SUZUKI

SV420D

SUPPLEMENTARY SERVICE MANUAL

USE THIS SERVICE MANUAL WITH MANUALS
MENTIONED IN THE FOREWORD OF THIS MANUAL.

SUZUKI
Caring for Customers

99501-78E00-01E
(英)

IMPORTANT

WARNING/CAUTION/NOTE

Please read this manual and follow its instructions carefully. To emphasize special information, the words **WARNING, CAUTION** and **NOTE** have special meanings. Pay special attention to the messages highlighted by these signal words.

WARNING:
Indicates a potential hazard that could result in death or injury.

CAUTION:
Indicates a potential hazard that could result in vehicle damage.

NOTE:
Indicates special information to make maintenance easier or instructions clearer.

WARNING:
This service manual is intended for authorized Suzuki dealers and qualified service mechanics only. Inexperienced mechanics or mechanics without the proper tools and equipment may not be able to properly perform the services described in this manual.
Improper repair may result in injury to the mechanic and may render the vehicle unsafe for the driver and passengers.

WARNING:
For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around air bag system components or wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Component and Wiring Location view in Section 9J before performing service on or around air bag system components or wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **If the air bag system and another vehicle system both need repair, Suzuki recommends that the air bag system be repaired first, to help avoid unintended air bag deployment.**
- **Do not modify the steering wheel, dashboard, or any other air bag system component (on or around air bag system componenrs or wiring). Modifications can adversely affect air bag system performance and lead to injury.**
- **If the vehicle will be exposed to temperatures over 93°C, 200°F (for example, during a paint baking process), remove the air bag system components (air bag inflator module, sensing and diagnostic module, forward discriminating sensor) beforehand to avoid component damage or unintended deployment.**

FOREWORD

This SUPPLEMENTARY SERVICE MANUAL is a supplement to VITARA (SE416, SV620 and SV420D) series SERVICE MANUALS (SERVICE MANUALS 99500-60A10, 99500-85F00, 99500-78E00, SUPPLEMENTARY SERVICE MANUALS 99501-60A60, 99501-60A70, 99501-61A10) and has been prepared exclusively for the following applicable model.

Applicable model:
SV420D vehicle on and after the following VIN No. and equipped with inter cooler.
(x) JSAETD31V00200001 (x)

It describes only different service information of the above applicable model as compared with SV420D vehicle of VIN No. before above listed one and not equipped with inter cooler.

Therefore, whenever servicing the above applicable model, consult this supplement first. And for any section, item or description not found in this supplement, refer to the SERVICE MANUALS and SUPPLEMENTARY SERVICE MANUALS mentioned in next page.

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

Related Service Manual

Service manuals listed below are in the chronological order with the latest one at the top.
For efficient use of manuals, start with the one at the top of the list (i.e., the latest one). If desired section, item or description is not found in it, try next one in the list and do the same one by one till what is being searched is found.

No.	SERVICE MANUAL RELATED TO THIS MANUAL	APPLICABILITY
1	SV420D SERVICE MANUAL (99500-78E00)	This manual describes the only different service information of SV420D as compared with the Service Manuals (99500-60A10, 99500-85F00, 99501-60A60, 99501-60A70, 99501-61A10) below.
2	VITARA (SE416/SV620) SUPPLEMENTARY SERVICE MANUAL (99501-61A10)	This manual describes the items that should be updated (modified and added) in the Service Manuals (99500-60A10, 99500-85F00, 99501-60A60, 99501-60A70) below. When servicing the SV420D vehicle using this manual, also refer to the sections, items, and descriptions related to the SV620.
3	SV620 SERVICE MANUAL (99500-85F00)	This manual describes the items that should be updated (modified and added) in the Service Manuals (99500-60A10, 99501-60A70) below.
4	VITARA (SE416) SUPPLEMENTARY SERVICE MANUAL (99501-60A70)	This manual describes the items that should be updated (modified and added) in the Service Manual (99500-60A10) below after it was issued.
5	VITARA (SE416) SUPPLEMENTARY SERVICE MANUAL FOR 5-DOOR MODEL WITH SLIDING ROOF (99501-60A60)	This manual describes the sliding roof only.
6	VITARA (SE416) SERVICE MANUAL (99500-60A10)	This manual is the base manual for the above manual.

NOTE:
For sections 0A, 0B, and 7E in this manual (SV420D SUPPLEMENTARY SERVICE MANUAL), refer to the related SERVICE MANUAL in the above table in the following order.

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 FOREWORD of this manual.

78E00-0A-1-1S

CONTENTS

78E00-0A-1-2S

ABBREVIATIONS 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
BBDC : Before Bottom Dead Center
BTDC : Before Top Dead Center

C

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

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
DSPV : Deceleration Sensing Proportioning Valve
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
ELR : Emergency Locking Retractor
EVAP : Evaporative Emission
EVAP Canister : Evaporative Emission Canister (Charcoal Canister)

F

FICD : Fast Idle Control Device
FIP : Fuel Injection Pump
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

L

LH : Left Hand
LSD : Limited Slip Differential
LSPV : Load Sensing Proportioning Valve

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)

N

NOx : Nitrogen Oxides

O

OBD : On-Board Diagnostic System (Self-Diagnosis Function)
OHC : Over Head Camshaft
O2S : Oxygen Sensor

P

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
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)
TCV : Timer Control Valve
TP Sensor : Throttle Position Sensor
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

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SECTION 0B

0B

MAINTENANCE AND LUBRICATION

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

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CONTENTS

78E00-0B-1-2S

MAINTENANCE SCHEDULE

MAINTENANCE SCHEDULE UNDER NORMAL DRIVING CONDITIONS

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 (except 1,000 km (600 miles) inspection).								
	km (x 1,000)	1	10	20	30	40	50	60	70	80
	miles (x 1,000)	0.6	6	12	18	24	30	36	42	48
	Months	–	6	12	18	24	30	36	42	48
ENGINE										
1-1. Drive belt		I	I	I	I	I	I	I	I	I
1-2. Camshaft timing belt		Replace every 100,000 km (60,000 miles)								
1-3. Valve lash (clearance)		–	–	I	–	I	–	I	–	I
1-4. Engine oil and oil filter		Replace every 5,000 km (3,000 miles)								
1-5. Engine coolant		–	–	–	–	R	–	–	–	R
1-6. Cooling system hoses and connections		–	–	I	–	I	–	I	–	I
1-7. Exhaust pipes and mountings (except catalyst)		–	–	–	–	I	–	–	–	I&(R)
FUEL SYSTEM										
3-1. Air cleaner filter element		–	I	I	I	R	I	I	I	R
3-2. Fuel tank cap, fuel lines and connections		–	–	–	–	I	–	–	–	I&(R)
3-3. Fuel filter		–	–	–	–	R	–	–	–	R
ELECTRICAL SYSTEM										
5-1. Wiring harness connections and headlights		–	–	–	–	I	–	–	–	I

NOTES:

"R": Replace or change

"I" : Inspect and correct or replace if necessary

- *Item 1-7 (R) is applicable to exhaust mounting rubber only.*
- *Item 3-2 (R) is applicable to fuel tank cap only.*

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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 – Towing a trailer
B – Repeated short trips
C – Driving on rough and/or muddy roads
D – Driving on dusty roads
E – Driving in extremely cold weather and/or salted roads
F – Repeated short trips in extremely cold weather

Severe Condition Code	Maintenance	Maintenance Operation	Maintenance Interval
— — C D — —	Water pump (fan) drive belt	I	Every 12,000 miles (20,000 km) or 12 months
		R	Every 24,000 miles (40,000 km) or 24 months
A B — D E F	Engine oil and oil filter	R	Every 3,000 miles (5,000 km) or 3 months For Diesel engine, replace more often.
A B C — E —	Exhaust pipes and mounting	I	Every 6,000 miles (10,000 km) or 6 months
— — — D — —	Air cleaner filter element *1	I	Every 1,500 miles (2,500 km)
		R	Every 12,000 miles (20,000 km) or 12 months
A B C D — —	Brake discs and pads (Front) Brake drums and shoes (Rear)	I	Every 6,000 miles (10,000 km) or 6 months
A B C — E —	Propeller shafts	I	Every 6,000 miles (10,000 km) or 6 months
A — C — — F	Manual transmission, transfer and differential oil	R	Every 12,000 miles (20,000 km) or 12 months
A — C — — F	Automatic transmission fluid	R	Every 12,000 miles (20,000 km) or 12 months
— — C — — —	Drive axle shaft boots	I	Every 6,000 miles (10,000 km) or 6 months
— — C — — —	Bolts and nuts on chassis	T	Every 6,000 miles (10,000 km) or 6 months

NOTE:
"I" : Inspect and correct or replace if necessary
"R": Replace or change
"T": Tighten to the specified torque
- **1: Inspect or replace more frequently if the vehicle is used under dusty conditions.*

RECOMMENDED FLUIDS AND LUBRICANTS

Engine oil	CD, CE, or CF-4 class
Engine coolant (Ethylene glycol base coolant)	"Antifreeze/Anticorrosion coolant"
Brake fluid	DOT 3 or SAE J1703
Manual transmission oil	API GL-4, SAE 75W-90
Transfer oil	
Differential oil (front & rear)	API GL-5, SAE 75W-90 Hypoid gear oil
Automatic transmission fluid and Power steering fluid	An equivalent of DEXRON®-II, DEXRON®-IIE or DEXRON®-III
Clutch linkage pivot points	Water resistance chassis grease (SUZUKI SUPER GREASE A 99000-25010)
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

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SECTION 1A

HEATER AND VENTILATION

1A

WARNING:
For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Component and Wiring Location view in Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic module (SDM).**

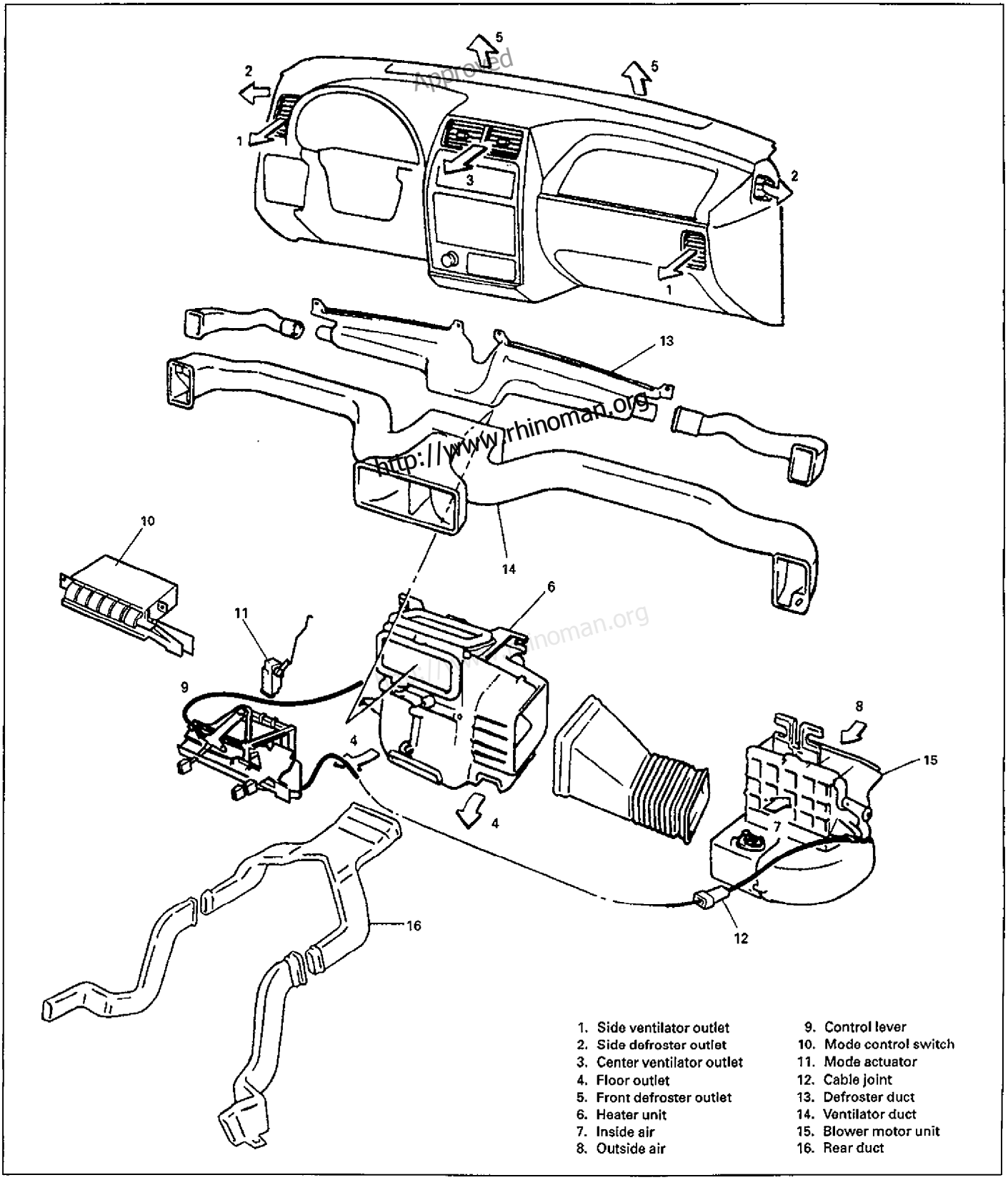
NOTE:

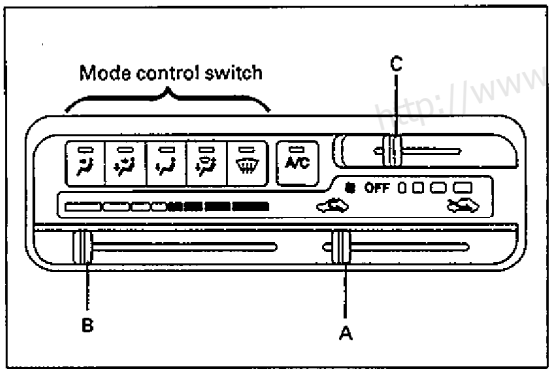
- **For the descriptions (items) not found in this section, refer to SECTION 1A of the Service Manual mentioned in FOREWORD of this manual.**
- **The link mechanism of the heater varies depending on the specifications.**

CONTENTS

GENERAL DESCRIPTION

The heater, an in and out air selectable-type hot water heater, is so constructed that it is possible to assure an agreeable ventilation at all times by providing the ventilator air outlets at the center and both sides (right and left) of the instrument panel, the hot air outlet at a place close to the feet of front passengers, and the defroster air outlets at places, right and left, along the windshield glass.
The heater and ventilation consist of following parts.





78E00-1A-3-1S

HEATER CONTROL OPERATION

For mode selection, press mode control switch as desired. Then the mode actuator will move the link to change the mode.

	VENTILATION
	BI-LEVEL
	HEAT
	HEAT & DEFROSTER
	DEFROSTER

60A20-1A-3-2

MODE CONTROL SWITCH

BI-LEVEL ( ) is a position used to keep cooling the head and warming the feet.

	CIRCULATION
	FRESH AIR

60A20-1A-3-3

CONTROL LEVER A

CONTROL LEVER B

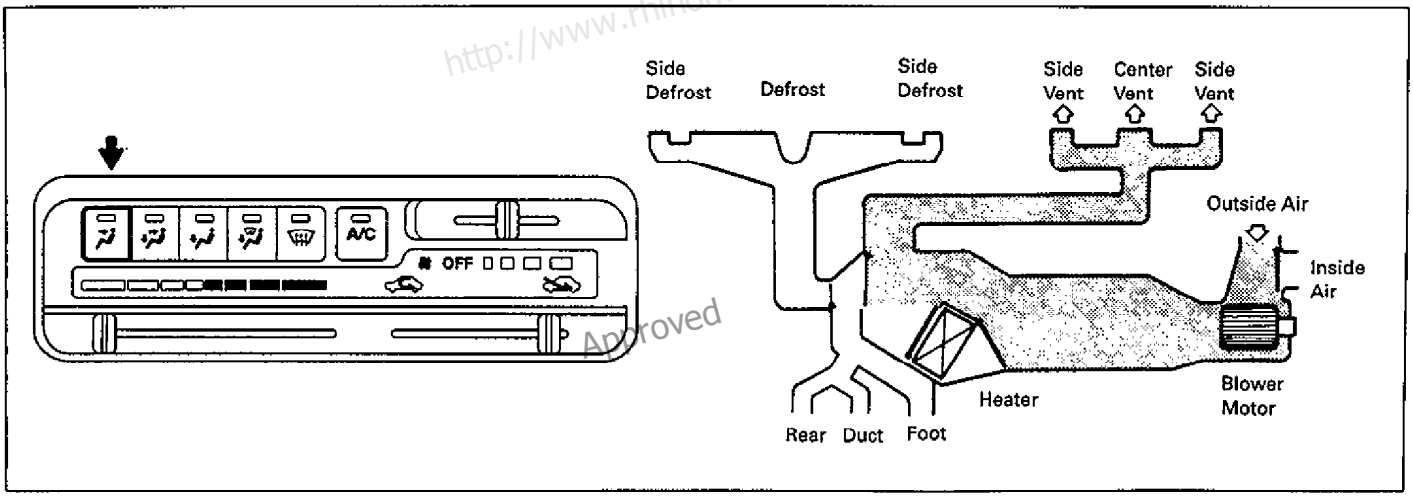
A temperature control lever.
The temperature of air is controlled by this lever.
To make the heater warmer, set it to the "HOT" position.

60A20-1A-3-4

CONTROL LEVER C

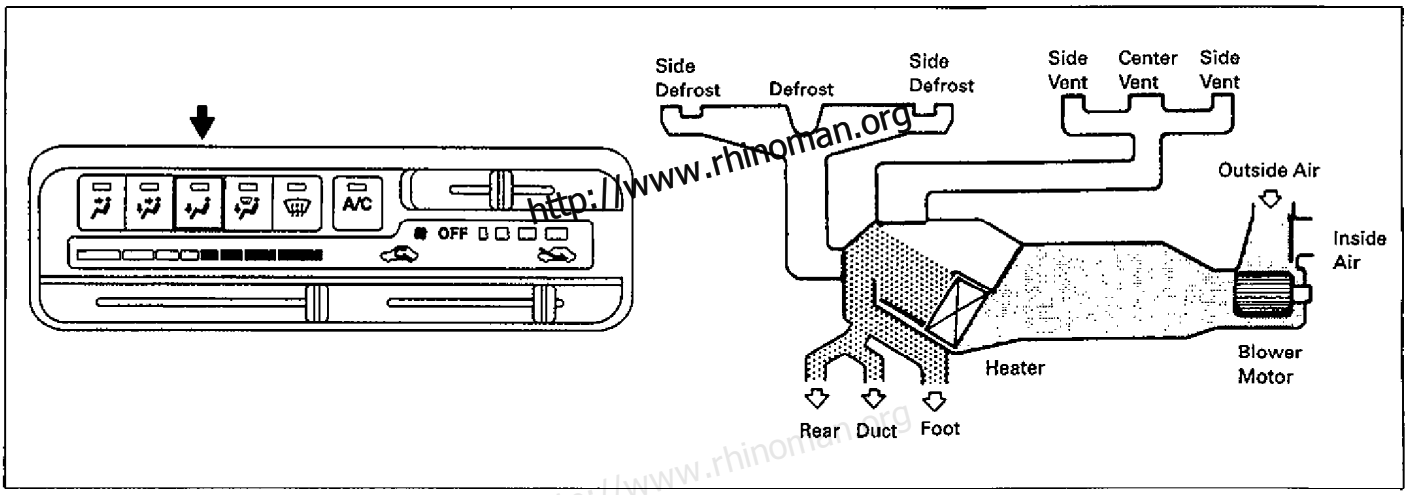
A blower speed selecting lever. The blower speed is increased as the lever is moved from left to right.

A. FORCED VENTILATION



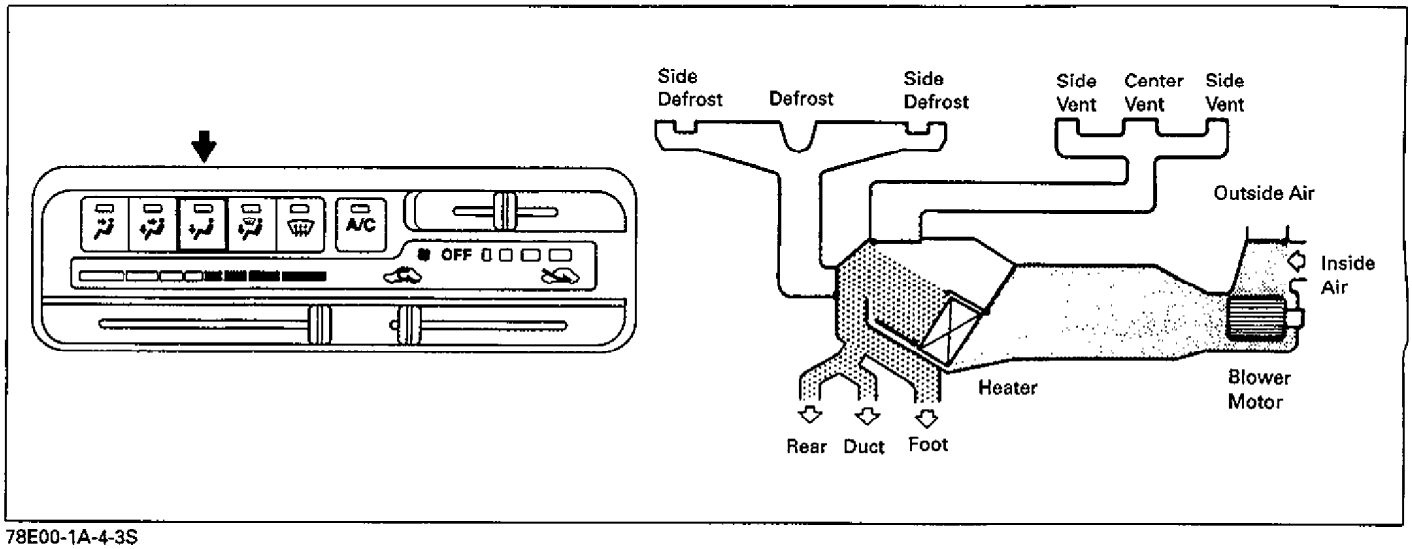
78E00-1A-4-1S

B. OUTSIDE AIR-INTRODUCED HEATING



78E00-1A-4-2S

C. INSIDE AIR-CIRCULATED HEATING



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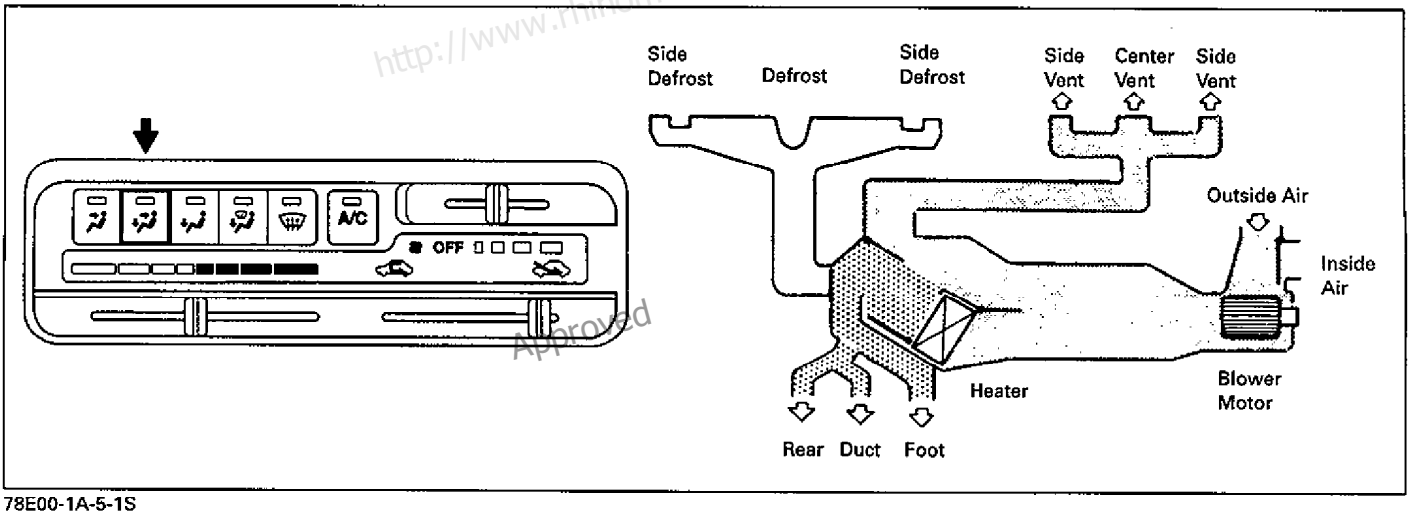
D. HEAD-COOLED / FEET-WARMED HEATING



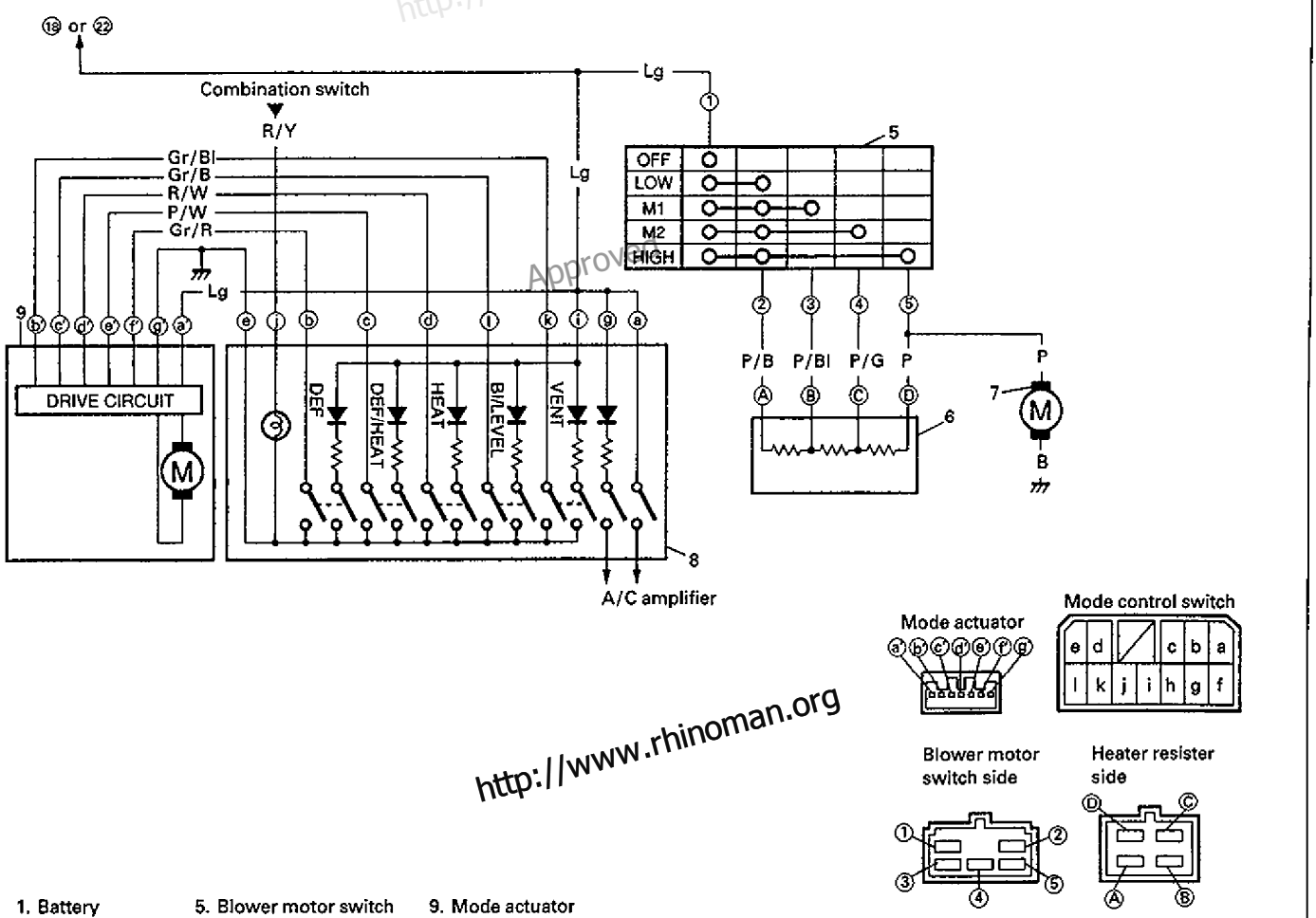
78E00-1A-5-1S

TROUBLE DIAGNOSIS

Trouble	Possible cause	Remedy
Heater blower won't work even when its switch is ON.	Blower fuse blown Blower resistor faulty Blower motor faulty Wiring or grounding faulty	Replace fuse to check for short. Check resistor. Replace motor. Repair as necessary.
Incorrect temperature output.	Control cables broken or binding Air damper broken Air ducts clogged Heater radiator leaking or clogged Heater hoses leaking or clogged	Check cables. Repair damper. Repair air ducts. Replace radiator. Replace hoses.
When mode control switch is changed, air outlet port is not changed.	Mode control switch faulty Mode actuator faulty Fuse blown Wiring or grounding faulty Air damper broken Air ducts clogged	Check and replace as necessary. Check and replace as necessary. Replace fuse to check for short. Repair as necessary. Repair damper. Repair air ducts.

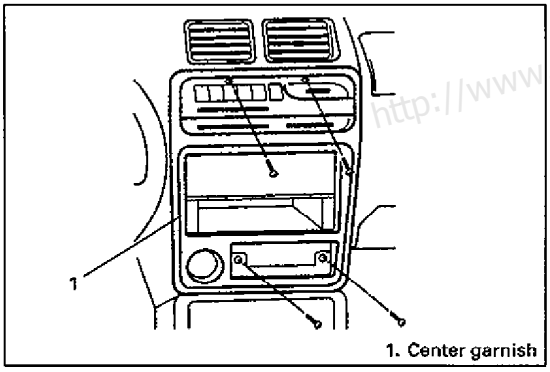
78E00-1A-5-2S

WIRING CIRCUIT



1. Battery
2. Main fuse
3. Main switch
4. Fuse box
5. Blower motor switch
6. Heater resister
7. Blower motor
8. Mode control switch
9. Mode actuator

78E00-1A-6-1S



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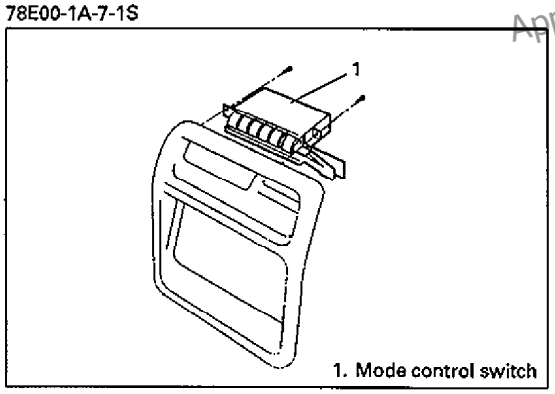

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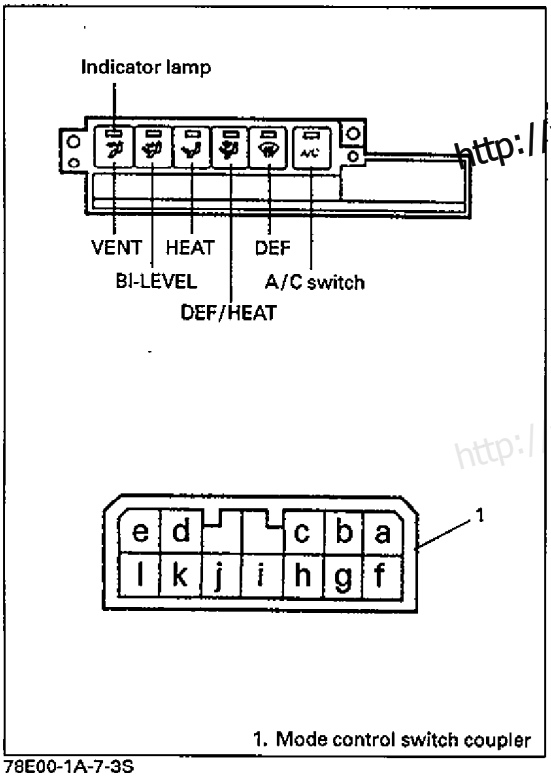


78E00-1A-7-3S

ON-VEHICLE SERVICE

MODE CONTROL SWITCH

REMOVAL

1) Disconnect negative (–) cable at battery.
2) If equipped with air bag system, disable air bag system. Refer to "Disabling Air Bag System" in Section 9J.
3) Pull off control lever knobs.
4) Remove ashtray and center garnish mounting screws.
5) Remove center garnish with mode control switch.
6) Remove mode control switch from center garnish.

INSPECTION

Mode Control Switch

- Check if continuity exists between each pair of terminals listed below when mode control button is pressed.

Mode	Mode control switch terminals
VENT	e – k
BI-LEVEL	e – l
HEAT	e – d
DEF/HEAT	e – c
DEF	e – b

- With battery voltage (+) connected to terminal "i" and (–) to terminal "e", press each mode control button and check if indicator lamp lights.
- With battery voltage (+) connected to terminal "j" and (–) to terminal "e", check if illumination lamp lights.

A/C Switch (if equipped)

- Press A/C button and check if there is continuity between terminals "a" and "f".
- With battery voltage (+) connected to terminal "g" and (–) to terminal "h", press A/C button and check if indicator lamp lights.

INSTALLATION

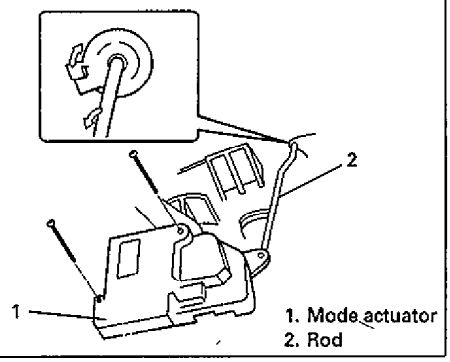
1) Install in reverse order of removal.
2) If equipped with air bag system, enable air bag system. Refer to "Enabling Air Bag System" in Section 9J.

MODE ACTUATOR

REMOVAL

1) Disconnect negative (–) cable at battery.
2) If equipped with air bag system, disable air bag system. Refer to "Disabling Air Bag System" in Section 9J.
3) Remove EBCM bracket with EBCM and ICM (if equipped).

78E00-1A-8-1S



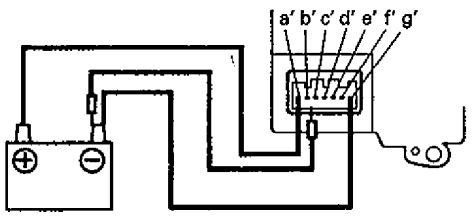
1. Mode actuator
2. Rod

4) Disconnect mode actuator coupler.
5) Disconnect mode actuator rod from heater unit.
6) Remove mode actuator from heater unit.

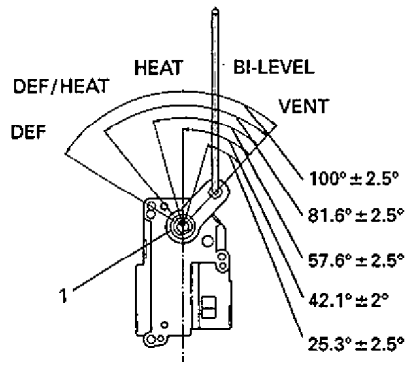
78E00-1A-8-2S

INSPECTION

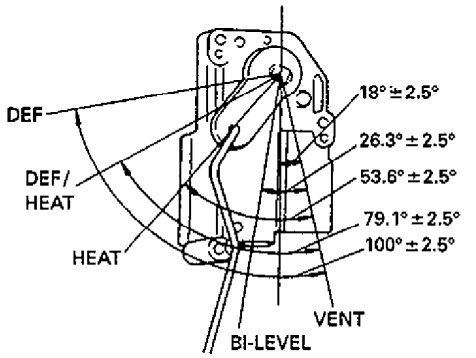
1) Connect battery voltage (+) to terminal "a'" and (–) to terminal "g'".
2) Connect each terminal listed below to terminal "g'" (negative (–) terminal of battery) and check if lever rotation angel is as specified in figure at the left.



FOR LEFT HAND STEERING VEHICLE



FOR RIGHT HAND STEERING VEHICLE



1. Lever

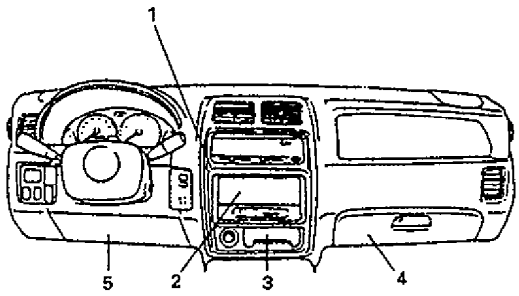
MODE	TERMINAL	
	Left hand steering vehicle	Right hand steering vehicle
VENT	f'	b'
BI-LEVEL	e'	c'
HEAT	d'	d'
DEF/HEAT	c'	e'
DEF	b'	f'

78E00-1A-8-3S

INSTALLATION

1) Install in reverse order of removal.
2) If equipped with air bag system, enable air bag system. Refer to "Enabling Air Bag System" in Section 9J.

78E00-1A-9-1S



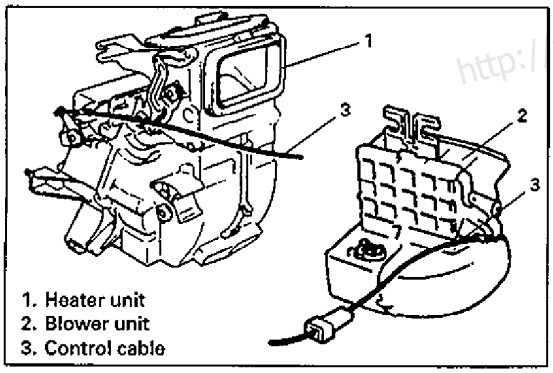
1. Center garnish
2. Instrument glove box compartment
3. Ashtray
4. Glove box
5. Column hole cover

HEATER CONTROL LEVER ASSEMBLY

REMOVAL

1) Disconnect negative (–) cable at battery.
2) If equipped with air bag system, disable air bag system. Refer to "Disabling Air Bag System" in Section 9J.
3) Pull off control lever knobs.
4) Remove ashtray and center garnish mounting screws.
5) Remove center garnish.
6) Remove glove box and column hole cover.
7) Remove instrument glove box compartment.

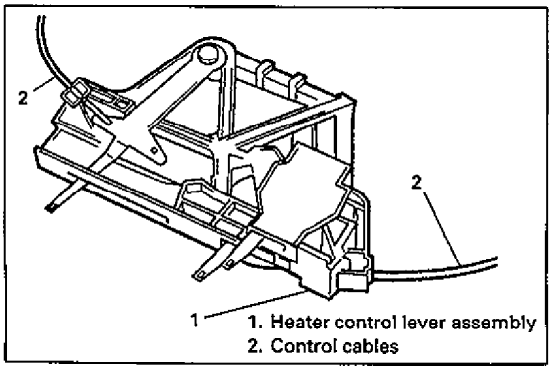
78E00-1A-9-2S



1. Heater unit
2. Blower unit
3. Control cable

8) Disconnect control cables from blower motor unit and heater unit.
9) Disconnect heater blower motor switch connector.

78E00-1A-9-4S



1. Heater control lever assembly
2. Control cables

10) Remove heater control lever assembly.

60A50-1A-10-1

INSPECTION OF HEATER BLOWER MOTOR SWITCH

Check heater blower motor switch for each terminal-to-terminal continuity. For the detail refer to "WIRING CIRCUIT" earlier in this section.

	Lg	P/B	P/Bl	P/G	P
LOW	○	○			
M1	○	○	○		
M2	○	○		○	
HIGH	○	○			○

Lg : Lightgreen
P : Pink
P/G : Pink/Green tracer
P/Bl : Pink with Blue tracer
P/B : Pink with Black tracer

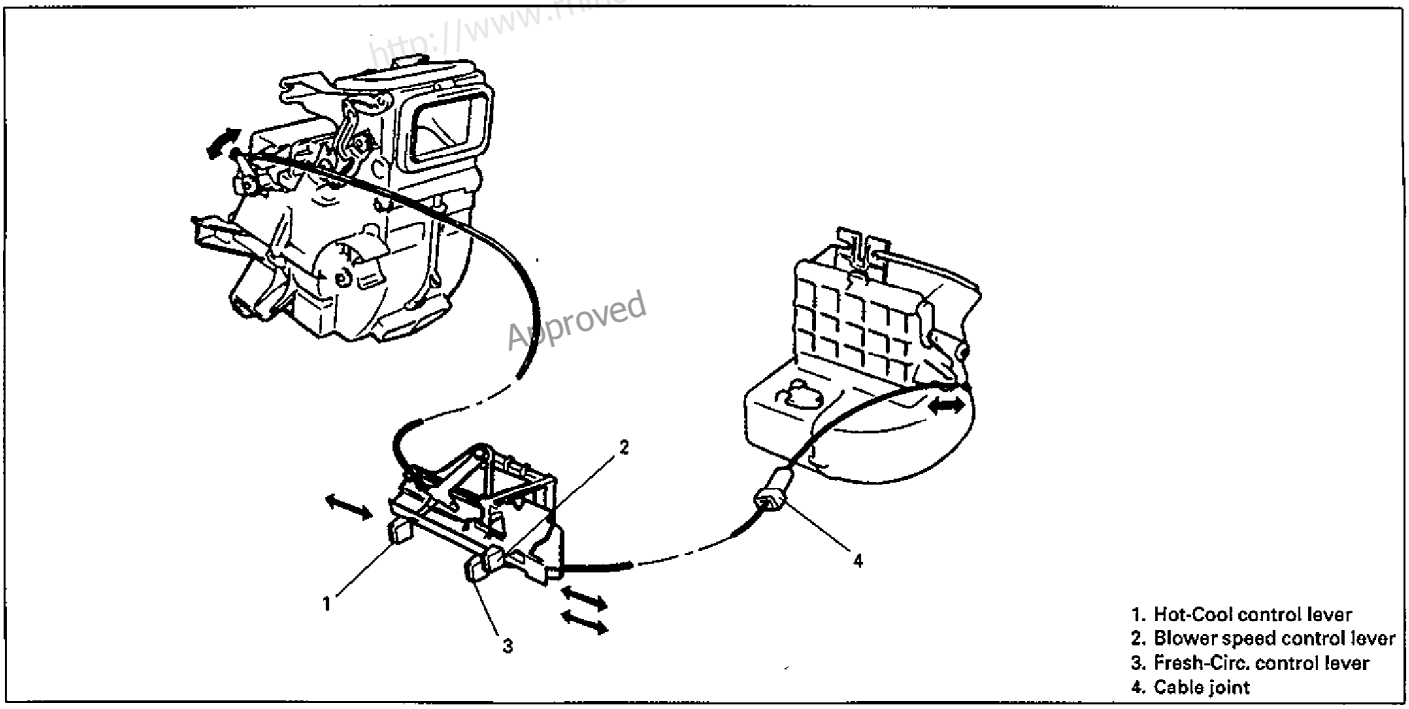
60A50-1A-10-2

INSTALLATION

1) Install in reverse order of removal.
2) If equipped with air bag, enable air bag system. Refer to "Enabling Air Bag System" in Section 9J.

60A50-1A-10-3

CONTROL CABLES



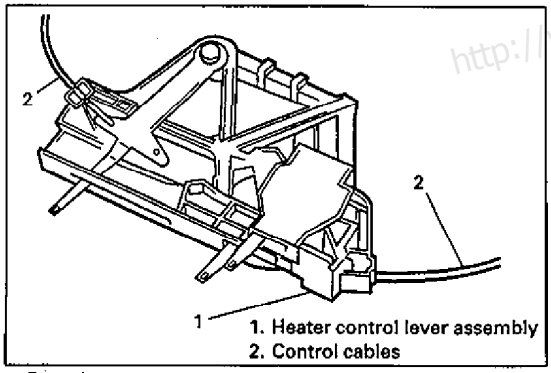
1. Hot-Cool control lever
2. Blower speed control lever
3. Fresh-Circ. control lever
4. Cable joint

85F00-1A-6-1

REMOVAL

1) Remove heater control lever assembly.
   Refer to "HEATER BLOWER MOTOR SWITCH" in this section.

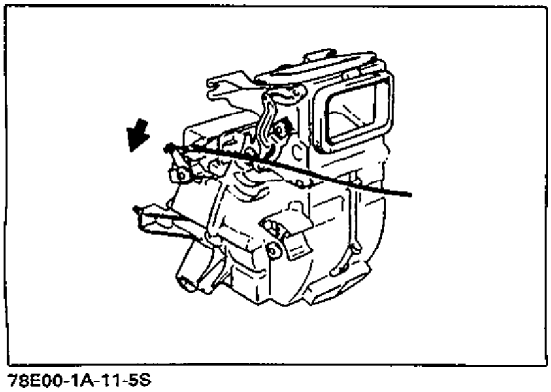
85F00-1A-6-3



1. Heater control lever assembly
2. Control cables

2) Disconnect control cables from control lever.

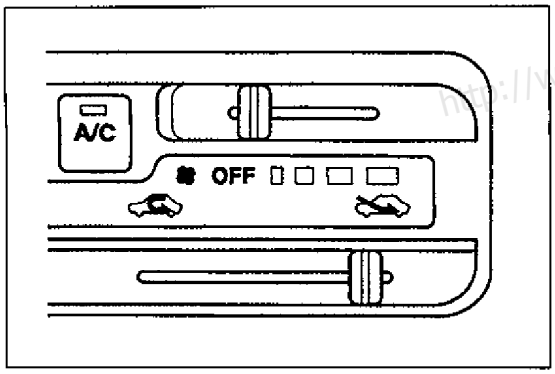
85F00-1A-6-4



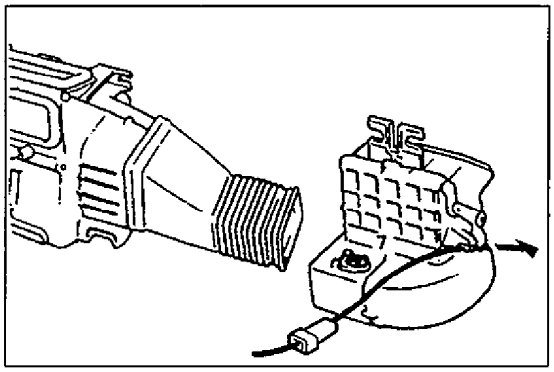
78E00-1A-11-5S

A. Heater Control (HOT-COOL Selector) Cable

1) Move control lever to COOL position.
2) Push lever fully in arrow direction to fix cable in position, as shown.



78E00-1A-12-1S



78E00-1A-12-2S

B. Fresh Air Control (FRESH-CIRC Selector) Cable

1) Move control lever to FRESH position.

2) Push lever fully in arrow direction and fix cable with clamp in position as shown in left figure.

SECTION 3C1

AIR BAG STEERING WHEEL AND COLUMN

WARNING:
The procedures in this section must be followed in the order listed to temporarily disable the Air Bag System and prevent false diagnostic codes from setting.
Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise un needed air bag system repairs.

CAUTION:
When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound, will be called out. The correct torque values must be used when installing fasteners that require them. If the above procedures are not followed, parts or system damage could result.

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

78E00-3C1-1-1S

CONTENTS

78E00-3C1-1-2S

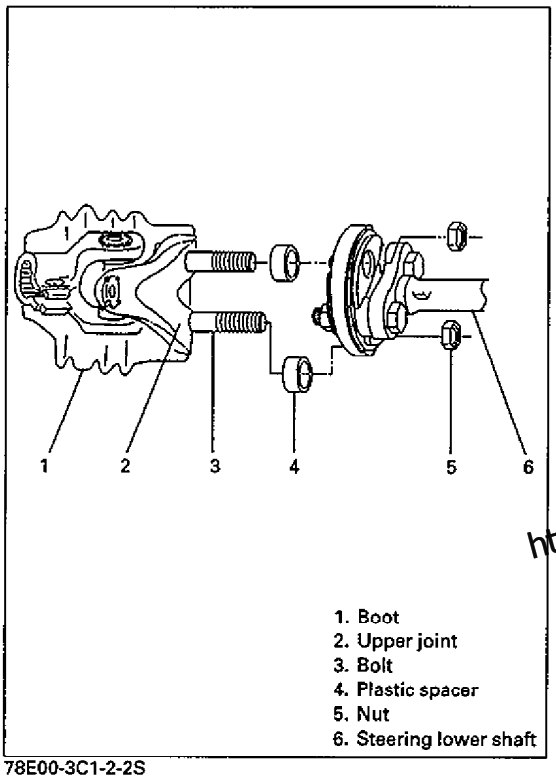
ON-VEHICLE SERVICE

STEERING LOWER SHAFT

REMOVAL, INSTALLATION AND INSPECTION

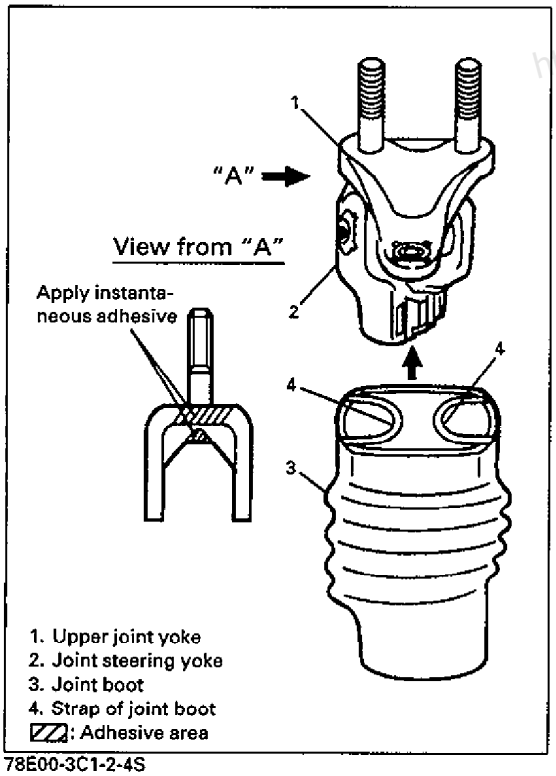
For removal, installation and inspection of steering lower shaft, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

78E00-3C1-2-1S



1. Boot
2. Upper joint
3. Bolt
4. Plastic spacer
5. Nut
6. Steering lower shaft

78E00-3C1-2-2S



1. Upper joint yoke
2. Joint steering yoke
3. Joint boot
4. Strap of joint boot

▨: Adhesive area

78E00-3C1-2-4S

DISASSEMBLY

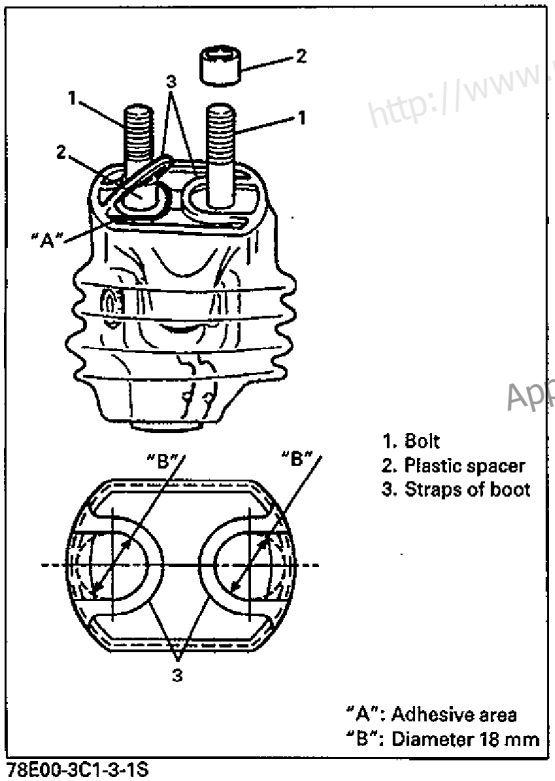
1) Remove joint nuts.
2) Remove upper joint with joint boots from lower shaft.
3) Remove plastic spacers.
4) Remove joint boot from upper joint. The upper joint boot is cemented to upper joint by instantaneous adhesive. If the paint is severely removed, add black painting.

REASSEMBLY

1) Install new joint boot to upper joint, aligning it in direction of joint steering yoke.
2) Adhere boot to both side surface of bolt flanges and to bolt heads with instantaneous adhesive as shown to prevent foreign material from entering.
3) Pull straps of joint boot and pass bolts through them.

CAUTION:
Be careful not to pull straps excessively. They will break.

NOTE:
Instantaneous adhesive must be for metal and rubber.



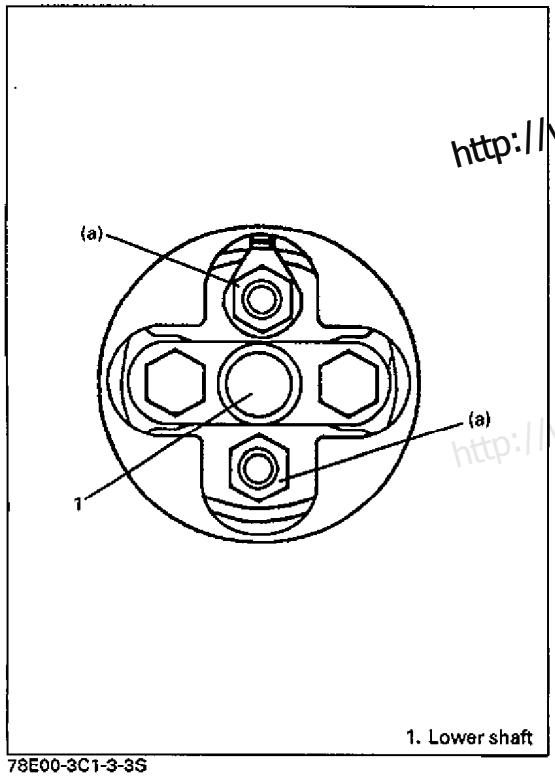
78E00-3C1-3-1S

4) Adhere straps of boot to upper joint with instantaneous adhesive as shown.

CAUTION:
Be sure to secure 18 mm for dimension "B" in figure. If not, strap of boot will get caught and cut between plastic spacer and upper joint yoke.

5) Install plastic spacers to bolts.
6) Install upper joint to lower shaft.

NOTE:
At this time, check to ensure that strap of boot is not caught between plastic spacer and upper joint yoke.



78E00-3C1-3-3S

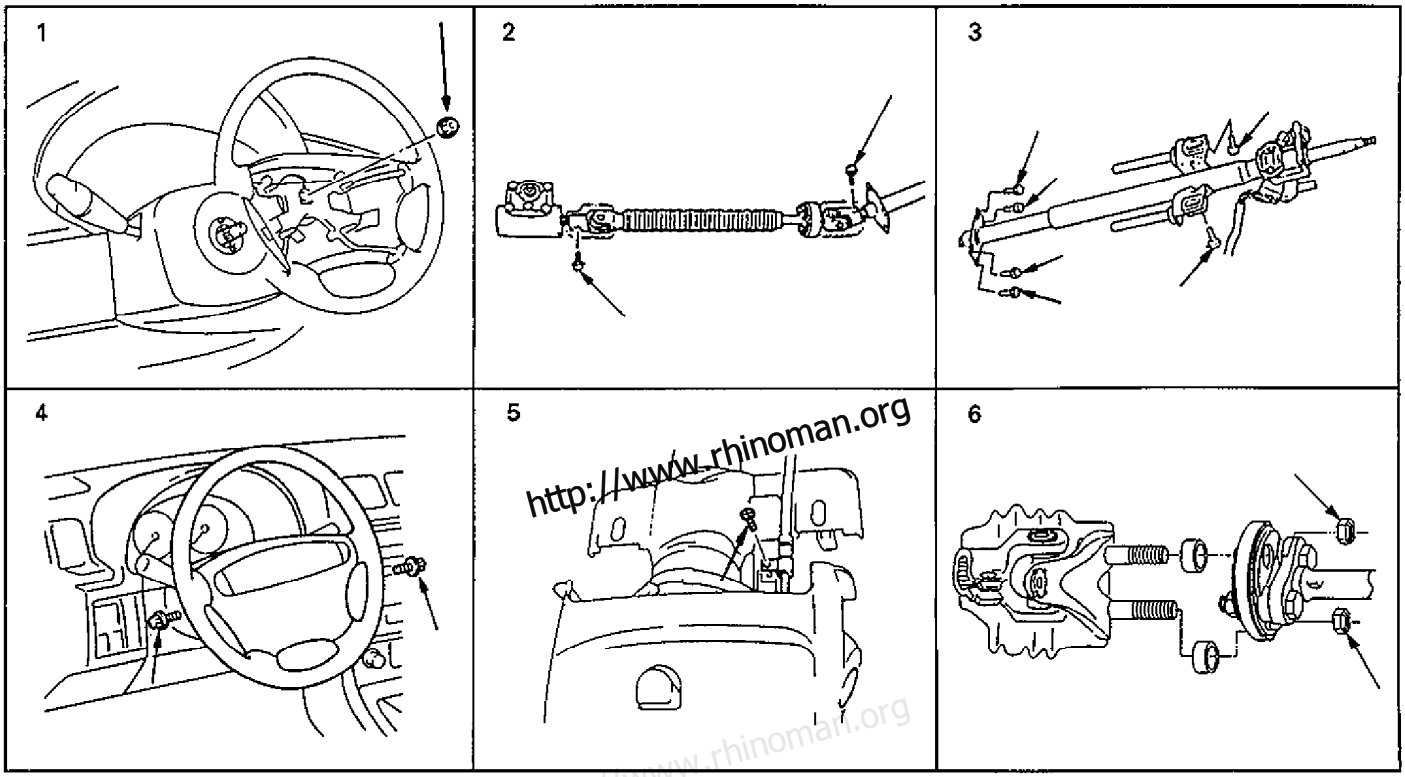
7) Tighten new joint nuts to specified torque.

Tightening Torque
(a): 27 N·m (2.7 kg-m, 19.5 lb-ft)

8) Make sure that horn operates properly upon completion of all service.

TIGHTENING TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
1. Steering shaft nut	33	3.3	23.5
2. Steering shaft joint bolts	25	2.5	18.0
3. Steering column bolts	23	2.3	17.0
4. Driver air bag (inflator) module bolts	23	2.3	17.0
5. Shift (key) interlock cable clamp screw	2.2	0.22	1.6
6. Upper joint nuts	27	2.7	19.5



78E00-3C1-4-1S

SECTION 3C2

STEERING WHEEL, COLUMN AND SHAFT (NOT EQUIPPED WITH AIR BAG)

NOTE:

- **For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**
- **All steering wheel and column fasteners are important parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**

85F00-3C2-1-1

CONTENTS

78E00-3C2-1-2S

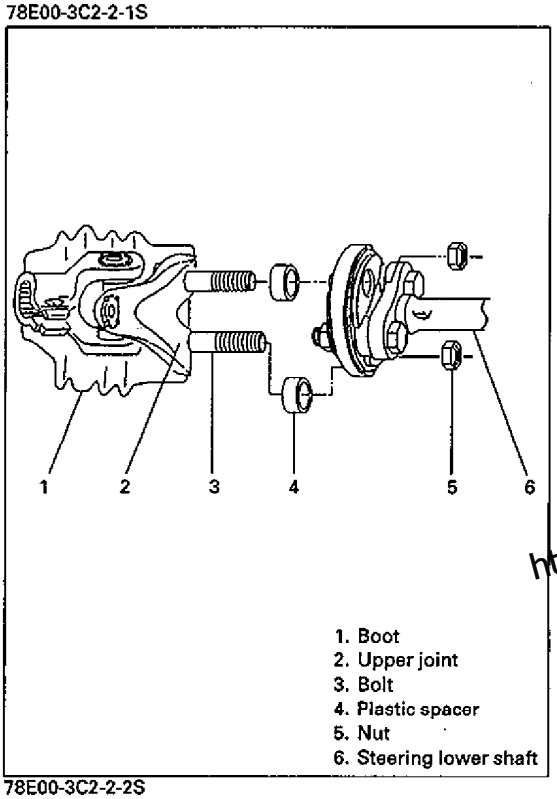
ON-VEHICLE SERVICE

STEERING LOWER SHAFT

REMOVAL, INSTALLATION AND INSPECTION

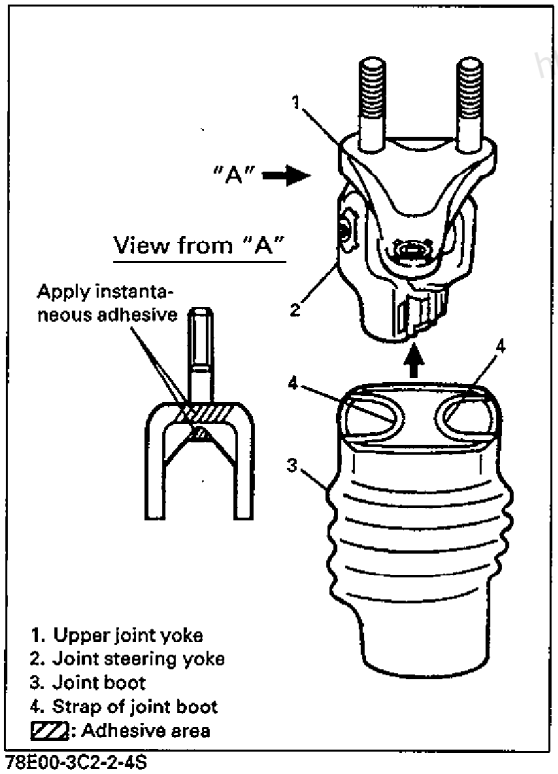
For removal, installation of steering lower shaft, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

78E00-3C2-2-1S



1. Boot
2. Upper joint
3. Bolt
4. Plastic spacer
5. Nut
6. Steering lower shaft

78E00-3C2-2-2S



1. Upper joint yoke
2. Joint steering yoke
3. Joint boot
4. Strap of joint boot

▨: Adhesive area

78E00-3C2-2-4S

DISASSEMBLY

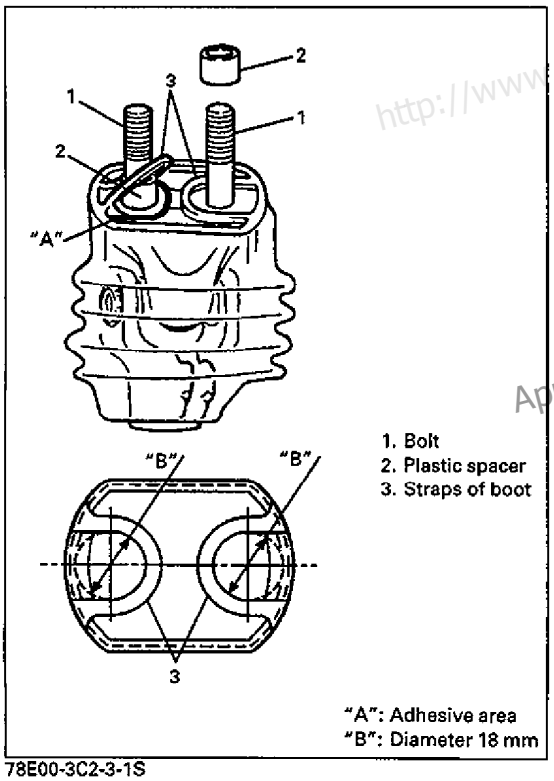
1) Remove joint nuts.
2) Remove upper joint with joint boots from lower shaft.
3) Remove plastic spacers.
4) Remove joint boot from upper joint. The upper joint boot is cemented to upper joint by instantaneous adhesive. If the paint is severely removed, add black painting.

REASSEMBLY

1) Install new joint boot to upper joint, aligning it in direction of joint steering yoke.
2) Adhere boot to both side surface of bolt flanges and to bolt heads with instantaneous adhesive as shown to prevent foreign material from entering.
3) Pull straps of joint boot and pass bolts through them.

CAUTION:
Be careful not to pull straps excessively. They will break.

NOTE:
Instantaneous adhesive must be for metal and rubber.



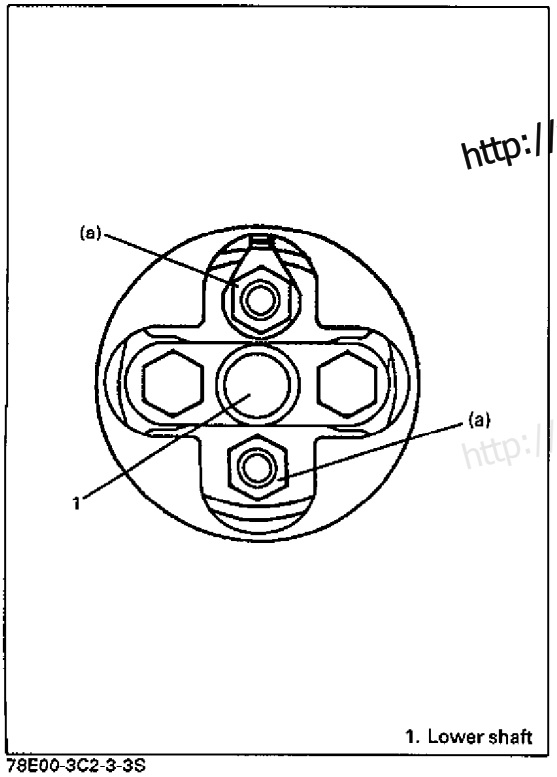
78E00-3C2-3-1S

4) Adhere straps of boot to upper joint with instantaneous adhesive as shown.

CAUTION:
Be sure to secure 18 mm for dimension "B" in figure. If not, strap of boot will get caught and cut between plastic spacer and upper joint yoke.

5) Install plastic spacers to bolts.
6) Install upper joint to lower shaft.

NOTE:
At this time, check to ensure that strap of boot is not caught between plastic spacer and upper joint yoke.



78E00-3C2-3-3S

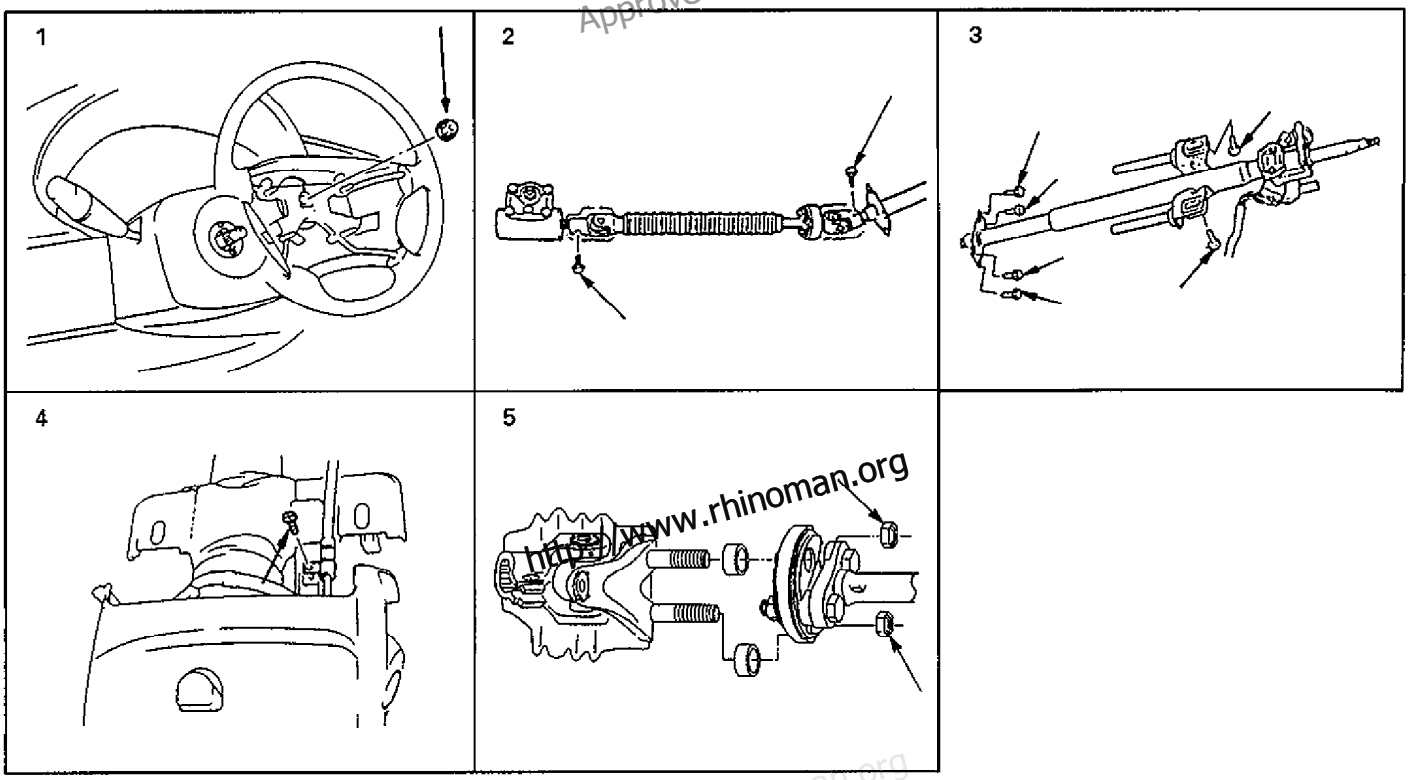
7) Tighten new joint nuts to specified torque.

Tightening Torque
(a): 27 N·m (2.7 kg-m, 19.5 lb-ft)

8) Make sure that horn operates properly upon completion of all service.

TIGHTENING TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
1. Steering shaft nut	33	3.3	23.5
2. Steering shaft joint bolts	25	2.5	18.0
3. Steering column bolts	23	2.3	17.0
4. Shift (key) interlock cable clamp screw	2.2	0.22	1.6
5. Upper joint nuts	27	2.7	19.5



78E00-3C2-4-1S

SECTION 3D

FRONT SUSPENSION

NOTE:

- **For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in Foreword of this manual.**
- **All front suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and / or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any front suspension part. Replace it with a new part or damage to the part may result.**

78E00-3D-1-1S

CONTENTS

78E00-3D-1-2S

FRONT FREE WHEELING HUB (IF EQUIPPED)

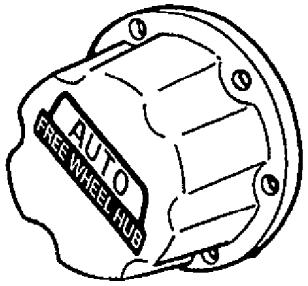
There are two types of the front free wheeling hub in this vehicle (if equipped). One is manual type and the other is automatic type.
As removal, installation and maintenance procedures vary between them, be sure to correct section applicable to each kind.

CAUTION:
- **Make sure that the same front free wheeling hub is installed for both right and left.**
- **For vehicle equipped with manual free wheeling hub, both of the right and left wheeling hub knobs must be set to the same position (either FREE or LOCK). Don't set one to "FREE" and the other to "LOCK" positions.**
- **Never disassemble free wheeling hub assembly. Disassembly will spoil its original function.**

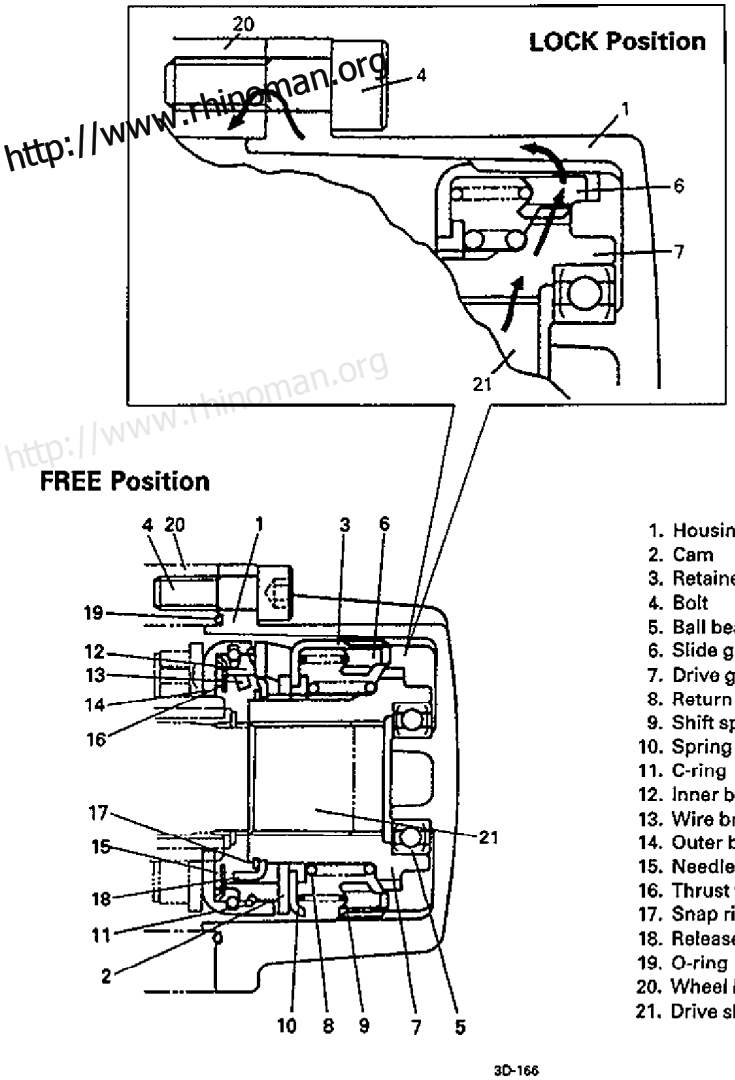
MANUAL FREE WHEELING HUB

Refer to the same section of the Service Manual mentioned in Foreword of this manual for operation, installation and maintenance.

AUTOMATIC FREE WHEELING HUB

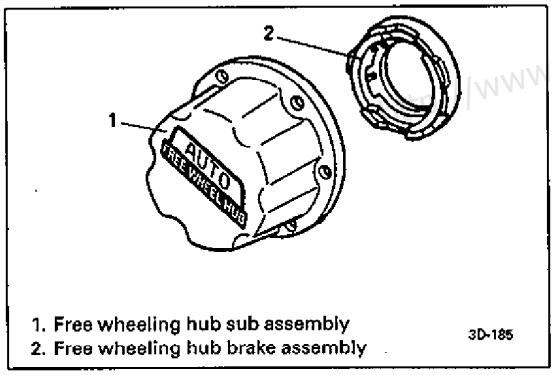


3D-165



1. Housing
2. Cam
3. Retainer
4. Bolt
5. Ball bearing
6. Slide gear
7. Drive gear
8. Return spring
9. Shift spring
10. Spring holder
11. C-ring
12. Inner brake
13. Wire brake
14. Outer brake
15. Needle bearing
16. Thrust washer
17. Snap ring
18. Release plate
19. O-ring
20. Wheel hub
21. Drive shaft

3D-166



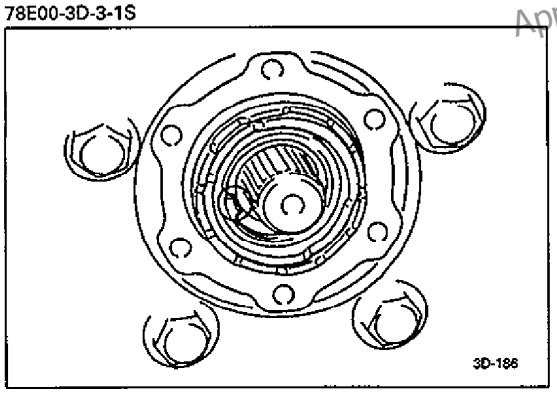
1. Free wheeling hub sub assembly
2. Free wheeling hub brake assembly

3D-185

78E00-3D-3-1S

REMOVAL

1) Set free wheeling hub to free condition. (Set transfer gear shift lever to 2H position, and move vehicle 2 m (6.5 ft) or more backward slowly.)
2) Hoist vehicle, if wheel (tire) removal is necessary.
3) Remove wheel (tire), if necessary.
4) Remove free wheeling hub (sub assembly and brake assembly) slowly.

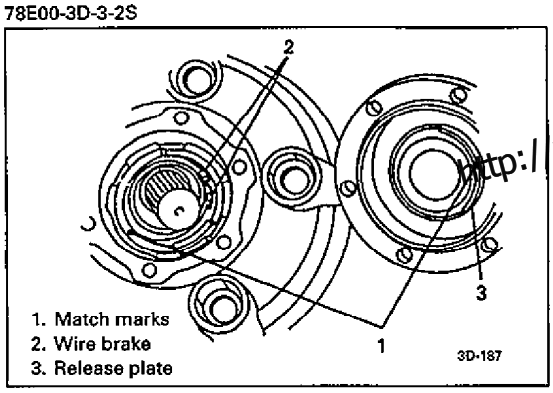


3D-186

78E00-3D-3-2S

INSTALLATION

1) Check O-ring for damage and clean mating surfaces of hubs.
2) Install free wheeling hub brake assembly to spindle aligning key of brake assembly with slot in spindle.



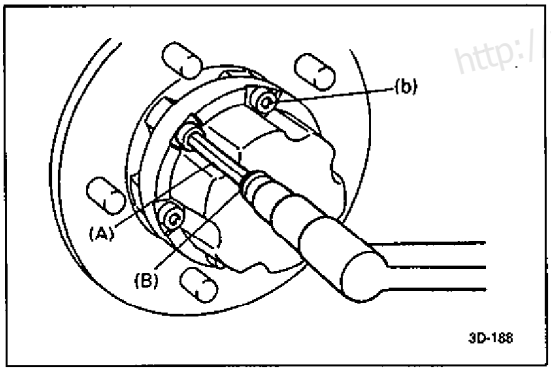
1. Match marks
2. Wire brake
3. Release plate

3D-187

78E00-3D-3-3S

3) Install free wheeling hub sub assembly to spindle aligning the match marks of brake assembly and sub assembly.

CAUTION:
Make sure that match marks are aligned. If they aren't, wire brake and release plate may interfere with each other, causing spring to break.



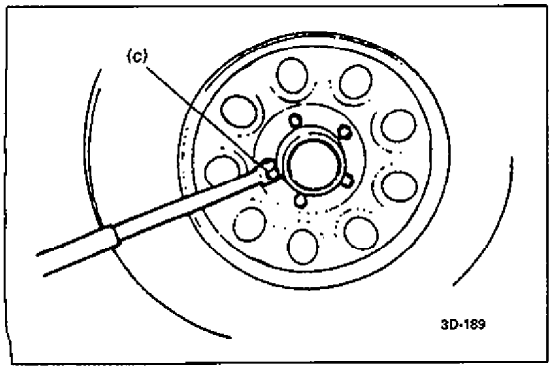
3D-188

78E00-3D-3-4S

4) Tighten hub bolts to specified torque.

Special Tool
(A): 09900-00414 (6 mm bit)
(B): 09900-00411 (Socket)

Tightening Torque
(b): 33 N·m (3.3 kg-m, 24 lb-ft)



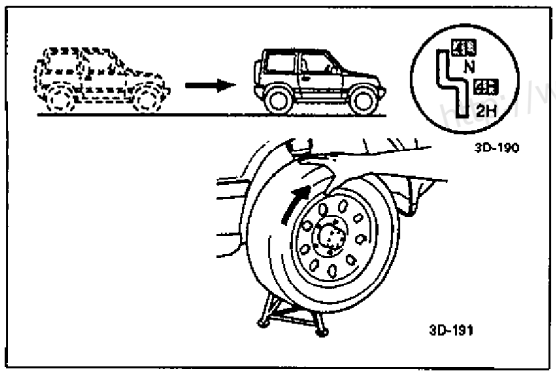
3D-189

78E00-3D-3-5S

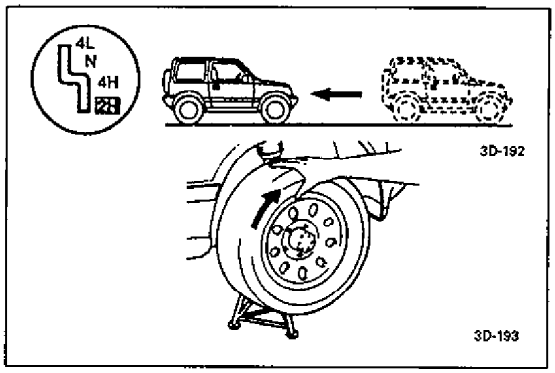
5) Install front wheels and tighten wheel nuts to specified torque, if removed.

Tightening Torque
(c): 95 N·m (9.5 kg-m, 69.0 lb-ft)

6) Dismount the vehicle from the lift, and be sure to carry out the operation check of free wheeling hub mentioned in the next item "Post-assembly confirmation".



78E00-3D-4-1S



78E00-3D-4-2S

Post-assembly confirmation

Confirm automatic free wheeling hub for proper operation in the sequence described below.

1) Set transfer gear shift lever to 4H or 4L position, and move vehicle 2 m (6.5 ft) or more forward slowly.
2) Hoist vehicle and check that wheel (tire) rotation is transmitted to drive shaft (lock condition) when rotating right wheel clockwise (left wheel counterclockwise) by hand.
3) Dismount vehicle from lift.
4) Set transfer gear shift lever to 2H position, and move vehicle 2 m (6.5 ft) or more backward slowly.
5) Hoist vehicle and check that wheel (tire) rotation is not transmitted to drive shaft (free condition) when rotating right wheel clockwise (left wheel counterclockwise) by hand.
6) Check to ensure that free wheeling hub locks and unlocks properly by reversing vehicle moving directions described in steps 1) and 4). (It should lock when moving backward and unlock when moving forward.)

If any malfunction is found as to the confirmation in the above steps 1) through 6), reinstall or replace free wheeling hub assembly.

78E00-3D-4-3S

MAINTENANCE SERVICE

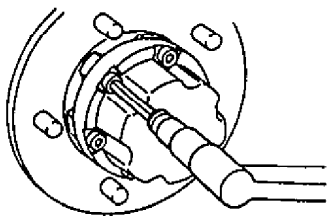
Confirm automatic free wheeling hub for proper operation periodically according to the procedure described previously in "Post-assembly confirmation". If automatic free wheeling hub shows any malfunction, replace it with new one.

78E00-3D-4-4S

TIGHTENING TORQUE SPECIFICATIONS

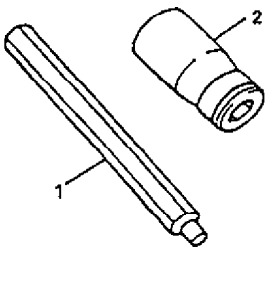
Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Automatic free wheeling hub bolts	33	3.3	24

Free wheeling hub bolts



78E00-3D-5-1S

SPECIAL TOOLS



1. 09900-00414
   Bearing installer handle
2. 09900-00411
   Hexagon wrench socket

78E00-3D-5-2S

SECTION 5B1

ANTILOCK BRAKE SYSTEM (ABS) (OPTIONAL)

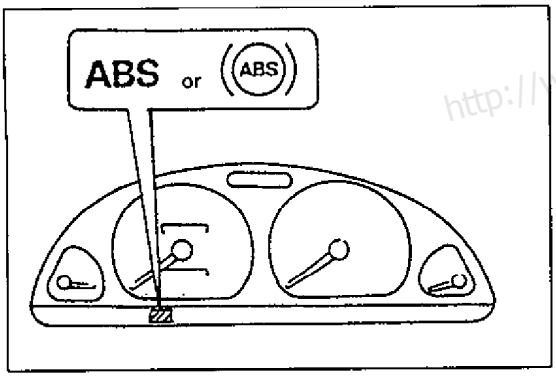
WARNING:
For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Component and Wiring Location view in Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

- **For the descriptions (items) not found in this section, refer to the same section of Service Manual mentioned in FOREWORD of this manual.**
- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**

CONTENTS



61A10-5B1-18-1

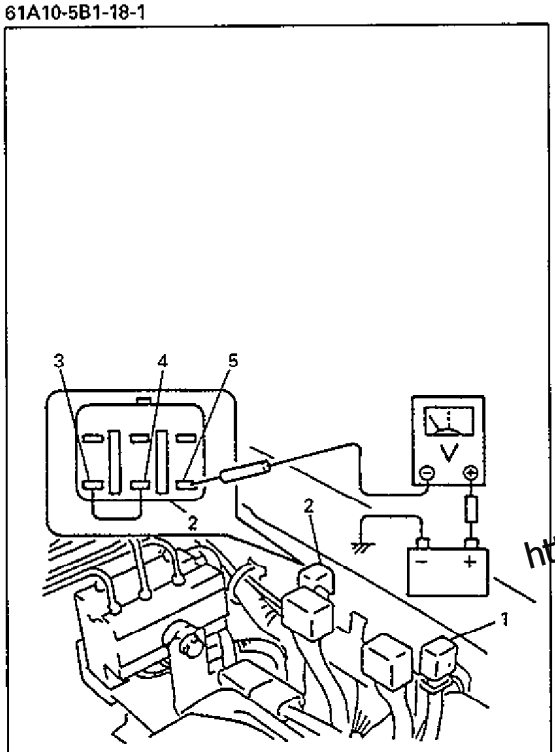
DIAGNOSIS

"ABS" WARNING LAMP CHECK

Turn ON the ignition switch and check that "ABS" warning lamp lights for about 2 seconds and then goes OFF.
If "ABS" warning lamp doesn't go OFF, advance to Diagnostic flow chart – A, B or C.

DIAGNOSTIC TROUBLE CODE (DTC) CHECK (USING ANALOG TYPE VOLTMETER AND/OR "ABS" WARNING LAMP)

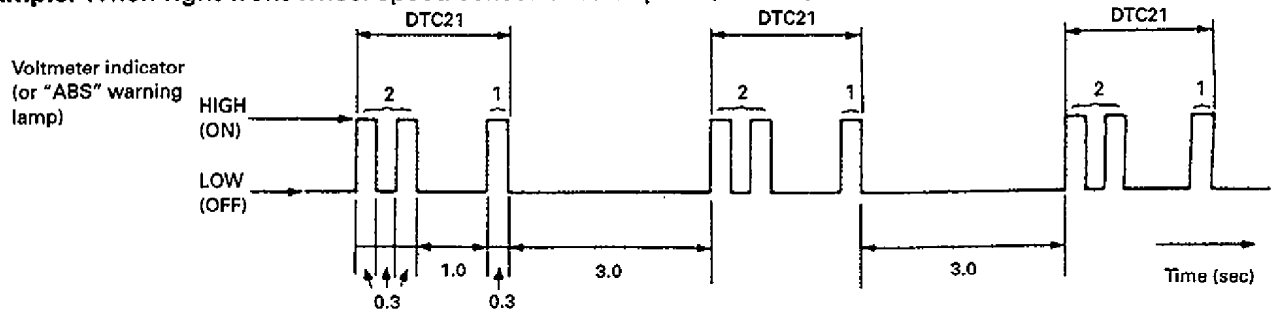
1) Using service wire, connect diag. switch terminal of DIAG-2 connector to ground.
2) For using analog type voltmeter:
   Connect positive probe of analog type voltmeter to positive terminal of battery and negative probe to diag. output terminal of DIAG-2 connector.
3) Turn ignition switch ON.
4) Drive vehicle between 6.5 and 12.5 mile/h (10 – 20 km/h) and then stop vehicle while engine running.
5) Read deflection of voltmeter indicator or frashing of "ABS" warning lamp which represents DTC as shown in example below and write it down. When more than 2 DTC's are stored in memory, deflection and flashing for each DTC is repeated three times starting with the smallest DTC number in increasing order.
   For details of DTC, refer to "DTC Table".
   If no DTC output is available (signal in voltage change is not output from diag. output terminal), check according to Diag. Flow Chart-D.



1. DIAG-1 connector
2. DIAG-2 connector (Black connector)
3. Ground terminal
4. Diag. switch terminal
5. Diag. output terminal

78E00-5B1-2-2S

Example: When right-front wheel speed sensor circuit opens (DTC 21)



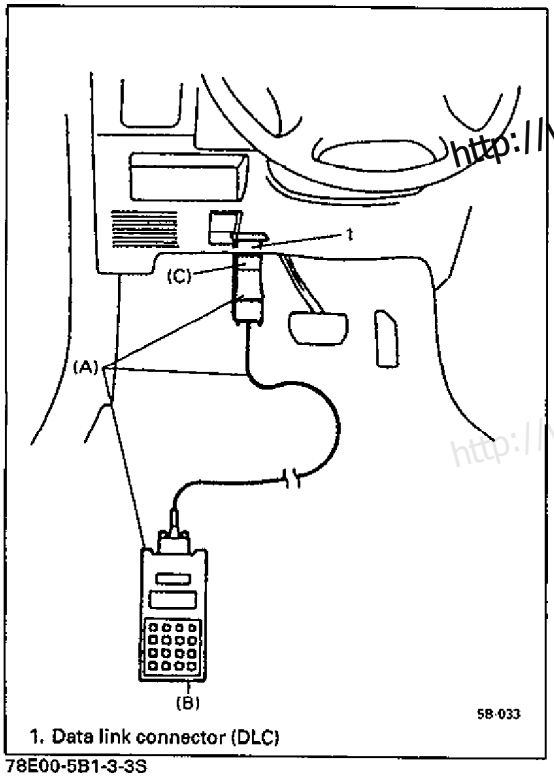
78E00-5B1-2-5S

NOTE:

- **"ABS" warning lamp indicates only following DTC's, DTC 12 which means that no malfunction DTC is stored and history DTC which indicates history trouble area. When there is a current trouble, "ABS" warning lamp remains ON and therefore DTC is not indicated.**
- **When the voltmeter indicates DTC as described in previous page, it indicates all current and history DTC's.**

6) After completing the check, turn ignition switch off and disconnect service wire from DIAG. connector.

78E00-5B1-3-1S



1. Data link connector (DLC)

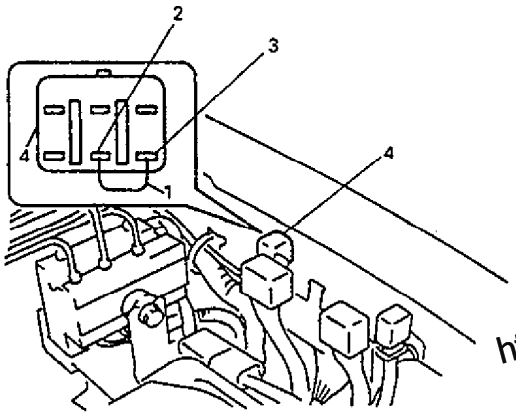
78E00-5B1-3-3S

DTC CHECK (USING SCAN TOOL, TECH-1)

1) After setting cartridge for ABS to Tech-1, connect Tech-1 to data link connector.

Special Tool
(A): 09931-76011 (Tech-1, scan tool)
(B): 09932-66020-001 (Cartridge for ABS, English)
09932-66020-003 (Cartridge for ABS, German)
09932-66020-004 (Cartridge for ABS, French)
(C): 09931-96020 (16/12 pin DLC adapter)

2) Turn ignition switch ON.
3) Drive vehicle between 6.5 and 12.5 mile/h (10 – 20 km/h) and then stop vehicle while engine running.
4) Read DTC according to instructions displayed on Tech-1 and print it or write it down. Refer to Tech-1 operator's manual for further details.
5) After completing the check, turn ignition switch off and disconnect Tech-1 from DLC.



1. Service wire
2. Diag. switch terminal
3. Diag. output terminal
4. DIAG-2 connector (Black connector)

DIAGNOSTIC TROUBLE CODE (DTC) CLEARANCE

WARNING:
- **When performing a road test, select a safe place where there is neither any traffic nor any traffic accident possibility and be very careful during testing to avoid occurence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road to avoid accident.**

After repair or replace malfunction part(s), clear all DTC's by performing described procedure below.

1) Drive vehicle between 6.5 and 12.5 mile/h (10 – 20 km/h).
2) Stop vehicle and turn ignition switch OFF.
3) Does "ABS" warning lamp go off 2 seconds after ignition switch is turned ON again?

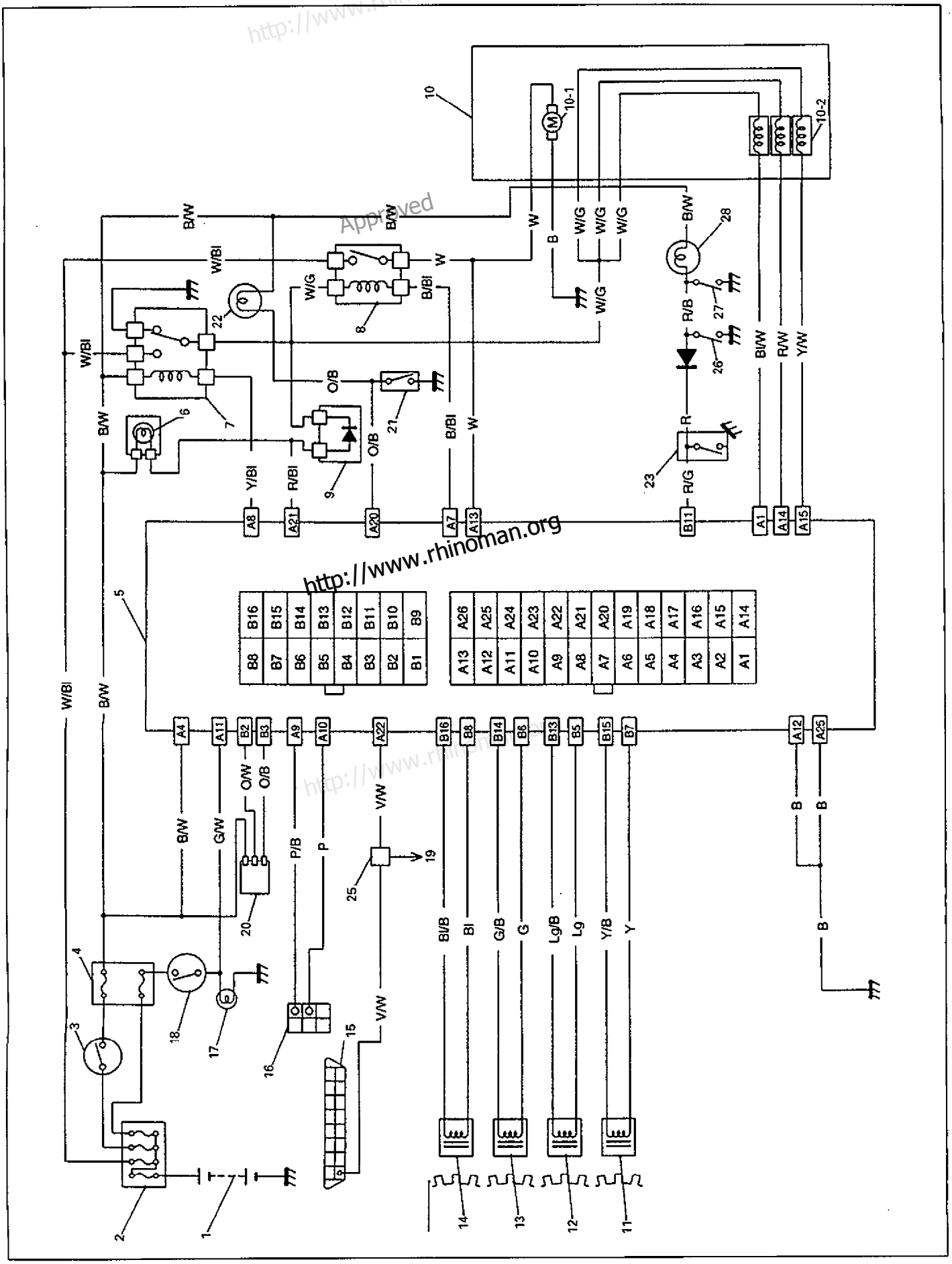
NO → Repair or replace malfunction part.

YES →

1) Turn ignition switch OFF.
2) Using service wire, connect diag. switch terminal of DIAG-2 connector to diag. output terminal.
3) With connection described in above 2) maintained, turn ignition switch ON and leave it as it is for longer than 10 seconds.
4) Turn ignition switch OFF and disconnect service wire from DIAG-2 connector.
5) Perform "Diagnostic Trouble Code (DTC) check" and confirm that normal DTC (DTC 12) is displayed and not malfunction DTC.

NOTE:
DTC can be cleared by using Tech-1, too. For procedure refer to Cartridge Manual.

SYSTEM CIRCUIT

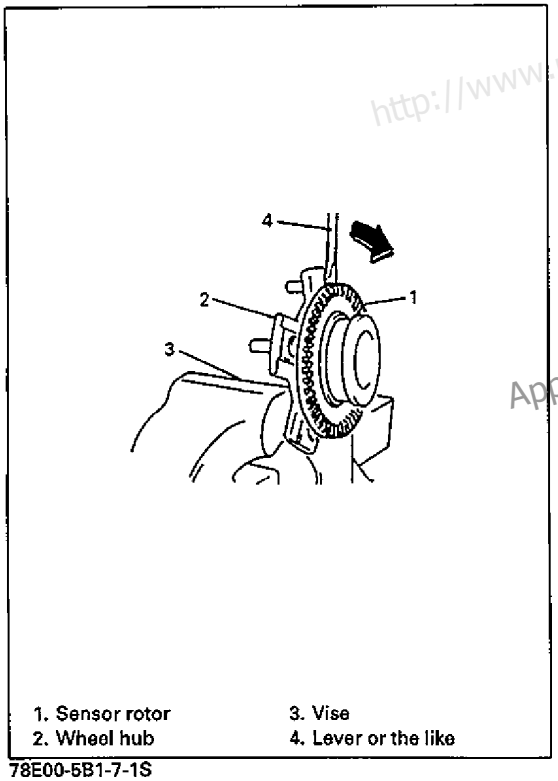


1. Battery
2. Main fuses
3. Ignition switch
4. Circuit fuses
5. ABS control module
5-1. Terminal arrangement for ABS control module
6. "ABS" warning lamp
7. ABS fail-safe relay (Solenoid valve relay)
8. ABS pump motor relay
9. Diode
10. ABS hydraulic unit
10-1. Pump motor
10-2. Solenoid valves
11. Right-rear wheel speed sensor
12. Left-rear wheel speed sensor
13. Right-front wheel speed sensor
14. Left-front wheel speed sensor
15. Data link connector
16. Diagnosis-2 connector (DIAG-2)
17. Stop lamp
18. Stop lamp switch
19. To ECM, TCM and SDM (if equipped)
20. G sensor
21. 4WD switch
22. 4WD indicator lamp
23. Differential switch
24. Blank
25. Connector
26. Parking brake switch
27. Brake fluid level switch
28. Brake warning (parking) light

Wire color

B : Black
B/W : Black/White
Bl : Blue
Bl/B : Blue/Black
Bl/W: Blue/White
G : Green
G/B : Green/Black
G/W : Green/White
Lg : Lightgreen
Lg/B: Lightgreen/Black
O/B : Orange/Black
O/W : Orange/White
P : Pink
P/B : Pink/Black
R/Bl : Red/Blue
R/G : Red/Green
R/W : Red/White
V/W : Violet/White
W : White
W/Bl: White/Blue
W/G : White/Green
Y : Yellow
Y/B : Yellow/Black
Y/Bl : Yellow/Blue

TERMINAL	CIRCUIT	TERMINAL	CIRCUIT
A1	Left-front solenoid valve	A23	———
A2	———	A24	———
A3	———	A25	Ground
A4	Ignition switch	A26	———
A5	———		
A6	———	B1	———
A7	ABS pump motor relay	B2	G sensor signal
A8	ABS fail-safe relay	B3	G sensor ground
A9	Diagnosis switch terminal	B4	———
A10	Diagnosis output terminal	B5	Left-rear wheel speed sensor (–)
A11	Stop lamp switch	B6	Right-front wheel speed sensor (–)
A12	Ground	B7	Right-rear wheel speed sensor (–)
A13	Motor voltage monitor	B8	Left-front wheel speed sensor (–)
A14	Right-front solenoid valve	B9	———
A15	Rear solenoid valve	B10	———
A16	———	B11	Differential switch
A17	———	B12	———
A18	———	B13	Left-rear wheel speed sensor (+)
A19	———	B14	Right-front wheel speed sensor (+)
A20	4WD switch	B15	Right-rear wheel speed sensor (+)
A21	"ABS" warning lamp	B16	Left-front wheel speed sensor (+)
A22	Data link connector		



1. Sensor rotor
2. Wheel hub
3. Vise
4. Lever or the like

78E00-5B1-7-1S

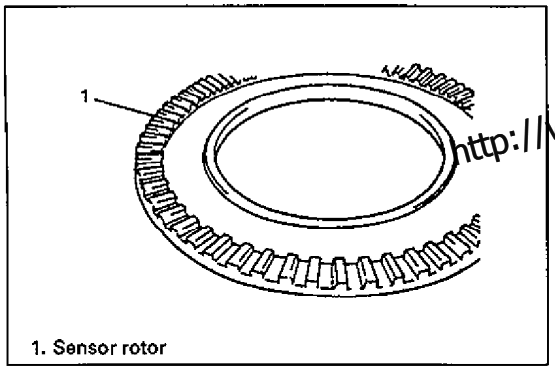
ON-VEHICLE SERVICE

FRONT SENSOR ROTOR

REMOVAL

1) Remove wheel hub with sensor rotor. Refer to SECTION 3D FRONT SUSPENSION of service manual mentioned in FOREWORD of this manual.
2) Remove sensor rotor from wheel hub as shown.

CAUTION:
Pull out sensor rotor from wheel hub gradually and evenly.
Attempt to pull it out partially may cause it to be deformed.



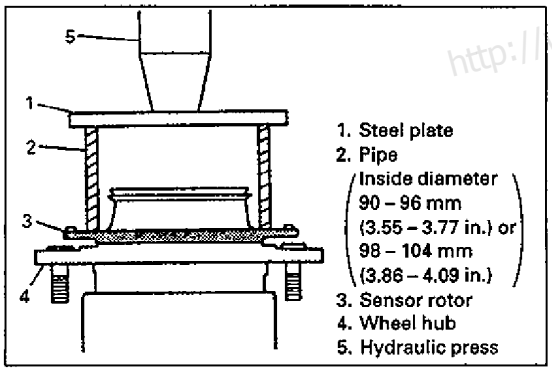
1. Sensor rotor

61A10-5B1-56-2

INSPECTION

- Check rotor serration (teeth) for being missing, damaged or deformed.
- Check sensor rotor for being deformed (warped).
- Check that no foreign material is attached.

If any faulty is found, repair or replace.



1. Steel plate
2. Pipe (Inside diameter 90 – 96 mm (3.55 – 3.77 in.) or 98 – 104 mm (3.86 – 4.09 in.))
3. Sensor rotor
4. Wheel hub
5. Hydraulic press

78E00-5B1-7-4S

INSTALLATION

1) Install sensor rotor as shown.

NOTE:

- **There are two types of sensor rotor. Pipe inner diameter should be as shown below. Outside of the pipe should not contact teeth of sensor rotor.**

Inner diameter of sensor rotor	Inner diameter of pipe
90 mm (3.55 in.)	90 mm – 96 mm (3.55 – 3.77 in.)
98 mm (3.77 in.)	98 mm – 104 mm (3.86 – 4.09 in.)

- **Use care not to insert wheel hub diagonally.**

2) Install wheel hub, brake disc, brake caliper, locking hub and wheel.
Refer to SECTION 3D FRONT SUSPENTION of service manual mentioned in FOREWORD of this manual.

SECTION 6

ENGINE

WARNING:
For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Component and Wiring Location view in Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

6

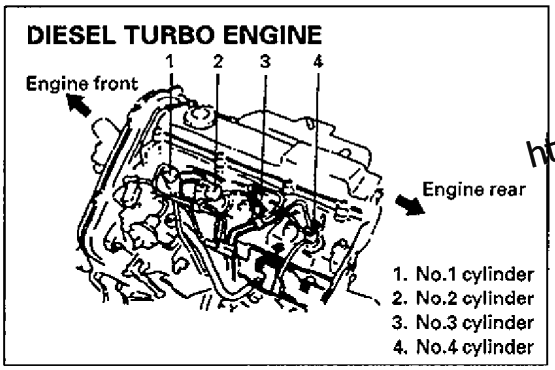
CONTENTS

GENERAL INFORMATION

STATEMENT OF CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of a millimeter (ten thousands of an inch). Accordingly, when any internal engine parts are serviced, care and cleanliness are important. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
  At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.



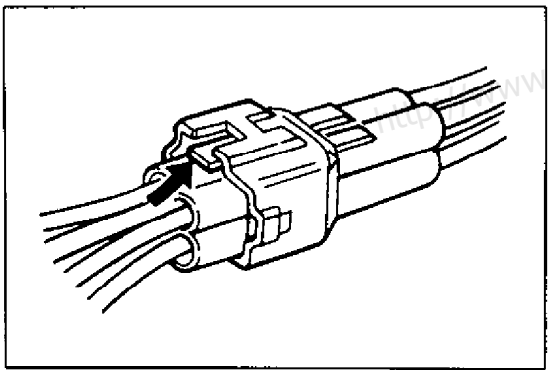
78E00-6-2-3

- Throughout this manual, the four cylinders of the engine are identified by numbers; No.1, No.2, No.3 and No.4 as counted from crankshaft pulley side to flywheel side.

GENERAL INFORMATION ON ENGINE SERVICE

FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE, AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, air intake pipe, throttle body or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.

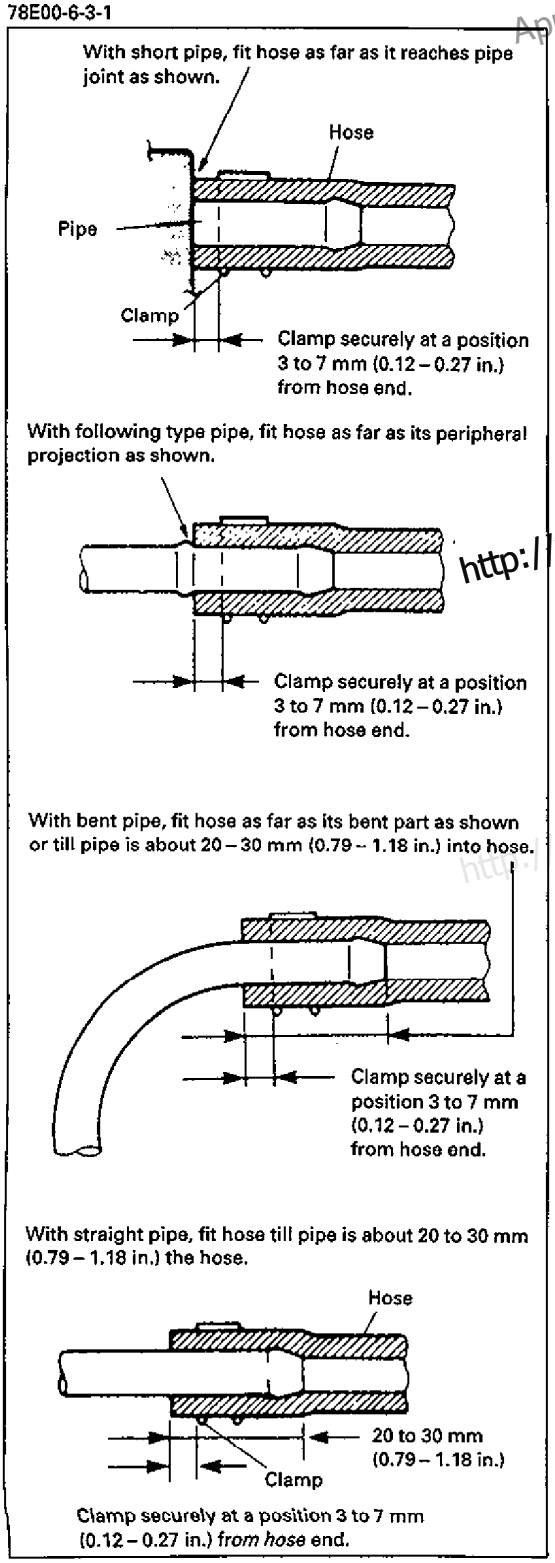


78E00-6-3-1

- When disconnecting couplers, don't pull wire harness but make sure to hold coupler itself. With lock type coupler, be sure to unlock before disconnection.
  Attempt to disconnect coupler without unlocking may result in damage to coupler.
  When connecting lock type coupler, insert it till clicking sound is heard and connect it securely.

PRECAUTION ON FUEL SYSTEM SERVICE

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel injection pump and fuel pipe) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.
  A small amount of fuel may be released after fuel line is disconnected.
  In order to reduce the chance of personal injury, cover fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Never run engine with fuel pump relay disconnected when engine and exhaust system are hot.
- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to figure "Hose Connection".
  After connecting, make sure that it has no twist or kink.
- When installing fuel filter union bolt or plug bolt on union bolt, always use new gasket and tighten it to specified torque. See Section 6E4 for specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O-ring with spindle oil or fuel.



78E00-6-3-2

ENGINE DIAGNOSIS

Condition	Possible Cause	Correction
Hard starting (Engine cranks OK)	**Fuel system out of order.**	
	• Lack of fuel in fuel tank	Refill.
	• Dirty fuel filter	Replace.
	• Dirty or clogged fuel hose or pipe	Clean.
	Engine and Emission control system out of order.	Refer to SECTION 6E4.
	Low compression.	
	• Incorrect valve lash	Adjust.
	• Compression leak from valve seat	Remove cylinder head and lap valves.
	• Sticky valve stem	Correct or replace valve and valve guide.
	• Weak or damaged valve springs	Replace valve springs.
	• Compression leak at cylinder head gasket	Repair or replace.
	• Sticking or damaged piston ring	Replace piston rings.
	• Worn piston, ring or cylinder	Replace ring and piston. Rebore or replace cylinder.
	Immobilizer control system out of order.	Refer to SECTION 8A.
	Others	
	• Broken valve timing belt	Replace timing belt and repair valve train.
Improper engine idling or engine fails to idle	**Fuel system out of order.**	
	• Shortage of fuel in fuel tank	Refill.
	• Clogged air cleaner element	Clean or replace.
	Engine overheating.	Refer to "Overheating" section.
	Engine and Emission control system out of order.	Refer to SECTION 6E4.
	Low compression	Previously outlined.
Engine hesitates when accelerating	**Fuel system out of order.**	
	• Clogged air cleaner element	Clean or replace.
	• Clogged fuel filter hose or pipe	Clean or replace.
	Engine overheating.	Refer to "Overheating" section.
	Engine and Emission control system out of order.	Refer to SECTION 6E4.
	Low compression	Previously outlined.
Overheating	• Insufficient coolant	Replenish.
	• Loose water pump belt	Adjust.
	• Inoperative thermostat	Replace.
	• Poor water pump performance	Replace.
	• Clogged or leaky radiator	Flush, repair or replace.
	• Improper engine oil grade	Replace with proper grade oil.
	• Clogged oil filter or oil strainer	Replace or clean (oil strainer).
	• Not enough oil	Replenish.
	• Poor oil pump performance	Repair or replace.
	• Oil leakage	Repair.
	• Dragging brakes	Repair or replace.
	• Blown cylinder head gasket	Replace.
Excessive fuel consumption	**Fuel system out of order.**	
	• Fuel leakage from fuel tank and lines	Repair or replace.
	Engine and Emission control system out of order.	Refer to SECTION 6E4.
	Low compression	Previously outlined.
	Others	
	• Poor valve seating	Repair or replace.
	• Dragging brakes	Repair or replace.
	• Thermostat out of order	Replace.
	• Improper tire pressure	Adjust.

Condition	Possible Cause	Correction
Excessive engine oil consumption	**Oil leakage**	
	• Loose oil drain plug	Tighten.
	• Loose oil pan bolts	Tighten.
	• Deteriorated or broken oil pan sealant	Replace sealant.
	• Leaky crankshaft oil seals	Replace.
	• Leaky cylinder head cover gasket	Replace.
	• Improper tightening of oil filter	Tighten.
	• Loose oil pressure switch	Tighten.
	• Blown cylinder head gasket	Replace.
	• Leaky camshaft oil seals	Replace.
	Oil entering combustion chamber	
	• Sticky piston ring	Remove carbon and replace rings.
	• Worn piston and cylinder	Replace or rebore cylinder, and replace piston.
	• Worn piston ring groove and ring	Replace piston and ring.
	• Improper location of piston ring gap	Reposition ring gap.
	• Worn or damaged valve stem seal	Replace.
	• Worn valve stem	Replace.
Low oil pressure	• Improper oil viscosity	Use oil of proper viscosity.
	• Malfunctioning oil pressure switch	Replace.
	• Not enough oil	Replenish.
	• Clogged oil strainer	Clean.
	• Functional deterioration of oil pump	Replace.
	• Worn oil pump relief valve	Replace.
	• Excessive clearance in various sliding parts	Replace worn parts.
Engine noise Note: Before checking mechanical noise, make sure that: • Injection timing is properly adjusted. • Specified fuel is used.	**Valve noise**	
	• Improper valve lash	Adjust.
	• Worn valve stem and guide	Replace.
	• Weak or broken valve spring	Replace.
	• Warped or bent valve	Replace.
	Piston, ring and cylinder noise.	
	• Worn piston, ring and cylinder bore	Rebore or replace cylinder. Replace piston and ring.
	Connecting rod noise.	
	• Worn rod bearing	Replace.
	• Worn crank pin	Repair by grinding or replace crankshaft.
	• Loose connecting rod nuts	Tighten nuts to specification.
	• Low oil pressure	Previously outlined.
	Crankshaft noise.	
	• Low oil pressure	Previously outlined.
	• Worn bearing	Replace.
	• Worn crankshaft journal	Repair by grinding, or replace crankshaft.
	• Loose bearing cap bolts	Tighten bolts to specification.
	• Excessive crankshaft thrust play	Replace thrust bearing.
	Engine and Emission control system out of order	Refer to SECTION 6E4.

SECTION 6A3

ENGINE MECHANICAL

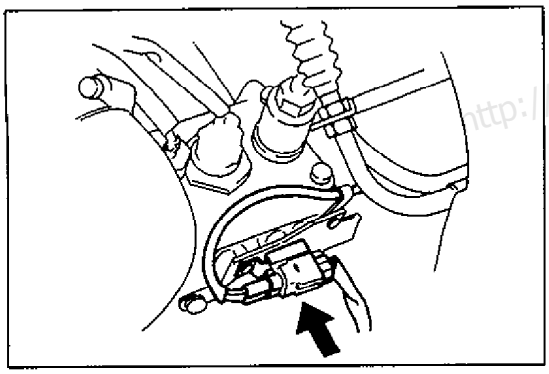
WARNING:
For vehicles euipped with a Supplemental Inflatable Restraint Air Bag System:

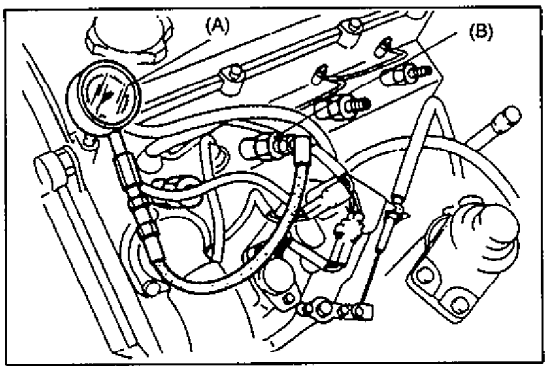
- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Components and Wiring Location view in Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

6A3

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

CONTENTS





ON-VEHICLE SERVICE

COMPRESSION CHECK

1) Warm up engine.
2) Stop engine after warming up.
3) Disconnect magnetic spill valve connector.
4) Remove intercooler.
5) Remove all fuel injection pipes, nozzles, washers and corrugate washers.
6) Install special tool to injection nozzle hole.

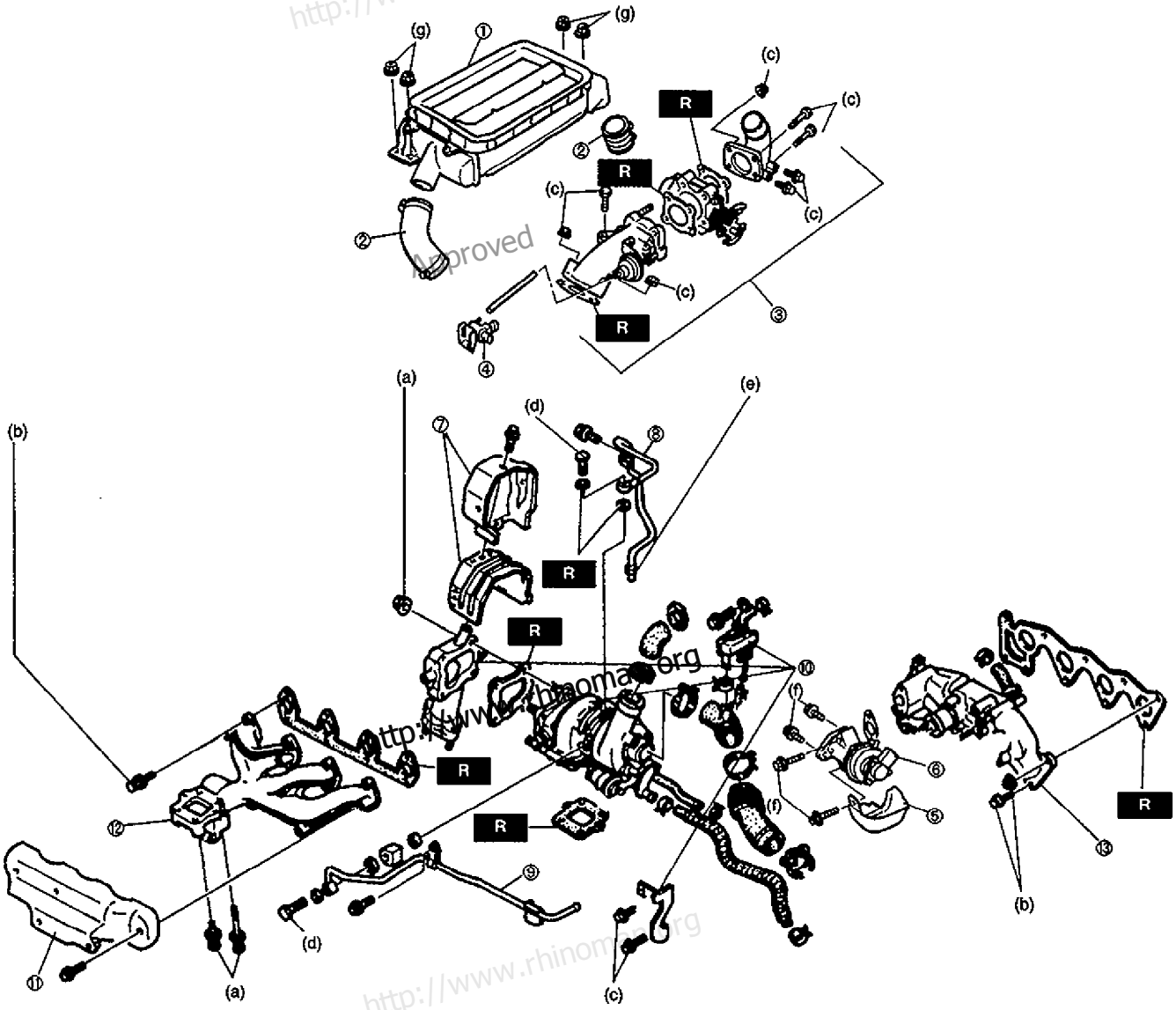
Special Tool
(A): 09912–57820
(B): 09912–57830

7) Crank engine and inspect compression pressure.

Compression pressure specification:
Standard: 3.0 MPa (30 kg/cm^2, 427 psi)–200 rpm
Minimum: 2.7 MPa (27 kg/cm^2, 348 psi)–200 rpm
Maximum difference between cylinders:
0.30 MPa (3.0 kg/cm^2, 43 psi)

8) Check each cylinder as above.
9) If compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder and recheck compression.
   (1) If compression increases, piston, piston rings or cylinder wall may be worn.
   (2) If compression stays low, valve may be stuck or seating improperly.
   (3) If compression in adjacent cylinders stays low, cylinder head gasket may be damaged or cylinder head distorted.
10) Removal special tool and install all fuel injection pipes, nozzles, washers and corrugate washers.
11) Install intercooler.
12) Connect magnetic spill valve connector.

INTAKE AND EXHAUST SYSTEM



① Intercooler
② Air hose
③ Air intake pipe, water hose and throttle body
④ Intake shutter solenoid valve
⑤ EGR cover
⑥ EGR valve
⑦ Turbocharger cover
⑧ Turbocharger pipe
⑨ Turbocharger pipe
⑩ Turbocharger assembly
⑪ Exhaust manifold cover
⑫ Exhaust manifold
⑬ Intake manifold

(a); 24 N·m (2.5 kg-m, 18 lb-ft)
(b): 26 N·m (2.6 kg-m, 18.8 lb-ft)
(c): 22 N·m (2.3 kg-m, 17 lb-ft)
(d): 30 N·m (3.0 kg-m, 22 lb-ft)
(e): 15 N·m (1.5 kg-m, 11 lb-ft)
(f): 19 N·m (1.9 kg-m, 13.7 lb-ft)
(g): 9 N·m (0.9 kg-m, 6.5 lb-ft)

R : Replace

REMOVAL

1) Remove battery and battery heat protector (left hand steering only).
2) Remove in order shown in figure above.

INSTALLATION

For installation, reverse removal procedure.

Be careful of following points after turbocharger removal.

- Do not hold actuator rod or hose when carrying turbocharger.
- Cover turbochager air inlet/outlet, exhaust inlet/outlet to prevent dirt or other material from entering.
- Use specified new studs when installing turbocharger.
- Idle engine for over 10 sec. after it is started.
  Rapid increase in engine speed can damage metal part of the turbocharger.
- Because turbocharger rotates at high speed and high temperature, do not allow foreign material from entering the oil line and deformation of the oil pipe.
- Avoid sudden engine racing and acceleration just after the engine is started or when vehicle has not been driven for extended period.

TURBOCHARGER OPERATION CHECK

Refer to section 6E4.

WASTEGATE VALVE

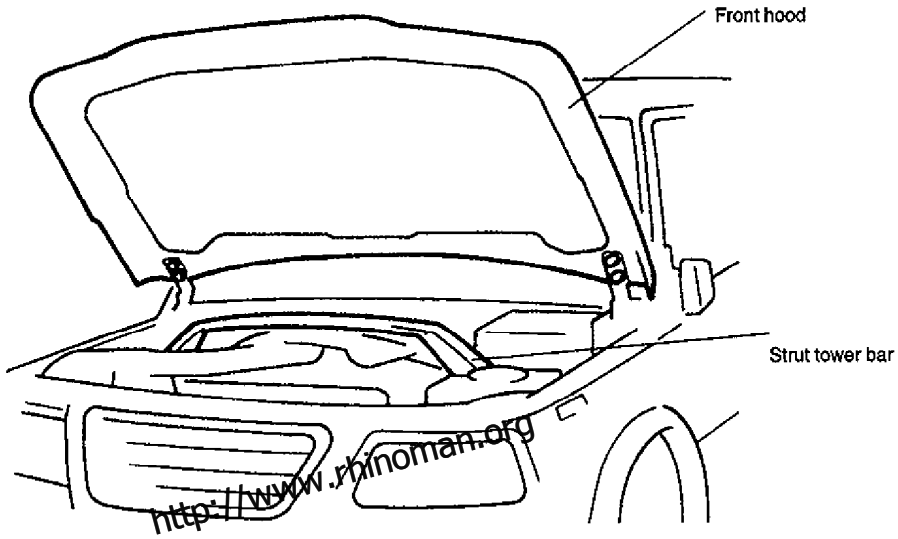
Refer to section 6E4.

ENGINE ASSEMBLY

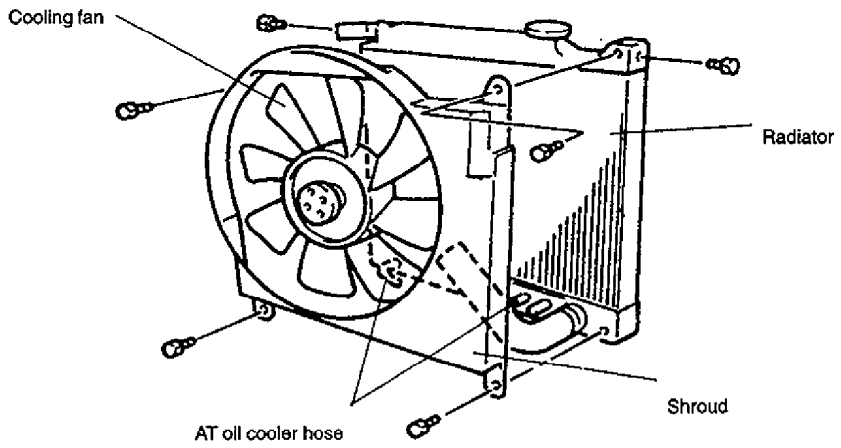
REMOVAL AND INSTALLATION

Removal

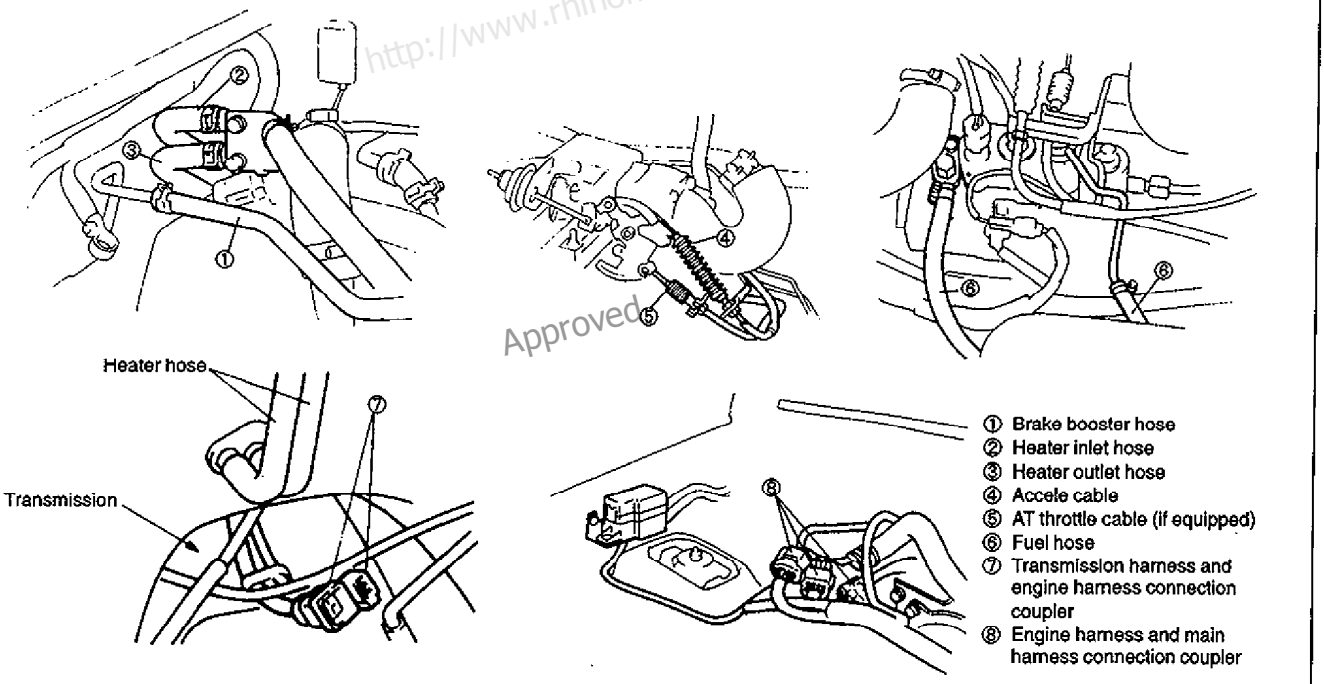
1. Remove fuel tank cap and release fuel pressure.
2. Drain engine coolant (Refer to Section 6B) and engine oil, and then remove oil filter.
3. Remove intercooler.
4. Remove battery and battery heat protector. (Left hand steering)
5. Remove strut tower bar and front hood.



6. Remove front diffelential. (Refer to Section 7E.)
7. Remove No.1 pipe from exhaust manifold. (Refer to Section 6A3.)
8. Remove air cleaner outlet hose.
9. Remove cooling fan and shroud.
10. Remove radiator.

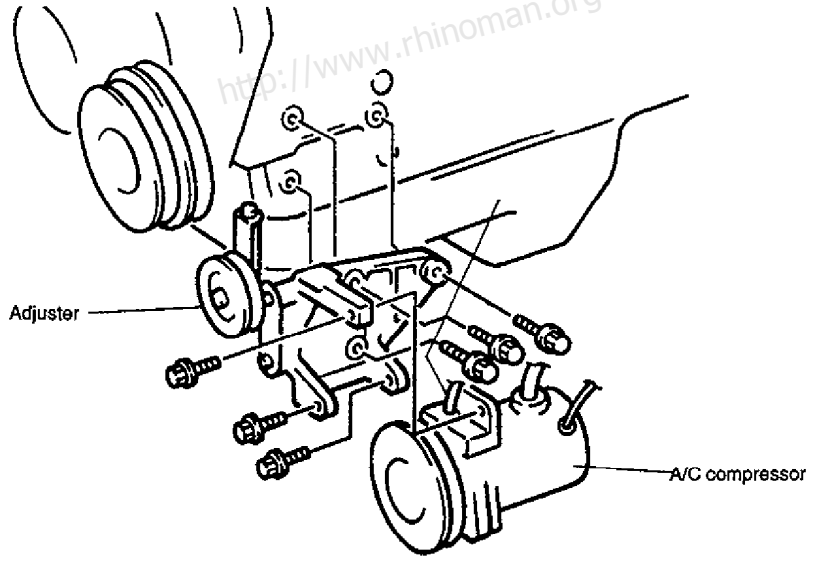


11. Remove in order shown in figure.

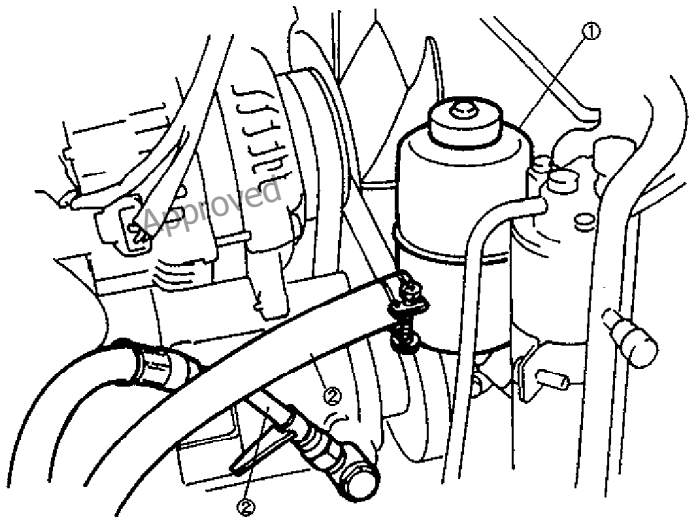


12. Loosen A/C compressor belt and remove A/C compressor from compressor bracket with hose still attached. (if equipped)

NOTE:
Suspend removed compressor at a place where no damage will be caused during removal and installation of engine assembly.

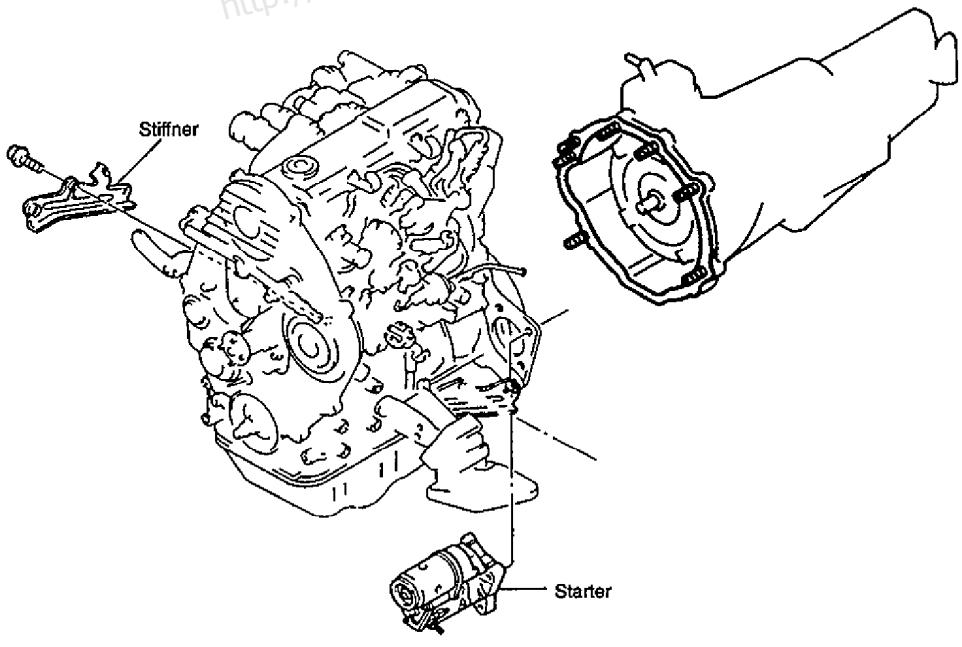


13. Remove oil tank and hoses.

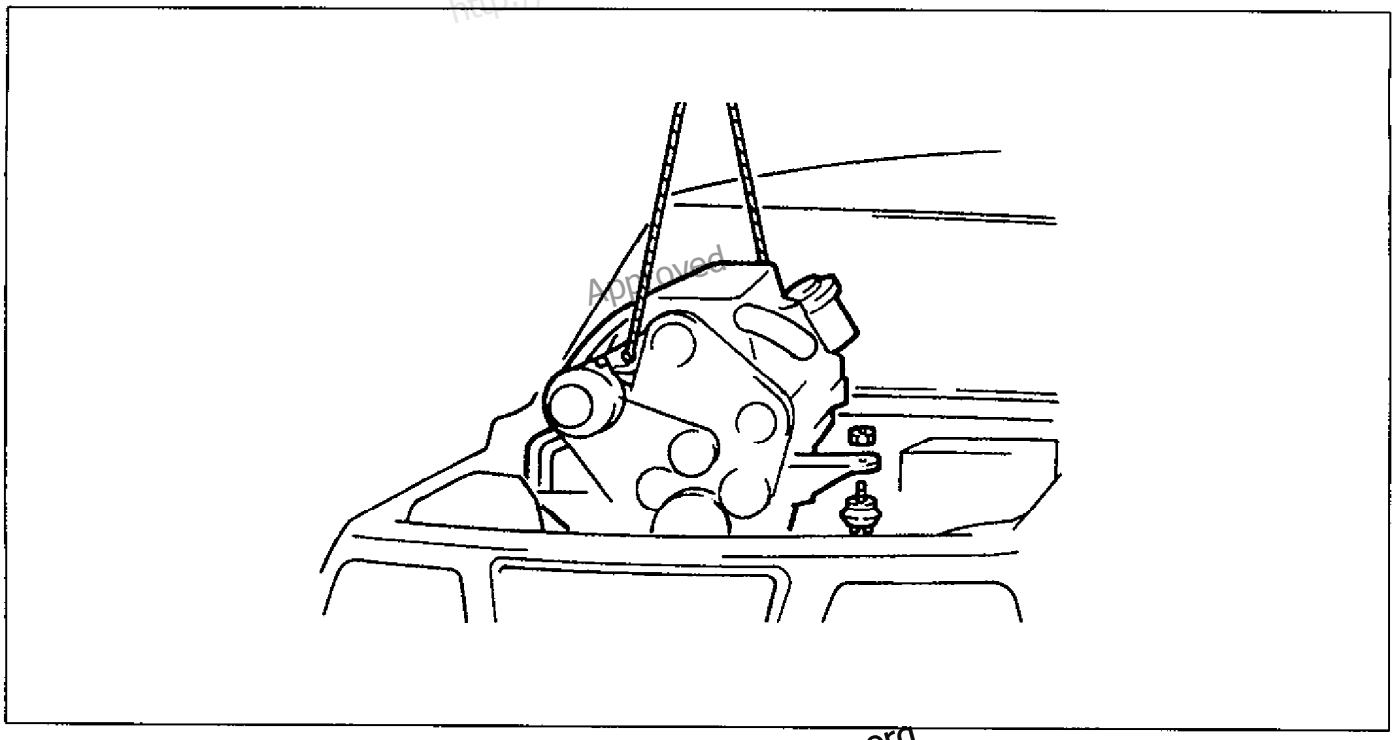


14. Remove starter motor. Hold torque converter with crankshaft pulley bolt and remove torque converter bolts through starter motor installation hole.
15. Remove RH stiffener and LH stiffener.
16. Remove inlet hose and outlet hose. (if equipped with automatic transmission)
17. Remove bolts and nuts connecting engine and transmission.

CAUTION:
Transmission tilts foreward when bolts and nuts are removed. Support front end of transmission with a jack.

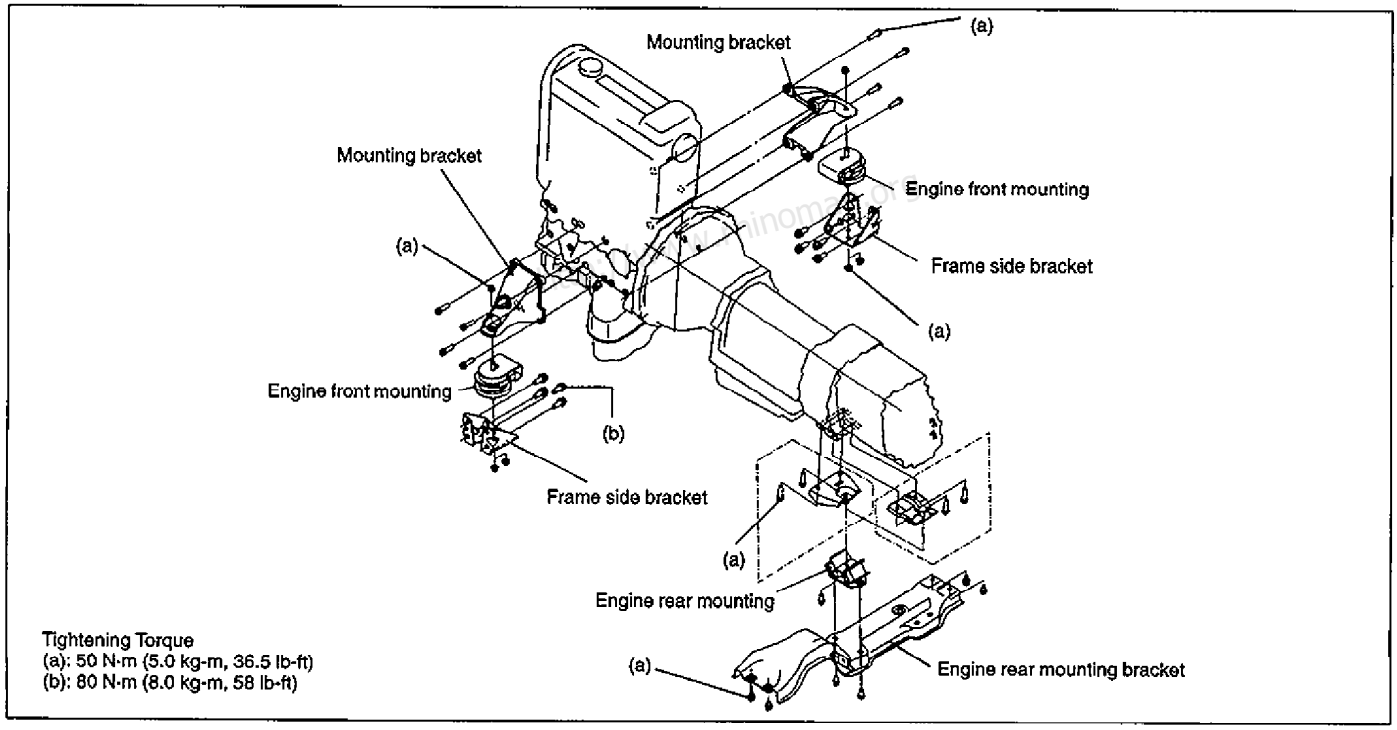


18. Support engine by a hoist at engine hook.
19. Remove RH and LH engine mountings.
20. Lift up and pull forward engine assembly to take it out from engine compartment.



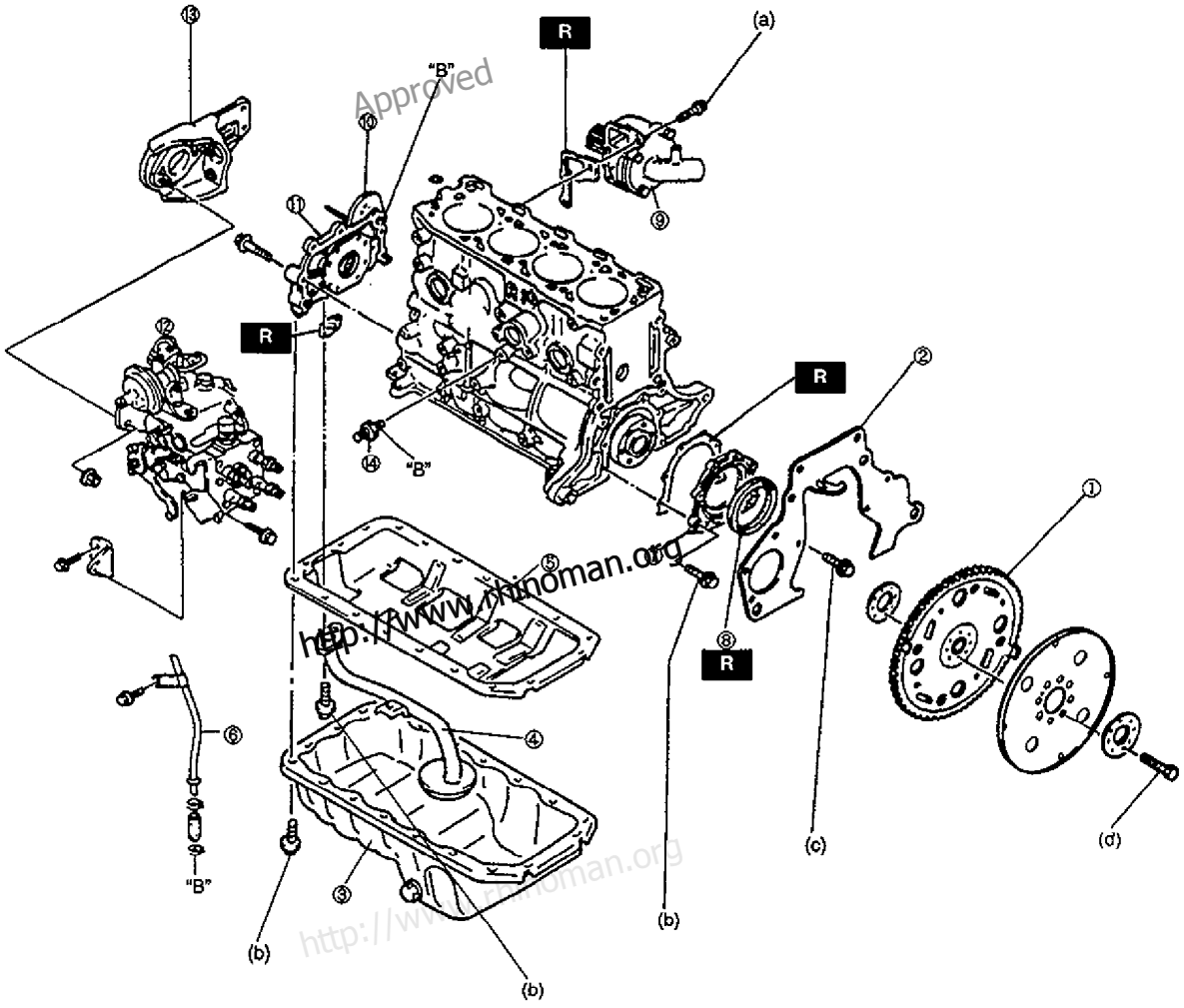
Installation

For installation, reverse removal procedure. Tighten bolts and nut to specified torque.



UNIT REPAIR OVERHAUL

CYLINDER BLOCK



① Drive plate
② End plate
③ Oil pan
④ Oil strainer
⑤ Oil buffle plate
⑥ Oil level gauge pipe
⑦ Rear cover
⑧ Rear oil seal
⑨ Water pump
⑩ Oil pump assembly
⑪ Front oil seal
⑫ Fuel injection pump
⑬ Fuel injection pump bracket
⑭ Oil pressure switch

(a): 40 N·m (4.0 kg-m, 29 lb-ft)
(b): 10 N·m (1.0 kg-m, 7 lb-ft)
(c): 23 N·m (2.3 kg-m, 17 lb-ft)
(d): 100 N·m (10.0 kg-m, 72.5 lb-ft)
"B": SUZUKI BOND No.1207C, 99000–31150
R : Replace

SECTION 6E4

ENGINE AND EMISSION CONTROL SYSTEM (ELECTRONICALLY–CONTROLLED DIESEL FUEL–INJECTION SYSTEM)

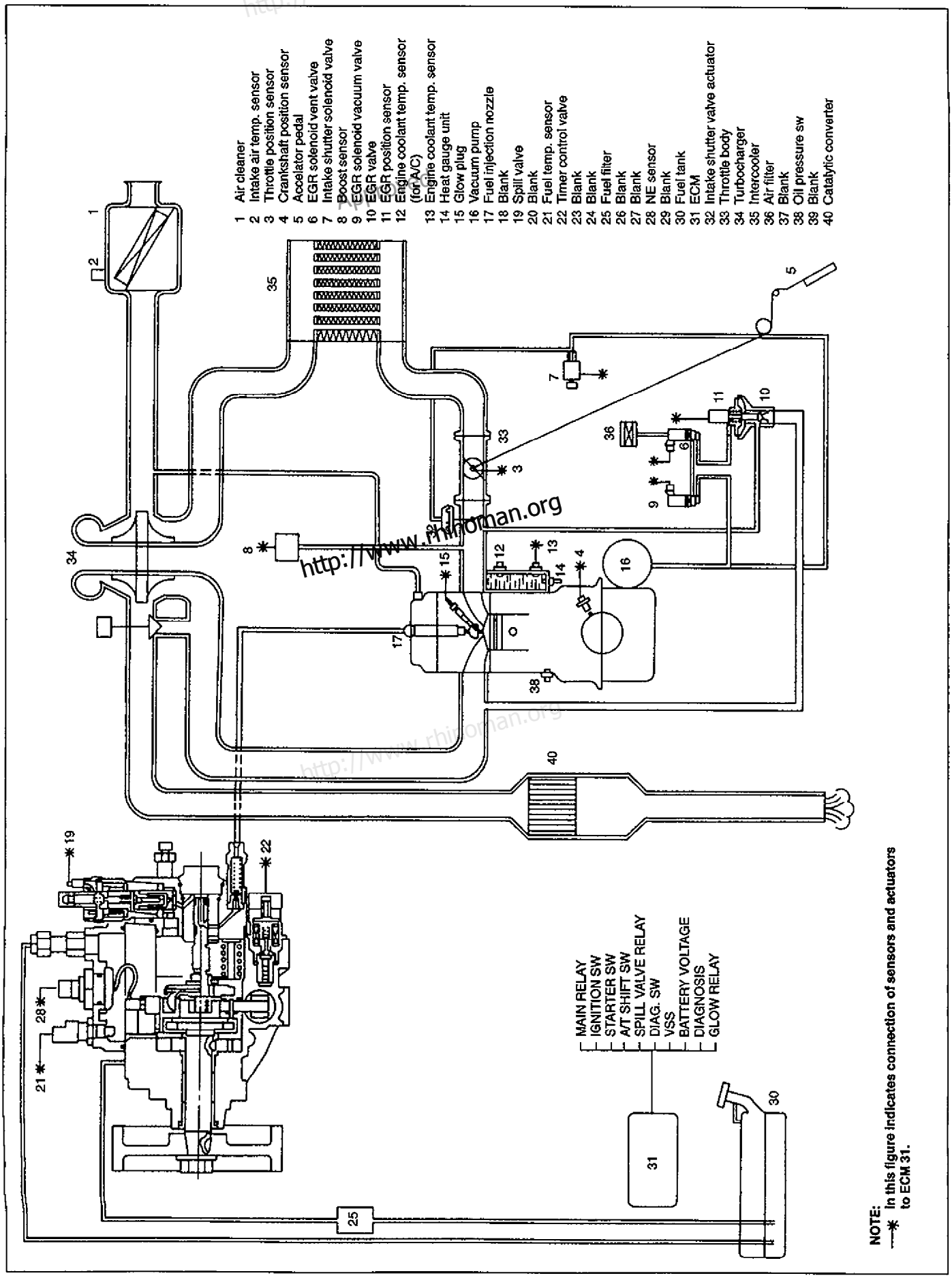
WARNING:
For vehicles euipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Components and Wiring Location view In Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

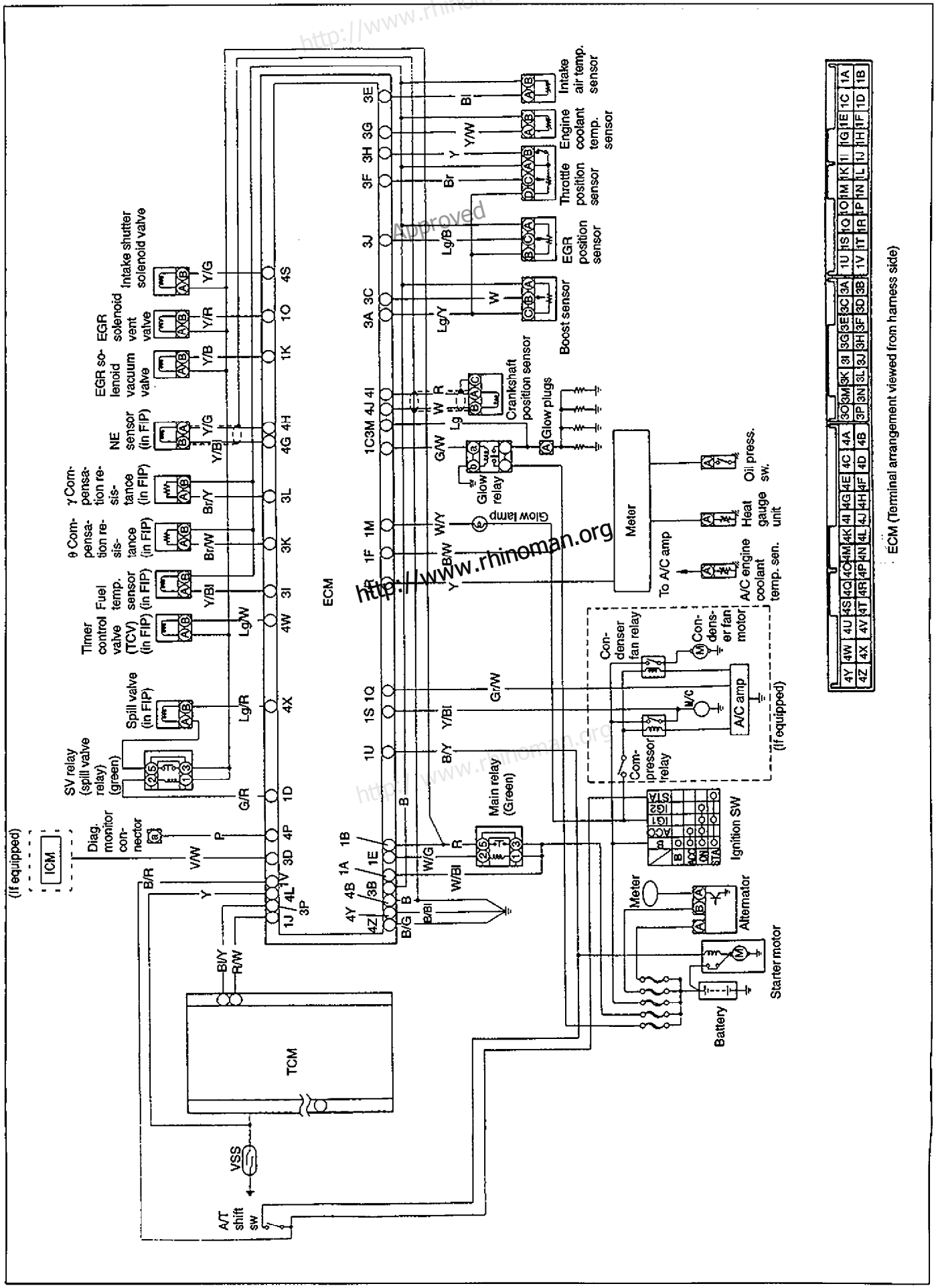
CONTENTS

GENERAL DESCRIPTION

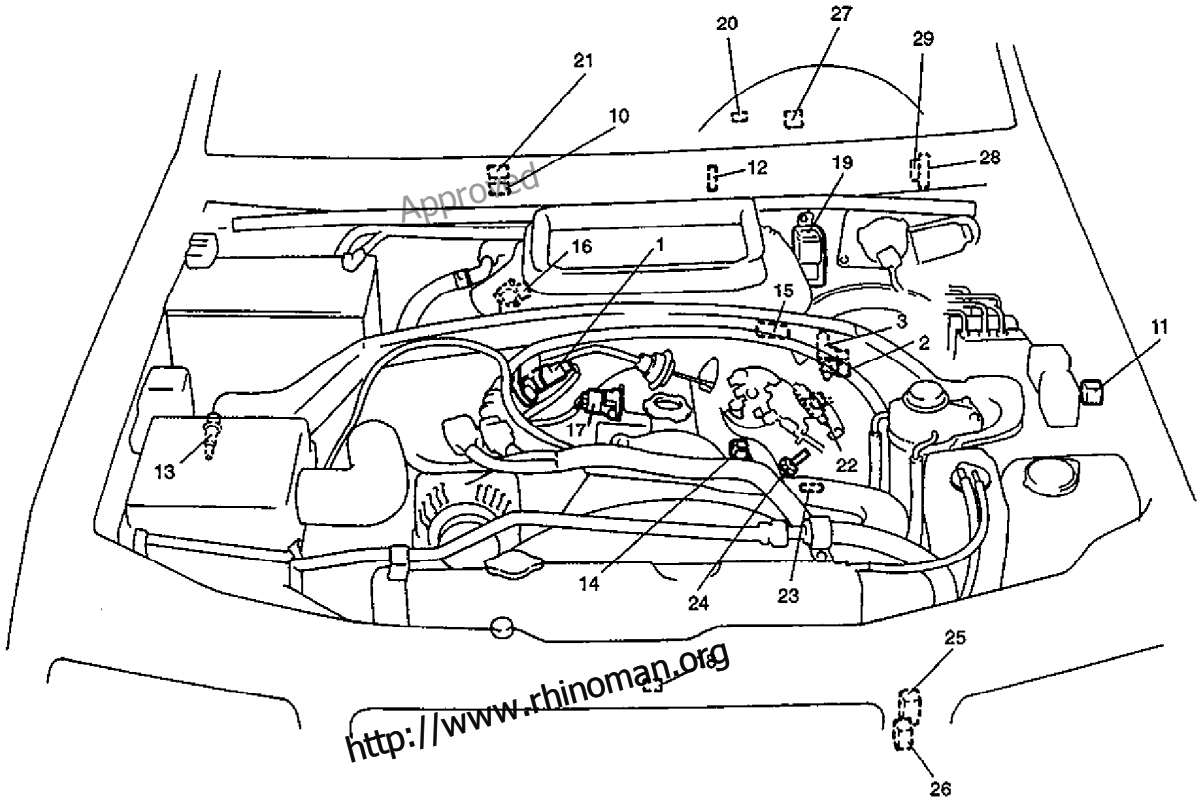
SYSTEM DIAGRAM

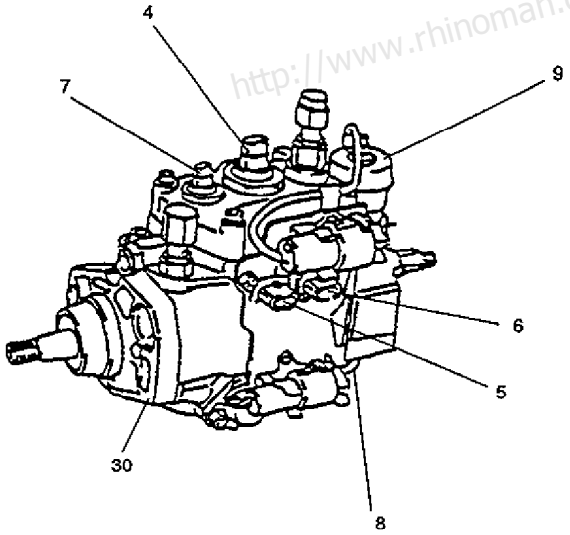


SYSTEM WIRING DIAGRAM



ENGINE AND EMISSION CONTROL SYSTEM LOCATION DIAGRAM

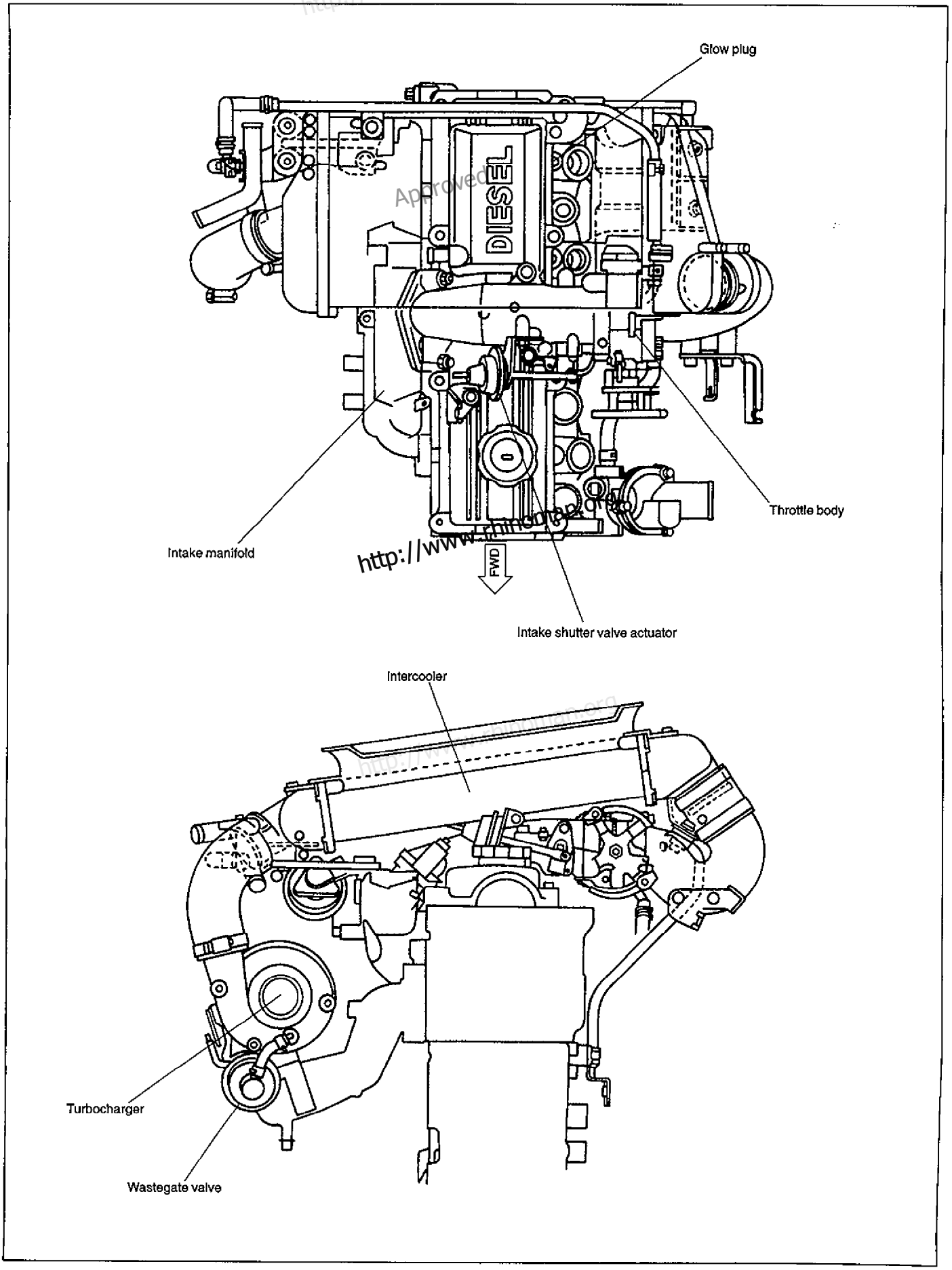


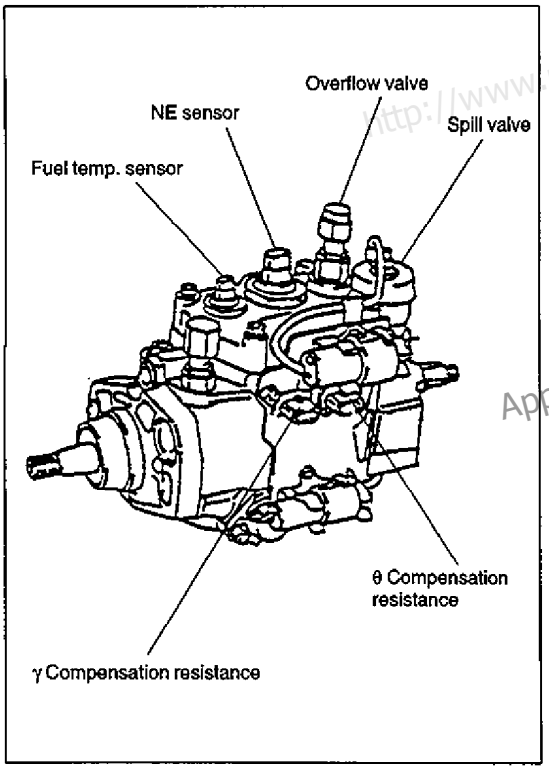


1 Intake shutter solenoid valve
2 EGR solenoid vent valve
3 EGR solenoid vacuum valve
4 NE sensor
5 γ Compensation resistance
6 θ Compensation resistance
7 Fuel temp. sensor
8 Timer control valve
9 Spill valve
10 Spill valve relay (Green)
11 Diag. monitor coupler
12 ICM (If equipped)
13 Intake air temp. sensor
14 Engine coolant temp. sensor
15 Throttle position sensor
16 EGR position sensor
17 Boost sensor
18 Crankshaft position sensor
19 Glow relay
20 Glow lamp
21 Main relay (Green)
22 Oil pressure switch
23 Heat gauge unit
24 Engine coolant temp. sensor (for A/C)
25 Condenser fan relay
26 Compressor relay
27 VSS
28 ECM
29 TCM
30 Fuel injection pump

AIR INTAKE SYSTEM

AIR INTAKE SYSTEM COMPONENTS LOCATION DIAGRAM





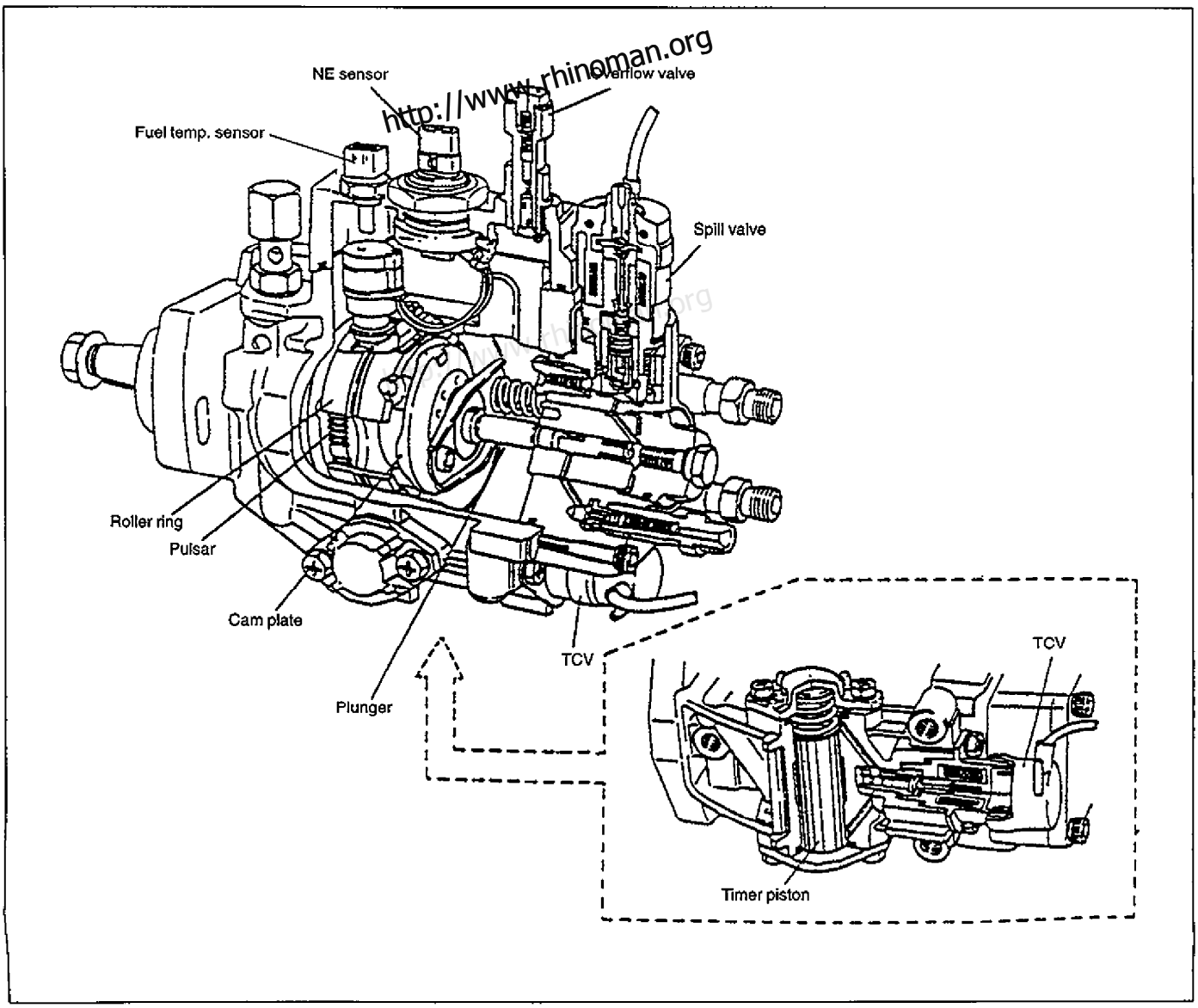
FUEL DELIVERY SYSTEM

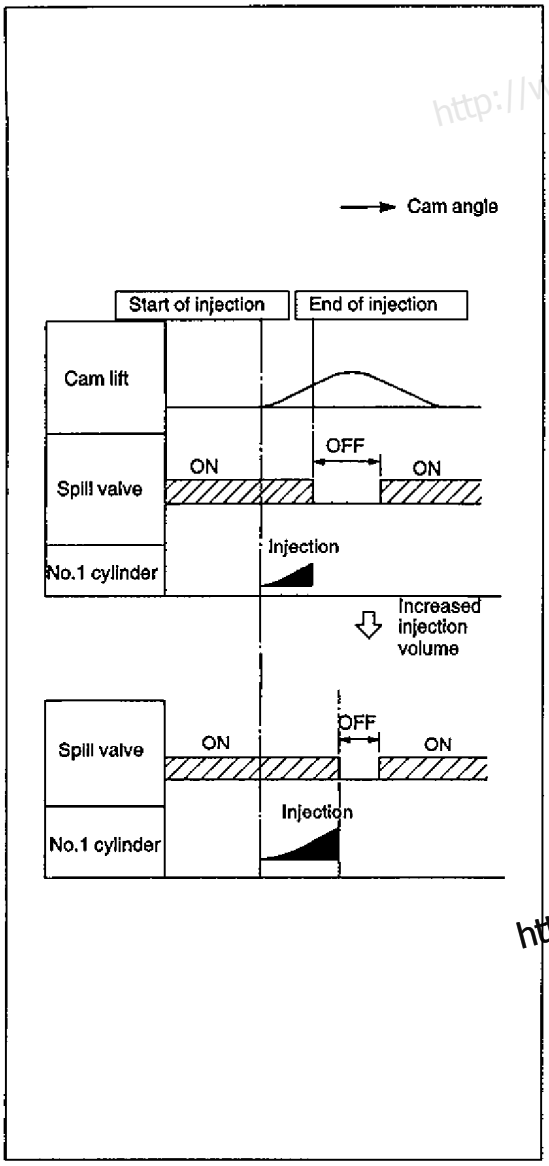
FUEL INJECTION PUMP (FIP)

The FIP is of a distribution type. The FIP controls the fuel injection volume via the electromagnetic valve, and directly spills the pressurized fuel.

The FIP is equipped with the following control units.

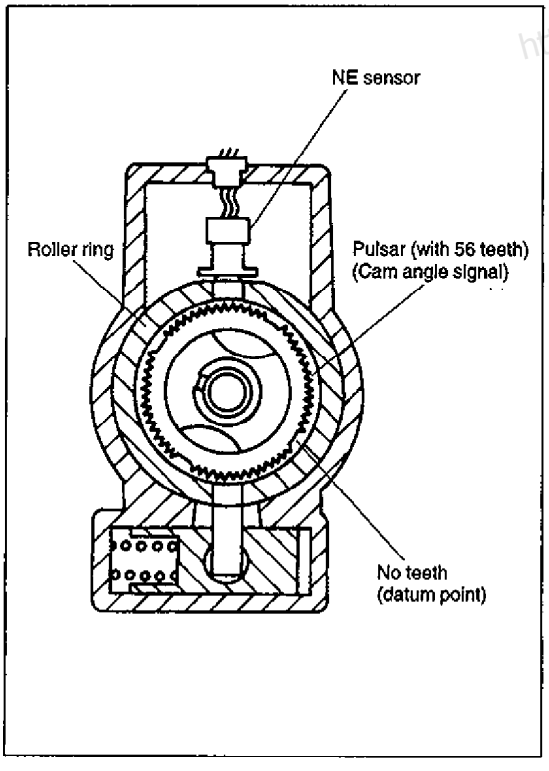
- For fuel injection volume control
  - Actuator .... NE spill valve
  - Sensor ..... Fuel temp. sensor
  - Adjustment . Compensation resistance (θ)
- For fuel injection timing control
  - Actuator .... Timing control valve (TCV)
  - Sensor ..... NE sensor
  - Adjustment . Compensation resistance (γ)
- For fuel–cut control
  - Actuator .... Spill valve



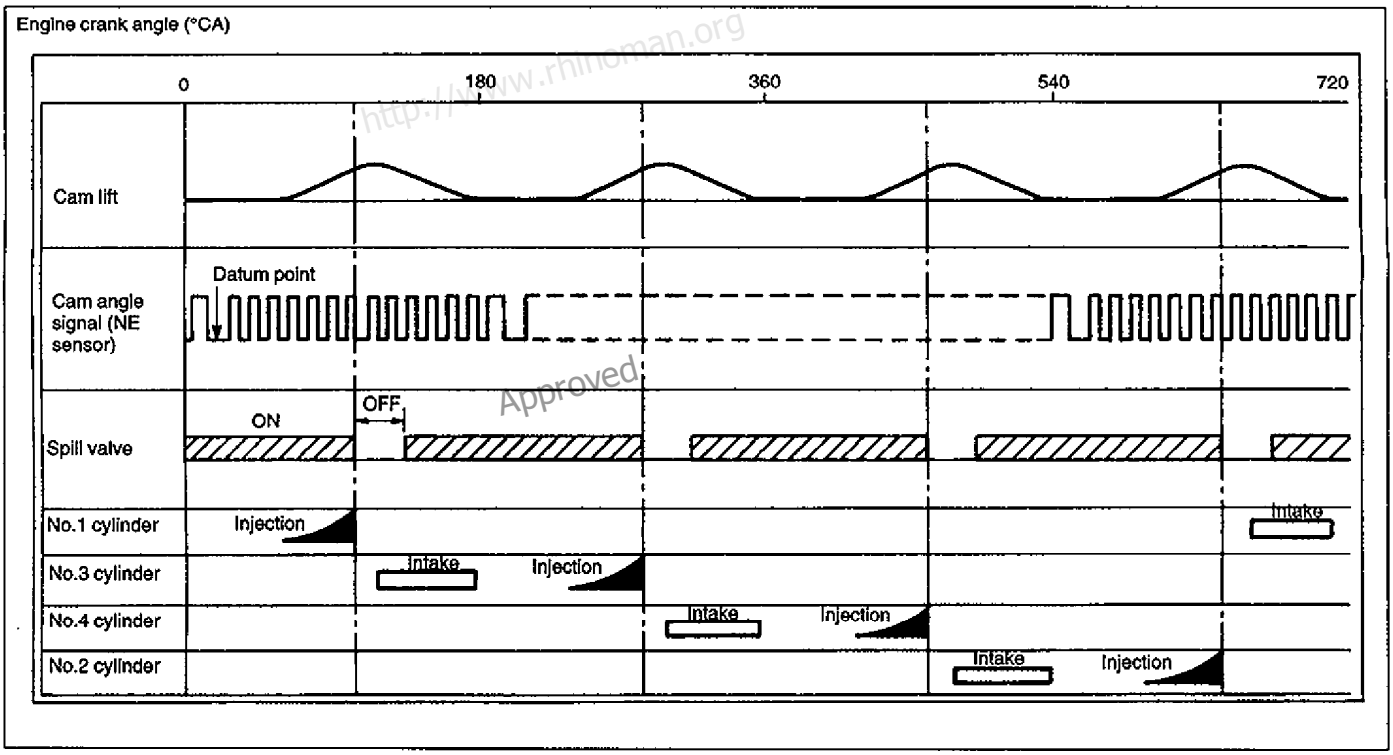


FUEL INJECTION VOLUME CONTROL

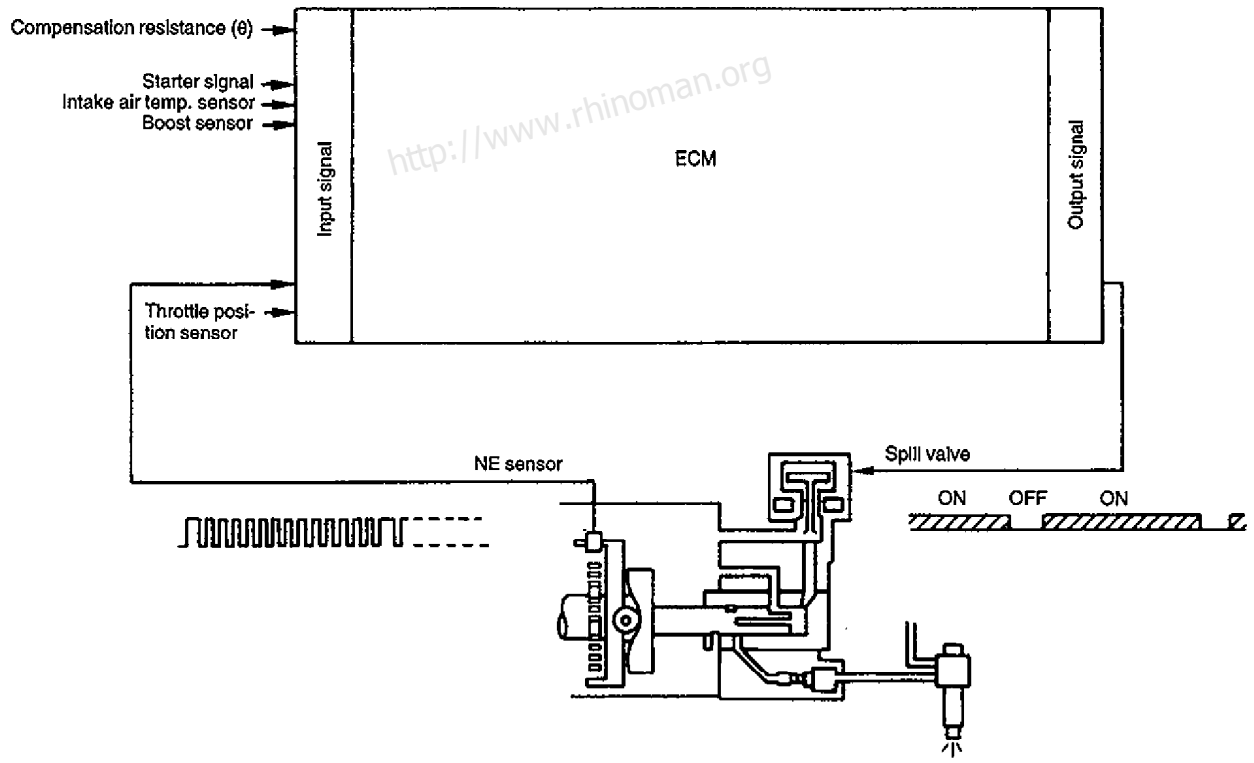
Start of the fuel injection will be determined according to the cam position. End of the fuel injection is when the spill valve opens to spill the pressurized fuel into the pump chamber. Adjustment of the fuel injection volume will be made by controlling the timing to end the fuel injection.



An NE sensor has been equipped to detect the cam angle which corresponds to the cam lift. According to the detection, the ECM determines the timing to output the OFF signal to the spill valve.
The NE sensor is installed over the roller valve, and generates electrical signals by detecting the projections on the pulsar, which is pressed onto the drive shaft.
Because the NE sensor moves together with the roller ring, accurate detection of the cam lift can be obtained.
Refer to the figure in the next page for each component.

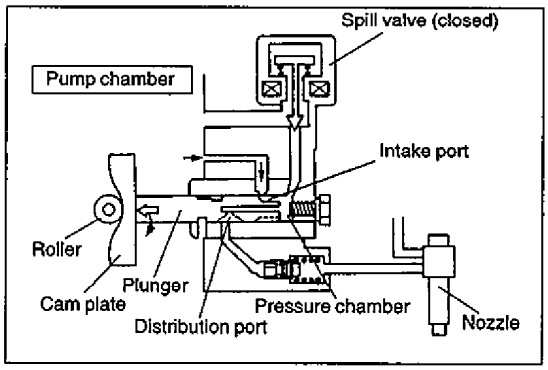


The ECM calculates the fuel injection volume based on conditions of the throttle position sensor, NE sensor, and charging pressure.
The compensation resistance (θ) is added to this calculation, then the result will be sent to the spill valve as an electrical signal.



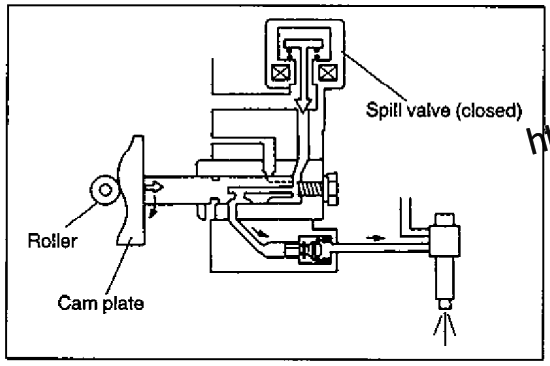
FUEL DELIVERY AND INJECTION

The spill valve is provided in the passage between the pump chamber and the plunger.
The spill valve is normal open type and closes when its coil is energized.



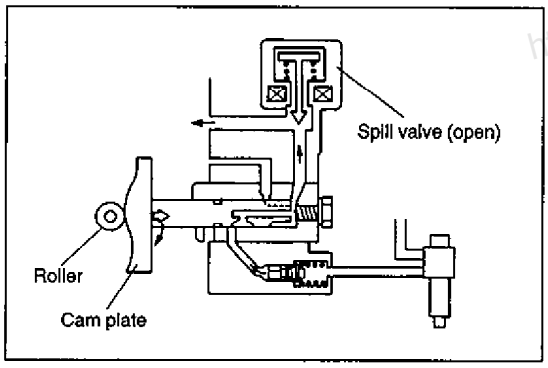
① Intake
As the plunger lowers, the fuel flows into the pressure chamber.

- Intake port ..... Open
- Distribution port ..... Closed
- Spill valve ..... Closed (Energized)



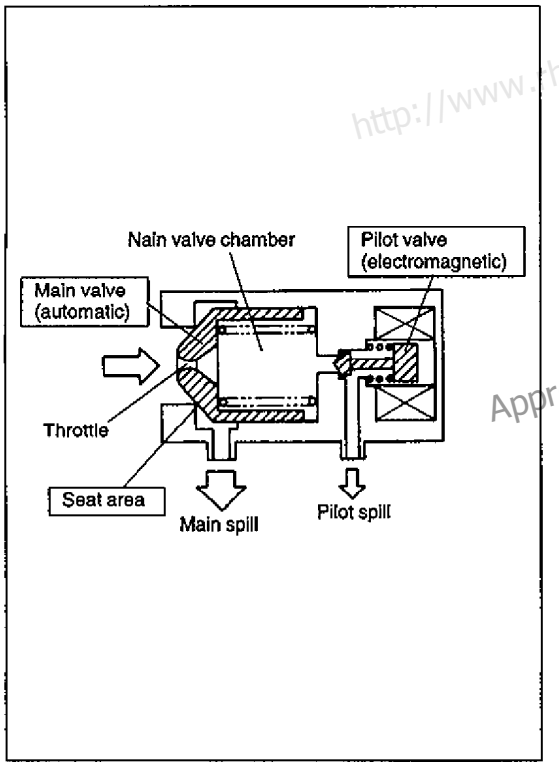
② Injection
The plunger rotates while it rises, and compresses and feeds the fuel.

- Intake port ..... Closed
- Distribution port ..... Open
- Spill valve ..... Closed (Energized)



③ End of injection
Power supply to the spill valve is stopped, and the valve opens.
Pressurized fuel in the plunger is forced back into the pump chamber. Pressure in the plunger lowers, and fuel injection is completed.

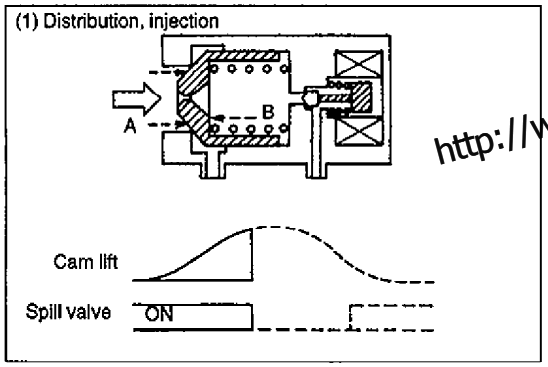
- Intake port ..... Closed
- Distribution port ..... Open
- Spill valve ..... Open (Deenergized)



SPILL VALVE

The spill valve consists of two valves; the main valve and the pilot valve. Types and purposes of each valve are as follows.

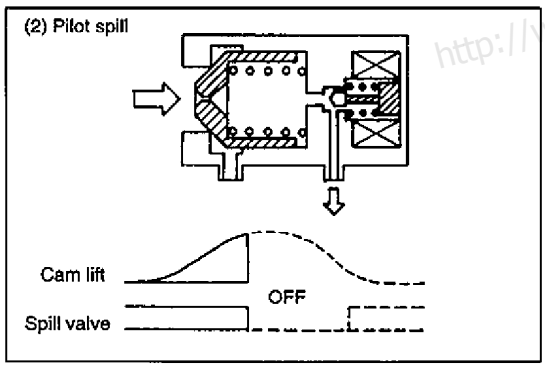
	Flow volume	Type	Purpose
Main valve	Large	Automatic valve (Hydraulic)	Spills compressed fuel in the plunger chamber and completes fuel injection.
Pilot valve	Small	Electro-magnetic valve	Creates hydraulic difference which causes the main valve to operate.



Operation

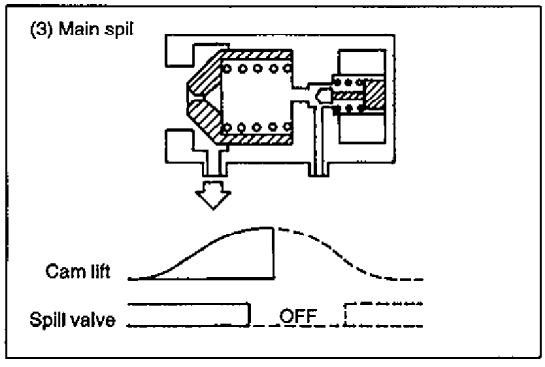
① Distribution, injection

Compressed fuel in the plunger chamber passes through the throttle and introduced in the main valve. At this time, fuel is injected from the fuel injection nozzle. In this condition, pressurized areas on the right side of the main valve (B) is greater than that of the left side of the main valve (A), and the main valve is firmly closed.



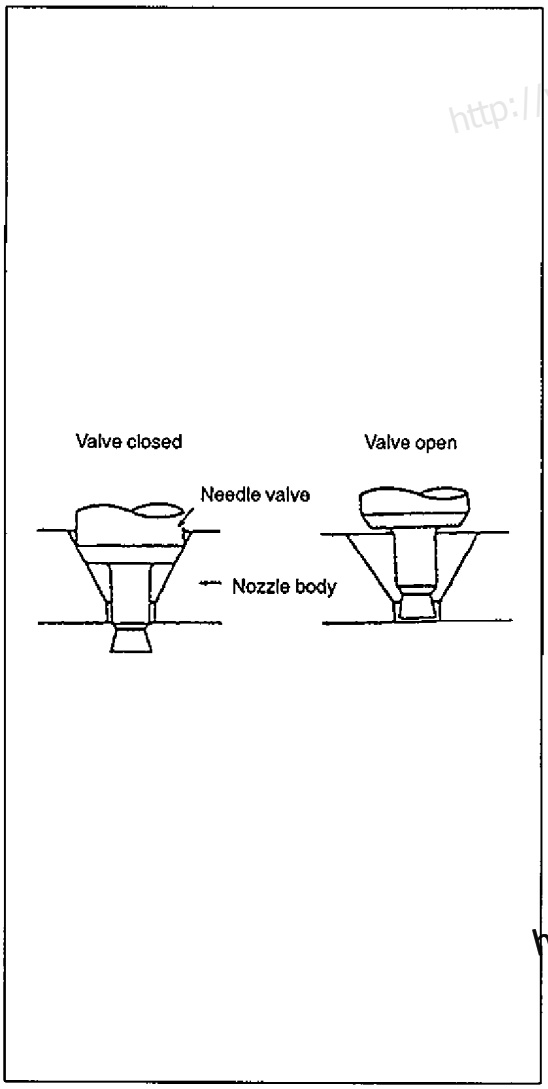
② Pilot spill

When power supply to the spill valve coil is stopped, the valve opens to allow a small amount of fuel in the main valve chamber to escape. Thus hydraulic pressure in the main valve chamber lowers.



③ Main spill

By the hydraulic pressure difference created in step (2), the main valve is lifted, causes a large amount of spill from the seat area. This completes fuel injection.



INJECTION NOZZLE

- The injection nozzle adjusts the fuel pressure supplied by the injection pump to 14.7 MPa (147 kg/cm^2, 2,090 psi), and injects the fuel into the combustion chamber (whirl type).

The injection nozzle consists of the needle valve and nozzle body assembled in the nozzle holder body. The needle valve is pressed against the nozzle body by the spring force.

When the fuel pressure supplied by the fuel injection pump exceeds the injection start pressure, it overcomes the spring force, pushes up the needle valve, thus the fuel is injected. The needle valve is designed to limit the injection port area at the start of injection, so that fuel injection volume during the ignition delay period is reduced, thus prevents diesel knocking caused by sharp increase in the fuel pressure.

During injection, part of the fuel passes through a narrow gap between the needle valve and the nozzle body to lubricate the needle valve, and returns to the fuel tank via the return pipe.

FUEL FILTER

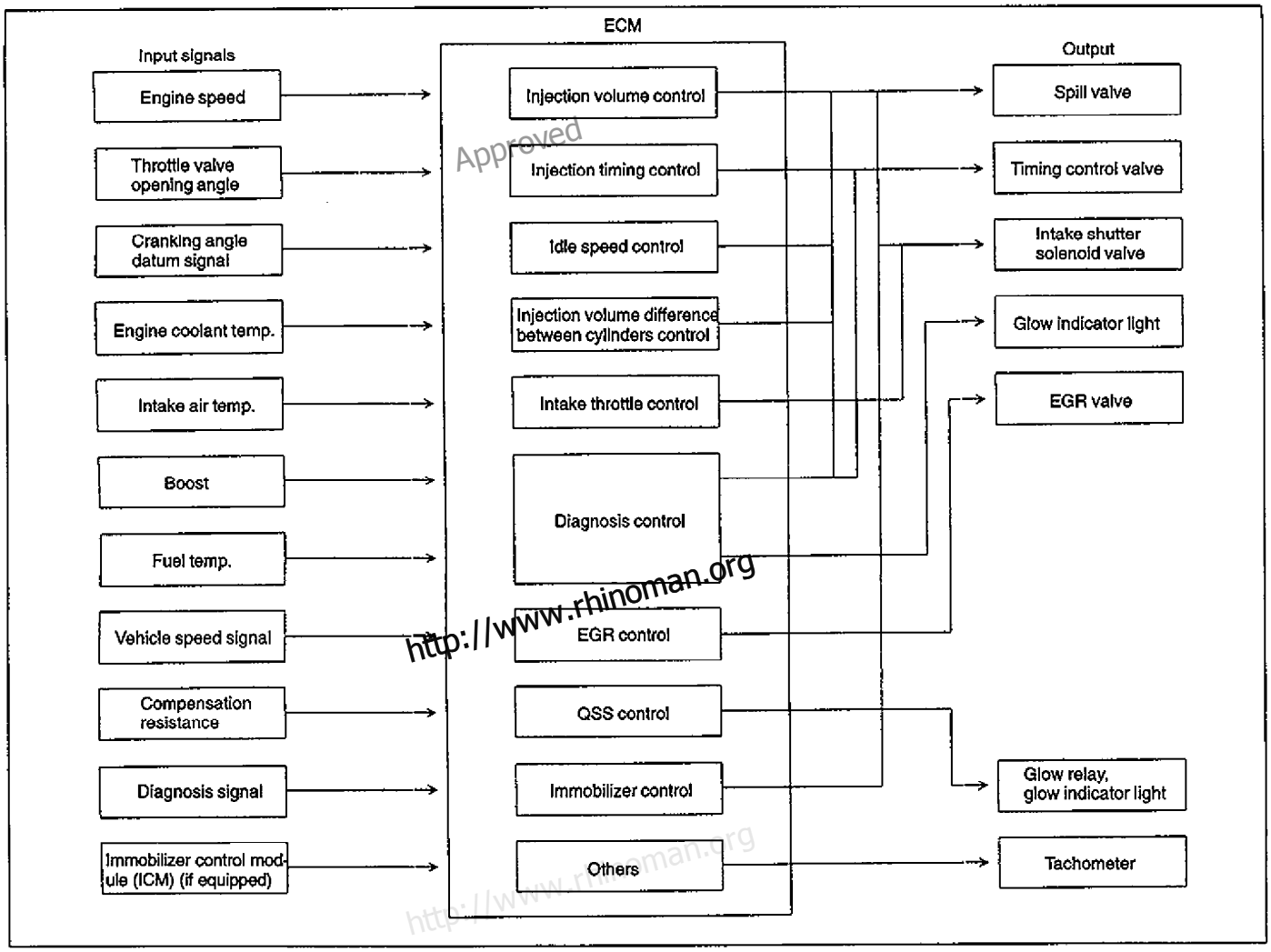
The fuel filter filters fuel supplied from the fuel tank.

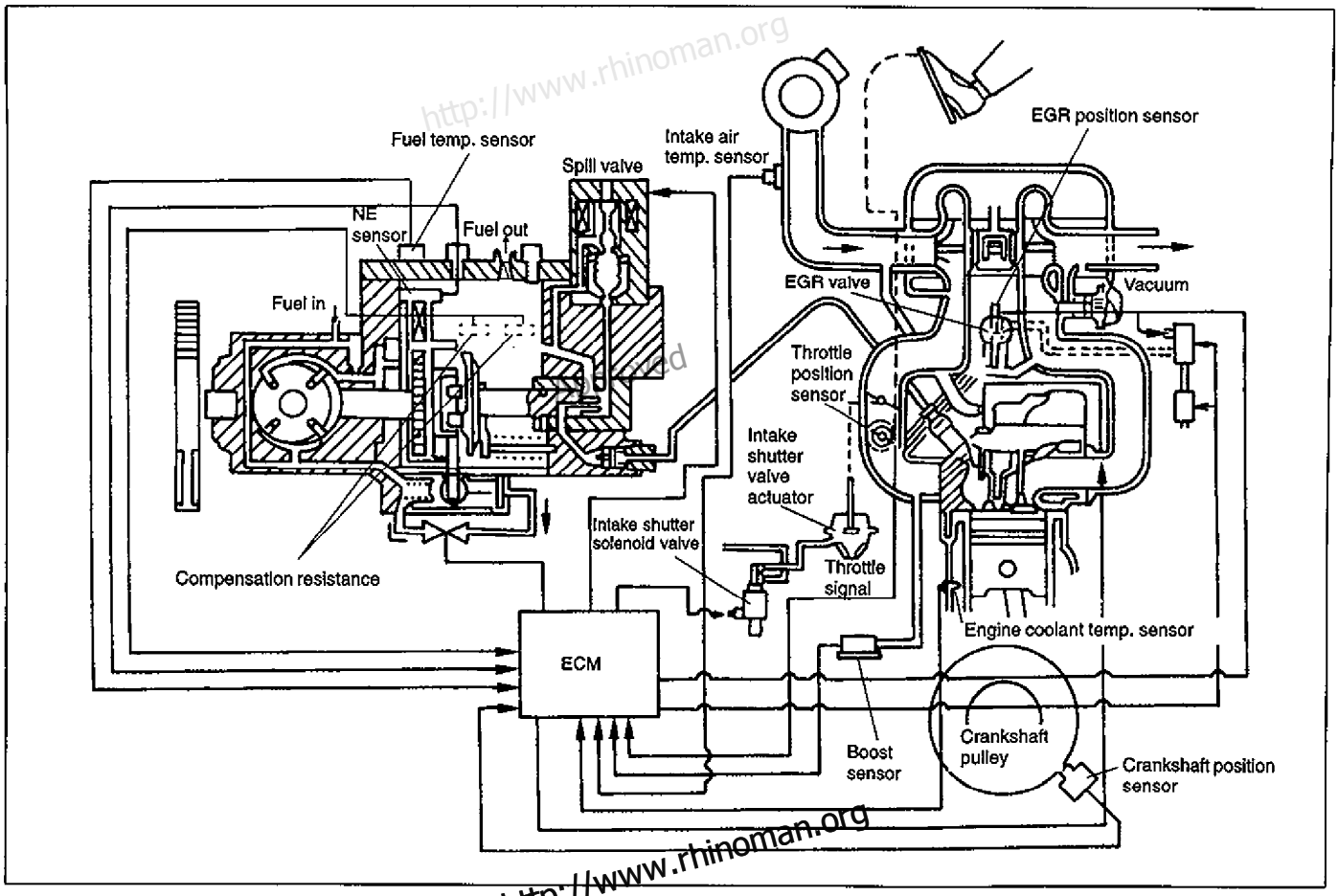
When over the specified amount of water has collected in the fuel filter, the sedimentor switch illuminates the sedimentor warning lamp in the instrument cluster.

The fuel filter with a fuel heater has the fuel warm-up function.

ELECTRONIC CONTROL SYSTEM

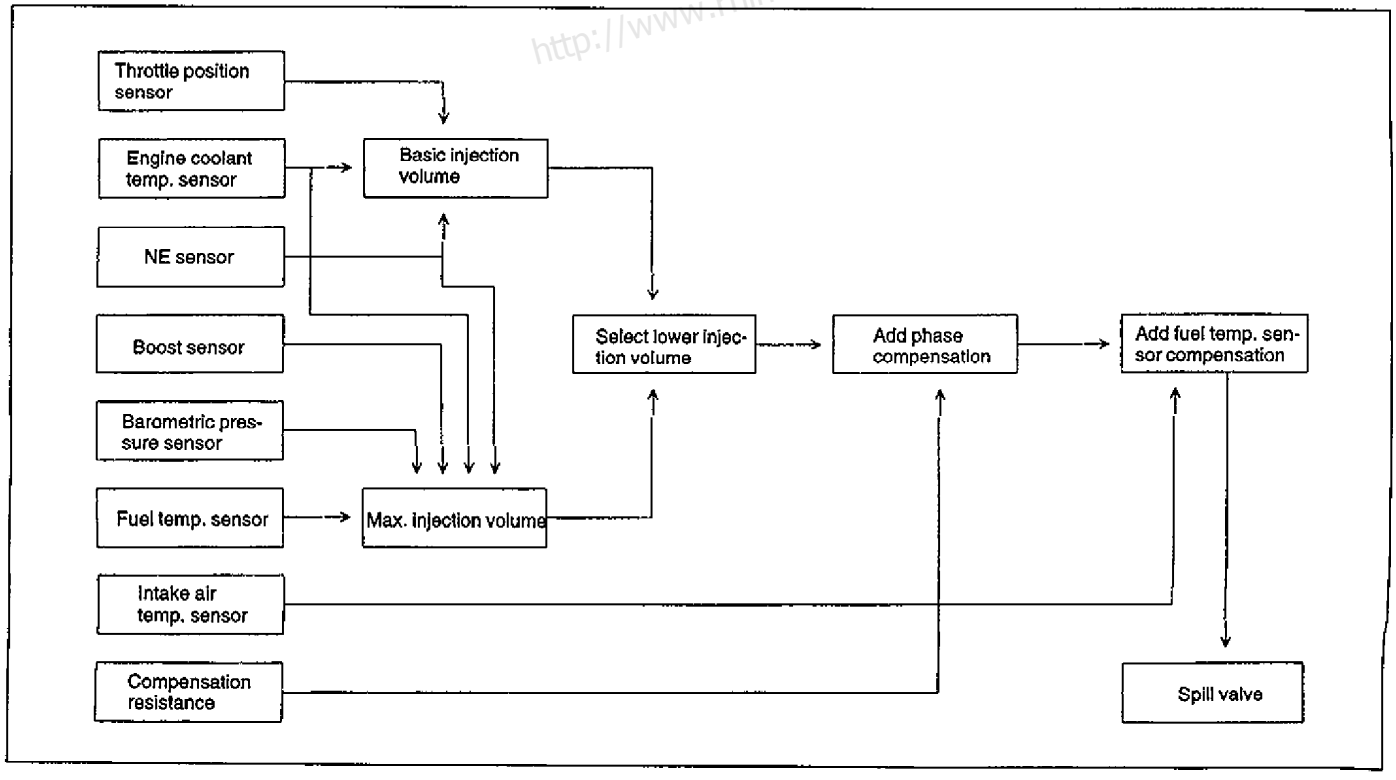
The electronic control system carries out various controls such as the fuel injection volume, fuel injection timing, idle speed, EGR, QSS, main rely, and A/C cutoff via the ECM. This system is equipped with the self–diagnosis function which detects abnormal condition in the ECM input/output signals. The system also has the fail–safe function.





FUEL INJECTION VOLUME CONTROL

The ECM calculates the basic injection volume based on the throttle opening angle and engine speed, and the maximum injection volume for the same engine conditions. Then the ECM compares the basic injection volume and the maximum injection volume, and chooses the lower one. The compensation resistance θ (injection volume compensation value) is added to the selected value for phase compensation. In this way, the final injection volume is determined.



BAROMETRIC PRESSURE COMPENSATION

The maximum injection volume is compensated by the barometric pressure.

BOOST COMPENSATION

The maximum injection volume is compensated by the intake air pressure. As the intake air pressure becomes higher, the injection volume is increased accordingly.

INTAKE AIR TEMPERATURE COMPENSATION

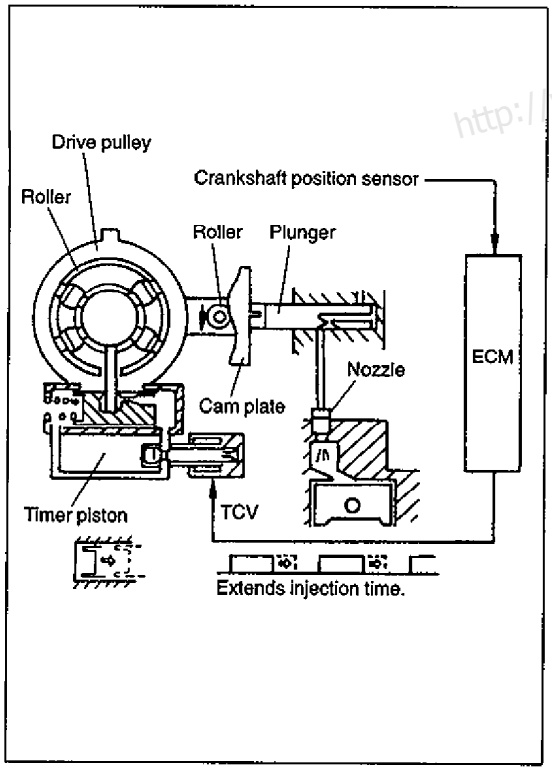
This compensation is added to compensate for deviation of the air/fuel ratio caused by the difference of the intake air concentration, which varies with the intake air temperature. As the intake air temperature becomes higher, the injection volume is decreased accordingly.

FUEL TEMPERATURE COMPENSATION

This compensation is added to compensate for deviation of the injection volume caused by the difference of the fuel concentration, which varies with the fuel temperature. As the fuel temperature becomes higher, the injection volume command value is increased accordingly.

COMPENSATION RESISTANCE θ

The cam angle signal, detected by the NE sensor, is used for the injection volume control. However, there is deviation between correlation of this signal and the injection pulse at each injection pump. This deviation affects the fuel injection volume. To compensated this deviation, compensation resistance θ (injection volume compensation) is added, selected for each injection pump.

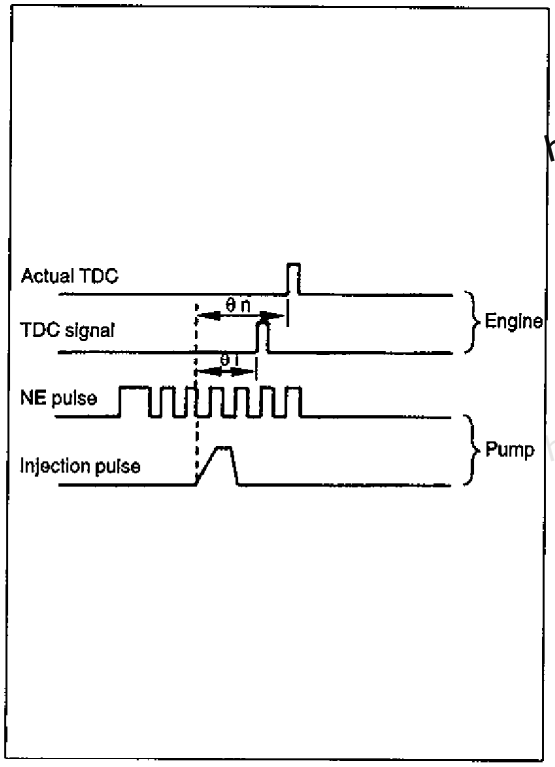


FUEL INJECTION TIMING CONTROL

The fuel injection timing control is made by moving the roller ring in the pump rotation direction or in the reverse direction.

Fuel in the pump is compressed by the reciprocating motion of the plunger, passes through the fuel injection pipe to reach the fuel injection nozzle.

The fuel injected from the fuel injection nozzle is burned after a period of ignition delay.



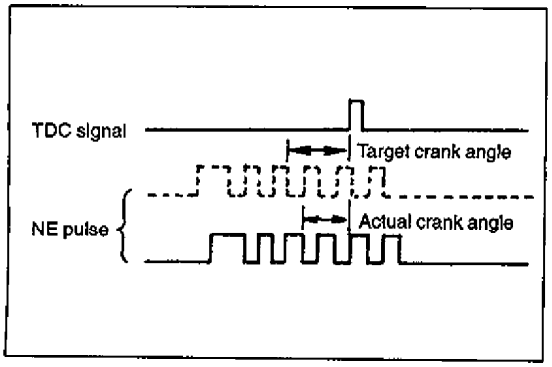
Crankshaft Position Feedback

The crankshaft position feedback for fuel injection timing control controls time angle θn between the actual TDC and the injection start. Because the actual TDC and injection pulse cannot be detected, time angle θn is controlled as follows.

(1) At the engine side, The actual TDC and the TDC signal from the crankshaft position sensor are correlated each other.

(2) At the pump side, the injection pulse and the Ne pulse from the revolution sensor are correlated each other.

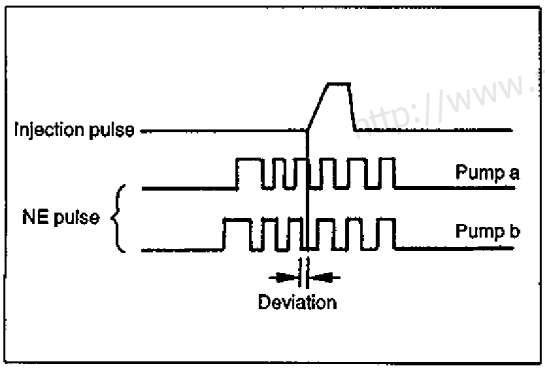
(3) According to (1) and (2), controlling time angle θi between the TDC signal and Ne pulse can control time angle θn.



(4) The target crank angle is calculated based on various input signals, and the duty ratio for the timing control valve is determined.

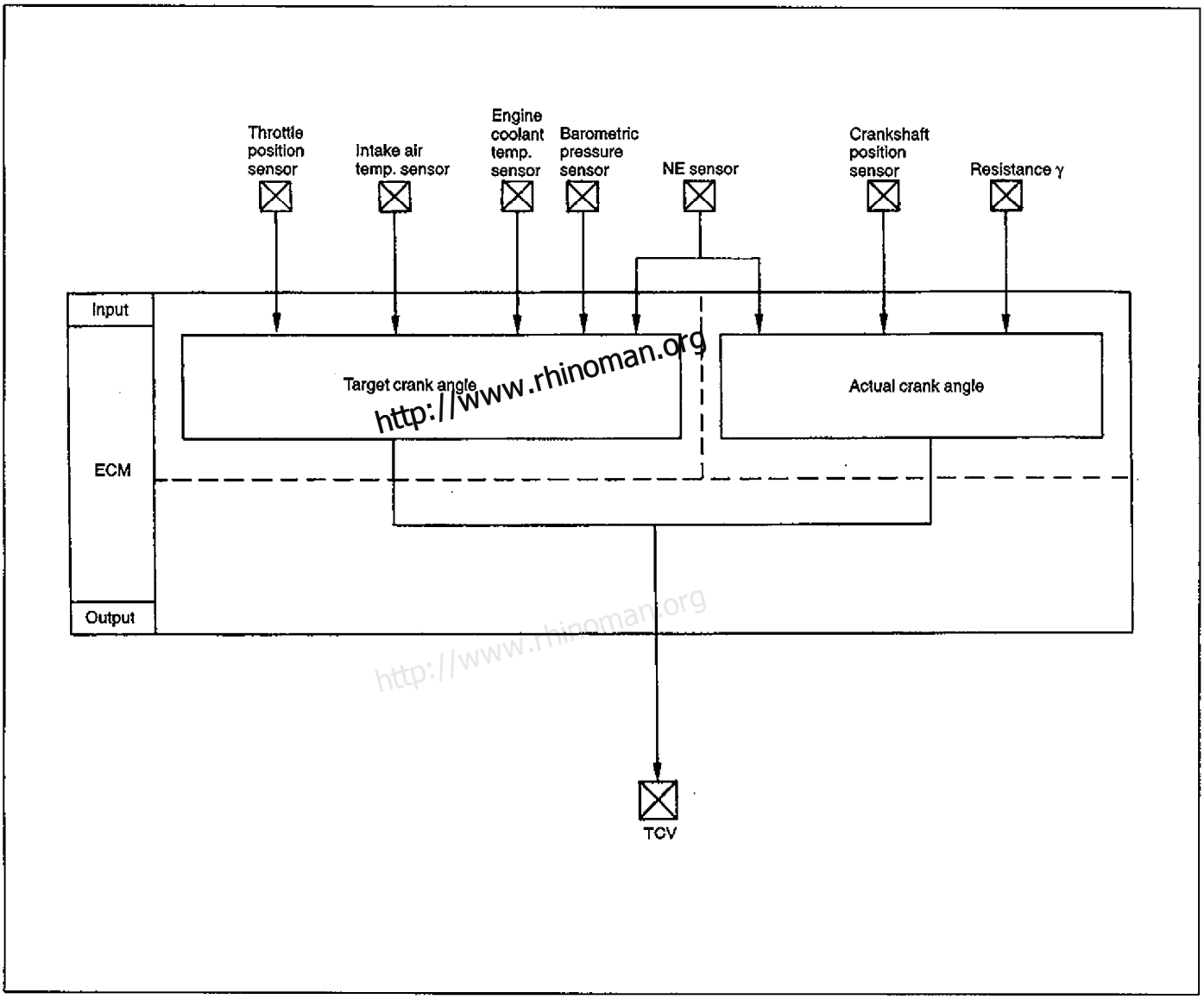
(5) The actual crank angle is calculated based on the TDC signal and Ne pulse.

(6) The timing control valve duty ratio is corrected until the target crank angle and the actual crank angle match.



The fuel injection timing control is made as described above. For improved accuracy, compensation resistance γ will be added to each pump to compensate for deviation of the correlation between the Ne pulse and the fuel injection pulse.

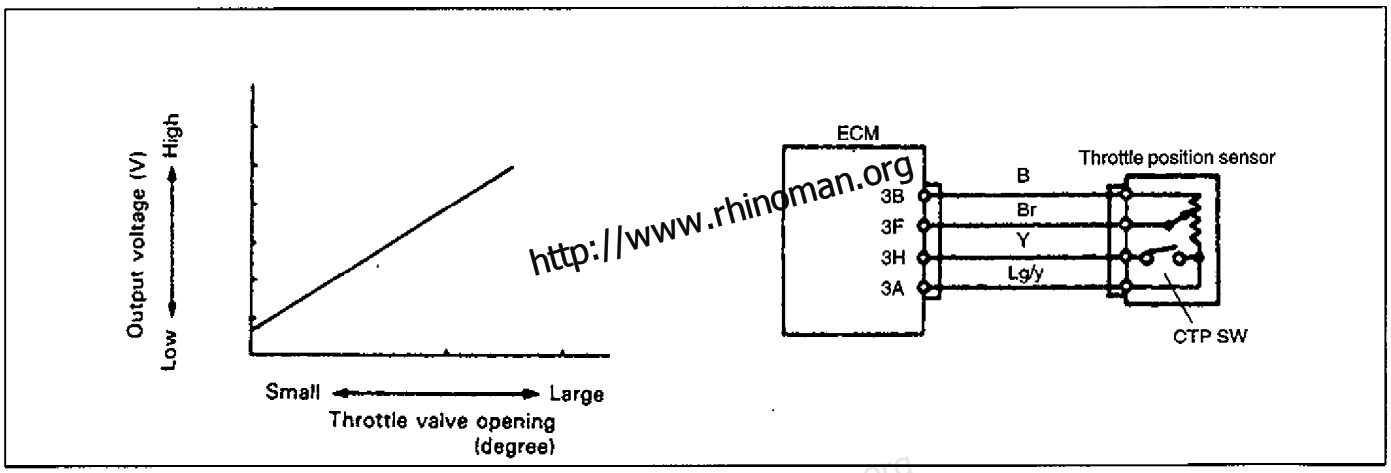
INPUT/OUTPUT SIGNALS FOR INJECTION TIMING CONTROL

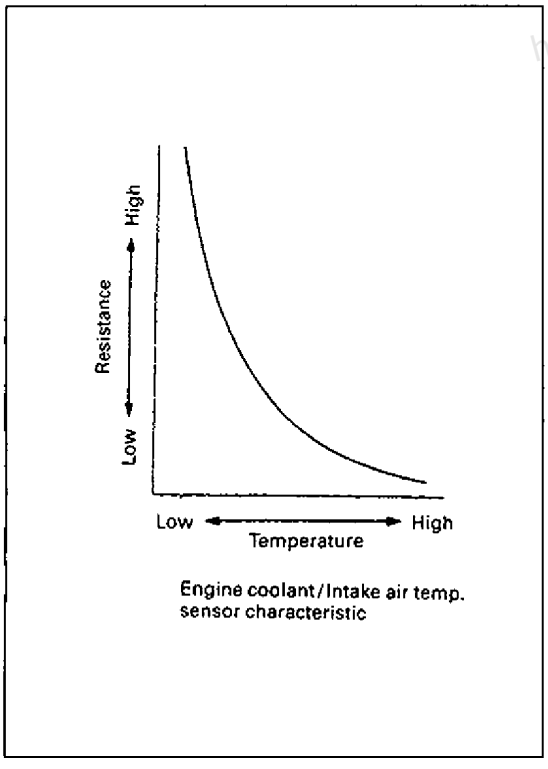


THROTTLE POSITION SENSOR

The throttle position sensor is installed on the side of the throttle body. The sensor detects the throttle valve condition by using the CTP switch and potentiometer.

- CTP switch
  One end of the CTP switch is connected to ECM terminal 3H and supplied with the sensor voltage, and the other end is connected to ECM terminal 3B.
  When the throttle valve is fully closed, the switch closes and the sensor voltage is grounded at ECM terminal 3B (sensor ground). Based on this change of the voltage at terminal 3B, the ECM judges whether the throttle valve is at the closed throttle position or at other position. Voltage at terminal 3B shows battery positive voltage when the throttle valve is fully closed, and sensor voltage when the throttle valve is open.
- Potentiometer
  One end of the potentiometer is connected to ECM terminal 3A and supplied with the sensor voltage, and the other end is grounded at ECM terminal 3B (sensor ground). A brush, which slides on the resistance according to the throttle valve opening angle, is connected to ECM terminal 3F.
  The voltage at ECM terminal 3F varies with the throttle valve opening angle; it decreases when the opening angle is small, and increases when the opening angle is large.





Engine coolant/Intake air temp. sensor characteristic

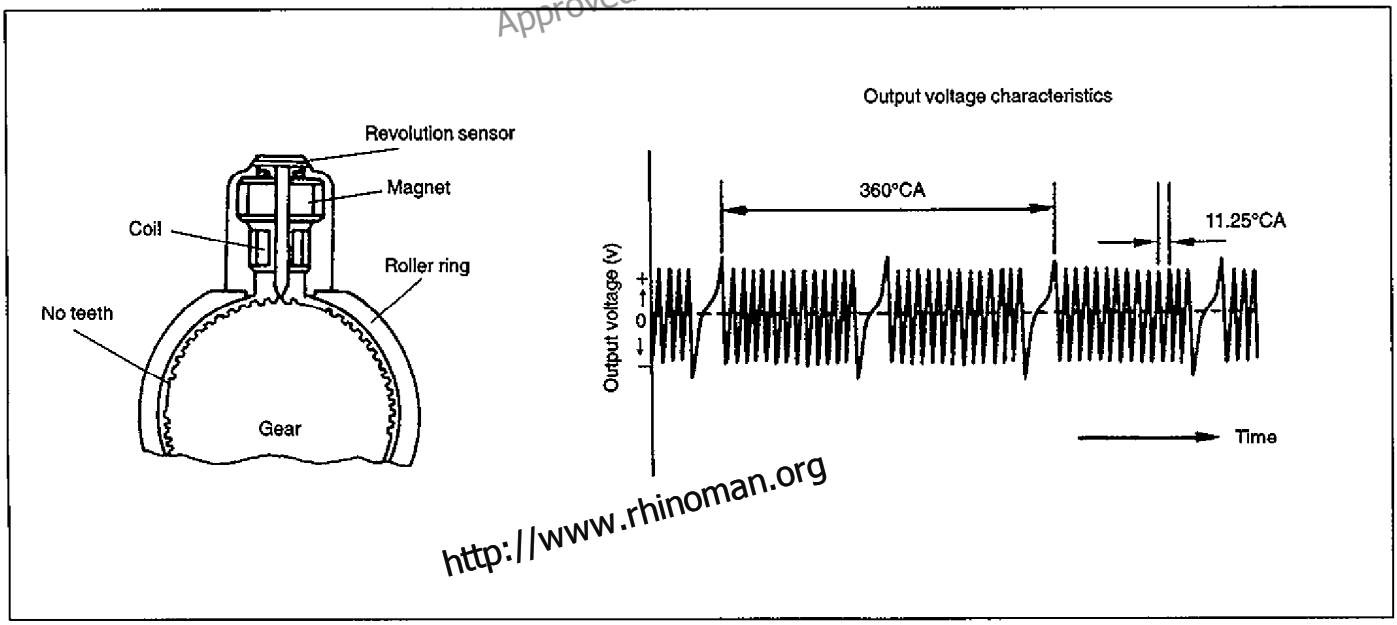
INTAKE AIR TEMPERATURE SENSOR (IAT SENSOR)

Located on the air cleaner, this sensor measures the temperature of the intake air and converts its change into that in resistance through the thermister.

By monitoring the resistance of the IAT sensor, the ECM detects the intake air temperature.

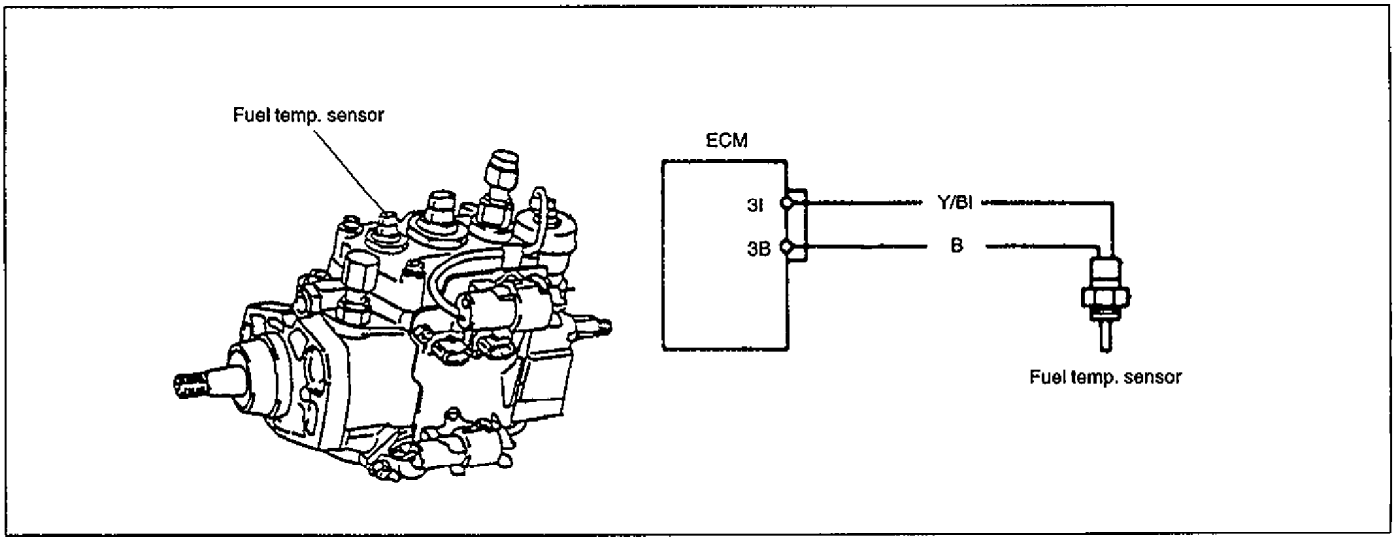
NE SENSOR

The NE sensor is installed on the roller ring in the fuel injection pump. The sensor is a signal generator which detects the relative speed of the roller ring and the drive shaft.
The NE sensor incorporates a magnet and a coil. When the gear rotates, magnetic flux which passes the coil increases, and alternating current is generated in the coil.
This alternating current is sent to the ECM and converted into pulse wave by the waveform shaping circuit.
The NE sensor is connected to ECM terminals 4G and 4F and detects fuel injection advance by comparing the engine speed and the following TDC sensor with the alternating current generated.
The gear has 56 teeth, with missing two teeth at four points, detects rotation angle at each 11.25°CA crank angle.



FUEL TEMPERATURE SENSOR

The fuel temperature sensor is installed in the fuel injection pump. By utilizing a thermistor of which resistance varies with temperature, the sensor detects temperature in the fuel injection pump.
One end of the sensor is connected to ECM terminal 3I and supplied with sensor voltage, and the other end is connected to ECM terminal 3B (sensor gound).
When the sensor temperature changes, thremistor resistance chages accordingly, and voltage applied to ECM terminal 3I changes.
The ECM detects this change in ECM 3I terminal voltage as fuel temperature.
The terminal voltage increases when the fuel temperature is low, and decreases when the fuel temperature is high.



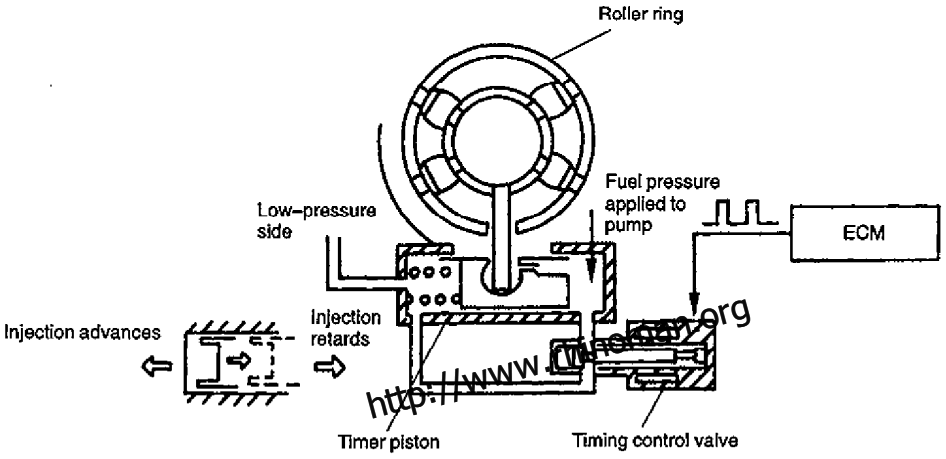
TIMER CONTROL VALVE (TCV)

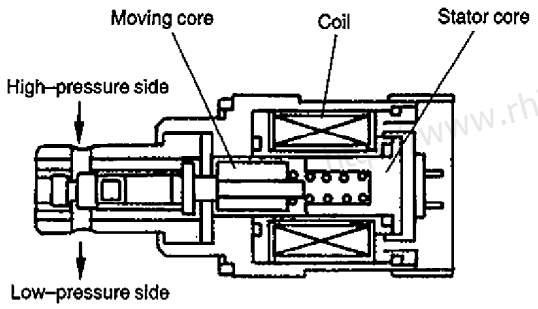
The timer control valve is installed in the fuel injection pump. According to the signals from the ECM, the valve opens/closes the fuel passage between the timer piston high–pressure chamber side and low–pressure chamber side.

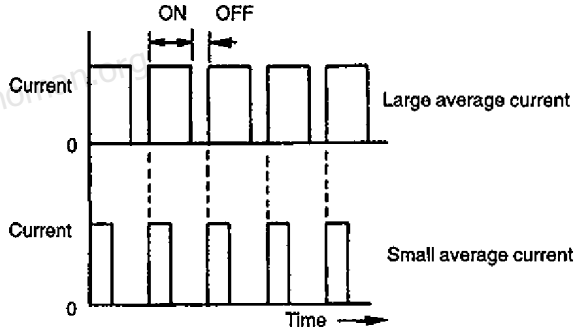
When the coil is energized, the spring is compressed by the moving core, thus the fuel passage opens.

One end of the timer control valve is connected to the main relay, and the other end is connected to ECM terminal 4W. Current flows to the stator core is duty controlled by this terminal, and as the ON time (time which ECM terminal 4W is grounded) becomes longer, the valve opening angle becomes wider.

When the timer control valve opening time becomes long, the feed pump fuel pressure which applied to the timer piston reduces, and the timer piston is moved to right in the figure by the spring force. Thus the roller piston which connected to the timer piston moves in the injection retard direction.





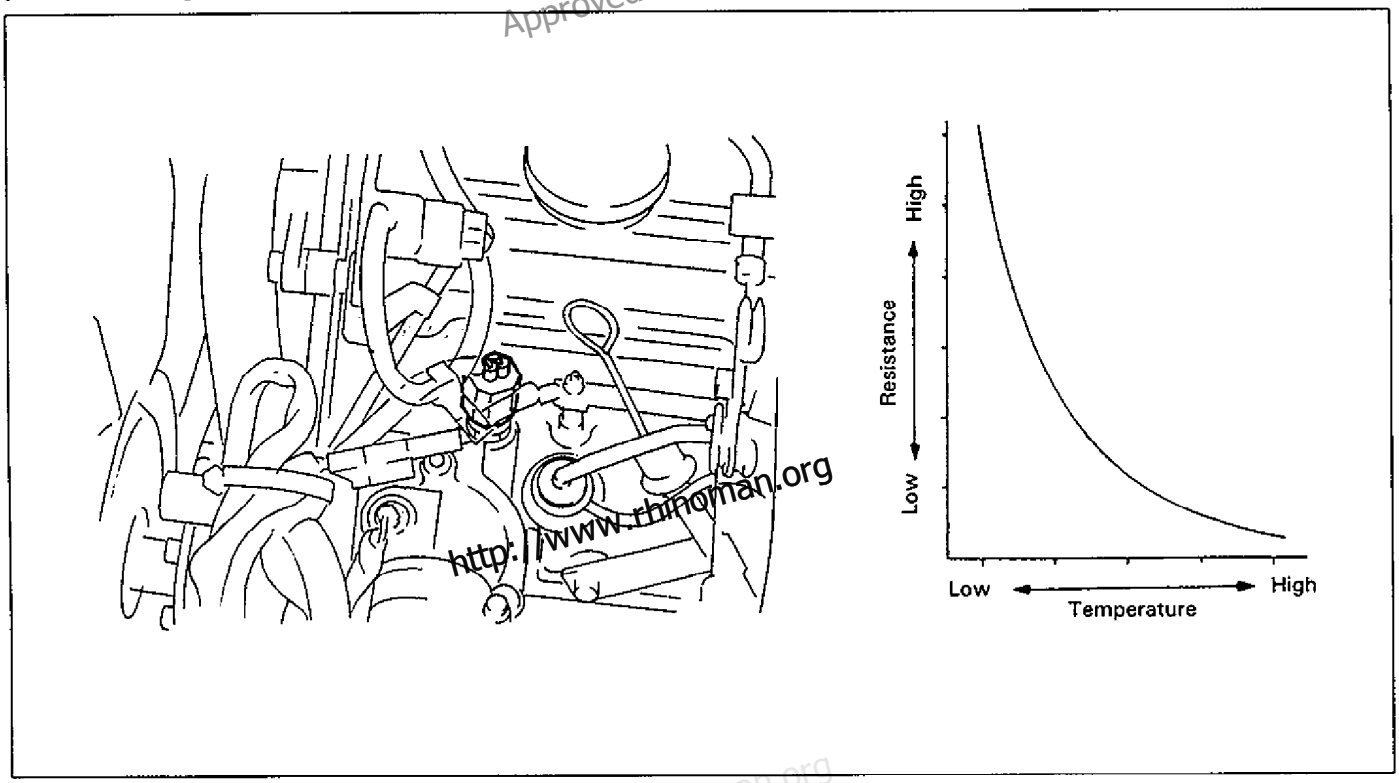


COMPENSATION RESISTANCE γ

The plunger angle signal, detected by the NE sensor, is used for the injection volume control. However, there is deviation between correlation of this signal and the injection pulse at each injection pump. This deviation affects the fuel injection volume. To compensated the deviation, compensation resistance γ is added for injection timing.

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is incorporated in the thermostat cap. By utilizing a thermistor of which resistance varies with temperature, the sensor detects the engine coolant temperature.
One end of the sensor is connected to ECM terminal 3G and supplied with sensor voltage, and the other end is connected to ECM terminal 3B (sensor gound).
When the sensor temperature changes, thremistor resistance chages accordingly, and voltage applied to ECM terminal 3G changes.
The controller detects this change in ECM 3G terminal voltage as engine coolant temperature.
The terminal voltage increases when the coolant temperature is low, and decreases when the coolant temperature is high.



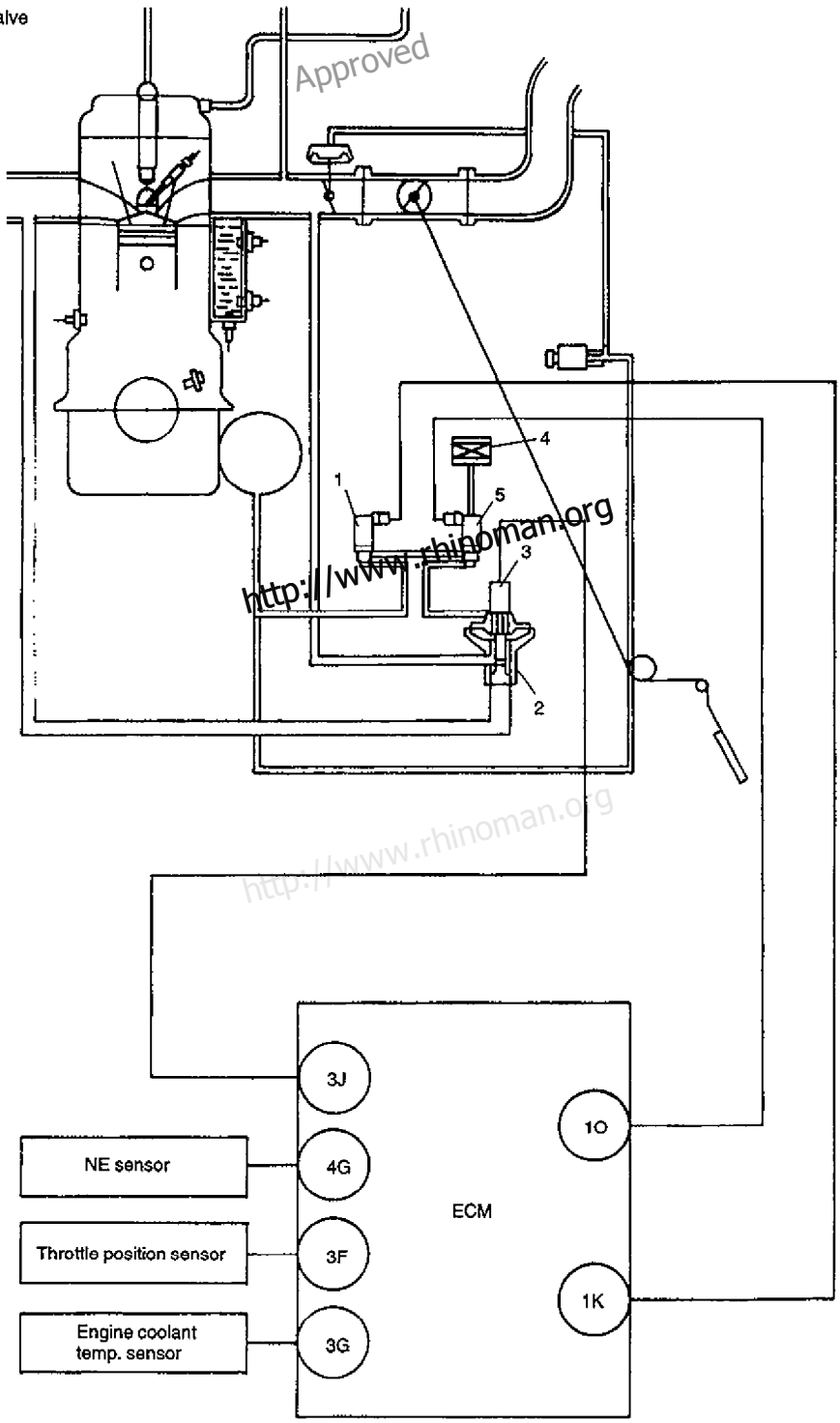
CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is fitted near the crankshaft pulley. By utilizing the projection on the signal plate at the rear side of the crankshaft pulley, the sensor generates one pulse per rotation of the engine.
The crankshaft position sensor is connected to ECM terminals 4I and 4J, and by detecting the pulse, the sensor detects the standard rotation angle.

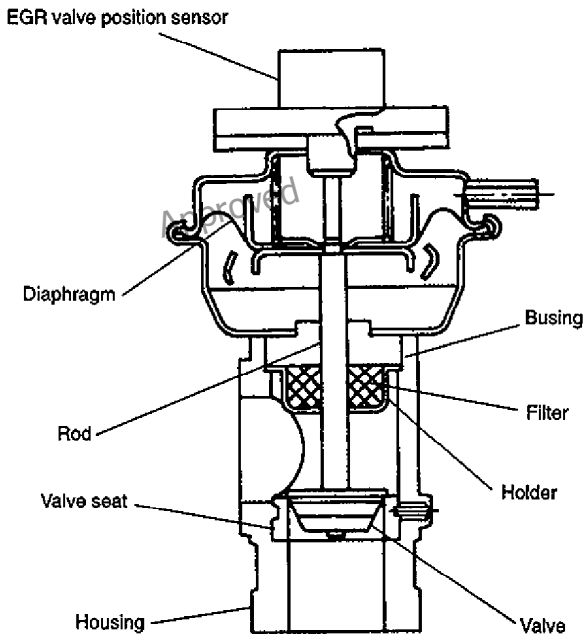
EGR CONTROL

The EGR control duty controls two soleoid valves (vacuum & vent) to control the EGR valve opening angle.

1. EGR solenoid vacuum valve
2. EGR valve
3. EGR position sensor
4. Air filter
5. EGR solenoid vent valve



EGR VALVE



Operation

The target EGR valve opening angle is determined based on the engine speed and the throttle valve opening angle.

By comparing this target value with the EGR valve position sensor signal, vacuum applied to the EGR valve is controlled by two duty solenoids so that the sensor signal becomes the target value.

To increase the EGR volume, the EGR solenoid valve (vacuum) is turned ON to increase vacuum working on the EGR valve, and the EGR valve opens. To decrease the EGR volume, the EGR solenoid valve (vent) is turned ON to decrease vacuum working on the EGR valve, and the EGR valve closes.

EGR control is inhibited when any of the following conditions is met:

1. Engine coolant temperature is 23°C or lower.
2. Throttle position sensor, EGR position sensor, NE sensor (open circuit only), and engine coolant temperature sensor have failed.

Duty control

The duty value is calculated using the following formula:

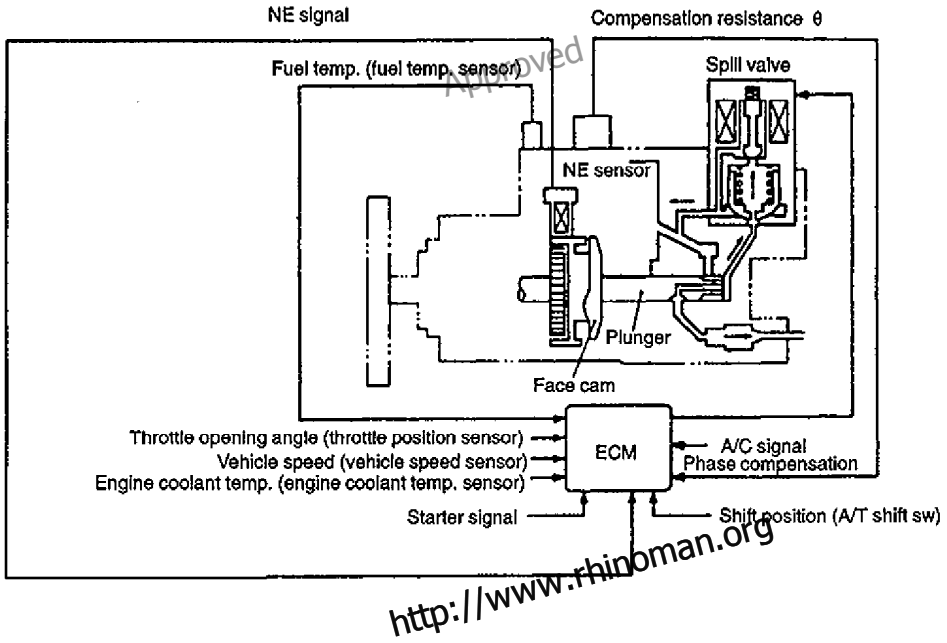
Duty value =Target EGR position value – Actual EGR position value

By subtracting the actual EGR position value from the target EGR position value (variation), the EGR valve opening angle is determined and the two solenoid valves are duty controlled accordingly.

When the variation is large, operation time of the solenoid valve (vacuum) becomes longer. When the variation is small, operation time of the solenoid valve (vent) becomes longer.

IDLE SPEED CONTROL

In the idle speed control, the ECM calculates the target idle speed according to the engine conditions, determines fuel injection volume from the FIP, and controls the idle speed.



Feedback control

When there is difference between the target idle speed calculated by the ECM and the actual idle speed while the throttle valve is fully closed, the ECM outputs signal to the spill valve to control the fuel injection volume and bring the actual idle speed to the target idle speed.

Fuel increase/decrease compensation control

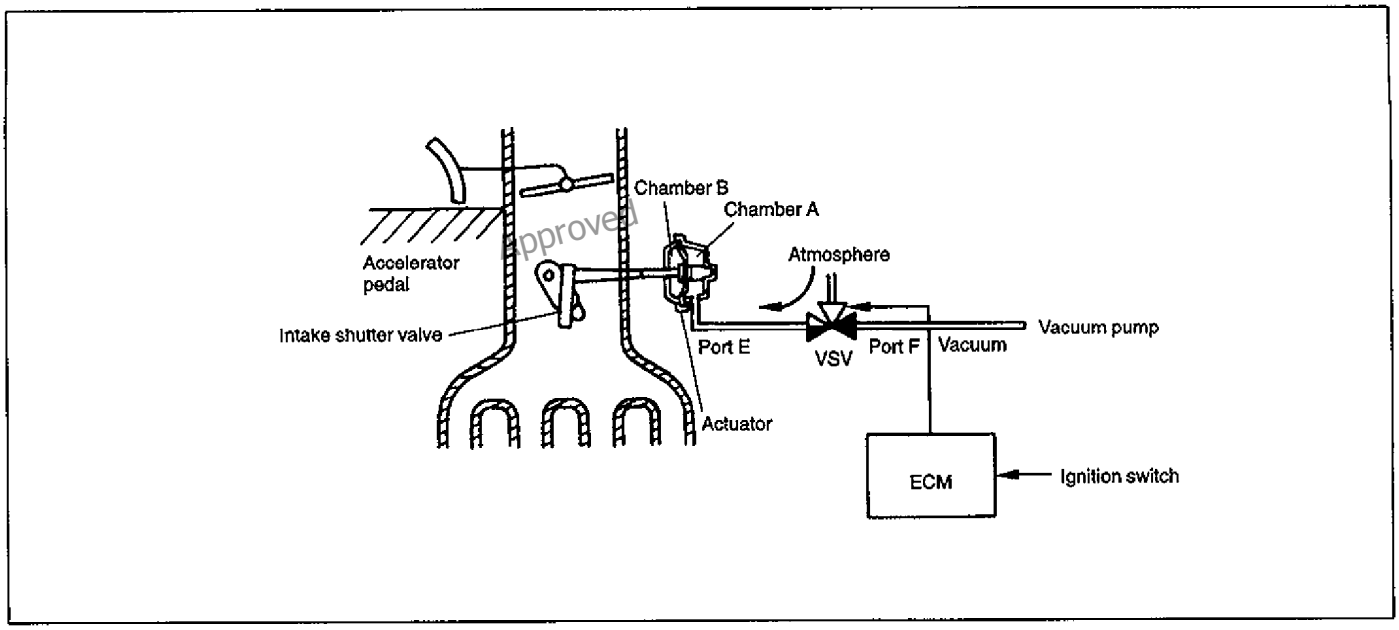
To prevent temporary change in the engine speed due to change in the A/C operation and engine load conditions, increase/decrease compensation of the fuel injection amount is carried out before the engine speed changes.

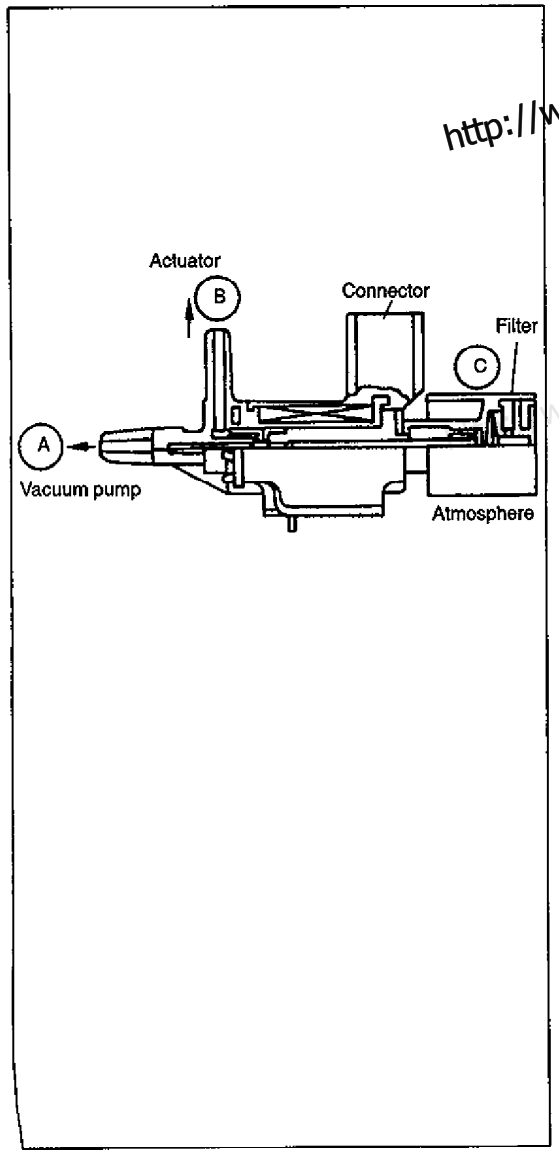
Engine speed change prevention control per cylinder

While the engine is idling, engine speed change in each cylinder is detected and fuel injection volume control is carried out for each cylinder.

INTAKE SOLENOID VALVE CONTROL

In the intake solenoid control, the intake shutter valve in the intake manifold is controlled in two stages (fully open, fully closed) to adjust the intake air volume.





INTAKE SHUTTER SOLENOID VALVE

According to the signal from the ECM, the intake shutter solenoid valve switches vacuum which acts on the intake shutter valve actuator and atmosphere.

Airflow condition

○—○ Airflow

	Ⓐ	Ⓑ	Ⓒ
Solenoid valve ON	○——	——○	
Solenoid valve OFF		○——	——○

	Intake shutter solenoid valve	Intake shutter valve actuator	Intake shutter valve
Engine idling	OFF	Atmosphere	Fully open
Engine running at high speed (Over 6,000 rpm)	ON	Vacuum	Fully closed
Ignition switch OFF and for 2 sec.	ON	Vacuum	Fully closed
Ignition switch ON	OFF	Atmosphere	Fully open

A/C CUT CONTROL (IF EQUIPPED)

The A/C cut control is carried out to maintain drivability of the vehicle when the engine is hot. The A/C relay is shut off for 4 seconds when any of the following conditions is met:

- Just after driving.
- Gear is in other than Neutral (P range) and throttle valve opening angle is over 20%.

A/C cut control is inhibited when the following conditions is met:

- Vehicle speed is 0 km/h.

SPILL VALVE RELAY CONTROL

The spill valve relay is energized for 0.2 seconds after the ignition switch is turned to OFF.

The spill valve relay will be turned off when the engine speed exceeded 5,800 rpm for 2 seconds.

IMMOBILIZER CONTROL (IF EQUIPPED)

When the immobilizer control system is actuated, the following controls will also be carried out. Refer to section 8 for the details.

Spill valve: OFF

Spill valve relay: OFF

Intake shutter valve: Fully closed

QUICK START SYSTEM (QSS) CONTROL

The QSS control controls the glow plug relay.
The glow plug relay is energized while the glow indicator light is illuminated, during quick glow control, long glow continuation control, and while the engine is cranking.

Glow indicator light control

The glow indicator light is illuminated for several seconds after the ignition switch is turned to ON to indicate that the QSS is operated and the engine can be started.
Illumination duration of the indicator light varies with the engine coolant temperature. (Refer to the table below.)
While the glow indicator light is illuminated, the glow plug relay also is energized.

Engine coolant temperature °C (°F)	Glow indicator light illumination duration (sec.)
60 (140)	1.6
40 (104)	1.8
20 (68)	2.6
0 (32)	3.8
–20 (–68)	5.6
–40 (–104)	7.4

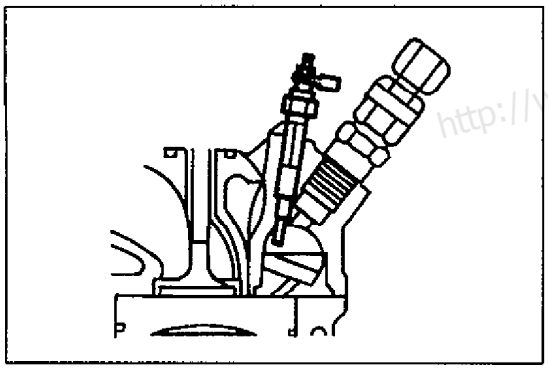
Quick glow control

To maintain engine startability during the engine is cold (engine coolant temperature below 60°C (140°F)), the glow relay will be energized for approx. 15 seconds when the ignition switch is left in ON position after the glow indicator light went out.
When the engine coolant temperature is over 60°C (140°F), the glow relay will be energized during cranking the engine.

Long glow continuation control

In the long glow continuation control, the glow plug will be energized for 10 minutes after cranking (just after engine start). The control will be inhibited when any of the following conditions is met:

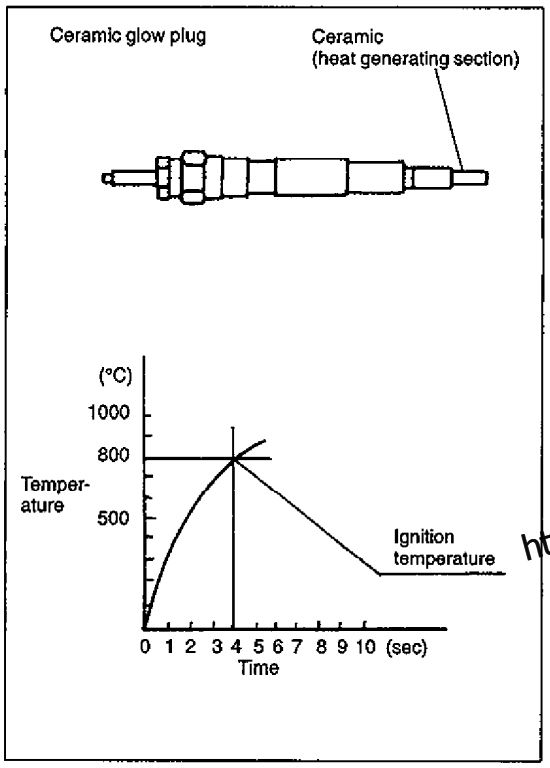
1. Engine coolant temperature is over 60°C (140°F).
2. Battery positive voltage exceeded 15 V.
3. Throttle valve opening angle exceeded a certain value or engine sped exceeded 2,000 rpm for over 30 seconds.
4. NE sensor, engine coolant temperature sensor, glow relay or throttle position sensor has failed.



GLOW PLUG

A glow plug is one of the starting aids that facilitate starting when the engine is cold.

The glow plug is installed in the swirl chamber in each cylinder head. With its heat coil heated red–hot, helps self ignition of the fuel injected into the combustion chamber.

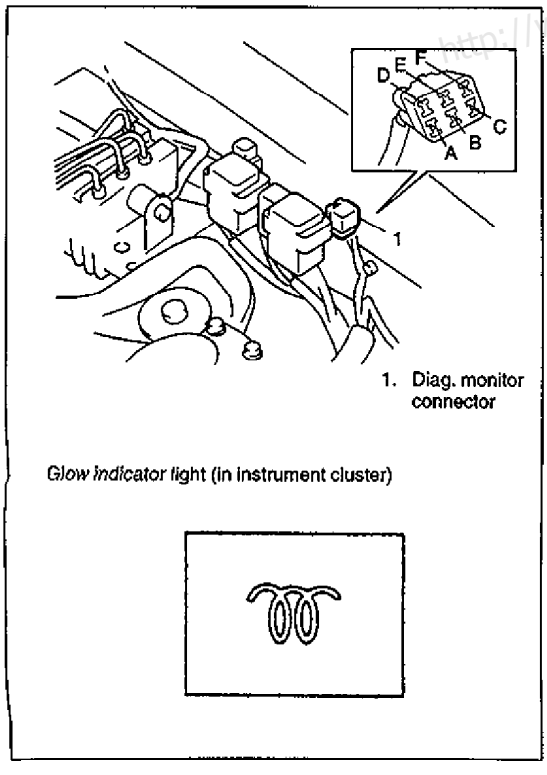


DIAGNOSIS FUNCTION

The ECM has two diagnosis functions; the self–diagnosis function for the engine and emission systems, and the fail–safe function.
Refer to section 8A for the self–diagnosis function for immobilizer control system, which is for the immobilizer control system–equipped vehicles only.

Self–diagnosis function (On–board diagnostic system)
Trouble detection of the input systems is carried out while the ignition switch is ON (include while the engine is running).
When a problem is detected, the glow indicator light flashes or illuminates while the ignition switch is ON (include while the engine is running) to indicate the presence of the problem.

Fail–safe function
When an input sensor has failed, the fail–safe function switches the input signal value of the failed sensor to the preset value in the ECM memory, so that the vehicle's drivability is maintained.



1. Diag. monitor connector

Glow indicator light (in instrument cluster)

Diagnosis connector
By connecting diagnosis connector terminals A and C with a service wire while the ignition switch is ON, diagnostic trouble code(s) stored can be retrieved by the number of flashes of the glow indicator light in the instrument cluster.
When all systems monitored are detected normal, diagnostic trouble code 12 will be indicated by the flash of the glow indicator light when coupler terminals A and C are connected with a service wire.

Diagnostic trouble code storage/clearance
The diagnostic trouble code(s) detected will be stored in the ECM memory when the ignition switch is ON and the engine is not cranking.
The diagnostic trouble code(s) stored in the ECM memory can be deleted by disconnecting the battery cable.

ON–VEHICLE SERVICE

IDLE SPEED ADJUSTMENT

1) Shift transmission into Neutral (MT) or P range (AT).
2) Start engine and warm it up to normal operating temperature.
3) Turn all electrical loads off.
4) Using tachometer, verify that idle speed is within specification.

Specification
720–820 (770 ± 50) rpm

5) If not, refer to troubleshooting "Rough idle".

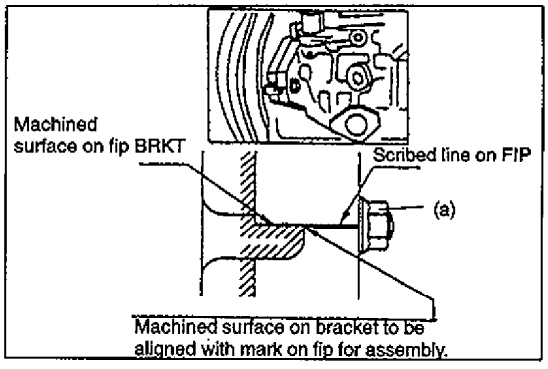
IDLE–UP SPEED ADJUSTMENT

1) Shift transmission into Neutral (MT) or P range (AT).
2) Start engine and warm it up to normal operating temperature.

3) Turn all electrical loads off.
4) Perform idle speed adjustment.
5) Operate A/C and verify that engine speed is within specification.

Specification
750–850 (800 ± 50) rpm

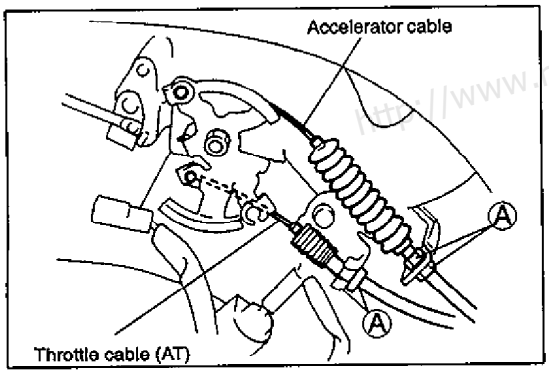
6) If not, refer to troubleshooting "Rough idle".



INJECTION TIMING ADJUSTMENT

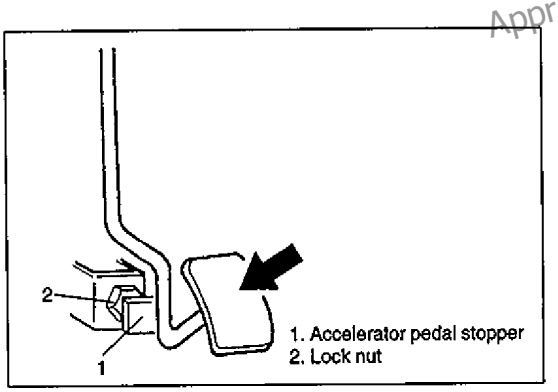
1) Loosen two fuel injection pump (FIP) mounting nuts and one bolt.
2) Align matching marks on FIP bracket and on FIP.
3) Tighten FIP mounting nuts and bolt.

Tightening torque
(a) : 22 N·m (2.2 kg–m, 15.9 lb–ft)

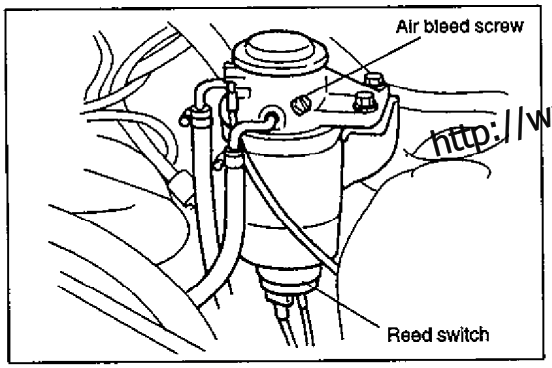


ACCELERATOR CABLE, THROTTLE CABLE INSPECTION

1) Warm up engine (engine coolant temp. 60°C (140°F) or over) and check cable play.
   Cable play: 1—3 mm (0.04—0.11 in)
2) If measured value is out of specification, adjust with nut (A).



3) Depress accelerator pedal by hand and verify that the control lever contacts idle stopper and maximum stopper.
4) If not, adjust accelerator pedal stopper bolt so that control lever contacts maximum stopper.



WATER DRAINING OF FUEL SYSTEM

Sedimentor Water Draining

When sedimantore warning lamp is illuminated, drain water from sedimentor in following procedure.

1) Loosen reed switch at bottom of fuel filter.
2) Loosen air bleeder screw.
3) Drain water and tighten reed switch.
4) Tighten air bleeder screw.

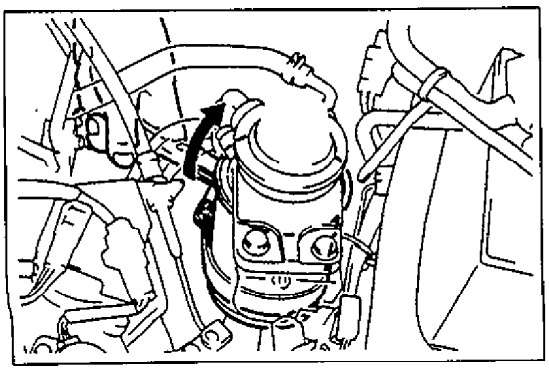
AIR BLEEDING OF FUEL SYSTEM

Air Bleeding

- Air bleeding must be carried out when fuel system has been disassembled or when vehicle ran out of fuel.

CAUTION:
Continuously cranking engine for over 30 seconds can damage battery and the starter.

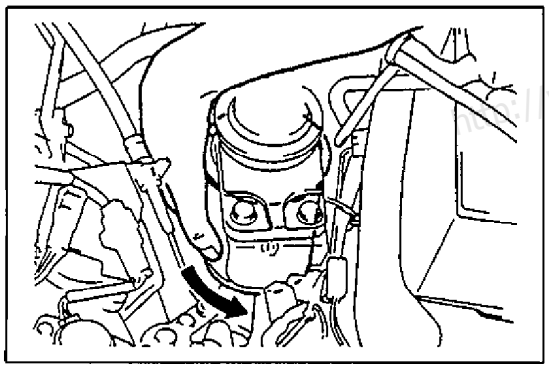
- Repeat cranking engine for 30 seconds and stop for 5—10 seconds until engine starts.



REPLACEMENT OF FUEL FILTER CARTRIDGE

Removal

1) Disconnect battery.
2) Disconnect fuel level sensor connector.
3) Loosen drain plug at the bottom of fuel filter and drain fuel.
4) Using a filter wrench, remove filter cartridge.



Installation

1) Apply small amount of fuel to new filter cartridge O-ring.
2) Fully tighten cartridge by hand, not by filter wrench.
3) Install new O-ring and fully tighten sensor body by hand.
4) Connect fuel level sensor connector.
5) After installation, bleed air in fuel and verify that there is no fuel leakage.

DIESEL SMOKE

Inspection

1) Completely warm up engine and set a diesel smoke tester (opacimeter).

CAUTION:
Insert tester probe into downstream of exhaust pipe as far as possible.

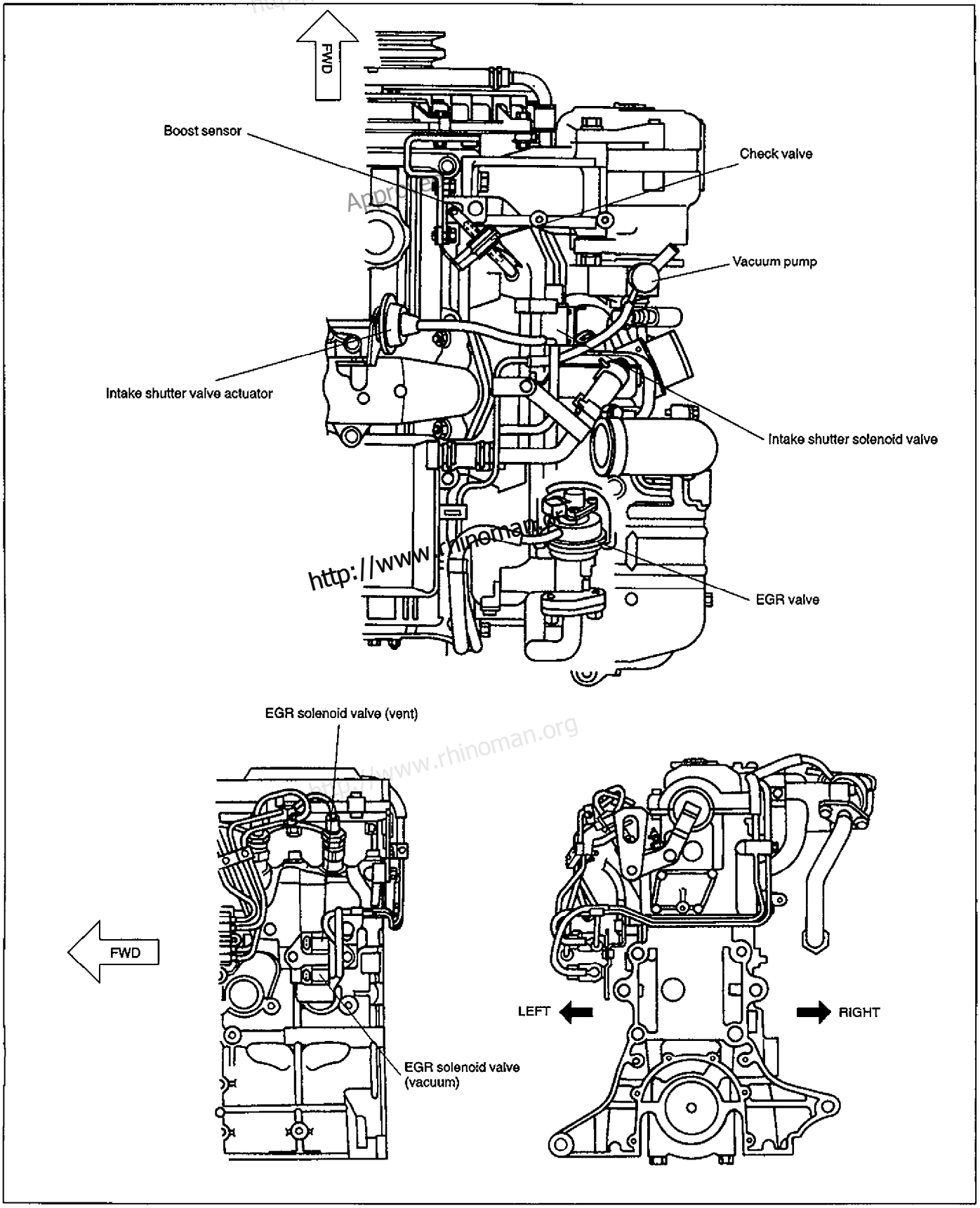
2) While engine is still hot, perform following steps at least 6 times.
   Ⓐ Shift gear in neutral.
   Ⓑ Keep engine idle for a while.
   Ⓒ Fully depress accelerator pedal at once, and when maximum engine speed is obtained, release accelerator pedal.
   Ⓓ In above condition, note maximum absorption coefficient.
   Ⓔ Let engine idle until opacimeter returns to initial condition.
3) For absorption coefficient judgement, average 4 coefficient values measured after it has been stabilized.

   Absorption coefficient concentration: 1.56 m^{-1} max.

4) If not within specification, inspect the air cleaner element, injection timing, fuel injection nozzle, and fuel injection pump.

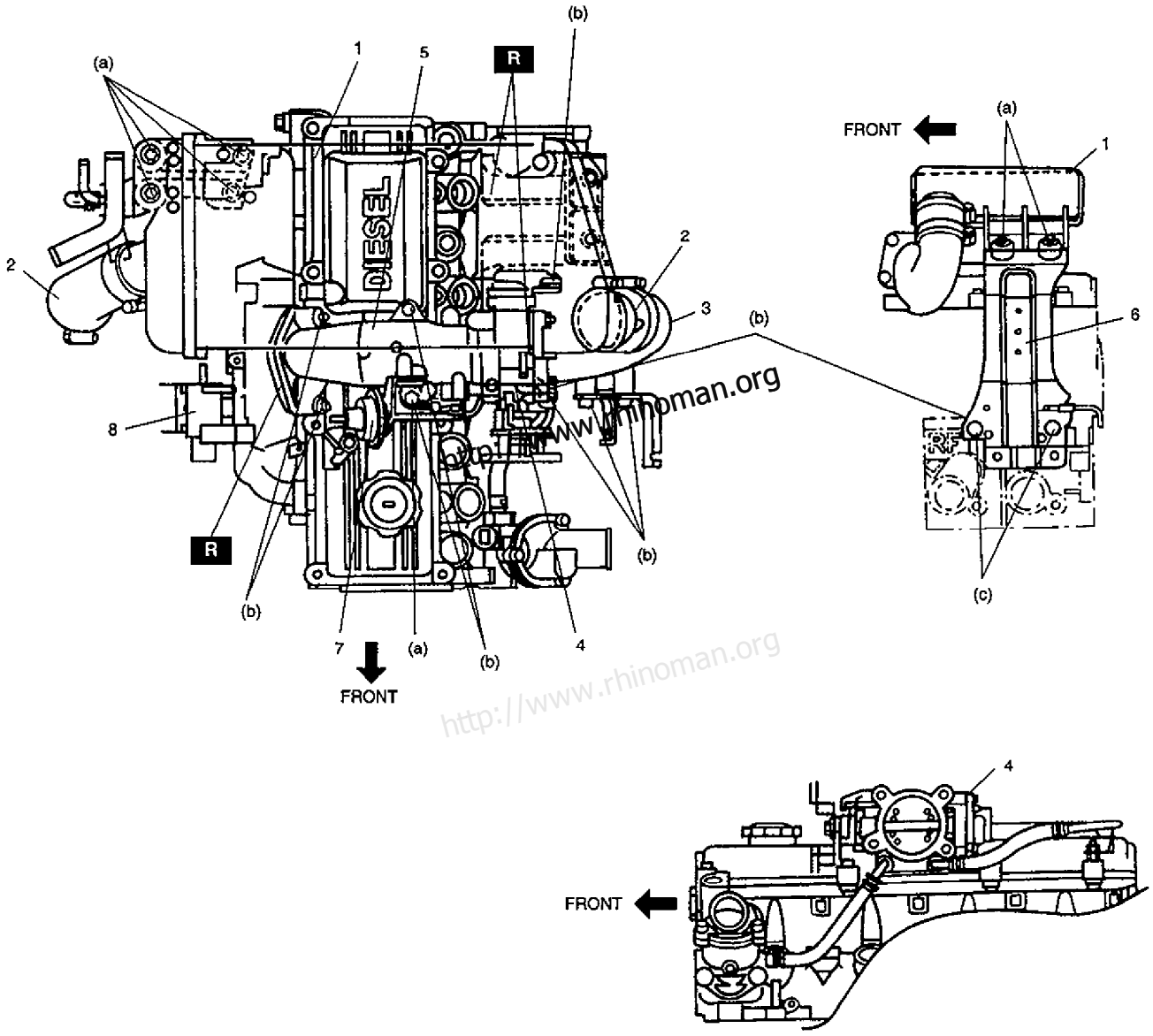
AIR INTAKE SYSTEM

VACUUM HOSE ROUTING DIAGRAM



AIR INTAKE SYSTEM REMOVAL/INSTALLATION

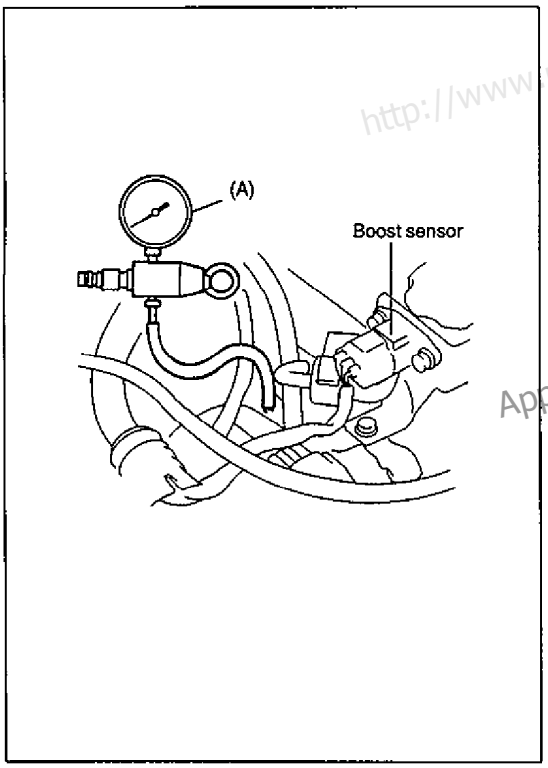
1) Disconnect negative battery cable.
2) Remove in order shown in figure.
3) Install in reverse order of removal.



1. Intercooler
2. Air hose
3. Air intake pipe
4. Throttle body
5. Air intake pipe
6. Intercooler bracket
7. Intake shutter valve actuator
8. Intake shutter solenoid valve

Tightening Torque
(a) : 9 N·m (0.9 kg–m, 6.5 lb–ft)
(b) : 22 N·m (2.2 kg–m, 15.9 lb–ft)
(c) : 45 N·m (4.5 kg–m, 32.5 lb–ft)

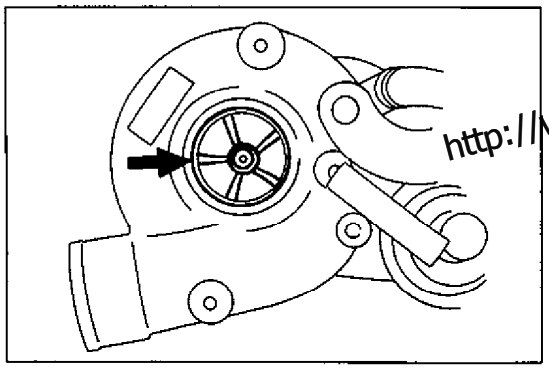
R : Replace



TURBOCHARGER

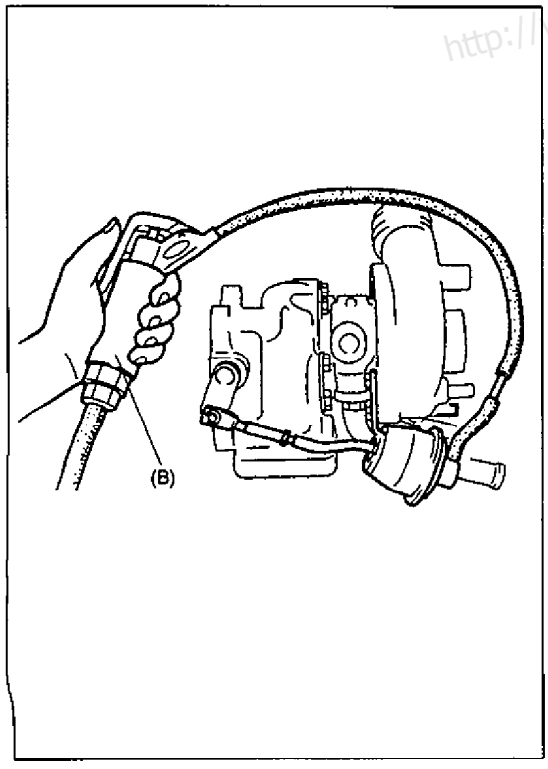
Charging pressure inspection

1) Disconnect vacuum hose between intake manifold and boost sensor at intake manifold side, and install special tool.
   Special Tool
   (A) : 09918–18110
2) Start engine and warm it up to normal operating temperature.
3) While applying full load to engine (throttle valve fully open), measure charging pressure.
   Specification
   78.3–84.9 kPa (587–637 mmHg)
   (Engine speed: 2,500 rpm)
4) If not as specified, check intake/exhaust system for leakage. If there is no leakage, check wastegate valve actuator. If actuator is normal, inspect turbocharger.



Turbocharger inspection

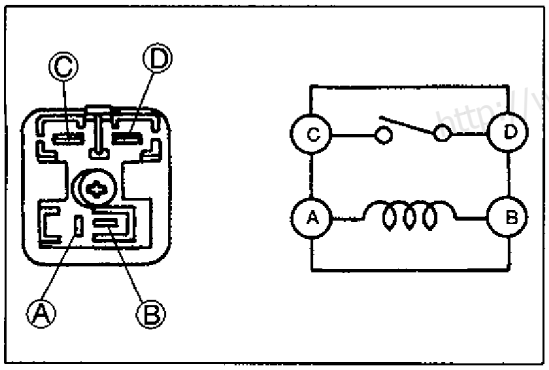
1) Remove turbocharger. (Refer to section 6A3, "INTAKE AND EXHAUST SYSTEM".)
2) Rotate turbine shaft by hand and verify that it turns smoothly without any abnormal noise and excessive runout.
3) If not as specified, replace the turbocharger.



WASTEGATE VALVE

1) Disconnect boost air hose.
2) Install special tool and apply compressed air.
   Special Tool
   (B): 09918–18110
3) Verify that wastegate actuator pulls rod at specified pressure.
   Pressure
   96–100 kPa (0.96–1.00 kg/cm^2, 13.7–14.22 psi)
4) If not, replace turbocharger. (Refer to section 6A3, "INTAKE AND EXHAUST SYSTEM".)

CAUTION:
Do not apply more than 110 kPa (1.1 kg/cm^2, 15.6 psi) pressure.



GLOW PLUG RELAY INSPECTION

1) Remove glow plug relay.
2) Using a circuit tester, verify that continuity between relay terminals is as specified below.

○—○ : Continuity V_B: Battery positive voltage

Step \ Terminal	A	B	C	D
1	○——	——○		
2	V_B	Ground	○——	——○

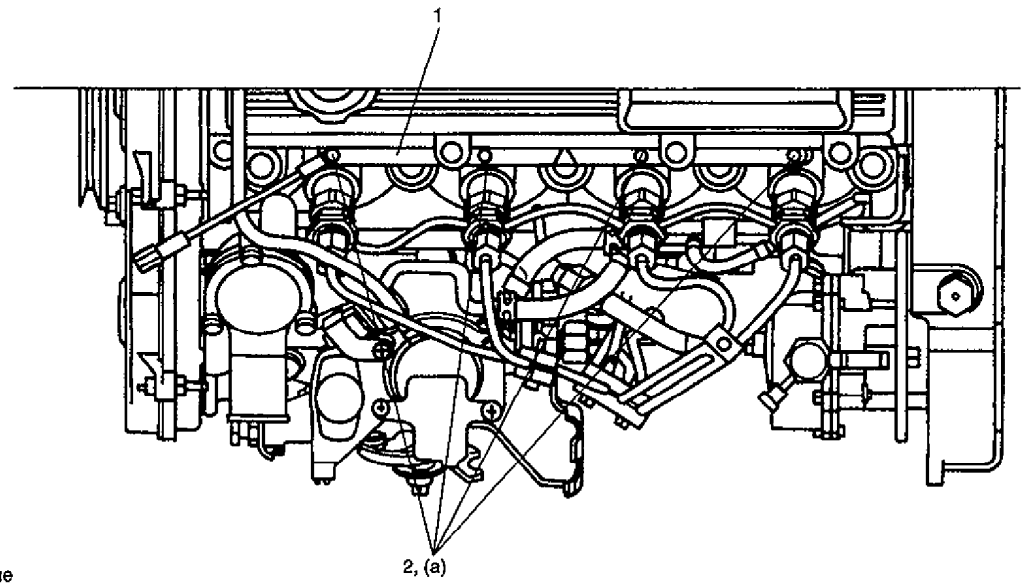
3) If not as specified, replace glow plug relay.

GLOW PLUG

REMOVAL/INSTALLATION

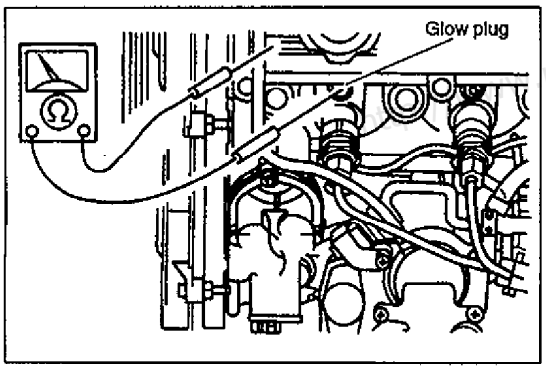
CAUTION:
- **Do not damage heating section of the glow plug.**
- **Do not use glow plug that has been dropped from height of over 10 cm (4 in).**
- **When removing glow plug, first loosen it by using a tool so that one or more screw threads remain engaged, then loosen and remove by hand.**

1) Disconnect negative battery cable.
2) Remove in order shown in figure.
3) Install in reverse order of removal.



1. Glow cord
2. Glow plug

Tightening Torque
(a) : 17 N·m (1.7 kg–m, 12.3 lb–ft)



INSPECTION

1) Disconnect glow plug cord, and measure resistance between glow plug positive terminal and cylinder head.

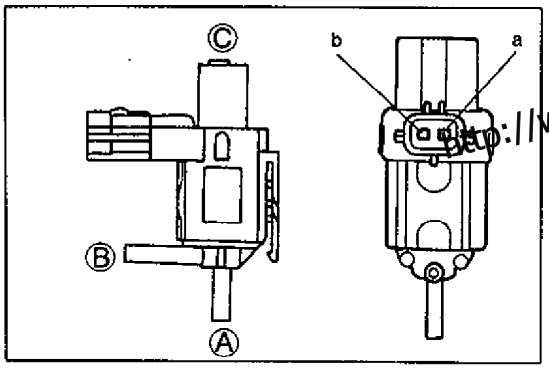
Resistance:
2Ω max.

2) If resistance is not within specification, replace glow plug.

INTAKE SHUTTER SOLENOID VALVE

Inspection

1) Remove intake shutter solenoid valve.



2) Check for airflow between ports of solenoid valve.

○—○ : Continuity ○═○ : Airflow

Step	Terminal		Port		
	a	b	A	B	C
1	○	○		○	○
2	12V	Ground	○	○	

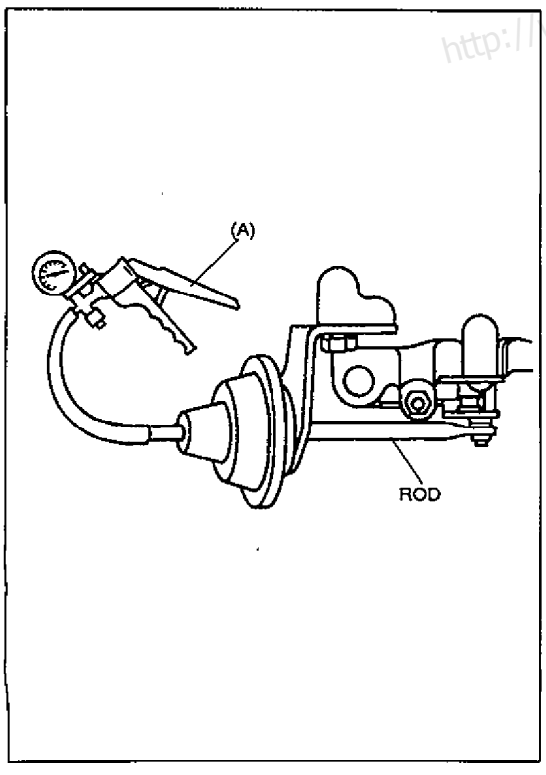
3) If not as specified, replace intake shutter solenoid valve.

INTAKE SHUTTER VALVE ACTUATOR

Inspection

1) Connect a vacuum pump gauge (Special Tool) to intake shutter valve actuator.

Special Tool
(A): 09917–47910



2) Gradually increase vacuum and check for rod operation.

Specification
Rod operation starting vacuum:
0—3.6kPa (0—0.036 kg/cm^2, 0—0.51 psi)
Rod operation completion vacuum:
–25.6—27.8 kPa
(–0.256—0.278 kg/cm^2, –3.64—3.95 psi)

3) If not as specified, replace air intake pipe.

QUICK START SYSTEM (QSS) CONTROL

System inspection

If engine startability is poor while engine is cold, or the QSS has failed, check following systems. If there is a problem, inspect and repair or replace as necessary, referring to Diagnostic index.

1) When ignition switch is turned to ON
   When engine coolant temperature is lower than 60 °C (140 °F), glow plug relay is energized for approx. 15 seconds after glow indicator lamp went out, then repeats ON-OFF cycle for approx. 15 seconds.
   When engine coolant temperature is higher than 60 °C (140 °F), energization of glow plug relay and ON–OFF cycle are inhibited.
2) While cranking engine
   Glow plug relay will be energized by ON-OFF cycle.
3) After engine start
   When engine coolant temperature is lower than 60°C (140 °F), glow plug relay is energized for approx. 10 minutes.
   When engine coolant temperature is higher than 60°C (140 °F), energization of glow plug relay is inhibited.

Diagnostic index

SYMPTOM	POSSIBLE CAUSE	ACTION
No voltage applied to glow plug	• Faulty battery contact • Faulty ignition switch of switch contact • Burned "ON" circuit fusible link or fuse (15A) • Faulty "ON" circuit contact • Faulty ground circuit contact • Burned glow plug circuit fusible link • Glow plug relay will not turn "ON"	Repair Repair or replace Replace Repair Repair Replace Repair or replace
Glow plug relay will not turn "ON"	• Faulty glow plug relay • Poor contact or disconnection of glow plug relay coupler • Faulty ECM • Poor contact or disconnection of ECM coupler	Replace Repair Replace Repair
Glow plug relay will not turn "OFF" after several seconds	• Faulty glow plug relay • Faulty ECM • Poor contact or disconnection of ECM coupler	Replace Replace Repair

FUEL DELIVERY SYSTEM

WARNING

- **Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel. Fuel line spills and leaks are dangerous. Fuel can ignite and cause serious injuries or death and damage.**
- **Fuel can also irritate skin and eyes. To prevent this, always complete following "Fuel Line Safety Procedures".**

PRECAUTION

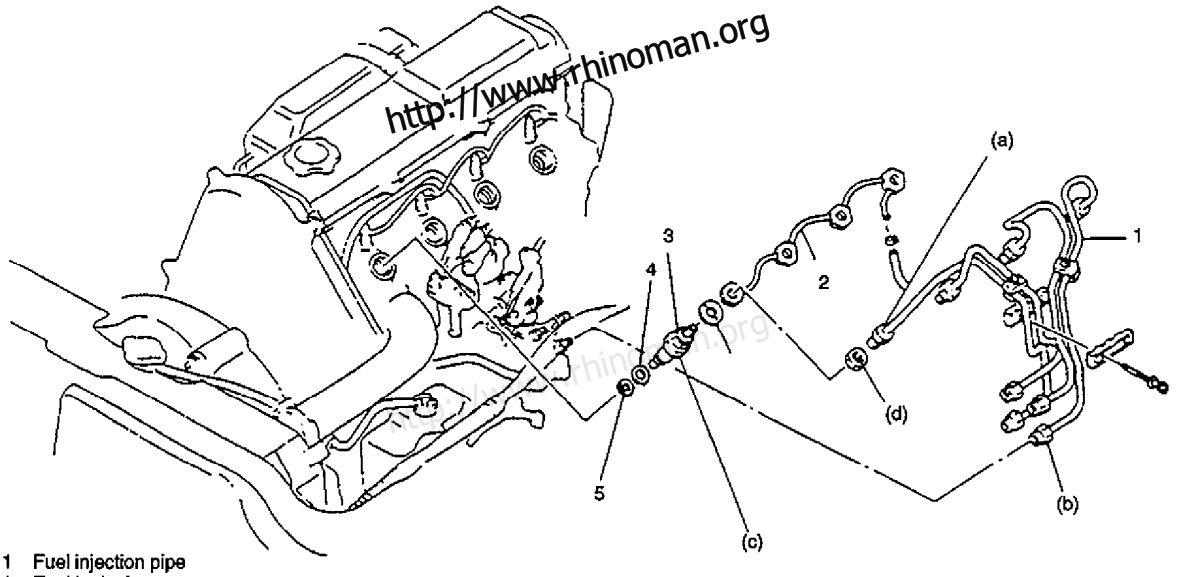
Fuel line safety procedures

- Before disconnecting a fuel hose, remove fuel filler cap to release pressure in fuel tank.
- When disconnecting a fuel hose, wrap rag around it to protect against fuel leakage. Plug disconnected hose.

INJECTION NOZZLE

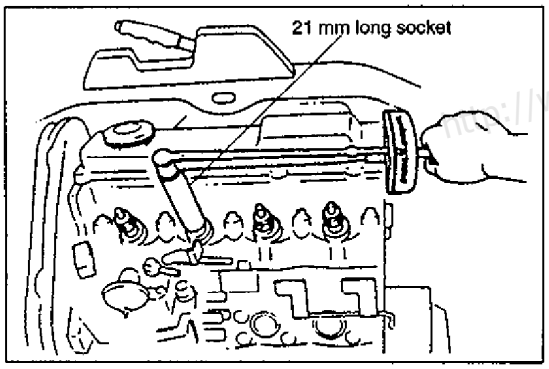
Removal / installation

1) Disconnect negative battery cable.
2) Remove intercooler, air hose, and air intake pipe.
3) Remove in order indicated in figure, referring to "Fuel Line Safety Procedures" and Removal Note.
4) Install in reverse order of removal, referring to Installation Note.



1 Fuel injection pipe
2 Fuel leak pipe
3 Fuel injection nozzle
4 Nozzle washer
5 Corrugate gasket

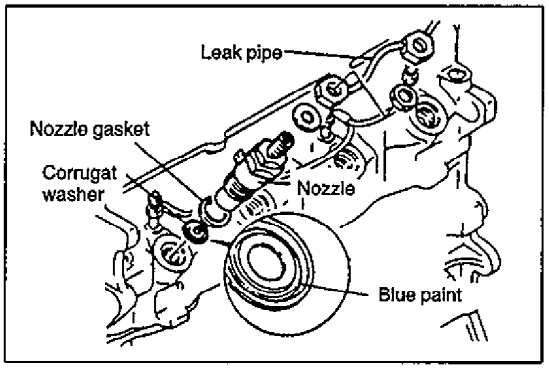
Tightening torque
(a) : 30 N·m (3.0 kg–m, 21.7 lb–ft)
(b) : 27 N·m (2.7 kg–m, 19.5 lb–ft)
(c) : 64 N·m (6.4 kg–m, 46.3 lb–ft)
(d) : 29 N·m (2.9 kg–m, 21.0 lb–ft)



Removal / Installation Note

- Remove injection nozzle by using a socket wrench (with 21 mm) long socket. When installing, tighten them to specified torque.

Tightening Torque:
64 N·m (6.4 kg-m, 46.3 lb-ft)

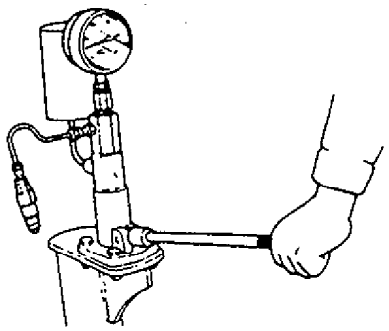


- Corrugated gasket must be installed with marked side (blue paint) facing upward.

Inspection
Injection starting pressure

WARNING:

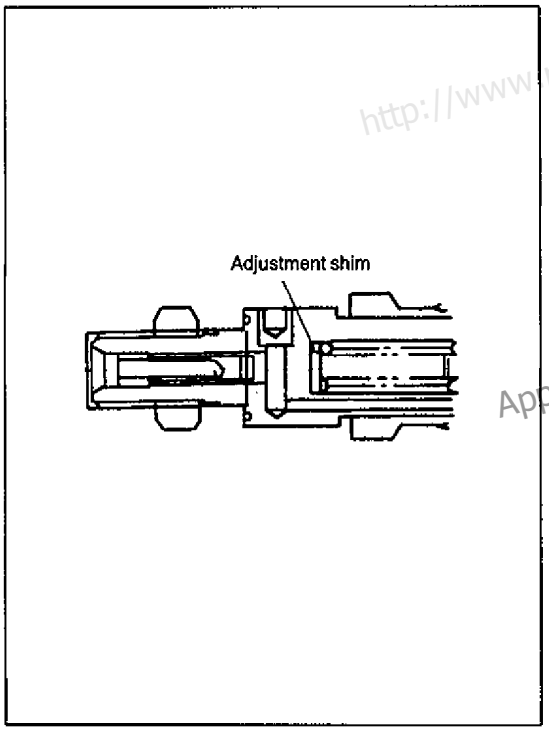
- **Fuel vapor injected from injection nozzle is under high pressure. Never touch it in order to avoid being injured.**
- **Fuel vapor is highly flammable. Keep it from any open flames including cigarrets.**



CAUTION:
Fuel and fuel tank used for nozzle tester must be clean in order to prevent foreign material from being binded in nozzle seal.

1) Install injection nozzle to nozzle tester.
2) Move pump lever of tester up and down several times to bleed air.
3) Slowly press pump lever to build up pressure and note pressure at moment when pressure gauge needle suddenly dropped.

Injection starting pressure (Reused nozzle):
14.7 MPa (150 kg/cm^2, 2133 psi)

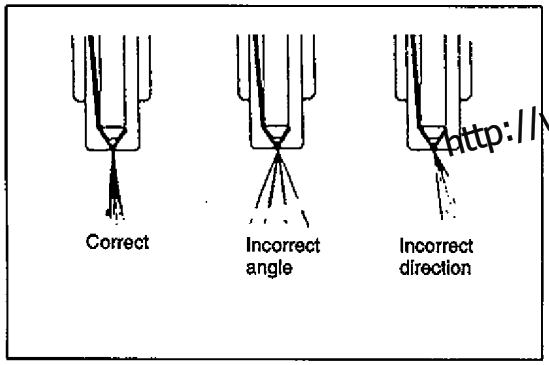


4) If not as specified, disassemble injection nozzle and adjust pressure by replacing adjustment shim.

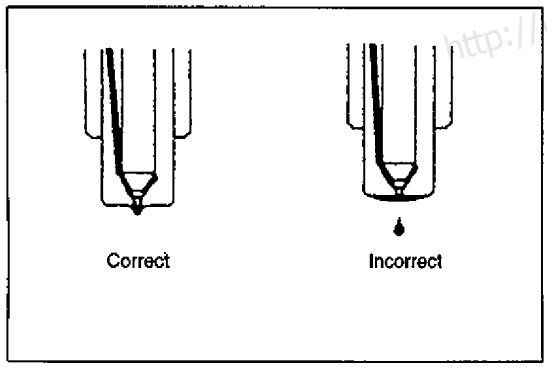
NOTE:
Adjustment shims are available in 20 different thicknesses. Using one size (0.05 mm (0.0020 in.)) thicker/thinner shim changes starting pressure approx. 980 kPa (9.8 kg/cm^2, 139 psi).

Adjustment Shims **mm (in.)**

1.00 (0.039)	1.40 (0.055)	1.80 (0.071)
1.05 (0.041)	1.45 (0.057)	1.85 (0.073)
1.10 (0.043)	1.50 (0.059)	1.90 (0.075)
1.15 (0.045)	1.55 (0.061)	1.95 (0.077)
1.20 (0.047)	1.60 (0.063)	–
1.25 (0.049)	1.65 (0.065)	–
1.30 (0.051)	1.70 (0.067)	–
1.35 (0.053)	1.75 (0.069)	–



Atomization condition inspection
1) Stop operation of pressure gauge of nozzle tester.
2) Operate pump lever 2 or 3 times and check injector atomization condition.
3) If not normal, disassemble and clean injection nozzle, recheck atomization condition, and replace nozzle if necessary.

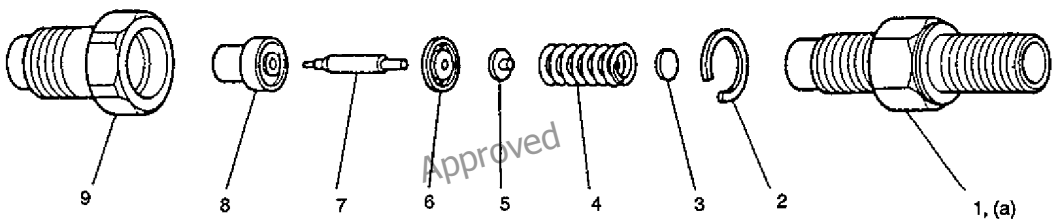


Valve seat oil tightness inspection
1) Slowly press pump lever to apply pressure to injection nozzle. Check if fuel leaks from injection port of nozzle when pressure gauge indicated specified pressure.

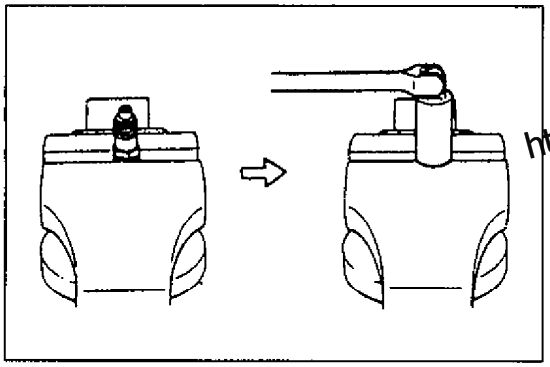
Pressure: 12.7 MPa (127 kg/cm^2, 1806 psi)

2) If fuel leaks, disassemble and clean injection nozzle, recheck fuel leakage, and replace nozzle if necessary.

Disassembly



1 Nozzle holder body
2 Ring
3 Shim
4 Nozzle spring
5 Spring seat
6 Spacer
7 Needle valve
8 Nozzle body
9 Retaining nut



Disassembly

Disassembly / Assembly Note

Retaining nut and nozzle holder

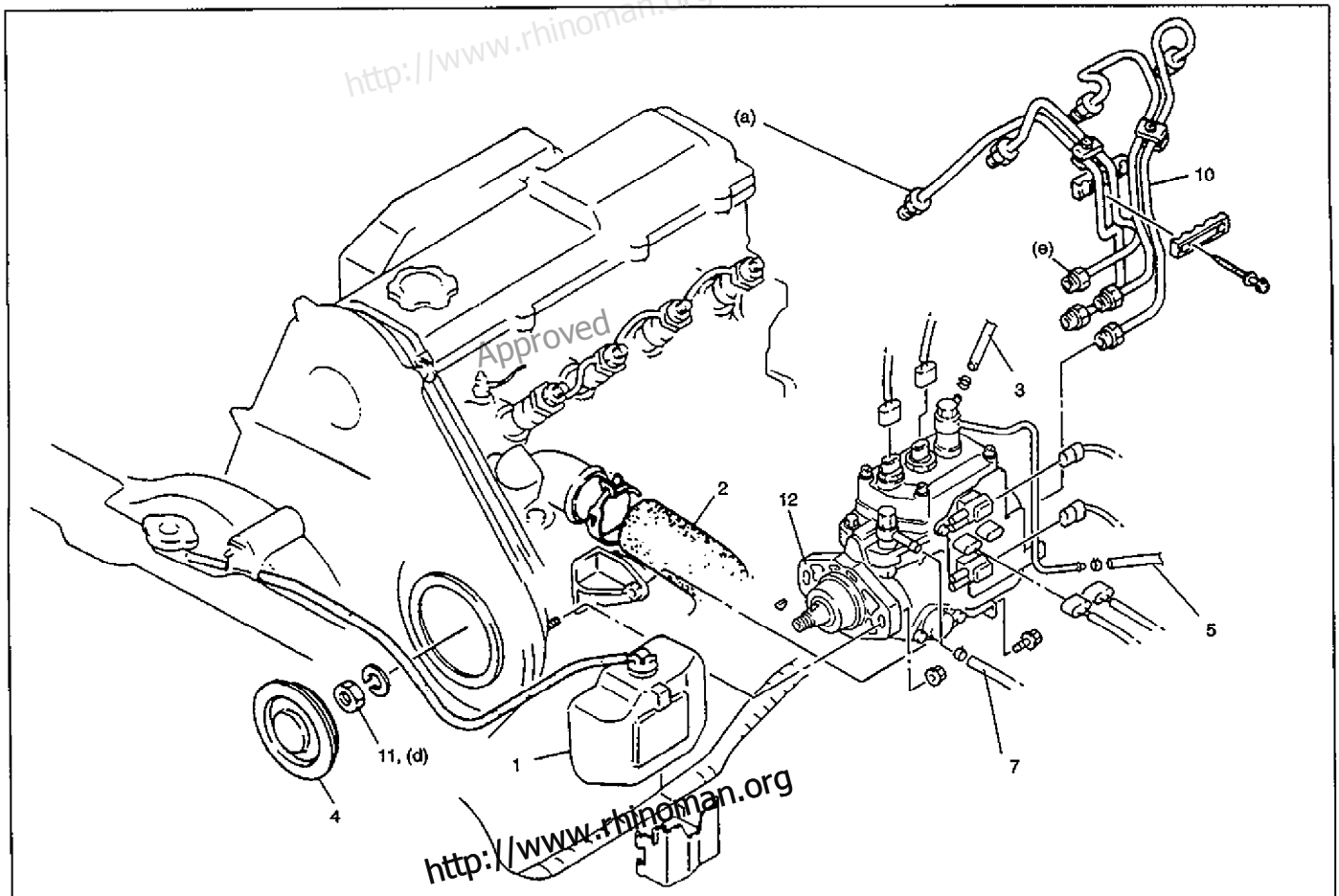
- Remove/install retaining nut and nozzle holder by using a socket wrench (with 21 mm) long socket. When installing, tighten nut to specified torque.

Tightening Torque:
37 N·m (3.7 kg-m, 26.8 lb-ft)

Nozzle body and needle valve

- When either nozzle body or needle valve has failed and need to be replaced, both of them must be replaced as a set.
- Sub injection port must be kept free of dust and other foreign material because it is very small.

INJECTION PUMP



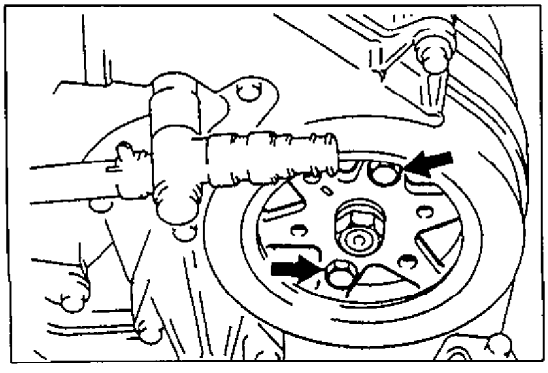
1 Reserve tank
2 Radiator inlet hose
3 Fuel leak hose (From fuel leak pipe)
4 Injection pump, service hole cap
5 Fuel return hose (To fuel fank)
6 Blank
7 Fuel hose (From fuel tank)
8 Blank
9 Blank
10 Injection pipe
11 Injection pump pulley lock nut
12 Injection pump

Tightening Torque
(a): 30 N·m (3.0 kg-m, 21.7 lb-ft)
(b): 22 N·m (2.2 kg-m, 15.9 lb-ft)
(c): 45 N·m (4.5 kg-m, 32.5 lb-ft)
(d): 65 N·m (6.5 kg-m, 47.0 lb-ft)
(e): 27 N·m (2.7 kg-m, 19.5 lb-ft)

NOTE:
Overhaul of injection pump requires use of special tools and testers, and therefore, pump is sealed to prevent unauthorized service.

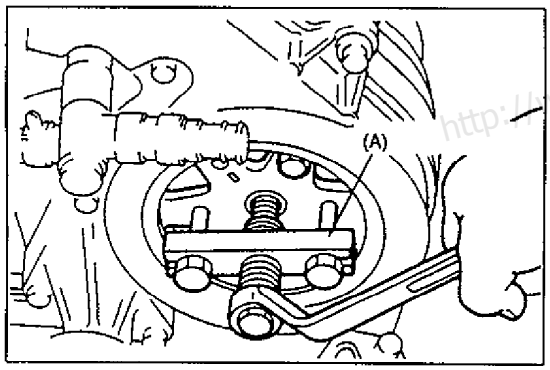
Removal

1) Position No.1 cylinder to compression TDC and remove timing belt.



2) Fix pump pulley by using two bolts as shown, and remove pulley locknut.

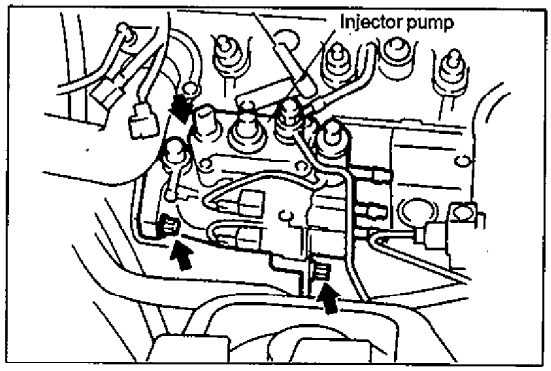
Bolts: M8, P1.25, 40 mm (1.59 in) in length



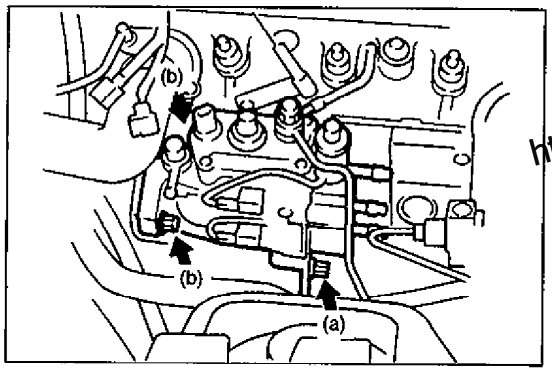
3) Leave bolts installed in step 2 in position and install special tool as shown.

Special Tool
(A): 09944–36011

4) Remove bolts, and remove pulley.
5) Remove coupler connections and hose connections, referring to structural view on previous page.
6) Remove pump side flare nut on the injection pipe.



7) Remove one bolt and two nuts attaching injection pump and remove injection pump.

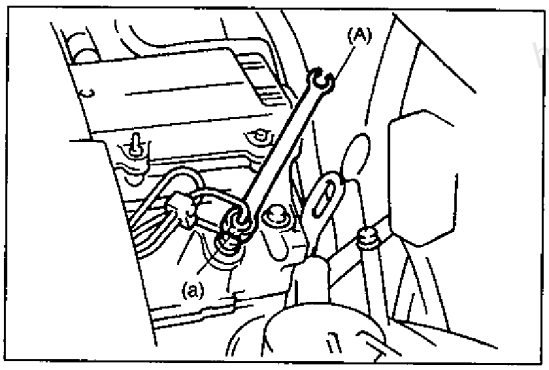


Installation

For installation, reverse removal procedure and note following instructions.

- Tighten bolt and nut that attaching pump to the specified torque.

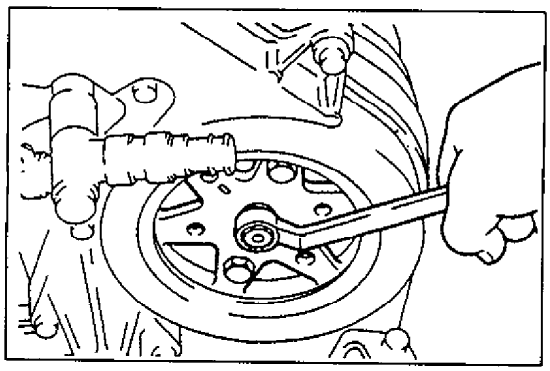
Tighten Torque
(a): 22 N·m (2.2 kg-m, 15.9 lb-ft)
(b): 45 N·m (4.5 kg-m, 32.5 lb-ft)



- Tighten injection pipe flare nut to specified torque by using special tool.

Special Tool
(A): 09950–76010

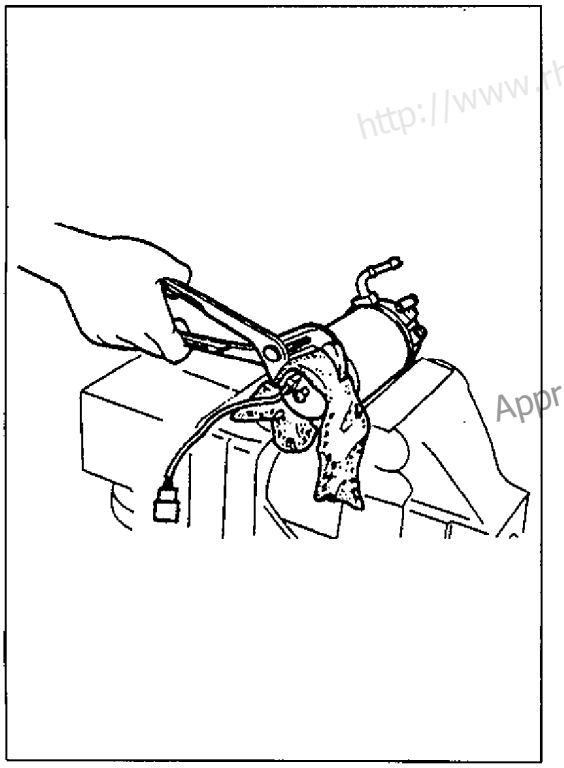
Tighten Torque
(a): 30 N·m (3.0 kg-m, 21.7 lb-ft)



- Tighten pulley locknut to specified torque.

Tightening Torque:
65 N·m (6.5 kg-m, 47 lb-ft)

- After installation, perform air bleeding (Refer to page 6E4–31.) and injection timing adjustment. (Refer to page 6E4–30.)



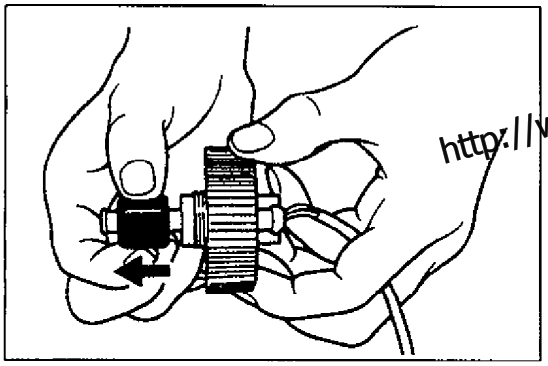
FUEL FILTER

Level Sensor of Sedimentor

Removal

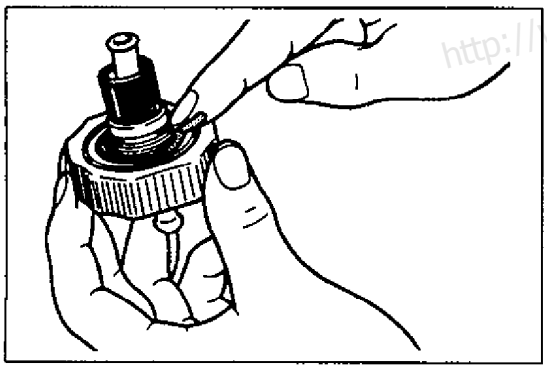
1) Fix priming pump in a vise and remove level sensor from filter cartridge by using water pump priers.

CAUTION:
A small amount of fuel may be released from filter cartridge when level sensor is removed. Place a container under filter cartridge to catch released fuel.



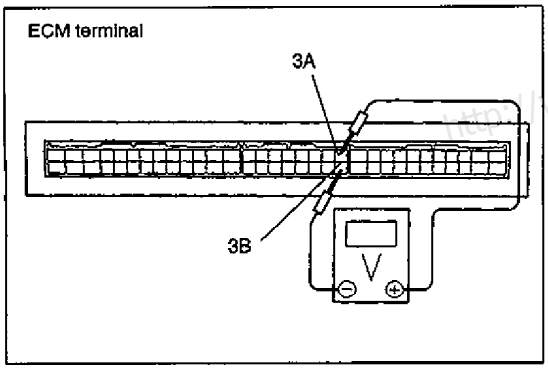
Inspection

1) Connect circuit tester to level sensor connector.
2) Raise float and verify that there is continuity.



Installation

1) Use new level sensor O-ring.
2) Apply thin coat of fuel to O-ring. Install level sensor to filter cartridge and fully tighten by hand.
3) Bleed air in system. (Refer to page 6E4–31.)
4) Verify that there is no leakage from fuel system.



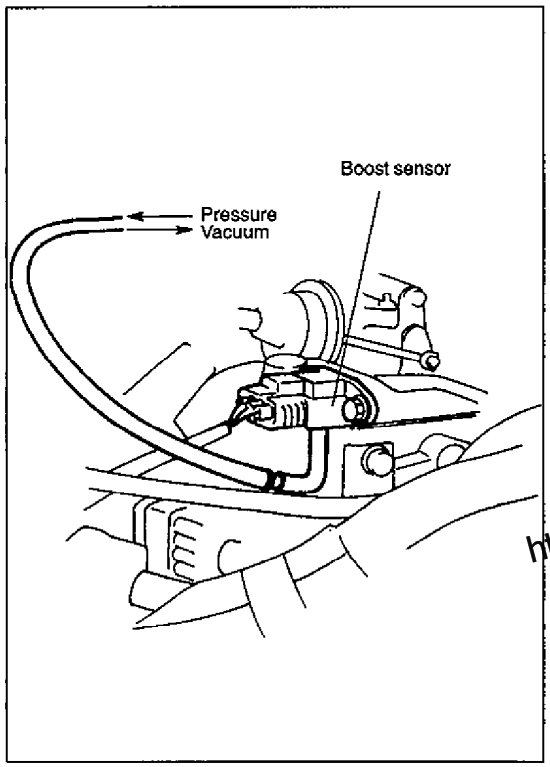
ELECTRONIC CONTROL SYSTEM

BOOST SENSOR

Inspection

1) Turn ignition switch to ON.
2) Using a circuit tester, measure voltage between ECM terminals 3A and 3B.

Specification
Approx. 5 V

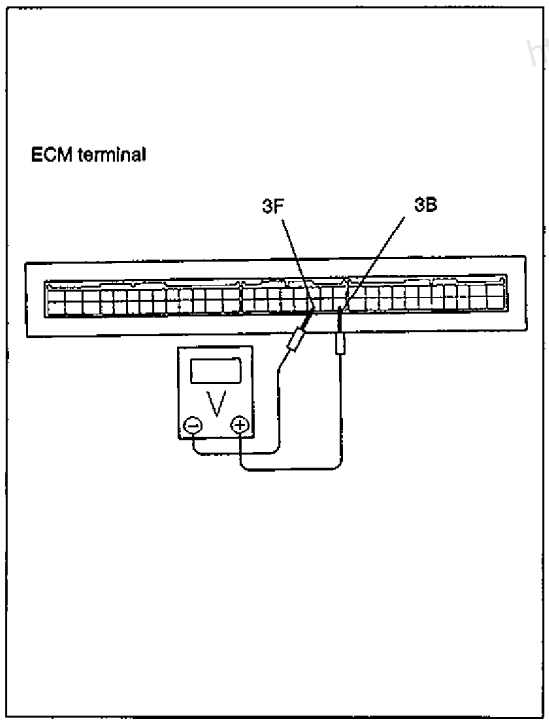


3) Disconnect vacuum hose from boost sensor.
4) Using a vacuum or pressure pump, apply vacuum or pressure to boost sensor as listed below, and measure voltage between ECM terminals 3C and 3B.

Specification

kPa (mmHg)	Output voltage (V)
13.3 (100) – Pressure pump gauge value	Approx. 5
101 (760) – Vacuum pump gauge value	Approx. 0.75
101 (760) – Barometer value	Approx. 2.6

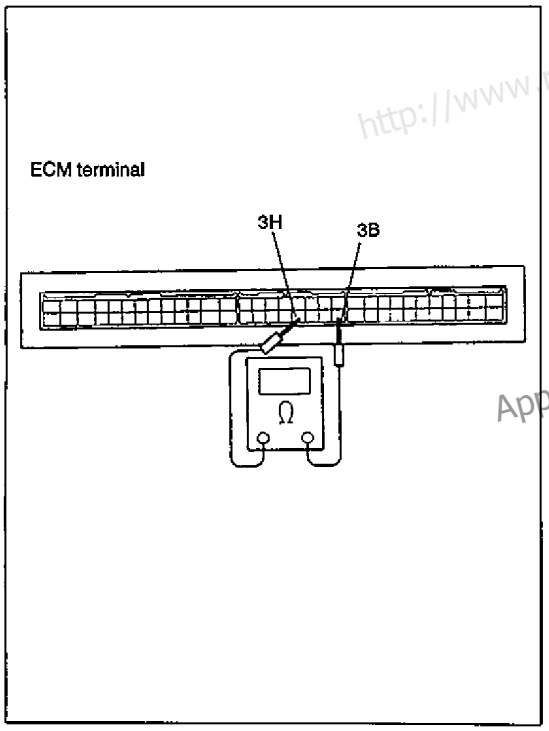
5) If not as specified, check related wiring harnesses. If they are normal, replace boost sensor.



THROTTLE POSITION SENSOR

Inspection

1) Carry out CTP switch inspection.
2) Verify that throttle valve is fully closed.
3) Turn ignition switch to ON.
4) Using a circuit tester, measure voltage at ECM terminals 3F and 3B as follows.
   Specification
   Closed throttle position: Approx. 0.6 V
   Wide open throttle: Approx. 3.3 V
5) If not as specified, check related wiring harnesses. If they are normal, replace throttle position sensor.

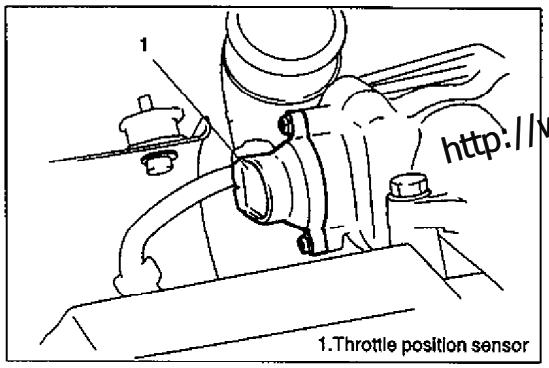


Closed throttle position (CTP) switch (in TP sensor)
Inspection

1) Verify that throttle valve is fully closed.
2) Turn ignition switch to OFF and disconnect ECM coupler.
3) Check for continuity between ECM terminals 3H and 3B as follows.

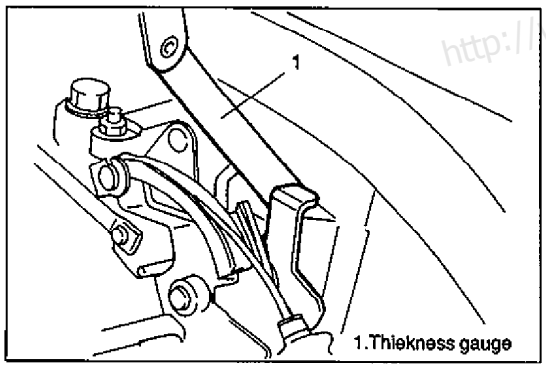
Specification
Closed throttle position: Continuity
Wide open throttle: No continuity

4) If not as specified, check related wiring harnesses. If they are normal, carry out CTP switch adjustment.

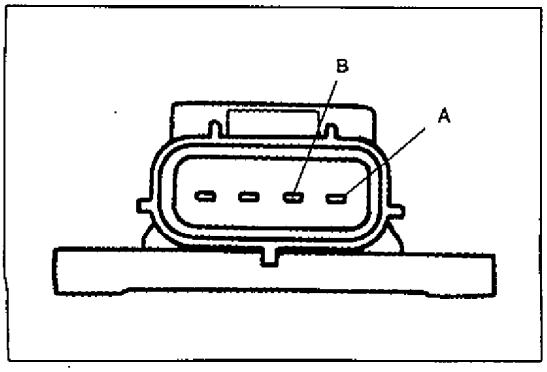


Closed throttle position (CTP) switch adjustment

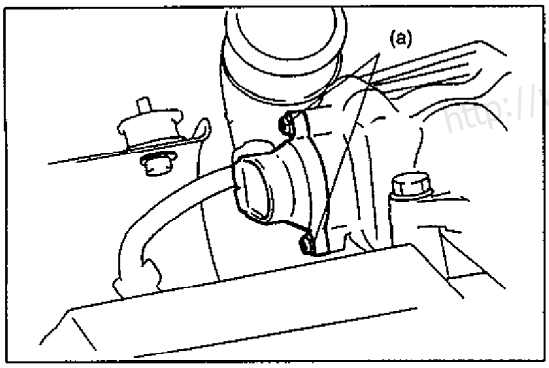
1) Loosen throttle position sensor mounting screw, and hand–tighten it.



2) Adjust gap between throttle lever and closed throttle position stopper to 0.48–0.78 mm (0.02–0.03 in).

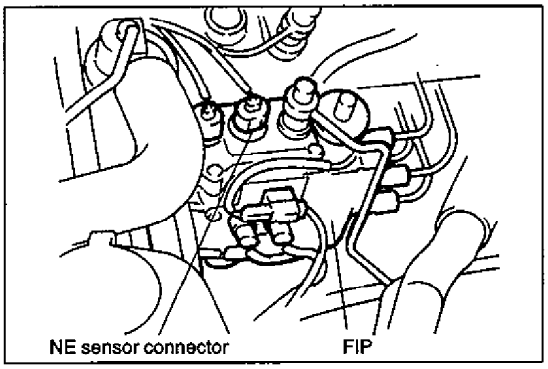


3) Turn ignition switch to ON.
4) Turn throttle position sensor until there is no more continuity between closed throttle position switch terminals A and B.



5) If continuity persists, replace throttle position sensor.
6) Tighten throttle position sensor screws.

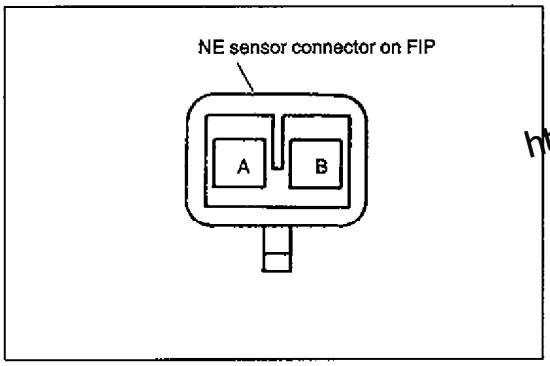
Tightening Torque
(a) : 2.0 N–m (0.2 kg–m, 1.4 lb–ft)



NE SENSOR (BUILT IN FIP)

Inspection

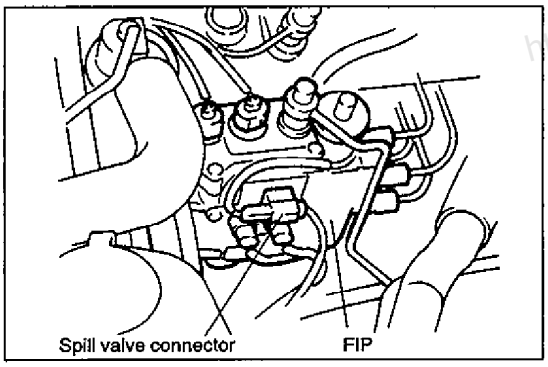
1) Disconnect NE sensor connector on FIP.



2) Verify that resistance between NE sensor terminals A and B is within specification.

Specification
Terminals A–B: 100–200 Ω
Terminal B–Ground: No continuity

3) If not as specified, replace FIP.

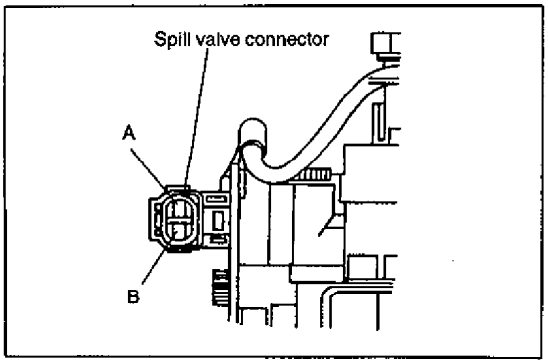


SPILL VALVE

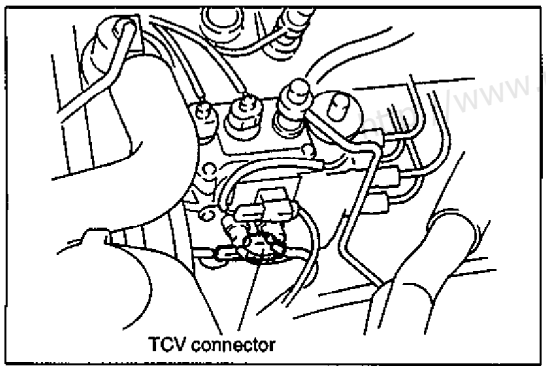
Inspection

1) Disconnect spill valve connector on side of FIP.
2) Verify that resistance between spill valve connector terminals A and B is within specification.

Specification
Terminals A–B: 1–2 Ω
Terminal B–Ground: No continuity



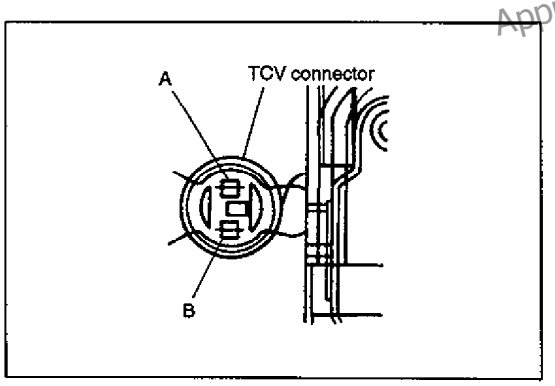
3) If not as specified, replace FIP.



TIMER CONTROL VALVE (TCV)

Inspection

1) Disconnect TCV connector on side of FIP.



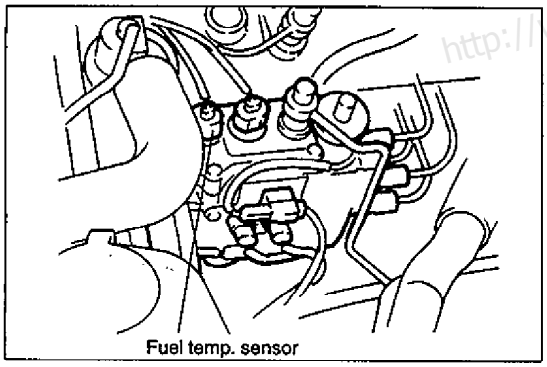
2) Verify that resistance between TCV terminals A and B is within specification.

Specification
10–14 Ω

3) If not as specified, replace FIP.

Operation inspection

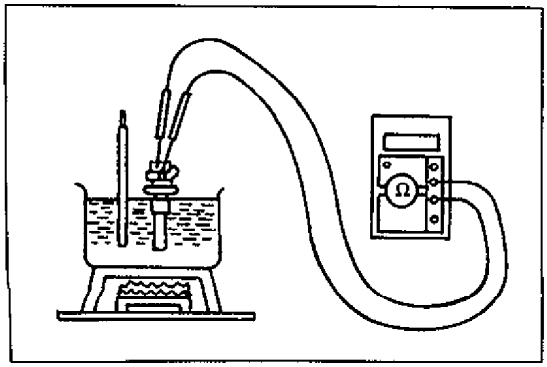
1) Disconnect TCV connector on side of FIP.
2) Apply battery positive voltage to TCV and verify that solenoid operation sound (a click) is heard.
3) If not, replace FIP.



FUEL TEMPERATURE SENSOR

Inspection

1) Remove fuel temperature sensor on top of FIP.



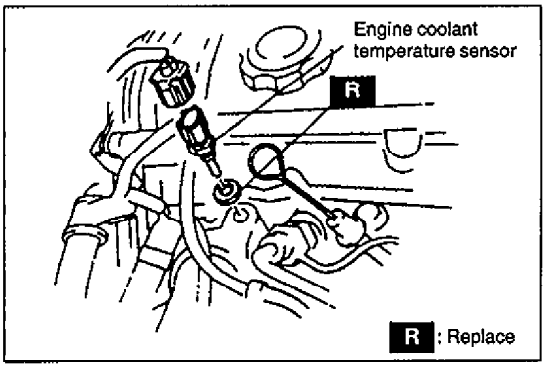
2) Place sensor and a thermometer in water. Heat water gradually and verify that resistance between fuel temperature sensor terminals at following temperatures is as specified.

Specification

Water temperature °C (°F)	Resistance (kΩ)
0 (32)	5.88 (Reference)
20 (68)	2–3
80 (176)	0.2–0.4

3) If not as specified, replace fuel temperature sensor.

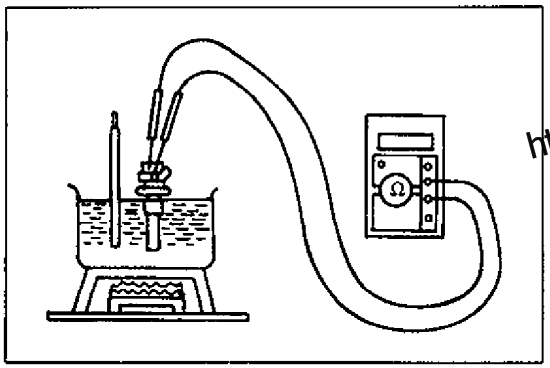
Tightening Torgue:
22 N·m (2.2 kg–m,15.9 lb–ft)



ENGINE COOLANT TEMPERATURE SENSOR

Inspection

1) Drain engine coolant for approx. 2 L (0.53 US gal, 0.44 Imp gal).
2) Remove engine coolant temperature sensor.



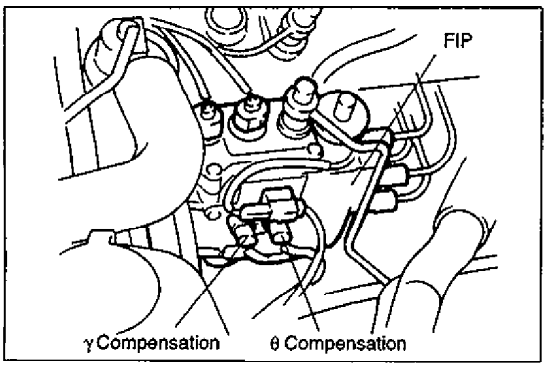
3) Place sensor and a thermometer in water. Heat water gradually and verify that resistance between engine coolant temperature sensor terminals at following temperatures is as specified.

Specification

Water temperature °C (°F)	Resistance (kΩ)
0 (32)	5.88 (Reference)
20 (68)	2–3
80 (176)	0.2–0.4

4) If not as specified, replace engine coolant temperature sensor.

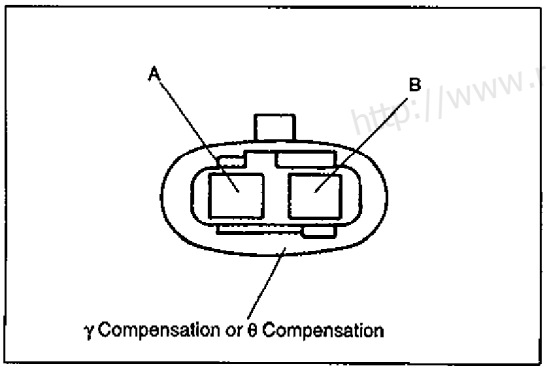
Tightening Torgue:
27 N·m (2.7 kg–m,19.5 lb–ft)



COMPENSATION RESISTANCE

Inspection

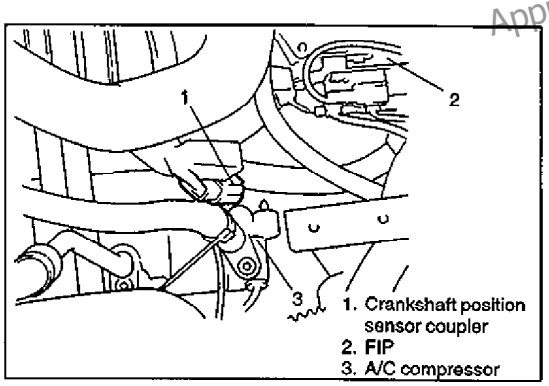
1) Disconnect compensation resistance connector on side of FIP.



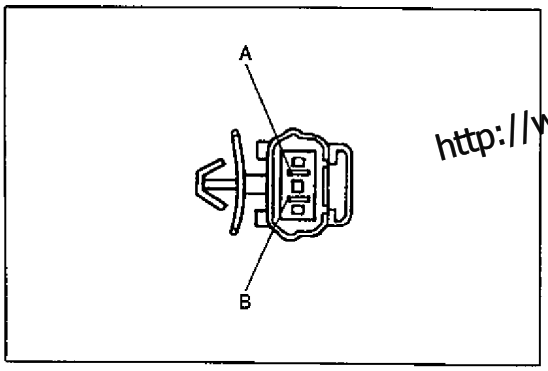
2) Verify that resistance between connector terminals A and B for γ compensation and θ compensation are within specification.

Specification
γ compensation: 0.05–1.5 (kΩ)
θ compensation: 0.1–2.5 (kΩ)

3) If not as specified, replace FIP.

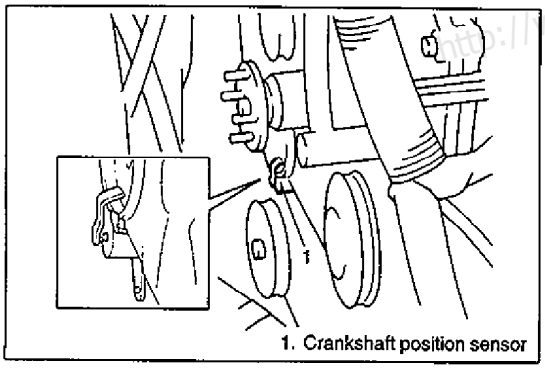


CRANKSHAFT POSITION SENSOR
Inspection
1) Disconnect crankshaft position sensor connector.

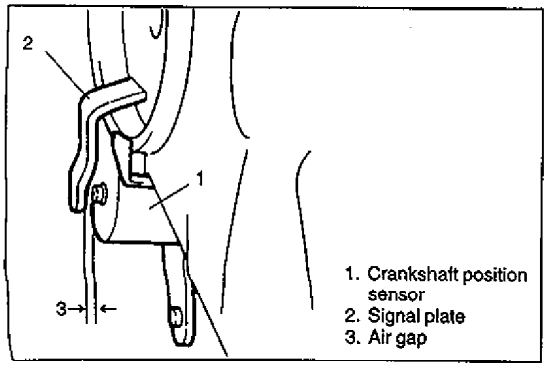


2) Verify that resistance between terminals A and B of connector is within specification.

Specification
Approx. 550 Ω max.



3) If not as specified, replace crankshaft position sensor.



Air Gap Inspection
1) Verify that air gap between tip of timing belt guide plate on rear side of crankshaft pulley and crankshaft position sensor is within specification.

Specification
2. 5–3.5 mm (0.098–0.138 in)

2) If not as specified, replace timing belt guide plate or crankshaft position sensor.

INSPECTION OF ECM AND ITS CIRCUITS

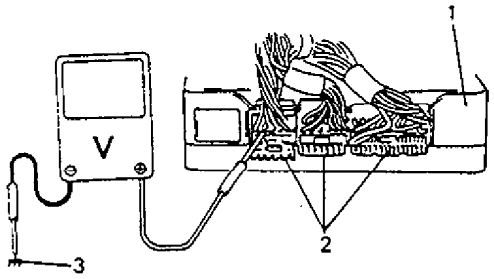
ECM and its circuits can be checked at ECM wiring couplers by measuring voltage and resistance.

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

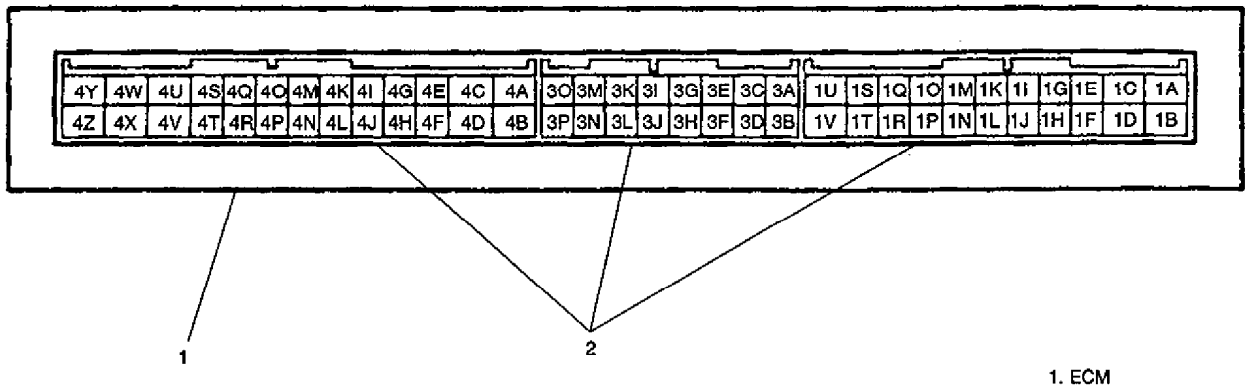
VOLTAGE CHECK

1) Remove ECM from body with ignition switch OFF.
2) Connect ECM couplers to ECM.
3) Check voltage at each terminal of couplers connected.

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



1. ECM
2. Couplers
3. Body ground



1. ECM
2. ECM couplers

V_B: Battery positive voltage

Terminal	Connected to	Measuring condition		Voltage (V)	Inspection points
1A	Fuse (15A)	Constant		V_B	• Fuse (15A) • Related harnesses
1B	Main relay (Power)	Ignition SW	ON	V_B	• Main relay • Related harnesses
			3 sec. after ignition switch OFF	1.0 max.	
1C	Glow plug relay	Engine coolant temperature below 60 °C	Ignition SW ON and for 15 sec.	V_B	• Glow plug relay • Related harnesses
			15 sec. after ignition SW ON	1.0 max.	
		Engine coolant temperature above 60 °C	While cranking	V_B	
			While idling	1.0 max.	
1D	Spill valve relay	Ignition SW	ON	Approx.0.36	• Spill valve relay • Related harnesses
			OFF	0	
		While idling		Approx.0.45	
		While ignition SW ON till just after OFF		V_B→1.0 max.	
1E	Main relay	Ignition SW	ON	1.0 max.	• Main relay • Related harnesses
			OFF	V_B	
		Idle		1.0 max.	
1F	Ignition SW	Ignition SW	ON	V_B	• Ignition SW • Related harnesses
			OFF	1.0 max.	
1G	–	–		–	–
1H	–	–		–	–
1I	–	–		–	–
1J	TCM (Engine coolant temp. signal)	–		–	–
1K	EGR solenoid vacuum valve	Ignition SW	ON	V_B	• EGR solenoid vacuum valve • Related harnesses
			OFF	1.0 max. after approx. 3 sec.	
		While idling		V_B	
1L	–	–		–	–
1M	Glow indicator light	Ignition SW	Several sec. after ignition switch ON	V_B	• Glow indicator light • Related harnesses
			OFF	1.0 max.	
1N	–	–		–	–
1O	EGR solenoid vent valve	Ignition SW	ON	V_B	• EGR solenoid vent valve • Related harnesses
			OFF	1.0 max. after approx. 3 sec.	
		While idling		1.0 max.	

V_B: Battery positive voltage

Terminal	Connected to	Measuring condition		Voltage (V)	Inspection points
1P	–	–		–	–
1Q	A/C amplifier (A/C cut)	A/C operating		V_B	• A/C amplifier • Related harnesses
		A/C operation is cut		1.0 max.	
1R	Instrument cluster (Tachometer)	Ignition SW ON		1.0 max.	• Related harnesses
1S	A/C SW	Ignition SW	ON and A/C SW ON	V_B	• A/C SW • Related harnesses
			OFF	1.0 max.	
1T	–	–		–	–
1U	Starter	While cranking		Approx. 10	• Starter • Related harnesses
		Other than above		1.0 max.	
1V	A/T shift SW	Ignition SW ON	P or N range	1.0 max.	• Transmission range switch • Related harnesses
			Other ranges	V_B	
3A	Boost sensor (Power to sensor)	Ignition SW	ON	5.0	• Sensor • Related harnesses
			OFF	1.0 max.	
3B	Ground	Constant		1.0 max.	• Related harnesses
3C	Boost sensor	Ignition SW ON and Barometric pressure:760 mmHg		Approx. 2.6	• Boost sensor • Related harnesses
3D	ICM	Ignition SW	ON	Approx. 5.0	• ICM • Related harnesses
			OFF	1.0 max. after approx. 3 sec.	
3E	Intake air temp. sensor	Ignition switch ON and ambient temp. :20 °C (68 °F)		Approx. 3.0	• Intake air temp. sensor • Related harnesses
3F	Throttle position sensor	Ignition SW	Closed throttle position	0.46	• Throttle position sensor • Related harnesses
			Wide open throttle	3.1	
3G	Engine coolant temp. sensor	–		–	–
3H	Throttle position sensor (Closed throttle position SW signal)	Ignition SW	Closed throttle position	0	• Throttle position sensor • Related harnesses
			Other than closed throttle position	V_B	

VB: Battery positive voltage

Terminal	Connected to	Measuring condition			Voltage (V)	Inspection points
3I	Fuel temp. sensor	Ignition switch ON and fuel temp. 60 °C (140 °F)			Approx. 0.74	• Fuel temp. sensor • Related harnesses
3J	EGR position sensor	Ignition SW ON			Approx. 0.5	• EGR position sensor • Related harnesses
					1.0 max.	
		While idling			Approx. 2.0	
3K	θ Compensation resistance	Ignition SW	ON		Approx. 0.2–Approx. 4.5	• θ Compensation resistance • Related harnesses
			3 sec. after OFF		1.0 max.	
3L	γ Compensation resistance	Ignition SW	ON		Approx. 0.2–Approx. 4.5	• γ Compensation resistance • Related harnesses
			3 sec. after OFF		1.0 max.	
3M	Glow plug relay	Ignition SW	ON and for approx. 15 sec.	Engine coolant temp. below 60 °C (140 °F)	Approx. 11	• Glow plug relay • Related harnesses
			OFF		1.0 max.	
		10 min.after idling			1.0 max.	
		While cranking	Engine coolant temp. more than 60 °C (140 °F)		VB	
		While idling			1.0 max.	
3N	–	–			–	–
3O	–	–			–	–
3P	TCM (Throttle position signal)	Ignition SW	Closed throttle position		Approx. 9.0	• Related harnesses
			Wide open throtle		Approx. 5.0	
		Ignition SW OFF			1.0 max.	
4A	–	–			–	–
4B	Ground	Constant			1.0 max.	• Related harnesses
4C	–	–			–	–
4D	–	–			–	–
4E	–	–			–	–
4F	–	–			–	–
4G	NE sensor (+)	Ignition SW	ON		Approx. 0.74	• NE sensor
			OFF		1.0 max. after approx. 3 sec.	
		Engine idling → racing			Approx. 0.72→ Approx. 0.69	
4H	NE sensor (–)	Ignition SW	ON		Approx. 0.74	• NE sensor
			OFF		1.0 max. after approx. 3 sec.	
		Engine idling → racing			Approx. 0.72→ Approx. 0.69	

V_B: Battery positive voltage

Terminal	Connected to	Measuring condition		Voltage (V)	Inspection points
4I	Crankshaft position sensor (+)	Ignition SW	ON	Approx. 0.68	• Crankshaft position sensor • Related harnesses
			OFF	1.0 max. after approx. 3 sec.	
		While idling		Approx. 0.65	
4J	Crankshaft position sensor (–)	Ignition SW	ON	Approx. 0.68	• EGR position sensor • Related harnesses
			OFF	1.0 max.after approx. 3 sec.	
		While idling		Approx. 0.65	
4K	–	–		–	–
4L	VSS	Ignition switch ON Rear left tire turned slowly with rear right tire locked		Indicator deflection repeated between 0–1 and 4–5 V	• VSS • Related harnesses
4M	–	–		–	–
4N	–	–		–	–
4O	–	–		–	–
4P	Diagnosis SW terminal	Ignition SW ON/OFF	Diagnosis SW terminal opened	V_B	• Related harnesses
			Diagnosis SW terminal shorted	1.0 max.	
4Q	–	–		–	–
4R	–	–		–	–
4S	Intake shutter solenoid valve	Ignition SW	ON	1.0 max.	• Related harnesses
			OFF		
		While idling		V_B	
4U	–	–		–	–
4V	–	–		–	–
4W	TCV	Ignition SW	ON	V_B	• TCV • Related harnesses
			OFF	1.0 max.	
		While idling		V_B	
4X	Spill valve	Ignition SW	ON	V_B	• Spill valve • Related harnesses
			OFF	1.0 max.	
		While idling		9.14	
		While racing		Approx. 11	
4Y	Ground	Constant		1.0 max.	• Related harnesses
4Z	Ground	Constant		1.0 max.	• Related harnesses

EGR SYSTEM

SYSTEM INSPECTION

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

1) Install a vacuum gauge between EGR valve and solenoid valve.

Special Tool
(A) : 09918–18110

2) Measure vacuum when EGR is operated and not operated.

Vacuum
EGR operated :40 kPa (300 mmHg)
EGR not operated :6.7 kPa (50 mmHg)

EGR operation conditions

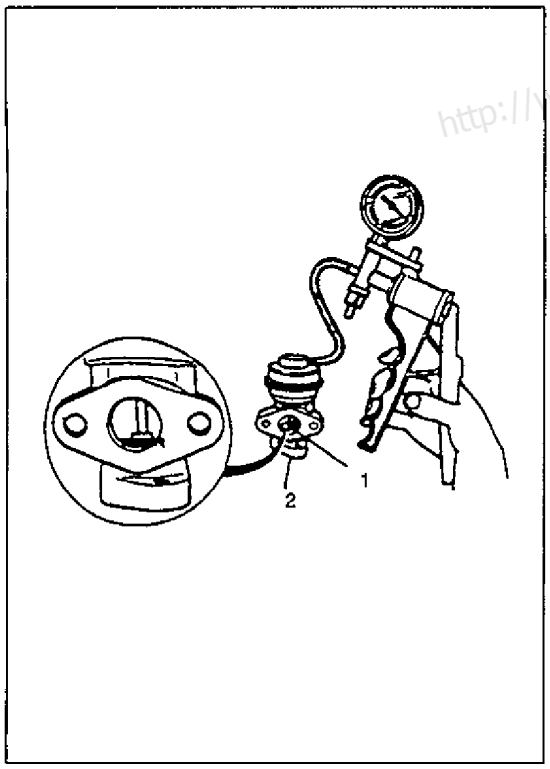
- Starter OFF
- Engine coolant temp. above 30 °C (86° F)
- Engine speed over 500 rpm

EGR non–operation conditions

- While cranking the engine
- Engine coolant temp. below 27 °C (81° F)
- Engine speed below 500 rpm

3) If EGR will not operate under EGR operation conditions, inspect EGR valve, EGR solenoid valve, EGR position sensor, and vacuum hose.

Vacuum Hose Inspection
Check hose for connection, leakage, clogs and deterioration. Replace as necessary.

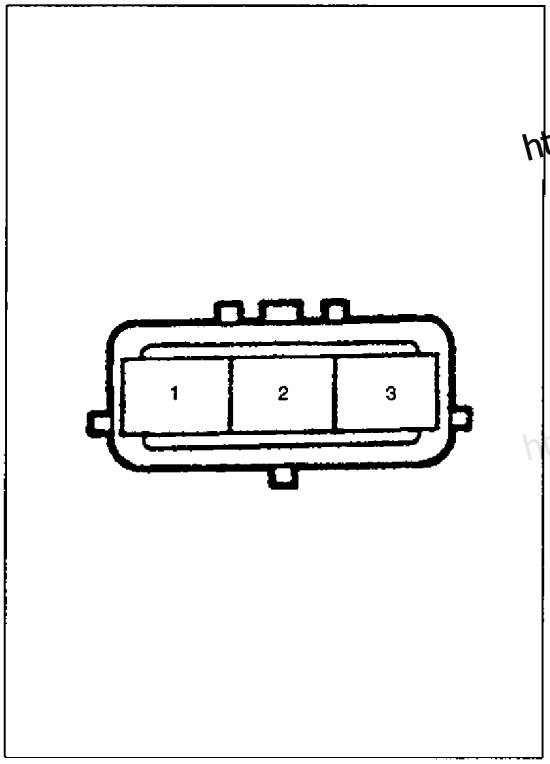


EGR VALVE INSPECTION

1) Using a vacuum pump, apply vacuum to diaphragm chamber. Check for airflow between ports 1 and 2.

Specification
Vacuum 23.3 ± 2.0 kPa
(175 ± 15 mmHg) less than : No airflow
Vacuum other than above : Airflow

2) Apply approx. 93.3 kPa (700 mmHg) vacuum to diaphragm chamber and verify that gauge needle stabilized.
3) If not as specified, replace EGR valve.



EGR POSITION SENSOR INSPECTION

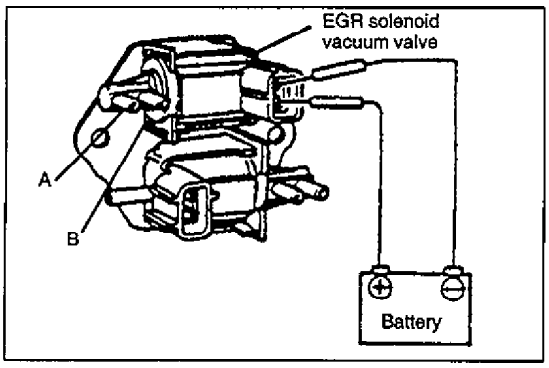
1) Disconnect EGR position sensor connector and measure resistance between terminals 1and 2.

Resistance
5 ± 1 kΩ

2) Turn EGR valve from fully closed position to fully open position, and check for resistance change between terminals 1 and 2.

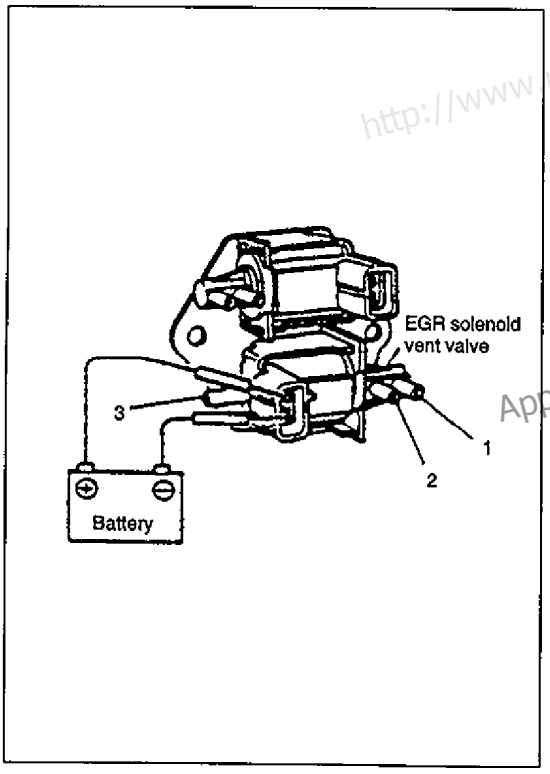
Specification
Resistance increases in direct proportion to control lever opening angle.

3) If not as specified, replace EGR position sensor.



EGR SOLENOID VACUUM VALVE INSPECTION

1) Blow air into valve through port A or B, and check for airflow.
Specification
No airflow
2) Apply battery positive voltage between terminals of valve connector, and check for airflow.
Specification
Airflow
3) If not as specified, replace EGR solenoid vacuum valve.



EGR SOLENOID VENT VALVE INSPECTION

1) Blow air into valve through each port, and check for airflow.

Specification
1—2: Airflow
1—3: Airflow
2—3: Airflow

2) Apply battery positive voltage between terminals of valve connector, and check for airflow.

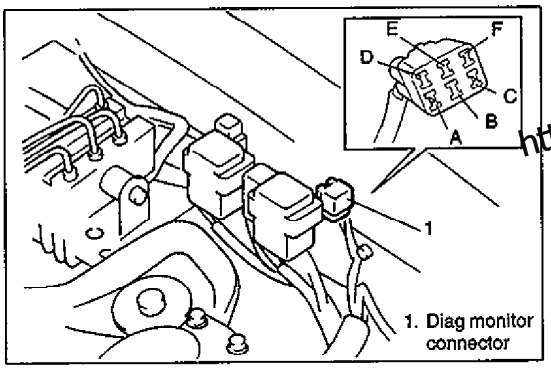
Specification
1—2: Airflow
1—3: No airflow
2—3: No airflow

3) If not as specified, replace EGR solenoid vent valve.

TROUBLESHOOTING

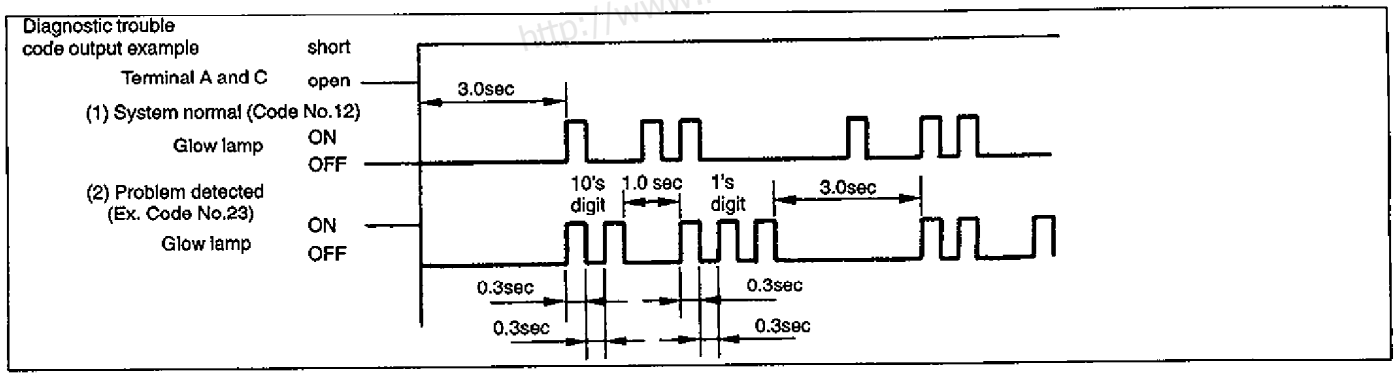
Precautions For Diagnostic Trouble Code Check

- 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 or main fuse.
  Such disconnection will erase memorized trouble in ECM memory.
- Because ECM stores diagnostic trouble codes in its memory, codes can be displayed even after detected problems have been repaired. Erase codes and perform confirmation test after repairs have been completed.
- As for vehicles equipped with immobilizer control system, if glow indicator light flashes when ignition switch is turned to ON (engine not started), follow procedures in "DIAGNOSTIC FLOW CHART" in section 8A.



DIAGNOSTIC TROUBLE CODE CHECK

Connect a service wire to diagnosis monitor connector terminals A and C, and check flashing pattern of glow indicator light.



DIAGNOSTIC TROUBLE CODE CLEARANCE

To erase diagnostic trouble codes stored in ECM memory, disconnect battery cable for more than 30 seconds.

DIAGNOSTIC TROUBLE CODE (DTC) TABLE

Code No.	Diagnosed system	Detection condition	Fail–safe	Inspection point
12	Normal	—	—	—
14	Engine coolant temp. sensor signal	• Short circuit • High signal voltage	Set engine coolant temp. to appropriate temp., and perform each control.	• Engine coolant temp. sensor • Related wiring harnesses
15		• Open circuit • Low signal voltage		
21	Throttle position sensor signal	• High signal voltage	Set throttle valve opening to 0% when accelerator pedal is not depressed, and to 15% when accelerator pedal is depressed, and perform each control.	• Throttle position sensor • Related wiring harnesses
22		• Low signal voltage		
23	Intake air temp. sensor signal	• Short circuit • High signal voltage	Set intake air temp. to appropriate temp., and perform each control.	• Intake air temp. sensor • Related wiring harnesses
25		• Open circuit • Low signal voltage		
24	Vehicle speed sensor (VSS) signal	• No VSS signal input	Detect vehicle speed as 0 km/h (0 mph), and perform each control.	• Vehicle speed sensor • Related wiring harnesses
27	Compensation resistance signal (θ,γ compensation)	• Open or shorted	• Set θ compensation resistance signal to specified value. • Set γ compensation resistance signal to specified value.	• Compensation resistance • Related wiring harnesses
28	Glow plug relay signal	• Open or shorted	Detect glow plug relay is OFF.	• Glow plug relay • Related wiring harnesses
31	Boost sensor signal	• Low signal voltage	Set sensor signal to medium value.	• Boost sensor • Related wiring harnesses
32		• High signal voltage		
35	NE signal	• No NE signal input	• Spill valve OFF • Fix TCV duty value to specification	• NE sensor • Related wiring harnesses
41	Timer control valve (TCV) signal	• Open or shorted	Reduce max. injection volume	• Timer control valve • Related wiring harnesses
42	Crankshaft position signal	• Open or shorted • Faulty pulsar projection	Fix TCV duty value to specification	• Crankshaft position sensor • Related wiring harnesses
43	Starter signal	• Starter signal turns on while engine is running.	Detects starter signal as OFF.	• Starter • Related wiring harnesses
		• Starter signal turns off while engine is cranking	Detects starter signal as ON.	
45	Closed throttle position switch signal	• Closed throttle position SW circuit shorted.	Detects throttle valve opening as 10%.	• Closed throttle position sensor • Related wiring harnesses
51	EGR position signal	• Open or shorted	Inhibits EGR control.	• EGR position sensor • Related wiring harnesses
52	Spill valve signal	• Open or shorted • Stuck spill valve	• Turns spill valve OFF. • Turns spill valve relay OFF. • Intake shutter valve actuator fully closed.	• Spill valve • Related wiring harnesses
73	Fuel temp. sensor signal	• Open or shorted	Detects fuel temperature as appropriate temp.	• Fuel temp. sensor • Related wiring harnesses
81	Refer to section 8A for information concerning code No. 81—84.			
82				
83				
84				
Illumination	ECM	—	—	—

BASIC INSPECTION

• Before proceeding with diagnosis following diagnostic index, perform following inspections.

NOTE:

- **When removing fuel injection pipe, cover pipe with rug for protection against fuel leakage.**
- **When ECM on the vehicle equipped with the immobilizer control system was replaced, including when replaced because re–checking by using a known–good ECM was necessary during trouble diagnosis, the ECM/ICM code must be registered in ECM. If it is not registered, the engine would not start and accurate trouble diagnosis would not be assured.**
  For more information, refer to "Procedure after ECM Replacement" in SECTION 8A.

Step	Inspection		Action
1	Glow indicator lamp inspection Does glow indicator lamp illuminate for several seconds and then go out when ignition switch is turned to ON (Engine not running)?	Yes	Go to step 4.
		No (Flashes)	Go to section 8A "DIAGNOSTIC FLOW CHART"
		No (Remains ON)	Go to step 2
		No (Not illuminate)	Check followings. • Main fuse/circuit fuse • Main relay and related circuit • Connection of ECM coupler and terminal • ECM ground circuit • Glow indicator lamp bulb and related circuit • ECM
2	Connect diagnosis connector terminals A and C with service wire, and check glow indicator lamp	Remains ON	Check followings. • Glow indicator lamp bulb and related circuit • Service wire continuity • Diagnosis connector circuit • ECM
		Flashes	Go to next step
3	1) Go to appropriate inspection point in Diagnostic Trouble Code Table according to code No. 2) After repairs, erase diagnostic trouble code. 3) Start engine and warm it up to normal operating temperature. 4) Connect diagnosis connector terminals A and C with service wire, and check glow indicator lamp. Is "12" indicated?	Yes	If any problem is detected, go to next step
		No	Repeat step 3
4	Fuel injection condition inspection Loosen fuel injection nozzle side flare nut at each cylinder one by one in order and crank the engine. Is fuel injected intermittently at each cylinder?	Yes	Go to next step
		No	(1) Check furl injection pipe for clogs. (2) If fuel injection pipe is OK, replace FIP
5	Cylinder balance test While idling engine, slowly loosen/tighten fuel injection nozzle side flare nut at each cylinder one by one in order, and check for change in engine speed and vibration. Does Idle speed drop and engine vibration change equally at all cylinders? **NOTE:** **• If idle speed will not drop or drops less at one cylinder, distribution at cylinder is weak.** **• If idle speed stabilizes when a small amount of fuel is released through flare nut, distribution at cylinder is strong.**	Yes	Go to next step
		No	Perform Compression Inspection. (Refer to Section 6A3.)
6	Does smoke emitted only when engine is started?	Yes	Perform QUICK START SYSTEM CONTROL Inspection
		No	Go to next step
7	Inspect fuel injection nozzle. (Refer to page 6E4–40.) Is it normal?	Yes	Go to appropriate Diagnostic Index
		No	Repair or replace as necessary

DIAGNOSTIC INDEX

Problem	Possible cause	Action
Poor starting	Control system • Faulty ECM	Inspect and replace
	Power system • Faulty ECM 15A fuse • Faulty Main relay • Faulty spill valve relay	Replace Inspect and replace Inspect and replace
	Fuel filter • Clogs • Water or air mixed in	Replace Repair
	FIP • Incorrect injection timing • Air mixed in • Pump internal damage • Faulty NE sensor • Faulty spill valve • Faulty θ compensation resistance • Faulty γ compensation resistance • Faulty timer control valve	Adjust Air bleeding of fuel system Replace Inspect and replace Inspect and replace Inspect and replace Inspect and replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	Adjust Replace Repair Replace
	Fuel injection pipe • Cracks • Fuel leakage from joints	Replace Correct
	Glow system • Faulty glow plug • Faulty glow relay • Faulty glow fusible link	Inspect and replace Inspect and replace Inspect and replace
	Immobilizer control system (If equipped)	Refer to section 8A
Engine stalls	Control system • Faulty ECM • Faulty vehicle speed sensor • Faulty A/T shift switch	Inspect and replace Inspect and replace Inspect and replace
	Electrical system • Faulty ECM 15A fuse • Faulty main relay • Faulty spill valve relay	Replace Inspect and replace Inspect and replace
	Fuel filter • Clogs • Water or air mixed in	Replace Repair
	FIP • Incorrect injection timing • Air mixed in • Pump internal damage • Faulty NE sensor • Faulty spill valve	Adjust Repair Inspect and replace Inspect and replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	Adjust Replace Repair Replace
	Fuel injection pipe • Cracks • Fuel leakage from joints	Replace Repair

Problem	Possible cause	Action
Poor idling	Control system • Faulty ECM • Faulty crankshaft position sensor • Faulty engine coolant temp. sensor • Faulty A/T shift switch • Faulty A/C signal	 Inspect and replace Inspect and replace Inspect and replace Inspect and replace Repair
	Fuel filter • Clogs • Water or air mixed in	 Replace Repair
	FIP • Incorrect injection timing • Air mixed in • Pump internal damage • Faulty spill valve • Faulty θ compensation resistance • Faulty γ compensation resistance • Faulty timer control valve	 Adjust Air bleeding of fuel system Replace Inspect and replace Inspect and replace Inspect and replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	 Adjust Replace Repair Replace
	Fuel injection pipe • Cracks • Fuel leakage from joints	 Replace Repair
	Glow system • Faulty glow plug • Faulty glow relay	 Inspect and replace Inspect and replace
	Intake system • Intake shutter solenoid valve	 Inspect and replace
	EGR system • Faulty EGR solenoid valve • Faulty EGR valve	 Inspect and repair or replace EGR system Inspect and repair or replace EGR system
Abnormal knocking	Control system • Faulty ECM system • Faulty boost sensor • Faulty crankshaft position sensor • Faulty engine coolant temp. sensor	 Inspect and replace Inspect and replace Inspect and replace Inspect and replace
	FIP • Faulty γ compensation resistance • Faulty timer control valve	 Inspect and replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	 Adjust Replace Repair Replace
	Fuel injection pipe • Cracks • Fuel leakage from joints	 Replace Correct

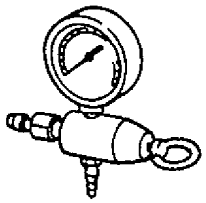
Problem	Possible cause	Action
Poor acceleration	Control system • Faulty ECM system • Faulty throttle position sensor • Faulty boost sensor • Faulty crankshaft position sensor • Faulty engine coolant temp. sensor • Faulty intake air temp. sensor	 Inspect and replace Inspect and replace Inspect and replace Inspect and replace Inspect and replace Inspect and replace
	Fuel filter • Clogs • Water or air mixed in	 Replace Repair
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	 Adjust Replace Repair Replace
	FIP • Incorrect injection timing • Air mixed in • Pump internal damage • Faulty θ compensation resistance • Faulty γ compensation resistance • Faulty timer control valve	 Adjust Air bleeding of fuel system Replace Inspect and replace Inspect and replace Inspect and replace
	Fuel injection pipe • Cracks • Fuel leakage from joints	 Replace Repair
	Intake system • Faulty turbocharger	 Replace
	EGR system • Faulty EGR solenoid valve • Faulty EGR valve	 Inspect and repair or replace EGR system Inspect and repair or replace EGR system
Black smoke	Control system • Faulty ECM • Faulty throttle position sensor	 Inspect and replace Inspect and replace
	FIP • Incorrect injection timing • Pump internal damage • Faulty spill valve	 Adjust Replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	 Adjust Replace Repair Replace
	Intake system • Faulty turbocharger	 Inspect and replace
	EGR system • Faulty EGR solenoid valve • Faulty EGR valve	 Inspect and repair or replace EGR system Inspect and repair or replace EGR system

Problem	Possible cause	Action
White smoke	Control system • Faulty ECM • Faulty throttle position sensor • Faulty boost sensor • Faulty crankshaft position sensor	 Inspect and replace Inspect and replace Inspect and replace Inspect and replace
	FIP • Pump internal damage • Faulty spill valve • Faulty γ compensation resistance • Faulty timer control valve	 Replace Inspect and replace Inspect and replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	 Adjust Replace Repair Replace
	Intake system • Intake shutter solenoid valve • Clogged air filter	 Inspect and replace Clean or replace
	Glow system • Faulty glow plug • Faulty glow relay • Faulty glow fusible link	 Inspect and replace Inspect and replace Inspect and replace
Hunts while driving	Control system • Faulty ECM • Faulty Throttle position sensor	 Inspect and replace Inspect and replace
	FIP • Pump internal damage • Faulty timer control valve	 Replace Inspect and replace
	Fuel injection nozzle • Incorrect valve opening pressure • Seized needle valve • Improperly installed nozzle holder • Faulty nozzle gasket	 Adjust Replace Repair Replace
	Fuel filter • Clogs • Water or air mixed in	 Replace Repair
	EGR system • Faulty EGR solenoid valve • Faulty EGR valve	Inspect and repair or replace EGR system Inspect and repair or replace EGR system

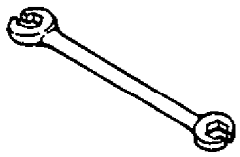
TIGHTENING TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Fuel injection pump mounting nut	22	2.2	15.9
Intercooler Intake shutter valve actuator	9	0.9	6.5
Air intake pipe	22	2.2	15.9
Intercooler bracket	45	4.5	32.5
Fuel injection pipe flare nut (Fuel injection nozzle side)	30	3.0	21.7
Fuel injection pipe flare nut (FIP side)	27	2.7	19.5
Fuel injection nozzle	64	6.4	46.3
Fuel injection nozzle nut	29	2.9	21.0
Nozzle holder body	37	3.7	26.8
Fuel injection pump mounting bolt	45	4.5	32.5
Fuel injection pump pulley locknut	65	6.5	47.0
Throttle position sensor mounting screw	2	0.2	1.4

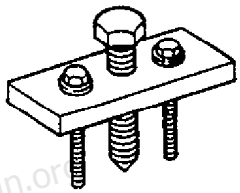
SPECIAL TOOL



09918-18110
Regulator assembly



09950-76010
Flare nut wrench (17—19 mm)



09944-36011
Steering wheel remover

SECTION 7A2

MANUAL TRANSMISSION (4WD MODEL)

CONTENTS

78E00-7A2-1-1S

GENERAL DESCRIPTION

The manual transmission consists of the input shaft, main shaft, counter shaft and reverse gear which are installed in the aluminum and castings cases. Its gears are of forward five speeds in synchro mesh and reverse one speed in constant mesh system.

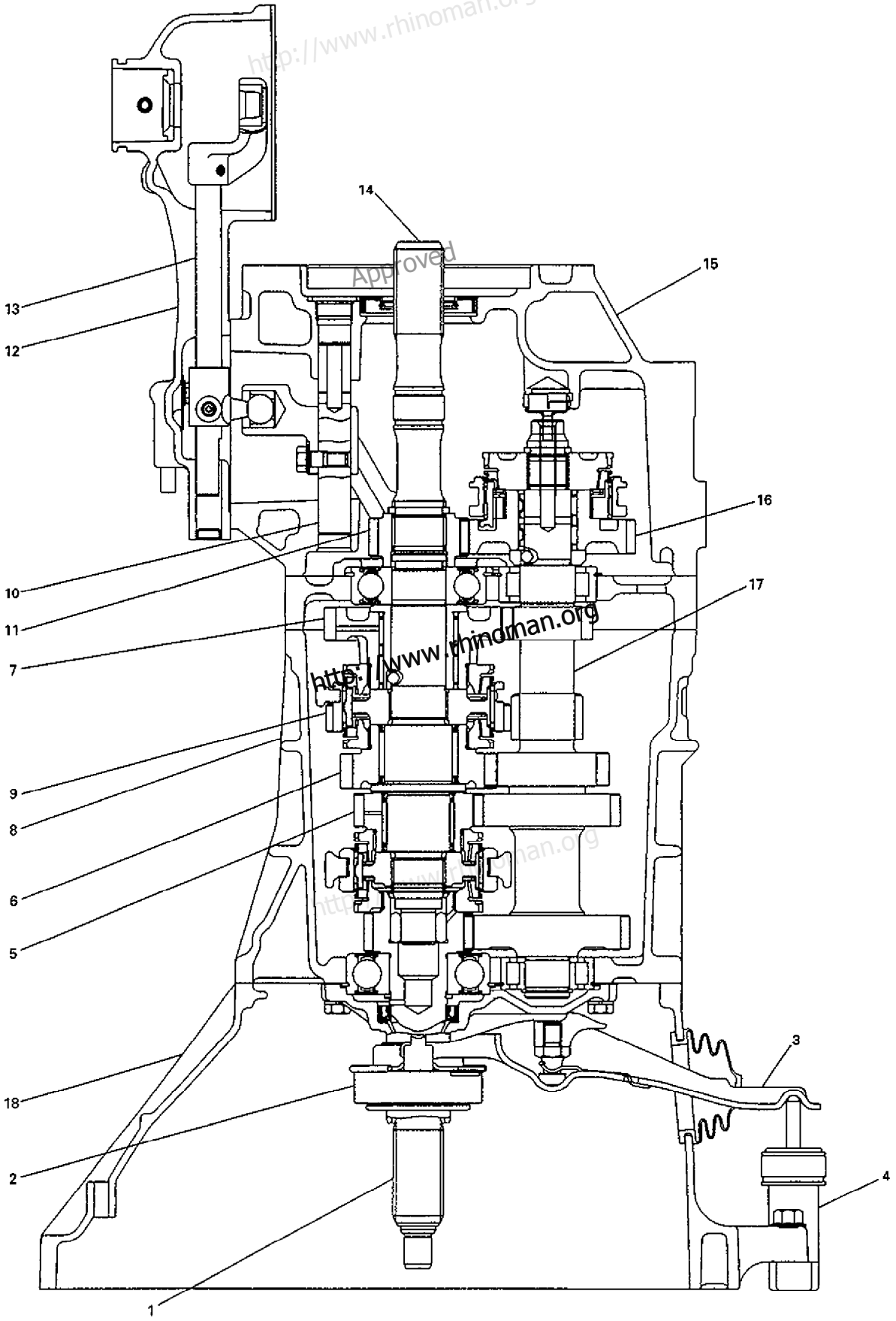
The main shaft gears are held by the needle bearings and on them the synchronizer rings and synchronizer sleeve & hubs are assembled.

The gear shift lever case is located at the upper behind the transmission case and has a cam which prevents direct gear shift from the 5th speed gear to the reverse gear.

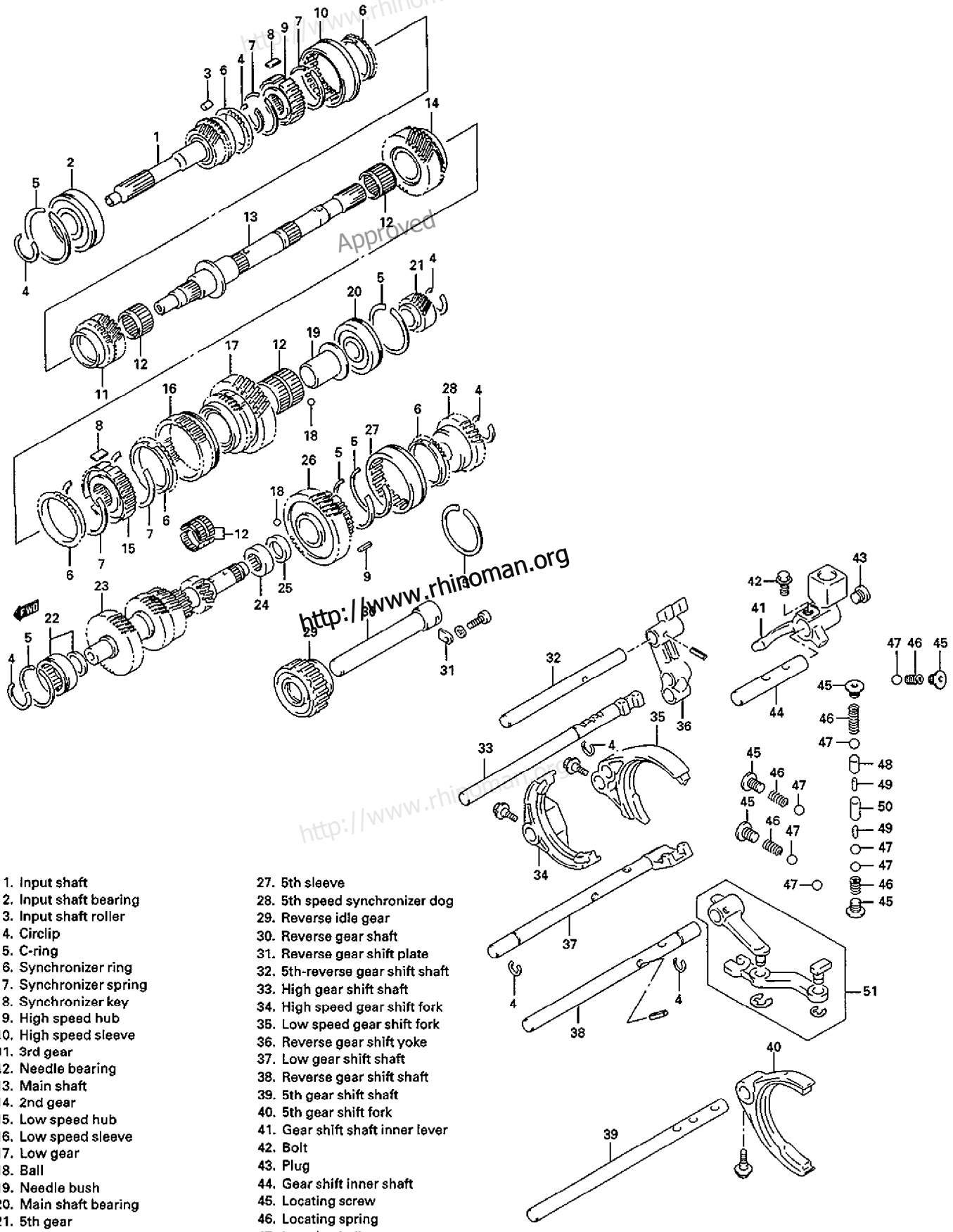
As the aluminum and castings cases are sealed with liquid type gasket, it is necessary to use genuine sealant or its equivalent on its mating surfaces when reassembling them. Also, the case fastening bolts must be tightened to specified torque by means of the torque wrench and tightening over or below the specified torque should be avoided.

The description under DIAGNOSIS and ON-VEHICLE SERVICE in this section covers the transfer which is next to the transmission as well, but their gear boxes are independent and each of them has its own drain and level/filler plugs for the oil change or the level check.
For the repair procedure of the transfer unit, refer to Section 7D.

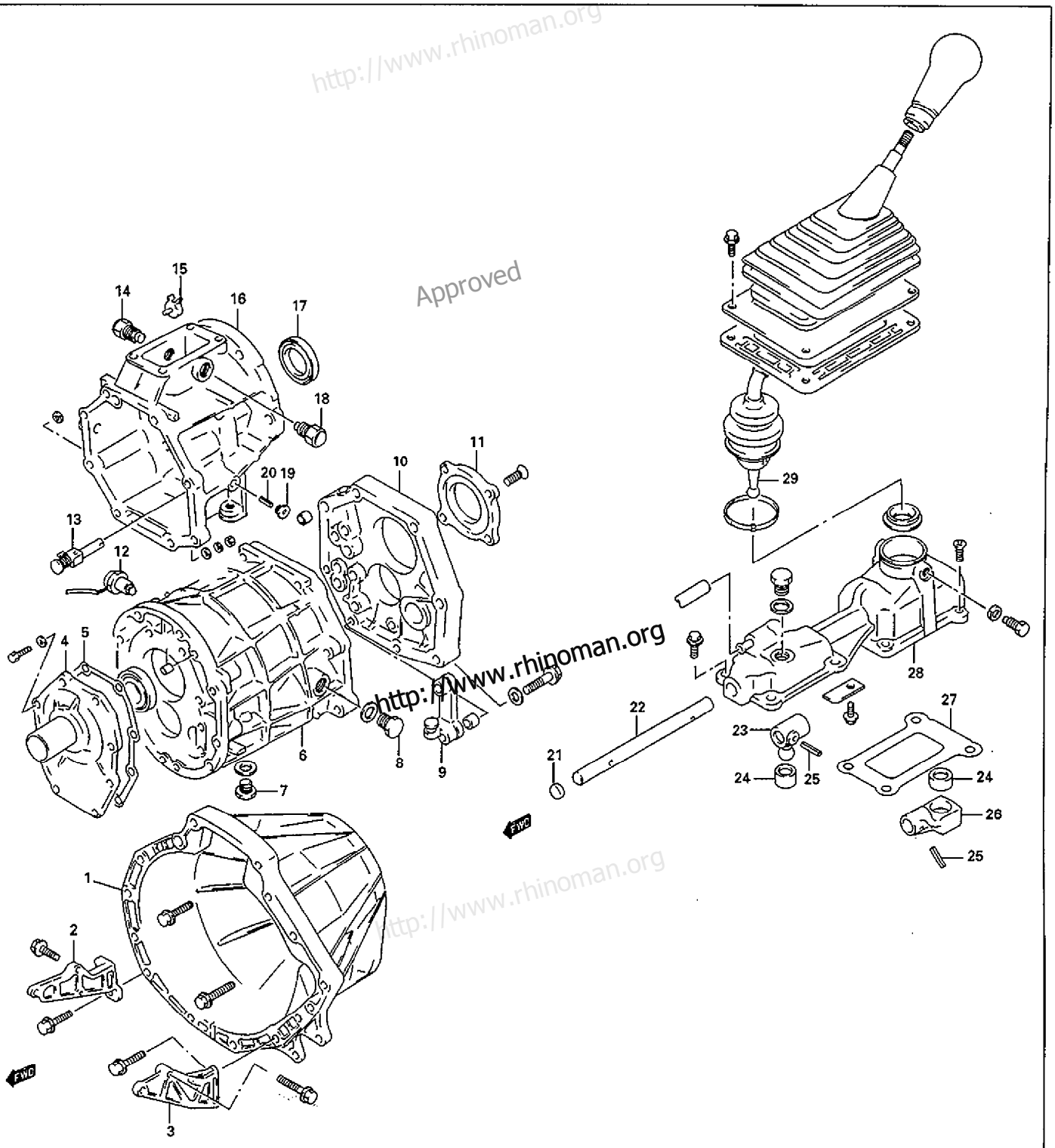
78E00-7A2-1-2S



1. Input shaft
2. Clutch release bearing
3. Clutch release fork
4. Clutch operating cylinder
5. Main shaft 3rd gear
6. Main shaft 2nd gear
7. Main shaft low gear
8. Front case
9. Main shaft reverse gear
10. Gear shift inner shaft
11. Main shaft 5th gear
12. Gear shift lever case
13. Gear shift shaft
14. Main shaft
15. Rear case
16. Counter shaft 5th gear
17. Counter shaft
18. Clutch housing



1. Input shaft
2. Input shaft bearing
3. Input shaft roller
4. Circlip
5. C-ring
6. Synchronizer ring
7. Synchronizer spring
8. Synchronizer key
9. High speed hub
10. High speed sleeve
11. 3rd gear
12. Needle bearing
13. Main shaft
14. 2nd gear
15. Low speed hub
16. Low speed sleeve
17. Low gear
18. Ball
19. Needle bush
20. Main shaft bearing
21. 5th gear
22. Counter shaft front bearing
23. Counter shaft
24. Counter shaft rear bearing
25. Thrust washer
26. Counter shaft 5th gear (and hub)
27. 5th sleeve
28. 5th speed synchronizer dog
29. Reverse idle gear
30. Reverse gear shaft
31. Reverse gear shift plate
32. 5th-reverse gear shift shaft
33. High gear shift shaft
34. High speed gear shift fork
35. Low speed gear shift fork
36. Reverse gear shift yoke
37. Low gear shift shaft
38. Reverse gear shift shaft
39. 5th gear shift shaft
40. 5th gear shift fork
41. Gear shift shaft inner lever
42. Bolt
43. Plug
44. Gear shift inner shaft
45. Locating screw
46. Locating spring
47. Locating ball
48. Locating roller No. 3
49. Locating roller No. 2
50. Locating roller No. 1
51. Reverse gear shift link comp.



1. Clutch housing
2. Case right stiffener
3. Case left stiffener
4. Input shaft bearing retainer
5. Gasket
6. Transmission front case
7. Oil drain plug
8. Oil filler/level plug
9. Reverse link stay
10. Transmission intermediate case
11. Main/counter shaft bearing plate
12. Back-up light switch
13. 5th-reverse interlock cam comp.
14. Return spring low bolt
15. Counter shaft gutter
16. Transmission rear case
17. Main shaft oil seal
18. Return spring reverse bolt
19. Interlock cam plug
20. Interlock cam pin
21. Case plug
22. Gear shift shaft
23. Gear shift lever
24. Bush
25. Spring pin
26. Gear shift arm
27. Case plate
28. Gear shift lever case
29. Gear shift control lever

DIAGNOSIS

Condition	Possible Cause	Correction
Gear slipping out of mesh	• Worn shift fork shaft	Replace
	• Worn shift fork or synchronizer sleeve	Replace
	• Weak or damaged locating spring	Replace
	• Worn bearings on input shaft or main shaft	Replace
	• Worn chamfered tooth on sleeve or gear	Replace sleeve and gear
	• Missing or disengagement of circlip(s)	Install
Gears refusing to disengage	• Weakened or broken synchronizer spring	Replace
	• Distorted shift shaft or shift fork	Replace
Hard shifting	• Improper clutch pedal free travel	Adjust
	• Distorted or broken clutch disc	Replace
	• Damaged clutch pressure plate	Replace clutch cover
	• Worn synchronizer ring	Replace
	• Worn chamfered tooth on sleeve or gear	Replace sleeve and gear
	• Distorted shift shaft	Replace
Noise	• Inadequate or insufficient lubricant	Replenish
	• Damaged or worn bearing(s)	Replace
	• Damaged or worn gear(s)	Replace
	• Damaged or worn synchronizer ring	Replace
	• Damaged or worn chamfered tooth on sleeve or gear	Replace

60A20-7A-4-1

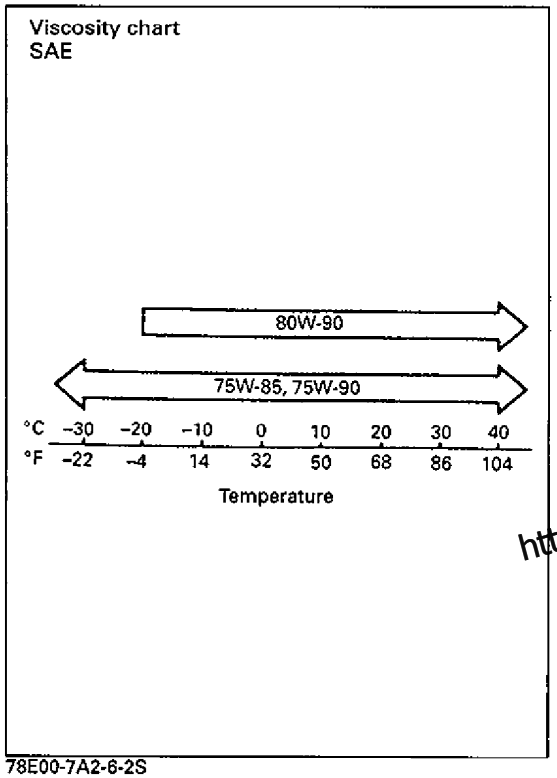
ON-VEHICLE SERVICE

–MANUAL TRANSMISSION AND TRANSFER– MAINTENANCE SERVICE

OIL CHANGE

1) Before changing or inspecting oil, be sure to stop engine and lift vehicle horizontally.
2) With vehicle lifted up, check oil level and leakage. If leakage exists, correct or repair it.

78E00-7A2-6-1S



3) Drain old oil and fill new specified oil as shown below by specified amount (roughly up to level hole).

NOTE:

- **It is highly recommended to use SAE 75W-90 gear oil.**
- **Whenever vehicle is hoisted for any other service work than oil change, also be sure to check for oil leakage and status of breather hoses.**
- **If water or rust is mixed in drained oil, be sure to check breather hose and boot of transmission and transfer.**

Gear Oil Specification
Oil grade: API GL-4
Viscosity: SAE 75W-85, 75W-90 or 80W-90

Oil Capacity:

Transmission	**2.6 liters (5.5/4.6 US/Imp. pt)**
Transfer	**1.7 liters (3.6/3.0 US/Imp. pt)**

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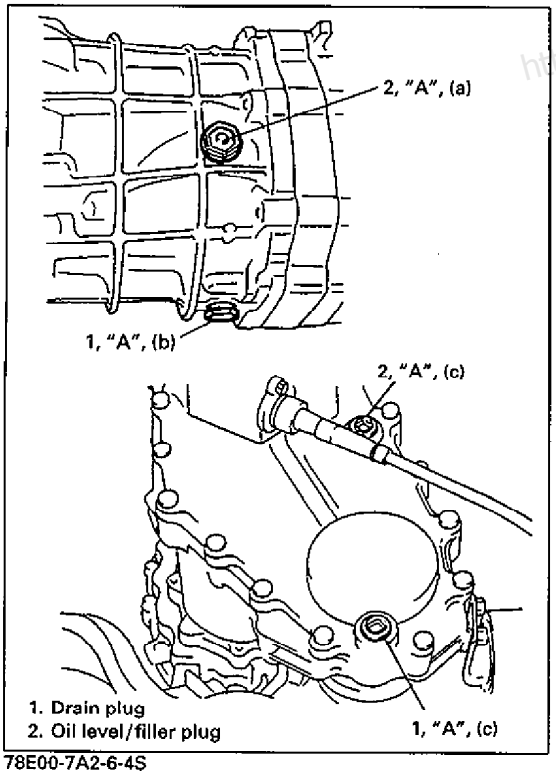


78E00-7A2-6-4S

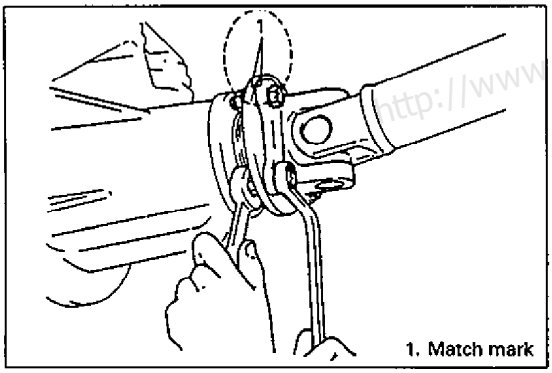
4) Torque drain plug and level/filler plug as specified below after applying sealant to its thread.

CAUTION:

- **Transmission oil must not be poured through gear shift control lever part.**
- **Do not loosen or remove reverse gear shaft bolt.**

"A": Sealant 99000-31110

Tightening Torque
(a): 38 N·m (3.8 kg-m, 27.5 lb-ft)
(b): 45 N·m (4.5 kg-m, 32.5 lb-ft)
(c): 23 N·m (2.3 kg-m, 17.0 lb-ft)



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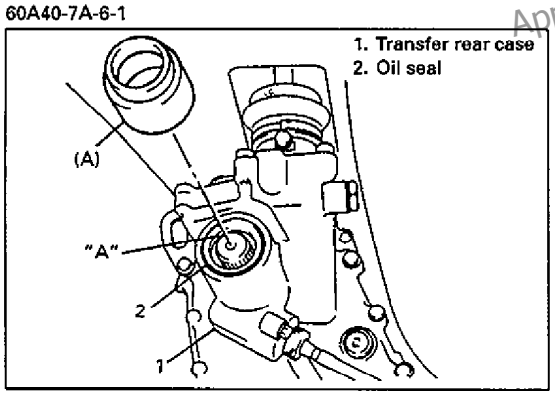

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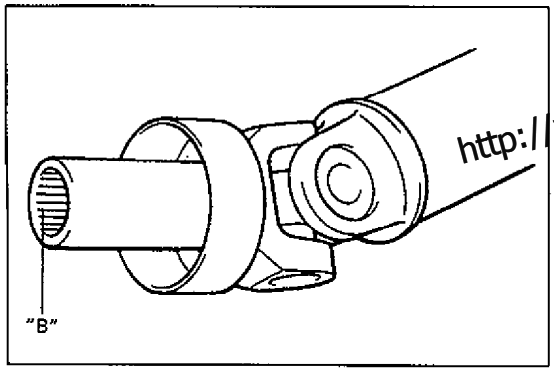

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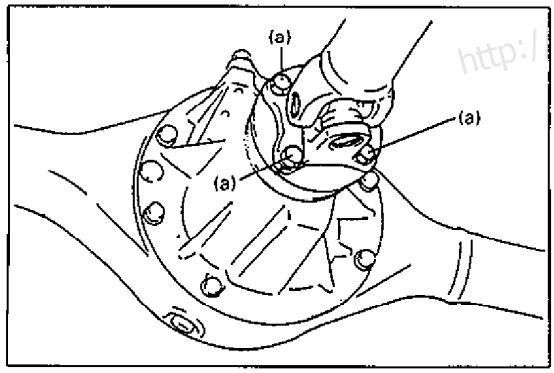


60A50-7A-6-4

TRANSFER OIL SEALS

REAR CASE OIL SEAL

1) Lift up vehicle horizontally.
2) Give match marks on joint frange and propeller shaft as shown in figure.
3) Remove 4 bolts from rear propeller shaft flange and remove propeller shaft.
4) Using screwdriver, remove oil seal.
5) Using special tool(A) and plastic hammer, pressfit new oil seal up to case surface. Be sure to apply grease to oil seal lip.

"A": Grease 99000-25010

Special Tool
(A): 09940-53111

6) Clean and inspect sliding portion of propeller shaft front end (where oil seal contacts) before installation and if even small dent or scratch exists, correct and clean it again.
Then apply grease inside splines of propeller shaft.

"B": Grease 99000-25010

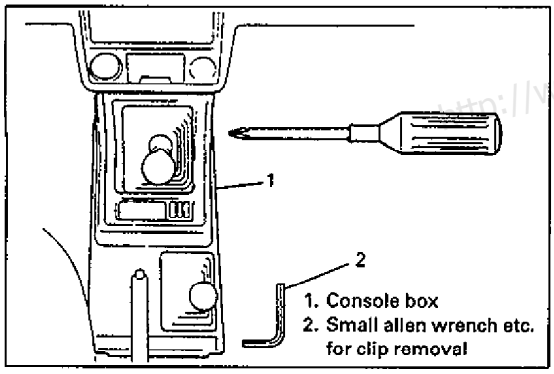
7) Install propeller shaft and torque universal joint flange bolts (a) to specification.

CAUTION:
Be sure to use only specified bolts, nuts, and lock washers for universal joint flange.

Tightening Torque:
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)

CENTER CASE OIL SEAL (Front side)

In addition to the procedure for rear case oil seal, it is necessary to drain and refill gear oil of transfer. Refer to page 7A2-6 for oil specification.



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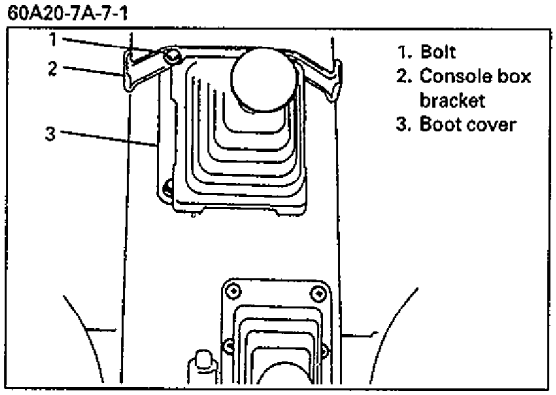

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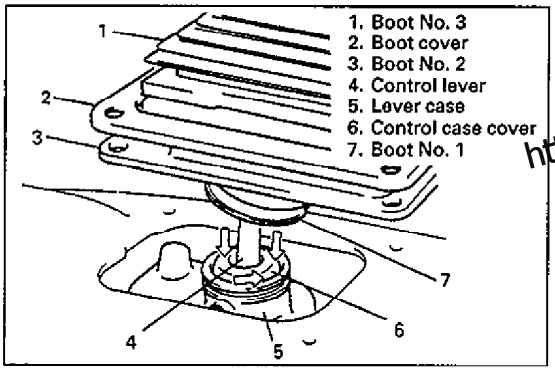

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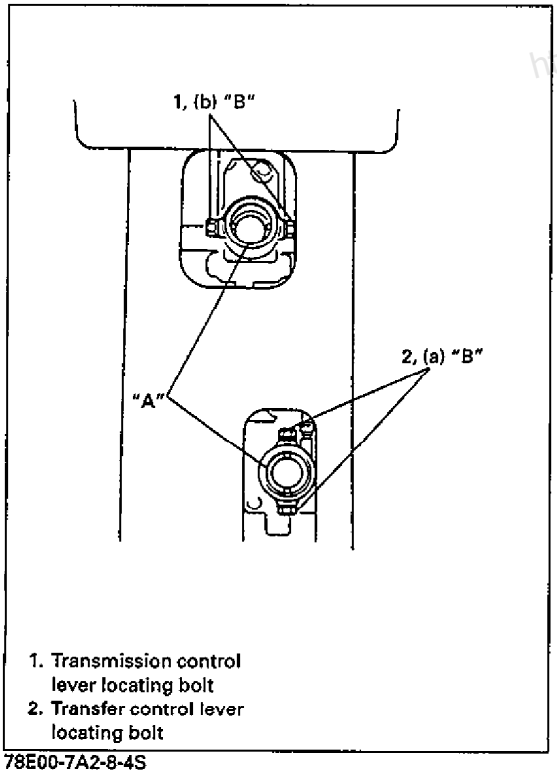


78E00-7A2-8-4S

SHIFT CONTROL LEVERS

REMOVAL

1) Remove 2 screws at the front and 2 clips at the rear, and then take off console box.

NOTE:
To remove clip, push in its center pin first.

2) Remove console box bracket by removing bolts and lift up boot cover and boot No. 2.
3) Remove boot clamp and then remove boot No. 1 from transmission shift lever case.
4) With gear shift control case cover pushed down with fingers, turn it to counterclockwise and take out shift control lever.
5) Take out transfer shift control lever in similar manner as described above.

INSPECTION AND INSTALLATION

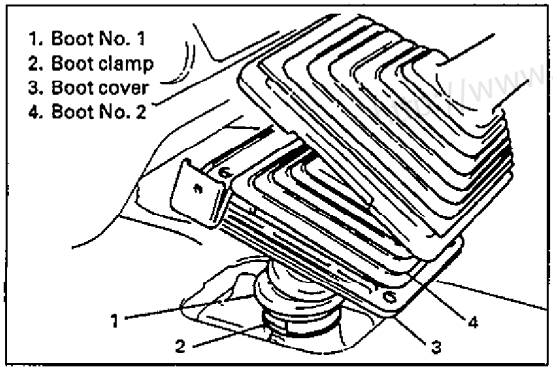
1) Check shift control lever lower portion and control lever locating sheet for excessive wear, and boot for damage. Correct or replace if necessary.
2) Apply grease to pivot portions and seat, then install shift control lever.

"A": Grease 99000-25010

3) Perform above steps also for transfer shift control lever.
4) If control lever locating bolts (a) are replaced or retightened, torque them as specified below.
Retighten of control lever locating bolts requires thread lock cement.

"B": Cement 99000-32020

Tightening Torque
(a): 17 N·m (1.7 kg-m, 12.5 lb-ft)
(b): 23 N·m (2.3 kg-m, 17.0 lb-ft)



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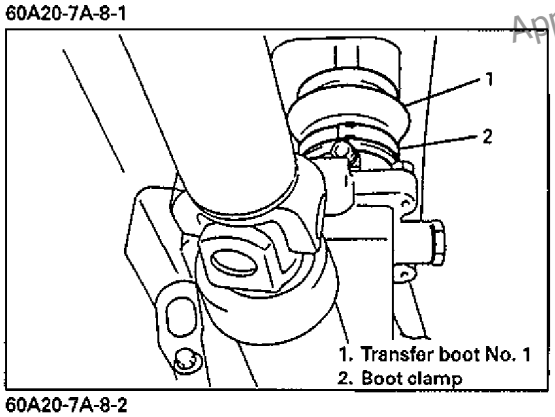
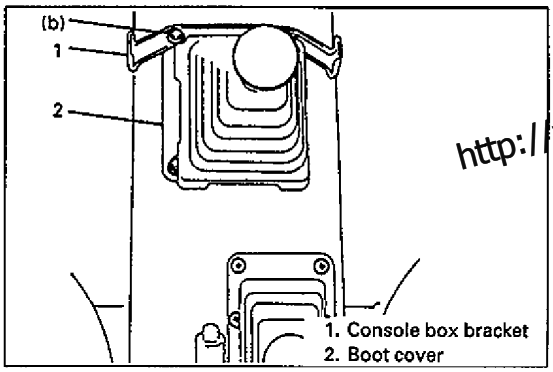
5) Install transmission boot No. 1 from inside of cabin and clamp it with a new clamp securely.



60A20-7A-8-2

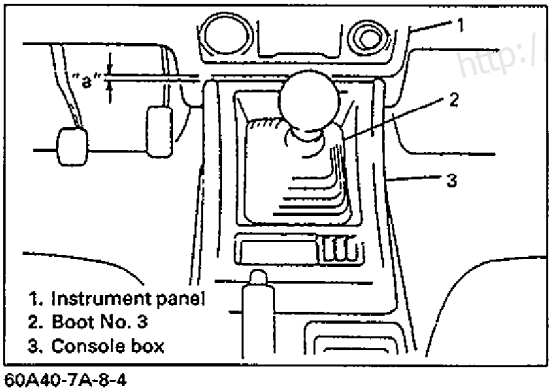
6) Install transfer boot No. 1 securely on lift and clamp it by using a new clamp.



60A50-7A-8-3

7) Tighten transmission boot No. 2 with boot cover and console box bracket.

Tightening Torque
(b): 6 N·m (0.6 kg-m, 4.0 lb-ft)

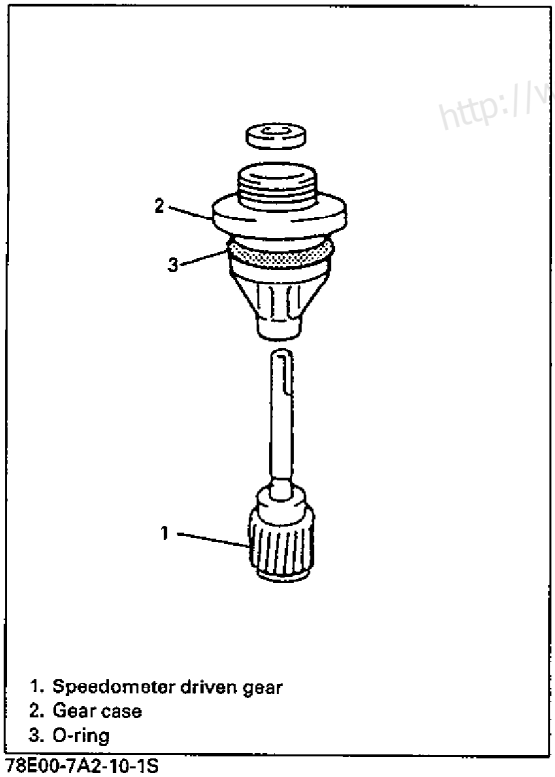


60A40-7A-8-4

8) Install console box leaving 2 mm (0.08 in.) from instrument panel as shown.

NOTE:
Be sure that flare end of transmission boot No. 3 is engaged with console box.

Clearance "a": 2 mm (0.08 in.)



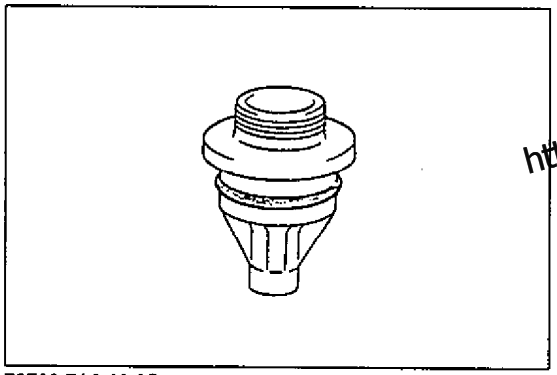
1. Speedometer driven gear
2. Gear case
3. O-ring

78E00-7A2-10-1S

SPEEDOMETER DRIVEN GEAR

REMOVAL

1) Lift up vehicle horizontally or rear up.
2) Disconnect speedometer cable at transfer case.
3) Remove bolt and take off gear case from transfer.
4) Remove speedometer driven gear.



78E00-7A2-10-3S

5) Remove oil seal from case.

NOTE:
Use small L-type drive handle to remove oil seal.

INSTALLATION

1) Make sure that O-ring and case have not been damaged.
2) Apply grease to lip portion of new oil seal and install it until bottom. Special tool (A) may be used for installation.

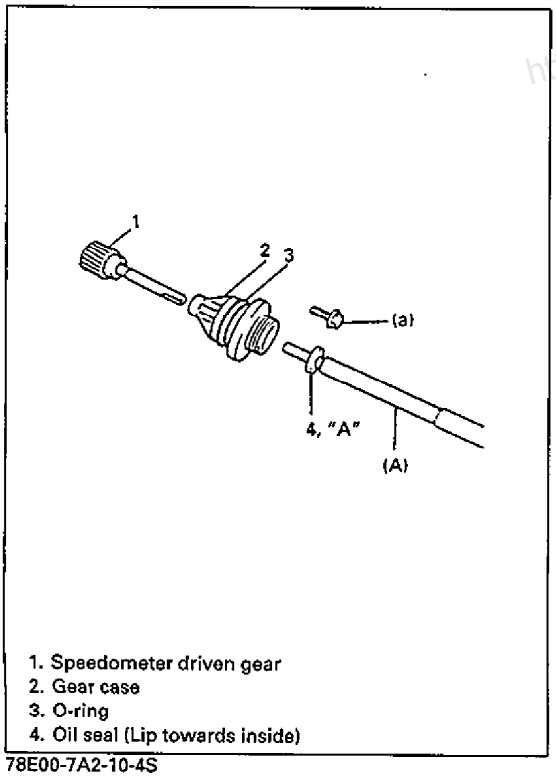
"A": Grease 99000-25010

Special Tool
(A): 09916-46010

3) Inspect speedometer driven gear for abnormal wear of gear teeth or bend of shaft portion and replace it if necessary.
4) Insert driven gear to case, then make sure its smooth rotation.
5) Install case assembly to transfer and connect cable as it was.

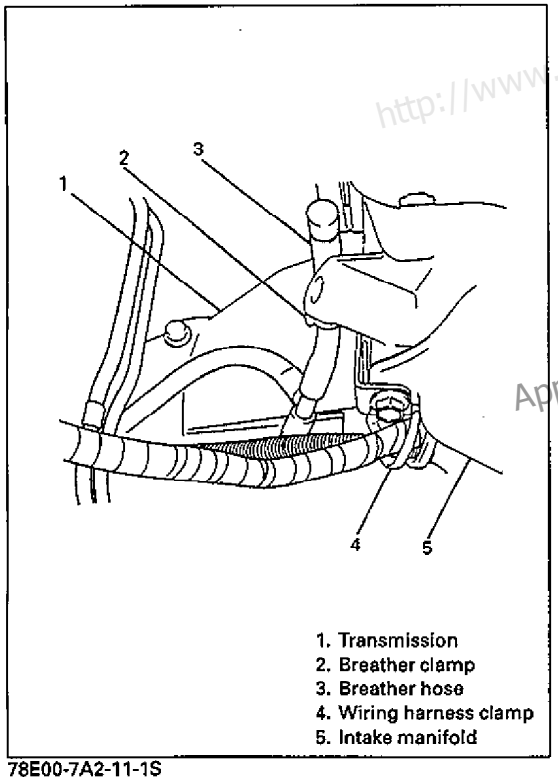
Tightening Torque
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

6) Make sure oil level is in specification.



1. Speedometer driven gear
2. Gear case
3. O-ring
4. Oil seal (Lip towards inside)

78E00-7A2-10-4S



1. Transmission
2. Breather clamp
3. Breather hose
4. Wiring harness clamp
5. Intake manifold

78E00-7A2-11-1S

UNIT REPAIR OVERHAUL

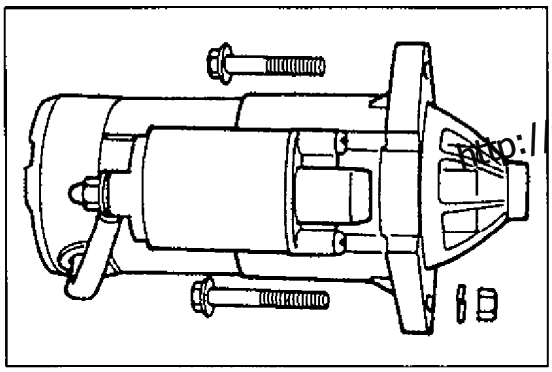
DISMOUNTING OF TRANS. UNIT

IN CABIN

Remove transmission shift control lever (refer to page 7A2-8) and transfer shift control lever knob.

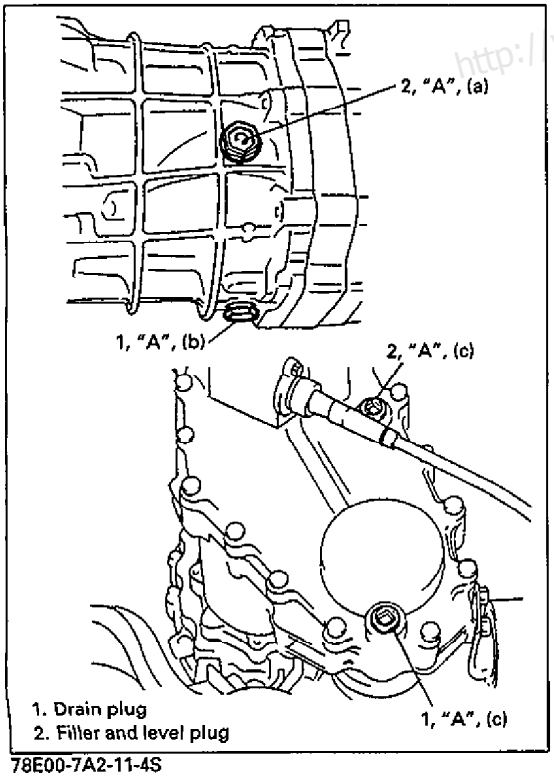
IN ENGINE ROOM

1) Remove battery, battery tray and heat protector (if equipped).
2) Remove intercooler referring to SECTION 6A3 of this manual for its detail.
3) Remove breather hose from clamp at the rear end of cylinder head.
4) Undo clamp at the rear end of intake manifold to free wiring harness.
5) Disconnect wiring harness coupler.



78E00-7A2-11-3S

6) Remove starter motor fixing nuts and remove starter.
7) Remove transmission fastening bolts.



1. Drain plug
2. Filler and level plug

78E00-7A2-11-4S

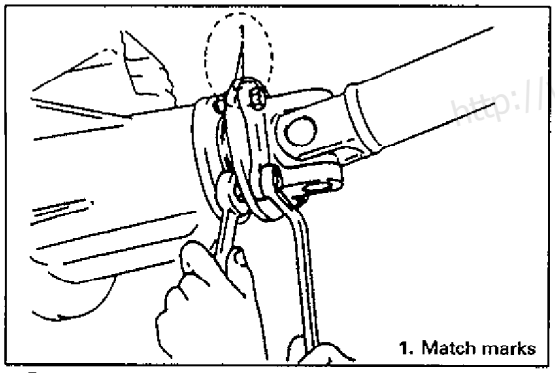
ON LIFT

1) Drain oil from transmission and transfer.

"A": Sealant 99000-31110

Tightening Torque
(a): 38 N·m (3.8 kg-m, 27.5 lb-ft)
(b): 45 N·m (4.5 kg-m, 32.5 lb-ft)
(c): 23 N·m (2.3 kg-m, 17.0 lb-ft)

NOTE:
It is not necessary to drain transmission oil when dismounting transmission and transfer for clutch maintenance only.



78E00-7A2-12-1S

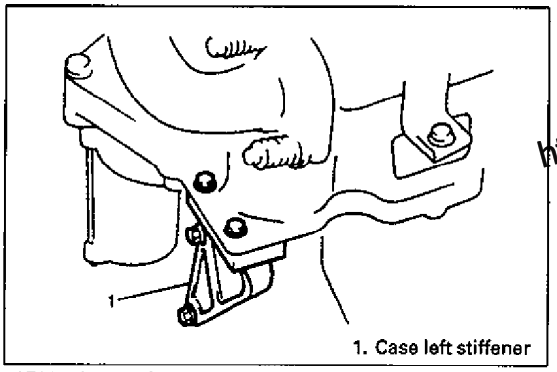
2) Before removing propeller shaft, give match marks on joint flange and propeller shaft as shown in left figure.
3) Remove universal joint flange bolts and take out rear propeller shaft.
4) Likewise, take out front propeller shaft.
5) Remove clutch operating cylinder from clutch housing.

6) Remove exhaust pipe No. 1 and No. 2.

WARNING:
Never work on exhaust system when the system is still hot. Start working after the exhaust system has cooled down.

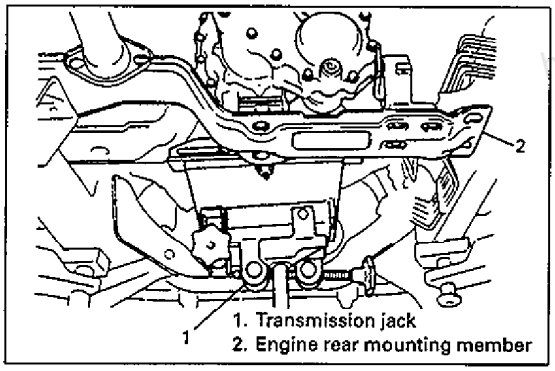
7) Remove speedometer cable end nut and disconnect cable.

78E00-7A2-12-2S



8) Remove case left and right stiffeners.
9) Remove clutch housing lower plate.
10) Remove nuts/bolts fastening engine and transmission.

78E00-7A2-12-3S



78E00-7A2-12-4S

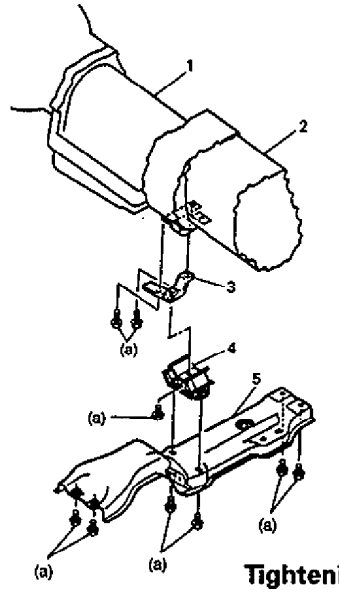
11) Apply transmission jack and take off rear mounting member, engine rear mounting and engine rear mounting bracket by removing its bolts.

11) After removing mounting member, move rearward transmission and transfer assemblies placed on jack and then lower them.

WARNING:
Transmission and transfer assemblies may tilt rear ward on jack. It is recommended to use an auxiliary arm of jack for the purpose of safety.

12) Remove wiring harness and breather hose.
13) Separate gear shift lever case and transfer assembly from transmission.

78E00-7A2-13-1S



Tightening Torque
(a): 50 N·m
5.0 kg-m
36.0 lb-ft

1. Manual transmission
2. Transfer
3. Engine rear mounting bracket
4. Engine rear mounting
5. Engine rear mounting member

78E00-7A2-13-3S

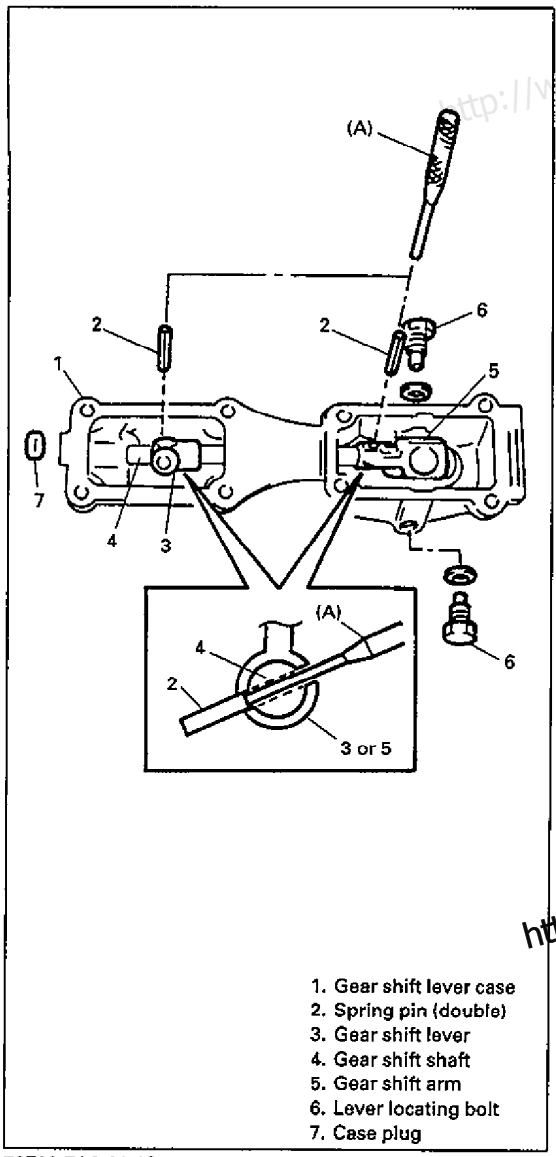
REMOUNTING

For remounting, reverse dismounting procedure noting following points.

- Use specified torque as given below and left.

Tightening torque	N·m	kg-m	lb-ft
• Exhaust pipe No. 1 to manifold nuts • Exhaust pipe No. 2 to muffler nuts	60	6.0	43.0
Universal joint flange bolts and nuts	55	5.5	40.0
Transfer oil filler/drain plugs	23	2.3	17.0
Transmission oil filler/level plug	38	3.8	27.5
Transmission oil drain plug	45	4.5	32.5
Engine to transmission bolts and nuts	80	8.0	58.0
• Stiffener bolts • Clutch operating cylinder bolts • Transmission to transfer bolts	50	5.0	36.5
Gear shift lever case bolt	23	2.3	17.0

- Set each clamp for wiring, hose and cable securely.
- Set clamp for shift control lever boots securely.
- For installing clutch operating cylinder, refer to SECTION 7C1.



1. Gear shift lever case
2. Spring pin (double)
3. Gear shift lever
4. Gear shift shaft
5. Gear shift arm
6. Lever locating bolt
7. Case plug

78E00-7A2-14-1S

GEAR SHIFT LEVER CASE

DISASSEMBLY

1) Remove case plate.
2) With case supported with soft jawed vise, remove lever locating bolts.

NOTE:
Use aluminum plates between vise and case to protect case against damage.

3) Using special tool, drive spring pin into gear shift arm as far as the position shown in figure.

CAUTION:
When driving spring pin, use care not to damage gear shift lever case.

Special Tool
(A): 09922-85811

4) Likewise, drive spring pin into gear shift lever as far as the position shown in figure.

CAUTION:
When driving spring pin, use care not to damage gear shift lever case.

Special Tool
(A): 09922-85811

5) Remove case plug.

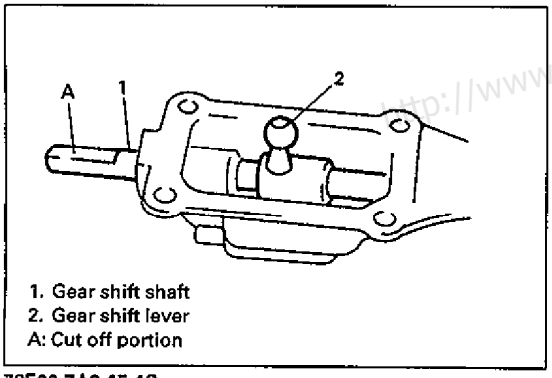
6) Pull out gear shift shaft from gear shift lever case and take out gear shift lever.

78E00-7A2-14-4S

INSPECTION AND REASSEMBLY

1) Wash and inspect each part and replace if necessary. Also check item as described below and correct whatever necessary carefully by using reamer, oilstone and the like, wash it thoroughly and reassemble it.
Item to be checked is;
- Shift shaft should go into case smoothly.

78E00-7A2-14-5S



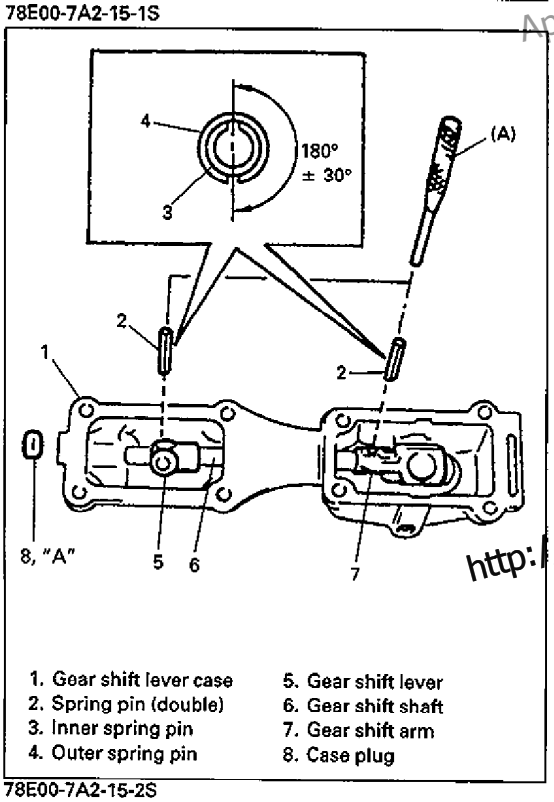
1. Gear shift shaft
2. Gear shift lever
A: Cut off portion

78E00-7A2-15-1S

2) Insert shift shaft as shown while making sure that inner parts are in proper direction.

NOTE:

- **Cut off in shift shaft should face downward when shift shaft is installed.**
- **Shift lever should be installed at the same time.**



1. Gear shift lever case
2. Spring pin (double)
3. Inner spring pin
4. Outer spring pin
5. Gear shift lever
6. Gear shift shaft
7. Gear shift arm
8. Case plug

78E00-7A2-15-2S

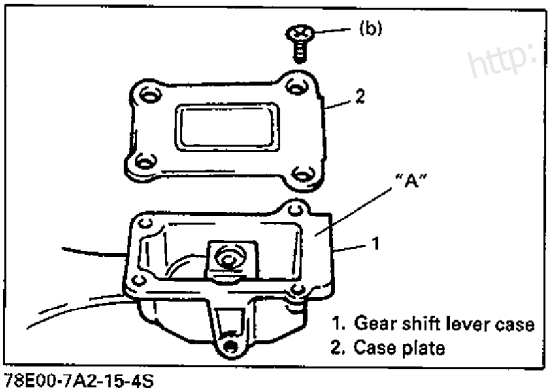
3) Drive in spring pins for gear shift lever and shift arm.

NOTE:
When driving in spring pins, position their slits 180° ± 30° apart.

Special Tool
(A): 09925-78210

4) Apply sealant to new case plug and drive it into lever case.

"A": Sealant 99000-25010



1. Gear shift lever case
2. Case plate

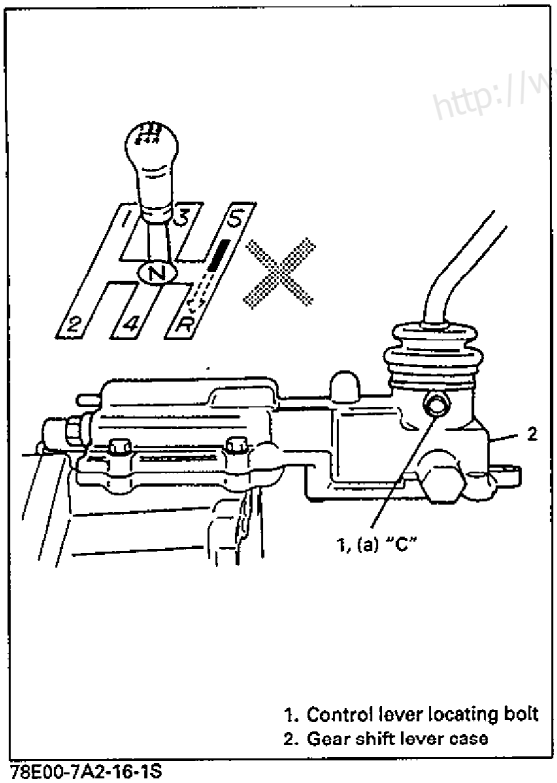
78E00-7A2-15-4S

5) Clean mating surface of gear shift lever case and case plate, and then apply sealant evenly to surface of gear shift lever case.

"A": Sealant 99000-31110

6) Tighten screws to specified torque.

Tightening Torque
(b): 6 N·m (0.6 kg-m, 4.5 lb-ft)



1. Control lever locating bolt
2. Gear shift lever case

78E00-7A2-16-1S

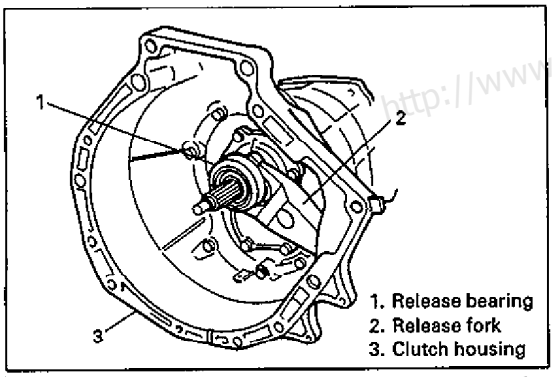
7) Install gear shift lever case to transmission without using sealant for functional check.
8) Install shift control lever and check to make sure that it shifts smoothly according to shift pattern as shown in following figure.

NOTE:

- **Apply thread lock cement to control lever locating bolts when retightening.**
- **Be sure to apply sealant to mating surface of gear shift lever for its final installation.**

"C": Cement 99000-32020

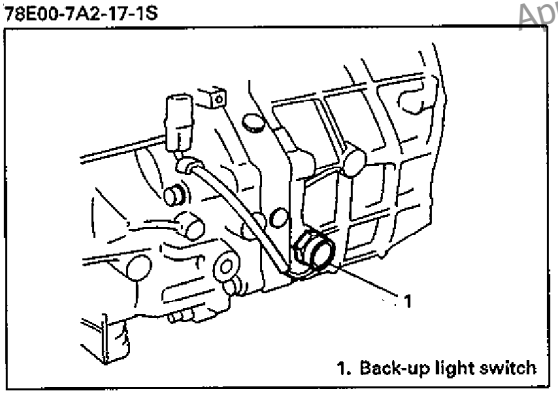
Tightening Torque
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)



78E00-7A2-17-1S

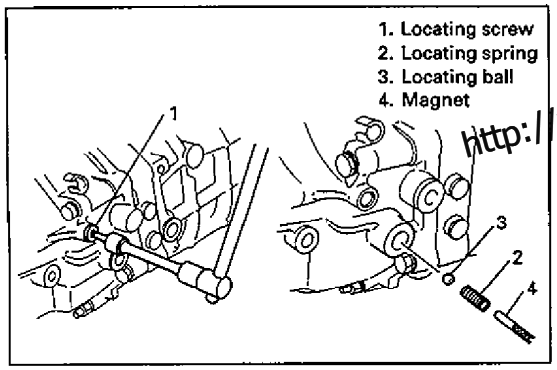
DISASSEMBLY

1) Remove clutch release bearing, release fork and clutch housing.



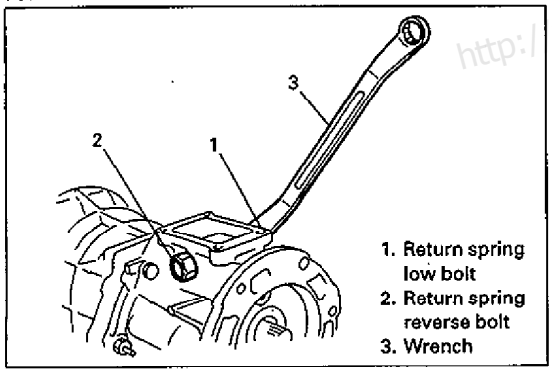
78E00-7A2-17-2S

2) Remove back-up light switch.



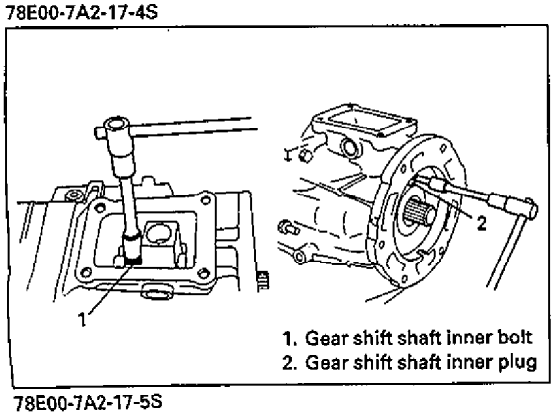
78E00-7A2-17-3S

3) Remove locating screw, locating spring and locating ball as shown.



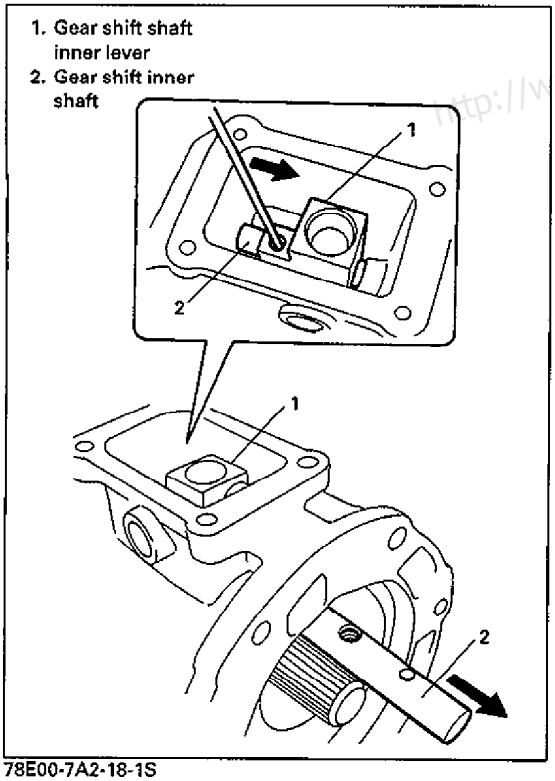
78E00-7A2-17-4S

4) Remove return spring low/reverse bolts.



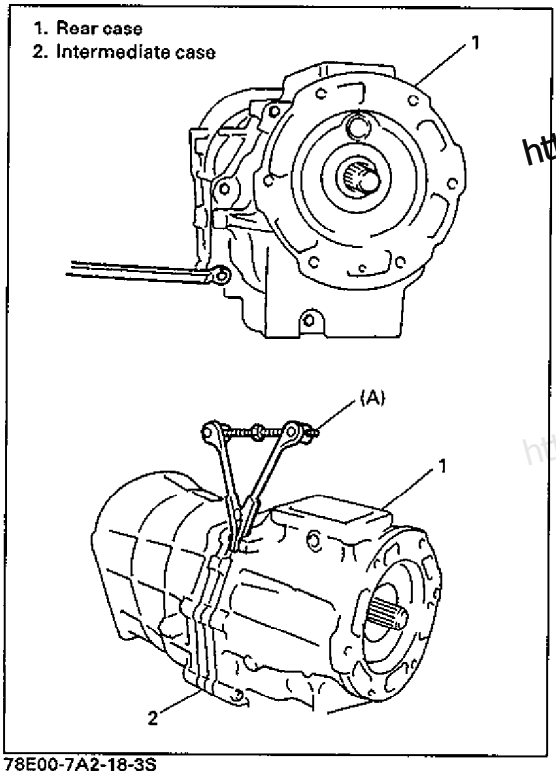
78E00-7A2-17-5S

5) Remove gear shift shaft inner bolt/plug.



78E00-7A2-18-1S

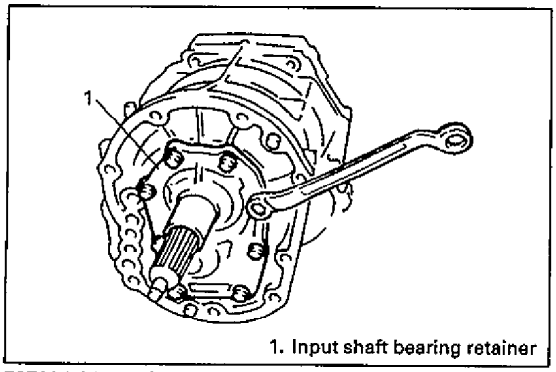
6) Using bolt hole, pull gear shift inner shaft and then remove gear shift shaft inner lever.



78E00-7A2-18-3S

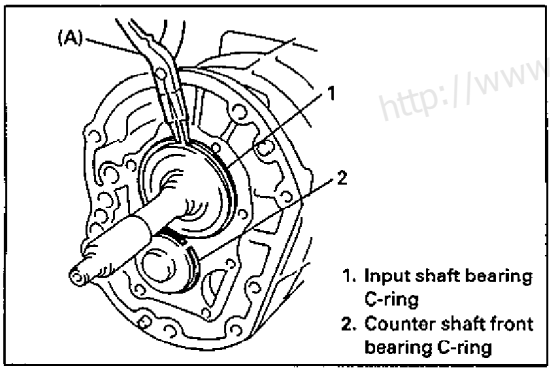
7) After removing transmission case bolts/nut, remove transmission rear case from intermediate case.

(A): 09912-34510



78E00-7A2-18-5S

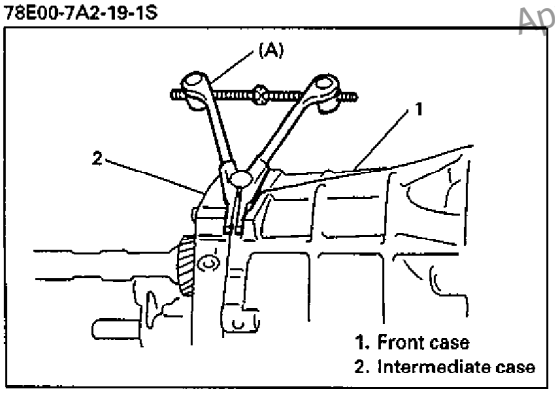
8) Remove input shaft bearing retainer and gasket.



78E00-7A2-19-1S

9) Remove C-rings of input shaft bearing and counter shaft front bearing.

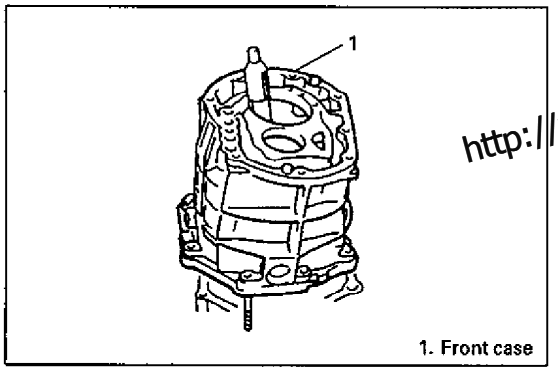
Special Tool
(A): 09900-06107



78E00-7A2-19-2S

10) Using special tool, separate transmission front case and transmission intermediate case.

Special Tool
(A): 09912-34510

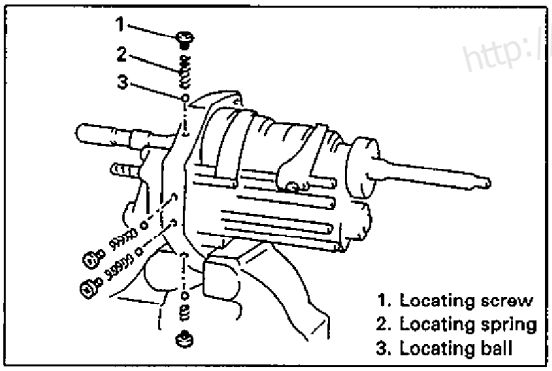


78E00-7A2-19-3S

11) Set transmission on workbench and remove transmission front case.

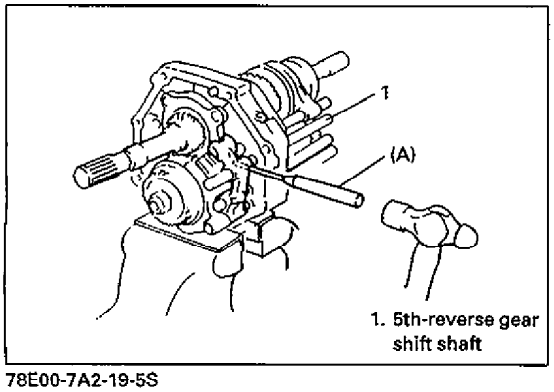
NOTE:
To remove transmission front case, tilt it as shown.

12) Set transmission intermediate case on vise securely.



78E00-7A2-19-4S

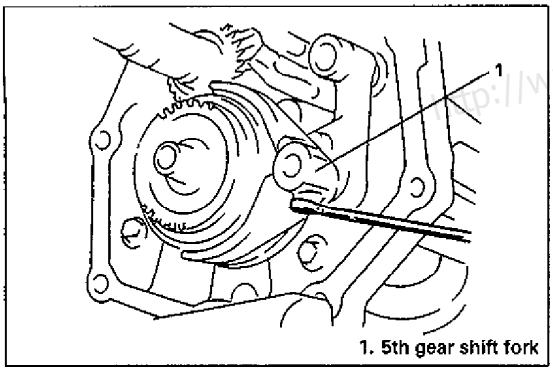
13) Remove locating screws, locating springs and locating ball as shown.



78E00-7A2-19-5S

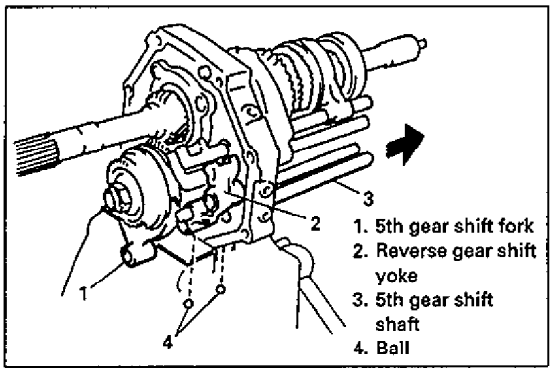
14) Using special tool, remove spring pin and then remove 5th-reverse gear shift shaft.

Special Tool
(A): 09922-85811



78E00-7A2-20-1S

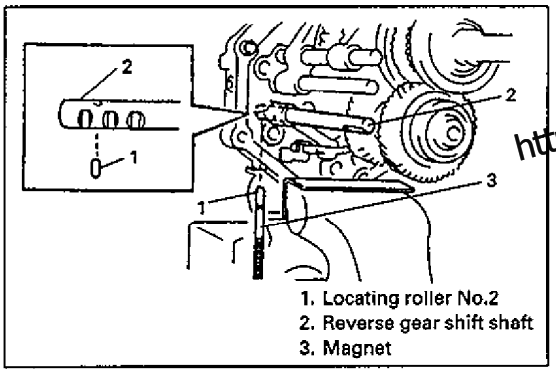
15) Remove bolt from 5th gear shift fork.



78E00-7A2-20-2S

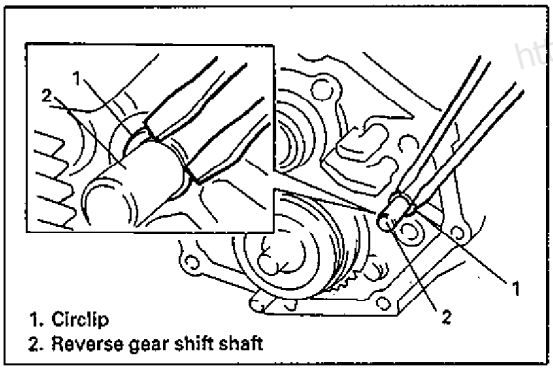
16) Remove 5th gear shift fork, 5th gear shift shaft and reverse gear shift yoke.

NOTE:
When pulling 5th gear shift shaft, place hand so as to catch balls dropping from reverse gear shift yoke and intermediate plate.



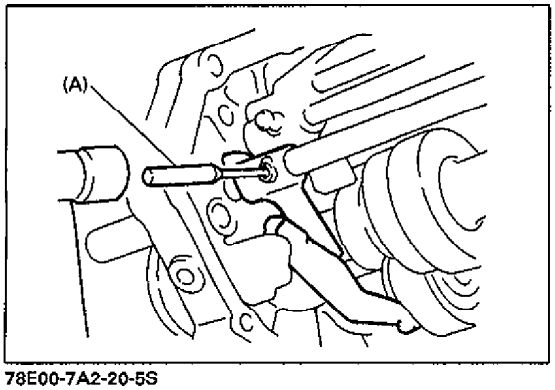
78E00-7A2-20-3S

17) Remove locating roller No.2 from reverse gear shift shaft by using magnet.



78E00-7A2-20-4S

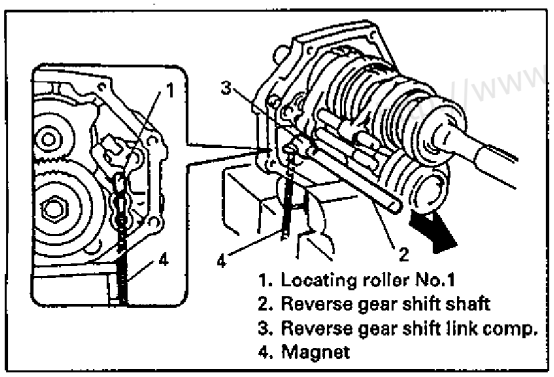
18) Remove circlip from reverse gear shift shaft as shown.



78E00-7A2-20-5S

19) Remove spring pin from reverse gear shift link component.

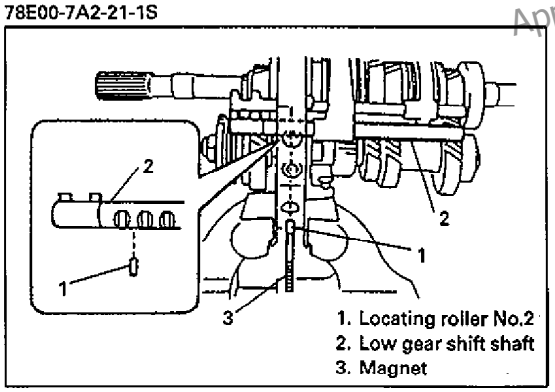
Special Tool
(A): 09922-85811



78E00-7A2-21-1S

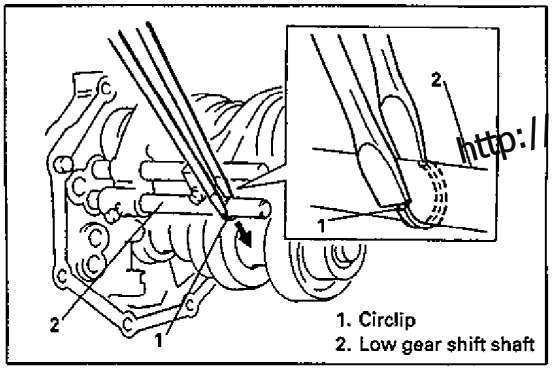
20) Remove reverse gear shift shaft, locating roller No. 1, and reverse gear shift link component.

NOTE:
When pulling gear shaft, hold locating roller No. 1 with magnet to prevent it from falling.



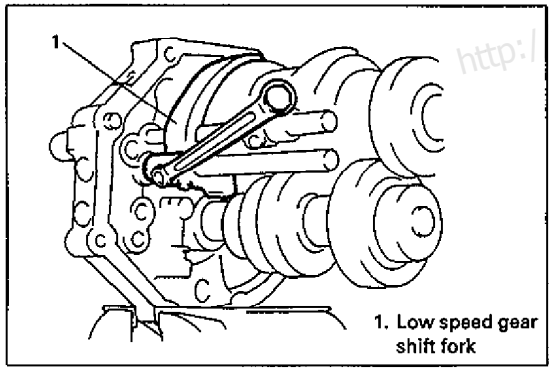
78E00-7A2-21-2S

21) Disassemble reverse gear shift link component by removing E-rings.
22) Remove locating roller No.2 from low gear shift shaft by using magnet.



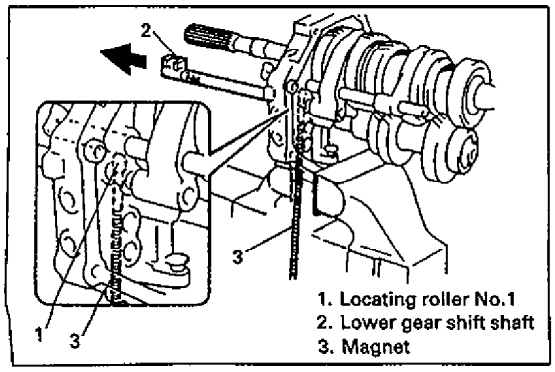
78E00-7A2-21-3S

23) Remove circlip from low gear shift shaft as shown.



78E00-7A2-21-4S

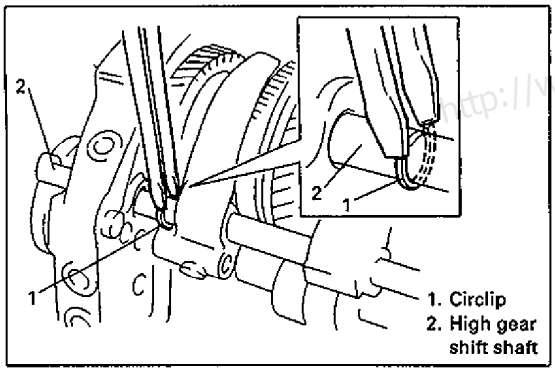
24) Remove bolt from low speed gear shift fork.



78E00-7A2-21-5S

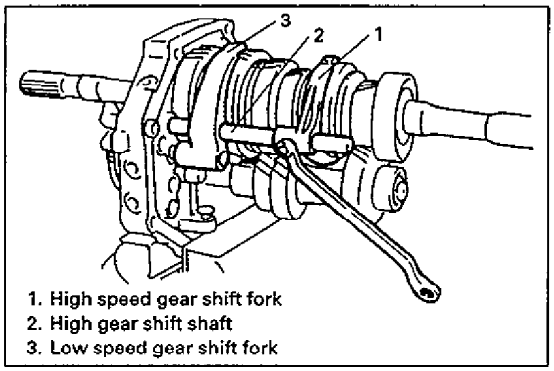
25) Remove low gear shift shaft and locating roller No.1.

NOTE:
When pulling gear shaft, hold locating roller No.1 with magnet to prevent it from falling.



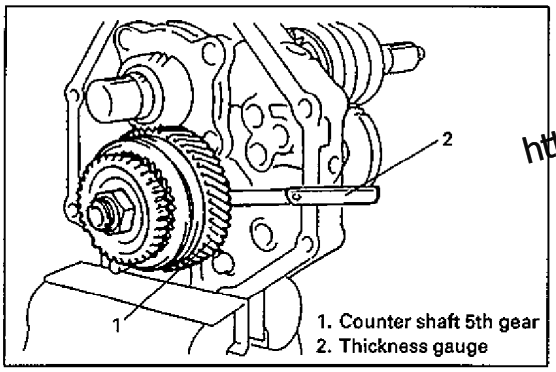
78E00-7A2-22-1S

26) Remove circlip from high gear shift shaft as shown.



78E00-7A2-22-2S

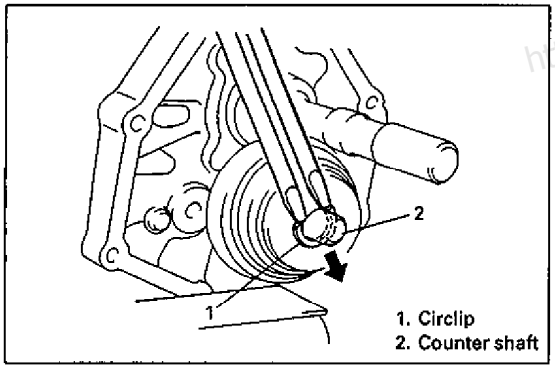
27) Remove bolt from high speed gear shift fork.
28) Remove high gear shift shaft, high speed gear shift fork and low speed gear shift fork.



78E00-7A2-22-3S

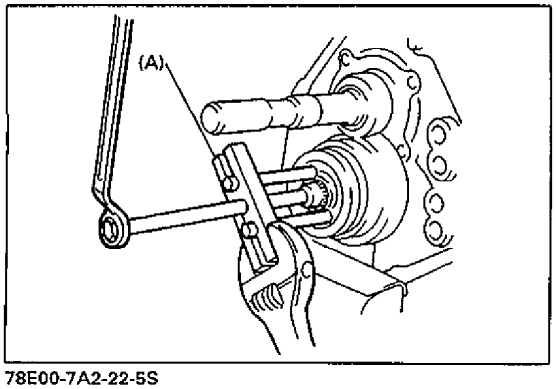
29) Check counter shaft 5th gear thrust clearance by using thickness gauge.

Standard: 0.10 – 0.30 mm (0.0040 – 0.0118 in.)



78E00-7A2-22-4S

30) Remove circlip from counter shaft as shown.

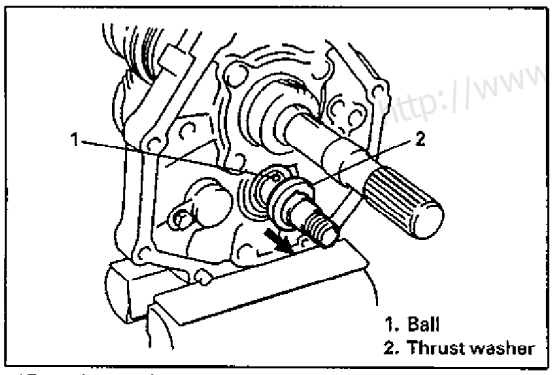


78E00-7A2-22-5S

31) Remove 5th speed synchronizer dog by using special tool.

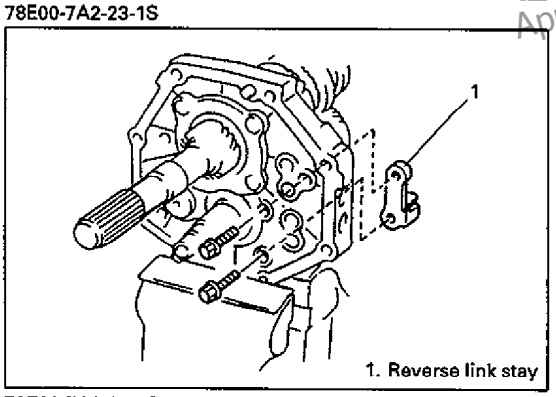
Special Tool
(A): 09944-84510

32) Remove synchronizer ring, needle bearing and counter shaft 5th gear.



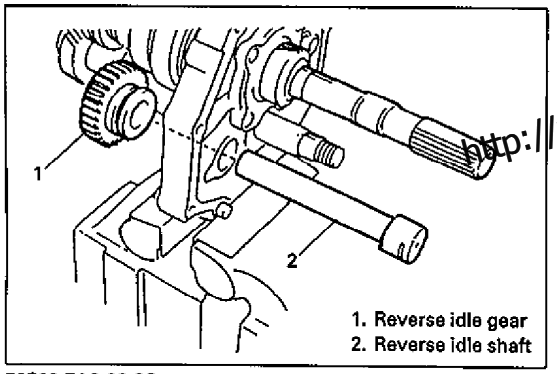
78E00-7A2-23-1S

33) Remove thrust washer and ball.



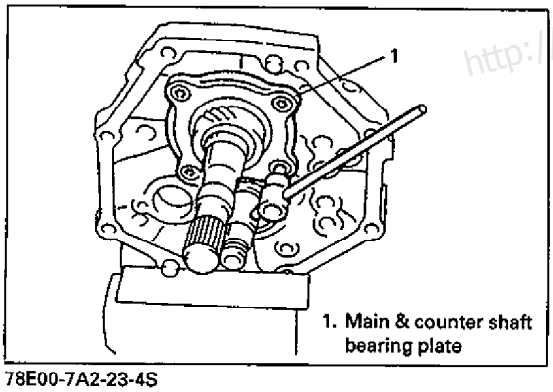
78E00-7A2-23-2S

34) Remove reverse link stay from intermediate case.



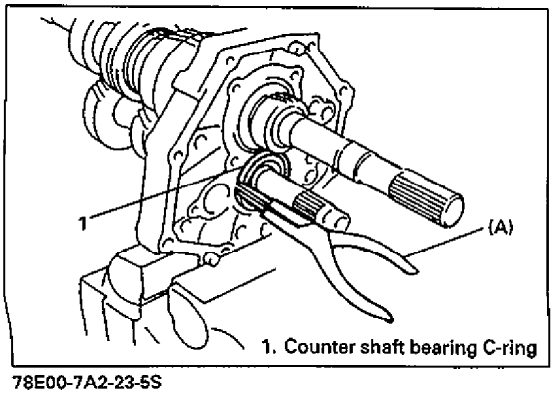
78E00-7A2-23-3S

35) Remove reverse idle gear and shaft.



78E00-7A2-23-4S

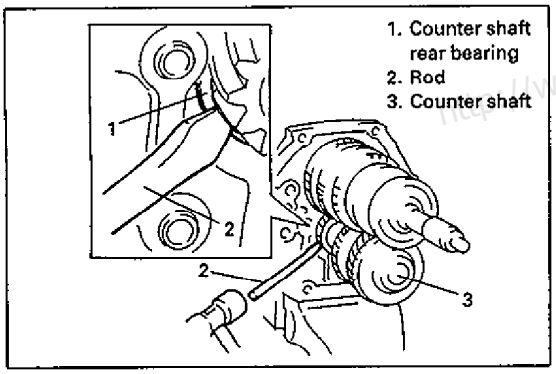
36) Remove main & counter shaft bearing plate.



78E00-7A2-23-5S

37) Remove C-ring of counter shaft rear bearing.

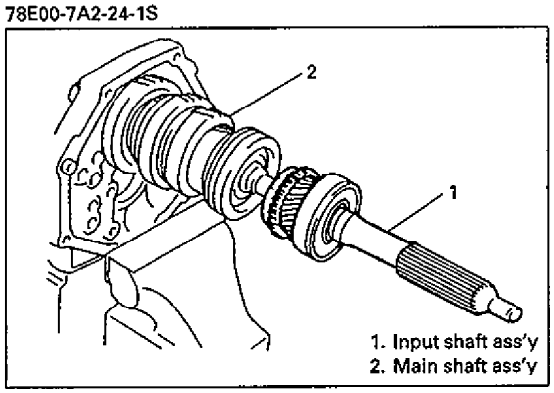
Special Tool
(A): 09900-06107



78E00-7A2-24-1S

38) Using rod and hammer, remove counter shaft rear bearing and counter shaft.

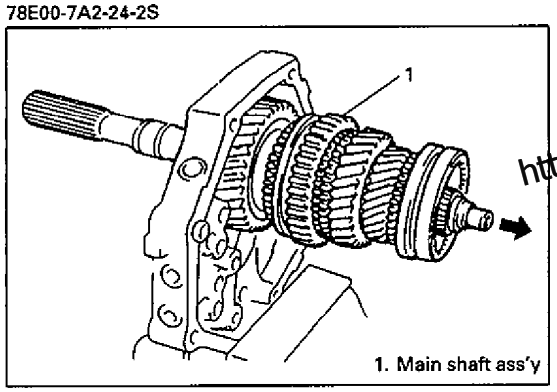
NOTE:
This removal requires 2 persons. One should hold counter shaft and the other should remove bearing by using rod and hammer.



78E00-7A2-24-2S

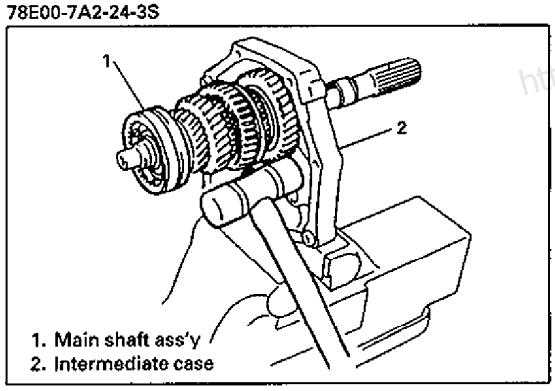
39) Remove input shaft ass'y with synchronizer ring from main shaft ass'y.

NOTE:
When removing input shaft, be careful not to drop bearing roller.



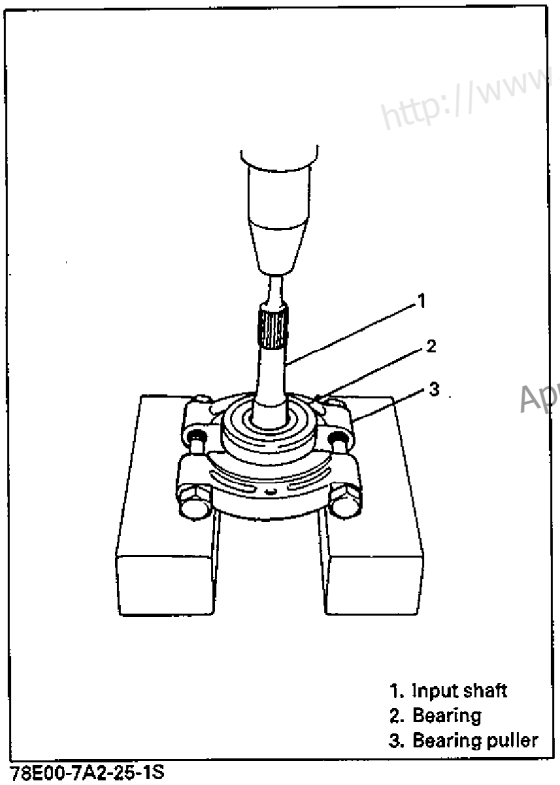
78E00-7A2-24-3S

40) Remove C-ring of main shaft and pull out main shaft ass'y.



78E00-7A2-24-4S

NOTE:
If intermediate case is engaged with bearing firmly, tap front face of intermediate case with plastic hammer lightly as it will cause main shaft ass'y to come off forward.



1. Input shaft
2. Bearing
3. Bearing puller

78E00-7A2-25-1S

SUB-ASSEMBLY

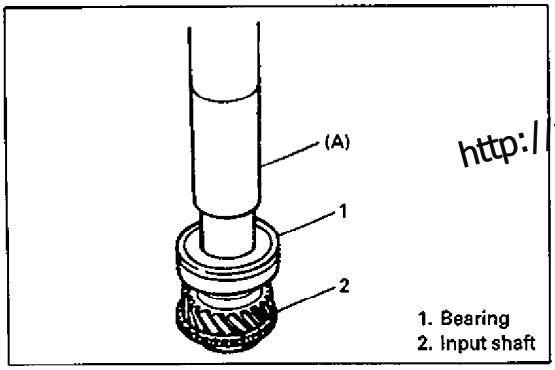
Input Shaft Ass'y

DISASSEMBLY

Remove circlip of input shaft and pull out bearing with puller and press.

NOTE:

Sealed bearing must not be washed. Replace it with new one when required.



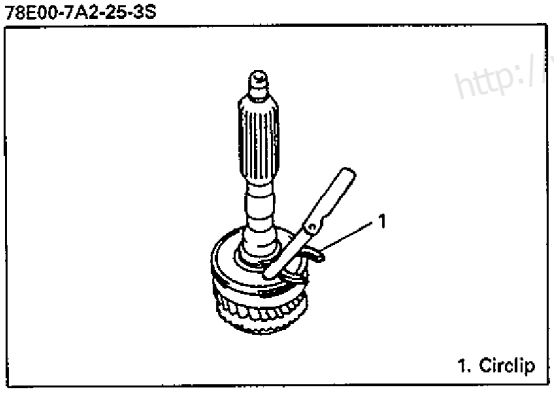
1. Bearing
2. Input shaft

78E00-7A2-25-3S

ASSEMBLY AND INSPECTION

1) Bring bearing (2) so that its groove for circlip is in the front and press-fit with special tool and press.

Special Tool
(A): 09940-51710

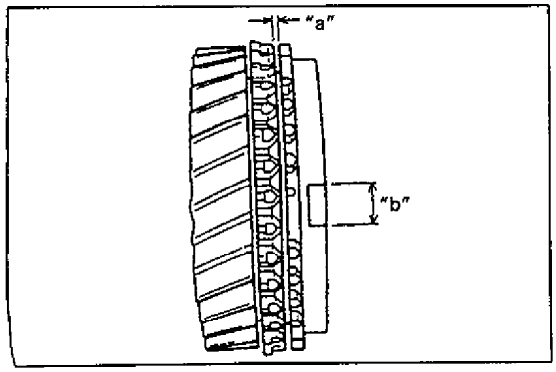


1. Circlip

78E00-7A2-25-4S

2) Select circlip that will make thrust clearance of bearing 0.1 mm (0.0039 in) or less and install it.

ID mark	Circlip thickness	ID mark	Circlip thickness
0	2.05 – 2.10 mm (0.0807 – 0.0826 in.)	3	2.20 – 2.25 (0.0867 – 0.0885 in.)
1	2.10 – 2.15 (0.0827 – 0.0846 in.)	4	2.25 – 2.30 (0.0886 – 0.0905 in.)
2	2.15 – 2.20 (0.0847 – 0.0866 in.)	5	2.30 – 2.35 (0.0906 – 0.0925 in.)

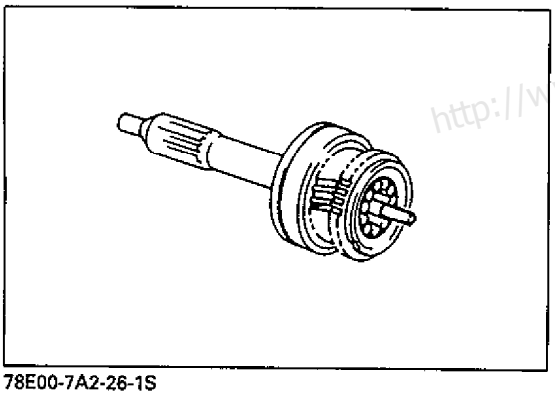


78E00-7A2-25-5S

3) Check clearance "a" between synchronizer ring and gear, key slot width "b" in synchronizer ring and each chamfered tooth of gear and synchronizer ring and replace with new one, if necessary. Also, check gear tooth.

Clearance "a" : Standard 1.0 – 2.0 mm (0.039 – 0.078 in.)
Service limit 0.8 mm (0.032 in.)

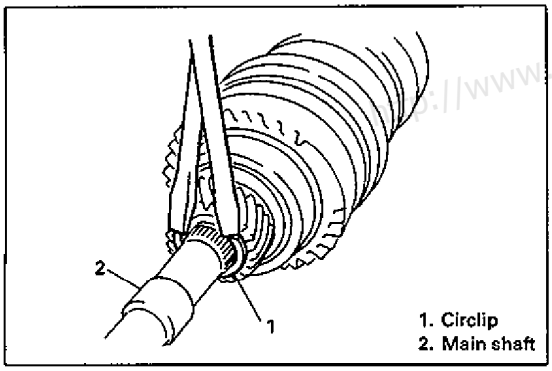
Slot width "b" : Standard 10.0 – 10.2 mm (0.394 – 0.401 in.)
Service limit 10.45 mm (0.411 in.)



78E00-7A2-26-1S

4) Apply grease to bearing roller and install it to input shaft.

Grease: 99000-25010

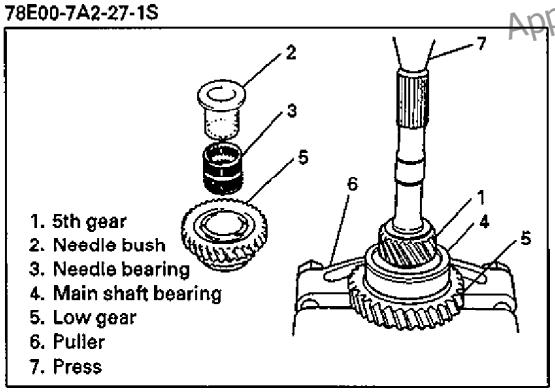


78E00-7A2-27-1S

Main Shaft Ass'y

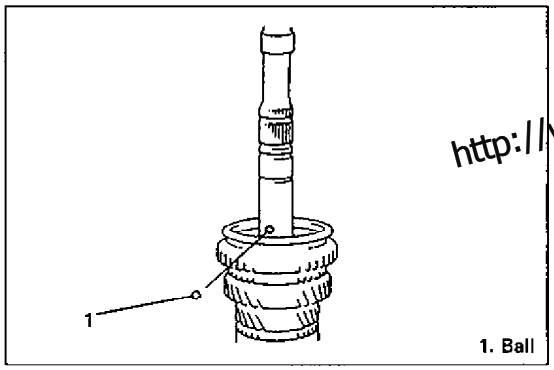
DISASSEMBLY

1) Remove circlip from main shaft as shown.



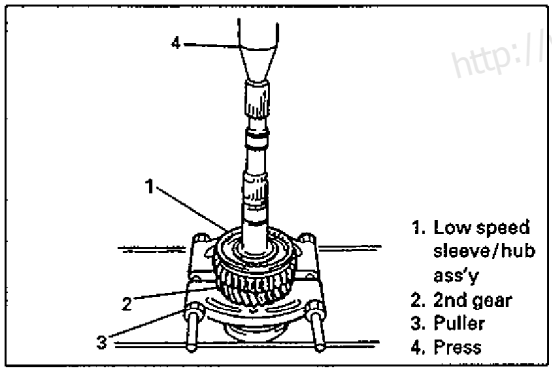
78E00-7A2-27-2S

2) Pull out 5th gear, needle bush, needle bearing, main shaft bearing and low gear with puller and press.



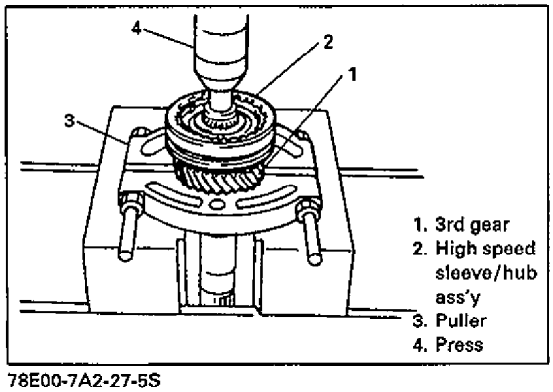
78E00-7A2-27-3S

3) Remove synchronizer ring and ball.



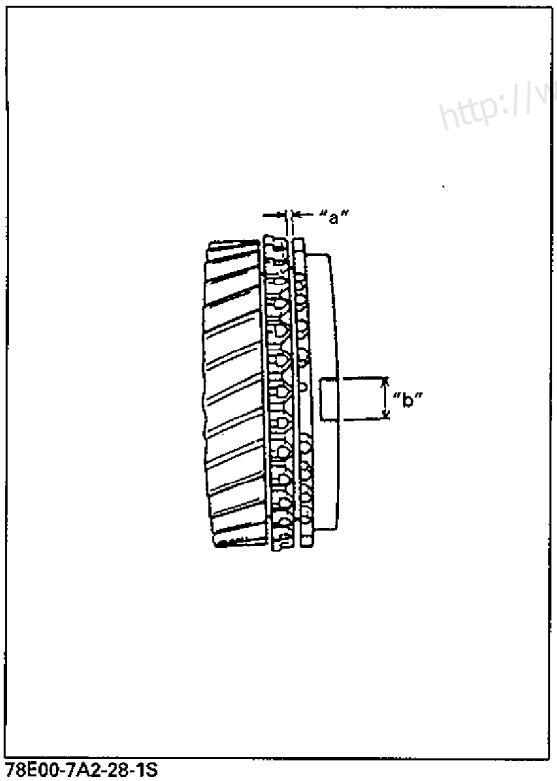
78E00-7A2-27-4S

4) Pull out low speed sleeve/hub synchronizer ring, needle bearing and 2nd gear from main shaft.
5) Pull off synchronizer springs/keys and low speed sleeve from hub.



78E00-7A2-27-5S

6) Remove circlip from front part of main shaft and pull out 3rd gear, needle bearing, synchronizer ring and high speed sleeve/hub.



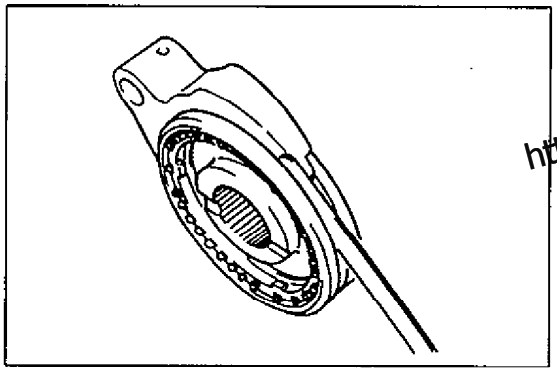
78E00-7A2-28-1S

INSPECTION

Check clearance "a" between synchronizer ring and gear, key slot width "b" in synchronizer ring and each chamfered tooth of gear and synchronizer ring and replace with new one, if necessary. Also, check gear tooth.

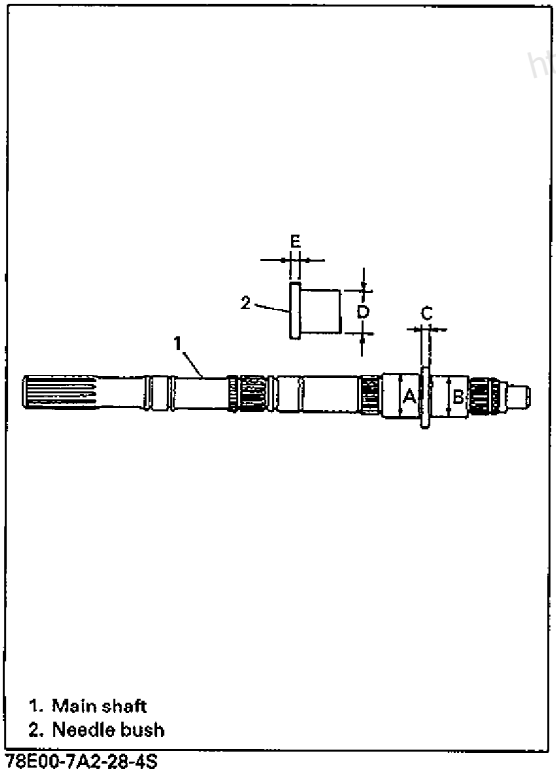
Clearance "a" : Standard 1.0 – 2.0 mm (0.039 – 0.078 in.)
Service limit 0.8 mm (0.032 in.)

Slot width "b" : 1st, 2nd
Standard 12.2 – 12.4 mm (0.481 – 0.488 in.)
Service limit 12.65 mm (0.498 in.)
3rd
Standard 10.0 – 10.2 mm (0.394 – 0.401 in.)
Service limit 10.45 mm (0.411 in.)


78E00-7A2-28-3S

- Check clearance between fork and sleeve.
  If clearance exceeds limit, replace fork and sleeve.

Standard : 0.15 – 0.35 mm (0.006 – 0.013 in.)
Limit : 1.0 mm (0.039 in.)

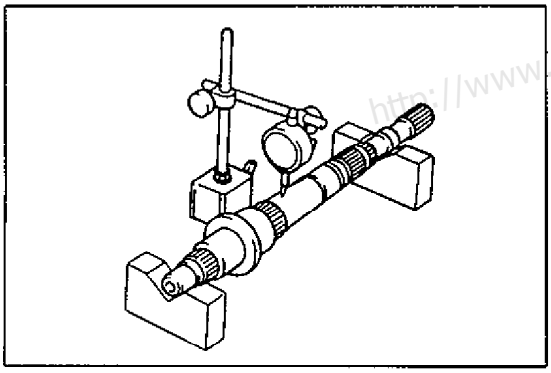


1. Main shaft
2. Needle bush

78E00-7A2-28-4S

- Check diameter of main shaft/needle bush and thickness of main shaft/needle bush flanges as shown. If measured value is out of specification, replace them (or it).

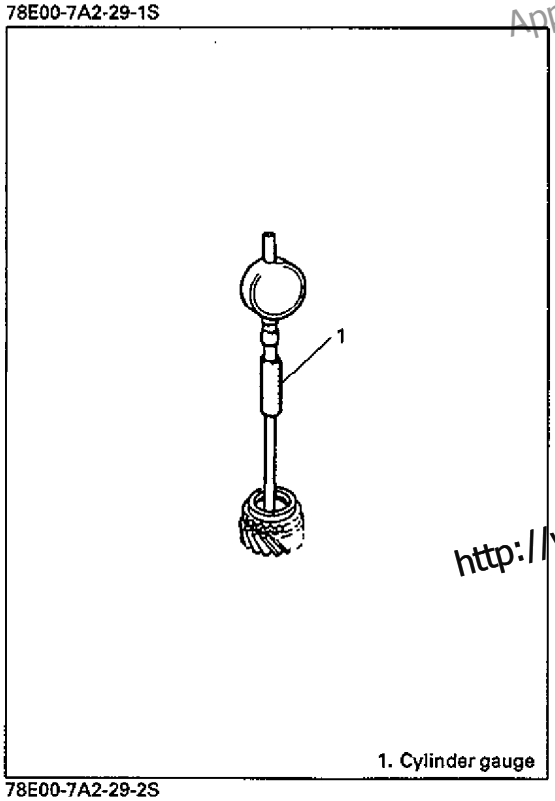
Measuring portion	Standard
A	37.984 – 38.000 mm (1.4955 – 1.4960 in.)
B	34.984 – 35.000 mm (1.3774 – 1.3779 in.)
C	4.80 – 5.20 mm (0.1840 – 0.2047 in.)
D	38.985 – 39.000 mm (1.5348 – 1.5354 in.)
E	3.955 – 4.195 mm (0.1558 – 0.1651 in.)



78E00-7A2-29-1S

- Using "V" blocks and dial gauge, check runout.
  If runout exceeds limit below, replace main shaft.

  Runout limit: 0.06 mm (0.0023 in.)



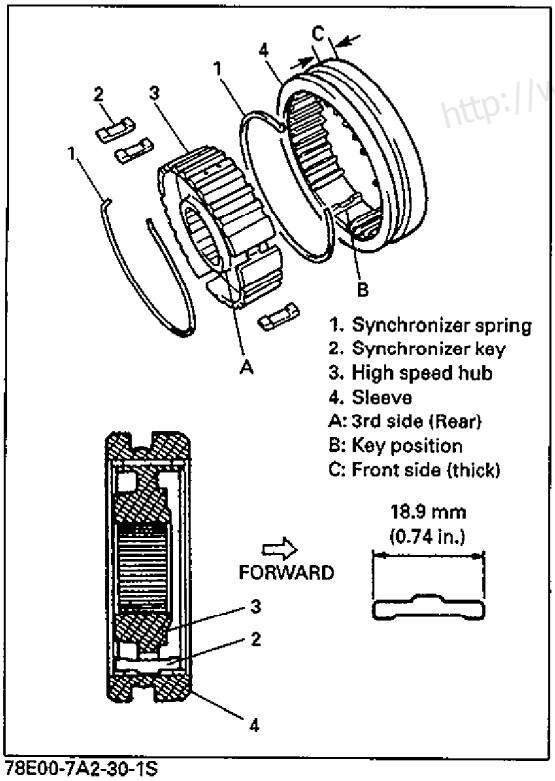
1. Cylinder gauge

78E00-7A2-29-2S

- Using cylinder gauge, check inside diameter of each gear.
  If its inside diameter exceeds specification, replace it.

	Standard
1st	44.015 – 44.040 mm (1.7329 – 1.7338 in.)
2nd	
3rd	

- Check chamfered part of each sleeve for damage and excessive wear, and replace as necessary.
- Check each synchronizer key and synchronizer spring and replace as necessary.
- Check splined portions and replace parts if excessive wear is found.



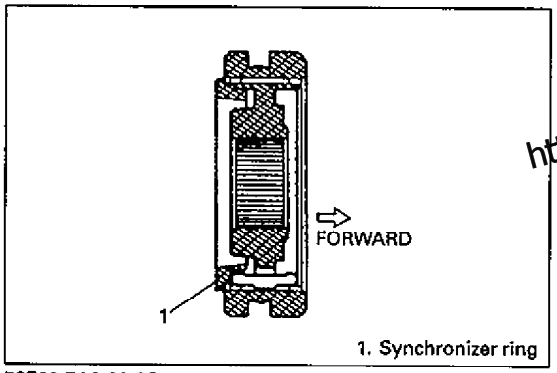
78E00-7A2-30-1S

ASSEMBLY AND INSPECTION

NOTE:

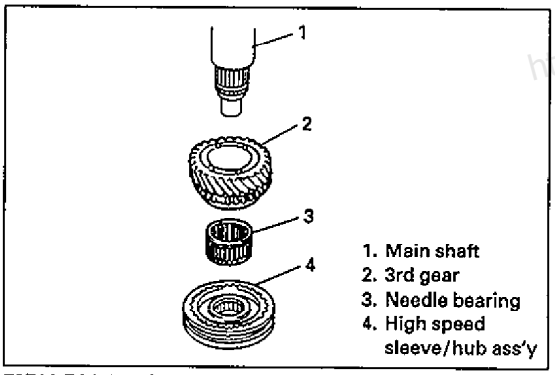
- **Before installation, wash each part and apply specified gear oil to sliding faces of bearing and gear.**
- **Use new circlips on shaft for installation. Don't reuse circlips.**

1) Fit sleeve to high speed hub, place 3 synchronizer keys and set synchronizer springs as shown.
   Neither sleeve nor key has specific installing direction.



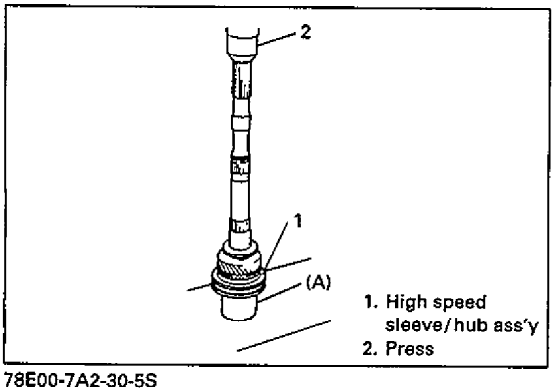
78E00-7A2-30-3S

2) Install synchronizer ring by matching its key slots to keys as shown.



78E00-7A2-30-4S

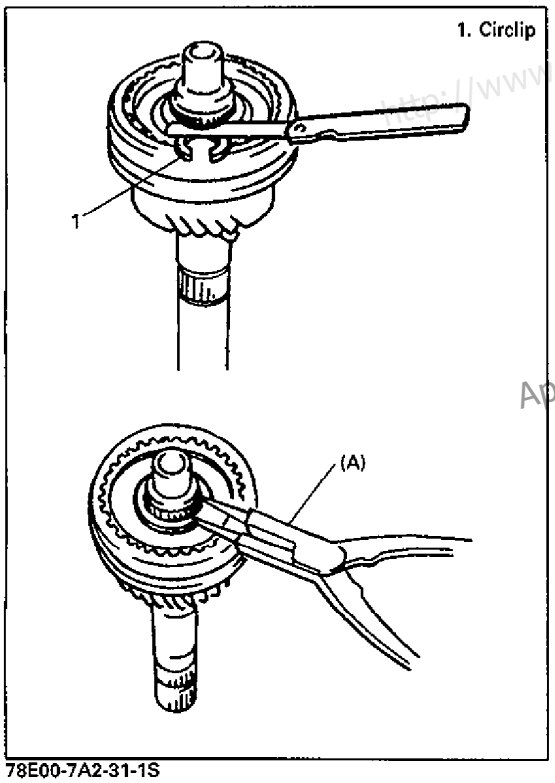
3) Insert 3rd gear, needle bearing and high speed sleeve/hub ass'y with synchronizer ring to main shaft.



78E00-7A2-30-5S

4) Press-fit high speed sleeve/hub ass'y with special tool and press.

Special Tool
(A): 09940-53111



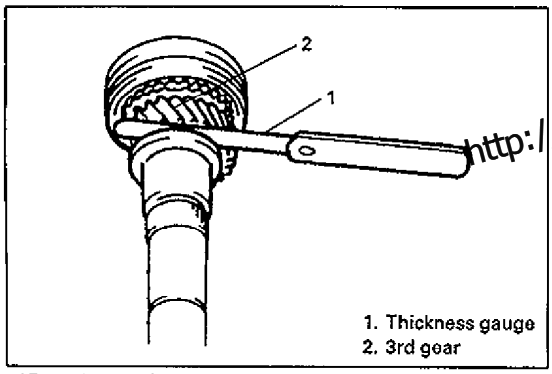
78E00-7A2-31-1S

5) Select circlip that will make thrust clearance of clutch hub 0.1 mm (0.0039 in) or less and install it.

ID mark	Circlip thickness	ID mark	Circlip thickness
C – 1	1.75 – 1.80 mm (0.0689 – 0.0708 in.)	E – 1	1.95 – 2.00 mm (0.0768 – 0.0787 in.)
D	1.80 – 1.85 mm (0.0709 – 0.0728 in.)	F	2.00 – 2.05 mm (0.0788 – 0.0807 in.)
D – 1	1.85 – 1.90 mm (0.0729 – 0.0748 in.)	F – 1	2.05 – 2.10 mm (0.0808 – 0.0826 in.)
E	1.90 – 1.95 mm (0.0749 – 0.0767 in.)		

Special Tool
(A): 09900-01607

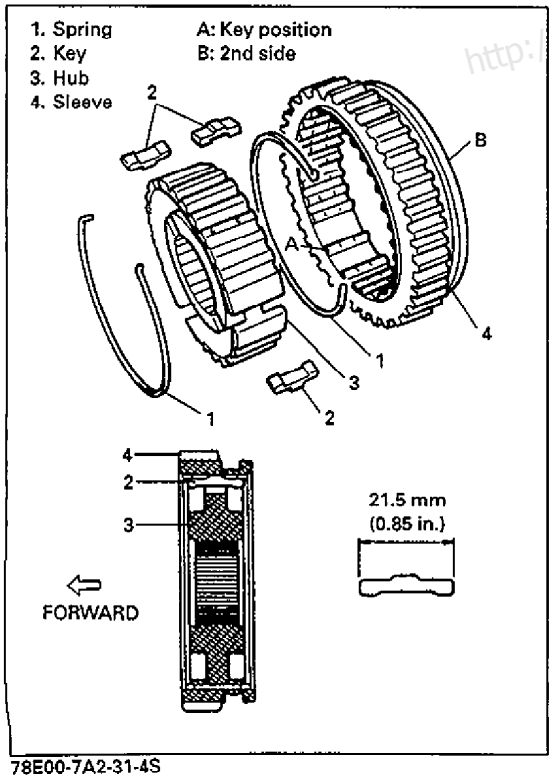
6) After installing circlip, check that 3rd gear turns lightly.



78E00-7A2-31-3S

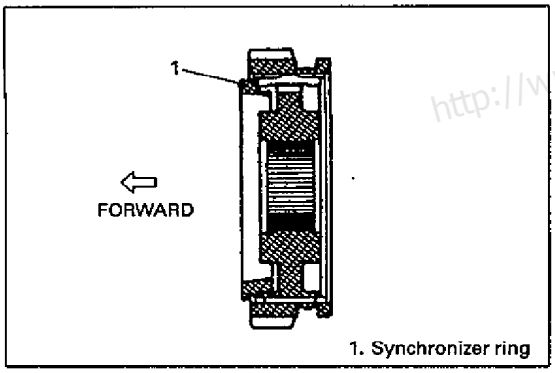
7) Check 3rd gear thrust clearance by using thickness gauge. If clearance is out of specification, repress-fit or replace.

Standard: 0.10 – 0.25 mm (0.004 – 0.009 in.)



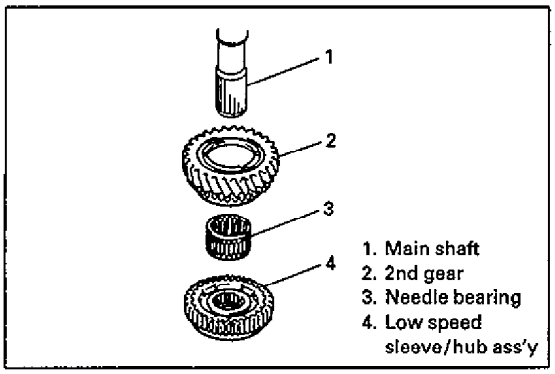
78E00-7A2-31-4S

8) Fit sleeve to low speed hub, place 3 synchronizer keys in it and then set synchronizer springs. Refer to figure for proper installing direction, sleeve and springs.



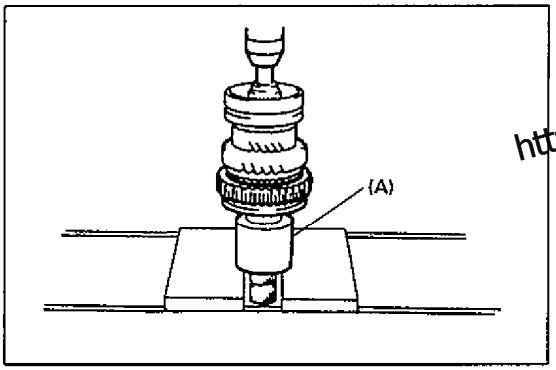
78E00-7A2-32-1S

9) Install synchronizer ring by matching its key slots to keys as shown.



78E00-7A2-32-2S

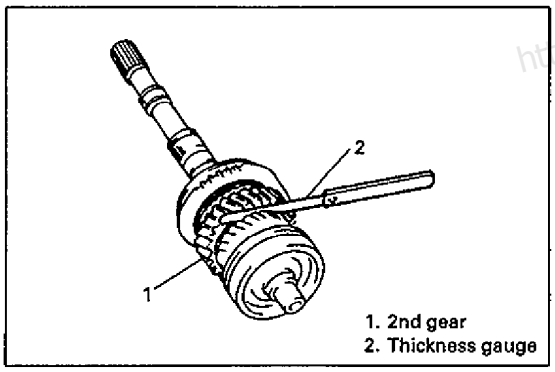
10) Insert 2nd gear, needle bearing and low speed sleeve/hub ass'y with synchronizer ring.



78E00-7A2-32-3S

11) Press-fit low speed sleeve/hub ass'y with special tool and press.

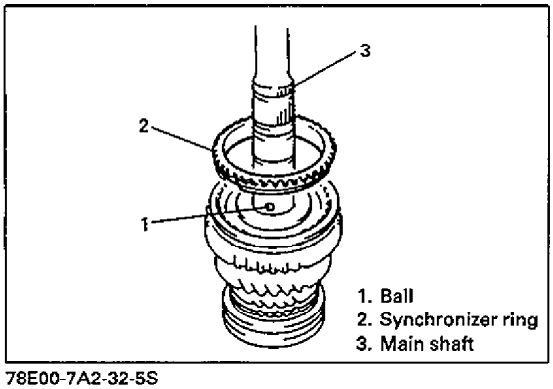
Special Tool
(A): 09940-53111



78E00-7A2-32-4S

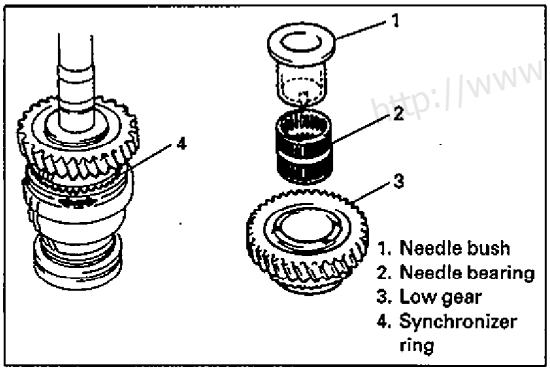
12) Check 2nd gear thrust clearance by using thickness gauge. If clearance is out of specification, repress-fit or replace defective part.

Standard: 0.10 – 0.25 mm (0.004 – 0.009 in.)



78E00-7A2-32-5S

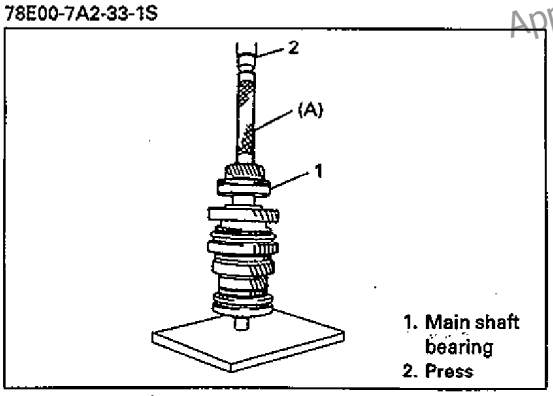
13) Apply grease to ball and set it to main shaft.
14) Install synchronizer ring.



78E00-7A2-33-1S

15) Install needle bearing, low gear and needle bush to main shaft.

NOTE:
- **Check the cut in needle bush and ball are engaged.**
- **After installation, check the synchronizer ring moves in circumferencial direction.**

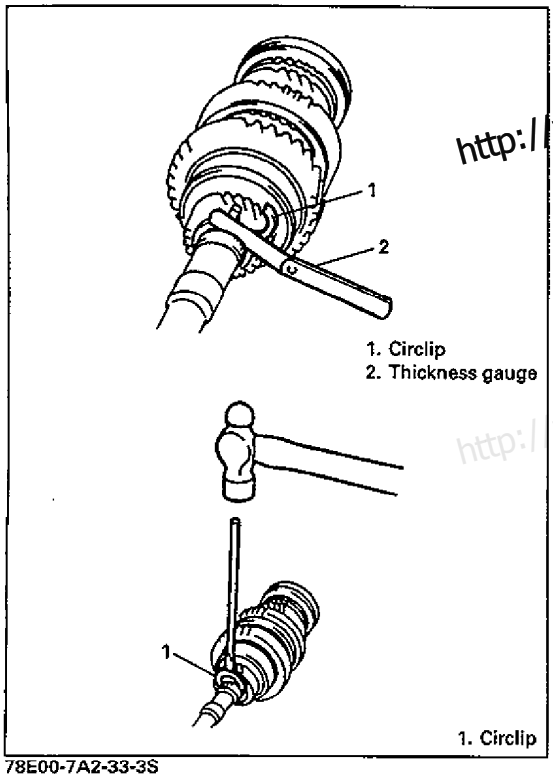


78E00-7A2-33-2S

16) Press-fit main shaft bearing and 5th gear with special tools and press.

NOTE:
Bring bearing so that its groove for circlip is in the rear.

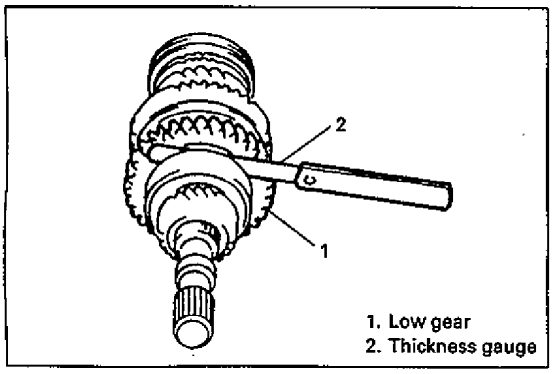
Special Tool
(A): 09940-51710 or 09925-18010



78E00-7A2-33-3S

17) Select circlip that will make its thrust clearance 0.1 mm (0.039 in.) or less and install it.

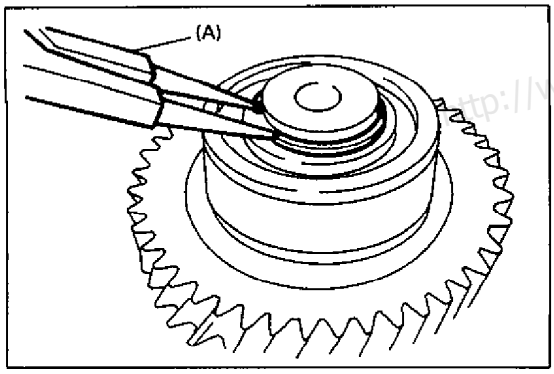
ID mark	Circlip thickness	ID mark	Circlip thickness
A	2.67 – 2.72 mm (0.1052 – 0.1070 in.)	G	3.03 – 3.08 mm (0.1193 – 0.1212 in.)
B	2.73 – 2.78 mm (0.1075 – 0.1094 in.)	H	3.09 – 3.14 mm (0.1217 – 0.1236 in.)
C	2.79 – 2.84 mm (0.1099 – 0.1118 in.)	J	3.15 – 3.20 mm (0.1241 – 0.1259 in.)
D	2.85 – 2.90 mm (0.1123 – 0.1141 in.)	K	3.21 – 3.26 mm (0.1264 – 0.1283 in.)
E	2.91 – 2.96 mm (0.1146 – 0.1165 in.)	L	3.27 – 3.32 mm (0.1288 – 0.1307 in.)
F	2.97 – 3.02 mm (0.1170 – 0.1188 in.)		



78E00-7A2-33-5S

18) Check low gear thrust clearance by using thickness gauge.
If clearance is out of specification, repress-fit or replace mainshaft bearing and 5th gear.

Standard: 0.10 – 0.25 mm (0.004 – 0.009 in.)



78E00-7A2-34-1S

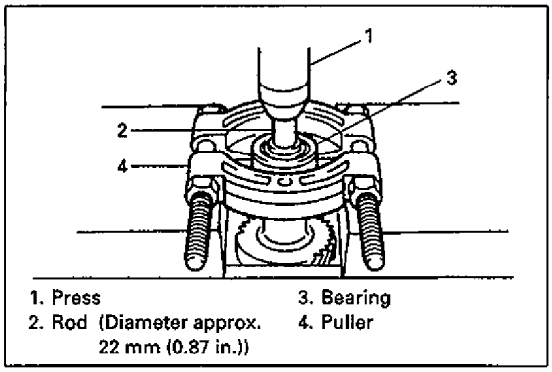
Counter Shaft & Reverse Idle Gear

DISASSEMBLY

1) Remove circlip from counter shaft.

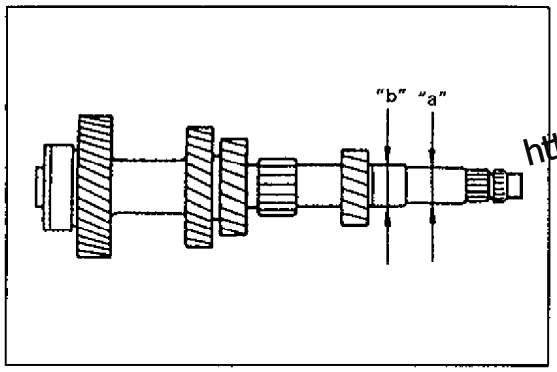
Special Tool
(A): 09900-01607

2) Pull out bearing from counter shaft by using puller, press and rod (diameter approx. 22 mm (0.87 in.))



1. Press
2. Rod (Diameter approx. 22 mm (0.87 in.))
3. Bearing
4. Puller

78E00-7A2-34-2S

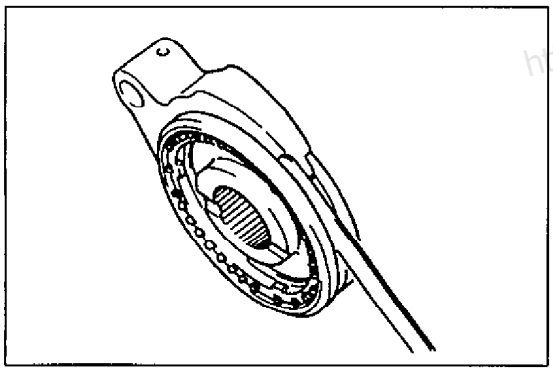


78E00-7A2-34-3S

INSPECTION

- Using micrometer, check diameter of counter shaft as shown. If measured valve is out of specification, replace it.

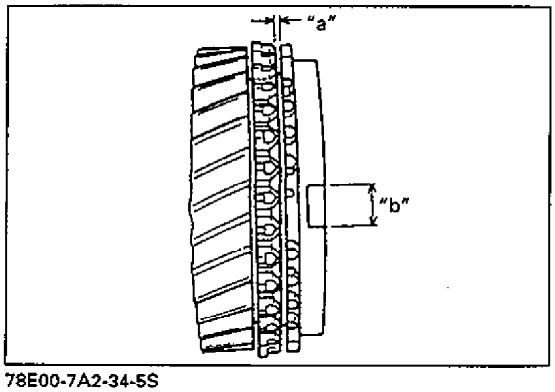
	"a"	"b"
Standard	25.986 – 26.00 mm (1.0231 – 1.0236 in.)	30.957 – 30.972 mm (1.2188 – 1.2193 in.)



78E00-7A2-34-4S

- Check clearance between fork and sleeve.
  If clearance exceeds limit, replace fork and sleeve.

Standard : 0.15 – 0.35 mm (0.006 – 0.013 in.)
Limit : 1.0 mm (0.039 in.)

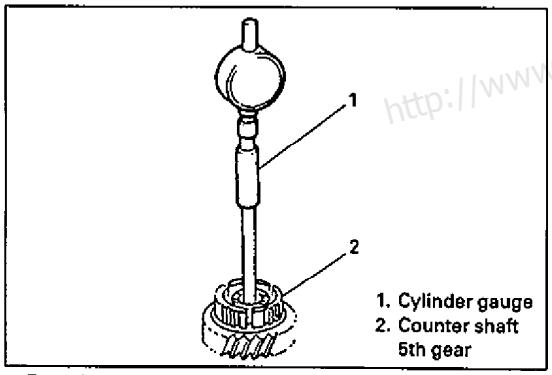


78E00-7A2-34-5S

- Check clearance "a" between synchronizer ring and gear, key slot width "b" in synchronizer ring and each chamfered tooth of gear and synchronizer ring and replace with new one, if necessary. Also, check gear tooth.

Clearance "a" : Standard 1.0 – 2.0 mm (0.039 – 0.078 in.)
Service limit 0.8 mm (0.032 in.)

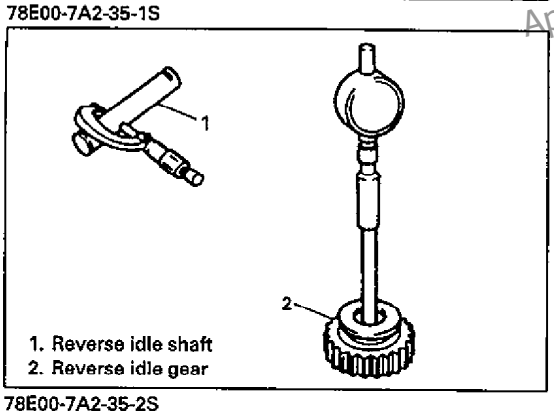
Slot width "b" : Standard 10.0 – 10.2 mm (0.394 – 0.4015 in.)
Service limit 10.45 mm (0.411 in.)



78E00-7A2-35-1S

- Using cylinder gauge, check inside diameter of counter shaft 5th gear. If measured value exceeds specification, replace gear.

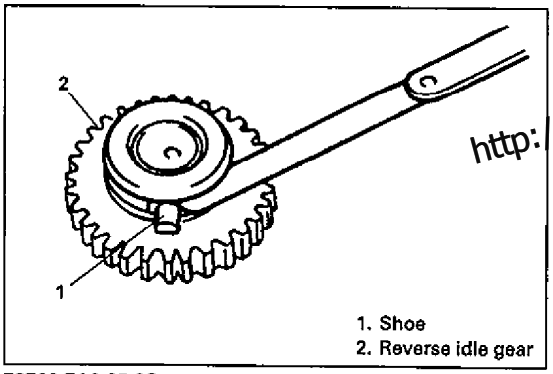
Standard : 33.015 – 33.040 mm (1.2999 – 1.3007 in.)



78E00-7A2-35-2S

- Check oil clearance between reverse idle gear and shaft by measuring inside diameter of gear and diameter of shaft and calculate its clearance.
  If clearance exceeds limit, replace gear and shaft.

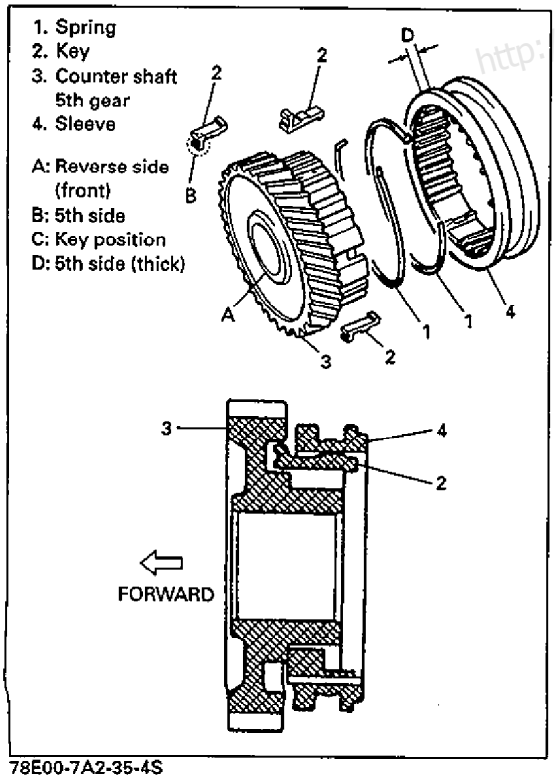
Standard : 0.040 – 0.082 mm (0.0016 – 0.0032 in.)
Limit : 0.13 mm (0.005 in.)



78E00-7A2-35-3S

- Check clearance between reverse idle gear and shoe of reverse gear shift link.
  If clearance exceeds limit, replace shoe.

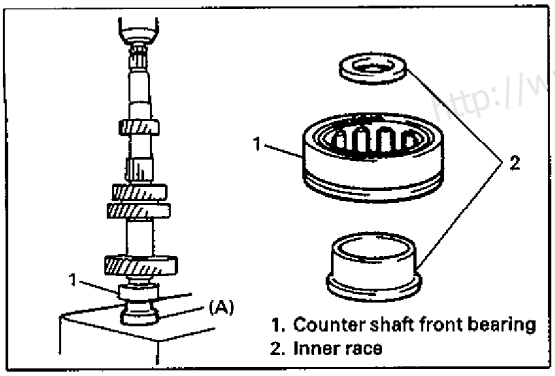
Standard : 0.05 mm – 0.28 mm (0.002 – 0.011 in.)
Limit : 0.5 mm (0.019 in.)



78E00-7A2-35-4S

ASSEMBLY

1) Fit sleeve to counter shaft 5th gear, place 3 synchronizer keys in it and then set synchronizer springs. Refer to figure for proper installing direction of gear, sleeve and springs. Also, note that key has specific installing direction.



78E00-7A2-36-1S

ASSEMBLY

1) Set inner race to counter shaft front bearing and press-fit bearing with press and special tool.

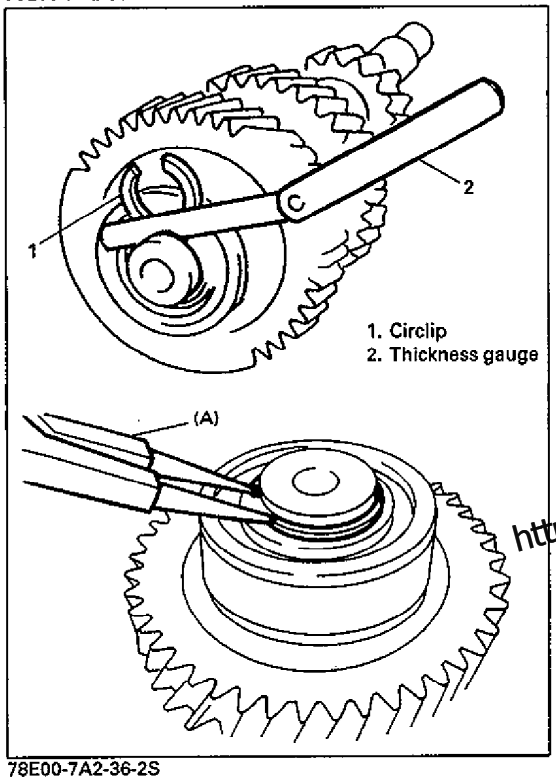
NOTE:
When installing bearing, bring it so that its groove for circlip is in the front.

Special Tool
(A): 09940-54950

2) Select circlip that will make its thrust clearance 0.1 mm (0.039 in.) or less and install it.

ID mark	Circlip thickness	ID mark	Circlip thickness
1	2.05 – 2.10 mm (0.0807 – 0.0826 in.)	4	2.20 – 2.25 mm (0.0867 – 0.0885 in.)
2	2.10 – 2.15 mm (0.0827 – 0.0846 in.)	5	2.25 – 2.30 mm (0.0886 – 0.0905 in.)
3	2.15 – 2.20 mm (0.0847 – 0.0866 in.)	6	2.30 – 2.35 mm (0.0906 – 0.0925 in.)

Special Tool
(A): 09900-06107



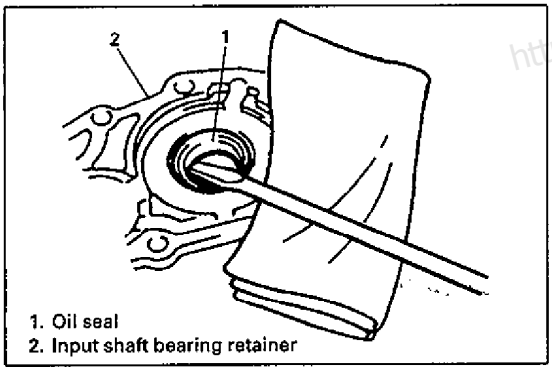
78E00-7A2-36-2S

Input Shaft Bearing Retainer and Oil Seal

REMOVAL

Remove oil seal from bearing retainer by using rod or the like as shown.

NOTE:
Unless oil seal is leaky or its lip is excessively hardened, replacement is not necessary.



78E00-7A2-36-4S

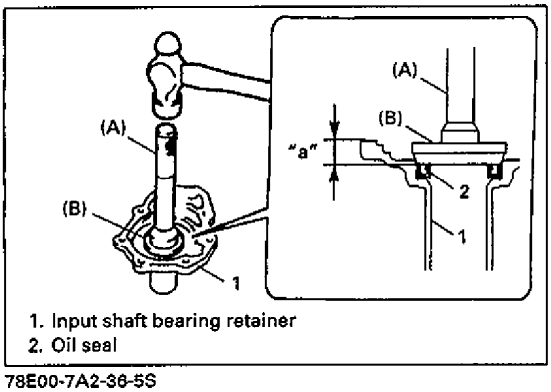
INSTALLATION

Install new oil seal to bearing retainer by using special tool as shown.
Apply grease to oil seal lip.

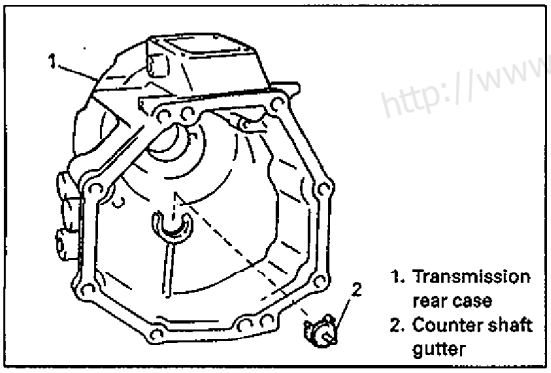
Grease "A": 99000-25010

Special Tool
(A): 09913-75821
(B): 09924-84510-004

"a": 12.2 – 13.2 mm (0.49 – 0.51 in.)



78E00-7A2-36-5S



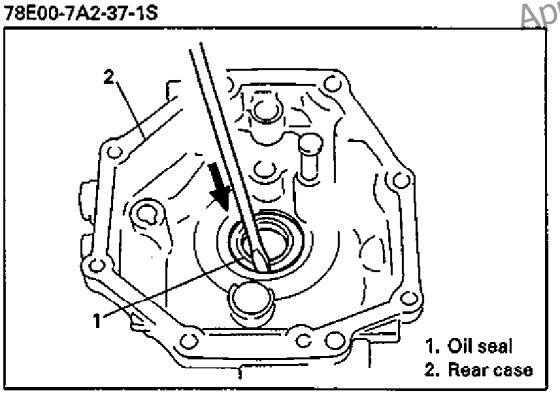
78E00-7A2-37-1S

Transmission Front Case, Intermediate Case and Rear Case

TRANSMISSION REAR CASE

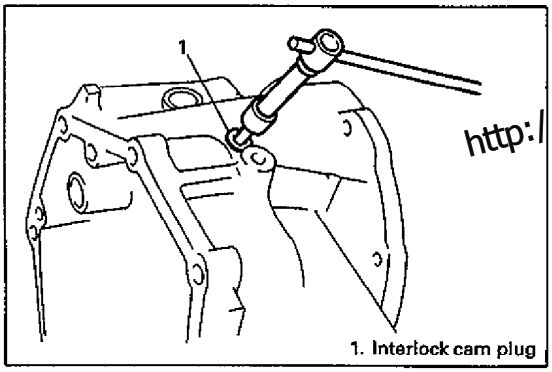
Disassembly

1) Remove counter shaft gutter.



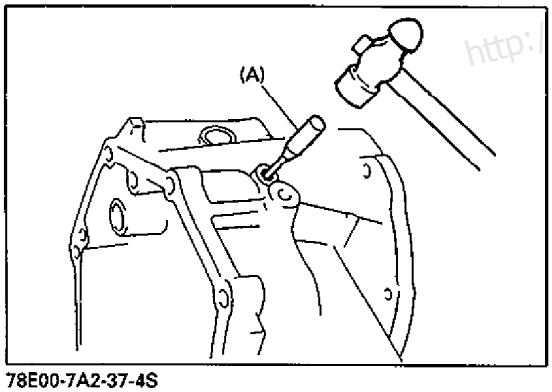
78E00-7A2-37-2S

2) Take out oil seal from rear case.



78E00-7A2-37-3S

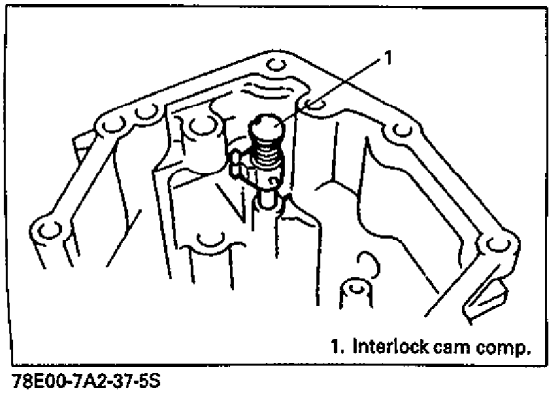
3) Remove interlock cam plug by using torx®.



78E00-7A2-37-4S

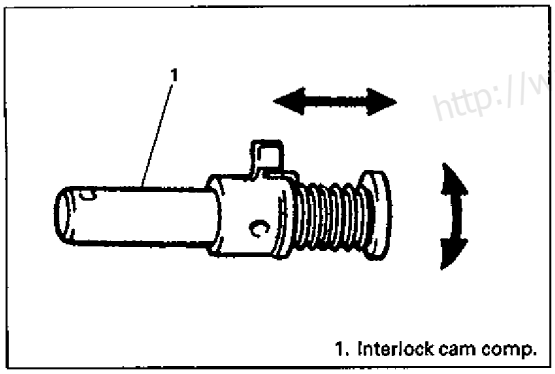
4) Remove pin by using special tool.

Special tool
(A): 09922-85811



78E00-7A2-37-5S

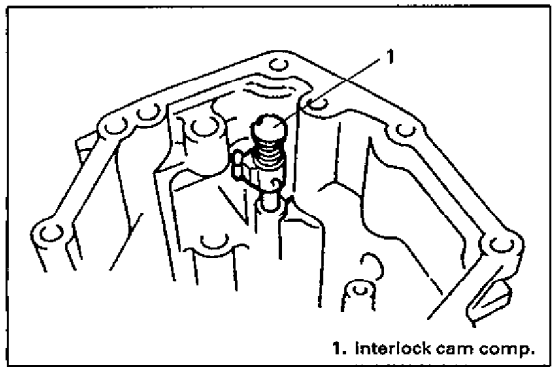
5) Pull out interlock cam comp..



78E00-7A2-38-1S

Inspection

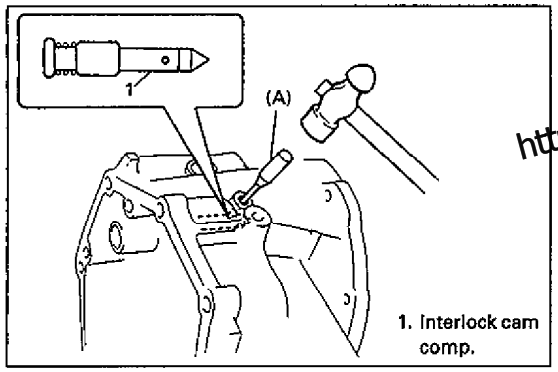
- Check that interlock cam comp. moves smoothly in both turning direction and sliding direction.



78E00-7A2-38-2S

Assembly

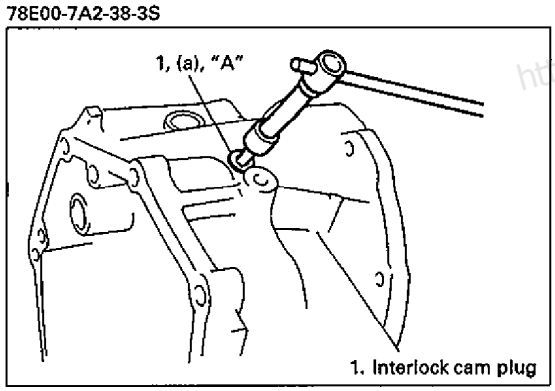
1) Insert interlock cam comp. to rear case.



78E00-7A2-38-3S

2) Set interlock cam comp. as shown and drive pin by using special tool.

Special Tool
(A): 09922-85811

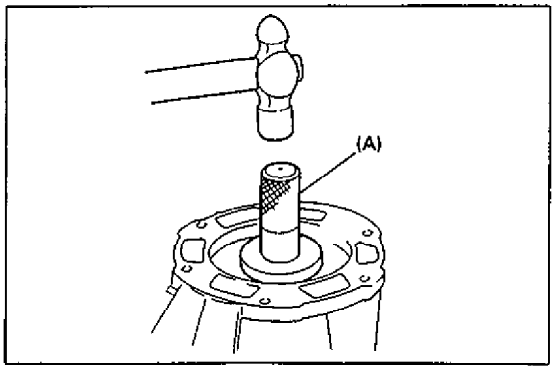


78E00-7A2-38-4S

3) Apply thread lock cement to thread of interlock cam plug and tighten it to specification.

"A": Cement 99000-32020

Tighten Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)

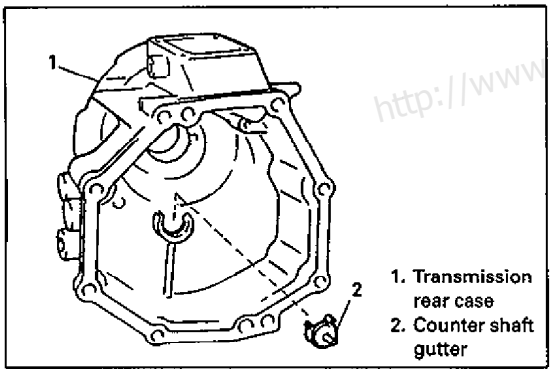


78E00-7A2-38-5S

4) Install oil seal to rear case so that end surface of oil seal becomes flush with that case. Apply grease to oil seal lip.

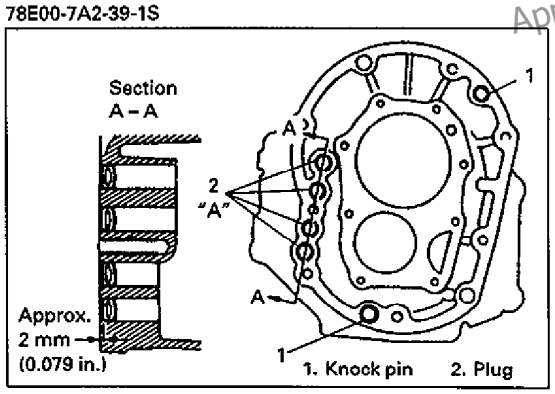
Grease: 99000-25010

Special Tool:
(A): 09913-77510



78E00-7A2-39-1S

5) Install counter shaft gutter.

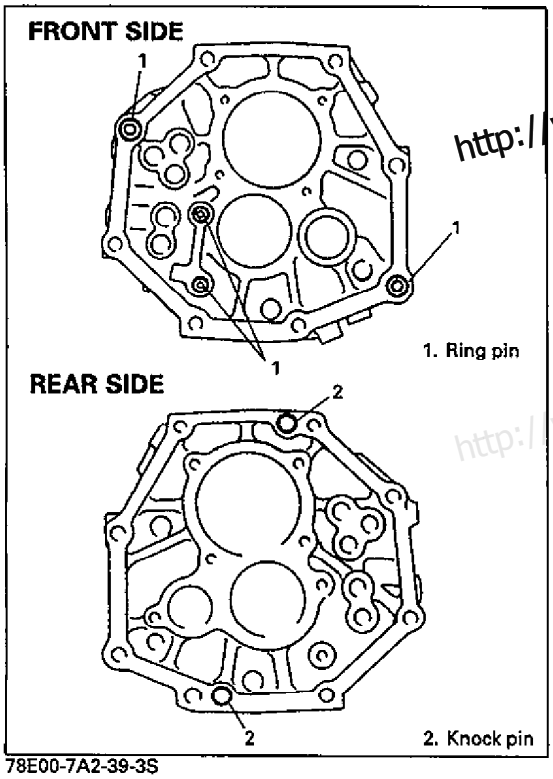


78E00-7A2-39-2S

TRANSMISSION INTERMEDIATE CASE & FRONT CASE
(Location of Knock and Plug)

- Install knock pin and plug (sealant applied) to front case as shown.

  "A": Sealant 99000-31110



78E00-7A2-39-3S

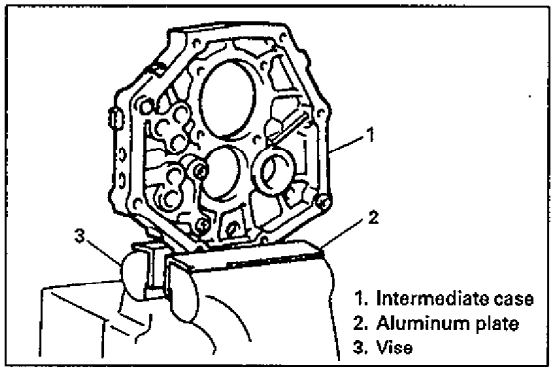
- Install knock pin/ring pin as shown.

ASSEMBLY

NOTE:

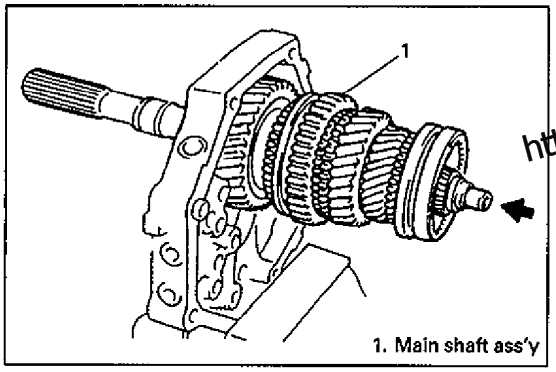
- **Before installation, wash each part and apply specified gear oil to sliding faces of bearing and gear.**
- **Use new circlips on shaft for installation. Don't reuse circlips.**

78E00-7A2-40-1S



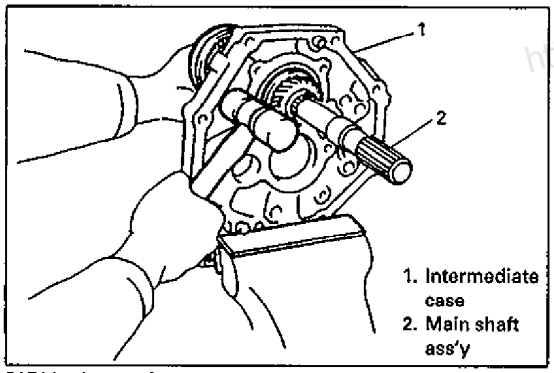
1) Set intermediate case to vise.
   Clean mating surfaces of intermediate case both sides, if intermediate case is reused.

78E00-7A2-40-2S



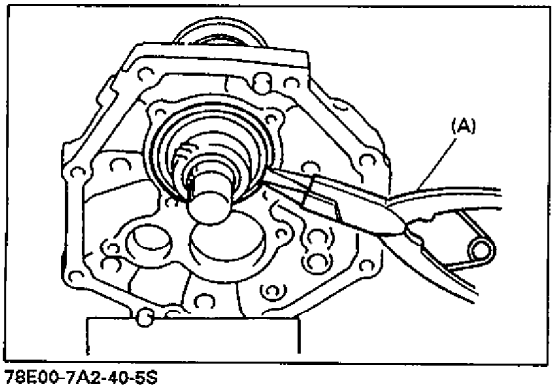
2) Install main shaft ass'y to intermediate case.

78E00-7A2-40-3S



NOTE:
When fitting of intermediate case and bearing is tight, tap rear face of intermediate case with plastic hammer lightly as it will cause main shaft ass'y to install.

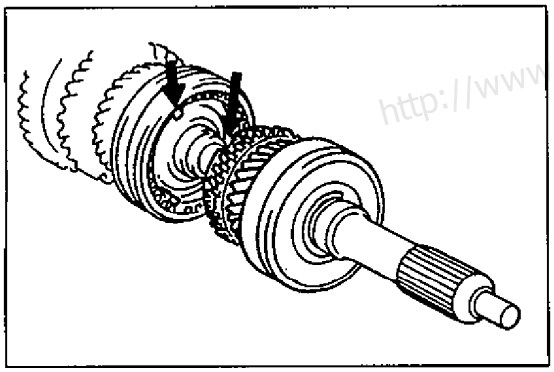
78E00-7A2-40-4S



3) Fix with C-ring by using special tool.

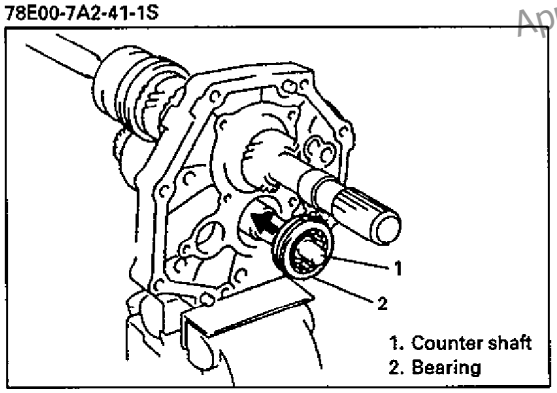
   (A): 09900-06107

78E00-7A2-40-5S


78E00-7A2-41-1S

4) Align key slots of synchronizer ring and synchronizer keys and set input shaft ass'y to main shaft ass'y. Check that input shaft ass'y turns lightly.
5) Fix with C-ring to counter shaft rear bearing.

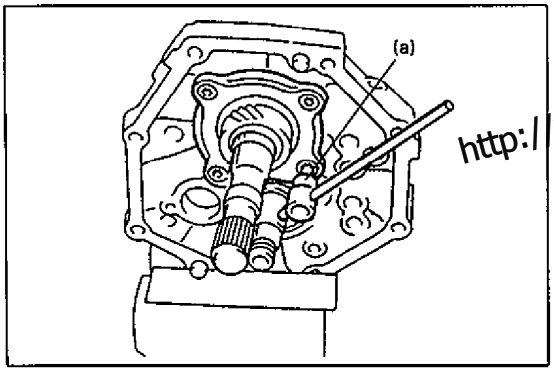
Special Tool
(A): 09900-01607



78E00-7A2-41-2S

6) Install counter shaft and rear bearing to intermediate case.

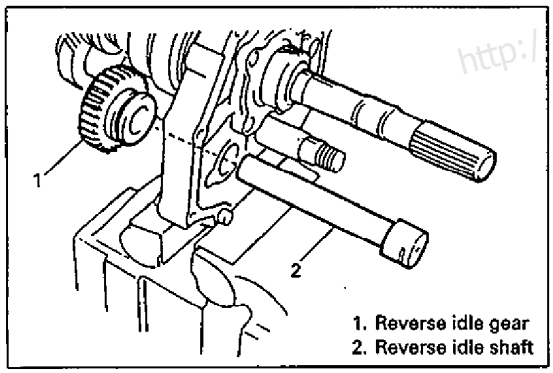
NOTE:
- **When installing bearing, bring it so that its C-ring side is at rear side of intermediate case as shown.**
- **When fitting of intermediate case and bearing is tight, tap outer race of bearing lightly and evenly with plastic hammer.**



78E00-7A2-41-3S

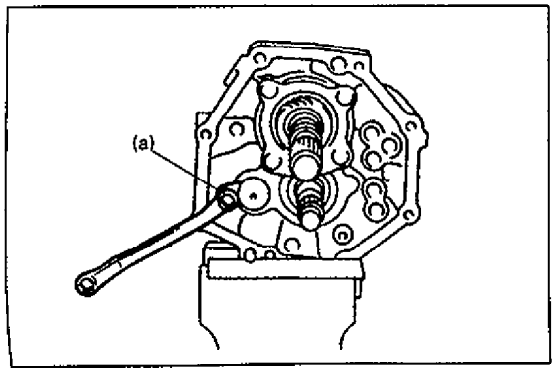
7) Install bearing plate.

Tightening Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)



78E00-7A2-41-4S

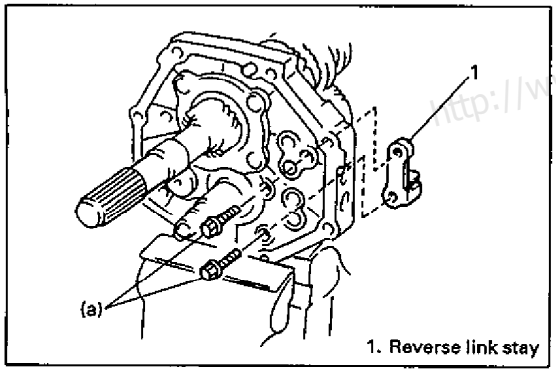
8) Install reverse idle gear and shaft.



78E00-7A2-41-5S

9) Tighten bolt to specification.

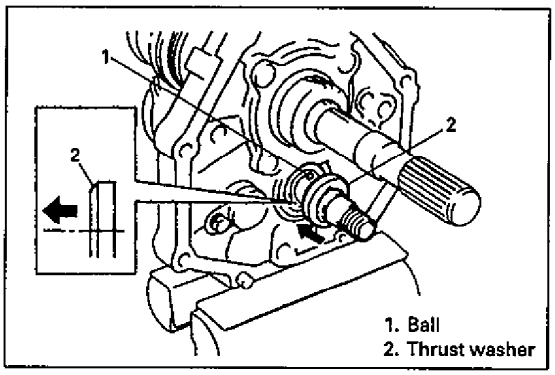
Tightening Torque
(a): 18 N·m (1.8 kg-m, 13.5 lb-ft)



78E00-7A2-42-1S

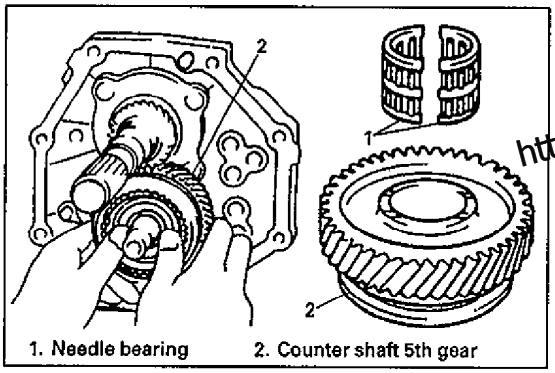
10) Install reverse link stay.

Tightening Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)



78E00-7A2-42-2S

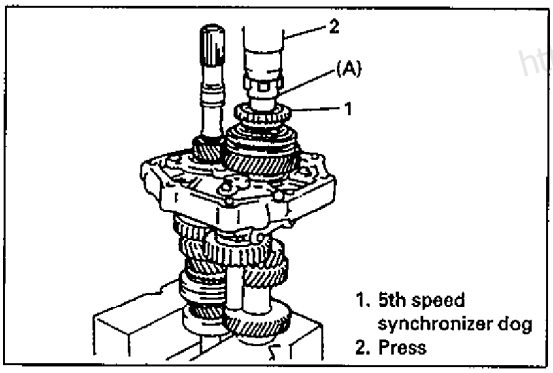
11) Set ball and thrust washer to counter shaft.



78E00-7A2-42-3S

12) Install needle bearing, counter shaft 5th gear and synchronizer ring.

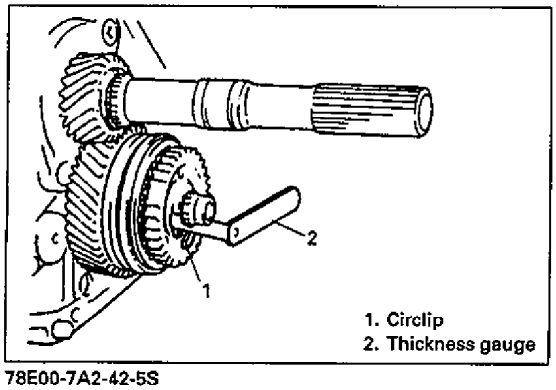
NOTE:
When setting synchronizer ring to sleeve of 5th gear, align synchronizer key slot to key.



78E00-7A2-42-4S

13) Press-fit 5th speed synchronizer dog to counter shaft with press and special tool.

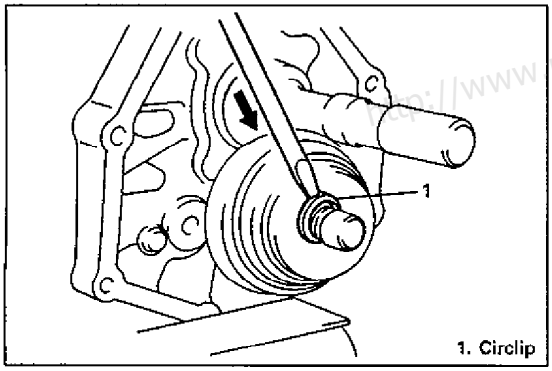
Special Tool
(A): 09927-08220



78E00-7A2-42-5S

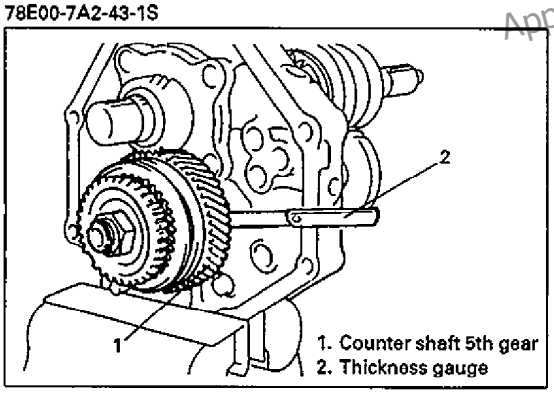
14) Select circlip that will make clearance in circlip groove 0.1 mm (0.039 in.) or less.

ID mark	Circlip thickness	ID mark	Circlip thickness
A	2.80 – 2.85 mm (0.1103 – 0.1122 in.)	E	3.00 – 3.05 mm (0.1182 – 0.1200 in.)
B	2.85 – 2.90 mm (0.1122 – 0.1141 in.)	F	3.05 – 3.10 mm (0.1201 – 0.1220 in.)
C	2.90 – 2.95 mm (0.1142 – 0.1161 in.)	G	3.10 – 3.15 mm (0.1221 – 0.1240 in.)
D	2.95 – 3.00 mm (0.1162 – 0.1181 in.)		



78E00-7A2-43-1S

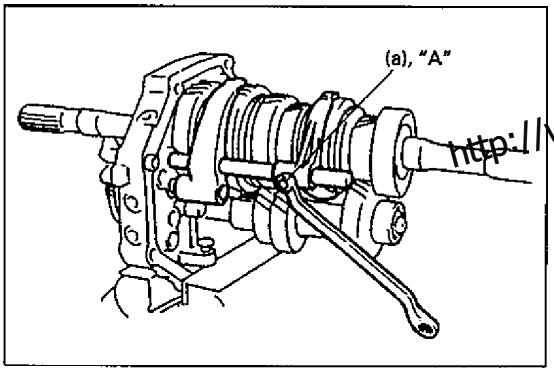
15) Fix with circlip as shown and check that counter 5th gear turns lightly.



78E00-7A2-43-2S

16) Check counter 5th gear thrust clearance by using thickness gauge.

Standard: 0.1 – 0.3 mm (0.0040 – 0.0118 in.)



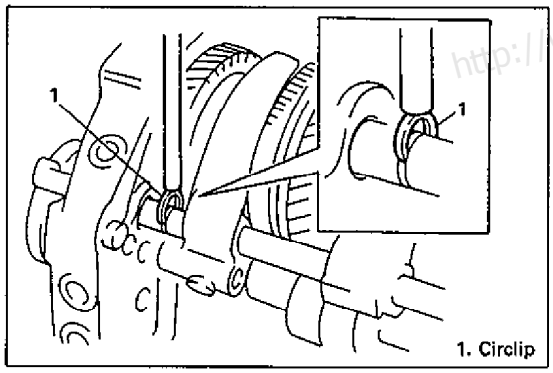
78E00-7A2-43-3S

17) Install low speed gear shift fork, high speed gear shift fork and shaft.

18) Apply thread lock cement to thread of fork bolt and tighten bolt to specification.

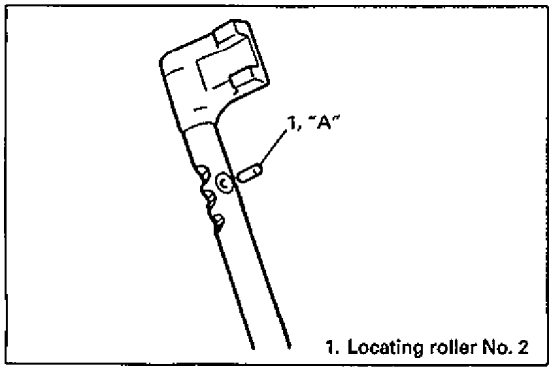
"A": Cement: 09900-32020

Tightening Torque
(a): 20 N·m (2.0 kg-m, 14.5 lb-ft)



78E00-7A2-43-4S

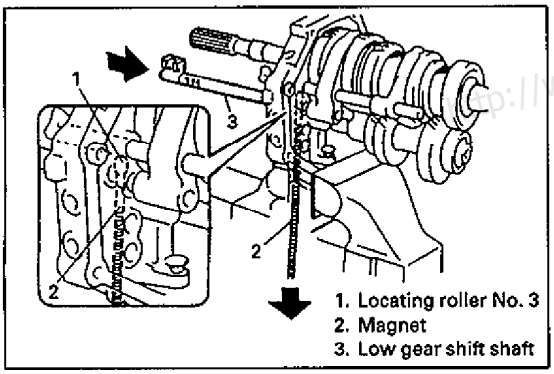
19) Fix new circlip to high gear shift shaft by using lever or the like and hammer.



78E00-7A2-43-5S

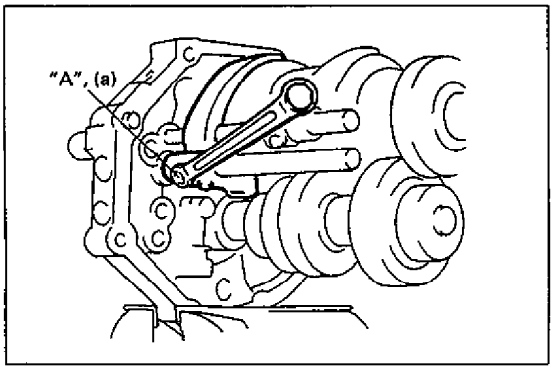
20) Apply grease to locating roller No.2 and install roller to low gear shift shaft.

"A": Grease: 99000-32020



78E00-7A2-44-1S

21) Supporting locating roller No. 3 by magnet, insert low gear shift shaft to intermediate case and low speed gear shift fork.

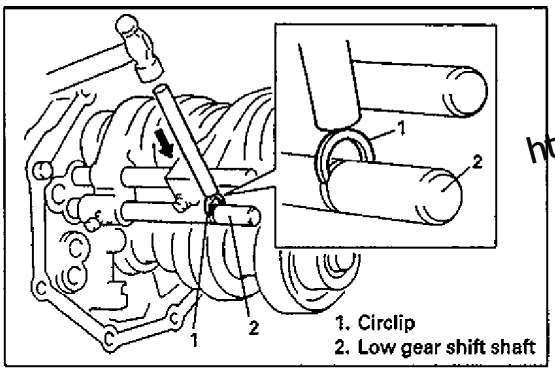


78E00-7A2-44-2S

22) Apply thread lock cement to thread of fork bolt and tighten bolt to specification.

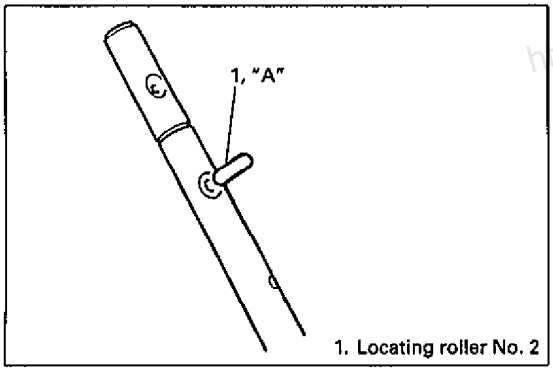
"A": Cement: 09900-32020

Tightening Torque
(a): 20 N·m (2.0 kg-m, 14.5 lb-ft)



78E00-7A2-44-3S

23) Fix with new circlip to low gear shift shaft by using lever or the like and hammer.

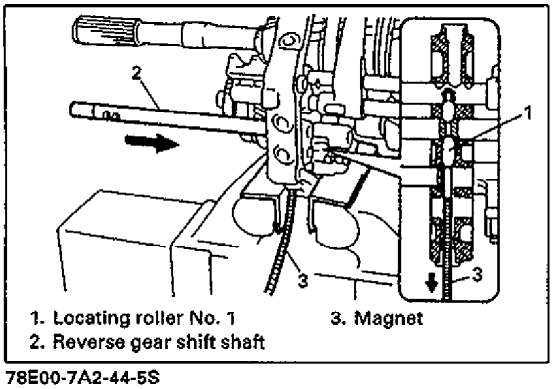


78E00-7A2-44-4S

24) Apply grease to locating roller No.2 and install roller to reverse gear shift shaft.

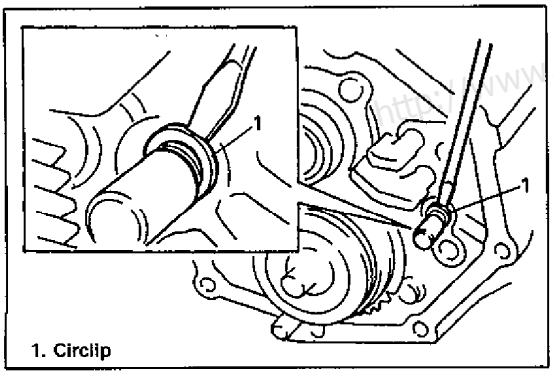
"A": Grease: 99000-32020

25) Assemble reverse gear shift link ass'y.



78E00-7A2-44-5S

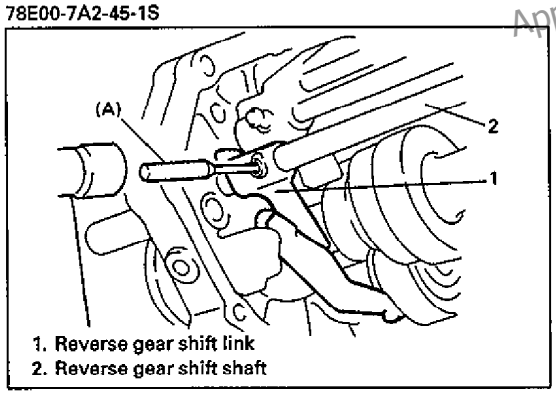
26) Insert reverse gear shift shaft into reverse gear shift link ass'y and intermediate case while holding locating roller No.1 with magnet.
27) Supporting locating roller No.1 with magnet, insert reverse gear shift shaft into reverse gear shift link and intermediate case.



1. Circlip

78E00-7A2-45-1S

28) Fix with new circlip to reverse gear shift shaft by using rod or the like and hammer.

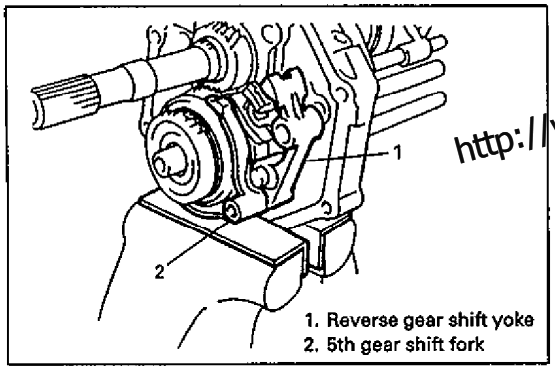


1. Reverse gear shift link
2. Reverse gear shift shaft

78E00-7A2-45-2S

29) Drive pin into reverse gear shift link and shaft by using special tool.

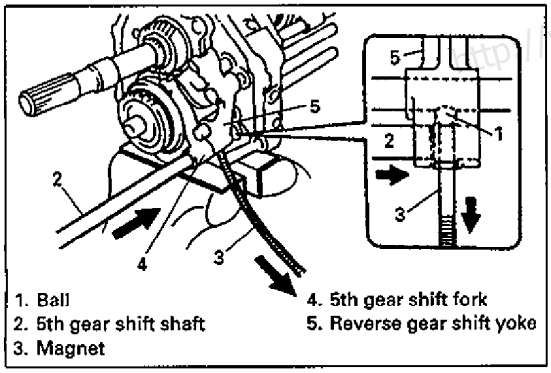
Special Tool
(A): 09922-85811



1. Reverse gear shift yoke
2. 5th gear shift fork

78E00-7A2-45-3S

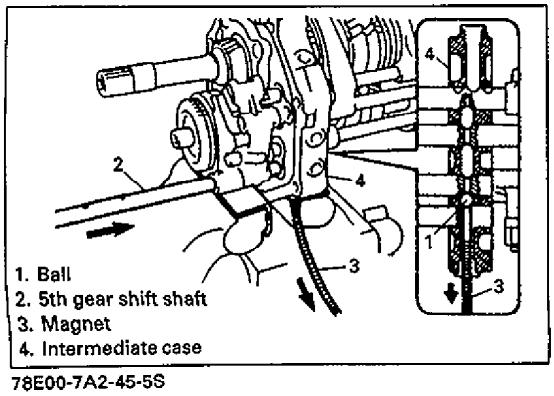
30) Install reverse gear shift yoke and 5th gear shift fork as shown.



1. Ball
2. 5th gear shift shaft
3. Magnet
4. 5th gear shift fork
5. Reverse gear shift yoke

78E00-7A2-45-4S

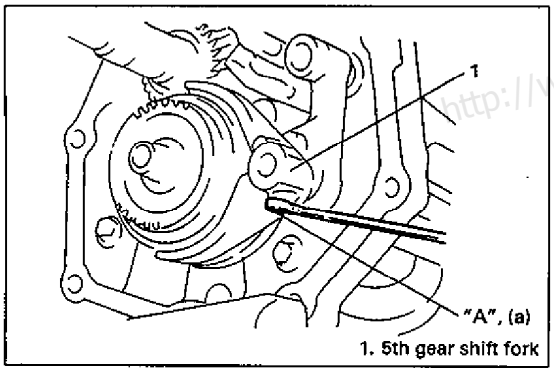
31) Supporting ball with magnet as shown, insert 5th gear shift shaft to 5th gear shift fork and reverse gear shift yoke.



1. Ball
2. 5th gear shift shaft
3. Magnet
4. Intermediate case

78E00-7A2-45-5S

32) Supporting ball with magnet as shown, insert 5th gear shift shaft into intermediate case.



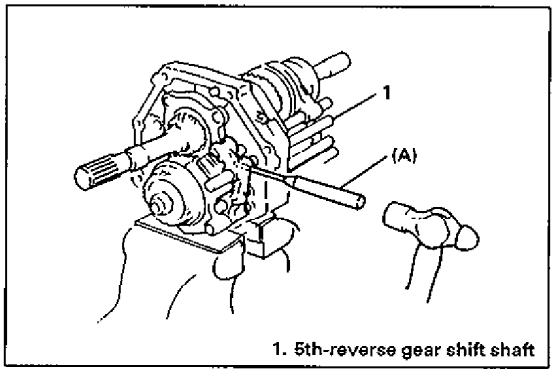
1. 5th gear shift fork

78E00-7A2-46-1S

33) Apply thread lock cement to thread of fork bolt and tighten bolt to specification.

"A": Cement: 09900-32020

Tightening Torque
(a): 20 N·m (2.0 kg-m, 14.5 lb-ft)

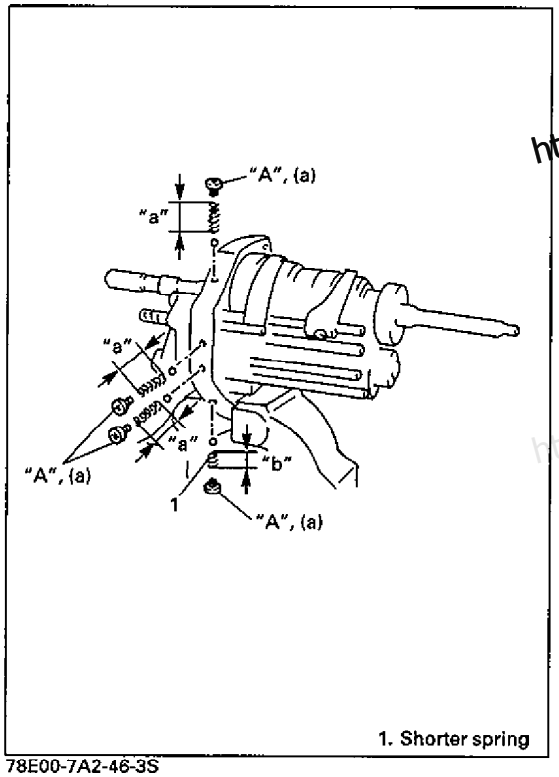


1. 5th-reverse gear shift shaft

78E00-7A2-46-2S

34) Insert 5th-reverse gear shift shaft to reverse gear shift yoke and drive pin into shaft and yoke.

Special Tool
(A): 09922-85811



1. Shorter spring

78E00-7A2-46-3S

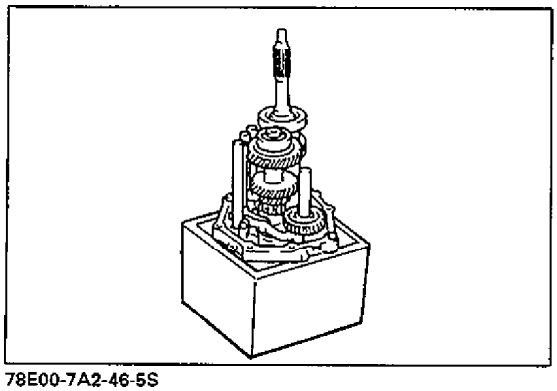
35) Install locating balls, locating springs and locating screw after checking free length of locating springs.

	Standard	Limit
"a"	31.0 mm (1.22 in.)	30.1 mm (1.19 in.)
"b"	20.2 mm (0.79 in.)	19.6 mm (0.77 in.)

NOTE:
For 5th gear locating spring, use shorter spring.

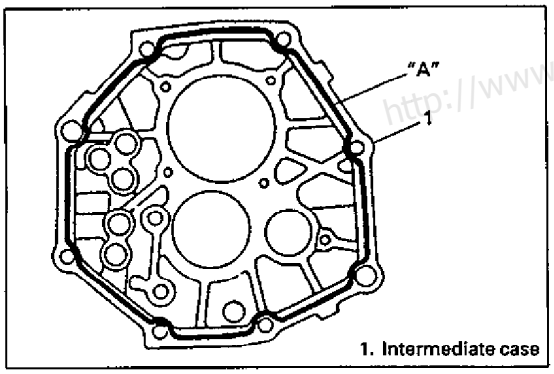
"A": Cement: 99000-32020

Tightening Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)



78E00-7A2-46-5S

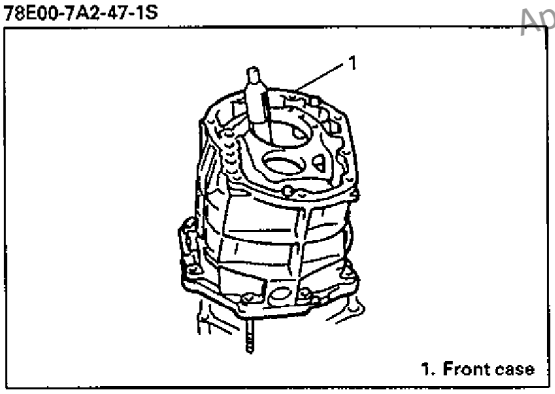
36) Place intermediate case ass'y upright as shown by using workbench or the like.



78E00-7A2-47-1S

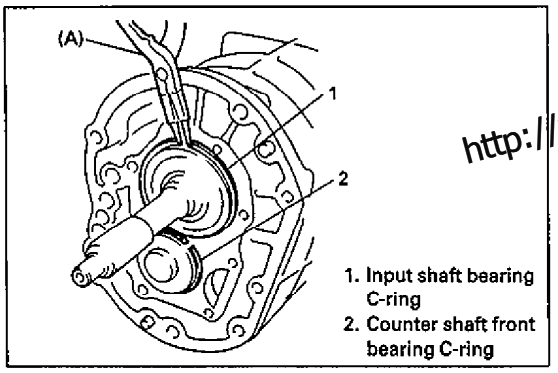
37) Apply sealant evenly to front case side of intermediate case as shown.

"A": Sealant: 99000-31110



78E00-7A2-47-2S

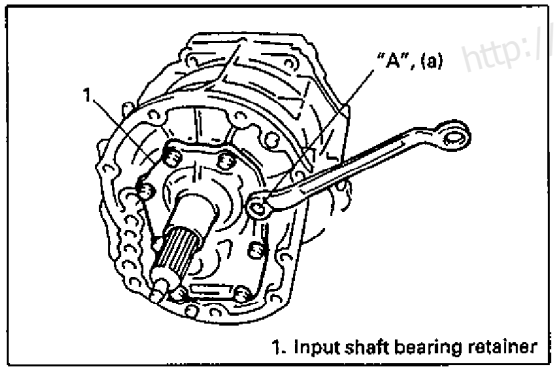
38) Clean mating surface of front case and install it to intermediate case.



78E00-7A2-47-3S

39) Fix C-rings to bearings as shown.

Special Tool
(A): 09900-01607

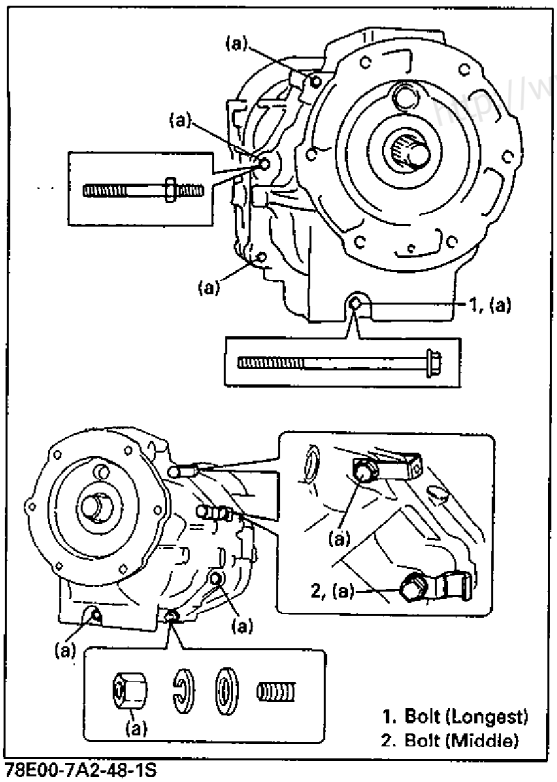


78E00-7A2-47-4S

40) Apply cement to input shaft bearing retainer bolt and install input shaft bearing retainer, new gasket and its bolts.

"A": Cement: 99000-32020

Tightening Torque
(a): 17 N·m (1.7 kg-m, 12.5 lb-ft)



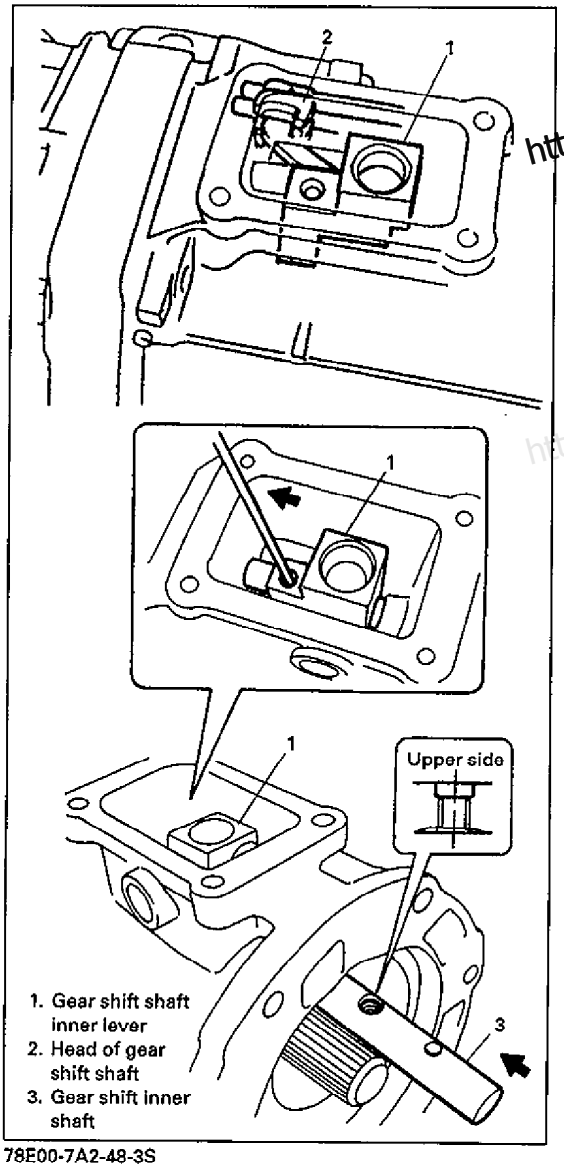
78E00-7A2-48-1S

41) Clean mating surface of rear case and apply sealant evenly to rear case side of intermediate case.

Sealant: 99000-31110

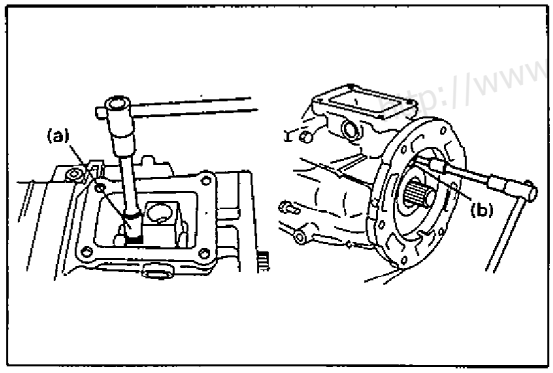
42) Install rear case to intermediate case.

Tightening Torque
(a): 35 N·m (3.5 kg-m, 25.5 lb-ft)



78E00-7A2-48-3S

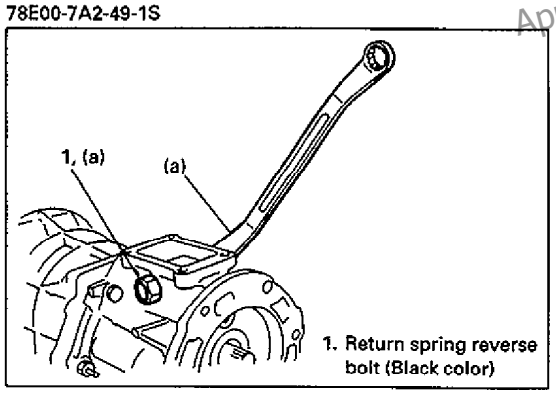
43) With tip end of gear shift shaft inner lever hooked on head of gear shift shaft, insert gear shift inner shaft into gear shift shaft inner lever.



78E00-7A2-49-1S

44) Apply cement to inner gear shift shaft bolt/plug and tighten them to specification.

Tightening Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)
(b): 39 N·m (3.9 kg-m, 28.5 lb-ft)

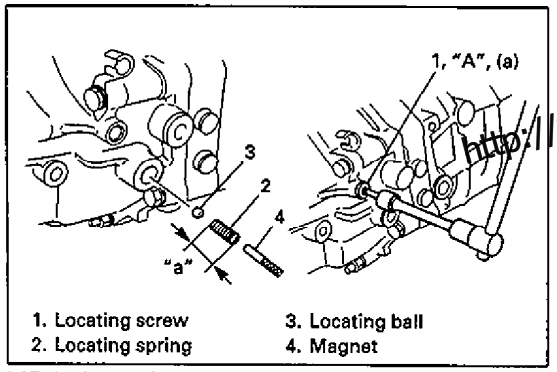


78E00-7A2-49-2S

45) Tighten return spring low bolt and return spring reverse bolt (Black color).

NOTE:
Install return spring reverse bolt (Black color) to left side of case.

Tightening Torque
(a): 28 N·m (2.8 kg-m, 20.5 lb-ft)

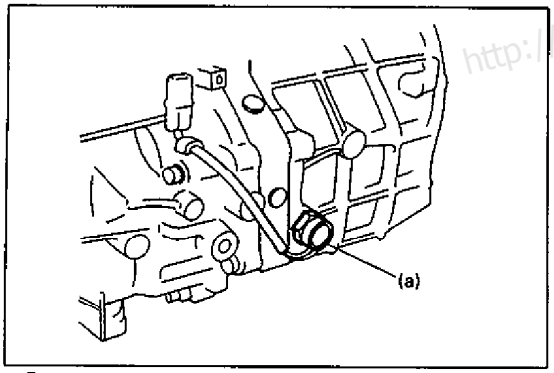


78E00-7A2-49-3S

46) Apply cement to locating screw and install locating ball, locating spring and screw to rear case.
"A": Cement: 99000-32020

Tightening Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)

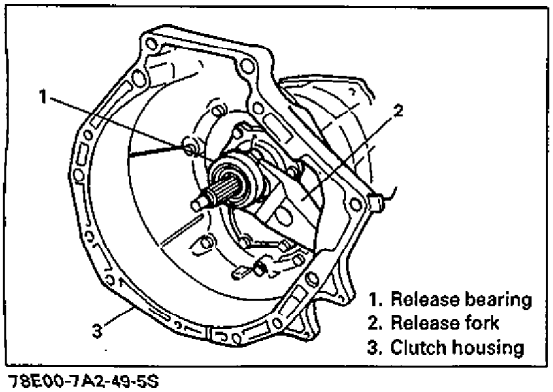
"a" Free length of locating spring
Standard : 22.1 mm (0.87 in.)
Limit : 21.4 mm (0.83 in.)



78E00-7A2-49-4S

47) Install back-up light switch and new gasket.

Tightening Torque
(a): 45 N·m (4.5 kg-m, 32.5 lb-ft)



78E00-7A2-49-5S

48) Install clutch housing and torque its bolts to specification.

Tightening Torque
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

TIGHTENING TORQUE SPECIFICATIONS

	Fastening portion	Tightening torque		
		N·m	kg-m	lb-ft
ON-VEHICLE	Transfer oil filler/level and drain plugs	23	2.3	17.0
	Transmission oil filler/level plug	38	3.8	27.5
	Transmission oil drain plug	45	4.5	32.5
	Control lever boot cover bolts	6	0.6	4.0
	4WD switch	20	2.0	14.5
	Speedometer driven gear case bolt	10	1.0	7.5
	Back-up light switch	45	4.5	32.5
	Clutch operating cylinder bolts	50	5.0	36.5
SHIFT CASE	Control lever locating bolts	23	2.3	17.0
	Shift lever case plate screws	6	0.6	4.5
	Gear shift lever case bolts	23	2.3	17.0
MOUNTING	Transmission to engine bolts and nuts	85	8.5	61.5
	Engine rear mounting bolts	50	5.0	36.5
	Exhaust pipe No. 1 to manifold nuts	60	6.0	43.0
	Muffler to exhaust No. 2 pipe nuts	60	6.0	43.0
	Universal joint flange bolts	55	5.5	40.0
	Stiffener bolts	50	5.0	36.5
TRANSMISSION UNIT	Interlock cam plug	19	1.9	14.0
	Main & counter shaft bearing plate screws	19	1.9	14.0
	Reverse gear shaft bolt	18	1.8	13.5
	Reverse link stay	19	1.9	14.0
	Shift fork bolts	20	2.0	14.5
	Locating spring screws	19	1.9	14.0
	Input shaft bearing retainer bolt	17	1.7	12.5
	Transmission case bolts	35	3.5	25.5
	Inner gear shift shaft bolt	19	1.9	14.0
	Inner gear shift shaft plug	39	3.9	28.5
	Return spring low/reverse bolts	28	2.8	20.5
	Clutch housing bolts	85	8.5	61.5
	Transmission to transfer bolts	50	5.0	36.5

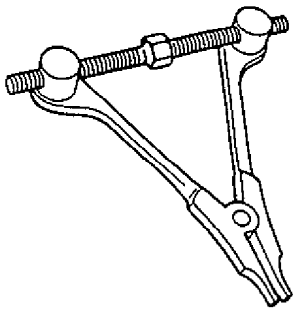
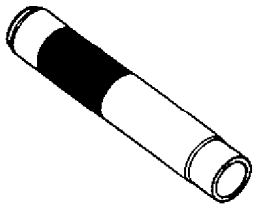
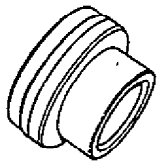
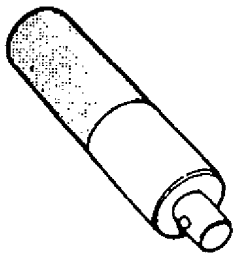
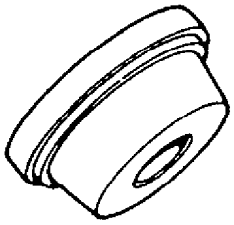
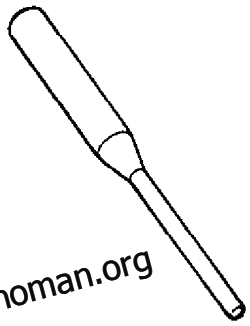
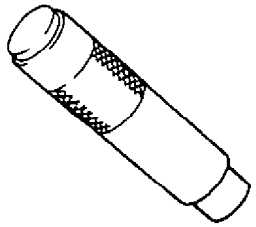
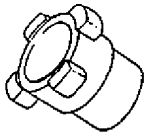
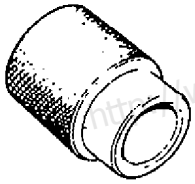
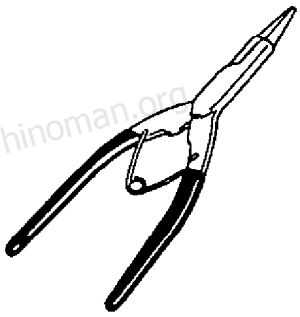
78E00-7A2-50-1S

REQUIRED SERVICE MATERIALS

MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lips • Select return system • Shift control lever • Input shaft bearing roller • Locating rollers
Thread lock cement	THREAD LOCK CEMENT SUPER 1333B (99000-32020)	• Shift control lever locating screws • Gear shift fork bolts • Input shaft retainer bolts
Sealant	SUZUKI BOND No. 1215 (99000-31110)	• Oil drain and filler/level plugs • Mating surface of gear shift lever case • Mating surface of transmission cases • Front case plugs • Gear shift shaft plug • Front case plug

78E00-7A2-51-1S

SPECIAL TOOLS

 09912-34510 Case separator	 09913-75510 (O.D. 70.5 mm) Bearing installer	 09940-51710 Bearing installer	 09940-54950 Bearing installer attachment
 09913-75821 Installer attachment	 09924-84510-004 Bearing installer adapter (C)	 09925-78210 (6 mm) 09922-85811 (4.5 mm) Spring pin remover	 09925-18010 Installer attachment
 09927-08220 Shaft remover	 09940-53111 Bearing installer	 09900-06107 Snap ring pliers (opening type)	

SECTION 7B1

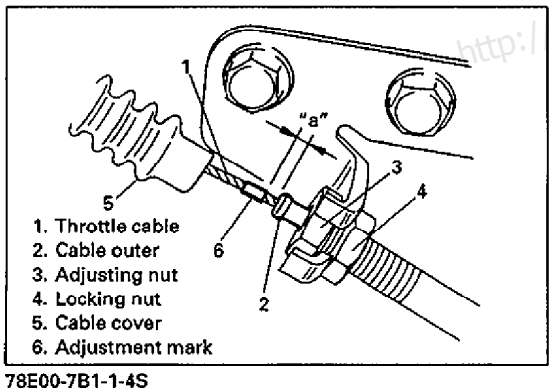
AUTOMATIC TRANSMISSION (4 A/T)

NOTE:
For the descriptions (items) not found in this section, refer to section 7B1 of SV420D service manual.

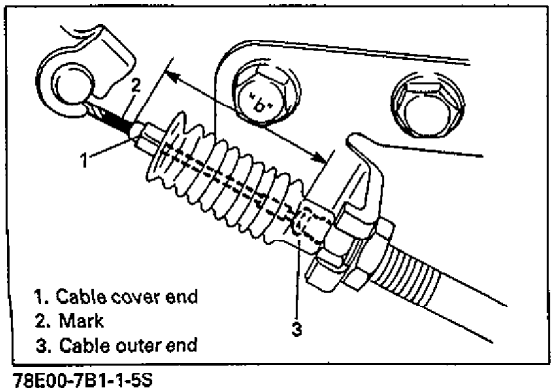
78E00-7B1-1-1S

CONTENTS

78E00-7B1-1-2S



78E00-7B1-1-4S



78E00-7B1-1-5S

ON-VEHICLE SERVICE

A/T THROTTLE CABLE

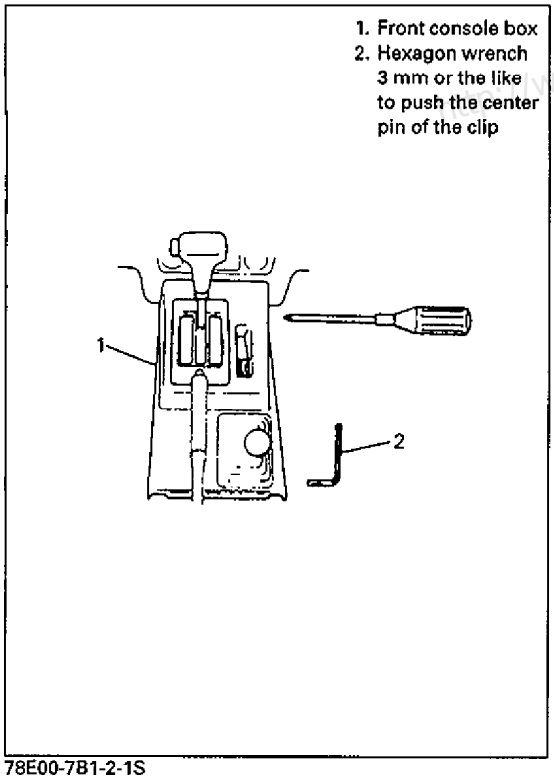
ADJUSTMENT

1) Slide throttle cable cover to watch adjustment mark.
2) Adjust distance between tip end of adjustment mark and end of cable outer by turning adjusting nut.

   Distance "a": 0.8 – 1.5 mm (0.031 – 0.059 in.)

3) Slide cable cover end as shown in figure and attach cable cover to cable outer end.

   Distance "b": 27 – 35 mm (1.06 – 1.38 in.)



78E00-7B1-2-1S

TRANSMISSION UNIT REPAIR OVERHAUL

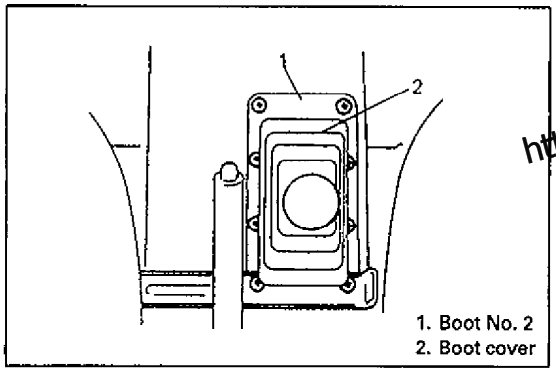
DISMOUNTING OF TRANSMISSION WITH TRANSFER

IN CABIN

1) Remove clips of rear console box.

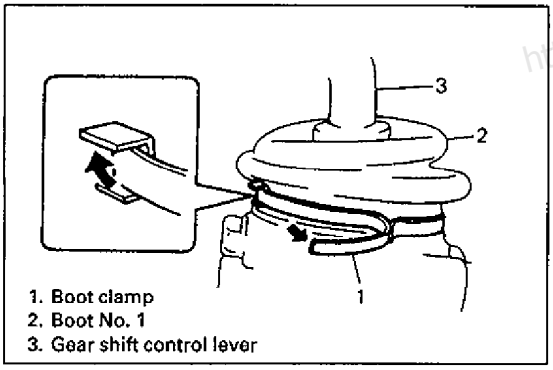
NOTE:
To remove clip, push in its center pin first.

2) Remove screws at the front and clips at the rear, and then remove front console box.



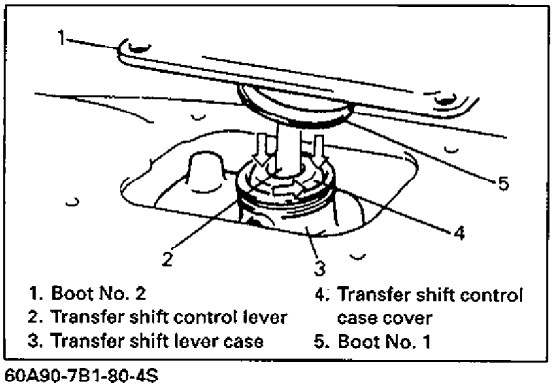
60A90-7B1-80-2S

3) Remove boot cover and boot No. 2 (if equipped).



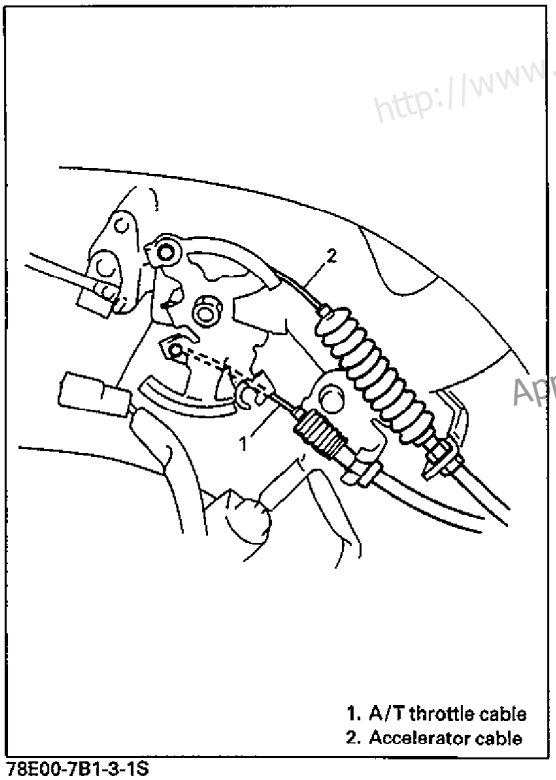
60A90-7B1-80-3S

4) Remove boot clamp and then remove boot No. 1 from transfer gear shift lever case (if equipped).



60A90-7B1-80-4S

5) With transfer shift control case cover pushed down with fingers, turn it to counterclockwise and take out shift control lever (if equipped).

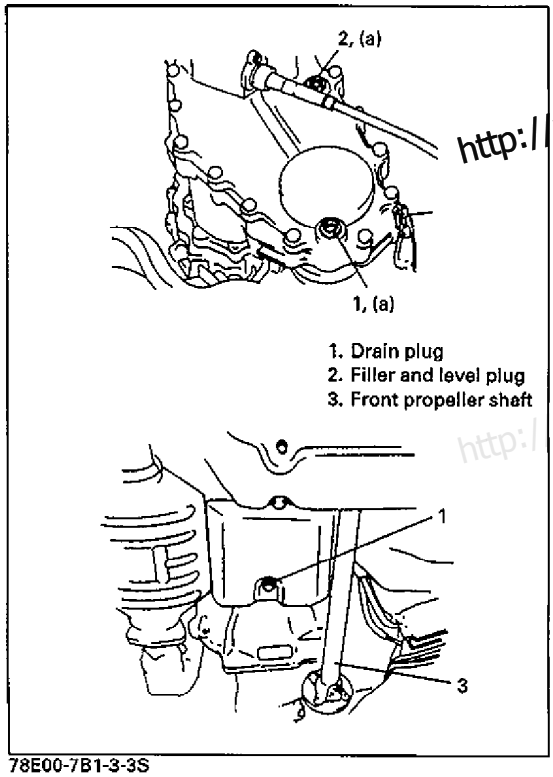


1. A/T throttle cable
2. Accelerator cable

78E00-7B1-3-1S

IN ENGINE ROOM

1) Remove battery, battery tray, battery heat protector (if equipped) and A/T fluid dipstick.
2) Remove intercooler. Refer to section 6A3 of this manual for its detail.
3) Disconnect A/T throttle cable from throttle cam and bracket.
4) Disconnect wiring harness couplers.
5) Remove starter motor.
6) Remove transmission to engine bolts.



1. Drain plug
2. Filler and level plug
3. Front propeller shaft

78E00-7B1-3-3S

ON LIFT

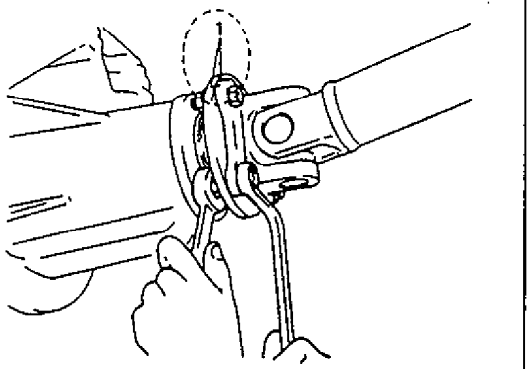
1) Drain transfer oil.

NOTE:

If automatic transmission is to be overhauled later on, draining A/T fluid at this point will facilitate work.

Tightening Torque

(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

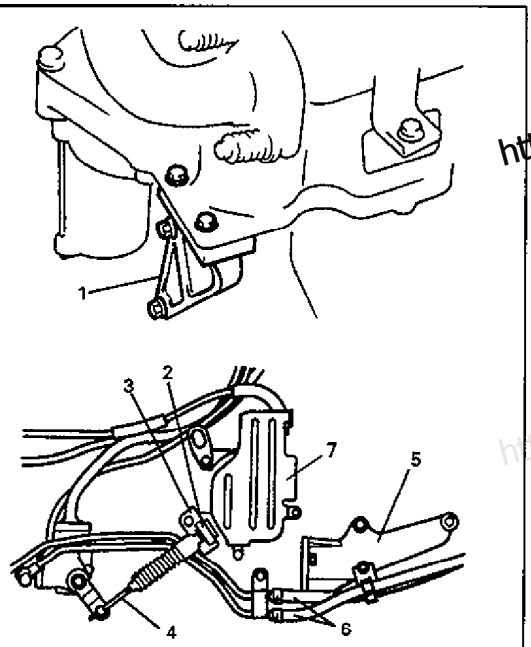


1. Match marks

78E00-7B1-4-1S

2) Before removing propeller shaft, give match marks on joint flange and propeller shaft as shown in left figure.
3) Remove universal joint flange bolts and take out rear propeller shaft.
4) Likewise, take out front propeller shaft.
5) Remove exhaust pipe No. 1 and No. 2.

WARNING:
Never work on exhaust system when the system is still hot.
Start working after the exhaust system has cooled down.



1. Left stiffener
2. E-ring
3. Cable bracket
4. Select cable
5. Right stiffener
6. Oil cooler hose
7. Select cable protector

78E00-7B1-4-3S

6) Remove nut from the end of select cable and E-ring from bracket to set cable free.
7) Remove select cable bracket by removing its 2 bolts.
8) Remove A/T fluid filler tube by removing upper bolt and loosening the lower bolt.
9) Remove case left stiffener.
10) Loosen clamps and disconnect oil cooler hoses from pipes.

NOTE:
To avoid leakage of transmission fluid, plug open ends of oil cooler pipes and hoses right after they are disconnected.

11) Remove case right stiffener.
12) Remove torque converter housing lower plate.
13) Holding crankshaft pulley bolt stationary, remove 4 torque converter mounting bolts with wrench through starter mounting hole.
14) Remove select cable protector.
15) Remove engine to transmission bolts and nut.
16) Remove speedometer cable end nut and disconnect cable.
17) Apply transmission jack and take off rear mounting member, engine rear mounting and engine rear mounting bracket by removing its bolts.
18) With transmission and transfer assemblies held up on jack, move them to the rear and lower them including torque converter.

78E00-7B1-4-5S

WARNING:
Transmission and transfer assemblies may tilt rearward on jack. It is recommended to use an auxiliary arm of jack for the purpose of safety.

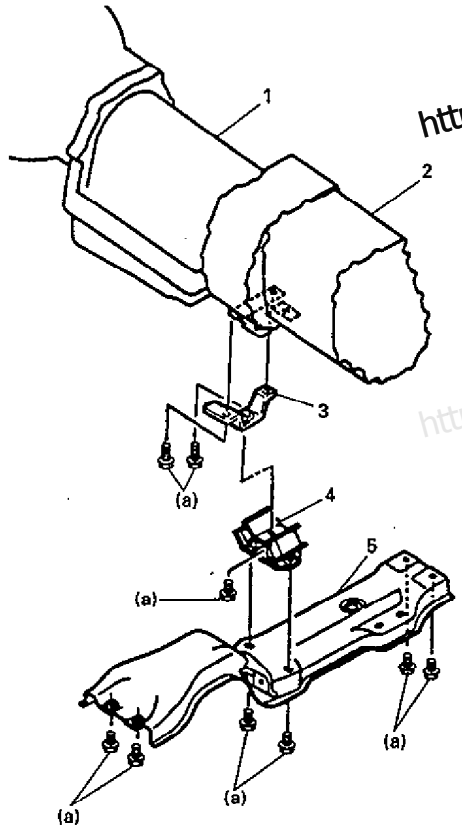
60A50-7B1-82-2S

AFTER DISMOUNTING

WARNING:
Be sure to keep transmission and transfer assemblies horizontal throughout the work. Should they be tilted, torque converter may fall off and cause personal injury and A/T fluid may flow out.

1) Remove wiring harness and breather hoses.
2) Remove transfer by removing its 12 bolts.

60A90-7B1-82-3S



1. Automatic transmission
2. Transfer
3. Engine rear mounting bracket
4. Engine rear mounting
5. Engine rear mounting member

78E00-7B1-5-3S

REMOUNTING

WARNING:
When moving transmission assembly with torque converter equipped in it, be sure to keep it horizontal. Tilting it with its front facing down may allow converter to fall off, whereby an injury may result.

For remounting, reverse dismounting procedure. Use specified torque as given below.

Tightening torque	N·m	kg-m	lb-ft
• Exhaust pipe No. 1 to manifold nuts • Exhaust pipe No. 2 to muffler nuts	60	6.0	43.5
Universal joint flange bolts and nuts	55	5.5	40.0
• Oil filler tube bolts • Select cable bracket bolts • A/T to transfer bolt	23	2.3	17.0
Engine to A/T bolts and nuts	80	8.0	58.0
Stiffener bolts	50	5.0	36.0
Drive plate to torque converter bolts	60	6.0	43.5

Tightening Torque
(a): 50 N·m (5.0 kg-m, 36.0 lb-ft)

SECTION 7C1

CLUTCH

CONTENTS

78E00-7C1-1-1S

GENERAL DESCRIPTION

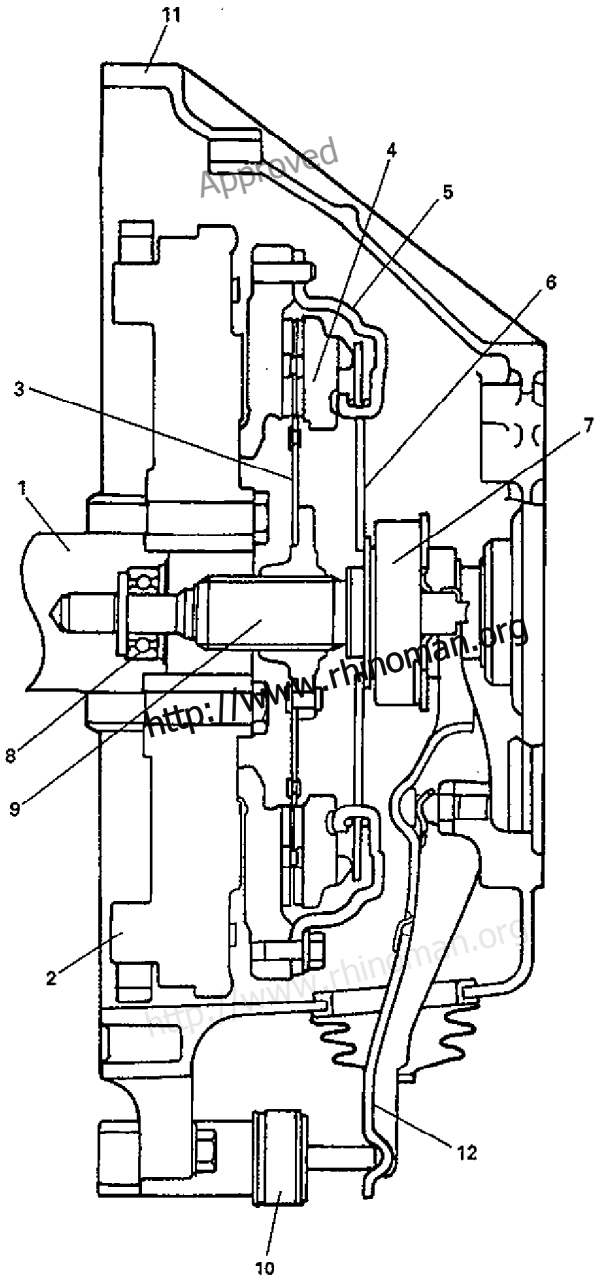
The clutch is a diaphragm-spring clutch of a dry single disc type. The diaphragm spring is of a tapering-finger type, which is a solid ring in the outer diameter part, with a series of tapered fingers pointing inward.

The clutch disc is positioned on the transmission input shaft with an involute spline fit. This clutch disc does not have the torsional springs.
The flywheel has viscous type torsional damper inside and this mechanism serves as a torsional spring on ordinary clutch disc, and it reduces the vibration of powertrain.

The clutch cover is secured to the flywheel, and carries the diaphragm spring in such a way that the peripheral edge part of the spring pushes on the pressure plate against the flywheel (with the disc in between), when the clutch release bearing is held back. This is the engaged condition of the clutch.

Depressing the clutch pedal causes the release bearing to advance and pushes on the tips of the tapered fingers of the diaphragm spring. When this happens, the diaphragm spring pulls the pressure plate away from the flywheel, thereby interrupting the flow of drive from flywheel through clutch disc to transmission input shaft.

78E00-7C1-1-2S

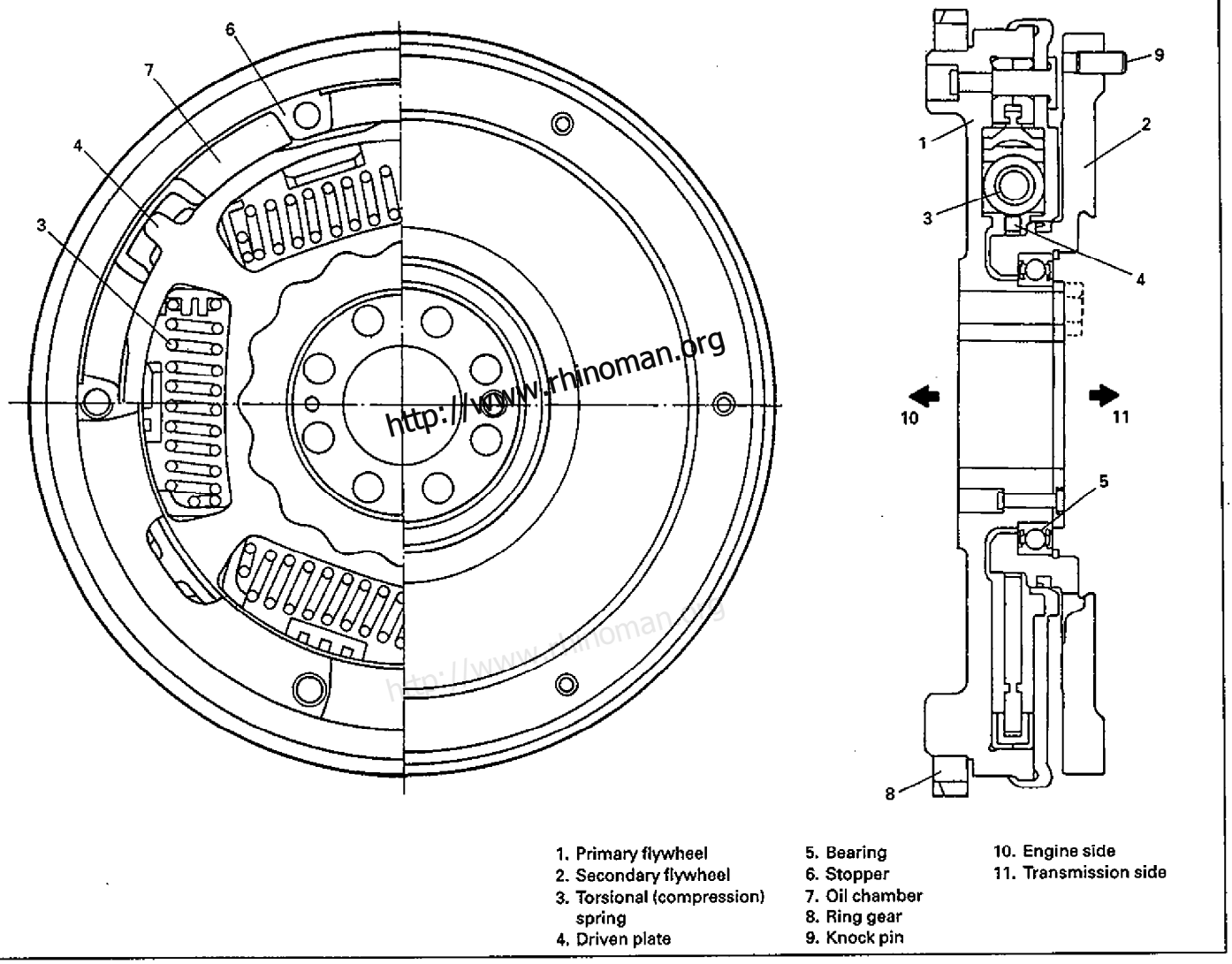


1. Crankshaft
2. Flywheel ass'y
3. Clutch disc
4. Pressure plate
5. Clutch cover
6. Diaphragm spring
7. Release bearing
8. Input shaft bearing
9. Input shaft
10. Operating cylinder
11. Clutch housing
12. Release fork

FLYWHEEL ASSEMBLY

GENERAL DESCRIPTION

The flywheel of this vehicle has viscous type torsional damper inside.
The components of this flywheel is mainly divided into primary (engine side) and secondary (transmission side) flywheels. In between, there are compression springs, driven plates and damping mechanism by viscous damping mechanism.
This flywheel can not be disassembled. If it is found faulty, replace it as an assembly.
Also, this flywheel needs some special care when handling it. Pay attention to NOTEs and WARNINGs during each step.



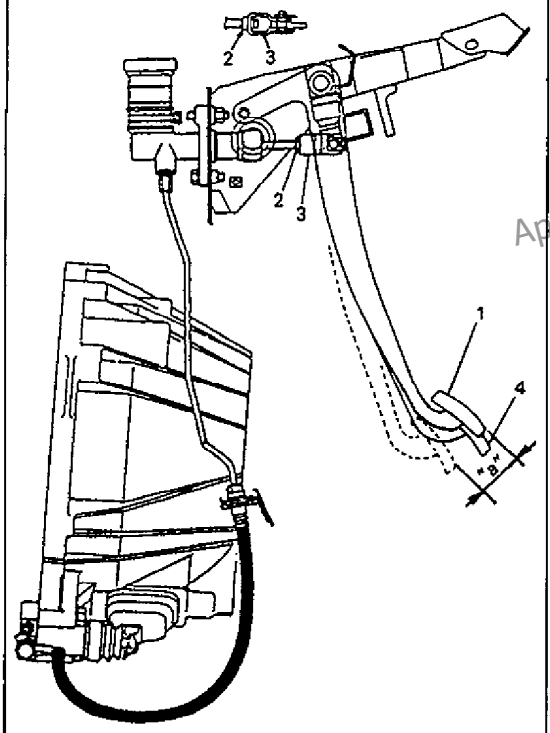
1. Primary flywheel
2. Secondary flywheel
3. Torsional (compression) spring
4. Driven plate
5. Bearing
6. Stopper
7. Oil chamber
8. Ring gear
9. Knock pin
10. Engine side
11. Transmission side

78E00-7C1-3-1S

DIAGNOSIS

Condition	Possible Cause	Correction
Slipping	• Improper clutch pedal free travel.	Replace clutch arm or master cylinder.
	• Worn on oily clutch disc facing.	Replace disc, and inspect flywheel.
	• Warped disc, pressure plate or flywheel surface.	Replace disc, clutch cover or flywheel.
	• Weakened diaphragm spring.	Replace clutch cover.
	• Master cylinder piston or seal cup not returning.	Repair master cylinder.
Dragging clutch	• Improper clutch pedal free travel.	Replace clutch arm or master cylinder.
	• Weakened diaphragm spring, or worn spring tip.	Replace clutch cover.
	• Rusted input shaft splines.	Lubricate.
	• Damaged or worn splines of transmission input shaft.	Replace input shaft.
	• Excessively wobbly clutch disc.	Replace disc.
	• Clutch facings broken or dirty with oil.	Replace disc.
	• Fluid leakage.	Repair or replace.
Clutch vibration	• Glazed (glass-like) clutch facings.	Repair or replace disc.
	• Clutch facings dirty with oil.	Replace disc.
	• Release bearing slides unsmoothly on input shaft bearing retainer.	Lubricate or replace input shaft bearing retainer.
	• Wobbly clutch disc, or poor facing contact.	Replace disc.
	• Clutch disc rivets loose.	Replace disc.
	• Distorted pressure plate or flywheel surface.	Replace clutch cover or flywheel.
	• Weakened or loosened engine mounting bolt or nut.	Retighten or replace mounting.
	• Oil leaking from flywheel.	Replace flywheel.
Noisy clutch	• Worn or broken release bearing.	Replace release bearing.
	• Input shaft front bearing worn down.	Replace input shaft bearing.
	• Excessive rattle of clutch disc hub.	Replace disc.
	• Cracked clutch disc.	Replace disc.
	• Pressure plate and diaphragm spring rattling.	Replace clutch cover.
	• Oil leaking from flywheel.	Replace flywheel.
Grabbing clutch	• Clutch disc facings soaked with oil	Replace disc.
	• Clutch disc facings excessively worn.	Replace disc.
	• Rivet heads showing out of facing.	Replace disc.

LH Steering vehicle shown



1. Clutch pedal
2. Clevis lock nut
3. Clevis
4. Brake pedal

78E00-7C1-5-1S

ON-VEHICLE SERVICE

CLUTCH PEDAL HEIGHT

For LH steering vehicle:

Clutch pedal height: clutch pedal is about 10 mm (0.39 in.) higher than brake pedal.

Adjust clutch pedal height by loosening clevis lock nut and turning push rod as shown.

For RH steering vehicle:

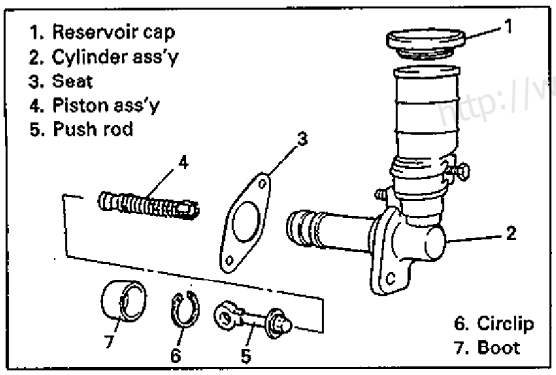
Clutch pedal height: clutch pedal is as high as brake pedal.

If the height is out of specification, find the cause and replace the part.

CLUTCH PEDAL FREE TRAVEL

Depress clutch pedal, stop the moment clutch resistance is felt and measure distance (clutch pedal free travel). Free travel should be within following specification.

Pedal free travel "a": 15 – 25 mm (0.6 – 1.1 in.)

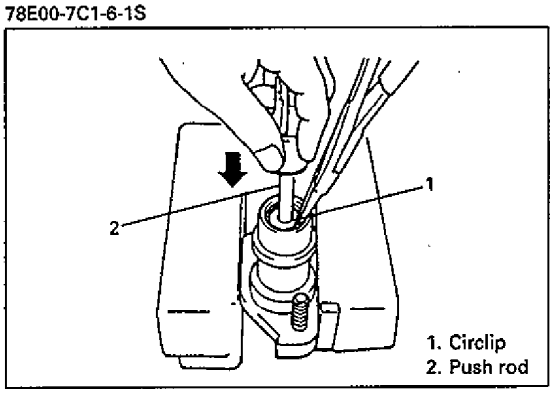


78E00-7C1-6-1S

DISASSEMBLY AND ASSEMBLY OF CLUTCH MASTER CYLINDER (FOR RH STEERING VEHICLE ONLY)

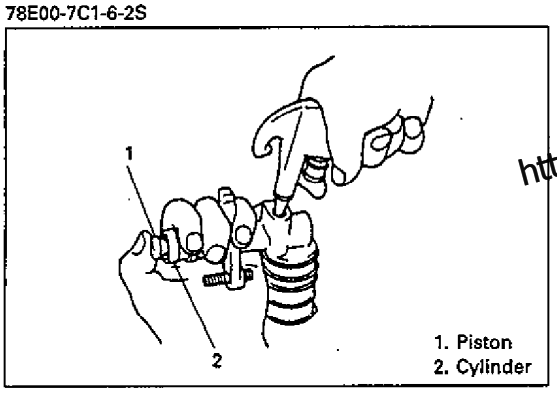
DISASSEMBLY

1) Remove boot and then circlip with piston pushed in.
2) Remove push rod.



78E00-7C1-6-2S

3) Blow compressed air gradually into hole for pipe connection to remove piston ass'y, using care to prevent it from jumping out.



78E00-7C1-6-3S

INSPECTION

Inspect all disassembled parts for wear or damage and replace parts if necessary.

NOTE:

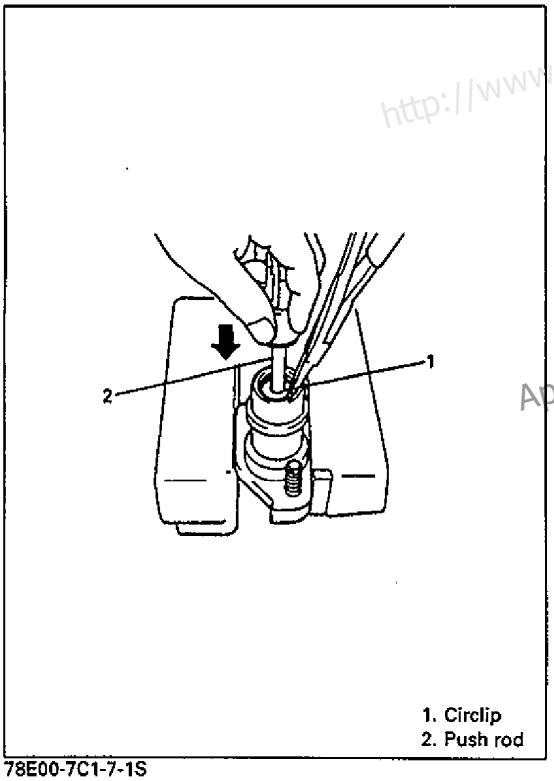
- **Wash disassembled parts with brake fluid.**
- **Do not reuse piston ass'y and circlip.**

Inspect cylinder bore for scoring or corrosion. It is best to replace corroded cylinder. Corrosion can be identified as pits or excessive roughness.

NOTE:

Polishing bore of cylinder with anything abrasive is prohibited, as damage to cylinder bore may occur.

Rinse cylinder in clean brake fluid. Shake excess rinsing fluid from cylinder. Do not use a cloth to dry cylinder, as lint from cloth cannot be kept away from cylinder bore surfaces.



1. Circlip
2. Push rod

78E00-7C1-7-1S

ASSEMBLY

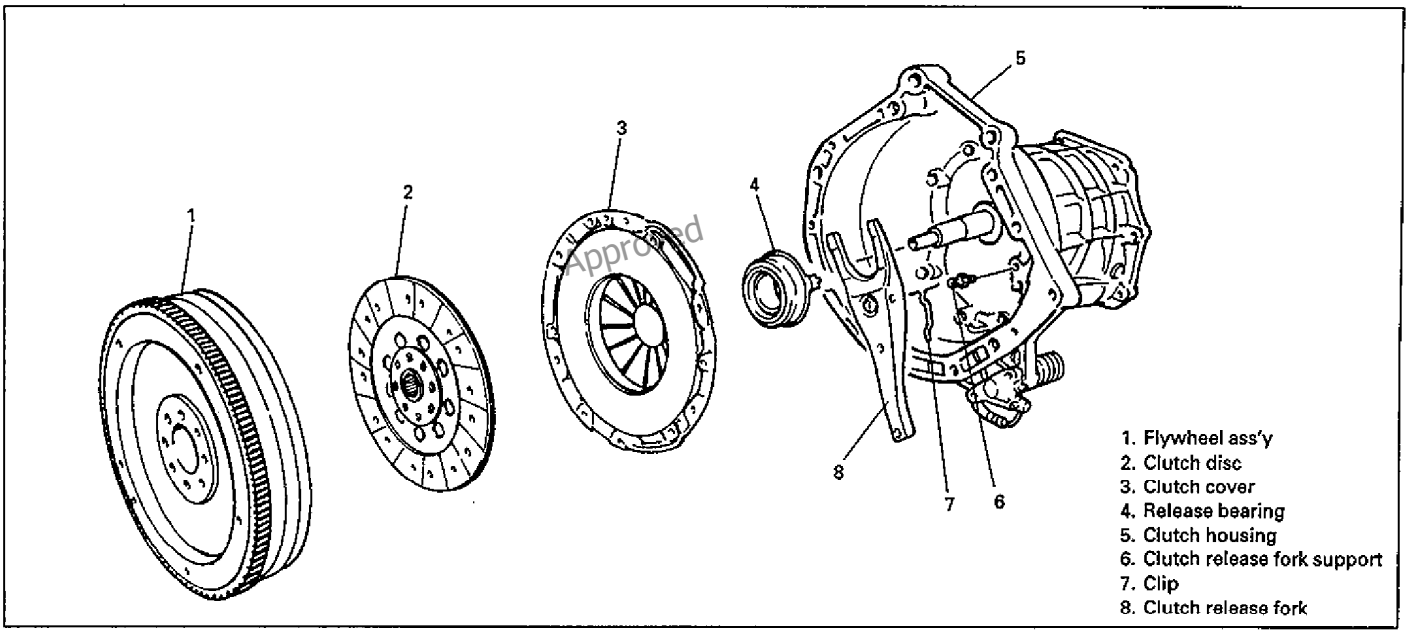
NOTE:

Before installation, wash each part in specified brake fluid.

1) Apply brake fluid to inside of piston ass'y and cylinder body.
2) Install piston ass'y into cylinder.
3) Install push rod.
4) With piston pushed down, install circlip as shown. And install boot.
5) For installation of master cylinder to vehicle, refer to CLUTCH MASTER CYLINDER INSTALLATION in the same section of service manual mentioned in FOREWORD of this manual.

UNIT REPAIR OVERHAUL

CLUTCH COVER AND CLUTCH DISC

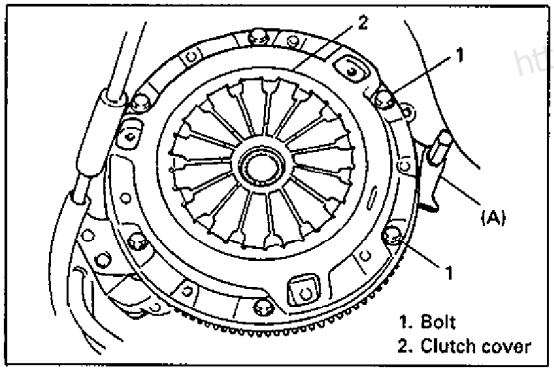


78E00-7C1-8-1S

DISMOUNTING/REMOUNTING OF MANUAL TRANSMISSION

Refer to SECTION 7A2 of this manual.

78E00-7C1-8-3S



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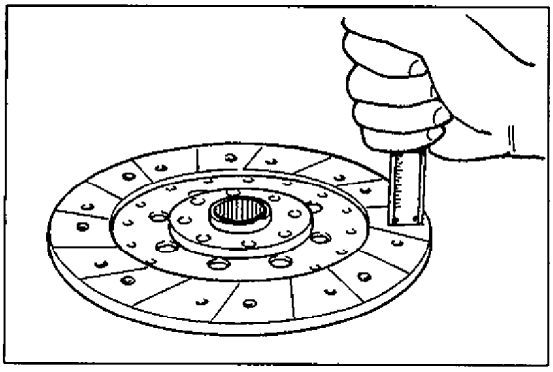


78E00-7C1-8-5S

REMOVAL

Fix flywheel with special tool (A) and remove clutch cover bolts, clutch cover and clutch disc.

Special Tool
(A): 09924-17810

INSPECTION

Clutch Disc

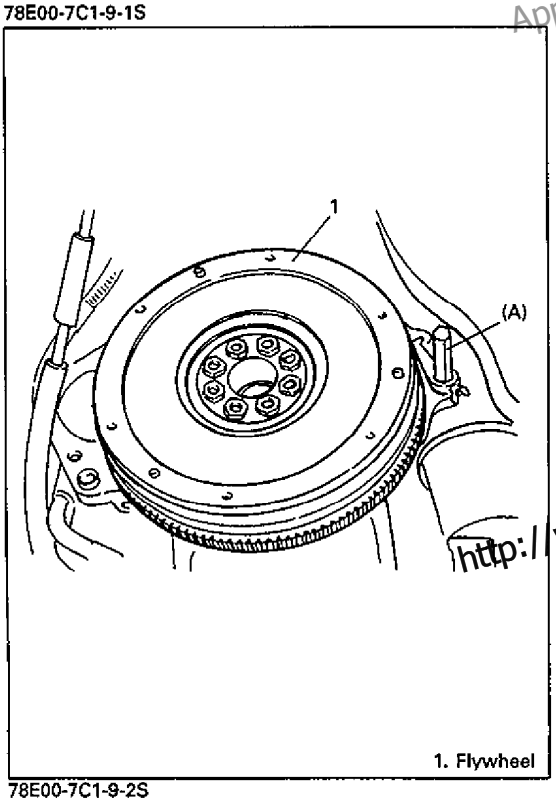
Measure depth of rivet head depression, i.e. distance between rivet head and facing surface. If depression is found to have reached service limit at any of holes, replace disc assembly.

Rivet head depth
Standard: 1.6 mm (0.06 in.)
Service limit: 0.5 mm (0.02 in.)

Clutch Cover

- Check diaphragm spring for abnormal wear or damage.
- Inspect pressure plate for wear or heat spots.
- If abnormality is found, replace it as assembly. Do not disassemble it into diaphragm and pressure plate.

78E00-7C1-9-1S



1. Flywheel

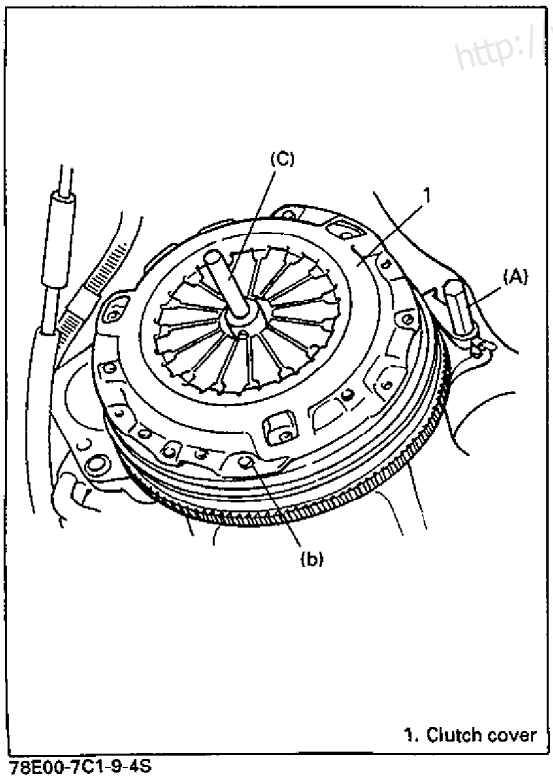
INSTALLATION

NOTE:
Before assembling, make sure that flywheel surface and pressure plate surface have been cleaned and dried thoroughly.

1) Lock flywheel with special tool.

Special Tool
(A): 09924-17610

78E00-7C1-9-2S



1. Clutch cover

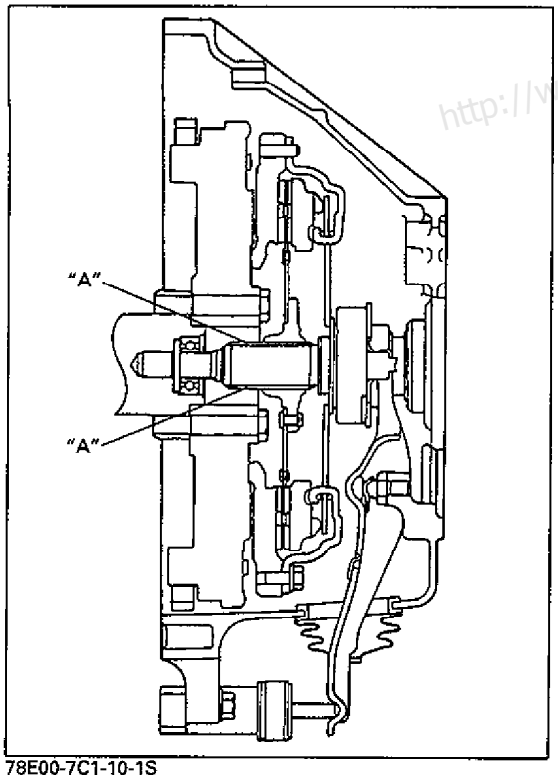
78E00-7C1-9-4S

2) Aligning clutch disc of flywheel center by using special tool (C), install clutch cover and bolts. Then tighten bolts to specification.

NOTE:
- **While tightening clutch cover bolts, compress clutch disc with special tool (C) by hand so that disc centered.**
- **Tighten cover bolts little by little evenly in diagonal order.**

Special Tool
(A): 09924-17810
(C): 09923-36320

Tightening Torque
(b): 23 N·m (2.3 kg-m, 16.5 lb-ft)



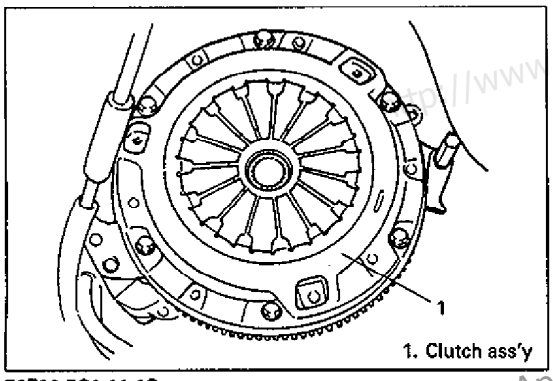
78E00-7C1-10-1S

3) Slightly apply grease to input shaft, then join transmission transfer assembly with engine. Refer to SECTION 7A2 of this manual for remounting procedure.

WARNING:
Never tilt the transmission ass'y, when the input shaft is attached to the clutch disc. If done so, the bearing between the primary and secondary flywheel may get damaged.

NOTE:
Turn crankshaft with wrench from front while inserting transmission input shaft to clutch disc until splines mesh.

"A": Grease 99000-25010

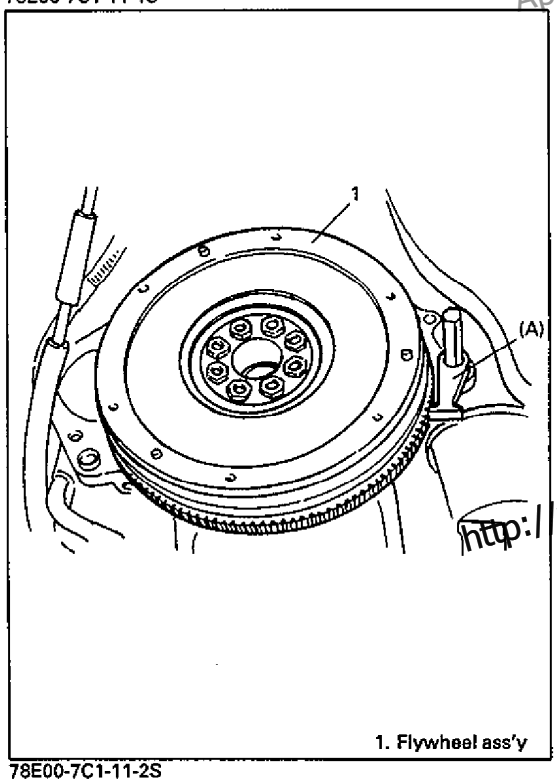


78E00-7C1-11-1S

FLYWHEEL

REMOVAL

1) Dismount manual transmission ass'y. Refer to section 7A2 of this manual.
2) Remove clutch cover and clutch disc, refer to CLUTCH COVER AND CLUTCH DISC REMOVAL in this section.



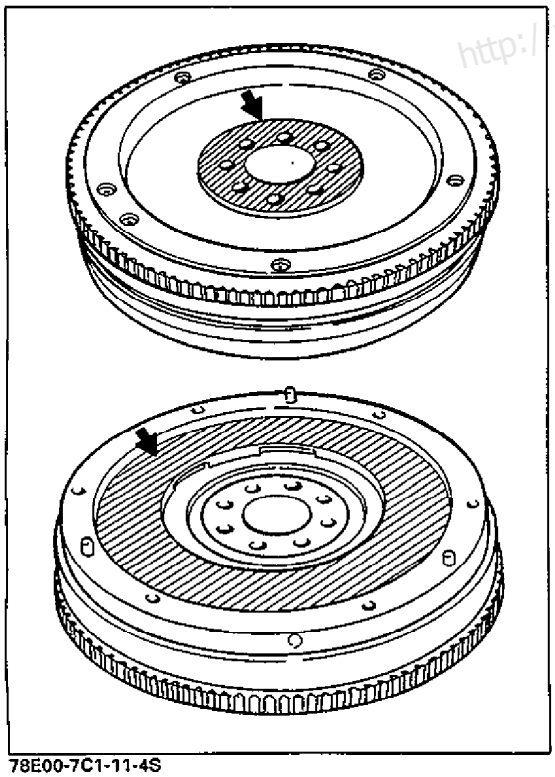
78E00-7C1-11-2S

3) Lock flywheel with special tool and remove flywheel ass'y.

Special Tool
(A): 09924-17610

NOTE:

- **Never drop flywheel ass'y. If done so, the bearing between primary and secondary flywheel may get damaged.**
- **Do not disassemble flywheel ass'y. If found faulty, replace as an assembly.**

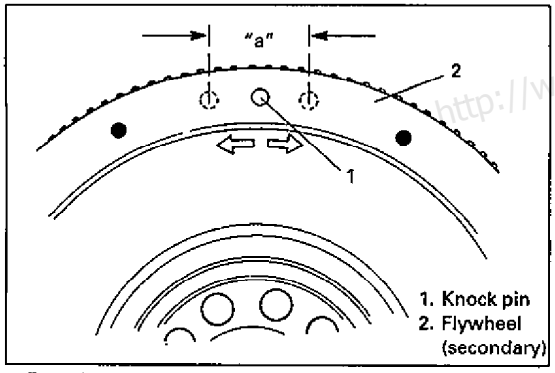


78E00-7C1-11-4S

INSPECTION

- Inspect the surface of flywheel where it meets the crankshaft, for rust.
- Also inspect the friction surface of flywheel where the clutch disc is to be pressed, for rust, abnormal wear or heat spots.

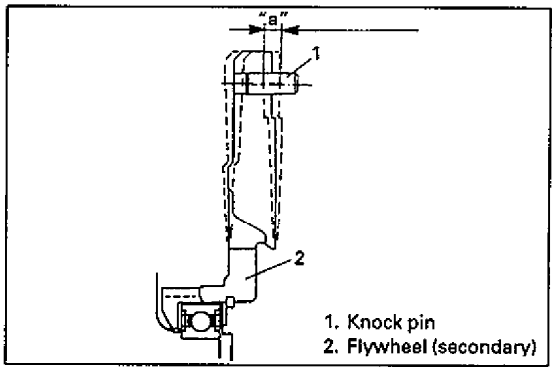
If above conditions are found, replace flywheel ass'y.



78E00-7C1-12-1S

- Fix primary flywheel and turn secondary flywheel to the right and left by hand, then observe the knock pin on secondary flywheel.
  If knock pin has traveled more than 9 mm, replace the flywheel assembly.

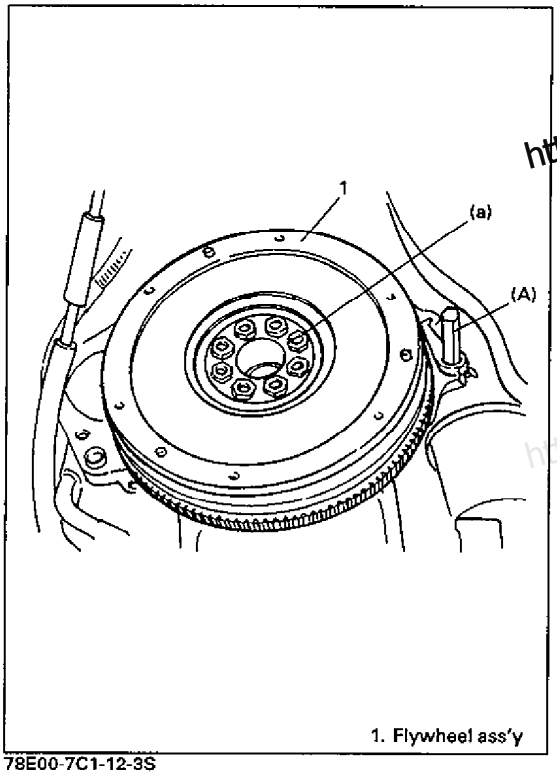
  "a": under 9 mm (0.35 in.)



78E00-7C1-12-2S

- Fix primary flywheel and move secondary flywheel back and forth to the axial direction by hand at about 10 kg force, then observe the knock pin on secondary flywheel.
  If knock pin has moved more than standard value replace the flywheel assembly.

  Standard value "a": under 0.75 mm (0.03 in.)



78E00-7C1-12-3S

INSTALLATION

Reverse removal procedure noting the following:

Special Tool
(A): 09924-17610

Tightening Torque for flywheel bolt
(a): 170 N·m (17.0 kg-m, 123.0 lb-ft)

NOTE:
Never drop flywheel ass'y. If done so, the bearing between primary and secondary flywheel may get damaged.

TIGHTENING TORQUE SPECIFICATIONS

Fastening portion	Tightening torque		
	N·m	kg-m	lb-ft
1. Flare nut	16	1.6	11.5
2. Master cylinder nut	13	1.3	9.5
3. Flywheel bolts	170	17.0	123.0
4. Clutch cover bolts	23	2.3	16.5
5. Operating cylinder bolt	50	5.0	36.0
6. Clutch hose union bolt	23	2.3	16.5

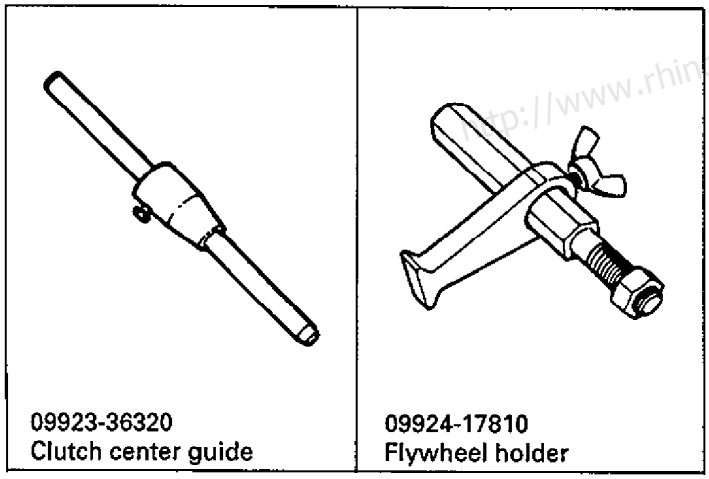
78E00-7C1-13-1S

REQUIRED SERVICE MATERIALS

MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Clutch master cylinder clevis pin. • Release fork end (bearing side). • Release fork support. • Push rod tip of operating cylinder. • Input shaft spline front end.
Clutch fluid (Brake fluid)	DOT3 or SAE J1703	• Clutch reservoir. • Clutch master cylinder. • Clutch operating cylinder.

85F00-7C1-15-2

SPECIAL TOOLS



09923-36320
Clutch center guide

09924-17810
Flywheel holder

78E00-7C1-13-3S

SECTION 7D

TRANSFER

WARNING:
For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNING and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Component and Wiring Location view in Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

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

61A10-7D-1-1S

CONTENTS

7D

78E00-7D-1-2S

GENERAL DESCRIPTION

For diagnosis, refer to Section 7A2 "Manual Transmission" in this manual.

78E00-7D-2-1S

ON-VEHICLE SERVICE

Refer to "On-Vehicle Service" in Section 7A2 "Manual Transmission" in this manual.

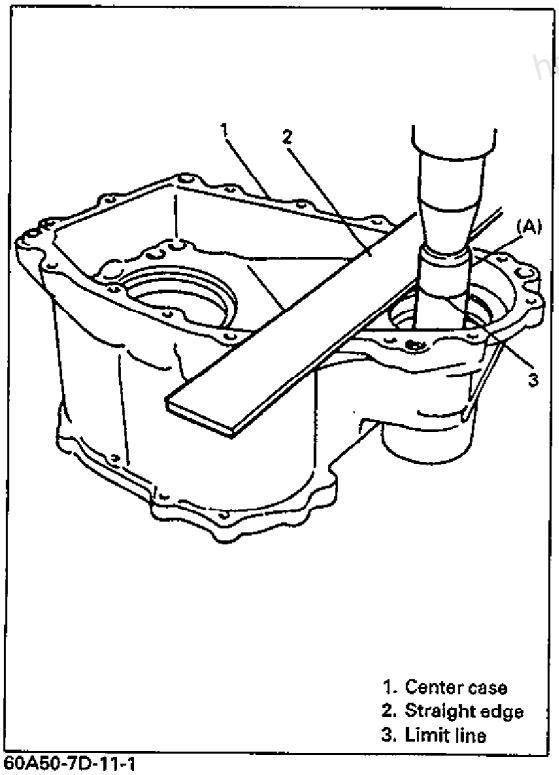
78E00-7D-2-2S

UNIT REPAIR OVERHAUL

DISMOUNTING

Refer to "Dismounting" in Section 7A2 for manual transmission and in Section 7B1 for automatic transmission.

78E00-7D-2-3S



1. Center case
2. Straight edge
3. Limit line

60A50-7D-11-1

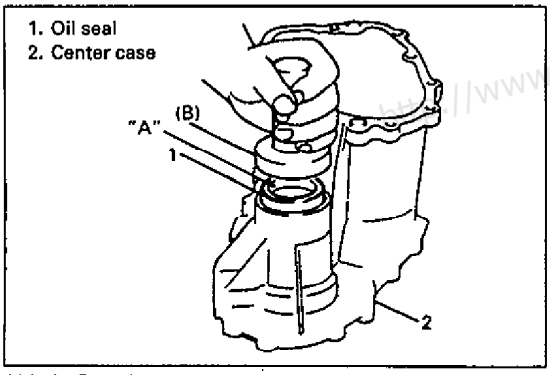
ASSEMBLING UNIT

1) Using press and special tool, press-fit needle bearing into center case. As shown in figure, apply straightedge to top surface of case and press-fit till limit line of special tool aligns with bottom surface of straightedge (i.e., case surface).

NOTE:

- **Press-fitting needle bearing according to above procedure will set needle bearing 3 mm before it hits case bottom.**
- **Once it is press-fit all way down to case bottom, removal would be very difficult if it becomes necessary.**

Special Tool
(A): 09951-76010

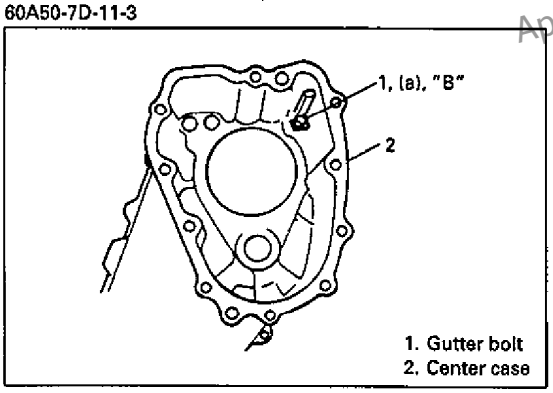


60A50-7D-11-3

2) Using special tool and hammer, drive oil seal into center case until it becomes flush with case surface. Apply grease to oil seal lip.

"A": Grease 99000-25010

Special Tool
(B): 09913-75520

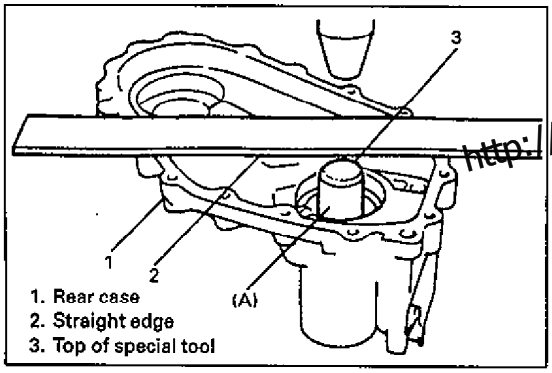


60A50-7D-11-4

3) Install oil gutter and tighten bolt applying thread lock cement.

Tightening Torque
(a): 6 N·m (0.6 kg-m, 4.0 lb-ft)

"B": Cement 99000-32020

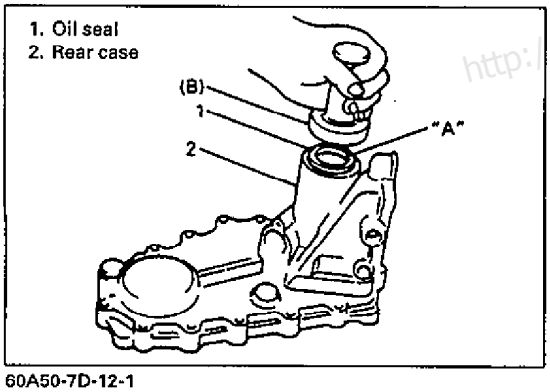


60A50-7D-11-5

4) Using special tool and press, install needle bearing into rear case. As shown in figure, apply straightedge to case surface and press-fit till top of special tool aligns with bottom surface of straightedge (i.e., case surface).

NOTE:
As with needle bearing in center case, above installation procedure will set needle bearing at a position 3 mm before it hits case bottom.

Special Tool
(A): 09951-76010

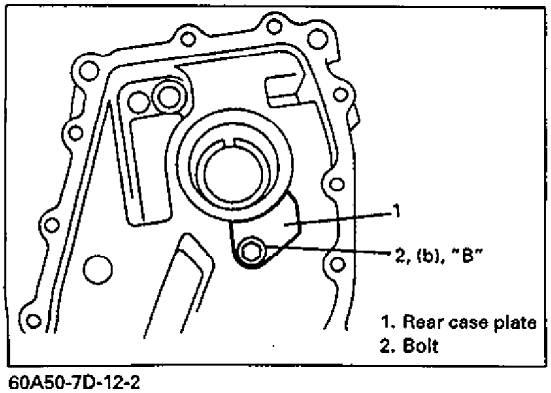


60A50-7D-12-1

5) Using special tool and hammer, install oil seal into rear case until it becomes flush with case surface. Apply grease to oil seal lip.

"A": Grease 99000-25010

Special Tool
(B): 09913-75520



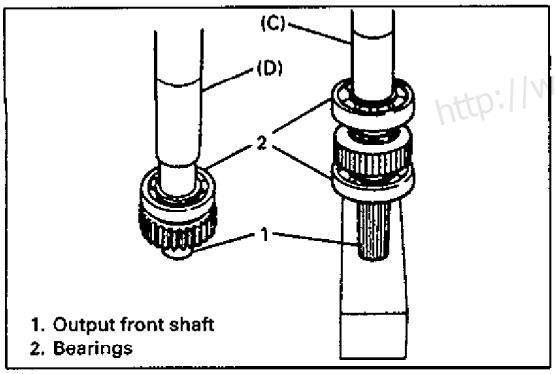
60A50-7D-12-2

6) Install rear case plate and bolt applying thread lock cement.

NOTE:
Removal of rear case plate is not required normally. However, if it is removed or replaced, install it with bolt applied with thread lock cement.

"B": Cement 99000-32020

Tightening Torque
(b): 6 N·m (0.6 kg-m, 4.0 lb-ft)

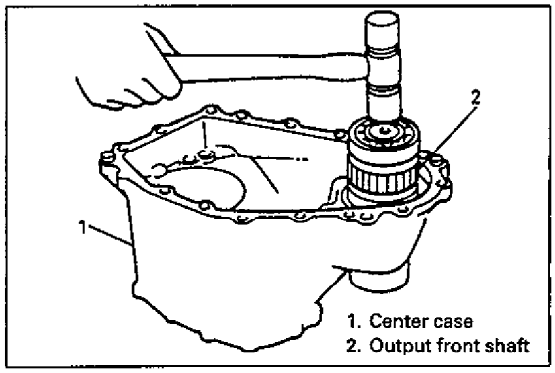


1. Output front shaft
2. Bearings

60A50-7D-12-3

7) Using press and special tools, install bearings to front shaft.
Bearings for both front and rear are identical.

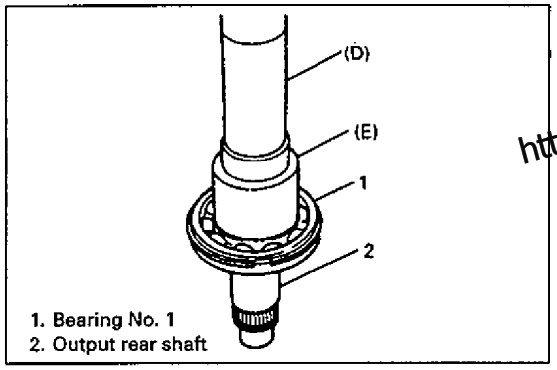
Special Tool
(C): 09913-84510
(D): 09925-18010



1. Center case
2. Output front shaft

60A50-7D-12-4

8) Using plastic hammer, drive output front shaft assembly into center case.

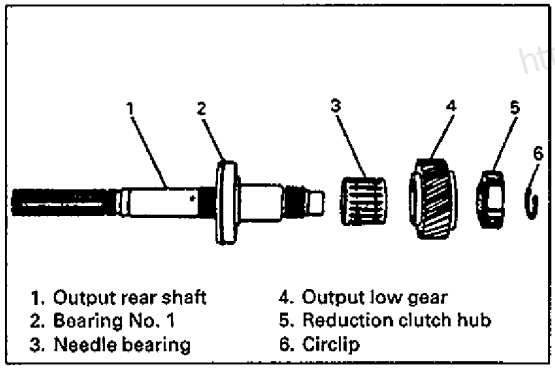


1. Bearing No. 1
2. Output rear shaft

60A50-7D-12-5

9) Using press and special tools, install bearing No. 1 into output rear shaft. Place circlip portion of bearing on top as shown in figure.

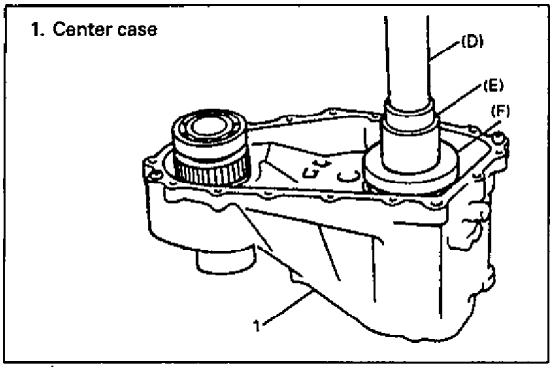
Special Tool
(D): 09925-18010
(E): 09940-53111



1. Output rear shaft
2. Bearing No. 1
3. Needle bearing
4. Output low gear
5. Reduction clutch hub
6. Circlip

60A50-7D-13-1

10) Install needle bearing, output low gear, reduction clutch hub onto output rear shaft and secure them with circlip.
Hub has no specific installing direction.

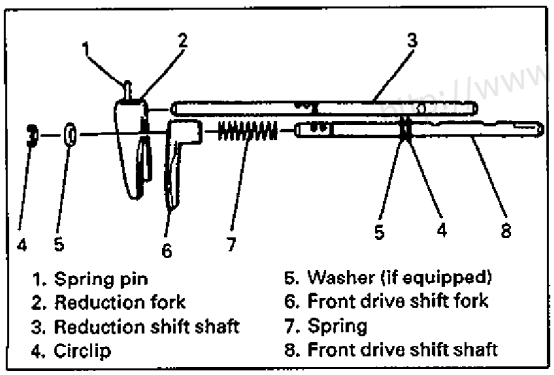


60A50-7D-13-3

11) Combine special tools and press fit output rear shaft assembly into center case.

NOTE:
Use special tool (F) with its under-cut side faced down (toward bearing).

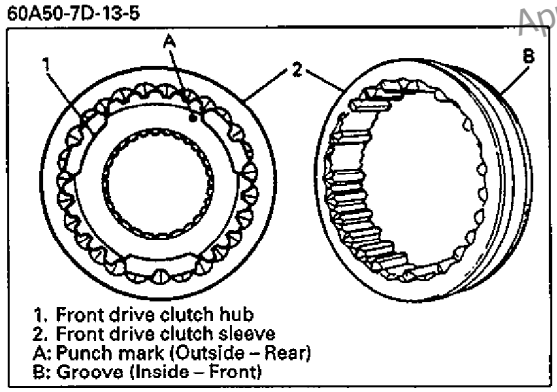
Special Tool
(D): 09925-18010
(E): 09940-53111
(F): 09951-26010



1. Spring pin
2. Reduction fork
3. Reduction shift shaft
4. Circlip
5. Washer (if equipped)
6. Front drive shift fork
7. Spring
8. Front drive shift shaft

60A50-7D-13-5

12) Install fork to corresponding shift shaft.



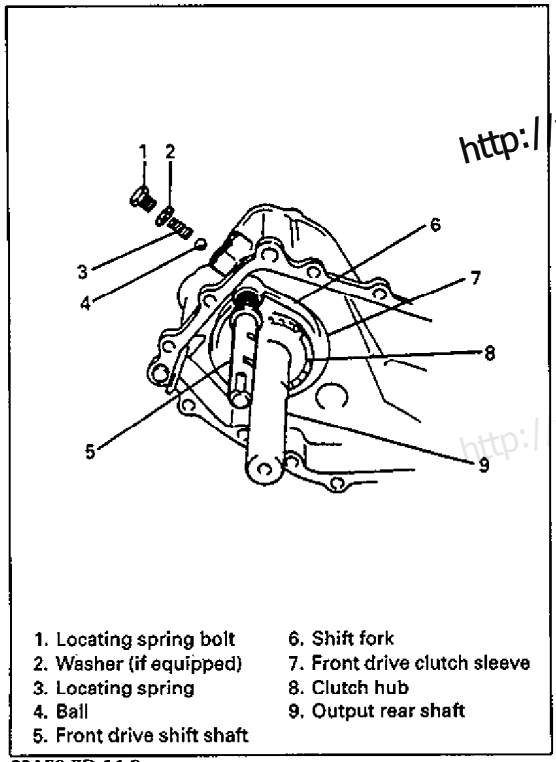
1. Front drive clutch hub
2. Front drive clutch sleeve
A: Punch mark (Outside – Rear)
B: Groove (Inside – Front)

60A50-7D-14-1

13) As shown in figure, fit front drive clutch hub and sleeve.

NOTE:

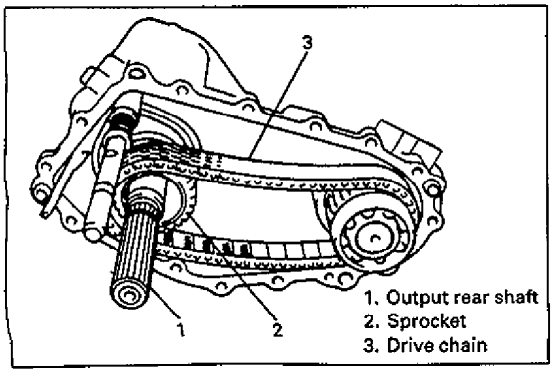
- **Sleeve with straight spline has no specific direction in dimension. However, it is recommended to install it facing its circumferential groove mark inward as it was originally so.**
- **With hub, its punch mark should face vehicle rear side (so that it can be seen).**



1. Locating spring bolt
2. Washer (if equipped)
3. Locating spring
4. Ball
5. Front drive shift shaft
6. Shift fork
7. Front drive clutch sleeve
8. Clutch hub
9. Output rear shaft

60A50-7D-14-3

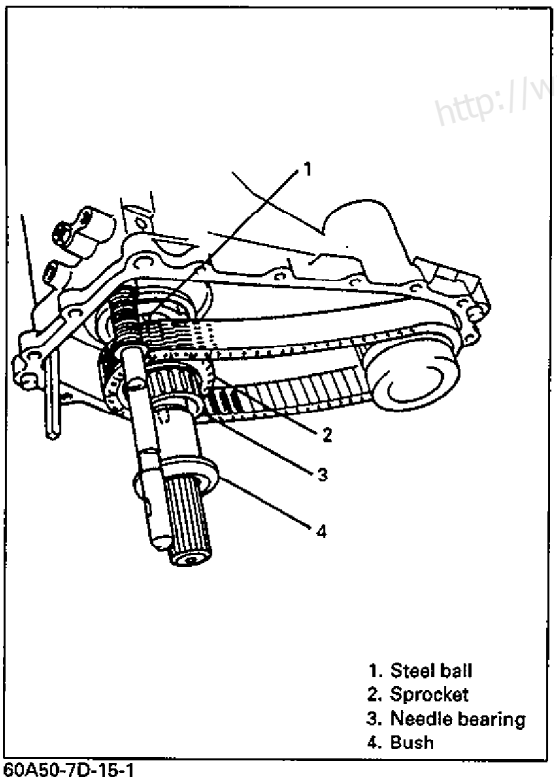
14) Install front drive fork shaft assembly and sleeve & hub together into center case all at once. Then put locating ball and spring also into case and loosely install bolt.



1. Output rear shaft
2. Sprocket
3. Drive chain

60A50-7D-14-5

15) Install sprocket to output rear shaft and apply drive chain.

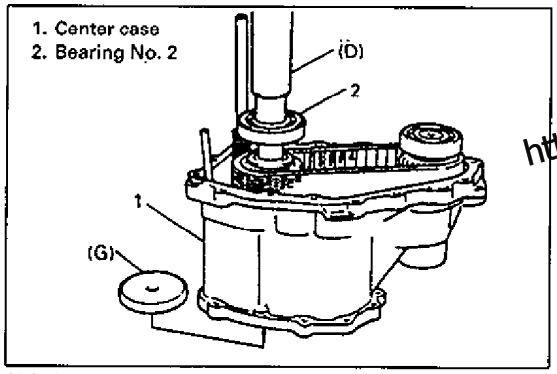


60A50-7D-15-1

16) Install needle bearing and bush to sprocket.
Also install steel ball, using care not to drop it.

NOTE:

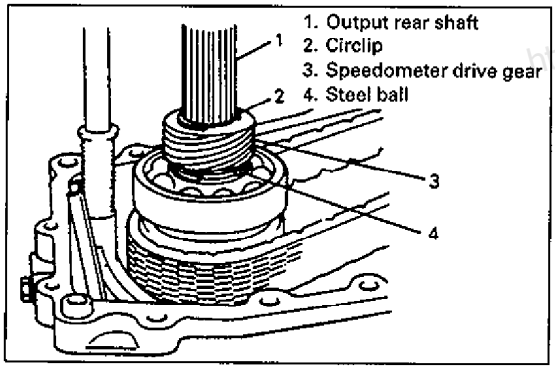
- **Point mark on output rear shaft between positions of bearing No. 2 and speedometer drive gear indicates steel ball location in the front.**
- **Point mark on bush flange also means position where steel ball is met.**



60A50-7D-15-3

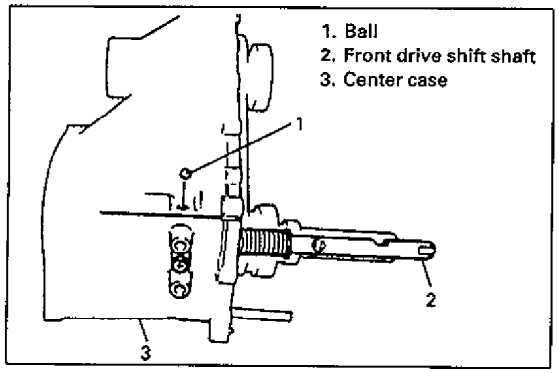
17) Using special tool, press-fit bearing No. 2 into output rear shaft. It is necessary to place support base at lower end of shaft.

Special Tool
(D): 09925-18010
(G): 09926-68310

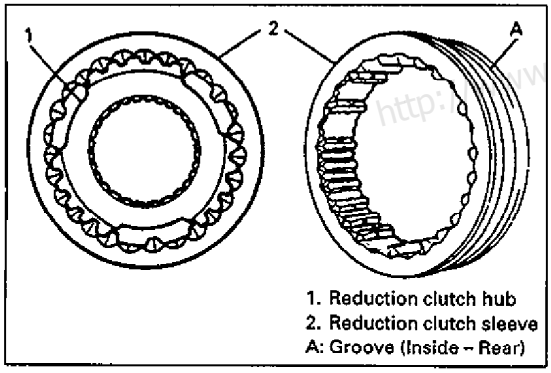


78E00-7D-6-4S

18) After installing large size circlip, install steel ball and speedometer drive gear and secure it with small size circlip.



19) Install interlock steel ball.



1. Reduction clutch hub
2. Reduction clutch sleeve

A: Groove (Inside – Rear)

60A50-7D-16-1

20) Fit reduction clutch hub and sleeve.

NOTE:

- **Sleeve used here is identified by tapered splines which make it different from front drive clutch sleeve.**
- **Circumferential groove mark (thicker rail side which works as shift stopper) should be inside (rear).**
- **Hub has no specific direction.**

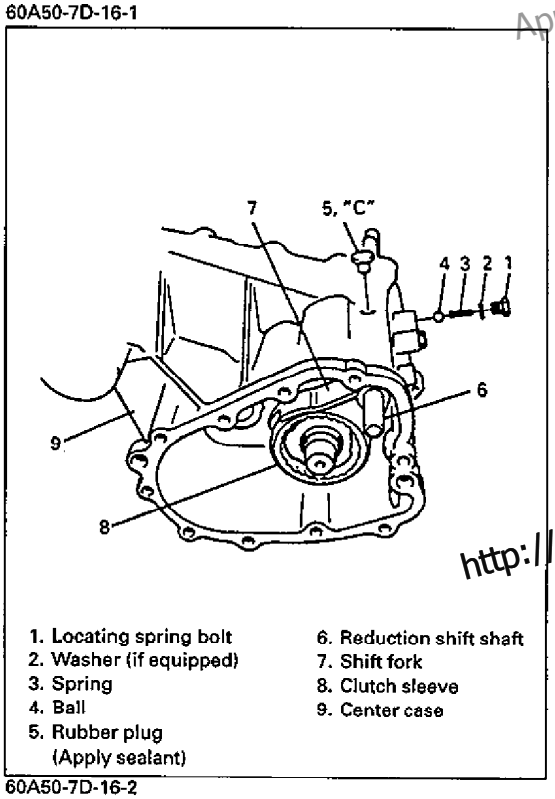
21) Combine sleeve & hub to reduction shift shaft assembly and install them into center case. Then put locating ball and spring also into case and loosely install bolt.

22) With sealant applied to rubber plug, insert it into hole in case.

NOTE:

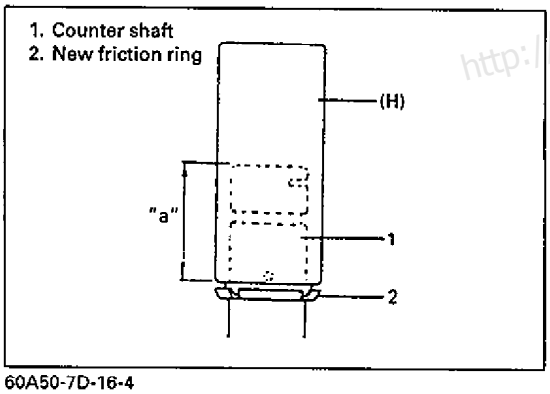
When installing reduction shift shaft, front drive shift shaft must be placed at 4WD position.

"C": Sealant 99000-31110



1. Locating spring bolt
2. Washer (if equipped)
3. Spring
4. Ball
5. Rubber plug (Apply sealant)
6. Reduction shift shaft
7. Shift fork
8. Clutch sleeve
9. Center case

60A50-7D-16-2

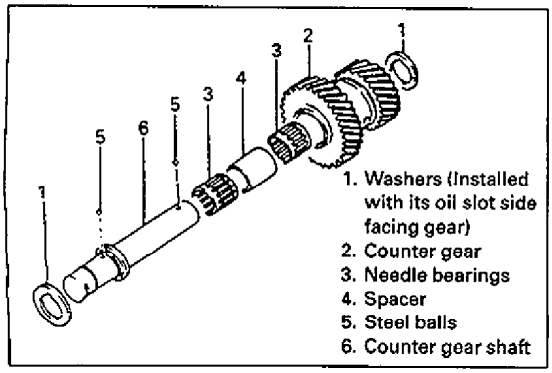


60A50-7D-16-4

23) If friction ring has been removed from counter shaft, press-fit new one onto shaft, using care so that it is installed in proper direction and position as shown in figure at the left.

Special Tool
(H): 09913-80112

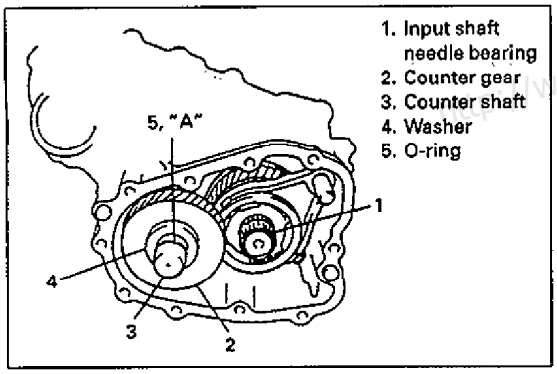
Installing position "a": 39.5 mm (1.56 in.)



1. Washers (Installed with its oil slot side facing gear)
2. Counter gear
3. Needle bearings
4. Spacer
5. Steel balls
6. Counter gear shaft

60A50-7D-16-5

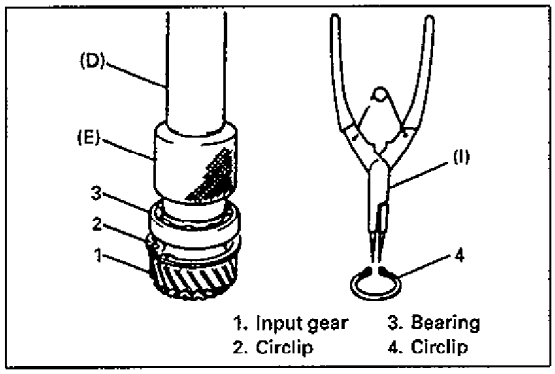
24) Install needle bearing, spacer, counter gear, steel balls and washers onto shaft.



60A50-7D-17-1

25) Install counter shaft assembly into case. If O-ring has been removed, install new O-ring onto shaft and apply grease.
Also, install low gear needle bearing.

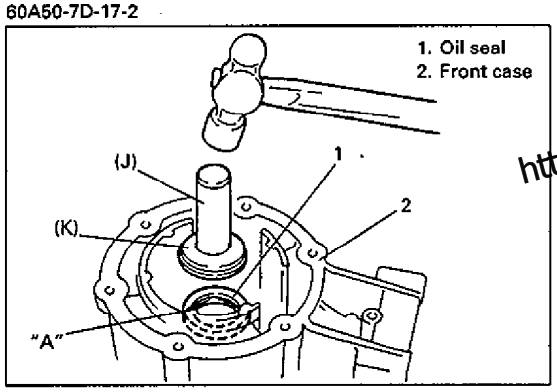
"A": Grease 99000-25010



60A50-7D-17-2

26) With circlip placed on input gear, press-fit input gear bearing.
27) Fix bearing with circlip.

Special Tool
(D): 09925-18010
(E): 09940-53111
(I): 09900-06107

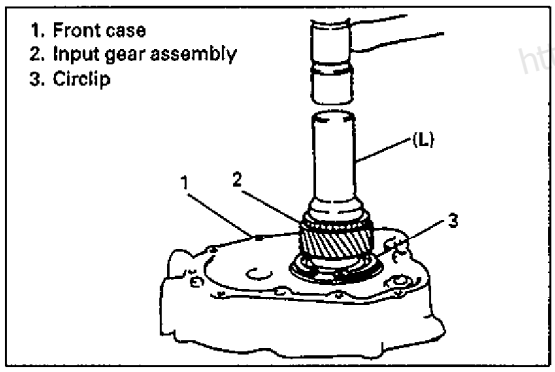


78E00-7D-8-3S

28) Install oil seal to front case so that end surface of oil seal becomes flush with that case. Apply grease to oil seal lip.

"A": Grease 99000-25010

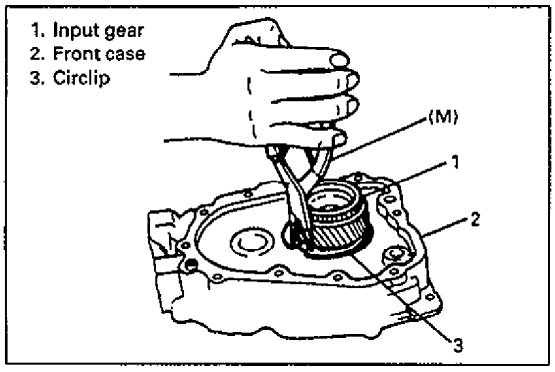
Special Tool
(J): 09924-74510
(K): 09944-68210



60A50-7D-17-4

29) Using special tool, drive input gear assembly into front case.

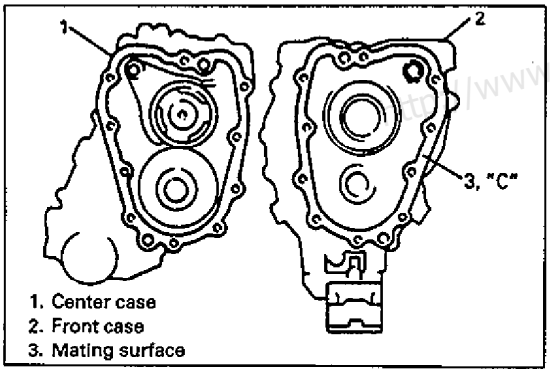
Special Tool
(L): 09951-16080



60A50-7D-17-5

30) Fix with circlip by means of snap ring pliers.

Special Tool
(M): 09900-06108



1. Center case
2. Front case
3. Mating surface

60A50-7D-18-1

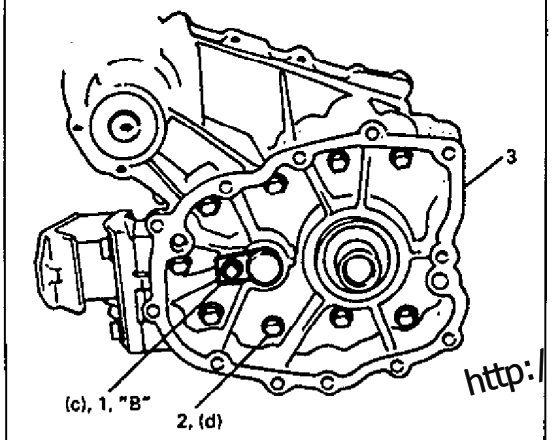
31) Oil to rotating parts and clean mating surfaces of both center and front cases.
32) Apply sealant to mating surface of front case evenly and put cases together.

NOTE:

- **For smooth installation of front case, apply grease to counter shaft O-ring.**
- **When mating front case, make sure that input gear meshes with counter gear first.**

"C": Sealant 99000-31110

For A/T vehicle



1. Plate bolt
2. Front case bolt
3. Front case

78E00-7D-9-2S

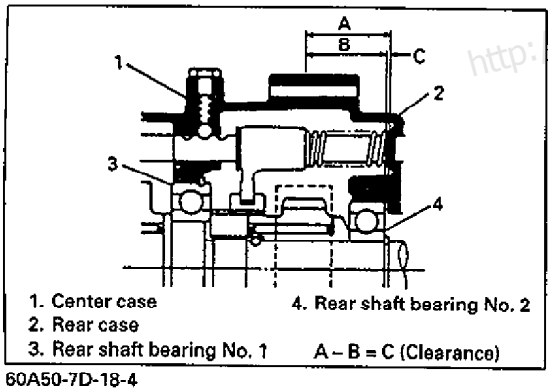
33) Torque 9 front case bolts to specification.
34) Torque counter shaft plate fixing bolt applied with thread lock cement to specification.

NOTE:

- **After tightening bolts, check input gear and output rear shaft for smooth rotation by hand at low and high speed position.**
- **Also check front drive shift for proper operation.**

"B": Cement 99000-32020

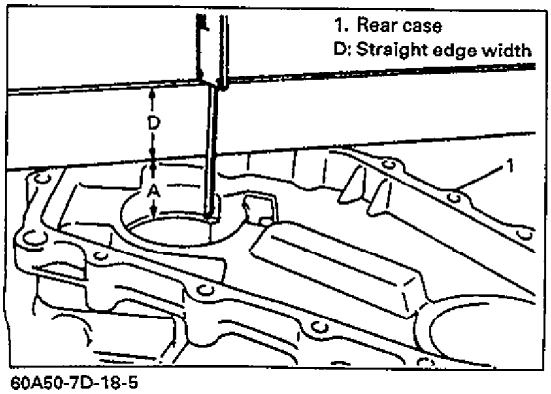
Tightening Torque
(c): 23 N·m (2.3 kg-m, 17.0 lb-ft)
(d): 23 N·m (2.3 kg-m, 17.0 lb-ft)



1. Center case
2. Rear case
3. Rear shaft bearing No. 1
4. Rear shaft bearing No. 2
A – B = C (Clearance)

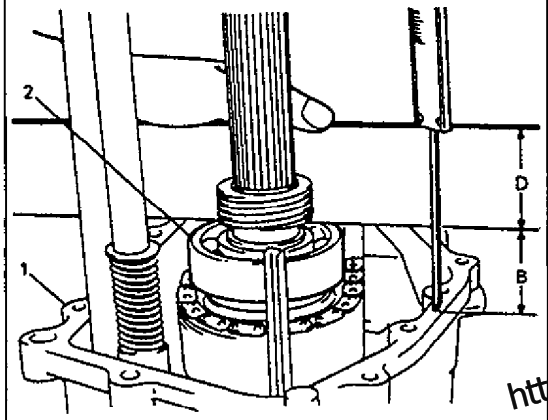
60A50-7D-18-4

35) Before assembling rear case, shim adjustment is required.
Follow steps described below.



60A50-7D-18-5

① Measure rear case dimension A (from mating surface to bearing bore bottom) by using straight edge and vernier caliper.
Width of straight edge D plus A is obtained.



1. Center case
2. Rear shaft bearing No. 2
3. Straight edge width

60A50-7D-19-1

② Place straight edge on bearing No. 2 securely and measure bearing height B (from center case mating surface to No. 2 bearing top).

CAUTION:
Bridging straight edge between No. 2 bearing and output front shaft bearing brings misreading.

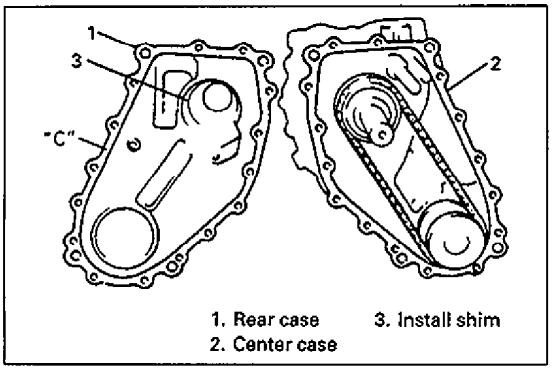
③ Obtain clearance C in following calculation.

C = (A + D) – (B + D)

④ Select a shim from among following available sizes and install it in bearing bore of rear case.

CAUTION:
Installing of over sized shim beyond specification in the following table may cause tight rotation of rear shaft and consequential bearing damage.

Clearance C	Shim size
0 – 0.13 mm 0 – 0.005 in	NO NEED
0.13 – 0.23 mm 0.005 – 0.009 in	0.1 mm 0.004 in
0.23 – 0.33 mm 0.009 – 0.013 in	0.2 mm 0.008 in
0.33 – 0.43 mm 0.013 – 0.017 in	0.3 mm 0.012 in
0.43 – 0.53 mm 0.017 – 0.021 in	0.4 mm 0.016 in
0.53 – 0.58 mm 0.021 – 0.023 in	0.5 mm 0.020 in

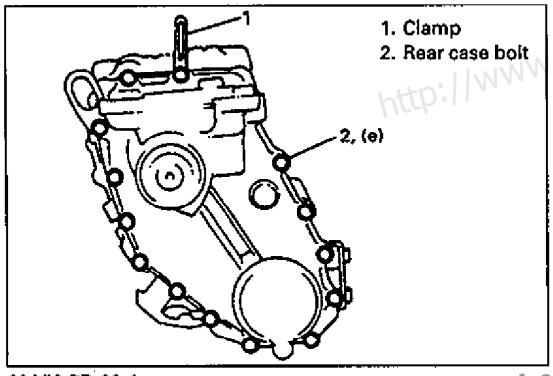


1. Rear case
2. Center case
3. Install shim

60A50-7D-19-5

36) Clean mating surfaces of both center and rear cases again, apply sealant to mating surface of rear case, and put them together.

"C": Sealant 99000-31110

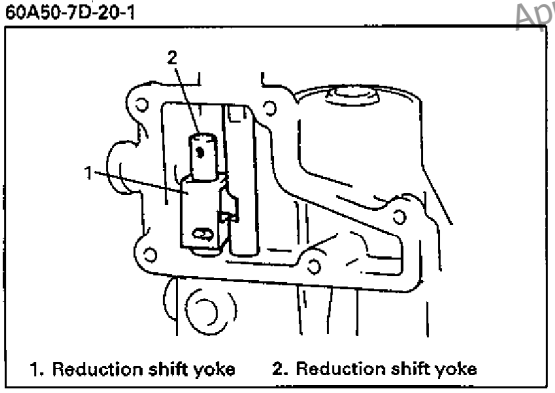


60A50-7D-20-1

37) Torque 15 rear case bolts to specification.

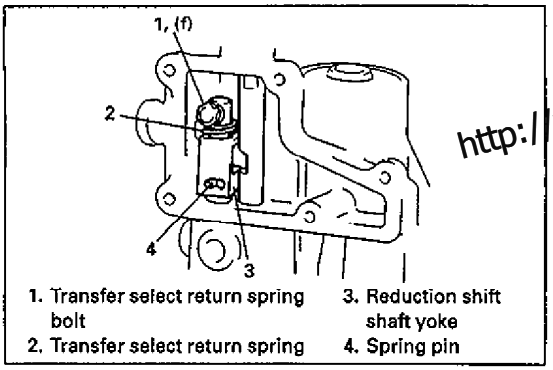
NOTE:
After tightening bolts, provisionally install universal joint flange into rear shaft and check to make sure smooth rotation of shaft.

Tightening Torque
(e): 23 N·m (2.3 kg-m. 17.0 lb-ft)



78E00-7D-11-2S

38) First, set reduction shift yoke at the illustrated position. Second, fit center case to rear case inserting shaft into yoke.



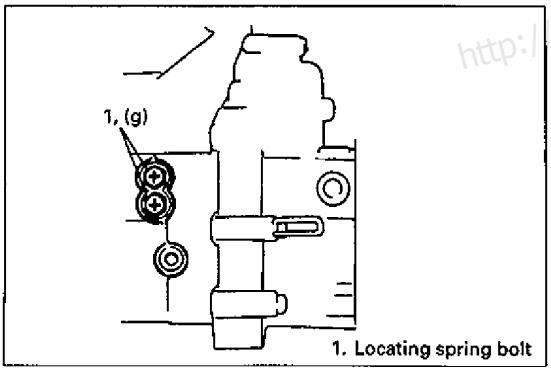
78E00-7D-11-3S

39) Fit reduction shaft yoke with spring pin.

NOTE:
Be careful not to let spring pin fall off.

40) Set transfer select return spring at the illustrated position, and fix it with bolt.

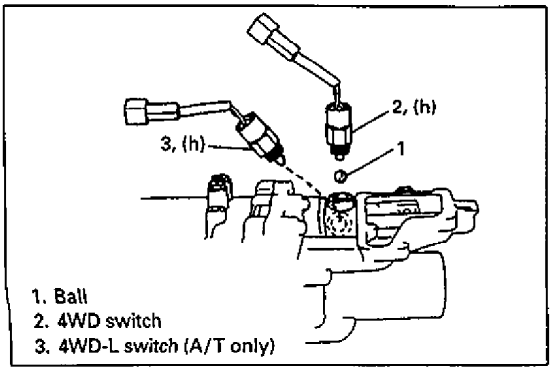
Tightening Torque
(f): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



78E00-7D-11-4S

41) Tighten locating spring bolts of shifters to specification.

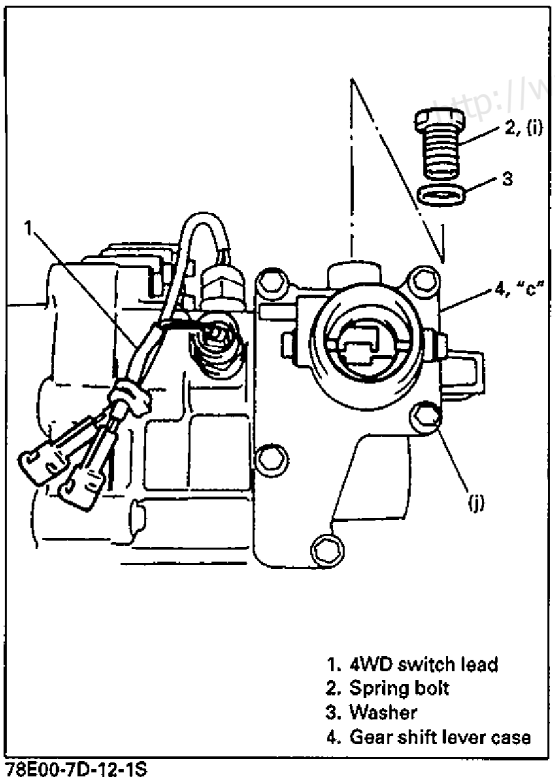
Tightening Torque
(g): 26 N·m (2.6 kg-m, 19.0 lb-ft)



78E00-7D-11-5S

42) Install steel balls, 4WD switch and 4WD-LOW switch (for A/T only).

Tightening Torque
(h): 20 N·m (2.0 kg-m, 14.5 lb-ft)



1. 4WD switch lead
2. Spring bolt
3. Washer
4. Gear shift lever case

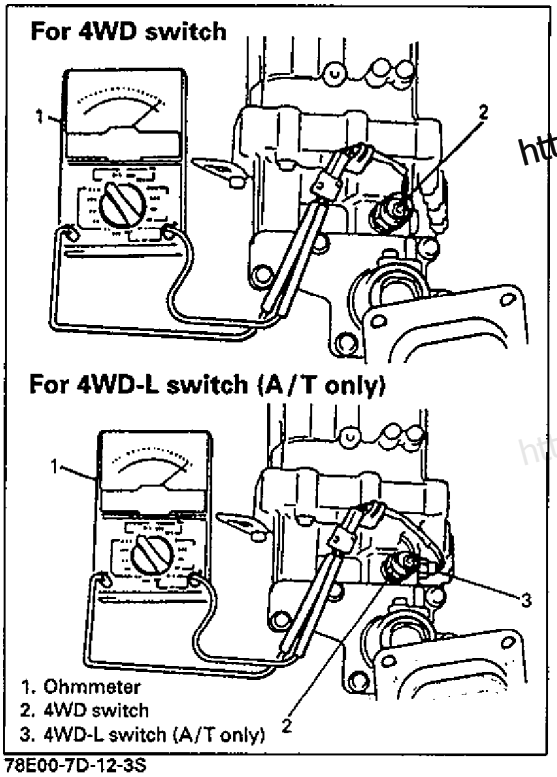
78E00-7D-12-1S

43) Fix lead of 4WD switch with clamp.
44) Install select return system parts. Then torque select return spring bolt to specification.
45) Clean mating surfaces of both gear shift lever case and rear case, and with sealant applied to mating surface of gear shift lever case, push both cases together.

"C": Sealant 99000-31110

46) Torque gear shift lever case bolts to specification.

Tightening Torque
(i): 35 N·m (3.5 kg-m, 25.5 lb-ft)
(j): 13 N·m (1.3 kg-m, 9.5 lb-ft)



1. Ohmmeter
2. 4WD switch
3. 4WD-L switch (A/T only)

78E00-7D-12-3S

47) Install gear shift control lever temporarily and check to make sure that it shifts to each shift position smoothly. Also check shaft for rotation.
48) Confirm 4WD switch has turned ON at 4WD position (4H and 2H).
49) For A/T vehicle, confirm 4WD-L switch has turned ON at 4WD-L and Neutral position.
50) Upon completion of above checks, remove shift control lever.

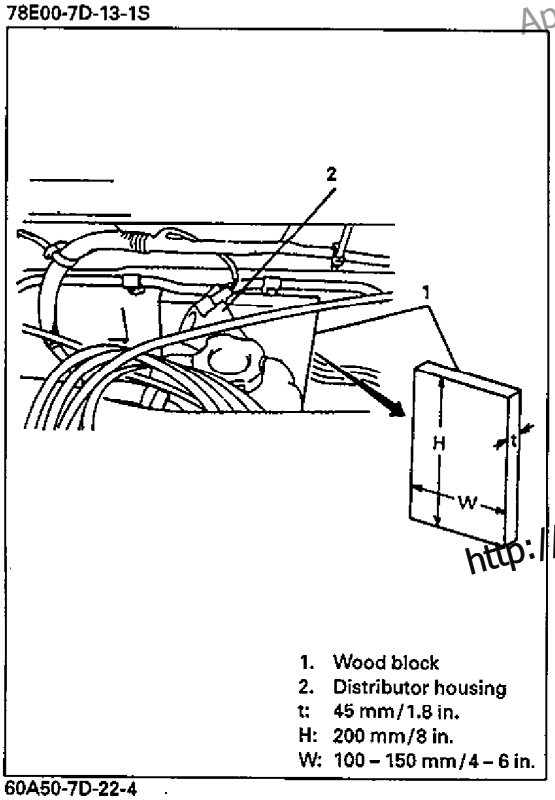
CONNECTION OF TRANSFER AND TRANSMISSION

Refer to Section 7A2 "MANUAL TRANSMISSION" in this manual.

DISMOUNTING/REMOUNTING OF TRANSFER ITSELF

Dismounting and remounting of transfer and transmission together as a unit is described in Section 7A2, but it is also possible to dismount and remount transfer assembly by itself as described below.

78E00-7D-13-1S



1. Wood block
2. Distributor housing
t: 45 mm/1.8 in.
H: 200 mm/8 in.
W: 100 – 150 mm/4 – 6 in.

60A50-7D-22-4

DISMOUNTING

IN ENGINE ROOM

1) Disconnect negative (–) cable from battery.
2) Remove distributor assembly.
3) Place wood block behind distributor housing so that it serves as stopper when engine, transmission and transfer unit hangs down as rear mounting member is removed.

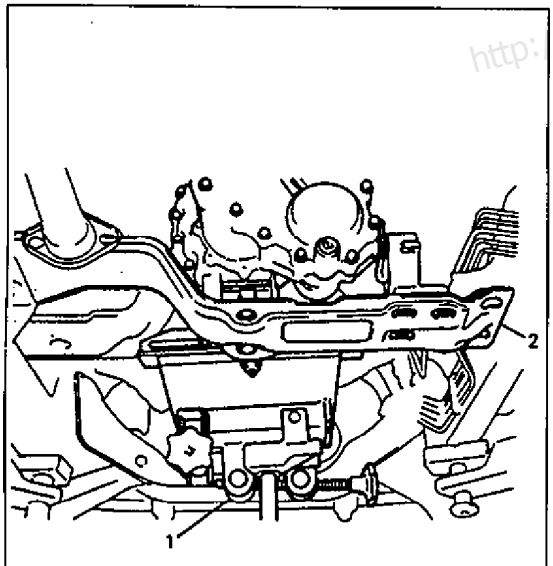
CAUTION:
Make sure to use wood block to prevent contact which may occur between distributor housing and dash panel, and fan and shroud. However, wood block of exact dimensions can prevent distributor from contacting dash panel even with distributor installed as it is.

IN CABIN

1) Remove console box.
2) Remove shift lever of transmission and transfer.

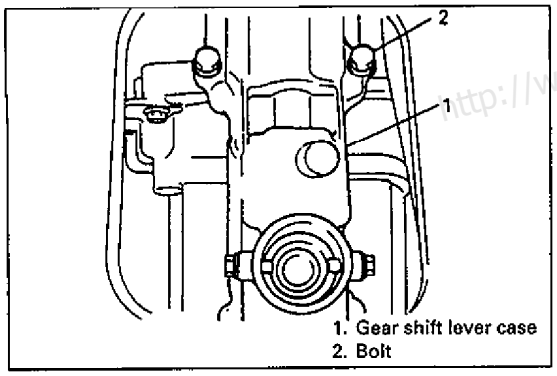
ON LIFT

1) Drain transmission (for M/T vehicle) and transfer oil.
2) Remove rear propeller shaft.
3) Remove front propeller shaft.
4) Disconnect exhaust center pipe.
5) Disconnect meter cable.
6) Place transmission jack and remove mounting member.
7) Lower transmission jack gradually and check to ensure that wood block serves as stopper between engine and dash panel.



1. Transmission jack
2. Engine rear mounting member

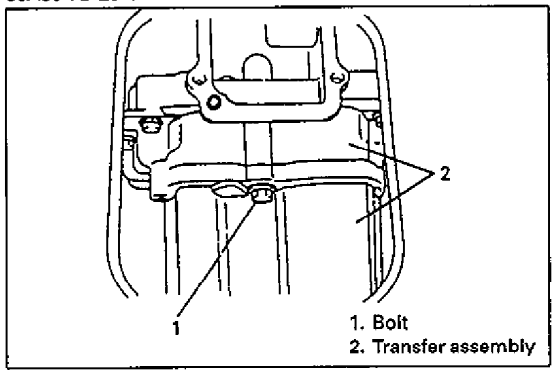
78E00-7D-13-4S



60A50-7D-23-4

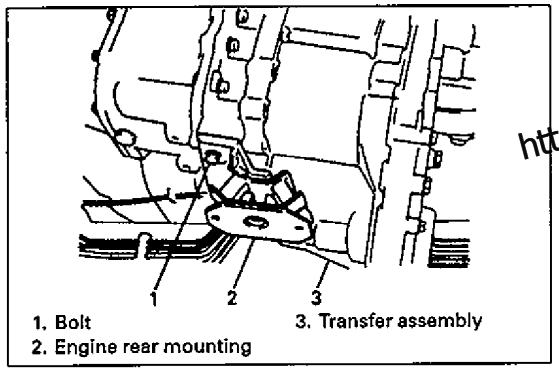
IN CABIN

1) Remove 4 bolts for gear shift lever case.
2) Slide forward clamp of breather and pull off breather hose.



60A50-7D-23-5

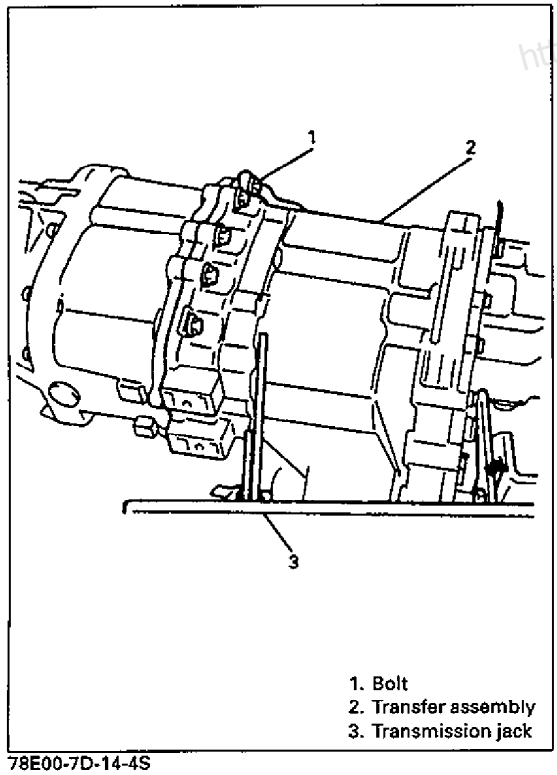
3) Remove gear shift lever case and then remove transfer center case bolt.



60A50-7D-24-1

ON LIFT

1) Remove transfer mounting (engine rear mounting) by removing bolts.



78E00-7D-14-4S

2) Apply transmission jack to transfer to support it.
3) Remove couplers for 4WD switch and 4WD-L switch (for A/T only) lead.
4) Remove transfer front case bolts.
5) With transfer assembly supported with transmission jack, slide it rearward and when it is apart from transmission, lower it.

REMOUNTING

For remounting, reverse dismounting procedure described above, noting following.

- Be sure to use specified torque for tightening.
- Clamp wiring and breather hose securely.
- Clamp shift lever boot securely.
- Clamp speedometer cable securely.
- Fill specified gear oil to transmission (for M/T vehicle) and transfer by specified amount.
- Connect battery and check for function.

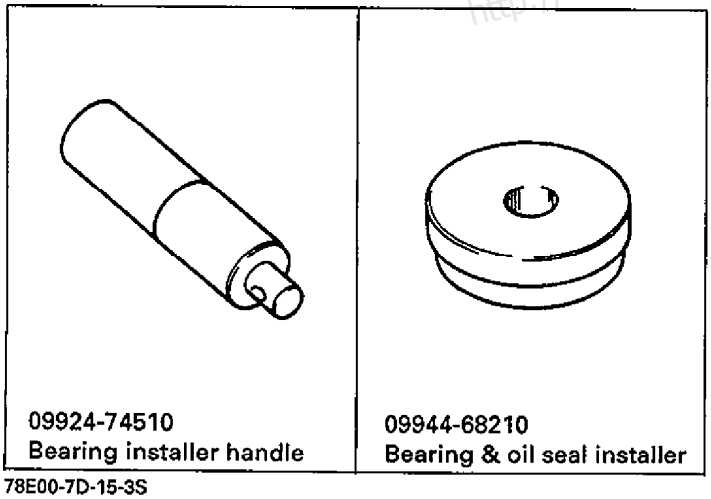
78E00-7D-15-1S

TIGHTENING TORQUE SPECIFICATION

Fastening portion		Tightening torque		
		N·m	kg-m	lb-ft
Front case bolt (Transfer to Transmission)	(M/T)	50	5.0	36.5
	(A/T)	23	2.3	17.0

78E00-7D-15-2S

SPECIAL TOOLS



09924-74510
Bearing installer handle

09944-68210
Bearing & oil seal installer

78E00-7D-15-3S

SECTION 7E

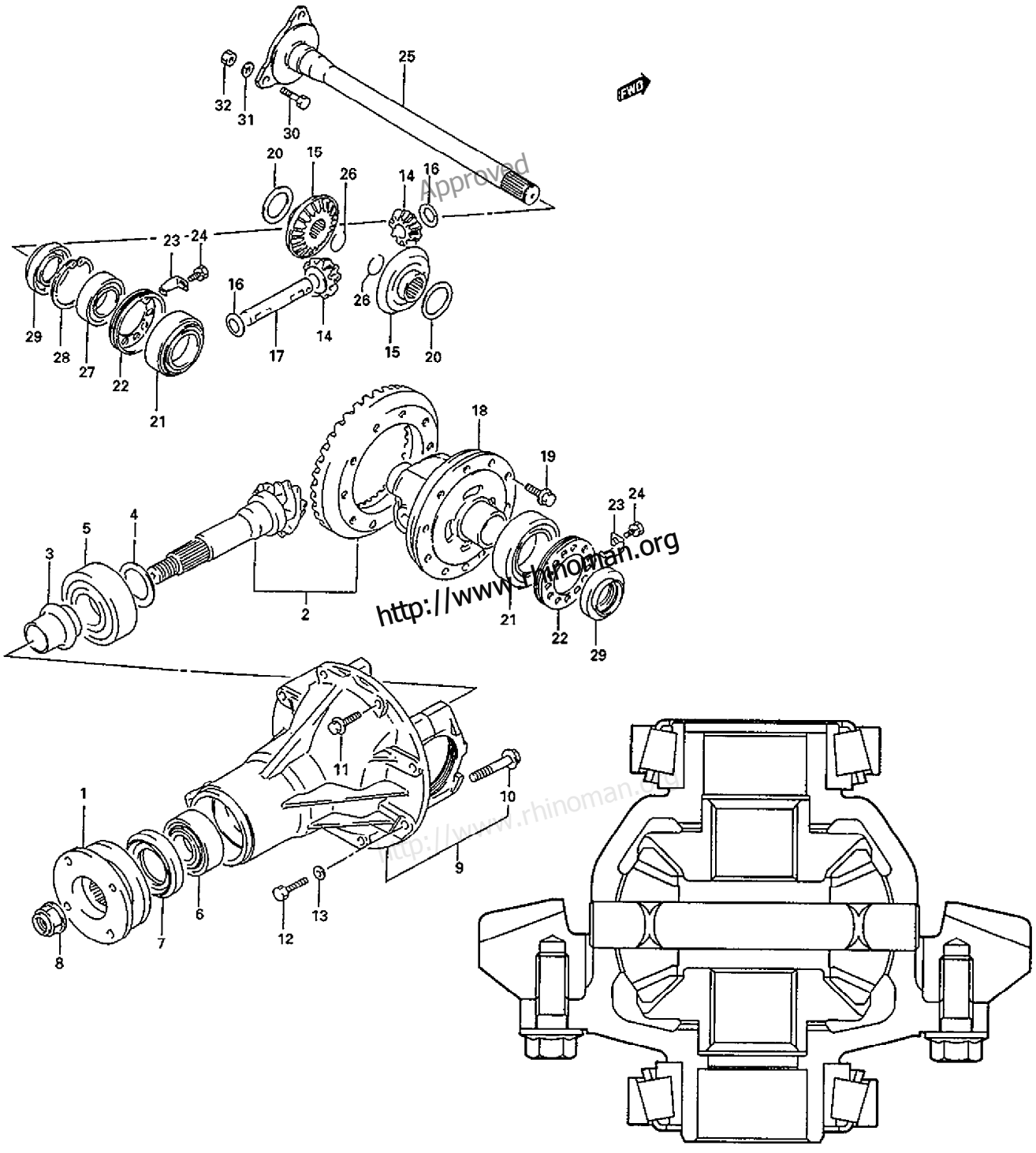
DIFFERENTIAL (FRONT AND REAR)

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

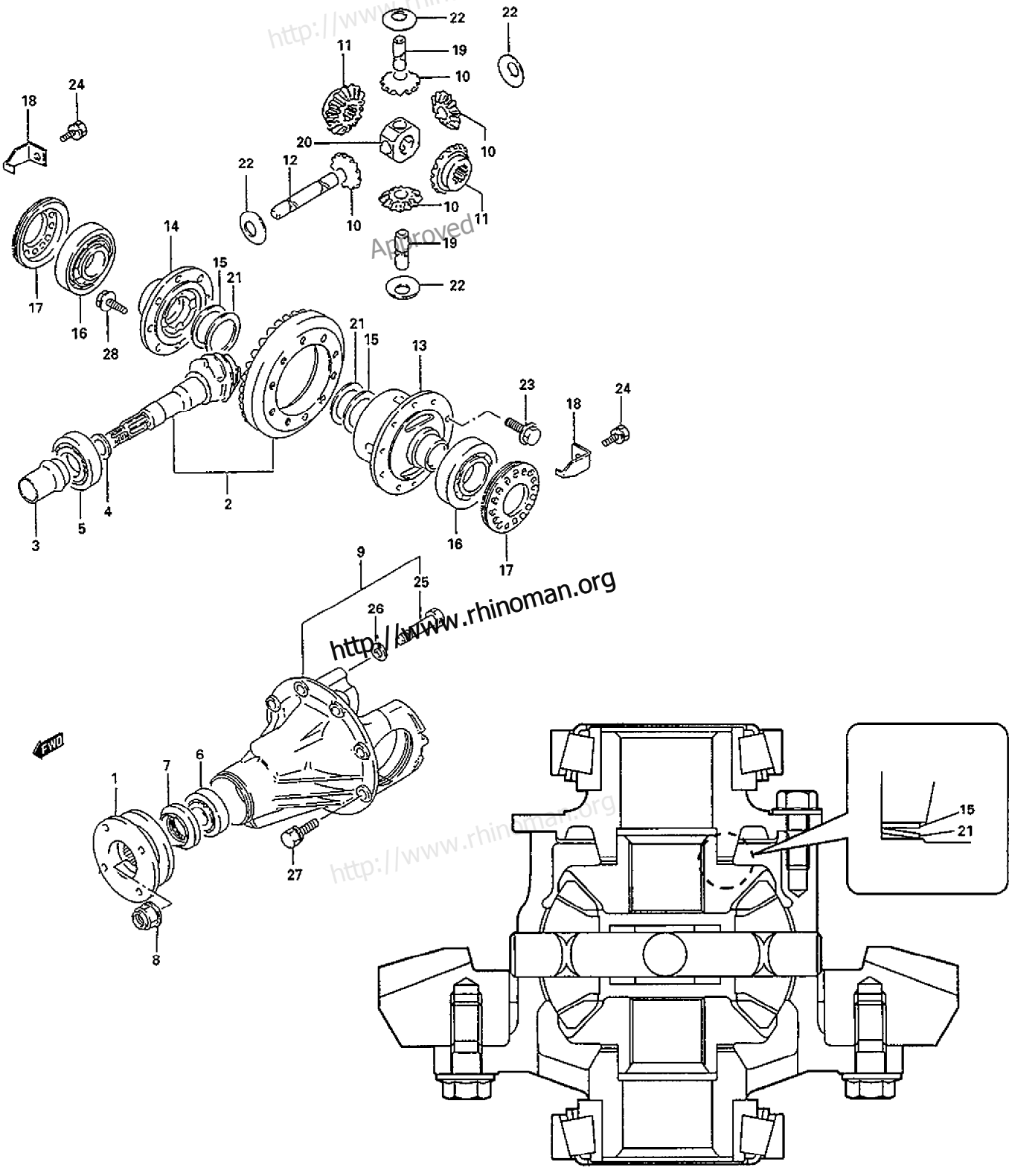
GENERAL DESCRIPTION

FRONT DIFFERENTIAL



1. Universal joint flange
2. Bevel pinion gear set
3. Bevel pinion spacer
4. Shim
5. Rear bearing
6. Front bearing
7. Oil seal
8. Flange nut
9. Front diff. carrier ass'y
10. Bolt
11. Bolt
12. Bolt
13. Lock washer
14. Differential pinion
15. Differential gear
16. Washer
17. Pinion shaft
18. Differential case
19. Bevel gear bolt
20. Thrust washer
21. Differential side bearing
22. Bearing adjuster
23. Lock plate
24. Bolt
25. Front drive shaft
26. Snap ring
27. Bearing
28. Circlip
29. Oil seal
30. Bolt
31. Lock washer
32. Nut

REAR DIFFERENTIAL



1. Universal joint flange
2. Bevel pinion gear set
3. Bevel pinion spacer
4. Shim
5. Rear bearing
6. Front bearing
7. Oil seal
8. Flange nut
9. Diff. carrier ass'y
10. Differential pinion
11. Differential gear
12. Pinion shaft No.1
13. Differential left case
14. Differential right case
15. Thrust washer
16. Differential side bearing
17. Bearing adjuster
18. Lock plate
19. Pinion shaft No.2
20. Pinion joint
21. Spring washer
22. Washer
23. Bevel gear bolt
24. Bolt
25. Bolt
26. Lock washer
27. Bolt
28. Differential case bolt

ON VEHICLE SERVICE

MAINTENANCE SERVICE

NOTE:

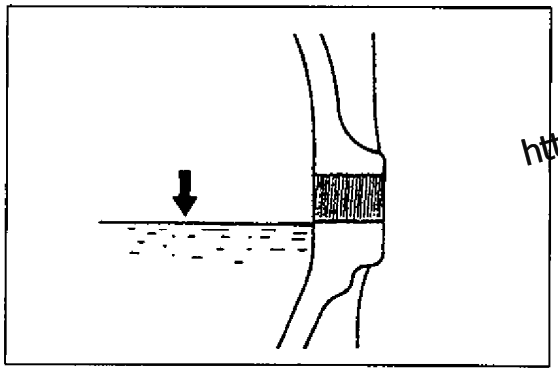
- **When having driven through water, check immediately if water has entered (if so, oil is cloudy). Water mixed oil must be changed at once.**
- **Whenever vehicle is hoisted for any other service work than oil change, also be sure to check for oil leakage and status of breather hoses.**

CHANGING OIL

NOTE:

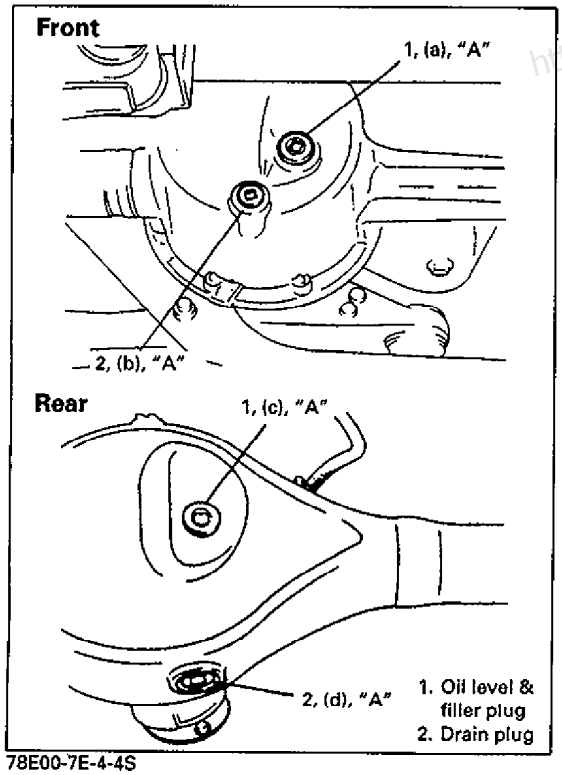
- **Hypoid gear oil must be used for differential.**
- **It is highly recommended to use SAE 80W – 90 viscosity.**

1) Before oil change or inspection, be sure to stop engine and lift up vehicle horizontally.



78E00-7E-4-3S

2) Check oil level and existence of leakage. If leakage is found, correct its cause.
3) Drain old oil and pour proper amount of gear oil as specified below (roughly up to level hole).

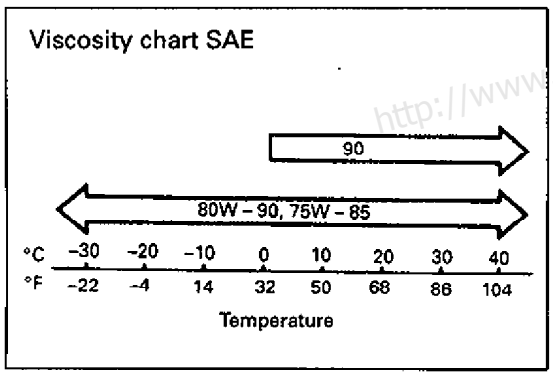


78E00-7E-4-4S

4) Apply sealant to thread of drain and level/filler plugs and torque plugs to specification.

"A": Sealant 99000-31110

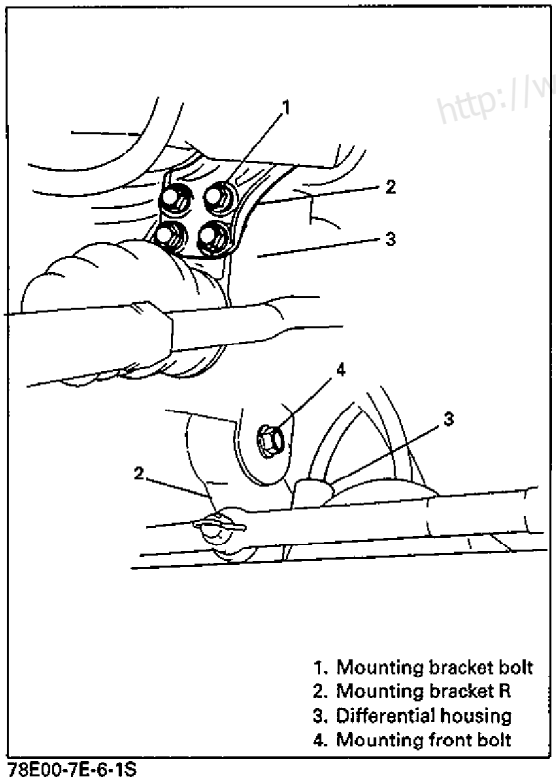
Tightening Torque
(a): 40 N·m (4.0 kg-m, 29.0 lb-ft)
(b): 23 N·m (2.3 kg-m, 17.0 lb-ft)
(c): 43 N·m (4.3 kg-m, 31.5 lb-ft)
(d): 22 N·m (2.2 kg-m, 16.0 lb-ft)



78E00-7E-5-1S

Specified gear oil: **Hypoid gear oil API GL-5**
SAE 75W – 85, 90 or 80W – 90
For oil viscosity, refer to left chart.

Oil capacity: **Front**
1.0 liters (2.1/1.8 US/Imp. pt)
Rear
2.2 liters (4.6/3.9 US/Imp. pt)



1. Mounting bracket bolt
2. Mounting bracket R
3. Differential housing
4. Mounting front bolt

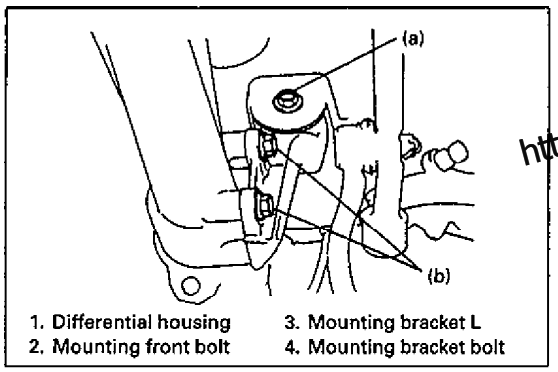
78E00-7E-6-1S

ON VEHICLE SERVICE

FRONT DIFFERENTIAL MOUNTING

RIGHT AND LEFT MOUNTINGS

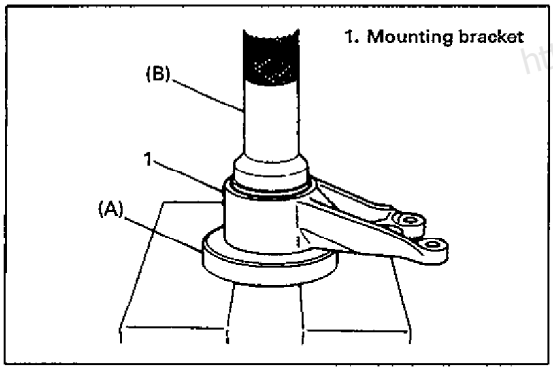
1) Lift up vehicle and turn steering wheel all way to the right.
2) Separate mounting bracket R from differential housing by removing bolts from its lower part.
3) Remove mounting bracket R by removing mounting front bolt from its upper part.



1. Differential housing
2. Mounting front bolt
3. Mounting bracket L
4. Mounting bracket bolt

78E00-7E-6-3S

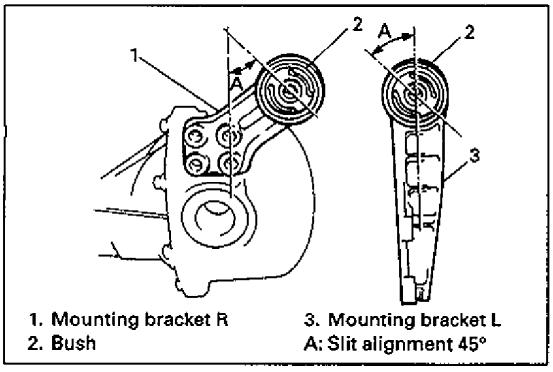
4) Remove mounting bracket L by removing upper and lower fastening bolts.



78E00-7E-6-4S

5) Check conditions of each bush. If it is damaged or deteriorated, drive it out with special tools and press for replacement.

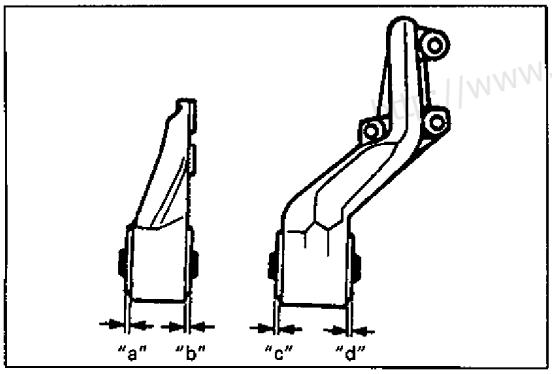
Special Tool
(A): 09951-26010
(B): 09951-16080



1. Mounting bracket R
2. Bush
3. Mounting bracket L
A: Slit alignment 45°

78E00-7E-6-5S

6) Position slit in each bush as shown when press-fitting it.



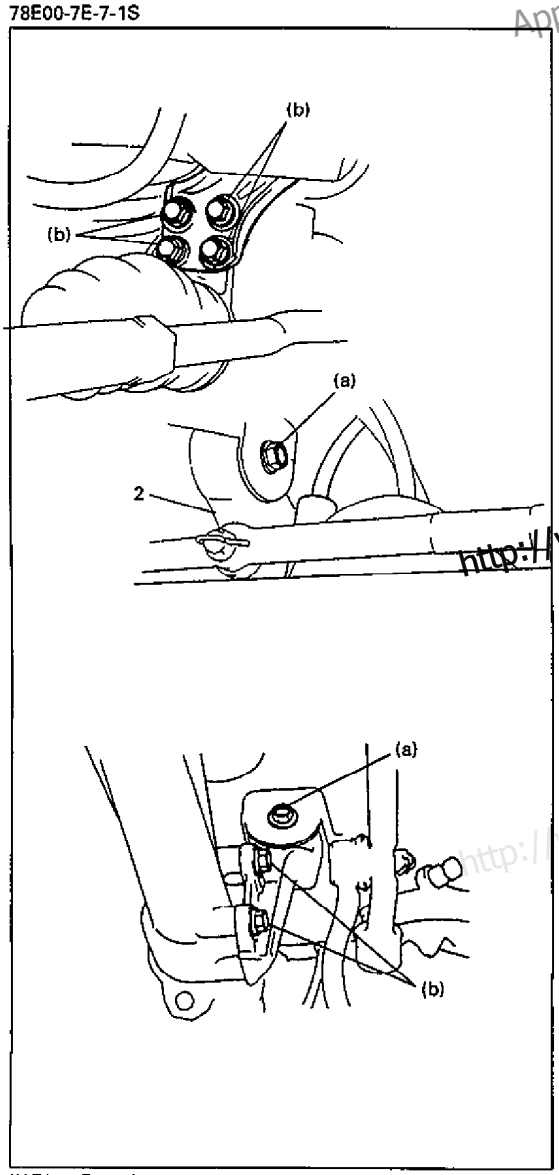
78E00-7E-7-1S

7) Position each bush to bracket as shown.

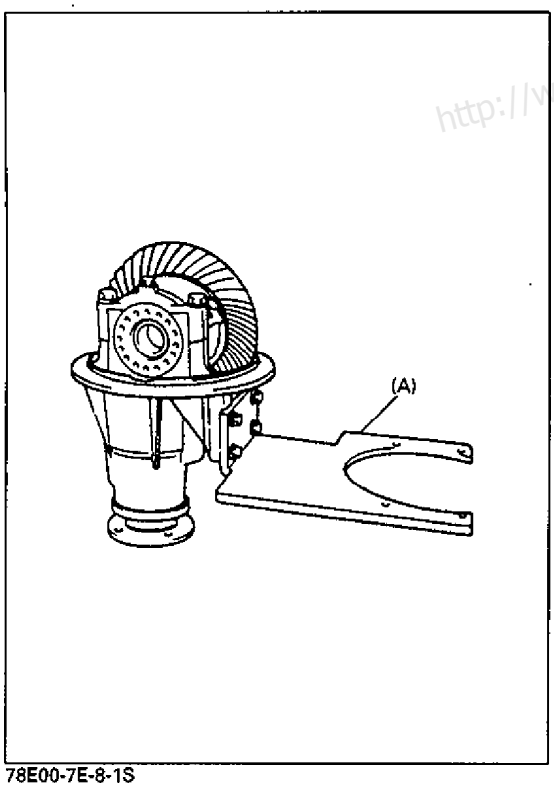
Length "a": 4.0 mm (0.16 in.)
"b": 4.0 mm (0.16 in.)
"c": 0.0 mm (0.00 in.)
"d": 0.0 mm (0.00 in.)

8) Use following torque for reinstallation.

Tightening Torque
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)
(b): 50 N·m (5.0 kg-m, 36.5 lb-ft)



78E00-7E-7-2S



78E00-7E-8-1S

UNIT REPAIR OVERHAUL

FRONT DIFFERENTIAL

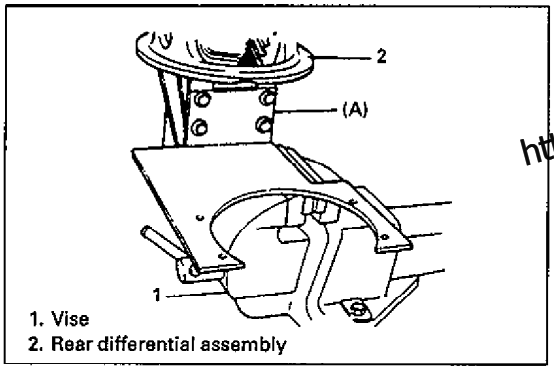
To overhaul of front differential, refer to exploded view on page 7E-2 and the same section of VITARA supplementary service manual (99501-61A10).

REAR DIFFERENTIAL

DISASSEMBLY

1) Hold differential assembly by special tool (A) as illustrated.

Special Tool
(A): 09944-76010

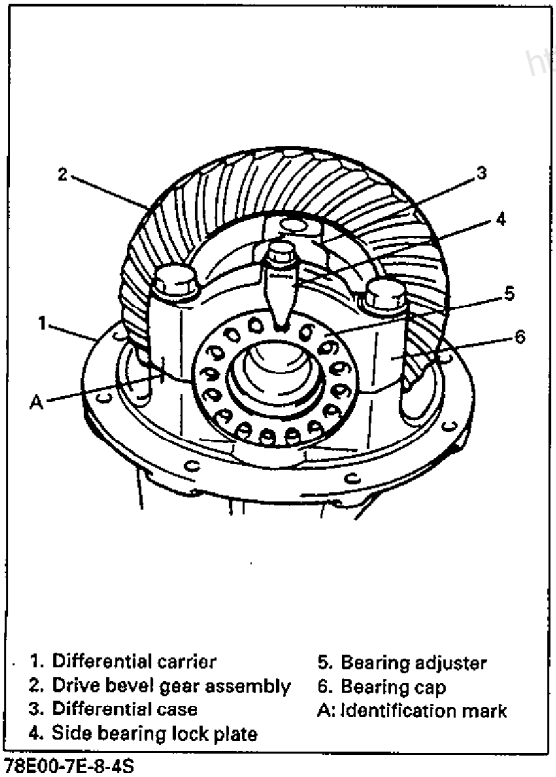


1. Vise
2. Rear differential assembly

78E00-7E-8-3S

2) Set special tool (A) with differential assembly on vise securely.

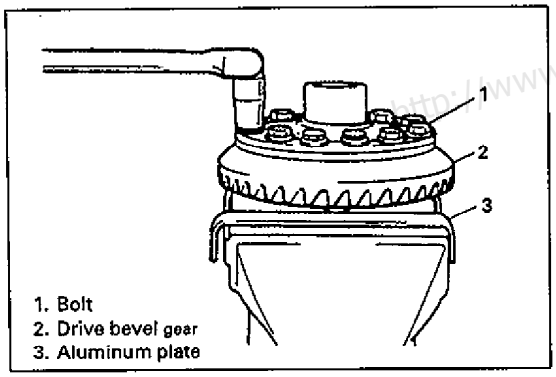
Special Tool
(A): 09944-76010



1. Differential carrier
2. Drive bevel gear assembly
3. Differential case
4. Side bearing lock plate
5. Bearing adjuster
6. Bearing cap
A: Identification mark

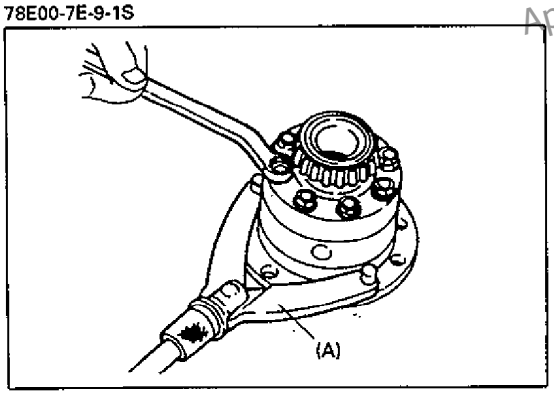
78E00-7E-8-4S

3) Put identification marks on differential side bearing caps.
4) Take off differential side bearing lock plates and differential side bearing caps by removing their bolts and then take out bearing adjusters, side bearing outer races and drive bevel gear with differential case.



78E00-7E-9-1S

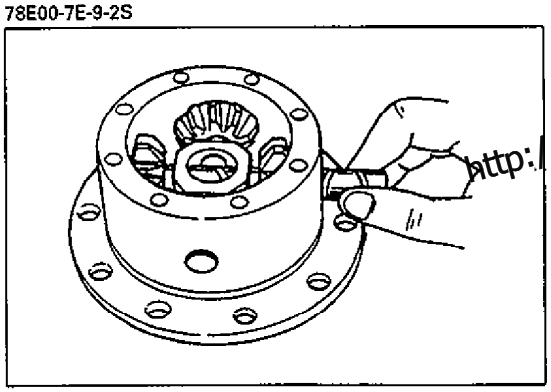
5) With aluminum plates placed on vice first, grip differential case with it and remove bevel gear by removing its 12 bolts.



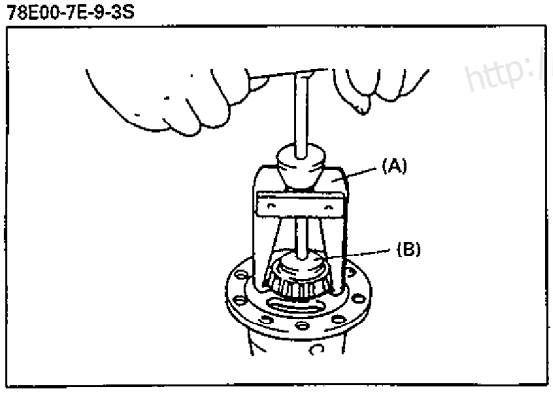
78E00-7E-9-2S

6) There are 8 bolts fastening two differential case halves together. Remove these bolts to sever right-hand case half from left-hand one, and take off right-hand one.

Special Tool
(A): 09930-40113


78E00-7E-9-3S

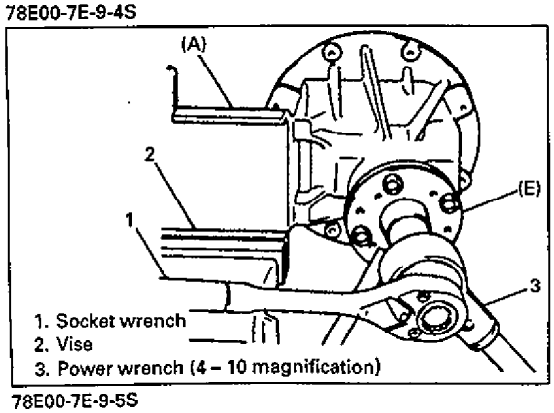
7) Remove pinion shaft, side gears, washers, differential pinions, spring washers, thrust washers.



78E00-7E-9-4S

8) Using special tools, extract side bearing from each differential case half.

Special Tool
(A): 09913-61510
(B): 09913-85230



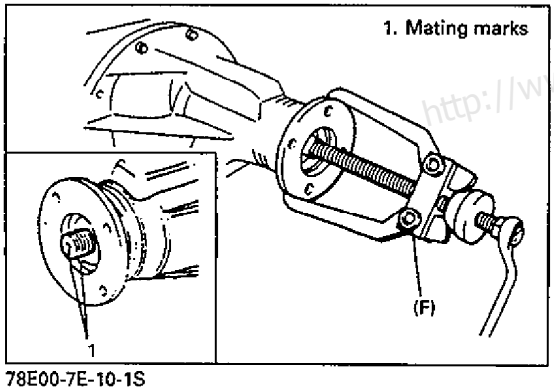
78E00-7E-9-5S

9) Remove bevel pinion assembly.
   i) Turn differential assembly together with special tool (A) by 90 degrees and grip it with vise again.

   Special Tool
   (A): 09944-76010

   ii) Hold universal joint flange with special tool (E) and then remove flange nut by using power wrench.

   Special Tool
   (E): 09922-66020

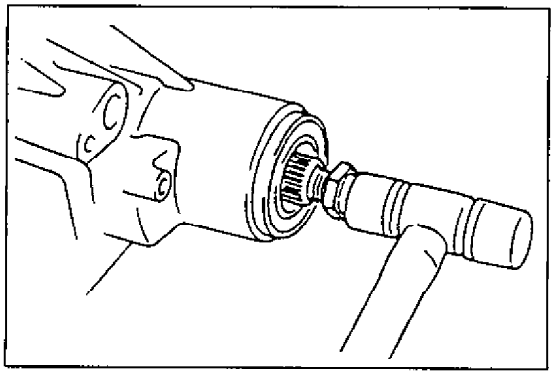


78E00-7E-10-1S

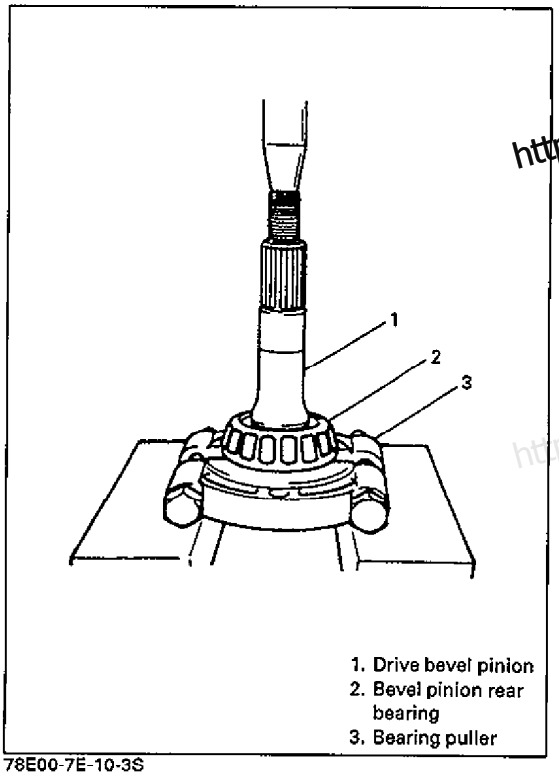
iii) Make mating marks on drive bevel pinion and companion flange.

CAUTION:
Don't make mating mark on the coupling surface of the flange.

iv) Remove companion flange from pinion. Use special tool if it is hard to remove.
Special Tool
(F): 09913-65135

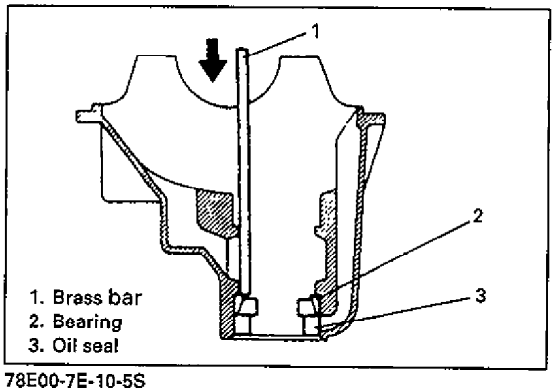

78E00-7E-10-2S

v) Remove bevel pinion with rear bearing, shim and spacer from carrier.
If it is hard to remove, screw an used nut into pinion and hammer on that nut with a plastic hammer but never directly on pinion.



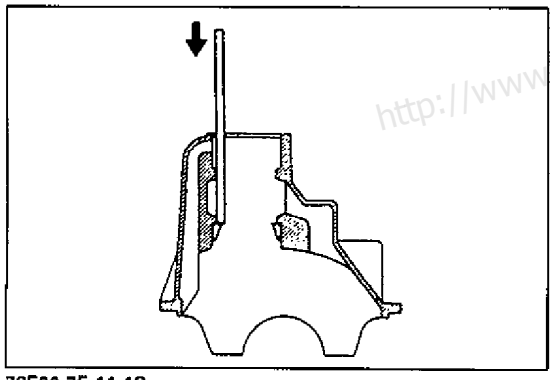
78E00-7E-10-3S

vi) Remove bevel pinion rear bearing by using bearing puller and press.



78E00-7E-10-5S

10) Using a hammer and brass bar, drive out front bearing outer race with bearing and oil seal.



78E00-7E-11-1S

11) Drive out rear bearing outer race in the same way as in the step 8).

INSPECTION

- Check companion flange for wear or damage.
- Check bearings for wear or discoloration.
- Check differential carrier for cracks.
- Check drive bevel pinion and bevel gear for wear or cracks.
- Check side gears, pinion gears and pinion shaft for wear or damage.
- Check side gear spline for wear or damage.

ADJUSTMENT AND REASSEMBLY

Judging from faulty conditions noted before disassembly and what is found through visual check of bearing and gear tooth etc. after disassembly, prepare replacing parts and proceed to reassembly according to procedures as described below.

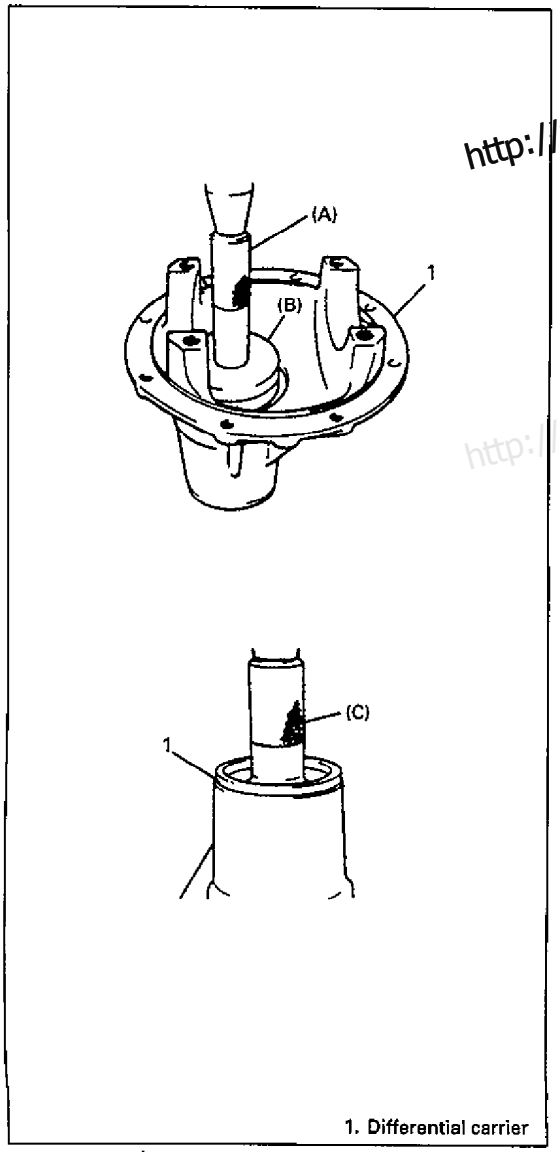
CAUTION:
- **Bevel gear and pinion must be replaced as a set when either replacement becomes necessary.**
- **When replacing taper roller bearing, replace as inner race & outer race assembly.**

DIFFERENTIAL CARRIER

For press-fitting bevel pinion bearing outer races, use special tools as shown.

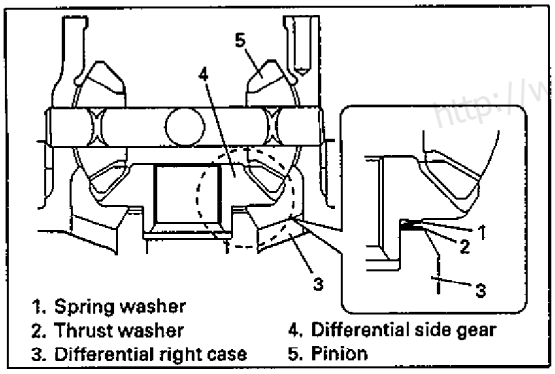
CAUTION:
Perform press-fitting carefully so as not to tilt outer race.

Special Tool
(A): 09924-74510
(B): 09926-68310
(C): 09913-75510



1. Differential carrier

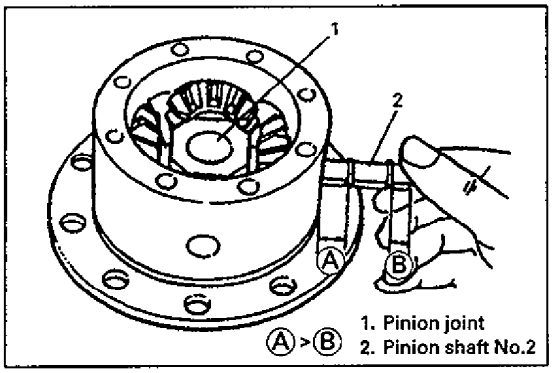
78E00-7E-11-3S



78E00-7E-12-1S

DIFFERENTIAL CASE

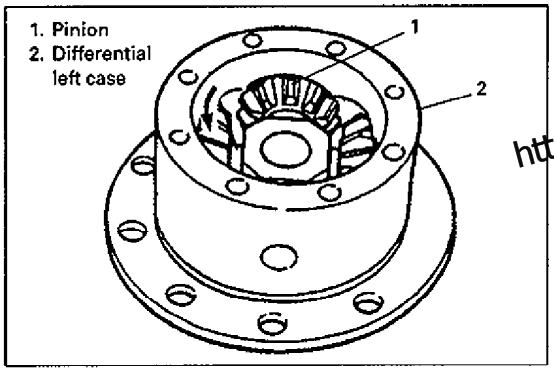
1) After applying differential oil to side gear, pinions, pinion shafts, washer, thrust washer and spring washer, install them in differential left case.
For correct installing direction of thrust washer and spring washer, refer to figure.



78E00-7E-12-2S

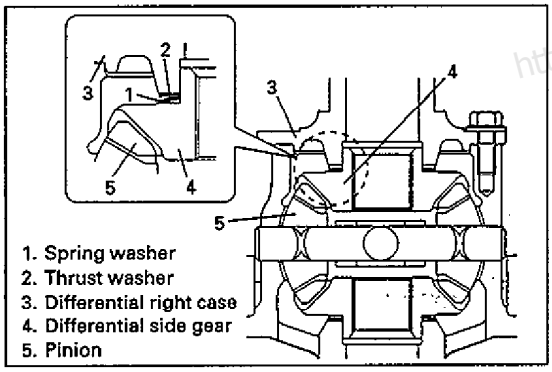
2) When installing pinion shaft No.2 (shorter) into differential case and pinion, insert its Ⓐ side into pinion joint.

NOTE:
Ⓐ is longer than Ⓑ. (Ⓐ > Ⓑ)



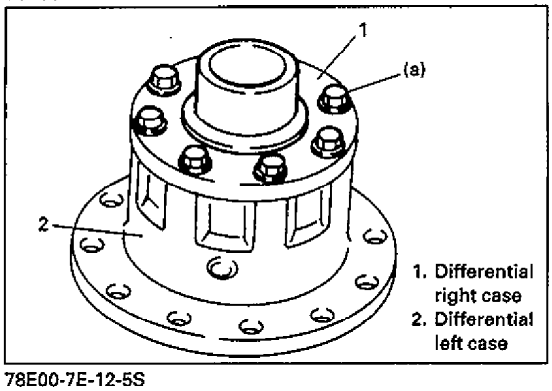
78E00-7E-12-3S

3) Check pinion gear for smooth rotation.



78E00-7E-12-4S

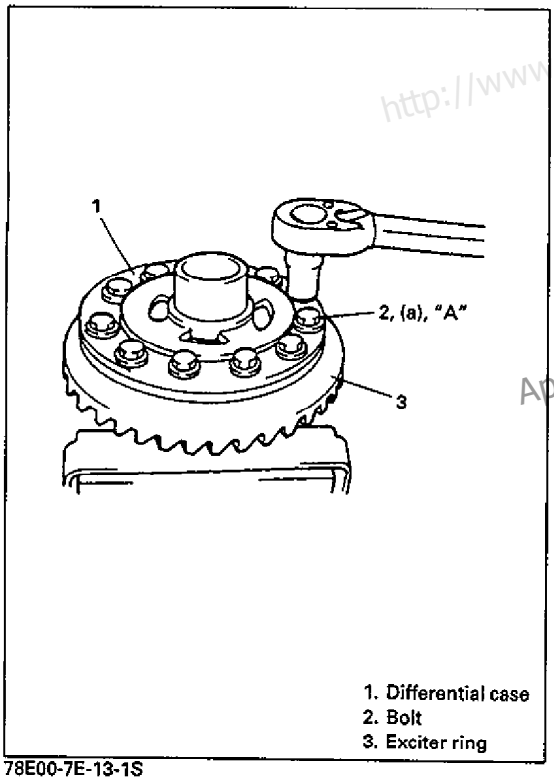
4) In the same manner as described in Step 1), install thrust washer, spring washer and side gear.



78E00-7E-12-5S

5) Install differential right case and then tighten bolts to specified torque.

Tightening Torque
(a): 41 N·m (4.1 kg-m, 30.0 lb-ft)



1. Differential case
2. Bolt
3. Exciter ring

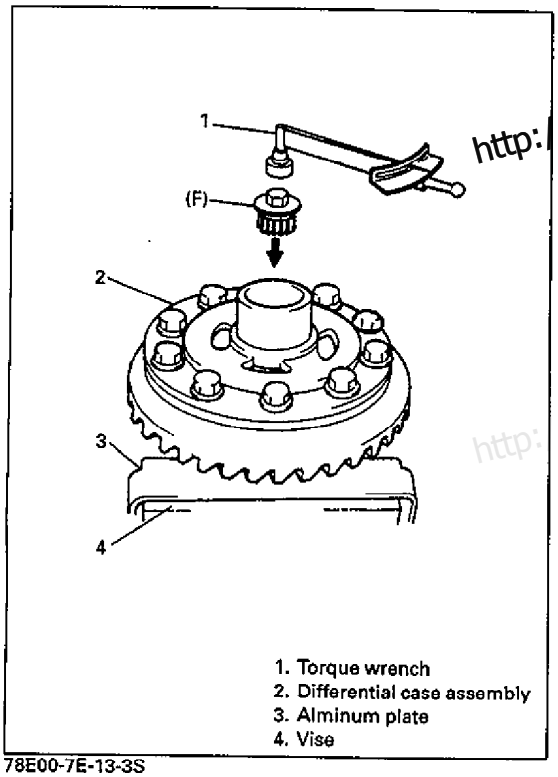
78E00-7E-13-1S

6) Put bevel gear on differential case and fasten them with bolts by tightening them to specified torque.
Use thread lock cement for bolts.

CAUTION:
Use of any other bolts than that specified is prohibited.

"A": Cement 99000-32020

Tightening Torque
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)



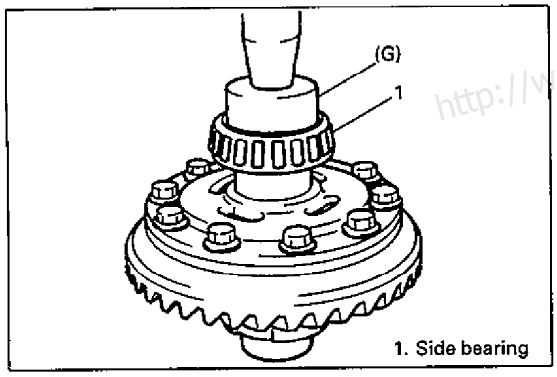
1. Torque wrench
2. Differential case assembly
3. Alminum plate
4. Vise

78E00-7E-13-3S

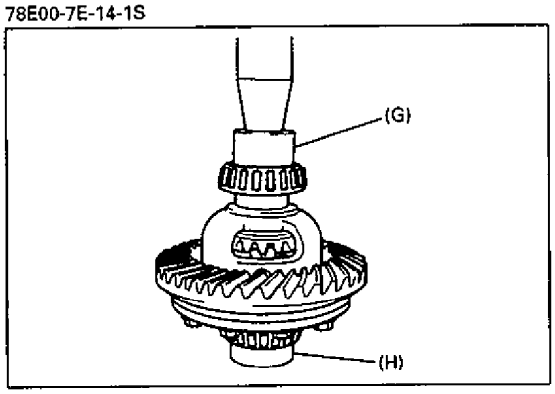
7) Install special tool (F) to differential case assembly and check that preload is within specification below. If preload exceeds specified value, check if foreign matter is caught or gear is damaged.

Special Tool
(F): 09928-06010-002

Side gear preload: Max. 25.0 kg-cm (Max. 1.8 lb-tt)



78E00-7E-14-1S



78E00-7E-14-2S

DIFFERENTIAL SIDE BEARING

1) Press-fit side bearing with special tool (G) and press.

Special Tool
(G): 09944-66020

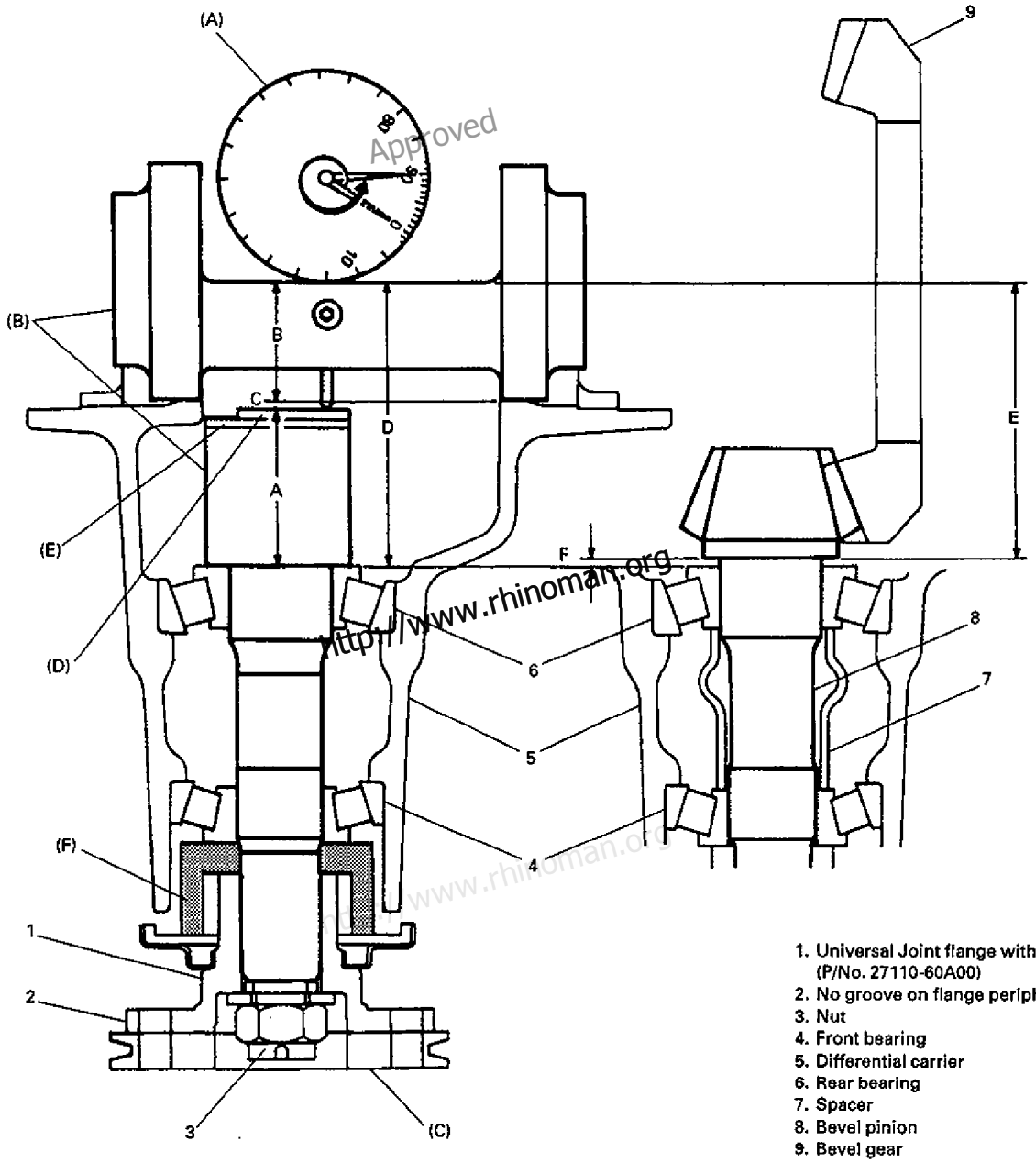
2) Hold bearing press-fitted in Step 1 with holder and pressfit side bearing on the other side.

NOTE:
Be sure to use bearing holder for the purpose of protecting lower bearing.

Special Tool
(G): 09944-66020
(H): 09951-16060

DRIVE BEVEL PINION

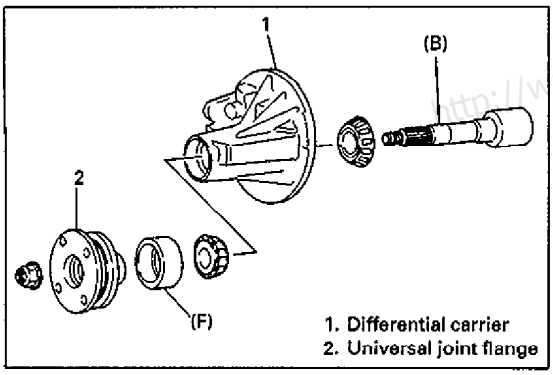
To engage bevel pinion and gear correctly, it is pre-required to install bevel pinion to differential carrier properly by using adjusting shim as described on following pages. Shown in this page are relative positions of bevel pinion, differential carrier and mounting dummy.



1. Universal Joint flange without groove (P/No. 27110-60A00)
2. No groove on flange periphery
3. Nut
4. Front bearing
5. Differential carrier
6. Rear bearing
7. Spacer
8. Bevel pinion
9. Bevel gear

A: Pinion dummy height + Attachment height
B: Axle dummy radius
A+B: Mounting dummy size 102.00 mm/4.01575 in.
C: Measured dimension
D: Differential carrier mounting distance (A + B + C)
E: Bevel pinion mounting distance (Marked in shaft in mm)
F: Shim size for mounting distance adjustment (D – E)

Special Tool
(A): 09900-20606
(B): 09926-78311
(C): 09922-75222
(D): 09951-16070
(E): 09922-77250
(F): 09951-46010



1. Differential carrier
2. Universal joint flange

78E00-7E-16-1S

1) Install special tools with bearings and universal joint flange to differential carrier.

NOTE:

- **This installation requires universal joint flange not equipped with groove on flange periphery.**
- **This installation requires no spacer or oil seal.**

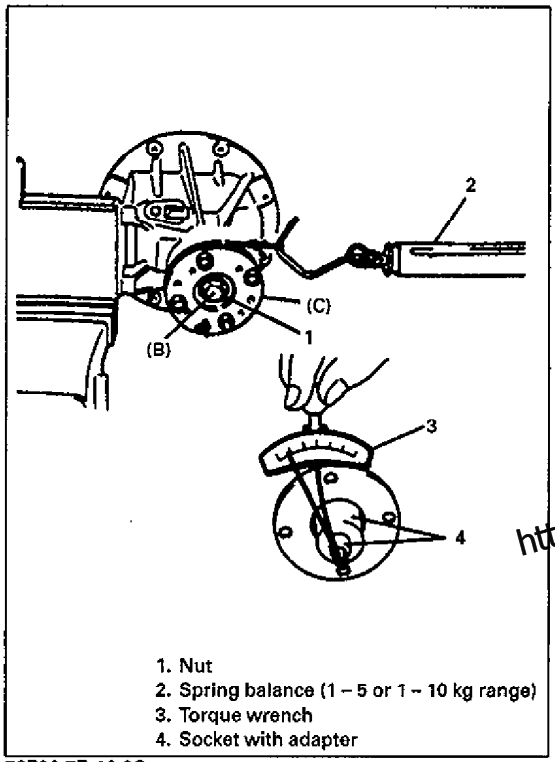
Special Tool
(B): 09926-78311
(F): 09951-46010

2) Tighten flange nut so that specified bearing preload is obtained.

NOTE:
Before taking measurement with spring balance or torque wrench, check for rotation by hand and apply small amount of oil to bearings.

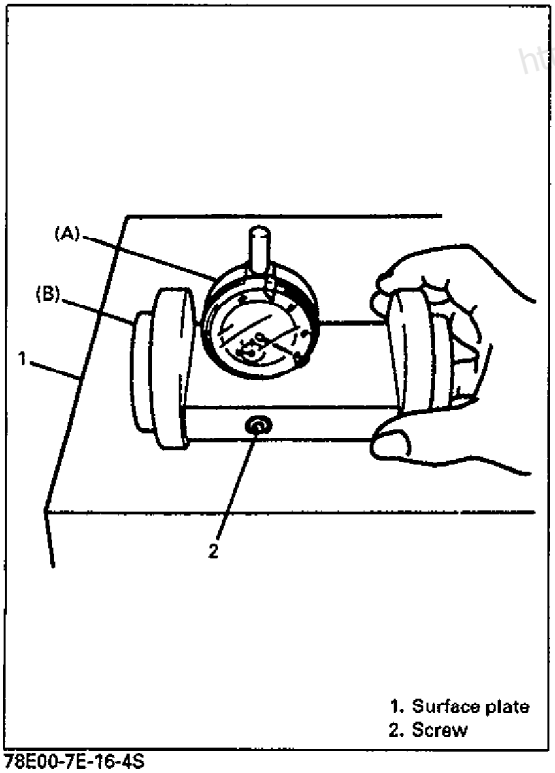
Special Tool
(B): 09926-78311
(C): 09922-75222

Pinion bearing preload: 9.0 – 17.0 kg-cm (7.8 – 14.7 lb-in.)
Starting torque with special tool: 1.8 – 3.4 kg (4.0 – 7.5 lb)



1. Nut
2. Spring balance (1 – 5 or 1 – 10 kg range)
3. Torque wrench
4. Socket with adapter

78E00-7E-16-2S



1. Surface plate
2. Screw

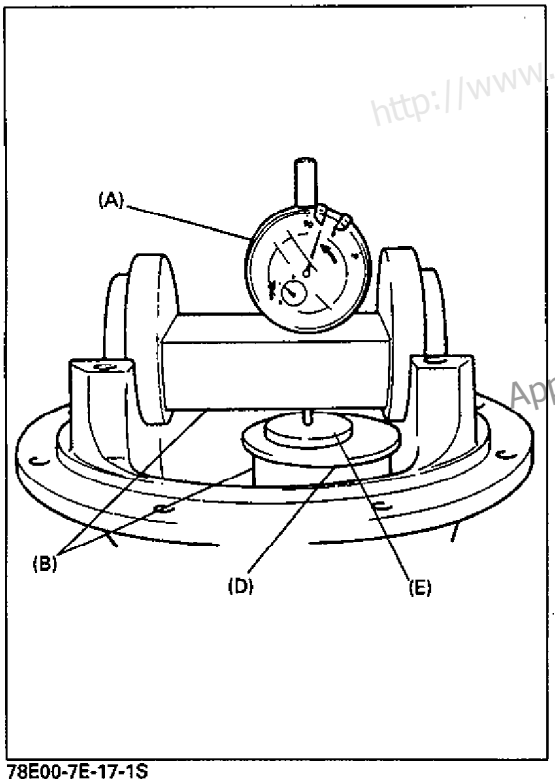
78E00-7E-16-4S

3) Set dial gauge to bevel pinion mounting dummy and make 0 (zero) adjustment on surface plate.

NOTE:

- **When setting dial gauge to mounting dummy, tighten screw lightly. Be careful not to overtighten it, which will cause damage to dial gauge.**
- **With dial gauge set, turn dummy back and force by hand a couple of times and attain accurate 0 (zero) adjustment.**
- **It is desirable that short pointer indicates beyond 2 mm when long one is at 0 (zero).**

Special Tool
(A): 09900-20606
(B): 09926-78311



78E00-7E-17-1S

4) Place zero-adjusted mounting dummy and dial gauge set on pinion dummy and take measurement between zero position and extended dial gauge measuring tip.

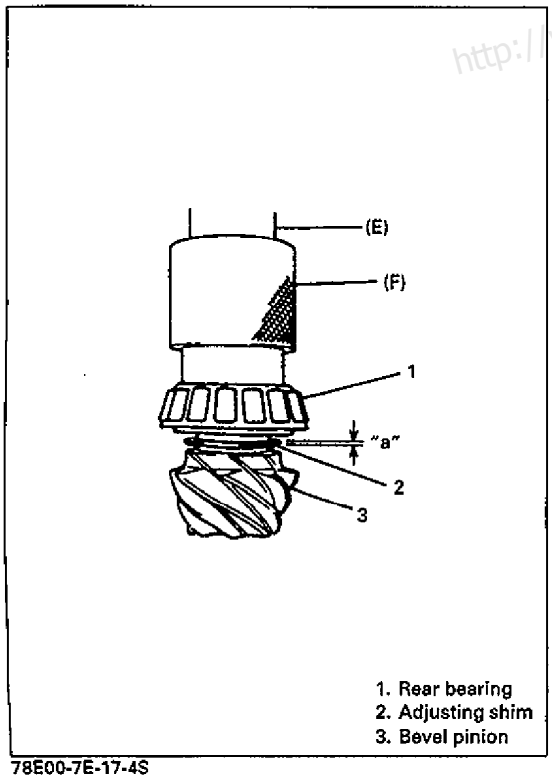
NOTE:
- **Repeat turning back and force of dummy and measure distance as far as top surface of pinion dummy accurately.**
- **When dial gauge measuring tip extends from 0 (zero) position, pointer turns counterclockwise.**
- **Measured value may exceed 1 mm. Therefore, it is also necessary to know reading of short pointer.**

Special Tool
(A): 09900-20606
(B): 09926-78311
(D): 09951-16070
(E): 09922-77250

5) Obtain adjusting shim thickness by using measured value by dial gauge (which represents C in P. 7E-15) in following equation.

Necessary shim thickness (F)	= 102 +	Dial gauge measured value (C)	−	Measurement printed on pinion (E)

102 in above equation is A + B of mounting dummy (special tool (B)) as shown in P. 7E-15.



1. Rear bearing
2. Adjusting shim
3. Bevel pinion

78E00-7E-17-4S

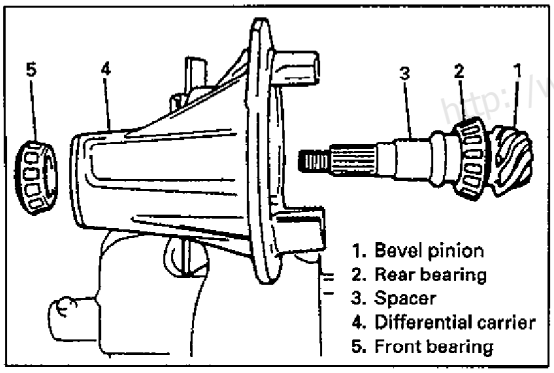
6) Select adjusting shim(s) closest to calculated value from among following available sizes and put it in place and then press-fit rear bearing.

CAUTION:
If special tool (F) interferes with outside area of bearing inner race, be sure to press-fit rear bearing by applying used spacer between special tool (F) and rear bearing.

Available shim thickness	1.12, 1.15, 1.18, 1.21, 1.24, 1.27, 1.30 and 0.3 mm 0.044, 0.045, 0.046, 0.047 0.048, 0.049, 0.050 and 0.012 in.

"a": Closest value to F (Calculated)

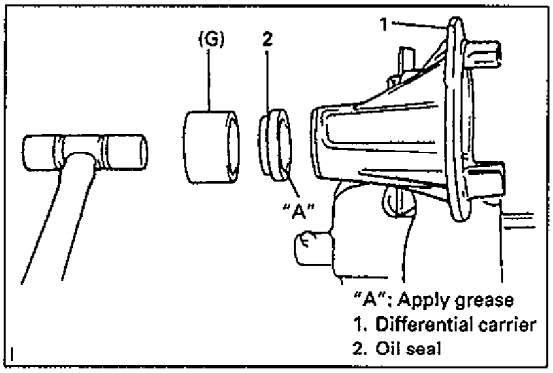
Special Tool
(E): 09925-18010
(F): 09940-53111



78E00-7E-18-1S

7) With new pinion spacer inserted as shown, install front bearing to differential carrier.

NOTE:
- **Make sure to use new spacer for reinstallation.**
- **Apply oil to bearings.**

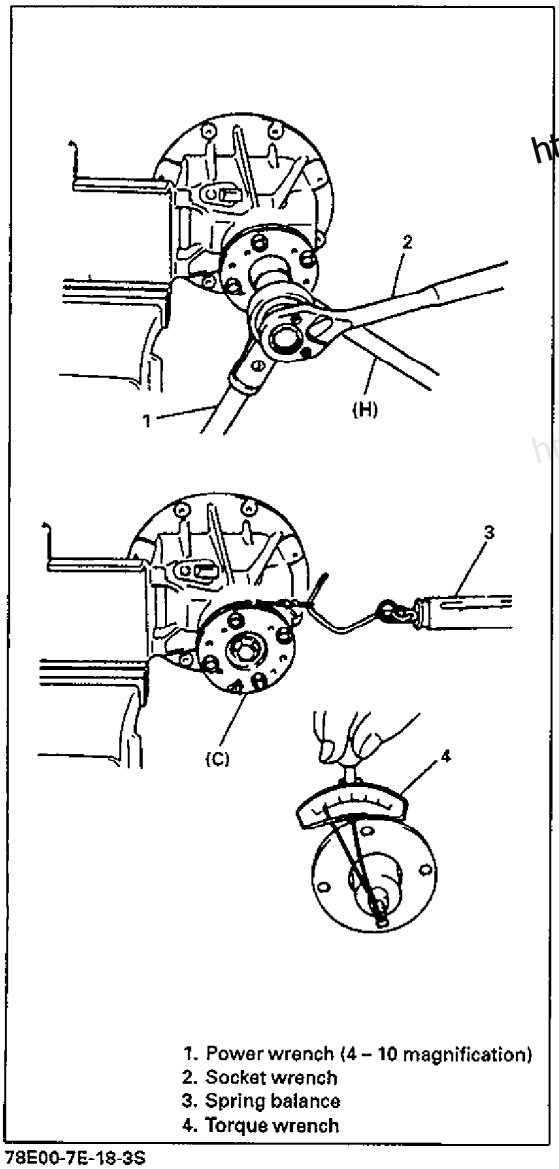


78E00-7E-18-2S

8) Using special tool and plastic hammer, drive oil seal into differential carrier till it becomes flush with carrier end. Then apply grease to oil seal lip.

"A": Grease 99000-25010

Special Tool
(G): 09951-18210



78E00-7E-18-3S

9) While tightening flange nut gradually with special tool (H) and power wrench, set preload of pinion to specification.

NOTE:
- **Before taking measurement with spring balance or torque wrench, check for smooth rotation by hand.**
- **Bearing preload can be measured roughly by pinion rotating angle which is due to arm weight of flange holder installed in flange. Refer to following page for further information.**
- **Be sure to tighten gradually and carefully till specified starting torque is obtained. Turning back overtightened flange nuts should be avoided.**

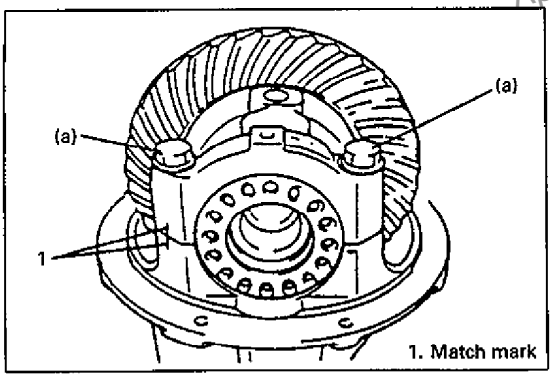
Pinion bearing preload: 0.9 – 1.7 N·m
(9.0 – 17.0 kg-cm, 7.8 – 14.7 lb-in.)

Starting torque with special tool: 18 – 34 N
(1.8 – 3.4kg, 4.0 – 7.5 lb)

Special Tool
(C): 09922-75222
(H): 09922-66020

ASSEMBLING UNIT

1) Place bearing outer races on their respective bearings. Used left and right outer races are not interchangeable.
2) Install case assembly in carrier.
3) Install side bearing adjusters on their respective carrier, making sure adjuster are threaded properly.



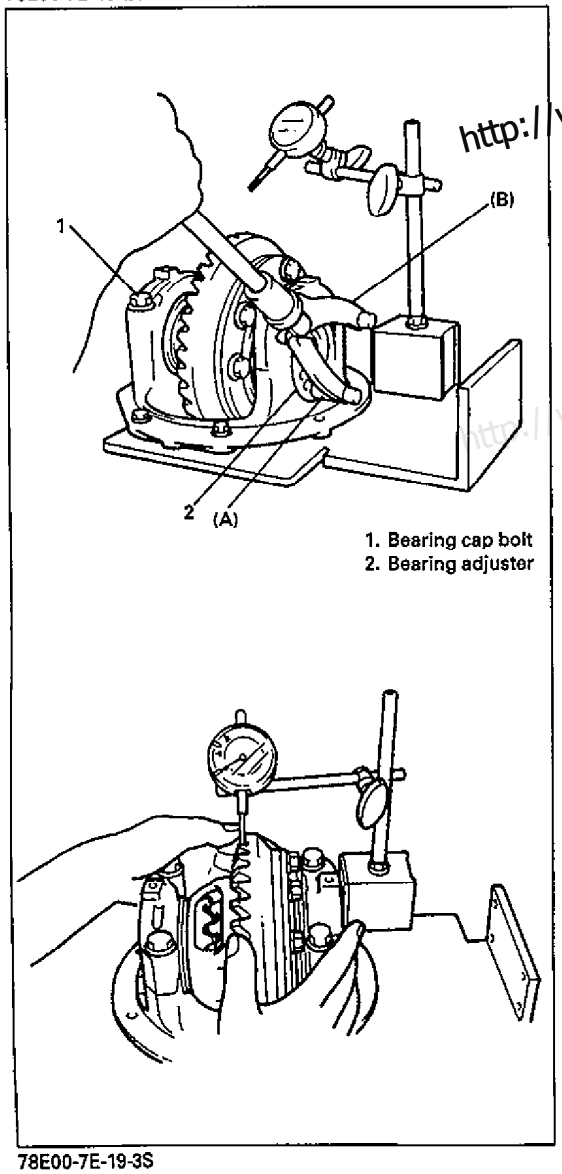
78E00-7E-19-2S

4) Align match marks on cap and carrier. Screw in two side bearing cap bolts two or three turns and press down bearing cap by hand.

NOTE:
If bearing cap does not fit tightly on carrier, side bearing adjuster is not threaded properly. Reinstall adjuster.

Tighten cap bolts.

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



78E00-7E-19-3S

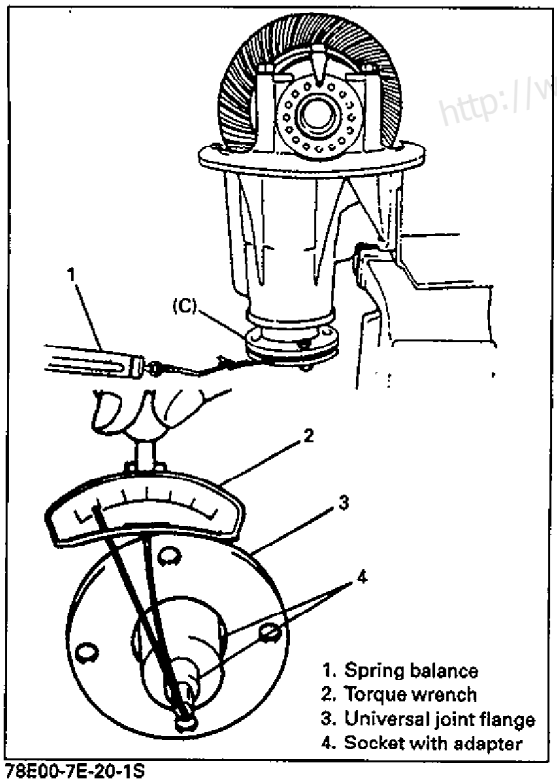
5) Tighten both bearing adjusters so as to obtain specified gear backlash and at the same time, obtain preload of side bearing.

NOTE:

- **Be sure to apply measuring tip of dial gauge at right angles to convex side of tooth.**
- **As a practical measure following would be recommended to obtain specified backlash and side bearing preload at the same time.**
  1. **Obtain specified backlash by turning both adjusters inward lightly.**
  2. **Tighten both adjusters further by one notch at a time.**
- **Measure at least 4 points on drive bevel gear periphery.**

Standard backlash 0.13 – 0.18 mm (0.005 – 0.007 in.)

Special Tool
(A): 09930-40120
(B): 09930-40113



1. Spring balance
2. Torque wrench
3. Universal joint flange
4. Socket with adapter

78E00-7E-20-1S

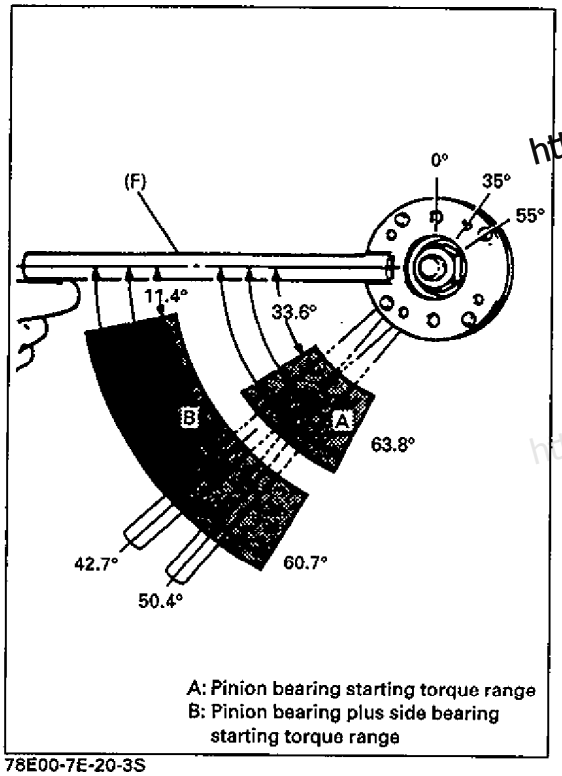
6) Measure preload of pinion with spring balance or torque wrench and check composite preload of pinion bearing and side bearing.

NOTE:

- **Standard preload is shown in graph on next page, which should be read as follows.**

Example:
When preload of bevel pinion is 26 N (2.6 kg, 5.73 lb), acceptable composite preload of both pinion bearings and side bearings should be between 2.8 and 3.2 kg/6.17 and 7.05 lb.

Special Tool
(C): 09922-75222

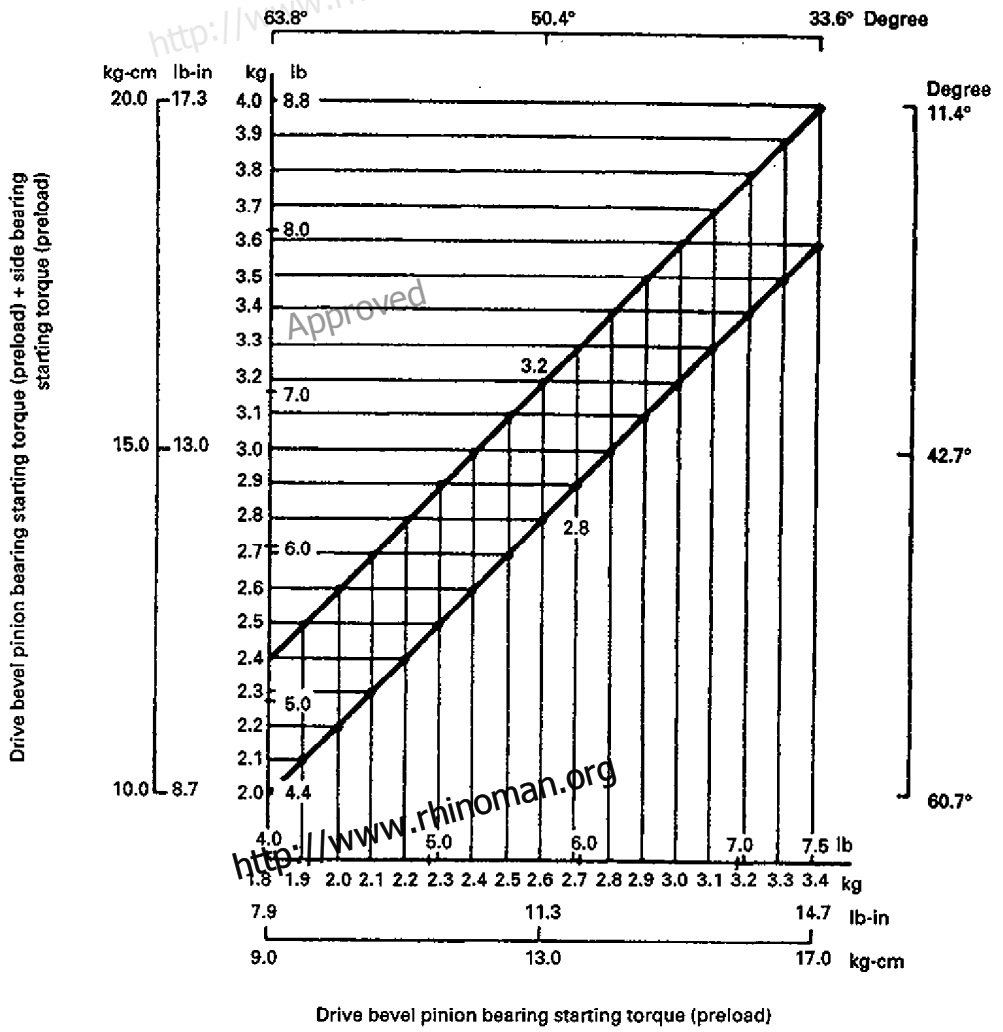


A: Pinion bearing starting torque range
B: Pinion bearing plus side bearing starting torque range

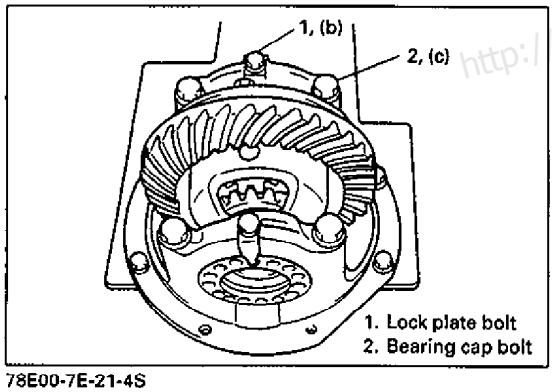
78E00-7E-20-3S

- **Bearing preload can be checked roughly by using flange holder as shown in left figure. In this measurement, holder arm itself will work as balance weight and torque will be replaced with angle. However, flange should be rotated very slowly with hand support so as not to allow over revolution due to inertia.**
- **Repeat side bearing adjustment until gear backlash and composite bearing preload are compatible within specification, if failed to obtain specified measurements first.**

Special Tool
(F): 09922-66020



78E00-7E-21-1S



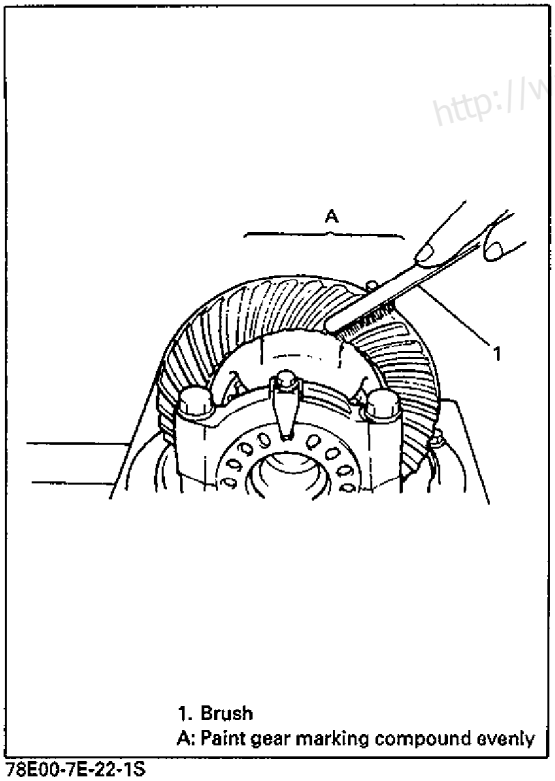
78E00-7E-21-4S

7) Torque bearing cap bolts to specification and install bearing lock plates.

Tightening Torque

(b): 12 N·m (1.2 kg-m, 9.0 lb-ft)

(c): 85 N·m (8.5 kg-m, 61.5 lb-ft)

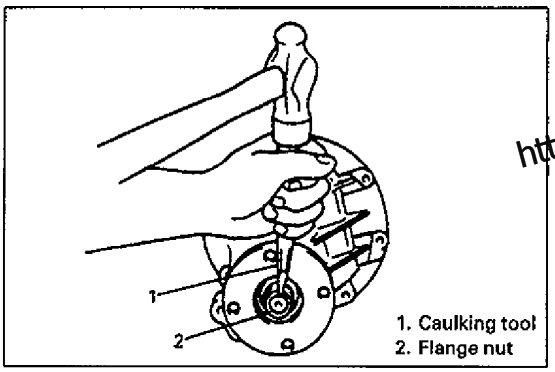


1. Brush
A: Paint gear marking compound evenly

78E00-7E-22-1S

9) As final step, check gear tooth contact as follows.
   i) After cleaning 10 bevel gear teeth, paint them with gear marking compound evenly by using brush or sponge etc.
   ii) Turn gear to bring its painted part in mesh with bevel pinion and turn it back and forth by hand to repeat their contact.
   iii) Bring painted part up and check contact pattern, referring to following chart. If contact pattern is not normal, readjust or replace as necessary according to instruction in chart.

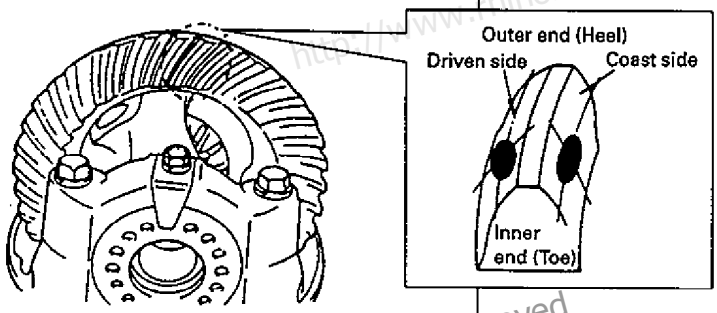
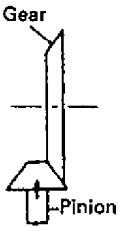
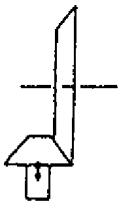
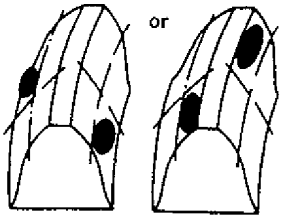
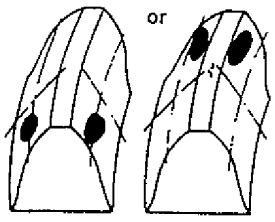
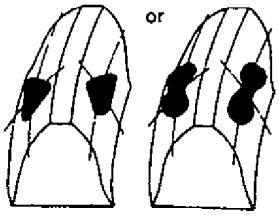
NOTE:
Be careful not to turn bevel gear more than one full revolution, for it will hinder accurate check.



1. Caulking tool
2. Flange nut

78E00-7E-22-3S

10) Upon completion of gear tooth contact check in Step 9, caulk flange nut with caulking tool and hammer.

TOOTH CONTACT PATTERN	DIAGNOSIS AND REMEDY
	NORMAL
	HIGH CONTACT Pinion is positioned too far from the center of drive bevel gear. 1. Increase thickness of pinion height adjusting shim and position pinion closer to gear center. 2. Adjust drive bevel gear backlash to specification. 
	LOW CONTACT Pinion is positioned too close to the center of drive bevel gear. 1. Decrease thickness of pinion height adjusting shim and position pinion farther from gear center. 2. Adjust drive bevel gear backlash to specification. 
	If adjustment is impossible, replace differential carrier.
	1. Check seating of bevel gear or differential case. (Check bevel gear for runout). 2. If adjustment is impossible, replace drive bevel gear & pinion set or differential carrier.
	Replace drive bevel gear & pinion set or differential case.

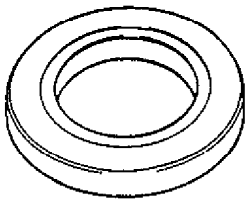
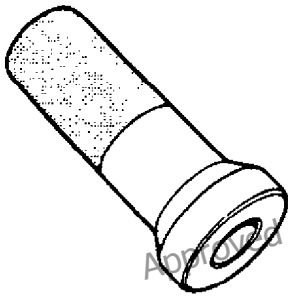
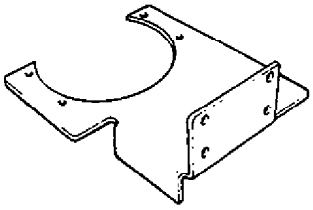
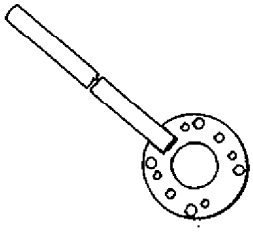
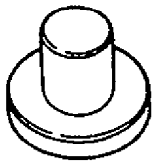
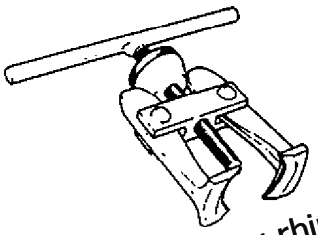
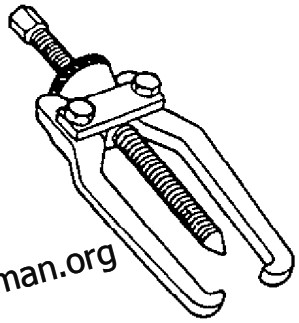
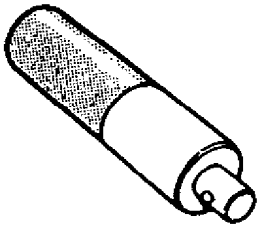
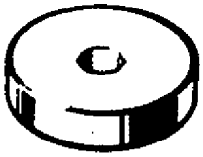
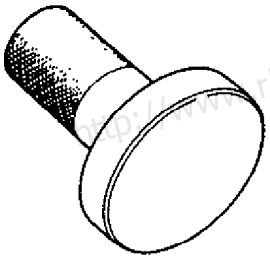
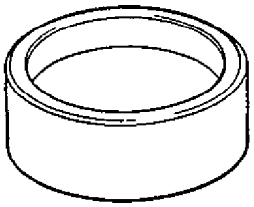
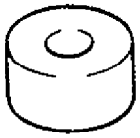
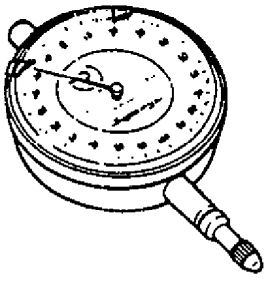
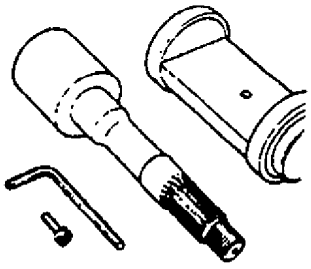
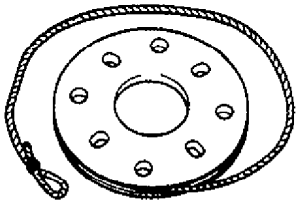
TIGHTENING TORQUE SPECIFICATIONS

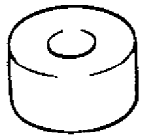
Fastening portion	Tightening torque		
	N·m	kg-m	lb-ft
Front diff. oil filler/level plug	40	4.0	29.0
Rear diff. oil filler/level plug	43	4.3	31.0
Front diff. oil drain plug	23	2.3	17.0
Rear diff. oil drain plug	22	2.2	16.0
Front diff. mounting front bolts	85	8.5	61.5
Front diff. mounting bracket bolts	50	5.0	36.5
Rear differential case bolts	41	4.1	30.0
Rear diff. bevel gear bolts	85	8.5	61.5
Rear diff. bearing cap bolts	85	8.5	61.5
Rear diff. lock plate bolts	12	1.2	9.0

REQUIRED SERVICE MATERIALS

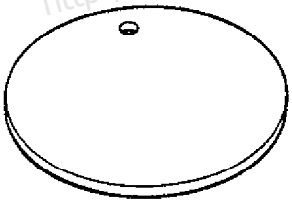
MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Thread lock cement	THREAD LOCK CEMENT SUPER 1333B (99000-32020)	Bevel gear bolts
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	Oil seal lips
Sealant	SUZUKI BOND NO. 1215 (99000-31110)	• Differential drain and level/filler plugs • Mating surface of differential housing

SPECIAL TOOLS

 09951-26010 Bush remover plate	 09951-16080 Bearing installer	 09944-76010 Differential carrier holder	 09922-66020 Flange holder
 09913-85230 Bearing removing jig	 09913-61510 Bearing puller	 09913-65135 Bearing puller	 09924-74510 Installer attachment
 09926-68310 Bearing installer	 09913-75510 Bearing installer	 09928-06010-002 Differential torque checking tool	 09944-66020 Bearing installer
 09951-16060 Lower arm bush remover	 09900-20606 Dial gauge	 09926-78311 Bevel pinion mounting dummy	 09922-75222 Preload adjuster



09951-46010
Drive shaft oil seal installer



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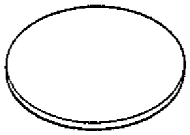
Attachment



09922-77250
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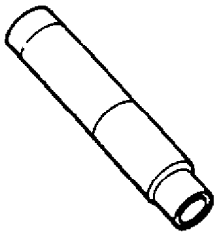
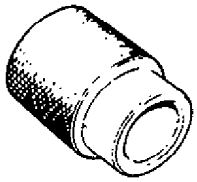
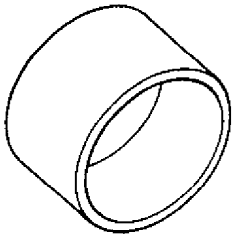


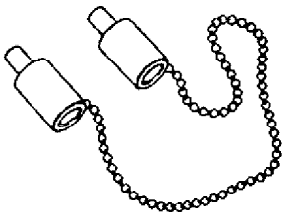
09925-18010
Bearing installer



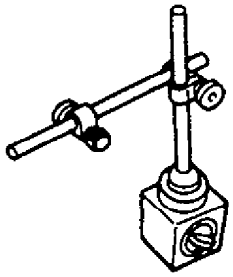
09940-53111
Bearing installer



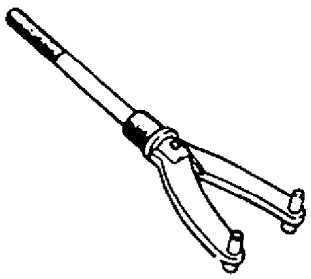
09951-18210
Oil seal remover & installer No. 3



09930-40120
Attachment



09900-20701
Magnetic stand



09930-40113
Rotor holder

78E00-7E-26-1S

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 manuals mentioned in FOREWORD of this manual.

78E00-8-1-1S

CONTENTS

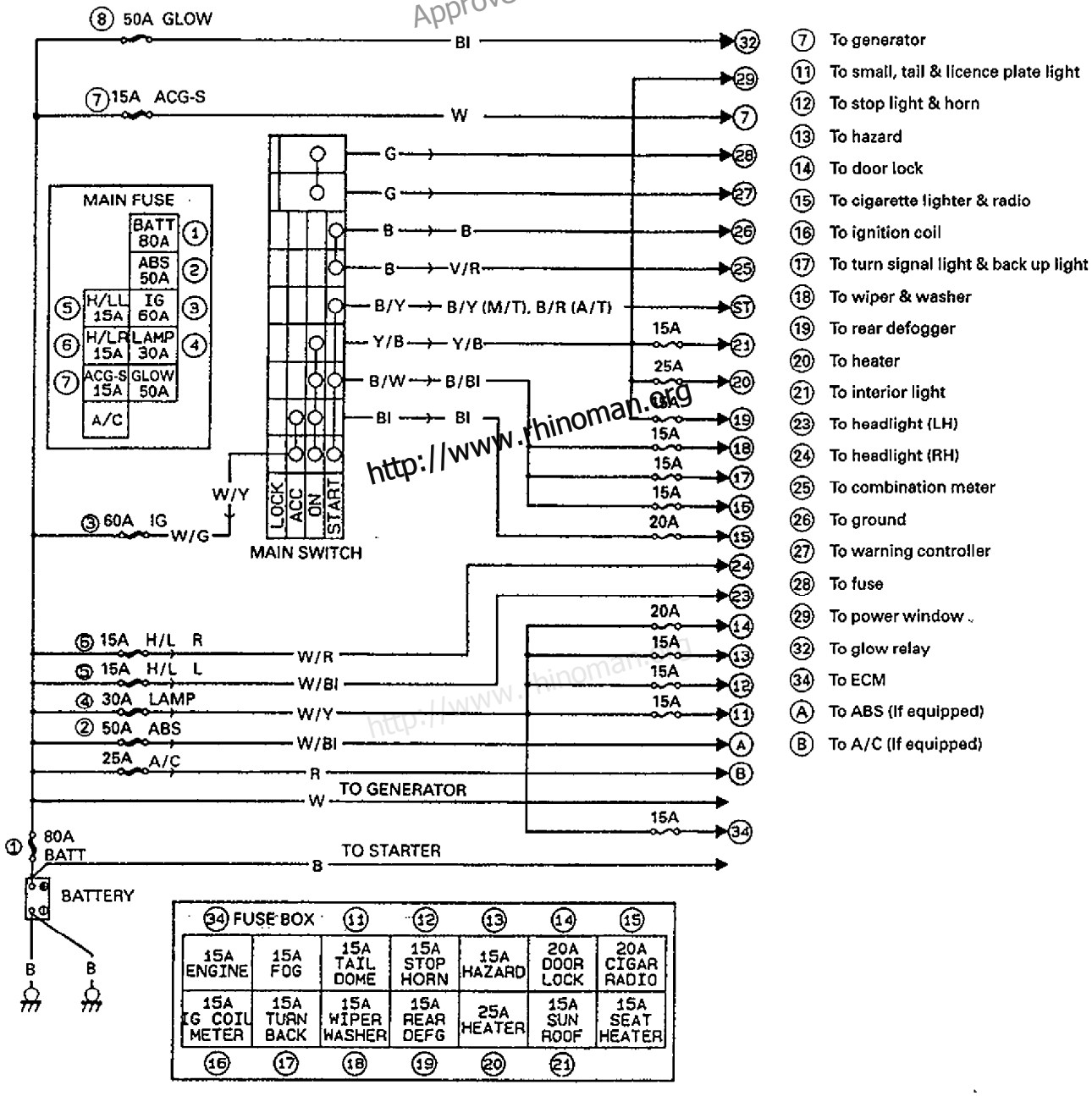
78E00-8-1-2S

BODY ELECTRICAL SYSTEM

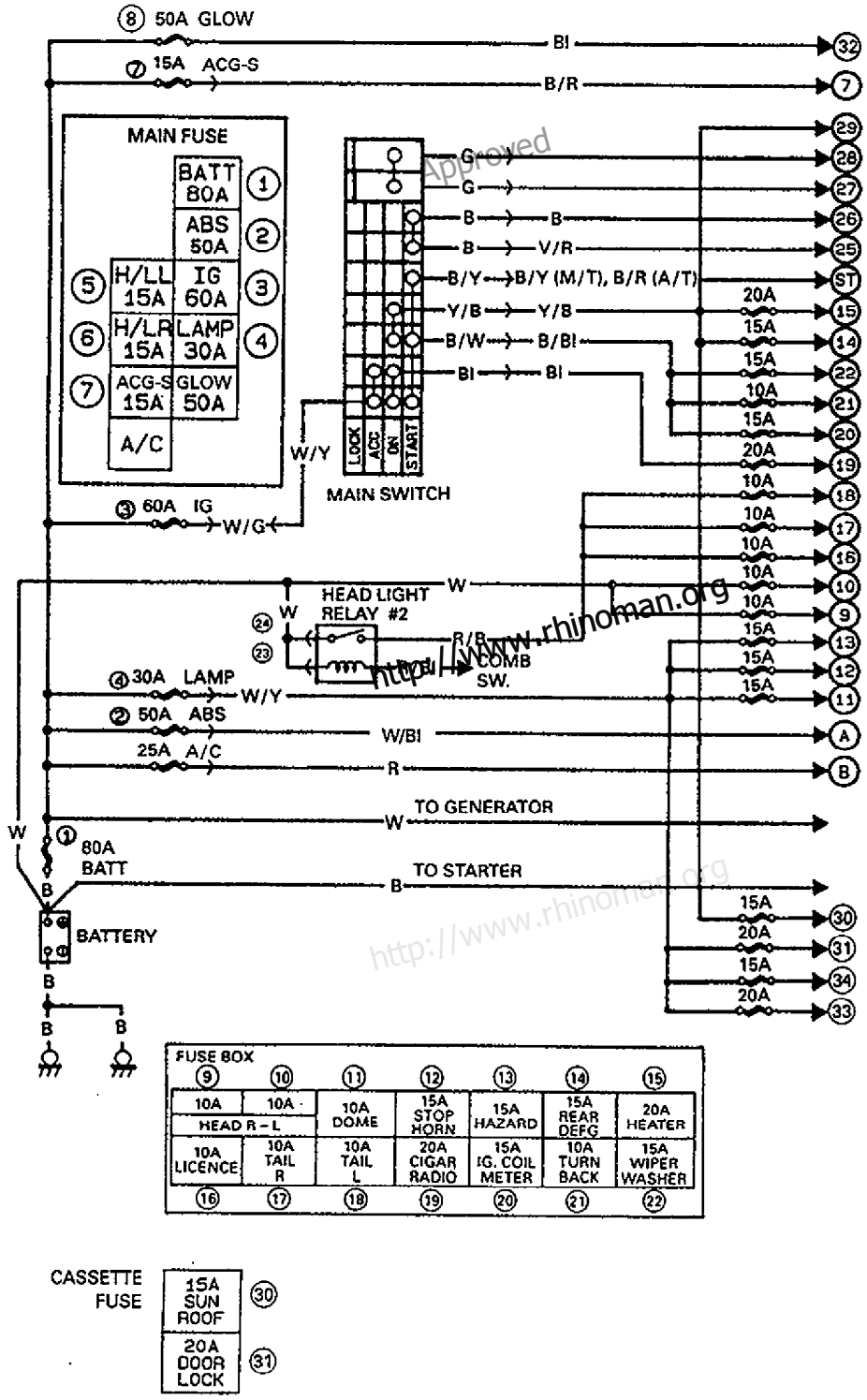
FUSES AND SWITCHES

FUSES

For Right Hand Steering Vehicle



For Left Hand Steering Vehicle



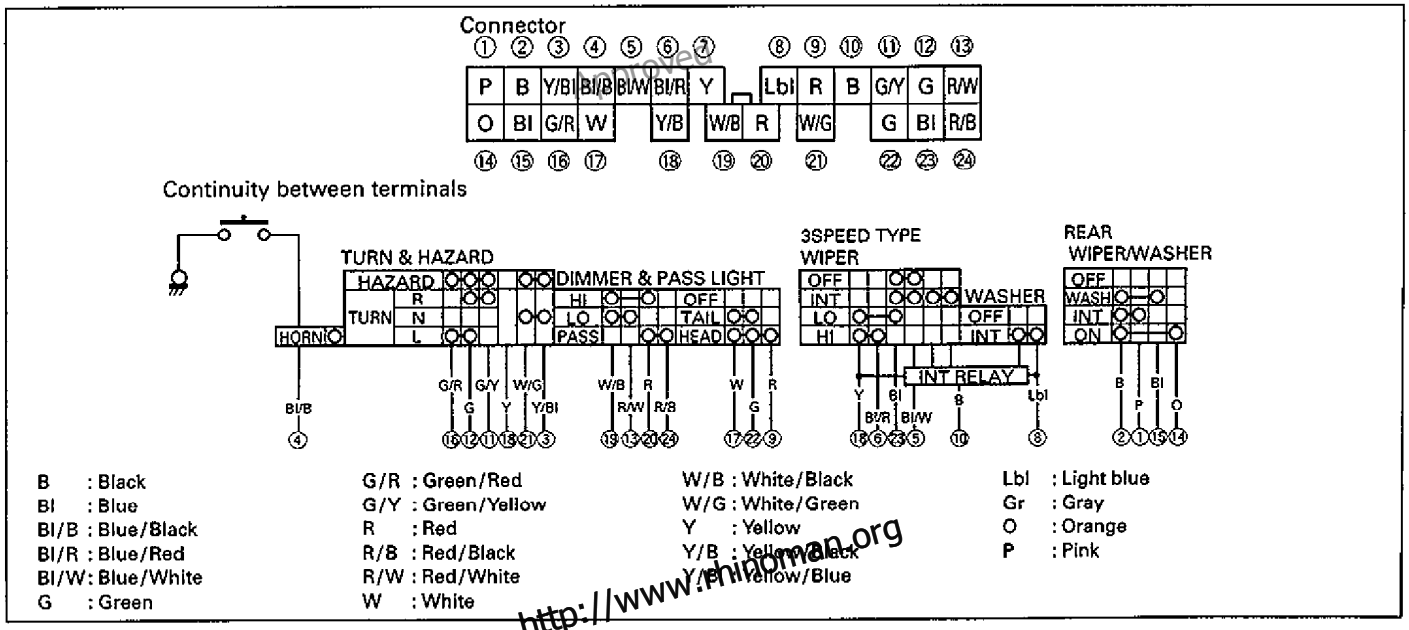
⑦ To generator
⑨ To headlight (LH)
⑩ To headlight (RH)
⑪ To interior light
⑫ To stop light & horn
⑬ To hazard
⑭ To rear defogger
⑮ To heater
⑯ To licence plate light
⑰ To small & tail (RH)
⑱ To small & tail (LH)
⑲ To cigarette lighter & radio
⑳ To ignition coil
㉑ To turn signal light & back up light
㉒ To wiper & washer
㉓ Blank
㉔ Blank
㉕ To combination meter
㉖ To ground
㉗ To warning controller
㉘ To fuse
㉙ To power window
㉚ To sliding roof (If equipped)
㉛ To central locking (If equipped)
㉜ To glow relay
㉝ To PTC
㉞ To ECM
Ⓐ To ABS (If equipped)
Ⓑ To A/C (If equipped)

COMBINATION SWITCH

The turn signal/dimmer switch incorporates the turn signal, hazard warning, dimmer and passing light switches.

Inspection

1. Disconnect negative cable at battery.
2. Remove lower steering column cover.
3. Disconnect combination switch couplers.



B : Black	G/R : Green/Red	W/B : White/Black	Lbl : Light blue
Bl : Blue	G/Y : Green/Yellow	W/G : White/Green	Gr : Gray
Bl/B : Blue/Black	R : Red	Y : Yellow	O : Orange
Bl/R : Blue/Red	R/B : Red/Black	Y/B : Yellow/Black	P : Pink
Bl/W : Blue/White	R/W : Red/White	Y/Bl : Yellow/Blue	
G : Green	W : White		

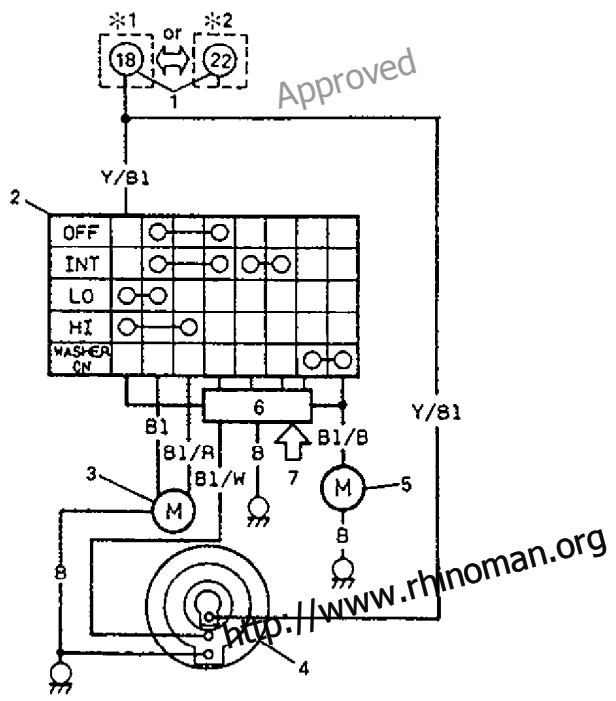
78E00-8-4-1S

ON-VEHICLE SERVICE

WINDSHIELD WIPERS (FRONT WIPER)

The windshield wiper is 3-speed type with variable intermittent switch and the windshield washer is equipped with a separate-type washer pump.

WIRING CIRCUIT



1. To connect fuses
   The wire No.s (⑱ and ㉒) are same No. as figure of FUSES and SWITCHES (Page 8-2, 3)
2. Combination switch
3. Wiper motor
4. Wiper return switch
5. Waher motor
6. Wiper intermittent relay
7. Variable resistor

B : Black
Bl : Blue
Bl/B : Blue/Black
Bl/R : Blue/Red
Bl/W: Blue/White
Y/Bl : Yellow/Blue

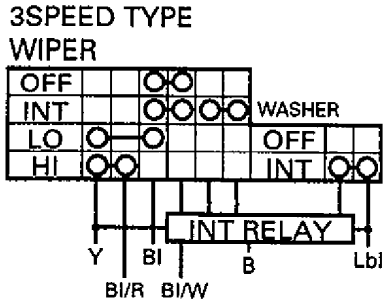
*1; For Right Hand Steering Vehicle
*2; For Left Hand Steering Vehicle

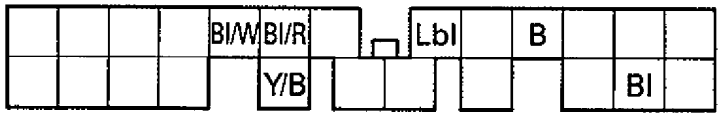
78E00-8-5-1S

INSPECTION

A. Wiper/washer Switch

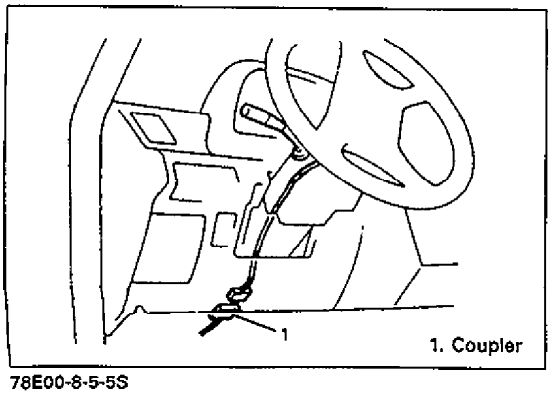
Use a circuit tester to check switch for each terminal-to-terminal continuity.





B : Black
Bl : Blue
Bl/R : Blue/Red
Bl/W: Blue/White
Lbl : Light Blue
Y/B : Yellow/Black

78E00-8-5-4S

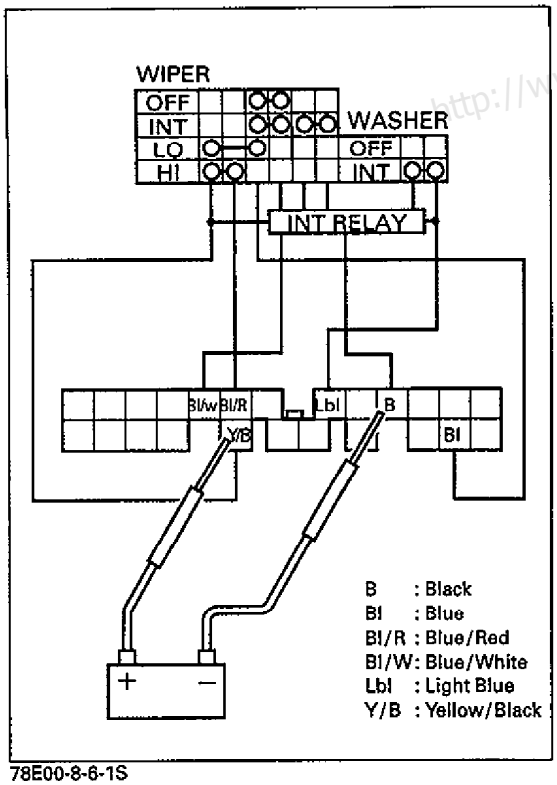


1. Coupler

78E00-8-5-5S

D. Intermittent Wiper Relay Circuit (If equipped)

1. Disconnect wiper & washer switch coupler.



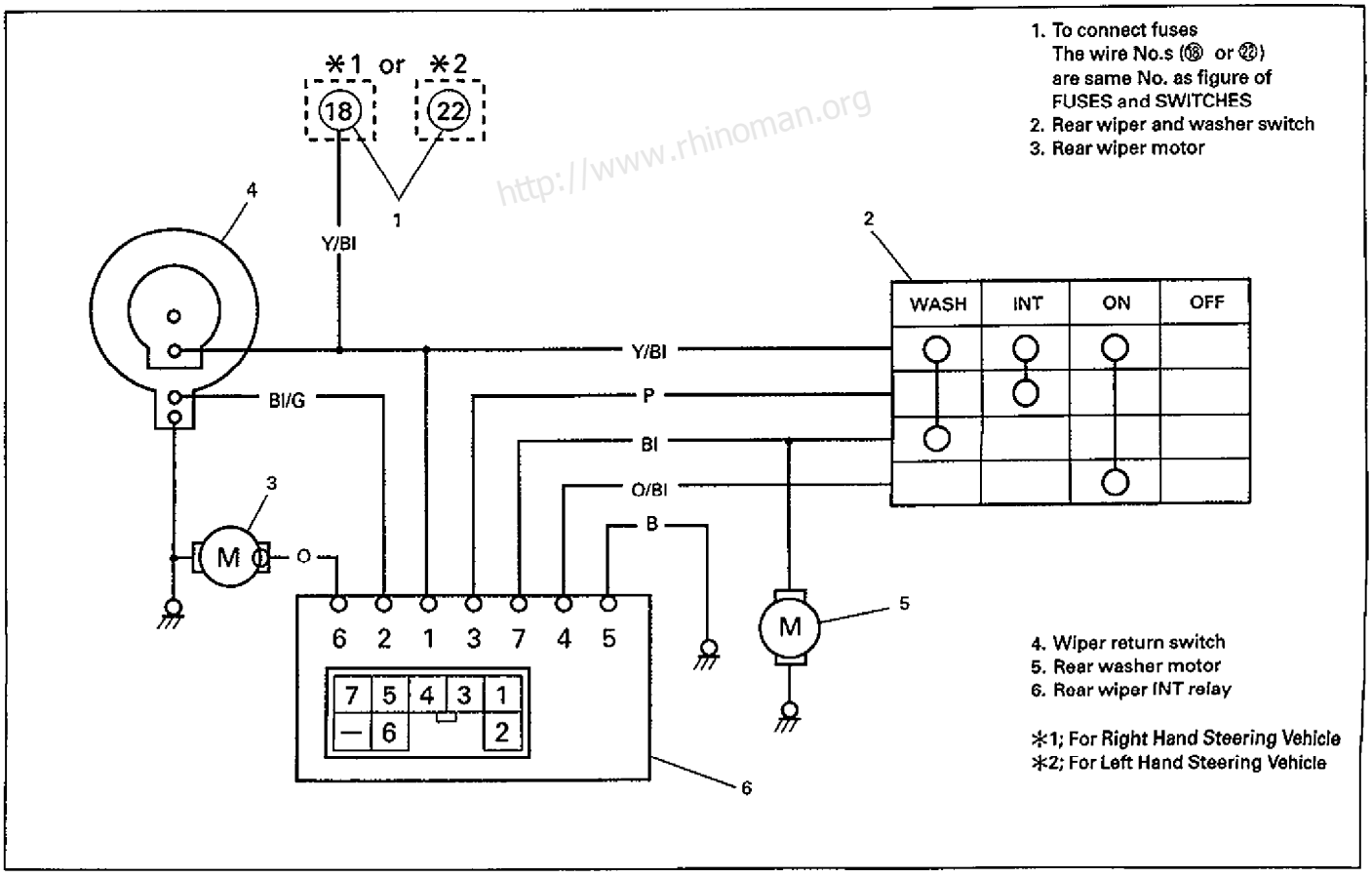
78E00-8-6-1S

2. Turn wiper switch to "INT" position.
3. Connect (+) cord and (–) cord of 12 V battery to coupler terminals as shown left. If an operating sound is heard from relay, it is at work properly.

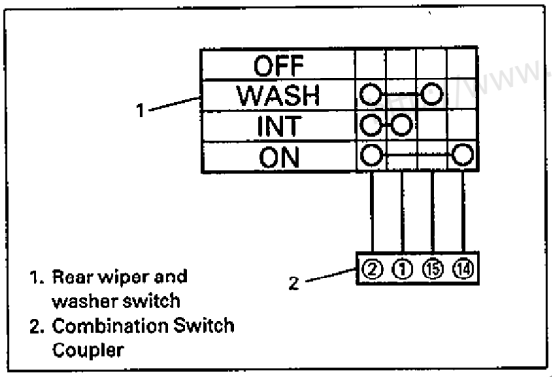
REAR WINDOW WIPER AND WASHER

The rear window wiper is of the 2-speed type and its washer is equipped with a separate-type washer pump.

WIRING CIRCUIT



78E00-8-6-2S



78E00-8-7-1S

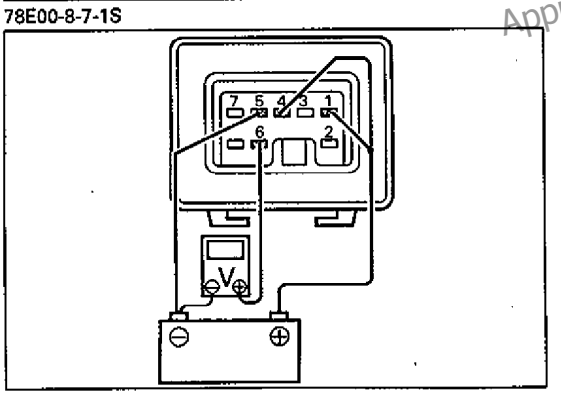
INSPECTION

A. Wiper And Washer switches

Use a circuit tester to check switches for continuity.

COUPLER

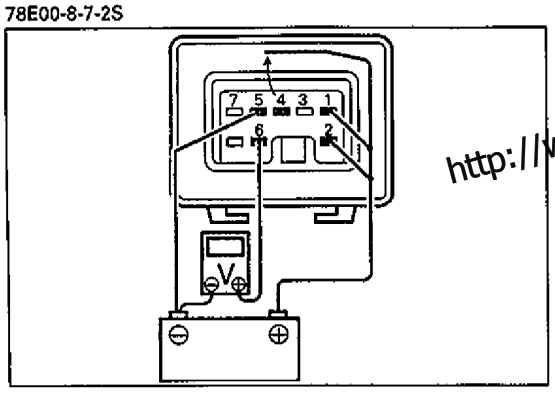
P	B	Y/Bl	Bl/B	Bl/W	Bl/R	Y		Lbl	R	B	G/Y	G	R/W
O	Bl	G/R	W		Y/B	W/B	R	W/G		G	Bl	R/B



78E00-8-7-2S

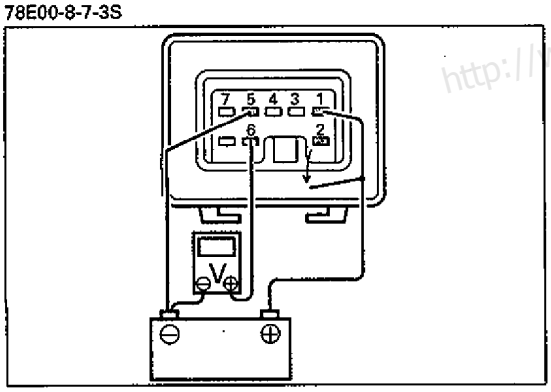
D. Rear Wiper Intermittent Relay ON circuit.

1. Connect positive terminal of battery to terminals ① and ④ of controller, negative terminal to terminal ⑤ of controller and check voltage between terminals ⑥ and ⑤ of controller.
   If measured voltage is battery voltage, controller is in good condition.
   If not, replace controller.



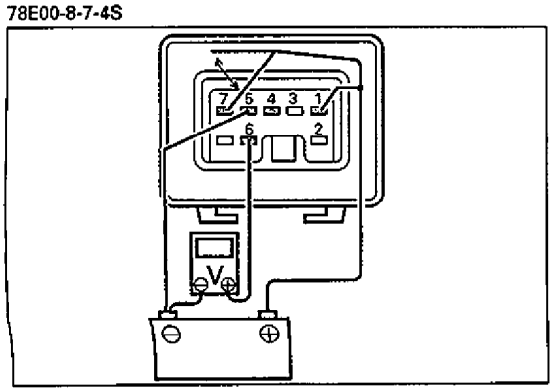
78E00-8-7-3S

2. Connect positive terminal of battery to terminal ② of controller, then disconnect positive terminal from terminal ④ of controller and check voltage between terminals ⑥ and ⑤ of controller.
   If measured voltage is battery voltage, controller is in good condition.
   If not, replace controller.



78E00-8-7-4S

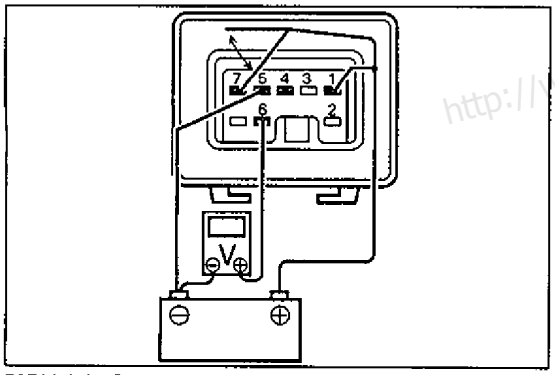
3. Disconnect positive terminal from terminal ② of controller and check voltage between terminals ⑥ and ⑤ of controller.
   If measured voltage is about 0V, controller is in good condition.
   If not replace controller.



78E00-8-7-5S

WASH circuit

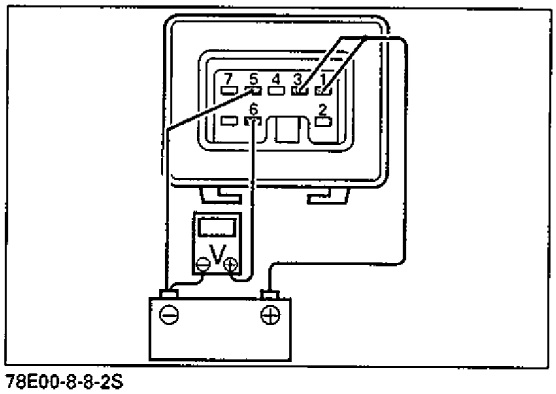
1. Connect positive terminal of battery to terminal ① of controller and negative terminal to terminal ⑤ of controller. Then connect positive terminal to terminal ⑦ checking voltage between terminals ⑥ and ⑤ of controller.
   If measured voltage changes from about 0V to battery voltage in 0.6 to 1.5 seconds after connecting positive terminal to terminal ⑦, controller is in good condition. If not, replace controller.



78E00-8-8-1S

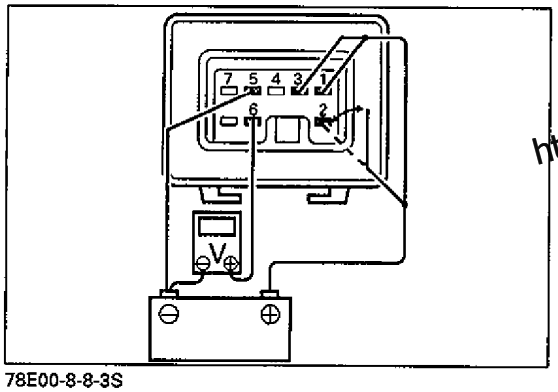
2. Disconnect positive terminal from terminal ⑦ checking voltage between terminal ⑥ and ⑤ of controller.
If measured voltage changes from battery voltage to about 0V 2.7 to 4.6 seconds after disconnecting positive terminal from terminal ⑦, controller is in good condition.
If not replace controller.

INT circuit



78E00-8-8-2S

1. Connect positive terminal of battery to terminals ① of controller and negative terminal to terminal ⑤ of controller. Then positive terminal to terminal ③ of controller checking voltage between terminals ⑥ and ⑤ of controller.
If measured voltage changes from about 0V to battery voltage when connecting positive terminal to terminal ③, controller is in good condition.
If not replace controller.

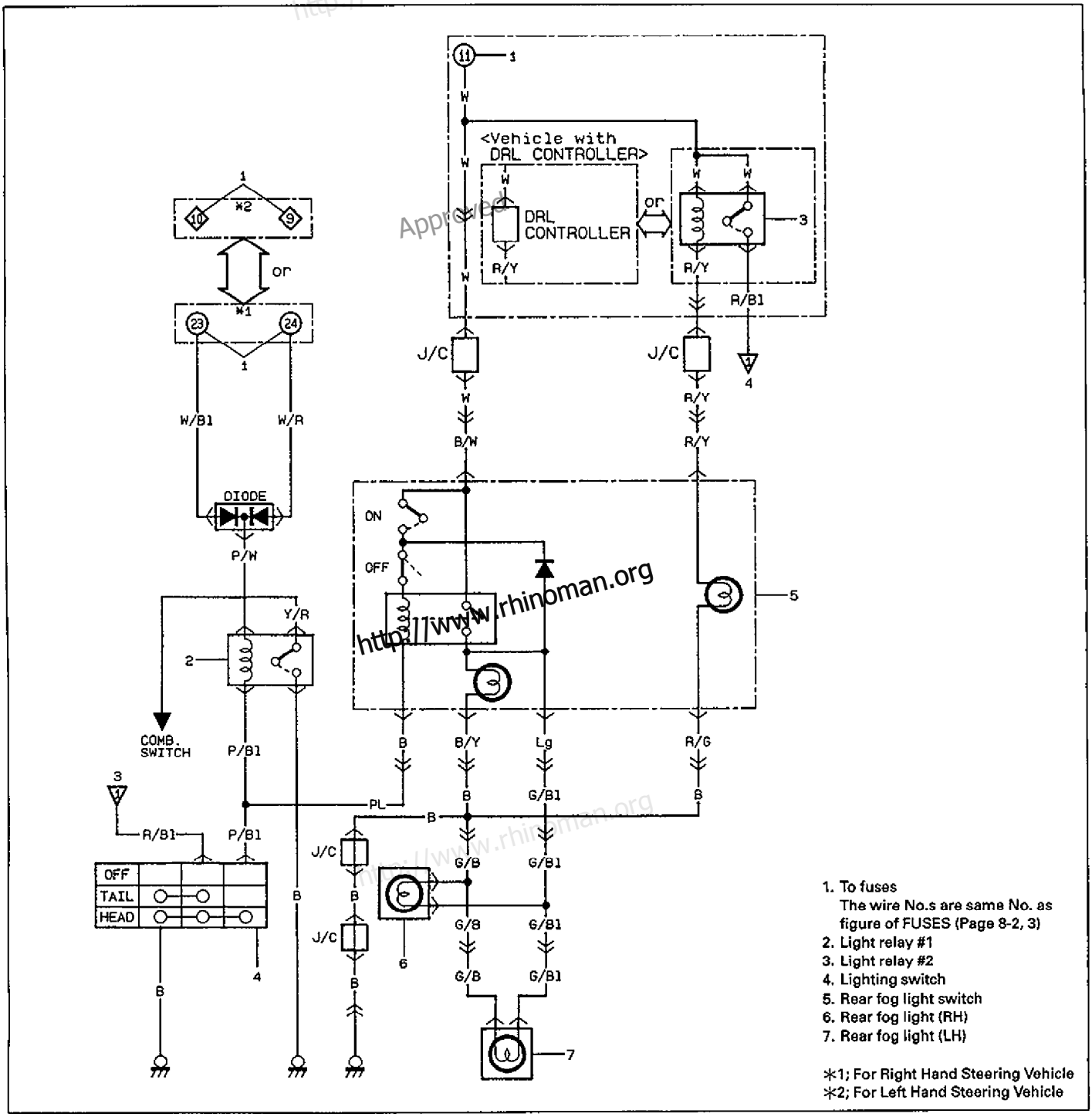


78E00-8-8-3S

2. Connect positive terminal of battery to terminal ② of controller, then disconnect positive terminal from terminal ② of controller checking voltage between terminals ⑥ and ⑤ of controller.
If measured voltage changes from battery voltage to about 0V when disconnecting positive terminal from terminal ② and about 0V to battery voltage 8 ± 2 seconds after disconnecting positive terminal from terminal ②, controller is in good condition.
If not replace.

REAR FOG LIGHT (If equipped)

WIRING CIRCUIT

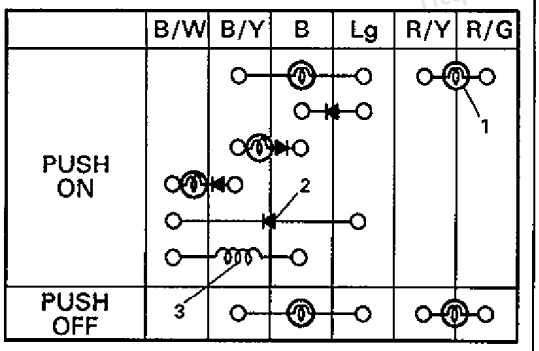


78E00-8-9-1S

TROUBLE DIAGNOSIS

Trouble	Possible Cause	Correction
Lights do not light.	• Main fuse and/or fuses blown	Replace main fuse and/or fuses to check for short.
	• Light relay faulty	Replace light relay
	• Lighting switch faulty	Check switch.
	• Wiring or grounding faulty	Repair as necessary.

78E00-9-4-2S



1. Rear fog light switch illumination lamp
2. Diode
3. Coil (in relay)

78E00-8-10-1S

INSPECTION

Use a circuit tester to check rear fog light switch for continuity. Hold the switch button (ON or OFF) pushed during checking switch according to left figure.

SECTION 8A

IMMOBILIZER CONTROL SYSTEM

WARNING:
For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- **Service on or around Air Bag System Components or Wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under "On-Vehicle Service" and the Air Bag System Component and Wiring Location view in Section 9J before performing service on or around Air Bag System Components or Wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

CONTENTS

8A

60G10-8A-2-1

GENERAL DESCRIPTION

The immobilizer control system is 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.

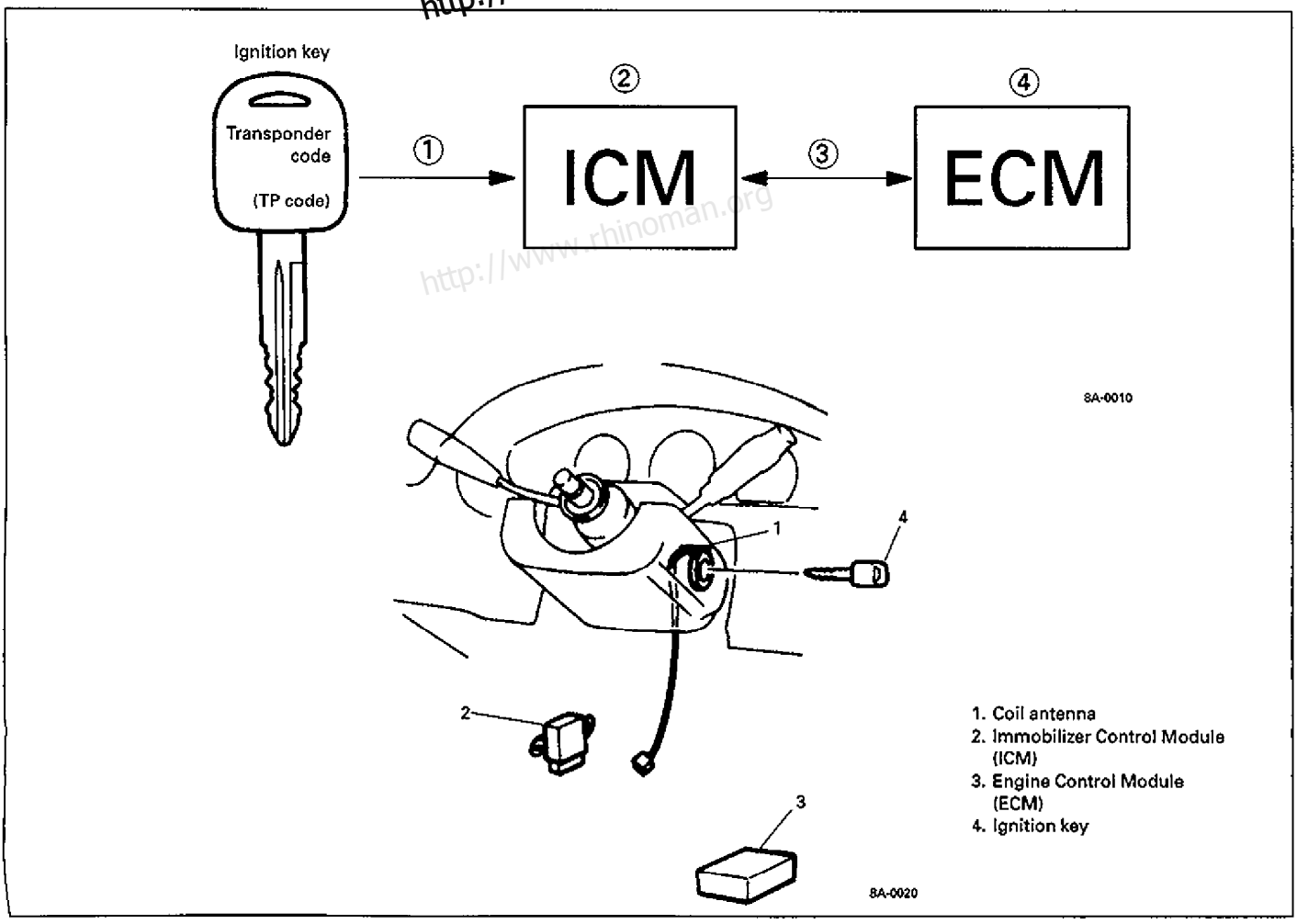
③ When it is confirmed that two TP codes match each other as described above, ICM and ECM check if ECM/ICM codes registered in them respectively match.

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).

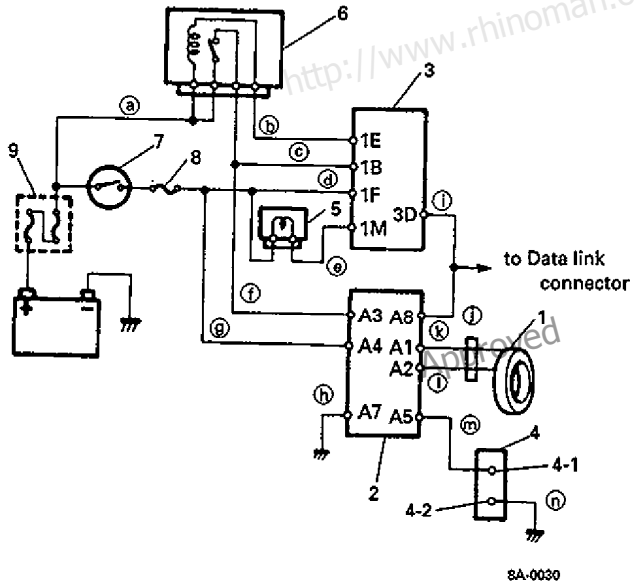
ECM will perform the following operations simultaneously.

- Spill valve relay OFF (Spill valve OFF)
- Intake shutter solenoid valve ON

60G00-8A-3-1S

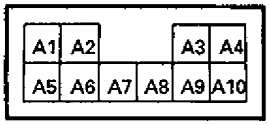


60G00-8A-3-3S



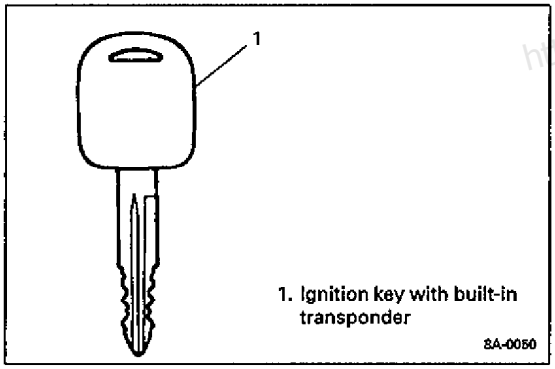
WIRE SYMBOL	WIRE COLOR
ⓐ	W/Bl
ⓑ	W/G
ⓒ	R
ⓓ	B/W
ⓔ	W/Y
ⓕ	R
ⓖ	B/W
ⓗ	B
ⓘ	V/W
ⓙ	V/W
ⓚ	Bl
ⓛ	R
ⓜ	Sb
ⓝ	B

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. Glow indicator lamp
6. Main relay
7. Ignition switch
8. Fuse
9. Main fuse



Terminal arrangement of immobilizer control module coupler (Viewed from harness side)

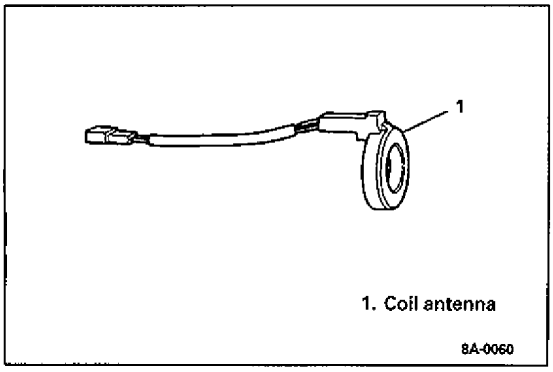
60G10-8A-4-1S



60G00-8A-4-4S

Ignition key

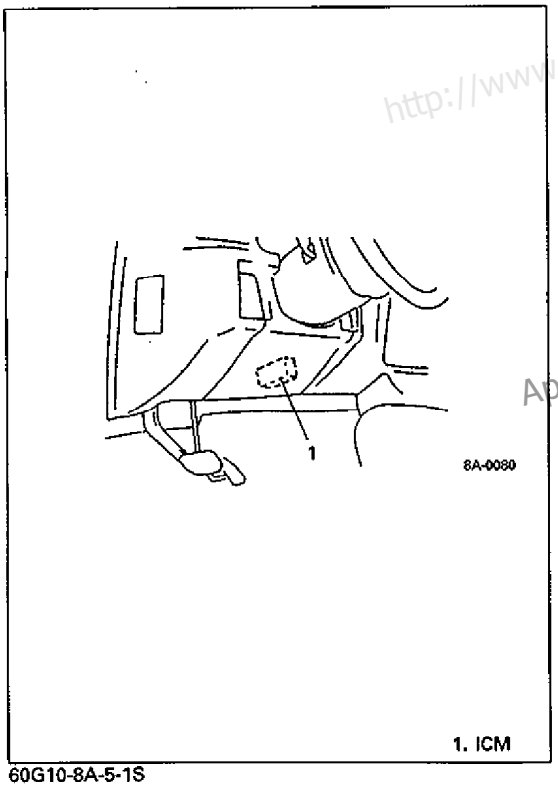
The ignition key for the immobilizer control system has a built-in transponder. Each transponder in the key has an each transmitting code (Transponder code). The code will transmitted from the key via the coil antenna to ICM when the ignition switch is turned ON.



60G00-8A-4-5S

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.



60G10-8A-5-1S

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.

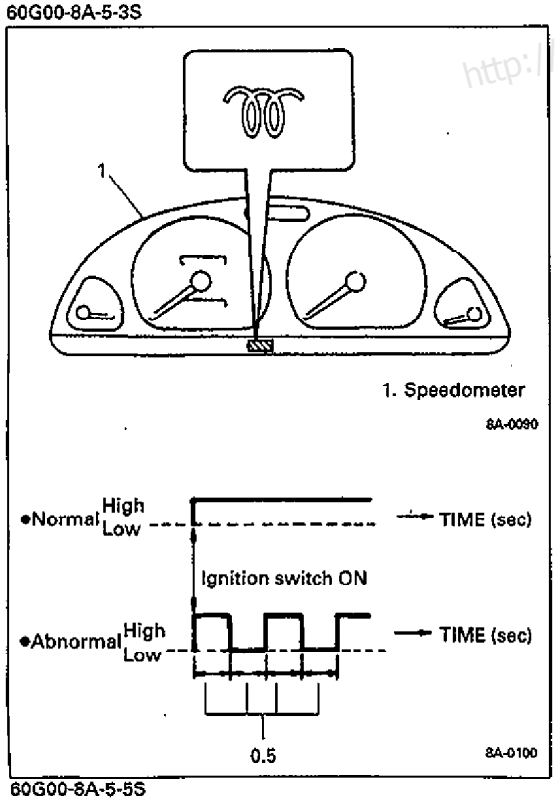
As main functions, ICM checks matching not only between the TP Code transmitted from the ignition key and that registered in ICM (Up to 4 different TP codes can be registered.) but also between the ECM/ICM code transmitted from ECM and that registered in ICM. In addition, it has an on-board diagnostic 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 Section 6E4.

60G00-8A-5-3S



60G00-8A-5-5S

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

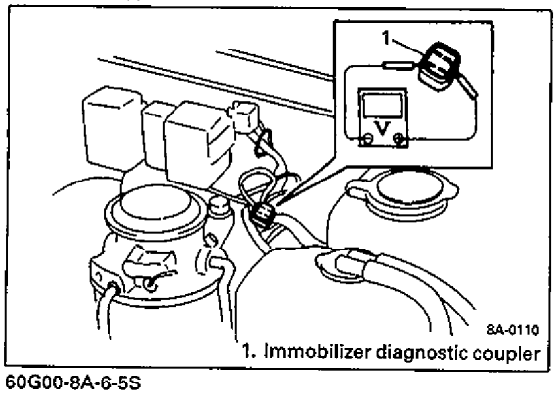
1) With the diagnosis switch terminal not grounded, the ignition switch turned ON (but the engine at stop) and regardless of the condition of the engine and emission control system, ECM indicates whether a trouble has occurred in the immobilizer control system or not by causing the glow indicator lamp to flash, turn OFF or ON. If the glow indicator lamp remains ON or turns OFF in a few seconds, 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 or the glow plug relay is operating, the glow indicator lamp 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 engine and emission control system by flashing the glow indicator lamp as listed below. (For positions of the diagnostic switch terminal and the ground terminal, refer to Section 6E4.)

Immobilizer control system	Engine and emission control system	Glow indicator lamp
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 engine and emission control 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 engine and emission control system and immobilizer control system are indicated alternately.

60G00-8A-6-1S



1. Immobilizer diagnostic coupler

60G00-8A-6-5S

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 perform the following operations simultaneously.

- **Spill valve relay OFF (Spill valve OFF)**
- **Intake shutter solenoid valve ON**

60G00-8A-7-1S

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.

60G00-8A-8-1S

PRECAUTIONS IN DIAGNOSING TROUBLES

[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC TROUBLE CODE]

ECM

- Before identifying diagnostic trouble code indicated by glow indicator lamp, don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine.
  Such disconnection will clear trouble codes for engine and emission control system stored in memory of ECM.
- If abnormality or malfunction lies in two or more areas, glow indicator lamp 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 engine and emission control system and immobilizer control system, glow indicator lamp 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.

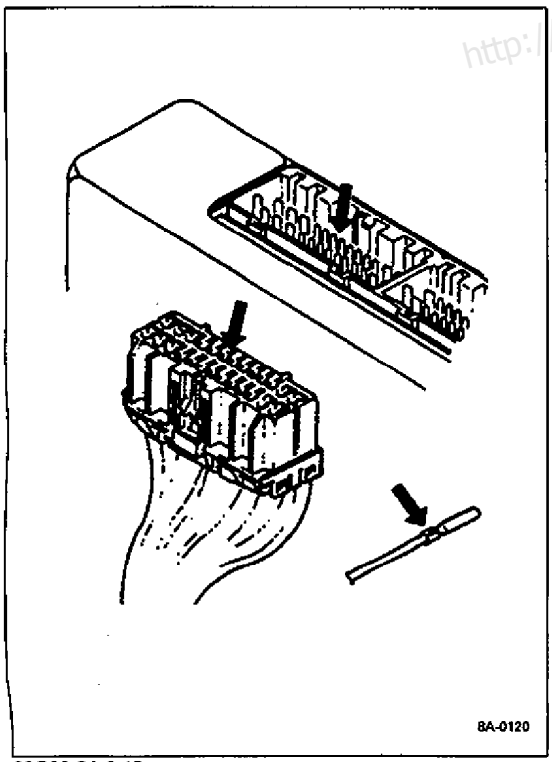
60G00-8A-8-2S

[INTERMITTENT TROUBLES]

- There are cases where output of diagnostic output terminal and/or glow indicator lamp indicate 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 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 coil antenna, ignition key, 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 output of diagnostic output terminal and/or glow indicator lamp indicate a trouble code:
    Diagnose trouble by using that code No. and if ignition key, coil antenna, wires and each connection are all in good condition, turn OFF ignition switch and then ON.

Then check what glow indicator lamp and/or output of diagnostic output terminal indicate.
Only when they indicate trouble code again, substitute a known-good ECM or ICM and check again.
If they indicate not trouble code but normal code, it means that an intermittent trouble did occur and has gone. In this case, check wires and connections carefully again.

60G10-8A-9-1S



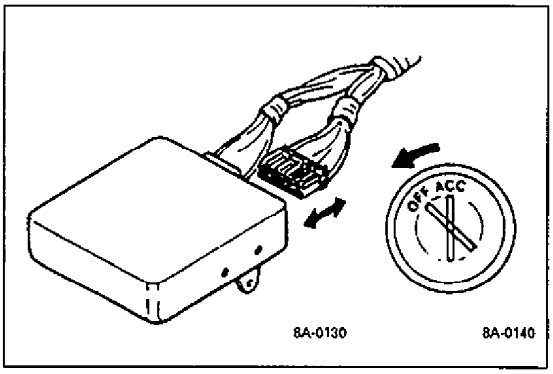
60G00-8A-9-4S

[NOTES ON SYSTEM CIRCUIT INSPECTION]

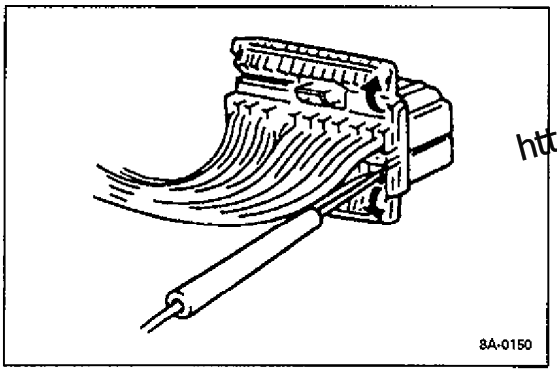
- Intermittent troubles
  Most intermittent problems are caused by faulty electrical connections or wiring.
  - Poor mating of coupler halves, or terminals not fully seated in coupler body (backed out).
  - Improperly formed or damaged terminals. All coupler terminals in problem circuit should be carefully 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. Attempting to do it may cause damage to ECM.
- Never connect an ohmmeter to ECM with its coupler connected to it. Attempting 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 or ICM may get damaged.

60G10-8A-10-1S

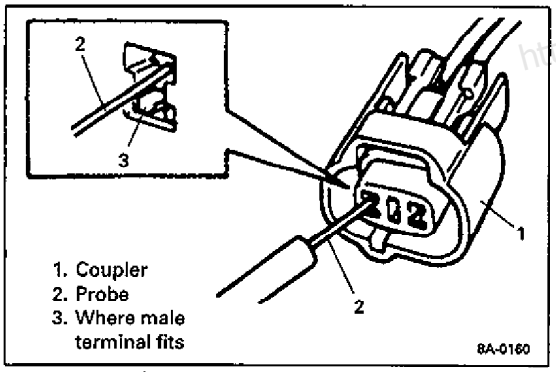


60G00-8A-10-2S



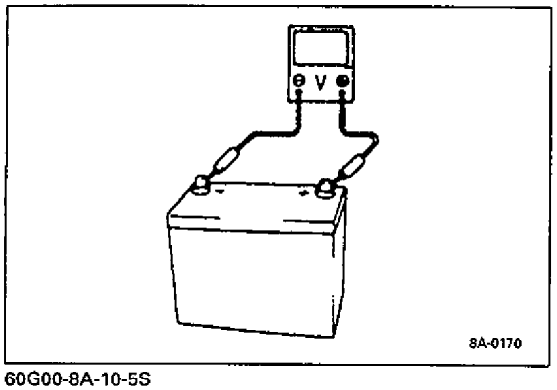
- When connecting a probe of ohmmeter, voltmeter, etc. to coupler terminal, be sure to connect it from wire harness side of coupler.

60G00-8A-10-3S



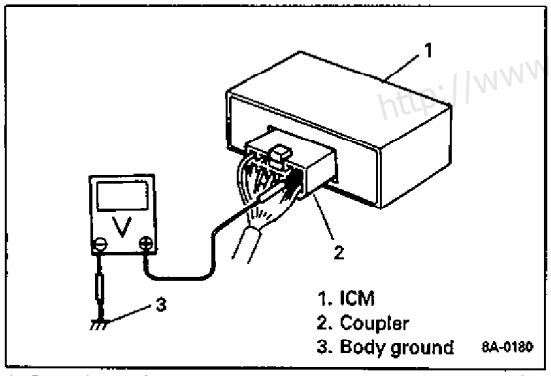
- When connecting meter probe from terminal side of coupler because it can't be connected from harness side, use extra care not to bend male terminal of coupler or force its female terminal open for connection.
  In case of such coupler as shown at the left, connect probe as shown to avoid opening female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

60G00-8A-10-4S



- 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.

60G00-8A-10-5S



60G00-8A-11-1S

- 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]

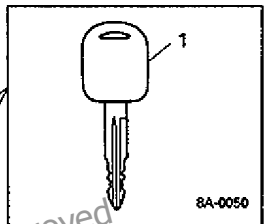
- When ECM was replaced, including when replaced because rechecking by using a known-good ECM was necessary during trouble diagnosis, the ECM/ICM code must be registered in ECM and ICM by performing procedure described in "Procedure after ECM Replacement" Section. If it is not registered, the engine 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.

60G00-8A-11-2S

DIAGNOSTIC FLOW CHART

START

1. Check that switch terminal is not grounded by service wire. For positions of diagnosis switch terminal and ground terminal, refer to Section 6E4.
2. Prepare all transponder built-in ignition keys used for vehicle being serviced and check that the number of those keys is 4 or less.
3. Using each ignition key, check glow indicator lamp while ignition switch is ON (but without starting engine) and repeat the same check with other keys. Is there any key which makes glow indicator lamp flash?



1: Ignition key with built-in transponder

CHECK ENGINE
In speedometer

NO (Remains ON)

Using service wire, ground diagnosis switch terminal for Engine and Emission Control System. (For positions of diagnostic switch terminal and ground terminal, refer to Section 6E4.)
Does glow indicator lamp flash?

NO

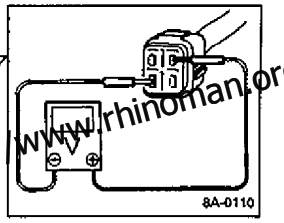
YES

END

NO (Remains OFF)

YES (Flashes)

1. Using one of ignition keys which made glow indicator lamp flash, connect positive probe of analog type voltmeter to diagnostic output terminal of immobilizer diagnostic coupler and negative probe to ground of immobilizer diagnostic coupler with ignition switch turned ON.
2. Is it possible to read diagnostic trouble code (DTC) by checking deflection of voltmeter indicator? (Refer to "DIAGNOSTIC TROUBLE CODE TABLE" section)



Proceed to "TROUBLE SHOOTING" in Section 6E4.

NO

Proceed to chart A–1.

YES

Does deflection of voltmeter indicate normal code?

NO

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

YES

1. After repair, connect positive probe of analog type voltmeter to diagnostic output terminal of immobilizer diagnostic coupler and negative probe to ground of immobilizer diagnostic coupler with ignition switch turned ON.
2. Using all ignition keys, check that "normal" diagnostic trouble code is indicated. Is there an ignition key not indicating normal code?

YES

NO

Does glow indicator lamp flash at ignition switch ON?

NO

END

YES

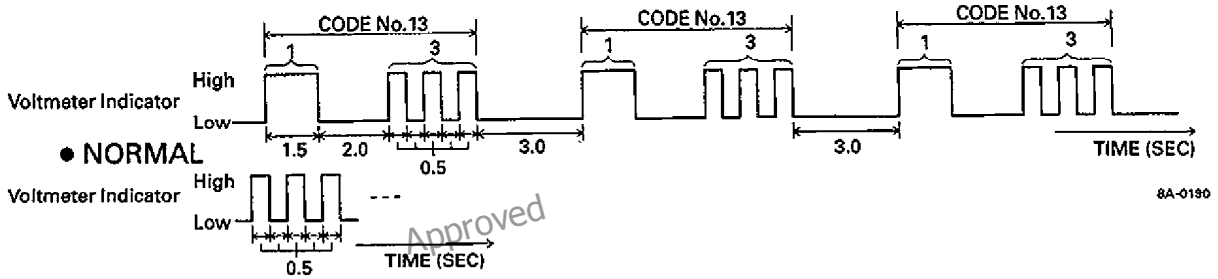
1. Using service wire, ground diagnosis switch terminal for Engine and Emission Control System. (For positions of diagnostic switch terminal and ground terminal, refer to Section 6E4.)
   Then read diagnostic trouble code (DTC) for immobilizer control system from flashing of glow indicator lamp.
2. Check and repair according to flow chart corresponding to that code No.
3. After repair, make sure that diagnostic trouble code(s) for immobilizer control system is (are) not indicated with diagnosis switch terminal grounded and ignition switch turned ON.
4. Remove service wire and reinstall cap.

END

DIAGNOSTIC TROUBLE CODE TABLE

Immobilizer Control Module (ICM) side

EXAMPLE :● COIL ANTENNA FAILURE (CODE NO. 13)



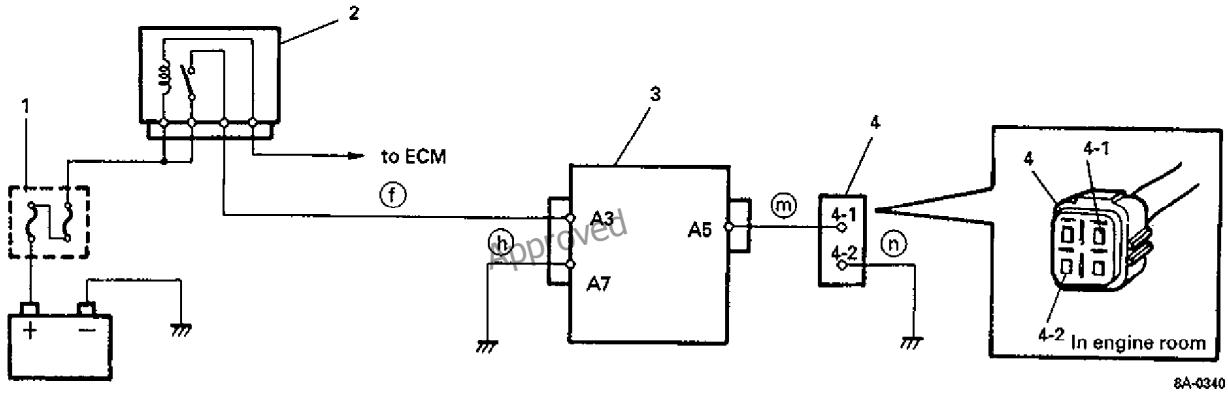
DIAGNOSTIC TROUBLE CODE		DIAGNOSTIC AREA	DIAGNOSIS
NO.	VOLTMETER INDICATION		
–	8A-0210	Normal	This code appears when none of the other codes are identified.
11	8A-0220	Transponder code (TP code)	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
31	8A-0230		
12	8A-0240	ICM	
13	8A-0250	Coil antenna of ignition key with built-in transponder	
21	8A-0260	ECM/ICM code	
22	8A-0270	Ignition switch circuit	
23	8A-0280	Serial data link wire	

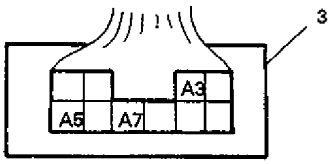
Engine Control module (ECM) side

To learn how to read diagnostic trouble code (DTC) from flashing of glow indicator lamp, refer to Section 6E4.

DIAGNOSTIC TROUBLE CODE		DIAGNOSTIC AREA	DIAGNOSIS
NO.	GLOW INDICATOR lamp INDICATION		
12	8A-0290	Normal	This code appears when it is confirmed that none of other trouble codes is set for immobilizer control system or engine and emission control system.
81	8A-0300	ECM/ICM code	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
84	8A-0310		
82	8A-0320	ECM	
83	8A-0330	Serial data link wire	

A-1 CODE (DTC) IS NOT OUTPUTTED FROM DIAGNOSTIC OUTPUT TERMINAL OF IMMOBILIZER DIAGNOSTIC COUPLER





1. Main fuse
2. Main relay
3. ICM
4. Immobilizer diagnostic coupler

4-1. Diagnostic output terminal
4-2. Ground terminal

60G00-8A-14-1S

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.

60G10-8A-14-3S

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.

60G00-8A-15-1S

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.

60G00-8A-16-1S

DTC12 FAULT IN IMMOBILIZER CONTROL MODULE (ICM)

DESCRIPTION:

This DTC is set when an internal fault is detected in ICM.

INSPECTION:

1) Ignition switch "OFF".
2) Disconnect connectors from ICM.
3) Check for proper connection to ICM at all terminals.
   Are they in good condition?

YES

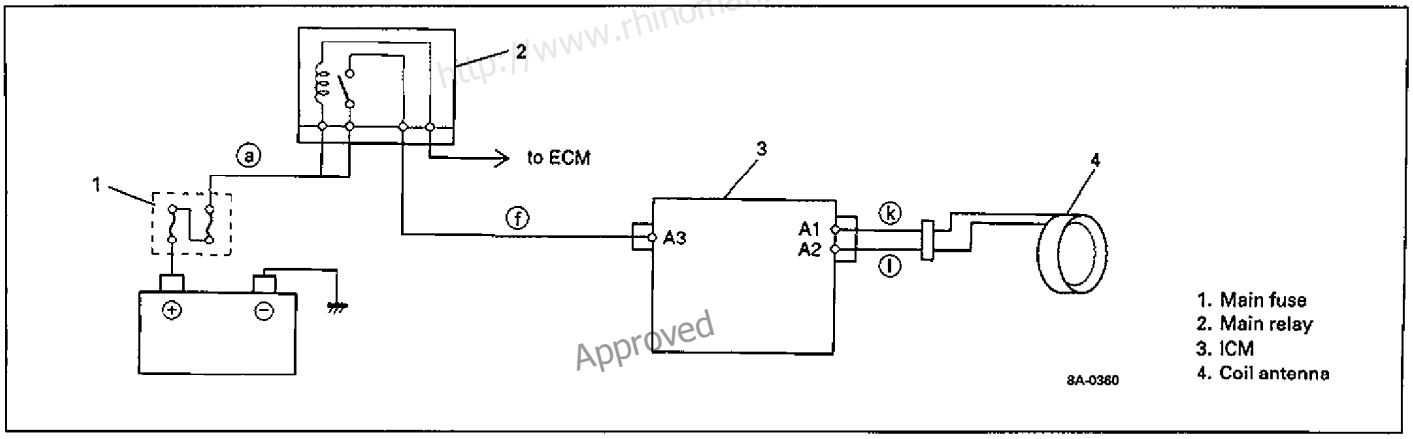
Substitute a known-good ICM and recheck.
NOTE:
After replacing with a known-good ICM, register ECM/ICM code in ECM and TP code and ECM/ICM code in ICM by performing procedure described in "Procedure after ICM Replacement" section.

NO

Repair or replace

60G00-8A-17-1S

DTC13 NO TP (TRANSPONDER) CODE TRANSMITTED OR COIL ANTENNA OPENED/SHORTED



60G00-8A-18-1S

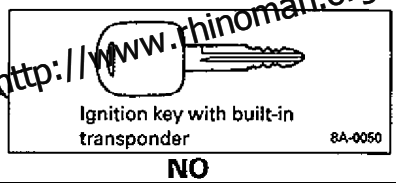
DESCRIPTION:

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?

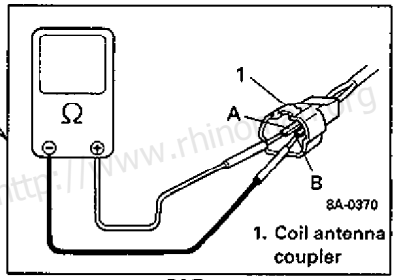
NO → Replace ignition key with built-in transponder and follow "DIAGNOSTIC FLOW CHART" again.



YES

1. Disconnect coil antenna coupler with ignition switch turned OFF.
2. Is there continuity between coil antenna coupler terminals A and B?

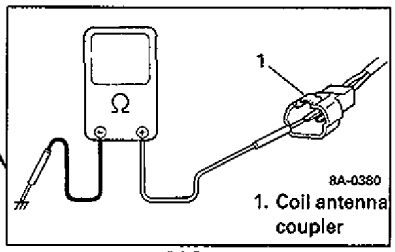
NO → Coil antenna open



YES

Measure resistance between terminals of coil antenna coupler and body ground.
Is it ∞ (infinity) Ω ?

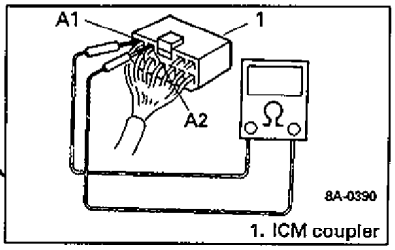
NO → Coil antenna shorted to ground



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

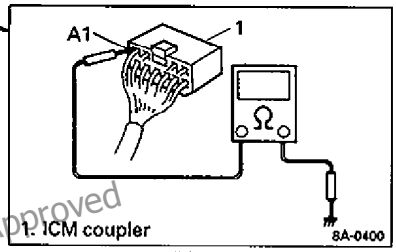
To be continued

60G00-8A-18-2S

continued

Measure resistance between terminal A1 of ICM coupler and body ground.
Is it ∞ (infinity) Ω ?

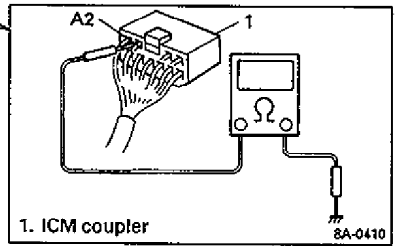
NO → "ⓚ" wire shorted to ground



YES

Measure resistance between terminal A2 of ICM coupler and body ground.
Is it ∞ (infinity) Ω ?

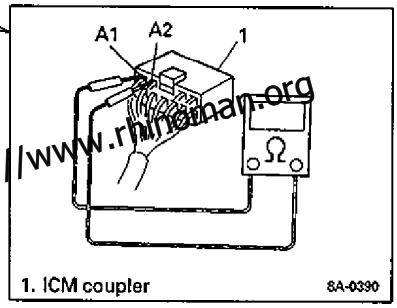
NO → "Ⓛ" wire shorted to ground



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:

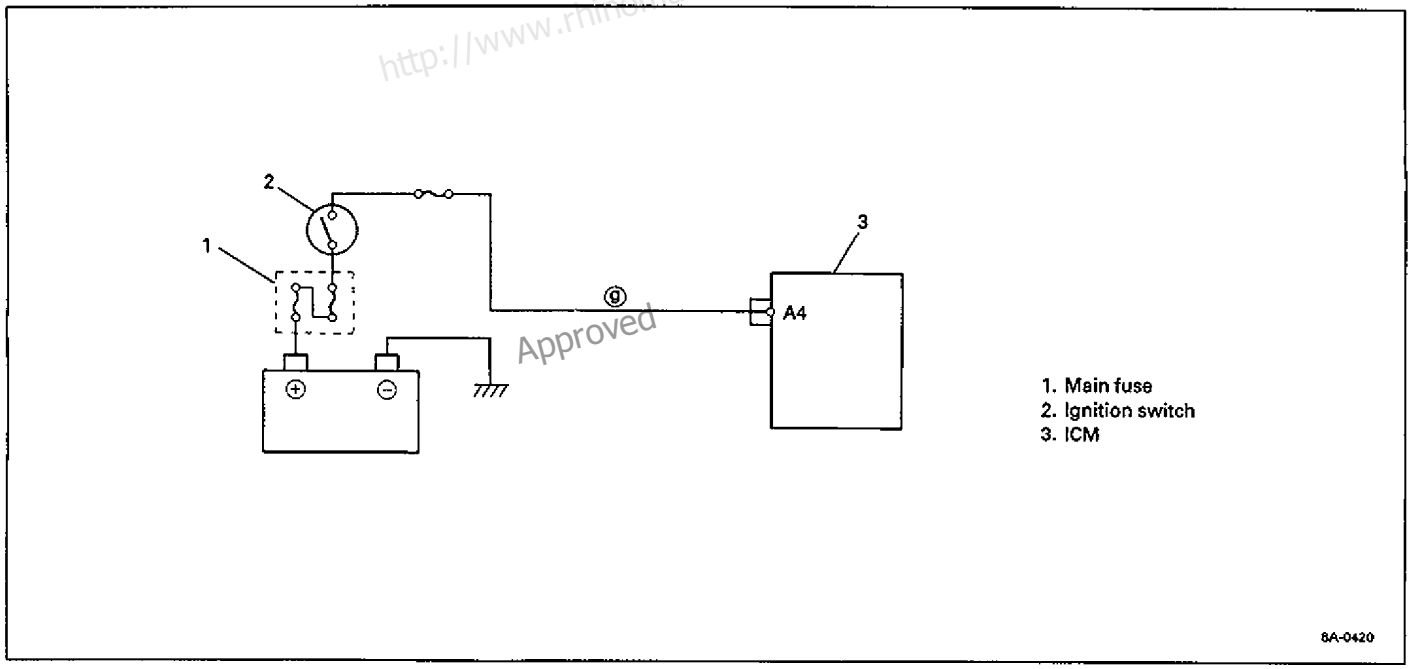
Using TECH1 (TECH1 cartridge for immobilizer control system and TECH1A kit), execute "RECORD ECM/ICM" command in SELECT MODE menu.

NOTE:

For operation procedure of TECH1, refer to TECH1 operator's manual.

60G00-8A-20-1S

DTC22 IGNITION SWITCH CIRCUIT OPEN/SHORT



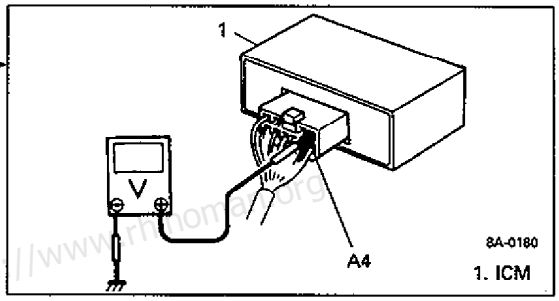
60G00-8A-21-1S

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

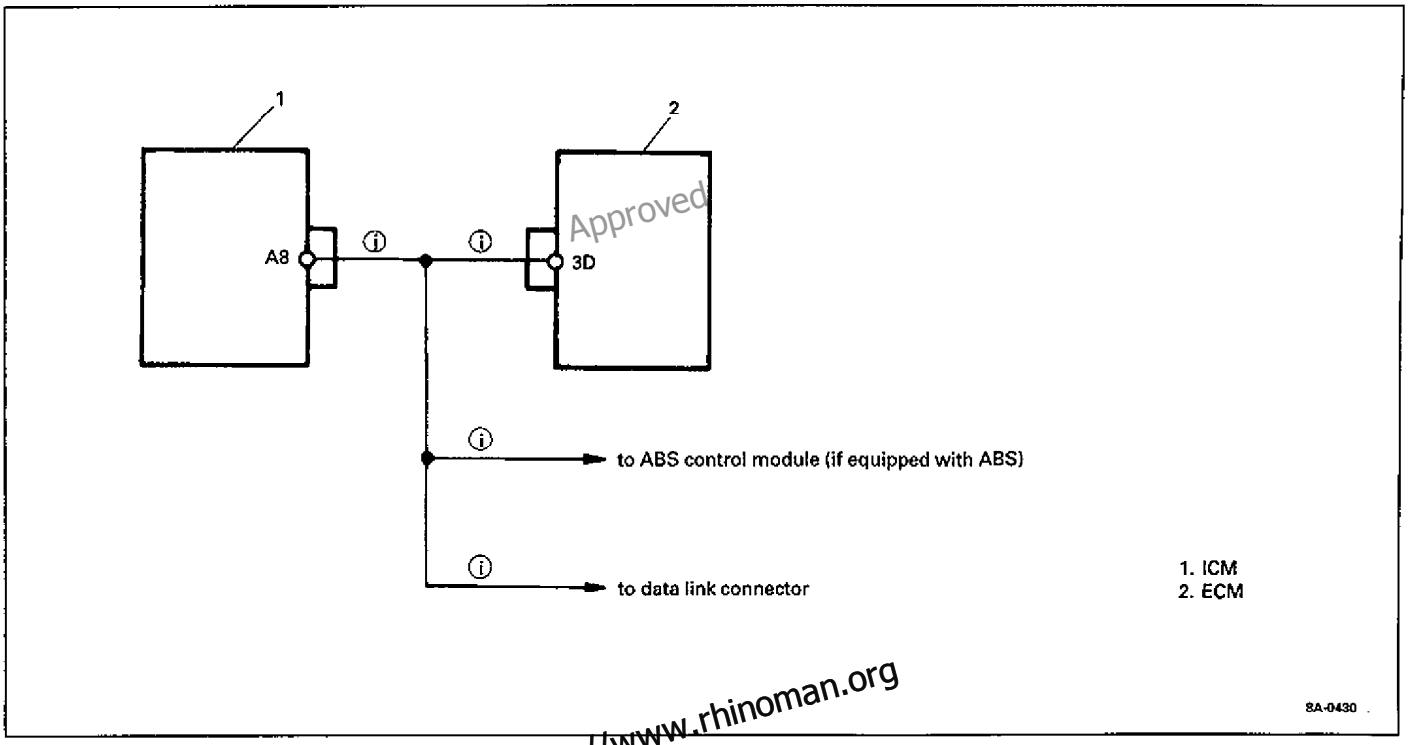
Poor A4 terminal connection.
If connection is OK, substitute a known-good ICM and recheck.
NOTE:
After replacing with a know-good ICM, register ECM/ICM code in ECM and TP code and ECM/ICM code in ICM by performing procedure described in "Procedure after ICM Replacement" section.

NO

" ⓖ " wire open or short

60G00-8A-21-2S

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



60G00-8A-22-1S

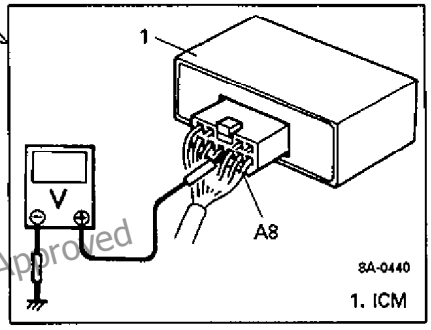
DESCRIPTION

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:

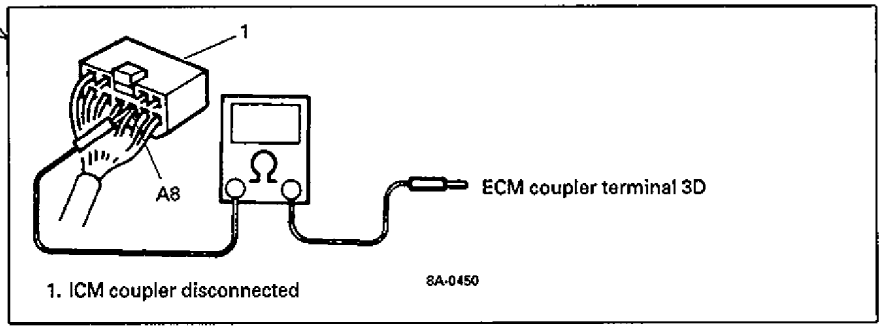
Check voltage between ICM coupler terminal A8 and body ground with ignition switch turned ON.
Is it 4–5V?

NO → "ⓘ" or "ⓙ" wire short



YES

1. Disconnect ECM coupler with ignition switch turned OFF.
2. Is there continuity between ICM coupler terminal A8 and ECM coupler terminal 3D.



NO → "ⓘ" or "ⓙ" wire between ICM and ECM open

YES

Poor A8 connection (ICM) or 3D 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:

1) Ignition switch "OFF".
2) Disconnect connectors from ECM.
3) Check for proper connection to ECM at all terminals.
   Are they in good condition?

YES

Substitute a known-good ECM and recheck.
NOTE:
After replacing with a known-good ECM/ICM, register ECM/ICM code in ECM by performing procedure described in "Procedure after ECM Replacement" section.

NO

Repair or replace

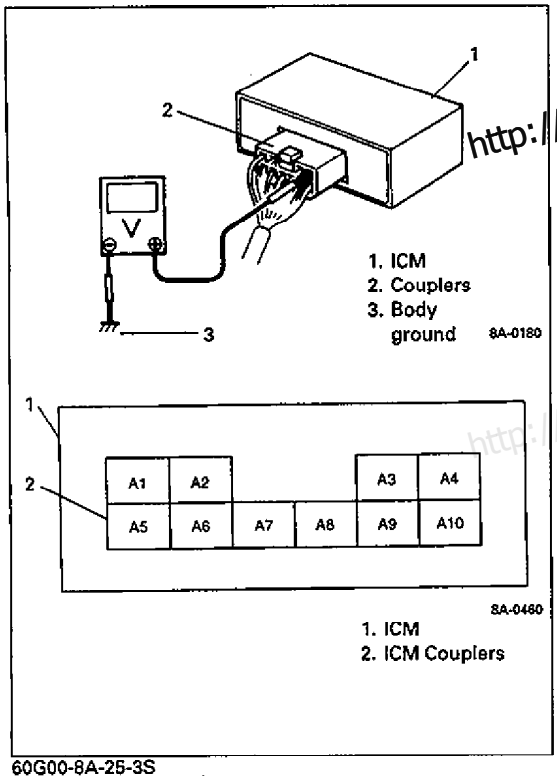
60G00-8A-24-1S

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 Section 6E4.

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

60G00-8A-25-1S



60G00-8A-25-3S

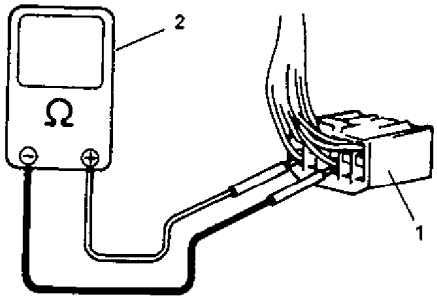
Voltage Check

1) Remove ICM from body with ignition switch OFF referring to p. 8A-28.
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-0470

Resistance Check

1) Disconnect ICM couplers from ICM with ignition switch OFF.

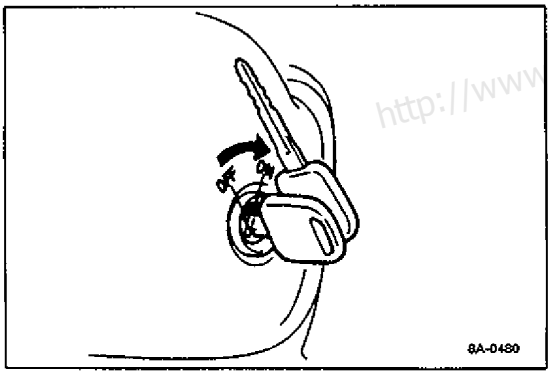
CAUTION:
Never touch terminals of ICM itself or connect voltmeter or ohmmeter.

2) Check resistance between each terminal of couplers disconnected.

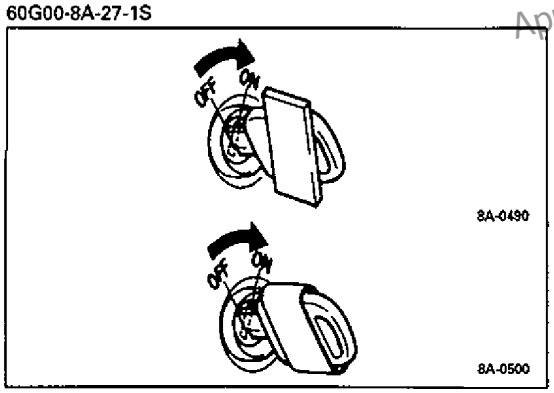
CAUTION:
- **Be sure to connect ohmmeter probe from wire harness side of coupler.**
- **Be sure to turn OFF ignition switch for this check.**
- **Resistance in table below represents that when parts temperature is 20°C (68°F).**

TERMINAL	CIRCUIT	NORMAL RESISTANCE	CONDITION
A1 – A2	Coil antenna	Continuity	–

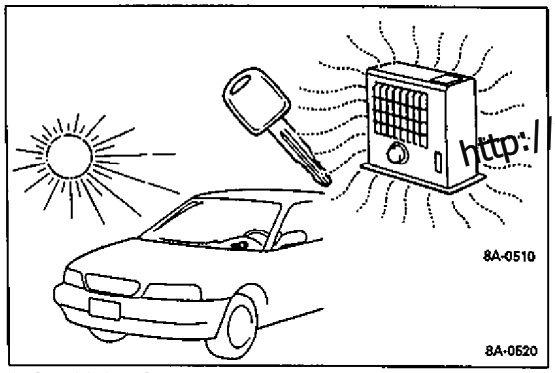
60G00-8A-26-1S



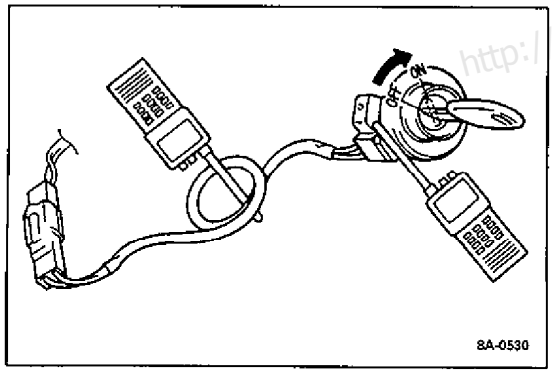
60G00-8A-27-1S



60G00-8A-27-2S



60G00-8A-27-3S



60G00-8A-27-4S

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.

60G00-8A-28-1S

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.

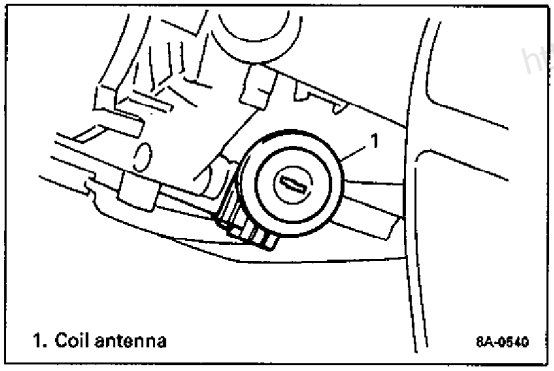
60G00-8A-28-2S

ENGINE CONTROL MODULE (ECM)

Removal and Installation Note

After replacing ECM, be sure to register ECM/ICM code in ECM by performing procedure described in "Procedure after ECM Replacement" section.

60G00-8A-28-3S



60G00-8A-28-4S

COIL ANTENNA

Removal

1) Disconnect negative (–) cable at battery.
2) Remove hole cover and steering column upper cover.
3) Remove coil antenna

Installation

For installation, reverse removal procedure, surely referring to Section 3C (without air bag) or 3C1 (with air bag).

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 glow indicator lamp 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 glow indicator lamp 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 glow indicator lamp 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 glow indicator lamp 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.

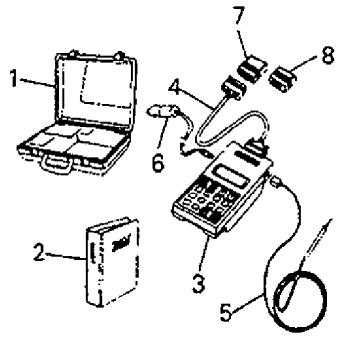
1) Prepare TECH1 (TECH1A kit and cartridge for immobilizer control system).

   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.

60G00-8A-31-1S

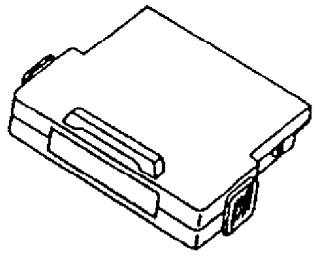
SPECIAL TOOLS



1. Storage case
2. Operator's manual
3. Tech 1A
4. DLC cable
5. TAL head/probe
6. Power source cable
7. DLC cable adapter
8. Self-test adapter

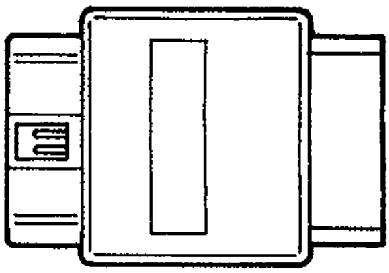
09931-76011
Tech-1 (scan tool) kit

8A-0650



Tech-1 cartridge for immobilizer control system

8A-0560



8A-0570

09931-96020
16/12 pin DLC adapter

60G10-8A-31-2S

SECTION 10

SERVICE DATA

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

78E00-10-1-1S

CONTENTS

78E00-10-1-2S

ENGINE

Item \ Engine		RF-TURBO
Cylinder Arrangement and Number		In-line, 4-cylinders
Firing Order		1–3–4–2
Valve System		OHC, belt-driven
Bore × Stroke [mm (in)]		86.0×86.0 (3.39×3.39)
Total Piston Displacement [cc (cu in)]		1,998 (121.9)
Compression Ratio		20.4 : 1
Compression Pressure [kg/cm^2 (psi)-rpm]	Standard	30 (427)-200
	Minimum	27 (384)-200
	Maximum Difference Between Cylinders	3.0 (43)
Injection Timing		13° ATDC
Injection Pressure [kg/cm^2 (psi)]		150 (2133)
Idle Speed [rpm]		770±50 (P range or neutral)

78E00-10-1-3S

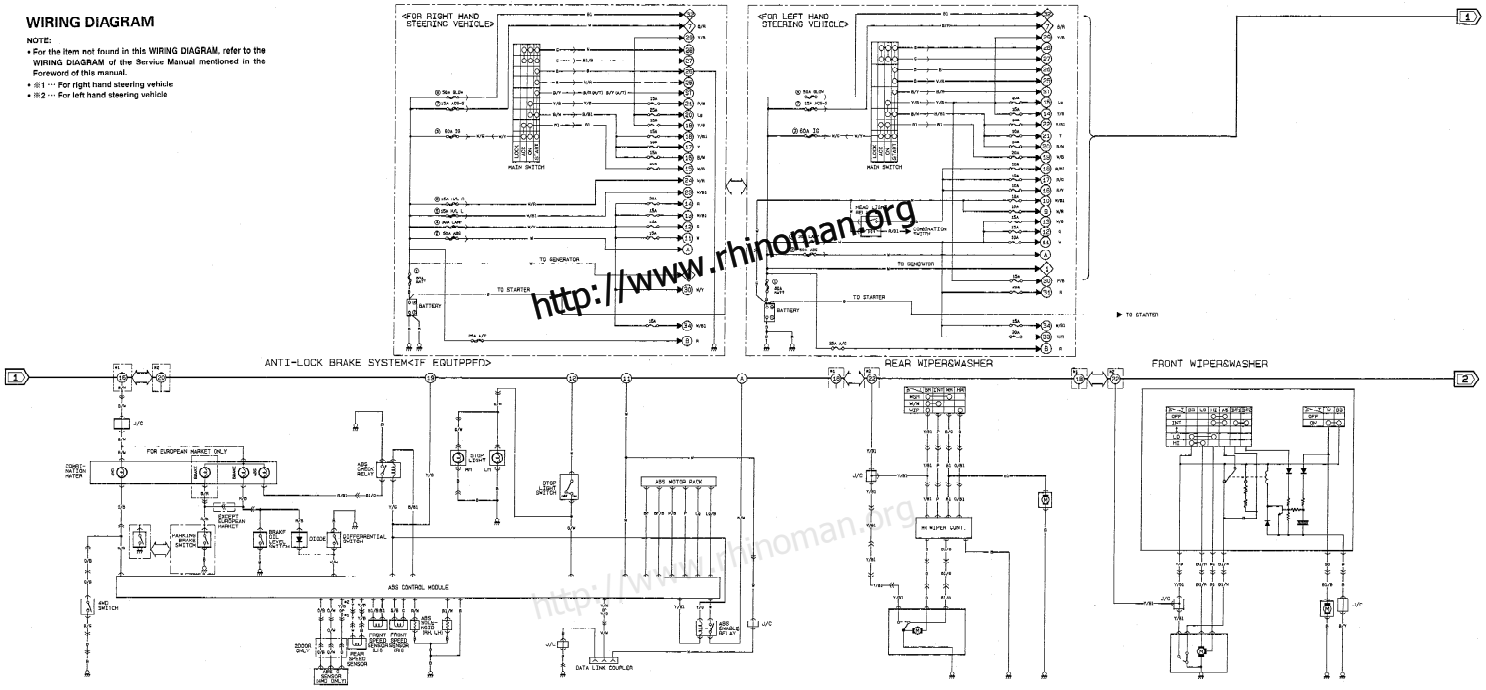
HEATER AND AIR CONDITIONING SYSTEM

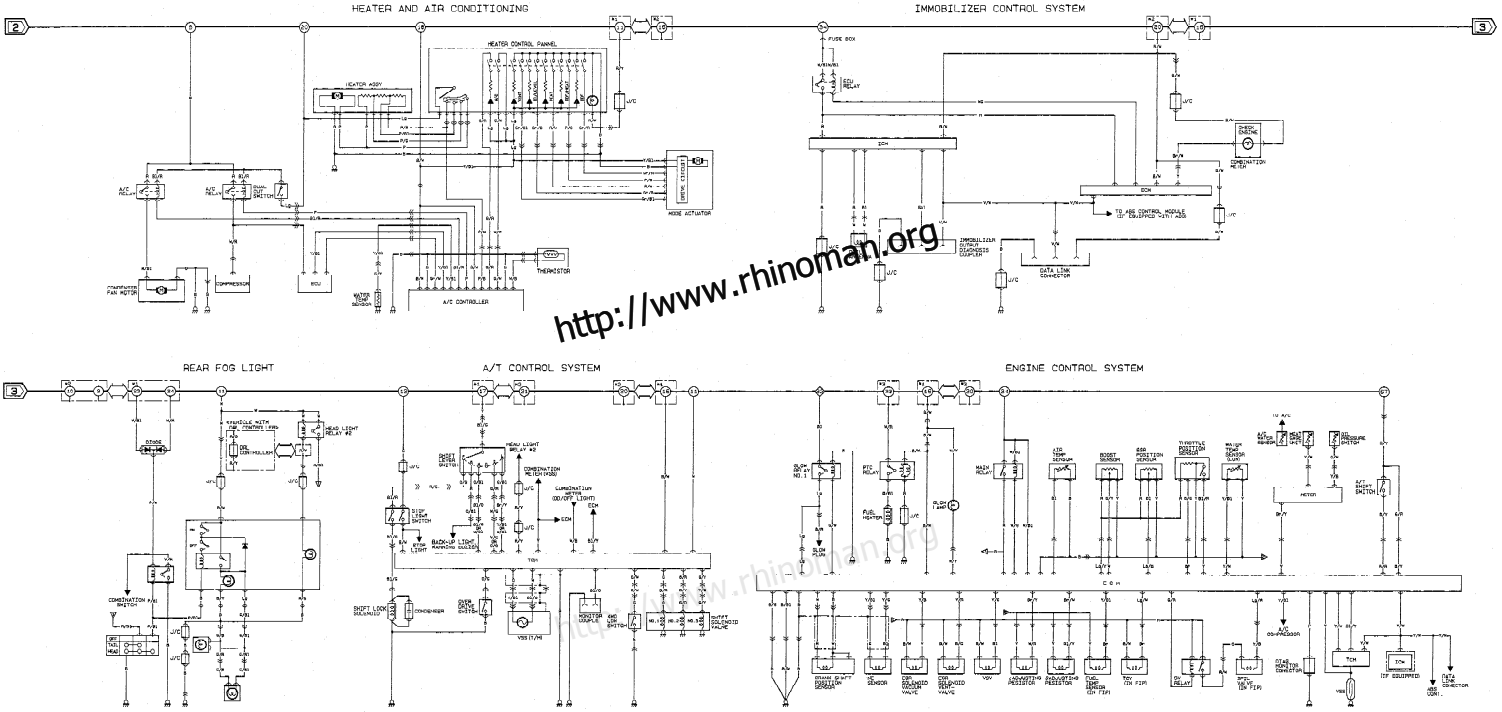
Item \ Engine	RF-TURBO
Compressor Belt Deflection [mm (in)]	8.0 – 10.0 (0.32 – 0.39)
Idle Up Speed (A/C ON) [rpm]	800±50

78E00-10-1-4S

WIRING DIAGRAM

NOTE:
- For the item not found in this WIRING DIAGRAM, refer to the WIRING DIAGRAM of the Service Manual mentioned in the Foreword of this manual.
- ※1 ··· For right hand steering vehicle
- ※2 ··· For left hand steering vehicle





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