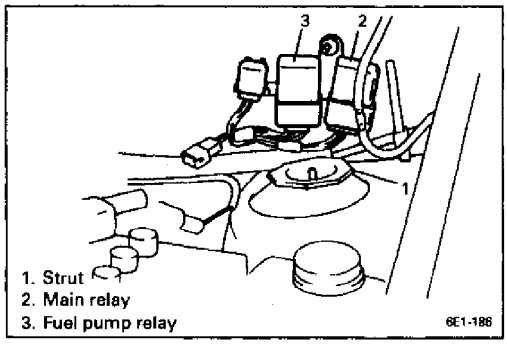
*1: Only vehicles with immobilizer control system

6E1-185

MAIN RELAY

NOTE:

Distinguish between main relay and fuel pump relay by wire colors.

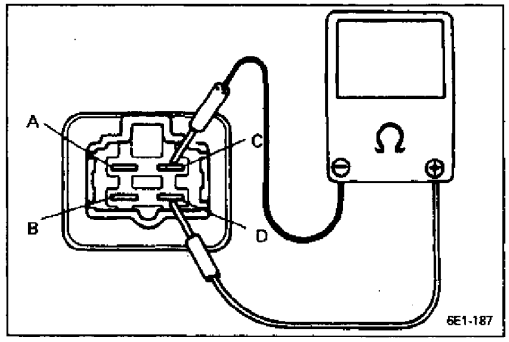


1. Strut
2. Main relay
3. Fuel pump relay

6E1-186

Inspection

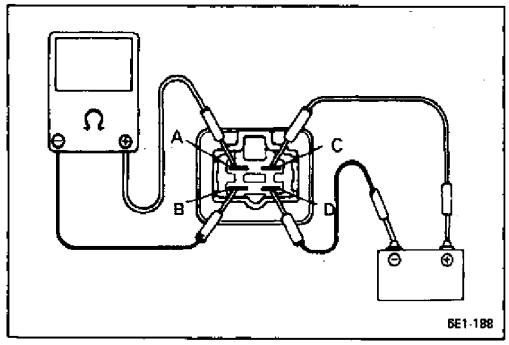
1) Disconnect negative cable at battery.
2) Remove main relay from bracket after disconnecting its coupler.



6E1-187

3) Check resistance between each two terminals as in table below.
   If check results are as specified, proceed to next operation check. If not, replace.

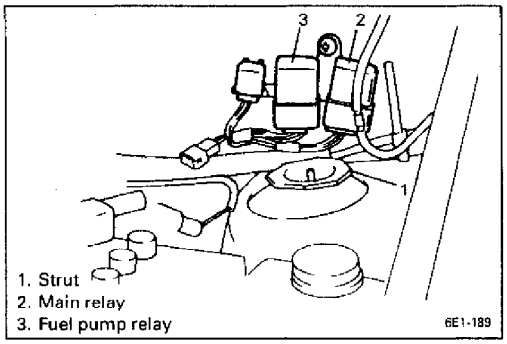
TERMINALS	RESISTANCE
Between A and B	∞ (infinity)
Between C and D	60 – 88 Ω



6E1-188

4) Check that there is continuity between terminals "A" and "B" when battery is connected to terminals "C" and "D".

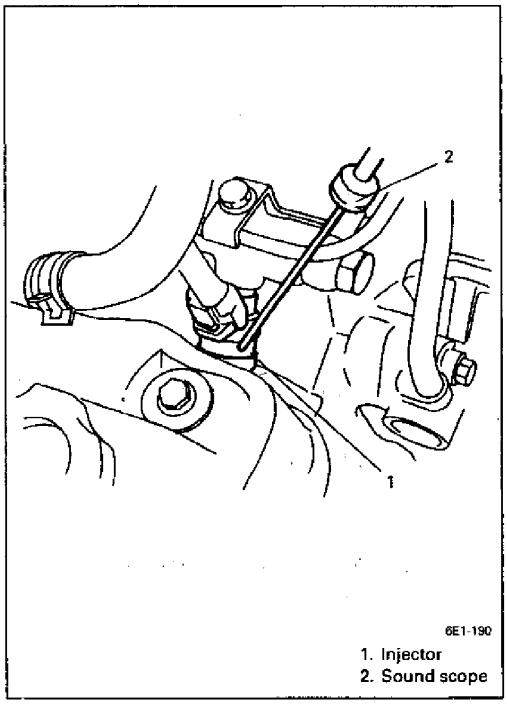
   If found defective, replace.



FUEL PUMP RELAY

Inspection

1) Remove fuel pump relay in the same way as main relay.
2) Structure of fuel pump relay is the same as that of main relay. Check its resistance and operation using the same procedure as that for main relay.
   If found defective, replace.



FUEL CUT OPERATION

Inspection

NOTE:
Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, select lever in "P" range) and that parking brake lever is pulled all the way up.

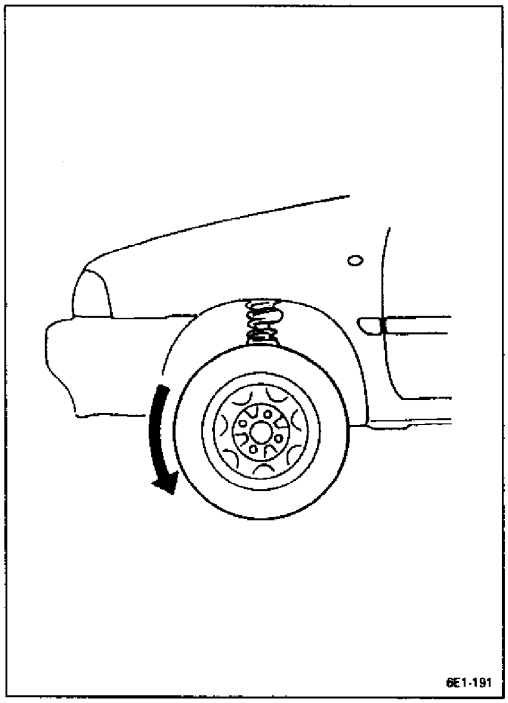
1) Warm up engine to normal operating temperature.
2) While listening to sound of injector by using sound scope or such, increase engine speed to higher than 1,800 r/min.
3) Check to make sure that sound to indicate operation of injector stops when throttle valve is closed instantly and it is heard again when engine speed is reduced to less than about 1,400 r/min.

EGR SYSTEM

NOTE:
Before inspecting EGR system, be sure to confirm the following.

- **Altitude is 7,810 ft, 2,380 m above sea level or lower and atmospheric pressure is 650 mmHg or higher.**
- **ECT sensor, TP sensor, vehicle speed sensor and MAP sensor are in good condition.**
- **Intake air temperature is 5°C (41°F) or higher.**

If even one of the above conditions do not apply, EGR valve don't operate.

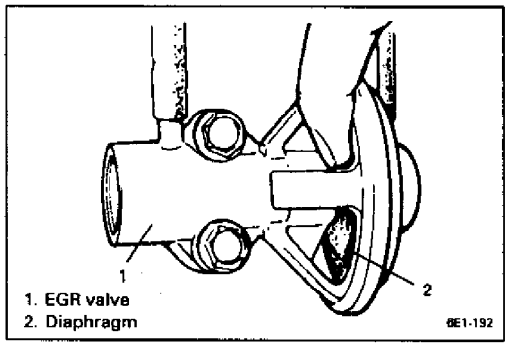


System Inspection

NOTE:
Before inspection, check to make sure that gear shift lever is in neutral position and that parking brake lever is pulled all the way up.

1) Hoist vehicle so that front wheels rotate freely.
2) Set M/T or A/T in "Neutral".
3) Start engine and check that front wheels are turning.
   If not, perform following check with one front wheel locked and the other turned by hand.

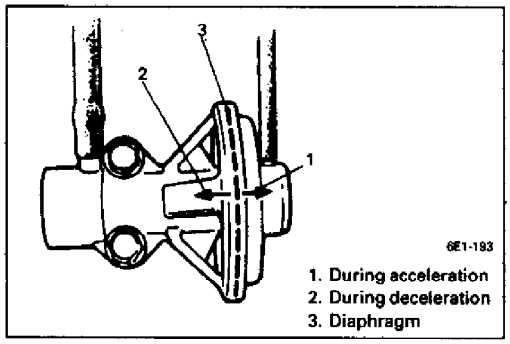
> **WARNING:**
> **Make sure that M/T is set to "Neutral" position for this check. If it is set to any other position, front tires will turn at high speed and a very dangerous situation may occurs.**



1. EGR valve
2. Diaphragm

4) When engine is cool, start engine and race it, and check that EGR valve diaphragm is not operating in this state, by touching diaphragm with finger.

> **CAUTION:**
> **If EGR valve is hot, it may be necessary to wear gloves to avoid burning fingers.**

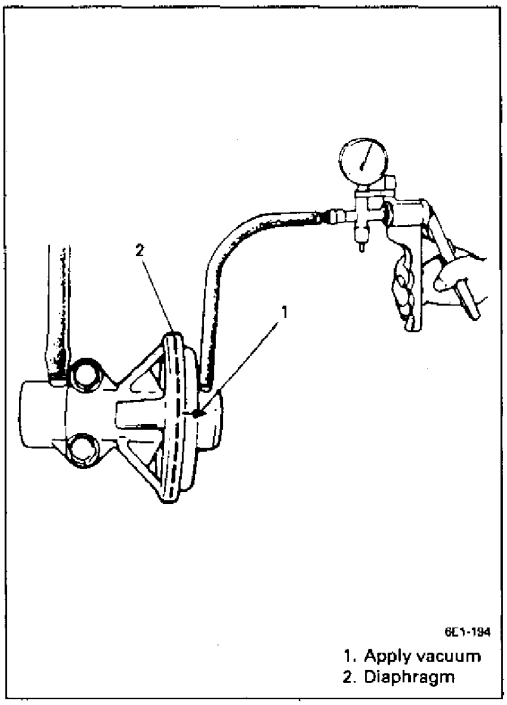


1. During acceleration
2. During deceleration
3. Diaphragm

5) Warm up engine to normal operating temperature and race it after warming up. Then check to be sure that diaphragm moves toward 1 in figure at the left during acceleration and toward 2 during deceleration.
   If EGR valve fails to operate properly, check vacuum hoses EGR valve, EGR pressure transducer, solenoid vacuum valve, wire harness and ECM.
6) Keep engine running at idle speed and open EGR valve by hand, and engine should either stop or reduce its speed.
   If neither occurs, EGR passage is clogged. Clean it.

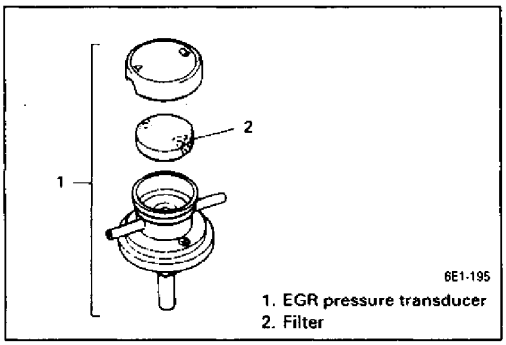
Vacuum Hose Inspection

Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.



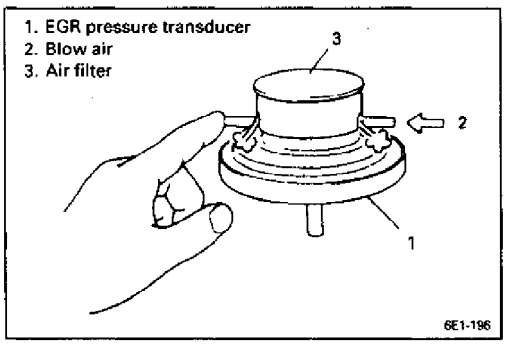
EGR Valve Inspection

1) Disconnect vacuum hose from EGR pressure transducer.
2) Connect vacuum pump gauge to its hose.
3) Check that EGR valve diaphragm moves smoothly and that it is held at the same position when 20 cmHg vacuum is applied to EGR valve.
   If diaphragm doesn't move smoothly, or it isn't held at the same position, replace EGR valve.
4) After checking, be sure to connect vacuum hose.

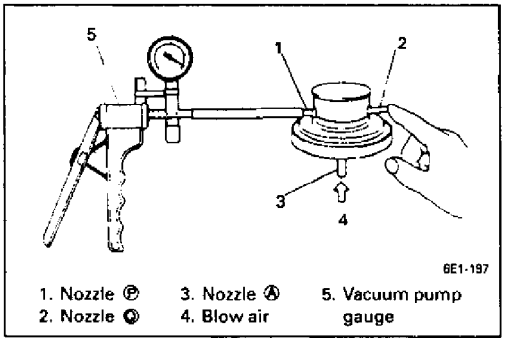


EGR Pressure Transducer Inspection

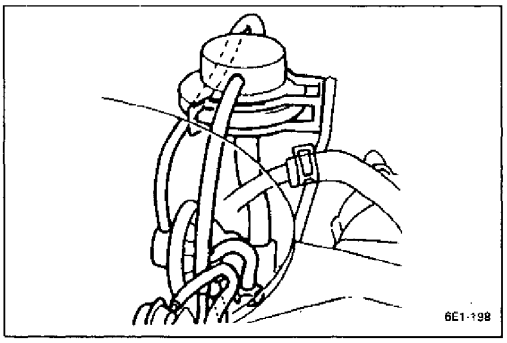
1) Check filter for contamination and damage.
   Using compressed air, clean filter.



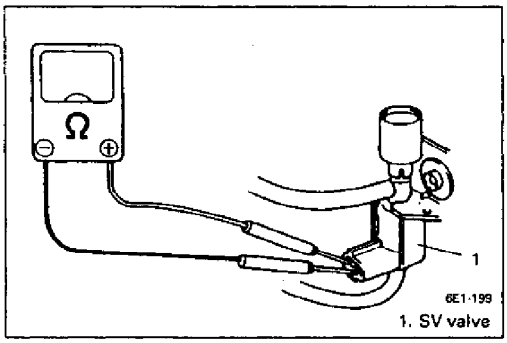
2) Remove EGR pressure transducer and plug nozzle with finger. Blow air into another nozzle and check that air passes through to air filter side freely.



3) Connect vacuum pump gauge to nozzle Ⓟ and plug nozzle Ⓠ with finger.
   While blowing air into nozzle Ⓐ, operate vacuum pump gauge and check that vacuum is applied to modulator.
   Then stop blowing nozzle Ⓐ and check that vacuum pump gauge indicates "0" (zero).
   If check result is not satisfactory, replace EGR pressure transducer.

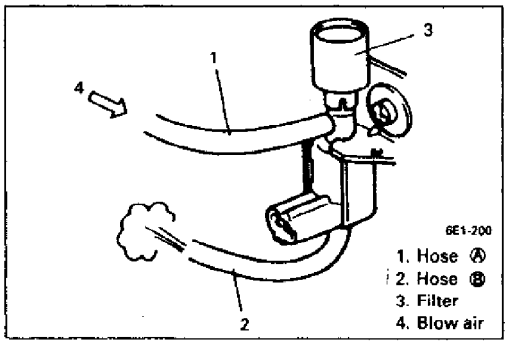


4) After checking, install pressure transducer and connect hoses securely. Refer to emission control information label for connection.

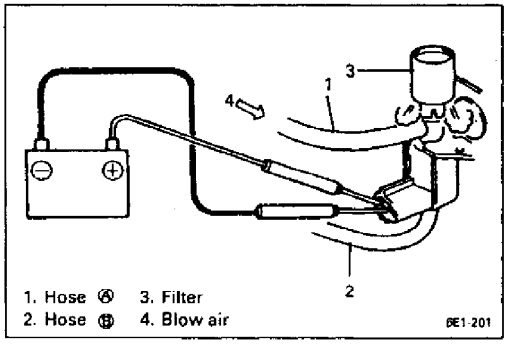


EGR Solenoid Vacuum Valve Inspection

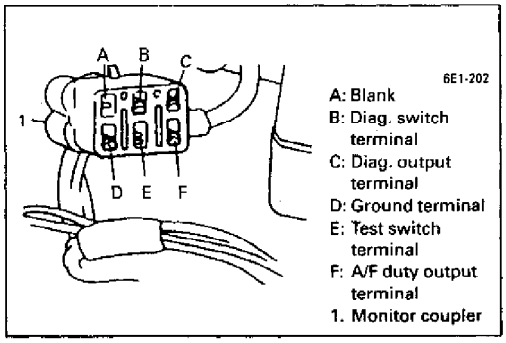
1) With ignition switch OFF, disconnect coupler from solenoid vacuum valve.
2) Check resistance between two terminals of solenoid vacuum valve.
   Resistance of EGR solenoid vacuum valve: 33 – 39 Ω
   If resistance is as specified, proceed to next operation check. If not, replace.



3) Disconnect vacuum hoses from EGR pressure transducer and vacuum pipe.
4) Blow into hose Ⓐ. Air should come out of hose Ⓑ and not out of filter.



5) Connect 12 V-battery to solenoid vacuum valve terminals. In this state, blow hose Ⓐ.
   Air should come out of filter and not out of hose Ⓑ.
   If check result is not as described above, replace solenoid vacuum valve.
6) Connect solenoid vacuum valve coupler securely.
7) Connect vacuum hoses securely.

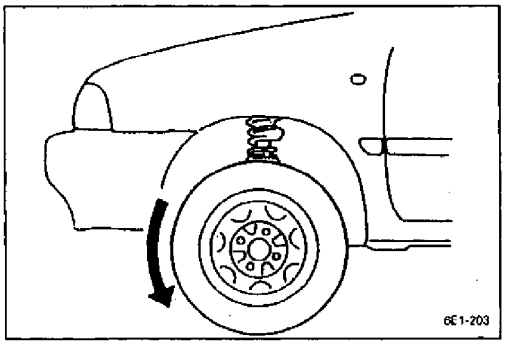


EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM

EVAP Canister Purge Inspection

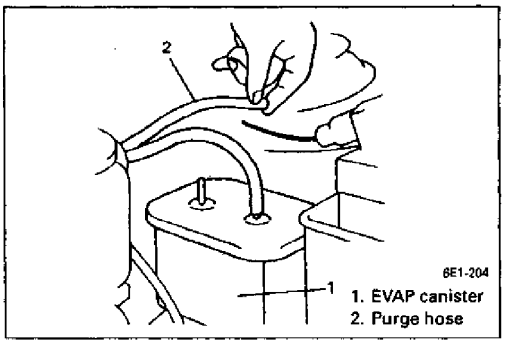
NOTE:
Before inspection, check to make sure that gear shift lever is in neutral position and that parking brake lever is pulled all the way up.

1) Warm up engine to normal operating temperature.
2) Remove monitor coupler from cap. Connect "D" and "E" terminals of monitor coupler by using service wire.



3) Hoist vehicle so that front wheels rotate freely.
4) Set M/T or A/T in "Neutral".
5) Start engine and check that front wheels are turning.
   If not, perform following check with one front wheel locked and the other turned by hand.

WARNING:
Make sure that M/T is set to "Neutral" position for this check. If it is set to any other position, front tires will turn at high speed and a very dangerous situation may occurs.



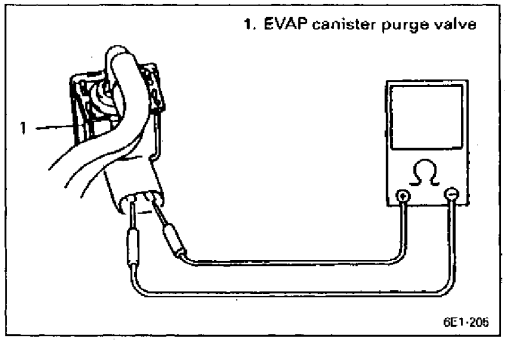
6) Disconnect purge hose from canister. Place finger against the end of disconnected hose as shown and check that vacuum is not felt there when engine is running at idle speed.
   Also check that vacuum is felt when engine speed is increased to higher than 1,500 r/min. by opening throttle valve.
   If check result is not satisfactory, check vacuum passage hoses, canister purge valve wire harness and ECM.

Vacuum Passage Inspection

Start engine and run it at idle speed. With finger placed against vacuum nozzle, check that vacuum is applied.
If it is not applied, clean vacuum passage by blowing compressed air.

Vacuum Hose Inspection

Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.

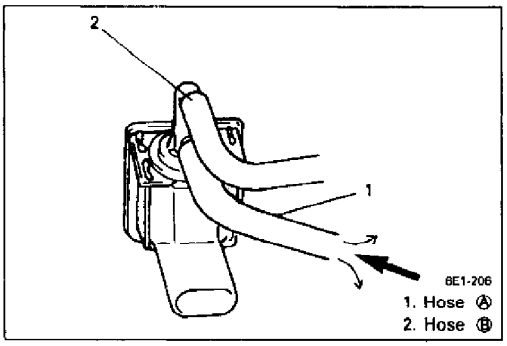


EVAP Canister Purge Valve Inspection

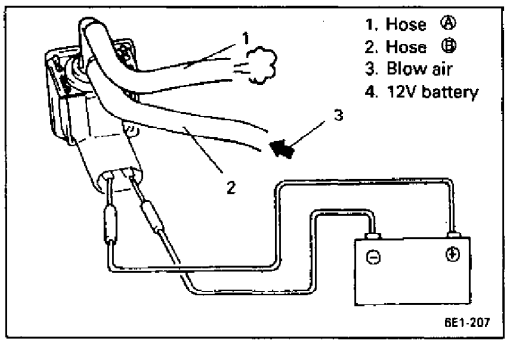
1) With ignition switch OFF, disconnect coupler from canister purge valve.
2) Check resistance between two terminals of canister purge valve.

Resistance of EVAP canister purge valve	33 – 39 Ω

If resistance is as specified, proceed to next operation check. If not, replace.



3) Disconnect vacuum hoses from intake manifold and canister.
4) With coupler disconnected, blow into hose Ⓐ. Air should not come out of hose Ⓑ.

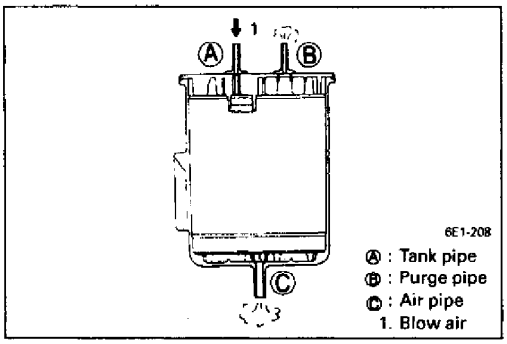


5) Connect 12V-battery to canister purge valve terminals. In this state, blow hose Ⓐ.
Air should come out of hose Ⓑ.

WARNING:
Do not suck the air through canister purge valve.
Fuel vapor inside canister purge valve is harmful.

If check result is not as described, replace canister purge valve.

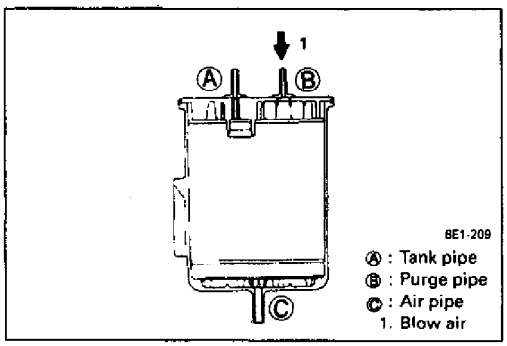
6) Connect vacuum hoses and canister purge valve coupler securely.



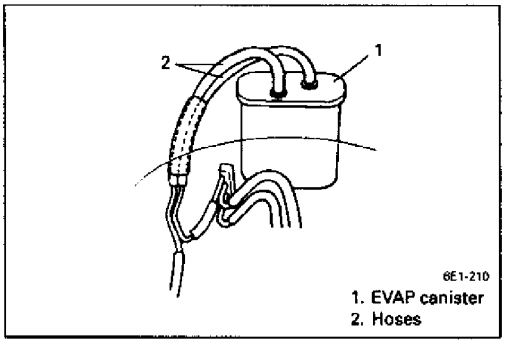
EVAP Canister Inspection

WARNING:
DO NOT SUCK nozzles on EVAP canister.
Fuel vapor inside EVAP canister is harmful.

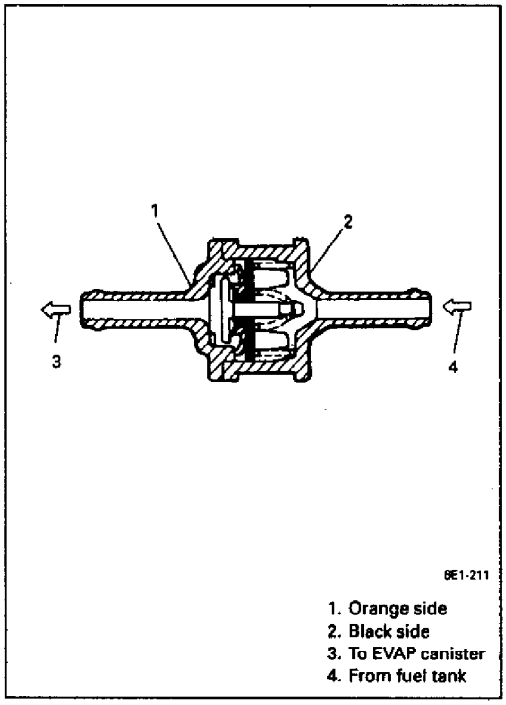
1) Disconnect vacuum hoses from canister.
2) When air is blown into pipe Ⓐ, there should be no restriction of flow through pipes Ⓑ and Ⓒ.



3) When air is blown into pipe Ⓑ, air should not pass through either pipe Ⓐ or Ⓒ.



4) If operation differs from above description, EVAP canister must be replaced.
5) Connect hoses to canister.



Tank Pressure Control Valve Inspection

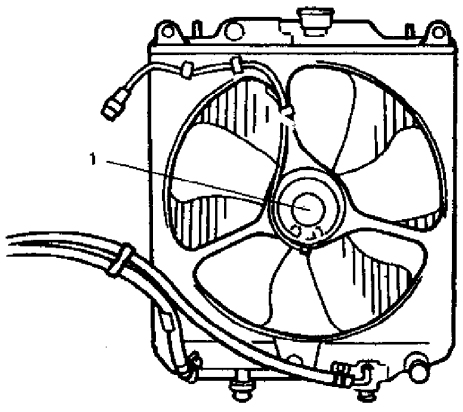
1) Remove fuel tank from body, refer to Section 6C.
2) Remove tank pressure control valve.
3) Air should pass through valve smoothly from fuel tank side (black side of check valve) to orange side when blown hard.
4) From orange side, even when blown softly, air should come out of black side.
5) If air doesn't pass through valve in Step 2) or hard blow is required in step 3), replace tank pressure control valve.

> **WARNING:**
> **DO NOT SUCK air through tank pressure control valve. Fuel vapor inside the valve is harmful.**

6) Install tank pressure control valve.

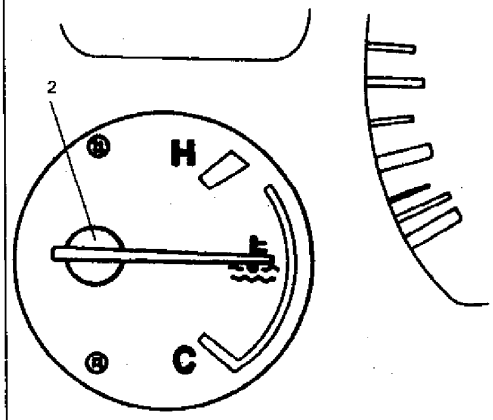
> **NOTE:**
> **When connecting tank pressure control valve between hoses, refer to left figure for installing direction.**

7) Install fuel tank to body, refer to Section 6C.



1. Radiator fan motor

6E1-212



2. Coolant temp. meter

6E1-213

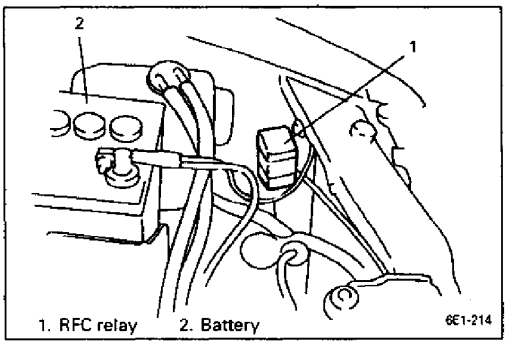
RADIATOR FAN CONTROL (RFC) SYSTEM

System Inspection

WARNING:
Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the "ON" position.

Start engine and keep it running to warm it up.
Now check to ensure that radiator fan is started when indicator of coolant temp. meter moves to as shown in figure.
If check result is not satisfactory, check RFC relay, wire harness, ECT sensor, ECM, coolant temp and meter.

Refer to "DIAGNOSTIC FLOW CHART B-7" of this section and "COOLANT TEMP AND METER INSPECTION" of SECTION 8.



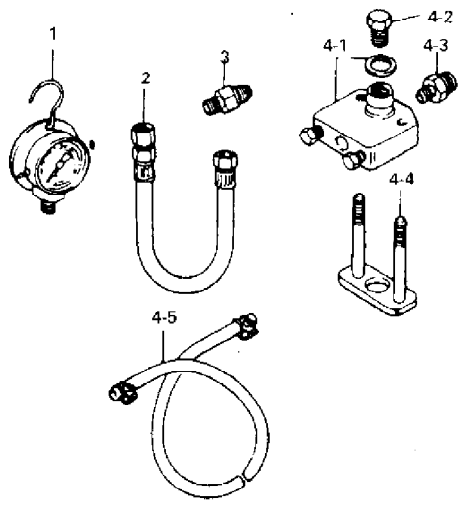
1. RFC relay 2. Battery

6E1-214

Radiator Fan Control Relay (RFC Relay) Inspection

1) Disconnect negative cable at battery.
2) Remove RFC relay.
3) Structure of RFC relay is the same as that of main relay. Check its resistance and operation using the same procedure as that for main relay. If found defective, replace.

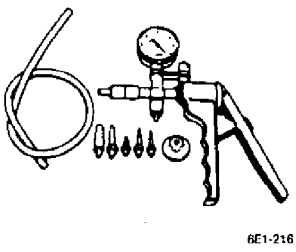
SPECIAL TOOLS



1. Pressure gauge
   09912-58441
2. Pressure hose
   09912-58431
3. Attachment
   09919-46010
4. Checking tool set
   09912-58421

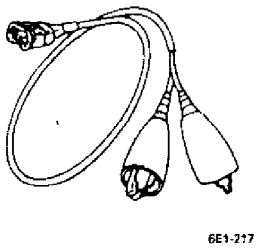
4-1. Tool body & washer
4-2. Body plug
4-3. Body attachment
4-4. Holder
4-5. Return hose & clamp

6E1 215



6E1-216

09917-47910
Vacuum pump gauge



6E1-217

09930-88530
Injector test lead

RECOMMENDED TORQUE SPECIFICATIONS

Fastening Parts	Tightening Torque		
	N·m	kg-m	lb-ft
Throttle body mounting bolt	10	1.0	7.2
Fuel delivery pipe plug bolt	30	3.0	21.7
Fuel pressure regulator bolt	10	1.0	7.2
Fuel delivery pipe bolt	30	3.0	21.7
TP sensor bolt	2.5	0.25	1.8
ECT sensor	15	1.5	11.0
Exhaust manifold bolt/nut	23	2.3	17.0
Exhaust pipe bolt	45	4.5	32.5
Heated oxygen sensor	40	4.0	29.0

SECTION 6F1

IGNITION SYSTEM

(FOR FUEL INJECTION MODEL)

NOTE:
For descriptions (items) not found in this section, refer to the same section of the Service manual mentioned in FOREWORD of this manual.

CONTENTS

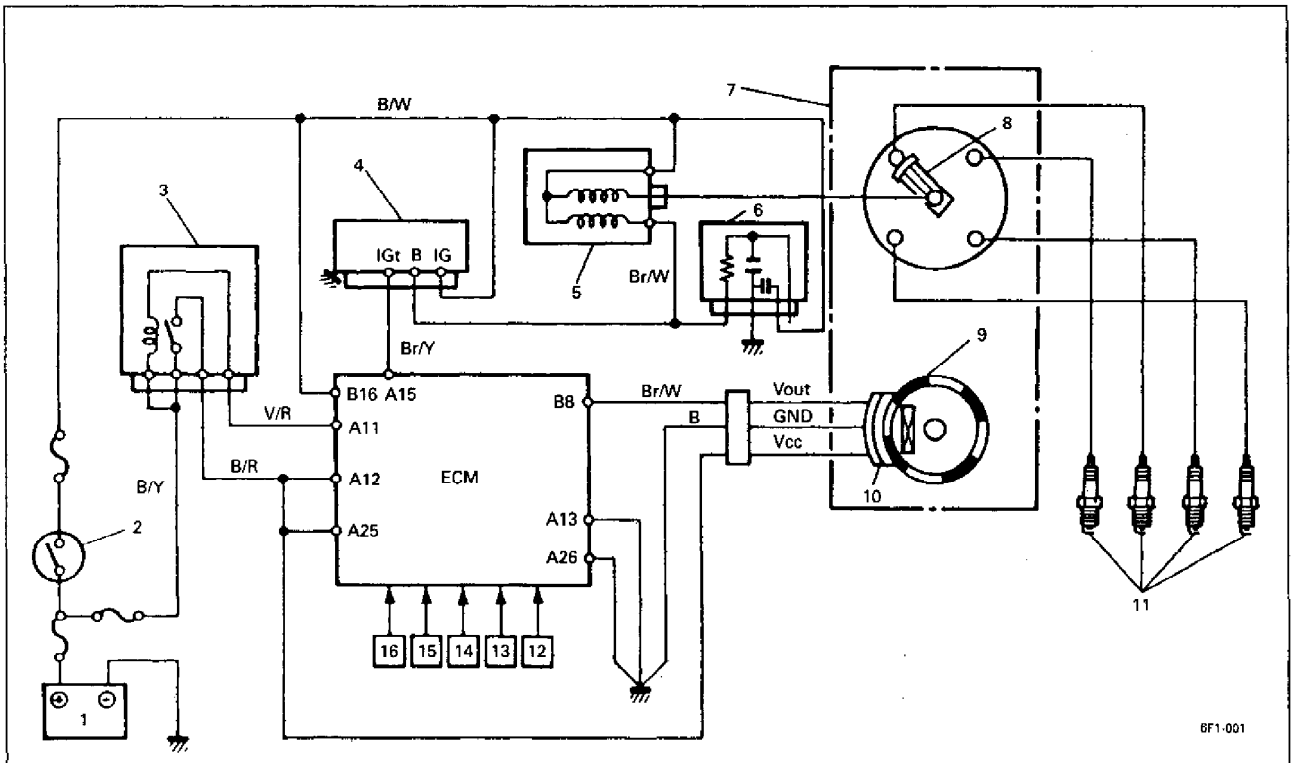
GENERAL DESCRIPTION

The ignition system used for this vehicle has an ESA (Electronic Spark Advance) system and consists of the following parts.

- ECM
  It detects the engine condition through the signals from the sensors, determines the most suitable ignition timing and time for electricity to flow to the primary coil and sends a signal to the igniter.
- Igniter (Power unit)
  It turns ON and OFF the primary current of the ignition coil according to the signal from ECM.
- Ignition coil
  When the ignition coil primary current is turned OFF, a high voltage is induced in the secondary winding.
- Distributor
  It distributes a high voltage current to each plug.
- High-tension cords and spark plugs.
- CMP sensor (Camshaft position sensor)
  Located in the distributor, it converts the crank angle into voltage variation and sends it to ECM. For its details, refer to Section 6E1.
- MAP sensor, TP sensor, ECT sensor and test switch terminal
  For their details, refer to Section 6E1.

In ESA system, the ECM is programmed for the best ignition timing under every engine condition. Receiving signals which indicate the engine condition from the sensors, e.g., engine revolution, intake air pressure, coolant temperature, etc., it selects the most suitable ignition timing from its memory and operates the igniter. Thus ignition timing is controlled to yield the best engine performance.

For more information, refer to Section 6E1.



1. Battery
2. Ignition switch
3. Main relay
4. Igniter
5. Ignition coil
6. Noise suppressor
7. Distributor
8. Distributor rotor
9. Signal rotor
10. CMP sensor
11. Spark plug
12. MAP sensor
13. TP sensor
14. ECT sensor
15. Engine start switch
16. Test switch terminal

DIAGNOSIS

Condition	Possible Cause	Correction
Engine cranks, but will not start or hard to start	**No spark**	
	• Blown fuse for ignition coil	Replace
	• Loose connection or disconnection of lead wire or high-tension cord (s)	Connect securely
	• Faulty high-tension cord (s)	Replace
	• Faulty spark plug (s)	Adjust, clean or replace
	• Cracked rotor or cap	Replace
	• Maladjusted signal rotor air gap	Adjust
	• Faulty ignition coil	Replace
	• Faulty noise suppressor	Replace
	• Faulty CMP sensor	Replace
	• Faulty igniter	Replace
	• Faulty ECM	Replace
	Maladjusted ignition timing	Adjust.
Poor fuel economy or engine performance	• Incorrect ignition timing	Adjust
	• Faulty spark plug (s) or high-tension cord (s)	Adjust, clean or replace
	• Faulty ECM	Replace

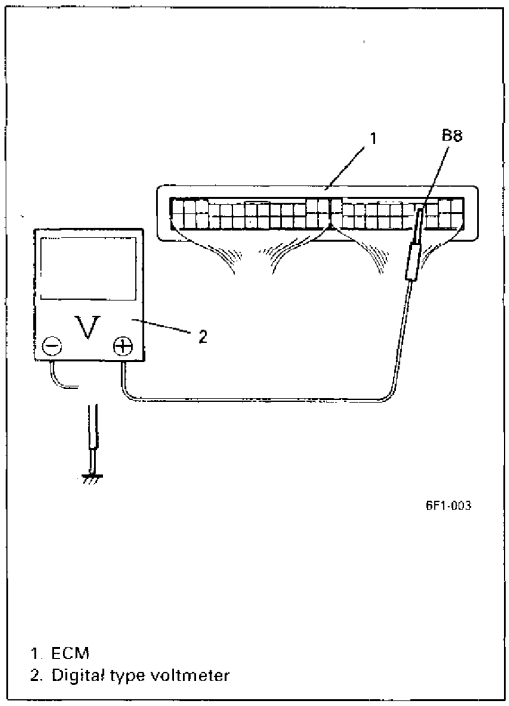
ON-BOARD DIAGNOSTIC SYSTEM (SELF-DIAGNOSIS)

1) To insure correct diagnosis, check to confirm that battery voltage is within standard value when engine is standstill.
2) Turn on ignition switch and make sure that malfunction indicator lamp ("CHECK ENGINE" light) lights.
3) If engine will not start but cranking is possible, crank it for more than 3 seconds.
4) While ignition switch is ON, ground diagnosis switch terminal in moniter coupler and then read diagnostic trouble code (observe malfunction indicator lamp ("CHECK ENGINE" light)).

DIAGNOSTIC TROUBLE CODE NO.42

6F1-007

ECM indicates that no CMP sensor signal is inputted for more that 3 seconds while engine is being cranked. Diagnose trouble according to "Diagnostic Flow Chart for Code No.42" in Section 6E1.



1. ECM
2. Digital type voltmeter

ON-VEHICLE SERVICE

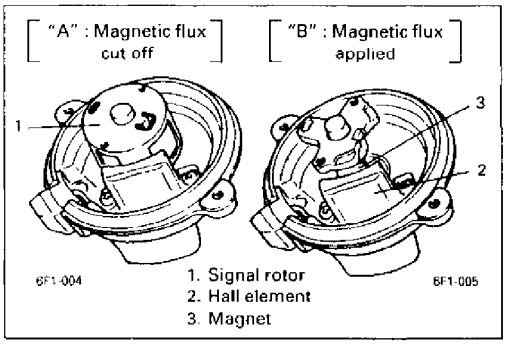
DISTRIBUTOR

Distributor Cap and Rotor

Check cap and rotor for crack and their terminals for corrosion and wear. Replace as necessary.

CMP Sensor

1) Remove distributor cap, rotor and shield cover.
2) Remove ECM, refer to ECM removal in SECTION 6E1.
3) Connect couplers to ECM securely.
4) Connect digital type voltmeter between B8 terminal and ground.



1. Signal rotor
2. Hall element
3. Magnet

NOTE:
Check to make sure that magnet is free from any metal particles.

4) Check voltage with signal rotor inserted between hall element and magnet ("A") and without it ("B") respectively.

"A"	0 – 1V
"B"	3 – 5 V

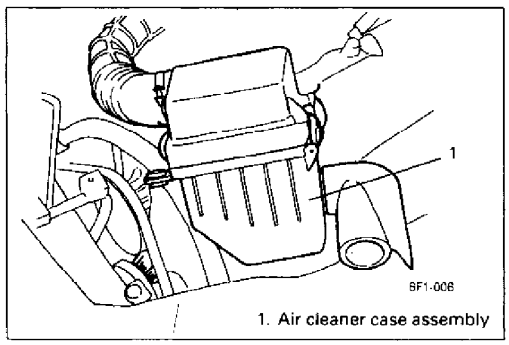
If check result is not satisfactory, repair wire harness or replace CMP sensor.

5) After checking, install ECM and distributor cap.

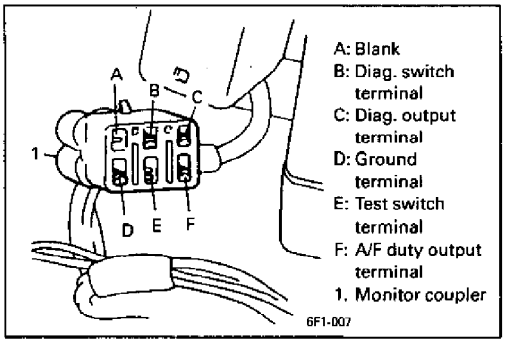
IGNITION TIMING

INSPECTION AND ADJUSTMENT

1) Start engine and warm it up to normal operating temperature.
2) Make sure that:
   - All of electrical loads except ignition are switched off.
   - A/C is OFF, if equipped.
   - M/T is set in neutral (A/T is set in "P" range).
   - Parking brake lever is pulled fully.
3) Check to be sure that idle speed is within specification.
4) Remove air cleaner case assembly from body.
5) Set timing light to No.1 high-tension cord.

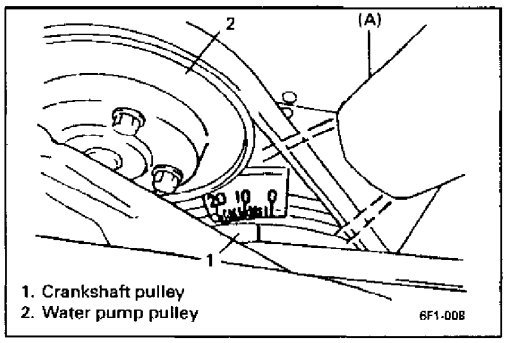


1. Air cleaner case assembly



6) Remove monitor coupler from cap. Connect "D" and "E" terminals of monitor coupler by using service wire so that ignition timing is fixed.

NOTE:
In this state, observe ignition timing with timing light. If it is varying (if it is not fixed), that indicates ungrounded "E" terminal which prevents accurate inspection and adjustment. Therefore, be sure to ground it securely.

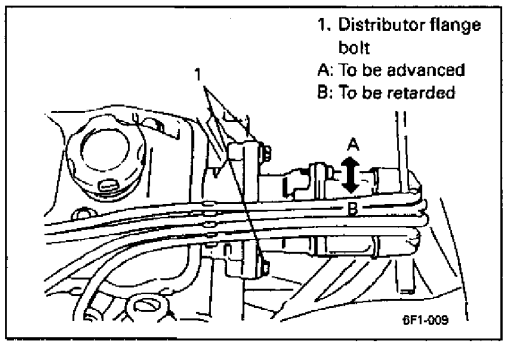


7) Using timing light, check that timing is within specification.

Initial ignition timing (Test switch terminal ground):
10° ± 1° BTDC at 800 r/min

Ignition order: 1 – 3 – 4 – 2

Special Tool
(A): 09900-27301 or 09900-76420



8) If ignition timing is out of specification, loosen flange bolt, adjust timing by turning distributor assembly while engine is running, and then tighten bolt.

Tightening Torque for distributor flange bolt
13 N·m (1.3 kg-m, 9.5 lb-ft)

9) After tightening distributor flange bolt, recheck that ignition timing is within specification.

10) After checking and/or adjusting, disconnect service wire from monitor coupler.

CAUTION:
Driving with test switch terminal grounded will cause damage to catalyst. Be sure to disconnect service wire after adjustment.

NOTE:
In this state, ignition timing may vary more or less of initial ignition timing but it is nothing abnormal.

11) Check that increasing engine speed advances ignition timing. If not, check TP sensor, test switch terminal circuit, engine start signal circuit and ECM.

SECTION 6G1

CRANKING SYSTEM

(0.9 kW Conventional Type, MITSUBISHI Make)

NOTE:
For cranking system (0.8 kW Conventional type, NIPPONDENSO make), refer to section 6G of the service manual mentioned in the FOREWORD of this manual.

CONTENTS

GENERAL DESCRIPTION

CRANKING CIRCUIT

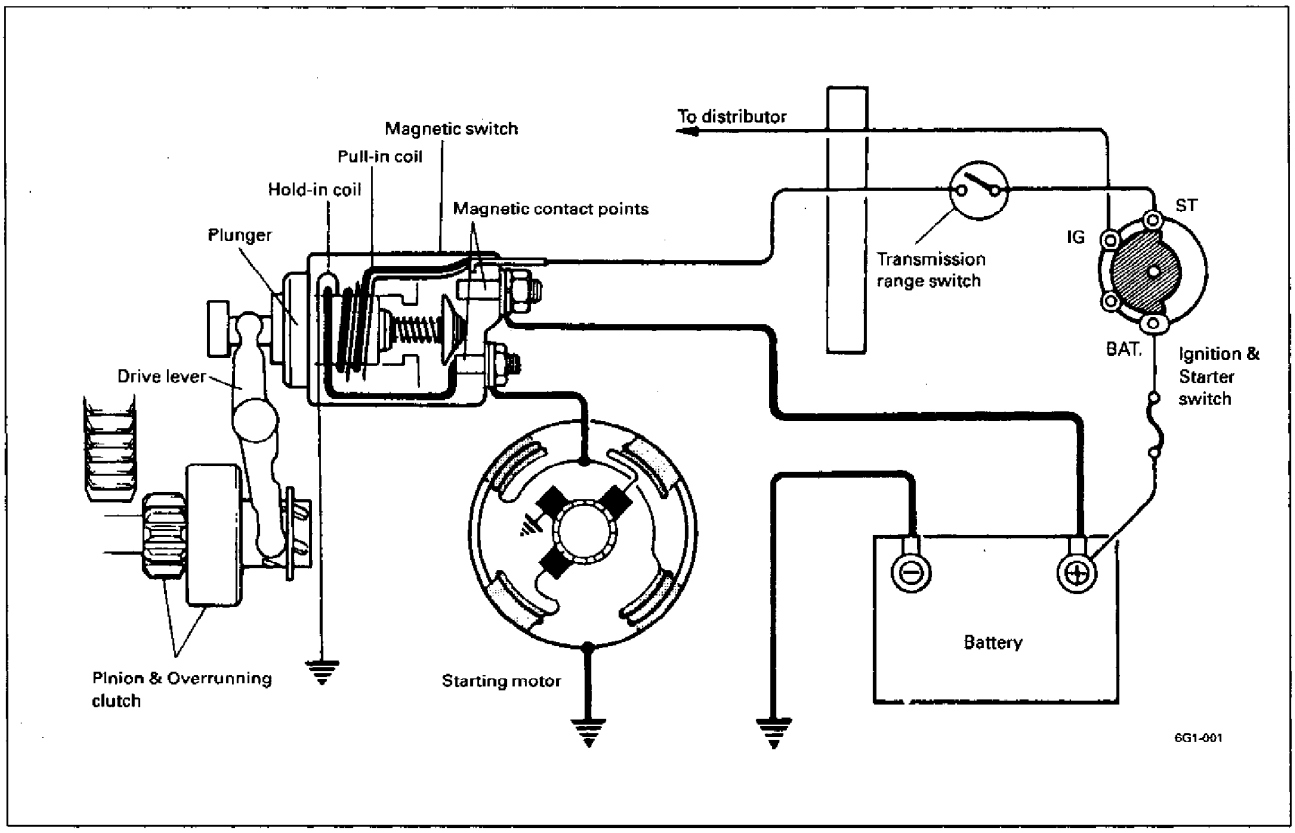
The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in figure below. Only the starting motor will be covered in this section.

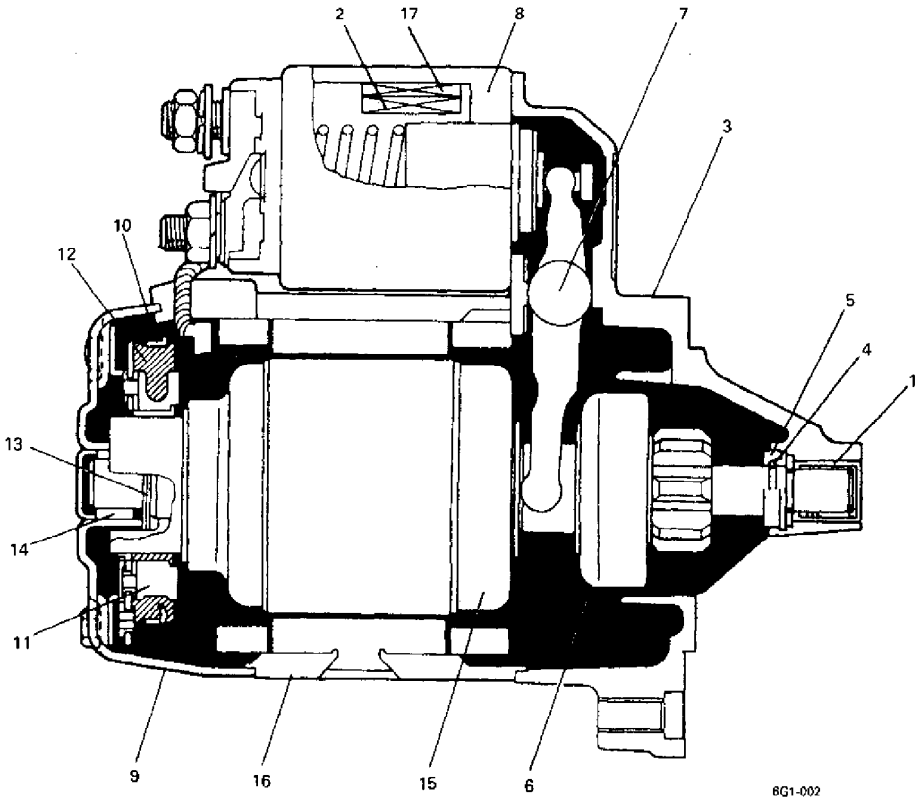
STARTING MOTOR

The starting motor consist of yoke assembly, armature assembly, overrunning clutch assembly, magnetic switch assembly, drive end frame (housing), rear end frame (commutator end housing), brush holder and drive lever.

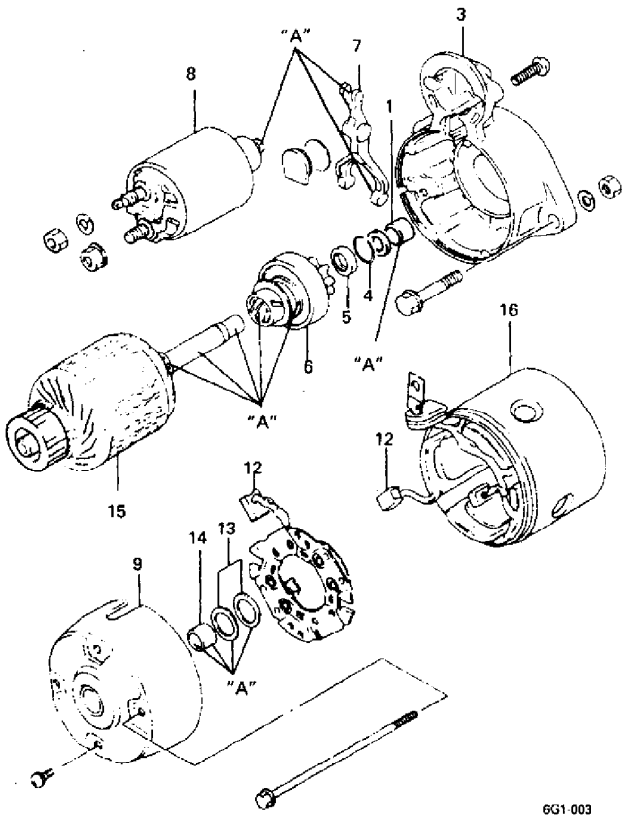
In the circuit shown in figure below, the magnetic switch coils are magnetized when the ignition switch is closed. The resulting plunger and drive lever movement causes the pinion to engage the engine flywheel gear and the magnetic contact points to close, and cranking takes place.

When the engine starts, the pinion overrunning clutch protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.





6G1-002



1. Needle bearing
2. Pull-in coil
3. Front housing
4. Ring
5. Stop ring
6. Overrunning clutch
7. Drive lever
8. Magnetic switch
9. Rear bracket
10. Brush spring
11. Brush holder
12. Brush
13. Washer
14. Rear bushing
15. Armature
16. Yoke
17. Hold-in coil

"A": Apply grease (99000-25010)

6G1-003

DIAGNOSIS

Possible symptoms due to starting system trouble would be as follows.

- Starting motor does not run (or runs slowly)
- Starting motor runs but fails to crank engine
- Abnormal noise is heard

Proper diagnosis must be made to determine exactly where the cause of each trouble lies ..... in battery, wiring harness, (including starting motor switch), starting motor or engine.

Do not remove motor just because starting motor does not run. Check following items and narrow down scope of possible causes.

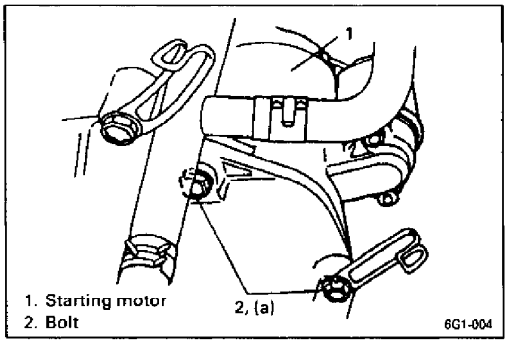
- Condition of trouble
- Tightness of battery terminals (including ground cable connection on engine side) and starting motor terminals
- Discharge of battery

Condition	Possible Cause	Correction
Motor not running	**No operating sound of magnetic switch**	
	1. Selector lever is not in P or N, or transmission range switch is not adjusted	Shift selector lever in P or N, or adjust transmission range switch
	2. Battery run down	Recharge battery.
	3. Battery voltage too low due to battery deterioration	Replace battery.
	4. Poor contact in battery terminal connection	Retighten or replace.
	5. Loose grounding cable connection	Retighten.
	6. Fuse set loose or blown off	Tighten or replace.
	7. Poor contacting action of ignition switch	Replace.
	8. Lead wire coupler loose in place	Retighten.
	9. Open-circuit between ignition switch and magnetic switch	Repair.
	10. Open-circuit in pull-in coil	Replace magnetic switch.
	11. Brushes are seating poorly or worn down	Repair or replace.
	12. Poor sliding of plunger	Replace.
Motor not running	**Operating sound of magnetic switch heard**	
	1. Battery run down	Recharge battery.
	2. Battery voltage too low due to battery deterioration	Replace battery.
	3. Loose battery cable connections	Retighten.
	4. Burnt magnetic contact points, or poor contacting action of magnetic switch	Replace magnetic switch.
	5. Brushes are seating poorly or worn down	Repair or replace.
	6. Weakened brush spring	Replace.
	7. Burnt commutator	Replace armature.
	8. Field coil grounding	Repair or replace yoke.
	9. Layer short-circuit of armature	Replace.
	10. Crankshaft rotation obstructed	Repair.

Condition	Possible Cause	Correction
Starting motor running but too slow (small torque)	**If battery and wiring are satisfactory, inspect starting motor**	
	1. Insufficient contact of magnetic contact points	Replace magnetic switch.
	2. Layer short-circuit of armature	Replace.
	3. Disconnected, burnt or worn commutator	Repair commutator or replace armature.
	4. Field coil open	Replace yoke.
	5. Worn brushes	Replace yoke or brush holder.
	6. Weakened brush springs	Replace spring
	7. Burnt or abnormally worn end bushing or needle bearing ,	Replace.
Starting motor running, but not cranking engine	1. Worn pinion tip	Replace overrunning clutch.
	2. Poor sliding of overrunning clutch	Replace.
	3. Overrunning clutch slipping	Replace.
	4. Worn teeth of ring gear	Replace flywheel.
Noise	1. Abnormally worn bushing or needle bearing	Replace.
	2. Worn pinion or worn teeth of ring gear	Replace pinion or flywheel.
	3. Poor sliding of pinion (failure in return movement)	Repair or replace.
	4. Lack of oil in each part	Lubricate.
Starting motor does not stop running	1. Sticky magnetic contact points	Replace magnetic switch.
	2. Short-circuit between turns of magnetic switch coil (layer short-circuit)	Replace magnetic switch.
	3. Failure of returning action in ignition switch	Replace.

UNIT REPAIR OVERHAUL

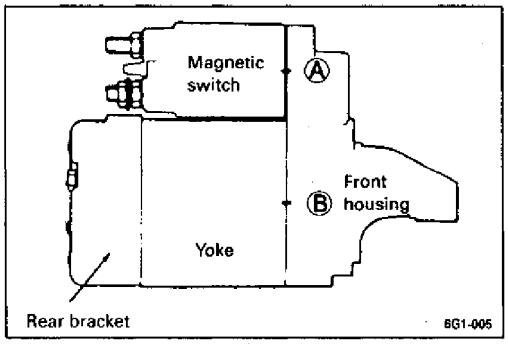
For overhauling of starting motor, it is recommended that component parts should be cleaned thoroughly. However, yoke assembly, armature coil, overrunning clutch assembly, magnetic switch assembly, rubber or plastic parts are NOT ALLOWED to be washed in degreasing tank or with grease dissolving solvent. Those parts should be cleaned by blowing air and wiping with cloth.



DISMOUNTING AND REMOUNTING

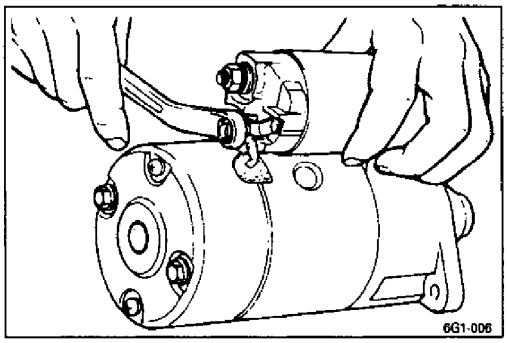
1. Disconnect negative (–) battery lead at battery.
2. Disconnect magnetic switch lead wire and battery cable from starting motor terminals.
3. Remove 2 mounting bolts.
4. Remove starting motor.
5. To remount, reverse above procedure.

Tightening Torque
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

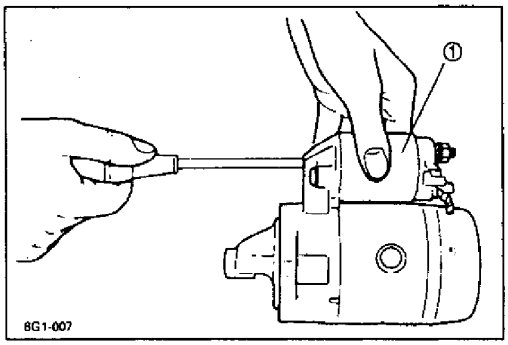


DISASSEMBLY

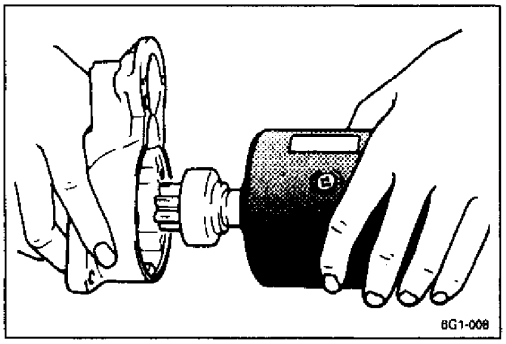
NOTE:
Before disassembling starting motor, be sure to put match marks at two locations (Ⓐ and Ⓑ) as shown in left figure so that any possible mistakes can be avoided.



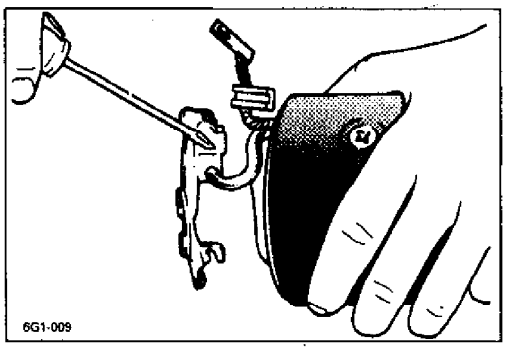
1) Remove nut securing the end of field coil lead to terminal on the head of magnetic switch.



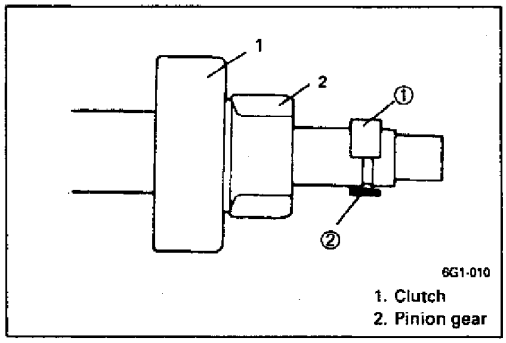
2) Take off magnetic switch ① from starting motor body by removing two mounting screws.



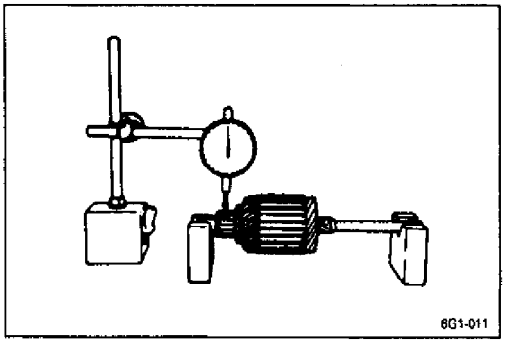
3) Loosen 2 bolts and 2 screws to remove rear bracket.
4) Separate front housing and armature from yoke.



5) Draw brushes out of holder.



6) Draw off overrunning clutch, as follows:
① Draw stop ring ① toward clutch side.
② Remove ring ② and slide off stop ring ① and clutch.



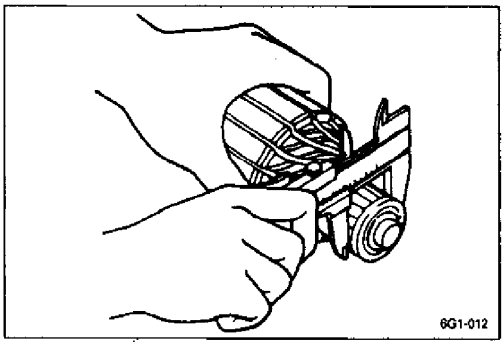
STARTING MOTOR INSPECTION

INSPECT COMMUTATOR

Check commutator for uneven wear. If deflection of dial gauge pointer exceeds limit, repair or replace.

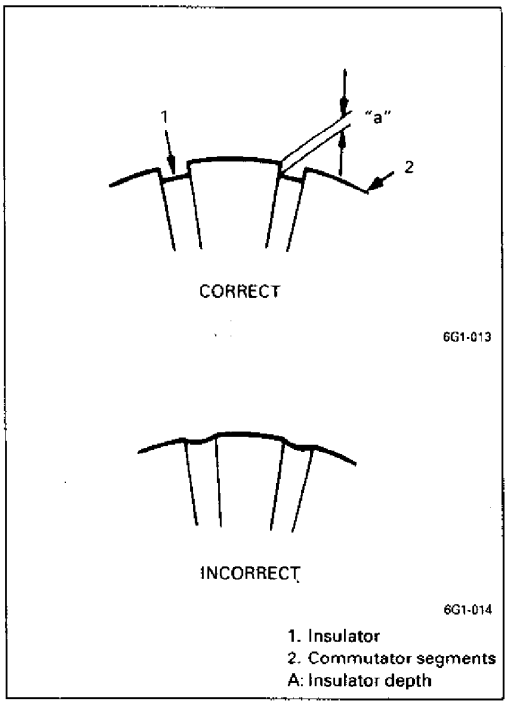
NOTE:
Below specification presupposes that armature is free from bend. Bent shaft must be replaced.

Commutator out of round
Standard : 0.05 mm (0.0019 in.) or less
Limit : 0.4 mm (0.015 in.)



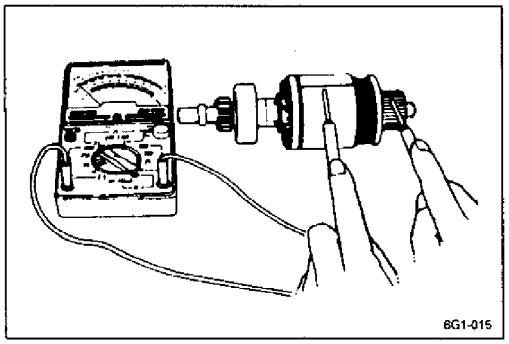
Inspect commutator for wear. If below limit, replace armature.

Commutator outside diameter
Standard : 32 mm (1.26 in.)
Limit : 31.4 mm (1.24 in.)

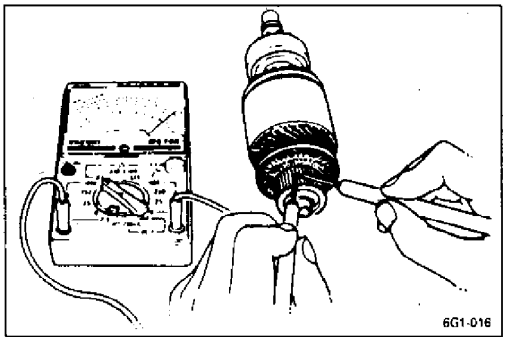


Inspect commutator for insulator depth. Correct or replace if below limit.

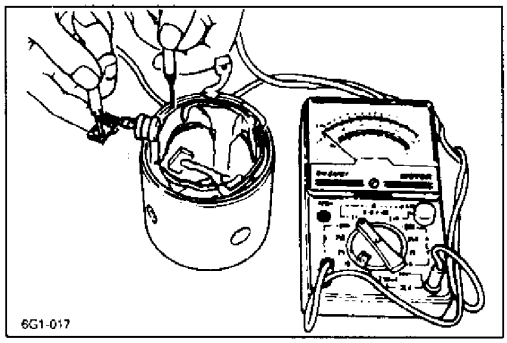
Commutator insulator depth "a"
Standard : 0.4 – 0.6 mm (0.015 – 0.023 in.)
Limit : 0.2 mm (0.0078 in.)



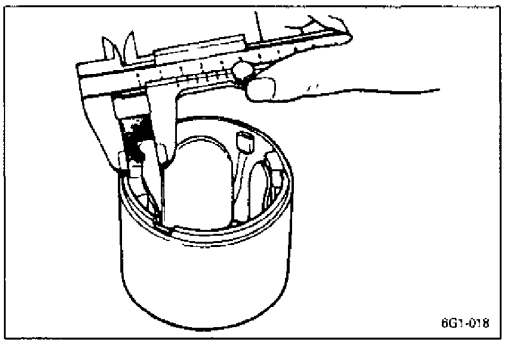
Ground Test
Check for continuity between commutator and armature core. If there is continuity, armature is grounded and must be replaced.



Open Circuit Test
Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and armature must be replaced.



INSPECT FIELD COIL
Ground Test
Check for continuity between brush and bare surface. If there is continuity, field windings are grounded. The yoke must be replaced.

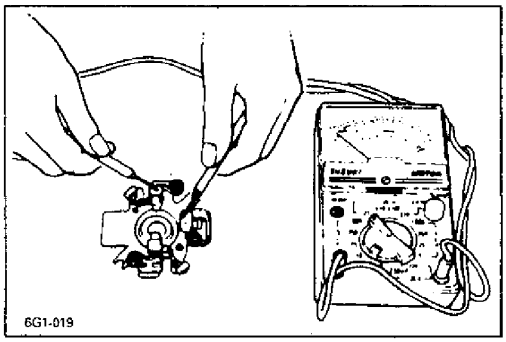


INSPECT BRUSH

Check brushes for wear. If below limit, replace brush.

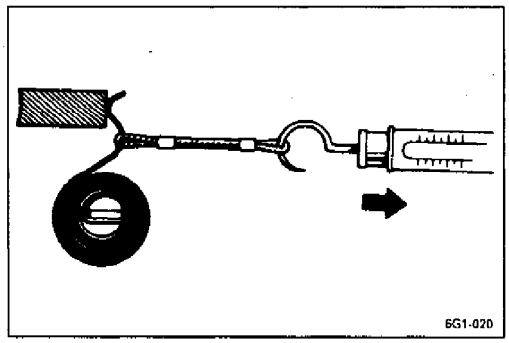
Brush length

Standard : 17 mm (0.67 in.)
Limit :11.5 mm (0.45 in.)



INSPECT BRUSH HOLDER AND SPRING

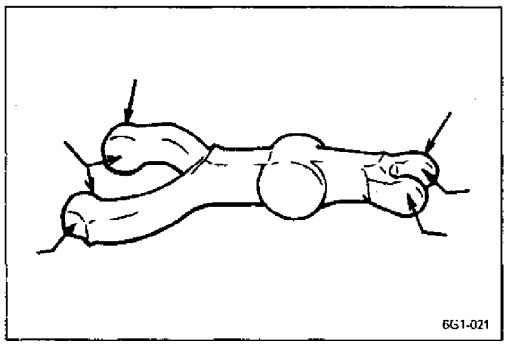
Check movement of brush in brush holder. If brush movement within brush holder is sluggish, check brush holder for distortion and sliding faces for contamination.
Clean or correct as necessary.
Check for continuity across insulated brush holder (positive side) and grounded brush holder (negative side).
If continuity exists, brush holder is grounded due to defective insulation and should be replaced.



Inspect brush spring for wear, damage or other abnormal conditions. Replace if necessary.

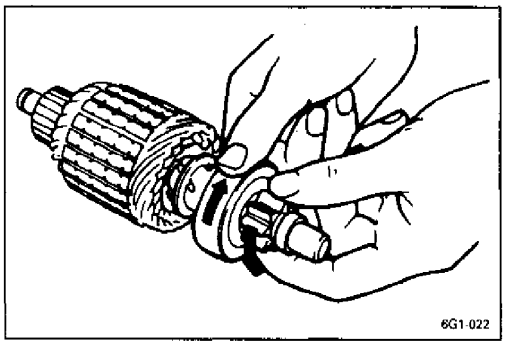
Brush spring tension

Standard : 1.95 kg (4.3 lb.)
Limit : 0.9 kg (1.98 lb.)



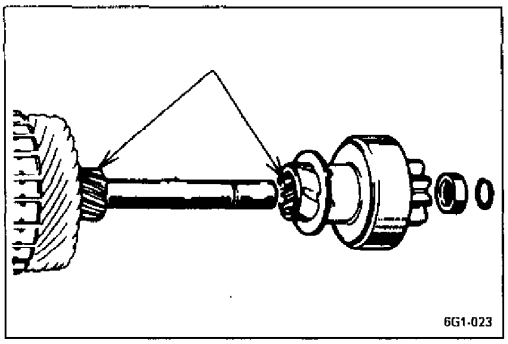
INSPECT DRIVE LEVER

Inspect drive lever for wear. Replace if necessary.

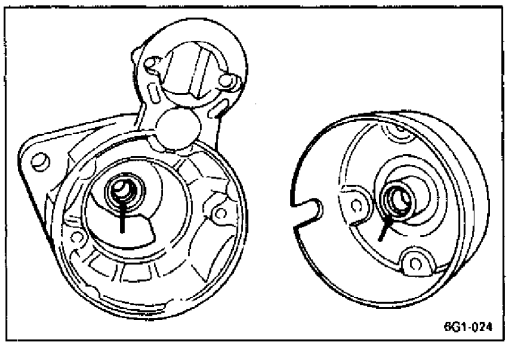


INSPECT PINION

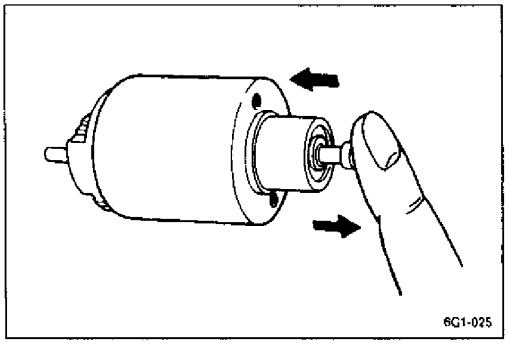
Inspect pinion for wear, damage or other abnormal conditions.
Check that clutch locks up when turned in direction of drive and rotates smoothly in reverse direction. Replace if necessary.



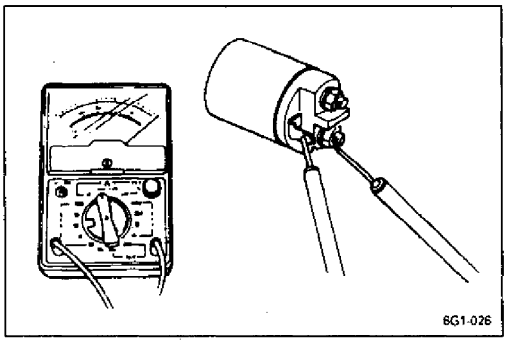
Inspect spline teeth for wear or damage. Replace if necessary.
Inspect pinion for smooth movement.



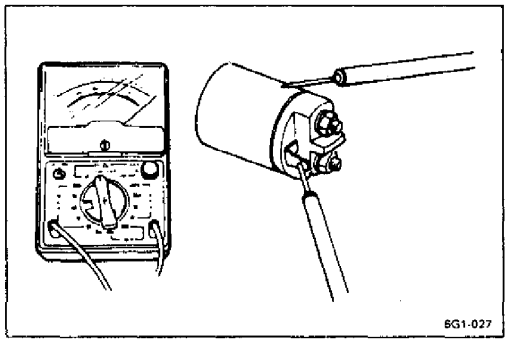
INSPECT BUSHING AND BEARING
Inspect bushing and needle bearing for wear or damage. Replace if necessary.



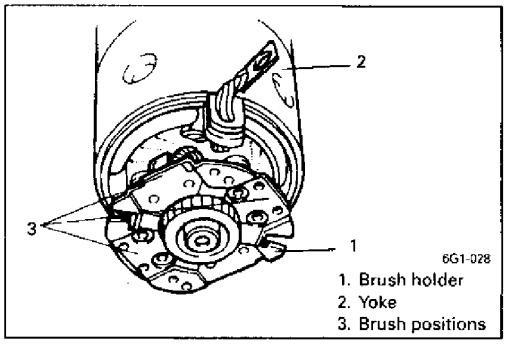
INSPECT MAGNETIC SWITCH
Push in plunger and release it. The plunger should return quickly to its original position. Replace if necessary.



Pull-in Coil Open Circuit Test
Check for continuity across magnetic switch "S" terminal and "M" terminal. If no continuity exists, the coil is open and should be replaced.



Hold-in Coil Open Circuit Test
Check for continuity across magnetic switch "S" terminal and coil case. If no continuity exists, the coil is open and should be replaced.



1. Brush holder
2. Yoke
3. Brush positions

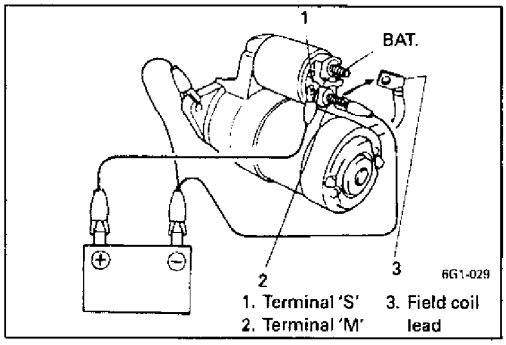
REASSEMBLY

Reverse disassembly procedure, using care on following points.

- When installing pinion drive lever, refer to figure in page 6G1-3 for its installation direction.
- When installing brush holder, be careful of brush position.

PERFORMANCE TEST

CAUTION:
Each test must be performed within 3 – 5 seconds to avoid coil from burning.

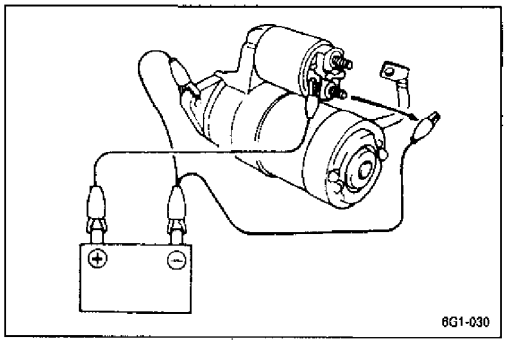


1. Terminal 'S'
2. Terminal 'M'
3. Field coil lead

PULL-IN TEST

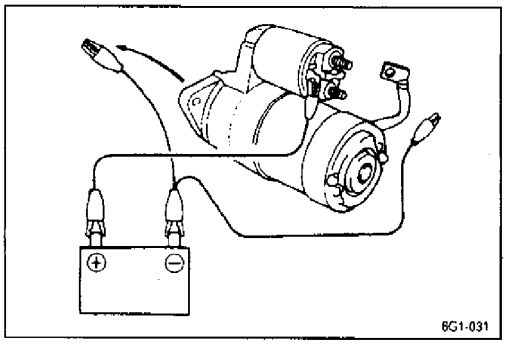
Connect test leads as shown and check that pinion (overrunning clutch) moves outward. If it does not, replace magnetic switch.

NOTE:
Before testing, disconnect field coil lead from terminal M.



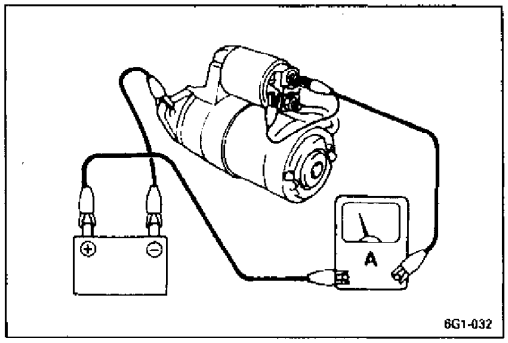
HOLD-IN TEST

While connected as the above with pinion out, disconnect negative lead from terminal M and check that pinion remains out. If not, replace magnetic switch.



PINION (PLUNGER) RETURN TEST

As a next step to the above, disconnect negative lead and check to make sure that pinion returns inward quickly.



NO-LOAD PERFORMANCE TEST

Connect test leads (proper starting motor cables) as follows and check that motor runs without fail with pinion moved out.

Also check that ammeter indicates specified current.

No load current: Within 60A at 11.5V

SPECIFICATIONS

Voltage	12 volts
Output	0.9 kW
Rating	30 seconds
Direction of rotation	Clockwise as viewed from pinion side
Brush length	17 mm (0.67 in.)
Number of pinion teeth	8
No-load characteristic	60 A maximum at 11.5 volts, 6,200 r/min minimum
Load characteristic	150 A maximum at 9 volts, 3.3 N·m (0.33 kg-m) torque and 1,550 r/min minimum
Locked characteristic	470 A maximum at 5 volts, 11.0 N·m (1.10 kg-m) minimum
Magnetic switch operating voltage	8 volts maximum

REQUIRED SERVICE MATERIAL

MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	Refer to page 6G1-3.

SECTION 6J

EMISSION CONTROLS

NOTE:
For the descriptions (items) not found in this section of this manual, refer to the same section of service manual mentioned in the FOREWORD of this manual.

CONTENTS

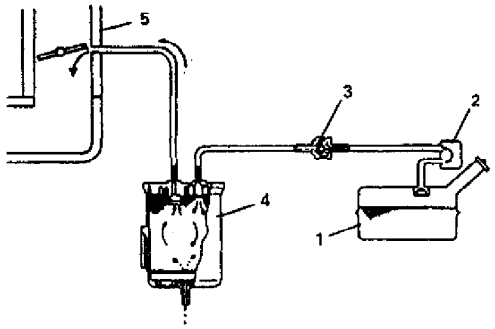
GENERAL DESCRIPTION

EVAPORATIVE EMISSION CONTROL SYSTEM (CARBURETOR MODEL, IF EQUIPPED)

An evaporative emission control system is used to prevent emission of fuel vapor.
The vapor generated in the fuel tank while driving or the engine at a stop passes through a tank pressure control valve and enters the EVAP canister where the charcoal absorbs and stores the fuel vapor.
Only when the following conditions are all satisfied, fuel vapor in the EVAP canister is sucked into throttle body together with fresh air.

- Engine is running
- Throttle valve opens larger than idle position.

In this state, the EVAP canister is purged or cleaned by air drawn through the filter at the bottom of the EVAP canister.
The tank pressure control valve is provided to keep the pressure in the fuel tank constant. When the pressure in the fuel tank becomes positive and reaches its specified value, it opens the valve to let the vapor flow into the EVAP canister. On the other hand, when the pressure in the fuel tank becomes negative and reaches its specified value, it opens the valve to let the air flow into the fuel tank.



1. Fuel tank
2. Liquid vapor separator
3. Tank pressure control valve
4. EVAP canister
5. Carburetor

ON-VEHICLE SERVICE

EVAPORATIVE EMISSION CONTROL SYSTEM (CARBURETOR MODEL, IF EQUIPPED)

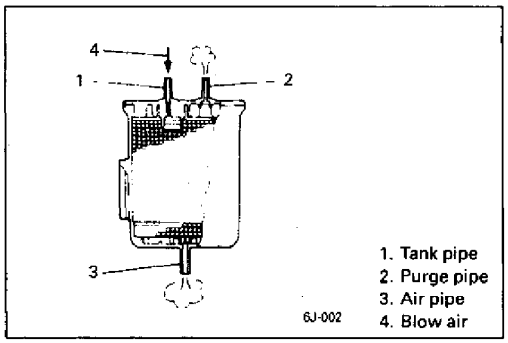
Vacuum Hoses

Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.

EVAP Canister Inspection

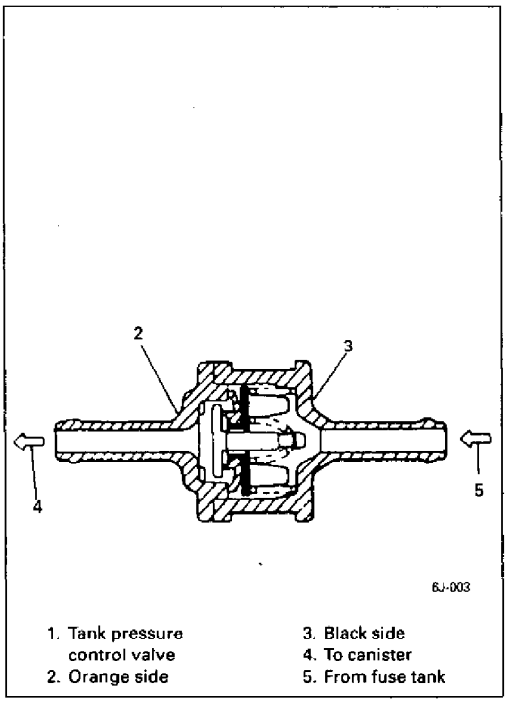
WARNING:
DO NOT SUCK nozzles on EVAP canister. Fuel vapor inside EVAP canister is harmful.

1) Disconnect vacuum hoses from EVAP canister.



1. Tank pipe
2. Purge pipe
3. Air pipe
4. Blow air

2) When air is blown into tank pipe, there should be no restriction of flow through purge pipe and air pipe.
3) If operation differs from above description, EVAP canister must be replaced.
4) Connect hoses to canister.



1. Tank pressure control valve
2. Orange side
3. Black side
4. To canister
5. From fuse tank

Tank Pressure Control Valve Inspection

1) Remove tank pressure control valve.
2) Air should pass through valve smoothly from fuel tank side (black side of tank pressure control valve) to orange side when blown hard.
3) From orange side, even when blown softly, air should come out of black side.
4) If air doesn't pass through valve in step 2) or hard blow is required in step 3), replace tank pressure control valve.

WARNING:
DO NOT SUCK air through tank pressure control valve. Fuel vapor inside the valve is harmful.

5) Install tank pressure control valve.

NOTE:
When connecting tank pressure control valve between hoses, refer to figure at the left for installing direction.

SECTION 7B

AUTOMATIC TRANSMISSION

CONTENTS

GENERAL DESCRIPTION

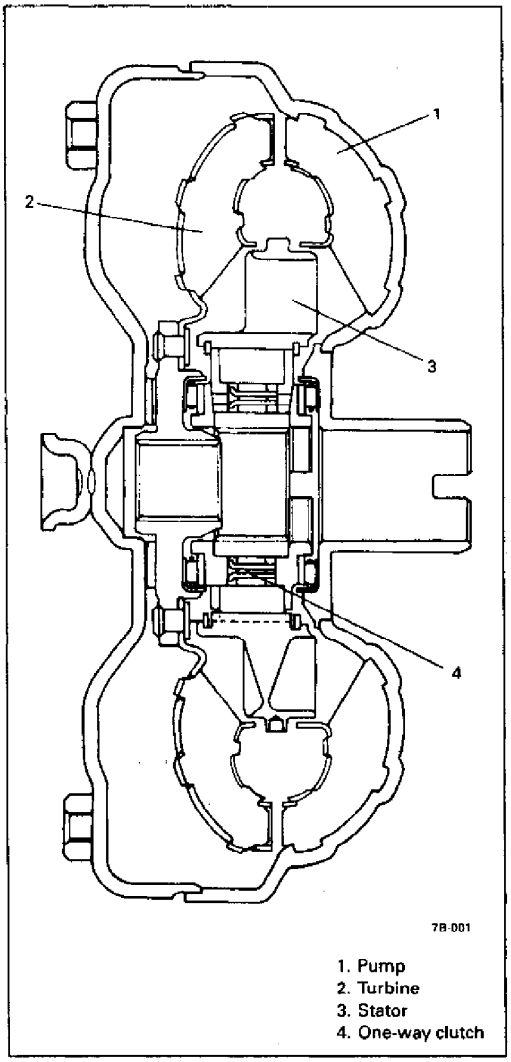
The automatic transmission consists of the hydraulic torque converter, electronically controlled 3-speed automatic transmission, countershaft and differential.

The transmission consists of 2 planetary gears, 2 disk clutches, 1 band brake, 1 disk brake and 1 one-way clutch. Its operation is controlled by selecting a position from 6 positions (P, R, N, D, 2 and L) manually by means of the selector lever installed on the compartment floor.

In the D or 2 range, the gear ratio is changed for the 1 st, 2nd or 3rd speed (D range only) automatically by powertrain control module (for fuel injection model) or transmission control module (for carburetor model) (electronic control).

For the automatic transmission fluid, DEXRON®-II, IIE, III or its equivalent must be used. Lubrication in the automatic transmission is provided by the oil pump which is operated by the engine revolution. Therefore, the engine should not be stopped even during coasting to obtain proper lubrication.

When it becomes necessary to be towed, front wheels must be raised so as not to roll them.



1. Pump
2. Turbine
3. Stator
4. One-way clutch

TORQUE CONVERTER

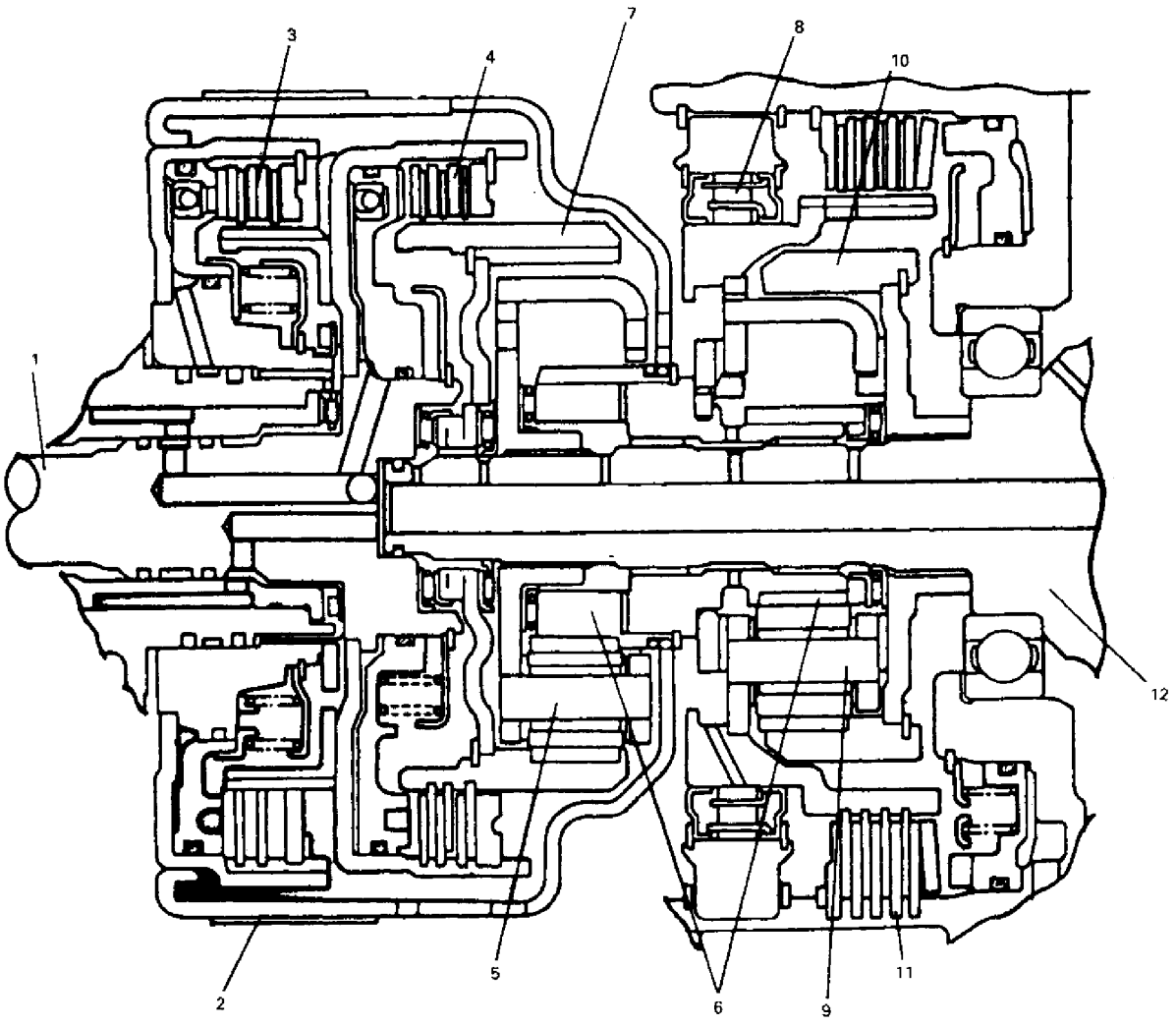
The torque converter is of 3-element hydraulic type and consists of the pump, turbine and stator in a unit incapable of disassembly. The pump is mounted to the crankshaft (drive plate), the turbine to the input shaft and the stator to the transmission case (oil pump cover) by way of the one-way clutch.

The torque converter, which increases torque when starting, accelerating and up-hill driving, functions as a fluid clutch while driving at a constant speed.

PLANETARY GEAR UNITS

In this unit, the sun gear is mounted in its center and engaged with it are 4 pinion gears supported by a carrier. Then, the outer ring gear is engaged with them. Depending on gear combinations, revolution is changed in speed or direction.

Among the units which operate in connection with the planetary gear unit, there are a direct clutch, a second brake, a forward clutch, a one-way clutch and a 1st-reverse brake.



1. Input shaft
2. Second brake band
3. Direct clutch
4. Forward clutch
5. Front planetary gear
6. Sun gear
7. Front ring gear
8. One-way clutch
9. Rear planetary gear
10. Rear ring gear
11. 1st-reverse brake
12. Output shaft

COMPONENTS OPERATION CHART

Range	Gear	Forward Clutch	Direct Clutch	Second Brake	1st & Reverse Brake	One-way Clutch	Parking Lock Pawl
P	Parking	—	—	—	**○	—	○
R	Reverse	—	○	—	○	—	—
N	Neutral	—	—	—	—	—	—
D	1st	○	—	—	—	○	—
	2nd	○	—	○	—	—	—
	3rd	○	○	—	—	—	—
2	1st	○	—	—	—	○	—
	2nd	○	—	○	—	—	—
L	1st	○	—	—	○	○	—
	*2nd	○	—	○	—	—	—

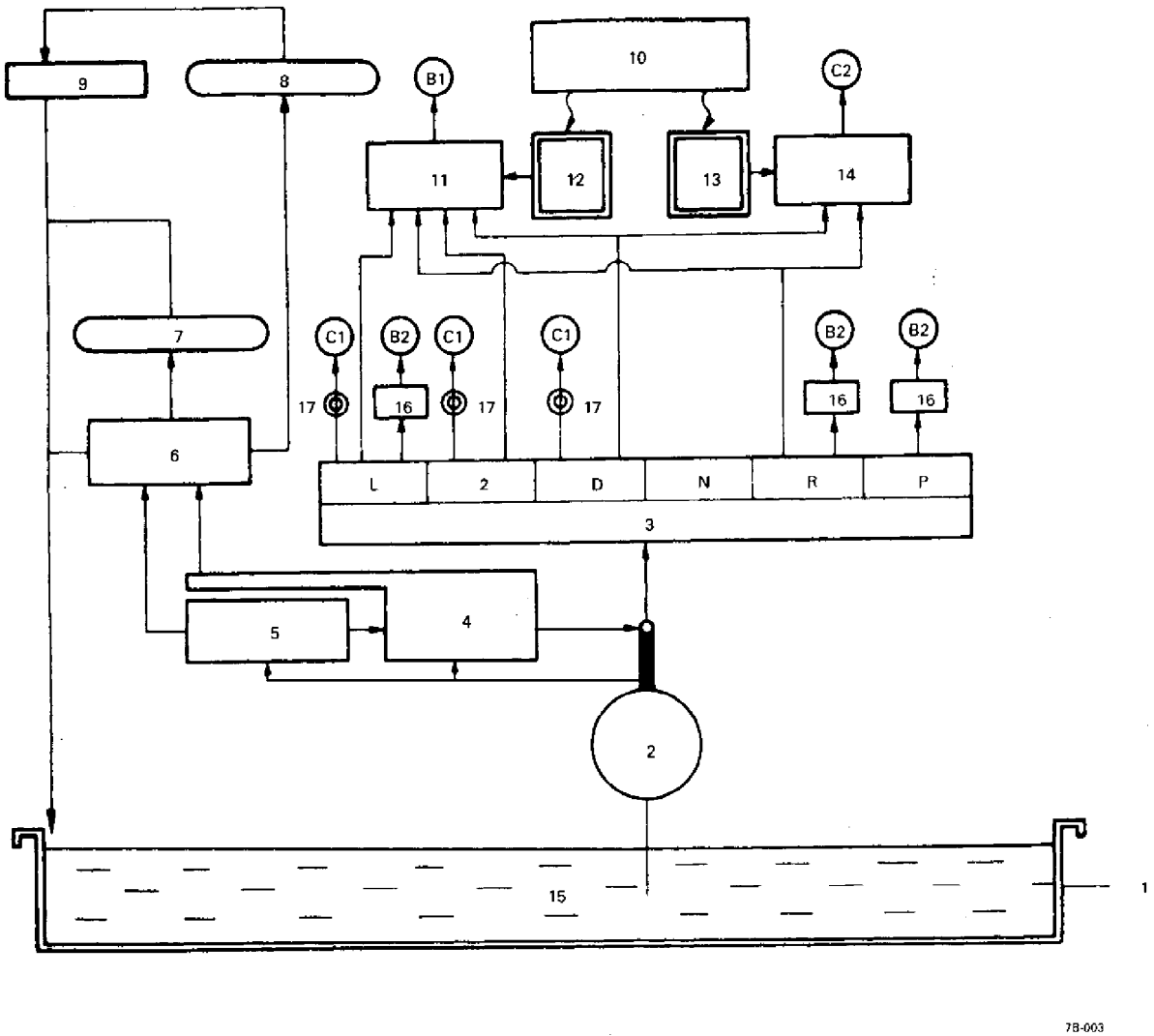
○ : Operated

* : To prevent overrevolution of engine, this 2nd gear is operated only when selector lever is shifted to L range at a higher than 53 km/h (33 mile/h) speed.

** : When engine is running.

OIL PRESSURE CONTROL SYSTEM

The oil pressure control system fundamentally consists of three parts: (1) oil pressure producing system which consists of an oil pump to produce oil pressure and regulator valve to regulate the pressure, (2) oil circuit to feed fluid into the torque converter, the oil cooler and the transmission components to be lubricated, and (3) control system to shift the gear of the planetary gear unit by acting on each clutch and brake.

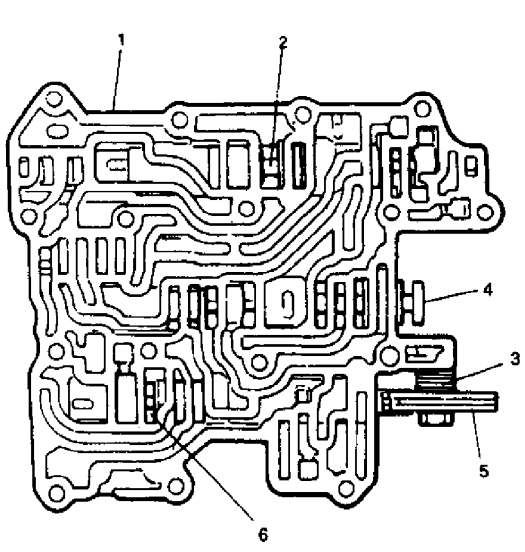


1. Oil pan
2. Oil pump
3. Manual valve
4. Primary regulator valve
5. Throttle valve
6. Secondary regulator valve
7. Lubrication
8. Torque converter
9. Oil cooler
10. Controller (Computer)
11. 1-2 shift valve
12. Second (2nd) brake solenoid valve
13. Direct clutch solenoid valve
14. 2-3 shift valve
15. Fluid
16. B_2 control valve
17. Accumulator

C1. Forward clutch
C2. Direct clutch
B1. Second (2nd) brake
B2. 1st-reverse brake

VALVE BODY

The valve body is installed in the oil pan and has valves to control oil pressure. In the valve body, oil passages connect valves.



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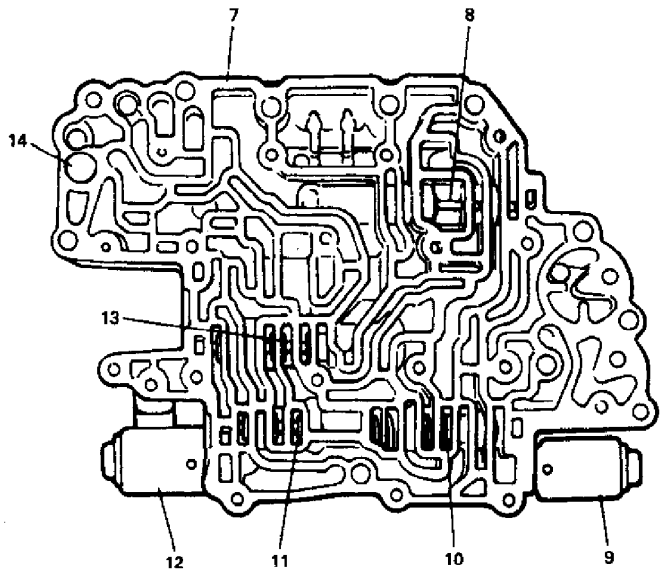
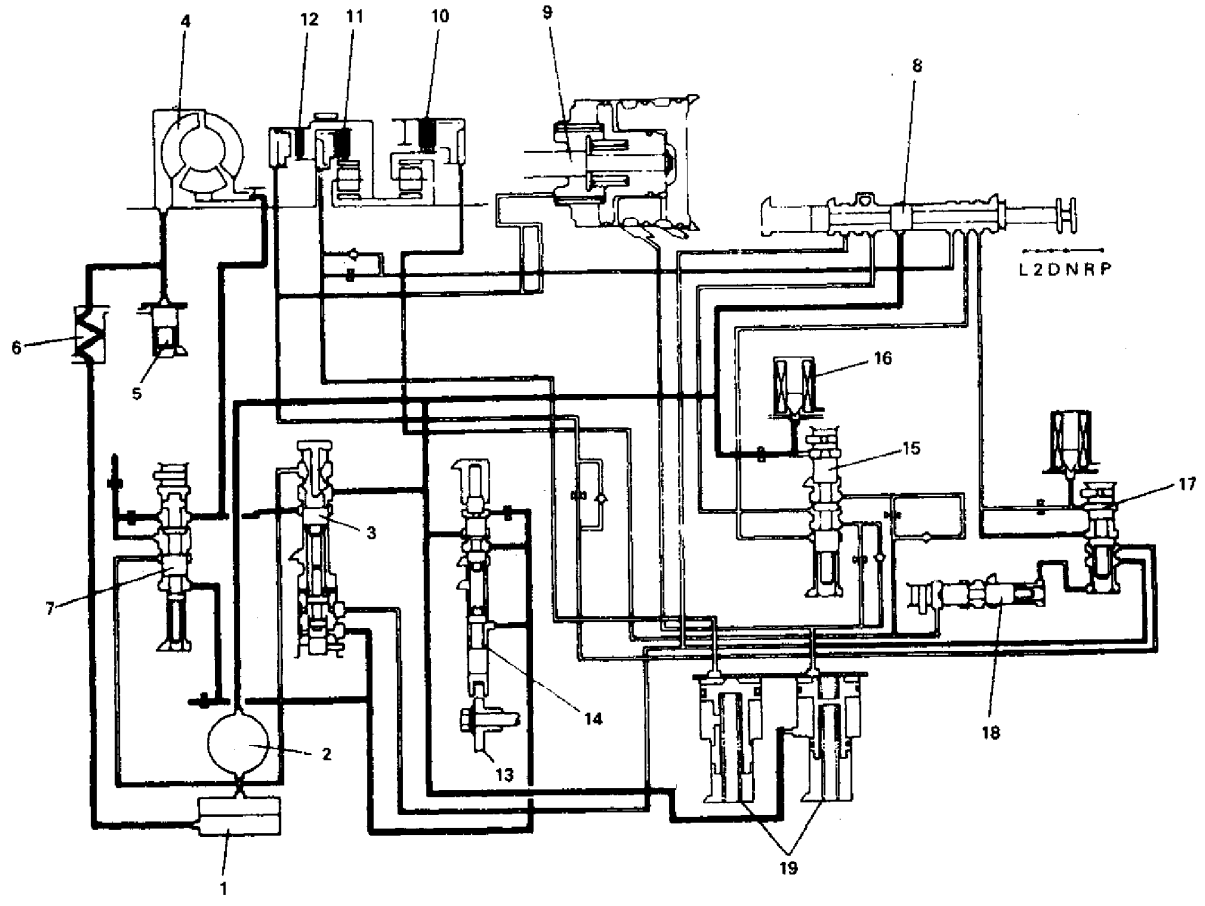


7B-005

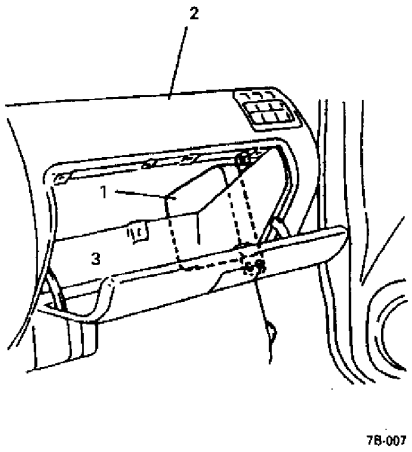
1. Upper valve body
2. Primary regulator valve
3. Return spring
4. Manual valve
5. Throttle valve cam
6. Throttle valve
7. Lower valve body
8. Secondary regulator valve
9. Direct clutch solenoid valve
10. 2-3 shift valve
11. B_2 control valve
12. 2nd brake solenoid valve
13. 1-2 shift valve
14. Cooler by-pass valve

OIL CIRCUIT IN "N" RANGE



1. Oil pan
2. Oil pump
3. Primary regulator valve
4. Torque converter
5. Cooler by-pass valve
6. Oil cooler
7. Secondary regulator valve
8. Manual valve
9. 2nd brake piston
10. 1st-reverse brake
11. Forward clutch
12. Direct clutch
13. Throttle valve cam
14. Throttle valve
15. 1-2 shift valve
16. 2nd brake solenoid valve
17. 2-3 shift valve
18. B_2 control valve
19. Accumulator

LH steering vehicle shown
(RH steering vehicle located opposite side)



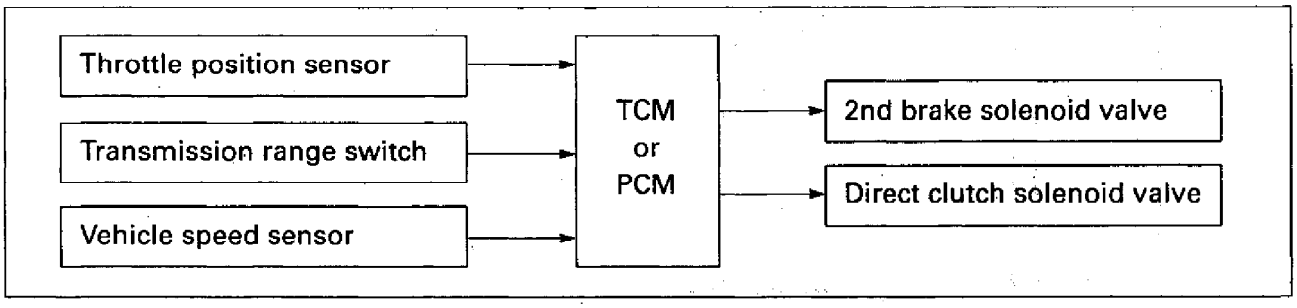
1. PCM or TCM
2. Instrument main panel
3. Glove box

ELECTRIC SHIFT CONTROL SYSTEM

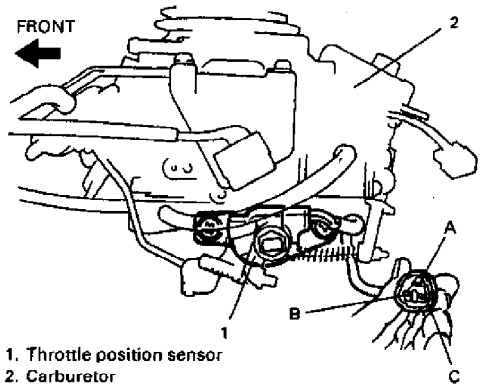
TRANSMISSION CONTROL MODULE (TCM) (FOR CARBURETOR MODEL)
POWERTRAIN (ENGINE) CONTROL MODULE (PCM/ECM) (FOR FUEL INJECTION MODEL)

The control module controls the 2nd brake solenoid valve and the direct clutch solenoid valve by sending electric signals to them so as to attain automatic gear shift between the 1st and 2nd gears, and the 2nd and 3rd gears.
Equipped as TCM or PCM sensed parameters are the throttle position sensor, shift lever switch and vehicle speed sensor. These switch and sensors sense the throttle valve opening, selector lever's position and vehicle speed, and send those signals to the control module. Then, the control module opens and closes valves of the above solenoids according to these signals.

GEAR SHIFT CONTROL SYSTEM

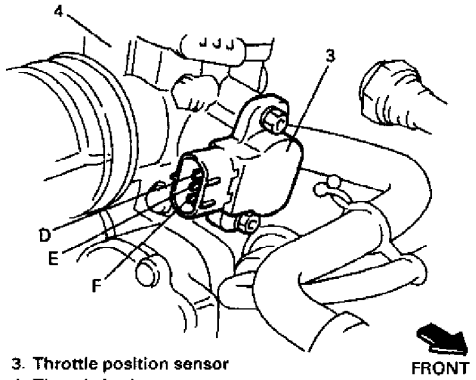


CARBURETOR MODEL



1. Throttle position sensor
2. Carburetor
A: Ground
B: Power supply from TCM
C: Output voltage

FUEL INJECTION MODEL



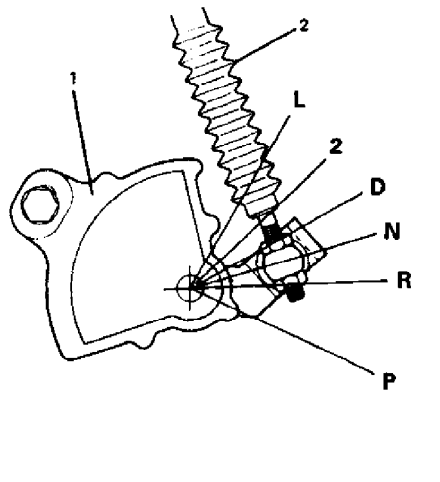
3. Throttle position sensor
4. Throttle body
D: Power supply from PCM
E: Output voltage
F: Ground

THROTTLE POSITION SENSOR (TP sensor)

The throttle position sensor consisting of a potentiometer is connected to the throttle valve shaft.

Throttle valve opening signal (output voltage) is transmitted from throttle position sensor to ECM (PCM for FUEL INJECTION model) as voltage signal.

TCM or PCM uses it as one of the signals to control transmission gear shift.

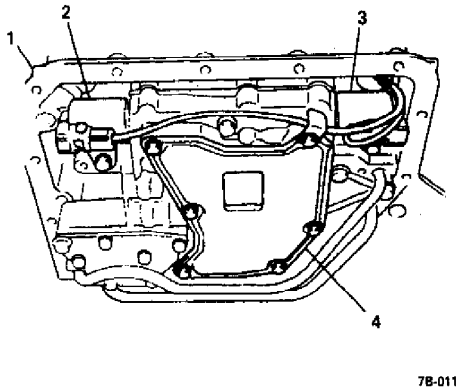


1. Transmission range switch
2. Select cable

TRANSMISSION RANGE SWITCH

Being linked with the selector lever, this switch changes selector lever positions into electric signals and send them to TCM or PCM. The contact points of this switch for P and N ranges are also connected with the starting motor circuit. So when the selector lever is shifted to the P or N position, the contact points for P or N range are connected and cause the starting motor to operate by turning the starter switch ON. When the selector lever is in any other position than P and N, the switch remains OFF and therefore the starting motor cannot be operated, that is, the engine cannot be started.

Also, as its contact point for R range is connected with the back up light circuit, only when the selector lever is shifted to R range, the contact point contacts to light the back up light.



1. Transmission
2. 2nd brake solenoid valve
3. Direct clutch solenoid valve
4. Oil strainer

DIRECT CLUTCH AND 2ND BRAKE SOLENOID VALVES

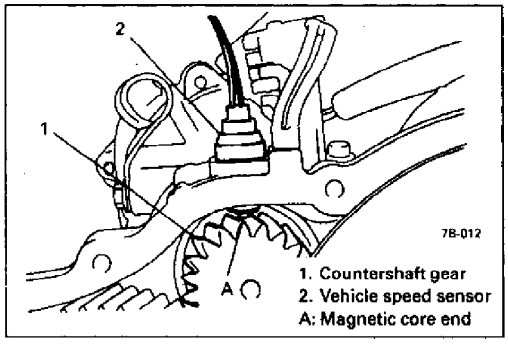
These solenoid valves are mounted on the valve body. They are turned ON and OFF by the signals from TCM or PCM and actuate each shift valve (1-2 and 2-3 valves) so as to control transmission gear shift.

2nd brake solenoid valve operates 1-2 shift valve, and direct clutch solenoid valve does 2-3 shift valve.

OPERATION OF DIRECT CLUTCH AND 2ND BRAKE SOLENOIDS

Range	D			2		L		P, N & R
Gear	1 st	2 nd	3 rd	1 st	2nd	1 st	(2nd)	—
Direct clutch solenoid valve	○	○	×	×	○	×	×	×
2nd brake solenoid valve	○	×	×	○	×	×	○	×

○: Operated (Solenoid Valve is Open) ×: Unoperated (Solenoid Valve is Closed)



1. Countershaft gear
2. Vehicle speed sensor
A: Magnetic core end

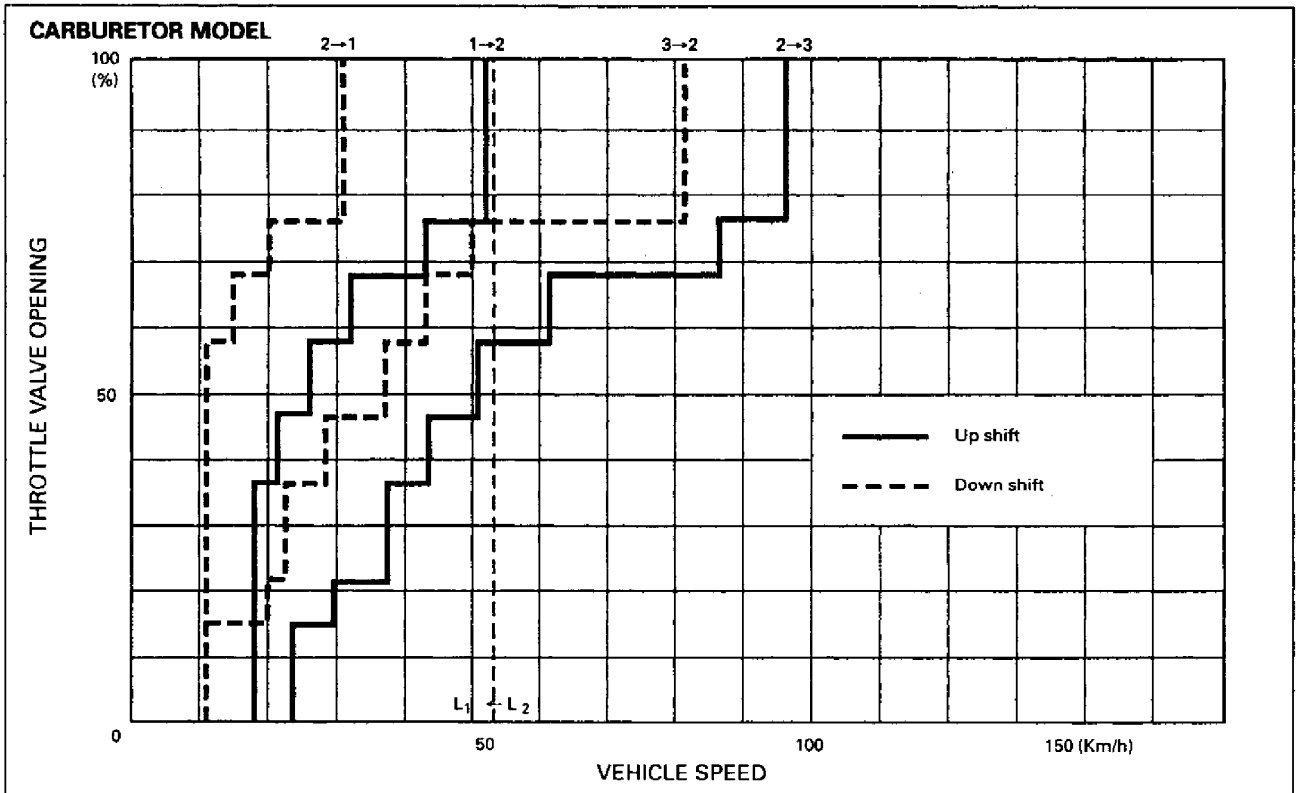
VEHICLE SPEED SENSOR

The vehicle speed sensor consists of a magnetic core with magnet and coil. It is mounted on transmission case with 0.6 mm (0.024 in.) air gap between the core end and countershaft gear tooth.

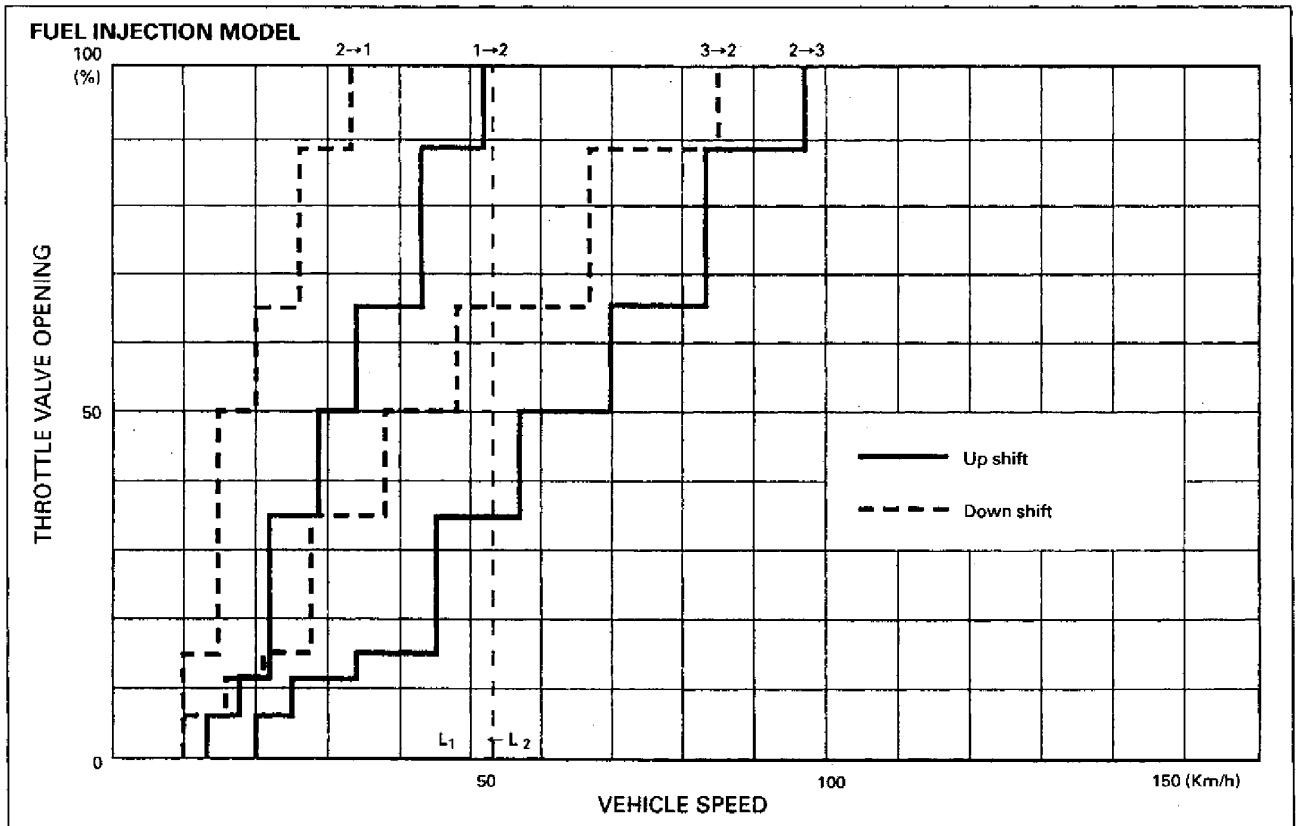
While the countershaft rotates, magnetic flux is cut by gear tooth thus a pulse is generated in the sensor coil according to the speed. And then, the pulse is transmitted to TCM or PCM as speed signal.

AUTOMATIC SHIFT DIAGRAM

Automatic shift schedule as a result of shift control is shown below. In case that selector lever is shifted to L at a higher than 53 km/h (33 mile/h) speed, 2nd gear is operated and then down shifts to 1st at a speed lower than that. No up shift is available in L.



Throttle / Speed / Gear \ Selector		D or 2	D		D or 2	L
		1→2	2→3	3→2	2→1	2→1
Full close	Km/h	18	24	11	11	53
	mile/h	9	15	7	7	33
Full open	Km/h	52	97	82	31	53
	mile/h	32	61	51	19	33



Selector / Throttle / Speed / Gear		D or 2	D		D or 2	L
		1→2	2→3	3→2	2→1	2→1
Full close	Km/h	13	20	10	10	53
	mile/h	8	13	6	6	33
Full open	Km/h	52	97	85	33	53
	mile/h	32	61	53	21	33

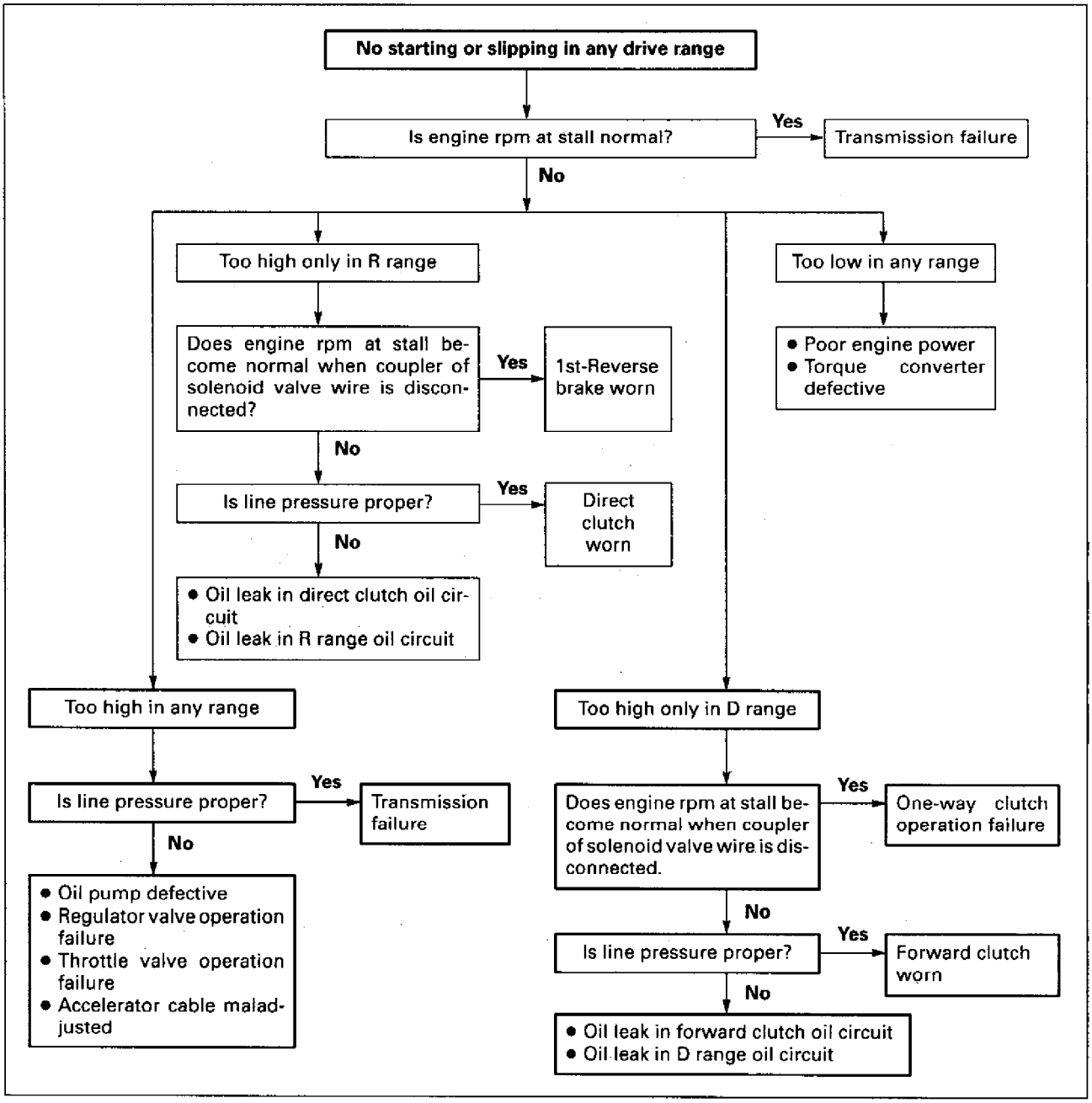
DIAGNOSIS

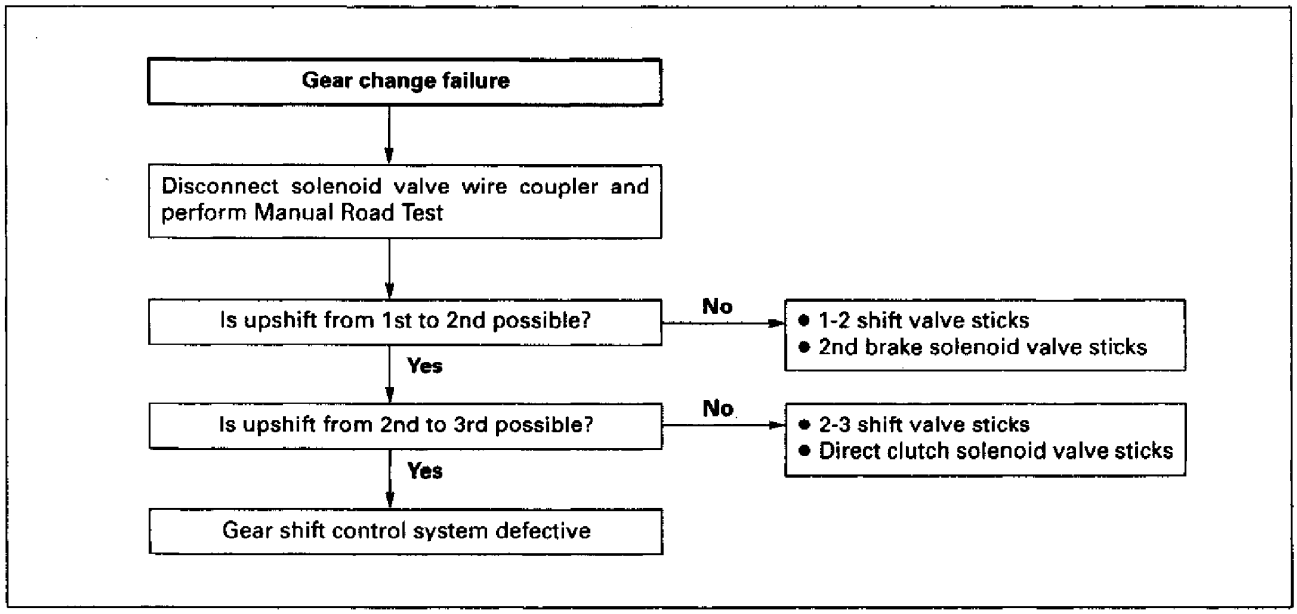
TRANSMISSION UNIT

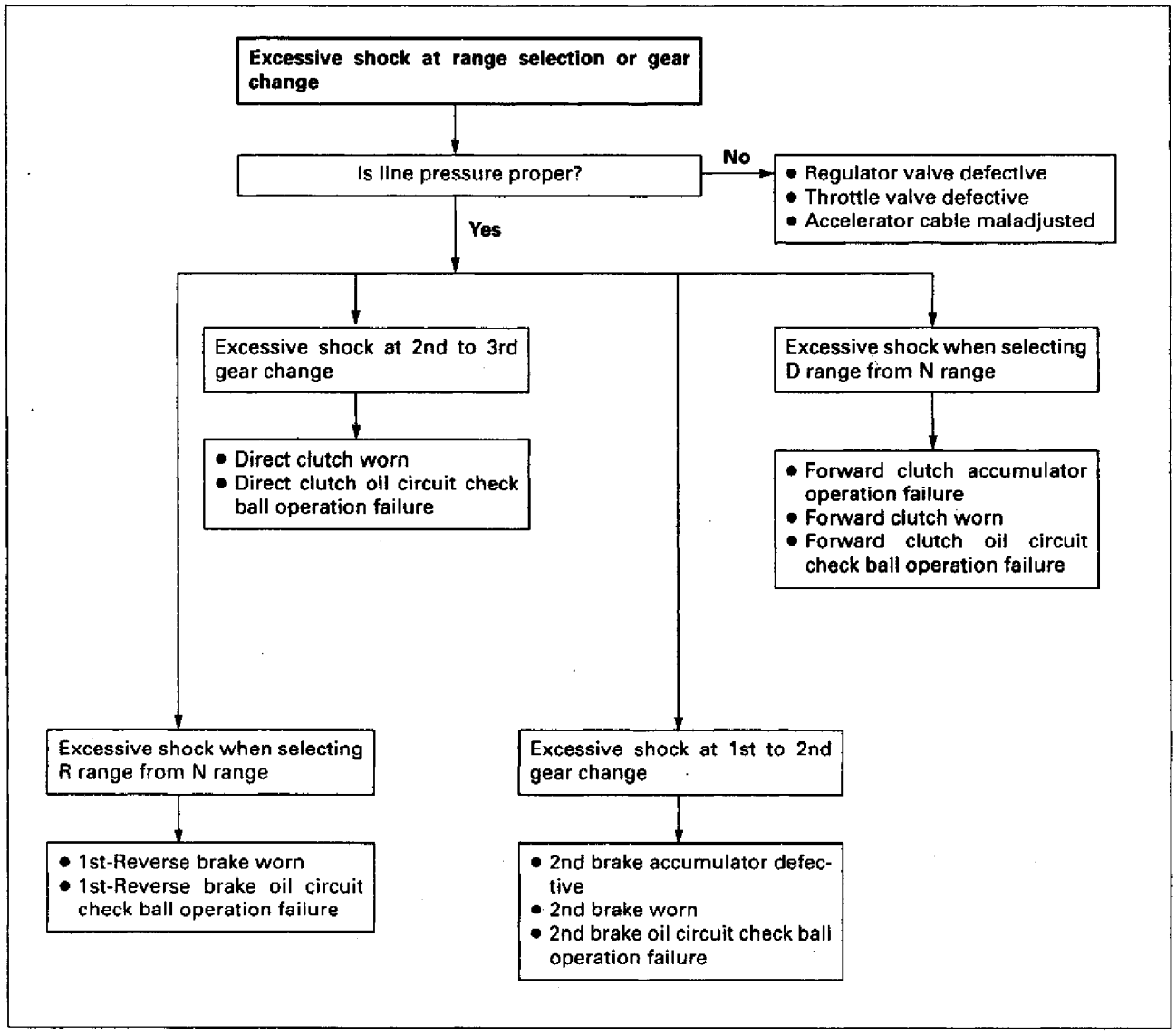
SYSTEMATIC TROUBLE SHOOTING

Before performing troubleshooting for mechanical function described hereafter, make sure to check each of the following.

1) Engine coolant temperature is at normal operating temperature.
2) Engine idle speed is within specification.
3) Transmission fluid level is between FULL HOT and LOW HOT on oil level gauge at normal operating temperature of transmission fluid.
4) Accelerator cable, oil pressure control cable and select cable are adjusted properly.
5) Electric circuit of gear shift control system is free from break, coupler disconnection and poor contact.




Gear change failure
Disconnect solenoid valve wire coupler and perform Manual Road Test
Is upshift from 1st to 2nd possible?
No
• 1-2 shift valve sticks
• 2nd brake solenoid valve sticks
Yes
Is upshift from 2nd to 3rd possible?
No
• 2-3 shift valve sticks
• Direct clutch solenoid valve sticks
Yes
Gear shift control system defective


Excessive shock at range selection or gear change
Is line pressure proper?
No
• Regulator valve defective
• Throttle valve defective
• Accelerator cable maladjusted
Yes
Excessive shock at 2nd to 3rd gear change
• Direct clutch worn
• Direct clutch oil circuit check ball operation failure
Excessive shock when selecting D range from N range
• Forward clutch accumulator operation failure
• Forward clutch worn
• Forward clutch oil circuit check ball operation failure
Excessive shock when selecting R range from N range
• 1st-Reverse brake worn
• 1st-Reverse brake oil circuit check ball operation failure
Excessive shock at 1st to 2nd gear change
• 2nd brake accumulator defective
• 2nd brake worn
• 2nd brake oil circuit check ball operation failure

STALL TEST

This test is to check overall performance of automatic transmission and engine by measuring stall speed at D and R ranges. Be sure to perform this test only when transmission fluid is at normal operating temperature and its level is between FULL HOT and LOW HOT.

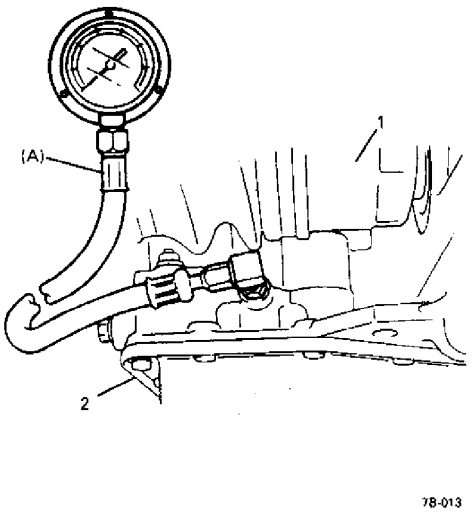
CAUTION:
Do not run engine at stall more than 5 seconds continuously, for oil temperature may rise excessively high.

1) Install tachometer.
2) Apply parking brake and block vehicle wheels.
3) Start engine with selector lever shifted to P.
4) Depress brake pedal.
5) Shift selector lever to D and depress accelerator pedal fully while watching tachometer. Read engine rpm quickly when it has become constant (stall speed).
6) Release accelerator pedal immediately after stall speed is checked.
7) In the same way, check stall speed at R range.
8) Stall speed should be within following specification.

   Stall speed: 2,200 – 2,700 r/min

9) Possible causes for out-of-specification stall speed are as follows. Check each part which is suspected to be the cause.

Stall speed measured	Possible causes
Lower than specification	• Engine output insufficient • Torque converter defective
Higher than specification in D range	• Forward clutch slippage • One-way clutch defective
Higher than specification in R range	• Direct clutch slippage • 1st-reverse brake slippage



1. Front drive shaft (LH)
2. Oil pan

LINE PRESSURE TEST

This test is to check oil pressure system for operation by measuring oil pressure in oil pressure line. Make sure to perform this test only when transmission fluid is at normal operating temperature.

NOTE:

- **Make sure that transmission fluid level is between FULL HOT and LOW HOT marks on oil level gauge at normal operating temperature of fluid.**
- **Check that transmission is free from fluid leakage.**

1) With engine at stop, remove plug and connect oil pressure gauge to plug hole.

Special Tool
(A): 09925–37810

2) Install tachometer.
3) Apply parking brake and block vehicle wheels.
4) With selector lever shifted to P, start engine.
5) Depress brake pedal fully.

6) Shift selector lever to D and check oil pressure with engine running at idling speed and at stall speed respectively.
7) Repeat the same check as in step 6 with selector lever shifted to R.

> **CAUTION:**
> **Do not run engine at stall more than 5 seconds continuously, for oil temperature may rise excessively high.**

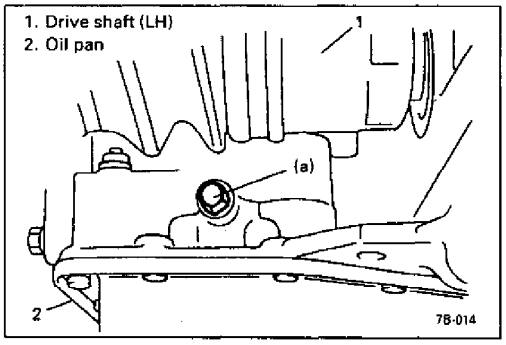
8) If line pressure is within respective specification in table below, oil pressure system is in good condition.

CABURETOR model and FUEL INJECTION model

Engine speed	Line pressure	
	D range	R range
Specified idling speed	200 – 400 kPa 2.0 – 4.0 kg/cm^2 28.5 – 56.8 psi	550 – 800 kPa 5.5 – 8.0 kg/cm^2 78.2 – 113.7 psi
Stall speed (2,200 – 2,700 r/min)	400 – 600 kPa 4.0 – 6.0 kg/cm^2 56.9 – 85.3 psi	900 – 1,250 kPa 9.0 – 12.5 kg/cm^2 128.0 – 177.8 psi

9) Possible causes for out-of-specification line pressure are as follows. Check each part which is suspected to be the cause.

Line pressure	Possible causes
Higher than specification in D and R ranges	• Regulator valve defective • Throttle valve in valve body defective • Accelerator cable and oil pressure control cable maladjusted
Lower than specification in D and R ranges	• Oil pump defective • Regulator valve defective • Throttle valve in valve body defective • Accelerator cable and oil pressure control cable maladjusted
Lower than specification only in D range	• Forward clutch oil pressure system oil leakage • D range oil pressure system oil leakage
Lower than specification only in R range	• Direct clutch oil pressure system oil leakage • 1st-reverse brake oil pressure system oil leakage • R range oil pressure system oil leakage



10) Reinstall plug and tighten it to specification.

Tightening Torque
(a): 7.5 N·m (0.75 kg-m, 5.5 lb-ft)

ROAD TEST

This test is to check if upshift and downshift take place at specified speeds while actually driving vehicle on a level road.

WARNING:
- **Carry out the test in very little traffic area to prevent an accident.**
- **The test requiers 2 persons, a driver and a tester.**

1) Warm up engine.
2) With engine running at idle, shift selector lever to D.

[For CARBURETOR Model]

3)① Accelerate vehicle speed by depressing accelerator pedal very little (within 4 deg. of throttle valve opening).
② Check if upshift takes place from 1st to 2nd at about 18 km/h (11 mile/h) and from 2nd to 3rd at about 24 km/h (15 mile/h).
③ Stop vehicle once. Then start it again and while accelerating by depressing accelerator pedal fully, check if upshift takes place form 1st to 2nd at 52 km/h (32 mile/h) and from 2nd to 3rd at 97 km/h (61 mile/h).
④ Stop vehicle again.
⑤ Start vehicle and keep it running at 30 km/h (19 mile/h) and then release accelerator pedal completely. 1 or 2 seconds later, depress accelerator pedal fully and check if downshift from 2nd to 1st takes place.
⑥ Keep vehicle running at 75 km/h (47 mile/h) and in the same way as in step ⑤ check if downshift from 3rd to 2nd takes place.
⑦ If upshift or downshift fails to take place at each specified speed in the road test, possible cuases for such failure are as follows. Check each part which is suspected to be the cause.

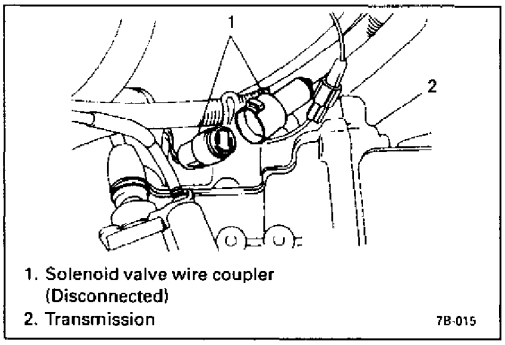
[For FUEL INJECTION Model]

3)① Accelerate vehicle speed by depressing accelerator pedal very little (within 4 deg. of throttle valve opening).
② Check if upshift takes place from 1st to 2nd at about 13 km/h(8 mile/h) and from 2nd to 3rd at about 20 km/h (13 mile/h).
③ Stop vehicle once. Then start it again and while accelerating by depressing accelerator pedal fully, check if up-shift takes place from 1st to 2nd at 52 km/h (32 mile/h) and from 2nd to 3rd at 97 km/h (61 mile/h).
④ Stop vehicle again.
⑤ Start vehicle and keep it running at 25 km/h (15 mile/h) and then release accelerator pedal completely. 1 or 2 seconds later, depress accelerator pedal fully and check if downshift from 2nd to 1st takes place.

⑥ Keep vehicle running at 75 km/h (47 mile/h) and in the same way as in step ⑤, check if downshift from 3rd to 2nd takes place.

⑦ If upshift or downshift fails to take place at each specified speed in the road test, possible causes for such failure are as follows. Check each part which is suspected to be the cause.

Condition	Possible causes
No upshift from 1st to 2nd	• 1-2 shift valve defective • 2nd brake solenoid valve defective • TCM or PCM defective, or disconnection or poor connection in electric circuit
No upshift from 2nd to 3rd	• 2-3 shift valve defective • Direct clutch solenoid valve defective • TCM or PCM defective, or disconnection or poor connection in electric circuit
No downshift from 2nd to 1st or 3rd to 2nd	• Throttle position sensor defective • TCM or PCM defective, or disconnection or poor connection in electric circuit



1. Solenoid valve wire coupler (Disconnected)
2. Transmission

7B-015

MANUAL ROAD TEST

This test checks the gears being used in L, 2 or D range when driven with unoperated gear shift control system. Test drive vehicle on a level road.

1) With selector lever in P, start engine and warm it up.
2) After warming up engine, disconnect coupler of solenoid valve wire as shown in figure.
3) With selector lever in L range, start vehicle and accelerate to 30 km/h (19 mile/h). Check in this state that 1st gear is being used.
4) At 30 km/h (19 mile/h), shift selector lever to 2 range and accelerate to 60 km/h (37 mile/h).
   Check in this state that 2nd gear is being used.
5) At 60 km/h (37 mile/h), shift selector lever to D range and check that 3rd gear is used when speed is higher than 60 km/h (37 mile/h).
6) After above checks, stop vehicle then engine, and connect solenoid valve wire coupler.

ENGINE BRAKE TEST

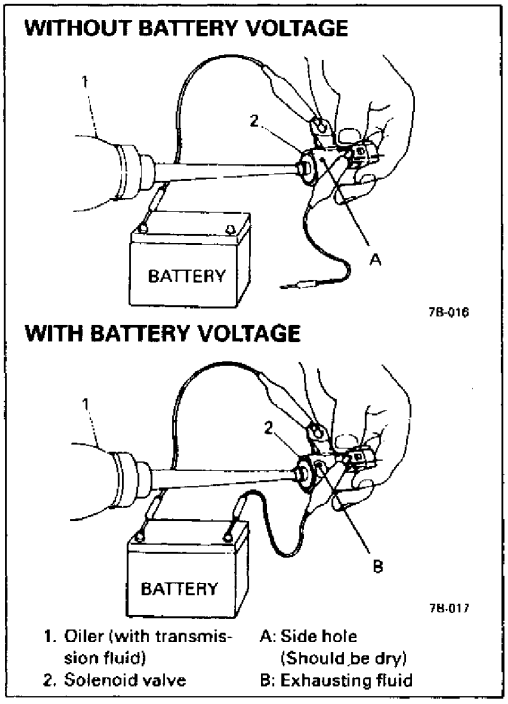
WARNING:
Before test, make sure that there is no vehicle behind so as to prevent rear-end collision.

1) While driving vehicle in 3rd gear of D range, shift selector lever down to 2 range and check if engine brake operates.
2) In the same way as in step 1), check engine brake for operation when selector lever is shifted down to L range.
3) If engine brake fails to operate in above tests, possible cause for such failure are as follows.
   Check each part which is suspected to be the cause.

Condition	Possible causes
Fails to operate when shifted down to 2 range	Second brake defective
Fails to operate when shifted down to L range	1st-reverse brake defective

"P" RANGE TEST

1) Stop vehicle on a slope, shift selector lever to P range and at the same time apply parking brake.
2) After stopping engine, release parking brake lever gradually and check that vehicle remains stationary.



1. Oiler (with transmission fluid)
2. Solenoid valve

A: Side hole (Should be dry)
B: Exhausting fluid

SHIFT SOLENOID VALVE CHECK

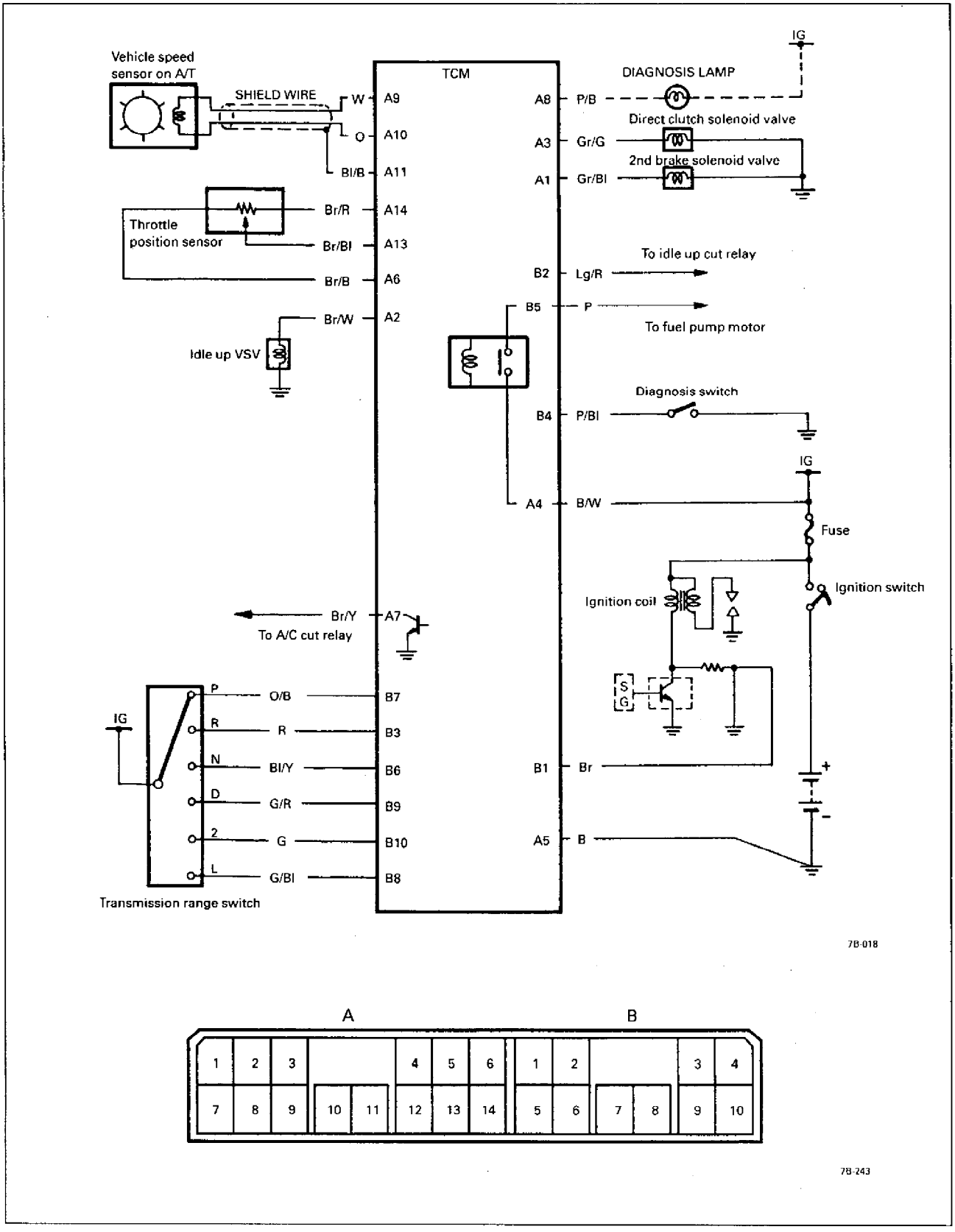
Whenever shift solenoid valves are removed from transmission, verify their valve function physically before they are reinstalled.

1) Apply oiler to solenoid valve and give compression by hands and then check to be sure that transmission fluid from oiler does not come out from side holes of solenoid valve when battery voltage is not conducted.
2) Holding the above condition, conduct battery voltage and then make sure that fluid is exhausted with vigor.

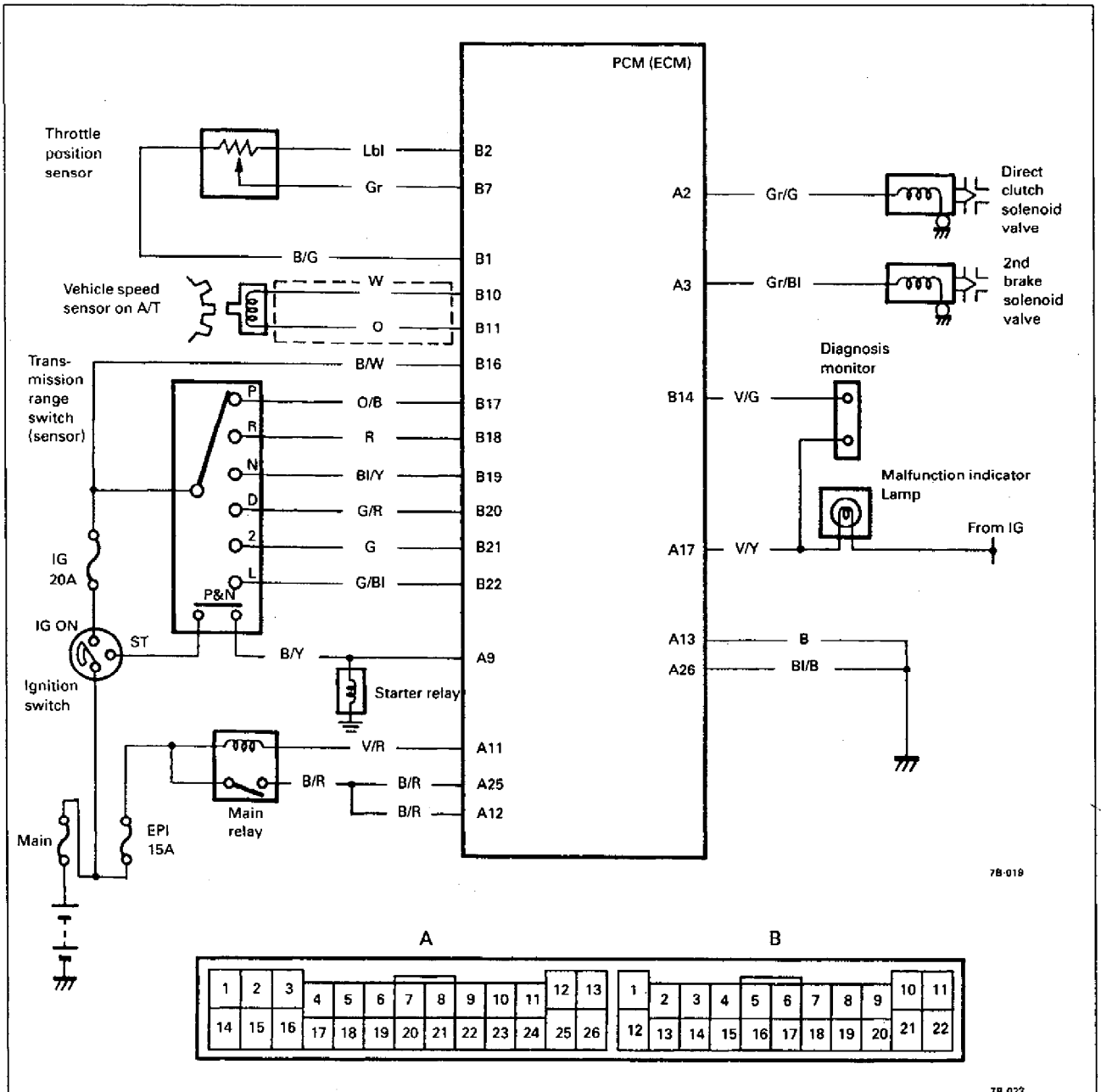
NOTE:
If fluid does not come out with vigor in above step 2) inspection, do not re-use that solenoid valve.

ELECTRIC SHIFT CONTROL SYSTEM (FOR CARBURETOR MODEL)

Process troubleshooting for electric control system by using ON-BOARD DIAGNOSTIC SYSTEM (SELF-DIAGNOSIS) and SYSTEMATIC TROUBLE SHOOTING and find and a defective area reasonably.



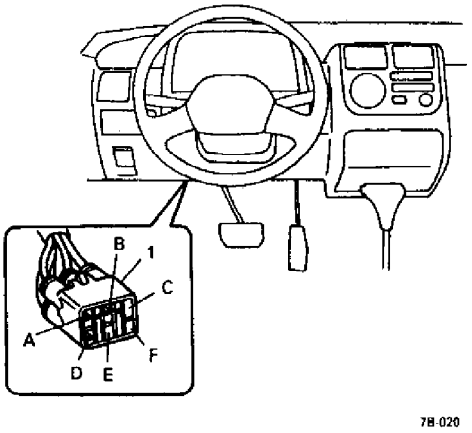
ELECTRIC SHIFT CONTROL SYSTEM (FOR FUEL INJECTION MODEL)



Wire color

B	: Black	Br/R	: Brown/Red	Lg/R	: Lightgreen/Red
B/G	: Black/Green	Br/W	: Brown/White	O	: Orange
B/R	: Black/Red	Br/Y	: Brown/Yellow	O/B	: Orange/Black
B/W	: Black/White	G	: Green	P	: Pink
B/Y	: Black/Yellow	G/Bl	: Green/Blue	P/B	: Pink/Black
Bl/B	: Blue/Black	G/R	: Green/Red	P/Bl	: Pink/Blue
Bl/Y	: Blue/Yellow	Gr	: Gray	R	: Red
Br	: Brown	Gr/Bl	: Gray/Blue	V/R	: Violet/Red
Br/B	: Brown/Black	Gr/G	: Gray/Green	V/Y	: Violet/Yellow
Br/Bl	: Brown/Blue	Lbl	: Lightblue	W	: White

LH steering vehicle shown
(RH steering vehicle located opposite side)



1. Monitor coupler

A. Diagnosis output terminal
B. Diagnosis switch terminal
C. Blank
D. Ground terminal
E. Blank
F. Blank

ON-BOARD DIAGNOSTIC (SELF-DIAGNOSIS) (FOR CABURETOR MODEL)

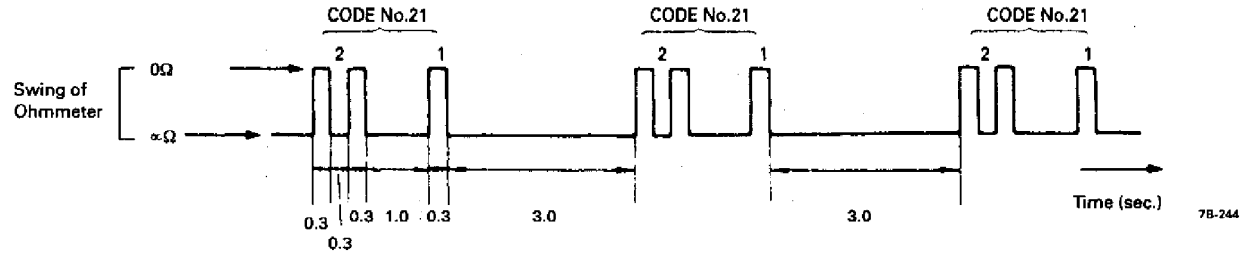
1) After test driving, hold engine running in P position applied with parking brake.
2) Connect ohmmeter probes between A terminal of monitor coupler and body ground (or D terminal of monitor coupler).
3) By using service wire, connect B terminal of monitor coupler and body ground (or D terminal of monitor coupler).
4) To read diagnostic trouble code, watch swing of ohmmeter indicator.

NOTE:

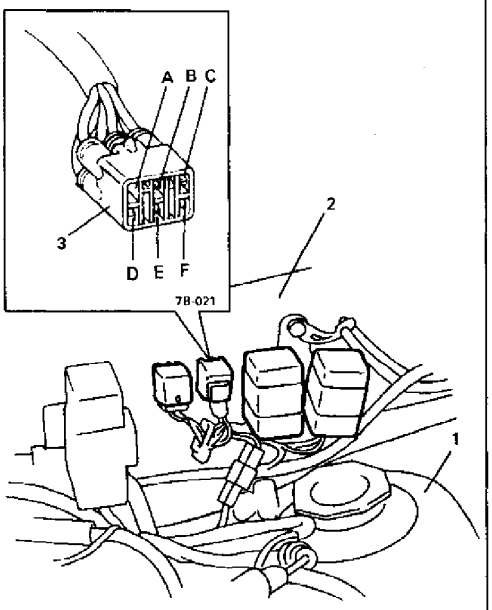
- **All applicable code will be indicated from smaller number to large number in order.**
- **Code memory, if any, will be erased when ignition switch is turned off.**
- **Ignition signal is used for fail-safe but it is not a factor of shift control.**

DIAGNOSTIC TROUBLE CODE (DTC) TABLE

EXAMPLE : SHIFT SOLENOID No.1 FAILURE (CODE No.21)



NO.	DIAGNOSTIC AREA	DIAGNOSIS
12	Normal	No problem exists as far as on-board diagnostic system (self-diagnosis system) is concerned.
21	Direct clutch solenoid valve	Open circuit.
22		Short circuit to ground.
23	2nd brake solenoid valve	Open circuit.
24		Short circuit to ground.
25	Idle up VSV	Short circuit to ground in wiring to TCM.
31	Vehicle speed sensor	Open circuit while running. However, this code does not appear once ignition switch is turned off.
32	Transmission range switch	2 point or more are turned on at once or all points are open.
33	Ignition signal	No ignition signal for more than 9 seconds while running at 30 km/h (19 mile/h) or more with throttle position sensor opened more than 28%.
34	Throttle position sensor	Throttle position sensor or its circuit open or short.



1. Left front strut tower
2. Dash panel
3. Monitor coupler

A. Blank
B. Diagnosis switch terminal
C. Diagnosis output terminal
D. Ground terminal
E. Test switch terminal
F. Duty output terminal

ON-BOARD DIAGNOSTIC (SELF-DIAGNOSIS) (FOR FUEL INJECTION MODEL)

1) After test driving, hold engine running in position applied with parking brake.
2) Using service wire, connect B terminal of monitor coupler and body ground (or D terminal of monitor coupler).
3) To read diagnostic trouble code, watch the flashing "CHECK ENGINE" light indicator.

PRECAUTIONS IN DIAGNOSING TROUBLES

[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC TROUBLE CODE]

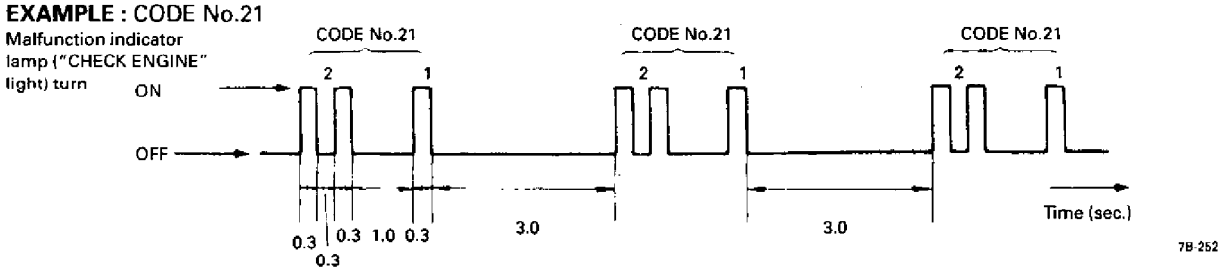
- Before identifying diagnostic trouble code indicated by "CHECK ENGINE" light, don't disconnect couplers from PCM, battery cable from battery, PCM ground wire harness from engine. Such disconnection will erase memorized trouble in PCM memory.
- The DTC stored in the PCM memory is output by flashing of "CHECK ENGINE" light with the diagnosis switch terminal grounded.
- If no DTC is stored in the PCM memory, Code 12 is output repeatedly.
- If DTCs are stored in the PCM memory, they are output after Code 12 output starting from the smallest code number in the increasing order. After all DTCs are output, Code 12 is output again and so are DTCs.
- When PCM stores a DTC (or DTCs) on transmission, PCM will not turn on "CHECK ENGINE" light in combination meter.

NOTE:

- **Frequency of code signal is the same with the one for ELECTRONIC FUEL INJECTION. Refer to SECTION 6E1.**

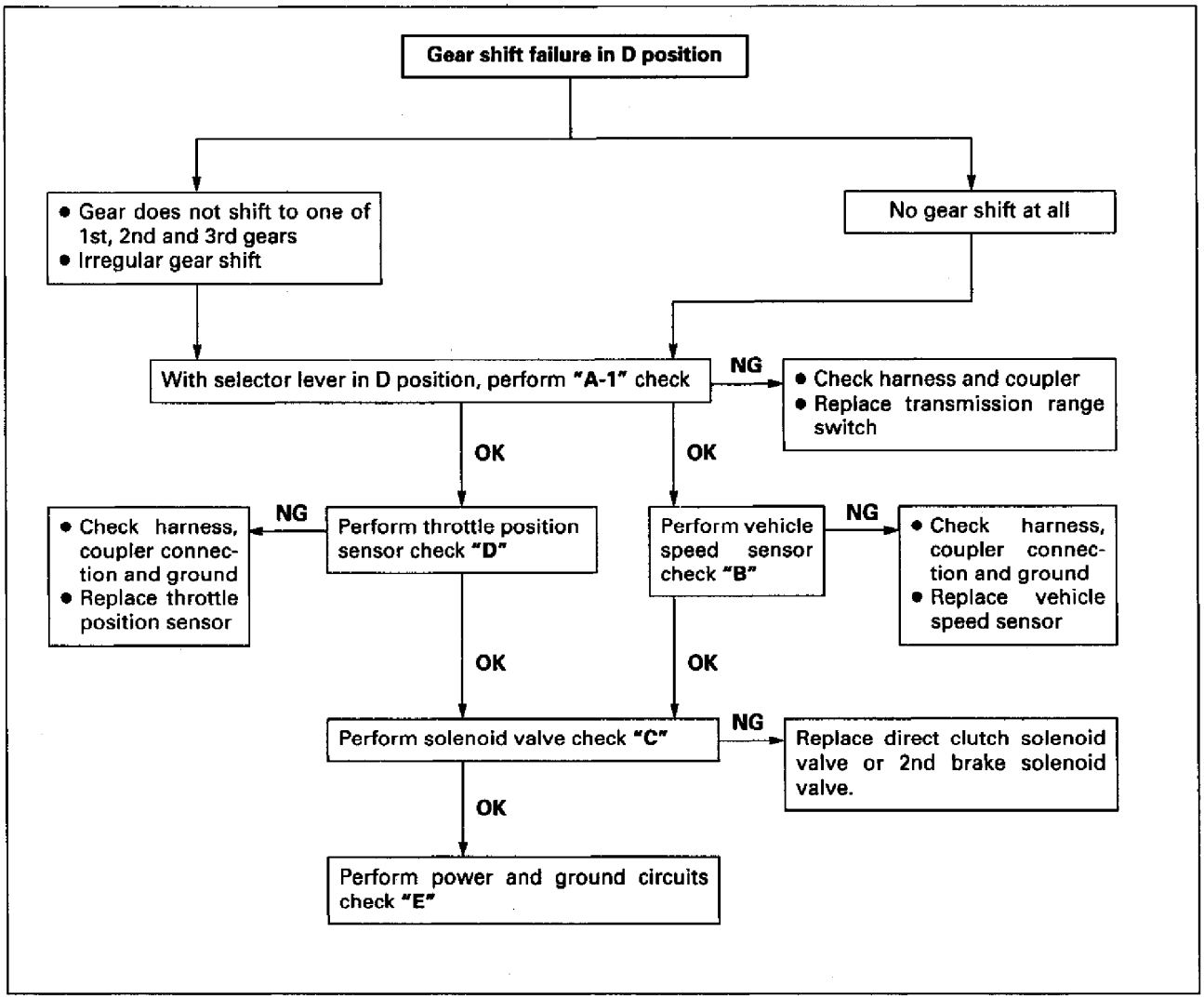
DIAGNOSTIC TROUBLE CODE (DTC) TABLE

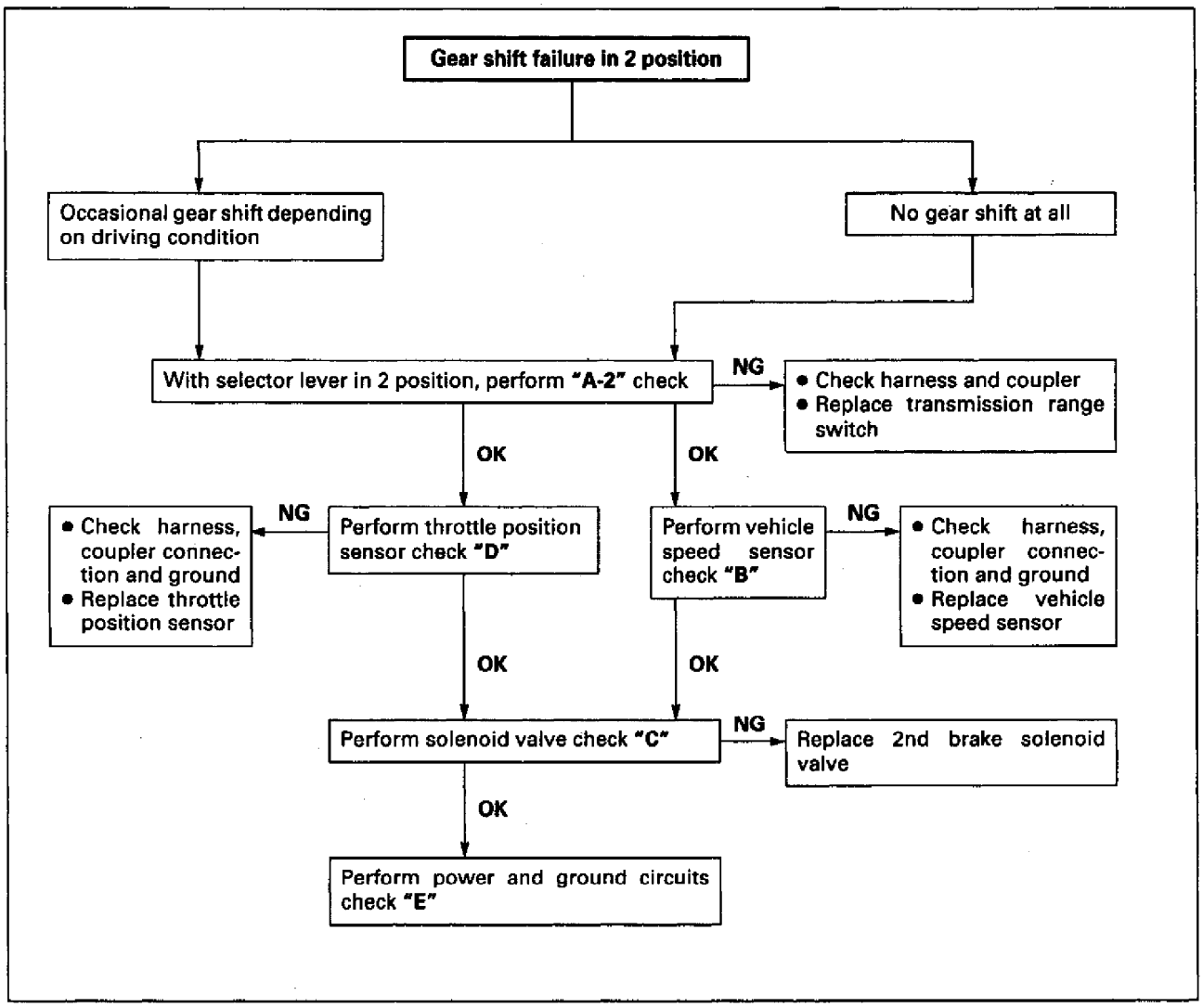
EXAMPLE : CODE No.21

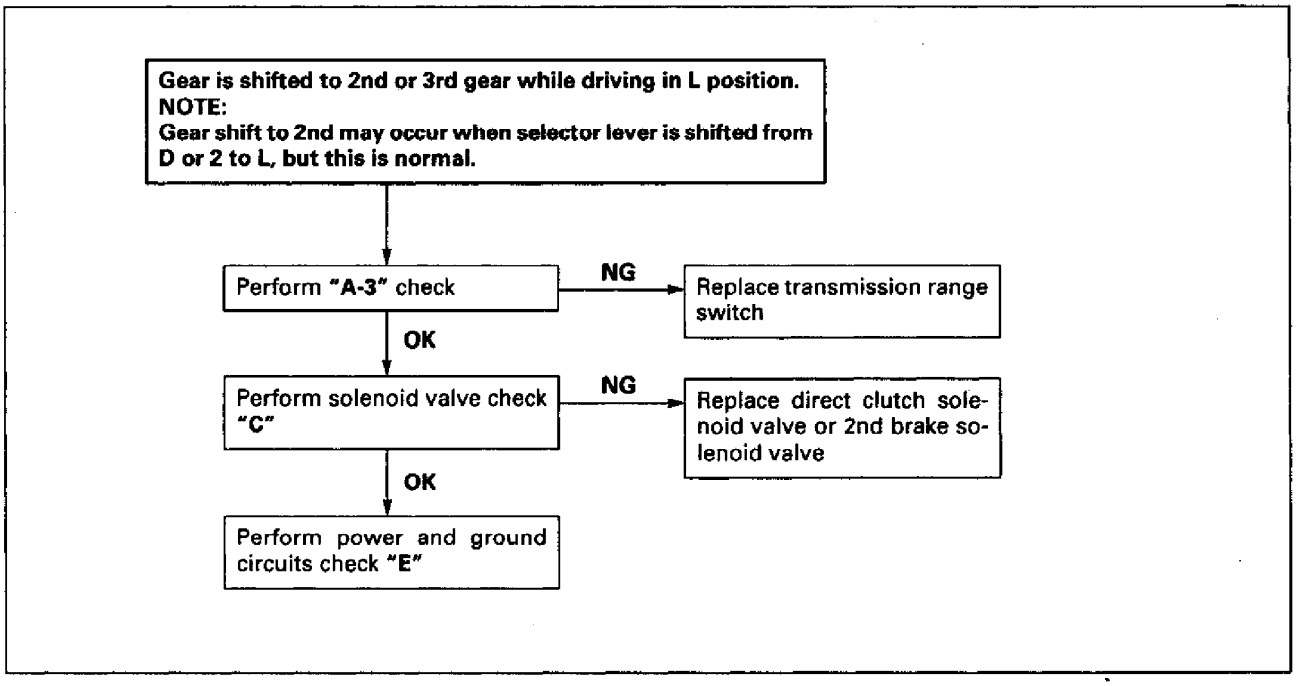


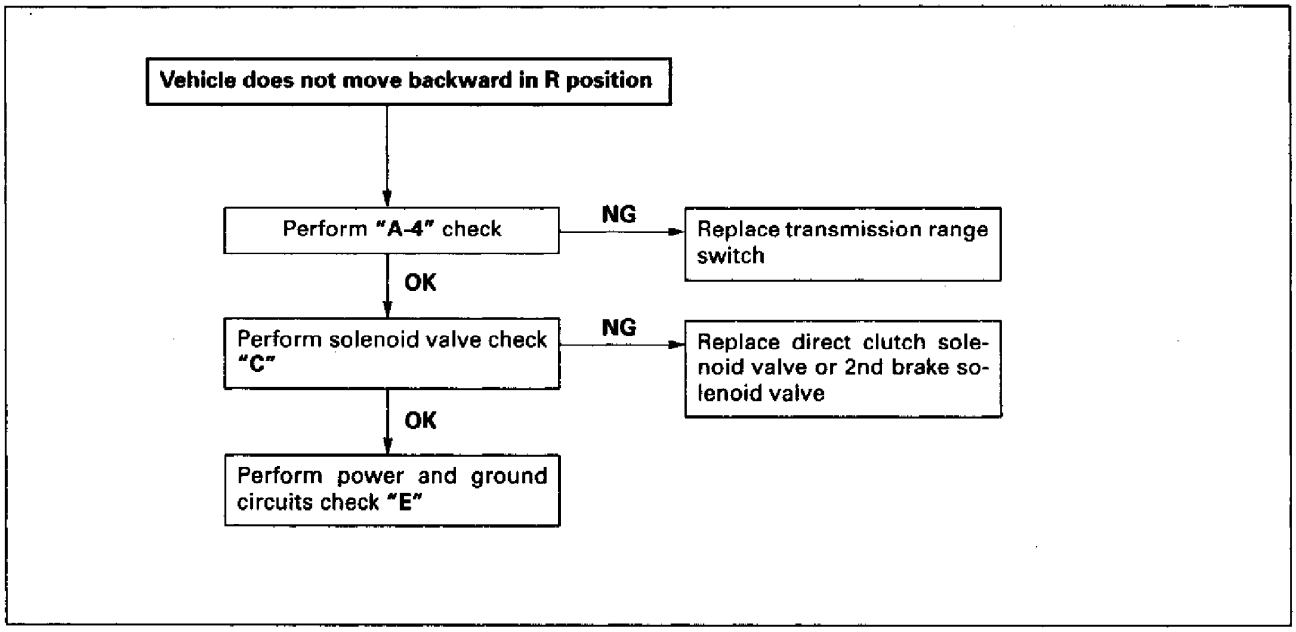
NO.	DIAGNOSTIC AREA	DIAGNOSIS
12	Normal	No problem exists as far as on-board diagnostic system (self-diagnosis system) is concerned.
61	Direct clutch solenoid valve	Open circuit.
62		Short circuit to ground.
63	2nd brake solenoid valve	Open circuit.
64		Short circuit to ground.
72	Transmission range switch	2 points or more are turned on at once or all points are open.

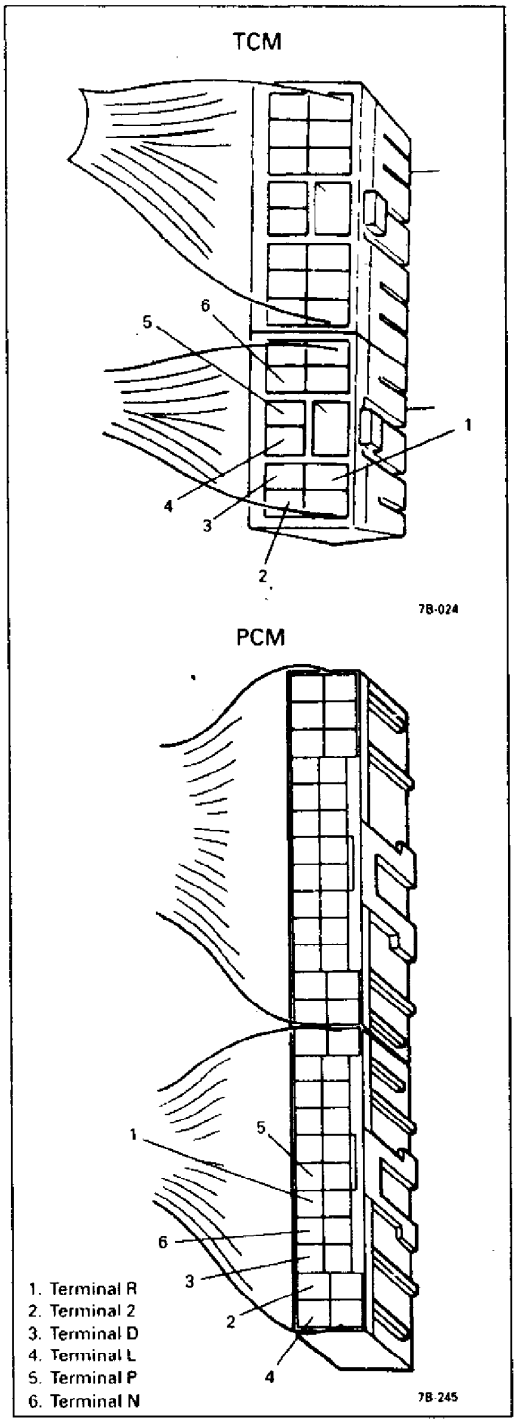
SYSTEMATIC TROUBLE SHOOTING




Gear shift failure in 2 position
Occasional gear shift depending on driving condition
No gear shift at all
With selector lever in 2 position, perform "A-2" check
NG
• Check harness and coupler
• Replace transmission range switch
OK
OK
• Check harness, coupler connection and ground
• Replace throttle position sensor
NG
Perform throttle position sensor check "D"
Perform vehicle speed sensor check "B"
NG
• Check harness, coupler connection and ground
• Replace vehicle speed sensor
OK
OK
Perform solenoid valve check "C"
NG
Replace 2nd brake solenoid valve
OK
Perform power and ground circuits check "E"


Gear is shifted to 2nd or 3rd gear while driving in L position.
NOTE:
Gear shift to 2nd may occur when selector lever is shifted from D or 2 to L, but this is normal.
Perform "A-3" check
NG
Replace transmission range switch
OK
Perform solenoid valve check "C"
NG
Replace direct clutch solenoid valve or 2nd brake solenoid valve
OK
Perform power and ground circuits check "E"

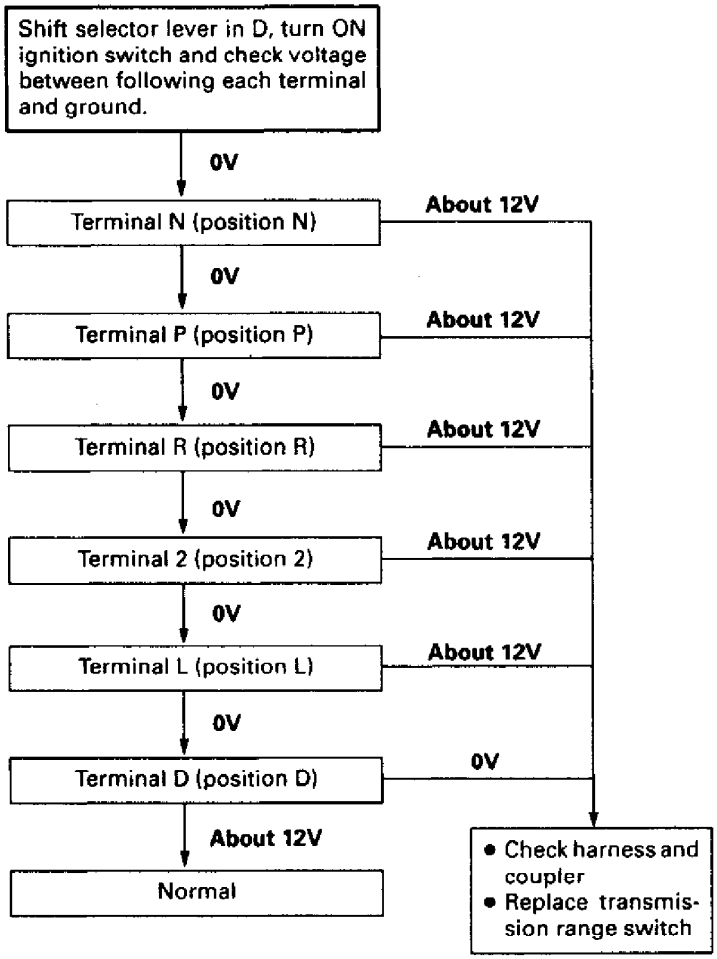

Vehicle does not move backward in R position
Perform "A-4" check
NG
Replace transmission range switch
OK
Perform solenoid valve check "C"
NG
Replace direct clutch solenoid valve or 2nd brake solenoid valve
OK
Perform power and ground circuits check "E"

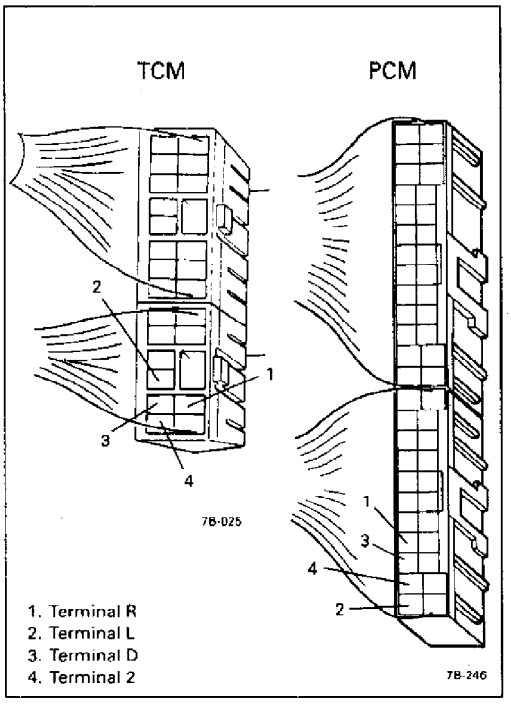


TRANSMISSION RANGE SWITCH CHECKING PROCEDURE

1) Turn OFF ignition switch.
2) Disconnect couplers from TCM or PCM.
3) For each check, bring tester probes in touch with coupler terminals from harness side.

A-1 Check Procedure



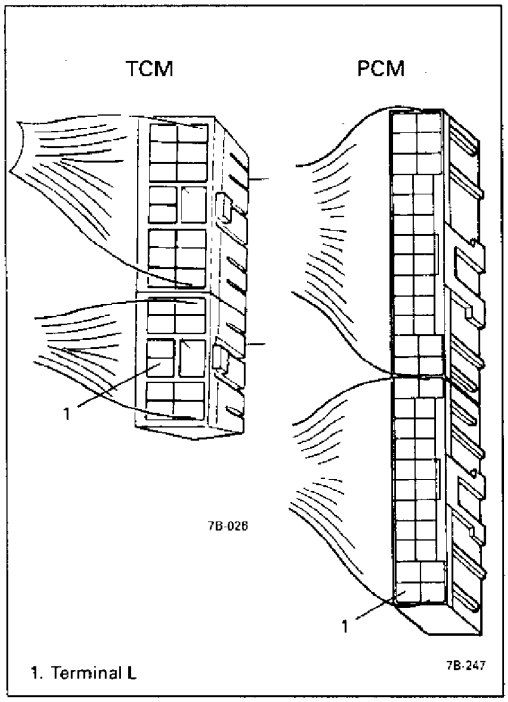


A-2 Check Procedure

Shift selector lever in 2, turn ON ignition switch and check voltage between following each terminal and ground.

Terminal L (position L)	About 12V
0V	
Terminal D (position D)	About 12V
0V	
Terminal R (position R)	About 12V
0V	
Terminal 2 (position 2)	0V
About 12V	
Normal	

- Check harness and coupler
- Replace transmission range switch

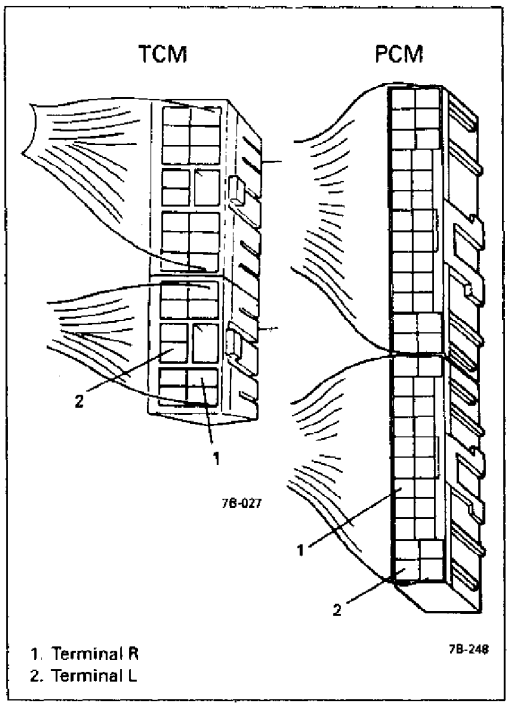


A-3 Check Procedure

Shift selector lever in L, turn ON ignition switch and check voltage between following each terminal and ground.

Terminal L (position L)	0V
About 12V	
Normal	

- Check harness and coupler
- Replace transmission range switch



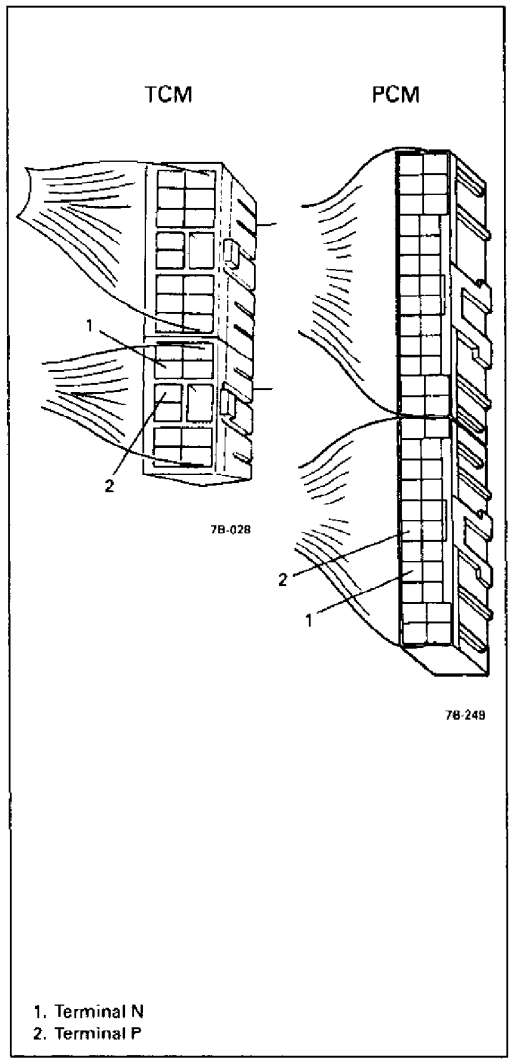
1. Terminal R
2. Terminal L

A-4 Check Procedure

Shift selector lever in R, turn ON ignition switch and check voltage between following each terminal and ground.

- Terminal L (position L) → About 12V
- Terminal L (position L) → 0V → Terminal R (position R)
- Terminal R (position R) → 0V
- Terminal R (position R) → About 12V → Normal

0V or About 12V →
- Check harness and coupler
- Replace transmission range switch



1. Terminal N
2. Terminal P

N P Check Procedure

Shift selector lever in N, turn ON ignition switch and check voltage between following each terminal and ground.

- Terminal N (position N) → 0V
- Terminal N (position N) → About 12V → Normal

0V or About 12V →
- Check harness and coupler
- Replace transmission range switch

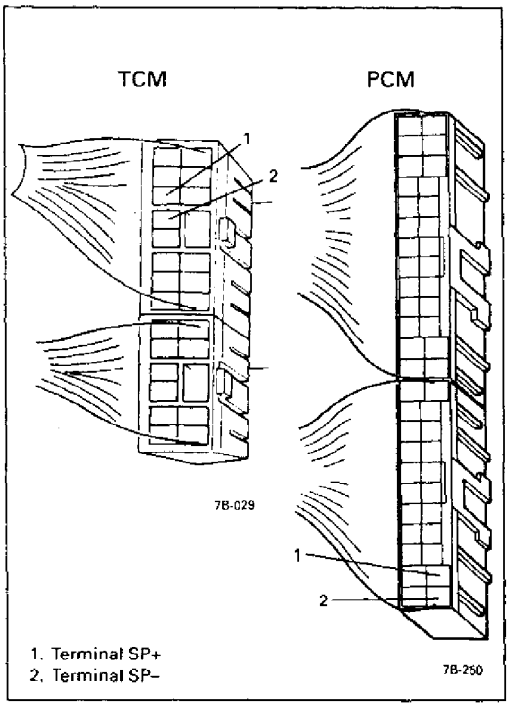
Shift selector lever in P, turn ON ignition switch and check voltage between following each terminal and ground.

- Terminal P (position P) → 0V
- Terminal P (position P) → About 12V → Normal

0V or About 12V →
- Check harness and coupler
- Replace transmission range switch

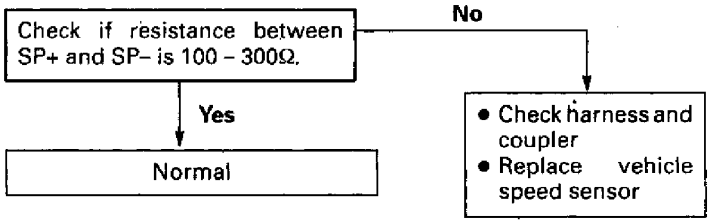
Separately from the above inspection, transmission range switch itself can be checked on continuity in each shift position. Refer to following table for connection and lead wire color.

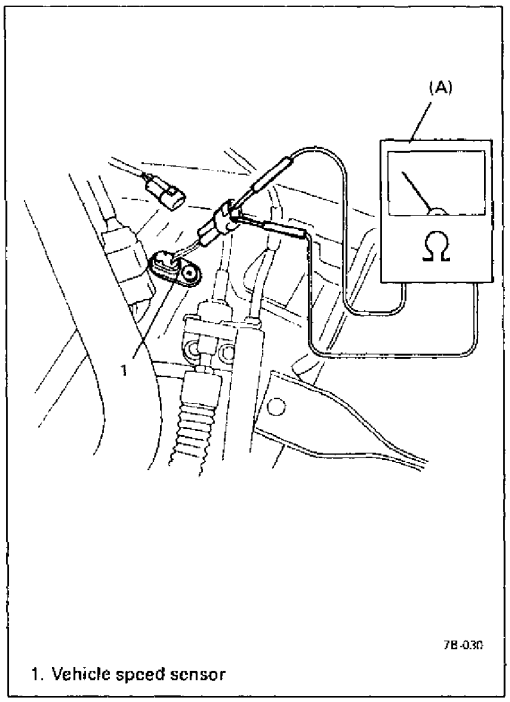
Position	Transmission range switch lead wire color								
	Black	Blue/ White	Blue	Green	Green/ Red	Green/ Blue	Red	Black/ Red	Black/ Yellow
P	○	○						○	○
R	○	—	—	—	—	—	○		
N	○	—	○					○	○
D	○	—	—	○					
2	○	—	—	—	○				
L	○	—	—	—	—	○			



VEHICLE SPEED SENSOR CHECKING PROCEDURE B

1) Turn OFF ignition switch.
2) Disconnect coupler(s) from TCM or PCM.
3) Bring ohmmeter probes in touch with coupler terminals from harness side.





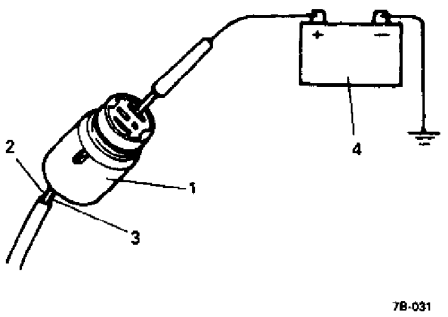
Separately from the above inspection, vehicle speed sensor itself can be checked on its resistance by disconneting coupler.

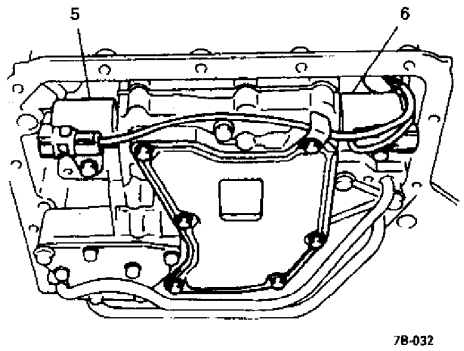
NOTE:

- **Function of vehicle speed sensor can be checked by measuring generated pulse as voltage.**
- **For its measurement, use an analog type voltmeter while spinning wheels on lift and with selector lever in D position.**

Special Tool
(A): 09900-25002

Vehicle speed sensor specifications	
Coil resistance	100 – 300 Ω
Output voltage at 40 km/h (37 mile/h)	Approximately 1V

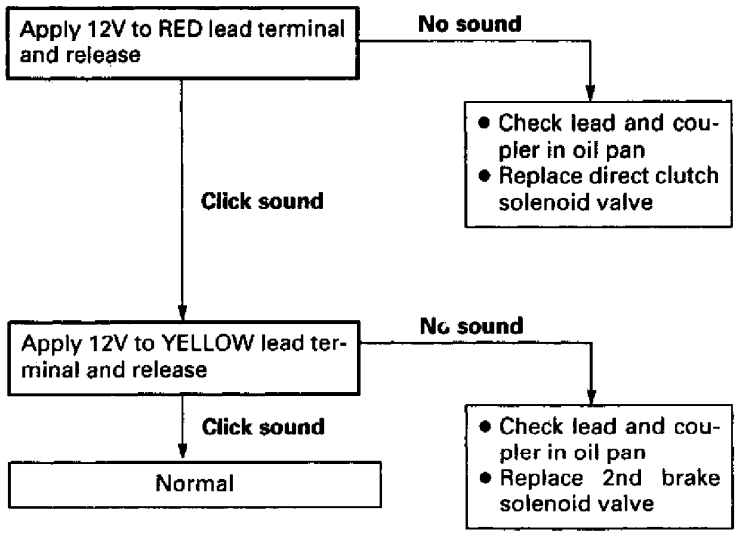




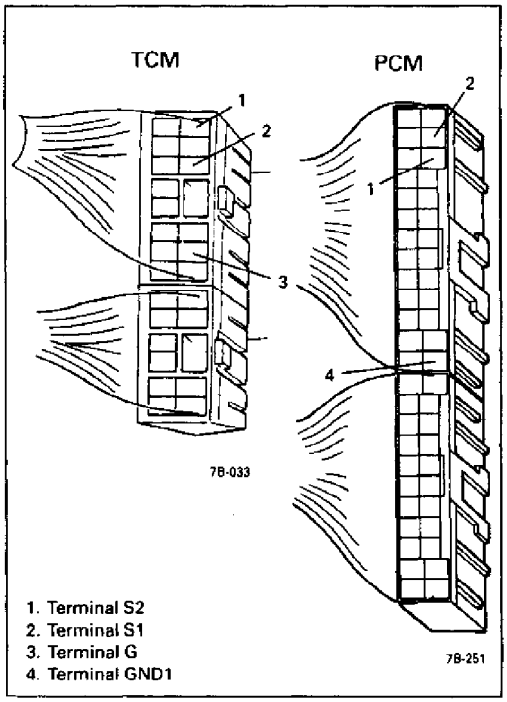
1. Solenoid valve wire coupler
2. RED wire for direct clutch solenoid
3. YELLOW wire for 2nd brake solenoid
4. 12V battery
5. 2nd brake solenoid valve
6. Direct clutch solenoid valve

SHIFT SOLENOID VALVE CHECKING PROCEDURE C

1) Disconnect shift solenoid valve coupler from harness.
2) Apply 12V to each terminal in solenoid valve coupler and check to be sure that a click sound is heard.



NOTE:
Refer to p. 7B-20 for physical function check of solenoid valves.



1. Terminal S2
2. Terminal S1
3. Terminal G
4. Terminal GND1

Shift solenoid valve circuit will be checked by using ohmmeter at TCM coupler.

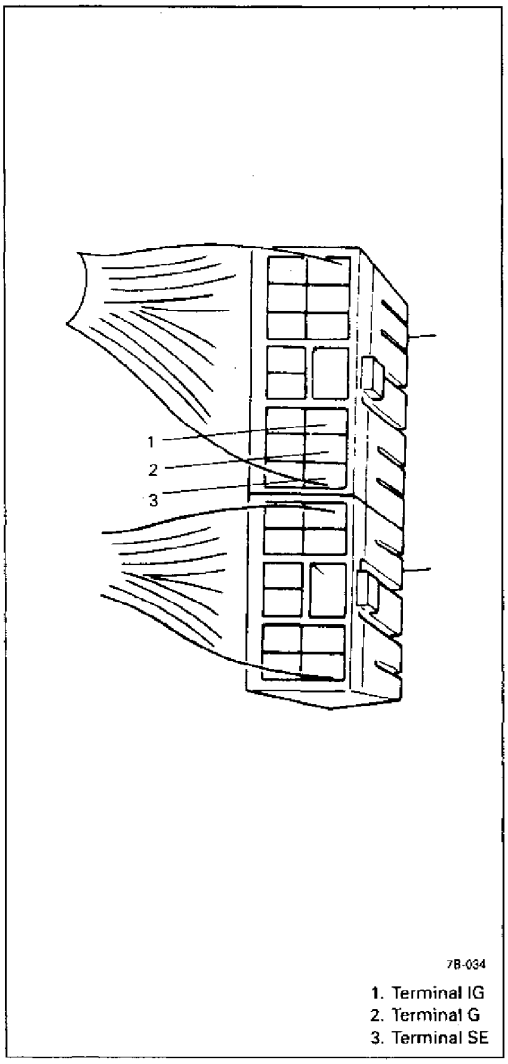
1) With ignition switch turned OFF, disconnect TCM or PCM coupler.
2) Bring ohmmeter probes in touch with coupler terminals from harness side and measure each resistance.

Solenoid	Terminal	Resistance
Direct clutch	S1 – G or GND1	8 – 20 Ω
2nd brake	S2 – G or GND1	8 – 20 Ω

THROTTLE VALVE OPENING SIGNAL CHECKING PROCEDURE D

FUEL INJECTION MODEL, for its procedure, refer to Section 6E1 of this manual.

CARBURETOR MODEL, for its procedure, refer to section 6D of this manual.

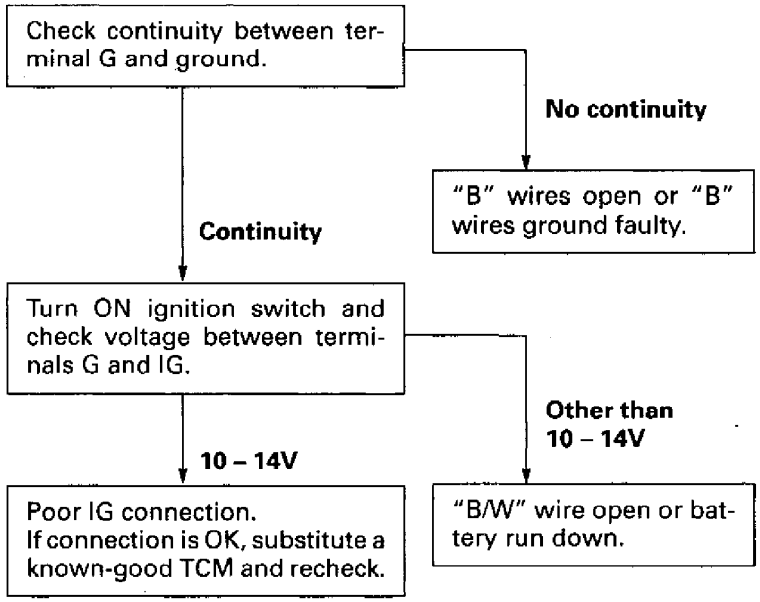


1. Terminal IG
2. Terminal G
3. Terminal SE

POWER AND GROUND CIRCUITS CHECKING PROCEDURE E
(FOR CARBURETOR MODEL)

NOTE:
For its procedure for FUEL INJECTION MODEL, refer to Section 6E1 of this manual.

1) Disconnect couplers from transmission control module (TCM).
2) Bring tester probes in each with coupler terminals from harness side.



ON-VEHICLE SERVICE

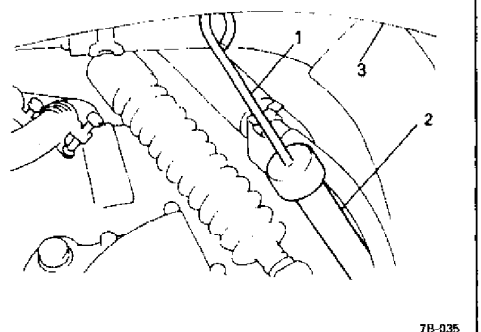
MAINTENANCE SERVICE

FLUID LEVEL

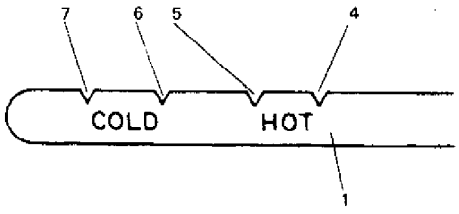
HOT Level Check at Normal Operating Temperature

Be sure to check fluid level at every engine oil change. As automatic transmission is designed to operate at normal operating temperature which corresponds to 70°C – 80°C (158°F – 176°F) of fluid, perform fluid level check when fluid temperature is within the above temperature range. Driving at 60 km/h (37 mile/h) in D range for about 15 minutes will raise fluid temperature to normal operating temperature.

1) Place vehicle on level surface.
2) Apply parking brake and block vehicle wheels.
3) With selector lever in P position, start engine. But DO NOT RACE ENGINE.
4) Run engine at idle speed and move selector lever through each range and put it in P position again.
5) With engine running at idle, remove oil level gauge from oil filler tube and wipe off oil level gauge with clean cloth.
6) Reinsert oil level gauge all the way into oil filler tube.
7) Take up the gauge and check oil level on it. The level should be between FULL HOT and LOW HOT marks. If level is below LOW HOT mark, add fluid to bring level to FULL HOT mark.



7B-035



7B-036

1. Oil level gauge
2. Oil filler tube
3. Radiator hose
4. FULL HOT mark
5. LOW HOT mark
6. FULL COLD mark
7. LOW COLD mark

NOTE:

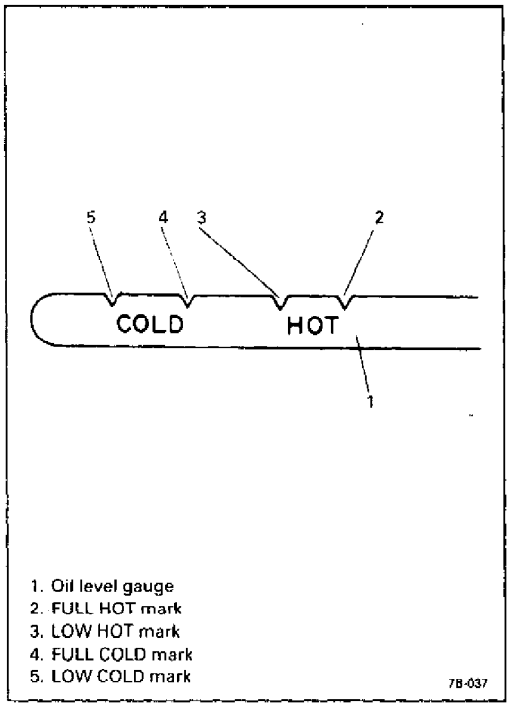
- **Do not overfill. Overfilling can cause foaming and loss of fluid through vent. Then slippage and transmission failure can result.**
- **Bringing fluid level from LOW HOT to FULL HOT requires 0.35 liters (0.74/0.62 US/Imp. pt).**
- **Lesser volume than following table may fill up transmission, in case that oil pan only is removed leaving valve body as it is and reinstalled soon.**

A/T fluid specification
An equivalent of DEXRON®-II, IIE, III

Fluid capacity	
Pan and valve body removal (left for 2 hours or more)	3.5 liters (7.4/6.2 US/Imp. pt)
Overhaul (assembled with a new torque converter)	4.9 liters (10.4/8.6 US/Imp. pt)

COLD Level Check at Room Temperature of About 25°C (77°F)

If transmission was overhauled or fluid was drained for oil pan (and or valve body) service, refill fluid after assembling and check its level according to following procedure.



1. Oil level gauge
2. FULL HOT mark
3. LOW HOT mark
4. FULL COLD mark
5. LOW COLD mark

1) Place vehicle on level surface.
2) Apply parking brake and block vehicle wheels.
3) With selector lever in P position, start engine and run it at idle for 5 minutes. DO NOT RACE ENGINE.
4) Move selector lever through each range and put it in P position again.
5) With engine running at idle, check fluid level on oil level gauge. Fluid level should be between FULL COLD and LOW COLD marks on oil level gauge.
6) If level is below LOW COLD mark, add fluid to bring level between LOW COLD and FULL COLD marks. Use DEXRON®-II, IIE, III) or equivalent automatic transmission fluid.
   DO NOT OVERFILL.

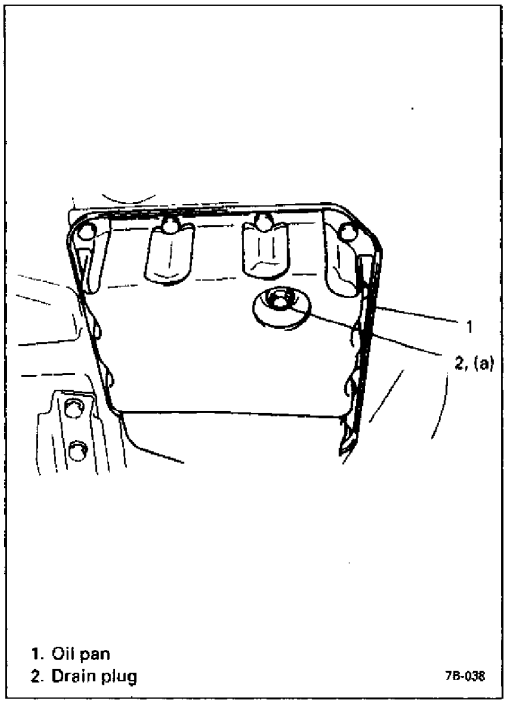
The above COLD level check is strictly temporary. Therefore, as a final check perform HOT level check at normal operating temperature as described previously.

FLUID CHANGE INTERVALS

If the vehicle is usually used under one or more of following severe conditions, change fluid every 160,000 km (100,000 miles).

Severe Condition

- In heavy city traffic where outside temperature regularly reaches 32°C (90°F).
- In very hilly or mountainous areas.
- Commercial use, such as taxi, police vehicle or delivery service.



1. Oil pan
2. Drain plug

7B-038

CHANGING FLUID

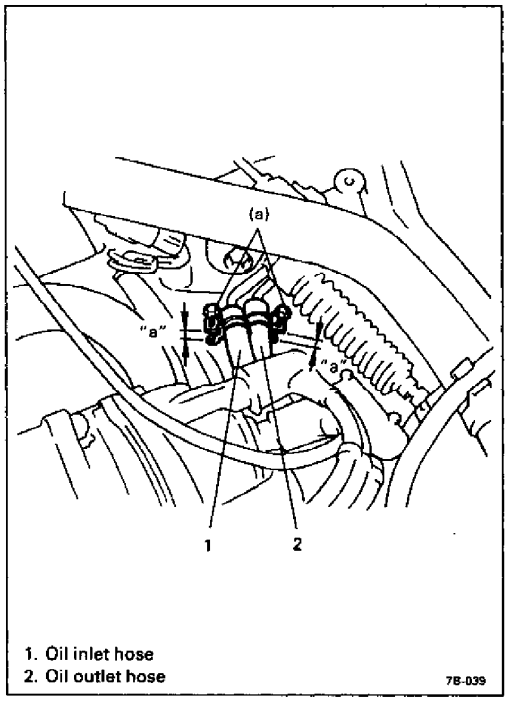
1) Raise vehicle.
2) With transmission cool, remove drain plug and drain fluid.
3) Install drain plug gasket and drain plug to oil pan, and tighten drain plug to specification.

Tightening Torque
(a): 21 N·m (2.1 kg-m, 15.0 lb-ft)

4) Remove oil level gauge from oil filler tube, and add new fluid from oil filler tube. Use DEXRON®-II, IIE, III or equivalent automatic transmission fluid.

NOTE:
- **About 0.8 liters (1.7/1.4 US/Imp.pt) of fluid would be necessary to refill oil pan.**
- **Draining or refilling volume of fluid may change depending on draining time or temperature etc.**

5) Check fluid level with transmission at room temperature and at normal operating temperature as previously outlined.



1. Oil inlet hose
2. Oil outlet hose

7B-039

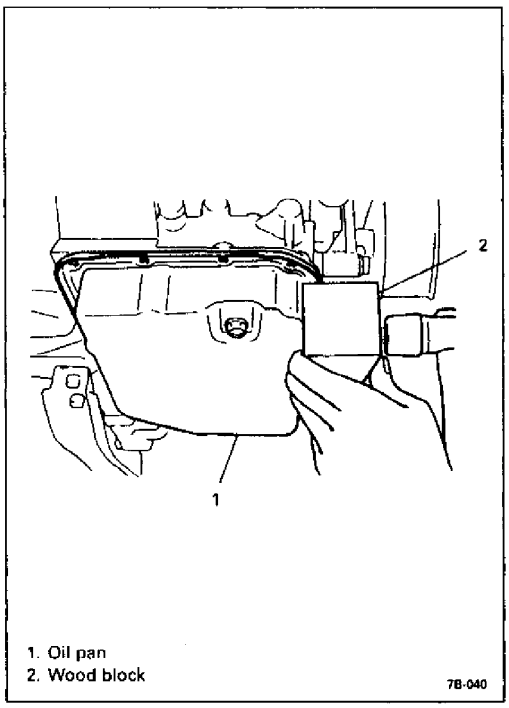
OIL COOLER HOSES

Rubber hoses for oil cooler should be replaced every 3 years or 60,000 km (36,000 miles), when replacing it, be sure to note the following.

- Replace clamps at the same time.
- Tighten clamps to specified torque.
- Check for fluid leakage after replacing.
- Confirm fluid level at normal operating temperature.

Tightening Torque
(a): 1.5 N·m (0.15 kg-m, 1.0 lb-ft)

Remaining thread for specified torque
"a": 7 – 5 mm (0.27 – 0.19 in.) as rough standard



1. Oil pan
2. Wood block

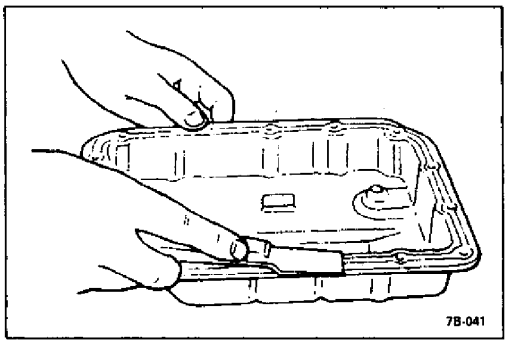
7B-040

OIL PAN GASKET

REMOVAL

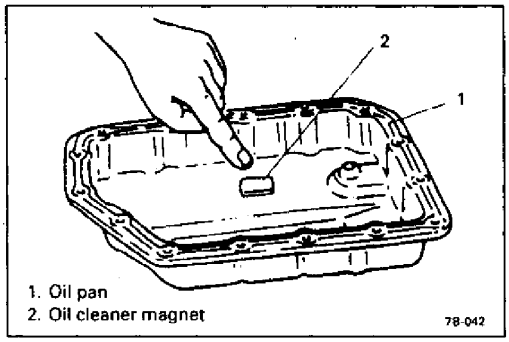
1) Raise vehicle and drain transmission fluid.
2) Remove oil pan from transmission.
   After removing oil pan bolts, tap around oil pan lightly with a plastic hammer for removal.

CAUTION:
- **Never hammer oil pan hard, or it may get deformed.**
  It is recommended to hit oil pan indirectly through wood block.
- **Do not force oil pan off by using a flat tip screwdriver or the like as it may cause damage to gasketed surface.**



7B-041

3) Remove gasket on mating surface thoroughly.



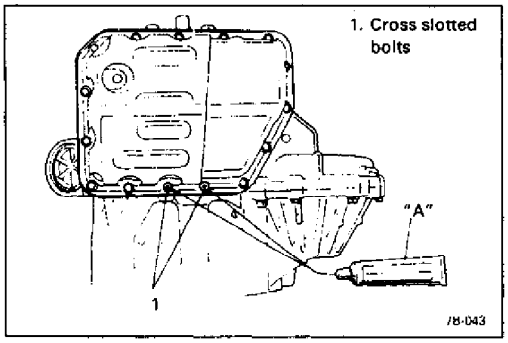
1. Oil pan
2. Oil cleaner magnet

7B-042

INSTALLATION

For oil pan installation, reverse its removal procedure using care for the following.

1) Make sure to use new gasket.
2) Clean inside of oil pan before installation.
3) Clean oil cleaner magnet and install it in the position right below oil strainer.

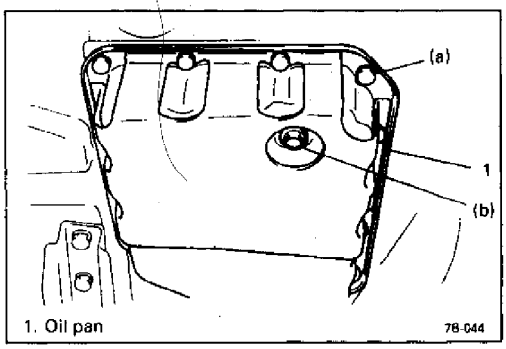


7B-043

4) There are 15 oil pan securing bolts in all and two of them have cross slot in their heads.
   Mount these cross slotted bolts in such positions as shown in figure after applying sealant to their threads. However, do not apply sealant to other 13 bolts.

CAUTION:
Do not use sealant to gasket surface.

"A": SUZUKI BOND No.1215, 99000-31110



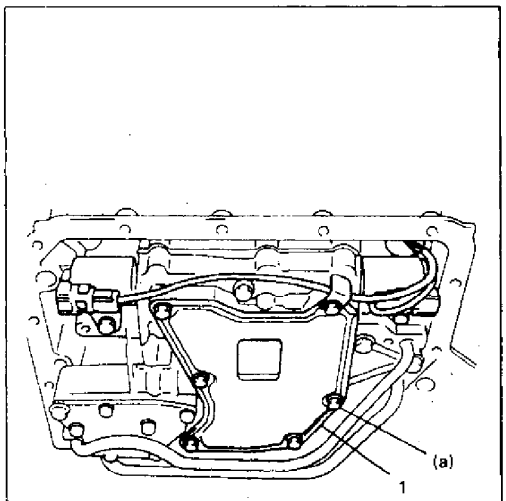
1. Oil pan 7B-044

5) Tighten oil pan bolts to the following torque one after another diagonally.

CAUTION:
Over tightening of bolts may cause fluid leakage.

Tightening Torque
(a): 5 N·m (0.5 kg-m, 3.5 lb-ft)
(b): 21 N·m (2.1 kg-m, 15.0 lb-ft)

6) Upon completion of installation, warm up transmission and check for fluid level and leakage.



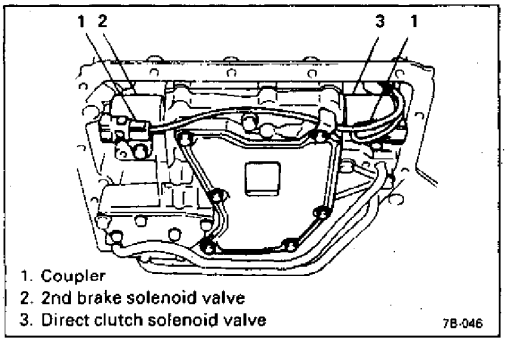
1. Oil strainer 7B-045

OIL STRAINER

1) Drain transmission fluid.
2) Remove oil pan.
3) Remove oil strainer.
4) Clean oil strainer.
5) Install oil strainer to lower valve body.

Tightening Torque
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

6) Reinstall oil pan and refill transmission fluid.
7) Upon completion of installation, warm up transmission and check for fluid level and leakage.

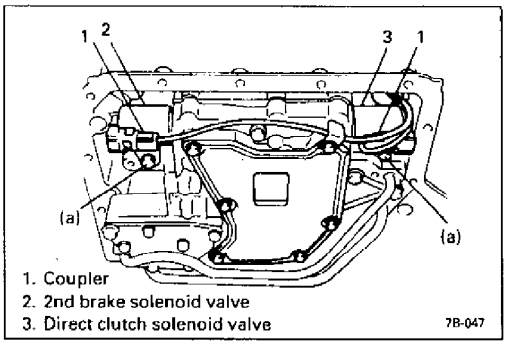


1. Coupler
2. 2nd brake solenoid valve
3. Direct clutch solenoid valve 7B-046

SHIFT SOLENOID VALVES

REMOVAL

1) Drain transmission fluid and remove oil pan.
2) Disconnect couplers from direct clutch and 2nd brake solenoid valves, and then remove solenoid valves.
3) Remove solenoid valve wire harness with grommet from upper side.

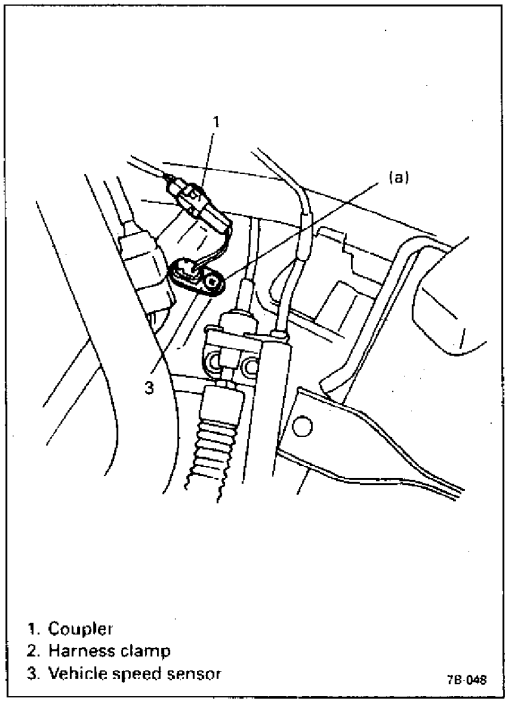


INSTALLATION

1) Install solenoid valve wire harness to transmission case. If grommet seal (O-ring) is damaged, replace.
2) Install direct clutch and 2nd brake solenoid valves to lower valve body. If solenoid seal (O-ring) is damaged, replace.

Tightening Torque
(a): 8 N·m (0.8 kg-m, 6.0 lb-ft)

3) Connect solenoid valve wires to each solenoid valve.
4) Install oil pan to transmission and then refill transmission fluid.
5) Connect solenoid valve wire harness coupler.
6) Upon completion of installation, warm up transmission and check for fluid level and leakage.



VEHICLE SPEED SENSOR

1) Undo wiring harness clamp.
2) Disconnect vehicle speed sensor coupler.
3) Remove vehicle speed sensor bolt.
4) Pull out vehicle speed sensor by gripping sensor body.
5) For installing, reverse removal procedure.

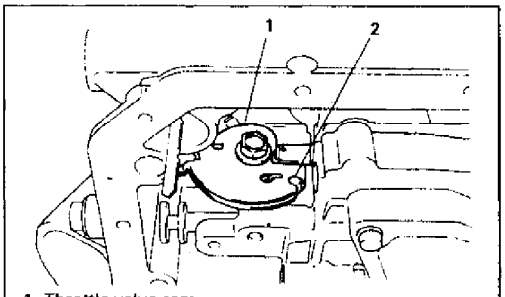
NOTE:
Check to be sure that O-ring is in good condition.

Tightening Torque
(a): 8 N·m (0.8 kg-m, 6.0 lb-ft)

OIL PRESSURE CONTROL CABLE

REMOVAL

1) Disconnect oil pressure control cable from accelerator cable after removing cable cover.
2) Drain transmission fluid.
3) Remove oil pan.



1. Throttle valve cam
2. Oil pressure control cable end

7B-049

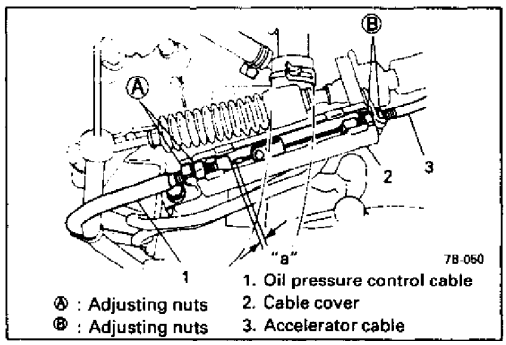
4) Disconnect oil pressure control cable from throttle valve cam.

NOTE:
Oil pressure control cable can be disconnected from throttle valve cam without removal of 2nd brake solenoid.

5) Disconnect oil pressure control cable from transmission case.

INSTALLATION

Reverse removal procedure for installation. After connecting oil pressure control cable to accelerator cable, check and adjust oil pressure control cable play.



7B-050

1. Oil pressure control cable
2. Cable cover
3. Accelerator cable

Ⓐ : Adjusting nuts
Ⓑ : Adjusting nuts

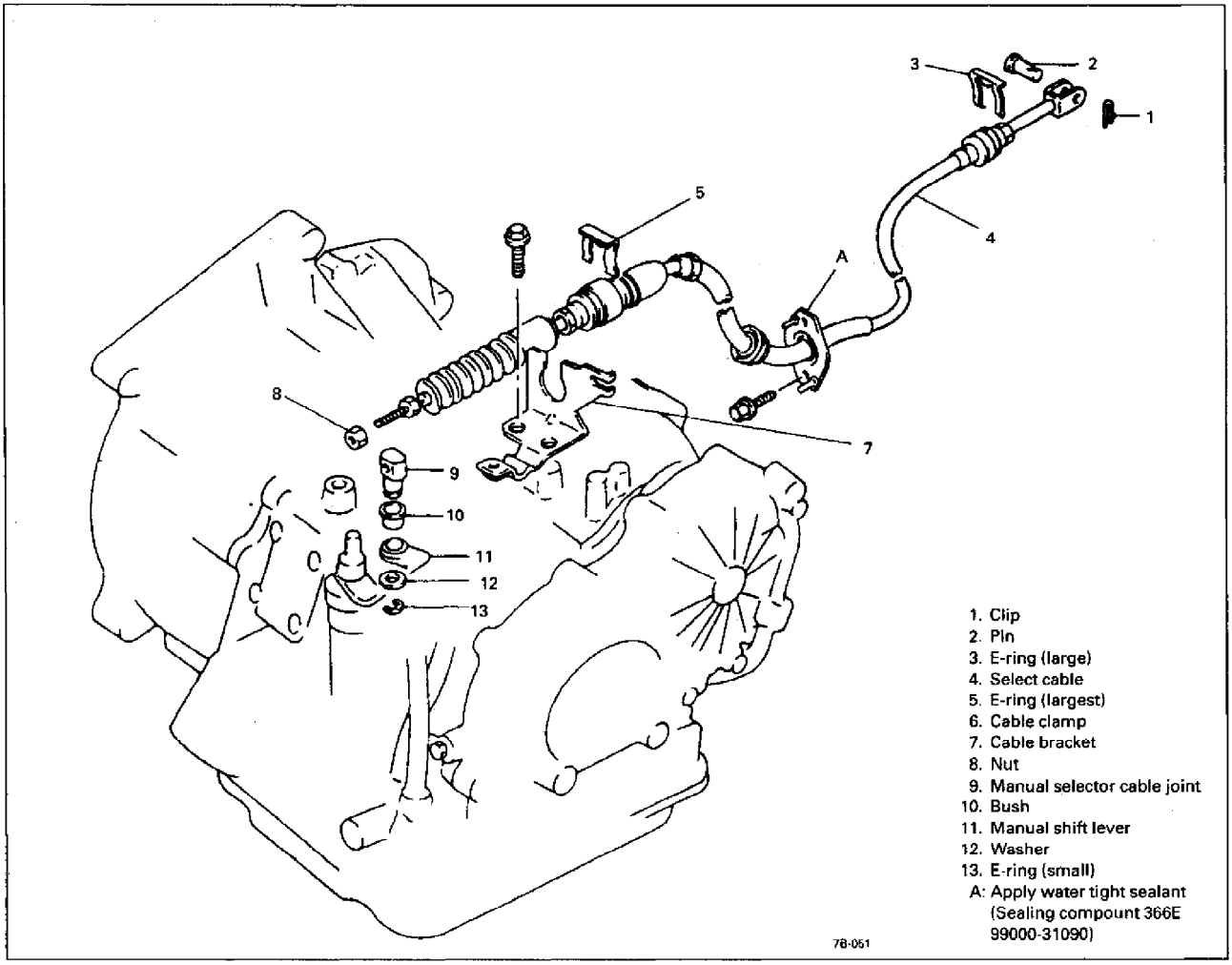
ADJUSTMENT

1) With cable cover removed, adjust clearance "a" to specification by turning nuts Ⓐ. Nuts Ⓑ can be used for this adjustment if necessary.

Clearance "a": 0 – 0.5 mm (0 – 0.02 in.)

2) Tighten nuts and install cable cover.

SELECT CABLE

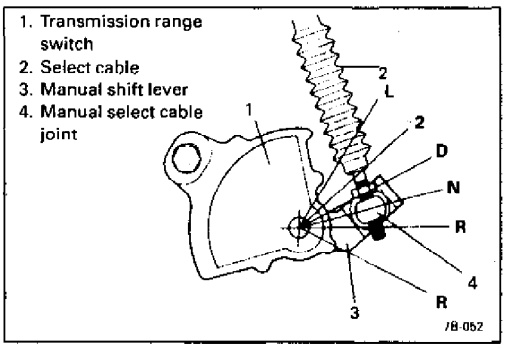


REMOVAL

1) Remove console box, if equipped.
2) Remove parking brake lever cover and shift control lever cover.
3) Remove select indicator.
4) Disconnect select cable from selector lever and then from floor bracket.
5) Disconnect select cable from transmission.
6) Disconnect select cable from dash panel.

INSTALLATION

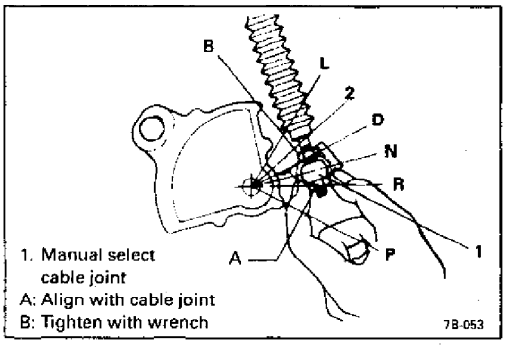
Install select cable by reversing removal procedure. Apply grease to pin and cable joint. Adjusting procedure is as follows.



ADJUSTMENT

1) Before tightening cable end nut, shift selector lever to N.
2) Also shift manual shift lever to N.

NOTE:
Make sure that nut and cable joint have clearance under above conditions.



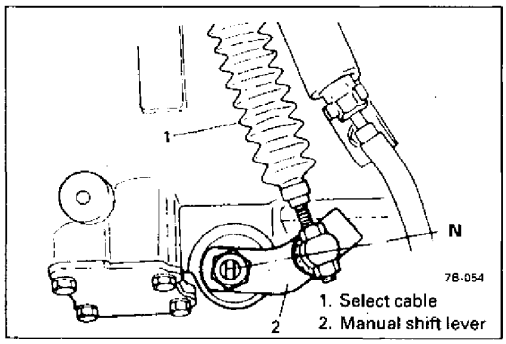
3) Turn nut A by hand till it contacts manual select cable joint.
   Then tighten nut B with wrench.
4) After select cable was installed, check for the following.
   - Push vehicle with selector lever shifted to P.
     Vehicle should not move.
   - Vehicle can not be driven in N.
   - Vehicle can be driven in D, 2 and L.
   - Vehicle can be backed in R.

TRANSMISSION RANGE SWITCH

REMOVAL

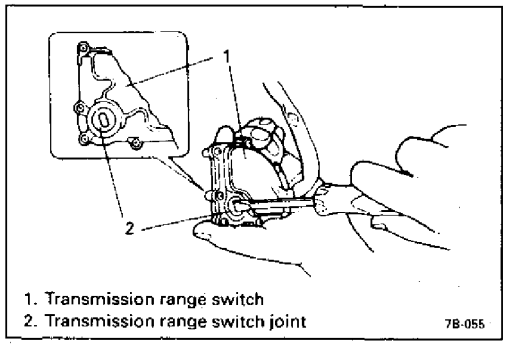
1) Disconnect transmission range switch coupler.
2) Remove transmission range switch from transmission.

CAUTION:
Do not overhaul transmission range switch.

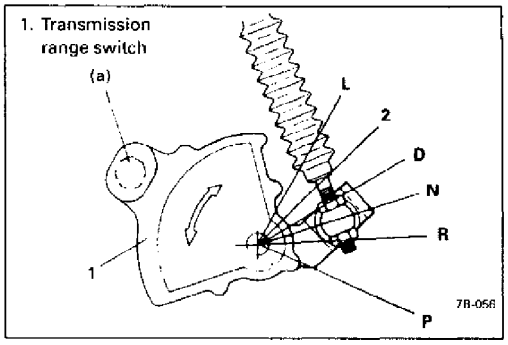


INSTALLATION

1) Shift manual shift lever to N, that is, to shift selector lever to N.



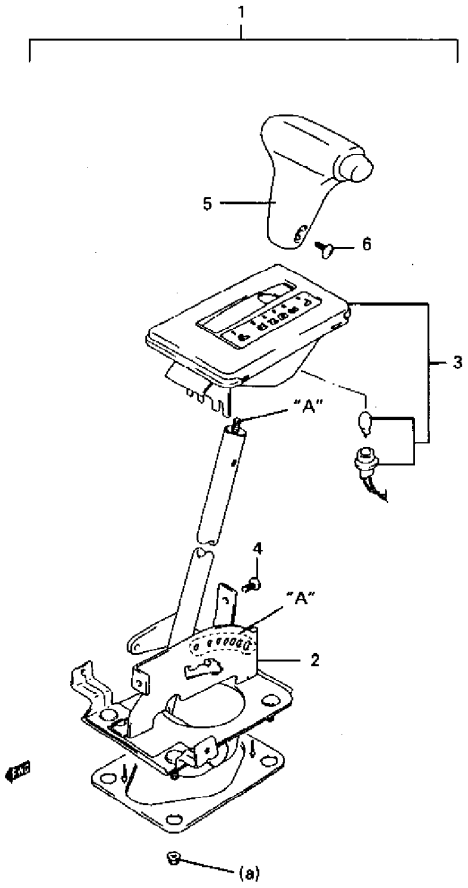
2) Using flat tip screwdriver, turn transmission range switch joint clockwise or counterclockwise to the position shown in figure and check that a "click" is heard from joint at this position.



3) After installing transmission range switch to manual shift shaft, move transmission range switch by hand in arrow direction as shown in figure. Stop at the position where a "click" from joint is heard or felt by hand and then secure it.

Tightening Torque
(a): 18 N·m (1.8 kg-m, 13.5 lb-ft)

4) Connect coupler and clamp wire harness.
5) Upon completion of transmission range switch installation, check for its proper installation according to the following.
   ① Apply parking brake and block vehicle wheels.
   ② With selector lever shifted to P, turn starter switch ON and check that this causes starting motor to operate.
   ③ Shift selector lever from P to N, turn starter switch ON and check that this causes starting motor to operate.
   ④ Shift selector lever from N to L and then back to N, turn starter switch ON and check that this causes starting motor to operate.
   ⑤ Shift selector lever from N to P and check starting motor for operation as in step ④.
   ⑥ Check to make sure that in any other range than P and N, starting motor doesn't operate even when starter switch is turned ON.
   ⑦ Turn ignition switch ON (without starting engine) and shift selector lever to R. Then check that back up lights light.
6) If any check result was unsatisfactory in step ⑤, remove transmission range switch and perform step ① to ④ all over again.



1. Selector assembly
2. Selector lever assembly
3. Indicator assembly
4. Screw
5. Knob assembly
6. Screw

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MANUAL SELECTOR

REMOVAL

1) Remove selector knob screws and then selector knob.
2) Remove console box, if equipped.
3) Remove select indicator assembly.
4) Remove illumination lamp coupler.
5) Remove select cable from selector lever.
6) Hoist vehicle.
7) Remove 4 housing nuts.
8) Remove lever housing with selector lever from floor.

NOTE:

- **Knob and push button must not be disassembled.**
- **Do not drive out detent pin.**

INSTALLATION

Assemble selector by reversing removal procedure, replacing parts with new ones as necessary. Apply grease to portions indicated as "A" in figure.

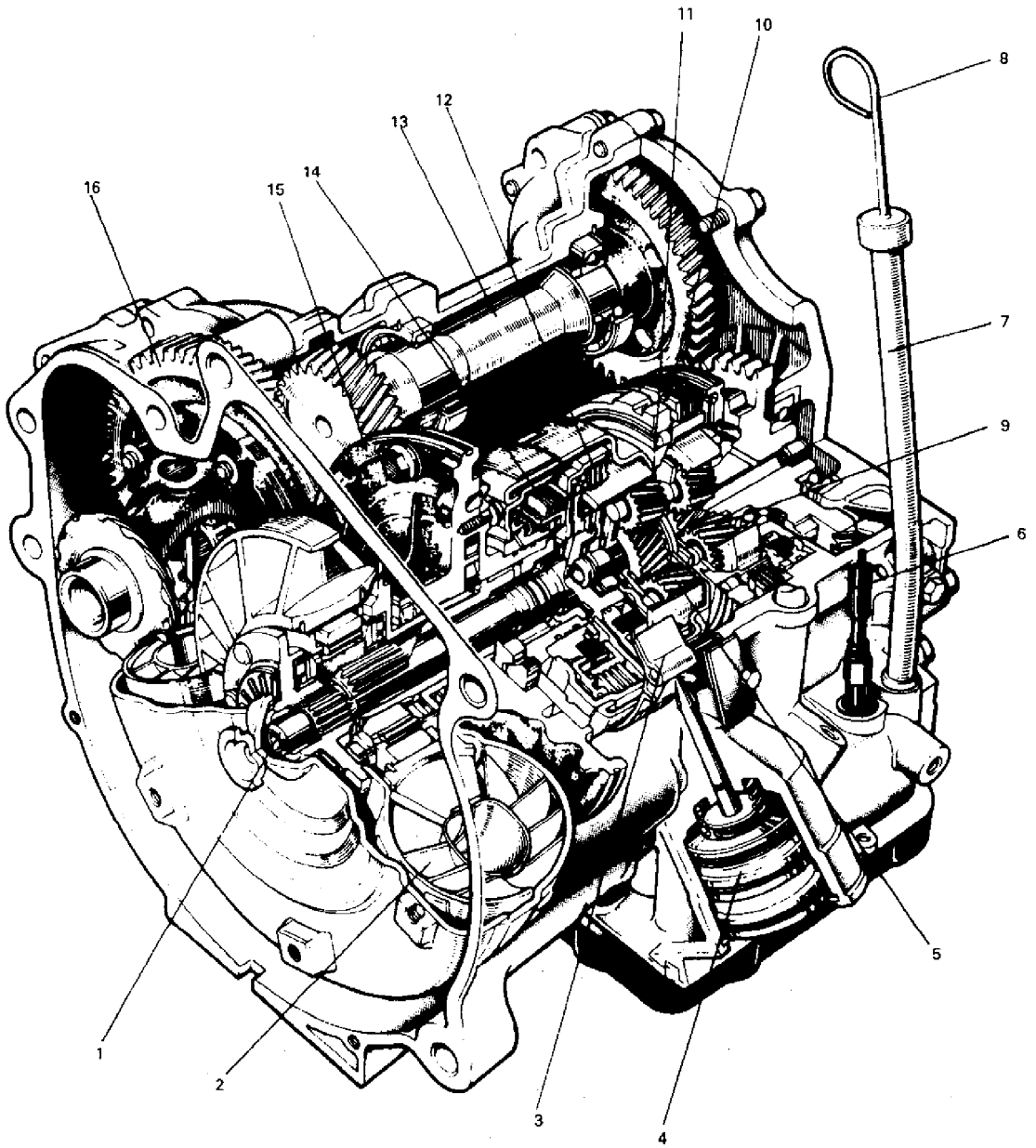
NOTE:

- **When installing knob, make sure that there is a slight clearance between detent pin and cam bottom when knob button is pushed in all the way.**
- **Check selector for proper operation as follows.**
  1. **With knob button pushed half way, N to R and D to 2 shifts are available (but not any other shift).**
  2. **With knob button pushed all the way in, 2 to L and R to P shifts are available.**
- **Check that illumination lamp lights when light switch is turned ON.**

Tightening Torque

(a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

TRANSMISSION UNIT REPAIR OVERHAUL



1. Input shaft
2. Torque converter
3. Second brake band
4. Second brake piston cover
5. Front planetary gear
6. Oil pressure control cable
7. Oil filler tube
8. Oil level gauge
9. Rear planetary gear
10. 1st-reverse brake
11. One-way clutch
12. Forward clutch
13. Countershaft
14. Direct clutch
15. Oil pump
16. Differential

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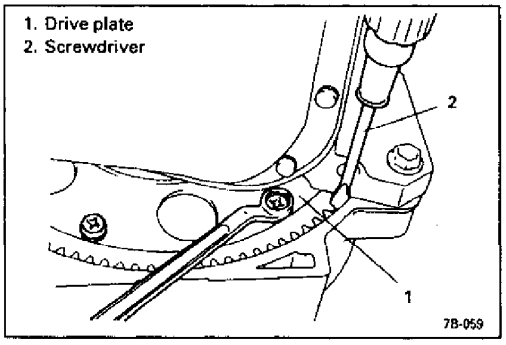
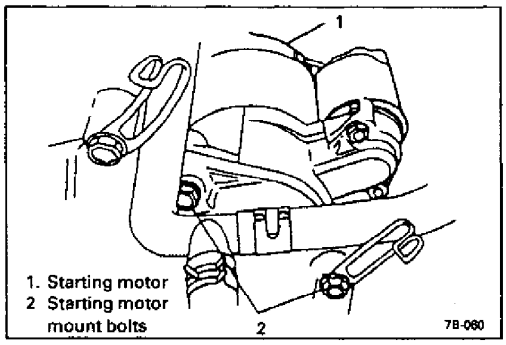


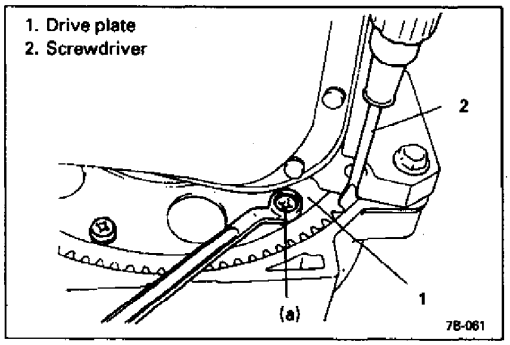


DISMOUNTING

1) Take down engine with transmission. (Refer to Section 6A1.)
2) Disconnect vehicle speed sensor, shift solenoid and transmission range switch from engine harness at couplers.
3) Remove torque converter housing lower plate.
4) Remove drive plate bolts.
   To lock drive plate, engage a screwdriver with the drive plate gear.
5) Remove starting motor.
6) Remove bolts and nuts fastening engine and transmission, and remove transmission from engine.

NOTE:
When removing transmission from engine, move it in parallel with crankshaft and use care so as not to apply excessive force to drive plate and torque converter.

WARNING:
Be sure to keep transmission with torque converter horizontal or facing up throughout the work. Should it be tilted with torque converter down, converter may fall off and cause personal injury

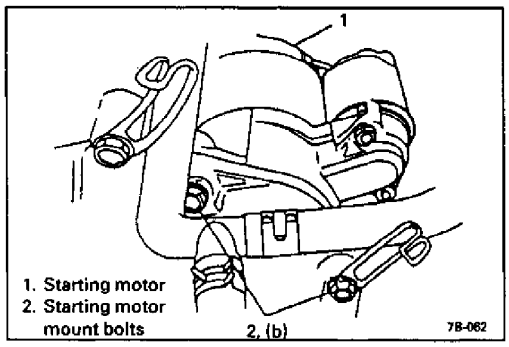


REMOUNTING

For remounting, reverse dismounting procedure.
The important steps in installation are as follows.

- Tighten drive plate bolts to specified torque.

  Tightening Torque
  (a): 18.5 N·m (1.85 kg-m, 13.5 lb-ft)



- Tighten starting motor mounting bolts.

  Tightening Torque
  (b): 23 N·m (2.3 kg-m, 16.5 lb-ft)

- Remount engine with transmission according to procedure described in Section 6A1.

- Set each clamp for wiring securely.
- Adjust accelerator cable.
- Adjust select cable.
- Refill fluid and adjust its level at normal operating temperature.
- Check to confirm engine and transmission function acceptably.
- Make sure that there is no evidence of fluid leakage.

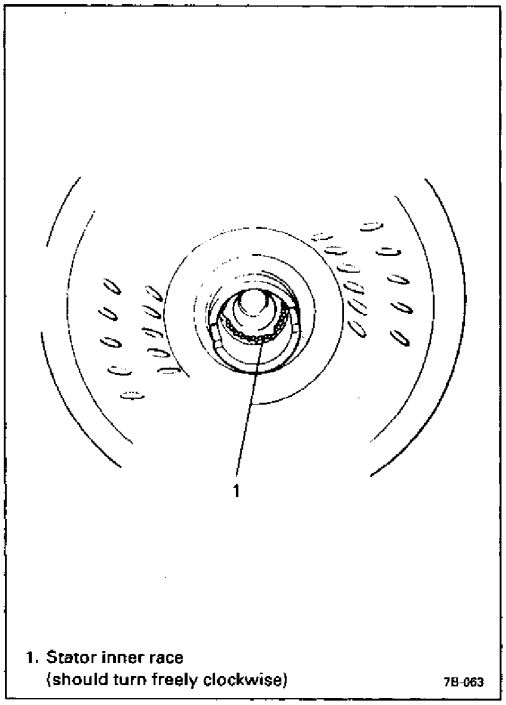
COOLER LINE FLUSHING

In a major transmission failure, where particles of metal have been carried with the fluid throughout transmission, it will be necessary to flush out oil cooler and connecting lines thoroughly.

TORQUE CONVERTER DIAGNOSIS

STATOR ASSEMBLY FREEWHEELS

If the stator roller clutch becomes ineffective, the stator assembly freewheels at all times in both directions. With this condition, the vehicle tends to have poor acceleration from a standstill. If poor acceleration problems are noted, what to be checked first are that the exhaust system is not blocked, the engine is running properly and the transmission is in 1st gear when starting out.



1. Stator inner race (should turn freely clockwise) 7B-063

STATOR ASSEMBLY REMAINS LOCKED UP

If the stator assembly remains locked up at all times, the engine rpm and vehicle speed will tend to be limited or restricted at high speeds. The vehicle performance when accelerating from a standstill will be normal. Engine overheating may be noted. Visual examination of the converter may reveal a blue color from the overheating that will result.

Under above conditions, if the converter has been removed from the transmission, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions.
The inner race should turn freely clockwise, but be heavy to turn counterclockwise.

NOTE:

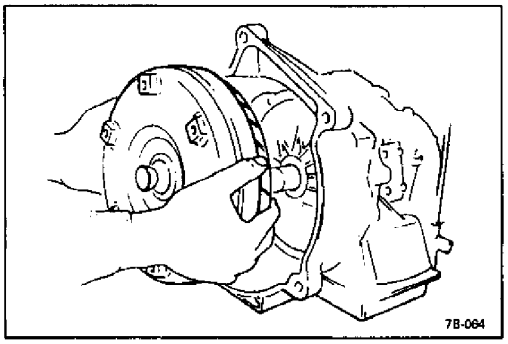
- **Converter placed with its flange upright does not fit for this inspection.**
- **For proper checking, position converter with its flange horizontal.**
- **Turn stator inner race clockwise as quickly as possible with finger, then turn reversely at the same speed and feel difference of enertia.**

DO NOT REPLACE CONVERTER FOR FOLLOWING CONDITIONS:

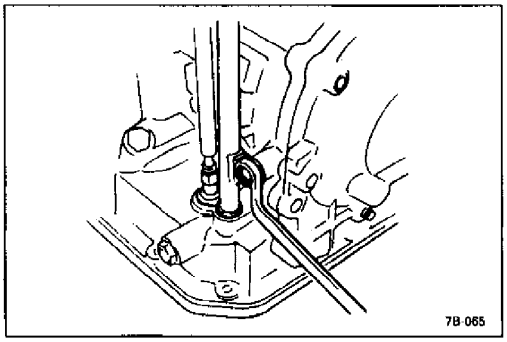
1) The fluid has an odor, is discolored, and there is no evidence of metal particles. There is no indication of existence of internal damage, or oil pump damage. Dump out as much fluid as possible from the converter and replace only the oil pump screen in the pan.
2) A small amount of wear (sometimes referred to as fretting wear) appears on the hub where the oil pump drive gear is located. A certain amount of such wear is normal for both the hub and oil pump gear. Neither the converter nor the oil pump assembly should be replaced.

DISASSEMBLY

CAUTION:
- **Thoroughly clean transmission exterior before overhauling it.**
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**



1) Remove torque converter.

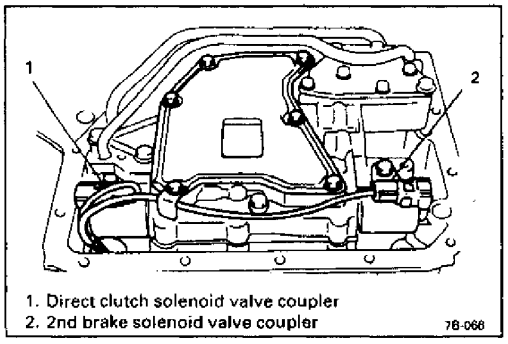


2) Remove engine mounting LH bracket.
3) Remove oil level gauge and oil filler tube.
4) Drain transmission fluid.
   To drain fluid better, tilt transmission in various directions.

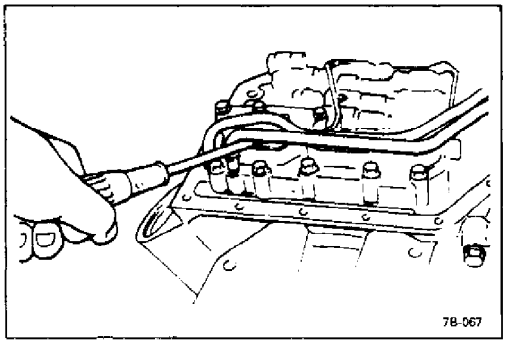
5) Remove oil pan and oil pan gasket.

NOTE:

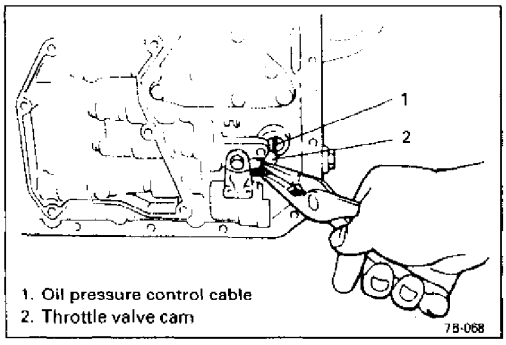
- **For removal of oil pan, do not turn transmission over as this will contaminate valve body with foreign matters in the bottom of oil pan.**
- **When removing oil pan, tap around it lightly with a plastic hammer. Do not force it off by using a screwdriver or the like.**



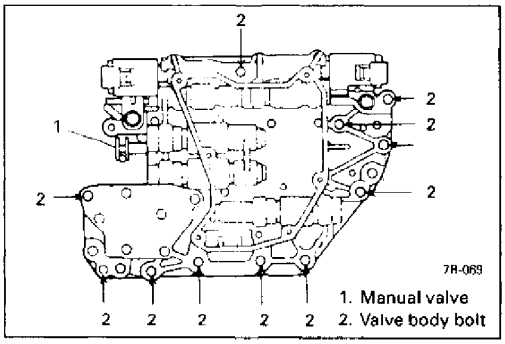
6) Disconnect couplers of direct clutch and 2nd brake solenoid valves.



7) Remove 2 oil tubes from lower valve body.
Remove them by pulling up tube end with a screwdriver.

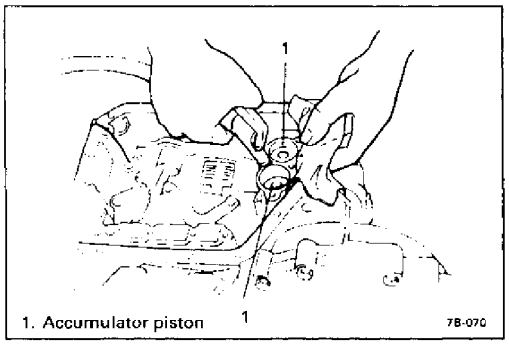


8) Disconnect oil pressure control cable from throttle valve cam and then remove cable.



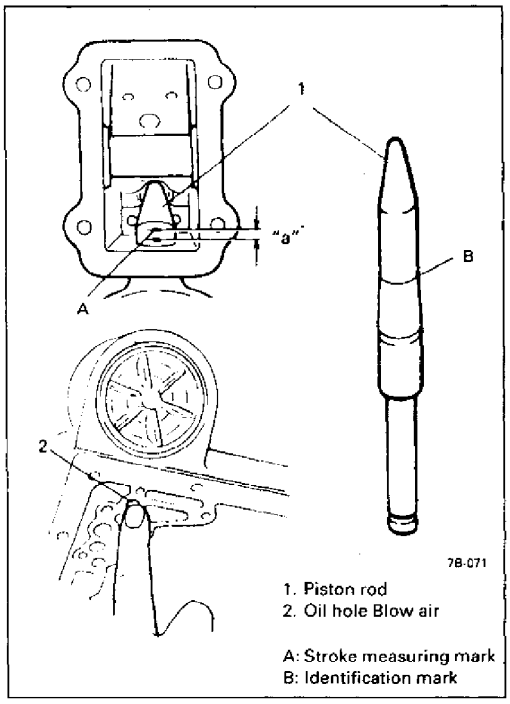
9) Remove oil strainer and lower valve body.
For removal of lower valve body, remove 11 bolts shown in figure.

CAUTION:
Be careful not to let manual valve fall off when removing valve body assembly.



1. Accumulator piston

10) Remove second brake accumulator upper spring and remove accumulator pistons and springs.
Position a rag on pistons to catch each piston.
To remove pistons, force low-pressure compressed air (1 kg/cm^2, 15 psi, 100 kPa, max) into hole as shown, and pop each piston into the rag.
NOTE:
Do not push accumulator pistons with fingers or anything before removing them. Pushing them may cause compressed fluid in accumulator to spew out of hole at face and clothes.



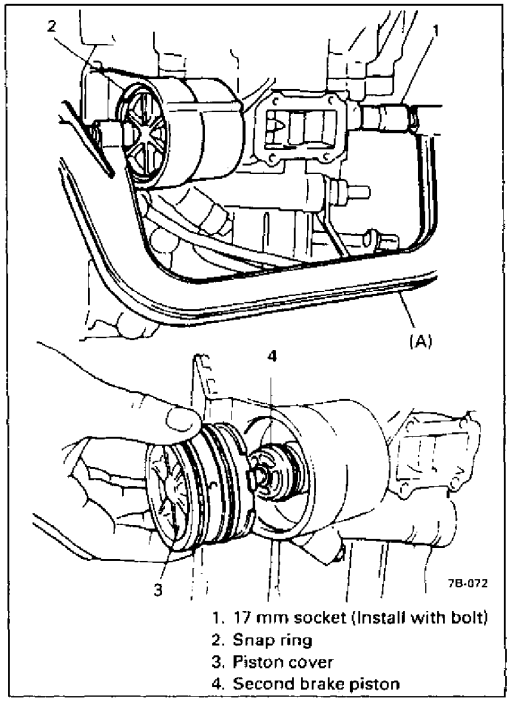
1. Piston rod
2. Oil hole Blow air

A: Stroke measuring mark
B: Identification mark

11) Remove second brake band cover and gasket.
12) After removing second brake band cover, check second brake piston stroke as follows.
① Scribe mark on piston rod as shown in left figure.
② Blow air into oil hole and measure rod stroke.
③ If stroke is out of specification, replace piston rod with the one of different length or replace second brake band.
2nd brake piston rod of 2 different lengths are available as spare parts.

Available piston rod	Piston rod length	Identification mark
	121.3 mm (4.77 in.)	Unmarked
	122.7 mm (4.83 in.)	Marked

Piston rod stroke "a": 1.5 – 3.0 mm (0.06 – 0.11 in.)

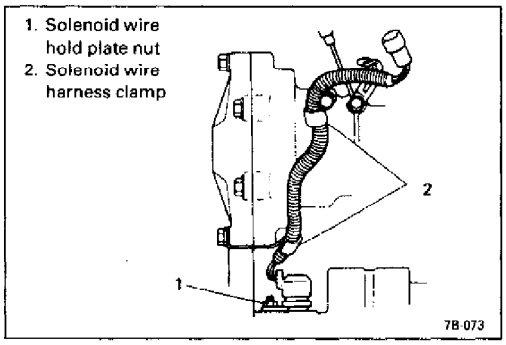


1. 17 mm socket (Install with bolt)
2. Snap ring
3. Piston cover
4. Second brake piston

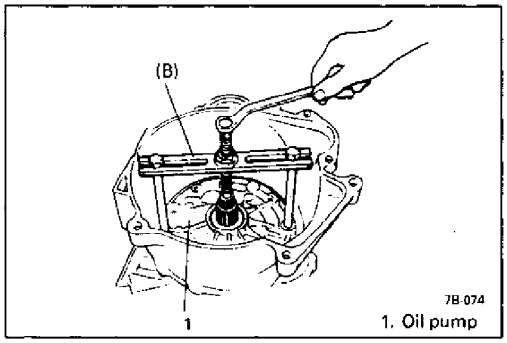
13) Remove second brake piston.
① Install 17 mm socket with 8 mm bolt.
② Apply valve lifter as illustrated and push in piston cover.

Special Tool
(A): 09916-14510

③ Remove snap ring by using screwdriver(s) or the like.
④ Remove tools and take out 2nd brake piston cover and piston. Tap cover head lightly to pull out cover.



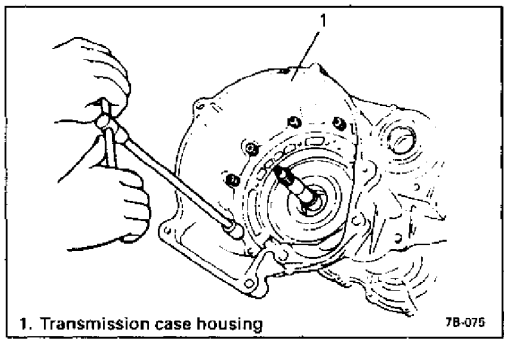
14) Remove solenoid wire harness.
① Remove wire hold plate securing nut.
② Remove 2 wire clamps on transmission and pull out solenoid wire.



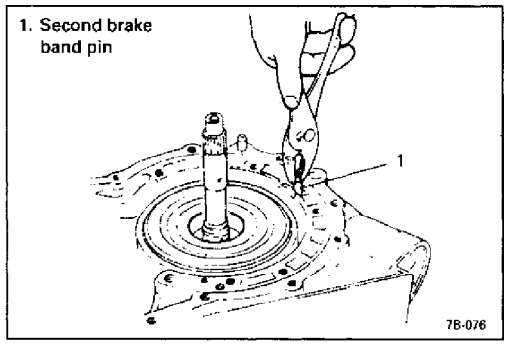
15) Remove oil pump.
① Remove 6 oil pump securing bolts.
② Remove oil pump by using special tool.

CAUTION:
Make sure that 2nd brake piston and piston rod have been removed before oil pump removal. If not, they may cause breakage of 2nd brake band.

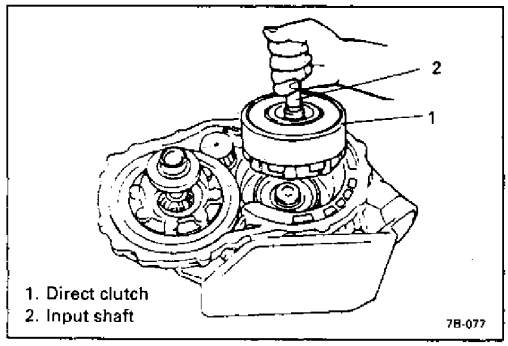
Special Tool
(B): 09918-48210



16) Remove transmission case housing.
① Remove housing internal bolts and external bolts.
② Remove housing while tapping around it lightly with a plastic hammer.

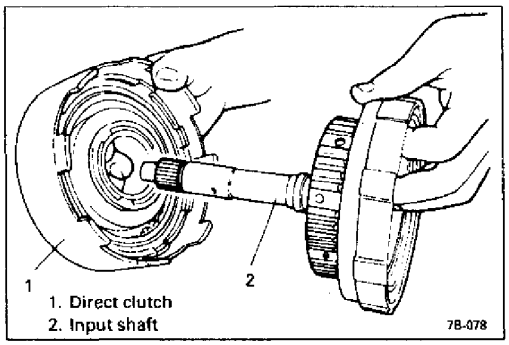


17) Remove second brake band pin.

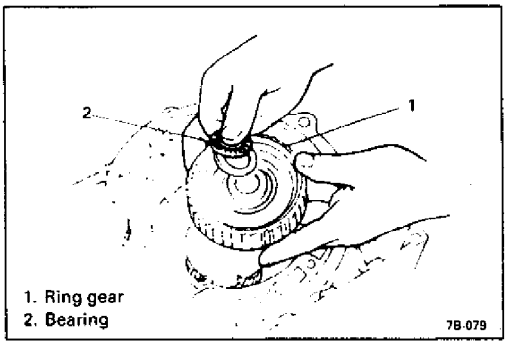


18) Remove direct clutch and forward clutch at the same time while holding input shaft.

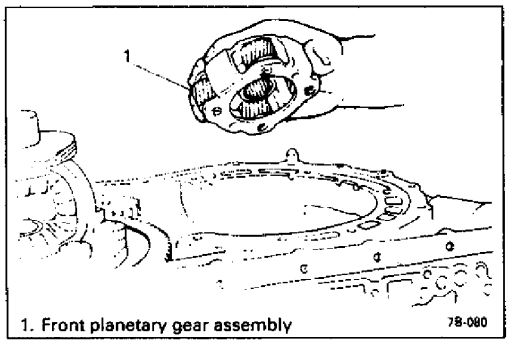
NOTE:
Be careful not to loose ring gear race and bearing which may sometimes stick to input shaft.



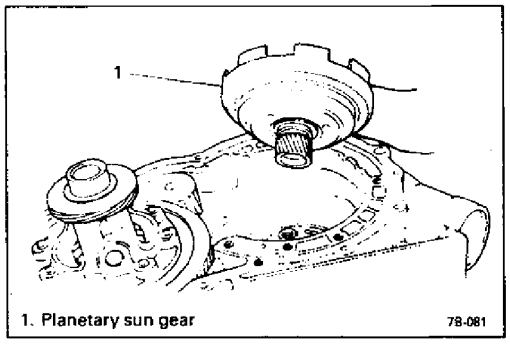
19) Remove direct clutch assembly from input shaft.
20) Remove second brake band.



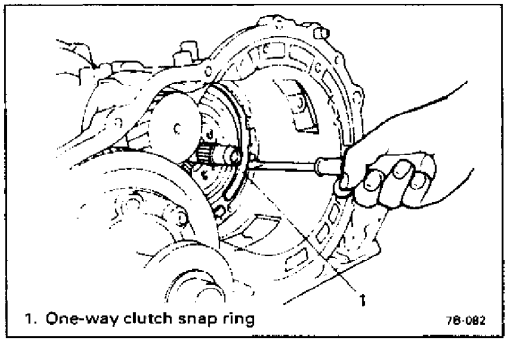
21) Remove front planetary ring gear and ring gear bearing.



22) Remove front planetary gear assembly.

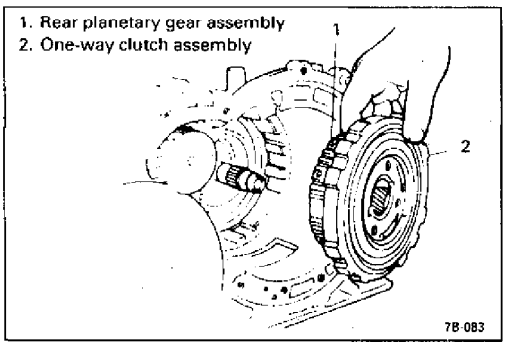


23) Remove planetary sun gear and front planetary gear bearing.

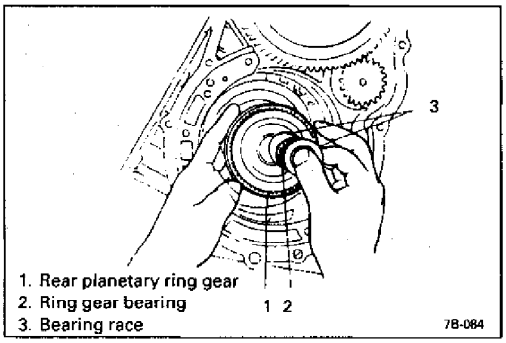


24) Remove one way clutch snap ring by using a screwdriver.

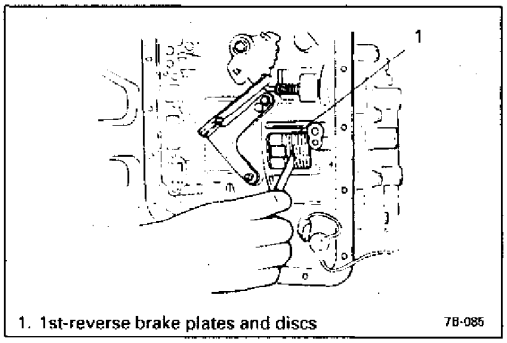
NOTE:
Use care not to damage transmission case when removing snap ring.



25) Remove one way clutch and rear planetary gear.

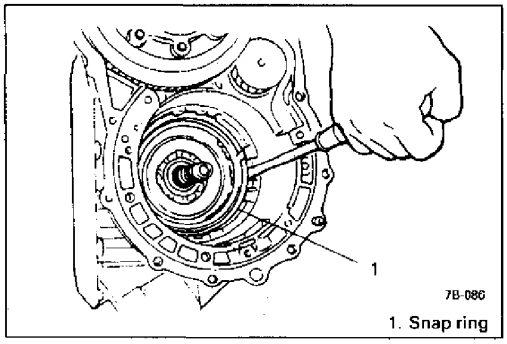


26) Remove rear planetary ring gear, ring gear bearing and washers.

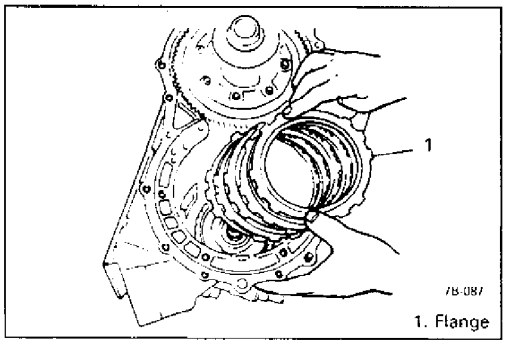


27) Check 1st-reverse brake clearance.
Measure clearance between snap ring and flange with feeler gauge. If out of specification, replace 1st-reverse brake discs or plates.

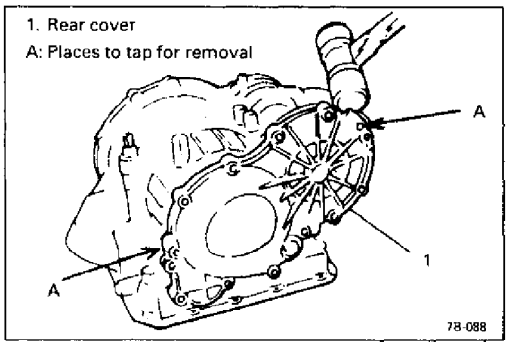
1st-reverse brake clearance
0.58 – 1.92 mm (0.023 – 0.075 in.)



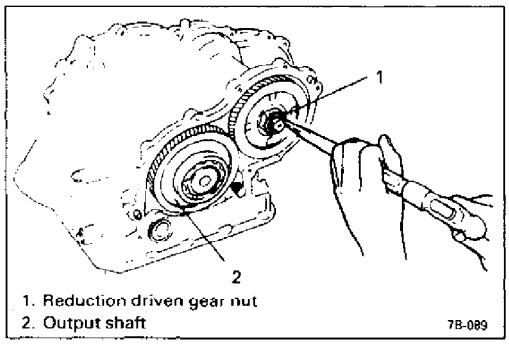
28) Remove 2 snap rings by using a flat tip screwdriver.



29) Remove 1st-reverse brake flange, discs, plates and damper plate.
30) Remove differential gear assembly.

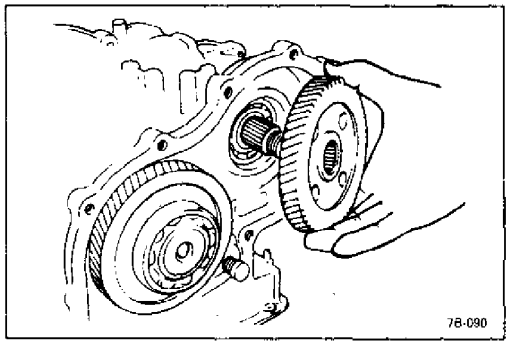


31) Remove rear cover.
① Remove 10 bolts and 2 nuts.
② Remove rear cover by tapping A with plastic hammer as shown in figure.

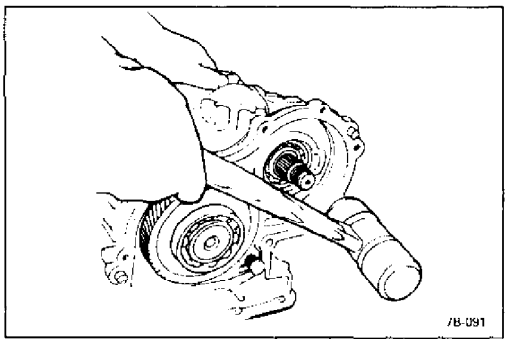


32) Remove reduction driven gear nut.
① Undo caulking.
② Shift manual shift lever to P so that output shaft is locked.
③ Loosen nut.

CAUTION:
Calmly apply torque to loosen nut so as not to damage reduction gear or parking lock pawl.

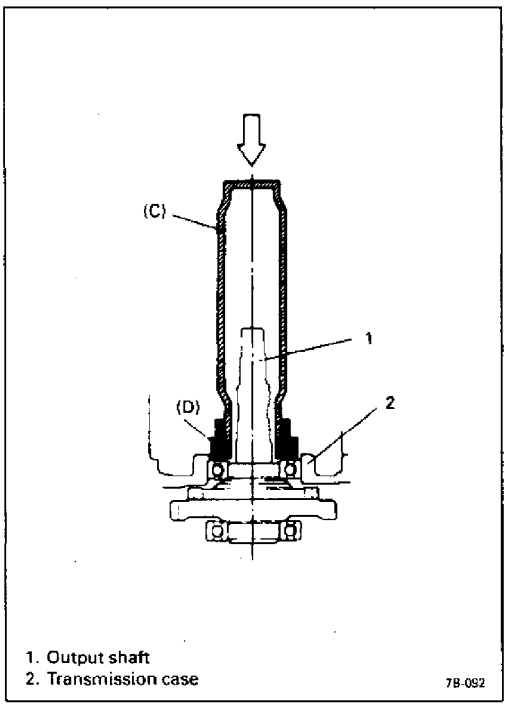


33) Pull out reduction driven gear.



34) Drive countershaft out with a plastic hammer.

CAUTION:
To avoid unnecessary damage of speed sensor due to contact with countershaft gear, it should be removed previously.

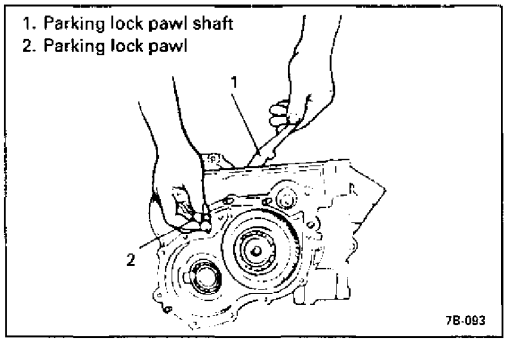


1. Output shaft
2. Transmission case
7B-092

35) Remove output shaft by pushing outer race of internal output shaft bearing with special tools from inside of transmission case.

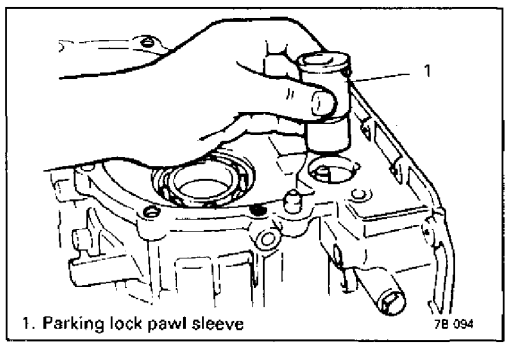
CAUTION:
- **Do not hit output shaft or shaft end will be damaged.**
- **Hold special tools by hand while hitting them and avoid their bounce.**

Special Tool
(C): 09925-18010
(D): 09927-08210



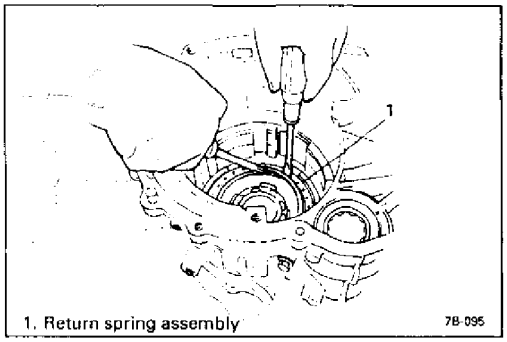
1. Parking lock pawl shaft
2. Parking lock pawl
7B-093

36) Remove parking lock pawl, pawl shaft and sleeve, etc.
① Pull out parking lock pawl shaft and spring.
② Remove parking lock pawl.



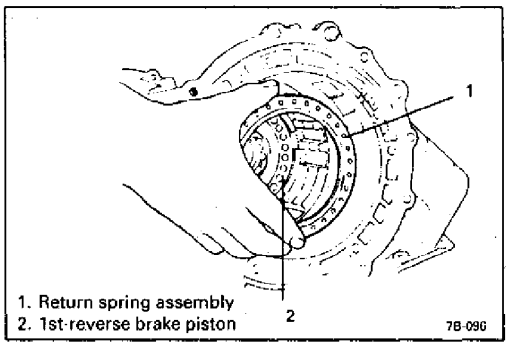
1. Parking lock pawl sleeve
7B-094

③ Pull out parking lock pawl sleeve.
④ Remove manual detent spring assembly and manual shift shaft.



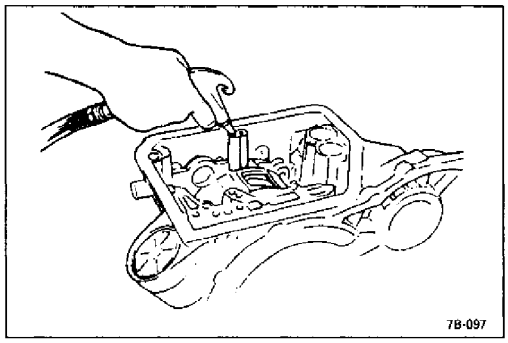
1. Return spring assembly
7B-095

37) Remove 1st-reverse brake piston.
① Push down return spring assembly and remove snap ring.



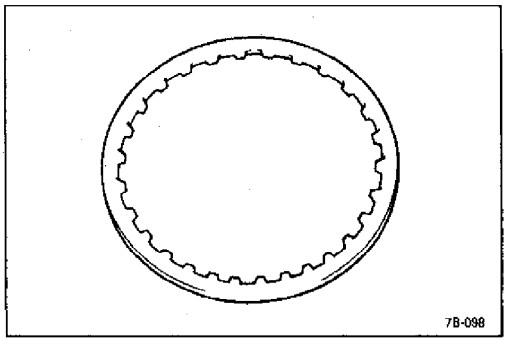
1. Return spring assembly
2. 1st-reverse brake piston

② Take out return spring assembly.



③ By blowing air, push out 1st-reverse brake piston.

CAUTION:
- **Blow air very carefully, or outer O-ring will be damaged.**
- **Pull out piston by using long nose pliers, if failed to remove it by air blow.**
- **Without replacing O-rings prepared, do not attempt to remove piston.**



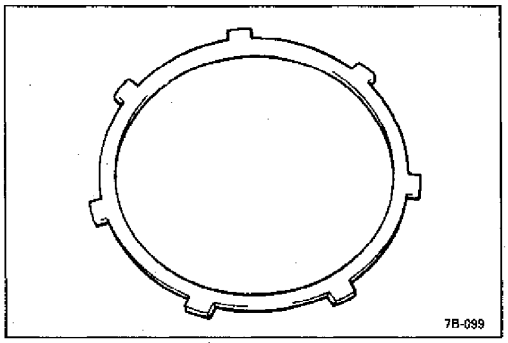
CLUTCH AND BRAKE PARTS DIAGNOSIS

SYMPTOMS

Clutch Discs and Brake Band

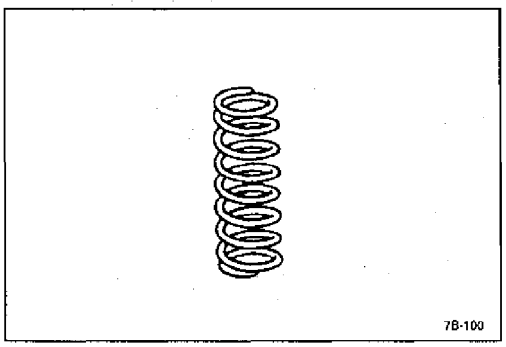
Dry and inspect them for pitting, flaking, wear, glazing, cracking, charring and chips or metal particles imbedded in lining.

If discs or brake band show any of the above conditions, replacement is required.



Clutch Steel Plates

Dry plates and check for discoloration. If plate surface is smooth and even color smear is indicated, the plate sould be reused. If severe heat spot discoloration or surface scuffing is indicated, the plate must be replaced.



Clutch or Brake Return Spring Assembly

Evidence of extreme heat or burning in the area of clutch may have caused springs to take a heat set and would require their replacement.

POSSIBLE CAUSES OF BURNING

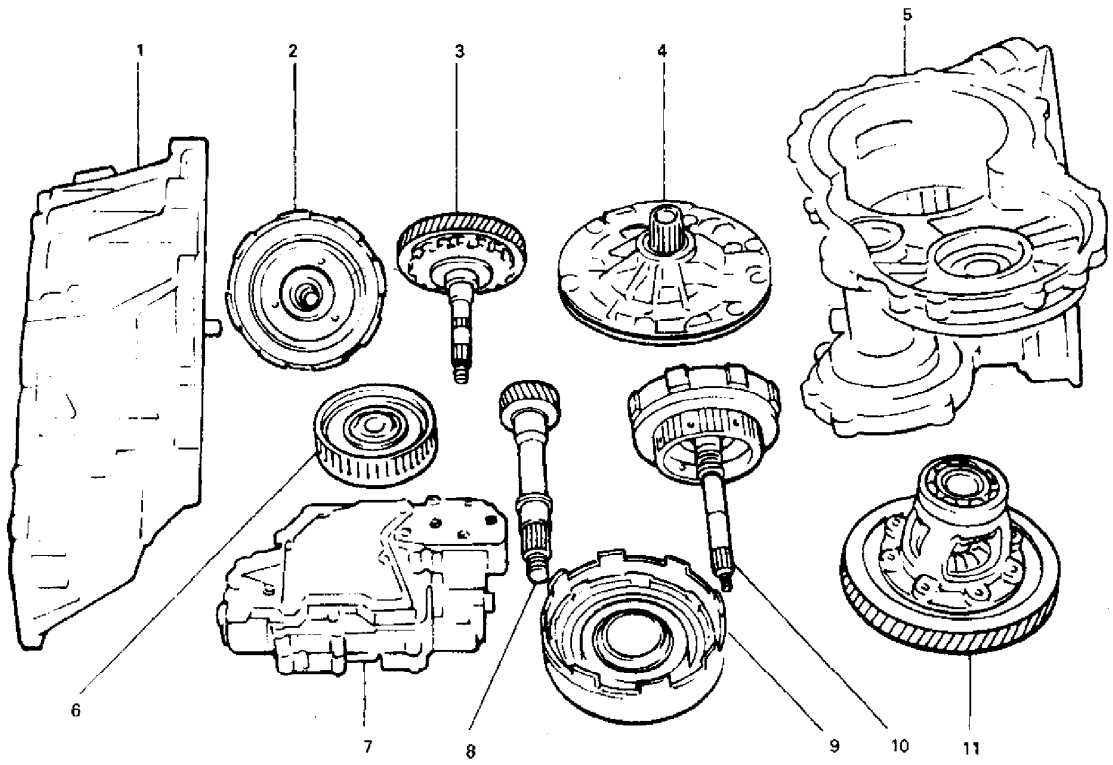
Forward and Direct Clutch Discs

- Stuck or leak in check ball in clutch piston.
- Damaged clutch piston seals.
- Worn or broken seal rings.
- Obstruction in solenoid valves or shift valves.
- Disconnected speed sensor, solenoid or controller.
- Leak in valve body gaskets.
- Low line pressure.

1st/REV Brake Discs and 2nd Brake Band

- Damaged piston seals.
- Obstruction in solenoid valves or shift valves.
- Leak in valve body gaskets.
- Low line pressure.

SUB ASSEMBLY SERVICE

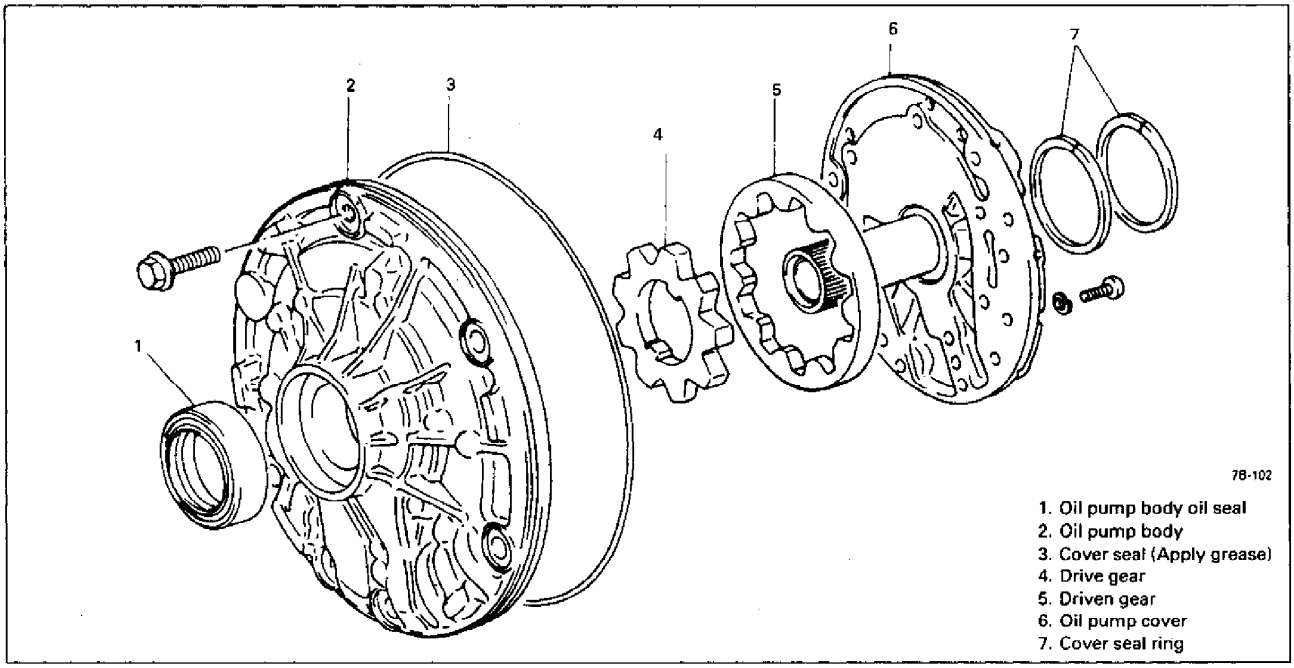


1. Transmission case housing
2. Sun gear & sun gear input drum
3. Output shaft
4. Oil pump
5. Transmission case
6. Front planetary ring gear
7. Upper & lower valve bodies
8. Countershaft
9. Direct clutch
10. Input shaft
11. Differential

CAUTION:

- **Keep component parts in group for each sub assembly and avoid mixing them up.**
- **Clean all parts with cleaning solvent thoroughly and air dry them.**
- **Use kerosene or automatic transmission fluid as cleaning solvent.**
- **Do not use wiping cloths or rags to clean or dry parts.**
- **All oil passages should be blown out and checked to make sure that they are not obstructed.**
- **Keep face and eyes away from solvent spray while air blowing parts.**
- **Check mating surface for irregularities and remove them, if any, and clean it again.**
- **Soak new clutch discs and brake band in transmission fluid for 2 hours or more before assembly.**
- **Replace all gaskets and O-rings with new ones.**
- **Apply automatic transmission fluid to all O-rings except oil pump cover seal.**
- **When installing seal ring, be careful so that it is not expanded excessively, extruded or caught.**
- **Replace oil seals that are removed and apply grease to their lips.**
- **Before installing, be sure to apply automatic transmission fluid to sliding, rolling and thrusting surface of all component part. Also after installation, make sure to check each part for proper operation.**
- **Always use torque wrench when tightening bolts.**

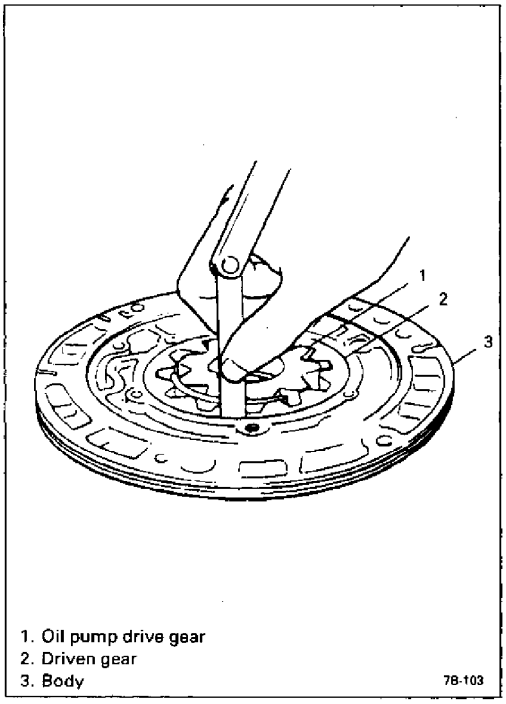
OIL PUMP



1. Oil pump body oil seal
2. Oil pump body
3. Cover seal (Apply grease)
4. Drive gear
5. Driven gear
6. Oil pump cover
7. Cover seal ring

Removal

1) Remove 2 oil pump cover seal rings.
2) Remove oil pump cover seal (O-ring).
3) Remove 11 bolts.
4) Remove oil pump cover.



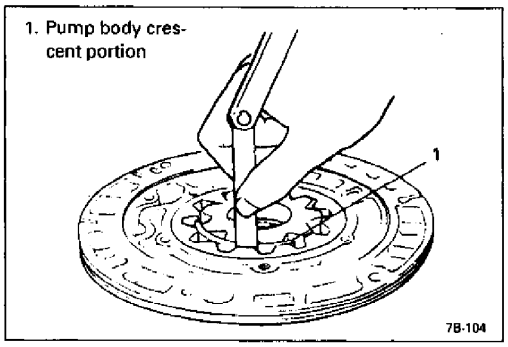
1. Oil pump drive gear
2. Driven gear
3. Body

Inspection

1) Inspect pump body oil seal.
   Check for wear, damage or cracks.
   Replace oil seal if necessary and apply grease to its lip portion slightly when it is installed.
2) Check body clearance of driven gear.
   Push driven gear to one side of body. Using a feeler gauge, measure clearance between driven gear and body.
   If clearance exceeds its limit, replace gear.

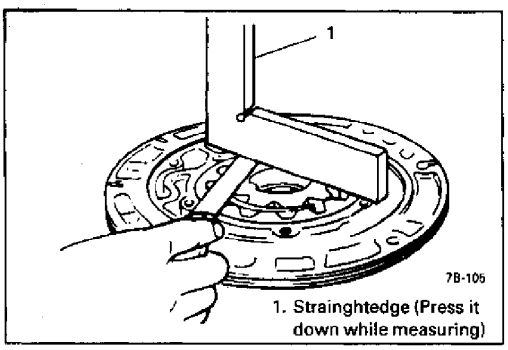
Body clearance

Standard : 0.07 – 0.15 mm (0.0028 – 0.0059 in.)
Limit : 0.3 mm (0.011 in.)



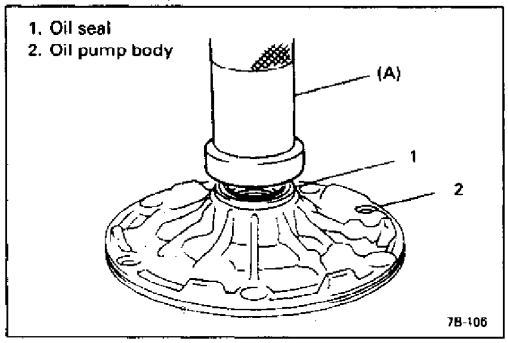
3) Check tip clearance of both drive and driven gears.
Measure radial clearance between gear tooth and crescent.
If clearance exceeds its limit, replace gear.

Tip clearance
Standard : 0.11 – 0.14 mm (0.0044 – 0.0055 in.)
Limit : 0.3 mm (0.011 in.)



4) Check side clearance of both gears.
Using a straightedge and a feeler gauge, measure side clearance between gear and pump body.

Side clearance
Standard : 0.02 – 0.05 mm (0.0008 – 0.0019 in.)
Limit : 0.1 mm (0.0039 in.)

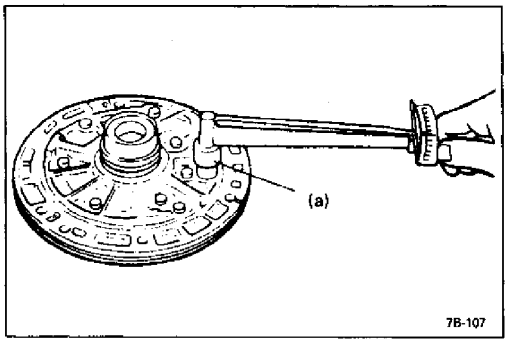


Installation

1) Install pump body oil seal.
Use special tool and hammer to install it, and then apply grease to its lip portion.

Special Tool
(A): 09913-85210

2) Install driven gear and drive gear to pump body after applying fluid to gears.

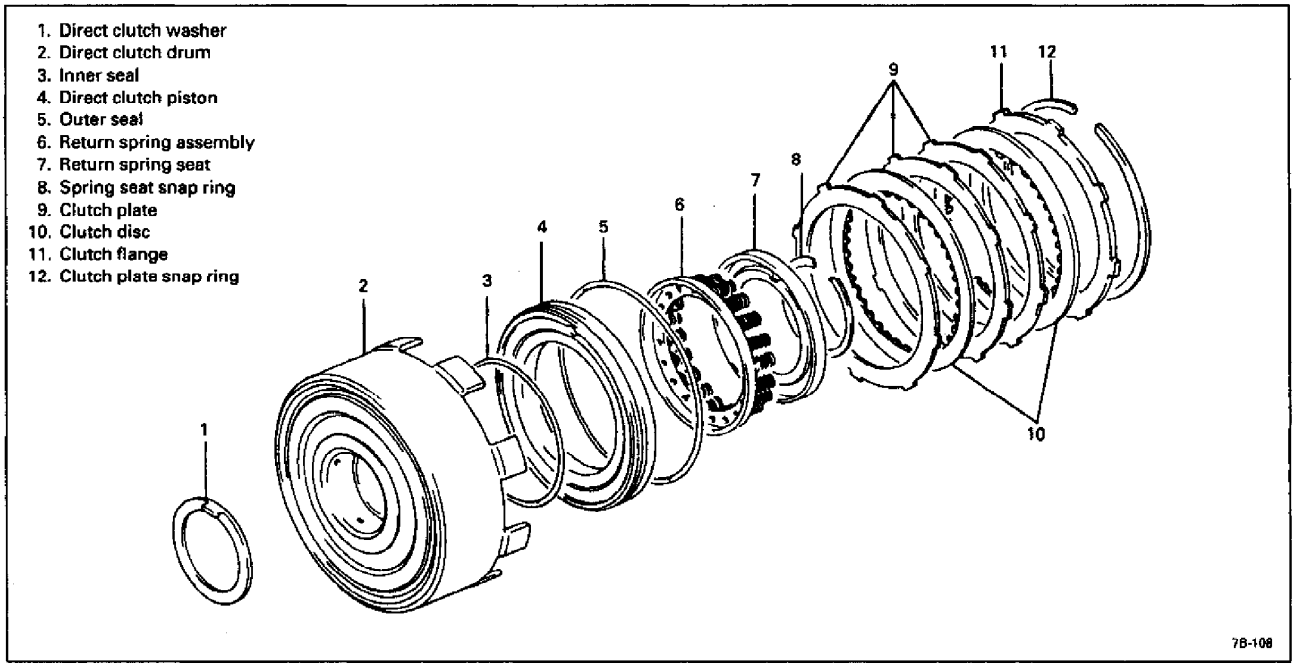


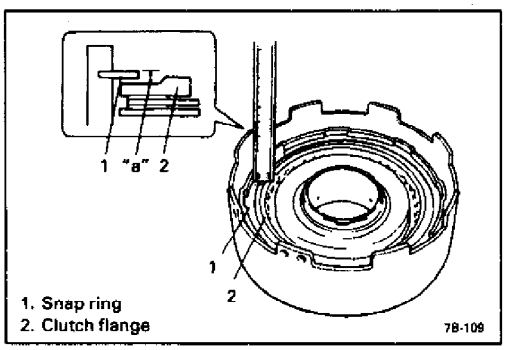
3) Install pump cover to pump body and tighten 11 pump cover bolts to specification.

Tightening Torque
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

4) Install 2 oil pump cover seal rings.
5) Apply transmission fluid to oil pump bushes and 2 seal rings.
6) Install cover seal (O-ring) applied with grease and make sure that it is not twisted or extruded.
7) Check drive gear for smooth rotation.

DIRECT CLUTCH



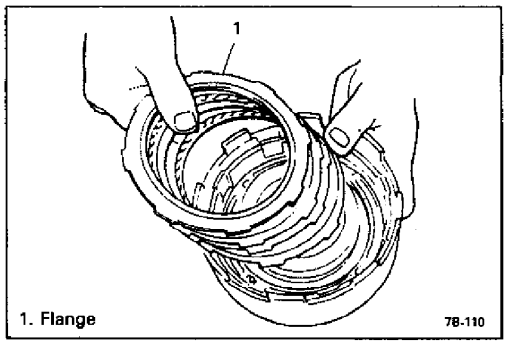


Preliminary Check

Check direct clutch clearance before disassembly.

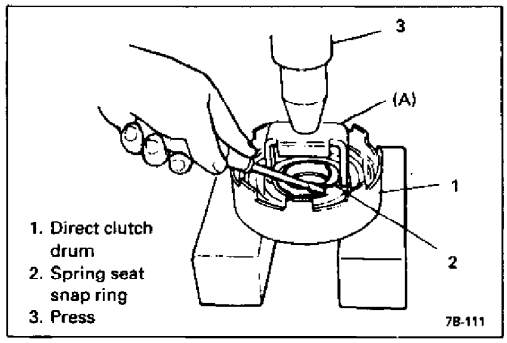
For checking clearance, measure height between snap ring and clutch flange by using vernier as shown in figure. If height is within specification, it means that clutch clearance is within specification. If height is out of specification, replace clutch discs or plates with new ones.

Height "a": 2.49 – 3.06 mm (0.098 – 0.120 in.)



Removal

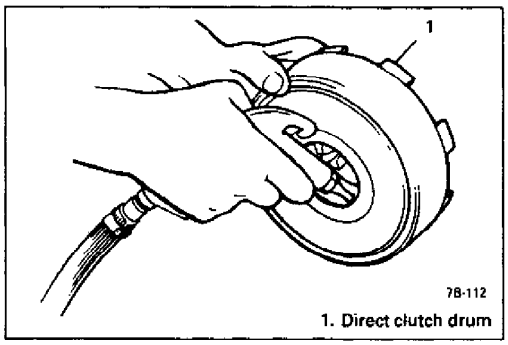
1) Remove clutch plate snap ring.
2) Remove clutch flange, discs and plates.



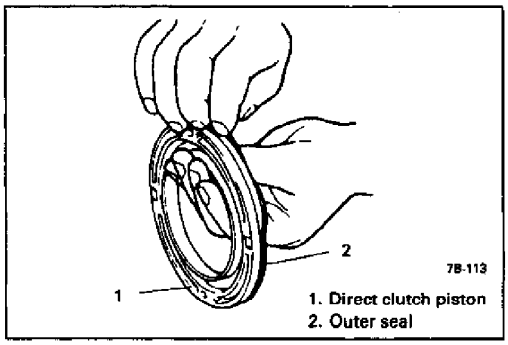
3) Remove spring seat snap ring.
   Compress piston return springs by using special tool and then remove snap ring.

CAUTION:
Do not compress spring seat too much. Excessive compression may cause to spring seat to become distorted.

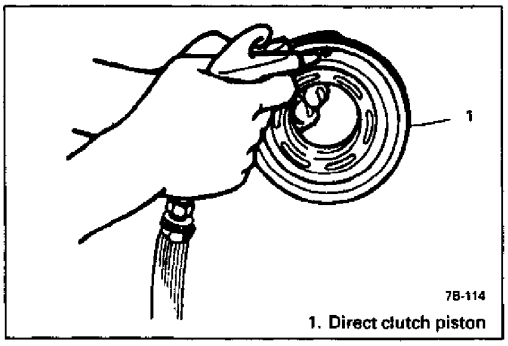
Special Tool
(A): 09926-98310



4) Remove spring seat and return spring assembly.
5) Remove direct clutch piston.
   Blow compressed air through drum oil hole to remove piston. If piston does not pop out, take out piston with long nose pliers.

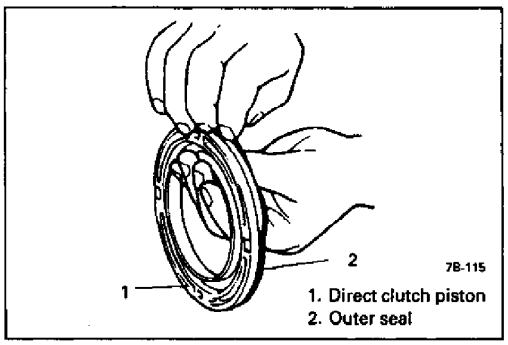


6) Remove inner seal from drum.
7) Remove outer seal from piston.



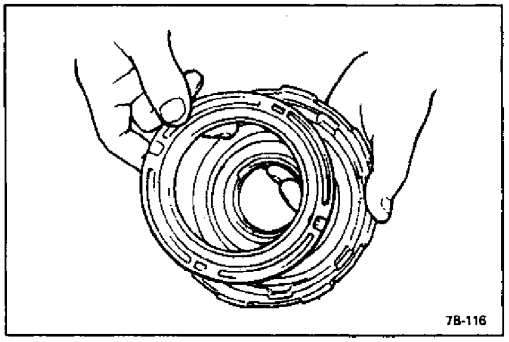
Inspection

1) Check valve (steel ball) for free movement in piston.
2) Check valve for leakage by using low pressure air.
   If found faulty, replace piston.

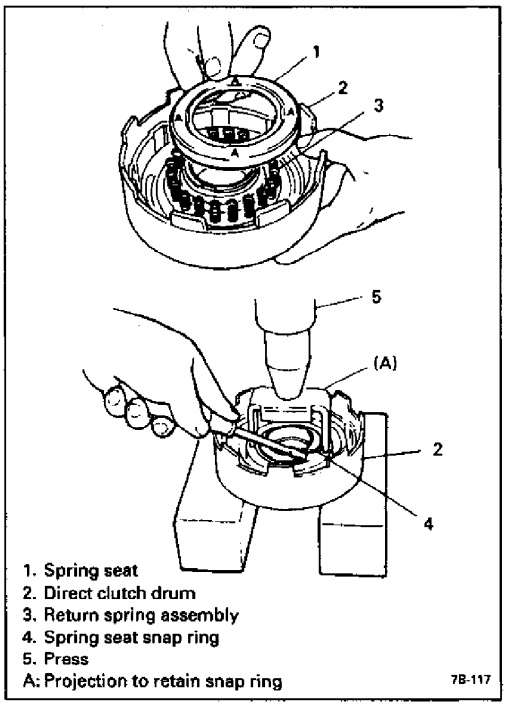


Installation

1) Install inner seal (O-ring).
   Apply transmission fluid to inner seal and fit it in drum.
   Use new inner seal.
2) Install outer seal (O-ring).
   Apply transmission fluid to outer seal and fit it to piston.
   Use new outer seal.



3) Install piston into drum.
   Be careful so that seals (O-rings) do not get twisted or caught.



1. Spring seat
2. Direct clutch drum
3. Return spring assembly
4. Spring seat snap ring
5. Press

A: Projection to retain snap ring

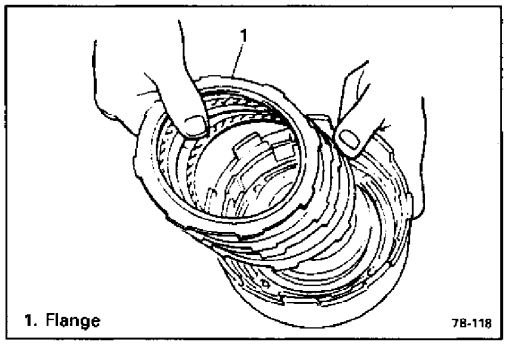
7B-117

4) Install clutch return spring assembly.
5) Install spring seat.
6) Install snap ring.

Compress return springs and install spring seat snap ring in groove. Place special tool (clutch spring compressor) on spring seat and compress springs with press, and then, install snap ring using a screwdriver.

CAUTION:
- **Check to make sure that snap ring is securely fitted in 4 projections A of spring seat.**
- **Do not compress return spring more than necessary.**

Special Tool
(A): 09926-98310



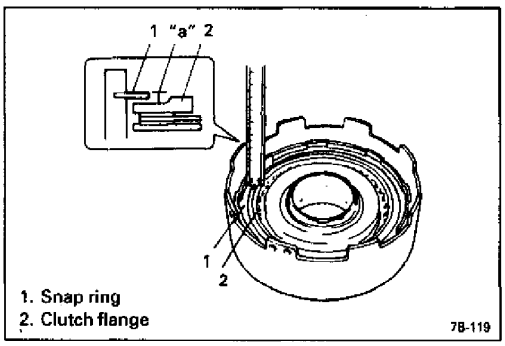
1. Flange

7B-118

7) Install discs, plates and flange in following order.
① Plate → ② Disc → ③ Plate → ④ Plate → ⑤ Disc → ⑥ Flange

NOTE:
If new clutch discs are installed, soak them in automatic transmission fluid for 2 hours or more before assembly.

8) Install clutch plate snap ring.



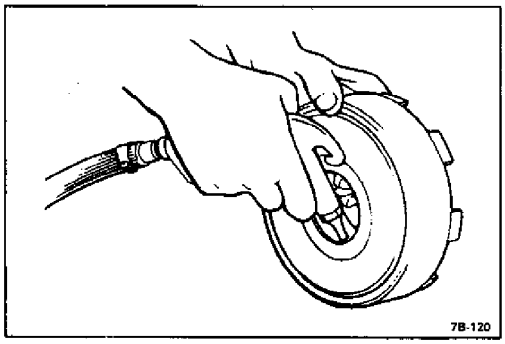
1. Snap ring
2. Clutch flange

7B-119

9) After installing clutch plate snap ring, measure height between snap ring and clutch flange as previously outlined. If height is out of specification even when new clutch discs and plates are installed, install flange of different thickness. Following 2 types of clutch flanges are available as spare parts.

Height "a": 2.49 – 3.06 mm (0.098 – 0.120 in.)

Available clutch flange size (thickness)	3.00 mm/0.118 in.
	3.37 mm/0.132 in.

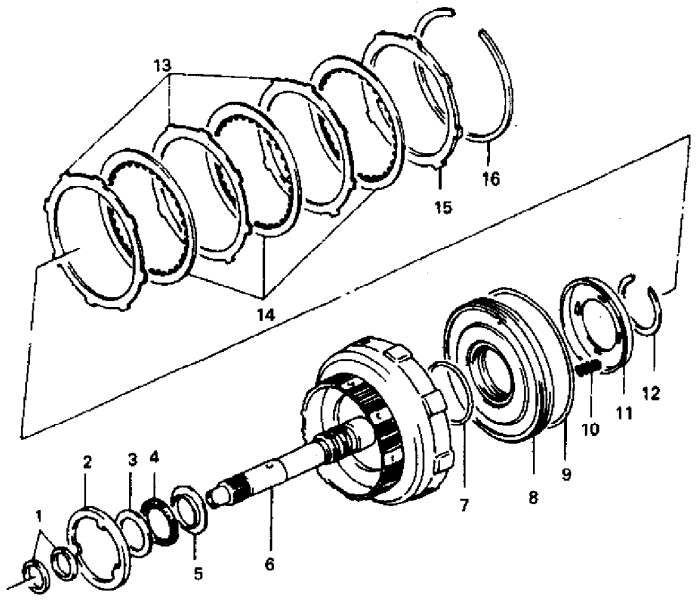


7B-120

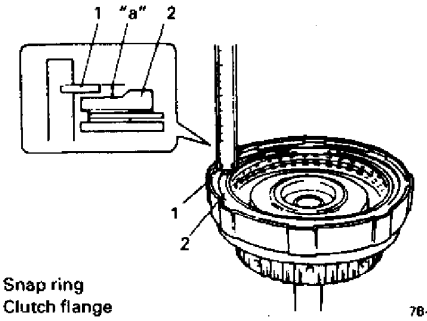
10) Check piston for movement by blowing air through oil hole in drum.

CAUTION:
Apply only low pressure air for checking movement.
Excessive air pressure may cause damage to spring seat.

FORWARD CLUTCH



1. Input shaft seal ring
2. Direct clutch washer
3. Input shaft bearing race
4. Input shaft bearing
5. Bearing race
6. Input shaft
7. Inner seal
8. Forward clutch piston
9. Outer seal
10. Return spring
11. Return spring seat
12. Spring seat snap ring
13. Clutch plate
14. Clutch disc
15. Clutch flange
16. Clutch plate snap ring



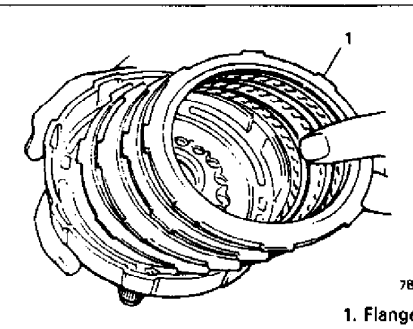
1. Snap ring
2. Clutch flange

Preliminary Check

Check forward clutch clearance before disassembly.

For checking clearance, measure height between snap ring and clutch flange by using vernier as shown in figure. If height is within specification, it means that clutch clearance is within specification. If height is out of specification, replace clutch discs or plates with new ones.

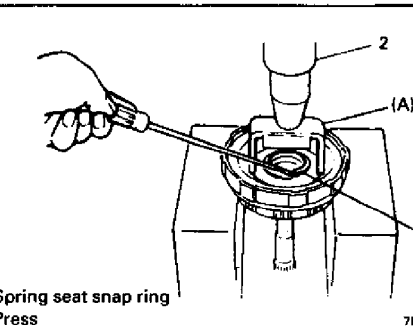
Height "a": 2.01 – 2.68 mm (0.079 – 0.105 in.)



1. Flange

Removal

1) Remove clutch plate snap ring.
2) Remove flange, discs and plates.

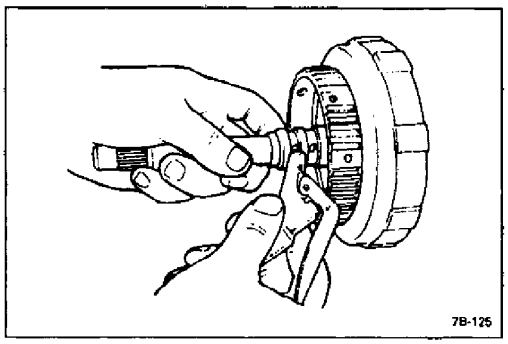


1. Spring seat snap ring
2. Press

3) Remove seat snap ring.
Compress piston return springs and remove snap ring. Place special tool (clutch spring compressor) on spring seat and compress spring with a press, and then, remove snap ring, using a screwdriver.

CAUTION:
Do not push down return spring more than necessary.

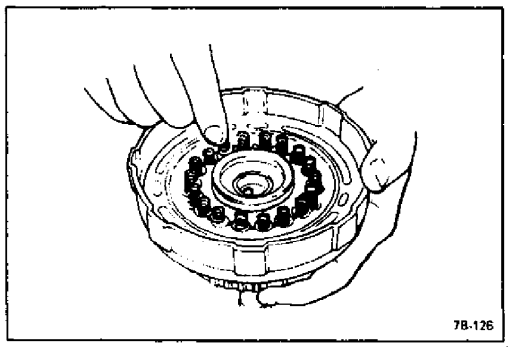
Special Tool
(A): 09926-98310



4) Remove spring seat and springs.
5) Remove forward clutch piston.
   Blow compressed air through input shaft oil hole to remove piston. If piston does not pop out, take it out with long nose pliers.
6) Remove inner and outer seals (O-rings) from piston.

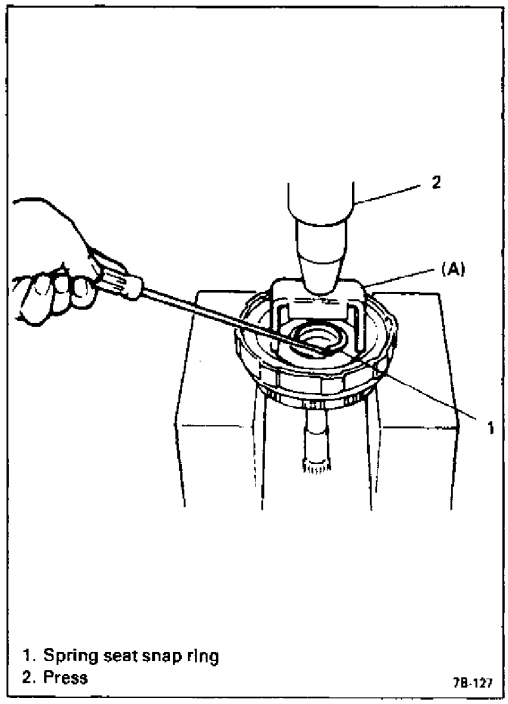
Inspection

1) Check valve (ball) for free movement in clutch piston.
2) Check valve for leakage by using low pressure air. If found faulty, replace clutch piston.



Installation

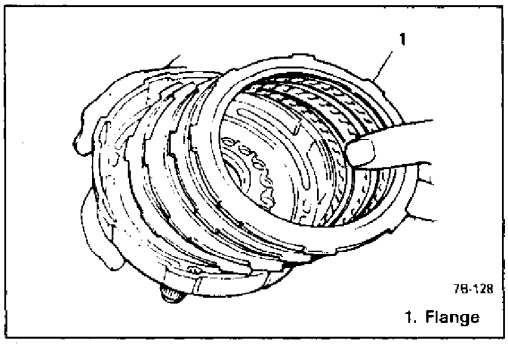
1) Install inner and outer seals (O-rings) to clutch piston.
   Apply transmission fluid to them and fit to piston. Use new seals.
2) Install piston into input shaft drum.
   Use care so that seals do not get twisted or caught.
3) Install 18 piston return springs and spring seat.



4) Install spring seat snap ring.
   Compress return springs and install snap rings in groove by using a screwdriver.
   Place special tool (clutch spring compressor) on spring seat and compress springs with a press.

CAUTION:
- **Check to make sure that snap ring is securely fitted in 4 projections of spring seat.**
- **Do not compress return spring more than necessary.**

Special Tool
(A): 09926-98310

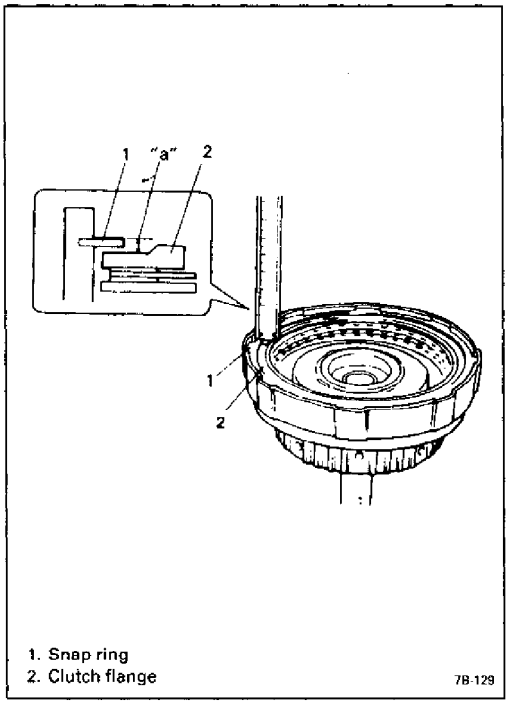


1. Flange

5) Install discs, plates and flange in following order.
① Plate → ② Disc → ③ Plate → ④ Disc → ⑤ Plate → ⑥ Disc → ⑦ Flange

NOTE:
Before assembly, new discs should be soaked in automatic transmission fluid for 2 hours or more.

6) Install clutch plate snap ring.

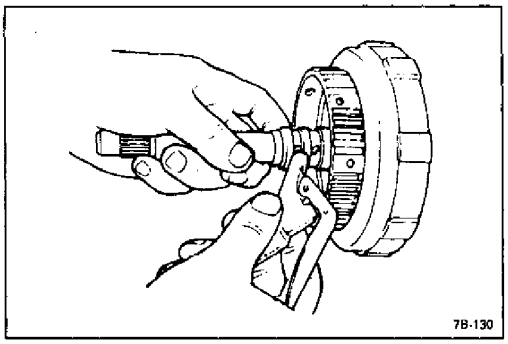


1. Snap ring
2. Clutch flange

7) After installing clutch plate snap ring, measure height between snap ring and clutch flange as previously outlined. If discs and plates are new and yet out of specification, install flange of different thickness. Following 2 types of clutch flanges are available as spare parts.

Height "a": 2.01 – 2.68 mm (0.079 – 0.105 in.)

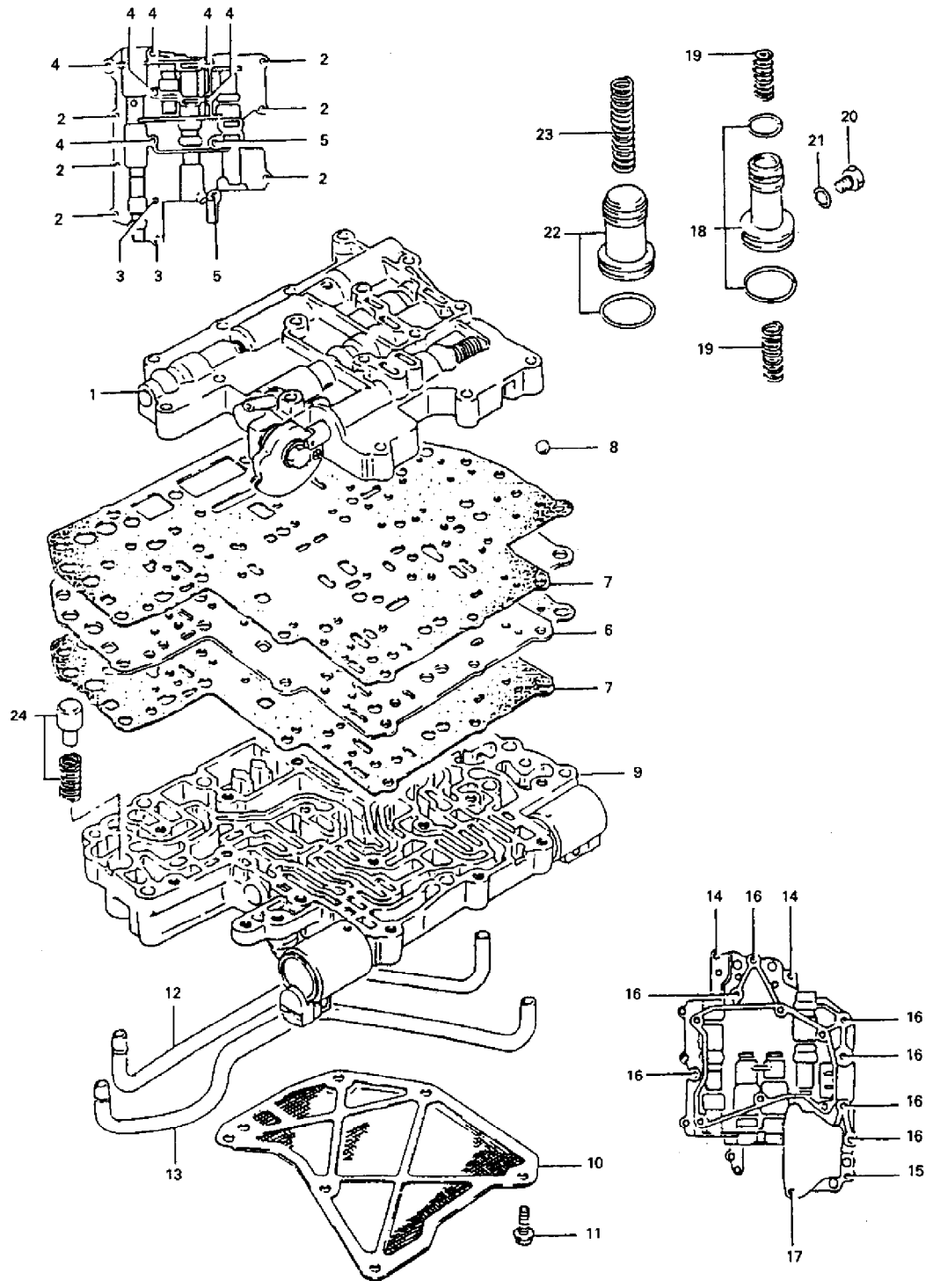
Available clutch flange size (thickness)	3.00 mm/0.118 in.
	3.37 mm/0.132 in.



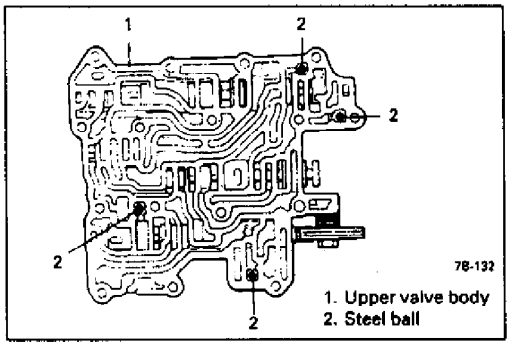
8) Check clutch piston for movement by blowing air through input shaft oil hole.

CAUTION:
Apply only low pressure air, or spring seat may be damaged.

VALVE BODY



1. Upper valve body ass'y
2. Valve body bolt
3. Valve body bolt
4. Valve body bolt
5. Valve body bolt
6. Valve body plate
7. Valve body gasket
8. Valve body ball
9. Lower valve body ass'y
10. Oil strainer
11. Bolt
12. Forward clutch accumulator tube
13. 2nd brake
14. Bolt
15. Bolt
16. Bolt
17. Bolt
18. 2nd brake accumulator piston
19. B1 accumulator spring
20. Booster plug
21. O-ring
22. Accumulator forward clutch piston
23. Accumulator spring
24. Cooler by-pass valve



Important Steps in Disassembly and Reassembly of Valve Bodies

- When disassembling valve body, be sure to keep each valve together with its corresponding spring.
- When removing upper valve body from lower one, be careful not to let 4 steel balls shown in figure fall off.
- When assembling, install these four (4) steel balls in such in upper valve body as shown in figure.

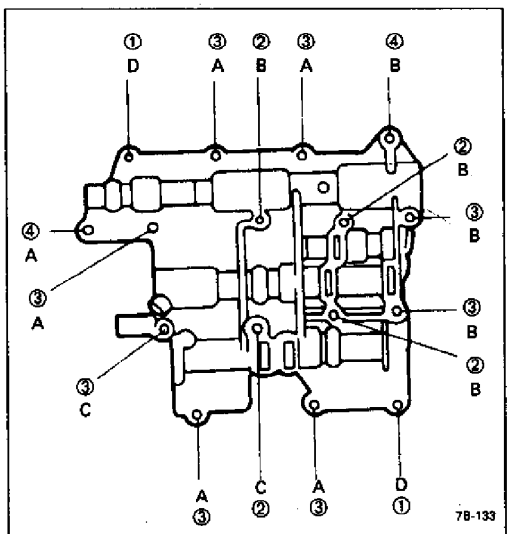
- Replace each gasket with new one. Make sure that new gasket is the same as old one before installation.
- When installing each valve to valve body, use special care for proper installing direction.
- Several of throttle valve rings are used at throttle valve in upper valve body. Be sure to install the same number of throttle valve rings as those used before disassembly.

- When installing lower valve body cover and gasket to lower valve body, tighten lower valve body bolts to specification.

Tightening Torque for lower valve body cover bolts
5 N·m (0.5 kg-m, 3.5 lb-ft)

- Tighten throttle valve cam bolt to specification.

Tightening Torque for cam bolt
7.5 N·m (0.75 kg-m, 5.5 lb-ft)

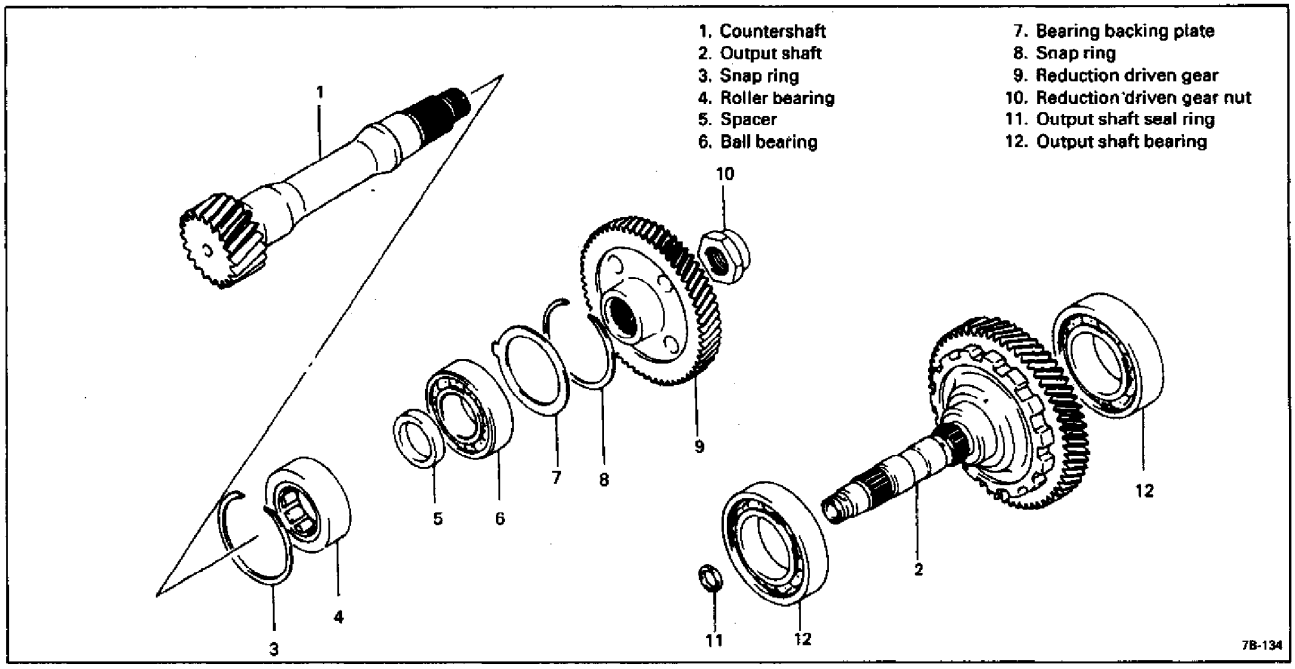


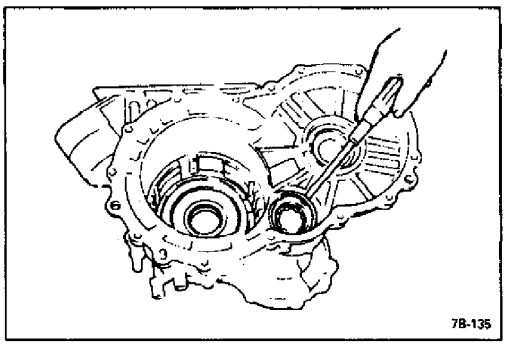
Bolt	Length	Bolt head shape	Pieces
A	29.5 mm (1.16 in.)	Deep recess	6
B	38 mm (1.49 in.)	Deep recess	6
C	44 mm (1.73 in.)	Deep recess	2
D	Reamer bolt	Normal recess	2

- When installing upper valve body to lower one, install 16 upper valve body bolts and tighten them to specified torque.
  1) – Lightly install 2 reamer bolts (positioning bolts) to D.
  2) – Install all other 14 bolts.
  3) – Tighten 4 bolts ② to specification.
  4) – Tighten 8 bolts ③ to specification.
  5) – Tighten 2 bolts ④ and 2 reamer bolts ① to specification.

Tightening Torque for upper valve body bolts
5.5 N·m (0.55 kg-m, 4.0 lb-ft)

COUNTERSHAFT AND OUTPUT SHAFT

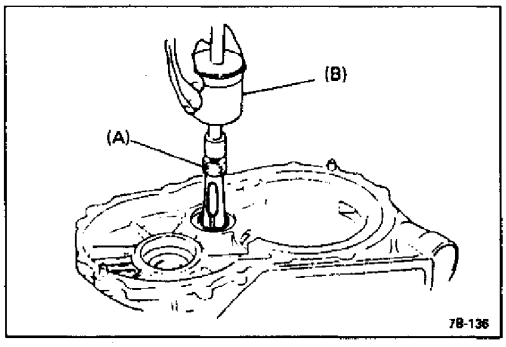




Countershaft Bearings

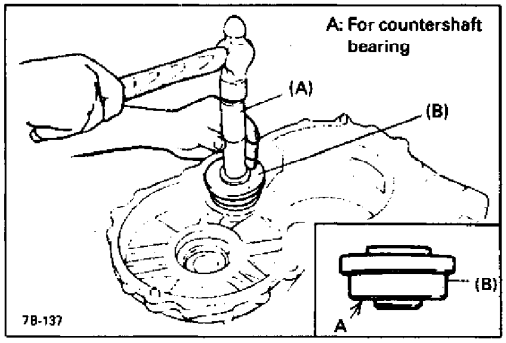
Removal

1) Remove snap rings by using a screwdriver.



2) Remove backing plate (rear cover side).
3) Remove front and rear countershaft bearings.
   ① Using special tools (Bearing remover and sliding shaft), remove bearing.
   ② Remove other side of bearing in the same way.

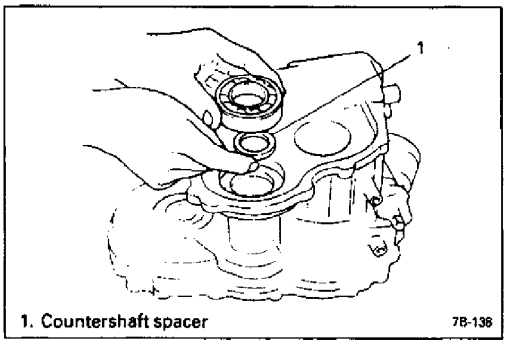
Special Tool
(A): 09941-64511
(B): 09930-30102



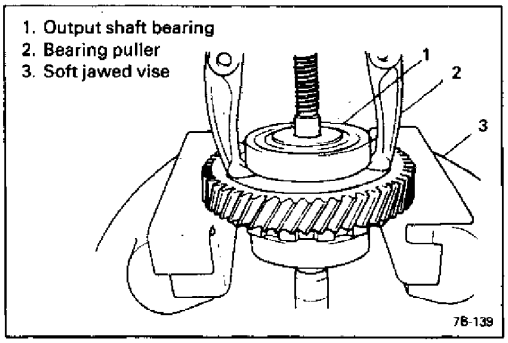
Installation

1) Install countershaft bearing (roller bearing) to case.
   Use special tools (Bearing installer attachment and installer handle).
   The bearing installer attachment has two sides.
   Use small side A for installation of countershaft bearings.

Special Tool
(A): 09924-74510
(B): 09926-88310



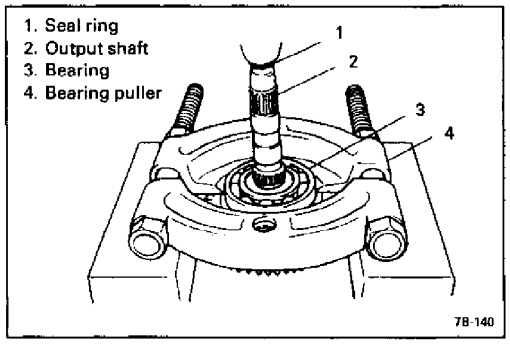
2) Install snap ring.
3) Install countershaft spacer to case.
4) Install another countershaft bearing (ball bearing) to case.
   Use special tools (Bearing installer attachment and installer handle).
5) Install bearing backing plate and snap ring.



Output Shaft Bearings

Removal

1) Remove cover side bearing.
   Hold output shaft with soft jawed vise and remove bearing by using bearing puller.



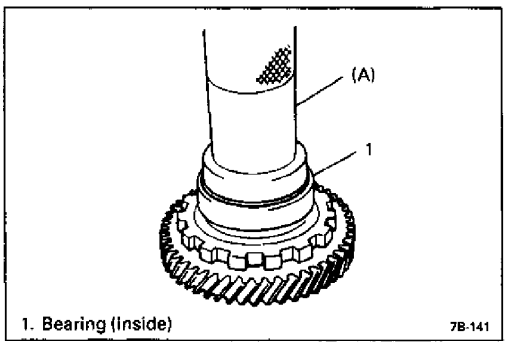
2) Install inside bearing.
   Hold bearing by using bearing puller and drive out shaft with press.

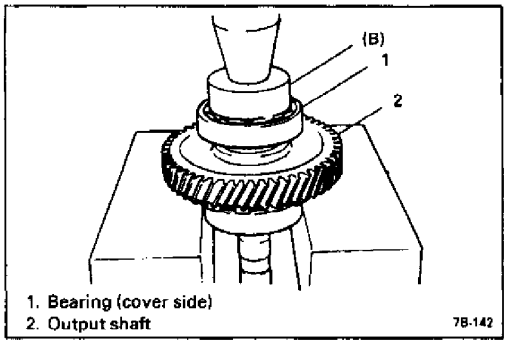
CAUTION:
Never hit shaft end where seal ring is installed so as not to distort ring slit.

Installation

1) Install inside bearing.
   Use special tool with press.

   Special Tool
   (A): 09913-85210



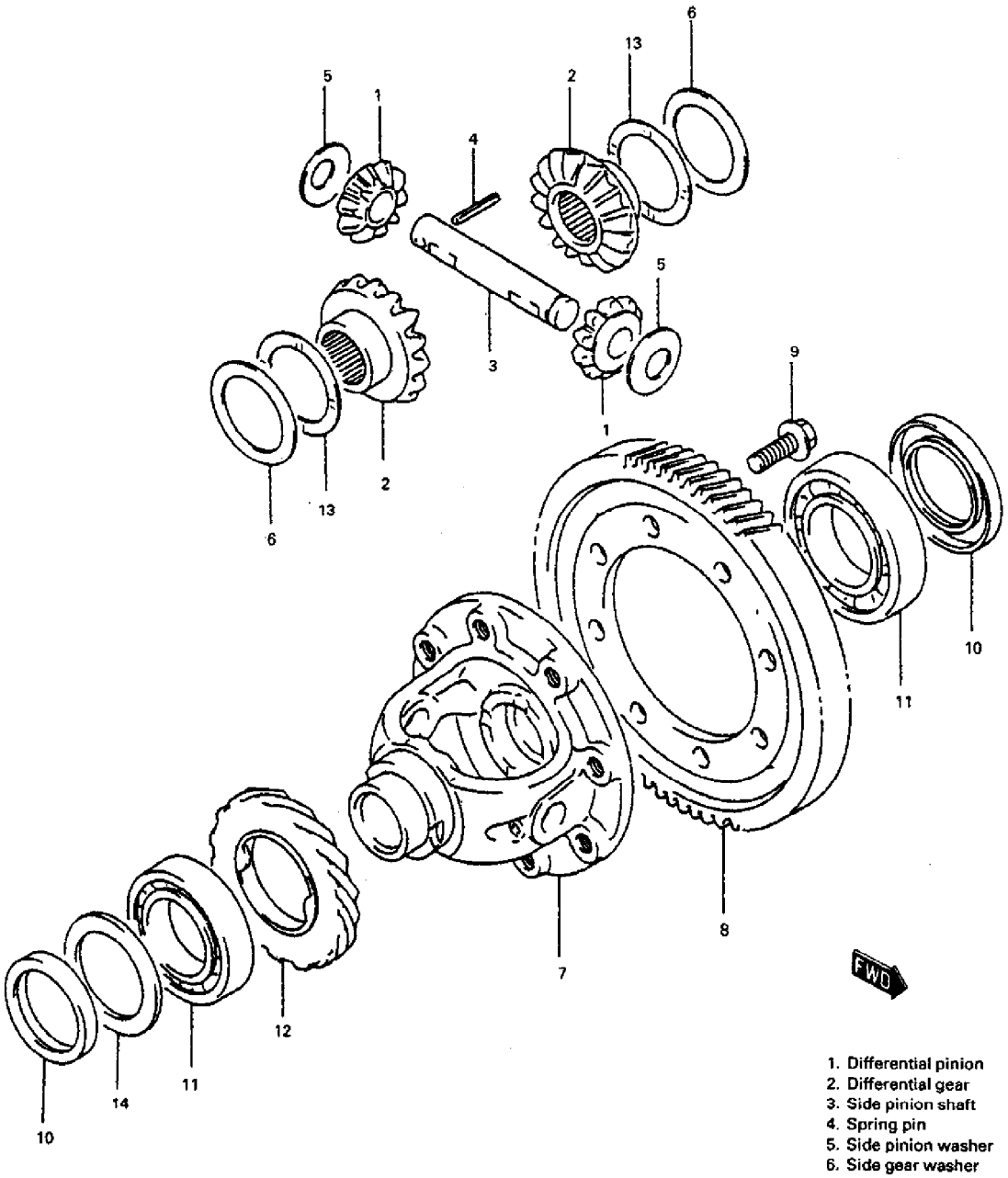


2) Install cover side bearing.
   Hold shaft at parking lock gear and press-fit bearing by using special tool with press.

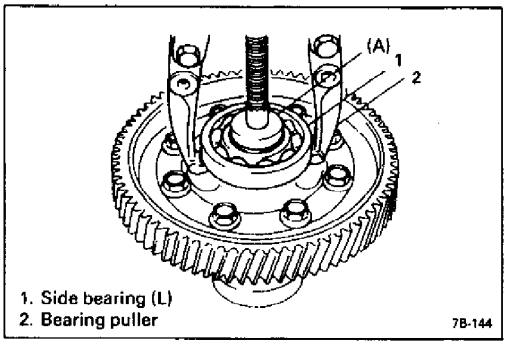
   Special Tool
   (B): 09944-66020

DIFFERENTIAL ASSEMBLY

Servicing procedure for differential assembly is similar to that for manual transmission. Section 7A of Service Manual mentioned in FOREWORD of this manual for further information.



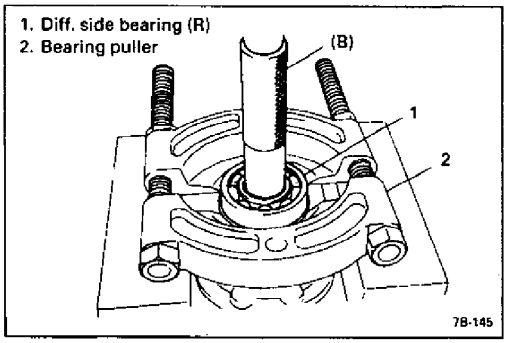
1. Differential pinion
2. Differential gear
3. Side pinion shaft
4. Spring pin
5. Side pinion washer
6. Side gear washer (selection)
7. Differential case
8. Final gear
9. Final gear bolt
10. Differential side oil seal
11. Differential side bearing
12. Speedometer drive gear
13. Washer
14. Side beaning shim (Selection)



Disassembly

1) Remove diff. side bearing (L).
   Use special tool and puller for its removal.

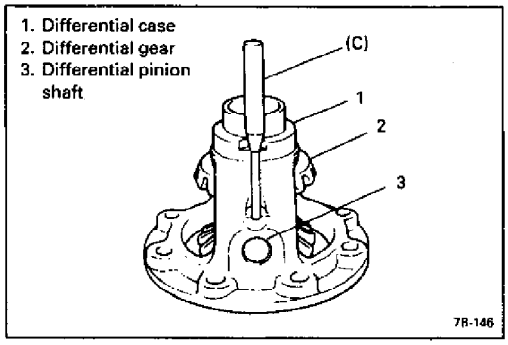
   Special Tool
   (A): 09925-88210



2) Remove final gear.
   Hold diff. case with soft jawed vise and remove 8 bolts then take out final gear.
3) Remove diff. side bearing (R).
   Drive it out by using special tool, bearing puller and press.

   Special Tool
   (B): 09913-80112

4) Remove speedometer drive gear.



5) Remove side pinion shaft pin.
   Use special tool and hammer for its removal.

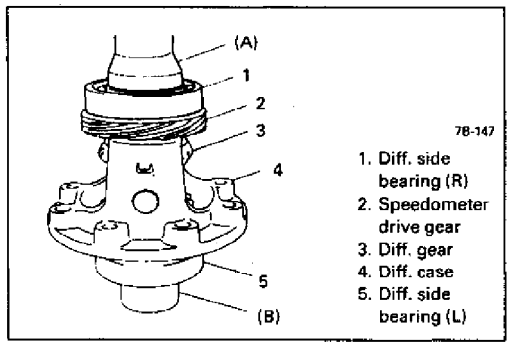
   Special Tool
   (C): 09922-85811

6) Remove side pinion shaft, differential pinions with each washer, differential gears with each washer.

Adjustment and Reassembly

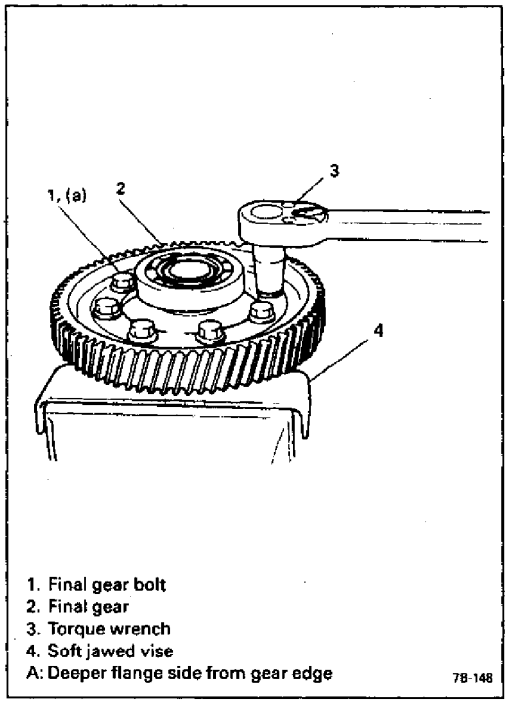
Prepare replacing parts as required and proceed to reassembly. Make sure that all parts are clean.

1) Install differential gears.
   Measure and adjust thrust play referring to Section 7A of Service Manual mentioned in FOREWORD of this manual, and then assemble them with suitable thrust washers.
2) Drive in side pinion shaft pin from right side till it is flush with diff. case surface.



3) Install diff. side bearing (L). Face its seal side inward (diff. case side) and press-fit by using the same special tool with right hand bearing in step 5).
4) Install speedometer drive gear.
5) Install diff. side bearing (R). Face its seal side inward and press-fit it by using special tool with copper hammer. While press-fitting, support diff. assembly as illustrated so that left hand bearing is floating.

   Special Tool
   (A): 09951-76010
   (B): 09951-16060



1. Final gear bolt
2. Final gear
3. Torque wrench
4. Soft jawed vise

A: Deeper flange side from gear edge

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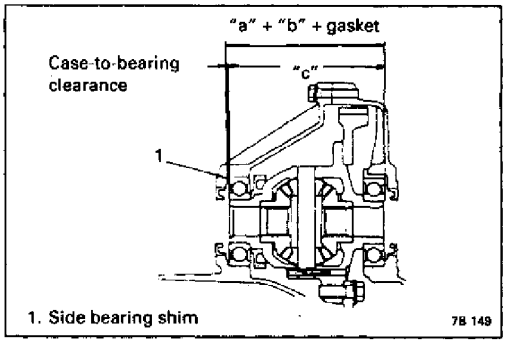
6) Hold differential assembly with soft jawed vise, install final gear and then tighten it with 8 bolts to specifed torque.

NOTE:
Place offset side of final gear flange toward differential case.

CAUTION:
Use of any other bolts than specified ones is prohibited.

Tightening Torque
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)



1. Side bearing shim

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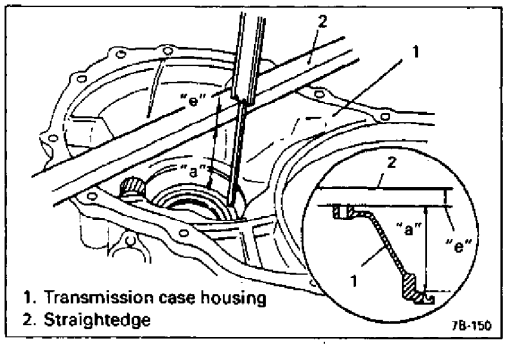
Shim Adjustment For Differential Side Bearing
Before installing differential assembly to transmission case, select a differential side bearing shim as follows.

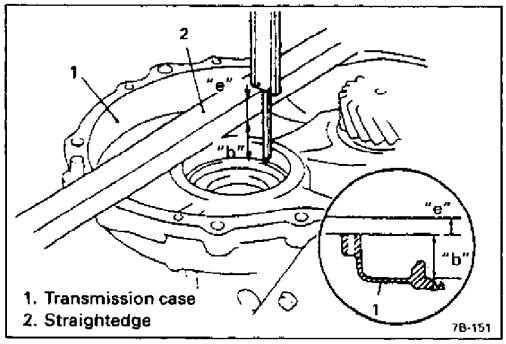


1. Transmission case housing
2. Straightedge

7B-150

1) With gasket removed, measure dimension "a" of transmission case housing (from mating surface to bearing bore bottom) by using straightedge and vernier caliper. The dimension "a" can be obtained by subtracting straightedge width "d" from measured value.

Dimension "a" = measured value – straightedge width "e"

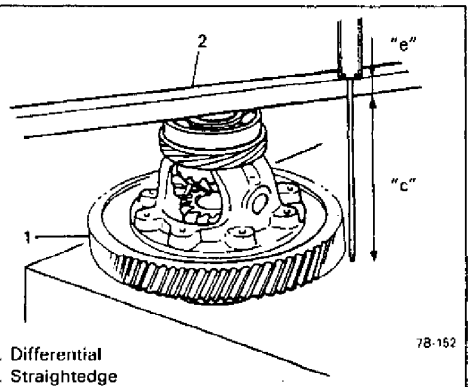


1. Transmission case
2. Straightedge

7B-151

2) In the same manner as the above 1), measure dimension "b" of transmission case (from mating surface to bearing bore bottom).

Dimension "b" = measured value – straightedge width "e"



1. Differential
2. Straightedge

Case-to-bearing clearance "d"	Available shim size
0.56 – 0.7 mm (0.022 – 0.028 in.)	0.56 mm (0.022 in.)
0.7 – 0.8 mm (0.028 – 0.031 in.)	0.7 mm (0.028 in.)
0.8 – 0.9 mm (0.031 – 0.035 in.)	0.8 mm (0.031 in.)
0.9 – 1.12 mm (0.035 – 0.044 in.)	0.9 mm (0.035 in.)

3) Place differential assembly on surface plate and measure dimension "c" (bearing-to-bearing).

Dimension "c" = measured value – straightedge width "d"

4) Obtain case-to-bearing clearance "d" in following calculation.

"d" = ("a" + "b" + 0.4) – ("c" + 0.2)
0.4mm (0.016 in.): Gasket thickness
0.2mm (0.008 in.): Intended to absorb the measurement error

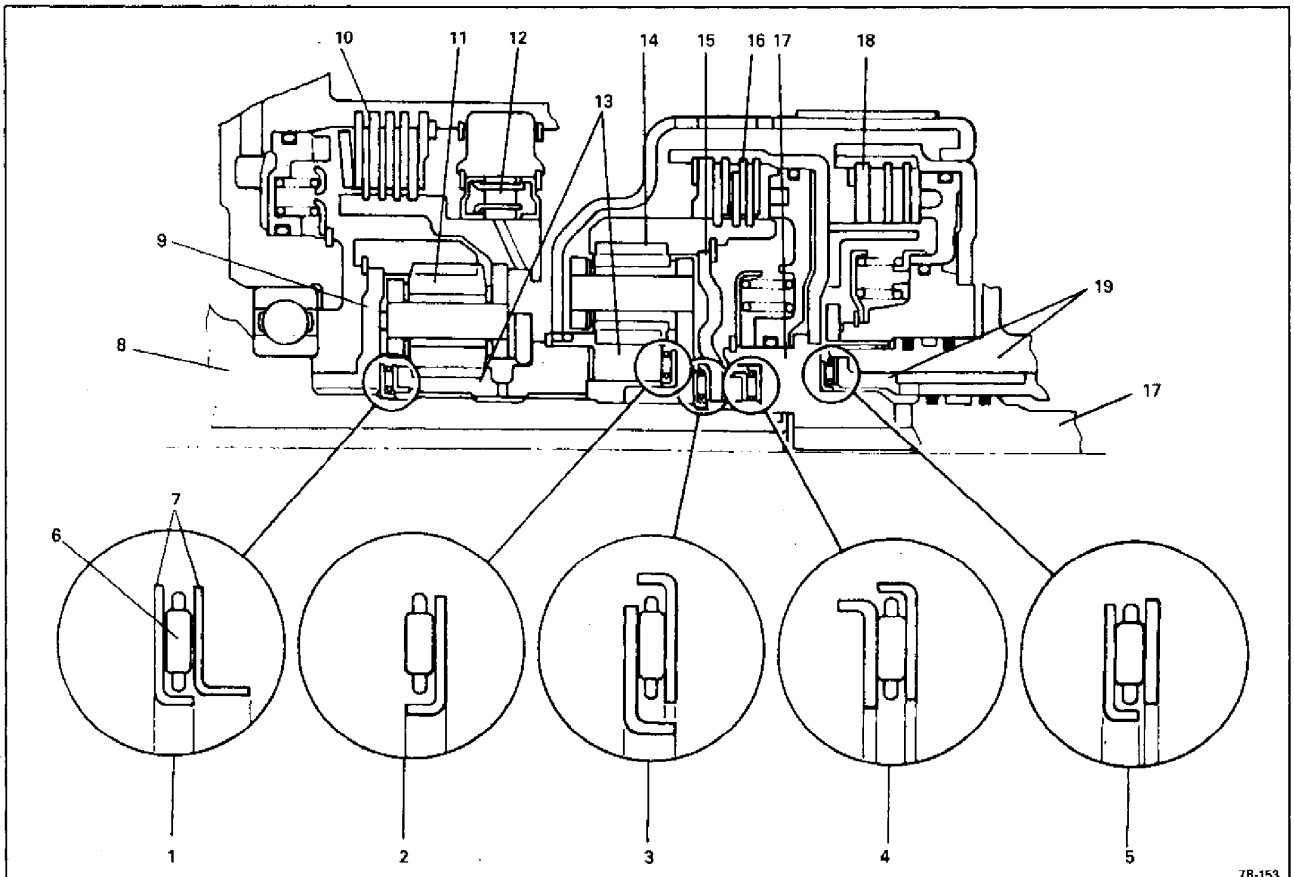
5) Select a shim from among available sizes and install it between transmission case and side bearing.

CAUTION:
Installing of over sized shim beyond specification may cause tight rotation and consequential bearing damage.

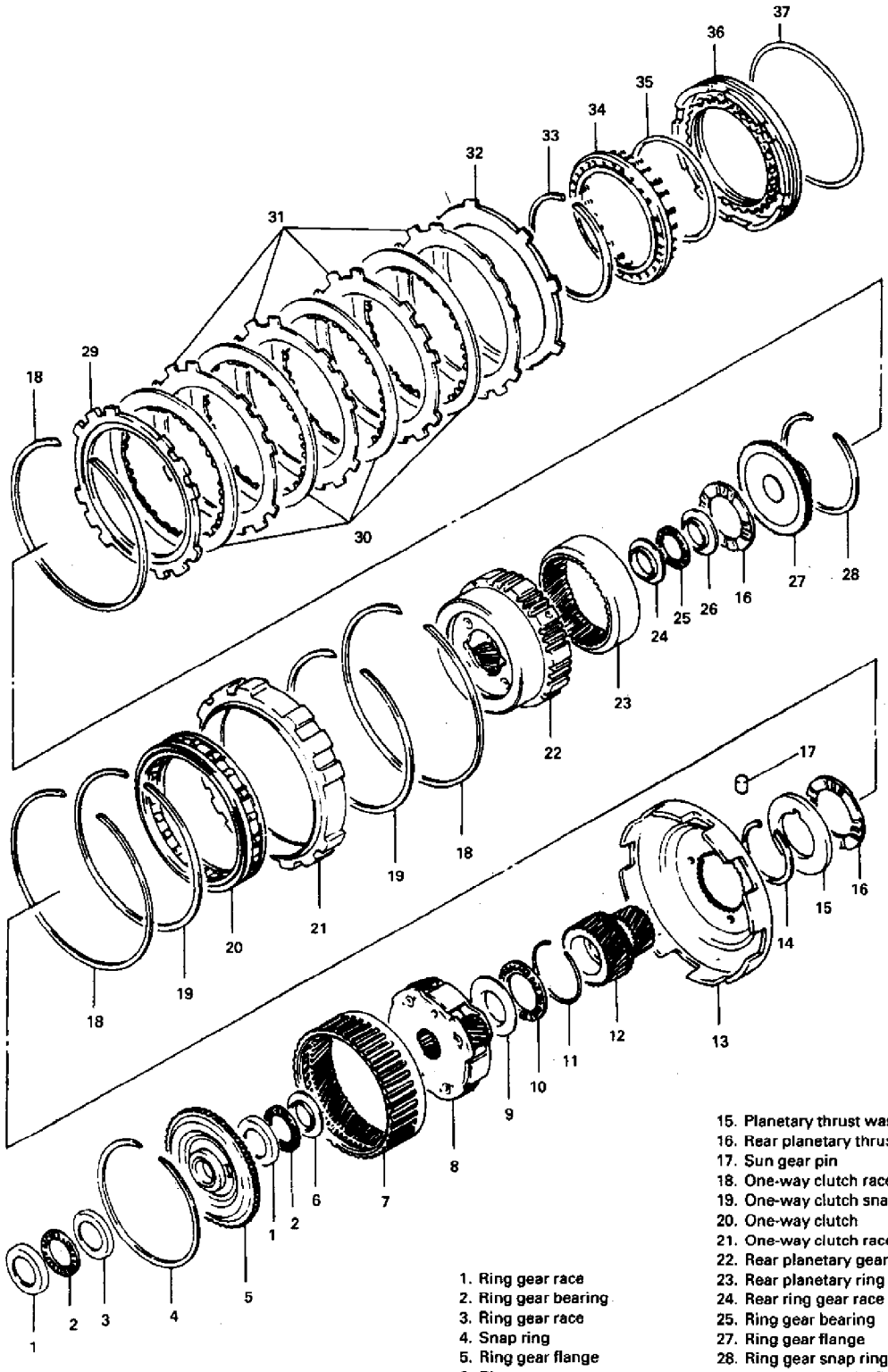
ASSEMBLING UNIT

CAUTION:

- **Automatic transmission consists of highly precise parts. As even a flaw in a small part may cause oil leakage or decrease in function, check each part carefully before installation.**
- **Clean all parts with compressed air. Never use wiping cloths or rags.**
- **Before assembling new clutch discs and brake band, soak them in automatic transmission fluid for at least 2 hours.**
- **Be sure to use new gaskets and O-rings.**
- **Lubricate O-rings with automatic transmission fluid.**
- **Apply automatic transmission fluid on sliding or rotating surfaces of the parts before assembly.**
- **Use yellow petrolatum grease or Suzuki super grease C to retain parts in place.**
- **Be sure to install thrust bearings and races in correct direction and position as shown in figure below.**
- **Make sure that snap ring ends are not aligned with one of cutouts and are installed in groove correctly.**
- **Do not use adhesive cements on gaskets and similar parts.**
- **Be sure to torque each bolt and nut to specification.**



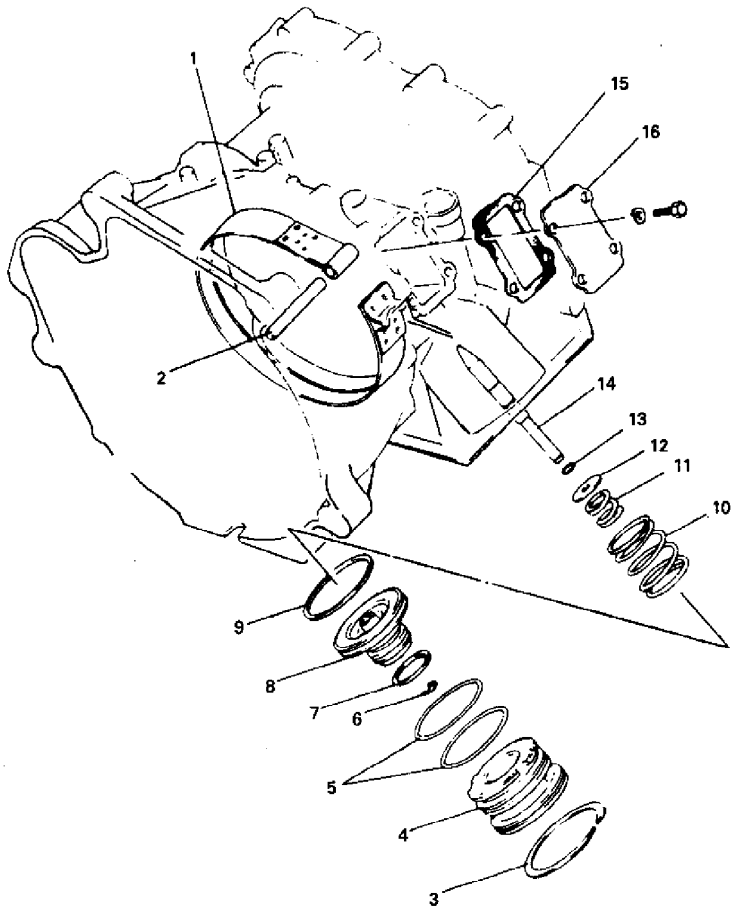
1. Rear ring gear races and bearing
2. Front planetary gear race and bearing
3. Ring gear races and bearing
4. Ring gear races and bearing
5. Input shaft bearing and races
6. Bearing
7. Race
8. Output shaft
9. Ring gear flange
10. 1st-reverse brake
11. Rear planetary gear
12. One-way clutch
13. Sun gear
14. Front planetary gear
15. Ring gear flange
16. Forward clutch
17. Input shaft
18. Direct clutch
19. Oil pump



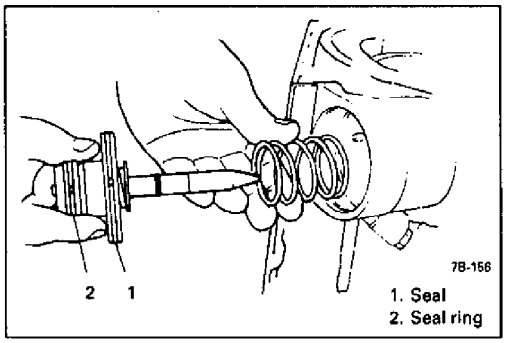
1. Ring gear race
2. Ring gear bearing
3. Ring gear race
4. Snap ring
5. Ring gear flange
6. Ring gear race
7. Front planetary ring gear
8. Front planetary gear assembly
9. Front planetary gear race
10. Front planetary gear bearing
11. Input drum snap ring
12. Planetary sun gear
13. Sun gear input drum
14. Snap ring
15. Planetary thrust washer
16. Rear planetary thrust washer
17. Sun gear pin
18. One-way clutch race snap ring
19. One-way clutch snap ring
20. One-way clutch
21. One-way clutch race
22. Rear planetary gear assembly
23. Rear planetary ring gear
24. Rear ring gear race
25. Ring gear bearing
27. Ring gear flange
28. Ring gear snap ring
29. 1st-reverse brake flange
30. 1st-reverse brake disc
31. 1st-reverse brake plate
32. 1st-reverse brake damper plate
33. Return spring snap ring
34. 1st-reverse brake return spring
35. Piston inner seal
36. 1st-reverse brake piston
37. Piston outer seal

INSTALLATION

1) Install 2nd brake piston.

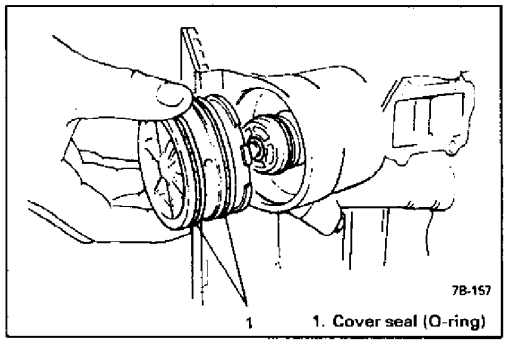


1. Second brake band
2. Pin
3. Piston cover snap ring
4. Piston cover
5. Cover seal (O-ring)
6. Retainer (E ring)
7. Seal ring
8. Second brake piston
9. Piston seal
10. Piston spring
11. Brake rod spring
12. Washer
13. Piston rod seal (O-ring)
14. Second brake piston rod
15. Cover gasket
16. Cover



1. Seal
2. Seal ring

① Put piston spring in transmission case and insert piston assembly into case after applying fluid to piston rod, seal and seal ring.

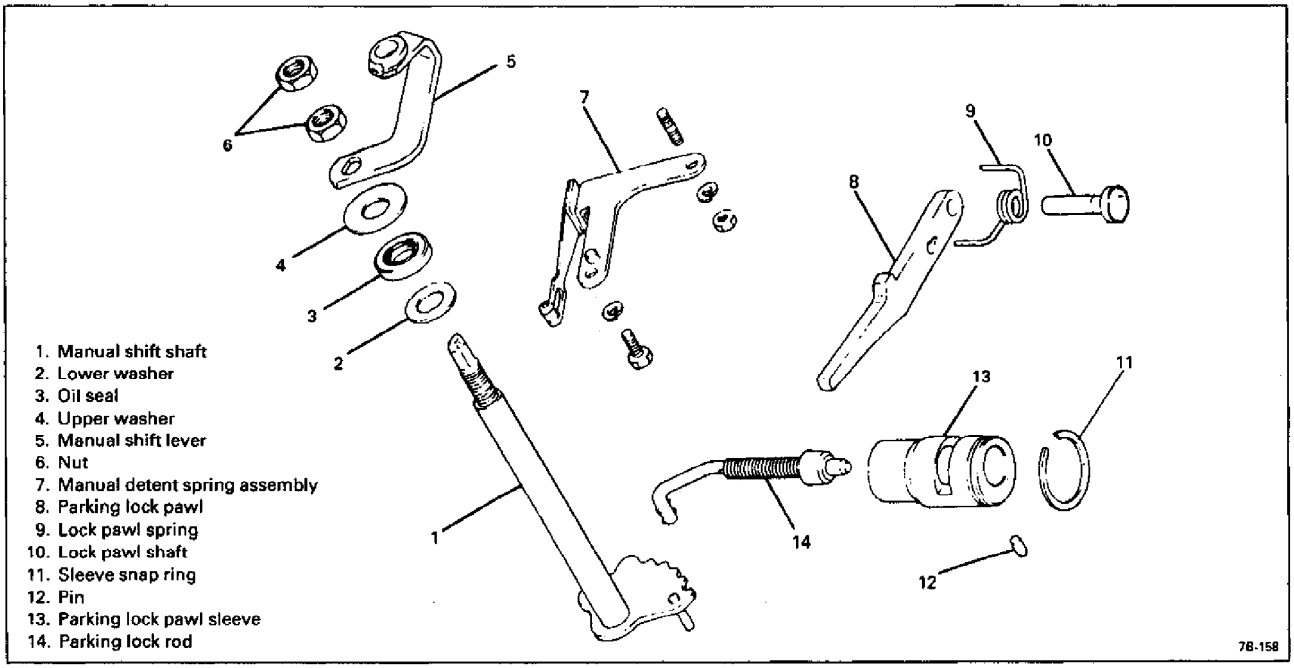


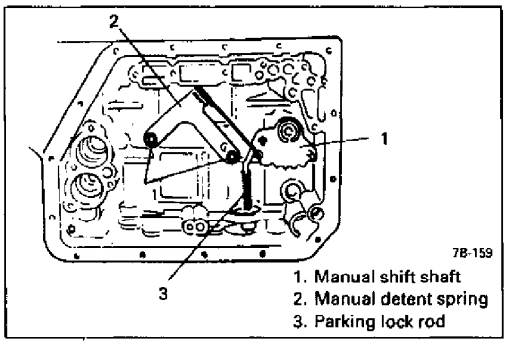
1. Cover seal (O-ring)

② Install piston cover to case after applying fluid to 2 cover seals.

③ Push down piston cover by using valve lifter with 17 mm socket and install snap ring. Refer to page 7B-52.

2) Install manual shift shaft and parking lock pawl.

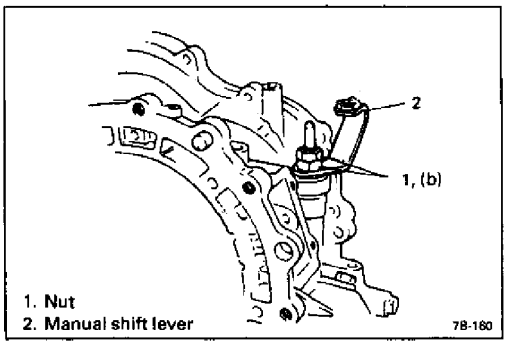




① Install lower washer and parking lock rod to manual shift shaft.

② Install manual shift shaft into transmission case, and then, manual detent spring.
Use special care so that manual shift shaft will not damage oil seal lip when passing through it.

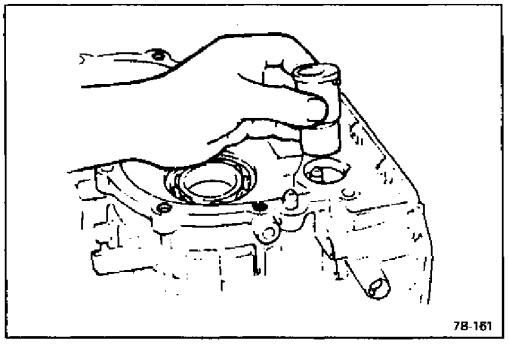
Tightening Torque
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



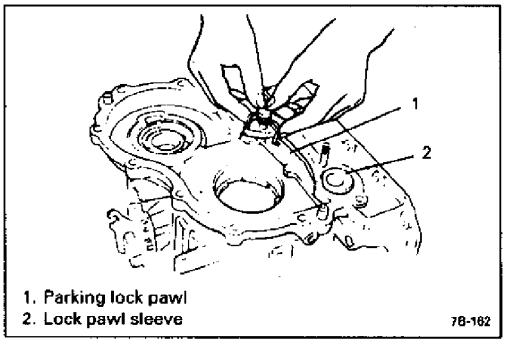
③ Install shift shaft upper washer and then manual shift lever to manual shift shaft. Tighten lower nut first and then upper nut.

Tightening Torque
(b): 30 N·m (3.0 kg-m, 22.0 lb-ft)

④ After tightening nuts, check manual shift shaft for smooth rotation.

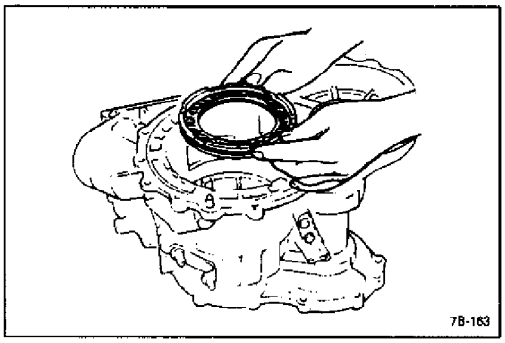


⑤ Install restrictor pin and snap ring to parking lock pawl sleeve. And then install it to case.

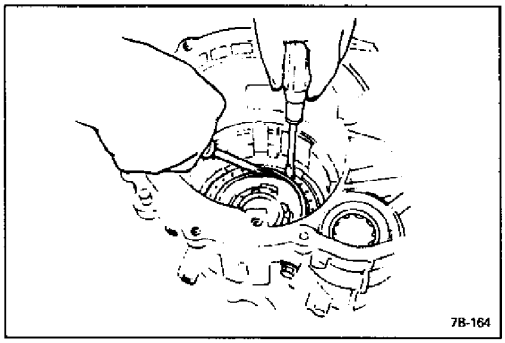


1. Parking lock pawl
2. Lock pawl sleeve
7B-162

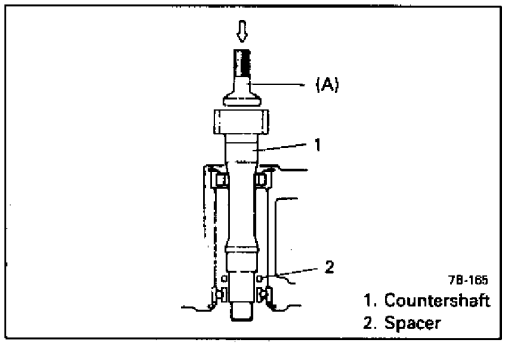
⑥ Install parking lock pawl.
a. Shift manual shift lever to a position other than P.
b. Install parking lock pawl.
c. Install lock pawl shaft and lock pawl spring, and then, check to make sure that parking lock pawl moves smoothly when manual shift lever is moved.


7B-163

3) Install 1st-reverse brake piston.
① Apply fluid to inner and outer seals (O-rings) and fit them to piston. Use new seals.
② Insert piston into case in such way that the side with spring holes comes to the top. Make sure that seals are not twisted or caught.
③ Place return spring assembly on piston. Check to make sure that each spring of return spring assembly is fitted securely in spring hole in piston.


7B-164

④ Push down return spring assembly and install snap ring.

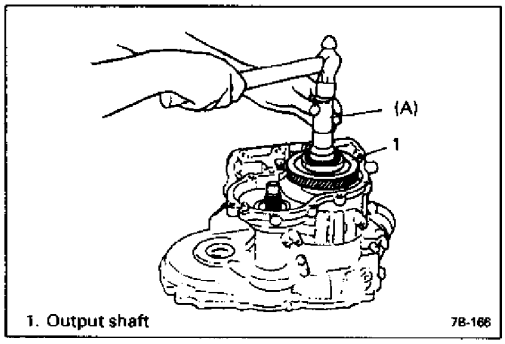


7B-165
1. Countershaft
2. Spacer

4) Using a special tool (Bearing installer) and a hammer, install countershaft.
When inserting countershaft into case, check to make sure that spacer is in such position as shown in figure.

CAUTION:
Do not hammer shaft excessively hard, or snap ring and case will be damaged.

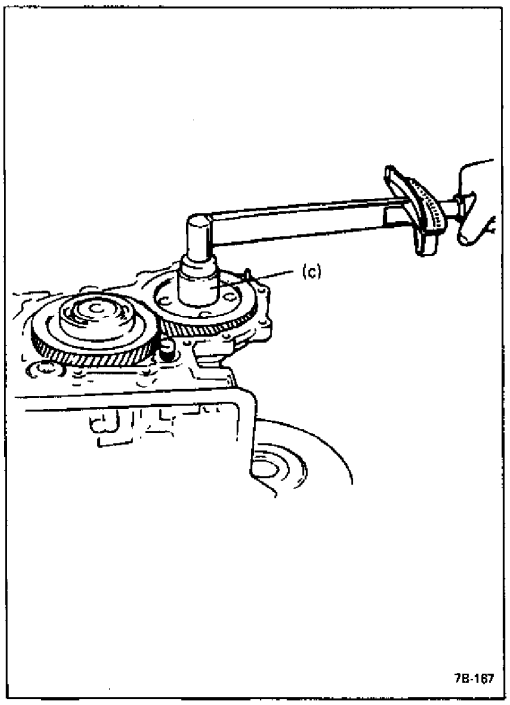
Special Tool
(A): 09951-76010



1. Output shaft
7B-166

5) Install output shaft.
① Shift manual shift lever to a position other than P.
② Using a special tool (Bearing installer) and hammer, install output shaft.

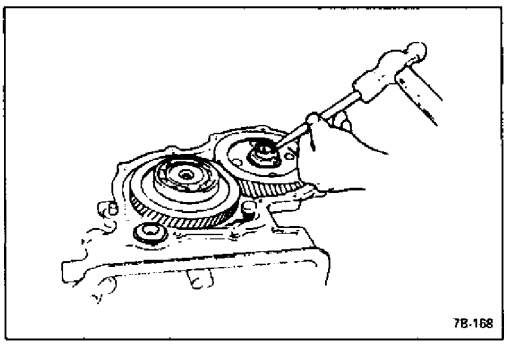
Special Tool
(A): 09951-76010



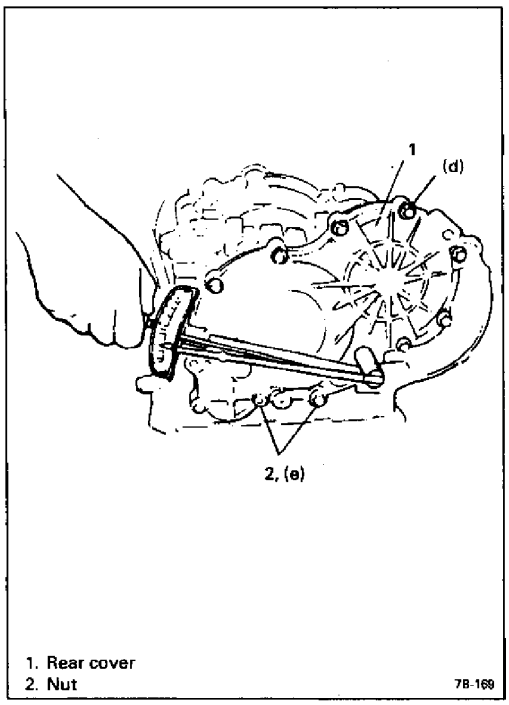
6) Install reduction driven gear on countershaft.
① Shift manual shift lever to P position so that output shaft is locked and cannot turn.
② Tighten driven gear nut to specification.

CAUTION:
- **Tighten nut by turning wrench by hand.**
- **Tightening nut by hammering wrench may cause damage to parking lock pawl, output shaft and reduction gear.**

Tightening Torque
(c): 130 N·m (13.0 kg-m, 94.0 lb-ft)



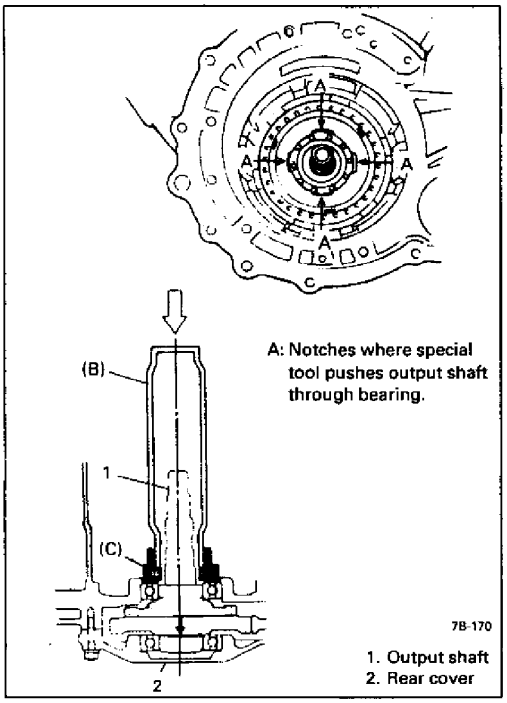
③ Using a chisel and a hammer, caulk driven gear nut at 2 places.



7) Install transmission rear cover.
① Install rear cover gasket.
② Install rear cover.
Check that output shaft bearing enters to rear cover bearing hole smoothly.
③ Install 10 bolts and 2 nuts.
Torque bolts and nuts to following specifications.

NOTE:
Check to make sure that the shafts rotate smoothly without abnormal noise.

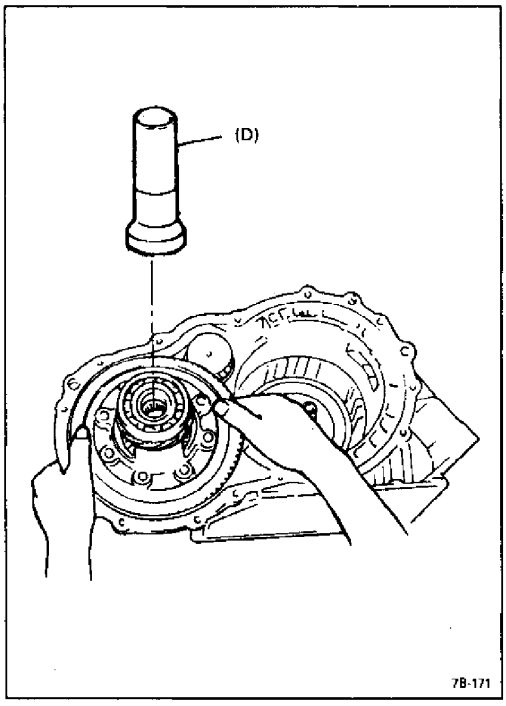
Tightening Torque
(d): 20 N·m (2.0 kg-m, 14.5 lb-ft)
(e): 13 N·m (1.3 kg-m, 9.5 lb-ft)



8) Using special tools (Output shaft remover and Bearing remover handle), push output shaft against rear cover side.
   ① Fit 4 projections of special tool (Output shaft remover) to 4 notches A in case.
   ② Push bearing and output shaft against rear cover side by tapping special tool (Bearing remover handle) with a hammer lightly.

CAUTION:
- **Do not hit output shaft directly, or shaft end will be damaged.**
- **Be careful not to hammer with special tool too hard.**

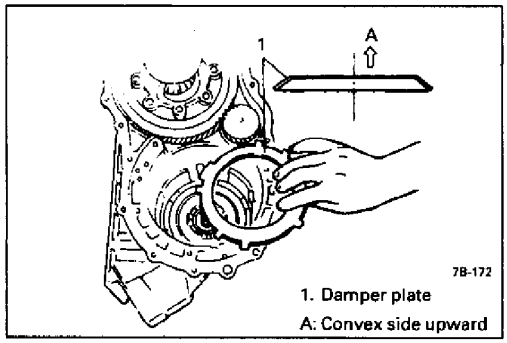
Special Tool
(B): 09925-18010
(C): 09927-08210



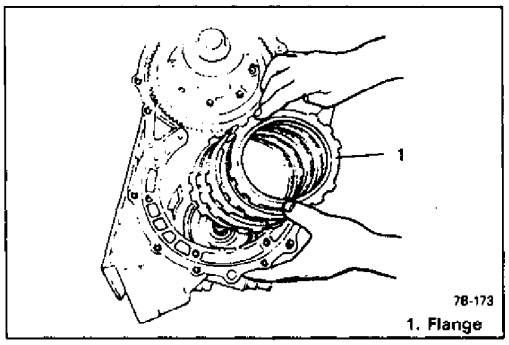
9) After engaging teeth of final gear and countershaft gear, install differential assembly.

CAUTION:
- **Be careful not to damage gear tooth by hitting it with other one.**
- **Make sure that differential assembly is placed on case straightly, while installing it.**
- **Drive in differential by giving force to side bearing inner race through special tool (bearing installer).**

Special Tool
(D): 09951-76010



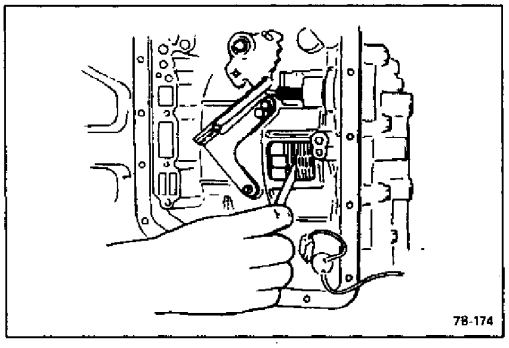
10) Install 1st-reverse brake parts.
   ① Install damper plate to return spring assembly with convex side upward. Use care not to install in reverse direction.



② Install discs, plates and flange in following order:
① Plate → ② Disc → ③ Plate → ④ Disc → ⑤ Plate → ⑥ Disc → ⑦ Plate → ⑧ Disc → ⑨ Flange (Flat side down)

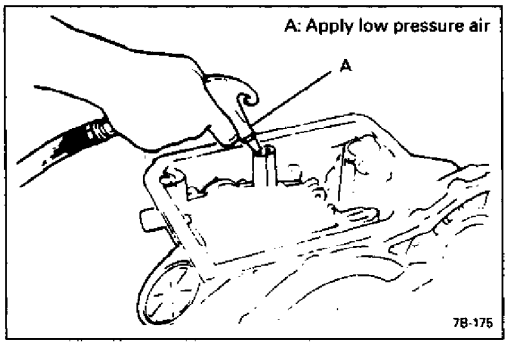
NOTE:
When using new discs for installation, soak them in fluid for more than 2 hours before installation.

③ Install snap ring.

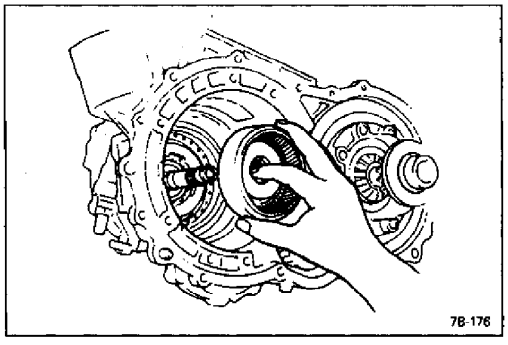


11) Measure 1st-reverse brake clearance.
Measure clearance between snap ring and flange.

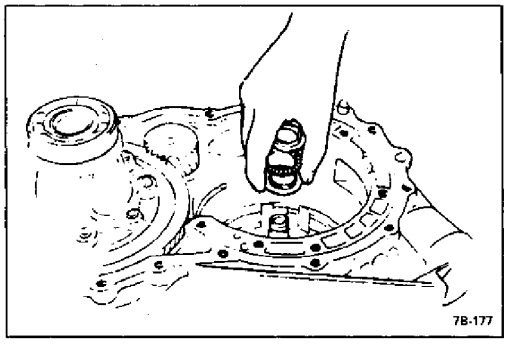
1st-reverse brake clearance
0.58 – 1.92 mm (0.023 – 0.075 in.)



12) Check 1st-reverse brake piston for operation.
Check for piston movement by blowing air into oil hole.



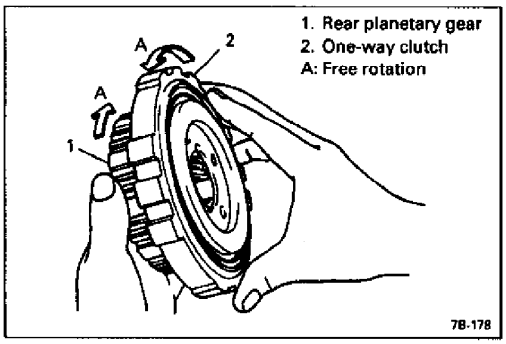
13) Install rear planetary ring gear.
Engage ring gear and output shaft spline, and insert.



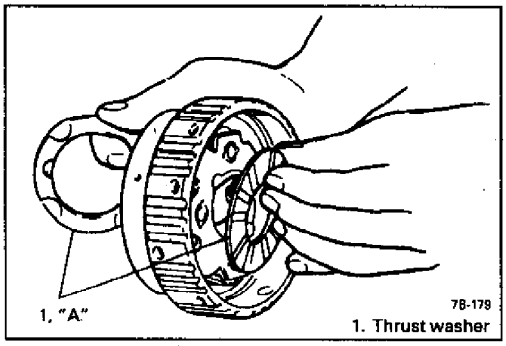
14) Install rear planetary ring gear races and bearing.
Install in following order:

① Race (flange side up)
② Bearing
③ Race (flange side up)

For proper positions and directions of ring gear races installation, refer to p. 7B-77.

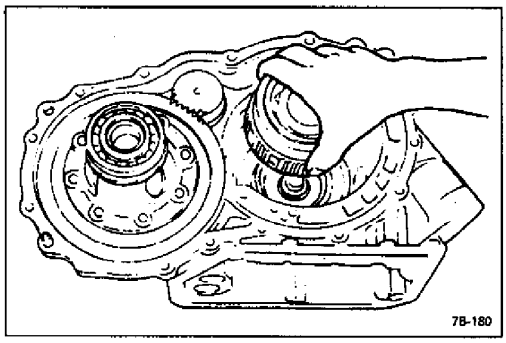


15) Check one-way clutch direction.
Provisionally assemble one-way clutch and rear planetary gear, then turn them by hand.
They should rotate freely in arrow direction A but lock in the other way.
Remove one-way clutch and keep its correct side in mind until it is installed into transmission.

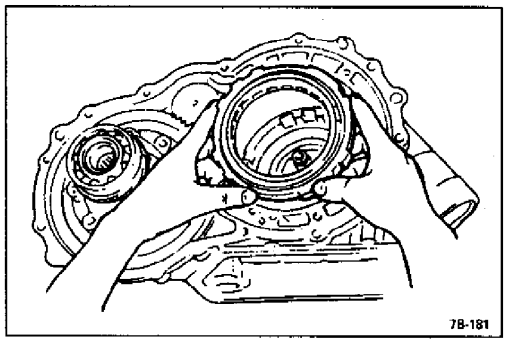


16) Install rear planetary thrust washers on rear planetary gear.
Apply grease to thrust washers and fit them before and behind planetary gear, one each.
Make sure that different lug shapes match slots in planetary gear.

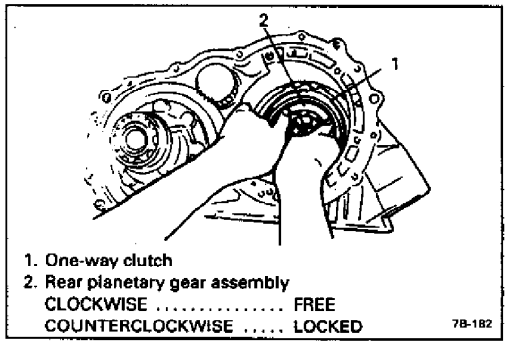
"A": SUZUKI SUPER GREASE C, 99000-25030



17) Install rear planetary gear with teeth of 1st-reverse brake discs aligned.
After installing rear planetary gear, check thrust washers and races for proper installation by moving rear planetary gear up and down lightly by hand. If gear assembly makes clear sound like "Click" when moved up and down, washers and races are installed in place. But if no sound or thick one is heard, it is possible that they are out of place.
In such case, remove gear assembly and check.

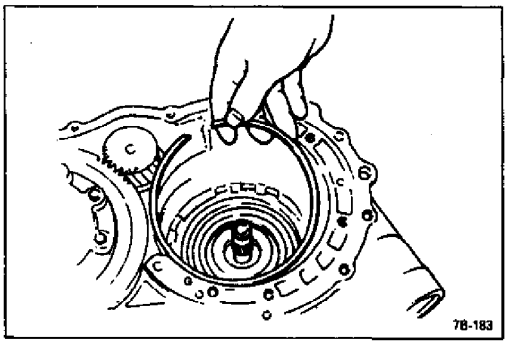


18) Install one-way clutch race snap ring into groove of transmission case.
19) Place one-way clutch on rear planetary gear and while turning planetary gear clockwise by hand, insert one-way clutch to correct position.

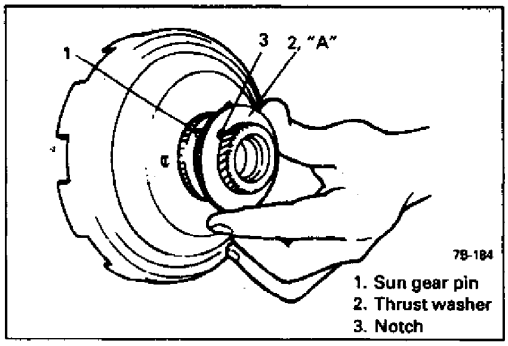


After installing one-way clutch to rear planetary gear, check to confirm that planetary gear turns clockwise but locks in the other way.

NOTE:
Rotation check must be performed without fail.

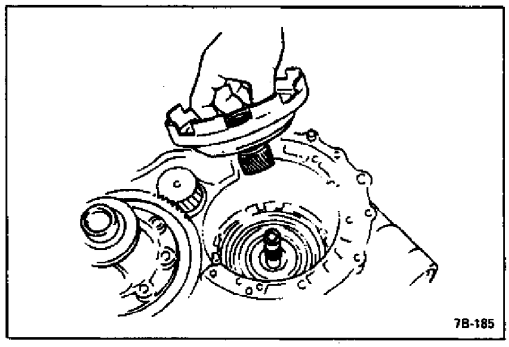


20) Push one-way clutch race snap ring into place by hand. Visually check to make sure that ring is fully seated. Also, make sure that ends of snap ring are between lugs.

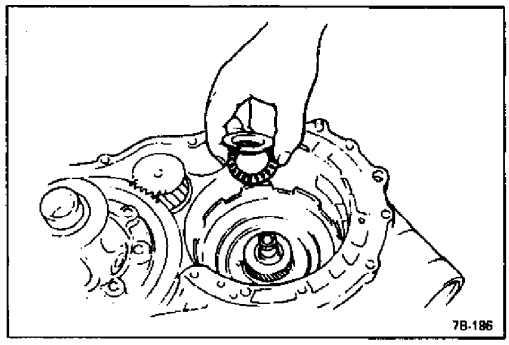


21) Install sun gear pin and thrust washer on sun gear assembly.
Apply grease to thrust washer so that it will not fall off. Check to make sure that pin is fitted in thrust washer notch.

"A": SUZUKI SUPER GREASE C, 99000-25030



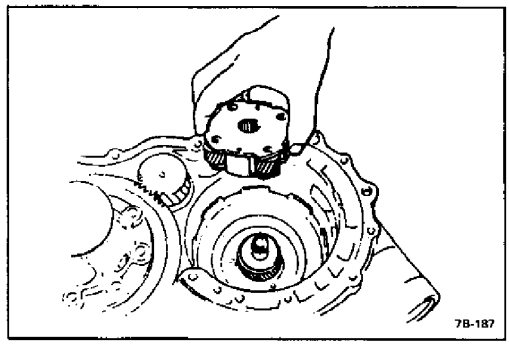
22) Push in sun gear assembly while engaging it with rear planetary gear. Be careful not to damage bushing inside sun gear. After installing sun gear, check thrust washers for proper installation by moving sun gear up and down lightly with finger. If sun gear makes clear sound like "Click" when moved up and down, washers are installed in place. But if no sound or thick one is heard, it is possible that they are out of places. In such case, remove sun gear and check.



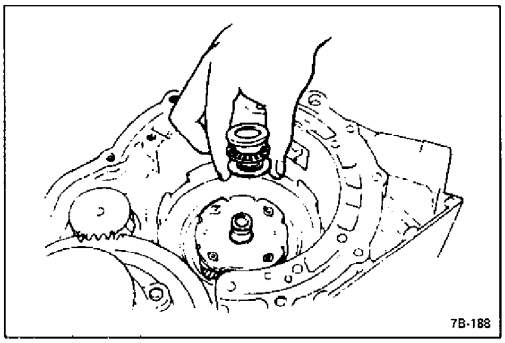
23) Install front planetary gear bearing and race to sun gear in following order.

① Bearing
② Race (flange side down)

Refer to p. 7B-77 for installation.



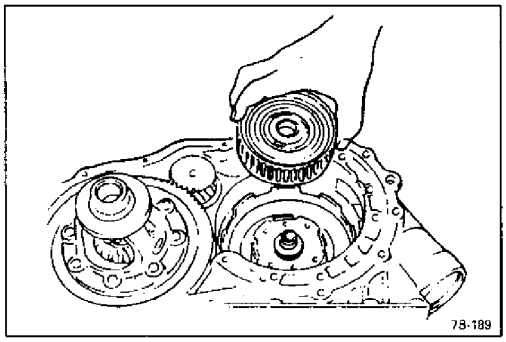
24) Install front planetary gear assembly while turning it back and forth. After installing front planetary gear assembly, check bearing and race installed in step 23) for proper installation by moving planetary gear assembly up and down lightly with finger. If planetary gear makes clear sound like "Click" when moved up and down, bearing and race are installed in place. But if no sound or thick one is heard, it is possible that they are out of place. In such case, remove planetary gear assembly and check.


7B-188

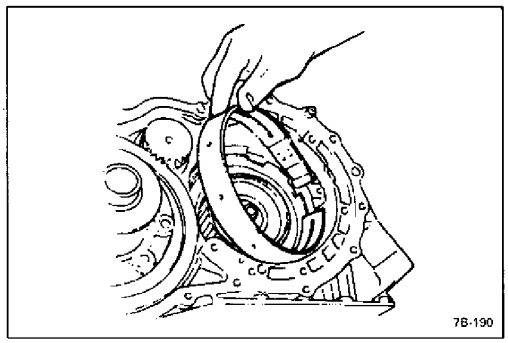
25) Install ring gear bearing and races on front planetary gear assembly in following order:

① Race (flange side up)
② Bearing
③ Race (flange side down)

Refer to p. 7B-77 for proper installation.

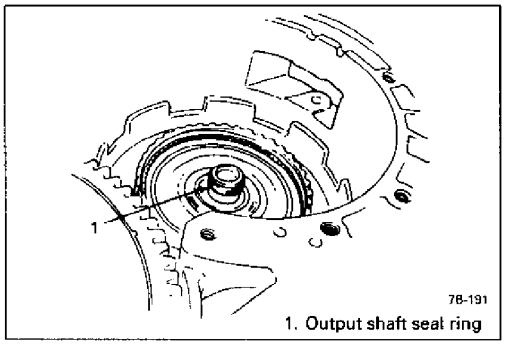

7B-189

26) Install front planetary ring gear assembly.
After installing front planetary ring gear assembly, check bearing and races installed in step. 25) for proper installation by moving ring gear assembly up and down lightly with finger. If ring gear assembly makes clear sound like "Click" when moved up and down, bearing and races are installed in place. But if no sound or thick one is heard, it is possible that they are out of place. In such case, remove ring gear assembly and check.


7B-190

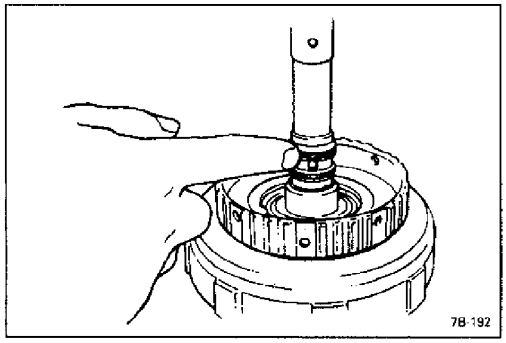
27) After making sure for its correct installing direction, install 2nd brake band in case.
Be careful not to bend it too much, or damage it.

NOTE:
When installing a new brake band, soak it in transmission fluid for more than 2 hours in advance.

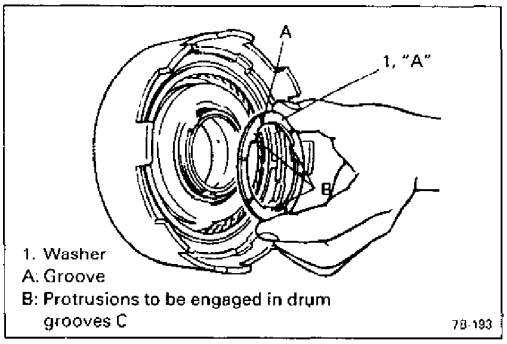


7B-191
1. Output shaft seal ring

28) Inspect output shaft seal ring for wear or damage, and replace if necessary.
Do not expand seal ring excessively when installing.


7B-192

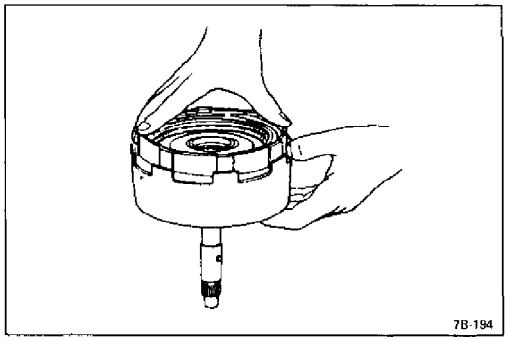
29) Install input shaft seal rings on input shaft, if replacing is required.
When installing input shaft seal rings, apply grease to grooves in input shaft before installation.
Do not expand seal ring excessively.



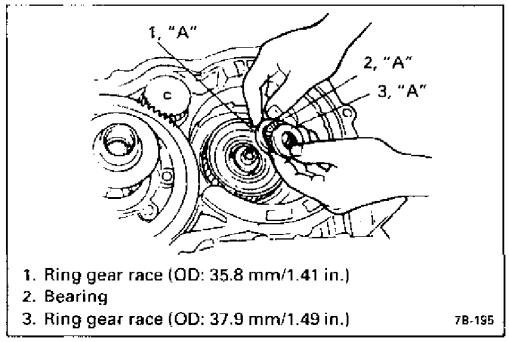
1. Washer
A. Groove
B: Protrusions to be engaged in drum grooves C
7B-193

30) Apply grease to direct clutch washer, and install it on direct clutch with its grooved face outward and aligning washer protrusions to direct clutch drum groove.

"A": SUZUKI SUPER GREASE C, 99000-25030


7B-194

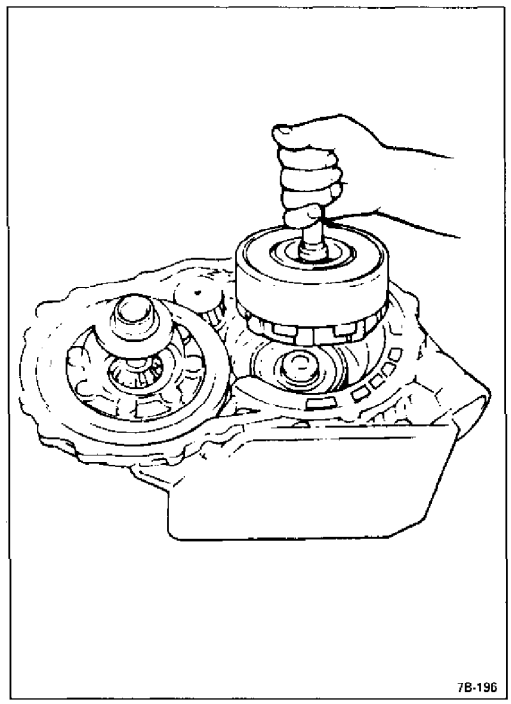
31) Align teeth of direct clutch discs and then install direct clutch on input shaft.
After installing direct clutch, check it for proper installation by moving it up and down lightly by hand. If direct clutch makes clear sound like "Click" when move up and down, it is installed in place. But if no sound or thick one is heard, it is possible that direct clutch is not installed correctly. In such case, remove direct clutch and reinstall.



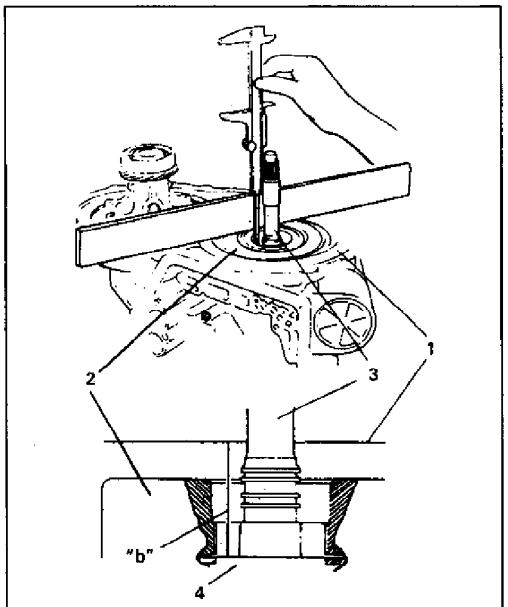
1. Ring gear race (OD: 35.8 mm/1.41 in.)
2. Bearing
3. Ring gear race (OD: 37.9 mm/1.49 in.)
7B-195

32) Apply grease to ring gear races and bearing.
Install ring gear race (OD: 35.8 mm/1.41 in.) on ring gear with its flange side down. Another ring gear race (OD: 37.9 mm/1.49 in.) and bearing are attached on input shaft.
Refer to page 7B-77 for proper installation.

"A": SUZUKI SUPER GREASE C, 99000-25030


7B-196

33) Install input shaft and forward and direct clutch assemblies.
Hold input shaft with direct clutch installed by hand and while turning it back and forth, insert it into case.
Align teeth of forward clutch discs before installation.
When installing input shaft, be careful so that its bearing and race will not fall off.
Be careful not to damage output shaft seal.
After installing input shaft, check it for proper installation by moving it up and down lightly by hand. If input shaft makes clear sound like "Click" when moved up and down, it is installed in place. But if it doesn't, try again for proper installation.

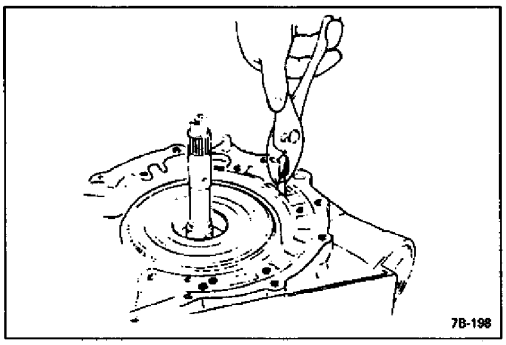


1. Transmission case end surface
2. Direct clutch drum
3. Input shaft
4. Input shaft flange

7B-197

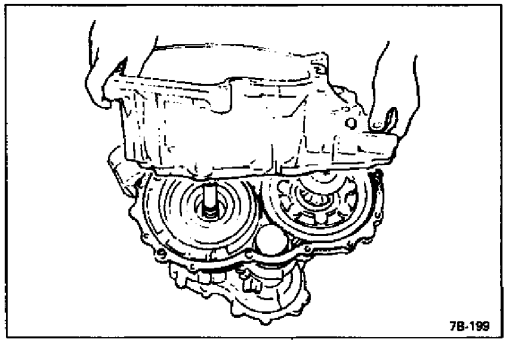
34) Check for correct installation of each component parts as follows.
After installing input shaft, check to make sure that each component is installed properly according to following description.
Place straightedge on transmission case end surface and measure the distance "b" by using vernier. For the distance "b", subtract the width of straightedge from vernier reading. If measured distance "b" is within following specification, it means that component parts other than direct clutch are installed properly.
If out of specification, remove input shaft with direct clutch and reinstall them properly.

Distance "b": 49.82 – 51.06 mm (1.962 – 2.010 in.)



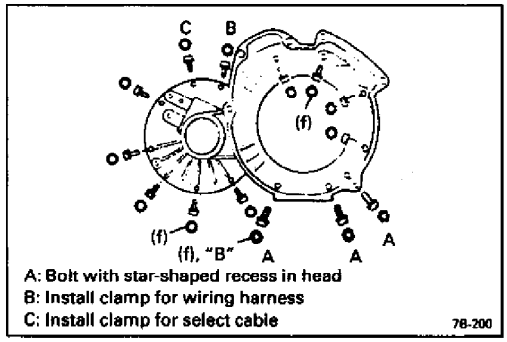
7B-198

35) Align hole in second brake band with case pin hole and insert second brake band pin.
Apply fluid to brake band pin before installation.



7B-199

36) Install case gasket and transmission case housing.
Use new gasket. Install gasket using care so that it will not protrude inside.



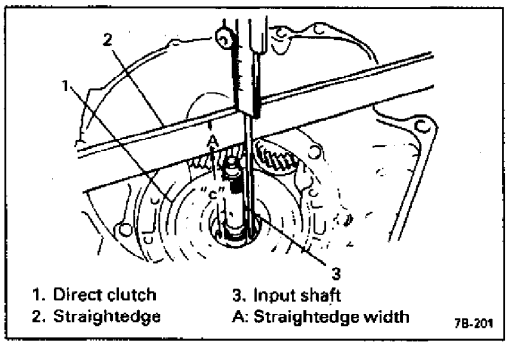
A: Bolt with star-shaped recess in head
B: Install clamp for wiring harness
C: Install clamp for select cable

7B-200

37) Among 14 bolts of case housing bolts, 3 bolts have star-shaped recess in their heads.
Install these 3 bolts in such positions as shown by A in figure after applying sealant to their threads. Do not apply thread locking compound to housing bolts. Tighten case housing bolts to specification.

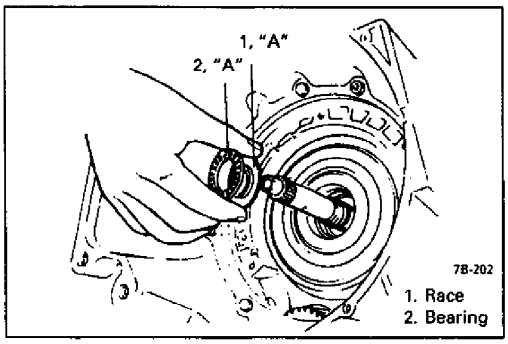
"B": SUZUKI BOND No.1215, 99000-31110

Tightening Torque
(f): 20 N·m (2.0 kg-m, 14.5 lb-ft)



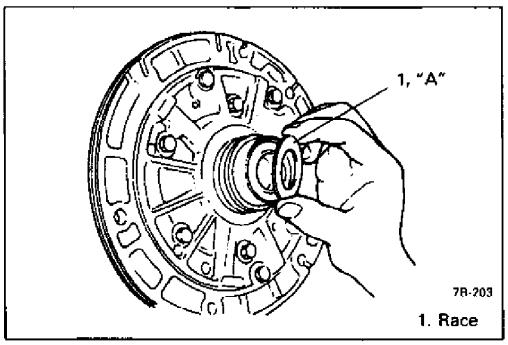
38) Measure input shaft position.
Seated position of input shaft can also be measured after installing case housing as distance "c" (Measured dimension – straightedge width A), and it should be 188.37 to 189.91 mm (7.416 to 7.477 in.).

Distance "c": 188.37 – 189.91 mm (7.416 – 7.477 in.)



39) Install input shaft bearing race and bearing on input shaft.
Grease bearing race and install it with its flange side outward together with bearing.
Install so that bearing does not get on bearing race flange.

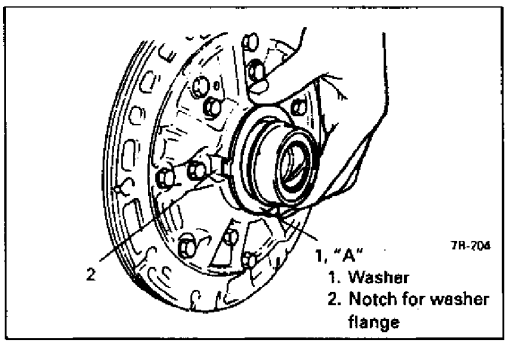
"A": SUZUKI SUPER GREASE, 99000-25030



40) Install another input shaft bearing race on oil pump.
Grease bearing race and attach it to oil pump body.

NOTE:
- **With this bearing race, input shaft thrust play is adjusted. Refer to step 44) for measuring procedure.**
- **Make sure seal rings are installed in pump cover flange in good condition lubricated with automatic transmission fluid.**

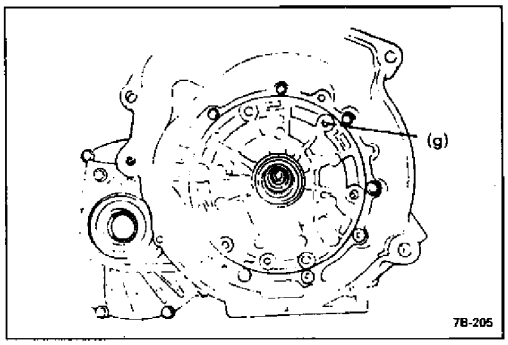
"A": SUZUKI SUPER GREASE C



41) Attach greased direct clutch washer on oil pump.
Fit washer flange into notch of oil pump body.

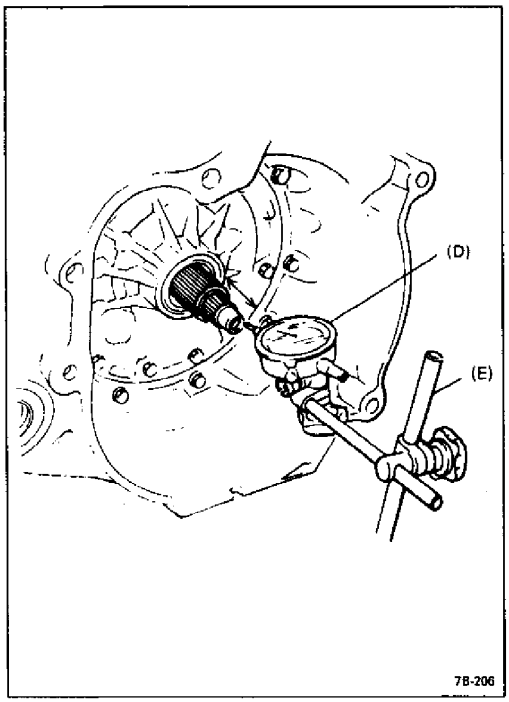
"A": SUZUKI SUPER GREASE C

42) Install greased new oil pump cover seal (O-ring) in outer groove of oil pump.
Make sure that cover seal is not twisted or extruded.



43) Align oil pump bolt hole with case bolt hole and push in pump gently by hand until it contacts case. Use care so that direct clutch washer does not fall off, and input shaft seal rings and pump cover seal rings will not come off or get damaged.
While making sure smooth rotation of input shaft, tighten 6 oil pump bolts gradually to specification.

Tightening Torque
(g): 23 N·m (2.3 kg-m, 16.5 lb-ft)



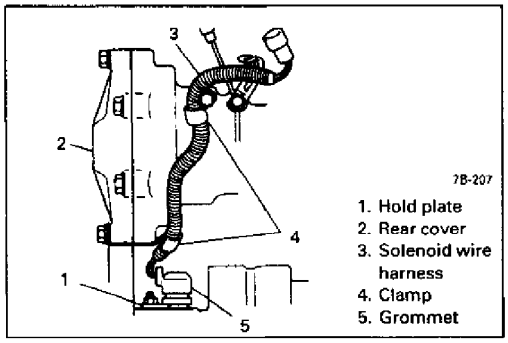
44) Check input shaft end play.
Apply dial gauge onto input shaft end surface and measure thrust play of input shaft.
If out of specification, remove oil pump and replace input shaft bearing race on oil pump side (Refer to step 40)).

NOTE:
Check to be sure that input shaft turns smoothly.

Special Tool
(D): 09900-20606
(E): 09900-20701

Input shaft thrust play: 0.3 – 0.9 mm (0.012 – 0.035 in.)

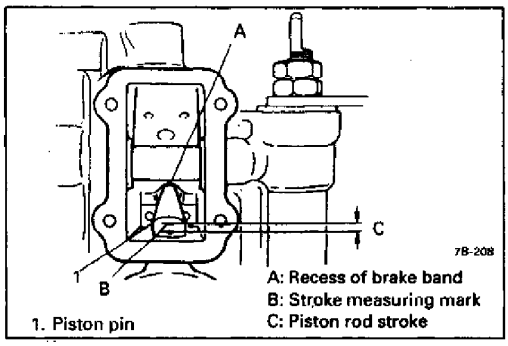
Available input shaft bearing race (oil pump side) thickness	0.8 mm/0.031 in.
	1.4 mm/0.055 in.



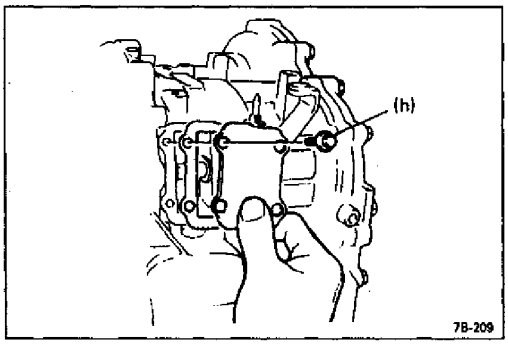
45) Install solenoid wire harness to case.
① Insert solenoid wire hold plate in groove in solenoid wire grommet and install it to stud bolt of transmission case.
② Secure hold plate with lock washer and nut.
③ Install solenoid wire clamps to rear cover and case. Secure harness with them.

NOTE:
When inserting grommet into case bore, check to be sure that its O-ring is in good condition.

46) Check second brake band for proper installation.
Looking through second brake band cover hole, check that second brake piston rod end is aligned with the center of recess in brake band as shown in below figure.
If rod end contacts outside of brake band recess, pull up second brake band by inserting thin wire in brake band fitting so that band recess aligns with rod end properly.



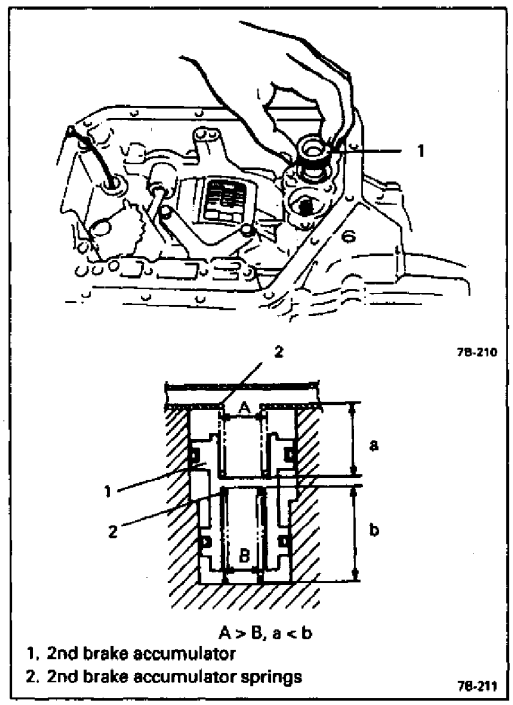
47) Check second brake piston stroke as previously described. For checking procedure, refer to p. 7B-52.



48) Install second brake band cover with new gasket.

Tightening Torque
(h): 8 N·m (0.8 kg-m, 6.0 lb-ft)

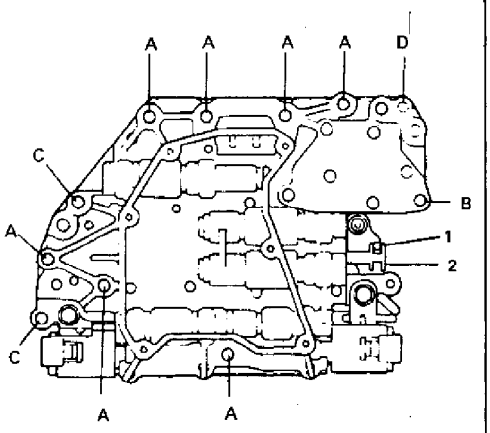
49) Install oil pressure control cable in case.



50) Install accumulator springs and pistons.
① Install new seal rings on pistons, if required.
Be sure to apply automatic transmission fluid to pistons and seal rings.
② Insert springs into accumulator bores.

NOTE:
Install 2nd brake accumulator springs as shown in figure.

③ Install pistons into case.
④ Install spring into 2nd brake accumulator piston.



1. Pin
2. Manual valve

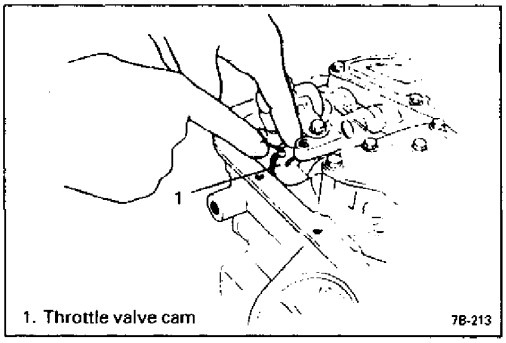
A: Bolt (35 mm/1.38 in – 7 pcs)
B: Bolt (47 mm/1.85 in – 1 pc)
C: Reamer bolt (25 mm/1 in – 2 pcs)
D: Reamer bolt (32 mm/1.26 in – 1 pc)

7B-212

51) Install valve body assembly to case.
Align manual valve with pin on manual shift lever and lower valve body into place.
Install 11 bolts in lower valve body.
Each bolt length is given in figure.
First, tighten 3 reamer bolts (positioning bolts) C and D lightly. Then tighten all bolts in diagonal order.

CAUTION:
Care should be taken to put manual shift lever pin in between two flanges at end of manual shift valve.

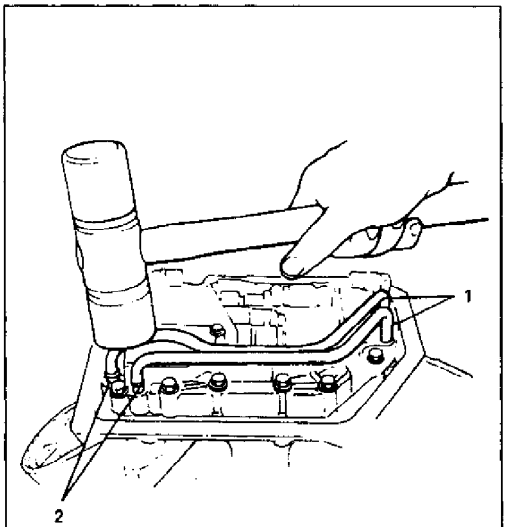
Tightening Torque for lower valve body bolts
10 N·m (1.0 kg-m, 7.5 lb-ft)



1. Throttle valve cam

7B-213

52) Connect oil pressure control cable on throttle valve cam.
While holding cam down with fingers, slip cable end into slot.

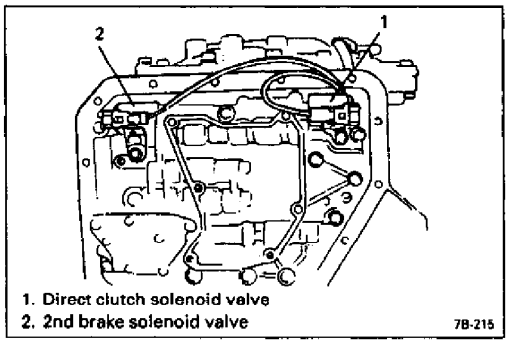


1. End with no flange
2. Flange

7B-214

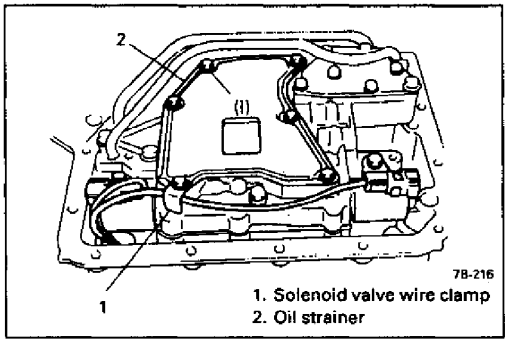
53) Install oil tubes to lower valve body.
First put the end of oil tube without flange about 2 mm (0.08 in.) into lower valve body, then insert the one with flange and push both ends of tube by hand. Next, tap them in lightly with a plastic hammer as far as flange position.

NOTE:
- **Install them horizontally to valve body.**
- **Make sure to insert them up to flange position securely.**
- **Care should be taken not to deform tubes.**



1. Direct clutch solenoid valve
2. 2nd brake solenoid valve
7B-215

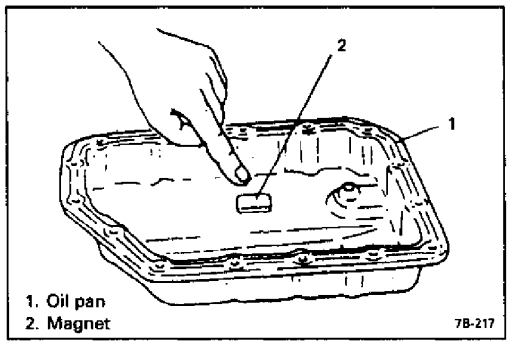
54) Connect 2 solenoid valve wires; one to direct clutch solenoid valve and the other to second brake solenoid valve.



7B-216
1. Solenoid valve wire clamp
2. Oil strainer

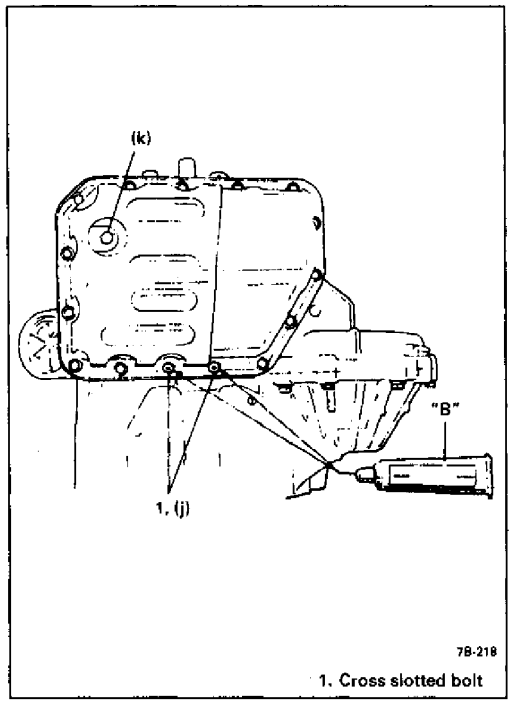
55) Install oil strainer and solenoid valve wire clamp.
Clamp solenoid valve wire by fastening solenoid valve wire clamp with oil strainer bolt in the position as shown in figure.

Tightening Torque
(i): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



1. Oil pan
2. Magnet
7B-217

56) Install magnet in oil pan and oil pan with new gasket.
① Install magnet in oil pan right under oil strainer.
② Check to make sure that oil tubes are not in contact with oil pan.



7B-218
1. Cross slotted bolt

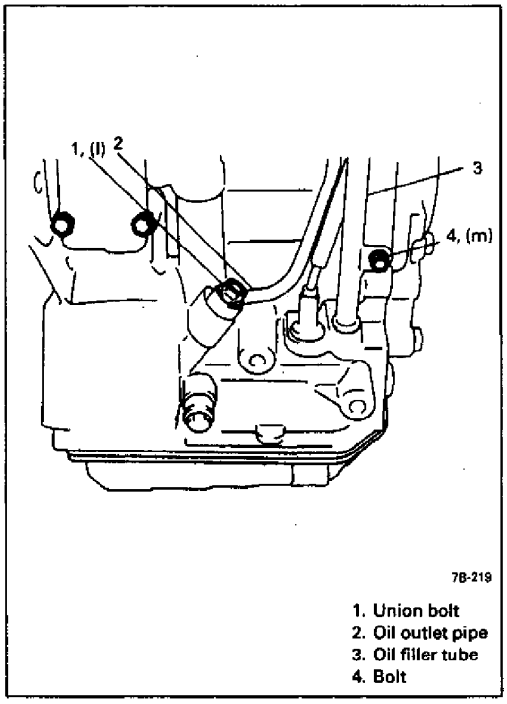
③ There are 15 oil pan bolts in all and two of them have cross slot in their heads. Mount these two cross slotted bolts in such positions as shown in figure after applying sealant to their threads.
Tighten 15 oil pan bolts to specification.

"B": SUZUKI BOND No.1215, 99000-31110

Tightening Torque
(j): 5 N·m (0.5 kg-m, 3.5 lb-ft)

④ Tighten oil pan drain plug to specification.

Tightening Torque
(k): 21 N·m (2.1 kg-m, 15.0 lb-ft)



1. Union bolt
2. Oil outlet pipe
3. Oil filler tube
4. Bolt

57) Install oil pipes.
① If oil outlet pipe has been removed or replaced, tighten it with union bolt with new gaskets to specified torque.

Tightening Torque
(l): 22 N·m (2.2 kg-m, 15.5 lb-ft)

② Clamp pipes with oil pipe plate through rubber tubes.

Tightening Torque to plate bolts
8 mm: 13 N·m (1.3 kg-m, 9.5 lb-ft)
6 mm: 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

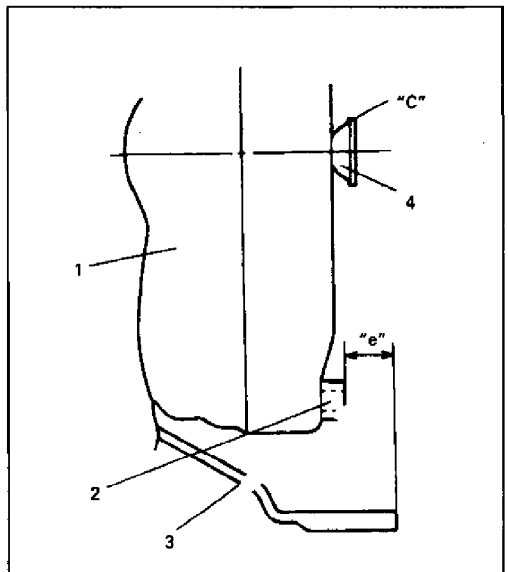
58) Install oil filler tube with O-ring.
Insert oil filler tube in case as far as its flange and tighten with bolt.

NOTE:
Check to make sure that oil filler tube O-ring is in good condition.

Tightening Torque
(m): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

59) Install engine mounting LH bracket.
Tighten bolts to specification. (Refer to Section 6A.)

Tightening Torque to bracket bolts
55 N·m (5.5 kg-m, 40.0 lb-ft)



1. Torque converter
2. Flange nut
3. Transmission case housing
4. Cup

60) Install torque converter to input shaft.
① Install torque converter, using care not to damage oil seal of oil pump.
② After installing torque converter, check to make sure that distance "e" is within specification.

Distance "e": More than 21.4 mm (0.85 in.)

③ Check torque converter for smooth rotation.
④ Apply grease around cup at the center of torque converter.
"C": SUZUKI SUPER GREASE A, 99000-25010

CAUTION:
- **Before installing converter, make sure that its pump hub portion is free from nicks, burrs or damage which may cause oil seal to leak.**
- **Be very careful not to drop converter on oil pump gear. Damage in gear, should it occur, may cause a critical trouble.**

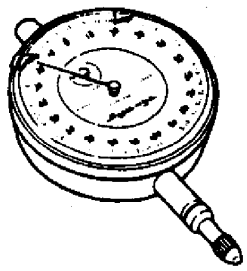
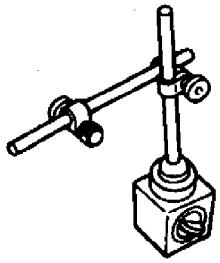
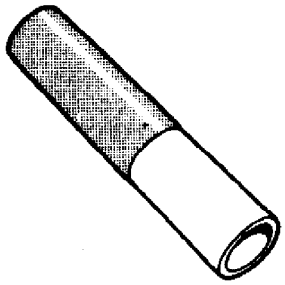
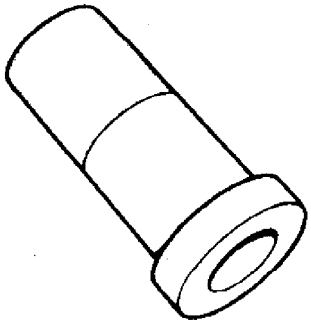
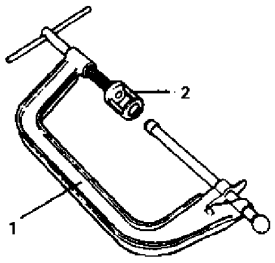
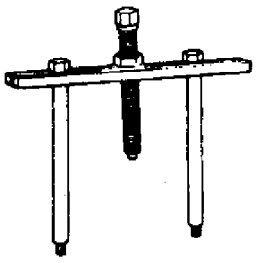
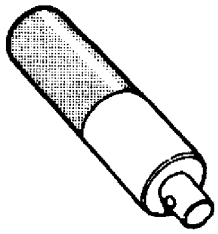
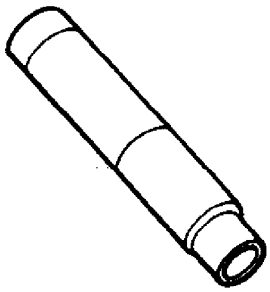
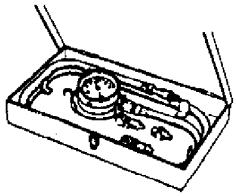
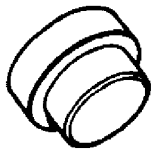
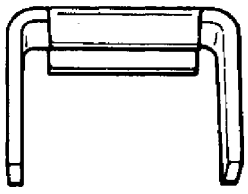
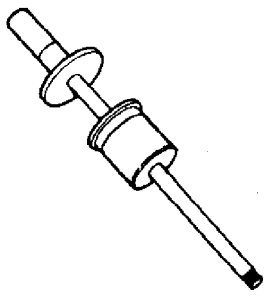
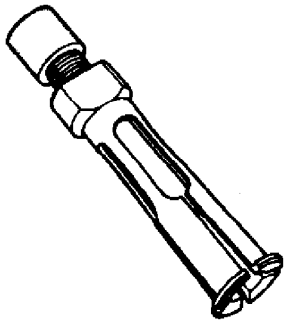
DIMENSION DATA

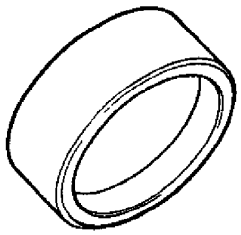
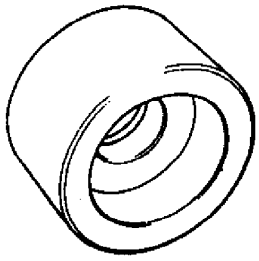
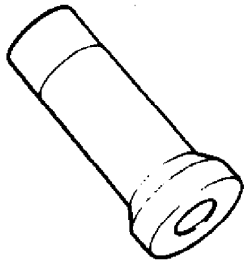
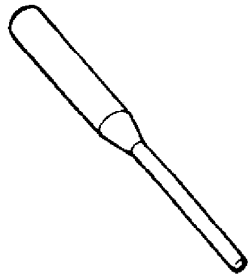
ITEM			DATA	
			Standard	Limit
Oil pump	Driven gear-to-body clearance		0.07 – 0.15 mm 0.0028 – 0.0059 in	0.3 mm 0.011 in
	Gear tooth tip clearance		0.11 – 0.14 mm 0.0043 – 0.0055 in	0.3 mm 0.011 in
	Gear side clearance		0.02 – 0.05 mm 0.0008 – 0.0019 in	0.1 mm 0.0039 in
Planetary gear	Side clearance		0.2 – 0.5 mm 0.008 – 0.019 in	0.7 mm 0.027 in
Bush bore	Oil pump body		38.113 – 38.138 mm 1.500 – 1.501 in	38.188 mm 1.503 in
	Direct clutch drum		51.520 – 51.545 mm 2.028 – 2.029 in	51.595 mm 2.031 in
	Planetary sun gear		22.025 – 22.046 mm 0.867 – 0.868 in	22.096 mm 0.870 in
	Ring gear flange		19.025 – 19.050 mm 0.749 – 0.750 in	19.100 mm 0.752 in
Clutch, brake and 2nd piston	Height between snap ring and clutch flange	Direct clutch	2.49 – 3.06 mm 0.098 – 0.120 in	3.26 mm 0.128 in
		Forward clutch	2.01 – 2.68 mm 0.079 – 0.105 in	2.88 mm 0.113 in
	1st-reverse brake clutch clearance		0.58 – 1.92 mm 0.023 – 0.075 in	2.12 mm 0.083 in
	2nd brake piston rod stroke		1.5 – 3.0 mm 0.06 – 0.11 in	———
Input shaft	Thrust play		0.3 – 0.9 mm 0.012 – 0.035 in	———
Torque converter	Converter flange to housing end		More than 21.4 mm 0.85 in	———

TIGHTENING TORQUE SPECIFICATIONS

	Fastening Portion		Tightening Torque		
			N·m	kg-m	lb-ft
ON VEHICLE SERVICE	1. Transmission case plug		7.5	0.75	5.5
	2. Drain plug		21	2.1	15.0
	3. Oil cooler hose clamps		1.5	0.15	1.0
	4. Oil pan bolts		5	0.5	3.5
	5. Oil strainer bolts		5.5	0.55	4.0
	6. Shift solenoid bolts		8	0.8	6.0
	7. Vehicle speed sensor bolt		8	0.8	6.0
	8. Transmission range switch bolt		18	1.8	13.5
	9. Selector lever shaft nut		20	2.0	14.5
	10. Selector housing nut		13	1.3	9.5
MOUNTING	1. Transmission to engine bolts and nuts		50	5.0	35.0
	2. Drive plate to converter bolts		18.5	1.85	13.8
	3. Engine mounting & bracket bolt & nut		Refer to Section 6A of this manual.		
TRANSMISSION OVERHAUL	1. Oil pump cover bolts		10	1.0	7.5
	2. Lower valve body cover bolts		5	0.5	3.5
	3. Throttle valve cam bolt		7.5	0.75	5.5
	4. Upper valve body bolts		5.5	0.55	4.0
	5. Lower valve body bolts		10	1.0	7.5
	6. Differential final gear bolts		85	8.5	61.5
	7. Manual detent spring bolt and nut		10	1.0	7.5
	8. Shift shaft nuts		30	3.0	22.0
	9. Reduction driven gear nut		130	13.0	94.0
	10. Rear cover bolts		20	2.0	14.5
	11. Rear cover nuts		13	1.3	9.5
	12. Transmission case housing bolts		20	2.0	14.5
	13. Oil pump bolts		23	2.3	16.5
	14. Second brake band cover bolts		8	0.8	6.0
	15. Oil pipe union bolts		22	2.2	16.0
	16. Oil pipe plate bolt	8 mm	13	1.3	9.5
		6 mm	5.5	0.55	4.0
	17. Oil filler tube bolt		5.5	0.55	4.0

SPECIAL TOOLS

 09900-20606 7B-221 Dial gauge	 09900-20701 7B-222 Magnetic stand	 09900-25002 7B-223 Pocket tester	 09913-80112 7B-224 Bearing installer
 09913-85210 7B-225 Bearing installer	 1. 09916-14510 7B-226 Valve lifter (Attachment 2 is included)	 09918-48210 7B-227 Oil pump remover	 09924-74510 7B-228 Installer handle
 09925-18010 7B-229 Remover handle	 09925-37810 7B-230 Oil pressure gauge	 09925-88210 7B-231 Bearing puller attachment	 09926-88310 7B-232 Bearing installer attachment
 09926-98310 7B-233 Clutch spring compressor	 09927-08210 7B-234 Output shaft remover	 09930-30102 7B-235 Sliding shaft	 09941-64511 7B-236 Bearing remover

 7B-237	 7B-238	 7B-239	 7B-240
09944-66020 Bearing installer	09951-16060 Bush remover	09951-76010 Bearing installer	09925-78210 Spring pin remover (6 mm)

REQUIRED SERVICE MATERIALS

MATERIALS	RECOMMENDED SUZUKI PRODUCT	USE
Automatic transmission fluid	An equivalent of DEXRON®-II, IIE, III	• Automatic transmission • Parts lubrication when installing
Sealant	SUZUKI BOND NO.1215 (99000-31110)	• Case housing star-shaped recess bolts (3 pcs only) • Oil pan cross slotted bolts (2 pcs only)
Lithium grease	SUZUKI SUPER GREASE C (99000-25030)	• Retaining parts in place when assembling • Oil seal lips • Oil pump O-ring
	SUZUKI SUPER GREASE A (99000-25010)	• Cable ends • Converter center cup
Water tight sealant	SUZUKI SEALING COMPOUND 366E (99000-31090)	Select cable fastening portion with dash panel

SECTION 8

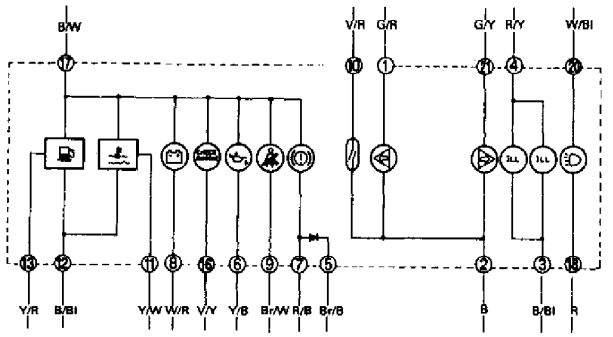
BODY ELECTRICAL SYSTEM

NOTE:
For the descriptions (items) not found in this section of this manual, refer to the same section of service manual mentioned in the FOREWORD of this manual.

INSTRUMENTS AND GAUGES

COMBINATION METER WIRING

For Australian spec. vehicle

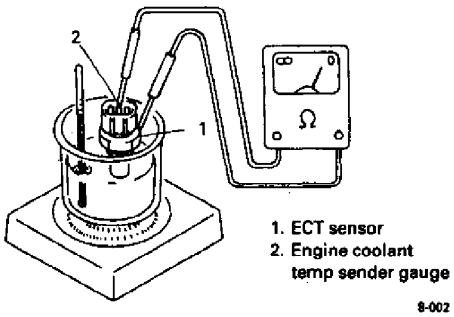


Terminal arrangement of meter connector (Viewed from wiring harness side)

1. To turn signal switch (LH)
2. To ground
3. To illumination controller ⊖
4. To illumination controller ⊕
5. To ignition switch
6. To oil pressure switch
7. To brake fluid level switch (and parking brake switch)
8. To generator
9. To seatbelt switch
10. To ECM
11. To coolant (water) temp. gauge
12. To ground
13. To fuel level gauge
14. ┐ Blank
15. ┘
16. To ECM
17. To ignition switch
18. To dimmer & passing switch
19. Blank
20. To circuit fuse
21. To turn signal switch (RH)
22. Blank

8-001

B : Black	G/Y : Green/Yellow	W/Bl : White/Blue
R : Red	R/B : Red/Black	W/R : White/Red
B/Bl : Black/Blue	R/Y : Red/Green	Y/B : Yellow/Black
B/W : Black/White	V/G : Violet/Green	Y/R : Yellow/Red
Br/B : Brown/Black	V/R : Violet/Red	Y/W : Yellow/White
G/R : Green/Red	V/Y : Violet/Yellow	



1. ECT sensor
2. Engine coolant temp sender gauge

8-002

ENGINE COOLANT TEMPERATURE GAUGE

INSPECTION

Warm up sender gauge. Thus make sure its resistance is decreased with increase of its temperature.

Temperature	Resistance
50°C (122°F)	136 – 216 Ω
120°C (248°F)	16.4 – 19.1 Ω

8

SECTION 8A

IMMOBILIZER CONTROL SYSTEM

CONTENTS

GENERAL DESCRIPTION

The immobilizer control system designed to prevent vehicle burglar consists of following components.

- Engine control module (ECM)
- Immobilizer control module (ICM)
- Ignition key (with built-in transponder)
- Coil antenna

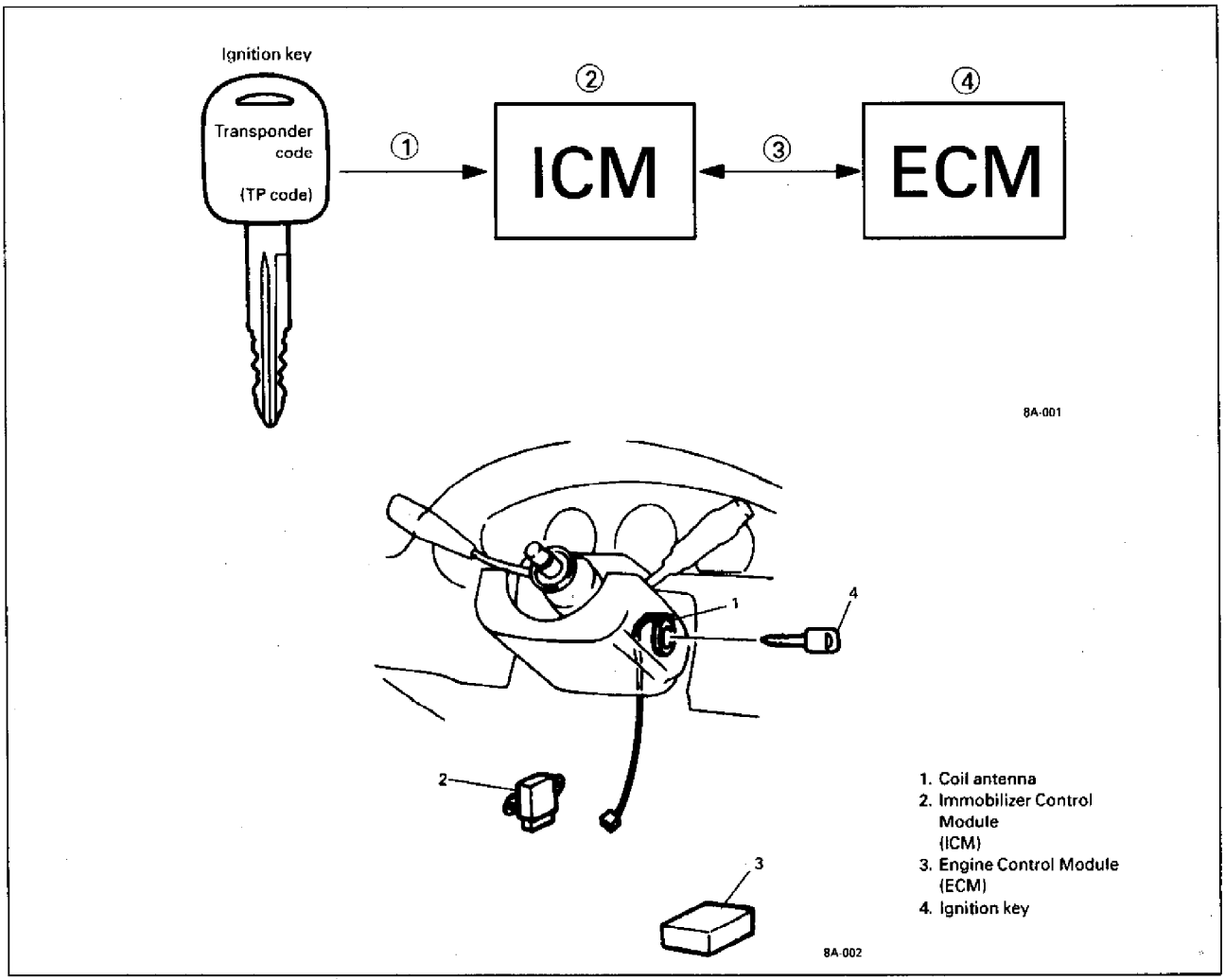
Operation of this system is as follows.

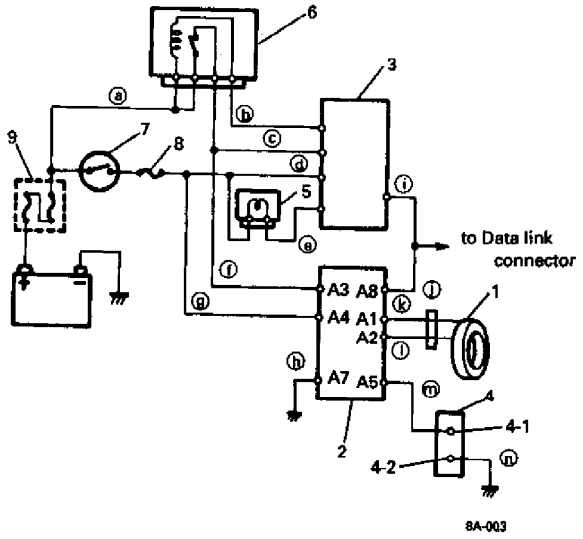
① Each ignition key has its own code (Transponder (TP) code) stored in memory. When the ignition switch is turned ON, ICM tries to read the TP code through the coil antenna installed to the steering lock assembly.

② ICM compares the TP code read in ① and that registered in ICM and checks if they match.

③ When it is confirmed that two TP codes match each other as described above, ICM and ECM check if ECM/ICM codes registered in them respectively match.

④ Only when it is confirmed that ECM/ICM codes match, the engine starts running. If TP codes in Step ② or ECM/ICM codes in Step ③ do not match, ECM will stop operation of the injector and the ignitor (i.e., ignition of spark plug).

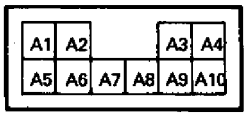




8A-003

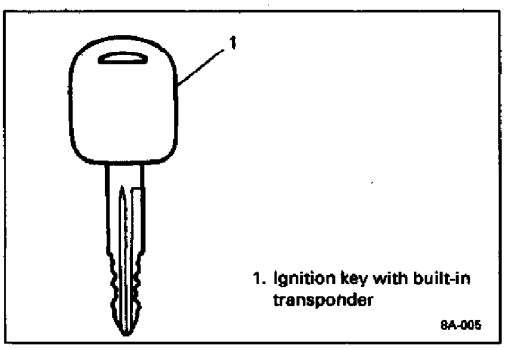
WIRE SYMBOL	WIRE COLOR
ⓐ	B/Y
ⓑ	V/R
ⓒ	B/R
ⓓ	B/W
ⓔ	V/Y
ⓕ	B/R
ⓖ	B/W
ⓗ	B
ⓘ	V/W
ⓙ	V/W
ⓚ	Bl
ⓛ	R
ⓜ	Sb
ⓝ	B

1. Coil antenna
2. Immobilizer control module (ICM)
3. Engine control module (ECM)
4. Immobilizer diagnostic coupler
4-1. Diagnostic output terminal
4-2. Ground terminal
5. Malfunction indicator lamp ("CHECK ENGINE" light)
6. Main relay
7. Ignition switch
8. Fuse
9. Main fuse



8A-004

Terminal arrangement of immobilizer control module coupler (Viewed from harness side)

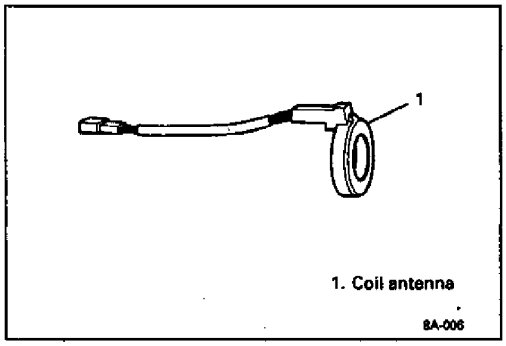


1. Ignition key with built-in transponder

8A-005

Ignition key

The ignition key for the immobilizer control system has a built-in transponder. Each transponder in the key has an each transmitting code (Transponder code). The code will transmitted from the key via the coil antenna to ICM when the ignition switch is turned ON.

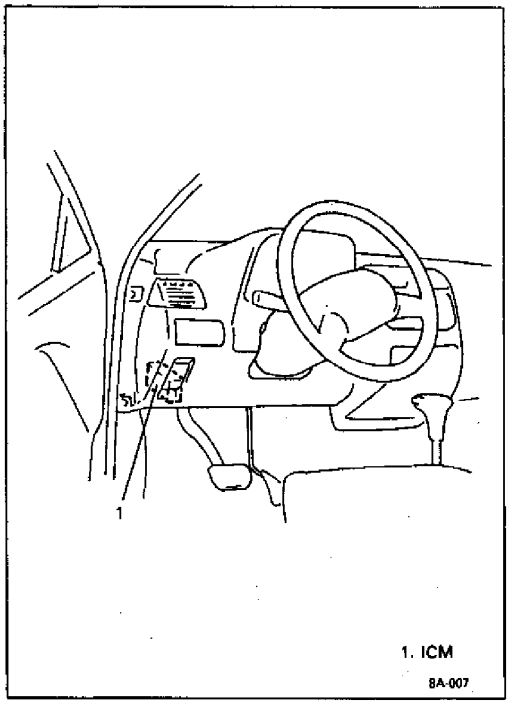


1. Coil antenna

8A-006

Coil antenna

The coil antenna is installed to the steering lock assembly. As it is energized by ICM, it transmits the transponder (TP) code of the ignition key to ICM.



IMMOBILIZER CONTROL MODULE (ICM) & ENGINE CONTROL MODULE (ECM)

ICM:

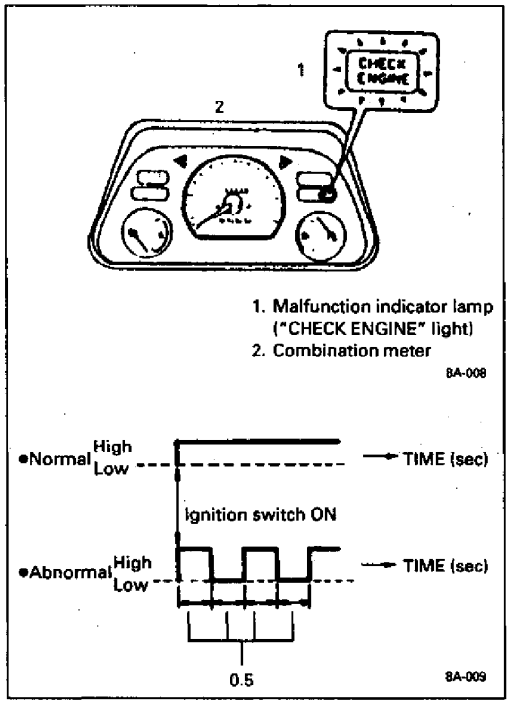
ICM is installed to the underside of the instrument panel at the driver's seat side.

As main functions, ICM checks matching not only between the TP Code transmitted from the ignition key and that registered in ICM (Up to 4 different TP codes can be registered.) but also between the ECM/ICM code transmitted from ECM and that registered in ICM. In addition, it has an on-board diagnostic system (self-diagnosis function) which is described in the next section.

ECM:

As main functions, ECM not only checks matching of ECM/ICM codes but also has an on-board diagnostic system (self-diagnosis function) as described in the next section.

For installation position of ECM, refer to "Electronic Fuel Injection System" section in Service Manual for the vehicle being serviced.



On-board diagnostic system (Self-diagnosis function)

ICM & ECM diagnose troubles which may occur in the area including the following parts when the ignition switch is ON. They indicate the diagnosis result by using following items in the manner as described below.

ECM:
- •ECM/ICM code
- •Data link connector wire
- •ECM

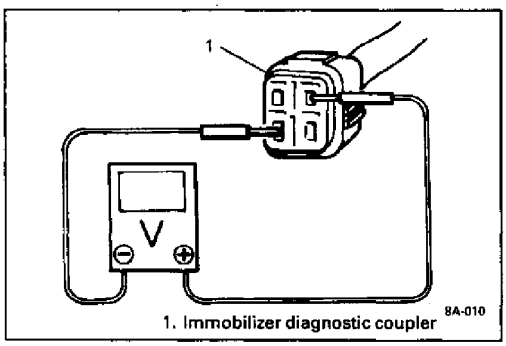
ICM:
- •Transponder code (TP code)
- •Coil antenna
- •ECM/ICM code
- •Data link connector wire
- •ICM
- •Ignition signal

1) With the diagnosis switch terminal not grounded, the ignition switch turned ON (but the engine at stop) and regardless of the condition of the electronic fuel injection system, ECM indicates whether a trouble has occurred in the immobilizer control system or not by causing the malfunction indicator lamp ("CHECK ENGINE" light) to flash or turn ON. If it is ON, it means that no trouble exists in the immobilizer control system currently and if it is flashing, it means that either ECM or ICM has detected some trouble in the immobilizer control system.

NOTE:
As soon as the ignition switch is turned ON, ECM and ICM diagnose if a trouble has occurred in the immobilizer control system. While the diagnosis is being made, the malfunction indicator lamp ("CHECK ENGINE" light) stays ON and if the diagnosis result is "abnormal", it immediately changes to flashing but if the result is "normal", it remains ON. Diagnosis takes about 3 seconds at maximum.

2) With the ignition switch turned ON and the diagnostic switch terminal grounded, ECM outputs the result (Diagnostic trouble code) of diagnosing above area of the immobilizer control system and the result (Diagnostic trouble code) of the electronic fuel injection system by flashing the malfunction indicator lamp ("CHECK ENGINE" light) as listed below. (For positions of the diagnostic switch terminal and the ground terminal, refer to "Electronic Fuel Injection System" Section in Service Manual of the vehicle being serviced.

Immobilizer control system	Electronic Fuel Injection system	Malfunction indicator lamp ("CHECK ENGINE" light)
ECM doesn't detect a trouble	ECM doesn't detect a trouble	Normal code (DTC 12) is indicated.
ECM doesn't detect a trouble	ECM detects a trouble	Fault code for electronic fuel injection system is indicated.
ECM detects a trouble.	ECM doesn't detect a trouble.	Fault code for immobilizer control system is indicated.
ECM detects a trouble.	ECM detects a trouble.	Fault code of both electronic fuel injection system and immobilizer control system are indicated alternately.



1. Immobilizer diagnostic coupler

3) With the ignition switch turned ON, ICM outputs the result (Diagnostic trouble code) of diagnosing the above area through the diagnostic output terminal of the immobilizer diagnostic coupler. This can be read by checking deflection of the voltmeter indicator as it deflects when the positive probe and the negative probe of the voltmeter are connected to the diagnostic output terminal and the ground terminal respectively.

NOTE:
When a trouble exists in the immobilizer control system (when ICM or ECM detects a diagnostic trouble code (DTC)), ECM will stop operation of the injector and the ignitor (i.e., ignition of spark plug).

DIAGNOSIS

ECM and ICM have on-board diagnostic system (a system self-diagnosis function) as described previously.
Investigate where the trouble is by referring to "DIAGNOSTIC FLOW CHART" and "DIAGNOSTIC TROUBLE CODE TABLE" on later pages.

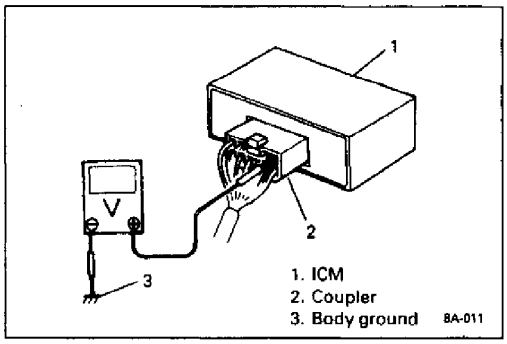
PRECAUTIONS IN DIAGNOSING TROUBLES
[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC TROUBLE CODE]
ECM

- Before identifying diagnostic trouble code indicated by malfunction indicator lamp ("CHECK ENGINE" light), don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine.
  Such disconnection will clear trouble codes for electronic fuel injection system stored in memory of ECM.
- If abnormality or malfunction lies in two or more areas, malfunction indicator lamp ("CHECK ENGINE" light) indicates applicable codes three times each.
  And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.
- When ECM detects a trouble in both electronic fuel injection system and immobilizer control system, malfunction indicator lamp ("CHECK ENGINE" light) indicates trouble codes of both systems alternately while the ignition switch is turned ON and the diagnosis terminal is grounded.
- Take a note of diagnostic trouble code indicated first.

ICM

- Take a note of diagnostic trouble code indicated first.

[INTERMITTENT TROUBLE] and [NOTES ON SYSTEM CIRCUIT INSPECTION]
Refer to SECTION 6E1.

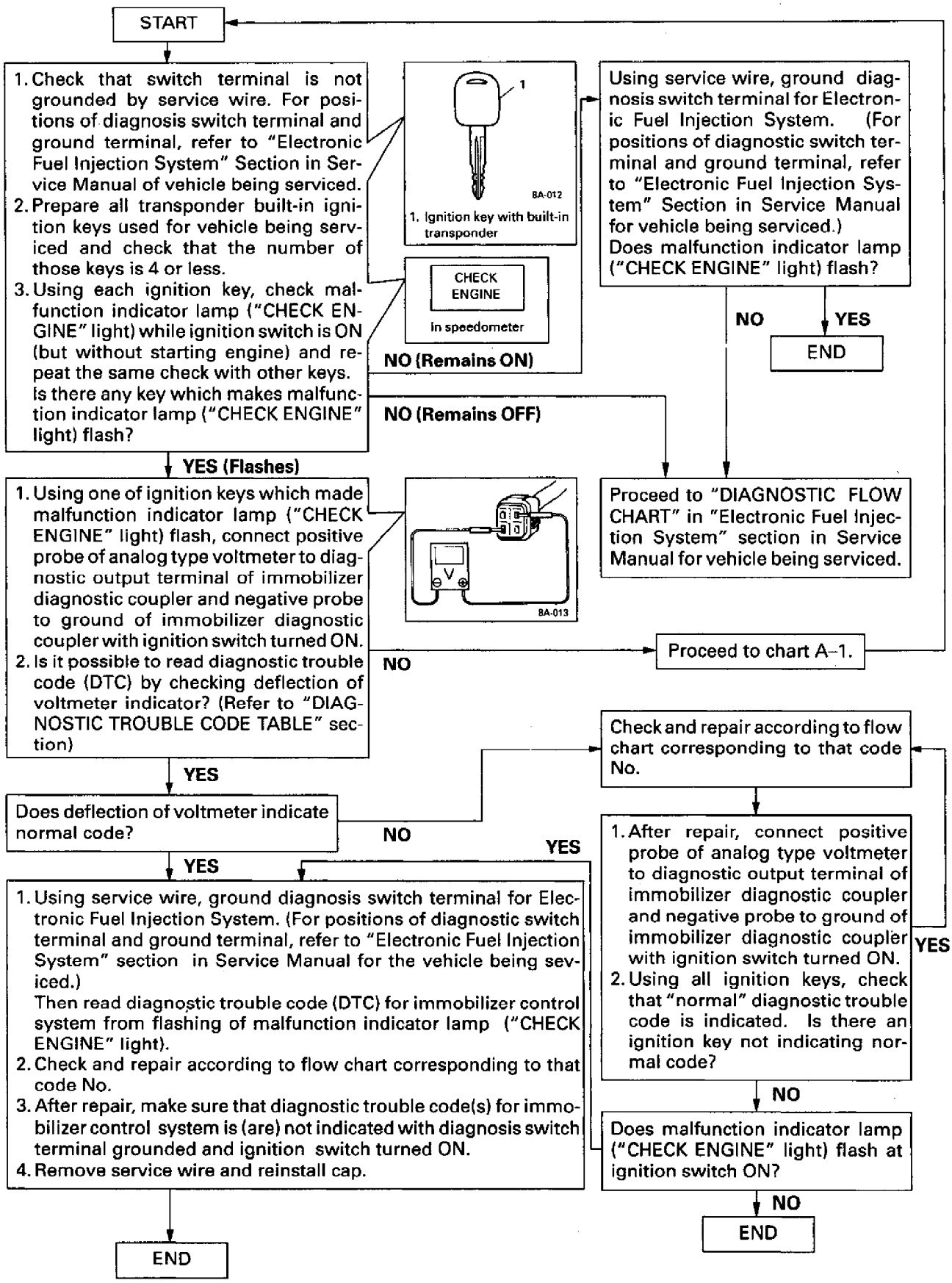


- When checking voltage at each terminal of the coupler which is connected to ECM or ICM, be sure to connect negative probe to body ground as shown. Any other way is prohibited even by accident.
  Applying probes of voltmeter improperly may cause the sensor, ECM or ICM to be shorted and damaged.

[Precaution after replacing ECM or ICM]

- When ECM was replaced, including when replaced because rechecking by using a known-good ECM was necessary during trouble diagnosis, the ECM/ICM code must be registered in ECM and ICM by performing procedure described in "Procedure after ECM Replacement" Section. If it is not registered, the engine would not start and accurate trouble diagnosis would not be assured.
- When ICM was replaced, including when replaced because rechecking by using a known-good ICM was necessary during trouble diagnosis, the TP code and ECM/ICM code must be registered in ICM and ECM/ICM code in ECM by performing procedure described in "Procedure after ICM Replacement" Section. If they are not registered, the engine would not start and accurate trouble diagnosis would not be assured.

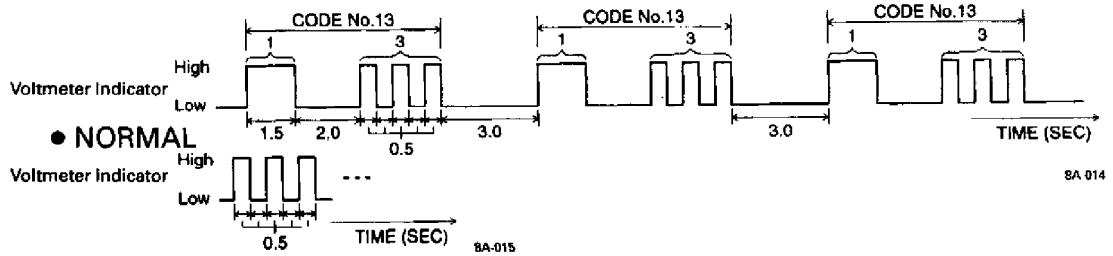
DIAGNOSTIC FLOW CHART

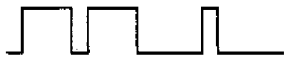
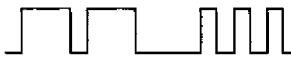


DIAGNOSTIC TROUBLE CODE TABLE

Immobilizer Control Module (ICM) side

EXAMPLE :• COIL ANTENNA FAILURE (CODE NO. 13)



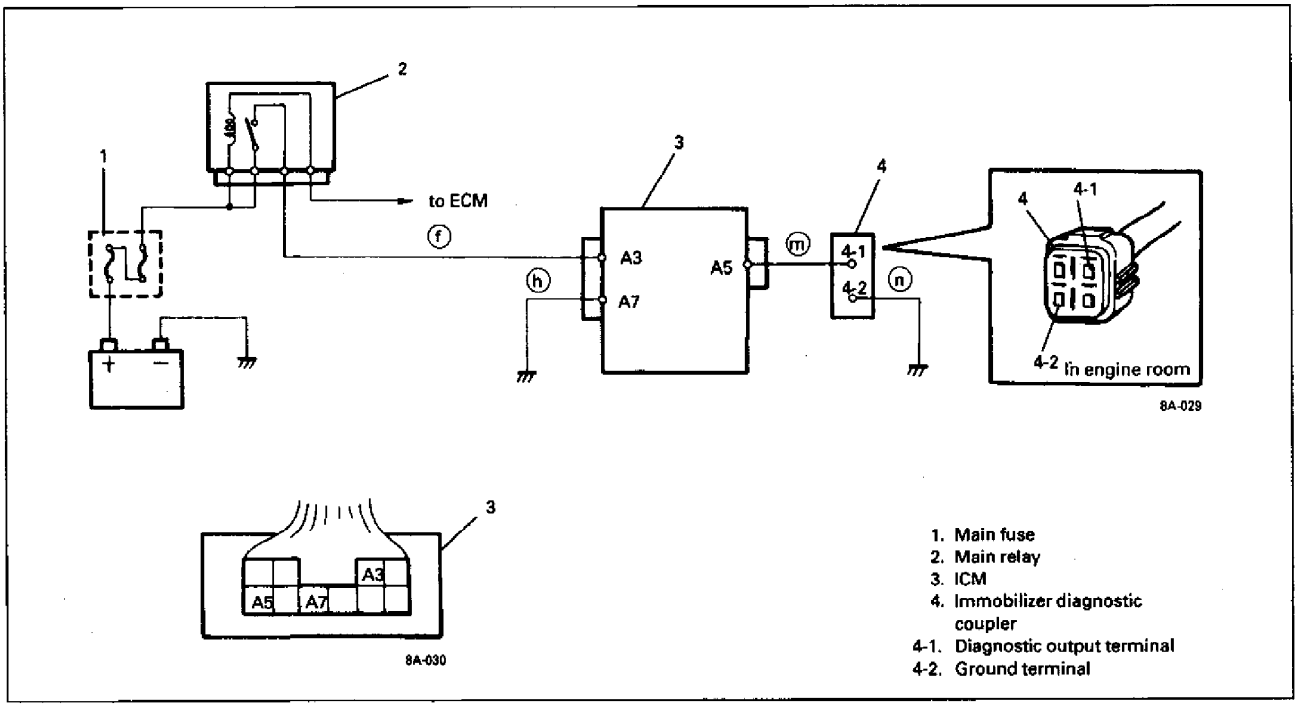
DIAGNOSTIC TROUBLE CODE NO.	DIAGNOSTIC TROUBLE CODE VOLTMETER INDICATION	DIAGNOSTIC AREA	DIAGNOSIS
–	 8A-016	Normal	This code appears when none of the other codes are identified.
11	 8A-017	Transponder code (TP code)	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
31	 8A-018		
12	 8A-019	ICM	
13	 8A-020	Coil antenna or ignition key with built-in transponder	
21	 8A-021	ECM/ICM code	
22	 8A-022	Ignition switch circuit	
23	 8A-023	Serial data link wire	

Engine Control module (ECM) side

To learn how to read diagnostic trouble code (DTC) from flashing of malfunction indicator lamp ("CHECK ENGINE" light), refer to "Electronic Fuel Injection System" Section in Service Manual for vehicle being serviced.

DIAGNOSTIC TROUBLE CODE NO.	DIAGNOSTIC TROUBLE CODE MALFUNCTION INDICATOR lamp ("CHECK ENGINE" light) INDICATION	DIAGNOSTIC AREA	DIAGNOSIS
12	 8A-024	Normal	This code appears when it is confirmed that none of other trouble codes is set for immobilizer control system or electronic fuel injection system.
81	 8A-025	ECM/ICM code	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
84	 8A-026		
82	 8A-027	ECM	
83	 8A-028	Serial data link wire	

A-1 CODE (DTC) IS NOT OUTPUTTED FROM DIAGNOSTIC OUTPUT TERMINAL OF IMMOBILIZER DIAGNOSTIC COUPLER



Check voltage between A3 terminal and body ground with ignition switch turned ON.
Is it 10-14V?

NO → "ⓕ" wire open.

YES

1. Connect voltmeter between A5 terminal and body ground.
2. Does voltmeter indicator deflect?

NO → ● Poor A3, A5 or A7 connection.
● "ⓗ" wire of A7 terminal open.
● "ⓜ" wire between A5 terminal and diagnostic output terminal of immobilizer diagnostic coupler short.
If wire and connections are OK, substitute a known-good ICM and recheck.
NOTE:
After replacing with a known-good ICM, register ECM/ICM code in ECM and TP code and ECM/ICM code in ICM by performing procedure described in "Procedure after ICM Replacement" section.

YES

1. Connect voltmeter between diagnostic output terminal of immobilizer diagnostic coupler and body ground.
2. Is it possible to read DTC by checking deflection of voltmeter indicator?

NO → "ⓜ" wire between A5 terminal and diagnostic output terminal of immobilizer diagnostic coupler open.

YES

"ⓝ" wire of ground terminal for immobilizer diagnostic coupler open.

DTC11 TP CODE (TRANSPONDER CODE) NOT MATCHED

DESCRIPTION:

- DTC11
  ICM checks if TP code transmitted from ignition key and that registered in ICM match when ignition switch is ON. If they do not, this DTC is set.

INSPECTION:

Register ignition key with built-in transponder by using TECH1 (TECH1 cartridge for immobilizer control system and TECH 1A kit) and performing following steps.

NOTE:

For operation procedure of TECH1, refer to TECH1 operator's manual.

1. Using TECH1, execute "ENT. TP CODE" command in SELECT MODE menu.
2. Turn ignition switch OFF, then turn it ON and check that DTC11 is not set.

DTC31 TP CODE (TRANSPONDER CODE) NOT REGISTERED
DESCRIPTION:

- DTC31
  ICM checks if TP code transmitted from ignition key and that registered in ICM match when ignition switch is ON. If there is no TP code registered in ICM, this DTC is set.

INSPECTION:
Register ignition key with built-in transponder by using TECH1 (TECH1 cartridge for immobilizer control system and TECH 1A kit) and performing following steps.
NOTE:
For operation procedure of TECH1, refer to TECH1 operator's manual.

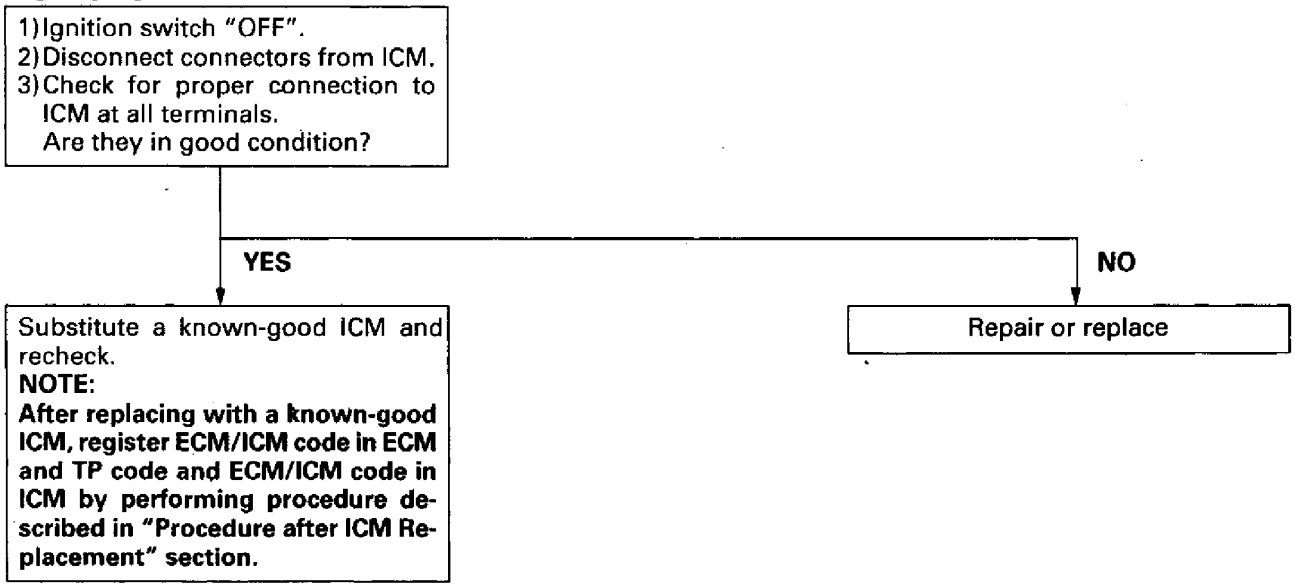
1. Prepare all ignition keys with built-in transponder to be registered. Up to 4 ignition keys can be registered for vehicle.
2. Using TECH1, execute "ENT. TP CODE" command in SELECT MODE menu.
3. Turn ignition switch OFF, then turn it ON and check that DTC31 is not set.
4. Repeat Step 2 as many times as the number of transponder built–in ignition keys not registered yet.

DTC12 FAULT IN IMMOBILIZER CONTROL MODULE (ICM)

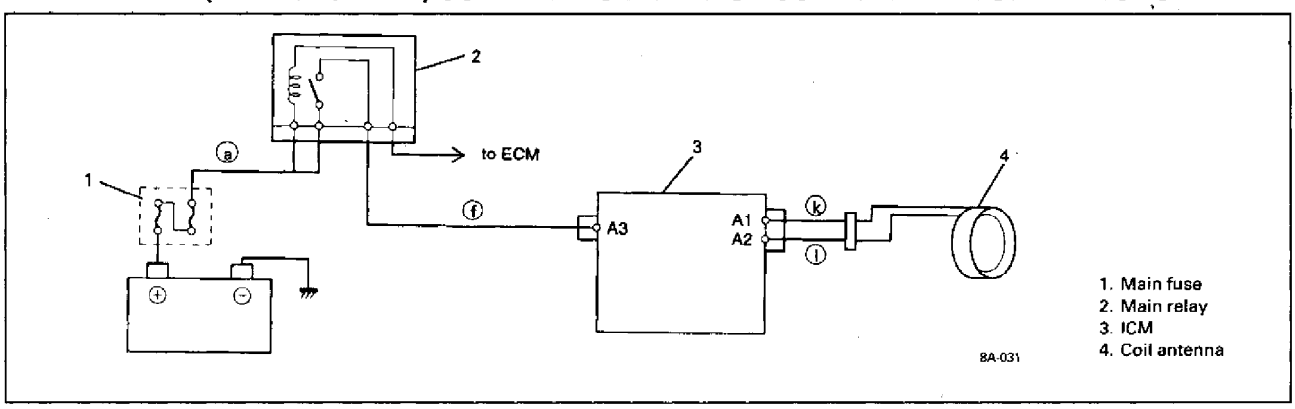
DESCRIPTION:

This DTC is set when an internal fault is detected in ICM.

INSPECTION:



DTC13 NO TP (TRANSPONDER) CODE TRANSMITTED OR COIL ANTENNA OPENED/SHORTED



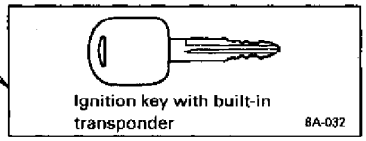
DESCRIPTION:

ICM energizes the coil antenna when the ignition switch is ON and reads TP code from the ignition key. When ICM cannot read TP code from the ignition key even when the coil antenna is energized, this DTC is set.

INSPECTION:

Does ignition key being used have built-in transponder?

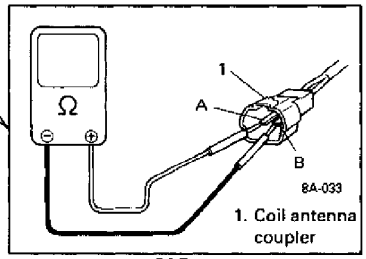
NO → Replace ignition key with built-in transponder and follow "DIAGNOSTIC FLOW CHART" again.



YES

1. Disconnect coil antenna coupler with ignition switch turned OFF.
2. Is there continuity between coil antenna coupler terminals A and B?

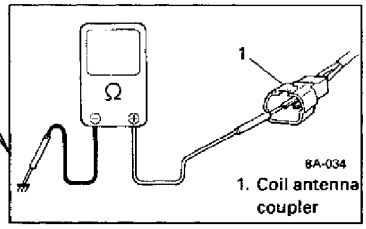
NO → Coil antenna open



YES

Measure resistance between terminals of coil antenna coupler and body ground.
Is it ∞ (infinity) Ω ?

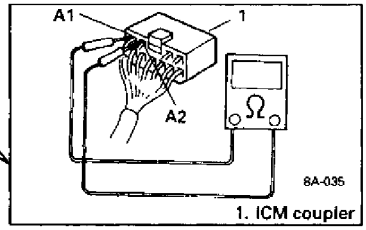
NO → Coil antenna shorted to ground



YES

1. With coil antenna coupler disconnected, disconnect ICM coupler.
2. Measure resistance between coil antenna terminals of ICM coupler.
Is it ∞ (infinity) Ω ?

NO → "ⓚ" wire shorted to "ⓘ" wire



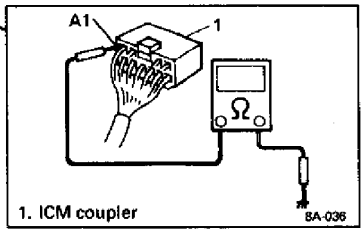
YES

To be continued

continued

Measure resistance between terminal A1 of ICM coupler and body ground.
Is it ∞ (infinity) Ω ?

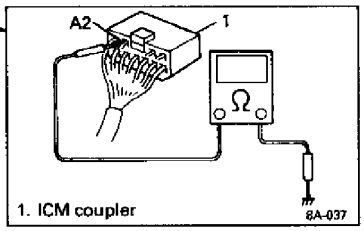
NO → " Ⓚ " wire shorted to ground



YES

Measure resistance between terminal A2 of ICM coupler and body ground.
Is it ∞ (infinity) Ω ?

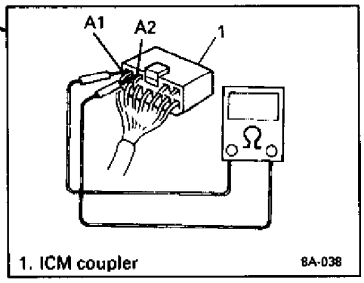
NO → "Ⓛ" wire shorted to ground



YES

1. Connect coil antenna coupler.
2. Is there continuity between ICM coupler terminals A1 and A2?

NO → • " Ⓚ " or "Ⓛ" wire open
• Poor coil antenna-to-coupler



YES

• Poor A1 or A2 connection.
1. If connections are OK, connect ICM coupler and substitute a known-good coil antenna.
2. Is DTC 13 also indicated with ignition switch turned ON?

NO → Faulty coil antenna

YES

Is DTC 13 still indicated even when another ignition key (with built-in transponder) for that vehicle used?

NO → Faulty ignition key

YES

Substitute a known-good ICM and recheck.
NOTE:
After replacing with a known-good ICM, register ECM/ICM code in ECM and TP code and ECM/ICM code in ICM by performing procedure described in "Procedure after ICM Replacement" section.

DTC21 ECM/ICM CODE NOT MATCHED (ICM SIDE)
DTC81 ECM/ICM CODE NOT MATCHED (ECM SIDE)
DTC84 ECM/ICM CODE NOT REGISTERED

DESCRIPTION:

- DTC21
  ICM checks if ECM/ICM code transmitted from ECM and that registered in ICM match when ignition switch is ON. If they do not, this DTC is set.
- DTC81
  ECM checks if ECM/ICM code transmitted from ICM and that registered in ECM match when ignition switch is ON. If they do not, this DTC is set.
- DTC84
  ECM checks if code transmitted from ICM and that registered in ECM match when ignition switch is ON. If there is no ECM/ICM code registered in ECM, this DTC is set.

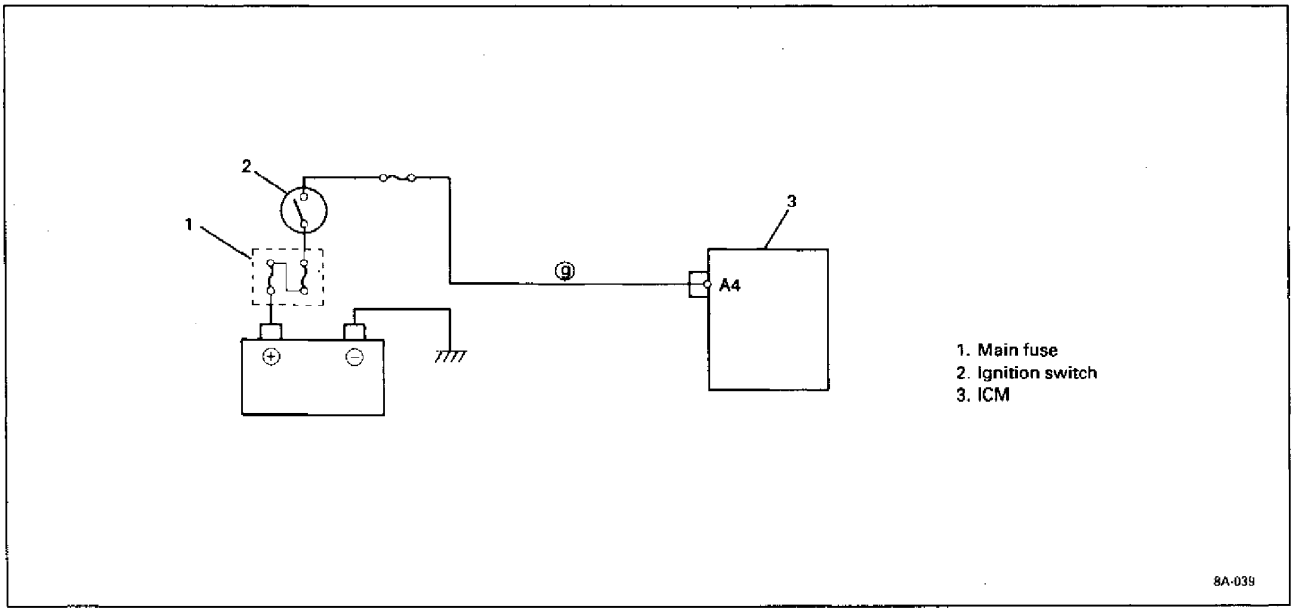
INSPECTION:

Using TECH1 (TECH1 cartridge for immobilizer control system and TECH1A kit), execute "RECORD ECM/ICM" command in SELECT MODE menu.

NOTE:

For operation procedure of TECH1, refer to TECH1 operator's manual.

DTC22 IGNITION SWITCH CIRCUIT OPEN/SHORT

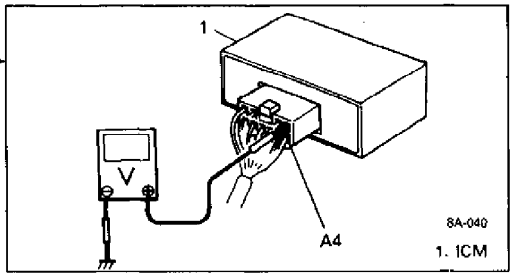


DESCRIPTION:

ICM monitors ignition signal when the ignition switch is ON. This DTC is set when no ignition signal input is detected by ICM.

INSPECTION:

Check voltage between ICM coupler terminal A4 and body ground with ignition switch turned ON.
Is it 10–14V?



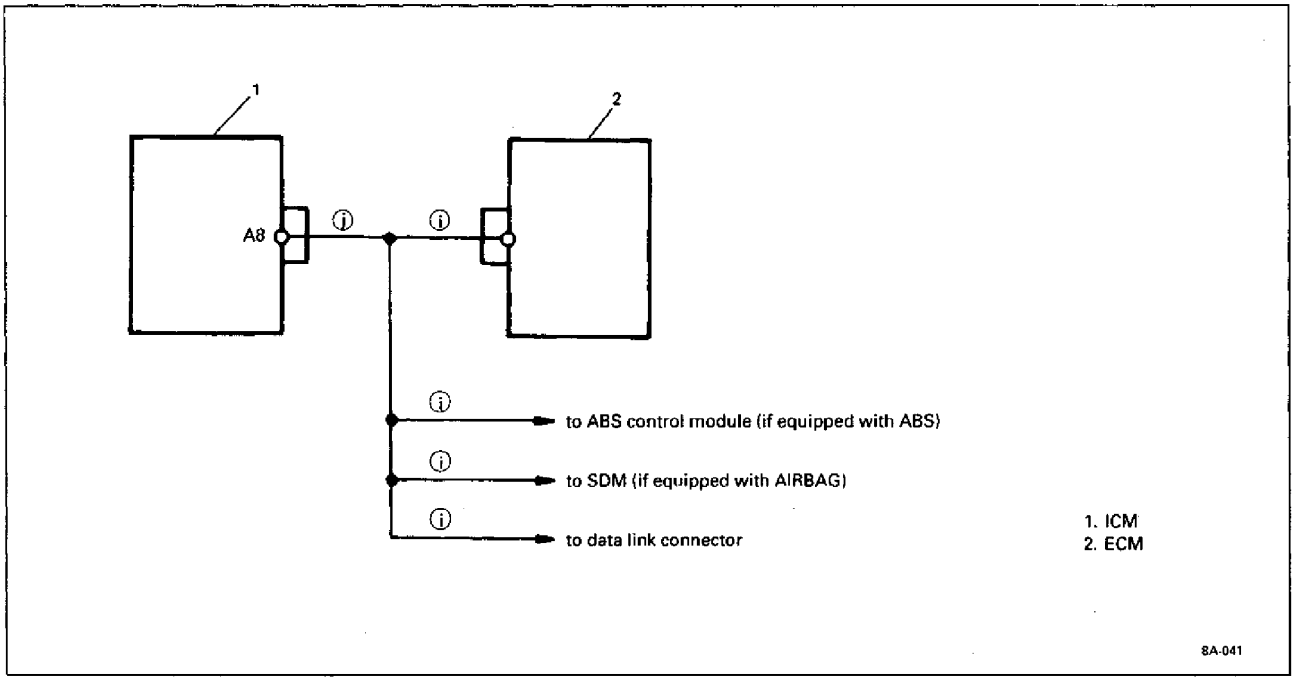
YES

Poor A4 terminal connection.
If connection is OK, substitute a known-good ICM and recheck.
NOTE:
After replacing with a know-good ICM, register ECM/ICM code in ECM and TP code and ECM/ICM code in ICM by performing procedure described in "Procedure after ICM Replacement" section.

NO

"ⓖ" wire open or short

DTC23 NO ECM/ICM CODE TRANSMITTED FROM ECM OR DATA LINK CONNECTOR WIRE OPENED/SHORTED
DTC83 NO ECM/ICM CODE TRANSMITTED FROM ICM OR DATA LINK CONNECTOR WIRE OPENED/SHORTED



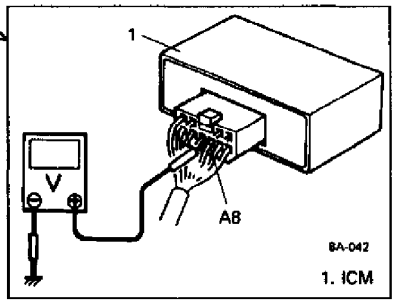
DESCRIPTION

When the ignition switch is ON, ICM requests ECM and ECM requests ICM to transmit ECM/ICM code. If ECM/ICM code is not transmitted from ECM or ICM, ICM sets DTC23 and ECM sets DTC83.

INSPECTION:

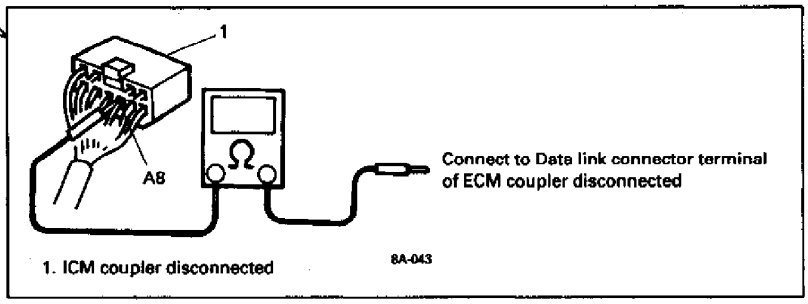
Check voltage between ICM coupler terminal A8 and body ground with ignition switch turned ON.
Is it 4–5V?

NO → "Ⓘ" or "Ⓙ" wire short



YES

1. Disconnect ECM coupler with ignition switch turned OFF.
2. Is there continuity between ICM coupler terminal A8 and Data link connector terminal of ECM coupler? (For positions of Data link connector terminal of ECM coupler, refer to "Electronic Fuel Injection System" section in Service Manual of vehicle being serviced.)



YES

NO → "Ⓘ" or "Ⓙ" wire between ICM and ECM open

Poor A8 connection (ICM) or Poor Data link connector terminal connection (ECM). If connections are OK, substitute a known-good ECM or ICM and recheck.

NOTE :

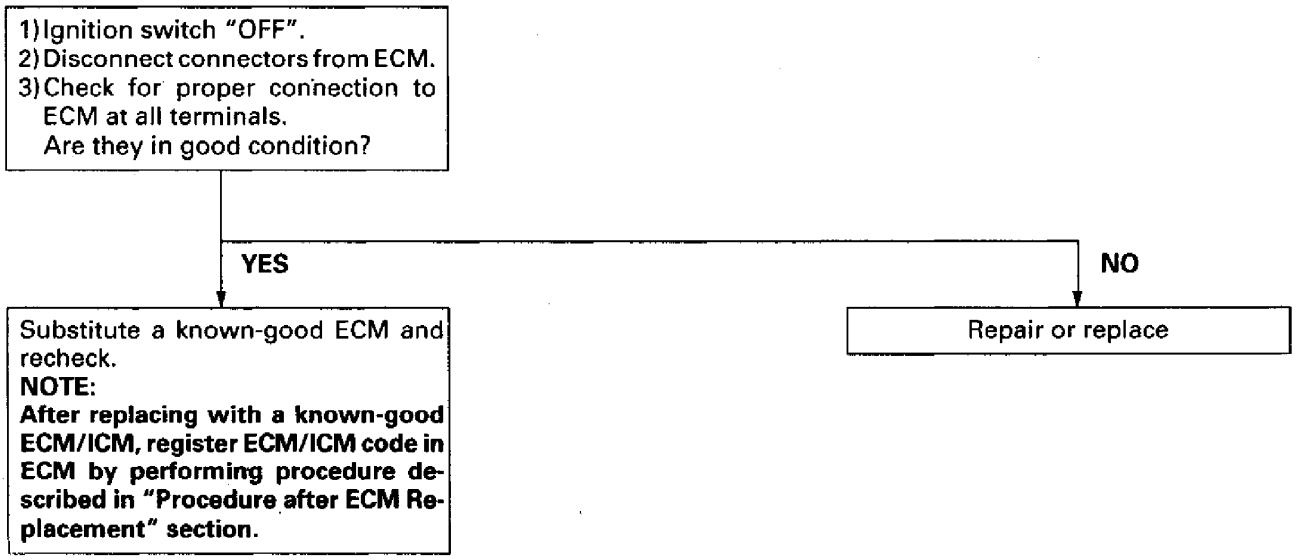
- **After replacing with a known-good ECM, register ECM/ICM code in ECM by performing procedure described in "Procedure after ECM Replacement" section.**
- **After replacing with a known-good ICM, register ECM/ICM code in ECM and TP code and ECM/ICM code in ICM by performing procedure described in "Procedure after ICM Replacement" section.**

DTC82 FAULT IN ENGINE CONTROL MODULE (ECM)

DESCRIPTION:

This DTC is set when an internal fault is detected in ECM.

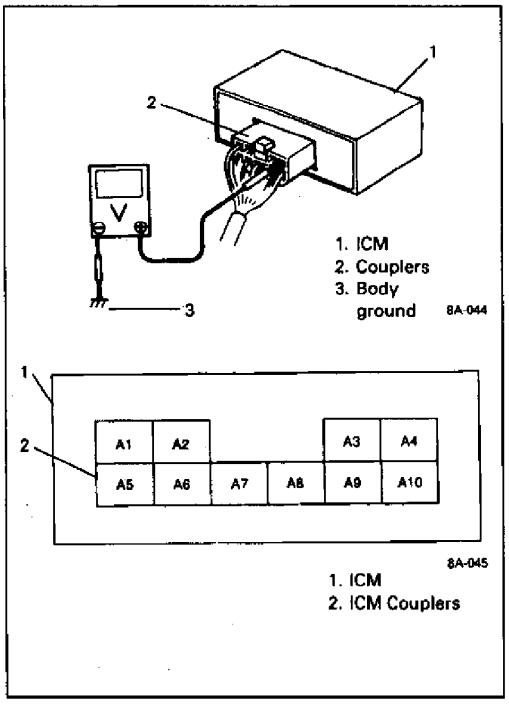
INSPECTION:



INSPECTION OF ECM, ICM AND ITS CIRCUIT

ECM, ICM and its circuit can be checked at ECM wiring couplers and ICM wiring coupler by measuring voltage and resistance. Described here is only inspection of ICM. For inspection of ECM, refer to "Electronic Fuel Injection System" section in Service Manual for the vehicle being serviced.

CAUTION:
ICM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ICM with coupler disconnected from it.



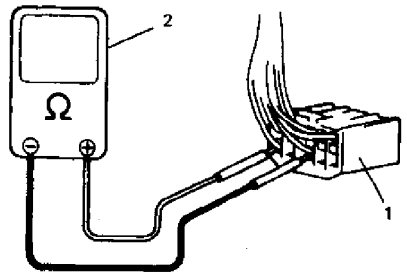
Voltage Check

1) Remove ICM from body with ignition switch OFF referring to p. 8A-25.
2) Connect ICM couplers to ICM.
3) Check voltage at each terminal of couplers connected.

NOTE:
As each terminal voltage is affected by the battery voltage, confirm that it is 11V or more when ignition switch is ON.

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A1	Coil antenna 1	0V	Ignition switch ON
A2	Coil antenna 2	0V	
A3	Power source	10–14V	
A4	Ignition signal	10–14V	Ignition switch ON
		0–0.8V	Ignition switch OFF
A5	Diagnosis output	0–14V	Ignition switch ON
		0V	Ignition switch OFF
A6	Blank	–	–
A7	Ground	–	–
A8	Data link connector (Serial data terminal)	4–5V	Ignition switch ON
A9 A10	Blank	–	–

NOTE:
When measuring voltage at A1 and A2 terminals with ignition switch turned ON, be sure to turn ignition switch ON before connecting positive probe of voltmeter to A1 or A2 terminal. If it is not turned ON first, DTC13 (Diagnostic Trouble Code 13) may be indicated.



1. ICM coupler disconnected
2. Ohmmeter

8A-046

Resistance Check

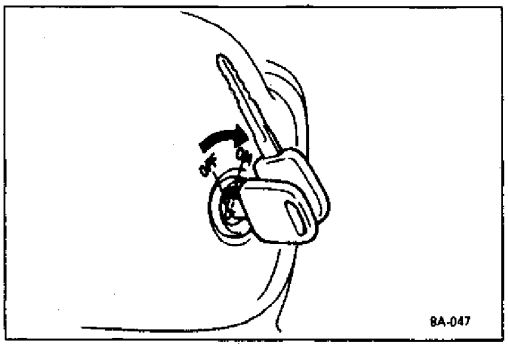
1) Disconnect ICM couplers from ICM with ignition switch OFF.

> **CAUTION:**
> **Never touch terminals of ICM itself or connect voltmeter or ohmmeter.**

2) Check resistance between each terminal of couplers disconnected.

> **CAUTION:**
> - **Be sure to connect ohmmeter probe from wire harness side of coupler.**
> - **Be sure to turn OFF ignition switch for this check.**
> - **Resistance in table below represents that when parts temperature is 20°C (68°F).**

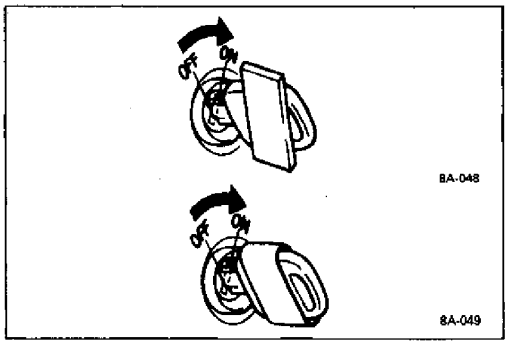
TERMINAL	CIRCUIT	NORMAL RESISTANCE	CONDITION
A1 – A2	Coil antenna	Continuity	–



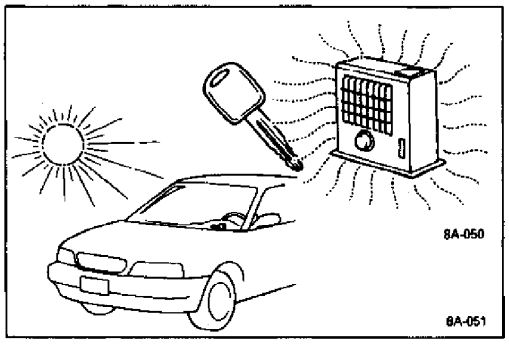
ON-VEHICLE SERVICE

Precautions in handling immobilizer control system

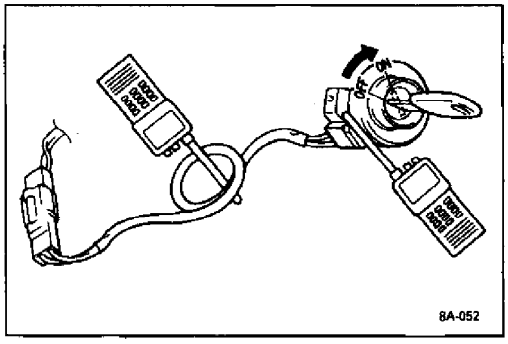
- Don't turn ON ignition switch with ignition key for immobilizer control system put together with another one or placed quite close to another one. Or the system may detect abnormal condition and prevent engine from starting.



- Do not turn ON ignition switch by using ignition key with any type of metal wound around its grip or in contact with it. Or the system may detect abnormal condition and prevent engine from starting.



- Do not leave ignition key where high temperature is anticipated. High temperature will cause transponder in ignition key to be abnormal or damaged.



- Do not turn ON ignition switch with a radio antenna placed near coil antenna or its harness to ICM. Or the system may detect abnormal condition and prevent engine from starting.

IMMOBILIZER CONTROL MODULE (ICM)

Removal

1) Disconnect negative (–) cable at battery.
2) Disconnect coupler.
3) Remove immobilizer control module.

Installation

Reverse removal procedure for installation

NOTE:

After replacing ICM, be sure to register TP code and ECM/ICM code in ICM and ECM/ICM code in ECM by performing procedure described in "Procedure after ICM Replacement" section.

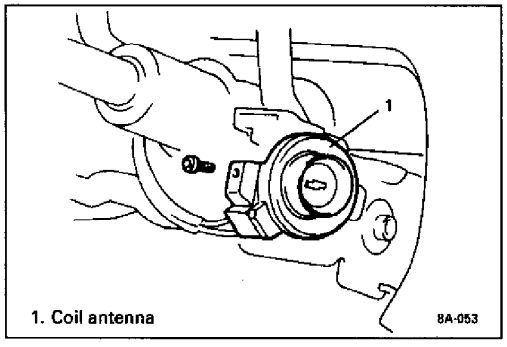
ENGINE CONTROL MODULE (ECM)

Removal and Installation

For removal and installation of ECM, refer to "Electronic Fuel Injection System" section in Service Manual for vehicle being serviced.

NOTE:

After replacing ECM, be sure to register ECM/ICM code in ECM by performing procedure described in "Procedure after ECM Replacement" section.



1. Coil antenna

COIL ANTENNA

Removal

1) Disconnect negative (–) cable at battery.
2) Remove air bag module (if equipped), steering wheel and combination switch assembly (together with steering sensor if suspension control system is equipped). Refer to Section 3C.
3) Remove coil antenna

Installation

For installation, reverse removal procedure, surely referring to Section 3C.

HOW TO REGISTER IGNITION KEY

Register the ignition key (TP code) in the immobilizer control system by using the following procedure.

1) Prepare ignition keys with a built-in transponder to be registered for the vehicle.
   NOTE:
   As up to 4 ignition keys may be used for immobilizer control system, make sure that total number of ignition keys that are used for the vehicle is 4 or less.
2) Prepare TECH1 (TECH1A kit and cartridge for immobilizer control system).
   NOTE:
   For operation procedure of TECH1, refer to TECH1 operator's manual.
3) If necessary, clear all TP codes registered in ICM by executing "CLEAR TP CODE" command in SELECT MODE menu with TECH1.
   NOTE:
   When "CLEAR TP CODE" command is executed with the malfunction indicator lamp ("CHECK ENGINE" light) ON, it remains ON even after execution of that command is over. It will start flashing when the ignition switch is turned OFF once and then turned ON after some seconds.
4) Using TECH1, register TP code in ICM one by one by executing "ENTER TP CODE" command in SELECT MODE menu.
   Then after completing registration of TP code for all ignition keys, turn ON ignition switch by using all ignition keys one by one and check that malfunction indicator lamp ("CHECK ENGINE" light) lights each time.
   NOTE:
   ICM does not accept registration of the same TP code.

PROCEDURE AFTER ICM REPLACEMENT

When ICM was replaced, including when replaced because rechecking by using a known-good ICM was necessary during trouble diagnosis, register TP code and ECM/ICM code in ICM and ECM/ICM code in ECM by performing following procedure.

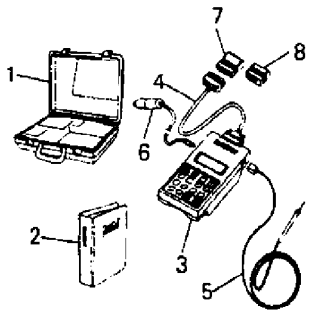
1) Prepare all existing ignition keys (those that have been used for that vehicle).
   NOTE:
   As up to 4 ignition keys may be used for immobilizer control system, make sure that total of existing ignition keys is 4 or less
2) Prepare TECH1 (TECH1A kit and cartridge for immobilizer control system).
   NOTE:
   For operation procedure of TECH 1, refer to TECH1 operator's manual.
3) Check the number of TP codes registered in ICM which has been replaced by executing "DATA LIST" command in SELECT MODE menu of TECH1. If even one TP code has been registered, execute "CLEAR TP CODE" command in SELECT MODE menu.
   NOTE:
   When "CLEAR TP CODE" command is executed with the malfunction indicator lamp ("CHECK ENGINE" light) ON, it remains ON even after execution of that command is over. It will start flashing when the ignition switch is turned OFF once and then turned ON after some seconds.
4) Using TECH1, register TP code in ICM one by one by executing "ENT. TP CODE" command in SELECT MODE menu.
   NOTE:
   ICM does not accept registration of the same TP code.
5) Using TECH1, register ECM/ICM code in both ICM and ECM by executing "RECORD ECM/ICM" command in SELECT MODE menu.
6) Turn ON ignition switch by using all ignition keys one by one and check that malfunction indicator lamp ("CHECK ENGINE" light) lights each time.

PROCEDURE AFTER ECM REPLACEMENT

When ECM was replaced, including when replaced because rechecking by using a known-good ECM was necessary during trouble diagnosis, register ECM/ICM code in ECM by performing following procedure.

1) Prepare TECH1 (TECH1A kit and cartridge for immobilizer control system).
   NOTE:
   For operation procedure of TECH 1, refer to TECH1 operator's manual.
2) Using TECH1, register ECM/ICM code in ECM by executing "RECORD ECM/ICM" command in SELECT MODE menu.

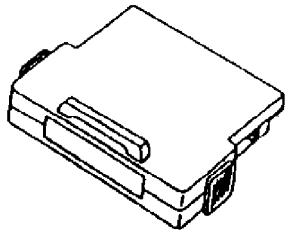
SPECIAL TOOLS



1. Storage case
2. Operator's manual
3. Tech 1A
4. DLC cable
5. Test lead/probe
6. Power source cable
7. DLC cable adapter
8. Self-test adapter

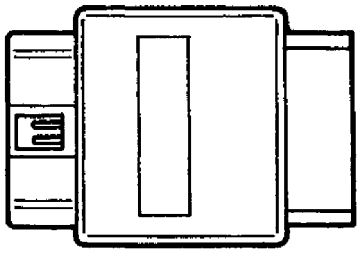
09931-76011
Tech-1 (scan tool) kit

8A-054



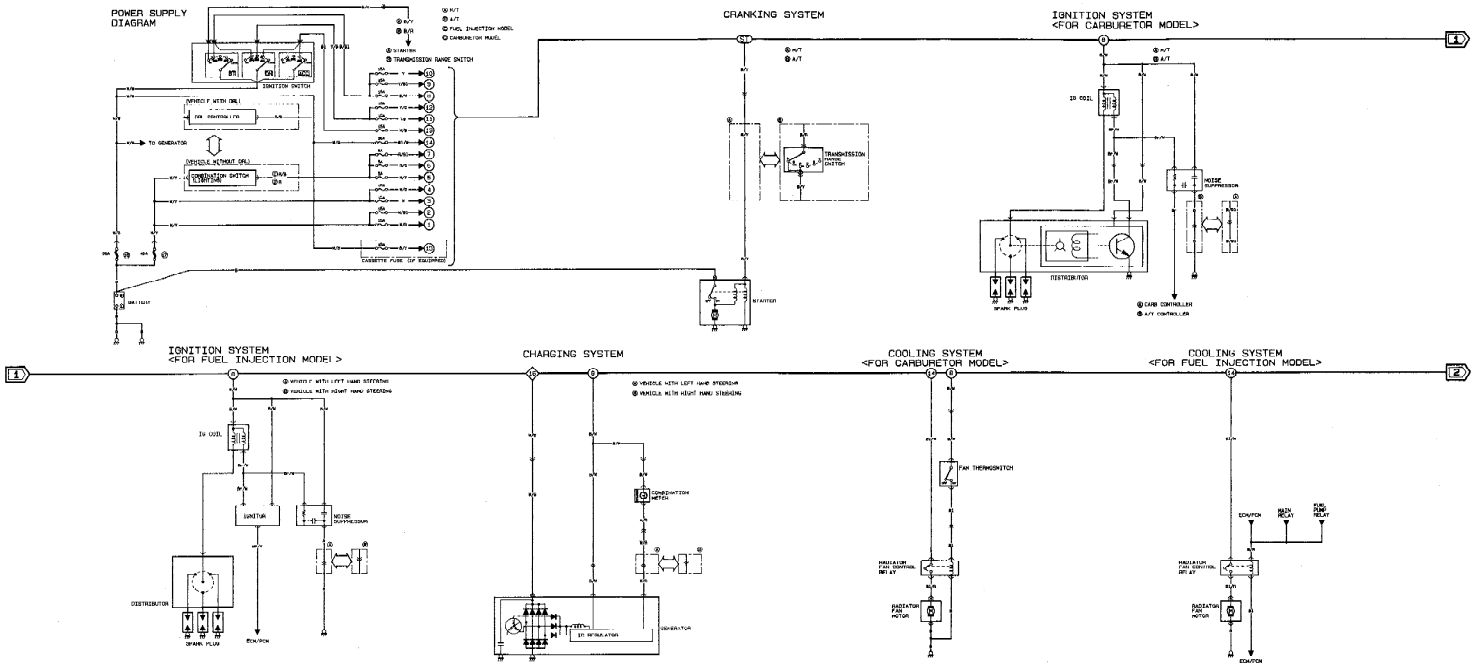
Tech-1 cartridge for immobilizer control system

8A-055

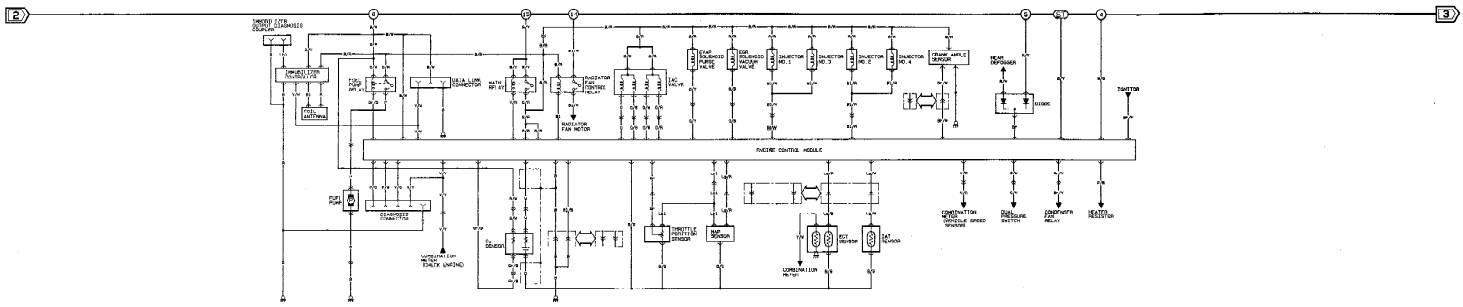


8A-056

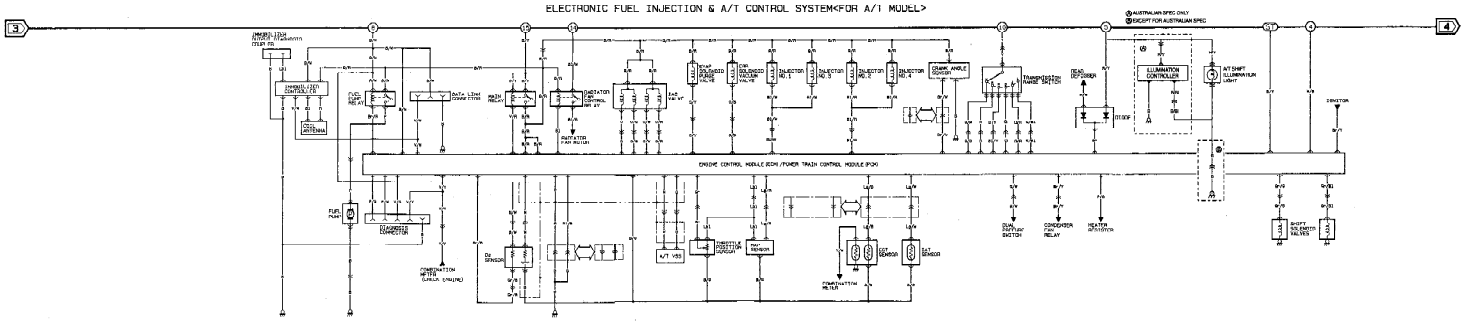
09931-96020
16/12 pin DLC adapter

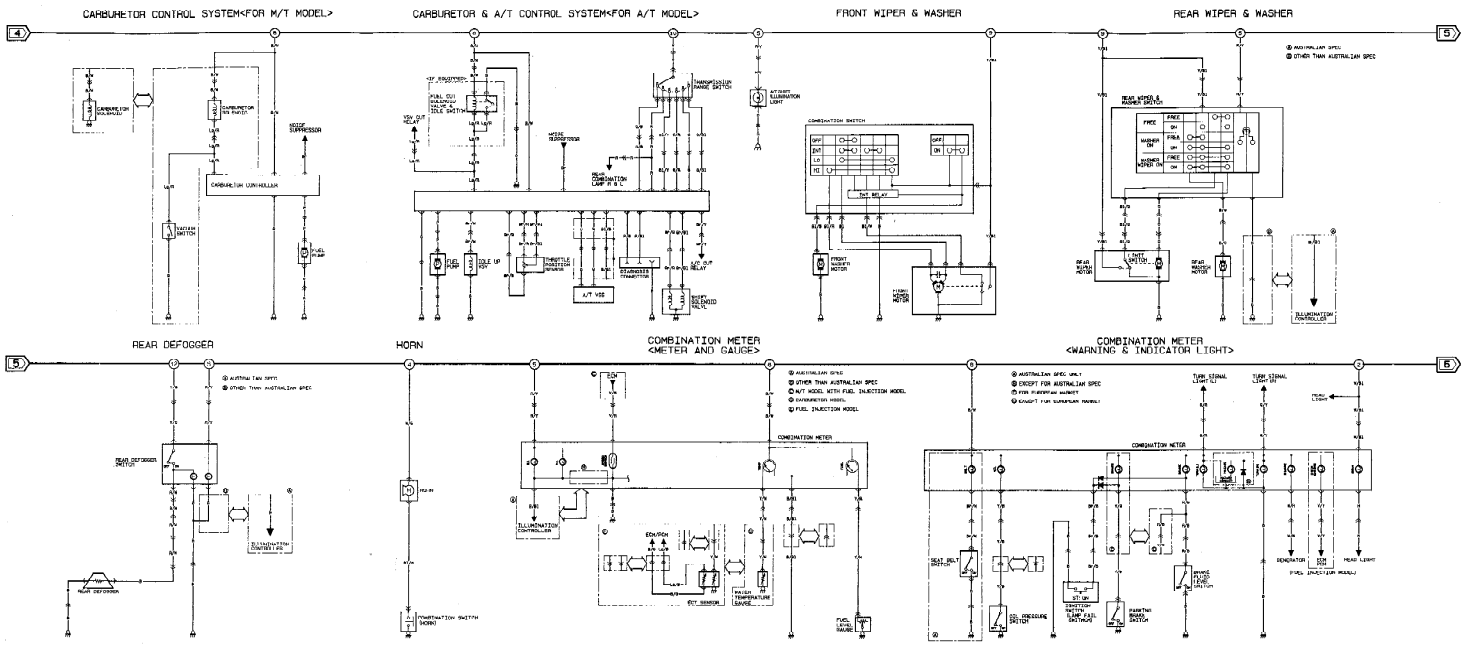

POWER SUPPLY DIAGRAM
CRANKING SYSTEM
IGNITION SYSTEM <FOR CARBURETOR MODEL>
IGNITION SYSTEM <FOR FUEL INJECTION MODEL>
CHARGING SYSTEM
COOLING SYSTEM <FOR CARBURETOR MODEL>
COOLING SYSTEM <FOR FUEL INJECTION MODEL>

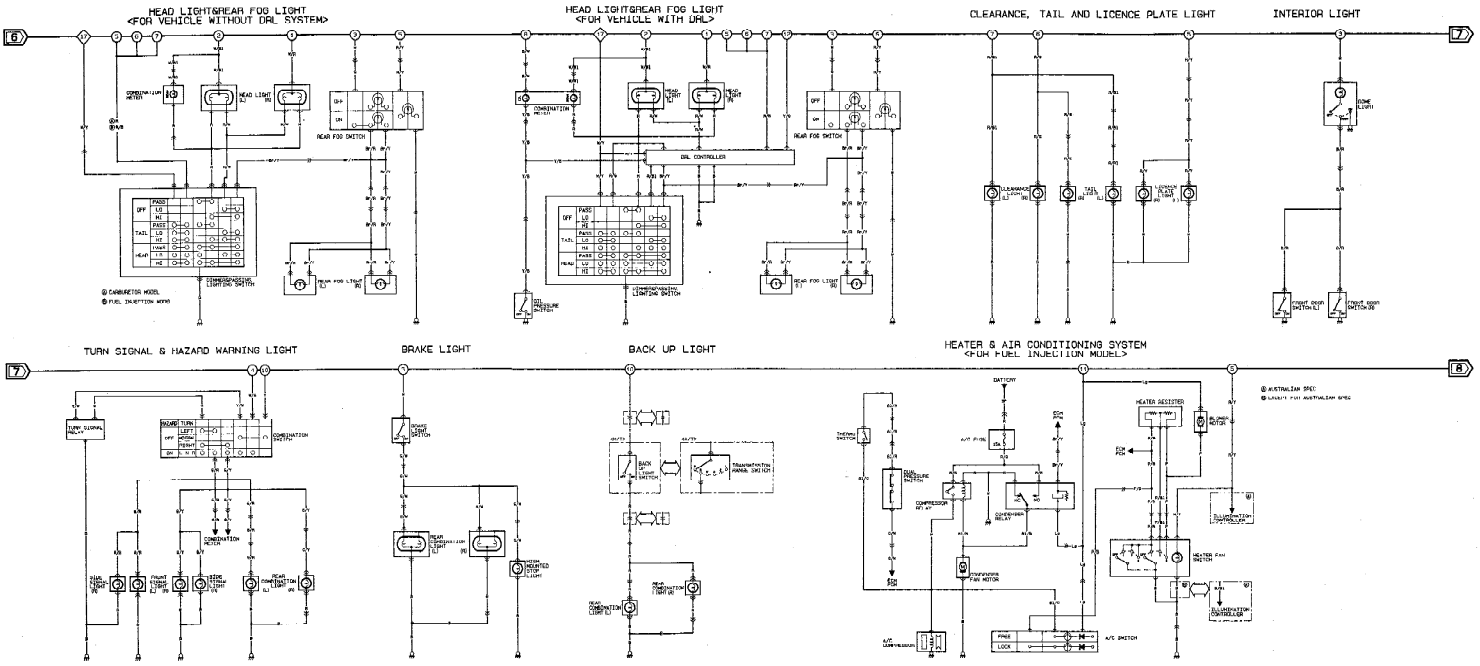
ELECTRONIC FUEL INJECTION SYSTEM<FOR M/T MODEL>

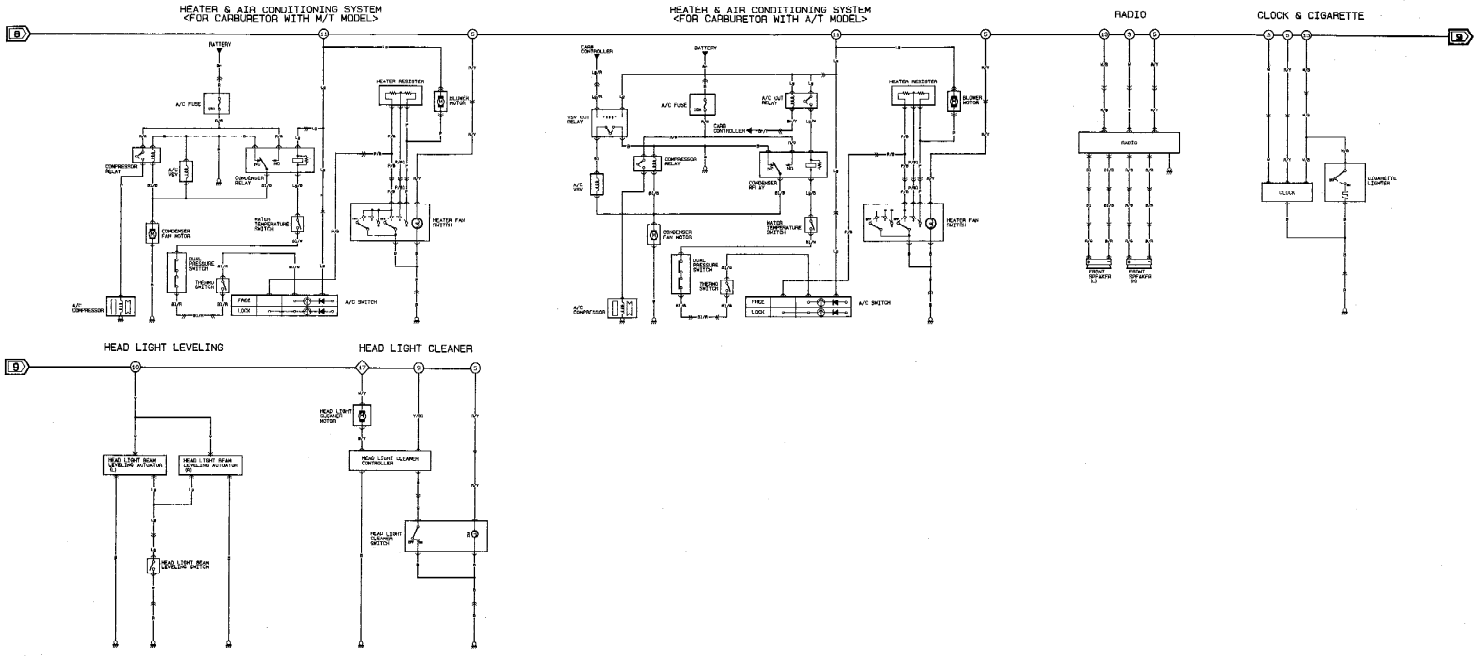


ELECTRONIC FUEL INJECTION & A/T CONTROL SYSTEM<FOR A/T MODEL>




CARBURETOR CONTROL SYSTEM<FOR M/T MODEL>
CARBURETOR & A/T CONTROL SYSTEM<FOR A/T MODEL>
FRONT WIPER & WASHER
REAR WIPER & WASHER
REAR DEFOGGER
HORN
COMBINATION METER
<METER AND GAUGE>
COMBINATION METER
<WARNING & INDICATOR LIGHT>
4
5
5
5


HEAD LIGHT&REAR FOG LIGHT
<FOR VEHICLE WITHOUT DRL SYSTEM>
HEAD LIGHT&REAR FOG LIGHT
<FOR VEHICLE WITH DRL>
CLEARANCE, TAIL AND LICENCE PLATE LIGHT
INTERIOR LIGHT
TURN SIGNAL & HAZARD WARNING LIGHT
BRAKE LIGHT
BACK UP LIGHT
HEATER & AIR CONDITIONING SYSTEM
<FOR FUEL INJECTION MODEL>
6
7
8


HEATER & AIR CONDITIONING SYSTEM
<FOR CARBURETOR WITH M/T MODEL>
HEATER & AIR CONDITIONING SYSTEM
<FOR CARBURETOR WITH A/T MODEL>
RADIO
CLOCK & CIGARETTE
HEAD LIGHT LEVELING
HEAD LIGHT CLEANER

Prepared by

MARUTI UDYOG LIMITED

Service Department
December, 1996

Part No. 99510M70F01-01E
Printed in India

ISSUI Date: 17.11.2007

SUZUKI MOTOR CORPORATION