KIA CARNIVAL 2002 - 2006 FACTORY WORKSHOP & SERVICE MANUAL

Also known as the Kia Sedona

To suit vehicles with Chassis Code KV-II

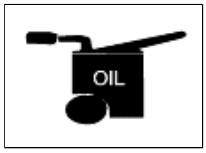
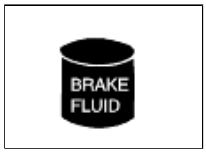
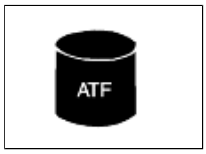
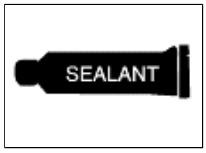
For reference purposes only.

NOT FOR SALE / NOT FOR RESALE

Fundamental procedures

Symbols

There are six primary symbols used to complement illustrations. These symbols indicate the areas to apply such materials during service.

Symbol	Meaning	Type
	Apply oil	New engine oil, gear oil, etc. as appropriate
	Apply brake fluid	Only brake fluid
	Apply automatic transmission fluid (ATF)	Only ATF
	Apply grease	Appropriate grease
	Apply sealant	Appropriate sealant
	Apply petroleum jelly	Appropriate petroleum jelly

NOTE

Whenever special oil or grease is required, it will be identified in figure.

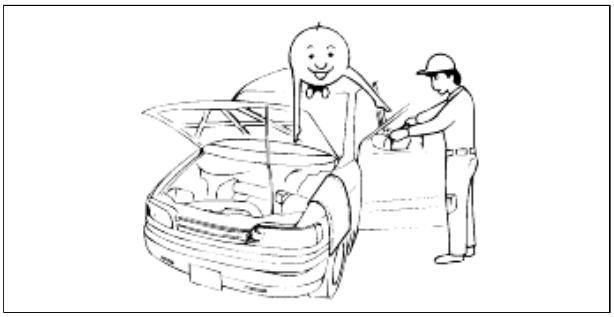
NOTICES, CAUTIONS AND WARNINGS

As you read through the various procedures, you will encounterNotices,CautionsandWarnings. Each one is there for a specific purpose.Noticesgive you added information that will assist you in completing a particular procedure.Cautionsprevent you from making an error that could damage the vehicle.Warningsremind you to be especially careful in specific areas where carelessness can cause personal injury.

The following items contain general procedures you should always follow when working on a vehicle:

PROTECTION OF VEHICLE

Always cover fenders, seats, and floor areas before starting work. Operate the engine only in a well-ventilated area to avoid

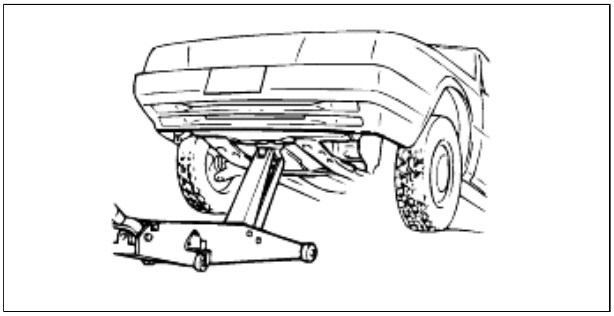


A WORD ABOUT SAFETY

The following precautions must be followed when jacking up the vehicle:

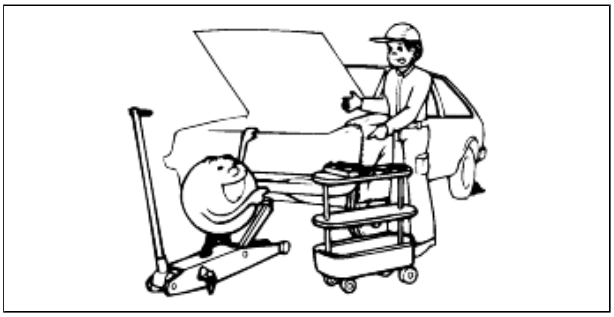
1. Block the wheels.
2. Use only the specified jacking positions.
3. Support the vehicle with safety stands.

The engine compartment must be clear of tools and people before starting the engine.



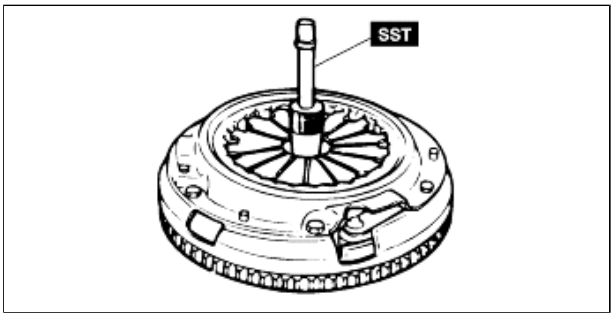
PREPARATION OF TOOLS AND MEASURING EQUIPMENT

All necessary tools and measuring equipment should be available before starting any work.



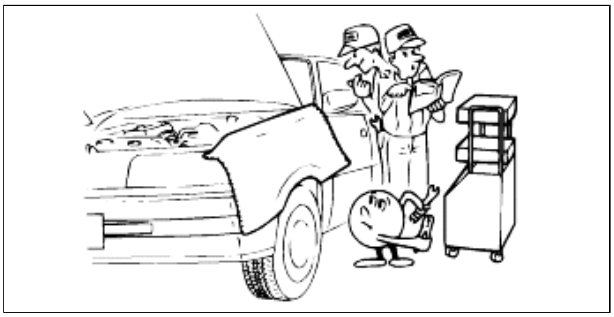
SPECIAL SERVICE TOOLS (SST'S)

Use special service tools when they are required. SST's can be found under "preparation"prior to any procedure requiring them.



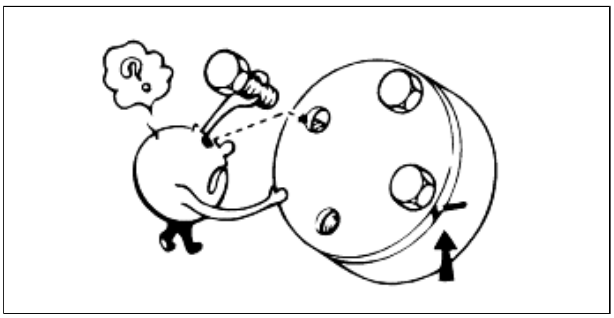
REMOVAL OF PARTS

Begin work only after first learning which parts and subassemblies must be removed and disassembled for replacement or repair.



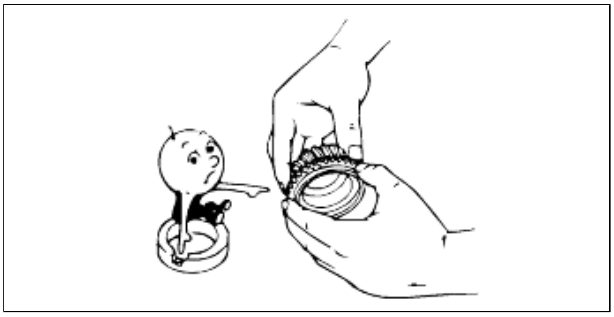
DISASSEMBLY

If the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be disassembled in a way that will not affect their performance or external appearance. Additionally, these parts should be identified so that reassembly can be done easily and efficiently.



INSPECTION OF PARTS

When removed, each part should be carefully inspected for malfunction, deformations, damage, or other problems.

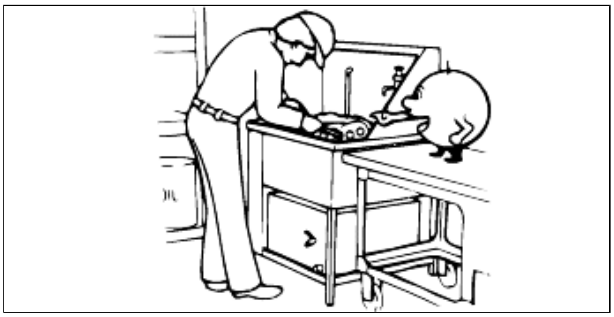


Arrangement of parts

All disassembled parts should be carefully arranged for reassembly. Separate or otherwise identify the parts to be replaced from those that will be reused.

CLEANING PARTS FOR REUSE

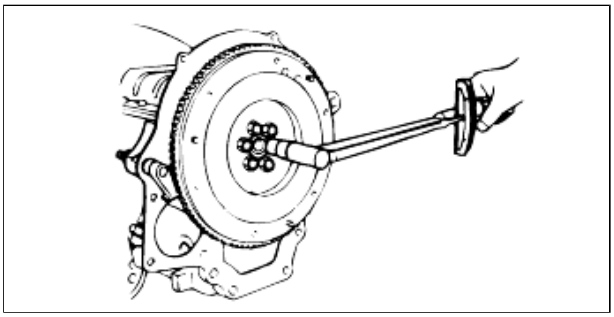
All parts that will be reused should be carefully and thoroughly cleaned using appropriate methods.



REASSEMBLY

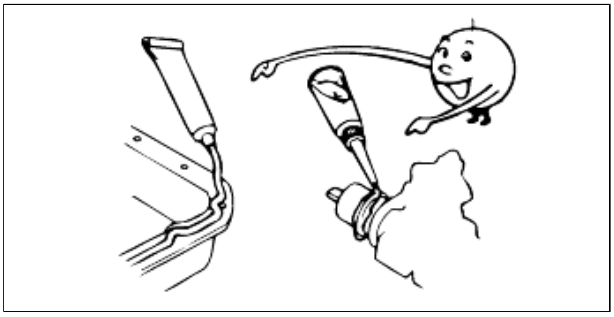
Standard values, such as torques and certain adjustments, must be strictly observed in the reassembly of all parts. If removed, the following parts should be replaced with new ones:

1. Oil seals
2. O-rings
3. Cotter pins
4. Gaskets
5. Lock washers
6. Nylon nuts



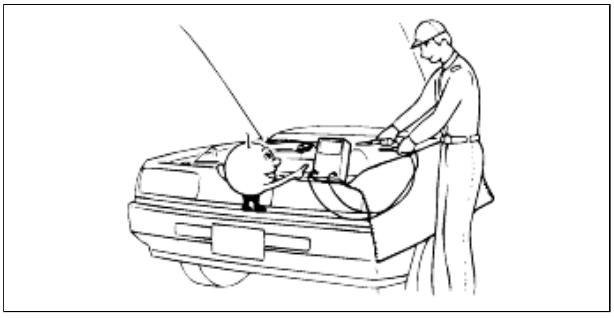
DEPENDING ON LOCATION:

1. Sealant should be applied or new gaskets installed.
2. Oil should be applied to the moving components of parts.
3. Specified oil or grease should be applied at the appropriate locations (such as oil seals) before reassembly.



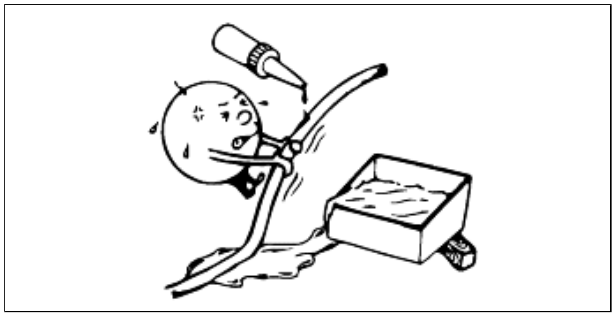
Adjustments

Use appropriate gauges and/or testers when making adjustments.



Rubber parts and tubing

Prevent gasoline or oil from contacting rubber parts or tubing.

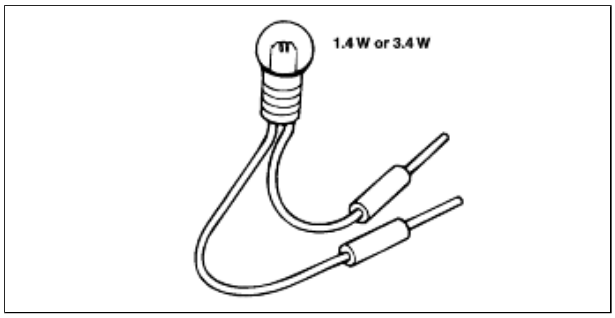


Electrical troubleshooting tools (Test Light)

The test light, as shown in figure, uses a 12V bulb. The two lead wires should be connected to probes.

The test light is used for simple voltage checks and in checking for short circuits.

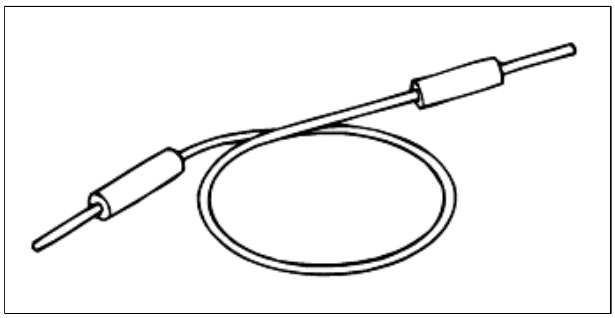
> CAUTION
>
> When checking the engine control module (ECM), never use a bulb exceeding 3.4W.



Electrical troubleshooting tools(Jumper wire)

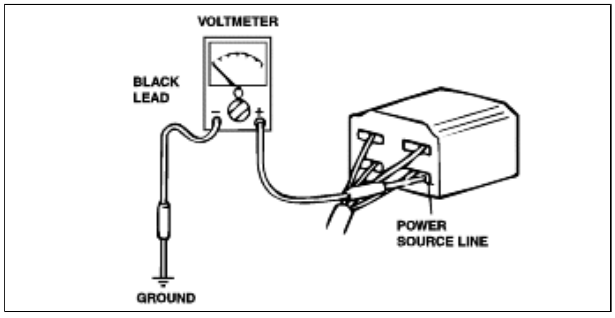
The jumper wire is used for testing by shorting across switch terminals and ground connections.

> CAUTION
>
> Do not connect a jumper wire from the power source line to a body ground. Such a connection may cause damage to harnesses or electronic components.



VOLTMETER

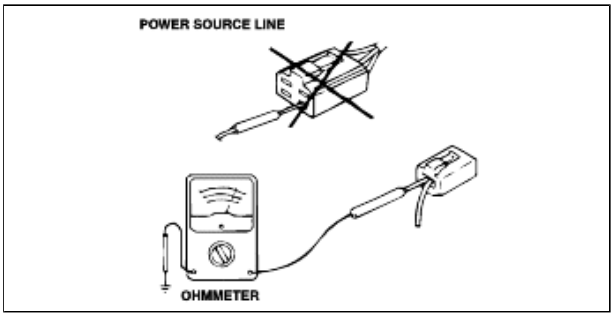
The DC voltmeter measures circuit voltage. A voltmeter with a range of 15V or more is used by connecting the positive (+) probe (red lead wire) to the point where voltage is to be measured, and the negative (-) probe (black lead wire) to a body ground.



OHMMETER

The ohmmeter is used to measure the resistance between two points in a circuit and also to check for continuity and the diagnosis of short circuits.

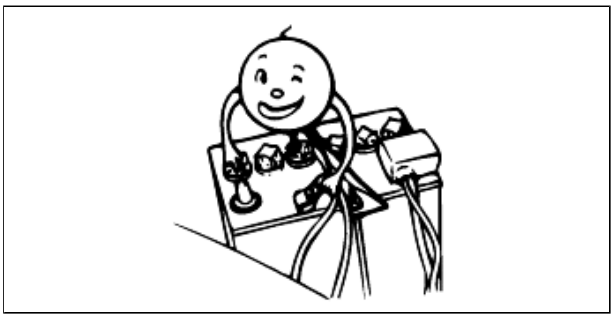
> CAUTION
>
> Do not attempt to connect the ohmmeter to any circuit in which voltage is applied. Such a connection may damage the ohmmeter.



Electrical parts

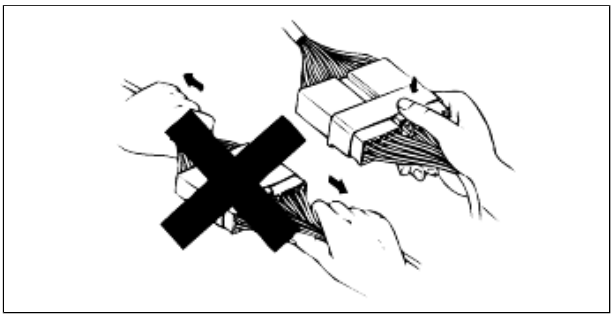
Battery cable

Before disconnecting connectors or replacing electrical parts, disconnect the negative battery cable.

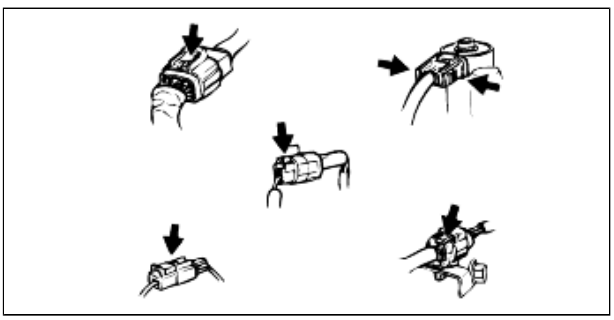


Connectors(Removal of connector)

1. Never pull on the wiring harness when disconnecting connectors.

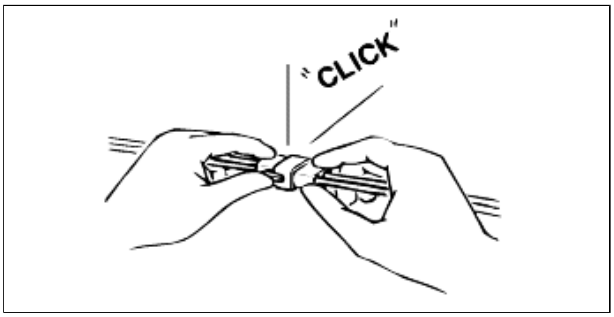


2. Connectors can be removed by pressing or pulling lock lever.



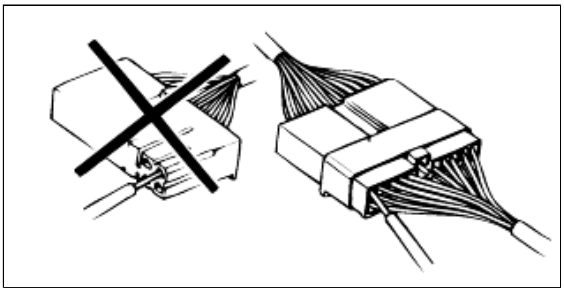
Connectors(Locking a connector)

Listen for a click when locking connectors. This sound indicates that they are securely locked.



Connectors(Inspection)

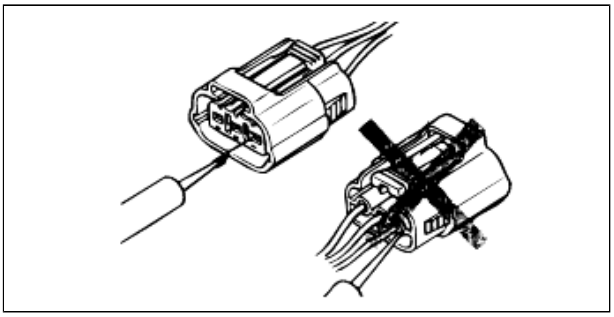
1. When a tester is used to check for continuity or to measure voltage, insert tester probe from wire harness side.



2. Check terminals of waterproof connectors from connector side because they cannot be accessed from harness side.

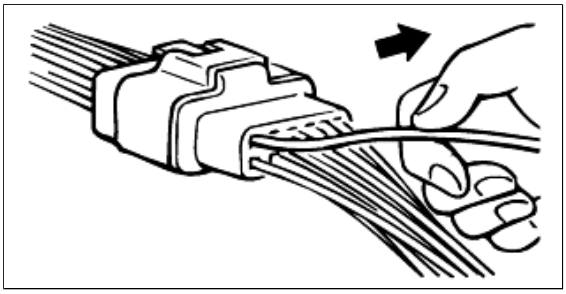
NOTE

1) Use a fine wire to prevent damage to the terminal.
2) Do not damage the terminal when inserting the tester lead.



Terminals(Inspection)

Pull lightly on individual wires to ensure that they are secured in the terminal.

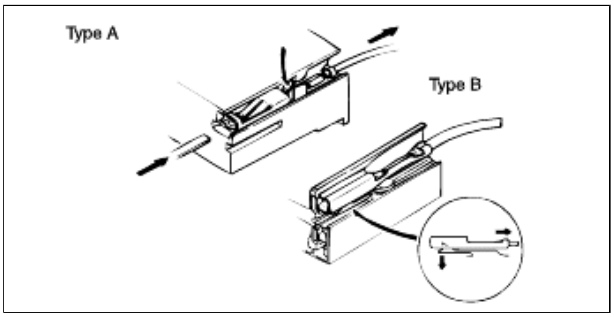


REPLACEMENT OF TERMINALS

Use appropriate tools to remove terminal as shown. When installing the terminal, insert it until it locks securely.

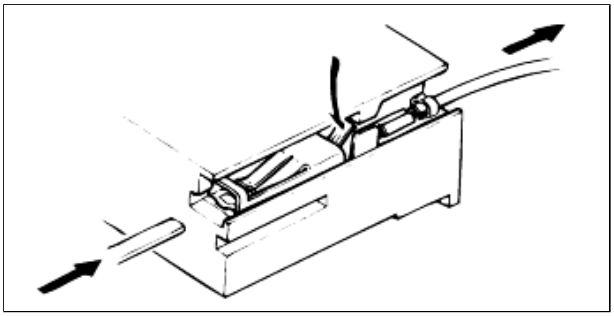
FEMALE

Insert a thin piece of metal from the terminal side of the connector, and then, with the terminal locking tab pressed down, pull the terminal out of the connector.



MALE

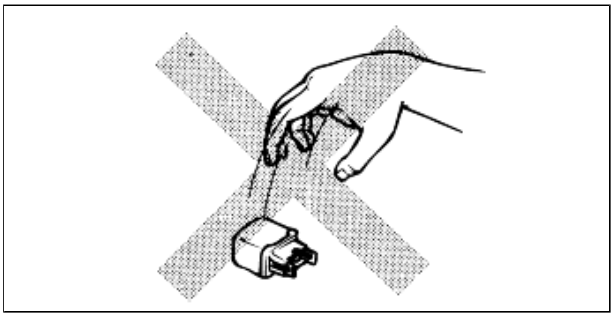
Follow the same procedure as female-type terminal.



SENSORS, SWITCHES, AND RELAYS

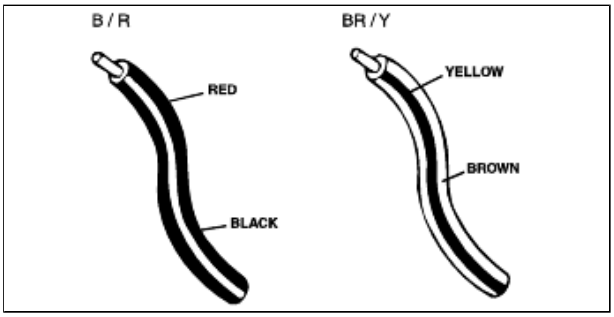
Always handle sensors, switches and relays carefully.

Do not drop them or accidentally strike them against other parts.



WIRING COLOR CODES

Two-color wires are indicated by a two-color code sysmbol. The firstcolor indicates the base color of the wire; the second color indicates the color of the stripe.

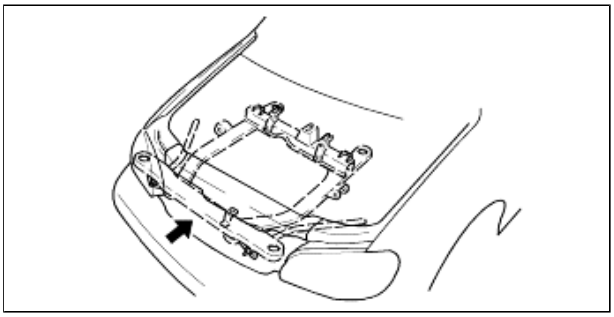


CODE	COLOR	CODE	COLOR
B	BLACK	P	PINK
BR	BROWN	R	RED
G	GREEN	S	SILVER(LIGHT BLUE)
GY	GRAY	T	TAWNY
L	BLUE	V	VIOLET
LG	LIGHT GREEN	W	WHITE
O	ORANGE	Y	TELLOW

JACK POSITIONS

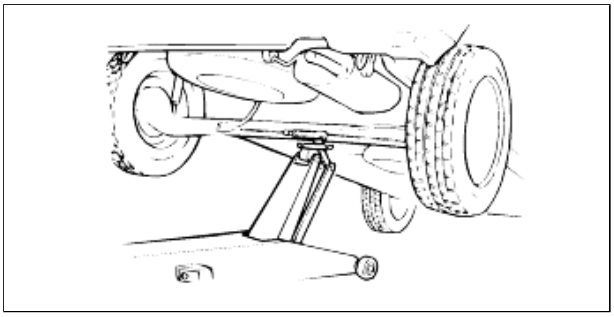
Front end jack position:

At the center of the sub-frame.



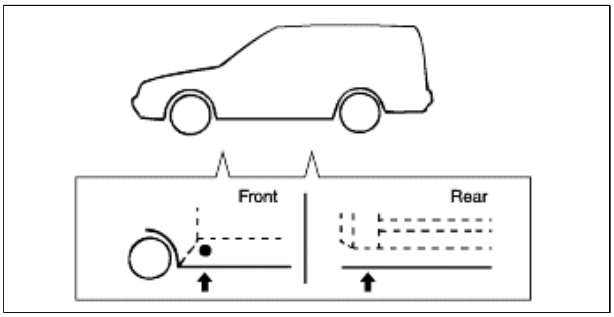
Rear end Jack position:

At the center of the rear axle.



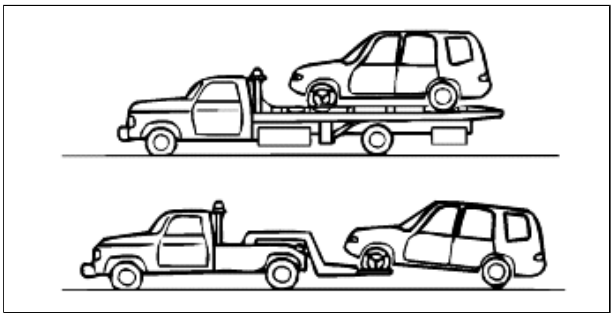
VEHICLE LIFT (2-SUPPORT TYPE) AND SAFETY STAND POSITIONS

Front end / Rear end



towing

Proper towing equipment is necessary to prevent damage to the vehicle. Always observe laws and regulations applicable to vehicles in tow. As a general rule, towed vehicles should be pulled with the driving wheels off the ground. If excessive damage or other conditions prevent towing the vehicle with the driving wheels off the ground, use wheel dollies.



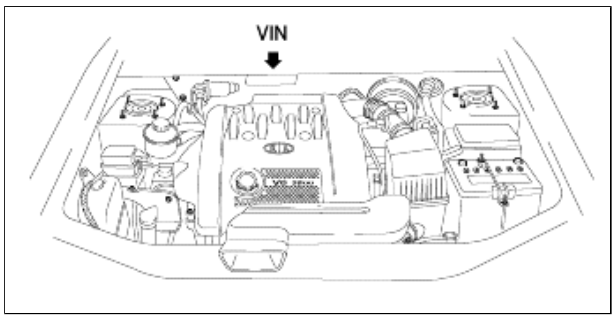
With either automatic or manual transmission:

1. Set the ignition switch in the ACC position.
2. Place the selector lever or shift lever in N (Neutral).
3. Release the parking brake.

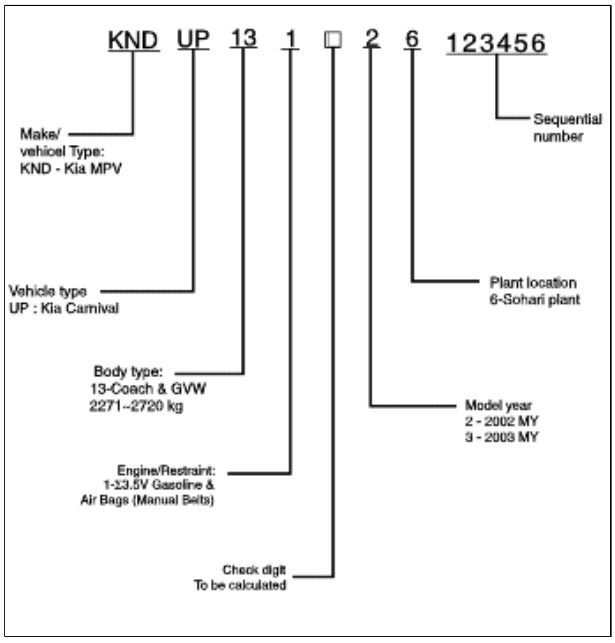
CAUTION

1) Do not tow vehicle backward with driving wheels on the ground. This may cause internal damage to transmission.
2) Do not use hook loops under the front and rear of the vehicle for towing purposes. These hook loops are designed ONLY for transport tie-down. If tie-down hook loops are used for towing, the front/rear bumper will be damaged.

VIN LOCATIONS

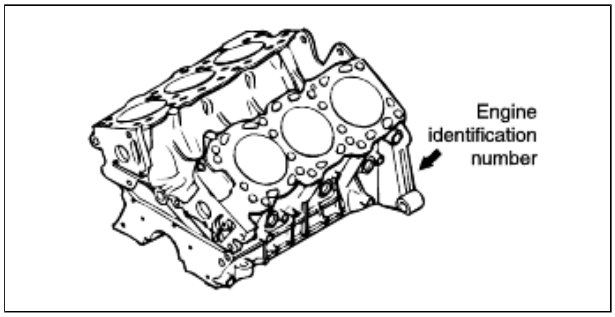


Vehicle identification number arrangement



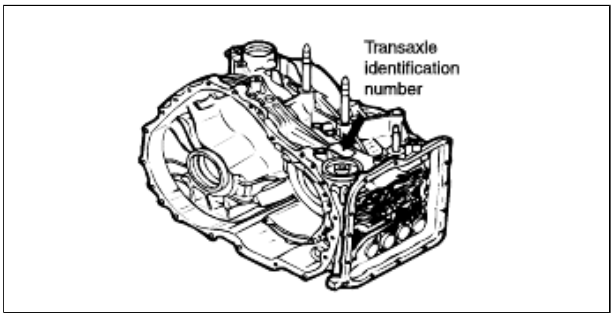
ENGINE NUMBER LOCATIONS

SIGMA 3.5



Transaxle number locations

SIGMA 3.5



English/Metric conversion table

Multiply	by	to get equivalent number of:	Multiply	by	to get equivalent number of:
	Length			Acceleration	
Inch (in)	25.4	millimeters (mm)	Foot/sec^2	0.3048	meter/sec^2 (m/s^2)
Foot (ft)	0.3048	meters (m)	Inch/sec^2	0.0254	meter/sec^2 (m/s^2)
Yard	0.9144	meters (m)		Torque	
Mile	1.609	Kilometers (km)	Inch-pound	0.11298	newton-meters (N·m)
			Foot-pound	1.3558	newton-meters (N·m)
	Area			Power	
Inch^2 (in^2)	645.2	millimeters^2 (mm^2)	Horsepower (HP)	0.746	kilowatts (kw)
	6.45	centimeters^2 (cm^2)		Pressure	
Foot (ft^2)	0.0929	meters^2 (m^2)	Pounds/inch^2 (psi)	6.895	kilopascals (kPa)
Yard	0.8361	meters^2 (m^2)			
	Volume			Energy	
Inch^3 (in^3)	16387	mm^3	Foot-pound	1.3558	joules (J)
	16.387	cm^3	Kilowatt-hour	3 600 000	joules (J)
	0.0164	liters (l)			
Quart (qt)	0.9464	liters (l)			
Gallon	3.7854	liters (l)			
Yard	0.7646	meters^3 (m^3)			
	Mass			Fuel performance	
Pound (lb)	0.4536	kilograms (kg)	Miles/gal (mpg)	0.4251	kilometers/liter (km/l)
Ton	907.18	kilograms (kg)			
	FORCE			Velocity	
Kilogram	9.807	newtons (N)	Miles/hour (mph)	1.6093	kilometers/hour
Ounce (oz)	0.2780	newtons (N)			
Pound (lb)	4.448	newtons (N)			
		Temperature			
To convert fahrenheit temperature to celsius temperature, use formula: C= 5/9 (F-32)			To convert celsius temperature to fahrenheit temperature, use formula: F= 9/5 C + 32		

UNITS

ft-lb or in-lb (N·m)	Torque
rpm	Rotational speed

A	Amperes
V	Volts
Ω	Resistance
psi (kPa)	Pressure
inHg (mmHg)	Pressure (usually negative vacuum)
W	Watts (electrical power)
US qt (liters)	Volume
in (mm)	Length

ABBREVIATIONS

ABDC	After bottom dead center
ABS	Anti-lock braking system
A/C	Air conditioner
ACC	Accessories
A/T	Automatic transaxle
ATDC	After top dead center
ATF	Automatic transmission fluid
BBDC	Before bottom dead center
BTDC	Before top dead center
CMP	Camshaft position sensor
CKP	Crankshaft position sensor
DIS	Distributorless ignition system
DLC	Data link connector
DOHC	Dual overhead Camshaft
EBD	Electronic brake-force distribution
ECM	Engine control module
ECT	Engine coolant temperature
E/L	Electrical load
EX	Exhaust
GND	Ground
HLA	Hydraulic lash adjuster
HO_2S	Heated oxygen sensor
IAT	Intake air temperature
IGN	Ignition
IN	Intake
INT	Intermittent

IAC	Idle air control
LH	Left hand
M	Motor
MAF	Mass air flow
MIL	Malfunction indicator light
M/S	Manual steering
M/T	Manual transaxle
OBD	On-board diagnosis
OFF	Switch off
ON	Switch on
PCV	Positive crankcase ventilation
P/S	Power steering
PRC	Pressure regulator control
P/W	Power window
RH	Right hand
SFI	Sequential fuel injection system
SST	Special service tool
SW	Switch
TCM	Transaxle control module
TCS	Traction control unit
TDC	Top dead center
TNS	Tail number side
TPS	Throttle position sensor
TWC	Three way catalyst
WU-TWC	Warm-up three-way catalyst

MAINTENANCE SCHEDULE

MAINTENANCE INTERVALS / MAINTENANCE ITEM		Number of months or kilometers (miles), whichever comes first																				
	Months	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110
	Milesx1,000	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110
	(Kmx1,000)	(8)	(16)	(24)	(32)	(40)	(48)	(56)	(64)	(72)	(80)	(88)	(96)	(104)	(112)	(120)	(128)	(136)	(144)	(152)	(160)	(168)	(176)
Drive belts					I				I				I				I				I		
Engine oil		**Replace every 3,000 miles (5,000 km)**																					
Engine oil filter		**Replace every 6,000 miles (10,000 km)**																					
Automatic transmission fluid				I			R			I			R			I			R			I	
Engine timing belt							I						R(1)						I				
Air cleaner element			I		R		I		R		I		R		I		R		I		R		I
Spark plugs	RC10PYP4						R						R					R					R
	PFR5N-11 RC10PYPB4												R										R
Cooling system				I			I			I			I			I			I			I	
Engine Coolant		**Replace every 5 year or every 62,000 miles (100,000 km)**																					
Idle speed							I(2)						I(2)						I(2)				
Fuel filter							R						R						R				
Fuel tank, cap, lines and hoses							I(2)						I(2)						I(2)				
Fuel hoses (California)		**Inspect every 105,000 miles (168,000 km)**																					
Hose and tube for emission	Outside California												I(2)										
	California	**Replace every 105,000 miles (168,000 km)**																					
Brake lines and connections				I			I			I			I			I			I			I	
Drum brakes		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Disc brakes		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Steering operation and linkage		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Front suspension ball joints					I				I				I				I				I		
Driveshaft dust boots					I				I				I				I				I		
Chassis/body nuts and bolts		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Exhaust system heat shield		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
All locks and hinges		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Air conditioner refrigerant (if equipped)		**Inspect refrigerant amount annually**																					
Air conditioner compressor (if equipped)		**Inspect operation annually**																					

I : Inspect and, if necessary, adjust, correct, clean or replace.
R : Replace or change
L : Lubricate.

(1) This maintenance is required in all states except California. However, we recommend that it also be performed on California vehicles.
(2) This maintenance is recommended by Kia. However, it is not necessary for emission warranty coverage or manufacturer recall liability.

MAINTENANCE SCHEDULE

MAINTENANCE INTERVALS / MAINTENANCE ITEM	Number of months or kilometers (miles), whichever comes first															
	Months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	Km x 1,000	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
Engine oil & Engine oil filter (1)	Change every 6,000 km or 3 months, whichever comes first																
Drive belt (tension)			I			I			I			I			I	
Cooling system hoses & connections		I		I		I		I		I		I		I		I
Engine coolant (1)	I	I	I	R	I	I	I	R	I	I	I	R	I	I	I	R
Fuel filter						R						R				
Fuel tank cap, lines and hoses				I				I				I				I
Air cleaner element (2)	I	I	I	R	I	I	I	R	I	I	I	R	I	I	I	R
Ignition wires				I				I				I				I
Spark plugs*				R				R				R				R
Idle speed		I		I		I		I		I		I		I		I
Evaporative emission canister & vapour lines					I					I					I	
PCV valve						I					I					
Engine timing belt	Replace every 102,000 km															
Air conditioner compressor operation & refrigerant amount		I		I		I		I		I		I		I		I
Exhaust pipes, heat shield & mounting	I		I		I		I		I		I		I		I	
Front suspension ball joins			I			I			I			I			I	
Brakes / clutch fluid (1)	I	I	I	I	R	I	I	I	I	R	I	I	I	I	R	I
Front brake pads & discs (3)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Rear brake pads & discs / drums (3)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Parking brake		I		I		I		I		I		I		I		I
Brake line & connections (including booster)		I		I		I		I		I		I		I		I
Clutch & brake pedal free play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Automatic transaxle fluid (1)	I	I	R	I	I	R	I	I	R	I	I	R	I	I	R	I
Chasis & underbody bolts & nuts	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Tire condition & inplating pressure	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Wheel alignment (4)	Inspect when abnormal condition noted																
Tire rotation	Rotate the tires every 12,000 km																
Steering operating & linkage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Power steering fluid & lines		I		I		I		I		I		I		I		I
Driveshaft dust boots			I			I			I			I			I	
Seat belts, buckles & anchors	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Locks, hinges & hood latch	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

I : Inspect these items and their related parts. If necessary, correct, clean, refill, adjust or replace.
R : Replace or change
L : Lubricate.
* PFR5N-11, RC10PYPB4 : Replace every 96,000 km.

Notice
Check the engine oil and coolant levels every week.

(1) Refer to the lubricant and coolant specification in the Owner's Manual
(2) More frequent maintenance is required if driving under dusty conditions.
(3) More frequent maintenance is required if the vehicle is operated under any of the following conditions:
a. Short-distance driving
b. Driving on dusty roads.
c. Extensive idling or slow-speed driving in stop-and go traffic.
(4) If necessary, rotate and balance the wheels.

Engine: Electrical System

TROUBLESHOOTING

IGNITION SYSTEM

Trouble symptom	Probable cause	Remedy
Engine will not start or is hard to start (Cranks OK)	Ignition lock switch faulty Ignition coil faulty Power transistor faulty Spark plugs faulty Ignition wiring disconnected or broken Spark plugs faulty	Replace ignition lock switch Inspect ignition coil Inspect power transistor Replace plugs Inspect wiring Replace plugs
Rough idle or stalls	Ignition wiring faulty Ignition coil faulty Spark plug cable faulty	Inspect wiring Inspect ignition coil Inspect spark plug cable
Engine hesitates/poor acceleration	Spark plugs faulty Ignition wiring faulty	Replace plugs Inspect ignition coil
Poor mileage	Spark plugs faulty	Replace plugs

CHARGING SYSTEM

Trouble symptom	Probable cause	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off	Fuse blown Light burned out Wiring connection loose Electronic voltage regulator faulty	Check fuses Replace light Tighten loose connections Replace voltage regulator
Charging warning indicator does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn Battery cables loose, corroded or worn Fuse blown Fusible link blown Electronic voltage regulator or generator faulty Wiring faulty	Adjust tension or replace drive belt Repair or replace cables Check fuses Replace fusible link Test generator Repair wiring
Engine hesitates/poor acceleration Overcharge	Drive belt loose or worn Wiring connection loose or open circuit Fusible link blown Poor grounding Electronic voltage regulator or generator faulty Worn battery Electronic voltage regulator faulty Voltage sensing wire faulty	Adjust tension or replace drive belt Tighten loose connection or repair wiring Replace fusible link Repair Test generator, if faulty, repair or replace Replace battery Replace voltage regulator Repair wire

STARTING SYSTEM

Trouble symptom	Probable cause	Remedy
Engine will not crank	Battery charge low Battery cables loose, corroded or worn out Transaxle range switch faulty (Vehicle with automatic transaxle only) Fusible link blown Starter motor faulty	Charge or replace battery Repair or replace cables Adjust or replace switch Replace fusible link Repair starter motor

	Ignition switch faulty Ignition lock switch faulty	Replace ignition switch Replace ignition lock switch
Engine cranks slowly	Battery charge low Battery cables loose, corroded or worn out Starter motor faulty	Charge or replace battery Repair or replace cables Repair starter motor
Starter keeps running	Starter motor faulty Ignition switch faulty	Repair starter motor Replace ignition switch
Starter spins but engine will not crank	Short in wiring Pinion gear teeth broken or starter motor faulty Ring gear teeth broken	Repair wiring Repair starter motor Replace flywheel ring gear or torque converter

SPECIFICATIONS

IGNITION

Type	Mold coil
Primary coil resistance	0.78 (Ω)
Secondary coil resistance	13.0 ± 2.6 (Ω)

SPARK PLUG

NGK Champion	PFR5N-11 RC10PYPB4
Plug gap	1.0-1.1 mm (0.039-0.043 in.)

STARTER MOTOR

Type Voltage Output	Reduction drive (with planetary gear) 12V 1.2 KW
No-load characteristics Terminal voltage Amperage Speed	 11V 90A or below 3,000 RPM MIN
Number of pinion teeth	8
Pinion gap	0.5-2.0 mm (0.0197-0.079 in.)

GENERATOR

Type Rated output Voltage regulator type Regulator setting voltage Temperature compensated	Battery voltage sensing 13.5V / 120A Electronic built-in type 14.4 ± 0.3 V -10 ± 3 mV/°C

BATTERY

Type Ampere hours 20HR Cold cranking [at -18°C (0°F)] Reverse capacity Specific gravity [at 25°C (77°F)]	 55-26 FL (MF) 70AH 600A 113 min. 1.280 ± 0.01

NOTE

COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2 or greater at a specified temperature. REVERSE CAPACITY RATING is the amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5 at 26.7°C (80°F).

CRUISE CONTROL SYSTEM

Speed control module Operating voltage range Operating temperature Voltage drop between unit and actuator	DC 11 - 16V -40~110°C 0.4V Low speed limit : 20~24 mile

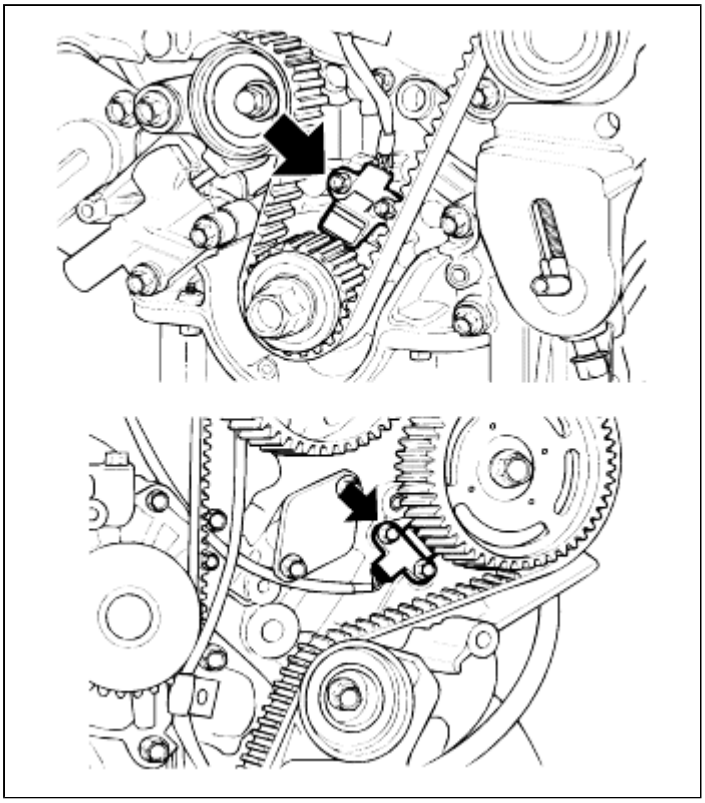
Operating speed range	High speed limit : 116~120 mile

TIGHTENING TORQUE

Items	N·m	Kg·cm	lb·ft
Generator terminal (B+)	5 - 7	50 - 70	3.6 - 5.1
Starter motor terminal (B+)	10 - 12	100 - 120	7.3 - 8.8
Battery terminal	4 - 6	40 - 60	2.9 - 4.3
Spark plug	20 - 30	200 - 300	15 - 22

GENERAL INFORMATION

Ignition timing is controlled by the electric control ignition timing system. The ignition timing data for the engine operating conditions are programmed in the memory of the power train control module (PCM).
The engine conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based upon these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the power transistor. The ignition coil is activated and timing is controlled at the optimum point.
*CKP : Crankshaft Position Sensor
*CMP : Camshaft Position Sensor

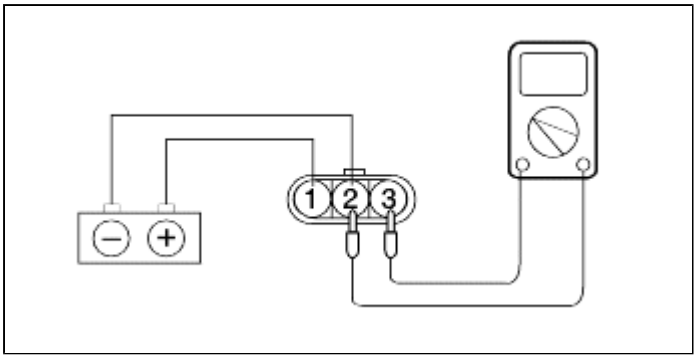


Inspection

1. Measurement of the primary coil resistance
   Connect the negative (-) terminal of a 3V power supply to terminal 2 of the power transistor; then check whether there is continuity between terminal 3 and terminal 2 when terminal 1 and the positive (+) terminal are connected and disconnected.

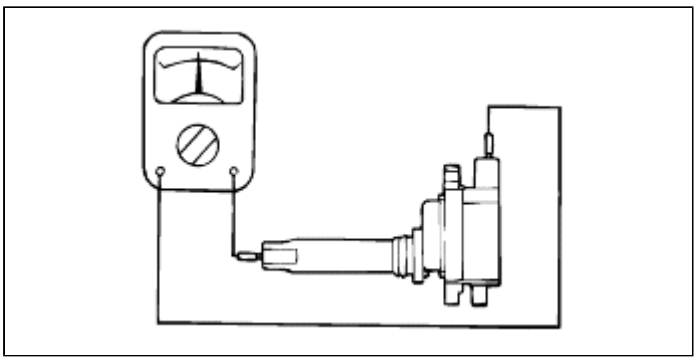
Terminal 1 and (+) terminal	Terminal 3 and terminal 2
Connected	Continuity (0.78Ω ± 10%)
Disconnected	Non continuity

   Replace the ignition coil if there is malfunction.



2. Measurement of the secondary coil resistance
   Measure the resistance between the high-voltage terminals of the ignition coil.

   Standard value : 13.0 ± 2.6 (kΩ)



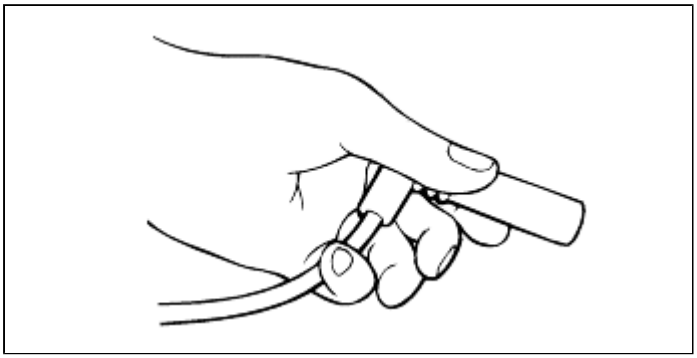
INSPECTION

1. Disconnect the spark plug cable from the spark plug.

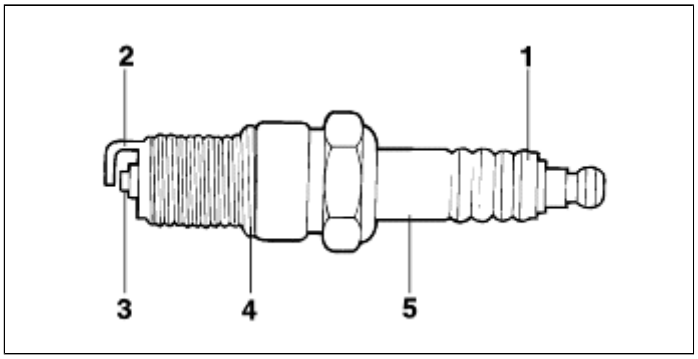
> NOTE
>
> Pull on the spark plug cable boot when removing the spark plug cable, not the cable, as it may be damaged.

2. Using the spark plug wrench, remove all of the spark plugs from the cylinder head.

> NOTE
>
> Take care not to allow contaminants to enter through the spark plug holes.

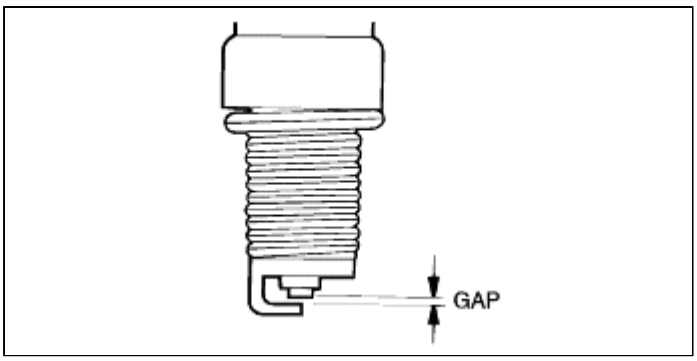


3. Check spark plugs for the following:
   (1) Broken insulator
   (2) Worn electrode
   (3) Carbon deposits
   (4) Damaged or broken gasket
   (5) Condition of the porcelain insulator at the tip of the spark plug



4. Check the spark plug gap using a wire gap gauge, and adjust if necessary.

Standard value	Spark plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)

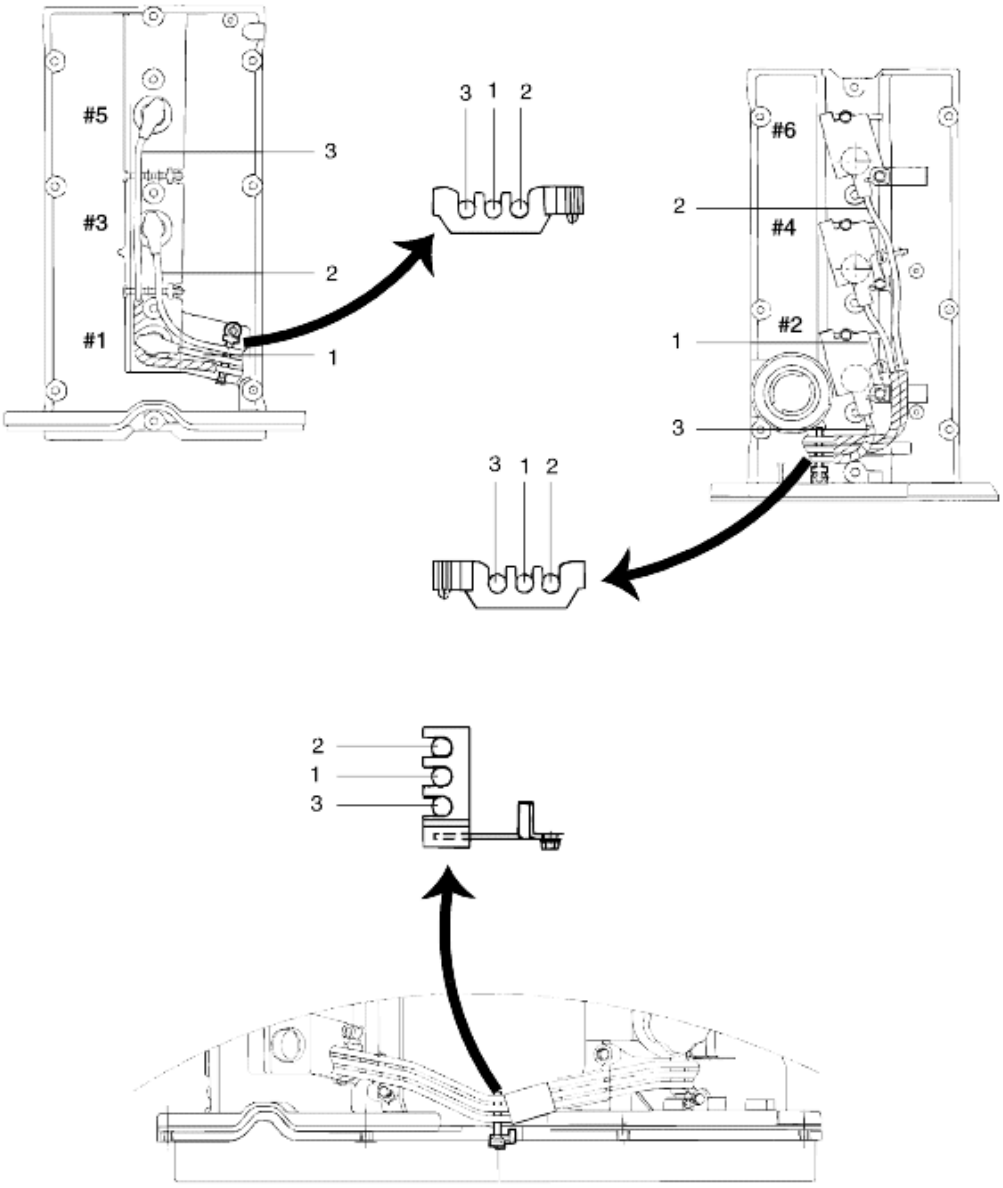


5. Re-insert the spark plug and tighten to the specified torque. If it is overtorqued, damage to the threaded portion of cylinder head may result.

Tightening torqueSpark plug : 20 - 30 N·m (200 - 300 kg·cm, 15-22 lb·ft)

NOTE

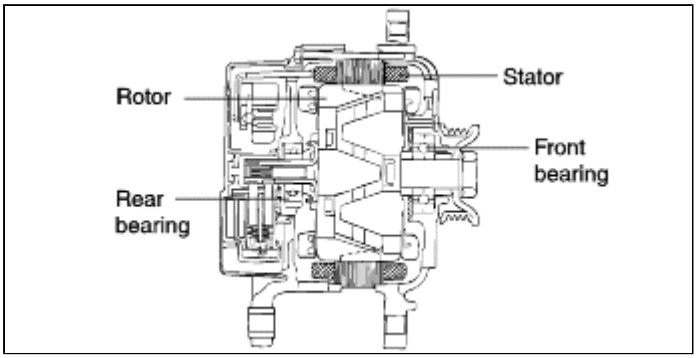
When replacing the spark plug, use the genuine parts which have resistance.



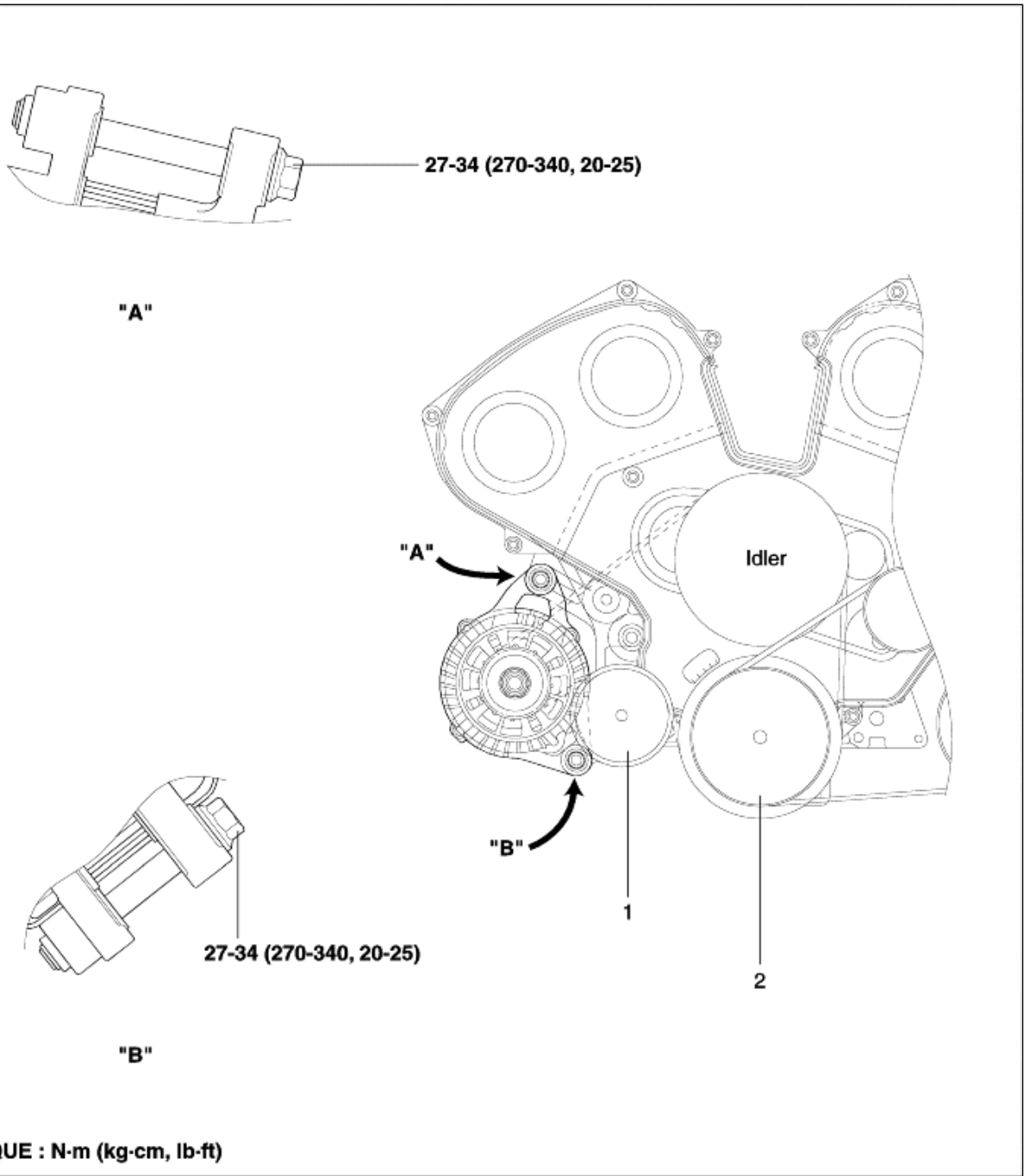
1. No.1 spark plug cable
2. No. 3 spark plug cable
3. No. 5 spark plug cable

GENERAL INFORMATION

The charging system included a battery, an generator with a built-in regulator, and the charging indicator light and wire. The generator has eleven built-in diodes (four positive, four negative and three exiter diodes), each rectifying AC current to DC current. Therefore, DC current appears at generator "B" terminal.
In addition, the charging voltage of this generator is regulated by the battery voltage detection system. The generator is regulated by the battery voltage detection system. The main components of the generator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.

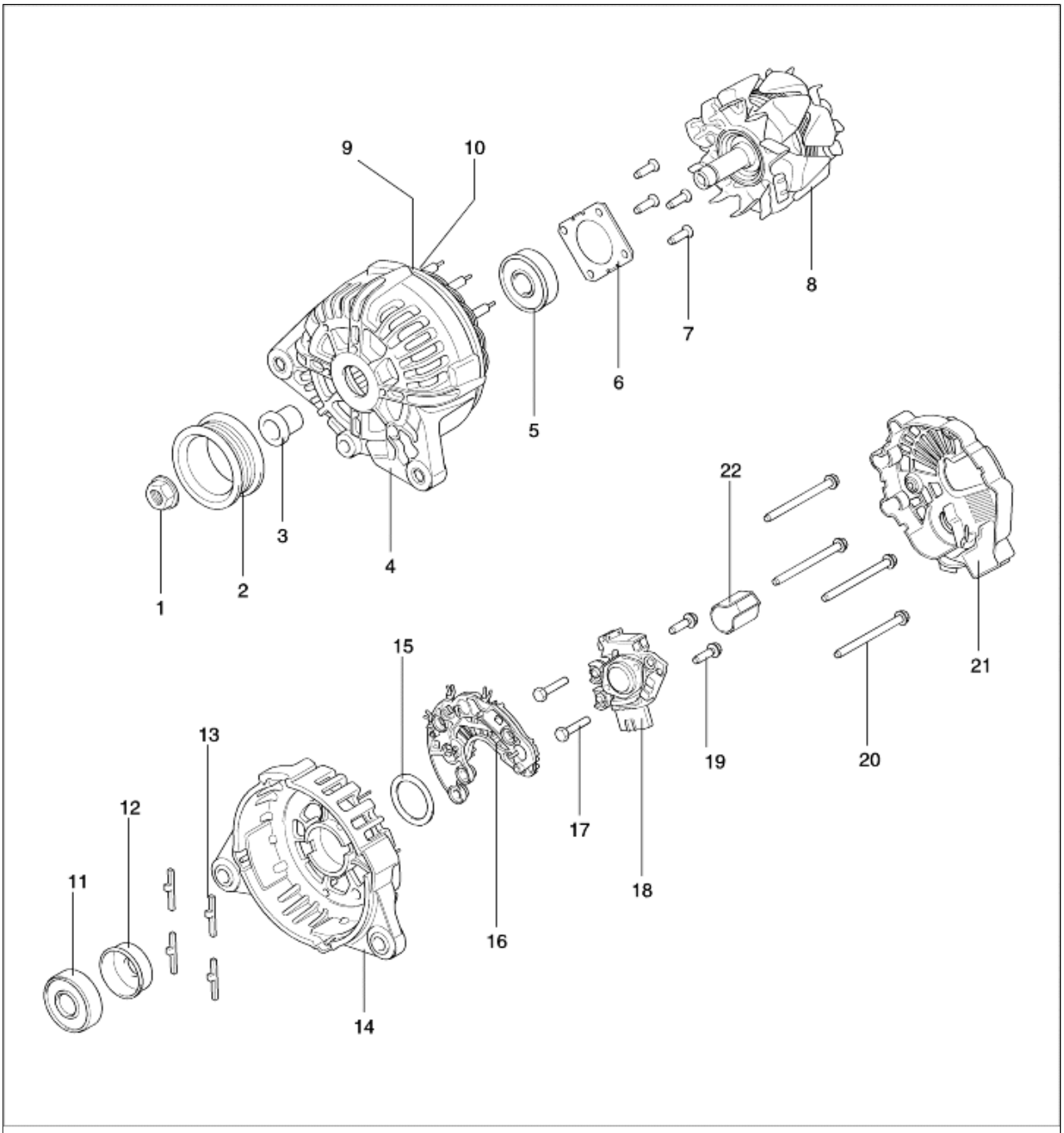


COMPONENTS



1. Generator tensioner
2. Crankshaft pulley

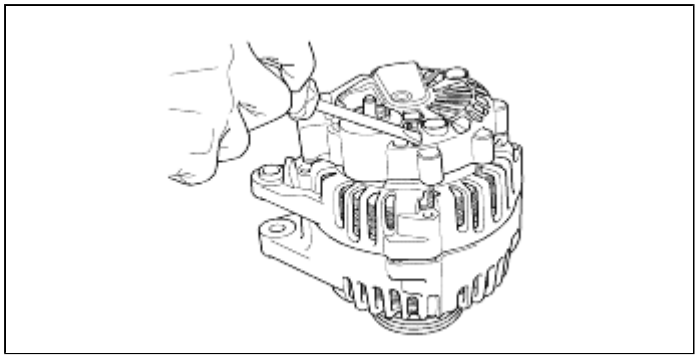
COMPONENTS



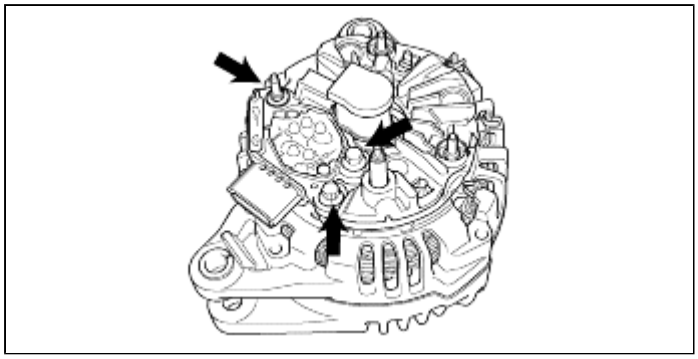
1. Hex nut	8.Rotor coil	15.Seal
2. Pulley	9.Silicon injection	16.Rectifier
3. Bushing	10.Stator coil	17.Bolts
4. Front cover assembly	11.Rear bearing	18.Brush holder assembly
5. Front bearing	12.Bearing cover	19.Brush holder bolt
6. Bearing cover	13.Damper	20.Bolts
7. Bearing bolt	14.Rear cover	21.Cover
		22.Guard

DISASSEMBLY

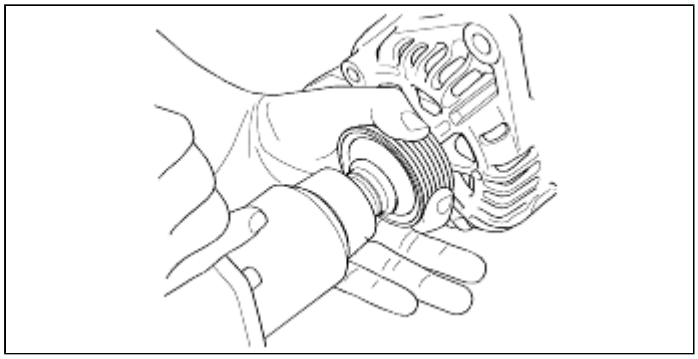
1. Remove the generator cover using a screwdriver or equivalent.



2. After loosening the 3 mounting bolts, detach the brush holder assembly.



3. Remove the nut, pulley, and spacer.

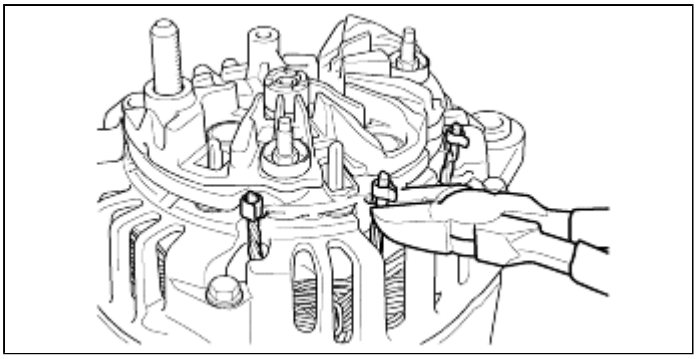


NOTE

Put on gloves to protect hands during working.

CAUTION

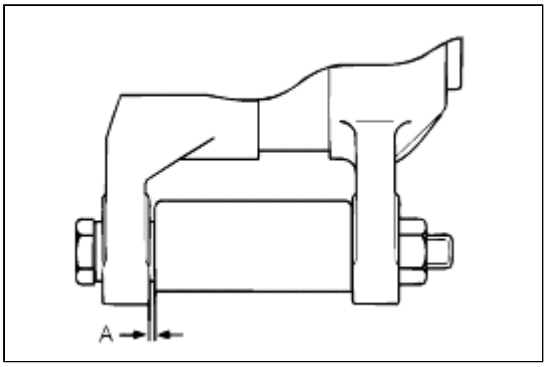
Cutting the stator coil lead line connecting to the rectifier may damage the generator beause the rectifier and the stator coil lead line are soldered together. So, do not disassemble further.



4. Reassembly is the reverse of disassembly.

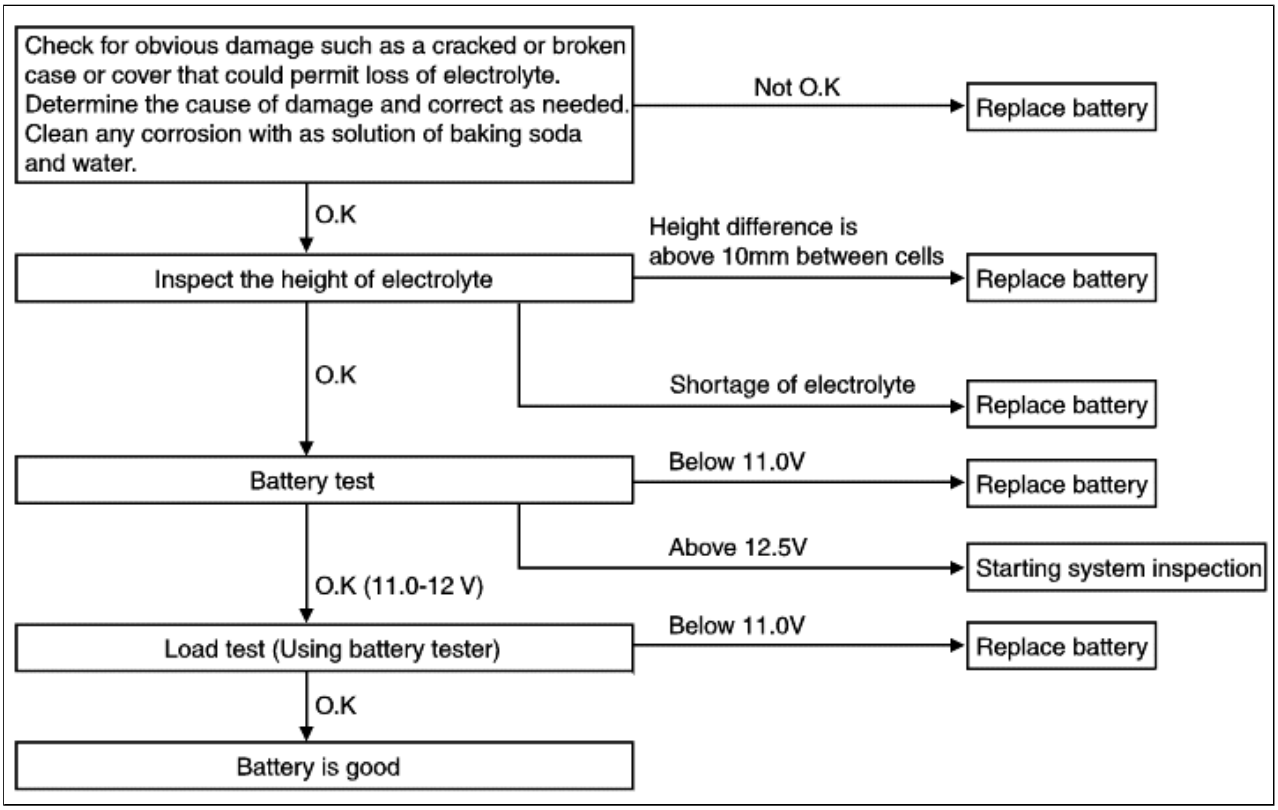
Installation

1. Place the alternator and insert a support bolt (Do not insert a nut this time).
2. After pushing the alternator forward, count that how many spacers (a spacer thickness: 0.198mm) should be inserted between the alternator front leg and front case as shown in "A".
3. After inserting spacers, insert and tighten a nut securely.



BATTERY VISUAL INSPECTION (1)

1. CHECKING FLOW



2. CHECKING SHEET

Item	Trouble	Cause	Remedy	Responsibility	
				User	Manufacturer
1. Visual inspection	* Battery terminal damage	* Carelessness * Over tightening the battery cable	Replace	○	
	Cover Breakage	* Carelessness	Replace	○	
	* Electrolyte leakage-Cover breakage - Cover leakage	* Carelessness * Bad cover seal	Replace Replace	○	○
2. Electrolyte height inspection	* Electrolyte height between cells is over 10mm * Shortage of electrolyte	* Cell shorted electrically * Vaporization caused by excessive temperature * Electrolyte loss caused by over-charge	Replace Replace Replace	○ ○	○
3. Voltage inspection	1. Battery voltage >13.2V 2. 12.5V < Battery voltage < 12.9V	1. Over charge 2. Normal	Replace * Check the electric system	○	
	3. 12.0V < Battery voltage < 12.4V (Simple discharge) 4. 11.0 V < Battery voltage < 12.0V (Over discharge)	1. Insufficient charge 2. Internal failure	* Battery Load Test (Refer to Load Test below)	○ ○	
	5. Battery voltage : 11.0V or less	1. Charge condition failure 2. Battery discharged for a long period 3. Internal circuit open	Replace	o ○	o

3. LOAD TEST

1. When discharging the battery during 15 seconds at half currency of Cold Cranking Power (CCP), the voltage of the battery should be as shown below.
   Regulating Voltage Table

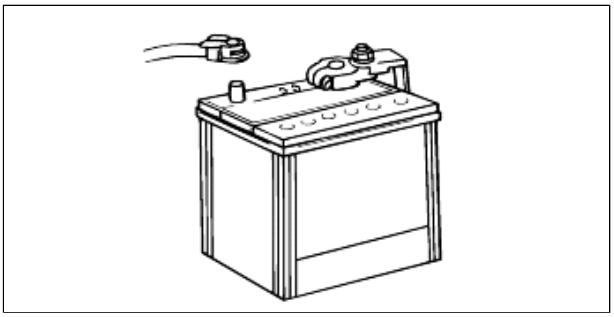
Ambient Temperature	Voltage
above 20°C	9.6V
~ 18°C	9.5V
~ 10°C	9.4V
~ 4°C	9.3V
~ -1°C	9.1V
~ -7°C	8.9V
~ -12°C	8.7V

2. When the voltage is not within specification, repeat the load test again, and re-charge.
3. If the battery is left alone for 2 hours after re-charging and its output is over 12.5V, and the voltage after a load test is over the standard value, the battery can be used.

BATTERY VISUAL INSPECTION (2)

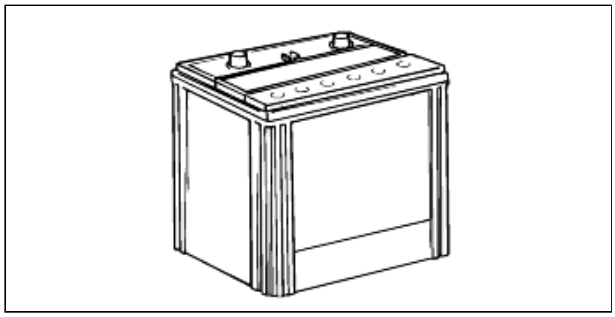
1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).
3. Remove the battery from the vehicle.

> CAUTION
>
> Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte. Heavy rubber gloves (not the household type) should be worn when removing the battery.



4. Inspect the battery carrier for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described in Step(4).
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure the tops of the terminals are flush with the tops of the posts.
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

> CAUTION
>
> When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuits at the terminals of batteries eing charged. A spark will occur when the circuit is broken. Keep open flames away from the battery.



INSPECTION

VOLTAGE DROP TEST OF GENERATOR OUTPUT WIRE

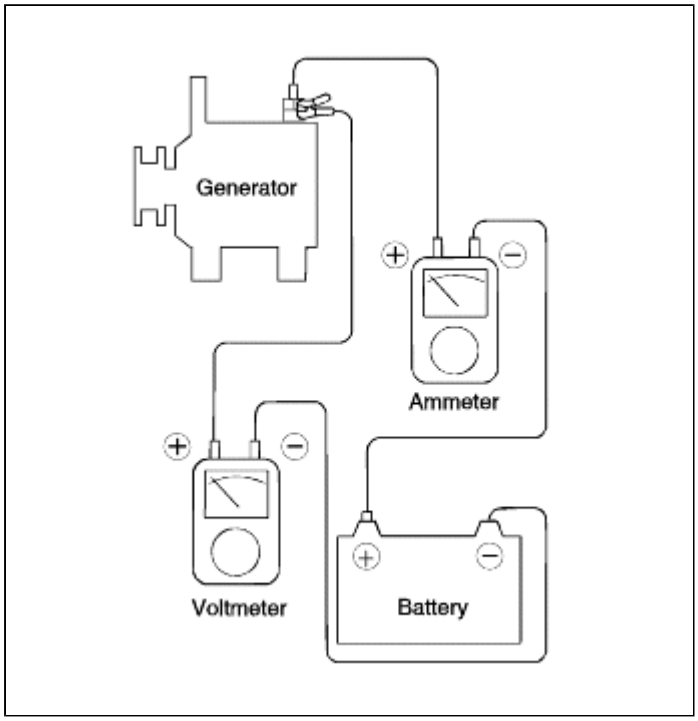
This test determines whether or not the wiring between the generator "B" terminal and the battery (+) terminal is good by the voltage drop method.

PREPARATION

1. Turn the ignition switch to "OFF".

> **NOTE**
>
> To find abnormal conditions of the connection, actions should not be taken on the two terminals and each connection during the test.

2. Connect a digital voltmeter between the generator "B" terminal and battery (+) lead wire to the battery (+) terminal. Connect the (+) lead wire of the voltmeter to the "B" terminal and the (-) lead wire to the battery (+) terminal.



CONDITIONS FOR THE TEST

1. Start the engine.
2. Switch on the headlamps, blower motor and so on. And then, read the voltmeter under this condition.

RESULT

1. The voltmeter may indicate the standard value.
   Standard value : 0.2V max.
2. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the generator "B" terminal to the fusible link to the battery (+) terminal. Check for loose connections, color change due to an overheated harness, etc. Correct them before testing again.
3. Upon completion of the test, set the engine speed at idle. Turn off the head lamps, blower motor and the ignition switch.

OUTPUT CURRENT TEST

This test determines whether or not the generator gives an output current that is equivalent to the nominal output.

PREPARATION

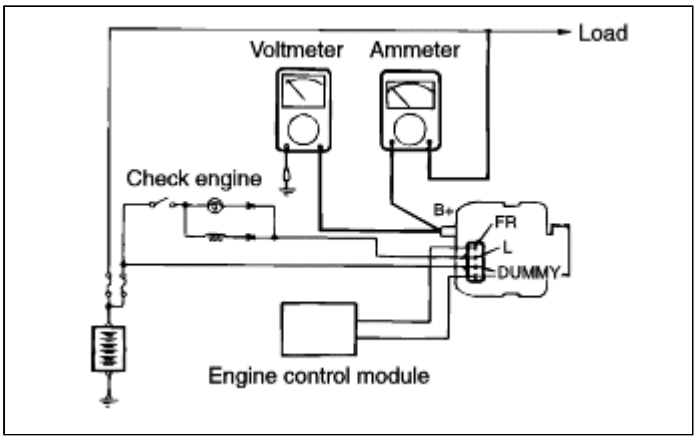
1. Prior to the test, check the following items and correct as necessary.
   (1) Check the battery installed in the vehicle to ensure that it is in good condition. The battery checking method is described in "BATTERY".

   > NOTE
   >
   > The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.

   (2) Check the tension of the generator drive belt. The belt tension check method is described in the section "COOLING".
2. Turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Disconnect the generator output wire from the generator "B" terminal.
5. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

   > NOTE
   >
   > Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

6. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the generator "B" terminal and (-) lead wire to a good ground.
7. Attach an engine tachometer and connect the battery ground cable.
8. Leave the engine hood open.



TEST

1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between the generator "B" terminal and battery (-) terminal, a blown fusible link or poor grounding is suspected.
2. Start the engine and turn on the headlights.
3. Set the headlights to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

   > NOTE
   >
   > After the engine starts up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

RESULT

1. The ammeter reading must be higher than the limit value. If it is lower but the generator output wire is in good condition, remove the generator from the vehicle and test it.

   Limit value (120A generator) : 84 A min.

   NOTE

   1) The nominal output current value is shown on the nameplate affixed to the generator body.
   2) The output current value changes with the electrical load and the temperature of the generator itself. Therefore, the nominal output current may not be obtained. If such is the case, keep the headlights on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.
      The nominal output current may not be obtained if the temperature of the generator itself or ambient temperature is too high.
      In such a case, reduce the temperature before testing again.

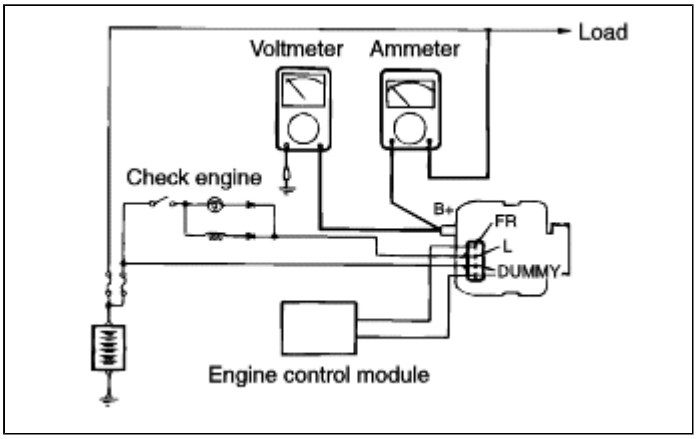
2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.
6. Connect the battery ground cable.

REGULATED VOLTAGE TEST

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

PREPARATION

1. Prior to the test, check the following items and correct if necessary.
   (1) Check that the battery installed on the vehicle is fully charged. For battery checking method, see "BATTERY."
   (2) Check the generator drive belt tension. For belt tension check, see "COOLING" section.
2. Turn ignition switch to "OFF."
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "B" terminal of the generator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the generator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the generator output wire from the generator "B" terminal.
6. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
7. Attach the engine tachometer and connect the battery ground cable.



TEST

1. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

   Voltage : Battery voltage

   If it reads 0V, there is an open circuit in the wire between the generator "B" terminal and the battery and the battery (+), or the fusible link is blown.
2. Start the engine. Keep all lights and accessories off.
3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the generator output current drops to 10A or less.

Result

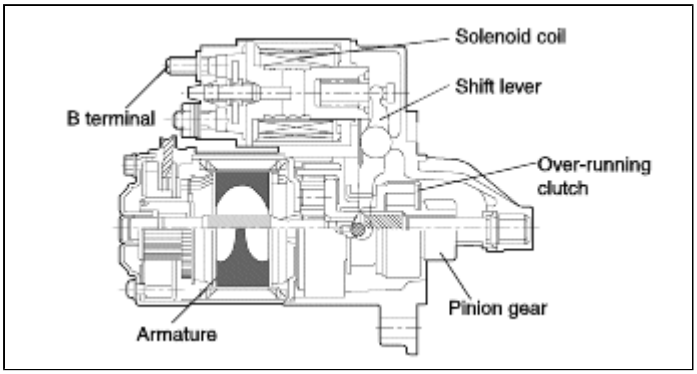
1. If the voltmeter reading agrees with the value listed in the Regulating Voltage Table below, the voltage regulator is functioning correctly. If the reading is other than the standard value, the voltage regulator or the generator is faulty.
   Regulating Voltage Table

Voltage regulator ambient temperature °C (°F)	Regulating voltage (V)
-20 (-4) 20 (68) 60 (140) 80 (176)	14.2 - 15.4 13.9 - 14.9 13.4 - 14.6 13.1 - 14.5

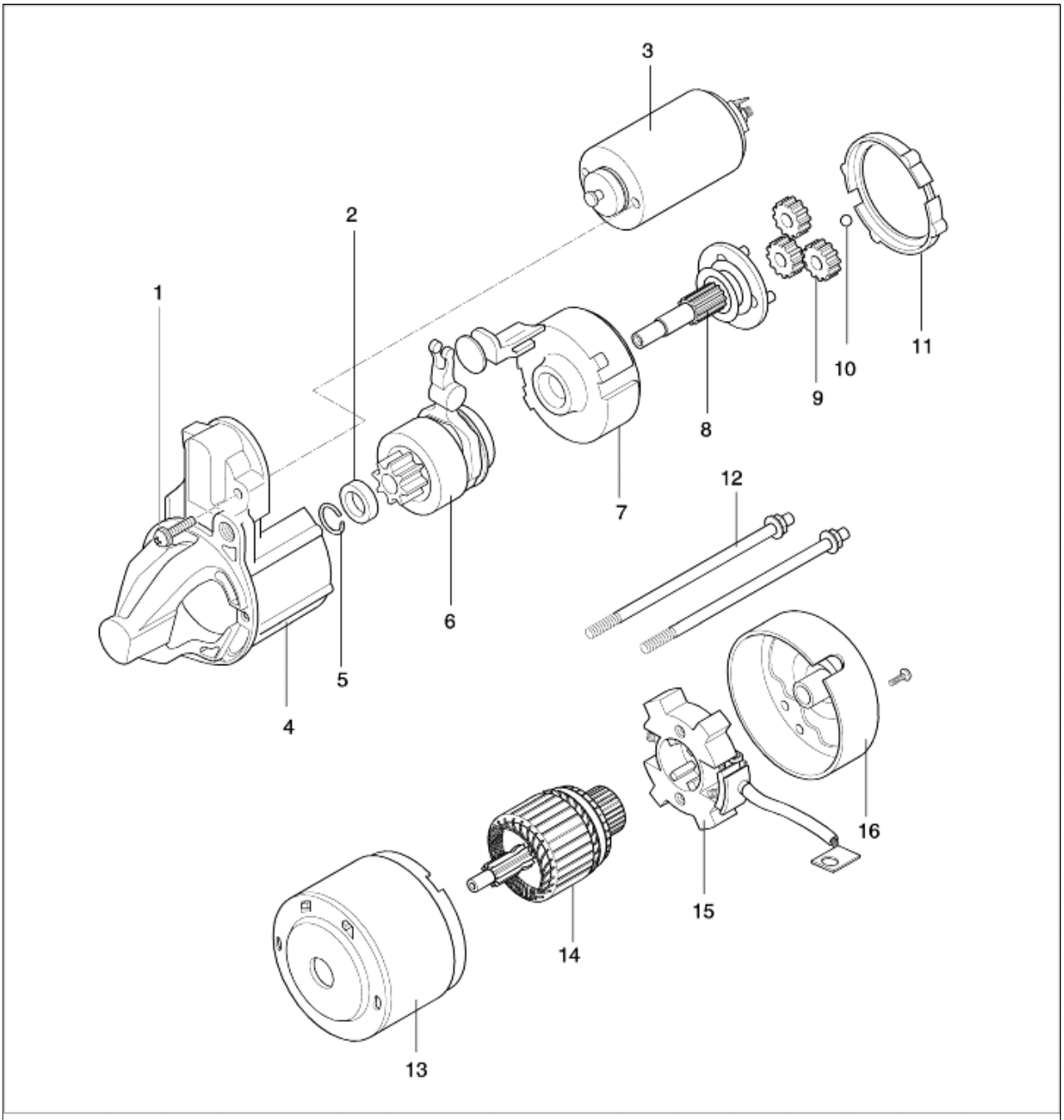
2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the voltmeter and ammeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.
6. Connect the battery ground cable.

GENERAL INFORMATION

The starting system includes the battery, starter motor, solenoid switch, ignition switch, inhibitor switch (A/T only), connection wires and the battery cables.
When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil. The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear. The contacts close and the starter motor cranks.
In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.



COMPONENTS



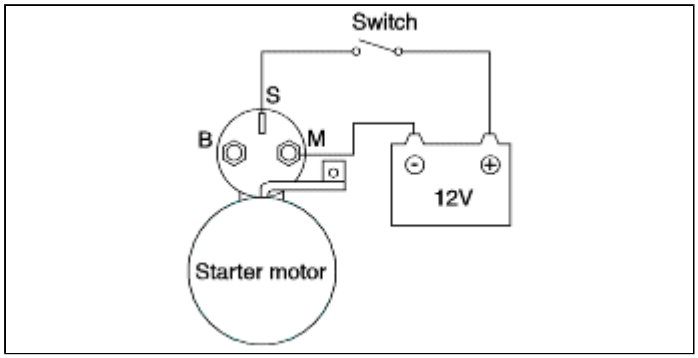
1. Guard	9.Planetary gear
2. Snap ring	10.Ball
3. Solenoid	11.Packing A
4. Front bracket	12.Planetary gear holder screws
5. Stop ring	13.Yoke assembly
6. Overrun clutch	14.Armature
7. Ring gear	15.Brush holder
8. Sun gear	16.Rear bracket

CHECKING FOR OPERATION

SERVICE ADJUSTMENT PROCEDURES FOR PINION GAP ADJUSTMENT

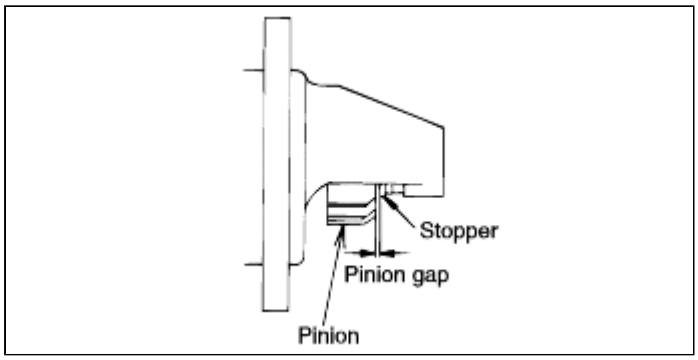
1. Disconnect the field coil wire from the M-terminal of the solenoid.
2. Connect a 12V battery the S-terminal and the M-terminal.
3. The pinion will move out.

> **CAUTION**
>
> This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

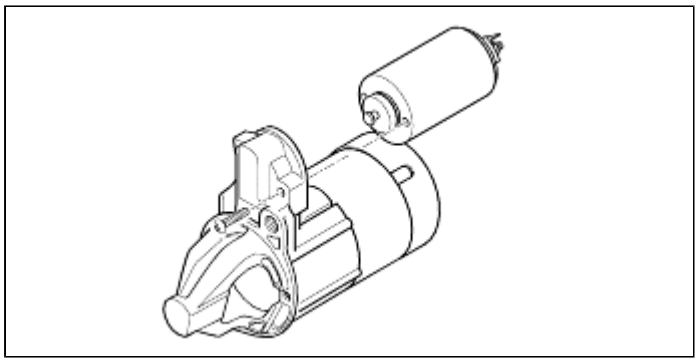


4. Check the pinion for stopper clearance (pinion gap) with a feeler gauge.

Pinion gap : 0.5 - 2.0 mm (0.02 - 0.079 in.)



5. If the pinion gap is out of specification, adjust by adding or removing gaskets between the solenoid and the front bracket.



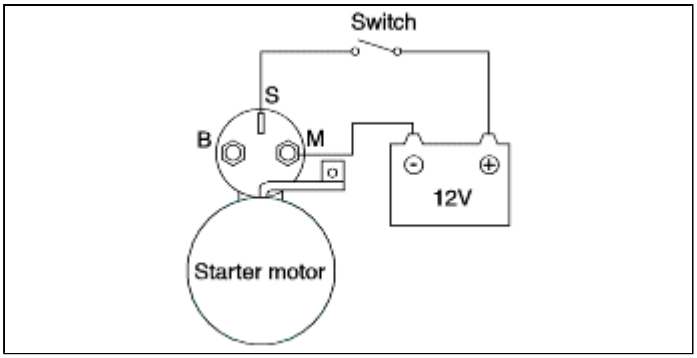
MAGNETIC SWITCH PULL-IN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the M- terminal.

CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. If the pinion moves out, then the pull-in coil is good. If it doesn't move out, replace the magnetic switch.



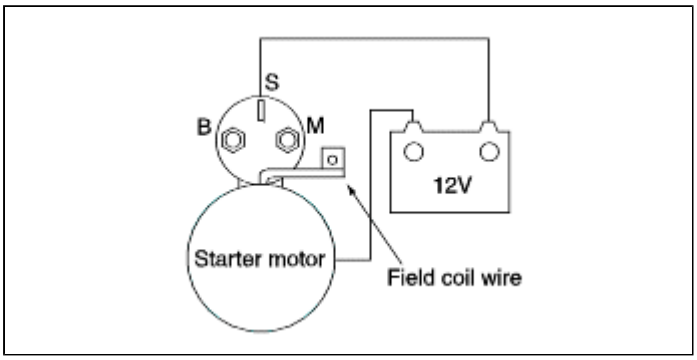
MAGNETIC SWITCH HOLD-IN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the body.

CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

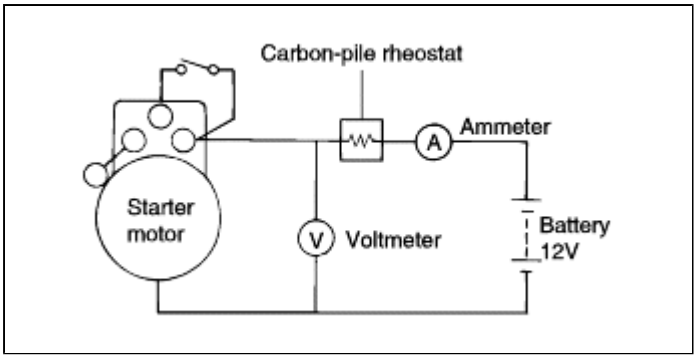
3. If the pinion moves out, everything is in order. If the pinion moves back and forth repeatedly, the hold-in circuit is open. Then replace the magnetic switch.



FREE RUNNING TEST

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows:
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat as shown is the illustration.
3. Connect a voltmeter (15-volt scale) across starter motor.
4. Rotate carbon pile to the off position.
5. Connect the battery cable from battery's negative post to the starter motor body.
6. Adjust until battery voltage shown on the voltmeter reads 11 volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely:

Current : Max. 90 AmpsSpeed : Min. 2,800 rpm

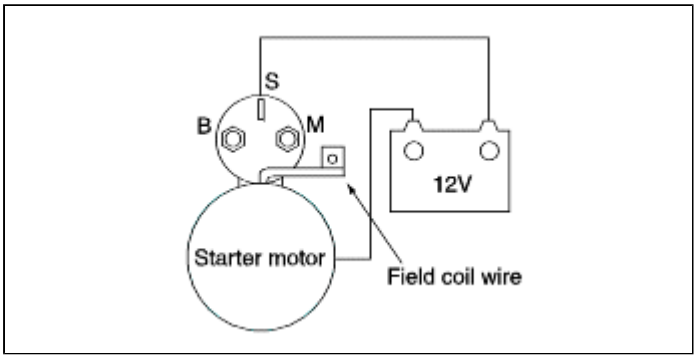


MAGNETIC SWITCH RETURN TEST

1. Disconnect field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between M-terminal and the body.

> NOTE
>
> This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. Pull pinion out and release. If pinion returns quickly to its original position, everything is in order. If it doesn't, replace the magnetic switch.

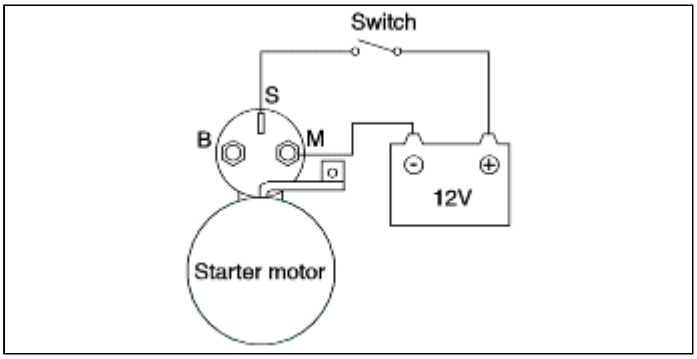


CHECKING FOR OPERATION

SERVICE ADJUSTMENT PROCEDURES FOR PINION GAP ADJUSTMENT

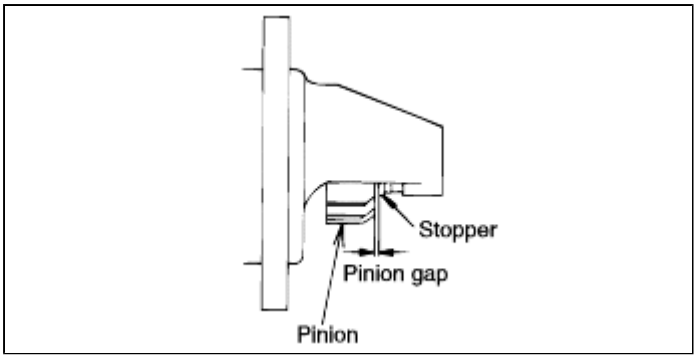
1. Disconnect the field coil wire from the M-terminal of the solenoid.
2. Connect a 12V battery the S-terminal and the M-terminal.
3. The pinion will move out.

> CAUTION
>
> This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

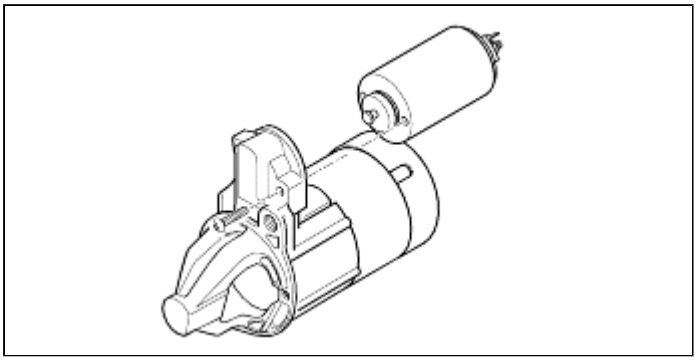


4. Check the pinion for stopper clearance (pinion gap) with a feeler gauge.

Pinion gap : 0.5 - 2.0 mm (0.02 - 0.079 in.)



5. If the pinion gap is out of specification, adjust by adding or removing gaskets between the solenoid and the front bracket.

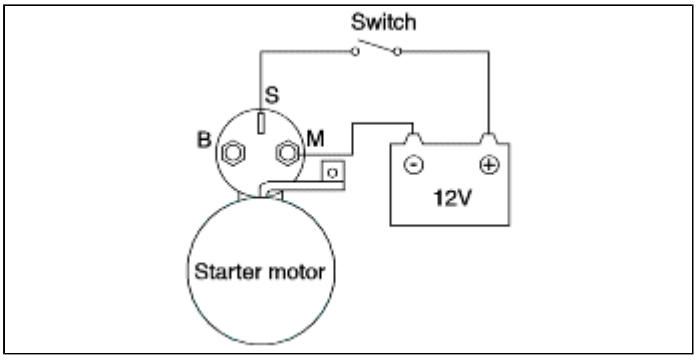


MAGNETIC SWITCH PULL-IN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the M- terminal.

> CAUTION
>
> This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. If the pinion moves out, then the pull-in coil is good. If it doesn't move out, replace the magnetic switch.

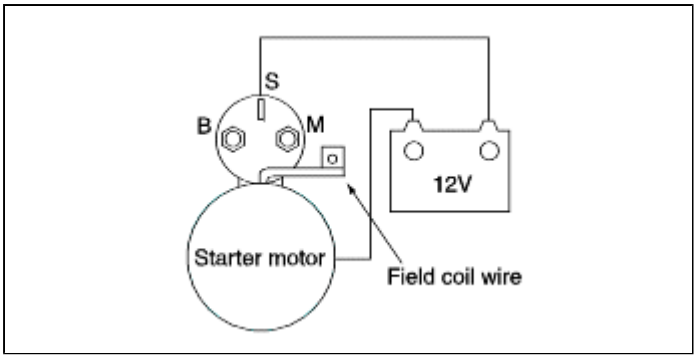


MAGNETIC SWITCH HOLD-IN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the body.

> CAUTION
>
> This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

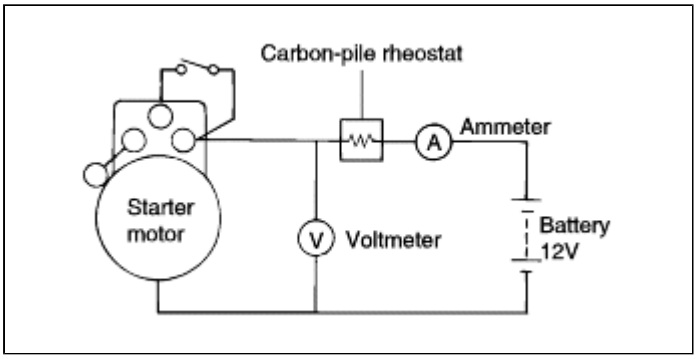
3. If the pinion moves out, everything is in order. If the pinion moves back and forth repeatedly, the hold-in circuit is open. Then replace the magnetic switch.



FREE RUNNING TEST

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows:
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat as shown is the illustration.
3. Connect a voltmeter (15-volt scale) across starter motor.
4. Rotate carbon pile to the off position.
5. Connect the battery cable from battery's negative post to the starter motor body.
6. Adjust until battery voltage shown on the voltmeter reads 11 volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely:

Current : Max. 90 AmpsSpeed : Min. 2,800 rpm

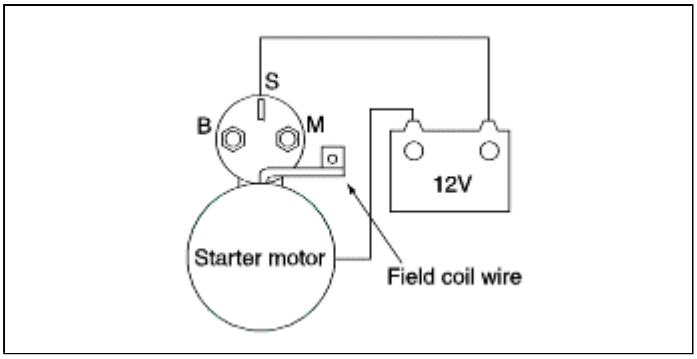


MAGNETIC SWITCH RETURN TEST

1. Disconnect field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between M-terminal and the body.

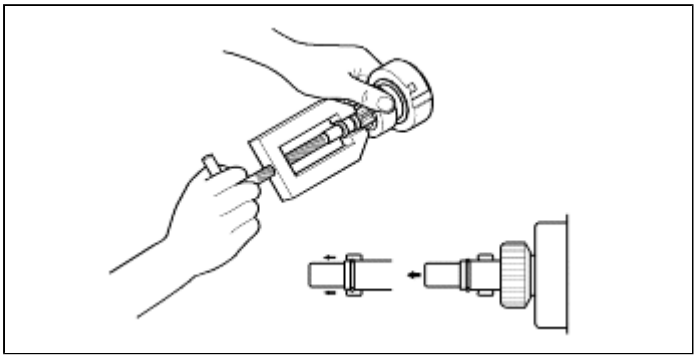
> NOTE
>
> This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. Pull pinion out and release. If pinion returns quickly to its original position, everything is in order. If it doesn't, replace the magnetic switch.



REASSEMBLY OF THE STOP RING AND SNAP RING

Using a suitable pulling tool, pull overrunning clutch stop ring over snap ring.

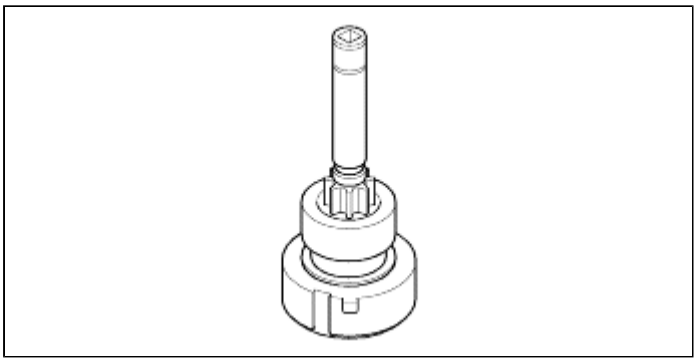


CLEANING STARTER MOTOR PARTS

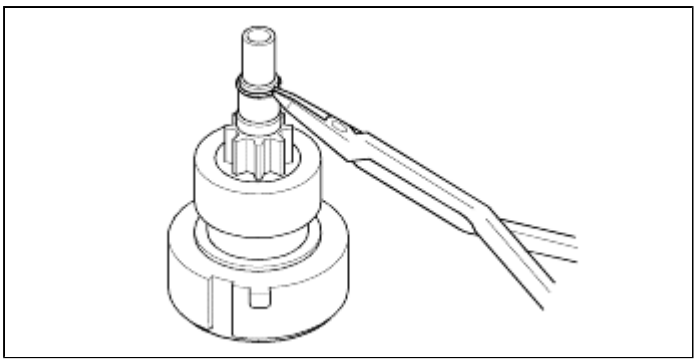
1. Do not immerse parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage insulation. Wipe these parts with a cloth only.
2. Do not immerse drive unit in cleaning solvent. Overrunning clutch is pre-lubricated at the factory and solvent will wash lubrication from clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

DISASSEMBLY

1. Press the stop ring to the snap ring side using a socket wrench to the snap ring side.

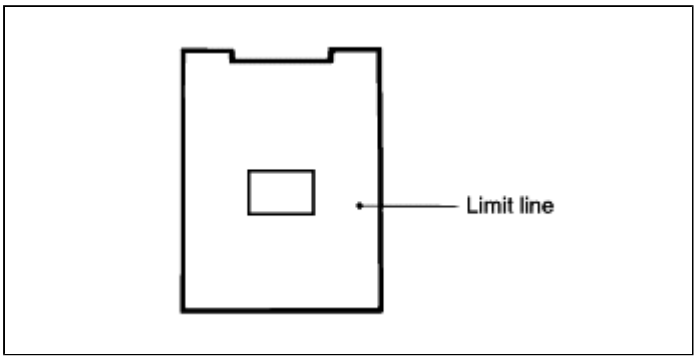


2. After removing the snap ring (using snap-ring pliers), remove the stop ring and the overrunning clutch.

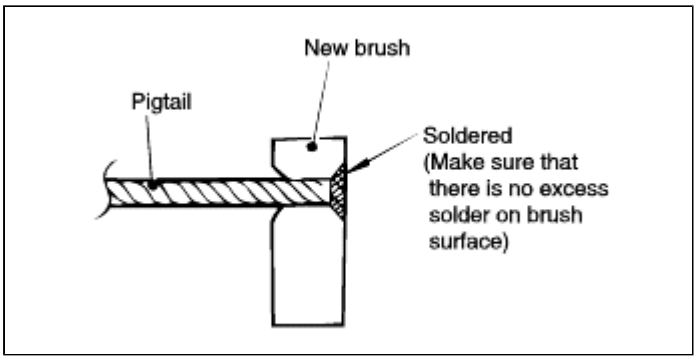


REPLACEMENT OF BRUSHES AND SPRINGS

1. Brushes that are worn out, or oil-soaked, should be replaced.
2. When replacing field coil brushes, crush worn out brush with pliers, taking care not to damage pigtail.



3. Sand the pigtail end with sandpaper to ensure good soldering.
4. Insert the pigtail into hole provided in the new brush and solder it. Make sure that the pigtail and excess solder do not come out onto the brush surface.
5. When replacing the ground brush, slide the brush from brush holder by prying retaining the spring back.



CRUISE CONTROL SYSTEM

PRE-TROUBLESHOOTING

Before starting troubleshooting, inspect each of the following sections, and if there is an abnormality, carry out a repair.

1. Check if the installation and connection routes of the cable is normal.
2. Check if there is no excessive play or tension in each cable.

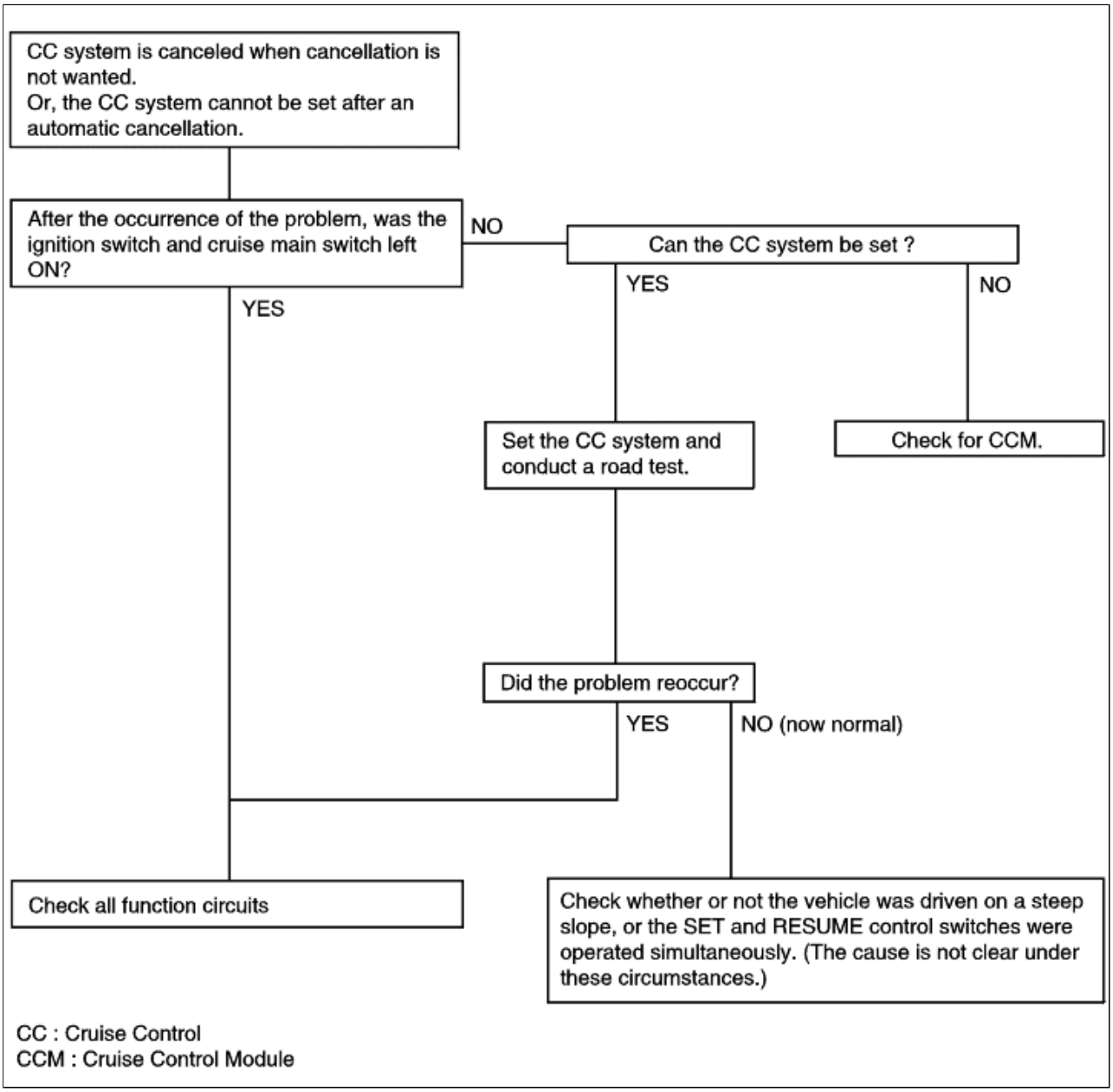
TROUBLESHOOTING PROCEDURES

First, select the applicable malfunction symptom from the "TROUBLE SYMPTOM CHARTS".
Determine the condition of all function circuits.

1. Make the following preliminary inspections.
   A. Check that the installation of the accelerator cable is correct, and that the cables and links are securely connected.
   B. Check that the accelerator pedal moves smoothly.
   C. Adjust the cable so there is not excessive tension or excessive play on the accelerator cable.
   D. Check that the CCM, cruise main and control switch,<?Pub Caret> and the connector of each cancel switch are connected securely.
2. Check in the sequence indicated in the "TROUBLE SYMPTOM CHARTS".
3. If these checks indicate a normal condition, replace the cruise control module.

TROUBLE SYMPTOM CHARTS

Trouble Symptom 1



Trouble Symptom 2

Trouble symptom	Probable cause	Remedy
The set vehicle speed varies greatly upward or downward "Surging" (repeated alternating acceleration and deceleration) occurs after setting	Malfunction of the vehicle speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of CCM	Replace the CCM

Trouble Symptom 3

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the brake pedal is depressed	Damaged or disconnected wiring of the brake pedal switch	Repair the harness or replace the brake pedal switch
	Malfunction of the CCM	Replace the CCM

Trouble Symptom 4

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the shift lever is moved to the "N"	Damaged or disconnected wiring of inhibitor switch input circuit	Repair the harness or repair or replace the inhibitor switch

position (It is canceled, however, when the brake pedal is depressed	Improper adjustment of inhibitor switch	
	Malfunction of the CCM	Replace the CCM

Trouble Symptom 5

Trouble symptom	Probable cause	Remedy
Cannot decelerate (coast) by using the SET switch	Temporary damaged or disconnected wiring of SET switch input circuit	Repair the harness or replace the SET switch
	Malfunction of the CCM	Replace the CCM

Trouble Symptom 6

Trouble symptom	Probable cause	Remedy
Cannot accelerate or resume speed by using the RESUME switch	Damaged or disconnected wiring, or short circuit, or RESUME switch input circuit	Repair the harness or replace the RESUME switch
	Malfunction of the CCM	Replace the CCM

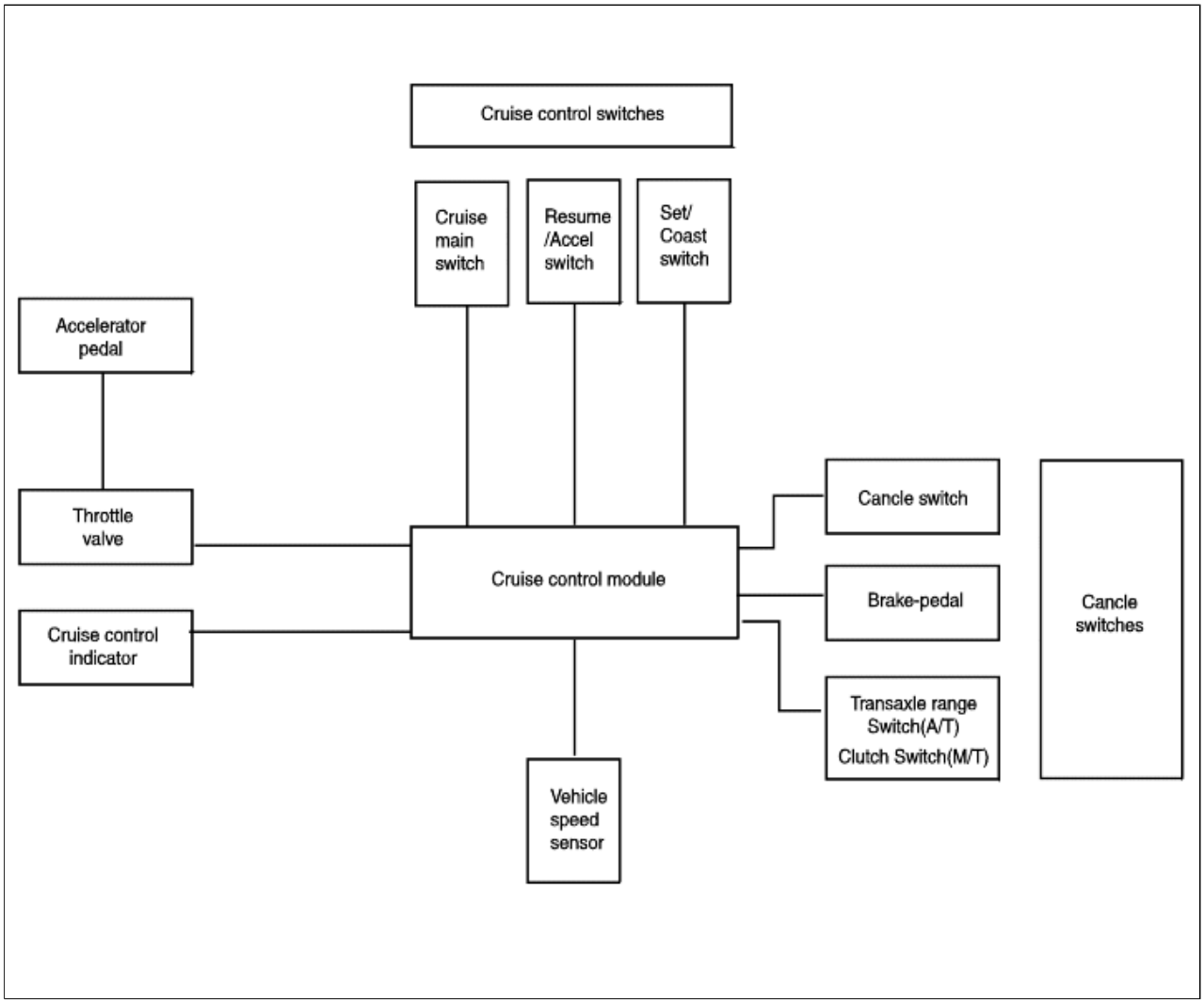
Trouble Symptom 7

Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the actuator and unit	Replace the actuator and unit

Trouble Symptom 8

Trouble symptom	Probable cause	Remedy
The cruise main switch indicator lamp does not illuminate (But CC system is normal)	Damaged or disconnected bulb of cruise main switch indicator lamp	Repair the harness or replace the part
	Harness damaged or disconnected	

System block diagram



Component parts and function outline

Component part		Function
Vehicle-speed sensor		Converts vehicle speed to pulse.
Cruise control module (CCM)		Receives signals from sensor and control switches; CCM controls all automatic speed control functions
Cruise control indicator		Illuminate when CRUISE main switch is ON (Built into cluster)
Cruise Control switches	CRUISE main switch	Switch for automatic speed control power supply.
	Resume/Accel switch	Controls automatic speed control functions by Resume/Accel switch (Set/Coast switch)
	Set/Coast switch	
Cancel switch	Cancel switch	Sends cancel signals to CCM
	Brake-pedal switch	
	Transaxle range switch(A/T) Clutch switch(M/T)	
Throttle valve		Regulates the throttle valve to the set opening by CCM.

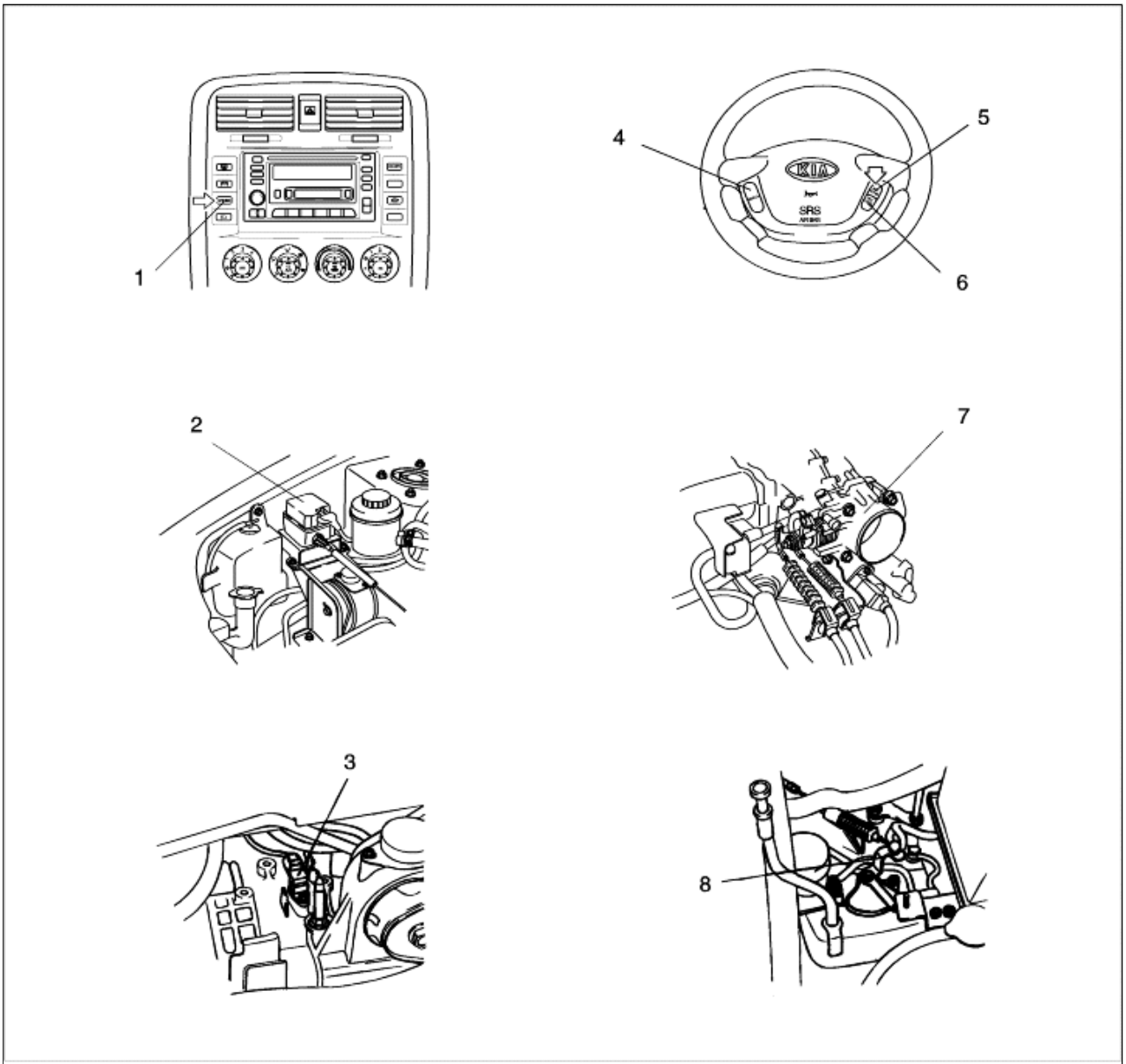
* CCM : Cruise Control Module
* CC : Cruise Control

Cruise control

Cruise control system is engaged by "CRUISE" main switch located on center instrument panel, right of steering wheel. System has the capability to cruise, coast, resume speed, and accelerate, and raise "tap-up" or lower "tap-down" set speed. It also has

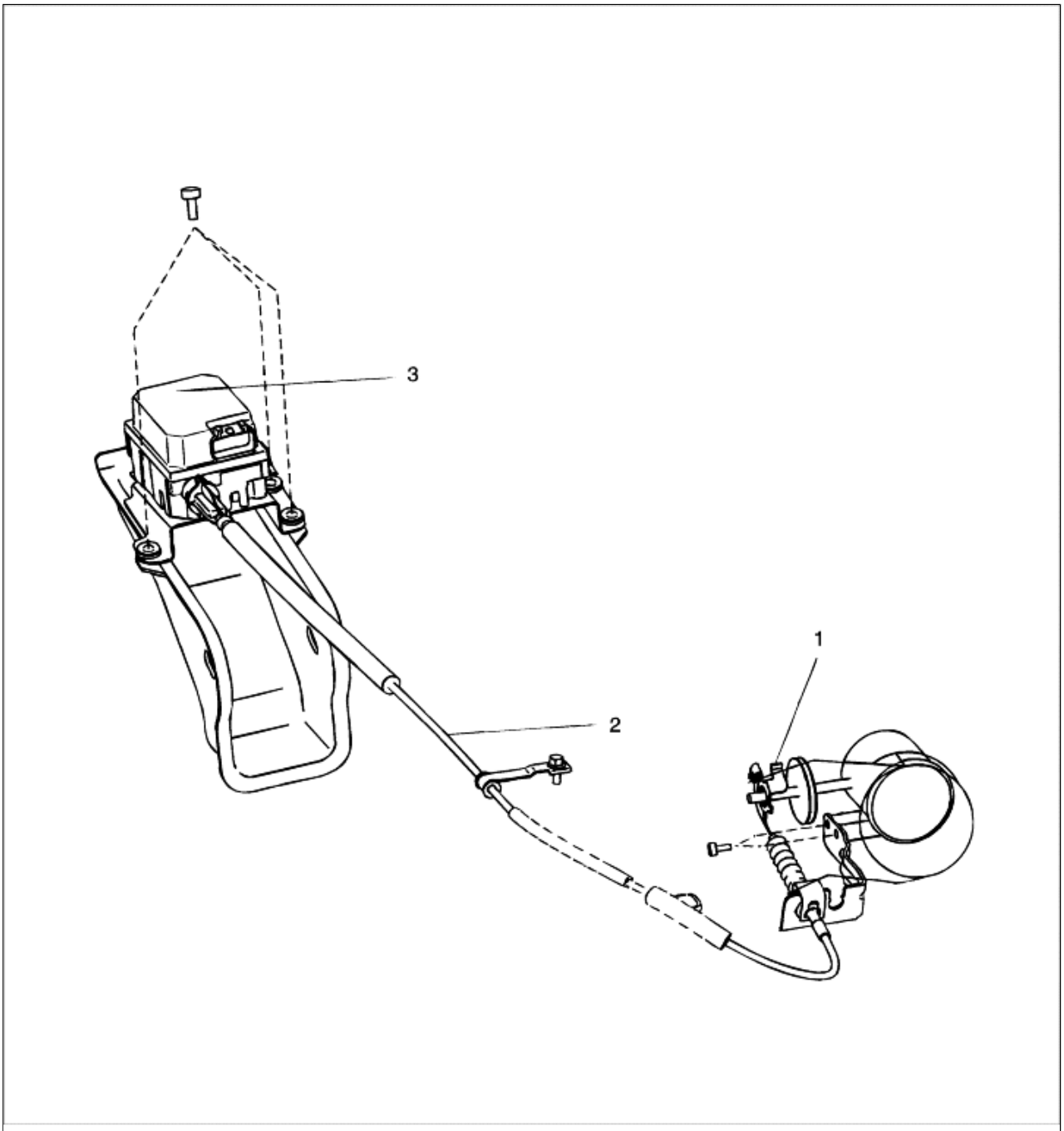
a safety interrupt, engaged upon depressing brake or shifting select lever.
Stepper Motor Cruise Control(SMCC x.5) is a speed control system that maintains a required vehicle speed at normal driving conditions.
The main components of SMCC system are mode control switches, transaxle range switch, brake switch, vehicle speed sensor, cruise control module and control cable that connect throttle body.
SMCC system uses a cruise control module to gain the required vehicle cruise operation. Two important components of the module are an electronic controller and a electric stepper motor.
The controller monitors vehicle speed and operates the electric stepper motor. The motor moves a ribbon and throttle linkage, in response to controller, to maintain the desired cruise speed. The cruise control module contains a low speed limit which will prevent system engagement below a minimum speed of 40Km/h (25mph). The operation of the controller is controlled by mode control switches located on steering wheel.
Transaxle range switch and brake switch are provided to disengage the cruise control system. The switches are on brake pedal braket and transxale. When the brake pedal depressed or select lever shifted, the cruise control system is electrically disengaged and the throttle is returned to the idle position.
Cruise main switch
SMCC system is engaged by pressing "CRUISE" push button. Releasing "CRUISE" push button release throttle, clears cruise memory speed, and puts vehichle is a non-cruise mode.
Set/Coast switch
SET/COAST switch located on inside of steering wheel has two positions - "Normal" and "Depressed" The set position - With SET/COAST switch depressed and then releasely the cruise speed will be set at the speed the vehicle was going when SET/COAST switch was released.
The coast position - With SET/COAST switch fully depressed, driver can lower cruise speed. To decrease cruise speed, Set/Coast switch is held in, disengaging cruise control system. When vehicle has slowed to required cruise speed, releasing SET/COAST switch will re-engage speed at new selected speed.
The tap down - To lower vehicle speed, cruise must be engaged and operating. Tap down is done by quickly pressing and releasing SET/COAST switch. Do no hold Set/Coast switch in depressed position.
Tap down is a function in which cruise speed car be decreased by 1mph(1.6Km/h).
Resume/Accel switch
RESUME/ACCEL switch located on inside of steering wheel has two positions - "Normal" and "Depressed".
The resume position - With RESUME/ACCEL switch depressed and then release, This switch also returns cruise control operation to last speed (which is temporarily disengaged by Cancel switch or Brake pedal), setting when momentarily operating RESUME/ACCEL switch by constant acceleration.
The accel position - With RESUME/ACCEL switch depressed and held in, disengaging cruise control system, when vehicle has accelerated to required cruise speed, releasing RESUME/ACCEL switch will re-engage speed at new selected speed.
The tap up - To increase vehicle speed, the cruise must be engaged and operating.
Tap up is done by quickly pressing and releasing RESUME/ACCEL switch less than 0.75 second. Do not hold RESUME/ACCEL switch is in depressed position. Tap up is a function in which cruise speed can be increased by 1 mph (1.6Km/h).
Cancel switch
SMCC system is temporarily disengaged by pressing "CANCEL" switch.
Cruise speed canceled by this switch will be recover by RESUME/ACCEL switch.

Components location



1. Cruise Main switch
2. Cruise control module
3. Vehicle speed sensor
4. Cancel switch
5. Coast/Set switch
6. Resume/Accel switch
7. Throttle body
8. Transmission range switch

Components

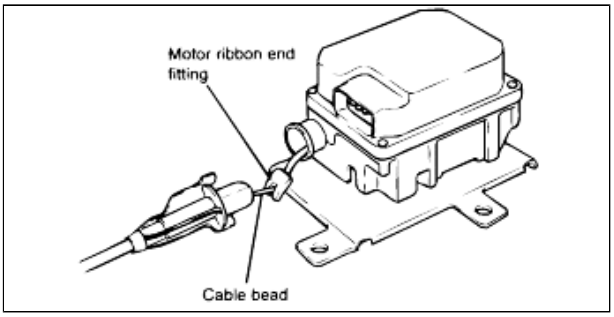


1. Throttle body
2. Control cable
3. Cruise control module

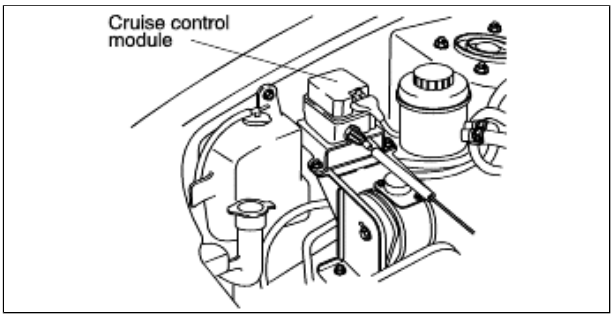
Removal

CRUISE CONTROL MODULE

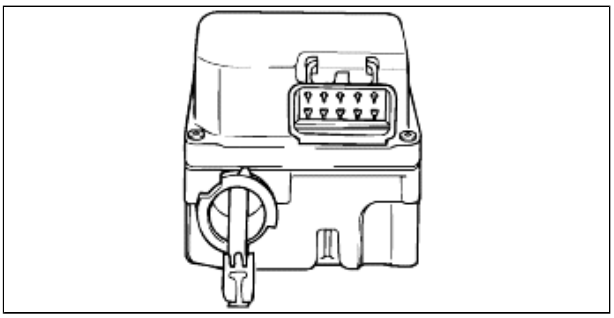
1. Disconnect battery negative cable.
2. Disconnect cruise control cable from throttle body.
3. Disconnect cruise control cable from cruise control module.



4. Disconnect control module connector from cruise control module.
5. Remove three bolts securing control module with bracket.

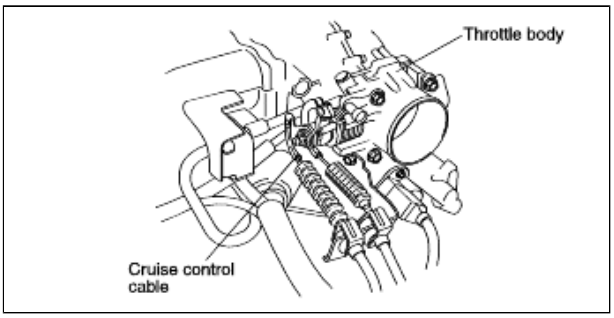


6. Remove control module with bracket from engine compartment.
7. Remove three bolts attaching cruise control module to bracket.
8. Remove control module from bracket.

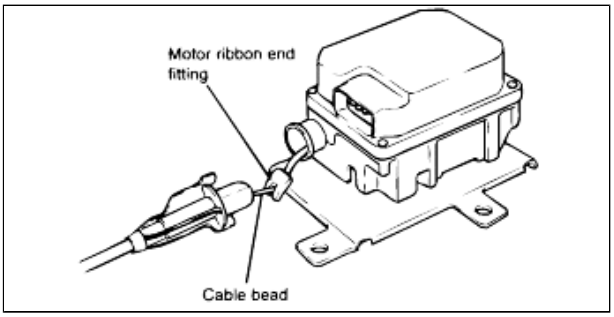


CRUISE CONTROL CABLE

1. Disconnect cable and conduit from engine bracket.
2. Disconnect cable and fitting from throttle body lever stud.



3. Disconnect cable bead from cruise motor ribbon end fitting on cruise control module.



4. Remove cable from vehicle.

Installation

1. Postion control module on control module bracket.
2. Install three bolts.

Tighten three bolts to :5.1~9.4 lb·ft (7~13 N·m, 0.7~1.3 kg-m)

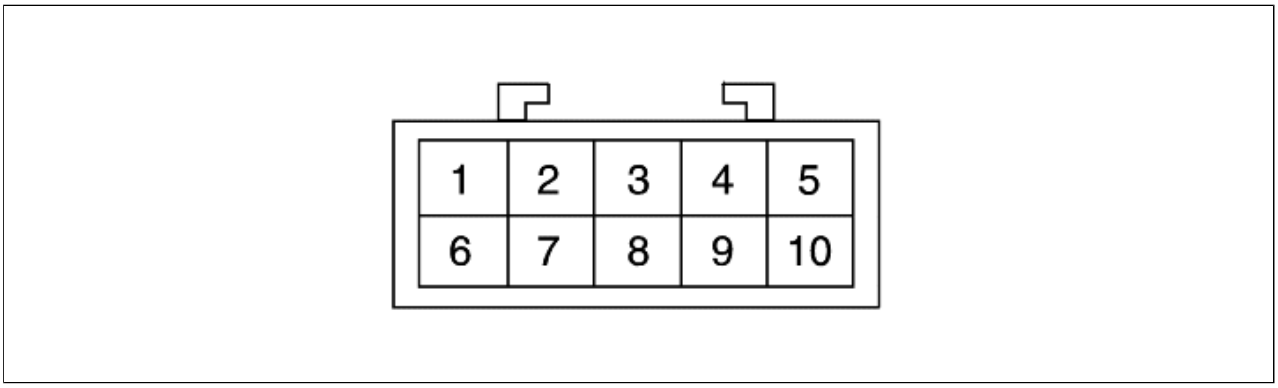
3. Postion control module bracket.
4. Secure control module bracket to body using three bolt.

Tighten three bolts to :15.2~26.8 lb·ft (21~36 N·m, 2.1~3.7 kg-m)

5. Connect control module connector.
6. Connect control cable.
7. Connect battery negative cable.

Inspection

1. Connect a voltmeter between cruise control unit terminals and ground.
2. Turn ignition switch "ON" and check that terminal voltages are as described on the following page.



Terminal	Connected to	Voltage	Procedure
1	Battery	Approx. 12V	Ignition switch ON and START
2(Output)	Brake pedal switch 2 (N.O.)	Approx. 0V Approx. 12V	Ignition switch ON Brake pedal depressed
3(Input)	Transaxle range switch(A/T) Clutch switch(M/T)	Approx. 0V Approx. 12V	N or P range and cruise control main switch ON Other range and cruise control main switch ON
4	-	-	-
5(Input)	Vehicle speed sensor	Pluses be-tween 0-5V	Ignition switch ON While rotating the rear tire
6	Ground	Approx. 0V	N.A.
7(Input)	Brake pedal switch 1 (N.C.)	Approx. 12V Approx. 0V	Cruise main switch ON Brake pedal depressed
8(Input)	Resume/Accel switch	Approx. 12V Approx. 0V	Switch depressed and cruise control main switch ON. Switch not depressed and cruise control main switch ON.

9(Input)	Set/Coast switch	Approx. 12V Approx. 0V	Switch depressed and cruise control main switch ON. Switch not depressed and cruise control main switch ON.
10(Input)	Cruise control main switch	Approx. 12V	Cruise control main switch ON.

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0300	Random misfire detected
Diagnostic trouble code No. P0301	Cylinder 1 misfire detected
Diagnostic trouble code No. P0302	Cylinder 2 misfire detected
Diagnostic trouble code No. P0303	Cylinder 3 misfire detected
Diagnostic trouble code No. P0304	Cylinder 4 misfire detected
Diagnostic trouble code No. P0305	Cylinder 5 misfire detected
Diagnostic trouble code No. P0306	Cylinder 6 misfire detected
[Related items]	1) Vacuum leak in air intake system 2) CKPS circuit malfunction 3) Ignition circuit malfunction 4) Faulty ignition coil or plug wire 5) Spark plug malfunction 6) Low compression due to blown head gasket, leaking valve or piston ring 7) Low/high fuel pressure due to faulty pressure regulator, restricted fuel lines, plugged fuel filter or faulty fuel pump 8) Fuel injector circuit malfunction 9) Faulty fuel injector **NOTE** If any injectors, HO2S, ECTS, and MAFS codes are present, do all repairs associated with those codes before proceeding this troubleshooting guide.

Step	Inspection		Action
1	Turn ignition switch to ON. Connect SCAN TOOL to data link connector or OBD-II check connector. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Check for any split, disconnected or perforated vacuum hoses. Also, check PCV valve for proper operation. Are vacuum hoses and PCV okay?	Yes	Go to step 3.
		No	Replace faulty vacuum hoses or PCV.
3	Turn ignition to OFF and disconnect ignition coil connector. Turn ignition to ON and measure voltage at ignition coil terminal 3. 1) Specification: approximately B+ Is battery voltage within specifications?	Yes	Go to step 4.
		No	Check for open between ignition switch and ignition coil terminal 3. If wiring is OK, check for loose, bent, misplaced or corroded terminals at ignition coil connector. Repair as necessary.

4	Turn ignition to OFF and check ignition coils and plug wires for cracks or carbon tracing. Check resistance of secondary coils (10.3~13.9 KΩ at 20°C). Check for resistance of plug wires (16 KΩ per 1m). Are ignition coils and plug wires OK?	Yes	Go to step 5.
		No	Repair or replace as necessary.
5	Release fuel pressure and attach fuel pressure gauge to service port on fuel rail. Start an engine and warm up to operating temperature. Check for fuel pressure at idle. 1) Fuel pressure at idle: 46~49 psi (320~340Kpa, 3.26~3.47kg/cm²) Is fuel pressure within specification?	Yes	Go to step 6.
		No	Check fuel delivery system.
6	Remove spark plugs and check gap (1.0~1.1 mm [0.027~0.031 in]) and plug condition. Are spark plugs gapped properly and in good condition?	Yes	Go to step 7.
		No	Repair as necessary.
7	Perform compression test [approximately (184 psi, 1275Kpa, 13.0kg/cm²) at 300rpm (no more than 10% between highest and lowest cylinder)]. Is compression OK?	Yes	Go to step 8.
		No	Perform leak down test to determine source of low compression and repair as necessary
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0320	Ignition failure system circuit malfunction
[Related items]	1) Open or short between ignition failure sensor and ECM 2) Open or short between ignition failure sensor and ignition coil 3) Open between ignition failure sensor and chassis ground 4) Faulty ignition failure sensor

Step	Inspection		Action
1	Disconnect ignition failure sensor connector and turn ignition switch to ON. Measure voltage between IFS harness terminal 1 and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Go to step 2.
		No	Open circuit or short circuit to chassis ground between IFS terminal 1 and ignition switch. Repair as necessary.
2	Measure voltage between IFS harness terminal 3 and chassis ground. 1) Specification: approximately 5V Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between IFS terminal 3 and ECM. Repair as necessary.
3	Measure resistance between IFS terminal 4 and chassis ground. 1) Specification: below 1Ω Is measured resistance within specification?	Yes	Go to step 4.
		No	Open circuit between IFS terminal 4 and chassis ground. Repair as necessary.
4	Turn ignition switch to OFF and reconnect ignition failure sensor. Turn ignition switch to ON and measure voltage between IFS terminal 2 and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Thoroughly check for loose, bent or corroded terminals at IFS. If OK, temporarily install a known good IFS and check for proper operation. If problem is corrected, replace IFS.
		No	Open circuit or short circuit to chassis ground between IFS and ignition coil. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0350	Ignition coil primary/secondary circuit malfunction
[Related items]	1) Open or short between ignition coil and ECM 2) Open or short between ignition coil and spark plug 3) Short between ignition coil wires 4) Faulty ignition coil 5) Poor connection at ignition coil 6) Faulty ignition system

Step	Inspection		Action
1	Using SCAN TOOL and monitor any DTCs. Is DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, or P0320 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Connect SCAN TOOL to data link connector or OBD-II check connector. Start engine and monitor spark plug signal pattern. Is signal pattern normal?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and ignition coils.
		No	Go to step 3.
3	Thoroughly check all coils and spark plug wires for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 4.
4	Start engine. Using SCAN TOOL monitor spark plug signal pattern. Are all signal patterns normal?	Yes	Go to step 5.
		No	Verify what ignition coil is problem and go to step 5.
5	Turn ignition to OFF and disconnect ignition coil connector. Turn ignition to ON and measure voltage of ignition coil power circuit between ignition coil harness connector and chassis ground. 1) Specification: approximately B+ Is voltage within specification?	Yes	Go to step 6.
		No	Open circuit or short circuit to chassis ground between ignition coil harness connector and ignition failure sensor connector. Repair as necessary.
6	Turn ignition to OFF and disconnect ECM connector. Measure resistance of ignition coil signal circuit between ignition coil harness connector and ECM harness connector. Measure resistance of ignition coil ground circuit between ignition coil harness connector and chassis ground. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 7.
		No	Open circuit between ignition coil harness connector and ECM harness connector and/or chassis ground. Repair as necessary.
7	Turn ignition to ON. Measure voltage of ignition coil signal circuit between ignition coil harness connector and chassis ground.	Yes	Go to step 8.
		No	Short circuit to power between ignition coil harness connector and ECM harness connector.

	1) Specifications: below 0.5V Is voltage within specifications?		Repair as necessary.
8	Turn ignition to OFF. Measures resistance between ignition coil harness connector and chassis ground at ignition coil signal circuit. 1) Specifications: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good ignition coil and check for proper operation. If problem is corrected, replace ignition coil.
		No	Short circuit to chassis ground between ignition coil harness connector and chassis ground. Repair as necessary.
9	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0560	Battery backup line open
[Related items]	1) Open or short between ECM and battery 2) ECM internal faulty

Step	Inspection		Action
1	Turn ignition to OFF and disconnect ECM connector. Measure voltage of backup circuit between battery and ECM harness connector. 1) Specification: approximately B+ Is voltage within specification?	Yes	Thoroughly check for poor connection, misplaced, corroded terminals at ECM connector. Repair as necessary.
		No	Open circuit or short circuit to chassis ground between ECM harness connector and battery. Repair as necessary.
2	1) Temporarily install a known good ECM and check for proper operation. If problem is corrected replace ECM. 2) Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1330	Spark timing adjustment
[Related items]	1) Short to GND between ROM change tool (RCT) and ECM

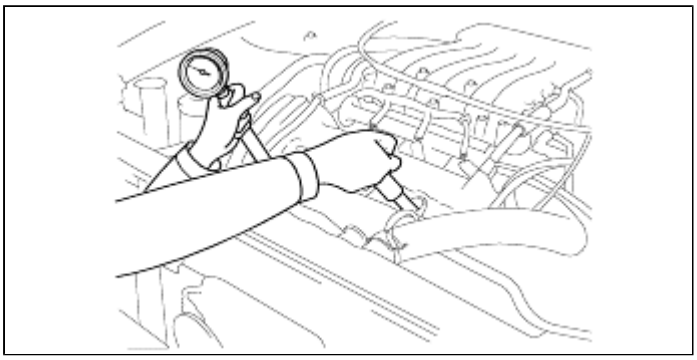
Step	Inspection		Action
1	Turn ignition to OFF and disconnect ECM connector. Measure resistance between RCT harness connector and chassis ground at spark timing adjustment circuit. 1) Specifications: infinite Does resistance indicate open circuit?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check connectors at ECM and RCT.
		No	Short circuit to chassis ground between RCT and ECM harness connector. Repair as necessary.
2	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Engine : Mechanical Section

Checking compression pressure

1. Before checking compression, check the engine oil level and that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until engine coolant temperature has risen to 80- 95°C
3. Stop the engine and disconnect the spark plug cables.
4. Remove the spark plugs.
5. Turn over the engine to remove any foreign objects in the cylinders.
6. Attach the compression gauge to the spark plug hole.
7. Depress the accelerator pedal to fully open the throttle valve.
8. Turn over the engine and read the gauge.

Standard value :1,275kPa (13.0kg / cm², 185 psi)Limit : 1,128 kPa (11.5kg / cm², 164 psi)



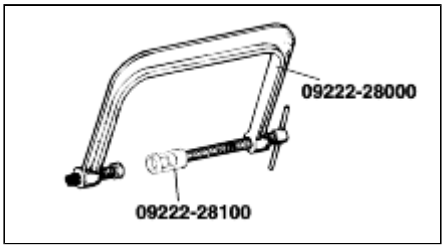
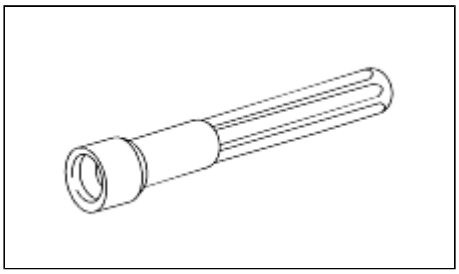
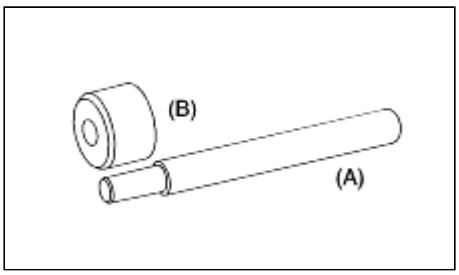
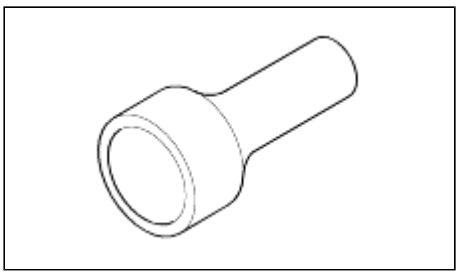
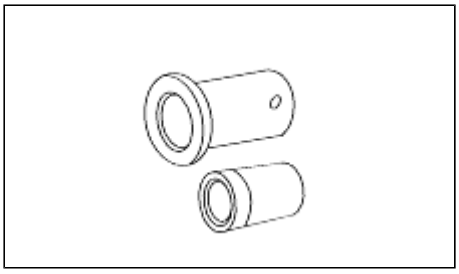
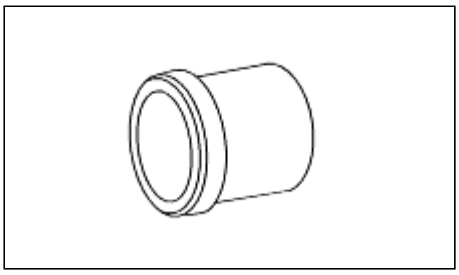
9. Repeat steps 6 through 8 on all cylinders, making sure ensuring that the pressure difference for each of the cylinders is within the specified limit.

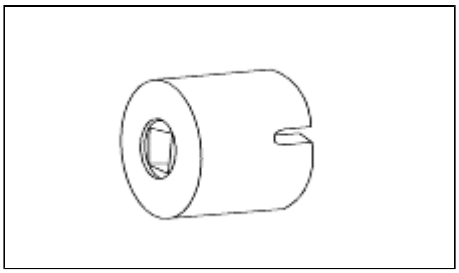
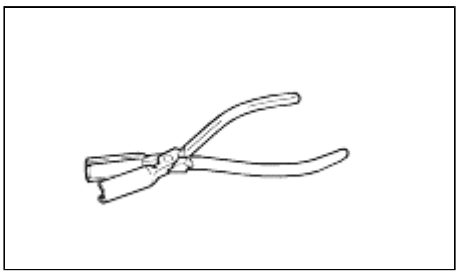
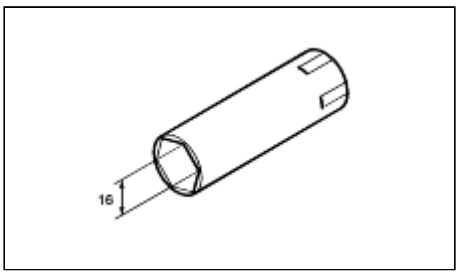
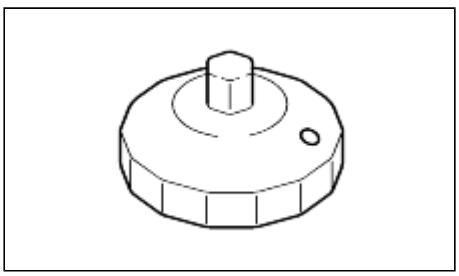
Limit :Max 100 kPa (1.0 kg/cm², 14 psi) for all cylinders.

10. If a cylinder's compression or pressure difference is below the specification,add a small amount of oil through the spark plug hole and repeat steps 6 through9.
    (1) If the addition of oil causes the compression to rise, it is possible that there is wear between the piston ring and cylinder wall.
    (2) If the compression doesn't rise, valve seizure, poor valve seating or a compression leak from the cylinder head gasket are all possible causes.

Tightening torqueSpark plug:20 - 30 N·m(200 - 300kg·cm, 14.75 - 22.13 lb·ft)

Special service tools

Tool (Number and name)	Illustration	Use
Valve spring compressor (09222-28000) Valve spring compressor adapter (09222-28100)		Removal and installation of intake and exhaust valve
Valve stem oil seal installer (09222-28200)		Installation of valve stem oil seal
Valve guide remover (09221-3F000(A)) Valve guide installer (09221-3F000(B))		Removal and installation of valve guide
09231-33000 Crankshaft rear oil seal installer		Installation of crankshaft rear oil seal
09214-33000 Crankshaft front oil seal installer		Installation of crankshaft front oil seal
09221-21000 Camshaft oil seal installer		Installation of camshaft oil seal

09231-33100 Crankshaft wrench		Used if the crankshaft needs to be rotated to attach the timing belt, etc.
09222-29000 Valve stem oil seal remover		Removal of valve stem oil seal
09188-38000 Spark plug socket wrench		Installation and removal of spark plug
09263-38000 Oil filter wrench		Removal of oil filter

TROUBLESHOOTING

Symptom	Probable cause	Remedy
Knocking of crankshaft and bearing	Worn main bearing	Replace
	Seized bearing	Replace
	Bent crankshaft	Replace
	Excessive crankshaft end play	Replace thrust bearing
Piston and connecting rod knock	Worn bearing	Replace
	Seized bearing	Replace
	Worn piston pin	Replace piston and pin or connecting rod
	Worn piston in cylinder	Recondition cylinder
	Broken piston ring	Repair or replace
	Improper connecting rod alignment	Replace
Noisy valves	Faulty auto-lash adjuster	Replace
	Thin or diluted engine oil (low oil pressure)	Change
	Worn or damaged valve stem or valve guide	Replace
Excessively worn cylinder and piston	Shortage of engine oil	Add or replace Check oil level on daily basis
	Dirty engine oil	Replace
	Poor quality of engine oil	Use proper oil
	Improperly assembled piston and connecting rod	Repair or replace
	Improper piston ring end clearance	Replace
	Dirty air cleaner	Clean air cleaner assembly and replace the air filter
Connecting rod and main beaing noise	Insufficient oil supply	Check engine oil level
	Thin or diluted engine oil	Change and determine cause
	Excessive bearing clearance	Replace
Damaged crankshaft bearing	Shortage of engine oil	Add or replace Check oil level on daily basis
	Low oil pressure	Adjust or repair
	Poor quality of engine oil	Use proper engine oil
	Worn or out-of -round of crankshaft journal	Replace
	Restricted oil passage in crankshaft	Clean
	Worn bearing	Replace bearing and check engine oil and lubrication system
	Bearing improperly installed	Replace
	Non-concentric crankshaft or bearing	Replace
Timing belt noise	Incorrect belt tension	Replace
	Blown cylinder head gasket	Replace gasket
	Worn or damaged piston rings	Replace rings

Low compression	Worn piston or cylinder	Repair or replace piston and/or cylinder block
	Worn or damaged valve seat	Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level	Check engine oil level
	Faulty oil pressure switch	Replace
	Clogged oil filter	Replace
	Worn oil pump gears or cover	Replace
	Thin or diluted engine oil	Change and determine cause
	Oil relief valve stuck (open)	Repair
	Excessive bearing clearance	Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine rolling and vibration	Loose engine roll stopper (front, rear)	Re-tighten
	Loose transaxle mount bracket	Re-tighten
	Loose engine mount bracket	Re-tighten
	Loose center member	Re-tighten
	Broken transaxle mount insulator	Replace
	Broken engine mount insulator	Replace
	Broken engine roll stopper insulator	Replace
Low coolant level	Leakage of coolant	
	Damaged radiator core joint	Replace
	Corroded or cracked hoses (Radiator hose, heater hose, etc)	Replace
	Faulty radiator cap valve or setting of spring	Replace
	Faulty thermostat	Replace
	Faulty engine coolant pump	Replace
Clogged radiator	Foreign material in coolant	Replace
Abnormally high coolant temperature	Faulty thermostat	Replace parts
	Faulty radiator cap	Replace
	Restriction of flow in cooling system	Replace
	Loose or missing drive belt	Adjust or replace
	Faulty engine coolant pump	Replace
	Faulty temperature gauge or wiring	Repair or replace
	Faulty electric fan	Repair or replace
	Faulty thermo-sensor on radiator	Replace
	Insufficient coolant	Refill coolant
Abnormally low coolant temperature	Faulty thermostat	Replace
	Faulty temperature gauge or wiring	Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection	Replace
	Blocked or collapsed hose and pipe	Repair or replace
Inoperative electrical		

cooling fan	Damaged	Replace or repair
Exhaust gas leakage	Loose connections	Re-tighten
	Broken pipe or muffler	Repair or replace
Abnormal noise	Detached baffle plate in muffler	Replace
	Broken rubber hanger	Replace
	Pipe or muffler contacting vehicle body	Correct
	Broken pipe or muffler	Repair or replace

Specificaitons

Description	Specificaitons-3.5	Limit
General		
Type	DOHC V-type	
Number of cylinders	6	
Bore	93 mm (3.66 in)	
Stroke	85.8 mm (3.38 in)	
Total displacement	3497 cc (213.3 cu.in)	
Compression ratio	10.0	
Firing order	1-2-3-4-5-6	
Idle R.P.M	700±100	
Ignition timing at idling speed	BTDC 10°±5°	
Valve timing		
Intake valve		
Opens (BTDC)	16.5°	
Close (ABDC)	55.5°	
Exhaust valve		
Opens (BBDC)	48.5°	
Close (ATDC)	15.5°	
Camshaft		
Cam height		
Intake	35.098 ~ 35.298mm(1.38 - 1.39 in)	
Exhaust	34.81 ~ 35.01mm(1.37 - 1.38 in)	
Journal O.D.	25.951 ~ 25.970mm(1.02 - 1.022 in)	
Bearing oil clearance	0.05 ~ 0.09mm(0.002 - 0.0035 in)	
End play	0.1 ~ 0.2mm(0.0039 - 0.0079 in)	
Cylinder head		
Flatness of gasket surface	0.03mm (0.0012 in)	
Flatness of manifold mounting surface		
Intake	Max 0.5mm (0.0197 in)	
Exhaust	Max 0.15mm (0.0059 in)	
Diameter of valve guide hole		
0.05 OS	12.05 - 12.068mm (0.474 - 0.475 in)	
0.25 OS	12.25 - 12.268mm (0.482 - 0.483 in)	
0.50 OS	12.50 - 12.518mm (0.492 - 0.493 in)	
Diameter of seat ring hole of intake valve		
0.3 OS	36.30 - 36.325mm (1.429 -1.430 in)	
0.6 OS	36.60 - 36.625mm (1.441 - 1.442 in)	
Diameter of seat ring hole of exhaust valve		

0.3 OS	33.30 - 33.325mm (1.311 - 1.312 in)	
0.6 OS	33.60 - 33.625mm (1.323 - 1.324 in)	
Valve		
Valve length		
Intake	106.28mm (4.18 in)	105.78mm (4.165 in)
Exhaust	105.4mm (4.15 in)	104.9mm (4.129 in)
Outer diameter of stem		
Intake	6.565 - 6.580mm (0.258 - 0.259 in)	
Exhaust	6.530 - 6.550mm (0.257 - 0.258 in)	
Face angle	45°- 45.5°	
Seat width (Margin)		
Intake	1.0mm (0.039 in)	0.5mm (0.02 in)
Exhaust	1.5mm (0.059 in)	1.0mm (0.039 in)
Clearance (Between stem and guide)		
Intake	0.02 - 0.05mm (0.0009 - 0.0020 in)	0.1mm (0.0039 in)
Exhaust	0.05 - 0.085mm (0.0020 - 0.0033 in)	0.15mm (0.0059 in)
Valve spring		
Free length	46.4mm (1.8268 in)	45.4mm (1.7874 in)
Load	24.0kgf / 37.9mm (53lb / 1.492 in)	
Rectangularity	2°	4°
Piston		
Outer diameter	92.97 - 92.98mm (3.6602 - 3.6606 in)	
Clearance (Between piston and cylinder)	0.03 - 0.05mm (0.0012 - 0.0020 in)	
Width of ring groove		
No. 1	1.53 - 1.55mm (0.0602 - 0.0610 in)	
No. 2	1.51 - 1.53mm (0.0594 - 0.0602 in)	
Oil ring	3.010 - 3.030mm (0.1185 - 0.1193 in)	
Rings for Service	0.25mm (0.010 in), 0.50mm (0.020 in) Oversize	
Piston Ring		
Number of rings per piston	3	
Compression ring	2	
Oil ring	1	
Compression ring type		
No. 1	Barral & innerbevel type	
No. 2	Taper & undercut type	
Oil ring type	3-piece type	
Ring end gap		
No.1	0.20 - 0.30mm (0.0079 - 0.0118 in)	0.8mm (0.031 in)
No.2	0.45 - 0.60mm (0.0177 - 0.0236 in)	0.8mm (0.031 in)

Oil ring side rail	0.2 - 0.7mm (0.0079 - 0.0276 in)	1mm (0.039 in)
Ring side clearance		
No.1	0.04 - 0.08mm (0.0016 - 0.0315 in)	0.1mm (0.0039in)
No.2	0.02 - 0.06mm (0.0008 - 0.0024 in)	0.1mm (0.0039in)
Rings for Service	0.25mm (0.010 in), 0.50mm (0.020 in), Oversize	
Connecting rod		
Side clearance	0.1 - 0.25 mm (0.00394 - 0.00984 in)	0.4mm (0.016 in)
Bend	0.05 or less/100 mm (0.002 in or less/3.937 in)	
Bearing oil clearance	0.022 - 0.040 mm (0.0009 - 0.0016 in)	0.1mm (0.0039 in)
Crankshaft		
Journal O.D	63.982 - 64.00mm (2.5190 - 2.5197 in)	
Pin O.D.	54.982 - 55.000 mm (2.1650 - 2.1654in)	
Out-of-roundness of journal and pin	0.03mm (0.0012 in)	
End play	0.05 - 0.25mm (0.002 - 0.01 in)	0.3 mm (0.012 in)
Main bearing oil clearance	0.018 - 0.036mm (0.0071 - 0.0014 in)	
Cylinder block		
Cylinder bore	93.0mm (3.6614 in)	
Flatness of gasket surface	0.05mm (0.002 in)	
Out -of-roundness Roundness	ø0.02mm (0.00079 in)	0.05mm (0.002 in)
Oil pump		
Side clearance		
Body clearance	0.1 - 0.181mm (0.0039 - 0.0071 in)	
Side clearance	0.04 - 0.095mm (0.0016 - 0.0037 in)	
Tip clearance	0.06 - 0.018mm (0.0024 - 0.0071 in)	
Relief Spring		
Free length	46.3mm (1.823 in)	
Load	6.9kg/39.1mm (15.3 lb/1.54 in)	
Oil filter type	Catridge, Full flow	
Engine oil pressure	80kPa (0.8 bar, 11.6 psi) at idle [Conditions : Oil temperature is 75 to 90°C (167 to 194°F)]	
Engine oil quantity	4.3liters (4.51 US.qts, 3.78 imp.qts)	
Cooling method	Engine coolant cooling, forced circulation with electric fan	
Cooling system quantity	8.2liters (8.61 US.qts, 7.2 imp.qts)	
Thermostat		
Type	Wax pellet type with jiggle valve	
Normal opening temperature (°C)	82 (179.6°F)	
Opening temperature range (°C)	80 - 84 (176 - 83.2°F)	

Wide open temperature (°C)	95 (2.3°F)	
Radiator		
Main valve opening pressure	93.2 - 122.6 kPa (0.95 - 1.25kg/cm², 13.5 - 17.8psi)	
Vaccum valve opening pressure	-0.98 - 4.90 kPa (-0.01 - 0.05kg/cm², -0.14 - 0.71 psi)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hanger	

Tightening torque

	N·m	kg.cm	lb.ft
Crankshaft bolt Timing belt tensioner Camshaft sprocket bolt Cylinder head cover bolts Main bearing cap bolts Connecting rod nuts Cylinder head bolts Cold engine	180 - 190 20 - 27 78.5 - 98.1 7.8 -9.8 68.6 - 78.5 35 + 92° 105 - 115	1,800 - 1,900 200 - 270 800 - 1000 80 -100 700 - 800 350 + 92° 1050 - 1150	130 - 138 15 - 20 57.9 - 72.3 5.8 - 7.2 50.6 - 57.9 26 + 92° 75 - 82
Oil pan drain plug Lower oil pan bolt Upper oil pan bolt [10 × 380 mm (0.937 × 1.4961 in.)] [171.5 mm (6.7519 in.)] [152.5 mm (6.7520 in.)] Oil screen bolt Oil pump case bolts Oil relief valve plug Oil pressure switch Oil pump cover screw Oil filter	35 - 45 10 - 12 30 - 42 5 - 7 5 - 7 15 - 22 12 - 15 40 - 50 8 - 12 8 - 15 11.8 - 15.7	350 - 450 100 - 120 300 - 420 50 - 07 50 - 07 150 - 220 120 - 150 400 - 500 80 - 120 80 - 150 120 - 160	26 - 32 7.2 - 9 22 - 30 3.7 - 5 3.7 - 5 11 - 15 9 - 10 29 - 36 5.8 - 8.7 5.8 - 11 8.7 - 11.6
Drive plate and adaptor plate bolt Air cleaner body installation bolt Surge tank stay Air intake surge tank to intake manifold (bolt) Air intake surge tank to intake manifold (nut) Intake manifold to engine Heat protector to exhaust manifold Exhaust manifold to engine Oil level gauge guide to engine Water outlet fitting bolt Power steering oil pump bracket to front cylinder head assembly Power steering oil pump to bracket Crank position sensor wheel screw	73 - 77 8 - 12 15 - 20 15 - 20 15 - 20 20 - 23 12 - 15 40 - 45 12 - 15 17 - 20 17 - 26 17 - 26 5 - 6	730 - 770 80 - 120 150 - 200 150 - 200 150 - 200 200 - 230 120 - 150 400 - 450 120 - 150 170 - 200 170 - 260 170 - 260 50 - 60	53 - 55 6 - 9 11 - 14 11 - 14 11 - 14 14 - 17 9 - 11 29 - 32 9 - 11 12.3 - 14.5 12 - 19 12 - 19 4 -5
Starter to engine bolt.	27 - 34	270 - 340	20 - 25

Generator inlet pipe to front cylinder head assembly	12 - 15	120 - 150	9 - 11
Fuel hose clamp to rear cylinder head assembly	12 - 15	120 - 150	9 - 11
Transaxle mounting plate	10 - 12	100 - 120	7 - 9
Rear plate			
Oil seal case	10 - 12	100 - 120	7.3 - 8.6
Crankshaft pulley bolt	10 - 12	100 - 120	7.3 - 8.6
Timing belt cover bolt (M6)	180 - 190	1,800 - 1,900	130 - 138
Timing belt cover bolt (M8)	10 - 12	100 - 120	7 - 9
Engine hanger bracket to engine	20 - 27	200 - 270	14 - 20
Generator mount bracket to engine	27 - 35	270 - 350	20 - 25
Generator mount nut (Engine front case side)	20 - 30	200 - 300	14 - 22
Generator mount bolt (Generator mount bracket side)	20 - 30	200 - 300	14 - 22
Starter to engine (Nut)	20 - 30	200 - 300	14 - 22
Drive belt pulley bolt	20 - 30	200 - 300	14 - 22
Drive belt tensioner nut	35 - 55	350 - 550	26 - 40
Engine coolant pump to cylinder block bolt head mark "7"	45 - 50	450 - 500	33 - 36
bolt(M8×5EA)	15 - 22	150 - 220	11 - 16
Engine coolant pump to cylinder block bolt head mark "7"	33 - 50	330 - 500	24 - 37
bolt(M10×1EA)	20 - 40	200 - 400	14 - 29
Engine coolant temperature sensor	17 - 20	170 - 200	12 - 14
Engine coolant inlet fitting attaching bolt			
Air cleaner mounting bolts	8 - 12	80 - 120	6 -9
Intake manifold to cylinder head nuts	12 - 15	120 - 150	9 - 11
Throttle body to surge tank bolts	10 - 13	100 - 130	7 - 9.5
Exhaust manifold to cylinder head nuts	25 - 30	250 - 300	18 - 22
Exhaust manifold heat protector to exhaust manifold bolts	12 - 15	120 - 150	9 - 11
Oxygen sensor to exhaust manifold	40 - 50	400 - 500	29 - 36
Front exhaust pipe to exhaust manifold nuts	30 - 40	300 - 400	22 - 29
Front exhaust pipe to catalytic converter bolts	40 - 60	400 - 600	29 - 43
Catalytic converter to center exhaust pipe nuts	30 - 40	300 - 400	22 - 29
Center exhaust pipe to main muffler nuts	30 - 40	300 - 400	22 - 29
Main muffler hanger support bracket bolts	10 - 15	100 - 150	7 - 11
Delivery pipe installation bolts	10 - 15	100 - 150	7 -11
Timing belt tensioner pulley bolt	43 - 55	430 - 550	31 - 40
Timing belt idler pulley	50 - 60	500 - 600	36 - 43
Timing belt tensioner arm FIXED BOLT	35 - 55	350 - 550	26 - 40
Auto tensioner fixed bolt	20 - 27	200 - 270	14 - 20
Starter to engine (Bolt)	27 - 34	270 - 340	20 - 25
Camshaft bearing cap	19 - 21	190 - 210	14 - 15
Outer	10 - 12	100 -120	7 - 9
Inner			

Service standard

Standard	
Antifreeze coolant concentration	40 ~ 50%

Antifreeze coolant

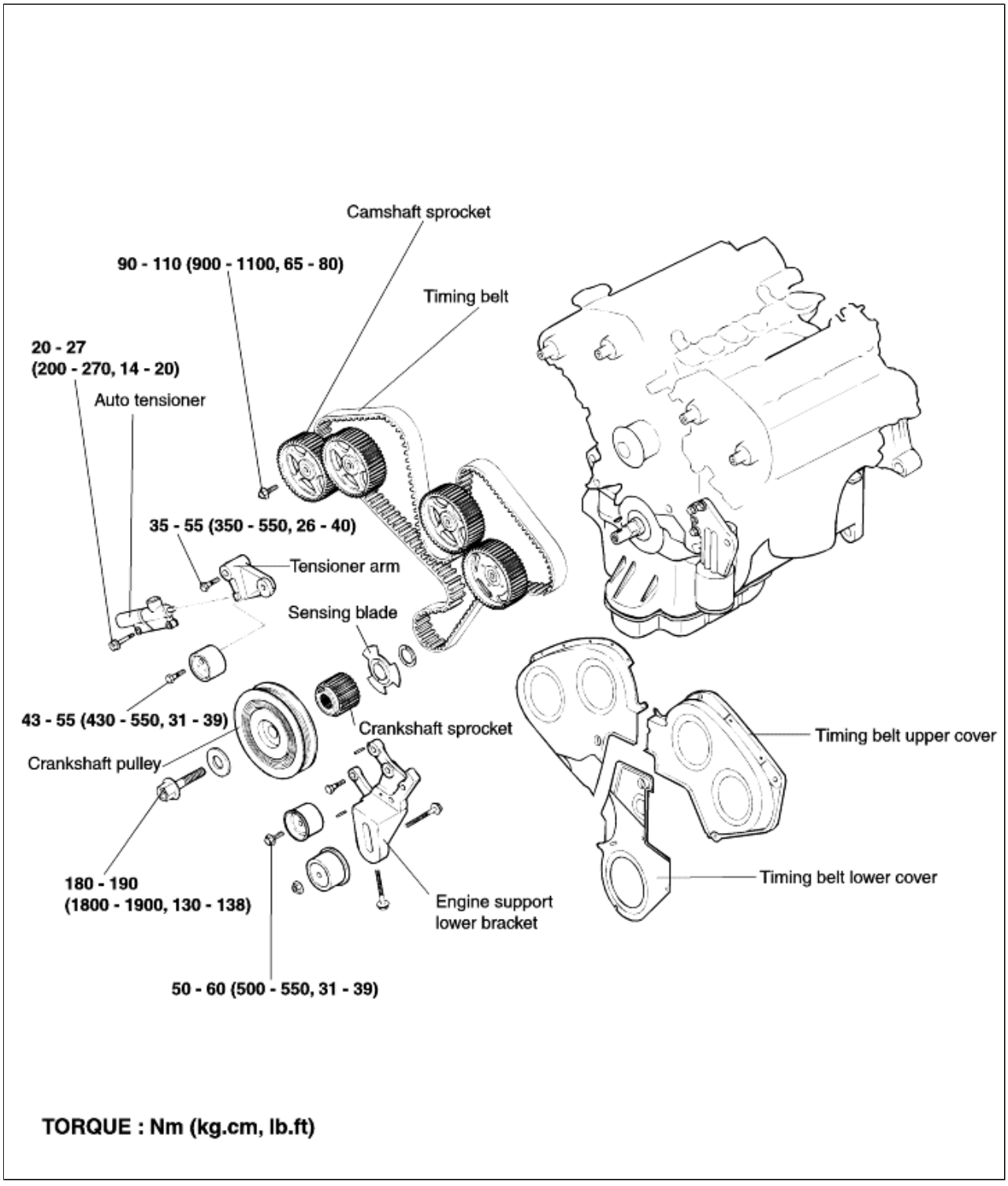
Antifreeze coolant	Ethylene glycol for aluminum radiator

Sealant

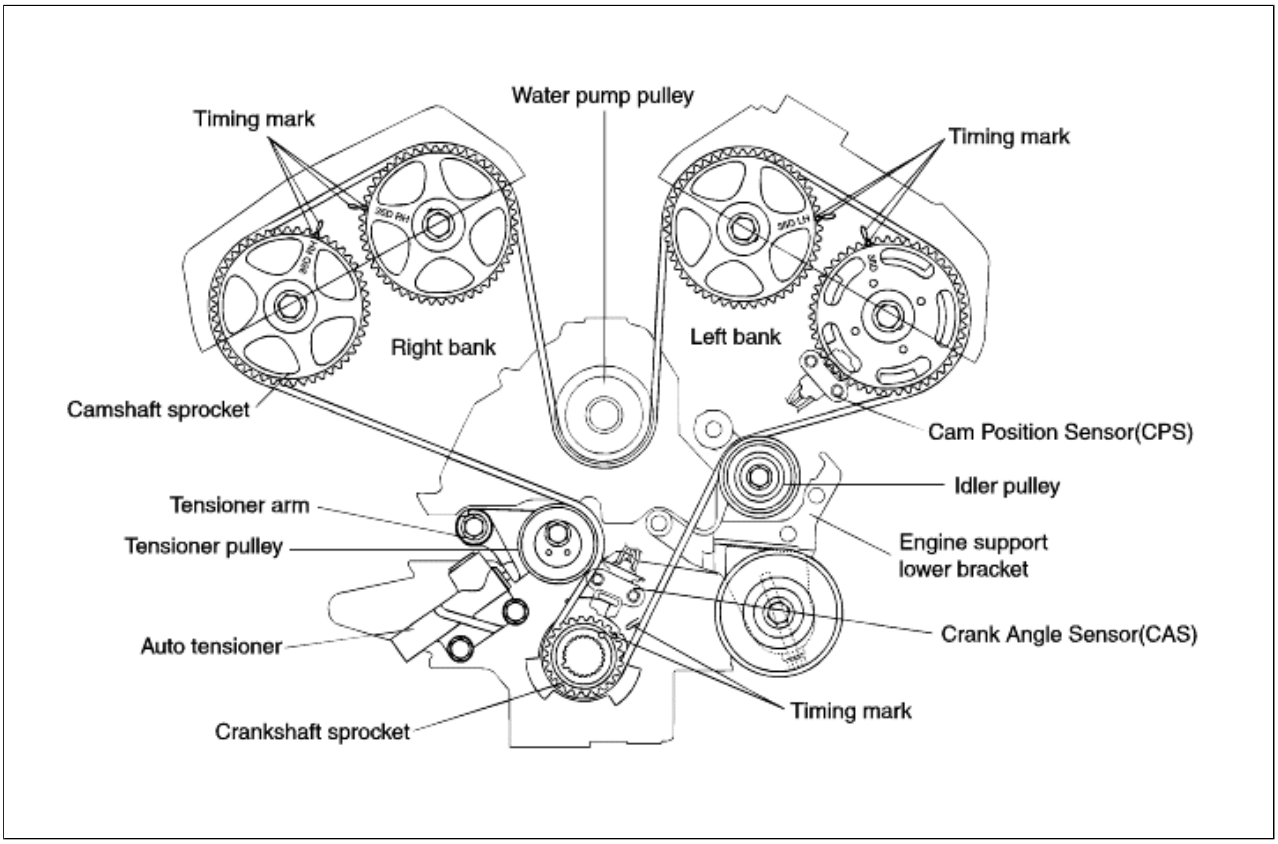
Water temperature sensor and gauge unit	No.2310 of Three Bond Co. or equivalent

Rocker cover	Roctite No.5699 or Three Bond No. 1141E
PCV valve	Loctite No. 242 or equivalent

Components

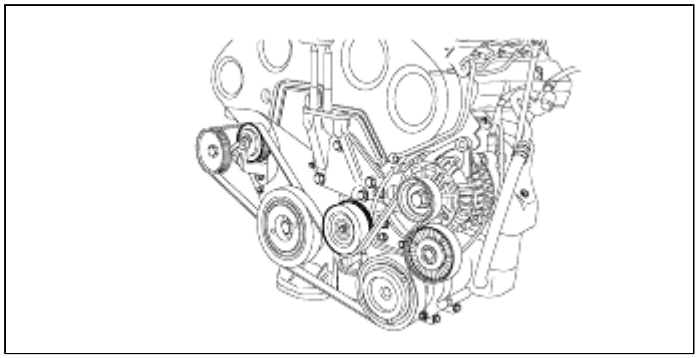


Components

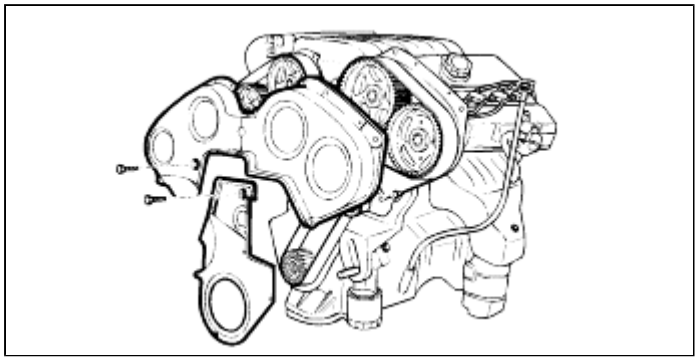

Water pump pulley
Timing mark
Timing mark
Right bank
Left bank
Camshaft sprocket
Cam Position Sensor(CPS)
Idler pulley
Tensioner arm
Tensioner pulley
Engine support
lower bracket
Crank Angle Sensor(CAS)
Auto tensioner
Timing mark
Crankshaft sprocket

Removal

1. Remove the engine cover.
2. Remove the drive belt.
3. Remove the idler pulley, crankshaft pulley, power steering pulley and tensioner pulley.



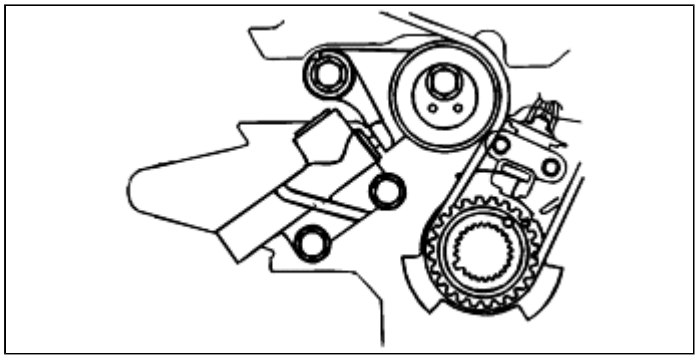
4. Remove the upper and lower timing belt cover.



5. Support the engine with garage jack or special tool, and then remove the engine mounting insulator.

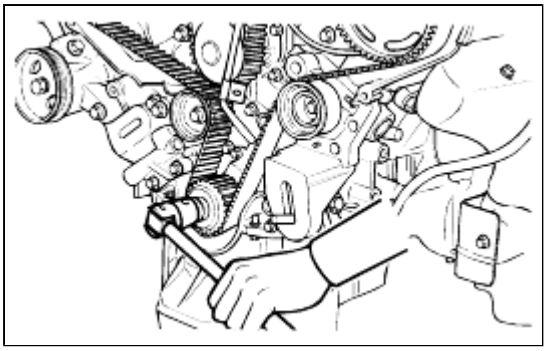
> CAUTION
>
> Take care not to deform the engine oil pan.

6. Remove the auto tensioner.



> NOTE
>
> Rotate the crankshaft clockwise and align the timing mark to get the No.1 cylinder's piston be in TDC position (compression stroke).
> At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with each other.

7. Remove the timing belt.



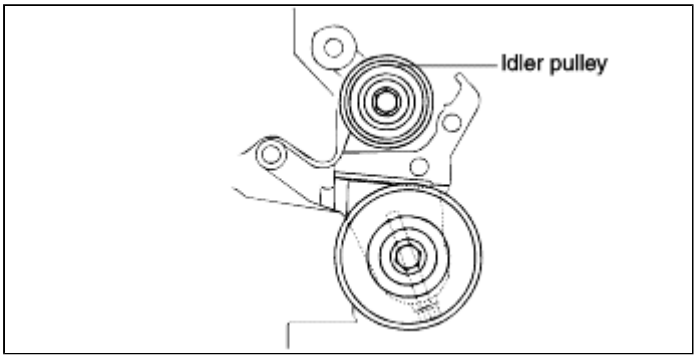
NOTE

When re-using timing belt, make sure of marking the rotating direction on the belt so as to install correctly.

Installation

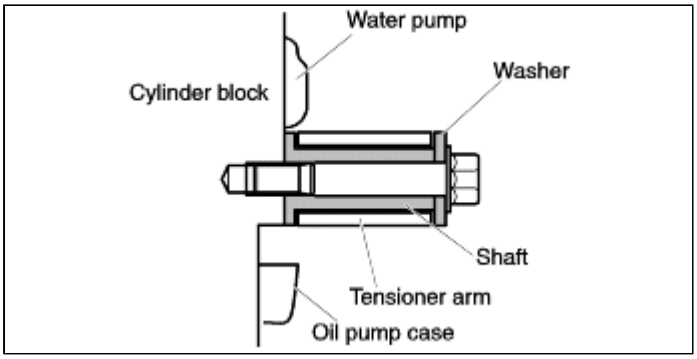
Method of installing timing belt and auto tensioner

1. Install the idler pulley to the engine support lower bracket.



2. Install the tensioner arm, shaft and plain washer to the cylinder block.

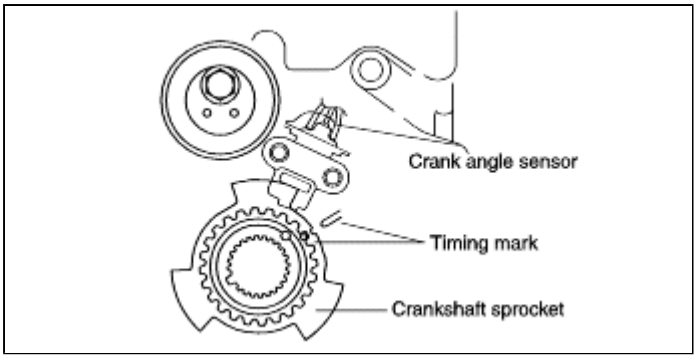
Tightening torque :35 - 55 N·m (350-550kg·cm, 25.82 - 40.57 lb·ft)



3. Install the crankshaft sprocket.

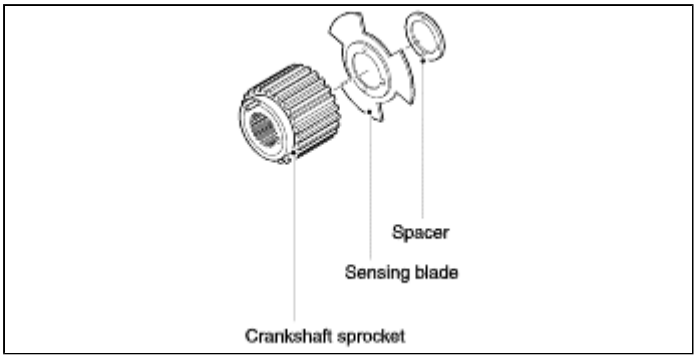
NOTE

Confirm if timing marks coincide with.



CAUTION

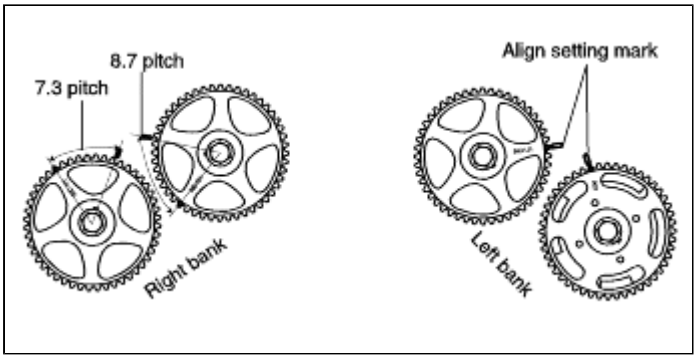
Align the spacer with a pin, and assemble it exerting even force not to deform the crankshaft sensing blade.



4. Install the camshaft sprocket.
   Align it like initial state as shown on the picture.

CAUTION

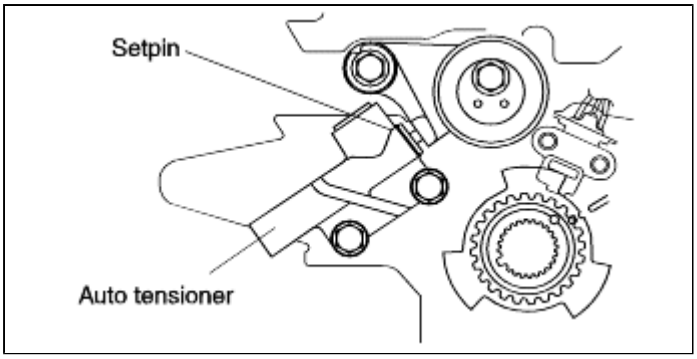
When installing camshaft sprocket, tighten the bolt holding hexagonal part of camshaft to prevent it from turning.



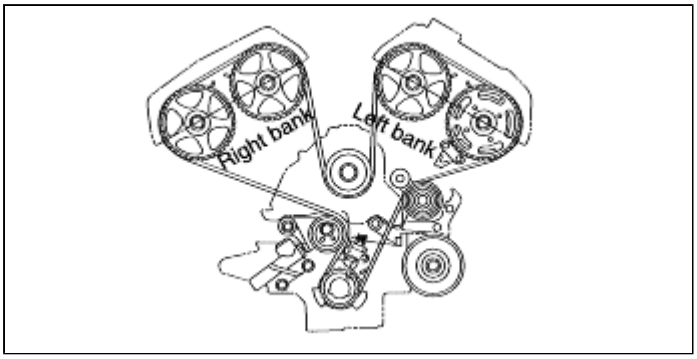
5. Install the auto tensioner to the oil pump case.

CAUTION

At this time the auto tensioner's set pin should be assembled completely.



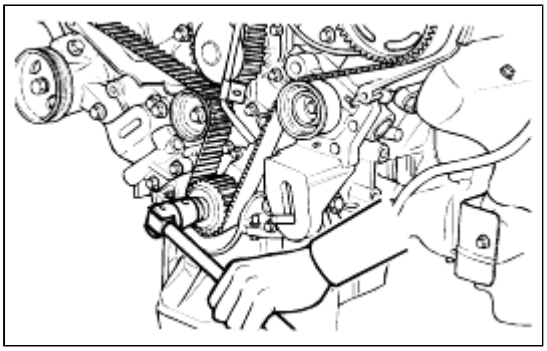
6. Align the timing marks of each sprocket and install the timing belt, maintaining the proper belt tension between each shaft in this order.
   Crankshaft sprocket → Idler pulley → Left bank exhaust camshaft sprocket → Left bank intake camshaft sprocket → Water pump pulley→ Right bank intake camshaft sprocket → Right bank exhaust camshaft sprocket → Tensioner pulley.



CAUTION

1) As a result of this, position of No.1 cylinder comes to compression TDC.
2) As each camshaft sprocket tends to rotate by itself, pay attention not to injure fingers or other bodily part. Especially be careful with the right bank.
3) In case the right bank camshaft sprocket rotates excessively, be cautious not to rotate more than the initial stable position. Always align timing mark of rotating sprocket by turning it reversely. In this case, pay attention not to rotate it reversely from the initial position.
   (If, with one sprocket fixed at No. 1 compression TDC position, the other sprocket is rotated one revolution clockwise or counter clockwise, then the intake and exhaust valve might interfere each other.)

7. After installing the timing belt, exert the reverse-directed force to the right bank exhaust camshaft sprocket to give tension on the belt. Holding this state, recheck if each timing mark is correctly positioned.
8. With tensioner pulley slightly pushing the belt down, tighten the center bolts lightly.

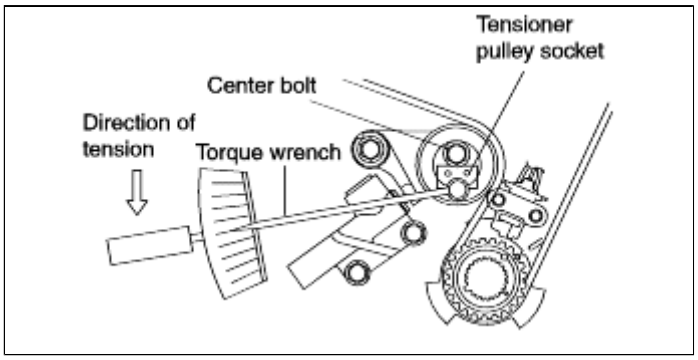


9. Pull out the auto tensioner set pin.

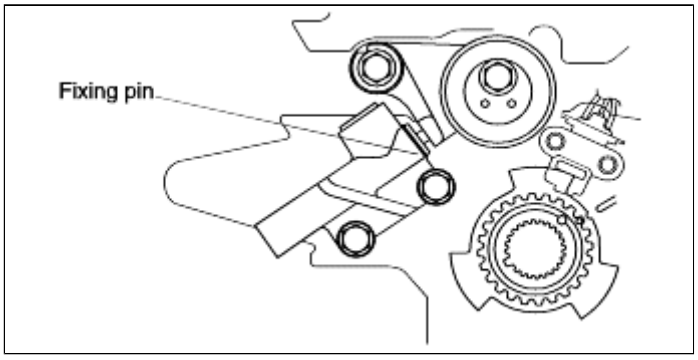
How to adjust timing belt tension

1. Tension setting (While auto tensioner is not operating : And set pin being kept installed.).
   (1) After rotating crankshaft 1/4 revolution reversely, rotate it clockwise to position No. 1 cylinder at TDC. Then, loosen the center bolt and give the belt 50kg-cm of tension with tensioner pulley socket (Two pins are attached) and torque wrench. While maintaining this state, tighten the center bolt to the standard torque.

   Center bolt standard torque :43 - 55 N·m (430 - 550kg·cm, 31.72 - 40.57 lb·ft)



   (2) Pull out the auto tensioner fixing pin.

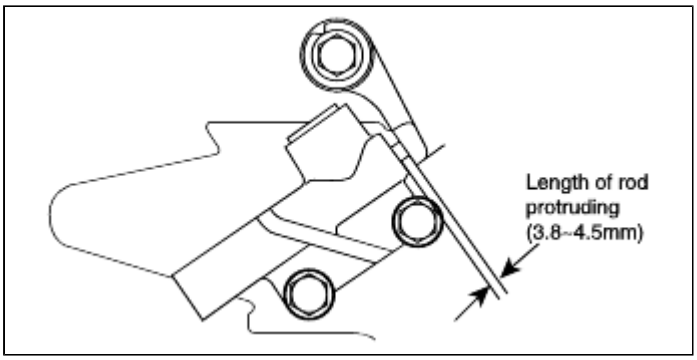


2. How to check tension (While auto tensioner is operating : and fixing pin being uninstalled.)
   (1) After rotating crankshaft 2 revolutions clockwise to position No. 1 cylinder at TDC, wait for about 5minutes, and measure the amount of protruding of the auto tensioner rod.

   CAUTION

   This is "leak down" time for the auto tensioner rod to protrude 1mm when tension caused by rotation of the crankshaft has changed.

   (2) Check if the amount of rod protruding is in the range of 3.8~4.5mm.



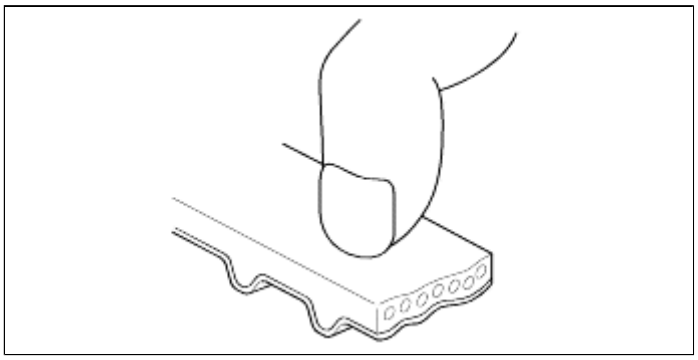
3. Recheck if each sprocket is within the specified range.

   NOTE

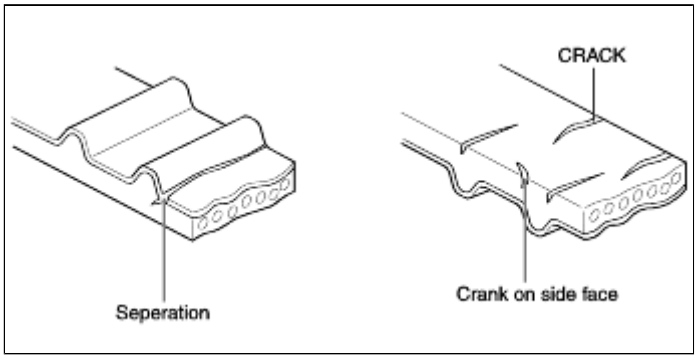
If it is not within the specified range, repeat from procedure 6 as service procedure of timing belt and auto tensioner installation method.

Inspection

1. Check the belt carefully and if any damage is found, exchange it with a new one.
   (1) Vulcanization of the rubber backside.
   The backside is glossy and non-elastic so that, even if a finger nail is forced into it, no mark is produced.

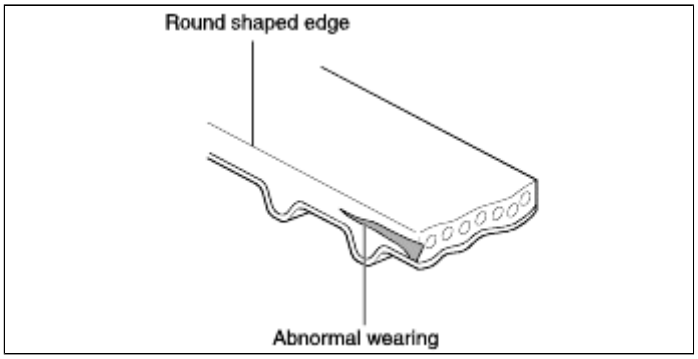


   (2) Crack on the rubber belt surface.

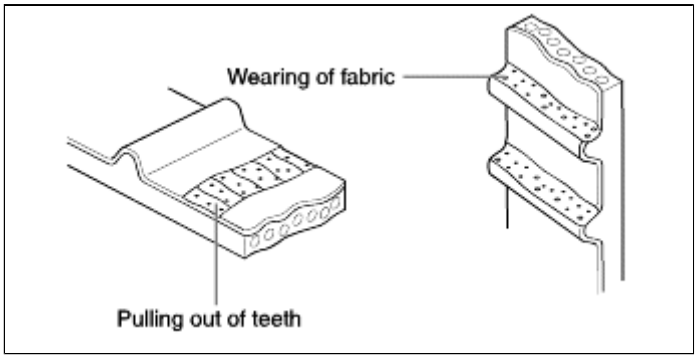


   (3) Abnormal wearing of side face of belt.

> CAUTION
>
> Belts in good condition seem to be cut by a sharp knife.



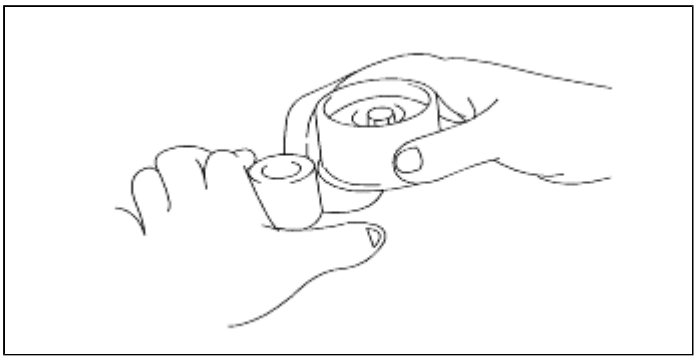
   (4) Abnormal tooth wearing



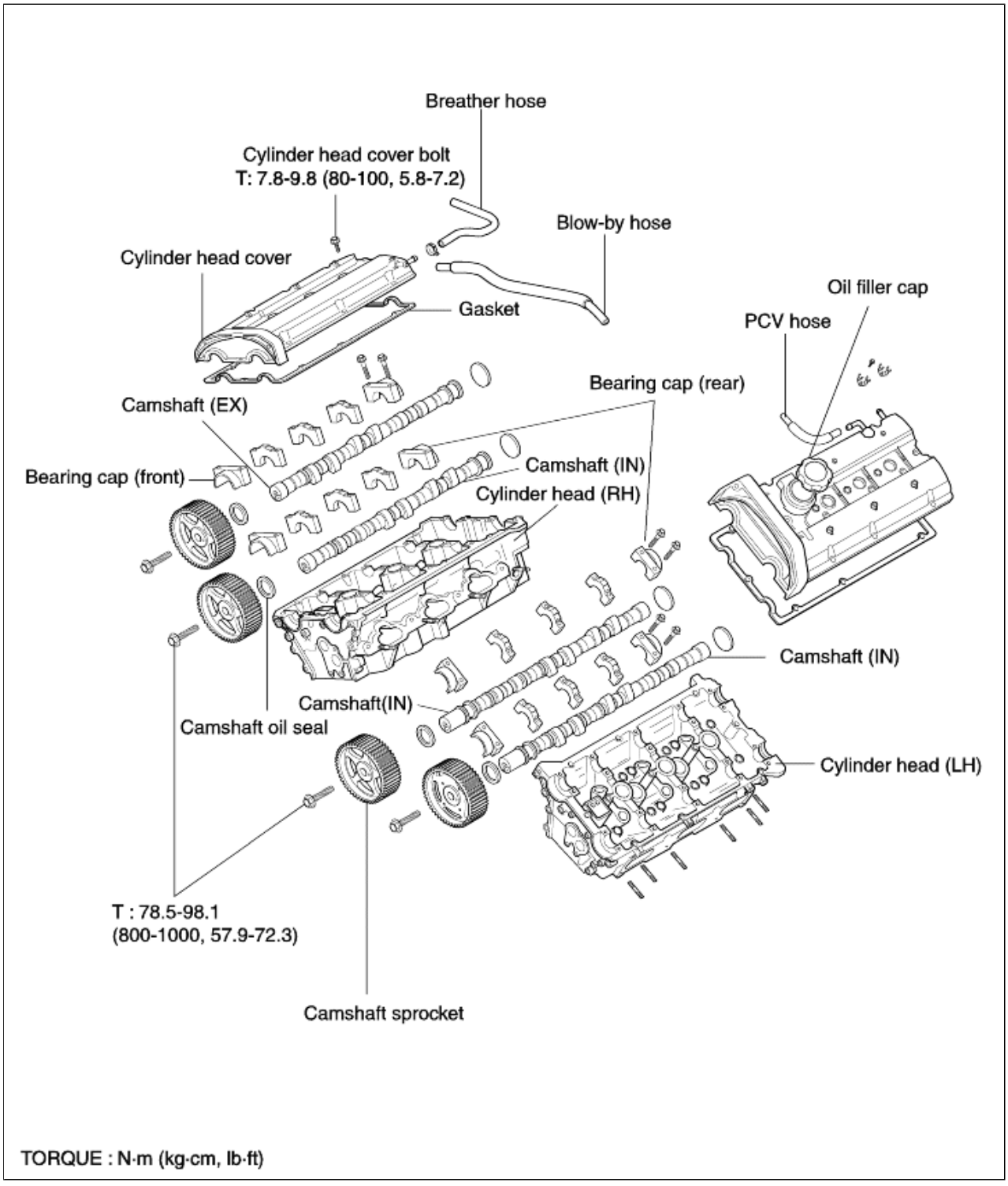
Initial stage
Wearing of side face of load exerting tooth (Fabric puff up, rubber material peel off with color changing to white and fabric become uneven and rough).
Last stage
Fabric wearing of side face of load exerting tooth occurs and rubber is exposed (Length between teeth decrease.).

(5) Missing tooth.

2. If any abnormal noise or difficulty in rotating the pulley by hand is noticed, replace the timing belt tensioner and idler pulley.

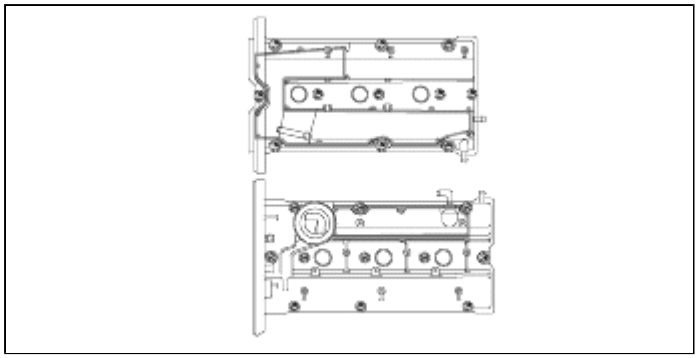


Components

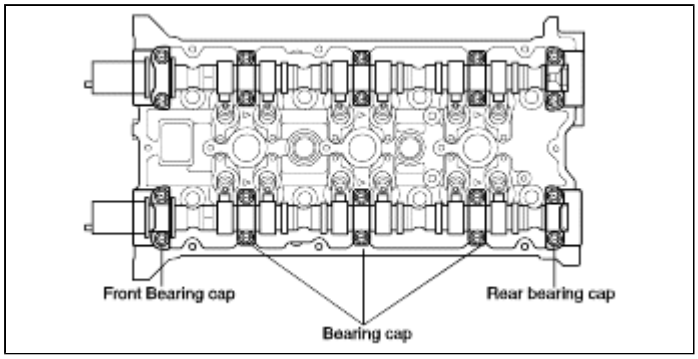

Breather hose
Cylinder head cover bolt
T: 7.8-9.8 (80-100, 5.8-7.2)
Blow-by hose
Cylinder head cover
Gasket
Oil filler cap
PCV hose
Bearing cap (rear)
Camshaft (EX)
Bearing cap (front)
Camshaft (IN)
Cylinder head (RH)
Camshaft (IN)
Camshaft(IN)
Camshaft oil seal
Cylinder head (LH)
T : 78.5-98.1
(800-1000, 57.9-72.3)
Camshaft sprocket
TORQUE : N·m (kg·cm, lb·ft)

Disassembly

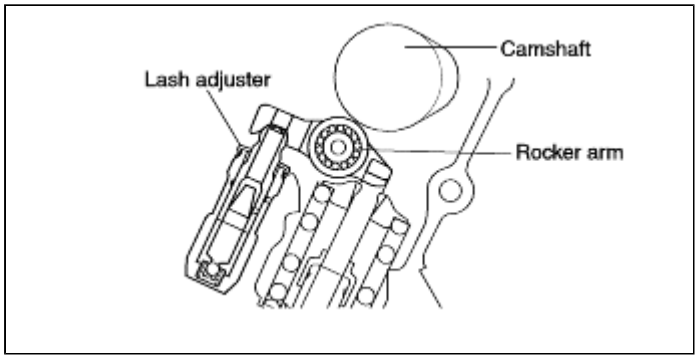
1. Remove the cylinder head cover.



2. Remove the front bearing cap.



3. Remove the rear bearing cap.
4. Remove the bearing cap.
5. Remove the camshaft oil seal.
6. Remove the camshaft.
7. Remove the rocker arm.
8. Remove the lash adjustor.

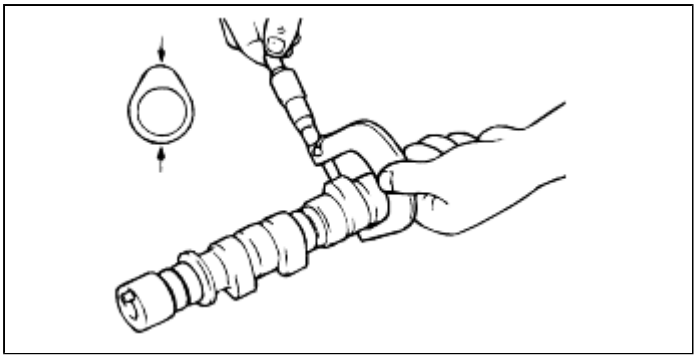


Inspection

Camshaft

1. If there is excessive wear or damage on the camshaft journal or/and cam lobe after checking, replace it with a new one. Measure the height of cam and if the readings are beyond the specification, replace it.

Standard value :Intake : 35.198 mm (1.385 in)Exhaust : 34.910 mm (1.375 in)



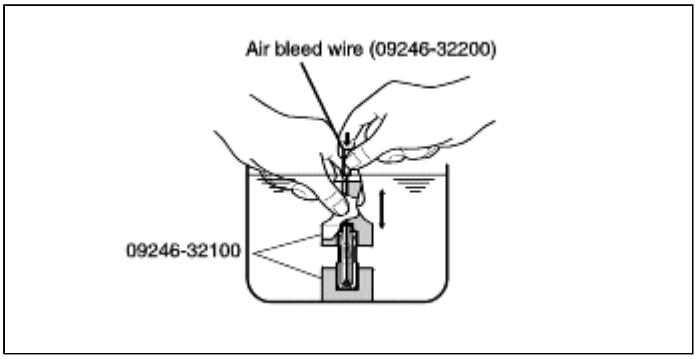
Rocker arm

1. Inspect the roller visually, if any damage or crack is found, replace it.
2. Check that the roller rotates smoothly. If there is excessive clearance, replace it.

Leak down test of lash adjuster

> CAUTION
>
> 1) As the lash adjuster is a precise part, take care not to let any dust and foreign object enter.
> 2) Do not disassemble the lash adjuster.
> 3) Only light oil should be used to clean the lash adjuster

1. Immerse the lash adjuster in light oil.
2. Push out the steel ball in the lash adjuster softly using the special tool(Air bleed wire 09246-32200) and shake the plunger upward and downward 4 or5 times. Using the special tool (09246-32100), release air from the rocker arm installation type lash adjuster.

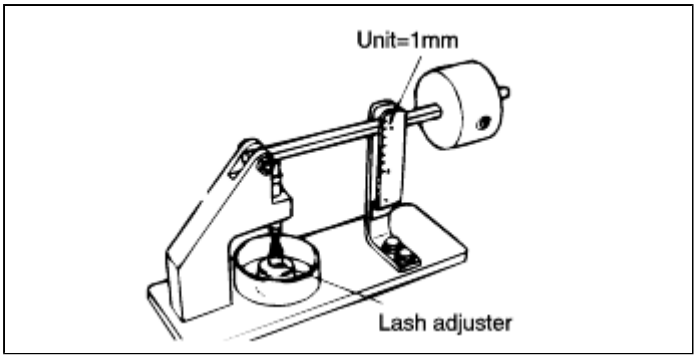


> CAUTION
>
> As the ball weight is very small (just a few grams), pushing the special tool excessively can damage the lash adjuster. Push it with care and appropriate force.

3. Take away the special tool (09246-32200) and push the plunger. If it feels tight, the lash adjuster is normal. If it feels soft and easy, then release air from plunger feels and test again. If the plunger feels still soft even after releasing air, replace it.

> CAUTION
>
> After releasing air, put the lash adjuster straight up not to spill the oil over, and make sure there is no dust or foreign material on it.

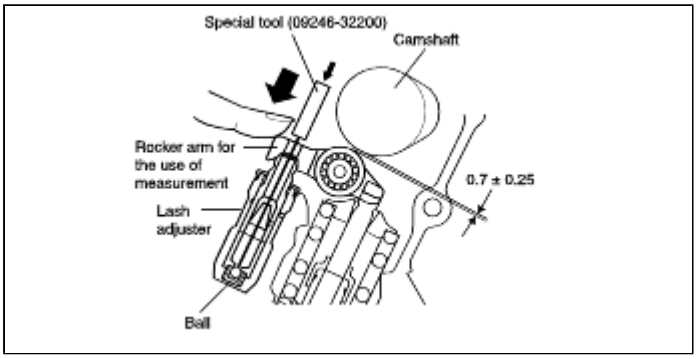
4. After finishing the air release, place the lash adjuster on the special tool(09246-32300).
5. After the plunger has gone down around 0.2~0.5mm, measure the time for the plunger to go down additional 1mm. Replace it if the time is out of standard range.
   Standard dropping down rate : 2~16.5sec/mm (Light oil, oil temperature 20~30°C)



Adjustment of rocker arm clearance

1. Replace the rocker arm with the one specially made for measurement.
2. After positioning the rocker arm roller on basic circle of camshaft, push down the ball lightly with special tool (09246-32200) and push down the rocker arm by hand. Maintaining that state, measure the thickness by inserting athickness gauge between the camshaft and rocker arm.

Clearance between camshaft (Basic circle) androcker arm (roller) :
0.7±0.25 mm(0.0276±0.0098 in)

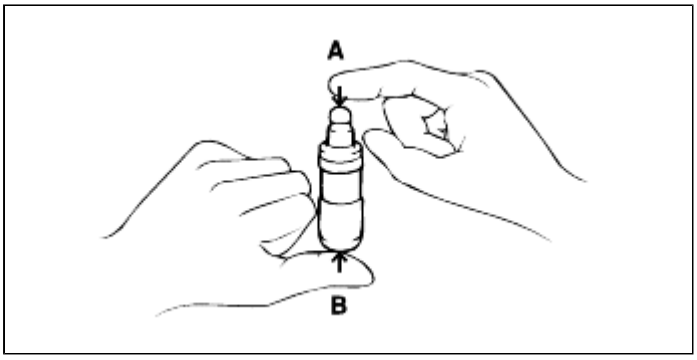


CAUTION

As the ball weight is very small (just a few grams), pushing the special tool excessively can damage the lash adjuster. Push it with care and appropriate force.

HLA (Hydraulic Lash Adjuster)

With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.



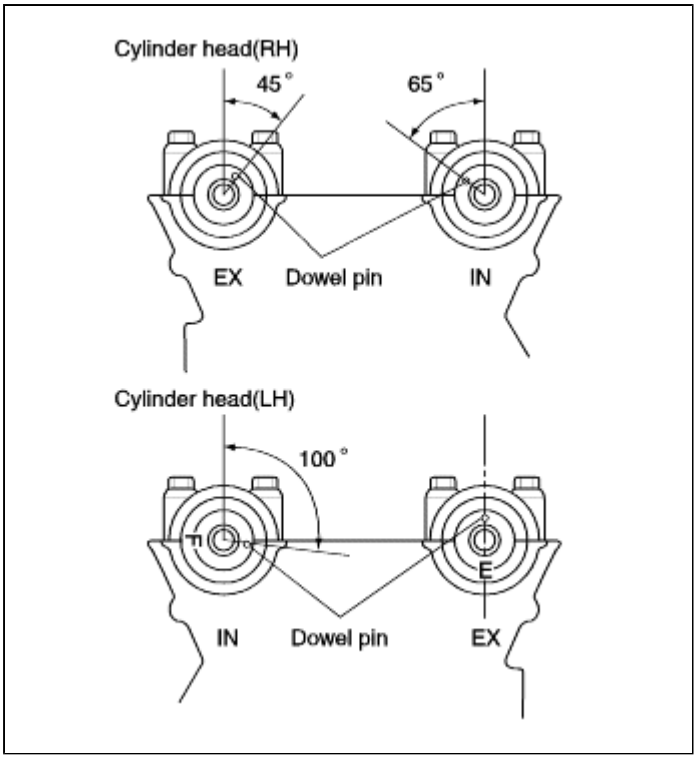
Problem		Possible cause	Action
1	Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
	Continuous noise when the	Oil leakage of the high pressure	

2	engine is started after parking more than 48 hours.	chamber on the HLA,allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm. If it doesn't disappear,refer to step 7 below.
3	Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
4	Continuous noise when the engine is started after excessivly craking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA	
5	Continuous noise when the engine is running after changing the HLA.		CAUTION Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.
6	Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
		Excessive amount of air in the oil at high engine speed.	Check oil supply system
		Deteriorated oil.	Check oil quality. If deteriorated, replace with specitied type.
7	Noise cotinues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
		Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.

Installation

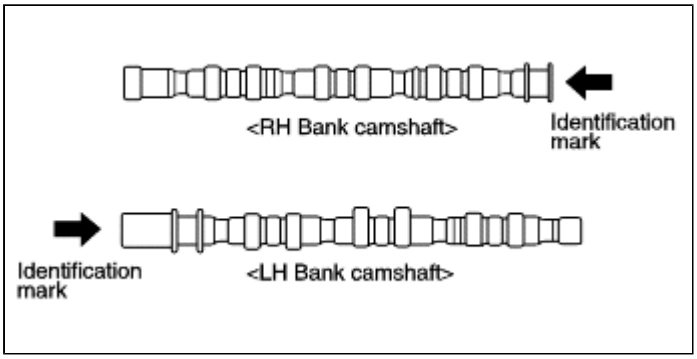
Camshaft and bearing cap

1. Rotate the crankshaft and No. 1 cylinder is in TDC.
   (Compression stroke)
2. Check the position of the rocker arm whether it is exactly installed on the lash adjuster and valve or not.
3. Install the camshaft dowel pin as illustration.



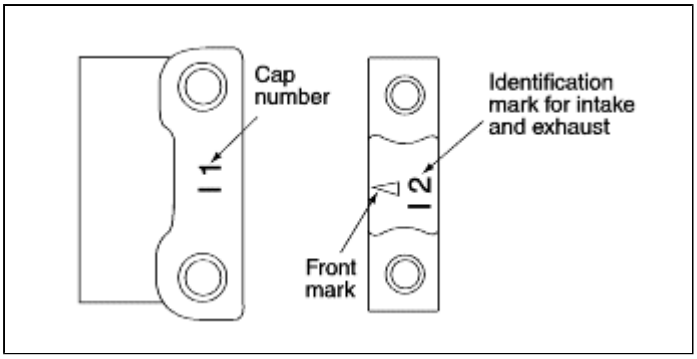
4. The left and right banks of the camshafts are different and you should be careful not to confuse them.

Identification signal Left bank Intake(IN) Exhaust(Ex) Right bank Intake (IN) Exhaust(Ex)	I E J H



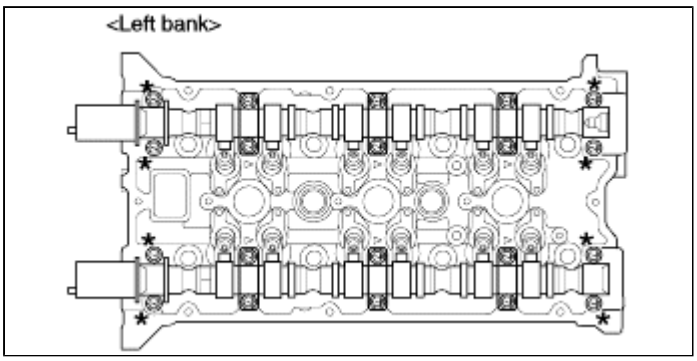
5. Confirm the identification mark and the number.
   Bearing caps of No. 3, No. 4, and No. 5 have the front mark and arrange the front mark upon the cylinder head while installing the bearing caps.

Identification mark Intake (IN) Exhaust(Ex)	I E



6. Tighten the bearing cap in two or three steps. Tighten it to the standard torque at the last stage.
   *Bearing cap standard torque

   Torque16 pieces at the both ends : 18.6 - 20.6 N·m(190 - 210kg·cm, 13.7 - 15.2 lb·ft)24 pieces in the middle : 10 - 12 N·m(100 -120kg·cm, 7.38 - 8.85 lb·ft)

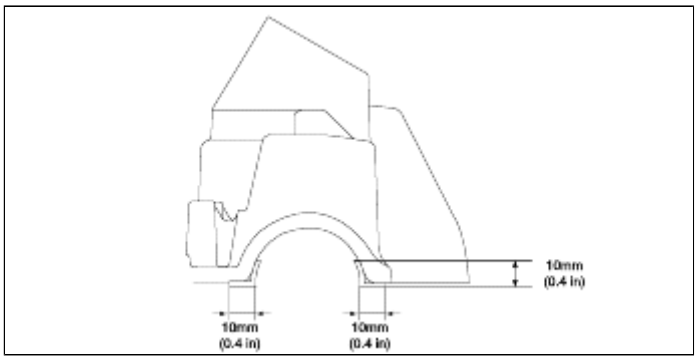


7. Install the cylinder head cover.
   (1) Install the gasket to the cylinder head cover correctly.
   (2) Clean sealing surface on camshaft cap.

   NOTE

   Clean sealing surface with use plastic scraper, to prevent oil leak.

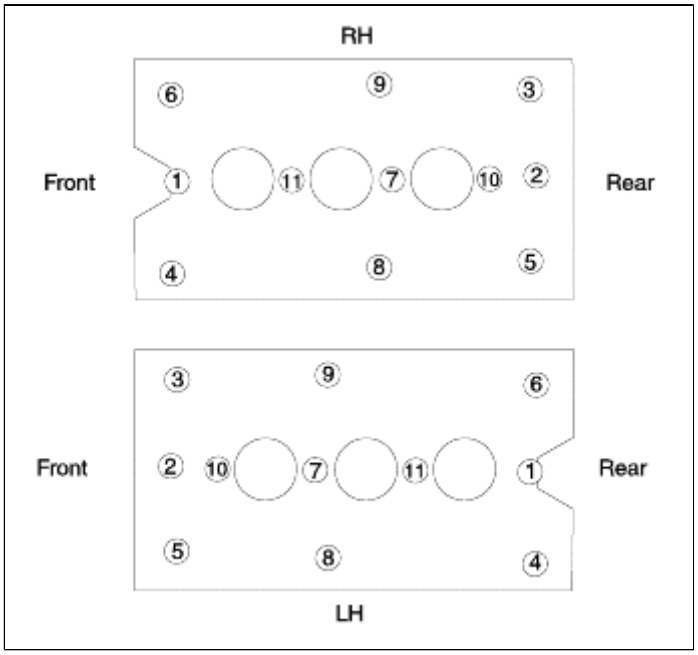
   (3) Apply sealant to the sealing surface on cylinder head cover and camshaft cap.
   Sealant type : LT 5900



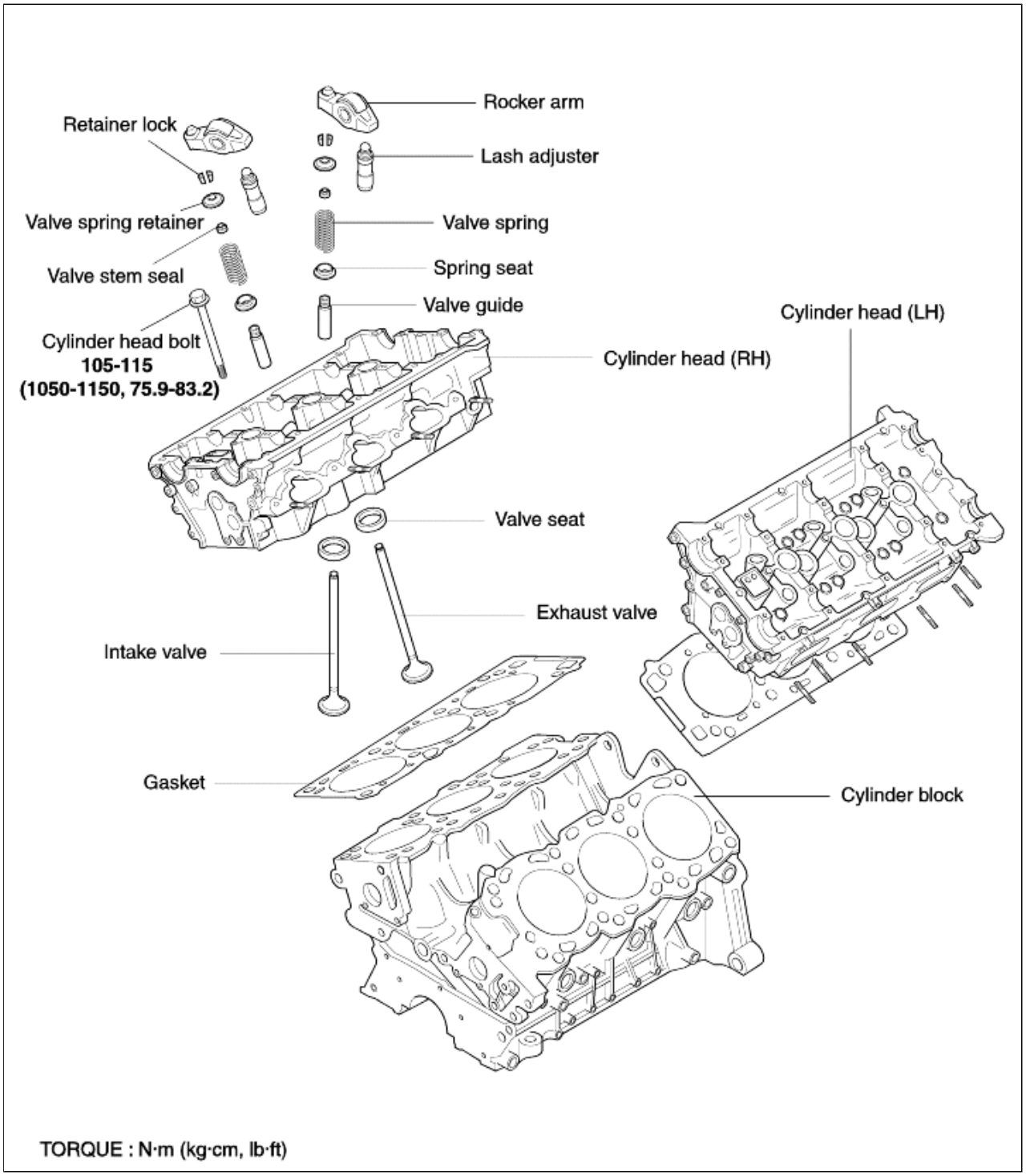
   (4) Install the cylinder head cover to the cylinder head.

   NOTE

   Be careful of gasket escapement when installing the cylinder head cover. You must use the washer when installing the cylinder head cover bolts.


RH
6
9
3
Front
1
11
7
10
2
Rear
4
8
5
3
9
6
Front
2
10
7
11
1
Rear
5
8
4
LH

Components

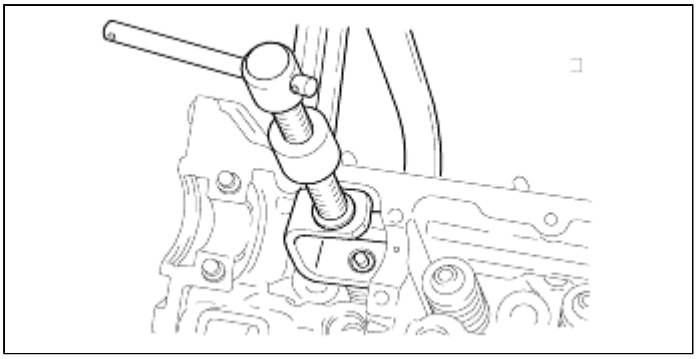

Rocker arm
Retainer lock
Lash adjuster
Valve spring retainer
Valve spring
Valve stem seal
Spring seat
Valve guide
Cylinder head bolt
105-115
(1050-1150, 75.9-83.2)
Cylinder head (LH)
Cylinder head (RH)
Valve seat
Exhaust valve
Intake valve
Gasket
Cylinder block
TORQUE : N·m (kg·cm, lb·ft)

Disassembly

Removal parts

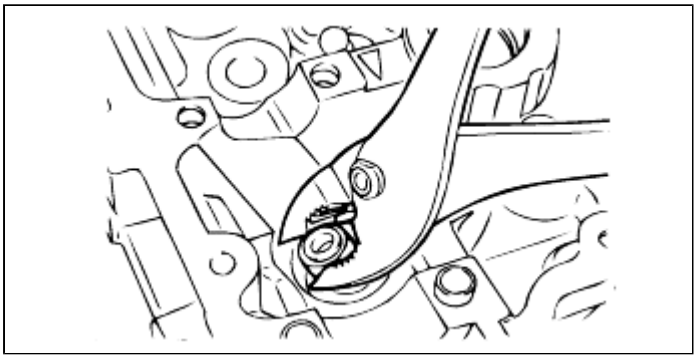
Arrange removal parts according to cylinder numbers, intake and exhaust valves.
Removal of cylinder head bolts
Remove the cylinder head bolts using the hexagonal wrench.
Removal of the retainer lock

1. Compress the valve spring using SST (09222-28000, 09222-28100).



2. Remove the retainer lock.

Valve stem seal
Do not reuse the valve stem seal.

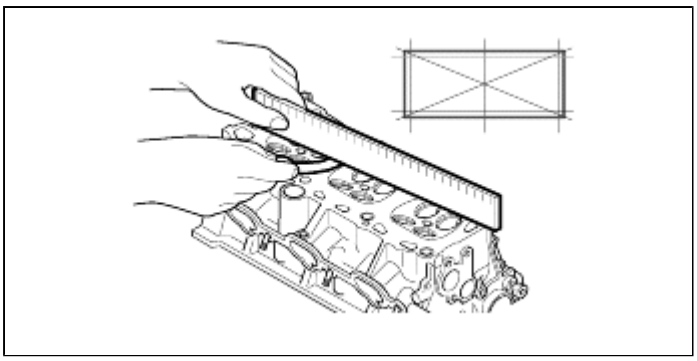


Inspection

Cylinder head

1. Remove scale, sealing compound and carbon deposits completely. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
2. Visually check the cylinder head for cracks, damage or water leakage.
3. Check the cylinder head gasket surface for flatness with a straight edge and feeler as shown in illustration

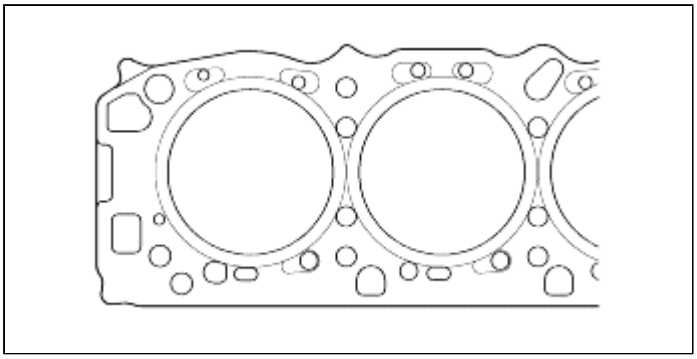
Flatness of cylinder head gasket :Standard dimension :0.03mm (0.0012 in) or lowerService limit : 0.2mm (0.0079 in)



Installation

Cylinder head gasket

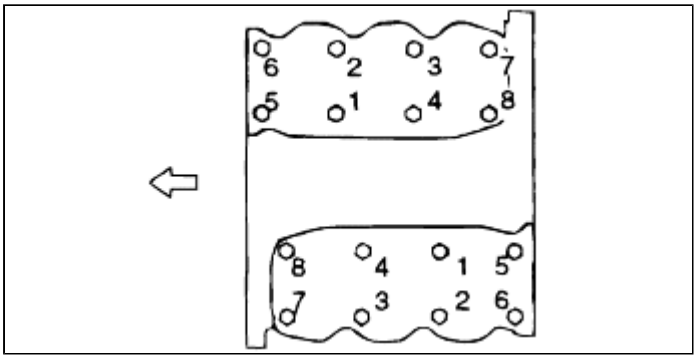
1. All mating faces for the gasket on the cylinder block and the cylinder head should be cleaned.
2. Install new cylinder head gasket on the cylinder head assembly. Do not smear the sealant on the gasket and only the new gasket must be used.



Cylinder head bolt

1. Tighten the cylinder head bolt as shown in the picture using the so-called special tool "head bolt wrench".

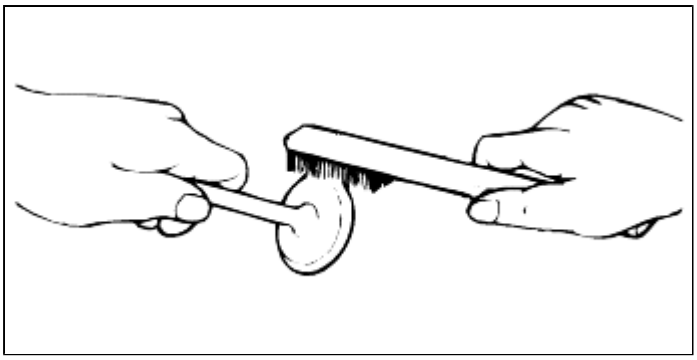
Tightening torque :105 - 115 N·m(1050 - 1150kg·cm, 75.9- 83.2 lb·ft)



Inspection

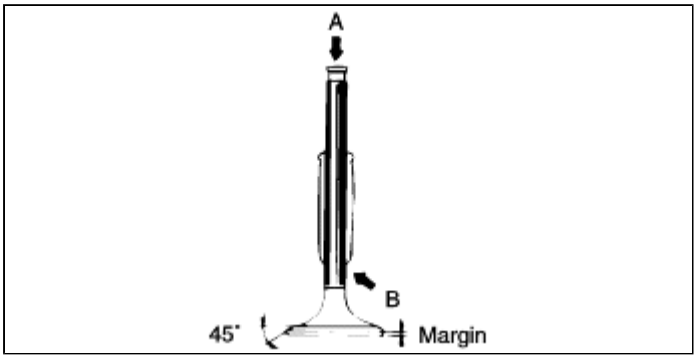
Valves

1. Clean the valve with wire brush.



2. Inspect wear and damage of each valve, and bending of the head and stem at "If " part which is at the end of valve has hollow or wear, replace the valve. If margin is smaller than service standard, replace the valve.

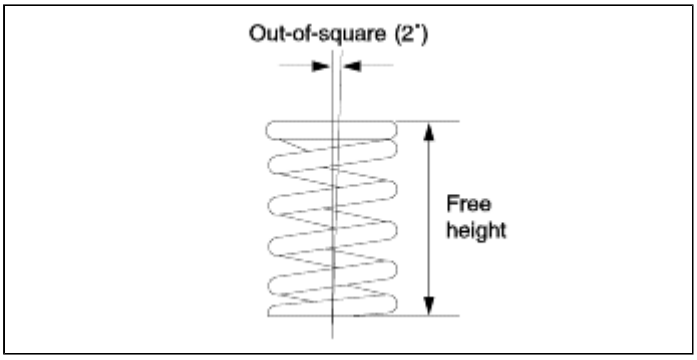
MarginStandard valueIntake : 1.0mm (0.039 in)Exhaust : 1.5mm (0.059 in)Limit valueIntake : 0.5mm (0.02 in)Exhaust : 1.0mm (0.039 in)



Valve springs

1. Check free height of each valve spring and replace if necessary.
2. Using a sqare, test sqareness of each valve spring. If spring is excessively out of square, replace it.

Valve springStandard valueHeight with no load : 46.4mm (1.8268 in) Weight : 24kg/37.9mm (52.8 lb/1.49 in)Deviation of rectangularity : less than 2°Service limitHeight with no load : 45.4mm (1.7874 in)Deviation of rectangularity : 4°

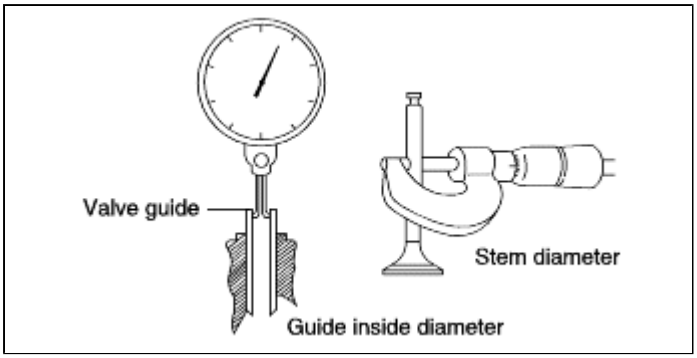


Valve guide

Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with

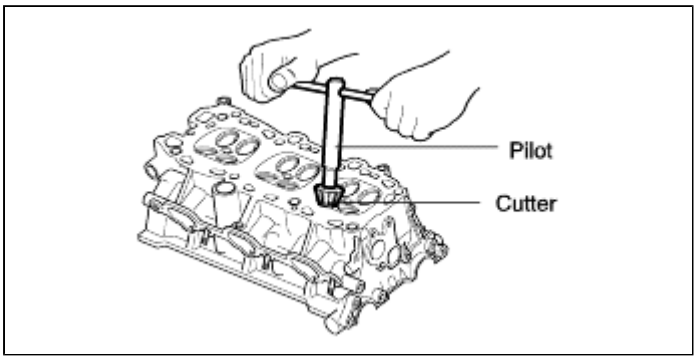
a new oversize guide.

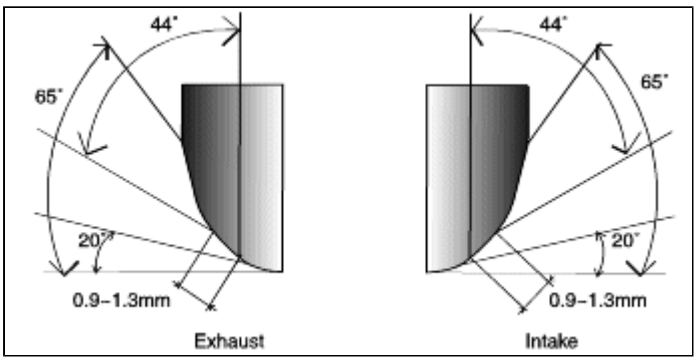
Clearance between valve stem and guideStandard valueIntake : 0.02-0.05mm (0.0009 - 0.0020 in)Exhaust : 0.05-0.085mm (0.0020 - 0.0033 in)Service limitIntake : 0.1mm (0.0039 in)Exhaust : 0.15mm (0.0059 in)



Valve seat insert

Inspect for any trace of overheating and the contact state of valve face. If necessary, repair or replace it. When repairing, inspect for wear in the valve guide. If the guide is worn, replace it and adjust the seat ring. Adjust the valve seat with grinder or cutter making valve seat contact width from the center of valve face be in the specified value. When adjusting the exhaust valve seat, use the valve seat cutter or pilot. After adjustment, lapping process be made by using applying compound on the valve and valve seat.

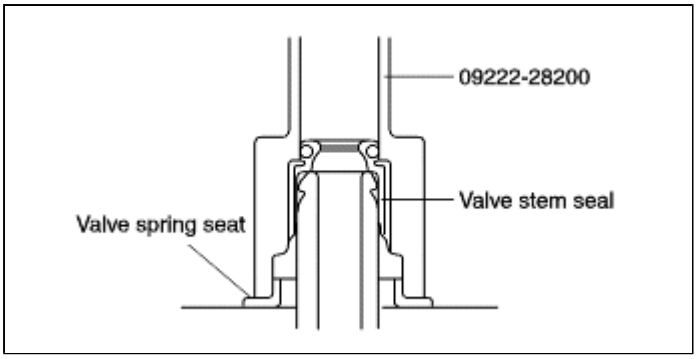




Installation

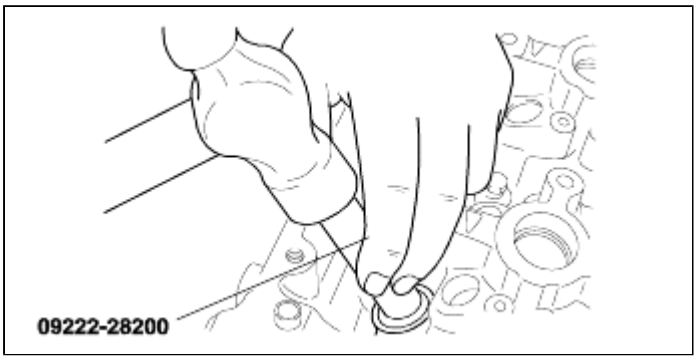
Valve stem seal

1. Install the valve spring seat.
2. Install a new stem seal on valve guide using the special tool (09222-28200).



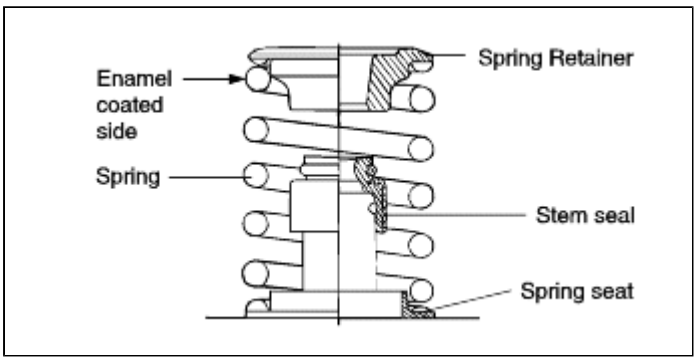
CAUTION

Valve stem seal should never be reused.
Incorrect seal installation can cause oil leakage through lower part of the valve guide. When the valve stem seal is removed due to missing of valve spring seat, the stem seal cannot be reused.



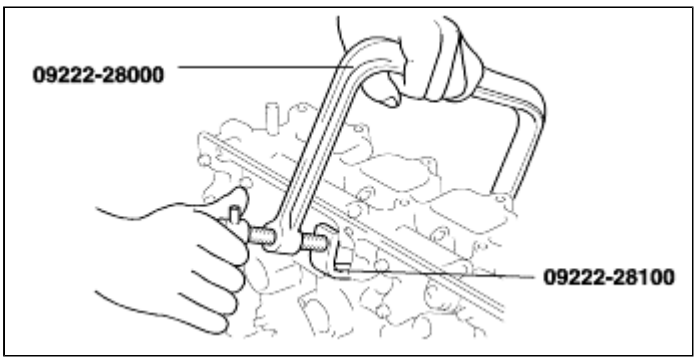
Valve spring

Install the valve spring so that the end part with identification mark is paced at the end of the spring retainer.



Retainer lock

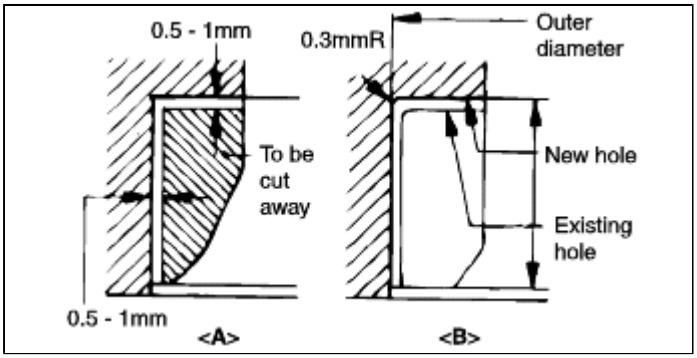
Insert the retainer lock by pressing down the valve spring with special tool(09222-28000).



Procedure for replacement of valve seat insert

1. If the valve seat insert is excessively worn, cut out the insert wall using valve seat cover at normal

temperature like "A" shown in the picture.



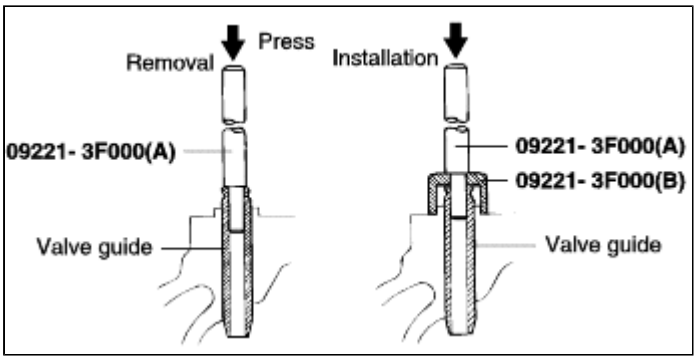
2. After removing the seat insert, match the seat insert bore using a reamer or cutter to the indicated size in the table below.
3. Heat the cylinder head up to 250°C and press in an oversize seat insert.At this time, the temperature of oversize seat insert must be the same as the room temperature. When new valve seat is installed, adjust the valve seat face. (Refer to "valve seat insert")

Description	Size (mm)	Size mark	Seat insert height H (mm)	Cylinder head I.D (mm)
Intake valve Seat insert	0.3 O.S.	30	7.5 - 7.7mm (0.2953 - 0.3031 in)	36.30 - 36.325 (1.429 - 1.430 in)
	0.6 O.S.	60	7.8 - 8.0.mm (0.3071 - 0.3150 in)	36.60 - 36.625 (1.441 - 1.442 in)
Exhaust valve Seat insert	0.3 O.S.	30	8.0 - 8.2mm (0.3150 - 0.3228 in)	33.30 - 33.325 (1.311 - 1.312 in)
	0.6 O.S.	60	8.3 - 8.5mm (0.3268 - 0.3346 in)	33.60 - 33.625 (1.323 - 1.324 in)

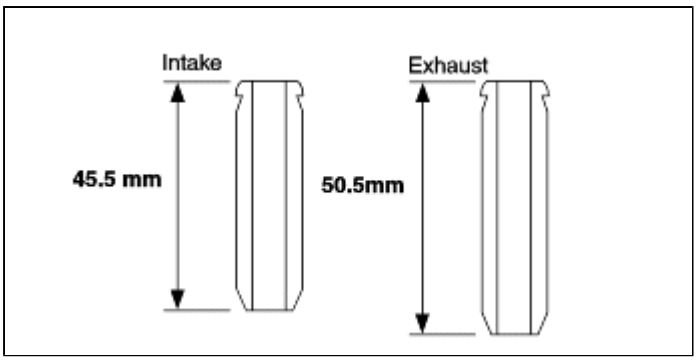
Procedure for replacement of valve guide

As the valve guide is tightly pressed in, replace the valve guide as following procedure, using the valve guide installer or appropriate tools.

1. Using the push rod of the valve guide installer, push it out of initial position by pushing it to the cylinder block side.
2. Machine insert hole of the cylinder head valve guide in the size of oversize valve guide.
3. Press in the valve guide using the valve guide installer or appropriate tools. By using the valve guide installer, it can be pressed in the specified height.



4. Valve guide is to be installed from the upside of the cylinder head.
   As length of the intake valve guide is different from that of the exhaust valve guide, be careful. (The lengths of guide for intake valve and exhaust valve are 45.5mm and 50.5mm respectively.)
   After installing the valve guide, insert the new valve and check sliding state.



5. When the valve guide is replaced, inspect for valve contact state. If necessary, adjust the valve seat.
   Valve Guide Insert Oversizes

Size (mm)	Size mark	Inner diameter of hole for guide insertion
0.05 O.S.	5	12.05-12.068 mm (0.474 - 0.475 in)
0.25 O.S.	25	12.25-12.268 mm (0.482-0.483 in)
0.50 O.S.	50	12.50-12.518 mm (0.492-0.493 in)

Removal

1. Remove the battery and engine cover.
2. Detach the air cleaner.
3. Disconnect the connectors for the engine harness.
4. Disconnect the connectors for the alternator harness, the oil pressure switch and the oil pressure sensor.
5. Disconnect the connector of starter motor harness.
6. Drain the engine coolant.
7. Disconnect transaxle oil cooler hose.

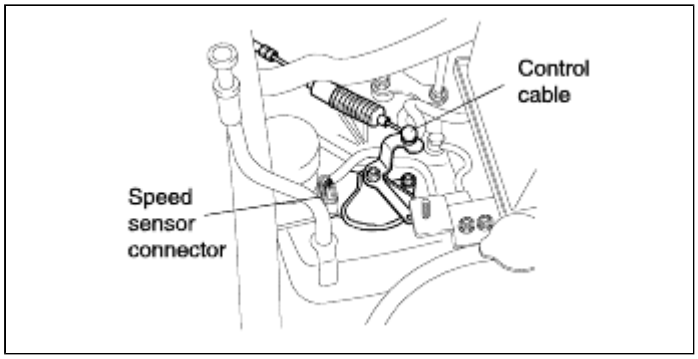
> **NOTE**
>
> When disconnecting the hoses, make indentification marks to avoid making any mistakes when re-installing them.

> **CAUTION**
>
> Be careful not to spill any of the oil or fluid out of the hoses. Plug the openings to prevent the entry of foreign material.

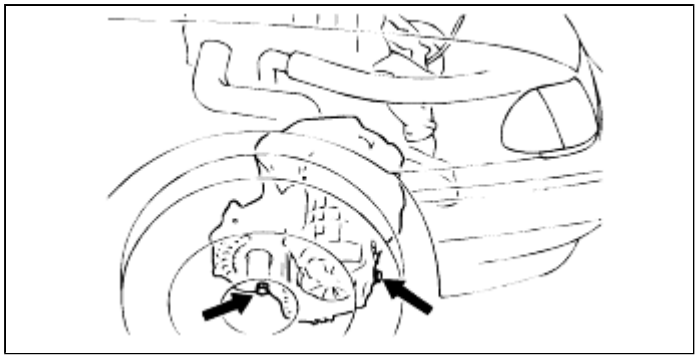
8. Disconnect the radiator upper and lower hoses on the engine side, and then remove the radiator assembly.
9. Disconnect the high tension cable and all wires to the distributor and the ignition coil.
10. Disconnect the engine ground.
11. Disconnect the brake booster vacuum hose.
12. Disconnect the EVAP canister hose.
13. Remove the main fuel line, and the return and vapor hoses from the engine side.

> **CAUTION**
>
> To reduce the residual pressure in the hoses, refer to Group Fuel System "filter replacement"

14. Disconnect the heater hose (Intake and exhaust) at the engine side.
15. The accelerator cable should be removed from the engine side.
16. The cruise control cable should be removed from the engine side.
17. Remove the control cable from the transaxle.
18. Disconnect the speed sensor connector from the transaxle.



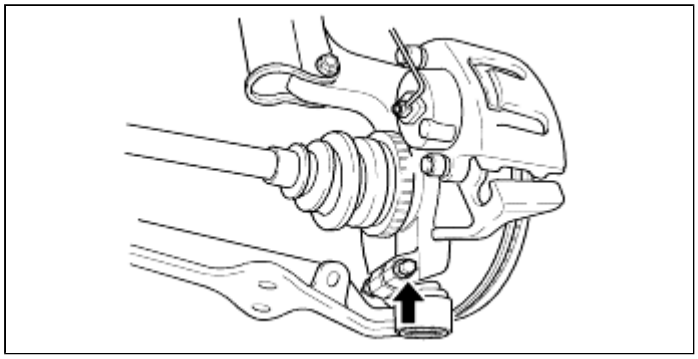
19. Remove the power steering oil pump hose.
20. Raise the vehicle.
21. Remove the oil pan shield.
22. Drain the transaxle oil.



23. Disconnect the front exhaust pipe from the manifold.

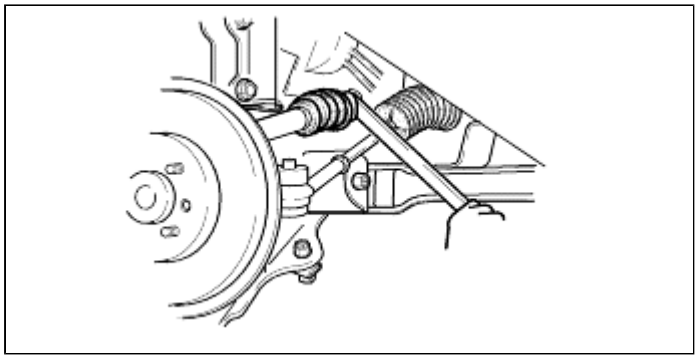
> NOTE
>
> Use a wire to suspend the exhaust pipe from the bottom of the vehicle.

24. Remove the tie rod end from steering knuckles.
25. Remove control link from stablilizer and lower arm.
26. Remove pinch bolt from kunckle. Separate lower arm form kunckle.

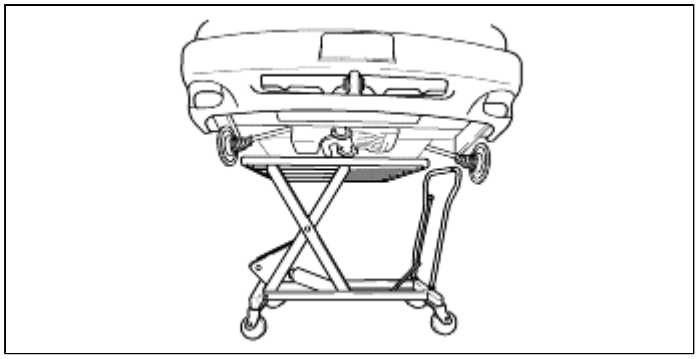


27. Remove the drive shaft from the transaxle housing.

> CAUTION
>
> 1) Plug up the holes of the transaxle case to prevent entry of foreign material.
> 2) The circlips on the drive shafts should be replaced whenever reinstalling.

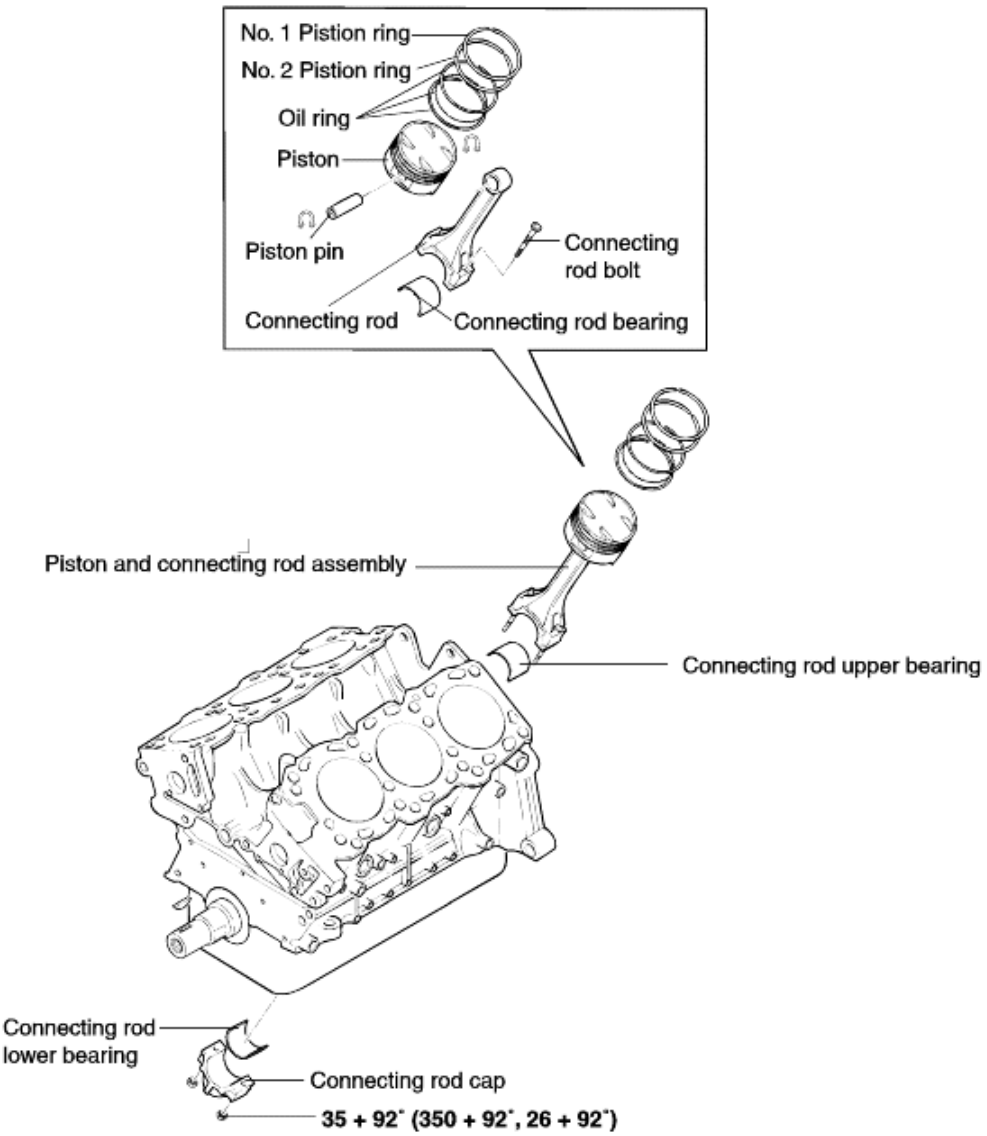


28. Remove intermediate shaft bolt.
    (Refer to section ST, steering system)
29. Remove No. 3, No. 4 engine mouting.
30. Support auto transaxle, engine and subframe with a suitable floor jack.



31. Remove nuts and blots of impact bar and subframe.
32. Slowly lower engine, auto transaxle and subframe.
33. Remove No. 1, No. 2 engine mouting from subframe.
34. Seperate auto transaxle from engine.

Components



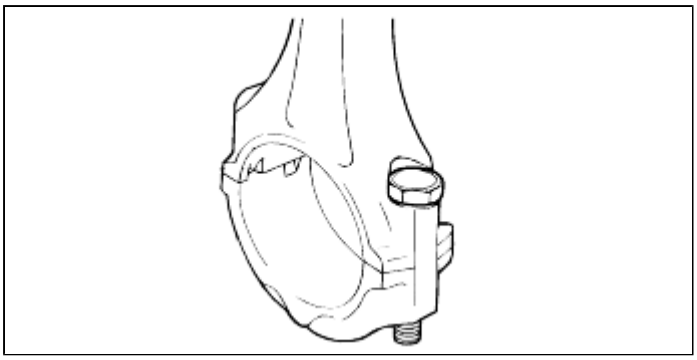
TORQUE : N·m (kg·cm, lb·ft)

DISASSEMBLY

Connecting rod cap

> CAUTION
>
> Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

1. Remove the connecting rod cap bolts, then remove the caps and the big end lower bearing mark for reassembly.
2. Push each piston connecting rod assembly toward the top of the cylinder.



INSPECTION

Pistons and Piston Pins

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings. When the piston requires replacement, its rings should also be replaced.
3. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be pressed smoothly by hand into the pin hole (at room temperature).

Piston Rings

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in the ring groove to measure the side clearance.If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace only the piston rings.

   Piston ring side clearanceNo.1 : 0.04 - 0.08mm (0.0016 - 0.0031in.)
   No.2 : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

   Piston ring end gap[Standard dimensions]No.1 : 0.2 - 0.3mm (0.0079 - 0.0118in.)No.2 : 0.45 - 0.60 mm (0.0177 - 0.0236in.)Oil ring side rail : 0.2-0.7 mm (0.0079 - 0.0276)

When replacing the ring without correcting the cylinder bore, check the gap with the ring situated at the lower part of cylinder that is less worn out.

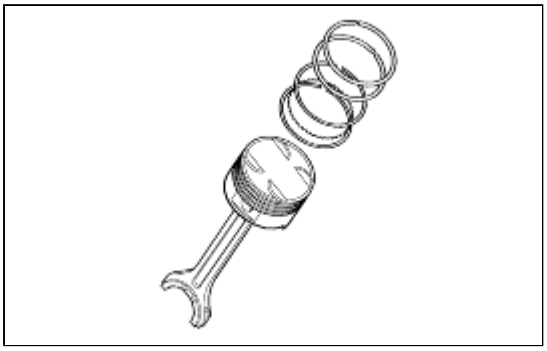
Piston ring service size and mark

Standard	None
0.25 mm (0.010 in.) O.S	25

0.50 mm (0.020 in.) O.S	50

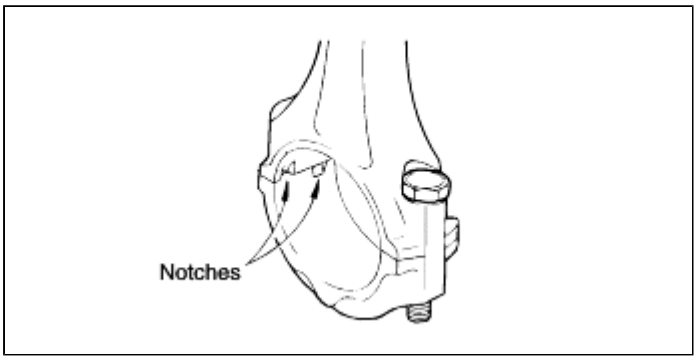
NOTE

The mark can be found on the upper side of the ring next to the end.



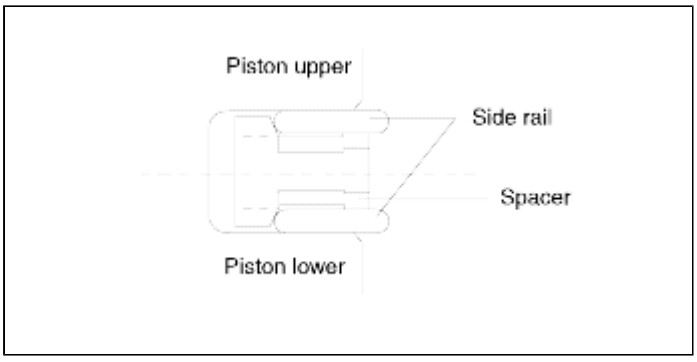
Connecting Rods

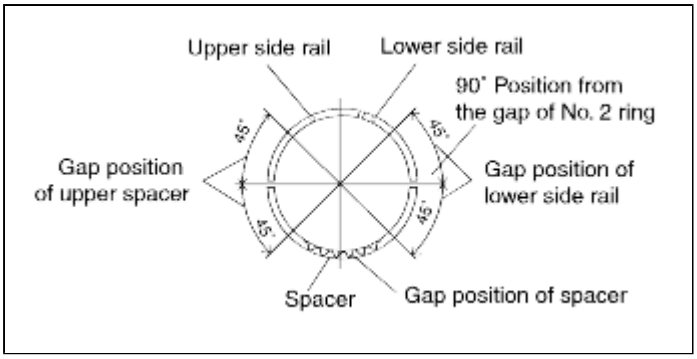
1. When the connecting rod cap is installed, make sure that the cylinder numbers,marked on rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches holding the bearing in place are onthe same side.
2. Replace the connecting rod if it is damaged at either end of the thrust faces.If it has a stratified wear, or if the surface of the inside diameter of the small end is severely rough, replace the rod.



REASSEMBLY

1. Install the expander.

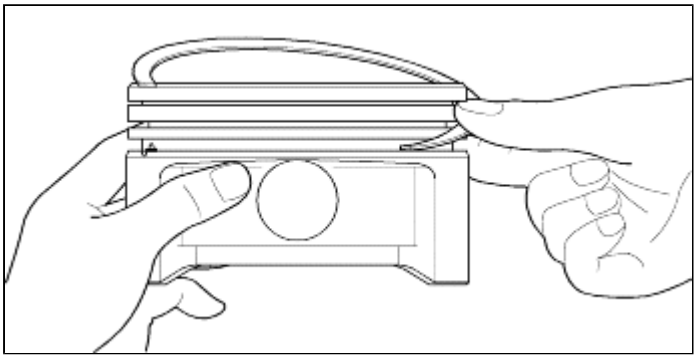




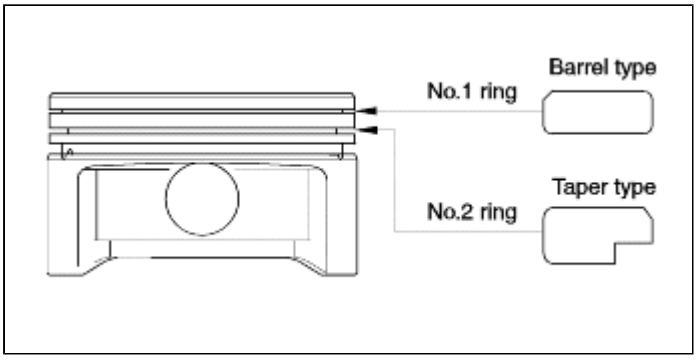
2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it firmly, and press down with finger on the portion to be inserted into the groove (as illustrated).

> **CAUTION**
>
> Do not use a piston ring expander when installing the side rail.

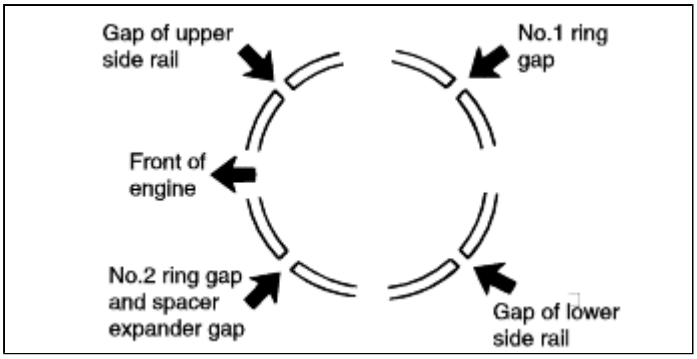
3. Install the lower side rail by the same procedure described in Step 2.



4. Apply engine oil around the piston and piston grooves.
5. Using a piston ring expander, install the No.2 piston ring.
6. Install the No. 1 piston ring.



7. Position each piston ring end gap as far away from its neighboring gaps as possible. Make sure that the gaps are not positioned in the thrust and pin directions.
8. Hold the piston rings firmly with a piston ring compressor as they are inserted into cylinder.

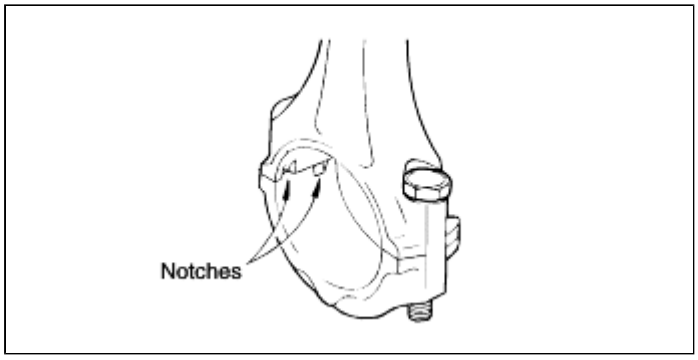


9. Install the upper connecting rod bearings in the connecting rod.
10. Install the lower connecting rod bearings in the connecting rod bearing caps.
11. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
12. When the connecting rod cap is installed, make sure that any cylinder numbers placed on the rod and cap at disassembly match.
13. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
14. When assembling, bolts should be fastened using the plastic angle technique as follows.
    (1) Apply oil to the threads and matching areas.
    (2) Tighten the connecting rod bolt.

Tightening torque :Connecting rod bolt :35 N·m+92° (350 kg-cm+92°, 26 lb.ft+92°)

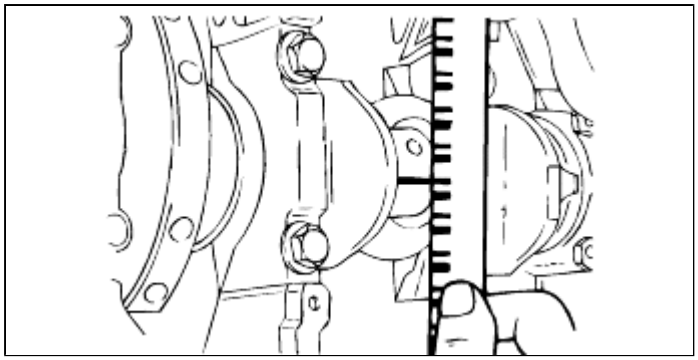
CAUTION

After removing the connecting rod bolt, do not use it again.
When using a new bolt, do not tighten the bolt more than 3 times.



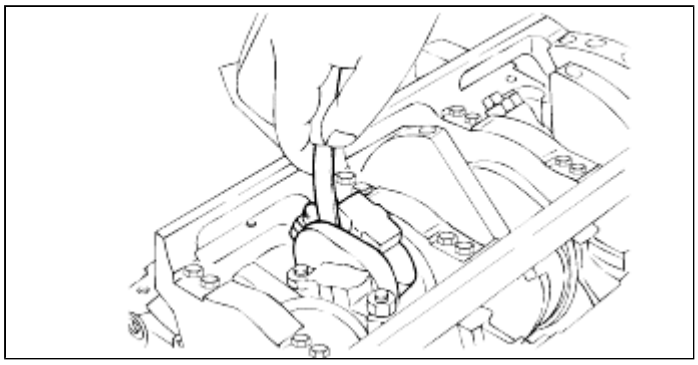
15. Check the bearing clearance as follows :
    (1) Remove oil and dirt from the bearings and journals.
    (2) Cut plastigauge to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
    (3) Install the bearing and cap. Tighten to the specified torque. During this operation, do NOT turn the crankshaft.
    (4) Remove the cap, measure at the widest part by using the scale printed on the plastigauge package.

Connecting rod cap bearing clearanceStandard value :0.022-0.040mm (0.0009-0.0016in)Limit : 0.1mm (0.0039 in)



16. Check the connecting rod side clearance.

Connecting rod side clearanceStandard : 0.10-0.25 mm (0.0039-0.0098 in.)Limit : 0.4 mm (0.0157 in.)



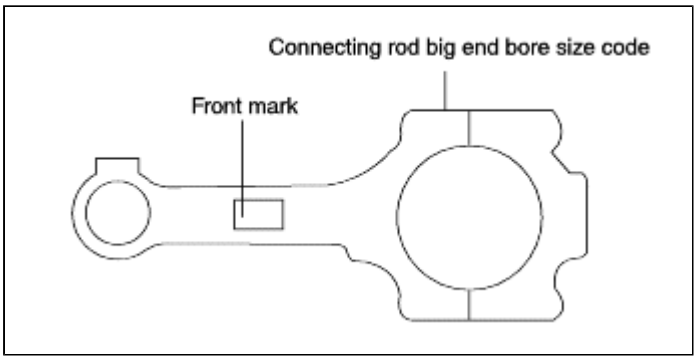
Replacement

Connecting rod bearing (3.5)

1. Check the connecting rod big-end bore size code.

NOTE

Record the connecting roe big-end bore size code letters on connecting rod cap as shown.



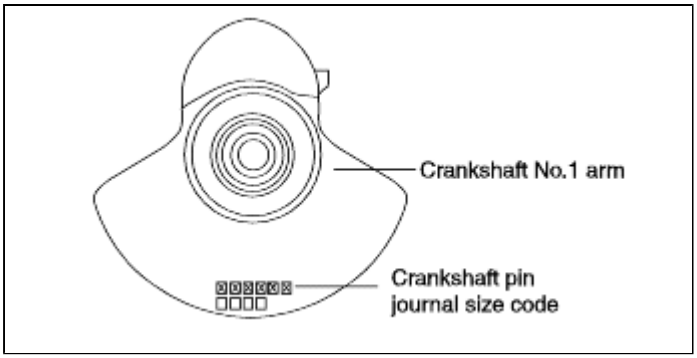
Connecting rod big-end diameter

Code	Connecting rod big-end diameter mm (in)
0	58.000-58.006 (2.2835-2.2837)
1	58.006-58.012 (2.2837-2.2839)
2	58.012-58.018 (2.2839-2.2842)

2. Check the crankshaft pin journal size code.

NOTE

Record the pin journal size code letters on the crankshaft balance weight.
Reading order is from left to right as shown, with No.1 pin journal size code shown first.



Crankshaft pin journal diameter

Code	Crankshaft pin journal diameter mm (in)
I	54.994-55.000 (2.1651-2.1654)
II	54.988-54.994 (2.1649-2.1651)
III	54.982-54.988 (2.1646-2.1649)

3. Choose proper connecting rod bearing in below table.

Connecting rod bearing selection table

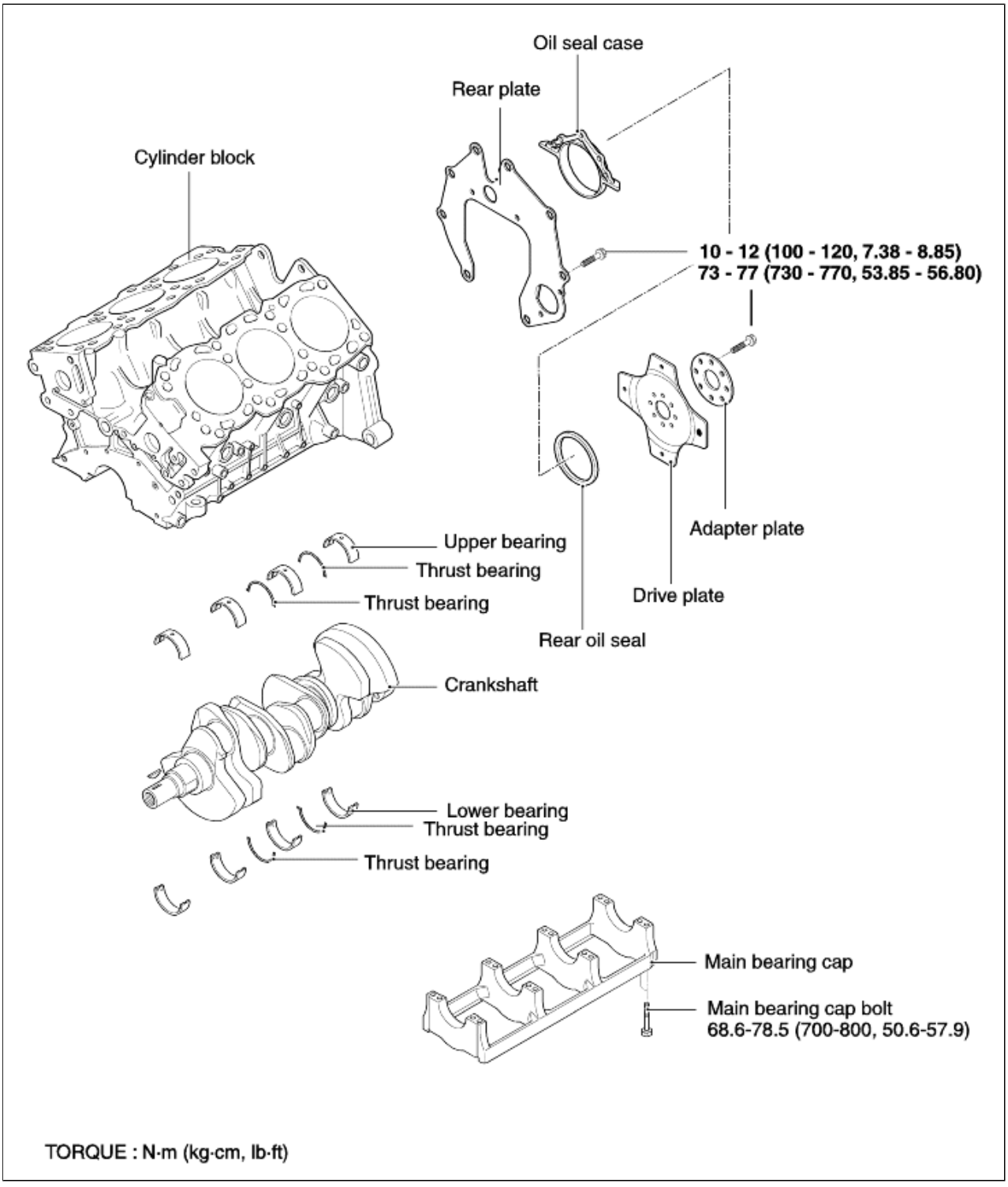
		Connecting rod big-end bore size code		
		0	1	2
Crankshaft pin journal size code	I	Pink	Red	None
	II	Red	None	Black
	III	None	Black	Brown

Connecting rod bearing oil clearance:0.026-0.044 mm (0.0010-0.0017 in)

Connecting rod bearing thickness (Reference data)

Color	Connecting rod bearing thickness mm (in)
Pink	1.484-1.487 (0.0584-0.0585)
Red	1.487-1.490 (0.0585-0.0587)
None	1.490-1.493 (0.0587-0.0588)
Black	1.493-1.496 (0.0588-0.0589)
Brown	1.496-1.499 (0.0589-0.0590)

Components


Oil seal case
Rear plate
Cylinder block
10 - 12 (100 - 120, 7.38 - 8.85)
73 - 77 (730 - 770, 53.85 - 56.80)
Adapter plate
Drive plate
Rear oil seal
Upper bearing
Thrust bearing
Thrust bearing
Crankshaft
Lower bearing
Thrust bearing
Thrust bearing
Main bearing cap
Main bearing cap bolt
68.6-78.5 (700-800, 50.6-57.9)
TORQUE : N·m (kg·cm, lb·ft)

Disassembly

1. Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate oil pan. For details, refer to their respective chapters.
2. Remove the oil seal case and the rear oil seal.
3. Remove the connecting rod caps.

> NOTE
>
> Mark the main bearing caps to reassemble in the original position and direction.

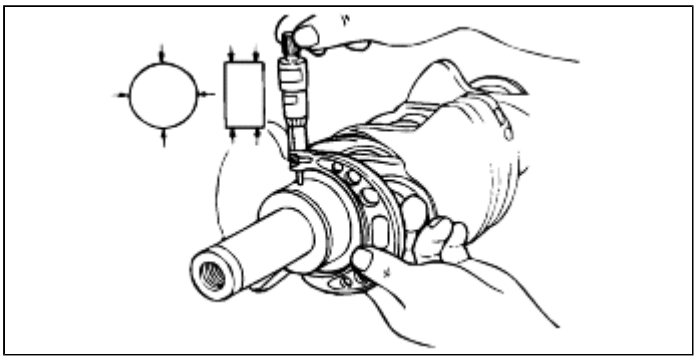
4. Remove the main bearing caps and remove the crankshaft.
   Keep the bearings in order by cap number.

Inspection

Crankshaft

1. Check the crankshaft journals and pins for damage, uneven wear and cracks.Also check the oil holes for restrictions.
   Repair or replace any defective part.
2. Inspect for out-of-roundness and taper of the crankshaft journal and pin.
   Standard value

Crankshaft journal O.D	Crankshaft pin O.D
63.982-64.000mm (2.519-2.520in)	54.982-55.000mm (2.164-2.165 in)



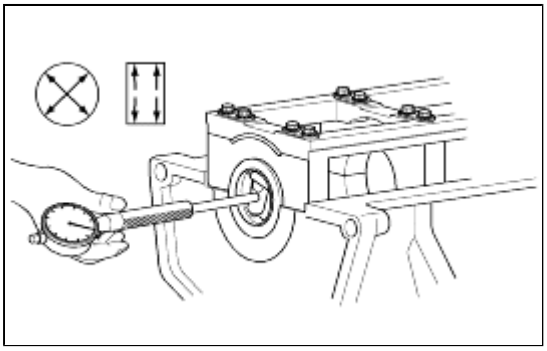
Main bearing and connecting rod bearing

Visually inspect each bearing for peeling, melt, seizure and improper contact. Replace any defective bearings.

Oil clearance measurement

Check for oil clearance by measuring the outside diameter of the crankshaft journal and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside and inside diameter.

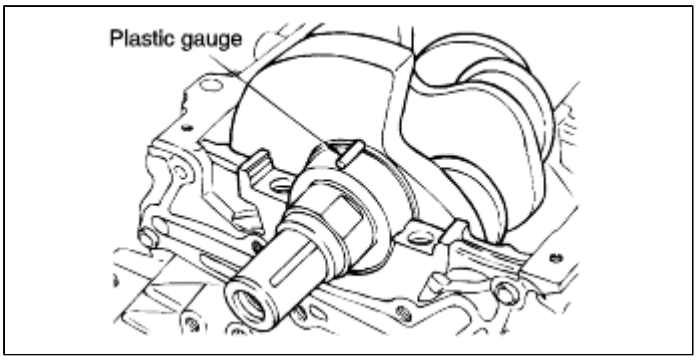
Standard valueOil clearanceCrankshaft main bearing :0.018 - 0.036mm (0.0007 - 0.0014 in)Connecting rod bearing :0.022 - 0.040mm (0.0009 - 0.0016 in)



Plastigauge method

Plastigauge may be used to measure the clearance.

1. Remove oil and grease and any other dirt from the bearings and journals.
2. Cut the plastigauge to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.



3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the the widest part by using the scale printed on the gauge package.
   If the clearance exceeds the repair limit, the bearing should be replaced or an undersize bearing should be used.
   When installing a new crankshaft, be sure to use standard size bearings.
   Should the standard clearance not be obtained even after bearing replacement, the journal and pin should be ground to undersize and a bearing of the corresponding undersize should be installed.

Oil Seal

Check the front and rear oil seals for damage or worn surfaces.
Replace any seat that is defective.

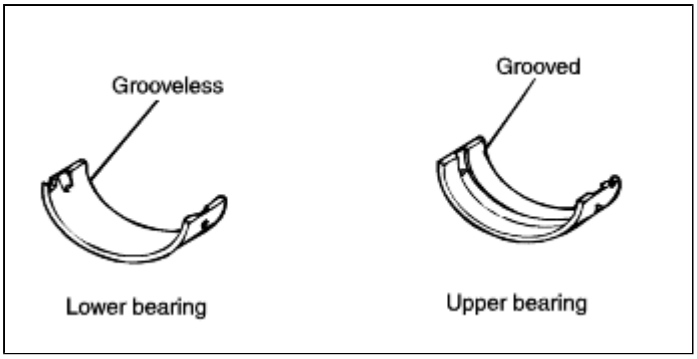
Driving Plate

Replace the distorted, damaged, or cracked drive plates.

Reassembly

Main bearing

1. Install the grooved main bearing (upper bearing) on the cylinder block side.

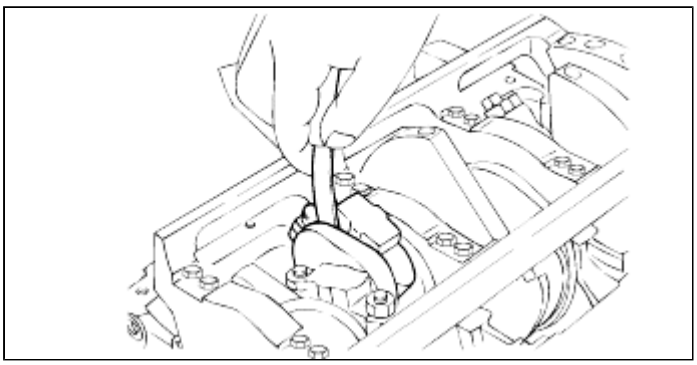


2. Install the grooveless main bearing (lower bearing) on the main bearing cap side.
3. Install the crankshaft. Apply engine oil to the journal and pin.
4. Caps should be installed with the arrow mark directed toward the front of the engine. The cap number sequence must be correct.
5. Tighten all cap bolts to the specified torque according to the order as shown in the picture.

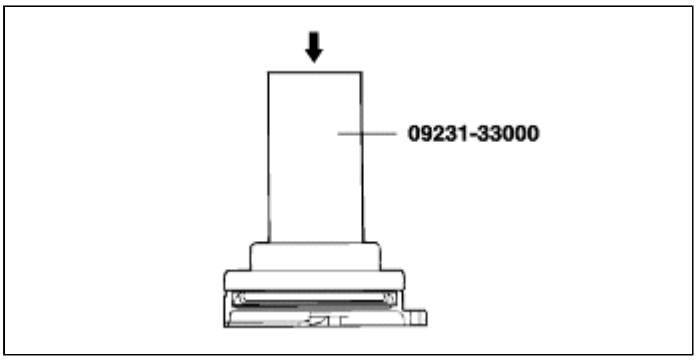
   Tightening torqueMain bearing cap bolt : 68.6 - 78.5 N·m(700 - 800 kg·cm, 50.6 - 57.9 lb·ft)

6. Cap bolt should be tightened to specified torque in 4~5 steps before being tightened to the specified torque.
7. Make certain that the crankshaft turns freely and has the proper crankshaft end play.

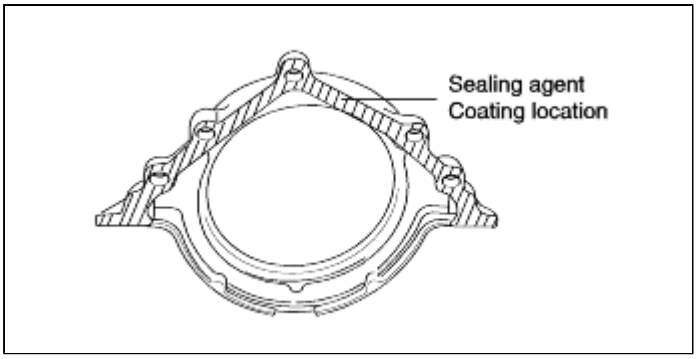
   Crankshaft end playStandard value : 0.050-0.250mm(0.00197-0.0098 in)Limit : 0.35mm (0.014 in)



8. Assemble the rear oil seal to oil case using the special tool (09231-33000).



9. Smear sealant on area indicated in the figure and install the oil seal case in the cylinder block.



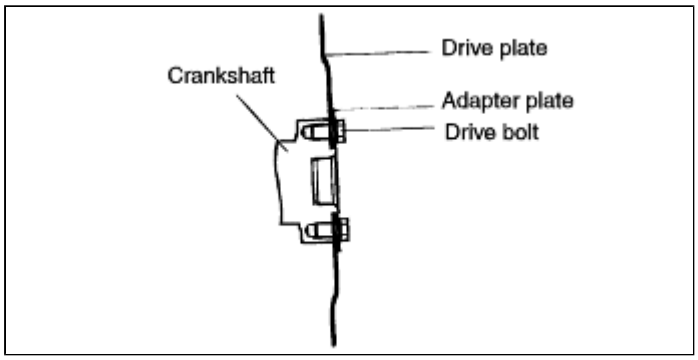
Tightening torqueOil seal case bolt : 10 - 12 N·m(100 - 120kg·cm, 7.38 - 8.85 lb·ft)

10. Install the rear plate to the specified torque.

Tightening torqueRear plate : 10 - 12 N·m(100 - 120kg·cm, 7.38 - 8.85 lb·ft)

11. Install the drive plate and the adapter plate.

Tightening torqueDrive bolt : 73 - 77 N·m(730 - 770 kg·cm, 53.85 - 56.80 lb·ft)



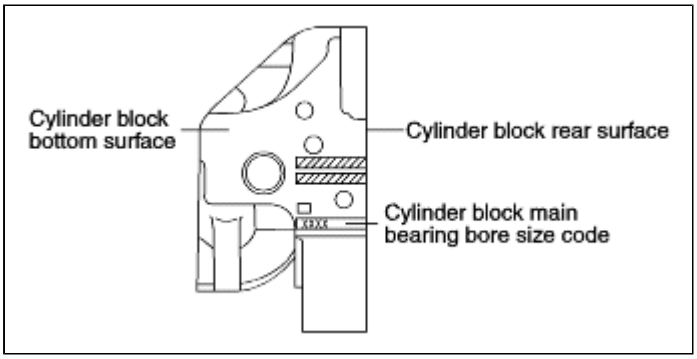
Replacement

Crankshaft main bearing (3.5)

1. Check the cylinder block main bearing bore size code.

NOTE

Record the cylinder block main bearing bore size code letters on cylinder block as shown.
Reading order is from left to right with front main bearing bore size code shown first.



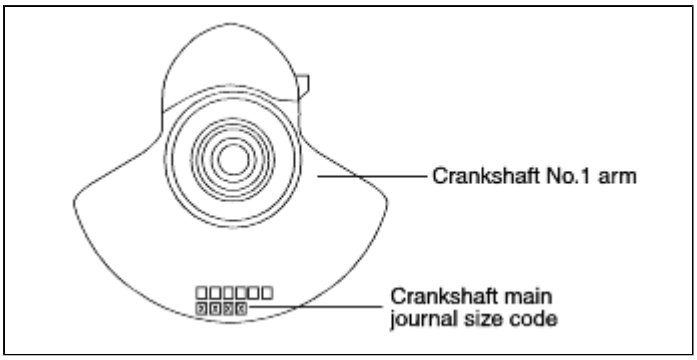
Cylinder block main bearing bore diameter

Code	Cylinder block main bearing bore diameter mm (in)
A	68.000-68.006 (2.6772-2.6774)
B	68.006-68.012 (2.6774-2.6776)
C	68.012-68.018 (2.6776-2.6779)

2. Check the crankshaft main journal size code.

NOTE

Record the main journal size code letters on the crankshaft balance weight.
Reading order is from left to right as shown, with No.1 main journal size code shown first.



Crankshaft main journal diameter

Code	Crankshaft main journal diameter mm (in)
1	63.994-64.000 (2.5194-2.5197)
2	63.988-63.994 (2.5192-2.5194)
3	63.982-63.988 (2.5190-2.5192)

3. Choose proper main journal bearing in below table.

Main journal bearing selection table

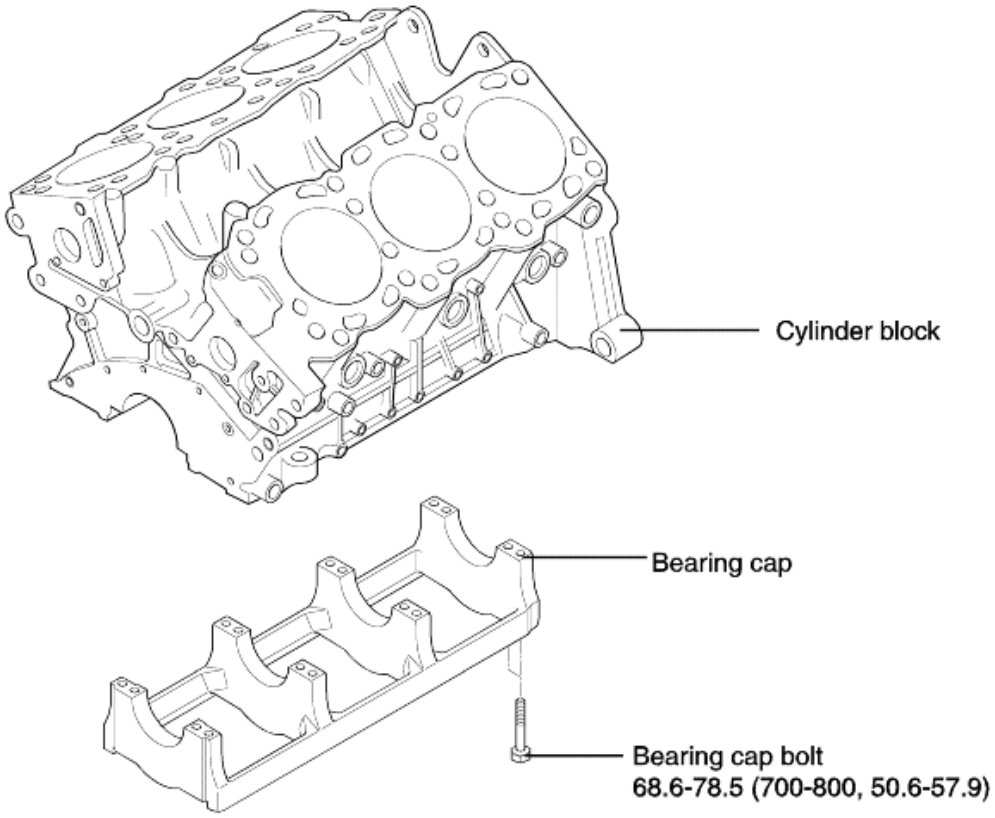
		Cylinder block main bearing bore size code		
		A	B	C
Crankshaft main journal size code	1	Pink	Red	None
	2	Red	None	Black
	3	None	Black	Brown

Main journal bearing oil clearance :0.022-0.040 mm (0.0009-0.0016 in)

Main journal bearing thickness (Reference data)

Color	Main journal bearing thickness mm (in)
Pink	1.986-1.989 (0.0782-0.0783)
Red	1.989-1.992 (0.0783-0.0784)
None	1.992-1.995 (0.0784-0.0785)
Black	1.995-1.998 (0.0785-0.0787)
Brown	1.998-2.001 (0.0787-0.0788)

Components



TORQUE : N·m (kg·cm, lb·ft)

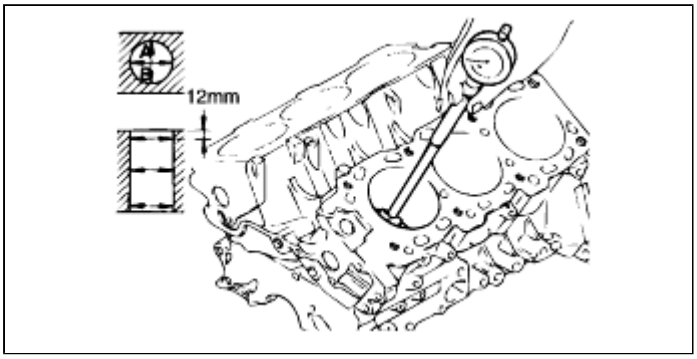
Disassembly

Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate, oil pan and the oil pump case.
For further details, refer to their respective chapters.

Inspection

Cylinder block

1. Visually check the cylinder block for scores, rust and corrosion. rust and corrosion.
   Also check for cracks or any other defects using a proper tool. Repair or replace the block if defective.
2. Measure the cylinder bore with a cylinder gauge at the three levels indicatedi n the directions of A and B.
   Level 1 : No.1 piston ring position with piston at TDC.
   Level 2 : Center of cylinder
   Level 3 : Bottom of cylinder



3. If the cylinder bores show more than the specified out-of round or taper,or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. New oversize pistons and rings should be installed.

Standard valueCylinder bore:93.00-93.03mm(3.66-3.663 in)Deviation of concentricity and taper of cylinder bore:0.02mm (0.00079 in) or less

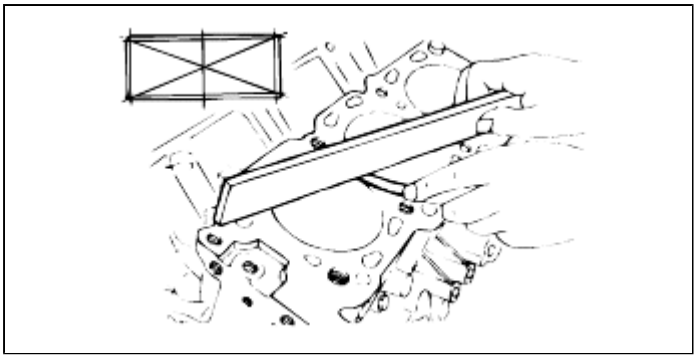
4. If a ridge exists at the top of the cylinder, cut it way with a ridge reamer.
5. Oversize pistons are available in two sizes.

Oversize piston size.0.25 O.S. : 0.25mm (0.01 in)0.50 O.S. : 0.50mm (0.02 in)

6. To rebore the cylinder to oversize, keep the specified clearance between the oversize piston and the bore, and make sure that all pistons used are of thesame oversize. When measuring the piston outside diameter measure the section of the thrust surface at 10mm (0.39 in) above the bottom of the piston skirt.

Clearance between piston and cylinder wall :0.03-0.05mm (0.001-0.002 in)

7. Check the flatness of the upper surface. If the top surface exceeds limits, grind it to a minimum limit value or replace. (Measuring method is same as that of cylinder head flatness.)



Standard valueFlatness of the gasket mating surface :less than 0.05mm (0.002 in)LimitFlatness of the gasket mating surface :0.1mm (0.0039 in)

CAUTION

When the cylinder head is assembled, grinding less than 0.2mm is permissible.Grind the gasket surface of the cylinder block less than 0.2mm.

Boring cylinder

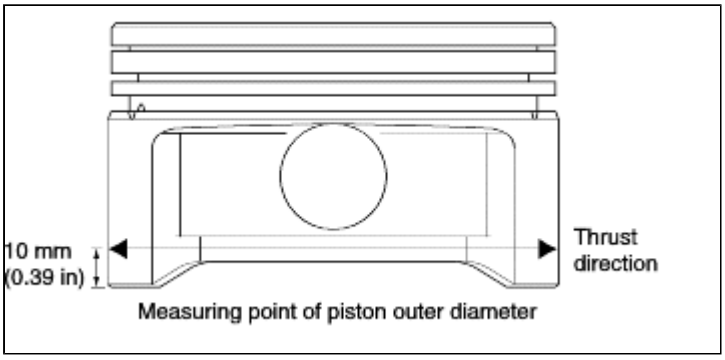
1. Oversize pistons used should be determined on the basis of the largest bore cylinder.

Size	Identification mark
0.25mm O.S. 0.50mm O.S.	0.25 0.50

NOTE

Size mark is stamped on top of the piston.

2. Measure the outside diameter of the piston to be used.



Measuring point of piston outer diameter

3. Based on the measured O.D., calculate the boring finish dimension.
   Boring finish dimension = piston outer diameter + 0.02~0.04mm (The clearance between piston outer diameter and cylinder) - 0.01mm (Honing margin)
4. Bore each of the cylinders to the calculated size.

CAUTION

To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order sequence.

5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

Standard value : 0.03-0.05mm(0.0012 - 0.0020 in)

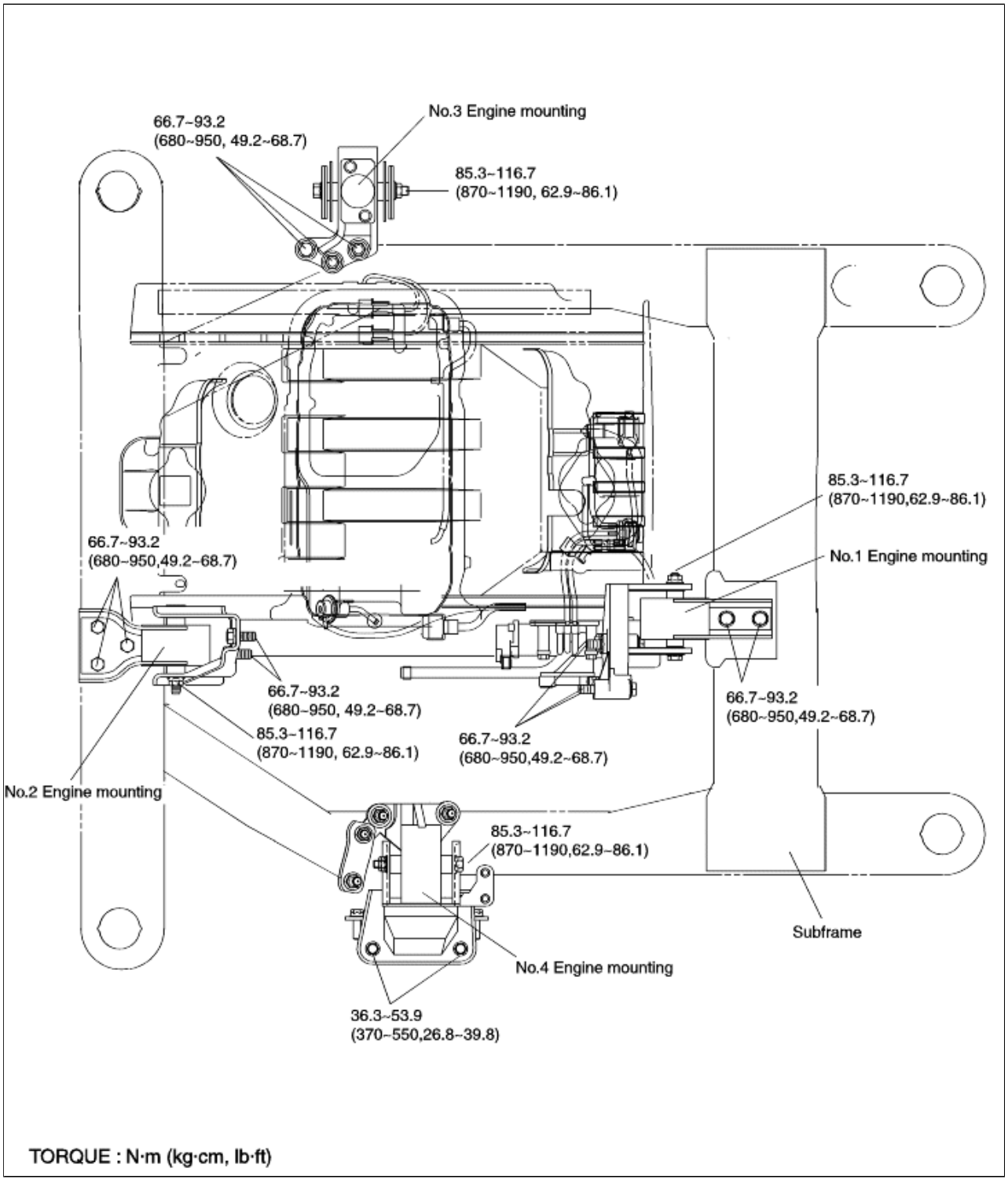
NOTE

1) 6 cylinders should be bored to the same oversize.
2) Never bore only one cylinder to an oversize.

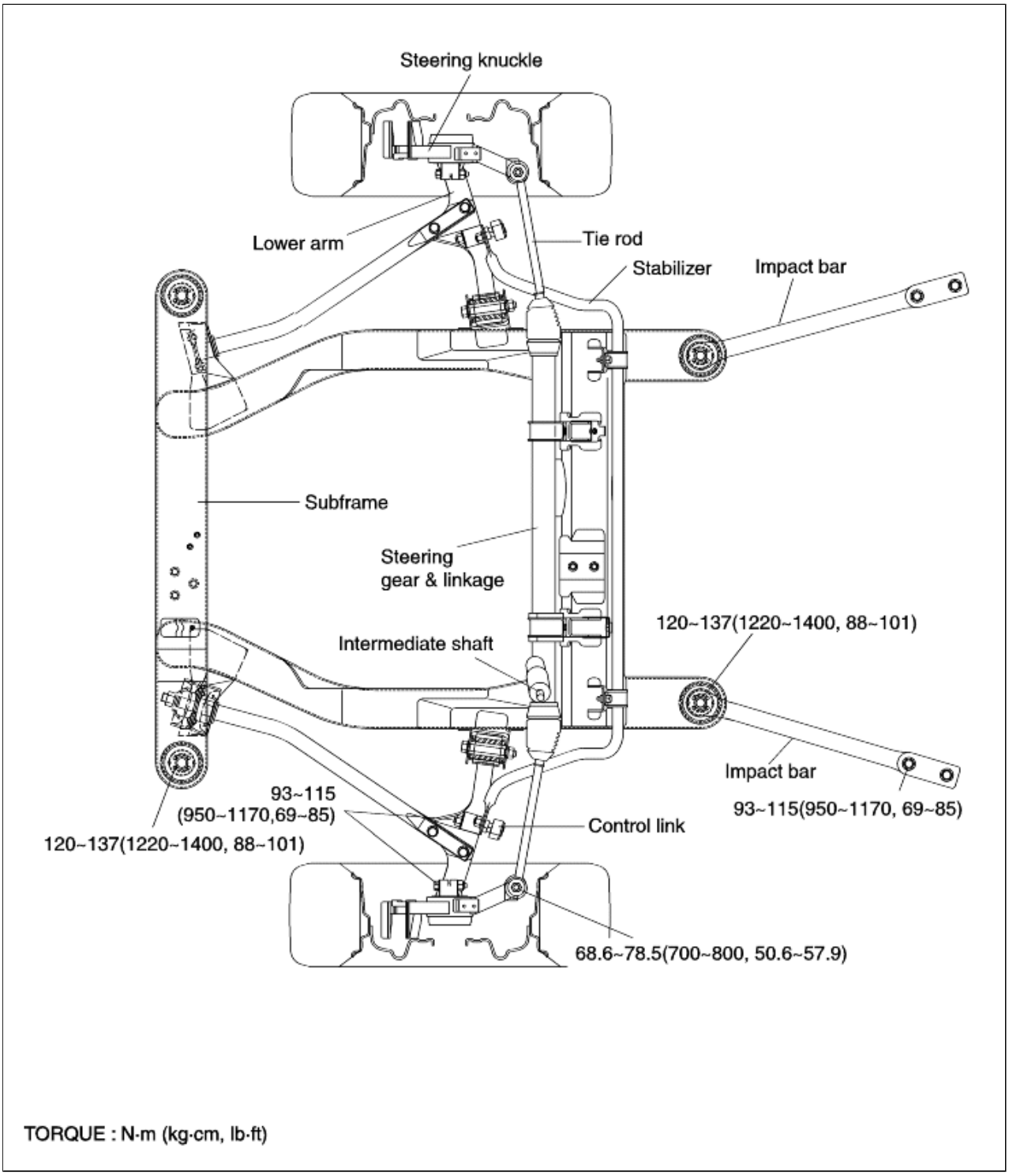
Reassemby

1. Assemble the following parts by referring to their respective sections.
   (1) Crankshaft
   (2) Drive plate
   (3) Piston
   (4) Cylinder head
   (5) Timing belt
   (6) Oil pump case

Components



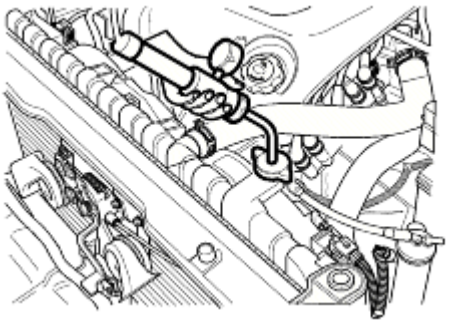
Components



TORQUE : N·m (kg·cm, lb·ft)

Coolant leak check

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 21.76psi(1.53 kg/cm²) pressure. Hold for two minutes in that condition, while checking,hose or connections.



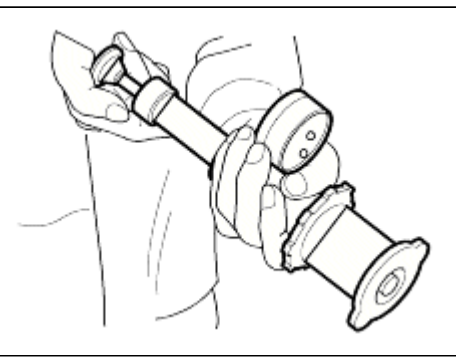
CAUTION

1) Radiator coolant may be extremely hot. Do not open the system while hot, or scalding Engine coolant could spray out causing personal injury. Allow the vehicle to cool before servicing this system.
2) Be sure to completely clean away any moisture from the places checked.
3) When the tester is removed, be careful not to spill any coolant from it.
4) Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.

4. If there is any leakage, repair or replace the appropriate part.

Radiator cap pressure test

1. Use an adapter to attach the cap to the tester.



2. Increase the pressure until the indicator of the gauge stops moving.

Main valve opening pressure :86.1 - 124.5 kPa (0.98-1.27kg/cm²,13.94 - 18.069 psi)Main valve closing pressure :83.4 kPa (0.85kg/cm², 12.1 psi)

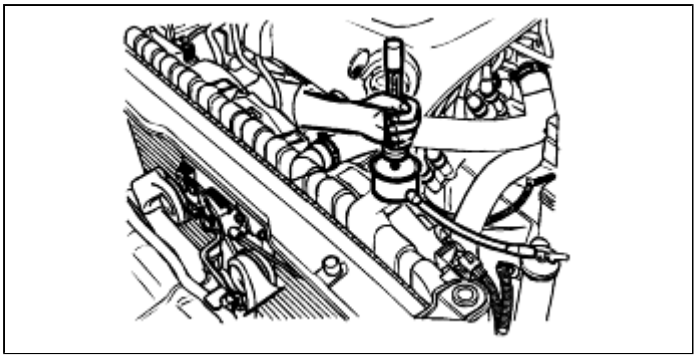
3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

NOTE

Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an improper indication.

Specific gravity test

1. Measure the specific gravity of the coolant with a hydrometer.



2. Measure the coolant temperature, and calculate the concentration from the relation between the specific gravity and temperature, using the following table for reference.
   Relation between concentration and specific gravity of coolant

Coolant temperature (°C) and specific gravity					Freezing temperature (°C)	Safe operation temperature (°C)	Coolant concentration (specific volume)
10	20	30	40	50			
1.054	1.050	1.046	1.042	1.036	-16	-11	30%
1.063	1.059	1.054	1.049	1.044	-20	-15	35%
1.071	1.067	1.062	1.057	1.052	-25	-20	40%
1.079	1.074	1.069	1.064	1.058	-30	-25	45%
1.087	1.082	1.076	1.070	1.064	-36	-31	50%
1.095	1.090	1.084	1.077	1.070	-42	-37	55%
1.103	1.098	1.092	1.084	1.076	-50	-45	60%

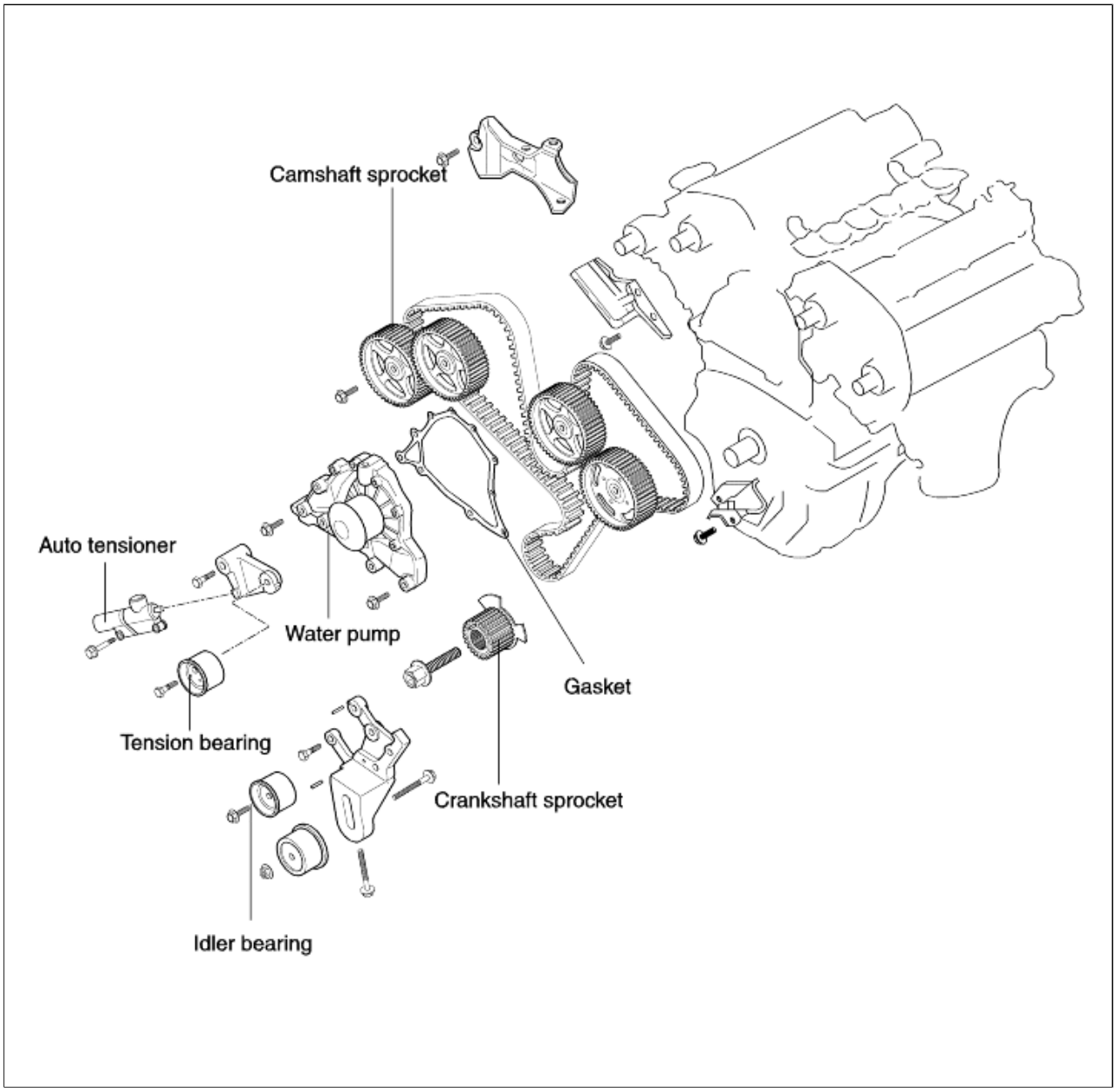
Example
If specific gravity is 1.058 when coolant temperature is 20°C, the safe operating temperature is -15°C.

> CAUTION
>
> If the concentration of the coolant is below 30%, the anti-corrosion property will be adversely affected. In addition, if the concentration is above 60%,both the anti-freeze and engine cooling properties will decrease, affect the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.
> Do not use together with another brand.

Recommended coolant

Anti-freezer	Concentration of anti-freezer in coolant
Ethylene glycol for aluminum	40 - 50 %

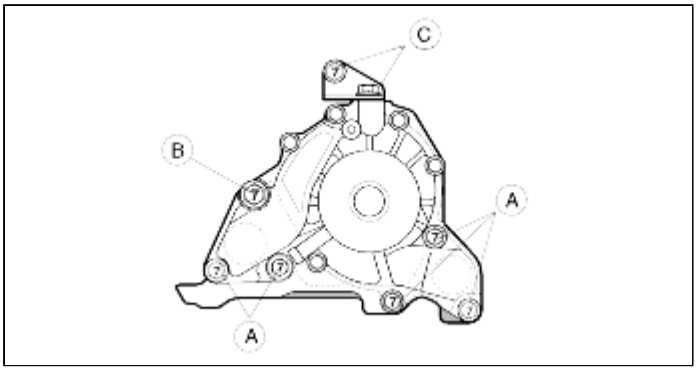
Components


Camshaft sprocket
Auto tensioner
Water pump
Gasket
Tension bearing
Crankshaft sprocket
Idler bearing

Installation

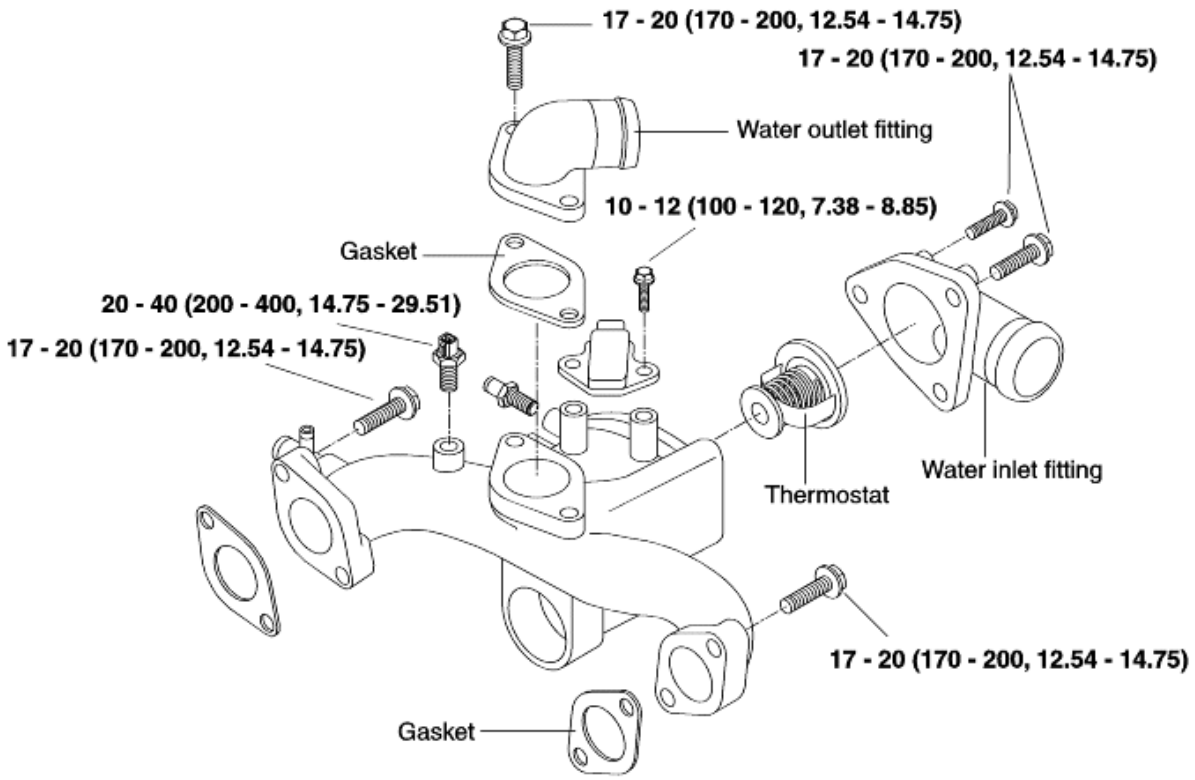
1. Clean the gasket mating surface of the water pump body and cylinder block.
2. After installing new O-ring in the groove at front of the water pipe, soak it with water. At this time, do not soak it with oil or grease.
3. After installing a new water pump gasket and water pump assembly, tighten it to the specified torque.

Tightening torque:(A) 5EA : 14.7-21.6 N·m(150-220 kg·cm, 10.8-15.9 lb·ft)(B) 1EA : 32.4-49.0 N·m(330-500 kg·cm, 23.9-36.2 lb·ft)(C) 2EA : 19.6-26.5 N·m(200-270 kg·cm, 14.5-19.5 lb·ft)



4. Install the timing belt tensioner and timing belt. After adjusting the timing belt tension, install the timing belt cover.
5. After installing the water pump pulley and driving belt, adjust the belt tension.
6. Refill it with cooling water.
7. Check the leakage by running the engine.

Components



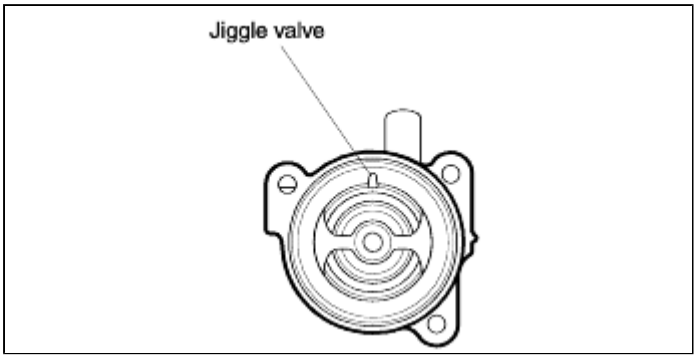
TORQUE : N·m(kg·cm, lb·ft)

Removal

1. Drain the cooling water to the bottom level of thermostat.
2. Remove the water outlet fitting.
3. Remove the thermostat.

Installation

1. Align the arrangement mark of thermostat housing with the jiggle valve.



2. Check to ensure that the flange of the thermost at is correctly seated in the socket of the thermost at housing. If the thermostat is installed in the wrong direction, the bottom of the thermostat will touch the rib inside the instake manifold, making it impossible to seat flange in position.
3. Install a new gasket and engine coolant outlet fitting.

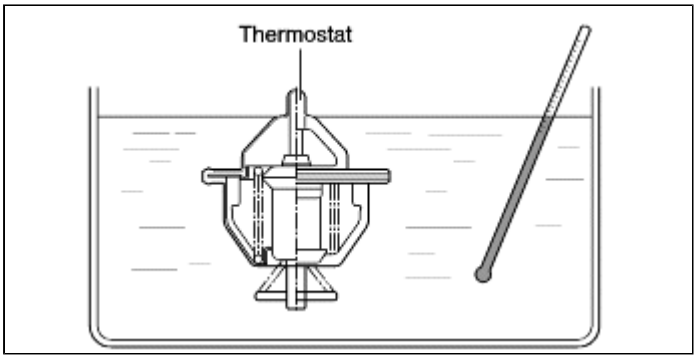
Tightening TorqueEngine coolant outlet fitting bolt :17 - 20N·m (170 - 200 kg·m,12.54 - 14.75 lb·ft)

4. Refill the coolant.

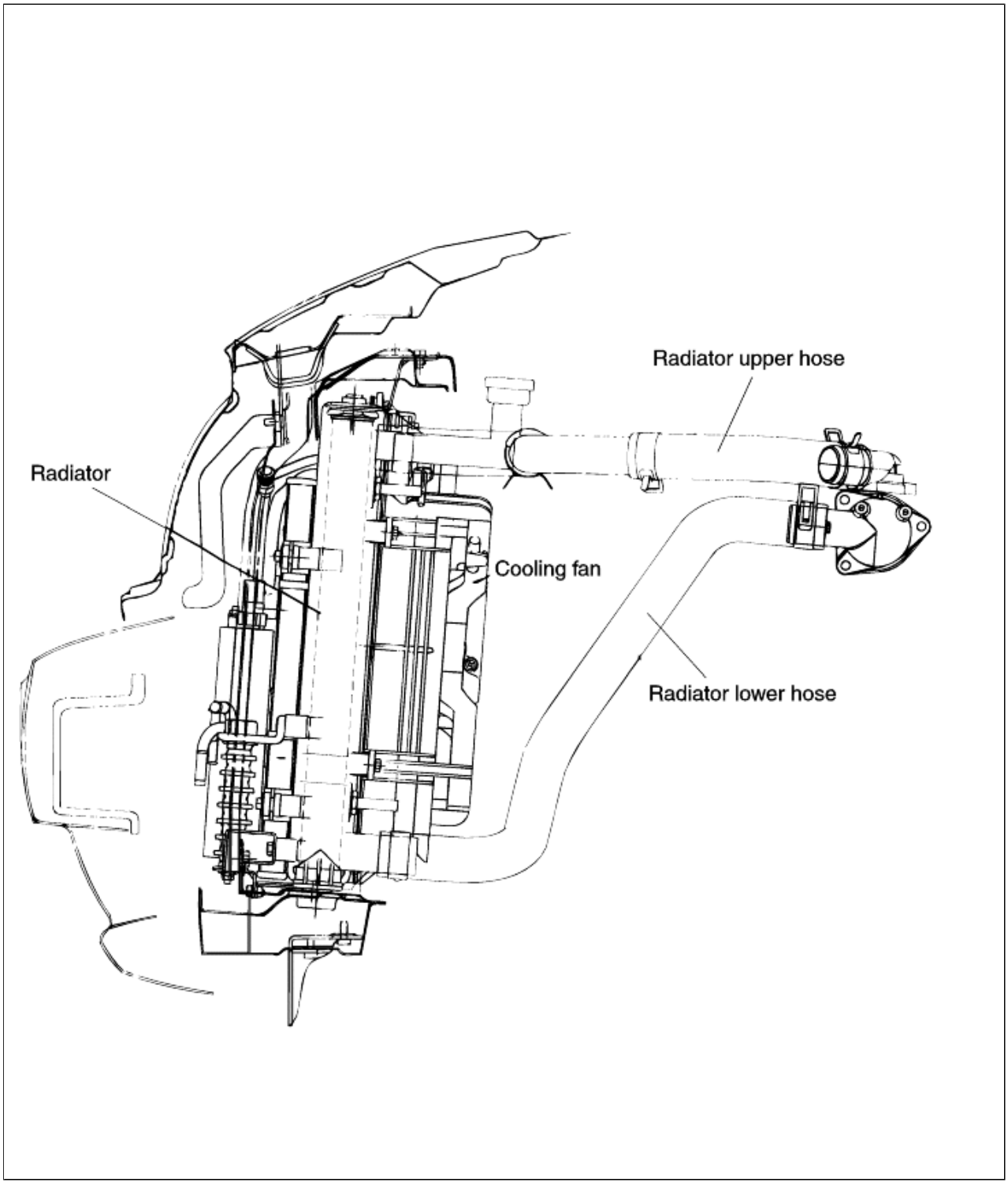
Inspection

1. Heat the thermostat and check if the valve operates properly.
2. Check to determine the temperature at which the value begins to open and is completely opened.

Valve opening temperature :80.0-84.0°C (176 - 183.2°F)The temperature when the valve is completely opened :95°C (203°F)



Components


Radiator upper hose
Radiator
Cooling fan
Radiator lower hose

Removal

1. Remove the air duct.
2. Remove the hood locker.
3. Disconnect the horn connector.
4. Remove the shroud upper member.
5. Disconnect the radiator fan motor connector and the condenser fan motor connector.
6. Remove the radiator fan and the condenser fan.
7. After marking on the radiator hose and clamp, disconnect the upper, lower hose and over flow hose.
8. Remove the radiator.

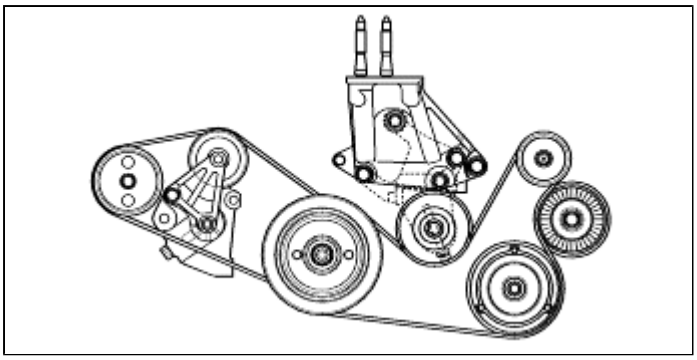
Installation

1. Fill the radiator reservoir tank with new cooling water.
2. Run the engine till cooling water temperature increases to open thermostat valve, and then stop the engine.
3. Remove the radiator cap and fill the radiator with water up to the filler neck, and fill the reservoir tank up to the specified level.
4. Check if there are any leakage from radiator, hose and connecting part.

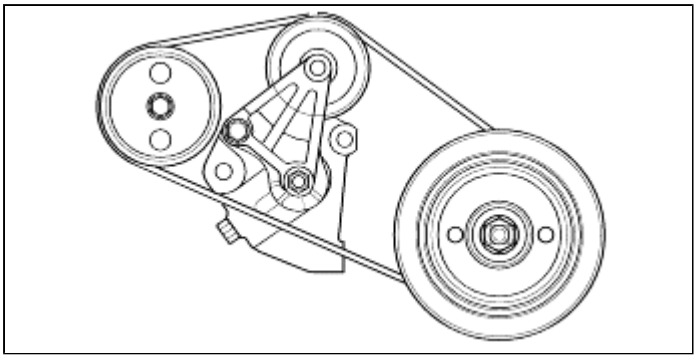
Inspecton

1. Check if there are foreign objects among radiator pins.
2. Inspect the radiator pin for damage, if necessary, straighten them up.
3. Inspect the radiator for corrosion, damage and rust.
4. Inspect the radiator for crack, damage and any weakened part.

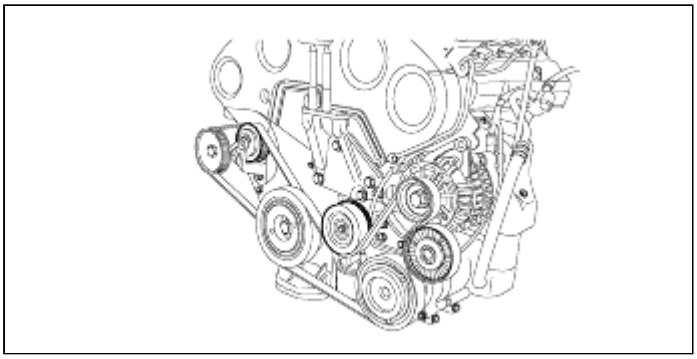
Drive belt and tension adjustment



1. Install the power steering belt.

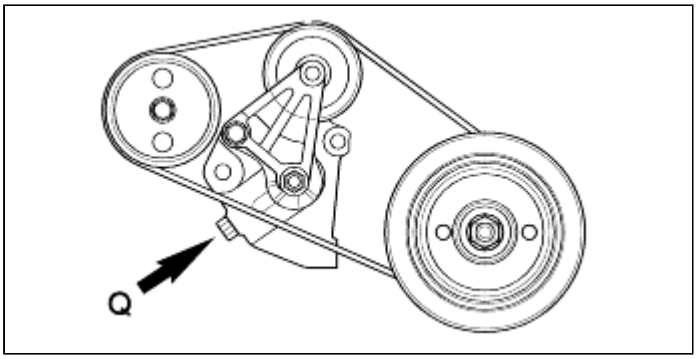


2. Install the drive belt.



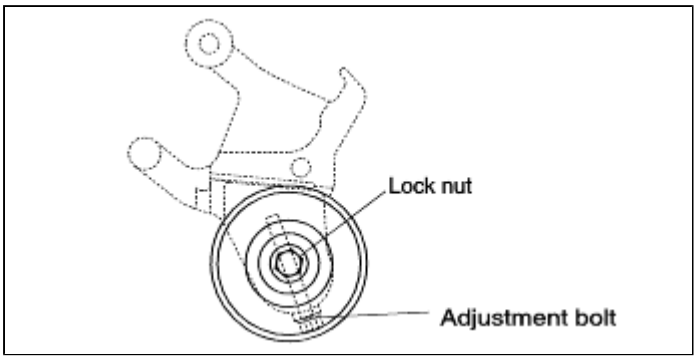
3. After installing the belt loosening the adjustment bolt counter clockwise at the "Q" arrow indication, apply tension to the belt by tightening the bolt clockwise.

> NOTE
>
> When adjusting belt tension, adjust it only after tightening the bolt lightly not making tension pulley eccentric.



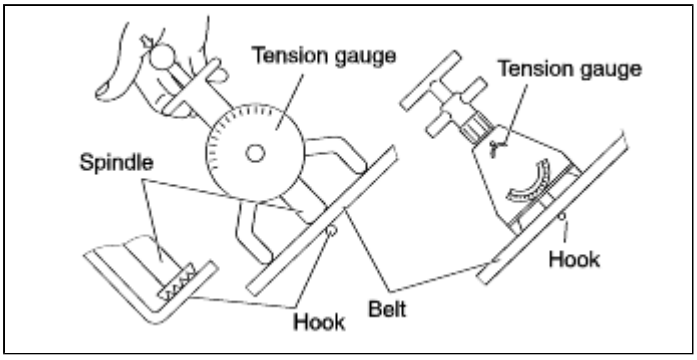
4. Adjusting drive belt tension.

Tightening torque :45 - 50 N·m (450 - 500 kg·cm, 33.19 - 36.88 lb·ft)

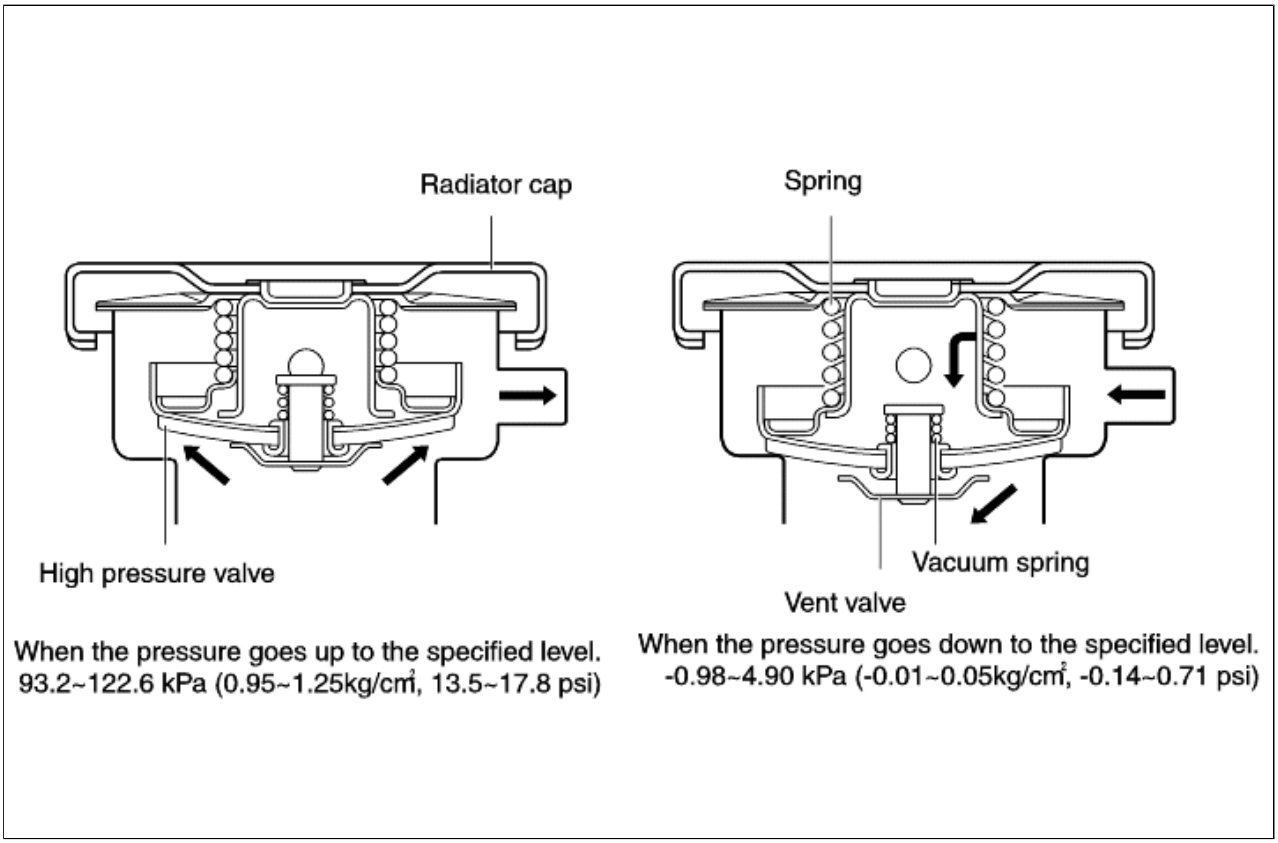


(MEASUREMENT METHOD OF BELT TENSION)

Insert the belt between spindle and hook holding the tension gauge by hand.Then release the tension gauge and read the value.

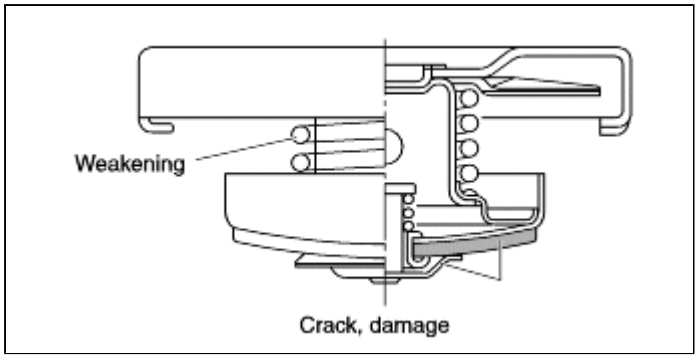


Components

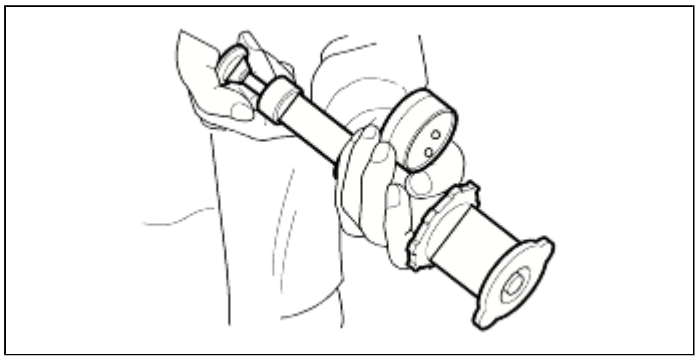

Radiator cap
High pressure valve
When the pressure goes up to the specified level.
93.2~122.6 kPa (0.95~1.25kg/cm², 13.5~17.8 psi)
Spring
Vacuum spring
Vent valve
When the pressure goes down to the specified level.
-0.98~4.90 kPa (-0.01~0.05kg/cm², -0.14~0.71 psi)

Inspection

1. Inspect the radiator cap for damage, crack and weakening.

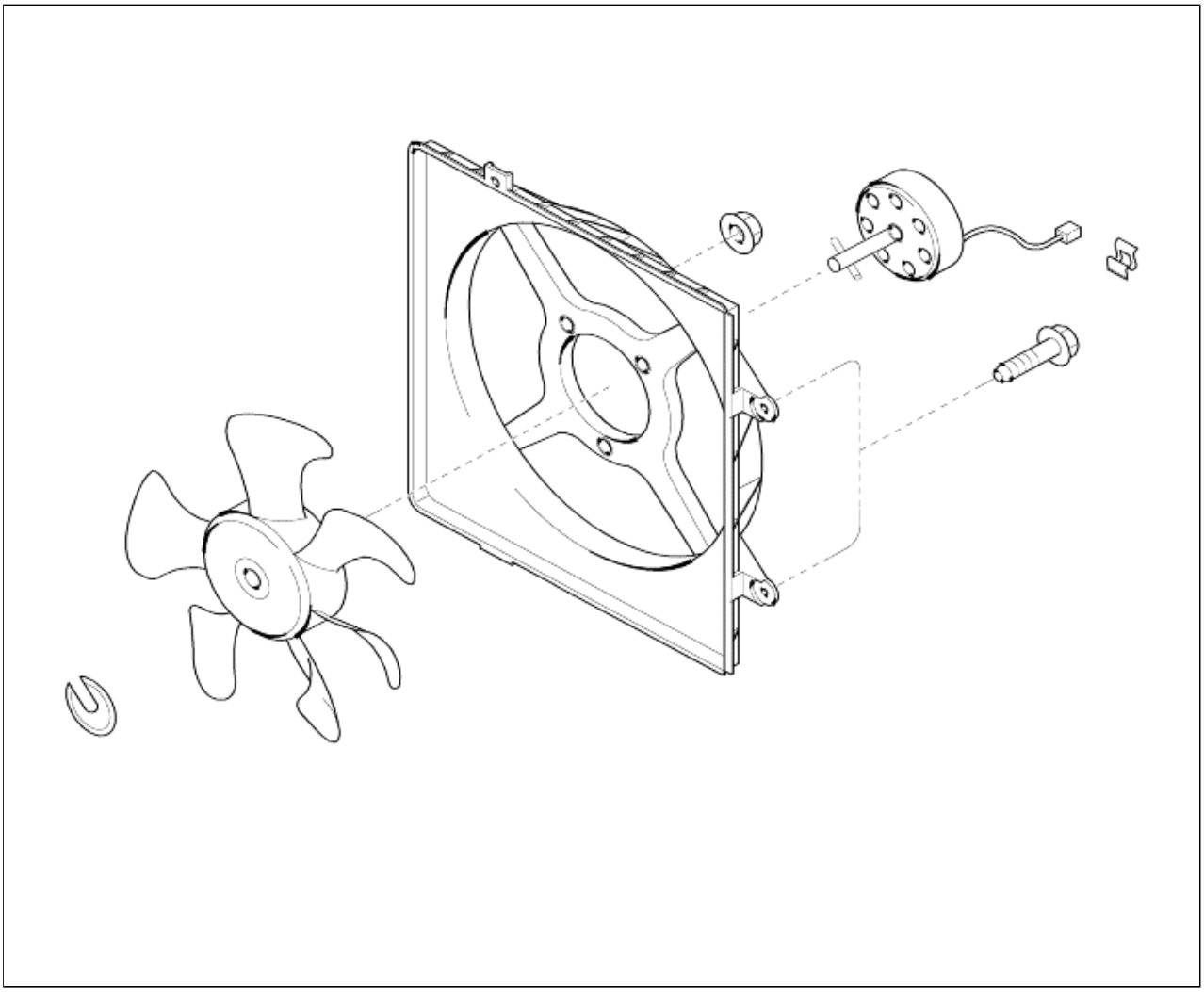


2. Connect the radiator cap tester to the radiator cap.
3. Apply the pressure to the tester till the needle is fixed.



4. If the needle stays at the same position for 10 seconds, the radiator capis in good condition.

Components



Removal

1. Remove the air duct.
2. Remove the hood locker.
3. Disconnect the horn connector.
4. Remove the shroud upper member.
5. Disconnect the radiator fan motor connector.
6. Remove the radiator fan.

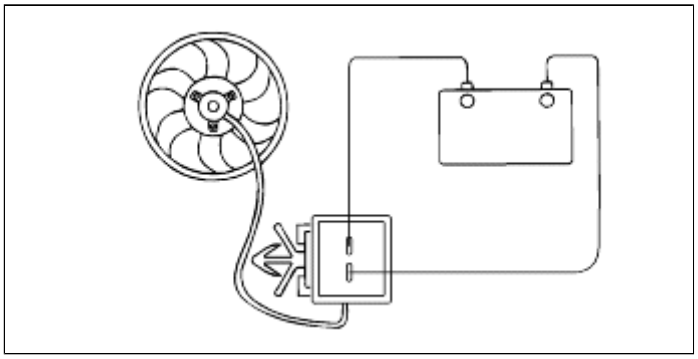
Installation

1. Installation is done in the reverse order of disassembly procedure.

> CAUTION
>
> 1) When assembling the shroud, be cautions not to touch the cooling fan.
> 2) After installing, while the fan is operating, check if there is abnormal noise and vibration.

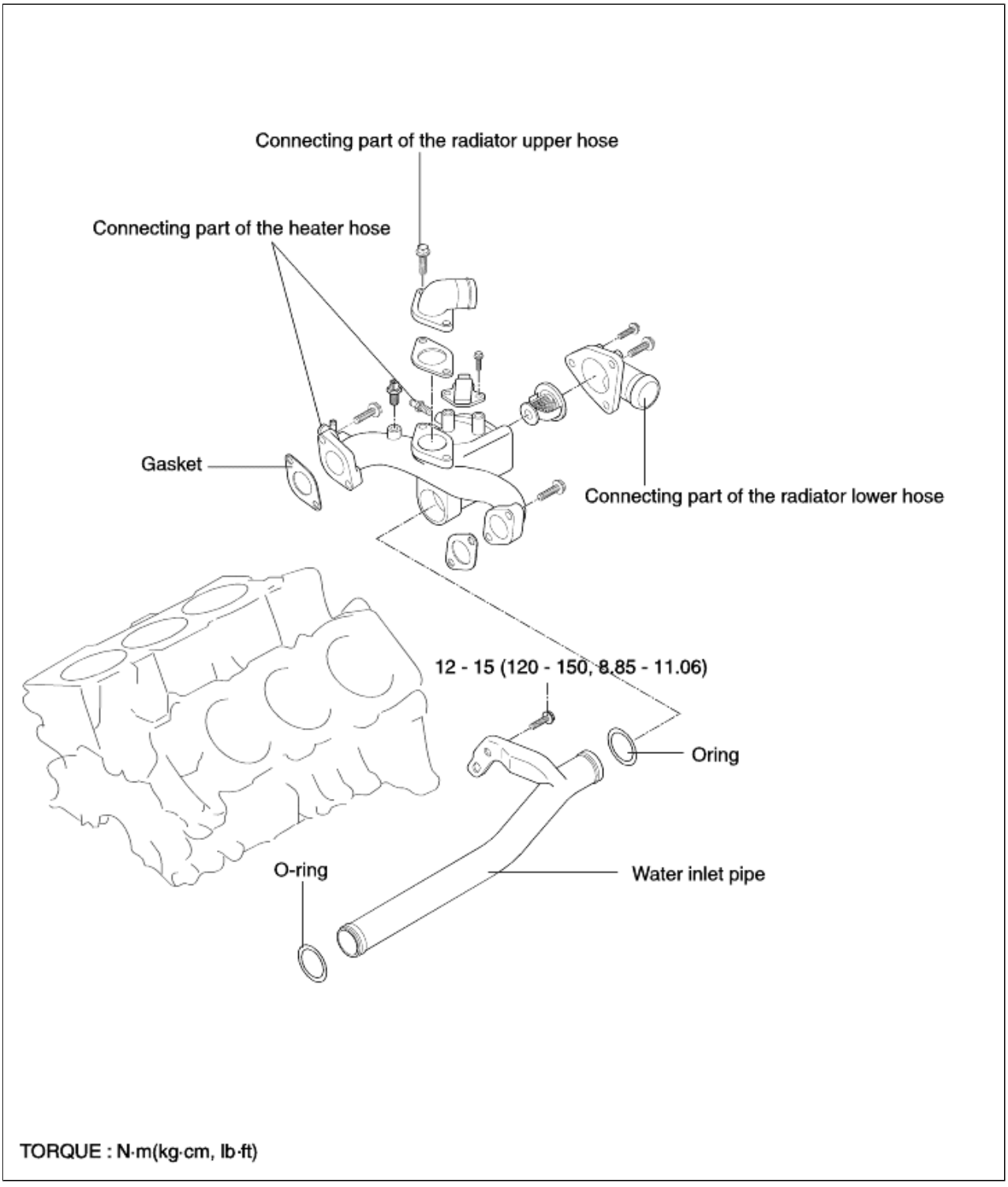
Inspection

1. Radiator fan motor
   (1) Check if the radiator fan is rotating when the battery voltage is supplied to both terminals as shown in the figure.



   (2) Check if there is abnormal noise while motor is rotating.

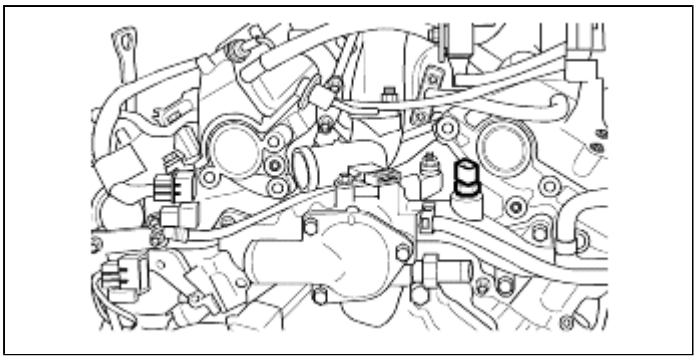
Components


Connecting part of the radiator upper hose
Connecting part of the heater hose
Gasket
Connecting part of the radiator lower hose
12 - 15 (120 - 150, 8.85 - 11.06)
Oring
O-ring
Water inlet pipe
TORQUE : N·m(kg·cm, lb·ft)

Removal

Water temperature gauge unit and sensor

1. Drain the cooling water to the bottom level of the gauge unit.
2. After disconnecting the battery ground cable, disconnect engine harness.
3. Remove the water temperature gauge unit and sensor.



Inspection

Engine coolant hose/pipes

Check that there are cracks, damages, or blockage on the water hose and pipe,and replace if necessary.

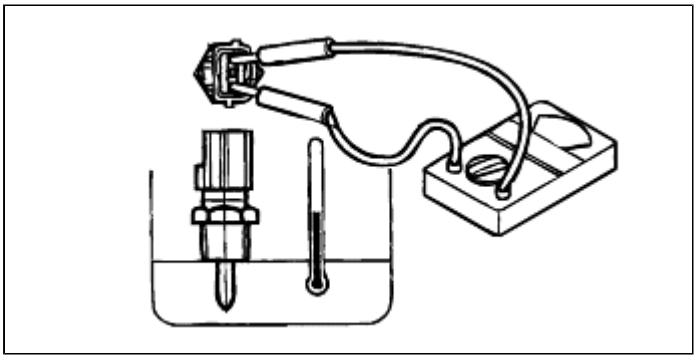
Water temperature gauge unit and sensor

1. Water temperature gauge unit
   (1) Heat up the water temperature gauge by immersing it in hot water.
   (2) Check if the resistance is within the specified range.

Specified Value	60°C (140°F)	125Ω	Coil type
	85°C (185°F)	8.4±5.8Ω	
	110°C (230°F)	$24^{+2.2}_{-1.3}$ Ω	
	125°C (257°F)	15.2Ω	

2. Water temperature sensor
   (1) Immerse the sensor in hot water.
   (2) Check if the resistance is within the specified range.

Specified value	20°C(68°F)	2.45±0.14kΩ
	80°C(176°F)	0.322kΩ



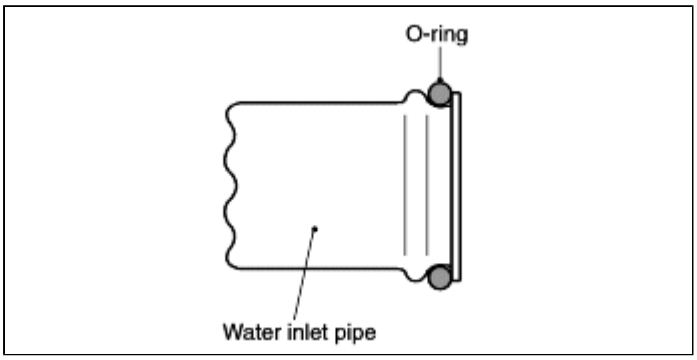
Installation

Engine coolant hose/pipes

After inserting O-ring into a groove at the lower part of water inlet pipe,soak O-ring in water and insert it into the water inlet pipe.

CAUTION

1) Be careful not to smear oil or grease on the water pipe O-ring.
2) Pay attention not to let a foreign object get into the connecting part ofthe water pipe.
3) Insert the water pipe up to its end part.



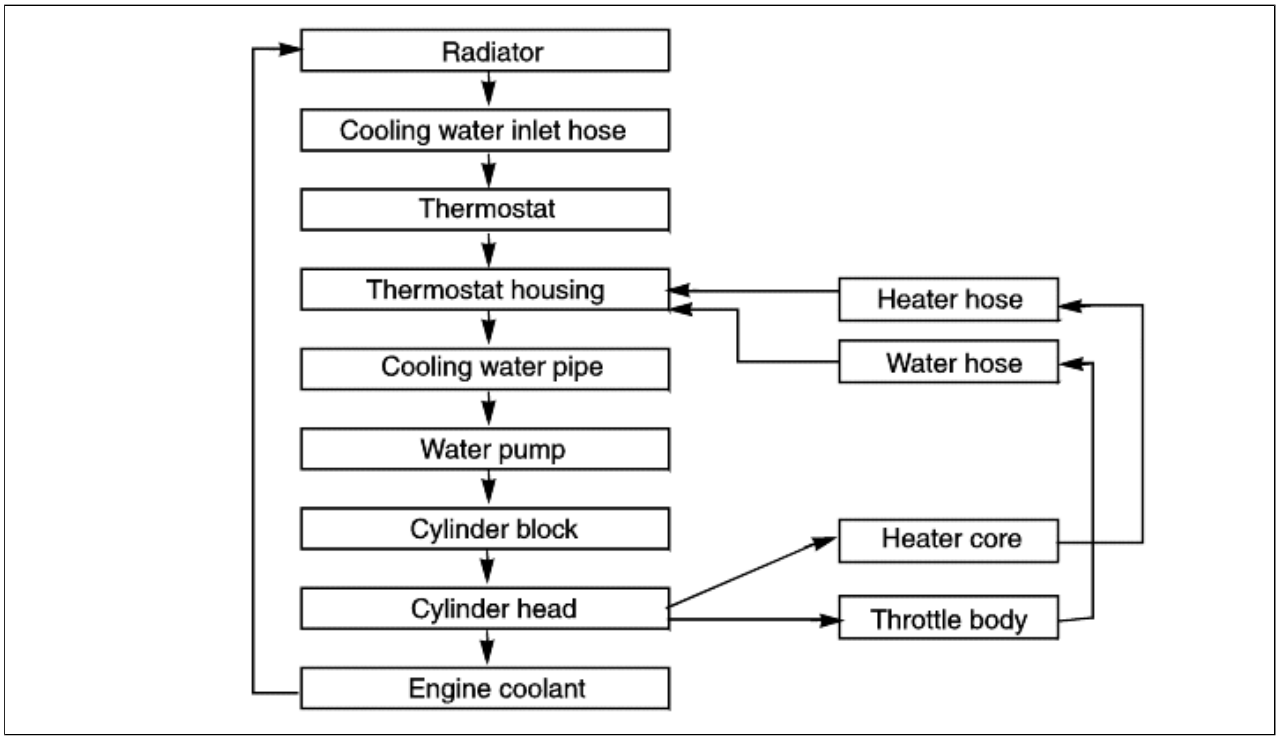
Water temperature gauge unit and sensor

1. Smear the sealant on thread and then tighten it to the specified torque.

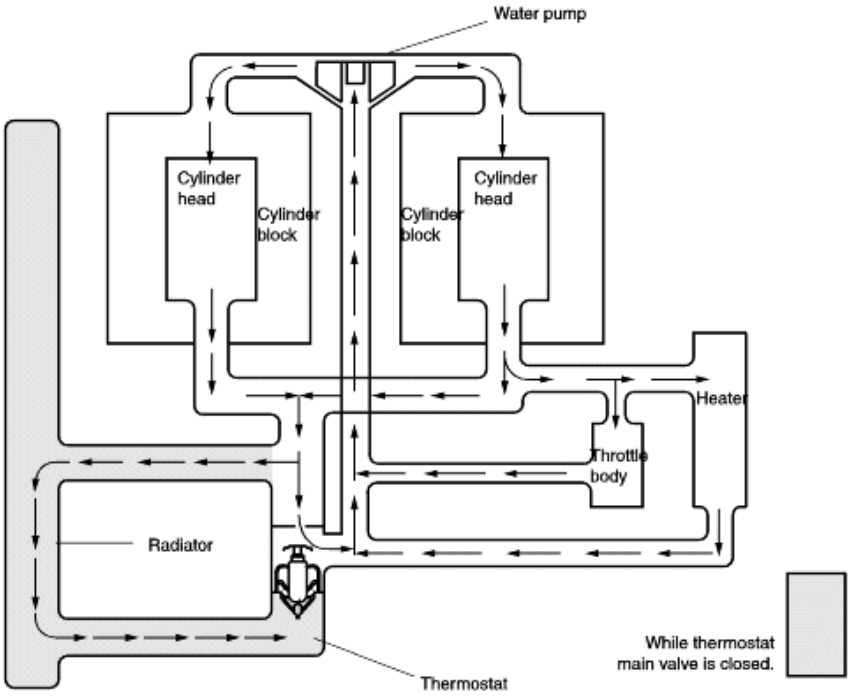
Description	Recommended sealant	Tightening torque (N·m (kg·cm, lb·ft))
Water temperature sensor	Loctite 962T or equivalent	20-40 (200-400, 14.5-28.9)

2. Connect the harness to water temperature gauge unit and cable.
3. Connect the battery ground cable.
4. Refill the coolant.

Inlet control



Flow chart

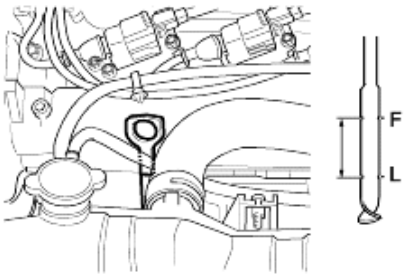

Water pump
Cylinder head
Cylinder block
Cylinder block
Cylinder head
Heater
Throttle body
Radiator
Thermostat
While thermostat main valve is closed.

Checking engine oil

1. Position a vehicle on a level surface.
2. Stop the engine.

> CAUTION
>
> In the case of a vehicle that has been out of service for a prolonged period, run the engine for several minutes. Stop the engine and wait a few minutes at least, then check the oil level.

3. If the oil level is found to have fallen to the lower limit (the L mark), refill to the "F" mark.

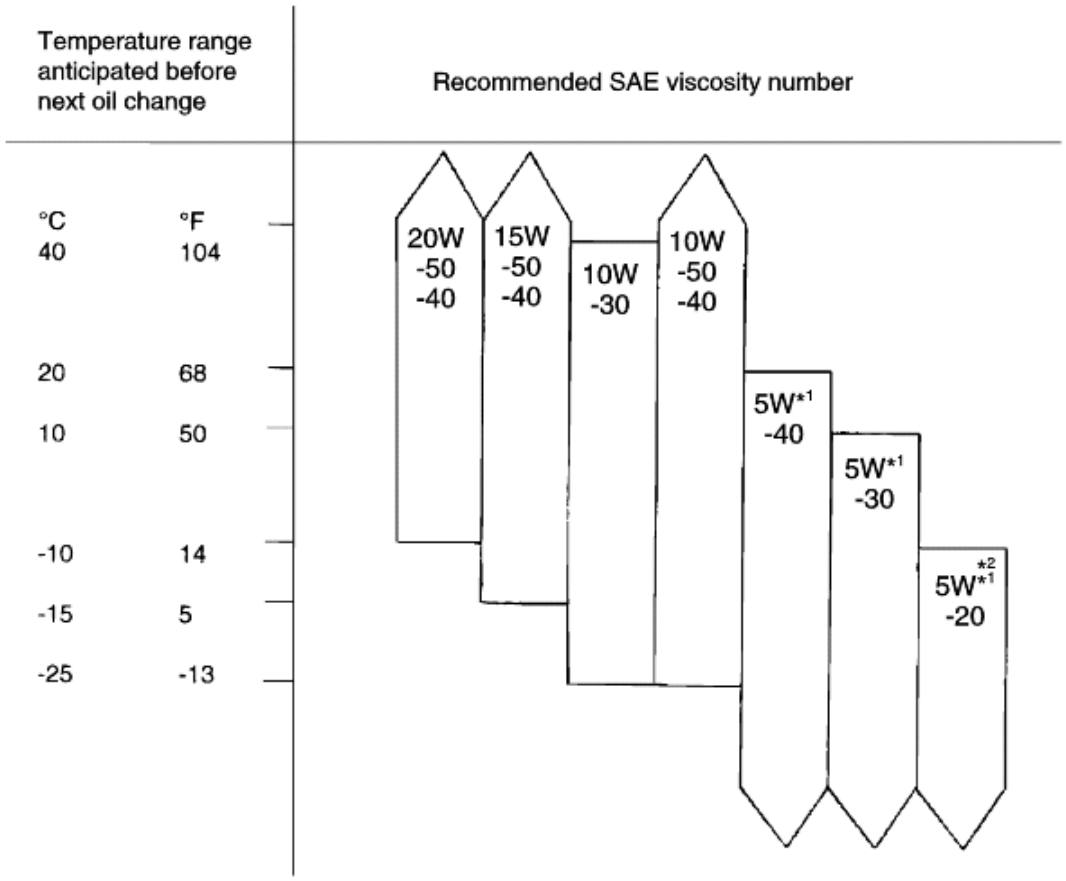


> CAUTION
>
> When refilling, use the same type of engine oil as the one currently being used.

4. Check that the oil is not dirty or mixed with coolant or gasoline, and that it has the proper viscosity.

Selection of engine oil

Recommended API classification : SE or above [For General]
Recommended API classification : SG or above [For North America, Europe]
Recommended SAE viscosity grades :



***1 Restricted by driving condition and environment.**
***2 Not recommended for sustained high speed vehicle operation**

CAUTION

For best performance and for maximum protection for all types of operation, select only those lubricants which :

1. Confirm to the requirements of the API classification.
2. Have proper SAE grade number for expected ambient temperature range.
   Lubricants which do not have both a SAE grade number and an API service classification on the container should not be used.

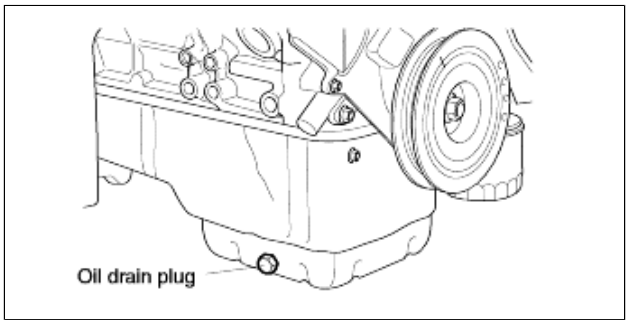
Changing engine oil

1. Run the engine until it reaches normal operating temperature.
2. Stop the engine.
3. Remove the oil filler cap (on rocker cover) and the drain plug (on the oil pan). Drain the engine oil.
4. Tighten the drain plug to the specified torque.

Tightening torque :35 - 40 N·m (350 - 400 kg·cm,25.82 - 29.51 lb·ft)

CAUTION

Whenever tightening an oil drain plug, use a new drain plug gasket.



5. Install oil filter.
6. Fill new engine oil through the oil filling hole.

Drain and filling	Amount of oil : 4.3l (4.55 US. qts, 3.78 Imp. qts)

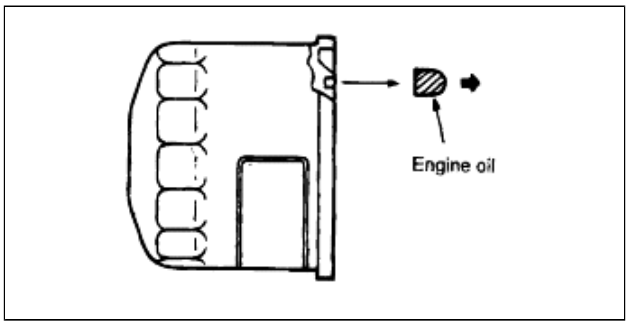
7. Close the oil filling hole cap.
8. Start the engine.
9. Stop the engine and check the oil level. If not sufficient, refill it.

Filter selection

All Kia Motor Company engines are equipped with a high quality, throw-away oil filter. This filter is recommended as a replacement filter on all vehicles.The quality of replacement filters varies considerably. Only high quality filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the mating surface on the engine block, before installing the new filter.

Replacing oil filter

1. Use a filter wrench to remove the oil filter.
2. Before installing the new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.



3. Tighten the oil filter to the specified torque.

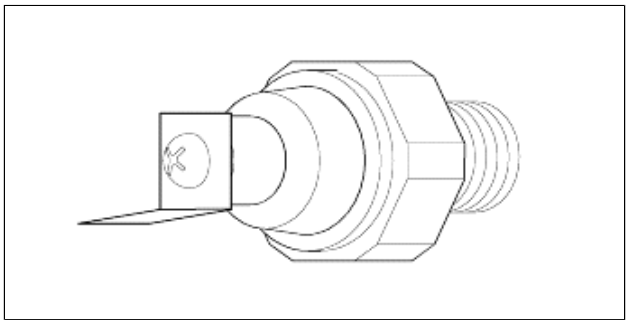
Tightening torque	Oil filter : 11.8 - 15.7 N·m (120 - 160 kg·cm, 8.7 - 11.6 lb·ft)

4. Fill the engine with the engine oil.
5. Start and run the engine and check for engine oil leaks.
6. After stopping the engine, check the oil level and add oil as much as necessary.

Oil pressure switch

1. If "OIL PRESSURE" indicating lamp lights when ignition switch is set to "ON" and goes out when engine is started and runs at idle, then everything is in order. If "OIL PRESSURE" lamp does not light when ignition switch is set to "ON" check switch, lamp and wiring.
2. If there is current flow when ignition switch is set to "ON" and if there is no current flow when engine is running at idle, switch is good.
   If switch is good, check lamp and wiring.

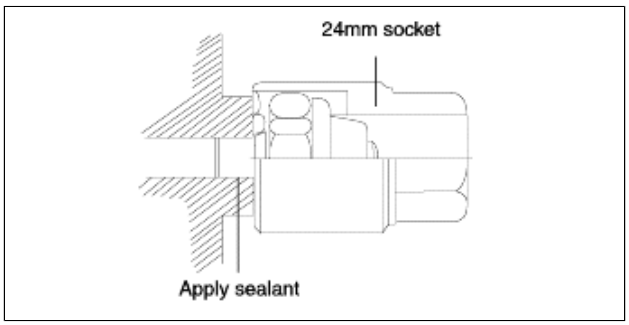
Operating pressure of oil pressure switch	19.6 - 39.2 kPa (0.2 - 0.4kg/cm², 2.84 - 5.69 psi)



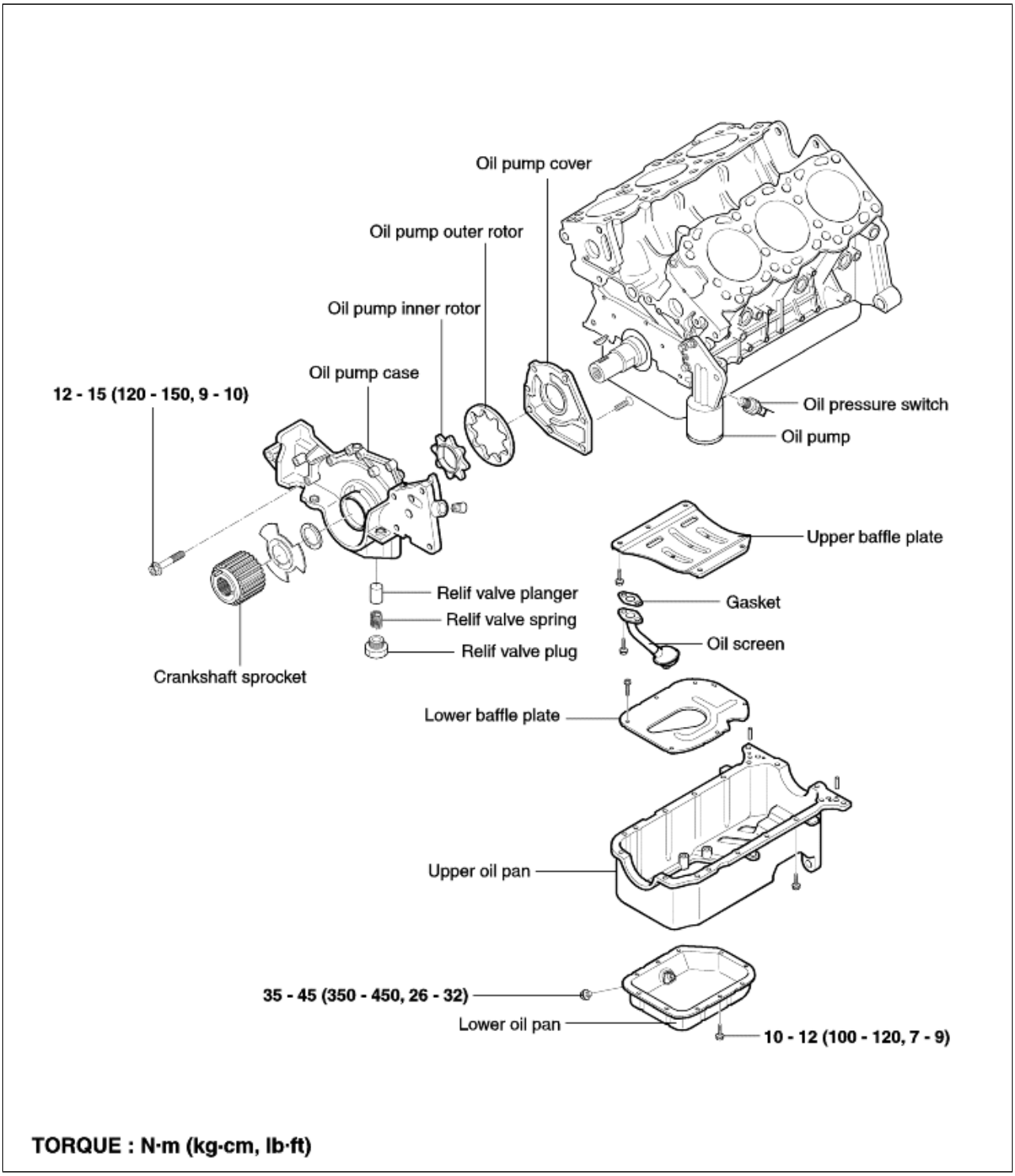
3. Using 24 mm deep socket, tighten the switch to the specified torque.

> NOTE
>
> Do not tighten the oil pressure switch to the excessive torque.

Tightening torqueOil pressure switch and sensor assembly:8 - 12 N·m (80~120kg·cm, 5.91- 8.85 lb·ft)

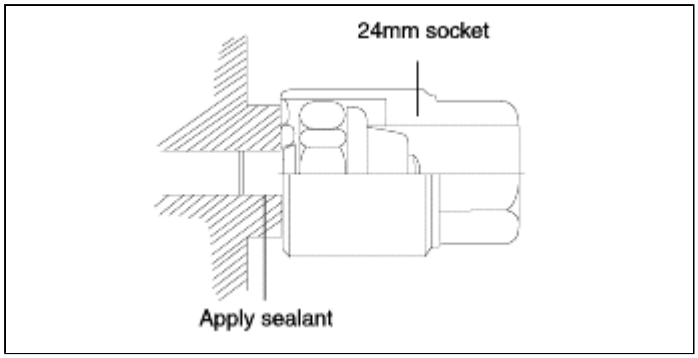


Components


Oil pump cover
Oil pump outer rotor
Oil pump inner rotor
Oil pump case
12 - 15 (120 - 150, 9 - 10)
Oil pressure switch
Oil pump
Upper baffle plate
Gasket
Oil screen
Relif valve plunger
Relif valve spring
Relif valve plug
Crankshaft sprocket
Lower baffle plate
Upper oil pan
35 - 45 (350 - 450, 26 - 32)
Lower oil pan
10 - 12 (100 - 120, 7 - 9)
TORQUE : N·m (kg·cm, lb·ft)

Disassembly

1. Remove the oil pressure switch, using 24 mm deep socket.



NOTE

Since a sealant is used on the threded area, be careful not to damage the oil pressure switch.

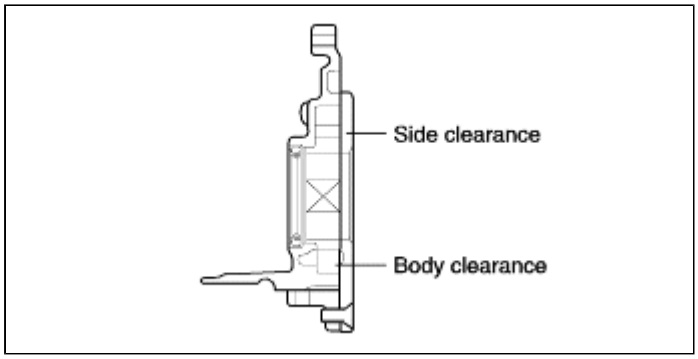
2. Remove the oil filter and the oil pan.
3. Remove the oil screen and gasket.
4. Remove the three bracket securing bolts and remove the oil filter bracket and gasket.
5. Remove the oil relief valve plug from the oil pump case.
6. Remove the oil pump case.

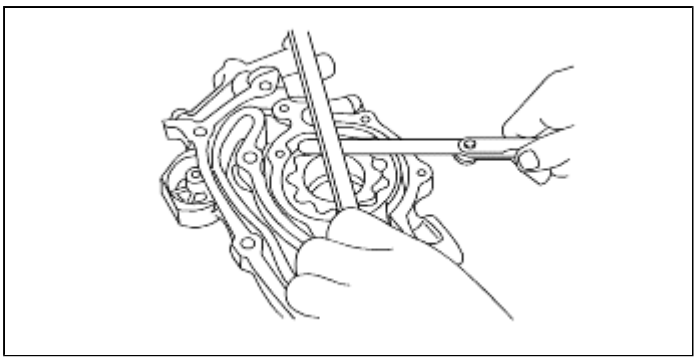
Inspection

Oil pump

1. Visually check the parts of the oil pump case for cracks and damage.
2. Assemble the rotor on the oil pump and then check the clearance with a thickness gauge.

Oil pump side clearance	Standard value
Body clearance	0.100-0.181mm(0.0039-0.0071 in)
Side clearance	0.040-0.095mm(0.0016-0.0037 in)





Relief plunger and spring

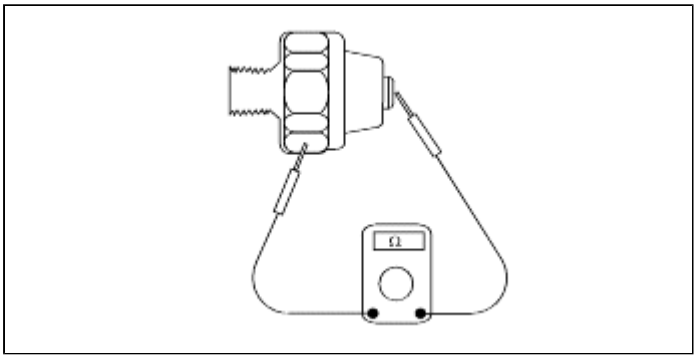
1. Check the relief plunger for smooth operation.
2. Check the relief spring for the deformed or broken condition.

Oil filter bracket

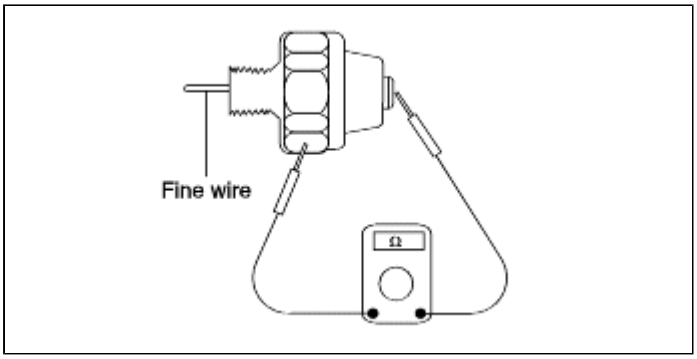
1. Make sure that there is no damage on the oil filter installation surface.
2. Check the oil filter bracket for oil leaks or cracks.

Oil pressure switch

1. Check the continuity by between terminal and body with an ohmmeter.
   If there is continuity, replace the oil pressure switch.



2. Check the continuity between the terminal and the body when the fine wedge is pushed. If there is continuity even when the fine wedge is pushed, replaceit.

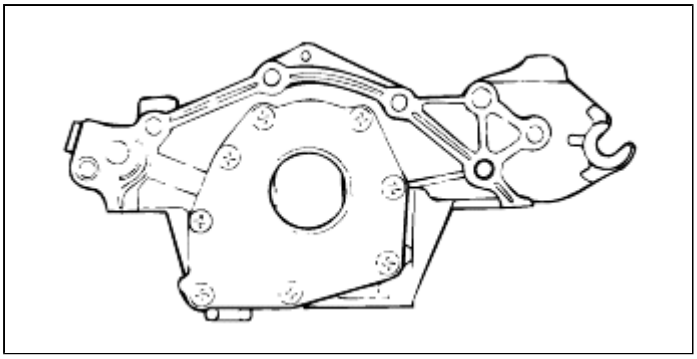


3. Or, if there is no continuity when a 50kPa (0.5 kg/cm², 7psi) vacuum is applied through the oil hole, the switch is operating properly. Check that air doesn't leak. If air leaks, the diaphragm is broken, and replace it.

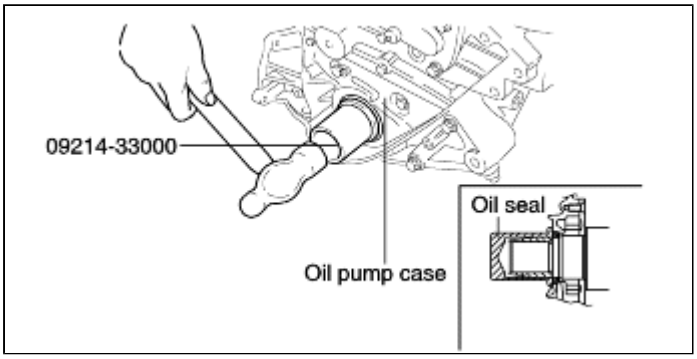
Reassembly

1. Install the oil pump case with the gasket.

Tightening torqueOil pump case bolt : 12 - 15 N·m(120 - 150kg·cm, 8.85 - 11.06 lb·ft)Oil pump cover screw : 8 - 12 N·m(80-120kg·cm, 5.91 - 8.85 lb·ft)

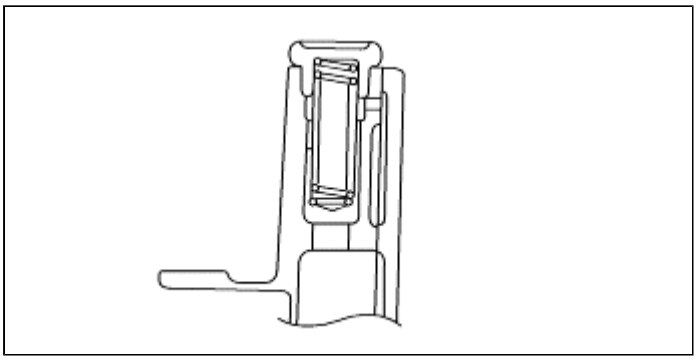


2. Install the oil seal in the oil pump case, using special tool (09214-33000).



3. Install the relief plunger and spring, and tighten the oil relief valve plug to the specified torque.

Tightening torqueOil relief valve plug : 40 - 50N·m(400 - 500kg·cm, 29.5 - 36.88 lb·ft)



4. Install the oil screen with a new gasket.

Tightening torqueOil screen bolt : 15 - 22 N·m(150 - 220kg·cm, 11.06 - 16.23 lb·ft)

5. Clean the gasket surfaces of the cylnder block and the oil pan.
6. Apply sealant into the groove of the oil pan flange.

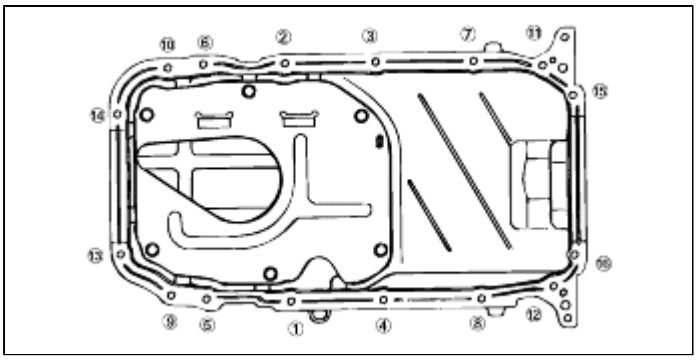
NOTE

Make the first cut from the end of the nozzle furnished with the sealant approx.4 mm. After application of the sealant, do not exceed 15 minutes before installing the oil pan.

7. Install the upper oil pan and tighten the bolts to the specified torque. Tightenthe oil pan bolts as shown in figure.

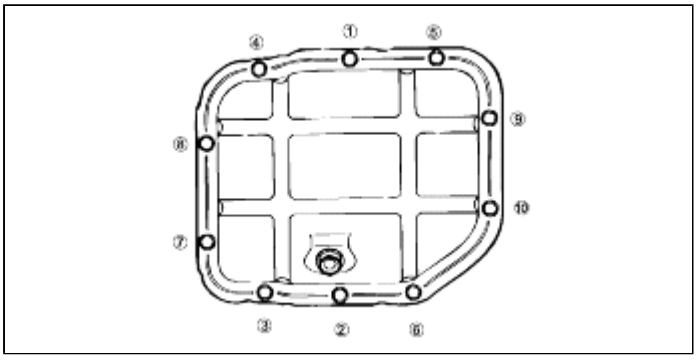
Tightening torqueUpper oil pan boltNo. 1-14 : 9.8 - 11.8 N·m(100 -

120kg·cm, 7.2 - 8.7 lb·ft)No. 15-16 : 5 - 7 N·m(50 - 70kg·cm, 3.68 - 5.16 lb·ft)Upper oil pan and transaxle mounting bolt(4EA):30 - 42 N·m(300 - 420kg·cm, 22.13 - 30.98 lb·ft)



8. Install the lower oil pan and tighten the bolts to specified torque.

Tightening torqueLower oil pan bolt: 9.8 - 11.8 N·m (100 - 120kg·cm, 7.2 - 8.7 lb·ft)

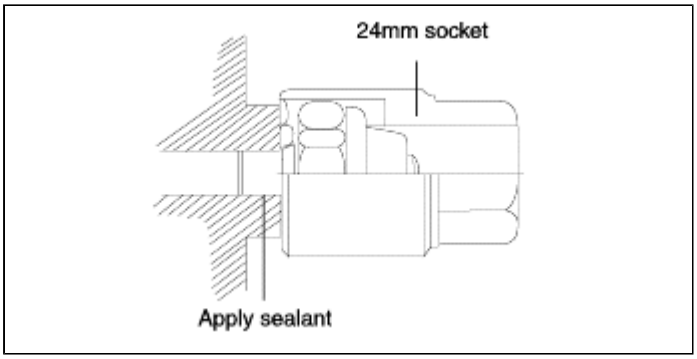


9. Using 24 mm deep socket, install the oil pressure switch after applying sealant to the threaded area. Sealant : Threebond 1104 or equivalent.

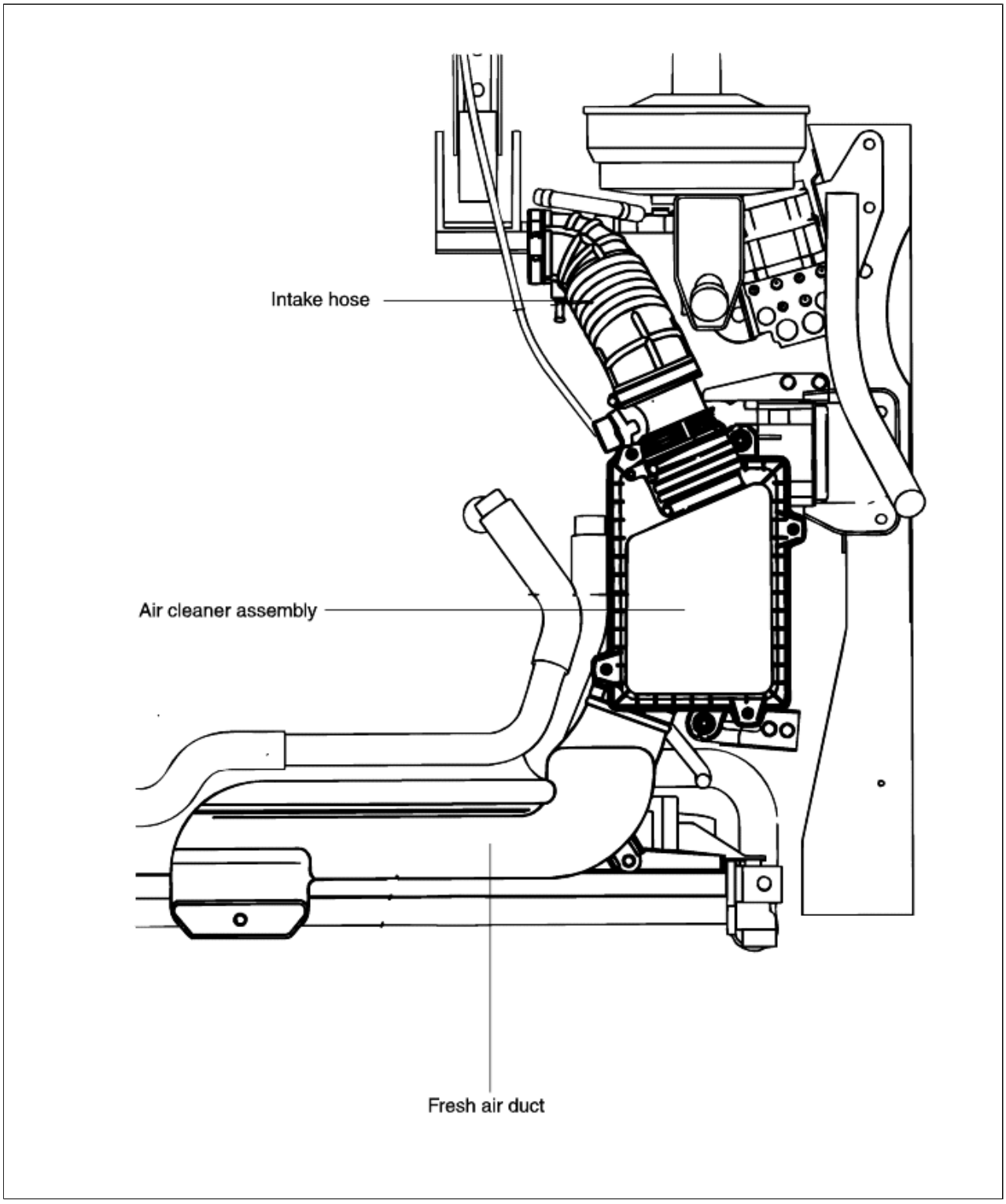
NOTE

Do not tighten the oil pressure switch to the excessive torque.

Tightening torqueOil pressure switch :8 - 12 N·m (80~120kg·cm, 5.91 - 8.85lb·ft)

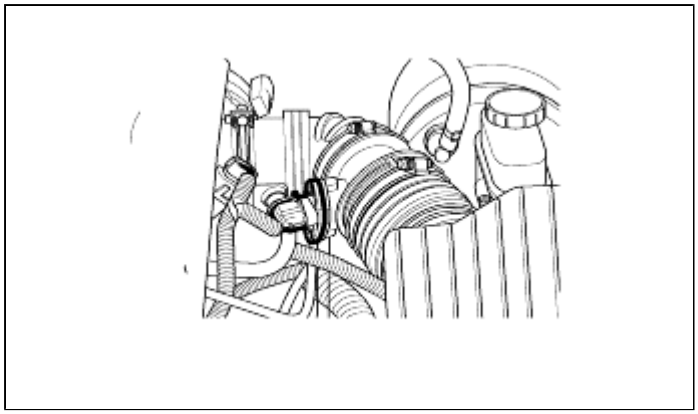


Components



Removal

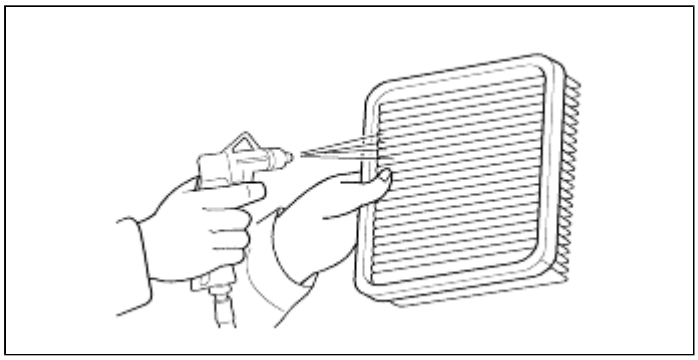
1. Disconnect the A.F.S. connector.



2. Pull out air duct which is connected to the air inlet hose and air cleaner.
3. Detach the air cleaner.

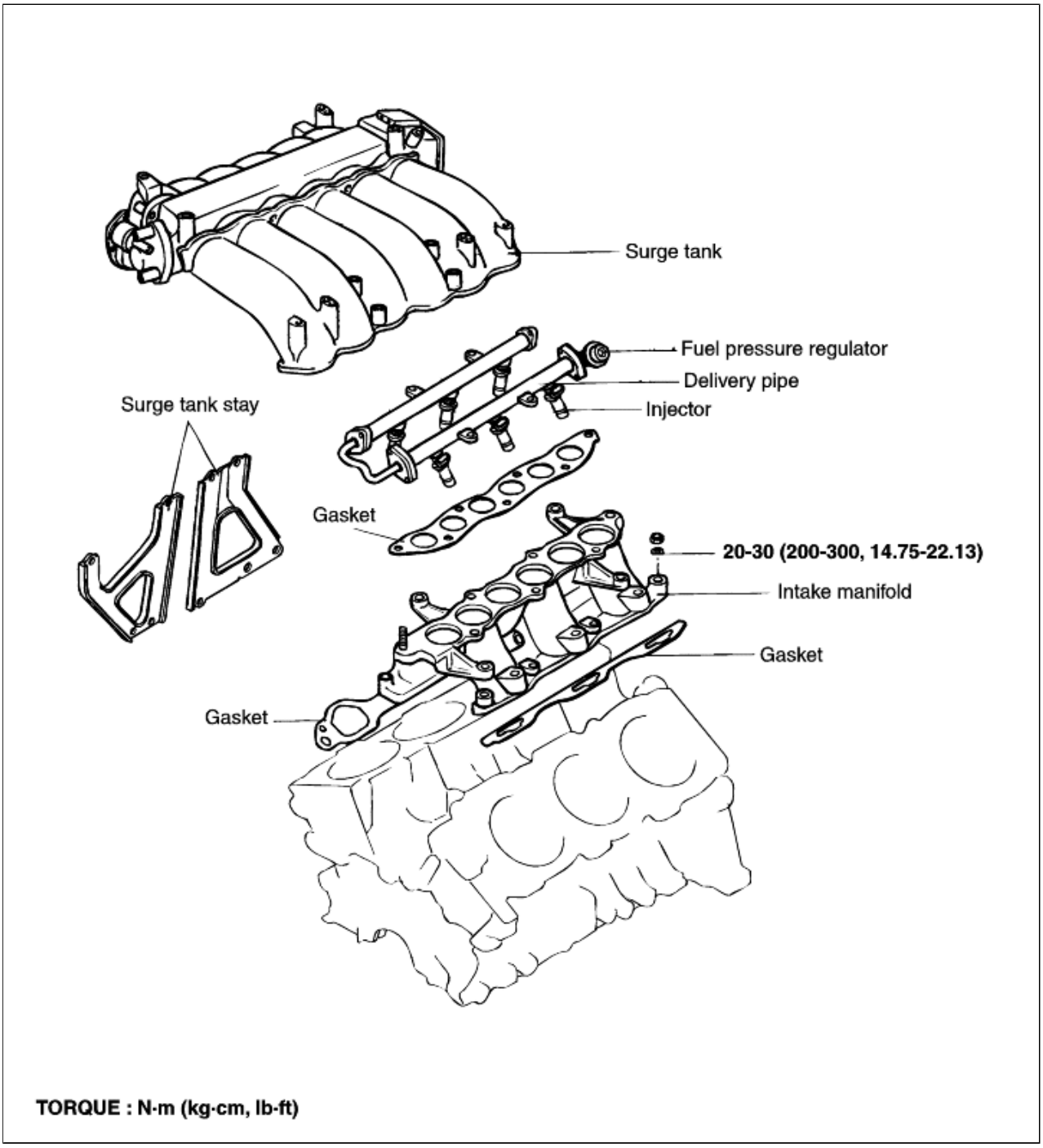
Inspection

1. Inspect the body, cover and packing of air cleaner for distortion, corrosion and damage.
2. Inspect the air duct for damage.
3. Inspect the air cleaner element for dirt, contamination and damage. If elementis choked a little, blow air from inside of element to get rid of the dust or other foreign object. If it is contaminated too much, replace it. While replacing it, be cautious not to let foreign object get in.



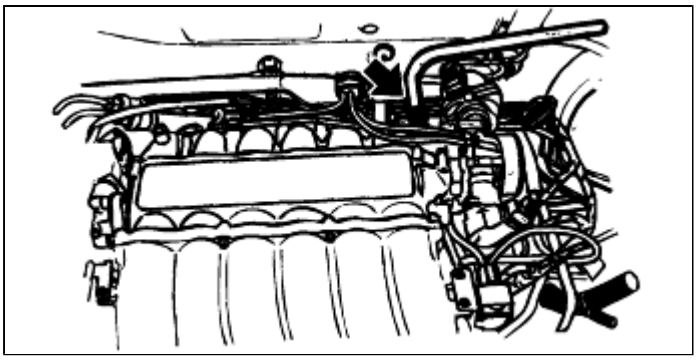
4. Inspect the air cleaner housing for dirt, contamination and damage.
5. If the inside of air cleaner housing is contaminated, eliminates the contaminated material.

Components

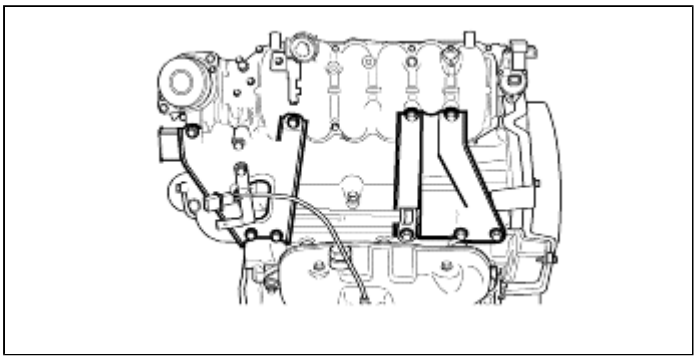

Surge tank
Fuel pressure regulator
Delivery pipe
Injector
Surge tank stay
Gasket
20-30 (200-300, 14.75-22.13)
Intake manifold
Gasket
Gasket
TORQUE : N·m (kg·cm, lb-ft)

Removal

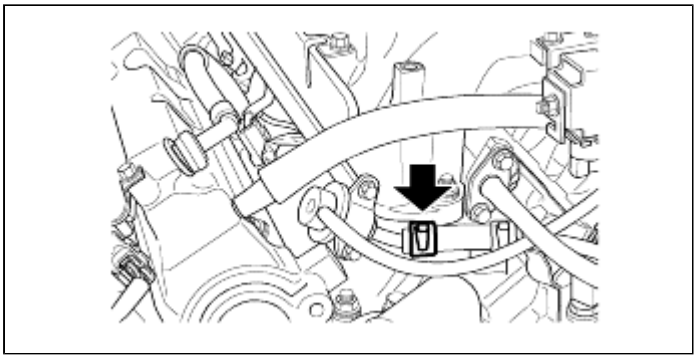
1. Detach the P.C.V. hose and brake booster vacuum hose.
2. Disconnect the connecting part of vacuum hose.



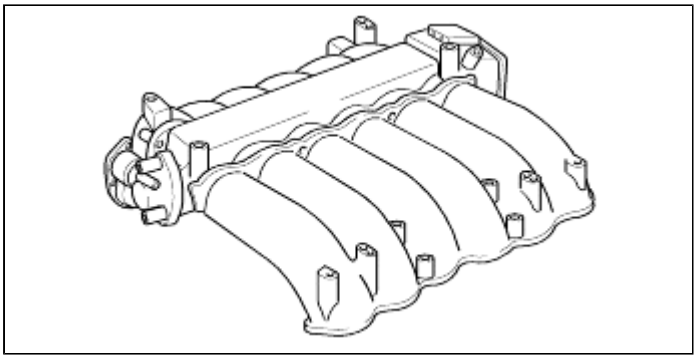
3. Remove the surge tank stay.



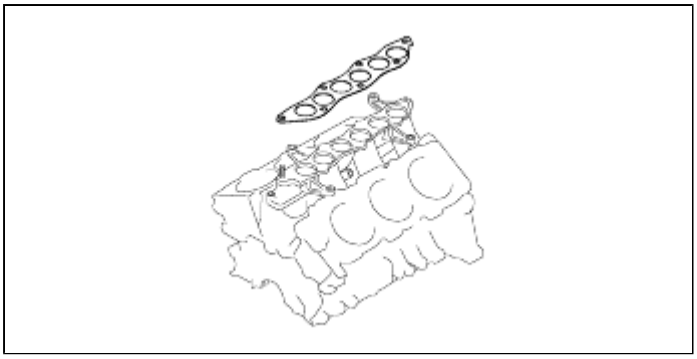
4. After reducing the pressure of fuel pipe line to prevent fuel overflow, disconnect the connecting part of the high pressure hose.



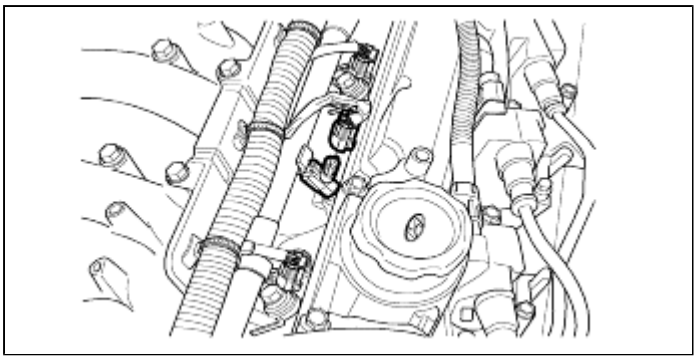
5. Remove the surge tank stay.



6. After removing the surge tank, remove the gasket.

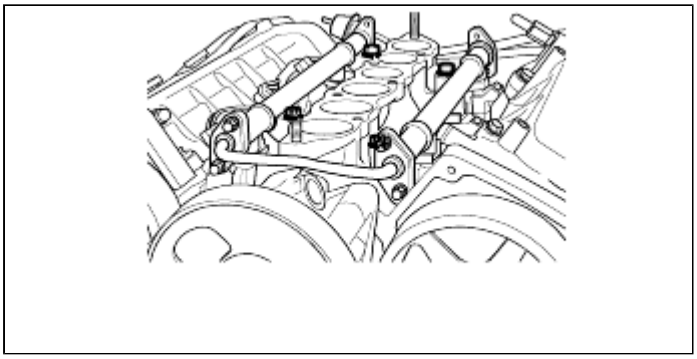


7. Disconnect the fuel injector harness connector.

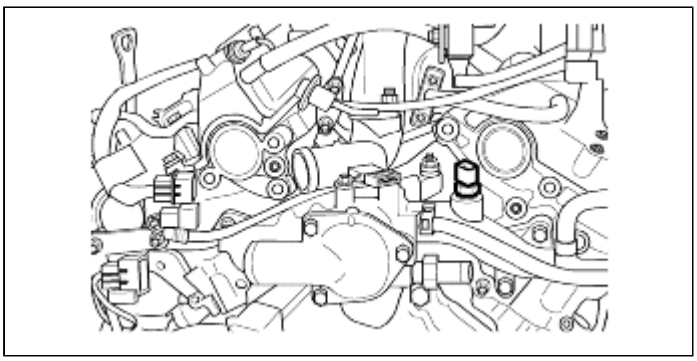


8. Remove the delivery pipe with fuel injector and pressure regulator attached.

> CAUTION
>
> When removing the delivery pipe, be cautions not to drop the injectors.



9. Disconnect the wiring harness connector which is connected to the water temperature gauge unit and water temperature sensor assembly.

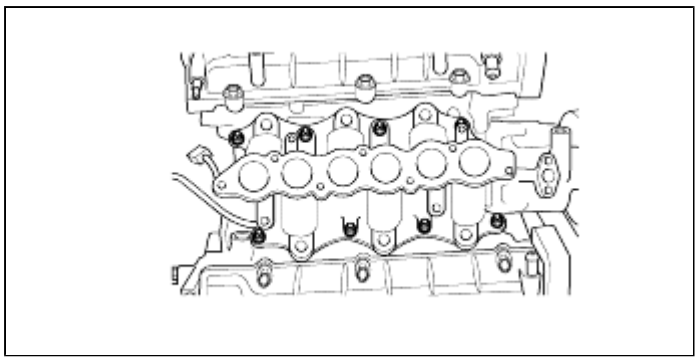


10. Remove the water outlet fitting and gasket.
11. Remove the thermostat.

Installation

1. After replacing the intake manifold gasket, install the surge tank tightening the specified torque.

   Tightening torque:19.6 - 22.6 N·m(200 - 230 kg-cm,14.5 - 16.6 lb-ft)

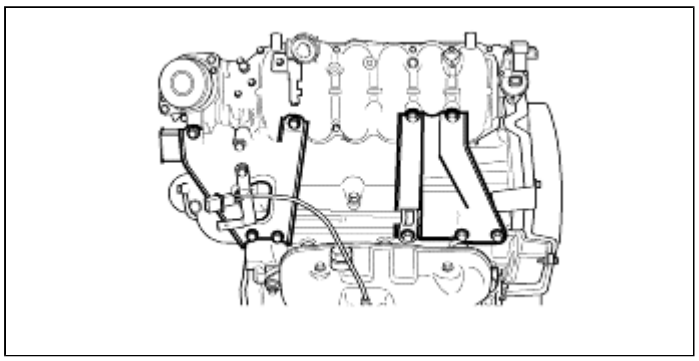


2. Install the delivery pipe and injector assembly to the intake manifold.

   CAUTION

   Check the interference between the injector and injector hole in intake manifold.

3. Install the surge tank stay.

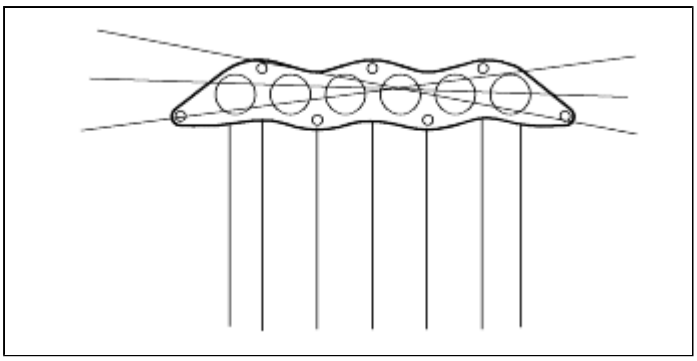


4. Install the fuel injector connector and wiring harness.
5. Connect the high pressure fuel hose.
6. Connect the various vacuum hose.
7. Connect the PCV valve hose and brake booster hose.
8. Install the idle speed actuator.
9. Installation of thermostat
   (1) Install the water outlet fitting gasket which is attached to thermost at housing.
   Align the arrangement mark on thermost at housing with jiggle valve.
   (2) Smear the sealant on cooling water temperature sensor and cooling water temperature gauge unit.
10. Install the air hose.
11. Install the accelerator cable.

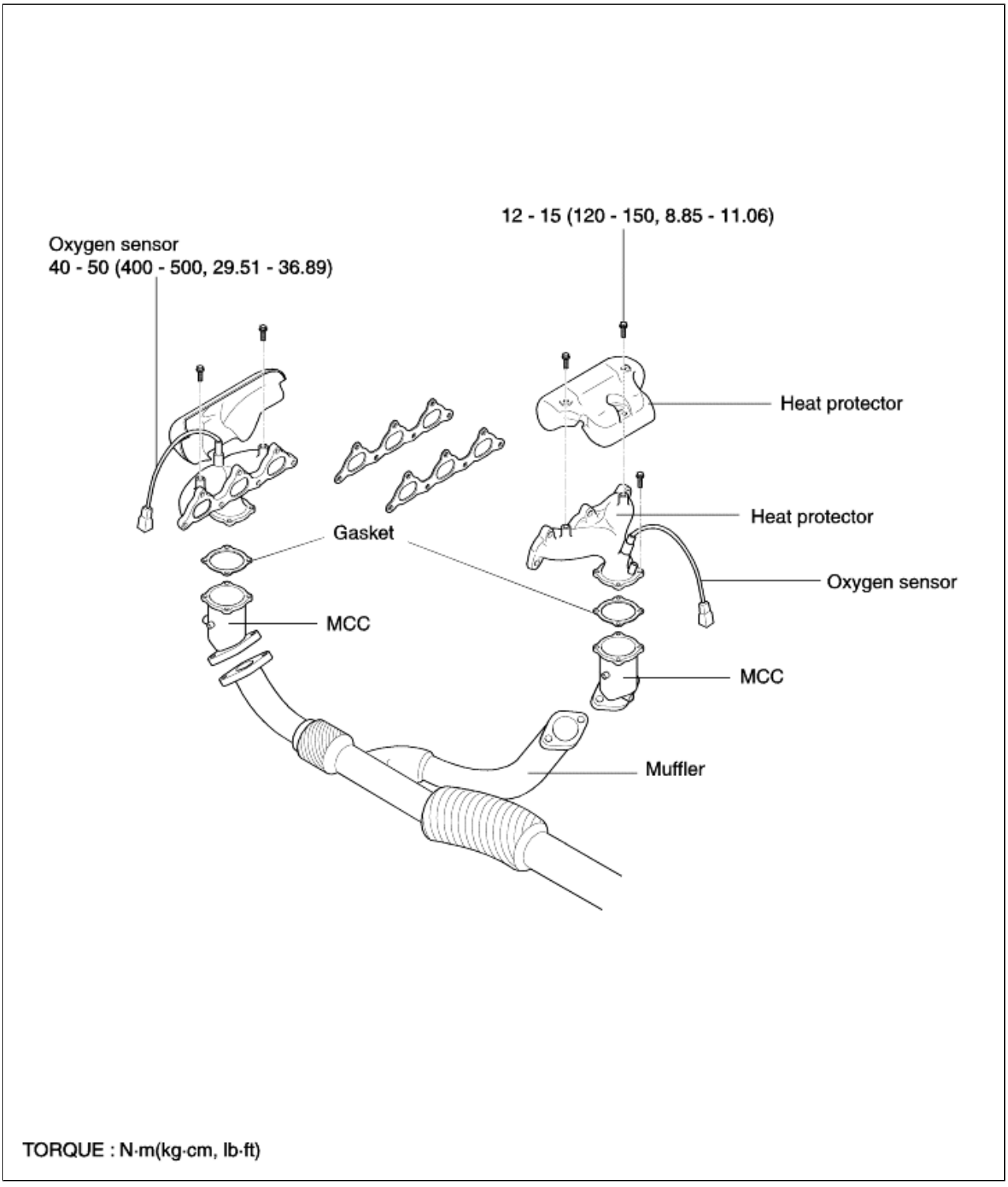
Inspection

1. Surge tank
   (1) Inspect the surge tank for damage and crack, if necessary, replace it.
   (2) Check if cooling water passage is blocked.
   (3) Inspect the mating surface for warpage using a straight edge or filler gauge.

   Standard value : 0.15mm (0.006 in)Service limit : 0.2mm (0.008 in)

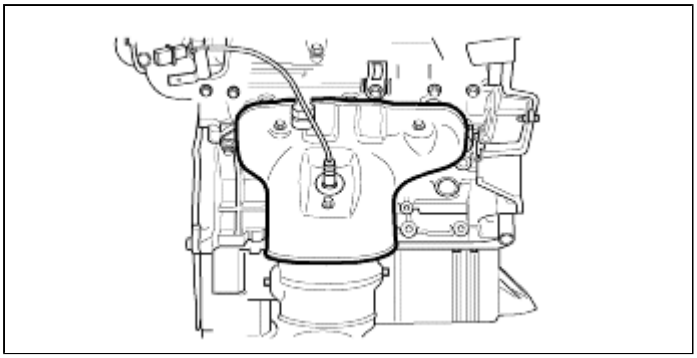


Components

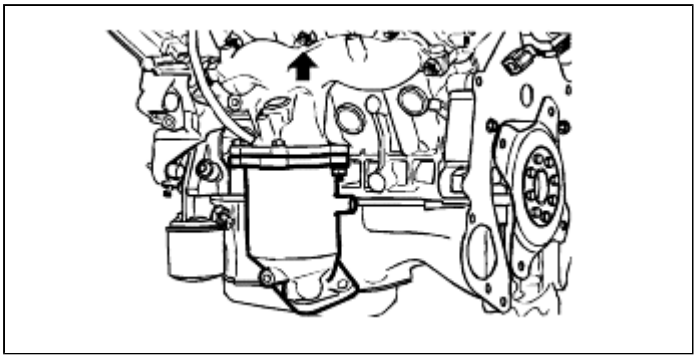

12 - 15 (120 - 150, 8.85 - 11.06)
Oxygen sensor
40 - 50 (400 - 500, 29.51 - 36.89)
Heat protector
Heat protector
Gasket
Oxygen sensor
MCC
MCC
Muffler
TORQUE : N·m(kg·cm, lb·ft)

Removal

1. Remove the heat protector.



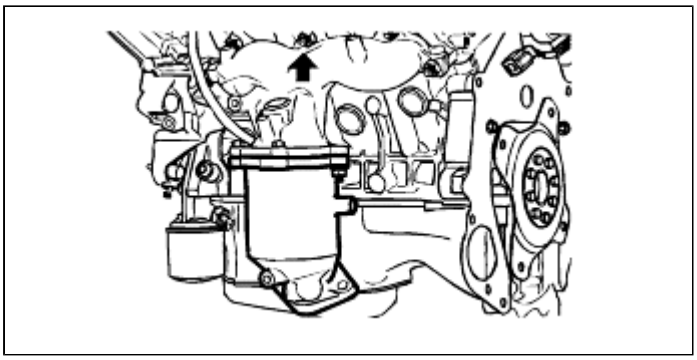
2. Remove the exhaust manifold.



Installation

1. After installing the gasket, install the exhaust manifold.

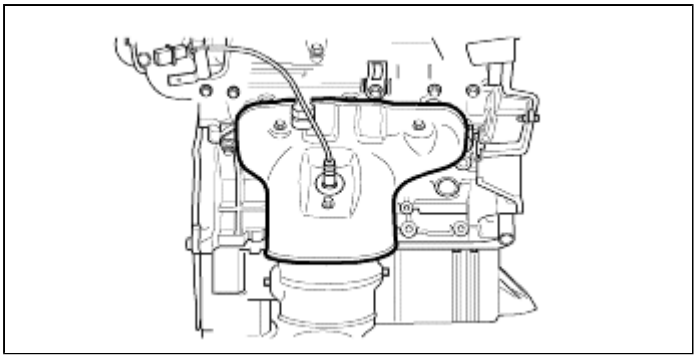
Thightening torque :40-50 N·m (400-500 kg·cm, 28.9-36.2 lb·ft)



CAUTION

Use only new exhaust manifold gaskets and nuts

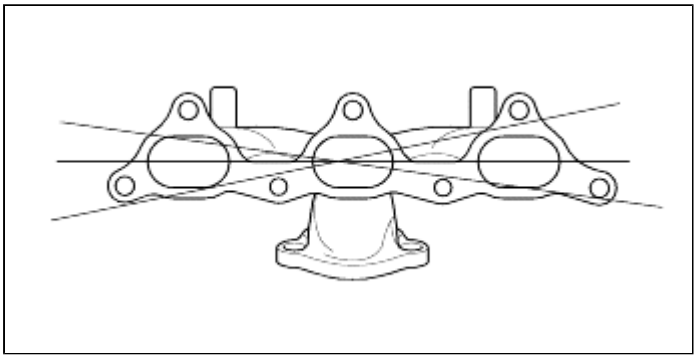
2. Install the heat protector.



Inspection

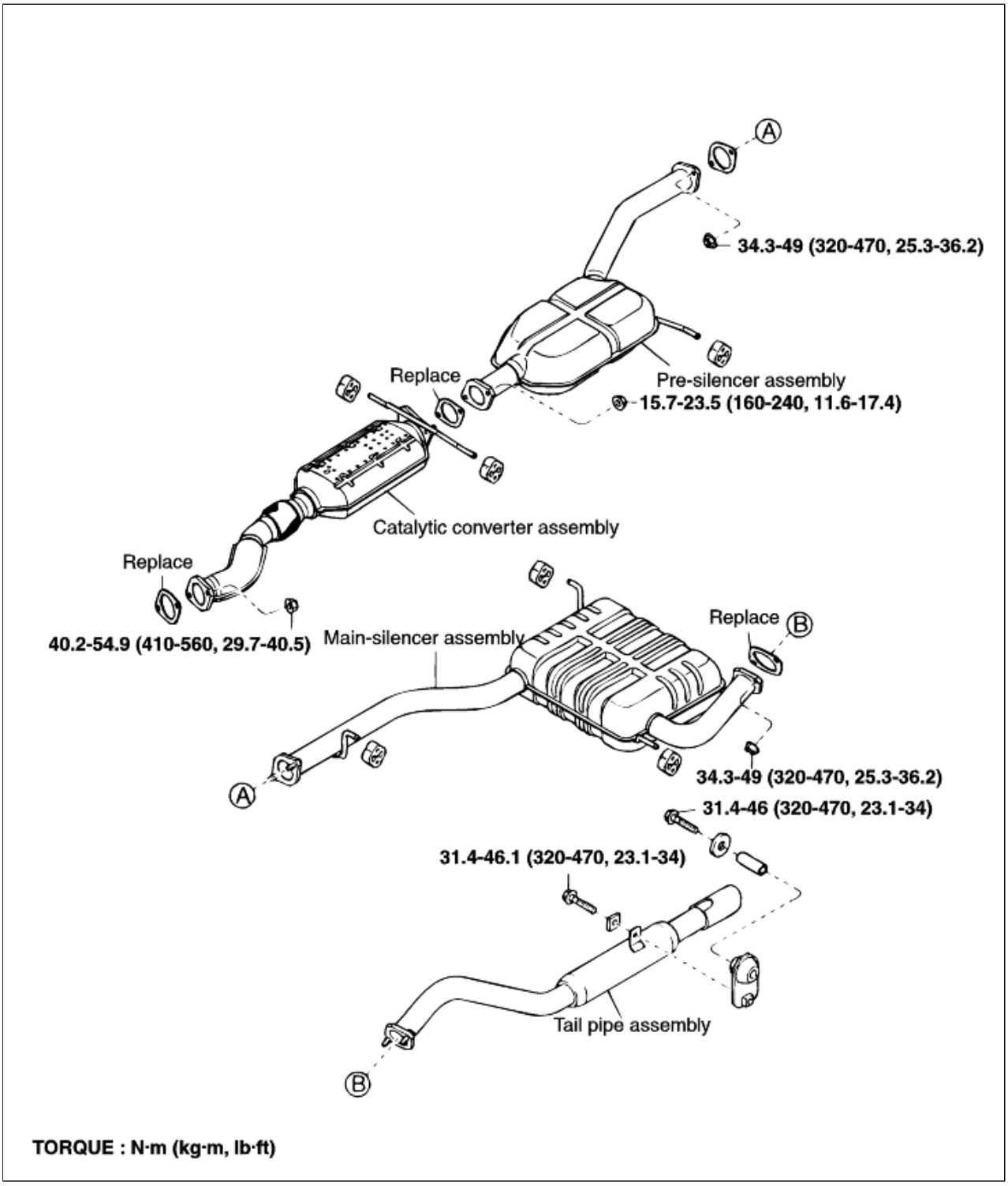
1. Exhaust manifold
   (1) Check for cracks, replace if neccesary.
   (2) Check the distortion in mating surface with a straight edge and filler gauge

Description	Torsion (mm)
Standard value	0.15 (0.006 in)
Limit	0.3 (0.012 in)



2. Heat protector, gasket
   (1) Check for damages and cracks in all parts, replace if necessary.

Components


A
34.3-49 (320-470, 25.3-36.2)
Pre-silencer assembly
Replace
15.7-23.5 (160-240, 11.6-17.4)
Catalytic converter assembly
Replace
40.2-54.9 (410-560, 29.7-40.5)
Main-silencer assembly
Replace
B
34.3-49 (320-470, 25.3-36.2)
31.4-46 (320-470, 23.1-34)
31.4-46.1 (320-470, 23.1-34)
Tail pipe assembly
A
B
TORQUE : N·m (kg·m, lb·ft)

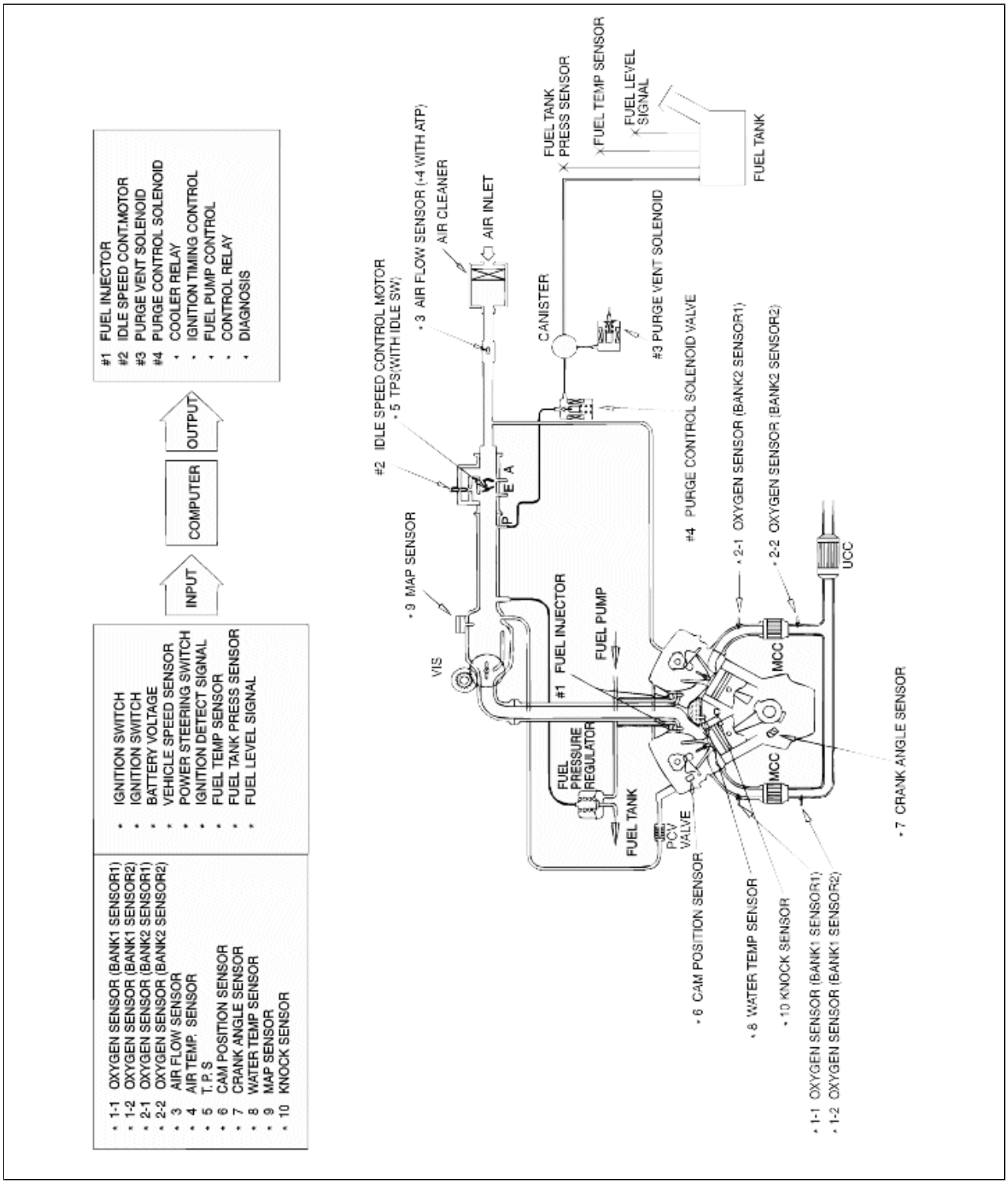
TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0128	Engine coolant thermostat open stuck
[Related items]	1) Thermostat stuck opened 2) After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) 3) Poor connections between ECTS and ECM 4) Misplaced, loose or corroded terminals 5) Contaminated, deteriorated ECTS

Step	Inspection		Action
1	Remove thermostat and check that thermostat is stuck. Is thermostat okay?	Yes	Go to step 2.
		No	Temporarily install a known good thermostat and check for proper operation. If problem is corrected, replace thermostat.
2	Connect SCAN TOOL to data link connector or OBD-II check connector and turn ignition to ON. Is DTC P0115, P0116, or P0125 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 3.
3	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor ECT signals. 1) 3.2~3.8V @ 0°C (32°F) 2) 2.3~2.8V @ 20°C (68°F) 3) 1.5~2.1V @ 40°C (104°F) 4) 0.4~0.8V @ 80°C (176°F) Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and ECTS.
		No	Go to step 4.
4	Check ECTS for contamination, deterioration or damage. Is ECTS contaminated, deteriorated or damaged? Thoroughly check for loose, bent or corroded connectors at ECM and ECTS connectors.	Yes	Clean ECTS with cleaner before installing. If damaged or deteriorated, replace.
		No	Go to step 5.
5	With ignition OFF, disconnect ECM and ECTS connectors. Measure resistance between ECTS and ECM on both circuits. Is resistance all below 1 ohm?	Yes	Go to step 6.
		No	Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Emissions Control Systems

Schematic drawing



Specifications

Components	Function	Remarks
Crankcase Emission System Positive crankcase ventilation (PCV) valve	HC reduction	Variable flow rate type
Evaporative Emission System EVAP Canister EVAP Canister Purge Solenoid Valve	HC reduction HC reduction	Duty solenoid valve
Exhaust Emission System MFI system (air-fuel mixture control device) Three-way catalytic converter	CO, HC, NOx reduction CO, HC, NOx reduction NOx reduction	Oxygen sensor feedback type Monolith type

EVAP : Evaporative Emission

Service standard

EVAP Canister Purge Solenoid Valve Coil resistance	30~34Ω[at20°C(68°F)]

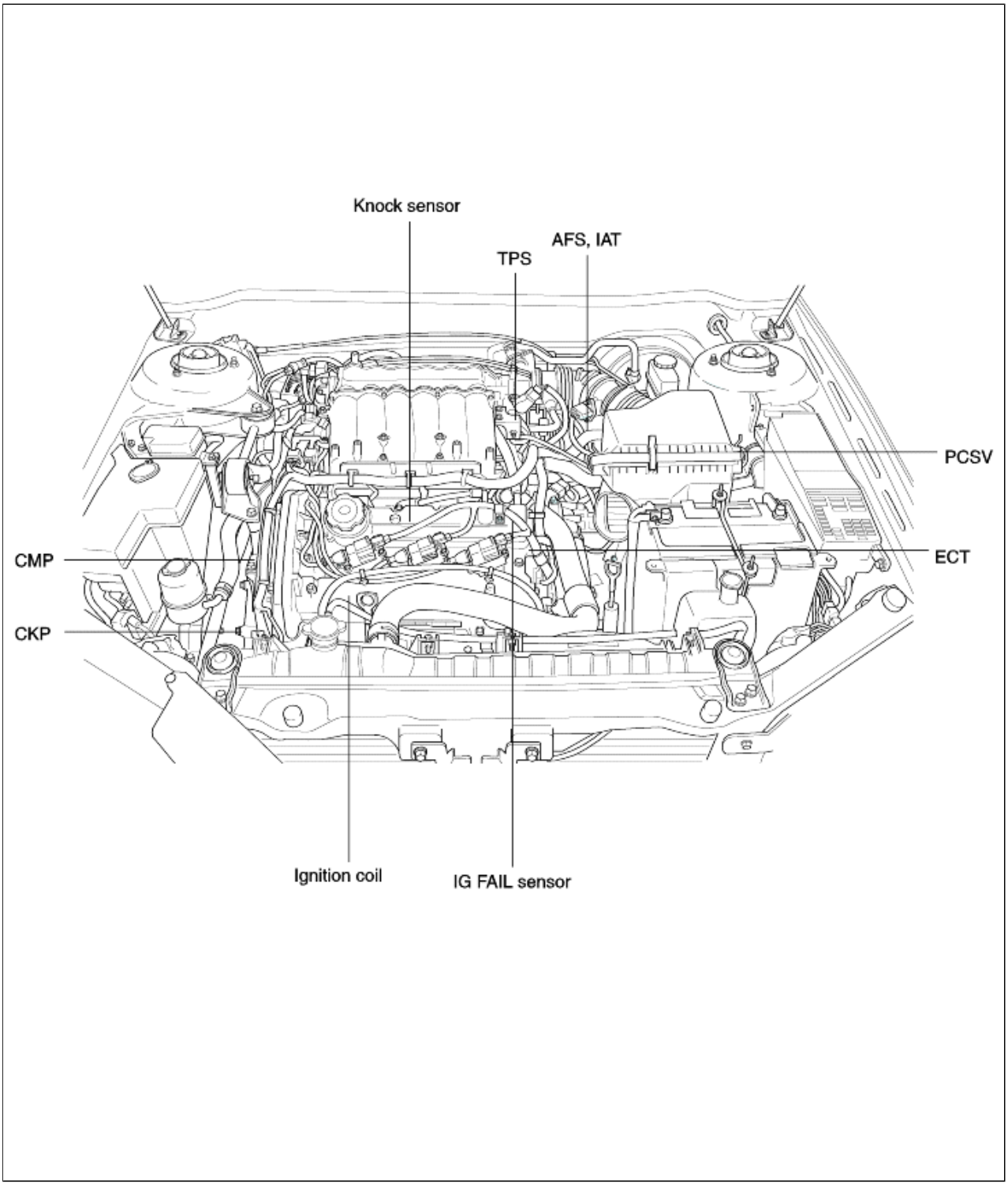
Sealant

Engine coolant temperature sensor threaded portion	THREE BOND 2403 or equivalent

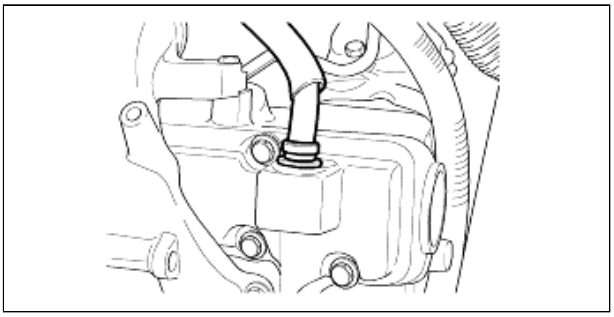
Troubleshooting

Symptom	Probable cause	Remedy
Engine will not start or hard to start	Vacuum hose disconnected or damaged	Repair or replace
	Malfunction of the EVAP Canister Purge	Repair or replace
	Solenoid Valve	Repair or replace
Rough idle or engine stalls	Vacuum hose disconnected or damaged	Repair or replace
	Malfunction of the PCV valve	Replace
	Malfunction of the EVAP Canister Purge System	Check the system; if there is a problem, check its component parts
Excessive oil consumption	Positive crankcase ventilation line clogged	Check positive crankcase ventilation system

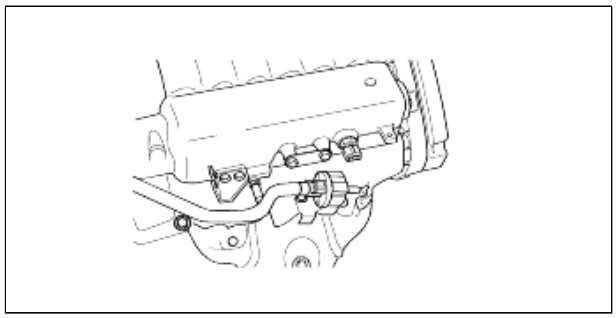
Emissioncontrol location



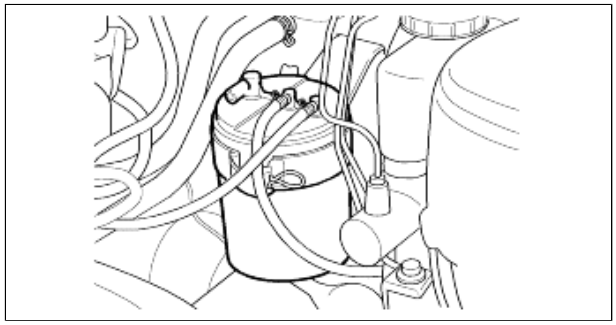
1. PCV Valve



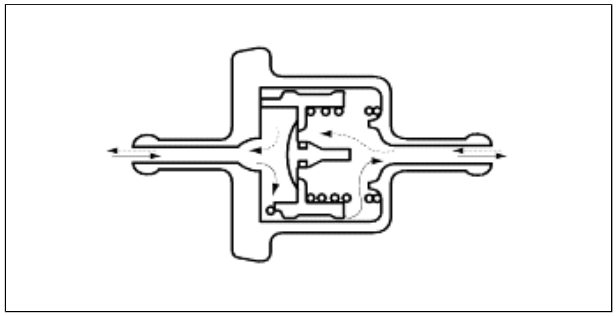
2. EVAP Canister Purge Solenoid Valve



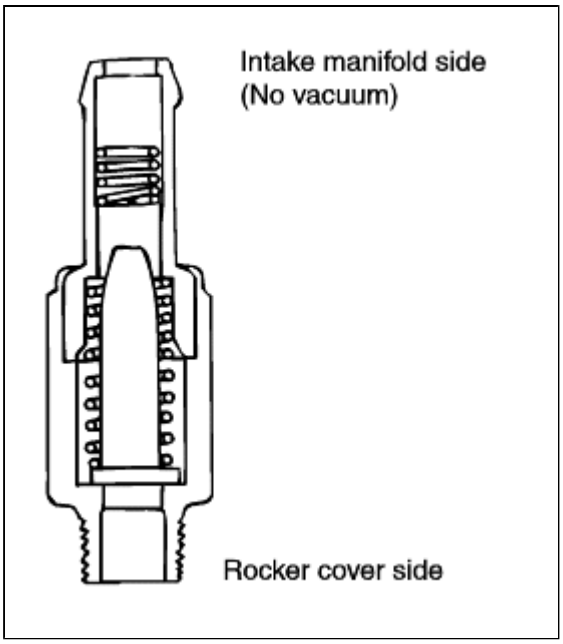
3. EVAP Canister



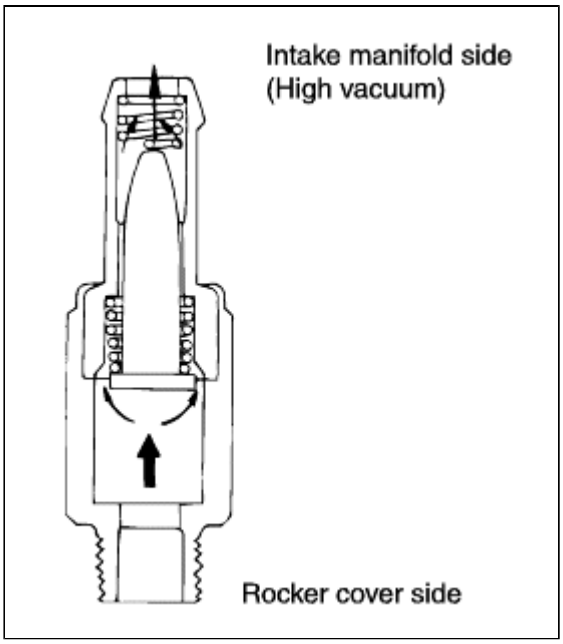
4. Two-way Valve



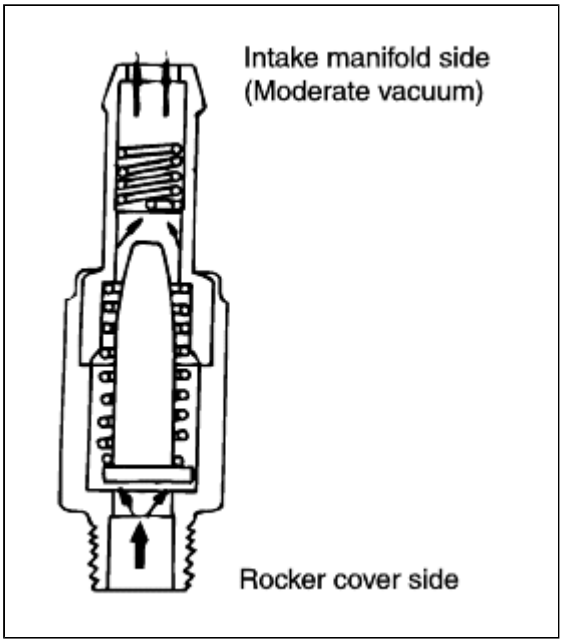
PCV Valve Operating



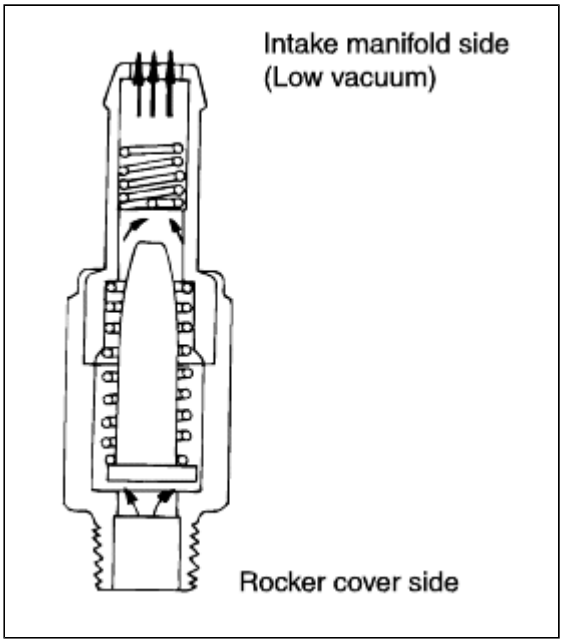
Engine condition	Not running
PCV valve	Not operating



Engine condition	Idling or decelerating
PCV valve	Fully operating (Full open)



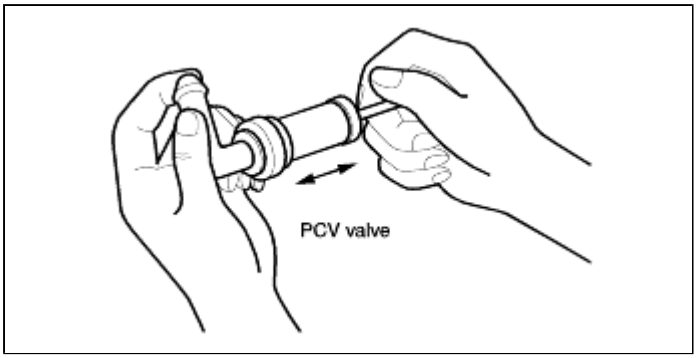
Engine condition	Normal operation
PCV valve	Properly operating



Engine condition	Accelerating and high load
PCV valve	Slightly operating

Checking PCV valve

1. Remove the PCV valve.
2. Insert a thin stick into the PCV valve from the threaded side to check that the plunger moves.
3. If the plunger does not move, the positive crankcase ventilation valve is clogged. Clean it or replace.



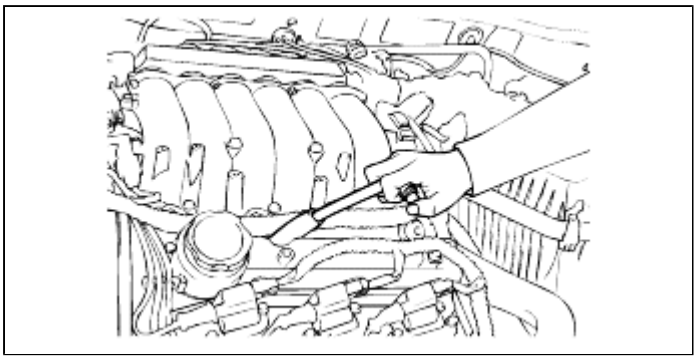
Installation

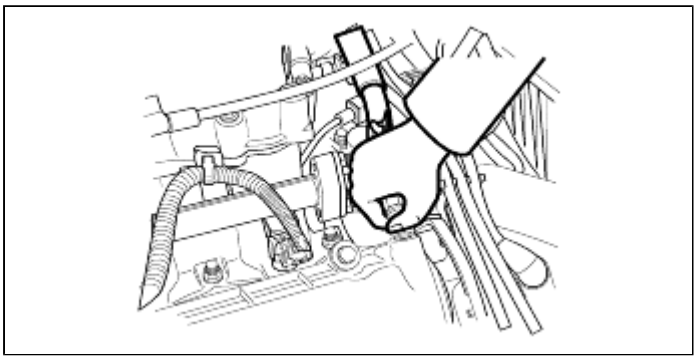
Install the PCV valve and tighten it to the specified torque.

PCV valve tightening torque : 0.8~1.2kg·m

Inspection

1. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve. Remove the PCV valve from the rocker cover and reconnect it to the ventilation hose.
2. Run the engine at idle and put a finger on the open end of the PCV valve, making sure that intake manifold vacuum is felt.
3. If vacuum is not felt, clean the PCV valve and ventilation hose in cleaning solvent or replace if necessary.





NOTE

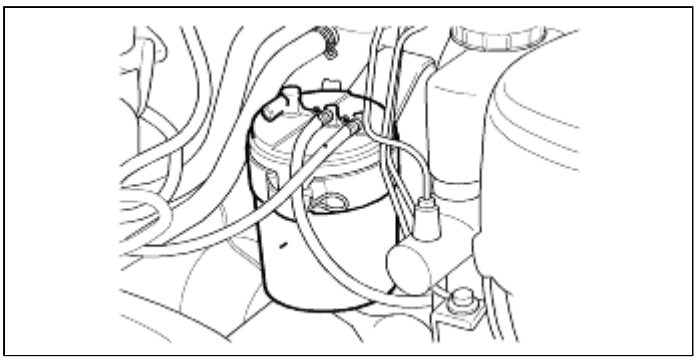
The plunger inside the PCV valve will move back and forth.

4. Clean the PCV valve and ventilation hose with cleaning solvent or replace if necessary.

EVAPORATIVE EMISSION CONTROL SYSTEM

DESCRIPTION

When the engine is not running, fuel vapors generated inside the fuel tank are absorbed and stored in the canister.
When the engine is running, the fuel vapors contained in the EVAP Canister are drawn into the surge tank through the EVAP Canister Purge Solenoid Valve.

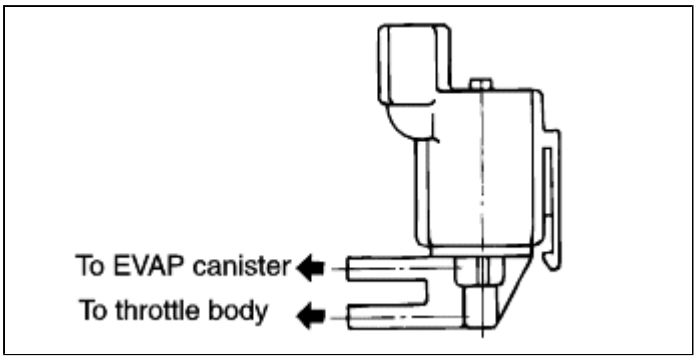


Inspection

1. Look for loose connections, sharp bends or damage in the fuel vapor lines.
2. Look for distortion, cracks or fuel leakage.
3. After removing the charcoal canister, inspect for cracks or damage.

DESCRIPTION

The EVAP Canister Purge Solenoid Valve is controlled by the ECM; when the engine coolant temperature is low, and also during idling, the valve closes so that evaporated fuel is not drawn into the surge tank. After engine warm-up, during ordinary driving, it opens to let stored vapors into the surge tank.

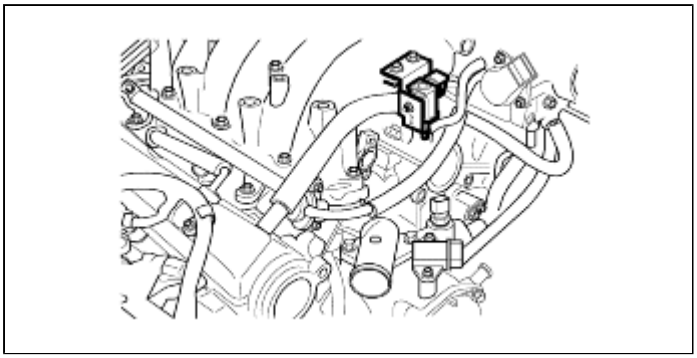


Inspection

NOTE

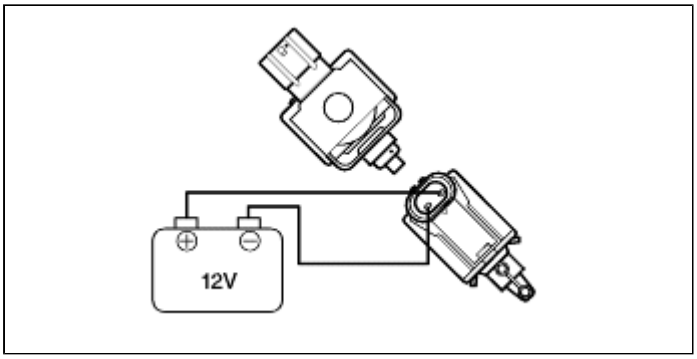
When disconnecting the vacuum hose, make an identification mark on it so that it can be reconnected to its original position.

1. Disconnect the vacuum hose (black with red stripe) from the solenoid valve.



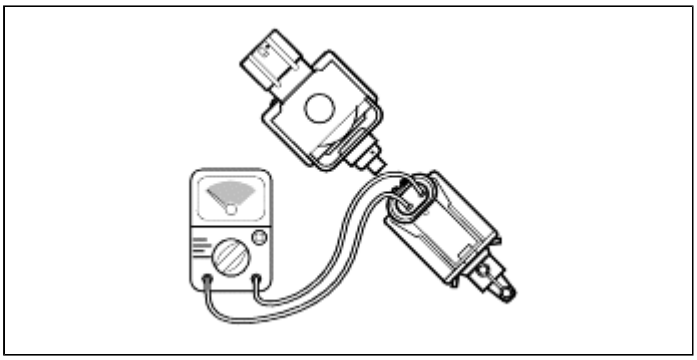
2. Detach the harness connector.
3. Connect a vacuum pump to the nipple to which the red-striped vacuum hose was connected.
4. Apply vacuum and check when voltage is applied to the EVAP Canister Purge Solenoid Valve and when the voltage is discontinued.

Battery voltage	Normal condition
When applied	Vacuum is released.
When discontinued	Vacuum is maintained



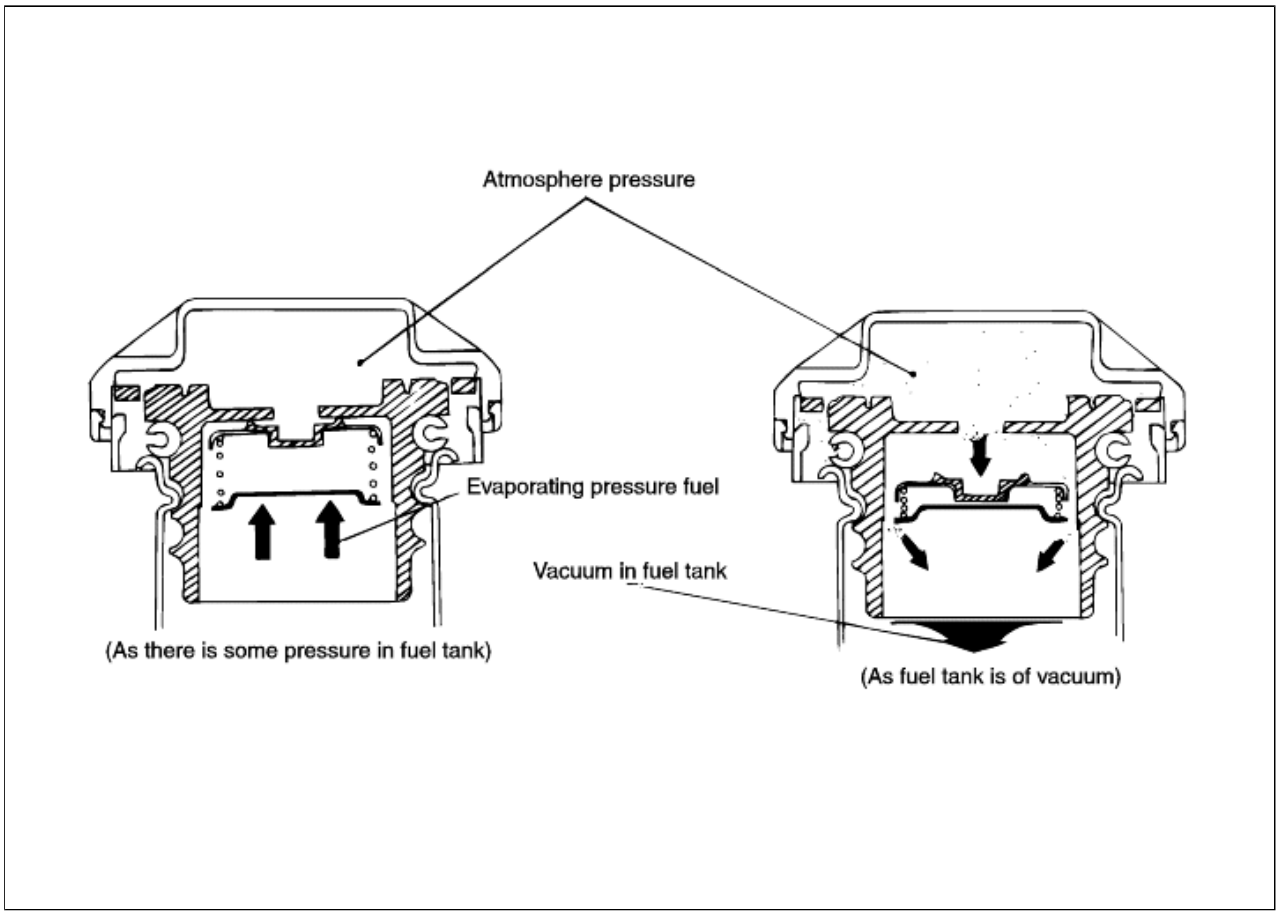
5. Measure the resistance between the terminals of the solenoid valve.

EVAP Canister Purge Solenoid ValveCoil resistance : 30-34Ω[at 20°C (68°F)]



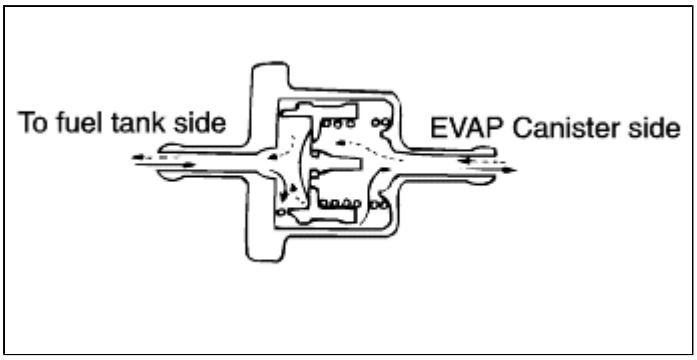
Fuel filler cap

The fuel filler cap is equipped with a vacuum relief valve to prevent the escape of fuel vapor into the atmosphere.



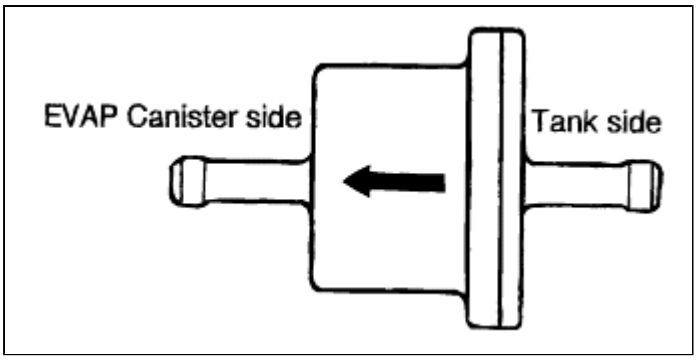
Description

The overfill limiter consists of a pressure valve and a vacuum valve. The pressure valve is designed to open when the fuel tank internal pressure has increased over the normal pressure and the vacuum valve opens when a vacuum has been produced in the tank.



Replacement

1. Disconnect the vapor hoses, and then remove the overfill limiter.
2. Connect the overfill limiter in the correct direction.

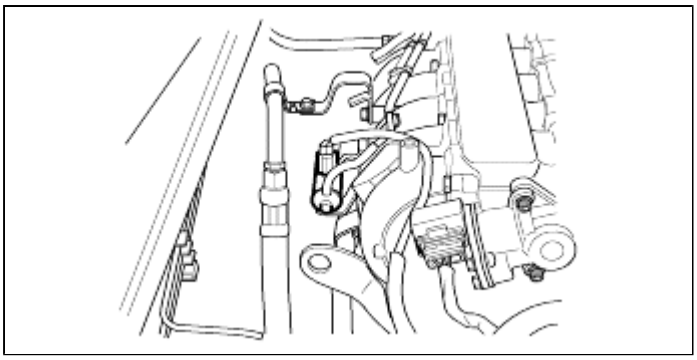


Description

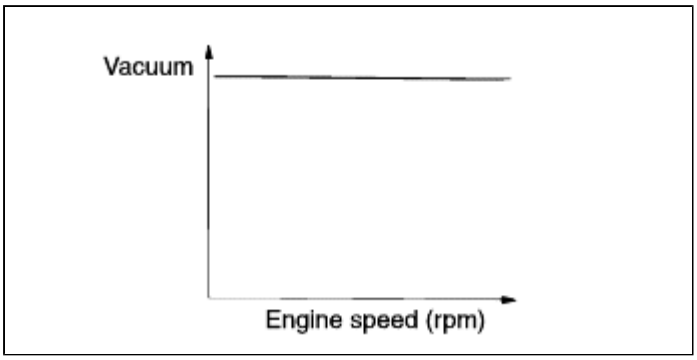
The fuel check valve is used to prevent fuel leaks if the car suddenly rolls over. This valve is connected in the fuel vapor line (between the EVAP Canister and the overfill limiter) and is installed on the fuel tank The fuel check valve contains two balls as shown in the illustration. Under normal conditions, the gasoline vapor passage in the valve is opened, but if a roll-over occurs, one of the balls closes the fuel passage, thus preventing fuel leaks.

Checking

1. Disconnect the vacuum hose from the throttle body, and connect a vacuum pump to the vacuum hose.
2. Plug the nipple connected to the vacuum hose.



3. Check the following points when the engine is cold [engine coolant temperature 40°C (104°F) or below] and when it is warm [engine coolant temperature 80°C (176°F) or higher].



When engine is cold

Engine operating condition	Applying vacuum	Result
Idling	50 kPa (7.3 psi)	Vacuum is held
3,000 rpm		

When engine is warm

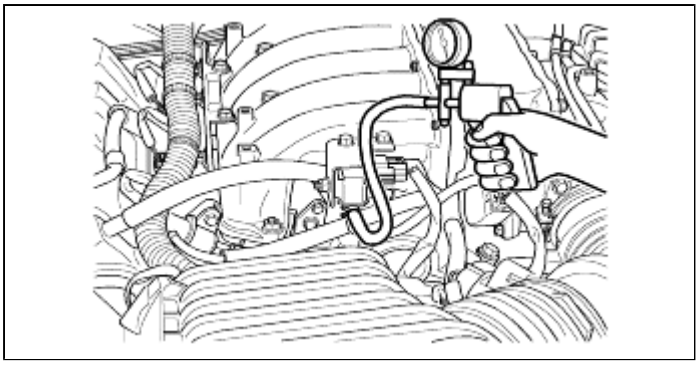
Engine operating condition	Applying vacuum	Result
Idling	50 kPa (7.3 psi)	Vacuum is held
Within 3 minutes after engine start 3,000 rpm	Try to apply vacuum	Vacuum is released
After 3 minutes have passed after engine start 3,000 rpm	50 kPa (7.3 psi)	Vacuum will be held momentarily, after which, it will be released

Evap canister purge port vacuum check

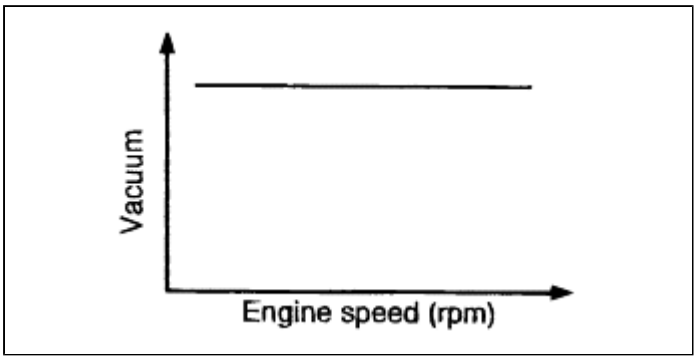
Checking Condition

Engine coolant temperature : 80-95°C(176-205°F)

1. Disconnect the vacuum hose from the throttle body EVAP Canister purge hose fitting and connect a vacuum pump.



2. Start the engine and check to see that, after increasing the engine speed, vacuum remains fairly constant.



NOTE

If there is no vacuum created, it is possible that the throttle body port may be restricted and required cleaning.

Exhaust emission control system

Exhaust emission system

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components.
Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system. Additional control devices include a catalytic converter.

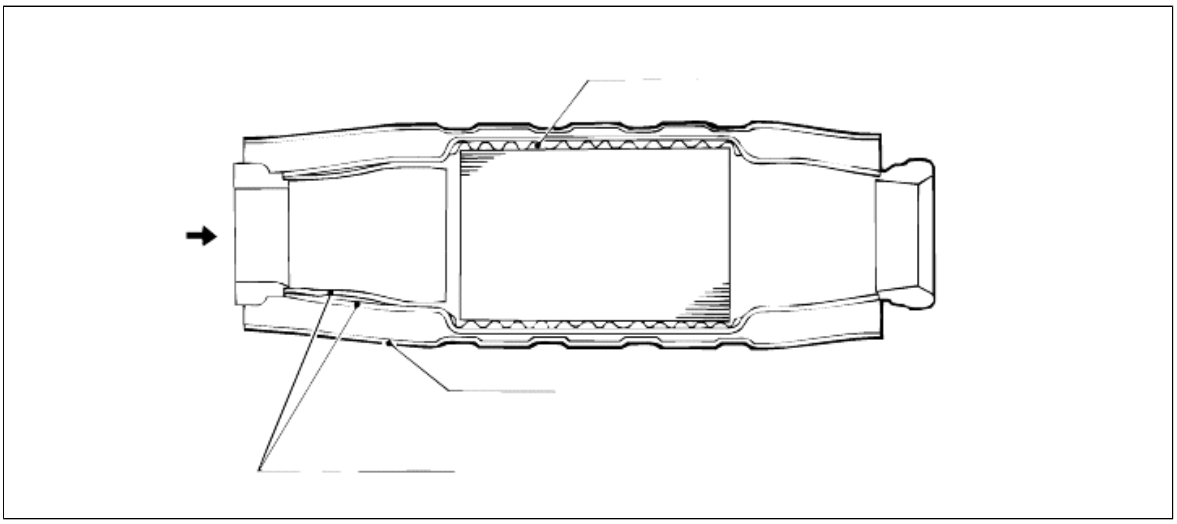
Air/fuel mixture ratio control system

[Multiport Fuel Injection (MFI) System]

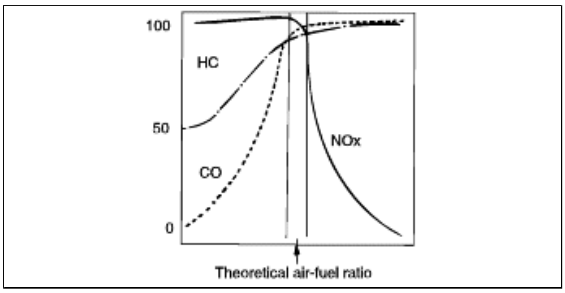
The MFI system is a system which employs the signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, thus precisely regulating the air/fuel mixture ratio and reducing emissions.
This in turn allows the engine to produce exhaust gases of the proper composition to permit the use of a three-way catalyst. The three-way catalyst is designed to convert the three pollutants (1) hydrocarbons (HC), (2) carbon monoxide (CO), and (3) oxides of nitrogen (NOx) into harmless substances. There are two operating modes in the MFI system:

1. Open Loop-air/fuel ratio is controlled by information programmed into the ECM at manufacture.
2. Closed Loop-air/fuel ratio is varied by the ECM based on information supplied by the heated oxygen sensor.

Catalytic converter



The three-way catalytic converter is a monolithic type with catalytic compositions applied to the integrally constructed honey-comb carrier surface that is installed in the center of the exhaust pipe. The converter, working in combination with the air/fuel ratio feed-back control, oxidizes CO and HC and reduces NOx.



Function

The three-way catalytic converter removes CO, HC and NOx most effectively in the vicinity of the theoretical air/fuel ratio. The air/fuel mixture to the theoretical air/fuel ratio and the catalytic converter promotes both oxidation and reduction of resultant exhaust gas to make it clean before it is released to atmosphere.

CAUTION

The catalytic converter requires the use of unleaded gasoline only. Leaded gasoline will destroy the effectiveness of the catalysts as an emission control device.
Under normal operating conditions, the catalytic converter will not require maintenance. However, it is important to keep the engine properly tuned. Engine misfiring may cause overheating of the catalyst. This may cause heat damage to the converter or vehicle components. This situation can also occur during diagnostic testing if any spark plug cables are removed and the engine is allowed to idle for a prolonged period of time with the cable removed.

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0181	Differential of fuel temperature and engine coolant temperature circuit low input
Diagnostic trouble code No. P0182	Fuel temperature circuit low input
Diagnostic trouble code No. P0183	Fuel temperature circuit high input
[Related items]	1) Open or short to ground between FTS and main relay 2) Open or short to ground between FTS and ECM 3) Short to battery between FTS and ECM 4) Short between FTS wires 5) Faulty FTS

Step	Inspection		Action
1	Turn ignition to OFF and disconnect FTS connector. Turn ignition to ON. Measure voltage of FTS signal circuit between FTS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specification?	Yes	Go to step 2.
		No	Open circuit or short circuit to chassis ground between FTS harness connector and ECM connector. Repair as necessary.
2	Thoroughly check FTS and ECM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is connection okay?	Yes	Temporarily install a known good FTS and check for proper operation. If problem is corrected, replace FTS.
		No	Repair as necessary.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0421	Main catalyst efficiency deterioration (bank1)
[Related items]	1) Catalytic converter deteriorated **NOTE** If any codes relating to HO2S sensor. MAFS, injectors, a P0171 or a P0172 are present, do all repairs associated with them before proceeding with this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and check other DTCs. Are DTC P0300~P0306, P0116~P0118, P0125, P0130, P0131, P0132, P0133, P0135, P0136, P0137, P0138, P0139, P0140 and/or P0141 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and warm up to operating temperature. Using SCAN TOOL monitor waveforms front HO2S and rear HO2S. Do both front HO2S and rear HO2S signals switch lean to rich and rich to lean?	Yes	Replace catalytic converter as necessary.
		No	Go to step 3.
3	Release fuel pressure and attach fuel pressure gauge to service port on fuel rail. Start engine and warm up to operating temperature. Check for fuel pressure at idle. 1) Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm²) Is fuel pressure within specification?	Yes	Go to step 4.
		No	Check fuel delivery system.
4	Check exhaust system for leaks, cracks, loose connection (especially exhaust manifold, catalyst around rear HO2S, etc) Is exhaust system okay?	Yes	Go to step 5.
		No	Repair or replace as necessary.
5	Check for any split, disconnected or perforated vacuum hoses. Also, check PCV valve for proper operation. Are vacuum hoses and PCV okay?	Yes	Go to step 6.
		No	Replace faulty vacuum hoses or PCV.
6	Check for fuel injector operation. Are fuel injectors working normal and dispensing proper volume?	Yes	Go to step 7.
		No	Repair as necessary.
7	Check intake system for leaks, cracks, loose connection as following items: 1) Throttle body gasket 2) Gasket between intake manifold and surge tank 3) Seals between intake manifold and fuel injectors	Yes	Replace catalytic converter as necessary.

	4) Seals between surge tank and PCV valves Is intake system okay?	No	Repair or replace as necessary.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0431	Main catalyst efficiency deterioration (bank2)
[Related items]	1) Catalytic converter deteriorated NOTE If any codes relating to HO2S sensor. MAFS, injectors, a P0174 or a P0175 are present, do all repairs associated with them before proceeding with this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and check any other DTCs. Are DTC P0300~P0306, P0116, P0117, P0118, P0125, P0150, P0151, P0152, P0155, P0156, P0157, P0158, P159, P0160, and/or P0161 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and warm up to operating temperature. Using SCAN TOOL monitor waveforms front HO2S and rear HO2S. Do both front HO2S and rear HO2S signals switch lean to rich and rich to lean?	Yes	Replace catalytic converter as necessary.
		No	Go to step 3.
3	Release fuel pressure and attach fuel pressure gauge to service port on fuel rail. Start an engine and warm up to operating temperature. Check for fuel pressure at idle. 1) Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm²) Is fuel pressure within specification?	Yes	Go to step 4.
		No	Check fuel delivery system.
4	Check exhaust system for leaks, cracks, loose connection (especially exhaust manifold, catalyst around rear HO2S, etc) Is exhaust system okay?	Yes	Go to step 5.
		No	Repair or replace as necessary.
5	Check for any split, disconnected or perforated vacuum hoses. Also, check PCV valve for proper operation. Are vacuum hoses and PCV okay?	Yes	Go to step 6.
		No	Replace faulty vacuum hoses or PCV.
6	Check for fuel injector operation. Are fuel injectors working normal and dispensing proper volume?	Yes	Go to step 7.
		No	Repair as necessary.
7	Check intake system for leaks, cracks, loose connection as following items 1) Throttle body gasket 2) Gasket between intake manifold and surge tank 3) Seals between intake manifold and fuel injectors	Yes	Replace catalytic converter as necessary.
		No	Repair or replace as necessary.

	4) Seals between surge tank and PCV valves Is intake system okay?		
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0441	EVAP emission control system purge solenoid valve stuck opened
[Related items]	1) Purge solenoid valve stuck opened

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and check other DTC. Is DTC P0443 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect vacuum hose from PCSV. Start engine and put a finger on the open end of hose. Is intake manifold vacuum felt?	Yes	Go to step 3.
		No	Repair or replace vacuum hose as necessary.
3	Turn ignition OFF and disconnect hose leading from PCSV to intake manifold at PCSV. Draw a vacuum at nipple and verify PCSV holds vacuum. Turn ignition to ON and jumper a wire to chassis ground at PCSV control terminal (should hear a faint click from PCSV). Vacuum should bleed off. Repeat this procedure 4 or 5 times to ensure PCSV reliability. Is PCSV working properly?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and PCSV.
		No	Temporarily install a known good PSV and check for proper operation. If problem is corrected replace PCSV.
4	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0442	EVAP emission control system small leak detected (1mm)
Diagnostic trouble code No. P0455	EVAP emission control system large leak detected
Diagnostic trouble code No. P0456	EVAP emission control system small leak detected (0.5mm)
[Related items]	1) Fuel filler cap loose or missing 2) Fuel filler cap o-ring missing or damaged 3) Faulty or damaged fuel filler pipe 4) Leaking,, disconnected or plugged fuel vapor lines 5) Fuel in lines due to faulty Rollover Valve (RV), On-Board Refueling Vapor Recovery Valve (ORVR valve) 6) Canister close valve clogged, stuck open or closed 7) Improperly installed purge solenoid valve (PCSV) 8) PSV stuck open or closed 9) Faulty fuel tank pressure sensor 10) Leaking canister or catch tank **NOTE** If any codes relating to FTPS, CCV, or PSV circuits are present, do all repairs associated with those codes before proceeding with this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and check any other DTCs. Is DTC P0441, P0443, P0446, P0451, P0452, or P0453 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL proceed EVAP leakage test. Is EVAP system okay?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and PCSV.
		No	Go to step 3.
3	Check fuel filler cap for being tightly installed, has o-ring seal installed and is in good condition. Verify cap releases vacuum at specified values (approximately 2psi pressure and approximately 1.5 inches hg vacuum). Are cap, o-ring and release pressures OK?	Yes	Go to step 4.
		No	Replace fuel filler cap.
4	Check fuel filler pipe for cracks, damage and o-ring seat for deformation. Is fuel filler pipe OK?	Yes	Go to step 5.
		No	Replace fuel filler pipe.
	Thoroughly check all fuel vapor hoses and hose clamps between: 1) Canister and rollover/ORVR valves 2) Canister and CCV 3) Canister and PCSV	Yes	Go to step 6.

5	4) PCSV and intake manifold (At this point, also verify arrow on PCSV is pointing towards intake manifold. If it is not, reverse installation). Are vapors hoses and clamps OK?	No	Replace all cracked/damaged hoses or loose clamps.
6	Turn ignition to OFF and remove FTPS access plate. Remove FTPS from tank unit. Turn ignition to ON (engine OFF) and monitor FTPS output voltage with SCAN TOOL. 1) Specifications: 2~3V Is voltage within specification?	Yes	Go to step 7.
		No	Temporarily install a known good FTPS and check for proper operation. If problem is corrected replace FTPS>
7	Turn ignition OFF and disconnect hose leading from PCSV to intake manifold at PCSV. Draw a vacuum at nipple and verify PCSV holds vacuum Turn ignition to ON and jumper a wire to chassis ground at PCSV control terminal (should hear a faint click from PCSV). Vacuum should bleed off. Repeat this procedure 4 or 5 times to ensure PCSV reliability. Is PCSV working properly?	Yes	Go to step 8.
		No	Temporarily install a known good PCSV and check for proper operation. If problem is corrected replace PCSV.
8	Turn ignition OFF and disconnect hose connecting CCV to canister. Blow air into hose removed from canister and verify air escapes. Turn ignition to ON and jumper a wire to chassis ground at CCV control terminal. Blow an air into hose and verify air does not escape from port. Repeat this procedure 4 or 5 times to ensure CCV reliability. Is CCV working properly?	Yes	Go to step 9.
		No	Temporarily install a known good CCV and check for proper operation. If problem is corrected, replace CCV.
9	Thoroughly check fuel gas leaks, cracks, damages of the following items: 1) Fuel filler cap 2) Fuel vent valve (ORVR) 3) Fuel cut valve (Rollover valve) 4) FTPS 5) EVAP hoses 6) Canister Are the above items okay?	Yes	Go to step 10.
		No	Repair or replace as necessary.
10	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0443	EVAP emission control system purge solenoid valve circuit malfunction
[Related items]	1) Open or short between main relay and purge solenoid valve 2) Open or short between purge solenoid valve and ECM 3) Faulty purge solenoid valve

Step	Inspection		Action
1	Thoroughly check PCSV for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect PCSV connector. Turn ignition to ON and measure voltage of PCSV power circuit between PCSV harness connector and chassis ground. 1) Specification: approximately B+ Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between PCSV harness connector and main relay. Repair as necessary.
3	Turn ignition to OFF. PCSV connector is still disconnected. Measure resistance between PCSV terminal 1 and terminal 2. 1) Specification: 30~34Ω at 20°C (68°F) Is resistance within specification?	Yes	Go to step 4.
		No	Temporarily install a known good PCSV and check for proper operation. If problem is corrected, replace PCSV.
4	Turn ignition to OFF and disconnect ECM connector. Measure resistance of PCSV signal circuit between PCSV harness connector and ECM harness connector. 1) Specification: below 1Ω Does resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between PCSV harness connector and ECM harness connector. Repair as necessary.
5	ECM connector PCSV connector is still disconnected. Measure resistance between PCSV harness connector and chassis ground at PCSV signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good PCSV and check for proper operation. If problem is corrected, replace PCSV.
		No	Short circuit to chassis ground between PCSV harness connector and ECM harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0446	MaEVAP emission control system vent control malfunction
[Related items]	1) Open or short to chassis ground between main relay and CCV 2) Open or short to battery between CCV and ECM 3) Short to chassis ground between CCV and ECM 4) Faulty CCV

Step	Inspection		Action
1	Thoroughly check CCV for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect CCV connector. Measure resistance between CCV signal terminal and battery terminal. 1) Specifications: 23~26Ω at 20°C (68°F) Is resistance within specification?	Yes	Go to step 3.
		No	Temporarily install a known good CCV and check for proper operation. If problem is corrected, replace CCV.
3	Turn ignition to ON and measure voltage of CCV power circuit between CCV harness connector and chassis ground. 1) Specifications: approximately B+ Is voltage within specification?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between CCV harness connector and main relay. Repair as necessary.
4	Turn ignition to OFF and disconnect ECM connector. Measure resistance of CCV signal circuit between CCV harness connector and ECM harness connector. 1) Specifications: below 1Ω Does resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between CCV harness connector and ECM harness connector. Repair as necessary.
5	Measure resistance between CCV harness connector and chassis ground at CCV signal circuit. 1) Specifications: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good CCV and check for proper operation. If problem is corrected, replace CCV.
		No	Short circuit to chassis ground between CCV harness connector and ECM harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0451	EVAP emission control system pressure sensor range/performance problem
[Related items]	1) Poor connections between FTPS and ECM 2) Misplaced, loose, bent or corroded terminals 3) Contaminated, deteriorated or damaged FTPS 4) Faulty FTPS 5) Stuck closed CCV 6) Blocked vapor hose between canister and CCV

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and check any other DTCs. Is DTC P0446, P0452, or P0453 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Loosen fuel cap. Using SCAN TOOL monitor FTPS voltage signals. 1) Specification: 2.2~2.8V Is voltage within specification?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and FTPS.
		No	Go to step 3.
3	Thoroughly check FTPS for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 4.
4	Turn ignition to OFF and disconnect FTPS connector. Turn ignition to ON and measure voltage of FTPS reference power circuit between FTPS harness connector and chassis ground. 1) Specification: 4.8~5.2V Is voltage within specification?	Yes	Go to step 5.
		No	If voltage is above specification, short circuit to battery. If voltage is below specification, open circuit or short circuit to chassis ground between FTPS harness connector and ECM. Repair as necessary.
5	Turn ignition to ON. Measure voltage of FTPS signal circuit between FTPS harness connector and chassis ground. 1) Specifications: below 0.5V Is voltage within specifications?	Yes	Go to step 6.
		No	Short circuit to power between FTPS harness connector and ECM harness connector. Repair as necessary.
6	Turn ignition to OFF and disconnect ECM connector. Measure resistance of FTPS signal circuit between FTPS harness connector and ECM harness connector. Measure resistance of FTPS ground circuit between FTPS harness connector and ECM harness connector. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 7.
		No	Open circuit between FTPS harness connector and ECM harness connector. Repair as necessary.
	Measure resistance between FTPS harness connector and chassis ground at FTPS signal	Yes	Temporarily install a known good FTPS and check for proper operation. If problem is corrected, replace FTPS.

7	circuit. 1) Specifications: infinite Does each resistance open circuit?	No	Short circuit to chassis ground between FTPS harness connector and ECM harness connector. Repair as necessary.
8	Remove CCV and blow through hose and verify air escapes from port on back of CCV. Connect battery positive to one terminal on CCV and battery negative to the other terminal. Verify air does not escape from back of CCV. Does CCV operate properly?	Yes	Thoroughly check for loose, bent, or corroded terminal between FTPS, CCV and ECM. Repair as necessary.
		No	Temporarily install a known good CCV and check for proper operation. If problem is corrected, replace FTPS.
9	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes..		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0452	EVAP emission control system pressure sensor low input
Diagnostic trouble code No. P0453	EVAP emission control system pressure sensor high input
[Related items]	1) Open or short to battery between FTPS and ECM 2) Short to chassis ground between FTPS and ECM 3) Poor connections between FTPS and ECM 4) Misplaced, loose or corroded terminals 5) Faulty FTPS

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Using SCAN TOOL monitor FTPS voltage signals. 1) Specification: 2.2~2.8V Is voltage within specification?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and FTPS.
		No	Go to step 2.
2	Thoroughly check FTPS for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect FTPS connector. Turn ignition to ON and measure voltage of FTPS reference power circuit between FTPS harness connector and chassis ground. 1) Specification: 4.8~5.2V Is voltage within specification?	Yes	Go to step 4.
		No	If voltage is above specification, short circuit to battery. If voltage is below specification, open circuit or short circuit to chassis ground. Repair as necessary.
4	Turn ignition to OFF and disconnect ECM connector. Turn ignition to ON. Measure voltage of FTPS signal circuit between FTPS harness connector and chassis ground. 1) Specifications: below 0.5V Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to power between FTPS harness connector and ECM harness connector. Repair as necessary.
5	Turn ignition to OFF and disconnect ECM connector. Measure resistance of FTPS signal circuit between FTPS harness connector and ECM harness connector. Measure resistance of FTPS ground circuit between FTPS harness connector and ECM harness connector. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 6.
		No	Open circuit between FTPS harness connector and ECM harness connector. Repair as necessary.
	Measure resistance between FTPS harness connector and ECM harness connector at FTPS	Yes	Temporarily install a known good FTPS and check for proper operation. If problem is corrected, replace FTPS.

6	signal circuit and ground circuit. 1) Specifications: infinite Does each resistance indicate open circuit?	No	Short circuit to chassis ground between FTPS harness connector and ECM harness connector. Repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System

Specifications

Fuel tank	
Capacity	19.8 gal.(75liter)
Fuel filter	
Type	High pressure type
Fuel pump	
Type	Electrical, in-tank type
Driven by	Electric motor
Throttle body	
Throttle position sensor (TP Sensor)	
Type	Potentiometer type
Output voltage at curb idle	0.3 - 0.9V
Output voltage at WOT	4.0 - 4.6V
Idle speed control (ISC) motor	
Type	Stepper motor
Resistance	37 - 38Ω at 20°C (68°F)
Idle position switch	
Type	Contact type (Built in TPS)
Input sensor	
Mass air flow sensor	
Type	Hot film type
Intake air temperature (IAT) sensor	
Type	Thermistor type
Resistance	2.33 - 2.97 kΩ or 2.5 - 2.7V at 20°C (68°F) 0.31 - 0.43 kΩ or 0.6 - 0.8V at 80°C (176°F)
Engine coolant temperature (ECT) sensor	
Type	Thermistor type
Resistance	2.4 kΩ or 2.5 - 2.7V at 20°C (68°F) 0.3 kΩ or 0.5 - 0.7V at 80°C (176°F)
Heated oxygen sensor (HO2S)	
Type	Zirconia sensor
Vehicle speed sensor	
Type	Hall IC type
Camshaft position (CMP) sensor	
Type	Hall effect sensor
Crankshaft position (CKP) sensor	
Type	Hall effect sensor
Output actuator	
Injector	
Type	Electromagnetic type
Number	6
Coil resistance	13 - 16Ω at 20°C (68°F)
Fuel pressure regulator	
Fuel pressure	46 - 49 psi (320-340 kPa, 3.26 - 3.47 kg/cm²)

Sealant

Engine coolant temperature sensor	LOCTITE 962T or equivalent

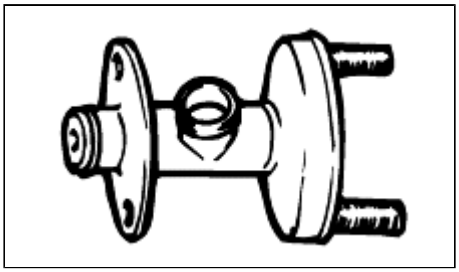
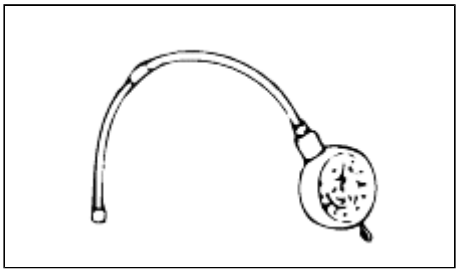
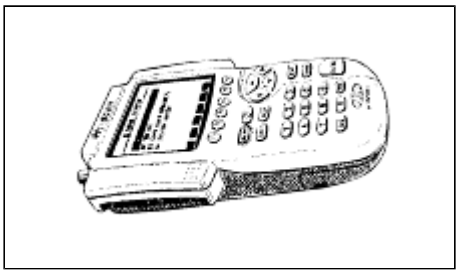
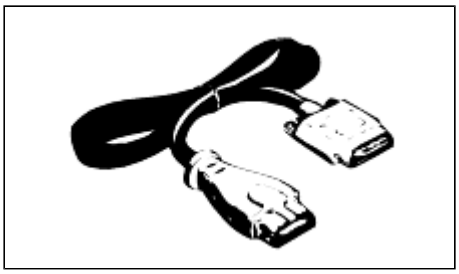
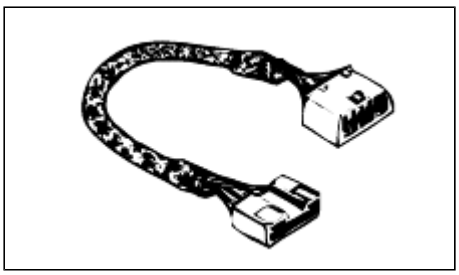
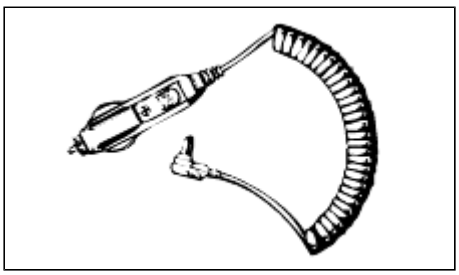
Service standard

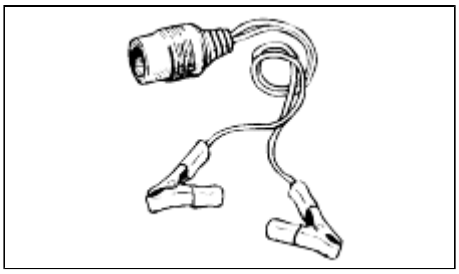
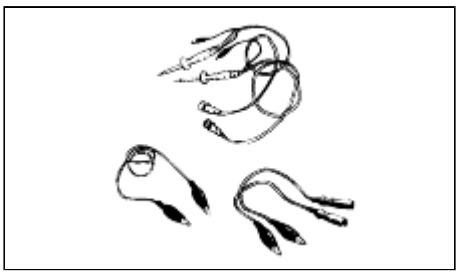
Basic ignition timing			BTDC 10° ± 2°at curb idle (Terminal grounded)
Curb idle speed	N-range	A/C OFF	700 ± 100 rpm
		A/C ON	800 ± 100 rpm

Tightening torques

Item	N·m	Kg·cm	lb·ft
Delivery pipe installation bolt	10 - 13	100 - 130	7 - 9
Engine coolant temperature sensor	20 - 40	200 - 400	14 - 29
Heated oxygen sensor	40 - 50	400 - 500	29 - 36
Heated oxygen sensor connector bracket bolt	8 - 12	80 - 120	5.8 - 8.7
Fuel pressure regulator installation bolt	7 - 11	70 - 110	5 - 8
High pressure hose and main fuel pipe	30 - 40	300 - 400	22 - 29
High pressure hose and fuel filter	25 - 35	250 - 350	18 - 25
High pressure hose to delivery pipe	3 - 4	30 - 40	2.2 - 3
Fuel pump assembly to fuel tank	2 - 3	20 - 30	1.4 - 2.2
High pressure hose at fuel tank	30 - 40	300 - 400	22 - 29
Throttle body to surge tank	10 - 13	100 - 130	7.2 - 9
Fuel tank drain plug	15 - 25	150 - 250	11 - 18
Accelerator arm bracket bolts	8 - 12	80 - 120	5.8 - 8.7
ISC motor (stepper motor)	2.5 - 4.5	25 - 45	1.8 - 3.3

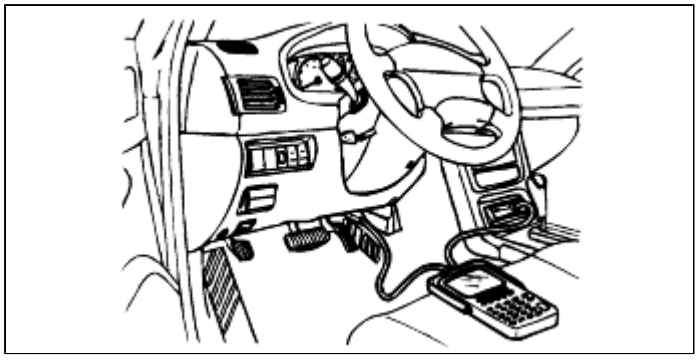
Special service tools

Tool (Number and name)	Illustration	Use
09353-38000 Fuel pressure gauge adapter		Connection of fuel pressure gauge to fuel supply pipe as fuel pressure measurement
09353-24100 Fuel pressure gauge and hose		Measurement of fuel pressure
09900-11000 Hi-scan body		For checking electronic control system
09900-21100 DLC cable 16		Connection of Hi-scan body to vehicle (16 pin)
09900-21200 DLC cable adapter		Connection of 12 pin diagnostic terminal with DLC cable (16 pin)
09900-27200 Power cable (for cigar. lighter)		For receiving electric power from cigar lighter plug

09900-27210 Power cable (for battery)		For supplying power from battery
09900-23100 Oscilloscope probe set		Used for signal test and driving actuator by the multi-meter function of oscilloscope

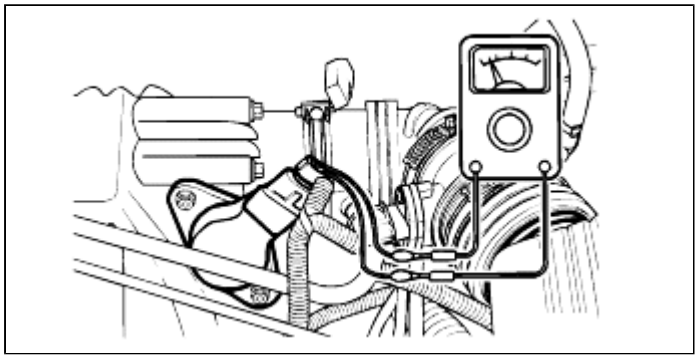
Adjustment

1. Connect a HI-SCAN to the data link connector.

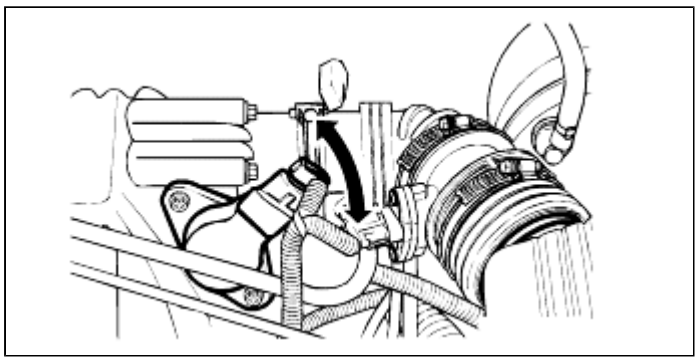


2. If a HI-SCAN is not used, connect a digital type voltmeter between connector 1 and 3.
3. Turn the ignition switch to the ON position (do not start engine) and check that the TP Sensor output voltage is as specified. If a HI-SCAN is used, press code No. 14 and read the voltage.

Standard value : 300 - 900mV



4. If it is out of specification, loosen TP Sensor mounting screws and adjust by turning the TP Sensor.



NOTE

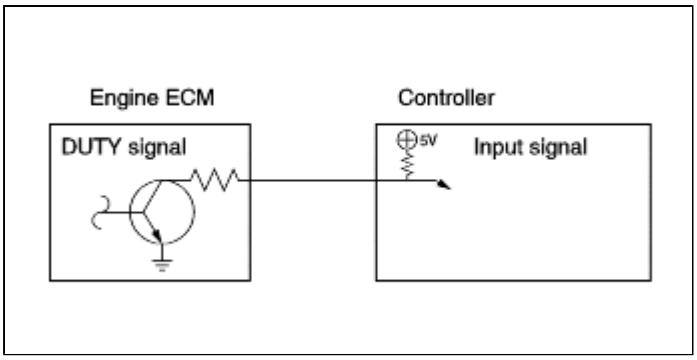
1) Turning the TP Sensor clockwise increases the output voltage.
2) Tighten the screws securely after adjustment.

5. Turn the ignition switch to the OFF position.

Cooling fan control

Cooling fan controller

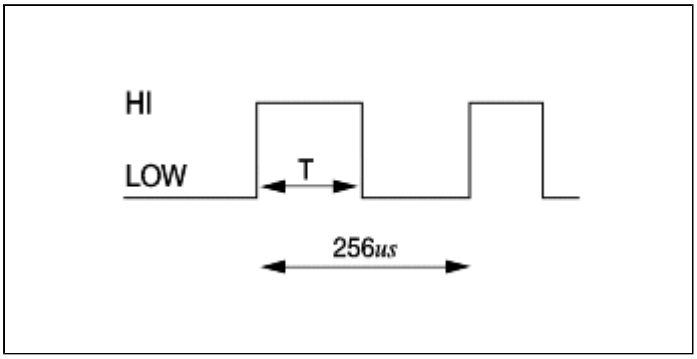
Engine ECM controls the rate of cooling fan with engine coolant temperature and vehicle speed. The cooling fan controller receives signal from the ECM to control the rate of cooling fan.



ECM output

DUTY = T/256μsx 100%

The control to cooling fan is performed in ECM output + duty.



Cooling fan logic

1. The duty at A/C OFF.

Unit (%)

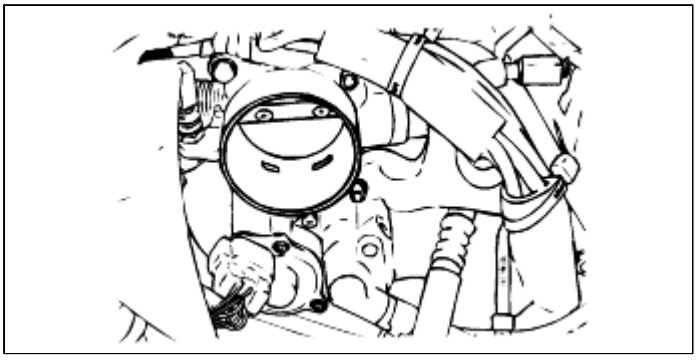
Vehicle speed (Km/h) / Coolant temp. (°C)	Below 45	45 ~ 70	Over 70
Below 90			
90 ~ 94	30	0	
94 ~ 96	35		
96 ~ 98	40		
98 ~101	50		
101 ~ 103	60		
103 ~ 105	65		
105 ~ 109	70		
Over 109	100		

cleaning

NOTE

Disconnect the intake air hose from the throttle body, and check the throttle valve surface for carbon deposits. Spray cleaning solvent on the valve to remove carbon deposits.

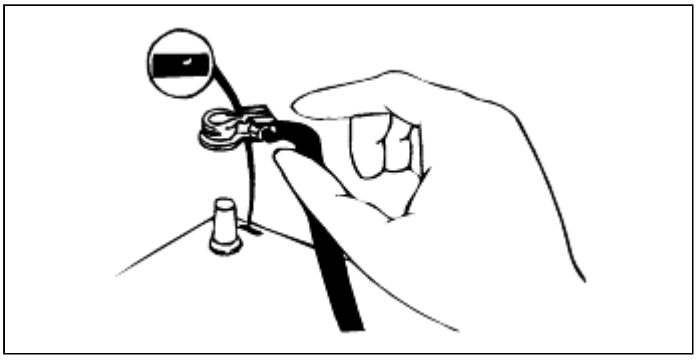
1. Warm up the engine, then stop it.
2. Remove the intake air hose from the throttle body.
3. Plug the bypass passage inlet of the throttle body.



NOTE

Make sure the solvent does not enter the by-pass passage.

4. Spray cleaning solvent onto the valve through the throttle body intake port and let it soak for about 5 minutes.
5. Start the engine, race it several times and allow the engine to idle for 1 minute.
6. Repeat Steps 4 and 5.
7. Unplug the bypass passage inlet.
8. Attach the intake air hose.
9. Disconnect the battery ground cable for more than 10 seconds.



10. Adjust the SAS (Speed Adjusting Screw)

A/C relay control

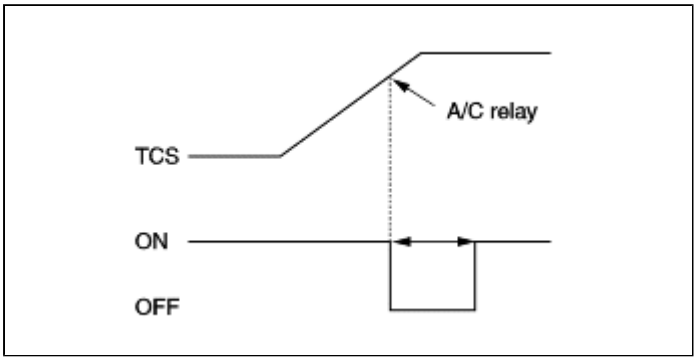
AT oscillation

When oscillation is made during vehicle is stopped but the A/C is in operation, the A/C relay is to be turned off for 1.5 sec.

	Judgement	OFF time period
Vehicle speed	Below 10km/h	1.5 sec
Shift step	First	
TPS clearance	Over 1.5V~2.2V	

AT accelerating

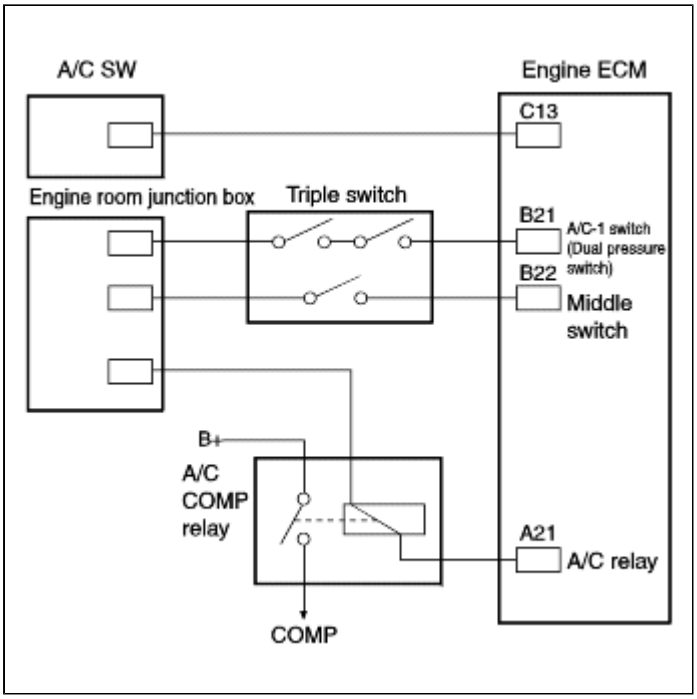
The A/C relay is turned OFF for 5 second when the TPS output voltage is over 3.9~4.1V.



AT high coolant temperature

The A/C relay is turned off at the coolant temperature over 110°C~115°C (230~ 239 °F) after engine start.

Circuit diagram



General information

The MFI consists of ECM, which controls the system by receiving the signal from the sensor, detects engine, and the actuator which operates under the control of ECM.
The ECM carries out the activities such as fuel injection control, idle air control and ignition timing control.
In addition, the ECM is equipped with several diagnostic test modes which simplify troubleshooting when a problem develops.

Fuel injection control

Injector drive time and injector timing is controlled so that always an optimum air/fuel mixture is supplied to the engine to correspond to the continually changing engine operation conditions.
A single injector is mounted at the intake port of each cylinder.
Fuel is sent under pressure from the fuel tank by the fuel pump with the pressure being regulated by the fuel pressure regulator. The fuel thus regulated is distributed to each of the injectors.
Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The firing order is 1-2-3-4-5-6.
The ECM provides a good air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance. In addition, when the engine is warm or carries out "Closed loop" control, the ECM provides an optimum performance by catalytic converter and controls the air/fuel mixture in order to obtain theoretical air/fuel mixture ratio.

Ignition timing control

The ignition power transistor is built in ECM and located in the ignition primary circuit which turns ON/OFF to control the basically remained current to the ignition coil.
It controls the ignition timing in order to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the ECM with engine speed, intake air volume, engine coolant temperature and atmosphere pressure.

Other control functions

1. Fuel pump control: Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking.
2. A/C Compressor Clutch Relay Control: Turns the compressor clutch when A/C is turned ON/OFF.
3. Fan relay control: The rates of radiator fan and condenser fan are controlled in response to engine coolant temperature and vehicle speed.
4. Exhaust emission purge control.

Diagnostic test mode

1. When an abnormality is detected in one of the sensors or actuators related with emission control, the SELF-DIAGNOSIS INDICATOR LAMP turns on.
2. When an abnormality is detected in one of the sensors or actuators, a diagnostic trouble code corresponding to the abnormality is output.
3. The data of ROM inside the ECM related with sensors and actuators is read by means of Hi-scan. The actuators can be controlled under certain circumstances.

How to cope with intermittent malfunctions

Most of intermittent malfunctions occur under certain conditions. The cause will be easily found, if those conditions can be identified.

To cope with intermittent malfunctions

1. Ask the customer about the malfunction.
   Ask what it feels like, what it sounds like, etc. Then ask about driving conditions, weather, frequency of occurrence, and so on.
2. Determine the conditions from the customer's responses
   Typically, almost all intermittent malfunctions occur from conditions like vibration, temperature and/or moisture change, poor connections. From the customer's replies, it should be reasoned which condition is influenced.
3. Use simulation test
   In the cases of vibration or poor connections, use the simulation tests below to attempt to duplicate the customer's complaint.
4. Verify the intermittent malfunction is eliminated
   Repair the malfunctioning part and try to duplicate the conditions again to verify again the intermittent malfunction has been eliminated.

Simulation tests

For these simulation tests, shake, then gently bend, pull and twist the wiring of each of these examples to duplicate the intermittent malfunction.

1. Shake the connector up and down, right and left.
2. Shake the wiring harness up and down, right and left.
3. Vibrate the part or sensor.

Inspection service points for a blown fuse

Remove the fuse and measure the resistance between the load side of the fuse and ground.
Set the switches of all circuits that are connected to this fuse to a condition of continuity.
If the resistance is almost 0Ω, there is a short circuit somewhere between these switches and the load.
If the resistance is not 0Ω, there is no short at the present time, but a momentary short has probably caused the fuse to blow.
The main causes of a short circuit:
Harness being clamped by the vehicle body, or worn
Damage to the outer casing of the harness due to overheat
Water getting into the connector or circuitry
Poor fastening

MFI system inspection

If the MFI system components (sensors, ECM, injector, etc.) fail, interruption or failure to supply the proper amount of fuel for various engine operating conditions will result.
The situations as below may be encountered.

1. Engine is hard to start or does not start at all.
2. Unstable idle
3. Poor driveability.

If none of the above conditions exists, first perform an inspection by self-diagnosis and subsequent basic engine checks (ignition system malfunction, incorrect engine adjustment, etc.), and then inspect the MFI system components.

On-board diagnostics

Record the diagnostic trouble code after detecting malfunction on ECM.
Record the self-diagnostic code if the same trouble occurs again after restarting the engine. (Malfunction detected in running)
However, as fuel system rich/lean misfiring, the diagnostic trouble code is recorded on the first detection of the malfunction.

Malfunction indicator light (MIL)

The On-board diagnostic lamp turns on to notify the driver for a problem on the vehicle.
However MIL will go off automatically after 3 sequential driving cycles, the same malfunction not redetected.
Immediately after the ignition switch is turned on, the malfunction indicator lamp keeps on for 5 seconds to indicate that the malfunction indicator lamp operates normally.
The items as below will be indicated by MIL.

1. Air flow sensor (AFS)
2. Engine coolant temperature sensor (ECTS)
3. Throttle position sensor (TPS)
4. Injector
5. Oxygen sensor (O2 sensor)
6. Crankshaft position sensor (CKPS)

Malfunction indicator lamp inspection

1. After turning on the ignition key, check that the light illuminates for 5 seconds without engine running.
2. If the light does not illuminate, check for an open circuit in harness, blown fuse and blown bulb.

Self-diagnosis

The ECM monitor the input/output signals. (Some signals at all times and the others under specified conditions)
When the ECM detects an irregularity, the trouble code is to be saved in memory and the output signal sent to the self-diagnosis output terminal.
The diagnosis result is read on Hi-scan.
The diagnostic trouble code (DTC) will remain in the ECM as long as the battery power is maintained.
The diagnostic trouble code will however, be erased when the battery terminal or engine control unit (ECM) connector is disconnected, or erased by the Hi-scan.

Inspection procedures (self-diagnosis)

NOTE

1) When the battery voltage is low, diagnostic trouble codes can not be read. Be sure to check the battery for voltage and charging system prior to starting the test.
2) Diagnosis memory is erased if the battery or ECM connector is disconnected.

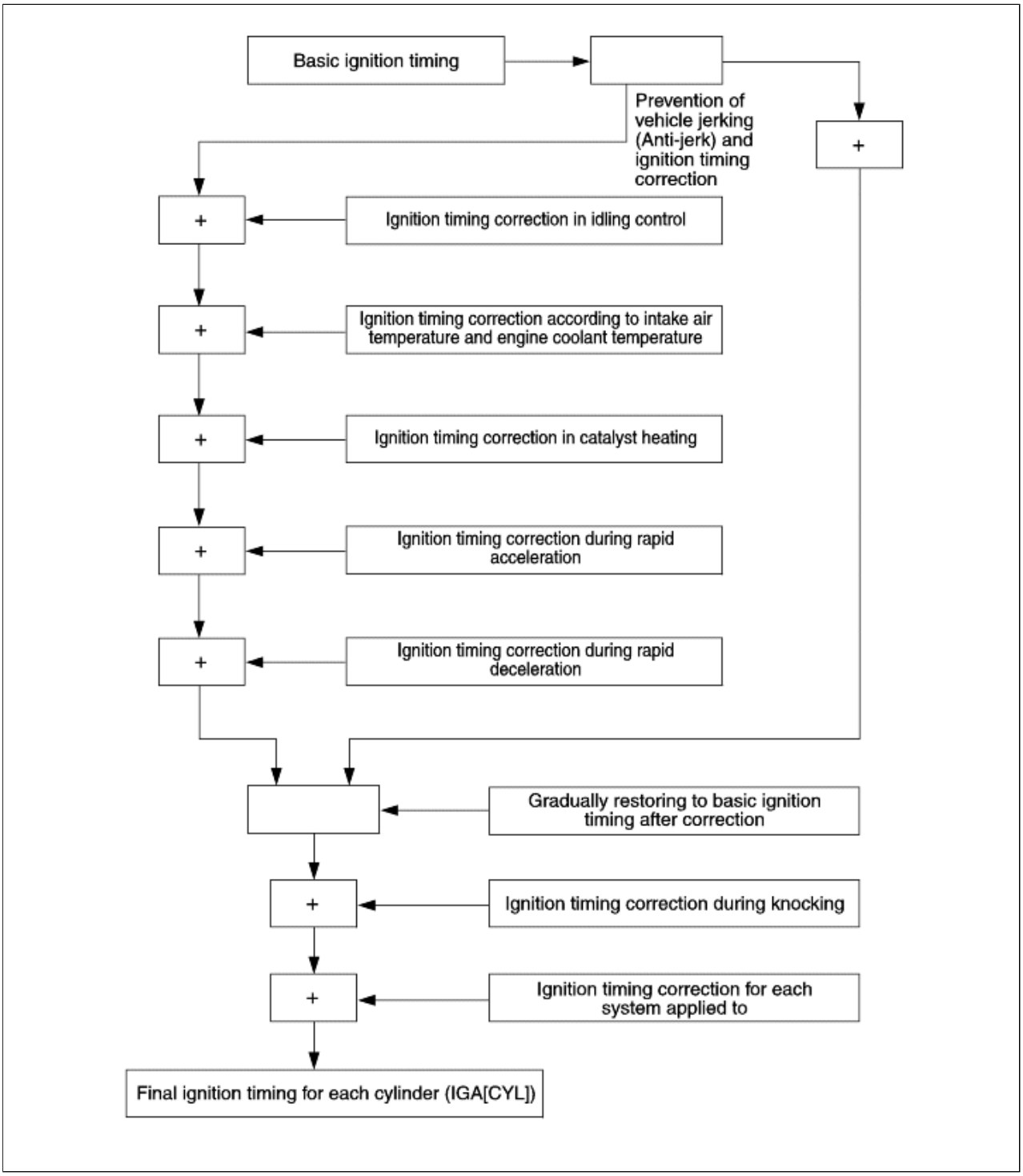
Inspection Procedures (using Hi-scan)

1. Turn OFF the ignition switch
2. Connect Hi-scan to the data link at the lower part of crash pad.
3. Turn ON the ignition switch
4. Use the Hi-scan to check the diagnostic trouble code.
5. Repair the faulty part referencing the diagnosis chart.
6. Erase the diagnostic trouble code.
7. Disconnect the Hi-scan.

Ignition system

Ignition control

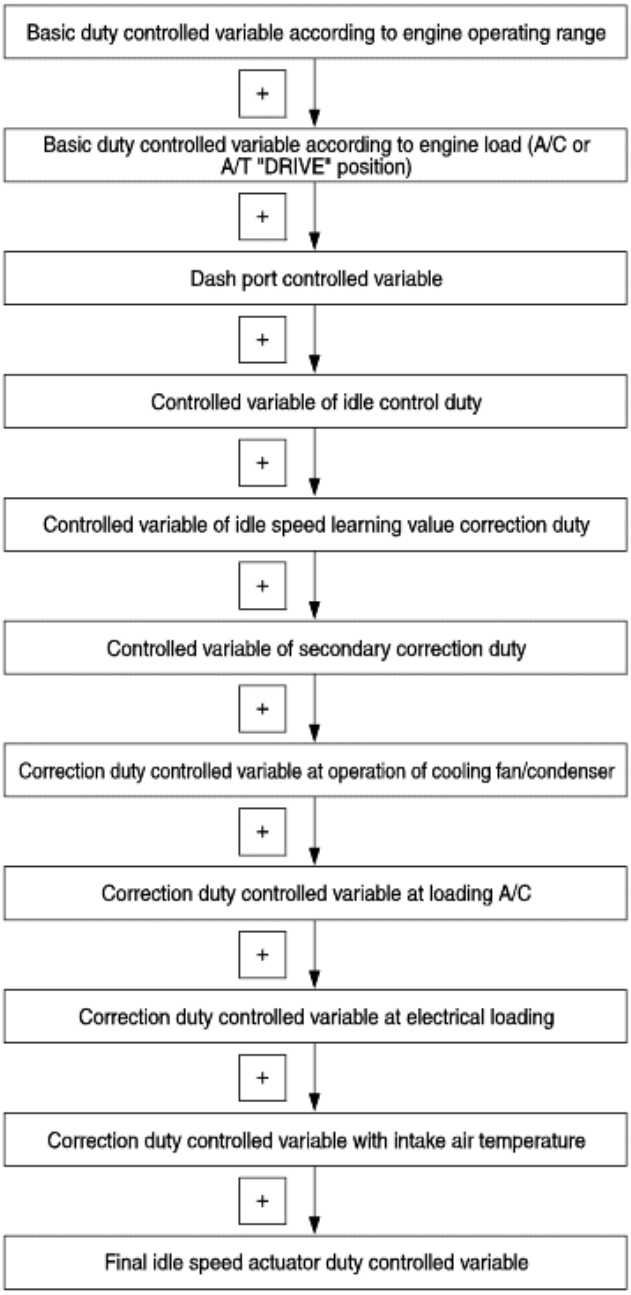
[Ignition timing chart]



Idling control system

Idling speed control

[Idling speed control chart]

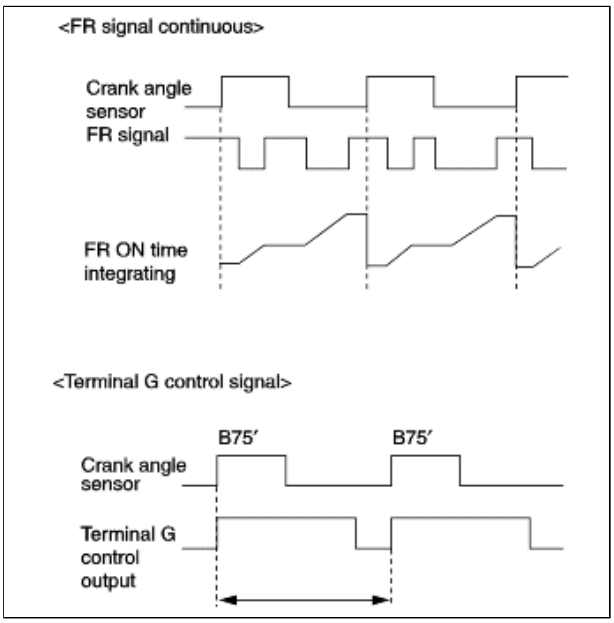


The duty at A/C on

<table>
<tr><td>A/C input S/
Vehicle speed (Km/h)
Coolant temp. (°C)</td><td colspan="3">LOW</td><td>MIDDLE</td><td>HIGH</td></tr>
<tr><td></td><td>Below 45</td><td>45 ~ 70</td><td>Over 70</td><td colspan="2">Over 0</td></tr>
<tr><td>Below 90</td><td rowspan="5">50</td><td rowspan="4">40</td><td rowspan="5">0</td><td rowspan="9">100</td><td rowspan="9">100 and COMP OFF</td></tr>
<tr><td>90 ~ 94</td></tr>
<tr><td>94 ~ 96</td></tr>
<tr><td>96 ~ 98</td></tr>
<tr><td>98 ~101</td><td>50</td></tr>
<tr><td>101 ~ 103</td><td colspan="3">60</td></tr>
<tr><td>103 ~ 105</td><td colspan="3">65</td></tr>
<tr><td>105 ~ 109</td><td colspan="3">70</td></tr>
<tr><td>Over 109</td><td colspan="3">100</td></tr>
<tr><td>Over 115</td><td colspan="3">100 and COMP PFF</td></tr>
</table>

Generated electric current control

The ECM detects the FR signal from the FR terminal of generator, computes the average duty rate and controls terminal G to control the generated electric current after determination of the generated current depended on the engine rate and FR duty, for the engine rate decrease prevention purpose at electrical loading.



Troubleshooting

First check the basic units when servicing the engine. Check the basic units as below when the engine does not crank, make rough idling or make inferior accelerating.

1. Power supply
   (1) Battery
   (2) Fusible link
   (3) Fuse
2. Body ground
3. Fuel supply
   (1) Fuel line
   (2) Fuel filter
   (3) Fuel pump
4. Ignition system
   (1) Spark plug
   (2) High tension cable
   (3) Ignition coil
5. Emission control system

(1) PCV system

(2) Vacuum leak

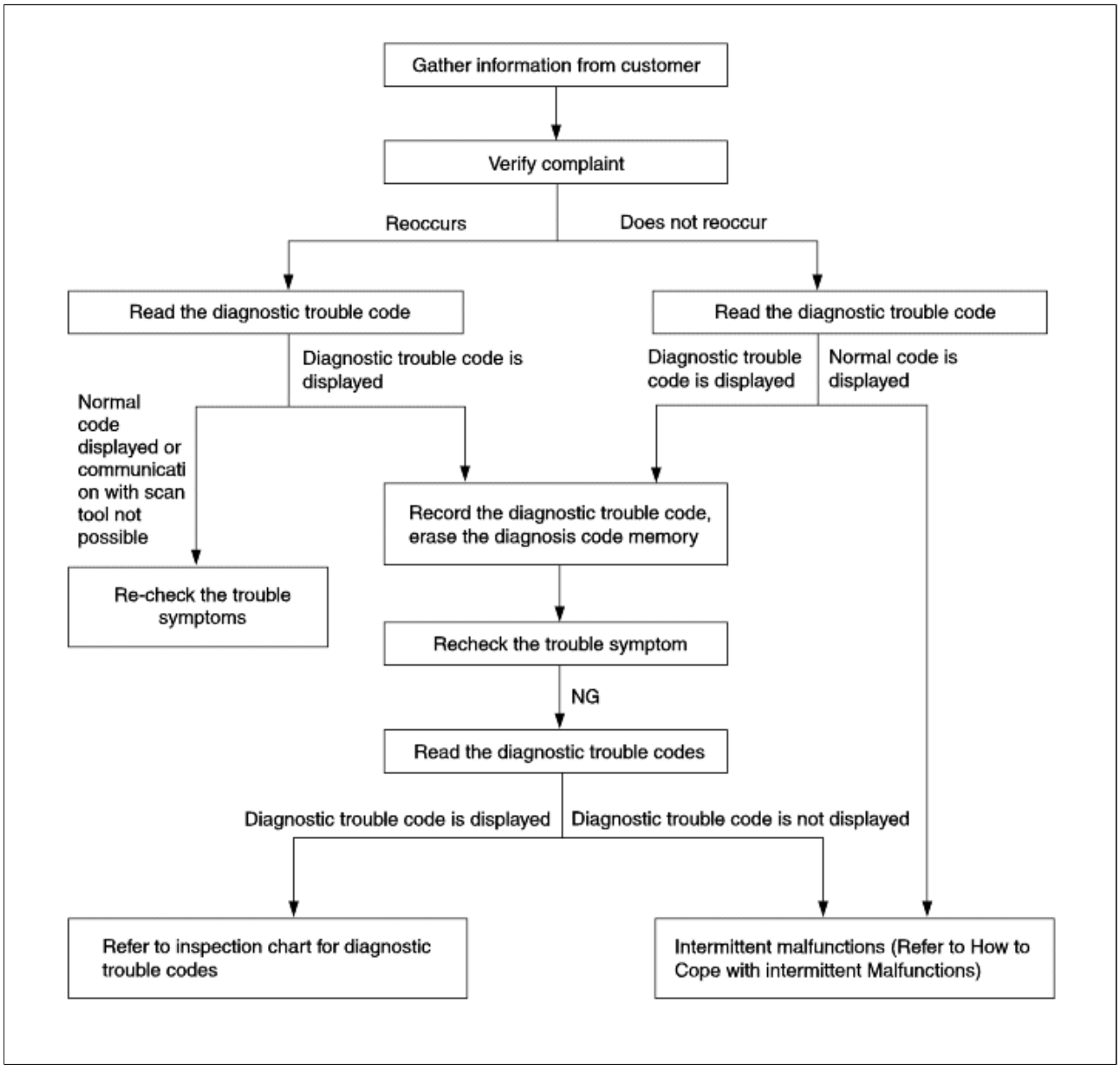
6. Others
   (1) Ignition timing

   (2) Idle speed

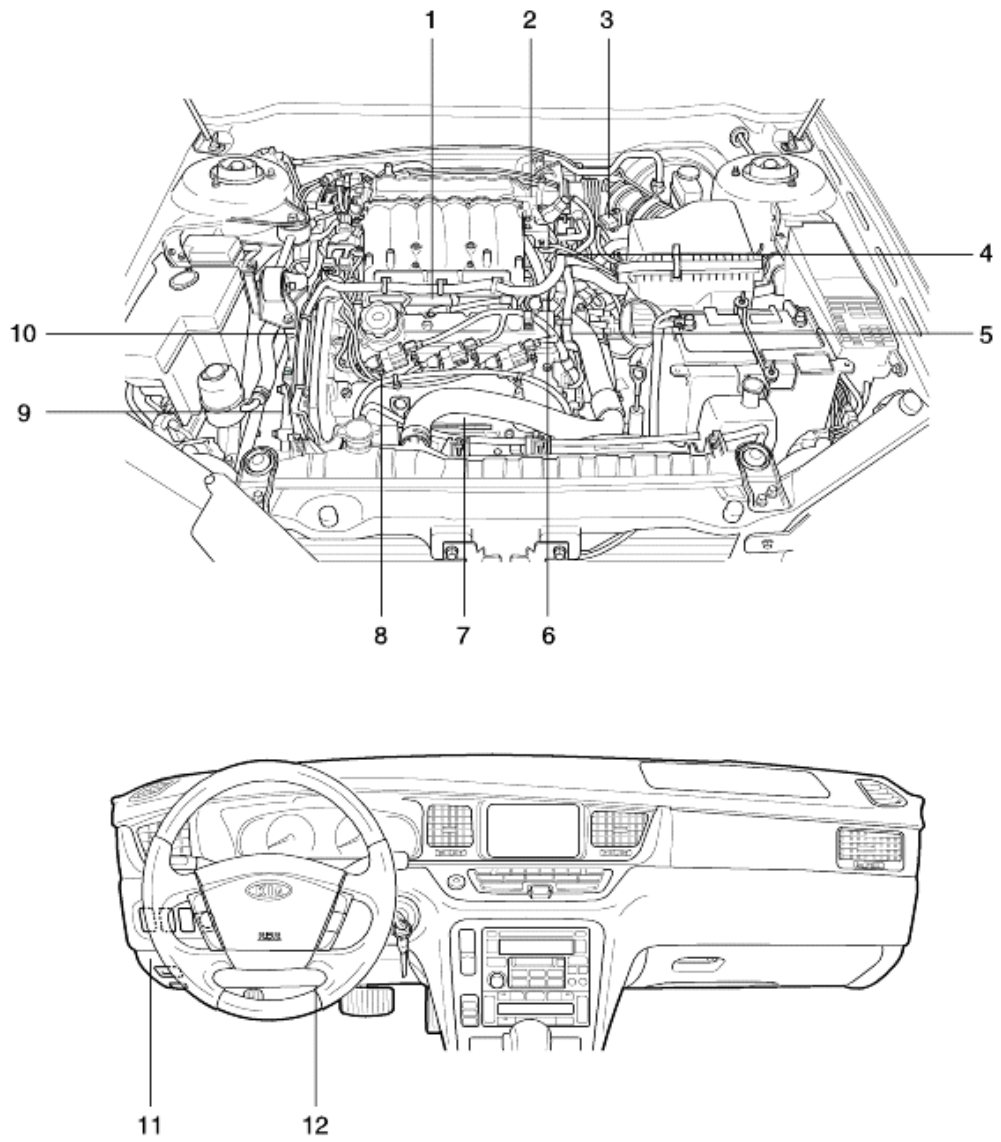
Trouble with MFI system is often caused by poor contact of the harness connectors. It is important to check all harness connectors and verify that they are securely connected.

Troubleshooting flow chart

Diagnosis and solution

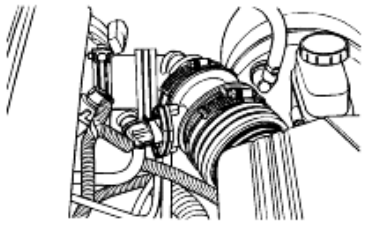


ENGINE CONTROL SYSTEM

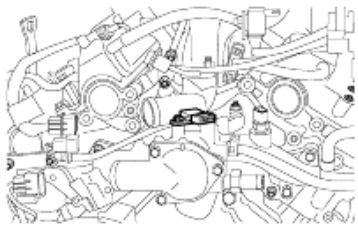


1. Knocking sensor
2. TPS
3. AFS,IAT
4. PCSV
5. ECT
6. IG FAIL sensor
7. O_2 sensor
8. Ignition coil
9. CKPS
10. CMPS
11. ECM control relay
12. Self-diagnosis terminal

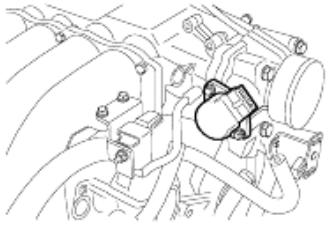
AFS, IATS



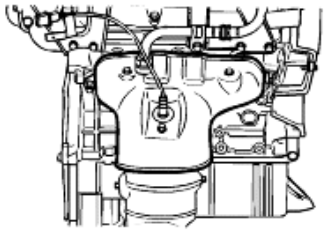
ECTS



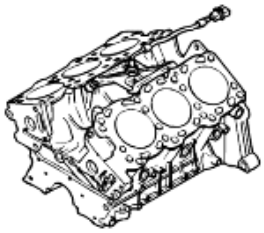
TPS



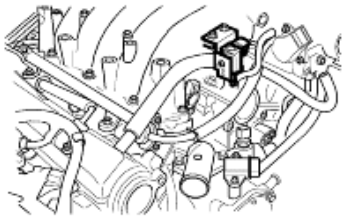
OXYGEN SENSOR



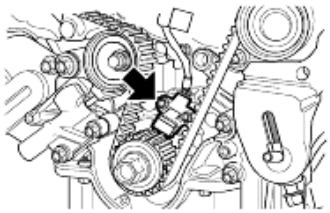
KNOCK SENSOR



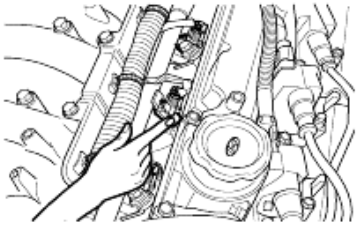
PCSV



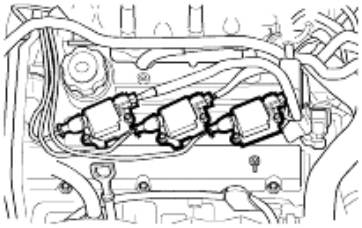
CKPS



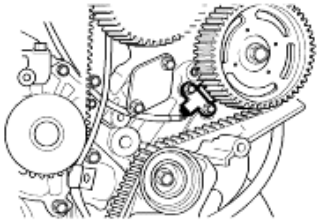
INJECTOR



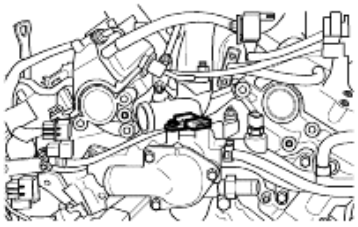
IGNITION COIL



CMPS



IG FAIL SENSOR



Troubleshooting guide chart

Check points / Check points	Starting		Stability of idling				Running					Stopping
	No start (Basic ignition failure)	Hard to start (Cranks slowly) (Engine stops after basic ignition)	Rough idle	Incorrect idle speed	Poor idle durability	Hesitation of engine	Poor acceleration	Unstable running condition	Shock	Surging	Knocking	Run-on (Dieseling)
Power supply and ignition switch	① (1)											
ECM ground	② (2)											
Fuel pump	③ (3)	① (1)			① (1)	① (1)	① (1)					
Air flow sensor		⑤ (6)			⑩ (9)	⑩ (10)		⑤ (5)	⑤ (5)			
Intake air temperature sensor			④			⑥ (6)	⑥ (6)					
Engine coolant temperature sensor		(3)	⑤ (4)	① (1)	④ (4)	⑧ (8)	⑦ (7)	④ (4)		③ (3)	③ (3)	
Throttle position sensor						⑦ (7)		③ (3)	④ (4)		② (2)	
Idle switch			② (2)	② (2)	③ (3)							
CMP sensor	⑤ (5)	⑦ (7)			⑦ (6)				② (2)			
Each sensor for crank	⑥ (6)	⑦			⑧ (7)				③ (3)			
Ignition S/W ST and transaxle range S/W (A/T)	④ (4)	③ (4)		⑥								
Vehicle speed sensor					⑤				⑥			
Power steering oil pressure switch				③								
Switch and relay of air conditioner				④								
Knocking sensor						⑨ (9)	⑧ (8)				① (1)	
Electrical load switch				⑤								
Intake control valve position transistor						④ (4)	④ (4)					
Injector	⑧ (8)	② (2)	① (1)		② (2)	② (2)	② (2)	① (1)		① (1)		①
Ignition coil and power transistor	⑦ (7)				⑨ (8)		⑨ (9)		① (1)		④ (4)	
Ventilation regulating solenoid signal						⑪ (11)	⑩ (10)	⑥ (6)				
A/T synthetic signal									⑥ (6)	⑤ (5)		
TCL signal			⑥ (5)	⑧ (3)		⑫ (12)	⑪ (11)	⑦ (7)		⑤ (5)		
Variable intake air control servo motor (DC motor)						⑤ (5)	⑤ (5)					
Fuel pressure		④ (5)	③ (3)		⑥ (5)	③ (3)	③ (3)	② (2)		② (2)		

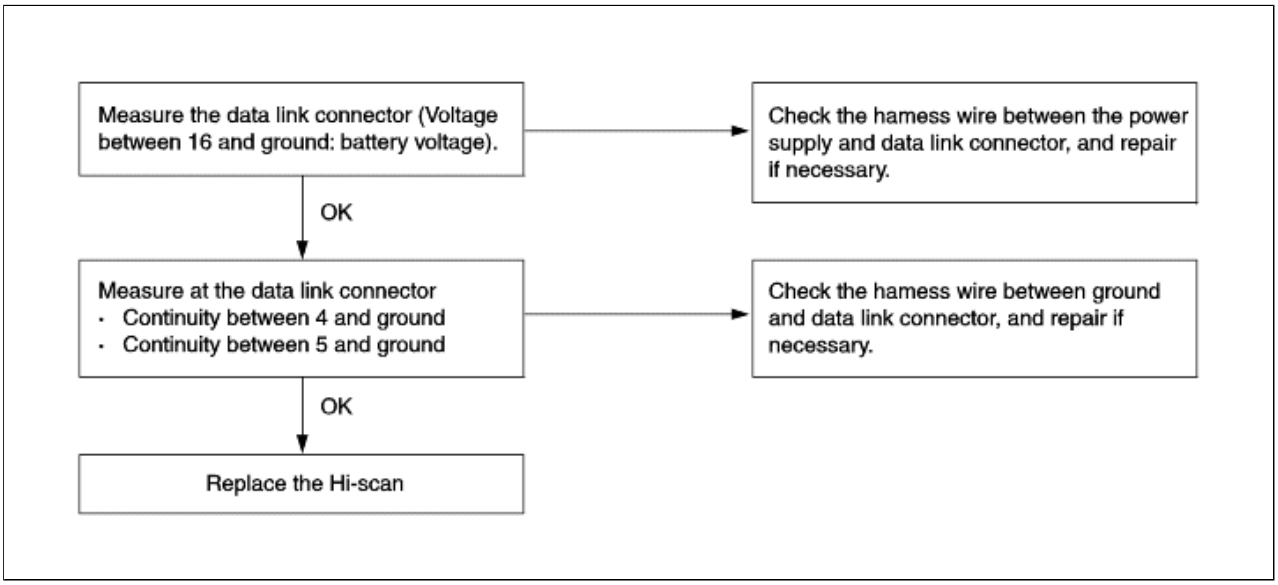
O : When warm. (Perform check operation in the order of the figures in circlets.)
( ) : When cold. (Perform check operation in the order of the figures in parenthesis.)

Main symptoms / Sub-symptoms / Check points	Engine stalls			Others			
	Soon after starting	After depressing accelerator pedal	After releasing accelerator pedal	During A/C ON	Excessive fuel consumption	Engine overheats consumption	Engine overcools
Fuel quality	1				2		
Fuel pressure regulator	2	4					
Fuel pump	3						
Fuel line	4	5					
Air flow sensor circuit	5	1	1		12		
Other sensor circuits	6				10		
Injector	7	6			9		
ECM	8	7	2	2	16		
Throttle position sensor		2			11		
Spark plug		3			5	8	
A/C circuit				1	13		
Fuel leakage					1		
Accelerator pedal link					3		
Brakes drag when released					4		
Compression					6		
Piston ring					7		
Ignition timing					8		
Oxygen sensor circuit					14		
Intake air temp. sensor circuit					15		
Engine coolant leakage						1	
Cooling fan						2	1
Thermo-switch						3	
Radiator and radiator cap						4	
Thermostat						5	2
Timing belt						6	
Water pump						7	
Oil pump						9	
Cylinder head						10	
Cylinder block						11	
Other sensors						12	3

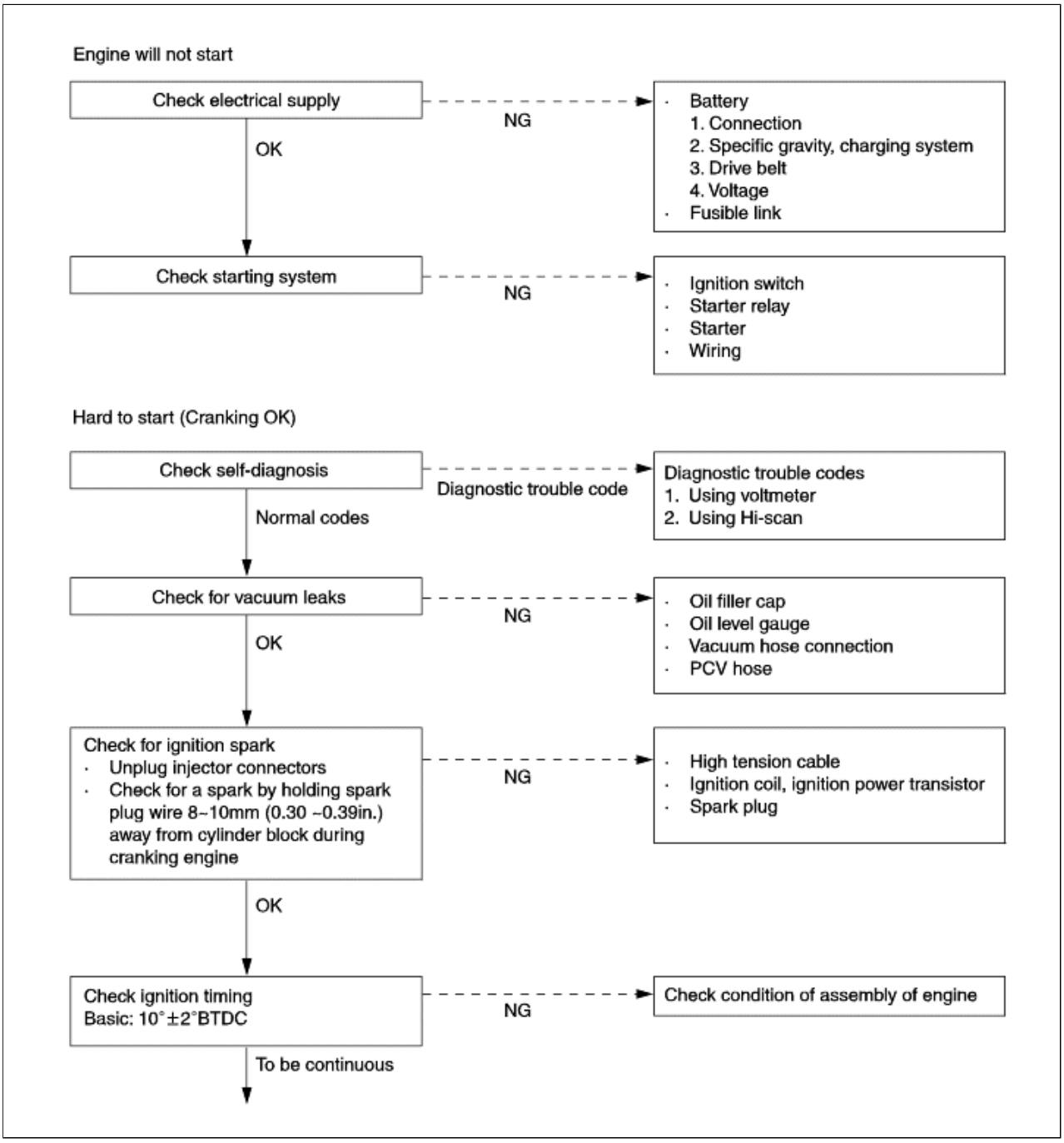
MFI Troubleshooting procedures

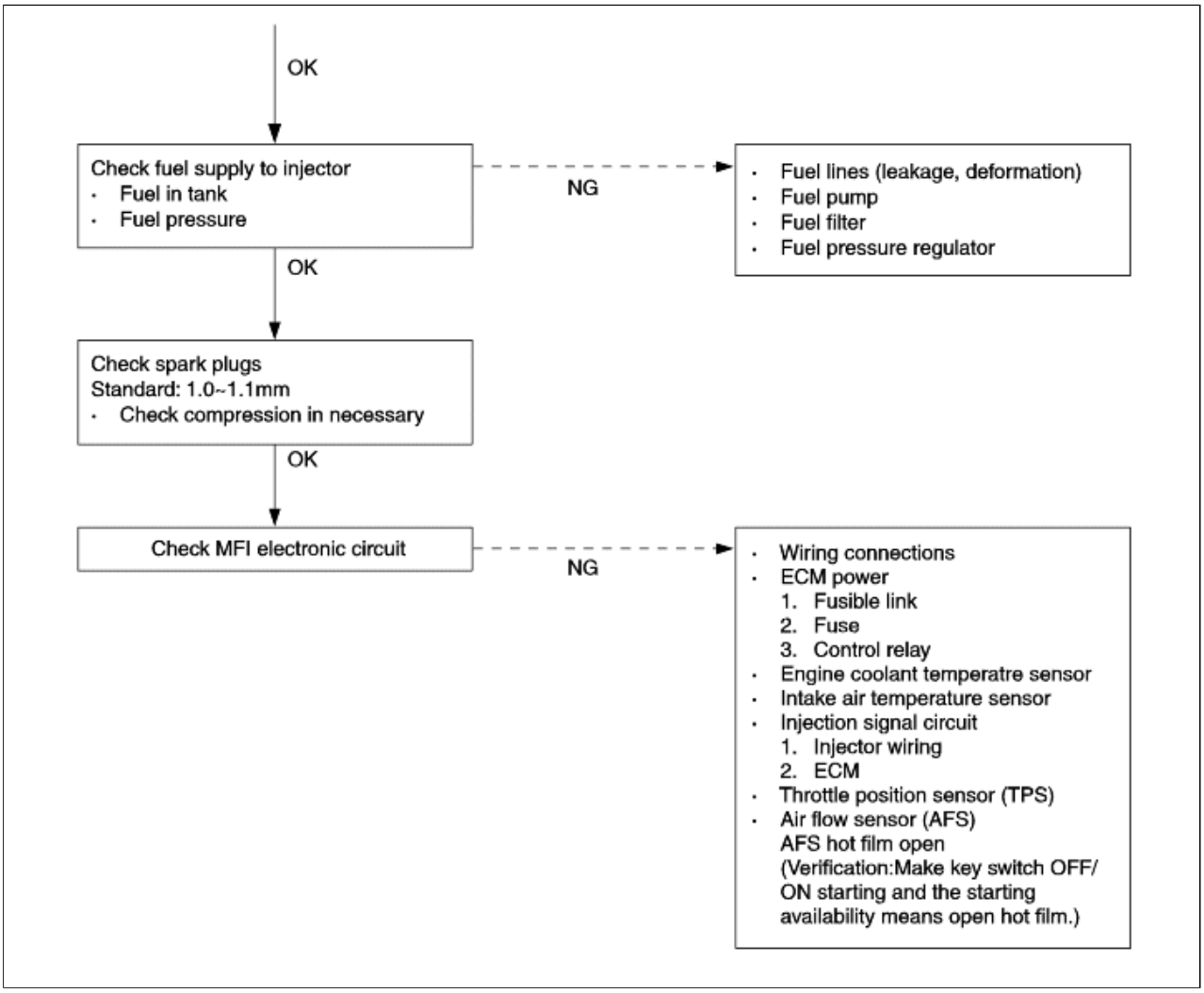
Problem

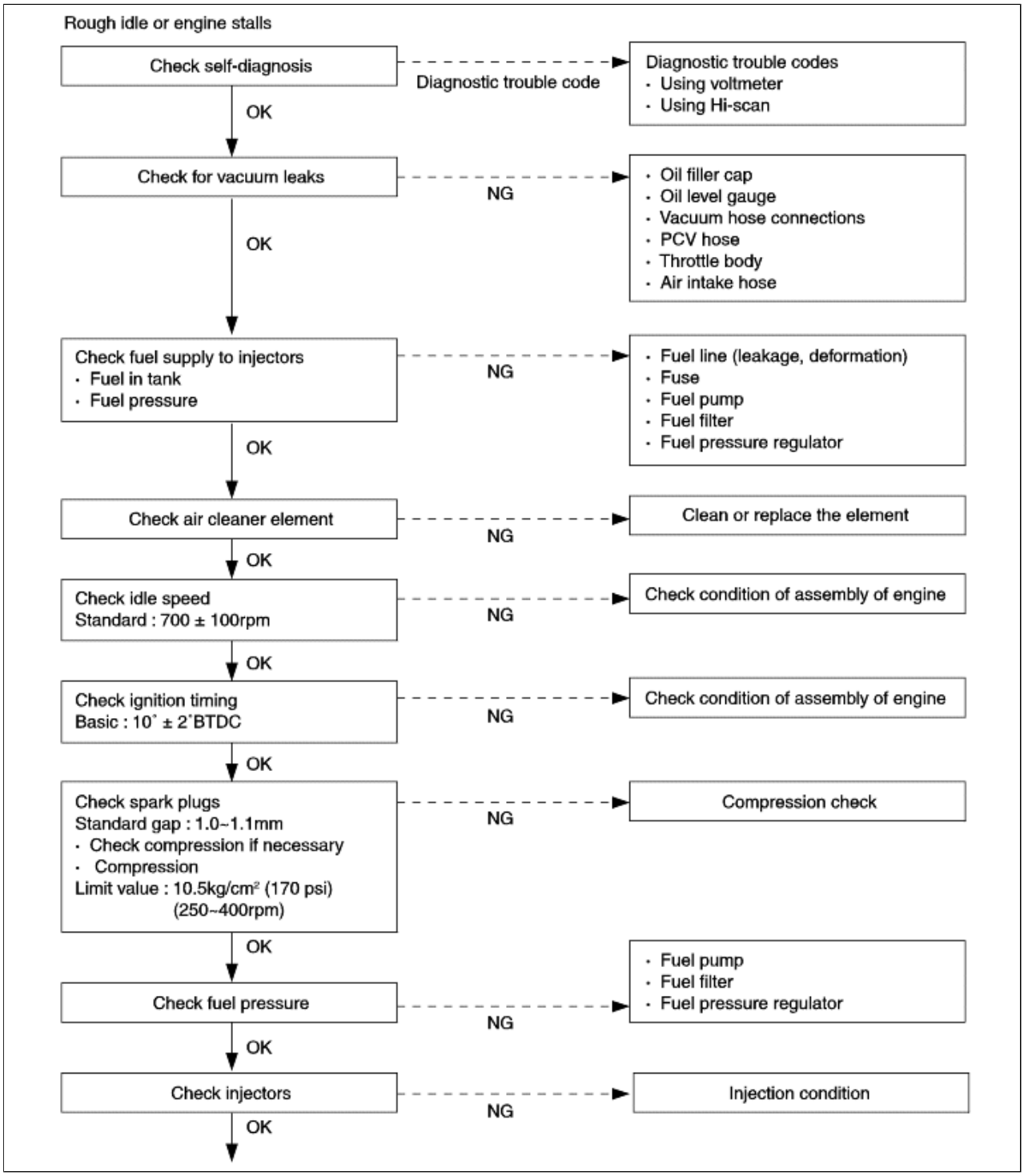
Communication with Hi-scan is not available.
(Communication with all systems is not available)

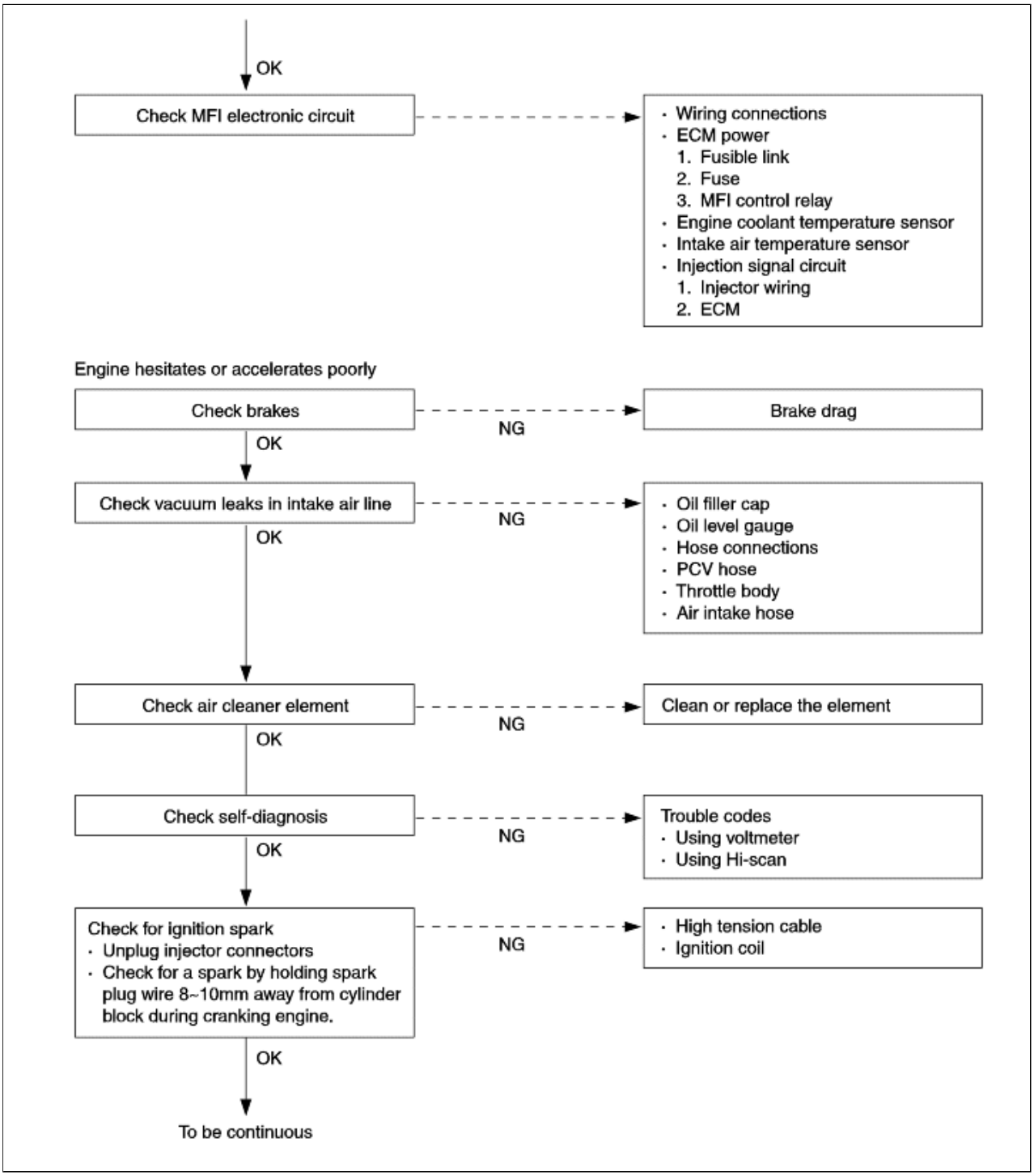


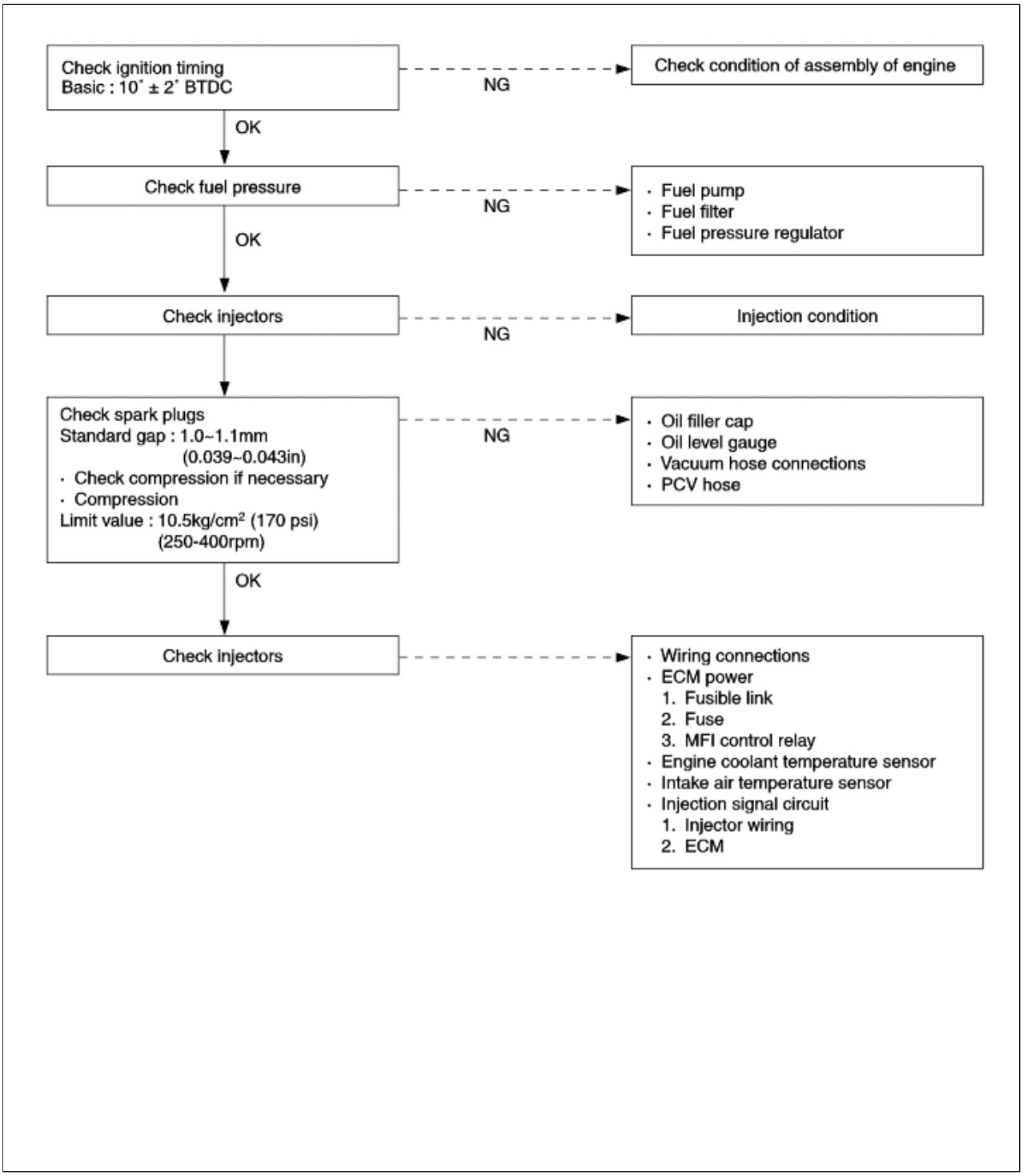
Item	Causes
One of the matters below needs check for 1) No power supply to ECM 2) Defective ground circuit of ECM 3) Defective ECM 4) Improper communication line between ECM and Hi-scan	 1) ECM power supply circuit faulty 2) ECM faulty 3) Open circuit between ECM and DLC


Engine will not start
Check electrical supply
NG
· Battery
1. Connection
2. Specific gravity, charging system
3. Drive belt
4. Voltage
· Fusible link
OK
Check starting system
NG
· Ignition switch
· Starter relay
· Starter
· Wiring
Hard to start (Cranking OK)
Check self-diagnosis
Diagnostic trouble code
Diagnostic trouble codes
1. Using voltmeter
2. Using Hi-scan
Normal codes
Check for vacuum leaks
NG
· Oil filler cap
· Oil level gauge
· Vacuum hose connection
· PCV hose
OK
Check for ignition spark
· Unplug injector connectors
· Check for a spark by holding spark plug wire 8~10mm (0.30 ~0.39in.) away from cylinder block during cranking engine
NG
· High tension cable
· Ignition coil, ignition power transistor
· Spark plug
OK
Check ignition timing
Basic: 10°±2°BTDC
NG
Check condition of assembly of engine
To be continuous


OK
Check fuel supply to injector
· Fuel in tank
· Fuel pressure
NG
· Fuel lines (leakage, deformation)
· Fuel pump
· Fuel filter
· Fuel pressure regulator
OK
Check spark plugs
Standard: 1.0~1.1mm
· Check compression in necessary
OK
Check MFI electronic circuit
NG
· Wiring connections
· ECM power
1. Fusible link
2. Fuse
3. Control relay
· Engine coolant temperatre sensor
· Intake air temperature sensor
· Injection signal circuit
1. Injector wiring
2. ECM
· Throttle position sensor (TPS)
· Air flow sensor (AFS)
AFS hot film open
(Verification:Make key switch OFF/ ON starting and the starting availability means open hot film.)


Rough idle or engine stalls
Check self-diagnosis
Diagnostic trouble code
Diagnostic trouble codes
· Using voltmeter
· Using Hi-scan
OK
Check for vacuum leaks
NG
· Oil filler cap
· Oil level gauge
· Vacuum hose connections
· PCV hose
· Throttle body
· Air intake hose
OK
Check fuel supply to injectors
· Fuel in tank
· Fuel pressure
NG
· Fuel line (leakage, deformation)
· Fuse
· Fuel pump
· Fuel filter
· Fuel pressure regulator
OK
Check air cleaner element
NG
Clean or replace the element
OK
Check idle speed
Standard : 700 ± 100rpm
NG
Check condition of assembly of engine
OK
Check ignition timing
Basic : 10˚ ± 2˚BTDC
NG
Check condition of assembly of engine
OK
Check spark plugs
Standard gap : 1.0~1.1mm
· Check compression if necessary
· Compression
Limit value : 10.5kg/cm² (170 psi)
(250~400rpm)
NG
Compression check
OK
Check fuel pressure
NG
· Fuel pump
· Fuel filter
· Fuel pressure regulator
OK
Check injectors
NG
Injection condition
OK


OK
Check MFI electronic circuit
· Wiring connections
· ECM power
1. Fusible link
2. Fuse
3. MFI control relay
· Engine coolant temperature sensor
· Intake air temperature sensor
· Injection signal circuit
1. Injector wiring
2. ECM
Engine hesitates or accelerates poorly
Check brakes
NG
Brake drag
OK
Check vacuum leaks in intake air line
NG
· Oil filler cap
· Oil level gauge
· Hose connections
· PCV hose
· Throttle body
· Air intake hose
OK
Check air cleaner element
NG
Clean or replace the element
OK
Check self-diagnosis
NG
Trouble codes
· Using voltmeter
· Using Hi-scan
OK
Check for ignition spark
· Unplug injector connectors
· Check for a spark by holding spark plug wire 8~10mm away from cylinder block during cranking engine.
NG
· High tension cable
· Ignition coil
OK
To be continuous



Troubleshooting

Symptom	Probable cause	Remedy
Engine will not crank	Low battery voltage	Charge or replace the battery
	Loose, corroded or worn battery cable(s)	Replace or re-tighten
	Defective transmission range switch (for vehicles with A/T only)	Adjustment or switch replacement
	Fusible link blown	Replace fusible link
	Starter motor faulty	Repair or replace
	Ignition switch faulty	Replace
Engine cranks slowly	Low battery voltage	Charge or replace the battery
	Loose, corroded or worn battery cable(s)	Replace or re-tighten

	Starter motor faulty	Repair or replace
Starter keeps running	Starter motor faulty	Repair or replace
	Ignition switch faulty	Replace
Starter spins but engine will not crank	Defective wiring	Repair wiring
	Broken starter motor pinion gear	Repair or replace
	Broken ring gear	Replace flywheel or torque converter ring gear

Fuel tank and fuel line

Symptom	Probable cause	Remedy
Engine malfunctions due to insufficient fuel supply	Bent or kinked fuel pipe or hose	Repair or replace
	Clogged fuel pipe or hose	Clean or replace
	Clogged fuel filter	Replace
	Water in fuel filter	Replace the fuel filter or clean the fuel tank and fuel lines
	Dirty or rusted fuel tank interior	Clean or replace
	Malfunctioning fuel pump (Clogged filter in the pump)	Replace
Evaporative emission control system malfunctions (Pressure is released when fuel filler cap is removed).	Incorrect vapor line	Repair wiring
	Separated vapor line	Replace
	Folded, bent, cracked or clogged vapor line	Repair or replace
	Separated vapor line (Defective overfill limiter)	Replace

DTC	Diagnostic items	Trouble area	Σ3.5
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	1) Dirty air cleaner 2) Air leak in intake system 3) Contaminated, deteriorated or damaged MAFS 4) Faulty mass air flow sensor or throttle position sensor 5) Poor connections at ECM, MAFS, or TPS	○
P0102	Mass or Volume Air Flow Circuit Low Input	1) Open or short to ground between MAFS and ECM 2) Open between MAFS and engine main relay 3) Short to battery between MAFS and ECM 4) Open between MAFS and ground 5) Faulty MAFS	○
P0103	Mass or Volume Air Flow Circuit High Input		○
P0106	Manifold absolute pressure sensor Circuit Malfunction	1) Open or short to ground between MAPS and ECM 2) Open between MAPS and ECM 3) Open between MAPS and ground 4) Poor connections between MAPS and ECM 5) Misplaced, loose or corroded terminals 6) Foreign materials fouled MAPS 7) Faulty MAPS	○
P0107	Manifold absolute pressure sensor Low Input		○
P0108	Manifold absolute pressure sensor High Input		○
P0112	Intake Air Temperature Circuit Low Input	1) Open or short to battery between IATS and ECM 2) Short to ground between IATS and ECM 3) Short between wires 4) Faulty IATS in MAFS	○
P0113	Intake Air Temperature Circuit High Input		○
P0116	Engine Coolant Temperature Sensor Circuit Range/ Performance Problem	1) After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) 2) Poor connections between ECTS and ECM 3) Misplaced, loose or corroded terminals 4) Foreign materials fouled, contaminated, deteriorated	○

		ECTS 5) Faulty ECTS 6) Faulty thermostat	
P0117	Engine Coolant Temperature Circuit Low Voltage	1) Open or short to battery between ECTS and ECM 2) Short to ground between ECTS and ECM 3) Short between ECTS wires 4) Faulty ECTS	○
P0118	Engine Coolant Temperature Circuit High Voltage		○
P0121	Throttle Position Sensor Circuit Range/Performance Problem	1) Open or short to ground between TPS and ECM 2) Short to battery between TPS and ECM 3) Short between TPS wires 4) Poor connections between TPS and ECM 5) Misplaced, loose or corrodes terminals 6) Contaminated, deteriorated TPS 7) Faulty TPS	○
P0122	Throttle Position Sensor Circuit Low Input		○
P0123	Throttle Position Sensor Circuit High Input		○
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control	1) After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) 2) Poor connections between ECTS and ECM 3) Misplaced, loose or corroded terminals 4) Foreign materials fouled, contaminated, deteriorated ECTS 5) Faulty ECTS 6) Faulty thermostat	○
P0128	Coolant thermostat stuck	1) Thermostat stuck opened	○
P0130	HO2S Circuit Open (Bank 1, Sensor 1)	1) Open or short to battery between front HO2S and ECM 2) Short to ground between front HO2S and ECM 3) Short between front HO2S wires 4) Faulty front HO2S 5) Poor connections between front HO2S and ECM 6) Misplaced, bent, loose or corroded connector terminals	○
P0131	HO2S Circuit Short to ground (Bank 1, Sensor 1)		○
P0132	HO2S Circuit Short to 5V (Bank 1, Sensor 1)		○
P0133	HO2S Circuit Slow Responsive (Bank 1, Sensor 1)	1) Abnormal combustion 2) Improper fuel pressure 3) Front and rear HO2S connections reversed 4) Faulty fuel delivery system 5) Leak in intake system 6) Leak in exhaust system 7) Faulty front HO2S	○
P0134	HO2S Circuit No Activity Detected (Bank 1, Sensor 1)	1) Open or short between HO2S signal terminal and ECM 2) Contaminated, deteriorated or aged HO2S 3) Misplaced, bent, loose or corroded connector terminals 4) Faulty HO2S	○
P0135	HO2S Heater Circuit Malfunction (Bank 1, Sensor 1)	1) Open or short to battery between front HO2S heater and ECM 2) Open or short to ground between HO2S heater and main relay 3) Short to ground between front HO2S heater and ECM 4) Incorrect front HO2S heater resistance 5) Faulty front HO2S heater	○
P0136	HO2S Circuit Open (Bank 1, Sensor 2)	1) Open or short to chassis ground between rear HO2S and ECM 2) Short to battery between rear HO2S and ECM 3) Short between rear HO2S wires 4) Misplaced, bent, loose or corroded connector terminals	○
P0137	HO2S Circuit Short to ground (Bank 1, Sensor 2)		○
P0138	HO2S Circuit Short to 5V (Bank 1,		○

	Sensor 2)	5) Faulty rear HO2S	
P0139	HO2S Heater Circuit Malfunction (Bank 1, Sensor 2)	1) Open or short to chassis ground between rear HO2S and ECM 2) Short to battery between rear HO2S and ECM 3) Short between rear HO2S wires 4) Misplaced, bent, loose or corroded connector terminals 5) Faulty rear HO2S	○
P0140	HO2S Heater Circuit Malfunction-stick (Bank 1, Sensor 2)		○
P0141	HO2S Heater Circuit Malfunction (Bank 1, Sensor 2)	1) Open or short to battery between rear HO2S heater and ECM 2) Open or short to ground between HO2S heater and main relay 3) Short to ground between rear HO2S heater and ECM 4) Incorrect rear HO2S heater resistance 5) Faulty rear HO2S heater	○
P0150	HO2S Circuit Open (Bank 2, Sensor 1)	1) Open or short to battery between front HO2S and ECM 2) Short to ground between front HO2S and ECM 3) Short between front HO2S wires 4) Poor connections between front HO2S and ECM 5) Misplaced, bent, loose or corroded connector terminals 6) Faulty front HO2S	○
P0151	HO2S Circuit Short to ground (Bank 2, Sensor 1)		○
P0152	HO2S Circuit Short to 5V (Bank 2, Sensor 1)		○
P0153	HO2S Circuit Slow Responsive (Bank 2, Sensor 1)	1) Abnormal combustion 2) Improper fuel pressure 3) Front and rear HO2S connections reversed 4) Faulty fuel delivery system 5) Leak in intake system 6) Leak in exhaust system 7) Faulty rear HO2S	○
P0154	HO2S Circuit No Activity Detected (Bank 2, Sensor 1)	1) Open or short between HO2S signal terminal and ECM 2) Contaminated, deteriorated or aged HO2S 3) Misplaced, bent, loose or corroded connector terminals 4) Faulty HO2S	○
P0155	HO2S Heater Circuit Malfunction (Bank 2, Sensor 1)	1) Open or short to battery between front HO2S heater and ECM 2) Short to ground between front HO2S heater and ECM 3) Open or short to ground between HO2S heater and main relay 4) Incorrect front HO2S heater resistance 5) Faulty front HO2S heater	○
P0156	HO2S Circuit Open (Bank 2, Sensor 2)	1) Open or short to battery between rear HO2S and ECM 2) Short to ground between rear HO2S and ECM 3) Short between rear HO2S wires 4) Poor connections between rear HO2S and ECM 5) Misplaced, bent, loose or corroded connector terminals 6) Faulty rear HO2S	○
P0157	HO2S Circuit Short to ground (Bank 2, Sensor 2)		○
P0158	HO2S Circuit Short to 5V (Bank 2, Sensor 2)		○
P0159	HO2S Circuit Malfunction (Bank 2, Sensor 2)	1) Open or short to battery between rear HO2S and ECM 2) Short to ground between rear HO2S and ECM 3) Short between rear HO2S wires 4) Poor connections between rear HO2S and ECM 5) Misplaced, bent, loose or corroded connector terminals 6) Faulty rear HO2S	○
P0160	HO2S Circuit Malfunction-stick (Bank 2, Sensor 2)		○
P0161	HO2S Heater Circuit Malfunction (Bank 2, Sensor 2)	1) Open or short to battery between front HO2S heater and ECM 2) Short to ground between front HO2S heater and ECM 3) Open or short to ground between HO2S heater and main	○

		relay 4) Incorrect front HO2S heater resistance 5) Faulty rear HO2S heater	
P0171	Fuel System Too Lean (Bank 1)	1) Faulty fuel delivery system 2) Clogged fuel injectors 3) Faulty fuel injectors 4) Leak in intake system 5) Leak in exhaust system 6) Faulty MAFS 7) Faulty TPS	○
P0174	Fuel System Too Lean (Bank 2)		○
P0172	Fuel System Too Rich (Bank 1)	1) Faulty ignition system 2) EVAP canister purge valve malfunction 3) Leak in intake system 4) Leak in exhaust system 5) Faulty fuel delivery system - Clogged fuel injectors - Faulty fuel injectors - Fuel pressure too high - Fuel pressure regulator failure 6) Faulty MAFS 7) Faulty front HO2S 8) Faulty TPS	○
P0175	Fuel System Too Rich (Bank 2)		○
P0181	Difference of Fuel Temperature and Engine Coolant Temperature at Start is too Large	1) Open or short to battery between FTS and ECM 2) Short to ground between FTS and ECM 3) Short between FTS wires 4) Faulty FTS	○
P0182	Fuel Temperature Circuit Low input		○
P0183	Fuel Temperature Circuit High input		○
P0201	Cylinder 1 Injector Circuit Malfunction	1) Open or short between main relay and injectors 2) Open or short between ECM and injectors 3) Short to battery between ECM and injectors 4) Faulty fuel injector	○
P0202	Cylinder 2 Injector Circuit Malfunction		○
P0203	Cylinder 3 Injector Circuit Malfunction		○
P0204	Cylinder 4 Injector Circuit Malfunction		○
P0205	Cylinder 5 Injector Circuit Malfunction		○
P0206	Cylinder 6 Injector Circuit Malfunction		○
P0300	Random Misfire Detected	1) Vacuum leak in air intake system 2) CKPS circuit malfunction 3) Ignition circuit malfunction 4) Faulty ignition coil or plug wire 5) Spark plug malfunction 6) Low compression due to blown head gasket, leaking valve or piston ring 7) Low/high fuel pressure due to faulty pressure regulator, restricted fuel lines, plugged fuel filter or faulty fuel pump 8) Fuel injector circuit malfunction Faulty fuel injector	○
P0301	Cylinder 1 Misfire Detected		○
P0302	Cylinder 2 Misfire Detected		○
P0303	Cylinder 3 Misfire Detected		○
P0304	Cylinder 4 Misfire Detected		○
P0305	Cylinder 5 Misfire Detected		○
P0306	Cylinder 6 Misfire Detected		○
P0320	Ignition Failure Sensor circuit Malfunction	1) Open or short between ignition failure sensor and ECM 2) Open or short between ignition failure sensor and ignition coil 3) Open between ignition failure sensor and ground 4) Faulty ignition failure sensor	○
		1) Open or short to GND between knock sensor and ECM	

P0325	Knock Sensor Circuit Malfunction	2) Source of high resistance between knock sensor and ECM 3) Faulty knock sensor	▲
P0335	Crankshaft Position Sensor Circuit Malfunction	1) Open or short to ground between CKPS and ECM 2) Short to battery between CKPS and ECM 3) Short between CKPS wires 4) Out of allowable air gap 5) Faulty Target wheel tolerance 6) Faulty CKPS	○
P0340	Camshaft Position Sensor Circuit Malfunction	1) Open or short to ground between CMPS and ECM 2) Short to battery between CMPS and ECM 3) Short between CMPS wires 4) Faulty CMPS	○
P0350	Ignition Coil Primary/Secondary Circuit Malfunction	1) Open or short between ignition coil and ECM 2) Open or short between ignition coil and spark plug 3) Short between ignition coil wires 4) Faulty ignition coil 5) Poor connection at ignition coil 6) Faulty ignition system	○
P0421	Main catalyst efficiency deterioration (Bank1)	1) Catalytic converter deteriorated	○
P0431	Main catalyst efficiency deterioration (Bank 2)	1) Catalytic converter deteriorated	○
P0441	EVAP Emission Control System Purge Solenoid Valve stuck opened	1) Purge solenoid valve stuck opened	○
P0442	EVAP Emission Control System Small Leak (1mm)	1) Fuel filler cap loose or missing 2) Fuel filler cap o-ring missing or damaged 3) Faulty or damaged fuel filler pipe 4) Leaking,, disconnected or plugged fuel vapor lines 5) Fuel in lines due to faulty Rollover Valve (RV), On-Board Refueling Vapor Recovery Valve (ORVR valve) 6) Canister close valve clogged, stuck open or closed 7) Improperly installed purge solenoid valve (PSV) 8) PSV stuck open or closed 9) Faulty fuel tank pressure sensor 10) Leaking canister or catch tank	○
P0455	EVAP emission control system large leak detected		○
P0456	EVAP Emission Control System Small Leak (0.5mm)		○
P0443	EVAP Emission Control System Purge Control Valve Circuit Malfunction	1) Open or short between main relay and purge solenoid valve 2) Open or short between purge solenoid valve and ECM 3) Faulty purge solenoid valve	○
P0446	EVAP Emission Control System Vent Circuit Malfunction	1) Open or short to ground between main relay and CCV 2) Open or short to battery between CCV and ECM 3) Short to ground between CCV and ECM 4) Faulty CCV	○
P0451	EVAP Emission Control System Fuel Tank Pressure Sensor Range/Performance Problem	1) Poor connections between FTPS and ECM 2) Misplaced, loose, bent or corroded terminals 3) Contaminated, deteriorated or damaged FTPS 4) Blocked vapor hose between canister and CCV 5) Stuck closed CCV 6) Faulty FTPS	○
P0452	EVAP Emission Control System Fuel Tank Pressure Sensor Low Input	1) Open or short to battery between FTPS and ECM 2) Short to ground between FTPS and ECM 3) Poor connections between FTPS and ECM 4) Misplaced, loose or corroded terminals	○
	EVAP Emission Control System		

P0453	Fuel Tank Pressure Sensor High Input	5) Faulty FTPS	○
P0460	Fuel Level Sensor Circuit Malfunction	1) Open or short to battery between FLS and ECM 2) Short to ground between FLS and ECM 3) Poor connections between FLS and ECM 4) Misplaced, loose, bent or corroded terminals 5) Faulty FLS or FLS stuck	▲
P0462	Fuel Level Sensor Low-Stick		▲
P0463	Fuel Level Sensor High-Stick		▲
P0506	Idle Control System RPM Lower Than Expected	1) Open or short between main relay and ISC STM (stepper motor) 2) Open or short between ECM and ISC STM 3) Carbon fouled throttle plate 4) Faulty ISC STM	○
P0507	Idle Control System RPM Higher than Expected	1) Short to ground between ISC STM and ECM 2) Air leak in intake system between head and throttle plate 3) Improperly adjusted accelerator cable 4) Carbon fouled throttle plate 5) Faulty ISC STM 6) Faulty TPS 7) Faulty PCV/PSV	○
P0510	Idle Switch Circuit Malfunction	1) Open or short to battery between idle switch and ECM 2) Short to ground between idle switch and ECM 3) Faulty idle switch	○
P0560	Battery backup line open	1) Open or short between ECM and battery 2) ECM internal faulty	○
P1159	VICS Valve Circuit Malfunction	1) Open or short to Chassis Ground Between VICS Valve and ECM 2) Faulty VICS Valve	▲
P1330	Spark Timing Adjustment	1) Short to GND between ROM change tool and ECM	○
P0551	Power Steering Switch Malfunction	1) Open between power steering switch and ECM 2) Short to ground between power steering switch and ECM 3) Faulty power steering switch	○

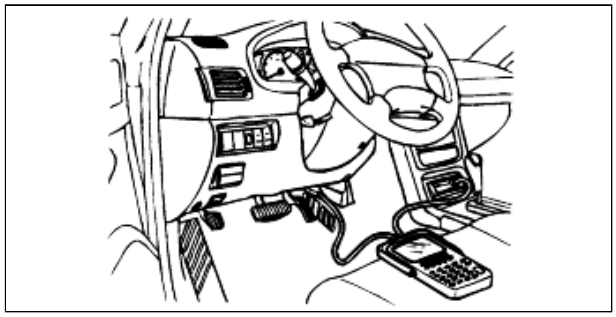
○ : Means fault code memory and MIL ON
▲ : Means fault code memory and MIL OFF
- : No application

Service adjustment procedures

Idle speed check procedures

Checking conditions;
Engine coolant temperature is 80 to 95°C (176 to 205°F).
Lights, electric cooling fan and all accessories are off.
Transaxle is in neutral ["P" or "N" range for A/T vehicles].
Steering wheel is straight forward position (Vehicles with power steering).

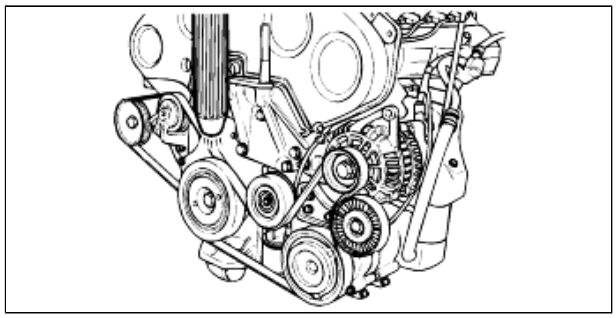
1. Using the Hi-scan, connect the cable at DLC terminal as shown in figure.



2. Ground the ignition timing adjustment terminal.
3. Run the engine and let it idle.
4. Check the basic ignition timing.

Basic ignition timing : 10° ± 2° BTDC (At idle)

5. To check idle speed, be sure stop grounding the ignition timing adjustment terminal.



6. Let the engine idle for 2 minutes.
7. Check the idle speed.

Idle speed : 700 ± 100 rpm

NOTE

The idling speed is automatically regulated by the idle-speed control system. If not within the standard value range, refer to the [Basic idle speed adjustment]

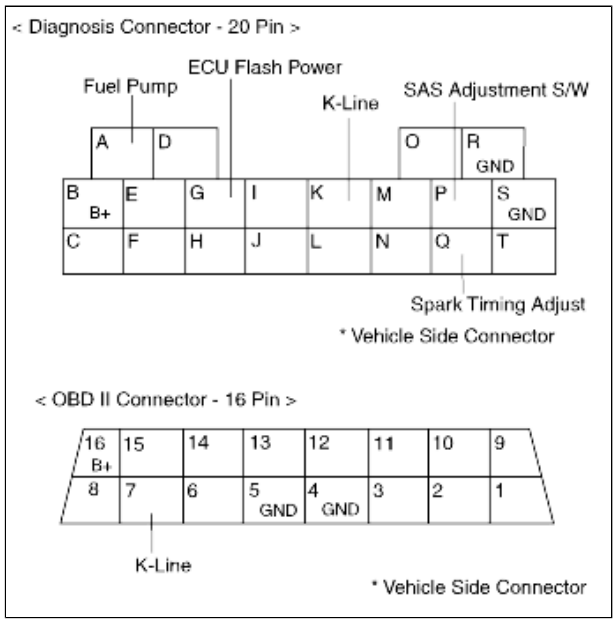
Basic idle speed adjustment

NOTE

1) Before adjusting idle speed, be sure to check the basic ignition timing and adjust if out of specification. Check that the spark plugs, injectors, ISC motor, compression, etc. are normal.
2) Clean the throttle body area.

Adjustment conditions;
Engine coolant temperature is 80 to 95°C (176 to 205°F).
Lights, electric cooling fan and all accessories are off.
Transaxle is in neutral ["P" or "N" range for A/T vehicles].
Steering wheel in straight forward position (Vehicles with power steering).

1. Loosen the accelerator cable.
2. Connect the HI-SCAN to the data link connector in the fuse box.
3. If the HI-SCAN is not used, connect a tachometer, and ground the NO.8 pin in the data link connector.



> **NOTE**
>
> Because the connection of the HI-SCAN grounds the diagnosis control terminal, be sure that steps 2 and 3 be done before going to the next step 4.

4. Ground the ignition timing adjustment terminal.
5. Run the engine for more than 5 seconds at an engine speed of 2,000 to 3,000 rpm.
6. Run the engine at idle for 2 minutes.
7. Check that the engine rpm is within the standard value.

Basic idle speed : 700 ± 100 rpm

> **NOTE**
>
> 1) The engine speed on a new vehicle driven less than 500 Km (300 miles) may be 20 to 100 rpm lower than specification, but no adjustment is necessary.
> 2) If the engine stalls or the engine speed is low after the vehicle has been driven a distance of 500 km (300 miles) or more, it is probable that deposits are adhered to the throttle valve, so clean it. Refer to the throttle body cleaning.

8. If the basic idle speed is out of specification, adjust using the speed adjusting screw (SAS) for the standard rpm. In adjusting use a tachometer.

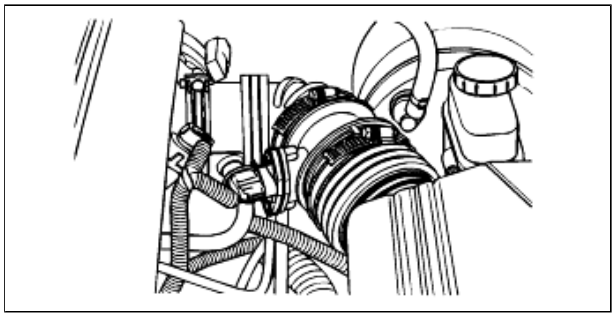
> **NOTE**
>
> If the idle speed is higher than specified, even with the speed adjusting screw (SAS) fully closed, check whether there is any indication that the idle switch (fixed SAS) has been moved or not. If there is an indication that it has been moved, adjust the idle switch (fixed SAS). Refer to the idle switch adjustment.

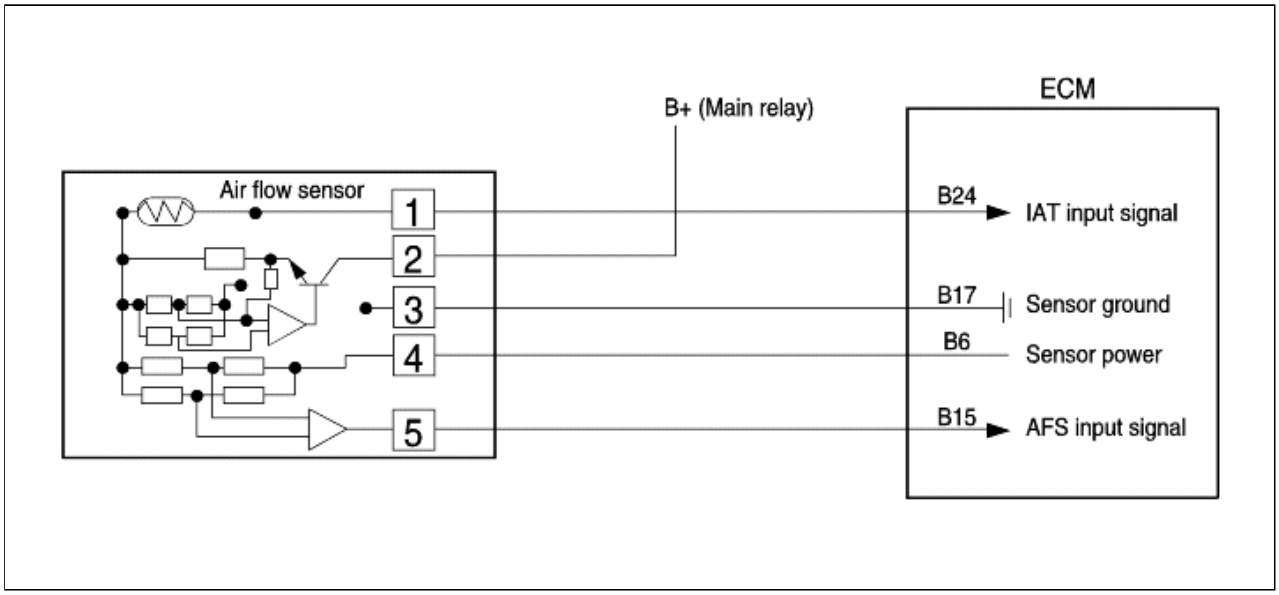
9. Turn the ignition switch to the OFF position.
10. If the scan tool was not used, disconnect the data link connector.
11. Disconnect the lead wire from the ignition timing adjusting terminals.
12. Run the engine again and let it idle for about 10 minutes. Check that the engine is in normal idling condition.
13. Adjust the accelerator cable.

MAFS, IAT

The air flow sensor adopts the feature of maintaining a certain temperature of the heater for sensor to make the hot film element detect the air flow and send related signal to the ECM.
The ECM then determines the fuel amount and ignition timing and check the information to apply the fuel and A/C load

correction.
The IAT is used to detect the temperature of intake air to support the correction of fuel flow and ignition timing, and the compensation of air temperature for idle control.



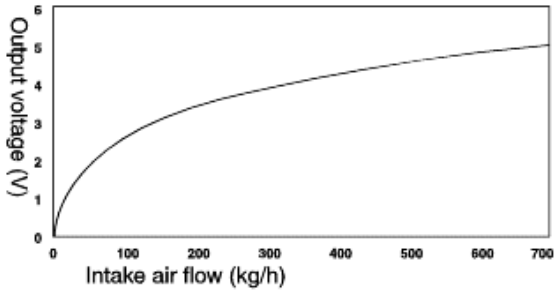


[Major features of HOT FILM AFS]

Item	Features	Remarks
Power supply	7.5 ~ 16 V	
Temperature regulating range	-40°C ~ 125°F	
Flow detecting range	7 ~ 640kg/h	
Output voltage	0 ~ 5V	
	0.5V at idling	
	1.0V at 2000 rpm	
Connector	PIN1: Intake air temperature sensor output	
	PIN2: Battery power	
	PIN3: Sensor ground	
	PIN4: Sensor power (5V)	
	PIN5: Air flow sensor output	

[Features of output of HOT FILM MAFS]

Output voltage (V)	Air mass (kg/h)	Output voltage (V)	Air mass (kg/h)
0.3	7.34	3.0	149.07
0.5	10.06	3.5	226.66
1.0	19.85	4.0	335.66
1.50	35.58	4.5	500.16
2.0	58.79	4.76	614.61
2.5	94.70	5.00	730.01



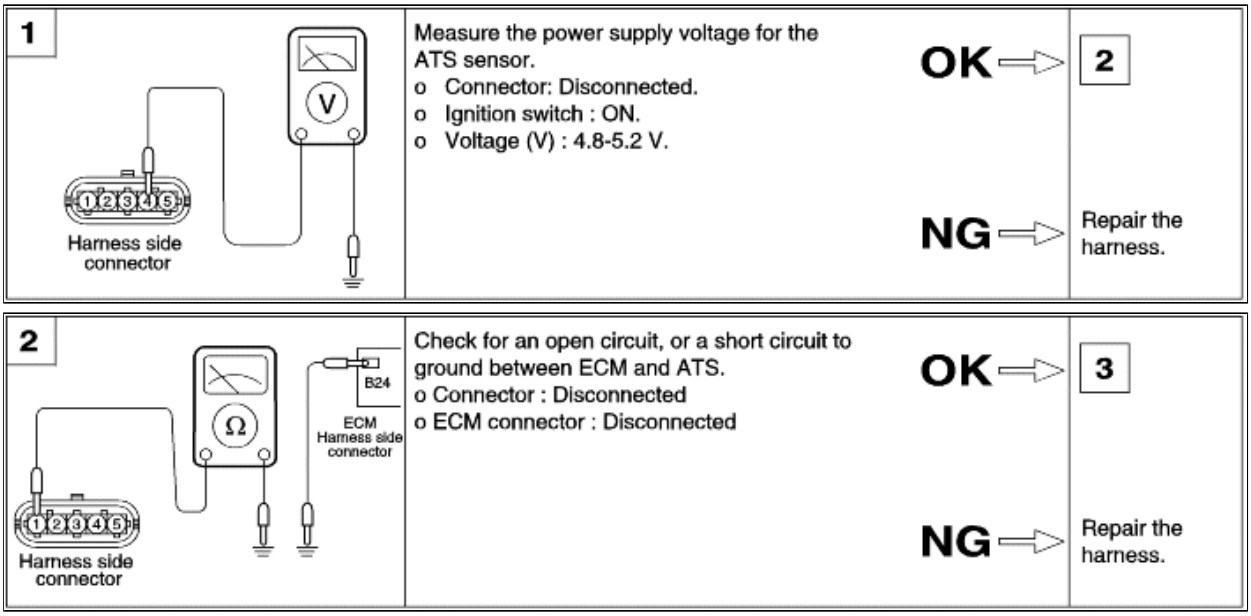
Troubleshooting hints

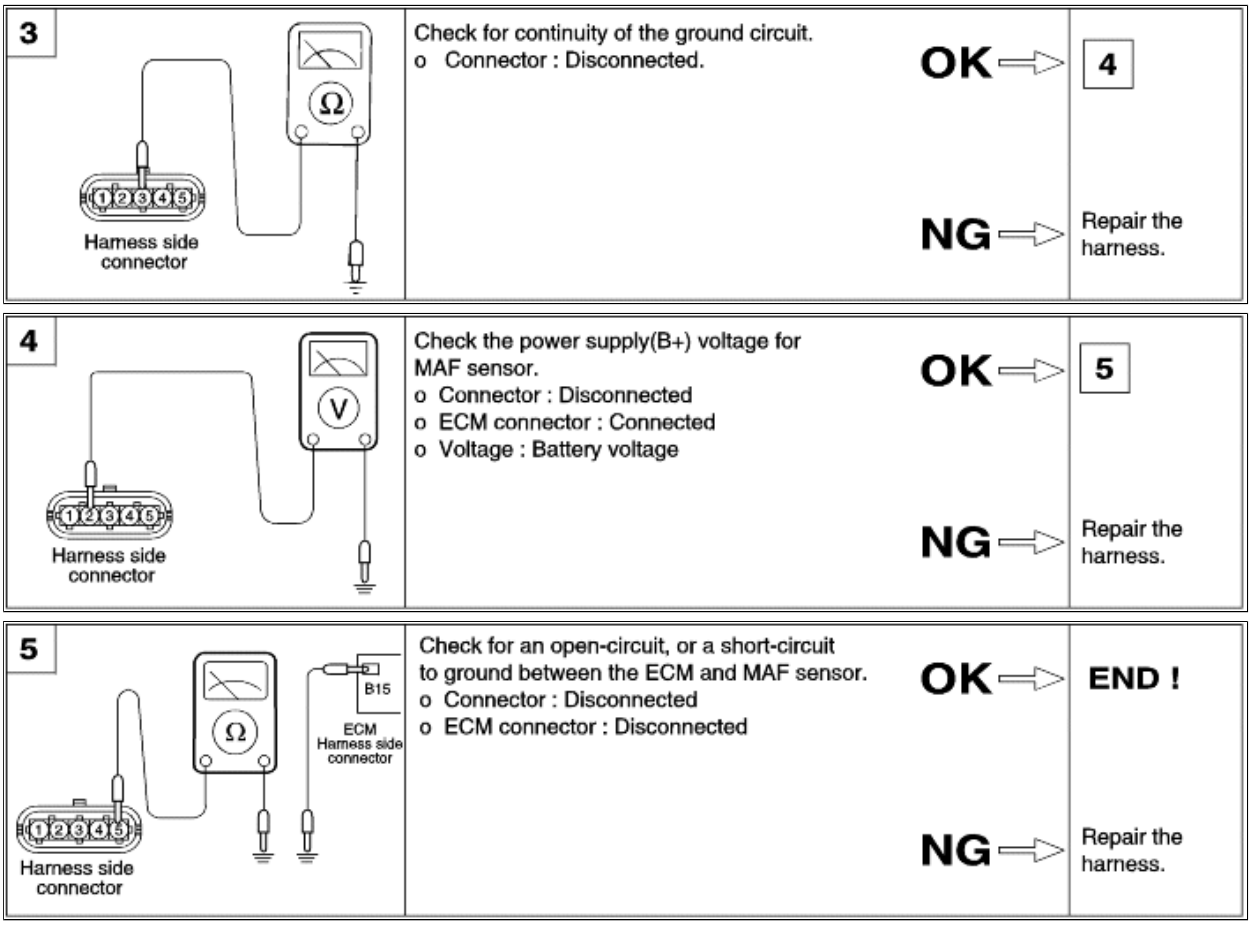
1. If the engine stalls occasionally, start the engine and shake the MAFS harness. If the engine stalls, check for poor contact at the MAFS connector.
2. If the MAFS sensor output voltage is other than 0 when the ignition switch is turned ON(do not start the engine), check for faulty MAFS and ECM.
3. If the engine can idle even if the MAFS output voltage is out of specification, check the conditions as below:
   A. Air flow distributed from MAFS, disconnected air duct and clogged air cleaner filter.
   B. Poor combustion in the cylinder, faulty spark plug, ignition coil, injector and incorrect comparison.
4. Though no MAFS malfunction occurs, check the mounting direction of the MAFS.

NOTE

1) The air quantity of mass air flow sensor will be about 10% higher in case of new vehicle (within initial running of about 500km (300 miles)).
2) Use an accurate digital voltmeter.
3) Before checking, warm up the engine until the engine coolant temperature reaches 80~90°C (175~198°F).

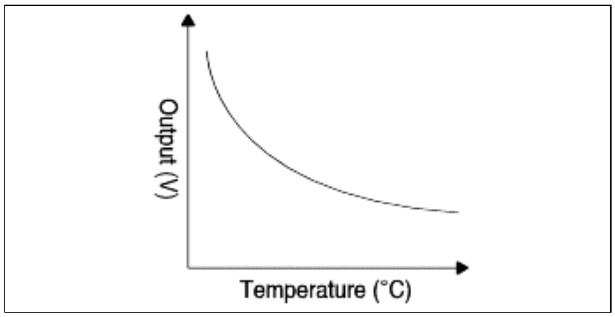
Harness inspection (MAFS)





Features of IAT output

For the measure feature of the IAT at malfunction, if the coolant temperature is normal, the intake air substitution value is 0°C when the coolant temperature is below 69.75°C while the value is 60°C when the coolant temperature is over 69.75°F.
The substitution value should be 60°C when the engine coolant temperature sensor is failed simultaneously.



Using voltmeter

Item to check	Data output	Condition to check	Intake air temp.	Resistance
Intake air temp. sensor	Intake air temp.	Ignition switch: ON or starting	-40°C	33.85~61.20 kΩ
			20°C	2.22~2.82 kΩ
			80°C	0.299~0.375 kΩ

Trobleshooting hints

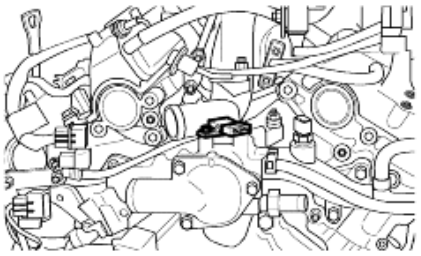
The MIL is turned ON and DTC (diagnostic trouble code) displayed on Hi-scan under the conditions as below.

1. The manifold pressure indicates 118mb or less for 0.1 second when the ignition key is turned on.
2. The manifold pressure indicates 118mb or less when the rate is 1980 rpm or less.
3. The rate is 2400rpm or above when the manifold pressure indicates 986mb or above, or the accelerator pedal is released (on decceleration).

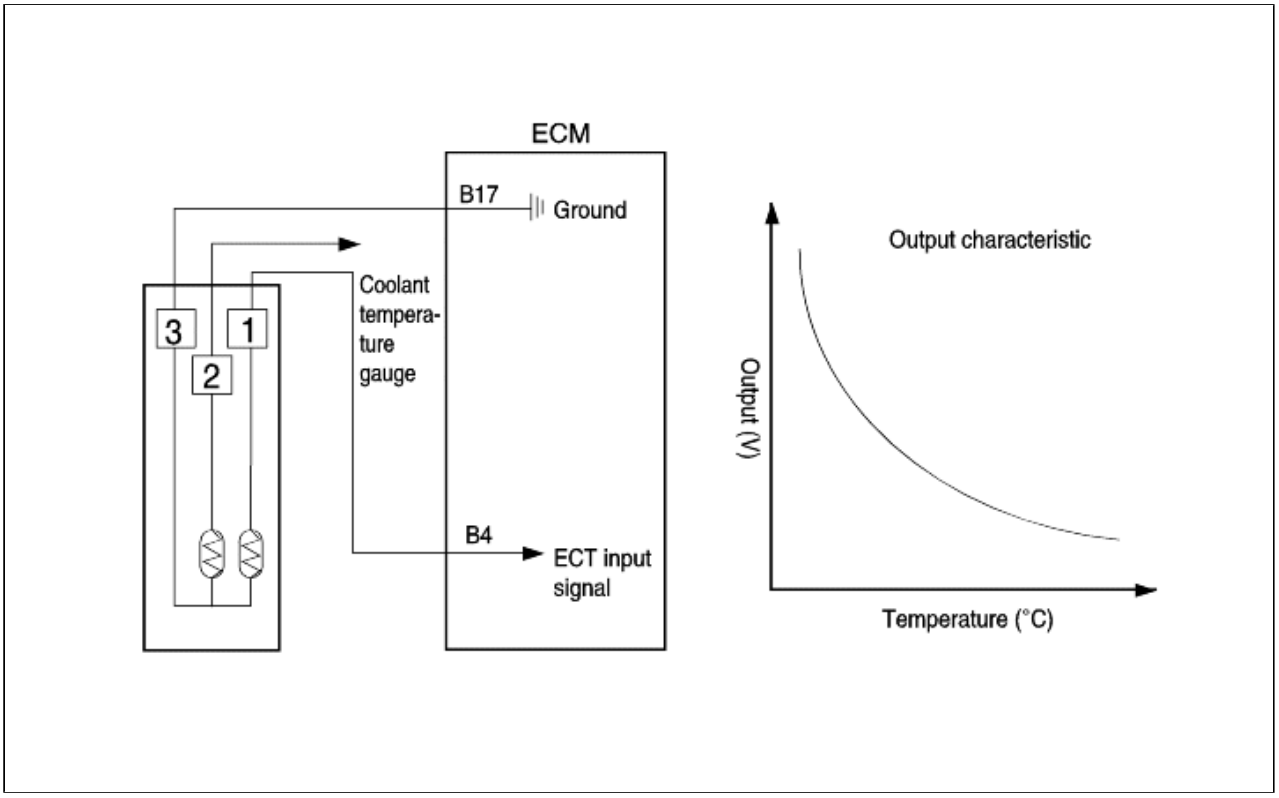
ECTS

Measure engine coolant temperature using NTC (Negative temperature coefficient) element. The thermistor resistance of NTC

element decrease in response to rise of temperature.
It's used in determination of basic fuel quantity and ignition timing at starting, determination of basic idle control duty at starting, fuel and cooling fan control, and emission gas temperature modeling necessary for controlling emissions.



[ECTS circuit and output features]



The measure at sensor malfunction is to take the initial intake air temperature as basic substitution value of coolant temperature and increase it up to max. 110°C in the interval of 0.5 sec in response to the quantity of air.
In case of the intake air temperature sensor malfunction, first take the substitution value of coolant temperature at 20°C and increase it up to 110°C in the interval of 0.5 second by the air quantity.
In case of intake air temperature sensor malfunction during engine running, first determine a proper temperature before first finding the trouble cause, and then increase it up to 110°C in the interval of 0.5 second by the air quantity.

Checking the sensor

1. Using Hi-scan

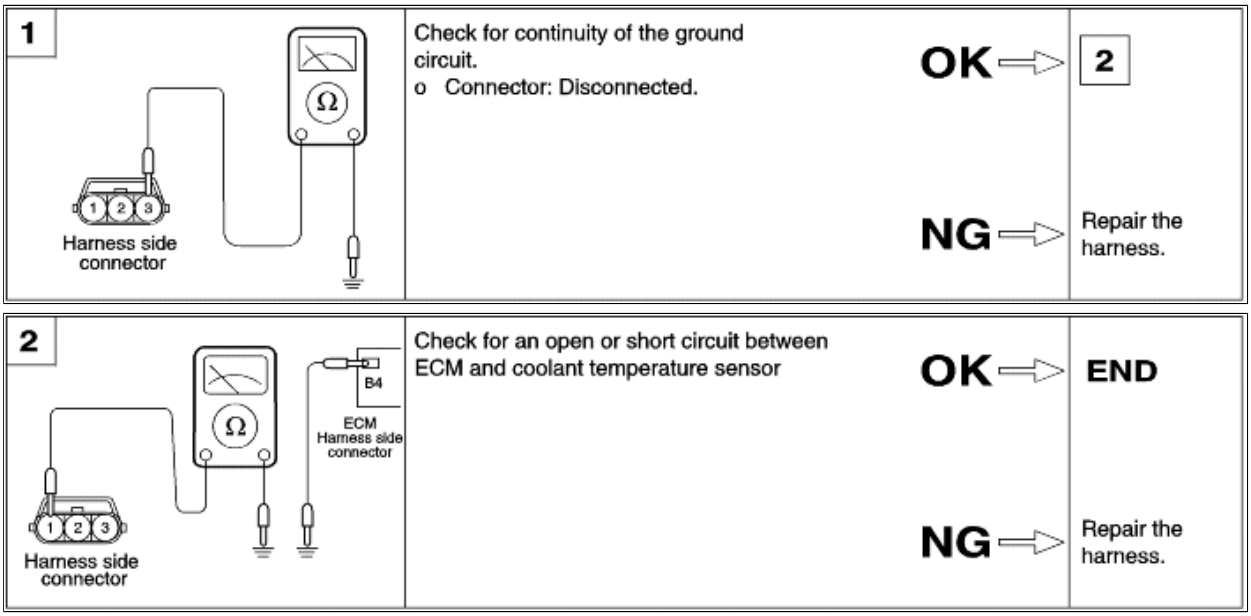
Check item	Data display	Check conditions	Coolant temp. sensor	Resistance
Coolant tempera-ture sensor	Coolant tempera-ture sensor	Ignition switch: ON or starting condition	-40 °C (-4 °F)	43.51 ~ 53.26 kΩ
			20 °C (68 °F)	2.31 ~ 2.59 kΩ
			80 °C (176 °F)	0.314 ~ 0.331 kΩ
			110 °C (230 °F)	0.145 ~ 0.149 kΩ

2. Using multi-tester
   (1) Remove the engine coolant temperature sensor from air intake manifold.
   (2) Soak the sensor part of the engine coolant temperature sensor to hot water and check the resistance value.

Temperature (°C)	Resistance (kΩ)
0 °C (32 °F)	5.9
20 °C (68 °F)	2.31 ~ 2.59
40 °C (104 °F)	1.1
80 °C (176 °F)	0.31 ~ 0.331

(3) Replace the sensor if the resistance deviates from the standard value.

Harness inspection



Troubleshooting hints

If the fast idle speed is not enough or the engine gives off dark smoke during the engine warm-up operation, the engine coolant temperature sensor might be faulty.

Installation

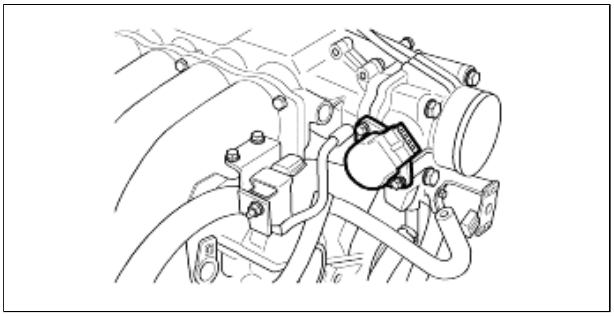
1. Apply sealant LOCTITE 962T or equivalent to the threaded portion.
2. Install the engine coolant temperature sensor and tighten it to specified torque.

Tightening torqueEngine coolant temperature sensor : 14.5~28.9 lb·ft (200~400 kg·cm)

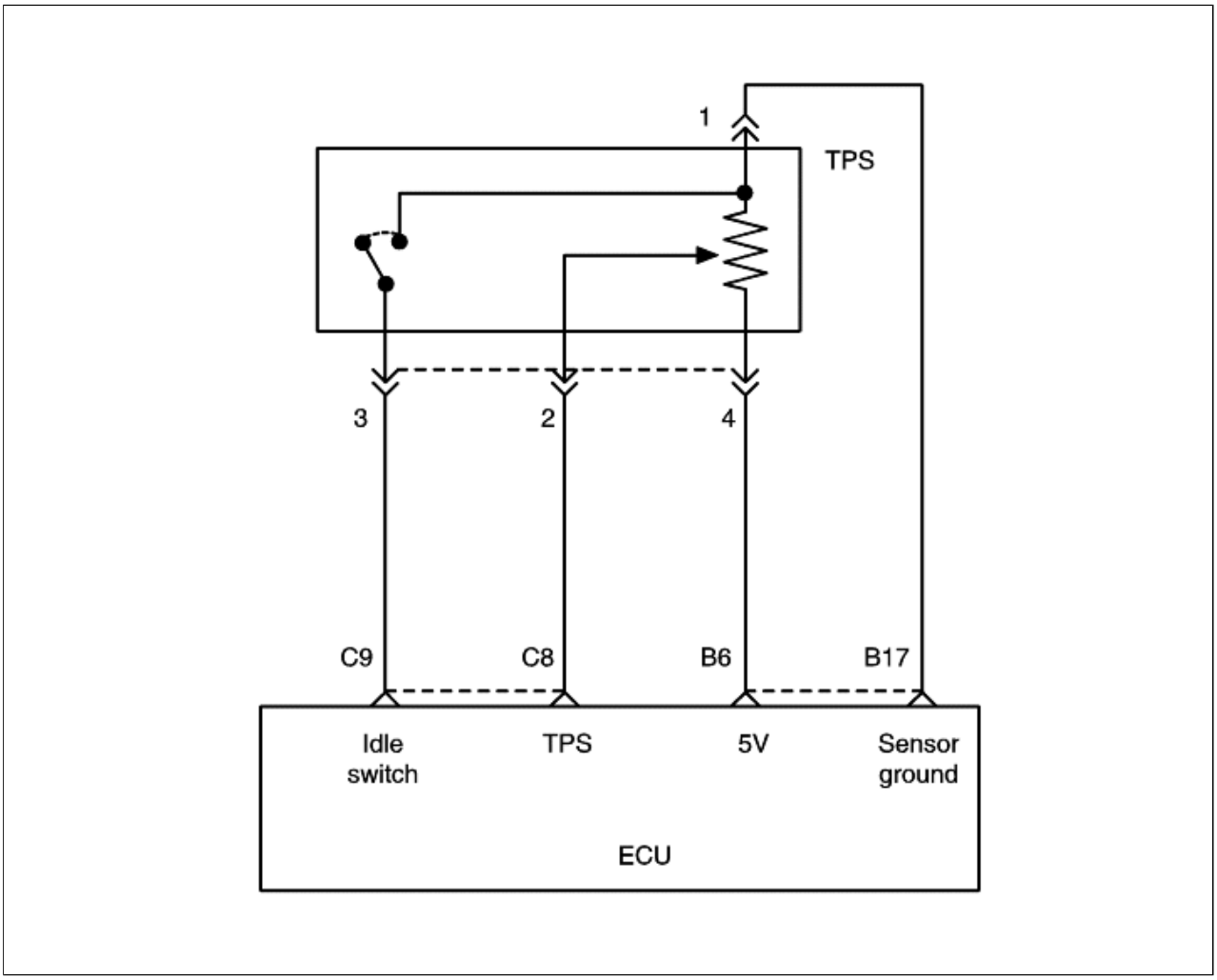
3. Securely connect the harness connector.

TPS

The TP sensor is a variable resistor type that rotates with the throttle body throtthle shft to sense the throttle valve angle. As the throttle shaft rotates, the output vlotage of the TP sensor changes. The ECM detects the throttle valve opening based on voltage change.



[TPS circuit]



Using ohmmeter

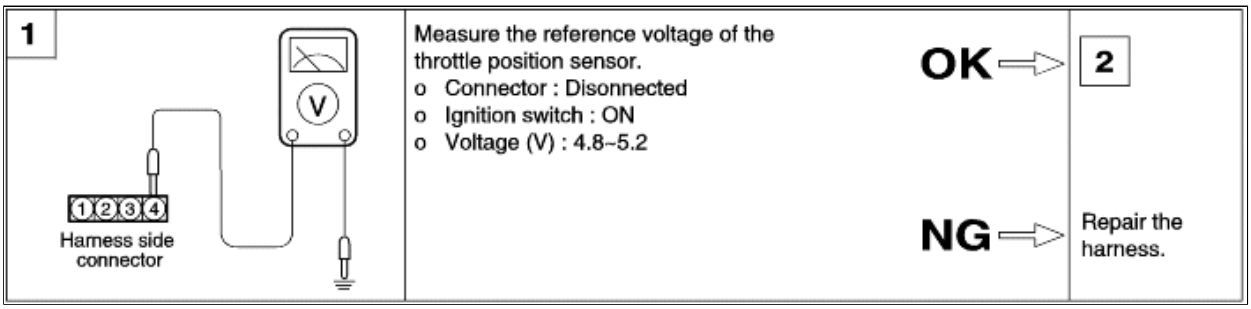
1. Disconnect the throttle position sensor connector.
2. Measure the resistance between terminal 1 (ground) and terminal 4 (sensor power).

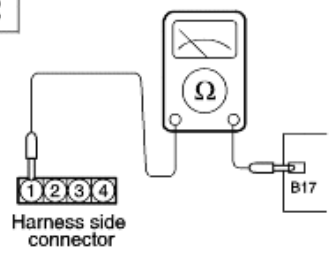
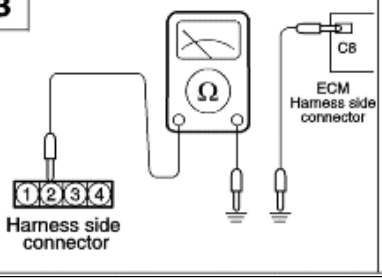
   Standard value : 3.5~6.5kΩ

3. Measure the resistance between terminal 1 (ground) and terminal 2 (sensor output).
4. Operate the throttle valve slowly from the idle position to full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.
5. If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

   Tightening torqueTPS : 1.5~2.5N·m(15~25kg·cm, 1.1~1.8lb·ft)

Harness inspection



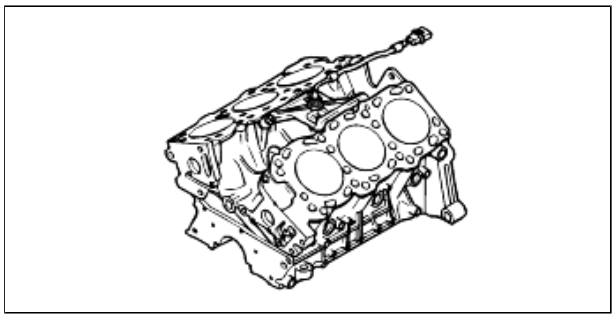
2 	Check for continuity of the sensor ground circuit. o Connector : Disonnected	OK ⇨ NG ⇨	3 Repair the harness.
3 	Check for an open-circuit, or short-circuit to ground between the engine control module and the throttle position sensor. o Throttle positon sensor connector : Disconnected. o Engine control module connector : Disconnected	OK ⇨ NG ⇨	END Repair the harness.

Troubleshooting hints

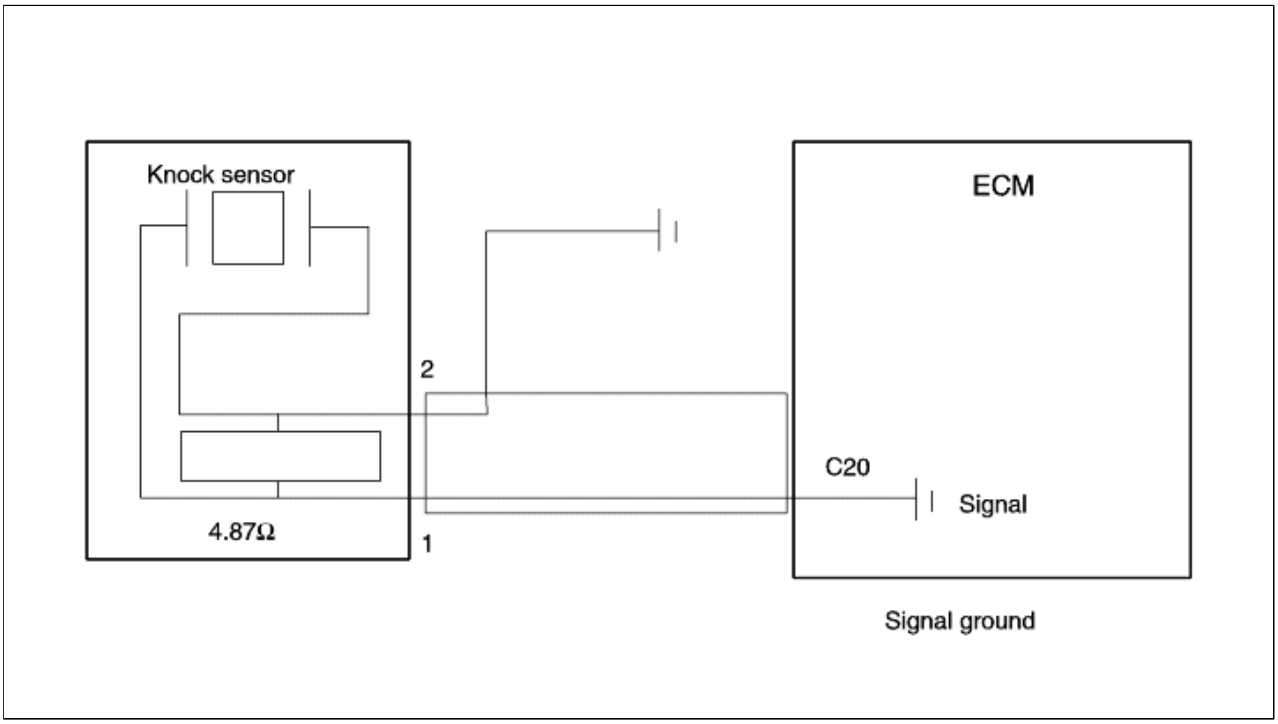
The TPS signal is important in the control of the automatic transaxle. Shift shock and othe trouble will occur if the sensor is faulty.

Knock sensor

A knock sensor with piezoelectric element (ceramic) is attached to the center of cylinder block of each bank #1/#2 to sense the engine knocking condition (Check for knocking for each cylinder).
The piezoelectric device output (V) = Q/C =2dF/C (d= piezoelectric integer, C = Electrostatic capacity).
The ignition timing for MBT, Minimum spark advance for best torque, is located at the positions front and rear to the knocking limit and the ECM performs the control to make the engine to operate in optimum condition before the knocking limit.



[Knock sensor circuit diagram]

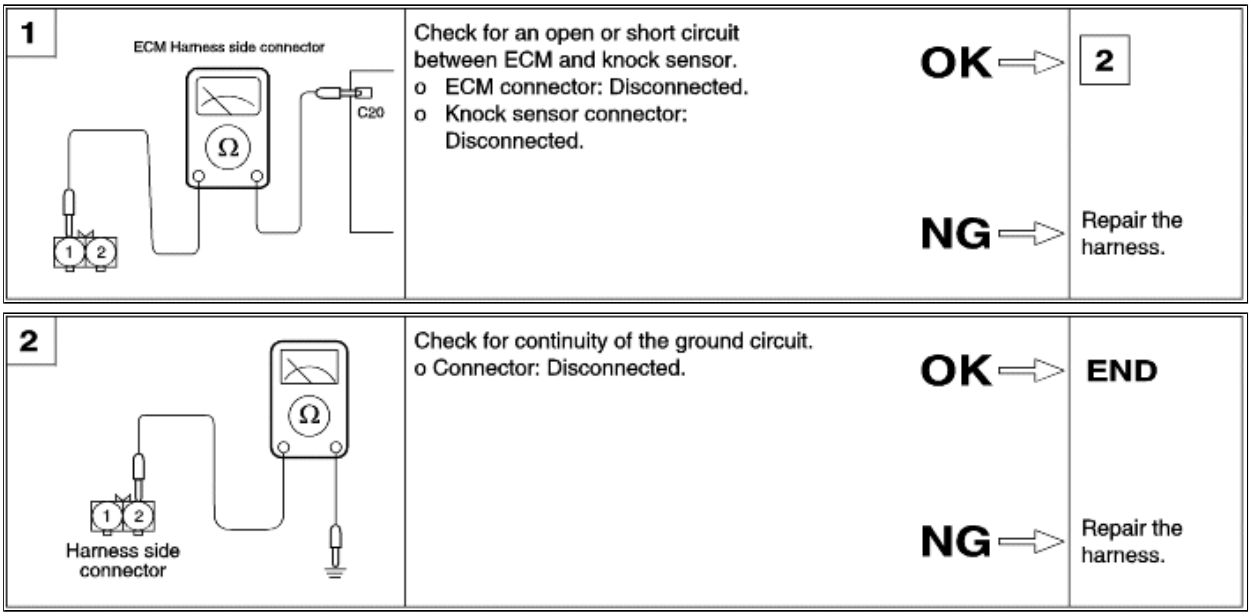


When the knock sensor malfunctions, the ignition timing is corrected by the MAP values such as engine rate, air flow and engine coolant temperature, etc.

Trobleshooting hints

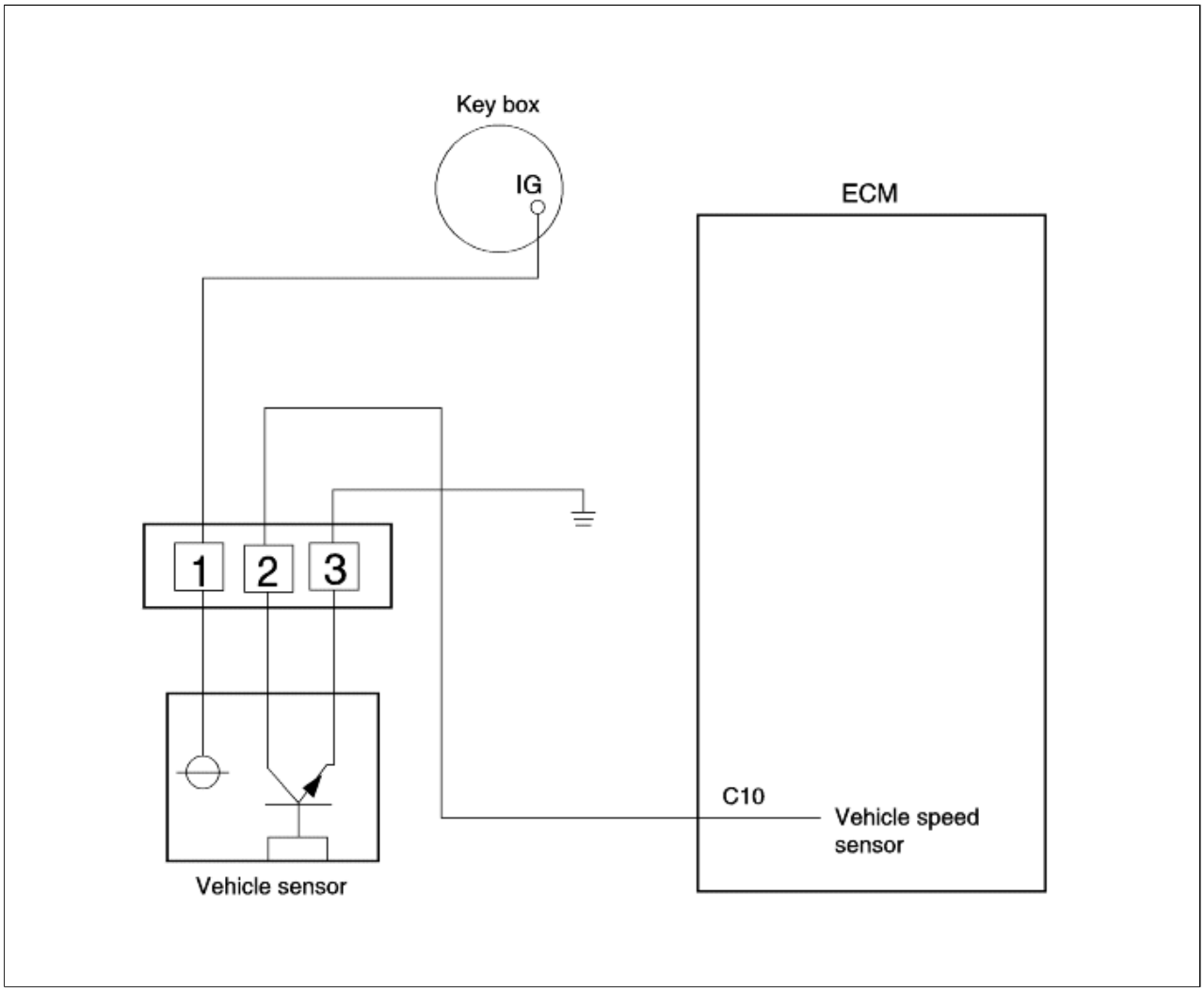
1. The MIL is ON or the DTC is displayed on the HI-SCAN under following condition.
   A. The knock sensor signal is not detected when the engine is in overload condition.
2. The knock sensor signal is abnormally low.

Harness inspection procedures



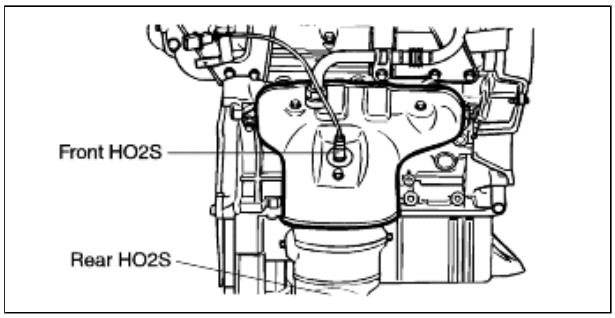
Vehicle speed sensor

The function of vehicle speed sensor is to sense the TOOTH signal in T/M housing (4 pulses are output per 1 turn) and send relevant signal to ECM. The signal is used for computing the vehicle speed and the speed display on the tachometer as well. The information is used for idle control correction duty range (the range of correction is limited with the vehicle speed and A/C load), cooling fan control, fuel injection prohibition at over vehicle speed, vehicle jerk control and traction control (At the torque being reduced with the exhaust gas modeling).
The action against malfunctions of the sensor is to fix the speed at 0 KPH. (The highest engine revolution should be limited to 2500 rpm).

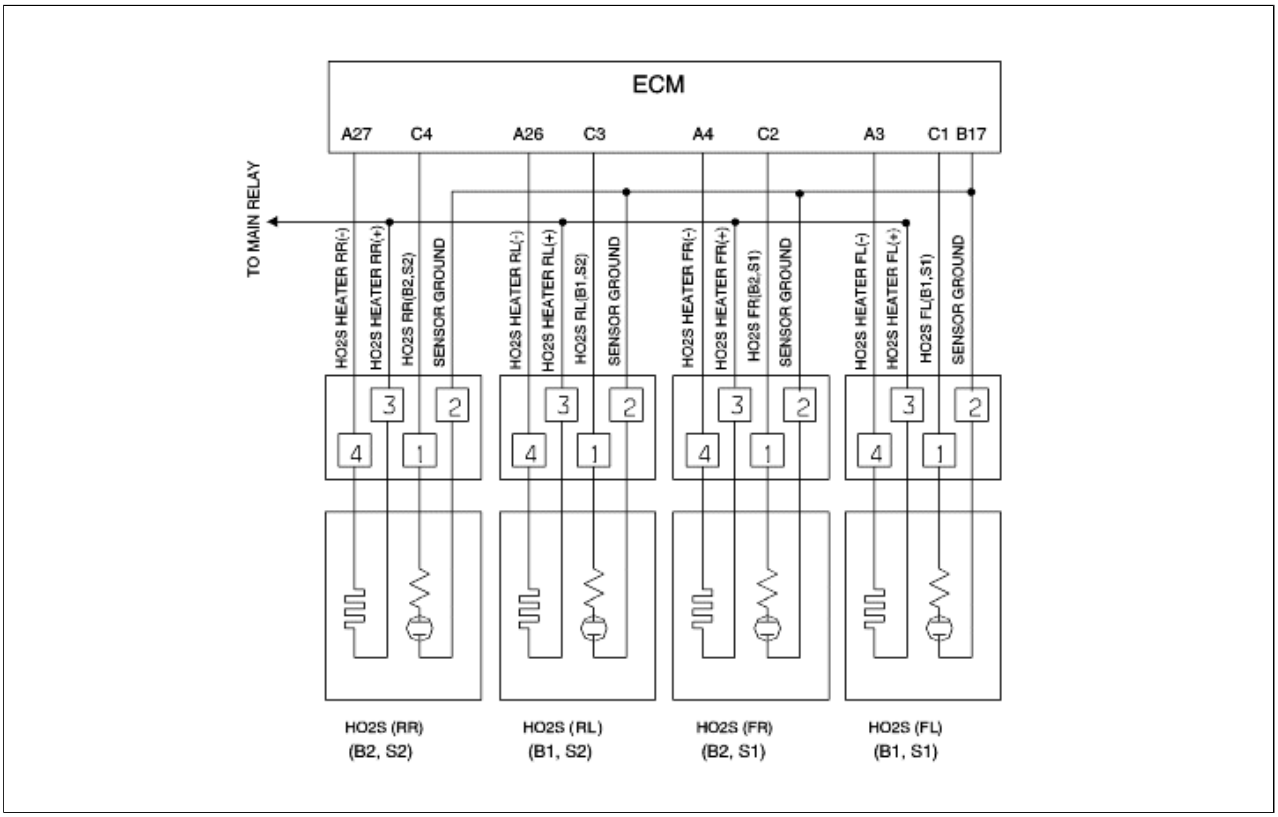


Heated oxygen sensor (HO2S)

The heated oxygen sensor senses the oxygen concentration in exhaust gas, converts it into a voltage, which is sent to the ECM. The oxygen sensor outputs about 1V when the air fuel ratio is richer than the theoretical ratio, and outputs about 0V when the ratio is leaner (higher oxygen concentration in exhaust gas.). The ECM controls the fuel injection ratio based on this signal so that the air fuel ratio is maintained at the theoretical ratio. The oxygen sensor has a heating element which ensures the sensor performance during all driving conditions.



[Oxygen sensor configuration and circuit diagram]



The basic principle of the operation of titania sensor is that, when the oxygen concentration from the exhaust emission manifold reduces (RH) , the volume of O2 and the electronic concentration value will increase to make the titania element resistance reduce and, reversely, when the oxygen concentration increases (leaner), the resistance will increase. Accordingly, the ohm value of above 100kΩ is regarded as corresponding leaner condition and the value below 100kΩ as richer condition.
The main point to check the oxygen sensor output function is to check the output voltage for being 0.1~0.9V and the frequency 1.1Hz at the engine rate of 3000 rpm after full warming up.
The point of service is to check that the frequency is about 1.1Hz while checking the output is also important.

Troubleshooting hints

1. Excessive exhaust gas will be emitted when the oxygen sensor is faulty.
2. Check the parts as below when the sensor output value is out of the specified range even though the sensor is in normal condition.
   A. Incomplete injector
   B. Air leakage from intake manifold
   C. Incomplete air flow sensor, intake air temperature sensor and engine coolant temperature sensor.
   D. Exhaust leakage

Using GST

Check items	Conditions	Engine condition	Specification
Oxygen sensor	Engine: warm-up (Reduction of the mixture ratio with deceleration of engine rate and getting richer with increase of the rate)	Sharp reduction from 4,000 rpm rate	200mV or less
		Sharp rise of the engine rate	600 ~ 1,000 mV
	Engine: warm-up (Check the air/fuel ratio based on the signal from heated oxygen sensor and check the control condition by the ECM.	700 rpm (idle condition)	200 ~ 1,000 mV (Oscillation)
		2,000 rpm	200 ~ 1,000 mV (Oscillation)

Inspection (using voltmeter)

NOTE

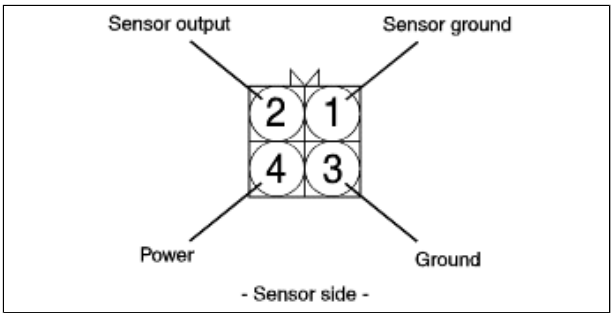
Warm up the engine up to the extent that the engine coolant temperature reaches 80-95°C (176-203 °F) prior to start the check.

1. Directly apply the battery voltage between terminal 4 and 3.

> NOTE
>
> Be sure to correctly apply the voltage since any incorrect connection or a short circuit may destroy the system.

2. Use a digital voltmeter to connect between terminal 2 and 1.
3. Measure the oxygen sensor output voltage during running the engine continuously.

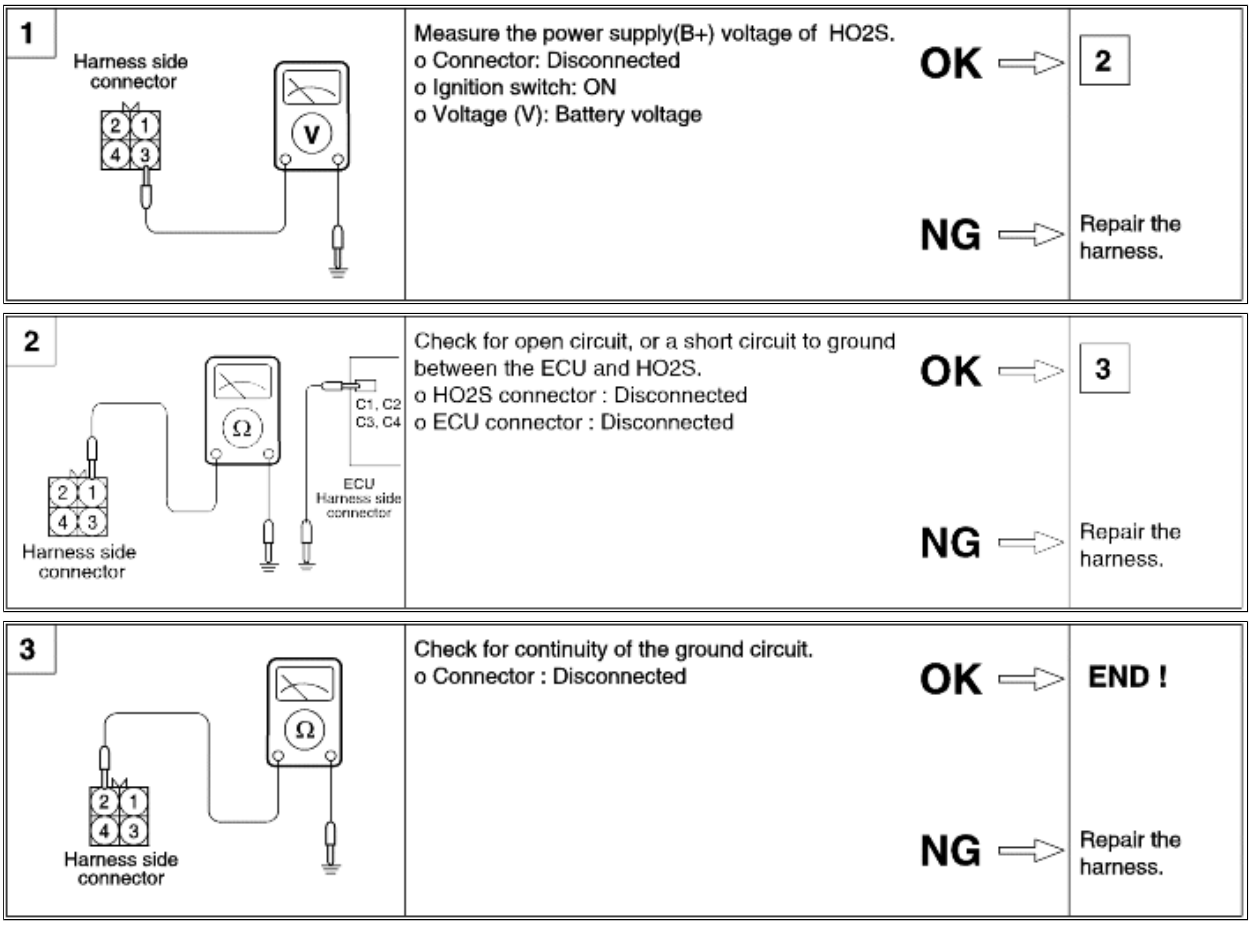
Engine	Oxygen sensor output voltage	Reference
Idle condition	1 V	Make the oxygen/fuel mix richer increasing the speed of engine



4. If there is any abnormality, it may be caused from the oxygen sensor.

Tightening torqueHeated oxygen sensor : 28.9~36.2 lb·ft (400~500kg·cm)

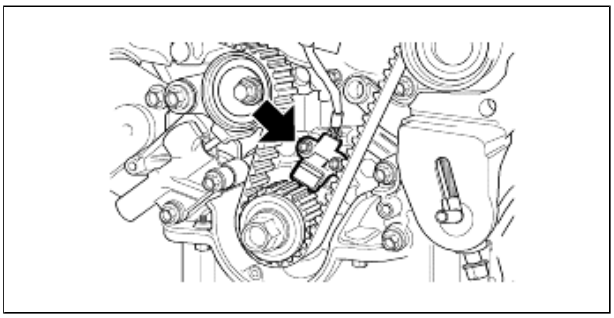
Harness inspection



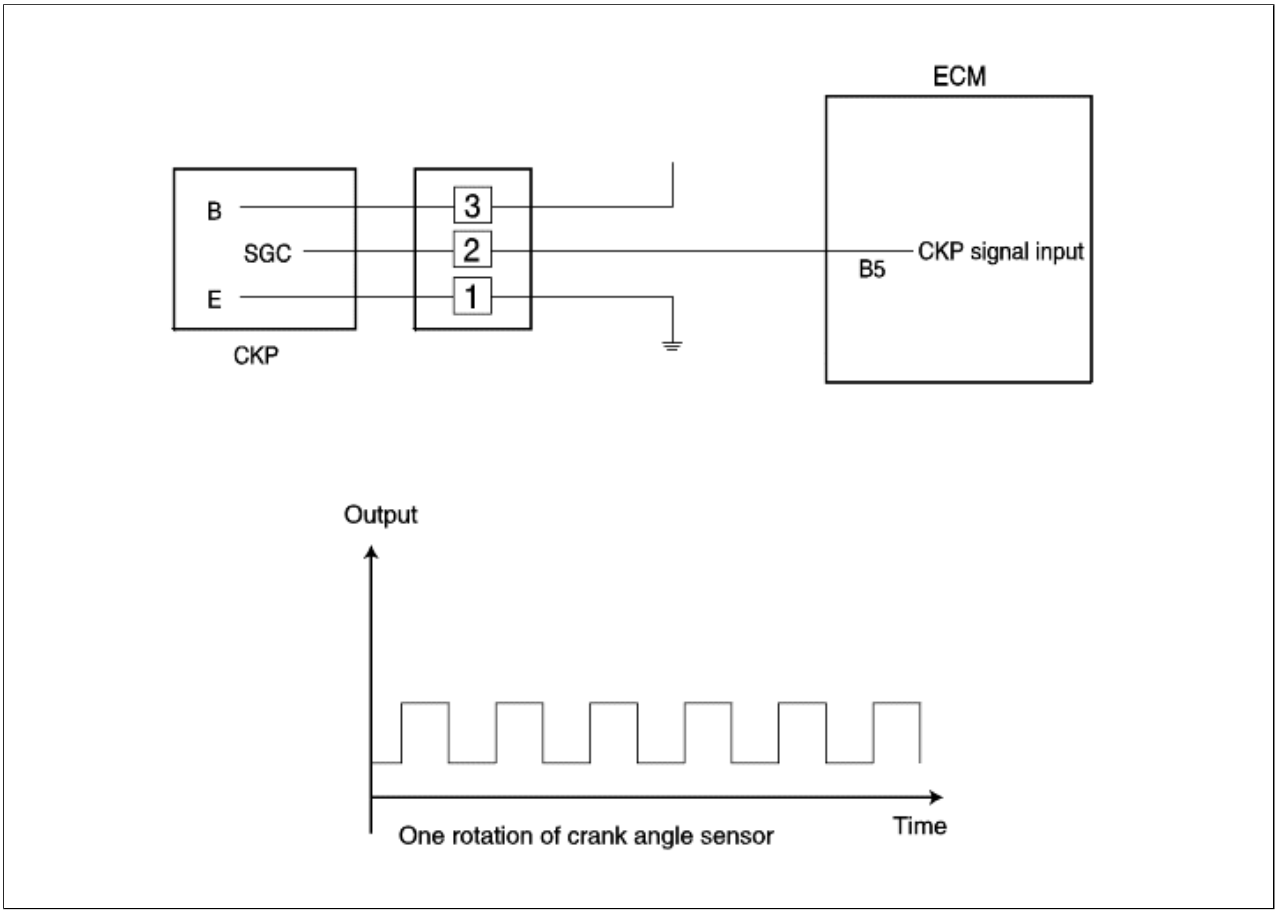
CKPS

The CKP sensor compares the signal from the crank position sensor with that from TDC sensor to measure the upper dead point of each cylinder piston. The position of CAM is detected immediately at the same time when the ignition key is turned ON.

It outputs digital signal by two hall devices.

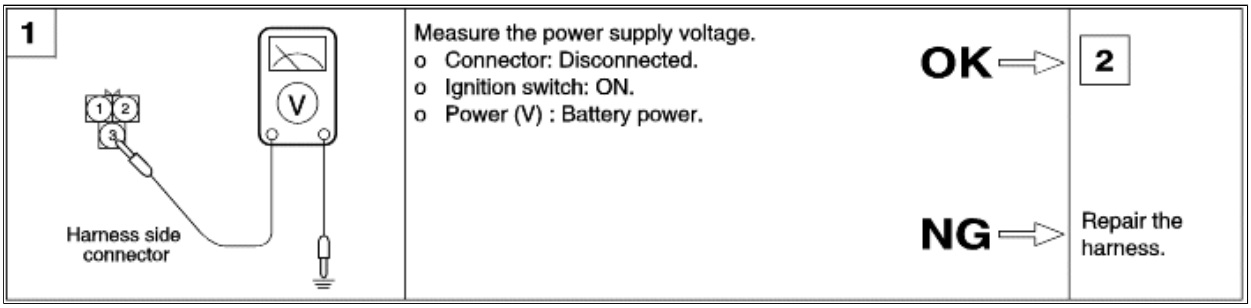


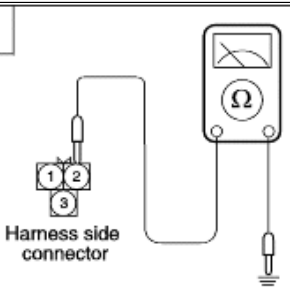
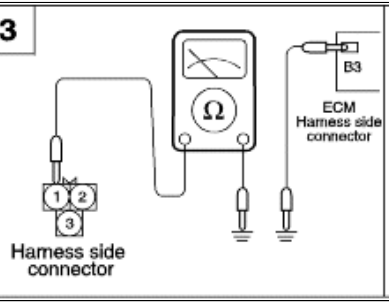
[CKP sensor circuit diagram and output signal]



In case of faulty TDC sensor, the CKP signal can be used to compute the TDC (The probability of cylinder #1 TDC is 50%) and engine rate to control the fuel quantity and ignition timing and provide availability of driving the engine.

Harness inspection



2 	Check for continuity of the ground. o Connector: Disconnected	OK ⇨	3
		NG ⇨	Repair the harness.
3 	Check for open circuit or short circuit between ECM and CKP	OK ⇨	END
		NG ⇨	Repair the harness.

Using HI-SCAN

Check item	Check conditions	Check content	Normal state
CKP sensor	1) Engine cranking 2) Tachometer connection (Check the ignition coil for on/off by tachometer)	Comparing cranking speed and multi-tester reading.	Permissible speed indication.

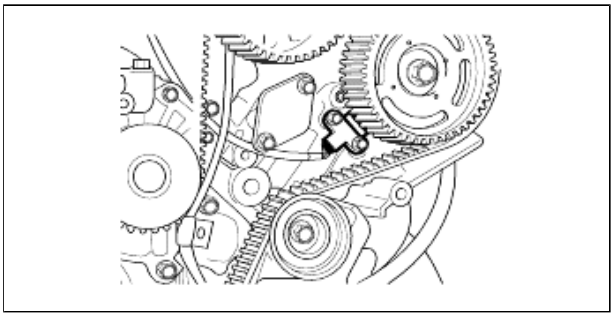
Check item	Check conditions	Coolant temperature	Check specification
CKP sensor	1) Engine: Running at idle 2) Idle position switch: ON	-20 °C (-4 °F)	1,500 ~ 1,700 rpm
		0 °C (32 °F)	1,350 ~ 1,550 rpm
		20 °C (68 °F)	1,200 ~ 1,400 rpm
		40 °C (104 °F)	1,000 ~ 1,200 rpm
		80 °C (176 °F)	650 ~ 850 rpm

Troubleshooting hints

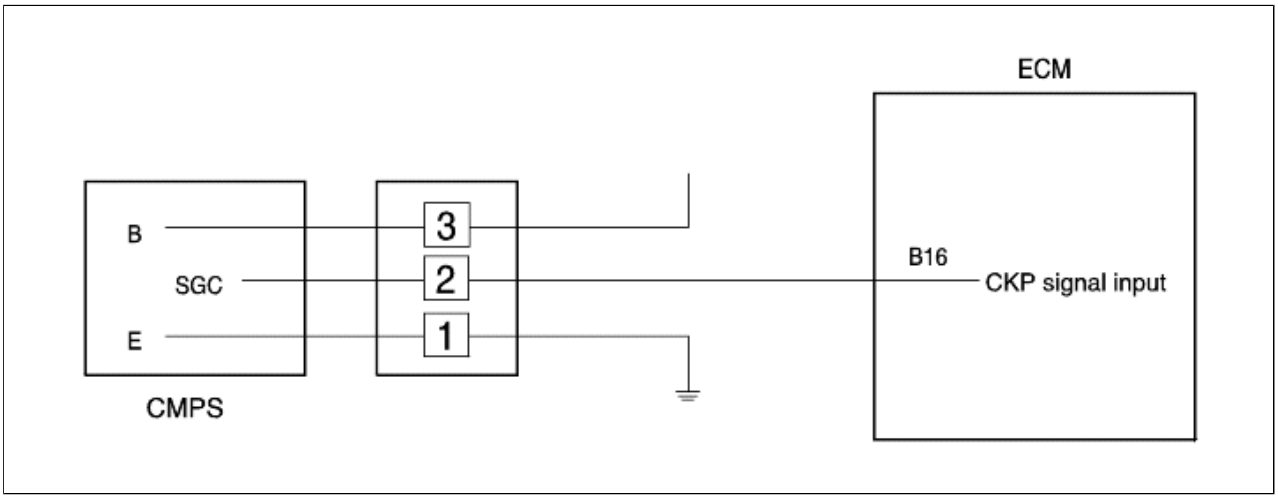
An abnormal operation of camshaft position sensor may cause engine stall, engine hesitation in idling or acceleration unavailability due to abnormal injection.

CMPS

The camshaft position sensor senses the position of crankshaft (piston) in reference to the upper dead point of compression of each cylinder and send the signal, based on which the ECM computes the engine speed and controls the fuel injection timing and ignition timing. Engine running condition (idle, partial load and full load) is determined in this process. It outputs digital signal by two hall devices.



[Circuit diagram and CMP signal features]

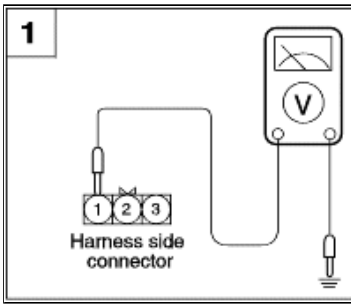
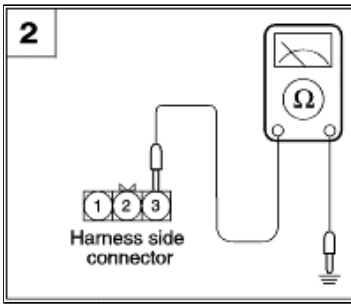


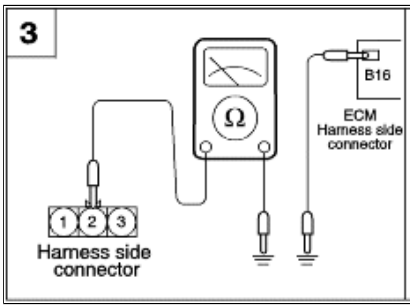
In case of faulty CMP, the TDC signal is analyzed to computing the crank position and engine rpm to further control the fuel quantity and ignition timing. Engine running is available at the same time. There is no engine stall at faulty CMP like existing system. (When the CMP is failed during engine running, the engine stalls, but restart of engine is available by the procedures of operation as IG KEY OFF → ON)

Troubleshooting hints

1. If an unexpected shock or engine stall occurs in running, try to shake the harness of crankshaft position sensor. Check the sensor connector(s) for defective contacts if engine stalls in the case.
2. If 0 rpm is indicated on tachometer with the engine in idling, check for faulty crankshaft angle sensor, damaged timing belt or faulty ignition system.
3. Check for the points as below if the crankshaft angle sensor indicates a value out of the specification though the engine is available of starting in idle.
   A. Faulty engine coolant temperature sensor.
   B. Faulty idle speed control motor.
   C. Failed standard idle speed control.

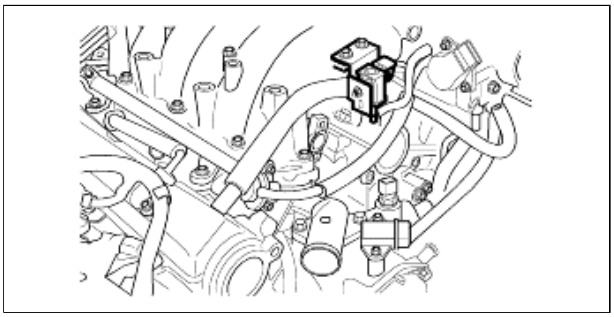
Harness inspection procedures

1 	Measure the power supply voltage. o Connector: Disconnected. o Ignition switch: ON. o Voltage (V) : Battery voltage.	OK ⇒ NG ⇒	2 Repair the harness.
2 	Check for continuity of the ground. o Connector: Disconnected	OK ⇒ NG ⇒	3 Repair the harness.

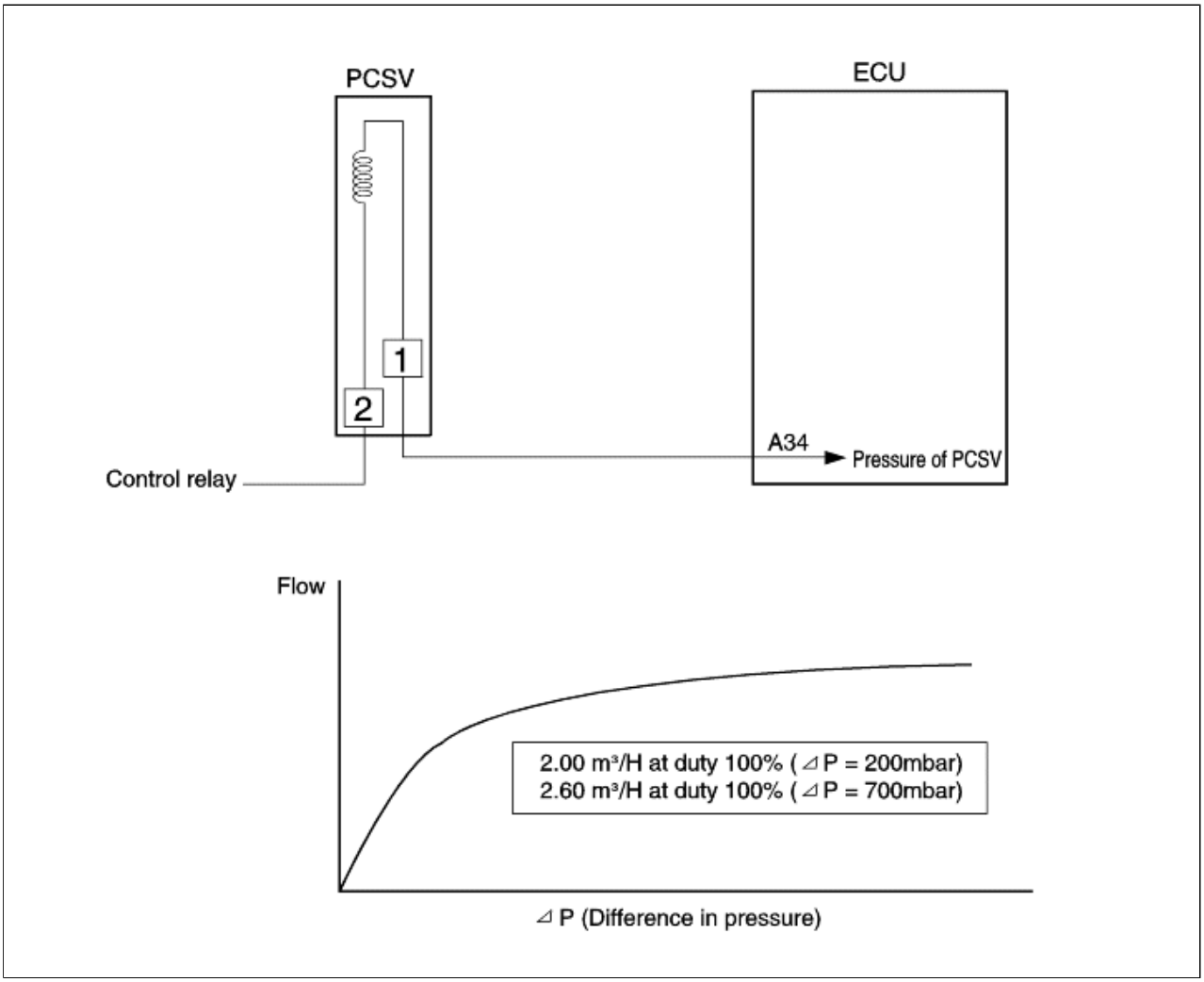
3		Check for an open circuit or short circuit between ECM and CMP	OK ⇨ END NG ⇨ Repair the harness.

Evaporative emission canister purge solenoid valve (PCSV)

The P.C.S.V is a duty control type, which controls purge air from the evaporative emission canister. The valve is controlled by ECM in idle running or partial load condition. It controls the amount of evaporated fuel gas after referring to the signal from heated oxygen sensor and the driving power duty is determined depended upon engine rate and air amount, etc.



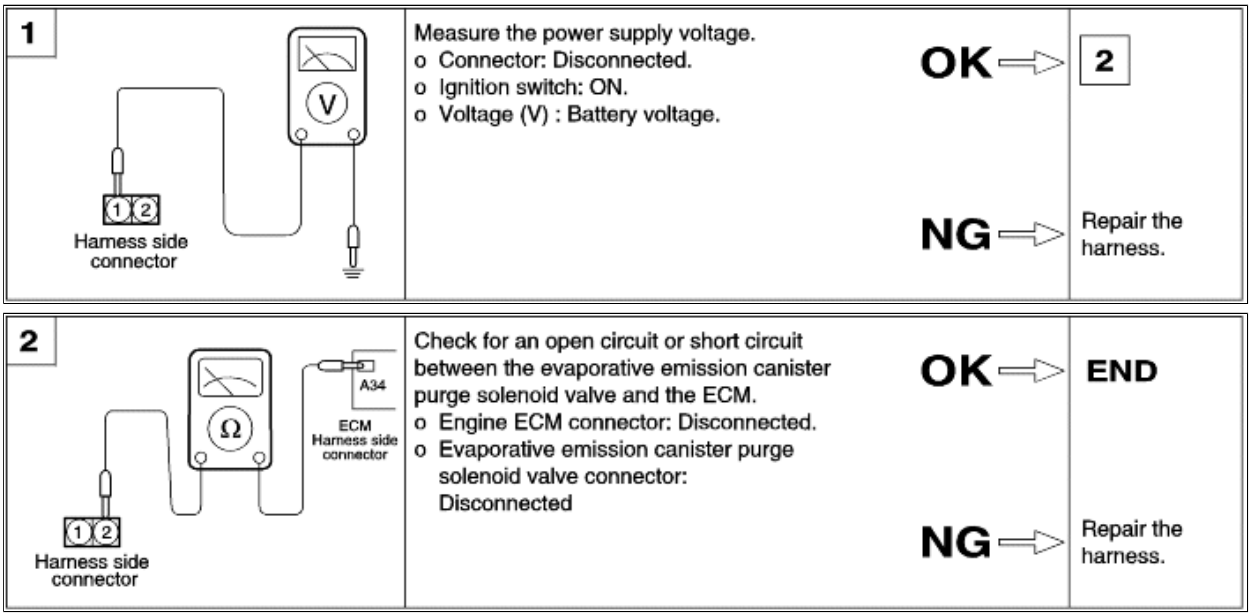
[Control circuit and output signal]



Using HI-SCAN

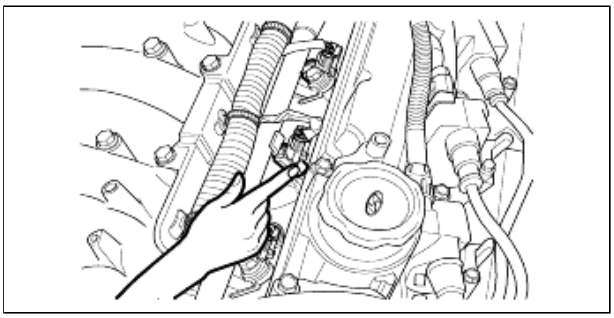
Check item	Check conditions	HI-SCAN indication	Type
Evaporative emission canister purge solenoid valve 1) Actuator test	IG. S/W ON (Do not start)	PURGE VALVE	Activate

Harness inspection procedures

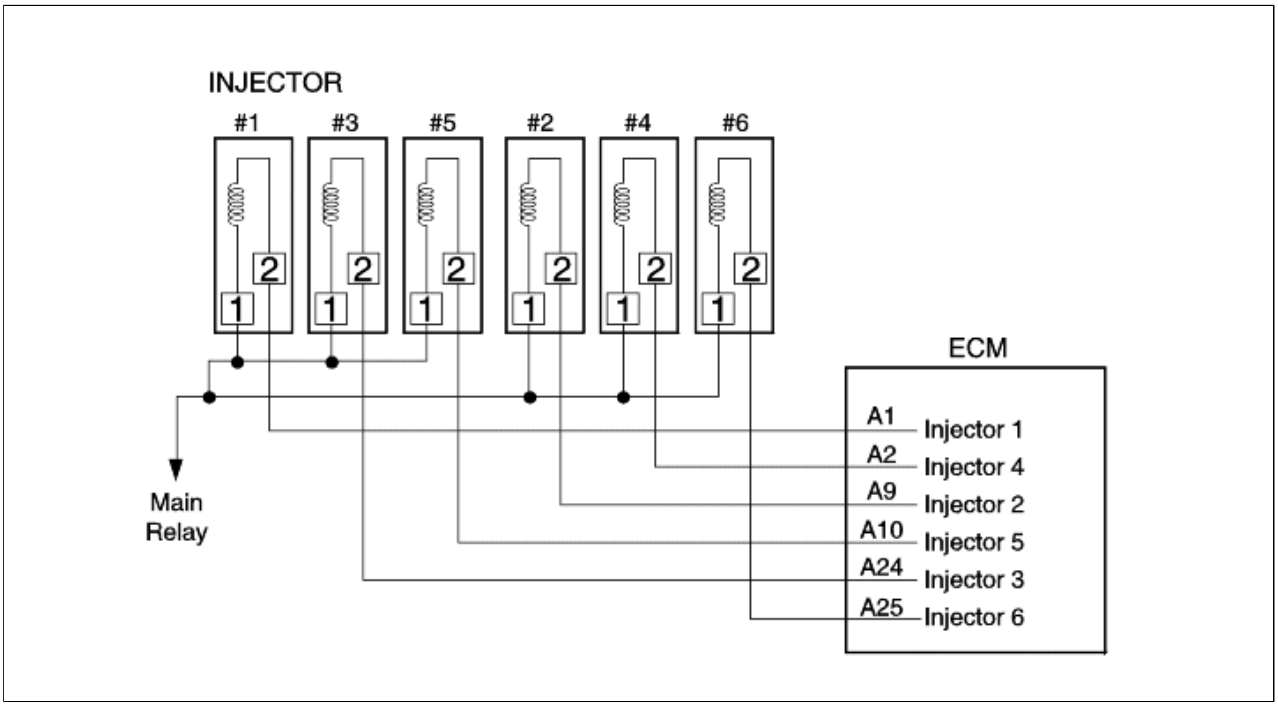


Fuel injector

The injectors inject fuel to cylinders according to the signal, suitable to engine condition, from ECM. The ECM drives the injectors by electric current driving mode.
The basic fuel amount is performed by the mapping value based on the air amount and engine rate, and the fuel amount is corrected in the case of fuel amount correction (Air fuel ratio control signal, fuel evaporative emission gas control, learning increase of the fuel amount, warm-up control, catalytic heating control, fuel amount control in deceleration, idle control, fuel amount increase in full load, fuel increase in acceleration and restarting).
The fuel injection is controlled under unavailable state for safety purpose.



[Injector circuit diagram]



Checking injectors

Using HI-SCAN

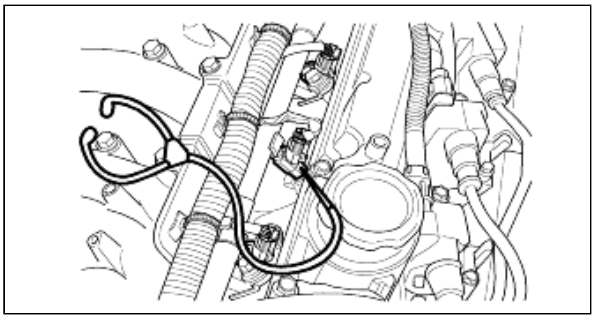
Check item	Data display	Check conditions	Check content	Check specification
Injector 1) Service data item	Drive time	Engine: Cranking	0°C (32°F)	approx. 17ms
			20°C (68°F)	approx. 35ms
			80°C (176°F)	approx. 8.5ms

Check item	Data display	Check conditions	Check content	Check specification
Injector 1) Service data item	Drive time	1) Engine coolant temperature: 80~95°C 2) Lamp, electric cooling fan and accessory module: All OFF state 3) Transaxle: Neutral (P range for the vehicles equipped with A/T) 4) Steering wheel: Neutral	700 ± 100rpm	2.2~2.0 ms
			2,000 rpm	1.8~2.6 ms
			Rapid racing	To increase

Check item	Data display	Check conditions	Check content	Check specification
Injector 1) Actuator test	01	No. 1 injector shut off	Engine: Idling after warm-up (Shut off the injector in sequence during and after engine warm-up; check the idle condition)	Idling state becomes unstable as the injectors are shut off.
	02	No. 2 injector shut off		
	03	No. 3 injector shut off		
	04	No. 4 injector shut off		
	05	No. 5 injector shut off		
	06	No. 6 injector shut off		

Using stethoscope and voltmeter

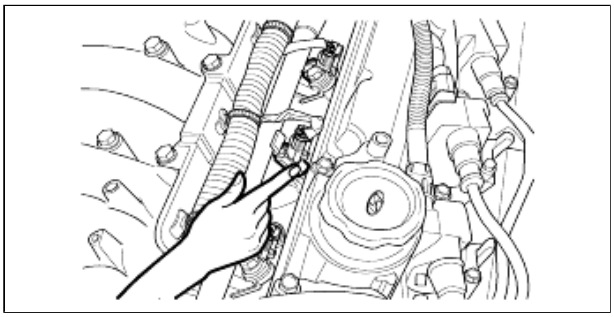
1. Checking operating sound using a stethoscope.
   (1) Check the injector for clicking at idling. Check the sound for getting shorter in intervals as the engine speed increases.



CAUTION

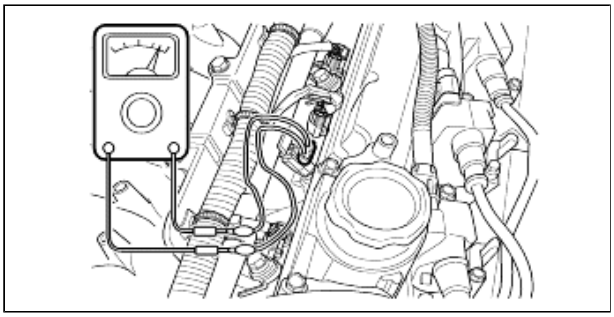
Be sure that the sound from an injector is not transmitted along the delivery pipe to an adjacent injector(s) not in operation.

(2) If a stethoscope is not available, sense the injectors?
Operation with your finger. If no vibration is felt, check the wiring connector, injector or injection signal from the ECM.



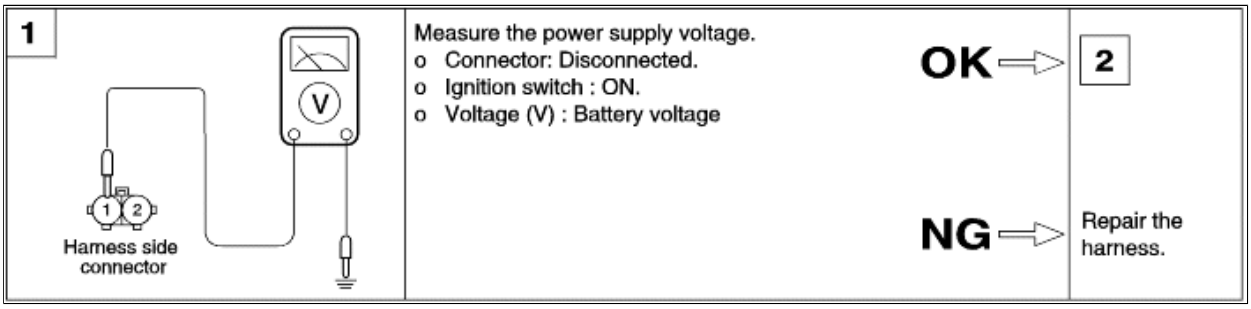
2. Measuring the resistance between the terminals.
(1) Disconnect the connector at the injector.
(2) Measure the resistance between the terminals.

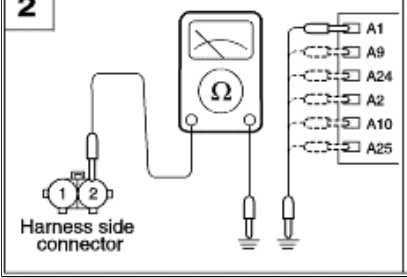
Standard value : 13~16Ω [at 20°C (68°F)]



(3) Connect the connector to injector.

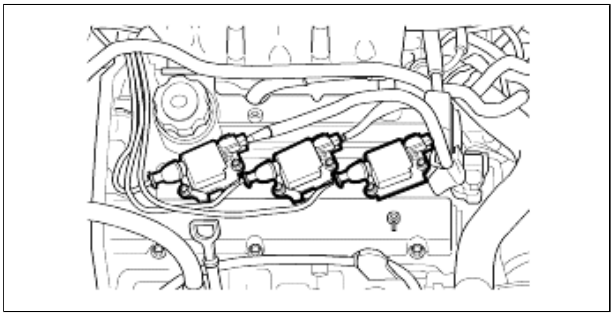
Harness inspection procedures



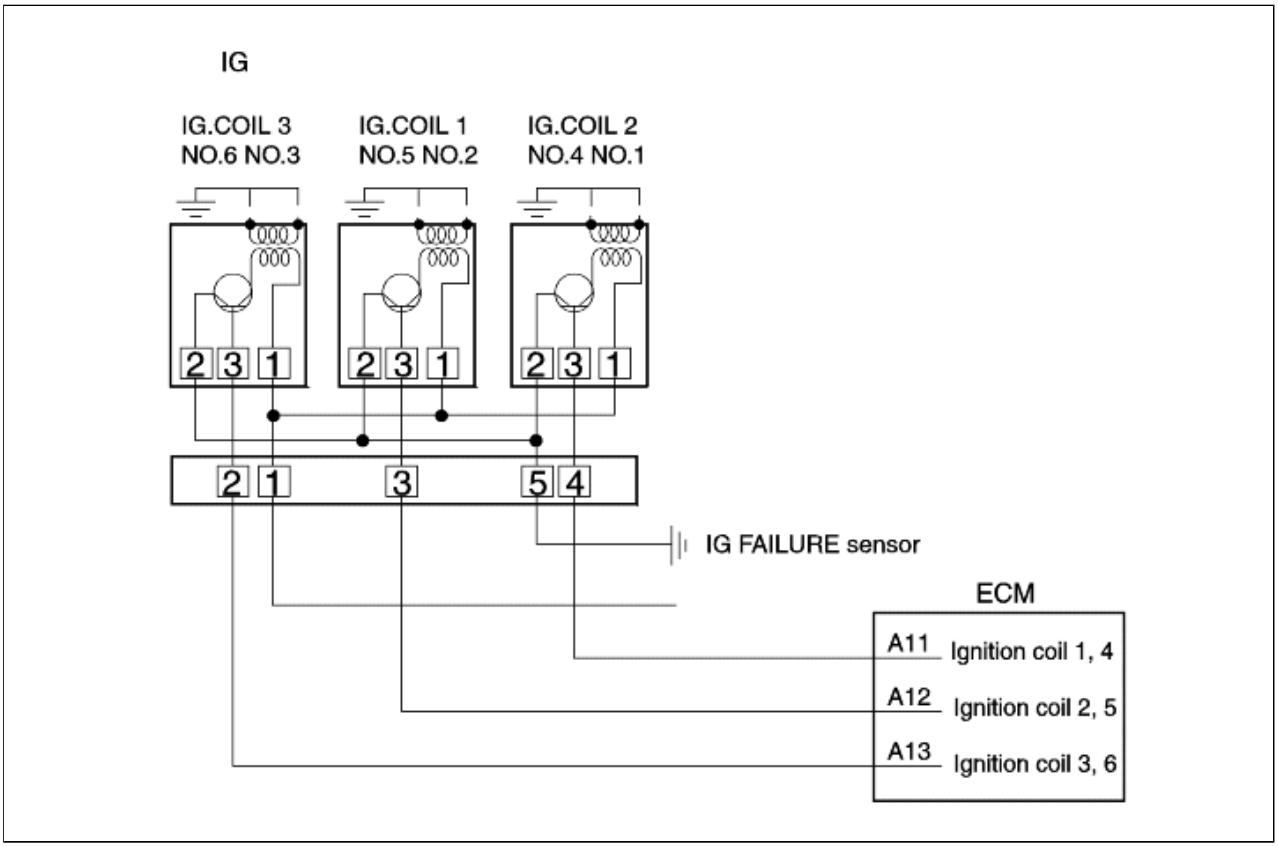
2 	Check for an open circuit, or a short circuit to ground between the powertrain control module and the injector. o ECM connector : Disconnected o Injector connector : Disconnected	OK ⇨	END !
		NG ⇨	Repair the harness.

Ignition coil

The ignition coil is of the type of ignition order of (#1/#4), (#2/#5), (#3/#6) and is controlled by the power TR built in the ECM.



[Coil circuit diagram]



Service data for sensors and actuantors

Inspection item	Inspection contents		Normal condition
Heated oxygen sensor (front)	Engine: Warm (Air/fuel mixture is made leaner when decelerating, and is made richer when racing.)	When at 4,000 r/min, engine is suddenly decelerated	200mV or less
		When engine is suddenly raced	600 - 1,000mV
	Engine: Warm (The heated oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the ECM.)	Engine is idling	400mV or less ↔ 600 - 1,000mV (Changes)
		2,500 r/min	
Mass air flow sensor	Engine coolant temperature: 80 - 90°C (176 - 203°F) Lights, electric cooling fan and all accessories: OFF Transaxle: Neutral (A/T: P range)	Engine is idling	1.4 - 1.6V
		3,000 r/min	1.7 - 2.0V
		Engine is idling	Voltage increases in responce to racing
Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is 0°C (32°F)	0°C (32°F) 3.2 - 3.8V
		When intake air temperature is 20°C (68°F)	20°C (68°F) 2.3 - 2.9V
		When intake air temperature is 40°C (104°F)	40°C (104°F) 1.5 - 2.1V
		When intake air temperature is 80°C (176°F)	80°C (176°F) 0.5 - 0.9V
Throttle position sensor	Ignition switch: ON	Set to idle position	300 - 900mV (6 - 20%)
		Gradually open	Increases in proportion to throttle opening angle
		Open fully	4.0 - 4.6V (80 - 100%)
Power supply voltage	Ignition switch: ON		Battery positive voltage
Cranking signal (Ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF
		Engine: Cranking	ON
Engine coolant temperature sensor	Ignition switch: ON or with engine running	When engine coolant temperature is 0°C (32°F)	0°C (32°F) 3.2 - 3.8V
		When engine coolant temperature is 20°C (68°F)	20°C (68°F) 2.3 - 2.8V
		When engine coolant temperature is 40°C (104°F)	40°C (104°F) 1.5 - 2.1V
		When engine coolant temperature is 80°C (176°F)	80°C (176°F) 0.4 - 0.8V
Crankshaft position sensor	Engine: Cranking Tachometer: Connected	Compare the rpm of the tachometer with the one of the scan tool.	Identical
		When engine coolant temperature is -20°C (-4°F)	1300 - 1500 r/min
		When engine coolant temperature is 0°C	1300 - 1500 r/min

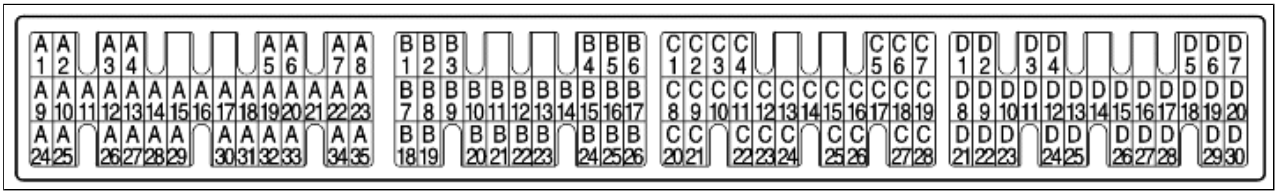
Idle speed test	Engine: Idling Idle position switch: ON	(32°F)	
		When engine coolant temperature is 20°C (68°F)	1150 - 1350 r/min
		When engine coolant temperature is 40°C (104°F)	950 - 1150 r/min
		When engine coolant temperature is 80°C (176°F)	650 - 850 r/min
Vehicle speed sensor	Drive at 40 km/h (25 miles/h)		Approx. 40 km/h (25mph)
Idle position switch	Ignition switch: ON Check by operating accelerator pedal repeatedly	Throttle valve: Set to idle position	ON
		Throttle valve: Slightly open	OFF
Power steering pressure switch	Engine: Idling	Steering wheel stationary	OFF
		Steering wheel turning	ON
A/C switch	Engine: Idling (When A/C switch is ON, A/C compressor should be operating.)	A/C switch :OFF	OFF
		A/C switch: ON	ON
Park/Neutral position switch (A/T)	Ignition switch: ON	P or N	P or N
		D, 2, L or R	D, 2, L or R
Injectors	Engine: Cranking	When engine coolant temperature is 0°C (32°F) (Injection is carried out for all cylinders simultaneously)	13.8 - 20.6 ms
		When engine coolant temperature is 20°C (68°F)	34 - 51 ms
		When engine coolant temperature is 80°C (176°F)	8.8 - 13.2 ms
Injectors	Engine coolant temperature: 80 - 95°C (176 - 203°F) Lights, electric cooling fan and all accessories: OFF Transaxle: Neutral (A/T : P range)	Engine is idling	2.6 - 3.8 ms
		2,500 r/min	2.3 - 3.5 ms
		When engine is suddenly raced	Increases
Ignition coils and ignition power transistors	Engine: After having warmed up Timing light is set. (The timing light is set in order to check actual ignition timing.)	Engine is idling	7 - 23° BTDC
		2,500 r/min	27 - 47° BTDC
A/C compressor clutch relay	Engine: After having warmed up/Engine is idling	A/C switch: OFF	OFF (Compressor clutch is not operating)
		A/C switch: ON	ON (Compressor clutch is operating)
ISC step motor	Engine coolant temperature: 80-95°C (176-203°F) Lights, electric cooling fan and all accessories: OFF Transaxle: Neutral (A/T: P range) Closed throttle position switch: ON Engine: Idling (When A/C switch is ON, A/C compressor should be operating.)	A/C switch: OFF	Increases by 2 - 20 steps
		A/C switch: OFF → ON	Increases by 8 - 50 steps
		A/C switch : OFF Select lever: N range → D range	Increases by 3 - 40 steps
Heated oxygen	Transaxle: 2nd gear (M/T) L range (A/T)	3,500 r/min	600 - 1,000mV

sensor (rear)	Drive with wide open throttle		
Long-term fuel compensation	Engine: Warm, idle without any load (during closed loop)	-12.5 ~ 12.5%	

Actuator test reference table

Item No.	Drive contents	Inspection item	Inspection contents		Normal condition
01	Injectors	Cut fuel to No.1 injector	Engine: Warm, idle (Cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)		Idle speed drops equally for each injector
02		Cut fuel to No.2 injector			
03		Cut fuel to No.3 injector			
04		Cut fuel to No.4 injector			
05		Cut fuel to No.5 injector			
06		Cut fuel to No.6 injector			
07	Fuel pump	Fuel pump operates and fuel is recirculated.	Engine: Cranking Fuel pump: Activated Inspect according to both the above conditions	Pinch the return hose with fingers to feel the pulse of the fuel being recirculated	Pulse is felt
				Listen near the fuel tank for the sound of fuel pump operation.	Sound of operation is heard
08	Evaporative emission purge solenoid	Solenoid valve turns from OFF to ON.	Ignition switch: ON		Clicks when solenoid valve is driven.
20	Radiator fan (Hi) Condenser fan (Hi)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at high speed.
21	Radiator fan (Hi) Condenser fan (Low)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at low speed.

ECM Terminal layout



Connector B-01 (A)

Terminal	Signal	Connected to
A1	Injector 1 control	Injector 1
A2	Injector 4 control	Injector 4
A3	HO2S Heater control (Bank 1, Sensor 1)	HO2S (Bank 1, Sensor 1)
A4	HO2S Heater control (Bank 2, Sensor 1)	HO2S (Bank 2, Sensor 1)
A5	-	-
A6	-	EGR solenoid valve
A7	-	-
A8	Alternator G terminal	Alternator

A9	Injector 2 control	Injector 2
A10	Injector 5 control	Injector 5
A11	Ignition coil 1 (1 & 4) control	Ignition coil 1
A12	Ignition coil 2 (2 & 5) control	Ignition coil 2
A13	Ignition coil 3 (3 & 6) control	Ignition coil 3
A14	Idle speed control step motor A	ISC step motor
A15	Idle speed control step motor C	ISC step motor
A16	-	-
A17	Cooling fan relay high control	Fan relay high
A18	Cooling fan relay low control	Fan relay low
A19	Trip ECU	Cluster
A20	Fuel pump relay control	Fuel pump
A21	A/C relay control	A/C relay
A22	MIL control	MIL
A23	Spark timing adjustment (+)	RCT
A24	Injector 3 control	Injector 3
A25	Injector 6 control	Injector 6
A26	HO2S heater control (Bank 1, Sensor 2)	HO2S (Bank 1, Sensor 2)
A27	HO2S heater control (Bank 2, Sensor 2)	HO2S (Bank 2, Sensor 2)
A28	Idle speed control step motor B	ISC step motor
A29	Idle speed control step motor D	ISC step motor
A30	Throttle position signal output	TPS
A31	-	-
A32	Variable Intake solenoid open	Variable Intake solenoid
A33	Variable Intake solenoid close	Variable Intake solenoid
A34	Evaporative purge solenoid valve control	PCSV
A35	Canister purge control valve control	CCV

Connector B-01 (B)

Terminal	Signal	Connected to
B1	Battery +	Battery
B2	Ground	Chassis
B3	Ignition detection signal input	Ignition failure sensor
B4	Engine coolant temperature sensor signal input	ECTS
B5	Crankshaft position sensor signal input	CKPS
B6	Sensor reference voltage	FTPS
B7	Battery +	Battery
B8	Ground	Ground
B9	Control relay control	Control relay
B10	AT control relay control	AT control relay
B11	-	-
B12	Power steering load input	Power steering switch
B13	Variable Intake solenoid MRS 1	Variable Intake solenoid
B14	Alternator "FR" terminal	Alternator
B15	Mass air flow sensor signal input	MAFS
B16	Camshaft position sensor signal input	CMPS

B17	Sensor ground	Sensors
B18	Starter "S" signal input	Starter
B19	-	-
B20	Fuel level sensor signal input	Fuel level sensor
B21	A/C pressure switch signal input (high/low)	A/C pressure switch
B22	A/C pressure switch signal input (middle)	A/C pressure switch
B23	Variable Intake solenoid MRS 2	Variable Intake solenoid
B24	Intake air temperature sensor signal input	IATS
B25	-	-
B26	Battery back up	Battery

Connector B-01 (C)

Terminal	Signal	Connected to
C1	HO2S signal input (Bank 1, Sensor 1)	HO2S (Bank 1, Sensor 1)
C2	HO2S signal input (Bank 2, Sensor 1)	HO2S (Bank 2, Sensor 1)
C3	HO2S signal input (Bank 1, Sensor 2)	HO2S (Bank 1, Sensor 2)
C4	HO2S signal input (Bank 2, Sensor 2)	HO2S (Bank 2, Sensor 2)
C5	Fuel temperature sensor signal input	Fuel temperature sensor
C6	Power ground	Ground
C7	AT control relay control	AT control relay
C8	Throttle position sensor signal input	TPS
C9	Idle switch signal input	Idle switch
C10	Vehicle speed sensor signal input	Vehicle speed sensor
C11	-	-
C12	-	-
C13	A/C switch signal input	A/C switch
C14	SAS switch	Data link connector
C15	Diagnosis data link k-line	Data link connector
C16	-	-
C17	-	-
C18	Power ground	Ground
C19	AT control relay control	AT control relay
C20	Knock sensor signal input	Knock sensor
C21	MAP sensor signal input	MAP sensor
C22	Fuel tank pressure sensor signal input	Tank pressure sensor
C23	-	-
C24	-	-
C25	-	-
C26	-	-
C27	Power ground	Ground
C28	IG +	Ignition switch

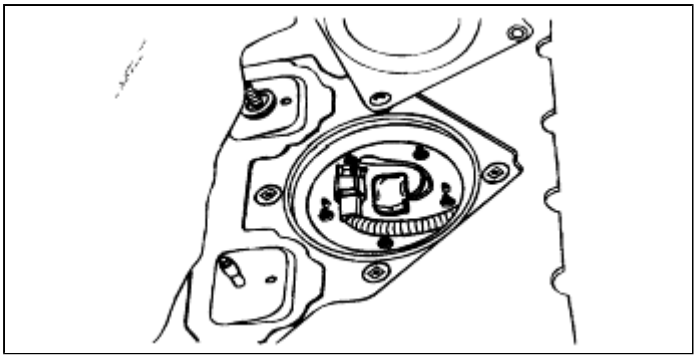
Connector B-01 (D)

Terminal	Signal	Connected to
D1	Inhibitor switch "P" signal input	Inhibitor switch
D2	Inhibitor switch "D" signal input	Inhibitor switch

D3	Pulse generator "A" signal input	Pulse generator "A"
D4	Pulse generator "B" signal input	Pulse generator "B"
D5	-	-
D6	AT 2nd solenoid control	2nd solenoid
D7	DCC solenoid control	DCC solenoid
D8	Inhibitor switch "R" signal input	Inhibitor switch
D9	OD OFF S/W	Inhibitor switch
D10	Inhibitor switch "2" signal input	Inhibitor switch
D11	-	-
D12	-	-
D13	Flash EEPROM battery	ROM change tool
D14	-	-
D15	-	-
D16	-	-
D17	-	-
D18	-	-
D19	RED solenoid control	RED solenoid
D20	U/D solenoid control	UD solenoid
D21	Inhibitor switch "N" signal input	Inhibitor switch
D22	Inhibitor switch "3" signal input	Inhibitor switch
D23	Stop lamp switch signal input	Stop lamp switch
D24	Oil temperature sensor signal input	Oil temperature sensor
D25	ACC switch signal input	ACC switch
D26	-	-
D27	-	-
D28	-	-
D29	LR solenoid control	LR solenoid
D30	O/D solenoid control	O/D solenoid

Fuel pump & fuel filter assembly replacement

1. Remove the fuel tank cap to lower the fuel tank's internal pressure.
2. Locate access cover.
3. Remove the fuel pump & fuel filter assembly installation screws, then remove the fuel pump & fuel filter assimbly from the fuel tank.



Fuel pump operation check

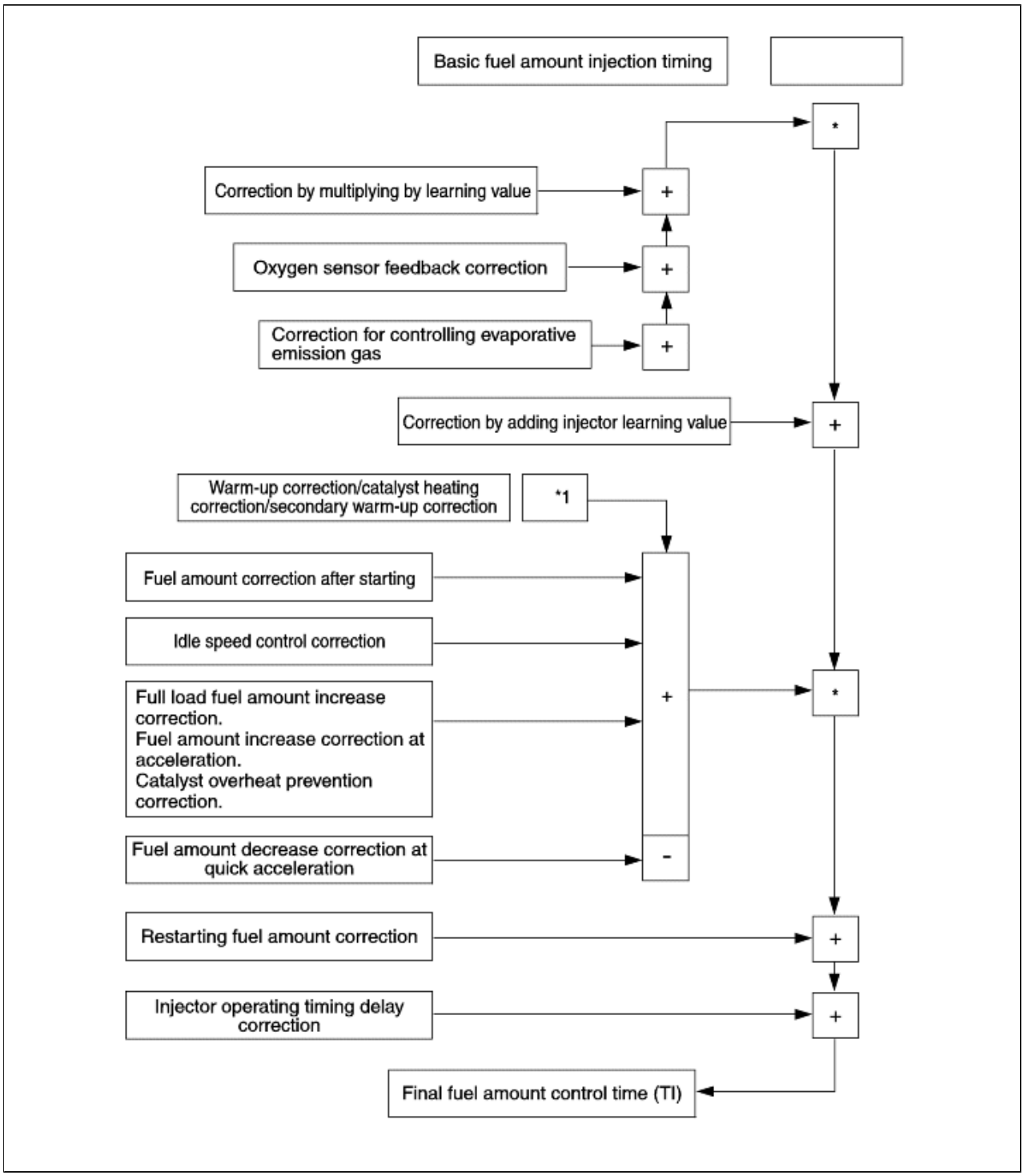
1. Turn the ignition switch to OFF.
2. Apply battery voltage to the fuel pump drive connector to check that the pump operates.

> NOTE
>
> The fuel pump is an in-tank type and its operating sound is hard to hear without removing the fuel tank cap.

Fuel system

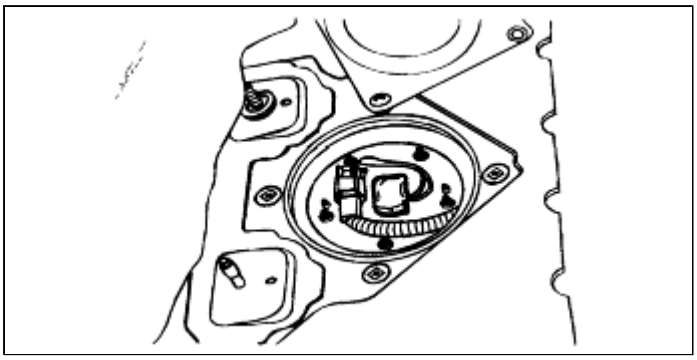
Fuel control

[Fuel flow control chart]

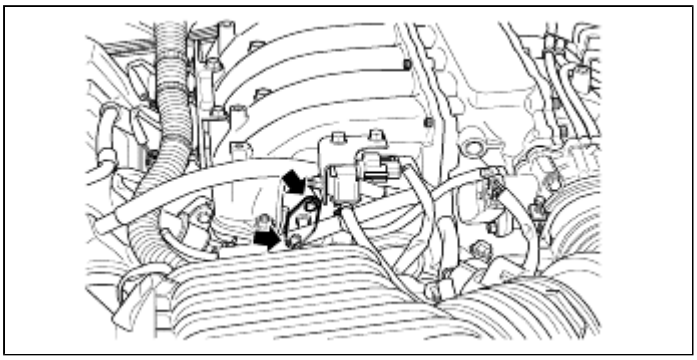


Fuel pressure test

1. Reduce the internal pressure of the fuel pipes and hoses by the following procedures.
   Disconnect the fuel pump harness connector in the rear seat side.
   Start the engine and, after it stops by itself, turn the ignition switch to the OFF position.
   Disconnect the battery negative (-) terminal.
   Connect the fuel pump harness connector.

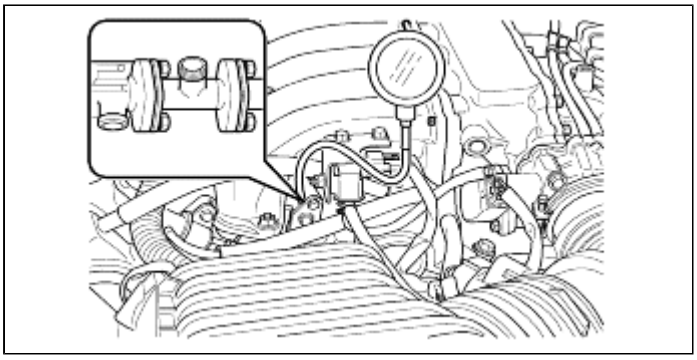


2. Disconnect the fuel high pressure hose at the fuel line side.



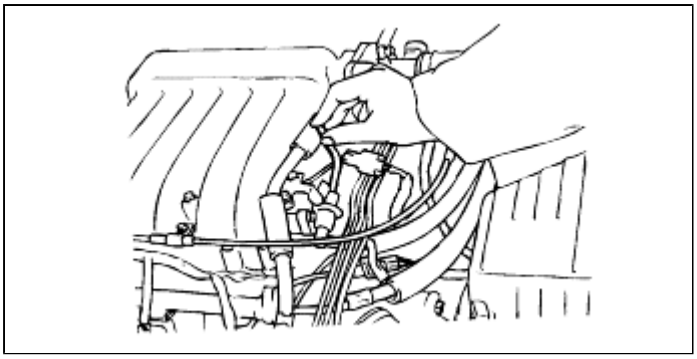
> **CAUTION**
>
> Cover the pipe connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

3. Using the fuel pressure gauge adapter, install the fuel-pressure gauge to the fuel high pressure hose.
4. Connect the battery's negative (-) terminal.
5. Apply battery voltage to the fuel pump drive terminal, activate the fuel pump; then, with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.



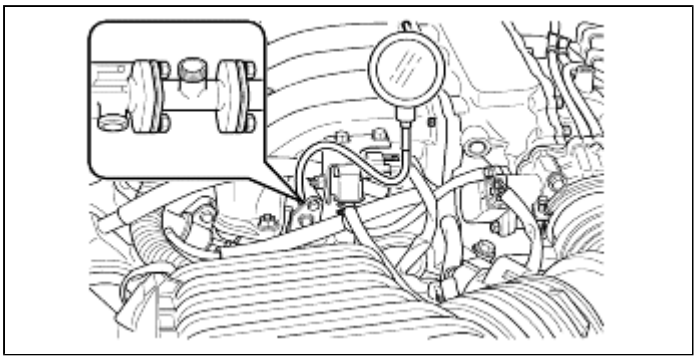
6. Disconnect the vacuum hose from the pressure regulator and plug the hose end. Measure the fuel pressure at idle.

Standard value :320-340 kPa (3.26-3.47kg/cm², 46-49 psi)



7. Measure the fuel pressure when the vacuum hose is connected to the pressure regulator (while engine is running).

Standard value : Approx. 270 kPa (2.75 kg/cm², 39 psi)



8. If the results of the measurements made in steps (6) and (7) are not within the standard value, use the table below to determine the probable cause, and make the necessary repairs.

Condition	Probable cause	Remedy
Fuel pressure too low	Clogged fuel filter. Fuel leakage to the return side, caused by poor seating of the fuel pressure regulator. Low discharge pressure of the fuel pump	Replace fuel filter. Replace fuel pressure regulator. Check the in-tank fuel hose for leakage or replace the fuel pump.
Fuel pressure too high	Sticking fuel-pressure regulator. Clogged or bent fuel return hose or pipe.	Replace fuel pressure regulator. Repair or replace hose or pipe.
There is no difference in fuel pressure when the vacuum hose is connected and when it is not.	Clogging, or damaged vacuum hose of the nipple. Sticking or poor seating of the fuel pressure regulator.	Repair or replace the vacuum hose or the nipple. Repair or replace hose or pipe.

9. Stop the engine and check for a change in the fuel pressure gauge reading, which should hold for approximately 5 minutes. If the gauge indication drops, observe the rate of drop. Determine and remove the causes according to the following table.

Condition	Probable cause	Remedy
Fuel pressure drops slowly after engine is stopped	Injector leakage	Replace injector
Fuel pressure drops immediately after engine is stopped	The check valve within the fuel pump is open	Replace fuel pump

10. Reduce the fuel pressure in the fuel line.
11. Disconnect the high pressure hose and remove the fuel pressure gauge.

> **CAUTION**
>
> Cover the pipe connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

12. Install a new O-ring at the groove in the end of the high-pressure hose.
13. Connect the high pressure fuel hose to the delivery pipe, and tighten the screws to the specified torque.

Tightening torqueHigh pressure fuel hose to delivery pipe :3·4 Nm 30 ·40 kg·cm, 2.2 - 3 lb·ft

14. Check for fuel leaks.
    Apply battery voltage to the fuel pump drive terminal to operate the fuel pump.
    With pressure, check the fuel line for leaks.

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0101	Mass or volume air flow circuit range/performance problem
[Related items]	1) Dirty air cleaner 2) Air leak in intake system 3) Contaminated, deteriorated or damaged MAFS 4) Poor connections at ECM, MAFS, or TPS 5) Faulty MAFS or TPS NOTE If any codes relating to MAFS or TPS are present, do all repairs associated with them before this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0102, P0103, P0121, P0122, or P0123 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL monitor MAFS voltage signals. 1) 1.4~1.6V @ idle Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and MAFS.
		No	Go to step 3.
3	Thoroughly check MAFS for loose, poor connection, bent, corrosion, contamination, deterioration, or damage. Is MAFS okay? Turn ignition switch to OFF and disconnect MAFS connector.	Yes	Go to step 4.
		No	Clean or repair as necessary.
4	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL monitor TP voltage signals. 1) 0.3~0.9V @ idle 2) 4.0~4.6V @ full open Is signal within specifications?	Yes	Go to step 5.
		No	Do all repairs associated with TPS.
5	Ignition ON and engine OFF. Using SCAN TOOL and monitor TP voltage signals while slowly opening the throttle. Does voltage signal increase?	Yes	Go to step 6.
		No	Temporarily install a known good TPS and check for proper operation. If problem is correcte, replace TPS.
6	Turn ignition switch to ON and measure voltage of MAFS power circuit between MAFS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specification?	Yes	Go to step 7.
		No	Open circuit or short circuit to chassis ground between MAFS harness connector and ECM connector. Repair as necessary.
	Turn ignition to OFF and disconnect ECM connector. Measure resistance of MAFS signal circuit	Yes	Go to step 8.

7	between MAFS harness connector and ECM harness connector. Measure resistance of MAFS ground circuit between MAFS harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	No	Open circuit between MAFS harness connector and ECM harness connector. Repair as necessary.
8	ECM connector and MAFS connector is still disconnected. Turn ignition to ON. Measure voltage of MAFS signal circuit between MAFS harness connector and chassis ground. 1) Specification: below 0.5V Does voltage within specification?	Yes	Go to step 9.
		No	Short circuit to battery between MAFS harness connector and ECM harness connector. Repair as necessary.
9	ECM connector and MAFS connector is still disconnected. Turn ignition to OFF. Measure resistance between MAFS harness connector and chassis ground at MAFS signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good MAFS and check for proper operation. If problem is corrected, replace MAFS
		No	Short circuit to chassis ground between MAFS harness connector and ECM harness connector. Repair as necessary.
10	Check air cleaner for dirt, blockage, or damage. Is air cleaner okay?	Yes	Go to step 11.
		No	Repair or replace as necessary.
11	Check entire air intake system for leaks or blockages such as; 1) Throttle body 2) PCV valve 3) Intake manifold 4) Gasket between intake manifold and surge tank 5) Seals between intake manifold and fuel injectors 6) Seal between surge tank and PCV pipe 7) Etc Is entire air intake system okay?	Yes	Temporarily install a known good MAFS and check for proper operation. If problem is corrected, replace MAFS
		No	Repair or replace as necessary.
12	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0102	Mass or volume air flow circuit low input
Diagnostic trouble code No. P0103	Mass or volume air flow circuit high input
[Related items]	1) Open between MAFS and engine main relay 2) Open or short to chassis ground between MAFS and ECM 3) Short to battery between MAFS and ECM 4) Open between MAFS and chassis ground 5) Faulty MAFS

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Start engine and monitor MAFS voltage signals. 1) Specification: 1.4~1.6V @ idle Is signal within specification?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and MAPS.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect MAFS connector. Turn ignition switch to ON. Measure voltage of MAFS reference 5V circuit between MAFS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between MAFS harness connector and ECM connector. Repair as necessary.
3	Turn ignition to OFF and disconnect ECM connector. Measure resistance of MAFS signal circuit between MAFS harness connector and ECM harness connector. Measure resistance of MAFS ground circuit between MAFS harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between MAFS harness connector and ECM harness connector. Repair as necessary.
4	ECM connector and MAFS connector is still disconnected. Turn ignition to ON. Measure voltage of MAFS signal circuit between MAFS harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specification?	Yes	Go to step 5.
		No	Short circuit to battery between MAFS harness connector and ECM harness connector. Repair as necessary.
5	ECM connector and MAFS connector is still disconnected. Turn ignition to OFF. Measure resistance between MAFS harness connector and chassis ground at MAFS signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good MAFS and check for proper operation. If problem is corrected, replace MAFS.
		No	Short circuit to chassis ground between MAFS harness connector and ECM harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0106	Manifold absolute pressure sensor circuit malfunction
Diagnostic trouble code No. P0107	Manifold absolute pressure sensor low input
Diagnostic trouble code No. P0108	Manifold absolute pressure sensor high input
[Related items]	1) Open or short to chassis ground between MAPS and ECM 2) Open between MAPS and ECM 3) Poor connections between MAPS and ECM 4) Misplaced, loose or corroded terminals 5) Foreign materials fouled MAPS 6) Faulty MAPS

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Start engine and allow engine to idle until engine reaches operating temperature. Monitor MAP voltage signals. 1) Specification: 0.8~2.4V Is voltage signal within specification?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and MAPS.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect MAPS connector. Turn ignition switch to ON and measure voltage of MAPS reference 5V between MAPS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specification?	Yes	Go to step 3.
		No	Open or short circuit to chassis ground between MAPS harness connector and ECM Repair wire as necessary.
3	Thoroughly check MAPS and ECM connectors for loose, bent, corroded, contaminated, deteriorated or damaged terminals. Is connection okay?	Yes	Go to step 4.
		No	Repair as necessary.
4	Check MAPS for contamination, deterioration or damage. Is MAPS contaminated, deteriorated or damaged?	Yes	Clean MAPS with cleaner before installing. If MAPS is damaged or deteriorated, replace.
		No	Go to step 5.
5	Turn ignition to OFF and disconnect ECM connector. Measure resistance of MAPS signal circuit between MAPS harness connector and ECM harness connector. Measure resistance of MAPS ground circuit between MAPS harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 6.
		No	Open circuit between MAPS harness connector and ECM harness connector. Repair as necessary.
	ECM connector and MAPS connector is still disconnected.	Yes	Go to step 7.

6	Turn ignition to ON Measure voltage of MAPS signal circuit between MAPS harness connector and chassis ground. 1) Specification: below 0.5V Does voltage within specification?	No	Short circuit to battery between MAPS harness connector and ECM harness connector. Repair as necessary.
7	ECM connector and MAPS connector is still disconnected. Turn ignition to OFF. Measure resistance between MAPS harness connector and chassis ground at MAPS signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good MAPS and check for proper operation. If problem is corrected, replace MAPS
		No	Short circuit to chassis ground between MAPS harness connector and ECM harness connector. Repair as necessary.
8	Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0112	Intake air temperature circuit low input
Diagnostic trouble code No. P0113	Intake air temperature circuit high input
[Related items]	1) Open or short to battery between IATS and main relay 2) Open or short to chassis ground between IATS and ECM 3) Short between IATS wires 4) Faulty IATS

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0102 or P0103 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor IAT voltage signals. 1) 3.2~3.8V @ 0°C (32°F) 2) 2.3~2.9V @ 20°C (68°F) 3) 1.5~2.1V @ 40°C (104°F) 4) 0.5~0.9V @ 80°C (176°F) Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and IATS.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect IATS connector. Turn ignition to ON, measure voltage of IATS battery power circuit between IATS harness connector and chassis ground. 1) Specification: approximately B+ Is voltage within specifications?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between IATS harness connector and main relay. Repair as necessary.
4	Turn ignition switch to OFF and disconnect IATS connector and ECM connector. Measure resistance of IAT signal circuit between IATS harness connector and ECM harness connector. Measure resistance of IAT ground circuit between IATS harness connector and ECM harness connector. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between IATS harness connector and ECM harness connector. Repair as necessary.
5	ECM and IATS connectors are still disconnected. Turn ignition to ON. Measure voltage at IATS signal circuit between IATS harness connector and ECM harness connector. 1) Specification: below 0.5V Is voltage within specification?	Yes	Go to step 6.
		No	Short circuit to battery between IATS harness connector and ECM harness connector. Repair as necessary.

6	Ignition OFF, IATS and ECM connectors are still disconnected. Measure resistance between IATS signal circuit and IATS ground circuit. Measure resistance between IATS harness connector and chassis ground at IATS signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 7.
		No	Short circuit between IATS signal circuit and ground circuit. Short circuit to chassis ground between IATS harness connector and ECM harness connector. Repair as necessary.
7	Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes..		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0116	Engine coolant temperature circuit range/performance problem
Diagnostic trouble code No. P0125	Insufficient coolant temperature for closed loop fuel control
[Related items]	1) After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) 2) Poor connections between ECTS and ECM 3) Misplaced, loose or corroded terminals 4) Foreign materials fouled, contaminated, deteriorated ECTS 5) Faulty ECTS 6) Faulty thermostat **NOTE** If any codes relating to ECTS are present, do all repairs associated with them before this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0115 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor ECT voltage signals. 1) 3.2~3.8V @ 0°C (32°F) 2) 2.3~2.8V @ 20°C (68°F) 3) 1.5~2.1V @ 40°C (104°F) 4) 0.4~0.8V @ 80°C (176°F) Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and ECTS.
		No	Go to step 3.
3	Check ECTS for contamination, deterioration or damage. Is ECTS contaminated, deteriorated or damaged?	Yes	Clean ECTS with cleaner before installing. If ECTS is damaged or deteriorated, replace.
		No	Go to step 4.
4	Thoroughly check for loose, bent or corroded connectors at ECM connector and ECTS connector. With ignition OFF, disconnect ECM connector and ECTS connector. Measure resistance of both circuits between ECTS harness connector and ECM harness connector. 1) Specifications: below 1Ω Does each circuit indicate continuity?	Yes	Go to step 5.
		No	Open circuit between ECTS harness connector and ECM harness connector. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0117	Engine coolant temperature circuit low voltage
Diagnostic trouble code No. P0118	Engine coolant temperature circuit high voltage
[Related items]	1) Open or short to battery between ECTS and ECM 2) Short to chassis ground between ECTS and ECM 3) Short between ECTS wires 4) Faulty ECTS

Step	Inspection		Action
1	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor ECT voltage signals. 1) 3.2~3.8V @ 0°C (32°F) 2) 2.3~2.8V @ 20°C (68°F) 3) 1.5~2.1V @ 40°C (104°F) 4) 0.4~0.8V @ 80°C (176°F) Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and ECTS.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect ECTS connector. Turn ignition to ON and measure voltage of ECTS reference power circuit between ECTS harness connector and ECM harness connector. 1) Specification: approximately 5V Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between ECTS harness connector and ECM harness connector. Repair as necessary..
3	Turn ignition to OFF and disconnect ECM connector. Measure resistance of ECTS ground circuit between ECTS harness connector and ECM harness connector. Measure resistance of ECTS signal circuit between ECTS harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between ECTS harness connector and ECM harness connector. Repair as necessary.
4	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of ECTS signal circuit between ECTS harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between ECTS harness connector and ECM harness connector. Repair as necessary.
5	Ignition OFF, ECTS connector and ECM connector is still disconnected. Measure resistance between ECTS signal circuit and ECTS ground circuit. Measure resistance between ECTS harness connector and chassis ground at ECTS signal	Yes	Temporarily install a known good ECTS and check for proper operation. If problem is corrected, replace ECTS.
			Short circuit between ECTS signal circuit and ground circuit.

	circuit. 1) Specification: infinite Does resistance indicate open circuit?	No	Short to chassis ground between ECTS harness connector and ECM harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0121	Throttle position sensor circuit range/performance problem
Diagnostic trouble code No. P0122	Throttle position sensor circuit low input
Diagnostic trouble code No. P0123	Throttle position sensor circuit high input
[Related items]	1) Open or short to chassis ground between TPS and ECM 2) Short to battery between TPS and ECM 3) Short between TPS wires 4) Poor connections between TPS and ECM 5) Misplaced, loose or corroded terminals 6) Contaminated, deteriorated TPS 7) Faulty TPS

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL monitor TP voltage signals. 1) 0.3~0.9V @ idle 2) 4.0~4.6V @ full open Is signal within specifications?	Yes	Go to step 3.
		No	Go to step 4.
3	Ignition ON and engine OFF. Using SCAN TOOL and monitor TP voltage signals while slowly opening the throttle. Does voltage signal increase?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and TPS.
		No	Temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS.
4	Turn ignition to OFF and disconnect TPS connector. Turn ignition to ON and measure voltage of TPS reference 5V circuit between TPS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specifications?	Yes	Go to step 5.
		No	Open circuit or short circuit to chassis ground between TPS harness connector and ECM connector. Repair as necessary.
5	Turn ignition to OFF and disconnect ECM connector. Measure resistance of TPS ground circuit between TPS harness connector and ECM harness connector. Measure resistance of TPS signal circuit between TPS harness connector and ECM harness connector. 1) Specification: below 1Ω	Yes	Go to step 6.
		No	Open circuit between TPS harness connector and ECM harness connector. Repair as necessary.

	Does each resistance indicate continuity circuit?		
6	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of TPS signal circuit between TPS harness connector and chassis ground 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 7.
		No	Short circuit to battery between TPS harness connector and ECM harness connector. Repair as necessary.
7	Ignition OFF, TPS connector and ECM connector is still disconnected. Measure resistance between TPS signal circuit and ground circuit. Measure resistance between TPS harness connector and chassis ground at TPS signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 8.
		No	Short circuit between TPS signal circuit and ground circuit. Short to chassis ground between TPS harness connector and ECM harness connector. Repair as necessary.
8	Thoroughly check TPS for contamination, deterioration, or damage. Is TPS contaminated, deteriorated or damaged?	Yes	If damaged or deteriorated, temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS.
		No	Temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS.
9	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0130	HO2S circuit open (Bank 1, Sensor 1)
Diagnostic trouble code No. P0131	HO2S circuit short to ground (Bank 1, Sensor 1)
Diagnostic trouble code No. P0132	HO2S circuit short to 5V (Bank 1, Sensor 1)
[Related items]	1) Open or short to battery between front HO2S and ECM 2) Short to chassis ground between front HO2S and ECM 3) Short between front HO2S wires 4) Faulty front HO2S 5) Poor connections between front HO2S and ECM 6) Misplaced, bent, loose or corroded connector terminals

Step	Inspection		Action
1	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor HO2S signal waveform. Does the HO2S signal switch lean to rich and rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and HO2S.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 3.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
3	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 4.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
	Thoroughly check HO2S for contamination,	Yes	If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation.

5	deterioration or damage. Is HO2S contaminated, deteriorated or damaged?		If problem is corrected, replace HO2S.
		No	Verify ECM and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0133	HO2S circuit slow responsive (Bank1, Sensor1)
[Related items]	1) Abnormal combustion 2) Improper fuel pressure 3) Front and rear HO2S connections reversed 4) Faulty fuel delivery system 5) Leak in intake system 6) Leak in exhaust system 7) Faulty front HO2S NOTE If any misfire, purge solenoid valve, MAFS or HO2S heater codes are present, do all repairs associated with those codes before proceeding this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Visually check for leak from exhaust system (especially between TWC converter and front exhaust pipe). Are any leaks present?	Yes	Repair exhaust system leaks as necessary.
		No	Go to step 3.
3	Visually check for leak from intake system. Are any vacuum leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 4.
4	Start engine after installing fuel pressure gauge at service valve in fuel rail. With engine running at operating temperature, is fuel pressure within specification? Fuel pressure at idle: 46~49 psi (320~340Kpa, 3.26~3.47kg/cm²)	Yes	Temporarily install a known good HO2s and check for proper operation. If problem is corrected, replace HO2S.
		No	1) If measured pressure is too high: Go to step 5 2) If measured pressure is too low: Go to step 6
5	Disconnect return line hose from fuel filter. Blow through line towards tank. Is return line restricted?	Yes	Check for blockage in return line, clean or replace as necessary.
		No	Repair pressure regulator.
6	Clamp a return line from fuel filter and check if pressure rises. Do fuel pressure rise?	Yes	Replace fuel delivery module.
		No	Check fuel filter at fuel pump. If it is OK, measure fuel pump maximum pressure and repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0134	HO2S circuit no activity detected (Bank1, Sensor1)
[Related items]	1) Open or short between HO2S signal terminal and ECM 2) Contaminated, deteriorated or aged HO2S 3) Misplaced, bent, loose or corroded connector terminals 4) Faulty front HO2S **NOTE** If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this trouble area.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTC Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich and rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
			If damaged or deteriorated, temporarily install a

6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECM and HO2S connectors are secure. If OK, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
7	Visually check for leak from exhaust system (especially between TWC converter and front exhaust pipe). Are any leaks present?	Yes	Repair exhaust system leaks as necessary
		No	Go to step 8.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0135	HO2S heater circuit malfunction (Bank1, Sensor1)
[Related items]	1) Open or short to battery between front HO2S heater and ECM 2) Short to chassis ground between front HO2S heater and ECM 3) Incorrect front HO2S heater resistance 4) Faulty front HO2S heater

Step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow an engine to idle. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Measure resistance between HO2S heater signal and battery power terminal of sensor. 1) 3.0~6.2Ω at 20°C (68°F) Is measured resistance within specification?	Yes	Go to step 5.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0136	HO2S circuit open (Bank 1, Sensor 2)
Diagnostic trouble code No. P0137	HO2S circuit short to ground (Bank 1, Sensor 2)
Diagnostic trouble code No. P0138	HO2S circuit short to 5V (Bank 1, Sensor 2)
[Related items]	1) Open or short to chassis ground between rear HO2S and ECM 2) Short to battery between rear HO2S and ECM 3) Short between rear HO2S wires 4) Misplaced, bent, loose or corroded connector terminals 5) Faulty rear HO2S

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 3.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
3	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 4.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
			Verify ECM and HO2S connectors are secure. If connectors are okay, temporarily install a known

		No	good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0139	HO2S circuit malfunction (Bank 1, Sensor 2)
Diagnostic trouble code No. P0140	HO2S circuit malfunction-stick (Bank 1, Sensor 2)
[Related items]	1) Open or short to chassis ground between rear HO2S and ECM 2) Short to battery between rear HO2S and ECM 3) Short between rear HO2S wires 4) Misplaced, bent, loose or corroded connector terminals 5) Faulty rear HO2S

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 3.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
3	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 4.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECM and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0141	HO2S heater circuit malfunction (Bank1, Sensor2)
[Related items]	1) Open or short to battery between rear HO2S heater and ECM 2) Short to chassis ground between rear HO2S heater and ECM 3) Incorrect rear HO2S heater resistance 4) Faulty rear HO2S heater

Step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow an engine to idle. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Measure resistance between HO2S heater signal and battery power terminal of HO2S. 1) 3.0~6.2Ω at 20°C (68°F) Is measured resistance within specification?	Yes	Go to step 5.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0150	HO2S circuit open (Bank 2, Sensor 1)
Diagnostic trouble code No. P0151	HO2S circuit short to ground (Bank 2, Sensor 1)
Diagnostic trouble code No. P0152	HO2S circuit short to 5V (Bank 2, Sensor 1)
[Related items]	1) Open or short to battery between front HO2S and ECM 2) Short to chassis ground between front HO2S and ECM 3) Short between front HO2S wires 4) Faulty front HO2S 5) Poor connections between front HO2S and ECM 6) Misplaced, bent, loose or corroded connector terminals

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor HO2S signal waveform. Does the HO2S signal switch lean to rich and rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.

	Does resistance indicate open circuit?		
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECM and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0153	HO2S circuit slow responsive (Bank2, Sensor1)
[Related items]	1) Abnormal combustion 2) Improper fuel pressure 3) Front and rear HO2S connections reversed 4) Faulty fuel delivery system 5) Leak in intake system 6) Leak in exhaust system 7) Faulty front HO2S NOTE If any misfire, purge solenoid valve, MAFS or HO2S heater codes are present, do all repairs associated with those codes before proceeding this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Visually check for leak from exhaust system (especially between TWC converter and front exhaust pipe). Are any leaks present?	Yes	Repair exhaust system leaks as necessary.
		No	Go to step 3.
3	Visually check for leak from intake system. Are any vacuum leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 4.
4	Start engine after installing fuel pressure gauge at service valve in fuel rail. With engine running at operating temperature, is fuel pressure within specification? Fuel pressure at idle: 46~49 psi (320~340Kpa, 3.26~3.47kg/cm²)	Yes	Temporarily install a known good HO2s and check for proper operation. If problem is corrected, replace HO2S.
		No	1) If measured pressure is too high: Go to step 5 2) If measured pressure is too low: Go to step 6
5	Disconnect return line hose from fuel filter. Blow through line towards tank. Is return line restricted?	Yes	Check for blockage in return line, clean or replace as necessary.
		No	Repair pressure regulator.
6	Clamp a return line from fuel filter and check if pressure rises. Do fuel pressure rise?	Yes	Replace fuel delivery module.
		No	Check fuel filter at fuel pump. If it is OK, measure fuel pump maximum pressure and repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0154	HO2S circuit no activity detected (Bank2, Sensor1)
[Related items]	1) Open or short between HO2S signal terminal and ECM 2) Contaminated, deteriorated or aged HO2S 3) Misplaced, bent, loose or corroded connector terminals 4) Faulty front HO2S **NOTE** If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this trouble area.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTC. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich and rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
			If damaged or deteriorated, temporarily install a known good HO2S and check for proper

6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	operation. If problem is corrected, replace HO2S.
		No	Verify ECM and HO2S connectors are secure. If OK, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
7	Visually check for leak from exhaust system (especially between TWC converter and front exhaust pipe). Are any leaks present?	Yes	Repair exhaust system leaks as necessary.
		No	Go to step 8.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0155	HO2S heater circuit malfunction (Bank2, Sensor1)
[Related items]	1) Open or short to battery between front HO2S heater and ECM 2) Short to chassis ground between front HO2S heater and ECM 3) Incorrect front HO2S heater resistance 4) Faulty front HO2S heater

Step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow engine to idle. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Measure resistance between HO2S heater signal and battery power terminal of sensor. 1) 3.0~6.2Ω at 20°C (68°F) Is measured resistance within specification?	Yes	Go to step 5.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0156	HO2S circuit open (Bank 2, Sensor 2)
Diagnostic trouble code No. P0157	HO2S circuit short to ground (Bank 2, Sensor 2)
Diagnostic trouble code No. P0158	HO2S circuit short to 5V (Bank 2, Sensor 2)
[Related items]	1) Open or short to battery between rear HO2S and ECM 2) Short to chassis ground between rear HO2S and ECM 3) Short between HO2S wires 4) Faulty HO2S 5) Poor connections between rear HO2S and ECM 6) Misplaced, bent, loose or corroded connector terminals

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 3.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
3	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 4.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or	Yes	If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
			Verify ECM and HO2S connectors are secure. If

	damaged?	No	connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0159	HO2S circuit malfunction (Bank 2, Sensor 2)
Diagnostic trouble code No. P0160	HO2S circuit malfunction-stick (Bank 2, Sensor 2)
[Related items]	1) Open or short to battery between rear HO2S and ECM 2) Short to chassis ground between rear HO2S and ECM 3) Short between rear HO2S wires 4) Faulty rear HO2S 5) Poor connections between rear HO2S and ECM 6) Misplaced, bent, loose or corroded connector terminals

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECM harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 3.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
3	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. 1) Specification: below 0.5V Is voltage within specifications?	Yes	Go to step 4.
		No	Short circuit to battery between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Ignition OFF, HO2S connector and ECM connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECM harness connector. Repair as necessary.
5	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECM and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0161	HO2S heater circuit malfunction (Bank2, Sensor2)
[Related items]	1) Open or short to battery between front HO2S heater and ECM 2) Short to chassis ground between front HO2S heater and ECM 3) Incorrect front HO2S heater resistance 4) Faulty front HO2S heater

Step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow engine to idle. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
3	Turn ignition to OFF and disconnect ECM connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECM harness connector. 1) Specification: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECM harness connector. Repair as necessary.
4	Measure resistance between HO2S heater signal and battery power terminal of sensor. 1) 3.0~6.2Ω at 20°C (68°F) Is measured resistance within specification?	Yes	Go to step 5.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0171	Fuel system too lean (Bank1)
Diagnostic trouble code No. P0174	Fuel system too lean (Bank2)
[Related items]	1) Faulty fuel delivery system 2) Clogged fuel injectors 3) Faulty fuel injectors 4) Leak in intake system 5) Leak in exhaust system 6) Faulty MAFS 7) Faulty TPS **NOTE** If any codes relating to injectors, HO2S, ECTS or MAFS are stored, do all repairs associated with those codes before proceeding with this troubleshooting procedure

Step	Inspection		Action
1	Turn ignition switch to ON. Connect SCAN TOOL to data link connector or OBD-II check connector. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL, monitor long-term on fuel trim data. 1) Long-term: -12.5~12.5% Is long-term within the specifications indicated?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared.
		No	Go to step 3.
3	Visually/physically inspect the following items: 1) Throttle body gasket 2) Gasket between intake manifold and surge tank 3) Seals between intake manifold and fuel injectors 4) Seals between surge tank and PCV valves 5) Crankcase ventilation valve and/or system for leaks 6) Contaminated fuel Are the above items okay?	Yes	Go to step 4.
		No	Repair or replace as necessary.
4	Visually/physically inspect the following items: 1) Air cleaner element for being restricted. 2) MAFS for proper installation and foreign objects 3) Exhaust system for leaks Are the above items okay?	Yes	Go to step 5.
		No	Repair or replace as necessary.
5	Check vacuum hoses for splits and proper connections to engine dynamic chamber (especially PCV, ISC hose, throttle body, intake manifold, and brake booster).	Yes	Go to step 6.

	Are connections OK?	No	Repair or replace as necessary.
6	With engine idling disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valveIs vacuum available at purge valve when EVAP valve is not operating?	Yes	EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair. procedures.
		No	Go to step 7.
7	After installing fuel pressure gauge to service port on fuel rail, connect DLC F/P and B (B+) with a jumper wire. 1) Fuel pressure at idle: 46~49 psi (320~340Kpa, 3.26~3.47kg/cm²) Is fuel line pressure correct with ignition switch ON?	Yes	Go to step 8.
		No	Low pressure: Clamp return-line and check if pressure rises: 1) If pressure rises: replace pressure regulator 2) If pressure does not rise: check the strainer at the fuel pump. High pressure: Disconnect return-line from fuel filter side and blow through line towards tank. 1) If line is clear: replace fuel delivery module. 2) If line is blocked: check for blockage in return line and clear or replace as necessary. If it is OK, check fuel.
8	Start engine and check for engine rpm decrease when disconnecting each injector connector in sequence. Measure the decreasing engine rpm of all 6 cylinders. Is there any cylinder with no change in rpm or only a small rpm change?	Yes	Repair as necessary
		No	Go to step 9.
9	Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders. Are any spark plugs with abnormal color compared to other cylinders?	Yes	Check for engine mechanical failure. If it is OK, replace spark plugs.
		No	Go to step 10.
10	Check for ECM input signal from MAFS, HO2S, TPS and other input signals. Are input signals within specification?	Yes	Go to step 11.
		No	Replace all failed parts.
11	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0172	Fuel system too rich (Bank1)
Diagnostic trouble code No. P0175	Fuel system too rich (Bank2)
[Related items]	1) Faulty ignition system 2) EVAP canister purge valve malfunction 3) Leak in intake system 4) Leak in exhaust system 5) Faulty fuel delivery system - Clogged fuel injectors - Faulty fuel injectors - Fuel pressure too high - Fuel pressure regulator failure 6) Faulty MAFS 7) Faulty front HO2S 8) Faulty TPS **NOTE** If any injectors, front HO2S, ECTS, and MAFS codes are present, do all repairs associated with those codes before proceeding this troubleshooting guide.

Step	Inspection		Action
1	Turn ignition switch to ON. Connect SCAN TOOL to data link connector or OBD-II check connector. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL, monitor long-term on fuel trim data. 1) Long-term: -12.5~12.5% Is long-term within the specifications indicated?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared.
		No	Go to step 3.
3	Visually/physically inspect the following items: 1) Throttle body gasket 2) Gasket between intake manifold and surge tank 3) Seals between intake manifold and fuel injectors 4) Seals between surge tank and PCV valves 5) Crankcase ventilation valve and/or system for leaks 6) Contaminated fuel Are the above items okay?	Yes	Go to step 4.
		No	Repair or replace as necessary.
4	Visually/physically inspect the following items: 1) Air cleaner element for being restricted. 2) MAFS for proper installation and foreign objects 3) Exhaust system for leaks	Yes	Go to step 5.
		No	Repair or replace as necessary.

	Are the above items okay?		
5	Check vacuum hoses for splits and proper connections to engine dynamic chamber (especially PCV, ISC hose, throttle body, intake manifold, and brake booster). Are connections OK?	Yes	Go to step 6.
		No	Repair or replace as necessary.
6	With engine idling disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valve Is vacuum available at purge valve when EVAP valve is not operating?	Yes	EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair procedures.
		No	Go to step 7.
7	After installing fuel pressure gauge to service port on fuel rail, connect DLC F/P and B (B+) with a jumper wire. 1) Fuel pressure at idle: 46~49 psi (320~340Kpa, 3.26~3.47kg/cm²) Is fuel line pressure correct with ignition switch ON?	Yes	Go to step 8.
		No	Low pressure: Clamp return-line and check if pressure rises: 1) If pressure rises: replace pressure regulator. 2) If pressure does not rise: check the strainer at the fuel pump. High pressure: Disconnect return-line from fuel filter side and blow through line towards tank. 1) If line is clear: replace fuel delivery module. 2) If line is blocked: check for blockage in return line and clear or replace as necessary. If it is OK, check fuel.
8	Start engine and check for engine rpm decrease when disconnecting each injector connector in sequence. Measure the decreasing engine rpm of all 6 cylinders. Is there any cylinder with no change in rpm or only a small rpm change?	Yes	Repair as necessary.
		No	Go to step 9.
9	Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders. Are any spark plugs with abnormal color compared to other cylinders?	Yes	Check for engine mechanical failure. If it is OK, replace spark plugs.
		No	Go to step 10.
10	Check for ECM input signal from MAFS, HO2S, TPS and other input signals. Are input signals within specification?	Yes	Go to step 11.
		No	Replace all failed parts.
11	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0201	Cylinder 1 injector circuit malfunction
Diagnostic trouble code No. P0202	Cylinder 2 injector circuit malfunction
Diagnostic trouble code No. P0203	Cylinder 3 injector circuit malfunction
Diagnostic trouble code No. P0204	Cylinder 4 injector circuit malfunction
Diagnostic trouble code No. P0205	Cylinder 5 injector circuit malfunction
Diagnostic trouble code No. P0206	Cylinder 6 injector circuit malfunction
[Related items]	1) Open or short between main relay and injectors 2) Open or short between ECM and injectors 3) Short to battery between ECM and injectors 4) Faulty fuel injector

Step	Inspection		Action
1	Turn ignition switch to OFF and disconnect injector connector. Measure resistance between injector terminal 1 and terminal 2. 1) 13~16Ω at 20°C (68°F) Is measured resistance within specification?	Yes	Go to step 2.
		No	Temporarily install a known good injector and check for proper operation. If problem is corrected, replace injector.
2	Turn ignition switch to OFF and disconnect injector connector. With ignition ON and measure voltage of injector power circuit between injector harness connector and chassis ground. 1) Specification: approximately B+ Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between main relay and injector harness connector. Repair as necessary.
3	Disconnect ECM connector and injector connector. Measure resistance between injector harness connector and ECM harness connector. 1) Specification: below 1Ω Does resistance indicate continuity?	Yes	Go to step 4.
		No	Open circuit between injector harness connector and ECM harness connector. Repair as necessary.
4	ECM connector and injector connector is still disconnected. Measure resistance between injector harness connector and chassis ground at injector signal circuit. 1) Specification: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good injector and check for proper operation. If problem is corrected, replace injector.
		No	Short circuit to chassis ground between injector signal terminal and ECM. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0325	Knock sensor circuit malfunction
[Related items]	1) Open or short to GND between knock sensor and ECM 2) Source of high resistance between knock sensor and ECM 3) Faulty knock sensor

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor KS signals. 1) Specifications: 2.3~2.7V Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECM and KS.
		No	Go to step 2.
2	Start and run engine. Using SCAN TOOL monitor KS voltage signals from idle to 3000rpm. Does voltage signal increase?	Yes	Check any other DTCs. If any DTCs is present, do all repairs associated with those codes before proceeding next step.
		No	Go to step 3.
3	Thoroughly check KS and ECM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 4.
4	Turn ignition to OFF and disconnect KS connector and ECM connector. Measures resistance of KS signal circuit between KS harness connector and ECM harness connector. Measure resistance of KS ground circuit between KS harness connector and chassis ground. 1) Specifications: below 1Ω Is each resistance within specification?	Yes	Go to step 5.
		No	Open circuit between KS harness connector and ECM harness connector and/or chassis ground. Repair as necessary.
5	Turn ignition to ON. KS connector and ECM connector is still disconnected. Measures voltage of KS signal circuit between KS harness connector and chassis ground. 1) Specifications: below 0.5V Is voltage within specifications?	Yes	Go to step 6.
		No	Short circuit to battery between KS harness connector and ECM harness connector. Repair as necessary.
6	Ignition OFF, KS connector and ECM connector is still disconnected. Measures resistance between KS harness connector and chassis ground at KS signal circuit. Measure resistance between KS signal circuit and ground circuit. 1) Specifications: infinite Does each resistance indicate open circuit?	Yes	Temporarily install a known good knock sensor and check for proper operation. If problem is corrected, replace knock sensor.
		No	Short circuit to chassis ground between KS harness connector and ECM harness connector. Short circuit between KS signal circuit and ground circuit. Repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending code.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0335	Crankshaft position sensor circuit malfunction
[Related items]	1) Open or short to chassis ground between CKPS and ECM 2) Short to battery between CKPS and ECM 3) Short between CKPS wires 4) Out of allowable air gap 5) Faulty Target wheel tolerance 6) Faulty CKPS

Step	Inspection		Action
1	Thoroughly check CKPS and ECM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect CKPS connector. Turn ignition to ON and measure voltage of CKPS power circuit between CKPS harness connector and chassis ground. 1) Specification: approximately B+ Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between CKPS harness connector and main relay. Repair as necessary.
3	Turn ignition to OFF and disconnect ECM connector. Measure resistance of CKPS signal circuit between CKPS harness connector and ECM harness connector. Measure resistance of CKPS ground circuit between CKPS harness connector and chassis ground. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between CKPS harness connector and ECM harness connector and/or chassis ground. Repair as necessary.
4	Turn ignition to ON. ECM connector is still disconnected. Measure voltage of CKPS signal circuit between CKPS harness connector and chassis ground. 1) Specifications: below 0.5V Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to power between CKPS harness connector and ECM harness connector. Repair as necessary.
5	Turn ignition to OFF. Measures resistance between CKPS harness connector and ECM harness connector at CKPS signal circuit. 1) Specifications: infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good CKPS and check for proper operation. If problem is corrected, replace CKPS.
		No	Short circuit to chassis ground between CKPS harness connector and ECM harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0340	Camshaft position sensor circuit malfunction
[Related items]	1) Open or short to chassis ground between CMPS and ECM 2) Short to battery between CMPS and ECM 3) Short between CMPS wires 4) Improper cam timing 5) Faulty CMPS

Step	Inspection		Action
1	Does vehicle lack power or show low engine vacuum?	Yes	Check cam timing.
		No	Go to step 2.
2	Thoroughly check CMPS and ECM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect CMPS connector. Turn ignition to ON and measure voltage of CMPS power circuit between CMPS harness connector and chassis ground. 1) Specification: approximately B+ Is voltage within specification?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between CMPS harness connector and main relay. Repair as necessary.
4	Turn ignition to OFF and disconnect ECM connector. Measure resistance of CMPS signal circuit between CMPS harness connector and ECM harness connector. Measure resistance of CMPS ground circuit between CMPS harness connector and chassis ground. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between CMPS harness connector and ECM harness connector and/or chassis ground. Repair as necessary.
5	Turn ignition to ON. ECM and CMPS connectors are still disconnected. Measure voltage of CMPS signal circuit between CMPS harness connector and chassis ground. 1) Specifications: below 0.5V Is voltage within specifications?	Yes	Go to step 6.
		No	Short circuit to power between CMPS harness connector and ECM harness connector. Repair as necessary.
6	Turn ignition to OFF. Measures resistance between CMPS harness connector and ECM harness connector at CMPS signal circuit. 1) Specifications: infinite Does resistance indicate open circuit?	Yes	Go to step 7.
		No	Short circuit to chassis ground between CMPS harness connector and ECM harness connector. Repair as necessary.
	Turn ignition to OFF and disconnect CMPS	Yes	Temporarily install a known good CMPS and check for proper operation. If problem is corrected, replace CMPS.

7	connector. Check for CMPS installation. Is CMPS installed properly?	No	Remove CMPS, install CMPS correctly, and check CMPS for proper operation. If not, temporarily install a known good CMPS and check for proper operation. If problem is corrected, replace CMPS.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

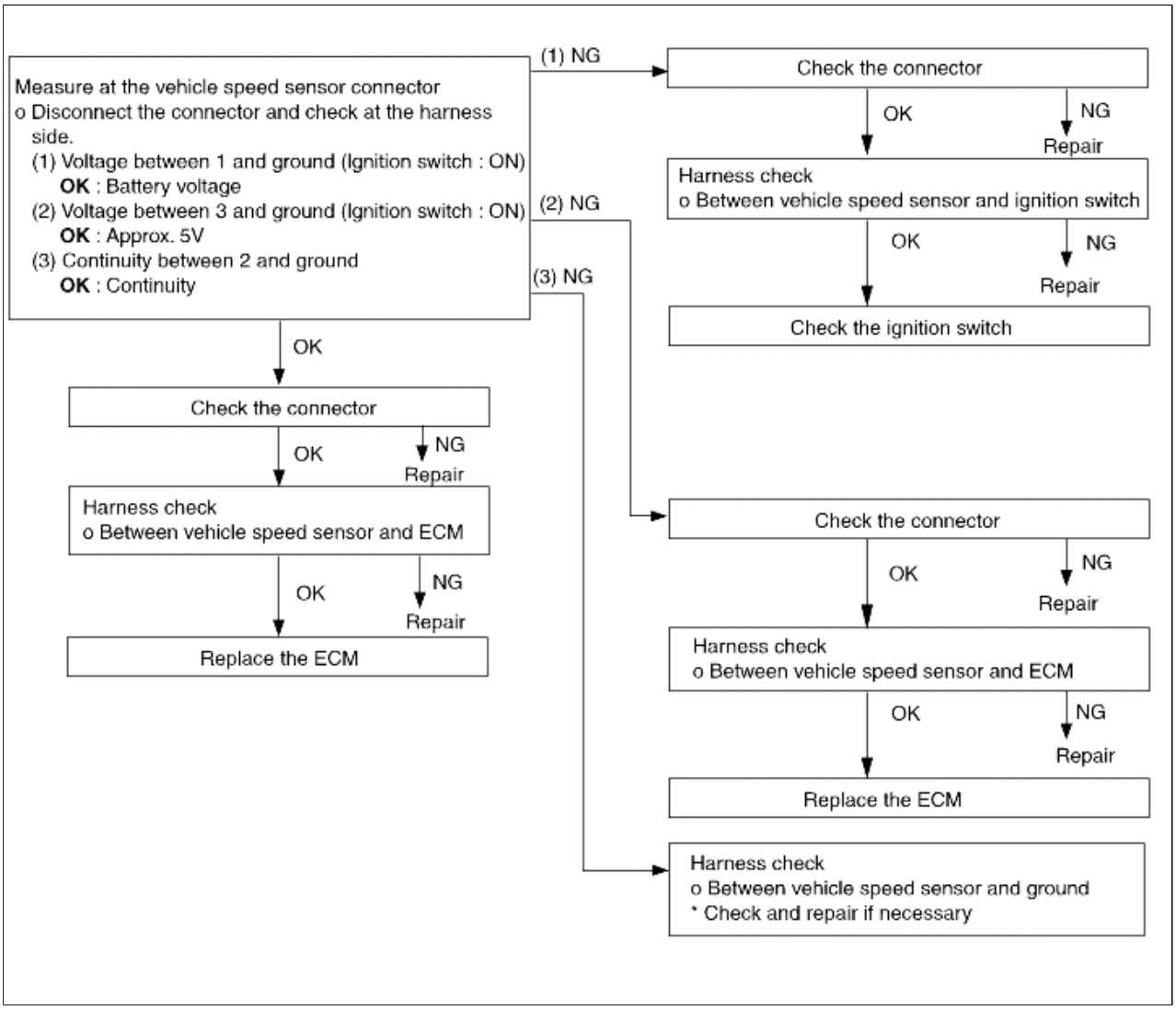
TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0460	Fuel level sensor circuit range/performance problem
Diagnostic trouble code No. P0462	Fuel level sensor circuit low input
Diagnostic trouble code No. P0463	Fuel level sensor circuit high input
[Related items]	1) Open or short to battery between FLS and ECM 2) Short to chassis ground between FLS and ECM 3) Poor connections between FLS and ECM 4) Misplaced, loose, bent or corroded terminals 5) Faulty FLS or FLS stuck

Step	Inspection		Action
1	Turn ignition to OFF and disconnect FLS connector. Turn ignition to ON. Measure voltage of FLS signal circuit between FLS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specification?	Yes	Go to step 2.
		No	Open circuit or short circuit between FLS harness connector and ECM connector. Repair as necessary.
2	Thoroughly check FLS and ECM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is connection okay?	Yes	Temporarily install a known good FLS and check for proper operation. If problem is corrected, replace FLS
		No	Repair as necessary.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

VEHICLE SPEED SENSOR

Code No.P0500 Vehicle speed sensor system	Probable cause
If no output pulse is detected from vehicle speed sensor while driving at a speed of 19mph(30 km/h) or morefor 30 second, it is judged to be an open circuit or short circuit in the vehicle speed sensor and diagnostic trouble code No.P0500 is output.	1) Malfunction of the vehicle speed sensor 2) Malfunction of connector 3) Malfunction of the ECM



TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0506	Idle control system rpm lower than expected
[Related items]	1) Open or short between main relay and ISC STM (stepper motor) 2) Open or short between ECM and ISC STM 3) Faulty ISC STM 4) Carbon fouled throttle plate **NOTE** If any codes relating to TPS, MAFS, or fuel injector are present, do all repairs associated with them before proceeding with this troubleshooting procedure.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTCs. Is DTC P0510 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Thoroughly check ISC STM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ISC STM connector. Turn ignition to ON. Measure voltage of two ISC STM power circuits at ISC STM harness connector terminal 2 and 5. 1) Specifications: approximately B+ Is each voltage within specifications?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between main relay and ISC STM. Repair as necessary.
4	Measure resistance between ISC STM terminal 5 and terminal 4. Measure resistance between ISC STM terminal 5 and terminal 6. Measure resistance between ISC STM terminal 2 and terminal 1. Measure resistance between ISC STM terminal 2 and terminal 3. 1) Specifications: 29~38Ω @ 20°C (68°F) Is each resistance within specifications?	Yes	Go to step 5.
		No	Temporarily install a known good ISC STM and check ISC STM for proper operation. If problem is corrected, replace ISC STM.
5	Check entire intake air system for debris, blockage, excessive dirt and other damage (specially, air tubes and air cleaner element). Is intake air system okay?	Yes	Go to step 6.
		No	Repair or replace as necessary.
6	Check entire intake air system for leaks (specially, PCV connectors and hose, vacuum supply connectors and hoses, intake air tubes, air cleaner housing, throttle body, gasket seals, etc). Is intake air system okay?	Yes	Go to step 7.
		No	Repair or replace as necessary.

7	Turn ignition to OFF and disconnect ECM connector and ISC STM connector. Measure resistance of four circuits between ECM harness connector and ISC STM harness connector. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 8.
		No	Open circuit between ECM harness connector and ISC STM harness connector. Repair as necessary.
8	Turn ignition to OFF and disconnect ECM connector and ISC STM connector. Measure voltage at four circuits between ECM harness connector and ISC STM harness connector. 1) Specifications: below 0.5V Is each voltage within specifications?	Yes	Go to step 9.
		No	Short circuit to power between ECM harness connector and ISC STM harness connector. Repair as necessary.
9	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes. Perform idle adjustment procedure.		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0507	Idle control system rpm higher than expected
[Related items]	1) Short to chassis ground between ISC STM and ECM 2) Air leak in intake system between head and throttle plate 3) Improperly adjusted accelerator cable 4) Carbon fouled throttle plate 5) Faulty ISC STM 6) Faulty TPS 7) Faulty PCV/PCSV **NOTE** If any codes relating to TPS, MAFS, fuel injector are present, do all repairs associated with them before proceeding with this troubleshooting guide.

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTCs. Is DTC P0510 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL and monitor TP voltage signals at idle (fully closed throttle body) 1) Specification: 0.3~0.9V Is voltage within specification?	Yes	Go to step 3.
		No	If DTC relating to TPS is present, Do all repairs associated with those codes. If DTC relating to TPS is not present, check TPS for proper installation.
3	Check accelerator cable free play [0.040~0.120 in (1.0~3.0 mm)]. Is accelerator cable free play within specification.	Yes	Go to step 4.
		No	Adjust accelerator cable as necessary.
4	Thoroughly check ISC STM for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 5.
5	Turn ignition to OFF and disconnect ISC STM connector. Turn ignition to ON. Measure voltage of two ISC STM power circuits at ISC STM harness connector pins 2 and 5. 1) Specifications: approximately B+ Is each voltage within specifications?	Yes	Go to step 6.
		No	Open circuit or short circuit to chassis ground between main relay and ISC STM. Repair as necessary.
6	Turn ignition OFF. Measure resistance between ISC STM terminal 5 and terminal 4. Measure resistance between ISC STM terminal 5 and terminal 6. Measure resistance between ISC STM terminal 2 and terminal 1.	Yes	Go to step 7.
			Temporarily install a known good ISC STM and

	Measure resistance between ISC STM terminal 2 and terminal 3. 1) Specifications: 29~38Ω @ 20°C (68°F) Is each resistance within specifications?	No	check ISC STM for proper operation. If problem is corrected, replace ISC STM.
7	Check entire intake air system for debris, blockage, excessive dirt and other damage (specially, air tubes and air cleaner element). Is intake air system okay?	Yes	Go to step 8.
		No	Repair or replace as necessary.
8	Check entire intake air system for leaks (specially, PCV connectors and hose, vacuum supply connectors and hoses, intake air tubes, air cleaner housing, throttle body, gasket seals, etc). Is intake air system okay?	Yes	Go to step 9.
		No	Repair or replace as necessary.
9	Turn ignition to OFF and disconnect ECM connector and ISC STM connector. Measure resistance between ISC STM harness connector and chassis ground at ISC STM harness terminal 1, 3, 4, and 6. 1) Specifications: below 1Ω Does each resistance indicate open circuit?	Yes	Go to step 10.
		No	Short circuit to chassis ground between ECM harness connector and ISC STM harness connector. Repair as necessary.
10	Turn ignition to OFF and disconnect ECM connector and ISC STM connector. Measure resistance of four circuits between ECM harness connector and ISC STM harness connector. 1) Specifications: below 1Ω Does each resistance indicate continuity circuit?	Yes	Go to step 11.
		No	Open circuit between ECM harness connector and ISC STM harness connector. Repair as necessary.
11	Turn ignition to OFF and disconnect ECM connector and ISC STM connector. Measure voltage at four circuits between ECM harness connector and ISC STM harness connector. 1) Specifications: below 0.5V Is each voltage within specifications?	Yes	Go to step 12.
		No	Short circuit to power between ECM harness connector and ISC STM harness connector. Repair as necessary.
12	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes. Perform idle adjustment procedure..		

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0510	Idle switch circuit malfunction
[Related items]	1) Open or short to battery between idle switch in TPS and ECM 2) Short to chassis ground between idle switch in TPS and ECM 3) Faulty idle switch in TPS

Step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector and turn ignition to ON. Is DTC P0120, P0122 or P0123 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Thoroughly check TPS for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect TPS connector. Turn ignition to ON and measure voltage of idle switch circuit between TPS harness connector and chassis ground. 1) Specification: approximately 5V Is voltage within specification?	Yes	Temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS.
		No	Open circuit or short circuit to chassis ground between TPS harness connector and ECM harness connector. Repair as necessary.
4	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

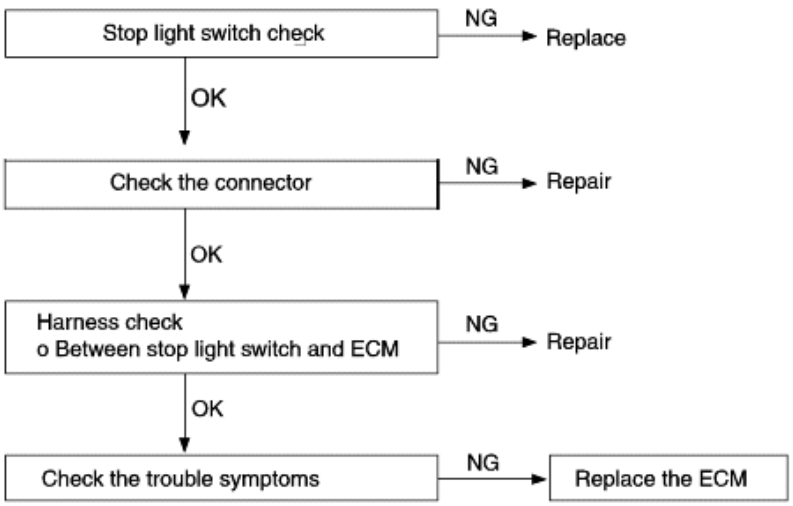
TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0551	Power steering switch malfunction
[Related items]	1) Open between power steering switch and ECM 2) Short to chassis ground between power steering switch and ECM 3) Faulty power steering switch

Step	Inspection		Action
1	Turn ignition to OFF and disconnect power steering switch. Turn ignition to ON. Measure voltage of power steering switch between power steering switch harness connector and chassis ground. 1) Specifications: approximately 10~15V Is voltage within specifications?	Yes	Check power steering switch for poor terminal contacts due to bent, damaged, or misplaced terminal at power steering switch. If OK, temporally install a known good power steering switch and check power steering switch for proper operation. If problem is corrected, replace power steering switch.
		No	Open circuit or short circuit to chassis ground between power steering switch connector and ECM.
2	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Stop light switch system

Code No.P0703 Stop light switch system	Probable cause
If the stop light switch is on for 5 minutes or more while driving, it is judged that there is a short circuit in the stop light switch and diagnostic trouble code P0703 is output.	1) Malfunction of the stop light switch 2) Malfunction of connector 3) Malfunction of the ECM



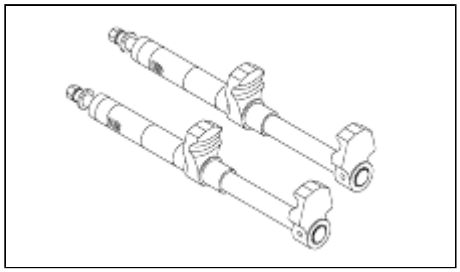
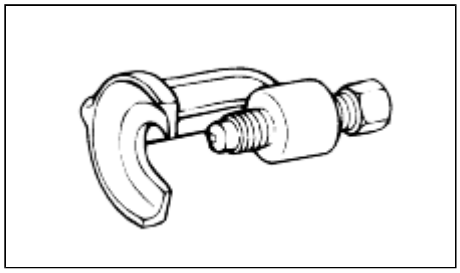
TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1159	VICS valve circuit malfunction
[Related items]	1) Open or short to chassis ground between VICS valve and ECM 2) Faulty VICS valve

Step	Inspection		Action
1	Thoroughly check VICS valve for loose, bent, corroded, contaminated, or damaged connectors. Is nay problem present?	Yes	Repair as necessary.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect VICS valve connector. Turn ignition to ON and measure voltage of VICS valve power circuit between VICS valve harness connector and chassis ground. 1) Specification : approximately B+ Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between VICS valve harness connector and main relay. Repair as necessary.
3	Turn ignition to OFF. VICS valve connector is still disconnected. Measure resistance between VICS valve battery power and signal terminal. 1) Specification : 13.8±3.5Ω @ 20°C (68°F) Is resistance within specification?	Yes	Check VICS valve for poor terminal contacts to oxidation, bent deformed, or misplacecd terminals. Repair as necessary.
		No	Temporarily install a known good VICS vlave and check for proper operation. If problem is corrected, replace VICS valve.
4	Turn ignition to OFF and disconnect ECM connector. Measure resistance of VICS valve signal circuit between VICS valve harness connector and ECM harness connector. 1) Specification : below 1Ω Does resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between VICS valve harness connector and ECM harness connector. Repair as necessary.
5	ECM connector VICS valve connector is still disconnected. Measure resistance betwenn VICS valve harness connector and chassis ground at VICS valve signal circuit. Measure resistance between VICS valve battery voltage circuit and signal circuit. 1) Specification : infinite Does resistance indicate open circuit?	Yes	Temporarily install a known good VICS vlave and check for proper operation. If problem is corrected, replace VICS valve.
		No	Short circuit to chassis ground between VICS valve harness connector and ECM harness connector. Short circuit between VICS valve battery power circuit and signal circuit. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving with SCAN TOOL connected and monitor for pending codes..		

suspension system

special Service tools

Tool (Number and Name)	Illustration	Use
0K2A1 341 AA1A Coil spring comp		Used to remove and install coil spring.
0K130 283 021 Ball joint puller		Used to remove tie rod and ball joint.

Symptom-related diagnostic procedure

Suspension system

Problem	Possible cause	Action
Body rolls	Deteriorated stabilizer bar and stabilizer control links Worn or deteriorated stabilizer bar bushing Worn or deteriorated lower arm bushing Shock absorber malfunction	Replace Replace Replace Replace
Poor riding comfort	Weak coil spring Shock absorber malfunction	Replace Replace
Abnormal noise from suspension	Poor lubrication or wear of lower arm ball joint Shock absorber malfunction Worn or deteriorated stabilizer bar bushing Worn or deteriorated lower arm bushing	Replace, Lubricate Replace Replace Replace
Instable riding	Weak coil spring Shock absorber malfunction Worn or deteriorated lower arm bushing Worn or deteriorated stabilizer bar bushing Improperly adjusted wheel alignment Damaged lower arm ball joint Steering system malfunction Deformed or unbalanced wheel	Replace Replace Replace Replace Adjust Replace Refer to section ST Gr. Refer to next page
Heavy steering wheel operation	Poor lubrication or wear of lower arm ball joint Improperly adjusted wheel alignment Steering system malfunction Deformed or unbalanced wheel	Replace, Lubricate Adjust Refer to section ST GR. Refer to next page
Steering pulls to one side	Weak coil spring Worn or deteriorated stabilizer bar bushing Worn or deteriorated lower arm bushing Damaged lower arm ball joint Improperly adjusted wheel alignment Steering system malfunction Brake system malfunction Deformed or unbalanced wheel	Replace Replace Replace Replace Replace Refer to section ST Gr. Refer to section BR Gr. Refer to next page
Steering wheel vibrates	Damaged lower arm ball joint Shock absorber malfunction Loose shock absorber installation Worn or deteriorated lower arm bush Worn or deteriorated stabilizer bar bush Improperly adjusted wheel alignment Worn or damaged wheel bearing Steering system malfunction Deformed or unbalanced wheel	Replace Replace Tighten Replace Replace Adjust Replace Refer to section ST Gr. Refer to next page
Steering wheel does not return	Lower arm ball joint stuck or damaged Improperly adjusted wheel alignment Steering system malfunction Deformed or unbalanced wheel	Replace Adjust Refer to section ST Gr. Refer to next page

Wheel and tire

Problem	Possible cause	Action

Excessive or irregular tire wear	Incorrect toe adjustment	Refer to next page.
Premature tire wear	Excessive tire pressure Insufficient tire pressure and high speed	Adjust Adjust
Tire squeal	Incorrect tire pressure Tire deterioration	Adjust Replace
Road noise and body vibration	Insufficient tire pressure Unbalanced wheel(s) Deformed wheel(s) or tire(s) irregular tire wear	Adjust Adjust Repair or replace Replace
Steering wheel vibration	Tire wear Unbalanced or damaged wheel Damaged tire Unequal tire pressure Loose lug nut Unbalanced wheel	Replace Repair or replace Replace Adjust Tighten Adjust
Uneven (one-side) braking	Unequal tire pressure Malfunction of braking system	Adjust Refer to section BR Gr.
Steering wheel instability	Incorrect tire pressure Unequal tire wear (between left and right) Unbalanced tire pressure Different tire types used together Incorrect lug nut tightening	Adjust Replace Adjust Replace Tighten
General driving instability	Unequal tire pressure Damaged and unbalanced wheels Loose lug nut	Adjust Repair or adjust Tighten
Excessive steering wheel grab	Loose lug nut Incorrect front wheel bearing preload	Tighten Refer to section DS Gr.

Specifications

Suspension system

Item				Specification
Front	Suspension type			Macpherson strut
	Shock absorber			Double-acting, Gas filled
	Stabilizer	Type		Torsion bar
		Diameter	in (mm)	1.02 (ø26)
	Wheel alignment	Toe in (mm)	No passenger load	-0.04±0.1 (-0.9±2.5)
			Five passenger load	-0.01±0.1 (-0.3±2.5)
		Camber (degree)	No passenger load	0.51°±0.5°
			Five passengers load	0.26°±0.5°
		Caster (degree)	No passenger load	1.88°±0.5°
			Five passengers load	1.94°±0.5°
Rear	Suspension type			Five links & coil
	Shock absorber			Double-acting, Gas filled
	Stabilizer	Type		Torsion bar
		Diameter in (mm)		1.18 (ø30)

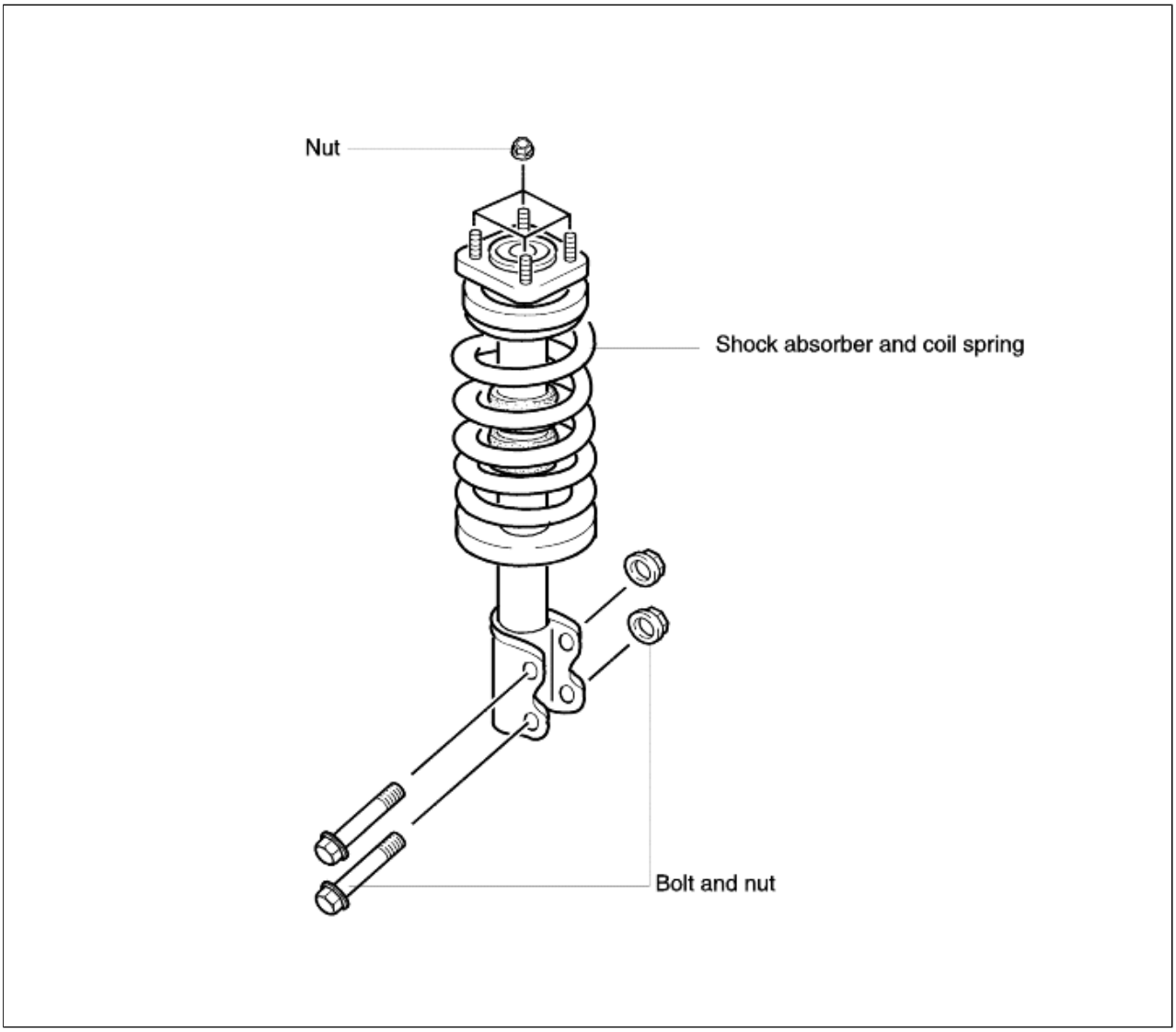
Wheel and tire

Item / Type		Standard	
Wheel	Size	6JJ x 15	
	Offset in (mm)	1.97±0.04 (50±1.0)	
	pitch circle diameter in (mm)	4.49 (114.3)	
	Material	Steel	Steel or aluminum
Tire	Size	P215/70 R15	
	Air pressure psi (kPa, kgf/cm²)	34 (235, 2.4)	

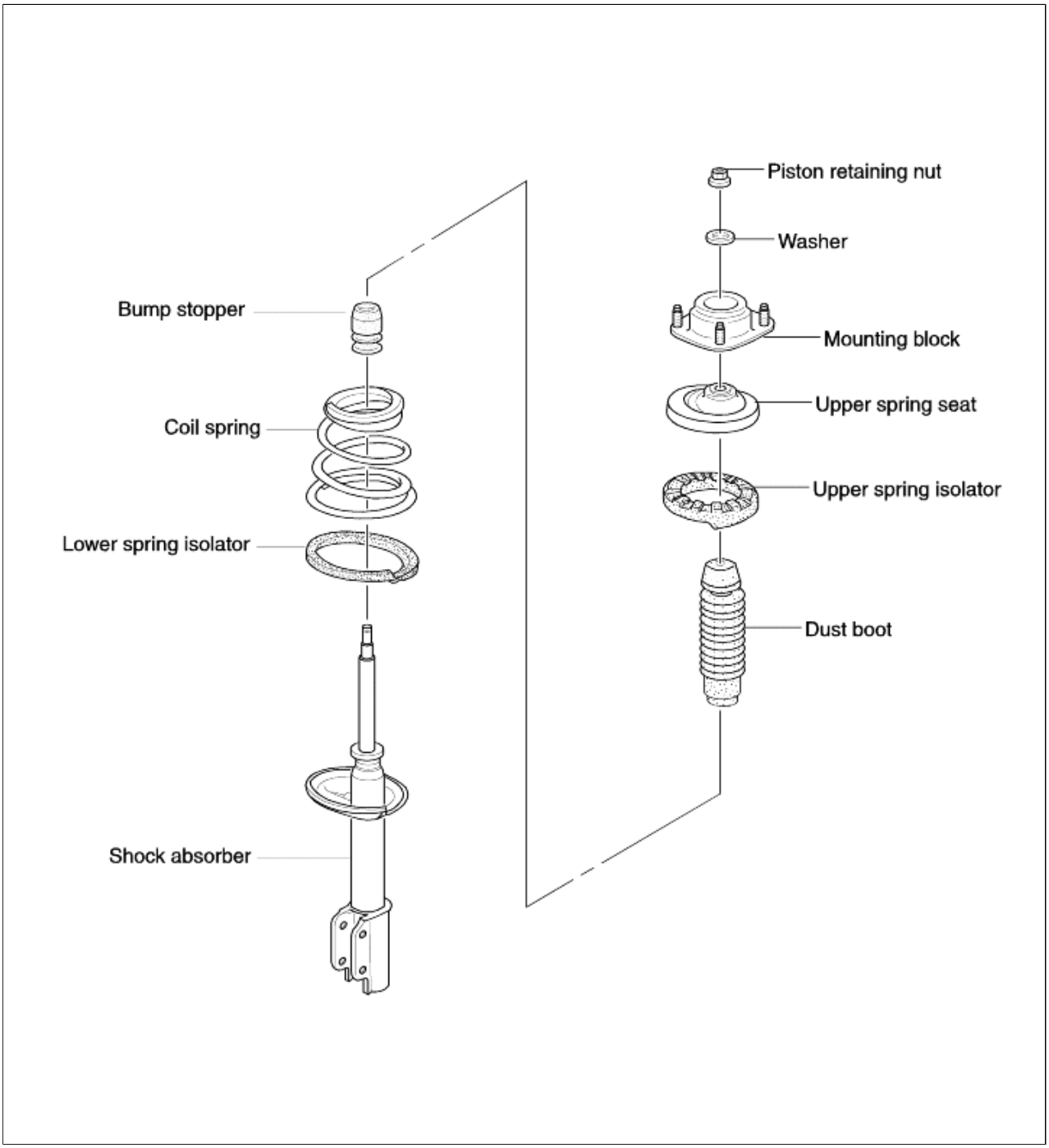
Do not install smaller than minimum size tires shown on the tire inflation placard on the vehicle.
*The following guide should help you understand tire designations:

P	Type (passenger)
205	Nominal width of tire in millimeters
70	Tire height-to-width ratio
R	Radial-ply tire (or "D"for bias-ply tire)
15	Nominal rim diameter in inches

component

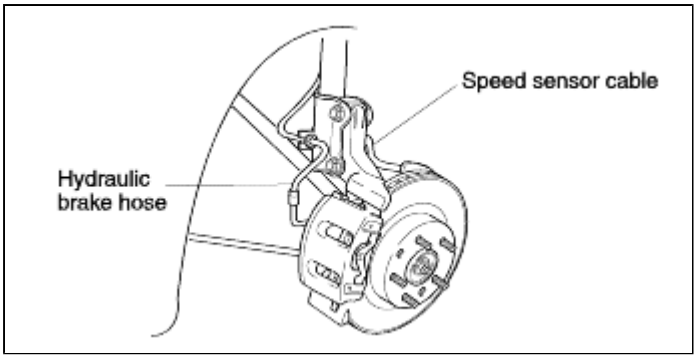


Component

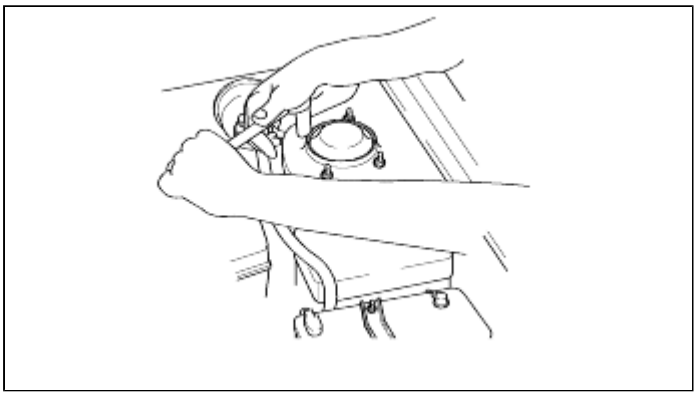

Piston retaining nut
Washer
Bump stopper
Mounting block
Coil spring
Upper spring seat
Upper spring isolator
Lower spring isolator
Dust boot
Shock absorber

Removal

1. Lift vehicle and support with safety stands.
2. Remove wheel and tire assembly.
3. Remove the brake hose and the speed sensor cable from routing bracket on the shock absorber strut assembly.



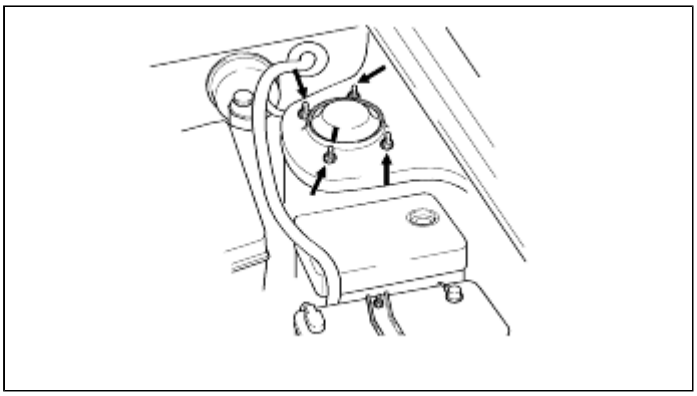
4. Remove the two shock absorber strut mounting nuts and bolts securing the spring and shock assembly to front wheel knuckle.
5. Remove the four front shock absorber upper mounting nuts.



6. Remove the shock absorber assembly from vehicle.

Replacement

1. Position the shock absorber assembly into the wheel housing. Be sure the direction indicator on the front shock absorber upper mounting bracket.



2. Secure the front shock absorber upper mounting bracket to the shock tower with nuts. Tighten the front shock absorber upper mounting bracket nuts.

Tightening torque : 33~46 lb·ft (46~62 N·m, 4.7~6.4 kg·m)

3. Install the front shock absorber assembly to the front wheel knuckle. Tighten the shock absorber knuckle attaching nuts.

Tightening torque : 88~101 lb·ft (119~137 N·m, 12.2~14 kg·m)

4. Position the hydraulic brake hose and speed sensor cable to the shock absorber assembly.
5. Install the wheel and tire assembly and tighten nuts.

Tightening torque : 80~101 lb·ft (108~137 N·m, 11~14 kg·m)

6. Lower vehicle.
7. Check the front wheel alignment.

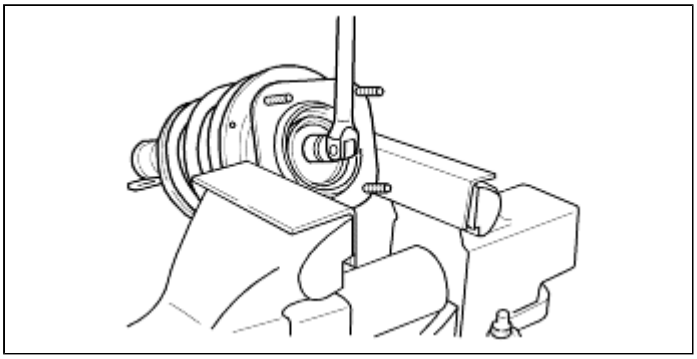
Disassembly

1. Remove the front spring and shock absorber refer to the procedure in this section.
2. Loosen four mounting bolts.
3. Place the mounting block in a vise.

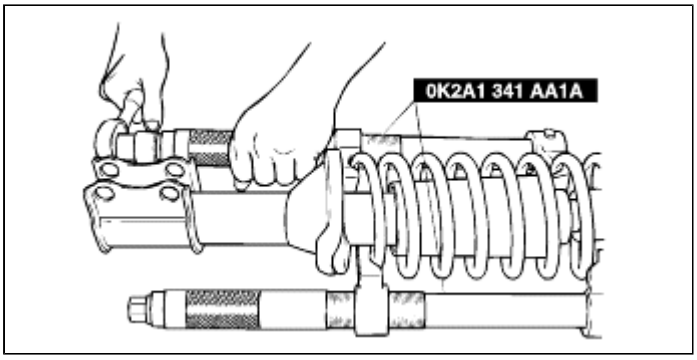
> NOTE
>
> Use protective plates to cover jaws of vise.

4. Loosen retaining nut two to three turns.

> NOTE
>
> Do not remove nut.



5. Compress the coil spring with SST(0K2A1 341 001).
6. Remove the retaining nut.
7. Note the position of the mounting block, then remove it. Remove the upper spring seat, upper spring isolator, coil spring, dust boot, bump stopper and lower spring seat.

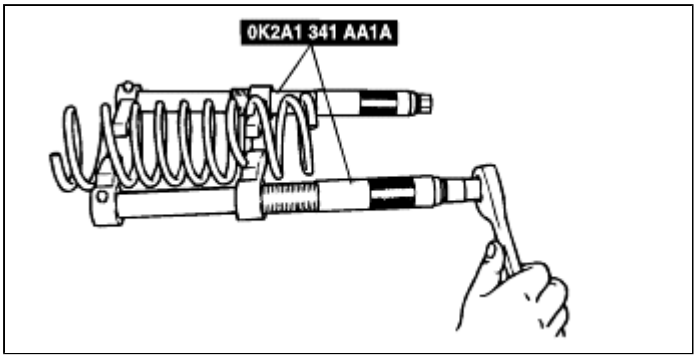


Assembly

1. Secure the shock absorber in a vise.

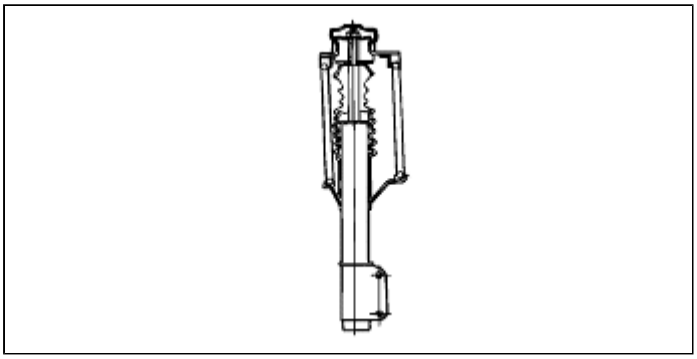
> NOTE
>
> Use protective plates to cover jaws of vise.

2. Compress the coil spring with SST(0K2A1 341 001).
3. Install the coil spring, inserting the bottom end of the spring into the recess of the lower seat.
4. Install the bump stopper.



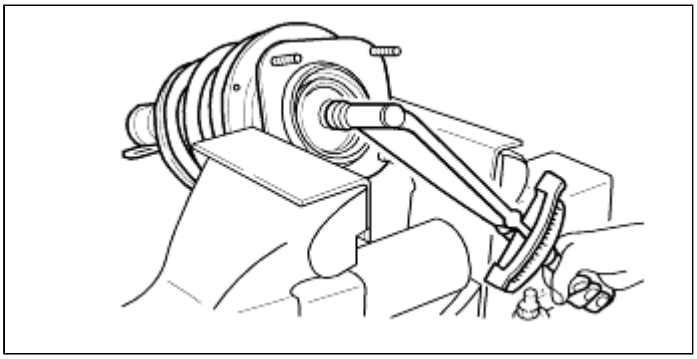
5. Apply rubber lubricant to the bump stopper and the upper spring seat contact surface.
6. Install the upper spring isolator and the upper spring seat.
7. Install the mounting block in its original position.
8. Install the piston retaining nut and tighten slightly.
9. Carefully loosen and remove SST(0K2A1 341 001).

> NOTE
>
> Verify that the coil spring is correctly seated in the upper and lower seats.



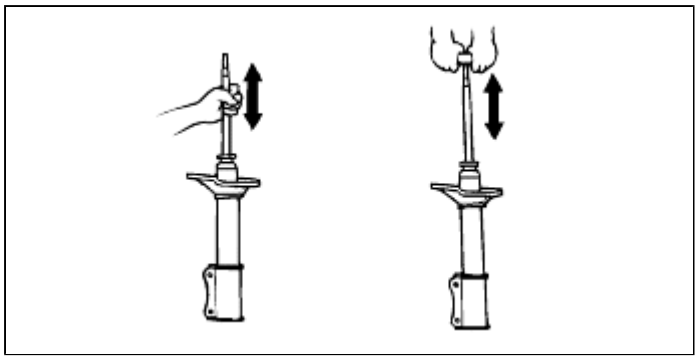
10. Secure the mounting block in a vise.
11. Tighten the piston retaining nut to specified torque.

Tightening torque : 88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

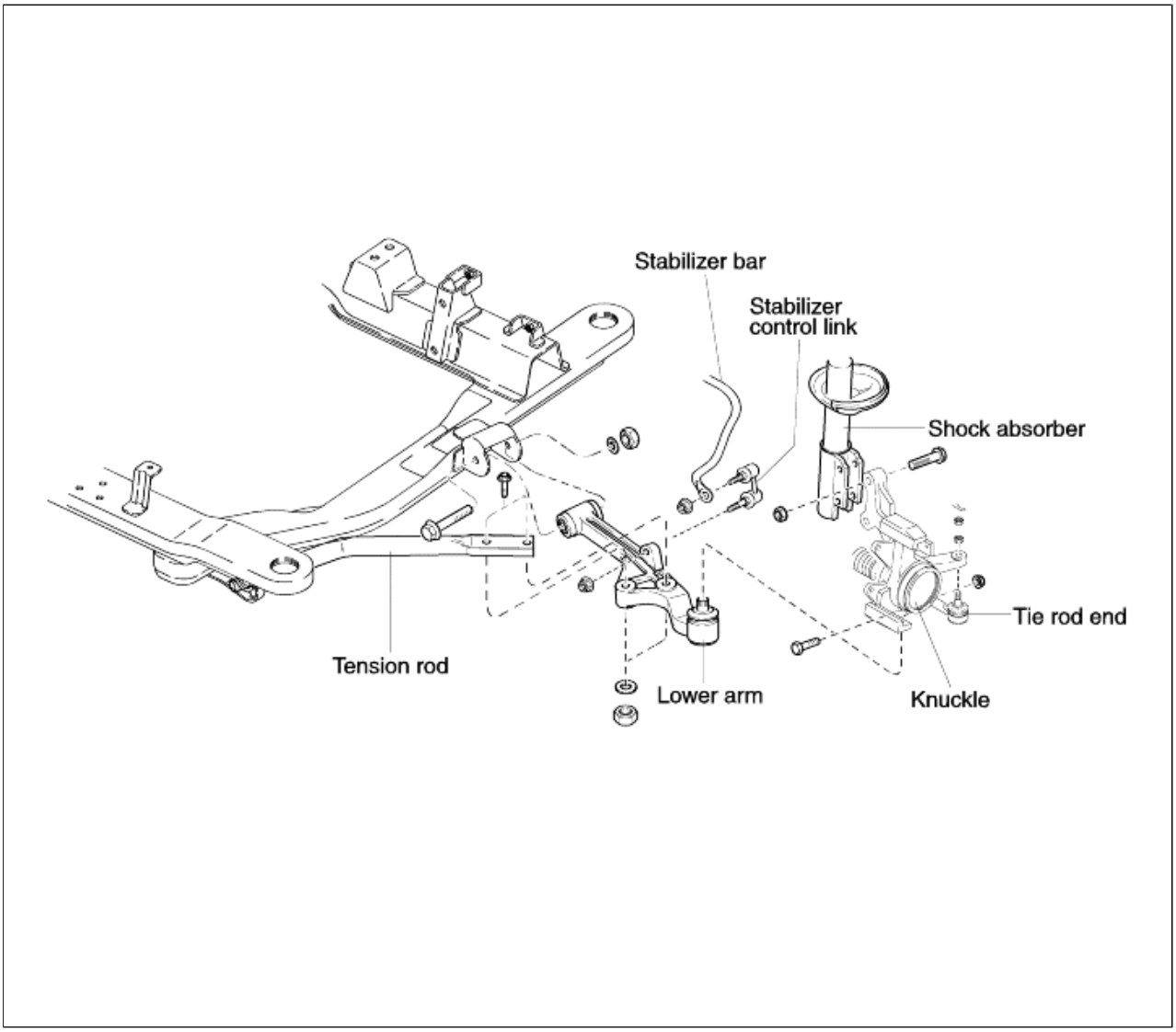


Inspection

1. Check for the following and replace the strut if necessary:
   A. Attach a handle to the piston rod, then collapse and expand the strut at least three times.
   B. Verify that operation is smooth, continuous, and does not change with each stroke.
   C. Verify that there is no unusual noise from within the strut.

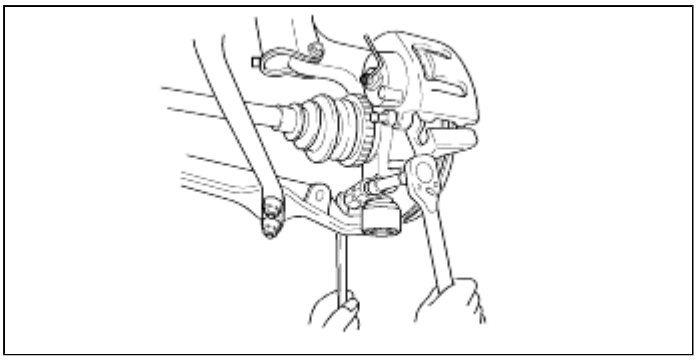


Component


Stabilizer bar
Stabilizer control link
Shock absorber
Tie rod end
Tension rod
Lower arm
Knuckle

Removal

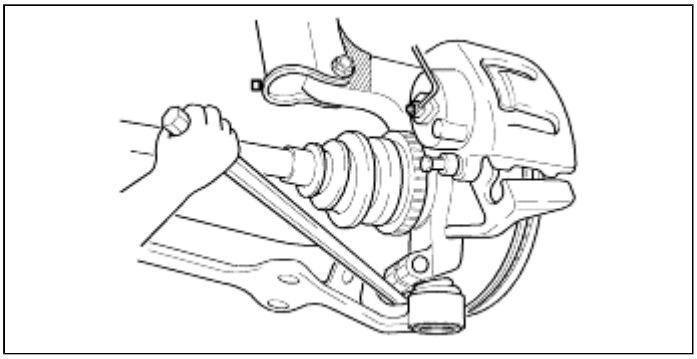
1. Lift vehicle and support with safety stands.
2. Remove wheel and tire assembly.
3. Remove stabilizer control link nut on the lower control arm.
4. Remove stabilizer control link nut from the stabilizer bar.
5. Remove the tension rod from the lower control arm after loosening two bolts and nuts.
6. Remove the lower arm ball joint bolt and nut from steering knuckle.



NOTE

Use caution when seperating lower control arm from steering knuckle, so ball joint seal does not get cut.

7. Using a prybar, seperate the steering knuckle from lower control arm.



8. Remove the lower control arm from the subframe after loosening bolt and nut.

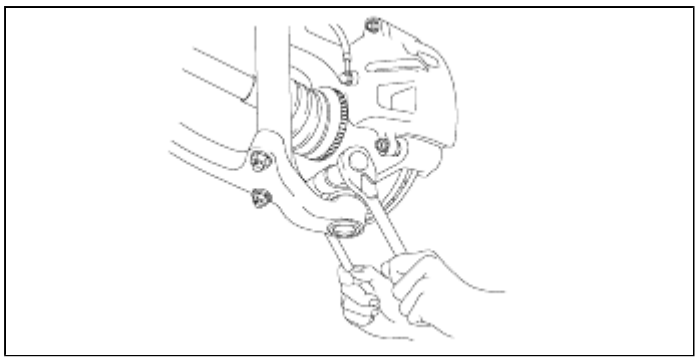
Replacement

1. Position the front lower arm to the subframe and secure it with bolt.
   Tighten the lower arm nut.

Tightening torque : 88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

2. Position the front lower arm ball joint into the wheel knuckle.
3. Tighten the lower arm ball joint bolt and nut to steering knuckle.

Tightening torque : 69~85 lb·ft (93~15 N·m, 9.5~11.7 kg·m)



4. Install the tension rod to the lower arm.
   Tighten bolts and nuts.

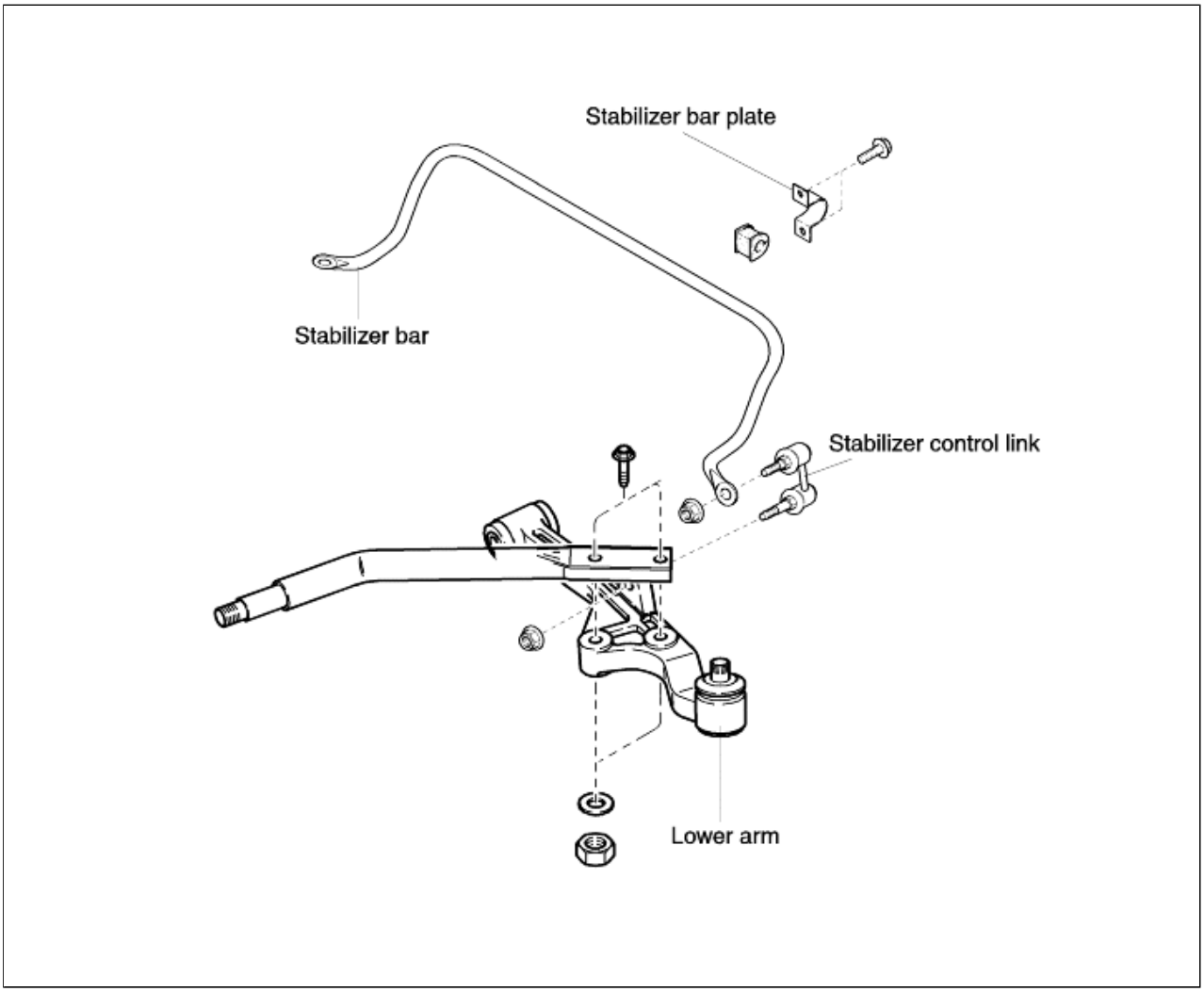
   Tightening torque :88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

5. Tighten the stabilizer control link nut to the stabilizer bar.

   Tightening torque : 69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)

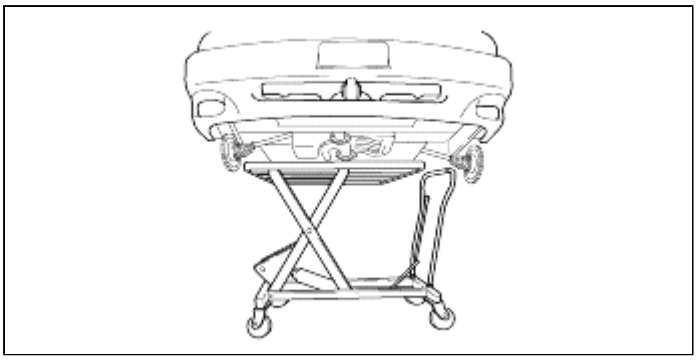
6. Tighten the stabilizer control link nut on the lower control arm.
7. Install wheel and tire assembly.
8. Lower vehicle.
9. Check the front wheel alignment.

Component


Stabilizer bar plate
Stabilizer bar
Stabilizer control link
Lower arm

Removal

1. Lift front of vehicle and support it with safety stands.
2. Remove wheel and tire.
3. Remove stabilizer from control link.
4. Remove control link from the lower control arm.
5. Remove the exhaust pipe.
6. Position a suitable transaxle jack under the transaxle and secure it to the transaxle.

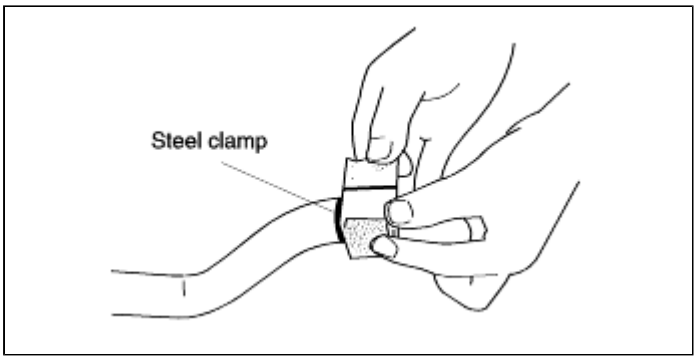


7. Remove engine mounting No.1 and 2 from the subframe.
8. Remove stabilizer mounting bolts from the subframe.
9. Lower the subframe enough to pull the stabilizer out from behind the subframe.
10. Remove the stabilizer bar.

Replacement

1. Align the stabilizer bushing with the steel clamp on the stabilizer bar. Locate the bushing adjacent to the position line on stabilizer bar.

> NOTE
>
> Do not change replacement direction of the stabilizer control link when installing.



2. Position stabilizer behind the subframe.
3. Raise the subframe into place and tighten engine mounting No.1 and 2 bolts and nuts to specified torque. (Refer to the section EM Gr.)
4. Tighten the stabilizer mounting bolts to the subframe.

Tightening torque : 16~20 lb·ft (21~26 N·m, 2.2~2.7 kg·m)

5. Install the exhaust pipe.
6. Install the stabilizer control link to the lower arm and stabilizer bar and then tighten two control link nuts.

Tightening torque : 69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)

NOTE

Tighten the two control ink nuts to specified torque before lowering vehicle. (Unload condition)

7. Remove a suitable transaxle jack under transaxle.

Description and operation

Front suspension description

An independent MacPherson strut type front suspension is used on these vehicles. Vertical shock absorbing MacPherson struts attach to the top of the steering knuckle and to the front strut tower.

This interconnection between the steering knuckle and the body of the vehicle provides for the correct steering knuckle position. This steering knuckle position provides for the correct front caster and camber settings for the vehicle, at the time the vehicle is designed. Lower arms are attached inboard to the front suspension subframe and outboard to the bottom of the steering knuckle. Attachment of the lower arm to the steering knuckle is done through a ball joint in the lower arm. During steering maneuvers, the strut and the steering knuckle (through the ball joint and a pivot bearing in the strut's upper retainer) turn as an assembly.

Suspension subframe

This vehicle uses one piece subframe for the front suspension. The subframe is used as the attaching points for the lower arm, stabilizer bar, tension rod and steering gear. The subframe is mounted to the body of the vehicle at four points.

Steering knuckle

The front suspension knuckle is not a repairable component of the vehicle front suspension. It must be replaced, if bent, broken or damaged in any way, do not attempt to straighten or repair the steering knuckle.

Service replacement of the front hub/bearing assembly can be done with the front steering knuckle remaining on the vehicle.

Wheel alignment

Wheel alignment is the proper adjustment of all the interrelated suspension angles affecting the running and steering of the front and rear wheels of the vehicle. There are six basic factors which are the foundation to front wheel alignment. There are vehicle height, caster, camber, toe-in, steering axis inclination and toe-out on turns of the six basic factors toe-in, camber, and caster are normally mechanically adjustable on this vehicle.

> CAUTION
>
> Do not attempt to modify any suspension or steering components to meet vehicle alignment specifications by heating and (or) bending.

Alignment checks and adjustment should be made in the following sequence.

1) Camber
2) Toe

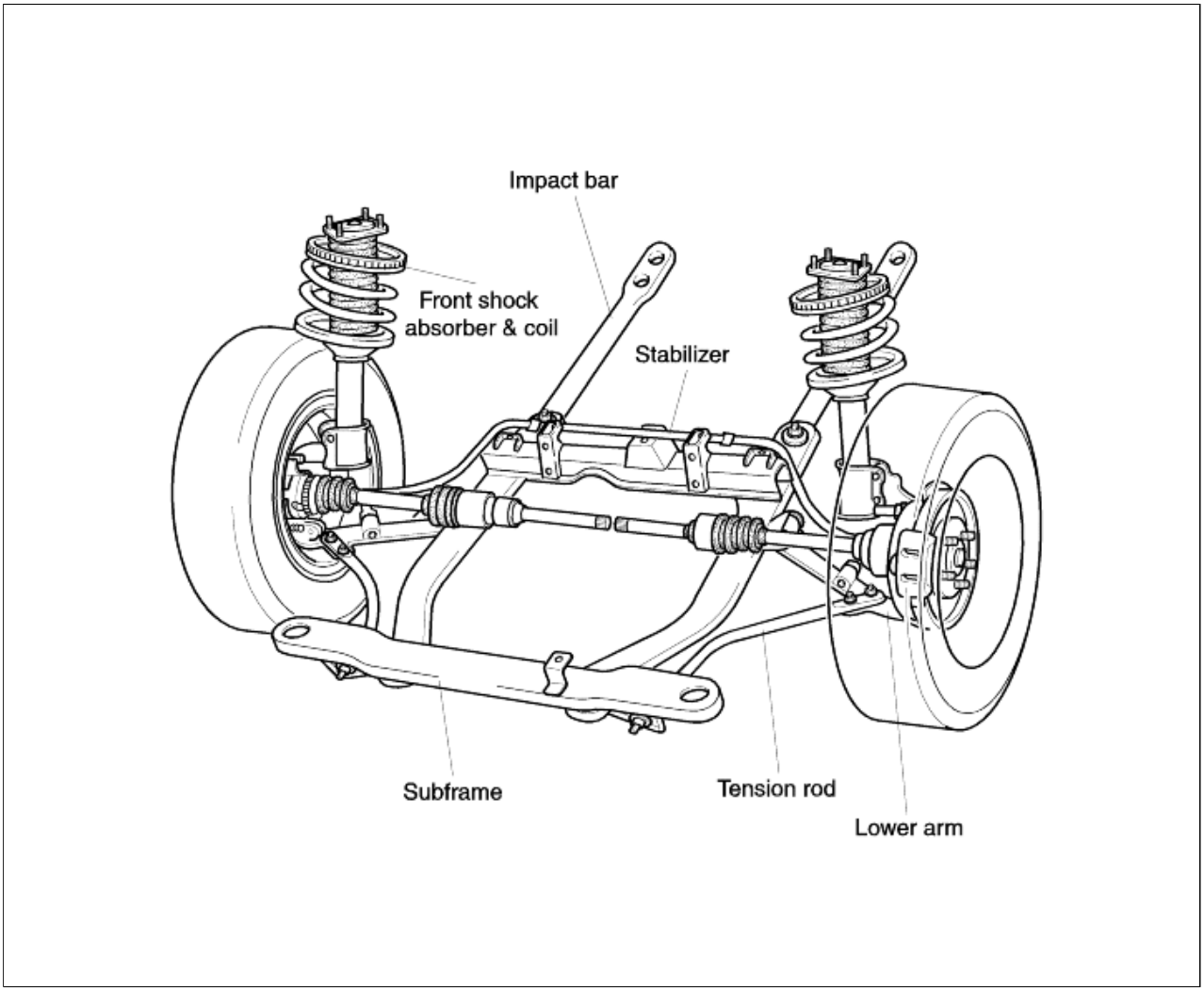
Camber is the number of degrees tilted inboard or outboard from a true vertical line when looking from front view. Inboard tilt is negative camber. Outboard tilt is positive camber. Excessive camber is a tire wear factor: negative camber causes wear on the inside of the tires tread surface, while positive camber causes wear to the outside of the tires tread surface.

Toe is measured in degree or inches (millimeters) and is the distance the front edges of the tires are closer (or father apart) than the rear edges.

component

CAUTION

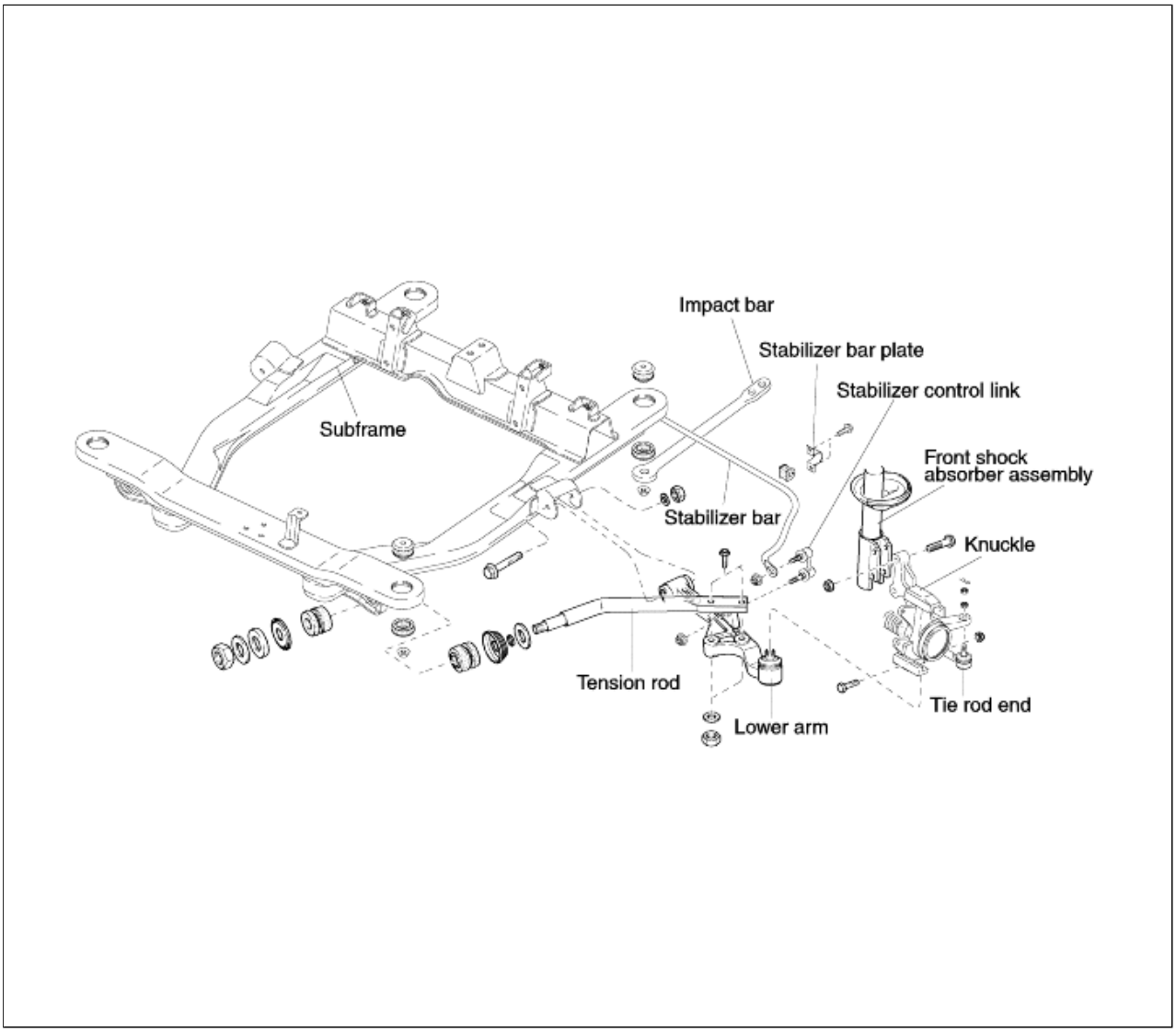
When tightening (by specified torque) the nuts of the arms and links of the front suspension system, the wheels of the vehicle shall be in contact with ground and under loads (2 passengers load at the front seats if possible).



component

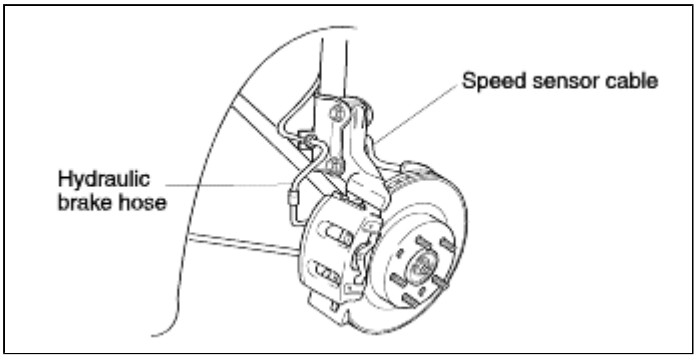
CAUTION

When tightening (by specified torque) the nuts of the arm and links of the front suspension system, the wheels of the vehicle shall be in contact with ground and under loads (2 passengers load at the front seats if possible).

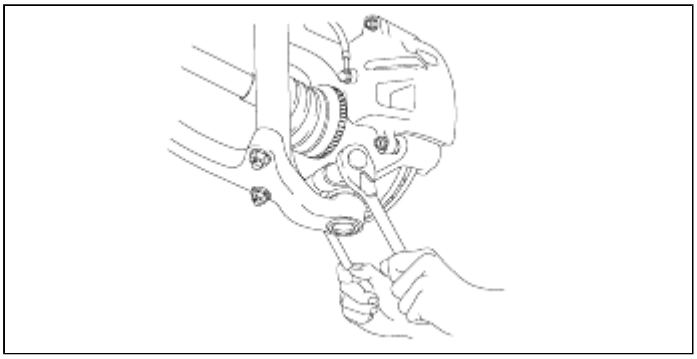

Impact bar
Stabilizer bar plate
Stabilizer control link
Subframe
Front shock absorber assembly
Stabilizer bar
Knuckle
Tension rod
Tie rod end
Lower arm

Removal

1. Raise vehicle and support it with safety stands.
2. Remove wheel and tires assembly.
3. Remove the hydraulic brake hose and the speed sensor cable from routing bracket on the strut assembly.

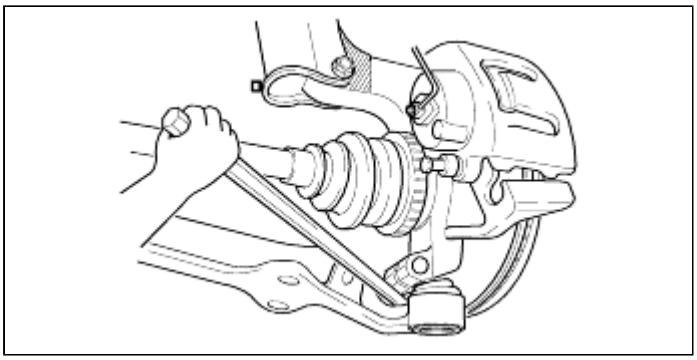


4. Remove the two stabilizer control link nut from installing on the lower control arm and to the end of the stabilizer.
5. Remove the tension rod from the lower control arm after loosening two bolts and nuts.
6. Remove the lower arm ball joint bolt and nut from steering knuckle.



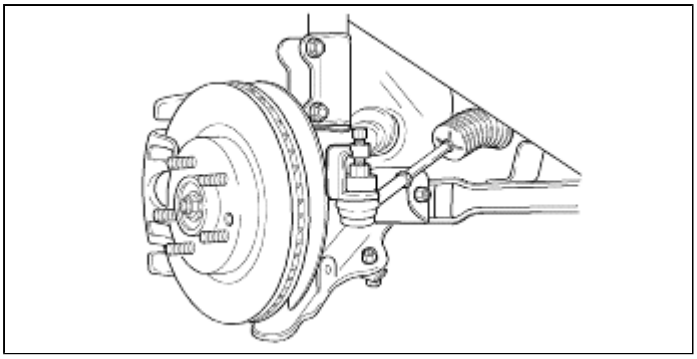
7. Using a pry bar, seperate steering knuckle from lower control arm.

> NOTE
>
> Use caution when seperating lower control arm from steering knuckle, so ball joint seal does not get cut.



> NOTE
>
> Do not damage dust boot when removing dust boot from ball joint.

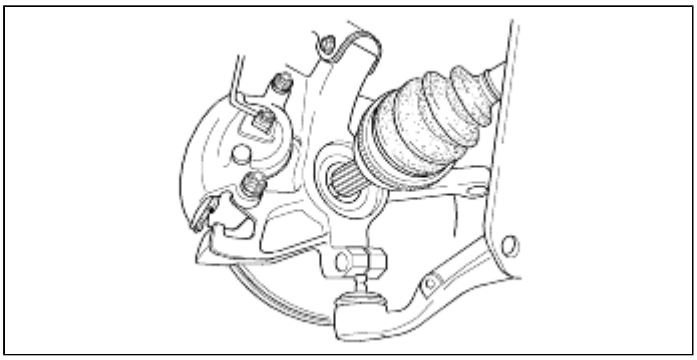
8. Remove the tie rod end nut and disconnect the tie-rod end with SST(0K130 283 021).



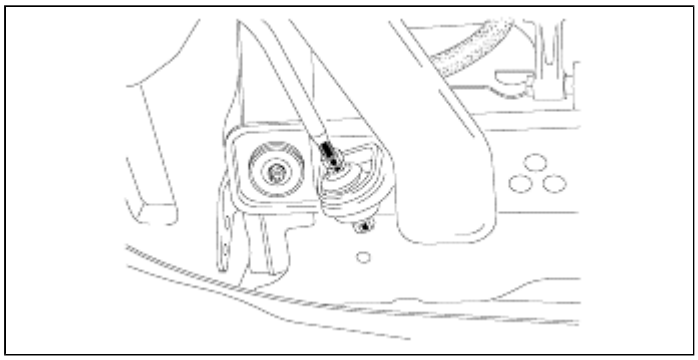
NOTE

1) Care must be taken not to seperate the inner C/V joint during this operation.
2) Do not allow driveshaft to hang by inner C/V joint after removing outer C/V joint from the hub/bearing assembly in steering knuckle.

9. Pull steering knuckle out and away from the outer C/V joint of the driveshaft.



10. Remove the steering knuckle from the front shock absorber assembly after loosening bolts and nuts.
11. Remove four nuts attaching the front shock absorber assembly upper mount.
12. Remove the lower control arm from the subframe after loosening bolt and nut.
13. Mark alignment of tension rod nuts and spacer washers before loosening tension rod nuts.



14. Remove the tension rod from the subframe.
15. Remove the stabilizer bar from the subframe after loosening bolts installed to subframe.
16. Remove the exhaust pipe.
17. Remove the fixed bracket after removing the power steering rack and pinion.
18. Support engine with engine support bar SST (0K201 170 AA0).
19. Remove the engine mounting No.1 and 2 from the subframe.
20. Remove mounting bolt and nuts of the impact bar.
21. Remove the subframe.

Replacement

1. Tighten the subframe with bolts.

   Tightening torque : 88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

2. Install the impact bar to the subframe and tighten bolts and nuts.

   Tightening torqueBolt : 65~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)Nut : 88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

3. Install the engine mounting No.1 and 2 to the subframe and tighten bolts and nuts. (Refer to the section EM Gr.)
4. Install the power steering rack and pinion to the subframe.

   Tightening torque : 55~69 lb·ft (74~93 N·m, 7.5~9.5 kg·m)

   NOTE

   When installing oil seal, be careful not to damage oil seal.

5. Install the exhaust pipe.
6. Remove engine support bar SST (0K201 170 AA0) from engine.
7. Install the stabilizer bar and stabilizer bar plate to the subframe and tighten bolts.

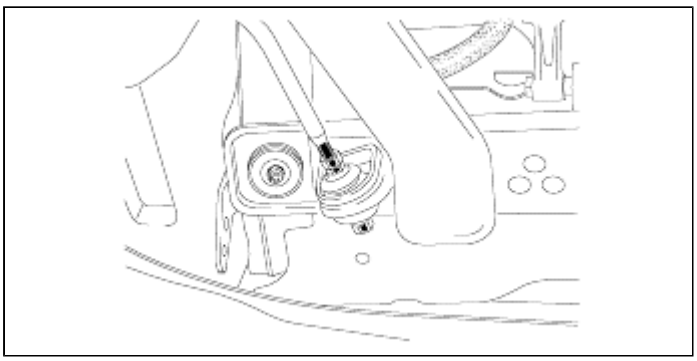
   Tightening torque : 16~20 lb·ft (21~26 N·m, 2.2~2.7 kg·m)

8. Put lower arm into the side of the subframe and then tighten lower arm and subframe with bolts and nuts.

   Tightening torque : 88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

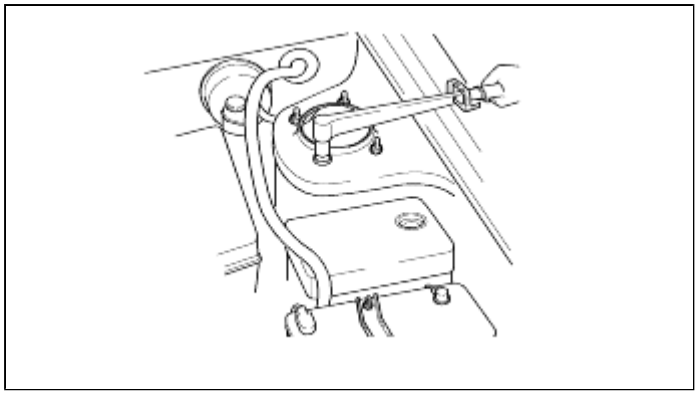
9. Tighten tension rod nuts after aligning with mark made.(Refer to this section Page SS-32)

   Tightening torque : 115~130 lb·ft (157~177 N·m, 16~18 kg·m)



10. Install the front shock absorber assembly upper mount and tighten nuts to specified torque.(Refer to this section - Page SS-31)

    Tightening torque : 34~46 lb·ft (46~63 N·m, 4.7~6.4 kg·m)



11. Install the steering knuckle to shock absorber strut bracket and tighten nuts and bolts.

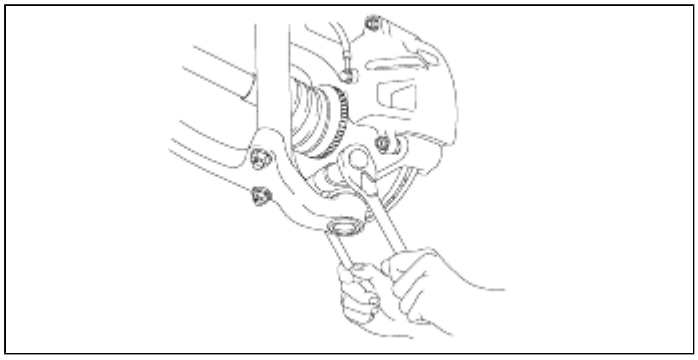
    Tightening torque : 88~101 lb·ft (119~137 N·m, 12.2~14 kg·m)

12. Slide driveshaft back into the front hub and bearing assembly.
13. Install tension rod to the lower arm and tighten bolts and nuts.

    Tightening torque : 88~101 lb·ft (119~137 N·m, 12.2~14 kg·m)

14. Attach the lower arm ball joint to the front wheel knuckle and tighten the lower arm ball joint nut and bolt.

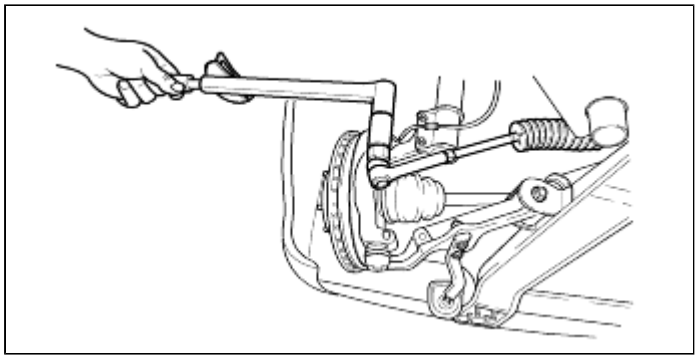
    Tightening torque : 69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)



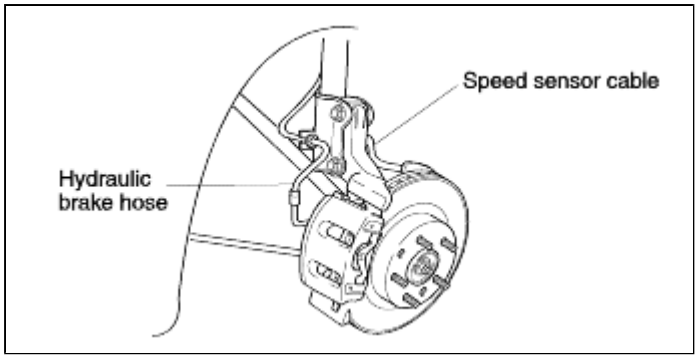
15. Install the stabilizer to the lower arm and tighten the stabilizer bolts.

    Tightening torque : 69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)

16. Attach the tie rod end to the front wheel knuckle. Tighten the tie rod nut and then install a new tie rod end cotter pin.

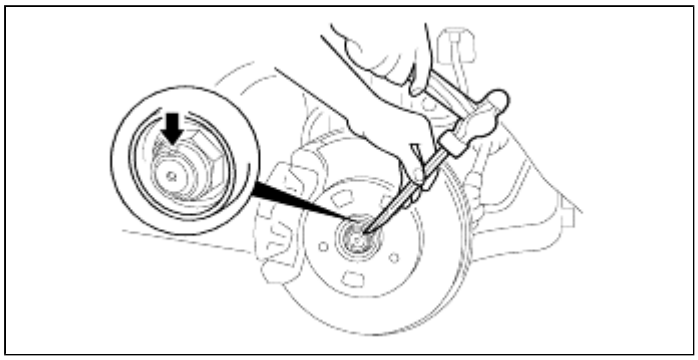


17. Install the hydraulic brake hose and the speed sensor cable to routing bracket on the strut assembly.



18. Install a new driveshaft lock nut and stake it, as shown.

Tightening torque : 177~199 lb·ft (240~270 N·m, 24.5~27.5 kg·m)



19. Install front wheel and tire assembly and tighten nuts.

Tightening torque : 80~101 lb·ft (108~137 N·m, 11~14 kg·m)

20. Lower vehicle.
21. Set front wheel alignment on vehicle to required specification.

Description and operation

Rear suspension
The rear suspension design on this vehicle uses coil springs, five links, shock absorber, stabilizer and rear axle assembly.

It is designed to handle the various load requirements of the vehicle. The rear coil springs provide a comfortable unloaded ride and also ample rear suspension travel when the vehicle is loaded.

Rear wheel alignment
Alignment adjustment is not required. The rear axle alignment setting are preset at the factory, therefore no alignment is necessary.

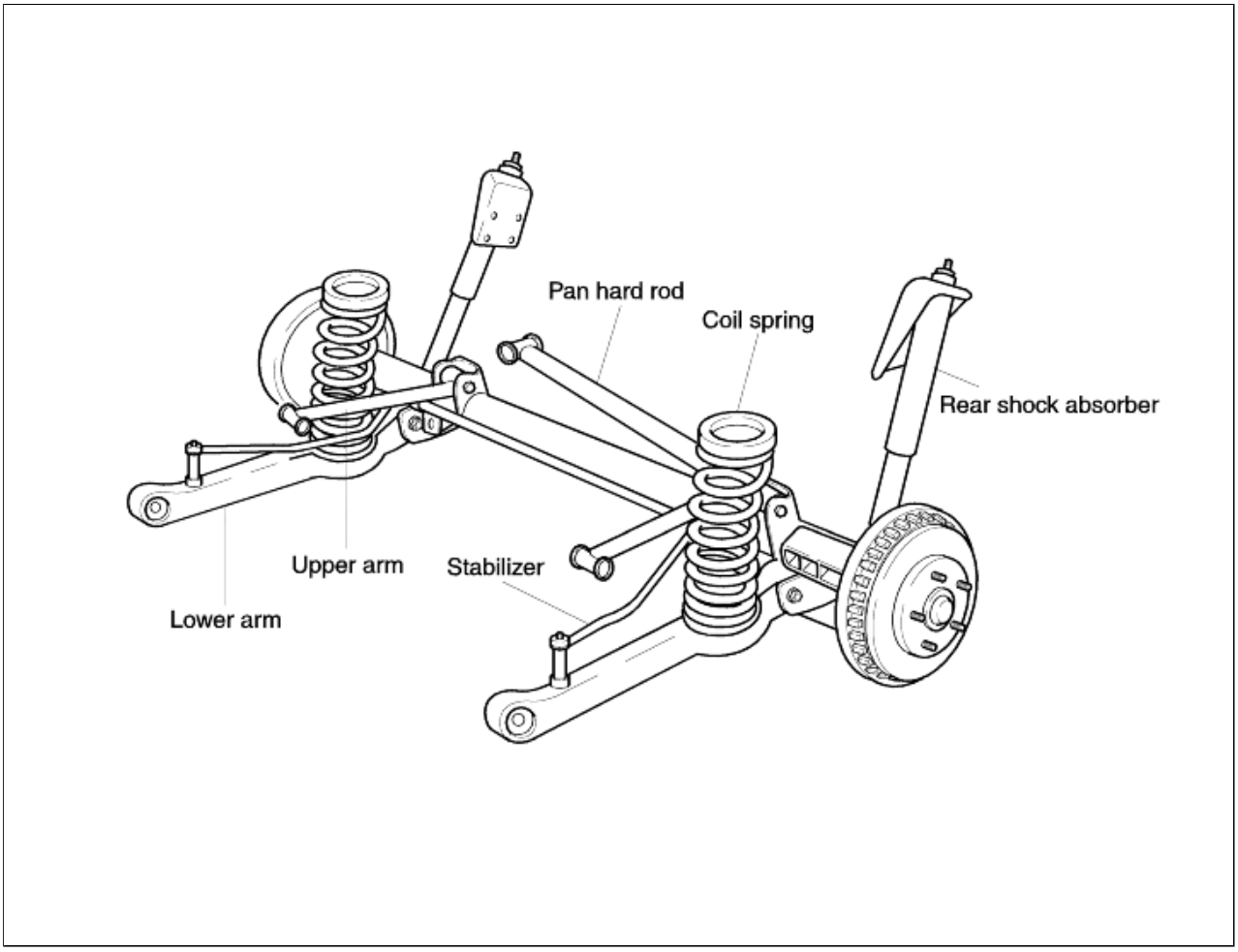
Panhard rod
The panhard rod prevents excessive side to side movement of the rear axle. The panhard rod is used to keep the location of the axle in the correct position for optimum handling and control of the vehicle.

Stabilizer bar
The stabilizer bar interconnects both sides of the rear axle and attaches to the rear lower arm jounce. Rebound movements affecting one wheel are partially transmitted to the opposite wheel to reduce body roll. All parts are serviceable, and axle bushings to the stabilizer is split for easy removal and replacement.

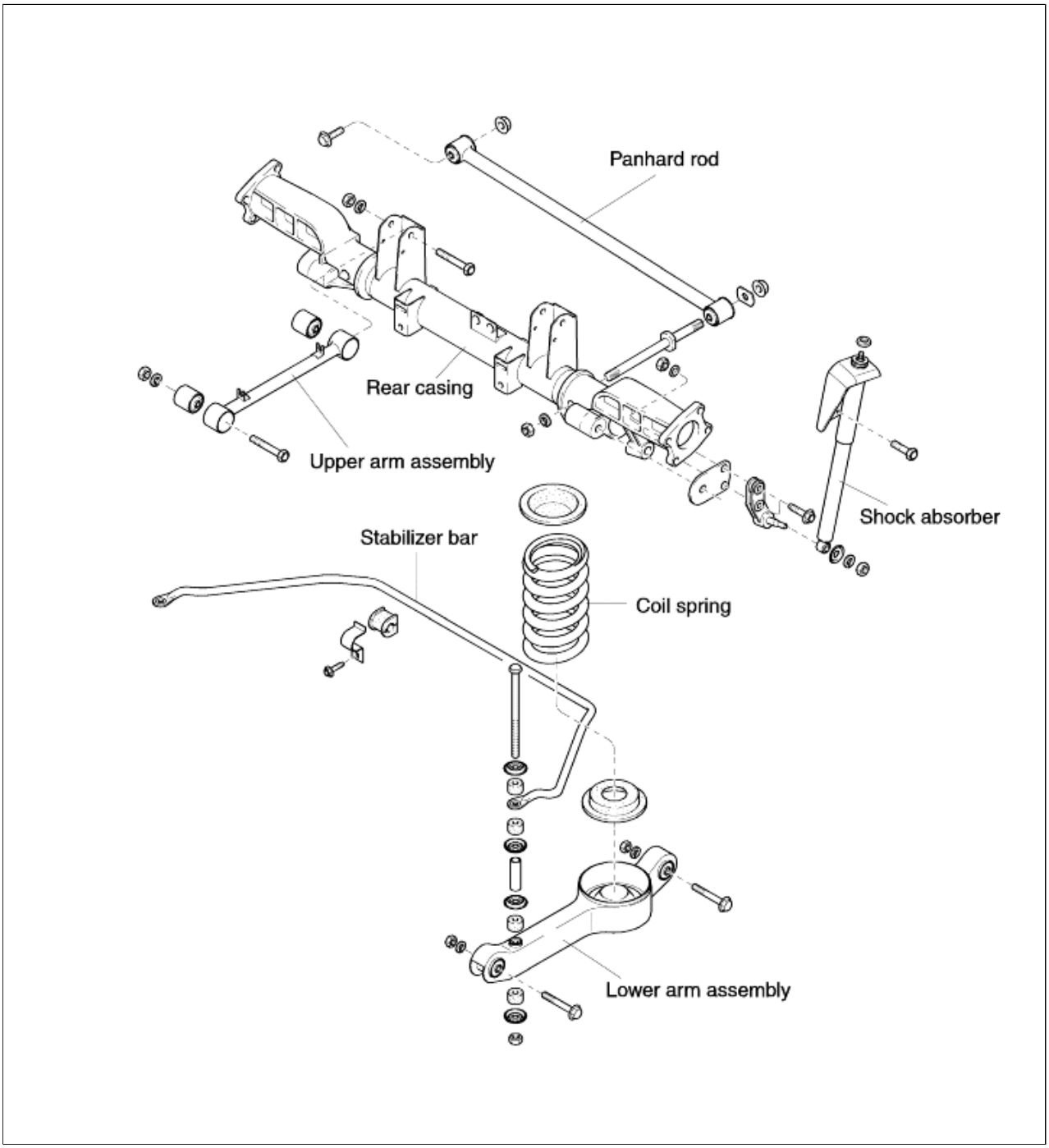
component

CAUTION

When tightening (by specified torque) the nuts of the arms and links of the rear suspension system, the wheels of the vehicle shall be in contact with ground and under loads (2 passengers load at the front seats if possible).



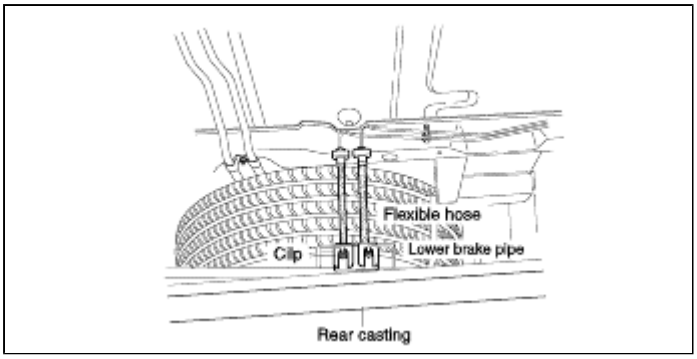
Component


Panhard rod
Rear casing
Upper arm assembly
Shock absorber
Stabilizer bar
Coil spring
Lower arm assembly

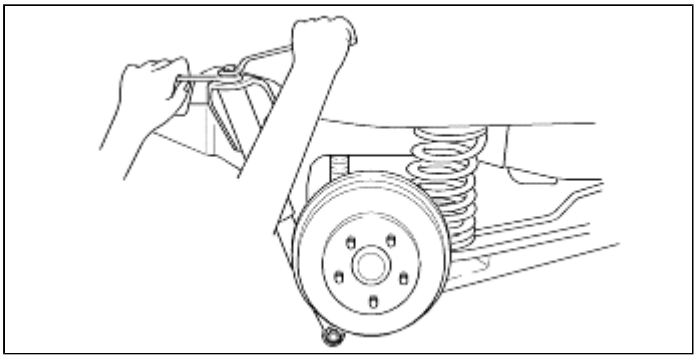
Removal

1. Raise the rear of vehicle and support it with safety stands.
2. Remove the rear wheels.
3. Disconnect lower brake pipes and flexible hoses after loosening the brake pipe nuts and pulling out the flexible hose clips.

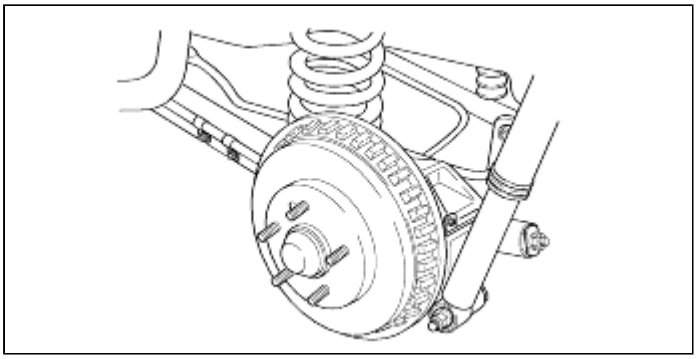
> NOTE
>
> After disconnecting lower brake pipes, plug them to prevent leakage of fluid from the flexible hoses.



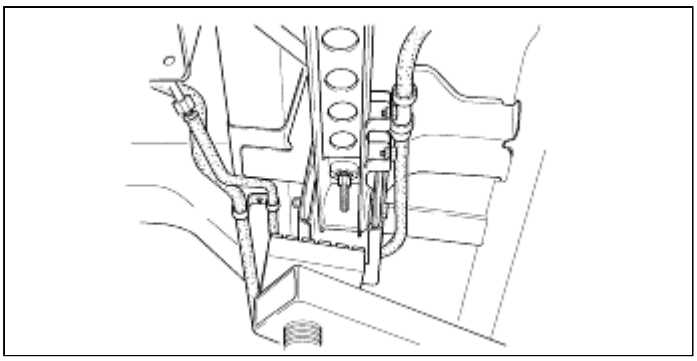
4. Raise the rear axle housing to facilitate removal of the rear suspension.
5. Remove the rear shock absorber safety nut, upper nut and washer.
6. Remove the shock absorber assembly.



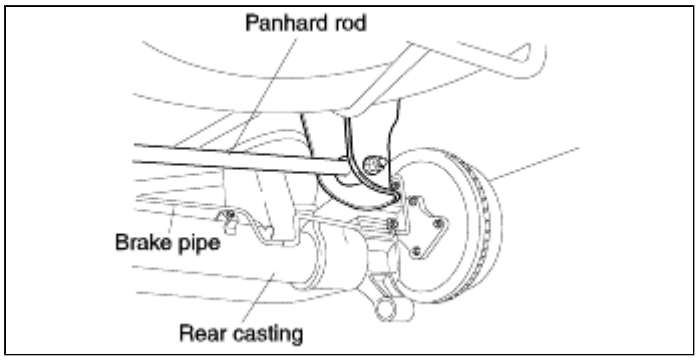
7. Remove the shock absorber lower nut and washer.



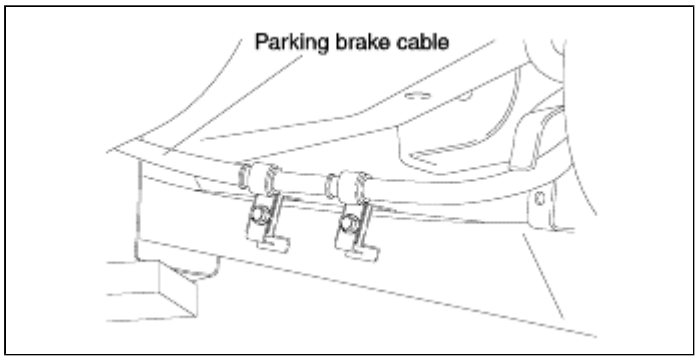
8. Loosen the stabilizer bar bolt and nut and remove pipe, cushions and retainers.



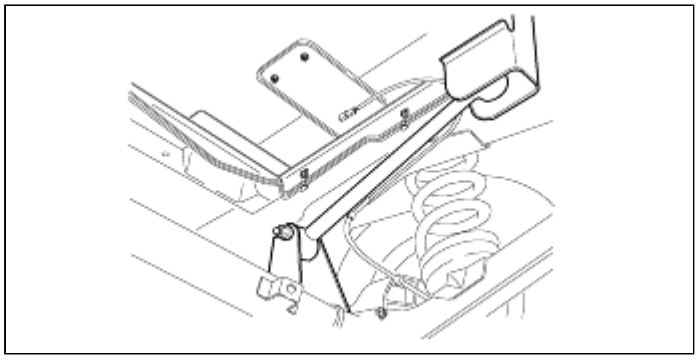
9. Remove the stabilizer plate and rubber bush after loosening bolt from the stabilizer bracket of rear casing.
10. Remove the stabilizer bar.
11. Loosen the panhard rod bolts and nuts and remove the panhard rod.



12. Remove the parking brake cable from the lower arm assembly after loosening the parking brake cable bolts.



13. Loosen the lower arm bolts and nuts and remove the lower arm assembly.
14. Loosen the upper arm bolts and nuts and remove the upper arm assembly.



15. Remove the seat rubber and coil spring.

Replacement/Inspection

1. Install the lower arm assembly to the rear casing and tighten the washer bolt and nut.

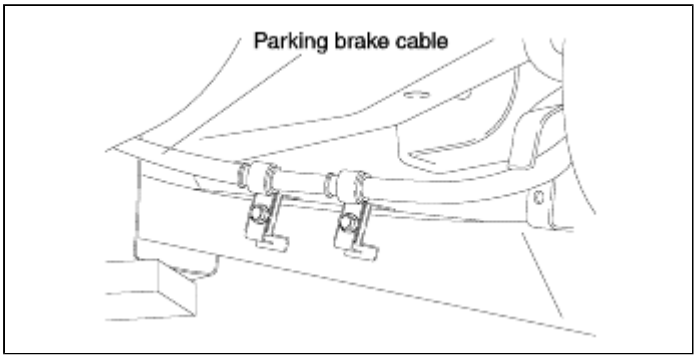
Tightening torque : 87~101 lb·ft (118~137 N·m, 12~14 kg·m)

2. Install the seat rubber and coil spring to the lower arm assembly.
3. Tighten the washer bolt and nut to body.

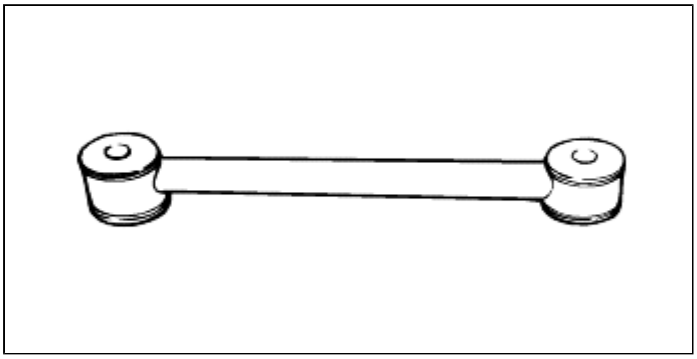
   Tightening torque : 87~101 lb·ft (118~137 N·m, 12~14 kg·m)

4. Install the parking brake cable to the lower arm assembly and tighten the parking brake cable bolts.

   Tightening torque : 14~19 lb·ft (16~23 N·m, 1.6~2.3 kg·m)

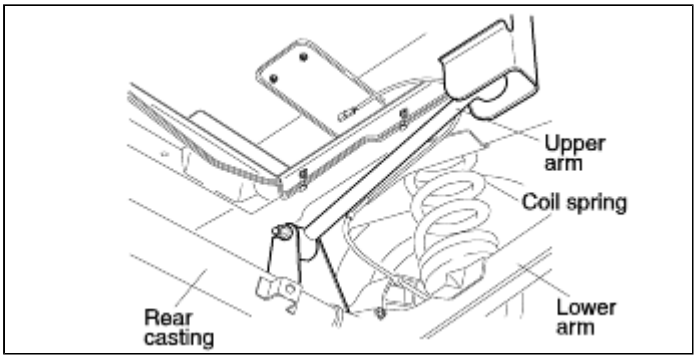


5. Inspect the upper arm for bends, cracks and/or other damage and inspect the upper arm bushings for wear and/or deterioration.



6. Install the upper arm assembly and bolts.

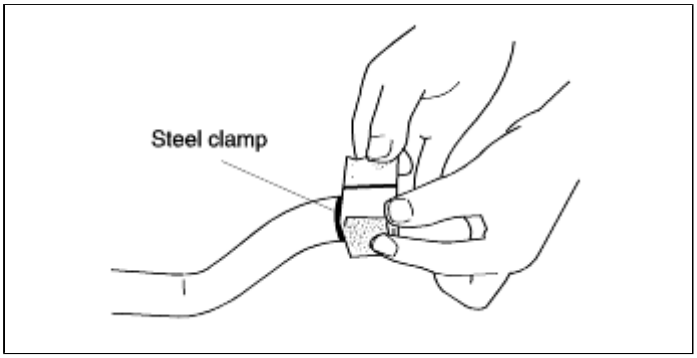
   Tightening torque : 55~69 lb·ft (74~93 N·m, 7.6~9.5 kg·m)



7. Inspect the panhard rod for bend, cracks and/or other damage and inspect the panhard rod bushings for wear and/or deterioration.
8. Install the panhard rod assembly and tighten bolts and nuts.

   Tightening torque -Axle : 99~116 lb·ft (134~157 N·m, 13.7~16 kg·m)
   Body : 135~155 lb·ft (183~210 N·m, 18.7~21.5 kg·m)

9. Align the stabilizer bushing with the steel clamp on the stabilizer bar.
   Located the bushing adjacent to the position line on stabilizer bar.



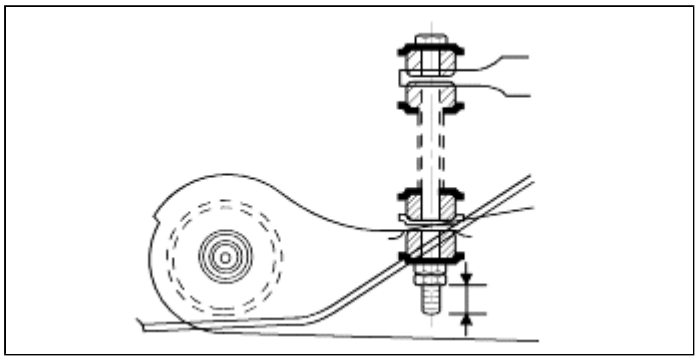
10. Tighten the stabilizer bolts to rear casting.

    Tightening torque : 32~40 lb·ft (43~54 N·m, 4.4~5.5 kg·m)

11. Tighten the stabilizer nuts so that the specified length of the thread is exposed and then tighten the lock nuts with the specified tightening torque.

    Specification: 0.37~0.60 in (9.4~15.4 mm)

    Tightening torque : 17~20 lb·ft (24~28 N·m, 2.4~2.9 kg·m)
    Specification: 0.37~0.60 in (9.4~15.4 mm)



12. Install the shock absorber bracket and tighten bolts.

    Tightening torque : 55~69 lb·ft (74~93 N·m, 7.6~9.5 kg·m)

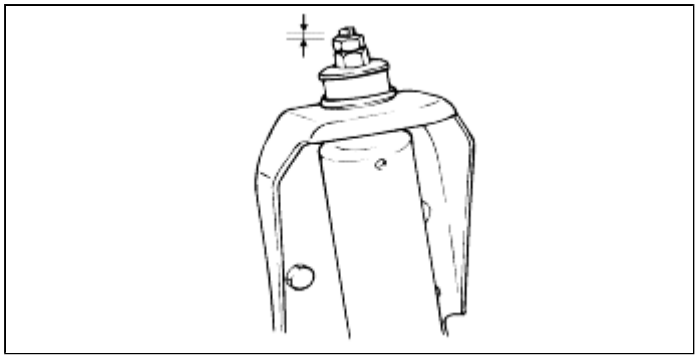
13. Tighten the shock absorber nuts until the specified length of the thread is exposed.

    Tightening torque : 41~47 lb·ft (55~64 N·m, 5.6~6.5 kg·m)

    Specification: 0.41~0.45 in (10.5~11.5 mm)
    Tightening torque : 41~47 lb·ft (55~64 N·m, 5.6~6.5 kg·m)

CAUTION

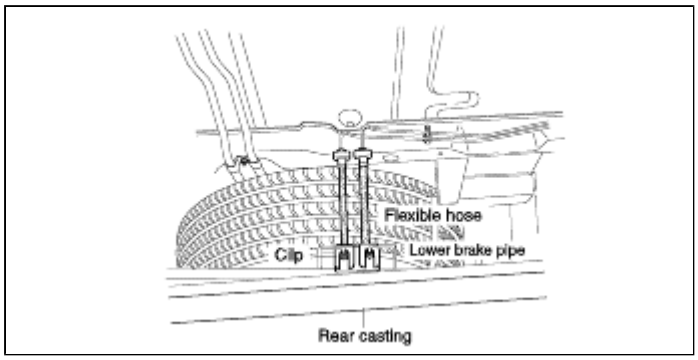
1) Tighten bolts and nuts lightly, and after lowering the vehicle(no passenger load condition) tighten it to the specified torque.
2) Do not remove rear jounce stop unless damage is detected.



14. Tighten the shock absorber lower bolts and nuts.

    Tightening torque : 55~69 lb·ft (74~93 N·m, 7.6~9.5 kg·m)

15. Lower the rear axle housing.
16. Connect the lower brake pipes and flexible hoses and fix the flexible hose clips to the bracket of rear casting.



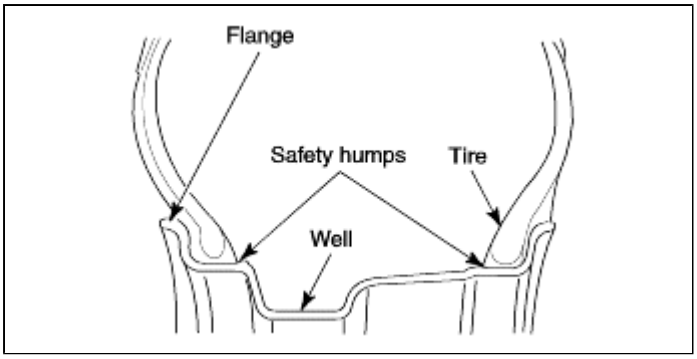
17. Install wheel and tires.
18. Lower vehicle.

General information

Wheel information

Original equipment wheels are designed for proper operation at all loads up to the specified maximum vehicle capacity.

All models use steel or aluminum drop center wheels.
Every wheel has raised sections between the rim flanges and rim drop well called safety humps.



Initial inflation of the tires forces the bead over these raised sections. In case of air loss the raised sections hold the tire in position on the wheel until the vehicle can be brought to a safe stop.
The wheel studs and nuts are designed for the specific wheel applications used on a vehicle and must be replaced with equivalent parts.
Before installing a wheel, remove any build up of corrosion on the wheel mounting surface.

CAUTION

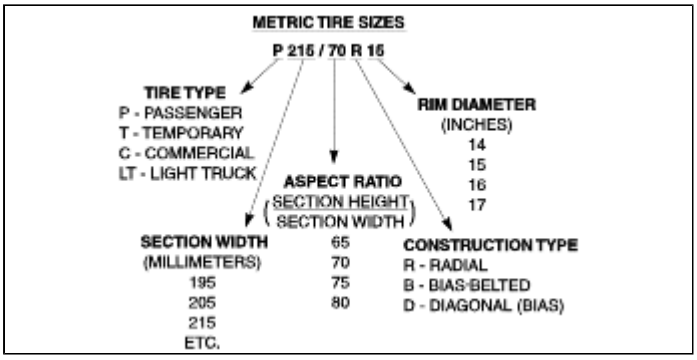
Installing wheels without good metal to metal contact could cause loosening of wheel lug nuts. This could adversely affect the safety and handling of your vehicle.

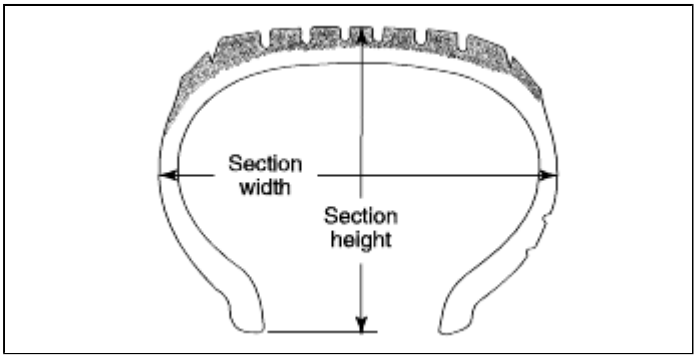
Tire identification

Tire type, size, aspect ratio and speed rating are encoded in the letters and numbers imprinted on the side wall of the tire. Refer to the chart to decipher the tire identification code as below.
Performance tires will have a speed rating letter after the aspect ratio number. The speed rating is not always printed on the tire sidewall. The letter S indicates that the tire is speed rated less than 112 mph (180 km/h)

1) T less than 118 mph (190km/h)
2) H less than 130 mph (210km/h)
3) V less than 149 mph (240km/h)

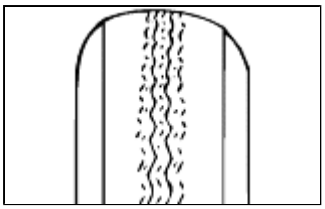
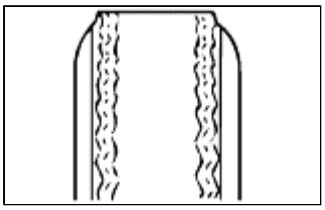
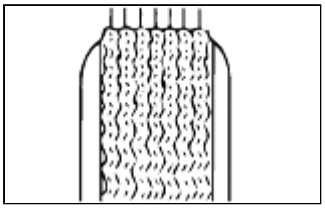
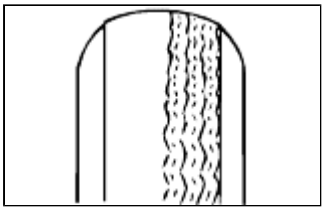
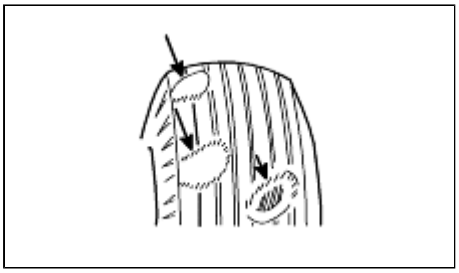
(consult the tire manufacturer for the specific speed rating)




Section
width
Section
height

Irregular tire wear

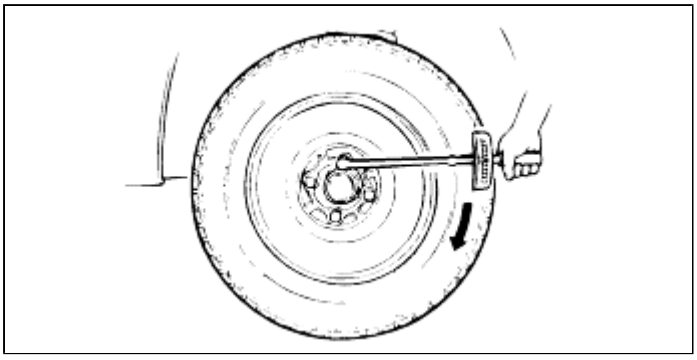
Refer to the chart for possible causes and remedies of irregular tire wear. Where lack of tire rotation is offered as a cause, consider previous tire location as possible source of trouble.

Problem	Possible cause	Remedy
Rapid wear at shoulders 	1) Underinflation (both sides worn) 2) Hard cornering 3) Lack of rotation	1) Measure and adjust air pressure 2) Reduce cornering speed
Rapid wear at center 	1) Overinflation 2) Lack of rotation	1) Measure and adjust air pressure
Feathered edge 	1) Incorrect toe adjustment	1) Adjust toe-in to specifications
Uneven wear parts 	1) Incorrect camber or caster 2) Worn or damaged suspension 3) Unbalanced wheel 4) Wobble in brake drum or disc 5) Lack of rotation 6) Hard cornering	1) Adjust camber or caster to specification 2) Repair or replace suspension component 3) Balance or replace 4) Reduce cornering speed
Bold sports 	1) Unbalanced wheel 2) Tire defect	1) Dynamic or static balance wheels 2) Replace tire

Removal/Installation

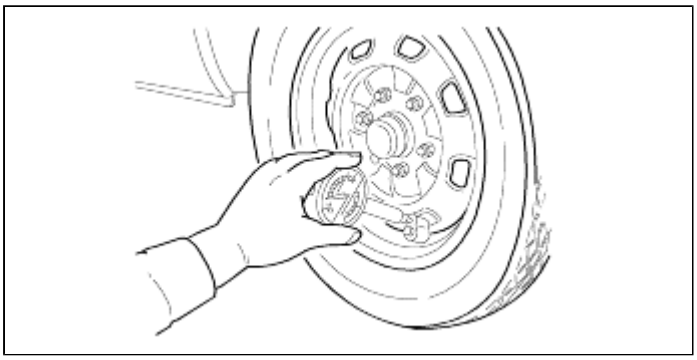
1. Contact surface between wheel and hub must be clean.
2. Tighten hub nuts to specified torque.

Tightening torque : 80~101 lb·ft (108~137 N·m, 11~14 kg·m)



Wheel alignment preinspection

1. Set tire inflation pressures to recommended pressure, if necessary.



2. Inspect front wheel bearing play; replace bearing if necessary.
3. Inspect wheel and tire runout.
4. Inspect ball joints and steering linkage for excessive play.
5. Vehicle must be on a level surface and have no luggage or passenger load.
6. Jounce the vehicle to check operation of shock absorbers.
7. Difference in height, between left and right sides of vehicle, from center of wheel up to edge of fender must not exceed 0.39 in (10 mm).
8. Check that fuel tank is full, radiator coolant and engine oil are at specified levels, and spare tire, jack and tools are in designated positions.

Notes on wheels and tires

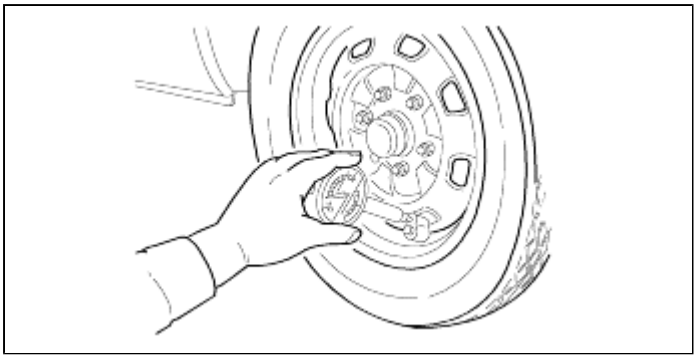
1. Do not use wheels or tires other than specified types.
2. Aluminum wheels are easily scratched. Use a soft cloth when washing them, never a wire brush. If vehicle is steam cleaned, do not allow boiling water to contact wheels.
3. If alkaline compounds (such as saltwater or road salts) get on aluminum wheels, wash them as soon as possible to prevent damage. Use a mild detergent only.

Inspection/Adjustment

Air pressure

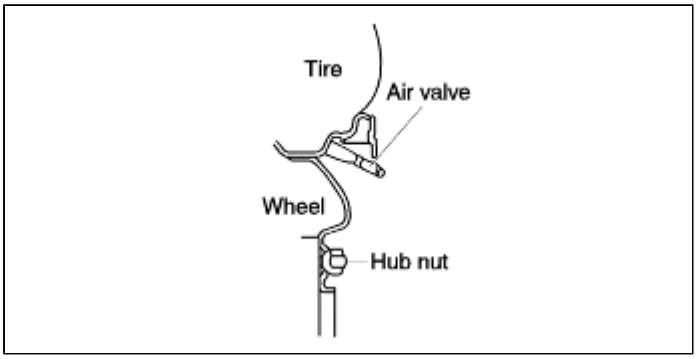
Check air pressure of all tires, including the spare tire, with an air pressure gauge. If necessary, adjust air pressure.

Tire size	Air Pressure psi (kPa, kgf/cm²)	
	Front Tires	Rear Tires
P215/70 R15	34 (235, 2.4)	



Air leakage

Verify that there is no air leaking from valve stem.

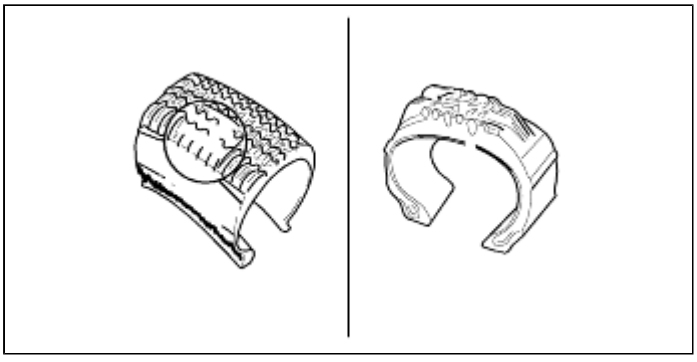


Tire wear

1. Check remaining tread depth.

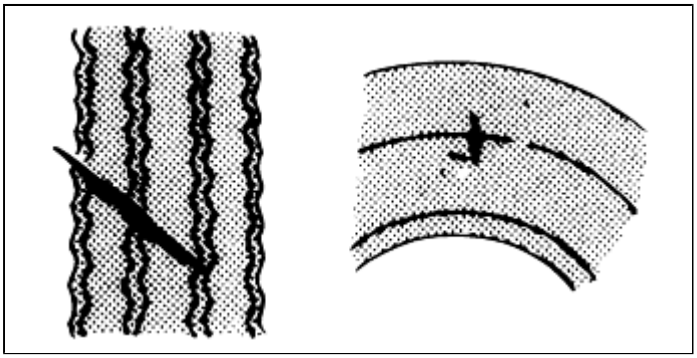
   Tread depth:Standard tires: 0.063 in (1.6 mm) minimumSnow tires: 50% of tread

2. Tire should be replaced if wear indicator ribs are exposed.



Tire and wheel

Tire should be replaced if any deep cracks, damage, deformation, or local baldness is found.

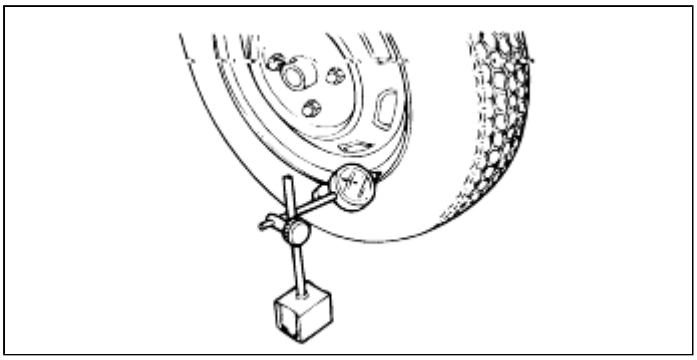


Wheel and tire runout

3. Raise vehicle and place it on safety stands.
4. Set dial indicator probe against wheel, and measure runout through one full revolution.

Runout:Wheel 0.06 in (1.5 mm) maximumTire 0.08 in (2.0 mm) maximum

5. Replace wheel if necessary.



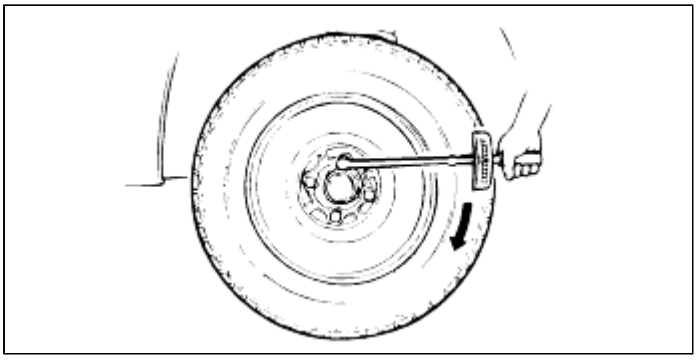
NOTE

Check wheel balance after replacement of a wheel or tire.

Hub nut

Tighten hub nuts to specified torque.

Tightening torque :80~101 lb·ft (108~137 N·m, 11~14 kg·m)



Notes regarding tire replacement

Note the following points when tires are to be removed or mounted onto wheels.

1. Be careful not to damage the tire bead, wheel rim bead, or outer edge of wheel rim.
2. Use a wire brush, fine sandpaper, or cloth to clean and remove all rust and/or dirt from wheel rim.
3. Clean aluminum wheels, with a soft cloth, never a wire brush or sandpaper.
4. Remove any pebbles, glass, nails, and other foreign items embedded in tire treads.

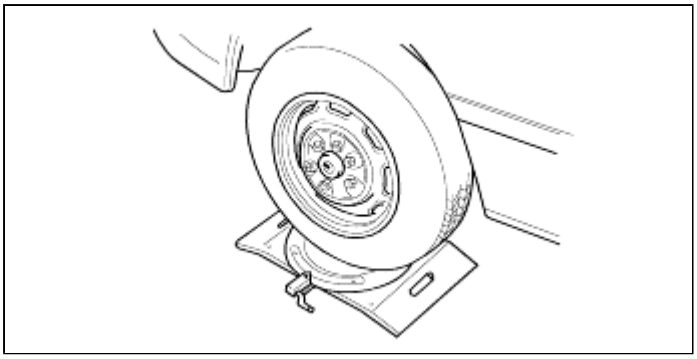
5. Be sure valve stem is installed carefully.
6. Apply a soapy solution to tire bead and edge of wheel.
7. If a tire iron must be used to change a tire on an aluminum wheel, use a piece of rubber between the tire iron and wheel to avoid damage. Work should be done on a rubber mat, not on a hard or rough surface.

Steering angle maximum

Inspection

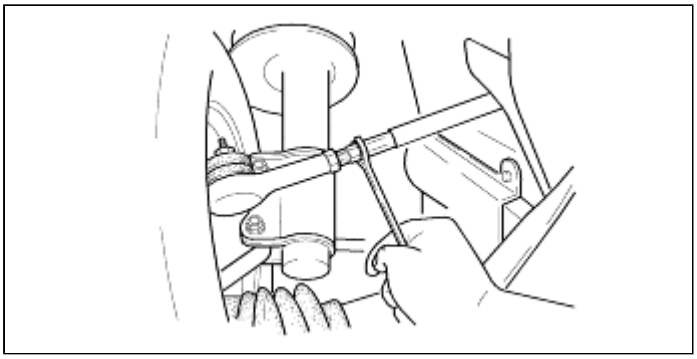
1. Measure the steering angle after placing the front wheel on a turning radius gauge.

   Standard : Inner : 34.19° ± 2°,Outer : 29.52° ± 2°



Adjustment

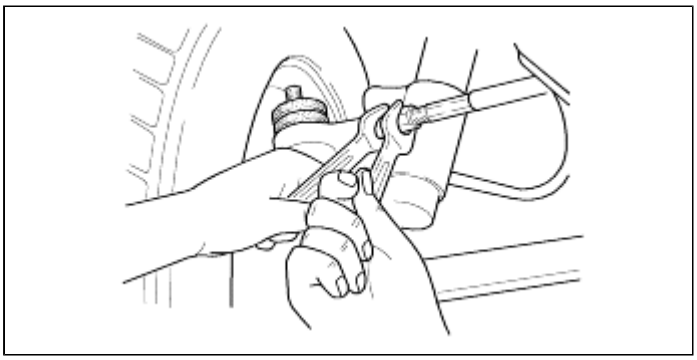
2. Place both front wheels on a turning radius gauge.
3. Turn wheels fully to left and note angles for left (inner) and right (outer) wheels.
4. Loosen both left and right tie rod lock nuts, then turn both tie rods to achieve specified angles. Tighten lock nuts.



5. Repeat for a full right turn; right is now inner and left is now outer.
6. Tighten tie rod lock nuts.

   Tightening torque :50~58 lb·ft (69~78 N·m, 7.0~8.0 kg·m)

7. Inspect and adjust toe after adjusting steering angle.

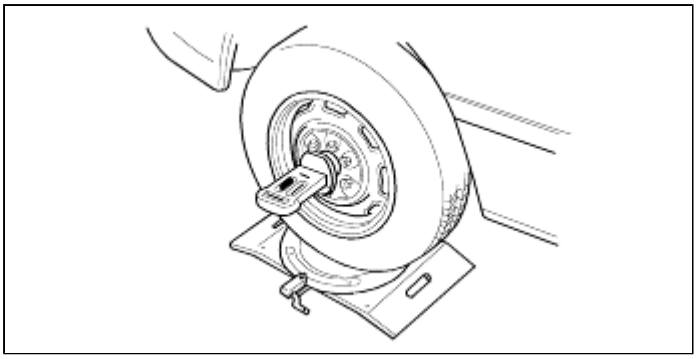


Caster and camber

Inspection

1. Place the front wheel on a turning radius gauge.
2. Attach caster/camber gauge to front hub.
3. Measure the caster/camber and note readings.

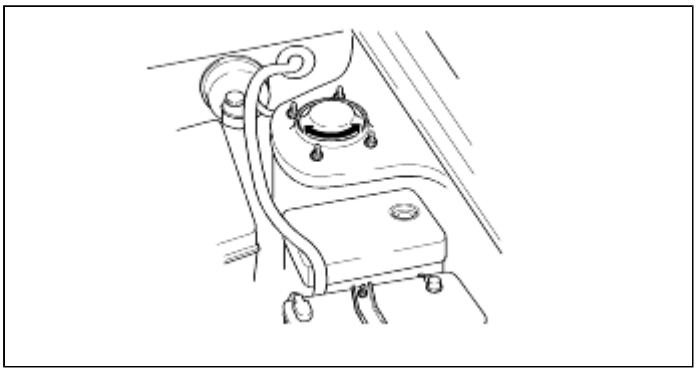
Camber :0.51°±0.5°(No passenger load)0.26°±0.5°(Five passengers load)Caster :1.88°±0.5°(No passenger load)1.94°±0.5°(Five passengers load)



Camber

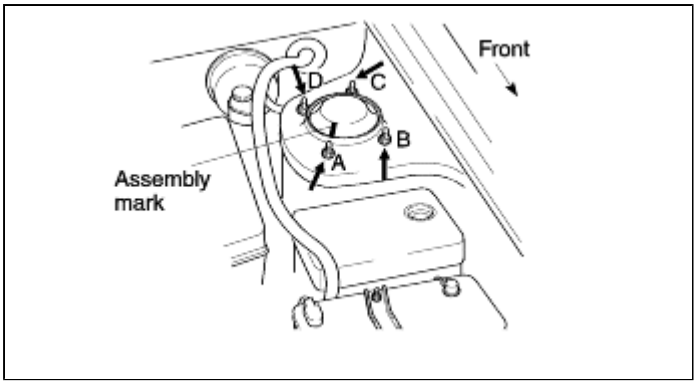
Adjustment

1. Attach camber gauge to front hubs per manufacturer's instructions, and note readings.
2. If readings do not meet specifications, lift front of vehicle until front wheels clear floor, and support with safety stands.
3. Remove four mounting block nuts.



4. Push mounting block downward to disengage studs, and turn it to position that corresponds to the difference between the initial reading and the specification.

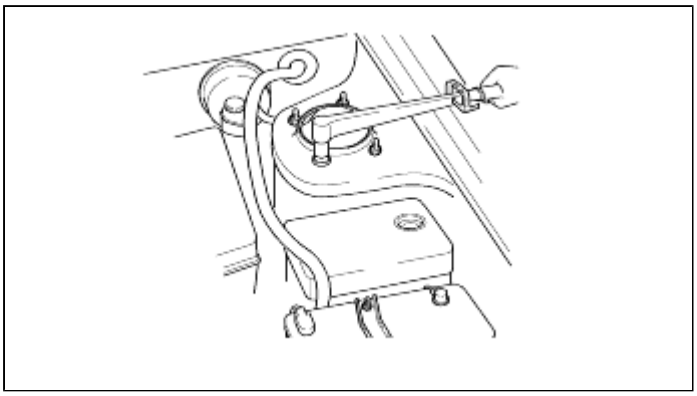
Alternate	Change from starting position
positions	Camber angle
A	0°
B	0.38°
C	0.38°
D	0°



5. Install and tighten mounting nuts to specified torque.

   Tightening torque :34~46 lb·ft (46~63 N·m, 4.7~6.4 kg·m)

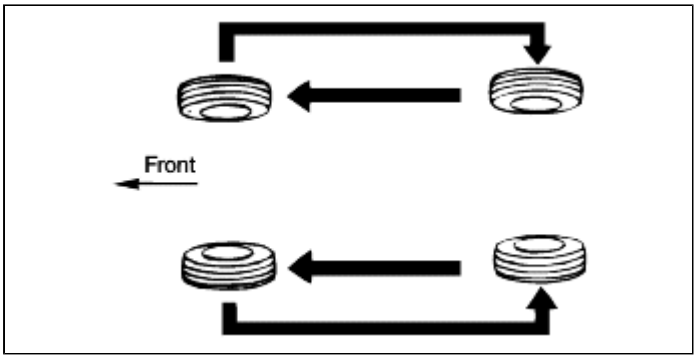
6. Lower vehicle and recheck camber.
   Readjust if necessary.



Tire rotation

To prolong tire life and ensure uniform tire wear.

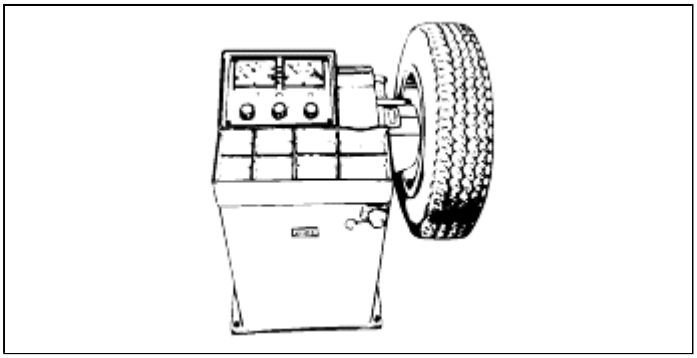
> CAUTION
>
> Keep the tires in the best condition at front. Do not move tires to opposite side of vehicle.



Wheel balance

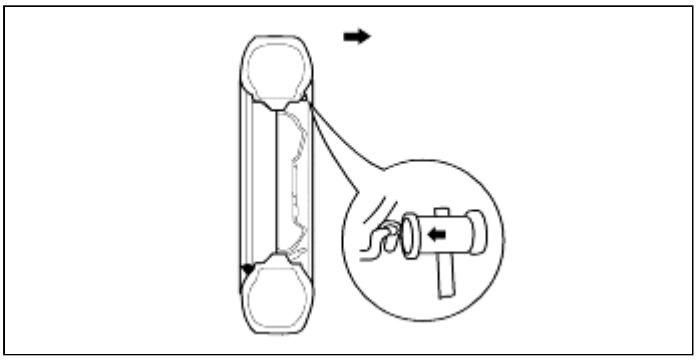
If a wheel becomes imbalanced or if a tire is replaced or repaired, wheel must be rebalanced.

Maximum imbalance at rim edge :2.12 oz (60g)



NOTE

1) Do not use more than two balance weights on the inner or outer side of a wheel.
2) If the total weight exceeds 3.53 oz (100g), move tire around on rim and rebalance.
3) Attach balance weights securely to wheel.
4) Select balance weights that are suitable for steel or aluminum alloy wheels.
5) Do not use an on-car balancer on automatic transmission models. Transmission damage may occur.

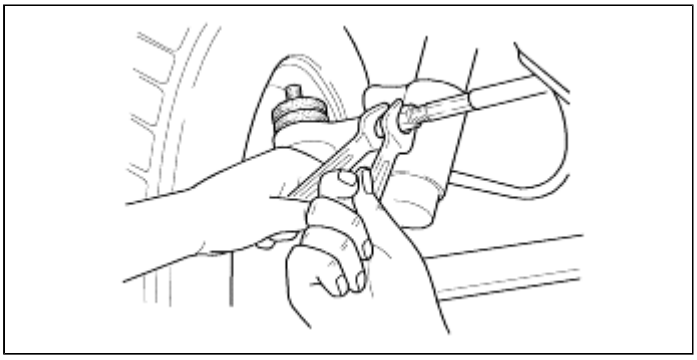


Toe (total)

1. Measure toe angle with a toe angle gauge per manufacturer instructions.
2. If measurement does not meet specification, loosen left and right tie rod lock nuts, then turn each tie rod as needed to achieve proper toe angle.

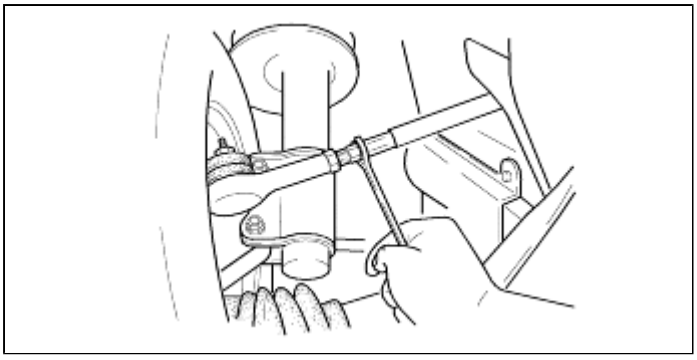
NOTE

1) Left and right tie rods are right hand threaded. To decrease toe angle thread right and left side tie rods into tie rod ends. To increase toe-in, unthread toe rods.
2) One full turn of both tie rods changes toe-in by about 0.24 in (6 mm).
3) If may be necessary to rotate one tie rod more than the other in order to achieve the proper toe angle and still retain a straight steering wheel.



3. Tighten tie rod lock nuts.

Tightening torque :50~58 lb·ft (69~78 N·m, 7.0~8.0 kg·m)



Rear wheel alignment

Alignment adjustment is not required. The rear axle alignment setting are preset at the factory, therefore no alignment is necessary.

Front wheel alignment procedure

Specifications

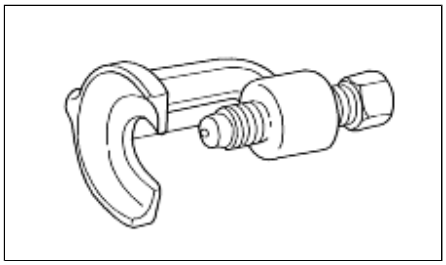
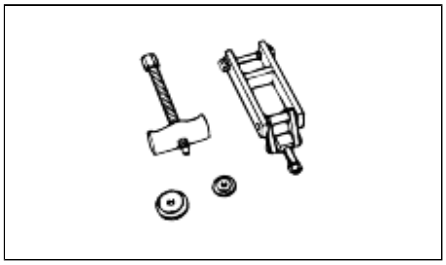
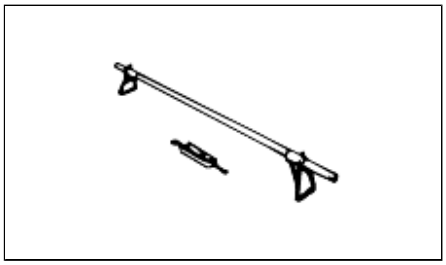
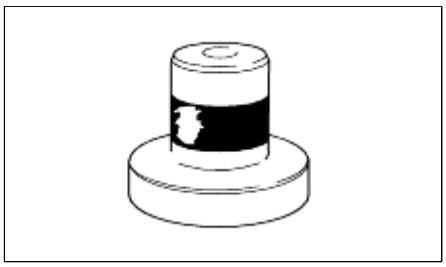
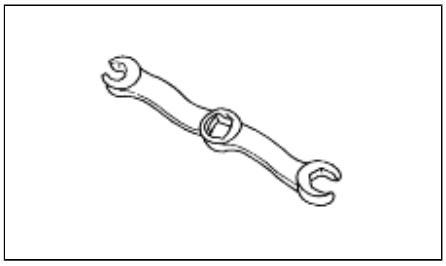
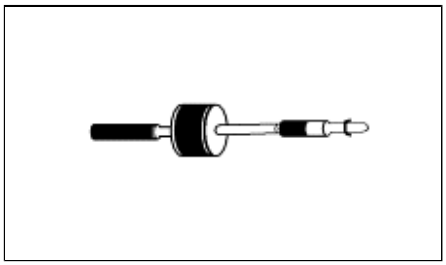
CAUTION

Do not attempt to adjust the vehicles caster or camber by heating, bending or by performing any other modification to the vehicle's front suspension components.

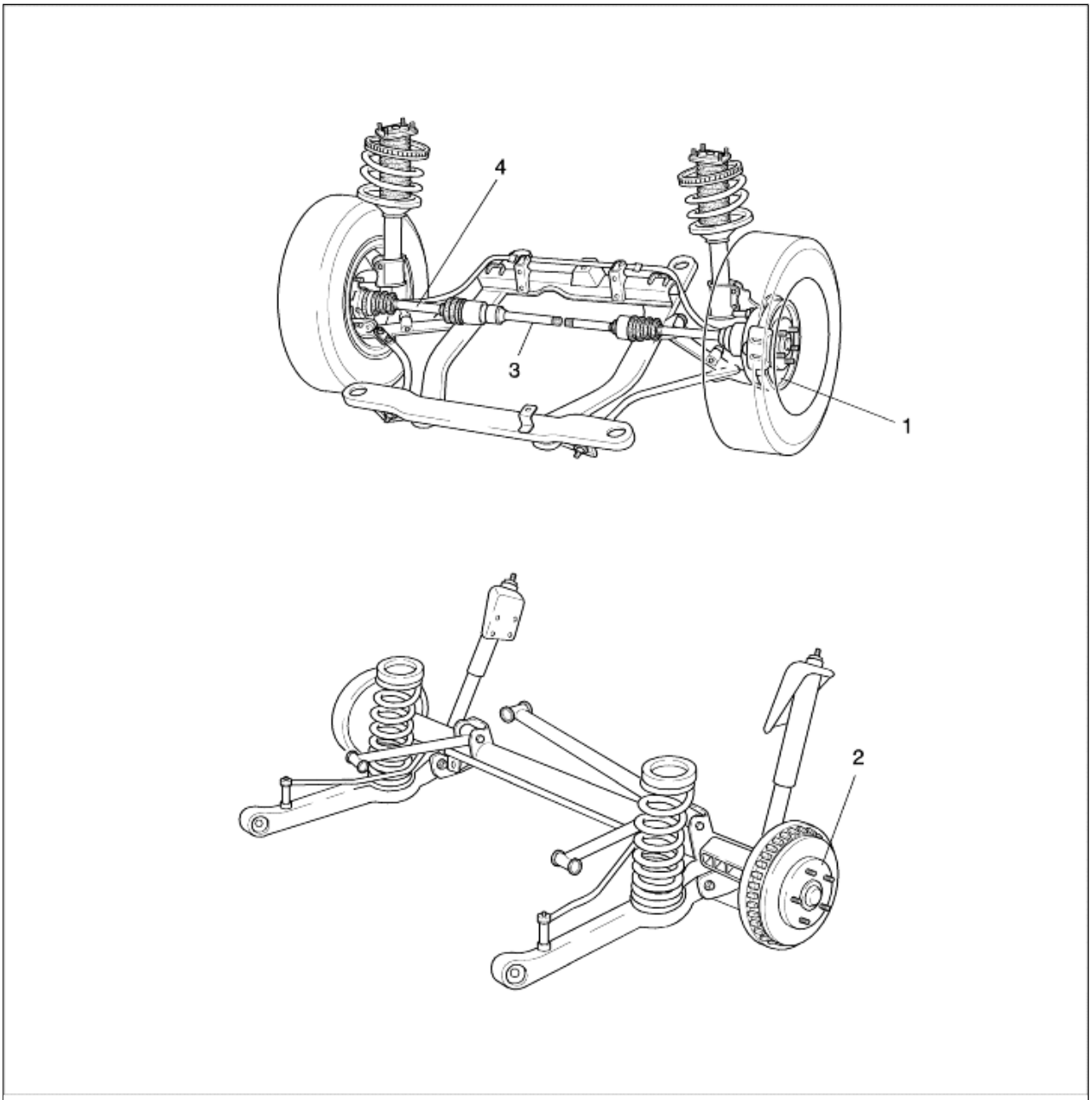
Item		Specifications
Steering angle maximum (degree)	Inner	34.19°
	Outer	29.52°
Toe in (mm)	No passenger load	-0.04±0.1 (-0.9±2.5)
	Five passengers load	-0.01±0.1 (-0.3±2.5)
Camber angle (degree)	No passenger load	0.51°±0.5°
	Five passengers load	0.26°±0.5°
Caster angle (degree)	No passenger load	1.88°±0.5°
	Five passengers load	1.94°±0.5°

driveshaft and axle

Special service tools

Tool (Number and Name)	Illustration	Use
0K130 283 021 Ball joint puller		Used to remove ball joint.
0K930 331AA0 Wheel hub puller		Used to remove wheel hub.
09517-43001 Engine support		Used to support engine when transaxle removal.
0K993 331 016 Oil seal installer		Used to install oil seal.
0K130 430 019 Flare nut wrench		Used to remove and install brake pipe.
0K410 111 012 Bearing puller		Used to remove bearing.

Component



1. Front axle
2. Rear axle
3. Joint shaft
4. Driveshaft

Symptom-related diagnostic procedure

Front axle

Problem	Possible cause	Action
Steering wheel vibration	Excessive wheel bearing play	Adjust or replace
	Damaged or worn wheel bearing	Replace
Pulling to one side	Excessive wheel bearing play	Adjust or replace
	Damaged or worn wheel bearing	Replace
	Bent steering linkage	Repair or replace
	Improper tire pressure	Adjust or replace
	Incorrect toe adjustment	Adjust
	Brake dragging	Repair or replace
	Fatigued front coil spring	Replace
	Bent front suspension lower arm or loose mounting	Repair or replace
Excessive steering wheel play	Loose front wheel bearing	Adjust or replace
	Incorrect steering gear preload adjustment	Adjust
	Steering gear worn	Repair or replace
	Steering column shaft worn or damaged	Repair or replace
	Front suspension lower arm mounting bolt bushing worn or damaged	Repair or replace
Linkage	Damaged or worn wheel bearing	Replace
	Insufficient grease on knuckle or joint of jointshaft	Lubricate or replace
	Bending of joint shaftor drive shaft	Replace
	Worn joint shaft spline or drive shaft	Replace
	Insufficient grease on joint or knuckle of drive shaft	Lubricate or replace
	Worn drive shaft	Replace
Grease leakage from boot	Damage or tear of boot	Replace
	Malfunction or misassembly of boot band	Replace
	Excessive grease	Repair
Abnormal noise from driveshaft and joint	Insufficient grease in driveshaft joint or knuckle	Lubricate or replace
	Excessive backlash on knuckle	Replace
	Worn front wheel driveshaft joint	Replace

Rear axle

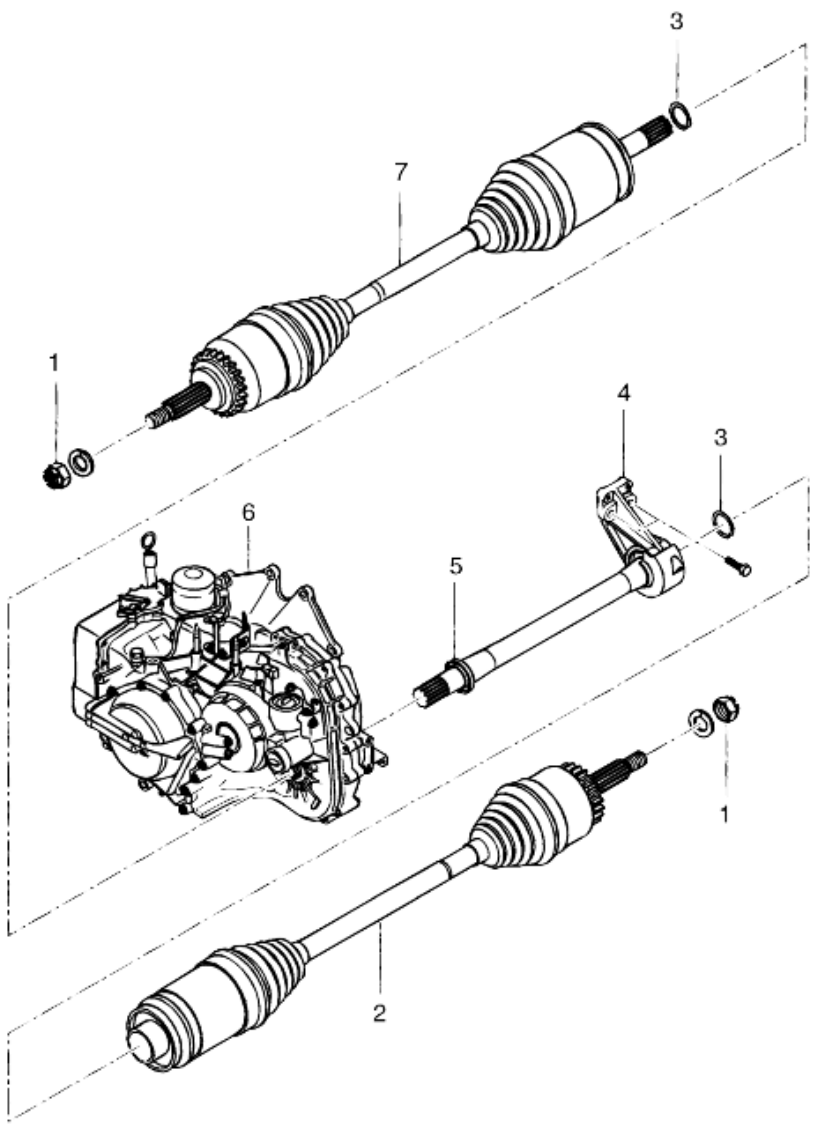
Problem	Possible cause	Action
Steering wheel vibration	Damaged or worn wheel bearing	Replace
	Excessive wheel bearing play	Adjust or replace
Pulling to one side	Damaged or worn wheel bearing	Replace
	Excessive wheel bearing play	Adjust or replace
	Improper tire pressure	Adjust or replace

Specifications

Item			Engine	Σ 3.5
				AT
Driveshaft	Type of joint	Inside		UTJ II
		Outside		Birfield ball joint
	Length in (mm)	Left side		27.51 (698.8)
		Right side		27.21 (691.2)
	Shaft diameter Øin (Ømm)	Left side		1.18 (30)
		Right side		1.18 (30)
Joint shaft	Length		in (mm)	16.18 (411)
	Shaft diameter		Øin (Ømm)	1.14 (29)
Front axle	in (mm)	Axis direction bearing play		0.002 (0.05)
Rear axle	in (mm)	Axis direction bearing play		0.002 (0.05)

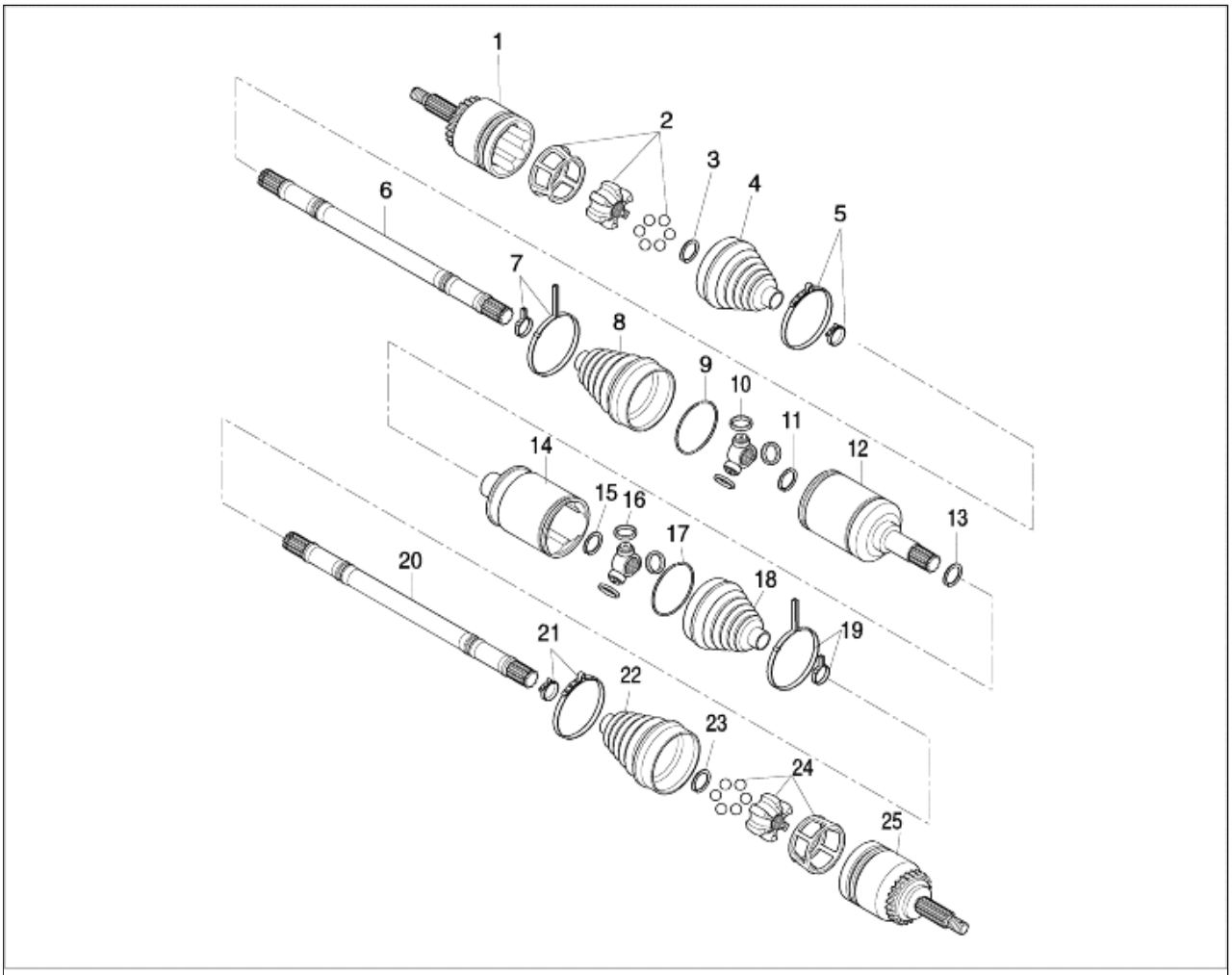
	Brake dragging	Repair or replace
	Fatigued rear coil spring	Replace
Excessive wheel play	Excessive wheel bearing play	Adjust or replace
	Loose rear wheel bearing	Adjust or replace
Linkage	Damaged or worn wheel bearing	Replace
	Insufficient grease on spindle	Lubricate or replace

Component



1. Wheel nut
2. Driveshaft (RH)
3. Circular clip
4. Center bearing bracket
5. Joint shaft
6. Automatic transaxle
7. Driveshaft (LH)

Component



Driveshaft(LH)
1. BJ assembly
2. BJ inner race and ball
3. Snap ring
4. BJ boot
5. BJ boot band
6. Driveshaft(LH)
7. UTJ boot band
8. UTJ boot
9. Circle pin
10. Spider assembly
11. Snap ring
12. UTJ assembly
13. Circlip

Driveshaft(RH)
14. UTJ assembly
15. Snap ring
16. Spider assembly
17. Circle pin
18. UTJ boot
19. UTJ boot band
20. Driveshaft(RH)
21. BJ boot band
22. BJ boot
23. Snap ring
24. BJ inner race and ball
25. BJ assembly

On-vehicle services

1. Raise vehicle and support it with safety stands.
2. Check dust boots on driveshaft for cracks, damage, leaking grease, or loose boot bands.
3. Check driveshaft for a bent condition, cracks, and wear of joints or splines.
4. Repair or replace driveshaft if necessary.
5. Lower vehicle.

Removal

NOTE

Drain transaxle oil before disassembly.

1. Raise vehicle and support it with safety stand.
2. Loosen and remove four wheel nuts.
3. Remove wheel and tire.
4. Loosen and remove control link nut and disconnect stabilizer bar from control link on lower control arm.

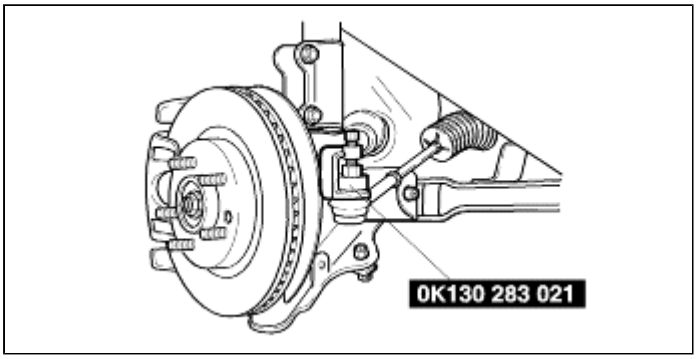
NOTE

Do not damage dust boot.

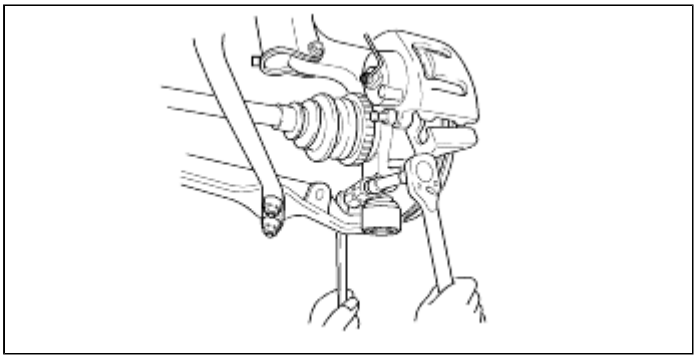
5. Loosen and remove tie rod nut and disconnect tie rod end with SST(0K130 283 021).

NOTE

Do not damage dust cover or oil seal.



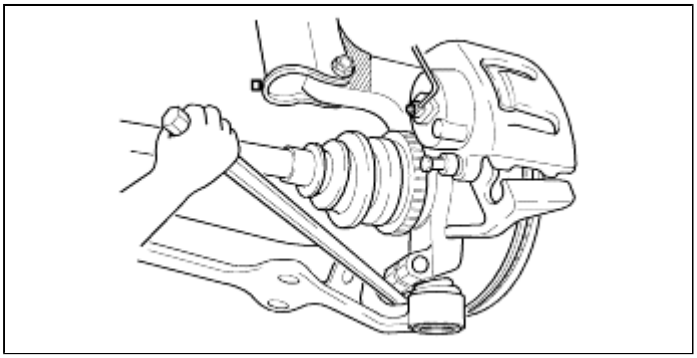
6. Remove the lower arm ball joint bolt and nut from the steering knuckle.



NOTE

Use caution when seperating lower arm from steering knuckle, so ball joint seal does not get cut.

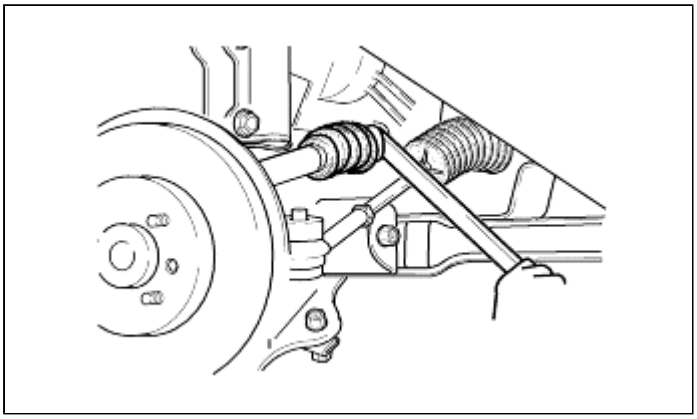
7. Using a pry bar, seperating steering knuckle from lower arm.



8. Use a pry bar to seperate the front wheel driveshaft from the transaxle.

NOTE

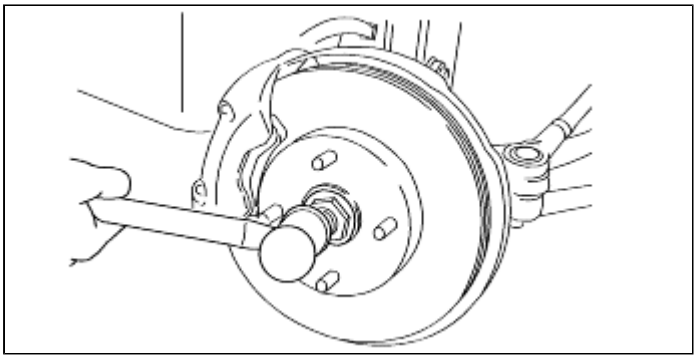
1) Seperate the front wheel driveshaft from transaxle gradually. If it is suddenly yanked out of transaxle, the differential oil seal may be damaged.
2) Plug the transaxle case opening with oil seal cap in order to avoid contamination.



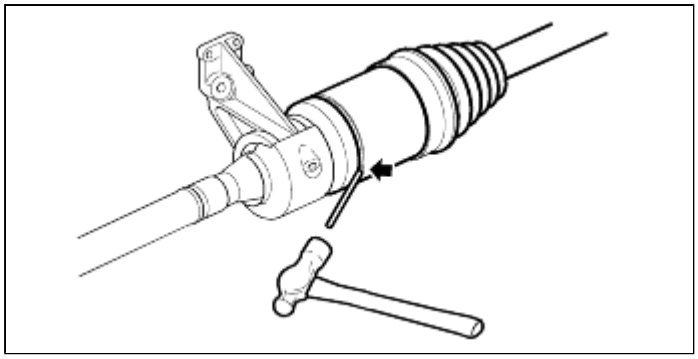
9. Remove driveshaft from front hub.

NOTE

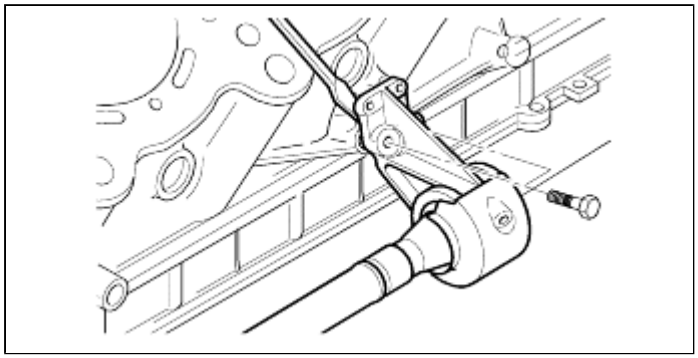
If driveshaft is frozen in front wheel hub, spray a penetrating solvent into splined area and then reinstall lock nut so that it is flush with end of shaft.Tap nut with a brass hammer to remove driveshaft.
Take care not to damage the inner wheel bearing oil seal while removing the front wheel driveshaft from the front wheel hub.



10. Insert a pry bar into the driveshaft groove and remove the driveshaft from joint shaft using a hammer. (RH)



11. Remove the joint shaft bracket mounting bolt and insert a pry bar between the bracket and the cylinder block to make a gap to disconnect the joint shaft mounting bracket from the cylinder block.



12. Pull joint shaft straight out.

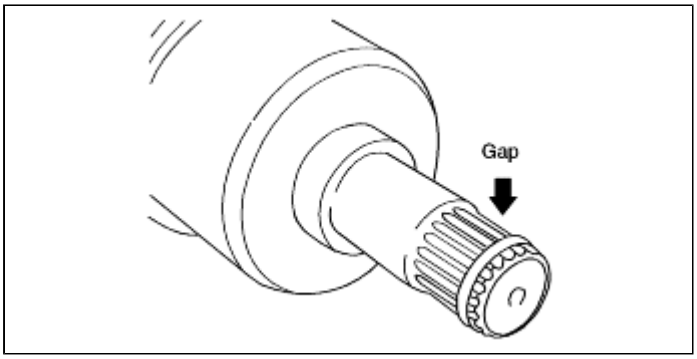
> NOTE
>
> Take care not to damage the dust cover of the joint shaft while placing on ground.

Replacement

> NOTE
>
> Do not damage dust cover or oil seal.

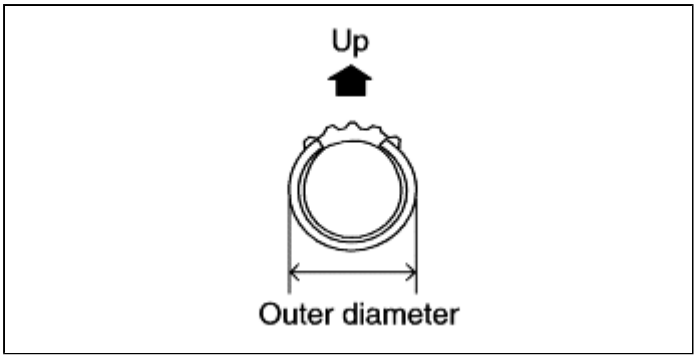
1. Install left driveshaft with circular clip gap facing upward as shown.

> NOTE
>
> The original driveshaft circular clip must not be reused.

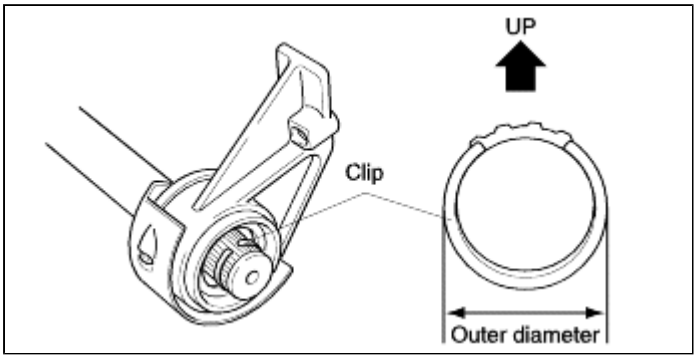


2. Lubricate the end of the front wheel driveshaft joint with grease.
3. Install a new clip so that opening is facing upward.
4. Measure outer diameter of clip after installing, and replace clip if it exceeds specification.

Outer diameter : 1.14 in (32mm)

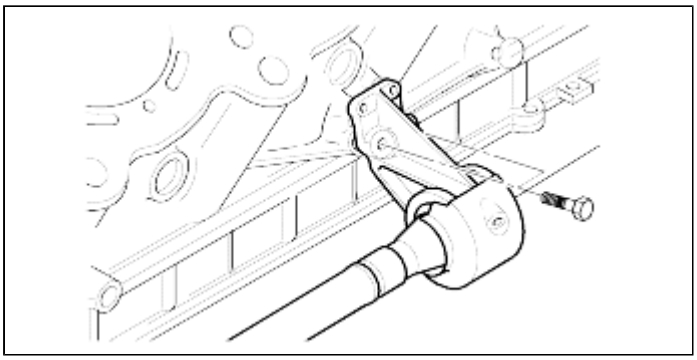


5. Measure outer diameter of clip of joint shaft after installing, and replace clip if it exceeds specification.
   Outer diameter : 1.221 in (31mm)

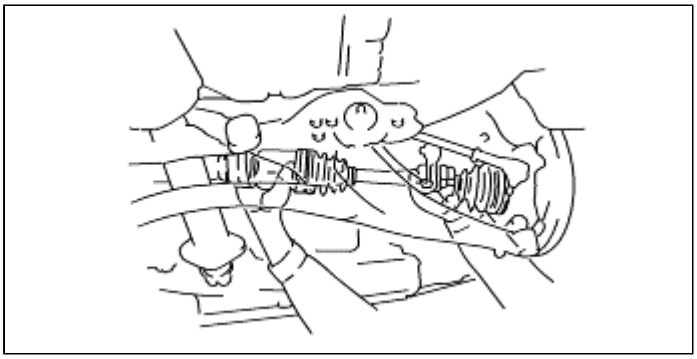


6. Install joint shaft and tighten mounting bolts.

   Tightening torque :31~46 lb·ft (42~62 N·m, 4.3~6.3 kg·m)



7. Push right driveshaft onto joint shaft.
8. After installation, pull front hub outward to verify that driveshaft is securely held by circular clip.



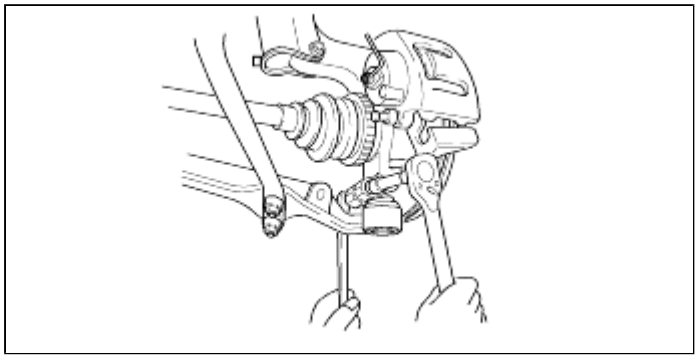
9. Apply transmission fluid oil around oil seal lip, and push driveshaft into trnsaxle.

NOTE

Do not damage dust boot. Do not damage oil seal of transaxle and joint shaft.

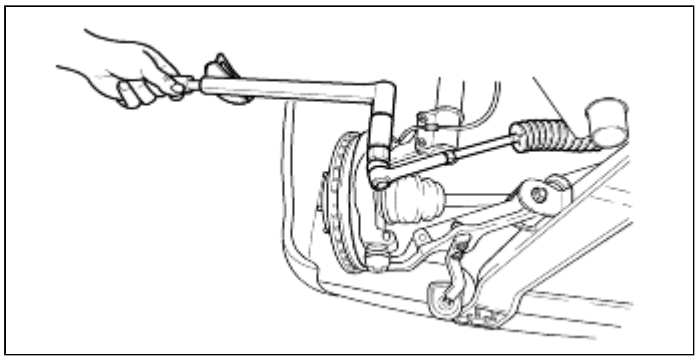
10. Attach the lower arm ball joint to the front wheel knuckle and tighten the lower arm ball joint nut and bolt.

Tightening torque :69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)



11. Install nut and secure it with a new cotter pin.

Tightening torque :43~58 lb·ft (59~78 N·m, 6.0~8.0 kg·m)

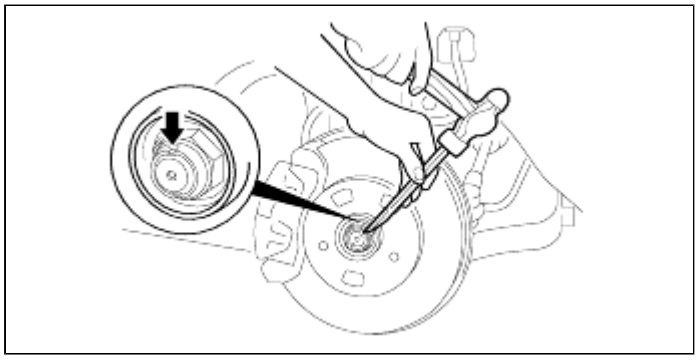


12. Connect stabilizer bar to control link and tighten control link nut.

Tightening torque :69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)

13. Install a new driveshaft lock nut and stake it, as shown.

Tightening torque :177~199 lb·ft (240~270 N·m, 24.5~27.5 kg·m)



14. Install wheel and tire.

Tightening torque :65~79 lb·ft (88~108 N·m, 9.0~11.0 kg·m)

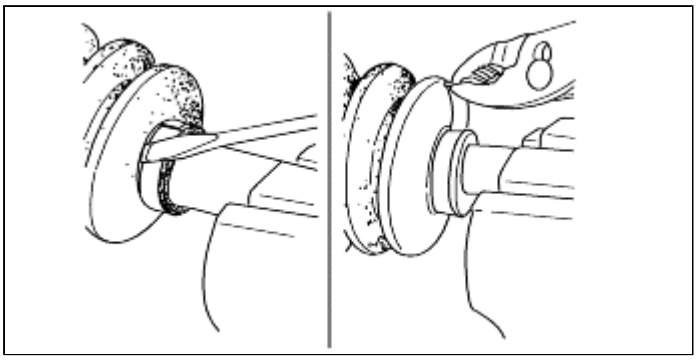
15. Lower vehicle.

Disassembly

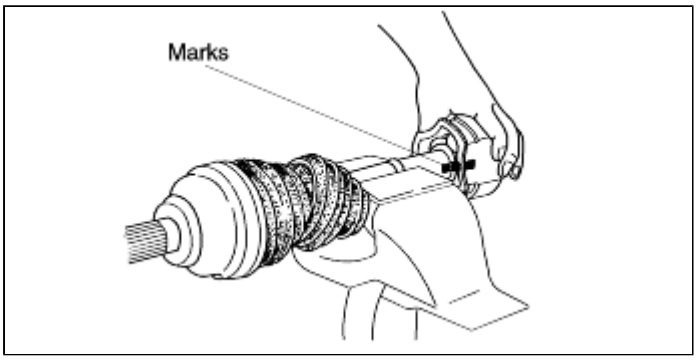
NOTE

Do not disassemble boot band on wheel side unless necessary.

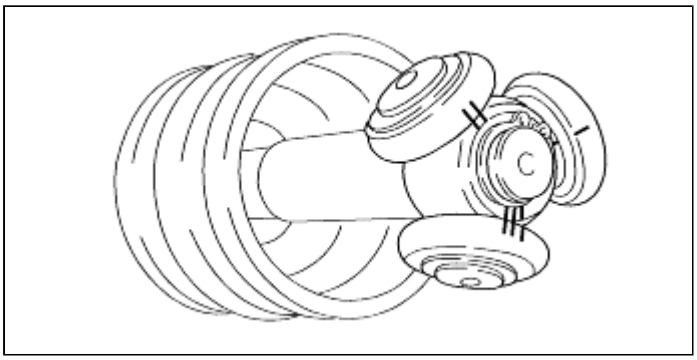
1. Pry up locking clip of transaxle-side boot retention band with a screwdriver.
2. Remove band with pliers.
3. Slide boot along shaft to expose joint.



4. Mark tripod housing and shaft for proper reassembly.
5. Remove outer ring.



6. Mark shaft and tripod joint for proper reassembly.

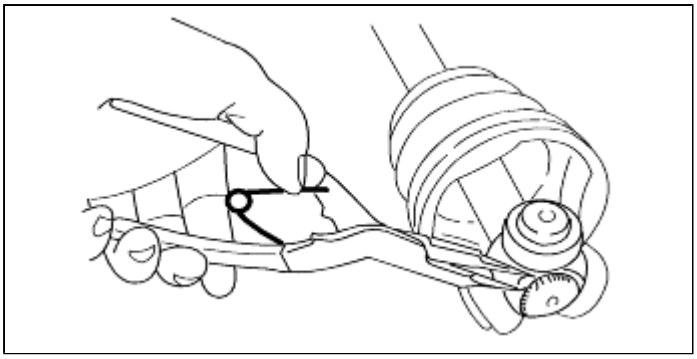


7. Remove snap ring with snap ring pliers.

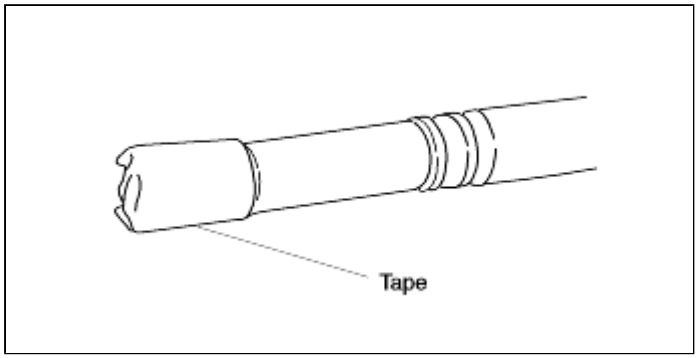
NOTE

Do not damage needle bearings.

8. Drive tripod joint from shaft with a bar and a hammer.



9. Wrap splines of shaft with tape to prevent damaging boot.
10. Slide boot off shaft.



NOTE

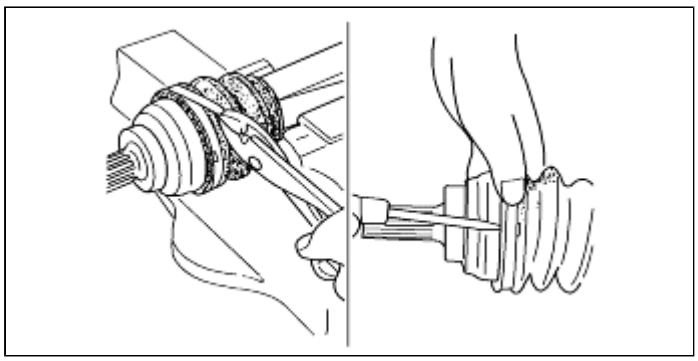
Do not remove dynamic damper unless necessary.

11. Pry up locking clip of damper retention band with a screwdriver.
12. Remove band with pliers.
13. Remove dynamic damper.

NOTE

Do not remove boot from outer joint unless necessary.

14. Pry up outer boot locking clip of small and large retention bands with a screwdriver, or similar tool.
15. Remove both bands with pliers.
16. Cover splines with tape and remove boot.

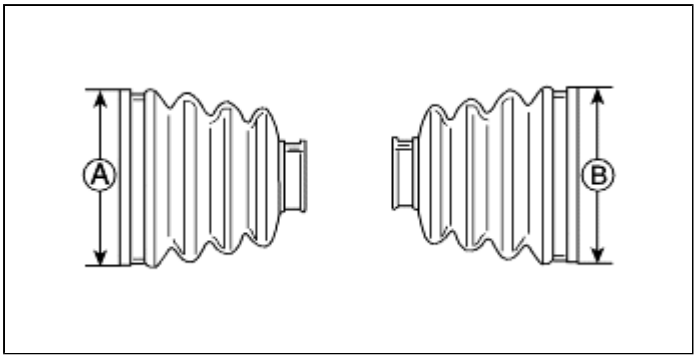


Assembly

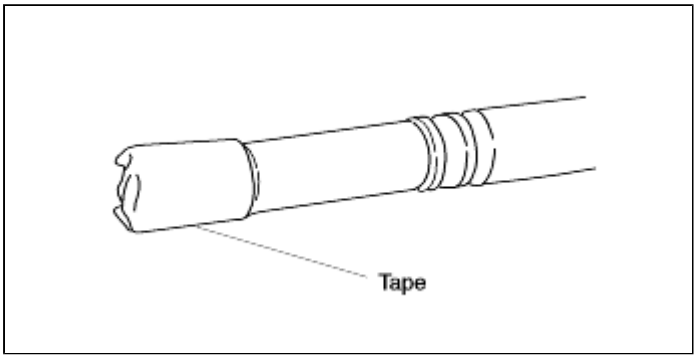
NOTE

Boot on wheel side of driveshaft is different from boot on differential side of driveshaft.

Engine	T/M	Boot diameter (in (mm))	
		Wheel side	T/M side
∑3.5	A/T	3.89 (99)	3.84 (97.5)



1. Cover splines of transaxle end with tape.
2. Install inner dust boot.



NOTE

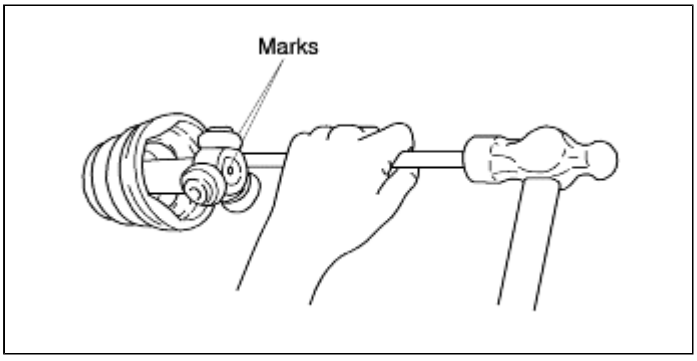
1) Always use new bands.
2) Bands should be installed so that their pointed ends initially point in forward direction of rotation.

3. Fold band back by pulling on end with pliers.
4. Lock end of band by bending its locking clip.
5. Install outer boot.

NOTE

Do not damage bearing.

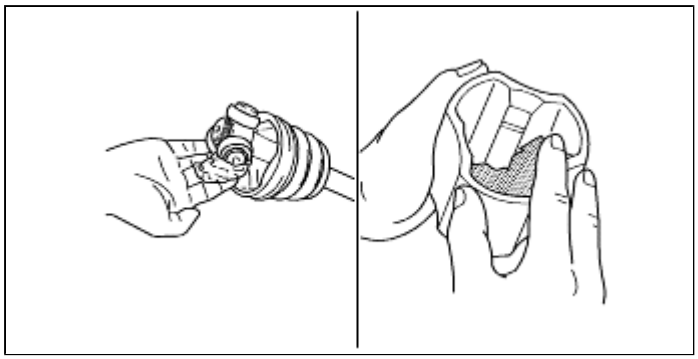
6. Align marks and carefully install tripod joint with a drift and a hammer.
7. Install snap ring with snap ring pliers.



8. Apply grease included in rebuild kit to the tripod joint, outer ring and boot.

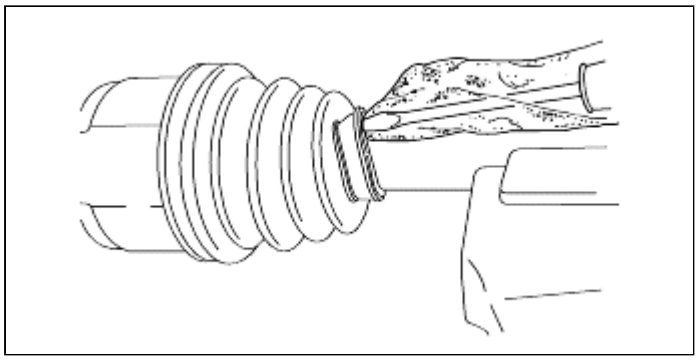
9. Install outer ring.
10. If outer boot was removed, fill it with correct quantity of specified grease.

Engine	T/M	Grease (oz. (g))	
		Wheel side	T/M side
∑3.5	A/T	7.75 (210)	7.50 (220)

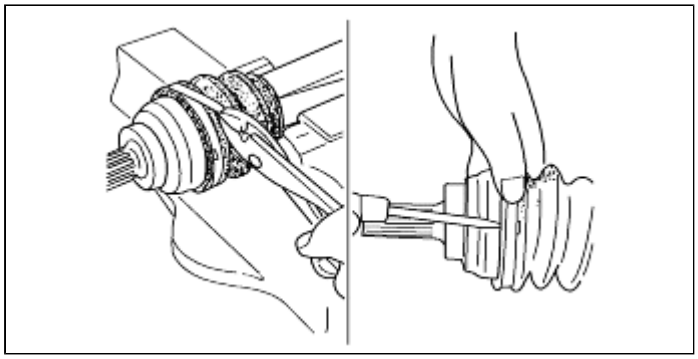


NOTE

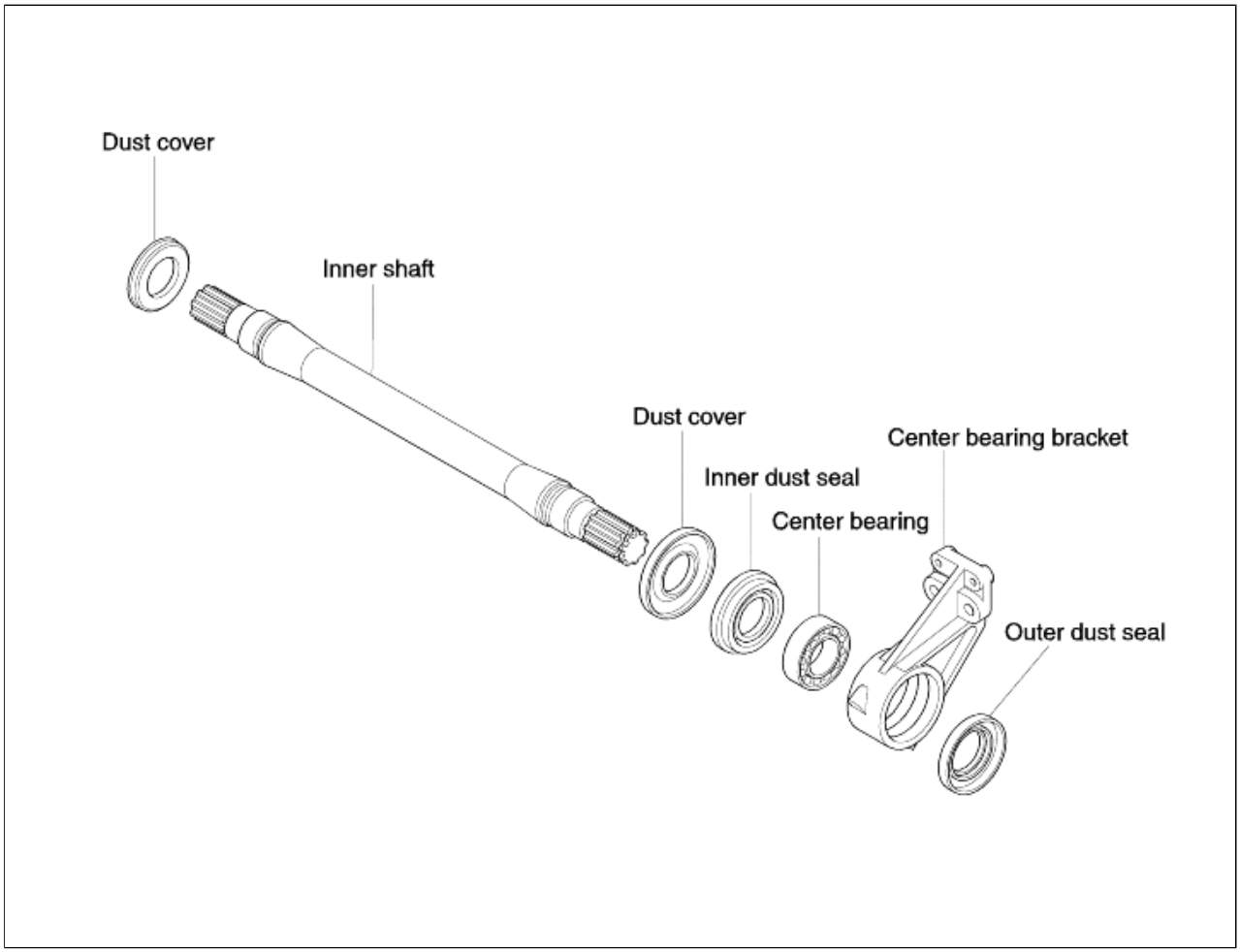
1) Be sure boots are not damaged.
2) Carefully lift up small end of boots to release any trapped air.



11. Install boot retention bands.
12. Fold bands back and pull on ends with pliers to tighten.
13. Lock ends of bands by bending locking clips.

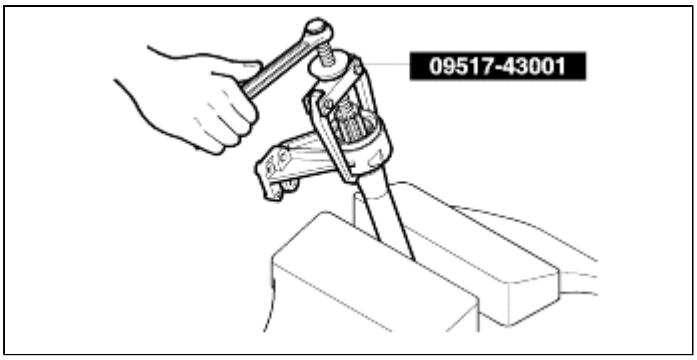


Component


Dust cover
Inner shaft
Dust cover
Inner dust seal
Center bearing
Center bearing bracket
Outer dust seal

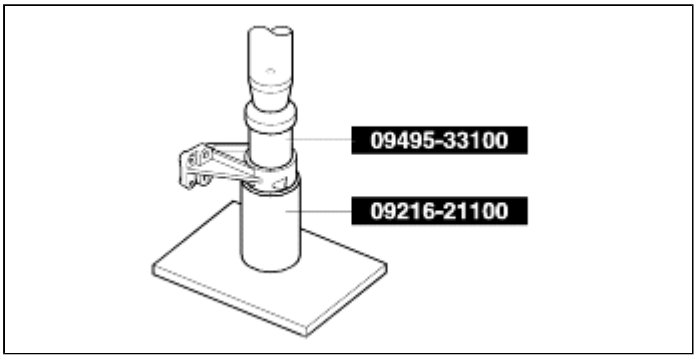
Disassembly

1. Disassemble in order shown on figure.
2. Disassemble the center bearing bracket from the inner shaft with SST (09517-43001)



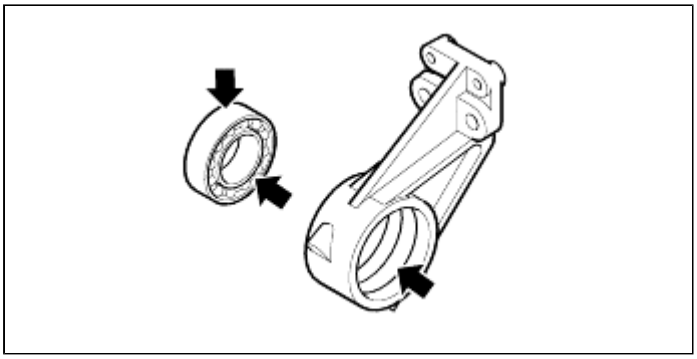
3. Press out the center bearing with SST(09216-21100, 09495-33100)

> **CAUTION**
>
> Press sst(09495-33100) correctly to prevent deformation of the seal plate.

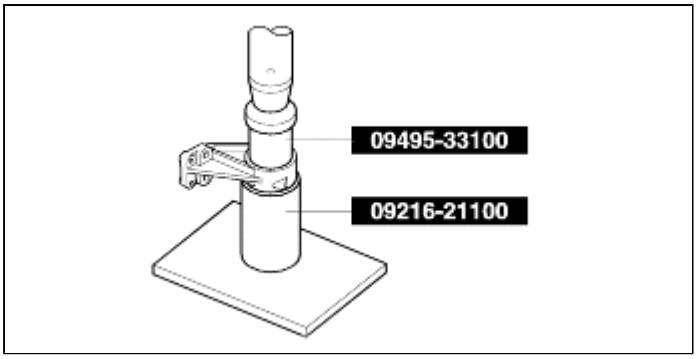


Assembly

1. Apply multi-purpose grease to the center bearing and center bearing bracket inside.

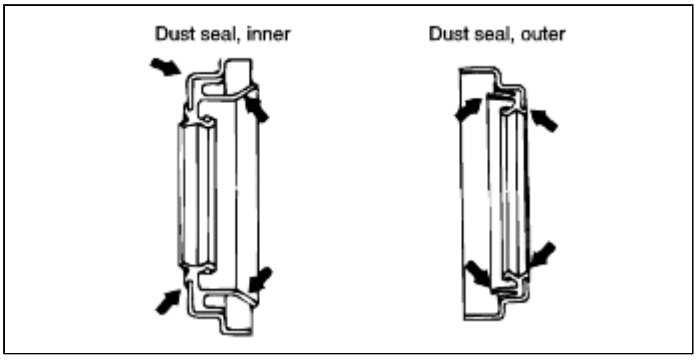


2. Press the center bearing into the center bearing bracket with SST.(Pressure should be less than 1,500kg)



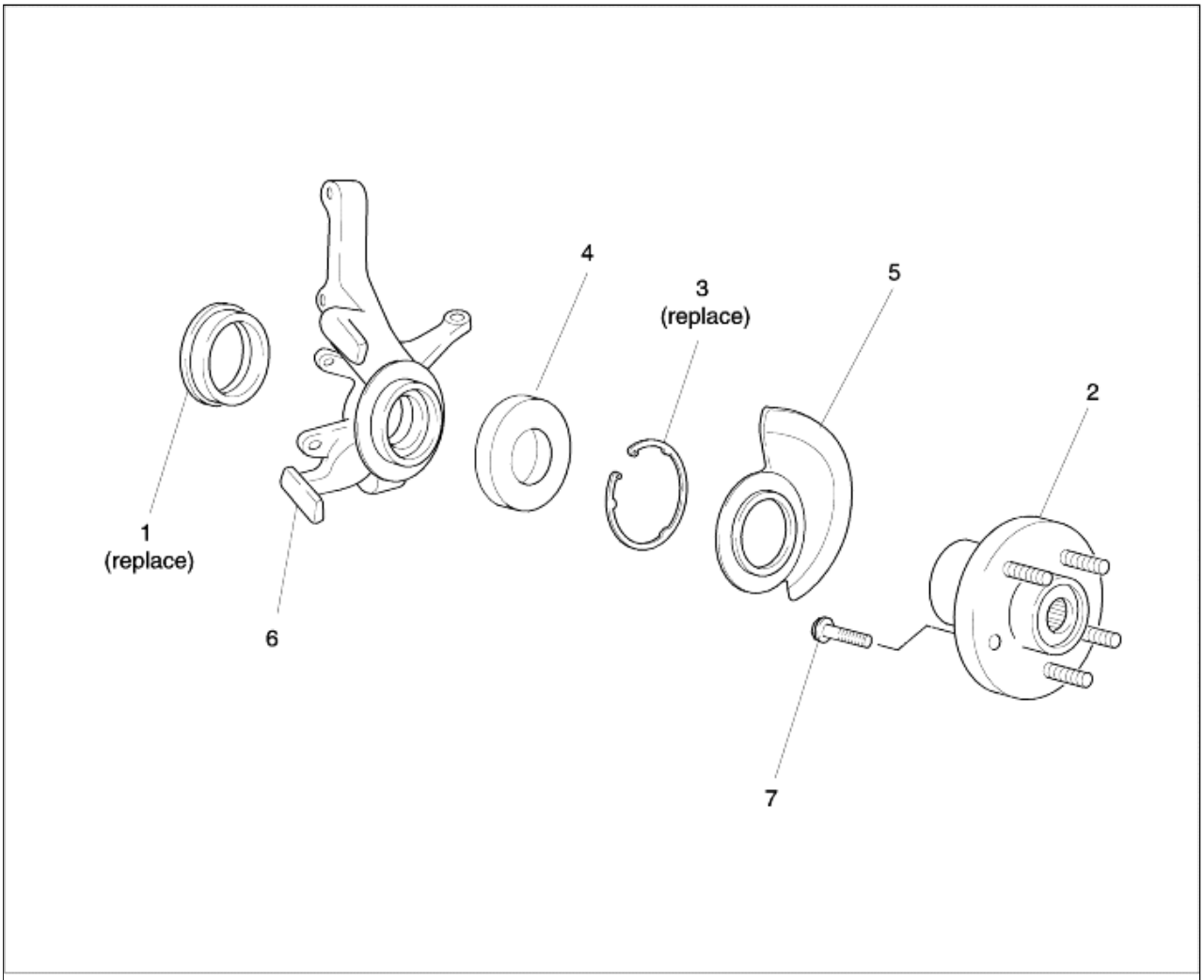
3. Apply multi-purpose grease to the back face of every new dust seal.
   Using the special tool, tap the outer dust seal and inner dust seal in that order until they are flush with the edge of the center bearing bracket.

Item	Specification
Dust seal, inner	7~10g
Dust seal, outer	4~6g



4. Install the center bearing bracket to the inner shaft.

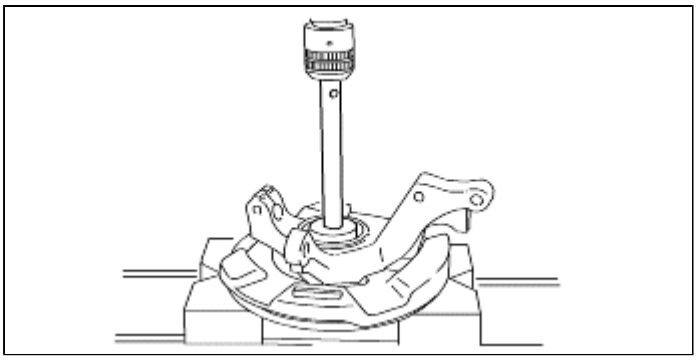
Component



1. Oil seal
2. Front wheel hub assembly
3. Retaining ring
4. Wheel bearing
5. Dust cover
6. Steering knuckle
7. Wheel hub bolt

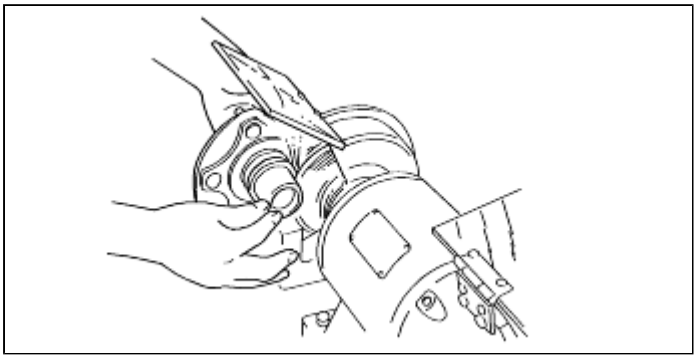
Disassembly

1. Remove oil seal from front wheel hub.
2. Remove front wheel hub assembly with suitable tool.

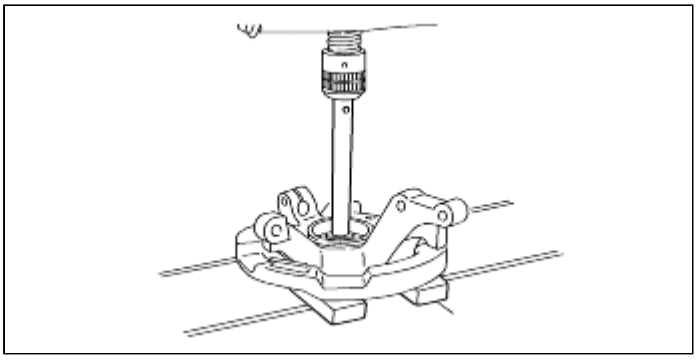


3. Remove retaining ring.

> NOTE
>
> If the bearing inner race remains on wheel hub, grind a section of inner race until approximately 0.020 in (0.5 mm) remains. Remove race with a chisel.

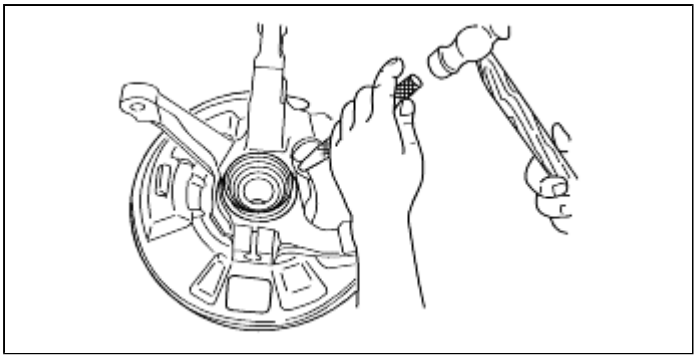


4. Remove wheel bearing with suitable tool.



> NOTE
>
> 1) Do not remove dust cover unless necessary.
> 2) Do not reuse dust cover if removed.

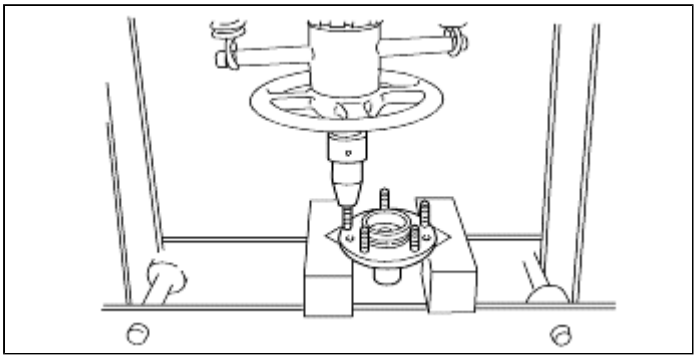
5. Mark relative positions of dust cover and knuckle for proper reassembly.
6. Remove dust cover with a chisel.



NOTE

1) Do not remove wheel hub bolt unless necessary.
2) Do not reuse wheel hub bolt if removed.

7. Remove wheel hub bolt with a press.

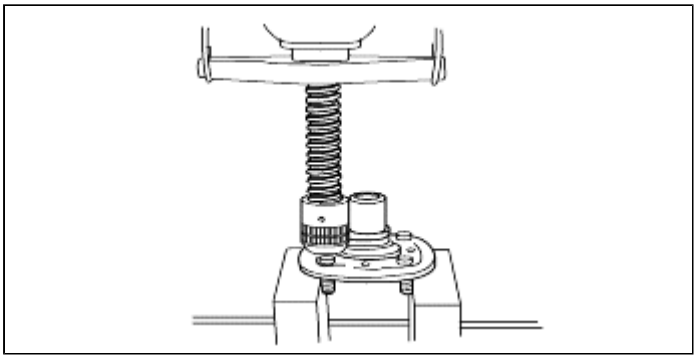


Assembly

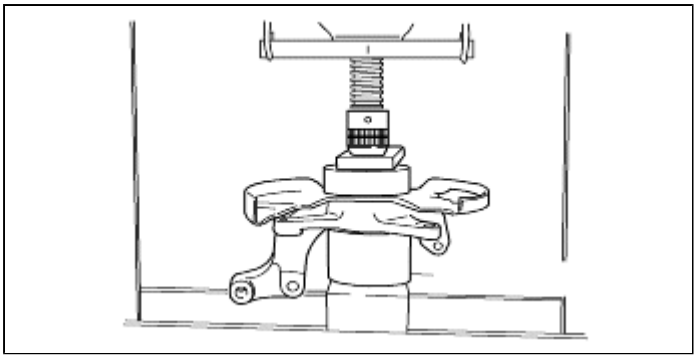
1. Press in new wheel studs.

NOTE

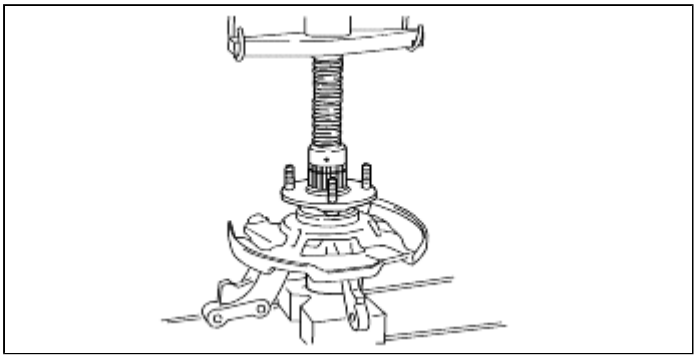
Front wheel hub press in either bolt turning or loosening by the torque of 108.5 lb·ft (147 N·m, 15 kg·m) shall not be premissible.



2. Mark new dust cover to match the removed dust cover.
3. Align mark on new dust cover with knuckle.
4. Install new dust cover with suitable tool.



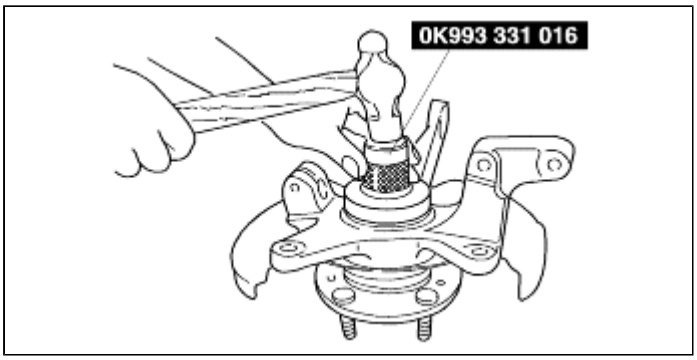
5. Install new wheel bearing with suitable tool.
6. Install front wheel hub assembly with suitable tool.



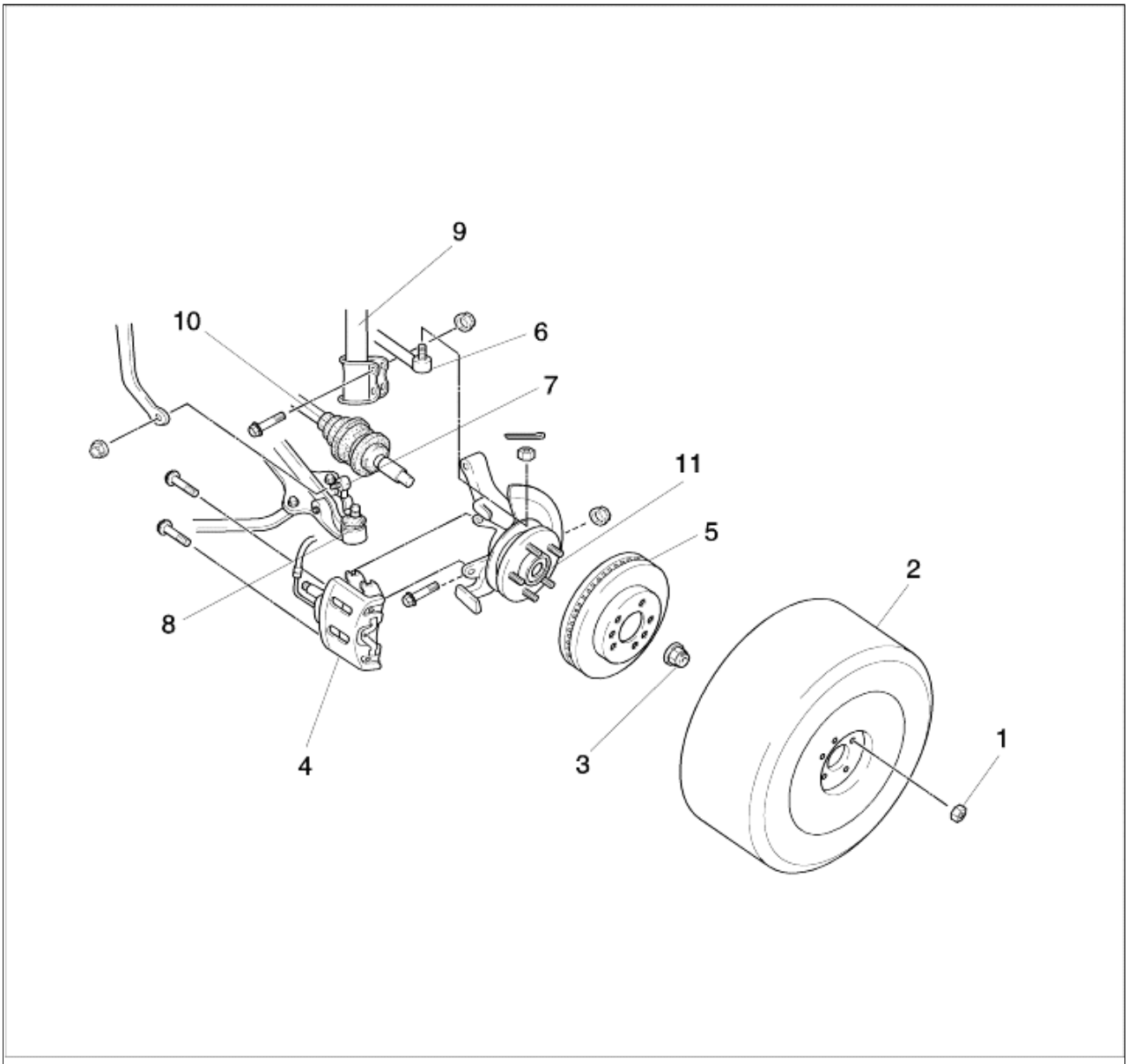
NOTE

1) Use a new oil seal, and apply grease to seal.
2) Install oil seal so that it is flush with knuckle.

7. Install new oil seal with SST(0K993 331 016).



Component

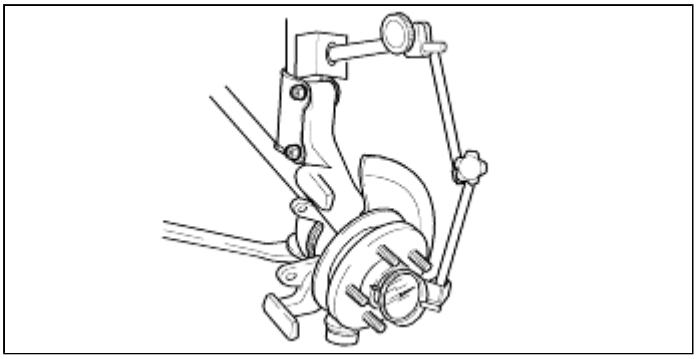


1. Wheel nuts
2. Wheel and tire
3. Lock nut
4. Brake caliper assembly
5. Disk plate
6. Tie rod end
7. Stabilizer control link
8. Lower arm ball joint
9. Suspension assembly
10. Driveshaft
11. Knuckle

On-vehicle services (wheel bearing play)

1. Raise vehicle and support it with safety stand.
2. Loosen and remove four wheel nuts.
3. Remove wheel and tire.
4. Loosen a lock nut and two disk plate screws.
5. Remove brake caliper assembly and disk plate.
6. Install a dial indicator on wheel hub and push and pull hub to measure bearing play. Replace the knuckle assembly if necessary.

Maximum wheel bearing play :0.002 in (0.05mm)



7. Install brake caliper assembly and disk plate.
8. Tighten a lock nut and two disk plate screws.

Tightening torque :Lock nut: 177~199 lb·ft(240~270 N·m, 24.5~27.5 kg·m)Rotor screw: 7~11 lb·ft(9.8~15 N·m, 1.0~1.5 kg·m)

9. Install wheel and tire.
10. Tighten four nuts.

Tightening torque :65~79 lb·ft (88~108 N·m, 9.0~11.0 kg·m)

11. Lower vehicle.

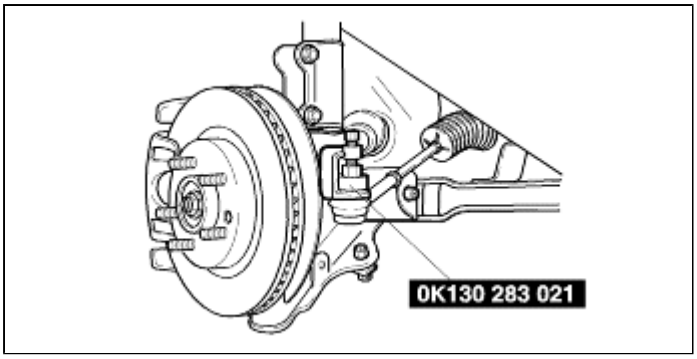
Removal

1. Raise vehicle and support it with safety stand.
2. Loosen four wheel nuts.
3. Remove wheel and tire.
4. Loosen a lock nut and two brake rotor screws.
5. Remove brake caliper assembly and disk plate.

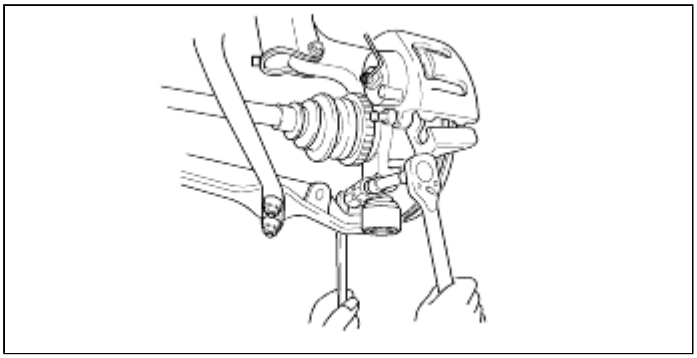
NOTE

Do not damage dust boot.

6. Loosen and remove nut and disconnect tie rod end with SST(0K130 283 021).



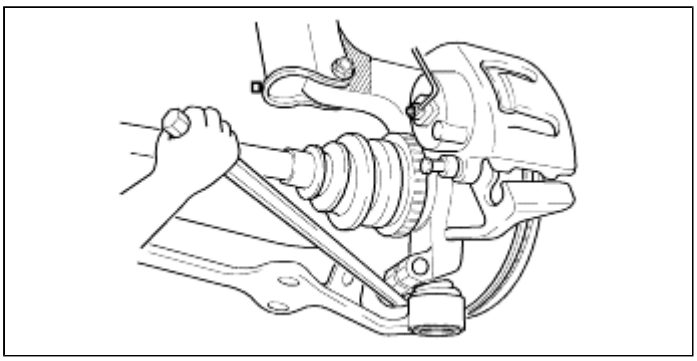
7. Disconnect stabilizer bar with control link on lower control arm.
8. Remove the lower arm ball joint bolt and nut from steering knuckle.



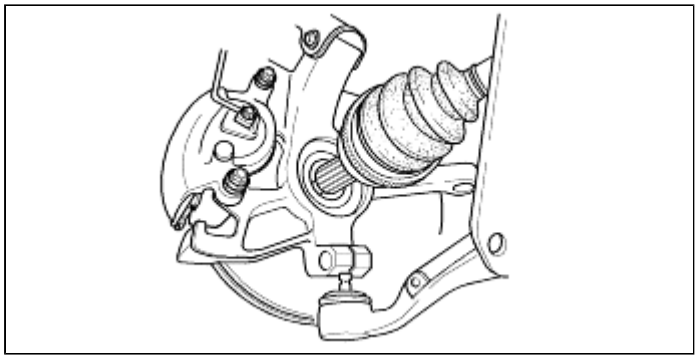
NOTE

Use caution when seperating lower arm from steering knuckle, so ball joint seal does not get cut.

9. Using a pry bar, seperate steering knuckle from lower arm.



10. Remove suspension assembly from steering knuckle.
11. Pull steering knuckle by hands to seperate steering knuckle and driveshaft.



12. Inspect all parts and repair or replace as necessary.

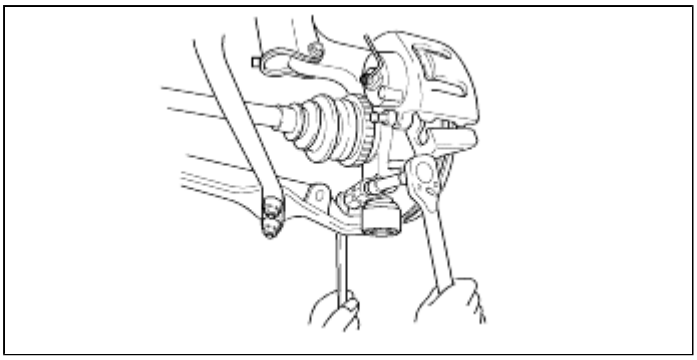
Replacement

1. Insert the end of the front wheel driveshaft into the knuckle.
2. Tighten two bolts after installing suspension assembly to knuckle.

   Tightening torque :88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

3. Connect ball joint of lower control arm to steering knuckle and tighten bolt and nut.

   Tightening torque :69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)

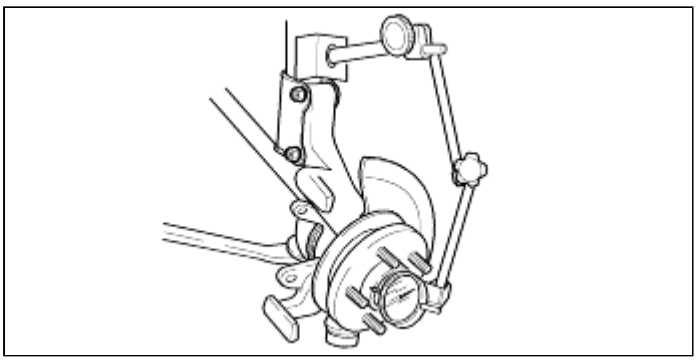


4. Install disk plate to wheel hub and tighten two disk plate screws.

   Tightening torque:7~11 lb·ft (10~15 N·m, 1.0~1.5 kg·m)

5. After installing disk plate to wheel hub, install a dial indicator on wheel hub and push and pull hub to measure bearing play and replace the wheel hub, if necessary.

   Maximum wheel bearing play :0.002 in (0.05 mm)



6. Install brake caliper assembly to steering knuckle and tighten two bolts.

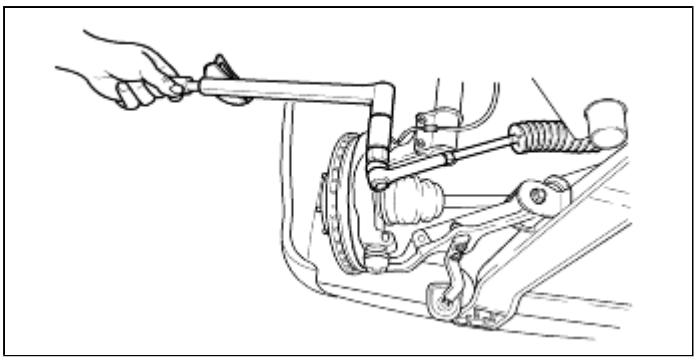
   Tightening torque :88~101 lb·ft (120~137 N·m, 12.2~14 kg·m)

   NOTE

   Do not damage dust boot.

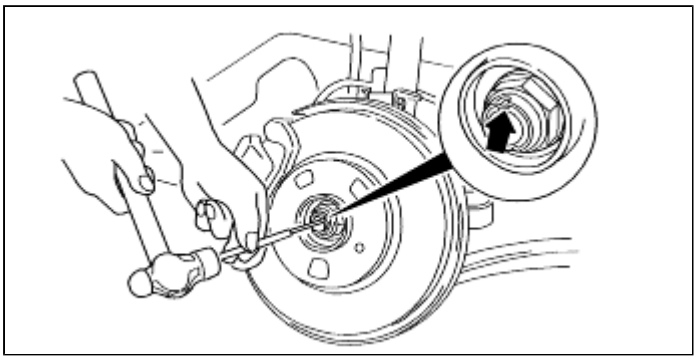
7. Install tie rod end to steering knuckle.
8. Install nut and secure it with a new cotter pin.

   Tightening torque :43~58 lb·ft (59~78 N·m, 6.0~8.0 kg·m)



9. Install a new lock nut and stake it, as shown.

Tightening torque :177~199 lb·ft (240~270 N·m, 24.5~27.5 kg·m)



10. Install wheel and tire.
11. Tighten four wheel nuts.

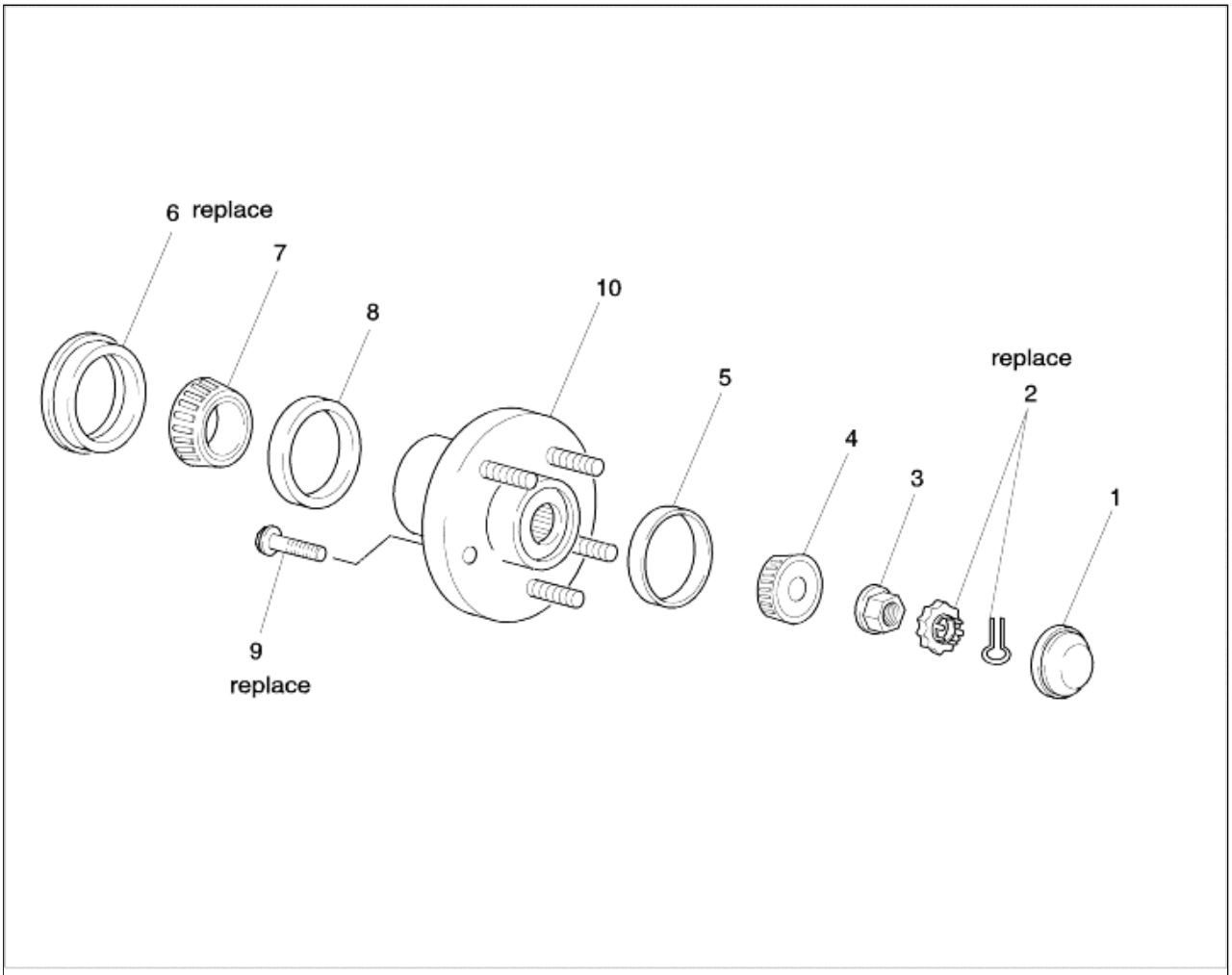
Tightening torque :65~79 lb·ft (88~108 N·m, 9.0~11.0 kg·m)

12. Install stabilizer nut loosely, and lower vehicle, then tight nut to specified torque.

Tightening torque :69~85 lb·ft (93~115 N·m, 9.5~11.7 kg·m)

13. After assembly, check front wheel alignment.

Component



1. Wheel hub cap
2. Cotter pin & cover set
3. Lock nut
4. Wheel bearing
5. Bearing outrace
6. Oil seal
7. Wheel bearing
8. Bearing outrace
9. Hub bolt
10. Hub bearing

Disassembly/Assembly

1. Disassemble rear wheel hub bearing in order shown on figure (Refer to disassembly note).
2. Assembly will be perform in the reverse order.

Disassemble note

Wheel hub bearing

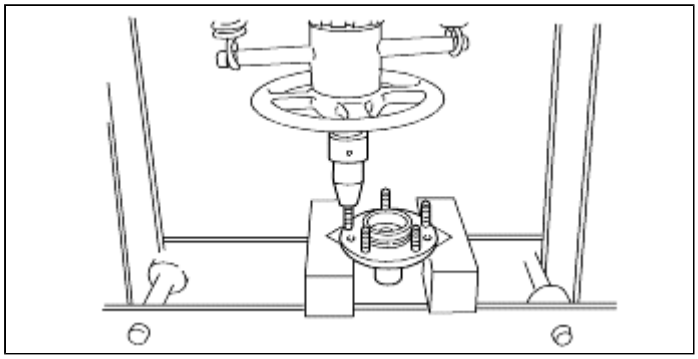
1. Disassemble hub bearing with SST(0K410 111 012).

Wheel hub bolt

NOTE

1) Do not disassemble wheel hub bolt if not necessary.
2) Do not reuse wheel hub bolt if disassembled.

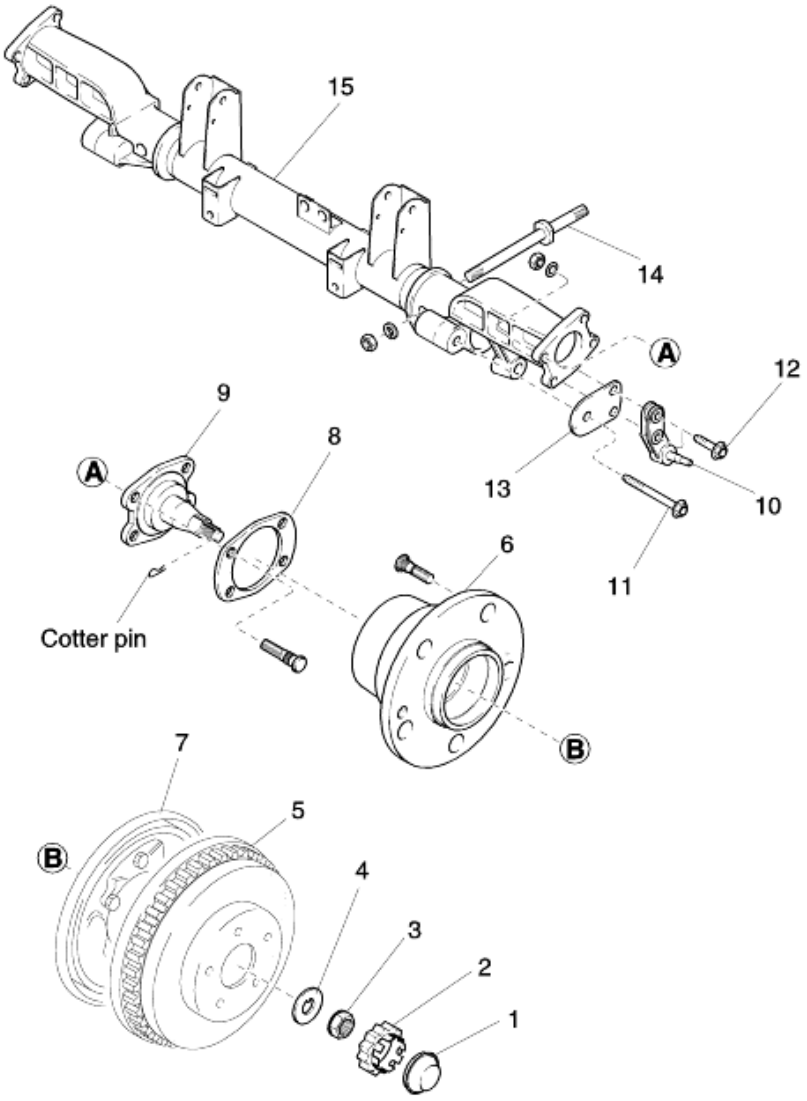
2. Remove wheel hub bolt with a press.



NOTE

Rear wheel hub press in either bolt turning or loosening by the torque of 108.5 lb·ft (147 N·m, 15 kg·m) shall not be permissible.

Component

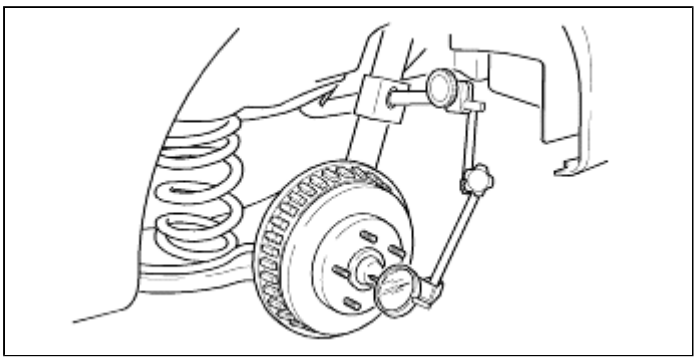


1. Hub cap
2. Cover set
3. Nut
4. Washer
5. Drum brake
6. Hub assembly
7. Rear drum brake & back plate
8. Plate retainer
9. Spindle
10. Shock absorber bolt
11. Lower arm bolt
12. Bolt
13. Lower arm bracket
14. Panhard bolt
15. Rear casting

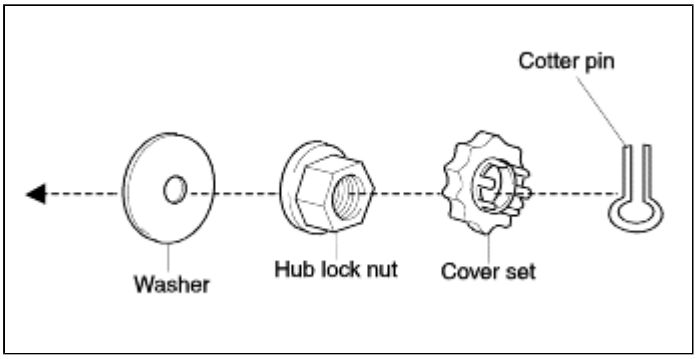
On-vehicle services (wheel bearing play)

1. Paise vehicle and support it with safety stand.
2. Loosen and remove four wheel nuts.
3. Remove wheel and tire.
4. Remove brake drum from rear brake after removing two brake drum screws.
5. Install a dial indicator on wheel hub and push and pull hub to measure bearing play.

Maximum wheel bearing play :0.001~0.006 in (0.025~0.152 mm)Run out: 0.002 in (0.05 mm)

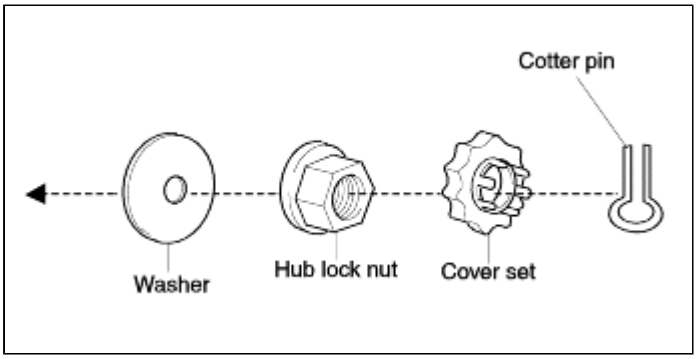


6. Adjust the wheel bearing play by tightening the lock nut.
7. Install cover set, and cotter pin on the end of spindle and wrap cotter pin prongs tightly.



Removal

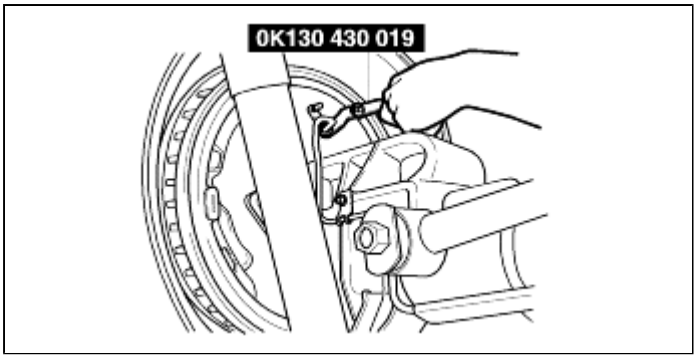
1. Raise vehicle and support it with safety stand.
2. Loosen and remove four wheel nuts.
3. Remove wheel and tire.
4. Remove two brake drum screws from wheel hub.
5. Remove hub cap, cotter pin, cover set, nut and washer from the end of the spindle.



6. Remove brake drum from rear brake assembly.
7. Remove hub assembly after loosening bolts from hub assembly.

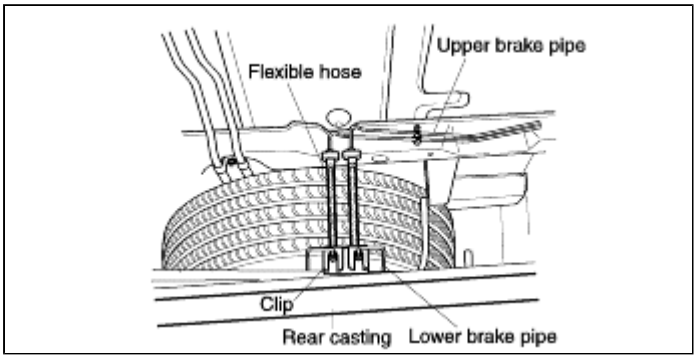
> NOTE
>
> After disconnecting brake line, plug it to prevent fluid leakage.

8. Disconnect brake line with SST(0K130 430 019).



9. Disconnect lower brake pipes and flexible hoses from the middle of rear casting after loosening the brake pipe nuts and then pulling out the flexible hose clips.

> NOTE
>
> After disconnecting lower brake pipes and flexible hoses, plug them to prevent fluid leakage.



10. Loosen the bolts from rear casting and remove plate retainer, back plate, and spindle.
11. Loosen the shock absorber bolts and nuts and remove the shock absorber from the rear casting.
12. Loosen the lower arm bolt and two bolts from rear casting and remove lower arm bracket and lower arm.
13. Loosen the upper arm bolt from the rear casting and remove the upper arm (Refer to section SS Gr.- Suspension).
14. Remove the stabilizer bracket and bolt in the middle of the rear casting.
15. Loosen the panhard bolt and remove the panhard.
16. Remove the rear casting.
17. Check all parts, and repair or replace if necessary.

Replacement

1. Install shock absorber to rear casting and tighten nut (Refer to section SSGr.- Suspension).

Tightening torque :99~116 lb·ft (134~157 N·m, 13.7~16 kg·m)

2. Install two upper arm to rear casting with bolt and nut and then tighten nut.

Tightening torque:55~69 lb·ft (74~93 N·m, 7.6~9.5 kg·m)

3. Install lower arm to rear casting and tighten lower arm bolt and nut.

   Tightening torque:87~101 lb·ft (118~137 N·m, 12~14 kg·m)

4. Tighten two stabilizer brackets and bolts to rear casting (Refer to section SSGr.- Suspension).

   Tightening torque:32~40 lb·ft (43~54 N·m, 4.4~5.5 kg·m)

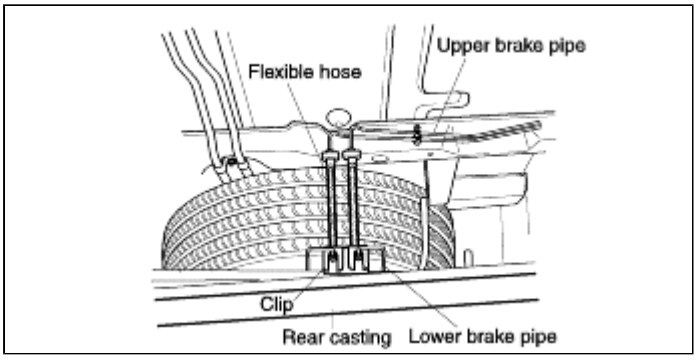
5. Install panhard rod and washer and then tighten the panhard rod nut.

   Tightening torque:99~116 lb·ft (134~157 N·m, 13.7~16 kg·m)

6. Install spindle, retainer plate, and back plate and tighten the bolts.

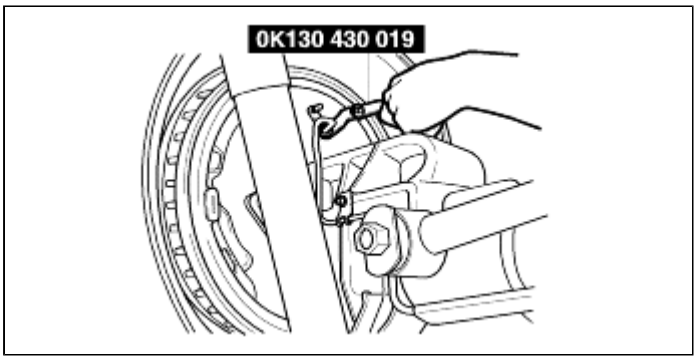
   Tightening torque:65~79 lb·ft (80~108 N·m, 9.0~11.0 kg·m)

7. Connect lower brake pipes and flexible hoses and fix the flexible hoses clips to the braket of rear casting.



8. Tighten brake line with SST(0K130 430 019).

   Tightening torque:9~13 lb·ft (13~18 N·m, 1.3~1.8 kg·m)

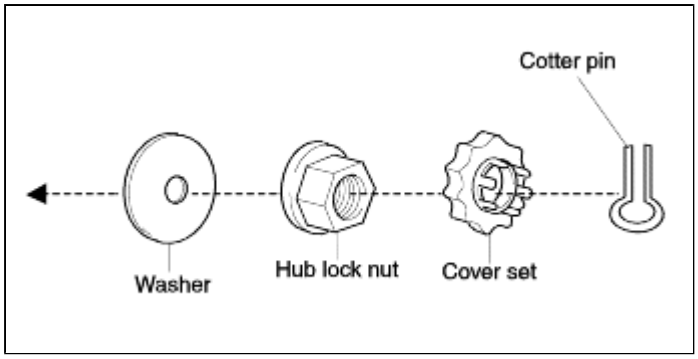


9. Install rear wheel hub assembly.
10. Put brake drum into rear wheel hub assembly and tighten two screws.

    Tightening torque:7~11 lb·ft (9.8~15 N·m, 1.0~1.5 kg·m)

11. Install washer, nut, cover set, and new cotter pin on the end of the spindle and wrap cotter pin prongs tightly around cover set.

    Tightening torque :177~198 lb·ft (240~270 N·m, 24.5~27 kg·m)



12. Install hubcap, wheel and tire.
13. Install and tighten four wheel nuts.
14. Bleed brake system.

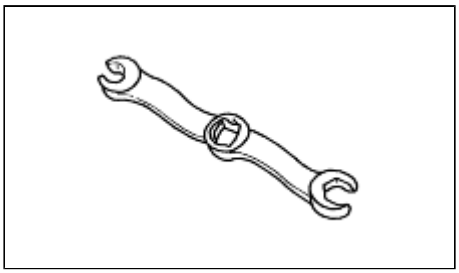
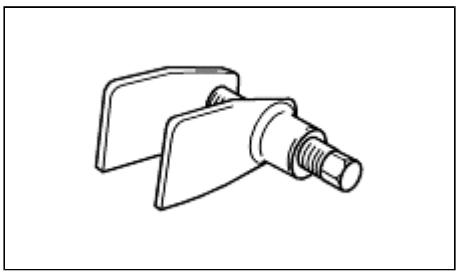
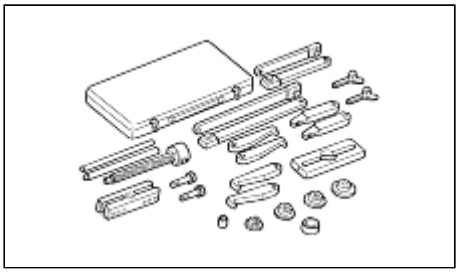
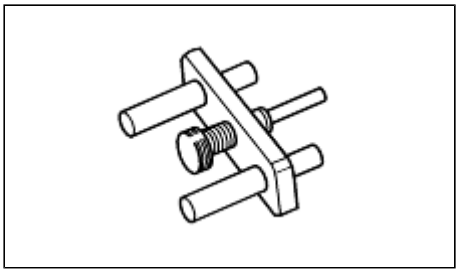
    Tightening torque:65~79 lb·ft (88~108 N·m, 9.0~11.0 kg·m)

15. Lower vehicle.

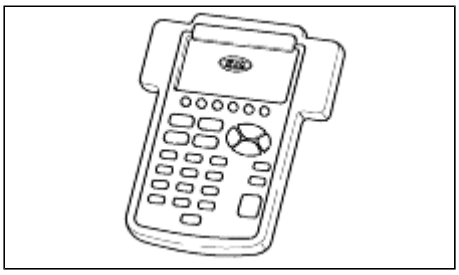
brake system

special service tools

Brake System

Tool (Number and name)	Illustration	Use
0K130 430 019 Flare nut wrench		Used to remove and install brake pipe.
0K130 430 017 Disk brake expander		Used to assemble disc pad.
0K670 990 AA0 Bearing installer set		Used to remove sensor rotor.
0K9A4 430 001 Adjustment gauge		Used to adjust push rod gap.

Anti-Lock Brake System

Tool (Nunber and name)	Illustration	Use
0K2CA 089 HSP Hi-scan pro		Used to diagnose anti-lock brake system.

Description and operation

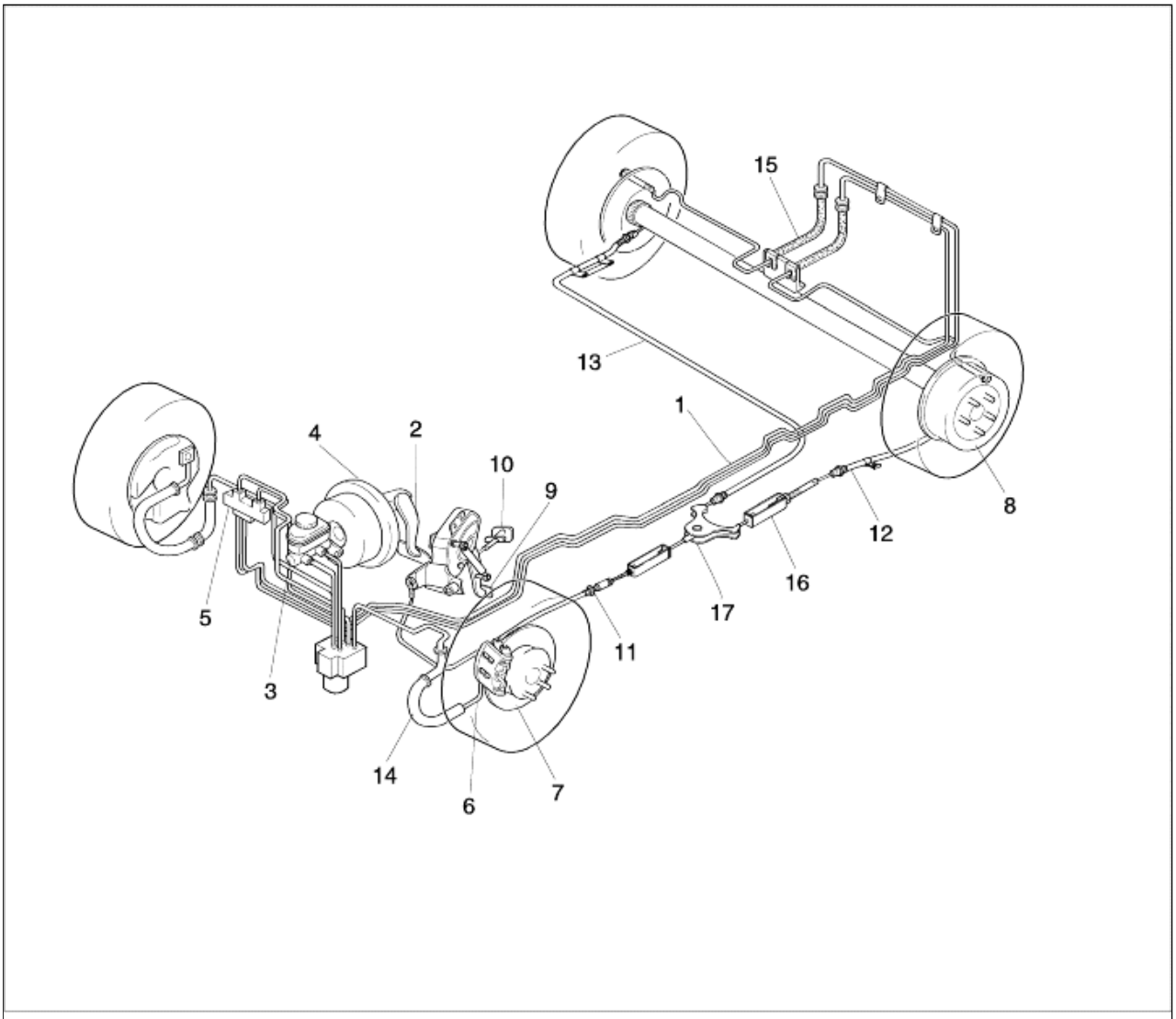
Front disc brake

The front disc brake system consists of a double piston, brake disc rotor, a floating front disc brake caliper assembly, shoes and linings. The front disc brake caliper is mounted directly to the steering knuckle, using boots, sleeves, and 2 sleeve bolts which thread directly into the steering knuckle. The sleeve bolts, sleeves and sleeve boots control the side to side movement of the caliper. The piston seal is designed to assist in maintaining the proper brake shoe to rotor clearance. All the front brake forces generated during braking of the vehicle are taken up directly by the steering knuckles of vehicle. The molded rubber dust boots mount in a counter bore of the cylinder bore opening and in a groove which is machined in the outer surface of the piston. This prevents contamination of the piston and the bore area. As lining wears, reservoir level will go down. If fluid has been added, reservoir overflow may occur when the piston is pushed back into the new lining position. Overflowing can be avoided by removing a small amount of fluid from the master cylinder reservoir.

Rear drum brake

The rear wheel drum brakes are two shoes, internal expanding type with an automatic adjust screw. The automatic adjuster screw is actuated each time the brakes are applied. The automatic adjuster screw is located directly below the wheel cylinder.

Structural view



1. Brake hydraulic line
2. Brake pedal
3. Master cylinder
4. Master vacuum
5. Joint pipe
6. Caliper (front)
7. Disc plate (front)
8. Rear drum brake
9. Parking brake pedal
10. Parking brake release lever
11. Parking brake front cable
12. Parking brake rear cable(LH)
13. Parking brake rear cable(RH)
14. Front flexible hose
15. Rear flexible hose
16. Adjuster
17. Equalizer

Symptom-related diagnostic procedure

Troubleshooting guide

Problem	Possible cause	Action
Poor braking	Leakage of brake fluid Air in system Worn pad or lining Brake fluid, grease, oil or water on pad or lining Hardening of pad or lining surface or poor contact Malfunction of disc brake piston Malfunction of master cylinder or wheel cylinder Malfunction of master vacuum unit Malfunction of check valve (vacuum hose) Damaged vacuum hose Deterioration of flexible hose Low engine vacuum Malfunction of dual proportioning valve	Repair Bleed air Replace Clean or replace Grind or replace Replace Repair or replace Replace Replace Replace Replace Repair or replace Replace
Brakes pull to one side	Worn pad or lining Brake fluid, grease, oil or water on pad or lining Hardening of pad or lining surface or poor contact Abnormal wear or distortion of disc, drum, pad, or lining Malfunction of automatic adjuster Loose backing plate/dust cover mounting bolts Malfunction of wheel cylinder Improperly adjusted wheel alignment Unequal tire air pressures	Replace Clean or replace Grind or replace Repair or replace Repair or replace Tighten Repair or replace Adjust Adjust
Brakes do not release	No brake pedal free play Improperly adjusted push rod clearance Clogged master cylinder return port Contaminated brake fluid Weak brake pad or shoe return spring Wheel cylinder not returning properly Malfunctioning piston seal on disc brake Incorrect shoe position	Adjust Adjust Clean Clean or replace Replace Clean or replace Replace Clean or replace
Excessive pedal travel (too much pedal stroke)	Improperly adjusted pedal play Worn pad or lining Air in pipes Damaged master cylinder Contaminated brake fluid Damaged vacuum hose Low engine vacuum	Adjust Replace Bleed air Replace Replace Replace Repair
Abnormal noise or vibration during braking	Worn pad or lining Deteriorated pad or lining Brakes do not release Foreign material or scratches on disc plate or drum contact surface Loose backing plate/dust cover or caliper mounting bolts Damaged disc or drum contact surface Poor contact of pad or lining Insufficient grease on sliding parts	Replace Grind or replace Refer to above problem Clean Tighten Replace Repair or replace Grease Replace

	Too much disc thickness variation	
Steering wheel pulls to one side	Dragging brake Malfunction of steering system Damaged or unbalanced wheel(s) Incorrect tire pressure Malfunction of suspension	Repair Refer to section ST Gr. Refer to section SS Gr. Refer to section SS Gr. Refer to section SS Gr.
Rear brakes do not release	No parking cable play Weak return spring Malfunction of wheel cylinder piston Distortion of parking cable Malfunction of auto adjuster	Adjust Replace Replace Repair or replace Repair or replace

specifications

Items			Specifications
General	System		MGH-20
	Type		4-Sensors and 4-Channels
	Mode		ABS+EBD
HCU	Type		Diagonal Split
	Hydraulic control method		Hold/ Rise/ Dump (3Mode)
	Type of pump		Radial pistons (2 pistons)
	Type of motor		4-pole DC motor
ECU	Operation voltage		DC 10~ 16V
	Operation temperature		-40 ~ 110°C
ABS sensor	Type		Electromagnetic induction
	Resistance		1275~1495Ω
	Air gap	Front	0.0079~0.048 in (0.2~1.2 mm)
		Rear	0.0039~0.048 in (0.1~1.2 mm)

specifications

Item		Specification
Brake pedal	Type	Suspended
	Pedal lever ratio	4.0
	Maximum stroke in (mm)	5.51 (140)
Master cylinder	Type	Tandem (with level sensor)
	Cylinder inner diameter in (mm)	ø1.0 (ø25.4)
Front disc brake	Type	Anchor disc
	Cylinder bore in (mm)	2 x ø1.81 (2 x ø46)
	Pad dimension (area x thickness) in² x in (mm² x mm)	9.998 x 0.41 (6,450 x 10.5)
	Disc plate dimension (outer diameter x thickness) in (mm)	10.866 x 1.02 (276 x 26) * 10.787 x 1.1 (274 x 28)
Rear drum brake	Type	Leading-trailing
	Cylinder inner diameter in (mm)	ø0.81 (ø20.64):CBS, ø0.88 (ø22.22):ABS
	Lining dimension (area x thickness) in² x in (mm² x mm)	41.68 x 0.17 (26,900 x 4.5) * 49.69 x 0.21 (32,060 x 5.5)
	Drum inner diameter in (mm)	ø10 (ø254), * ø11.6 (ø295)
	Shoe clearance adjustment	Incremental auto adjustment
Power brake unit	Type	Tandem vacuum booster
	Outer diameter in (mm)	8+9 (203+229)
Brake fluid	Type	FMVSS 116 : DOT-3, SAE J1703, DOT-4
Parking brake	Type	Mechanical
	Operating system	Foot lever
	Lever ratio	6.2
Brake force control system (Without ABS)	Type	LS PV (Load sensing proportioning valve)

* The VIN of application (KNTUP 131246552190~)

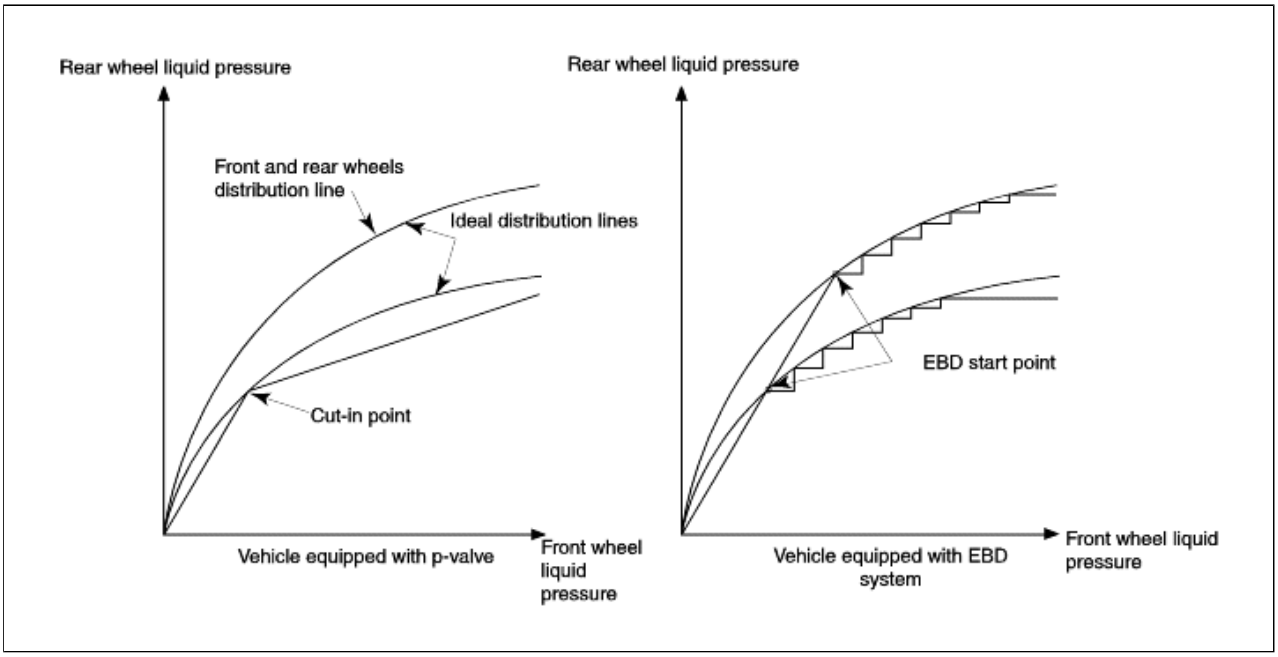
VIN : Vehicle Identification Number

Necessary

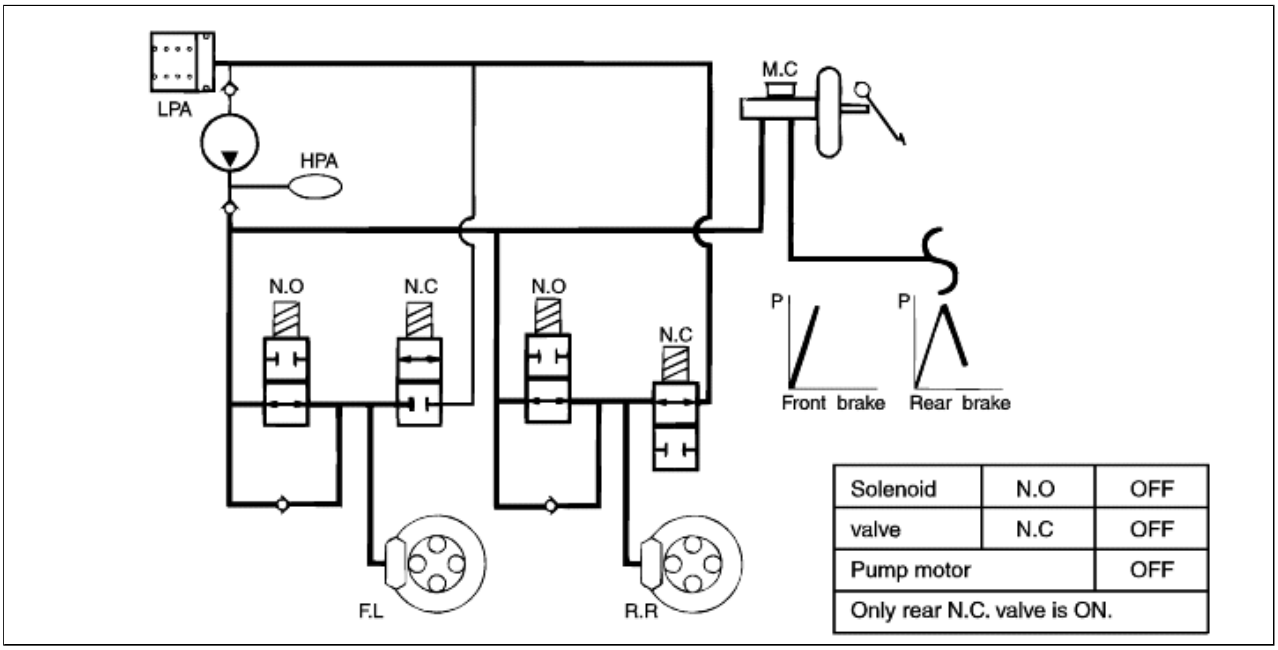
1. Because accident can arise due to generation of spin in vehicle by preceding locking of rear wheel to front wheel owing to drift of vehicle weight at time of sudden braking during running, the preceding locking of rear wheel has been prevented by decreasing the braking pressure of rear wheel in comparison with front wheel, having furnished with P-valve(proportioning valve-passenger car) or LCRV,LSPV (load conscious reducing valve, load sensing proportioning valve-small business car) as a countermeasure to that problem.
2. But these are all mechanical equipments and did not realize ideal rear brake force distribution.
3. Especially, though LCRV and LSPV applied in small business cars distributed rear brake force according to vehicle load to a certain degree, P-valve applied in passenger cars could not perform brake force distribution to weight increase, so inferiority in brake force has been viewed as problem.
4. And the required liquid pressure distribution curves for ideal braking differ by respective wheels according as the brake forces generated at respective wheels differ from one another depending on friction material dispersion in brake lining and pad; but ideal braking could not be achieved as only a certain constant liquid pressure distribution curve is maintained if only with mechanical P-valve, LCRV or LSPV.
5. Driver cannot know symptom at trouble time of P-valve, LCRV,LSPV etc ; and vehicle body spin may arise at time of sudden braking during period of faulty trouble.
6. Wherefore ABS ECU controls so that rear wheel may be locked at same time of later than front wheel to solve the above problem matters, which is called EBD(electronic brake-force distribution) control.

Principle

1. The principle is approximate control of brake force near the required liquid pressure distribution curve(ideal braking distribution curve)by way of adding a logic to ABS ECU instead of the existing P-valve.
2. Rear liquid pressure is controlled so that rear slip ratio will always be less than or same as that of front, having calculated the slip ratio from each wheel speed sensor at braking time.
3. Therefore rear wheel locking does not precede that of front wheel.
4. Consequently brake force improves as rear brake liquid pressure can be enlarged in amount of parts of as shown by deceleration liquid pressure in the figure below.
5. And eventually whole brake force improvement is realized as brake force can be controlled by liquid pressure distribution curves required of wheel according to friction material dispersion.



EBD operation



1. Just before rear wheel is locked precedingly to front wheel, ABS ECU lets NC valve of wheel side about to be locked be ON (OPEN) so that the brake oil pressure of wheel about to be locked be decreased and the locking be prevented.
2. If the wheel rotates as brake force is decreased, ABS ECU again lets NC valve be OFF(CLOSE) so that the brake pressure applied at MC be transmitted to clipper.
3. Motor pump does not act at this time.

Effect

1. Brake distance is decreased as rear brake force is enhanced in comparison with existing P-valve.
2. Stability is secured at time of rotating braking because as right and left rear wheel liquid pressures may be controlled independently from each other.
3. Brake pedal force decreases.
4. Stable braking effect can be achieved bacause front brake pad abrasion and temperature rise etc. are decreased as braking effect of rear brake is increased at braking time.
5. P-valve can be eliminated.

EBD type

Category	Vehicle equipped with EBD system
General performance Comparison	Ideal rear brake force distribution is feasible because control of pressure much greater than 30 bars at sudden braking time is feasible under condition of heavyvehicle (five persons boarded) and high speed.
At time of failure	When it is transferred to ordinary brake but please drive slowly becausegeneration of spin is worried because there is no P-valve. Abstain from behavior of taking a sudden brake; go to maintenance center at once to take measures.

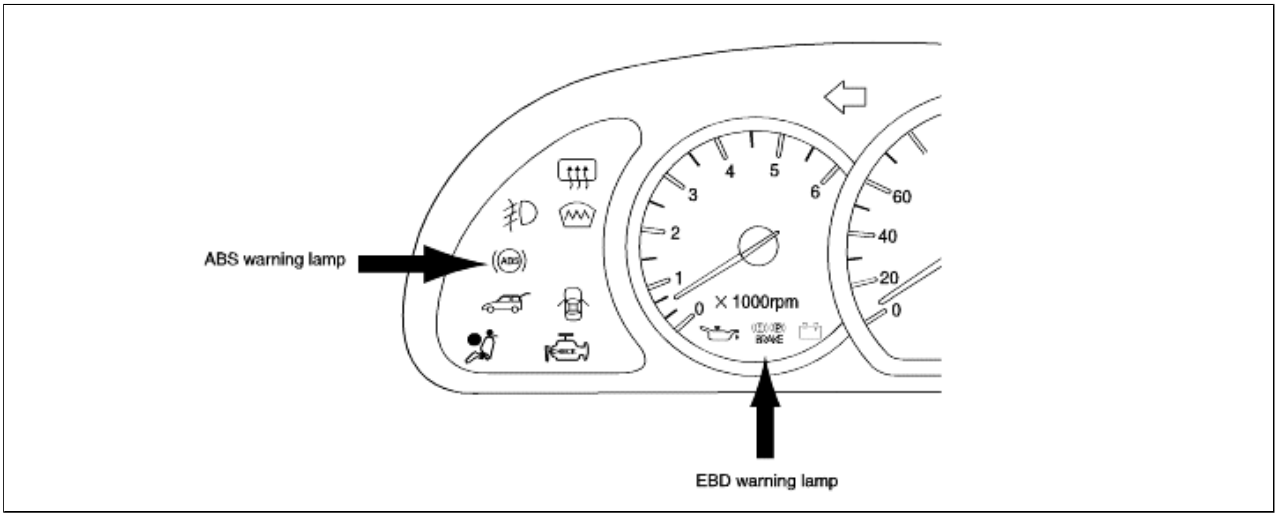
Safety

1. Failure trouble ratio decreases than with ABS because EBD continues to control even in the following cases among ABS failure causes.
   (1) One wheel speed sensor failure.
   (2) Motor pump failure.
   (3) Failure by low voltage of battery.
2. Though there is no alarm instrument for P-valve by which driver may always be informed so that drive cannot know whether or not of failure trouble, in which case body spin may be generated if taken a sudden braking under condition of failure situation; in case of EBD failure trouble, the existing parking brake lamp is lighted to alarm EBD failure situation to driver so that driver can repair.
3. EBD fail-safe.

	System		Warning lamp	

Cause of system failure	ABS	EBD	ABS	EBD
None	operate	operate	OFF	OFF
1 Sensor failure	does not operate	operate	ON	OFF
Pump failure	does not operate	operate	ON	OFF
Low voltage of battery	does not operate	operate	ON	OFF
Failure of Plural sensors Valve failure ECU failure Other failures	does not operate	does not operate	ON	ON

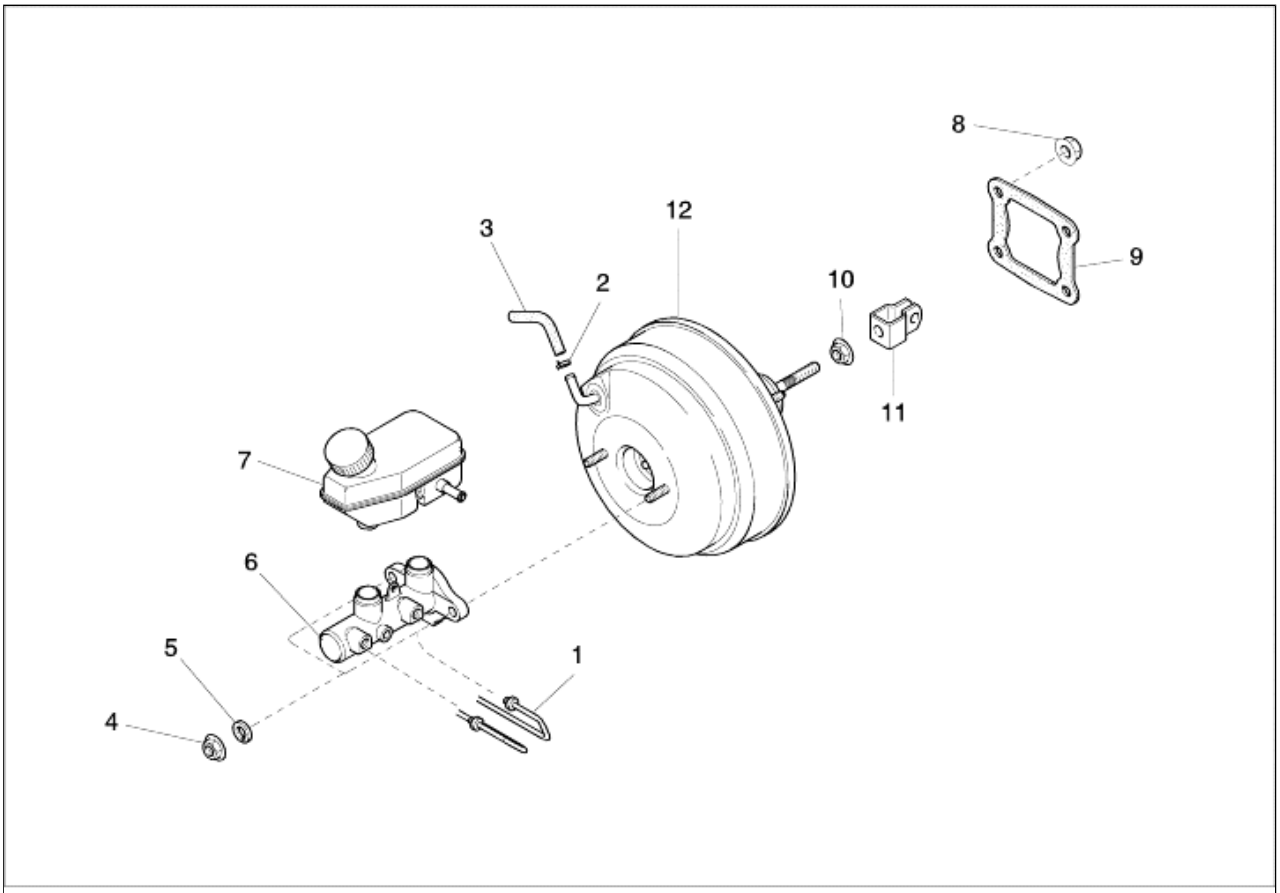
WARNING LAMP



1. ABS warning lamp.
   (1) It is turned on for three seconds at time of ON of ignition Key and turns off afterwards.
   (2) It is extinguished at start of operation.
   (3) It is lighted if system abnormality arise.
   (4) It is lighted during self-diagnosis.
   (5) During its lighting, ABS control is interrupted and only ordinary brake operates in same way as ABS-noninstalled vehicle.
   (6) It is lighted when ECU connector is removed.

2. EBD(electronic brake-force distribution) warning lamp.
   (1) It is lighted at time of ON of ignition Key.
   (2) It is extinguished at start of operation.
   (3) It is lighted when parking brake switch is ON.
   (4) It is lighted when brake oil is deficient.
   (5) It is lighted when EBD control is infeasible.
      1) When there is trouble at solenoid valve.
      2) When there is trouble in more than one sensor.
      3) When there is trouble in ECU.
      4) In case of high voltage.

COMPONENT



1. Brake pipe
2. Clip
3. Vacuum hose
4. Nut
5. Lock washer
6. Master cylinder
7. Reserve tank
8. Nut
9. Packing
10. Nut
11. Fork
12. Brake booster

Removal

1. Remove a battery.
2. Disconnector the master cylinder electrical connector.

> CAUTION
>
> Before removing the brake pipes and reserve tank from master cylinder.
> Be sure they are clean to prevent dirt particles from entering the brake hydraulicsystem.

3. Loosen the brake pipe flare nuts and disconnect the brake pipe from the brake master cylinder.
4. On manual transaxle vehicles, remove the clamp and pull the clutch master cylinder hose from the master cylinder reserve tank.
5. Cap the brake pipe and the brake master cylinder ports.
6. Remove two nuts and lock washers and remove the master cylinder.
7. Loosen the vacuum hose clamp and remove the vacuum booster hose from the powerbrake booster.
8. From inside vehicle, remove the pin and discard it.
9. Remove the clevis pin.
10. Remove the four power brake booster nuts.
11. Remove the power brake booster.
12. Remove the power brake booster gasket and discard it.

Replacement

> CAUTION
>
> When replacing the master cylinder on a vehicle, a new vacuum seal must beinstalled on the master cylinder. Use only procedure detailed below for installingthe vacuum seal onto the master cylinder.

1. Install a new gasket onto the power brake booster studs.
2. Have an assistant position the power brake booster.
3. From inside vehicle, install four nuts.
   Tighten the power brake booster nuts.

   Tightening torque:14~19 lb·ft (19~26 N·m, 1.9~2.6 kg·m)

4. Lubricate the clevis pin with grease and install it.
5. Install a new pin.
6. Position the vacuum booster hose to the power brake booster and install the vacuum hose clamp.
7. Position the brake master cylinder and install the two nuts.

   Tightening torque:7.2~11.5 lb·ft (10~16 N·m, 1.0~1.6 kg·m)

8. On manual transaxle vehicle, position the clutch master cylinder and install the clamp.
9. Uncap the brake pipes and the brake master cylinder ports.

> CAUTION
>
> When installing the primary and secondary brake pipes on master cylinder, be sure brake pipe do not contact any other components within the vehicle and that there is slack in the flexible sections of the pipes. This is required due to the movement between the ABS hydraulic control module(HCU) and the

master cylinder, when the vehicle is in motion.

10. Connect the brake pipes to the brake master cylinder and tighten the brakepipe flare nuts.

    Tightening torque:9~16 lb·ft (13~21 N·m, 1.3~2.2 kg·m)

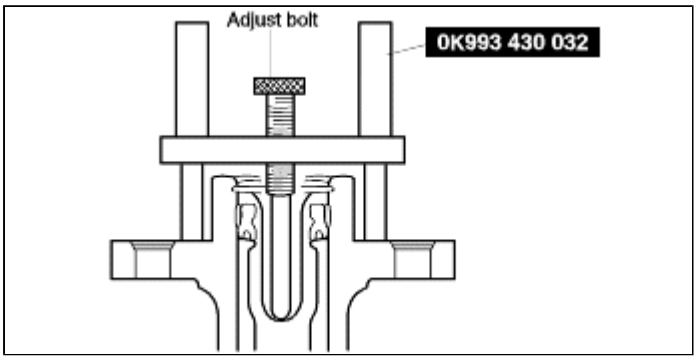
11. Connect the brake master cylinder connector.
12. Installa battery.
13. Bleed the brake system.

Inspection

Master cylinder

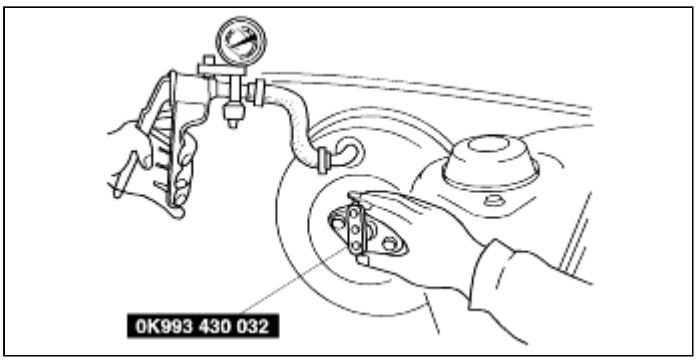
1. Measure a clearance between a push rod of power brake booster and a mastercylinder piston by using the SST(0K993 430 032).

   Clearance: 0 in (0 mm)



2. If the clearance is out of the specification, a push rod will be turned to adjust the clearance.

Vacuum pressure inHg (mmHg)	Clearance between push rod and piston in(mm)
0 (0)	0.016~0.024 (0.4~0.6)
19.7 (500)	0.0039~0.016 (0.1~0.4)



Brake fluid level sensor

1. Check for a continuity by using an ohmmeter when the fluid level is below Min.

Load sensing proportioning valve (LSPV)-without abs

Description

1. LSPV is installed between a master cylinder and a rear wheel brake to vary the fluid pressure on the rear wheel brake.
2. Install the valve on the frame and connect it to the rear axle by using a spring. The distance between the valve and rear axle will be varied by the loading condition. This distance difference will reveal as a different spring length, and it will make the valve working.

Inspection

Step 1.

1. Check whether the rear brake applied earlier than the front brake when the vehicle is empty and stops suddenly.
2. Check the brake works effectively enough when empty vehicle, full loading, and moving backward.
3. Check the brake works effectively when the vehicle moves straight forward and with full loading.

Step 2.

1. If there is a problem with step 1, check the pressure of LSPV.
2. The pressure can be checked by using a pressure gage for both input and output.
3. The measuring condition will be Empty vehicle + One passenger.
4. Stop the engine and set the vacuum of power brake unit to 0. (Depress the brake pedal 10 times).

Step 3

1. Disconnect the outlet pipe joint of LSPV, and install a pressure gage 9810 kPa (100 kg/cm², 1422 psi) at there.
2. Disconnect the front brake pipe from the master cylinder, and install a pressure gage.
3. Bleed the air from the brake system.
4. Depress the brake pedal until the master cylinder pressure equal to A, then record rear brake pressure A'.
5. Depress the brake pedal again, and apply additional pressure until the pressure equal to B, then record pressure B'.

> CAUTION
>
> If the pressure exceeds the specification, replace the LSPV.

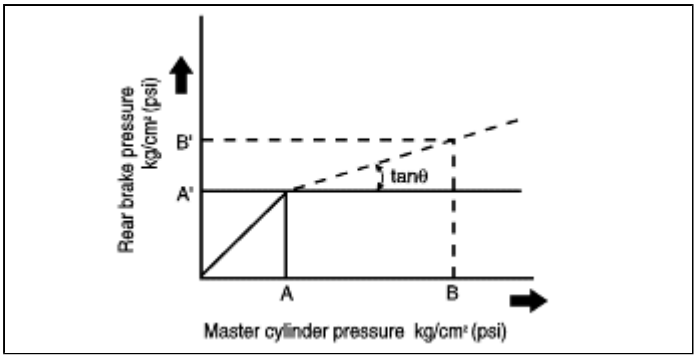
Specification (Dynamic condition)

Item	Slop (tanΘ)	Split point
L.L.V.W	0.25	35 bar
G.V.W	0.25	80 bar

Unit : kg/cm² (psi)

Master cylinder output pressure		Rear brake pressure
L.L.V.W	A: 35.69 (507.6)	A': 35.69 (507.6)
	B: 71.38 (1015.3)	B': 44.61 (634.5)
G.V.W	A: 81.58 (1160.3)	A': 81.58 (1160.3)
	B: 91.77 (1305.3)	B': 84.13 (1196.6)

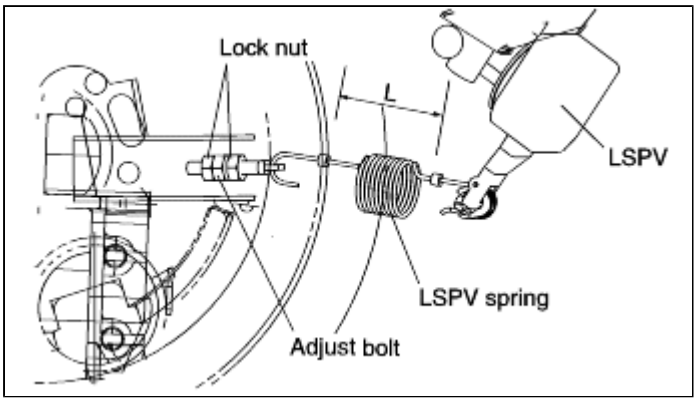
L.L.V.W : Light Load Vehicle Weight
G.V.W : Gross Vehicle Weight



Adjustment

1. Empty vehicle + One passenger.
2. Place the vehicle on a leveled ground.
3. Loosen the lock nut and turn the adjust bolt to adjust the spring length "L" to the specifications.

L = 90 mm (3.54 in)

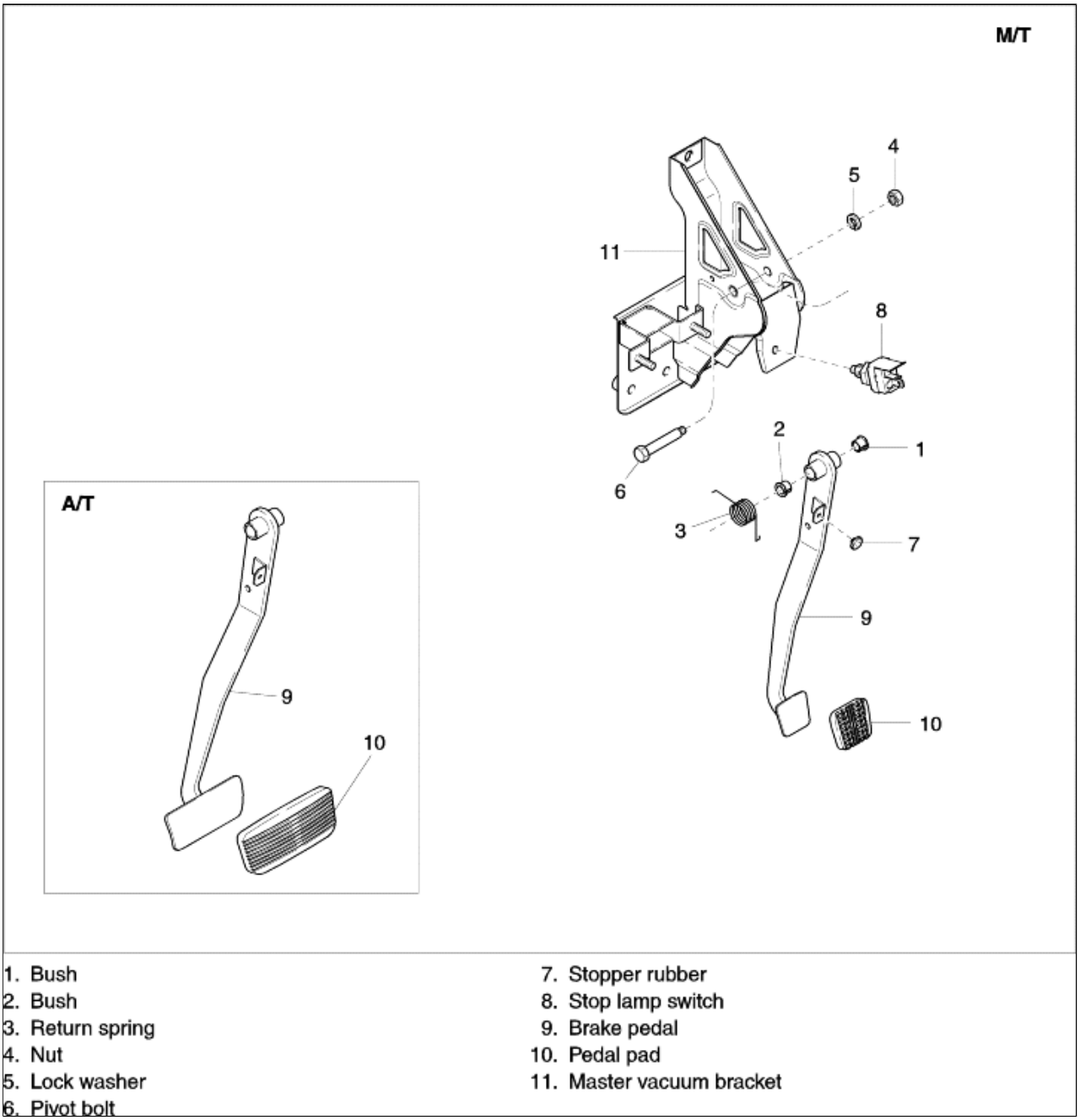


CAUTION

Make sure of the mounting direction of spring.

Brake pedal

Component



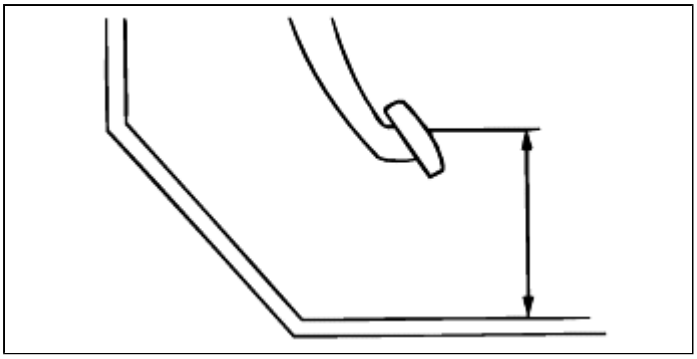
1. Bush
2. Bush
3. Return spring
4. Nut
5. Lock washer
6. Pivot bolt
7. Stopper rubber
8. Stop lamp switch
9. Brake pedal
10. Pedal pad
11. Master vacuum bracket

Brake pedal height

Inspection

Check whether the distance from the center of pedal pad upper side to the floor pannel in the specification.

Pedal height: 7.29 ± 0.12 in (185.2 ± 3 mm)



Adjustment

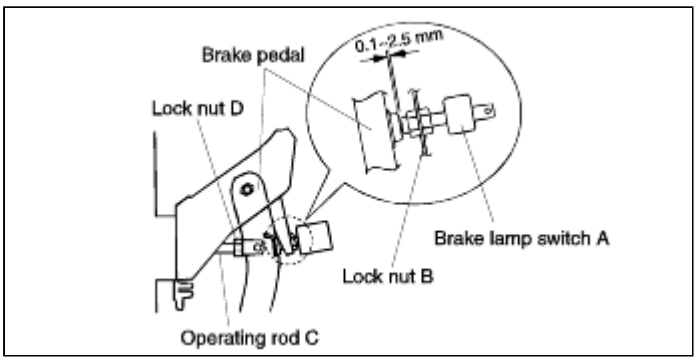
1. Disconnect brake lamp switch connector.
2. Loosen the lock nut B, and turn the switch A counterclockwise until it no longer contacts the brake pedal.
3. Loosen the lock nut D, and adjust the pedal height by turning a push rod C.

   Pedal free play: 0.16~0.31 in (5~8 mm)

4. Tighten the operating rod lock nut D after adjusting pedal free play.
5. Turn the switch A till the white rod of the switch appears about 0.1~2.5mm and tighten lock nut B.

   Tightening torque:10~13 lb·ft (14~18 N·m, 1.4~1.8 kg·m)

6. Connect the brake lamp switch connector.

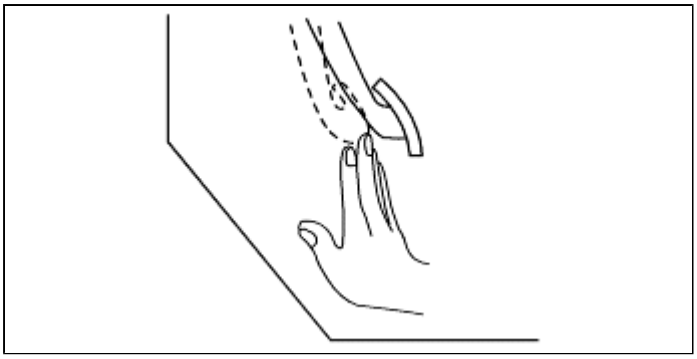


Pedal free play

Inspection

1. Depress the pedal serval times to eliminate the vacuum in the system.
2. Remove a spring clip, and check that the holes on a fork and a pedal are aligned,then assemble the clip again.
3. Check the pedal free play by depressing the pedal lightly with hand.

   Pedal free play: 0.16~0.31 in (5~8 mm)



Adjustment

1. Adjust the pedal free play as the method of adjustment of the brake pedal height.

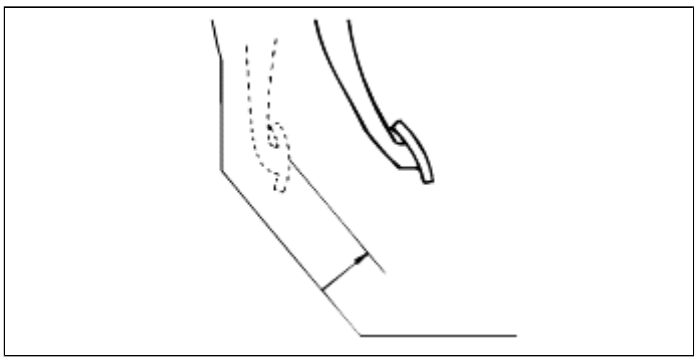
Pedal-to-floor clearance

Inspection

1. Start the engine, and check that the clearance from a dash pannel to a center of pedal pad upper side is in the specification when the pedal is depressed with 589 N (132 lb, 60 kg).

Pedal-to-floor distance: 1.02 in (26 mm)

2. If the clearance is less than the specification, following points have tobe tested.
   (1) Air insertion in the inside of brake system
   (2) Wearness of pads
   (3) Excessive clearance of shoe
   (4) Failed auto adjust
   (5) Leakage of master cylinder



Removal

1. Disconnect the stop lamp switch connector.
2. Remove the nut and washer from the pedal through pivot bolt.
3. Slide out the brake pedal through bolt.
4. Remove the brake pedal return spring from the brake pedal.
5. Remove the brake pedal.
6. Remove the brake pedal bushings from the brake pedal.
7. Remove the stopper rubber from the brake pedal.

Replacement

1. Lubricate the brake pedal bushings and install them to the brake pedal.
2. Position the brake pedal and slide the brake pedal through bolt into place.

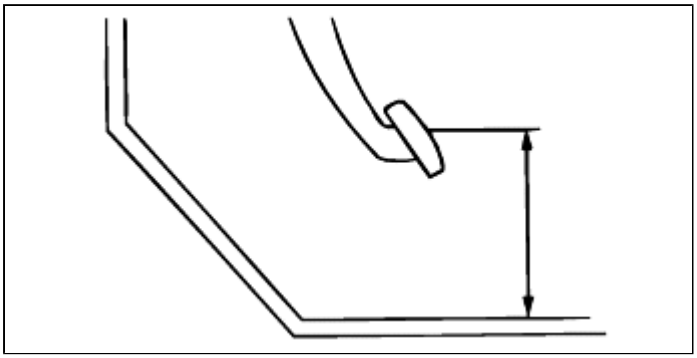
3. Install the nut and washer onto the brake pedal through bolt.
4. Install the brake pedal return spring.
5. Connect the stop lamp switch connector.

Brake pedal height

Inspection

Check whether the distance from the center of pedal pad upper side to the floor pannel in the specification.

Pedal height: 7.29 ± 0.12 in (185.2 ± 3 mm)



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2. Loosen the lock nut B, and turn the switch A counterclockwise until it no longer contacts the brake pedal.
3. Loosen the lock nut D, and adjust the pedal height by turning a push rod C.

   Pedal free play: 0.16~0.31 in (5~8 mm)

4. Tighten the operating rod lock nut D after adjusting pedal free play.
5. Turn the switch A till the white rod of the switch appears about 0.1~2.5mm and tighten lock nut B.

   Tightening torque:10~13 lb·ft (14~18 N·m, 1.4~1.8 kg·m)

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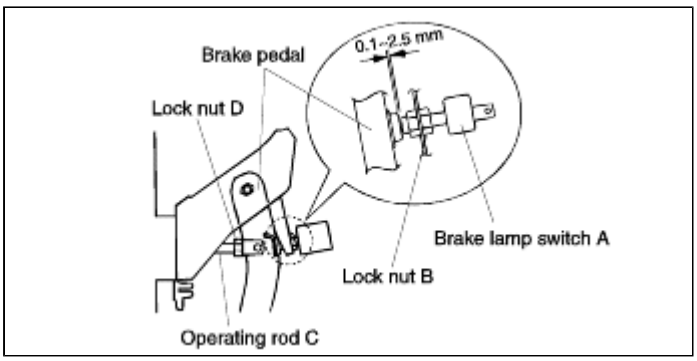

Pedal free play

Inspection

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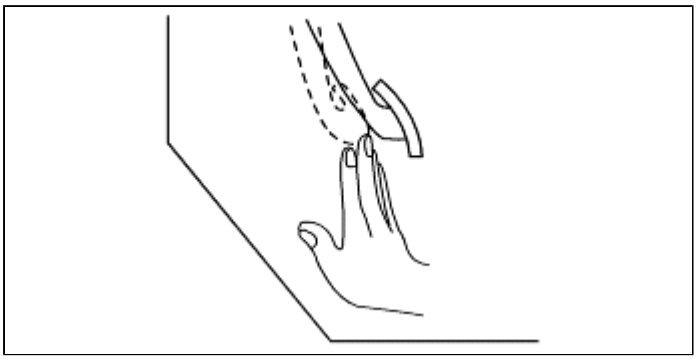

Adjustment

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Pedal-to-floor clearance

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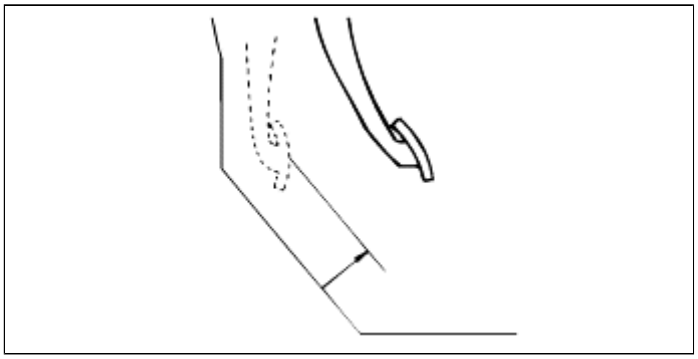
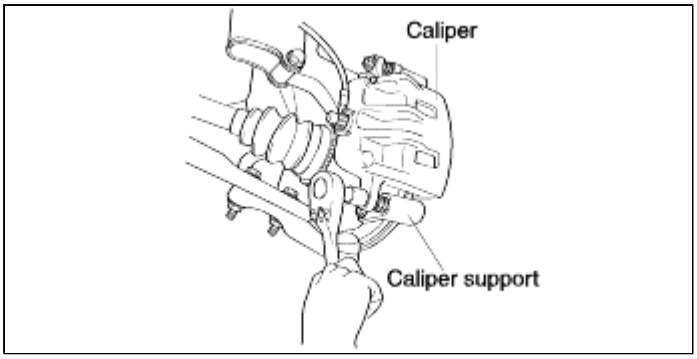


Removal

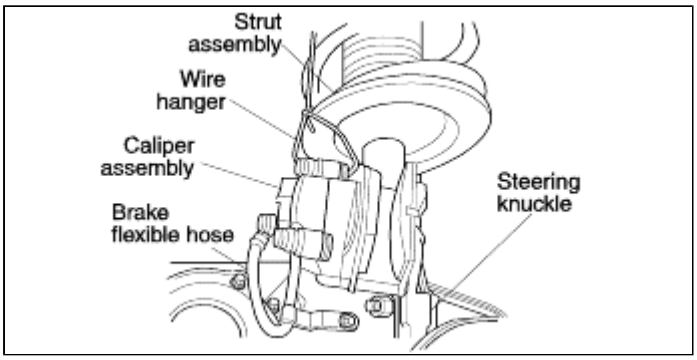
1. Raise and support vehicle.
2. Remove front wheel and tire assemblies.

> **CAUTION**
>
> During service procedures, grease or any other foreign material must be kept off brake shoe assemblies, and braking surfaces of brake drum and external surfaces of hub/bearing assembly.

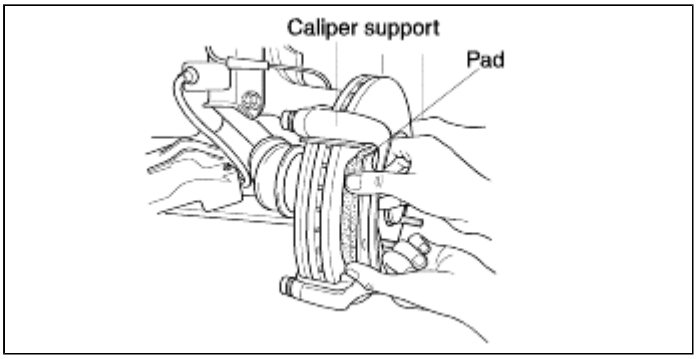
3. Loosen the two caliper mounting bolts from the caliper support.



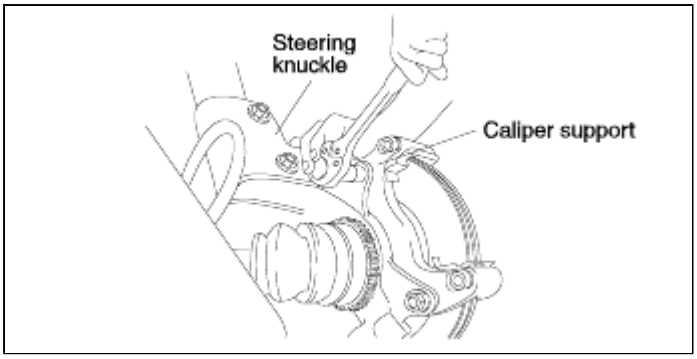
4. Remove caliper from caliper support.
5. Support caliper firmly to prevent weight of caliper from being supported by the brake fluid flexible hose. Supporting weight of caliper by the brake fluid flexible hose, can damage the flexible brake hose.



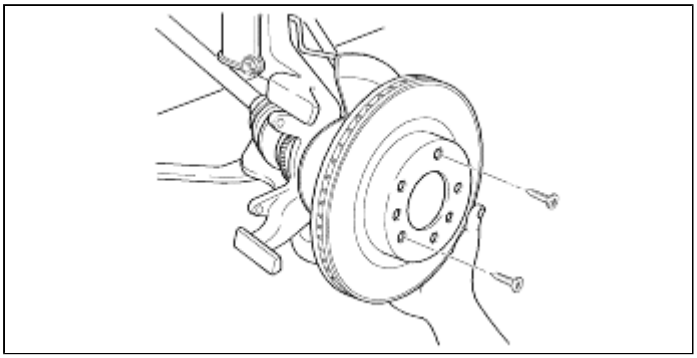
6. Remove the pad assembly from the caliper support.



7. Loosen the two caliper support mounting bolts and remove the caliper support from the steering knuckle.



8. Loosen the two disc plate screws from the front hub assembly. Then pull the disc plate out from the front hub assembly.



Replacement

NOTE

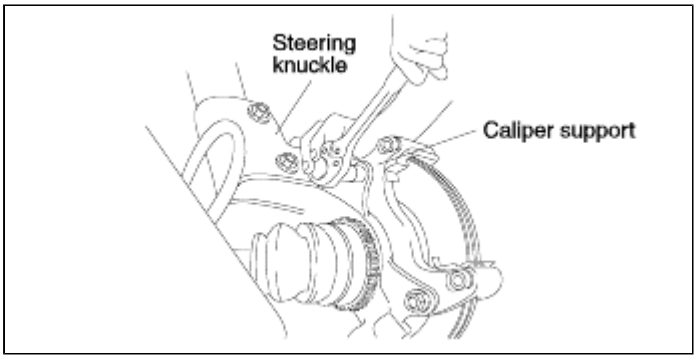
Perform the following steps after the replacement.
1) Fill the fluid and bleed air.
2) Check the leakage of fluid.
3) Depress the brake pedal several times, and check that the brake does not haveany friction when the wheel is turned by hand.

1. Install the disc plate to the front hub assembly before tightening the two disc plate screws.

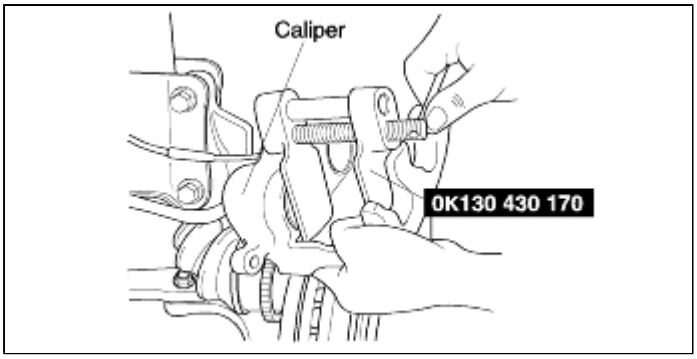
Tightening torque:7~11 lb·ft (10~15 N·m, 1.0~1.5 kg·m)

2. Install the caliper support to the steering knuckle and tighten the caliper support mounting bolts.

Tightening torque:72.33 ~ 94.03lb.ft (98 ~ 127.5 N.m , 10 ~ 13 kg.m)

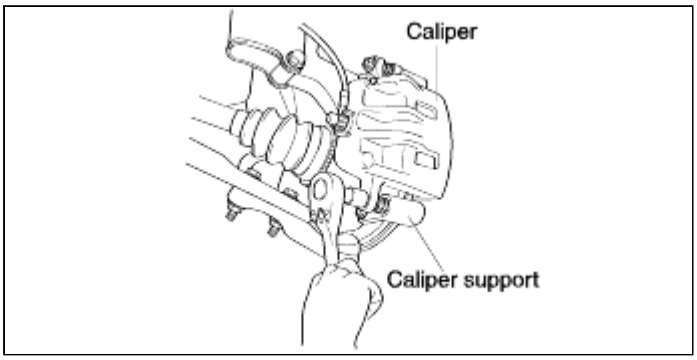


3. Install the pad assembly to the caliper support.
4. Expand the piston using SST (0K130 430 017) and install the caliper into calipersupport.



5. Tighten the caliper mounting bolts.

Tightening torque:15.9 ~ 23.1 lb.ft (21.57 ~ 31.38 N.m , 2.2 ~ 3.2 kg.m)



CAUTION

Use care when installing the caliper assembly onto the steering knuckle, so the seals on the caliper bushings do not get damaged by the steering knuckle bosses.

6. Install wheel and tires.
7. Tighten hub nuts.

Tightening torque:65~79 lb·ft (88~108 N·m, 9.0~11.0 kg·m)

8. Before moving vehicle, pump the brake pedal several times to insure vehicle has a firm brake pedal.

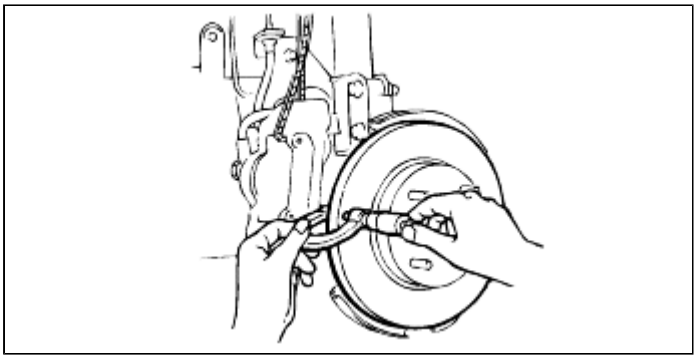
Inspection

Disc plate

1. Measure thickness of disc plate.

Standard: 1.02 in (26 mm), * 1.10 in.(28 mm)Minimum: 0.94 in (24 mm), * 1.02 in.(26 mm)

* The VIN of application (KNTUP 131246552190~)

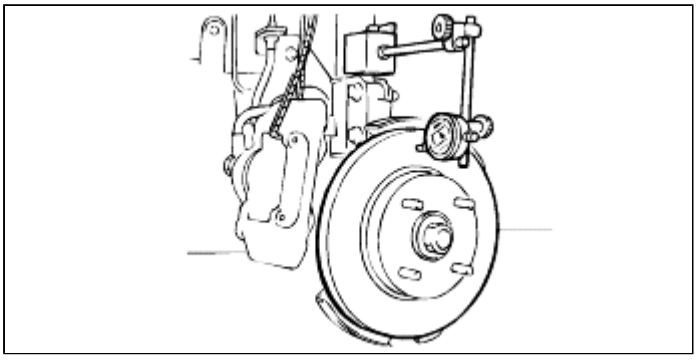


2. Measure runout at 0.47~0.63 in (12~16 mm) inside from outer edge of contact surface of disc pad.

Runout: 0.002 in (0.05 mm) Max.

CAUTION

1) There must be no wheel bearing looseness.
2) Measurement location is outer edge of disc plate surface.

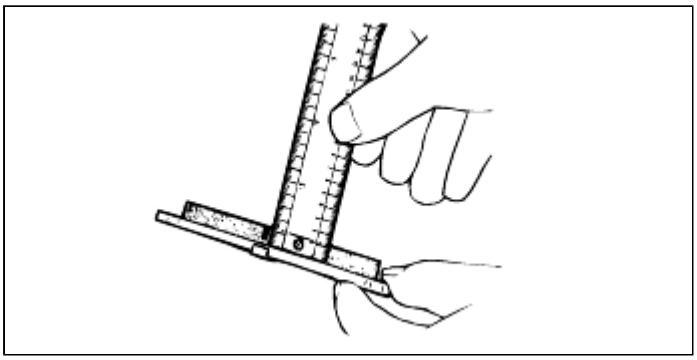


Disc brake pad

1. Check facing for oil or grease abnormal wear, cracks, and deterioration or damage from heat. Measure thickness of lining.

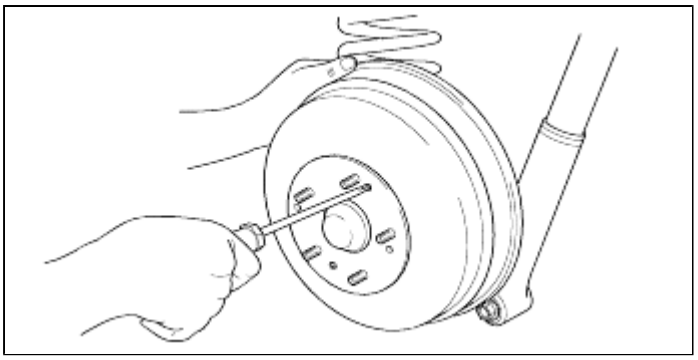
Specified thickness: 0.41 in (10.5 mm)Minimum: 0.1 in (2.5 mm)

2. Visually check for damage or wear on the guide plate.

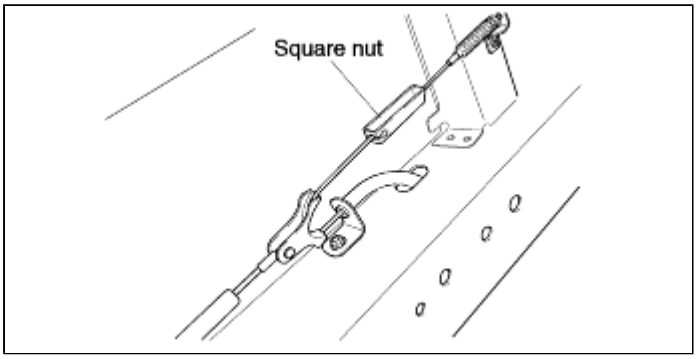


Removal

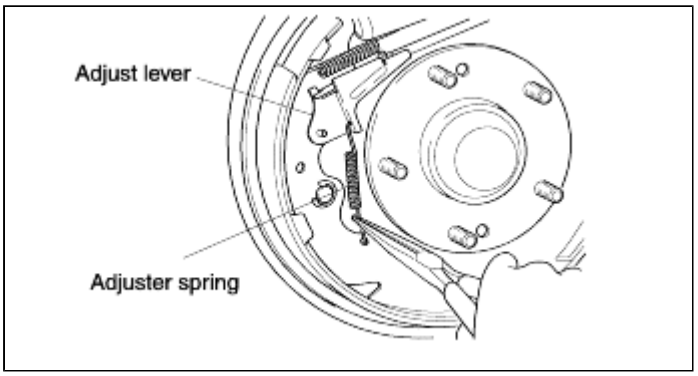
1. Remove rear wheel and tire assembly from vehicle.
2. Remove rear brake drums from hub and bearing assemblies after loosening the two brake drum screws.



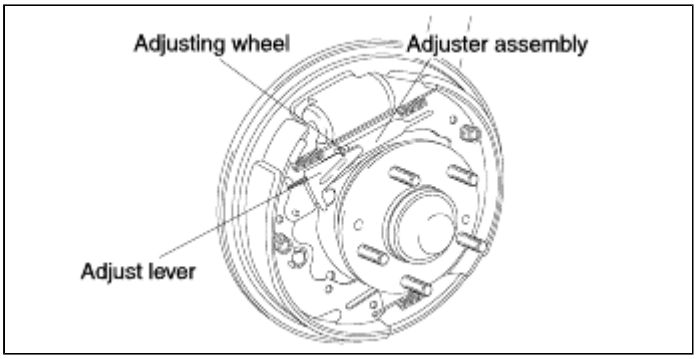
3. Be sure that the parking brake pedal is in the release(most upward) position.
4. Completely loosen square nut of the rear parking brake cable. Then create slack in the rear parking brake cables.



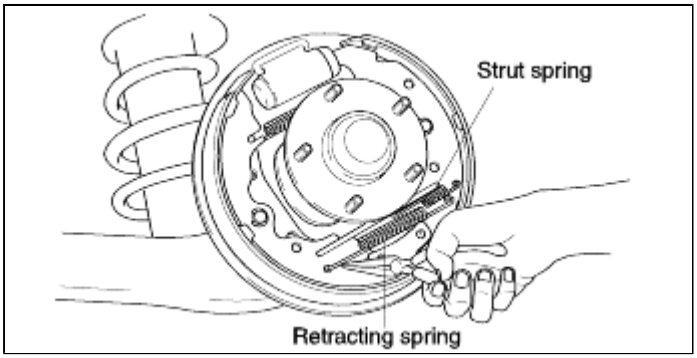
5. Remove adjuster spring from adjust lever and brake shoe.



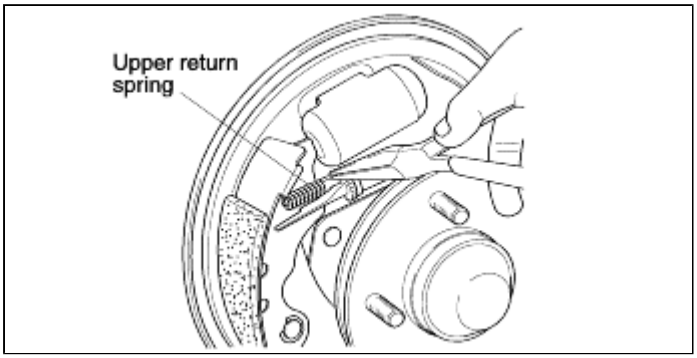
6. Remove adjust lever and turn the adjusting wheel of adjuster assembly to the direction of the arrow as shown.



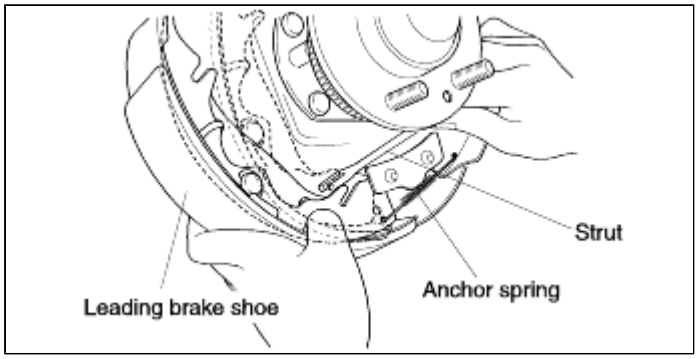
7. Remove the strut spring and the lower retracting spring from the brake shoe.



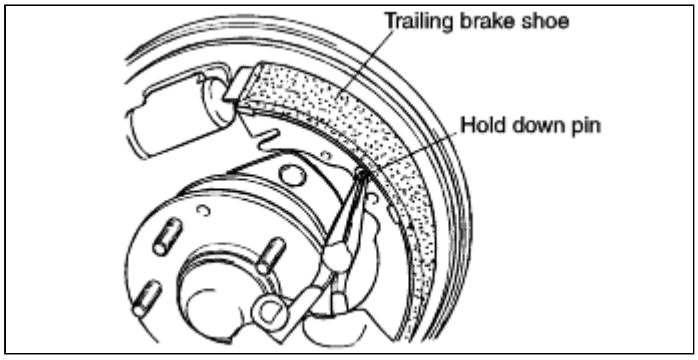
8. Remove the upper return spring from the brake shoe.



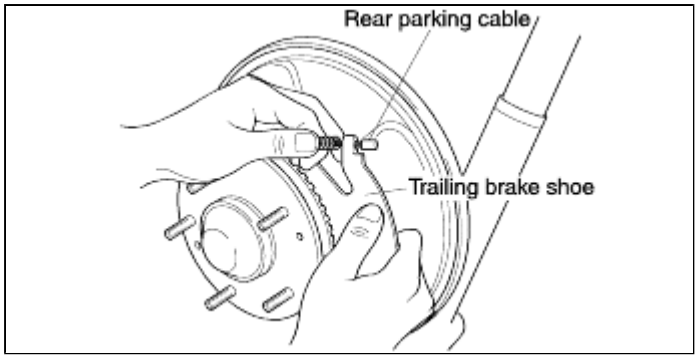
9. Remove brake back plate hold down spring and pin from the leading brake shoe assembly.
10. Remove the leading brake shoe. Then remove the adjuster assembly, strut and anchor spring from the trailing brake shoe.



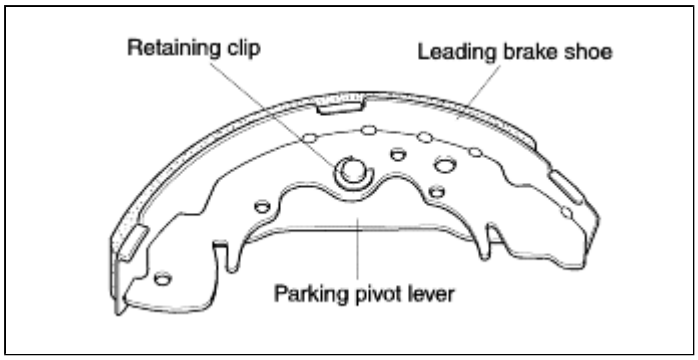
11. Remove the trailing brake shoe from the brake back plate after removing hold down spring and pin.



12. Remove the trailing brake shoe from the rear parking cable.

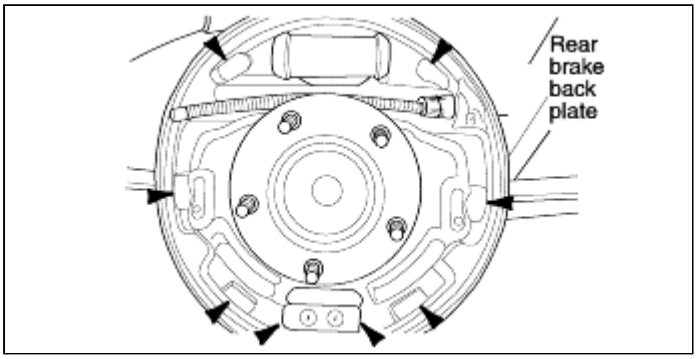


13. Remove parking pivot lever from the leading brake shoe.

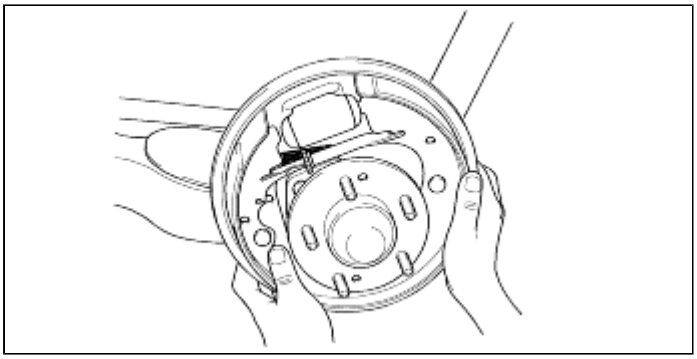


Replacement

1. Lubricate the eight shoe contact areas on the back plate and anchor.

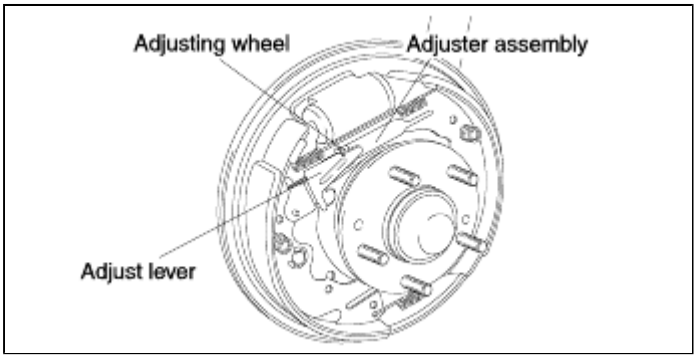


2. Install the trailing brake shoe to the rear parking cable.
3. Install trailing brake shoe on brake back plate and install the trailing brake shoe hold down spring and pin on the brake shoe.
4. Tighten the square nut of rear parking cable.
5. Install the anchor spring then install adjuster assembly, and strut.
6. Install leading brake shoe on brake back plate.

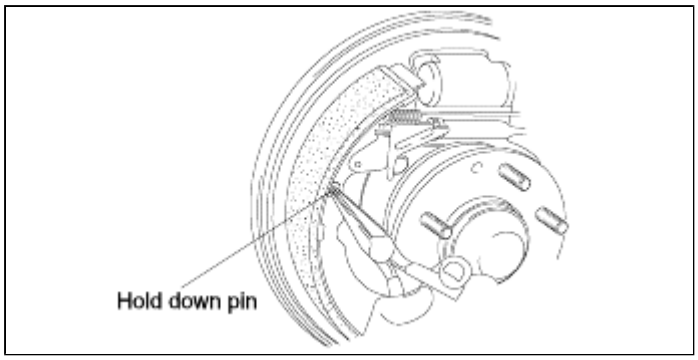


7. Install the brake shoe upper return spring, strut spring and the lower retracting spring to the brake shoe.

8. Properly rotate the adjusting wheel of adjuster assembly to the direction of the arrow in as shown.



9. Install the adjuster spring on the adjust lever and leading brake shoe assembly.
10. Install the leading brake shoe hold down spring and pin on the brake shoe.



11. Adjust brake shoes assemblies so as not to interfere with brake drum installation.
12. Install the rear brake drums on the hubs.
13. Check and adjust whether the pedal stroke in the specification.(Refer to section BR Gr./On-vehicle service/Pedal stroke of parking brake)
14. Install wheel and tire.
15. Push the parking brake pedal to the floor once and release pedal. This will automatically remove the slack from and correctly adjust the parking brake cables.
16. Test the vehiche on the road. The adjust will continue the brake adjustment during the road test of vehicle.

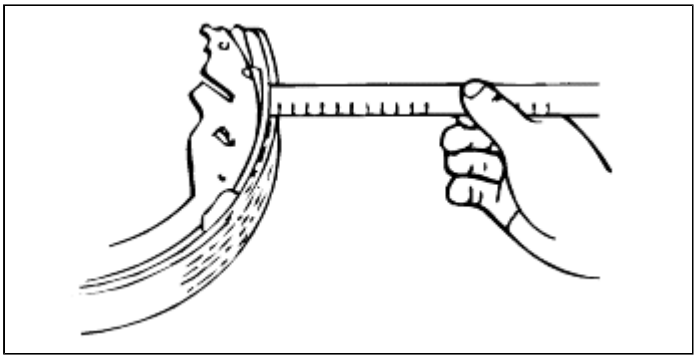
Inspection

1. Inspect the disassembled parts for wear, rust or damage.
2. Measure the thickness of brake shoe lining.

Standard : 0.17 in (4.5 mm), * 0.21 in.(5.5 mm)Minimum : 0.04 in (1 mm)

* The VIN of application (KNTUP 131246552190~)

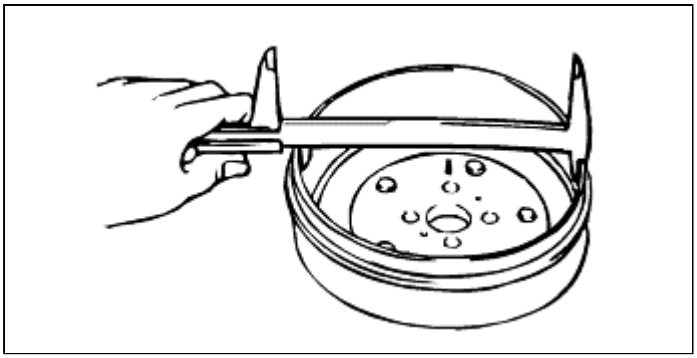
3. If the shoe lining is less than minimum or shows signs of uneven wear, replace new one.



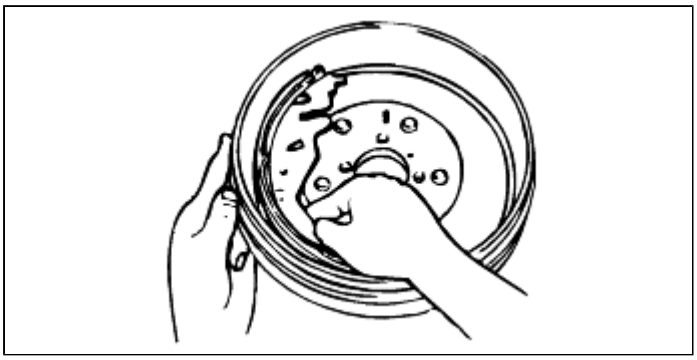
4. Measure the inside diameter of the brake drum.

Standard : 10 in (254 mm), * 11.6 in.(295 mm)Maximum : 10.07 in (256 mm), * 11.7 in.(297 mm)

* The VIN of application (KNTUP 131246552190~)



5. If the inside diameter of the brake drum is more than maximum or shows signs of uneven wear, replace new one.
6. Inspect the lining and drum for proper contact. If the contact condition is improper, repair it with a grinder or replace the brake shoe assembly.



Air bleeding (CBS)

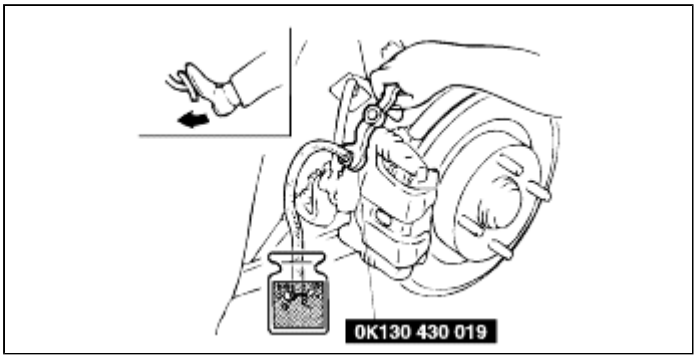
1. Jack up vehicle and support it with safety stands.

> **CAUTION**
>
> Brake fluid reservoir must be 3/4 full during air bleeding.

2. Remove bleeder cap and attach a vinyl hose to bleeder plug.
3. Place other end of vinyl tube in a clear container.
4. Depress brake pedal a few times, and then hold it in depressed position.
5. Have a second person loosen the bleeder screw, drain out fluid, and retightenscrew with SST(0K130 430 019).

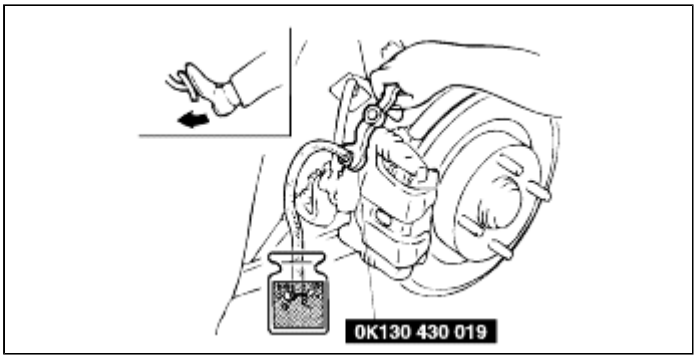
Tightening torque:16~22 lb·ft (21~29 N·m, 2.2~3.0 kg·m)

> **CAUTION**
>
> 1) Both people should stay in voice contact with each other.
> 2) Be sure pedal remains depressed until air bleed screw is tightened.



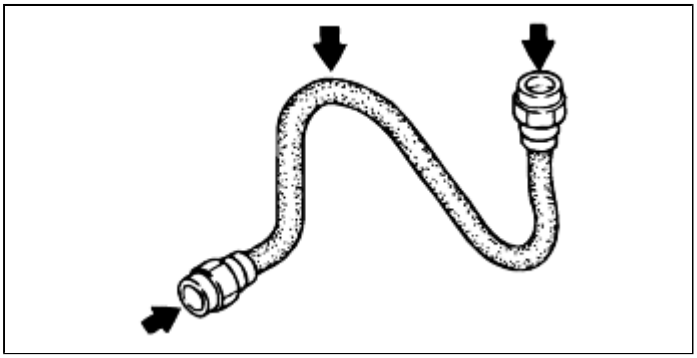
6. Repeat steps 4 and 5 until no air bubbles are seen.
7. Check for correct brake operation.
8. Verify that there is no fluid leakage. Clean away any spilled fluid with rags.
9. After air bleeding, add brake fluid to reservoir until specified level.

> **NOTE**
>
> Air bleeding must be starten from bleeder screw that is farthest from the master cylinder.



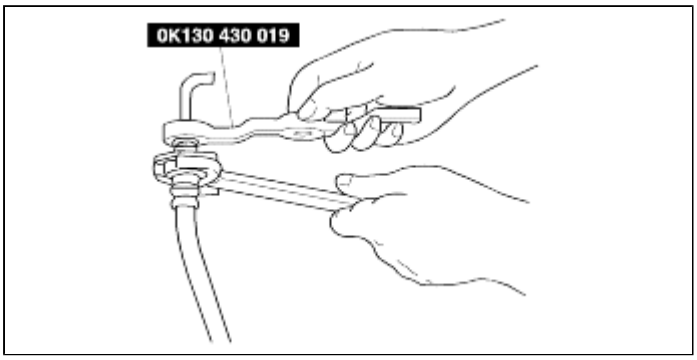
Flexible hose (Inspection)

Check for scars, cracks, and swelling of flexible hose. Replace hose if necessary.



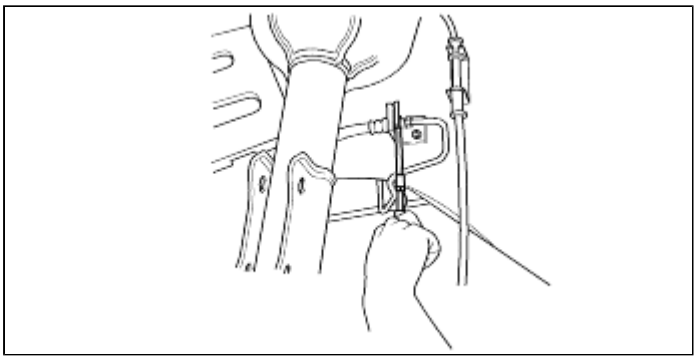
Flexible hose (Removal)

1. Remove brake pipe with SST(0K130 430 019).
2. Disconnect clip and remove flexible hose from bracket.



flexible hose (Installation)

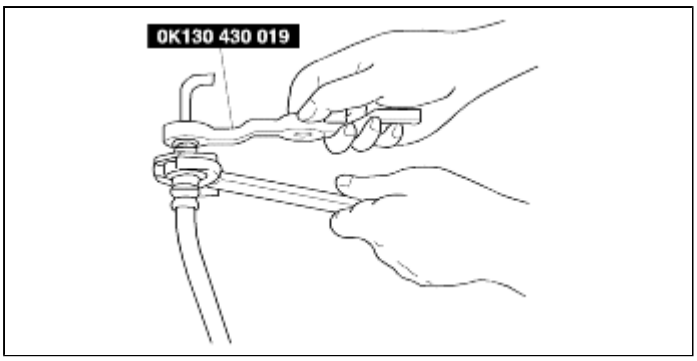
1. Place flexible hose in bracket and fix flexible hose with clip.



2. Connect flexible hose to brake pipe and tighten flare nut with SST(0K130 430 019).

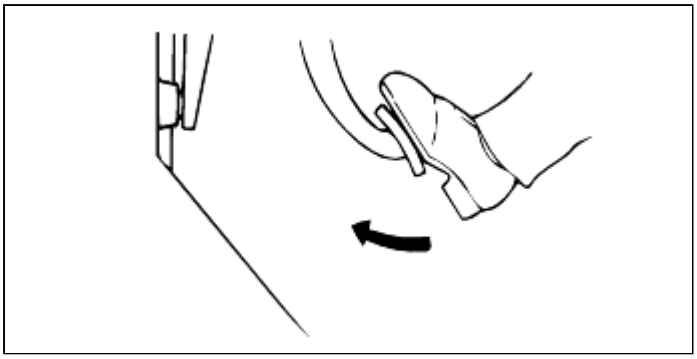
> CAUTION
>
> 1) Verify that hose is not twisted.
> 2) Verify that hose does not touch other parts when vehicle bounces or when steering wheel is turned fully right or left.

Tightening torque:9~16 lb·ft (13~22 N·m, 1.3~2.2 kg·m)



Brake fluid

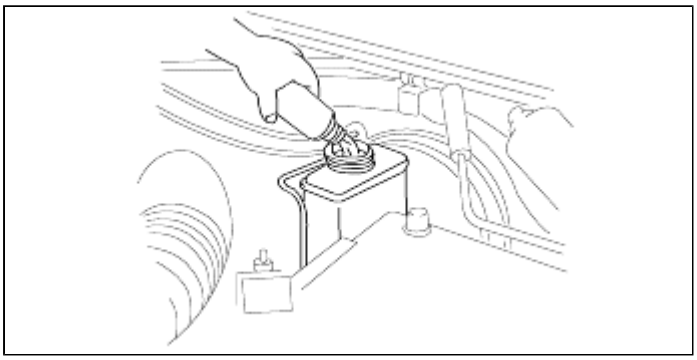
Leakage inspection
Depress brake pedal several times and inspect for leakage in brake line system.



Brake fluid level

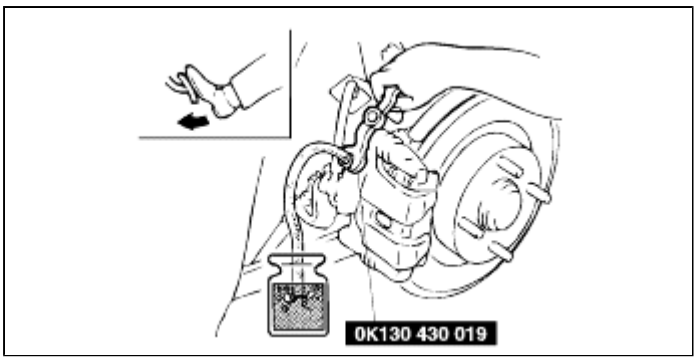
Leakage check

Verify that fluid level in reservoir is between Max and Min lines on reservoir.
Add fluid if it is below Min.

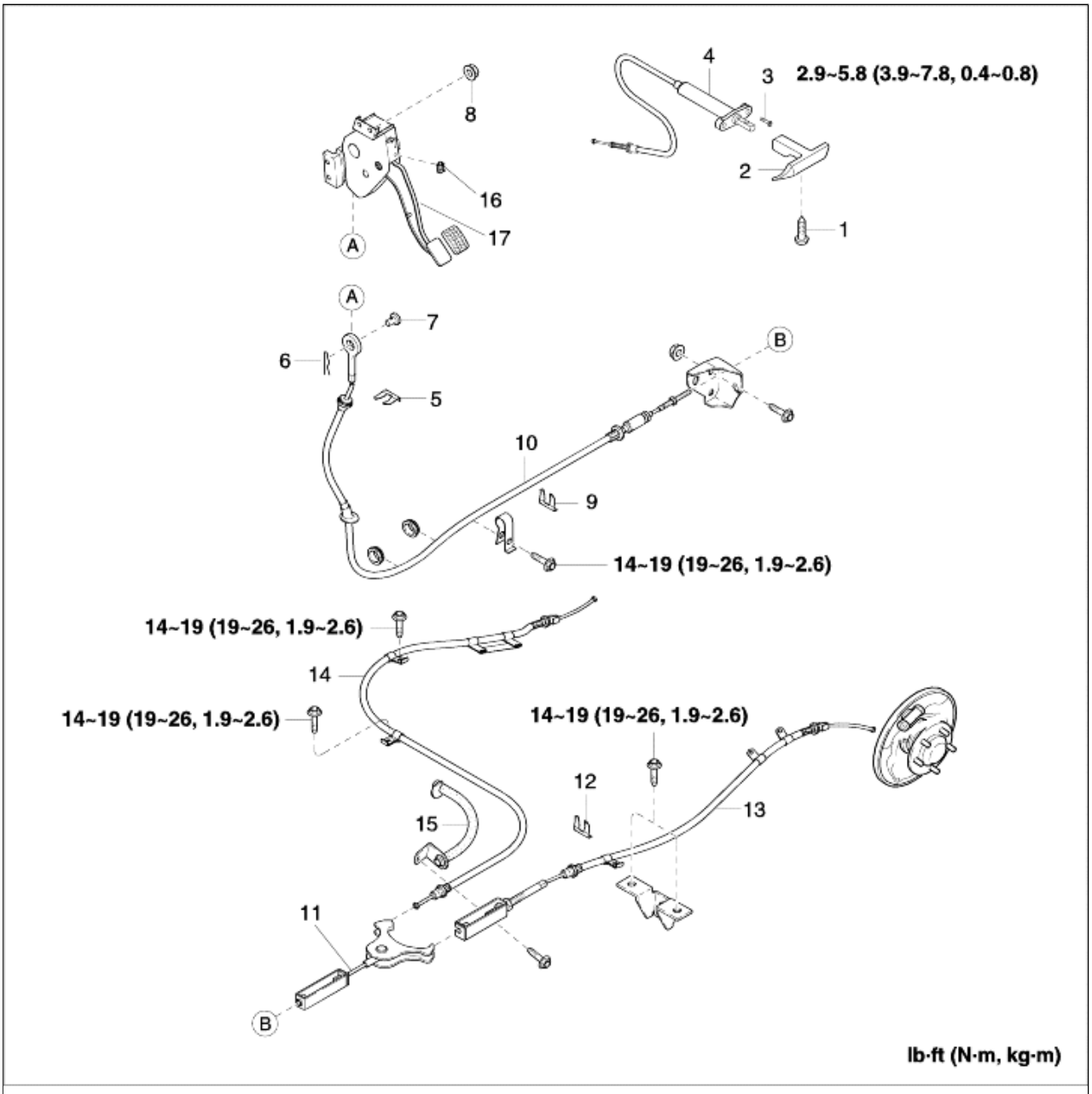


Replacement

1. Follow procedure outline in air bleeding.
2. Continue bleeding and replacing the brake fluid until only clean fluid is expelled.
3. Fill reservoir to Max level.


0K130 430 019

Component



1. Screw
2. Release lever
3. Bolts
4. Release cable
5. Flexible hose clip
6. Spring pin
7. Joint pin
8. Nuts
9. Clip
10. Front cable
11. Equalizer assembly
12. Clip
13. Rear cable-LH
14. Rear cable-RH
15. Guide bracket
16. Parking brake switch
17. Parking brake pedal

Inspection

NOTE

1) Check whether parking brake pedal stroke is in the specification when parkingbrake pedal is depressed down.
2) Check whether rear brake is not released during wheel is being turned by hands,after depressing brake pedal down a few times.
3) Check whether parking brake warning lamp turns on when parking brake pedalis depressed down.

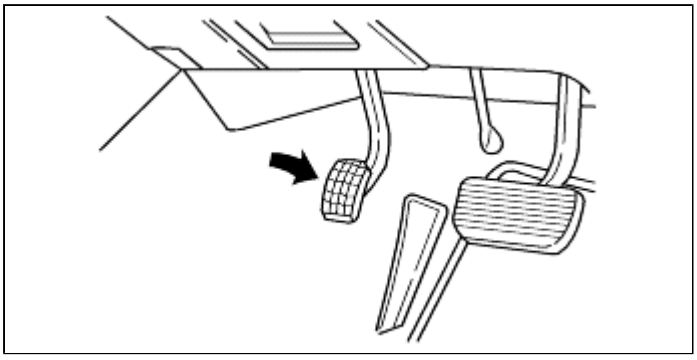
1. Refer to section BR Gr/On-vehicle service/lever stroke of parking brake.

Pedal stroke of parking brake

Inspection

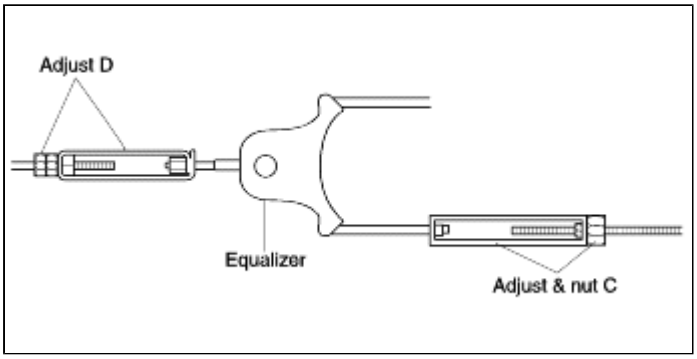
1. Check whether the pedal stroke is in the specification when the parking brake pedal is depressed with 196 N (44 lb, 20 kg).

Pedal stroke: 3.50~4.33 in (90~110 mm)

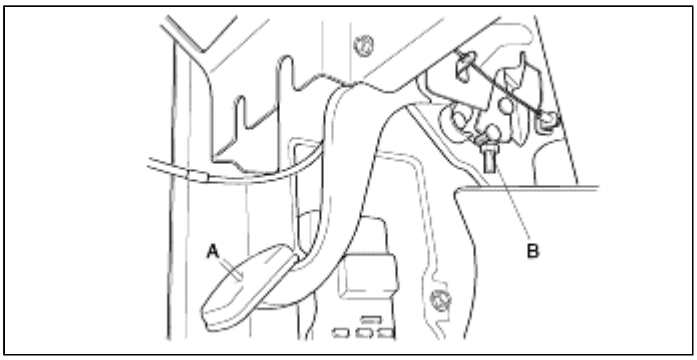


Adjustment

1. Adjust the adjust & nut C or the adjust D so that the pedal stroke becomes 3.54~4.33 in (90~110 mm) and then adjust the adjust nut B finally when 196 N (44 lb, 20 kg) is applied on foot parking pedal pad A.



2. The stroke shall be free from the dragging when the foot parking pedal is pushed to 1.57 in (40 mm).



NOTE

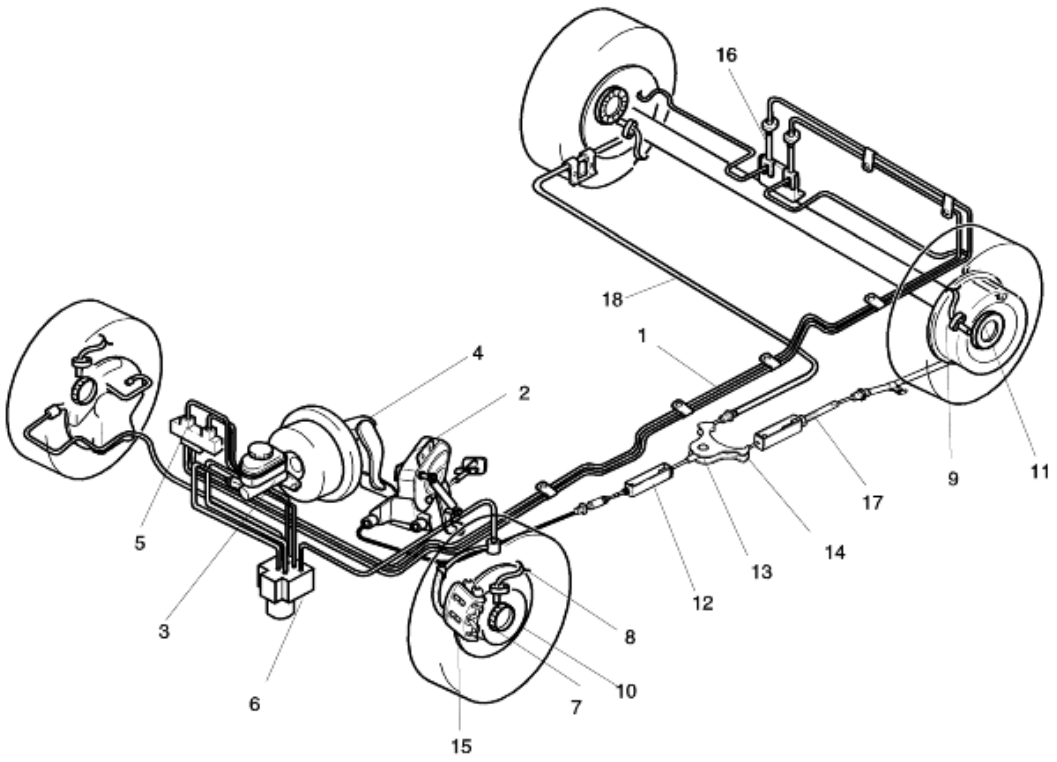
1) Adjust parking brake pedal stroke and check whether parking brake warninglamp turns on when brake pedal is pushed to 0.78 in (20 mm).
2) Check whether the rear wheel is dragged when rear wheel is turned by hands.
3) Be careful not to twist the cable during adjusting the adjust nut.

Description and operation

Structural view

Weather, road surface, and tire condition will affect vehicle performance. The MGH 20 system has been specifically calibrated for the vehicle to achieve the best possible balance between stopping distance, stability, and vehicle steering control.
4-wheel anti-lock brake systems are designed to provide the driver with:

1) Enhanced steering control by enabling the vehicle to move in a driver controlled direction during braking.
2) Enhanced braking stability by making the most of available traction (on most road surfaces).



(1) Brake hydraulic line
(2) Brake pedal
(3) Master cylinder
(4) Master vacuum
(5) Joint pipe
(6) Electronic & Hydraulic control unit(HECU)
(7) Disc plate(front)
(8) Front sensor
(9) Rear sensor
(10) Front sensor rotor
(11) Rear sensor rotor
(12) Parking brake cable(front)
(13) Equalizer
(14) Adjuster
(15) Front flexible hose
(16) Rear flexible hose
(17) Parking brake cable(rear LH)
(18) Parking brake cable(rear RH)

Functional description

MGH 10 is a 4 channel system because it controls four separate hydraulic circuits: the left front wheel, the right front wheel, the right rear wheel, and the left rear wheel. The system accomplishes this using information from 4 separate wheel speed sensors, one at each front wheel and one at each rear wheel.
4-wheel ABS limits wheel lockup by automatically modulating the brake pressure during hard braking. The MGH 10 can improve steering control during hard braking and reduce stopping distances under most conditions.

NOTE

Pumping the brake pedal is no longer necessary and should not be done.

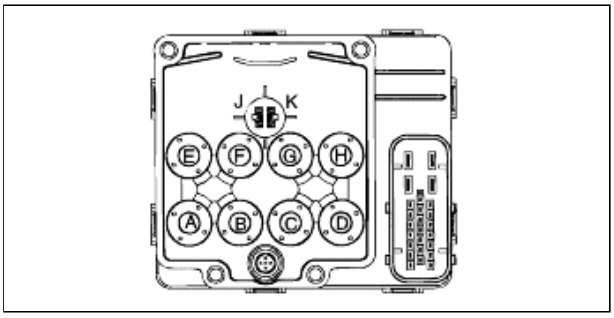
The ABS controls all 4 channels (both fronts and rears) independently. The brake force required to engage the ABS function may vary depending on road surface conditions and tire adhesion. A dry paved surface requires a higher brake force than a slippery surface to engage ABS.
The driver may feel a pedal pulsation (up and down movement of the brake pedal) during an ABS event. In addition, a noise from inside the engine compartment may be heard. This is considered a normal characteristic. The brake pedal effort and pedal

feel during normal braking are similar to that of a conventional brake system.

Electronic control unit (ECU)

Introduction

The electronics and microprocessor are integrated with the solenoid coils inside a Coil Integrated Module The ECU is mounted directly to the hydraulic control unit. The coils are used to operate the HCU valves during an ABS event. The ECU has circuits that monitor system status.



A: INLET VALVE (FR)
B: INLET VALVE (RL)
C: INLET VALVE (RR)
D: INLET VALVE (FL)
E: OUTLET VALVE (FR)
F: OUTLET VALVE (RL)
G: OUTLET VALVE (RR)
H: OUTLET VALVE (FL)
J: MOTOR (GND)
K: MOTOR(M+)

Self monitoring functions

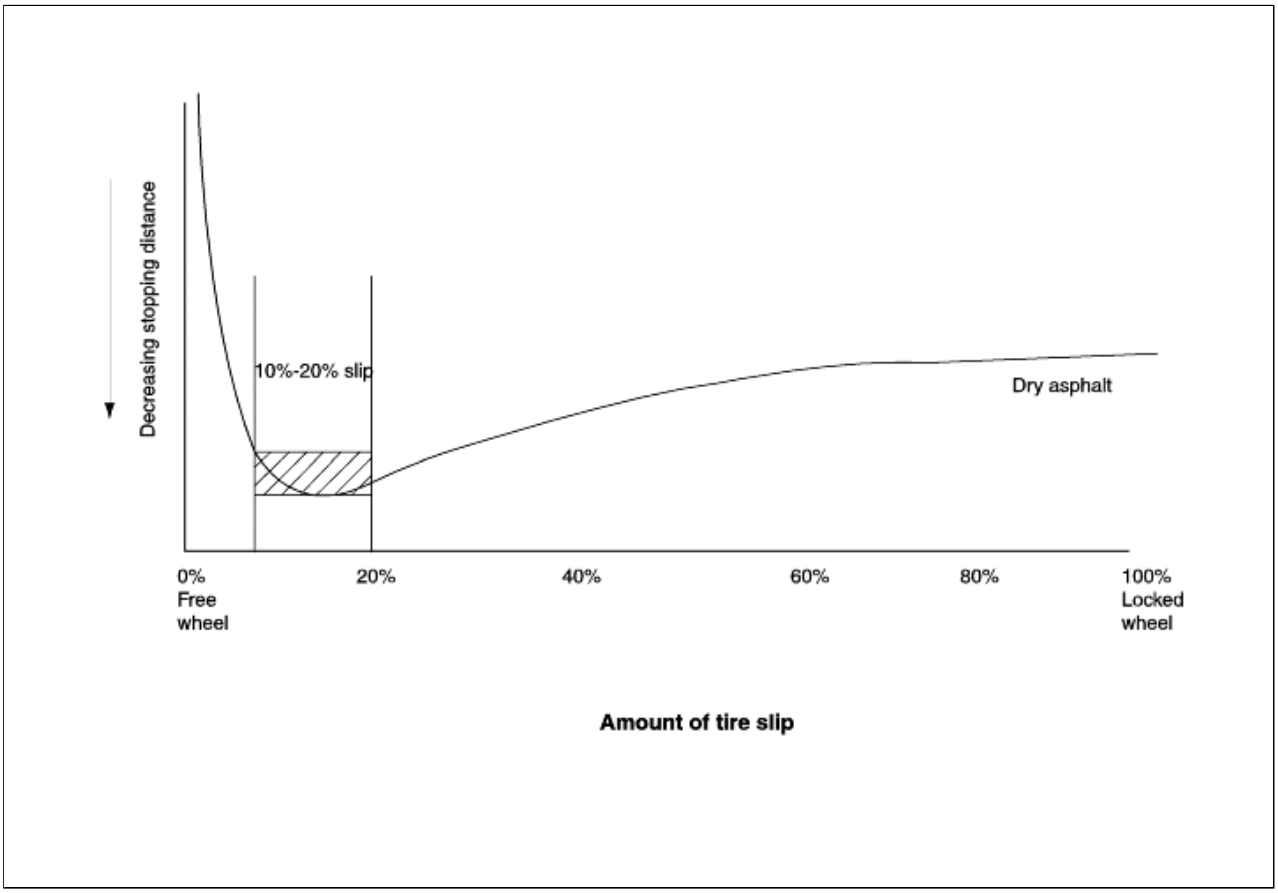
The ECU monitors the components of the system for faults. If a fault is detected, the ABS system will set a Diagnostic Trouble Code (DTC) and illuminate the amber ABS & EBD lamp, causing the ABS or EBD to be disabled. Although the ABS or EBD is inhibited, conventional brakes remain.
When the ignition switch is placed in the run position, the ECU will perform a preliminary self check on the anti-lock electrical system indicated by an illumination of the amber ABS or EBD warning lamp in the instrument cluster.

Solenoid valve control

Solenoid valve operates when one side of valve coil applies positive voltage through valve relay and the other side connects to ground by MOSFET.
When valve relay turns ON and MOSFET turns ON by µ-processor signal, concerned solenoid valve operates.

Wheel slip

How well a vehicle can stop is related to how well the tire contact surface grips the road. At 0 % slip, the tire rotates freely. At 100 % slip, the tire and wheel are locked and the weight of the vehicle pushes the locked tires along the road surface. In this situation, vehicle stability may be lost, and steering control will be lost.
Normally, tires will grip to the road surface on average between 10 % and 20 % slip during hard braking. In this slip range, vehicle stopping distances and steering control will be at their best. Some slip is necessary to stop the wheel and achieve maximum braking performance.



Hydraulic control unit (HCU)

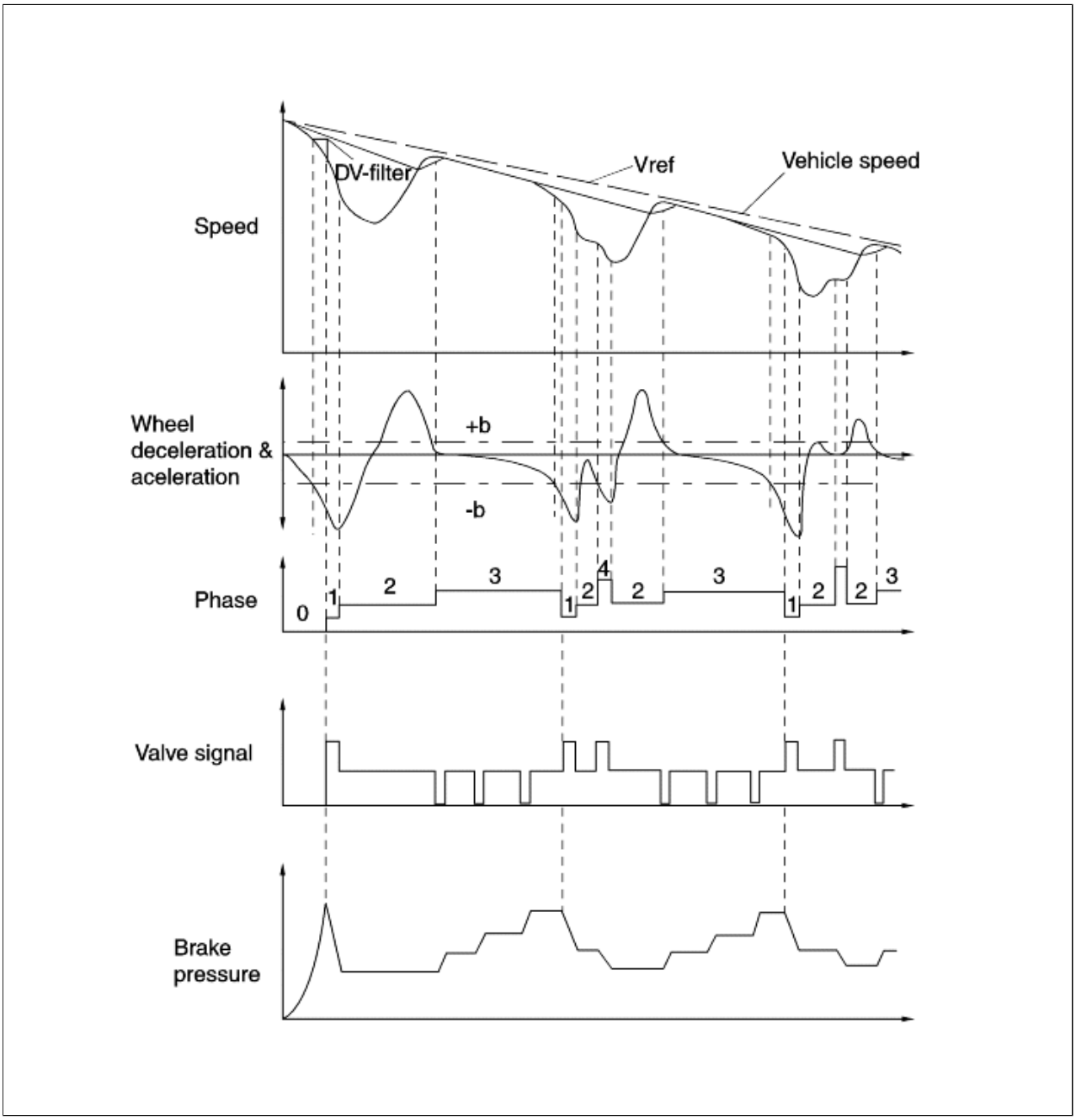
ABS control steps

PHASE 0 : Outside of ABS
PHASE 1 : Pressure decreasing condition
PHASE 2 : Pressure holding conditio
PHASE 3 : Pressure increasing condition
PHASE 4 : Pressure decreasing condition
PHASE 5 : Pressure decreasing condition

Basic control

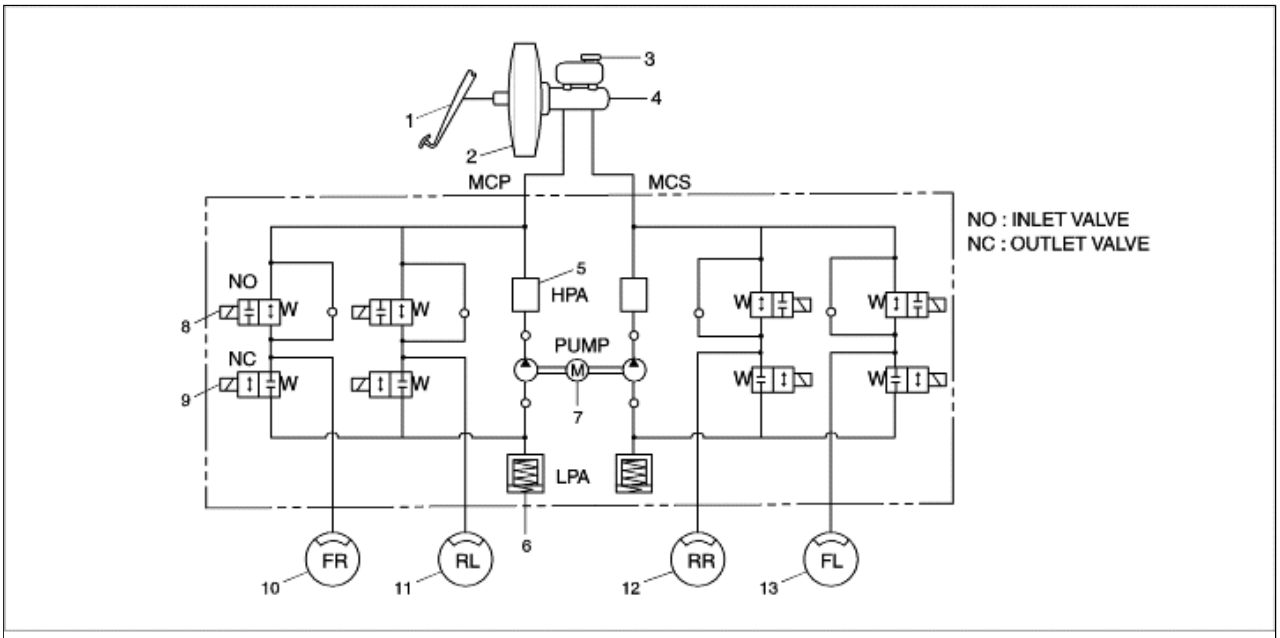
PHASE 0-PHASE 1 :
When ABS ECU detects the wheel locking, ABS ECU changes PHASE 0 to PHASE 1.
PHASE 1-PHASE 2 :
If wheel cylinder liquid pressure is decreased, ABS ECU changes PHASE 1 to PHASE 2.
PHASE 2-PHASE 3 :
If it is judged tha there is no lock phenomenon in wheel, ABS ECU changes PHASE 2 to PHASE 3.
PHASE 2-PHASE 4 :
If wheel cylinder liquid pressure is cascading on the deceleration section, ABS ECU changes PHASE 2 to PHASE 4.
PHASE 2-PHASE 5 :
If wheel cylinder liquid pressure is cascading on the aceleration section, ABS ECU changes PHASE 2 to PHASE 5.

ABS control flow



ABS OPERATING MODES

1. WHEN ABS IS NOT OPERATED



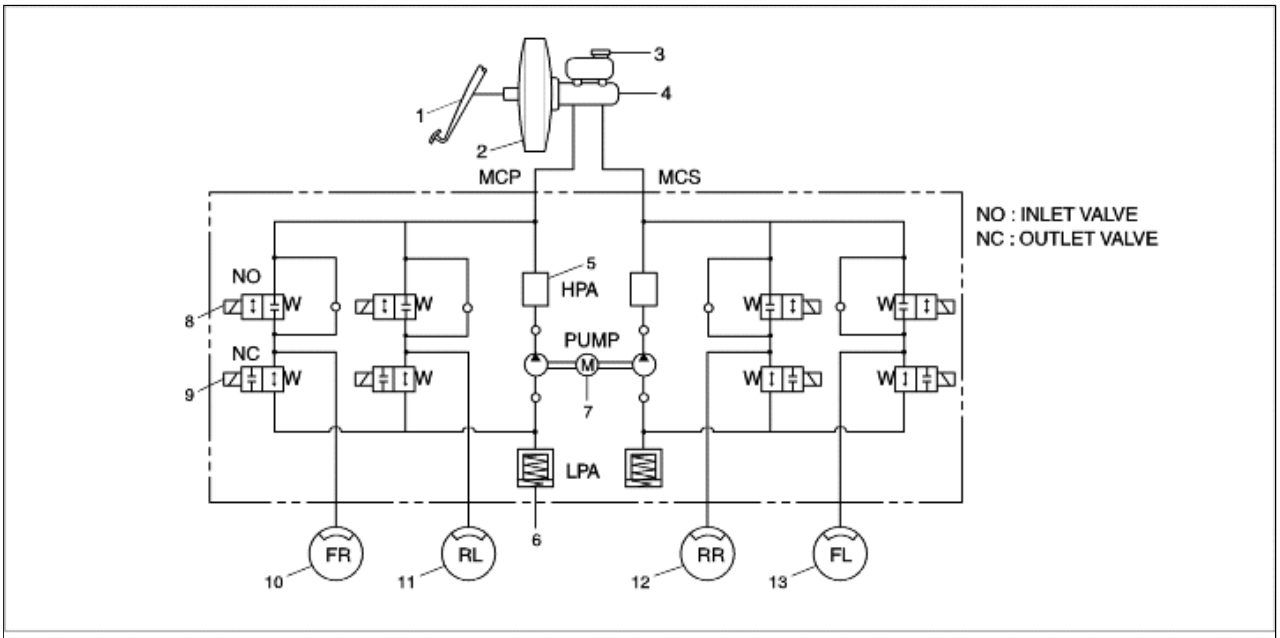
1. Brake pedal
2. Master vacuum
3. Brake reserve tank
4. Master cylinder
5. High pressure accumulator
6. Low pressure accumulator
7. Motor pump
8. Normal open (Inlet valve)
9. Normal close (Outlet valve)
10. Front right wheel & caliper
11. Rear left wheel & caliper
12. Rear right wheel & caliper
13. Front left wheel & caliper

Operating condition

Solenoid valve	Electricity status	Valve open-close	Open-close channel
INLET	OFF	OPEN	Master cylinder ↔ Wheel cylinder
OUTLET	OFF	CLOSE	Wheel cylinder ↔ reservoir

In ordinary brakes, each solenoid valve is turned OFF when electricity is turned on from ABS ECU to the solenoid valve IN, OUT.
As for solenoid valve at this time, IN is opened and OUT is closed by spring action. If brake pedal is pushed down, master cylinder liquid pressure passes the solenoid valve and arrives at wheel cylinder, and the brake acts.
Afterwards if brake pedal is released, the liquid pressure passes IN and check valve to return to master cylinder, then brake is releassed.

2. DUMP MODE-BRAKE PRESSURE DECREASING



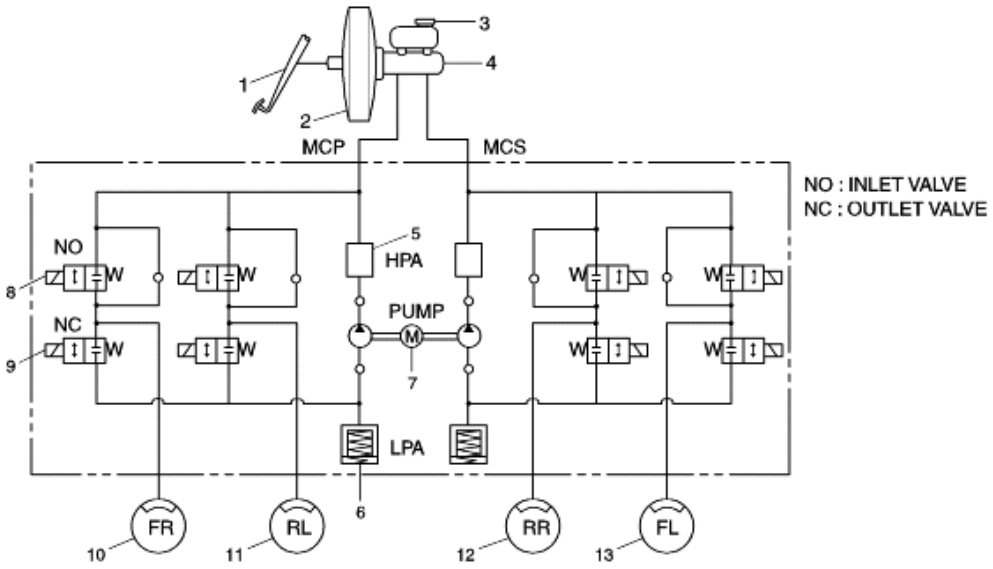
1. Brake pedal
2. Master vacuum
3. Brake reserve tank
4. Master cylinder
5. High pressure accumulator
6. Low pressure accumulator
7. Motor pump
8. Normal open (Inlet valve)
9. Normal close (Outlet valve)
10. Front right wheel & caliper
11. Rear left wheel & caliper
12. Rear right wheel & caliper
13. Front left wheel & caliper

Operating condition

Solenoid valve	Electricity status	Valve open-close	Open-close channel
INLET	ON	CLOSE	Master cylinder ↔ Wheel cylinder
OUTLET	ON	OPEN	Wheel cylinder ↔ reservoir

If wheels are about to be locked at sudden braking, ABS ECU outputs the signal decreasing the liquid pressure in solenoid valve, and each solenoid valve is turned ON.
At this time the solenoid valve IN is shut and interrupts the liquid channel from master cylinder. And solenoid valve OUT is opened and releases the liquid channel from wheel cylinder to the reservoir therfore the liquid pressure in wheel cylinder passes the solenoid valve OUT to arrive at reservoir solenoid valve OUT to arrive at reservoir so that pressure is decreased.

3. HOLD MODE-BRAKE PRESSURE MAINTAINED



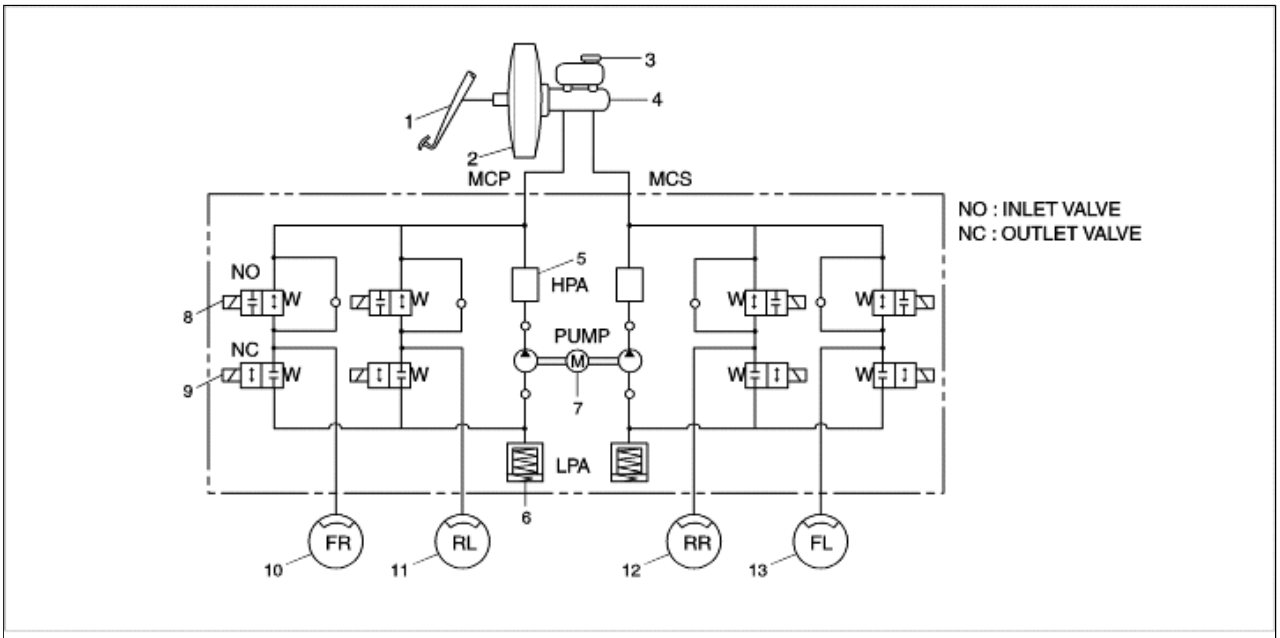
1. Brake pedal
2. Master vacuum
3. Brake reserve tank
4. Master cylinder
5. High pressure accumulator
6. Low pressure accumulator
7. Motor pump
8. Normal open (Inlet valve)
9. Normal close (Outlet valve)
10. Front right wheel & caliper
11. Rear left wheel & caliper
12. Rear right wheel & caliper
13. Front left wheel & caliper

Operating condition

Solenoid valve	Electricity status	Valve open-close	Open-close channel
INLET	ON	CLOSE	Master cylinder ↔ Wheel cylinder
OUTLET	OFF	CLOSE	Wheel cylinder ↔ reservoir

If wheel cylinder liquid pressure is decreased to the ultimate state, ABS ECU outputs the signal maintaining the liquid pressure in solenoid valve, so that solenoid valve IN is turned ON and OUT is turned OFF.
Then wheel cylinder liquid because solenoid valve In and out are both shut so that liquid channel is interrupted.

4. RISE MODE-BRAKE PRESSURE INCREASING



1. Brake pedal
2. Master vacuum
3. Brake reserve tank
4. Master cylinder
5. High pressure accumulator
6. Low pressure accumulator
7. Motor pump
8. Normal open (Inlet valve)
9. Normal close (Outlet valve)
10. Front right wheel & caliper
11. Rear left wheel & caliper
12. Rear right wheel & caliper
13. Front left wheel & caliper

Operating condition

Solenoid valve	Electricity status	Valve open-close	Open-close channel
INLET	OFF	OPEN	Master cylinder ↔ Wheel cylinder
OUTLET	OFF	CLOSE	Wheel cylinder ↔ reservoir

If it is judged that there is no lock phenomenon in wheels, then ABS ECU interrupts electricity in solenoid valve therefore each solenoid valve is turned OFF and the liquid pressure by motor pump passes the solenoid valveIN to arrive at wheel cylinder so that pressure is increased.

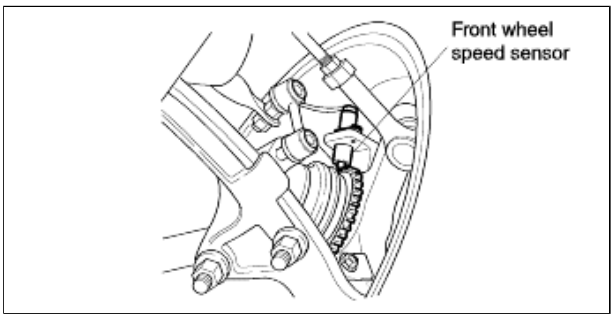
Fail-safe function

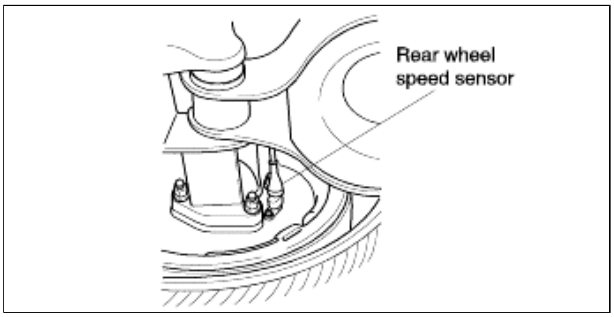
If failure occurred in ABS ECU system and the hydraulic, then the fail-safe circuit turns off the relay that supplies electricity to solenoid valve, stopping the control signal output, lighting the warning lamp at the same time to inform ABS failure to driver, in which case the ordinary brake function is secured under same condition as vehicles without ABS system.

ABS speed sensors

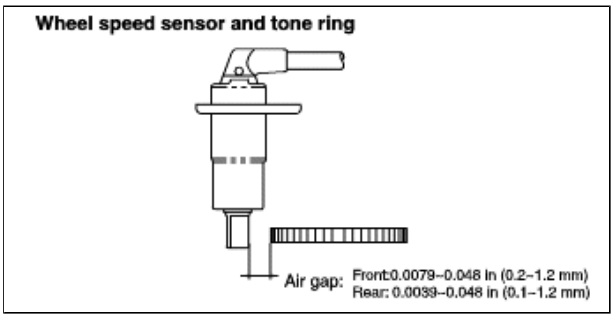
The speed sensors are a single pole, variable reluctance sensor, mounted to both rear hubs and both front half shafts. A toothed tone ring is press fit to the rear hub assemblies and provides the signal for the rear sensor.

The front tone rings are press fit to the half shaft assemblies. The signal generated is proportional to the speed of the wheels and is used by the ECU to monitor the wheel speeds.





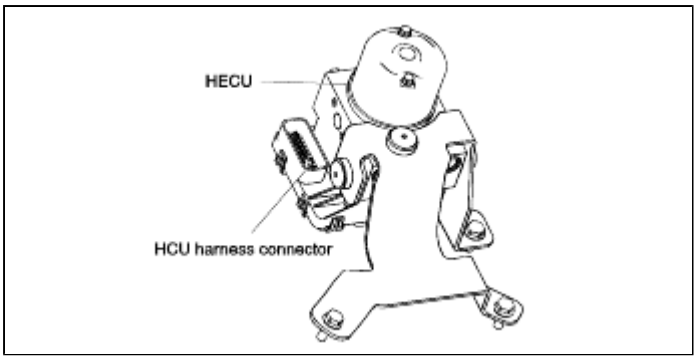
As the teeth of the tone ring move through the magnetic field of the sensor, an AC voltage is generated. This signal frequency increases or decreases proportionally to the speed of the wheel. The ECU monitors this signal to check for changes in wheel speeds. If the deceleration of one or more wheels is not within a predetermined amount, an ABS event is initiated.



Removal

1. Turn ignition " OFF".
2. Disconnect ECU harness connector from ECU assembly.

> **CAUTION**
>
> Do not apply a 12V power source to any terminal of the ECU connector when disconnectered.

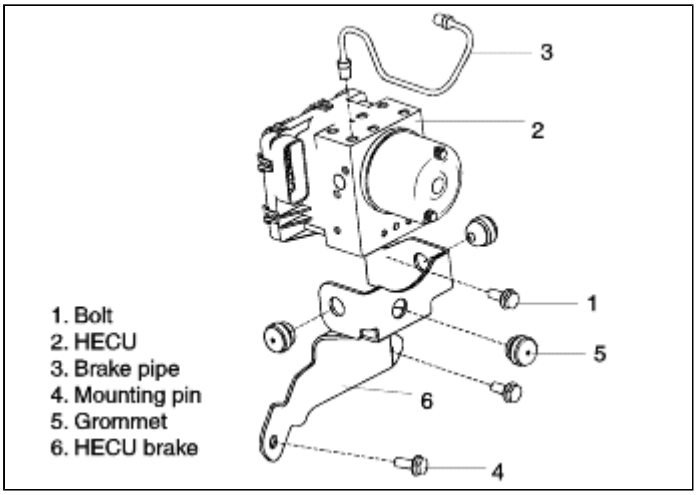


3. Mark the brake pipes going into and out of the HCU with tags so reinstallation of the brake lines will be correct.

> **CAUTION**
>
> Before removing the brake pipes from HCU, the HCU must be thoroughly cleaned to prevent dirt particks from falling into the ports of HCU or entering the brake pipes.

4. Remove the brake pipes from the HCU.
5. Loosen the mounting pin and grommet from HECU bracket and then remove HECU from HECU bracket.
6. Remove bolts attaching the ECU to the HCU.
7. Lift the ECU assembly straight from the HCU.
8. Clean the top of the HCU with a clean, dry cloth.

Removal



1. Turn ignition "ON".
2. Disconnect ECU connectors from ECU assembly.

> **CAUTION**
>
> Do not apply a 12 volt power source to any terminal of the ECU connector when disconnected.

3. Mark the brake pipes going into and out of the HCU with tags so reinstallation of the brake lines will be correct

> **CAUTION**
>
> Before removing the brake pipes from HCU, the HCU must be thoroughly cleaned to prevent dirt particles from falling into the ports of HCU or entering the brake pipes.

4. Remove the brake pipes from the HCU.
5. Remove the bolts attaching the HECU bracket to the fender.
6. Remove HECU and bracket from vehicle.
7. Remove the mounting pin and grommet attaching the HECU to the bracket and remove HECU from bracket.
8. Remove the bolts securing the ECU to the HCU and lift the ECU carefully off the HCU.
9. Verity that the seal on the ECU is free from nicks or cracking.

Replacement

1. Lower ECU onto the HCU and tighten its bolts to specification.

Tightening torque:1.3~1.4 lb·ft (1.7~1.9 N·m, 0.18~1.2 kgf·m)

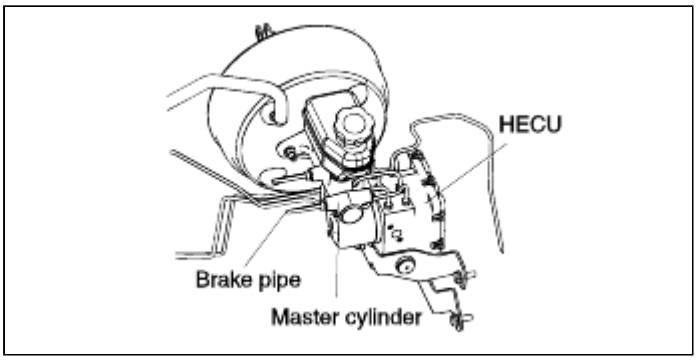
2. Carefully place HECU to the HECU bracket.
3. Tighten the mounting pin and grommet to the HECU bracket.

Tightening torque:5.8~7.2 lb·ft (7.8~9.8 N·m, 0.8~1 kgf·m)

4. Reconnect six brake lines. Be certain that the four outlet lines have been connected to the correct ports. Tighten the nuts to specification.

Tightening torque:9.4~15.9 lb·ft (12.8~21.6 N·m, 1.3~2.2 kg·m)

> **NOTE**
>
> When installing the brake pipe lines on the HCU valve block, they must be located correctly in the valve block to ensure proper ABS operation.



5. Connect the ECU harness connector to ECM assembly.
6. Bleed the base brakes.
7. Road test vehicle to ensure proper operation of the base and ABS systems.

Replacement

1. Carefully replace ECU on the replacement HCU.
2. Torque the ECU bolts in the following two steps:

A. Start all bolts into the HCU and hand tighten.
B. Torque in the sequence shown until a final achieved for each bolt.

Tightening torque:1.3~1.4 lb·ft (1.7~7.9 N·m, 0.18~0.2 kg·m)

3. Reattach bracket to the HECU mounting pin and grommet.

Tightening torque:5.8~7.2 lb·ft (7.8~9.8 N·m, 0.8~1.0 kg·m)

4. Reinstall bolts and nuts attaching bracket to fender.

Tightening torque:9.4~15.9 lb·ft (12.8~21.6 N·m, 1.3~2.2 kg·m)

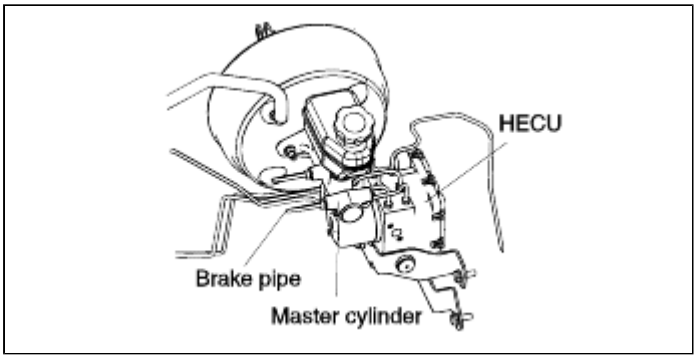
NOTE

When installing the brake pipe lines on the HCU valve block, they must be located correctly in the valve block to ensure proper ABS operation.

5. Attach brake pipes to HECU, be careful to reattach the pipes in the same positions which they were in prior to removal.

Tightening torque:9.4~15.9 lb·ft (12.8~21.6 N·m, 1.3~2.2 kg·m)

6. Reconnect ECU harness connectors.
7. Bleed the brakes.
8. Road test vehicle to ensure proper operation of the base and ABS systems.

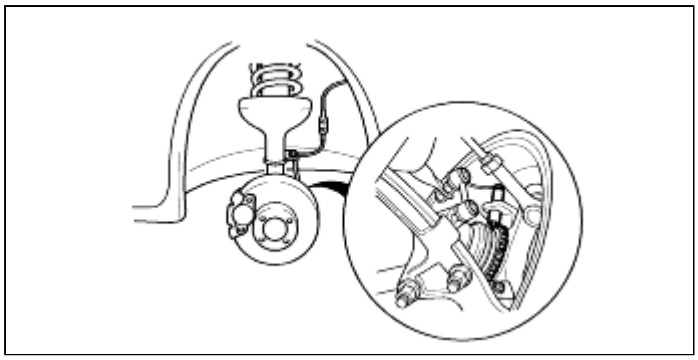


Removal

CAUTION

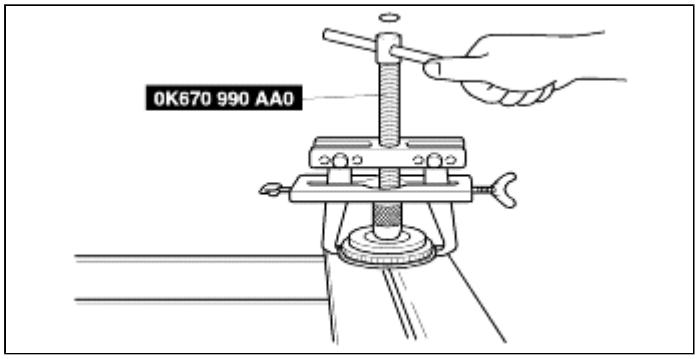
When disconnecting the wheel speed sensor from vehicle wiring harness, be careful not to damage pins on connector.

1. Remove harness connector.
2. Remove sensor bolt and remove the speed sensor.



Removal

1. Remove wheel hub assembly from the vehicle.
2. Remove rotor with SST(0K670 990 AA0). Do not re-install a rotor which is removed.



Replacement

1. Clean speed sensor attaching surface.
2. Install speed sensor.

Tightening torque:7 lb·ft (9.5 N·m, 1 kg·m)

3. Install the wiring harness connector with wheel speed sensor cable.
   Be sure speed sensor cable connector is fully seated and locked into vehicle wiring harness connector.
4. Check the air gap between the face of the wheel speed sensor and the top surface of the tone-wheel.

Air gap : 0.0079~0.048 in (0.2~1.2 mm)

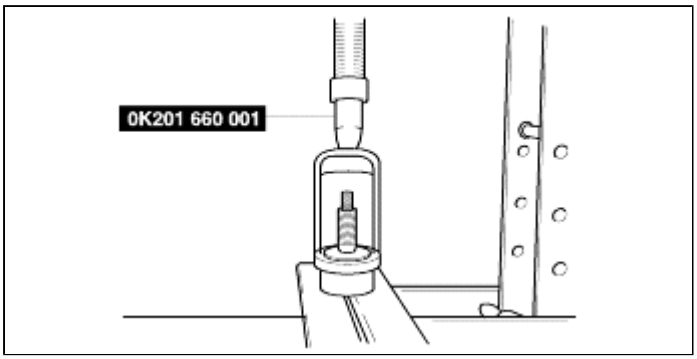
5. Road test vehicle to ensure proper operation of the base and ABS brake system.

Replacement

1. Position a new sensor rotor on wheel hub as shown.

Number of sensor rotor teeth: 54

2. Press rotor onto wheel hub with SST(0K201 660 001).



3. Reinstall wheel hub assembly to vehicle.
4. Check the air gap between the face of the wheel speed sensor and the top surface of the tone-wheel.

Air gap : 0.0079~0.048 in (0.2~1.2 mm)

5. Road test vehicle to ensure proper operation of the base and ABS brake system.

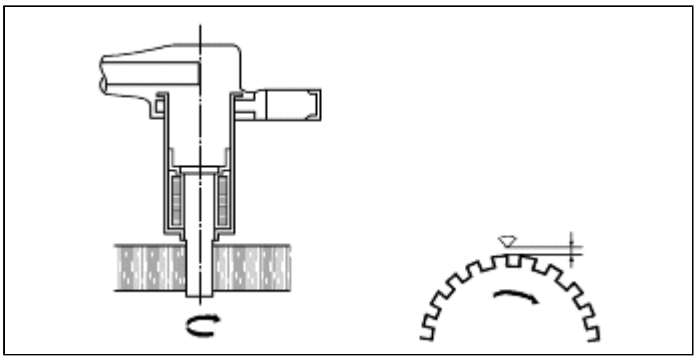
Inspection

1. Measure clearance.

Specified clearance:0.0079~0.048 in (0.2~1.2 mm)

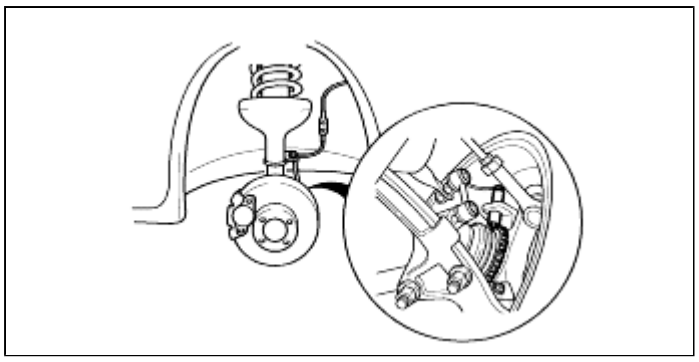
2. Measure speed sensor resistance.

Resistance: 1275~1495Ω



Inspection

1. Lift and properly support front of the vehicle.
2. From backside of wheel, closely inspect sensor rotor. Rotate wheel to examine all teeth.
3. Replace rotor if teeth are missing or damaged. See Removal, this section.



Inspection

1. Check clearance.
   A. Measure the clearance.

Specified clearance:0.0039~0.048 in (0.1~1.2 mm)

2. Measure speed sensor resistance.

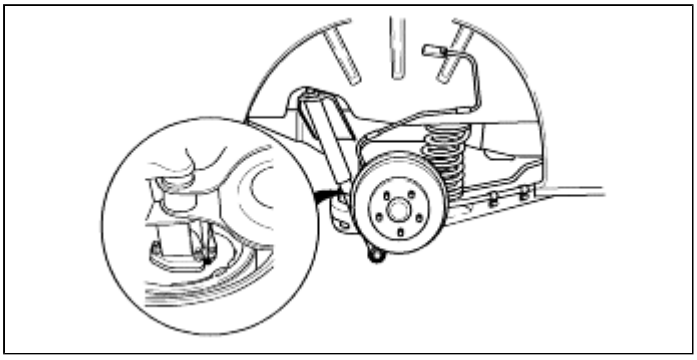
Resistance: 1275~1495Ω

Removal

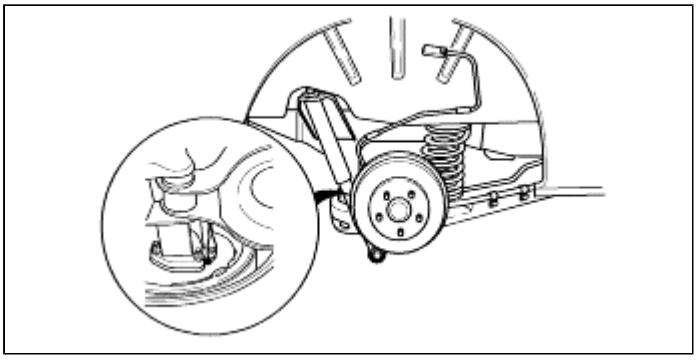
CAUTION

When unplugging speed sensor cable from vehicle wiring harness be careful not to damage pins on the electronical connectors.

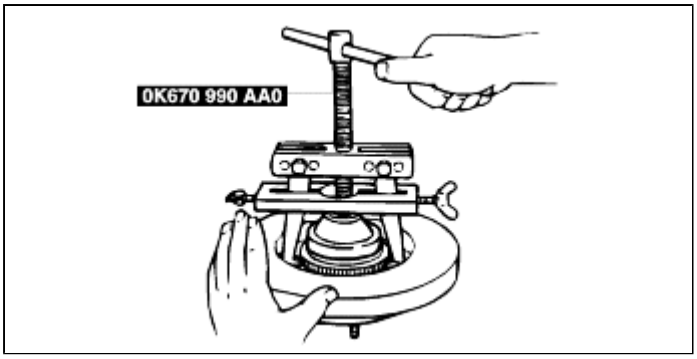
1. Remove the harness connector.
2. Remove the sensor bolt and remove the speed sensor.



Removal



1. Remove the rear wheel hub assembly from the vehicle.
2. Remove the sensor rotor with SST(0K670 990 AA0).



Replacement

1. Clean the speed sensor attaching surface.
2. Install the speed sensor.

   Tightening torque:6~7 lb·ft (8~9.5 N·m, 82~97 kg·cm)

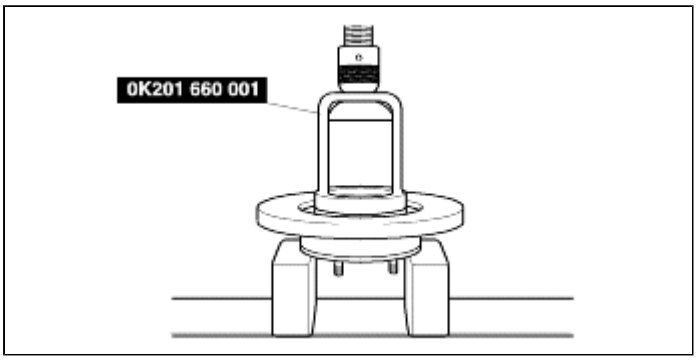
3. Install the wiring harness connector with wheel speed sensor cable.
   Be sure speed sensor cable connector is fully seated and locked into vehicle wiring harness connector.
4. Check the air gap between the face of the wheel speed sensor and the top surface of the tone-wheel.

   Air gap: 0.0039~0.048 inch (0.1~1.2 mm)

5. Road test vehicle to ensure proper operation of the base and ABS brake system.

Replacement

Number of sensor rotor teeth: 54

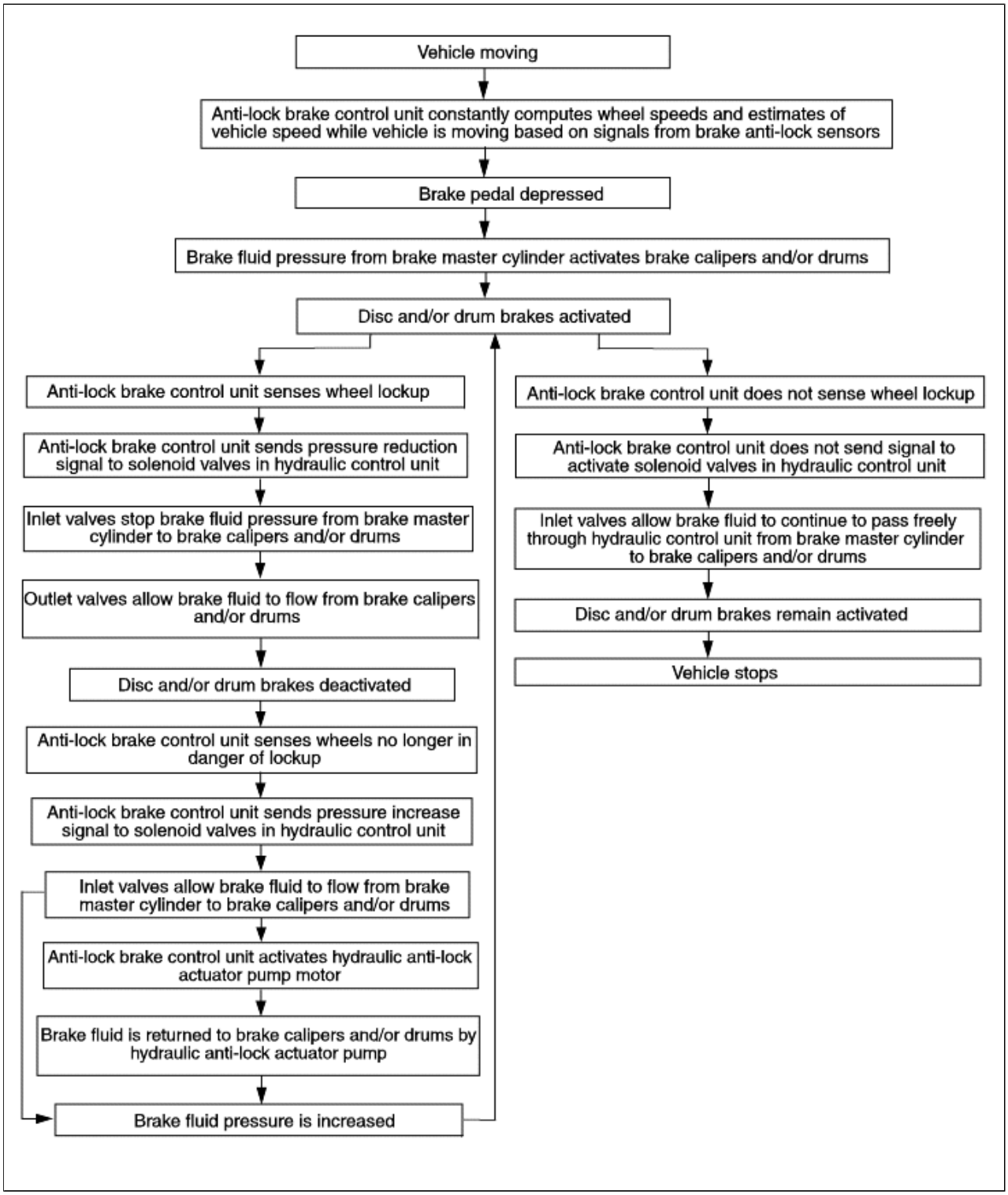


1. Install a sensor rotor with SST(0K201 660 001).
2. Install the rear wheel hub assembly.
3. Check the air gap between the face of the wheel speed sensor and the top surface of the tone-wheel.

   Air gap : 0.0039~0.048 in (0.1~1.2 mm)

4. Road test vehicle to ensure proper operation of the base and ABS brake system.

System operation flow chart



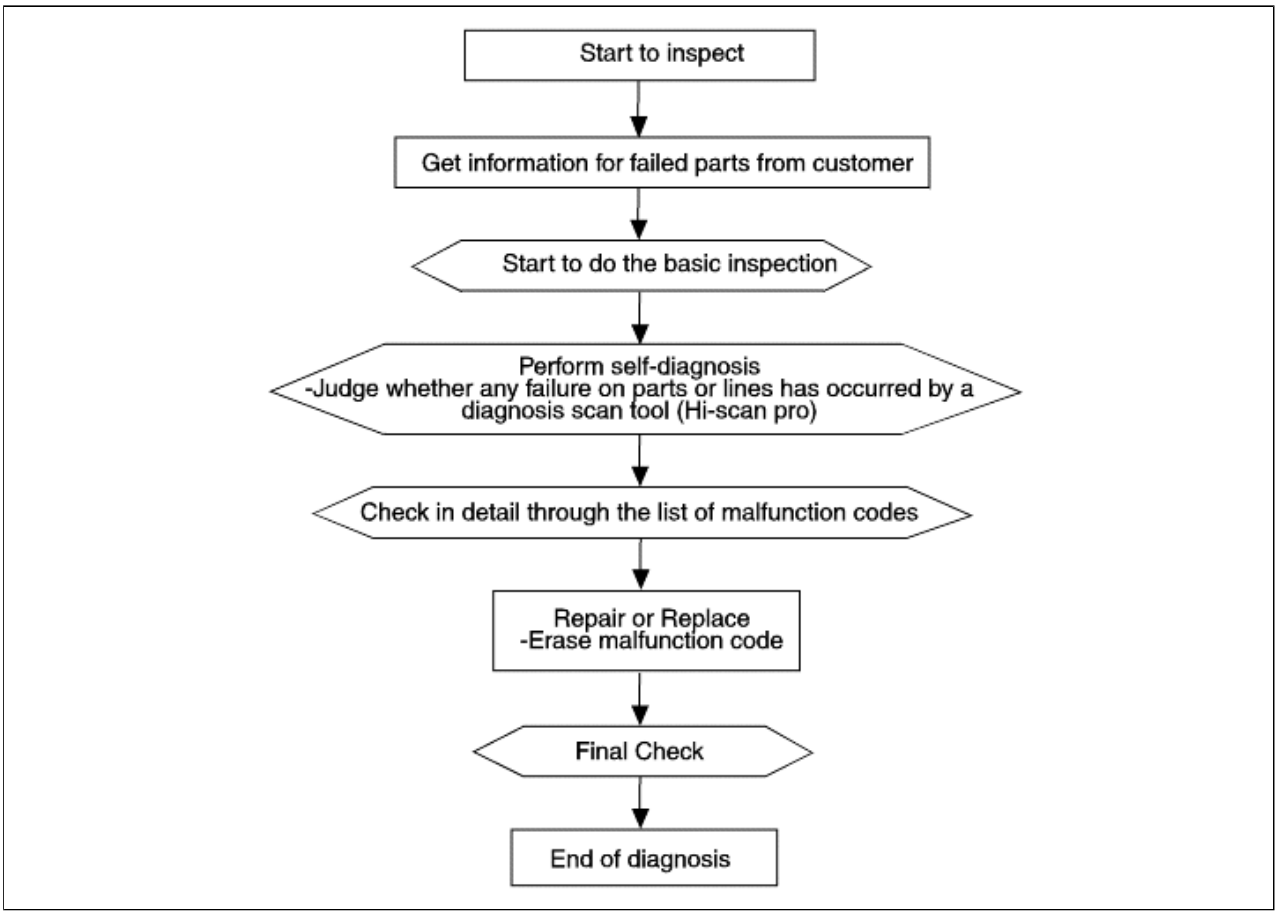
Symptom related diagnostic procedures(abs)

The wheel ABS is composed of electrical and mechanical components (hydraulic unit), and components of the standard brake system.

The system uses 4-sensors and 4-channels which control front wheels and rear wheels each independently. When the system detects a slip in one of the wheels, hydraulic pressure is applied to the brakes on the side where the slip is first detected.

Any malfunction of the ABS electrical or mechanical components is judged by the self-diagnosis function in the ABS control unit. All malfunctions are indicated by the warning lamp in the instrument panel. In normal condition, the ABS warning lamp is on for 2~3 seconds after engine starts and goes out. If it stays on continuously, you may have malfunction with ABS system. The location of a malfunction is indicated to the technician by a diagnosis scan tool (Hi-scan pro). The self-diagnosis and indication functions must be used when diagnosing malfunctions of the ABS.

HOW TO USE DIAGNOSIS AND TROUBLESHOOTING

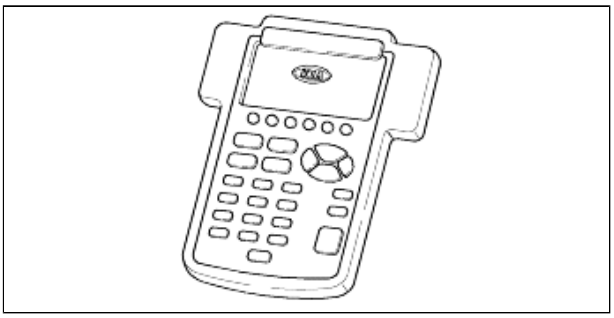


Self-diagnosis

The ABS control unit starts self-diagnostic functions after the ignition is switched ON. The ABS control unit detects failure for each circuit and component by comparing condition of the system with limited condition set inside the ABS control unit, ABS control unit stores the failure code and then outputs the four-digits of malfunction code to the diagnostic scan tool (Hi-scan pro) when the ABS terminal of the diagnostic connector is connected.

Self-diagnosis procedures(with the diagnostic scan tool)

1. With the ignition switch OFF, connect the diagnostic scan tool (Hi-scan pro) to the data link connector located under side of master vacuum in engine compartment.



2. Make sure the ignition switch is in the on position, and then choose correct vehicle and model, proceed to diagnostic data link menu item.
3. Choose the inspection item after initializing the unit.
4. Press malfunction code detection No.1 and diagnostic scan tool will display any malfunction code found.

> NOTE
>
> A malfunction code is a four-digits number which is continuously outputs until the failure code is erased by the diagnostic scan tool.

5. From the list of failure codes, verify the failed part and repair it according to self-diagnosis procedures.
6. After repair, erase all malfunction codes stored in the ABS control unit by selecting inspection item (No.4).

How to erase malfunction code(With the diagnostic scan tool)

ABS control unit has an automatic malfunction code erasing function as below.

1. After the failures have been serviced, confirm the vehicle functions properly.
2. Press the enter key in malfunction code erase item (No.4) among the inspection items of the diagnostic scan tool (Hi-scan pro).

connector terminal list

Connector Terminal			Specification	Note
No.	Mark	Terminal Name		
6	IGN+	Power source via Ignition Switch terminal	Over voltage range: 16.5±0.5V<V<20V Operating voltage range: 9.5±0.5V<V<16.5±0.5V Low voltage threshold: 9.5±0.5V Low voltage range: 7.2±0.5V<V<9.5±0.5V System down range: 6.0±0.5V<V<7.2±0.5V Controller off range: V<5.5±0.5V Max. current: I<300mA	
2 18	GND1 GND2	Ground terminal	Max. current(total of 2 terminals): I<60A	Inside control
24	BRAKE	Brake lamp Switch input terminal	Input voltage(low): -1.00<V(IL)<2.75V Input voltage(high): 5.00<V(IH)<16.0V	
9 23 5 19 8 22 4 20	FL+ FR+ RL+ RR+ FL- FR- RL- RR-	Wheel sensor Input terminal	Min. sensor voltage: V(s)>150mVpp Resistance: 1100Ω± 50% Output range: 30~2000Hz Inductance: 0.7H ±50% Permissible offset voltage range: 2.15V<V(offset)<3.5V	
10	ABS Warning lamp	ABS warning lamp output terminal	Max. current: I<200mA Saturation voltage, at I=200mA: Vsat<1.5V	
15	EBD Warning lamp	EBD warning lamp output terminal	Max. current: I<200mA Saturation voltage, at I=200mA: Vsat<1.5V	
3	Diagnosis	Diagnosis interface terminal	Input voltage: V(IL)<0.3VBV V(IH)<0.7VBV Output voltage: V(IL)<0.2VBV V(IH)<0.8VBV	VB: Ignition voltage
2	Batt1	Battery power Source 1 terminal (valve power source)	Max. current (inside control): I<30A Max. current (outside control): I<20mA Dark current: I<0.3mA	
17	Batt2	Battery power Source 2 terminal (Motor power source)	Inside control Max. rush current : I<100A(t<100msec) Max. current : I<30A(t>100msec) Dark current: I<0.3mA	T: the running time of motor

The management of failure detected

No.	Description
1	System down. Both the ABS and the EBD function are inhibited and the ABS and the EBD warning lamps is activated. In this failure, the valve relay and all solenoids are prevented from being switched on.
	Only the ABS function is inhibited.

2	The ABS warning lamp is activated and the EBD warning lamp not activated.
3	Sensor failure outside the ABS control cycle 1) Only one wheel failure: take the same action as management. 2) More than two wheels failure : take the same action as management.
4	Sensor failure inside the ABS control cycle 1) One front wheel failure: inhibit the ABS control of the Failed-wheel and maintain the ABS control of normal wheel. After the controller completes the ABS control, take the same action as the management. 2) Rear wheel failure: inhibit ABS control of both front wheels and the pressure of rear wheel is decreased. After the controller completes the ABS control, take the same action as the management. 3) More than two wheels failure: take the same action as the management.
5	Low operating voltage 1) Outside the ABS control cycle: inhibit the ABS control of front wheels and allow the ABS control of rear wheel, deactivating the motor. And the ABS warning lamp is directly switched on. When the voltage recover to the normal operating range, enable ABS function and ABS function and ABS warning lamp is switched off and erase the error code of low voltage. 2) Inside the ABS control cycle: inhibit the ABS control of front wheels and allow the ABS control of rear wheel, deactivating the motor. The ABS warning lamp is directly switched on and the state keeps continuously. The error code is always stored.
6	Motor failure inside the ABS control cycle. 1) Inhibit the ABS control of front wheels and allow the ABS control of rear wheel, deactivating the motor (in only motor failure). After the controller completes the ABS control, take the same action as the management 2.

Detect mode
A: Initial check
B: Outside the ABS control cycle
C: Inside the ABS control cycle
D: Diagnosis mode
E: Failure mode

Diagnostic trouble code descriptions

No.	Failure Location	Failure Cause	Condition for Detection	Error code	Management/ Detect mode				
					A	B	C	D	E
1.1	Sensor (wiring, harness, exciter, ECU)	Short to GND, Short to Batt, Open	The wheel velocity is below 7Km/h and the offset voltage of the sensor is outside the permitted range (2.15~3.5V). If this condition is continued for more than 140msec.	FL: C1200 FR: C1203 RL: C1206 RR: C1209	3 3 3 3	3 3 3 3	4 4 4 4	3 3 3 3	3 3 3 3
1.2		Speed Jump	The wheel deceleration of [-100(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure.	FL: C1201 FR: C1204 RL: C1207 RR: C1210	- - - -	3 3 3 3	4 4 4 4	3 3 3 3	3 3 3 3
1.3		Large Air gap	This monitoring is performed for the period that the minimum velocity rises from 2km/h to 10km/h. 1) When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h with the acceleration of <; z0.4g, the controller start comparing the velocity of other wheels except the min. wheel. If their difference below 4km/h is continued for 154msec, otherwise, if their difference beyond 4km/h or> [0.4g is contiuned for 120 seconds. 2) 1n < z0.4g, when the velocity of more two	FL: C1202 FR: C1205 RL: C1208 RR: C1211	- - - -	3 3 3 3	- - - -	3 3 3 3	3 3 3 3

			wheels is 2km/h and the max. Wheel velocity exceeds 10km/h, the condition is continued for 5sec. Otherwise, 1> [0.4g, the condition is 120 seconds.						

No.	Failure Location	Failure Cause	Condition for Detection	Error code	Management/ Detect mode				
					A	B	C	D	E
1.4	Sensor (wiring, harness, exciter, ECU)	Wrong Exciter	1) Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. If this condition is lasted for 120sec. 2) Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. If this condition lastes for 120sec.	FL: C1201 FR: C1204 RL: C1207 RR: C1210	- - - -	3 3 3 3	4 4 4 4	3 3 3 3	3 3 3 3
1.5		Long term ABS mode	1) During the ABS control cycle, if the wheel velocity of 2km/h lasts for more than 12sec. 2) If the ABS control cycle is continued for more than 36sec.	FL: C1202 FR: C1205 RL: C1208 RR: C1211	- - - -	- - - -	4 4 4 4	- - - -	- - - -
2.1	Valve relay (wiring harness, ECU)	Open	When the valve relay is switched on, the reference voltage of valve relay is outside the permitted range, which is continued for 56msec.	C2112	1	1	1	1	-
2.2		Short	When the valve relay is switched off, the reference voltage of valve relay is over the criterion, which is continued for 56msec.		1	-	-	-	1
3	Solenoid valve (ECU, wiring harness)	Open, Short, Leakage Current	1) When the valve relay is switched off, the drain voltage of the solenoid drive MOSFET is over the criterion, which is continued for 56msec. 2) When the valve relay is switched on and a solenoid off, the drain voltage of the solenoid drive MOSFET is under the criterion, which is continued for 56msec. 3) When the valve relay and a solenoid are switched on, the drain voltage of the solenoid drive MOSFET is over the criterion, which is continued for 56msec.	C1604	1	1	1	1	1

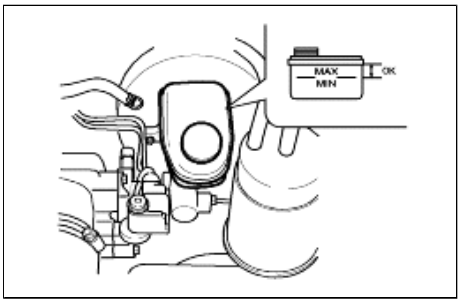
No.	Failure Location	Failure Cause	Condition for Detection	Error code	Management/ Detect mode				
					A	B	C	D	E
4.1	Motor relay, motor (wiring harness, ECU)	Motor relay or fuse open, motor short to GND	When the motor relay is switched on, the reference voltage of motor is under the criterion, which is continued for 49msec.	C2402		2	2	2	
4.2		Motor lock	The controller starts monitoring the motor voltage for 84msec from the time when the motor relay is switched off. If the motor voltage is under the criterion for 49msec, after 1.8sec from driving the motor off, the motor is reactivated for 1sec and the above check is performed again. In second check, when the motor voltage is under the criterion for 49msec, the controller recognizes the failure.			2	2	2	
4.3		Motor short to BATT	The controller starts monitoring the motor after 1.8sec from the time when the motor relay is switched off. If the motor voltage is over the criterion for 200msec.		2	2		2	2

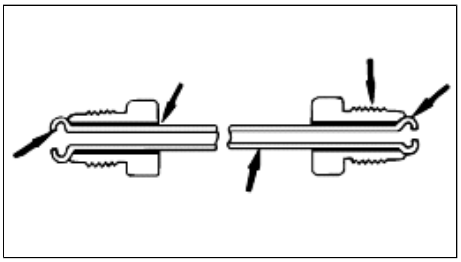
4.4		Motor open	The controller starts monitoring the motor after 1.8sec from the time when the motor relay is switched off. If the motor vol tage is outside the permitted range for 200msec.		2	2		2	2

No.	Failure Location	Failure Cause	Condition for Detection	Error code	Management/ Detect mode				
					A	B	C	D	E
5.1	Power supply	Low voltage	1) When V(IGN) < 9.4V is continued for 500msec 2) If the voltage reaches to more than 9.6V, the controller recovers to normal state.	C1102	5	5	5	5	5
			1) When V(IGN) < 7.2V is detected during state 1) 2) If the voltage reaches to more than 7.5V, the controller recovers to state 1)		1	1	1	1	1
5.2		Over voltage	1) When V(IGN)>17V is continued for 500msec, or when V(IGN)>18V is continued for 49msec. 2) If the voltage recovers normal operating range, the controller is reset.	C1101	1	1	1	1	1
6.1	ECU	EEPROM failure	After the master processor writes the pre-defined data to EEPROM, read the data and compare each other. If they differ from each other.	C1604	1	1	1	1	1
6.2		MCU failure	If the master/slave processor detects abnormal operation in RAM, status register, interrupt, timer, A/D converter and cycle time.		2	2		2	2

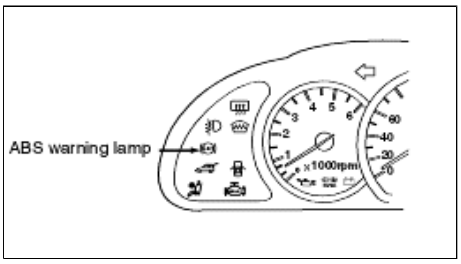
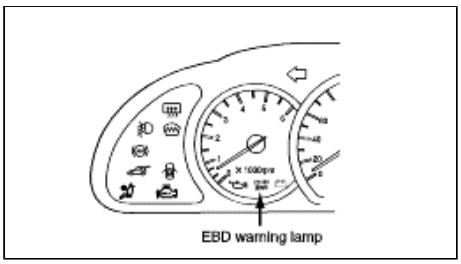
basic inspection

Visual observation

Step	Inspection		Actions
1	Check if parking brake is working properly. 1) Stroke: 3.50-4.33 in (90-110 mm)	Yes	Go to next step.
		No	1) Repair or replace lever/cable. 2) Inspect parking brake switch. 3) Check operation. 4) Turn adjusting nut.
2	Check if brake fluid level in the reservoir tank is between "Max" and "Min". 	Yes	Go to next step.
		No	Fill up brake fluids.
3	Check if brake fluids leak on all hydraulic lines.	Yes	Replace corresponding part.
		No	Go to next step.

			
4	Check if ABS fuse is fully seated and intact. 1) Opened or shorted 2) Connection	Yes	Go to next step.
		No	Replace it.
5	Check if following component is fully seated and intact. 1) ABS sensor 2) Hydraulic control unit (Include ECU) 3) Brake fluids reserve tank 4) Stop lamp switch 5) ABS warning module 6) EBD Warning module (Parking brake switch)	Yes	Check functions.
		No	Connect it again. Repair or replace it.

Checking functionality

Step	Inspection		Actions
1	Verify if ABS warning lamp turns on for 2 to 3 seconds when ignition is switched ON. 	Yes	Go to next step.
		No	Check ABS warning lamp and wiring harness.
2	1) Verify if brake warning lamp(EBD warning lamp) turns off when parking brake is released. 2) Verify if brake warning lamp turns on for 2 to 3 seconds when ignition is switched ON. After parking brake is released. 	Yes	Go to next step.
		No	1) Check level of brake fluids. 2) Inspect brake pipes, hoses, wheel cylinder, seal and leak at master cylinder. 3) Brake warning lamp (EBD warning lamp) can turn on with ABS warning lamp at the same time when ABS is defective. 4) Although parking brake is released, brake warning lamp can turn on intermittently when ignition is switched on.
3	Retrieve malfunction codes using diagnostic tool (Hi-scan pro).	Yes	Go to corresponding detail inspection.
		No	Go to next step.
4	Go to step 3 again after driving vehicle, and retrieve malfunction codes.	Yes	Go to corresponding detail inspection.
		No	1) Check each connector and connections. 2) System OK.

Diagnostic trouble code inspection

DTC	Trouble location	Symptom
C1101	Battery voltage over volt	> 17V
C1102	Battery voltage low volt	< 9.4V

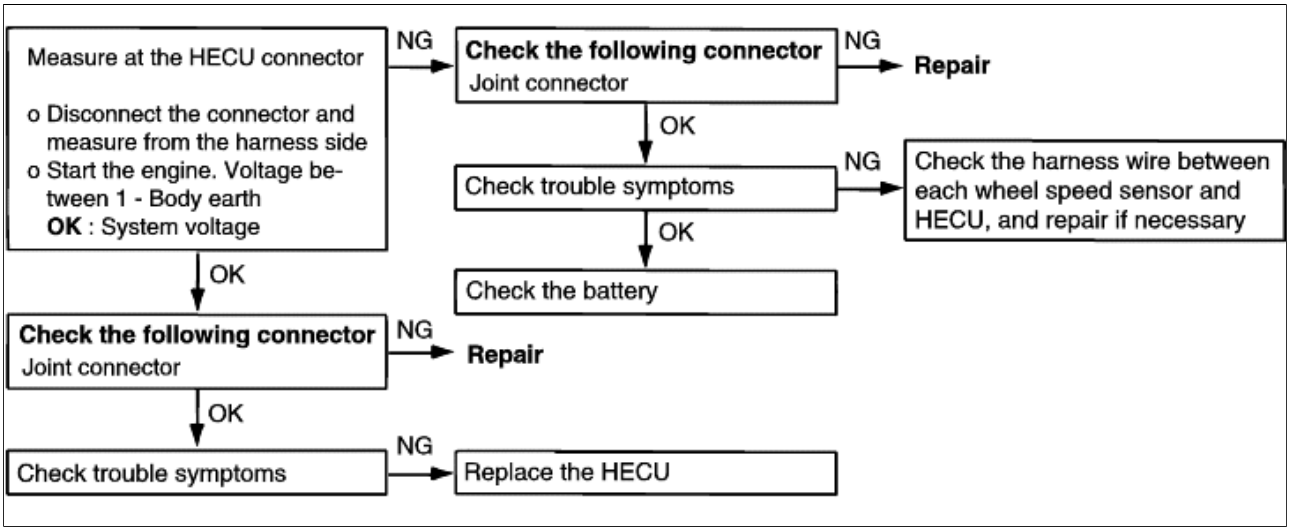
C1200	FL wheel sensor	Open or short to GND
C1201	- Range/ Performance	Speed jump or damaged exciter
C1202	- No signal	Air-gap error or wrong excite
C1203	FR wheel sensor	Open or short to GND
C1204	- Range/Performance	Speed jump or damaged exciter
C1205	- No signal	Air-gap error or wrong excite
C1206	RL wheel sensor	Open or short to GND
C1207	- Range/ Performance	Speed jump or damaged exciter
C1208	- No signal	Air-gap error or wrong excite
C1209	RR wheel sensor	Open or short to GND
C1210	- Range/Performance	Speed jump or damaged exciter
C1211	- No signal	Air-gap error or wrong excite
C1604	ECU hardware	ECU internal or valve failure
C2112	Valve relay, Fuse	Valve relay or fuse failure
C2402	Motor- Electrical or motor lock fail	Open or short to battery, motor relay, fuse

Voltage

DTC No. C1101, C1102 Voltage out of range (Under and over voltage)	Probable cause
[Comment] The voltage of the HECU power supply drops lower or rises higher then specified value. If the voltage returns to the specified value, this code is no longer outpurt.	1) Malfunction of wiring harness or connector 2) Malfunction of HECU

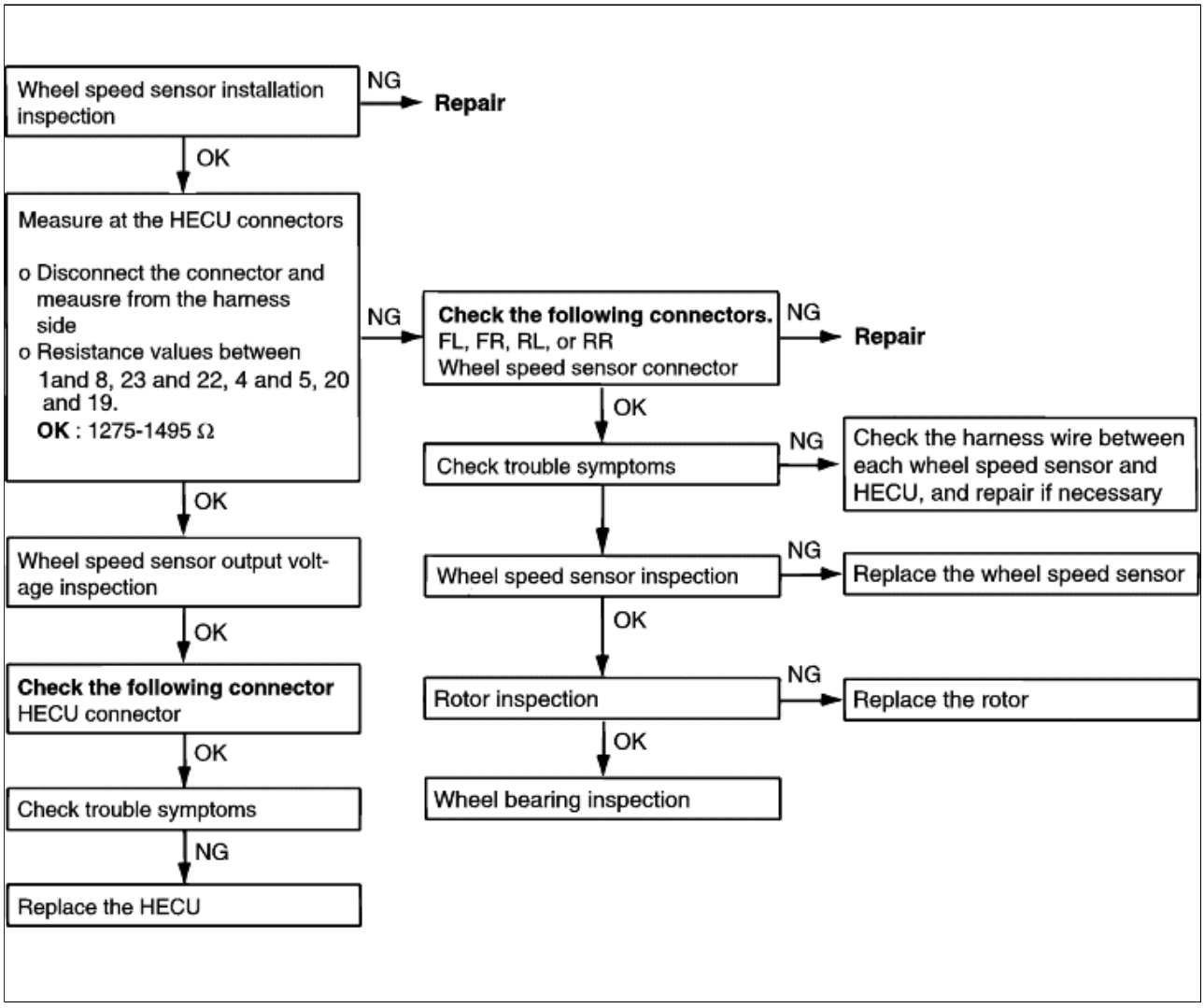
CAUTION

If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to standard value, this code is no longer output.
Before carrying out the following inspection, check the battery level, and refill it if necessary.



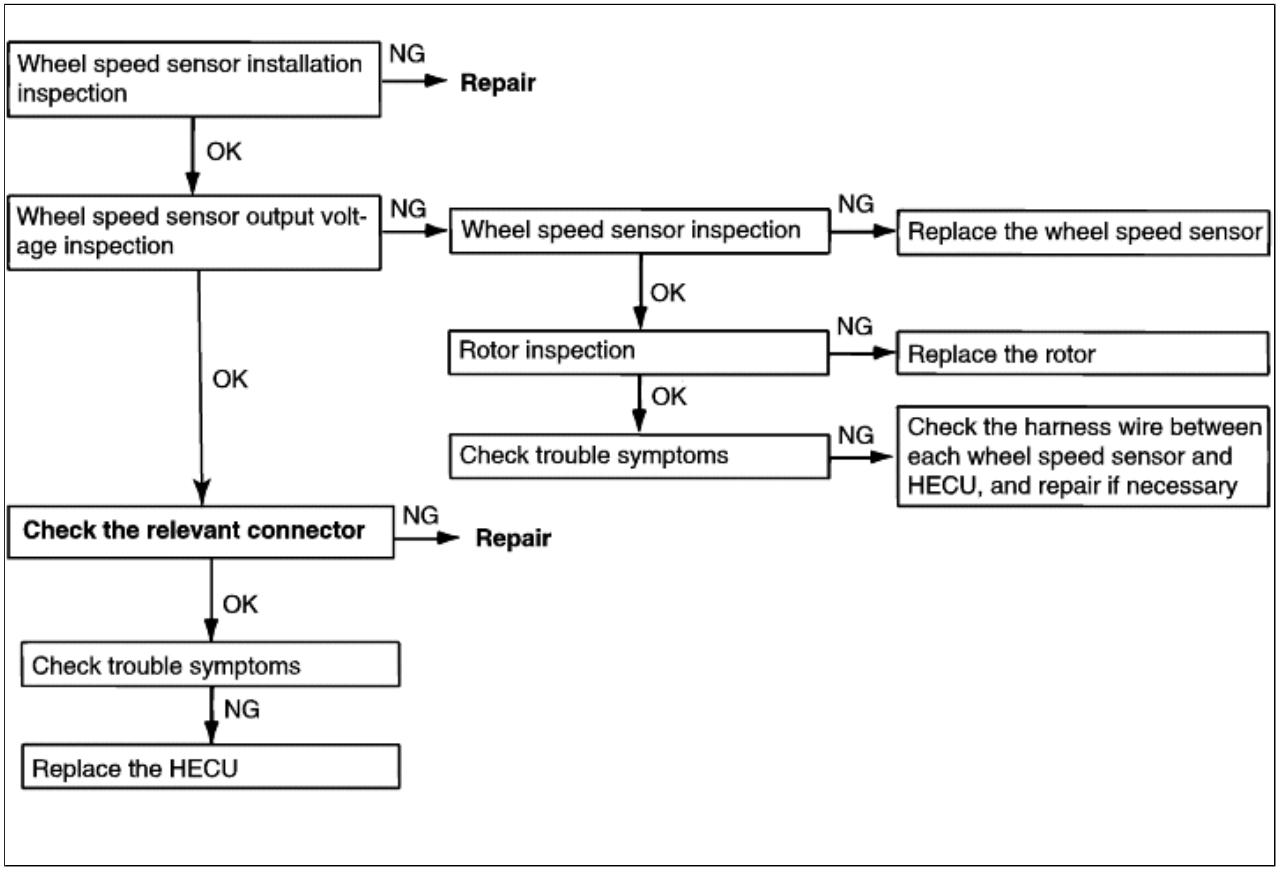
WHEEL SPEED SENSOR

DTC No. C1200, C1203, C1206, C1209 Wheel speed sensor open or short GND circuit	Probable cause
[Comment] The HECU determines that an open or short circuit occurs in more than one line of wheel speed sensors.	1) Malfunction of wheel speed sensor 2) Malfunction of wiring harness or connector 3) Malfunction of HECU



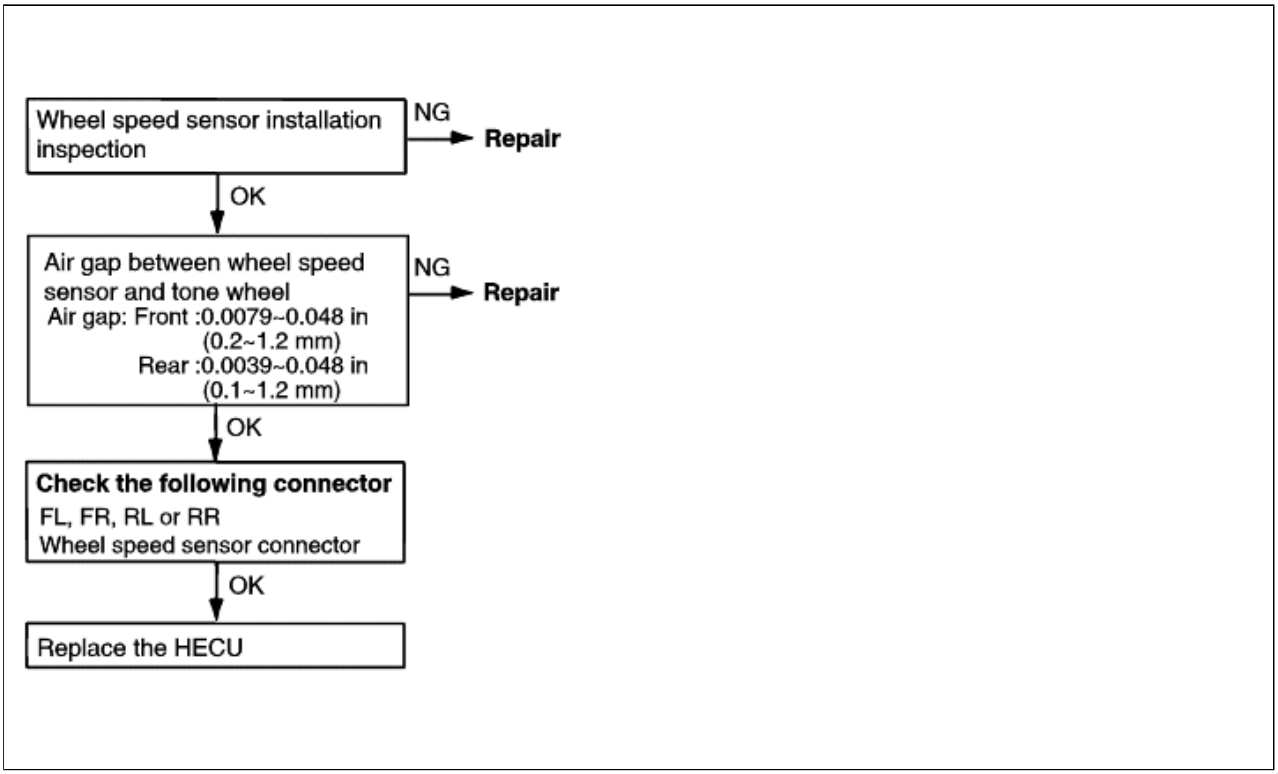
Speed jump or wrong exciter

DTC No. C1201, C1204, C1207, C1210 (Speed jump or wrong exciter)	Probable cause
[Comment] A wheel speed sensor outputs an abnormal signal (other than an open short-circuit).	1) Improper installation of wheel speed sensor 2) Malfunction of wheel speed sensor 3) Malfunction of rotor 4) Malfunction of wheel bearing 5) Malfunction of wiring harness or connector 6) Malfunction of HECU



Air gap error

DTC No. C1202, C1205, C1208, C1211 (Air gap error)	Probable cause
[Comment] A wheel speed sensor outputs an abnormal signal.	1) Malfunction of wheel speed sensor 2) Iproper installation of wheel speed sensor 3) Malfunction of rotor 4) Malfunction of wiring harness or connector 5) Malfunction of HECU



ECU Hardware

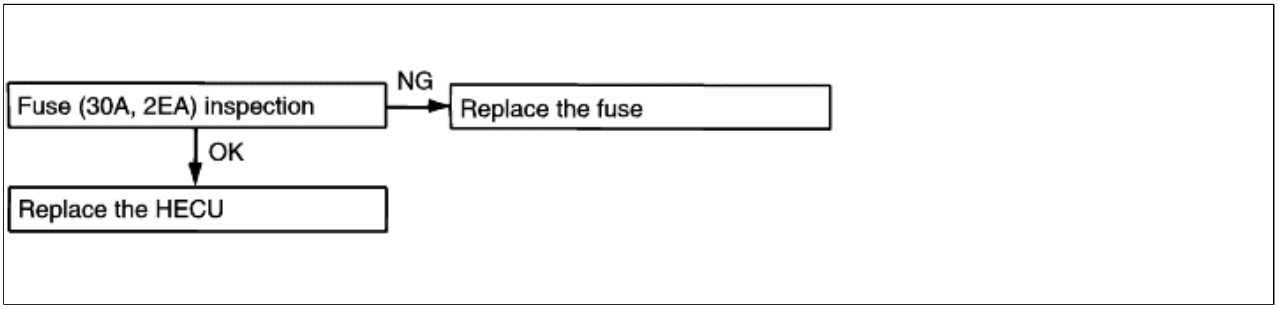
DTC No. C1604 ECU Hardware (Error valve failure)	Probable cause
[Comment] The HECU always monitors the solenoid valve drive circuit. It determines that there is an open or short-circuit in the solenoid coil or in a harness : When no current flows in the solenoid even though the HECU turns on it, and vice versa.	1) Malfunction of wiring harness 2) Malfunction of hydraulic unit 3) Malfunction of HECU

Valve relay

DTC No. C2112 Valve relay (Including fuse failure)	Probable cause
[Comment] When the ignition switch is turned to ON, the HECU switches the valve relay off and on during the initial check. In that way, the HECU compares the signals sent to the valve relay with the voltage in the valve power monitor line. That is how to check if the valve relay is operating normally. The HECU always checks if current flows in the valve power monitor line, too. It determines that there is an open circuit when no current flows. If no current flows in the valve power monitor line, this diagnosis code is output.	1) Malfunction of valve relay 2) Malfunction of wiring harness or connector 3) Malfunction of HECU 4) Malfunction of hydraulic unit

NOTE

Whenever reading the diagnosis codes using the ABS warning lamp, this diagnosis code will be output.

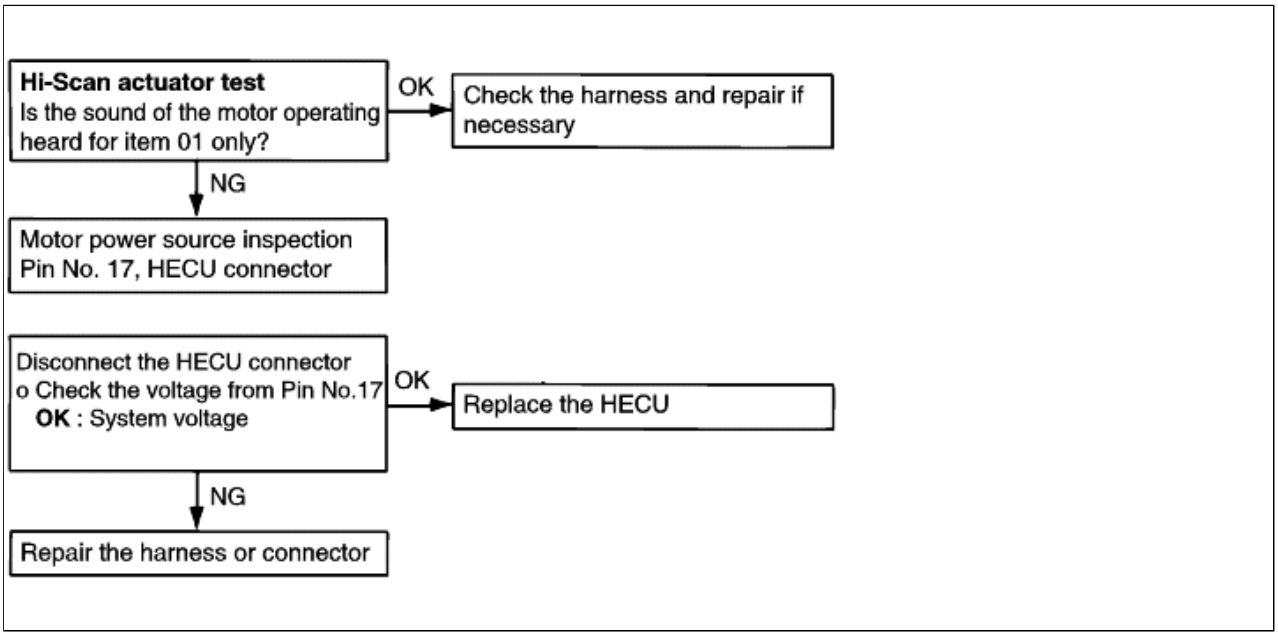


Pump-motor

DTC No. C2402 Electrical (Pump-motor)	Probable cause
[Comment] When the motor power line is normal but no signal is inputed to the motor monitor line when the motor power line is faulty.	1) Malfunction of wiring harness or connector 2) Malfunction of hydraulic unit 3) Malfunction of HECU

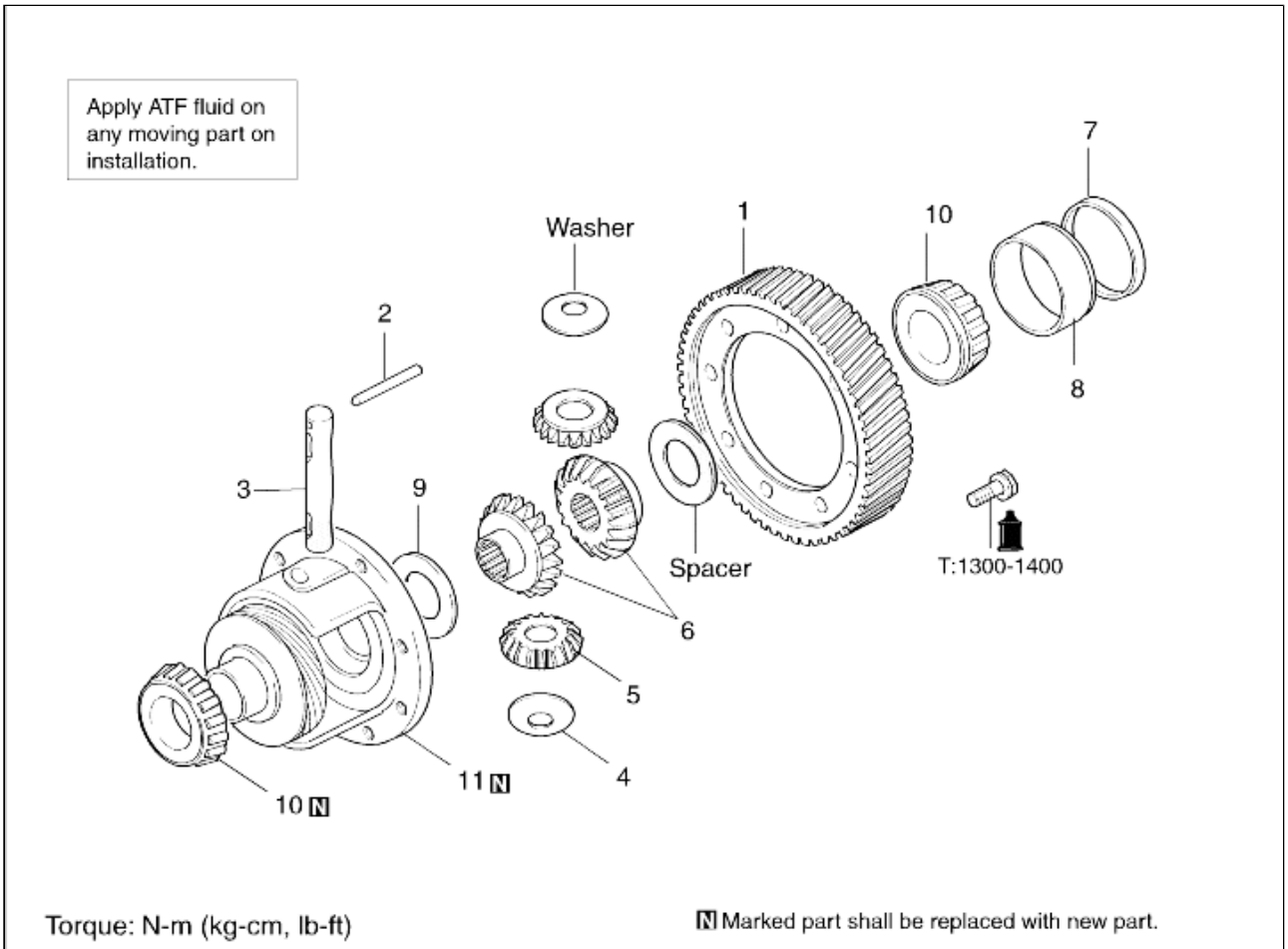
CAUTION

Because force-driving of the motor by means of the actuator test will drain the battery, the engine should be started and left to run for a while after testing is completed.



manual transaxle system

Components



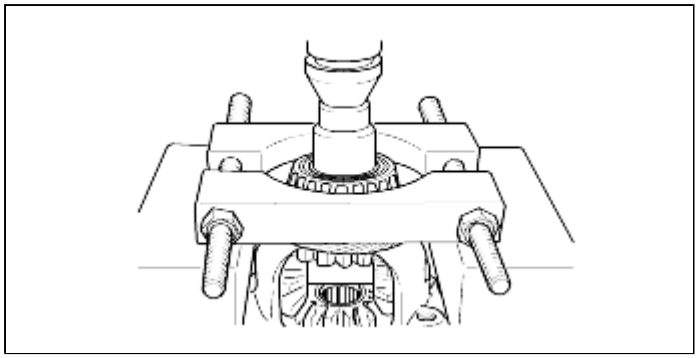
Torque: N-m (kg-cm, lb-ft)

N Marked part shall be replaced with new part.

1. Differential drive gear
2. Lock pin
3. Pinion shaft
4. Washer
5. Pinion gear
6. Side gear
7. Spacer
8. Outer race
9. Spacer
10. Taper roller bearing
11. Differential case

Disassembly

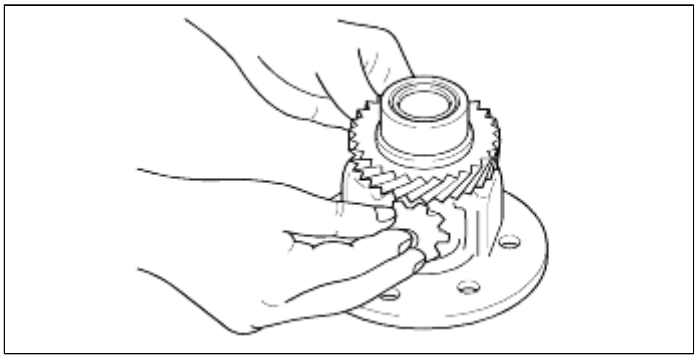
1. Remove the taper roller bearing.



Reassembly

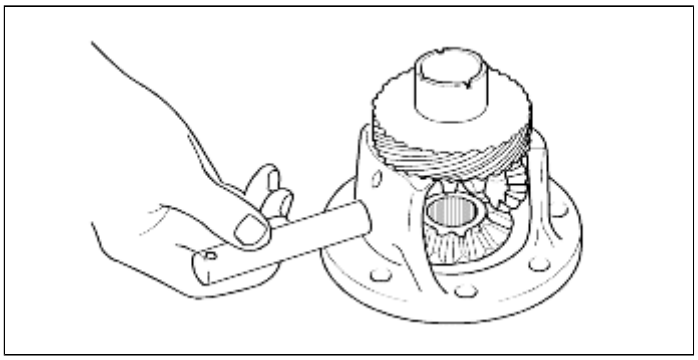
1. Remove the spacer, the side gear, the washer, the pinion and the pinion shaft.
   (1) Connect the side gear with the spacer, and install the side gear into differential case.

> NOTE
>
> Use a spacer of neutral thickness
> 0.037~0.039in(0.93~1.00mm) for a new side gear.



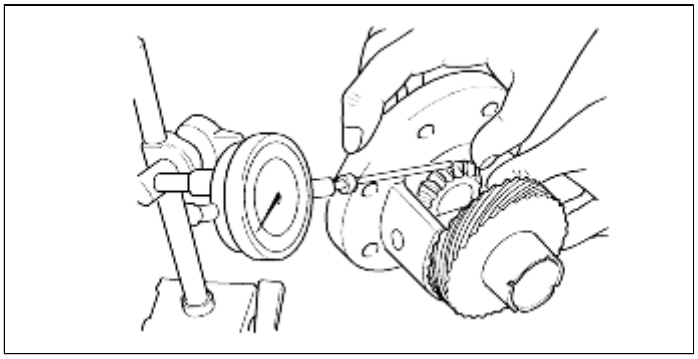
   (2) Connect the washer to the pinion and install them simultaneously at the point so that they may lock with the side gear.

   (3) Install the pinion shaft.



   (4) Check the side gear pinion backlash and install a proper spacer.

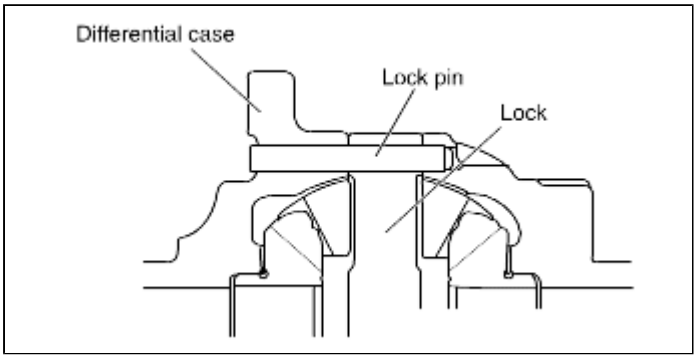
Standard value :0.00098~0.0059in(0.025~0.150mm)



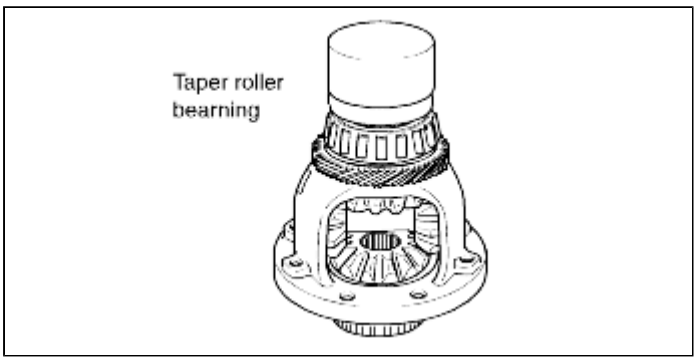
NOTE

Adjust backlashes at both sides to be within standard value.

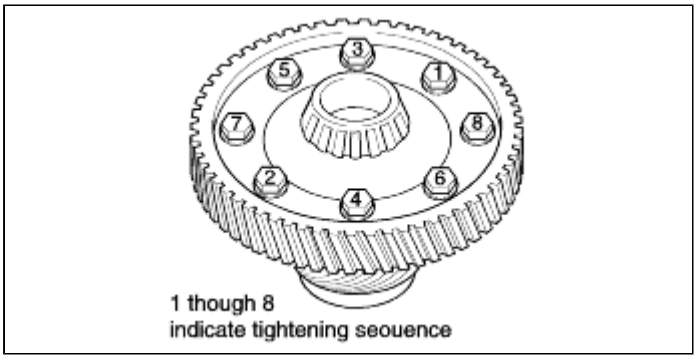
2. Install the lock pin.
   Install the lock pin at the direction illustrated on the figure.



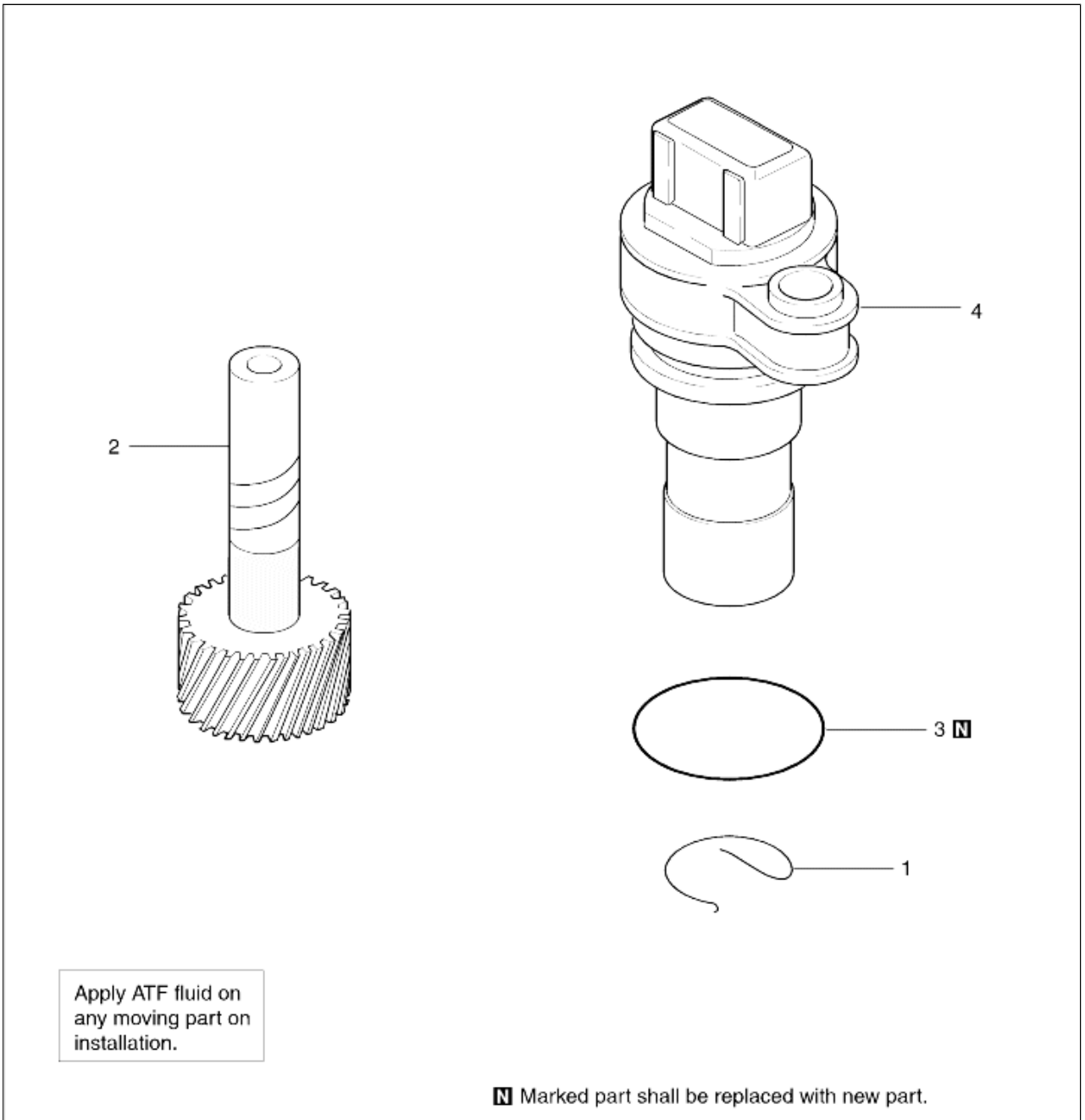
3. Install the taper roller bearing.



4. Install the differential drive gear.
5. Apply ATF on bolts and install them in the order illustrated on the figure and tighten them with tightening torque.



Components



Disassembly procedure

1. E-clip
2. Speedometer driven gear
3. O-ring
4. Sleeve

automatic transaxle system

Tightening torque

Item	N·m	kg·cm	lb·ft
Wiring harness bracket	20-26	200-260	14-18
Control cable bracket	20-26	200-260	14-18
Eye bolt	27-33	270-330	19-23
Oil cooler feed tube	10-12	100-120	7-8
Input shaft speed sensor	10-12	100-120	7-8
Output shaft speed sensor	10-12	100-120	7-8
Manual control lever	18-25	180-250	13-18
Transaxle range switch	10-12	100-120	7-8
Vehicle speed sensor	4-6	40-60	3-4
Valve body cover	8-10	80-100	6-7
Valve body mounting bolt	10-12	100-120	7-8
Oil temperature sensor	10-12	100-120	7-8
Manual control shaft detent	5-7	50-70	4-5
Rear cover	20-26	200-260	14-18
Torque converter housing	42-54	420-540	29-38
Oil pump	20-26	200-260	14-18
Transfer drive gear	31-36	320-370	23-27
Output shaft lock nut	160-180	1600-1800	110-126
Output shaft bearing retainer	20-26	200-260	14-18
Oil filler tube	29-34	290-340	20-24
Oil drain plug	29-34	290-340	20-24
Transfer drive gear lock nut	180-210	1800-2100	126-147
Differential drive gear	130-140	1300-1400	91-98
Valve body	10-12	100-120	7-8
Solenoid valve support	5-7	50-70	4-5
Plate	5-7	50-70	4-5
Pressure check plug	8-10	80-100	6-7
Front roll stopper bracket to cross member bolts	60-80	600-800	43-58
Front roll stopper insulator bolt and nut	50-65	500-650	36-47
Front roll stopper bracket to transaxle bolts	60-80	600-800	43-58
Rear roll stopper bracket to cross member bolts	50-65	500-650	36-47
Rear roll stopper insulator bolt and nut	50-65	500-650	36-47
Rear roll stopper bracket to transaxle bolts	60-80	600-800	43-58
Transaxle mounting sub bracket nut	60-80	600-800	43-58
Transaxle mounting bracket bolts	60-80	600-800	43-58

Transaxle mounting insulator bolt	90-110	900-1100	65-80

CAUTION

ALWAYS FOLLOW TORQUE TIGHTENING LEVELS. FAILURE TO FOLLOW SUCH LEVELS CAN RESULT IN PARTS BREAKING IF OVER-TIGHTENED OR LOOSENING IF UNDER-TIGHTENED. IN EITHER CASE, SERIOUS PERSONAL INJURY OR DEATH COULD RESULT TO THE VEHICLE OCCUPANTS.

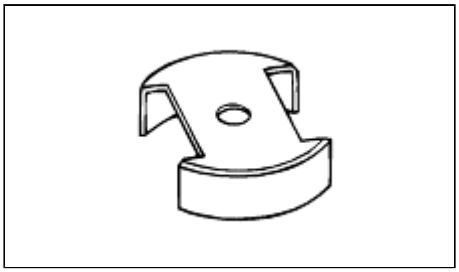
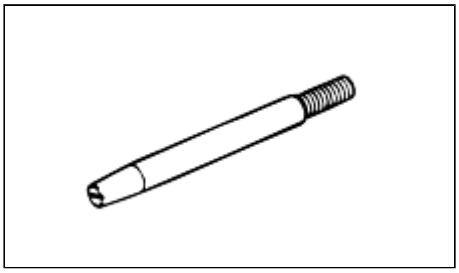
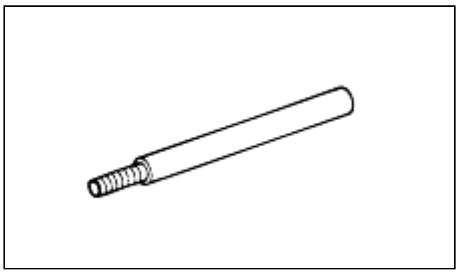
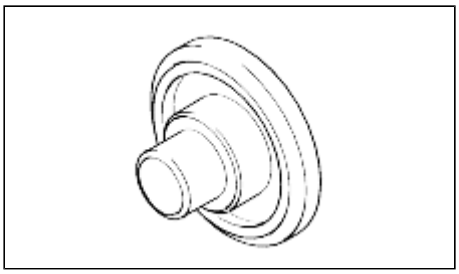
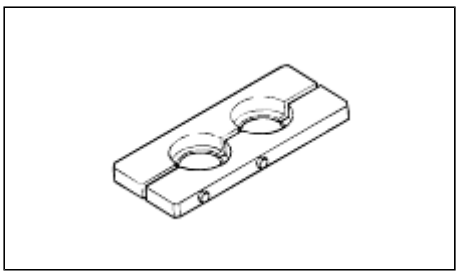
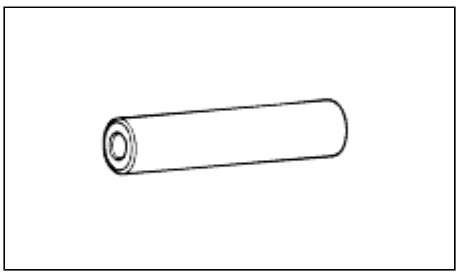
Lubricant

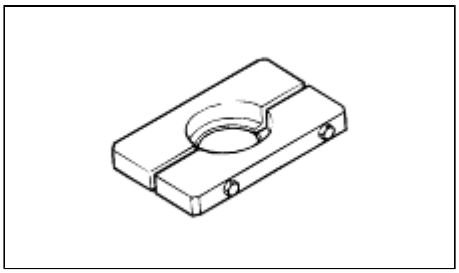
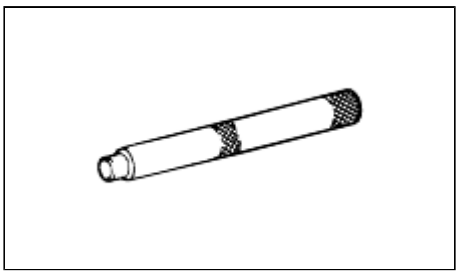
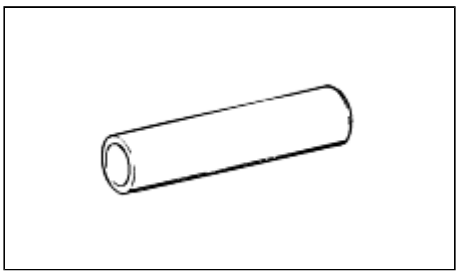
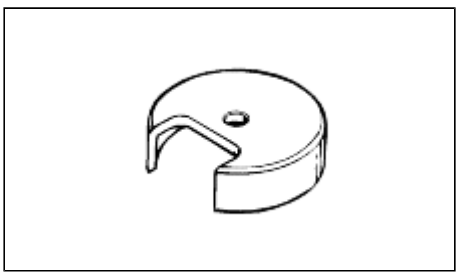
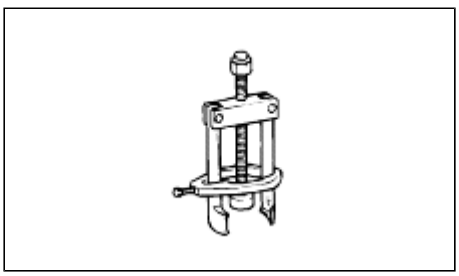
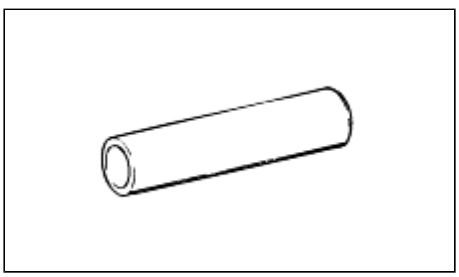
Items	Specified lubricant	Quantity
Transaxle fluid lit.	GENUINE DIAMOND ATF SP-III	8.5lit (8.9US qt, 7.4 lmp qt)

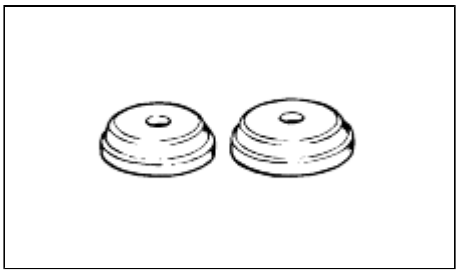
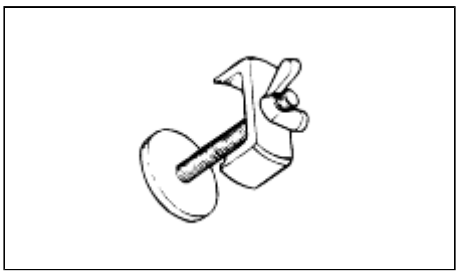
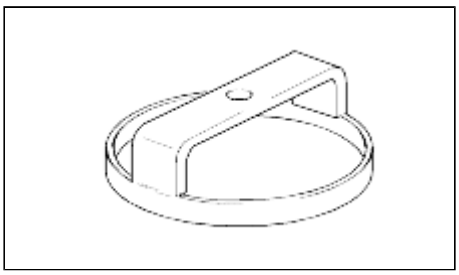
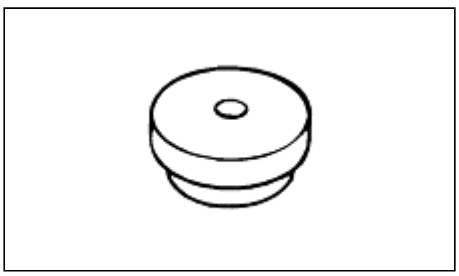
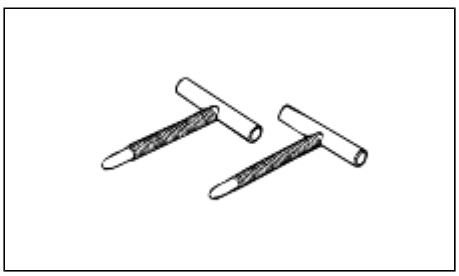
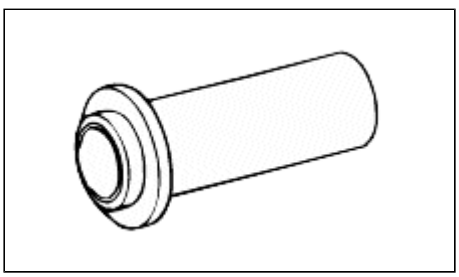
Sealants

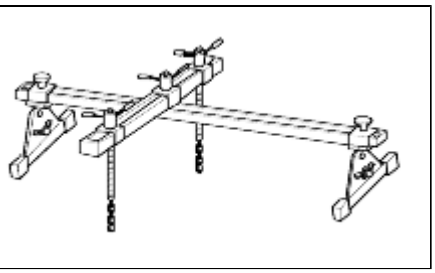
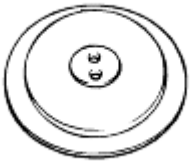
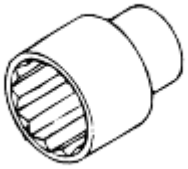
Items	Specified sealant
Rear cover Torque converter housing Valve body cover	KMC's approved sealant TB 1281B or LOCTITE FMD546

Special service tools

Tool (Number and Name)	Illustration	Use
09453-24000 Snap ring compressor		Removal and installation of the underdrive clutch snap ring.
09452-21401 Guide pin		Installation of the oil pump and transfer drive gear. (use with 09452-21301)
09453-33100 Dial gauge extension		Measurement of the low and reverse and second brake end play.
09431-39000 Oil seal installer		Installation of the drive shaft oil seal.
09432-33200 Remover plate		Removal of the transfer shaft bearing.
09432-33800 Bearing installer		1) Removal of the transfer drive gear taper bearing. (use with 09433-21000) 2) Installation of the transfer shaft bearing.

09433-21000 Remover plate		1) Removal of the transfer drive gear taper bearing. (use with 09432-33800) 2) Removal of the differential ball bearing.
09500-11000 Bar		Installation of the differential outlace bearing. (use with 09532-11500)
09455-33200 Bearing installer		Installation of the differential ball bearing and output shaft taper roller bearing.
09453-21100 Snap ring compressor		Removal and installation of the low and reverse brake snap ring. (use with 09453-2100)
09455-21000 Bearing and gear puller		Removal of the transfer drive gear and bearing.
09455-21100 Bearing installer		1) Installation of the transfer drive gear and bearing. 2) Installation of the transfer drive gear taper bearing.
09532-11500 Bearing installer		Installation of the differential outlace bearing. (use with 09500-11000)

		
09453-21000 Snap ring compressor		1) Removal and installation of the low&reverse brake snap ring. 2) Removal and installation of the overdrive clutch snap ring. (use with 09456-39000)
09456-39000 Spring compressor		Removal and installation of the low and reverse brake and overdrive clutch snap ring.
09432-21701 Bearing outlace installer		Installation of the output shaft outlace.
09452-33100 Oil pump remover		Removal of the oil pump.
09452-21200 Oil pump oil seal installer		Installation of the oil pump oil seal.
09200-38001 Engine support		Removal and installation of the transaxle.

		
09456-39100A/B Clearance dummy plate		Measurement of the low and reverse and second brake end play.
09457-39000 Socket wrench (41)		Removal and installation of the output lock nut.

Specifications

Items \ Model		F5A51-3
Torque converter type		3 elements, 1 stage, 2 phase
Transaxle type		5-speed forward, 1-speed reverse
Engine type		Σ 3.5 DOHC
Gear ratio	First	3.789
	Second	2.057
	Third	1.421
	Fourth	1.000
	Fifth	0.731
	Reverse	3.865
Final gear ratio		3.333

Service specifications

in(mm)

Item \ Model	F5A51-3
Underdrive clutch end play	0.063 – 0.071(1.6–1.8)
Overdrive clutch end play	0.063 – 0.071(1.6–1.8)
Reverse clutch end play	0.059– 0.067(1.5–1.7)
Second brake end play	0.043 – 0.061(1.09–1.55)
Low and reverse brake end play	0.065 – 0.083(1.65–2.11)
Direct clutch end play	0.024 – 0.031(0.6–0.8)
Underdrive sun gear end play	0.0098^{L} – 0.0177^{L}(0.25^{L}–0.45^{L})
Input shaft end play	0.027^{L} – 0.057^{L}(0.70^{L}–1.45^{L})
Differential case end play	0.0177^{T} – 0.0041^{T}(0.45^{T}–0.105^{T})
Differential side gear and pinion gear end play	0.00098^{L} – 0.0059^{L}(0.025^{L}–0.150^{L})
Brake reaction plate end play	0 – 0.0063^{L}(0–0.16^{L})

Snap ring, spacer, thrust washer and pressure plate

Part name	Models	Thickness in(mm)	Identification symbol
Thrust washer (For adjustment of input shaft end play)	F5A51-3	0.071(1.8)	18
		0.079(2.0)	20
		0.087(2.2)	22
		0.094(2.4)	24
		0.102(2.6)	26
		0.110(2.8)	28
Snap ring (For adjustment of underdrive clutch and overdrive clutch end play)	F5A51-3	0.079(2.0)	colorless
		0.083(2.1)	blue
		0.087(2.2)	brown
		0.091(2.3)	colorless
		0.094(2.4)	blue
		0.098(2.5)	brown
		0.102(2.6)	colorless
		0.106(2.7)	blue
		0.110(2.8)	brown

		0.114(2.9)	colorless
		0.118(3.0)	blue
		0.075(1.9)	brown
		0.071(1.8)	blue
		0.067(1.7)	colorless
		0.063(1.6)	brown
Snap ring (For adjustment of low and reverse brake reaction plate end play)	F5A51-3	0.085(2.2)	colorless
		0.091(2.3)	blue
		0.094(2.4)	brown
		0.098(2.5)	colorless
Pressure plate (For adjustment of low and reverse brake and second brake reaction plate end play)	F5A51-3	0.071(1.8)	E
		0.079(2.0)	D
		0.087(2.2)	C
		0.094(2.4)	B
		0.102(2.6)	A
		0.110(2.8)	O
		0.118(3.0)	I
		0.063(1.6)	F
Pressure plate (For adjustment of second brake reaction plate end play)	F5A51-3	0.094(2.4)	P
		0.102(2.6)	R
		0.110(2.8)	S
		0.118(3.0)	T
		0.126(3.2)	U
		0.134(3.4)	V
Snap ring (For adjustment of reverse clutch end play)	F5A51-3	0.079(2.0)	blue
		0.083(2.1)	brown
		0.087(2.2)	colorless
		0.091(2.3)	blue
		0.094(2.4)	brown
		0.098(2.5)	colorless
		0.102(2.6)	blue
		0.106(2.7)	brown
		0.110(2.8)	colorless
		0.075(1.9)	colorless
		0.071(1.8)	brown
		0.067(1.7)	blue
		0.063(1.6)	colorless
Snap ring (For adjustment of reverse brown and overdrive clutch spring retainer colorless end play)	F5A51-3	0.0583(1.48)	brown
		0.0602(1.53)	colorless
		0.0622(1.58)	blue
		0.0642(1.63)	brown
		0.036(1.6)	-
		0.067(1.7)	-
		0.071(1.8)	-
		0.075(1.9)	-
		0.079(2.0)	-

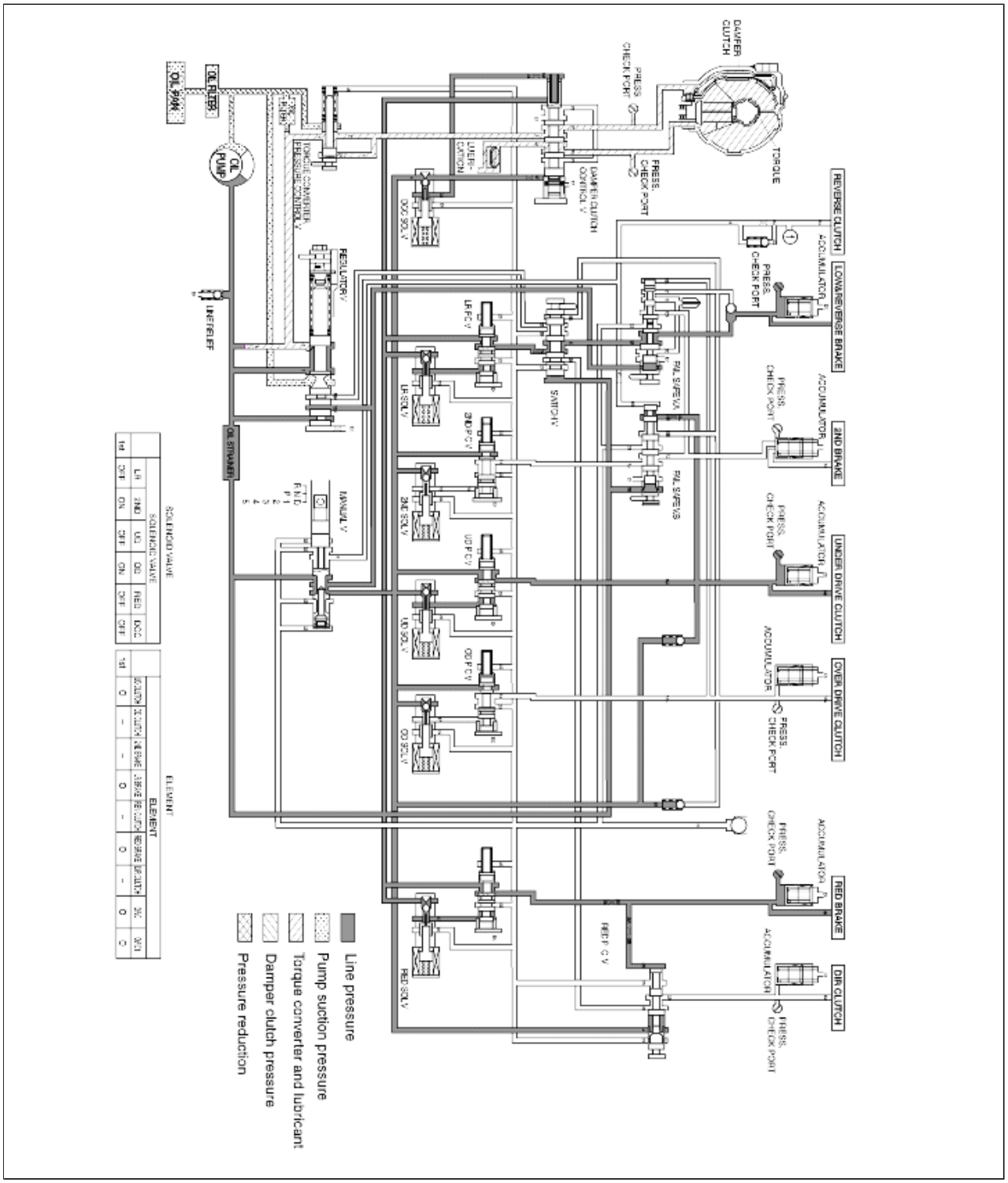
Thrust washer (For adjustment of underdrive sun gear end play)	F5A51-3	0.083(2.1)	-
		0.087(2.2)	-
		0.091(2.3)	-
		0.094(2.4)	-
		0.098(2.5)	-
		0.102(2.6)	-
Snap ring (For adjustment of direct clutch end play)	F5A51-3	0.075(1.9)	brown
		0.079(2.0)	colorless
		0.083(2.1)	blue
		0.087(2.2)	brown
		0.091(2.3)	colorless
		0.094(2.4)	blue
		0.098(2.5)	brown
		0.102(2.6)	colorless
		0.106(2.7)	blue
		0.110(2.8)	brown
		0.114(2.9)	colorless
		0.118(3.0)	blue
Spacer (For adjustment of output shaft preload)	F5A51-3	0.074(1.88)	88
		0.076(1.92)	92
		0.077(1.96)	96
		0.079(2.00)	00
		0.080(2.04)	04
		0.082(2.08)	08
		0.083(2.12)	12
		0.085(2.16)	16
		0.087(2.20)	20
		0.088(2.24)	24
		0.089(2.28)	28
		0.091(2.32)	32
		0.093(2.36)	36
		0.094(2.40)	40
		0.096(2.44)	44
		0.097(2.48)	48
		0.099(2.52)	52
		0.101(2.56)	56
		0.102(2.60)	60
		0.104(2.64)	64
		0.106(2.68)	68
		0.107(2.72)	72
		0.109(2.76)	76
Spacer (For adjustment of differential gear	F5A51-3	0.024(0.6)	-
		0.027(0.7)	-
		0.031(0.8)	-
		0.035(0.9)	-
		0.039(1.0)	-

backlash)		0.043(1.1)	-
		0.047(1.2)	-
		0.051(1.3)	-
		0.055(1.4)	-
Spacer (For adjustment of differential case preload)	F5A51-3	0.033(0.83)	83
		0.034(0.86)	86
		0.035(0.89)	89
		0.036(0.92)	92
		0.037(0.95)	95
		0.038(0.98)	98
		0.040(1.01)	01
		0.041(1.04)	04
		0.042(1.07)	07
		0.043(1.10)	10
		0.044(1.13)	13
		0.046(1.16)	16
		0.047(1.19)	19
		0.048(1.22)	22
		0.049(1.25)	25
		0.050(1.28)	28
		0.052(1.31)	31
		0.053(1.34)	34
		0.054(1.37)	37

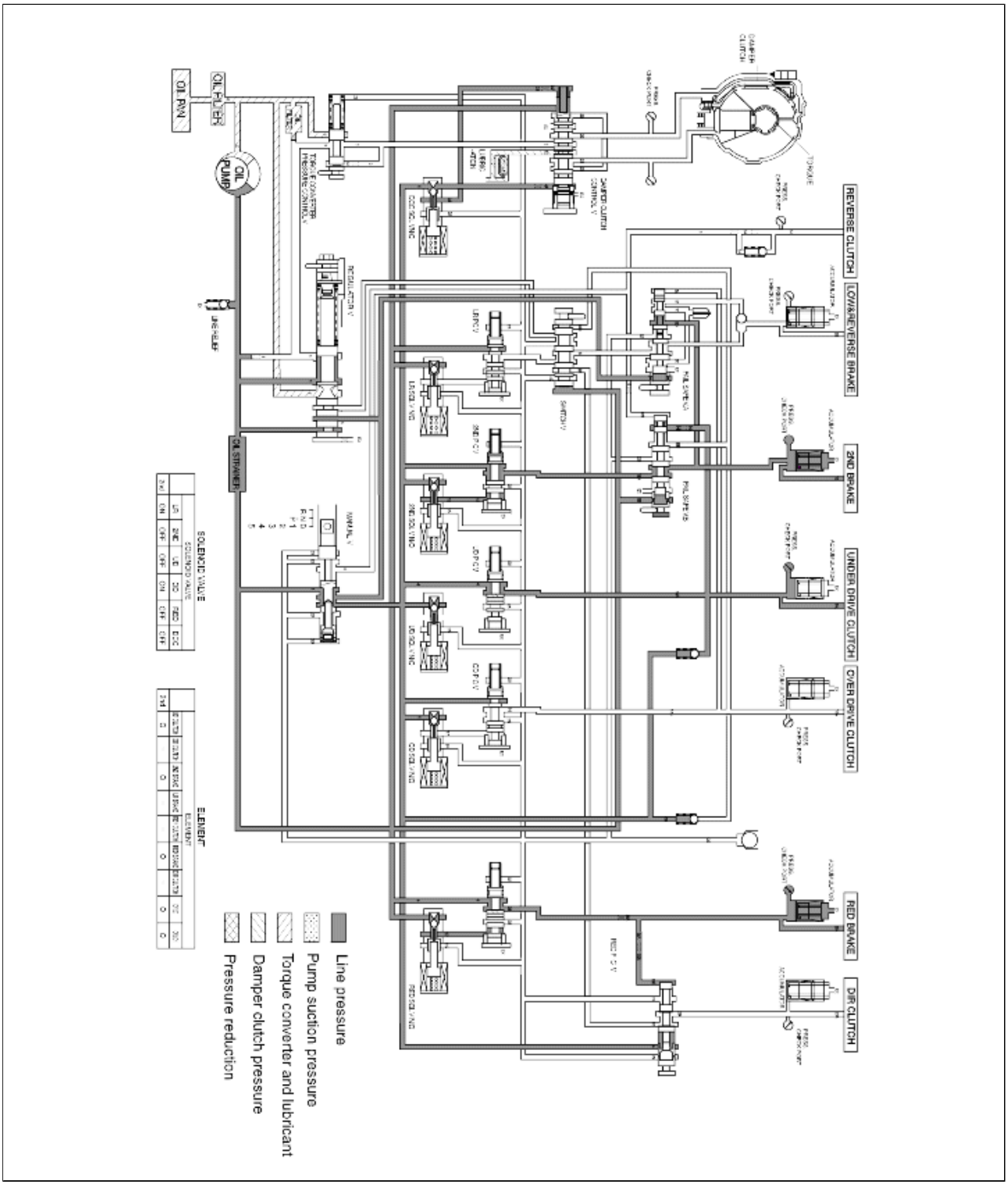
SEDONA MANUAL

Hydraulic pressure circuit

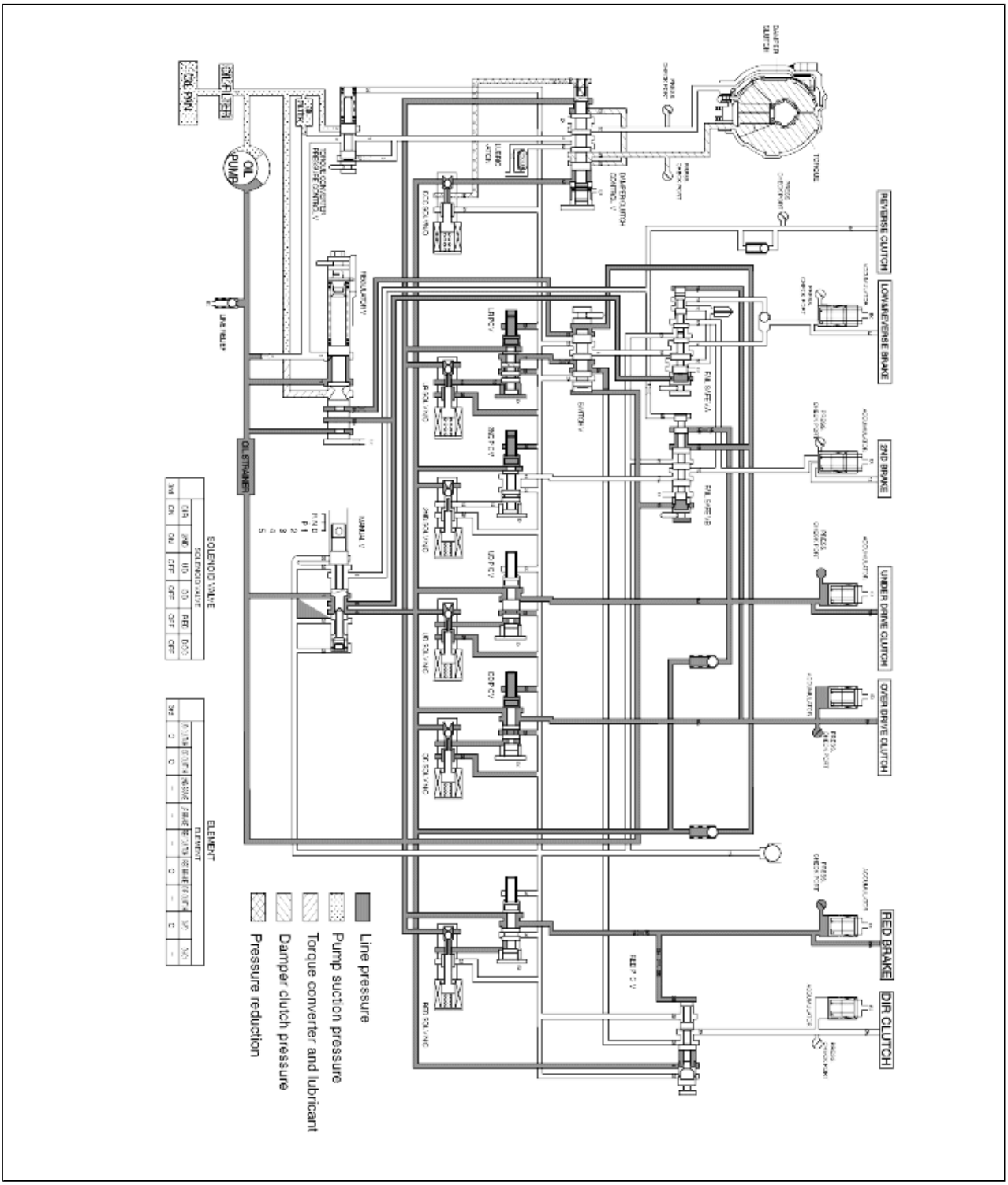
First speed



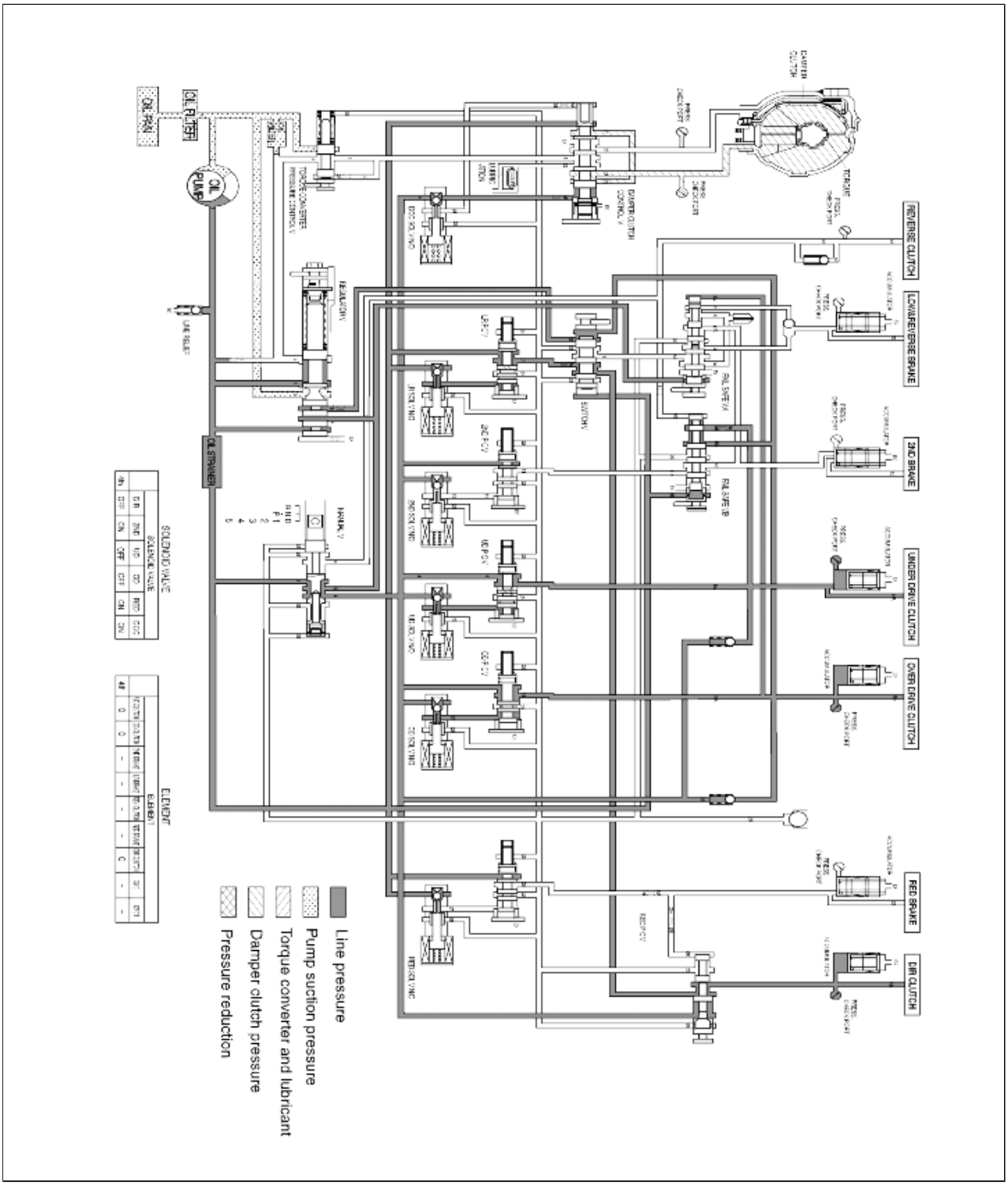
Second speed


REVERSE CLUTCH
LOW&REVERSE BRAKE
2ND BRAKE
UNDER DRIVE CLUTCH
OVER DRIVE CLUTCH
RED BRAKE
DIR CLUTCH
OIL PUMP
OIL STRAINER
SOLENOID VALVE
ELEMENT
Line pressure
Pump suction pressure
Torque converter and lubricant
Damper clutch pressure
Pressure reduction

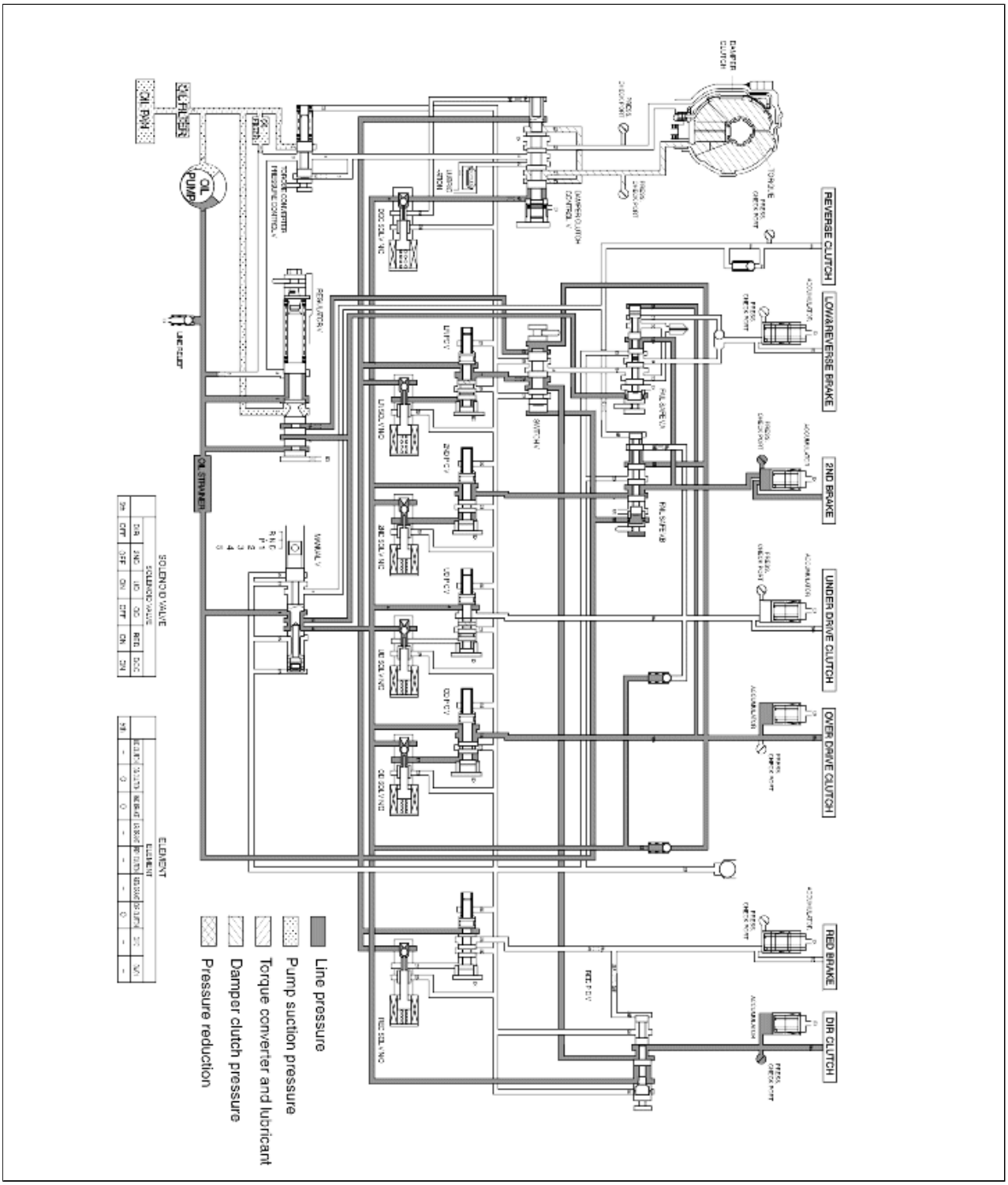
Third speed



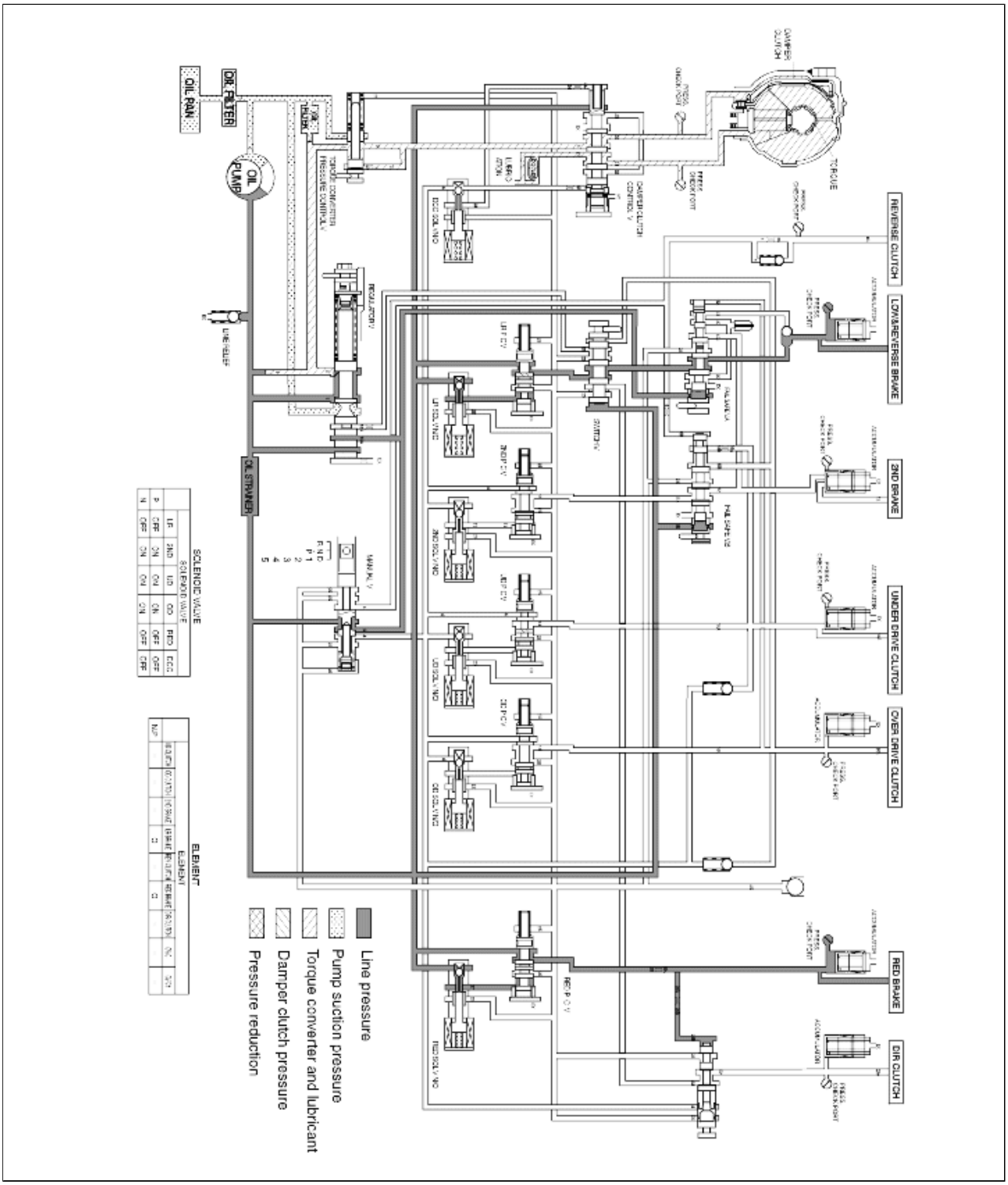
Fourth speed


REVERSE CLUTCH
LOW&REVERSE BRAKE
2ND BRAKE
UNDER DRIVE CLUTCH
OVER DRIVE CLUTCH
RED BRAKE
DIR CLUTCH
OIL PAN
OIL FILTER
OIL PUMP
OIL STRAINER
SOLENOID VALVE
ELEMENT
Line pressure
Pump suction pressure
Torque converter and lubricant
Damper clutch pressure
Pressure reduction

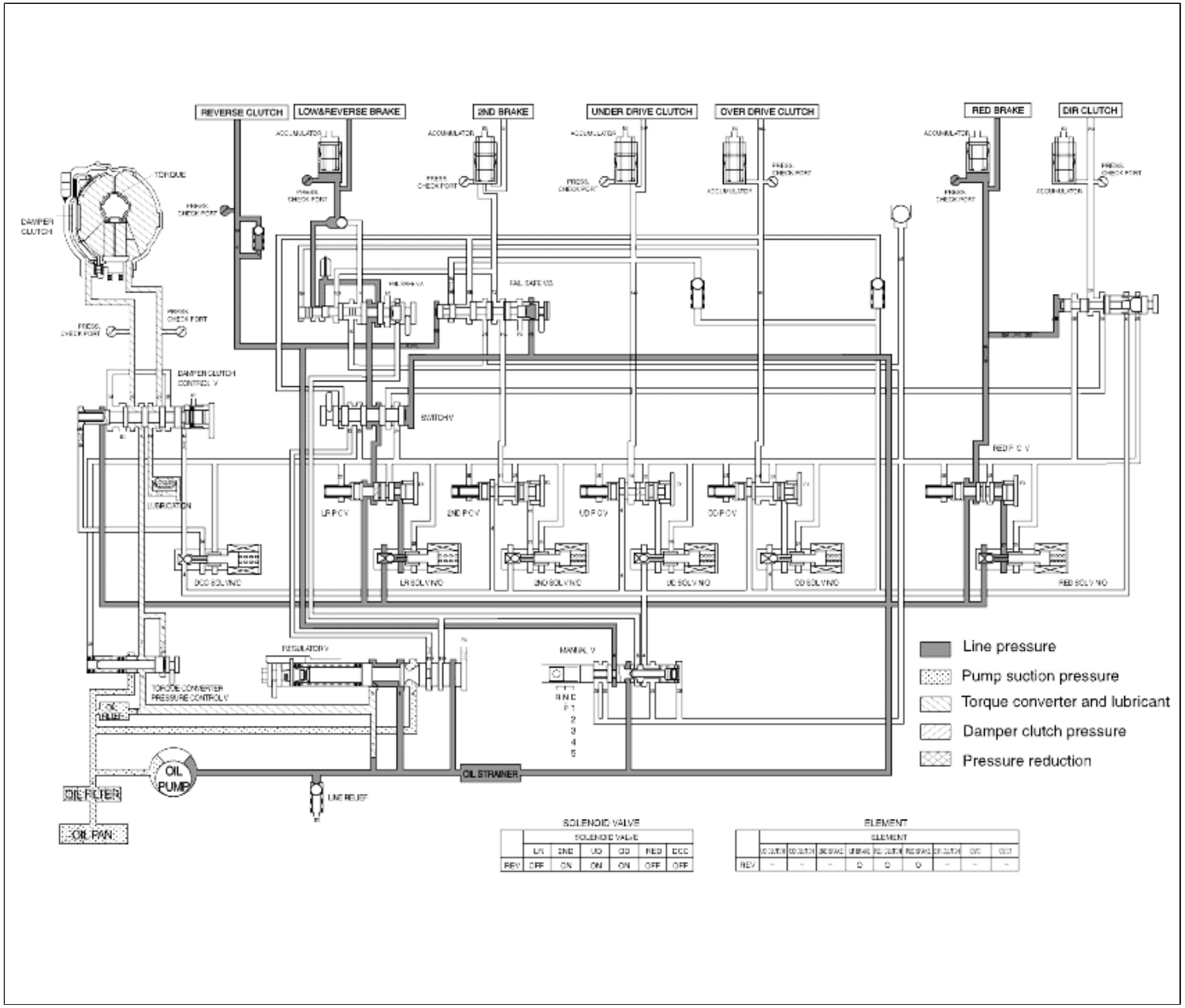
Fifth speed



Neutral and parking


REVERSE CLUTCH
LOW&REVERSE BRAKE
2ND BRAKE
UNDER DRIVE CLUTCH
OVER DRIVE CLUTCH
RED BRAKE
DIR CLUTCH
OIL PAN
OIL FILTER
OIL PUMP
OIL STRAINER
Line pressure
Pump suction pressure
Torque converter and lubricant
Damper clutch pressure
Pressure reduction

Reverse



SOLENOID VALVE

	SOLENOID VALVE					
	L/R	2ND	UD	DD	RED	DCC
REV	OFF	ON	ON	ON	OFF	OFF

ELEMENT

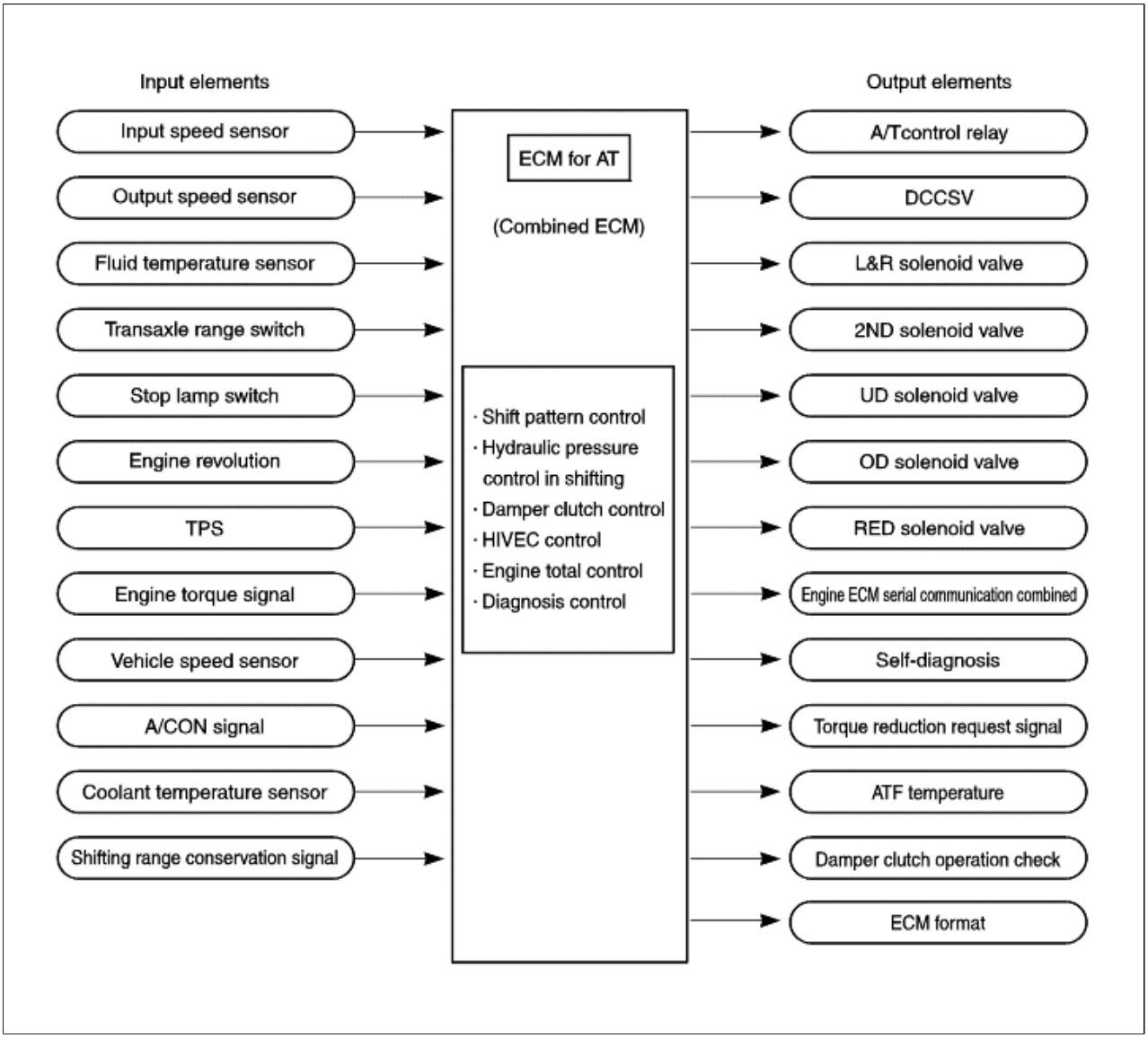
	ELEMENT								
	DC CLUTCH	DD CLUTCH	2ND BRAKE	LR BRAKE	RD. CLUTCH	RED BRAKE	DR CLUTCH	OWC	OWC
REV	–	–	–	O	O	O	–	–	–

Electronic control system

Summary

HMC has integrated nervous network and artificial intelligence onto HIVEC (Hyundai Intelligent Vehicle Electronic Control) Control System.
HIVEC System will provide optimum shift control in accordance with driver's habit and driving condition. Each clutch or brake has its own solenoid valve to implement clutch-to-clutch control, and then most comfortable shifting and durability are ensured.

Input/output chart



Clutch and brake operating elements of each shifting range

Range		UD clutch	OD clutch	2ND brake	LR brake	REV clutch	RED brake	DIR clutch	OWC1	OWC2
P		-	-	-	o	-	o	-	-	-
R		-	-	-	o	o	o	-	-	-
N		-	-	-	o	-	o	-	-	-
D	First speed	o	-	-	(o)	-	o	-	o	o
	Second speed	o	-	o	-	-	o	-	o	-
	Third speed	o	o	-	-	-	o	-	o	-
	Fourth speed	o	o	-	-	-	-	o	-	-
	Fifth speed	-	o	o	-	-	-	o	-	-

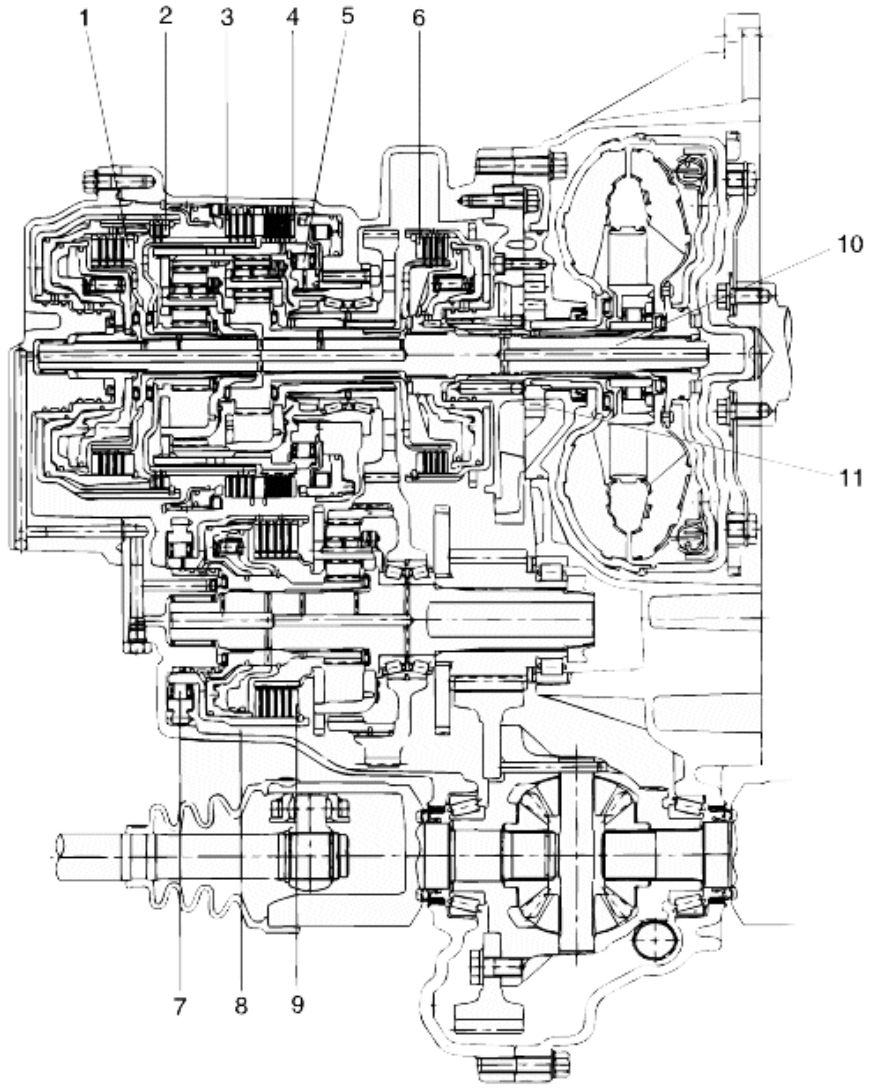
Clutch and brake function

Operating elements	Symbol	Function
Underdrive clutch	UD	Connect between input shaft and underdrive sun gear
Reverse clutch	REV	Connect between input shaft and reverse sun gear
Overdrive clutch	OD	Connect between input shaft and overdrive carrier
Director clutch	DIR	Connect between director sun gear and director carrier
Low and reverse brake	LR	Hold annulus gear and overdrive carrier
Second brake	2ND	Hold reverse sun gear
Reduction brake	RED	Hold director sun gear
One way clutch 1	OWC1	Restrict low and reverse ring gear turing direction
One way clutch 2	OWC2	Restrict director sun gear turning direction

Solenoid valve operating elements of each shift range

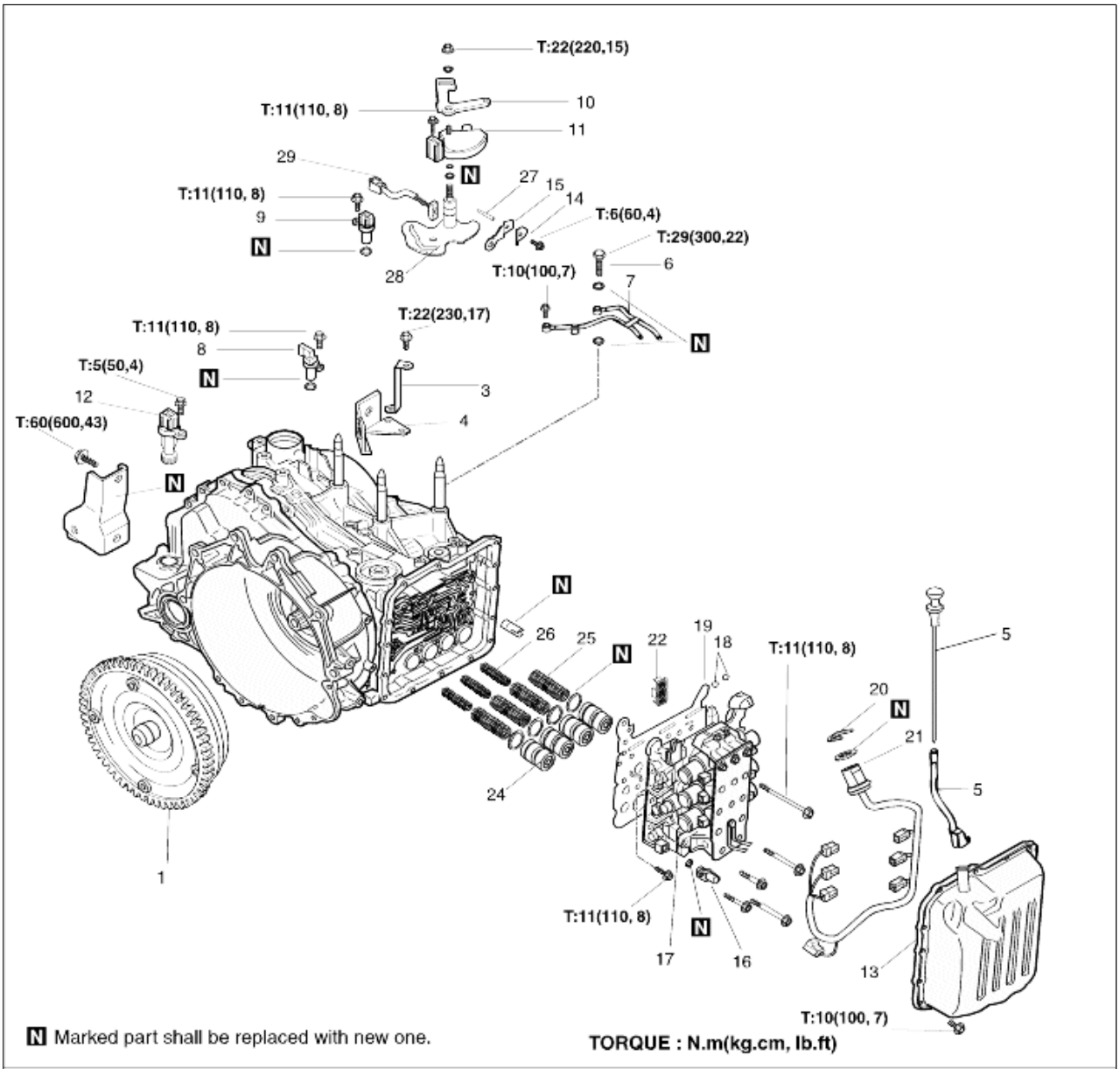
Item	Solenoid valve					
Shift range	LR (DIR)	2ND	UD	OD	RED	DCC(reference)
First speed	OFF (LR)	ON	OFF	ON	OFF	OFF
Second speed	ON (LR)	OFF	OFF	ON	OFF	OFF
Third speed	ON (DIR)	ON	OFF	OFF	OFF	OFF
Fourth speed	OFF (DIR)	ON	OFF	OFF	ON	ON
Fifth speed	OFF (DIR)	OFF	ON	OFF	ON	ON
Reverse	OFF (LR)	ON	ON	ON	OFF	OFF
Neutral, parking	OFF (LR)	ON	ON	ON	OFF	OFF

SECTIONAL VIEW



1. Overdrive clutch
2. Reverse clutch
3. Second clutch
4. Low and reverse clutch
5. One way clutch 1
6. Underdrive clutch
7. One way clutch 2
8. Reduction clutch
9. Director clutch
10. Input shaft
11. Oil pump

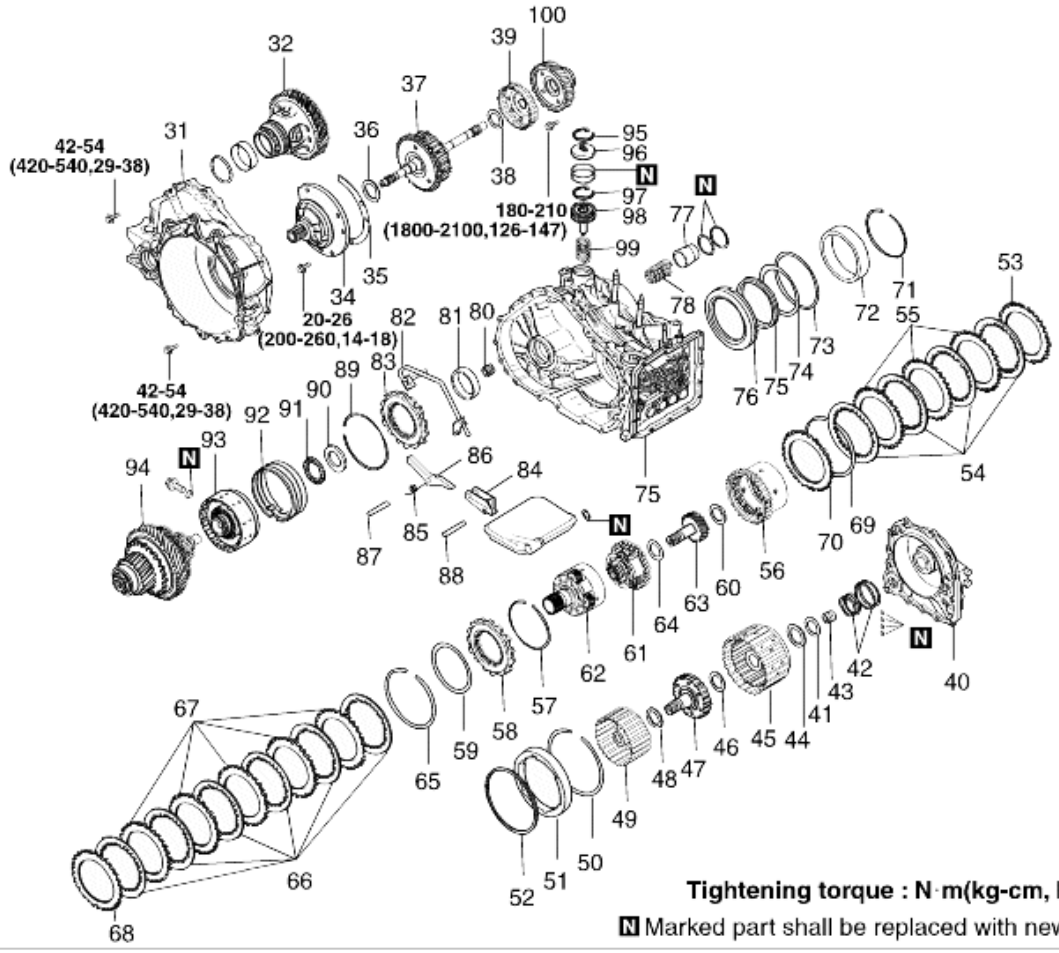
Components



N Marked part shall be replaced with new one.

TORQUE : N.m(kg.cm, lb.ft)

1. Torque converter
3. Harness bracket
4. Shift cable bracket
5. Fluid level gauge & filler tube
6. Eyebolt
7. Fluid cooler feed tube
8. Output shaft speed sensor
9. Input shaft speed sensor
10. Manual control lever
11. Transaxle range switch
12. Vehicle speed sensor
13. Valve body cover
14. Manual control shaft detent spring
15. Detent spring
16. Fluid temperature sensor
17. Valve body
18. Steel ball
19. Gasket
20. Snap ring
21. Solenoid valve harness
22. Strainer
24. Accumulator piston
25. Accumulator spring
26. Accumulator spring
27. Manual control lever shaft roller
28. Manual control lever shaft
29. Parking roller rod

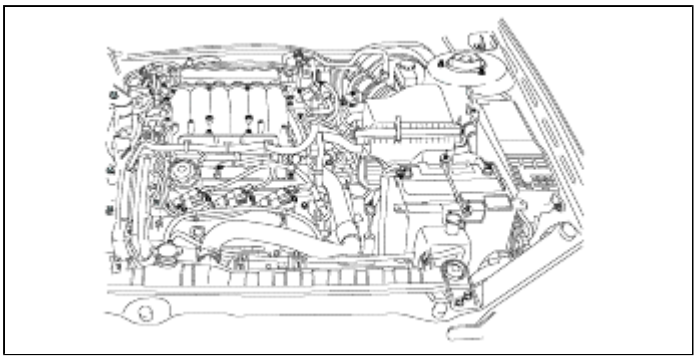


31. Converter housing
32. Differential
34. Oil pump
35. Gasket
36. Thrust washer #1
37. Underdrive clutch and input shaft
38. Thrust bearing #2
39. Underdrive clutch hub
40. Rear cover
41. Thrust race #8
42. Sealing
43. Input shaft rear bearing
44. Thrust bearing #7
45. Reverse and overdrive clutch
46. Thrust bearing #6
47. Overdrive clutch hub
48. Thrust bearing #5
49. Planetary carrier reverse sun gear
50. Snap ring
51. Second brake piston
52. Return spring
53. Pressure plate
54. Second brake disc
55. Second brake plate
56. Low & reverse annulus gear
57. Snap ring
58. One way clutch 1
59. Stopper plate
60. Thrust bearing #4
61. Overdrive planetary carrier
62. Output planetary carrier
63. Underdrive sun gear
64. Thrust bearing #3
65. Snap ring
66. LR brake disc
67. LR brake plate
68. Pressure plate
69. Snap ring
70. Reaction plate
71. Snap ring
72. Inner race
73. Wave spring
74. Spring retainer
75. Return spring
76. LR brake piston
77. Accumulator pistion
78. Spring
80. Needle bearing
81. Outer race
82. Pipe
83. Owe way clutch 2
84. Parking roller support
85. Hole spring
86. Parking ball spring
87. Parking pole shaft
88. Parking roller support shaft
89. Snap ring
90. Thrust race
91. Thrust bearing
92. Reduction brake band
93. Direct clutch
94. Direct planetary carrier
95. Snap ring
96. Reduction brake piston cover
97. Snap ring
98. Reduction brake piston
99. Reduction brake spring
100. Transfer drive gear set

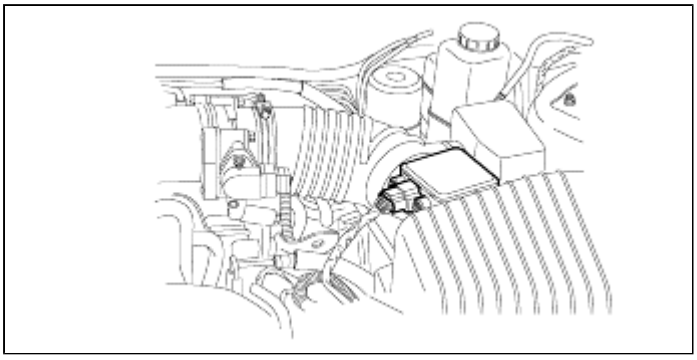
Automatic transaxle system

Removing transaxle

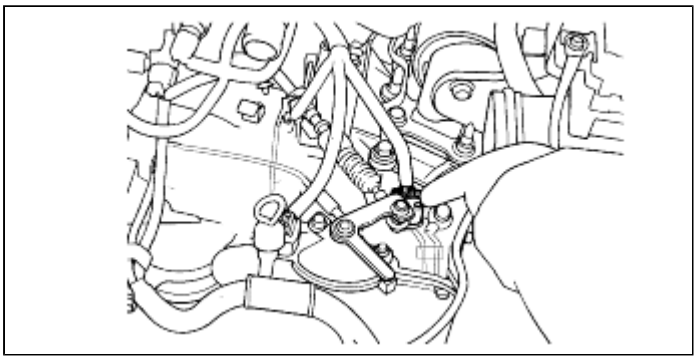
1. Remove the battery and the tray assembly.



2. Remove the engine wiring and the transaxle wiring.

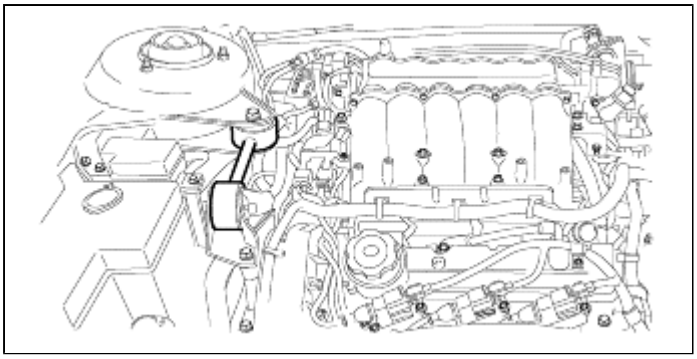


3. Remove the air cleaner (air duct, hose) assembly.
4. Disconnect the shift cable from the transaxle.

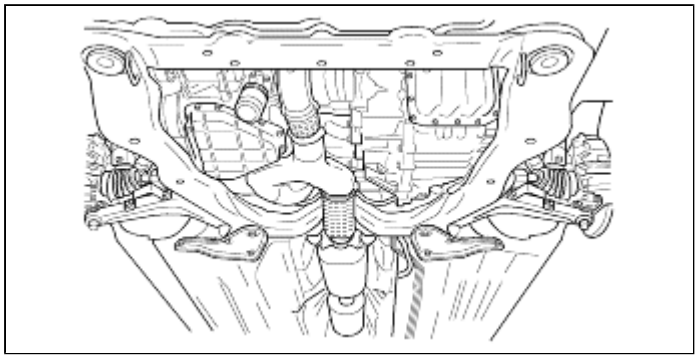


5. Disconnect the cooler hose from the transaxle.
6. Remove the radiator and the hose (drain coolant).
7. Disconnect the heater hose.
8. Disconnect the power steering column and the gear box universal joint.
9. Remove the power steering oil pressure and return the tube from the gear box.

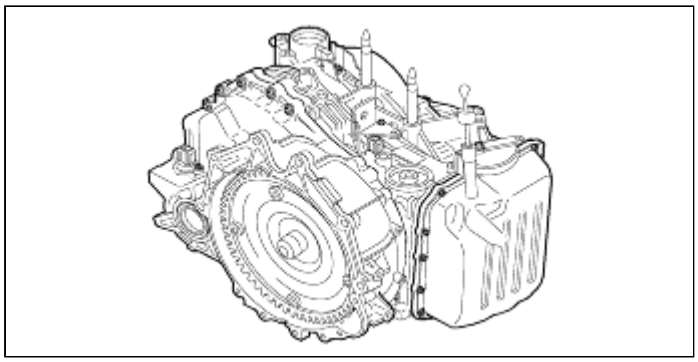
> NOTE
>
> Collect dropping oil with a container when disconnecting tube.



10. Remove the engine upper roll stopper and the bracket.
11. Lift vehicle and remove wheels.



12. Remove the oxygen sensor connector and the front muffler.
13. Drain the transaxle fluid.
14. Remove the tie rod, lower arm ball joint, and the drive shaft.
15. Remove the steering tube mounting bolt attached to the cross member (subframe).
16. Install the cross member removal jack.
17. Remove the cross member mounting bolt, and remove the cross member assembly with the steering gear box and the stabilizer attached.
18. Remove the start motor assembly.
19. Remove the transaxle housing cover.
20. Install the transaxle removal jack.
21. Remove the drive plate and the torque converter connecting bolt, turning the crankcase shaft.
22. Remove the transaxle support bolt.
23. Remove the transaxle.



Installation

1. Installation is reverse order of removal.
2. Add coolant, power-steering oil, and transaxle fluid correctly after installation.

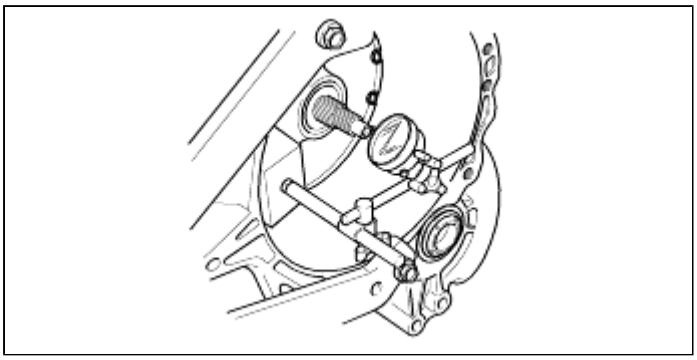
3. Ensure good mounting and no interference in wiring.
4. Fill air conditioner refrigerant.

Disassembly

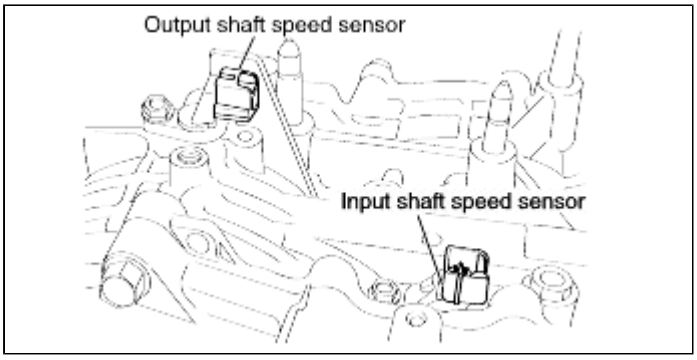
CAUTION

1) Automatic transaxle consists of precision parts. Be careful not to damage them in disassembly and assembly.
2) Keep clean workbench, and rubber and mat thereon.
3) Do not use cotton or muslin fiber. Use nylon fabric or paper towel.
4) Clean the disassembled components. Clean the metal parts with cleaning agent or dry them with a blower.
5) Clean the clutch disc, thrust plate made of resin, and rubber parts with ATF and keep them dust free.
6) If transaxle body is damaged, disassemble and clean the cooler line.

1. Remove the torque converter.
2. Measure the input shaft end play using a dial gauge.



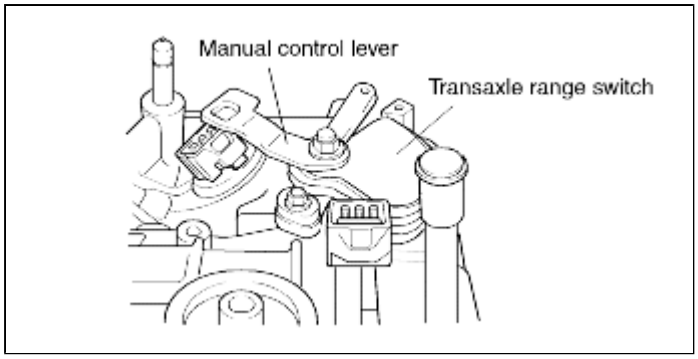
3. Remove each bracket.
4. Remove the wiring harness bracket.
5. Remove the shift control cable bracket.
6. Remove the fluid level gauge.
7. Remove the eyebolt, gasket, and the fluid cooler feed tube.
8. Remove the fluid filter.
9. Remove input speed sensor and the output speed sensor.



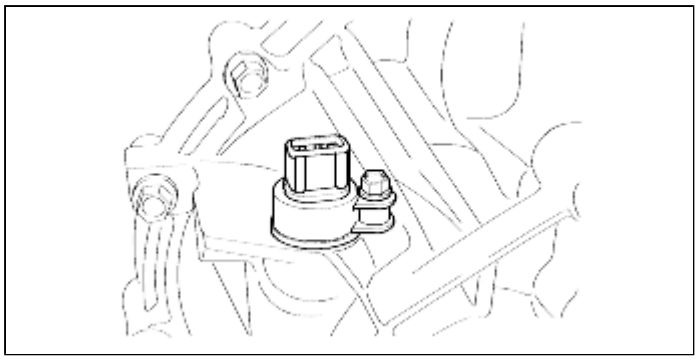
10. Remove the manual control lever and transaxle range switch.

CAUTION

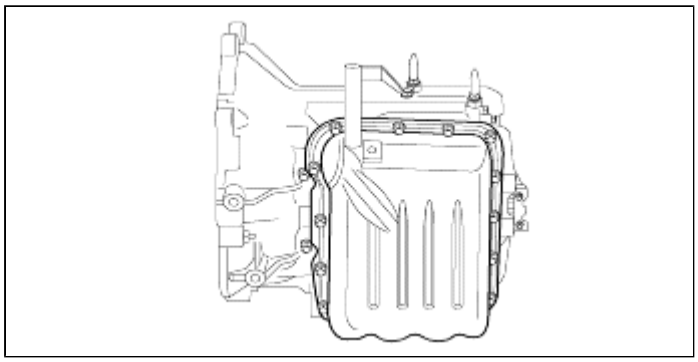
Remove transaxle range switch with valve body installed without fail.



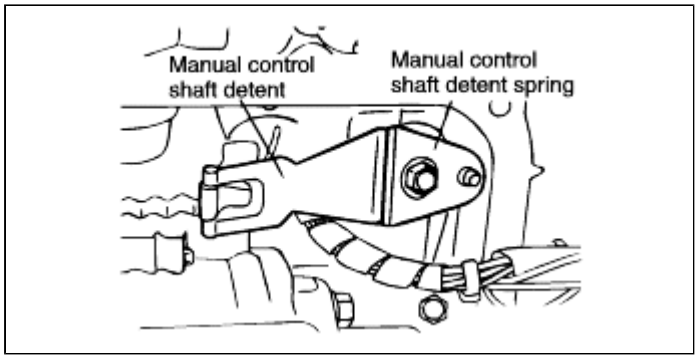
11. Remove the speedometer gear.



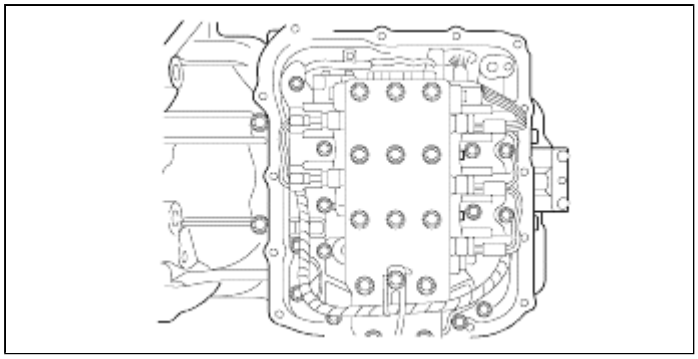
12. Remove the valve body cover.



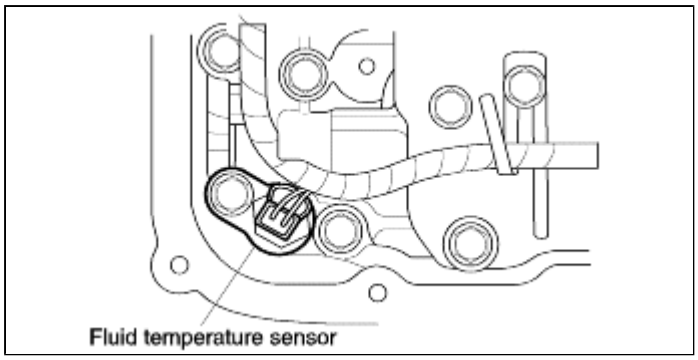
13. Remove the manual control shaft detent spring and the detent.



14. Disconnect the harness connector from the valve body.
15. Remove the valve body mounting bolts (28), except those bolts marked on illustration with arrow.

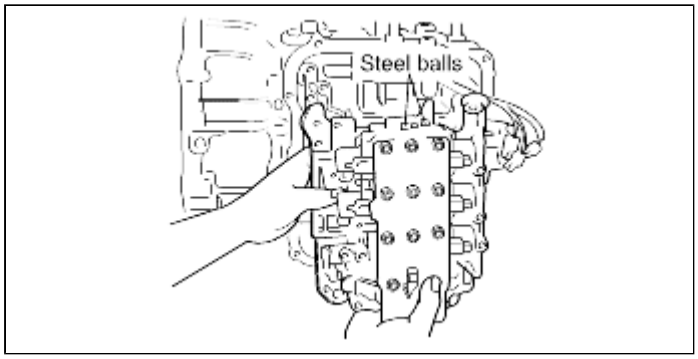


16. Remove the fluid temperature sensor.

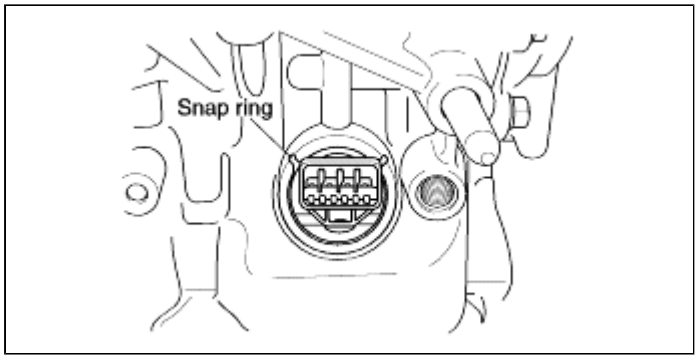


17. Remove the valve body, the gasket and the steel balls (two).

> CAUTION
>
> Be careful not to lose the steel balls.



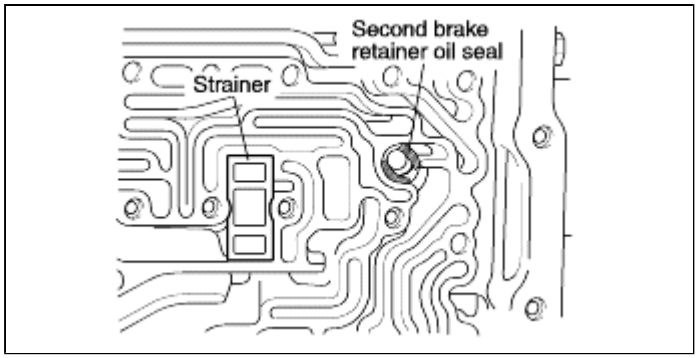
18. Remove the solenoid valve harness snap ring.



19. Remove the solenoid valve harness.
20. Remove the strainer.
21. Remove the second brake retainer oil seal.

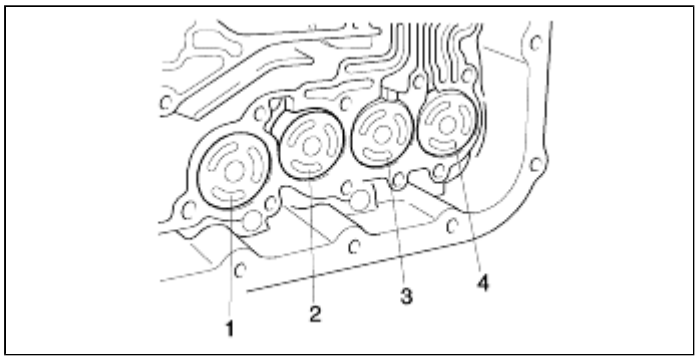
CAUTION

If the second brake retainer oil seal is not removed, it may be damaged when removing and installing the second brake piston.

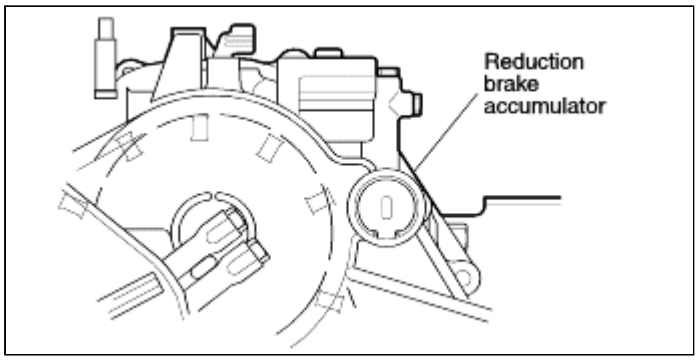


22. Remove each accumulator piston and spring.

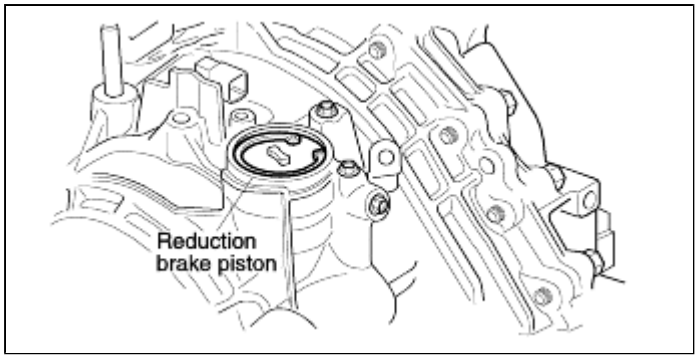
No.	Use
1	LR brake
2	UD clutch
3	Second brake
4	OD clutch



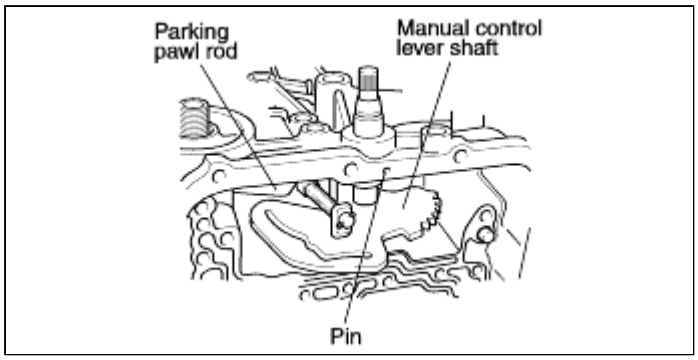
23. Remove the snap ring and then the reduction brake accumulator and the spring.



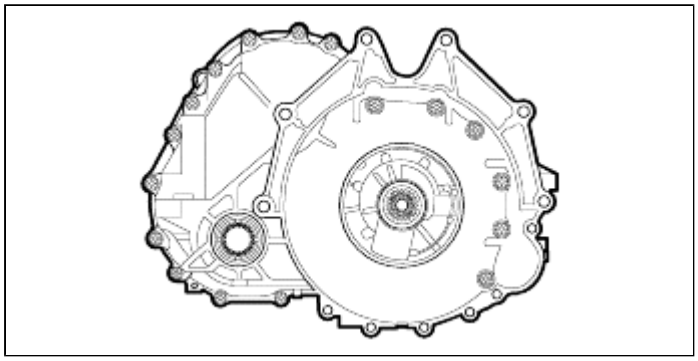
24. Remove the snap ring and the reduction brake piston.



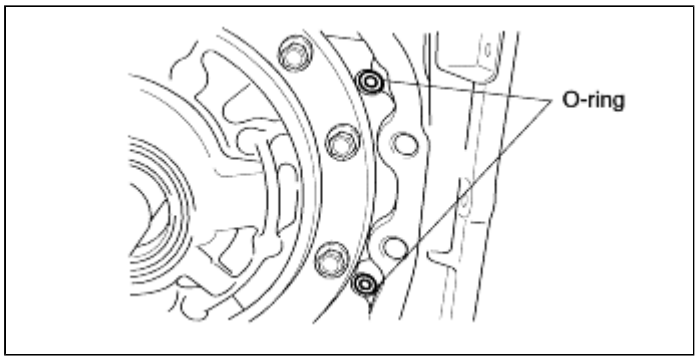
25. Remove the inner snap ring, and then the brake piston and the spring.
26. Remove the manual control shaft pin.
27. Remove the manual control shaft.



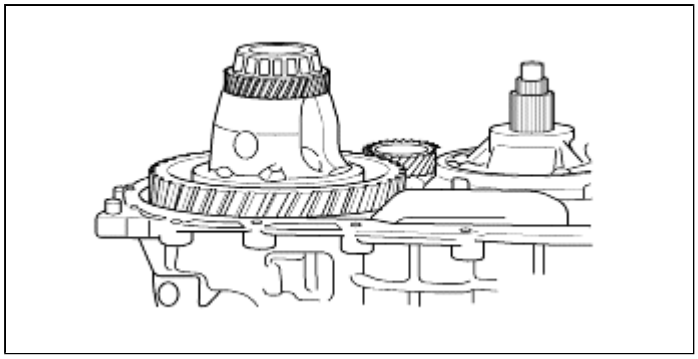
28. Remove the parking roller rod assembly.
29. Remove the converter housing mounting bolts (twenty) and the converter housing.



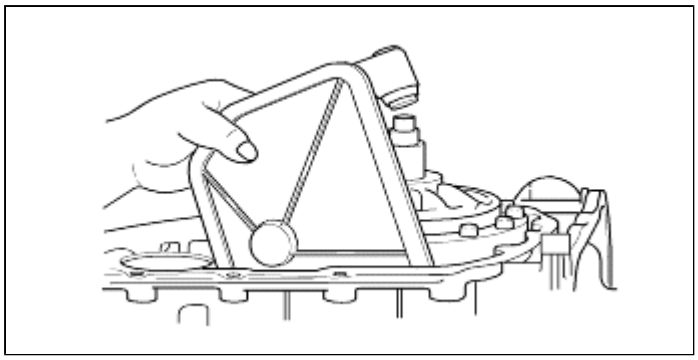
30. Remove the O-ring (two).



31. Remove the differential.

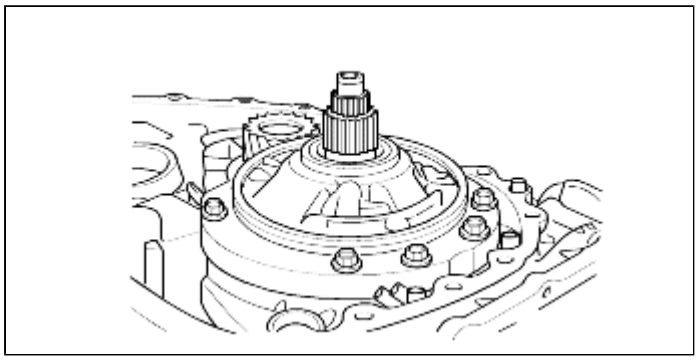


32. Remove the main oil filter.

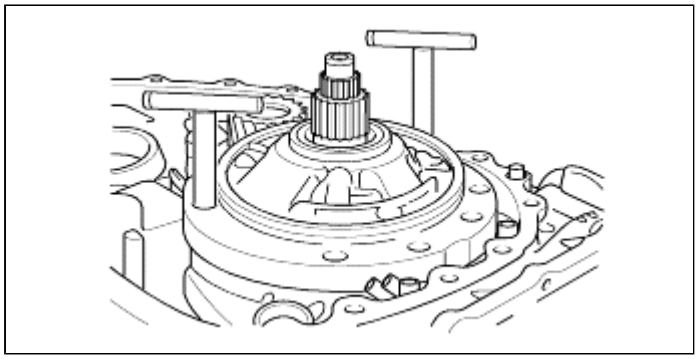


33. Release the fluid pump mounting bolts(six).

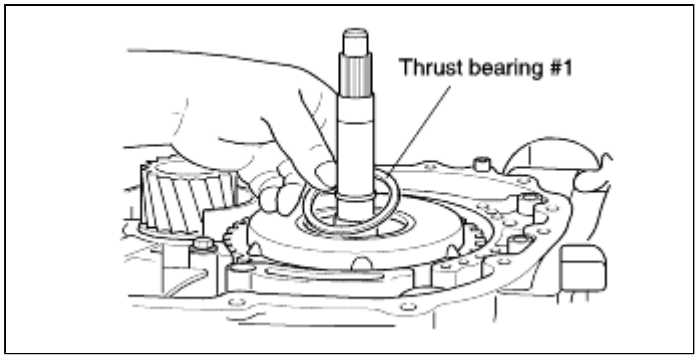
> CAUTION
>
> Do not disassemble the fluid pump. Misalignment during assembly may damage the pump and the transaxle.



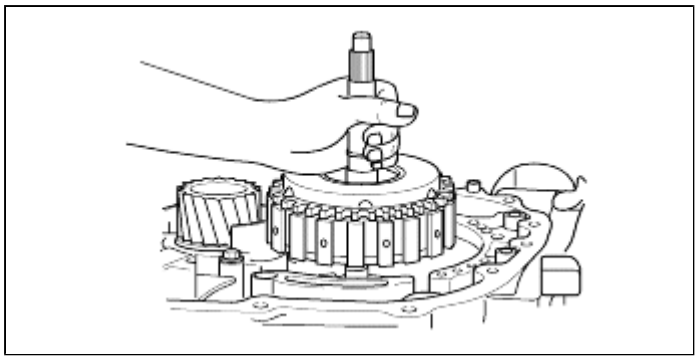
34. Install the special tool (09452-33100).



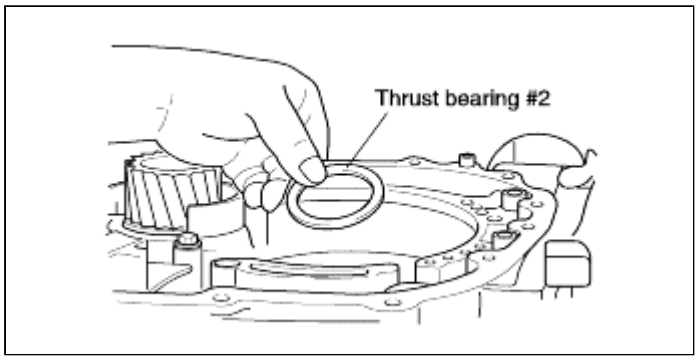
35. Remove the fluid pump using the special tool.
36. Remove the fluid pump gasket.
37. Remove the thrust washer #1.



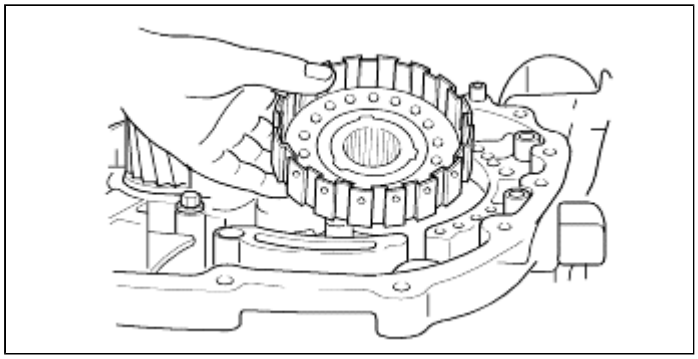
38. Hold the input shaft with one hand and remove the underdrive clutch.



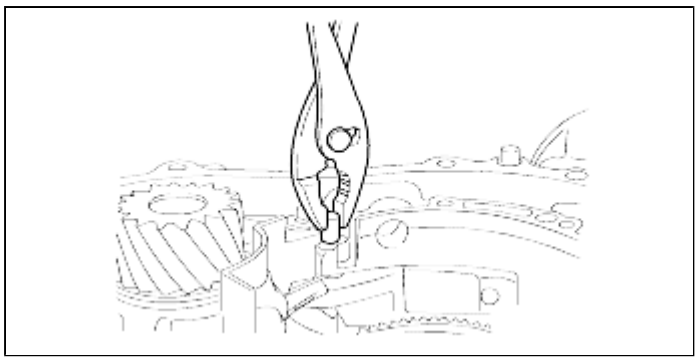
39. Remove the thrust bearing #2.



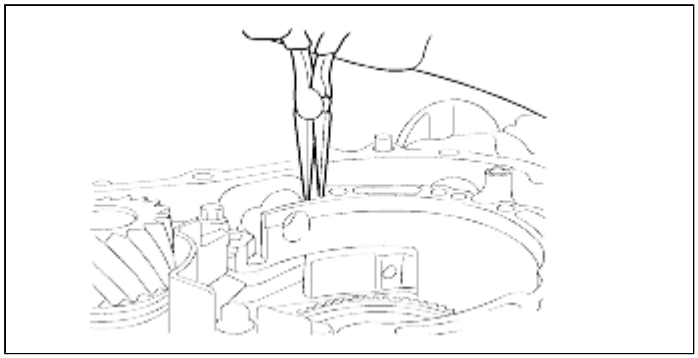
40. Remove the underdrive clutch hub.



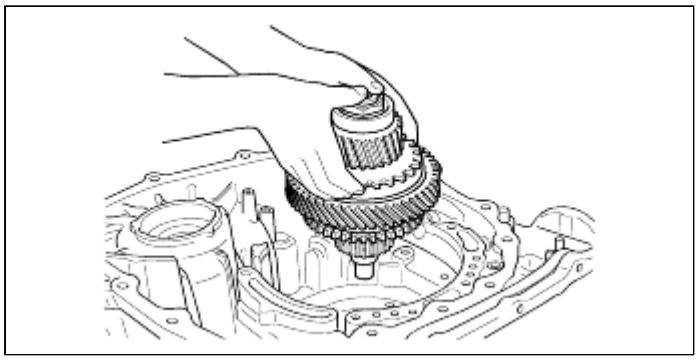
41. Remove the parking sprag shaft.



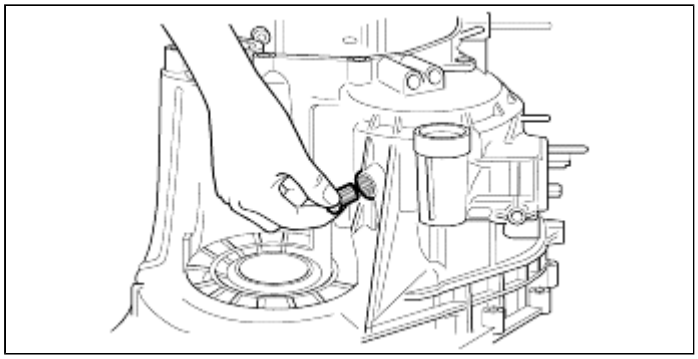
42. Remove the parking sprag shaft spacer and spring.
43. Remove the parking roller support shafts(two).



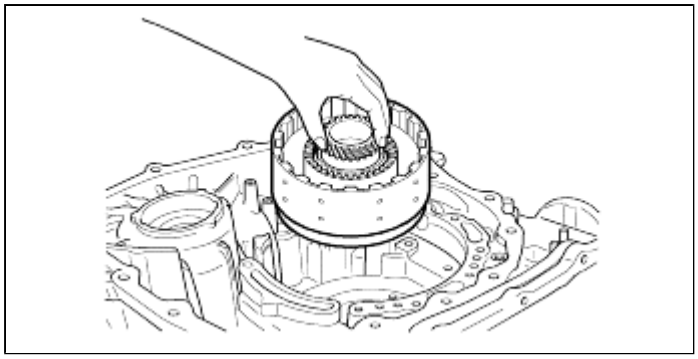
44. Remove the parking roller support.
45. Remove the direct planetary carrier assembly.



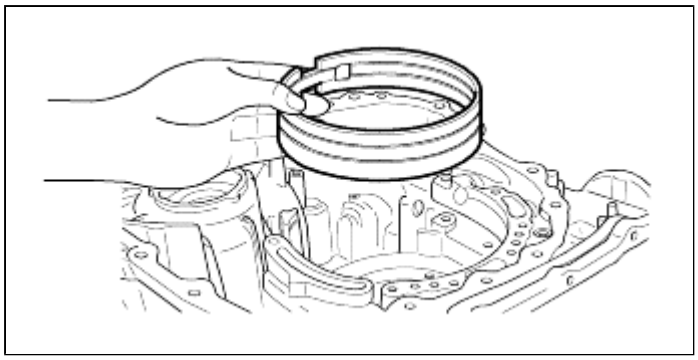
46. Remove the anchor plug and O-ring.



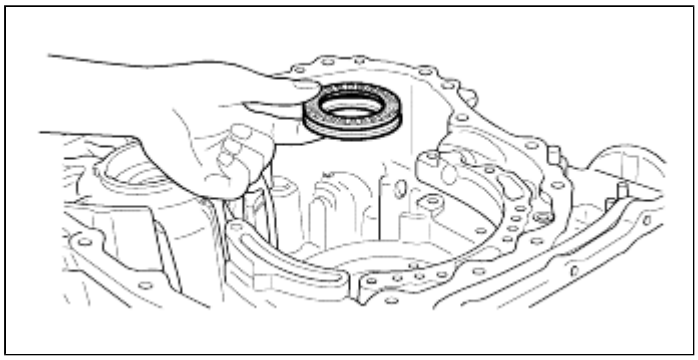
47. Remove the direct clutch assembly.



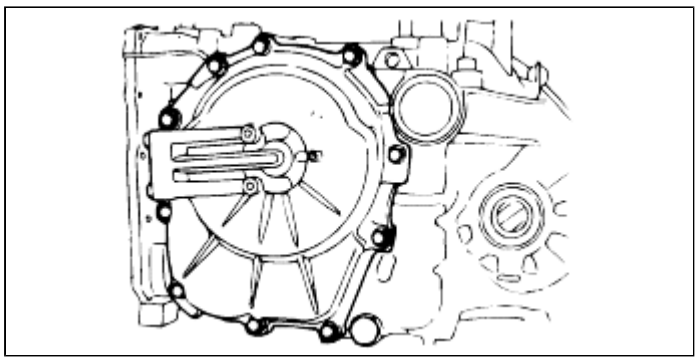
48. Remove the reduction brake band.



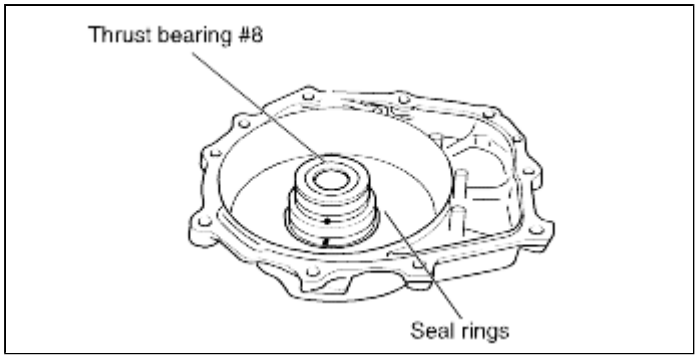
49. Remove the thrust bearing #11.



50. Remove the thrust bearing #12.
51. Remove the rear cover.



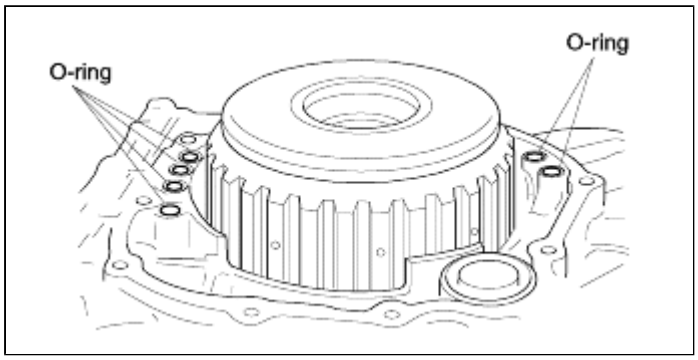
52. Remove the thrust bearing #8.



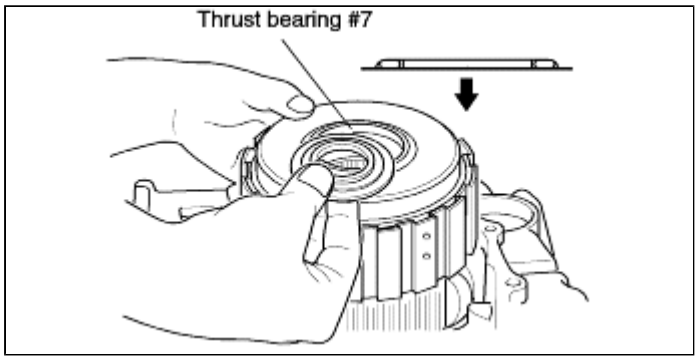
53. Remove the seal rings(four).
54. Remove the input shaft rear bearing.

> **CAUTION**
>
> The rear cover may be damaged in replacing the rear bearing, therefore do not replace it if not faulty after checking.

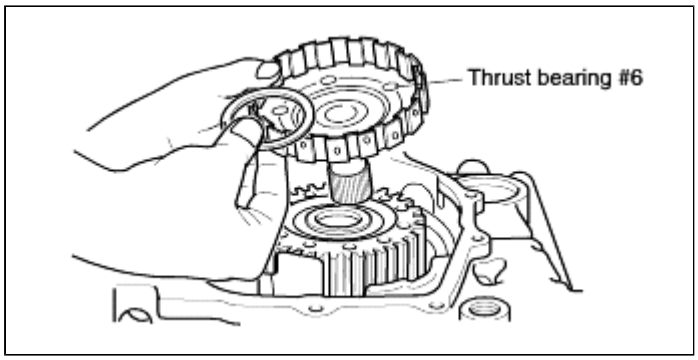
55. Remove O-rings(six).



56. Remove the thrust bearing #7.

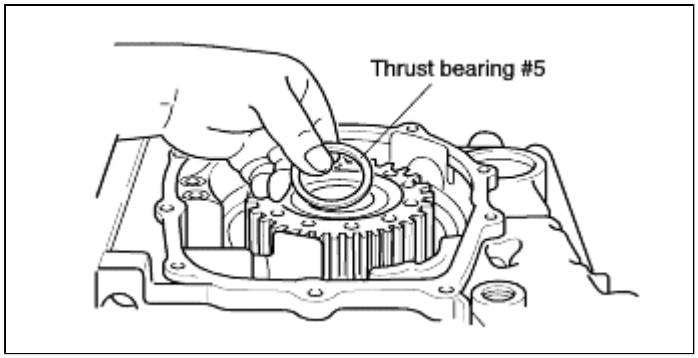


57. Remove the reverse and overdrive clutch.
58. Remove the thrust bearing #6.

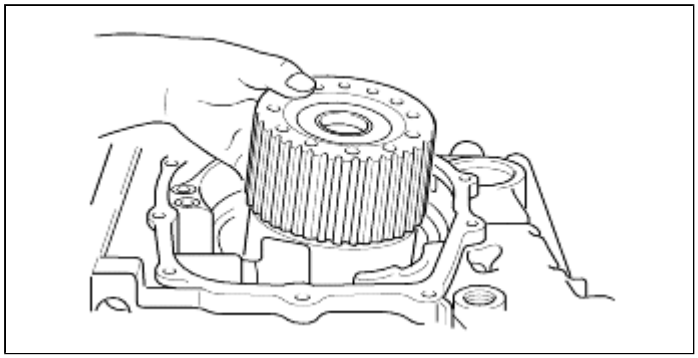


59. Remove the overdrive clutch hub.

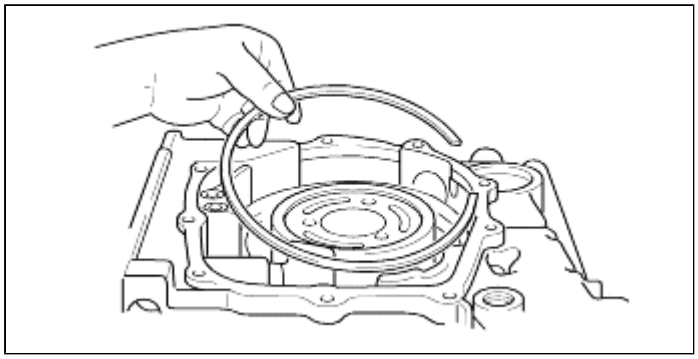
60. Remove the thrust bearing #5.



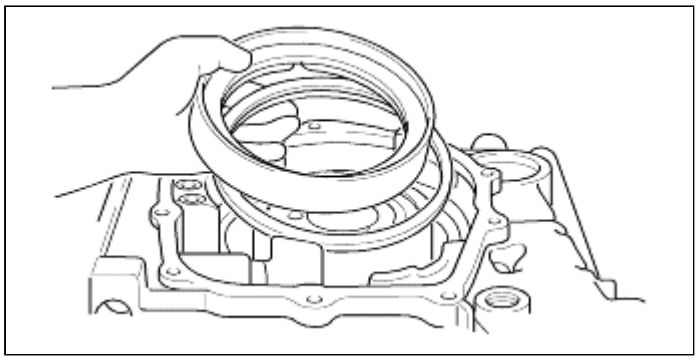
61. Remove the planetary gear reverse sun gear.



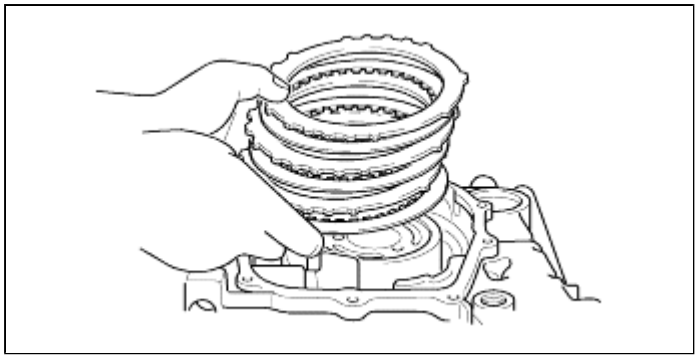
62. Remove the second brake piston snap ring.



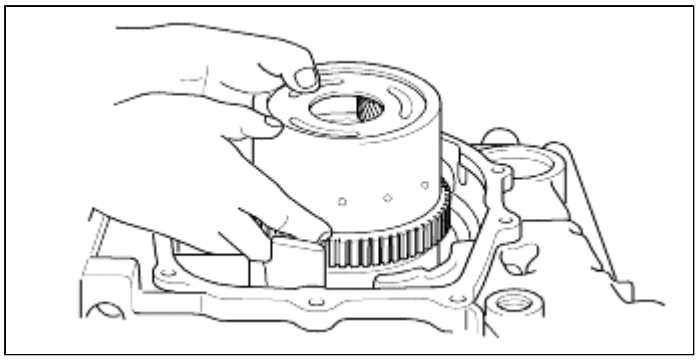
63. Remove the second brake piston and return spring.



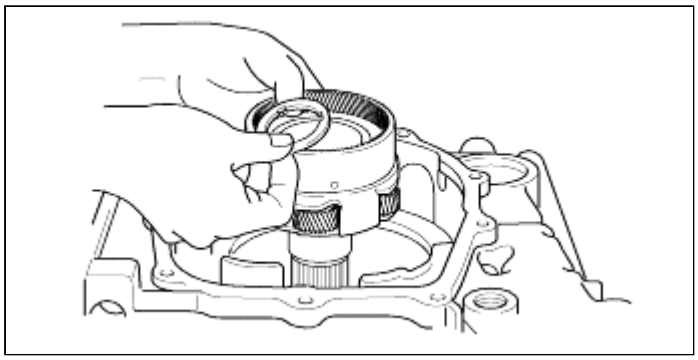
64. Remove the pressure plate, brake disc and brake plate.



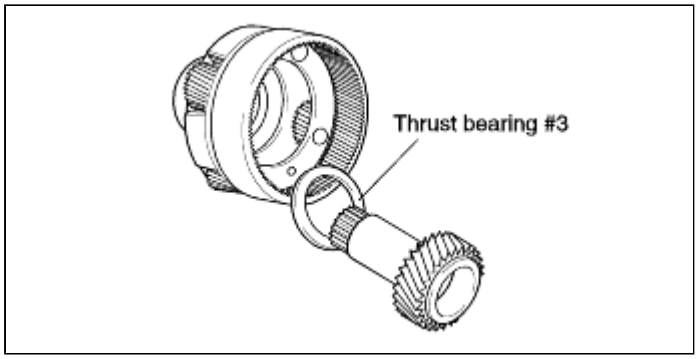
65. Remove the overdrive planetary carrier.



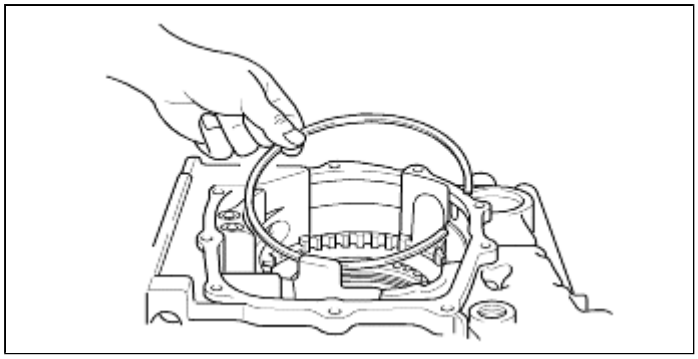
66. Remove the output planetary carrier thrust bearing #4.



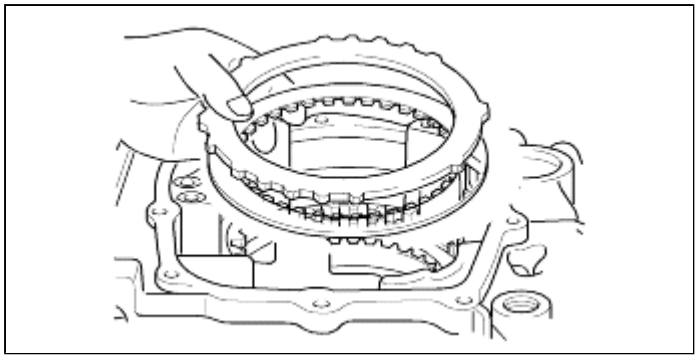
67. Remove the output planetary carrier.
68. Remove the underdrive sun gear.
69. Remove the thrust bearing #3.



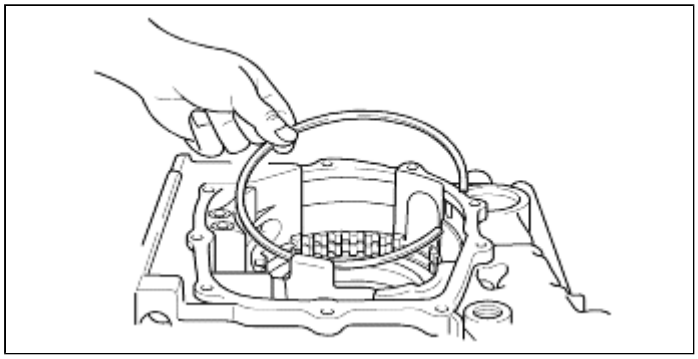
70. Remove the LR reaction plate snap ring.



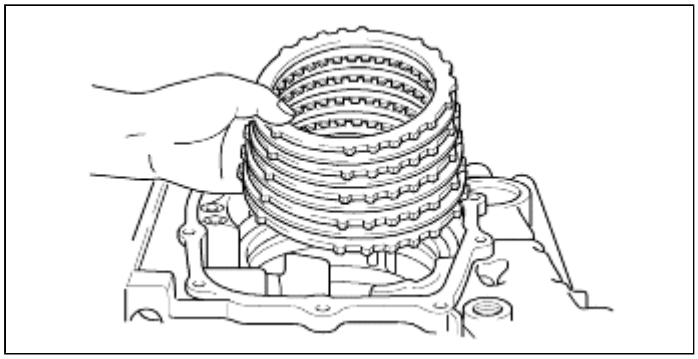
71. Remove the reaction plate and brake disc.



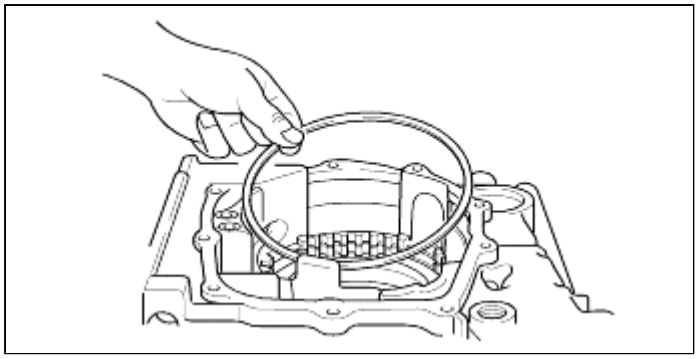
72. Remove the LR brake snap ring.



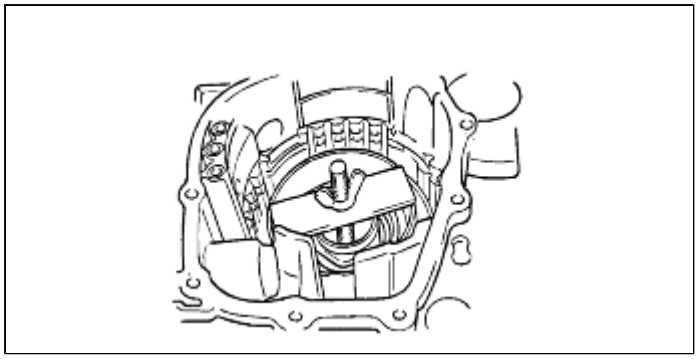
73. Remove the brake plate, the brake disc, and the pressure plate.



74. Remove the wave spring.

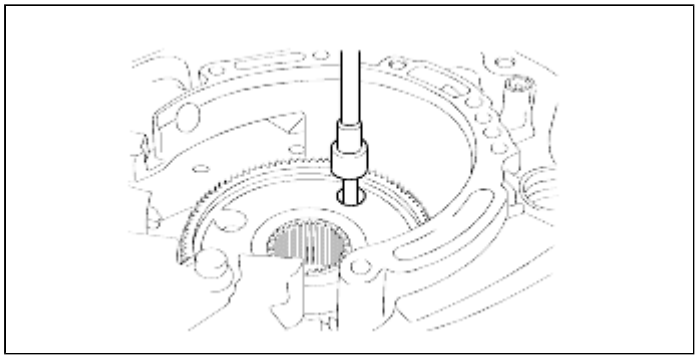


75. Remove the snap ring using special tool.

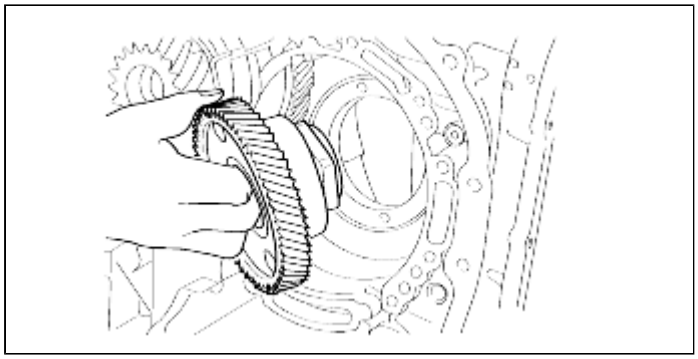


76. Remove the one way clutch inner race.
77. Remove the spring retainer, return spring and LR brake piston.
78. Release the transfer drive gear mounting bolts (eight).

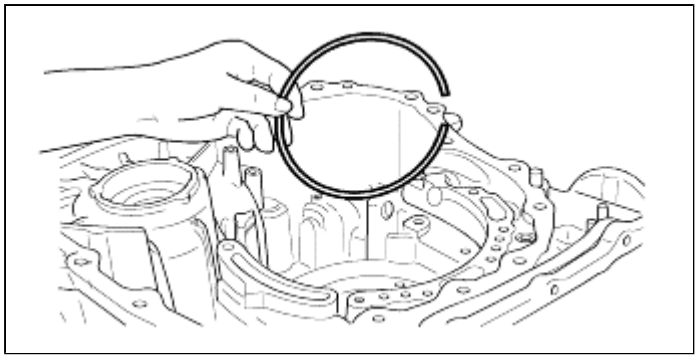
> NOTE
>
> Remove the revolving drive gear by turning it.



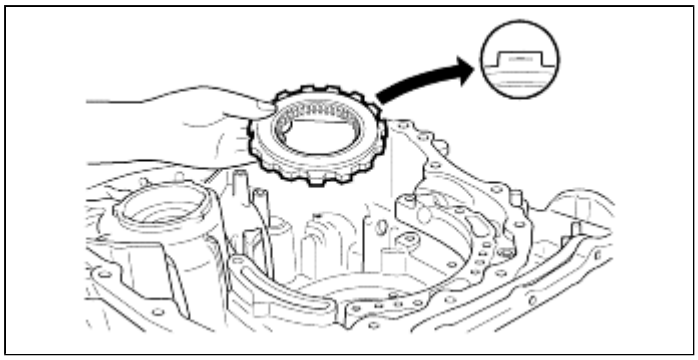
79. Remove the transfer drive gear.



80. Remove the one way clutch holding snap ring.



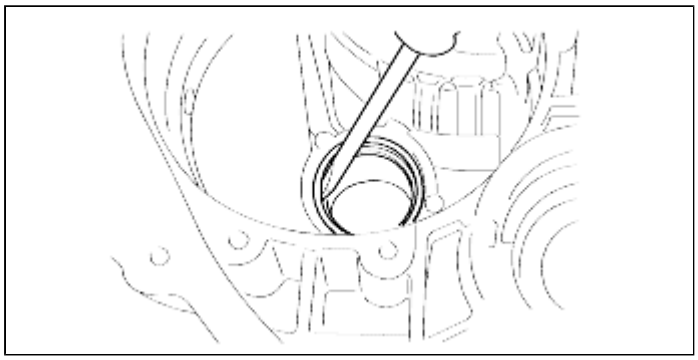
81. Remove the one way clutch assembly.



82. Remove the seal rings (two).
83. Remove the needle bearing.

> CAUTION
>
> Transaxle case may be damaged in replacing the output shaft rear bearing, therefore do not replace it if not faulty after checking.

84. Remove the differential bearing output race and spacer out of converter housing.



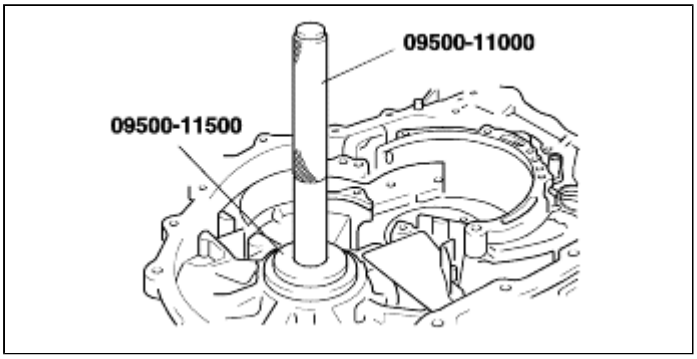
85. Remove the differential bearing output race out of the transaxle case.

Reassembly

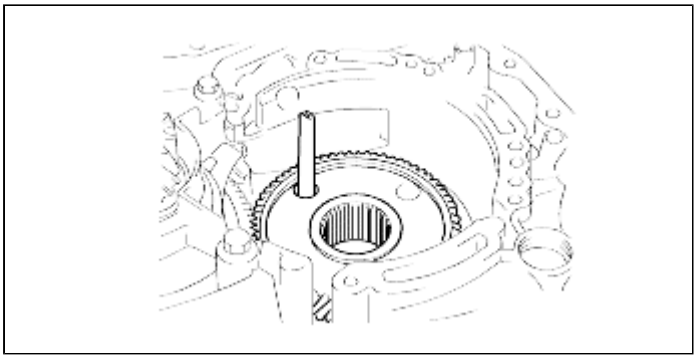
> CAUTION
>
> 1) Keep the workbench and parts always clean and dirt free.
> 2) Do not use cotton gloves.
>   Use paper towel and nylon rag. Do not use nappy fabric.
>   Kimberly's Kimtowel J130, Kim WIPE L-100 or equivalent.
> 3) Do not use grease at any place otherwise specified.
>   Use white vaseline or blue mineral oil if necessary.
> 4) Insert each snap ring firmly into the seat. Do not use deformed rings.
> 5) Do not allow dirt remain on the surface to apply liquid gasket during reassembly.

6) Gasket, O-ring, and oil shall not be used again, and use new ones in assembly.
7) A new clutch disc and a new brake disc shall be dipped in ATF for 2 hours or more before use.
8) Replace the ATF and clean the filter thoroughly in reassembly. Replace the damaged filter element with a new one.
9) Apply required minimum quantity of white vaseline, blue mineral oil, or ATF on each of the bearing part, the thrust face moving part, the fluid pump moving part, the seal ring, and the O-ring.
10) Do not replace the ATF in the fluid cooler.
11) Be careful not to allow dirt come through the transaxle openings before mounting onto the vehicle. (including electronic part connector)

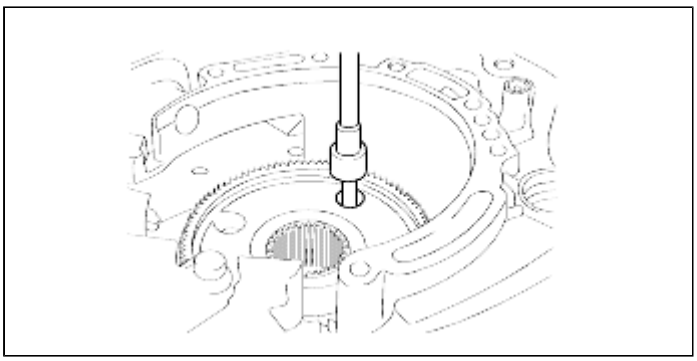
1. Install the differential bearing output race on the transaxle case using the special tool.



2. Apply ATF on the transaxle case and install 2 guide pins.
3. Install the transfer drive gear.



4. Connect the transfer drive gear mounting bolts (eight) using tightening torque.

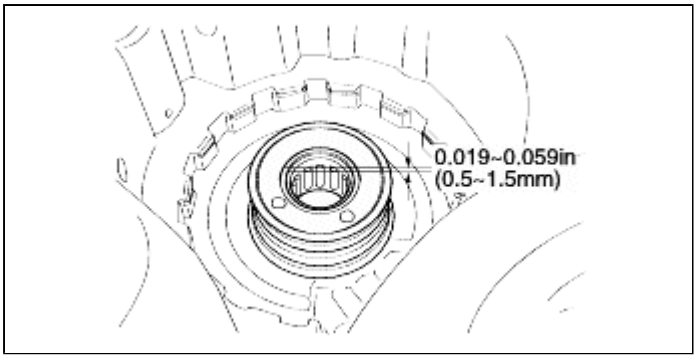


Tightening torqueF5A51-3 :31.4~36.3 N·m (320~370 kg·cm, 23~27 lb·ft)

NOTE

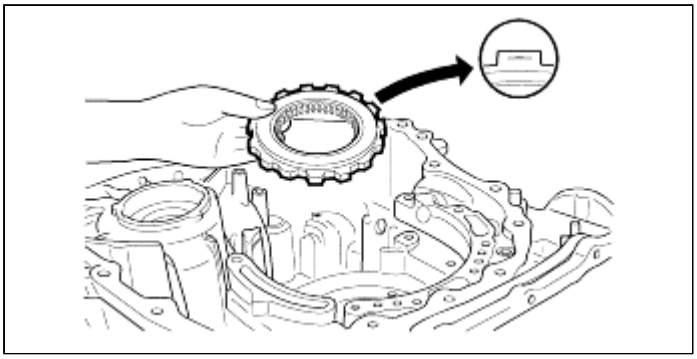
Turn the transfer drive gear one revolution and ensure no interference with bolts.

5. Install the output shaft rear bearing.

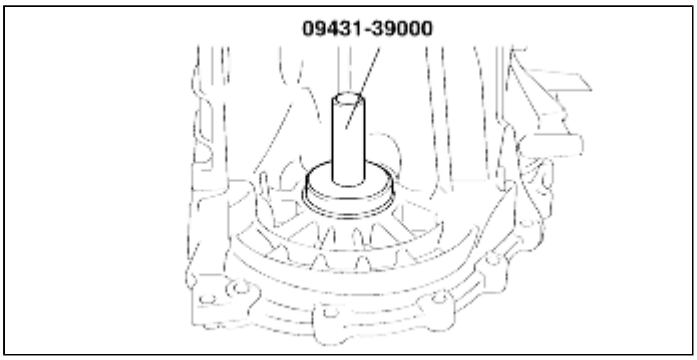


6. Install the 4 seal rings.
7. Install the one way clutch.

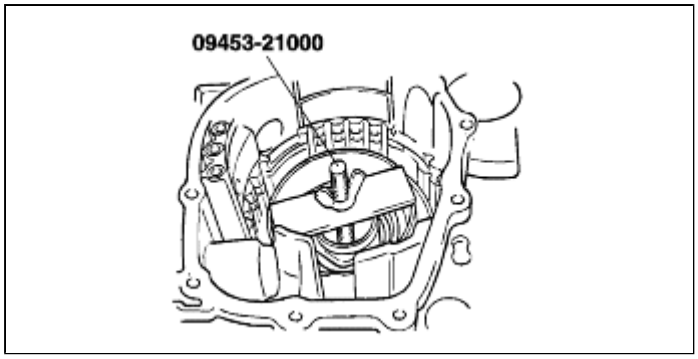
> **NOTE**
>
> Be cautious to the direction of the one way clutch. Line marked side shall be located forward. (see figure)



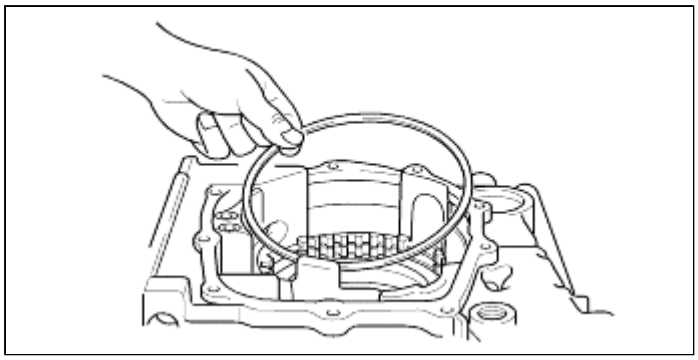
8. Install the one way clutch holding snap ring.
9. Install the driveshaft oil seal on the transaxle case.



10. Install the LR brake piston and the return spring.
11. Install the spring retainer.
12. Install the one way clutch inner race.
13. Install the snap ring using the special tool.

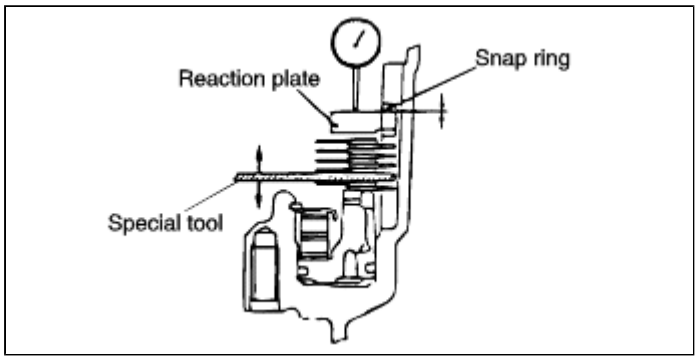


14. Install the wave spring.



15. Install the LR brake pressure plate on the special tool, and install the brake disc, the brake plate and the snap ring as illustrated on the figure.

Brake disc	Brake plate
6	5

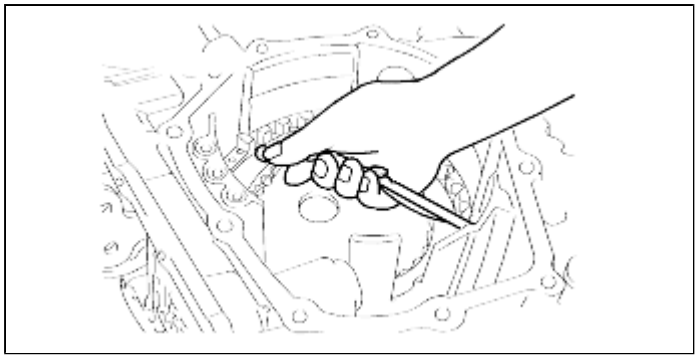


16. Install the reaction plate and the used snap ring.
17. Move special tool and check the end play, and install appropriate snap rings (8 sizes).

Standard value : 0~0.0063in(0~0.16mm)

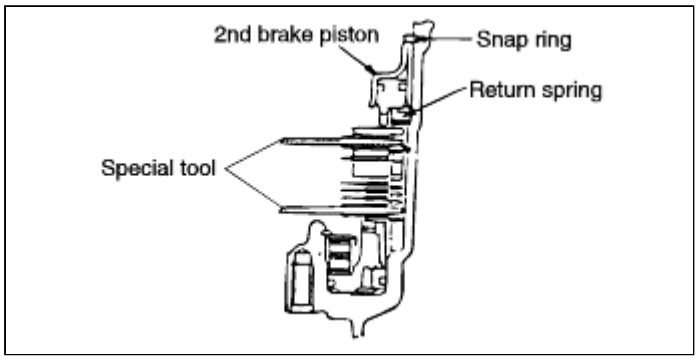
NOTE

Upon releasing the clutch, determine the actual gap between the LR brake disc and the plate.



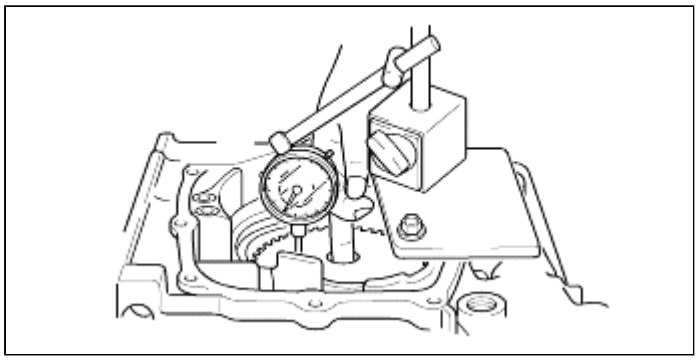
18. Install the brake disc, the brake plate, and second brake pressure plate using special tool as illustrated on figure.

Model	Brake disc	Brake plate
F5A51-3	4	4



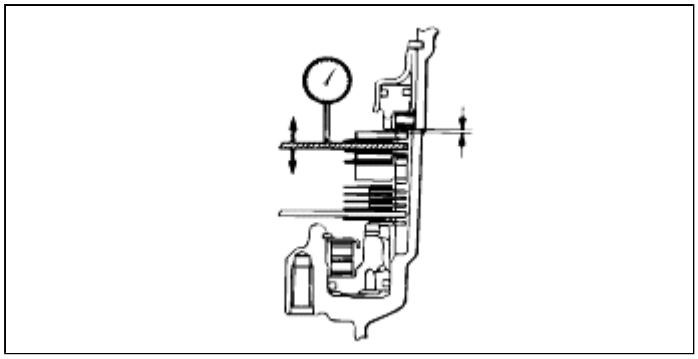
19. Install the return spring, the second brake piston, and the snap ring.
20. Move the special tool and check the end play.

Standard valueF5A51-3 : 0.043~0.061in(1.09 ~ 1.55 mm)



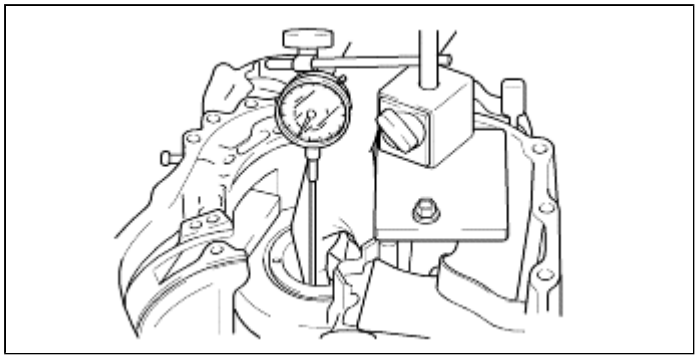
NOTE

Using the below formula and the special tool installed at procedure 10, choose a pressure plate : F5A51-3
[A (travel)+special tool thickness 0.079in(2.0mm)-0.061in(1.55mm)]
~[A (travel)+special tool thickness 0.079in(2.0mm)-0.043in(1.09mm)]



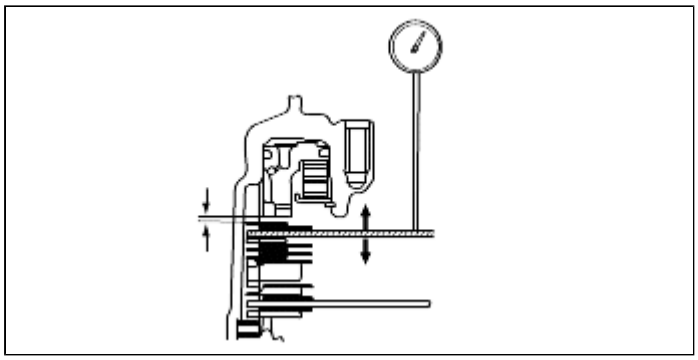
21. Turn the transaxle upside down.
22. Connect the special tool (09453-33100) with dial gauge, and move the special tool to check the end play.

Standard value :F5A51-3 : 0.065~0.083in(1.65 ~ 2.11 mm)



NOTE

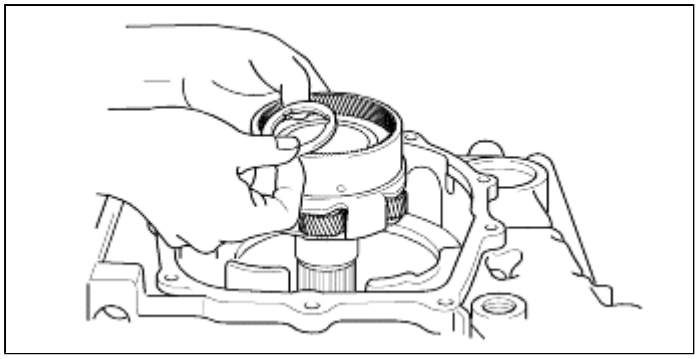
Using the below formula and the special tool installed at procedure 7, choose a pressure plate : F5A51-3
[A (travel)+special tool thickness 0.079in(2.0mm)-0.083in(2.11mm)]
~[A (travel)+special tool thickness 0.079in(2.0mm)-0.065in(1.65mm)]



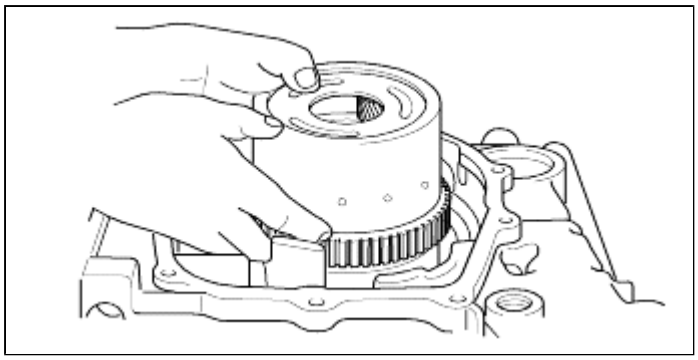
23. Remove parts installed in procedures 14~22.
24. Install the output planetary carrier and the thrust bearing #4.

NOTE

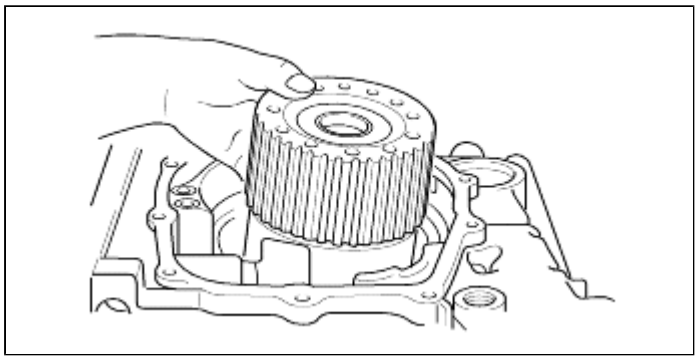
Be careful not to reverse the direction of the thrust bearing.



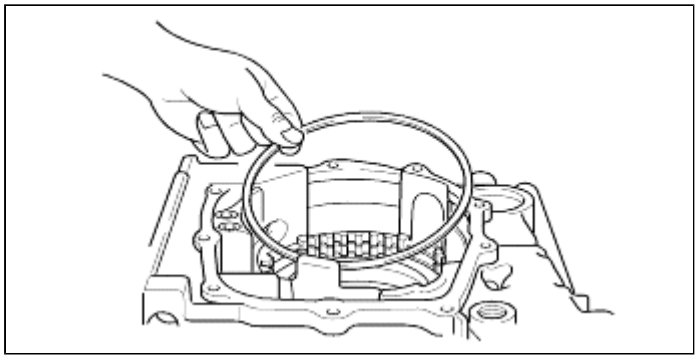
25. Install the overdrive planetary carrier.



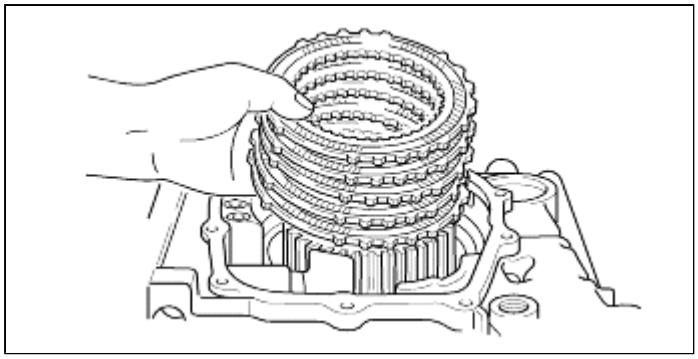
26. Install the planetary gear reverse sun gear.



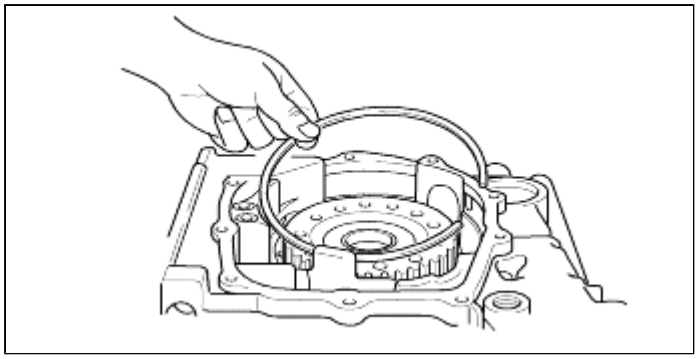
27. Install the wave spring.



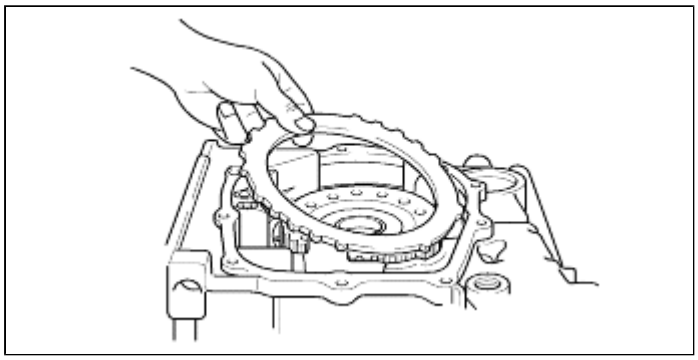
28. Install the pressure plate, the brake disc, and the brake plate.



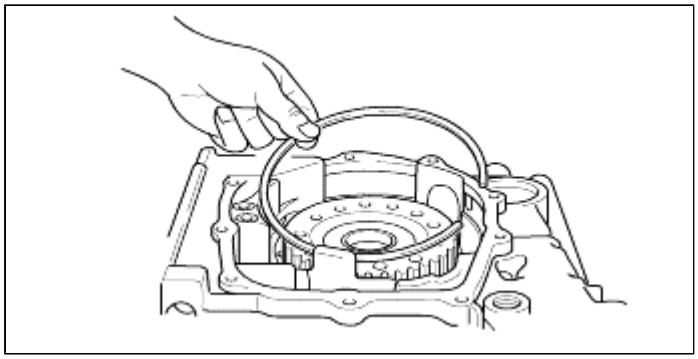
29. Install the snap ring.



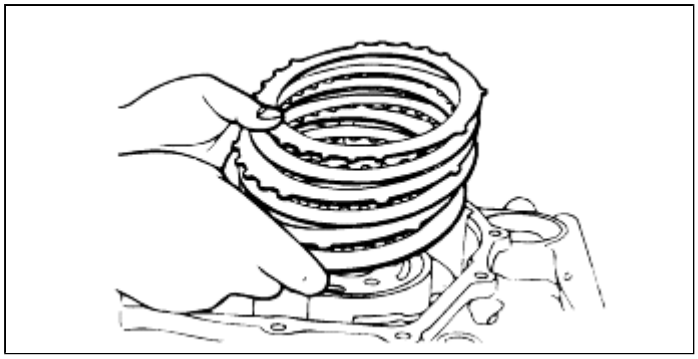
30. Install the reaction plate.



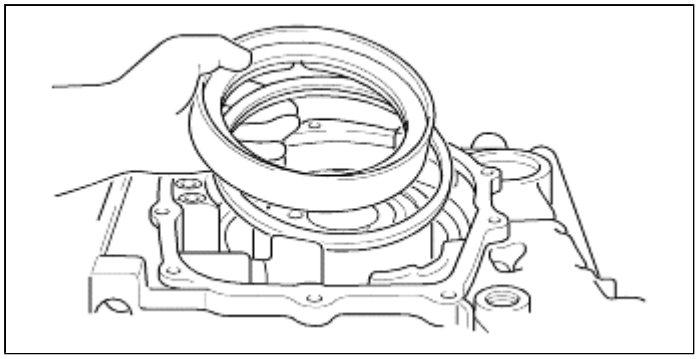
31. Install the snap ring.



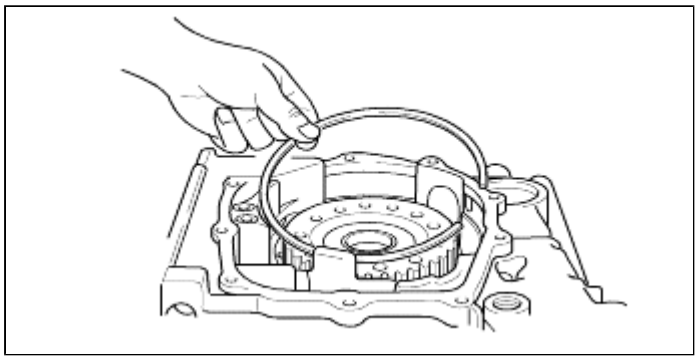
32. Install the brake disc, the brake plate, and the pressure plate.



33. Install the return spring and the second brake piston.

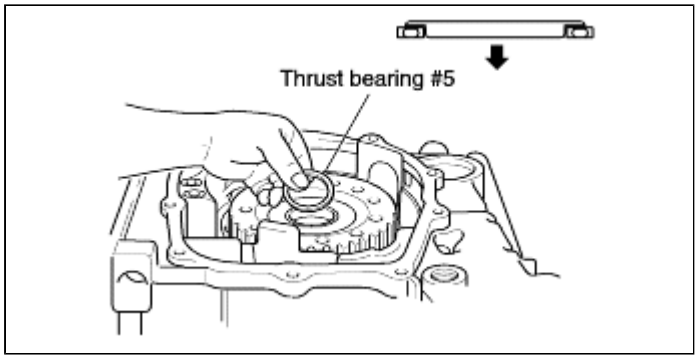


34. Install the snap ring.



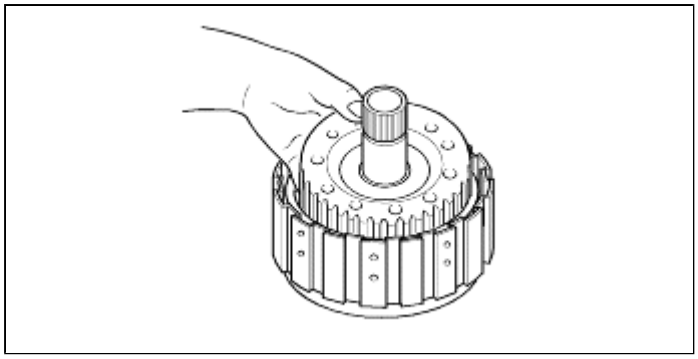
35. Install the thrust bearing #5.

> **CAUTION**
>
> Be careful not to reverse the direction of the thrust bearing.



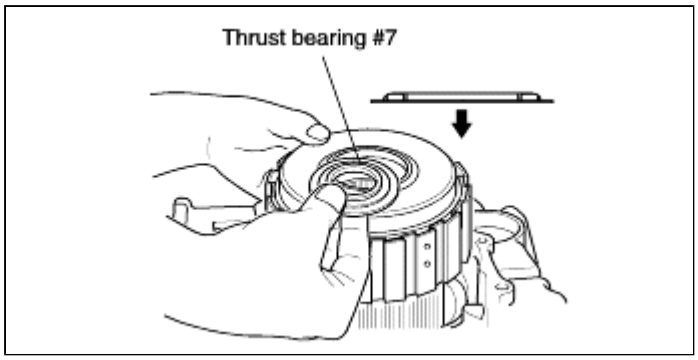
36. Assemble the overdrive clutch hub and the thrust bearing #6 into the reverse & overdrive clutch.

> **CAUTION**
>
> Be careful not to reverse the direction of the thrust bearing.



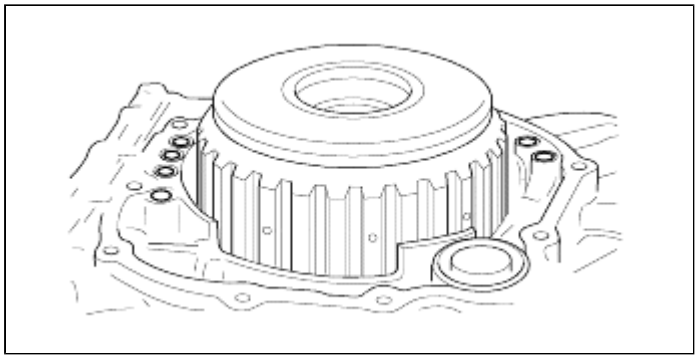
37. Install the reverse and overdrive clutch and the thrust bearing #7.

> CAUTION
>
> Be careful not to reverse the direction of the thrust bearing.

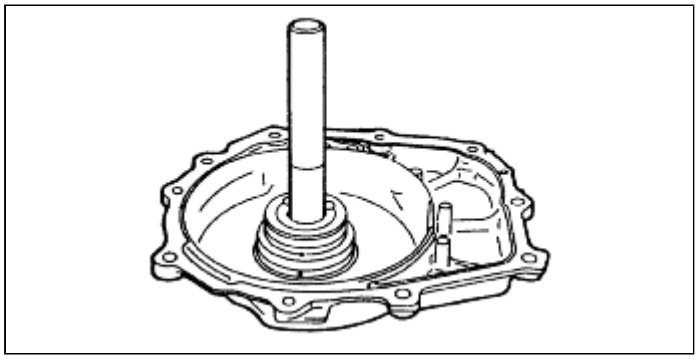


38. Install the overdrive clutch assembly.

> NOTE
>
> Upon correct assembly the clutch retainer hole will match with the case surface.



39. Install O-rings(six).
40. Install the input shaft bearing



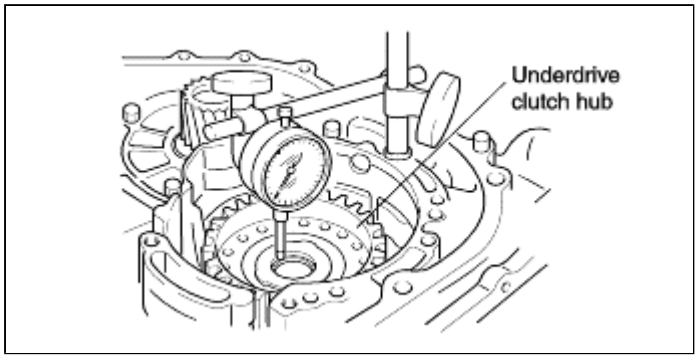
41. Install the seal rings(four).

42. Insert the used thrust bearing #8 and install the rear cover.

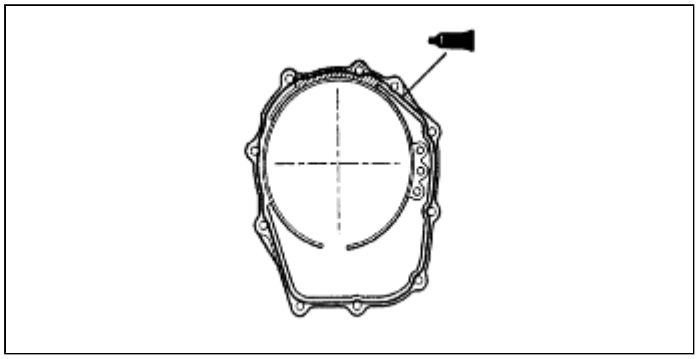
> NOTE
>
> Rear cover will be installed in order to check the underdrive sun gear gap.

43. Measure the underdrive sun gear end play. Choose the installed thrust race in the order of standard value, and install it.

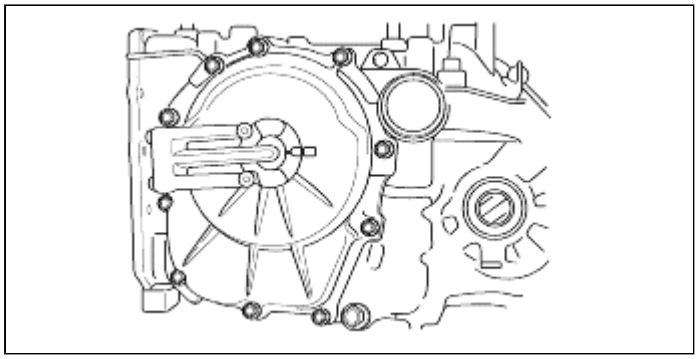
Standard value : 0.0098~0.0177in(0.25~0.45mm)



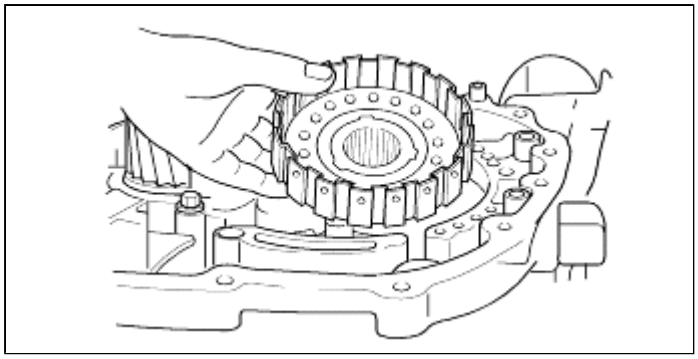
44. Continue to apply liquid gasket at application points at the rear cover with Ø0.063in(1.6mm) thickness.
Liquid gasket
Part name:Threebond 1281B or LOCTITE FMD546



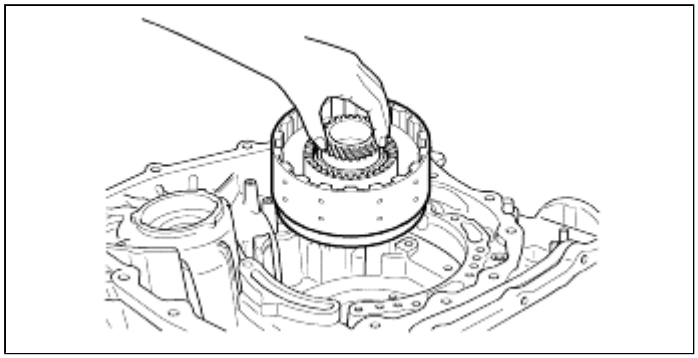
45. Install the rear cover and tighten it with tightening torque.



46. Install the underdrive clutch hub.

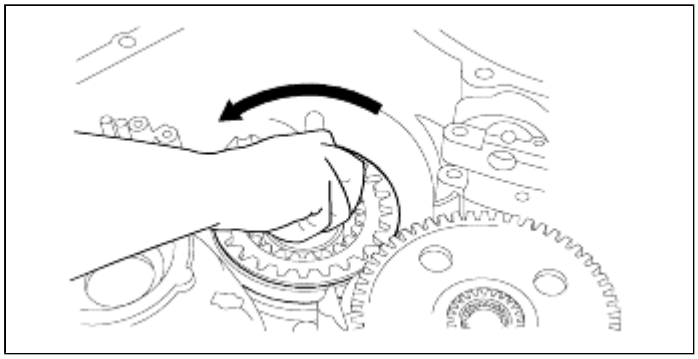


47. Install the director clutch assembly.
48. Install the reduction brake band.

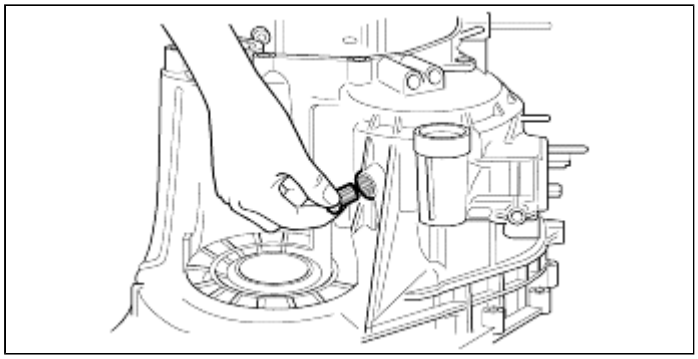


NOTE

Turn the direct clutch counterclockwise to install.



49. Insert the anchor plug with hand matching into the reduction brake band hole.



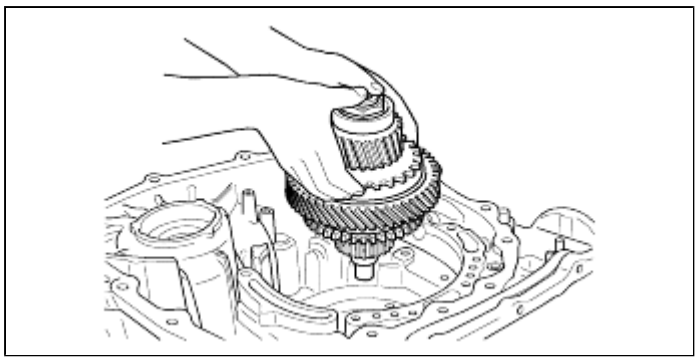
50. Install the director planetary carrier assembly.

NOTE

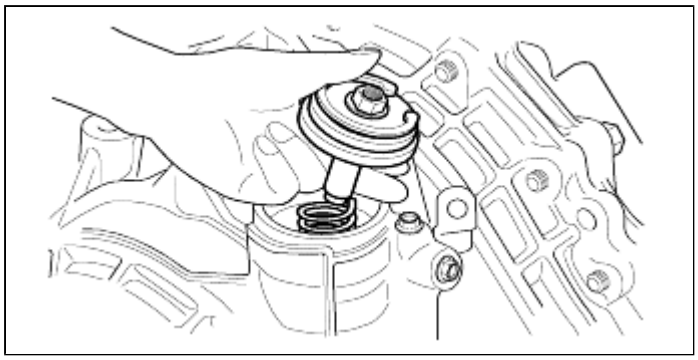
Look into the hole where output speed sensor will be installed, in order to check if direct planetary carrier assembly is seated correctly.

CAUTION

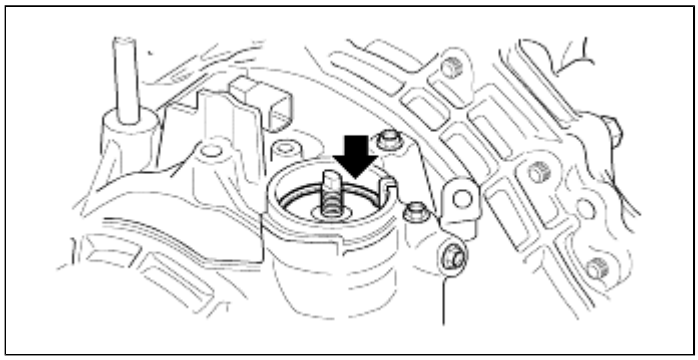
On moving the transaxle case, be careful that the director assembly do not slide out.



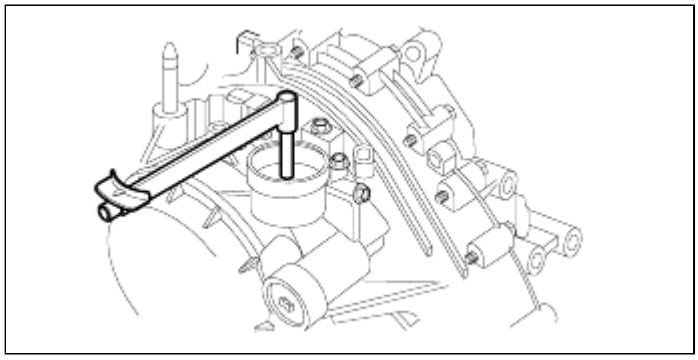
51. Install the spring and reduction brake piston assembly.



52. Adjust the reduction brake band in the following procedure:
    (1) Install the reduction brake piston snap ring.

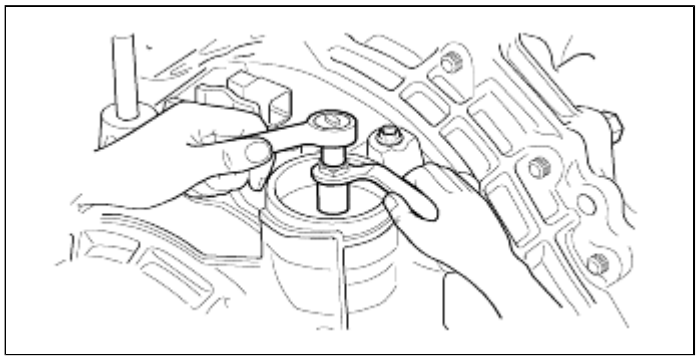


    (2) Hold the reduction brake piston not to turn and tighten and release the adjustor rod 2 times with tightening torque (100kg·cm).
    (3) Tighten with 50kg·cm torque again and release 5.5~5.75 times.

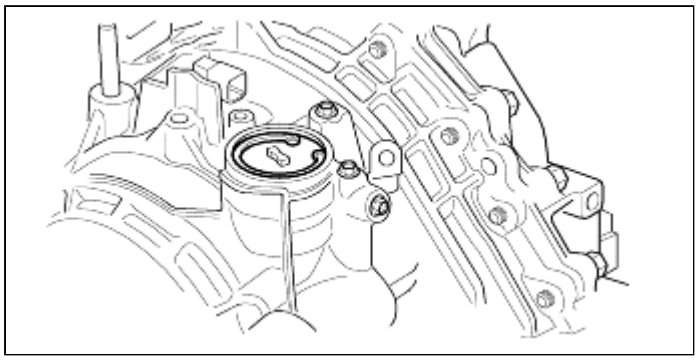


    (4) Tighten the reduction brake piston rod holding nut with tightening torque.

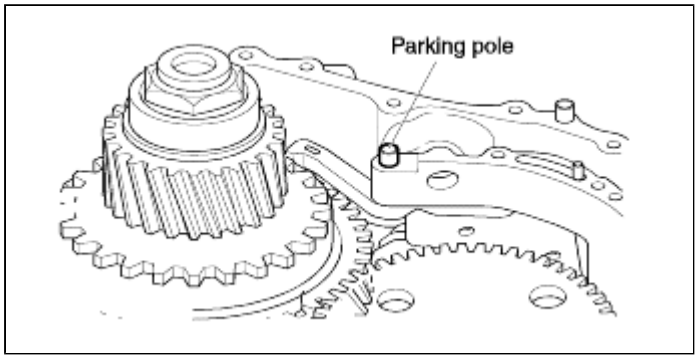
Tightening torque :14.7~21.6N·m(150~220kg·cm, 10.8~15.9 lb·ft)



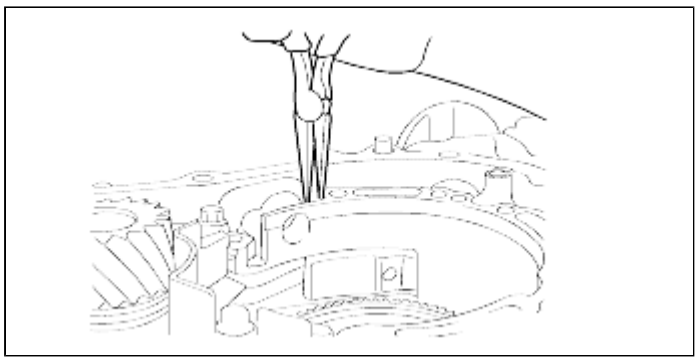
53. Install the outer reduction brake piston and the snap ring.



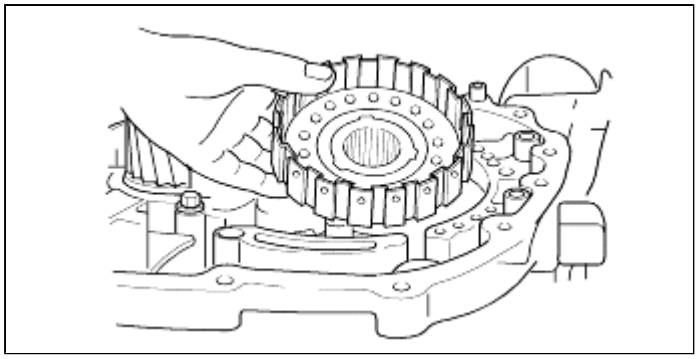
54. Install the parking pole, the spacer and the spring and then the parking pole shaft.



55. Install the parking roller support and the roller shafts(two).

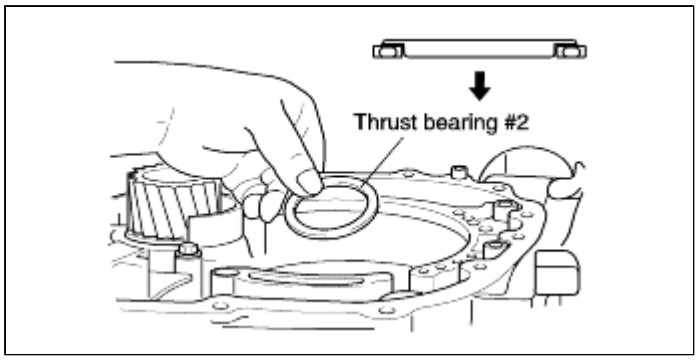


56. Install the underdrive clutch hub.



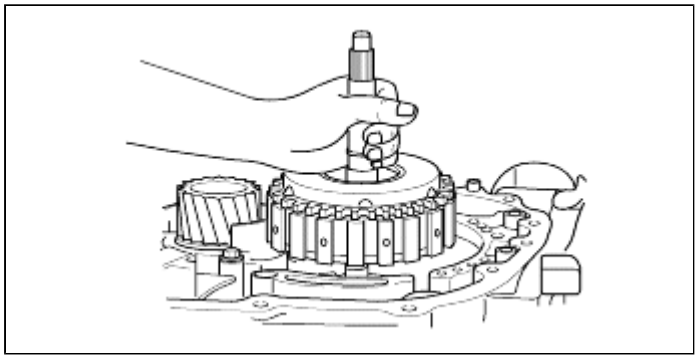
57. Install the thrust bearing #2.

> **CAUTION**
>
> Be careful not to reverse the direction of the thrust bearing.

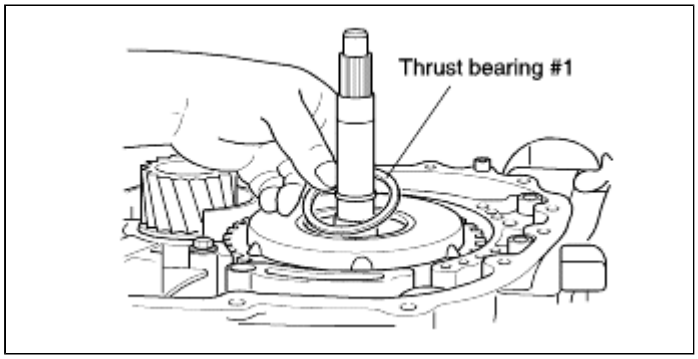


58. Hold the input shaft and install the underdrive clutch.

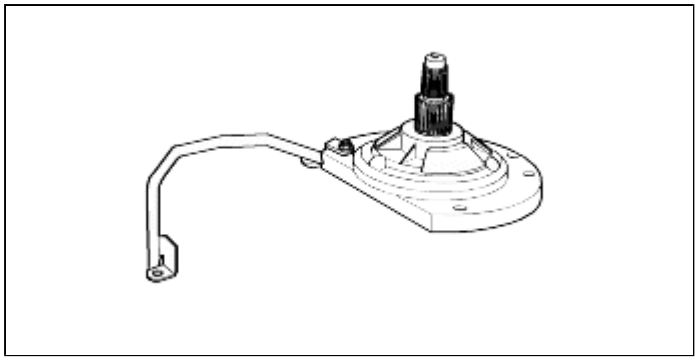
> **NOTE**
>
> Look into the hole where the output speed sensor will be installed, in order to check if direct planetary carrier assembly is seated correctly.



59. Install the used thrust washer #1.

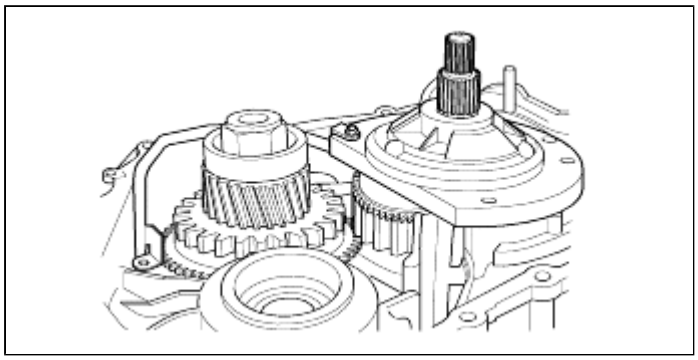


60. Connect the pipe to the fluid pump.



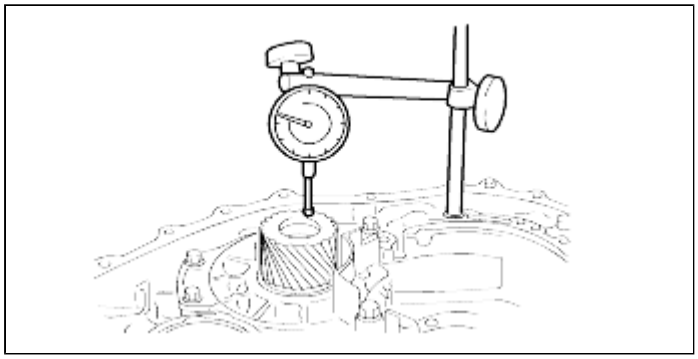
61. Install the new fluid pump gasket and the oil pump assembly.

> CAUTION
>
> Do not reuse used gasket.

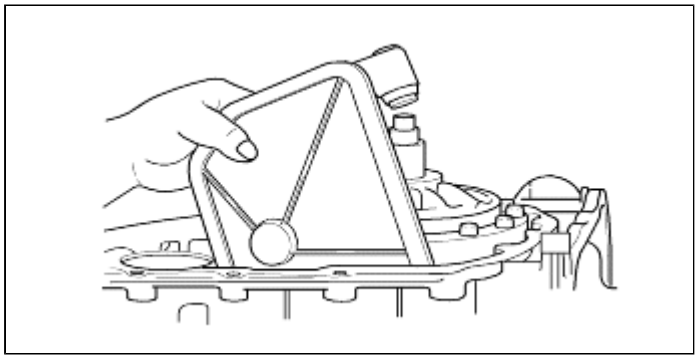


62. Tighten the fluid pump mounting bolt with tightening torque.
63. Check the input shaft end play and install the appropriate thrust washer in procedure 59.

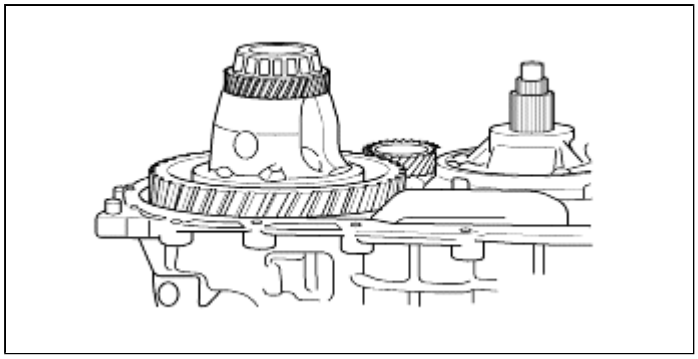
Standard rangeF5A51-3 : 0.027~0.057in(0.70~1.45mm)



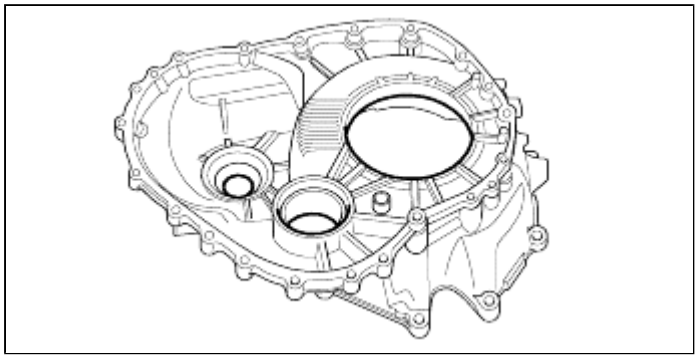
64. Install the main fluid filter.



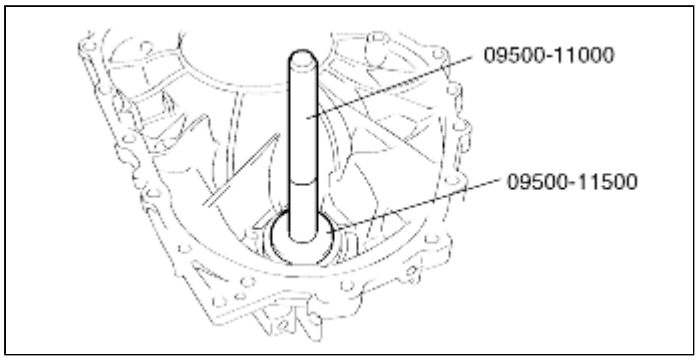
65. Install the differential assembly.



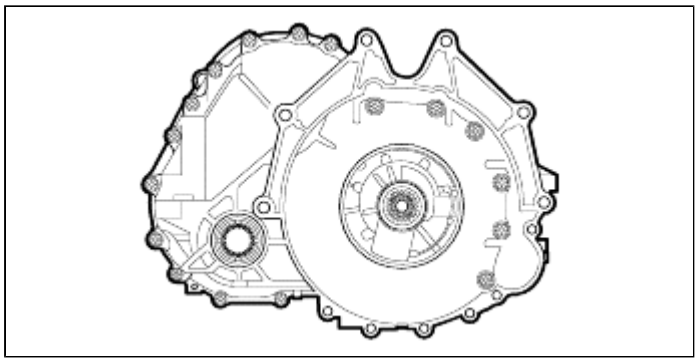
66. Install 3 solders (length approx 0.39in(10mm), thickness 0.12in(3mm) on the torque converter housing at positions illustrated on the figure.



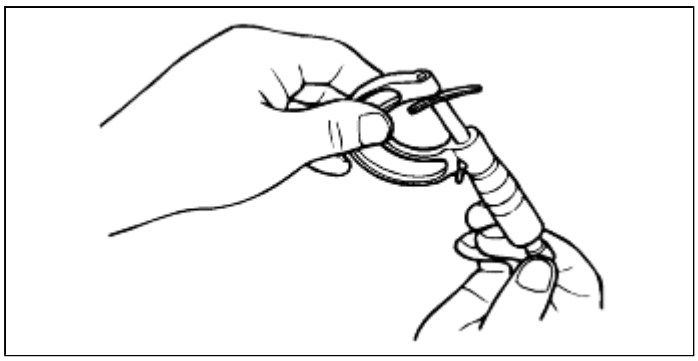
67. Hit output race into the housing using the special tool.



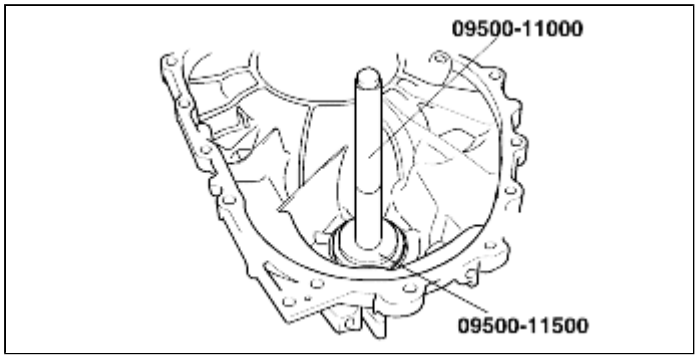
68. Install the torque converter housing onto the transaxle case without applying sealing material and tighten with tightening torque.



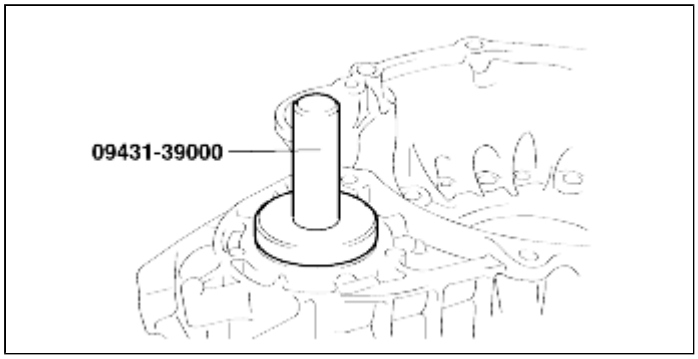
69. Release the bolts and remove the solders.
70. Measure the solder thickness with a micrometer and choose a spacer using the below formula: (T+0.0022in(0.056mm)~(T+0.0041in(0.105mm)



71. Install the spacer chosen at procedure 70 on the converter housing. Tap the output race into it using the special tool.

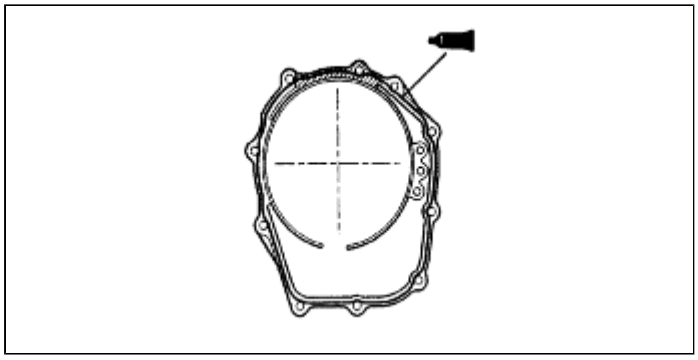


72. Install the driveshaft oil seal on the torque converter housing case.

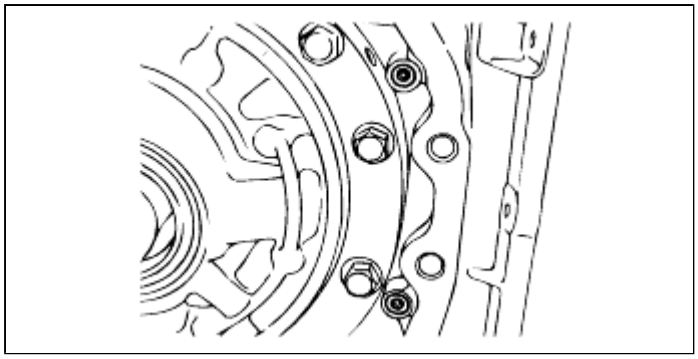


73. Continually apply liquid gasket at the torque converter housing at Ø0.063in(1.6mm) thickness as the figure.

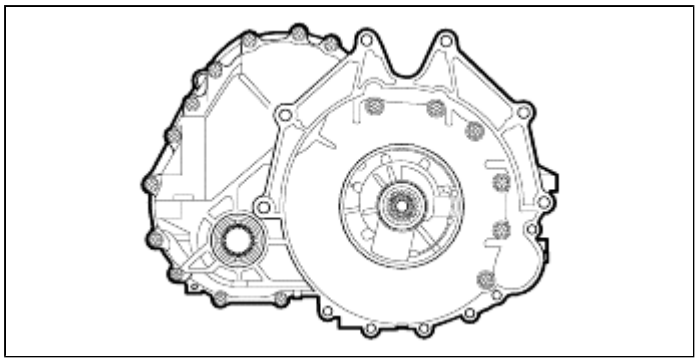
Standard sealant :Threebond 1281B or LOTITE FMD546



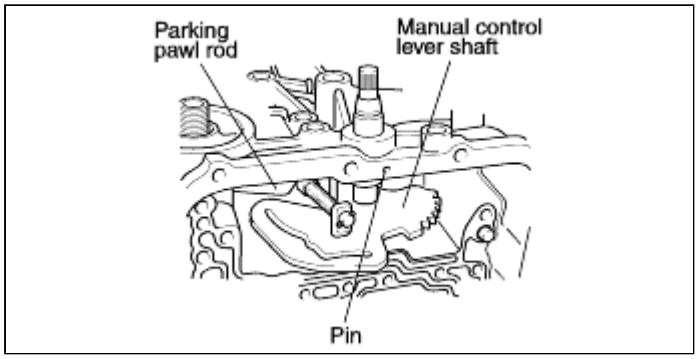
74. Install new O-rings(two).



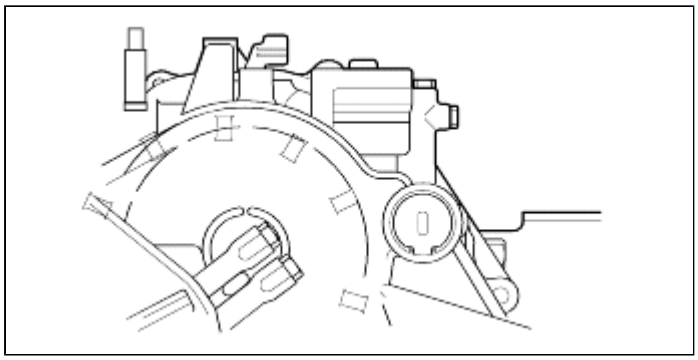
75. Connect the torque converter housing and tighten the connecting bolts (twenty) with tightening torque.



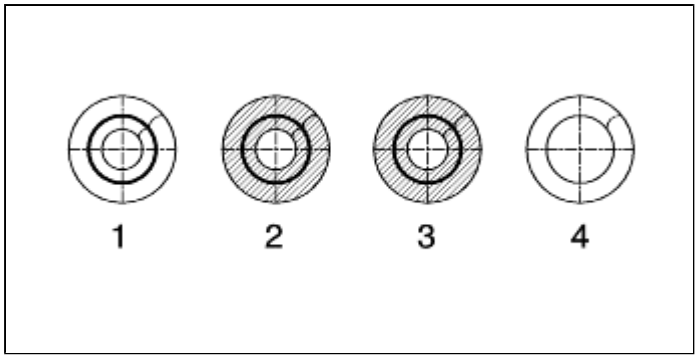
76. Install the manual control shaft and the parking pole rod.
77. Install the manual control shaft roller.



78. Install the reduction brake accumulator spring and the piston and then the snap ring.



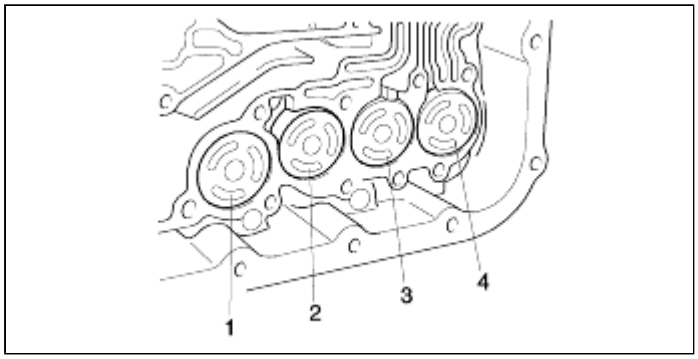
79. Install each accumulator piston, a new seal ring, and the piston.



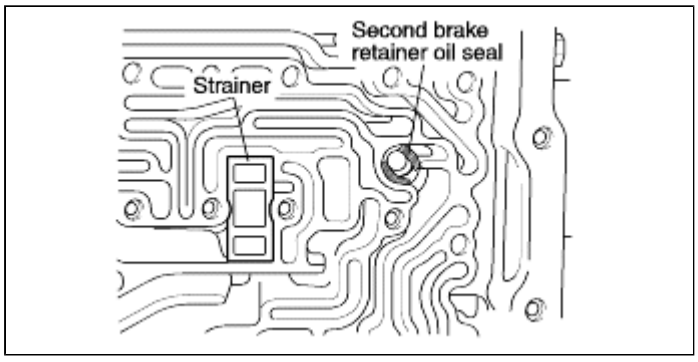
NOTE

Accumulator spring identification

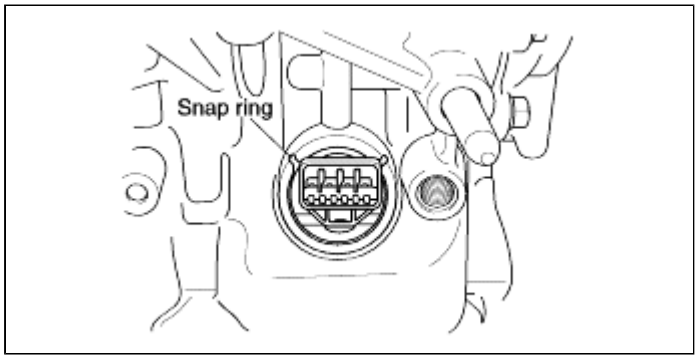
No.	Use	I.D.Color
1	LR brake	Colorless
2	UD clutch	Yellow
3	2ND brake	White
4	OD clutch	Colorless



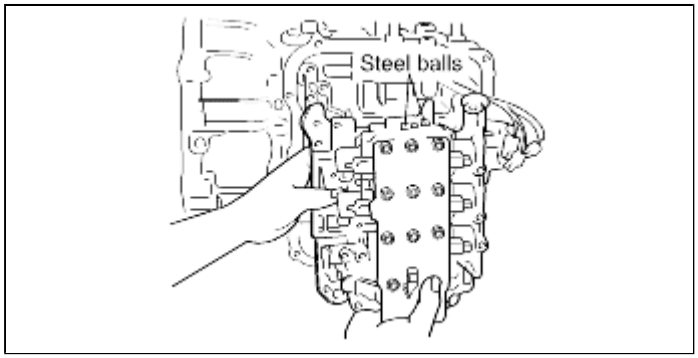
80. Install the strainer and the second brake retainer oil seal.



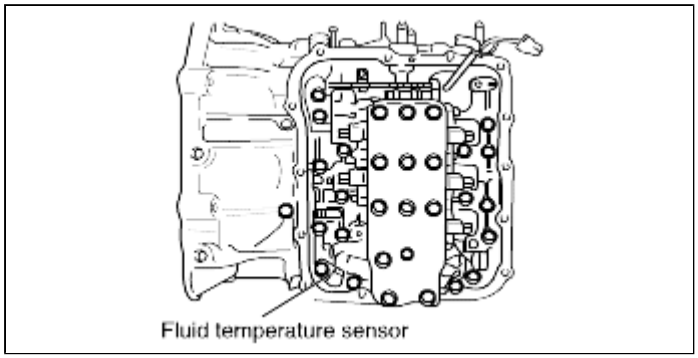
81. Install the solenoid valve harness and install the snap ring around the connector tightly.



82. Install the valve body, the gasket and the steel balls(two).



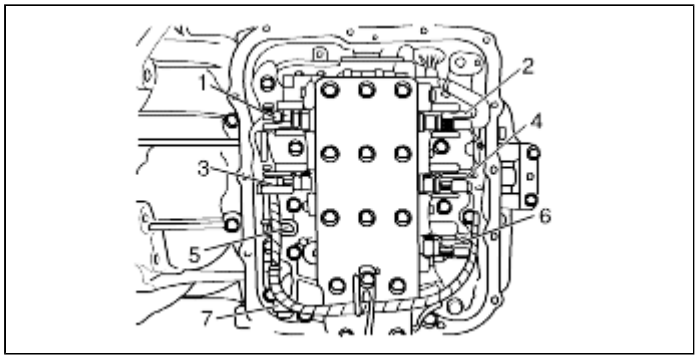
83. Install the fluid temperature sensor.



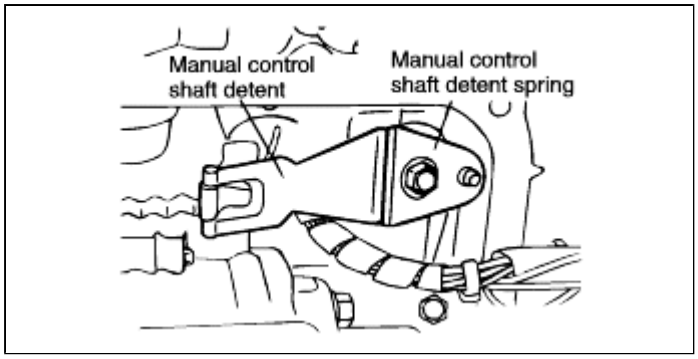
84. Install the valve body mounting bolts(twenty eight).

85. Connect the connector valve body.

No.	Connecting point	Wire color	Connector housing color
1	OD solenoid valve	Red	Black
2	UD solenoid valve	White, red, red	Black
3	LR solenoid valve	Brown, yellow	Milky white
4	2nd solenoid valve	Green, red, red	Milky white
5	RED solenoid valve	Brown, yellow, yellow	Black
6	DCC solenoid valve	Blue, yellow, yellow	Black
7	Temperature sensor	Black, red	Black

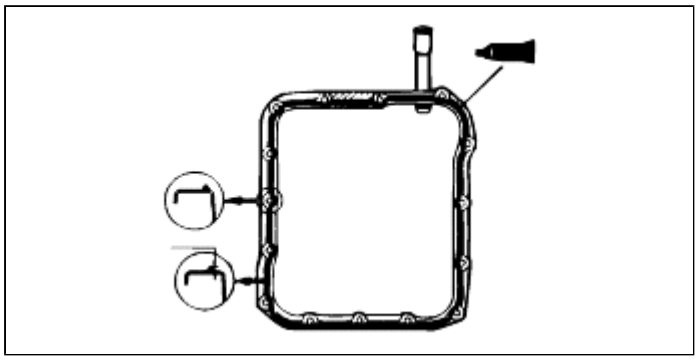


86. Install the manual control shaft detent spring and the detent.

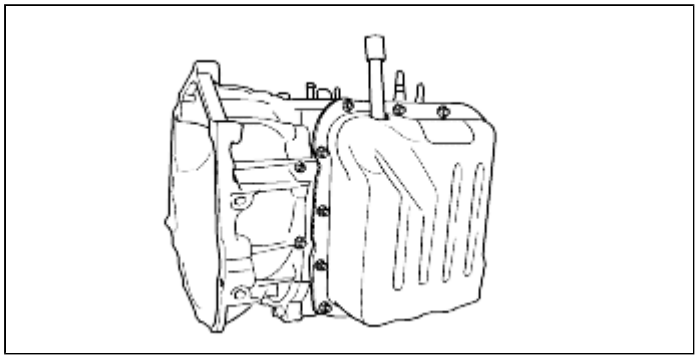


87. Continually apply liquid gasket at the valve body at Ø0.098in(2.5mm) thickness as the figure.

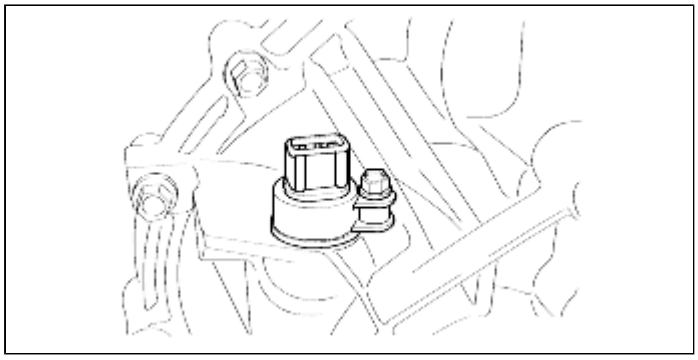
Liquid gasket	Standard sealant	Threebond 1281B or LOCTITE FMD546



88. Install the valve body cover and tighten the mounting bolts with tightening torque.

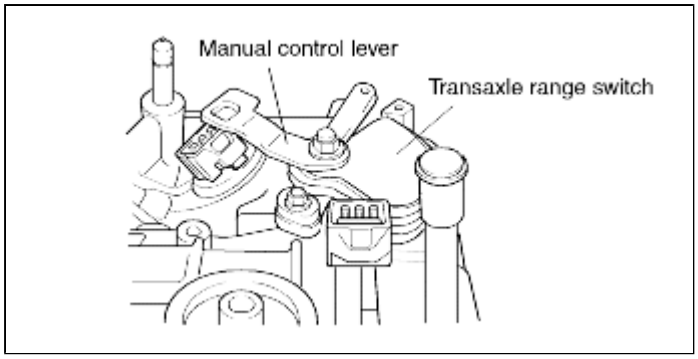


89. Install the speedometer gear.

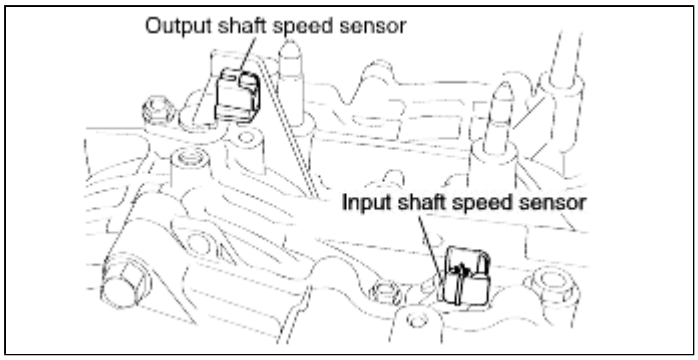


90. Install the transaxle range switch and the manual control lever.

> CAUTION
>
> The transaxle range switch shall be installed with the valve body installed as it was.



91. Install the input speed sensor and output speed sensor.

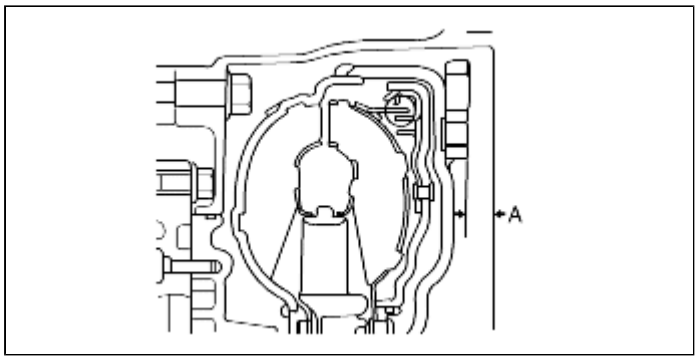


92. Install the evebolt, a new gasket, and the oil cooler feed tube.
93. Install the fluid level gauge.
94. Install each bracket.
95. Install the torque converter and tighten it into tolerance.

Tolerance:approx. 0.37in(9.4mm)

CAUTION

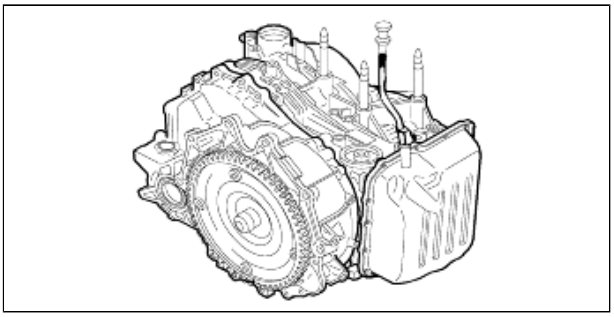
Apply ATF to avoid damage on the torque converter shaft and the oil pump seal lip.



SERVICE ADJUSTMENT PROCEDURES

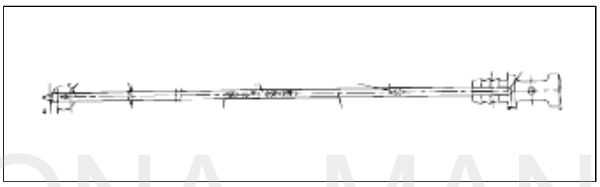
ATF checking

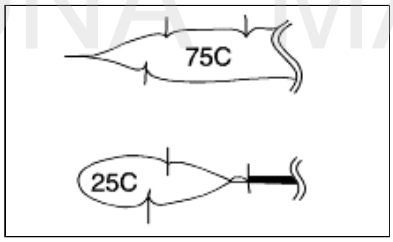
1. Drive the vehicle to warm ATF up to operating temperature. (70-80°C (158-176°F))
2. Park the vehicle at even surface and engage the parking brake. (Depress the parking brake pedal for foot type)
3. Move the selector lever through all positions and place it at position "P or "N".



4. Remove dirt around the fluid level gauge and clean the gauge to check ATF.

> NOTE
>
> If there's burnt odor, it means that ATF is contaminated by fine particles from bush (metal) or abrasive materials. Thenyou must overhaul the transaxle and cleanse the cooler line.





Gauge end

SEDONA MANUAL

5. Check the ATF level. ATF shall reach "HOT" range of the fluid level gauge. Otherwise, add the fluid to "HOT" range. Use GENUINE DIAMOND ATF SP-III fluid

> NOTE
>
> 1) Low ATF level will make fluid pump inhale outside air to generate bubbles within the fluid pressure line. Then fluid pressure will be decreased to cause retarded shift or slip of the clutchs and the brakes.
> 2) Surplus fluid will make gears pump up fluid to generate bubbles resulting to the same effect as low fluid level.
> 3) High or low fluid level will cause fluid overheating and oxidation, and the valves, the clutches, and the brake will not operate properly. Besides, bubble will make fluid overflow into air bleeder or fluid filter tube though there is no fluid leakage.

> CAUTION
>
> When new, automatic transmission fluid should be red. The red dye is added so the assembly plant can identify it as transmission fluid and distinguish it from engine oil or antifreeze. The red dye, which is not an indicator of fluid quality, is not permanent. As the vehicle is driven the transmission fluid will begin to lock darker. The color may eventually appear light brown.

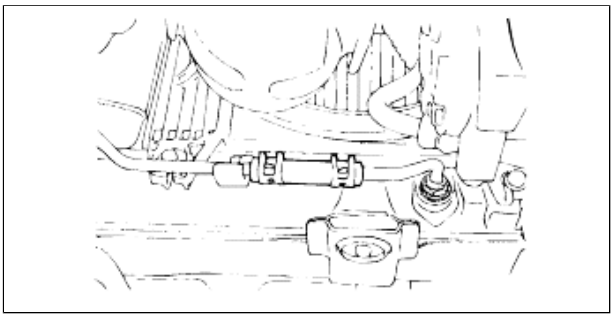
6. Insert the fluid level gauge correctly.

Automatic transaxle fluid replacement

1. Warm up ATF to operation temperature, (70-80°C (158-176°F)).

2. Disconnect the out hose of the oil cooler.
3. Start the engine and drain the fluid, at "N" range and idling.

> **CAUTION**
>
> Stop the engine for one minute after start-up or when ATF is drained up, at either time whichever earlier.



4. Open the drain plug and drain up fluid, then tighten the plug with tightening torque.

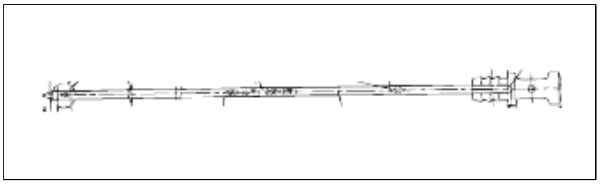
Tightening torque29~34 N·m (290~340 kg·cm, 20~24 lb·ft)

5. Reconnect the fluid cooler hose and fill ATF through the fluid filler tube.

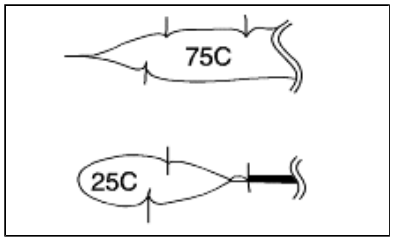
Type	Capacity	Specified ATF
F5A51-3	8.5 lit 98.9 US qt, 7.4 Imp qt)	GENUINE DIAMOND ATF SP-III

6. Start the engine and idle it for one or two minutes.
7. Move the selector lever through every position and place the lever at "P" or "N" position.
8. Check the fluid level gauge if the ATF level is within the range marked "COLD". Add fluid if necessary.
9. Run the vehicle to warm up ATF to operating temperature (70-80°C(158-176°F)) and check the ATF level again. ATF level shall be within the range marked HOT.

> **NOTE**
>
> "HOT" level is more important than "COLD" level.
> "COLD" level is only for complementary information.



Gauge end



10. Install the fluid level gauge into fluid filler tube.

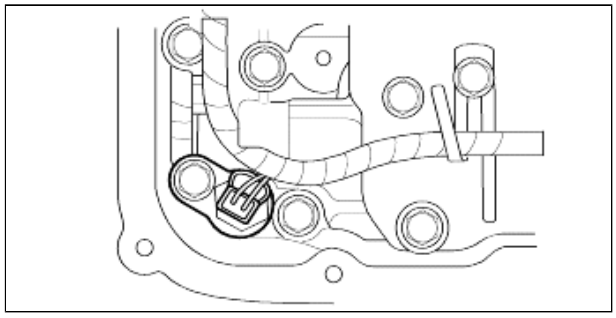
Checking transaxle control

Components throttle position sensor checking

The TPS is a variable resistor type that rotates with the throttle body shaft to sense the throttle valve angle. As the throttle shaft rotates, the output voltage of the TPS changes. The ECM detects the throttle valve opening based on voltage change (Refer to FL-section).

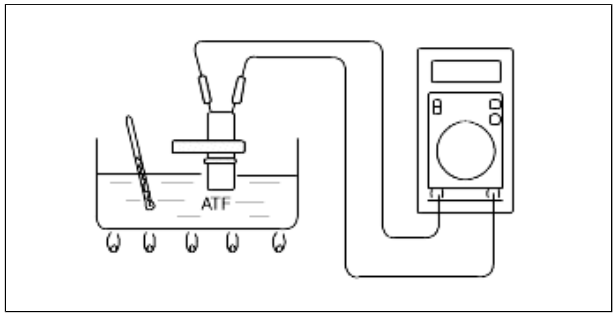
Fluid temperature sensor checking

1. Remove the fluid temperature sensor.



2. Check the resistance between the connector terminal No.1 and 2 at the fluid temperature sensor side.
   Standard value

Temp.(°C(°F))	Resistance(kΩ)	Temp.(°C(°F))	Resistance(kΩ)
-40(-40)	139.5	80(176)	1.08
-20(-4)	47.7	100(212)	0.63
0(32)	18.6	120(248)	0.38
20(68)	8.1	140(284)	0.25
40(104)	3.8	160(320)	0.16
60(140)	1.98		



3. If the resistance deviates from the standard value, then replace the temperature sensor.

Checking vehicle speed sensor

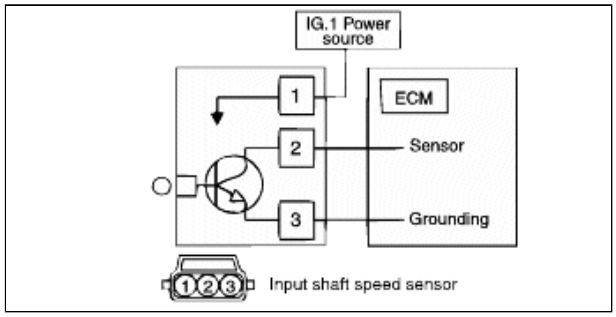
1. The sensor will detect the vehicle running speed at speedometer's gear part.
2. Remove the speed sensor and measure resistance as shown on fig.

   Standard value : 3~10 kΩ

3. Turn axis of the speed sensor and check the output voltage between terminal No.2 and 1.
   (1rev=4pulses)

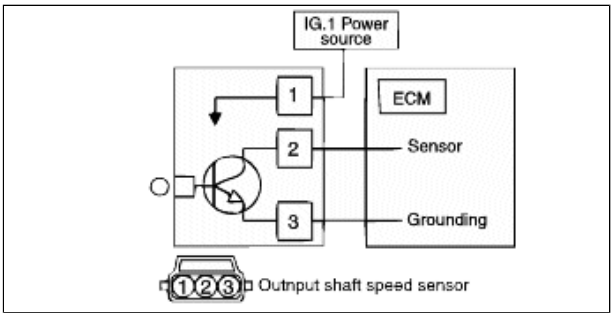
Checking input and output shaft speed sensor

1. Measure the wave pattern between No.2 and 3 using Hi-Scan.



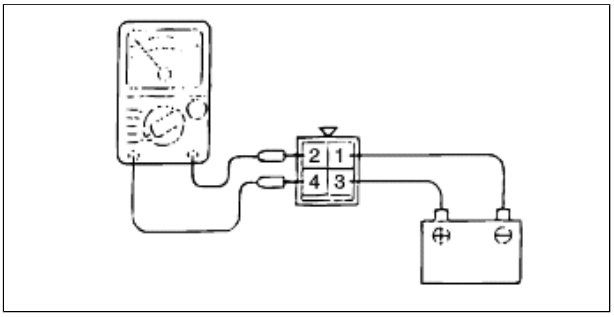
	Check item	Standard value
		0.051 in

Air gap	Input shaft speed sensor	(1.3 mm)
	Output shaft speed sensor	0.0335 in (0.85 mm)
Coil insulation resistance	Input shaft speed sensor	1㏁ or more
	Output shaft speed sensor	1㏁ or more
Output voltage	HIGH side	4.8 - 5.2V
	LOW side	0.8V or less



A/T control relay checking

1. Remove the A/T control relay in the fuse box.
2. Use jumper wires to connect A/T control relay terminal (1) to the battery (-) terminal and terminal (3) to the battery (+) terminal.



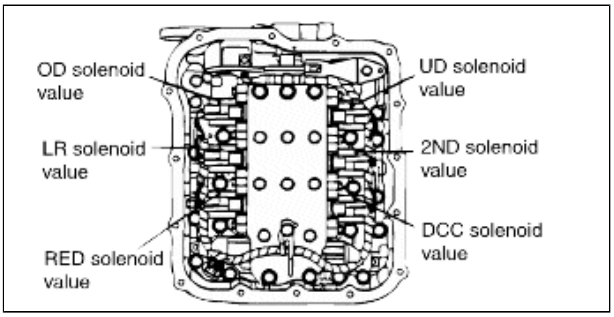
3. Check the continuity between terminal (2) and terminal (4) of the A/T control relay when the jumper wires are connected to and disconnected from the battery.

Jumper wire	Continuity between terminals No.2 and No.4
Connected	Continuity
Disconnect	No continuity

4. If there is a problem, replace the A/T control relay.

Solenoid valve checking

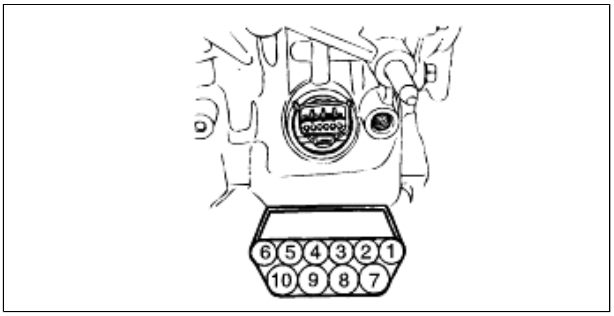
1. Remove the valve body cover.



2. Disconnect the connectors of each solenoid valve.

Standard value(at 20°C(68°F)) : 2.7 - 3.4Ω

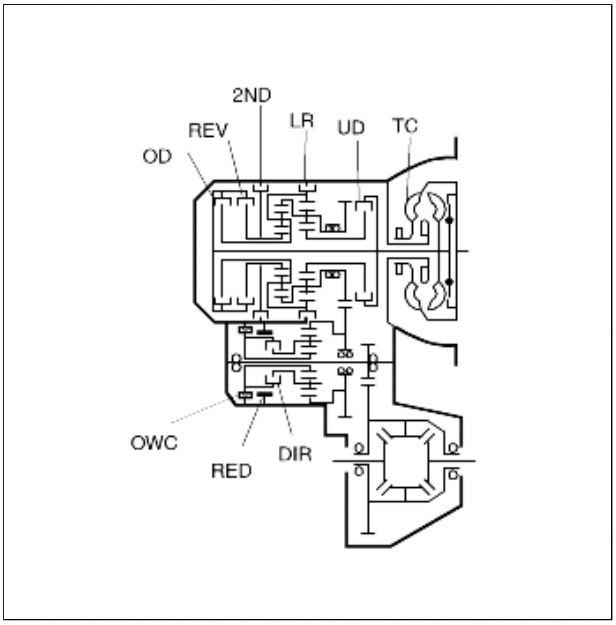
3. If the resistance is outside the standard value, replace the solenoid valve.
4. Measure the resistance of the solenoid valve.



Terminal No.	Name	Resistance
7 & 10	Damper clutch solenoid valve	2.7-3.4Ω (at 20°C)
7 & 1	Low and reverse solenoid valve	
8 & 3	Second solenoid valve	
8 & 4	Underdrive solenoid valve	
8 & 2	Overdrive solenoid valve	

Torque converter stall test

This test measures the maximum engine speed when the selector lever is at the D or R position and the torque converter stalls to test the operation of the torque converter, starter motor and oneway clutch operation and the holding performance of the clutches and brakes in the transmission.



CAUTION

Do not let anybody stand in front of or behind the vehicle while this test is being carried out.

1. Check the automatic transmission fluid level and temperature and the engine coolant temperature.
   A. ATF level : At the HOT mark on the oil level gauge.
   B. ATF temperature : 70-80°C(158-176°F)
   C. Engine coolant temperature : 80-100°C(176-212°F)
2. Check both rear wheels. (left and right)
3. Pull the parking brake lever on, with the brake pedal fully depressed.
4. Start the engine.
5. Move the selector lever to the D position, fully depress the accelerator pedal and take a reading of the maximum engine speed at this time.

CAUTION

1) The throttle should not be left fully open for any more than eight seconds.
2) If carrying out the stall tet two or more times, move the selector lever to the N position and run the engine at 1,000 r/min to let the automatic transmission fluid cool down before carrying out subsequent tests.

Standard valueStall speed: 1,800-2,600 r/min

6. Move the selector lever to the R position and carry out the same test again.

Standard valueStall speed: 1,800~2,600 r/min

Torque converter stall test judgement results

1. Stall speed is too high in both D and R ranges.
   A. Low line pressure
   B. Low and reverse brake slippage
2. Stall speed is too high in D range only.
   A. Underdrive clutch slippage
3. Stall speed is too high in R range only.
   A. Reverse clutch slippage
4. Stall speed too low in both D and R ranges.
   A. Malfunction of torque converter
   B. Insufficient engine output

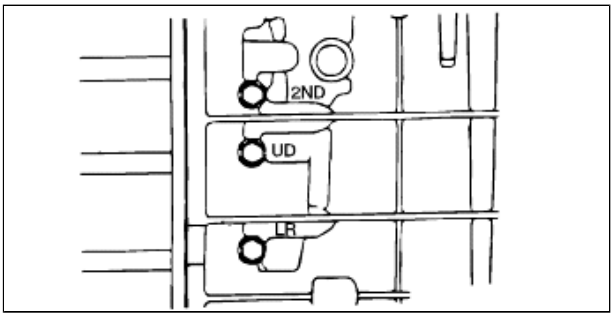
Hydraulic pressure test

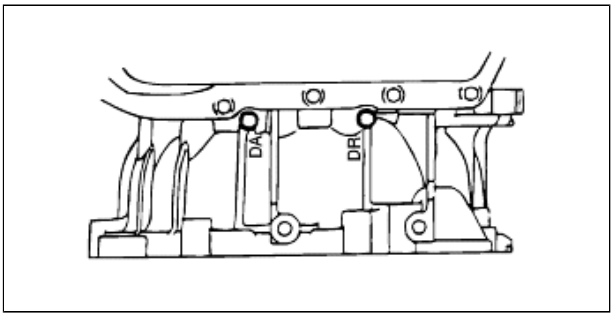
Hydraulic pressure test is used to indirectly check the normal operation of fluid pump and piston oil seal of each element by measuring operating pressure of each element in case of transaxle shock or slip.
If will be required to perform basic checks and inspect the electronic control system before testing the hydraulic pressure.

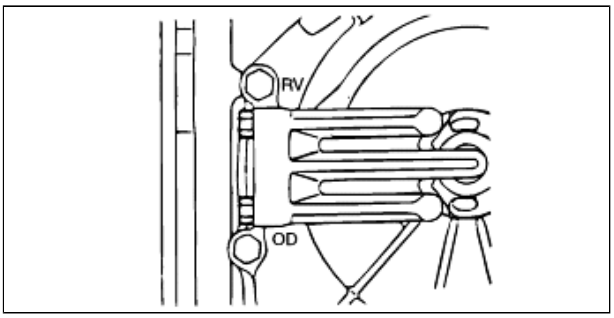
Procedure

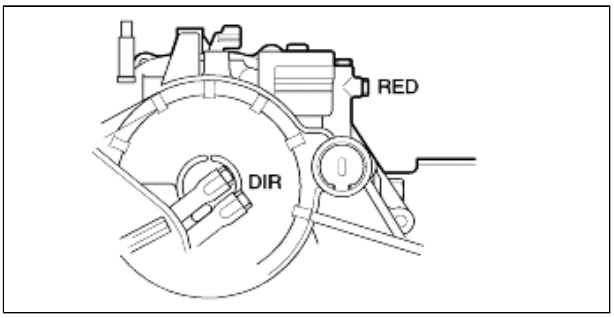
1. Warm up the ATF to 70-80°C(158-176°F).
2. Suspend the vehicle to idle wheels.
3. Install the special tools; fluid pressure gauge 2943kpa(30kg/cm², 426.6psi) and adapter (RED, DIR pressure) at each fluid pressure outlet.
4. Measure fluid pressure at each outlet and compare it with standard value referring to standard fluid pressure table.
5. If the pressure deviates from standard value, take corrective measure referring to fluid pressure test diagnosis chart.
   Abbreviation

Abbreviation	Description
UD	Underdrive clutch operating pressure
LR	Low and reverse brake operating pressure
2ND	Second brake operating pressure
DA	Damper clutch operating pressure
DR	Damper clutch release pressure
RV	Reverse clutch operating pressure
OD	Overdrive clutch operating pressure
RED	Reduction clutch operating pressure
DIR	Direct clutch operating pressure





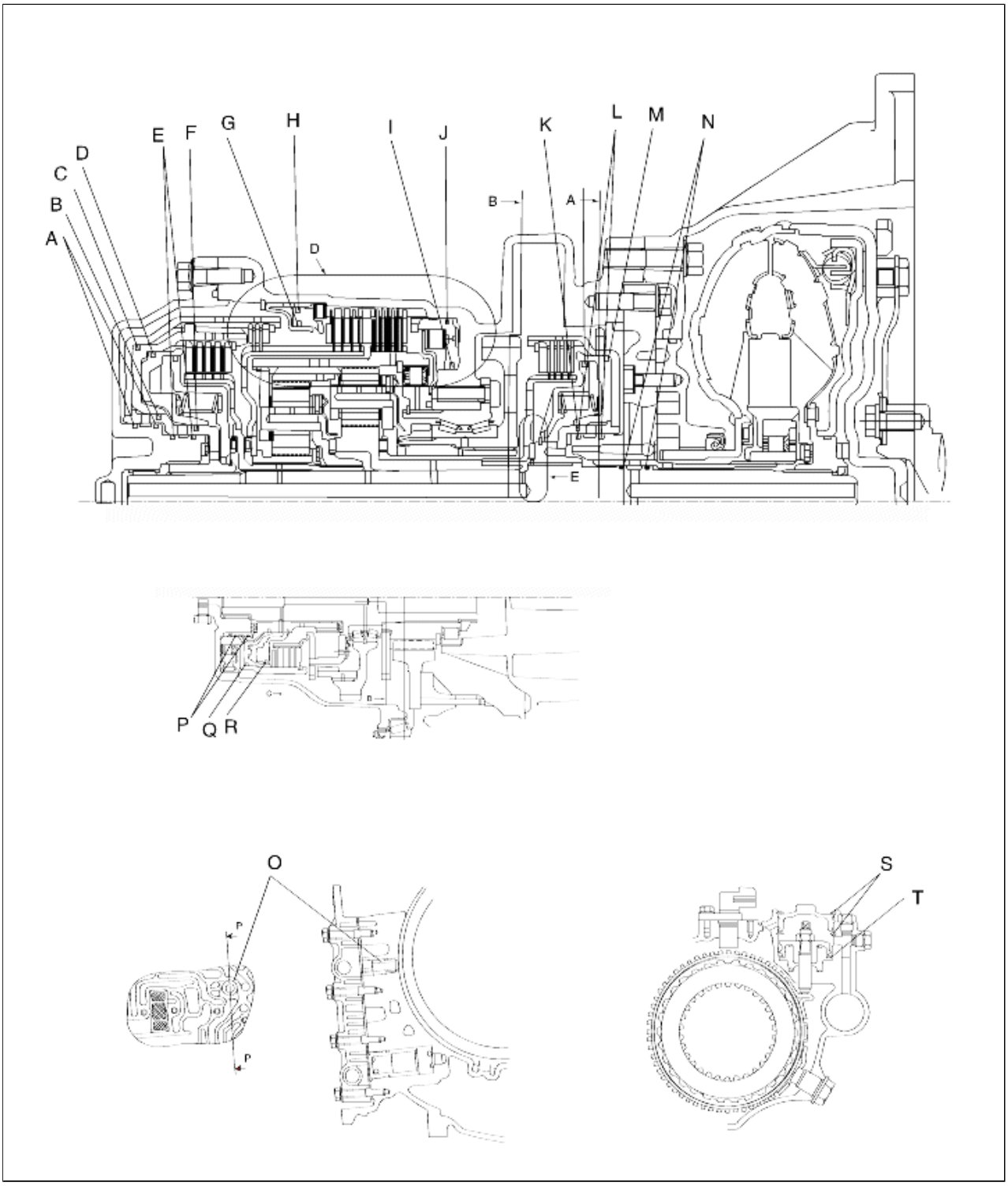




Normal fluid pressure specification table

Condition			Normal pressure kpa (kg/cm², psi)							
Selector lever position	Shifting range	Engine rpm (r/min)	Underdrive clutch pressure (UD pressure)	Reverse clutch pressure (REV pressure)	Overdrive clutch pressure (OD pressure)	Directer clutch pressure (DIR pressure)	Low& reverse brake pressure (LR pressure)	Second brake pressure (2ND pressure)	Reduction brake pressure (RED pressure)	Torque converter pressure (DR pressure)
P	-	2500	-	-	-	-	1010-1050 (10.3-10.7, 146.5-152.2)	-	1010-1050 (10.3-10.7, 146.5-152.2)	216-363 (2.2-3.7, 31.3-52.6)
R	Reverse	2500	-	1275-1766 (13.0-18.0, 184.9-256.0)	-	-	1275-1766 (13.0-18.0, 184.9-256.0)	-	1275-1766 (13.0-18.0, 184.9-256.0)	500-697 (5.1-7.1, 72.5-101.0)
N	-	2500	-	-	-	-	1010-1050 (10.3-10.7, 146.5-152.2)	-	1010-1050 (10.3-10.7, 146.5-152.2)	216-363 (2.2-3.7, 31.3-52.6)
D	First speed	2500	1010-1050 (10.3-10.7, 146.5-152.2)	-	-	-	1010-1050 (10.3-10.7, 146.5-152.2)	-	1010-1050 (10.3-10.7, 146.5-152.2)	500-697 (5.1-7.1, 72.5-101.0)
	Second speed	2500	1010-1050 (10.3-10.7, 146.5-152.2)	-	-	-	-	1010-1050 (10.3-10.7, 146.5-152.2)	1010-1050 (10.3-10.7, 146.5-152.2)	500-697 (5.1-7.1, 72.5-101.0)
	Third speed	2500	-	-	78.5-883 (8.0-9.0, 113.8-128.0)	-	-	78.5-883 (8.0-9.0, 113.8-128.0)	78.5-883 (8.0-9.0, 113.8-128.0)	451-647 (4.6-6.6, 65.4-93.9)
	Fourth speed	2500	-	-	78.5-883 (8.0-9.0, 113.8-128.0)	78.5-883 (8.0-9.0, 113.8-128.0)	-	78.5-883 (8.0-9.0, 113.8-128.0)	-	451-647 (4.6-6.6, 65.4-93.9)
	Fifth speed	2500	78.5-883 (8.0-9.0, 113.8-128.0)	-	78.5-883 (8.0-9.0, 113.8-128.0)	78.5-883 (8.0-9.0, 113.8-128.0)	-	-	-	451-647 (4.6-6.6, 65.4-93.9)

OIL SEAL LOCATIONS



Hydraulic pressure test diagnosis chart

Item	All pressures high	All pressures low	R abnormal	3-4 speed abnormal	UD abnormal	REV abnormal	OD abnormal	*DIR abnormal	*LR abnormal	2ND abnormal	RED abnormal	DR abnormal	Pressurization outside of operating area
Transaxle control cable adjustment improper													O
Oil pump failure		O											
Oil cooler colgged		O											O
Oil seal A failed						O							
Oil seal B failed						O							
Oil seal C failed						O							
Oil seal D failed							O						
Oil seal E failed							O						
Oil seal F failed							O						
Oil seal G failed										O			
Oil seal H failed										O			
Oil seal I failed									O				
Oil seal J failed									O				
Oil seal K failed					O								
Oil seal L failed					O								
Oil seal M failed					O								
Oil seal N failed												O	
Oil seal O failed										O			
Oil seal P failed								O					
Oil seal Q failed								O					
Oil seal R failed								O					
Oil seal S failed											O		
Oil seal T failed											O		
Underdrive solenoid valve failed					O								
Overdrive solenoid valve failed							O						
Low&reverse solenoid valve failed (dual use with DIR)								O	O				
Second solenoid valve failed										O			
Damper clutch control solenoid valve failed												O	
Reduction solenoid valve failed											O		
Underdrive pressure control valve failed					O								
Overdrive pressure control valve failed							O						
Low&reverse pressure control valve failed								O	O				
Second pressure control valve failed										O			
Damper clutch control valve failed												O	
Torque converter pressure control valve failed												O	
Reduction pressure control valve failed											O		
Regulator valve failed	O	O	O	O									
Manual valve failed													O
Switch valve failded				O				O	O				
Fail-safe valve A failed									O				
Fail-safe valve B failed										O			
Fail-safe valve C failed								O					
Relief valve failed		O											
Each check-ball failed					O	O	O		O				
Each orifice failed					O	O	O	O	O	O	O	O	
Valve body installation failure		O			O	O	O	O	O	O	O	O	O

End play adjustment procedure

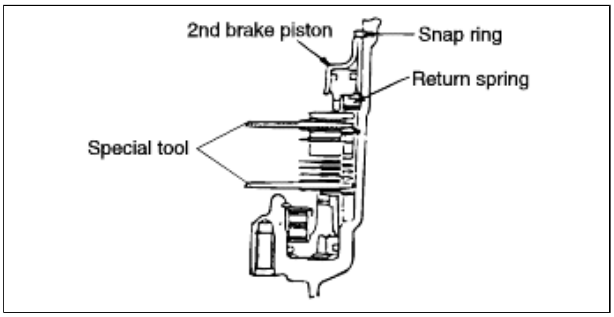
Adjusting the brake reaction plate end play.

Replace/LR brake plate using the special tool, and install the brake disc, the brake plate, and the snap ring as illustrated on the figure. Install the reaction plate and the snap ring. Move the special tool and measure the end play. Adjustthe end play into standard range using a new snap ring.

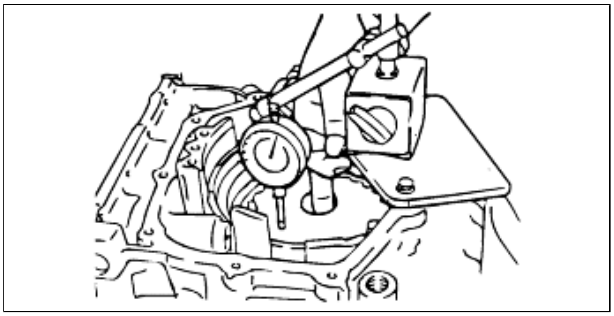
Standard end playF5A51-3 : 0-0.0063in(0-0.16mm)

Adjusting 2nd brake end play

Replace the second brake pressure plate using the special tool and install the brake disc and the brake plate as illustrated on the figure. Install the return spring, the second brake piston and the snap ring.



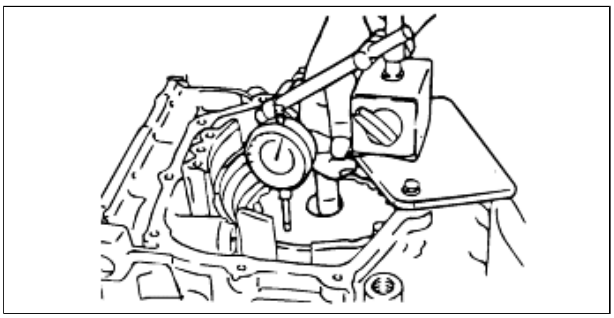
Standard end playF5A51-3 : 0.039-0.061in(1.09-1.55mm)



Adjusting LR brake end play

Rotate transaxle.
Adjust the end play of the pivot.

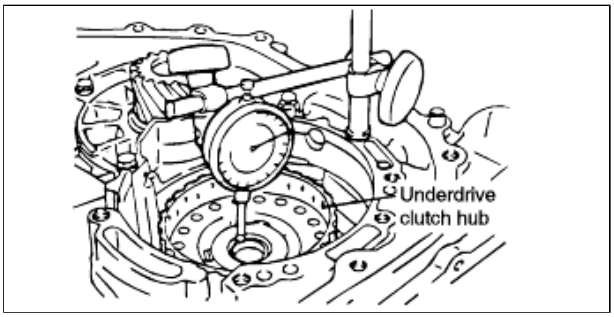
Standard end playF5A51-3 : 0.065-0.083in(1.65-2.11mm)



Adjusting underdrive sun gear end play

Assemble the used thrust race (No.8) and the rear cover. Measure the underdrive sun gear.
Adjust the end play to standard value using a new thrust race (No.8).

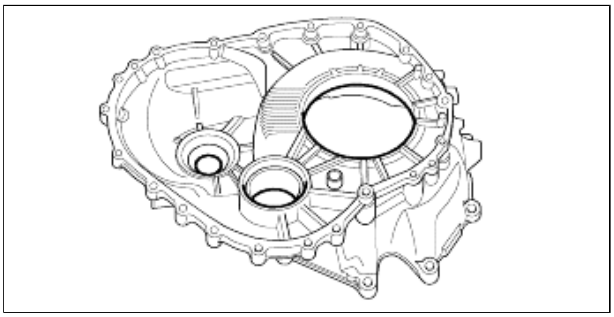
Standard valueF5A51-3 : 0.0098L-0.0177L (0.25L-0.45L mm)



Assemble underdrive clutch hub, then it will be easy to measure underdrive sun gear.

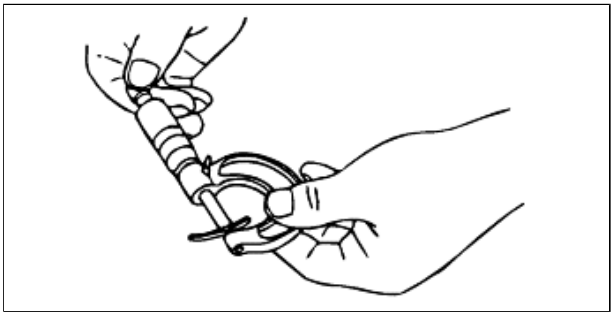
Adjusting differential case preload

Place 3 solders (length 10mm approx. dia 3mm) on the torque converter housing as illustrated on the figure.



Assemble the torque converter housing on the transaxle case without applying sealant.
Tighten the connecting bolts with tightening torque. Release the bolts and remove the solders.
Measure solder's compressed thickness(T) using a micrometer. Use one within standard value.

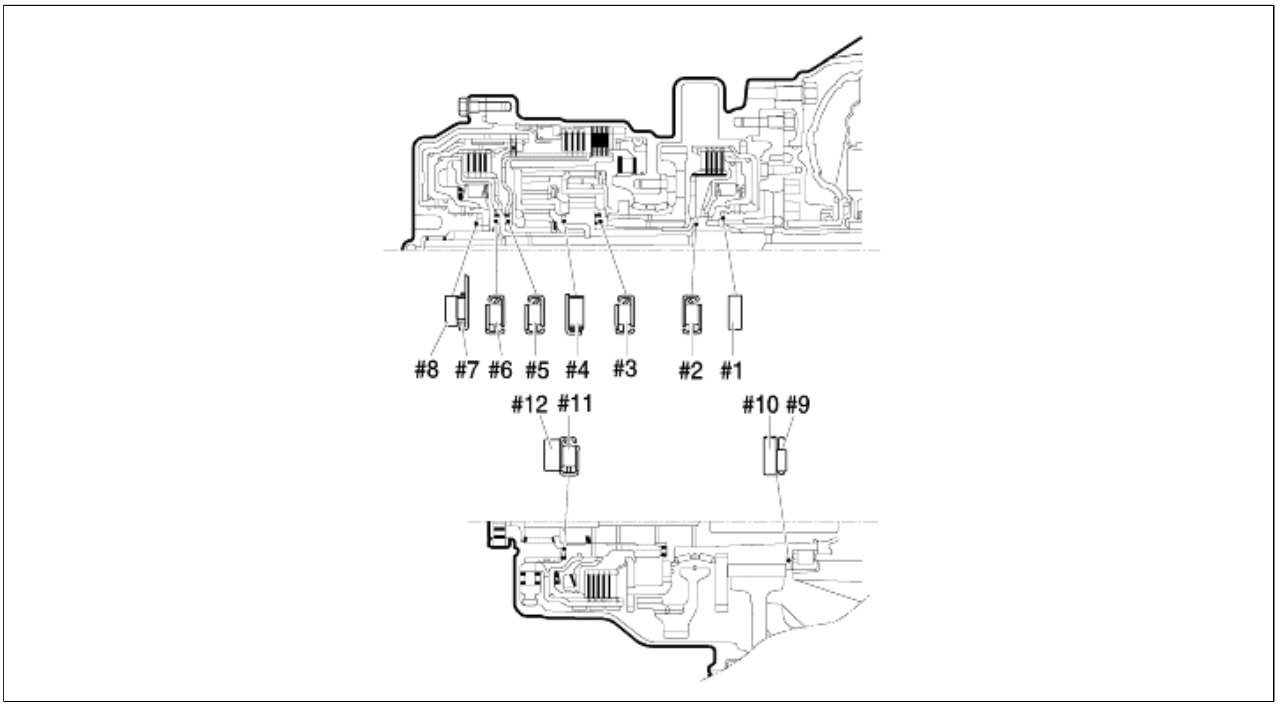
Standard valueF5A51-3 : 0.0177T-0.0041T (0.45T-0.105T mm)



Sensor and actuator functions

Item	Functions
Input speed sensor	Detect the turbine rpm at the UD retainer part
Output speed sensor	Detect at the direct planetary carrier part
Crank angle sensor	Detect the engine rpm at the crankshaft part
TPS	Detect the pedal press level through the potentiometer
Fluid temperature sensor	Detect the ATF temperature through the thermistor
Transaxle range switch	Detect the shift lever position by the contact switch
Stop lamp switch	Detect the brake operation by the contact switch at the brake pedal part
Vehicle speed sensor	Detect the vehicle speed at the speedometer gear part
Air conditioner load switch	Detect the compressor operation through the hydraulic pressure switch
A/T control relay	Power supply to the solenoid valve
DCC solenoid valve	Control the fluid pressure to the pressure control valve for shift control
LR (DIR) solenoid valve	Control the fluid pressure to the pressure control valve for shift control
2ND solenoid valve	Control the fluid pressure to the pressure control valve for shift control
UD solenoid valve	Control the fluid pressure to the pressure control valve for shift control
OD solenoid valve	Control the fluid pressure to the pressure control valve for shift control
RED solenoid valve	Control the fluid pressure to the pressure control valve for shift control
Engine ECM	Receive the control signals via communication with A/T ECM

COMPONENT



THRUST BEARING AND THRUST RACE IDENTIFICATION

OD	ID	Thickness (in (mm))	Symbol		OD	ID	Thickness (in (mm))	Symbol
59	47	0.071(1.8) 0.079(2.0) 0.087(2.2) 0.094(2.4) 0.102(2.6) 0.110(2.8)	#1		48.9	37	0.071(1.8) 0.075(1.9) 0.079(2.0) 0.083(2.1) 0.087(2.2) 0.091(2.3)	#8
49	36	0.142(3.6)	#2				0.094(2.4)	
57	38.5	0.162(4.12)	#3				0.098(2.5)	
54.4	38.5	0.130(3.3)	#4				0.102(2.6)	
57	38.5	0.162(4.12)	#5		78.5	60	0.098(2.5)	#9
57	38.5	0.162(4.12)	#6		80	60	0.098(2.5)	#10
59	37	0.110(2.8)	#7		58	40.7	0.162(4.2)	#11
48.5	37	0.063(1.6)	#8		54.7	43	0.118(3.0)	#12
		0.067(1.7)						

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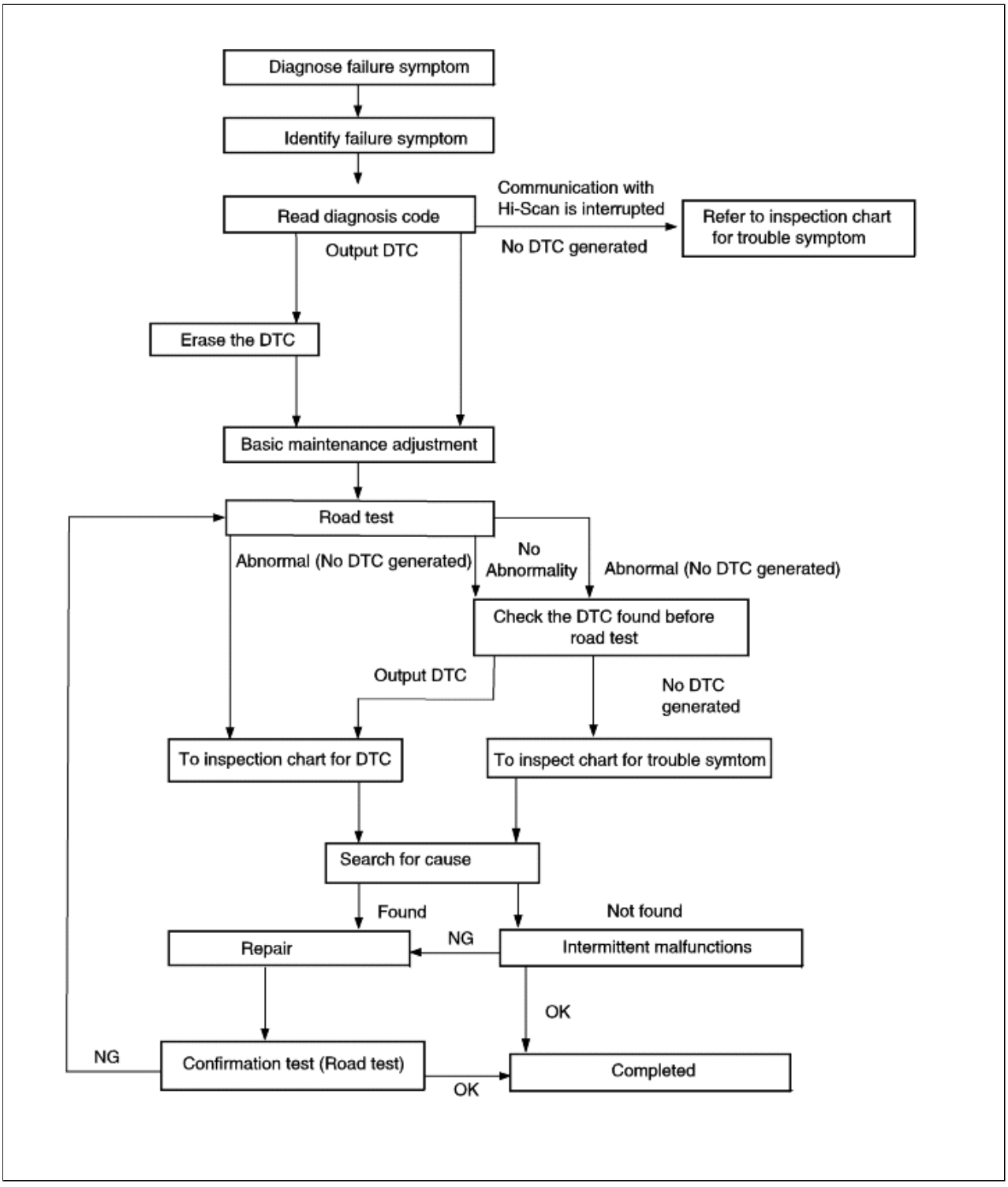
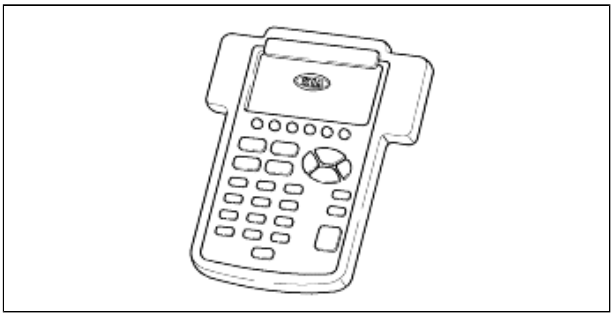
Troubleshooting



Diagnosis procedure

1. Connect Hi-Scan with the self-diagnosis connector and the cigar-lighter socket.



2. Wait 3~4 seconds and select the vehicle model.

3. Upon selecting vehicle, press "YES" button.
4. Screen will display MENU and then chose diagnosis code or maintenance data item to output.

> NOTE
>
> 1) Hi-Scan will store max.8 diagnosis codes and max.3 fail safe items in the order of generation in RAM.
> 2) The same code will not be stored twice or more.
> 3) If codes or fail safe items occur more than RAM capacity, they will be erased in the order of generation.
> 4) Upon disconnecting battery power of all stored codes and fail safe items will be erased. Do not separate battery power before completing the procedure.
> 5) Place shift lever at "P"or "N"and stop the vehicle.

How to erase diagnosis codes

1. Spontaneous erasion
   When ATF warms up and reaches to temperature 50°C(0°F), 200 times after the last generated fail or code stored in the memory, all stored codes will be erased.
2. Forced erasion
   (1) Use Hi-Scan to erase codes with the below condition:
      1) Ignition key "ON".
      2) Detect no engine revolution (engine off)
      3) No detection from output speed sensor (vehicle stop)
      4) No detection from vehicle speed sensor (vehicle stop)
      5) Fail safe not operating

   (2) 15 seconds after disconnecting the battery terminal (-)

   (3) 15 seconds after removing the back-up fuse

DIAGNOSTIC TROUBLE CODE DESCRIPTION

DTC No.	Diagnosis item		Fail-safe	Remark
P0703	Stop lamp switch	Short circuit/open circuit	-	
P0707	Transaxle range switch	Open circuit	-	
P0708		Short circuit	-	
P0712	Fluid temperature sensor	Short circuit	-	
P0713		Open circuit	-	
P0715	Input speed sensor	Short circuit/open circuit	O	
P0720	Output speed sensor	Short circuit/open circuit	O	
P0731	Gear shift incomplete	1st	O	
P0732		2nd	O	
P0733		3rd	O	
P0734		4th	O	
P0735		5th	O	
P0736		Reverse	O	
P0741	TCC system	System defect/stuck on	-	
P0742 (P0740)			-	
P0743	TCC solenoid valve	Short circuit/open circuit	O	
P0750	LR solenoid valve	Short circuit/open circuit	O	
P0755	UD solenoid valve	Short circuit/open circuit	O	
P0760	2nd solenoid valve	Short circuit/open circuit	O	
P0765	OD solenoid valve	Short circuit/open circuit	O	
P0770	Reduction brake solenoid	Short circuit/open circuit	O	
P1630	CAN-BUS OFF	TCM Fail/open/short	-	
P1631	CAN-TIME OUT ECM	ECM Fail/open/short	-	

P1723	A/T control relay	Earth short circuit/open circuit	O	
P1764	CAN MI-COM CIRCUIT	TCM internal circuit malfunction	-	
P0500	Vehicle speed sensor	Short circuit/open circuit	-	

Actuator checking

No.	Items	Forced operation details	Forced operation conditions
1	L & R solenoid valve	Operate the solenoid valve using Hi-Scan for five seconds. (Other solenoid valves shall not be energized.)	1) Ignition key "ON" 2) Transaxle range switch normal 3) Shift lever "P" range 4) Vehicle speed 0 mph(0 km/h) 5) Engine stop
2	Underdrive solenoid valve		
3	Second solenoid valve		
4	OD solenoid valve		
5	Reduction solenoid valve		
6	Damper clutch solenoid valve		
7	Auto control relay	Off for 3 seconds	
8	HIVEC control inhibition	Inhibit until ignition off	

Road test

No.	Condition	Operation	Judgement: value	Check	DTC	Probable cause
1	Ignition switch OFF	Ignition switch (1) ON	Data list No.54 (1) battery voltage (mV)	A/T control relay	P1723	A/T control relay line
2	Ignition switch ON Engine stop Selector lever position "P"	Selector lever position (1) P (2) R (3) N (4) D	Data list No.61 (1) P (2) R (3) V (4) D	Transaxle range switch	P0707 P0708 (P0705)	Inhibitor switch line
		Brake pedal (1) press (2) release	Data list No.26 (1) ON (2) OFF	Stop lamp switch	P0703	Stop lamp switch line
3	Ignition switch START Engine stop	Start-up test at position "P", "N"	Engine start-up	Start or not	-	No start-up
4	Warming-up running	Drive for 15 minutes or more so that the automatic fluid temperature becomes 70-90°C(158-194°F)	Data list No.15 rise little by little to 70-90°C(158-194°F)	Fluid temperature sensor	P0713 P0712 (P0710)	A/T oil temperature sensor line
5	Engine idling Selector lever position "N"	Brake pedal (re-test) (1) press (2) release	Data list No.20 (1) ON (2) OFF	Stop lamp switch	P0703	Stop lamp switch line
		A/C switch (1) ON (2) OFF	Data list No.65 (1) ON (2) OFF	Triple switch	-	Triple switch line
		Accelerator pedal (1) close (2) press	Data list No.64 (1) ON (2) OFF	Idle switch	-	Idle switch line
			Data list No.21 (1) 600-900rpm (2) Rise little by little from	Crank angle sensor	P0725	Crank angle sensor line
			(1) Data list No.57 (2) Data will change	Communication with engine ECM	P1749	Serial communication line
		Selector lever position (1) N→D (2) N→R	No shifting shock Retardation shall be 2 seconds or less	Vehicle starting trouble Unable to run	-	Engine stall during shift
					-	N→D shock, longer retardation
					-	N→R shock, longer retardation
						N→D shock, N→R

					-	shock longer retardation
6	Selector lever position "D" (at even straight road)	Selector lever position and engine condition (1) Idling at first speed (vehicle stop) (2) Running at constant speed, 6.2mph(10km/h) at first speed (3) Running at constant speed, 18.6mph (30km/h) at second speed (4) Running at constant speed, 31mph(50km/h) at third speed (5) Running at constant speed, 31mph (50km/h) at fourth speed (maintain each step at least 10 seconds) (6) Running at constant speed, 43.4mph (70km/h) at fifth speed	Data list No. 63 (2) First speed (3) Second speed (4) Third speed (5) Fourth speed (6) Fifth speed	Shift condition	-	
			Data list No. 31 (2) 0 % (3) 100 % (4) 100 % (5) 100 %	LR solenoid valve	P0750	LR solenoid valve line
			Data list No. 32 (2) 0 % (3) 0 % (4) 0 % (6) 100 %	UD solenoid valve	P0755	UD solenoid valve line
			Data list No. 33 (1)100 % (2) 0 % (4) 100 % (6) 0 %	2ND solenoid valve	P0760	2ND solenoid valve line
			Data list No. 34 (2) 100 % (3) 100 % (4) 0 % (6) 0 %	OD solenoid valve	P0765	OD solenoid valve line
			Data list No. 35 (2) 0 % (3) 0 % (5) 100 % (6) 100 %	RED solenoid valve	P0770	RED solenoid valve line
			Data list No. 29 (1) 0mph(0km/h) (5) 31.0mph(50km/h)	Vehicle speed sensor	P0500	Vehicle speed sensor line
			Data list No. 22 (5) 1800-2100rpm	Input speed sensor	P0715	Input speed sensor line
			Data list No. 23 (5) 1800-2100rpm	Output speed sensor	P0720	Output speed sensor line
			Data list No. 36 (3) 0 % (6) approx. 70-90 %	DCC solenoid valve	P0743 (P0740)	DCC solenoid valve line
			Data list No. 52 (3) approx. 100-300rpm (6) approx. 0-10rpm			
	Stop HIVEC function using Hi-	Monitor data list No. 11, 23, 63 using Hi-Scan (1) Speed up to fifth speed with TPS output 1.5 V (30% open) (2) Reduce speed slowly and stop (3) Speed up to fifth speed with TPS output 2.5V (50% open) (4) Down-shift to fourth speed from fifth speed,	Steps (1), (2) and (3) shall generate normal output speed (vehicle	Shifting trouble	-	Shock, turbine rpm valve
				Shift timing failure	-	Every shifting time
					-	One or some shifting time
				No shift	-	No diagnosis code
					P0715	Input speed sensor line
					P0720	Output speed sensor line
				No 1→2 shift or No 2→1 shift	P0750	LR solenoid valve line
					P0760	2ND solenoid valve line
					P0731	First speed before completing shift
					P0732	Second speed before completing shift
					P0760	2ND solenoid valve line

7	Scan Selector lever position "D" (at even straight road)	37.2mph (60km/h) using selector lever (5) Down-shift to third speed from fourth speed, 24.8mph (40km/h) (6) Down-shift to second speed from third speed, 18.6mph (30km/h) (7) Down-shift to first speed from second speed, 12.4 mph (20km/h)	speed) and no abnormal shock. Down-shift right after each of (4), (5), (6) steps	No 2→3 shift or No 3→2 shift	P0765	OD solenoid valve line
					P0732	Second speed before completing shift
					P0733	Third speed before completing shift
				No 3→4 shift or No 4→3 shift	P0755	LR solenoid valve line
					P0760	RED Solenoid valve line
					P0733	Third speed before completing shift
					P0734	Fourth speed before completing shift
				No 4→5 shift or No 5→4 shift	P0755	UD solenoid valve line
					P0760	2ND solenoid valve line
					P0734	Fourth speed before completing shift
					P0735	Fifth speed before completing shift
8	Selector lever position "N"	Monitor data list No.22 and 23 using Hi-Scan (1) Move Selector lever to "R" and run vehicle at constant speed 6.2mph(10km/s)	Ratios at data list No.22 and 23 coincide with shift ratio in reversing	No shift	P0715	Input speed sensor line
					P0720	Output speed sensor line
					P0736	Reversing before completing shift

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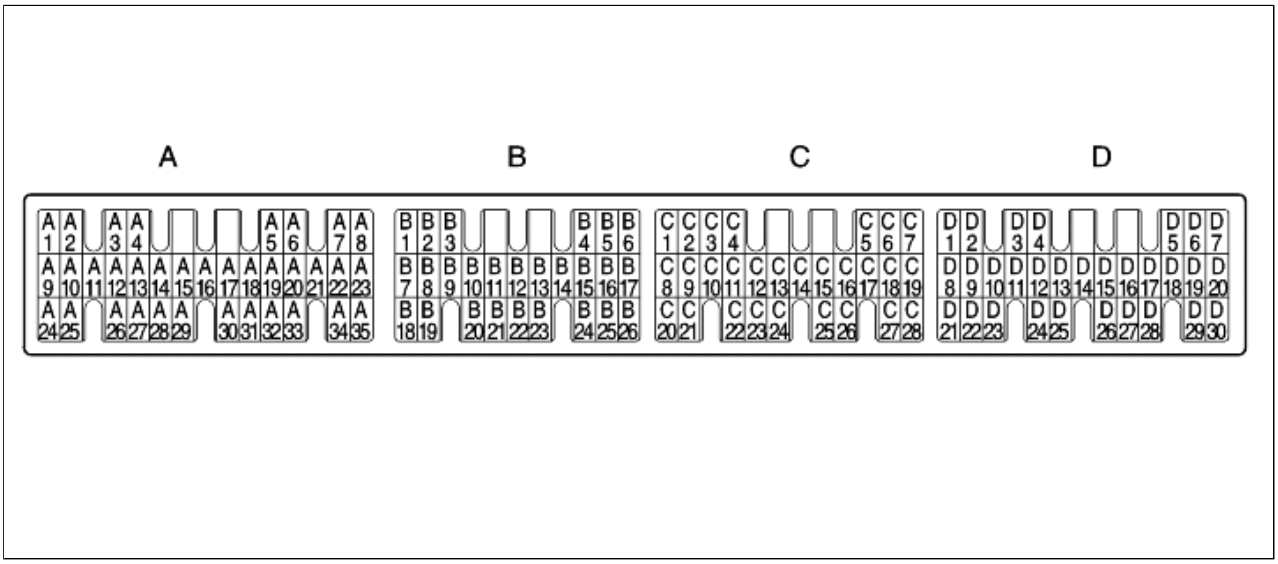
Combined ECM(only AT) connector pin no. and name

Pin No.	Pin Name	Pin No.	Pin Name
A30	TPS output	D04	Output speed sensor
B10	AT control relay	D06	2ND solenoid
B17	Oil temperature sensor ground	D04	DCC solenoid
C06	Power ground	D08	Inhibitor SW (R)
C07	AT battery	D09	O/D OFF SW
C08	TPS	D10	Inhibitor SW (L)
C10	Vehicle speed sensor	D19	RED solenoid
C15	Diagnosis K terminal	D20	U/D solenoid
C18	Power ground	D21	Inhibitor SW (N)
C19	AT battery	D22	Inhibitor SW (3)
C27	Power ground	D23	Stop lamp SW
C28	IG SW	D24	Oil temperature sensor
D01	Inhibitor SW (P)	D29	LR solenoid
D02	Inhibitor SW (D)	D30	O/D solenoid
D03	Input speed sensor		

Combined ECM connector



Trouble codes and details

Code	Conditions		Probable cause
P0713 P0712 (P0710)	Fluid temperature sensor line If fluid temperature sensor output is 4.57V or above (oil temperature does not rise) after driving 10 minutes or longer,it will determine fluid temperature sensor breakage and generate trouble code P0713. If the sensor output voltage is below 0.49V for 1 second or longer, it will generate P0712.	Circuit open/short circuit	Fluid temperature sensor failure Connector failure ECM failure
P0715	Input speed sensor line If it fails to receive input speed sensor signal for 1second or more at third speed or fourth speed and above vehicle speed 18.6mph(30km/h), it will determine broken or short circuit from input speed sensor, and generate trouble code P0715.If trouble code P0715 is generated four times or more, gear will be locked at third ("D" range) or second speed for safety.	Circuit open/short circuit	Input speed sensor failure UD clutch retainer failure Connector failure ECM failure
P0720	Output speed sensor line If output shaft speed sensor output continues to be lower than 50% of the vehicle speed at third speed or fourth speed and above vehicle speed 18.6mph(30km/h), it will determine broken or short circuit from the output speed sensor, and generate trouble code P0720. If trouble code P0720 is generated four times or more, gear will be locked at third ("D" range)or second speed for safety	Circuit open/short circuit	Output speed sensor failure DIR planetary carrier failure Connector failure ECM failure
P0703	Stop lamp switch line If stop lamp lights up for five minutes or more during driving, it will determine short circuit in stop lamp switch, and generate trouble code P0703.	Short circuit	Stop lamp switch failure Connector failure ECM failure
P0750 P0755 P0760 P0765 P0770	LR solenoid valve line UD solenoid valve line 2ND solenoid valve line OD solenoid valve line RED solenoid valve line If the solenoid valve resistance is too high or too low, it will determine broken or short circuit in solenoid valve, and generate trouble code. The gear will be locked for safety at third gear.	Short circuit/open	Solenoid valve failure Connector failure ECM failure
P0741	DCC system If the DCC solenoid valve's drive duty is 100% continuously for 4 seconds, it will determine thedamper clutch control system failure.	Stuck OFF	DCC system failure
P0742	DCC system If the calculated slip rpm(Ne-Ni) is smaller than ±5 rpm, it will	Stuck ON	

	determine the damper clutchcontrol system failure.		
P0743 (P0740)	DCC solenoid valve line If the DCC solenoid valve resistance is too low, it will determine the DCC solenoid valve's broken or short circuit and generate trouble code P0743.	Short circuit/open	Solenoid valve failure Connector failure ECM failure
P0731	First gear incorrect ratio If (the output speed sensor output at first gear X first gear ratio) is not same as input speed sensor output, it will generate the trouble code P0731. If the trouble code P0731 is output 4 times or more, the gear will be locked for safety at third gear.		Input speed sensor failure Output speed sensor failure UD clutch retainer failure DIR planetary carrier failure LR brake line failure UD brake line failure RED brake line failure
P0732	Second gear incorrect ratio If (the output shaft speed sensor output at second gear X second gear ratio) is not same as input shaft speed sensor output, it will generate the trouble code P0732. If the trouble code P0732 is output 4 times or more, the gear will be locked for safety at third gear.		Input speed sensor failure Output speed sensor failure UD clutch retainer failure DIR planetary carrier failure 2ND brake line failure UD brake line failure RED brake line failure
P0733	Third gear incorrect ratio If (the output speed sensor output at third gear X third gear ratio) is not same as the input speed sensor output, it will generate the trouble code P0733. If the trouble code P0733 is output 4 times or more, the gear will be locked for safety at the third gear.		Input speed sensor failure Output speed sensor failure UD clutch retainer failure DIR planetary carrier failure 2ND brake line failure UD brake line failure RED brake line failure
P0734	Fourth gear incorrect ratio If (the output speed sensor output at fourth gear X fourth gear ratio) is not same as the input speed sensor output, it will generate the trouble code P0734. If the trouble code P0734 is output 4 times or more, the gear will be locked for safety at the third gear.		Input speed sensor failure Output speed sensor failure UD clutch retainer failure DIR planetary carrier failure DIR clutch line failure
P0735	Fifth gear incorrect ratio If (the output speed sensor output at fifth gear X fifth gear ratio) is not same as the input speed sensor output, it will generate the trouble code P0735. If the trouble code P0735 is output 4 times or more, the gear will be locked for safety at the third gear.		Input speed sensor failure Output speed sensor failure UD clutch retainer failure DIR planetary carrier failure DIR clutch line failure
P0736	Reverse gear incorrect ratio If the output speed sensor output at fourth gear X reverse gear ratio is not same as the input speed sensor output, it will generate the trouble code P0736. If the trouble code P0736 is output 4 times or more, the gear will be locked for safety at the third gear.		Input speed sensor failure Output speed sensor failure UD clutch retainer failure DIR planetary carrier failure LR brake line failure Reverse clutch line failure RED brake line failure Noise
P1723	A/T control relay line If the A/T control voltage is lower than 7V with ignition switch on, it will determine breakage or short-circuit at the A/T control relay grounding, and generate the trouble code P1723. The gear will be locked for safety at the third gear.	Short circuit/open	A/T control relay failure Connector failure ECM failure
P0707 P0708 (P0705)	Transaxle range switch No signal continually for 30 seconds. 2 or more signals continually for 30 seconds.	Open/short circuit	Transaxle range switch failure
P0500	Vehicle speed sensor No signal continually for 30 seconds at above vehicle speed 18.6mph(30km/h).	Open/short circuit	Vehicle speed sensor failure

CAN ECM

Code	Diagnosis item	Probable cause

P1630	CAN-BUS OFF 1) Ignition switch OFF 2) No 3 speed hold fail 3) No PGA, B fail 4) Battery voltage > 10V continuously for 0.5 second 5) No engine stop 6) Receive BUS OFF information from CAN CONTROLLER	1) ECM Fail 2) ECM side open & short * PGA : Input shaft speed sensor * PGB : Output shaft speed sensor
P1631	CAN-TIME OUT TCM 1) No 3 speed hold fail 2) No PGA, B fail 3) Battery voltage > 10V continuously for 0.5 second 4) No engine stop 5) No output signal for 1.5 second	1) ECM fail 2) ECM side open & short
P1764	ECM CAN CONTROLLER MALFUNCTION 1) No 3 speed hold fail 2) No PGA, B fail 3) Battery voltage > 10V continuously for 0.5 second 4) No engine stop 5) Communication error output is continuously for > 1 second	1) CAN CONTROLLER circuit malfunction

Trouble symptom chart

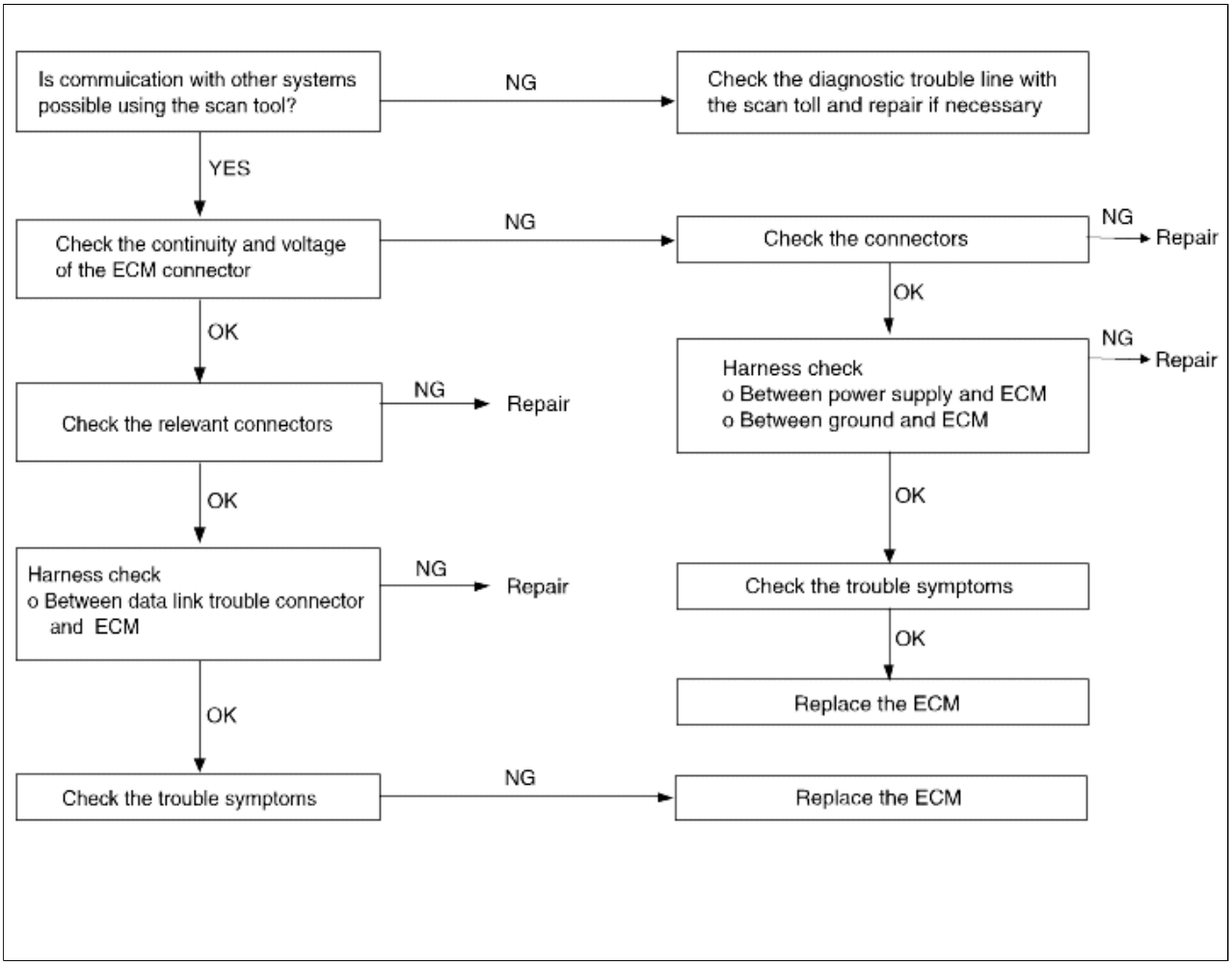
Trouble symptom		Probable causes
Data communication trouble with Hi-Scan Trouble in communication with Hi-Scan may be caused by diagnosis line failure or failed ECM.		Diagnosis line failure Connector failure ECM failure
Driving trouble	No start up No start-up with the shift lever at position "P" or "N". It may be caused by the engine system failure, the torque converter failure, or the oil pump failure.	Engine system failure Connector failure ECM failure
	No forward motion Vehicle does not move forward when the shift lever moves from "N" to "D" with the engine running. It may be caused by the abnormal line pressure, the underdrive clutch failure, or the valve body failure.	Abnormal line pressure UD solenoid valve failure UD clutch failure Valve body failure
	No reverse motion Vehicle does not move backward when the shift lever moves from "N" to "R" with engine running. It may be caused by abnormal pressure in the reverse clutch or the LR brake, or the reverse clutch failure, the LR brake failure, or the valve body failure.	Abnormal reverse clutch pressure Abnormal LR brake pressure LR brake solenoid valve failure Reverse clutch failure LR brake failure Valve body failure
	No forward and backward motion Vehicle moves neither forward nor backward in any position of the shift lever with the engine running. It may be caused by the abnormal line pressure, failed powertrain, failed oil pump, or failed valve body.	Abnormal line pressure Powertrain failure Oil pump failure Valve body failure
Malfunction in start-up	Engine stops in shifting If the engine stops when shifting N→D or N→R with the engine idling, it may be caused by failure in the engine system, the damper clutch, the solenoid valve, the valve body or the torque converter (the damper clutch).	Engine system failure DCC solenoid valve failure Valve failure Valve body failure Torque converter failure (Damper clutch failure)
Shifting shock	Shock and retardation in shifting N→D If there is abnormal shock and retardation longer then 2 seconds in shifting N→D with the engine idling, it may be caused by abnormal the UD clutch pressure or the UD clutch failure, the valve body failure or the throttle position sensor failure.	Abnormal UD clutch pressure Abnormal LR brake pressure UD solenoid valve failure Valve body failure Idling position switch failure
	Shock and retardation in shifting N→R	Abnormal reverse clutch pressure Abnormal low pressure and reverse brake pressure

Shifting shock	If there is abnormal shock and retardation longer than 2 seconds in shifting N→R with the engine idling, it may be caused by an abnormal reverse clutch pressure or abnormal LR brake pressure, or the reverse clutch failure, the LR brake failure, the valve body failure, or the throttle position sensor failure.	Low pressure and reverse solenoid valve failure Reverse clutch failure Low pressure and reverse brake failure Valve body failure Throttle position switch failure
	Shock and retardation in shifting N→D and N→R If there is abnormal shock and retardation longer than 2 seconds in shifting N→D and N→R with the engine idling, it may be caused by abnormal line pressure, the fluid pump failure or the valve body failure.	Abnormal line pressure Oil pump failure Valve body failure
Malfunction in shifting	Shock, turbine rpm increase If up-shifting or down-shifting shock occurs or the transaxle speed is higher than the engine speed during driving, it may be caused by abnormal line pressure, the solenoid valve failure, the oil pump failure, the valve body failure or the clutch brake failure.	Abnormal line pressure Each solenoid valve failure Oil pump failure Valve body failure Each clutch brake failure
Incorrect shifting range	Shifting range error at every shifting point (shift timing error) If timing error occurs in every shifting point during driving, it may be caused by the speed sensor failure, the TPS failure, or the solenoid valve failure.	Output shaft speed sensor failure Throttle position sensor failure Each solenoid valve failure Abnormal line pressure Valve body failure ECM failure
	One or some shifting points (shift timing error) If timing error occurs in one or some shifting points during driving, it may be caused by faulty valve body or faulty control. It is not a failure.	Valve body failure
No shifting	No trouble code output No shifting and no trouble code output during driving, may be caused by the transaxle range switch failure or ECM failure.	Transaxle range switch failure ECM failure
Trouble during driving	Poor acceleration If there occurs downshifting but no acceleration during driving, it may be caused by the engine system failure, the clutch failure, or the brake failure.	Engine system failure Clutch or brake failure
	Vibration If there occurs vibration during driving at a constant speed or during acceleration/deceleration the highest range, it maybe caused by abnormal damper clutch pressure, or the engine system failure, the damper clutch control solenoid valve failure, the torque converter failure, or the valve body failure.	Abnormal clutch pressure Engine system failure Damper clutch control solenoid valve failure Torque converter failure Valve body failure
Others	Transaxle inhibitor switch line Caused by the transaxle range switch circuit failure, the ignition switch circuit failure, or the ECM failure.	Transaxle range switch failure Ignitor switch failure Connector failure ECM failure
	Throttle position sensor line Caused by the throttle position sensor circuit faultiness, or the ECM failure.	Throttle position sensor Connector failure ECM failure
	Triple switch line Caused by the triple switch circuit faultiness or the ECM failure.	Triple switch failure Connector failure A/C system failure ECM failure
	Vehicle speed sensor line Caused by the vehicle speed sensor circuit faultiness or the ECM failure	Vehicle speed sensor failure Connector failure ECM failure

Inspection procedure for trouble symptoms

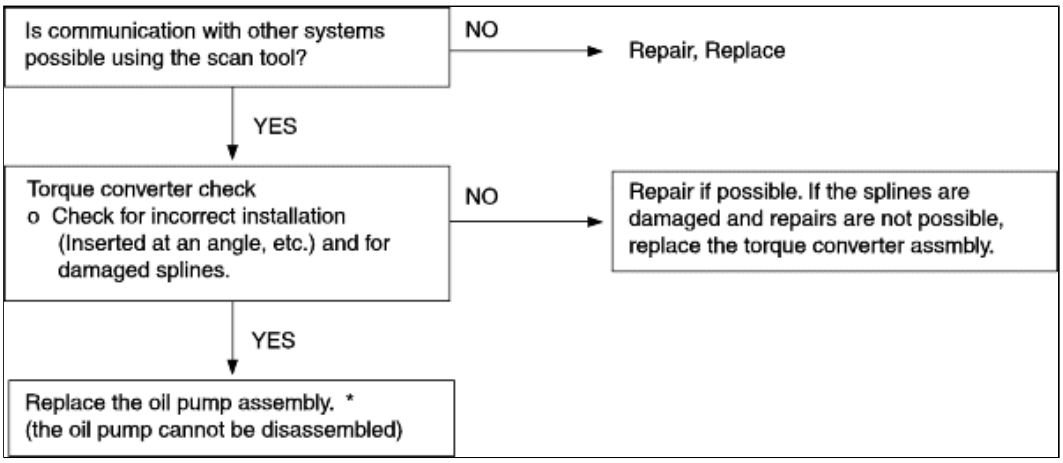
Inspection procedure 1

Communication with the scan tool	Probable cause
If communication with the scan tool is not possible, the cause is probably a defective diagnostic trouble line or the ECM is not functioning.	1) Malfunction of diagnostic trouble line 2) Malfunction of connector 3) Malfunction of the ECM



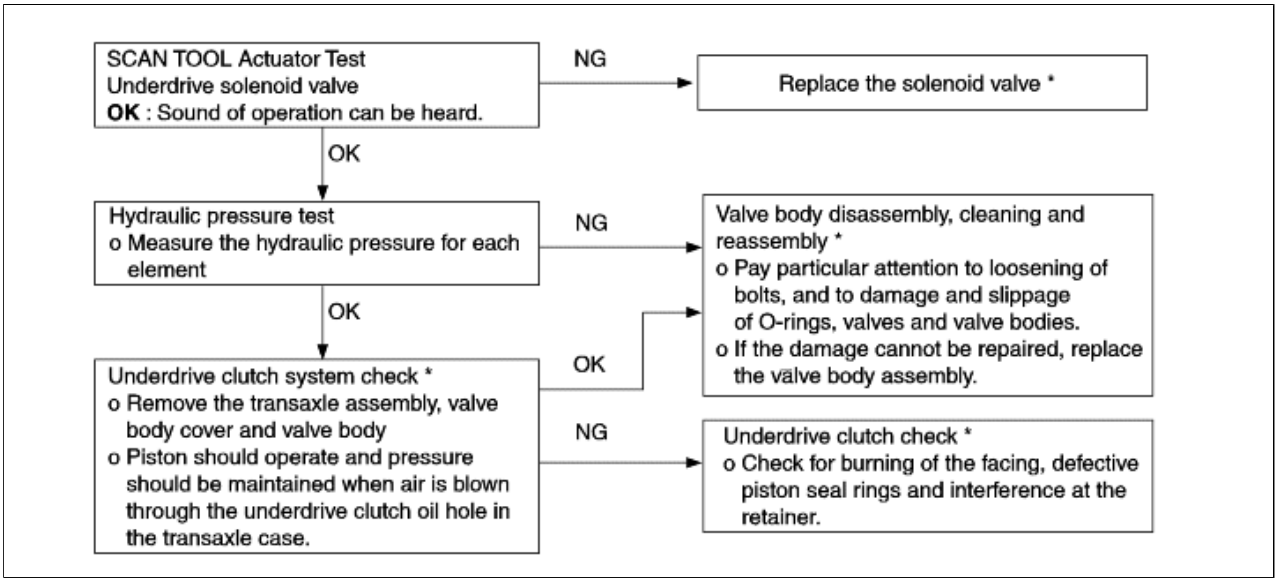
Inspection procedure 2

Starting impossible	Probable cause
Starting is not possible when the selector lever is in P or N range. In such cases, the cause is probably a defective engine system, torque converter or oil pump.	1) Malfunction of the engine system 2) Malfunction of the torque converter 3) Malfunction of the oil pump



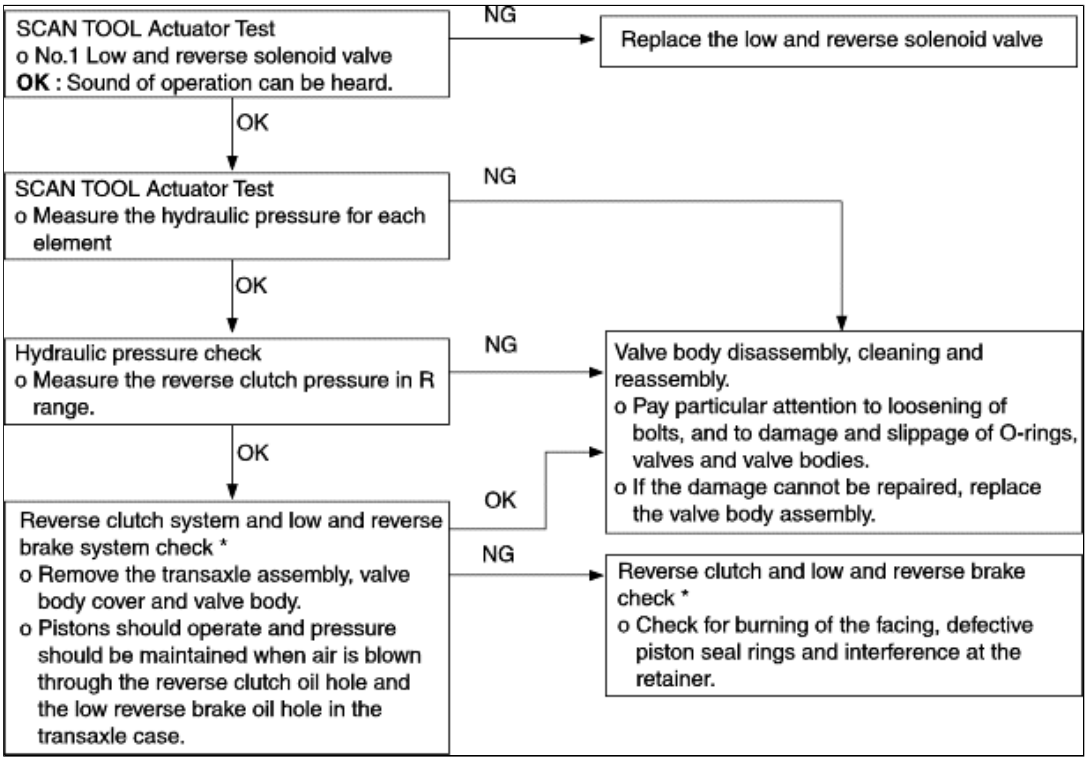
Inspection procedure 3

Does not move	Probable cause
If the vehicle does not move forward when the selector lever is shifted from N to D range while the engine is idling, the cause is probably abnormal line pressure or a malfunction of the underdrive clutch or valve body.	1) Abnormal line pressure 2) Malfunction of the underdrive solenoid valve 3) Malfunction of the underdrive clutch 4) Malfunction of the valve body



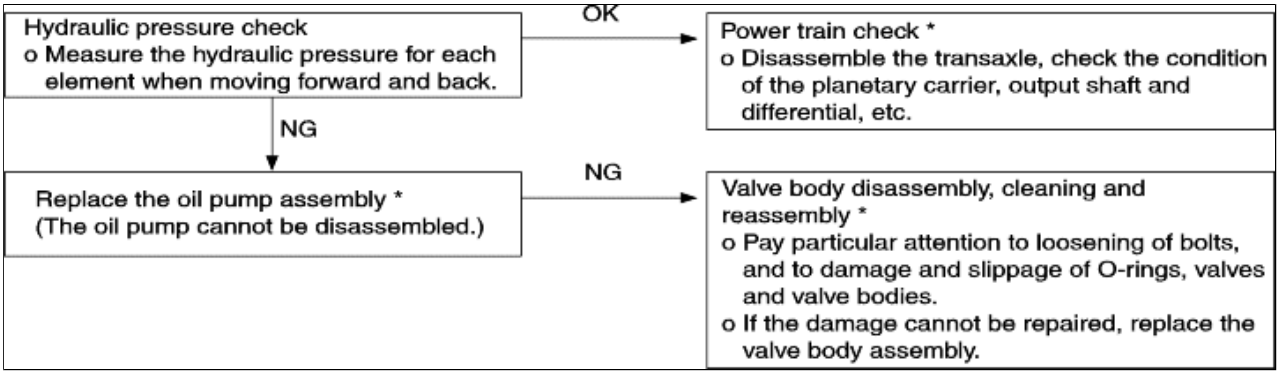
Inspection procedure 4

Does not reverse	Probable cause
If the vehicle does not reverse when the selector lever is shifted from N to R range while the engine is idling, the cause is probably abnormal pressure in the reverse clutch or low and reverse brake or a malfunction of the reverse clutch, low and reverse brake or valve body.	1) Abnormal reverse clutch pressure 2) Abnormal low and reverse brake pressure 3) Malfunction of the low and reverse solenoid valve 4) Malfunction of the reverse clutch 5) Malfunction of the low and reverse brake 6) Malfunction of the valve body



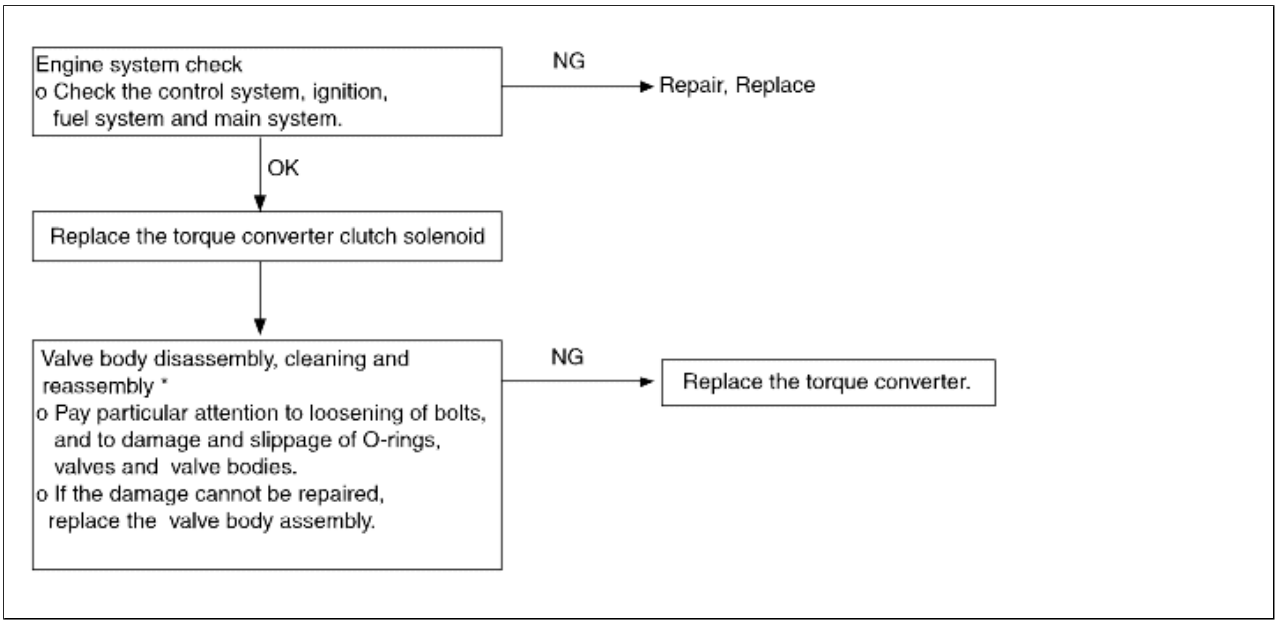
Inspection procedure 5

Does not move (Forward reverse)	Probable cause
If the vehicle does not move forward or reverse when the selector lever is shifted to any position while the engine is idling, the cause is probably abnormal line pressure, or a malfunction of the power train, oil pump or valve body.	1) Abnormal line pressure 2) Malfunction of the underdrive solenoid valve 3) Malfunction of the underdrive clutch 4) Malfunction of the valve body



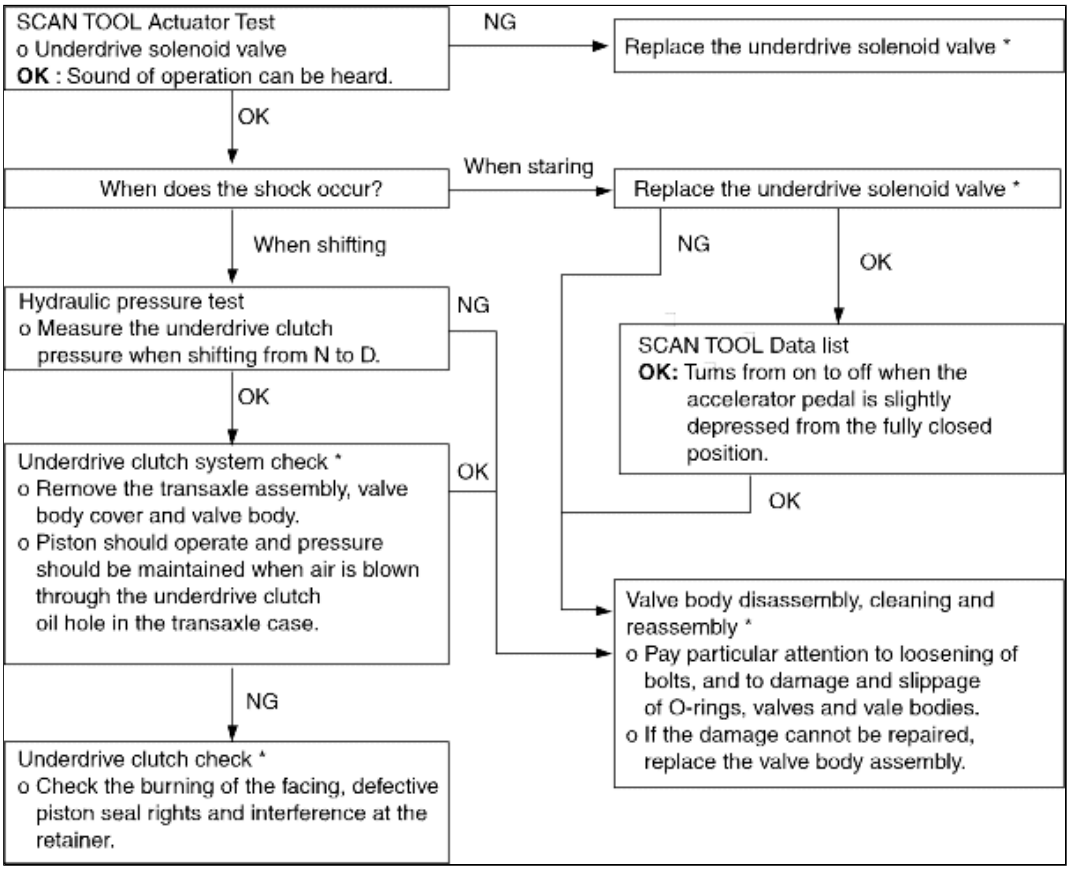
Inspection procedure 6

Engine stalling when shifting	Probable cause
If the engine stalls when the selector lever is shifted from N to D or R range while the engine is idling, the cause is probably a malfunction of the engine system, torque converter clutch solenoid, valve body or torque converter (torque converter clutch malfunction)	1) Malfunction of the engine system 2) Malfunction of the torque converter clutch solenoid 3) Malfunction of the valve body 4) Malfunction of the torque converter (Malfunction of the torque converter clutch)



Inspection procedure 7

Shocks when changing from N to D and range time lag	Probable cause
If abnormal shocks or a time lag of 2 second or more occur when the selector lever is shifted from N to D range while the engine is idling, the cause is probably abnormal underdrive clutch pressure or a malfunction of the underdrive clutch,valve body or closed throttle position switch.	1) Abnormal line pressure 2) Malfunction of the underdrive solenoid valve 3) Malfunction of the underdrive clutch 4) Malfunction of the valve body 5) Malfunction of the closed throttle position switch



Inspection procedure 8

Shock when changing from N to R and large time lag	Probable cause
If abnormal shocks or a time lag of 2 seconds or more occurs when the selector lever is shifted from N to R range while the engine is idling, the cause is probably abnormal reverse clutch pressure or low and reverse brake pressure, or a malfunction or the reverse clutch, low and reverse brake, valve body or closed throttle position switch.	1) Abnormal reverse clutch pressure 2) Abnormal low and reverse brake pressure 3) Malfunction of the low and reverse solenoid valve 4) Malfunction of the reverse clutch 5) Malfunction of the low and reverse brake 6) Malfunction of the valve body 7) Malfunction of the closed throttle position switch

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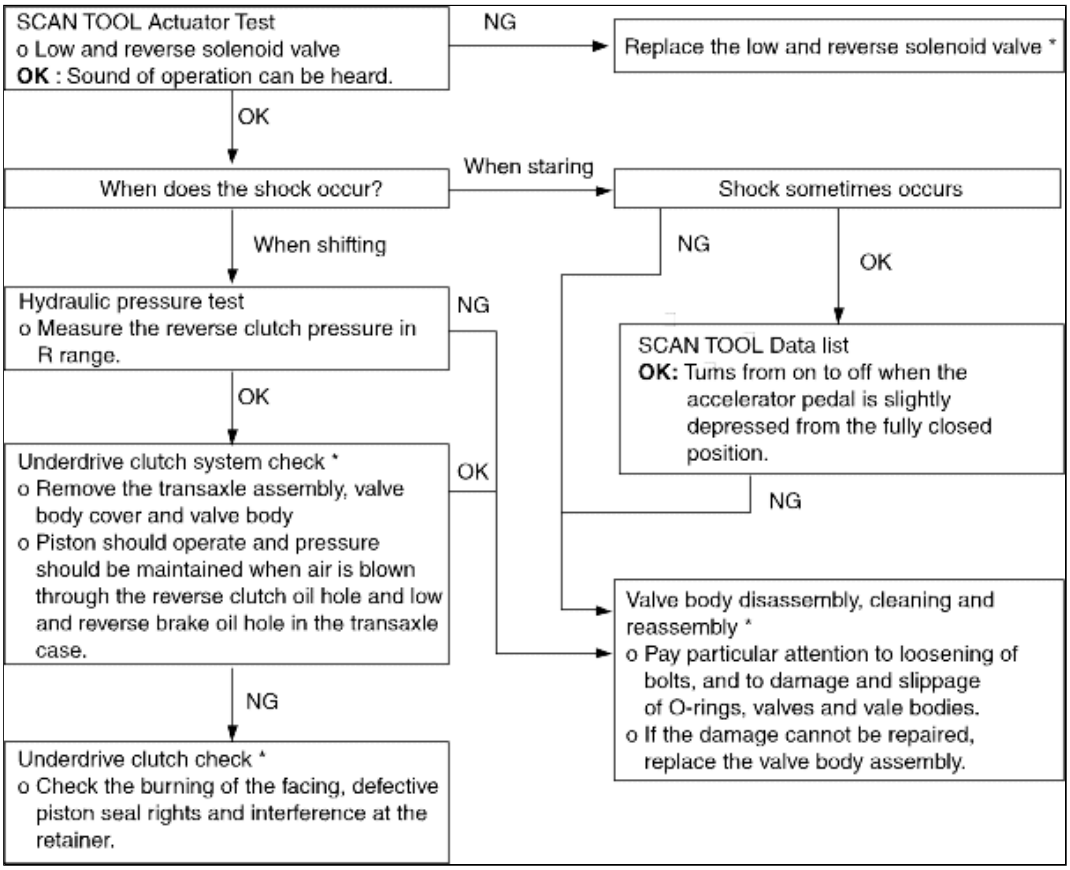
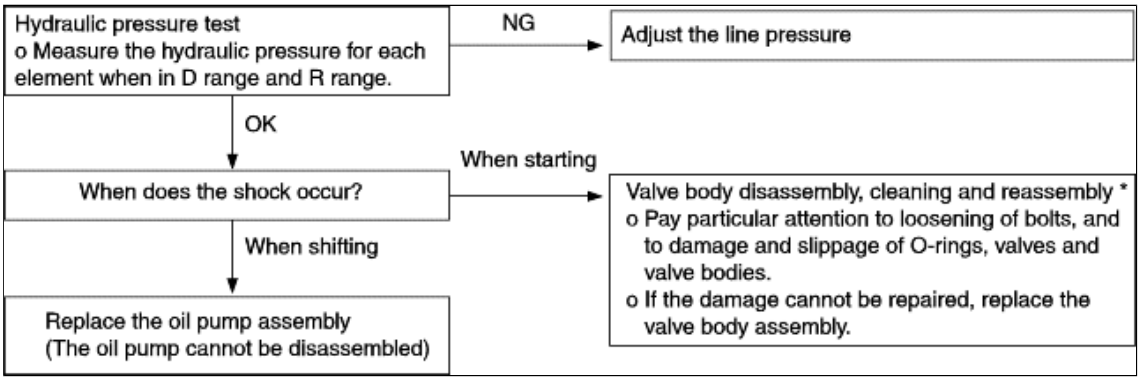


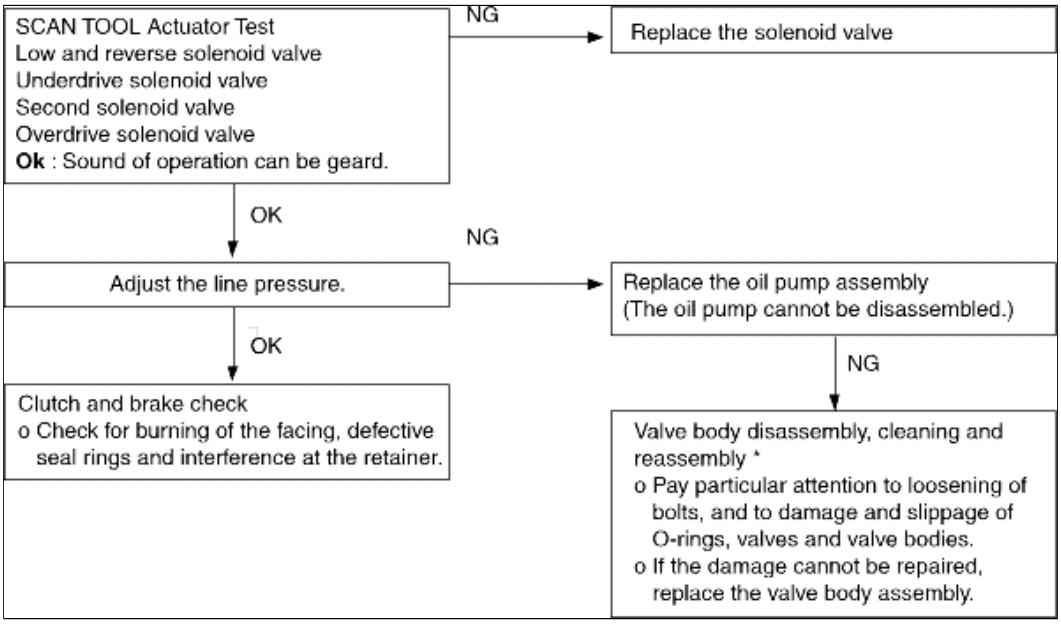
Inspection procedure 9

Shocks when changing from N to R and large time lag	Probable cause
If abnormal shocks or a time lag of 2 seconds or more occurs when the selector lever is shifted from N to D, N to R range while the engine is idling, the cause is probably abnormal line pressure or a malfunction of the oil pump or valve body.	1) Malfunction of the valve body 2) Abnormal line pressure 3) Malfunction of the oil pump



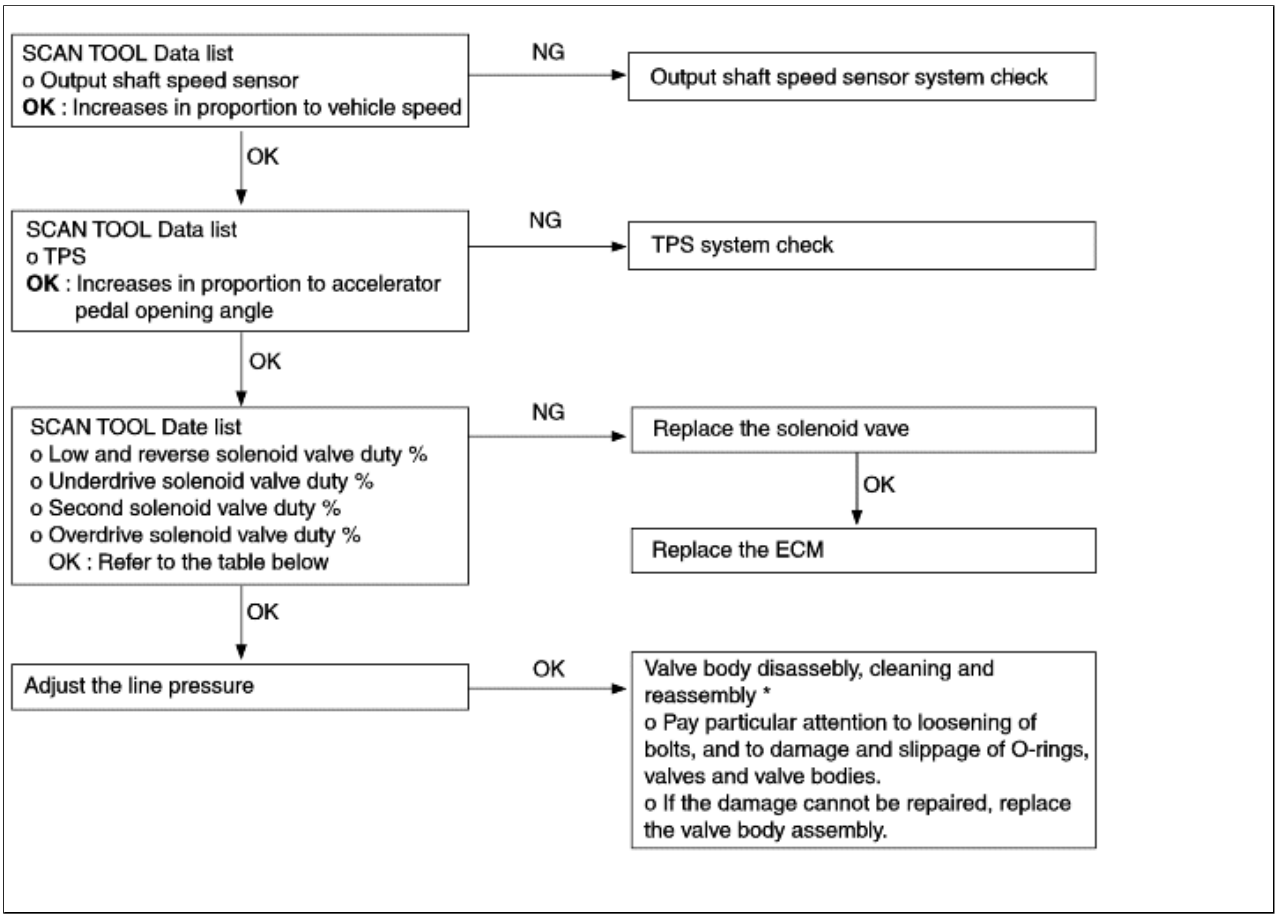
Inspection procedure 10

Shocks and running up	Probable cause
If shocks occur when driving due to upshifting or downshifting and the transaxle speed becomes higher than the engine speed, the cause is probably abnormal line pressure or a malfunction of a solenoid valve, oil pump, valve body or a brake or clutch.	1) Abnormal line pressure 2) Malfunction of each solenoid valve 3) Malfunction of the oil pump 4) Malfunction of the valve body 5) Malfunction of each brake or each clutch



Inspection procedure 11

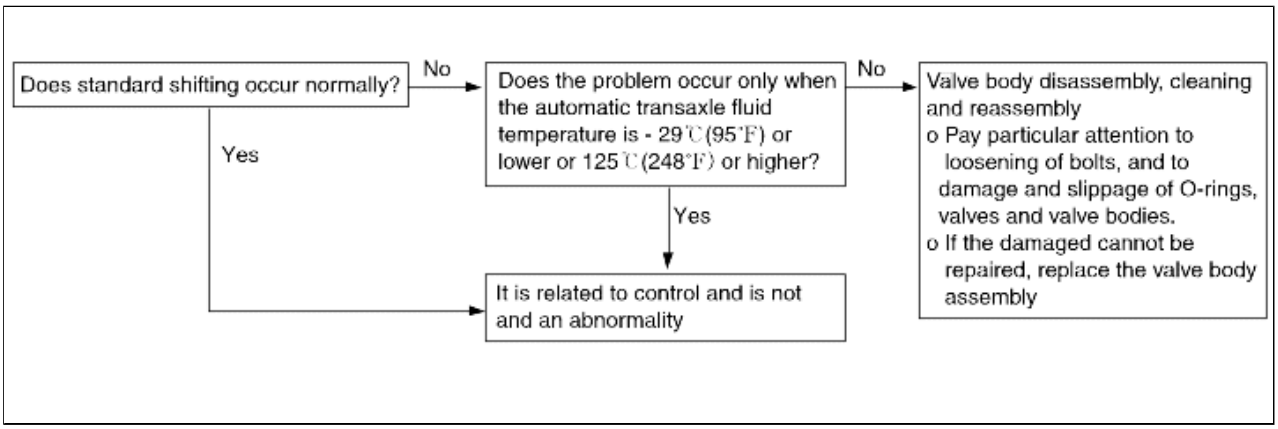
All points (Displaced shifting points)	Probable cause
If all shift points are displaced while driving, the cause is probably a malfunction of the output shaft speed sensor, TPS or of a solenoid valve.	1) Malfunction of the output shaft speed sensor 2) Malfunction of the throttle position sensor 3) Malfunction of each solenoid valve 4) Abnormal line pressure 5) Malfunction of the valve body 6) Malfunction of the ECM



Inspection procedure 12

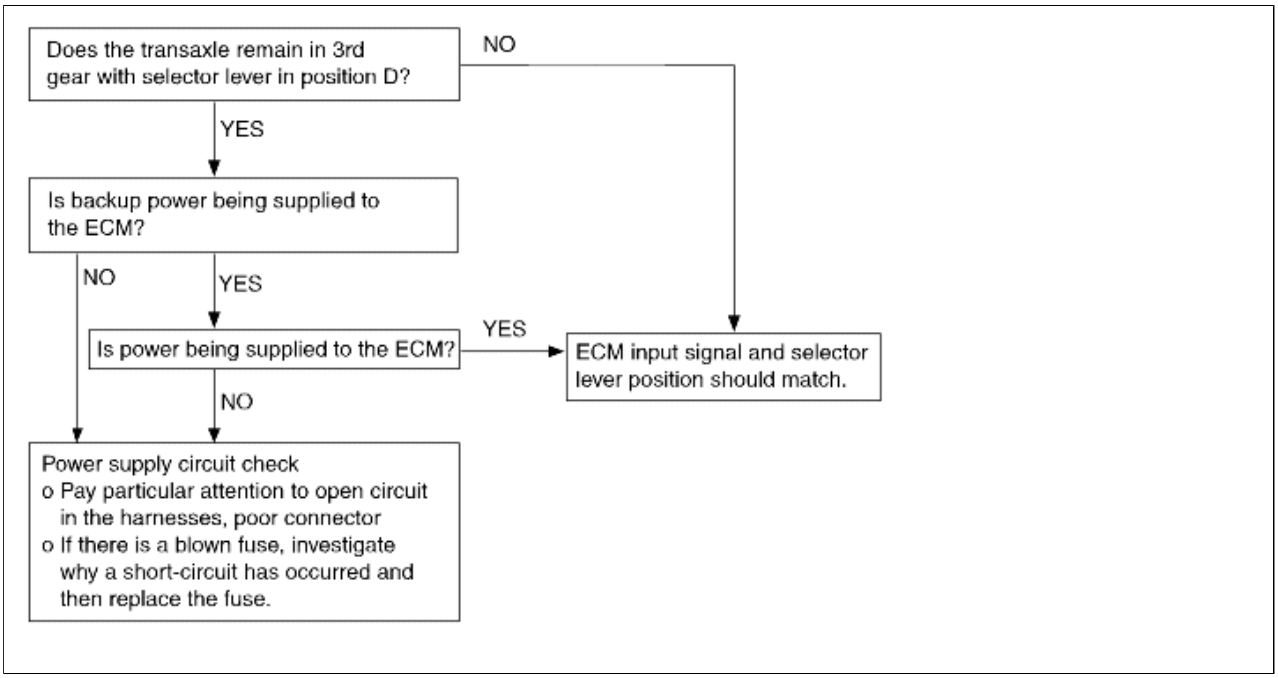
Some points (Displaced shifting points)	Probable cause

If some of the shift points are displaced while driving, the cause is probably a malfunction of the valve body, or it is related to control and is not an abnormality.	1) Malfunction of the valve body



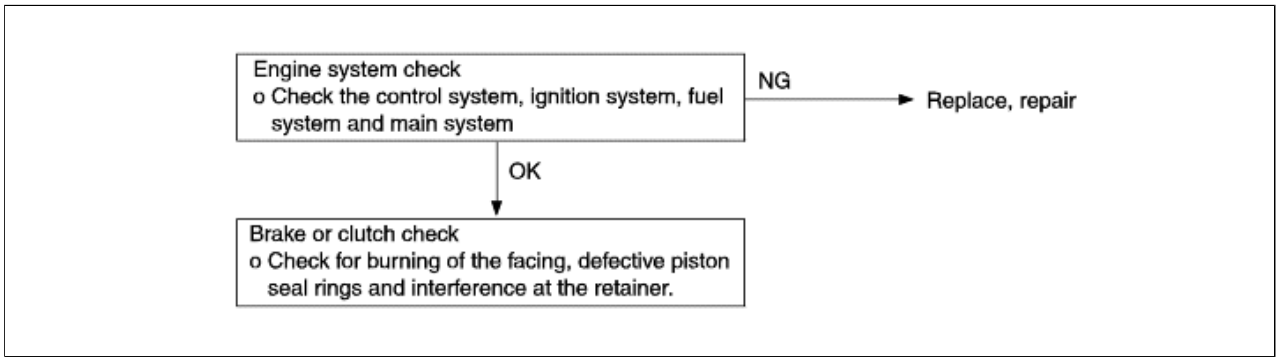
Inspection procedure 13

No diagnostic trouble codes (Does not shift)	Probable cause
If shifting does not occur while driving and no diagnostic trouble codes are output, the cause is probably a malfunction of the Park/Neutral position switch, or ECM.	1) Malfunction of the Park/Neutral position switch 2) Malfunction of the ECM



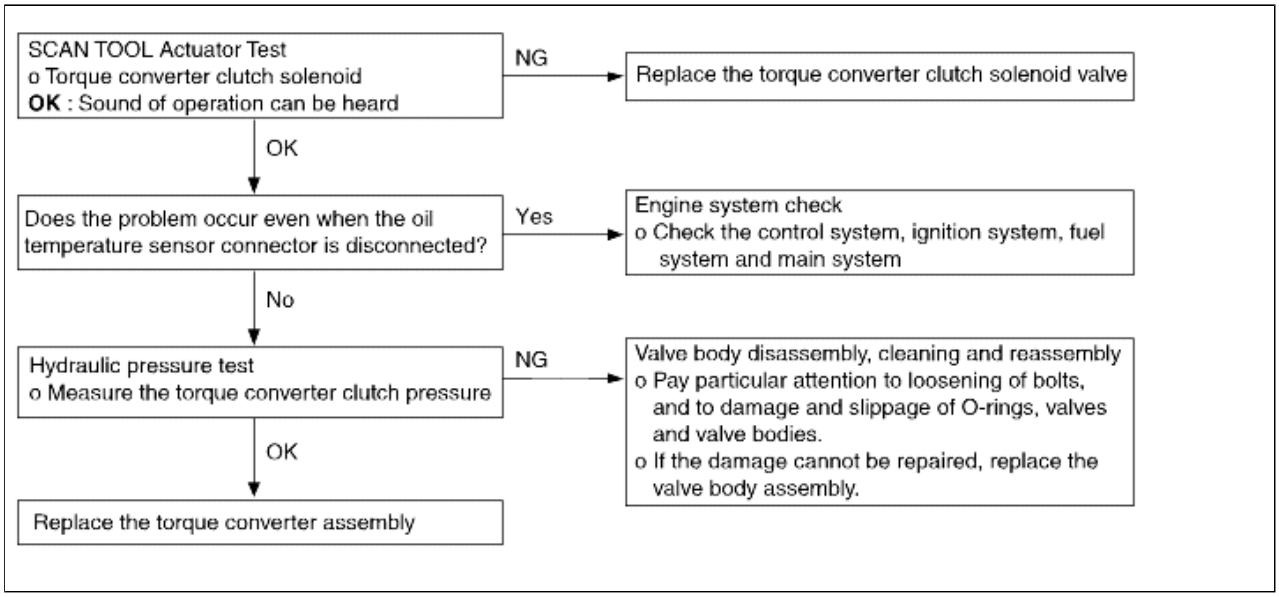
Inspection procedure 14

Poor accelerator	Probable cause
If acceleration is poor even if downshifting occurs while driving, the cause is probably a malfunction of the engine system or of a brake or clutch.	1) Malfunction of the engine system 2) Malfunction of the brake or clutch



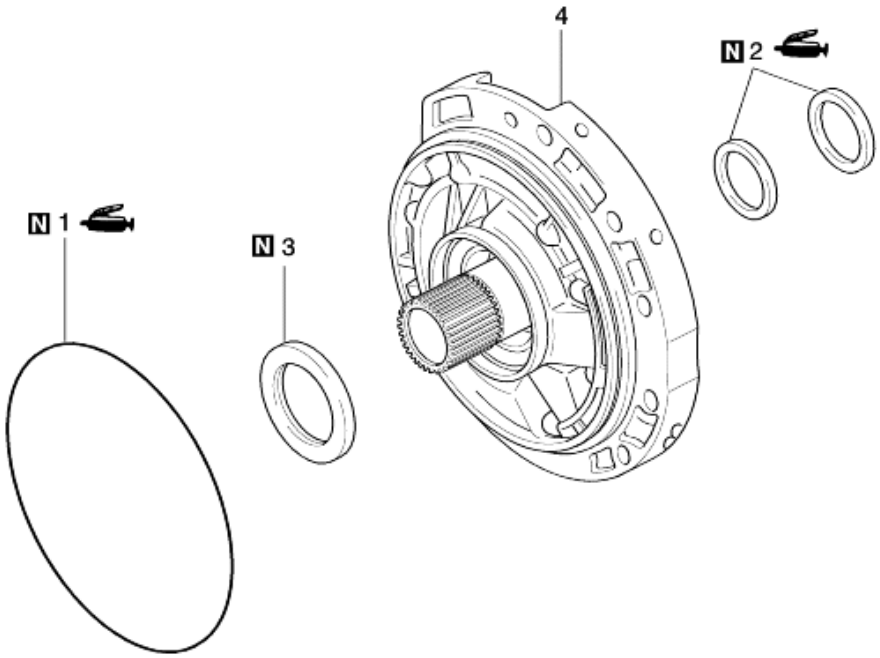
Inspection procedure 15

Vibration	Probable cause
If vibration occurs when driving at constant speed or when accelerating in top range, the cause is probably abnormal torque converter clutch pressure or a malfunction of the engine system, torque converter clutch solenoid, torque converter or valve body.	1) Abnormal torque converter clutch pressure 2) Malfunction of the engine system 3) Malfunction of the torque converter clutch solenoid 4) Malfunction of the torque converter 5) Malfunction of the valve body



Components

N Marked part shall be replaced with new part.

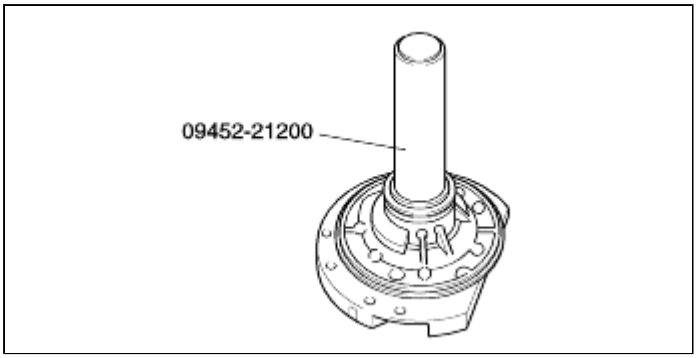


Disassembly steps

1. O-ring
2. Seal ring
3. Oil seal
4. Oil pump assembly

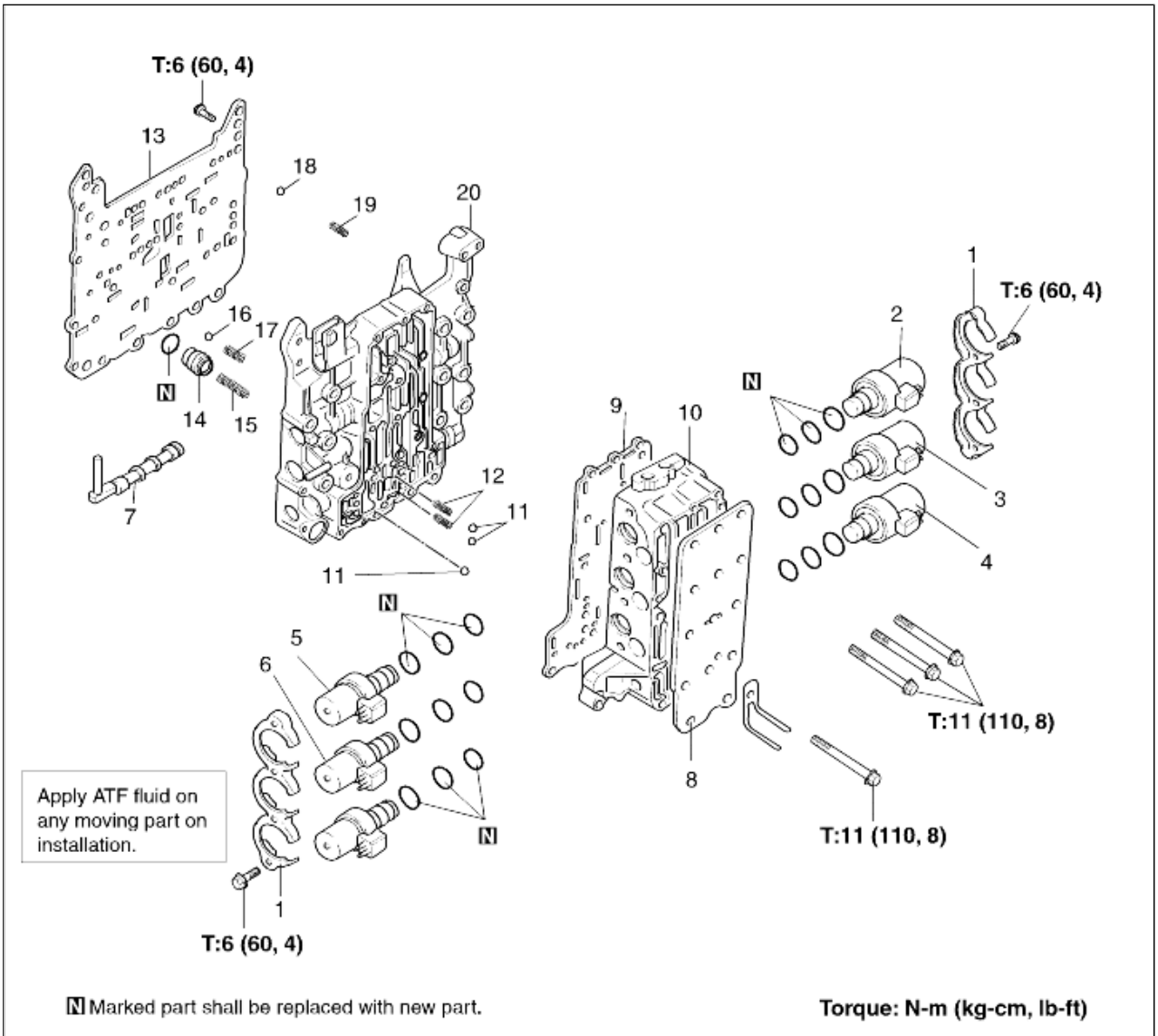
Assembly

1. Install the oil seal.



2. Install the O-ring
   Install the new O-ring around fluid pump and apply ATF, blue mineral oil, or white vaseline around the O-ring.

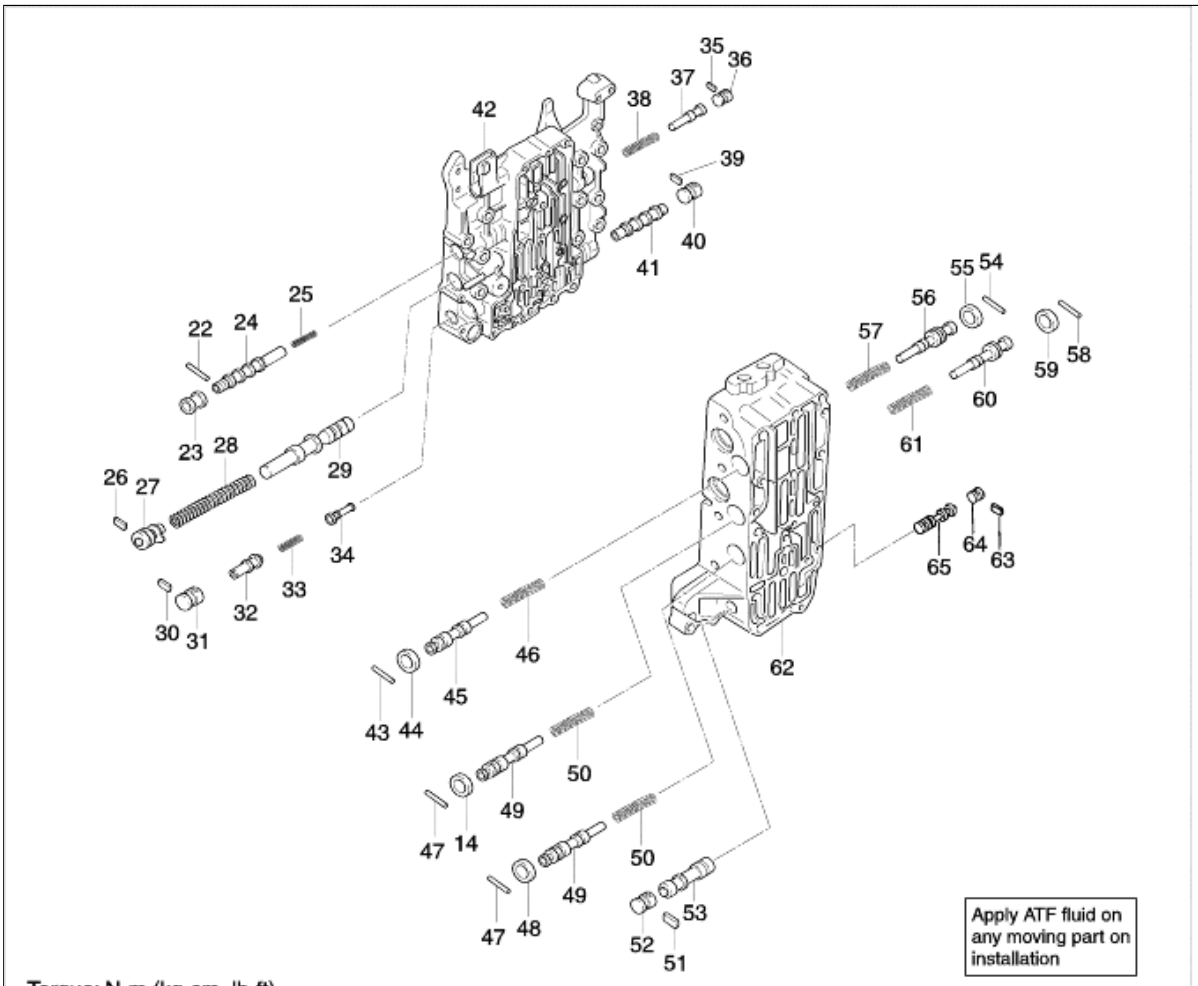
Components A



Disassembly steps

1. Solenoid valve support
2. UD clutch solenoid valve
3. 2nd brke solenoid valve
4. Damper clutch control solenoid valve
5. OD clutch solenoid valve
6. L&R brake solenoid valve
7. Manual valve
8. Cover
9. Plate
10. Outside valve body assembly
11. Still ball (Orfice check ball)
12. Spring
13. Plate
14. Damping valve
15. Damping valve spring
16. Steel ball (line relief)
17. Spring
18. Steel ball (Orfice check ball)
19. Spring
20. Inside valve body assembly

Components B



Torque: N-m (kg-cm, lb-ft)

Disassembly procedure

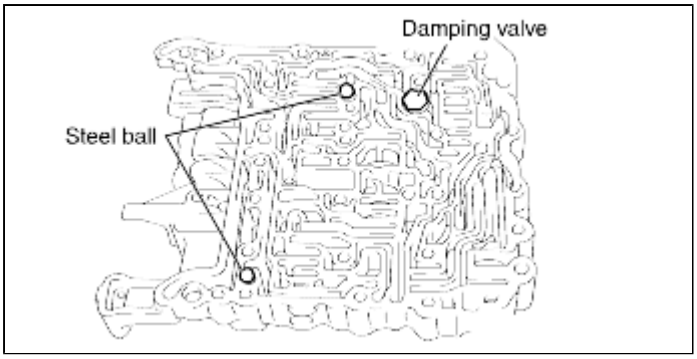
22. Roller
23. Damper clutch control valve sleeve
24. Damper clutch control valve
25. Damper clutch control valve spring
26. Plate
27. Screw
28. Regulator valve spring
29. Regulator valve
30. Plate
31. Failsafe valve A sleeve
32. Failsafe valve A2
33. Failsafe A spring
34. Failsafe valve A1
35. Plate
36. Plug
37. Torque converter valve
38. Torque converter valve spring
39. Plate
40. Failsafe B sleeve
41. Failsafe B
42. Inside valve body
43. Roller
44. Overdrive pressure control valve sleeve
45. Overdrive pressure control valve
46. Overdrive pressure control valve spring
47. Roller
48. Low and reverse pressure control valve sleeve
49. Low and reverse pressure control valve
50. Low and reverse pressure control valve spring
51. Plate
52. Plug
53. Switch valve
54. Roller
55. Underdrive pressure control valve sleeve
56. Underdrive pressure control valve
57. Underdrive pressure control valve spring
58. Roller
59. Second pressure control valve sleeve
60. Second pressure control valve
61. Second pressure control valve spring
62. Outside valve body
63. Plate
64. Failsafe valve C sleeve
65. Failsafe valve C

Disassembly

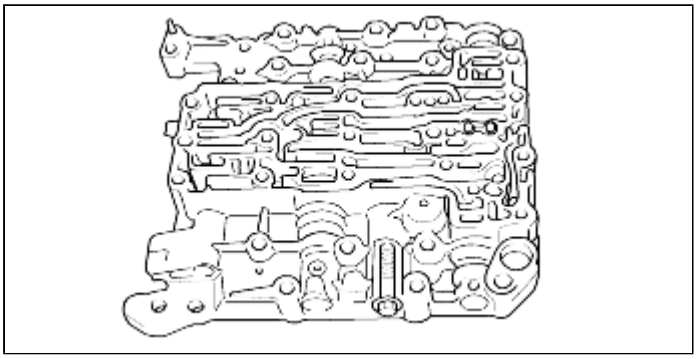
1. Remove each solenoid valve.
   Mark each installation point with white paint or so.

Reassembly

1. Install the spring/steel ball/damping valve/damping valve spring.

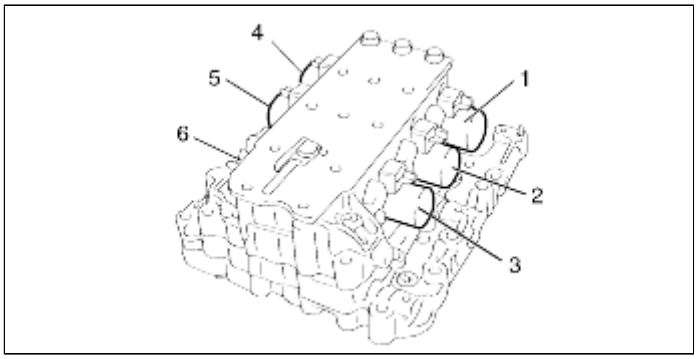


2. Install the spring/steel ball.

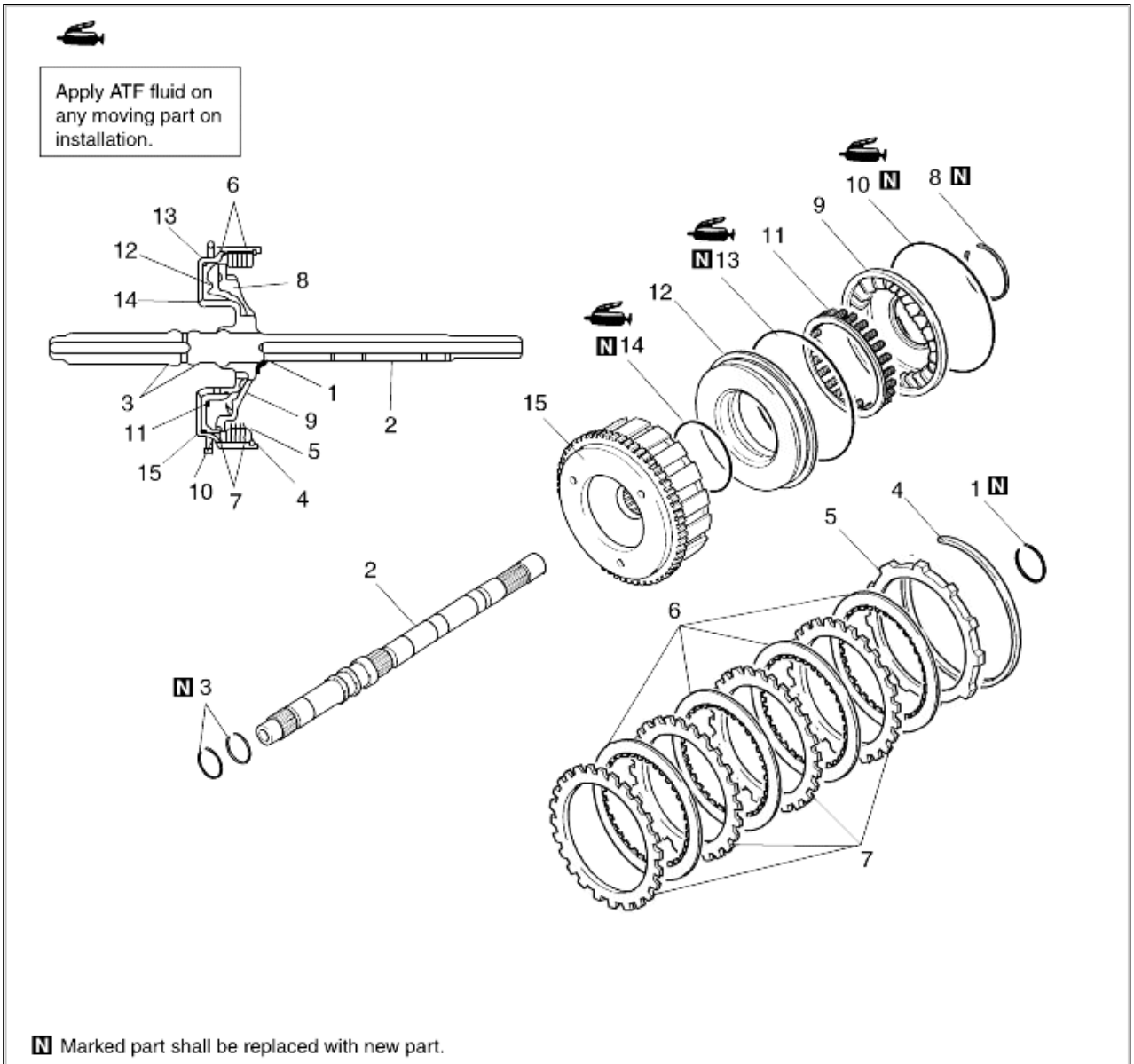


3. Install each solenoid valve.
   (1) Apply ATF or white vaseline on the O-ring and assemble it caring not to damage it.
   (2) Remove the marking made in disassembly and install them.

No.	Name
1	Underdrive solenoid valve
2	Second solenoid valve
3	Damper clutch control solenoid valve
4	Overdrive solenoid valve
5	Low and reverse solenoid valve
6	Reduction solenoid valve (5 A/T)



Components



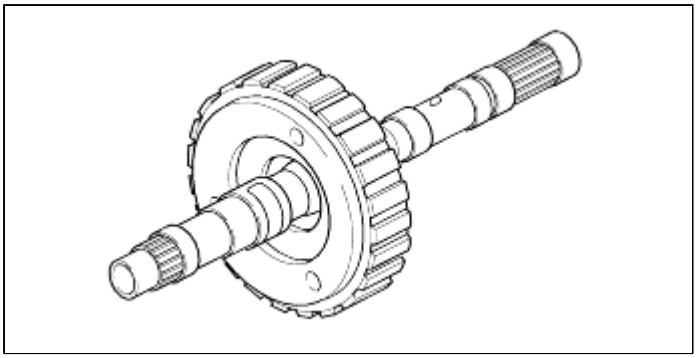
N Marked part shall be replaced with new part.

Disassembly procedure

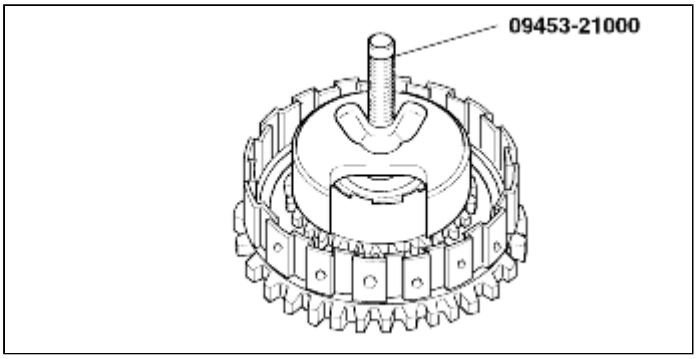
1. Snap ring
2. Input shaft
3. Seal ring
4. Snap ring
5. Clutch reaction plate
6. Clutch disc
7. Clutch plate
8. Snap ring
9. Underdrive clutch spring retainer
10. O-ring
11. Return spring
12. Underdrive clutch piston
13. O-ring
14. O-ring
15. Underdrive clutch retainer

Disassembly

1. Remove the input shaft snap ring.



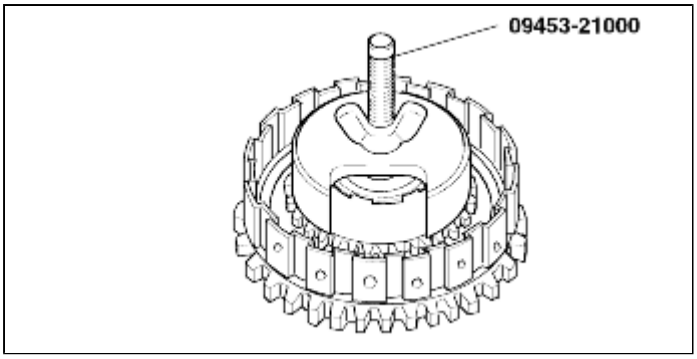
2. Disconnect the input shaft.
3. Remove seal rings(two).
4. Remove the clutch reaction plate snap ring.
5. Disconnect the clutch reaction plate.
6. Disassemble the clutch disce (four) and plates (four).
7. Remove the under clutch piston snap ring using the special tool.



8. Remove the clutch spring retainer.
9. Remove the O-ring.
10. Remove the clutch return spring.
11. Remove the under clutch piston using compressed air.
12. Remove the O-rings(two).

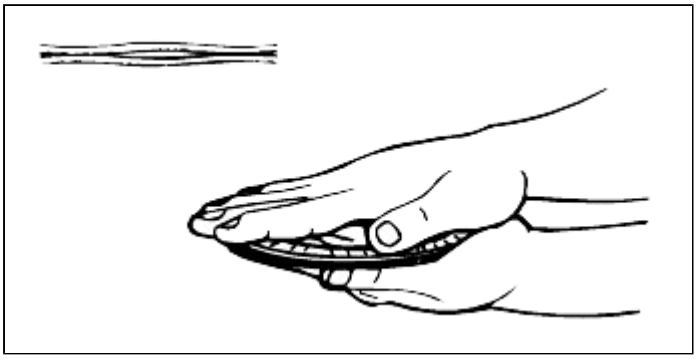
Reassembly

1. Install the O-ring(two).
2. Install the underdrive clutch piston.
3. Install the clutch return spring.
4. Install the O-ring.
5. Install the clutch spring retainer.
6. Install the clutch spring retainer snap ring using the special tool.



NOTE

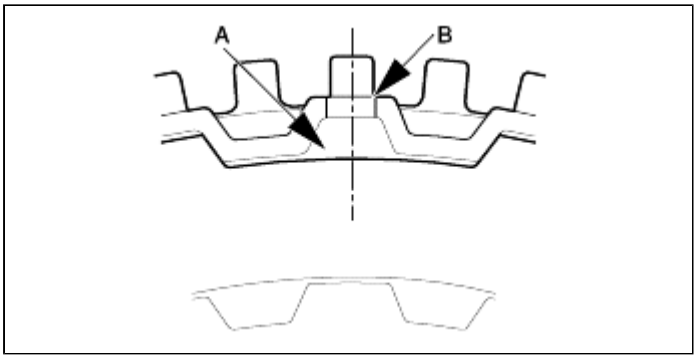
Hold the 2 clutch discs together, and slide them a little, If there is a gap, they are wave discs.



7. Align the teeth of the clutch plate, the clutch disc and the clutch reaction plate (fig.A), and hold the underdrive clutch(fig.B).

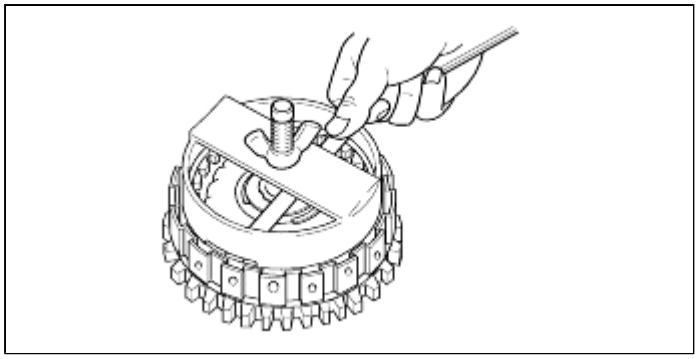
CAUTION

Dip the clutch disc in ATF sufficiently before assembly.

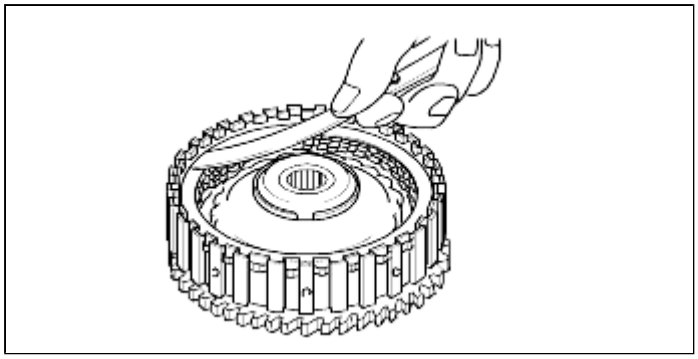


8. Install the clutch reaction plate in the direction on figure.
9. Install the snap ring.
10. Check the gap between the snap ring and the reaction plate.

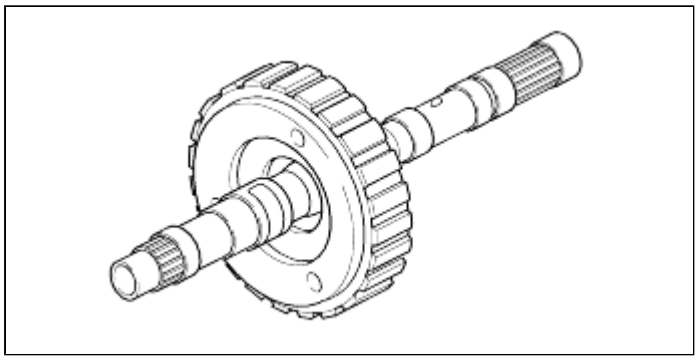
Standard valueF5A51-3 : 0.063~0.071in(1.6~1.8mm)



11. If the gap deviates from standard value, choose a proper snap ring(15 sizes).

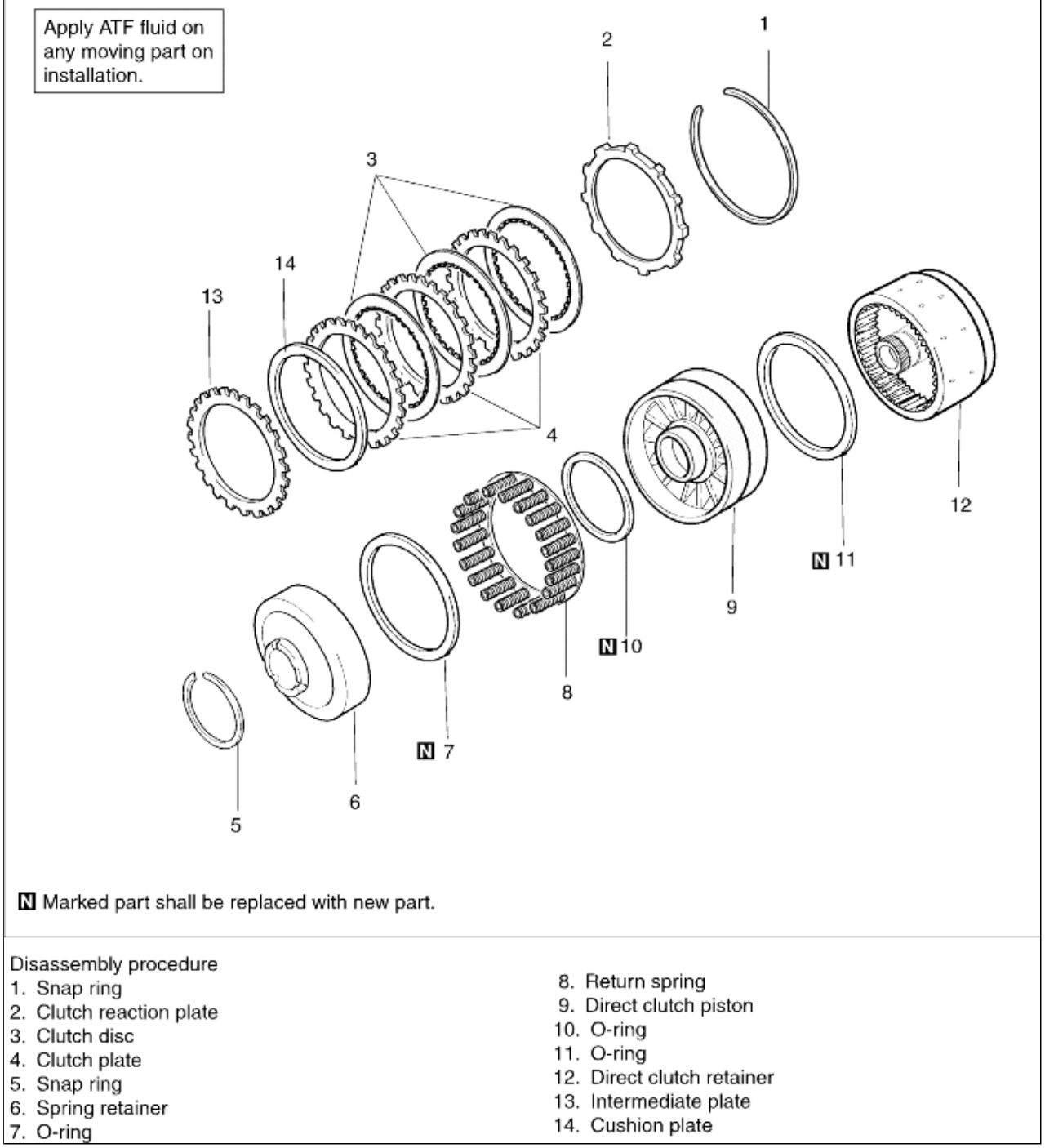


12. Install the underdrive clutch assembly on the input shaft.



13. Install the snap ring on the input shaft.

Components

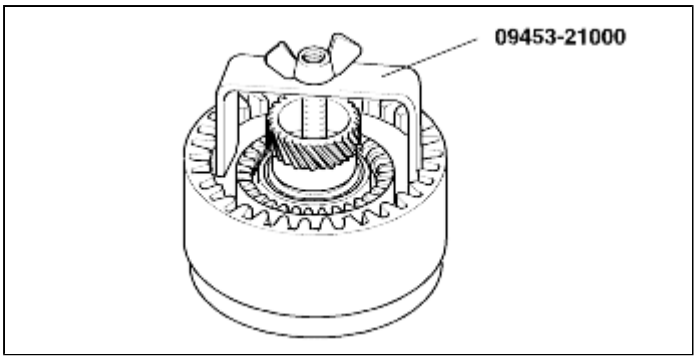


N Marked part shall be replaced with new part.

Disassembly procedure
1. Snap ring
2. Clutch reaction plate
3. Clutch disc
4. Clutch plate
5. Snap ring
6. Spring retainer
7. O-ring
8. Return spring
9. Direct clutch piston
10. O-ring
11. O-ring
12. Direct clutch retainer
13. Intermediate plate
14. Cushion plate

Disassembly

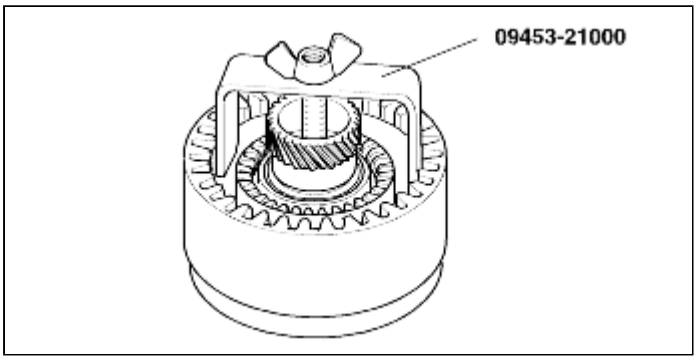
1. Remove the direct clutch snap ring.
2. Remove the clutch reaction plate.
3. Remove the clutch discs (five) and plates (five).
4. Remove the snap ring using special tool.



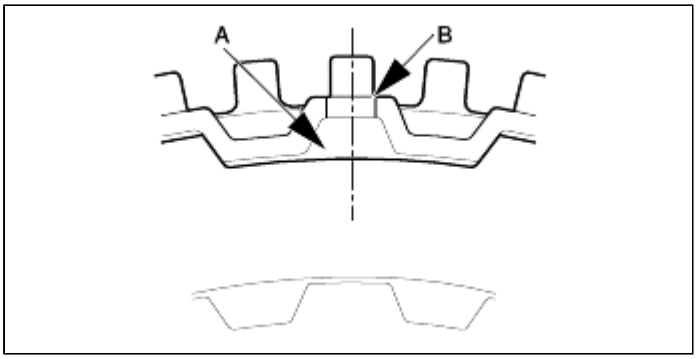
5. Remove the direct spring retainer.
6. Remove the return spring.
7. Remove the direct clutch piston and O-ring.

Reassembly

1. Install the O-rings on direct clutch retainer and piston.
2. Install the clutch piston.
3. Install the O-ring on spring retainer and install return spring and retainer.
4. Install the snap ring using the special tool.



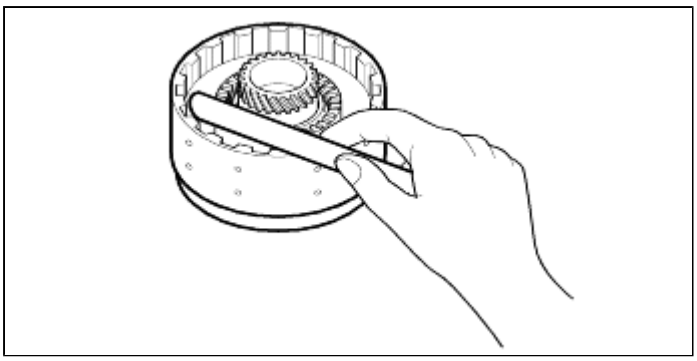
5. Aligning the teeth of the clutch plate, the clutch disc, and the clutch reaction plate (fig.A) and the direct clutch retainer hole (fig.B), assemble them.



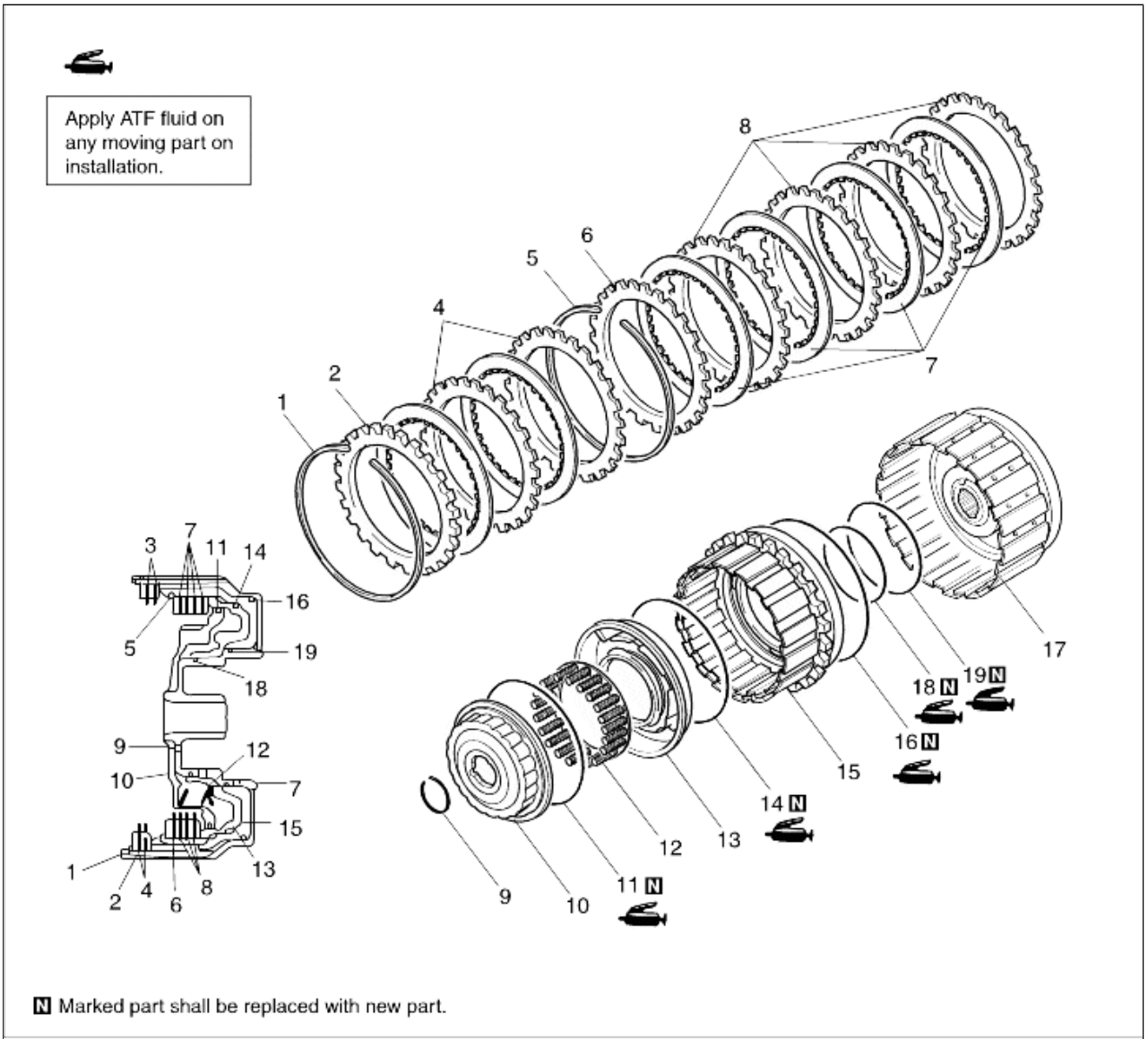
6. Install the direct clutch reaction plate as illustrated on the figure.
7. Applying force of 5kg on the direct clutch reaction plate, measure the gap with the snap ring using a gauge. If

the measurement deviates from standard value, use an appropriate snapring (12 sizes).

Standard valueF5A51-3 : 0.024~0.031in(0.6~0.8mm)



Components

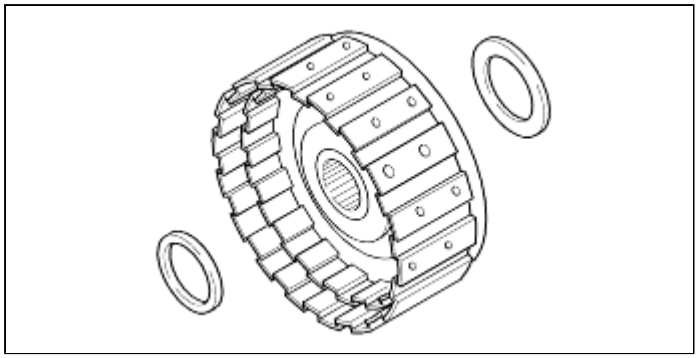


Disassembly steps

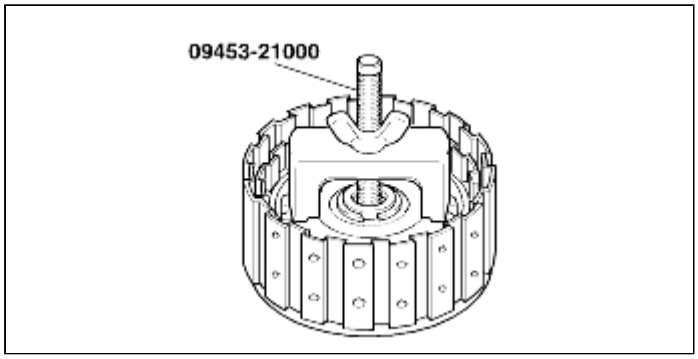
1. Snap ring
2. Clutch reaction plate
3. Clutch disc
4. Clutch plate
5. Snap ring
6. Clutch reaction plate
7. Clutch disc
8. Clutch plate
9. Snap ring
10. Spring retainer
11. O-ring
12. Return spring
13. Overdrive clutch piston
14. O-ring
15. Reverse clutch piston
16. O-ring
17. Reverse clutch retainer
18. O-ring
19. O-ring

Disassembly

1. Remove the overdrive clutch reaction plate snap ring.



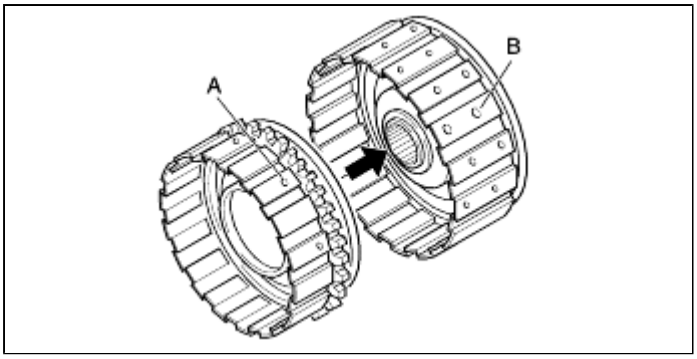
2. Remove the overdrive reaction plate.
3. Remove the overdrive clutch discs(four) and the plates(four).
4. Remove the reverse clutch reaction plate snap ring.
5. Remove the reverse clutch reaction plate.
6. Remove the reverse clutch discs(two) and the plates(two).
7. Remove the clutch spring retainer snap ring using special tool.



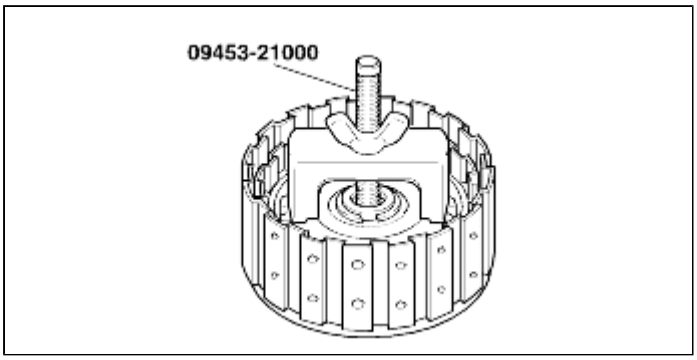
8. Disconnect the clutch spring retainer.
9. Remove the O-ring.
10. Remove the clutch return spring.
11. Remove the overdrive clutch piston using compressed air.
12. Remove the O-ring.
13. Remove the reverse clutch piston.
14. Remove the O-rings(three).

Reassembly

1. Install the O-rings(three).
2. Connect the reverse retainer and reverse piston aligning holes A & B.

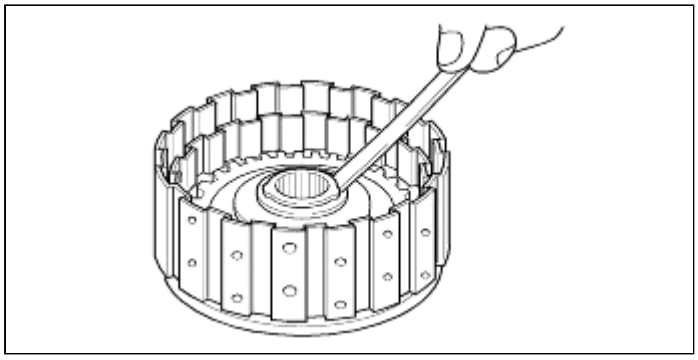


3. Install the reverse clutch piston.
4. Install the O-ring.
5. Install the overdrive clutch piston.
6. Install the clutch return spring.
7. Install the O-ring.
8. Install the clutch spring retainer.
9. Install the overdrive clutch spring retainer snap ring using the special tool.



10. Measure the gap with the snap rings by using special tool. If the gap deviates from standard value, use an appropriate snap ring(4 sizes).

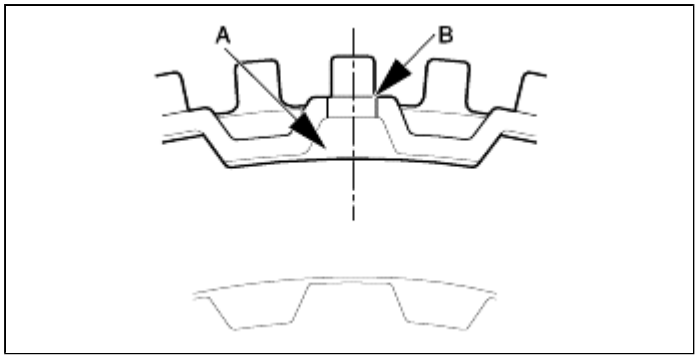
End play : 0~0.035L in(0T~0.09L mm)



CAUTION

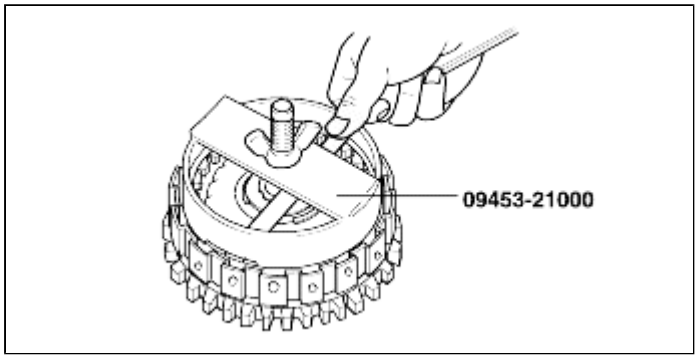
Dip the clutch disc in ATF sufficiently before assembly.

11. Aligning the teeth of the clutch plate, the clutch disc, and the clutch reaction plate (fig.A) and the reverse clutch retainer hole (fig.B), assemble them.

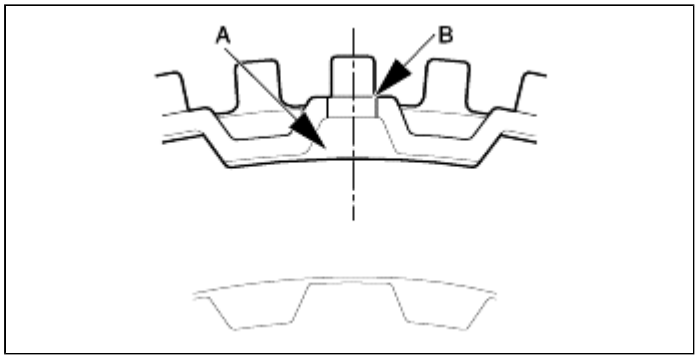


12. Install the reverse clutch discs (two) and plates (two).
13. Install the reverse clutch reaction plate.
14. Install the snap ring.
15. Measure the gap between the reverse clutch reaction plate and the snap ring by using special tool. If the gap deviates from standard value, use an appropriate snap ring (4 sizes).

Standard valueF5A51-3 : 0.059~0.067in(1.5~1.7mm)

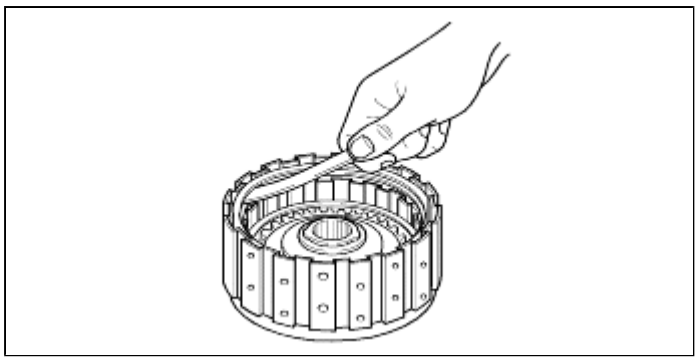


16. Aligning the teeth of the clutch plate, the clutch disc, and the clutch reaction plate (fig.A) and the overdrive clutch retainer hole (fig.B), assemble them.

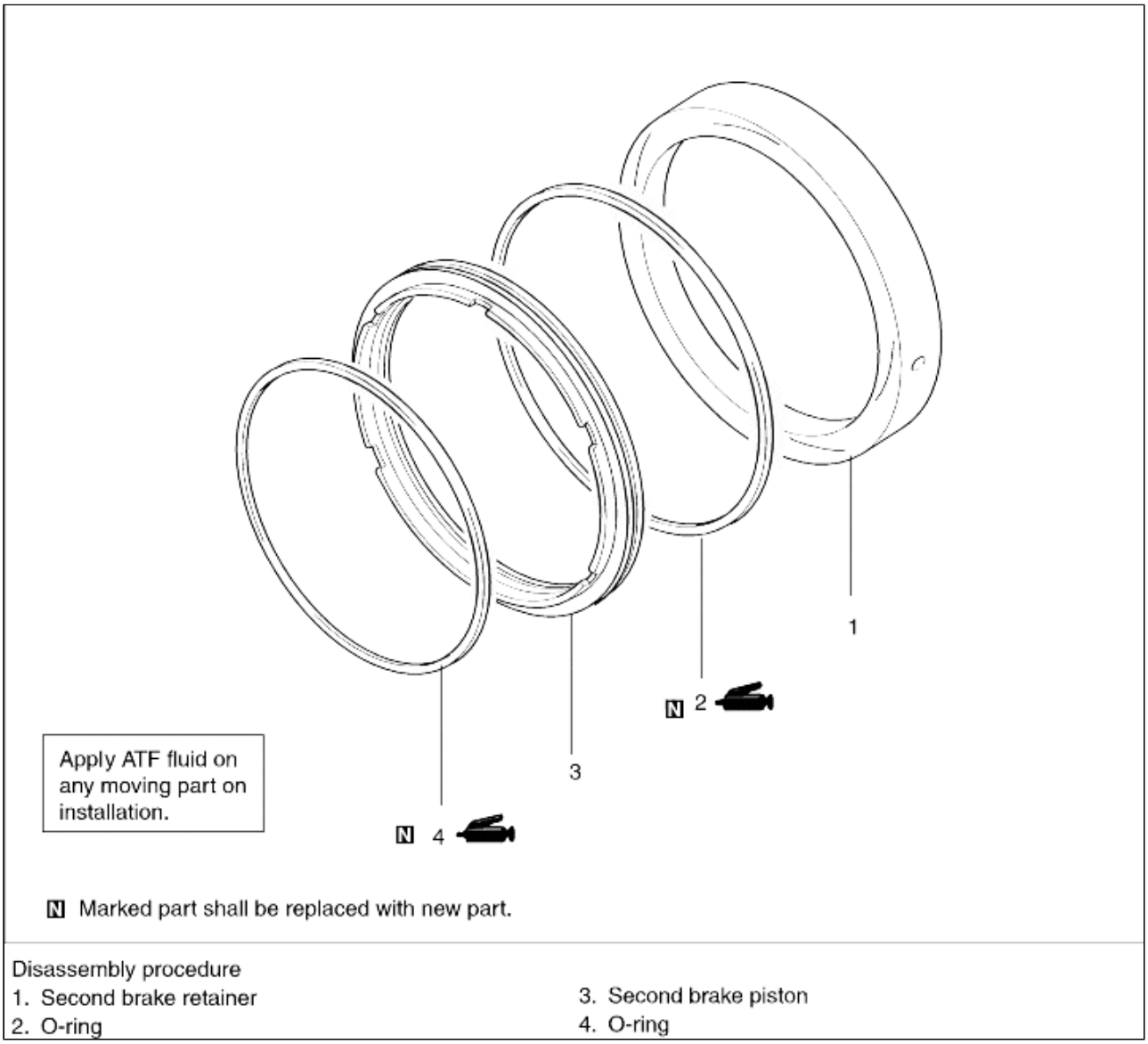


17. Install the overdrive clutch discs (four) and plates (four).
18. Install the overdrive clutch reaction plate.
19. Install the snap ring.
20. Measure the gap between the overdrive reaction plate and the snap ring. If the gap deviates from standard value, use an appropriate snap ring (15 sizes).

Standard valueF5A51-3 : 0.063~0.071in(1.6~1.8mm)



Components



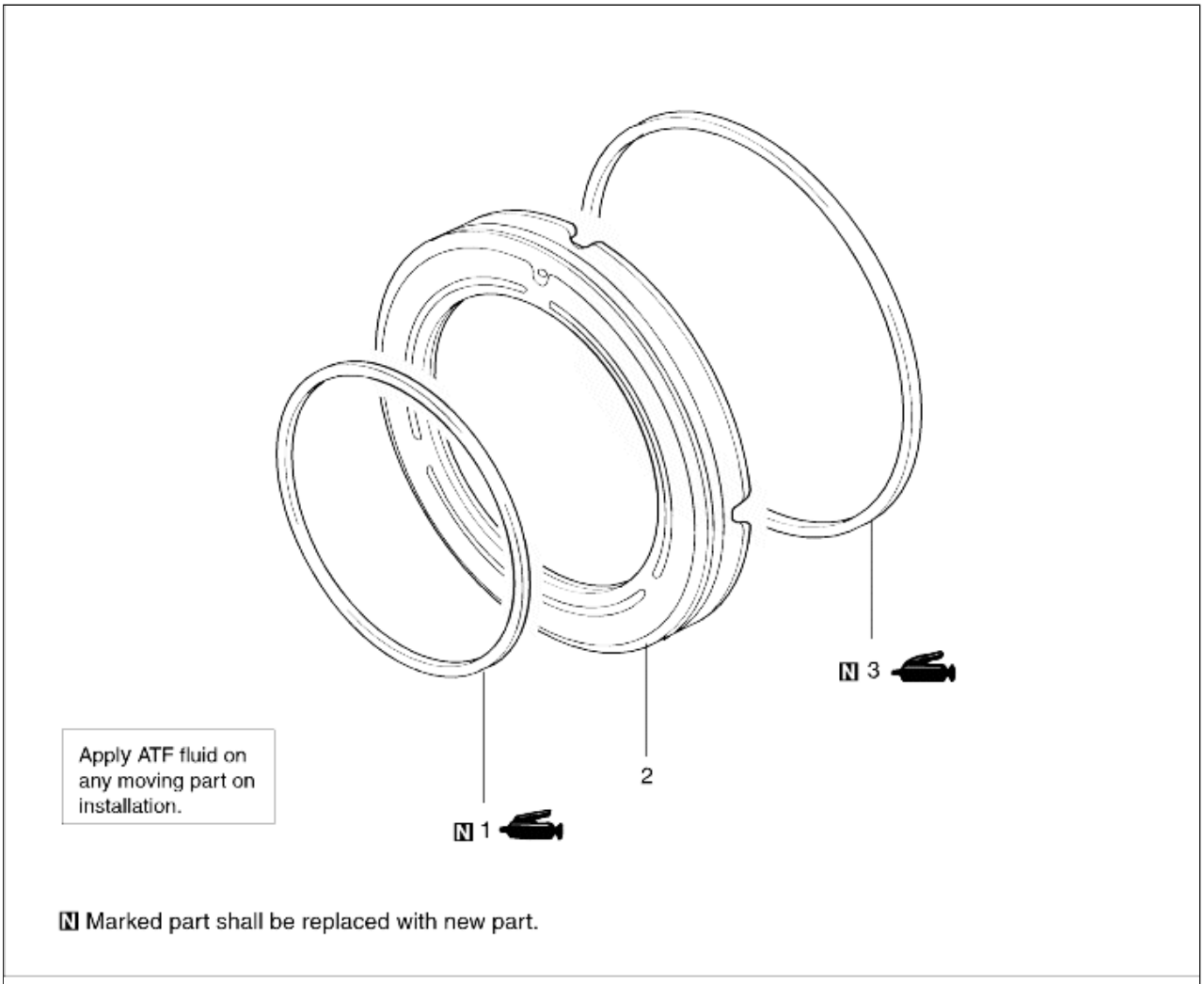
Disassembly procedure

1. Second brake retainer
2. O-ring
3. Second brake piston
4. O-ring

Assembly

1. Install the O-ring.
   Apply ATF or white vaseline on the seal ring and install it caring not to damage it.

Components

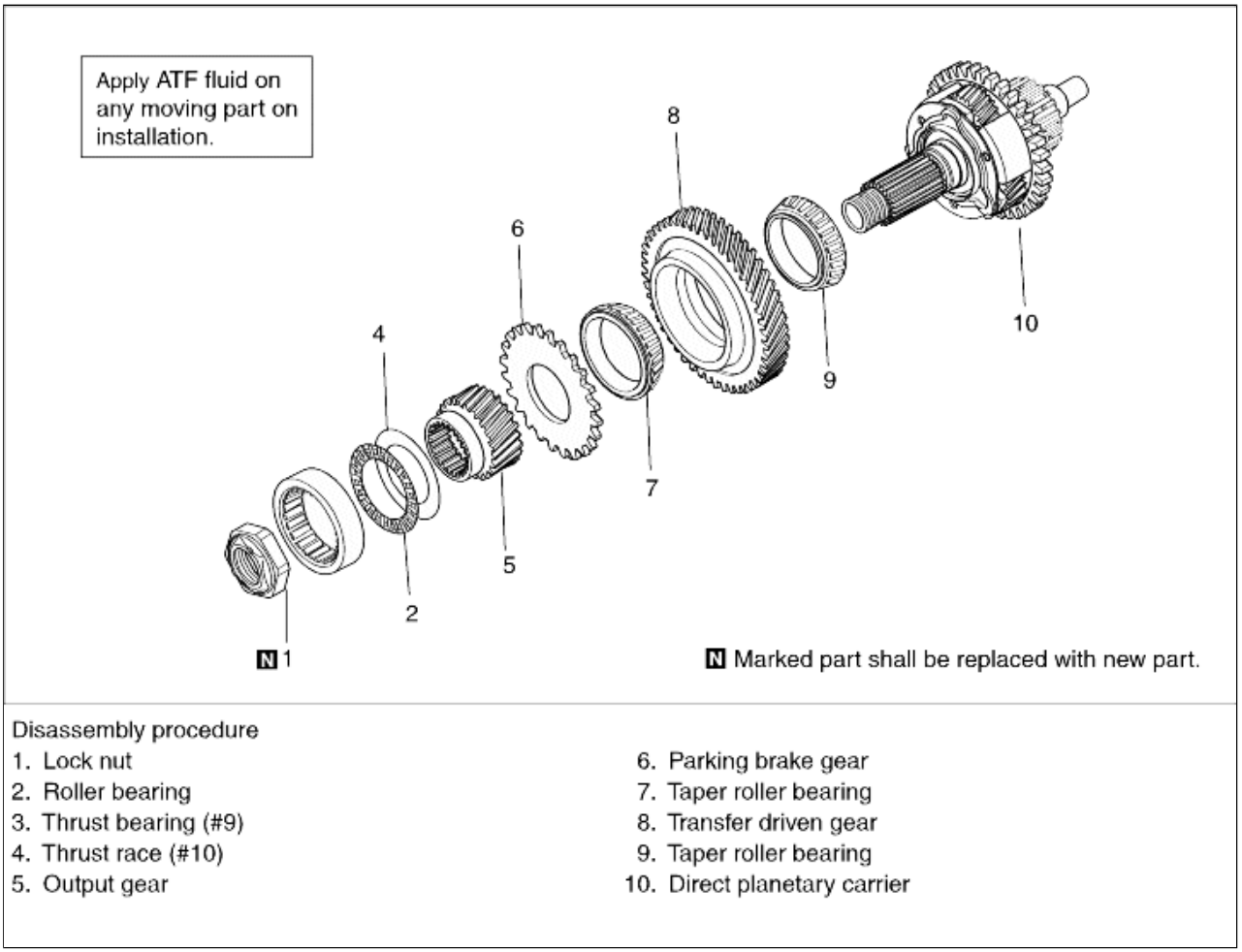


Disassembly procedure
1. O-ring
2. Low and reverse brake piston
3. O-ring

Assembly

1. Install the seal ring.
   Apply ATF or white vaseline on the seal ring and install it caring not to damage it.

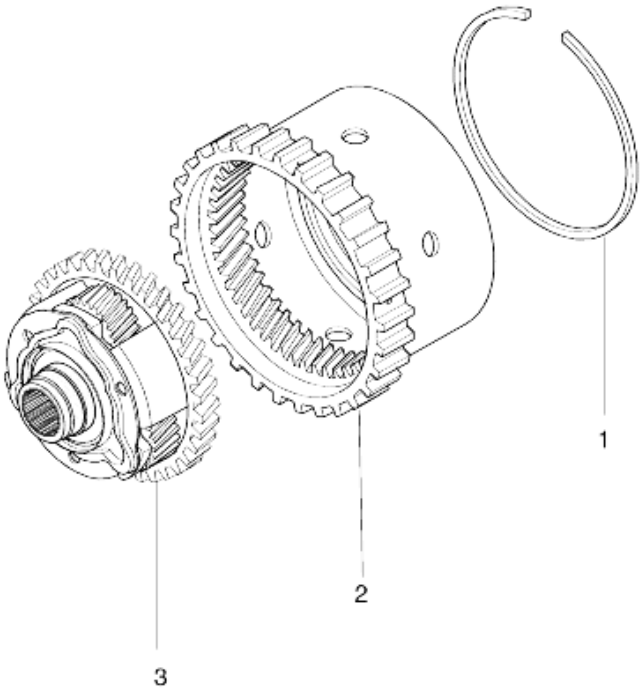
Components



Disassembly procedure

1. Lock nut
2. Roller bearing
3. Thrust bearing (#9)
4. Thrust race (#10)
5. Output gear
6. Parking brake gear
7. Taper roller bearing
8. Transfer driven gear
9. Taper roller bearing
10. Direct planetary carrier

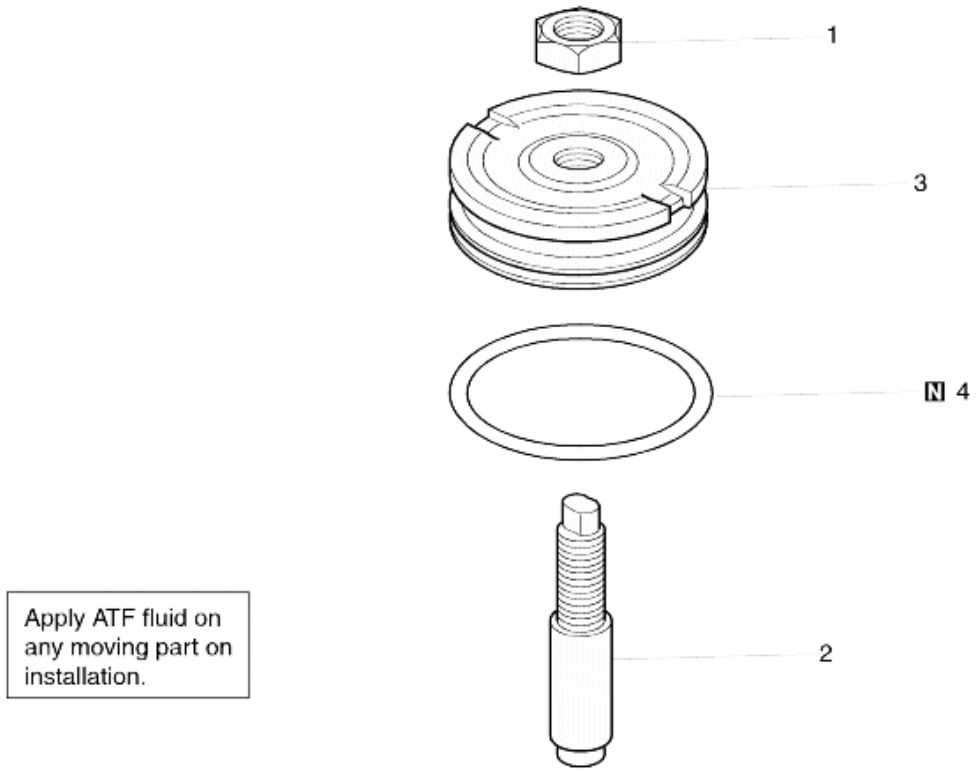
Components



Apply ATF fluid on any moving part on installation.

Disassembly procedure
1. Snap ring
2. Overdrive planetary carrier
3. Overdrive annulus gear

Components



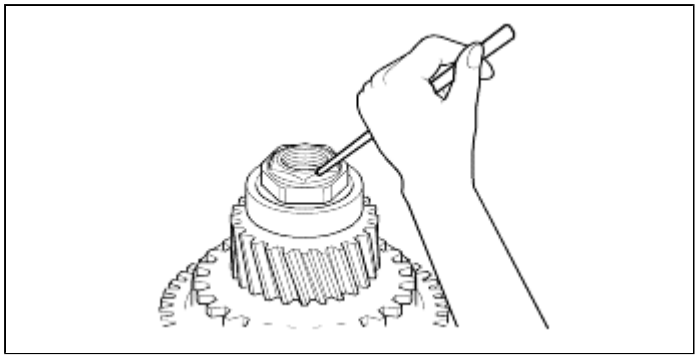
N Marked part shall be replaced with new part.

Disassembly procedure

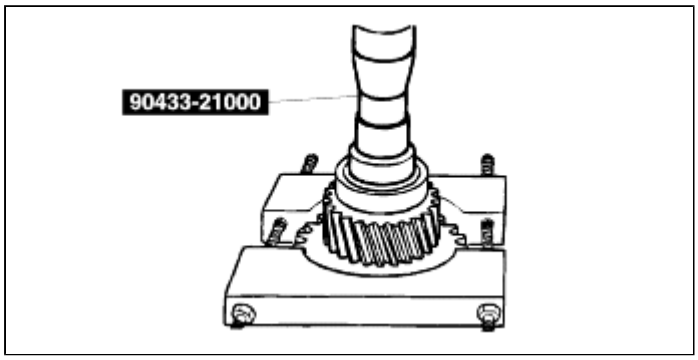
1. Nut
2. Adjust rod
3. Reduction brake piston
4. Seal ring

Disassembly

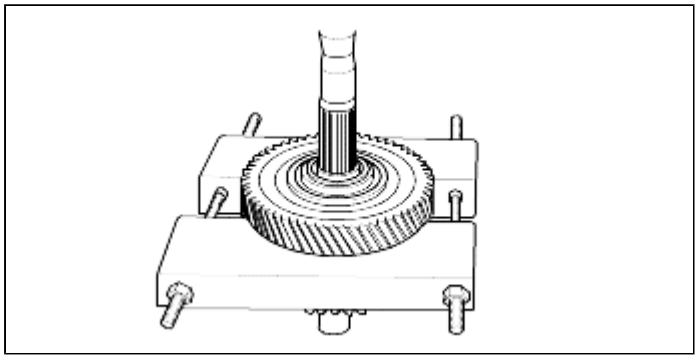
1. Cock the lock nut only enough to trum.



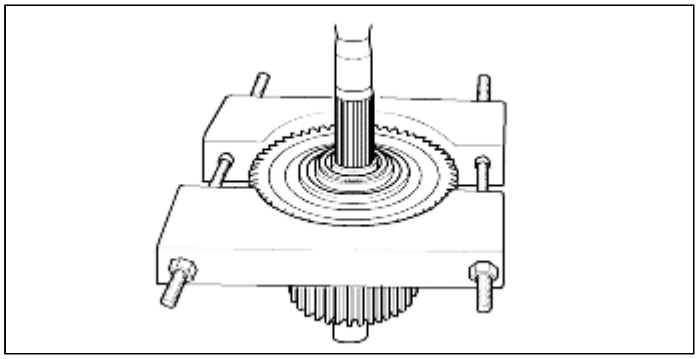
2. Remove the lock nut.
3. Remove the output gear and the parking brake gear using the special tool.



4. Remove the taper roller bearing and the transfer driven gear.

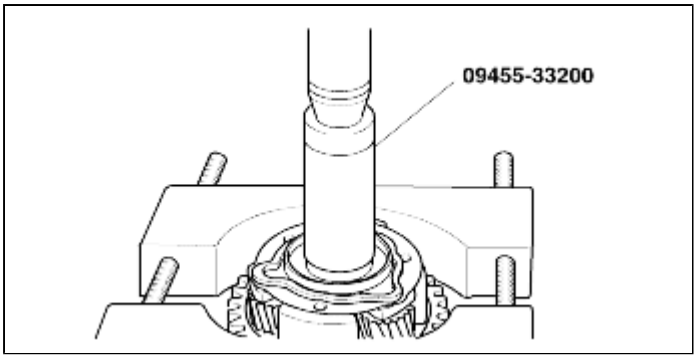


5. Remove the inner taper roller bearing.

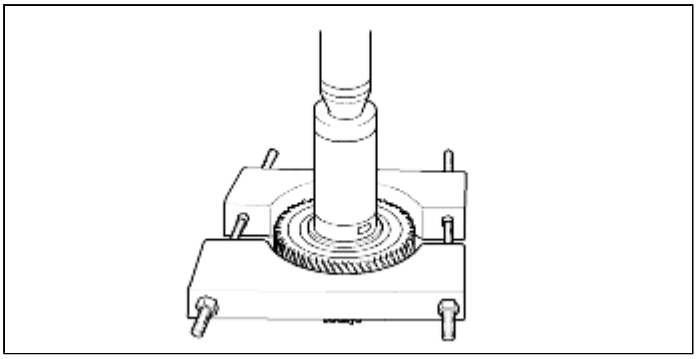


Reassembly

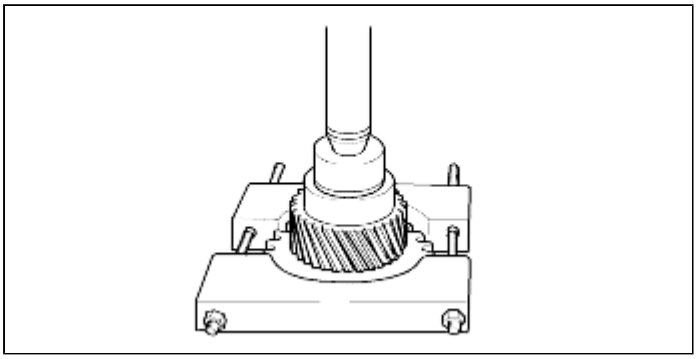
1. Install the inner taper roller bearing using the special tool.



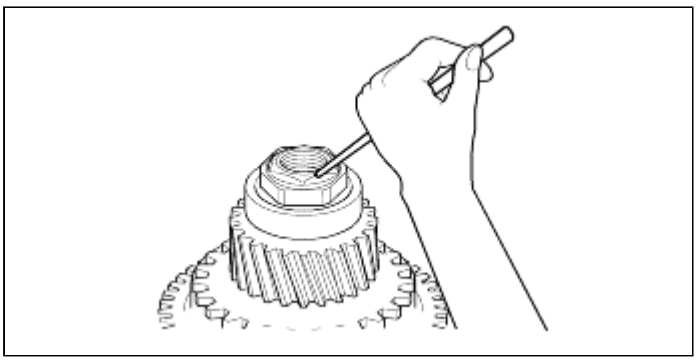
2. Install the transfer driven gear and the taper roller bearing



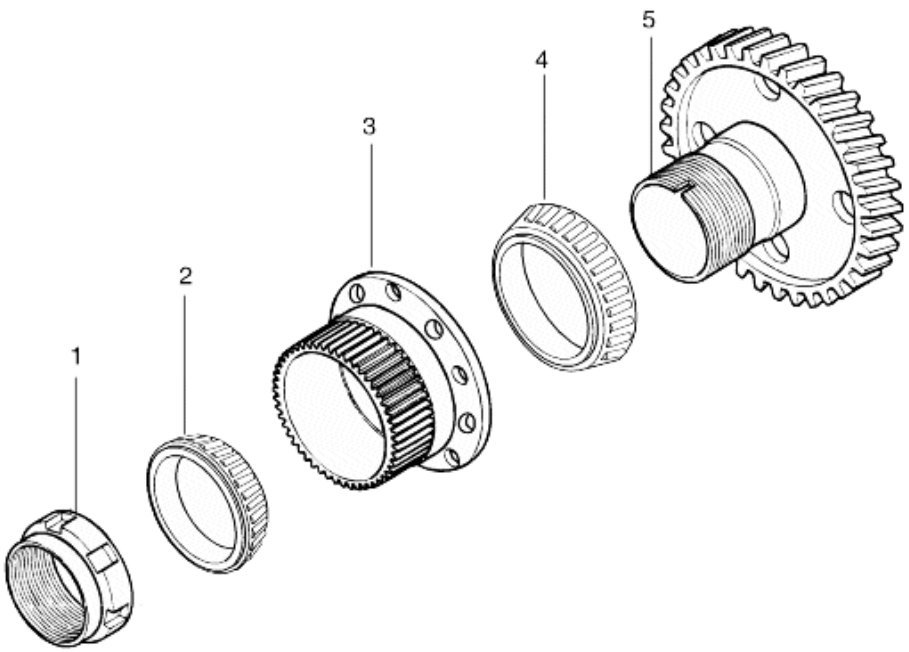
3. Install the parking brake gear and the output gear.
4. Install the roller bearing and tighten the lock nut with tightening torque.



5. Cock the lock nut (two points) not to move.



Components

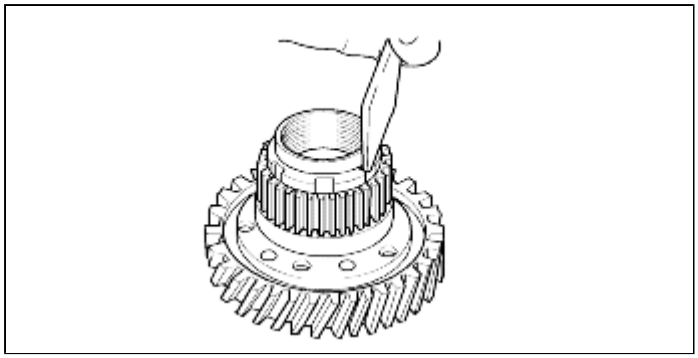


Disassembly procedure

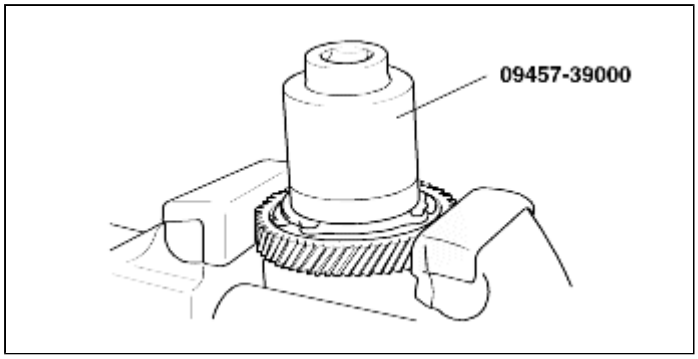
1. Lock nut
2. Roller bearing
3. Transfer drive gear bearing
4. Taper roller
5. Transfer drive gear

Disassembly

1. Cock the lock nut only enough to turn.

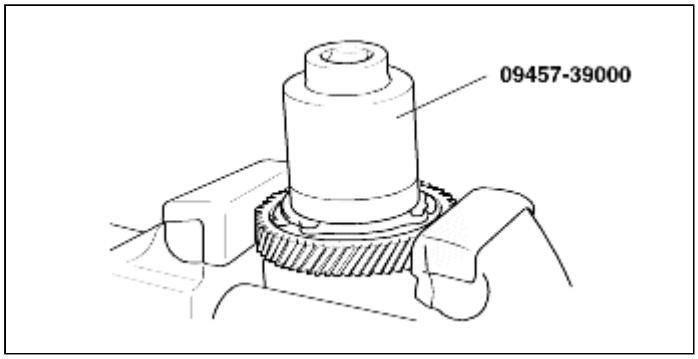


2. Remove the output gear and the parking brake gear using the special tool.

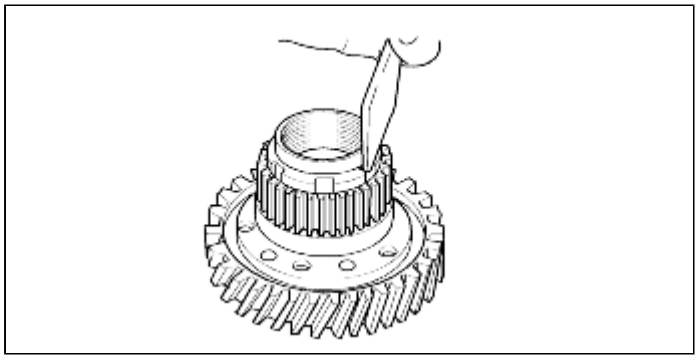


Reassembly

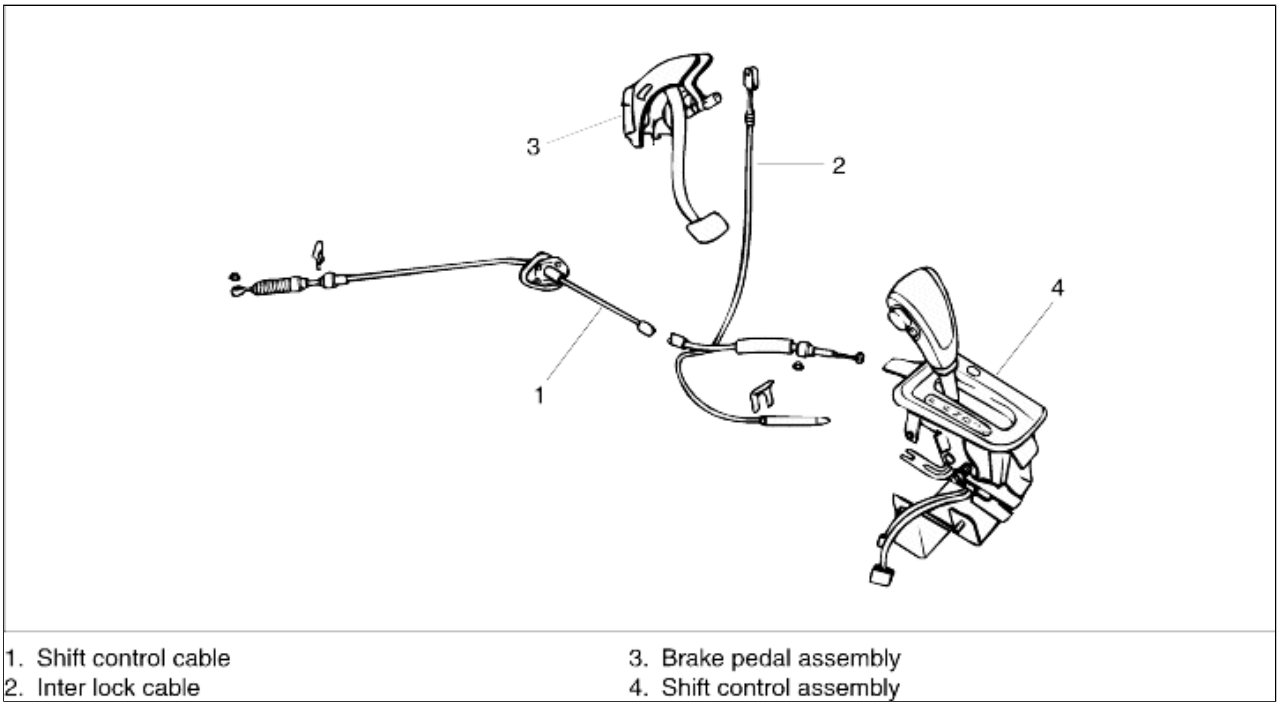
1. Assemble the transfer drive gear bearing.



2. Apply ATF on a new lock nut and tighten it with tightening torque.
   Release it one revolution and retighten it with tightening torque.
3. Tighten the lock nut with punch (2 points).



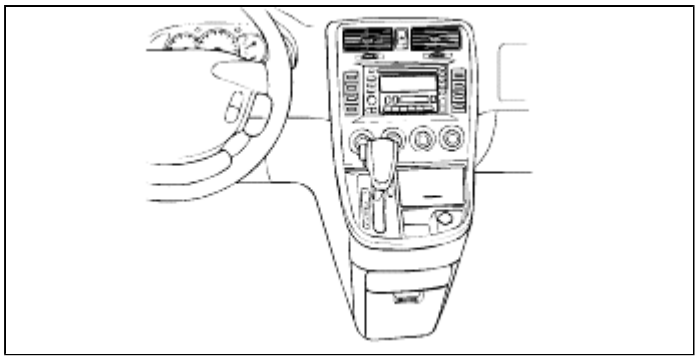
Automatic transaxle shift control



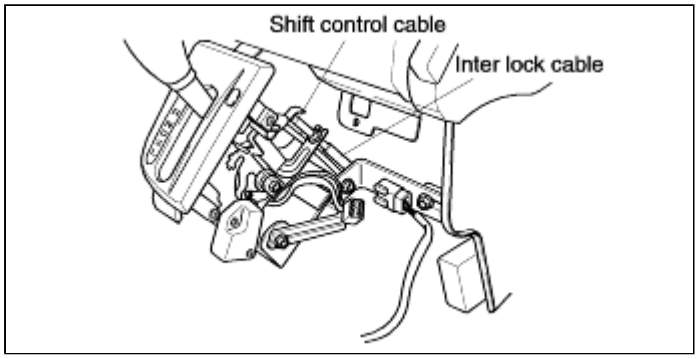
1. Shift control cable
2. Inter lock cable
3. Brake pedal assembly
4. Shift control assembly

Removal

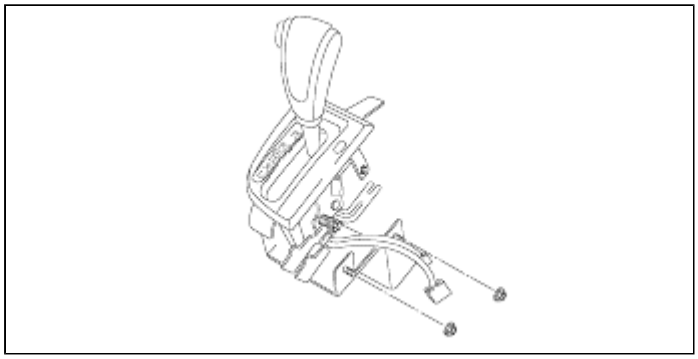
1. Remove the audio cover plate.
2. Remove the center console.



3. Remove the shift control cable.
4. Remove the inter lock cable.
5. Disconnect the harness connector.



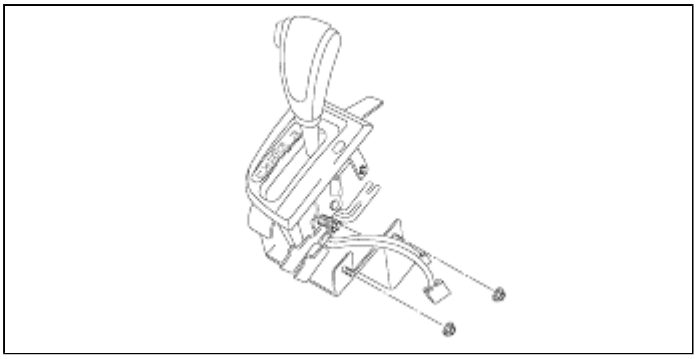
6. Remove the selector lever assembly.



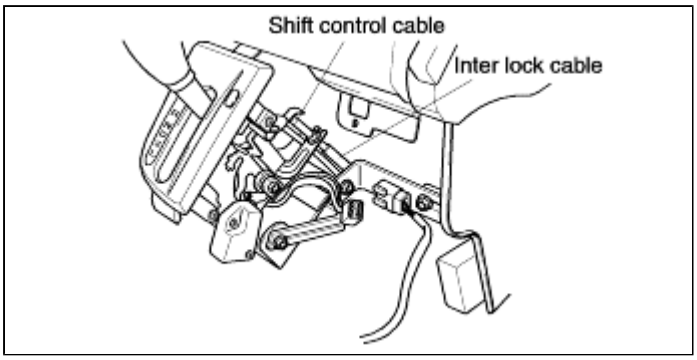
Installation

1. Install the selector lever assembly with tightening torque.

Tightening torque :8.8~13.7 N·m (90~140 kg·cm, 65~10.1 lb·ft)

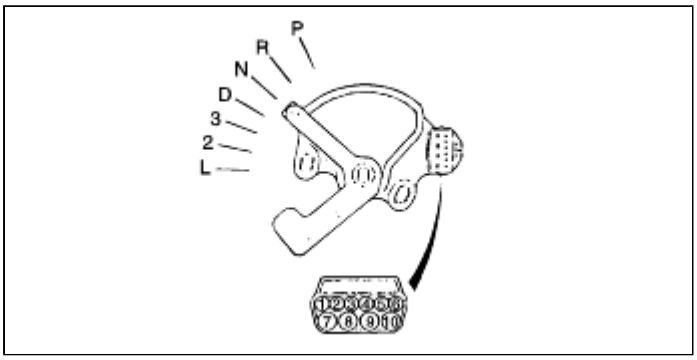


2. Install the inter lock cable.
3. Install the shift control cable.
4. Connect the harness connector.
5. After installing the inter lock cable, move the selector lever to "P" and press the brake pedal to check the inter lock cable operation.



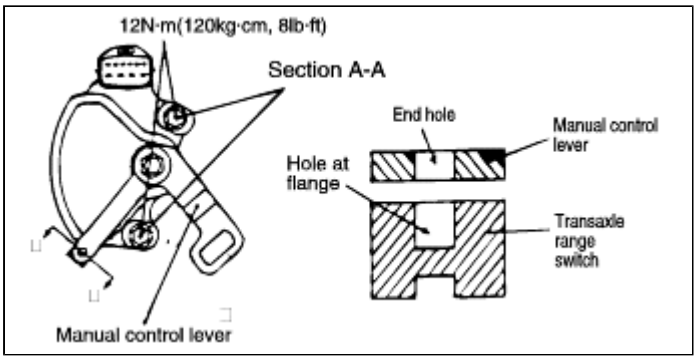
Checking continuity of the transaxle range switch

Items	Terminal No.									
	1	2	3	4	5	6	7	8	9	10
P			○					○	○	○
R							○	○		
N				○				○	○	○
D	○							○		
3					○			○		
L		○						○		



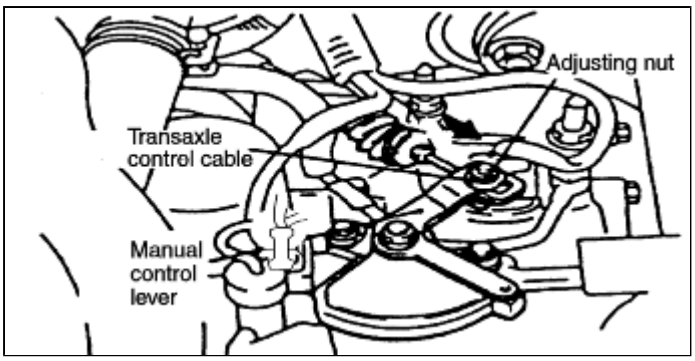
Control cable adjustment

1. Move the shift lever to position "N".
2. Release the adjusting nut at the connection between the transaxle control cable and the manual control lever and separate them.



3. Move the manual control lever to position "N".
4. Insert ±0.197in(±5mm) pin into holes ±0.197in(±5mm) transaxle range switch and the manual control lever. Adjust the transaxle range switch and manual control lever at position "N" correctly.

> **CAUTION**
>
> If you do not insert ±0.197in(±5mm) pin, position "N" may move when tightening the adjusting nut.



Control cable checking

1. Press the brake pedal and engage the parking brake completely.
2. Move the shift lever at position "R".
3. Turn the engine start switch to position "ST".
4. Move the shift lever to position "P".
   If starter motor operates when it clicks, control cable is adjusted correctly.
5. With the same manner, move the shift lever to position "N". If the starter motor operates, it is correct.
6. If the starter motor operates at positions "P" and "N" as described above and does not operate at any other position, then the control cable is adjusted properly.

O/D switch

Operatation inspection

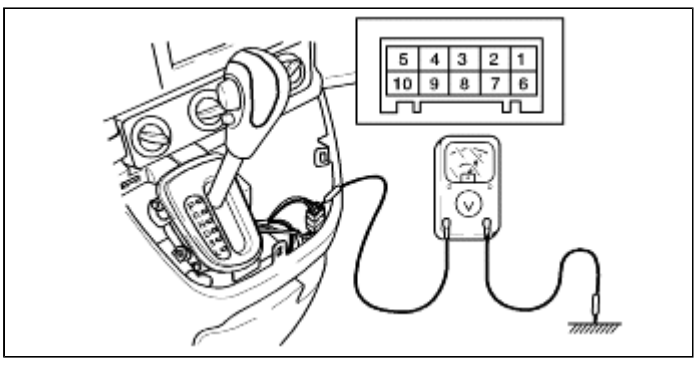
1. Turn ignition switch ON.
2. Verify that the O/D indicator light is not illuminated.
   Depress O/D switch and verify that the O/D indicator light illuminates.
3. If O/D indicator light does not operate, continue with inspection of voltage test.

Voltage inspection

1. Remove center panel(Refer to section BD, body).
2. Turn ignition switch ON.
3. Measure voltage at O/D switch connector.

Position	Connector terminal	
	6	7
Normal (V)	O	B+
Depressed (V)	O	O

B+ : Battery positive voltage



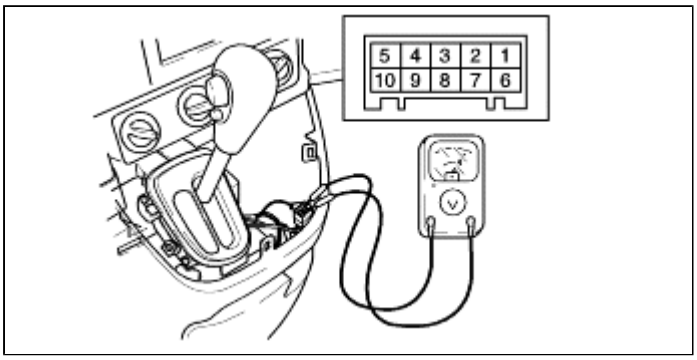
4. If not as specified, check for continuity at O/D switch.
5. Install center panel(Refer to section BD, body).

Continuity inspection

1. Disconnect negative battery cable.
2. Disconnect O/D switch connector.
3. Check a continuity on 6 terminal and 7 terminal.

Position	Connector terminal	
	6	7
Normal (V)		
Depressed (V)	O	O

O—O: Indicates continuity

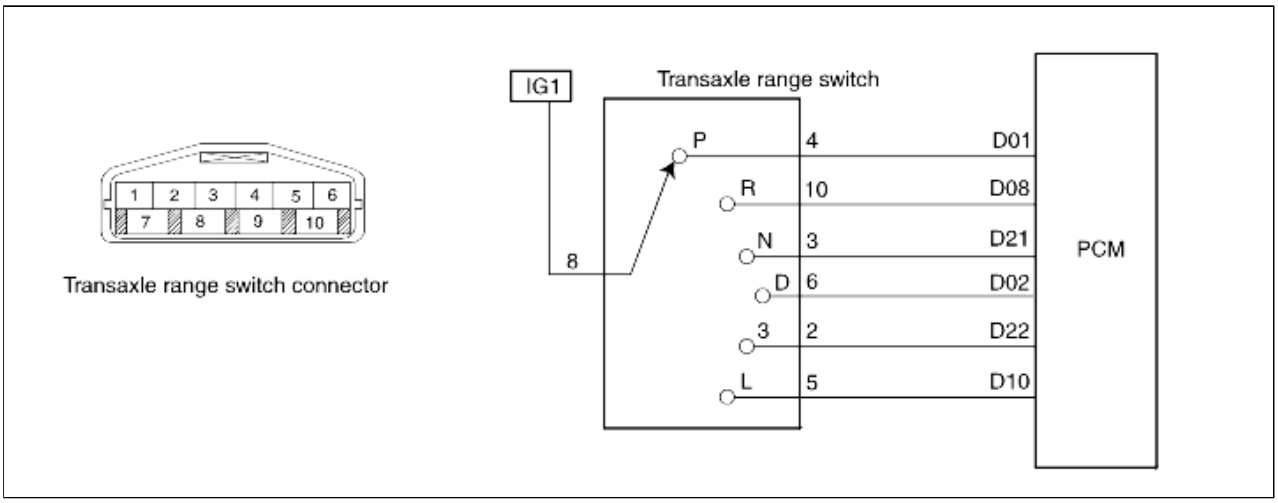


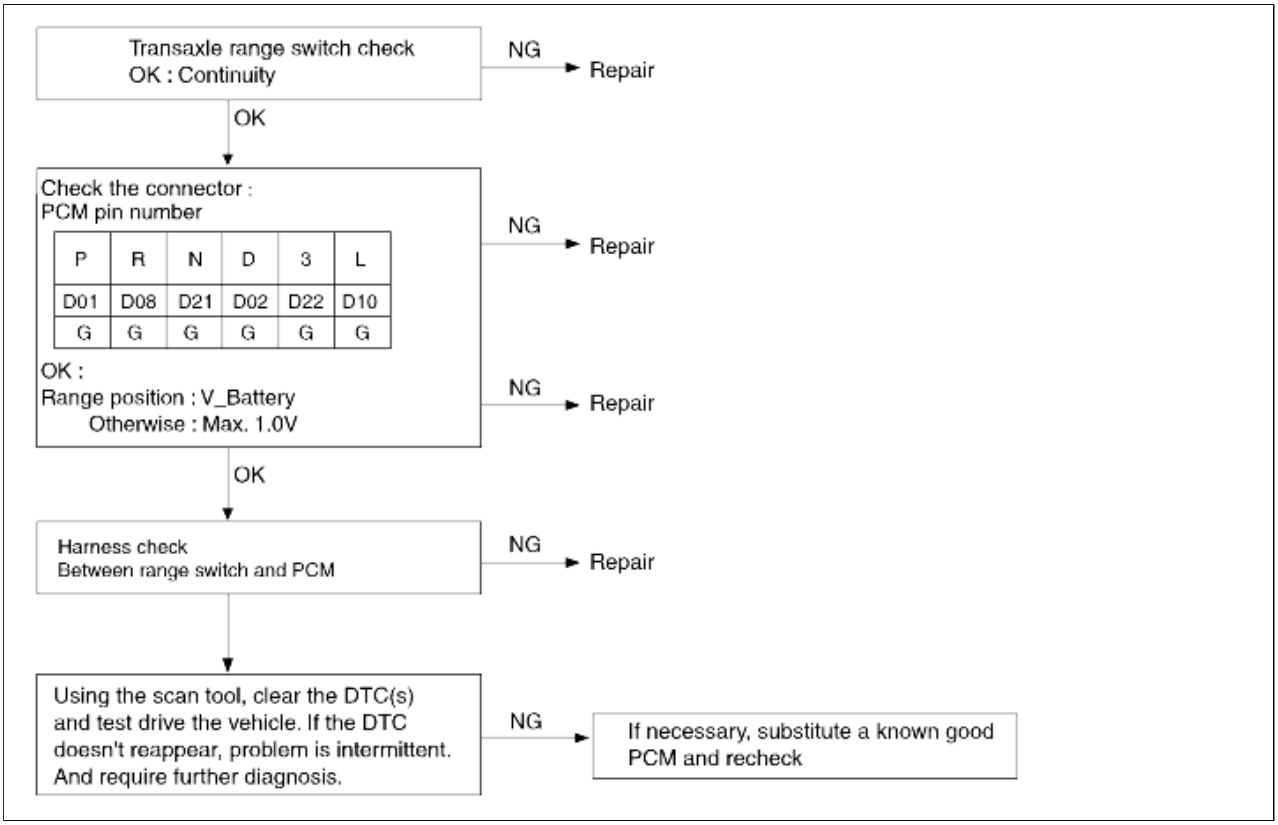
4. Replace selector lever knob if not as specified.
5. Check wiring harness for continuity if switch is operating correctly(from O/D switch to ECM, and from O/D switch to ground).

TRANSAXLE RANGE SWITCH

Code No.P0705 Transaxle range switch Code No.P0707 Transaxle range switch circuit low input Code No.P0708 Transaxle range switch circuit high input	Probable cause
No signal continually for 30 seconds. 2 or more signals continually for 30 seconds.	1) P R N D 3 L open circuit or contact failure 2) Short to battery voltage in signal line 3) Short between each signal line in transmission range switch

CIRCUIT DIAGRAM

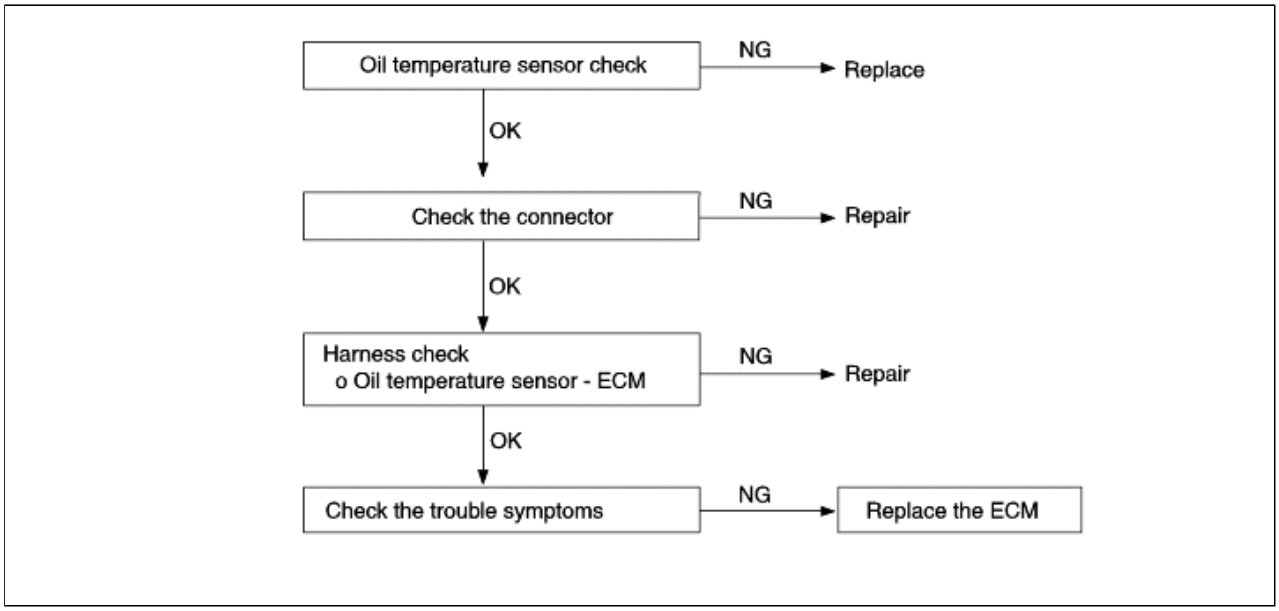




INSPECTION PROCEDURES FOR DIAGNOSTIC TROUBLE CODES

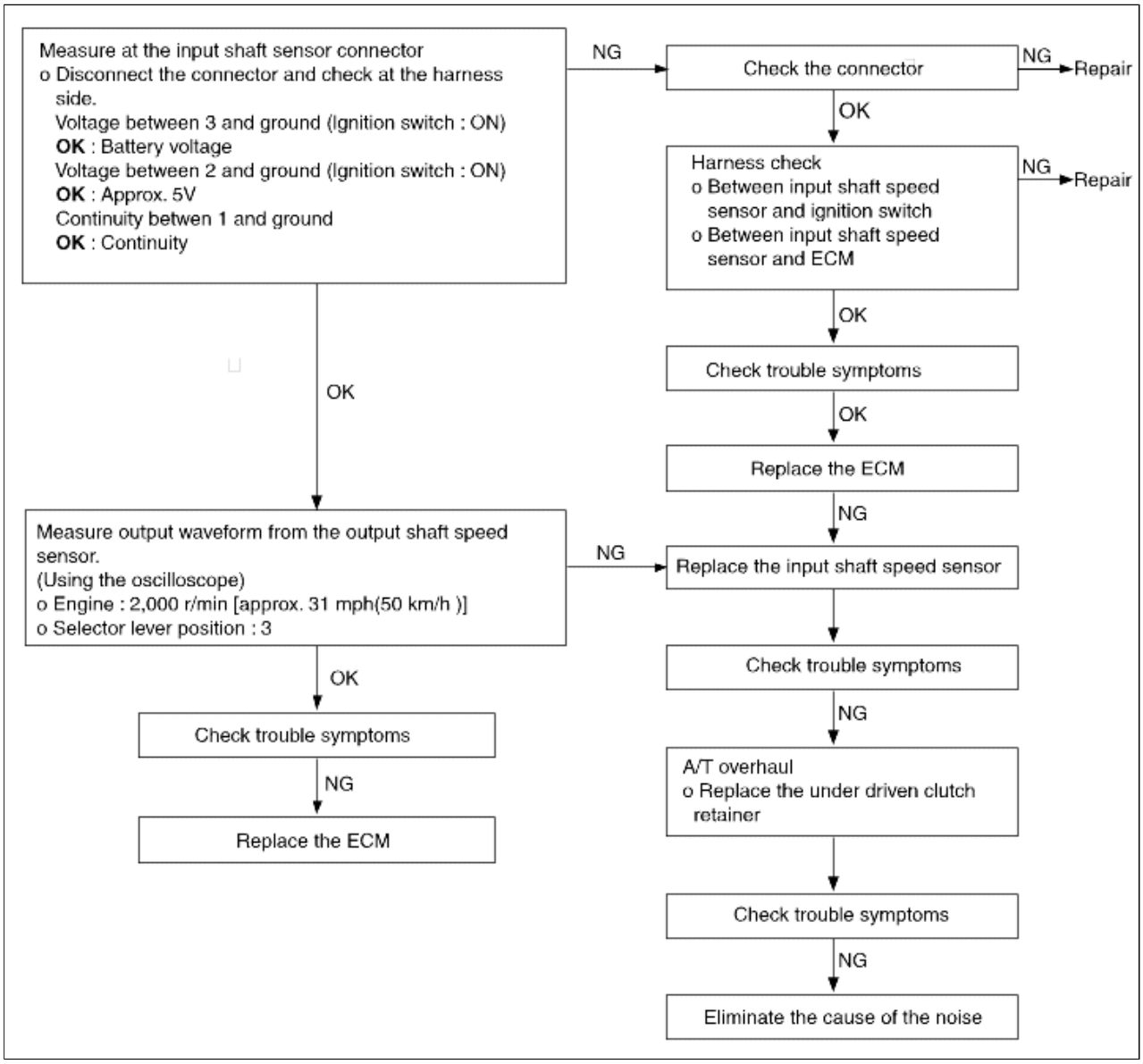
Oil temperature sensor system

Code No.P0712/P0713 Oil temperature sensor system	Probable cause
If the oil temperature sensor output voltage is 2.6V or more even after driving for 10 minutes or more (If the oil temperature does not increase), it is judged that there is an open circuit in the oil temperature sensor and diagnostic trouble code No. P0712/P0713 is output. If the oil temperature sensor output detects the voltage which corresponds to 200°C(392°F) or more for more than one second, it is judged that there is an open circuit in oil temperature sensor and diagnostic trouble code No. P0712/P0713 is output.	1) Malfunction of the oil temperature sensor 2) Malfunction of connector 3) Malfunction of the ECM



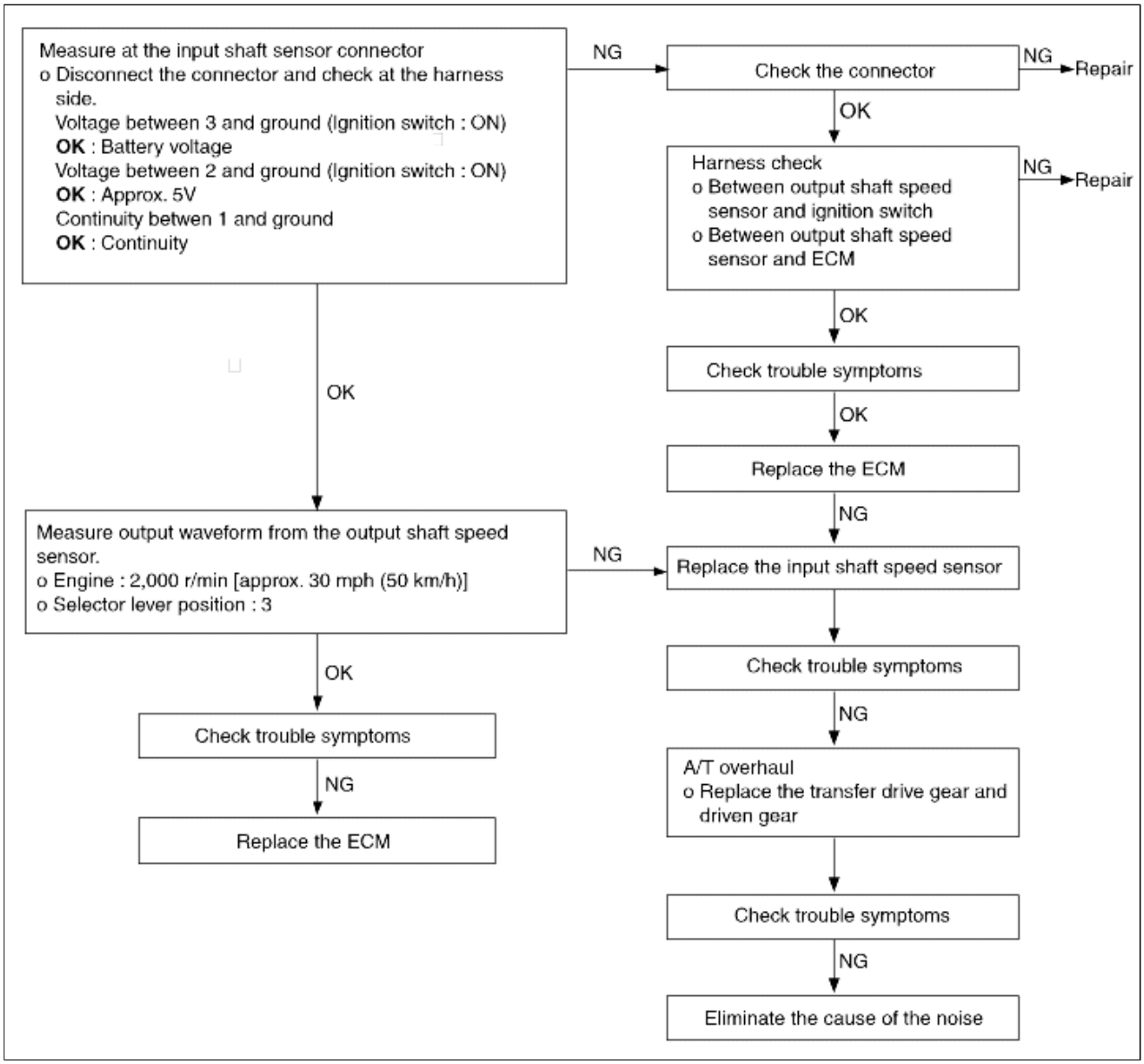
Input shaft speed sensor system

Code No.P0715 Input shaft speed sensor system	Probable cause
If no output pulse is detected from the input shaft speed sensor for 1 second or more while driving in 3rd or 4th gear at a speed of 19mph(30 km/h) or more, it is judged to be an open circuit or short circuit in the input shaft speed sensorand diagnostic trouble code No.P0715 is output. If diagnostic trouble code P0715 is output four times, the transaxle islocked into 3rd gear or 2nd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the underdrive clutch retainer 3) Malfunction of connector 4) Malfunction of the ECM



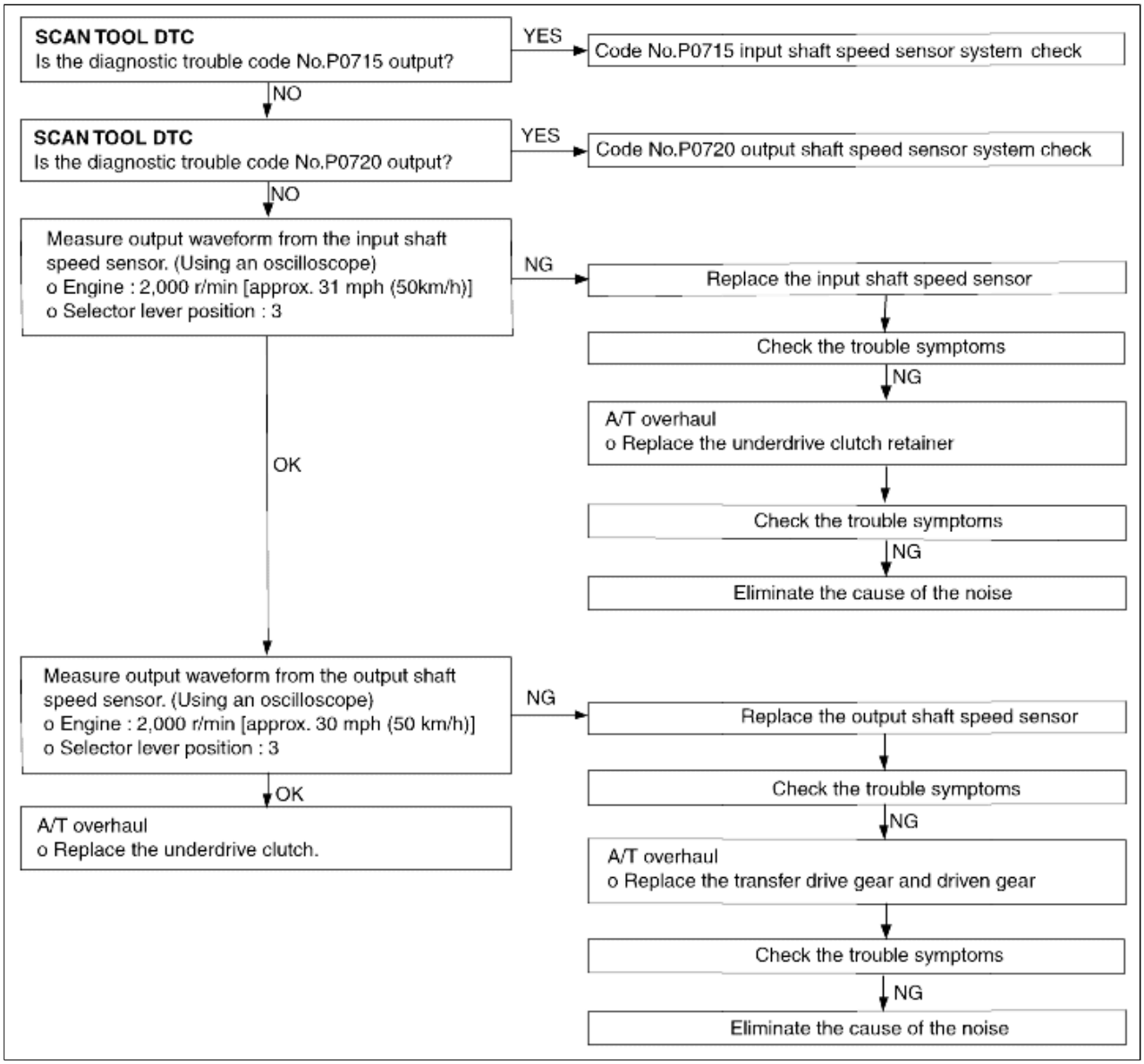
Output shaft speed sensor system

Code No.P0720 Output shaft speed sensor system	Probable cause
If the output from the output shaft speed sensor is continuously 50% lower than the vehicle speed for 1 second or more while driving in 3rd or 4th gear at a speed of 18.6mph(30 km/h) or more, it is judged to be an open circuit or short circuit in the output shaft speed sensor and diagnostic trouble code No.P0720 is output. If diagnostic trouble code No.P0720 is output four times, the transmission is locked into 3rd gear or 2nd gear as a fail-safe measure.	1) Malfunction of the output shaft speed sensor 2) Malfunction oQf the transfer drive gear or driven gear 3) Malfunction of connector 4) Malfunction of the ECM



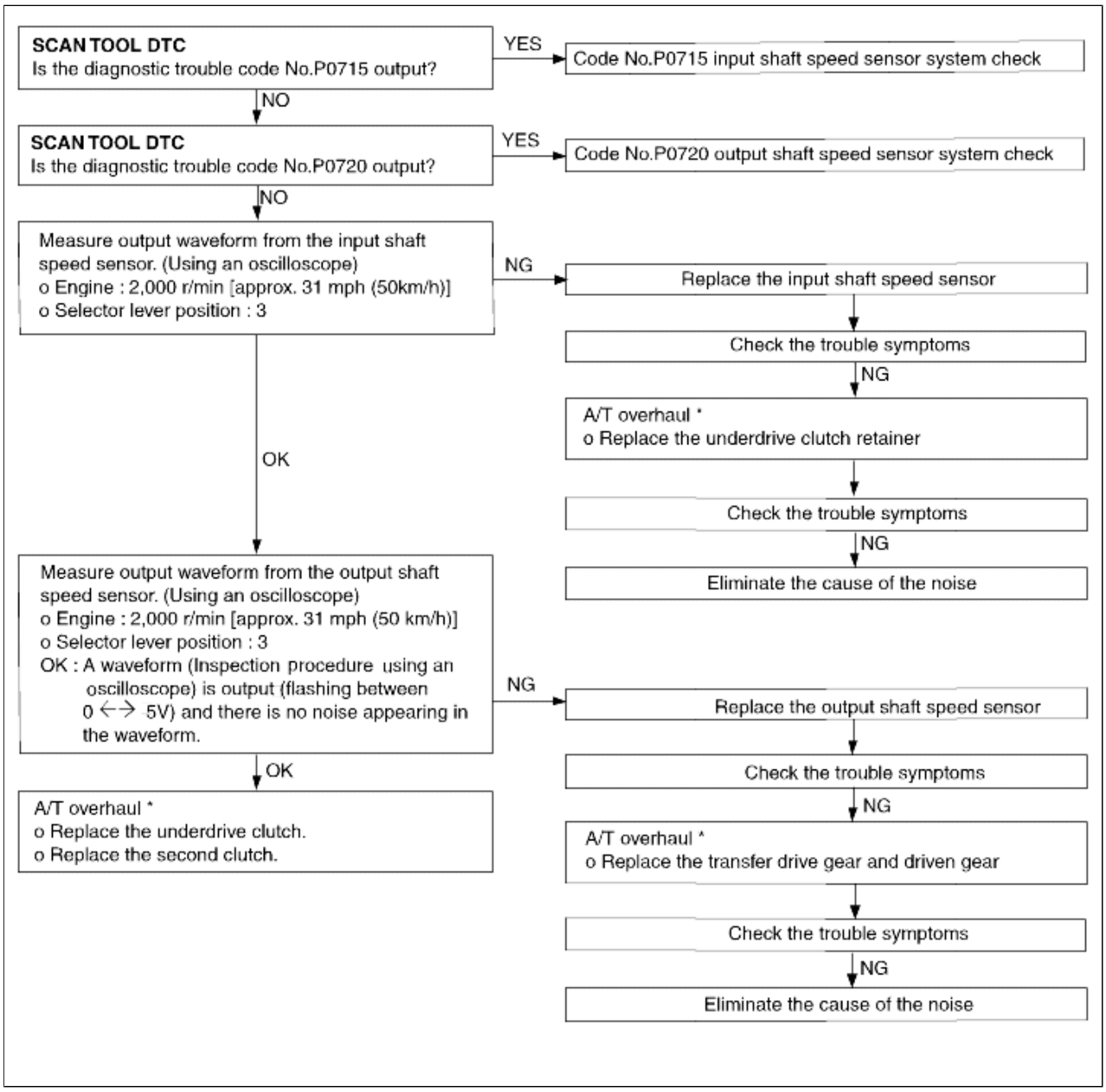
1st gear incorrect ratio

Code No.P0731 1st gear incorrect ratio	Probable cause
If the output from the output shaft speed sensor multiplied by the 1st gear ratio is not the same as the output from theinput shaft speed sensor after shifting to 1st gear has been completed, diagnostic trouble code No.P0731 is output. If diagnostic trouble code No.P0731 is output four times, the transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the output shaft speed sensor 3) Malfunction of the underdrive clutch retainer 4) Malfunction of the transfer drive gear or driven gear 5) Malfunction of the low and reverse brake system 6) Malfunction of the underdrive clutch system 7) Malfunction of the reduction brake system 8) Noise generated



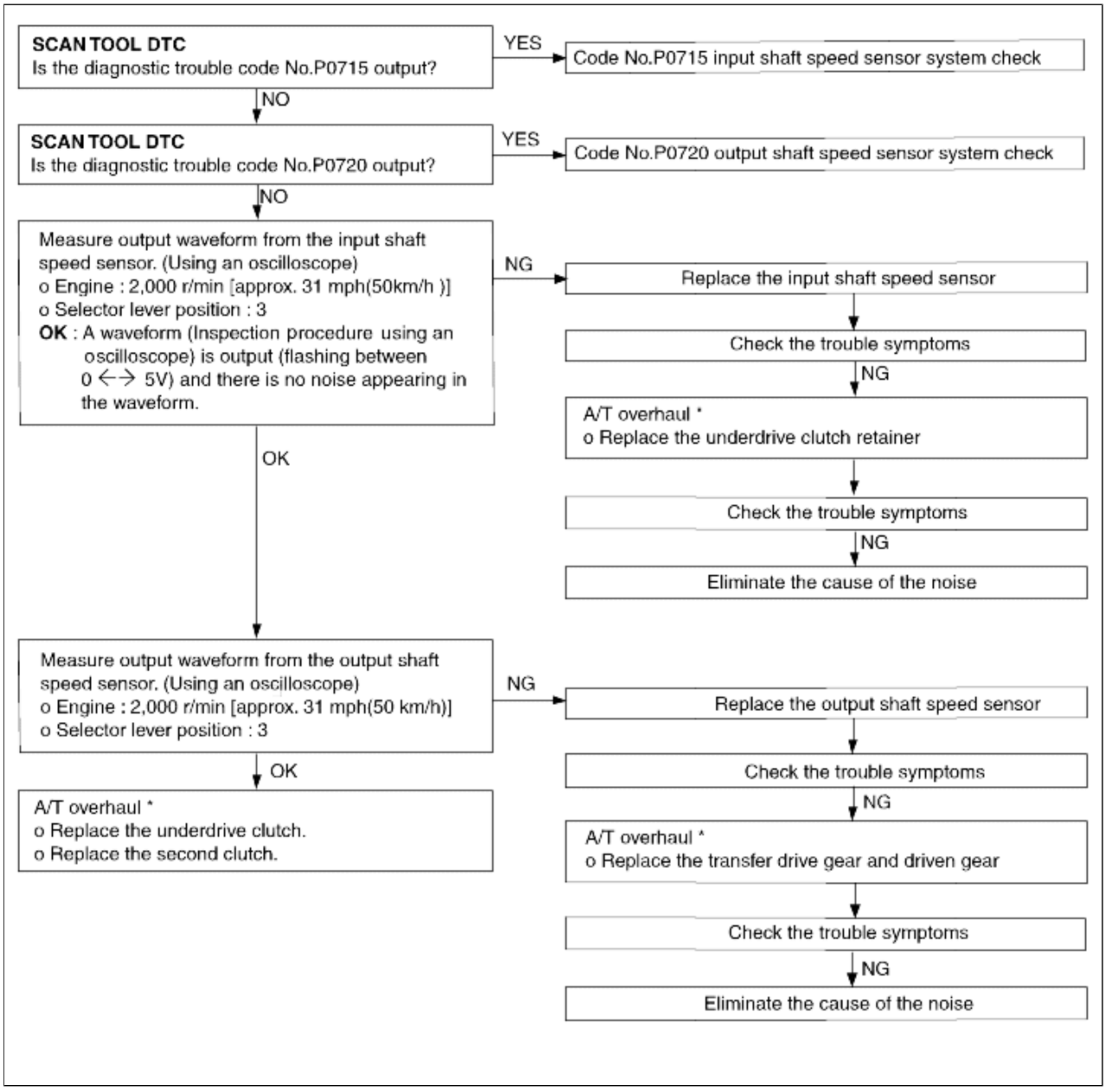
2nd gear incorrect ratio

Code No.P0732 2nd gear incorrect ratio	Probable cause
If the output from the output shaft speed sensor multiplied by the 2nd gear ratio is not the same as the output from theinput shaft speed sensor after shifting to 2nd gear has been completed, diagnostic trouble code No.P0732 is output. If diagnostic trouble code No.P0732 is output four times, the transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the output shaft speed sensor 3) Malfunction of the underdrive clutch retainer 4) Malfunction of the transfer drive gear or driven gear 5) Malfunction of the second brake system 6) Malfunction of the underdrive clutch system 7) Malfunction of the reduction brake system 8) Noise generated



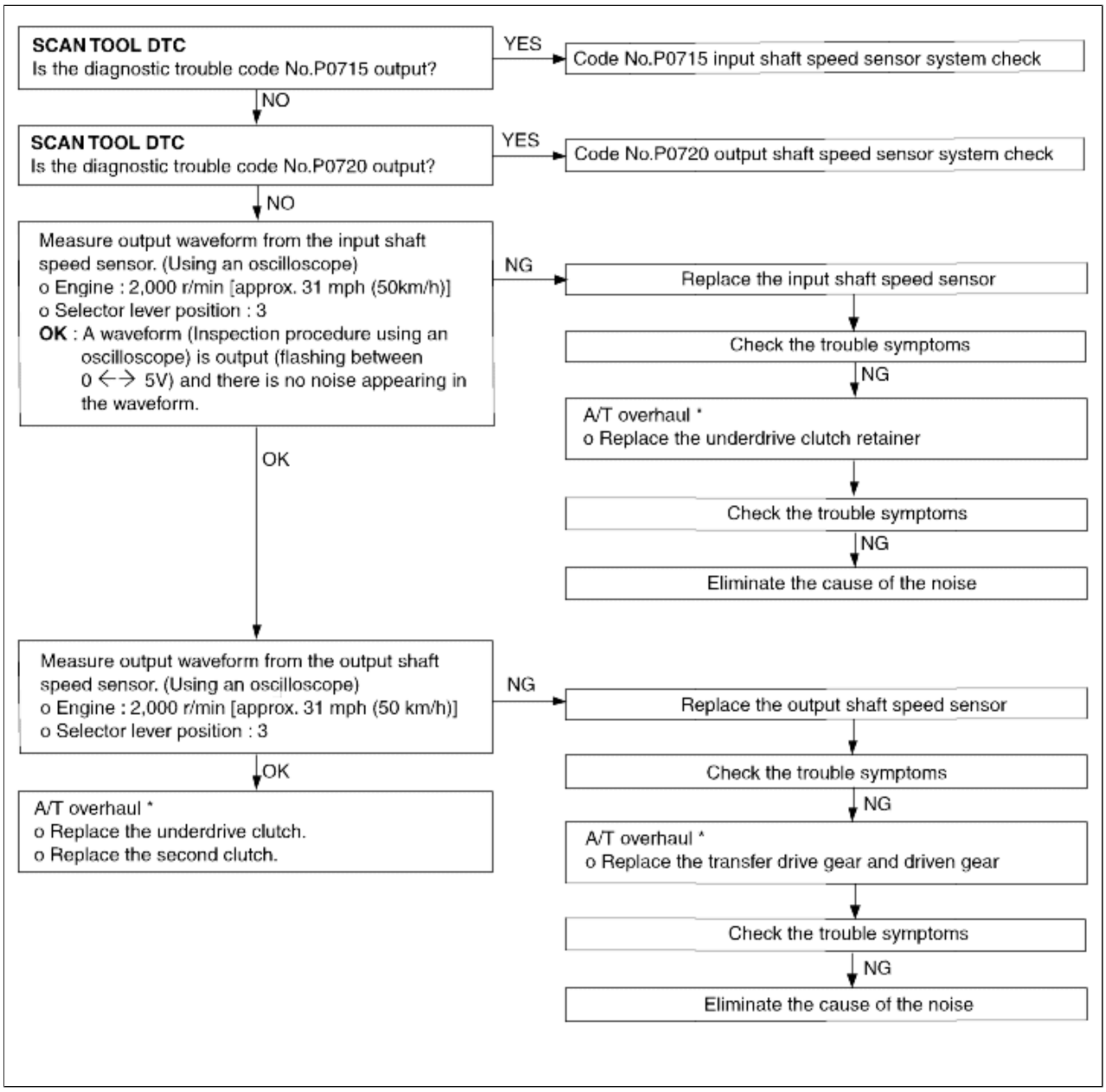
3rd gear incorrect ratio

Code No.P0733 3rd gear incorrect ratio	Probable cause
If the output from the output shaft speed sensor multiplied by the 3rd gear ratio is not the same as the output from theinput shaft speed sensor after shifting to 3rd gear has been completed, diagnostic trouble code No.P0733 is output. If diagnostic trouble code No.P0733 is output four times, the transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the output shaft speed sensor 3) Malfunction of the underdrive clutch retainer 4) Malfunction of the transfer drive gear or driven gear 5) Malfunction of the low and reverse brake system 6) Malfunction of the underdrive clutch system 7) Malfunction of the reduction brake system 8) Noise generated



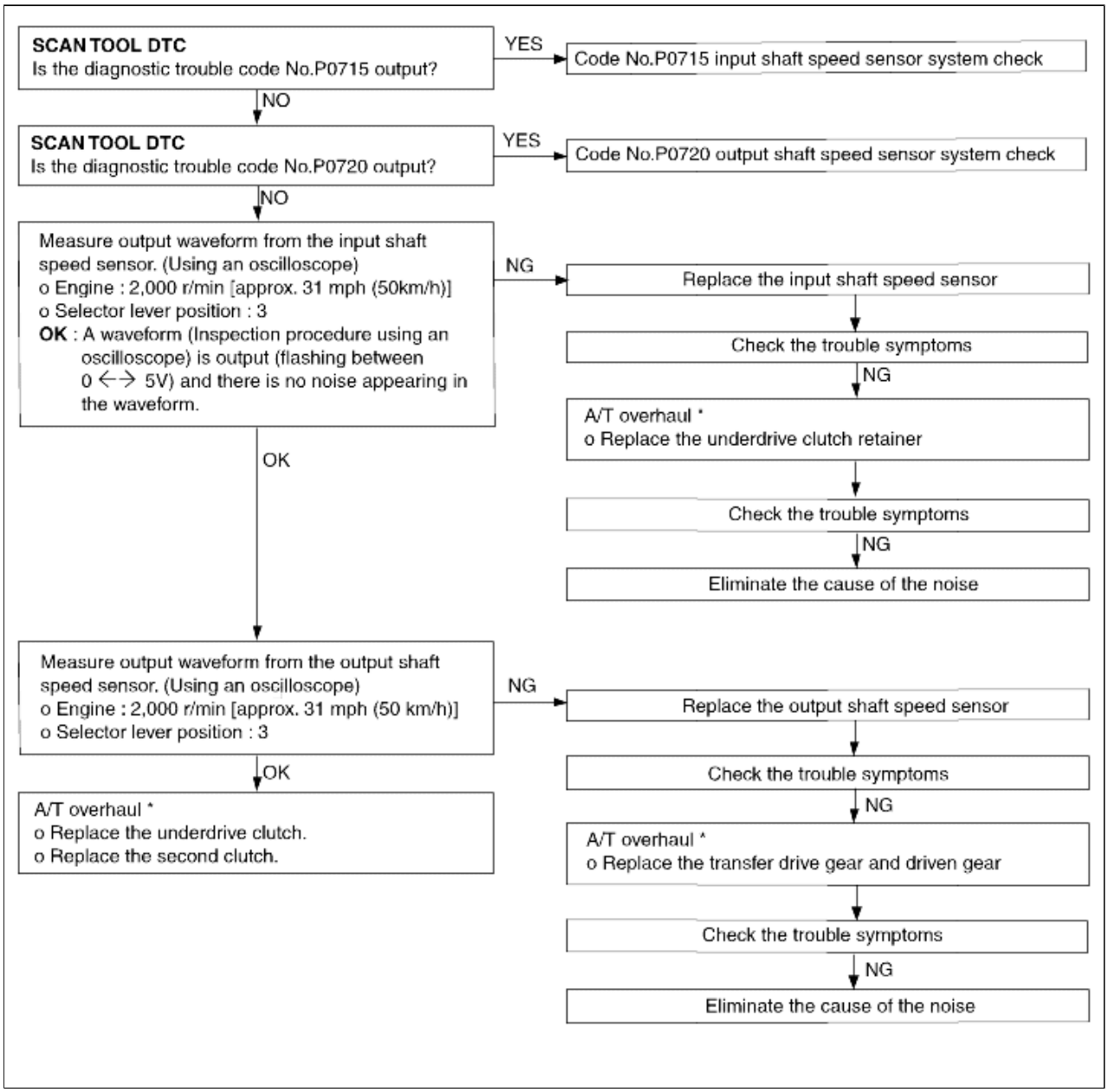
4th gear incorrect ratio

Code No.P0734 4th gear incorrect ratio	Probable cause
If the output from the output shaft speed sensor multiplied by the 4th gear ratio is not the same as the output from theinput shaft speed sensor after shifting to 4th gear has been completed, diagnostic trouble code No.P0734 is output. If diagnostic trouble code No.P0734 is output four times, the transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the output shaft speed sensor 3) Malfunction of the underdrive clutch retainer 4) Malfunction of the transfer drive gear or driven gear 5) Malfunction of the underdrive clutch system 6) Malfunction of the direct planetary system 7) Malfunction of the direct clutch system 8) Noise generated



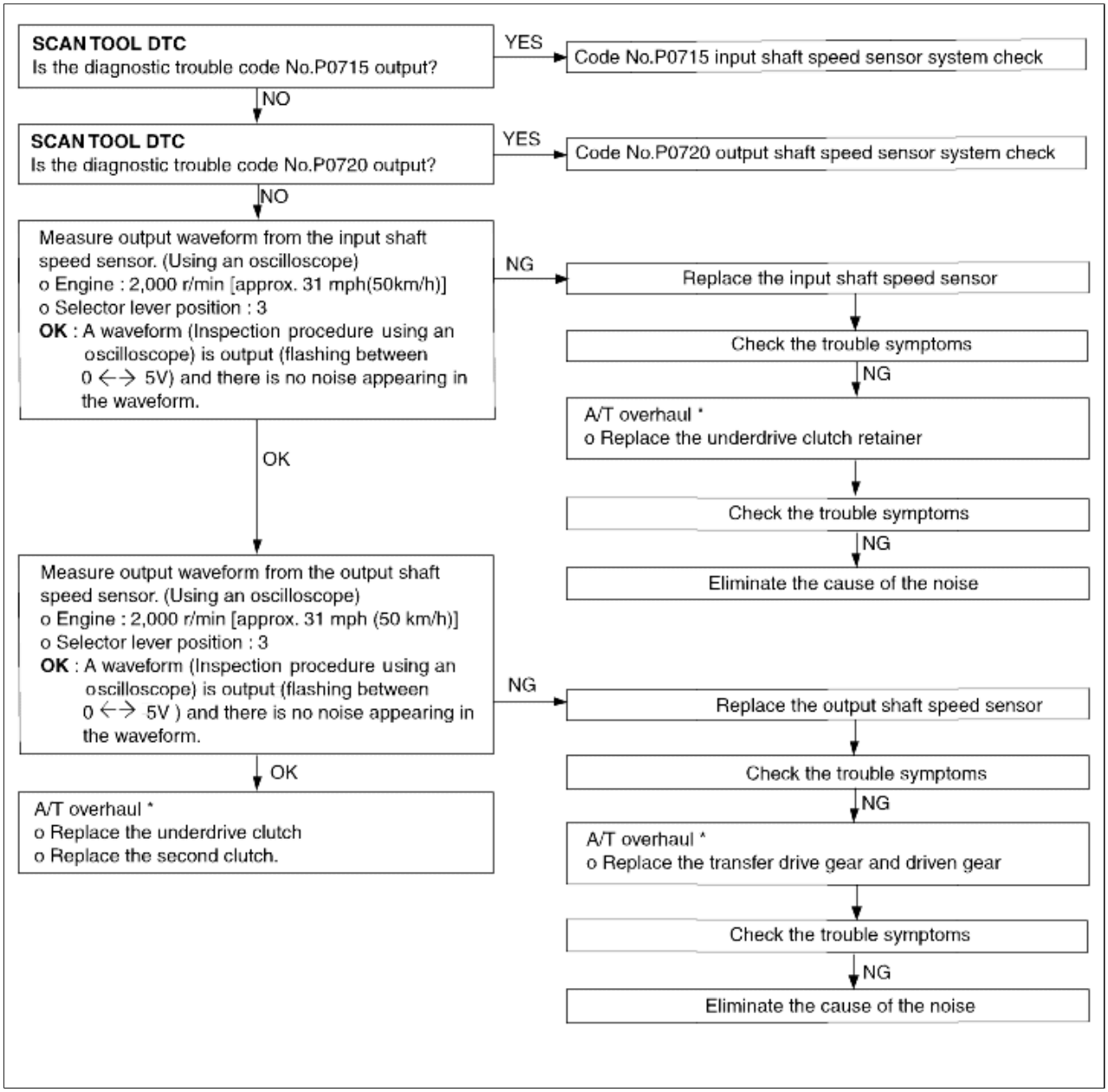
5th gear incorrect ratio

Code No.P0735 5th gear incorrect ratio	Probable cause
If the output from the output shaft speed sensor multiplied by the 5th gear ratio is not the same as the output from theinput shaft speed sensor after shifting to 5th gear has been completed, diagnostic trouble code No.P0735 is output. If diagnostic trouble code No.P0735 is output four times, the transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the output shaft speed sensor 3) Malfunction of the direct planetary carrier 4) Malfunction of the second brake system 5) Malfunction of the overdrive clutch system 6) Malfunction of the direct clutch system 7) Noise generated



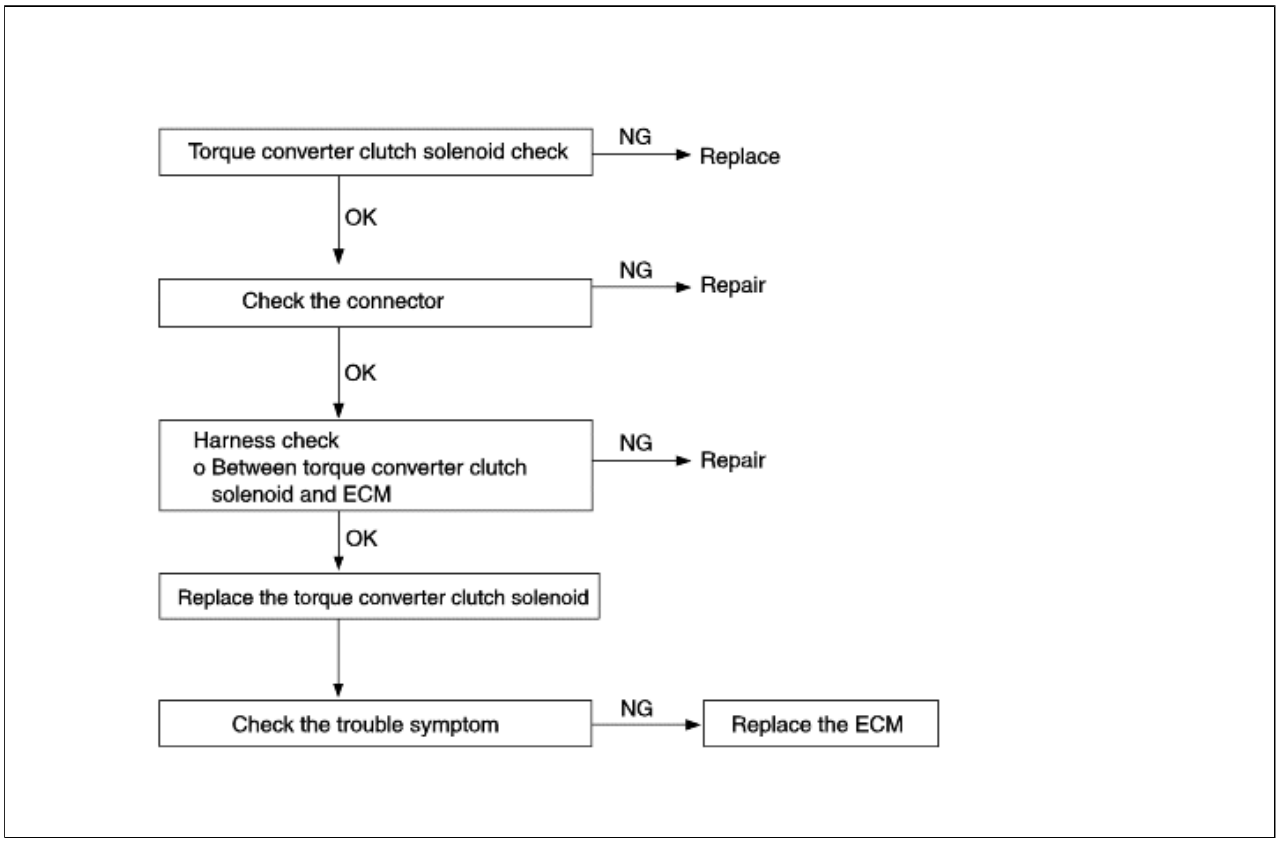
Reverse gear incorrect ratio

Code No.P0736 Reverse gear incorrect ratio	Probable cause
If the output from the output shaft speed sensor multiplied by the reverse gear ratio is not the same as the output fromthe input shaft speed sensor after shifting to reverse gear has been completed, diagnostic trouble code No.P0736 is output. If diagnostic trouble code No.P0736 is output four times, the transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the input shaft speed sensor 2) Malfunction of the output shaft speed sensor 3) Malfunction of the transfer drive gear or driven gear 4) Malfunction of the low and reverse brake system 5) Malfunction of the direct planetary carrier 6) Malfunction of the reduction brake system 7) Noise generated



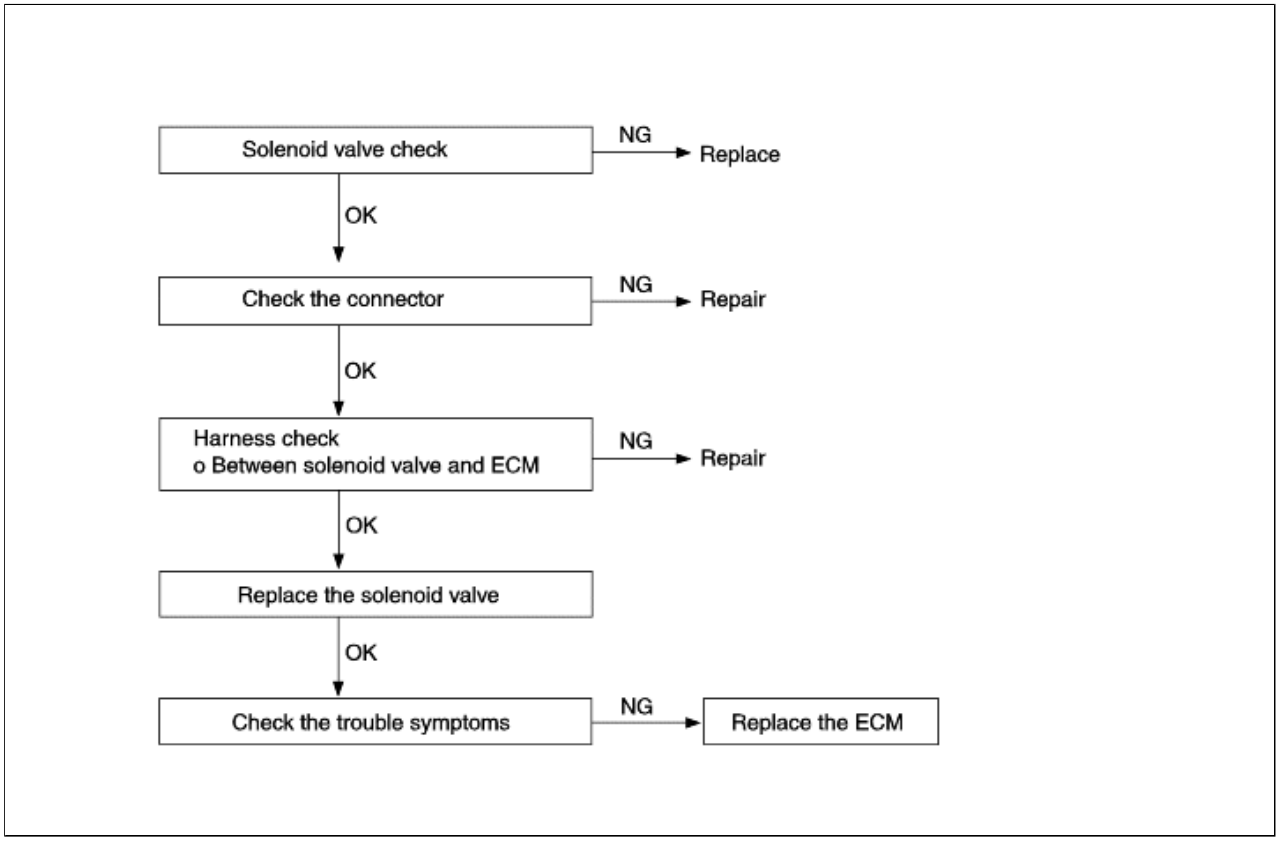
Torque converter clutch solenoid system

Code No. P0743/P0740 Torque converter clutch solenoid system	Probable cause
If the resistance value for the torque converter clutch solenoid is too large or too small, it is judged that there is ashort circuit or an open circuit in the torque converter clutch solenoid and diagnostic trouble code No.P0742/P0741 is output.If the drive duty rate for the torque converter clutch solenoid is 100% for a continuous period of 4 seconds or more, it is judged that there is an abnormality in the torque converter clutch system and diagnostic trouble code No.P0743is output. When diagnostic trouble code No.P0742/P0741 is output, the transaxle is locked into 3rd gear as a fail-safe measure. If the lock-up clutch remains engaged for a continuous period of 10 seconds when the ECM is attempting to disengage the lock-up clutch, it is judged that the torque converter clutch is stuck on and diagnostic trouble code P0742/P0741.	1) Malfunction of the torque converter clutch solenoid 2) Malfunction of connector 3) Malfunction of the ECM



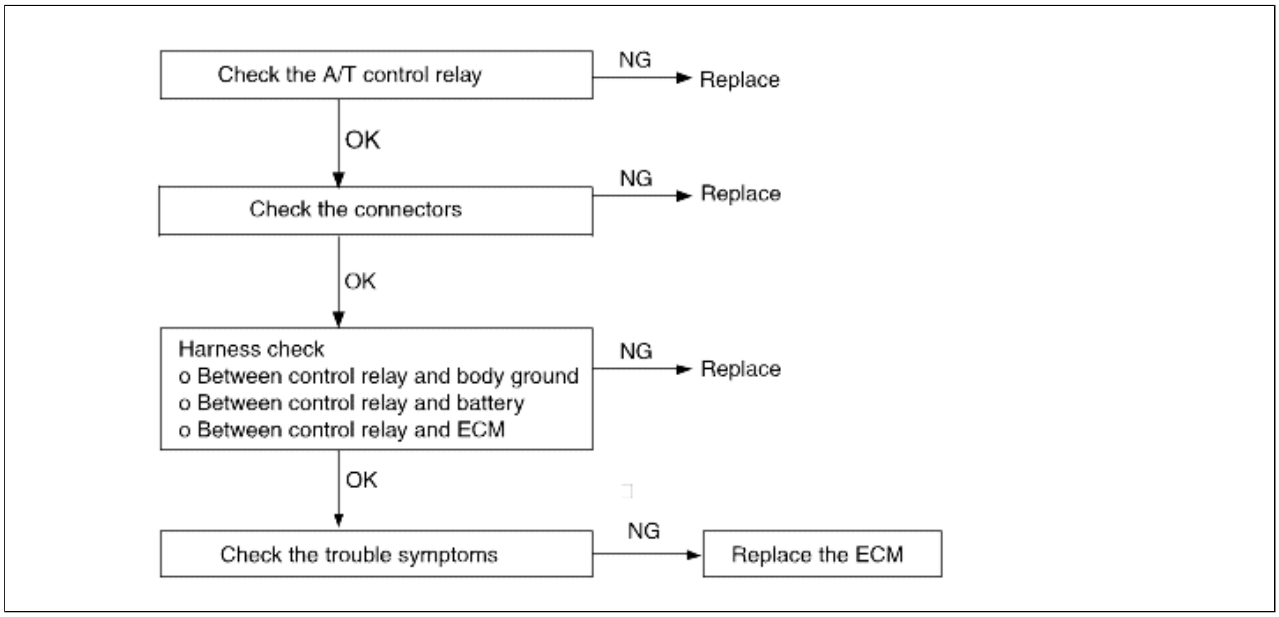
Low and reverse solenoid valve system

Code No.P0750 Low and reverse solenoid valve system	Probable cause
Code No.P0755 Underdrive solenoid valve system	
Code No.P0760 Second solenoid valve system	
Code No.P0765 Overdrive solenoid valve system	
Code No.P0770 Reduction solenoid valve system	
If the resistance value for a solenoid valve is too large or too small, it is judged that there is a short circuit or anopen circuit in the solenoid valve and the respective diagnostic trouble code is output. The transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the oil temperature sensor 2) Malfunction of connector 3) Malfunction of the ECM



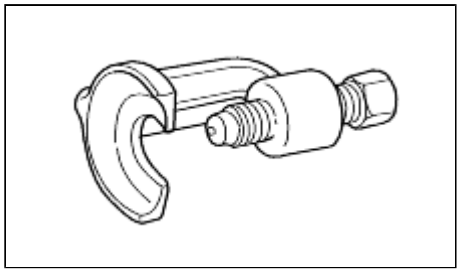
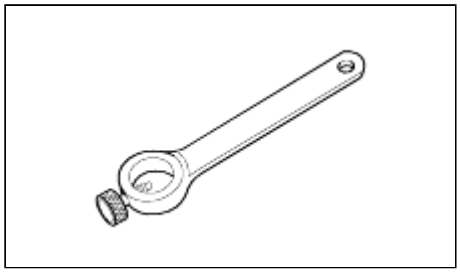
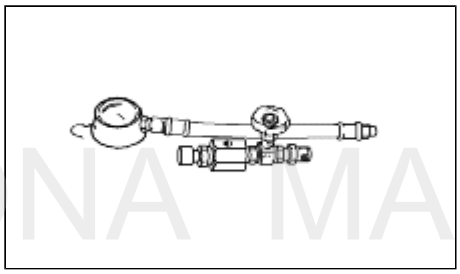
A/T Control relay system

Code No.P1723 A/T control relay system	Probable cause
If the relay voltage is less than 7V after the ignition switch has been turned to ON, it is judged that there is an open circuit or a short-circuit in the A/T control relay earth and diagnostic trouble code P1723 is output. The transaxle is locked into 3rd gear as a fail-safe measure.	1) Malfunction of the A/T control relay 2) Malfunction of connector 3) Malfunction of the ECM



steering system

special Service tools

Tool (Number and Name)	Illustration	Use
0K130 283 021 Puller, ball joint		Used for removing tie rod end.
0K130 322 020 Attachment, steering worm bearing preload measuring		Used for measuring pinion pre-load.
0K210 323 AA0 Gauge set, power steering		Used for measuring fluid pressure.

SEDONA MANUAL

Symptom-related diagnostic procedure

Problem	Possible cause	Action
Movements of steering feels heavy	Looseness or damage of power steering belt	Adjust or replace power steering belt
	Insufficient power steering fluid or air insertion	Fluid fill up or air bleeding
	Crushed or twisted hoses	Replace hoses
	Pipe damage	Replace pipes
	Leakage of power steering fluid	Repair or replace leaking parts
	Low fluid pressure	Repair or replace power steering pump or gear
	Insufficient air pressure in tire	Adjust tire air pressure
	Incorrect wheel alignment adjustment	Adjust wheel alignment
	Steering gear linkage binding	Replace or repair steering gear linkage
	Interference between steering column and parts	Repair or replace steering column
	Steering column intermediate shaft coupling does not operate	Perform the turning effort
Poor returning of steering wheel	Insufficient air pressure in tire	Adjust tire air pressure
	Incorrect wheel alignment adjustment	Adjust wheel alignment
	Steering gear linkage binding	Repair or replace steering gear linkage
	Malfunction of steering gear	Replace steering gear
	Steering column intermediate shaft coupling does not operate	Perform the turning effort
	Steering column is overweight, restricted or bent	Inspect steering column or replace
Irregular steering power	Looseness of power steering belt	Adjust power steering belt
	Malfunction of steering column or looseness of mounting bolt	Repair or tightening of steering column
	Steering gear linkage binding	Repair or replace steering linkage
	Malfunction of steering gear	Replace steering gear
Steering wheel pulls to one side	Insufficient air pressure in tire	Adjust tire air pressure
	Improper preload adjustment or worn of wheel bearing	Adjust or replace wheel bearing
	Incorrect wheel alignment	Adjust wheel alignment
	Malfunction of steering gear	Replace steering gear
	Uneven tire wear	Replace tire or align
	Fatigued front coil spring	Replace coil spring
	Dragging brake(s)	Adjust brake(s)

	Damaged front wheel tie rod(s)	Replace front wheel tie rod
	Damaged front wheel knuckle	Inspect knuckle or replace
	Front suspension lower arm or stabilizer bar bushing worn or damaged	Repair or replace
	Front suspension lower arm bent or loose	Replace or tighten
Leakage of power steering fluid	Problem with hose coupling	Repair or replace hose coupling
	Clogged or damaged hoses	Replace hoses
	Damage of power steering fluid reservoir	Replace reservoir
	Over flow	Air bleeding or adjust fluid level
	Malfunction of power steering pump	Replace power steering pump
	Malfunction of steering gear	Replace steering gear
Abnormal noise	Looseness of power steering pump	Tightening of power steering pump
	Looseness of steering gear	Tightening of steering gear
	Looseness of power steering pump bracket	Tightening of power steering pump bracket
	Looseness of power steering pump pulley nut	Tightening of power steering pump pulley nut
	Excessive tightness or looseness of belt	Adjust power steering pump belt
	Air insertion	Air bleeding
	Malfunction of steering gear	Replace steering gear
	Malfunction of power steering pump	Replace power steering pump
	Interference on steering column or pressure hose	Remove interference on steering column or repair/replace hoses
	Looseness or excessive tightness of steering linkage	Adjust tightness of steering linkage or replace steering linkage

SEDONA MANUAL

Specifications

Item		Type	P/S
Steering wheel	Outer diameter	in (mm)	14.96 (380)
	Lock to lock turns		3.40
Steering column	Type		Collapsible
	Joint type		Universal joint
	Tilt stroke	(degree)	±4.7°
Steering rack	Type		Rack and pinion
	Gear ratio		19.24 : 1
	Rack travel	in (mm)	5.51 (140)
P/S fluid	Capacity	US qt (liter)	1.05 (1.0)
	Type		PSF-III

Description and operation

Power steering components
The power steering system has a rack and pinion design.

The power steering system consists of the following components:

1) Steering shaft
2) Steering gear & linkage
3) Tie rods & tie rod ends
4) Power steering pump
5) Power steering oil pump
6) oil pipes & hoses
7) Power steering oil cooler

Power steering pump
The power steering pump is mounted on the front of the engine. The power steering pump is a vane type design and is driven by the crankshaft through a P/S drive belt. Power steering fluid is drawn into the power steering pump from the power steering pump reservoir when engine is running.

The fluid is pressurized by the rotation of the rotor and vanes, then sent to the steering gear.

Power steering gear
The power steering gear input shaft and control is a one-piece unit.

It is the only valve assembly serviced within the steering gear housing.

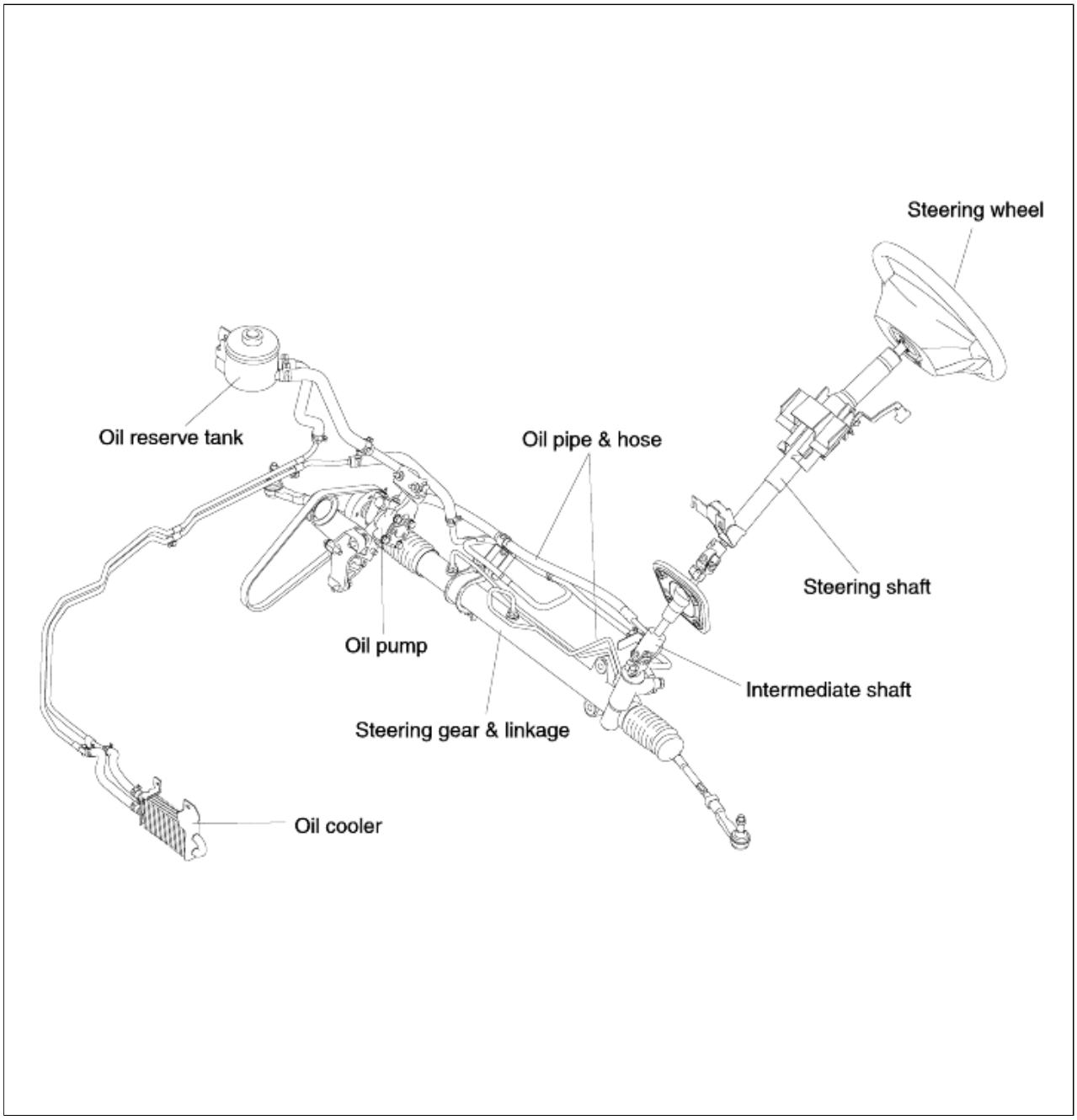
Hoses, Pressure and return
Since most fluid leaks occur at the hose fittings and connections in a power steering hydraulic system, these parts should be check before any parts are replaced. Note the possible leak locations for the power steering system.(Refer to on-vehicle service)

Hydraulic operation
The power steering pump, which is driven by the crankshaft through a P/S drive belt and pulleys, develops the hydraulic pressure necessary to operate the system.

When the steering wheel is turned, the steering gear converts this hydraulic pressure and flow into mechanical motion that will move the front wheels in the direction of the turn.

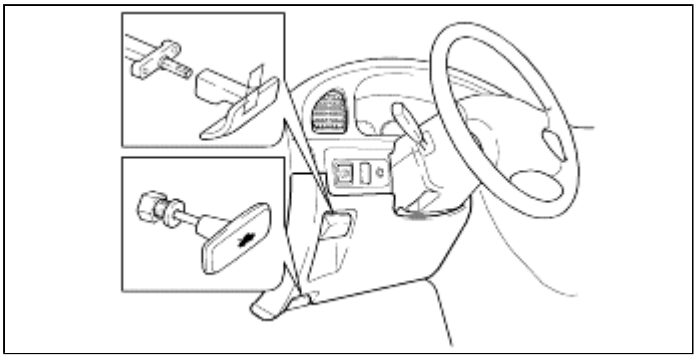
Fluid is drawn into the vane type power steering pump from the power steering pump reservoir when the engine is running.

Component

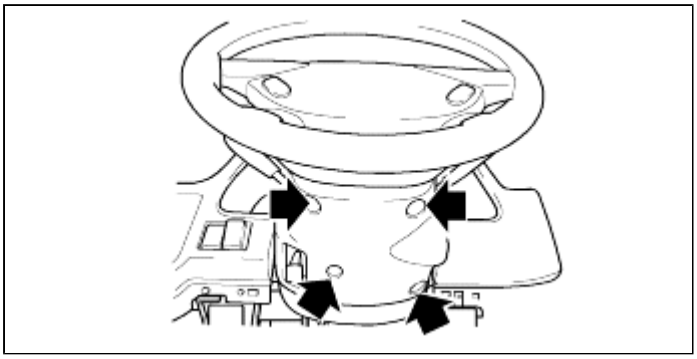

Steering wheel
Oil reserve tank
Oil pipe & hose
Steering shaft
Oil pump
Intermediate shaft
Steering gear & linkage
Oil cooler

Removal

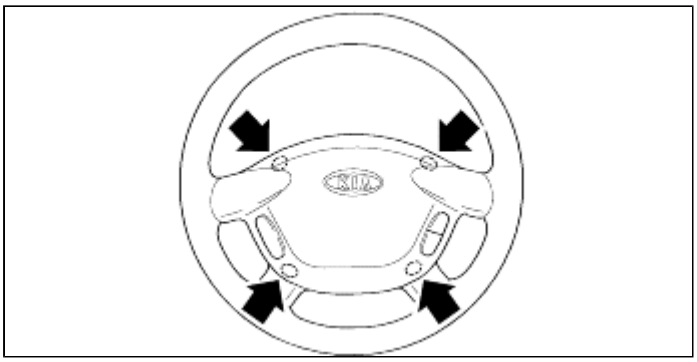
1. Disconnect (-) terminal of battery.
2. Place vehicle in a straight forward position.
3. Remove under cover



4. Loosen four lower steering column cover screws and seperate upper and lower steering column covers.

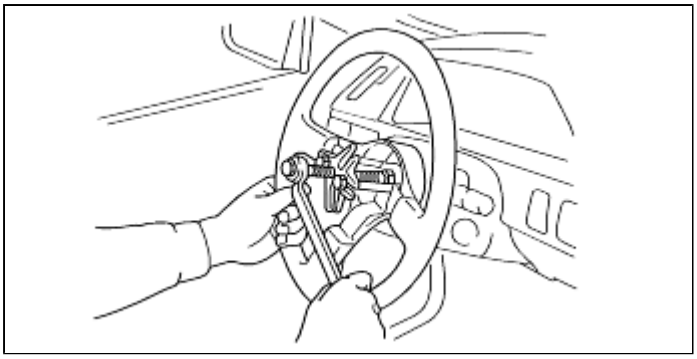


5. Loosen four bolts from steering wheel and remove steering wheel cover.

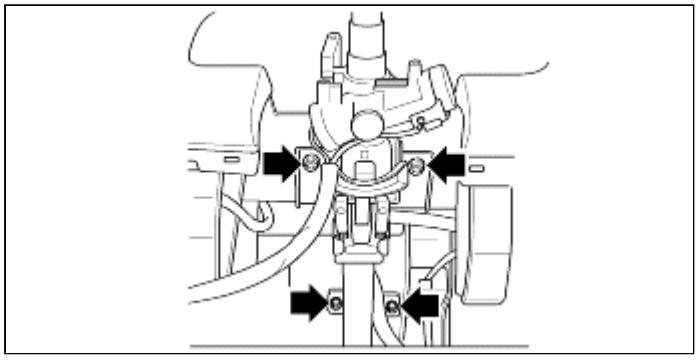


6. Disconnect horn switch connector.
7. Make an alignment mark on steering wheel and steering shaft for proper installation.
8. Remove nut from end of steering shaft.
9. Remove steering wheel with a suitable puller.

> **NOTE**
>
> Do not remove steering wheel by hitting end of shaft with a hammer. Damage to shaft threads and shaft support bearings could occur.



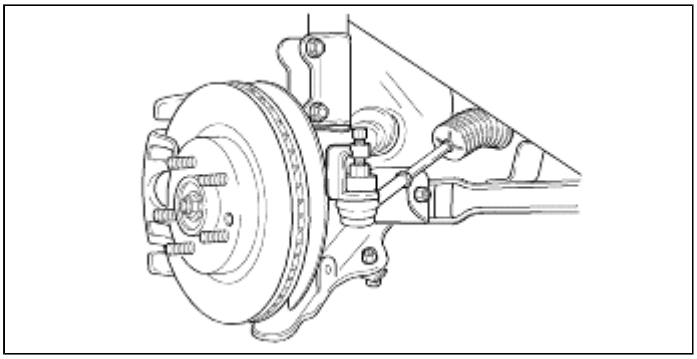
10. Loosen three screws and remove clock spring.
11. Loosen three combination switch screws.
12. Disconnect combination switch connectors.
13. Slide combination switch off steering column shaft.
14. Disconnect ignition switch connector.
15. Remove inter lock cable and then remove inter lock mounting bracket.
16. Loosen two universal joint pinch bolt.
17. Loosen four upper tilt assembly mounting nuts, and remove the upper tilt assembly.



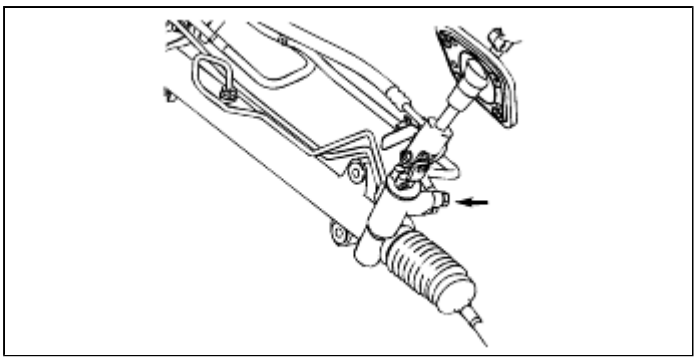
Removal

1. Raise front of vehicle and support with it safety stand.
2. Remove wheel and tire.
3. Pull out cotter pin and remove nut.
4. Seperate tie rod from knuckle arm with SST(0K130 283 021).

> NOTE
>
> Replace nut temporarily so that screw threads do not become damaged.



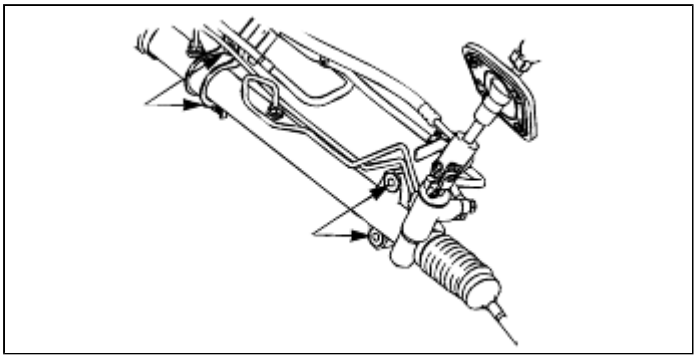
5. Loosen the bolts from the return oil pipe and pressure oil pipe and disconnect return oil pipe and pressure oil pipe.



NOTE

Use a container or rags to catch power steering fluid when disconnecting return oil pipe and/or pressure oil pipe.

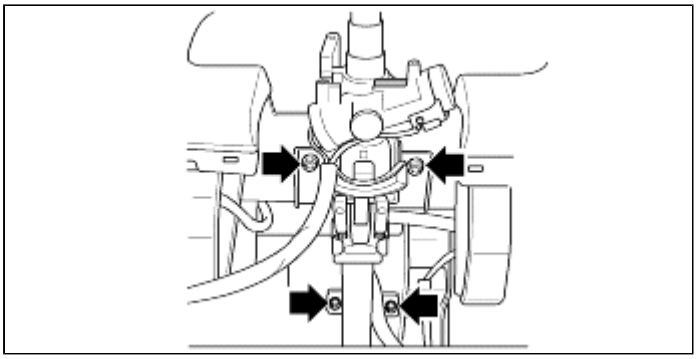
6. Remove intermediate shaft from the steering rack and linkage.
7. Loosen the bolts and nuts from the steering rack brackets.



8. Remove slowly steering rack from right side of vehicle if necessary. Replace rack and linkage entirely. Do not disassemble.

Replacement

1. Install upper tilt assembly to intermediate shaft.
2. Tighten four upper tilt assembly mounting nuts temporary.



3. Tighten lower mounting nuts.

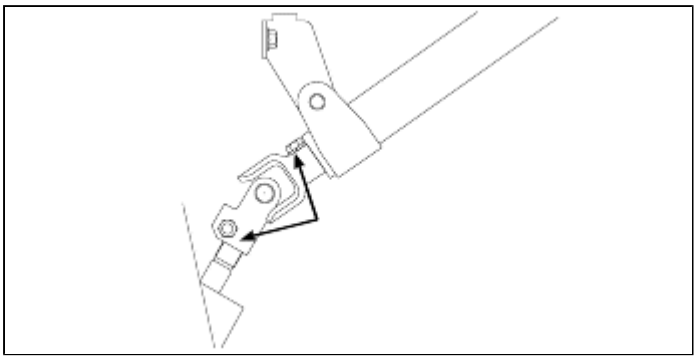
Tightening torque : 12 ~ 17 lb·ft (16 ~ 23 N·m, 1.6 ~ 2.3 kg·m)

4. Tighten upper mounting nuts.

Tightening torque : 12 ~ 17 lb·ft (16 ~ 23 N·m, 1.6 ~ 2.3 kg·m)

5. Tighten the two universal joint bolts.

Tightening torque : 16~20 lb·ft(21~26 N·m, 2.2~2.7 kg·m)



6. Tighten inter lock mounting bracket bolt and install inter lock cable.
7. Install combination switch to upper tilt assembly.
8. Install clock spring.

> NOTE
>
> 1) Set front wheels straight.
> 2) Turn clock spring clockwise to lock then back off 2.75 turns.
> 3) Align mark

> CAUTION
>
> 1) Do not give more than 2.5 turns in either direction from zero point to avoid damage to clock spring.
> 2) Do not disassemble.
> 3) Do not apply oil or grease.

9. Connect all connector and fix the wire harness with clamp.
10. properly Install steering wheel to steering shaft.
11. Tighten nut

Tightening torque : 29~36 lb·ft(39~49 N·m, 4~5 kg·m)

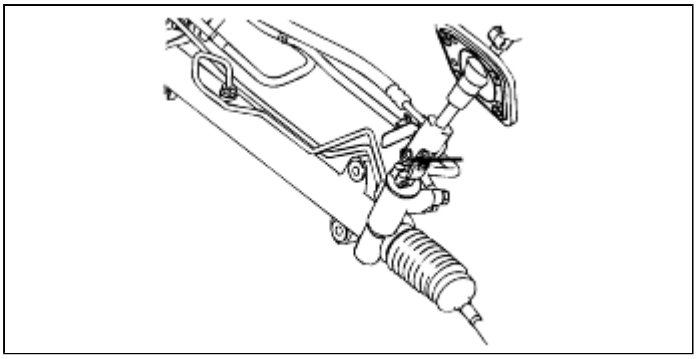
12. Connect horn switch connector.
13. Install steering wheel cover and tighten four bolts.
14. Install upper and lower steering column cover.
15. Tighten three lower steering column cover screws and one ignition switch screw.

> NOTE
>
> Be careful that the screw do not change each other.

Replacement

1. Install steering rack into right side of vehicle.
2. Tighten bolts and nuts to steering rack brackets.
3. Tightening intermediate shaft bolt.

Tightening torque : 16~20 lb·ft (21~26 N·m, 2.2~2.7 kg·m)



4. Connect return oil pipe and pressure oil pipe and tighten bolts from the return oil pipe and pressure oil pipe.

   Tightening torque : 17~26 lb·ft (24~35 N·m, 2.4~3.6 kg·m)

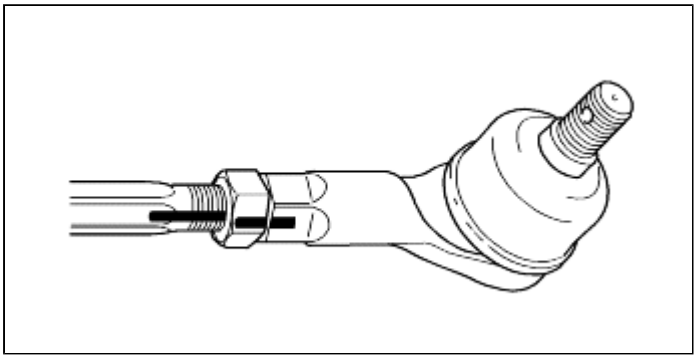
5. Install tie-rod into steering knuckle arm.
6. Tighten nut and install new cotter pin.

   Tightening torque : 43~58 lb·ft (59~78 N·m, 6.0~8.0 kg·m)

7. Install wheels and tires.
8. Lower vehicle.

Disassembly

1. Mark alignment of tie rod, jam nut, and tie rod end as shown.



2. Loosen tie rod jam nut, and then remove tie rod.

Assembly

1. Install tie rod jam nut and align with mark made before disassembly.
2. Install tie rod end and rotate to align with mark made before disassembly.
3. Tighten tie rod jam nut.

   Tightening torque : 50~58 lb·ft (69~78 N·m, 7.0~8.0 kg·m)

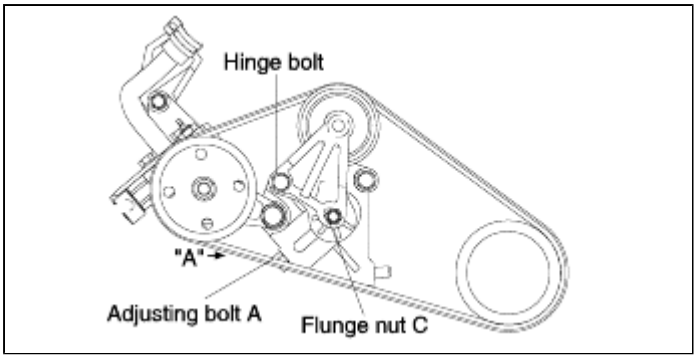
4. Install tie rod to knuckle arm.

Removal

CAUTION

Power steering oil, engine compartments and the exhaust system may be extremely hot, if engine has been running. Do notstart engine with any loose or disconnected hoses. Do not allow hoses to touch hot exhaust manifold or catalyst.

1. Loosen the adjusting bolt counterclockwise looking from "A" position and then remove the P/S belt.

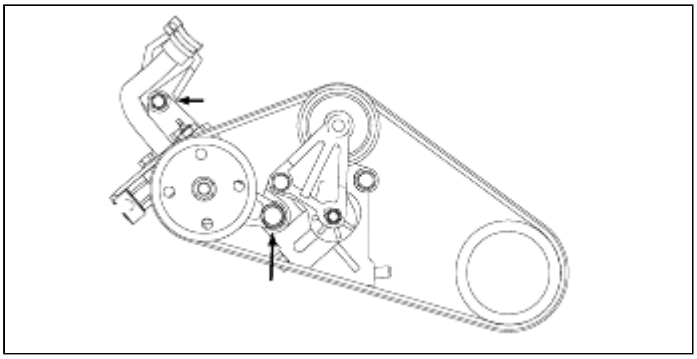


2. Remove cap from power steering fluid reserve tank.
3. Using a siphon pump or suitable tool, reserve as much power steering fluid as possible from the reserve tank.
4. Disconnect the suction hose from power steering pump after removing clamps.
5. Remove the pressure hose from power steering pump after loosening bolt.

NOTE

Using container or rags to catch power steering fluid when disconnecting the suction hose and pressure hose.

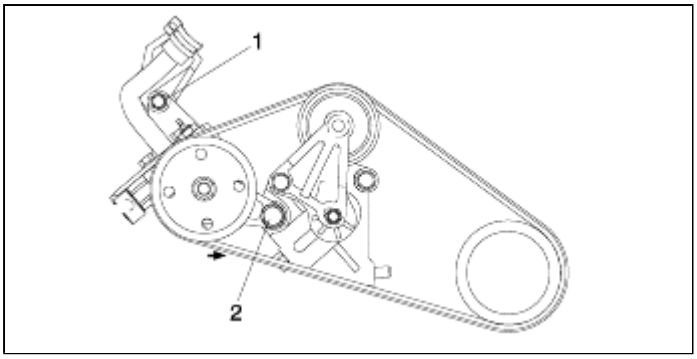
6. Remove the power steering pump from the engine after loosening bolts.



Replacement

1. Install the power steering pump to the right side of the engine and tighten the bolts to the power steering pump.

Tightening torque :1 : 13.7~20.2 lb·ft (18.6~27.5 N·m, 1.9~2.8 kg·m)2 : 50.6~68.7 lb·ft (68.6~93.1 N·m, 7.0~9.5 kg·m)



NOTE

Before connecting the power steering hoses to the power steering pump, inspect the O-ring on the steering hoses for damage and replace if damaged.

2. Install the suction hose on the power steering pump and install hose clamps.
3. Install the pressure hose and tighten bolt.

Tightening torque : 39.7~47.0 lb·ft (54.0~63.7 N·m, 5.5~6.5 kg·m)

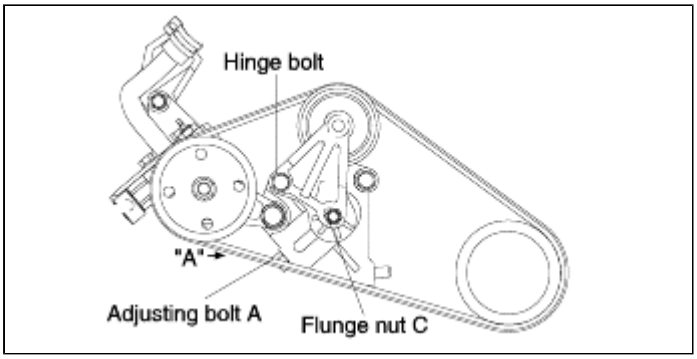
NOTE

Be sure hose clamps are properly reinstalled and suction hose is clear of all accessory drive belt.

4. Install the P/S belt to the power steering pump.
5. Adjust the belt deflection by turning the adjusting bolt.

New one : 0.35 ~ 0.43 in (8.8 ~ 11 mm)Used one(more than 5 minutes) : 0.49 ~ 0.56 in (12.5 ~ 14.3 mm)Upon tension check : 0.46 ~ 0.60 in (11.7 ~ 15.3 mm)

6. After making the adjustment, tighten the hinge bolt and the flunge nut.



Tightening torqueHinge: 23.8 ~ 40 lb·ft (32.3 ~ 54 N·m, 3.3 ~ 5.5 kg·m)
Flunge: 13.7 ~ 20.2 lb·ft (18.6 ~ 27.4 N·m, 1.9 ~ 2.8 kg·m)

NOTE

In order to prevent the asymmetrical alignment of the tension pulley upon tension adjust, preliminary tight the hinge bolt and the flunge nut before adjusting tension.

7. Fill the steering pump reserve tank to correct fluid level.
8. Install cap on the power steering pump reserve tank.

9. Start engine and turn steering wheel several times from stop to stop to bleed air from fluid in system. Stop engine, check fluid level and inspect system for leaks.

On-Vehicle service

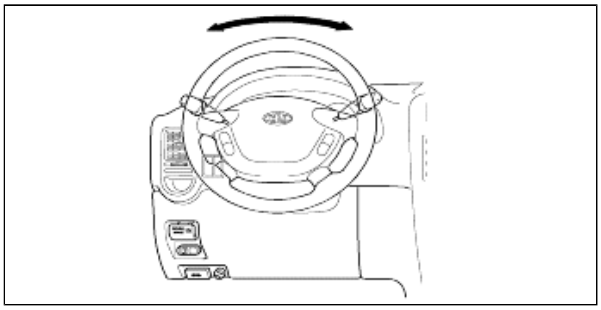
Steering wheel play

1. With wheels in straight-ahead position, gently turn steering wheel left and right to determine if play is within specification. Play is measured at outer rim of wheel.

Play: 1.18 in (30 mm) Max.

NOTE

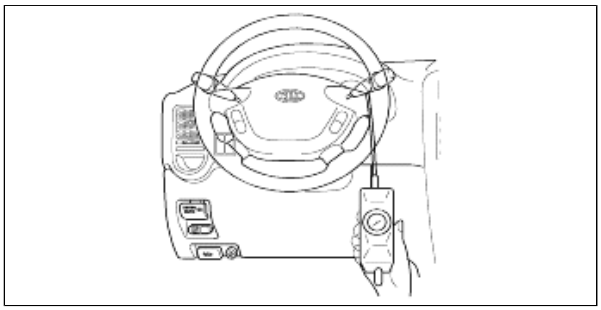
If play exceeds specification, either steering joints are worn or backlash in steering rack is excessive.



Steering wheel effort

1. With vehicle on a hard level surface, point wheels in straight-ahead position.
2. Start engine and warm power steering fluid to 122~140°F (50~60°C). Turn steering wheel fully left and right several times to warm fluid.
3. With engine running at idle speed, attach a pull scale to outermost point of a steering wheel spoke. Then, beginning with wheels in straight-ahead position, check steering effort required to turn steering wheel to left and to right.
4. If measured effort exceeds specification, check the following: fluid level, air in system, fluid leakage at hose or its connections, function of P/S oil pump and steering gear, and tire pressures.

Steering wheel effort: 6.6 lb (29 N, 3.0 kg) Max.

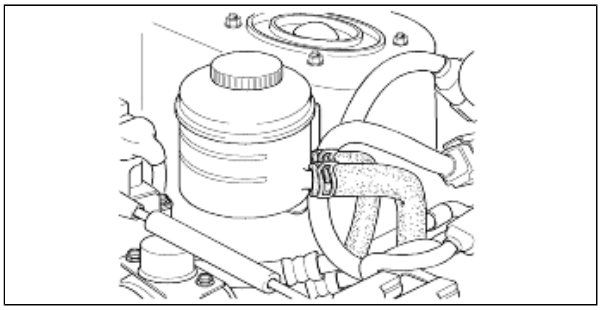


Power steering fluid level

NOTE

Add only specified power steering fluid.

1. Verify that the fluid level is between MAX and MIN marks.
2. Add or remove fluid if not within specification.

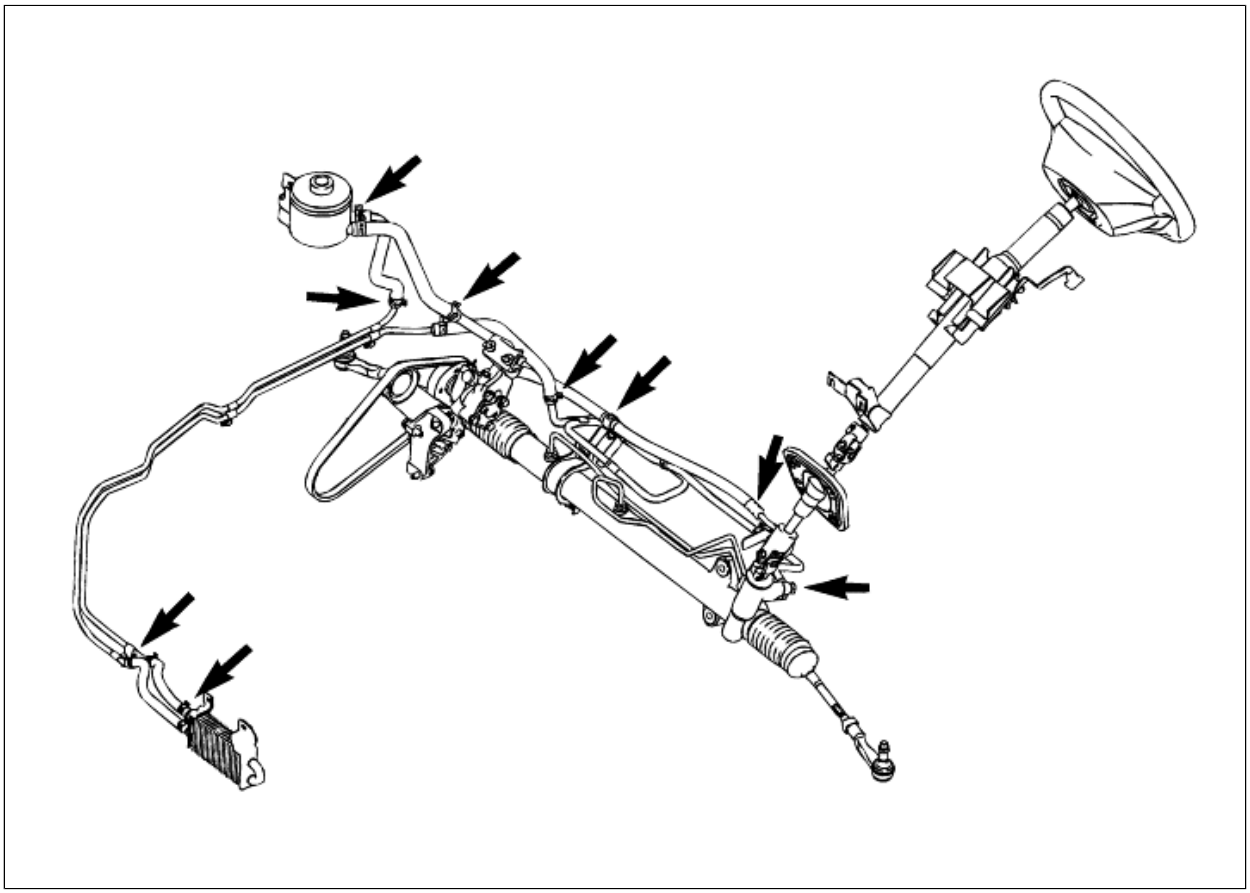


Power steering fluid leakage

1. Clean the outside of the steering gear, the bottom surfaces of the power steering pump, and all lines and fittings. Be sure all dirt, oil, and grease is removed from areas where leaks may exist.
2. Start engine.
3. Remember to turn steering wheel fully left and right to build fluid pressure.
4. Check for fluid leakage.

NOTE

1) To prevent damage, do not keep steering wheel fully turned for more than 15 seconds.
2) Points where fluid leakage might occur are indicated by arrows in figure.



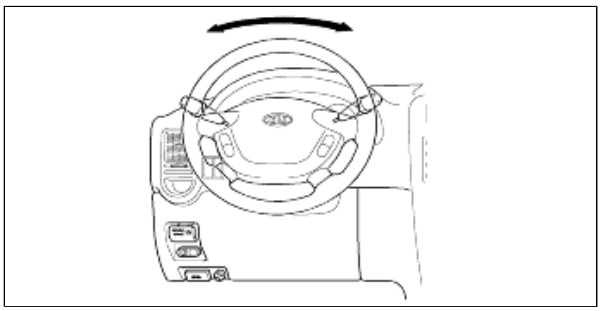
Power steering air bleeding

CAUTION

1) Do not start engine.
2) Lift front of vehicle, and support with safety stands.

1. Check fluid level.
2. Turn steering wheel fully to left and right several times with engine not running.
3. Recheck fluid level. If level has lowered, add fluid.

4. Repeat steps 2 and 3 until fluid level stabilizes.
5. Start engine and let it idle.
6. Turn steering wheel fully to left and right several times.
7. Check that fluid has not foamed, and that fluid level has not dropped.
8. If necessary, add fluid and repeat steps 6 and 7.

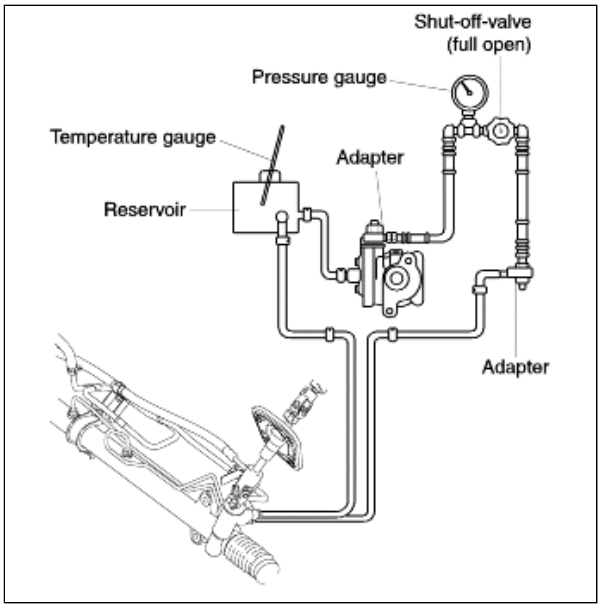


Power steering fluid pressure check

1. Assemble SST(0K210 323 AA0) and tighten its fittings.

   Tightening torque : 39.7~47 lb·ft (54.0~63.7 N·m, 5.5~6.5 kg·m)

2. Disconnect high pressure hose from pump, and connect SST(0K210 323 AA0) between hose and pump as illustrated.



   NOTE

   Before disconnecting hose, place marks at connections for proper reinstallation.

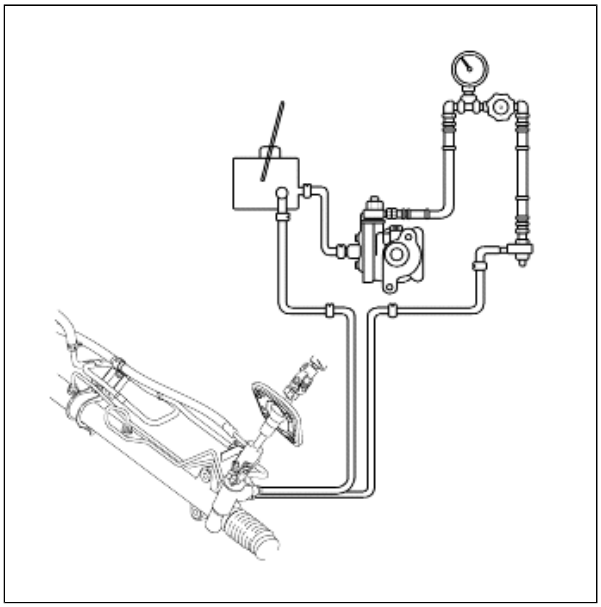
3. Bleed air from system. (Refer to steering system on-vehicle service)
4. Open gauge valve fully. Start engine and turn steering wheel fully left and right to raise fluid temperature to 122~140°F (50~60° C).

   NOTE

   If valve is left closed for more than 15 seconds, fluid temperature will increase excessively and damage oil pump.

5. Close gauge valve completely. Increase engine speed to 1,000~1,500 rpm and measure fluid pressure generated by power steering pump. If pressure is below specification, replace power steering pump assembly.

   Power steering pump fluid pressure : 1,266~1,351 psi (8,728~9,316 kPa, 89~95 kg/cm²)



6. Open gauge valve fully and again increase engine speed to 1,000~1,500 rpm.
7. Turn steering wheel fully to left and right and measure fluid pressure generated by gear housing. If pressure is below specifications, replace gear housing assembly.

Gear housing fluid pressure : 1,266~1,351 psi (8,728~9,316 kPa, 89~95 kg/cm²)

NOTE

If steering wheel is kept in fully turned position for more than 15 seconds, fluid temperature will rise excessively and damage oil pump.

8. Remove SST(0K210 323 AA0). Replace and tighten high-pressure hose. Tighten to specified torque.

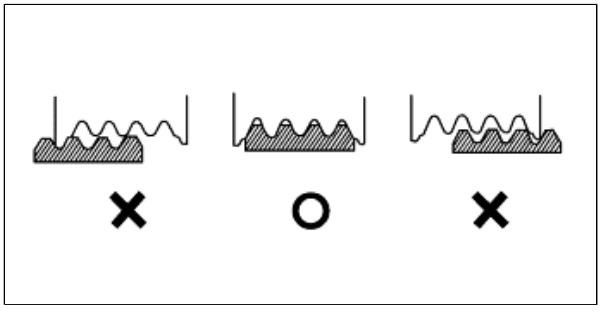
Tightening torque : 39.7~47.0 lb·ft (54.0~63.7N·m, 5.5~6.5kg·m)

9. Bleed air from system. (Refer to steering system on-vehicle service)

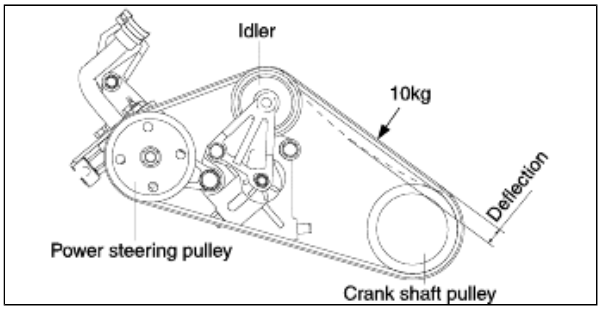
Drive belt

Inspection

1. Check the drive belts for wear, cracks, and fraying. Replace if necessary.
2. Verify that the drive belts are correctly mounted on the pulleys.



3. Check the P/S drive belt deflection by applying moderate pressure (22 lb, 98 N, 10 kg) midway between the pulleys.

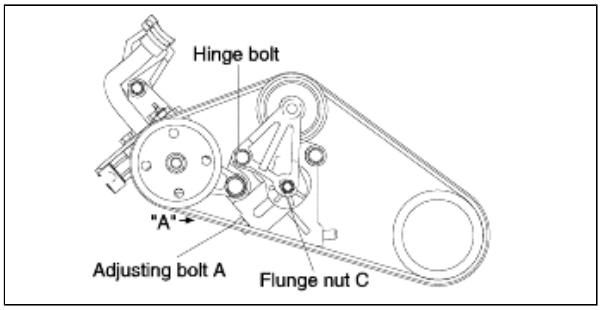


CAUTION

1) Measure the belt deflection between the pulleys.
2) Consider the belt as a new one if it has been used on a running engine for less than five minutes.
3) Check the belt deflection when the engine is cold or at least 30 minutes after the engine is stopped.

P/S drive belt deflectionNew one: 0.35 ~ 0.43 in (8.8 ~ 11 mm)Used one (more than 5 minutes): 0.49 ~ 0.56 in (12.5 ~ 14.3 mm)Upon tension check: 0.46 ~ 0.60 in (11.7 ~ 15.3 mm)

Adjustment



4. Loosen the adjusting bolt conuterclockwise looking from "A" position.
5. Adjust the belt deflection by turning the adjusting bolt A.

Deflection (when applying 22 lb, 98 N, 10 kg) -New one : 0.35 ~ 0.43 in (8.8 ~ 11 mm)Used one(more than 5 minutes) : 0.49 ~ 0.56 in (12.5 ~ 14.3 mm)Upon tension check : 0.46 ~ 0.60 in (11.7 ~ 15.3 mm)

6. After making the adjustment, tighten the hinge bolt B and the flunge nut C.

Tightening torqueHinge : 23.8 ~ 40 lb·ft (32.3 ~ 54 N·m, 3.3 ~ 5.5 kg·m)
Flunge : 13.7~20.2 lb·ft (18.6~27.4N·m, 1.9~2.8 kg·m)

NOTE

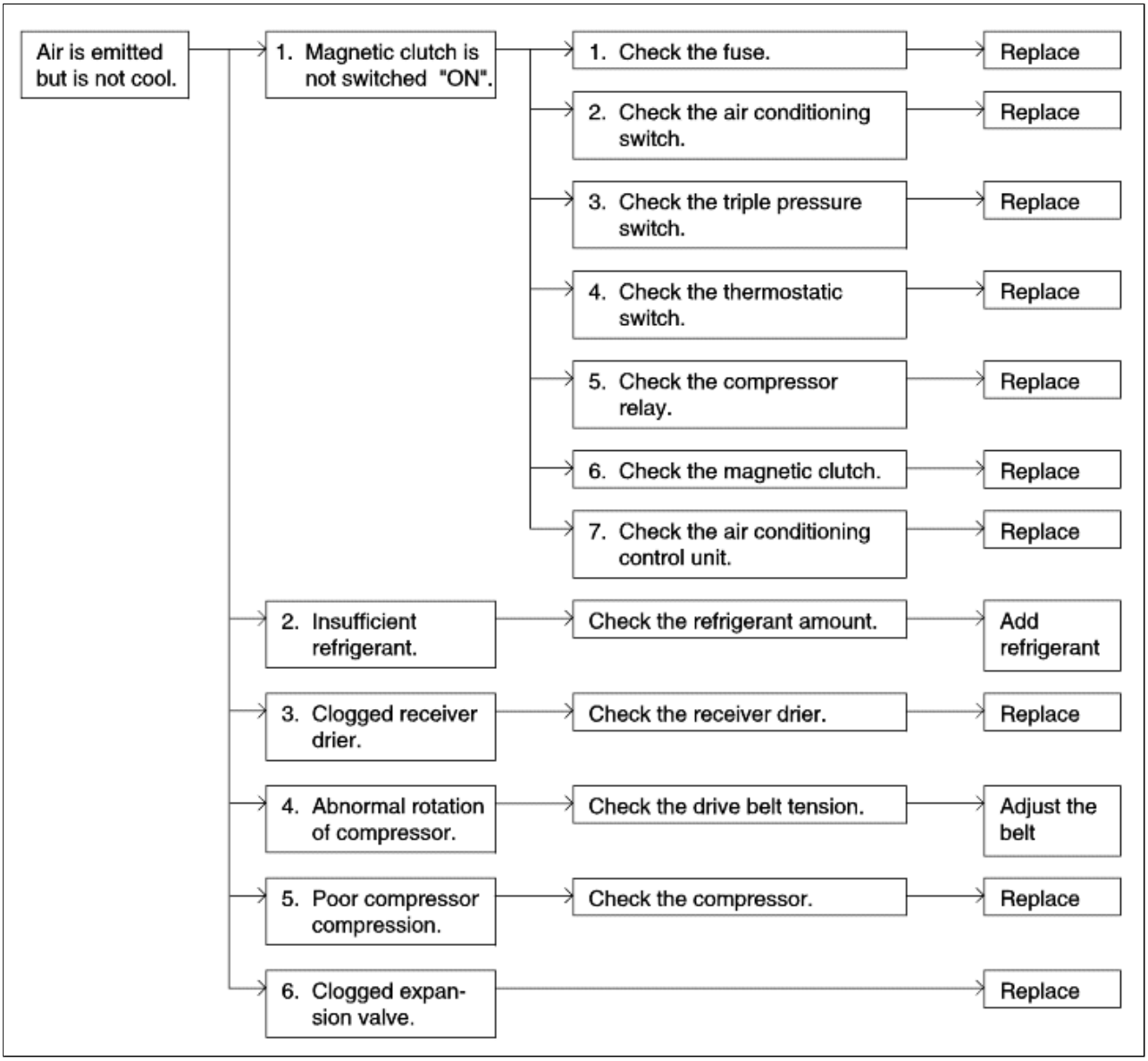
In order to prevent the asymmetrical alignment of the tension pulley upon tension adjust, preliminary tight the hinge bolt B and the flunge nut C before adjusting tension.

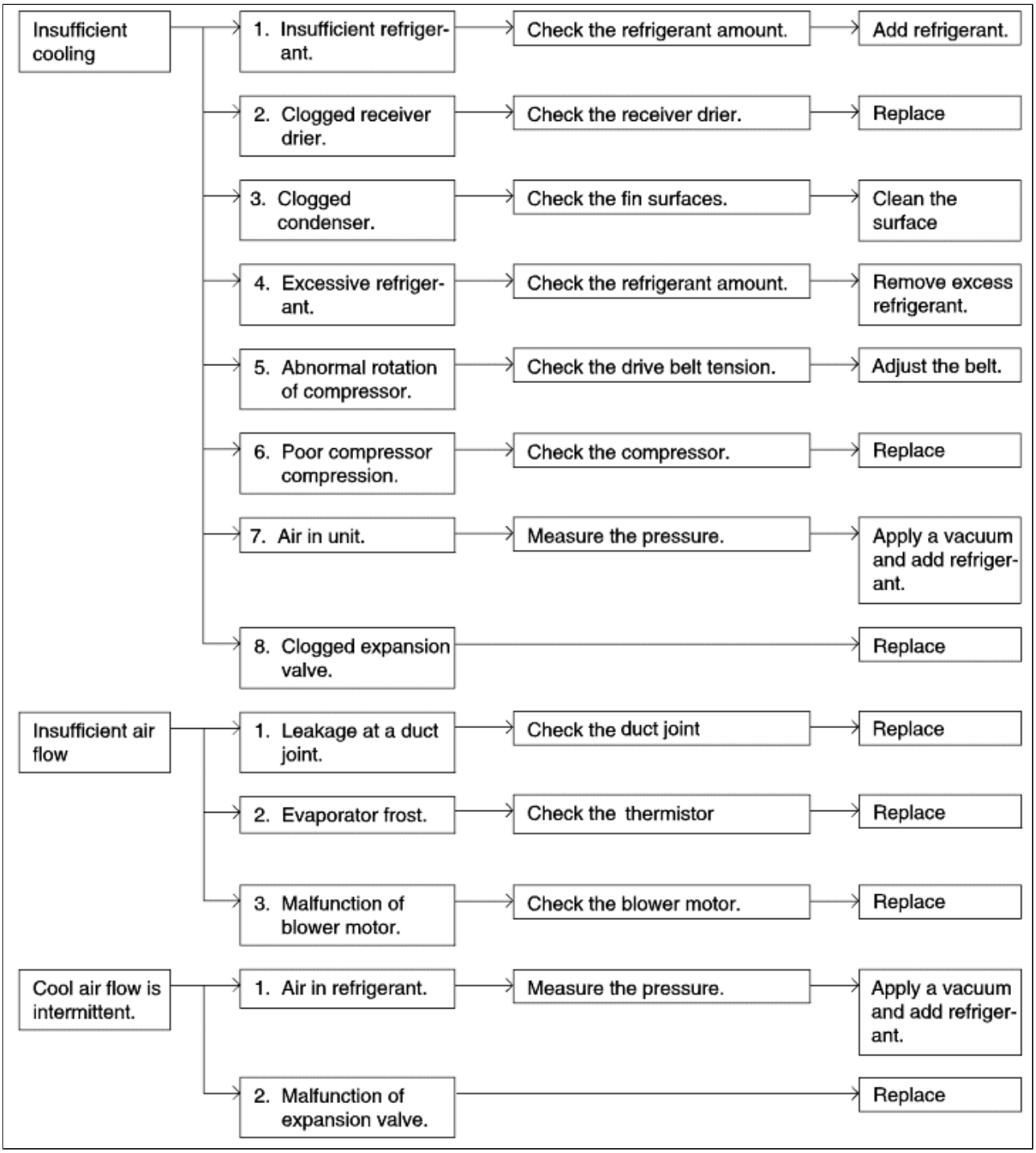
heating, ventilation, air con

TROUBLESHOOTING

Before replacing or repairing air conditioning components, first determine if the malfunction is due to the refrigerant charge, air flow or compressor.

The following diagnostic charts have been developed as a quick reference for determining the cause of the malfunction. If these charts do not satisfactorily describe the problem, refer to the appropriate section for a more detailed explanation. After correcting the malfunction, check the complete system to ensure that performance is satisfactory.




Insufficient cooling
1. Insufficient refrigerant.
Check the refrigerant amount.
Add refrigerant.
2. Clogged receiver drier.
Check the receiver drier.
Replace
3. Clogged condenser.
Check the fin surfaces.
Clean the surface
4. Excessive refrigerant.
Check the refrigerant amount.
Remove excess refrigerant.
5. Abnormal rotation of compressor.
Check the drive belt tension.
Adjust the belt.
6. Poor compressor compression.
Check the compressor.
Replace
7. Air in unit.
Measure the pressure.
Apply a vacuum and add refrigerant.
8. Clogged expansion valve.
Replace
Insufficient air flow
1. Leakage at a duct joint.
Check the duct joint
Replace
2. Evaporator frost.
Check the thermistor
Replace
3. Malfunction of blower motor.
Check the blower motor.
Replace
Cool air flow is intermittent.
1. Air in refrigerant.
Measure the pressure.
Apply a vacuum and add refrigerant.
2. Malfunction of expansion valve.
Replace

SPECIFICATIONS

A/CON

ITEM		GASOLINE
		Σ3.5
Compressor	Type	HS-18 (Swash plate)
	Oil type & Capacity	FD46XG (PAG), 210± 10cc
Comp.pulley	Type	6PK
	Pulley Dia. [in(mm)]	Ø4.528 (Ø115)
Condenser	Type	Corrugated
Triple Pressure S/W (Dual pressure S/W)	High [psi (kg/cm²)]	455±28 (32.0 ± 2.0)
	Medium [psi (kg/cm²)]	256±11 (18.0 ± 0.8)
	Low [psi (kg/cm²)]	$32.7\pm\frac{3.60}{4.27}$ $(2.3\pm\frac{0.25}{0.30})$
Expansion Valve Type		Block
Refrigerant	Type	R-134a
	Capacity [oz (g)]	37±0.88 (1050±2.5)

BLOWER AND EVAPORATOR UNIT (Front)

ITEM		MANUAL
Fresh and Recirculation	Operating method	Actuator
Blower	Rotating direction	Clockwise
	Speed step	1 - 4 Speed
	Speed control	Resistor
Evaporator	Type	Laminate
	Temp. control type	Thermister
	Thermistor	OFF: 36.5°F (2.5°C) ON: 45.5°F (7.5°C)
	Cooling capacity	4500 kcal/h ± 10%

BLOWER AND EVAPORATOR UNIT (Rear)

ITEM		SPECIFICATION
Fresh and Recirculation	Operating method	Actuator
Blower	Rotating direction	Clockwise
	Speed step	1 - 3 Speed
	Speed control	Resistor
Evaporator	Type	Laminate
	Cooling capacity	4100 kcal/h ± 10%

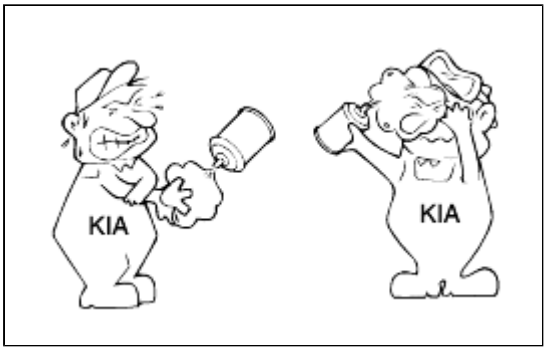
HEATER UNIT

ITEM		FRONT	REAR
Heater mode selection	Type	Dimpled	←
	Heating capacity	4900 kcal/h ± 10%	←
	Operating method	Actuator	-
Temp selection	Operating method	Actuator	←

INSTRUCTIONS

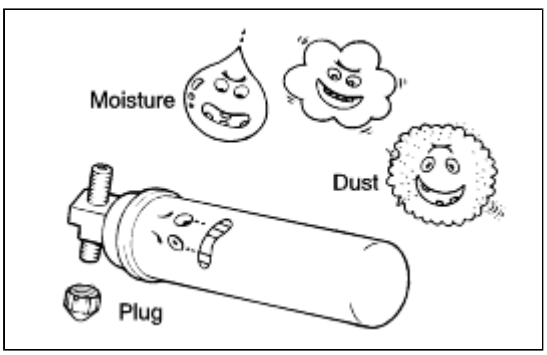
WHEN HANDLING REFRIGERANT

1. R-134a liquid refrigerant is highly volatile. A drop on the skin of your hand could result in localized frostbite. When handling the refrigerant, be sure to wear gloves.
2. It is standard practice to wear goggles or glasses to protect your eyes, and gloves to protect your hands. If the refrigerant splashes into your eyes, wash them with clean water immediately.
3. The R-134a container is highly pressurized. Never leave it in a hot place, and check that the storage temperature is below 52°C (126°F).
4. A electronic leak detector should be used to check the system for refrigerant leakage. Bear in mind that the R-134a, upon coming into contact with flame, produces phosgene, a highly toxic gas.
5. Use only recommended the lubricant for R-134a systems. If lubricants other than the recommended one used, system failure may occur.
6. PAG lubricant absorbs moisture from the atmosphere at a rapid rate, therefore the following precautions must be observed:
   A. When removing refrigerant components from a vehicle, cap immediately the components to prevent from the entry of moisture.
   B. When installing refrigerant components to a vehicle, do not remove the cap until just before connecting the components.
   C. Complete the connection of all refrigerant tubes and hoses without delay to prevent the A/C system from taking on moisture.
   D. Use the recommended lubricant from a sealed container only.
7. If an accidental discharge in the system occurs, ventilate the work area before resuming service.



WHEN REPLACING PARTS ON A/C SYSTEM

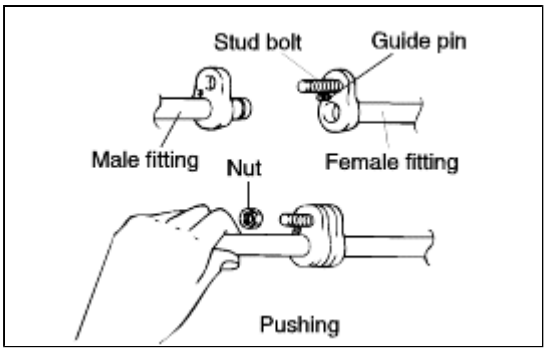
1. Never open or loosen a connection before discharging the system.
2. Seal the open fittings of components with a cap or plug immediately to prevent intrusion of moisture or dust.
3. Do not remove the sealing caps from a replacement component until it is ready to be installed.
4. Before connecting an open fitting, always install a new sealing ring. Coat the fitting and seal with refrigerant oil before making the connection.



WHEN INSTALLING CONNECTING PARTS

FLANGE WITH GUIDE PIN

Check the new O-ring for damage (use only the specified) and lubricate it using compressor oil. Tighten the nut to specified torque.



Size	Tightening torque (N·m (kg·m, lb-ft))	
	General bolt, nut	
	4T	7T
M6	4 - 6 (0.4 - 0.6, 2.9 - 4.3)	7 - 11 (0.7 - 1.1, 5.0 - 7.9)
M8	9 - 14 (0.9 - 1.4, 6.5 - 10)	17 - 26 (1.7 - 2.6, 12 - 18)
M10	19 - 28 (1.9 - 2.8, 14 - 20)	35 - 55 (3.5 - 5.5, 25 - 39)
Size	Flange bolt, nut	
	4T	7T
M6	5 - 7 (0.5 - 0.7, 3.6 - 5.0)	8 - 12 (0.8 - 1.2, 5.8 - 8.6)
M8	10 - 15 (1.0 - 1.5, 7 - 10)	19 - 28 (1.9 - 2.8, 14 - 20)
M10	21 - 31 (2.1 - 3.1, 15 - 22)	39 - 60 (3.9 - 6.0, 28 - 43)

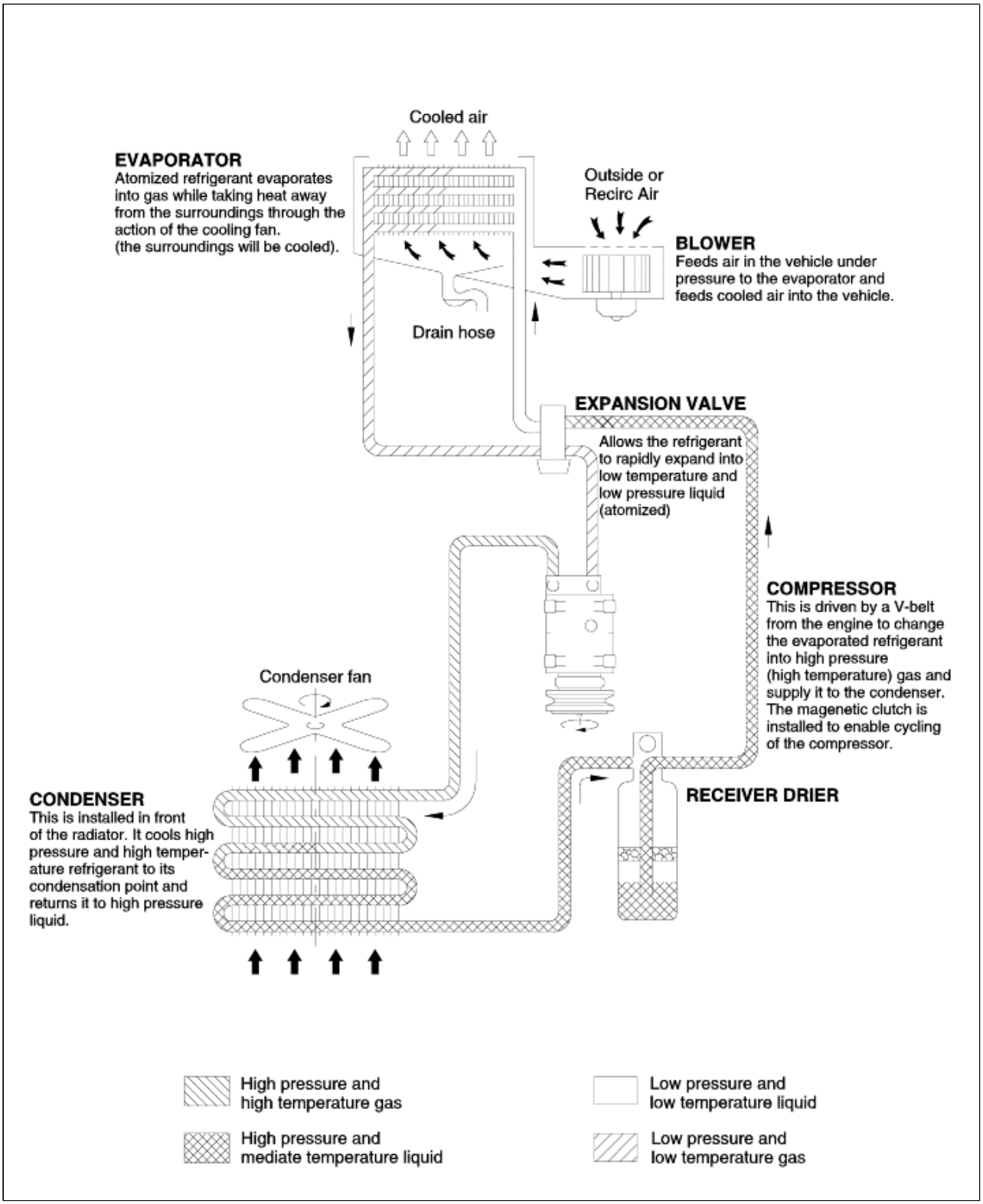
HANDLING TUBING AND FITTINGS

The internal parts of the refrigeration system will remain in a state of chemical stability as long as pure moisture-free refrigerant and refrigerant oil are used. Abnormal amounts of dirt, moisture or air can upset the chemical stability and cause problems or serious damage.

THE FOLLOWING PRECAUTIONS MUST BE OBSERVED

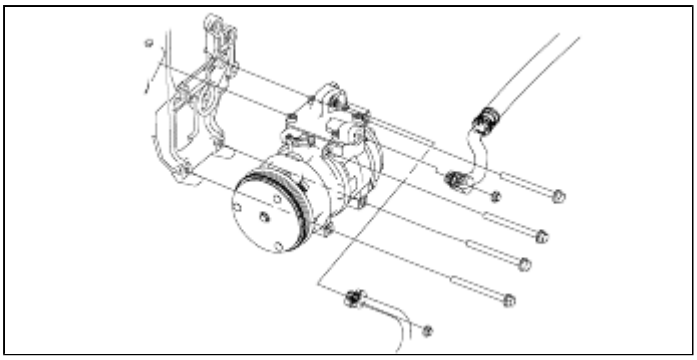
1. When it is necessary to open the refrigeration system, have everything you will need to service the system ready so the system will not be left open any longer than necessary.
2. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture.
3. All lines and components in parts stock should be capped or sealed until they are ready to be used.
4. Never attempt to rebend formed lines to fit. Use the correct line for the installation you are servicing.
5. All tools, including the refrigerant dispensing manifold, the gauge set manifold and test hoses, should be kept clean and dry.

REFRIGERATION CYCLE



REMOVAL AND INSTALLATION

1. Remove the drive belt after loosening the tension pulley.
2. Discharge the refrigerant.
3. Remove the discharge and suction hoses.
4. Remove the compressor.



5. Installation is the reverse of removal.

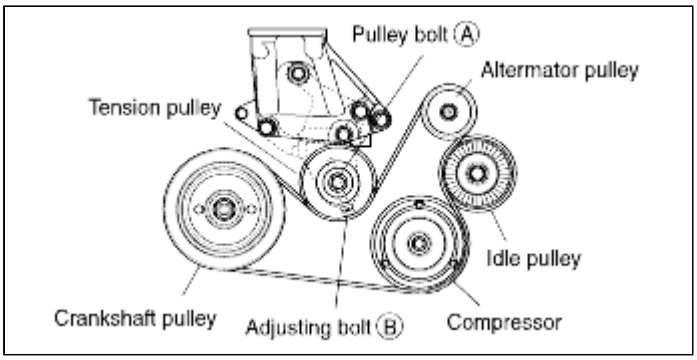
Tightening torque20-30 N·m(2.0~3.0 kg-m, 14-21 lb-ft)

Adjustment

1. Loosen the pulley bolt A.
2. Turn the adjusting bolt B and adjust the deflection of the drive belt to the within specification.

Belt	Deflection: When applying moderate pressure 98N (10kg, 22lb)
New	8~9 (0.31~0.35 in)
Old	9~10 (0.35 ~0.39 in)

3. Tighten the pulley bolt A.



COMPRESSOR OIL

Oil lubricates the compressor and circulates in the system while the compressor is operating. Whenever replacing any component of the system, or when a large amount of gas leakage occurs, add oil to maintain the original total amount of oil.

HANDLING OF OIL

1. The oil should be free from moisture, dust, metal filings, etc.
2. Do not mix oils.
3. The moisture content in the oil increases when exposed to the air for prolonged periods. After use, seal the container immediately.

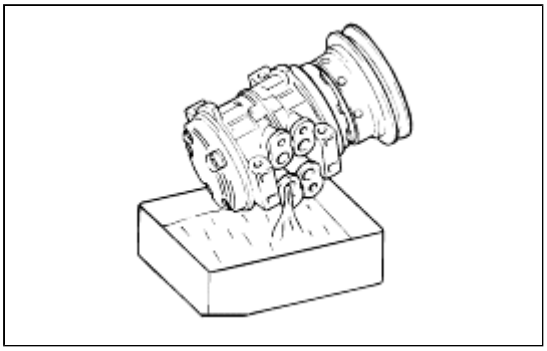
OIL RETURN OPERATION

To check the oil level or add the oil, idle the engine for 20-30 minutes with the controls set to maximum cooling and blower level, to return the lubricant to compressor.

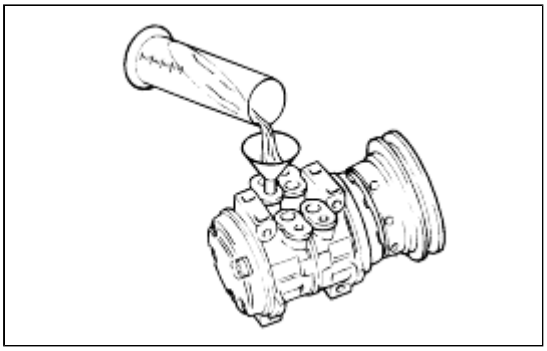
CHECKING AND ADDING OF COMPRESSOR OIL LEVEL

In order to add oil to an operating compressor, check the compressor oil using the following procedure:

1. Stop the engine, discharge the refrigerant, and dismantle the compressor from the vehicle.
2. Pour oil from the system line outlet.



3. Check the volume of the discharged oil. If it is less than 70cc, it means there is little leak. Perform the leakage teston each system connection, and repair or replace faulty parts if necessary.
4. Check the oil for contamination and replenish the oil level in the following procedure:



A. When oil is clean

Discharge	Setting
Above 70cc	Oil level is normal. Add an equal amount of discharged oil.
Below 70cc	Oil level is low. Add 70cc of oil.

B. If the oil is contaminated with metal fragments or other material, clean the receiver drier after charging the refrigerant.

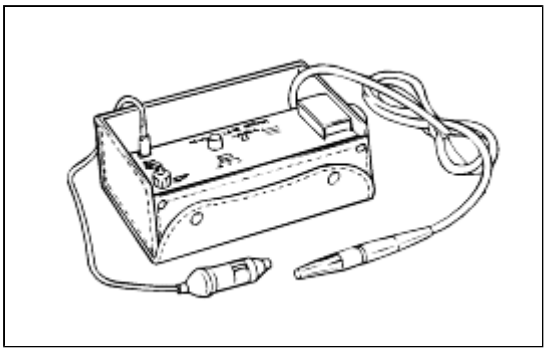
CHECKING FOR REFRIGERANT LEAKS

Always conduct a leak test with an electronic leak detector whenever leakage or refrigerant is suspected and when conducting service operations which are accompanied by disassembly or loosening or connection fittings.

> **NOTE**
>
> In order to use the leak detector properly, read the manual supplied by the manufacturer.

If a gas leak is detected, proceed as follows:

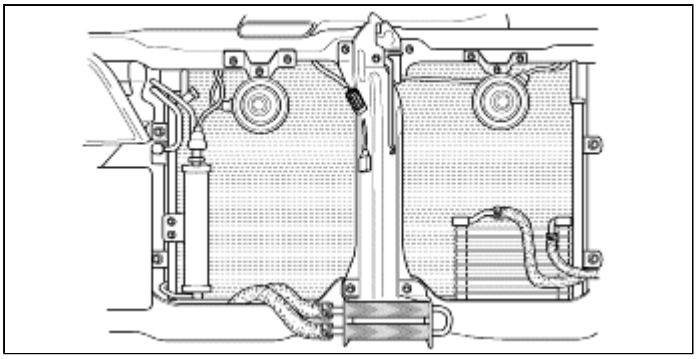
1. Check the torque on the connection fittings and, if too loose, tighten to the proper torque. Check for gas leakage with a leak detector.
2. If leakage continues even after the fitting has been tightened, discharge the refrigerant from the system, disconnect the fittings, and check their seating faces for damage. Always replace, even if the damage is slight.
3. Check the compressor oil and add oil if required.
4. Charge the system and recheck for gas leaks. If no leaks are found, evacuate and charge the system again.



CHECKING

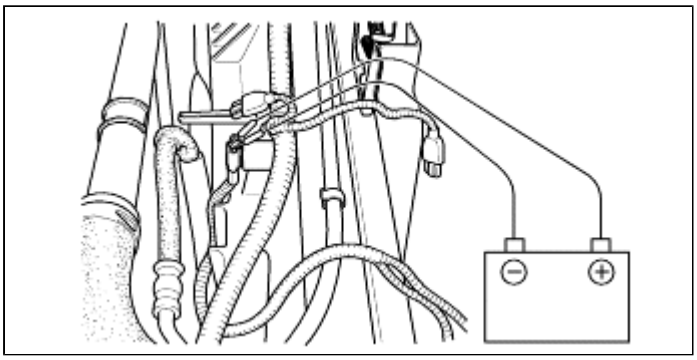
CONDENSER

1. Check the condenser fins for clogging and damage. If clogged, clean them with water, and blow them with compressed air. If bent, gently bend themusing a screwdriver or a pliers.
2. Check the condenser connections for leakage, and repair or replace it, if required.



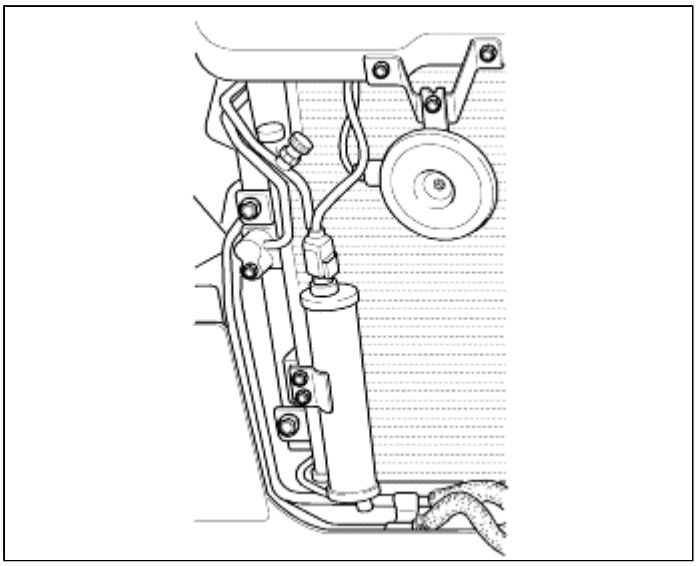
CONDENSER FAN

1. Check the condenser fan for proper operation.
2. Check the harness connector.
3. Check the condenser fan motor using battery voltage as shown below.



Check

1. Check the fusible plug and the fittings for leakage, using a leak detector.
2. Run the engine at fast idle with the air conditioning "ON", and check both the inlet and outlet temperatures. If the difference in temperatures between the inlet and outlet is large, replace the receiver-drier.

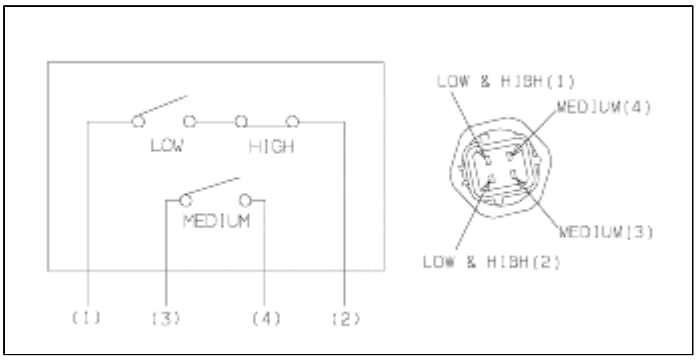


NOTE

1) Plug the all open fittings immediately to keep moisture out of the system.
2) Do not remove plugs until ready for connection.
3) Evacuate, charge and test the refrigeration system.

DESCRIPTION

The triple switch is a combination of a medium switch as well as conventional low pressure and high pressure switches. The low pressure switch will be turned off to stop compressor operation if refrigerant pressure is low. The high pressure switch will be turned off to stop compressor operation if refrigerant pressure is too high. The medium switch will be turned on at medium level pressure to cool the A/C system operating radiator fan and condenser fan at high speed.

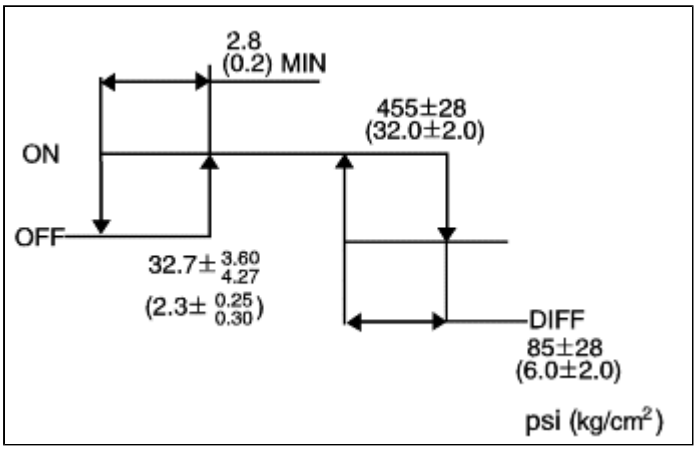


OPERATING CHARACTERISTIC

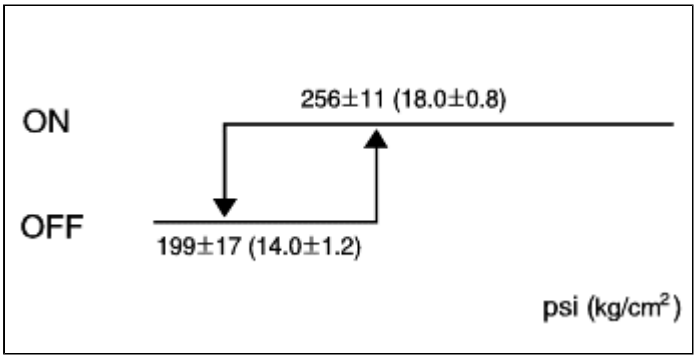
psi (kg/cm^2)

Pressure	ON	OFF(DIFF)
High	455±28 (32.0±2.0)	85±28 (6.0±2.0)
Low	$32.7\pm{}^{3.60}_{4.27}$ ($2.3\pm{}^{0.25}_{0.30}$)	2.8 (0.2)
Medium	256±11 (18.0±0.8)	199±17 (14.0±1.2)

LOW & HIGH



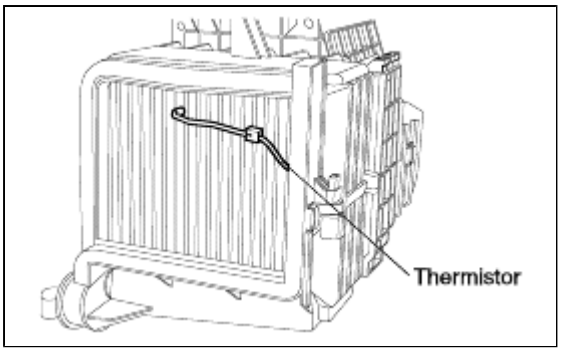
MEDIUM



SENSOR CHECKING

The thermistor will detect the core temperature and interrupt compressor relay power, in order to prevent evaporator freezing by excessive cooling.

The thermistor is an NTC device.

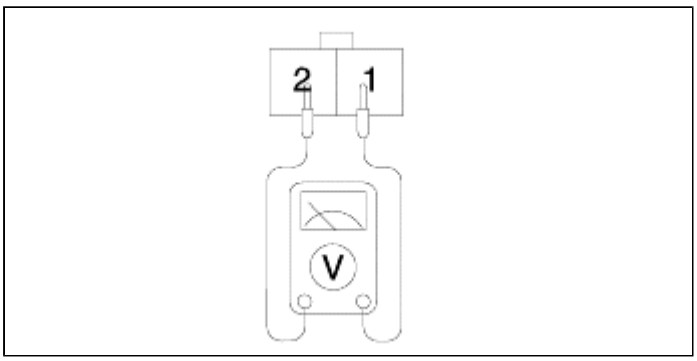


THERMISTOR CHECK

1. Remove the glove box.
2. Start the engine.
3. Turn on the air conditioner.
4. Using the multi-tester, check the output voltage between terminals 1 and 2 in the thermistor.

Thermistor	Operating temperature	Output voltage
ON	45.5°F (7.5°C)	0V
OFF	36.5°F (2.5°C)	12V

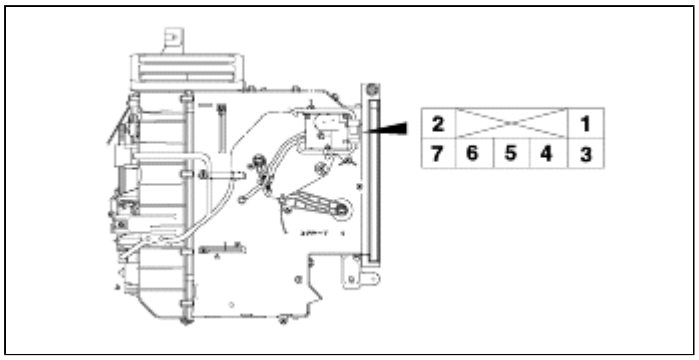
SEDONA MANUAL



TEMP. ACTUATOR POTENTIOMETER

INSPECTION (Front)

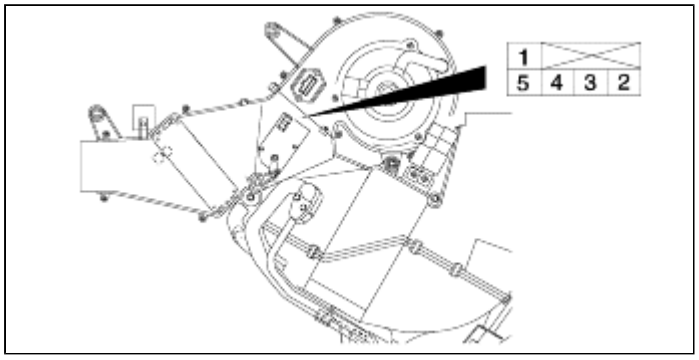
1. Temperature control actuator is installed in the heater unit case. The control switches and the vent duct switch will operate actuator to regulate the temperature and discharge air.



2. Verify that the temp actuator operates to the warm position when connecting 12V to the terminal 1 and grounding terminal 3.
3. Verify that the temp actuator operates to the cool position when connecting in the reverse.

INSPECTION (Rear)

1. Temperature control actuator is installed in the rear heater unit case. The control switches and the vent duct switch will operate actuator to regulate the temperature and discharge air.

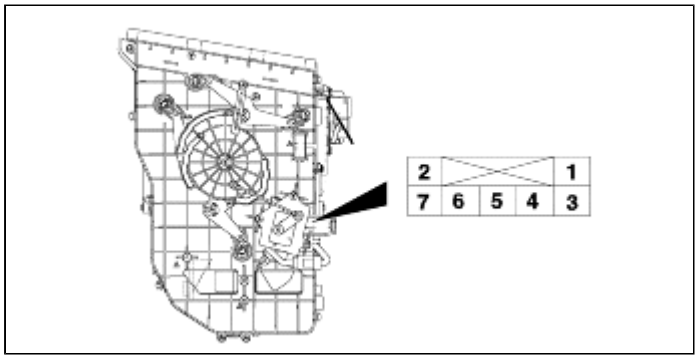


2. Verify that the temp actuator operates to the warm position when connecting 12V to the terminal 1 and grounding terminal 4.
3. Verify that the temp actuator operates to the cool position when grounding terminal 5.

MODE CONTROL ACTUATOR

INSPECTION

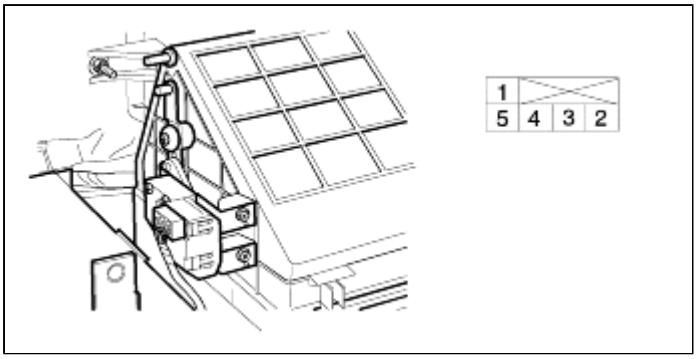
1. Apply 12V to mode actuator terminal 2 and ground terminal 1.
2. Verify that the mode actuator operates as below when grounding terminals 3,4,5,6 and 7 in sequence.
VENT → BI/LEVEL → HEAT → D/F → DEF



FRESH AND RECIRCULATION ACTUATOR

DESCRIPTION

The intake selection switch is located on the control panel. Pressing the switch will shift between recirculation and fresh air modes.



CHECK

Input (Manual)		Output
+	-	Fresh/recirculation shifting
1	5	Recirculation
1	3	Fresh

REFRIGERANT SYSTEM SERVICE BASICS

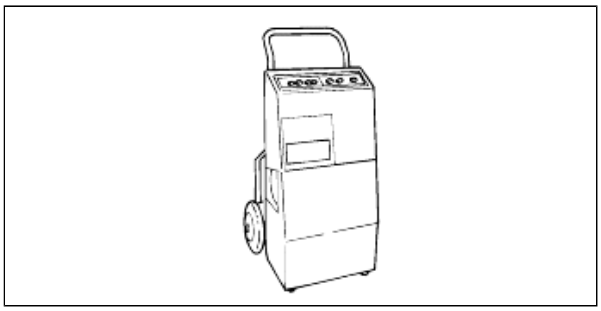
REFRIGERANT RECOVERY

Use only service equipment that is U.L-listed and is certified to meet the requirements of SAE J2210 to remove HFC-134a(R-134a)from the air conditioning system.

> CAUTION
>
> 1) Air conditioning refrigerant or lubricant vapor can irritate your eyes, nose, or throat.
> 2) Be careful when connecting service equipment.
> 3) Do not breathe refrigerant or vapor.

If accidental system discharge occurs, ventilate work area before resuming service.
Additional health and safety information may be obatined from the refrigerant and lubricant manufacturers.

1. Connect a R-134a refrigerant Recovery/Recycling/Charging System to the high-pressure service port and the low-pressure service port as shown, following the equipment manufacturer's instructions.



2. Measure the amount of refrigerant oil removed from the A/C system after the recovery process is completed. Be sure to install the same amount of new refrigerant oil back into the A/C system before charging.

SYSTEM EVACUATION

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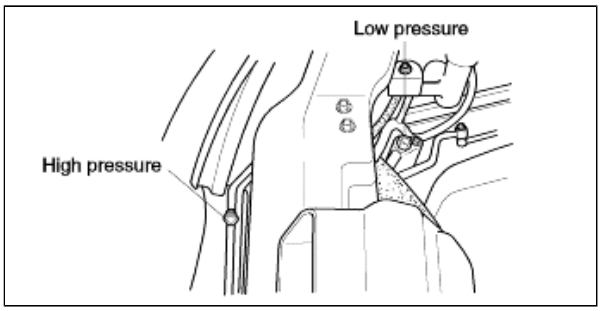
1. When an A/C System has been opened to the atmosphere, such as during in stallation or repair, it must be evacuated using a R-134a refrigerant Recovery/Recycling/Charging System. (If the system has been open for several days, the receiver/dryer should be replaced, and the system should be evacuated for several hours.)
2. Connect a R-134a refrigerant Recovery/Recycling/Charging System to the high-pressure service port and the low-pressure service port as shown, following the equipment manufacturer's instructions.



3. If the low-pressure does not reach more than 93.3 kPa(700 mmHg, 27.6 in.Hg) in 15 minutes, there is probably a leak in the system. Partially charge the system, and check for leaks (see Leak Test.)

SYSTEM CHARGING

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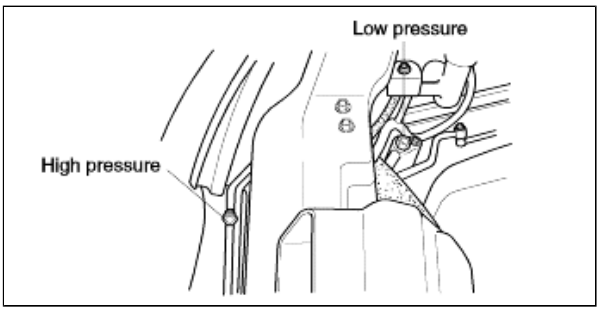

Add the same amount of new refrigerant oil to system that was removed during recovery. Use only Specified refrigerant oil.
Charge the system with 1050±25g (37±0.88 oz)of R-134a refrigerant. Do not overcharge the system the compressor will be damaged.

REFRIGERANT LEAK TEST

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2) Be careful when connecting service equipment
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If accidental system discharge occurs, ventilate work area before resuming service.
R-134a service equipment or vehicle air conditioning systems should not be pressure tested or leak tested with compressed air.

CAUTION

1) Compressed air mixed with R-134a forms a combustible vapor.
2) The vapor can burn or explode causing serious injury.
3) Never use compressed air to pressure test r-134a service equipment or vehicle air conditioning systems.

Additional health and safety information may be obatined from the refrigerant and lubricant manufacturers.

1. Connect a R-134a refrigerant Recovery/Recycling/Charging System to the high-pressure service port and the low-pressure service port as shown in the previous column, following the equipment manufacturer's instructions.
2. Open the high-pressure valve to charge the system to the specitled capacity, then close the supply valve, and remove the charging system couplers.

   Refrigerant capacity : 1050±25g (37±0.88 oz)

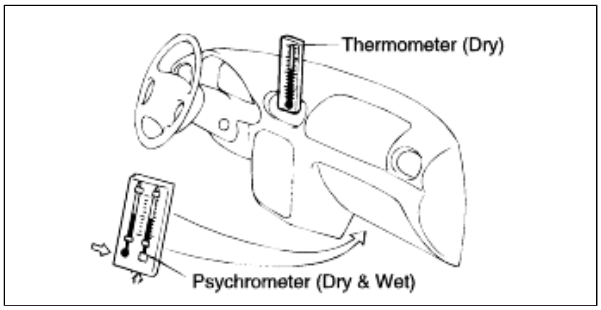
3. Check the system for leaks using a R-134a refrigerant leak detector with an accuracy of 14g(0.5 oz)per year or better.
4. If you find leaks that require the system to be opened(to repair or replace hoses, fittings, etc.) recover the system according to the Recovery Procedure.
5. After checking and repairing leaks, the system must be evacuated.

PERFORMANCE TEST

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the controls for maximum cooling and high blower speed.
3. Keep all windows and doors open.
4. Place a dry-bulb thermometer in the cool air outlet.
5. Place a wet-dry thermometer close to the inlet of the cooling unit.
6. Check that the reading on the high pressure gauge is 1,373-1,575 kPa (14-16& kg/cm², 199-228 psi). If the reading is too high,

pour water on the condenser. If the reading to too low, cover the front of the condenser.

7. Check that the reading on the dry-bulb thermometer at the air inlet at 25-35°C (77-95°F).
8. Calculate the relative humidity from the psychrometric graph by comparing the wet-and dry-bulb reading at the air inlet.

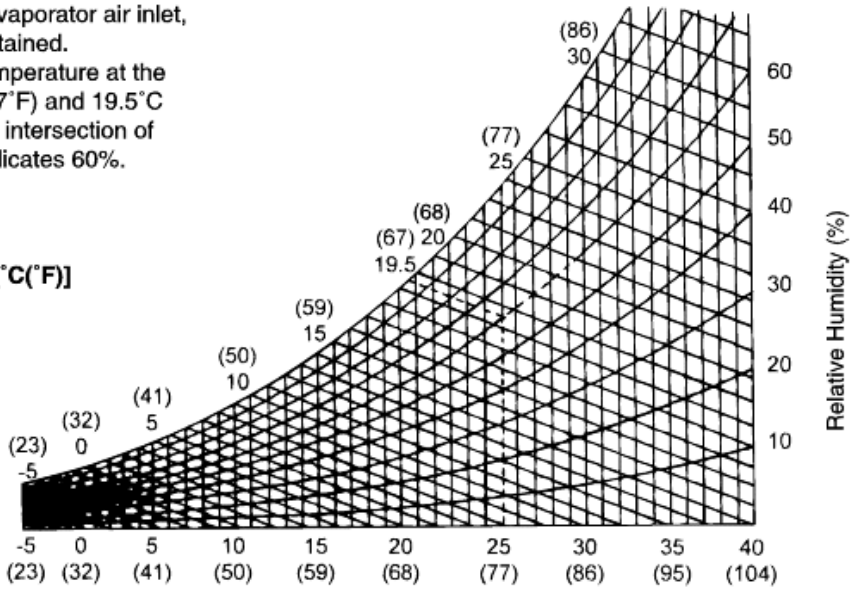


HOW TO READ THE GRAPH :

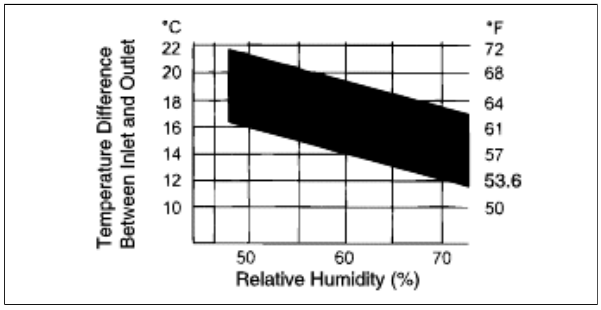
After measuring the temperatures of the wet and dry-bulb thermometers at the evaporator air inlet, relative humidity (%) can be obtained.
Example : Dry-and wet-bulb temperature at the evaporator air inlet are 25˚C (77˚F) and 19.5˚C (67˚F) respectively, the point of intersection of the dotted lines in the graph indicates 60%.

WET-BULB TEMPERATURE [˚C(˚F)]

100	(212)
90	(194)
80	(176)
70	(158)
60	(140)
50	(122)
40	(104)
30	(86)
20	(68)
10	(50)



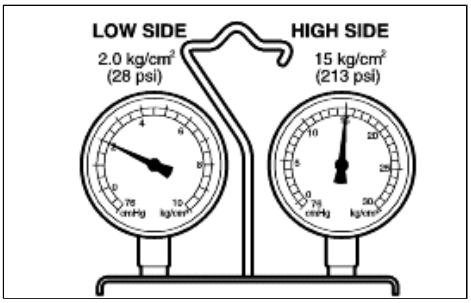
9. Measure the dry-bulb temperature at the cool air outlet, and calculate the difference between the inlet dry-bulb and outlet dry-bulb temperatures.
10. Check that the intersection of the relative humidity and temperature difference falls within the block below.
    If the intersection is within the block, cooling performance is satisfactory.



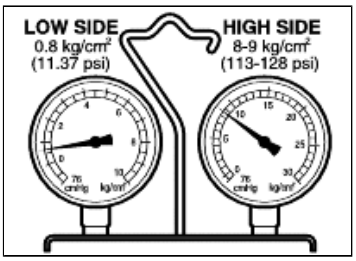
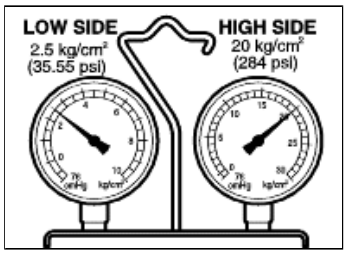
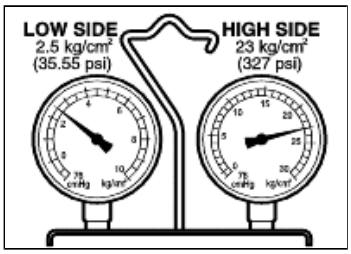
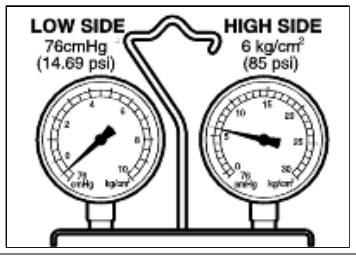
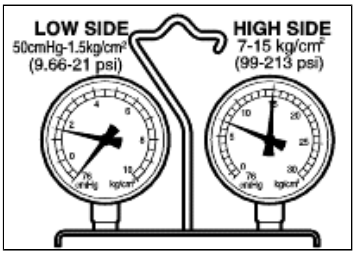
PERFORMANCE TEST DIAGNOSIS USING MANIFOLD GAUGE

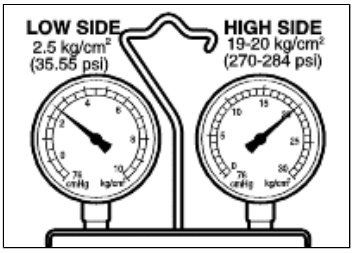
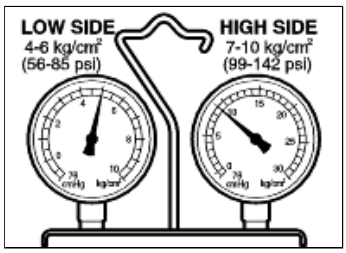
STANDARD VALUE

If cooling cycle is operating normally, the manifold gauge reading will be approx.1.5-2.0kg/cm²(21-28psi) for the low pressure side and approx. 14.5-15kg/cm²(206-213psi) for the high pressure side. Inlet temperature should be 30-35°C(80-95°F), with the engine at 2,000 rpm, maximum cooling selected, and the blower on highest level.



DIAGNOSIS

SYMPTOMS	PROBABLE CAUSES	REMEDY	MANIFOLD GAUGE READINGS
1) Low pressure and high pressure are low. 2) Cooler outlet air is a little cooler.	1) Gas leak.	1) Check and repair. 2) Add refrigerant.	
1) Low pressure and high pressure are high.	1) Faulty cooling or condenser freezing. 2) Belt slip.	1) Maintain the proper level of refrigerant. Clean the condenser. 2) Adjust the belt.	
1) Low pressure and high pressure are high. 2) Low pressure pipe is not cold.	1) Air in the system.	1) Clean or repair the receiver drier. 2) Check for oil contamination.	
1) Low pressure side indicates negative pressure and high pressure side indicates low pressure. 2) Frost or dew on pipes connected with receiver or expansion valve.	1) Dust or moisture frozen at expansion valve. 2) Gas leak.	1) Repair the receiver drier and replace the expansion valve. 2) Replace the expansion valve if the receiver-drier is faulty.	
1) Low pressure side pressure sometimes goes to negative pressure or normal.	1) Intaken moisture is frozen at expansion valve hole.	1) Repair and bleed receiver drier	
1) Low pressure and high pressure are high. 2) Much frost or dew on the low pressure side piping.	1) Expansion valve failure. Receiver-drier faulty. 2) Flow control faulty.	1) Repair receiver drier. 2) Check oil contamination.	

			
1) Low pressure side pressure is high and high pressure side pressure is low.	1) Leak inside compressor.	1) Replace compressor.	

REFRIGERANT SYSTEM SERVICE BASICS

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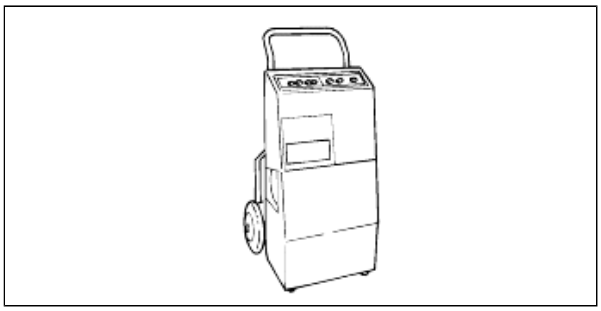

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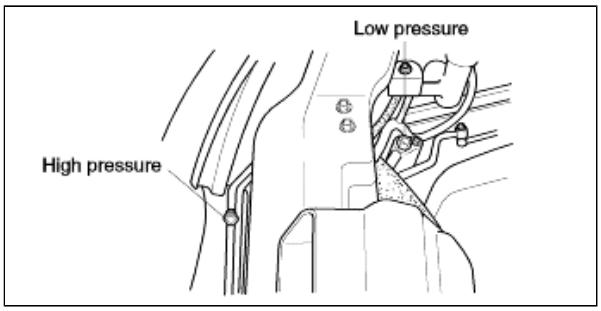

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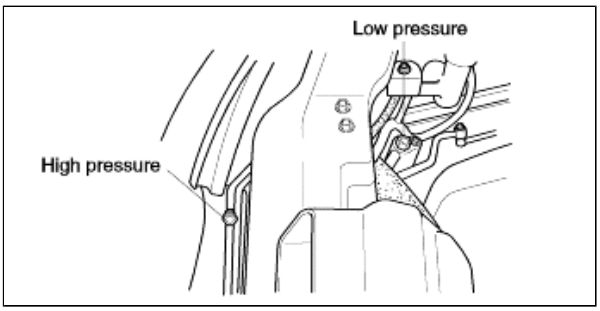

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3. Check the system for leaks using a R-134a refrigerant leak detector with an accuracy of 14g(0.5 oz)per year or better.
4. If you find leaks that require the system to be opened(to repair or replace hoses, fittings, etc.) recover the system according to the Recovery Procedure.
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PERFORMANCE TEST

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the controls for maximum cooling and high blower speed.
3. Keep all windows and doors open.
4. Place a dry-bulb thermometer in the cool air outlet.
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6. Check that the reading on the high pressure gauge is 1,373-1,575 kPa (14-16& kg/cm², 199-228 psi). If the reading is too high,

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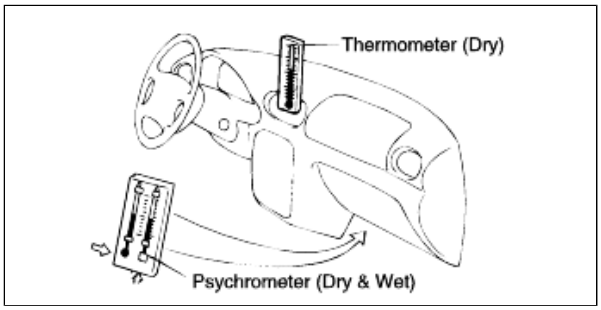

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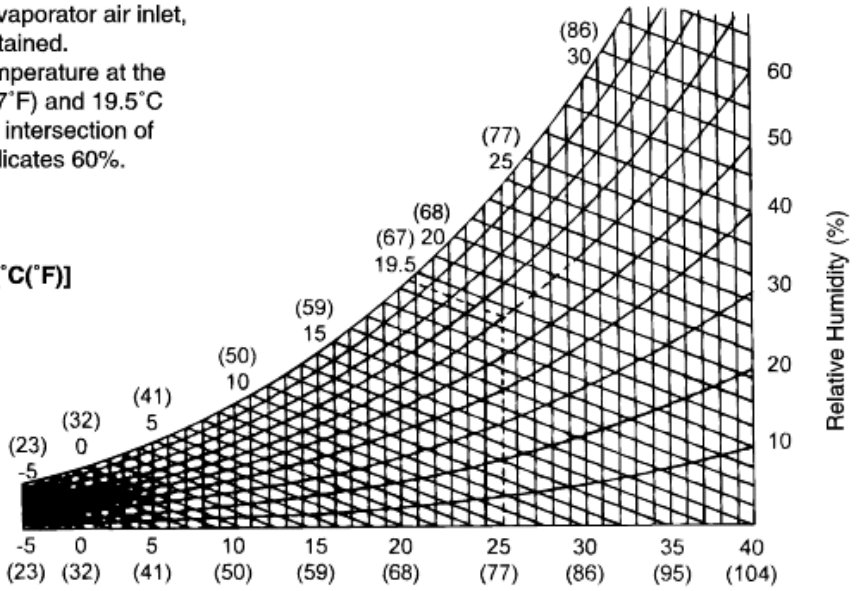

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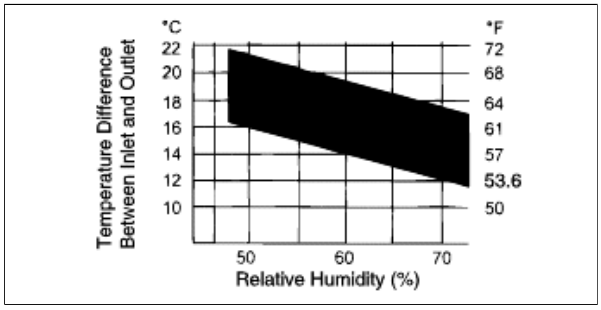

PERFORMANCE TEST DIAGNOSIS USING MANIFOLD GAUGE

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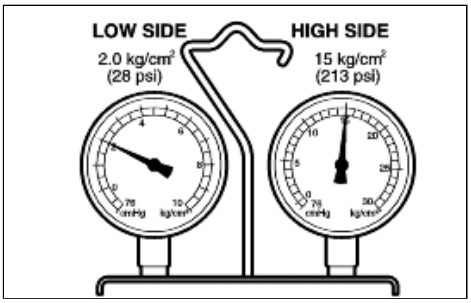
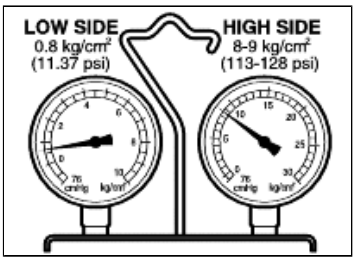
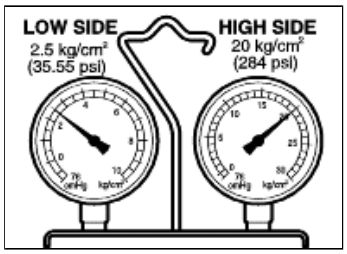
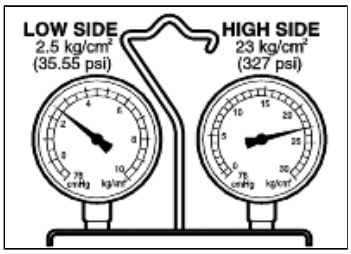
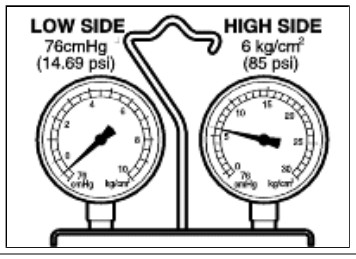
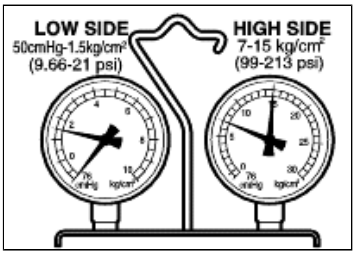
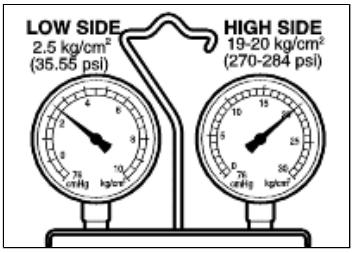
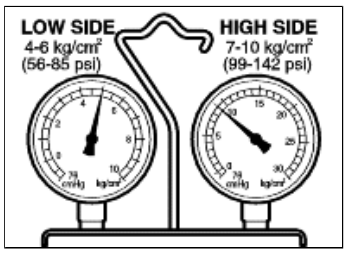


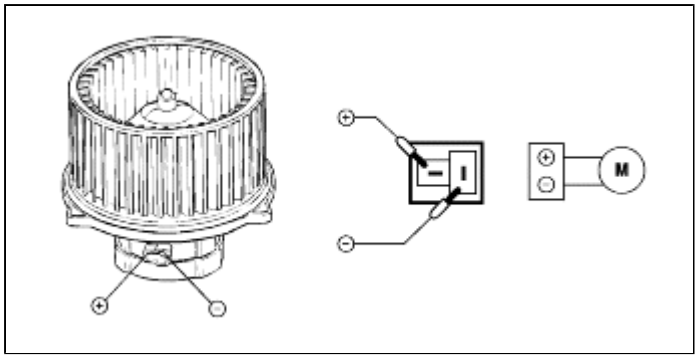
DIAGNOSIS

SYMPTOMS	PROBABLE CAUSES	REMEDY	MANIFOLD GAUGE READINGS
1) Low pressure and high pressure are low. 2) Cooler outlet air is a little cooler.	1) Gas leak.	1) Check and repair. 2) Add refrigerant.	
1) Low pressure and high pressure are high.	1) Faulty cooling or condenser freezing. 2) Belt slip.	1) Maintain the proper level of refrigerant. Clean the condenser. 2) Adjust the belt.	
1) Low pressure and high pressure are high. 2) Low pressure pipe is not cold.	1) Air in the system.	1) Clean or repair the receiver drier. 2) Check for oil contamination.	
1) Low pressure side indicates negative pressure and high pressure side indicates low pressure. 2) Frost or dew on pipes connected with receiver or expansion valve.	1) Dust or moisture frozen at expansion valve. 2) Gas leak.	1) Repair the receiver drier and replace the expansion valve. 2) Replace the expansion valve if the receiver-drier is faulty.	
1) Low pressure side pressure sometimes goes to negative pressure or normal.	1) Intaken moisture is frozen at expansion valve hole.	1) Repair and bleed receiver drier	
1) Low pressure and high pressure are high. 2) Much frost or dew on the low pressure side piping.	1) Expansion valve failure. Receiver-drier faulty. 2) Flow control faulty.	1) Repair receiver drier. 2) Check oil contamination.	

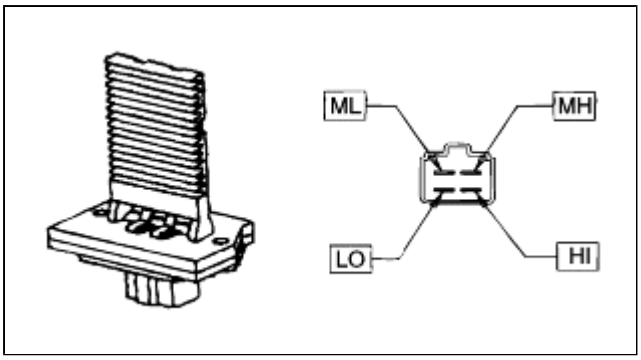
			
1) Low pressure side pressure is high and high pressure side pressure is low.	1) Leak inside compressor.	1) Replace compressor.	

CHECK

1. Connect the battery voltage and check the blower motor rotation.

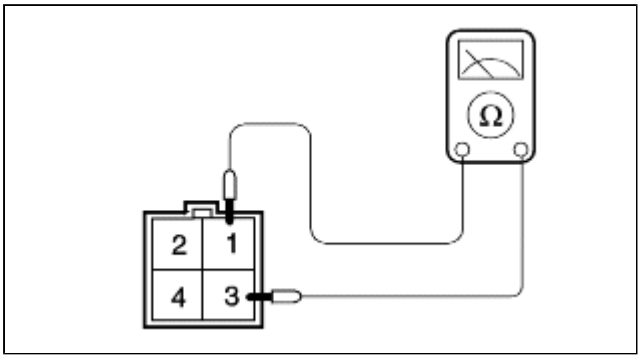


CHECK (Front)

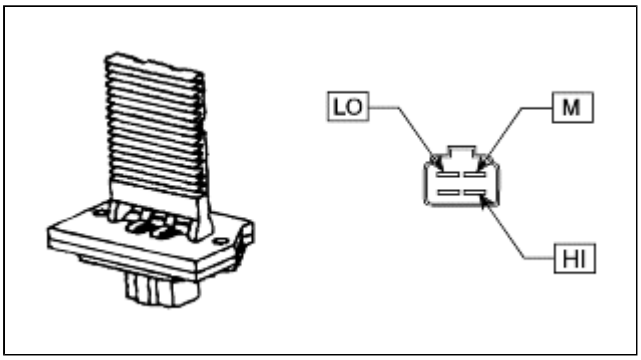


1. Check for continuity and resistance between terminals.

Terminal	Resistance (Ω)
3 - 1 3 - 2 3 - 4	0.35 0.90 1.87



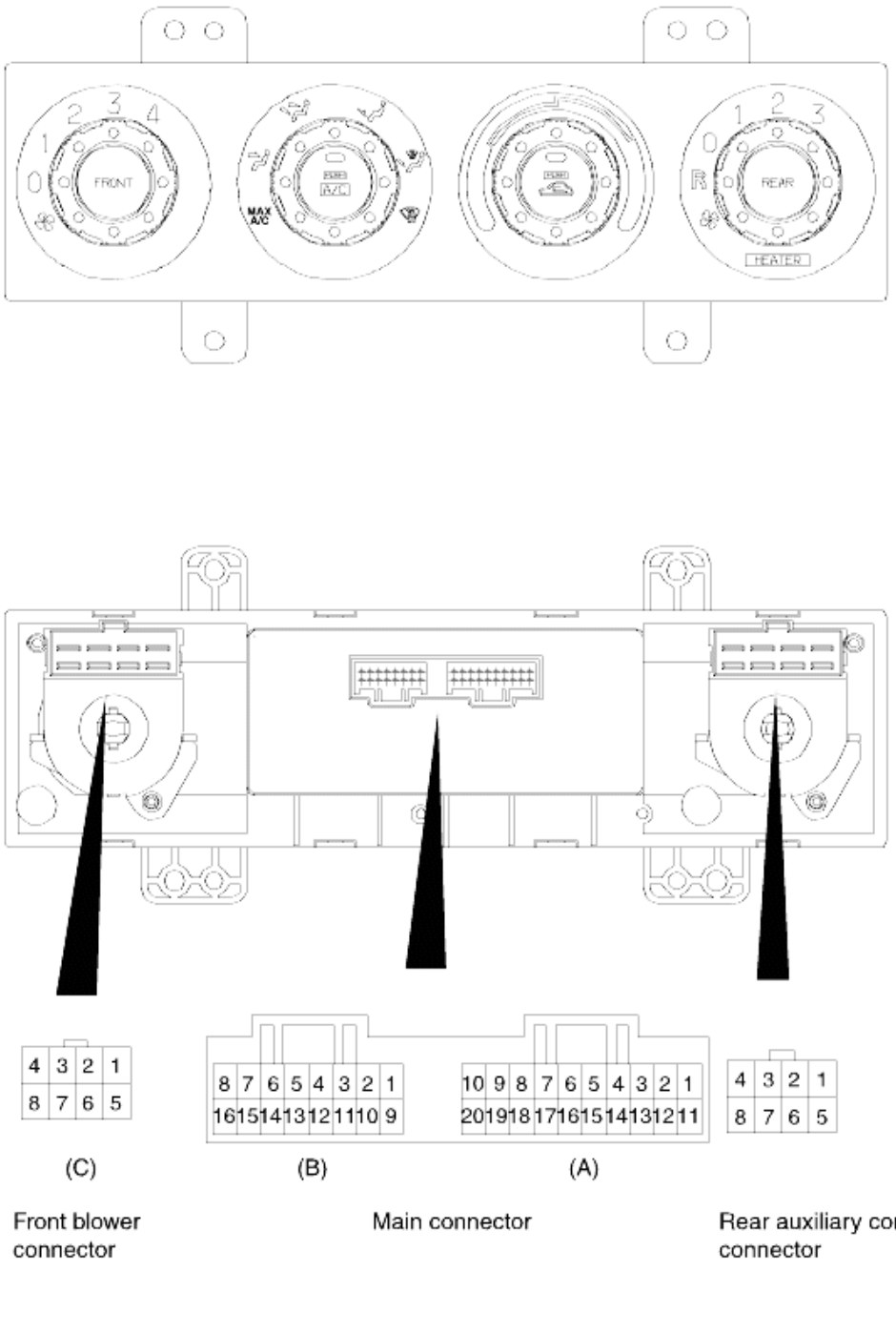
CHECK (Rear)



1. Check for continuity and resistance between terminals.

Terminal	Resistance (Ω)
3 - 1 3 - 2	0.35 0.80

CONTROL PANEL



CONNECTOR PIN DESCRIPTION

Item	PIN NO.	PIN Name	Item	PIN NO.	PIN Name
	1	ILL +		1	Middle low
	2	Intake (Fresh)		2	Middle high
	3	-		3	High
	4	Sensor voltage (5V)		4	Ground
	5	Mix feedback		5	Common
	6	Mix (Warm)		6	Low

Main Connector (A)	7	Mode (Face - floor)	Front blower (C)	7	ILL+
	8	Mode (Floor - defrost)		8	ILL-
	9	Check coupler			
	10	IG1			
	11	ILL -			
	12	Intake (Recirculation)			
	13	C5 joint (Blower on)			
	14	Sensor ground			
	15	Mix (Cool)			
	16	Mode (Face)			
	17	Mode (Floor)	Rear auxiliary control switch	1	Low
	18	Mode (Defrost)		2	Middle
	19	B+		3	High
	20	Ground		4	Ground
Main Connector (B)	1	Thermistor		5	-
	2	-		6	Auxiliary relay ground
	3	-		7	ILL +
	4	-		8	ILL -
	5	A/C Select high			
	6	Rear heater switch			
	7	-			
	8	-			
	9	-			
	10	-			
	11	-			
	12	-			
	13	A/C Thermo high			
	14	-			
	15	-			
	16	-			

SEDONA MANUAL

DEFROST LOGIC

1. IG-ON/OFF logic

Condition	Mode	A/C	Intake
IG OFF	-	-	Fresh
IG ON	Face, Face - floor	Memory	Memory
	Floor	Memory	Fresh
	Defrost, Floor - defrost	ON	Fresh

NOTE

Memory function
1) When moving blower switch off to on, A/C and intake are changed to previous status.
2) At initial the battery on, the A/C is off and the intake is changed to fresh status.
3) At blower switch off, the intake is changed to fresh status.

2. Defrost, Floor - defrost logic

Mode		A/C output	A/C indicator	Intake
Defrost, Floor - defrost	ON	ON	Previous	Fresh
	OFF	Indicator status	Previous	Previous

NOTE

The intake button enables to change the intake status at defrost and floor - defrost mode.
The A/C button enables to change the A/C button indicator status, but A/C output is always on at defrost and floor - defrost mode.
Be impossible to enter defrost and floor - defrost logic again as defrost ↔ floor - defrost changing.

3. Function of MAX A/C

Condition	Mode	A/C	Intake
Blower off	Face	OFF	Fresh
Blower on (Step : 1, 2, 3, 4)	Face	ON	Recirculation

4. Dissolution & Reinstatement of logic
(1) Turn off the blower switch.
(2) Move to defrost mode.
(3) Press the intake button more than 5 times within 3 seconds.
(4) Indicator of intake button is flashed 3 times.
(5) Dissolution & reinstatement of logic is completed.
(6) A/C and intake status is initialized to "A/C off" and "fresh status"

NOTE

When the battery happens to be disconnected or disconnected or discharged, the logic is reinstated.

r e s t r a i n t

DESCRIPTION AND OPERATION

The supplemental restraint system (SRS AIRBAG) is designed to supplement the seat belt to help reduce the risk or severity of injury to the driver and passenger by activating and deploying the driver and passenger side airbag in certain frontal or side collisions.

The SRSCM type equipped with this model is HAE-3.

HAE-3 is applied for DAB + PAB + 2BPT.

The SRS (Airbag) consists of : a driver side airbag module located in the center of the steering wheel, which contains the folded cushion and an inflator unit ; a passenger side airbag module located in the passenger side crash pad contains the folded cushion assembled with inflator unit ; side airbag modules located in the driver and passenger seat contain the folded cushion and an inflator unit. SRSCM located on the floor under the heater core which monitors the system, an accelerometer which senses the vehicle deceleration, a spring interconnection (clock spring) located within the steering column; system wiring and wiring connector; and a knee bolster located under the steering column. The impact sensing function of the SRSCM is carried out by electronic accelerometer that continuously measure the vehicle's acceleration and delivers a corresponding signal through amplifying and filtering circuity to the microprocessor.

Deployment of the airbag is designed to occur in frontal or near-frontal or side impacts of moderate of severe force.

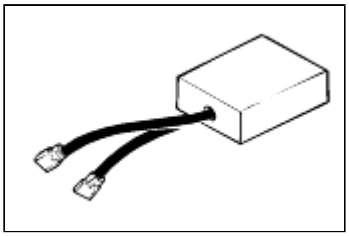
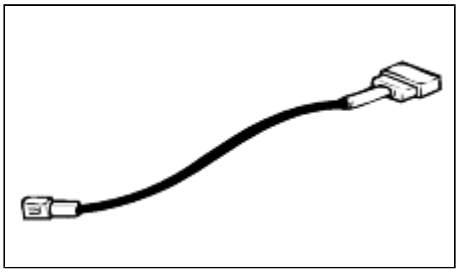
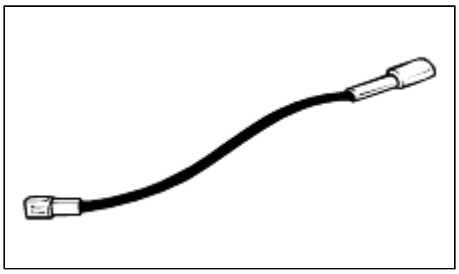
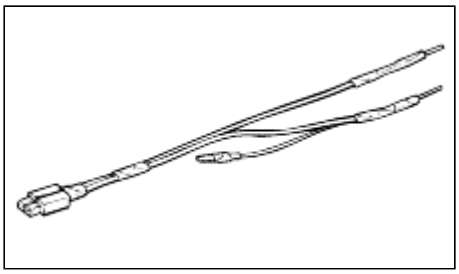
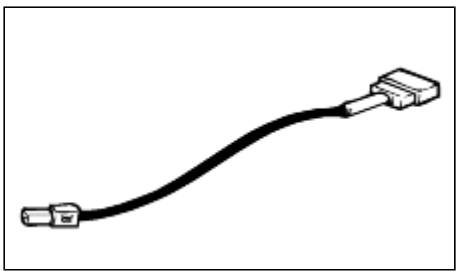
Only authorized service personnel should do work on or around the SRS components. Those service personnel should read this manual carefully before doing any such work. Extreme care must be used when servicing the SRS to avoid injury to the service personnel (by inadvertent deployment of the airbag) or the driver (by render the SRS inoperative).

CUSTOMER CAUTIONS

Failure to carry out service operations in the correct sequence could cause the airbag system to unexpectedly deploy during servicing, possibly leading to a serious injury Further, if a mistake is made in servicing the airbag system, it is possible that the airbag may fail to operate when required. Before performing servicing (including removal or installation of parts, inspection or replacement), be sure to read the following items carefully.

1. Be sure to proceed airbag related service after approx. 30 seconds or longer from the time the ignition switch is turned to the LOCK position and the negative (-) terminal cable is disconnected from the battery. The airbag system is equipped with a back-up power source to assure the deployment of airbag when the battery cable is disconneted by an accident. The back-up power is available for approx. 150ms.
2. When the negative(-) terminal cable is disconnected from the battery, memory of the clock and audio systems will be canceled. So before starting work, make a record of the contents memorized by the audio memory system. When the work is finished, reset the audio system and adjust the clock.
3. Malfunction symptoms of the airbag system are difficult to confirm, so the diagnostic codes become the most important source of information when troubleshooting.
4. When troubleshooting the airbag system, always inspect the diagnostic codes before disconnecting the battery.
5. Never use airbag parts from another vehicle. When replacing parts, replace them with new parts.
6. Never attempt to disassemble and repair the airbag modules (DAB,PAB, BPT), clock spring and wiring in order to reuse them.
7. If any component of SRS has been dropped, or if there are cracks, dents or other defects in the case, bracket or connector, replace them with new ones.
8. After work on the airbag system is completed, perform the SRS SRI check
   The airbag indicator lamp can be interrupted by other curcuit fault in some cases. Therefore if the airbag indicator lamp goes on, be sure to erase the DTC codes using Hi-scan just after repairing or replacing the troubled parts including fuse.
9. Especially in case of welding the body, never fail to disconnect the battery negative (-) terminal.

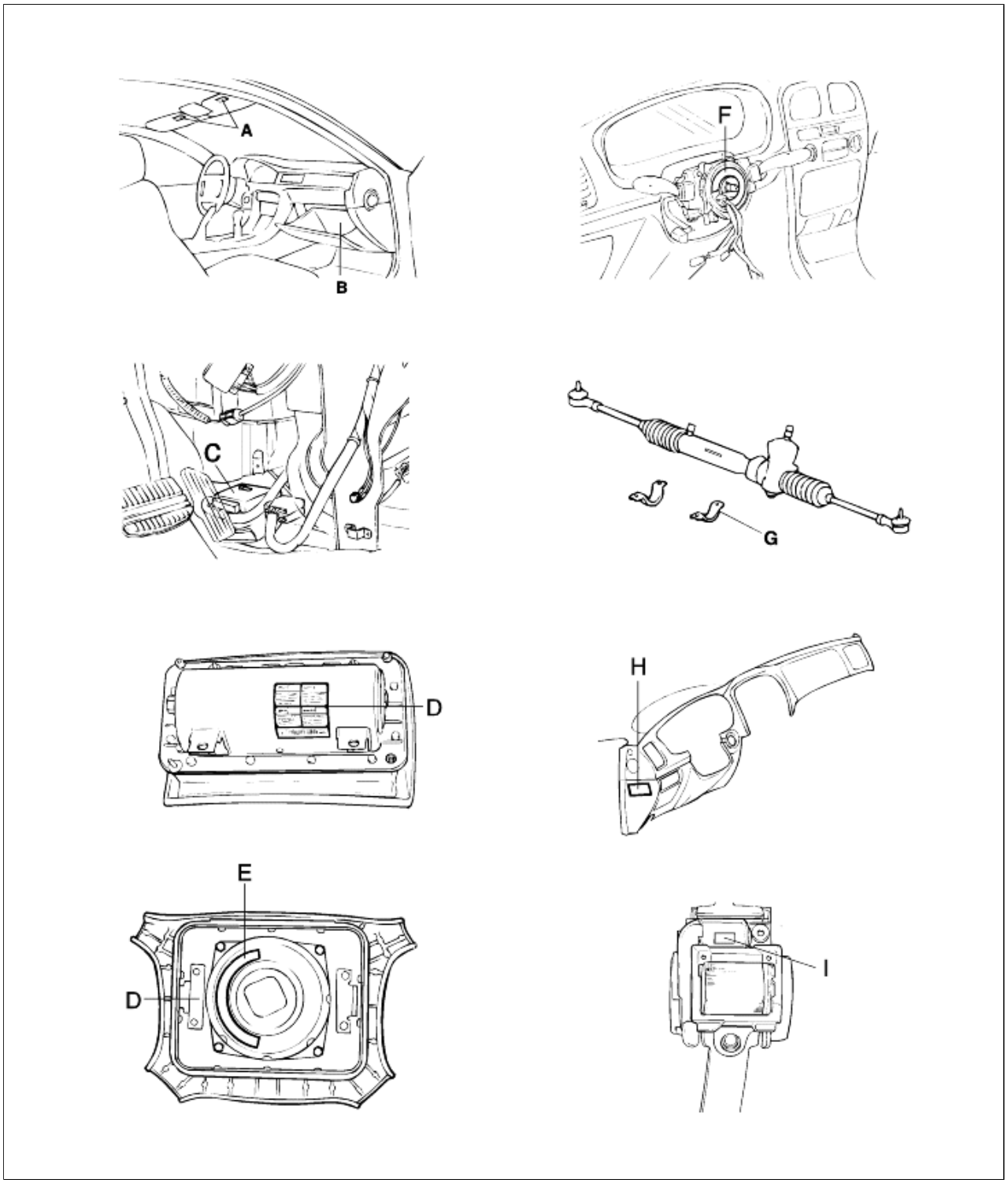
SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Use
0957A-38200 Dummy		Simulator to check the resistance of each wiring harness (Use with 0957A-38000, 0957A-38300, 0957A-38400)
0957A-38300 Dummy adapter		Adapter to connect DAB, PAB
0957A-38400 Dummy adapter		Adapter to connect BPT
0957A-38000 Diagnosis checker		Wiring harness checker of each module (use with 0957A-38200, 0957A-38300, 0957A-38400)
0957A-38100 Deployment adapter		Deployment adapter (Use with 0957A-34100A)

WARNING/CAUTION LABELS

A number of caution labels relating to the SRS are found in the vehicle, as shown in the following illustration. Follow label instructions when servicing SRS.

If labels are dirty of damage replace them with new ones



A. DAB + PAB Caution TO AVOID SERIOUS INJURY: 1) For maximum safety protection in all types of crashes, you must always wear your safety belt. 2) Do not install rearward-facing child seats in any front	B. Supplemental restraint system (airbag) information The airbag is a supplemental restraint system (SRS). You must always wear the seat belts. The airbag system condition is normal if "SRS"lamp in cluster flashes approximately 6 times after ignition key is turned on and then goes out. If any of the following conditions occur, the system must be

passenger seat position. 3) Do not sit or lean unnecessarily close to the airbag. 4) Do not place any objects over the airbag or between the airbag and yourself. 5) See the owner's manual for further information and explanation.	serviced: 1) "SRS"lamp does not light when key is turned on. 2) "SRS"lamp stays lit or flashes continuously. 3) The airbag has inflated. The airbag system must be inspected by an authorized dealer ten years after vehicle manufacture date shown on certification label located on left front door opening area.
C. Caution : airbag control unit Detach connector before removing. Assemble strictly according to manual instructions.	D. Caution : supplemental restraint system module To help avoid personal injury due to unwanted inflation do not service or dispose of this unit without following instructions in the service manual.
E. Warning Contents are poisonous and extremely flammable. Do not probe with electrical devices or otherwise tamper with in any way. Servicing of this unit must be performed only by authorized personnel.	F. Caution : SRS clock spring This is not a repairable part. Do not disassemble or tamper. If defective replace entire unit per service manual instructions. To re-center rotate clockwise until tight. Then rotate in opposite direction approximately 3 turns and align ><. Failure to follow to instructions may render SRS system inoperative risking serious driver injury.
G. Caution : SRS Before removal of steering gearbox, read service manual, center front wheels and remove ignition key. Failure to do so may damage SRS clock spring and render SRS system inoperative, risking serious driver injury.	H. Warning This car is equipped with a side airbag in each front seat. 1) Do not use any accessory seat covers. 2) Use of other seat covers could reduce the effect of the system. 3) Do not install any accessories on the side or near the side airbag. 4) Do not use excessive force on the side of the seat. 5) For further information, see owner's manual.
I. Attention Do not open, remove or put into another vehicle.	

ELECTRICAL SYSTEM

The SRS airbag system has sophisticated electrical and electronic components, therefore the airbag operating components should be handled very carefully.

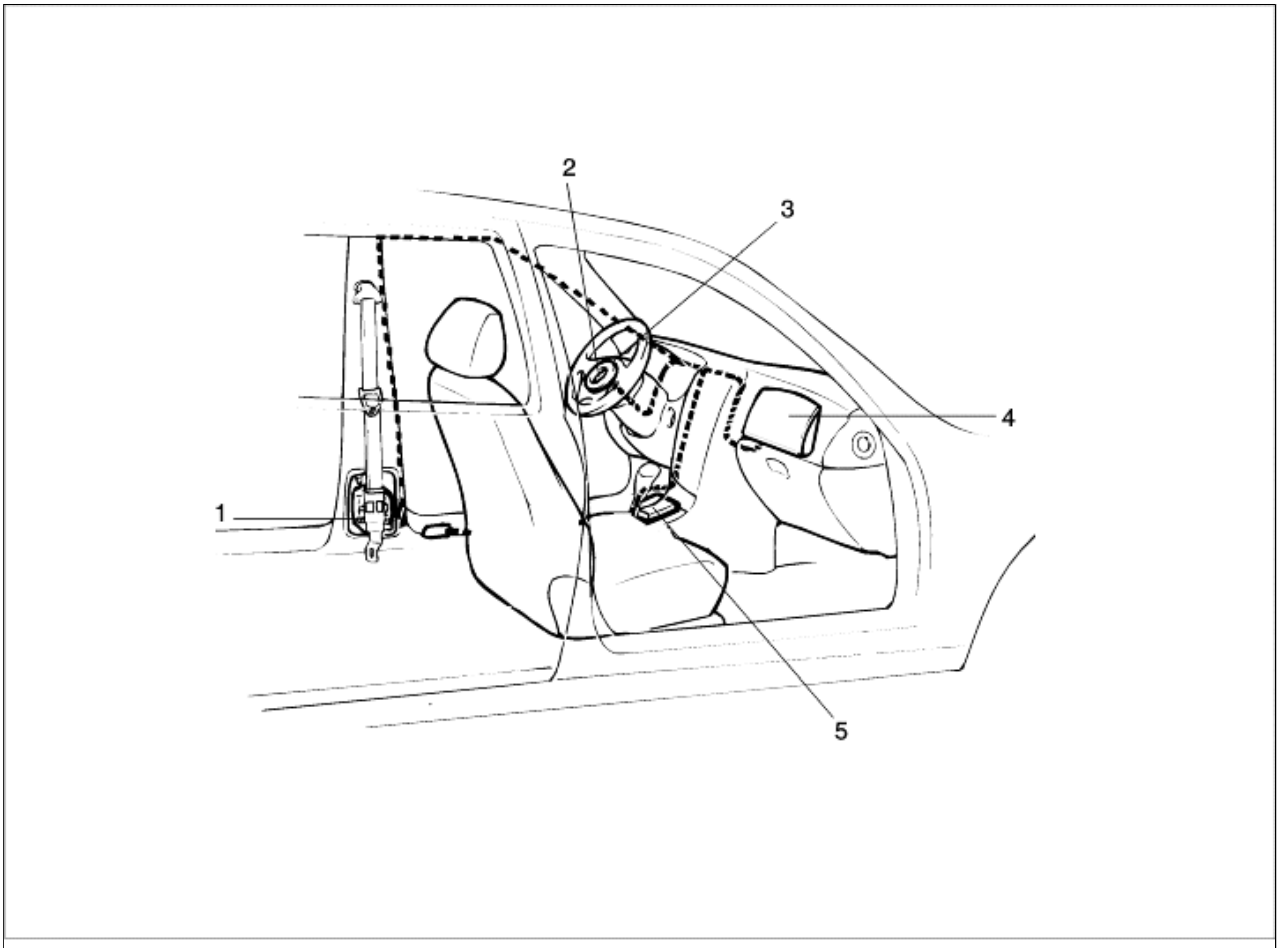
1. SRSCM (Supplemental Restraint System Control Module).
2. SRSCM determines to deploy the airbag module by sensing the frontal and side impact sensed by the sensor built in SRSCM.
   A. DC/DC convertor : The power supply DC/DC converters include a step-up and step-down converter, which provides the firing voltage for two firing circuits and the internal operating voltage. If the internal operating voltage falls below a defined threshold, a reset is executed.
   B. Arming sensor/safing sensor : The arming/safing sensor built in the airbag firing circuit has the function of arming the airbag circuit under all required deployment conditions and maintaining the airbag firing circuits unarmed under normal driving conditions. The safing sensor is a dual-contact electromechanical switch which closes if it experiences a deceleration exceeding a specified threshold.
   C. Back-up power : The SRSCM reserves the energy supply to provide deployment energy for a short second when the vehicle voltage is low or if lost in a vehicle frontal crash.
   D. Malfunction detection : The SRSCM continuously monitors the current SRS operation status while the ignition key is turned on and detects the malfunction of the system. The malfunction can be displayed in the form of diagnostic trouble code using scan tool (Hi-scan).
   E. MIL (Malfunction Indication Lamp) notification : If any fault is detected, the SRSCM sends signal to the indicator lamp on the cluster to warn the vehicle driver. The MIL indicator is the key to driver notification of SRS faults. Verify lamp and SRSCM operation by flashing 6 times when the ignition switch is first turned on.
   F. Malfunction recording : Once a fault occurred in the system SRSCM records the fault in the memory in the form of DTC and the DTC can only be erased with the scan tool.
   G. Data link connector : The SRSCM memory stored data is accessed through the OBD-II Data Link Connector (DLC) using a scan tool. The DLC is located underneath the driver side crash pad.
   H. After firing the airbags once, the SRSCM cannot be used again and must be replaced.
   I. Crash output
   The crash output is used to control an external device such as door control module in case of a crash event.
   The crash output is specified as follows : The crash output is open-collector type switch logic output with 500mA of sine

current and its output impedance is 100Ω. The crash output is switched to ground for 200ms after the crash detected.

INFLATOR MODULE (DAB, PAB)

DAB (Driver airbag)and PAB (Passenger airbag) module are comprised of inflator and cushion. The initiator (A gas generator igniting device) is assembled in the inflator.

When the vehicle is in a frontal or side crash of sufficient force to close the sensor of SRSCM, current is developed through the deployment loop. Current passing through the initiator ignites the material in the DAB and PAB module and inflates the airbag.



1. BPT
2. DAB
3. Clock spring
4. PAB
5. SRSCM

1. When removing the airbag module or handling a new airbag module, it should be placed with the pad top surface facing up. In this case, the twin-lock type connector lock lever should be in the lock state and care should be taken to place it so the connector will not be damaged. Do not store a steering wheel pad on top of another one. (Storing the pad with its metallic surface up may lead to a serious accident if the airbag should inflate for some reasons.)
2. Never measure the resistance of the airbag squib. (This may cause the airbag to deploy, which is very dangerous.)
3. Store the airbag module where the ambient temperature remains below 93°C (200°F), without high humidity and away from electrical noise
4. When using electric welding, disconnect the airbag connectors under the steering column near the MULTI-FUNCTION SWITCH connector before starting work.

SRS HARNESS

The SRS harness is wrapped in a yellow split-wrap tube so that it can be easily identified from the other vehicle harness. A shorting bar is included inside the wiring connectors of DAB, PAB and BPT inflator side. The shorting bar shorts the current flow DAB, PAB and BPT module circuit when the connectors are disconnected. The circuits to the inflator module are shorted in this way to help prevent unwanted deployment of the airbag when servicing the airbag module.

SRSCM INDEPENDENT LAMP ACTIVATION

The SRS malfunction indicator lamp (MIL) is located on the cluster and provides information of SRS operating conditions by the control signals from SRSCM.

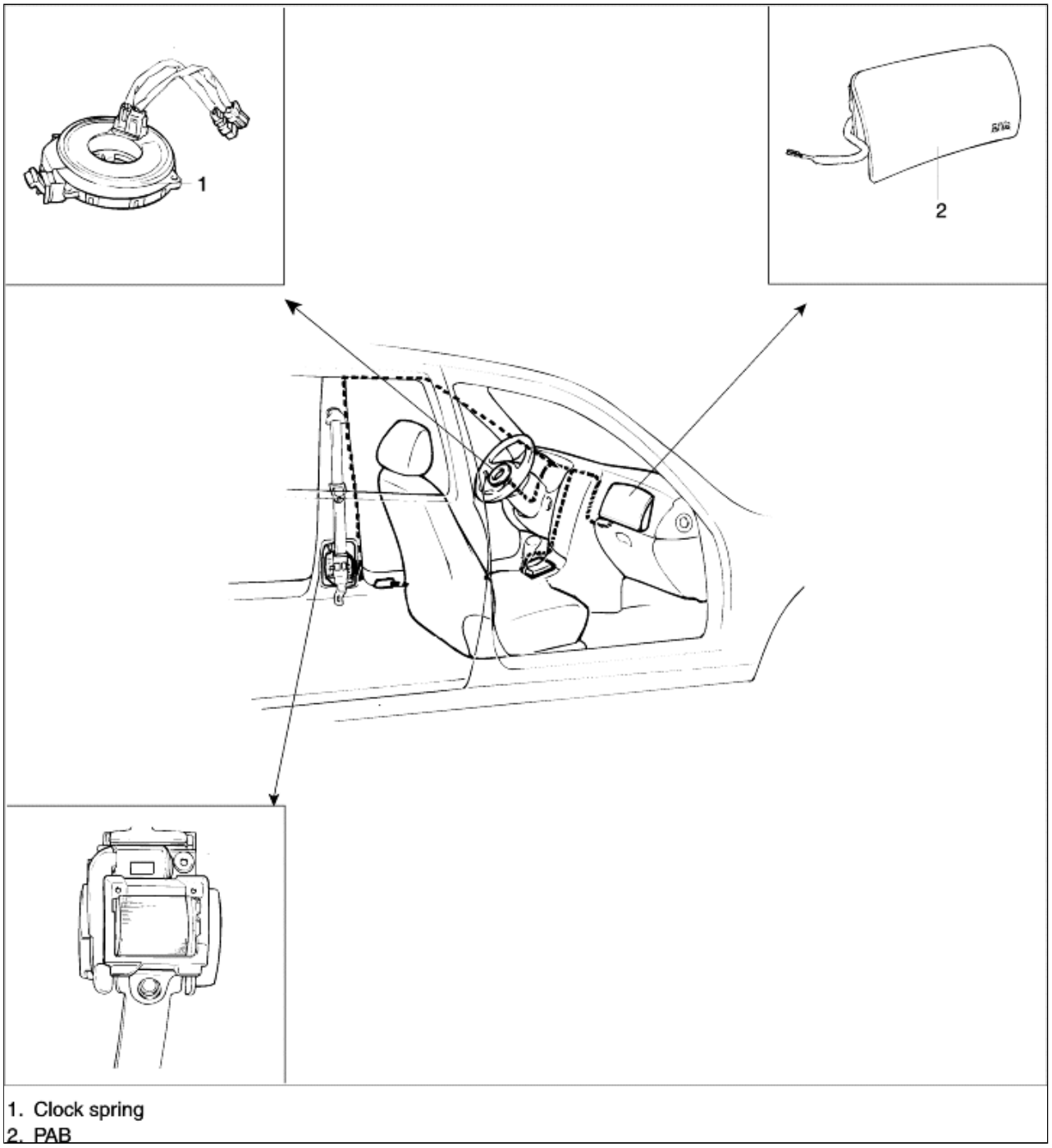
There are certain fault conditions in which the SRSCM (SRS Control Module) cannot function and thus cannot control the operation of the lamp. In these cases, the lamp is directly activated by appropriate circuitry that operates independently of the SRSCM, as follow:

1. Loss of ignition voltage supply to the SRSCM : lamp turned on continuously.
2. Loss of internal operating voltage : lamp turned on continuously.
3. RSCM not connected : lamp turned on through shorting bar in wiring harness connector.

MIL OPERATING METHOD

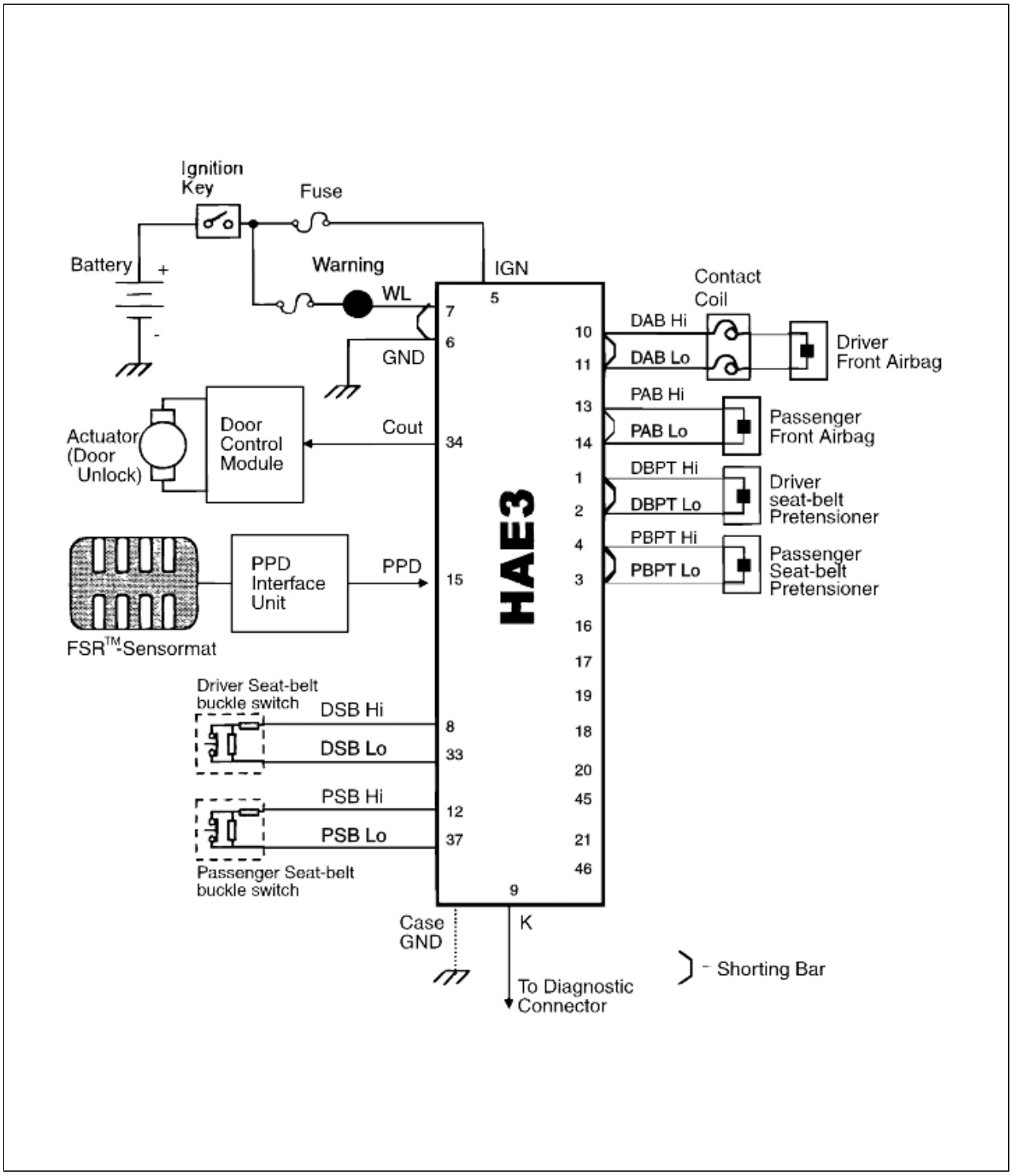
	Operating situation	Operating method
RUNNING	• Return to normal from temporary fault	ON →OFF
	• ΣFaults frequency ≥ 5 • Active fault	Turn it on continuously
STARTING	• Normal	Blink 6 fimes
	• ΣFaults frequency ≤ 4	On to off after 6 seconds
	• ΣFaults frequency ≥ 5 • Active fault	Turn's on continuously

SYSTEM COMPONENT AND LAYOUT

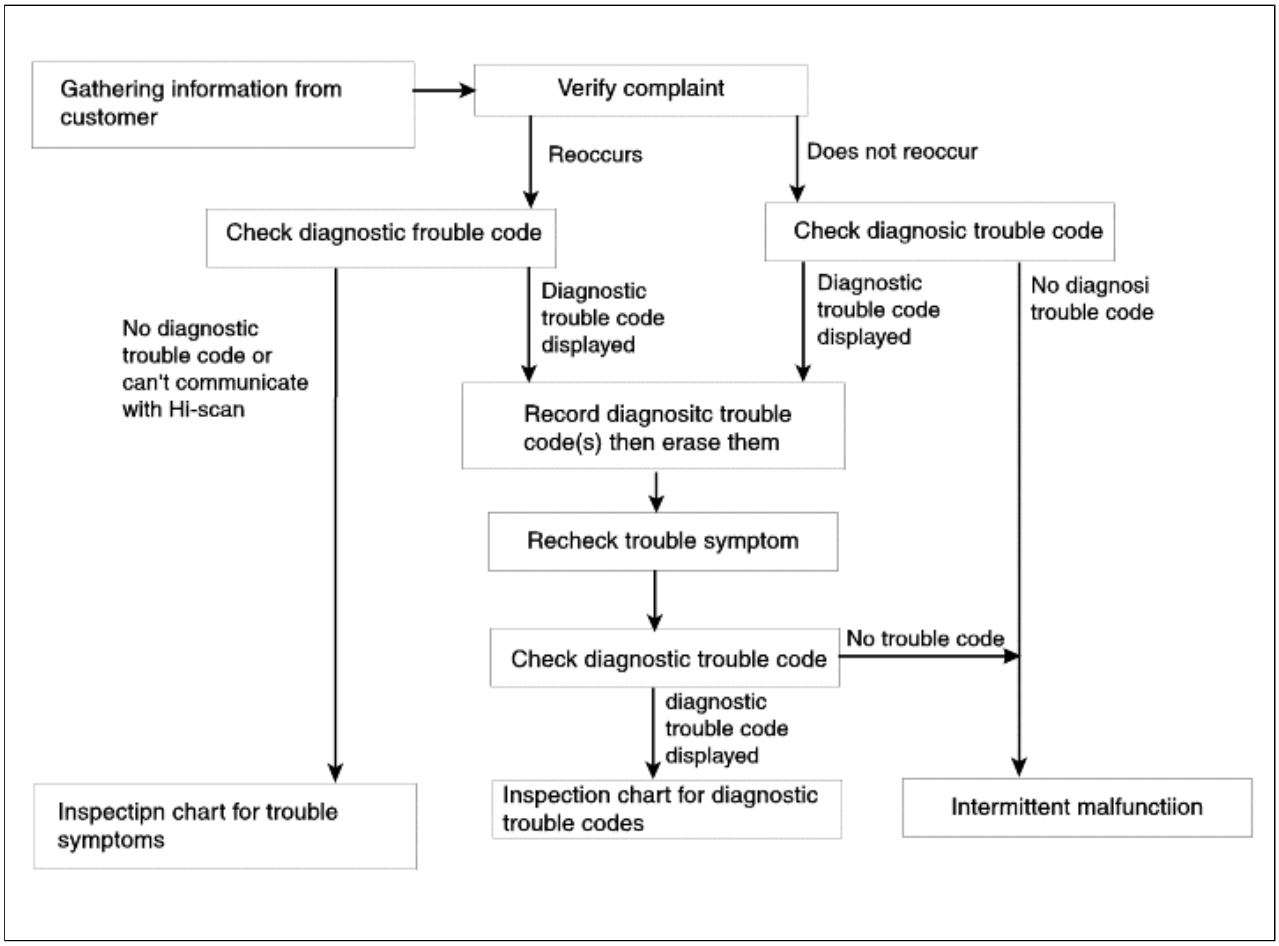


1. Clock spring
2. PAB

CIRCUIT DIAGRAM



DIAGNOSTIC TROUBLESHOOTING FLOW



SPECIFICATION

Items \ Squibs	DAB	PAB	BPT
Resistance	2 Ω ± 0.3 Ω		2.15 Ω ± 0.35 Ω
No-fire current	0.36 A for 10 sec	0.25 A for 10 sec	200mA for 10 sec
All-fire current	1.2 A for 3 msec	1.2A for 2 msec	800mA for 2 ms
Cyclic test current	100mA continous		40mA continous

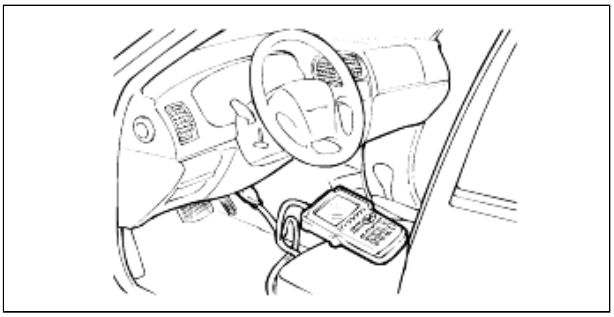
CAUTION

Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

DIAGNOSIS WITH HI-SCAN

CHECK PROCEDURES

1. Connect the Hi-scan DLC to the vehicle data link connector located underneath the dash panel.

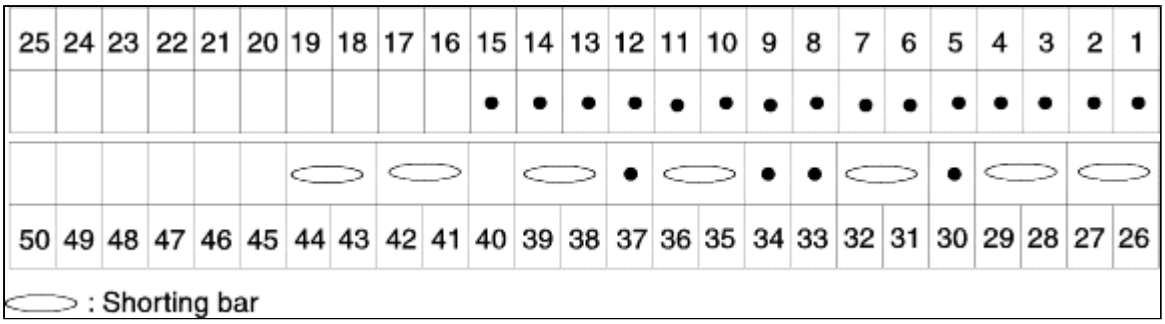


2. Turn the ignition key to "ON" position and turn on Hi-scan.
3. Perform the SRS diagnosis according to the vehicle model configuration.
4. If a fault code is retrieved, then replace the component. Never attempt to repair the component.
5. If the Hi-scan finds that a component of the system is faulty, there is a possibility that the fault is not in the components but in SRS wiring or connector.

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODE

DTC No.	Fault description
B1111	Battery voltage too high
B1112	Battery voltage too low
B1346	DAB resistance too high or open
B1347	DAB resistance too low or short
B1348	DAB short to GND
B1349	DAB short to battery
B1352	PAB resistance too high or open
B1353	PAB resistance too low or short
B1354	PAB short to GND
B1355	PAB short to battery
B1361	Driver seat belt pretensioner resistance too high or open
B1362	Driver seat belt pretensioner resistance too low or short
B1363	Driver seat belt pretensioner short to GND
B1364	Driver seat belt pretensioner short to battery
B1367	Passenger seat belt pretensioner resistance too high or open
B1368	Passenger seat belt pretensioner resistance too low or short
B1369	Passenger seat belt pretensioner short to GND
B1370	Passenger seat belt pretensioner short to battery
B1407	PPD communication error
B1406	PPD defect
B1661	ECU mismatching
B1511	Driver seat belt buckle switch short to battery or open
B1512	Driver seat belt buckle switch short to GND or short
B1513	Passenger seat belt buckle switch short to battery or open
B1514	Passenger seat belt buckle switch short to GND or short
B1650	Crash recorded front airbag
B1655	Crash recorded side airbag
B1657	Ignition recorded belt pretensioner
B2500	Warning lamp failure
B1620	Internal fault

SRSCM CONNECTOR (SRE-HMC)



PIN DESCRIPTION

Pin #	Description	In/Out
1	Belt pretensioner high (Driver side)	O
2	Belt pretensioner low (Driver side)	O
3	Belt pretensioner low (Passenger side)	O
4	Belt pretensioner high (Passenger side)	O
5	Battery supply	I
6	GND	I
7	Warning lamp	O
8	Seat-belt buckle switch high (Driver side)	O
9	K-diagnostic line	I,O
10	Front airbag high (Driver side)	O
11	Front airbag low (Driver side)	O
12	Seat-belt buckle switch high (Passenger side)	O
13	Front airbag high (Passenger side)	O
14	Front airbag low (Passenger side)	O
15	PPD	O
16	Not used	-
17	Not used	-
18	Not used	-
19	Not used	-
20	Not used	-
21	Not used	-
22-25	Not used	-
26-29	Shorting bar	-
30	Battery voltage output for seat-belt buckle switch	O
31-32	Shorting bar	-
33	Seat-belt buckle switch low (Driver side)	I
34	Crash output	O
35-36	Shorting bar	-
37	Seat-belt buckle switch low (Passenger side)	I

38-39	Shorting bar	-
40	Not used	-
41-44	Shorting bar	-
45	Not used	-
46	Not used	-
47-50	Not used	-

FIELD DEPLOYMENT PROCEDURES

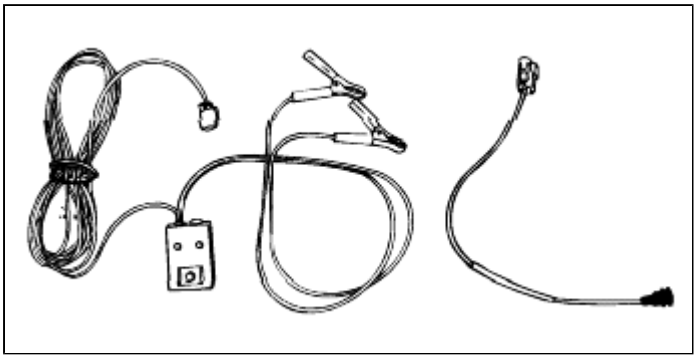
CAUTION

When handling the deployed airbag, be careful not to let the by-product dust enter to eye and always wear gloves to avoid direct contact the by-product material.

Airbag module disposal procedures

Before either disposing of a vehicle equipped with an airbag, or prior to disposing of the airbag module, be sure to first follow the procedures described below to deploy the airbag.

Airbag remote delpoyment devices

Tool, Number, Name	Use
Deployment tool (0957A-34100-A) SRS DEPLOYMENT ADAPTER HARNESS DAB : 0957A-38000 PAB : 0957A-34200 	o Deployment inside the vehicle (when vehicle will not longer be driven)

DISPOSAL PLAN

When the problem occurs, take disposal steps as follows.

Case		Disposal plan
Abnormal problems in airbag module		Return to KMC
Car scrapping	DAB, PAB, BPT	Deploy the airbag module in the scrapper yard with SST
Crash (Deployed)		Service station disposes the airbag module

UNDEPLOYED AIRBAG MODULE DISPOSAL

CAUTION

1) If the vehicle is to be scrapped, junked, or otherwise disposed of, deploy the airbag inside the vehicle.
2) Since there is a loud noise when the airbag is deployed, avoid residential areas whenever possible. If anyone is nearby, give warning of the impending noise.
3) Since a large amount of smoke is produced when the airbag is deployed, select a well-ventilated site. Moreover, never attempt the test near a fire or smoke sensor.

DEPLOYMENT INSIDE THE VEHICLE

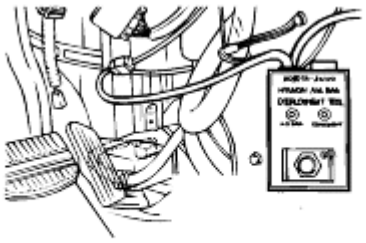
WHEN VEHICLE WILL NO LONGER BE DIRVEN

1. Open all windows and doors of the vehicle. Move the vehicle to an isolated spot.
2. Disconnect the negative (-) and positive (+) battery cables from the battery terminals, and then remove the

battery from the vehicle.

CAUTION

Wait at least 30 seconds after disconnecting the battery cable before doing any further work.



Airbag
Deployment Tool
0957A-34100-A

3. Remove the center crash pad side cover.
4. Disconnect airbag SRSCM connector.
5. Connect deployment tool to the connector of each module.
6. At location as far away from the vehicle as possible, press the push button (removed from the vehicle) to deploy the airbag.

CAUTION

1) Before deploying the airbag in this manner, first check to be sure that there is no one in or near the vehicle. Wear safety glasses.
2) The inflator will be quite hot immediately following the deployment, so wait at least 30 minutes to allow it to cool before attempting to handle it.
   Although not poisonous, do not inhale gas from airbag deployment.
   See Deployed Airbag Module Disposal Procedures for post-deployment handling instructions.
3) If the airbag fails to deploy when the procedures above are followed, do not go near the module. Contact your local distributor.

DEPLOYMENT OUTSIDE VEHICLE

CAUTION

1) Failure to follow all warnings, cautions, notices and procedures could result in personal injury or death.
2) Surface of a deployed airbag may contain small amounts of sodium hydroxide(NaOH). Prevent contact of airbag module with liquids, combustibles, and flammable materials. Immediately wash hands and exposed skin areas with mild soap and water. Flush eyes with water if exposed to by products. Failure to following these instructions could result in chemical burns and personal injury.
3) A live(undeployed) airbag module may accidently deploy during handling. When carrying a live airbag module, point trim cover away from your body to lessen chance of injury in case of accidental deployment. Never carry module by its wiring or connectors.
4) Always place live airbag modules face up to lessen motion of module in case of accidental deployment. Keep area clear of parts, tools, and debris.
5) Never place items on or above trim cover of a live airbag module. In case of accidental deployment, such items may cause serious injury or death.
6) Damaged airbag modules should be stored away from all acids, halogens, heavy metals, and metal salts. Damaged units may produce hydrozoic acid if exposed to liquids. If an undeployed airbag module or inflator is ruptured or tampered with, refer to particular module's msds(Material Safety Data Sheet) for important information concerning constituents of undeployed modules. Exposure to high concentrations of airbag porpellant mixture can cause headaches, nausea, blurred vision, faintness, cyanosis, lowering of blood pressure or tachycardia. Failure to comply with this warning can result in

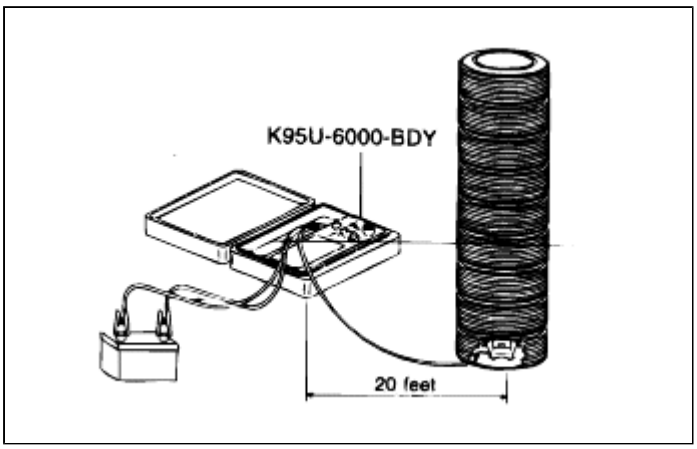
fire, noxious fumes, severe personal injury, or death.

7) Air bag module components are very hot after deployment. Units should be deployed outdoors or in an open area to preventfires. Allow components at least twenty minutes to thoroughly cool. Cooling modules should be continuously monitored toensure hot components do not create fires with spilled liquids or other debris. Failure to allow unit to cool could result in burns, fires or personal injury.
8) Always wear rubber gloves and safety glasses when handling a deployed airbag module.

CAUTION

Storage, transportation, disposal and recycling of airbag module and components must be performed in accordance with allapplicable state and local regulations including, but not limited to, environmental protection, occupational health andsafety, and transportation.
Failure to follow the following procedures could result in personal in jury or death.

1. Remove battery.
2. Wait 30 seconds before proceeding.
3. Disconnect appropriate airbag module, and remove from vehicle.
4. Locate airbag in an area that will provide protection to personnel when it deploys. An example of a safe deployment siteis a stack of used tires, 6-8 high, with undeployed bag located inside column of tires.

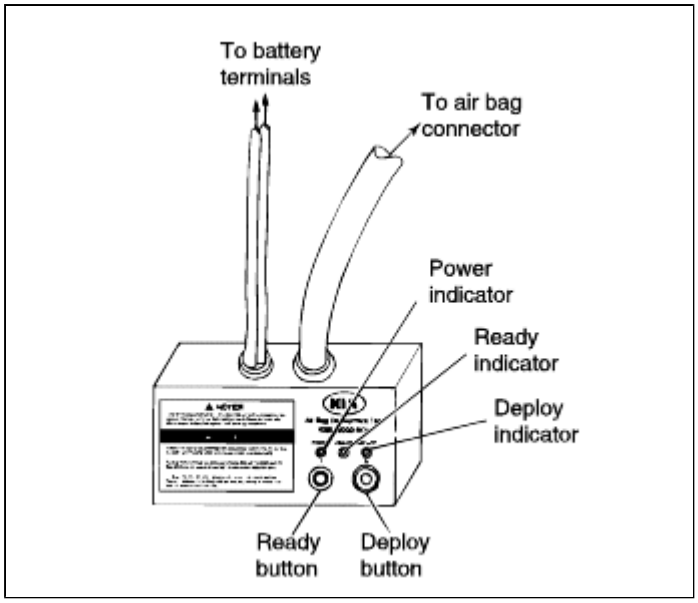


5. Connect the airbag Deployment Tool (K95U-6000-BDY) to the airbag module connector, and position the deployment tool 20 feet away from the deployment site.
6. Connect the red lead to the positive terminal of the battery.
7. Connect the black lead to the negative battery terminal.

CAUTION

DO NOT PLACE THE AIRBAG WITH THE TRIM COVER FACING DOWN, AS THE FORCE OF THE DEPLOYING AIRBAG COULD CAUSE IT TO RICOCHET AND CAUSE PERSONAL INJURY.

8. Verify that green POWER indicator on deployment tool is illuminated.
9. Depress and hold READY button (button number 1).
10. Verify that yellow READY indicator is flashing.
11. Depress and hold DEPLOY button (button number 2).
12. Verify that airbag module has deployed, If not, verify that red DEPLOY indicator is illuminated.
13. Release both READY and DEPLOY buttons.
14. Verify that both READY and DEPLOY indicators are no longer illuminated.



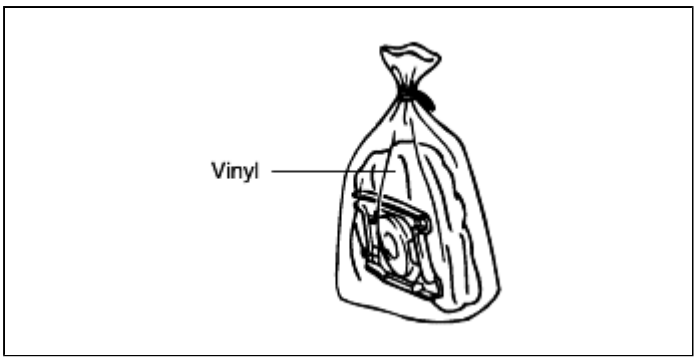
15. If airbag successfully deployed, allow a minimum of twinty minutes for bag to cool before handling. Monitor bag throughout cool-down period to ensure that hot components do not start a fire.
16. If airbag did not deploy, keep area around deployment site clear of personnel for a minimum of 30 minutes.
17. Disconnect the power leads from the battery.
18. Remove the airbag from the stack of tires carefully, wearing rubber gloves and eye/face protection to protect yourself from possible chemical exposure.
19. Dispose of the complete airbag assembly. No part of the airbag may be reused. Place the airbag into a sturdy plastic bagand seal securely. Dispose of the deployed airbag according to federal, state and local laws and regulations including,but not limited to, EPA and OSHA regulations.

20. Install battery.

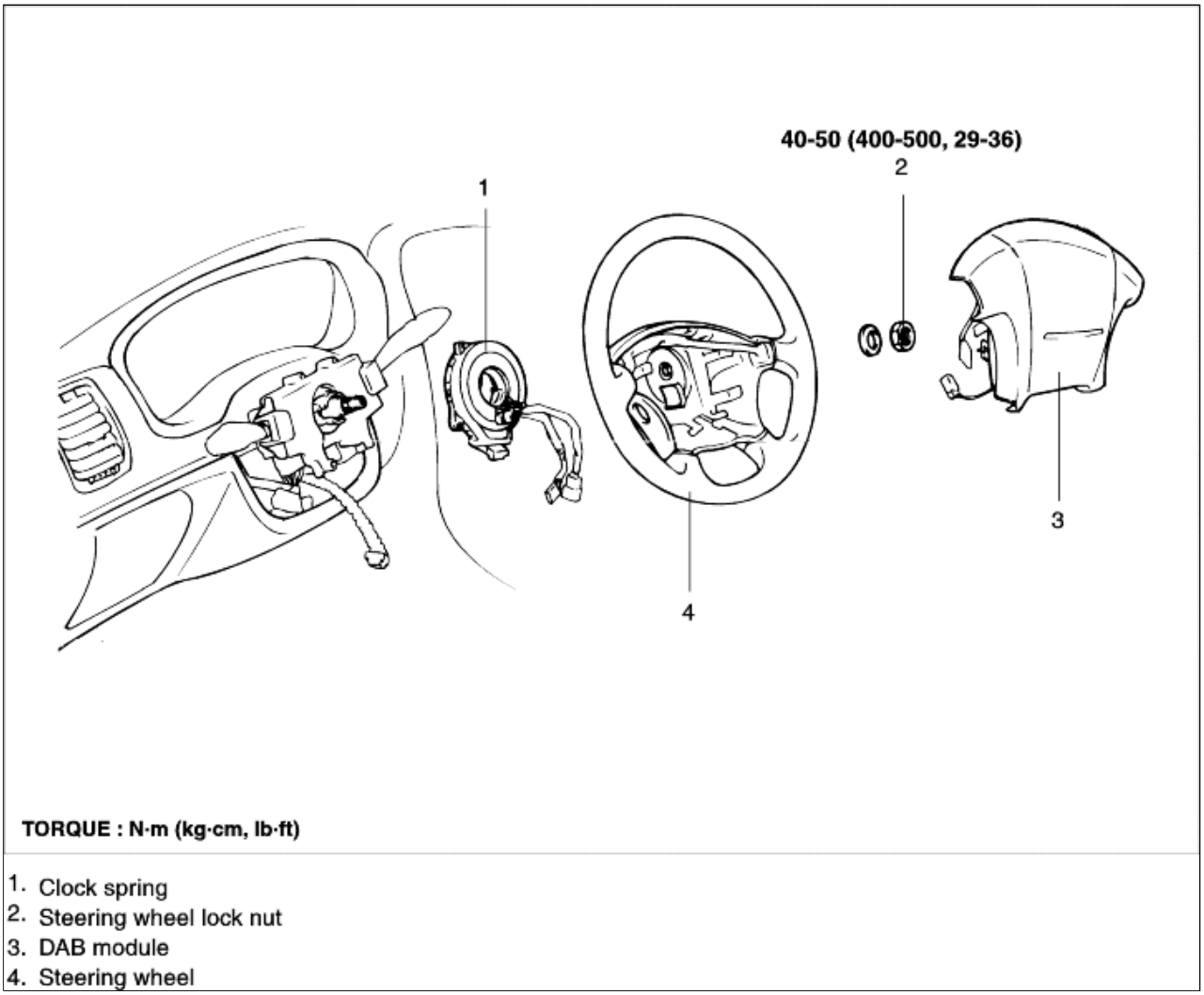
Deployed airbag module disposal procedures

After deployment, the airbag module should be disposed of in the same manner as any other scrap parts, except that the following points should be carefully noted during disposal.

1. The inflator will be quite hot immediately following deployment, so wait at least 30 minutes to allow it to cool before attempting to handle it.
2. Do not put water or oil on the airbag after deployment.
3. There may be, adhered to the deployed airbag module, material that could irritate the eyes and/or skin, so wear gloves and safety glasses when handling a deployed airbag module. IF DESPITE THESE PRECAUTIONS, THE MATERIAL DOES GET INTO THE EYE OR ON THE SKIN, IMMEDIATELY RINSE THE AFFECTED AREA WITH A LARGE AMOUNT OF CLEAN WATER. IF ANY IRRITATION DEVELOPS, SEEK MEDICAL ATTENTION.
4. Tightly seal the airbag module in a strong vinyl bag for disposal.
5. Be sure to always wash your hands after completing this operation.


Vinyl

COMPONENTS



1. Clock spring
2. Steering wheel lock nut
3. DAB module
4. Steering wheel

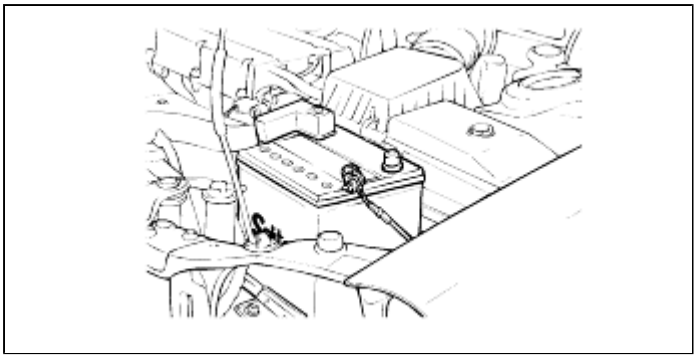
CLOCK SPRING

The clock spring (coil spring) consists of two current carrying coils. It is attached between the steering column and the steering wheel. It allows rotation of the steering wheel while maintaining continuous contact of the deployment loop through the inflator module.

The steering wheel must be fitted correctly to the steering column with the clock spring at the neutral position, otherwise cable disconnection andother troubles may result.

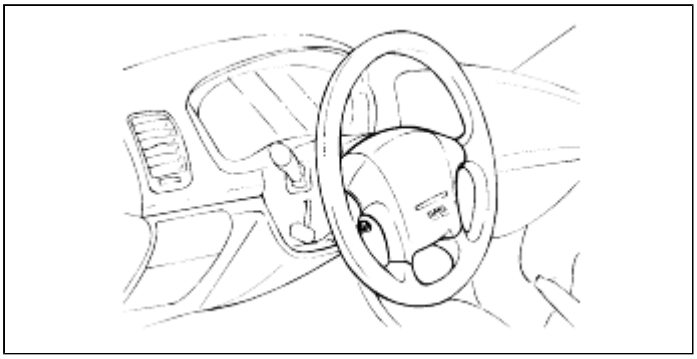
Removal

1. Disconnect the negative battery cable and keep it secured away from the battery.

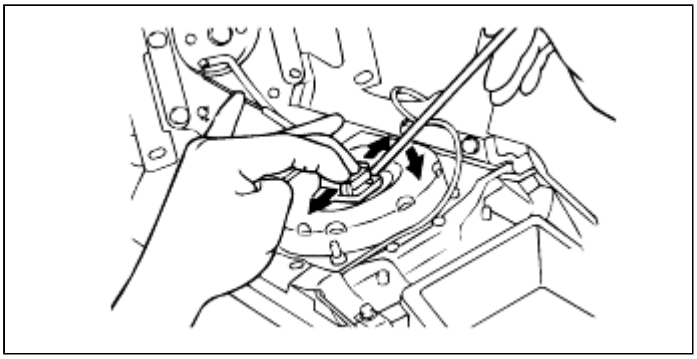


> CAUTION
>
> Wait at least 30 seconds after disconnecting the battery cable before doing any further work to prevent inadvertent deployment of the airbags.

2. When disconnecting the clock spring connector from the airbag module, pull the locking device on the connector outward and spread it open.

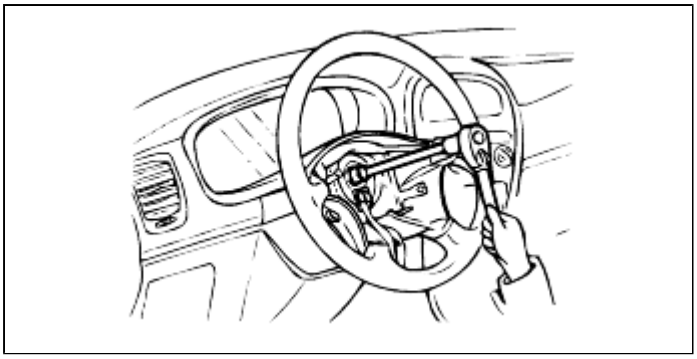


3. When disconnecting the connector of the clock spring from the airbag module, pull the airbag's lock toward the outer side to spread it open.



> CAUTION
>
> 1) When disconnecting the airbag module-clock spring connector, take care not to apply excessive force to it.
> 2) The removed airbag module should be stored in a clean, dry place with the pad cover face up.

4. Remove the steering wheel.



CAUTION

Do not hammer on the steering wheel. Doing so may damage the collapsible column mechanism, thus reducing the protection to the driver in a frontal crash.

INSPECTION(AIRBAG MODULE)

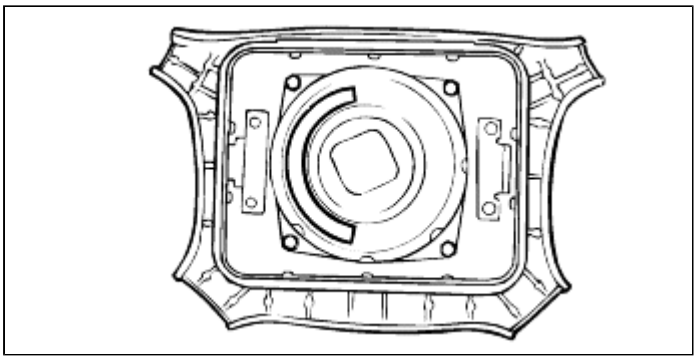
If any improper parts are found during the following inspection, replace the airbag module with a new one.

Dispose the old module according to the specified procedure.

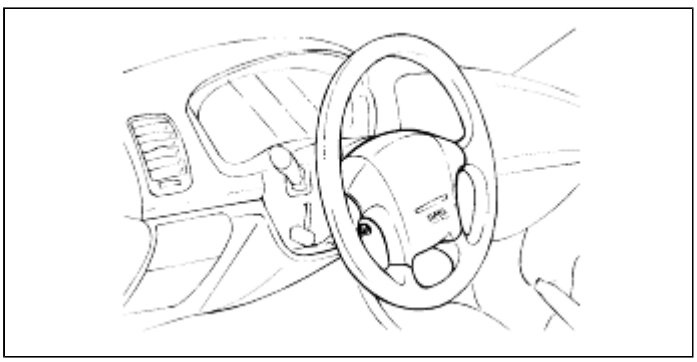
CAUTION

Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

1. Check pad cover for dents, cracks or deformities.
2. Check the airbag module for denting, cracking or deformation.
3. Check hooks and connectors for damage, terminals for defor-mities, and harness for binds.
4. Check airbag inflator case for dents, cracks or deformities.



5. Install the airbag module to steering wheel to check fit or align with the wheel.

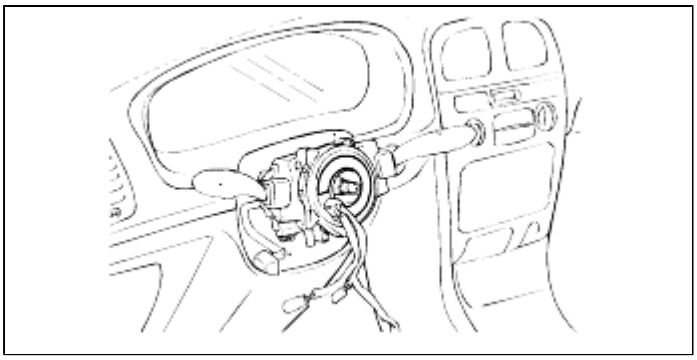


INSPECTION(CLCOK SPRING)

If, as a result of the following checks, even one abnormal point is discovered, replace the clock spring with a

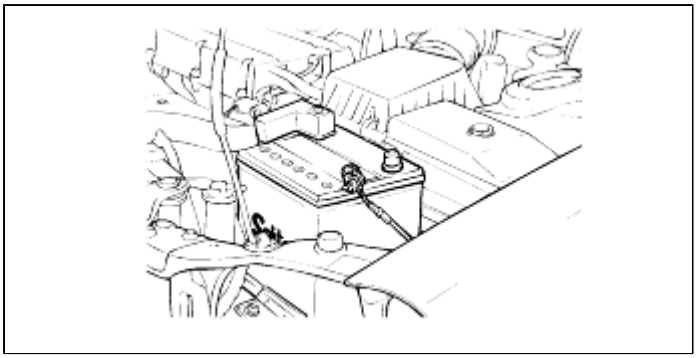
new one.

1. Check connectors and yellow protective tube for damage, and terminals for deformities.



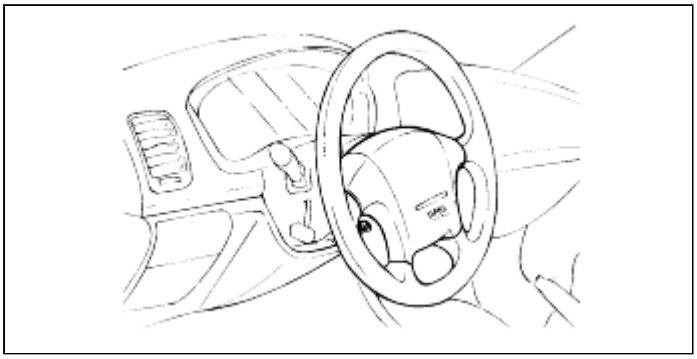
Removal

1. Disconnect the negative battery cable and keep it secured away from the battery.

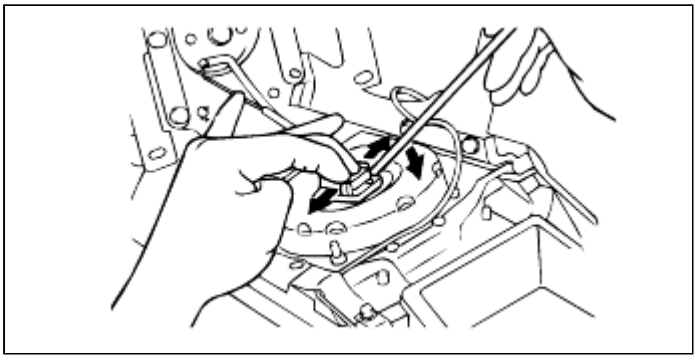


> CAUTION
>
> Wait at least 30 seconds after disconnecting the battery cable before doing any further work to prevent inadvertent deployment of the airbags.

2. When disconnecting the clock spring connector from the airbag module, pull the locking device on the connector outward and spread it open.



3. When disconnecting the connector of the clock spring from the airbag module, pull the airbag's lock toward the outer side to spread it open.



> CAUTION
>
> 1) When disconnecting the airbag module-clock spring connector, take care not to apply excessive force to it.
> 2) The removed airbag module should be stored in a clean, dry place with the pad cover face up.

4. Remove the steering wheel.

REASSEMBLY

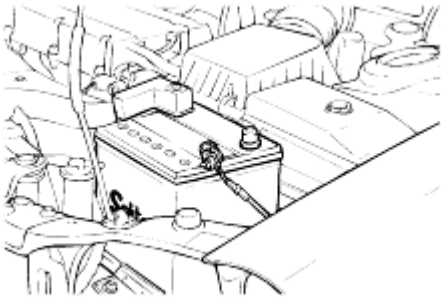
Refer to BD section of this manual for crash pad removal procedures.

REMOVAL

CAUTION

1) Never attempt to disassemble or repair the airbag module.
2) Do not drop the airbag module or allow contact with water, grease or oil. Replace it if a dent, crack, deformation or rust are detected.
3) The airbag module should be stored on a flat surface and placed so that the pad surface is facing upward. Do not place anything on top of it.
4) Do not expose the airbag module to temperature over 93°C (200°F)
5) An undeployed airbag module should only be disposed of in accordance with the procedures contained in this manual.
6) Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.
7) Whenever the PAB is deployed, it should be replaced with a new PAB assembled with an extension wire. When the PAB deploys, the squib melts making the extension wire on the deployed airbag module useless.

1. Disconnect the battery negative (-) terminal cable.



CAUTION

Wait at least 30 seconds in order to prevent inadvertent airbag deployment.

2. Remove the glove box.
3. Disconnect the PAB module connector.
4. Remove the crash pad assy and then do the PAB module.

PPD (Passenger presence detection)

The passenger presence detection system detects the presence of passenger in the seat. The system is designed primarily to prevent replacement of airbag components that fire needlessly in an accident. The PPD system consists of a weight sensor and an interface unit.

The threshold for PPD is ; occupied (15 kg), not occupied (0.6kg).

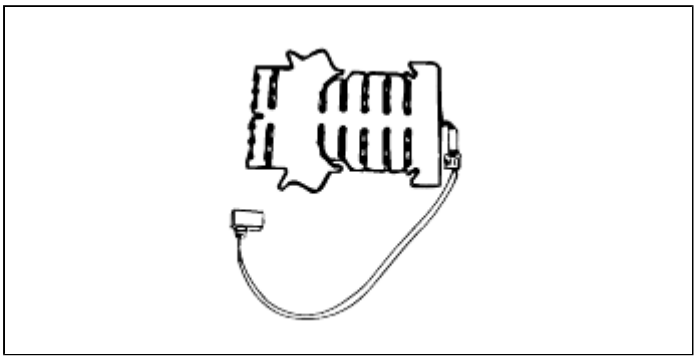
The sensor characteristics is defined:

RP ≤50 kΩ for W ≥ 15 kg

RP >50 kΩ for W ≥ 0.6 kg

(RP : Resistance of force sensing resistor)

(W: Mass of weight)



BATTERY VOLTAGE

DTC	B1111 B1112	Battery voltage too high Battery voltage too low

CIRCUIT DESCRIPTION

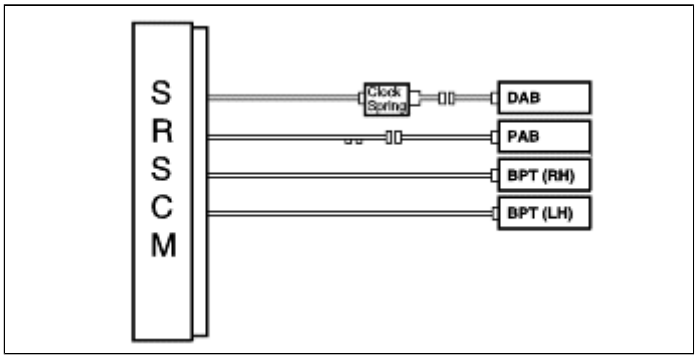
Since the source voltage can fluctuate, the SRS is equipped with a voltage-increase/voltage-decrease circuit (DC/DC converter) in the SRSCM to adjust for any fluctuations in the source voltage. When the battery voltage fluctuates, the DC/DCconverter adjust the voltage to the SRS by either increasing or decreasing to maintain normal system voltage.

The diagnosis system malfunction display for this circuit is different than other circuits-when the SRS warning lamp remains lit up and the DTC is a B1111 or B1112 code, battery voltage too high or low is indicated.

Malfunction in this circuit is not recorded in the B1111 or B1112 code, battery voltage too high or low, and the voltagereturns to normal, the SRS warning light automatically goes off.

INSPECTION PROCEDURE

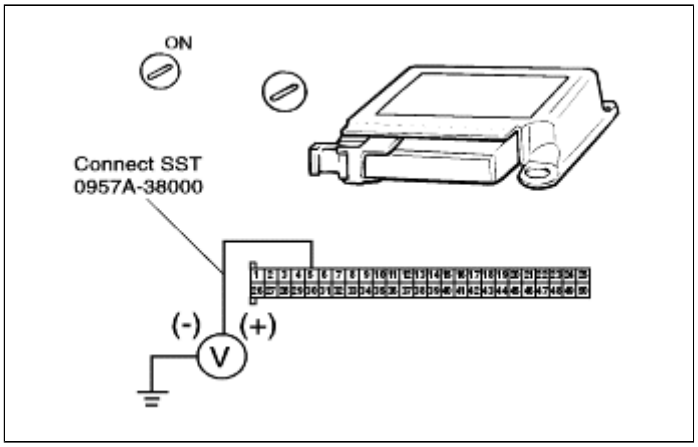
1. Preparation.
   (1) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.
   (2) Remove the DAB module.
   (3) Disconnect connectors of PAB, left and right side airbag, belt pretensioner and satellite sensor.
   (4) Disconnect connector of SRSCM.



CAUTION

Store the DAB with the front surface facing upward.

2. Check source voltage.
   (1) Connect negative (-) terminal cable to battery.
   (2) Turn ignition switch ON.



[Check]
Measure voltage between the battery supply 5 of SRS connector and body ground.

LIMIT : 10 - 16.5 V

NG → Check the harness between battery and SRSCM, and check the battery and charging system.

OK

↓

3. Does SRS warning light turn off?
[Preparation]
(1) Turn ignition switch to LOCK.
(2) Connect the DAB module.
(3) Connect PAB connector, left and right side airbag, belt pretensioner and satellite connectors.
(4) Connect SRSCM connector.
(5) Turn ignition switch ON.

[Check]
Check that SRS warning light goes off.

NG → Check for DTCs. If a DTC is output, pertorm froubleshooting for the DTC. If B1111 or B1112 is output, replace SRSCM.

OK

↓

From the results of the above inspection, the malfunctioning part and can now be considered normal.

DAB RESISTANCE

DTC	B1346 B1347	DAB resistance too high DAB resistance too low

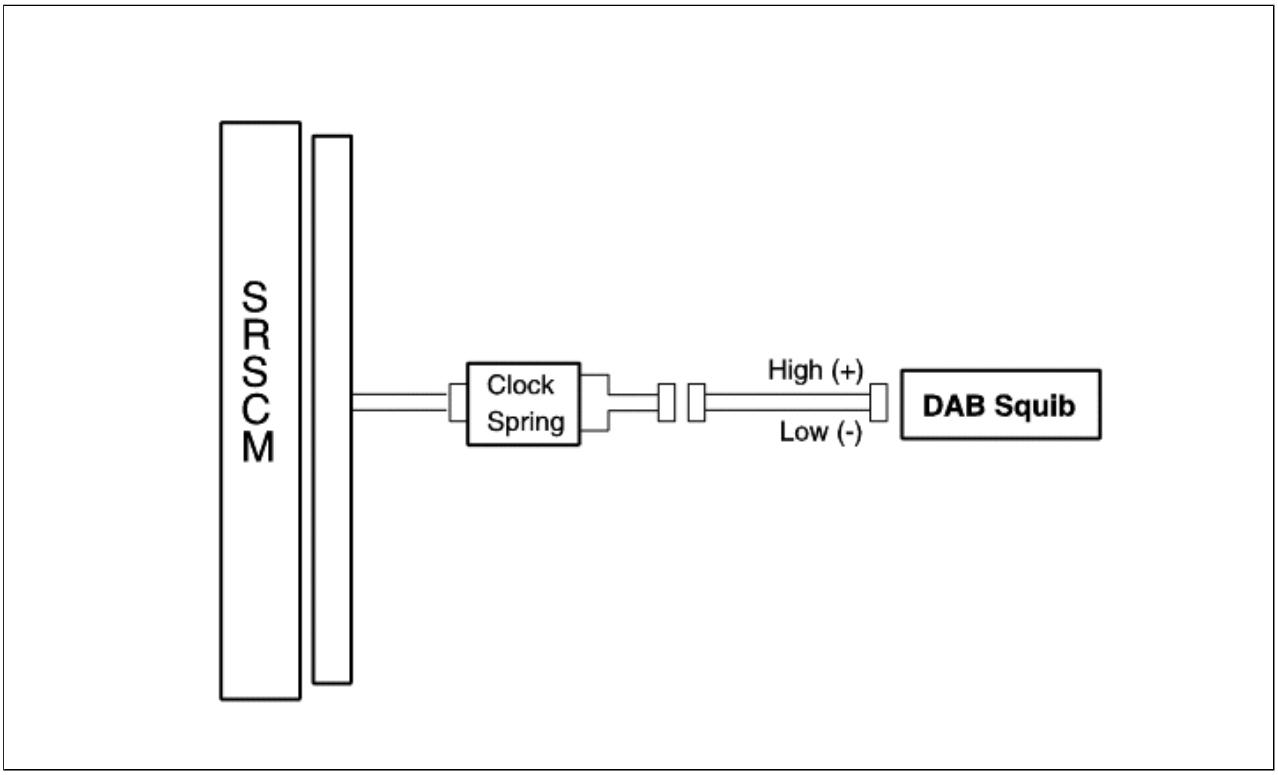
CIRCUIT DESCRIPTION

The DAB squib circuit consists of the SRSCM, clock spring and DAB. The squib is what causes the airbag to deploy when airbag deployment conditions are satisfied.

The above DTC's are recorded when DAB resistance too high or low is detected in the DAB squib circuit.

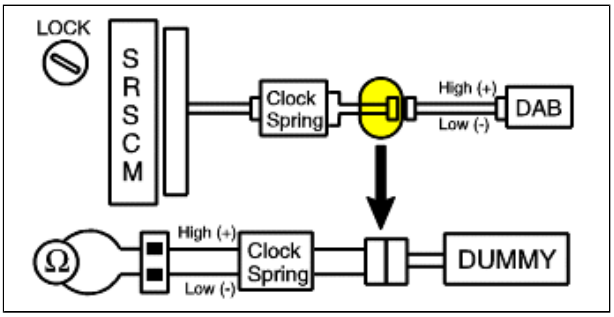
DTC detecting condition	Trouble area
1) Too high or low resistane between DAB high (+) wiring harness and DAB low (-) wiring harness of squib. 2) DAB malfunction 3) Clock spring malfunction 4) SRSCM malfunction	1) DAB squib 2) Clock spring 3) SRSCM 4) Wire harness

WIRING DIAGRAM



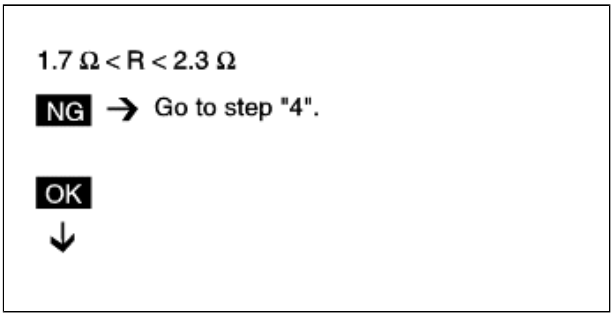
INSPECTION PROCEDURE

1. Preparation. (See step "1" on tronbleshooting procedure of DTC B1111, B1112)
2. Check DAB resistance.
   [Preparation]
   Release airbag activation prevention mechanism on SRSCM side of airbag squib side.
   Connect the dummy (0957A-38200) to clock spring side connector.



[Check]

Measure the resistance between DAB high (+) and low (-).



3. Check DAB squib.

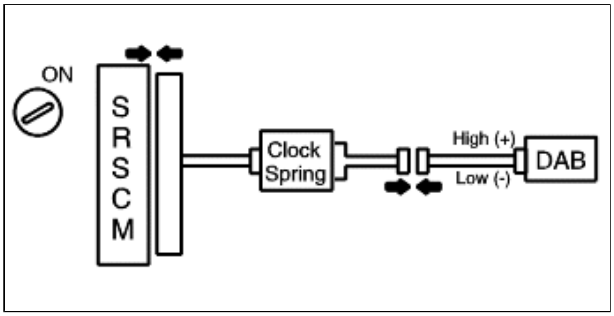
[Preparation]

(1) Turn ignition switch to LOCK.

(2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.

(3) Connect DAB connector.

(4) Connect negative (-) terminal cable to the battery, and wait at least 30 seconds.



[Check]

(5) Turn ignition switch to ON, and wait at least 30 seconds.

(6) Clear malfunction code stored in memory with Hi-scan.

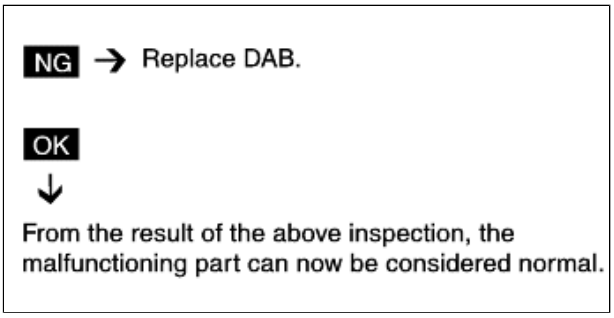
(7) Turn ignition switch to LOCK, and wait at least 30 seconds.

(8) Turn ignition switch to ON, and wait at least 30 seconds.

(9) Using Hi-scan, check DTC.
DTC is not output.

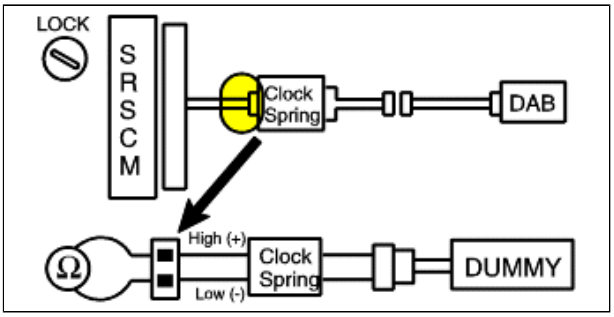
[Hint]

Codes other than these ones may be output at this time, but they are not relevant to this check.



4. Check Clock spring.

[Preparation]
Disconnect connector between SRSCM clock spring, and connect the dummy connector (0957A-38200) to clock spring side connector.



5. [Check]
Measure the resistance between DAB high (+) and low (-).

1.7 Ω < R < 2.3 Ω

NG → Replace clock spring.

OK

↓

Repair or replace the harness between SRSCM an clock spring.

DAB, PAB, BPT, AND, BBS SHORT TO GROUND

DTC	B1348	DAB short to ground
	B1354	PAB short to ground
	B1363	Driver BPT short to ground
	B1369	Passenger BPT short to ground
	B1512	Driver seat belt buckle switch to ground or short
	B1514	Passenger seat belt buckle switch to ground or short

CIRCUIT DESCRIPTION

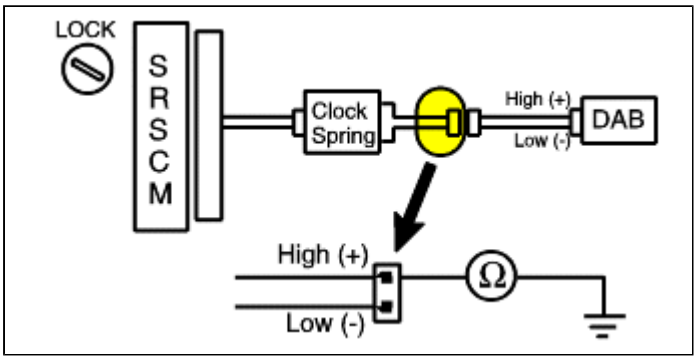
The squib circuit consists of the SRSCM, clock spring, DAB, PAB, BPT, BBS, and front satellite sensors. If it causes theSRS to deploy when the SRS deployment conditions are satisfied.

The above DTC's are recorded when a short to ground is detected in the squib circuit.

DTC Detecting condition	Trouble area
1) Short circuit in squib wire harness (to ground) 2) Squib malfunction 3) Clock spring malfunction 4) SRSCM malfunction	1) DAB squib 2) PAB squib 3) BPT squib 4) BBS squib 5) Clock spring 6) SRSCM 7) Wire harness

INSPECTION PROCEDURE

1. Disconnect DAB.
2. Check DAB squib circuit.



[Check]
For the connector (on the clock spring side) between clock spring and DAB, measure the resistance between DAB high and body ground.

Resistance : ∞

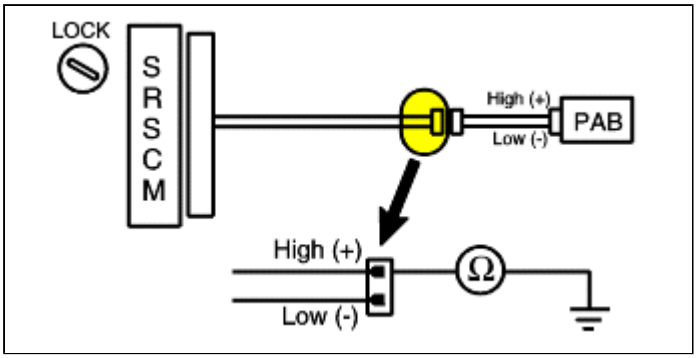
NG → Go to step "9".

OK

↓

Go to step "6".

3. Check PAB squib circuit.
   A. Disconnect PAB.



[Check]

For the connector (on the SRSCM side) between SRSCM and PAB, measure the resistance between PAB high and body ground.

Resistance : ∞

NG → Repair or replace hamess or connector between SRSCM and PAB.

OK

↓

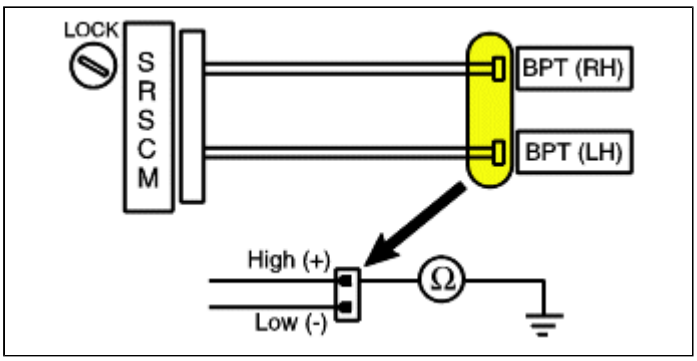
Go to step "9".

CAUTION

1) Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester.If the circuit resistance is measured with a tester, accidental airbag deployment will result in serious personal injury.

4. Check BPT squib circuit.

A. Disconnect BPT



[Check]

For the connector (on the SRSCM side) between SRSCM and BPT, measure the resistance between BPT high and body ground.

Resistance : ∞

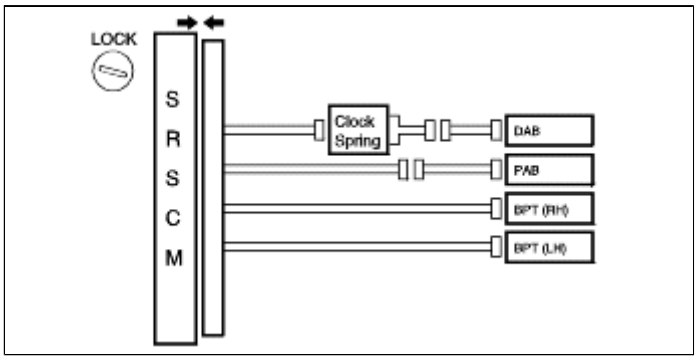
NG → Repair or replace harness between SRSCM and BPT.

OK

↓

Go to step "8".

5. Check SRSCM.
[Preparation]
(1) Connector to SRSCM.
(2) Using a service wire, connect DAB high and DAB low on the clock spring side of connector between clock spring and DAB.
(3) Using a service wire, connect PAB high and low on SRSCM side of connector between SRSCM and PAB.
(4) Connect BPT using the same method.
(5) Connect negative (-) terminal cable to battery, and wait at least 30 seconds.



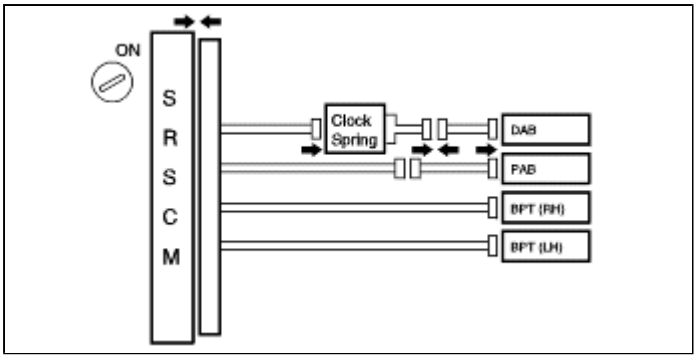
[Check]
(6) Turn ignition switch to ON, and wait at least 30 seconds.
(7) Clear malfunction code stored in memory with Hi-scan.
(8) Turn ignition switch to LOCK, and wait at least 30 seconds.
(9) Turn ignition switch to ON, and wait at least 30 seconds.
(10) Using Hi-scan, check DTC.
DTC is not output.

[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace SRSCM.

OK
↓
From the result of the above inspection, the malfunction part can now be considered normal.

6. Check DAB squib.
[Preparation]
(1) Turn ignition switch to LOCK.
(2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.
(3) Connect DAB connector.
(4) Connect negative (-) terminal cable to the battery, and wait at least 30 seconds.



[Check]

(5) Turn ignition switch to ON, and wait at least 30 seconds.

(6) Clear malfunction code stored in memory with Hi-scan.

(7) Turn ignition switch to LOCK, and wait at least 30 seconds.

(8) Turn ignition switch to ON, and wait at least 30 seconds.

(9) Using Hi-scan, check DTC.
DTC is not output.

[Hint]

Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace DAB.

OK

↓

From the result of the above inspection, the malfunction part can now be considered normal.

7. Check PAB squib.

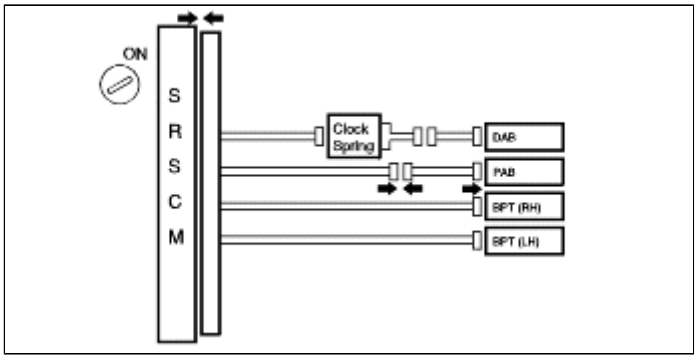
[Preparation]

(1) Turn ignition switch to LOCK.

(2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.

(3) Connect PAB connector.

(4) Connect negative (-) terminal cable to the battery, and wait at least 30 seconds.



[Check]

(5) Turn ignition switch to ON, and wait at least 30 seconds.

(6) Clear malfunction code stored in memory with Hi-scan.

(7) Turn ignition switch to LOCK, and wait at least 30 seconds.

(8) Turn ignition switch to ON, and wait at least 30 seconds.

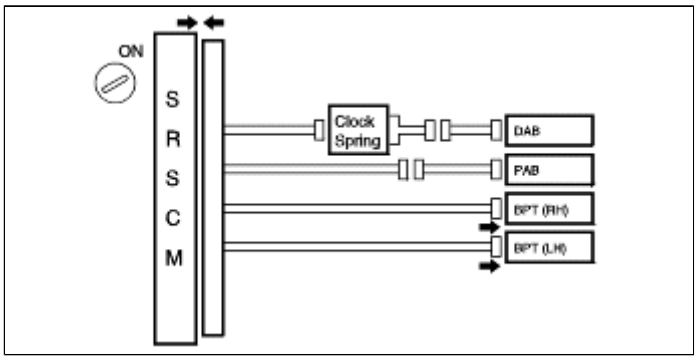
(9) Using Hi-scan, check DTC.
DTC is not output.

[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace PAB.

OK
↓
From the result of the above inspection, the malfunction part can now be considered normal.

8. Check BPT squib.
[Preparation]
(1) Turn ignition swich to LOCK.
(2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.
(3) Connect BPT connector.
(4) Connect negative (-) terminal cable from the battery, and wait at least 30 seconds.



[Check]
(5) Turn ignition switch to ON, and wait at least 30 seconds.
(6) Clear malfunction code stored in memory with Hi-scan.
(7) Turn ignition switch to LOCK, and wait at least 30 seconds.
(8) Turn ignition switch to ON, and wait at least 30 seconds.
(9) Using Hi-scan, check DTC.
DTC is not output.

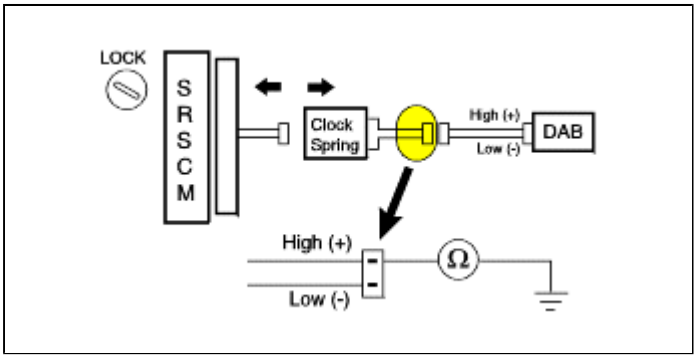
[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace BPT.

OK
↓
From the result of the above inspection, the malfunction part can now be considered normal.

9. Check clock spring circuit.
[Preparation]

Disconnect connector between SRSCM and clock spring.



[Check]

Measure resistance between DAB high on clock spring side of connector between clock spring and DAB and body ground.

Resistance : ∞

NG → Replace clock spring.

OK

↓

Repair or replace harness or connector between SRSCM and clock spring.

DAB, PAB, BPT AND BBS SHORT TO BATTERY

DTC	B1349	DAB short to battery
	B1355	PAB short to battery
	B1364	BPT (Driver) short to battery
	B1370	BPT (Passenger) short to battery
	B1511	Driver seat belt buckle switch short to battery
	B1513	Passenger seat belt buckle switch short to battery

CIRCUIT DESCRIPTION

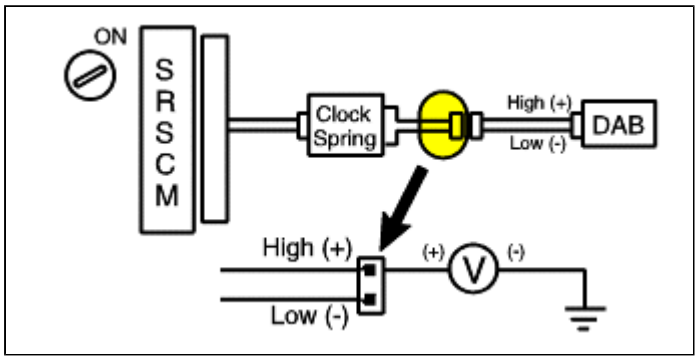
The squib circuit consists of the SRSCM, clock spring, DAB, PAB, BPT, BBS, and satellite sensor. If it causes the SRS to deploy when the SRS deployment conditions are satisfied.

The above DTC's are recorded when a B+ short is detected in the squib circuit.

DTC detecting condition	Trouble area
1) Short circuit in squib wire harness (to B+) 2) Squib malfunction 3) Spiral cable malfunction 4) SRSCM malfunction	1) DAB squib 2) PAB squib 3) BPT squib 4) Wire harness

INSPECTION PROCEDURE

1. Preparation. (See step "1" on troubleshooting procedure of DTC B1111, B1112)
2. Check DAB squib circuit.
   A. Disconnect DAB



[Check]
For the connector (on the clock spring side) between clock spring and DAB, measure the voltage between DAB high and body ground.

Voltage : 0 V

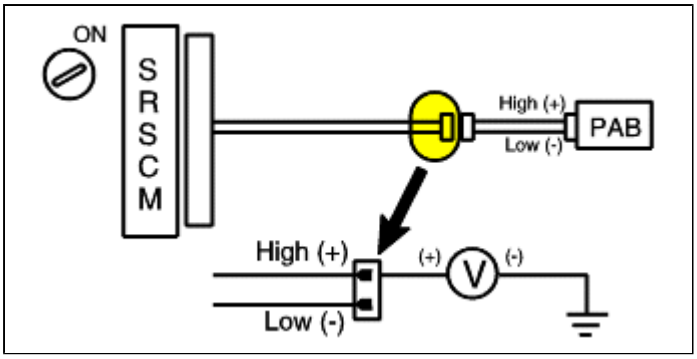
NG → Go to step "9".

OK

↓

Go to step "6".

3. Check PAB squib circuit.
   A. Disconnect PAB



[Check]

For the connector (on the SRSCM side) between SRSCM and PAB, measure the voltage between PAB high and body ground.

Voltage : 0 V

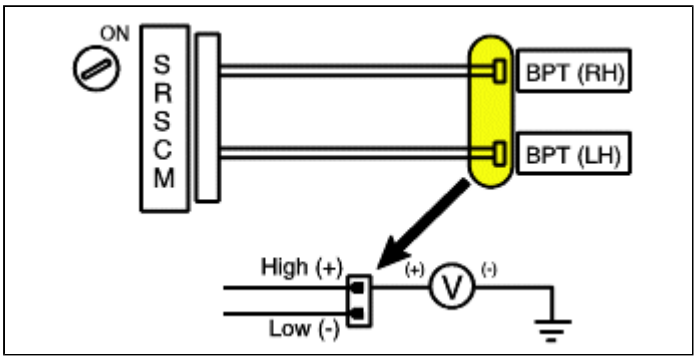
NG → Repair or replace harness between. SRSCM and PAB.

OK

↓

Go to step "7".

4. Check BPT squib circuit.
   A. Disconnect BPT



[Check]

For the connector between SRSCM and BPT, measure the voltage between BPT high and body ground.

Voltage : 0 V

NG → Repair or replace harness between. SRSCM and BPT.

OK

↓

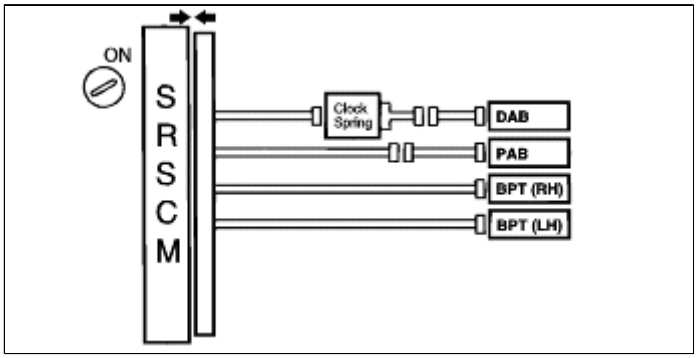
Go to step "8".

5. Check SRSCM.
   [Preparation]
   (1) Connect connector to SRSCM.
   (2) Using a service wire, connect DAB high and low on the clock spring side of connector between clock spring and DAB.

(3) Using a service wire, connect PAB high and low on SRSCM side of connector between SRSCM and PAB.

(4) Using a service wire, connect BPT high and low on SRSCM side connector between SRSCM and BPT.

(5) Connect negative (-) terminal cable to battery, and wait at least 30 seconds.



[Check]

(6) Turn ignition switch to ON, and wait at least 30 seconds.

(7) Clear malfunction code stored in memory with Hi-scan.

(8) Turn ignition switch to LOCK, and wait at least 30 seconds.

(9) Turn ignition switch to ON, and wait at least 30 seconds.

(10) Using Hi-scan, check DTC.
DTC is not output.

[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace SRSCM.

OK
↓
From the result of the above inspection, the malfunction part can now be considered normal.

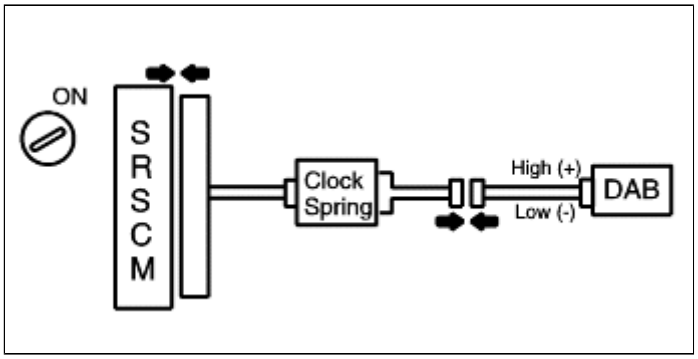
6. Check DAB squib.
[Preparation]

(1) Turn ignition switch to LOCK.

(2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.

(3) Connect DAB connector.

(4) Connect negative (-) terminal cable to the battery, and wait at least 30 seconds.



[Check]

(5) Turn ignition switch to ON, and wait at least 30 seconds.

(6) Clear malfunction code stored in memory with Hi-scan.

(7) Turn ignition switch to LOCK, and wait at least 30 seconds.

(8) Turn ignition switch to ON, and wait at least 30 seconds.

(9) Using Hi-scan, check DTC.
DTC is not output.

[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace DAB.

OK

↓

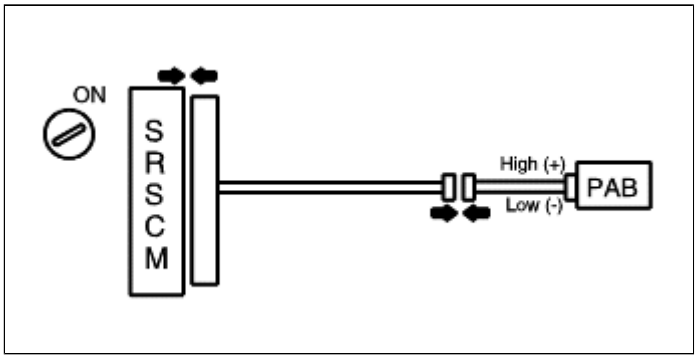
From the result of the above inspection, the malfunction part can now be considered normal.

7. Check PAB squib.
[Preparation]
(1) Turn ignition switch to LOCK.

(2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.

(3) Connect PAB connector.

(4) Connect negative (-) terminal cable to the battery, and wait at least 30 seconds.



[Check]
(5) Turn ignition switch to ON, and wait at least 30 seconds.

(6) Clear malfunction code stored in memory with Hi-scan.

(7) Turn ignition switch to LOCK, and wait at least 30 seconds.

(8) Turn ignition switch to ON, and wait at least 30 seconds.

(9) Using Hi-scan, check DTC.
DTC is not output.

[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

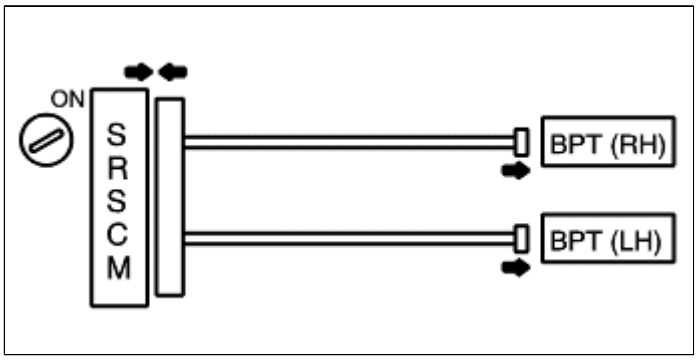
NG → Replace PAB.

OK

↓

From the results of the above inspection, the malfunctioning part can now be considered normal.

8. Check BPT squib.
   [Preparation]
   (1) Turn ignition switch to LOCK.
   (2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.
   (3) Connect BPT connector.
   (4) Connect negative (-) terminal cable from the battery, and wait at least 30 seconds.



   [Check]
   (5) Turn ignition switch to ON, and wait at least 30 seconds.
   (6) Clear malfunction code stored in memory with Hi-scan.
   (7) Turn ignition switch to LOCK, and wait at least 30 seconds.
   (8) Turn ignition switch to ON, and wait at least 30 seconds.
   (9) Using Hi-scan, check DTC.
   DTC is not output.

   [Hint]
   Codes other than these ones may be output at this time, but they are not relevant to this check.

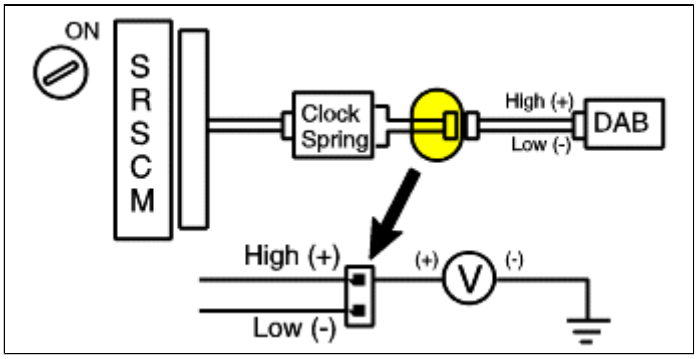
NG → Replace BPT.

OK

↓

From the results of the above inspection, the malfunctioning part can now be considered normal.

9. Check clock spring.
   [Preparation]
   (1) Turn ignition switch to LOCK
   (2) Disconnect connector between SRSCM and clock spring.



[Check]
Turn ignition switch to ON, and measure voltage DAB high on side and body ground.

Voltage : 0 V

NG → Replace clock spring.

OK

↓

Repair or replace harness between SRSCM and clock spring.

PAB RESISTANCE

DTC	B1352 B1353	PAB resistance too high PAB resistance too low

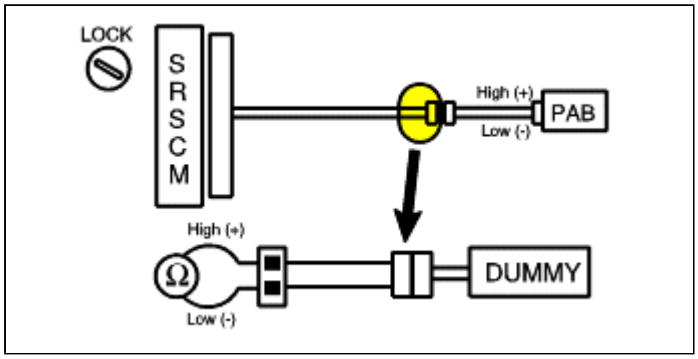
Circuit description

The PAB squib circuit consists of the SRSCM and PAB. The squib is what causes the airbag to deploy when airbag deployment conditions are satisfied.
The above DTC's are recorded when PAB resistance too high or low is detected in the PAB squib circuit.

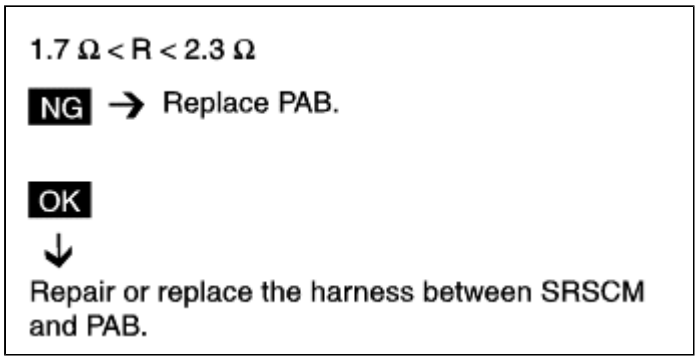
DTC detecting condition	Trouble area
1) Too high or too low resistance between PAB high (+) wiring harness and PAB low (-) wiring harness of squib. 2) PAB malfunction 3) SRSCM malfunction	1) PAB squib 2) SRSCM 3) Wire harness

INSPECTION PROCEDURE

1. Preparation.(See step "1" on troubleshooting procedure of DTC B111, B1112)
2. Check PAB resistance.
   [Preparation]
   Release airbag activation prevention mechanism on SRSCM side of airbag squib side.
   Connect the dummy connector (0957A-38200)to PAB connector of the SRSCM connector side.

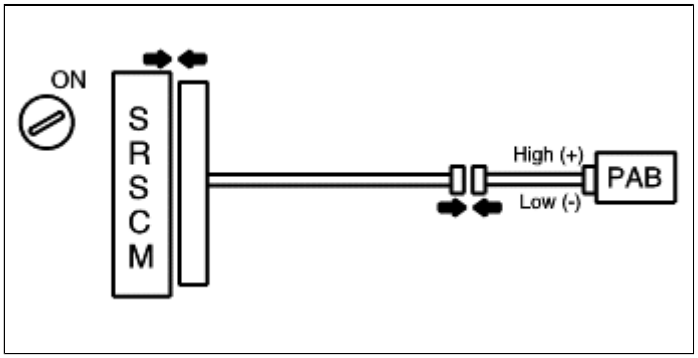


   [Check]
   Measure the resistance between PAB high (+) and PAB low (-).



3. Check PAB squib.
   [Preparation]
   (1) Turn ignition swich to LOCK.
   (2) Disconnect negative (-) terminal cable from the battery, and wait at least 30 seconds.
   (3) Connect PAB connector.

(4) Connect negative (-) terminal cable to the battery, and wait at least 30 seconds.



[Check]

(5) Turn ignition switch to ON, and wait at least 30 seconds.

(6) Clear malfunction code stored in memory with Hi-scan.

(7) Turn ignition switch to LOCK, and wait at least 30 seconds.

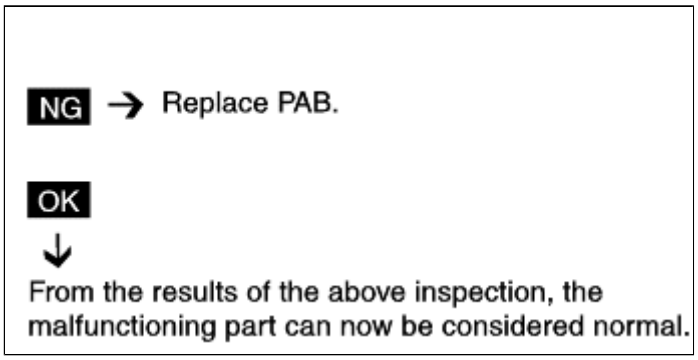
(8) Turn ignition switch to ON, and wait at least 30 seconds.

(9) Using Hi-scan, check DTC.

DTC is not output.

[Hint]

Codes other than these ones may be output at this time, but they are not relevant to this check.



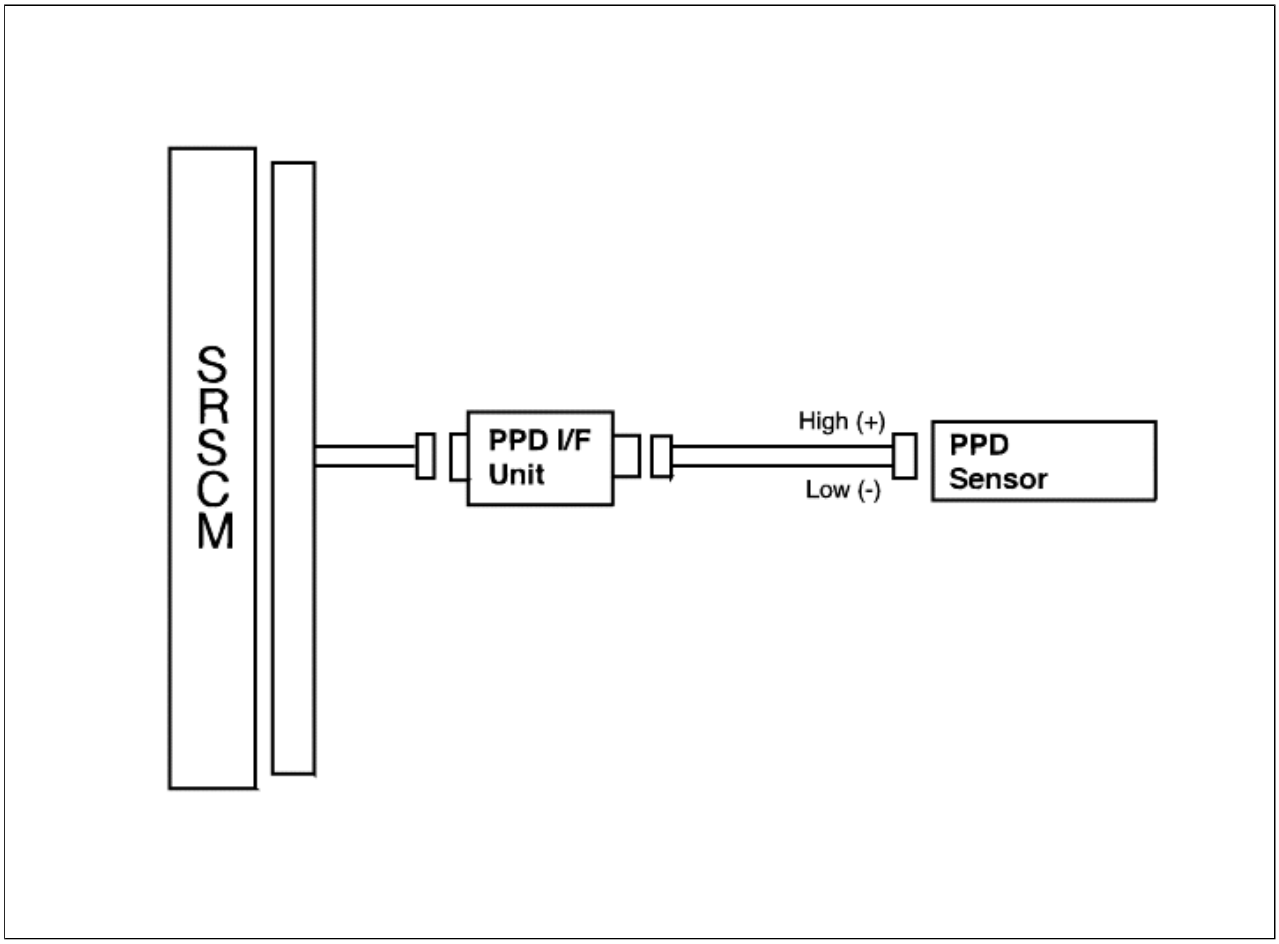
PPD communication error

DTC	B1407 B1406	B1407 PPD communication error B1406 PPD defect

Circuit description

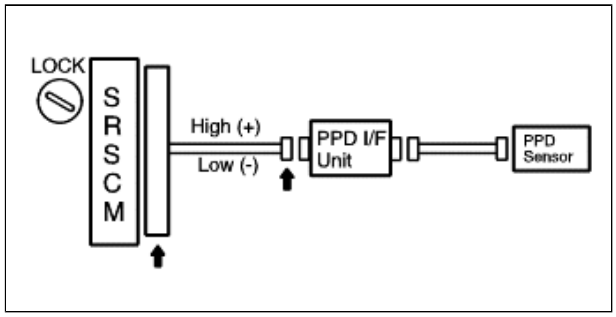
The release system for the airbag consists of the SRSCM, an interface unit and PPD.
The above DTC? are recorded when the defect or communication error of PPD is detected in the PPD circuit.

Wiring diagram



Inspection procedure

1. Preparation (See step ??on page RT-20).
2. Check PPD circuit (Communication error).
   Check continuity between SRSCM connector and PPD interface unit as high (+) and high, low (-) and low (-).

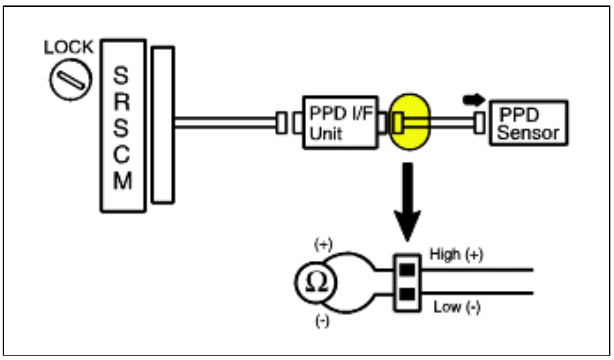


OK : Continuity

NG → Replace harness between SRSCM and PPD I/F unit.

OK ↓

3. Check PPD interface unit.
   Check continuity of PPD interface unit as high (+) and high (+), low (-) and low (-).
4. Check PPD sensor (Defect).

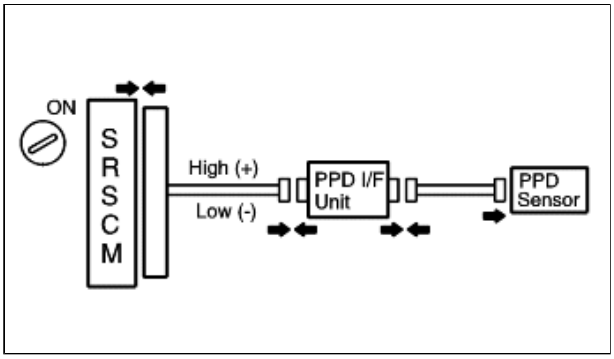


[Check]
Check the resistance in accordance with the changed weight.
R≥ 50 kΩ for W ≥ 15 kg
R> 50 kΩ for W ≤ 0.6 kg

NG → Replace PPD sensor.

OK ↓

5. Check PPD squib.
   [Preparation]
   (1) Connect connector to SRSCM.
   (2) Connect negative (-) terminal cable to battery, and wait at least 30 seconds.



[Check]

   (3) Turn ignition switch to ON, and wait at least 30 seconds.
   (4) Clear malfunction code stored in memory with Hi-scan.
   (5) Turn ignition switch to LOCK, and wait at least 30 seconds.
   (6) Turn ignition switch to ON, and wait at least 30 seconds.

(7) Using Hi-scan, check DTC.
DTC is not output.

[Hint]
Codes other than these ones may be output at this time, but they are not relevant to this check.

NG → Replace SRSCM.

OK
↓
From the result of the above inspection, the malfunction part can now be considered normal.

SRSCM MALFUINTION

DTC	B1661	ECU mismatching
	B1650	Crash recorded front airbag
	B1657	Ignition recorded belt pretensioner
	B1620	Internal fault

CIRCUIT DESCRIPTION

SRSCM MALFUNCTION

The SRSCM also cyclically monitors the following :

1. Functional readiness of the firing circuit activation transistors.
2. Adequacy of deployment energy reserves.
3. Safing sensor integrity : detection of faulty closure.
4. Plausibility of accelerometer signal.
5. Operation of SRSCM components.
   The timely completion of all tests is monitored by a separate hardware watchdog. During normal operation, the watch dog is triggered periodically by the SRSCM ; If the SRSCM fails to trigger the watchdog, the watchdog will reset the SRSCM and activate the SRI (Service Reminder Indicator).
   The SRSCM must be replaced once the fault codes above mentioned are confirmed.

WARNING LAMP FAILURE

DTC	B2500	Warning lamp failure

CIRCUIT DESCRIPTION

The SRS warning lamp is located on the cluster.

When the airbag system is normal, the Service Reminder Indicator (SRI) or SRS Warning Lamp flashes for approximately 6 seconds after the ignition switch is turned ON, and then turns off automatically.

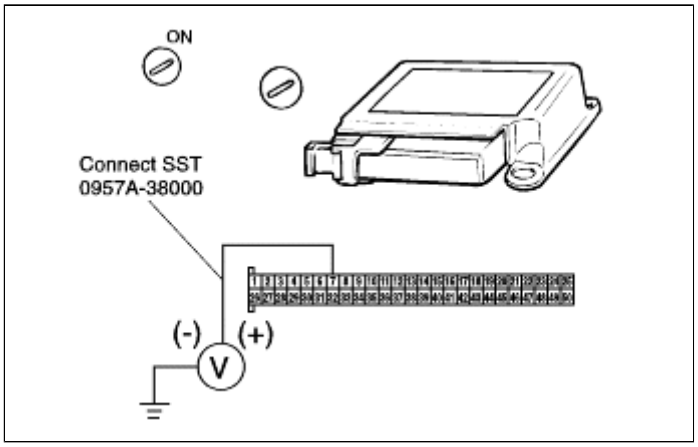
If there is a malfunction in the airbag system, the SRI lights up to inform the driver of the abnormality.

The SRSCM measures the voltage at the airbag SRI output pin, both when the lamp is on and when the lamp is off, to detect whether the commanded state matches the actual state.

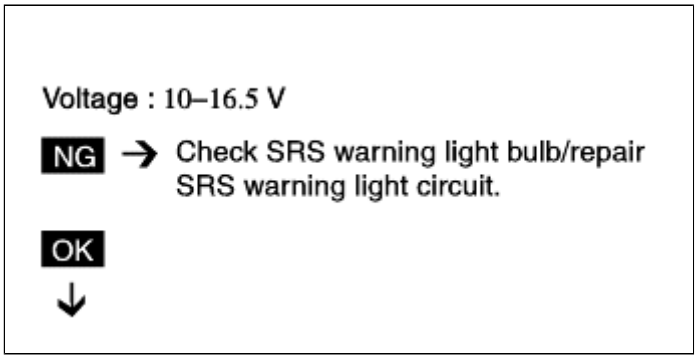
INSPECTION PROCEDURE

1. Check the fuse.
   [Preparation]
   (1) Remove the fuse No. 11 and 14 from the junction block.
   (2) Inspect the condition of fuse.
   (3) Replace if necessary.

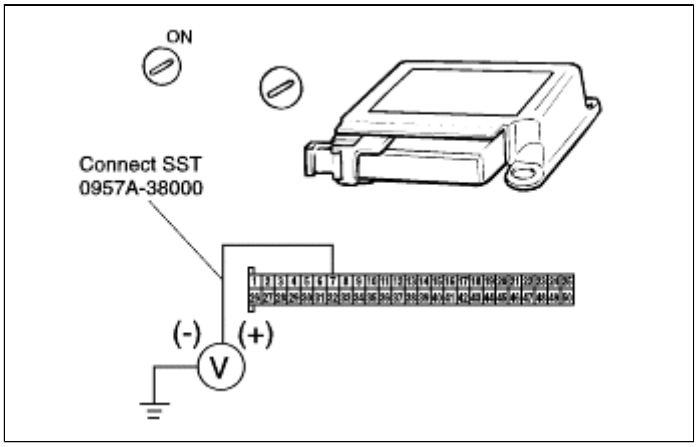
2. Check SRS warning lamp circuit.
   [Preparation]
   (1) Connect negative (-) terminal cable to the battery.
   (2) Turn ignition switch to ON.



   [Check]
   (3) Measure voltage of harness side connector of SRSCM.



   (4) Check SRS SRI (Service Reminder Indicator).



OK : SRS SRI ON

NG → If no fault is found in wiring or connector, replace the SRSCM.

OK

↓

From the result of the above inspection, the malfunctioning part can now be considered normal.

body interior and exterior

SPECIFICATIONS

Hood Type	Rear hinged, front opening type (gas lifter type)
Front door Construction Regulator system Locking system	Front hinged, full door construction X-arm type Pin-fork system
Rear door Construction Locking system	Slide type Pin-fork system
Tailgate Type	Inner hinged, gas lifter type
Glass thickness. Windshield glass Front door glass Slide door glass Quarter window glass Tail gate glass	Laminated clear, tinted 5.0mm (0.20 in.) 3.2mm (0.13 in.) 3.5mm (0.14 in.) 3.5mm (0.14 in.) 3.5mm (0.14 in.)
Seat belts	3 point type with Emergency Locking Retractor (E.L.R)

TROUBLESHOOTING

Hood

Problem	Possible cause	Action
Hood does not open or close completely	Striker and latch not properly aligned	Adjust
	Incorrectly installed hood	Adjust
	Incorrect hood bumper height	Adjust

Tailgate

Problem	Possible cause	Action
Water leak from tailgate edge	Cracked or defective opening weatherstrip	Replace
Tailgate lift	Incorrect latch or striker adjustment	Adjust
Heavy tailgate opening lock	Incorrect latch or striker adjustment	Adjust
	Incorrect tailgate latch link assembly adjustment	Adjust
Uneven gap between body	Incorrect tailgate installation	Adjust position

Front door

Problem	Possible cause	Action
Door window malfunction	Incorrect window glass installation	Adjust position
	Incorrect door sash contact	Adjust contact
	Damaged or defective sash	Correct or replace
	Damaged or defective regulator arm or regulator	Correct or replace
Stiff window regulator handle	Incorrect window glass installation	Adjust position
	Damaged or defective sash	Correct or replace
	Damaged or defective regulator arm or regulator	Correct or replace
Water leak through door edge	Cracked or defective opening weatherstrip	Replace
Water leak from door center	Drain hole clogged	Remove foreign objects
	Inadequate waterproof film contact or damage	Correct or replace
Door hard to open	Incorrect latch or striker adjustment	Adjust
Door does not open or close completely	Incorrect latch or striker adjustment	Adjust position
	Defective door check	Correct or replace
	Door check hinge requires grease	Apply grease
Uneven gap between body	Incorrect door installation	Adjust position

Slide door

Problem	Possible cause	Action
Water leak from door edge	Cracked or defective opening weatherstrip	Replace
	Incorrect latch or striker adjustment	Adjust

Stiff door operation	Incorrect door installation	Adjust position
Stops half way when sliding or stiff	Incorrect roller arm installation or requires grease	Adjust or grease
	Defective roller arm	Replace
Uneven gap between body	Misaligned door	Adjust position

Sunroof

Problem	Possible cause	Action
Water leaks from sunroof	Dirt accumulated in drain tube	Clear dirt inside of drain
	Clogged drain tube	Blow air into drain to remove dirt
	Broken or dislocated drain tube, defective or cracked clip	Check tube installation and flange contact
	Deteriorated roof lid weatherstrip	Replace
	Excessive roof lid-to-body clearance and improperly fitted weatherstrip	Adjust
Wind noise around sunroof	Loose or deformed deflector, gaps in body work	Retighten adjust or replace
Sunroof makes a noise when moved	Foreign particles lodged in guide rail	Check drive cable and guide rails for foreign particles
	Loose guide rails and lid	Retighten
Motor runs but sunroof does not move or moves only halfway	Foreign particles lodged in guide rail	Check drive cable and guide rails for foreign particles
	Incorrect engagement of motor pinion with drive cable	Check for loose motor installation and damaged pinion
	Decrease in motor's clutch slipping force	Adjust
	Increased sunroof sliding resistance or interference of sunroof with drive cables, weatherstrip, etc. due to maladjustment of sunroof	Adjust or replace
Noise in motor (clutch slipping noise from motor when sunroof is fully opened or closed is not an unusual noise.)	Incorrect engagement of motor pinion with drive cable	Check pinion installation and retighten motor
	Worn out or damaged motor pinion bearing	Replace motor assembly
	Worn out or deformed drive cable	Replace

Roof carrier

Problem	Possible cause	Action
Push button does not return to normal position	Cross bar is not in a detent Broken spring	Move cross bar to a detent Replace slide
Missing attaching hardware	Vibration	Replace hardware
Broken slide rail	Accident	Replace slide rail
Broken cross bar	Accident	Replace cross bar
Broken slide	Accident	Replace slide
Missing base cover	Vibration or accident	Replace base cover

Windshield glass

Problem	Possible cause	Action
Water leak through windshield	Defective weatherstrip seal	Fill sealant
	Cracked or defective weatherstrip	Replace
	Defective body flange	Correct
Water leak through tailgate window	Cracked or devective weatherstrip	Replace
	Defective tailgate window flange	Correct
Water leak through front door window	Incorrect window glass installation	Adjust position
	Gap at upper window glass	Adjust position
Water leak through front door window	Defective window frame	Replace
Water leak through fixed type quarter window	Cracked or devective weatherstrip	Replace
	Defective quarter panel flange	Correct

Stationary glass

Problem	Possible cause	Action
Water leak	Faulty seal	Seal the edge around the top and both sides
Wind noise	Faulty seal	Seal the edge around the top and both sides
Minor chip	Pebble, BB, etc.	Repair
Major chip	Rock, falling object, etc.	Repair
Major crack	Accident, malicious mischief	Replace
Deformation	Accident, malicious mischief	Replace
Pitting	Sand storm	Replace

Bumpers

Problem	Possible cause	Action
Bumper face damaged	Accident	Replace
Energy absorbing foam damaged or deteriorated	Accident or exposure	Replace
Reinforcement damaged	Accident	Replace
Brackets or stays damaged	Accident	Repair or replace
Missing attached hardware	Accident or vibration	Replace

Seat belts

Problem	Possible cause	Action
Buckle release does not release reliably	Faulty spring or dirt in the mechanism	Replace buckle assembly
Buckle release does not depress	Jammed mechanism	Replace buckle assembly
Buckle release button does not		

return to normal position	Jammed mechanism	Replace buckle assembly
Webbing is frayed	Caught in door	Replace retractor assembly
Stitching is loose	Wear or accident	Replace retractor assembly
Belt retracts part-way	Faulty spring	Replace retractor assembly
Belt does not extend completely	Faulty mechanism	Replace retractor assembly
Belt does not retract	Wear or accident	Replace retractor assembly
Belt does not extend	Faulty mechanism	Replace retractor assembly
Buckle assembly is loose	Vibration or accident	Tighten to specified torque
Retractor assembly is loose	Vibration or accident	Tighten to specified torque
Anchor assembly is loose	Vibration or accident	Tighten to specified torque
Driver's seat belt is fastened but reminder lamp either does not actuate or fails to deactivate	Cable harness, computer module, or indicator light	Isolate fault with continuity tester. If test fails, repair or replace thecable. If test does not fail, replace the computer

TIGHTENING TORQUE

Item	Description	N·m	kg·m	lb·ft
Front fender	Mounting bolts	7 ~ 9	0.7 ~ 0.9	5 ~ 7
Hood	Hinge	19 ~ 26	1.9 ~ 2.6	14 ~ 19
	Latch assembly	8 ~ 11	0.8 ~ 1.1	6 ~ 8
Tail gate	Hinge	18 ~ 27	1.8 ~ 2.7	13 ~ 20
	Damper stay bolt	7 ~ 10	0.7 ~ 1.0	5 ~ 7
	Damper stay nut	15 ~ 23	1.5 ~ 2.3	11 ~ 17
	Striker	16 ~ 23	1.6 ~ 2.3	12 ~ 17
	Latch	8 ~ 10	0.8 ~ 1.0	6~ 7
	Remote controller	7 ~ 10	0.7 ~ 1.0	5 ~ 7
Front door	Checker (Body side)	18 ~ 27	1.8 ~ 2.7	13 ~ 20
	Checker (Door side)	12 ~ 26	1.2 ~ 2.6	9 ~ 19
	Hinge (Body side)	18 ~ 30	1.8 ~ 3.0	13 ~ 22
	Hinge (Door side)	18 ~ 30	1.8 ~ 3.0	13 ~ 22
	Glass guide	12 ~ 16	1.2 ~ 1.6	9 ~ 12
	Regulator assembly	3 ~ 4	0.3 ~ 0.4	2 ~ 3
	Latch assembly	4 ~ 6	0.4 ~ 0.6	3 ~ 5
	Outside Handle	13	1.3	9
	Striker	18 ~ 27	1.8 ~ 2.7	13 ~ 20
Slide door	Upper wedge	4 ~ 6	0.4 ~ 0.6	3 ~ 5
	Door pole	12 ~ 16	1.2 ~ 1.6	9 ~ 12
	Lower wedge	4 ~ 6	0.4 ~ 0.6	3 ~ 5
	Upper roller	18 ~ 27	1.8 ~ 2.7	13 ~ 20
	Lower roller	4 ~ 6	0.4 ~ 0.6	3 ~ 5
	Center roller	18 ~ 27	1.8 ~ 2.7	13 ~ 20
	Door lock	4 ~ 6	0.4 ~ 0.6	3 ~ 5
	Door lock striker	18 ~ 27	1.8 ~ 2.7	13 ~ 20
	Inner handle	3 ~ 4	0.3 ~ 0.4	2 ~ 3
	Outer handle	7 ~ 10	0.7 ~ 1.0	5 ~ 7
Front bumper	Reinforcement mounting	10 ~ 15	1.0 ~ 1.5	7 ~ 11
	Face attaching bolt	8 ~ 11	0.8 ~ 1.1	6 ~ 8
	Side bracket	4 ~ 6	0.4 ~ 0.6	3 ~ 4
Rear bumper	Install mounting bolt	90 ~ 120	9 ~ 12	65 ~ 87
	Reinforcement mounting	10 ~ 15	1.0 ~ 1.5	7 ~ 11
Seat	Seat mounting bolt/nut	35 ~ 57	3.5 ~ 5.7	25 ~ 41
	Front upper anchor	40 ~ 55	4.0 ~ 5.5	29 ~ 40
	Front lower anchor	40 ~ 55	4.0 ~ 5.5	29 ~ 40
	Front height adjuster	40 ~ 55	4.0 ~ 5.5	29 ~ 40

Seat belt	Retractor	40 ~ 55	4.0 ~ 5.5	29 ~ 40
	Buckle mounting bolt	40 ~ 55	4.0 ~ 5.5	29 ~ 40
	Rear upper/lower anchor	40 ~ 55	4.0 ~ 5.5	29 ~ 40
	Child anchor	18 ~ 27	1.8 ~ 2.7	13 ~ 20

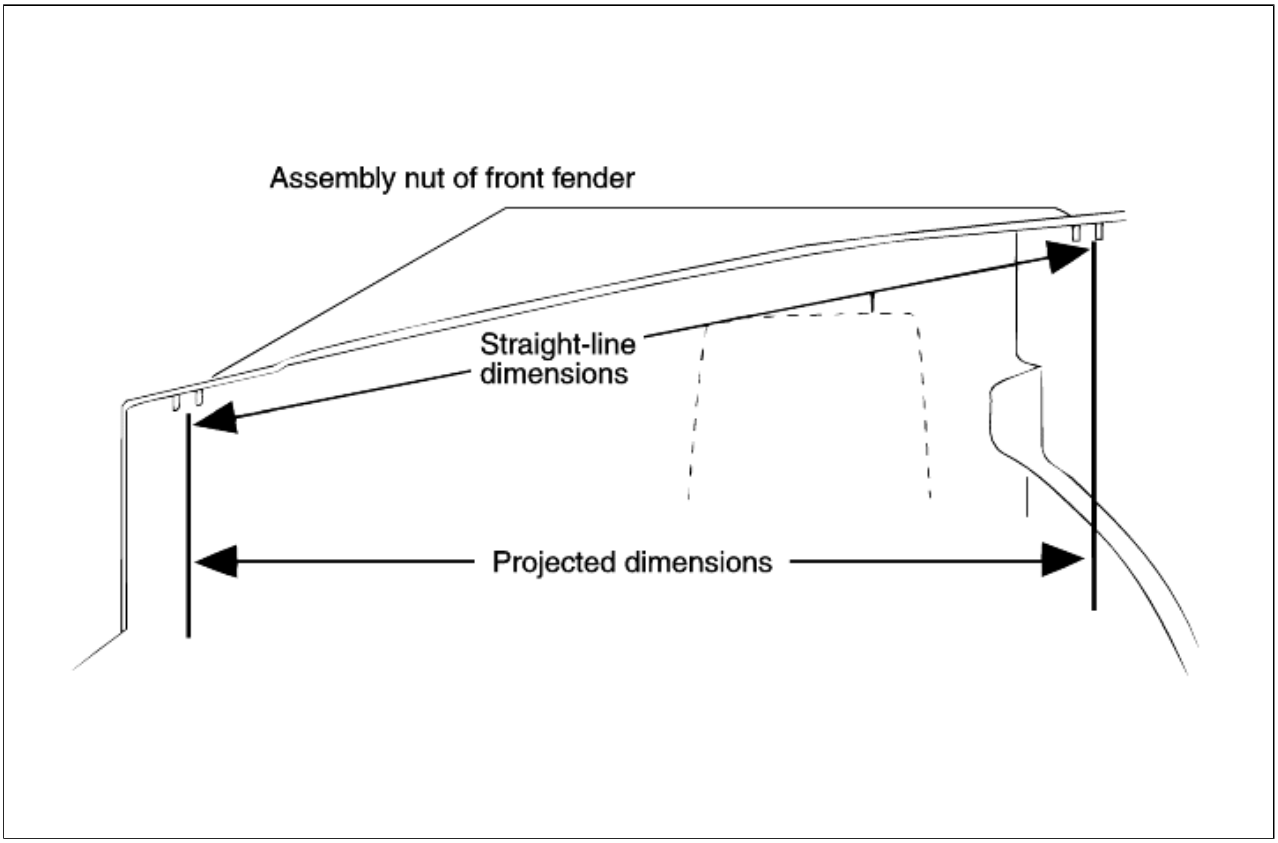
Body dimension indication

Projected dimensions

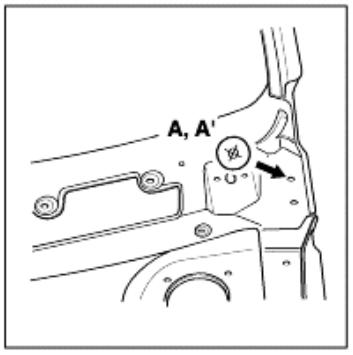
The projected dimension indicates a dimension from a reference point on the body. (Height may be different in some cases)

Straight-line dimensions (Actual measured dimensions)

The straight-line dimension indicates a actual measured dimension between the measurement reference points.



Front body straight-line dimensions



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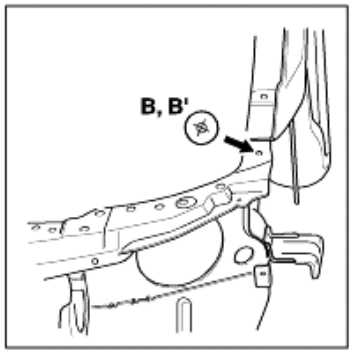

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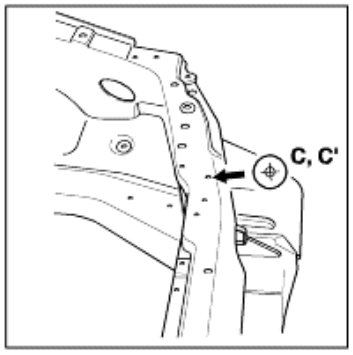

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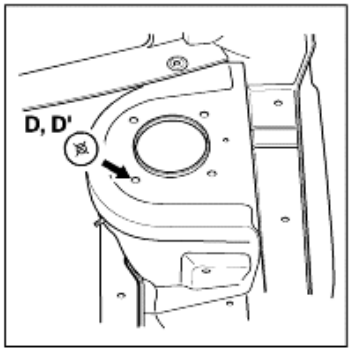

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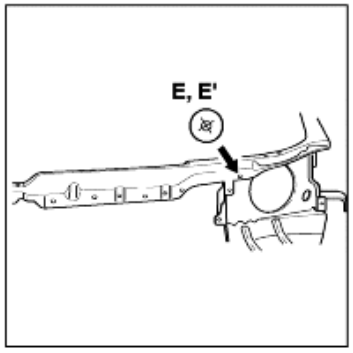

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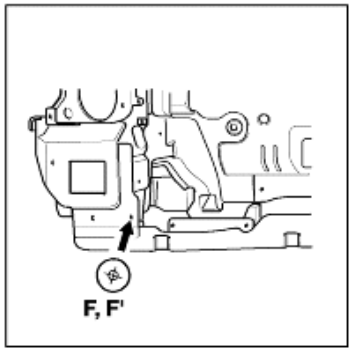

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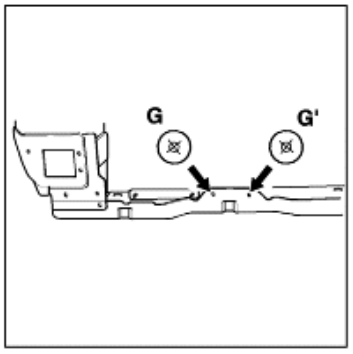

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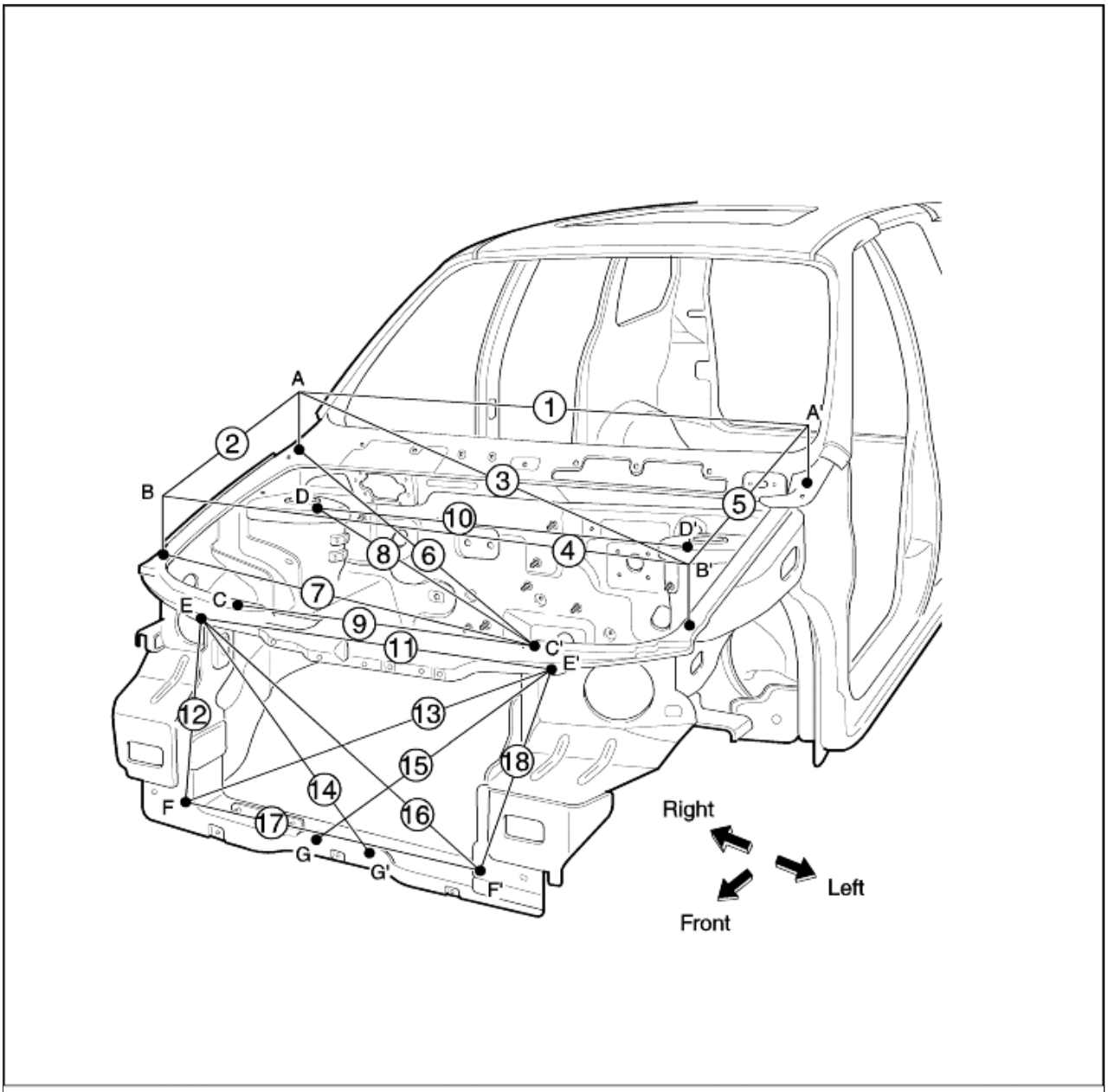
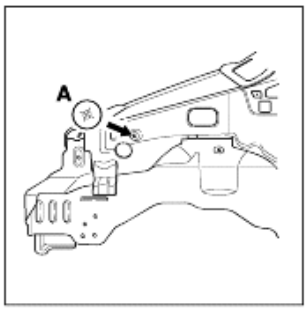


No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Dimension (mm)	1601	697	1693	1486	697	1531	1212	1186	912
No.	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	
Dimension (mm)	1124	930	441	969	680	680	969	800	

Side frame straight-line dimensions



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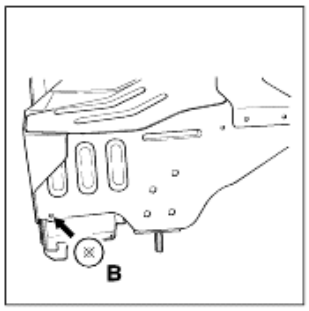
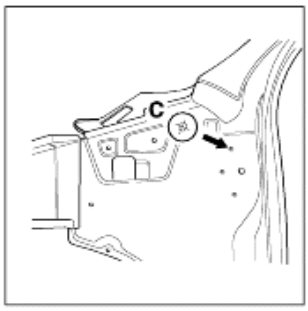
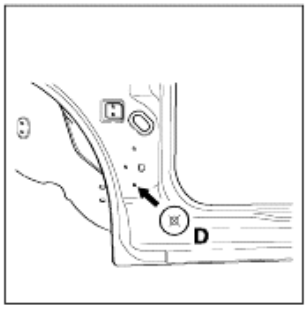


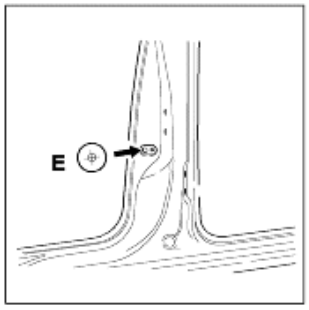
Mud guard mounting hode Ø8.4



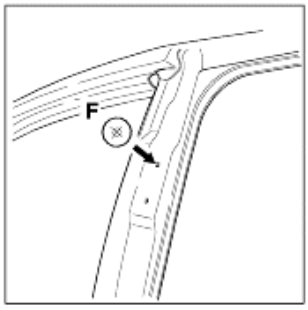
Front door hinge bracket mounting hode Ø12



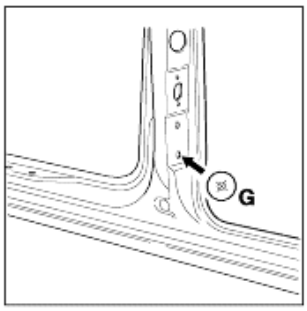
Front door hinge bracket mounting hode Ø12



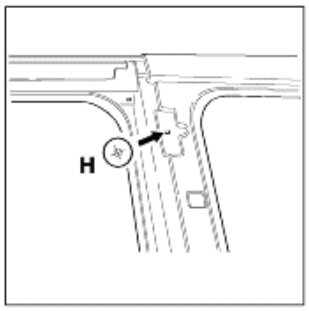
Front door switch mounting hole Ø14



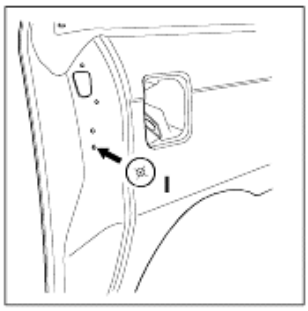
Ø12



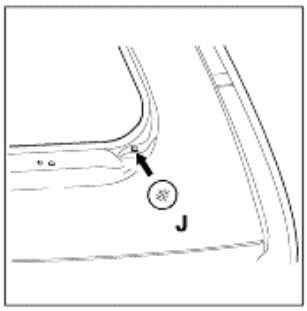
Ø12X17



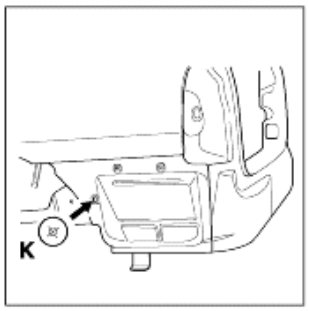
Window bracket mounting hole Ø 7



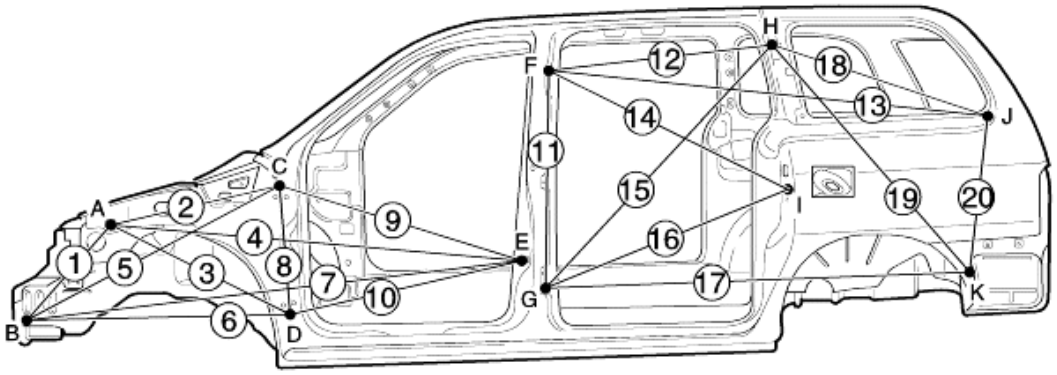
Door striker mounting hole Ø12

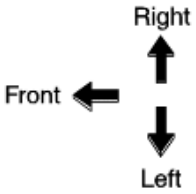


Rail cover mounting hole Ø 8



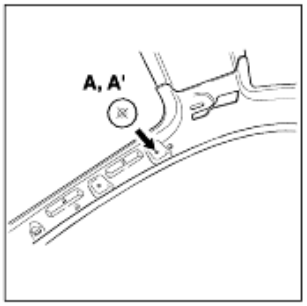
Location hole Ø16



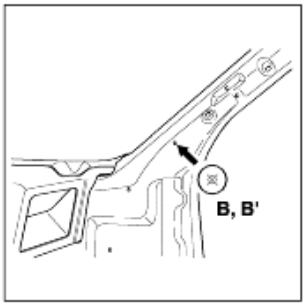


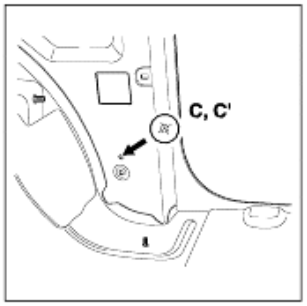
No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Dimension (mm)	686	785	856	1772	1409	1295	2274	500	1046
No.	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱
Dimension (mm)	1003	920	971	1829	1121	1422	1051	1750	915
No.	⑲	⑳							
Dimension (mm)	1247	651							

Interior A straight-line dimensions

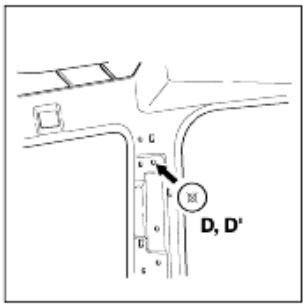


Assist handle mounting hole Ø 7

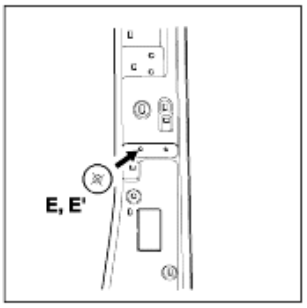




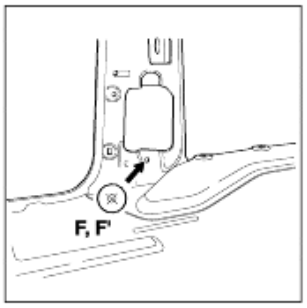
Trim location hole Ø10



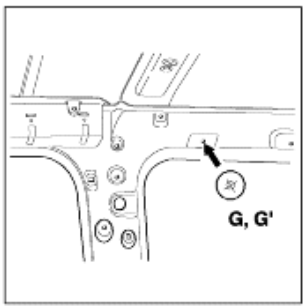
Seat belt anchor mounting hole Ø15



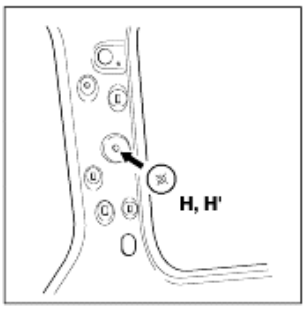
Seat belt guide mounting hole Ø 6



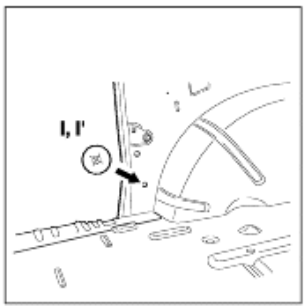
Seat belt retractor mounting hole Ø 18



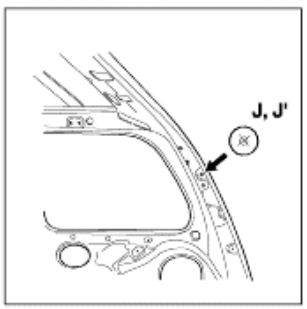
Assist handle mounting hole Ø10



Seat belt retractor mounting hole Ø15

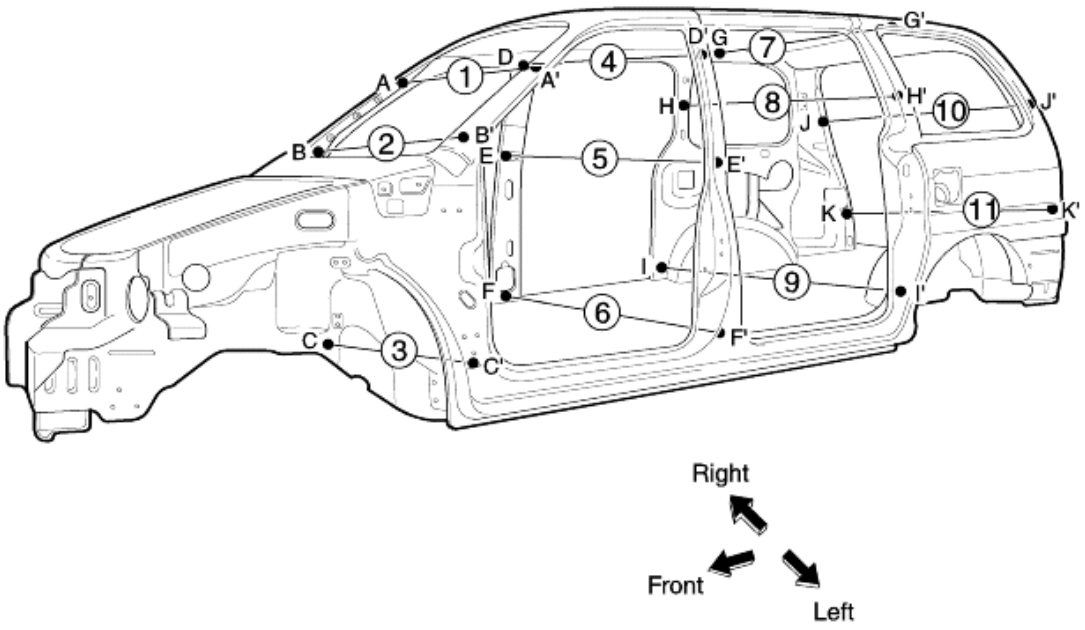


Ø15



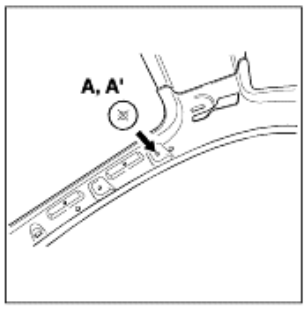
Seat belt retractor mounting hole Ø15

Location hole Ø15

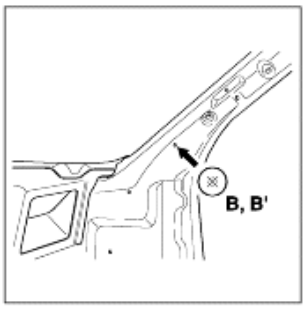


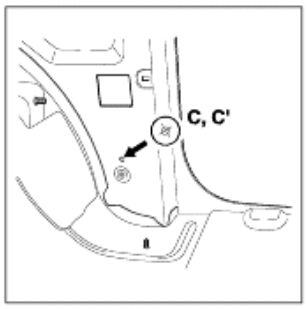
No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Dimension (mm)	1330	1522	1458	1315	1540	1589	1215	1405	1602
No.	⑩	⑪							
Dimension (mm)	1197	1277							

Interior B straight-line dimensions

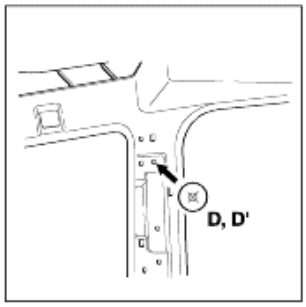


Assist handle mounting hole Ø 7



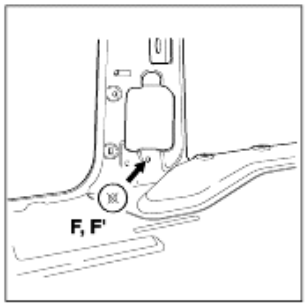


Trim location hole Ø10

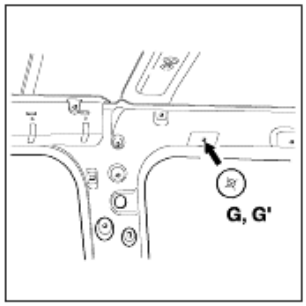


Seat belt anchor mounting hole Ø15

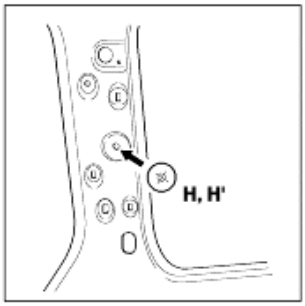
Seat belt guide mounting hole Ø 6



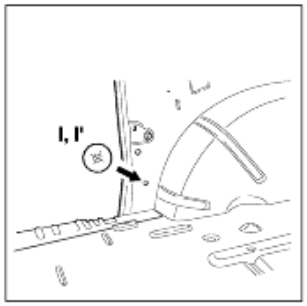
Seat belt retractor mounting hole Ø 18



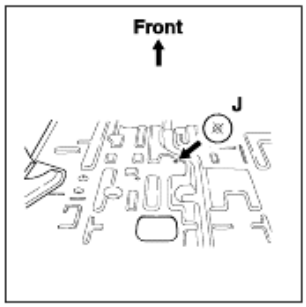
Assist handle mounting hole Ø10



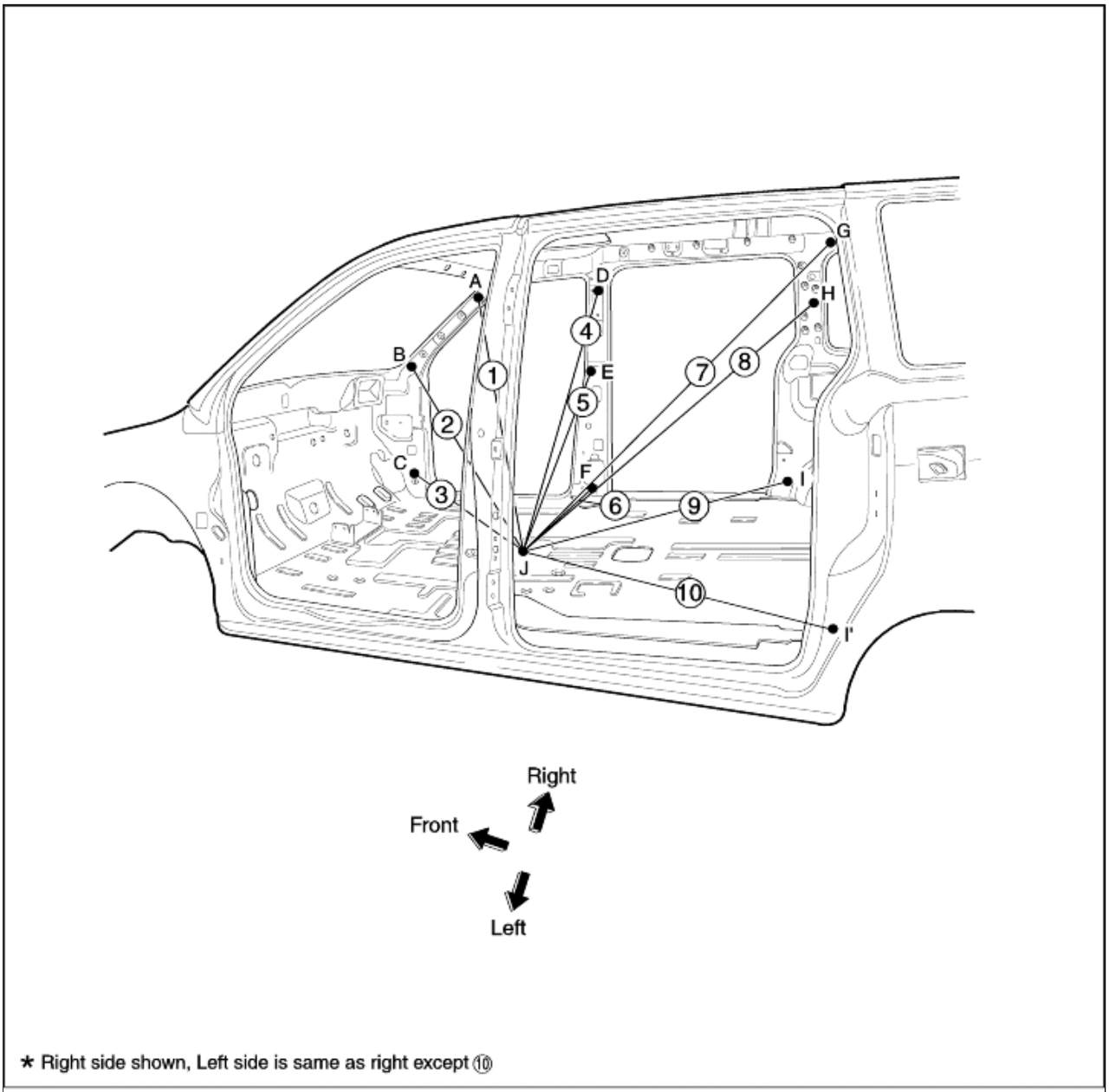
Seat belt retractor mounting hole Ø15



Ø15



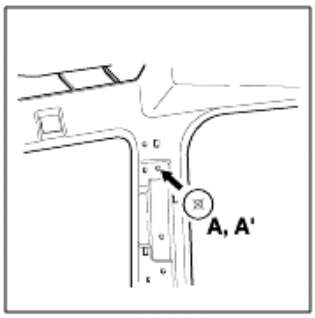
Floor carpet mounting hole Ø 6



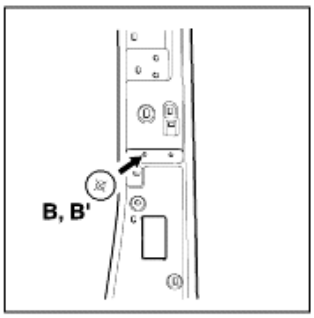
* Right side shown, Left side is same as right except ⑩

No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Dimension (mm)	1333	1363	1157	1300	1075	809	1920	1703	1384
No.	⑩								
Dimension (mm)	1366								

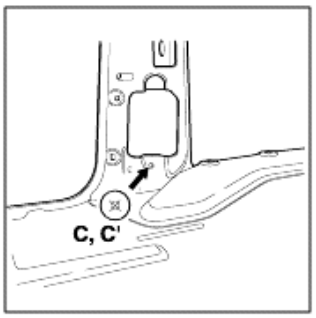
Interior C straight-line dimensions



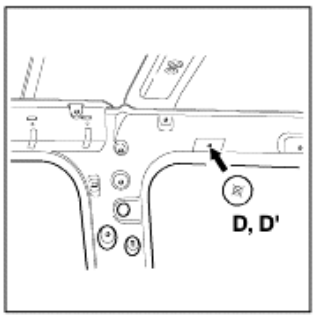
Seat belt anchor mounting hole Ø15



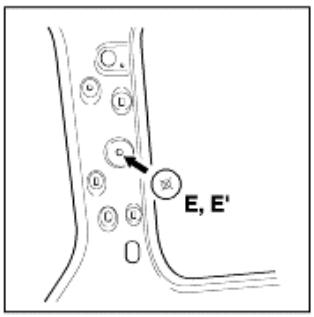
Seat belt guide mounting hole Ø 6



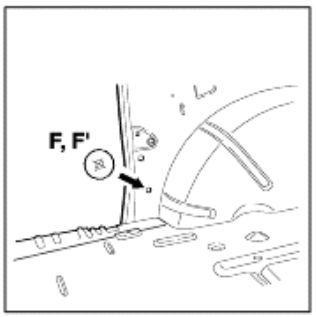
Seat belt retractor mounting hole Ø18



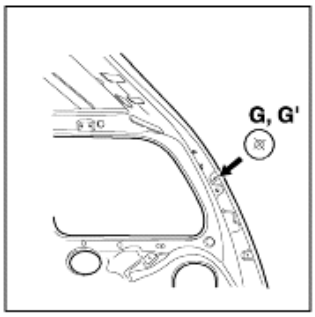
Assist handle mounting hole Ø10



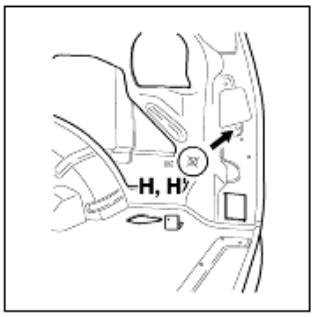
Seat belt retractor mounting hole Ø15



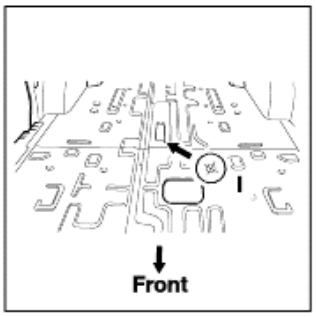
Ø15



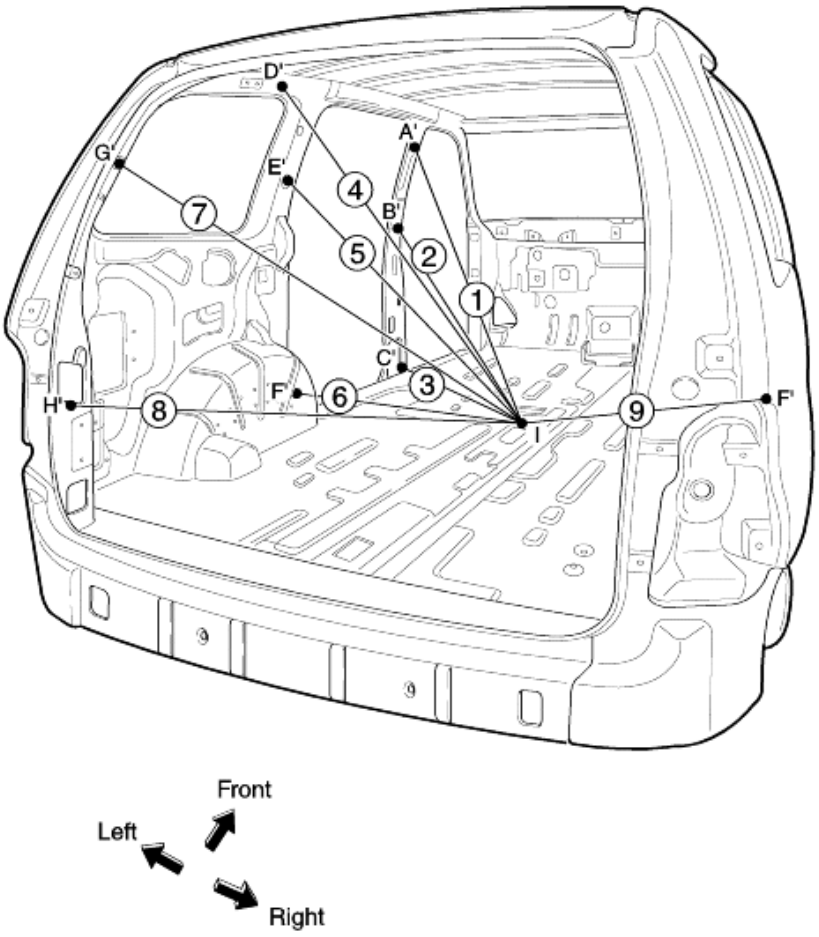
Seat belt retractor mounting hole Ø15



Location hole Ø15



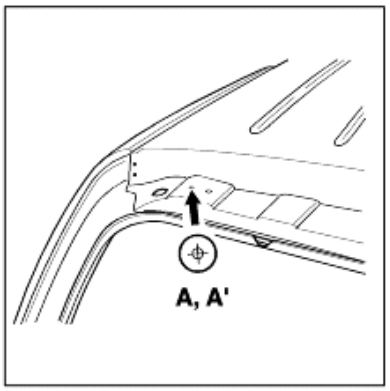
Floor mat mounting hole Ø 6



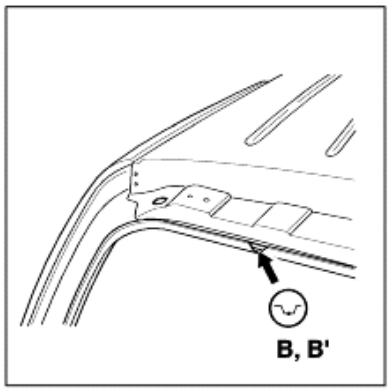
★ Right side shown, Left side is same as right except ⑨

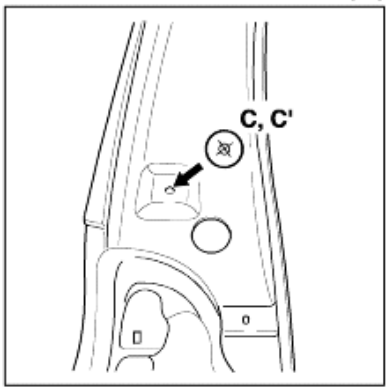
No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Dimension (mm)	1378	1220	1051	1414	1212	856	1718	1654	850

Rear body straight-line dimensions

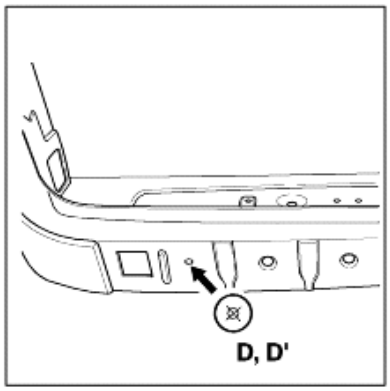


Back door hinge mounting hole Ø8(RH)
Ø8X12(LH)

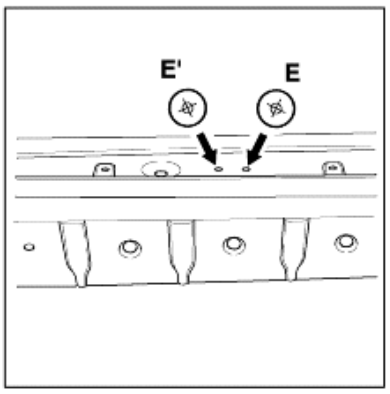




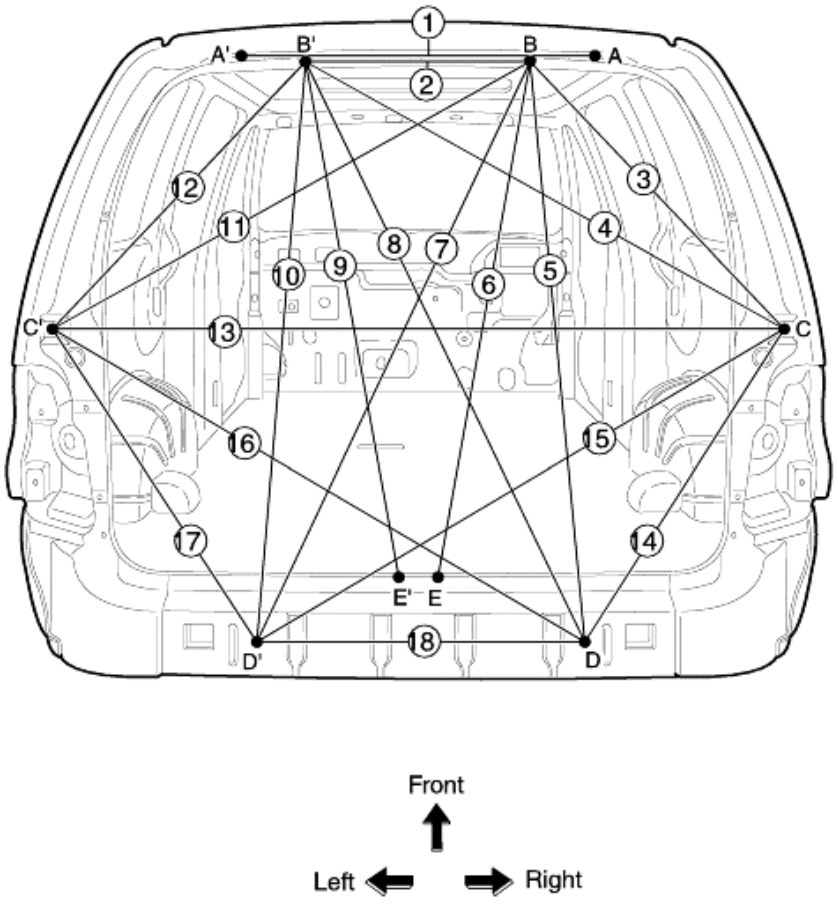
Damper stay mounting hole Ø9



Location hole Ø10x12(LH)
Ø10(RH)



Back door striker mounting hole Ø13

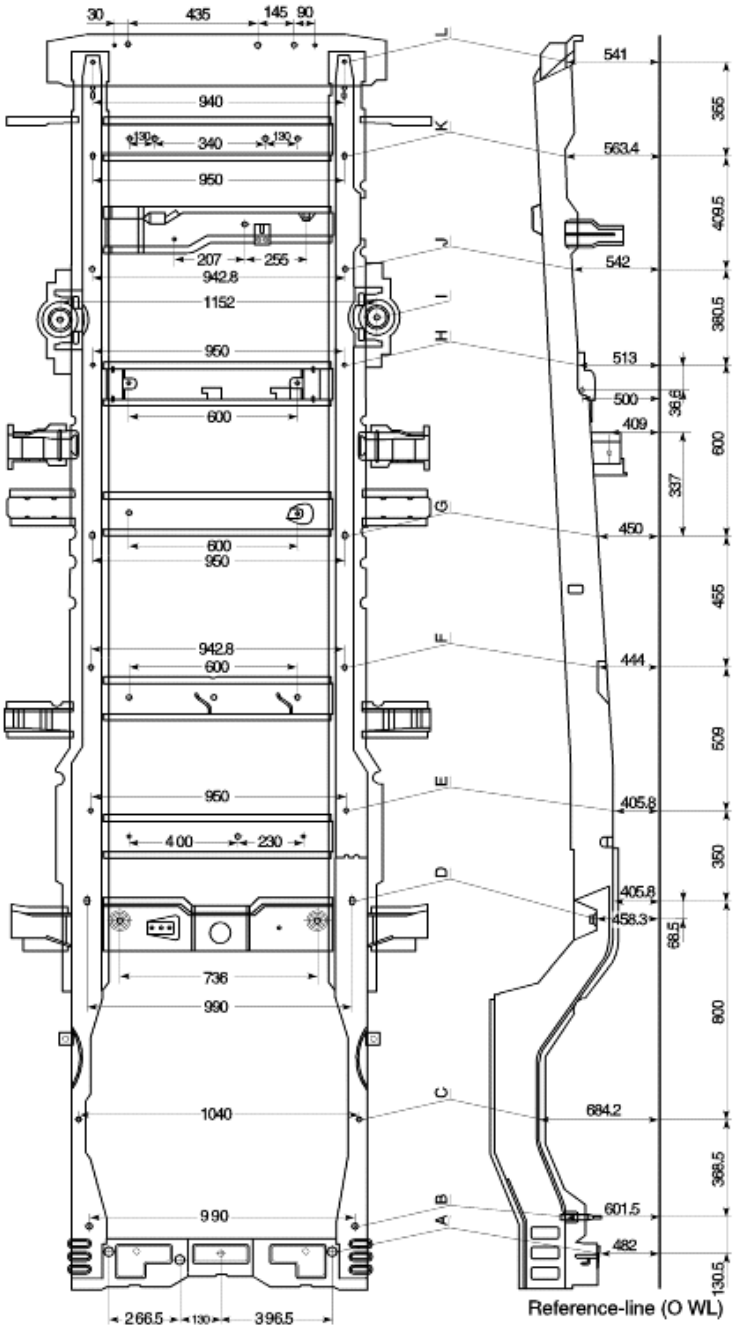


No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Dimension (mm)	825	500	799	1184	1230	1128	1365	1365	1128
No.	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱
Dimension (mm)	1230	1184	799	1529	747	1276	1276	747	700

Under body Projected dimensions

Measurement point	Description	Size of hole
A	Shroud lower member drain hole	Ø20
B	Sub frame bracket mounting hole (front)	Ø26
C	Front frame location hole	Ø20
D	Front frame location hole	Ø20 x 26
E	Datum hole	Ø16
F	Center frame hole	Ø7
G	Substitute datum hole	Ø16 x 20
H	Rear frame location hole	Ø16

I	Panhard rod bracket hole	Ø30
J	Rear frame location hole	Ø16 x 20
K	Bumper bracket mounting hole	Ø12

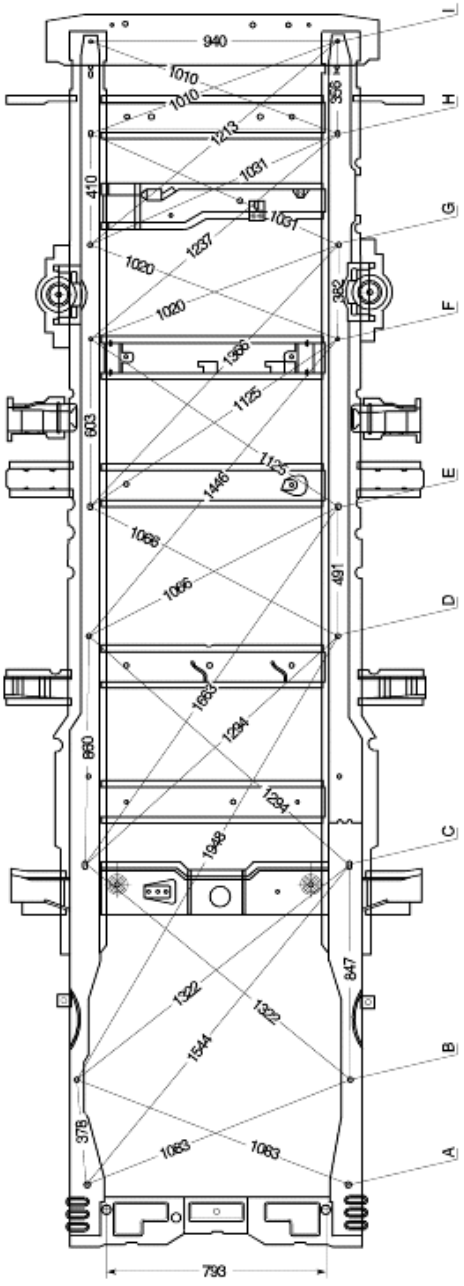


Unit : mm

Under body Straight-line dimensions

Measurement point	Description	Size of hole
A	Sub frame bracket mounting hole (front)	Ø26
B	Front frame location hole	Ø20
C	Front frame location hole	Ø20 x 26
D	Center frame hole	Ø7
E	Substitute datum hole	Ø16 x 20

F	Rear frame location hole	Ø16
G	Panhard rod bracket hole	Ø30
H	Rear frame location hole	Ø16 x 20
I	Bumper bracket mounting hole	Ø12

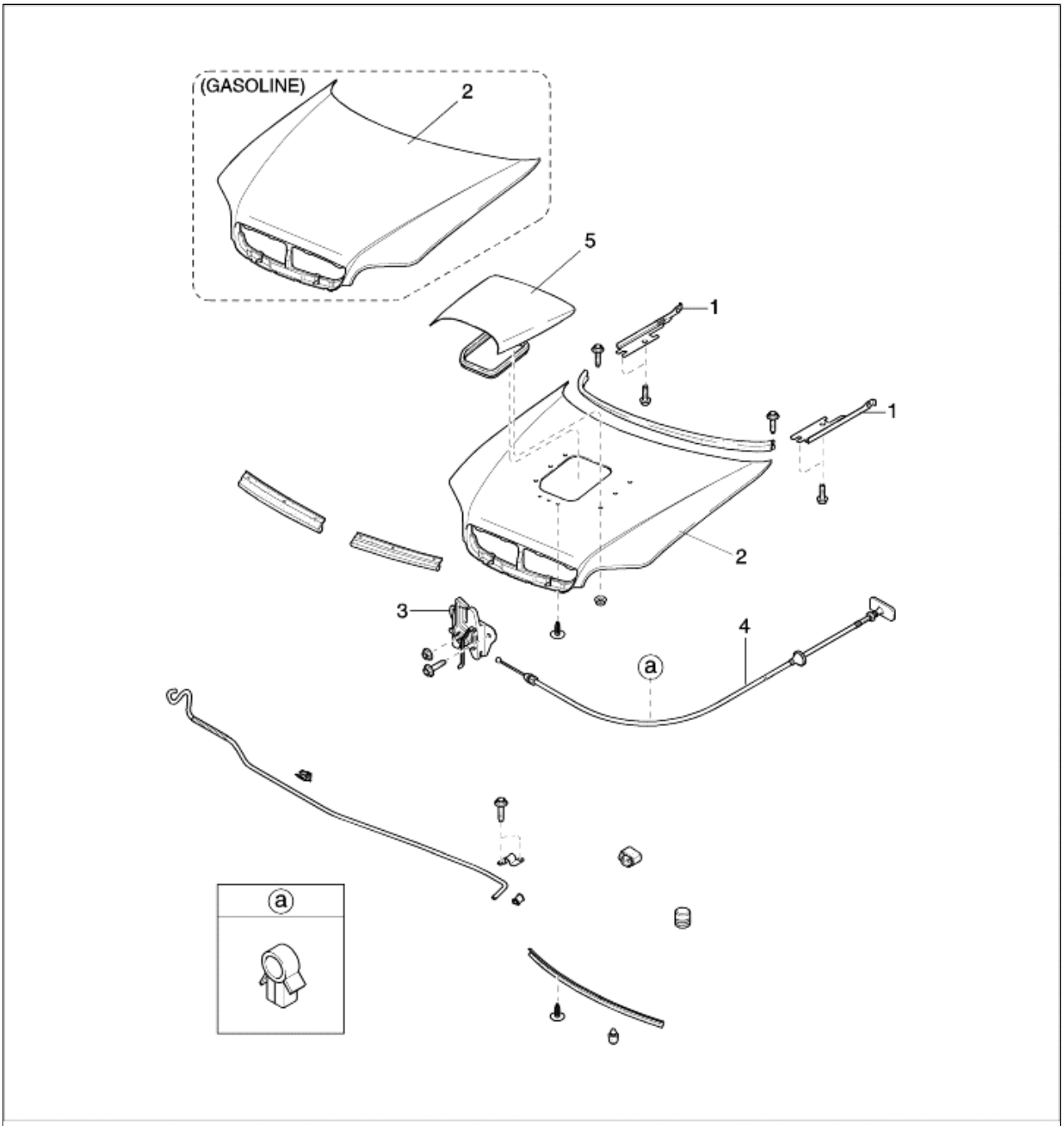


Unit : mm

Description

The hood is a front-opening type secured by a standard double-release latch. The hood release T-handle is located below and to the left of the steering column. When the hood is opened, it pivots on two hinges and is held open by a hood prop. The two hinges are secured to the body with two bolts and to the hood with two bolts on each hinge. The hood can be aligned fore-and-aft and side-to-side by loosening the hood bolts and adjusting. The hood latch can be adjusted in both axes to match the position of the permanently attached striker.

Components



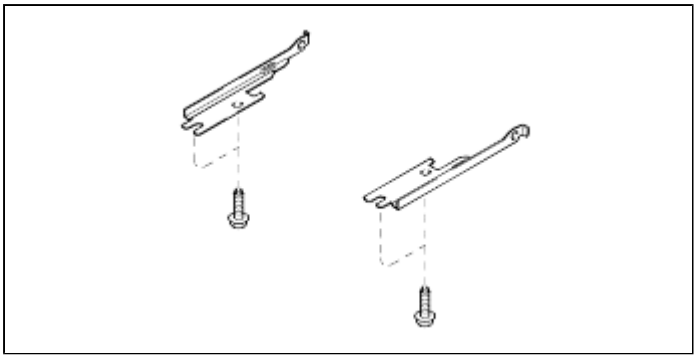
1. Hinge assembly
2. Hood
3. Lock assembly
4. Release wire assembly
5. Air guide assembly

Removal

1. Raise hood and support with prop.
2. Remove the tubing from the underside of the hood.
3. Support hood so it will not fall when hinges are removed.

> NOTE
>
> Have an assistant help remove hood.

4. Remove hinges from hood by removing two bolts.



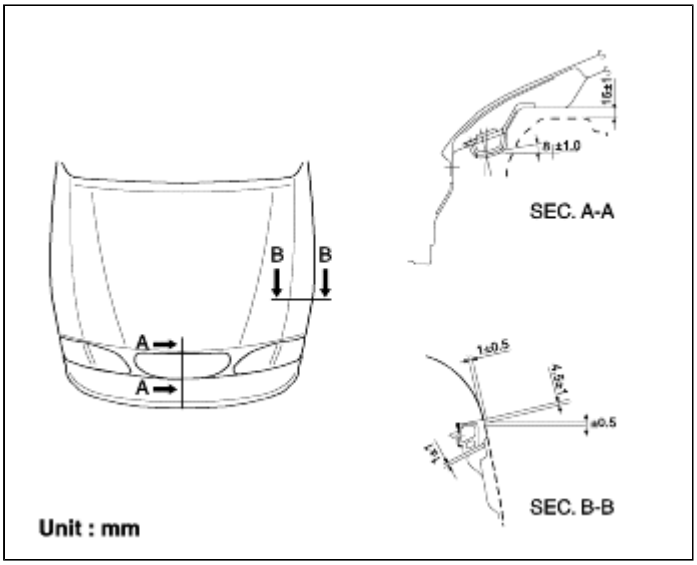
5. Remove prop from hood.
6. Remove hood.

Installation

> NOTE
>
> Have an assistant help install hood.

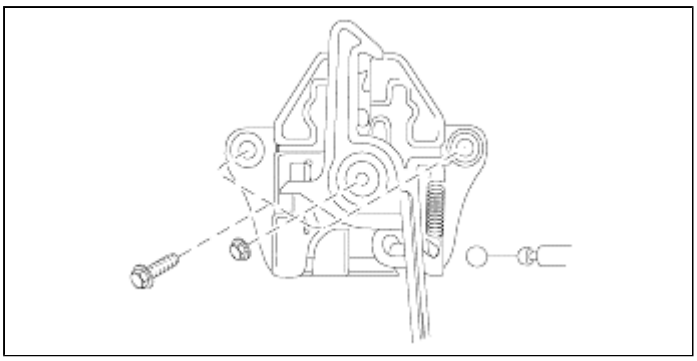
1. Install in reverse order of removal.
2. Tighten four hinge bolts to just over finger-tight.
3. Lower and lock the hood.
4. Check fit and adjust as required in accordance with illustrated specifications.

Tighten latch and bolts to :8~11 N·m (0.8~1.1 kg·m, 6~8 lb·ft)



5. Check alignment of locking mechanism and hood striker and align required.

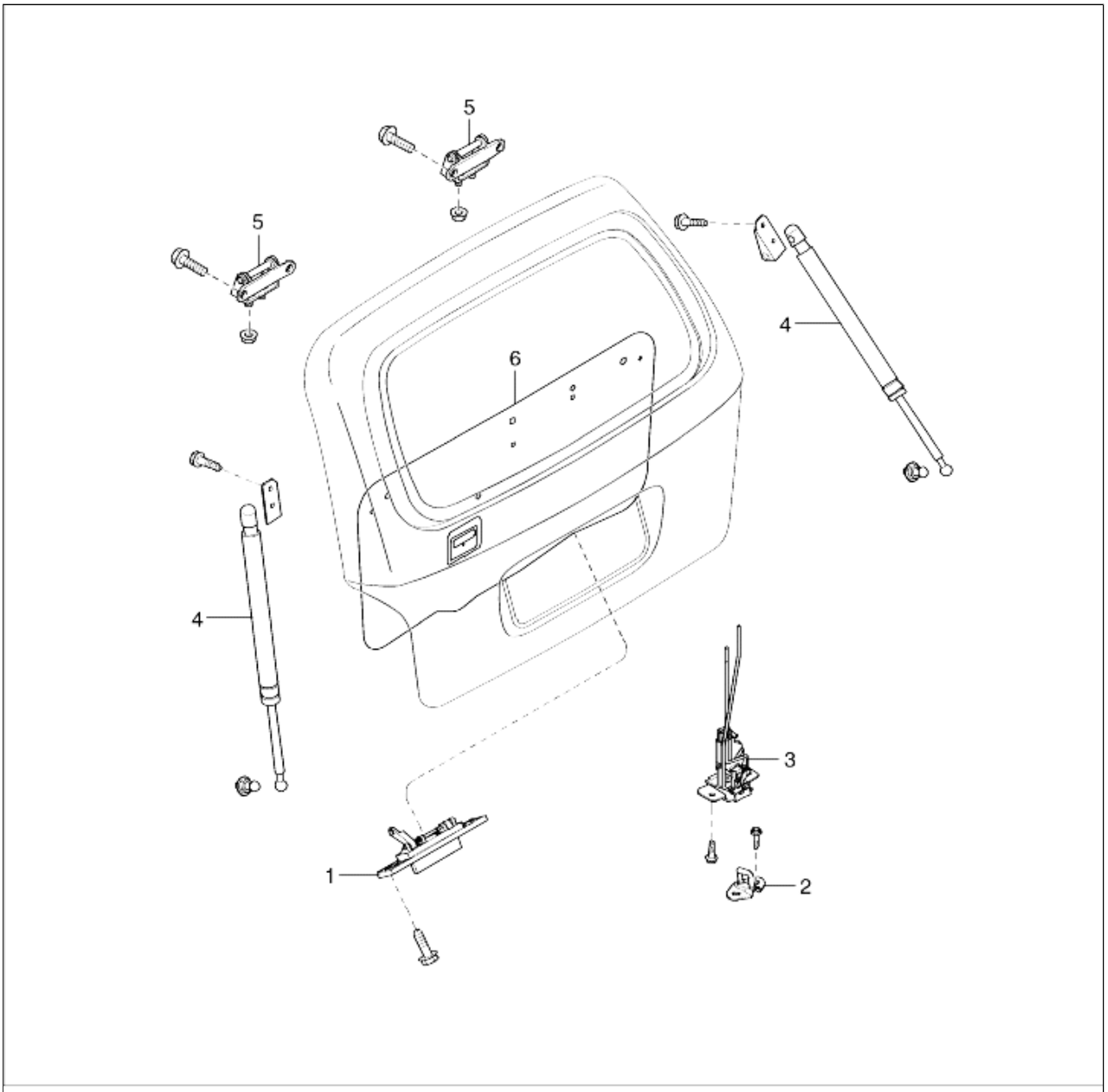
Tighten latch and bolts to :8~11 N·m (0.8~1.1 kg·m, 6~8 lb·ft)



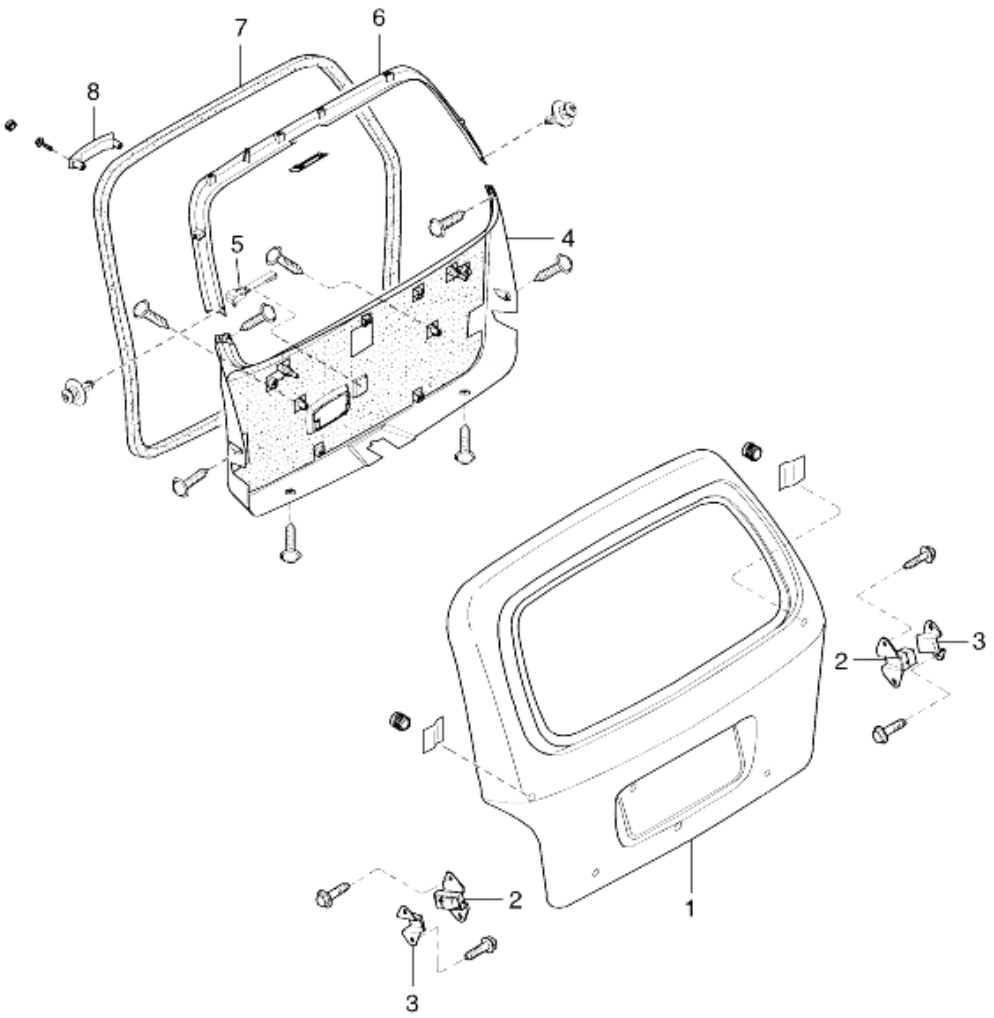
Description

The tail gate is attached to the body by two pin-type hinges riveted to the body and bolted to the tail gate. A damper stay on either side of the tail gate provides an assist in raising the tail gate and fully supports it when it is open. A tail gate at the center-bottom of the opening secures the tail gate in the closed position. Weatherstripping on the tail gate jamb flange prevents leaks between the tail gate and the body. The tail gate is fully adjustable.

Components



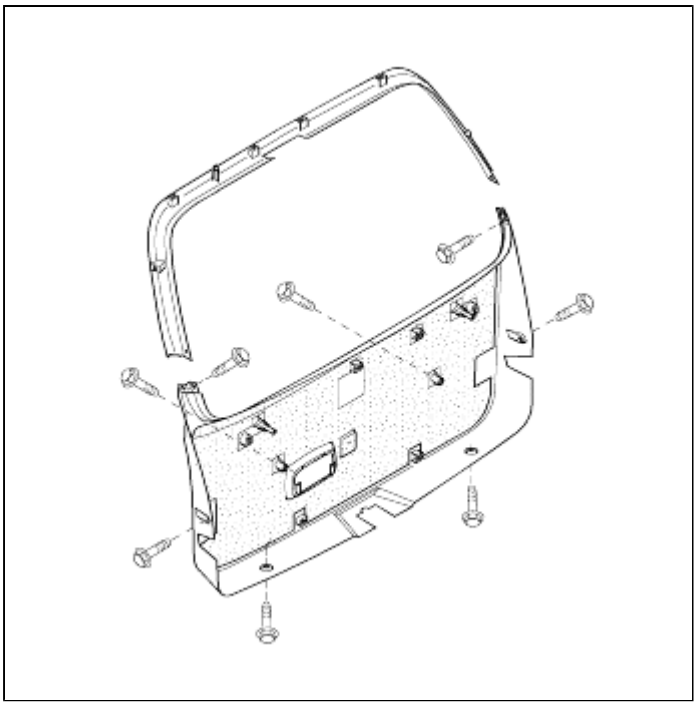
1. Outer handle assembly
2. Tail gate lock striker
3. Tail gate lock assembly
4. Damper stay assembly
5. Hinge sub assembly
6. Tail gate screen



1. Tail gate assembly
2. Tail gate dove tail
3. Tail gate wedge
4. Lower trim
5. Assist grip
6. Upper trim
7. Weatherstrip
8. Assist handle

Removal

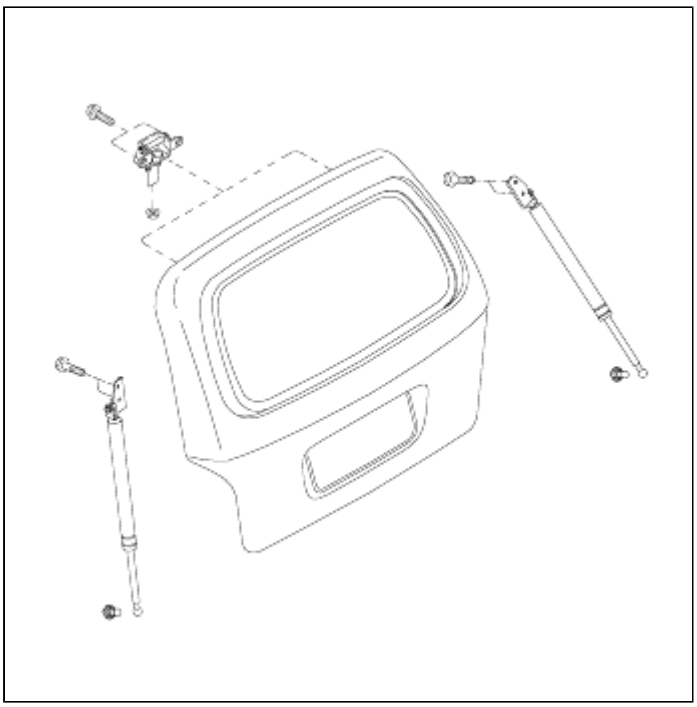
1. Remove high-mounted brake light assembly.
2. Remove tail gate trim.



3. Peel off the plastic door screen carefully by pulling it away gradually from the door frame.

> NOTE
>
> Removal of the damper stay assemblies requires that the tail gate be well supported to permit it to remain in the open position so there is access to the tail gate hinges. Have an assistant help in tail gate removal.

4. Remove damper stay.



5. Remove the tail gate.

A. Remove one bolt from the left and right-hand hinges.

> NOTE
>
> The last step in the removal of the tail gate is a two-man job. Have an assistant help remove the hatch.

B. Remove the last two bolts from the tail gate.

C. Remove the tail gate and secure it.

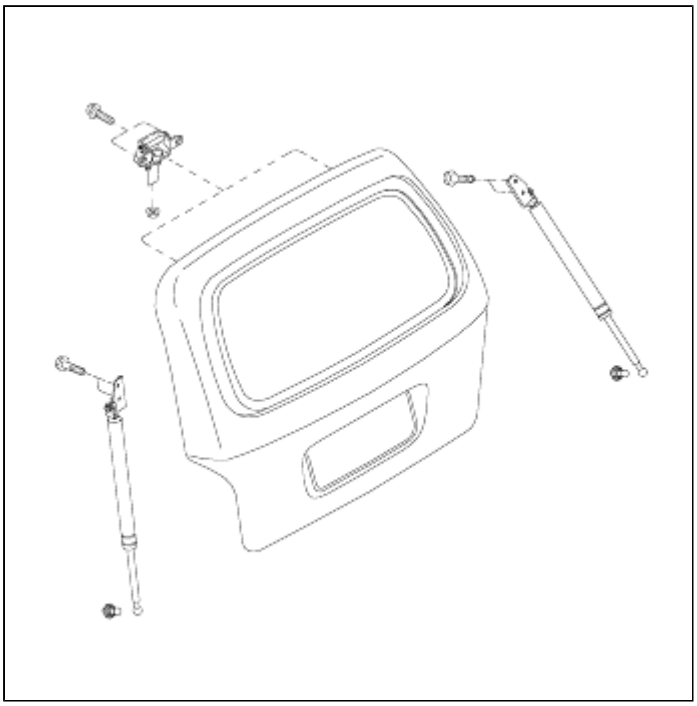
Installation

1. Install the tail gate hinge mounting bolts.

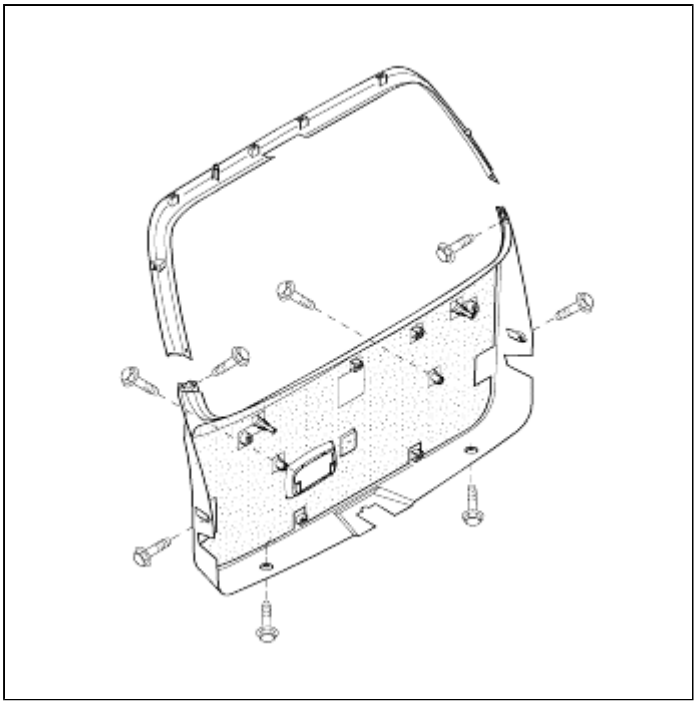
   Tightening torque :18~27 N·m (1.8~2.7 kg·m, 13~20 lb·ft)

2. Install damper stay.

   Tightening torque : bracket mounting bolts.7~10 N·m (0.7~1.0 kg·m, 5~7 lb·ft)Tightening torque : stud ball nut15~23 N·m (1.5~2.3 kg·m, 11~17 lb·ft)



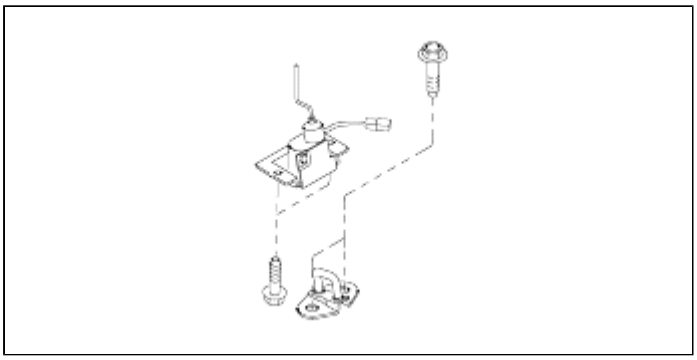
3. Install hatch screen.
4. Install tail gate trim.



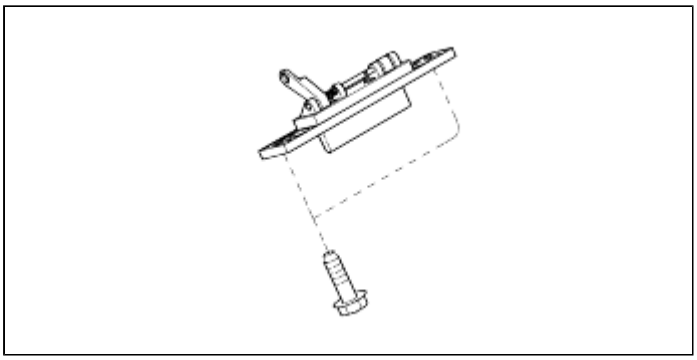
5. Install Hi-mounted brake light assembly.

Disassembly

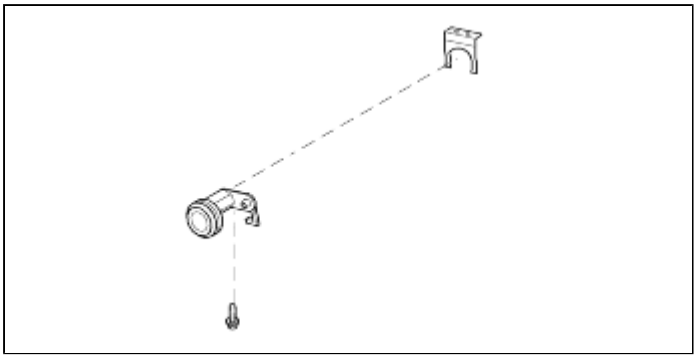
1. Remove tail gate lock.



2. Remove outside handle.

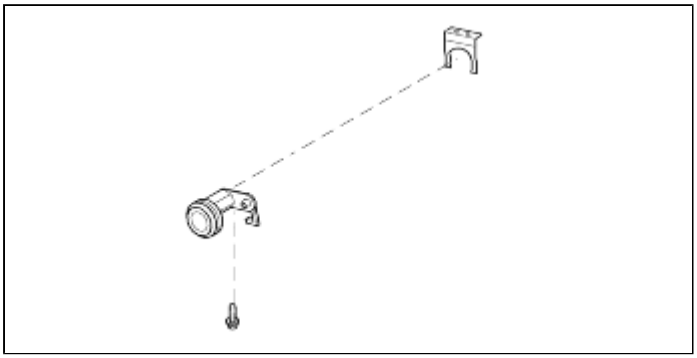


3. Remove key cylinder assembly.
   A. Remove key cylinde clip.
   B. Remove mounting bolt.

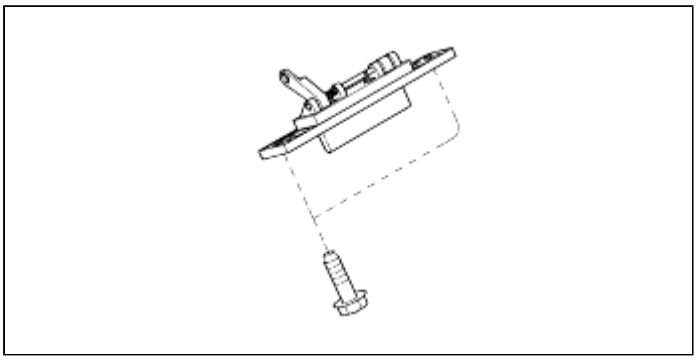


Reassembly

1. Install key cylinder assembly.

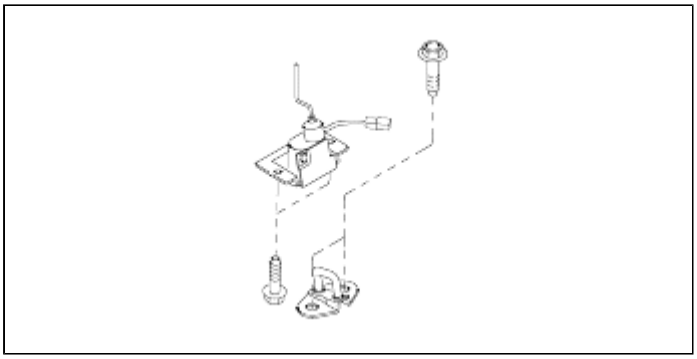


2. Install outside handle.



3. Install tail gate lock.

Tightening torque :8~10 N·m (0.8~1.0 kg·m, 6~7 lb·ft)

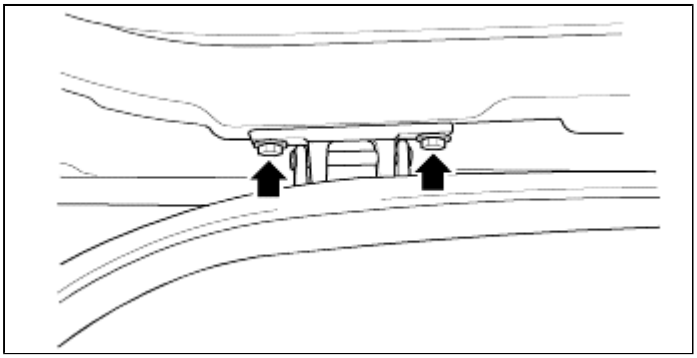


Adjustment

Tail gate hinge

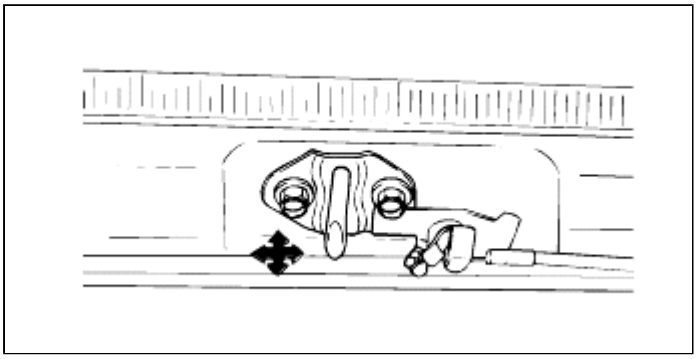
1. Check that the tail gate can be closed easily and that there is no play. If there is a problem, open the tail gate and tighten the tail gate hinge install bolts.

2. To adjust the tail gate-to-body offset, loosen the tail gate hinge install bolts and make the adjustment.



Tail gate lock striker

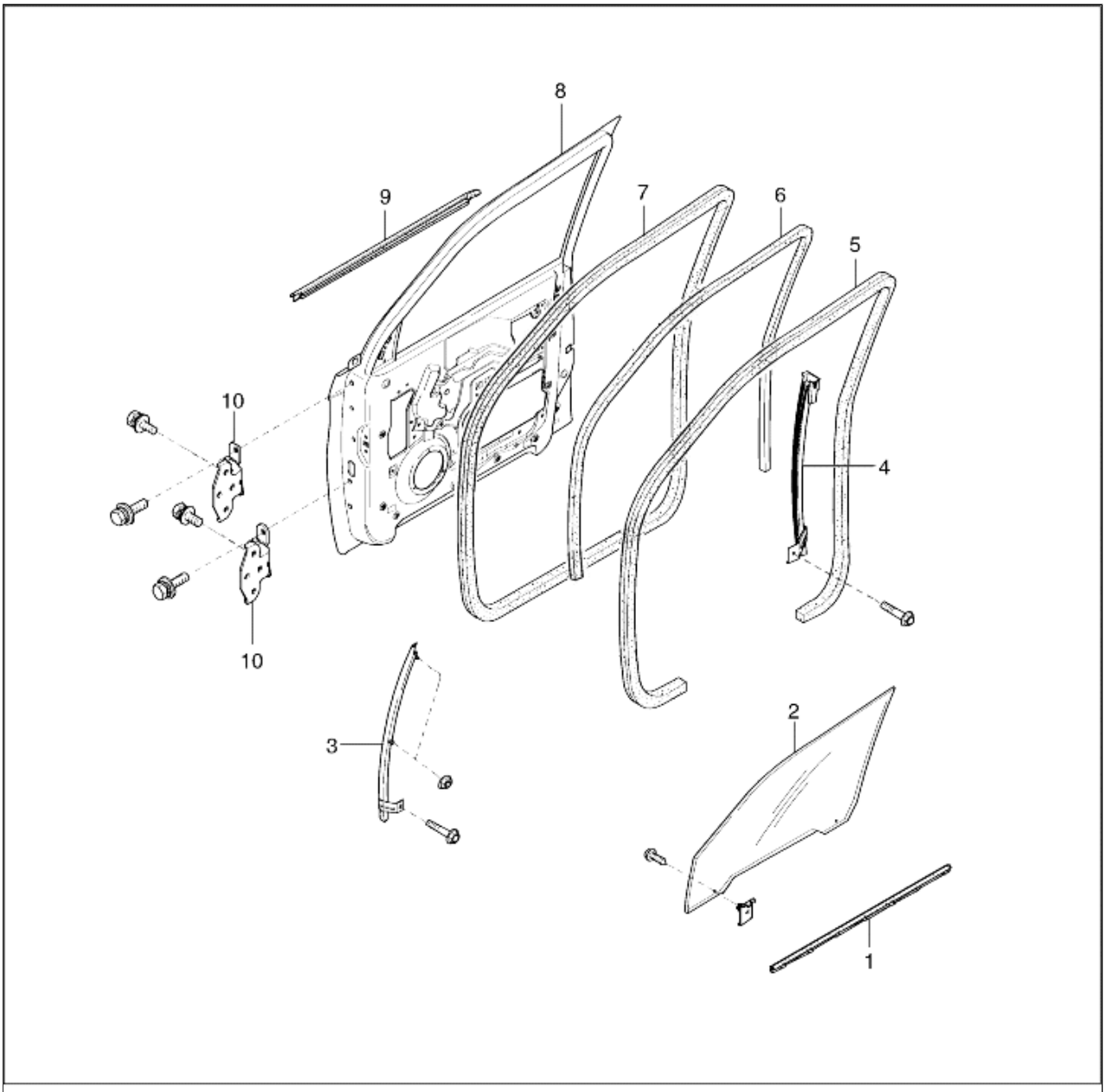
1. Check that the tail gate can be closed easily. If there is a problem, loosen the striker install bolts and adjust the tail gate by moving the striker vertically and horizontally.
2. Adjust the rear offset of the tail gate to the body by moving the tail gate lock striker horizontally.



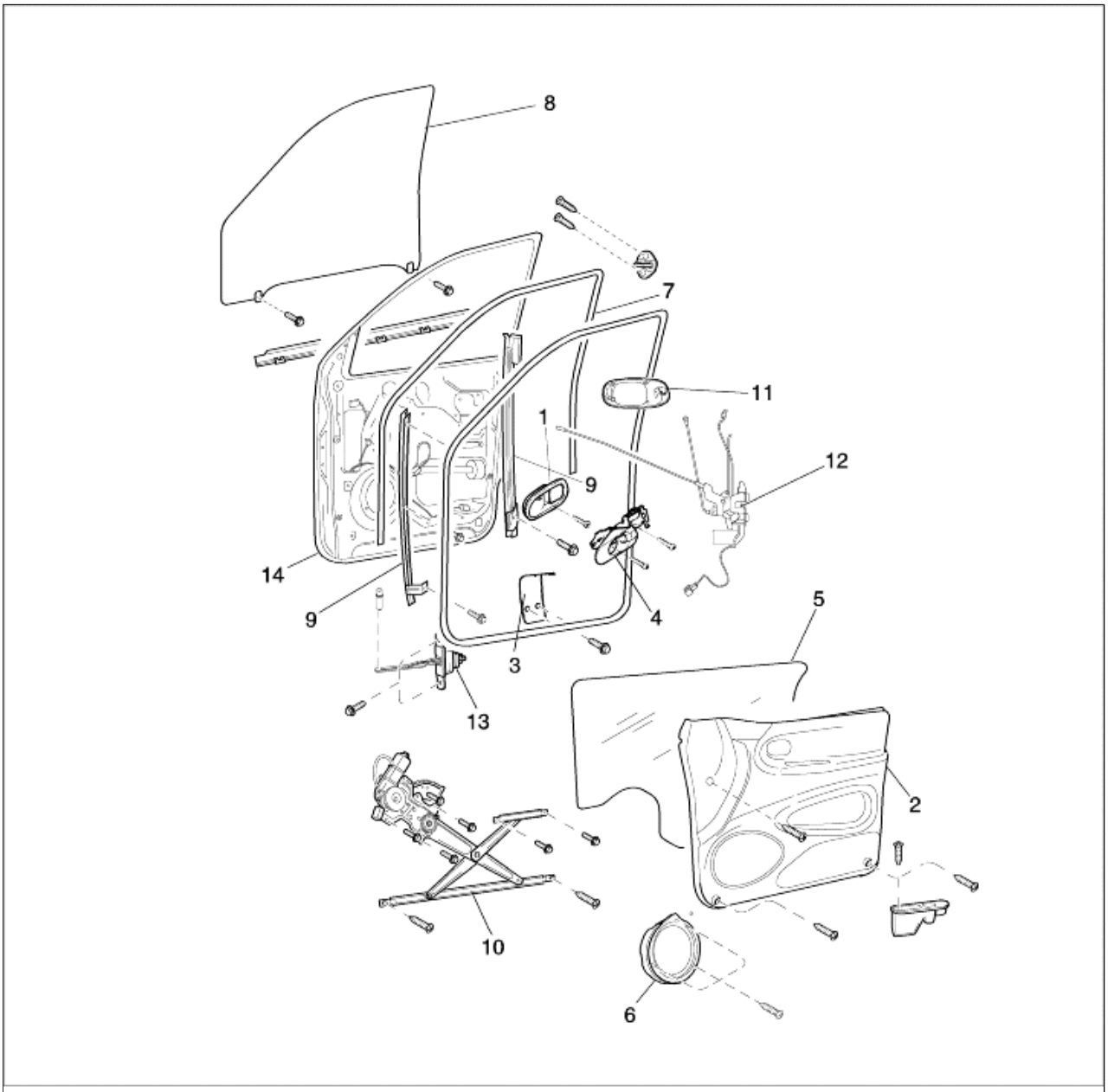
Description and operation

The doors attached to the vehicle body by two hinges and a door checker. The door checker limits the swing of the vehicle door. A hollow rubber weather-strip is installed on the door opening flange which prevents leaks between the vehicle door and the inside of the vehicle door and the inside of the vehicle body. The door lock assembly is linked with the outside door handle, the inside door lock knob by means of connecting rods. The power window is comprised of a window regulator assembly (on which the glass is fastened), a front glass guide (which guides the movement of the glass at the front side) and a window power switch (switch for up and down movement of the glass, which is attached to the armrest). A plastic door screen covers the doorframe protecting all the components. A door trim covers the entire doorframe and has the armrest and the door pocket (also referred to as the speaker grille) attached to it. The door striker may be adjusted for proper and easy door closure.

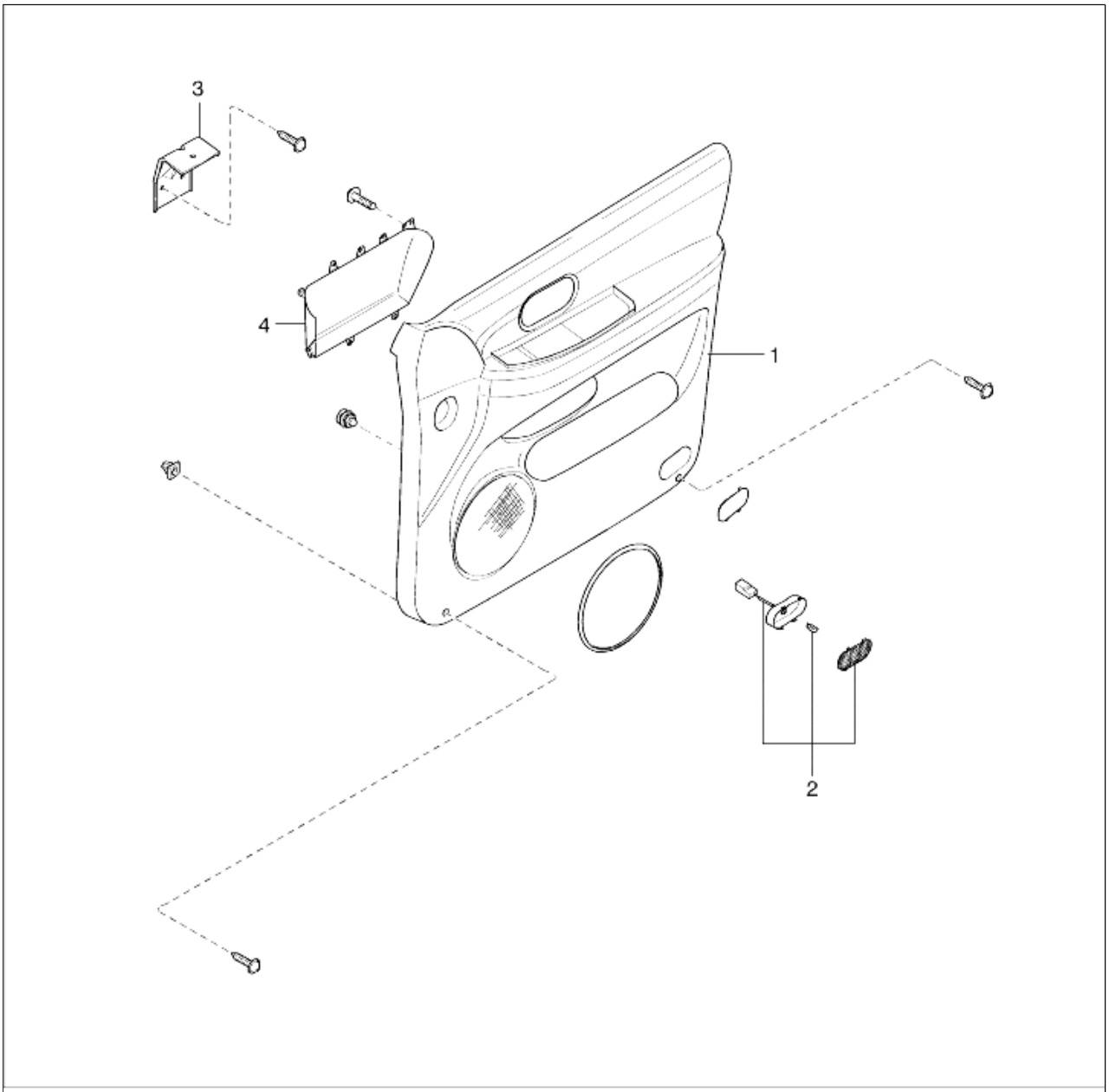
Components



1. Glass inner weatherstrip
2. Door glass
3. Glass guide
4. Glass guide B
5. Door weatherstrip
6. Glass run channel
7. Door weatherstrip
8. Door panel assembly
9. Door outer glass weatherstrip
10. Door hinge



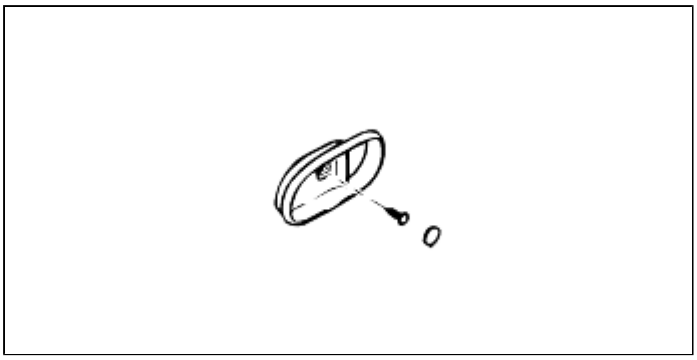
1. Inner handle cover
2. Door trim
3. Pull handle barcket
4. Inner handle
5. Door screen
6. Door speaker
7. Glass run channel
8. Glass
9. Glass guide
10. Regulator assembly
11. Ooutside door handle
12. Door lock assembly
13. Door checker
14. Door frame



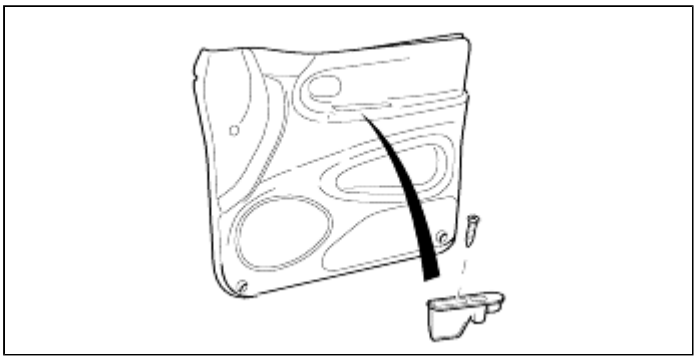
1. Front door trim assembly
2. Courtesy lamp
3. Pull handle bracket
4. Pocket cover

Removal

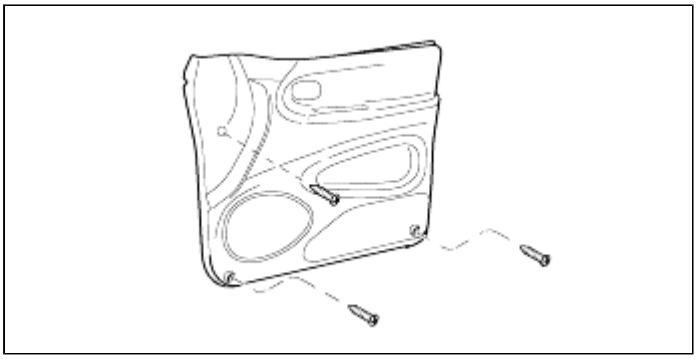
1. Disconnect negative battery cable.
2. Remove door trim.
   A. Remove door garnish.
   B. Remove one screw on the inside door handle cover.



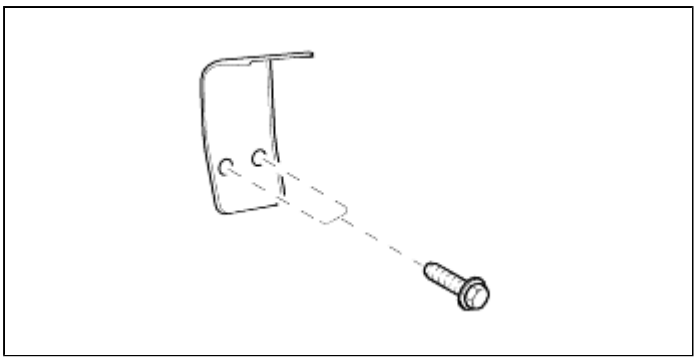
   C. Remove inside door handle cover.
   D. Remove one screw on the pull handle.



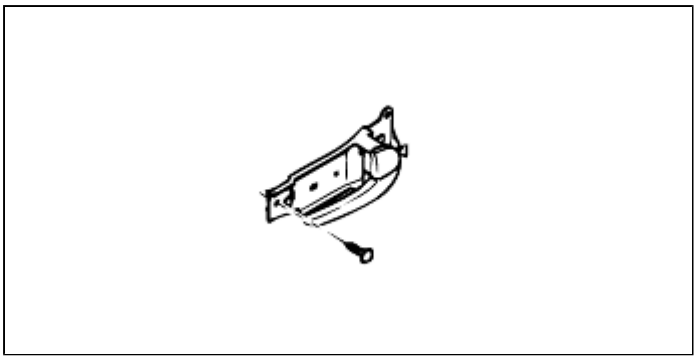
   E. Remove three screws on the trim.



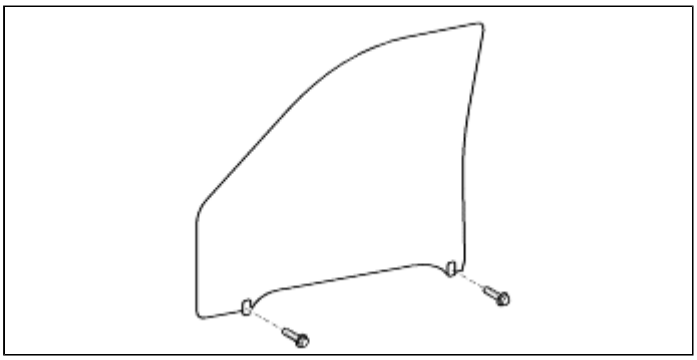
   F. Remove door trim by lifting it up.
   G. Disconnect window operating switch connectors.
3. Remove two screws on the pull handle bracket.



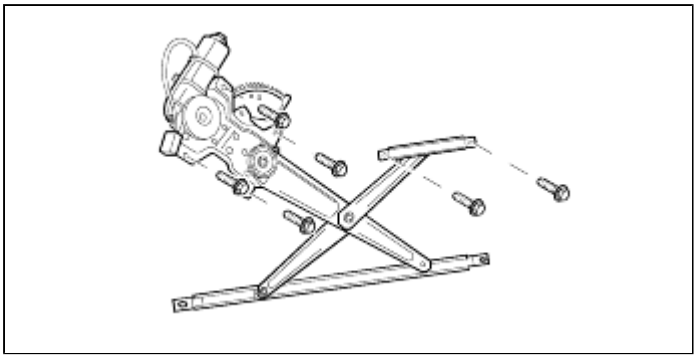
4. Remove inside door handle.



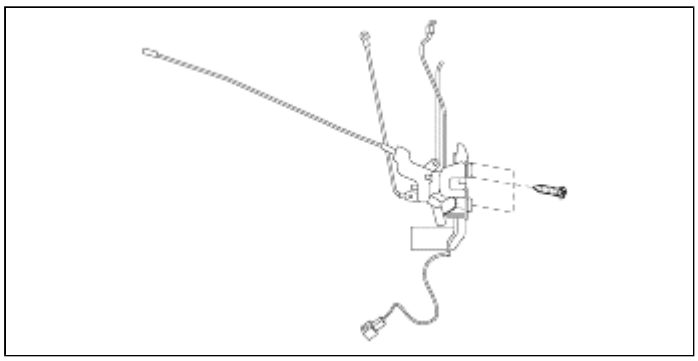
   A. Disconnect inside door handle rod.
   B. Remove three screws on the inside door handle.
5. Peel off the plastic door screen carefully by pulling it away gradually from the door frame.
6. Remove door speaker.
   A. Remove three screws on the door speaker.
   B. Unfasten the harness connector from the door frame.
   C. Pull out the speaker and disconnect the connectors.
7. Remove run channel.
8. Remove window glass.
   A. Reconnect window operating switch.
   B. Turn the ignition "ON" and position the window glass about halfway.
   C. Turn the ignition "OFF".
   D. Remove two glass mounting bolts from the power window regulator.
   E. Remove glass carefully; hold the glass from both its inner and outer surfaces. While tilting it toward the hinge side of the door, pull it out from outside the door frame.



9. Remove regulator assembly.
   A. Disconnect electrical connector for the regulator assembly motor.
   B. Remove six bolts on the door frame.
   C. Remove regulator assembly from out of access hole.



10. Remove glass guide.
    A. Remove two bolts and one nut on the glass guide.
    B. Remove glass guide from access hole.
11. Remove door lock assembly.
    A. Disconnect two remote control rods from outside door handle assembly.
    B. Remove three screws from door lock assembly and remove assembly from access hole.

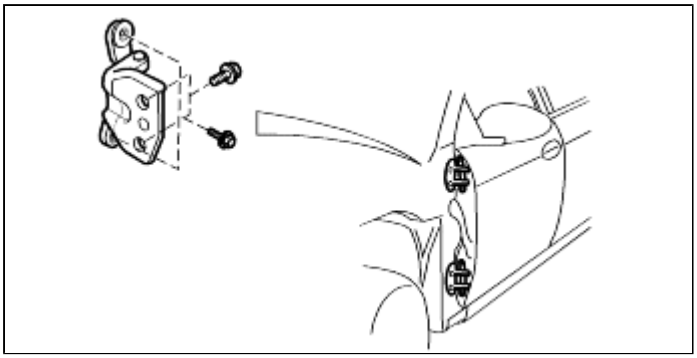


12. Remove mounting bolts from outside door handle.
13. Remove rearview mirror from door.
    A. Disconnect electrical connector.
    B. Remove three mounting screws and remove mirror.
14. Remove wiring harness.
    A. Disconnect harness connectors from inner door frame.
    B. Pull out wiring harness from access hole.
15. Remove door checker installation bolt from body.
16. Remove door by removing bolts on both hinges.

Installation

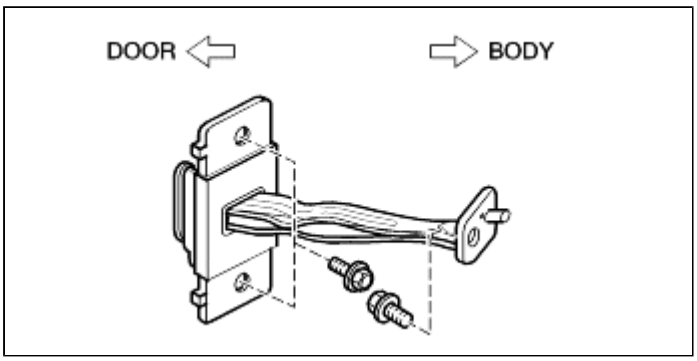
1. Install the door.
    A. Position the door on the vehicle properly.
    B. Install the bolts on both the hinges.

Tightening torque :18~30 N·m (1.8~3.0 kg·m, 13~22 lb·ft)

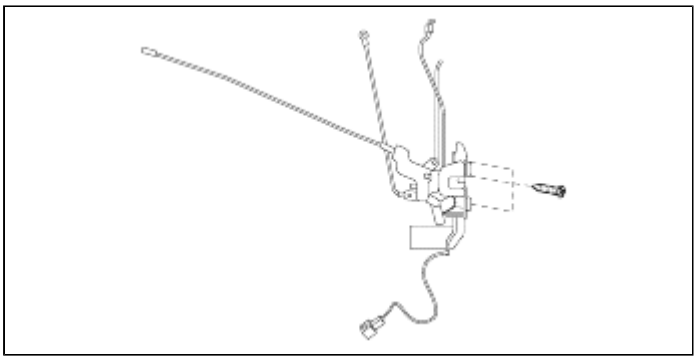


2. Install the dust weatherstrip.
3. Install the door checker assemblyInstall the dust weatherstrip.
   A. Install one bolt.

   Tightening torque : Body side18~27 N·m (1.8~2.7 kg·m, 13~20 lb·ft)
   Tightening torque : Door side12~26 N·m (1.2~2.6 kg·m, 9~19 lb·ft)



4. Install the wiring harness.
   A. Position the wiring harness in the access hole.
   B. Fasten the five harness connectors onto the door frame.
5. Install rearview mirror on the door.
   A. Position the rearview mirror on the door as originally positioned.
   B. Install the three mounting screws.
   C. Connect the electrical connector.
6. Install outside door handle.
7. Install door lock assembly.



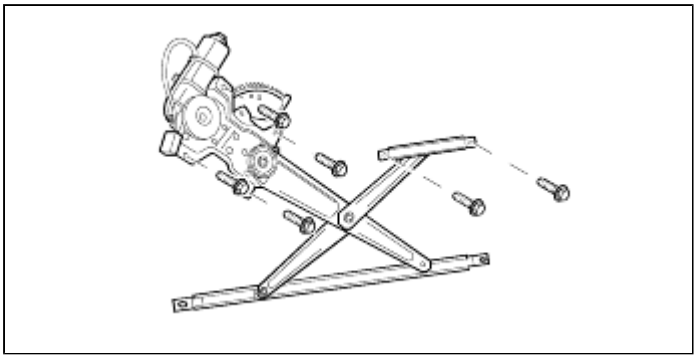
   A. Position it as originally positioned through the access hole.
   B. Install three mounting bolts.

   Tightening torque :4~6 N·m (0.4~0.6 kg·m, 3~5 lb·ft)

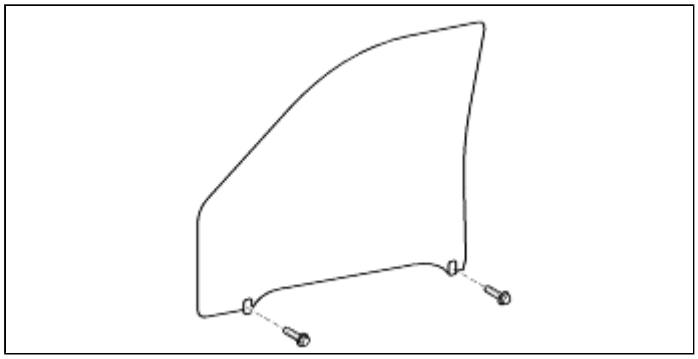
   C. Connect the two remote control rods of the door lock assembly to the outside door handle.

8. Install the glass guide.
   A. Position the glass guide as originally positioned through the access hole.
   B. Install two bolts and one nut.
9. Install the regulator assembly.
   A. Position the regulator assembly through the access hole.
   B. Install six mounting bolts.

   Tightening torque :3~4 N·m (0.3~0.4 kg·m, 2~3 lb·ft)



   C. Connect the electrical connector for the motor of the regulator assembly.
10. Install window glass.
   A. Position the glass carefully :
      Hold the glass from both its inner and outer surfaces. While tilting it towards the hinge side of the door, place it on the small bracket on the window regulator assembly.
   B. Loosely install two glass mounting bolts on the power window regulator assembly.



   C. Reconnect the window operating switch.
   D. Connect the negative battery cable.
   E. Turn on the ignition and move the glass up and down to ensure proper function.
   F. Make adjustments as necessary.
   G. Turn off the ignition.

   CAUTION

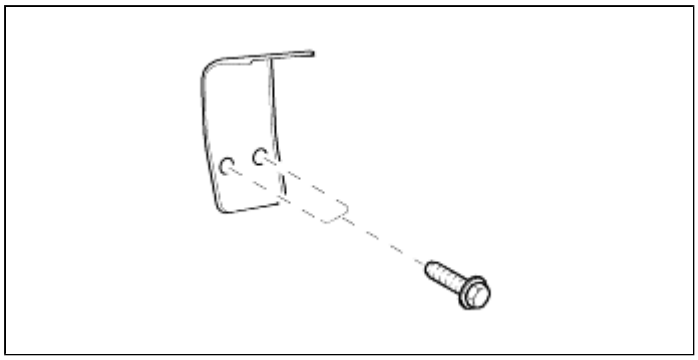
   When removing or installing any electrical units wiring or electrical connectors, disconnect the negative battery cable to prevent possible short circuits which could lead to personal injury and/or property damage.

   H. Disconnect the negative battery cable.
   I. Tighten two glass mounting bolts on the power window regulator assembly.
   J. Connect the negative battery cable.
   K. Turn on the ignition.
   L. Position the window all the way down.
   M. Turn off the ignition.

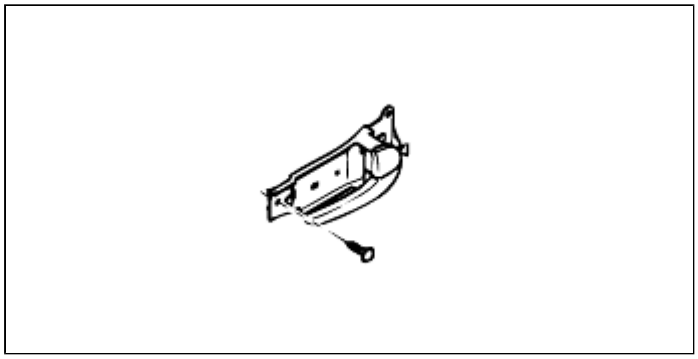
CAUTION

When removing or installing any electrical units wiring or electrical connectors, disconnect the negative battery cable to prevent possible short circuits which could lead to personal injury and/or property damage.

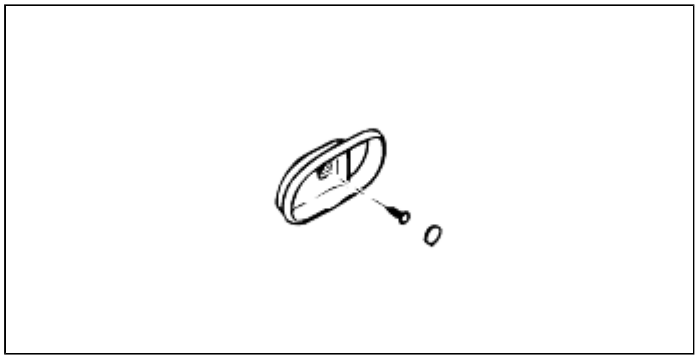
11. Install the run channel. Use soap and water for lubrication.
12. Install the plastic door screen.
    A. Fasten the plastic door screen.
    B. Pull out the electrical harness connector from the plastic door screen.
    C. Pull out the remote control rod for the inside door handle from the plastic door screen.
13. Install the door speaker with four mounting screws.
14. Install the pull handle bracket with two mounting screws.



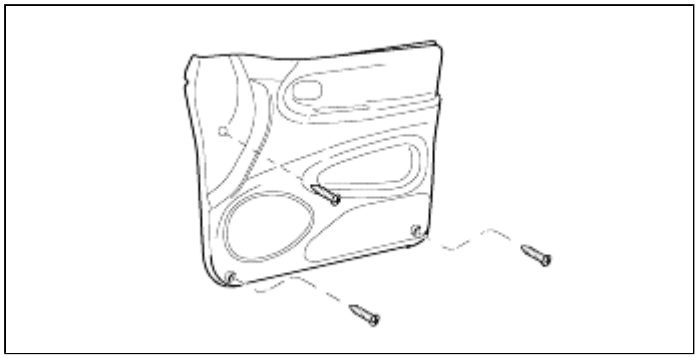
15. Install the inside door handle with three mounting screws.



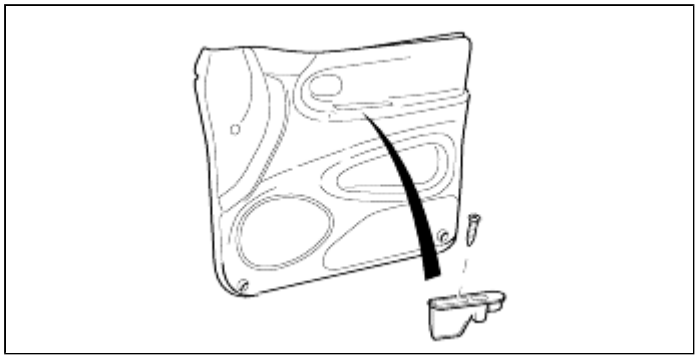
16. Install door trim
    A. Install the door trim by lifting it up.
    B. Connect the electrical connector.
    C. Install the inner door handle cover with one mounting screw.



    D. Fasten the door trim.
    E. Install three mounting screws.



F. Install the screw on the pull handle.

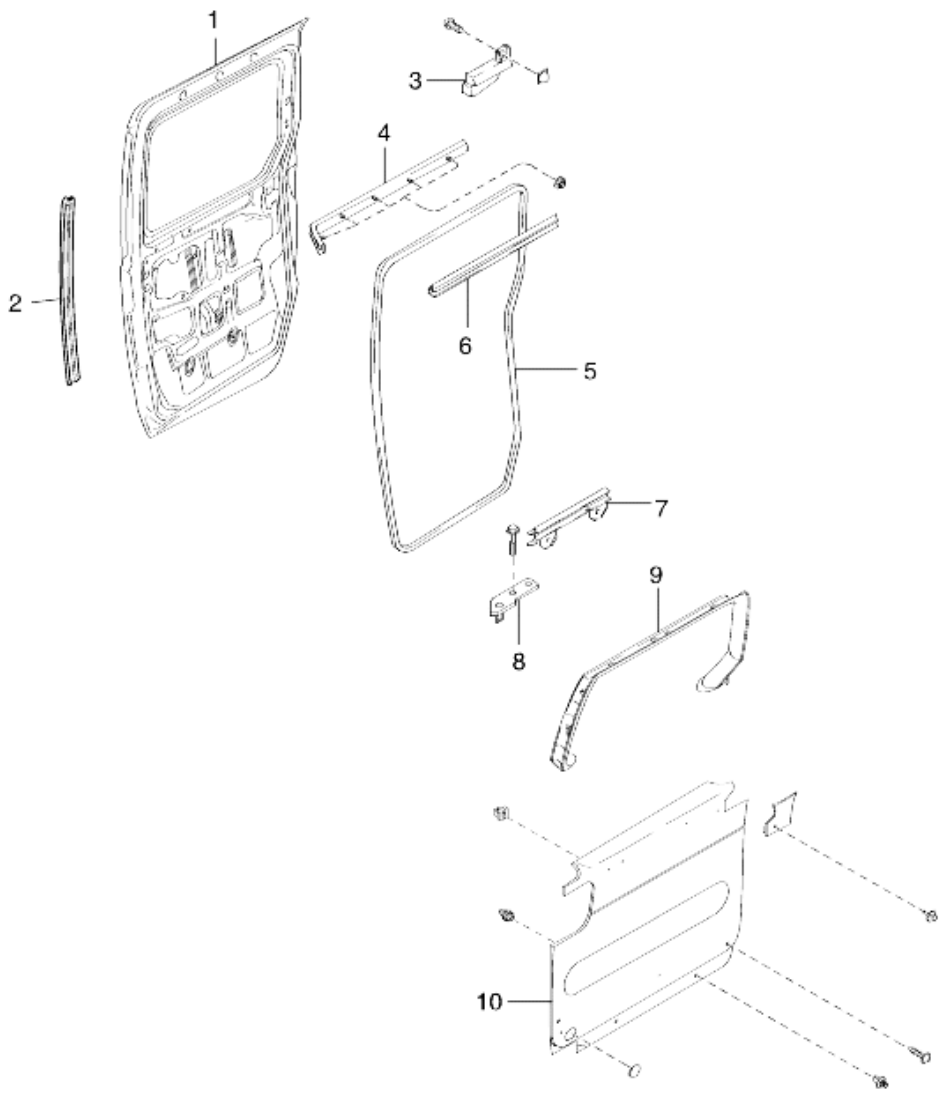


17. Install inner door garnish.
18. Install inner weatherstrip.
19. Connect negative battery cable.

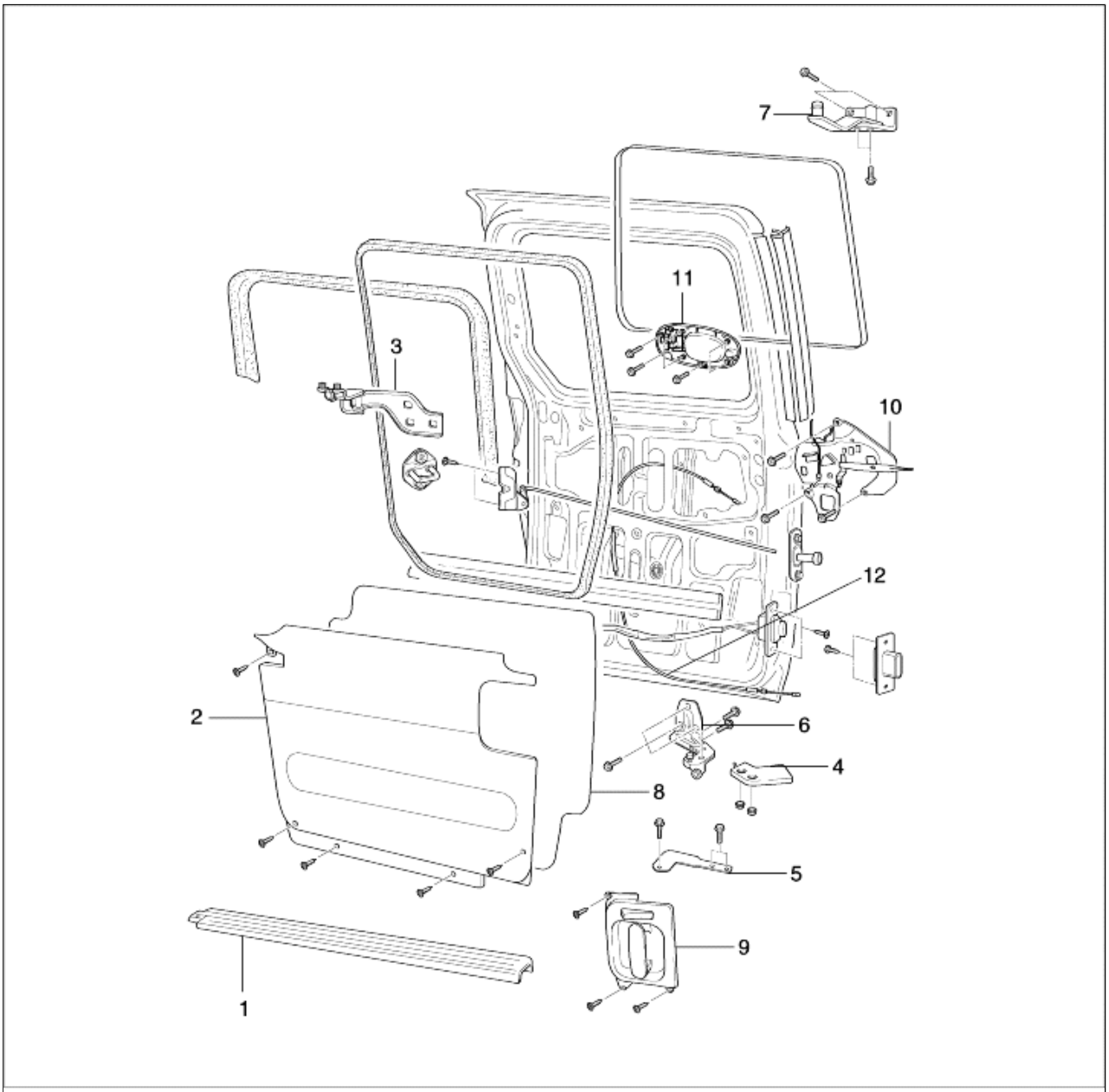
Adjustment

1. Check that door can be closed easily and properly. If door is loose, tighten door hinge installation bolts.
2. To adjust door-to-body offset, loosen door hinge installation bolts and make adjustment.
3. Check that door can be closed easily and properly. If there is a problem, loosen striker installation bolts and adjust door by moving striker vertically and horizontally.
4. Adjust rear offset of door to body by moving door lock striker horizontally.

Components



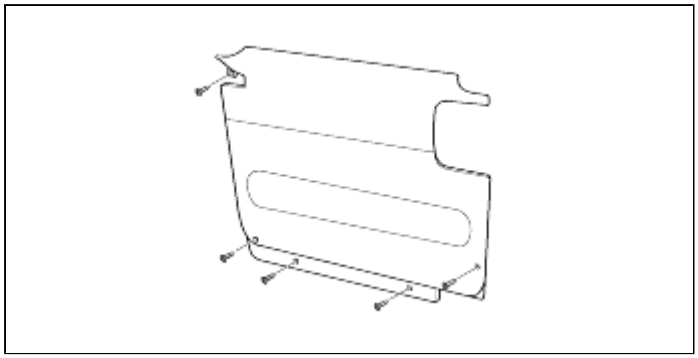
1. Door assembly
2. Door molding
3. Guide rail protector
4. Guide rail assembly
5. Door weatherstrip
6. Rain rail weatherstrip
7. Lower rail guide
8. Hold open lock striker assembly
9. Door upper trim assembly
10. Door lower trim assembly



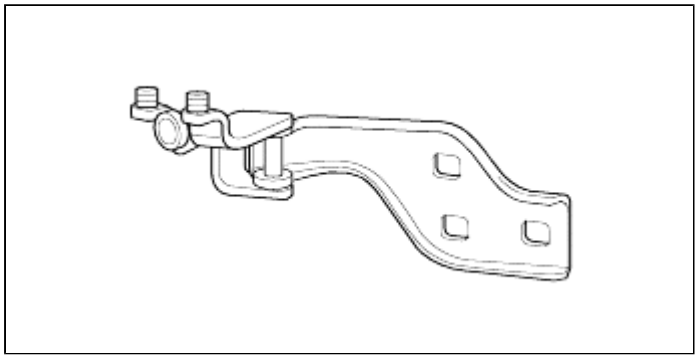
1. Lower roller guide cover
2. Door trim
3. Center roller
4. Door hold open lock
5. Lower guide rail
6. Lower roller
7. Upper roller
8. Door screen
9. Inner handle
10. Door lock assembly
11. Outer handle
12. Door hold open lock release cable

Removal

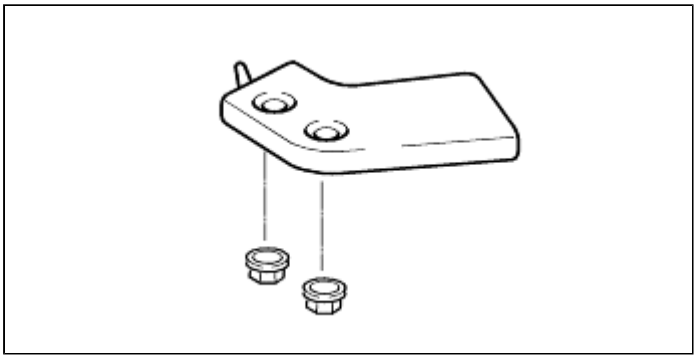
1. Disconnect negative battery cable.
2. Remove three mounting screws and lower roller cover.
3. Remove screws and door trim.



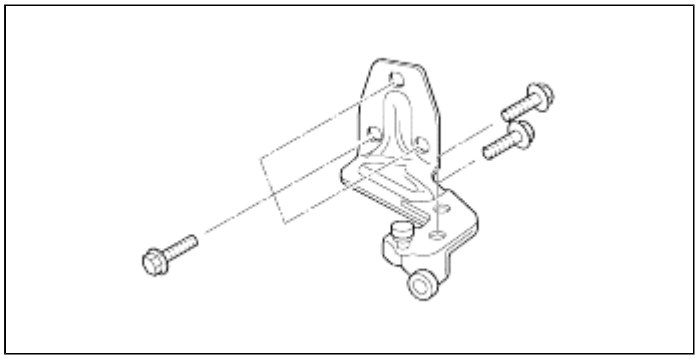
4. Peel off the plastic door screen carefully by pulling it away gradually from the door frame.
5. Remove center roller.



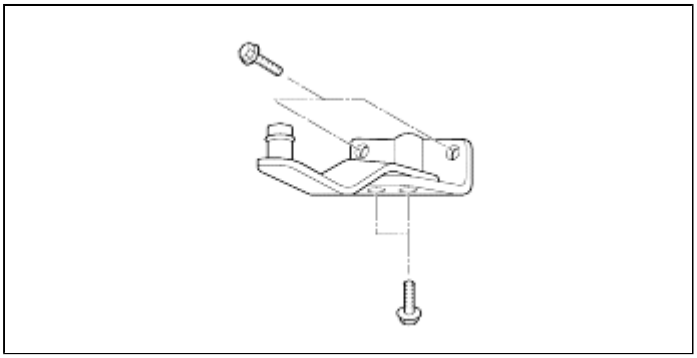
6. Remove door hold open lock.
   A. Remove two mounting bolts on door hold open lock.



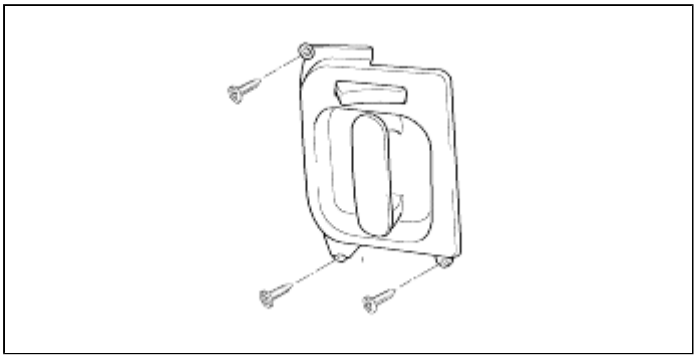
   B. Remove cable from door hold open lock.
7. Remove three mounting bolts and lower roller.



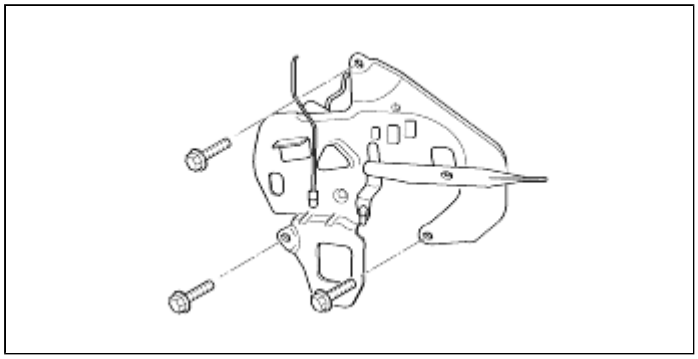
8. Remove mounting bolts and upper roller.



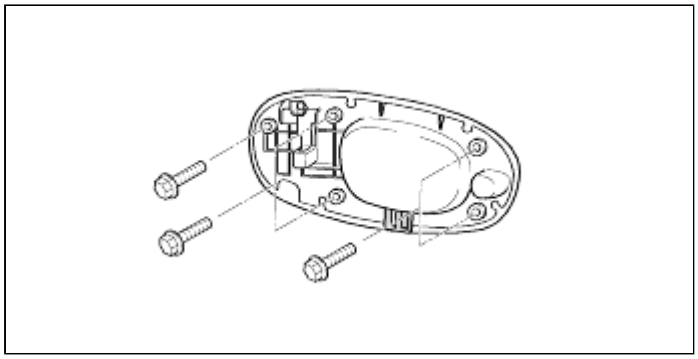
9. Remove three mounting bolts and Inner handle.



10. Remove remote controller.



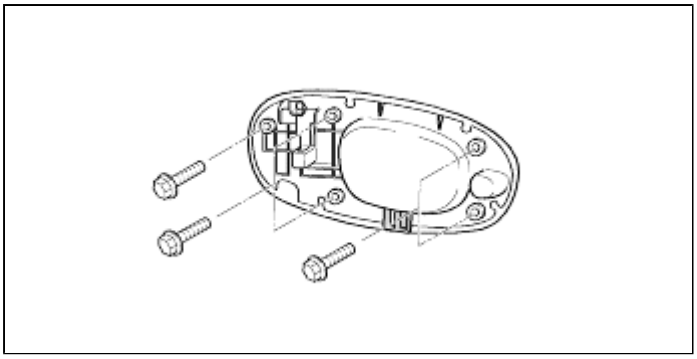
11. Remove five mounting bolts and outside handle assembly.



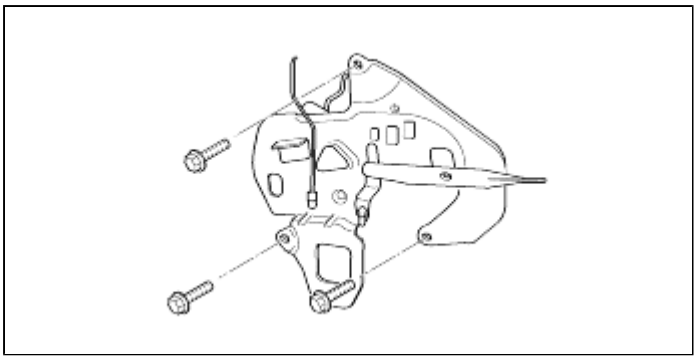
Installation

1. Install outside handle.

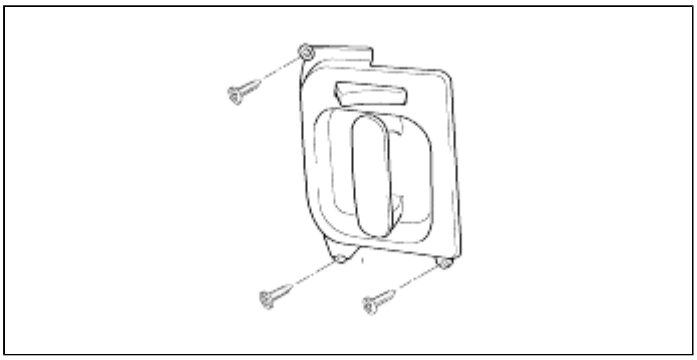
Tightening torque :7~10 N·m (0.7~1.0 kg·m, 5~7 lb·ft)



2. Install remote controller.

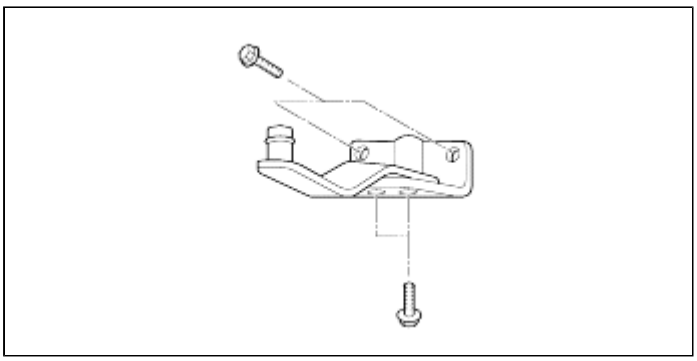


3. Install inner handle.

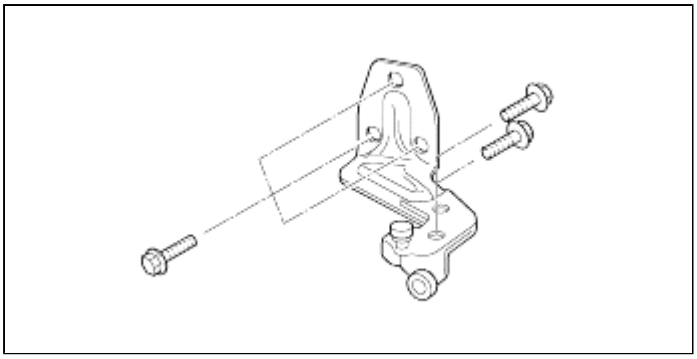


4. Install upper roller.

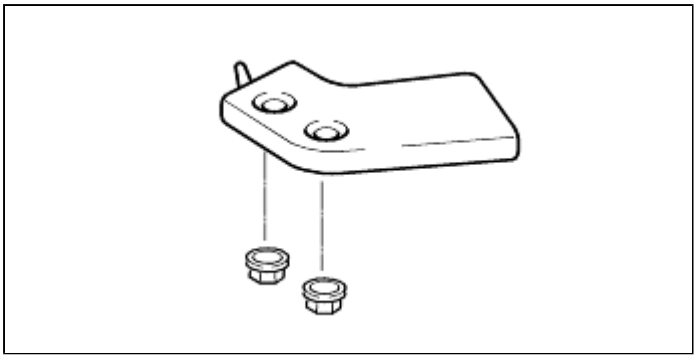
Tightening torque :18~27 N·m (1.8~2.7 kg·m, 13~20 lb·ft)



5. Install lower roller.

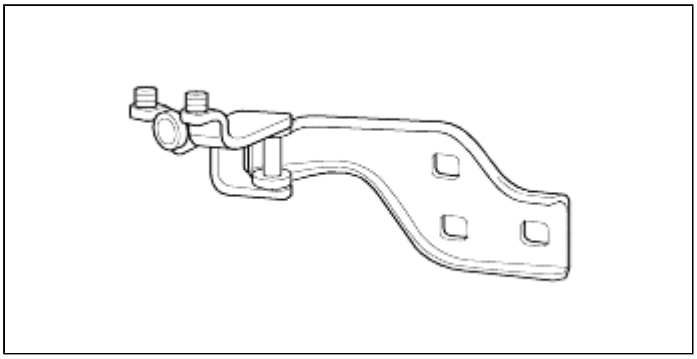


6. Install door hold open lock.

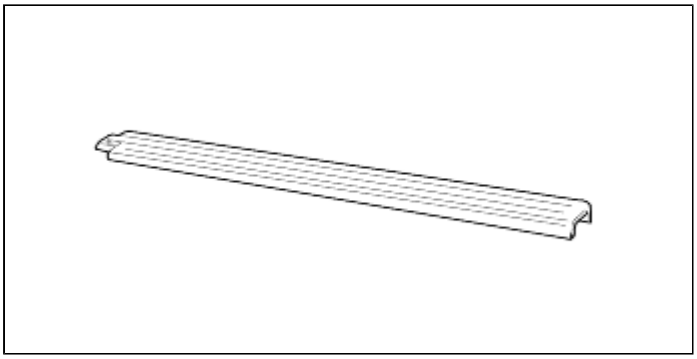


7. Install center roller.

Tightening torque :18~27 N·m (1.8~2.7 kg·m, 13~20 lb·ft)



8. Install door screen.
9. Install lower roller guide cover.

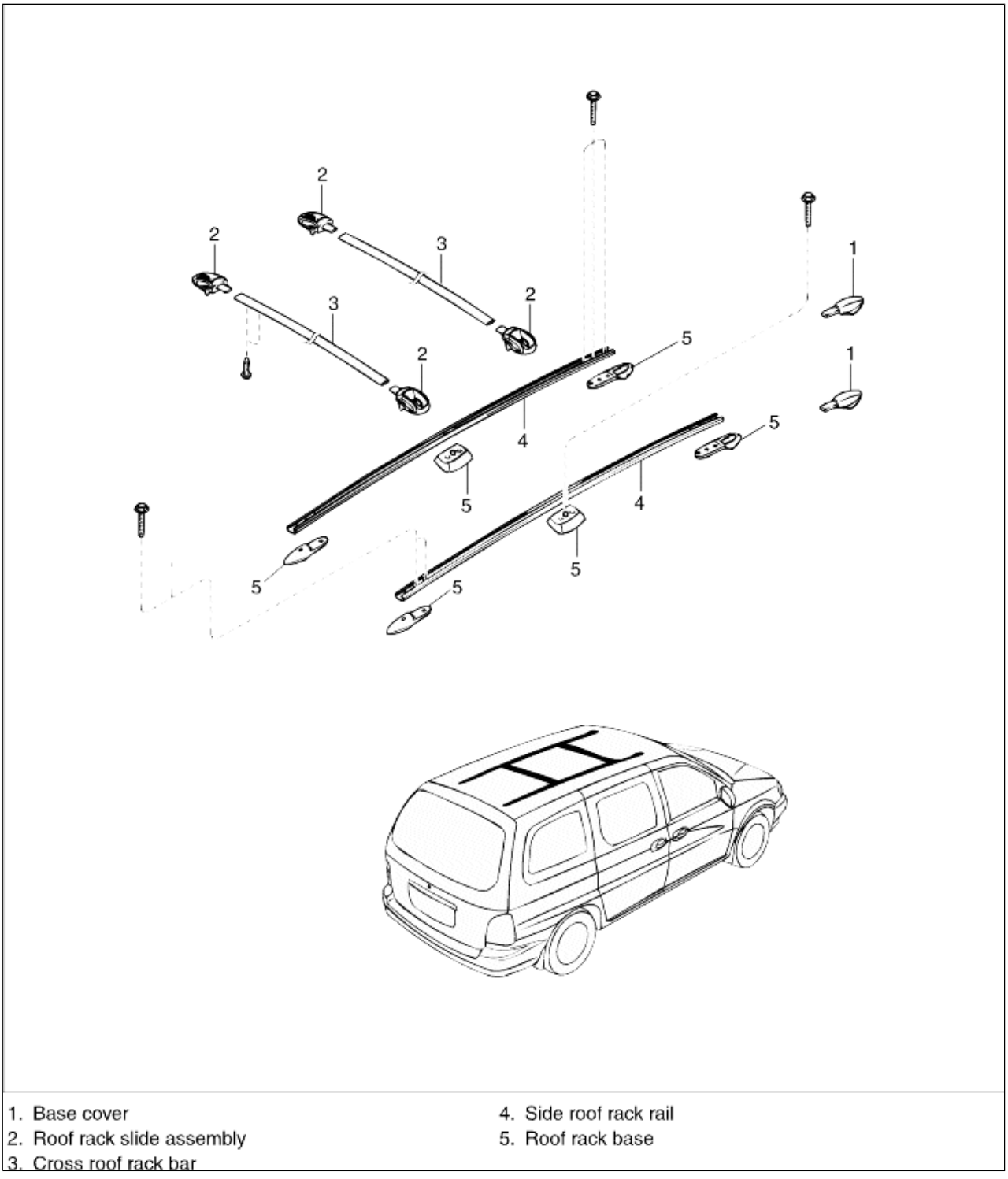


Description and operation

The roof carrier is a general purpose luggage rack consisting of twelve main parts: two cross bars, two slide rails, two left slide, two right slide, four bases, and two base covers.
Each cross bar is individually adjustable to predetermined locking detents that are approximately 3 inches apart. The cross bars are released from their detent by pressing a push button on the side.

Roof carrier

Components

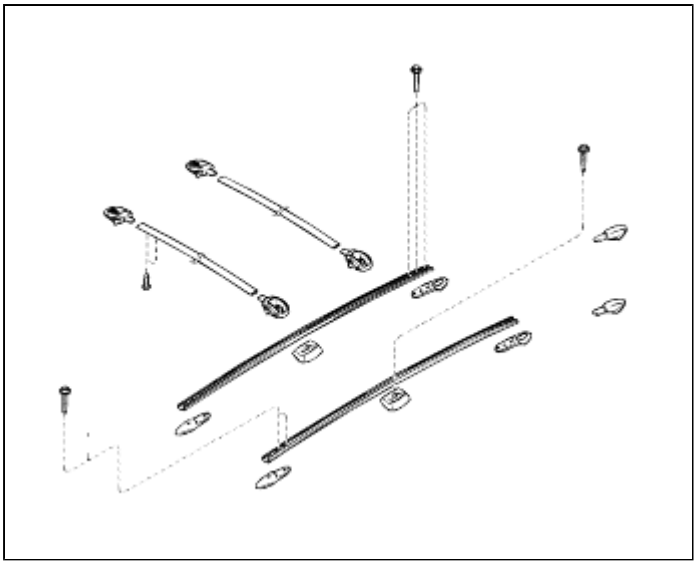


1. Base cover
2. Roof rack slide assembly
3. Cross roof rack bar
4. Side roof rack rail
5. Roof rack base

Removal/Installation

1. Remove components in the order shown in the figure.

Tightening torque :11 N·m (110 kg·cm, 8 lb·ft)

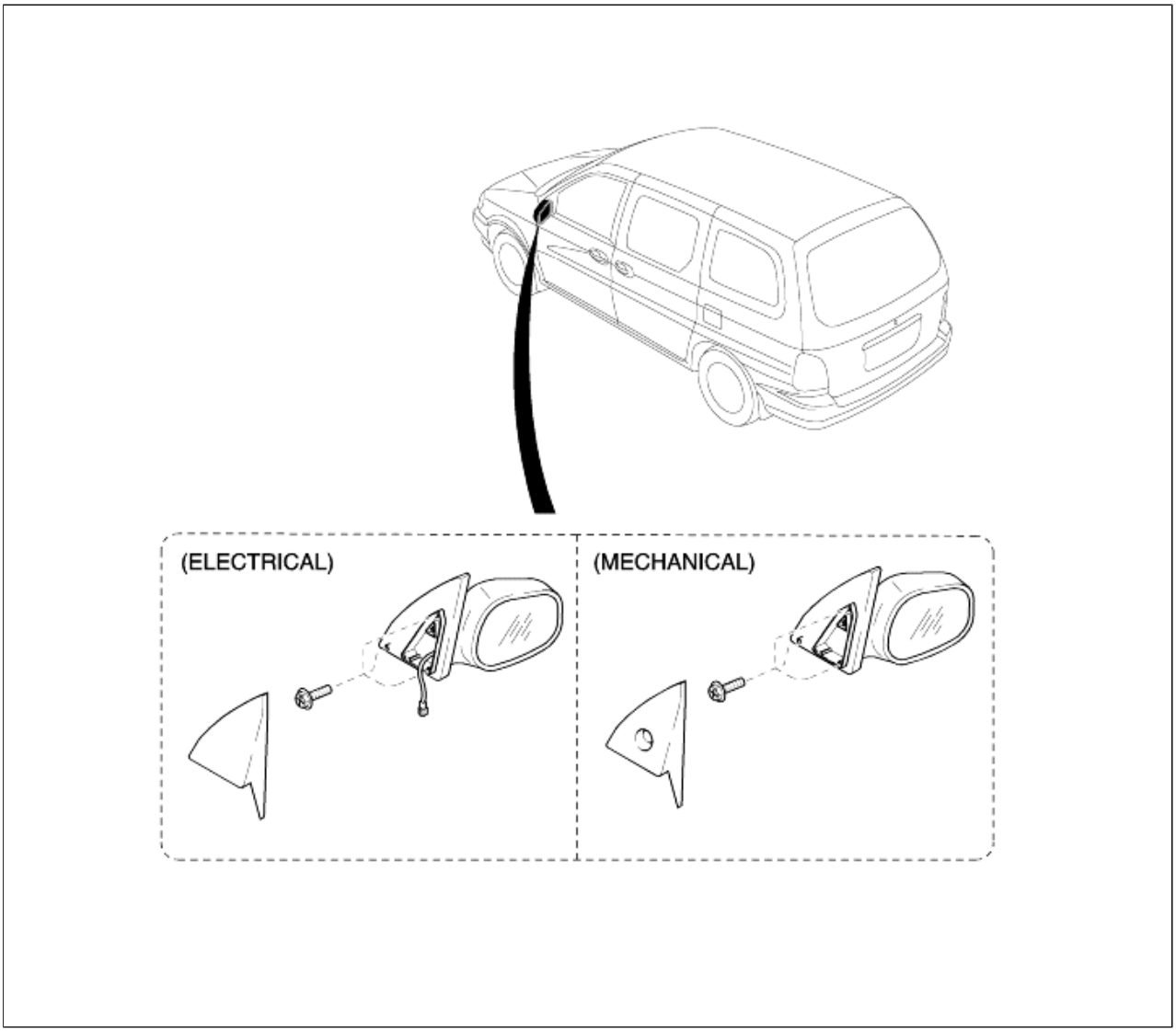


2. Install components in the reverse procedure of removal.

Description and operation

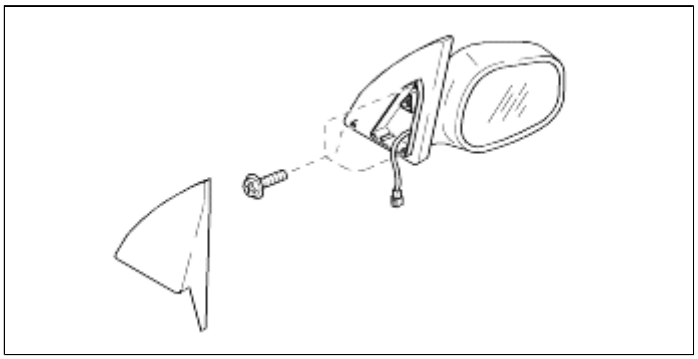
The outside rearview mirror assembly is comprised of mirror glass, a mirror frame (which holds the mirror glass), a motor (only for electric), a wire harness, and an inner garnish trim. Each outside rearview mirror can be adjusted in four directions from inside the vehicle.

Components



Removal and installation

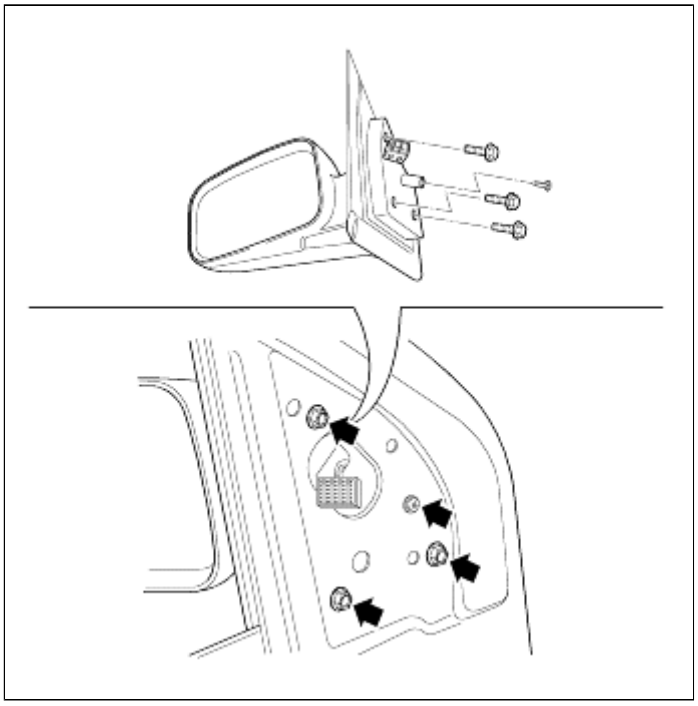
1. Disconnect negative battery cable.
2. Remove outside rearview mirror garnish.
   (1) Remove garnish from door frame.



   (2) Disconnect electrical connector.

3. Remove outside rearview mirror.
   (1) Remove bolts(3) and clip(1).

Tightening torque : bolt4.5-6.6 N·m (0.45-0.66 kg·m, 3-5 lb·ft)

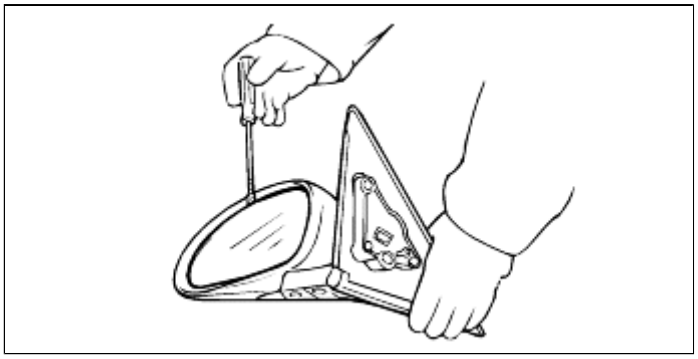


   (2) Disconnect electrical connector.

4. Remove mirror.

> **CAUTION**
>
> Wear gloves to remove and install the mirror holder

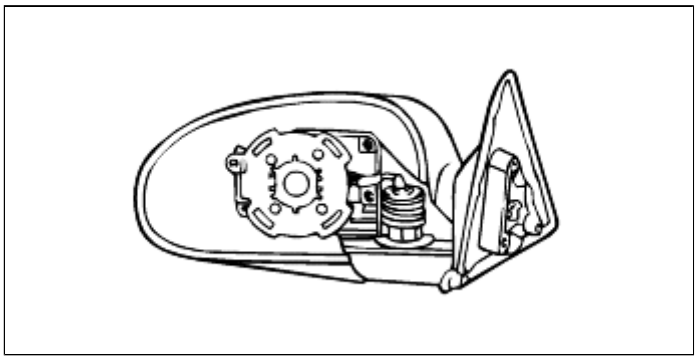
   (1) Insert flat bladed screwdriver between the outside rearview mirror holder and the mirror assembly.



5. Remove outside rearview mirror actuator.

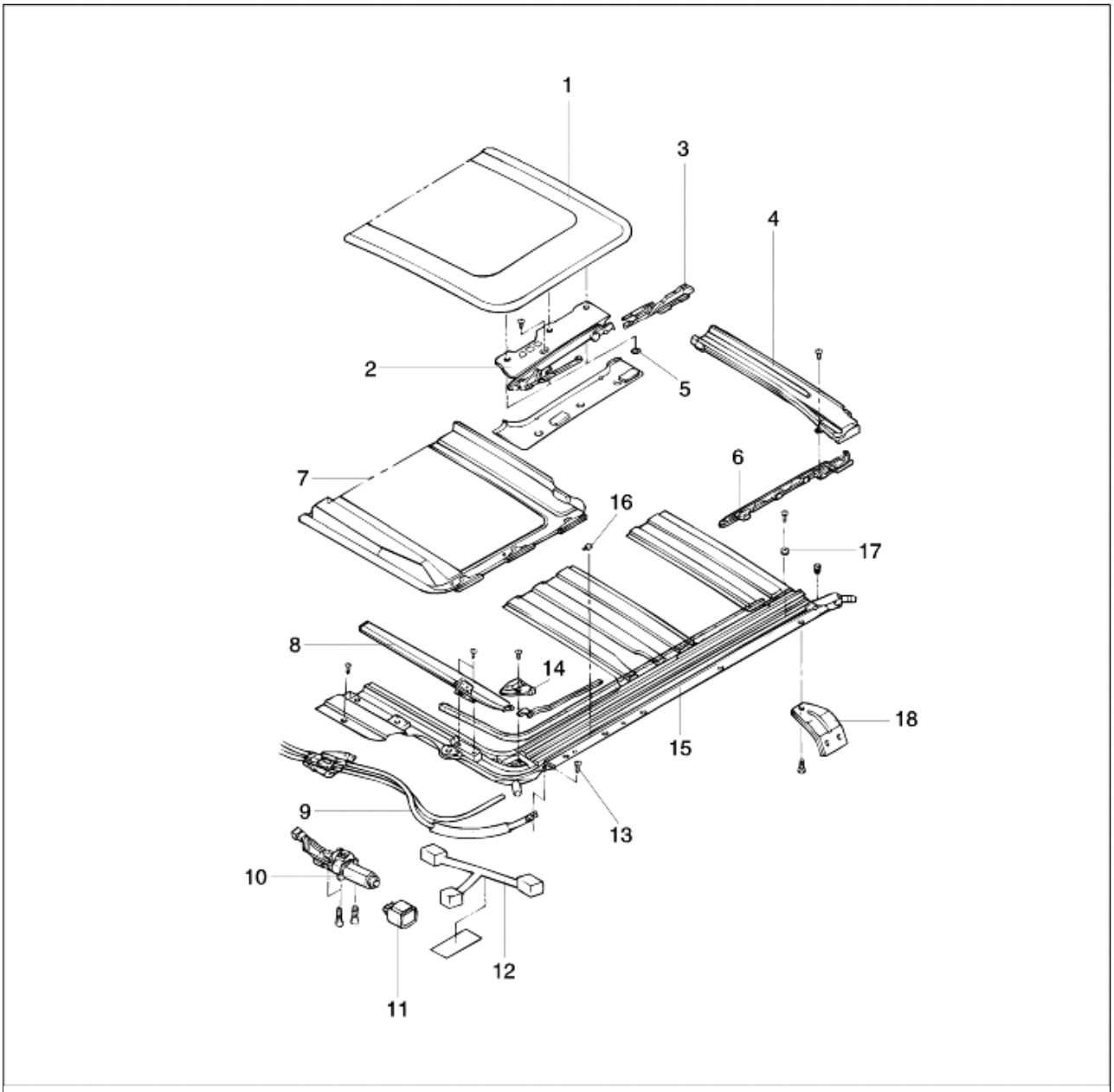
> CAUTION
>
> When prying with a flat bladed screwdriver, wrap it with a shop towel to prevent damage.

(1) Remove the outside rearview mirror actuator from the outside rearview mirror housing.



6. Install in reverse order of removal.

Components

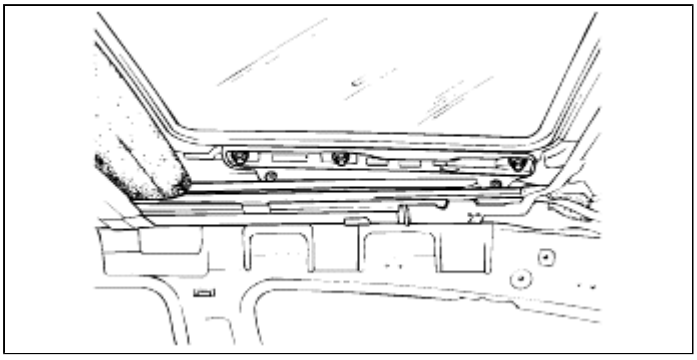


1. Glass panel	7. Sunshade assembly	13. Deflector link
2. Guide assembly	8. Deflector assembly	14. Rail cover
3. Slider assembly	9. Drive unit assembly	15. Frame assembly
4. Drip rail assembly	10. Motor assembly	16. Sunroof link connector
5. Decoration cover	11. Relay	17. Stopper
6. Decoration link assembly	12. Harness assembly	18. Bracket

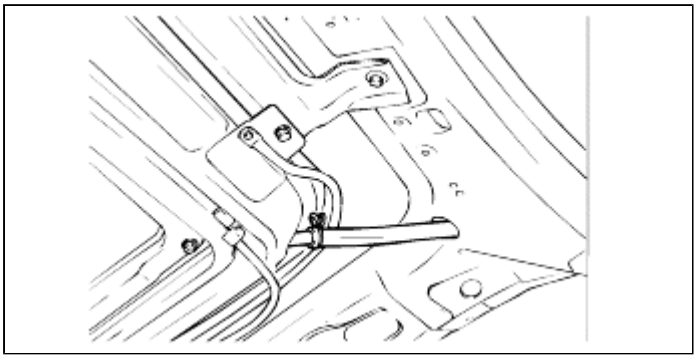
Removal

1. Remove headliner. Refer to "Trim" in this section.
2. Remove glass panel.

Tighten glass mounting nuts to4~6 N·m (40~60kg·cm, 35~52 lb·ft)

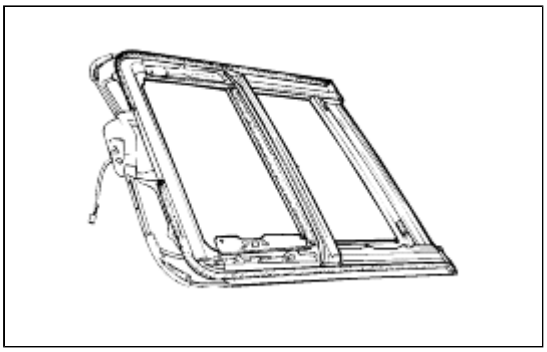


3. Disconnect the drain hose.



4. Remove the sunroof mounting bolts and nuts, and remove the sunroof assembly.

Tighten sunroof mounting bolts to7~11 N·m (70~110 kg·cm, 61~95 lb·ft)
Tighten sunroof mounting nuts to4~6 N·m (40~60 kg·cm, 35~52 lb·ft)



NOTE

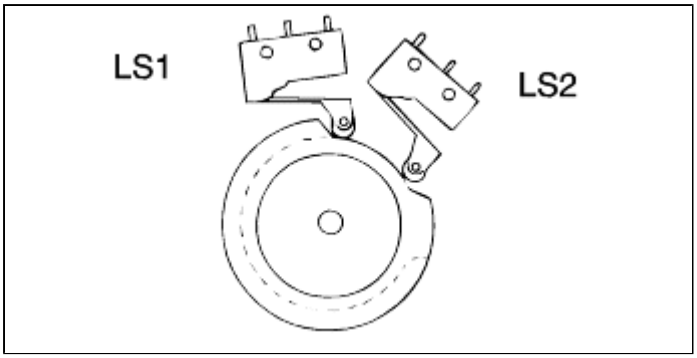
When removing the sunroof assembly, carefully pull out the sunroof assembly to avoid damage to the other parts.

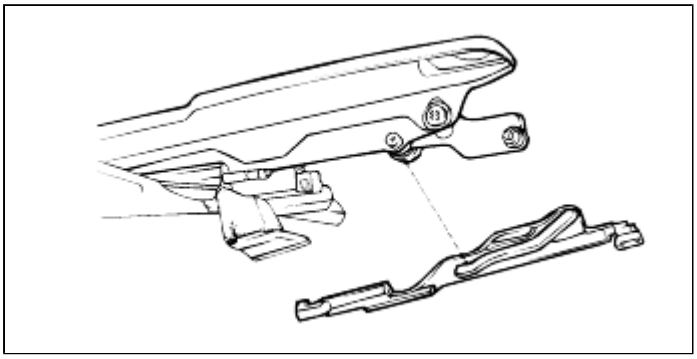
Installation

Installation is the reverse of removal.

NOTE

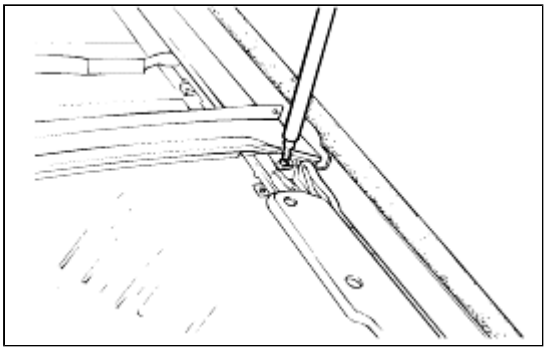
Check that the limit switches (LS1 and LS2) of the motor are at the fully closed position.
Align the guide roller center and slider mating mark at the fully closed position.



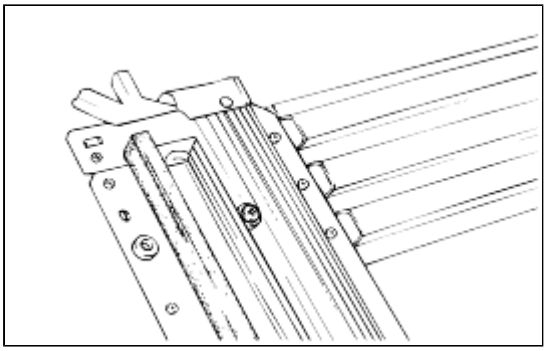


Disassembly

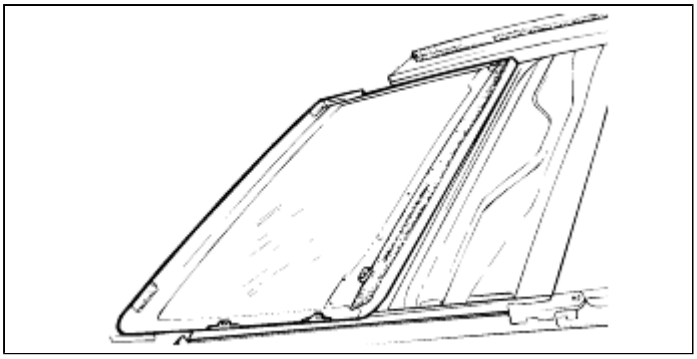
1. Remove the drip rail.



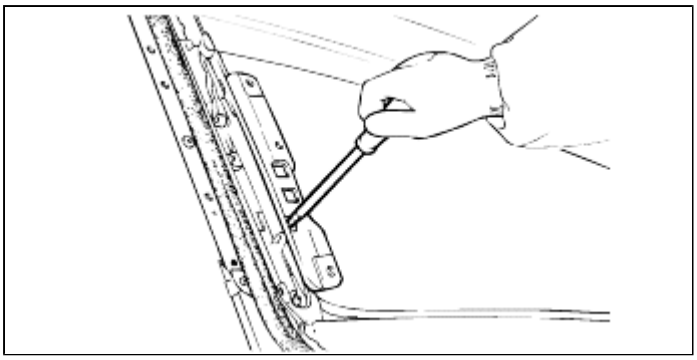
2. Remove the stopper.



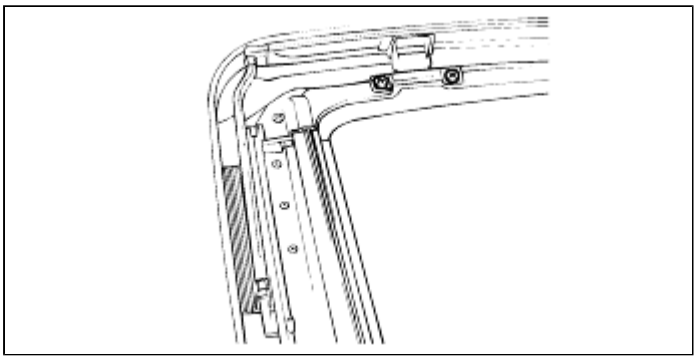
3. Remove the sunshade.



4. Remove the guide assembly.

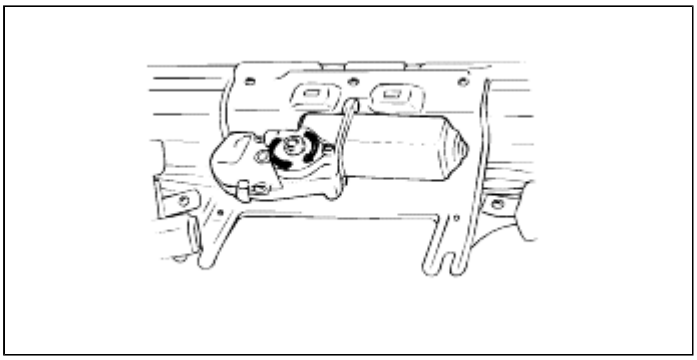


5. Remove the deflector.



6. Remove the motor assembly.

> CAUTION
>
> When removing the motor, the slider assembly should always be in the fully closed position. If there is a discrepancy between the glass position and the motor ring fully closed position, the sunroof will not operate correctly.



Assembly

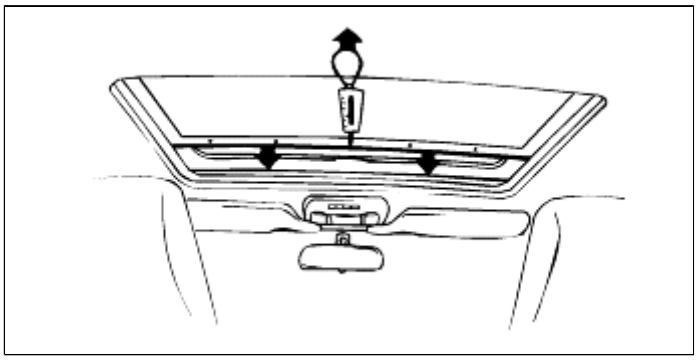
Assembly is the reverse of disassembly.

Check operating condition after installation

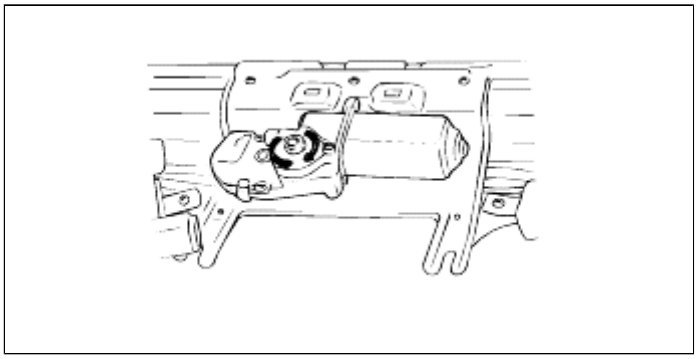
1. If the glass panel movement is difficult, check and adjust.
   (1) Make sure the battery voltage is normal.
   (2) Make sure that the sunroof sliding unit is free of foreign material.
   (3) Make sure that, when the glass panel opens, the rear position of panel dose not interfere with the roof panel.

> NOTE
>
> If the stopper is moved forward too far, it may cause malfunction or leaks. Make sure the gap between the glass panel and roof panel is not more than 0.3 mm.

   (4) Measure the driving force of the motor, and adjust it to 15~25 kg (33.1~55.7 lb) with the torque adjustment nut on the motor.
   (5) To measure, use the deep hole in the center of the lid lower panel.

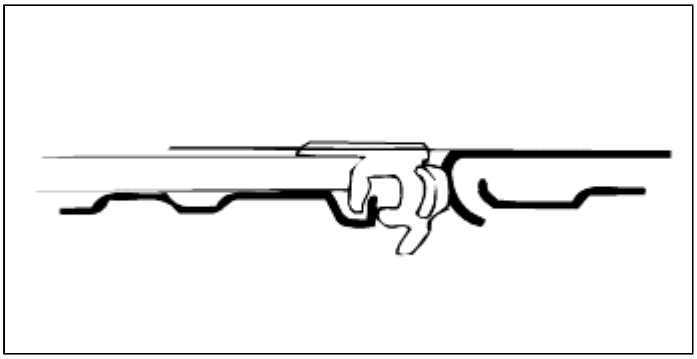


   (6) After adjustment, be sure to sure to lock the nut with the pawl washer.

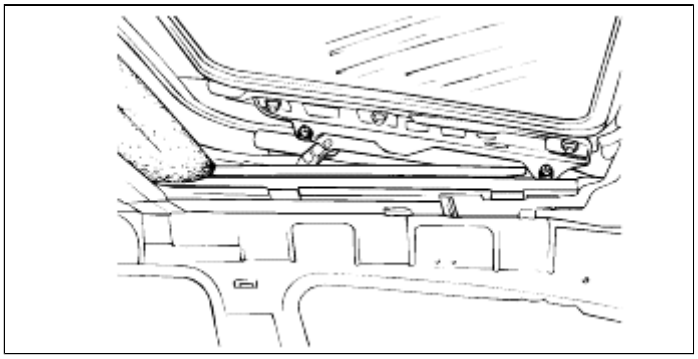


Adjustment

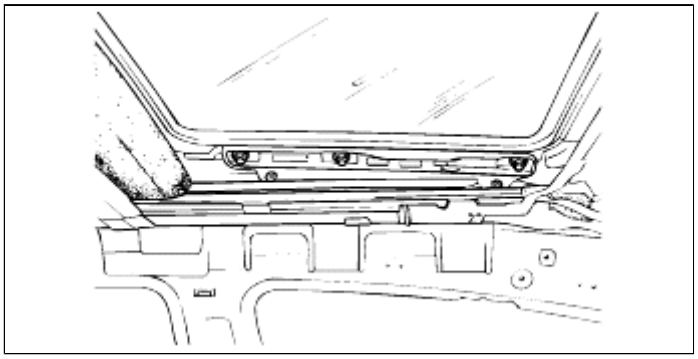
1. Adjust the difference between the height of the glass panel and the roof panel.
   Front side : -1~0 mm
   Rear side : 0~1 m
   If the difference is not as specific, adjust the following procedure.



   (1) Loosen the front screw and rear screw and adjust the height between the glass panel and roof panel.

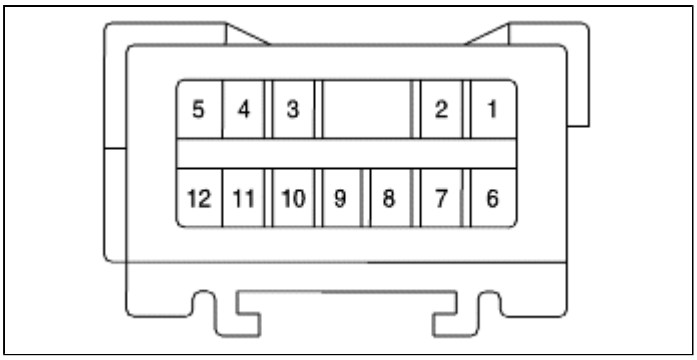


(2) Loosen the glass panel mounting nuts and adjust the gap between the glass panel and roof panel.



Inspection

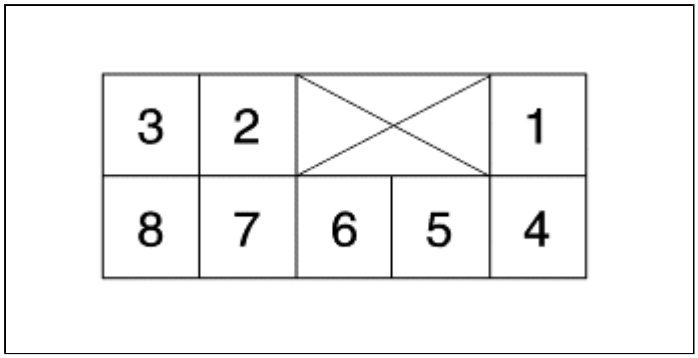
1. Operate the switch and check for the continuity between the terminal.
2. If the continuity is not as specified. replace the switch.



Condition		Terminal 2	7	9	10	11
Slide	Open	○	○			
	Close		○	○		
Tilt	Up		○		○	
	Down		○			○

Inspection

1. Apply battery voltage to the terminal 1, 8 and grounded the terminal 3.



2. Apply the battery voltage to terminals as below table, and check that the sunroof unit operates as below table.

Terminal / Function	4	5	6	7
Tilt up	⊕			
Tilt down		⊕		
Slide open			⊕	
Slide close				⊕

Description

Instrument panel

Instrumentpanel houses the instrument cluster, center panel and a number of special switches and controls. Instrument panel electrical system is discussed in electrical troubleshooting manual.

Center panel

Center panel is a housing for ventilation control panel, radio, glove box, and with center panel trim serves as a base for cigarette lighter and ashtray. Center panel may remain in place when instrument panel is removed.

Interior lights control switch

Interior lights control switch allows adjustment of brightness of panel lights.

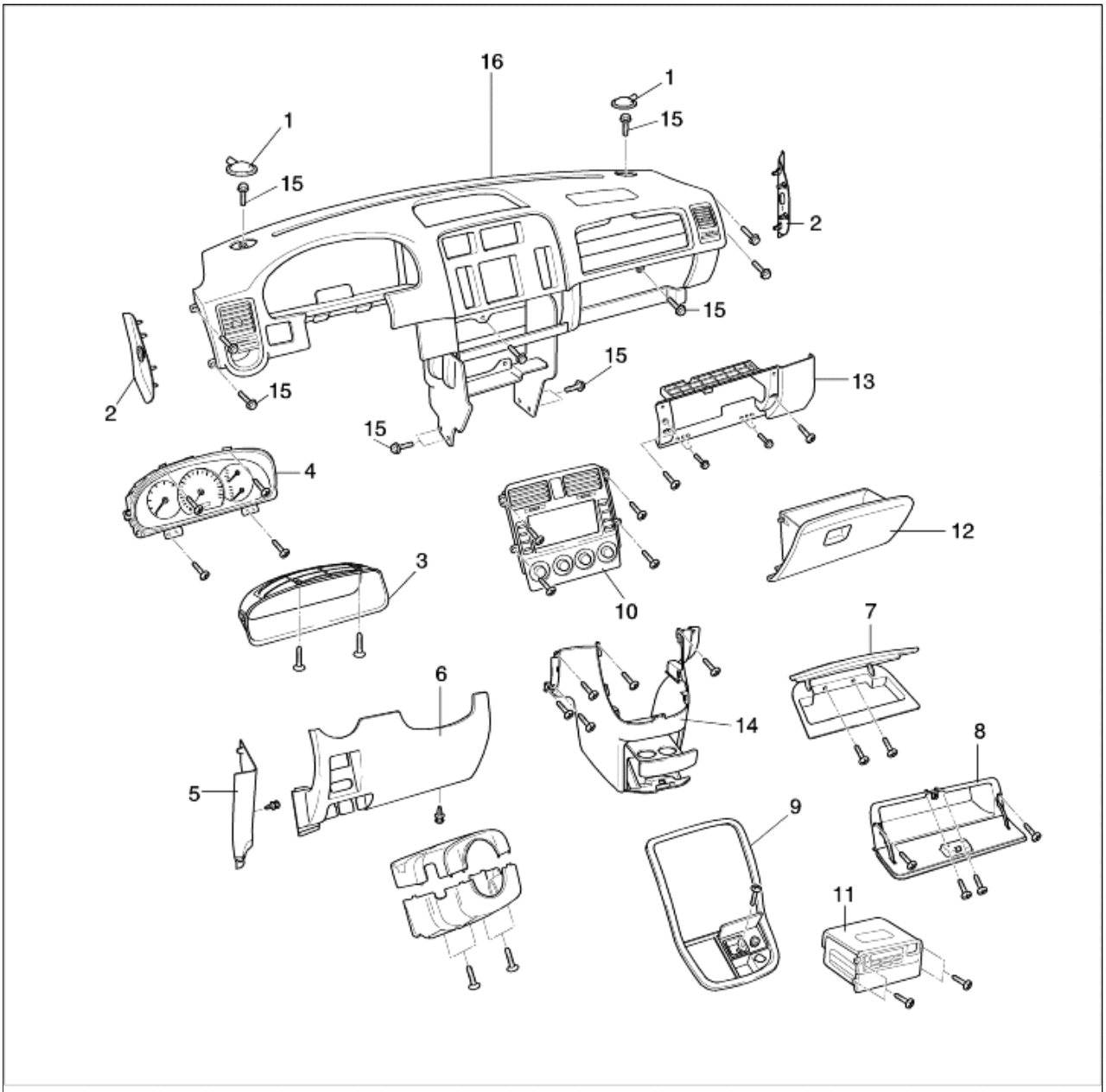
Radio and antenna cable

When a radio is installed in vehicle, user instructions are supplied. Radio is located in center panel. Antenna and electrical connections are located atrear of unit. Antenna cable connects to radio. It is routed behind instrument panel and connects to antenna. Radio receives signals through antenna cable from antenna. It is necessary to remove radio when instrument panel is removed.

Ventilation control panel

Ventilation control panel provides control of heating and air conditioning for vehicle and is mounted in center panel.

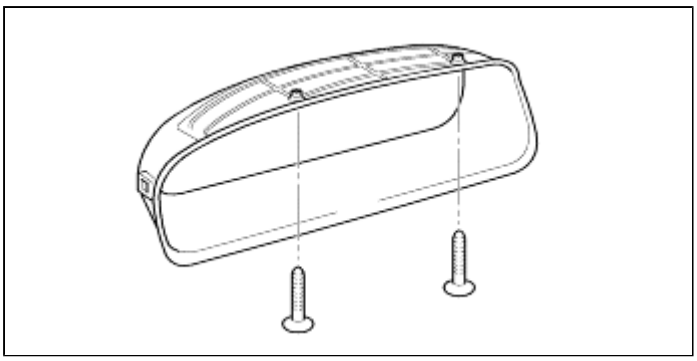
Components



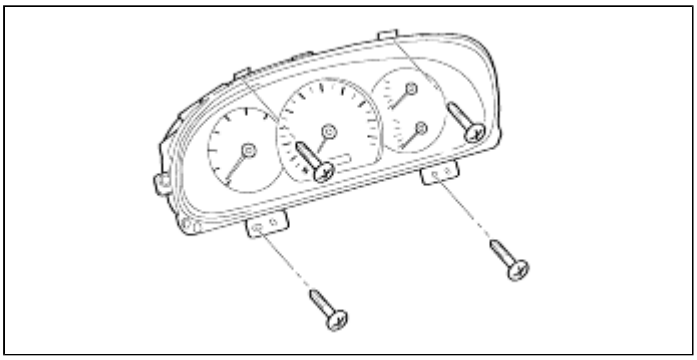
1. Speaker assembly
2. Side cover
3. Instrument cluster trim
4. Instrument cluster
5. A-pillar lower trim
6. Lower LH panel
7. Center upper tray
8. Multi box
9. Audio panel
10. Heater control panel
11. Audio
12. Glove box
13. Lower RH panel
14. Center console
15. Mounting bolt
16. Instrument panel

Removal

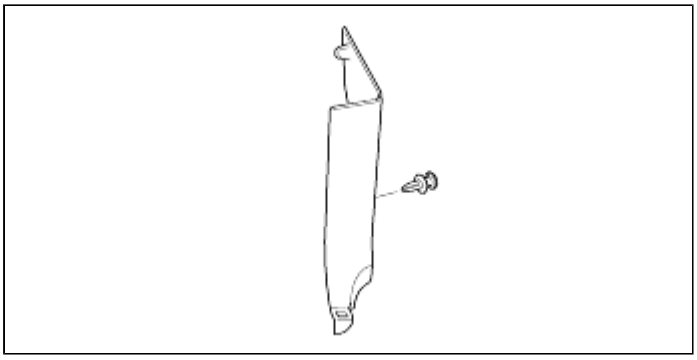
1. Disconnect negative battery cable.A-pillar lower trim.
2. Remove driver air bag module.
3. Remove steering wheel, turn signal assembly, and upper/lower column covers.
4. Remove A-pillar upper trim.
5. Remove instrument cluster trim.
   A. Remove two screws from instrument cluster trim.
   B. Remove instrument cluster trim from mounting space.



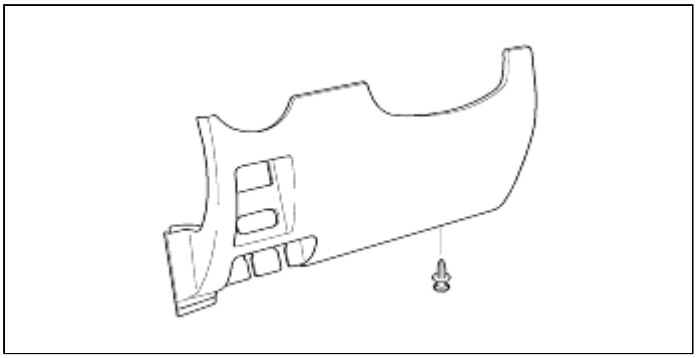
6. Remove instrument cluster.
   A. Remove four screws from instrument cluster assembly.
   B. Disconnect electrical connector from rear of unit.



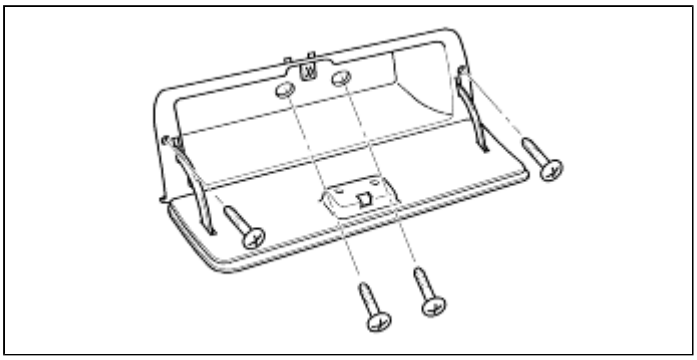
7. Remove A-pillar lower trim.
   A. Remove one fastener from A-pillar lower trim.
   B. Unfasten A-pillar lower trim.



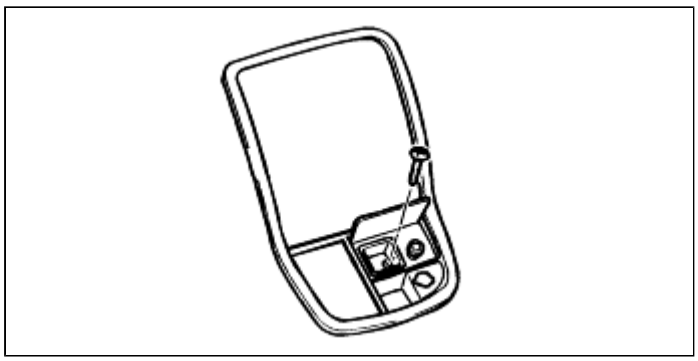
8. Remove lower LH panel.
   A. Remove hood release handle.
   B. Remove one fastener from bottom of panel.
   C. Disconnect electrical connector from rear of panel.



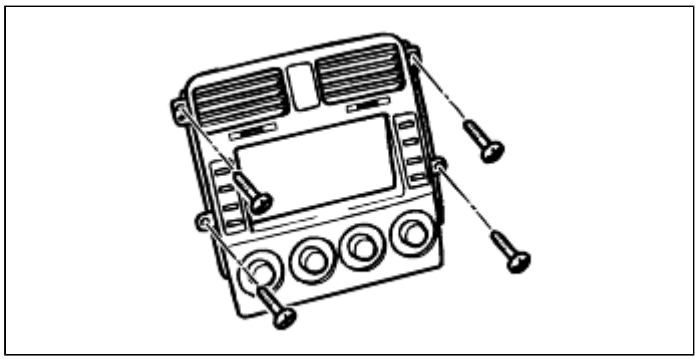
9. Remove multi box.
   A. Remove mounting screws from instrument panel.
   B. Unfasten multi box



10. Remove audio panel.
    A. Unfasten ashtray from audio panel.
    B. Remove one screw from audio panel.
    C. Disconnect electrical connector from rear of panel.

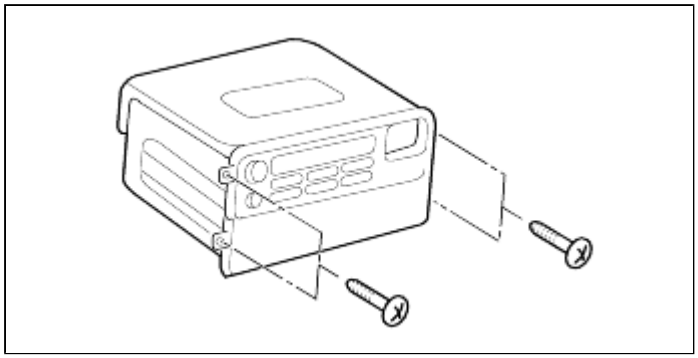


11. Remove ventilation control panel.
    A. Remove four screws from ventilation control panel.
    B. Disconnect electrical connector from rear of panel.

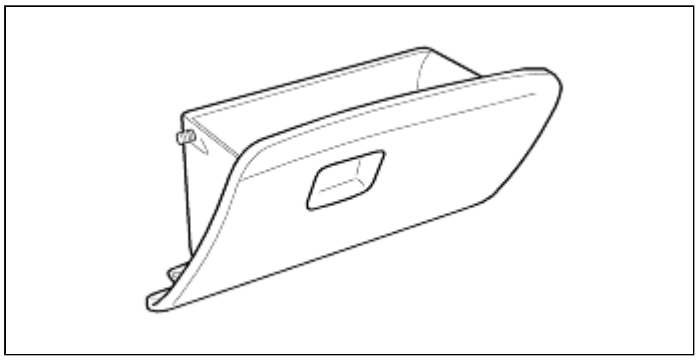


12. Remove audio.
    A. Remove four screws from front of audio.

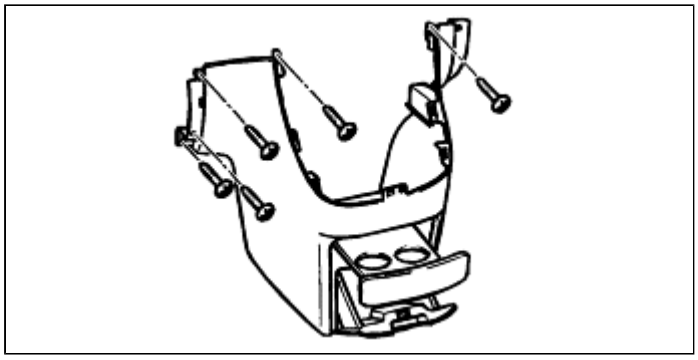
B. Remove audio from mounting space.
C. Disconnect electrical connector and antenna cable from rear of unit.



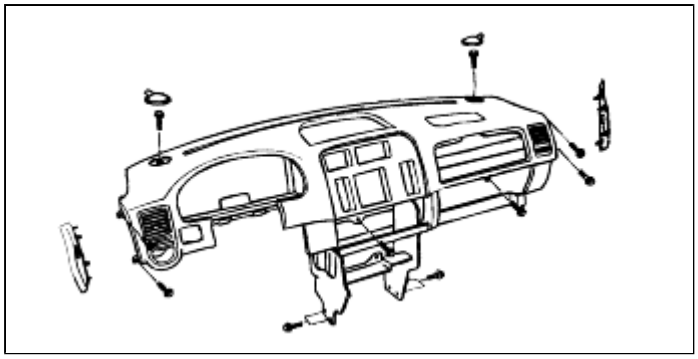
13. Remove glove box.
    A. Open glove box.
    B. Remove glove box stopper from lower RH panel.
    C. Remove four mounting bolts from mounting bracket.



14. Remove center console.
    A. Remove select lever boots.
    B. Remove five mounting screws.



15. Remove speaker and mounting bolts from top of instrument panel.
16. Remove side cover.
17. Remove mounting bolts from T-bar.
18. Remove mounting bolts from bottom of instrument panel.
19. Disconnect all connectors between the instrument panel and the vehicle bulkhead electrical wire harness.
20. Remove instrument panel.



21. Install instrument panel in reverse order of removal.

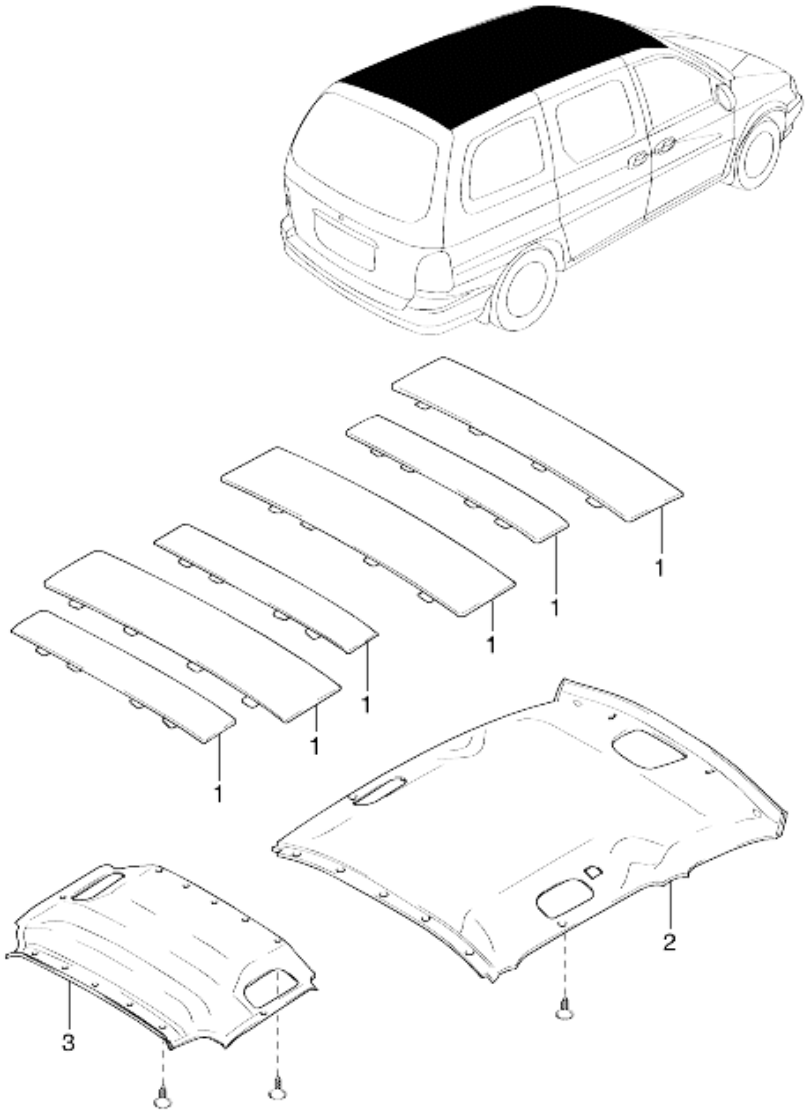
Tightening torque :Instrument panel mounting bolt8~12 N·m (0.8~1.2 kg·m, 5.8~8.7 lb·ft)

Description and operation

The top ceiling is a cloth cushion that serves as a buffer between the passengers and the top of the vehicle. It also covers thermal and acoustic insulation in the top of the vehicle and the wiring for the dome light. Both the top ceiling and the insulation are replaceable.

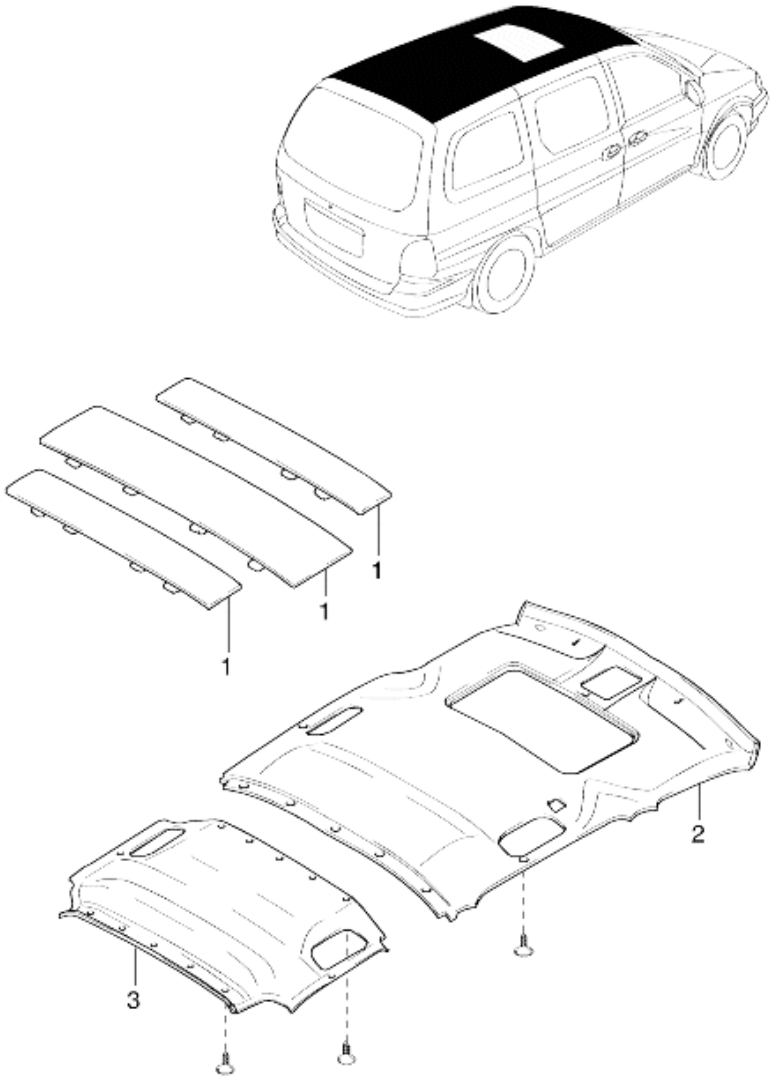
Components

<WITHOUT SUNROOF>

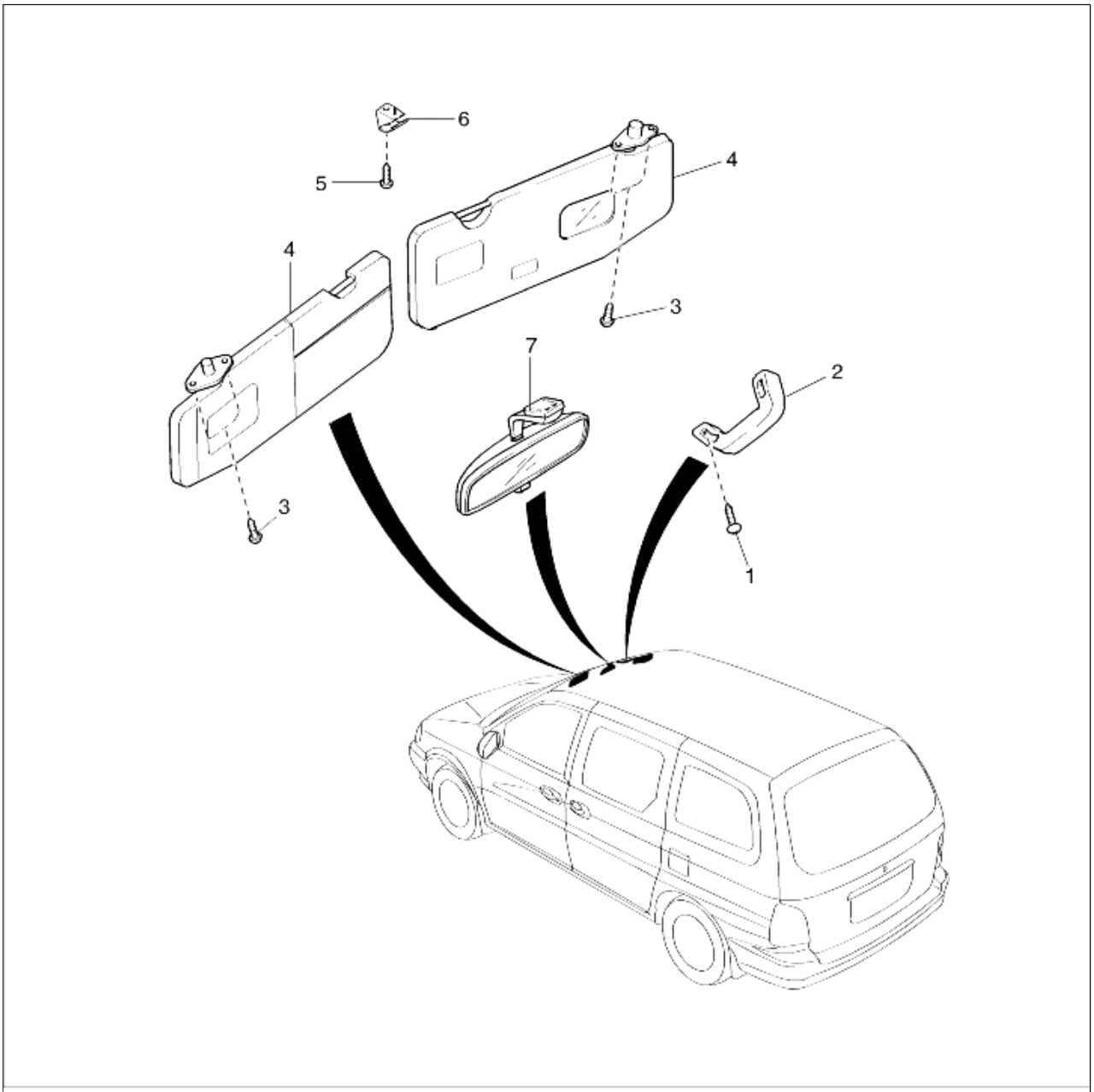


1. Insulator
2. Front top ceiling
3. Rear top ceiling

<WITH SUNROOF>



1. Insulator
2. Front top ceiling
3. Rear top ceiling

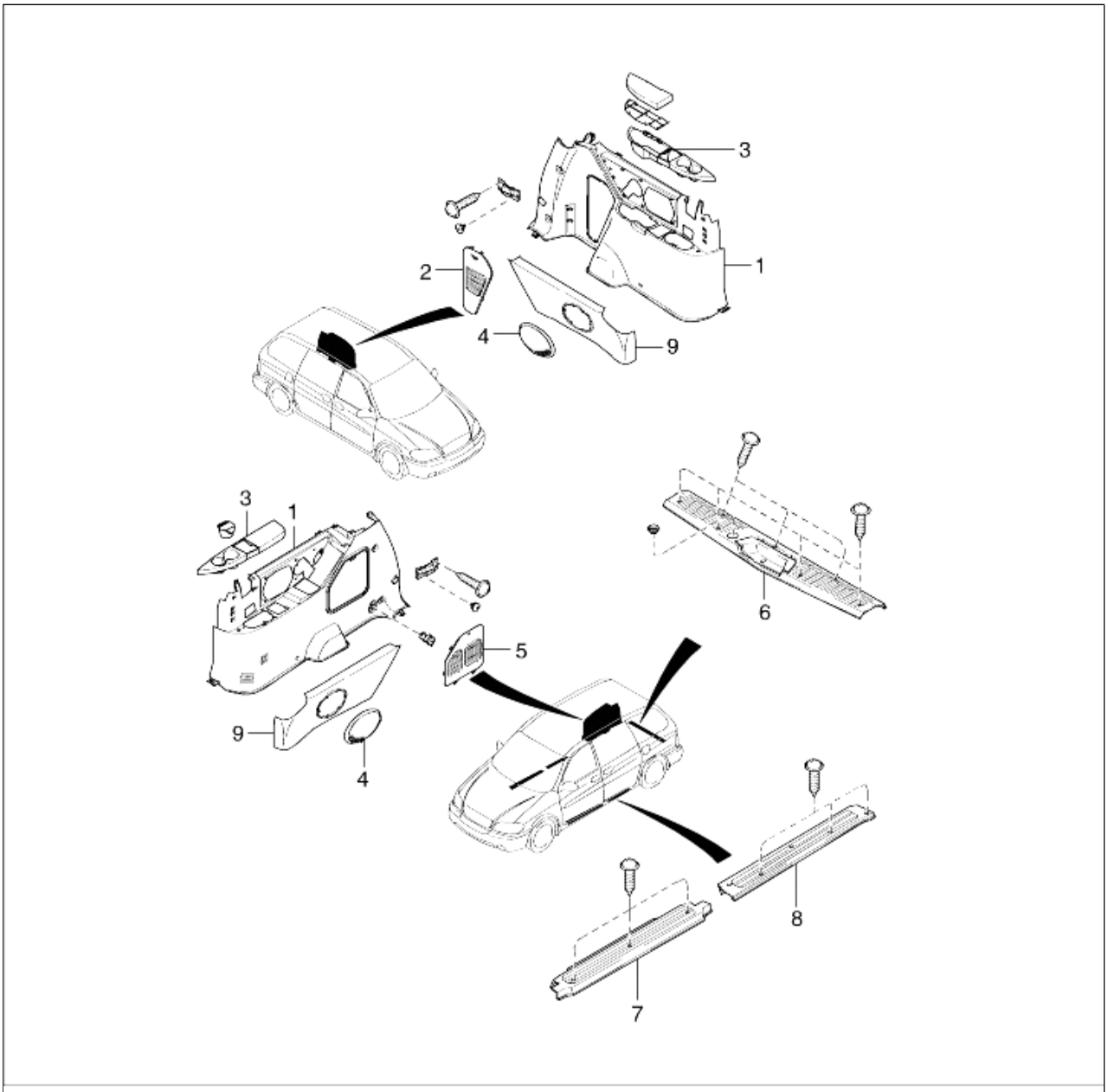


1. Screw
2. Assist handle
3. Screw
4. Sun visor
5. Screw
6. Adapter center
7. Inside mirror

Description and operation

The trim is a plastic component thermosetting molding and is used to cover the interior of the vehicle. It assists vehicle insulation by covering it in addition to hiding the vehicle metal frame. It also acts as a sound barrier. It is used on all four doors of the vehicle door opening sills, A, B, C and D pillars, rear quarter area, rear hatch, and rear hatch opening sill. All door trim on the vehicle includes armrests. Each trim on the front two doors provides a pocket for keeping maps, etc.

Components

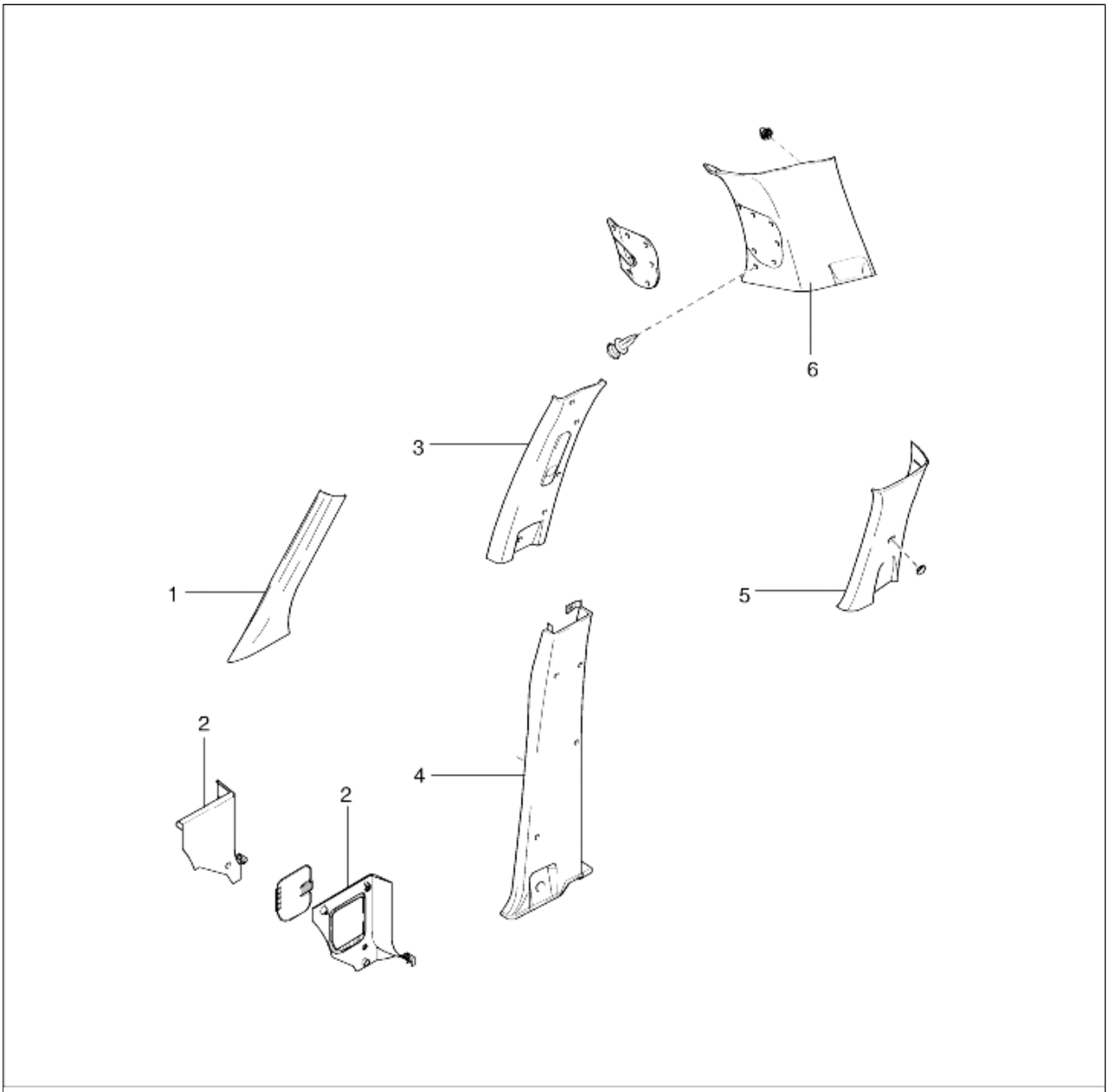


1. Rear side trim assembly
2. Tool box lid
3. Cup holder assembly
4. Speaker grille
5. Service lid
6. Rear mat plate trim
7. Front scuff plate
8. Side step plate
9. Rear side pad trim

Description and operation

The trim is a plastic component thermosetting molding and is used to cover the interior of the vehicle. It assists vehicle insulation by covering it in addition to hiding the vehicle metal frame. It also acts as a sound barrier. It is used on all four doors of the vehicle door opening sills, A, B, C and D pillars, rear quarter area, rear hatch, and rear hatch opening sill. All door trim on the vehicle includes armrests. Each trim on the front two doors provides a pocket for keeping maps, etc.

Components

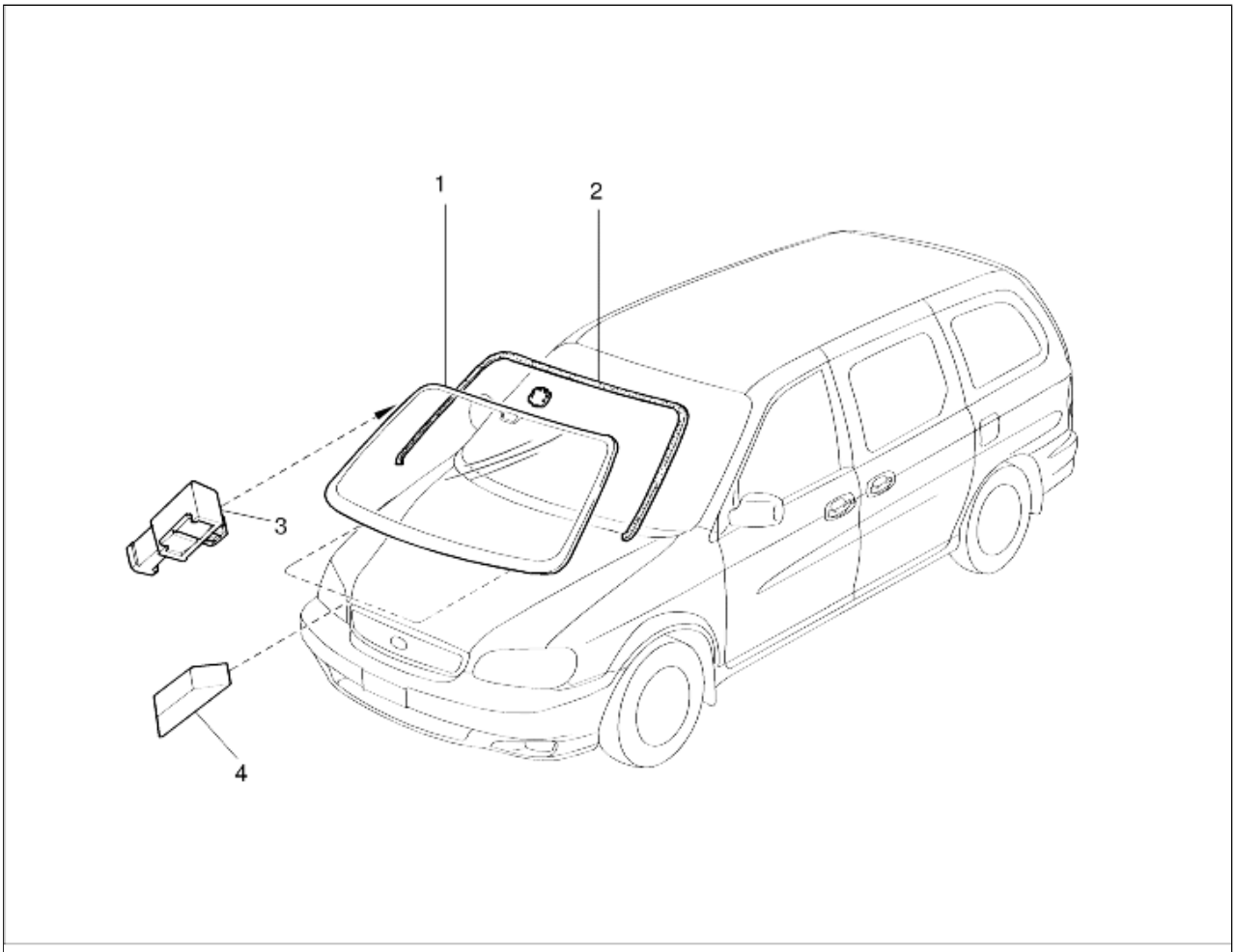


1. A-pillar upper trim
2. A-pillar lower trim
3. B-pillar upper trim
4. B-pillar lower trim
5. C-pillar trim
6. D-pillar trim

Description

The windshield glass is safety glass-plastic-laminate sandwiched between two sheets of glass. The windshield and bonded to the body with urethane sealant. A molding encloses the body glass joint on the top and both sides. Molding for the bottom is attached to the cowl vent.

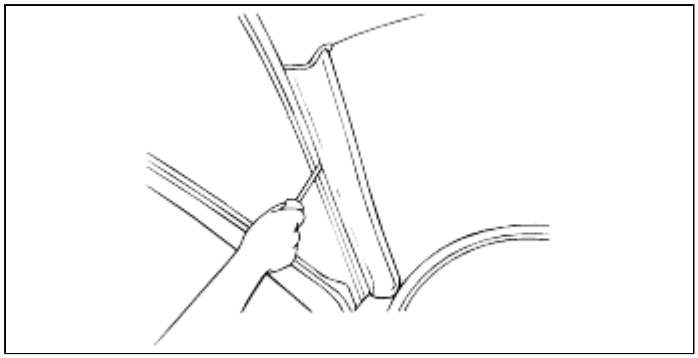
Components



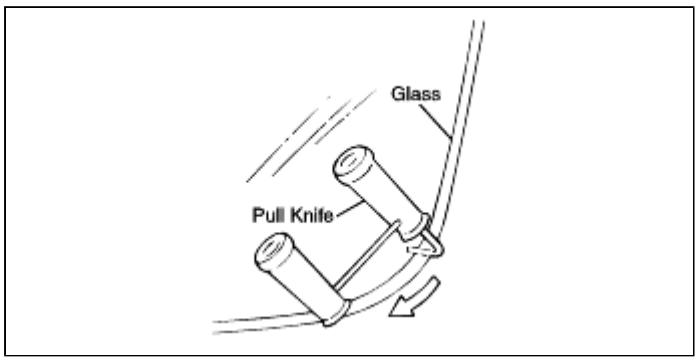
1. Windshield glass assembly
2. Sealant dam
3. Spacer
4. Spacer

Removal

1. Remove LH and RH A-pillar moldings by carefully prying them from the pillar.



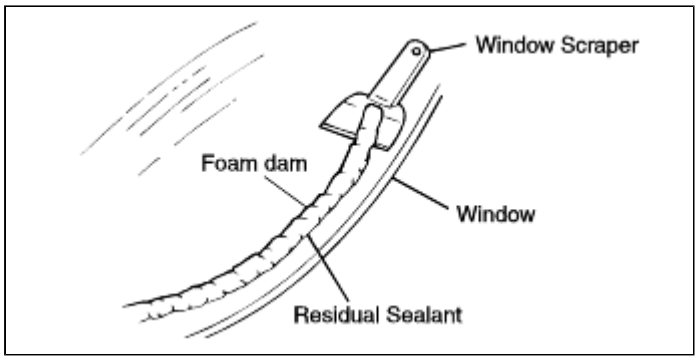
2. Remove inside rearview mirror by prying its base cover off, and then removing two screw.
3. Remove LH and RH windshield wiper arms by removing one nut each.
4. Remove cowl vent.
5. Remove the rubber molding from around the windshield. Start at a corner.
6. Pierce the sealant with a pull knife and cut all the way around the windshield from outside the vehicle.



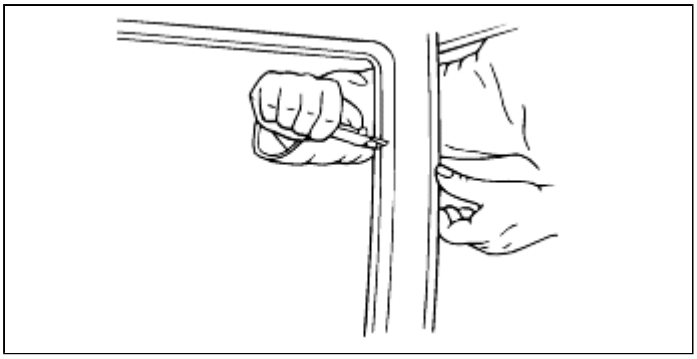
7. Remove the glass to a safe place.

Installation

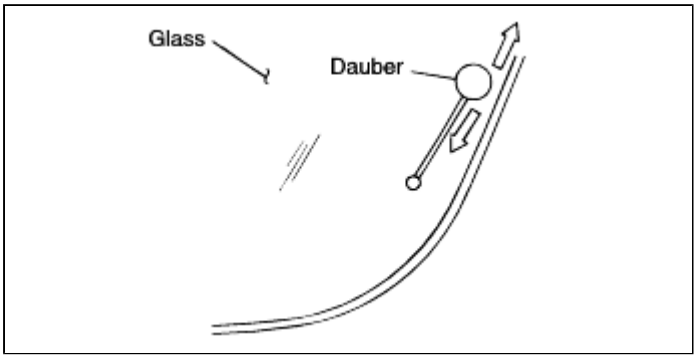
1. Remove the excess sealant from the glass with a window scraper.



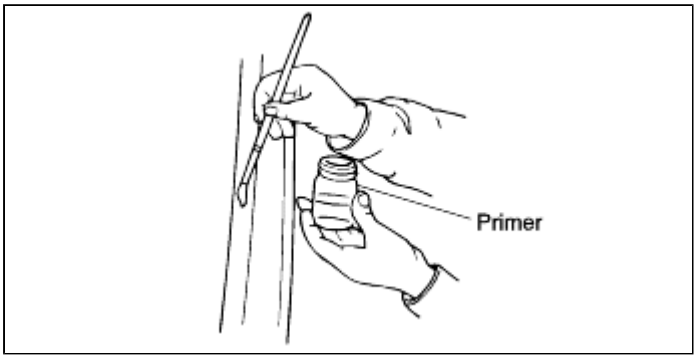
2. Remove the exces sealant and foam dam from the body with a knife.



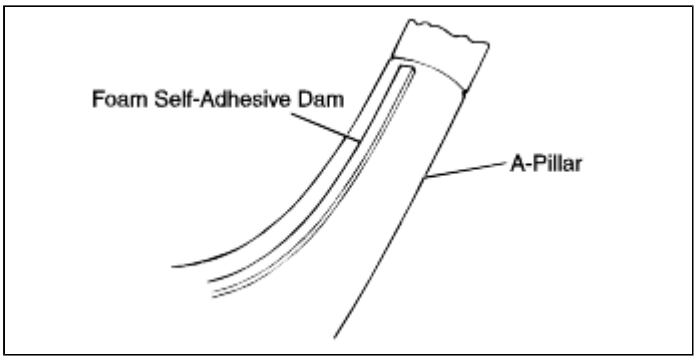
3. Clean the inside of the glass with commercial glass cleaner and a lint-free cloth.
4. Prime an area approximately 3/4 inch (19mm) wide around the complete perimeter of the glass.



5. Prime the contact area on the body.



6. Reprime the same area on the inside surface of the glass.
   Do not permit any primed surface to become contaminated with dirt, water, oil, etc. Do not touch primed surfaces with your hands. Contamination will affect adhesion.
7. Install the self-adhesive foam dam to the body where the original dam had been.

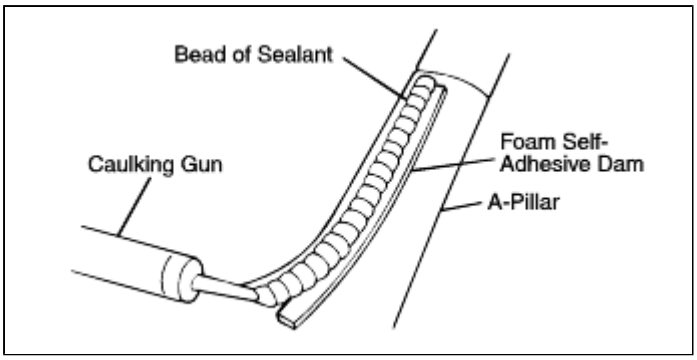


NOTE

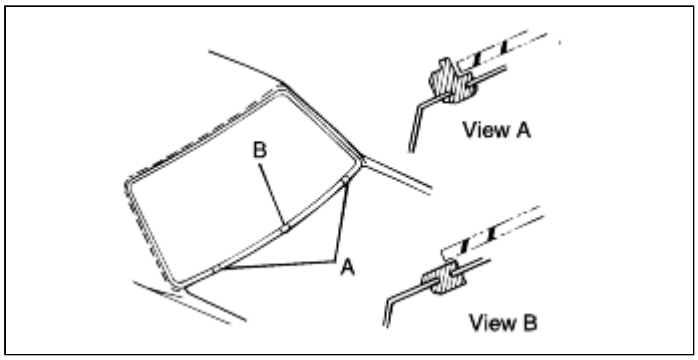
The following cure times may be critical. Attempting to replace a windshield in ambient temperature over 95°F (35°C) should be avoided because the surface of the sealant may harden before completing the application.

Temperature	Surface Hardening Time	Time Required Until Vehicle Can Be Returned To Service
41°F (5 °C)	Approx 1.5 hrs	12 hrs
55°F (13 °C)	Approx 1.2 hrs	8 hrs
68°F (20 °C)	Approx 1 hrs	4 hrs
81°F (28 °C)	Approx 0.5 hrs	3 hrs
95°F (35 °C)	Approx 10 hrs	2 hrs

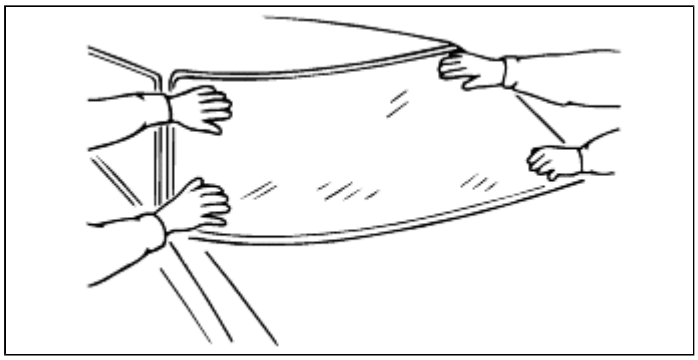
8. Apply the urethane bead to the body just outside the dam. The bead should be slightly higher than the dam.



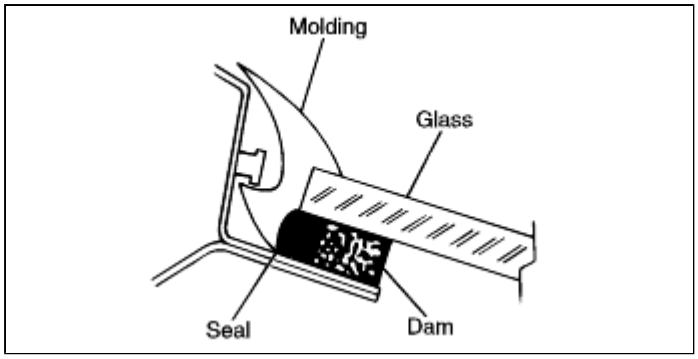
9. Install molding on the glass.
10. Install the glass into the body making sure the glass rests upon the two spacers at the bottom of the sindshield.



11. Press glass firmly into place.



12. Press molding firmly into place.



13. Lower both front door windows and leave them in that condition until the vehicle can be put back into service. If the vehicle were completely closed, quickly closing a door could break the seal.
14. Remove excess urethane, if any.
15. Perform water leak test immediately.
16. Clean the outside of the windshield.
17. Install both of the A-pillar trims.
18. Install the rearview mirror with two screws.
19. Install the cowl vent with six screws and two fasteners.
20. Install both wiper arm assemblies with one nut each.

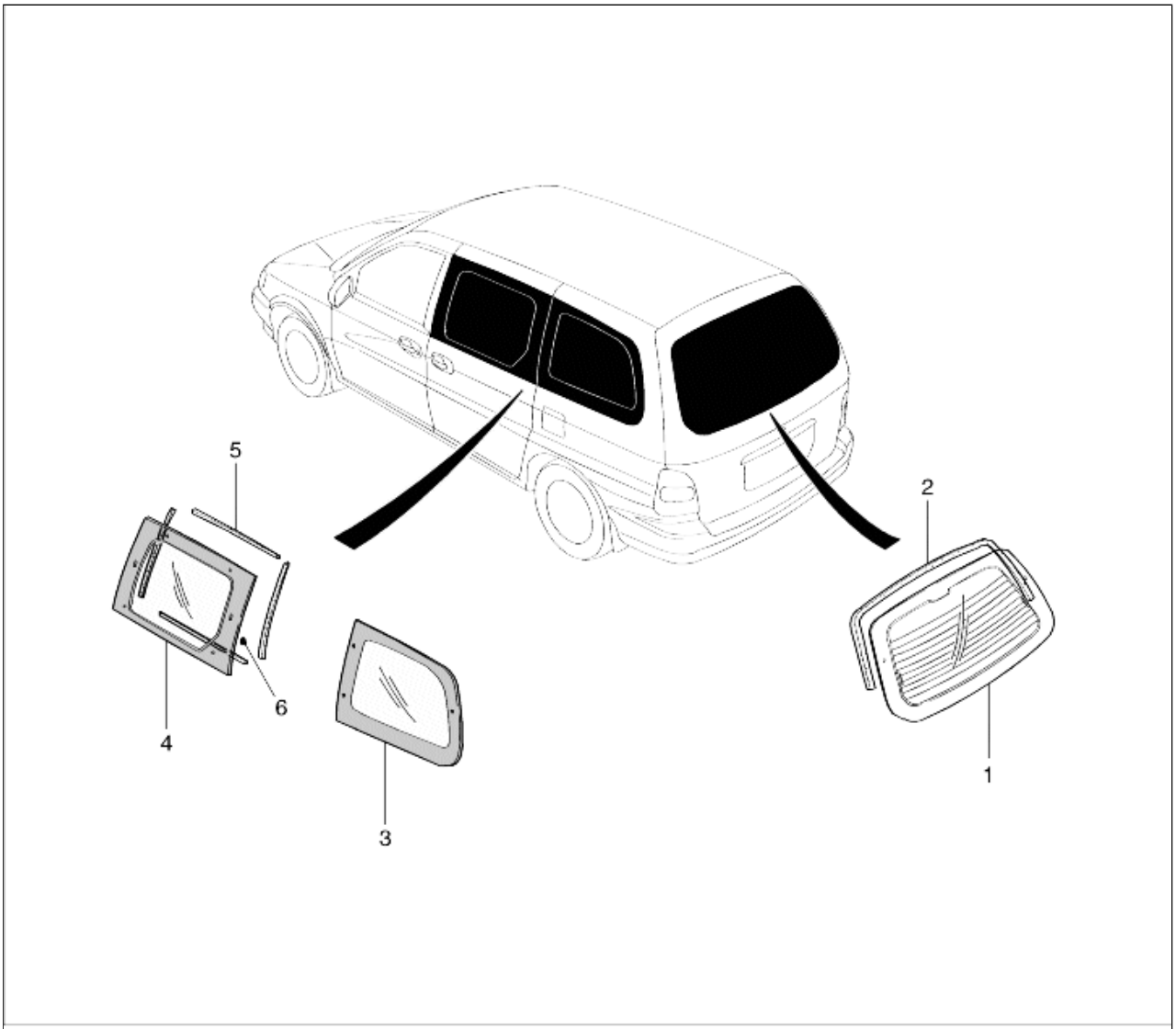
Description and operation

The tail gate glass bonds to the body of the rear hatch with sealant. The inside of the tail gate is further sealed with weatherstrip. Outside molding protects the edge of the glass. The tail gate window defroster is located on the inside of the window and has an electrical connector on each side.

The quarter and slide door window glass is bonded to the body with sealant. It has rubber molding around it on the outside and weatherstripping on the inside.

The windshield glass is safety glass approved. The windshield is sealed and bonded to the body with urethane sealant. A molding encloses the body glass joint on the top and both sides. Molding for the bottom is attached to the cowl vent.

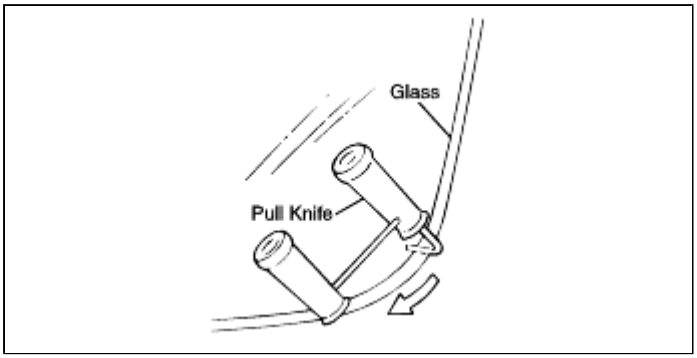
Components



1. Tail gate glass
2. Dam
3. Quarter window glass
4. Slide door glass
5. Slide door glass dam
6. Pad foam

Removal

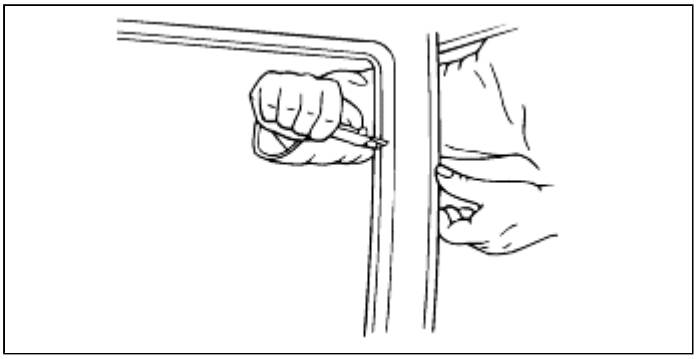
1. Raise windshield wiper and tape in the raised position.
2. Remove each of the window defroster connectors.
3. Remove the rubber molding from around the window glass.
4. Remove the weatherstripping from the inside.
5. Pierce the sealant with the pull knife and cut around the perimeter of the glass.



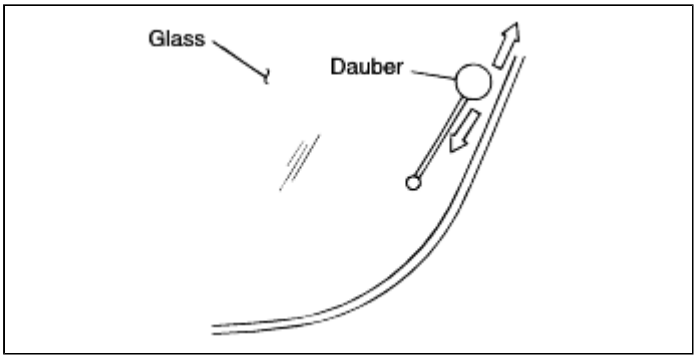
6. Remove the glass to a safe place.

Installation

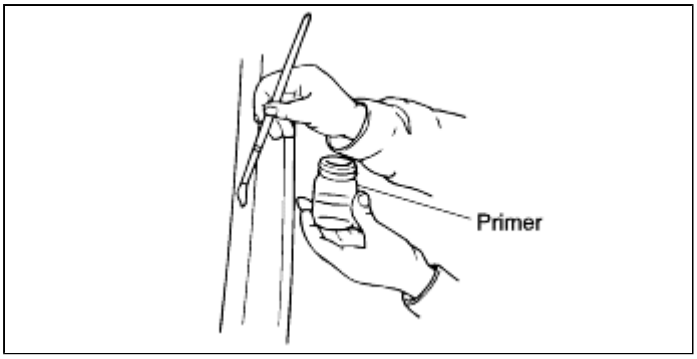
1. Clean the body of excess sealant with a knife.



2. Clean the glass of excess sealant with a window scraper
3. Prime an area approximately 3/4 inch (19 mm) wide around the perimeter of the glass.



4. Prime the contact area on the body.



5. Reprime the glass.
6. Install the molding around the perimeter of the glass.
7. Install the weatherstripping in the door.

> **NOTE**
>
> The following cure times may be critical. Attempting to replace a windshield in ambient temperature over 95°F (35°C) should be avoided because the surface of the sealant may harden before completing the application.

Temperature	Surface Hardening Time	Time Required Until Vehicle Can Be Returned To Service
41°F (5 °C)	Approx 1.5 hrs	12 hrs
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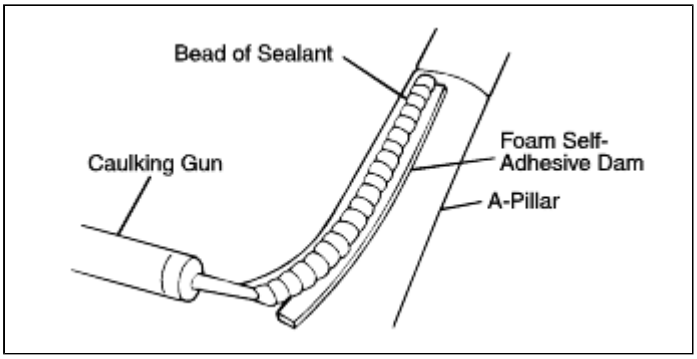
68°F (20 °C)	Approx 1 hrs	4 hrs
81°F (28 °C)	Approx 0.5 hrs	3 hrs
95°F (35 °C)	Approx 10 hrs	2 hrs

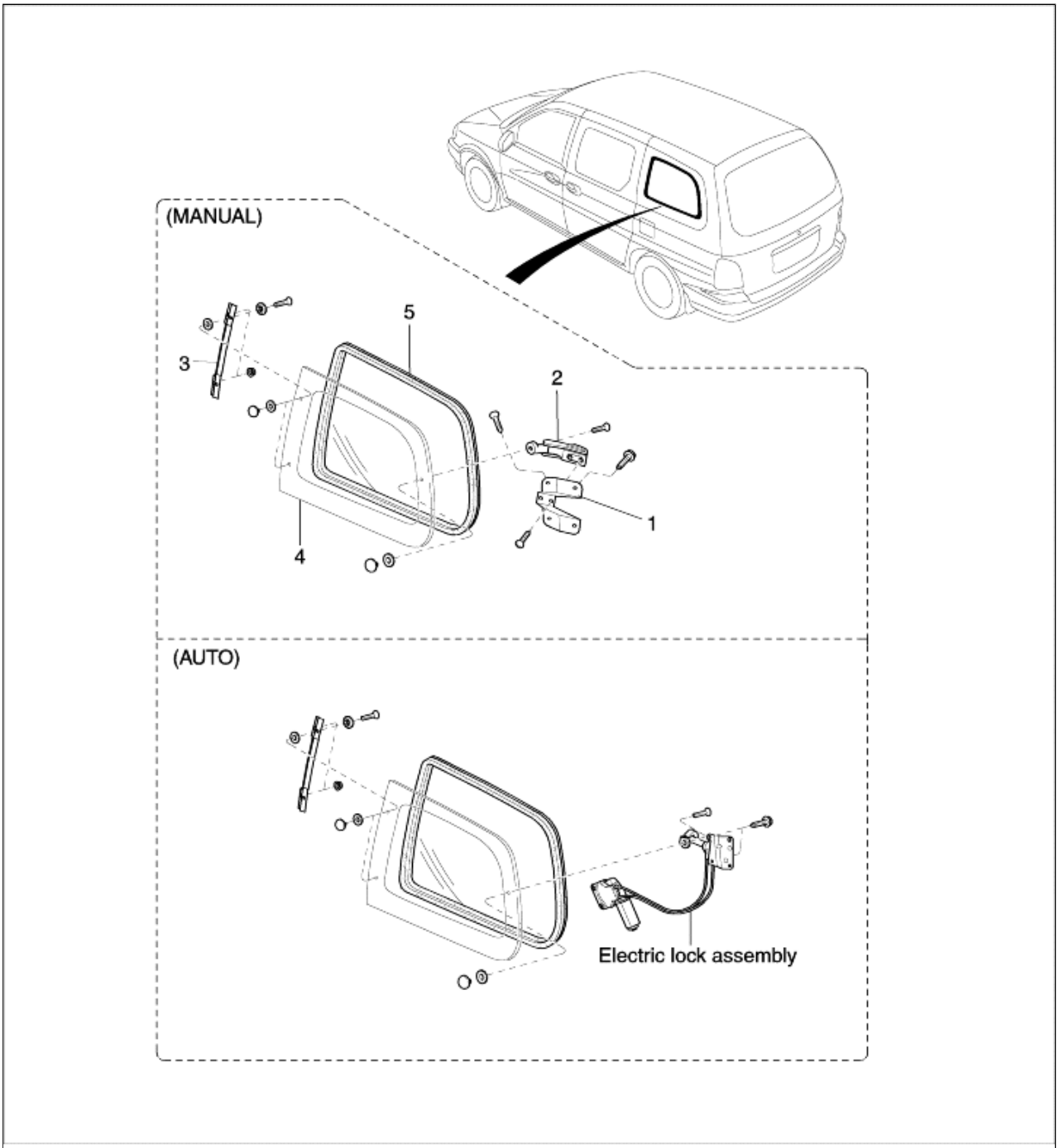
8. Apply sealant to the door where it was sealed before.



9. Clean the inside of the glass with a commercial glass cleaner and a lint-free cloth.
10. Install molding on the glass.
11. Install the glass into the body.
12. Press the glass firmly into the urethane sealant.
13. Press the molding firmly into place.
14. Remove excess sealant, if any.
15. Tape the window firmly into place so it will not creep down from its own weight.
16. Perform water leak test immediately.
17. Clean the outside of the glass with a commercial glass cleaner and a lint-free cloth.
18. Remove the tape from the windshield wiper and lower it onto the glass.

19. Connect the rear window defroster connectors.

Components

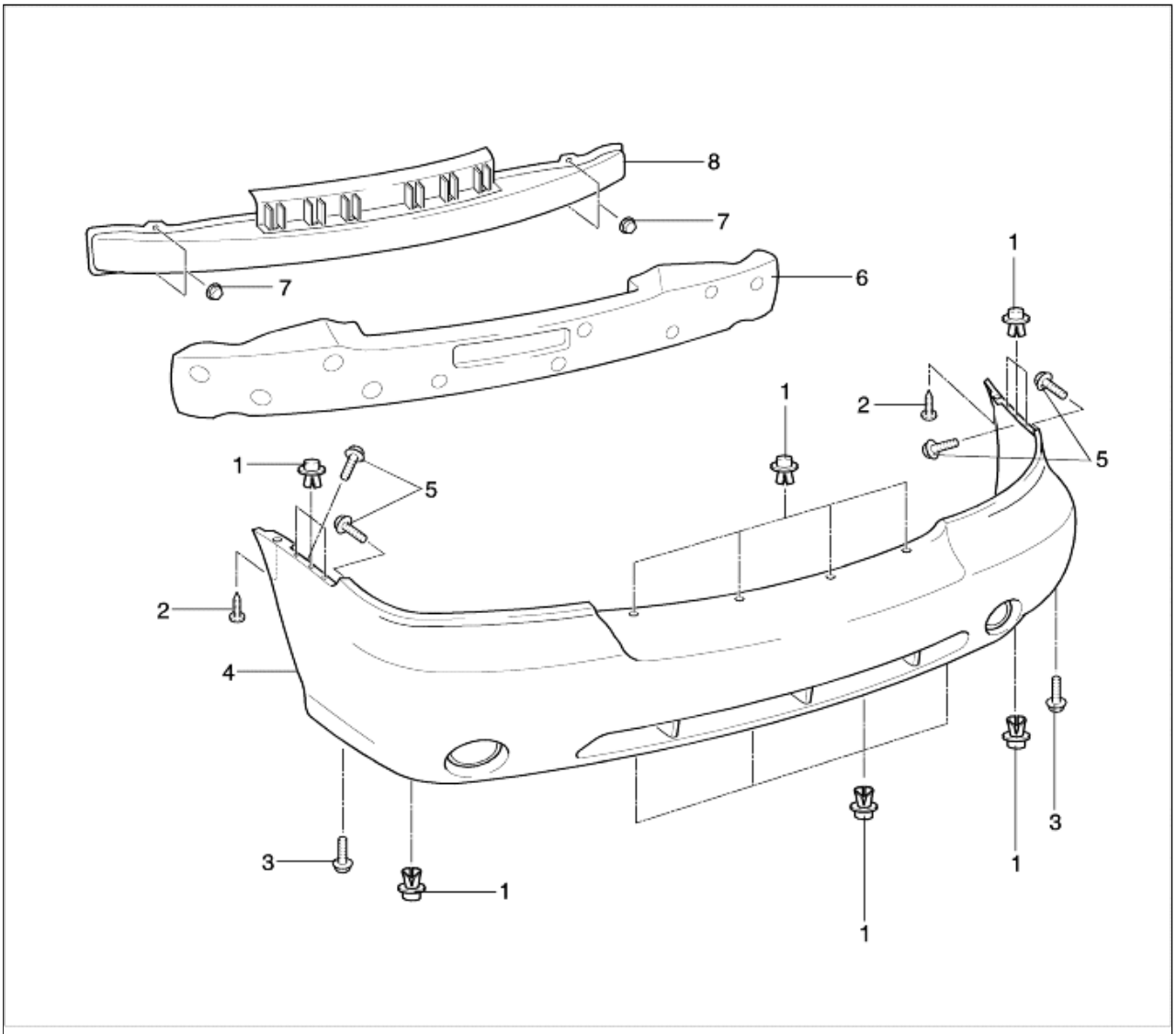


1. Stay assembly
2. Quarter glass lock assembly
3. Quarter glass hinge assembly
4. Glass
5. Quarter window weatherstrip

Description and operation

The front and rear bumpers consist of three parts; bumper face, energy absorbing foam, and bumper reinforcement. The bumper face is made of polypropylene and the absorption medium is styrofoam. Reinforcement is constructed of polypropylene and reinforcing fiber with energy absorbing foam placed between bumper face and the reinforcement.

Components



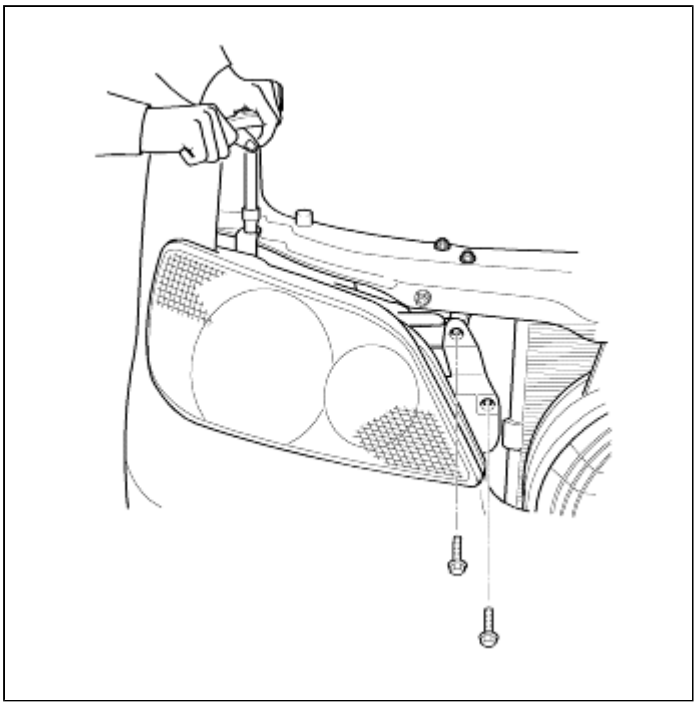
1. Bumper fastener
2. Bumper retaining screw
3. Bumper retaining bolt
4. Bumper face
5. Bumper retaining nut
6. Energy absorbent foam
7. Bumper mounting nut
8. Bumper reinforcement

Inspection

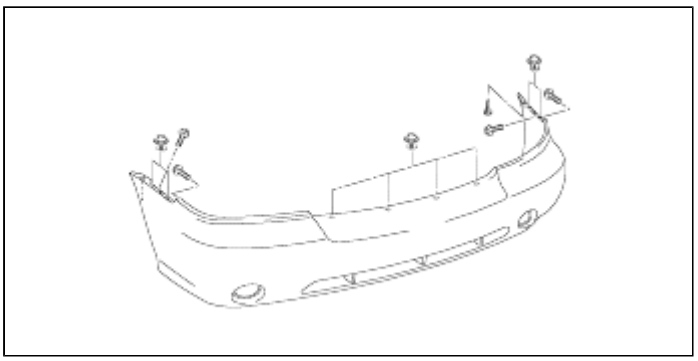
1. Inspect bumper face for damage and check that bumper is securely mounted.
2. Inspect bumper for missing attaching hardware.

Removal

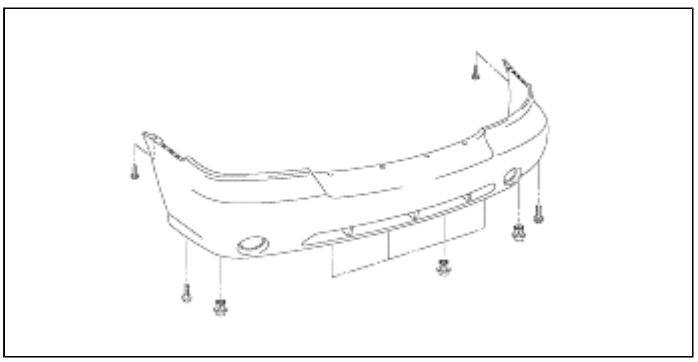
1. Remove headlight and combination light assembly.
   A. Remove three mounting bolts.
   B. Disconnect electrical connector from rear of light assembly.



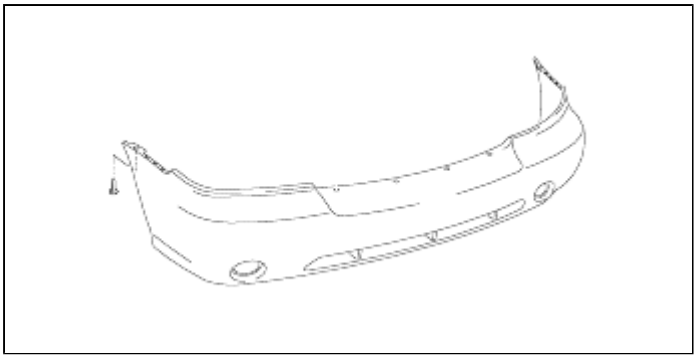
2. Remove bumper face and energy absorbent foam assembly.
   A. Remove eight fasteners and four retaining bolts from top of bumper assembly.



   B. Remove six fasteners and two bolts from bottom of bumper assembly.



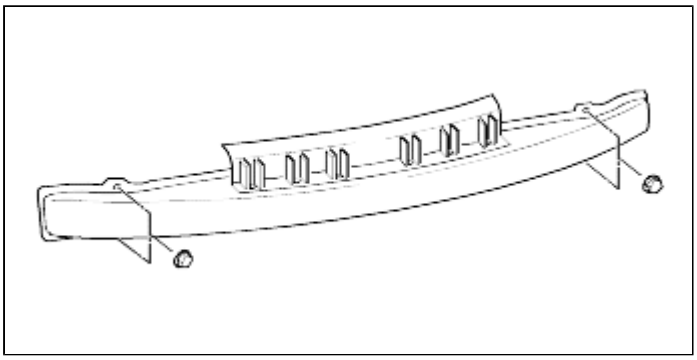
C. Remove two screws from side of bumper assembly.



D. Disconnect electrical connector from fog light assembly.

3. Remove bumper reinforcement and bumper stay assembly.

A. Remove four mounting nuts from front side of bumper reinforcement.



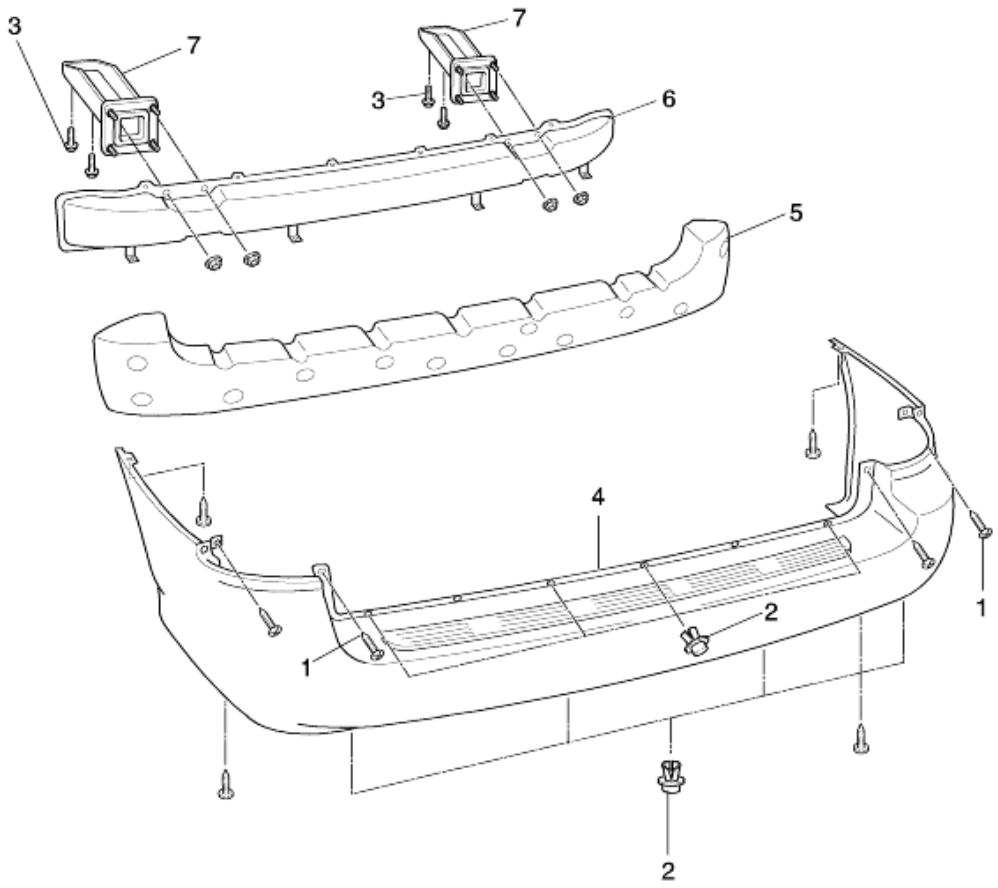
4. Install front bumper in reverse order of removal.

Tightening torque :Bumper mounting nut10~15 N·m (1.0~1.5 kg·m, 7~11 lb·ft)

Description and operation

The front and rear bumpers consist of three parts; bumper face, energy absorbing foam, and bumper reinforcement. The bumper face is made of polypropylene and the absorption medium is styrofoam. Reinforcement is constructed of polypropylene and reinforcing fiber with energy absorbing foam placed between bumper face and the reinforcement.

Components



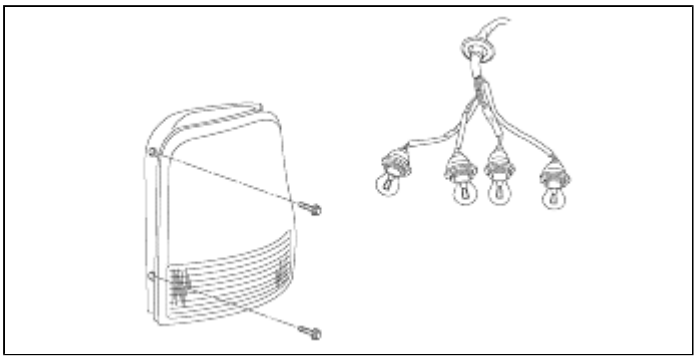
1. Bumper retaining screw
2. Bumper fastener
3. Bumper mounting bolt
4. Bumper face
5. Energy absorbent foam
6. Bumper reinforcement
7. Bumper stay

Inspection

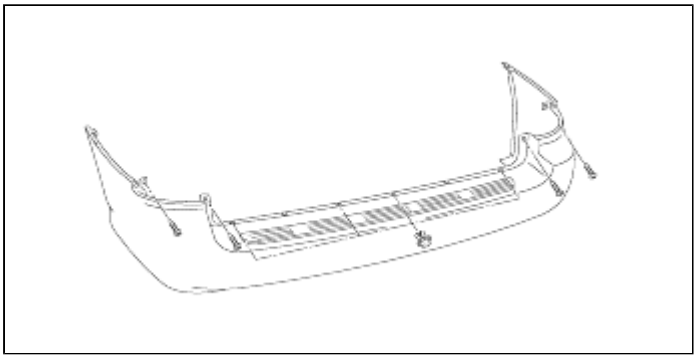
1. Inspect bumper face for damage and check that bumper is securely mounted.
2. Inspect bumper for missing attaching hardware.

Removal

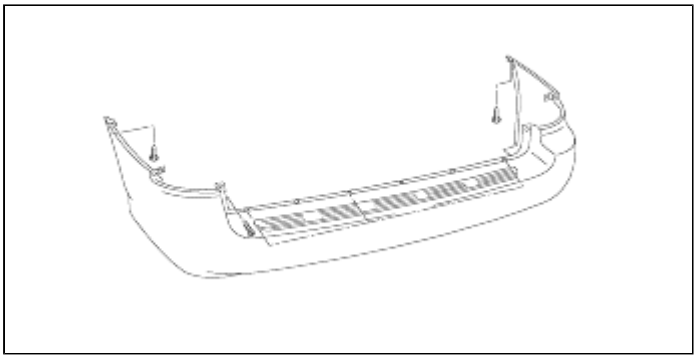
1. Remove rear combination light assembly.
   A. Remove two mounting screws.
   B. Disconnect electrical connector from rear side of light assembly.



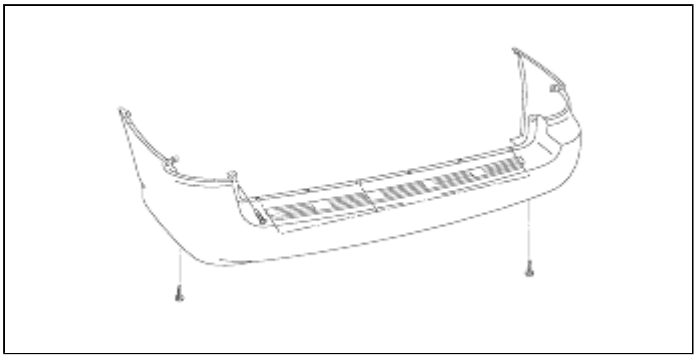
2. Remove bumper assembly.
   A. Remove four fasteners and four retaining screws from top of bumper assembly.



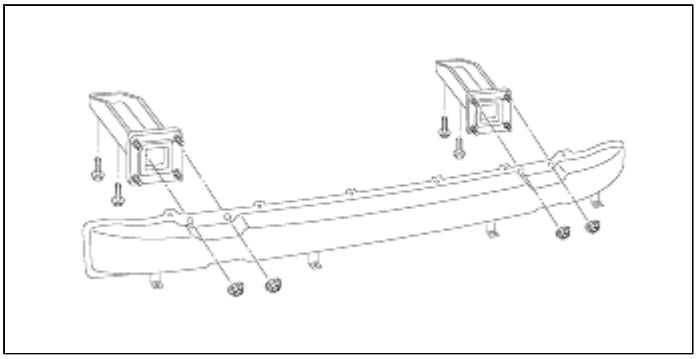
   B. Remove mud flap from bumper assembly.
   C. Remove two screws from bottom of bumper assembly.



   D. Remove two screws from side of bumper assembly.

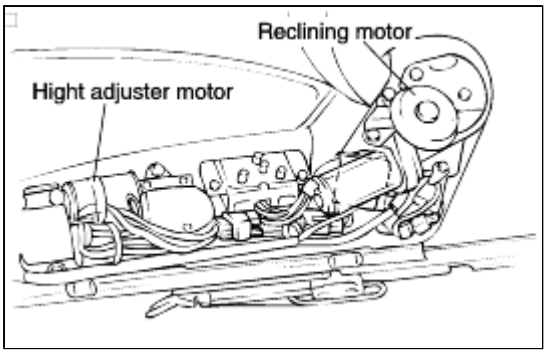


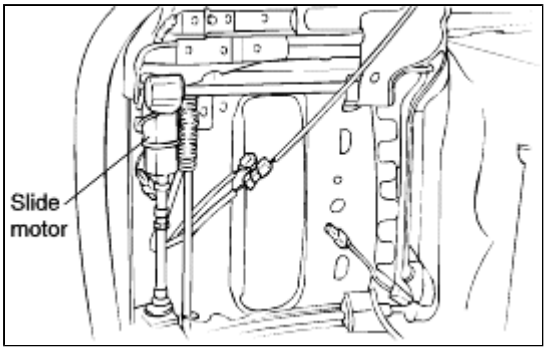
E. Remove four bumper mounting bolts from under of vehicle.



3. Install rear bumper in reverse order of removal.

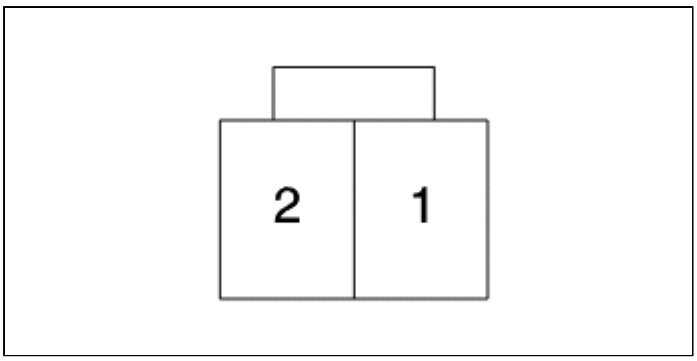
Inspection





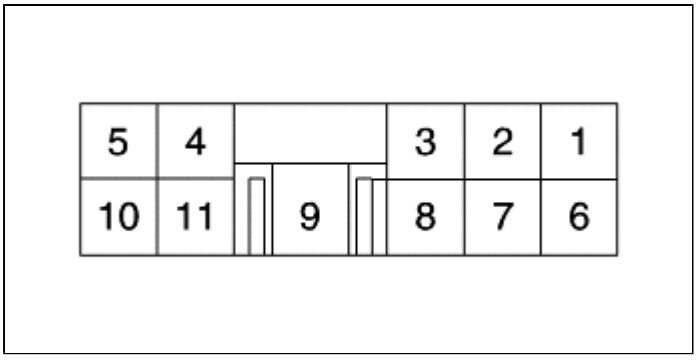
1. Disconnect the connectors for each motor.
2. When the battery connected directly to the motor terminals, check if the motors run smoothly.
3. Reverse the connections and check that the motor reversely turns.
4. If there is an abnormality, replace the motors.

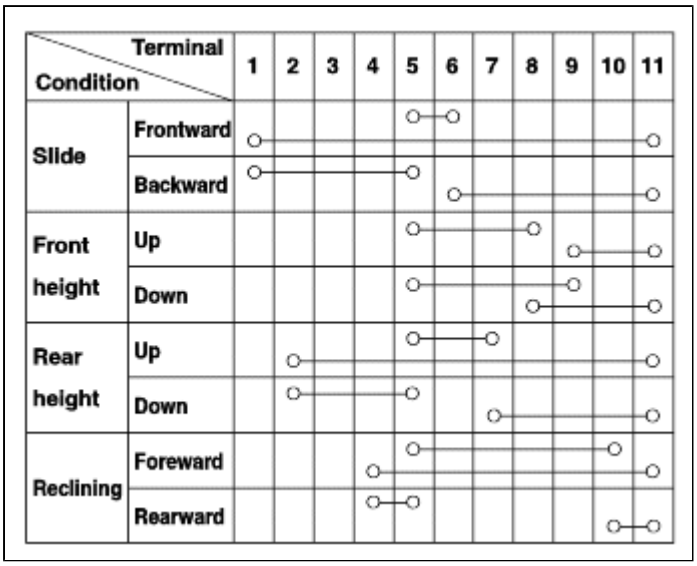
Condition \ Terminal		1	2
Slide motor	Frontward	⊕	⊖
	Backward	⊖	⊕
Reclining motor	Frontward	⊕	⊖
	Rearward	⊖	⊕
Height adjuster motor(Front)	Up	⊖	⊕
	Down	⊕	⊖
Height adjuster motor(Rear)	Up	⊕	⊖
	Down	⊖	⊕
Lumber motor	Frontward	⊖	⊕
	Backward	⊕	⊖


2
1

Inspection

Operate the power seat switch and check the continuity between terminals. If continuity is not as specified, replace the switch.

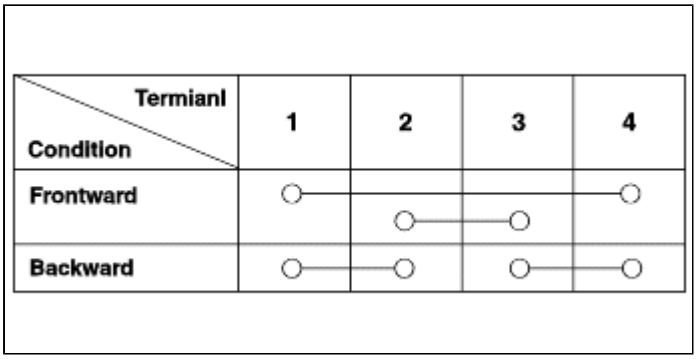


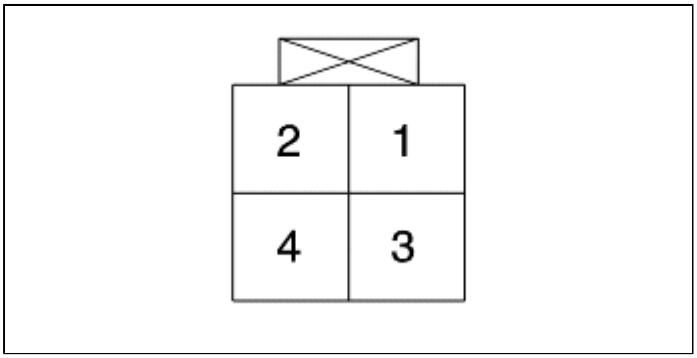


Power lumbar switch

Inspection

Operate the power lumbar switch and check the continuity between terminals. If continuity is not as specified, replace the switch.




2
1
4
3

Description

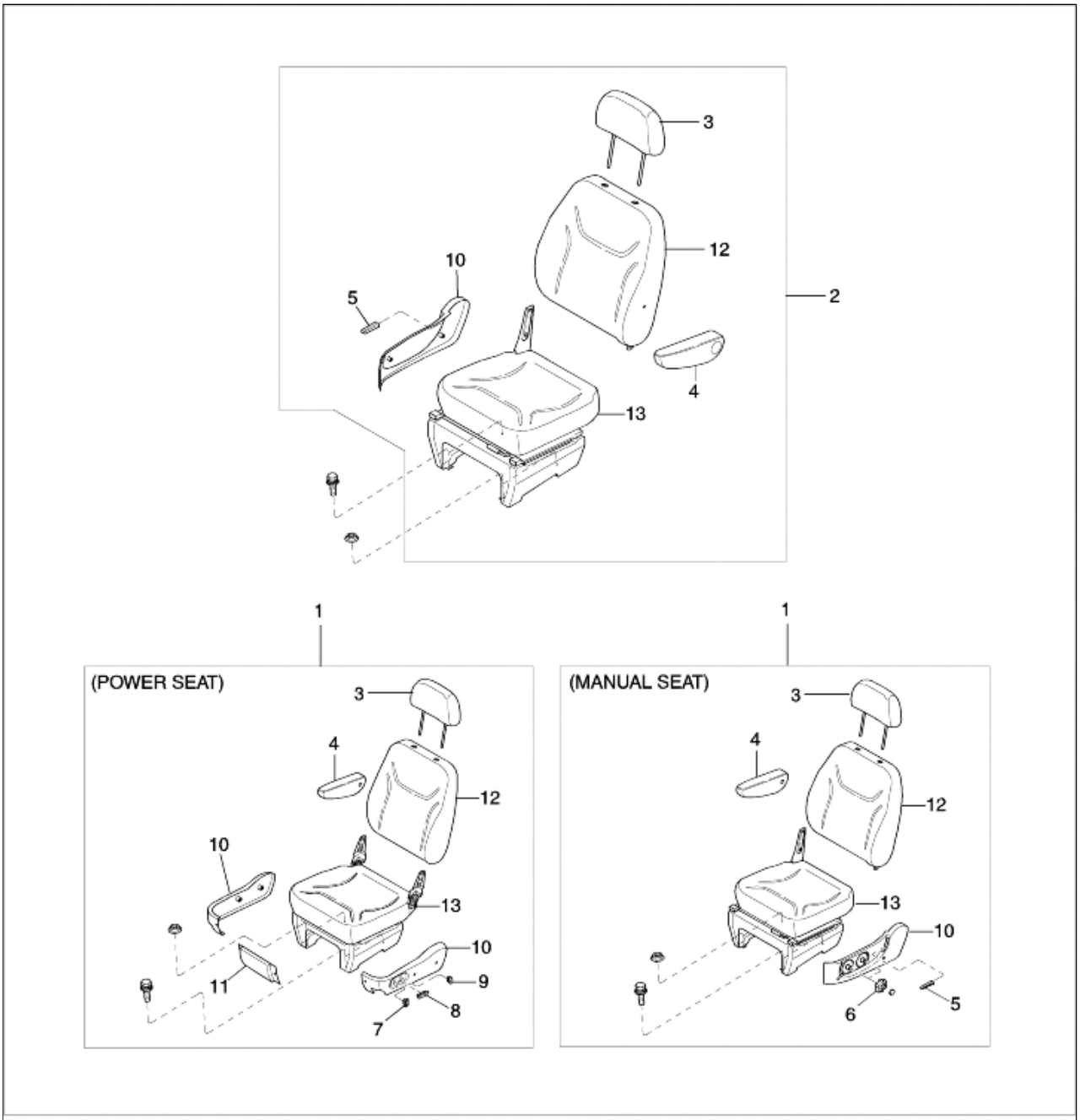
The front seat consists of a seat back and a cushion. Both items are replaceable or serviceable. Both seats can be reclined or adjusted front-to-rear by two levers, the adjusting lever and reclining knuckle lever. The head restraint can also be adjusted or removed.

The seat adjuster lever is under the right front corner of either front seat. Pulling on this lever unlocks the seat, allowing it to slide forward or backwardon a track attached to the vehicle floor. The track assembly and seat adjuster lock are replaceable items.

The reclining knuckle lever arm is placed on the door side of either seat. If this lever is pulled up and pressure is placed on the seat back, the seatback will recline. If no pressure is applied, the seat will spring forward past the vertical driving position. If pressure is applied to the seat back,it will recline to the vertical driving position and then lock. The reclining knuckle is a replaceable item.

The reclining knuckle lever arm is placed on the door side of either seat. If this lever is pulled up and pressure is placed on the seat back, the seatback will recline. If no pressure is applied, the seat will spring forward past the vertical driving position. If pressure is applied to the seat back,it will recline to the vertical driving position and then lock. The reclining knuckle is a replaceable item. The driver's seat is also equipped with a lumbarsupport. This is controlled by a lever on the right side of the driver's side seat back.

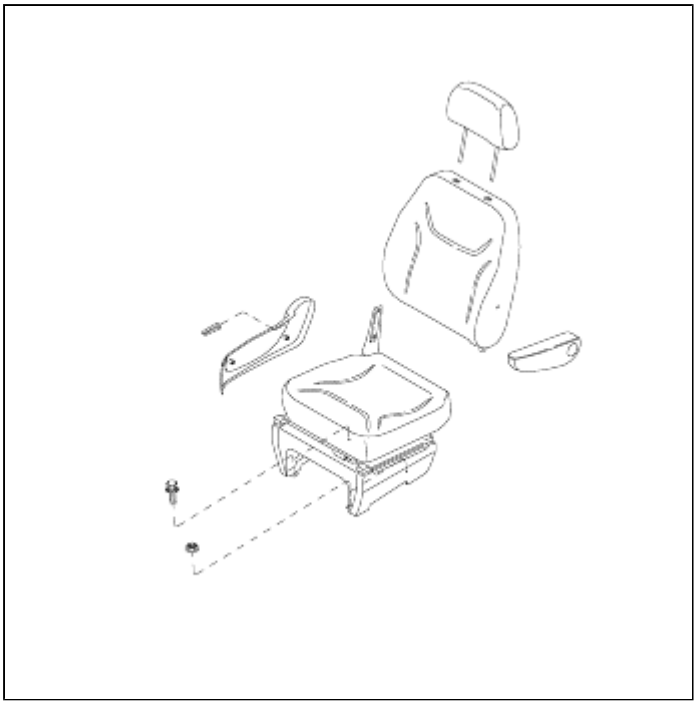
Components



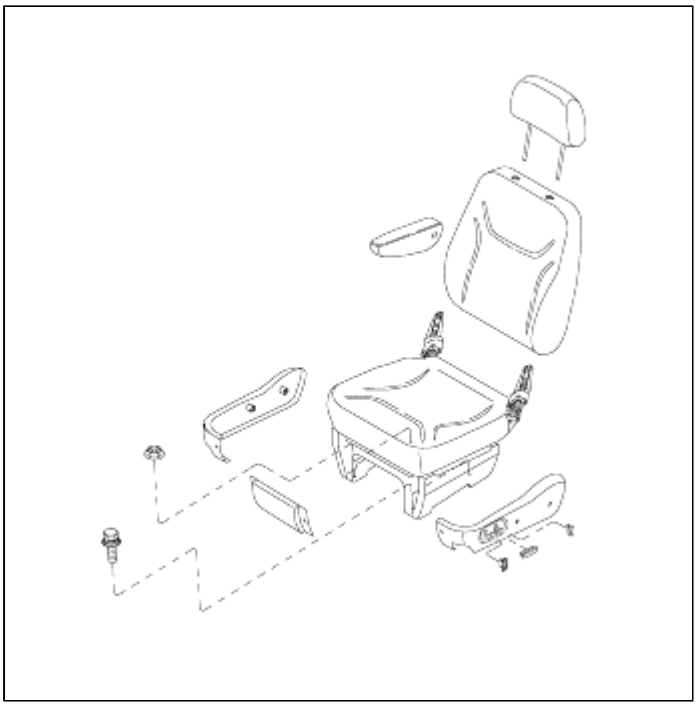
1. Driver seat
2. Passenger seat
3. Head rest
4. Arm rest
5. Knob
6. Lifter dial
7. Air lumbar switch
8. Recliner knob
9. Slider knob
10. Side garnish
11. Front garnish
12. Front back
13. Front cushion

Removal

1. Remove seat assembly from vehicle.
   A. Remove two mounting bolts and two nut from under seat.



   B. Disconnect electrical connector from bottom of seat.
2. Remove side garnish assembly.

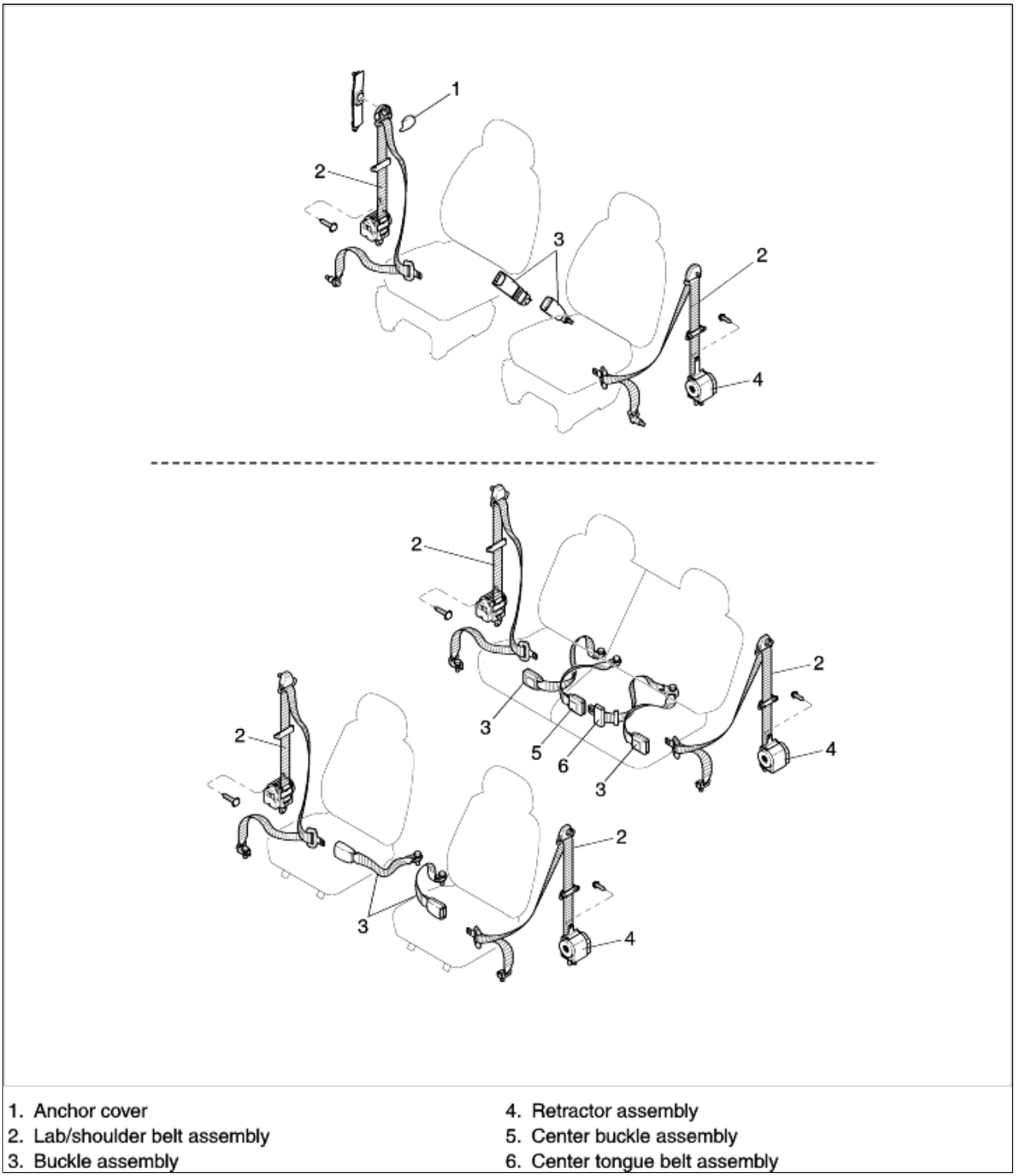


   A. Remove reclining knob.
   B. Remove lumber support switch.
   C. Remove slider lifter knob.
   D. Remove mounting screws from side of seat.
3. Remove arm rest.
   A. Remove mounting screws from side of seat.

4. Remove arm rest.
   A. Remove mounting bolt from arm rest.
5. Remove seat back.
   A. Remove mounting bolts from side of seat.
6. Remove seat cushion
   A. Remove mounting bolts from bottom of seat.
7. Install front seat in reverse order of removal.

Tightening torque :Seat mounting bolts and nut to35~57 N·m (3.5~5.7 kg·m, 25~41 lb·ft)

Components



1. Anchor cover
2. Lab/shoulder belt assembly
3. Buckle assembly
4. Retractor assembly
5. Center buckle assembly
6. Center tongue belt assembly

Inspection

1. Inspect buckle assembly mounting to ensure that it is secure.
2. Inspect anchor assembly mounting to ensure that it is secure.
3. Remove pillar lower trim.
4. Inspect retractor assembly mounting to ensure that it is secure.
5. Install pillar lower trim.
6. Extend safety belt fully to ensure its motion is smooth and easy.
7. Retract safety belt fully to ensure its motion is smooth and easy.
8. Buckle safety belt. Pull firmly on each side of buckle to ensure that it is secure.
9. Press buckle release button to ensure that it releases correctly and returns to its original position.
10. Inspect safety belt reminder system with driver's safety belt retracted. Turn ignition key to "ON" position. Safety belt icon on warning and indicator panel will light up and a chime will be heard. Lighted icon and chime indicate that driver's safety belt is not buckled. Chime will not be heard after 5~6 seconds. Turn ignition key to "LOCK" position. Safety belt icon and chime will extinguish. Turn key to "ON" position. Just as before, safety belt icon will light up and chime will be heard. Buckle driver's safety belt. Safety belt icon and chime will extinguish. Turn key to "LOCK" position and remove key.

> **CAUTION**
>
> If a safety belt is not functioning and cannot be immediately repaired, warn the customer not to use that seating position. If the customer must use that seating position, encourage the customer to use a substitute vehicle until the proper repair can be made. If the customer refuses, refer the matter to the Service Manager.

Disassembly

1. Remove bolt cover near bottom of assembly.
2. Remove one bolt from mounting bracket.

Reassemble

1. Install one bolt through mounting bracket.

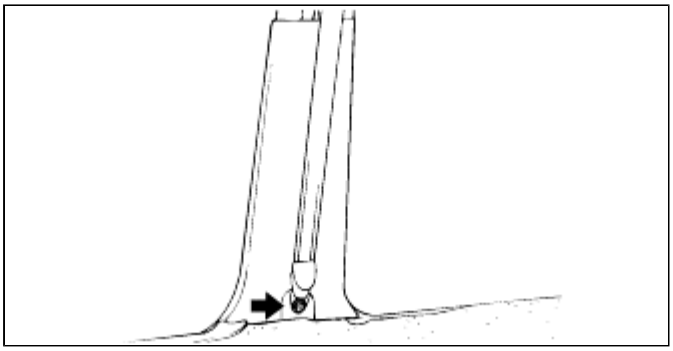
Tighten anchor bolts to :40~55 N·m (4.0~5.5 kg·m, 29~40 lb·ft)

2. Install bolt cover.

Lap/Shoulder belt assembly

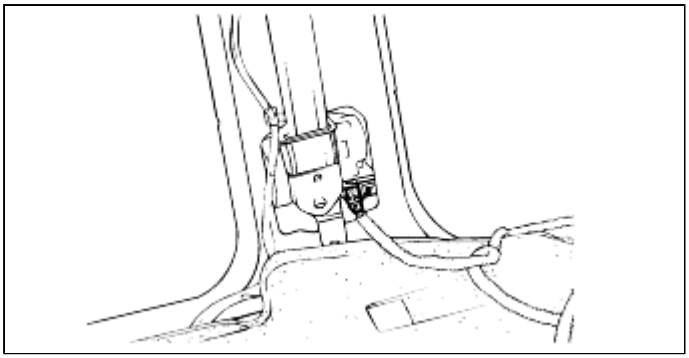
Removal

1. Remove lower anchor bolt.



2. Retract belt slowly as far as it will go.

3. Unsnap the captive shoulder belt anchor bolt cover from bottom and lift up.
4. Remove upper anchor bolt.
5. Remove pillar lower trim.
6. Remove belt guide.
7. Remove one bolt and one sheet metal screw to remove retractor assembly.



CAUTION

1) A pretensioner functions one time only. Be sure to replace the pretensioner safety belt after it is deployed.
2) Do not attempt to disassemble or repair the seat belt pretensioner. If it malfunctions, replace it with a new pretensioner safety belt.
3) Be cautions in handling a pretensioner safety belt, and do not expose it to water or oil. If crushed, damaged, or deformed, replace it with a new one.
4) Connect the battery only after the installation of the pretensioner safety belt has been correctly completed.
5) Removal of pretensioner retractor :
1) Turn ignition switch "OFF".
2) Disconnect negative battery cable.
3) Wait for about 1 minute.
4) Disconnect gas generator connector.
5) Remove retractor screw.

Installation

1. Install one bolt and one sheet metal screw to attach the retractor assembly.

Tighten anchor bolts to :40~55 N·m (4.0~5.5 kg·m, 29~40 lb·ft)

CAUTION

Exercise care to install the belt so there are no twists in it. A twisted belt may be hamful to a passenger in a serious accident. A twisted belt alters the distribution of force resulting from sudden deceleration.

2. Install two screws in belt guide.
3. Install pillar trim.
4. Install upper anchor bolt.

Tighten anchor bolts to :40~55 N·m (4.0~5.5 kg·m, 29~40 lb·ft)

5. Install anchor bolt cover.
6. Install lower anchor bolt through lap belt mounting bracket.

Tighten anchor bolts to :40~55 N·m (4.0~5.5 kg·m, 29~40 lb·ft)

7. Install bolt cover.

body electrical system

Troubleshooting

Instrument and warning system

Symptom	Possible cause	Remedy
Tachometer does not operate	Fuse blown	Check for short and replace fuse
	Tachometer faulty	Check tachometer
	Wiring faulty	Repair if necessary
Fuel gauge does not operate	Fuse blown	Check for short and replace fuse
	Fuel gauge faulty	Check gauge
	Fuel sender faulty	Check fuel sender
	Wiring faulty	Repair if necessary
Low fuel warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Fuel level sensor faulty	Check sensor
	Wiring or ground fraulty	Repair if necessary
Water temperature gauge does not operate	Fuse blown	Check for short and replace fuse
	Water temperature gauge faulty	Check gauge
	Water temperature sender faulty	Check sender
	Wiring or ground faulty	Repair if necessary
Oil pressure warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Oil pressure sender faulty	Check sender
	Wiring or ground faulty	Repair if necessary
Low brake fluid warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Brake fluid level warning switch faulty	Check switch
	Parking brake switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Open door warning lamp does not light	Fuse blown	Check for connection
	Bulb burned out	Replace bulb
	Door switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Seat belt warning lamp does not light	Fuse blown	Check for short and replace fuse
	Bulb burned out	Replace bulb
	Buckle switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary

Lighting system

Symptom	Possible cause	Remedy

One lamp does not light (all exterior)	Bulb burned out	Replace bulb
	Socket, wiring or ground faulty	Repair if necessary
Head lamps do not light	Bulb burned out	Replace bulb
	Fuse blown - Low beam	Check for short and replace fuse
	Fuse blown - high beam	Check for short and replace fuse
	Head lamp relay faulty	Check relay
	Lighting switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Tail lamps do not light	Tail lamp fuse blown	Replace fuse and check for short
	Fusible link blown	Replace fusible link
	Tail lamp relay faulty	Check relay
	Lighting switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Stop lamps do not light	Fuse blown	Replace fuse and check for short
	Stop lamp switch faulty	Adjust or replace switch
	Wiring or ground faulty	Repair if necessary
	Stop lamp relay faulty	Replace relay
Stop lamps stay on	Stop lamp switch faulty	Adjust or replace switch
	Stop lamp relay faulty	Replace relay
Instrument lamps do not light (Tail lamps light)	Rheostat faulty	Check rheostat
	Wiring or ground faulty	Repair if necessary
Turn signal lamp does not flash on one side	Bulb burned out	Replace bulb
	Turn signal switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Turn signal lamps do not operate	Fuse blown	Replace fuse and check for short
	Flasher faulty	Check flasher
	Turn signal switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Hazard warning lamps do not operate	Fuse blown	Replace fuse and check for short
	Flasher faulty	Check flasher
	Hazard switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Flasher rate too slow or too fast	Lamps' wattages are smaller or larger than specified	Replace lamps
	Defective flasher	Replace flasher
Back up lamps do not light up	Fuse blown	Replace fuse and check for short
	Back up lamp switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Overhead console lamp does not light up	Fuse blown	Check for short and replace fuse
	Wiring or ground faulty	Repair if necessary

Windshild wiper

Symptom	Possible cause	Remedy
Wipers do not operate or return to off position.	Wiper fuse blown	Check for short and replace fuse
	Wiper motor faulty	Check motor
	Wiper switch faulty	Check switch
	Wiring or ground faulty	Repair if necessary
Wipers do not operate in INT position	ETACS Module faulty	Check ETACS Module
	Wiper switch faulty	Check switch
	Wiper motor faulty	Check motor
	Wiring or ground fautly	Repair if necessary

Power window

Symptom	Possible cause	Remedy
No windows operate from the main switch on the driver's door	Fuse blown	Check for short and rplace fuse
	Poor ground	Clean and retighten the ground terminal mounting bolt
	Defective power window main switch	Check the switch Replace if necessary
	Open circuit in wires or loose or disconnected connector	Repair or replace
Driver's side window does not operate	Defective power window main switch	Check for driver's window switch
	Defective motor or circuit breaker	Replace the motor
	Open circuit in wires or loose or disconnected connector	Check the harness and the connector
Passenger's side window does not operate	Defective power window subswitch	Replace the switch
	Defective motor or circuit breaker	Replace the motor
	Wiring faulty or disconnected connector	Repair if necessary

Power door mirror

Symptom	Possible cause	Remedy
No mirrors operate	Fuse blown	Check the circuit and replace fuse
	Poor ground	Clean and retighten the gound terminal mounting bolt
	Defective mirror switch	Check the switch Replace if necessary
	Open circuit in wires or loose or disconnected connector	Repair or replace
One mirror does not operate	Defective mirror switch	Check the switch Replace if necessary
	Defective mirror actuator	Replace the actuator
	Open circuit wires or loose or	

	disconnected connector	Repair or replace

Instruments and warning system

Illumination	3.0w x 4EA	
Warning lamps	Bulb wattage (w)	Color
Turn signal (LH, RH)	1.4	Green
High beam	1.4	Blue
Front fog	1.4	Green
Front windshield defroster	1.4	Amber
Rear window defroster	1.4	Amber
Rear door open	1.4	Red
Door ajar	1.4	Red
O/D OFF	1.4	Amber
Air bag	1.4	Red
Engine check	1.4	Amber
Auto cruise	1.4	Green
Oil pressure	1.4	Red
Parking brake	1.4	Red
Battery charge	1.4	Red
Immobilizer check (For Canada)	1.4	Amber
ABS	1.4	Amber
Power	1.4	Amber
Seat belt	1.4	Red
Low fuel	1.4	Amber
A/T	1.4	Red
R, P	1.4	Green
N, D, 3, L		

Service specifications

Indicators and gauges

Speedometer

Type

o Electric speedometer (Coil type)

Standard values

Velocity (Km/h)	20	40	60	80	100	120
Tolerance (%)	+0	+0	+0	+0	+0	+0
	-12.6	-7.3	-5.9	-5.2	-5	-5
Velocity (Km/h)	140	160	180	200	220	-
Tolerance (%)	+0	+0	+0	+0	+0	-
	-5	-5	-5	-5	-5	-

Velocity (MPH)	10	20	40	60	80	100
Tolerance (%)	+0	+0	+0	+0	+0	+0
	-13.6	-8.8	-5.7	-5	-5	-5
Velocity (MPH)	120	-	-	-	-	-
Tolerance (%)	+0	-	-	-	-	-
	-5	-	-	-	-	-

o Tap the speedometer to prevent hysterisis effects during inspection.

Tachometer

Type

o Cross - coil type (Σ3.5 : 3pulses/rev)

Standard values

Revolution (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	Remarks
Tolerance (%)	+6	+7.5	+6	+6	+6	+6	+6	Gasoline
	-12	-1.5	-	-	-	-	-	

o Tap the tachometer to prevent hysterisis effects during inspection.

Fuel gauge

Type

o Cross - coil type (Fixed point type : Pointer should not fall into the "E" point but indicate remaining fuel level when the ignition is off)

Standard values

Level	Gauge	Gauge angle (°)
	Resistance (Ω)	
E (Empty)	180	-30 ± 2.4
1/2	54.5	0 ±5.0
F (Full)	12	30 ± 2.4

o Inspection order : E → F → E
The level must be reached within 2 seconds after the resistance is set for Full or Empty.

o Point stability tolerance : Within 9°
Apply power for 10 minutes. Then turn off the power for 30 minutes and read the position of the pointer.

Temperature gauge

Type

o Cross - coil type (Intermedia stability type).

Indication standard

Temperature	Angle (°)
122°F (50°C)	-30
181.4°F~221°F (83°C - 105°C)	-10 ~ 10
Red zone (over 257°F (125°C))	30

o Inspection order : OFF → C → H

Resistance of temperature sender (NTC)

Temperature [°F(°C)]	122(50)	181.4(83)	221(105)	250(125)
Resistance (Ω)	180.5	48.7	26.7	15.9

Lighting system

Items	Bulb wattage(W)
Head lamp	55W / 55W (High / Low)
Front turn signal lamp	28W
Front position lamp	8W
Front fog lamp	27W
Rear combination lamps Tail/stop lamp Back up lamp Turn signal lamp	8W / 27W 27W 27W
License plate lamp	5W
Sun visor illumi.lamp	5W
Room lamp (Center / Cargo)	10W
Over head lamp	10W
Courtesy lamp	5W
High mount stop lamp	18W

CUSTOMER COMPLAINT ANALYSIS CHECK SHEET

TROUBLE IN	☐ ALL ☐ AM ☐ FM ☐ TAPE ☐ CD ☐ MP3 ☐ CD changer ☐ AMP ☐ Athers
TROUBLE OCCURS	☐ Always ☐ Engine start ☐ Engine Running ☐ Cold ☐ Warm ☐ Sometimes ☐ Most of the time ☐ Engine off
TYPE OF TROUBLE	☐ Will not play ☐ Tape speed not proper ☐ Weak ☐ Noise squeal ☐ East tape ☐ Display/illumination poor ☐ CD skips & jumps ☐ Tape/CD will not eject or insert ☐ Others (Describe) :
OTHERS	▶ Customer complaint contents : ▶ Have you checked customer's defects :
* Using the customer complaint analysis check sheet for reference, ask the customer as much detail as possible about the problem.	

TROUBLESHOOTING

There are six areas where a problem can occur: wiring harness, the radio, the cassette tape deck, the CD player, and speaker. Troubleshooting enables you to confine the problem to a particular area.

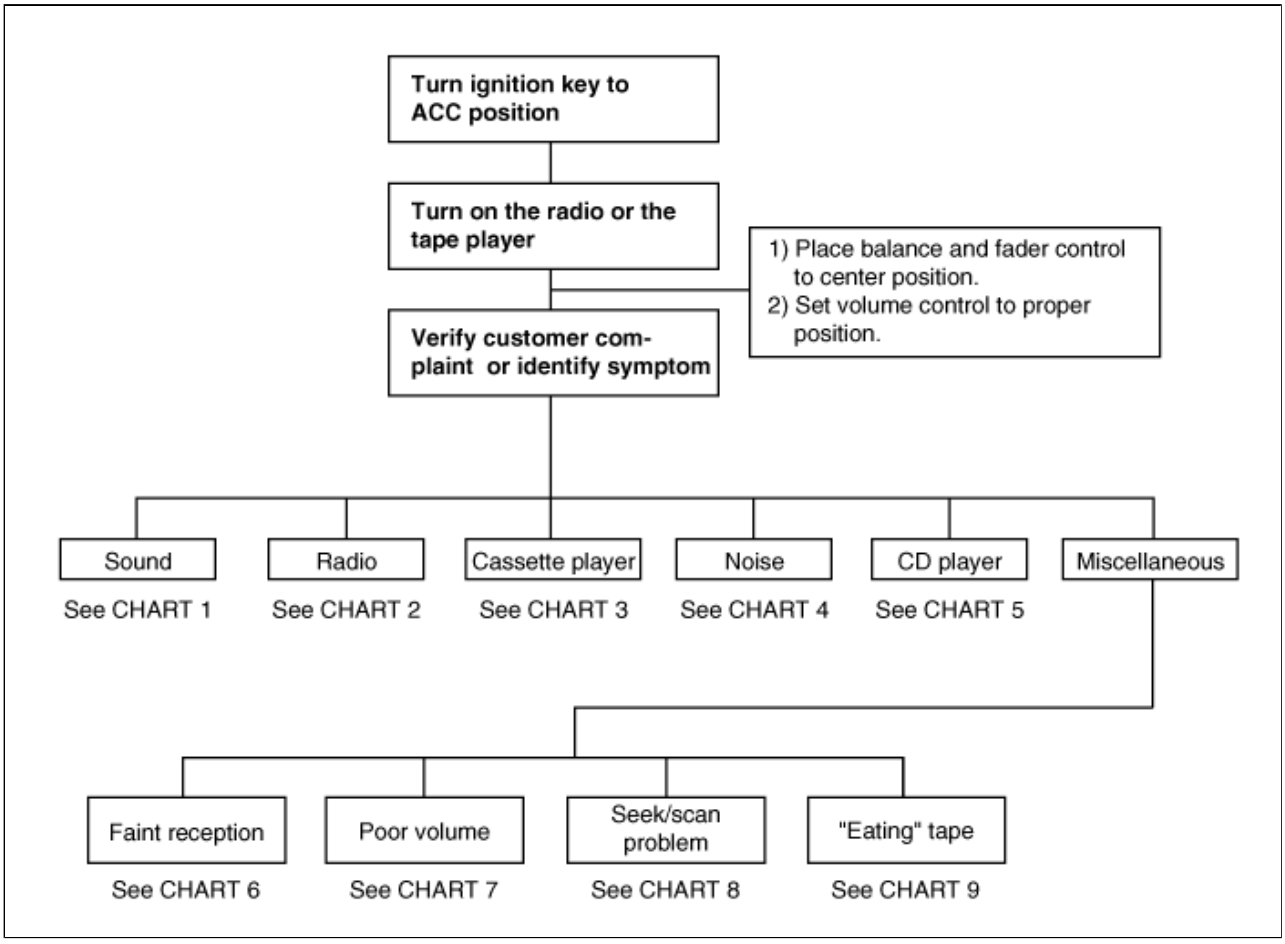
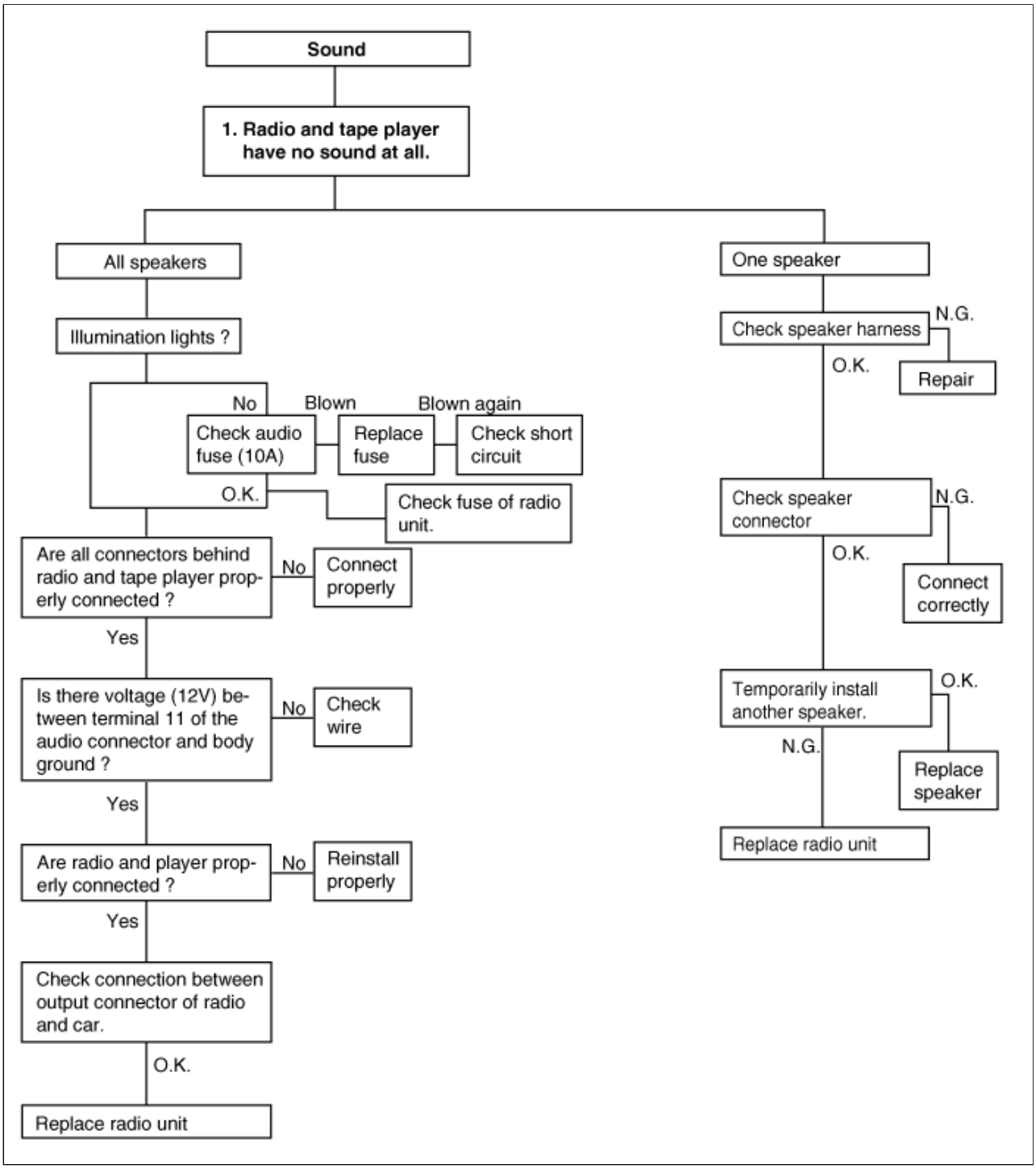


Chart 1


Sound
1. Radio and tape player have no sound at all.
All speakers
Illumination lights ?
No
Blown
Blown again
Check audio fuse (10A)
Replace fuse
Check short circuit
O.K.
Check fuse of radio unit.
Are all connectors behind radio and tape player properly connected ?
No
Connect properly
Yes
Is there voltage (12V) between terminal 11 of the audio connector and body ground ?
No
Check wire
Yes
Are radio and player properly connected ?
No
Reinstall properly
Yes
Check connection between output connector of radio and car.
O.K.
Replace radio unit
One speaker
Check speaker harness
N.G.
O.K.
Repair
Check speaker connector
N.G.
O.K.
Connect correctly
Temporarily install another speaker.
O.K.
N.G.
Replace speaker
Replace radio unit

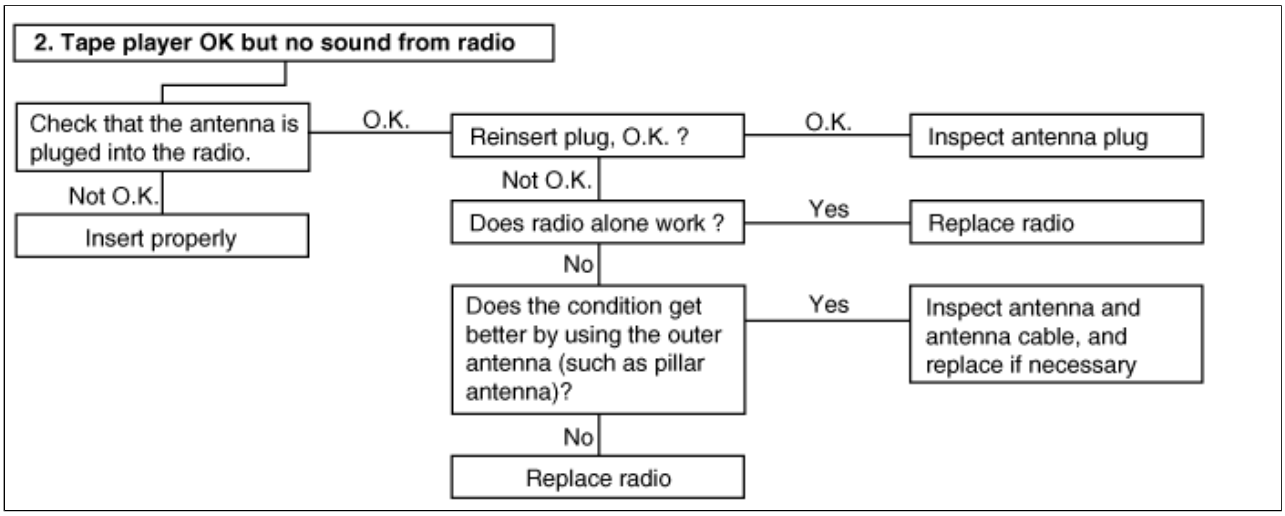


Chart 2

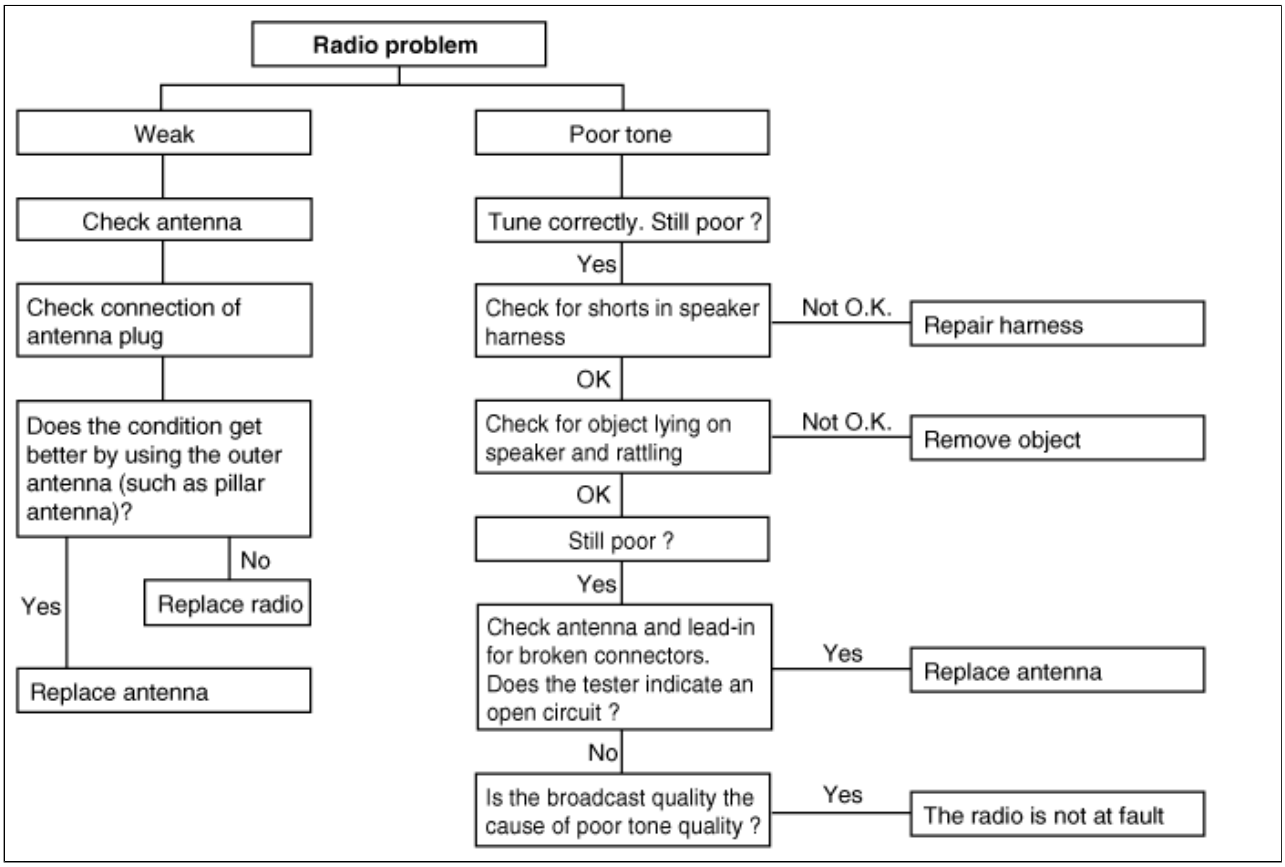


Chart 3

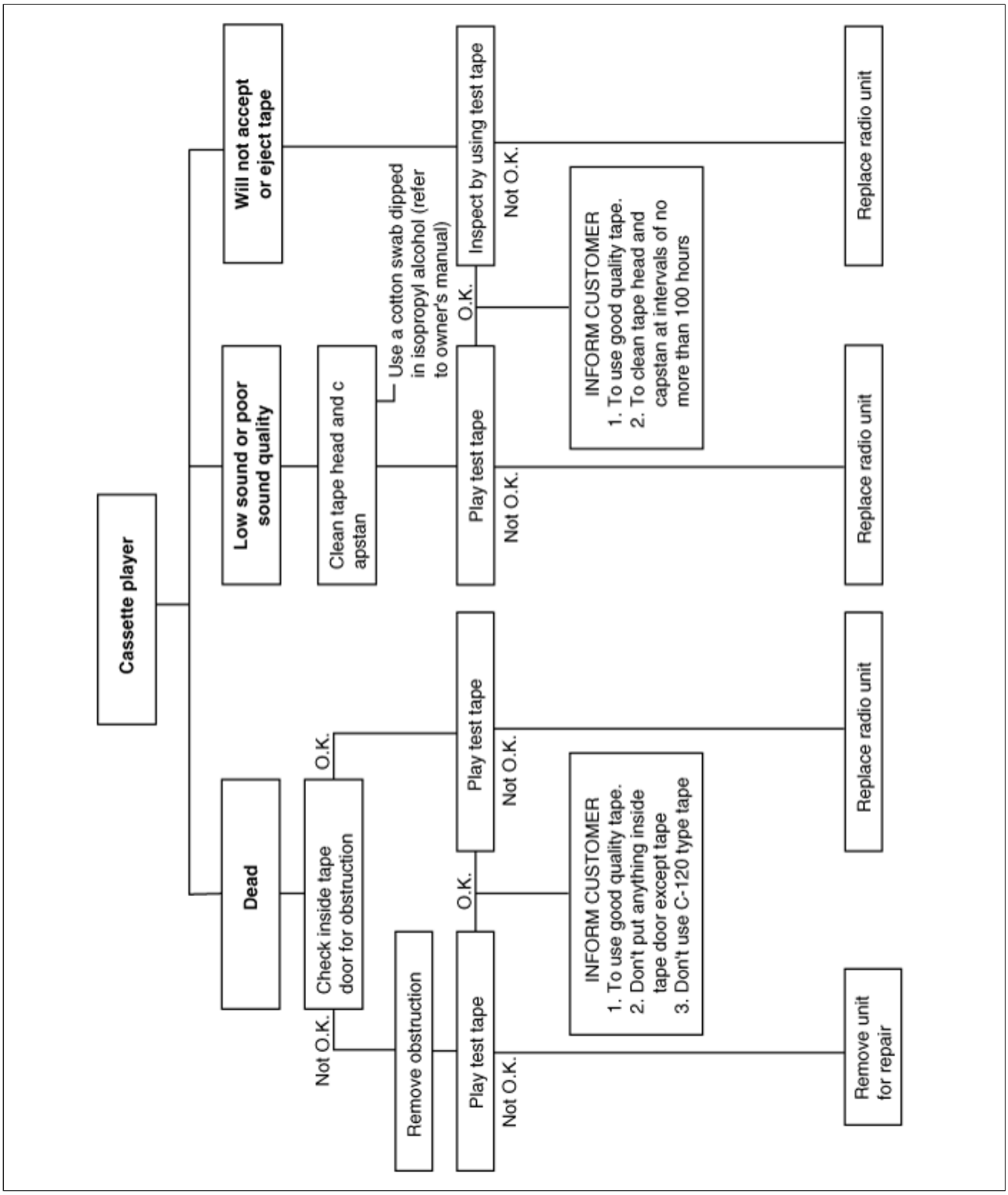
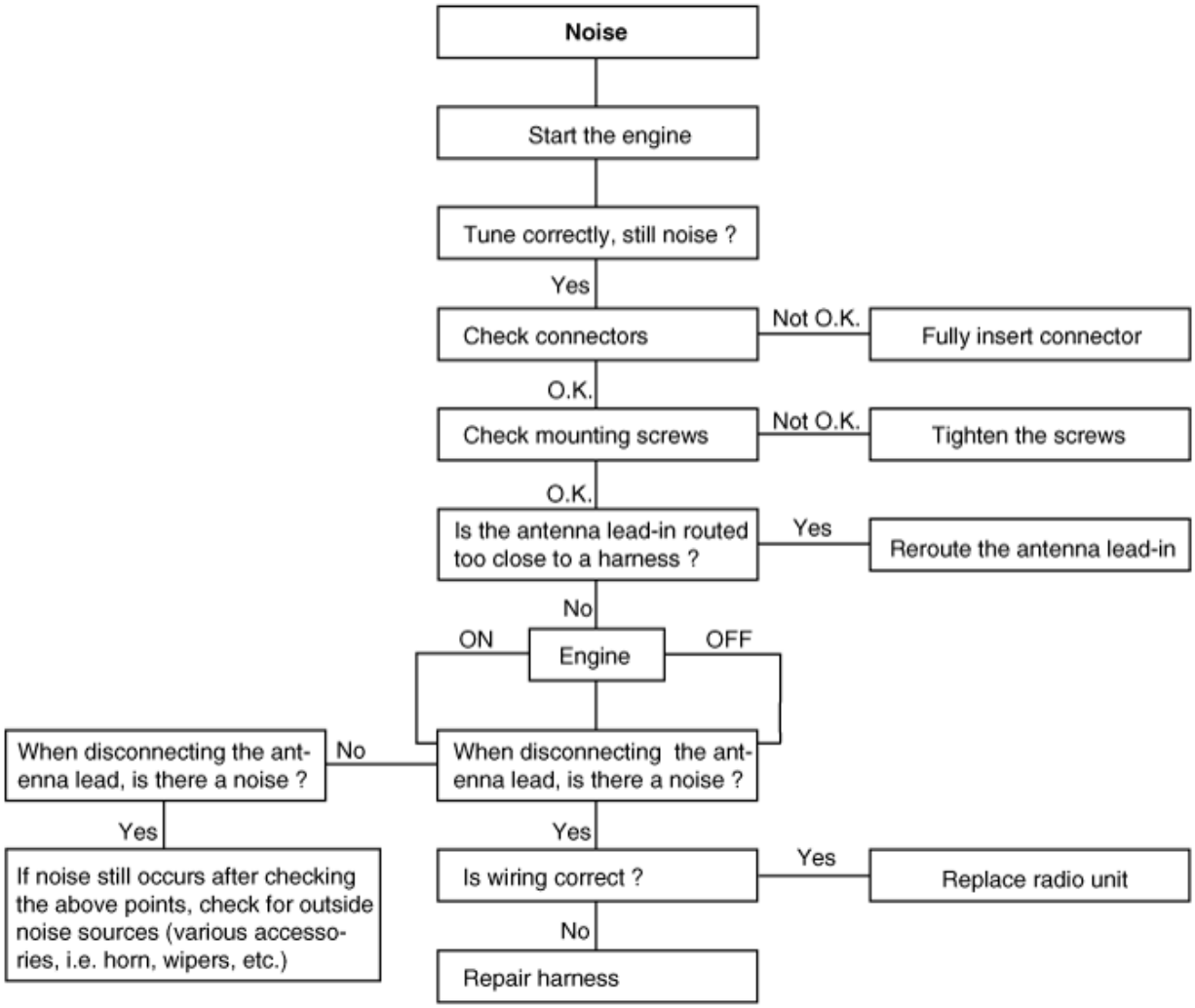

Cassette player
Will not accept or eject tape
Low sound or poor sound quality
Dead
Inspect by using test tape
Use a cotton swab dipped in isopropyl alcohol (refer to owner's manual)
Clean tape head and c apstan
Check inside tape door for obstruction
Play test tape
Play test tape
Play test tape
Remove obstruction
INFORM CUSTOMER
1. To use good quality tape.
2. To clean tape head and capstan at intervals of no more than 100 hours
INFORM CUSTOMER
1. To use good quality tape.
2. Don't put anything inside tape door except tape
3. Don't use C-120 type tape
Replace radio unit
Replace radio unit
Replace radio unit
Remove unit for repair
O.K.
Not O.K.
O.K.
Not O.K.
O.K.
Not O.K.
O.K.
Not O.K.

Chart 4

1. RADIO


Noise
Start the engine
Tune correctly, still noise ?
Yes
Check connectors
Not O.K.
Fully insert connector
O.K.
Check mounting screws
Not O.K.
Tighten the screws
O.K.
Is the antenna lead-in routed too close to a harness ?
Yes
Reroute the antenna lead-in
No
ON
Engine
OFF
When disconnecting the antenna lead, is there a noise ?
No
When disconnecting the antenna lead, is there a noise ?
Yes
If noise still occurs after checking the above points, check for outside noise sources (various accessories, i.e. horn, wipers, etc.)
Yes
Is wiring correct ?
Yes
Replace radio unit
No
Repair harness

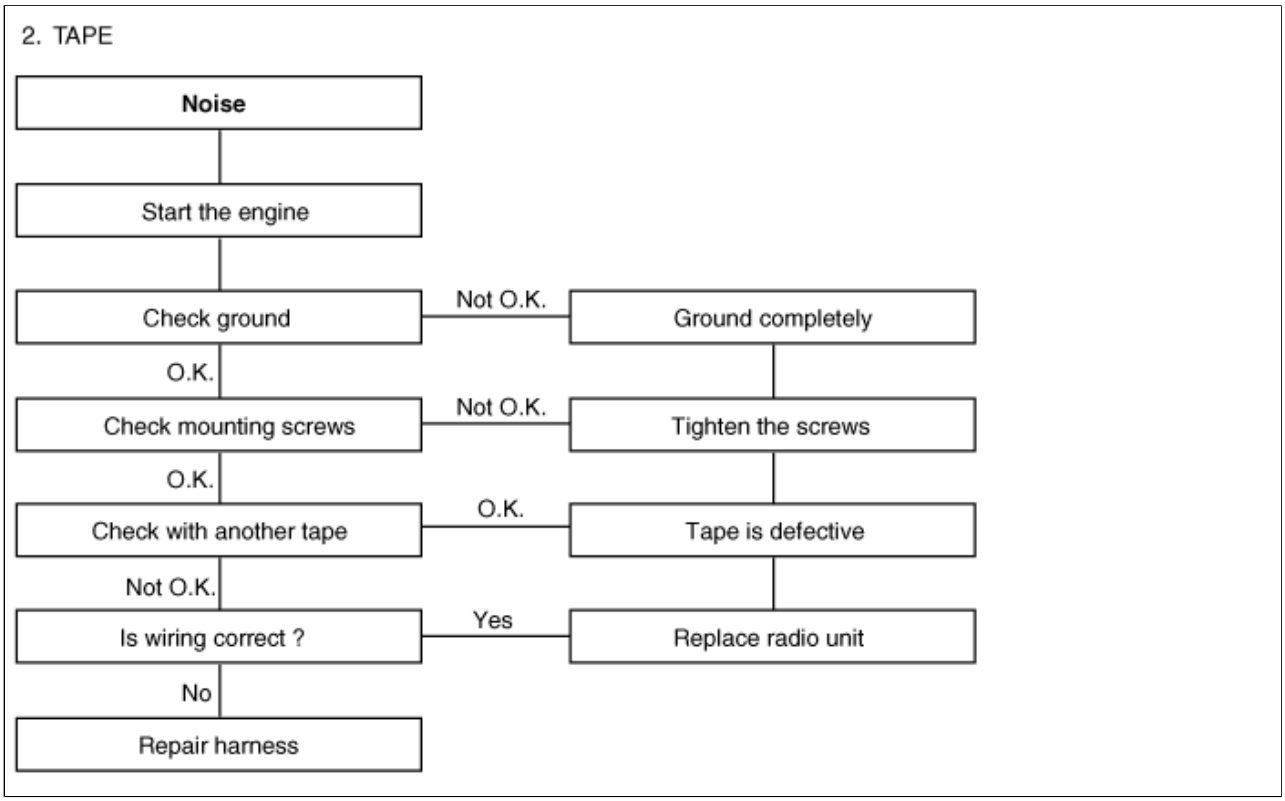
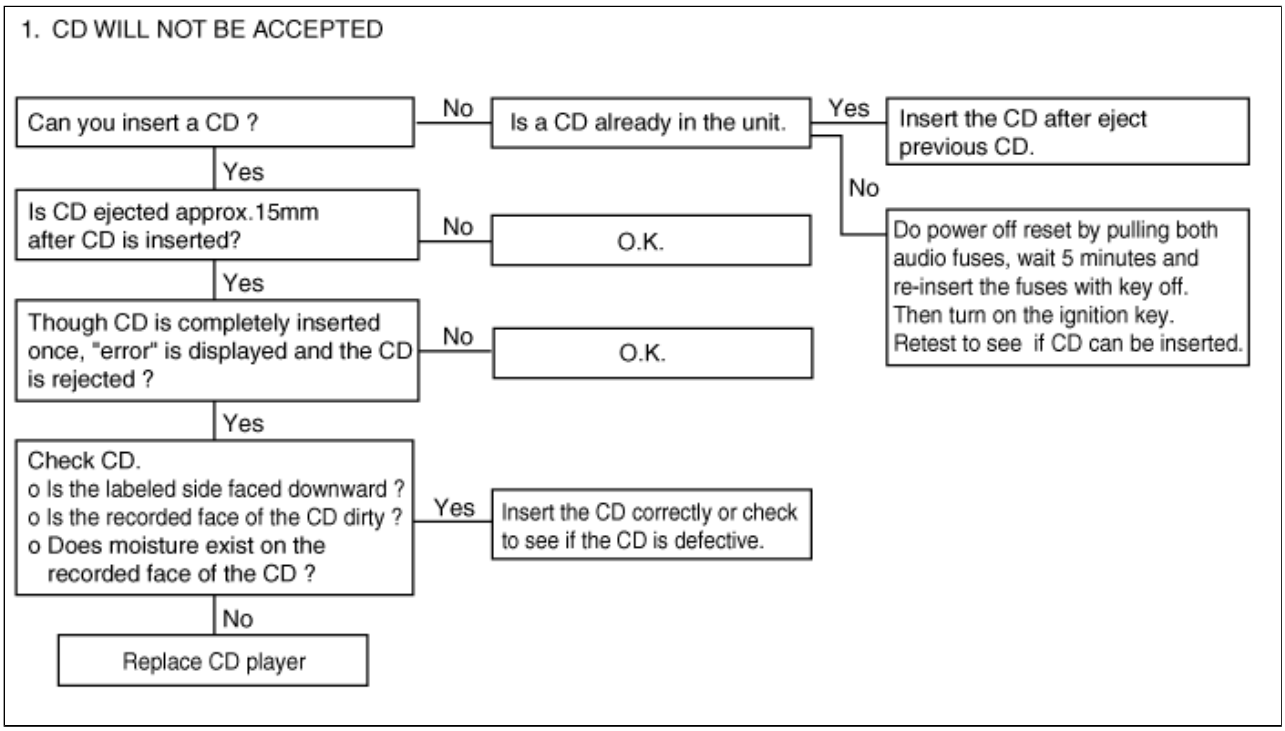
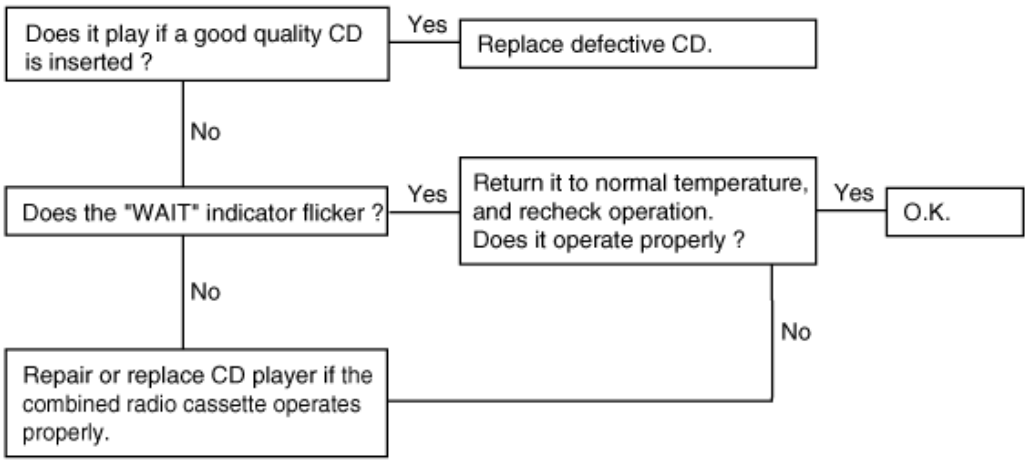

2. TAPE
Noise
Start the engine
Check ground
Not O.K.
Ground completely
O.K.
Check mounting screws
Not O.K.
Tighten the screws
O.K.
Check with another tape
O.K.
Tape is defective
Not O.K.
Is wiring correct ?
Yes
Replace radio unit
No
Repair harness

Chart 5

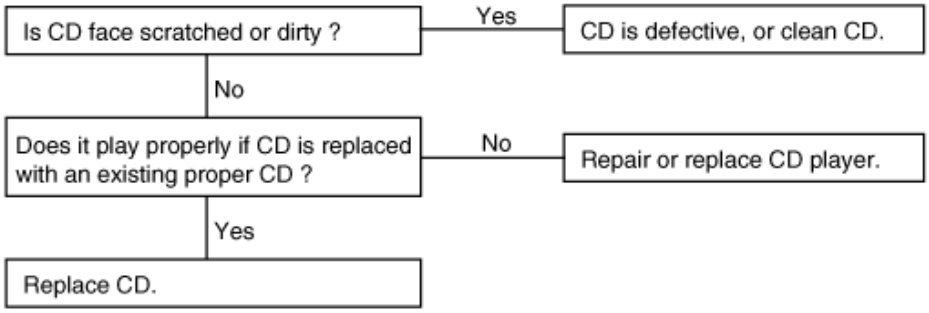

1. CD WILL NOT BE ACCEPTED
Can you insert a CD ?
No
Is a CD already in the unit.
Yes
Insert the CD after eject previous CD.
No
Do power off reset by pulling both audio fuses, wait 5 minutes and re-insert the fuses with key off. Then turn on the ignition key. Retest to see if CD can be inserted.
Yes
Is CD ejected approx.15mm after CD is inserted?
No
O.K.
Yes
Though CD is completely inserted once, "error" is displayed and the CD is rejected ?
No
O.K.
Yes
Check CD.
o Is the labeled side faced downward ?
o Is the recorded face of the CD dirty ?
o Does moisture exist on the recorded face of the CD ?
Yes
Insert the CD correctly or check to see if the CD is defective.
No
Replace CD player

2. NO SOUND

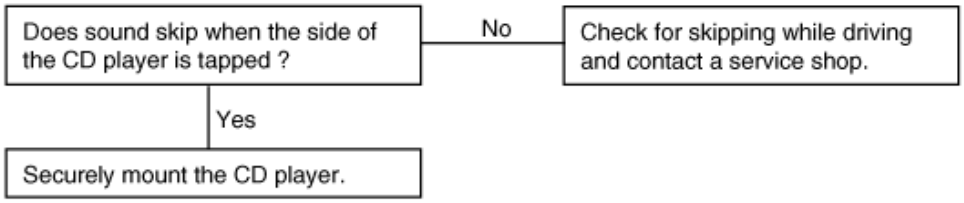


3. CD SOUND SKIPS

1) Sound sometimes skips when parking.



2) Sound sometimes skips when driving.
(Stop vehicle, and check it.)
(Check by using a CD which is free of scratches, dirt or other damage.)



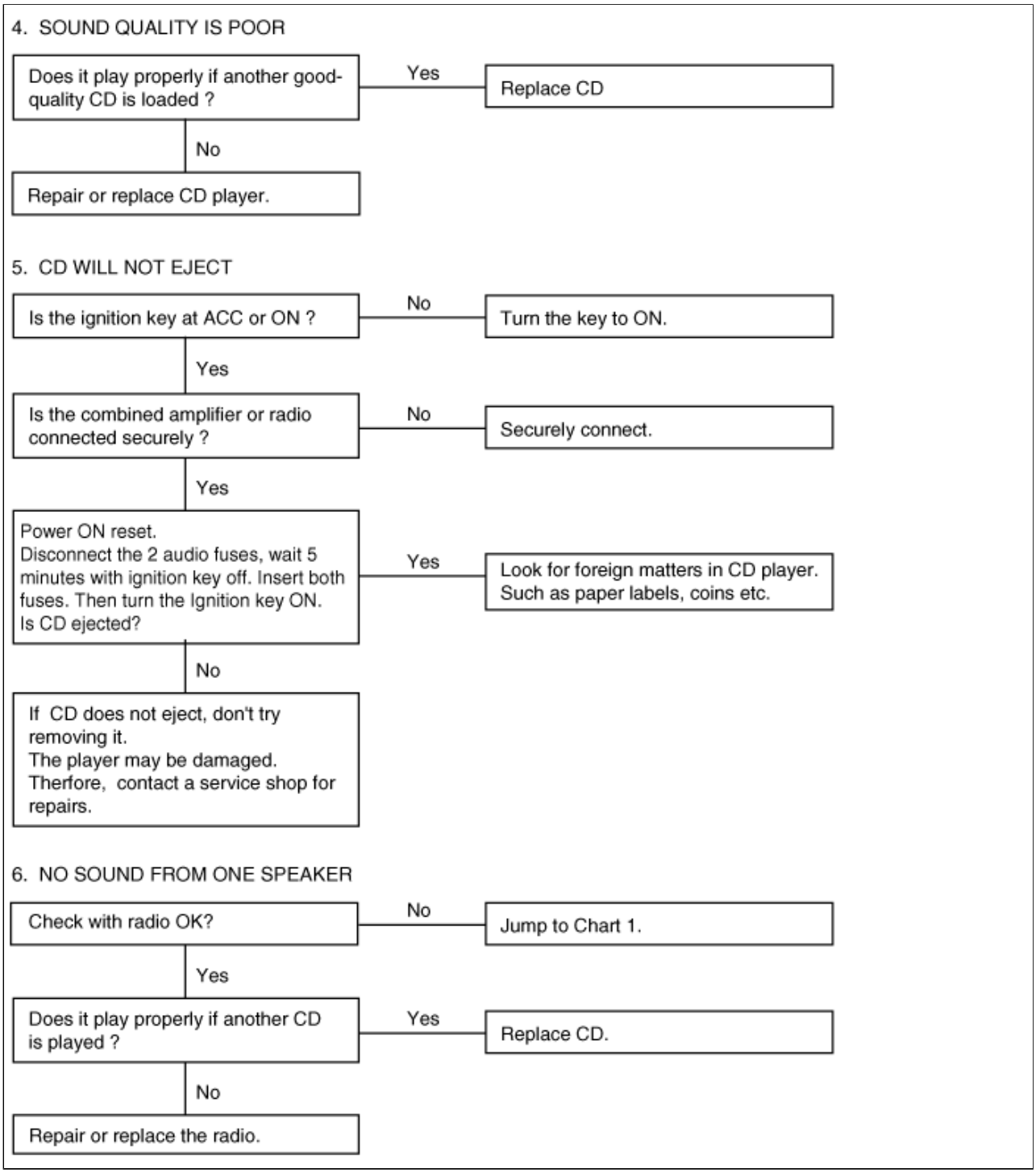

4. SOUND QUALITY IS POOR
Does it play properly if another good-quality CD is loaded ?
Yes
Replace CD
No
Repair or replace CD player.
5. CD WILL NOT EJECT
Is the ignition key at ACC or ON ?
No
Turn the key to ON.
Yes
Is the combined amplifier or radio connected securely ?
No
Securely connect.
Yes
Power ON reset.
Disconnect the 2 audio fuses, wait 5 minutes with ignition key off. Insert both fuses. Then turn the Ignition key ON.
Is CD ejected?
Yes
Look for foreign matters in CD player.
Such as paper labels, coins etc.
No
If CD does not eject, don't try removing it.
The player may be damaged.
Therfore, contact a service shop for repairs.
6. NO SOUND FROM ONE SPEAKER
Check with radio OK?
No
Jump to Chart 1.
Yes
Does it play properly if another CD is played ?
Yes
Replace CD.
No
Repair or replace the radio.

Chart 6

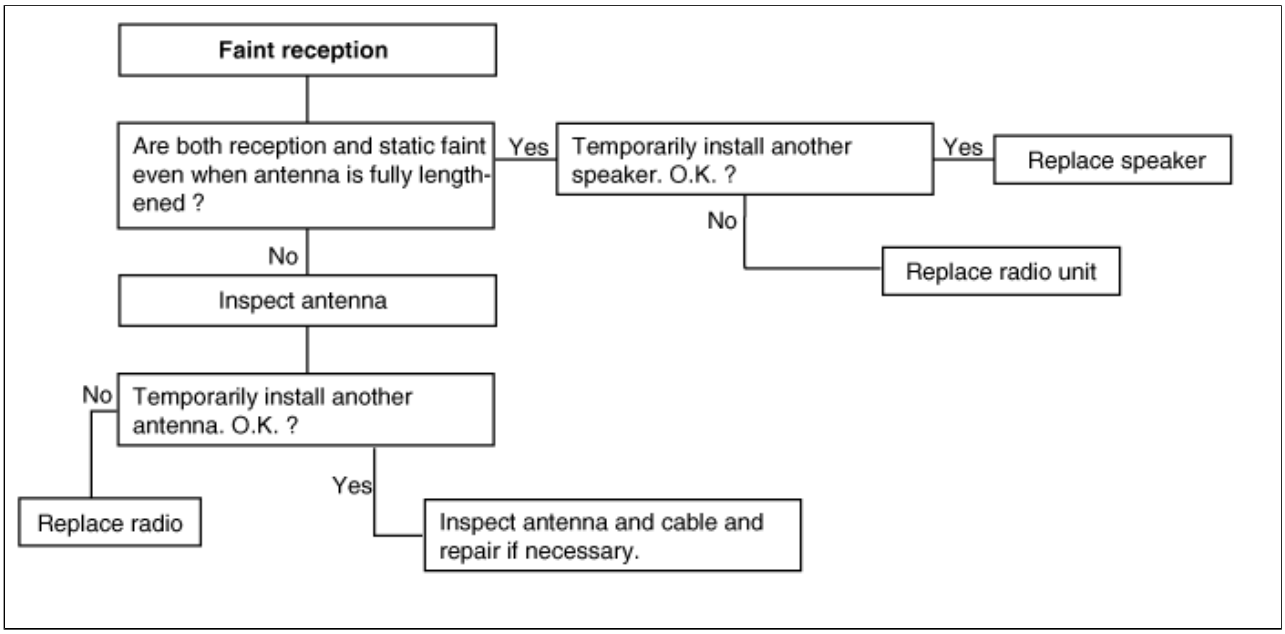


Chart 7

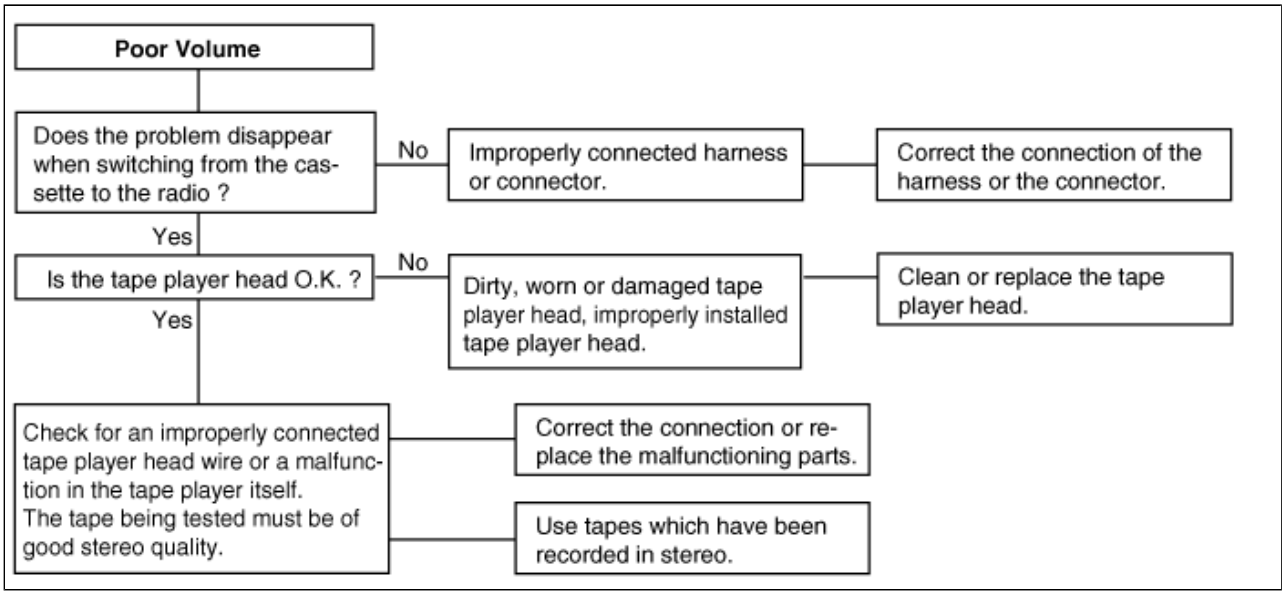


Chart 8

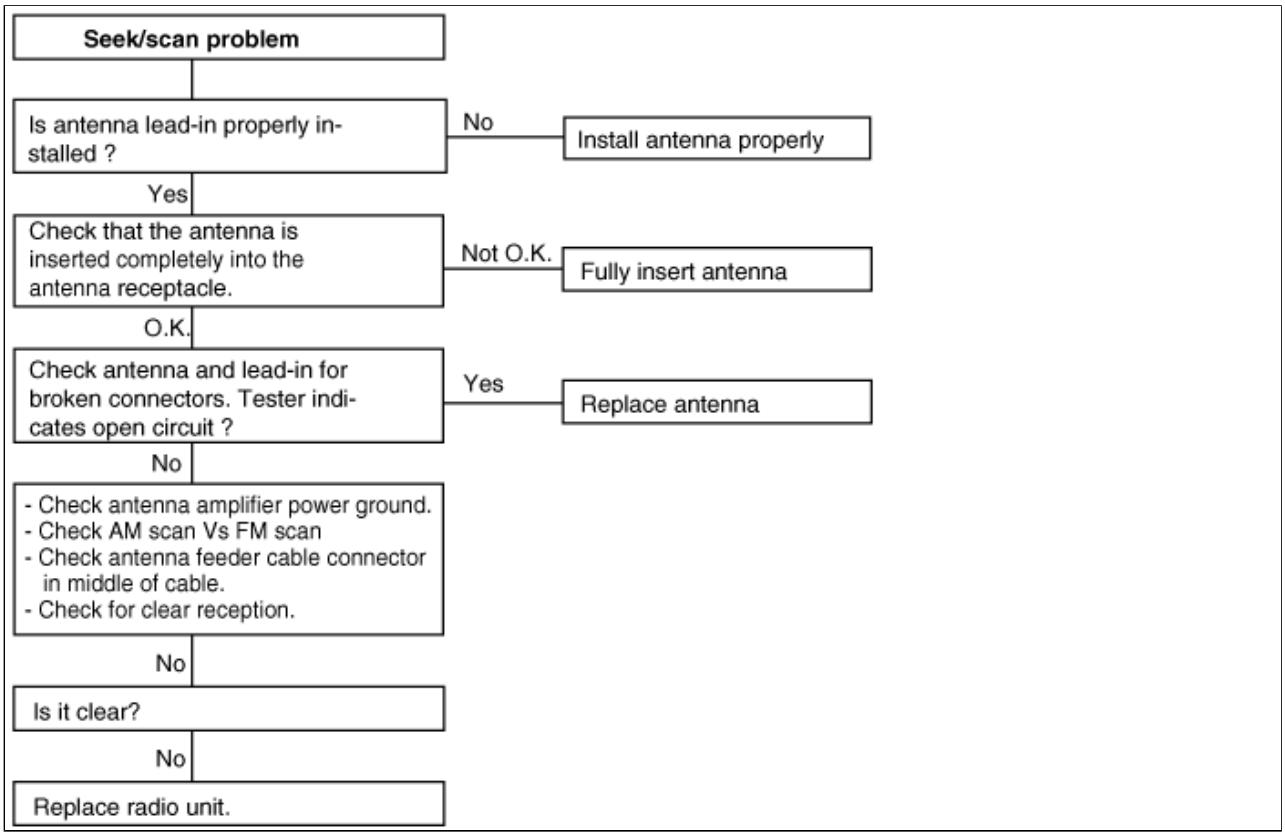
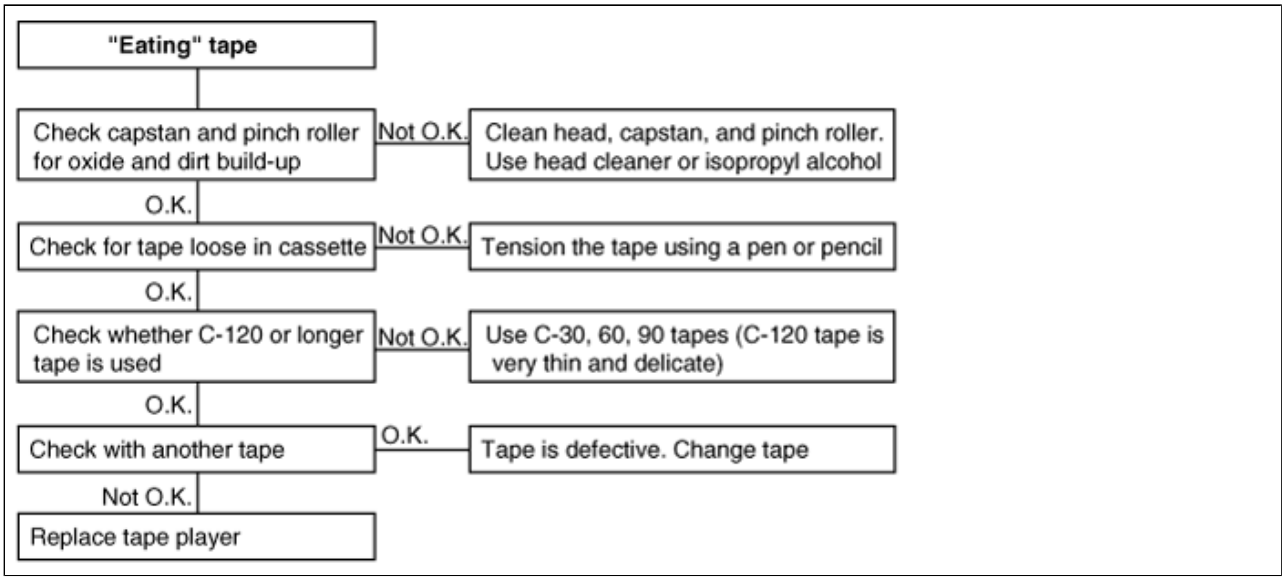
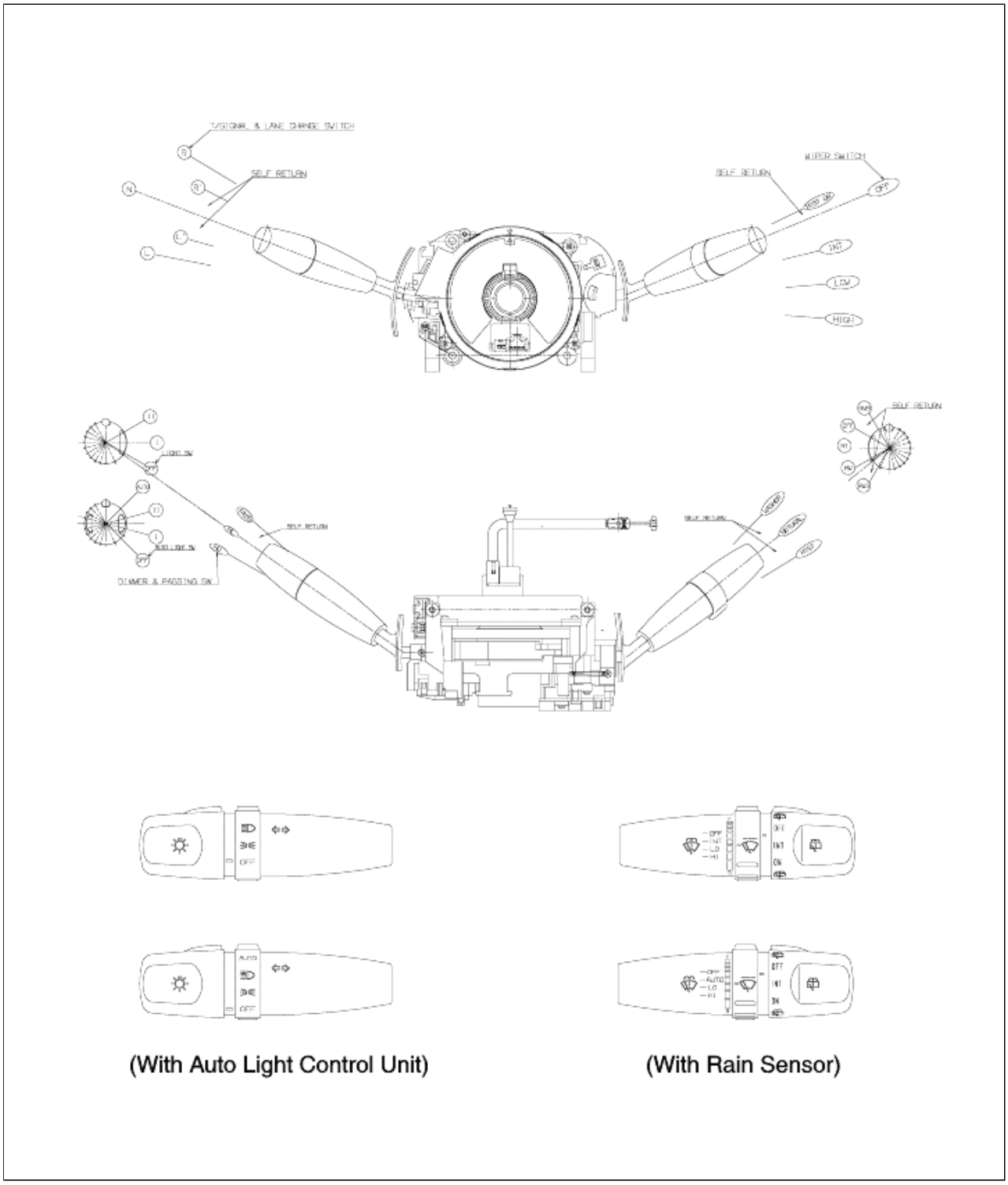

Seek/scan problem
Is antenna lead-in properly installed ?
No
Install antenna properly
Yes
Check that the antenna is inserted completely into the antenna receptacle.
Not O.K.
Fully insert antenna
O.K.
Check antenna and lead-in for broken connectors. Tester indicates open circuit ?
Yes
Replace antenna
No
- Check antenna amplifier power ground.
- Check AM scan Vs FM scan
- Check antenna feeder cable connector in middle of cable.
- Check for clear reception.
No
Is it clear?
No
Replace radio unit.

Chart 9


"Eating" tape
Check capstan and pinch roller for oxide and dirt build-up
Not O.K.
Clean head, capstan, and pinch roller. Use head cleaner or isopropyl alcohol
O.K.
Check for tape loose in cassette
Not O.K.
Tension the tape using a pen or pencil
O.K.
Check whether C-120 or longer tape is used
Not O.K.
Use C-30, 60, 90 tapes (C-120 tape is very thin and delicate)
O.K.
Check with another tape
O.K.
Tape is defective. Change tape
Not O.K.
Replace tape player

Components


SELF RETURN
WIPER SWITCH
SELF RETURN
INT
LOW
HIGH
SELF RETURN
DIMMER & PASSING SW
SELF RETURN
OFF
OFF
(With Auto Light Control Unit)
(With Rain Sensor)

Removal and installation

Prior to removing of the multi function switch assembly in vehicles equipped with air bags, be careful to follow the following:

CAUTION

1) Never attempt to disassemble or repair the air bag module or clock spring. If faulty, replace it.
2) Do not drop the air bag module or clock spring or allow contact with water, grease or oil. Replace if a dent, crack, deformation or rust is detected.
3) The air bag module should be stored on a flat surface and placed so that the pad surface is facing upward. Do not place anything on top of it.
4) Do not expose the air bag module to temperatures over 93°C(200°F).
5) After deployment of an air bag, replace the clock spring with a new one.
6) Wear gloves and safety glasses when handing an air bag that has been deployed.
7) An undeployed air bag module should only be disposed of in accordance with the procedures mentioned in the restraints section.
8) When you disconnect the air bag module-clock spring connector, take care not to apply excessive force.
9) The removed air bag module should be stored in a clean, dry place.
10) Prior to installing the clock spring, align the mating mark and "NEUTRAL" position indicator of the clock spring, and after turning the front wheels to the straight-ahead position, install the clock spring to the column switch. If the mating mark of the clock spring is not properly aligned, the steering wheel may not completely rotate during a turn, or the flat cable within the clock spring may be broken obstructing normal operation of the SRS and possibly leading to serious injury to the vehicle's driver. To inspect the clock spring, refer to the restraints section.

Inspection

Check the continuity between the terminals while operating the switch.

Lighting switch

Terminal / Position	15	5	10
OFF			
I	○	○	
II	○	○	○

Dimmer and passing switch

Terminal / Position	7	12	16	17
HU	○	○		
HL			○	○
P	○			○

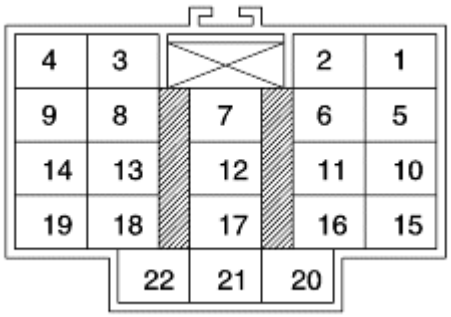
HU : Head lamp high beam
HL : Head lamp low beam
P : Head lamp passing switch

Turn signal and lane change switch

Hazard switch / Terminal / Turn signal switch		6	2	11
OFF	L		○—○	
	N			
	R	○—○		

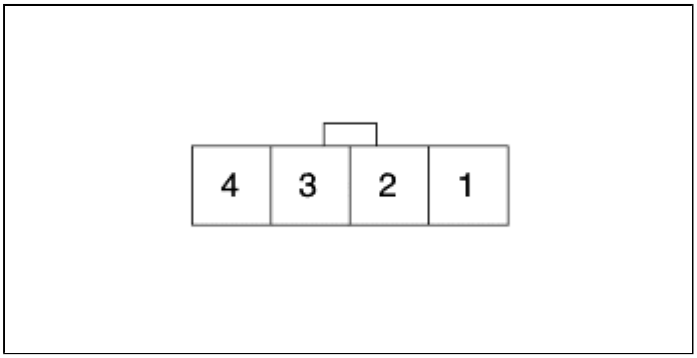
Wiper & washer switch (With rain sensor)

Position / Terminal		9	13	18	3	4 (14)	8
OFF	OFF	○—○					
	MIST		○—○		○—○		
INT (Auto)		○—○			○—○		
LOW			○—○		○—○		
HI				○—○			
WASHER					○—○		



Rear wiper & washer switch

Position / Terminal	1	2	3	4
Washer	○—○			○—○
OFF				
INT	○—○	○—○		
ON	○—○		○—○	
Washer	○—○			○—○


4
3
2
1

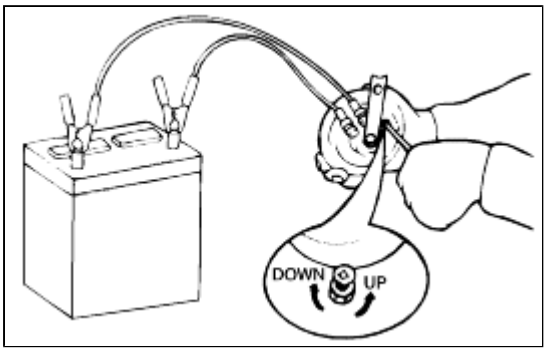
Inspection

1. Test the horn by connecting battery voltage to the 1 terminal and ground the 2 terminal.
2. The horn should make a sound. If the horn fails to make a sound, replace it.

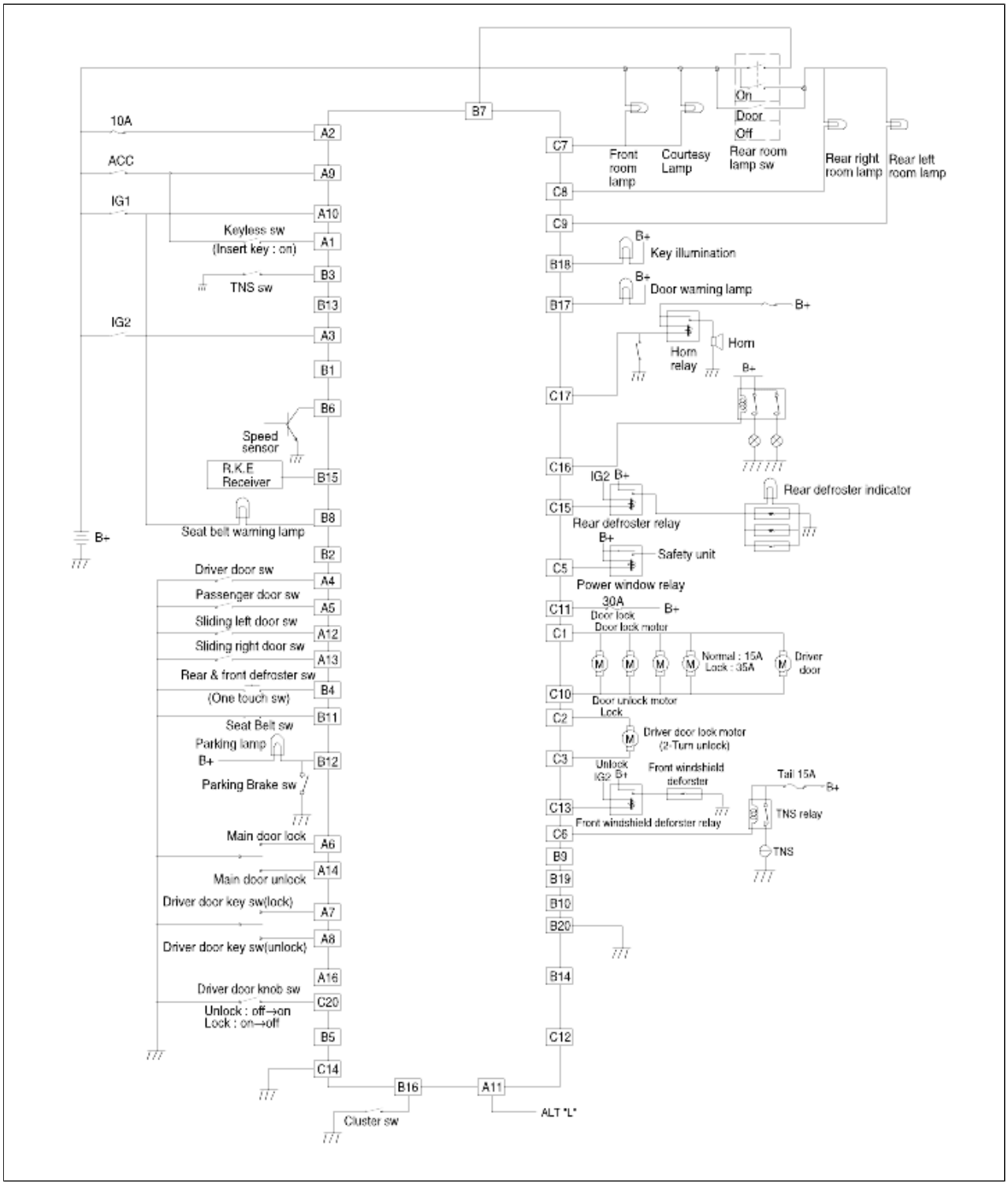
Adjustment

Operate the horn, and adjust the tone to a suitable level by turning the adjusting screw.

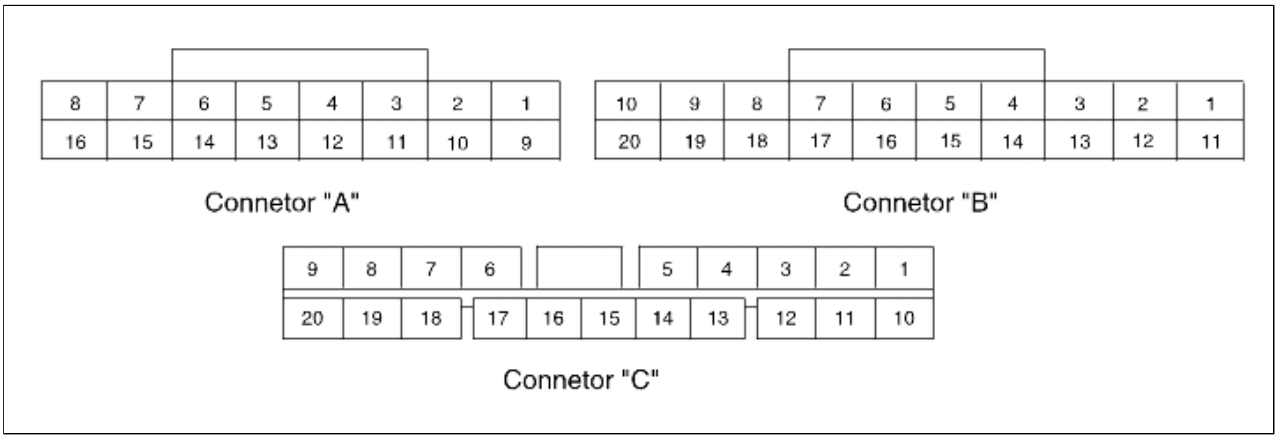
> NOTE
>
> After adjustment, apply a small amount of paint around the screw head to keep it from loosening.



Circuit diagram



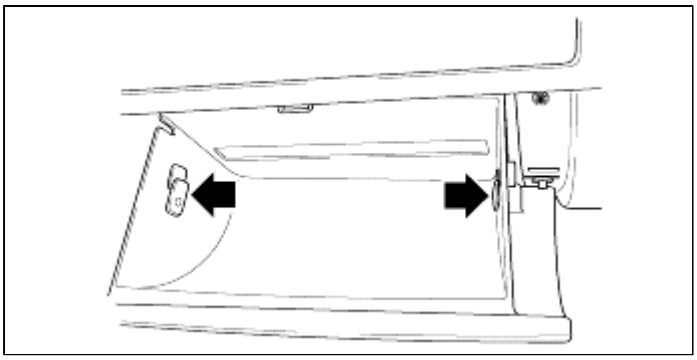
Etacs pin no. and description



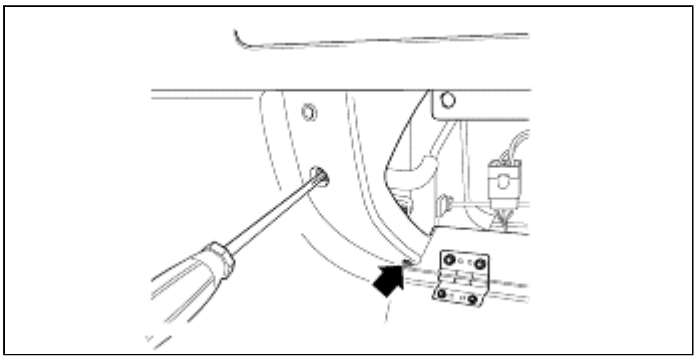
PIN NO.	CONNECTOR "A"	PIN NO.	CONNECTOR "A"	PIN NO.	CONNECTOR "B"
1	Keyless sw	1	-	1	Door lock motor
2	B+	2	-	2	2-Turn unlock motor (lock)
3	IG2	3	TNS sw	3	2-Turn unlock motor (unlock)
4	Driver door sw	4	Rear & front defroster sw	4	-
5	Passenger door sw	5	-	5	Power window relay
6	Main door lock sw	6	Speed sensor	6	TNS relay
7	Driver door key sw (lock)	7	Rear room lamp sw	7	Door courtesy lamp
8	Driver door key sw (unlock)	8	Seat belt lamp	8	Rear right room lamp
9	ACC	9	-	9	Rear left room lamp
10	IG1	10	-	10	Door unlock motor
11	ALT "L"	11	Seat belt sw	11	B+
12	Sliding left door sw	12	Parking brake sw	12	-
13	Sliding right door sw	13	-	13	Front windshield defroster relay
14	Main door unlock sw	14	-	14	Ground
15	-	15	R.K.E	15	Rear defroster relay
16	-	16	Cluster sw	16	Hazard relay
		17	Door warning lamp	17	Horn relay
		18	Key illumination lamp	18	-
		19	-	19	-
		20	Ground	20	Driver door knob sw

Removal and installation

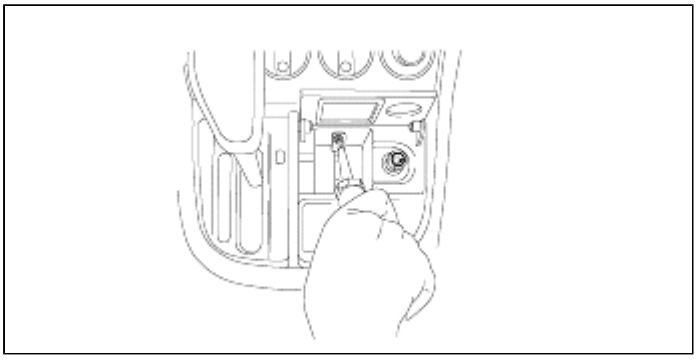
1. Disconnect the negative battery terminal.
2. Open the glove box and remove the release checker to open fully.



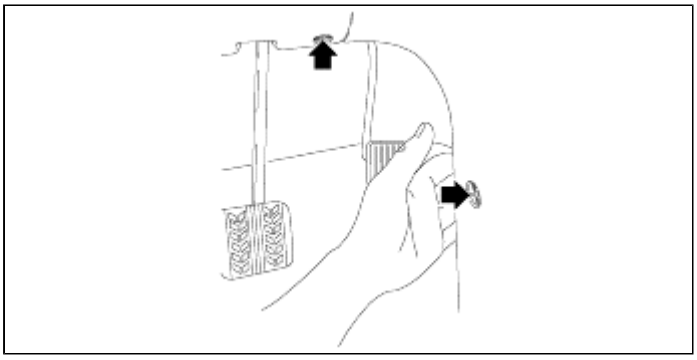
3. Loosen the screw of the center console.



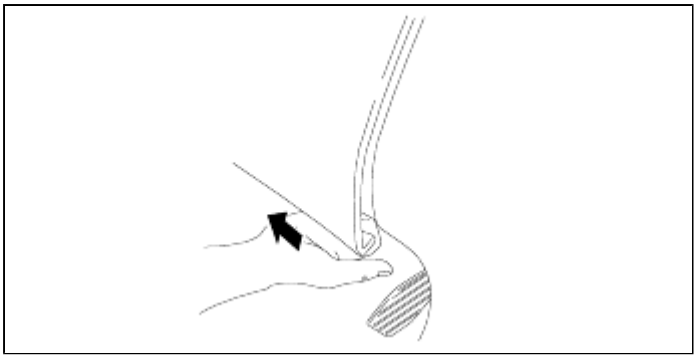
4. Remove the ashtray and loosen the screw to remove the center facia.



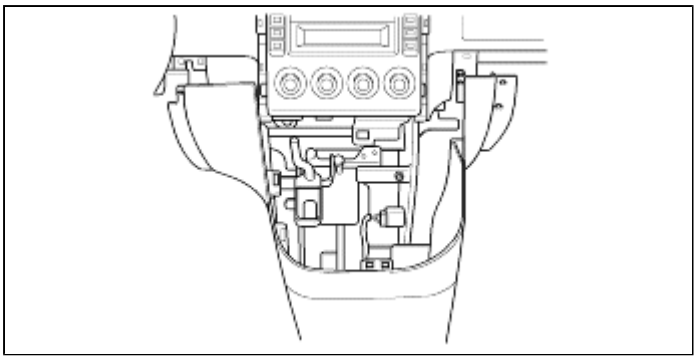
5. Loosen the screw of the panel and the center console.



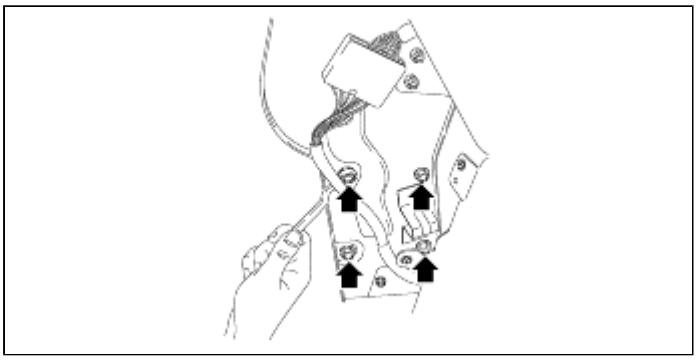
6. Pull the panel to loosen the screw of the center console.



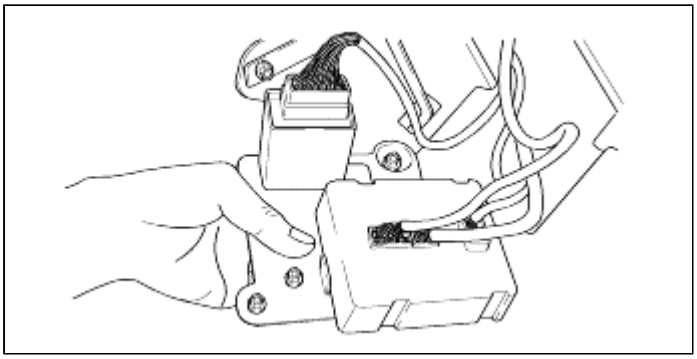
7. Remove the center console.



8. Loosen the bolts of the in panel member bracket.



9. Disconnect the connector.



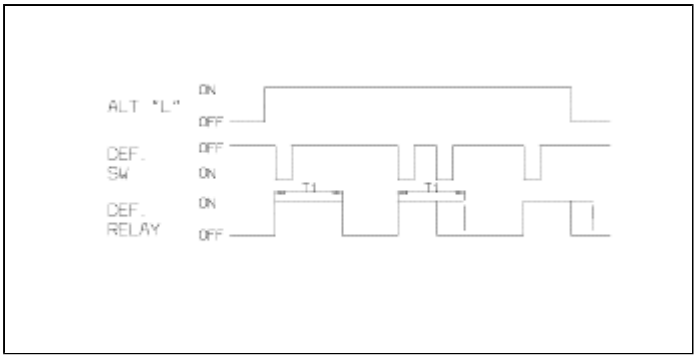
10. Installation is the reverse of removal.

Inspection

While operating the components, check whether the operations are normal with timing chart.

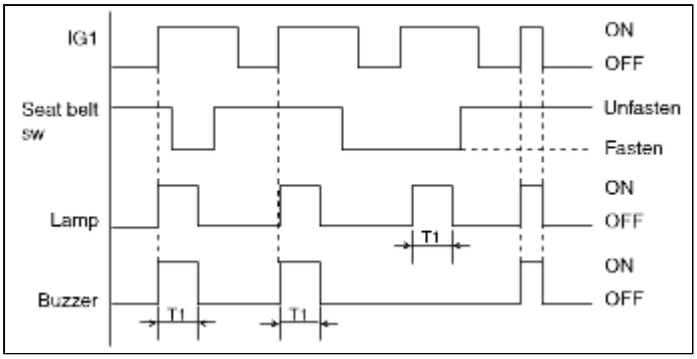
Etacs function

1. Rear window defroster and front windshield defroster.



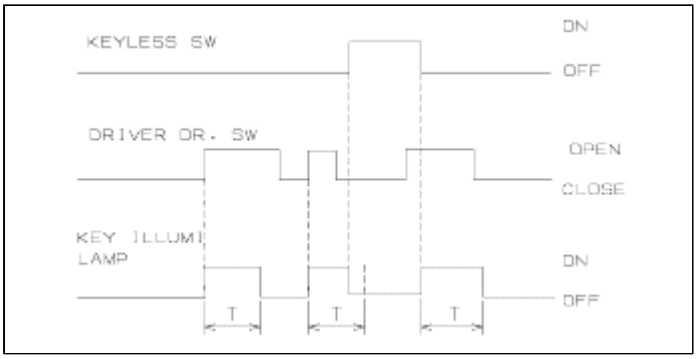
Time specification
T1 : 15 ± 3 min.

2. Seat belt warning



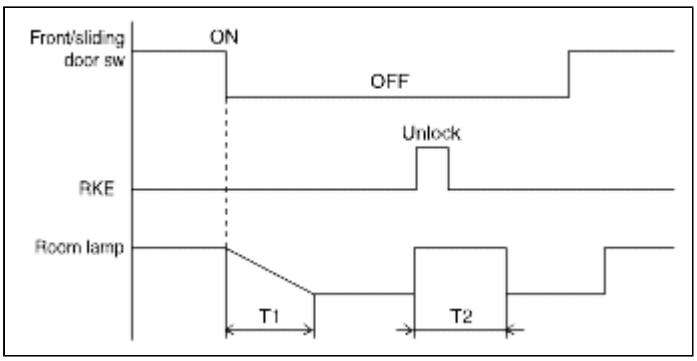
Time specification
T1 : 6 ± 1.5 sec.

3. Ignition key hole illumination



Time specification
T : 30 ± 10 sec.

4. Decayed out room lamp



Time specification
T1 : 4.5 ± 1.0 sec.
T2 : 10 ± 2.0 sec.
(1) Upon the front door or sliding door open with keyless switch OFF, the room lamp and courtesy lamp

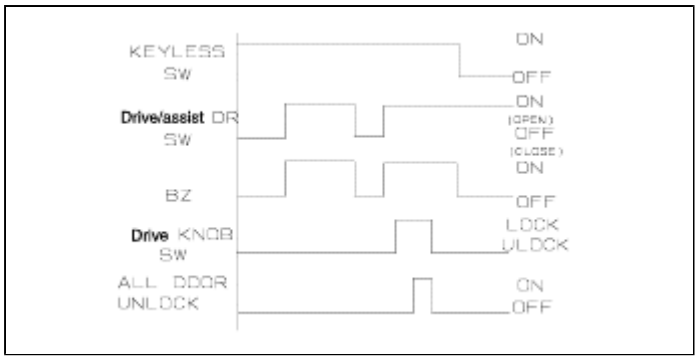
turns on for 20 minutes.

(2) Upon the door switch OFF with ACC is OFF, the room lamp declines 100% to 0% for T1.

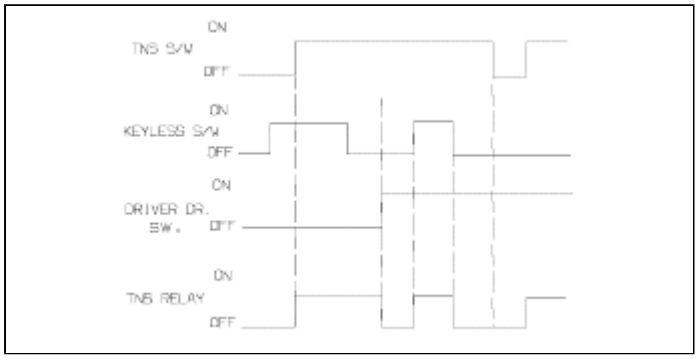
(3) Upon the door switch OFF with ACC is ON, the room lamp turns on for T1.

(4) The room lamp turns on for T2 when the door unlock signal is ON by RKE.

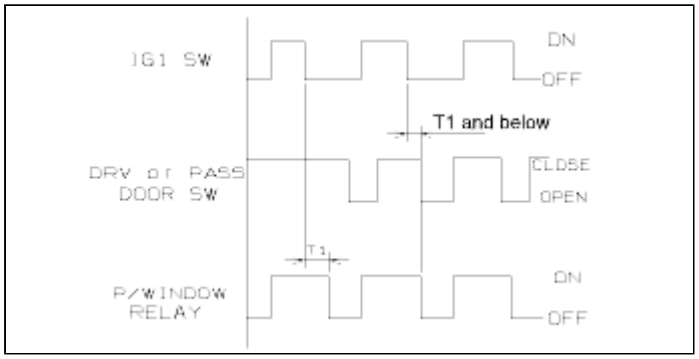
5. Ignition key reminder



6. Battery saver.



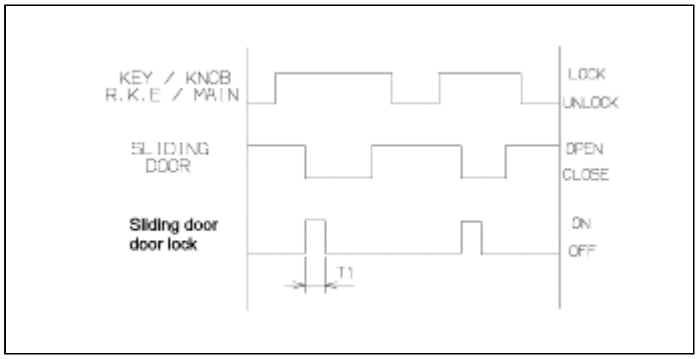
7. Time lag power window timer



Time specification

T1 : 30 ± 6 sec.

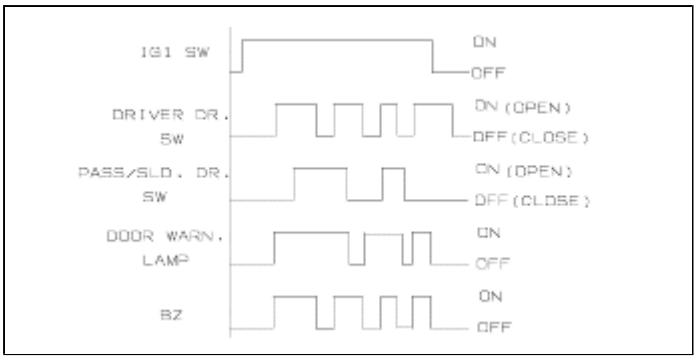
8. Sliding door lock



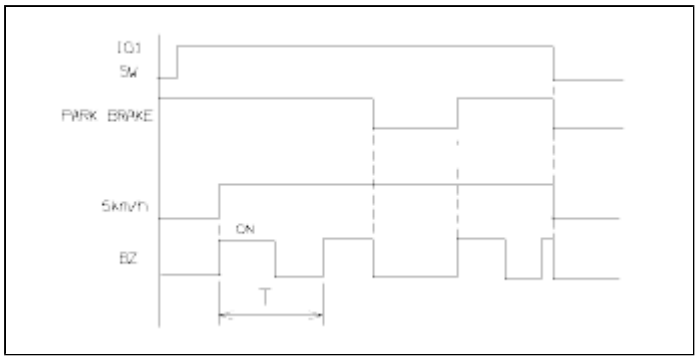
Time specification

T1 : 0.5 ± 0.1 sec.

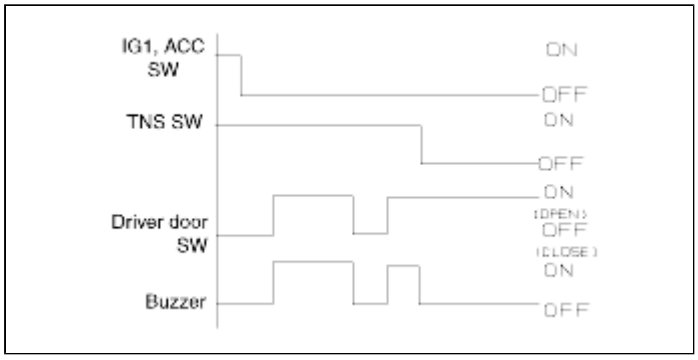
9. Door ajar warning



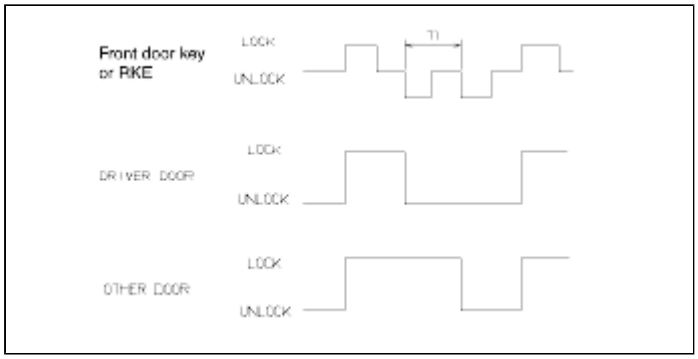
10. Parking on drive warning



11. Light warning



12. Two-Turn unlock



Time specification

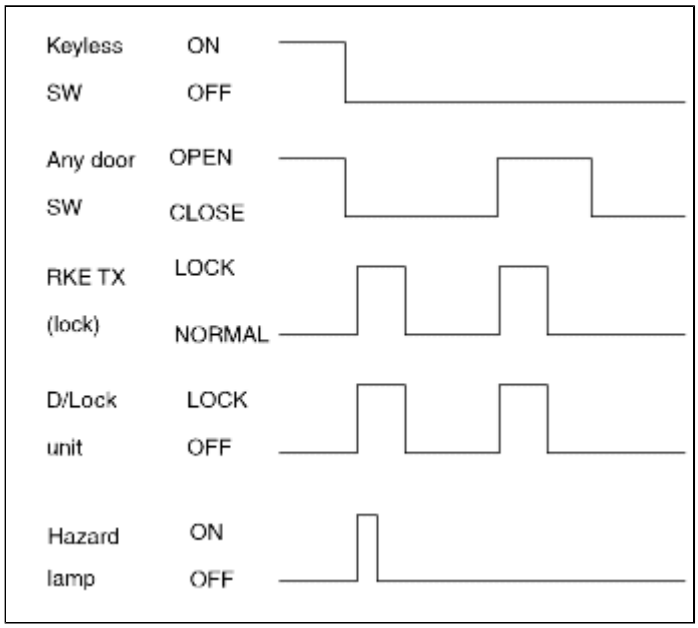
T1 : 3±0.5 sec.

13. Central door lock/unlock.

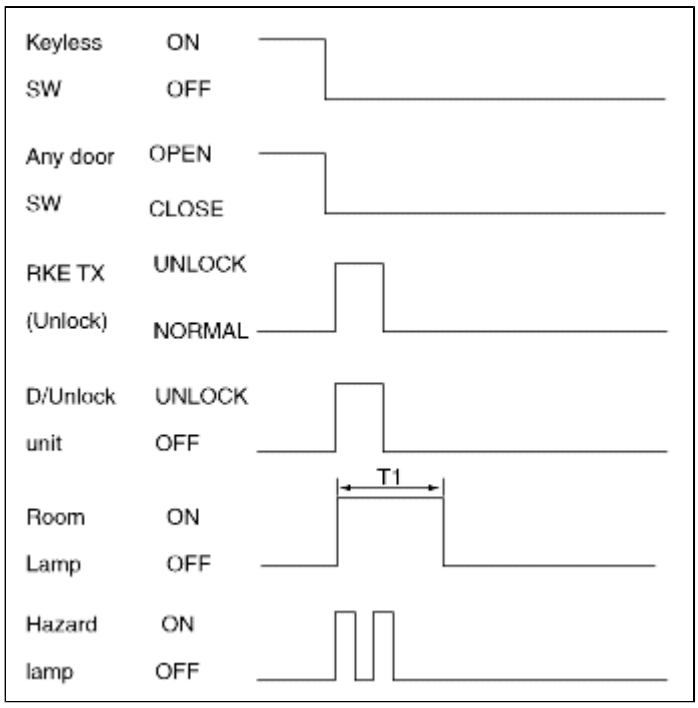
Input	Door	Status
R.K.E TX	Lock	All lock
	Unlock	All unlock (Tow turn unlock)
Diriver door key	Lock	All lock
	Unlock	All unlock (Tow turn unlock)
Passenger door key	Lock	–
	Unlock	–
Diriver knob Switch	Lock	All lock
	Unlock	–
Passenger knob Switch	Lock	–
	Unlock	–
Main door lock switch	Lock	All lock
	Unlock	All unlock

14. Remote Keyless Entry(R.K.E) system.

(1) Door lock

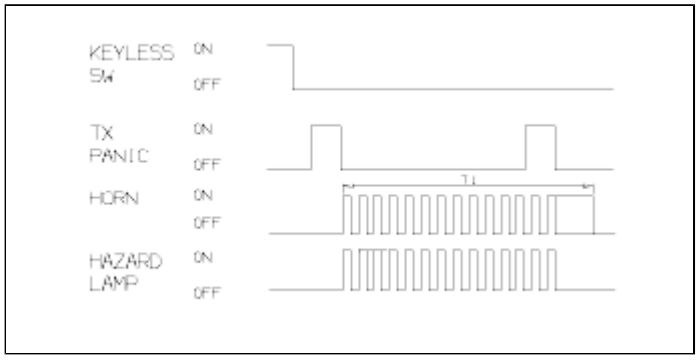


(2) Door unlock



Time specification
T1 : 30 sec.
If the door will not be opened within 30 seconds, the door will be locked automatically.

(3) Panic



Time specification
T1 : 27±2 sec.

15. Code saving method

(1) Connect the coding connector to the Diagnosis connector in order to jump between terminal 12 and terminal 16 if you have a coding connector, use a jumper wire between the above-mentioned terminals.

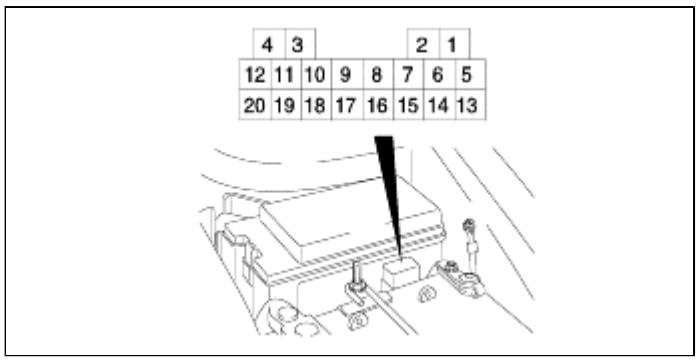
(2) Turn the ignition switch to "ON" position.

(3) Press LOCK button of transmitter two times. If success, the buzzer will operate for approximately one second.

(4) Turn the ignition switch to "OFF" position and remove ignition key from key set.

(5) Disconnect the codling connector from the diagnosis connect.

(6) Check for LOCK and UNLOCK operation.


4 3 2 1
12 11 10 9 8 7 6 5
20 19 18 17 16 15 14 13

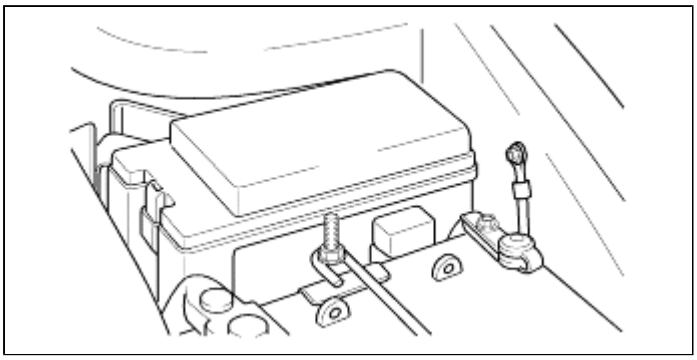
Components

MAIN 120A
K52W
20A HORN
30A (ABS2)
10A (P/TRN)
15A (INJECTOR)
15A AUDIO
15A HEAD(HI)
10A (LLUM)
15A (C2(ON))
DEF RELAY
15A HEAD(LO)
10A (EXT)
25A P/W(RH)
15A (C2(UP))
25A DEF
15A (FUEL)
25A P/W(LH)
10A (ECU)
10A MEMORY
FUSE PULLER
START RELAY
IGN 2 30A
BTN 3 40A
TNS RELAY
(ABS1) 30A
R.HTR 30A
(MAIN RELAY)
HEAD(HI) RELAY
C/FAN1 40A
F/BLW 30A
HEAD(LO) RELAY
C/FAN2 30A
BTN 1 40A
F/BLW RELAY
IGN 1 30A
BTN 2 40A
HORN RELAY
C/FAN(H2) RELAY
P/WIN RELAY
(FUEL RELAY)
C/FAN(HI) RELAY
A/CON RELAY
30A SPARE
20A SPARE
15A SPARE
10A SPARE
C/FAN(LO) RELAY
USE THE DESIGNATED FUSES ONLY.
*( ) FOR OPTION.

Inspection

1. Check for a burnt fusible link with an ohmmeter.
2. If a fusible link burns out, there is a short or some other problem in the circuit. Carefully determine the cause and correct it before replacing the fusible link

> **CAUTION**
>
> The fusible link will burn out within 15 seconds if a higher than specified current flows through the circuit.

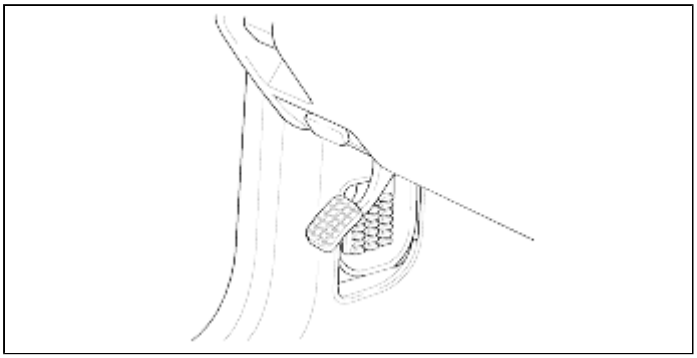


Specification

Inspection

1. Be sure there is no play in the fuse holders, and that the fuses are held securely.
2. Are the fuse capacities for each circuit correct?
3. Are there any blown fuses?
   If a fuse is to be replaced, be sure to use a new fuse of the same capacity. Always determine why the fuse blew first and completely eliminate the problem before installing a new fuse.

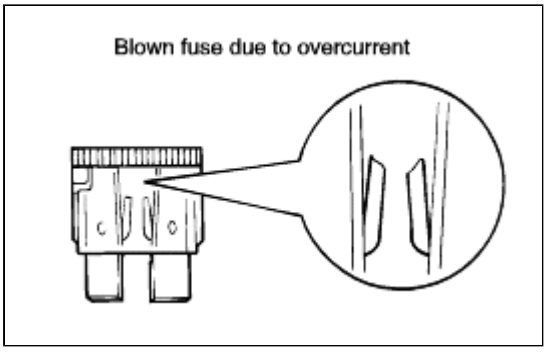
> CAUTION
>
> Never use a fuse of higher capacity than specified.



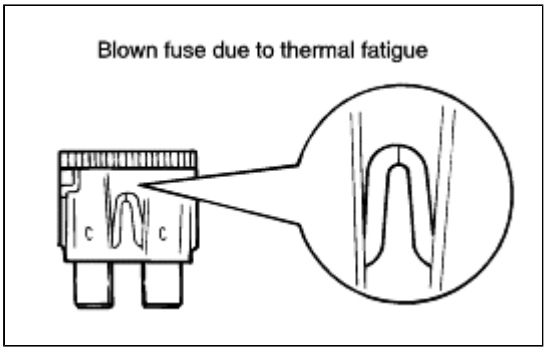
Inspection of fuses

When a fuse is blown, there are two probable causes. The two causes can easily be determined by a visual check after removing the fuses.

1. Fuse blown due to over-current.
   Prior to replacing the fuse with a new one, check the circuit for a short and the related parts for abnormal conditions. Only after the correction of a short or replacement of abnormal parts, should a fuse with the same ampere rating be installed.

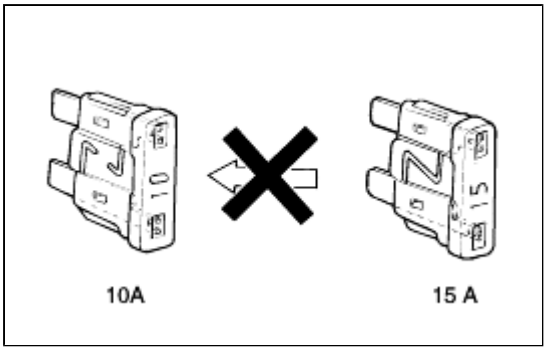


2. Fuse blown due to repeated on-off current.
   Normally, this type of problem occurs after a fairly long period of use, and is less frequent than #1 above. In this case, you may simply replace with a new fuse of the same capacity.

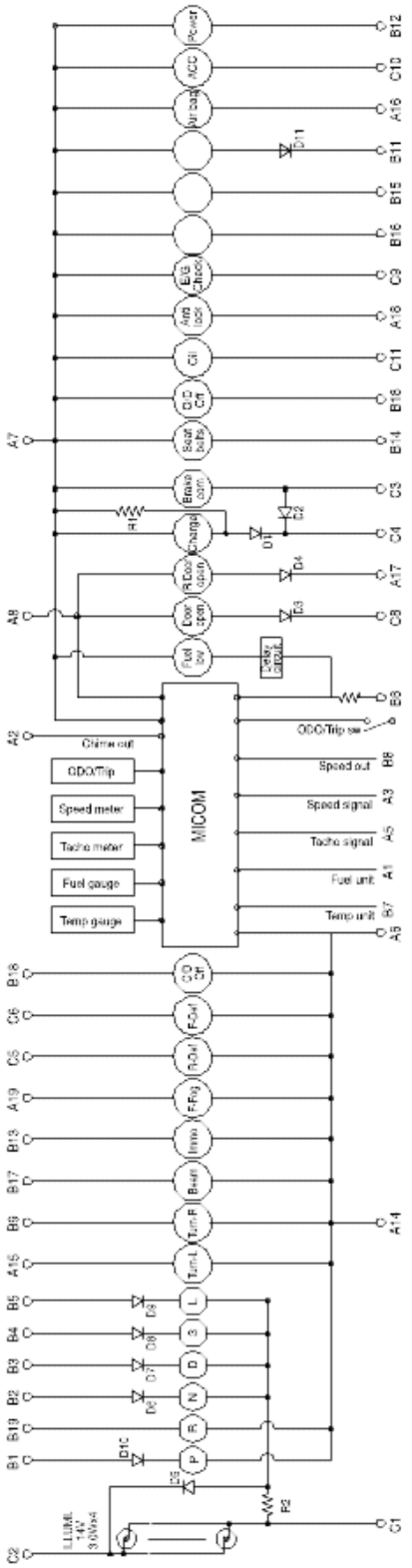


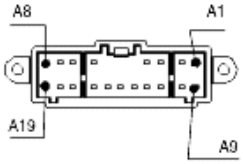
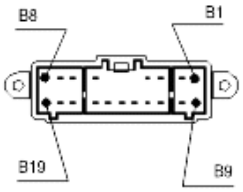
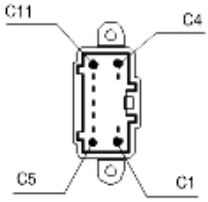
CAUTION

A blade type fuse is identified by the numbered value in amperes. If the fuse is blown, be sure to replace a fuse with the same ampere rating. If a fuse of higher capacity than specified is used, parts may be damaged and a danger of fire exists. To remove or insert a fuse, use the fuse puller in the fuse box.

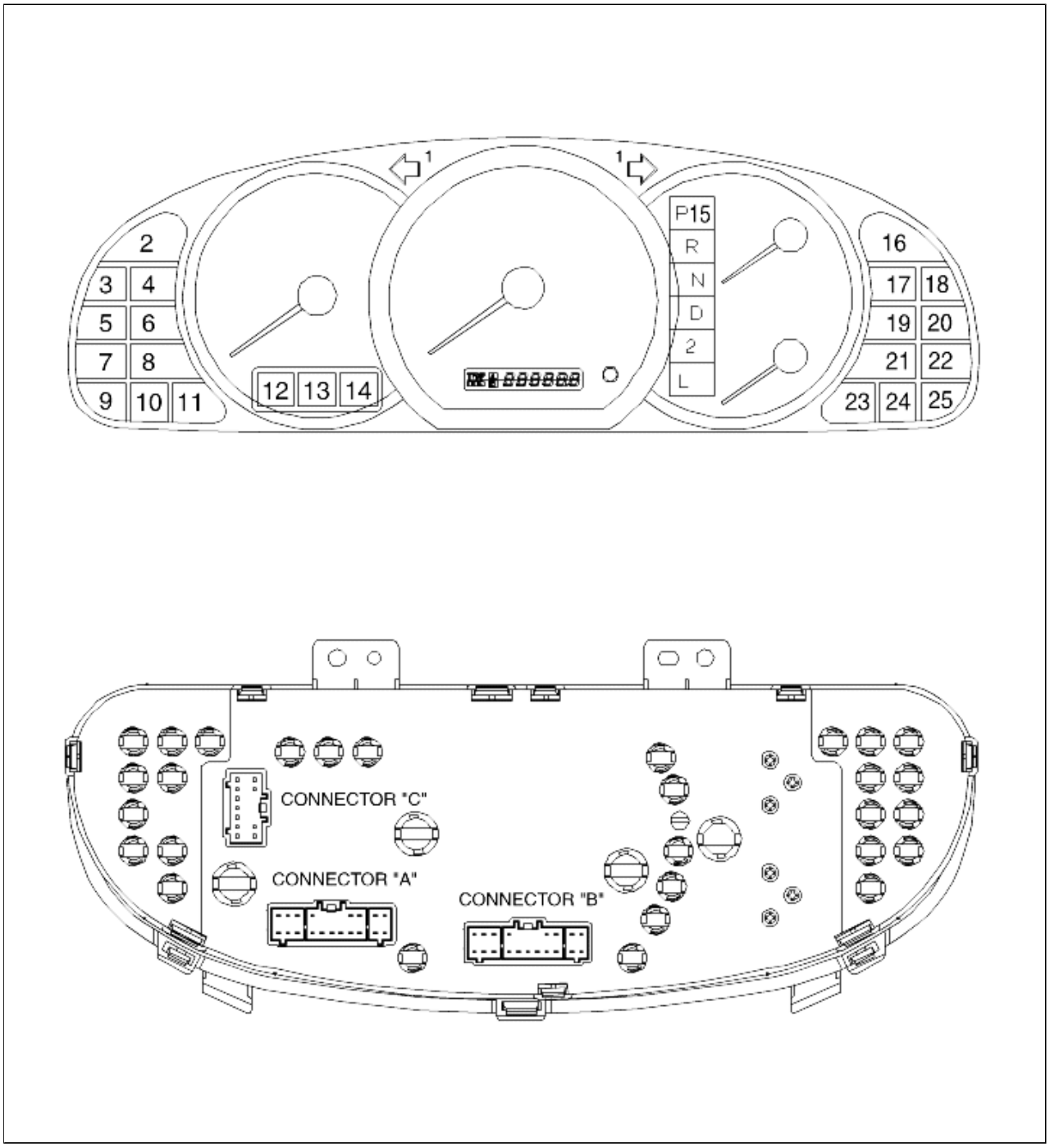


Circuit diagram



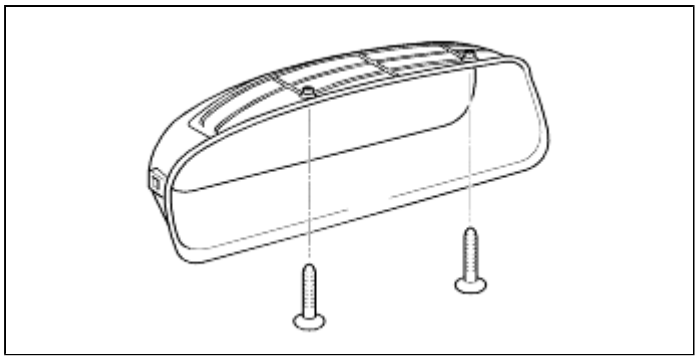
Terminal no.		Terminal name
 CONNECTOR "A"	1	Fuel unit
	2	Chime out
	3	Speed signal
	4	-
	5	Tacho signal
	6	Ground
	7	IG+
	8	B+
	9	-
	10	-
	11	-
	12	-
	13	-
	14	Ground
	15	Turn-left
	16	Air bag
	17	Rear door open
	18	ABS
	19	Front fog
 CONNECTOR "B"	1	P
	2	N
	3	D
	4	3
	5	L
	6	-
	7	Temperature unit
	8	Speed out
	9	Turn-right
	10	-
	11	-
	12	Power
	13	Immobilizer check
	14	Seat belt
	15	-
	16	-
	17	High beam
	18	O/D Off
	19	R
 CONNECTOR "C"	1	ILL-
	2	ILL+
	3	Brake
	4	Charge
	5	Rear defroster
	6	Front defroster
	7	-
	8	Door
	9	Engine check
	10	ACC
	11	Oil

Component

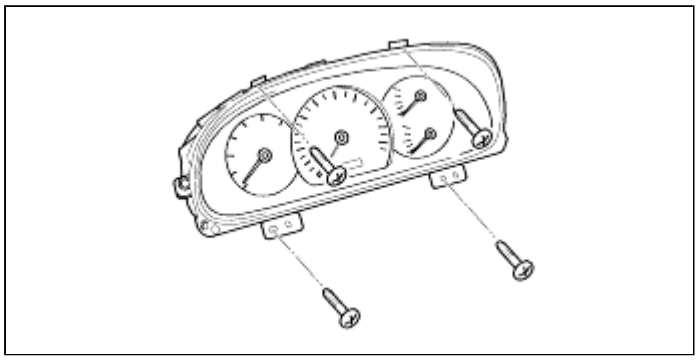

1
1
P15
R
N
D
2
L
2
3
4
5
6
7
8
9
10
11
12
13
14
16
17
18
19
20
21
22
23
24
25
CONNECTOR "C"
CONNECTOR "A"
CONNECTOR "B"

Removal and installation

1. Disconnect the negative (-) battery terminal.
2. Remove the cluster housing after removing 2 screws.



3. Remove the 4 screws holding the cluster and remove the instrument cluster.



4. Installation is the reverse of removal.

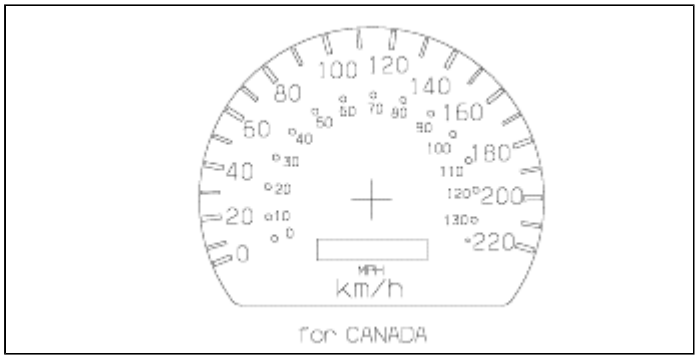
Inspection of components

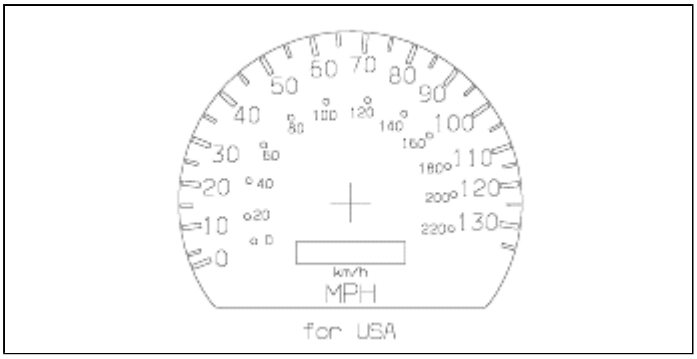
Speedometer

1. Adjust the pressure of the tires to the specified level.
2. Drive the vehicle onto a speedometer tester. Use wheel chocks as appropriate.
3. Check if the speedometer indicator range is within the standard values in the service specifications.

> **CAUTION**
>
> Do not operate the clutch suddenly or increase/ decrease speed rapidly while testing.

> **NOTE**
>
> Tire wear and tire over or under inflation will increase the indication error.



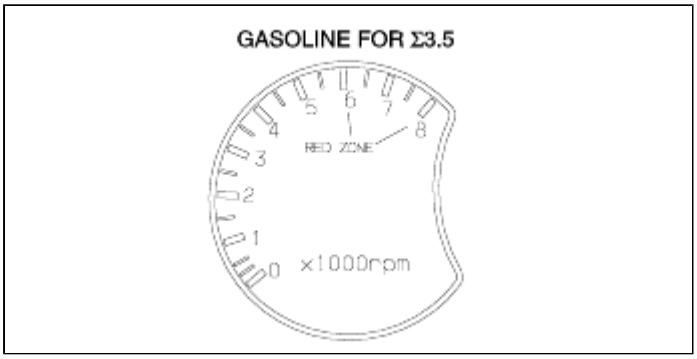


Tachometer

1. Connect the scan tool to the diagnostic link connector or install a tachometer.
2. With the engine started, compare the readings of the tester with that of the tachometer. Replace the tachometer if the tolerance is exceeded.

> **CAUTION**
>
> When removing or installing the tachometer, be careful not to drop it or subject it to severe shock.

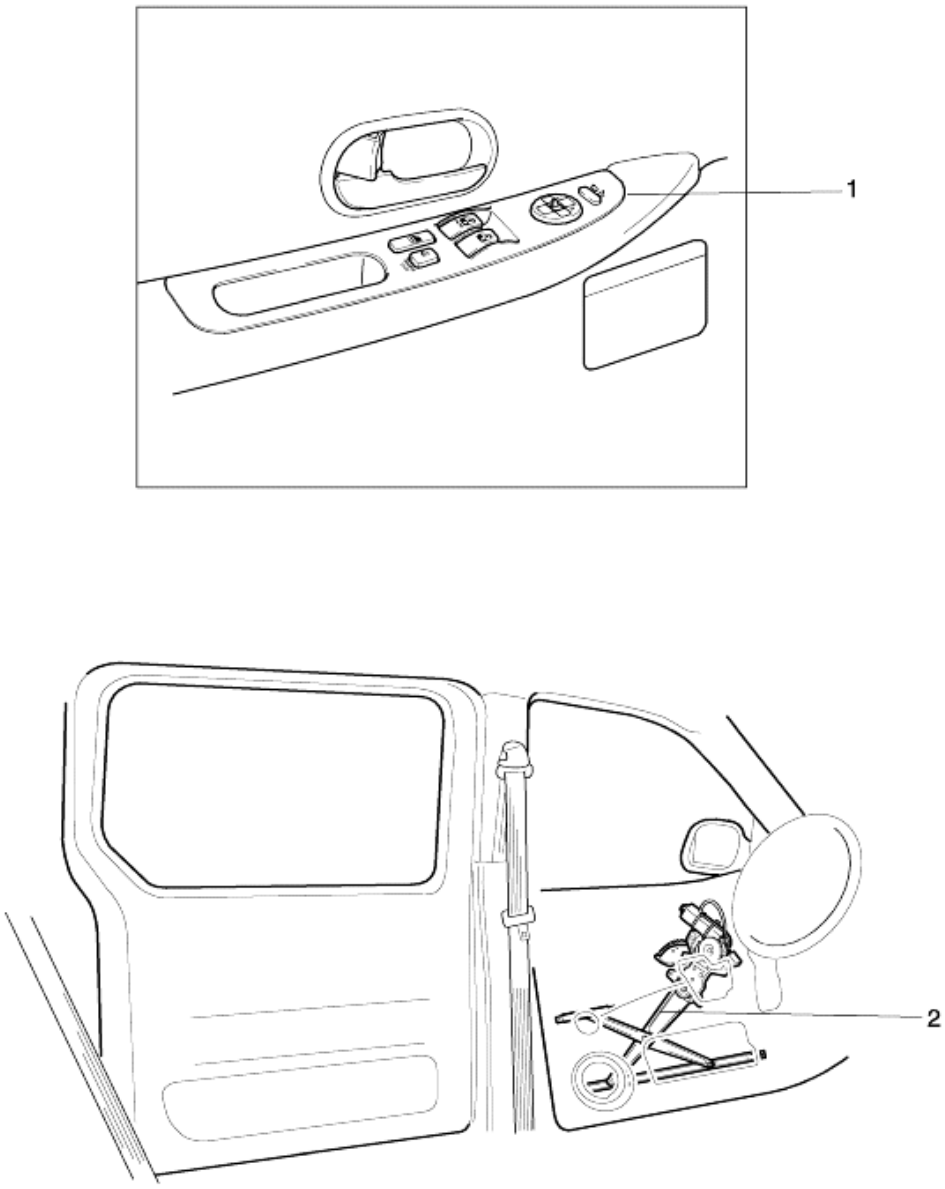
Revolution (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	Remark
Tolerance (%)	+6 -12	+7.5 -1.5	+6	+6	+6	+6	+6	Gasoline



Specification

No.	Item		Specification	
			Bulb capacity	Color
1	Turn signal (RH, LH)		1.4W	Green
2	Rear window defroster		1.4W	Amber
3	Front fog		1.4W	Amber
4	Front windshield defroster		1.4W	Amber
5	ABS		1.4W	Amber
7	Rear door open		1.4W	Red
8	Door ajar		1.4W	Red
9	Air bag		1.4W	Red
10	Check engine		1.4W	Amber
11	Auto cruise		1.4W	Green
12	Oil pressure		1.4W	Red
13	Parking brake		1.4W	Red
14	Battery charge		1.4W	Red
15	A/T indicator	N, D, 3, L	1.4W	Green
		P, R	1.4W	Red
16	Low fuel		1.4W	Amber
17	Seat belt		1.4W	Red
22	Power		1.4W	Amber
23	O/D OFF		1.4W	Amber
24	High beam		1.4W	Green
25	Immobilizer check (For Canada)		1.4W	Amber

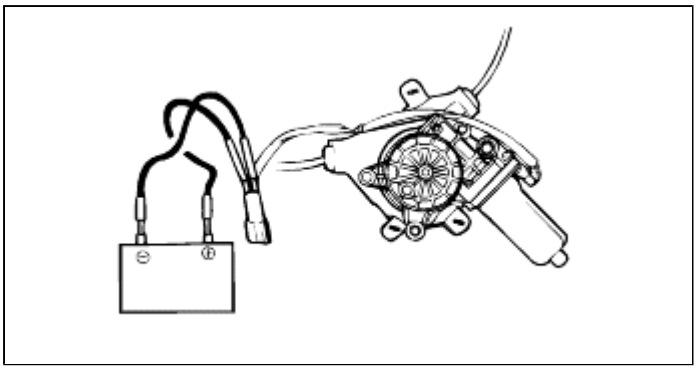
Component



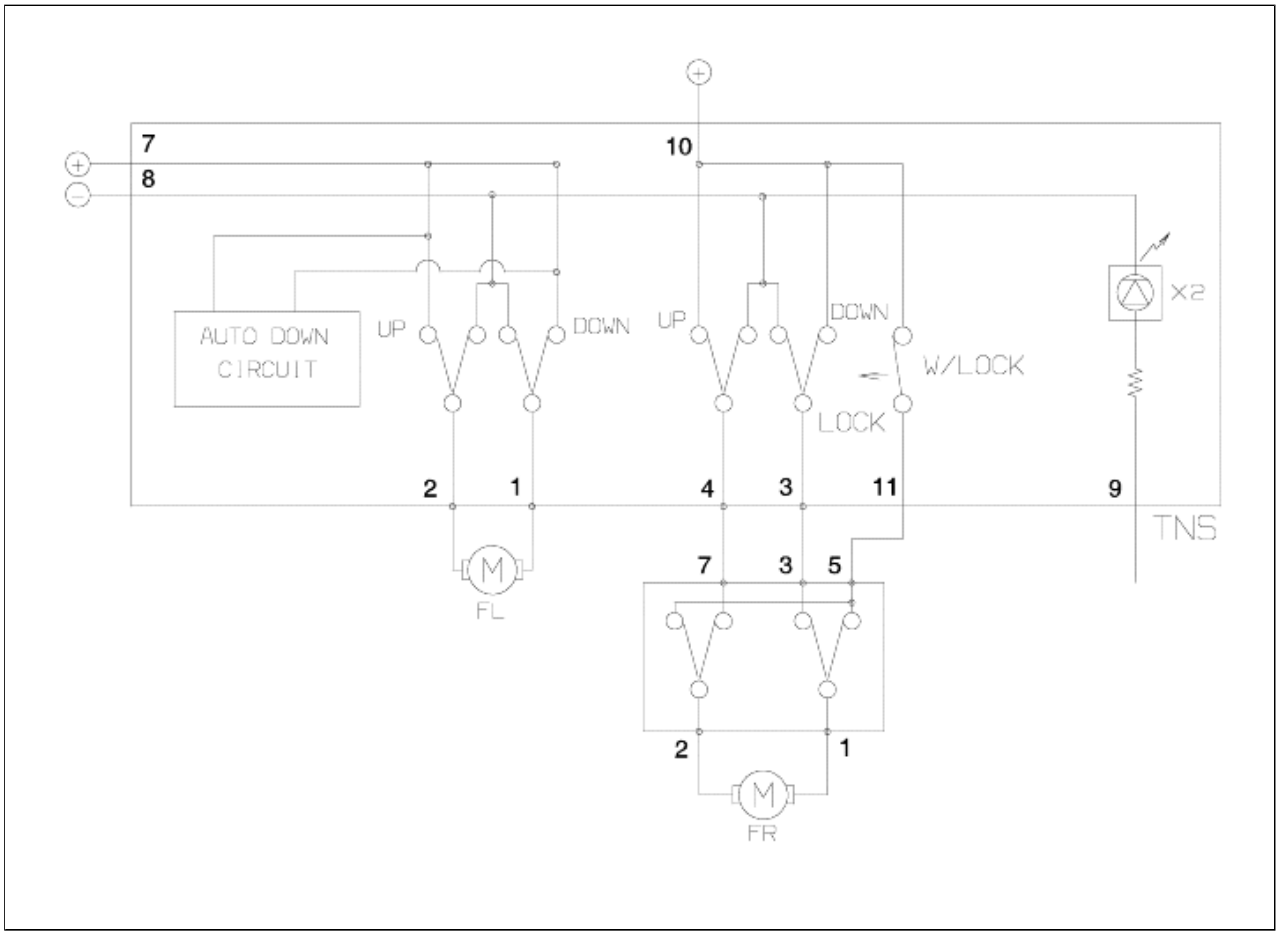
1. Power window switch assembly
2. Power window regulator assembly

Inspection

Connect the motor terminals directly to battery voltage(12V) and check that the motor operates smoothly. Next, reverse the polarity and check that the motor operates smoothly in the reverse direction. If the operation is abnormal, replace the motor.



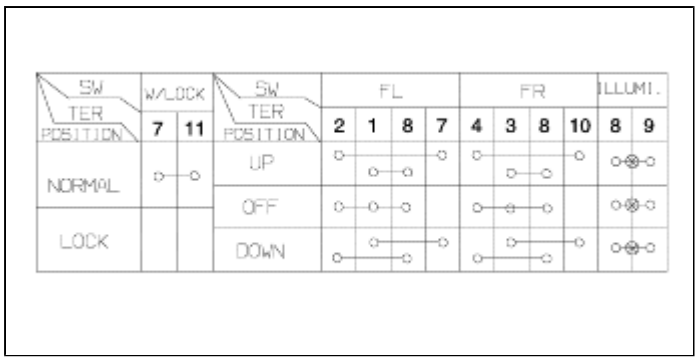
Circuit diagram

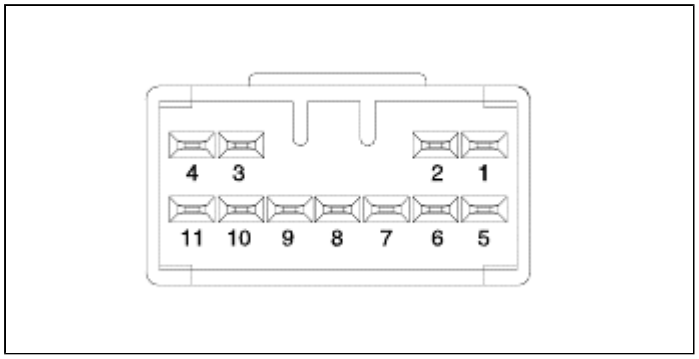


Inspection

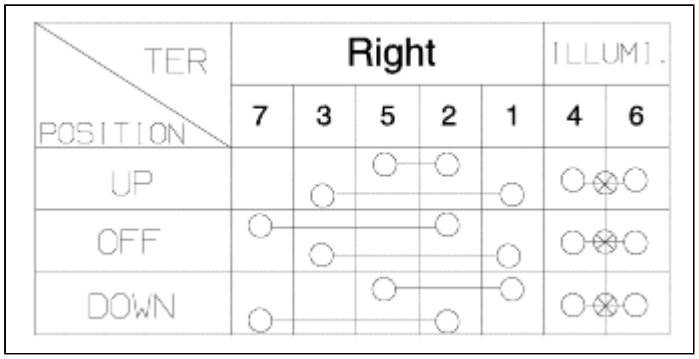
Power window main switch

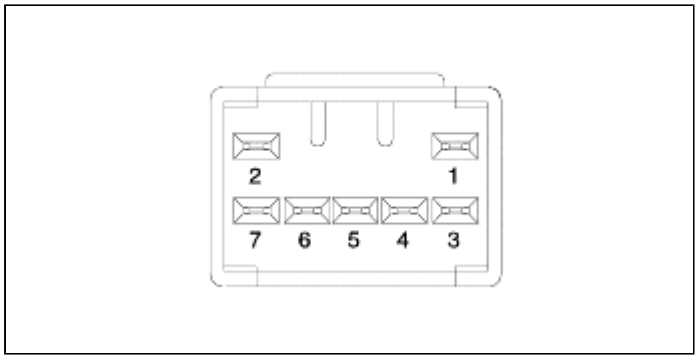
1. Remove the switch from the door trim panel.
2. Check for continuity between the terminals. If continuity is not as specified in the table, replace the power window switch.





Power window sub switch

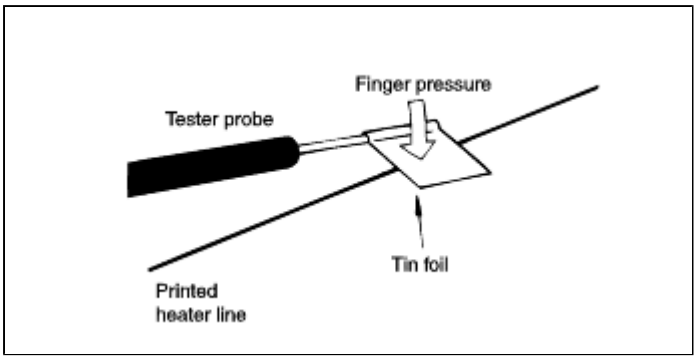




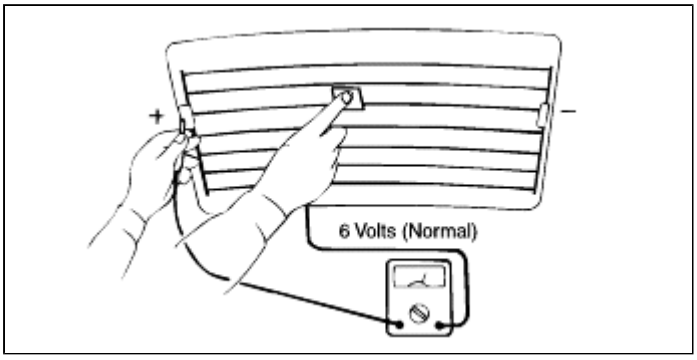
Inspection

CAUTION

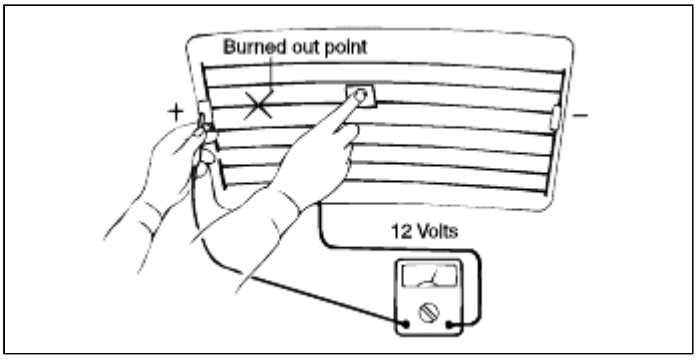
Wrap tin foil around the end of the voltmeter test lead to prevent damaging the heater line. Apply finger pressure on the tin foil, moving the tin foil along the grid line to check for open circuits.



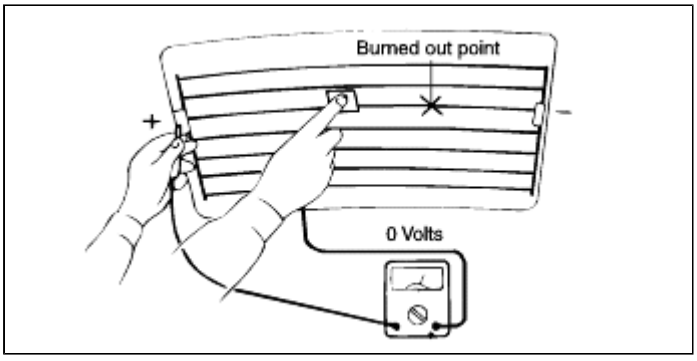
1. Turn on the defogger switch and use a voltmeter to measure the voltage of each heater line at the glass center point. If a voltage of approximately 6V is indicated by the voltmeter, the heater line of the rear window is considered satisfactory.



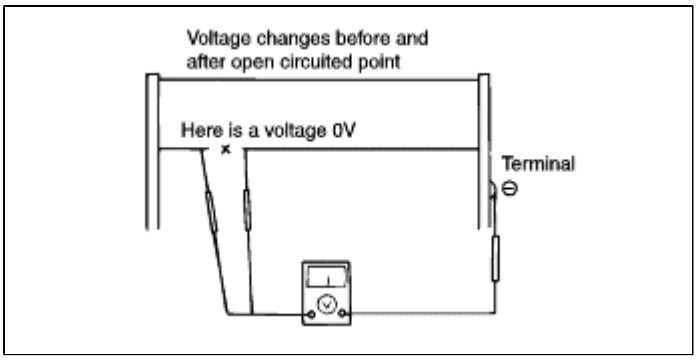
2. If a heater line is burned out between the center point and (+) terminal, the voltmeter will indicate 12V.



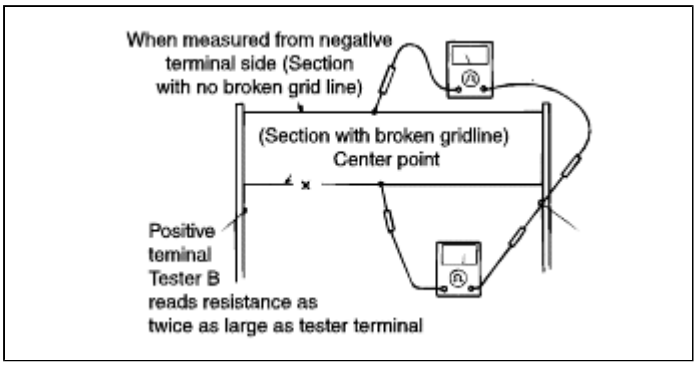
3. If a heater line is burned out between the center point and (-) terminal, the voltmeter will indicate 0V.



4. To check for open circuits, slowly move the test lead in the direction that the open circuit seems to exist. Try to find a point where a voltage is generated or changes to 0V. The point where the voltage has changed is the open-circuit point.



5. Use an ohmmeter to measure the resistance of each heater line between a terminal and the center of a grid line, and between the same terminal and the center of one adjacent heater line. The section with a broken heater line will have a resistance twice as that in other sections. In the affected section, move the test lead to a position where the resistance sharply changes.

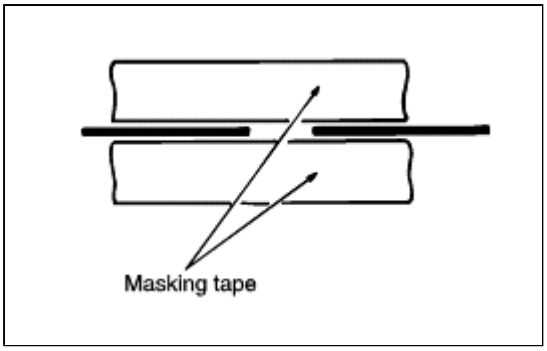


Repair of broken heater line

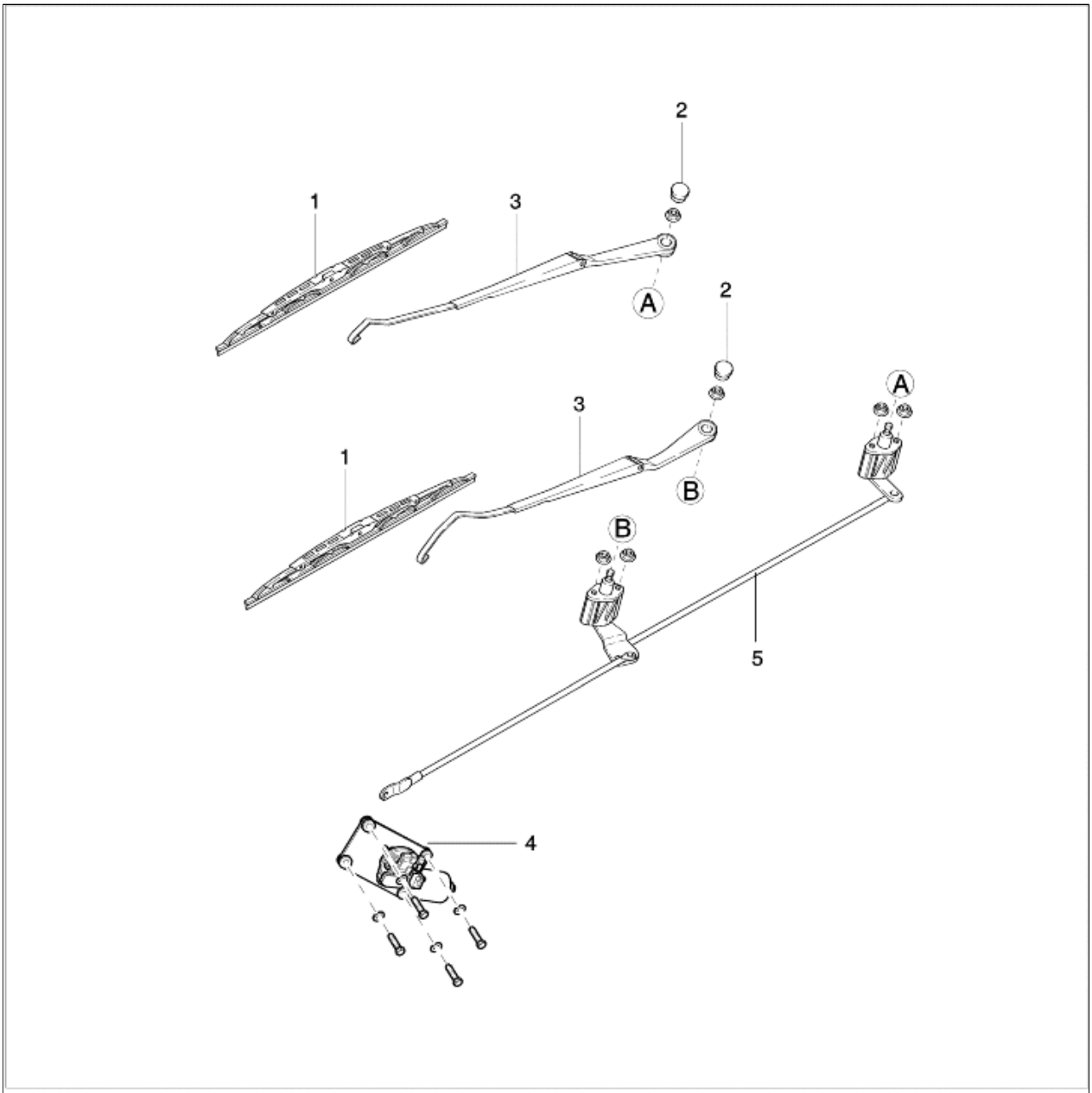
Prepare the following items:

1. Conductive paint.
2. Paint thinner.
3. Masking tape.
4. Silicone remover.
5. Thin brush.
   Wipe the glass adjacent to the broken heater line, clean with silicone remover and attach the masking tape as shown. Shake the conductive paint container well, and apply three coats with a brush at intervals of about 15 minutes apart. Remove the tape and allow sufficient time for drying before applying power. For a better finish, scrape away excess deposits with a knife after the paint has completely dried. (allow 24 hours).

> **CAUTION**
>
> After repairing, clean the glass with a soft dry cloth or wipe along the grid line with a slightly moistened cloth.

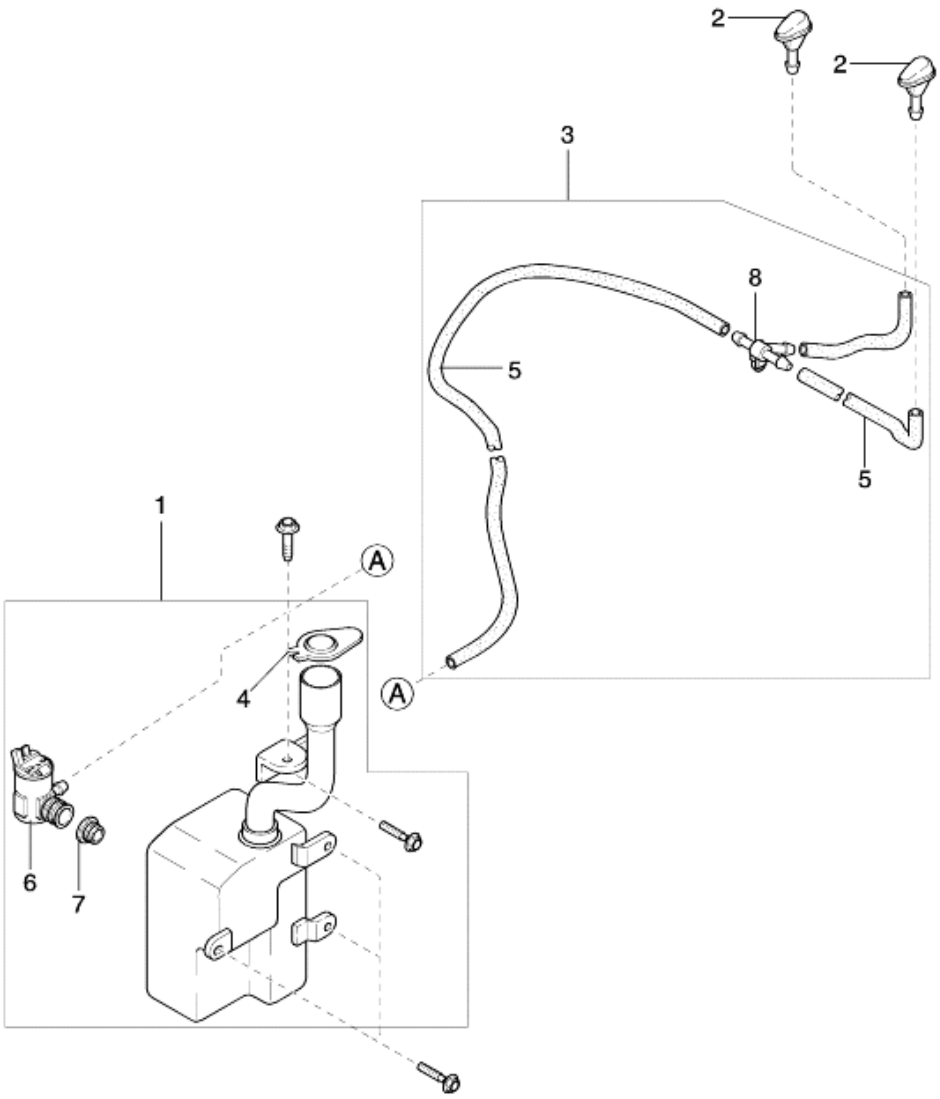

Masking tape

Front wiper (Component)



1. Wiper blade
2. Wiper arm cover
3. Wiper arm
4. Motor assembly
5. Link assembly

Front washer (Component)

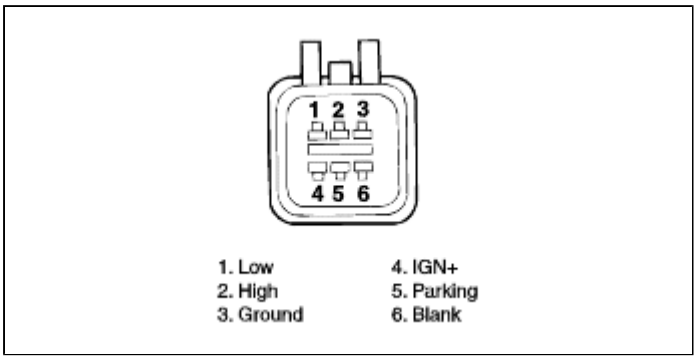


1. Washer tank assembly
2. Washer nozzle
3. Pipe assembly
4. Tank cap
5. Hose
6. Motor assembly
7. Grommet
8. Pipe clip

Inspection

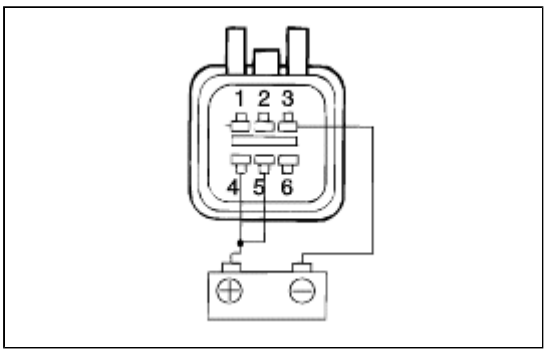
Speed operation check

1. Remove the connector from the wiper motor.
2. Attach the positive (+) lead from the battery to terminal 1 and the negative (-) lead to terminal 3.
3. Check that the motor operates at low speed.
4. Connect the positive (+) lead from the battery to terminal 2 and the negative (-) lead to terminal 3.
5. Check that the motor operates at high speed.

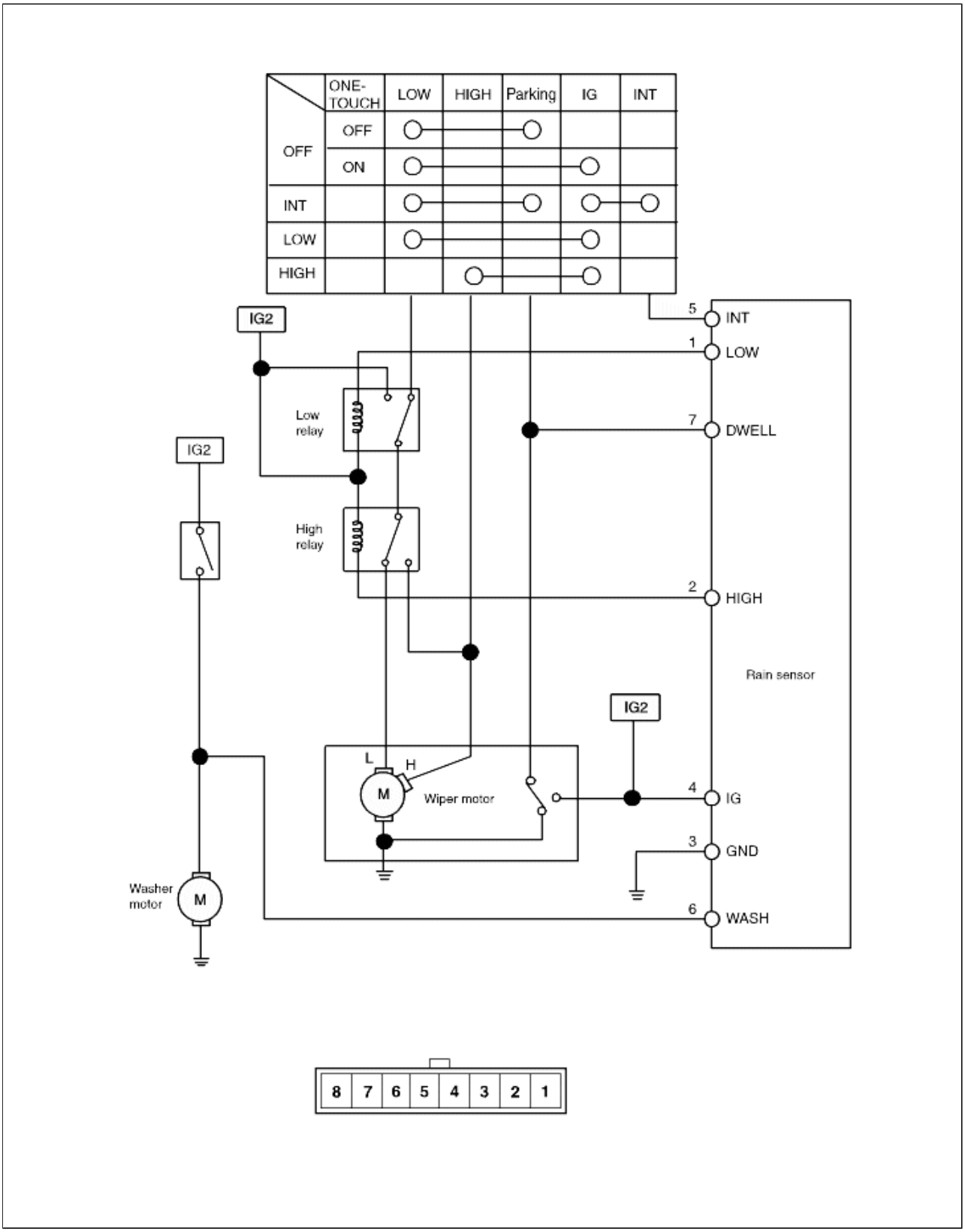


Automatic stop operation check

1. Operate the motor at low speed.
2. Stop the motor operation anywhere except at the off position by disconnecting terminal 3.
3. Connect terminals 4 and 5
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 3.
5. Check that the motor stops running at the off position.

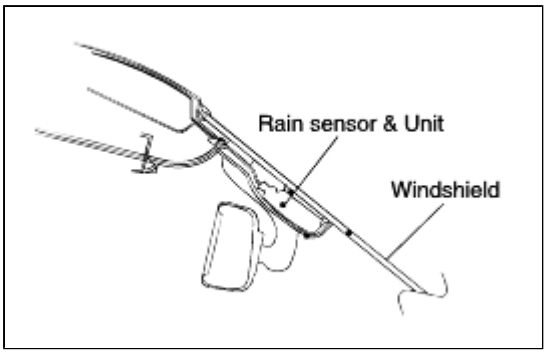


Circuit


ONE-TOUCH
LOW
HIGH
Parking
IG
INT
OFF
OFF
ON
INT
LOW
HIGH
IG2
Low relay
High relay
IG2
5
INT
1
LOW
7
DWELL
2
HIGH
Rain sensor
IG2
L
H
M
Wiper motor
4
IG
3
GND
6
WASH
Washer motor
M
8 7 6 5 4 3 2 1

Description

The rain sensing windshield wiper system is a wiper system that, in addition to providing normal wiper functions off, mist, manual low speed, manual high speed, and washer, provides automatic control of automatic int, automatic low, and automatic high speeds.



MULTI FUNCTION SWITCH POSITION	RAINSENSOR OPERATING MODE	SENSOR ACTION
MIST	MIST	Mist is controlled by the column switch The sensor has no affect on this function.
OFF	OFF	If not already parked, wiper motor moves with low speed until blades are in the depressed park position.
AUTOMATIC Automatic mode has 9 sensitivity settings.	AUTOMATIC	Automatic INT/speed control The sensitivity to raindrop accumulation on the windshield is set by the multifunction switch sensitivity adjustment.
LOW SPEED	MANUAL	Wiper motor runs continuously in low speed for example 45 wipes/minute. The sensor has no affect on this function.
HI SPEED	MANUAL	Wiper motor runs continuously with high speed for example 60 wipes/minute. The sensor has no affect on this function.
WASHER When washer switch is turned on during 0.6 sec or more	WASHER	If washer switch is turned on during 0.6 sec or more, the wiper operate during 2.5~3.8 sec.
WASHER When washer switch is turned on during 0.6 sec or less	WASHER	If washer switch is turned on during 0.6 sec or less, the wiper operates only one time.

Off mode

With the wiper switch "OFF" the ignition switch "ON" the rain sensor is considered to be in the "OFF" mode.
In this mode, the sensor commands the wiper motor to be "OFF".

Automatic mode

When the multifunction switch is moved to auto position and the ignition switch is in the run or accessory positions, the rain sensor is considered to be in "automatic" mode.
Once a single "instant wipe" has occurred, the wipers remain at "inner wipe/park" until the rain sensor determines that the dwell time at that position is appropriate for the amount of precipitation an the windshield, rain sensor provides input to the wiper motor to activate the wipers to clear the precipitation from the windshield.

Automatic int

For all automatic int, operations the rain sensor commands the wipers to operate in low speed for one wipe, followed by a variable dwell period in the inner wipe position.

Automatic low

Automatic low speed operation is utilized when the amount of precipitation impinging on the windshield exceeds the automatic int to automatic low threshold.
This threshold includes sufficient hysteresis to prevent cycling between automatic int and automatic low speed operationwith a steady amount of precipitation accumulation on the windshield.

Automatic high

Automatic high speed operation utilized when the amount of precipitation impinging on the windshield exceeds the automatic low to automatic high threshold.
This threshold includes sufficient hysteresis to prevent cycling between automatic low and automatic high speed operation with a steady amount of precipitation accumulation on the windshield.

Washer mode

The rain sensor monitors the multifunction switch to determine if the washer function is selected.
Rain sensor enables the wiper motor to run in low speed during the washer mode and performs wipes from 2.5 to 3.8 sec.

Manual mode

The rain sensor determines when a manual mode such as manual low, mist, off or manual high is selected.
The column performs these modes and the rain sensor has no affect.

Replacement

The rain sensor module is mounted to the coupler using two snap fit stainless steel clips.
This allows the rain sensor module to be easily removed and replaced in the event of a rain sensor module failure.
If the windshield requires replacement, the existing rain sensor module may be unsnapped fro the original windshield and reinstalled onto the new windshield.
It is snap-fit to the new coupler, an integral portion of the replacement windshield as delivered by the replacement windshield manufacturer.

Troubleshooting

The rain sensor has two levels of fault detection as described below.

Fault A

Fault A is indicated when the sensor has detected that the sensor servo operating point is above the expected limits. This is and indication of damage to the windscreen in the area of the coupler of the sensor has been removed from the coupler.

Fault B

Fault B is indicated when the sensor has detected that it no longer is responding to rain signals.
This is an indication of damage to the windscreen in the area of the coupler or, more likely, that the sensor has detected and electrical failure within the sensor.

Attachment grade value

Attachment grade is used to determine when fault in A is detected. The attachment grade value is set at 140.
This allowsthe product to operate in all conditions other than the most severe damage the windscreen.

Use sensitivity adjustment to indicate fault

A method to indicate detected faults is available to a service garage technician by using the sensitivity input and thewipers as an indicator. The service method is described as follows.

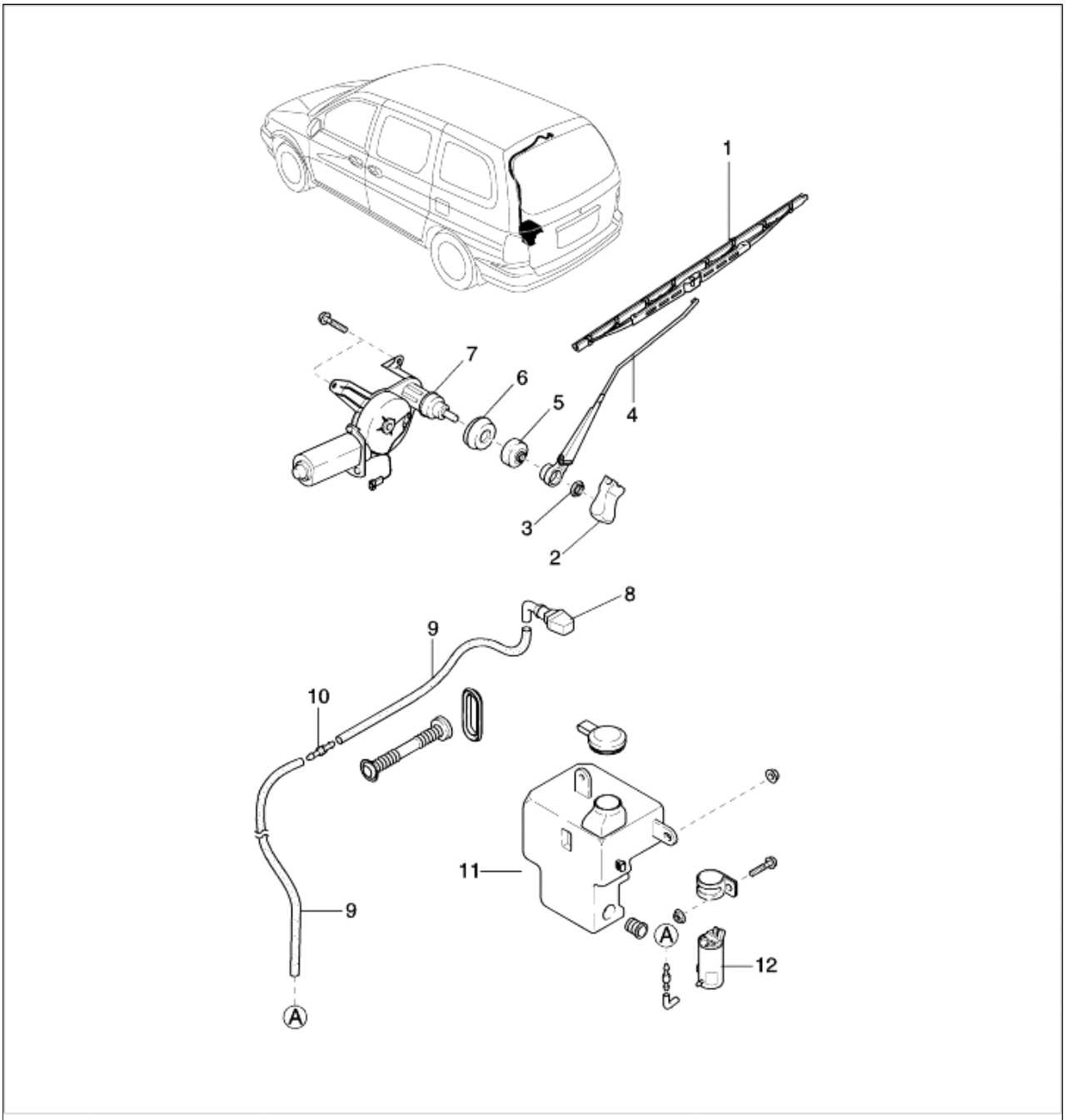
1. With ignition "ON", move the sensitivity adjustment to the high sensitivity setting.
2. Decrease the sensitivity by one setting.
3. If a wipe occurs, then Fault A has been detected and the service technician should assure that the coupler area on the windscreen is not damaged and the sensor is secured to the coupler.
4. Decrease the sensitivity one more setting.
5. If a wipe occurs, then fault B has been detected and the sensor should be remove and replaced with a known good sensor.

CAUTION

When the ignition key is "ON" and the multi function switch is in the auto position the wiper could operate in the following conditions.

1) Be careful not to touch the upper sensor front window glass.
2) Be careful not to touch the upper sensor front window glass with a cloth.
3) Be careful not to vibrate the front window glass.

Component



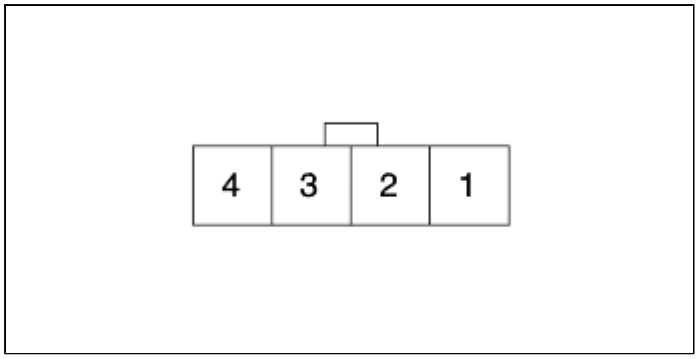
1. Wiper blade
2. Wiper arm cover
3. Nut
4. Wiper arm
5. Cap seal
6. Outer bush
7. Motor assembly
8. Washer nozzle
9. Hose
10. Check valve
11. Washer tank assembly
12. Washer motor

Rear wiper motor

Inspection

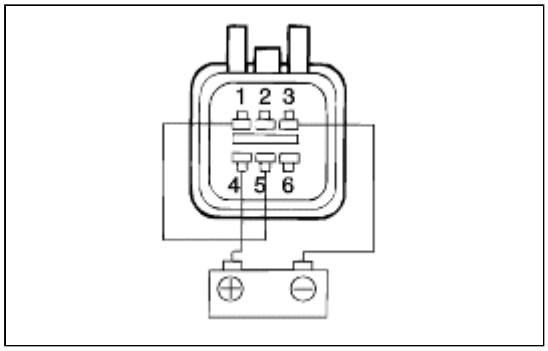
Speed operation check

1. Remove the connector from the wiper motor.
2. Attach the positive (+) lead from the battery to terminal 2 and the negative (-) lead terminal 1.
3. Check that the motor operates at low speed.

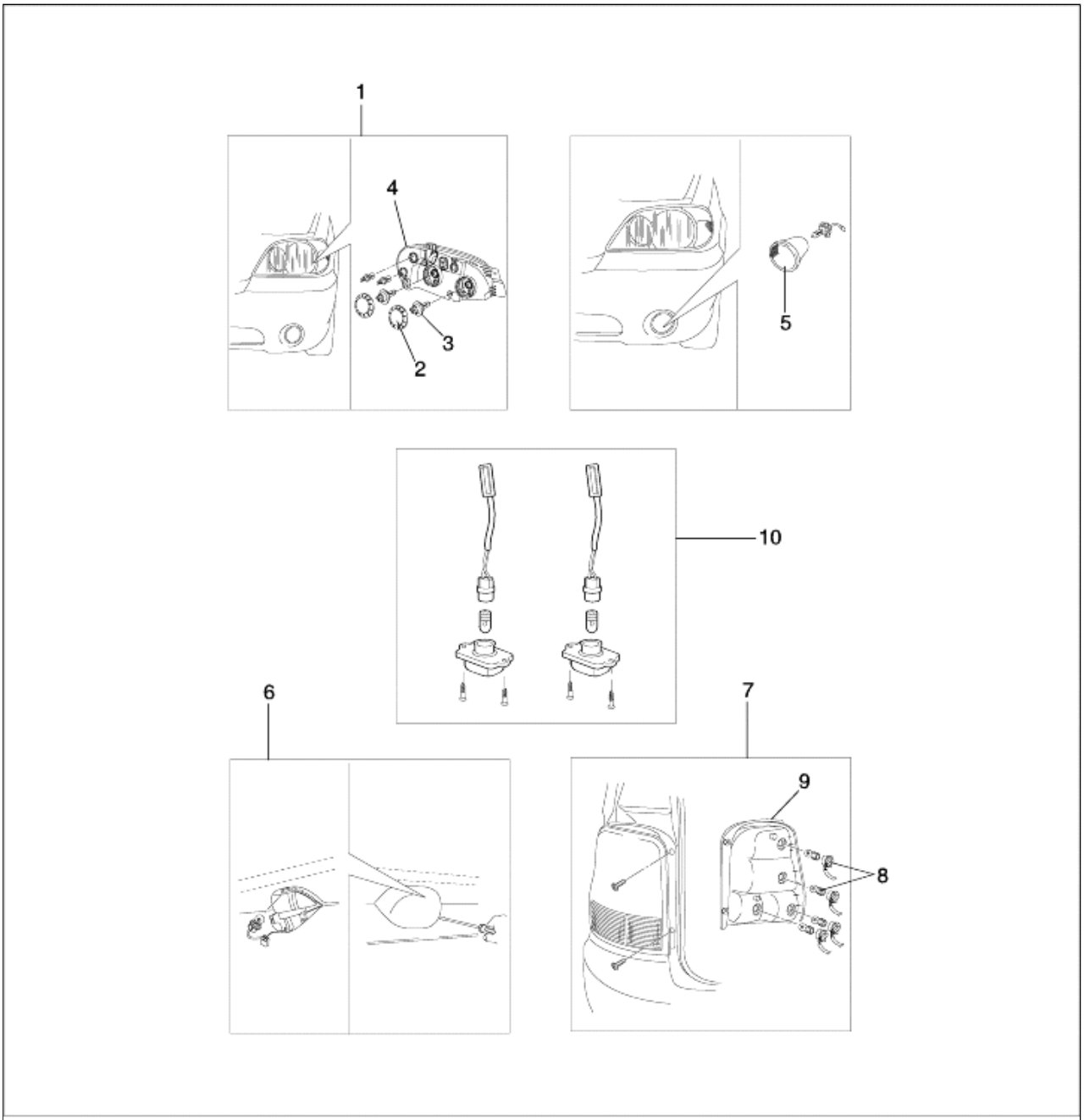


Automatic stop operation check

1. Operate the motor at low speed.
2. Stop the motor operation anywhere except at the off position by disconnecting terminal 1.
3. Connect terminals 1 and 2.
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 1.
5. Check that the motor stops running at the off position.



Headlight / combination light & fog lights component



1. Headlight & Combination light assembly
2. Dust cover
3. Bulb
4. Housing
5. Fog light
6. High-mounted brake light assembly
7. Rear combination light
8. Socket and bulb
9. Housing
10. License plate light assembly

Head lamp aiming instructions

The headlamps should be aimed with the proper beam-setting equipment, and in accordance with the equipment manufacturer's instructions.

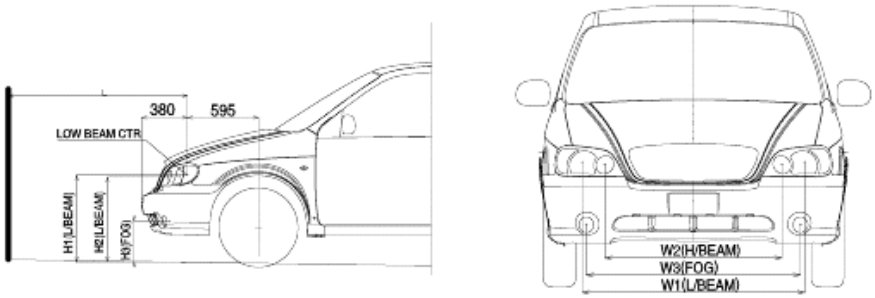
> **NOTE**
>
> If there are any regulations pertinent to the aiming of headlamps in the area where the vehicle is to be used, adjust so as to meet those requirements.

Alternately turn the adjusting gear to adjust the headlamp aiming. If beam-setting equipment is not available, proceed as follows:

1. Inflate the tires to the specified pressure and remove any loads from the vehicle except the driver, spare tire, and tools.
2. The vehicle should be placed on a flat floor.
3. Draw vertical lines (Vertical lines passing through respective headlamp centers) and a horizontal line (Horizontal line passing through center of headlamps) on the screen.
4. With the headlamp and battery in normal condition, aim the headlamps so the brightest portion falls on the horizontal and vertical lines.
   Make vertical and horizontal adjustments to the lower beam using the adjusting wheel.

Front fog lamp

The front fog lamps should be aimed as the same manner of the head lamps aiming.
With the front fog lamps and battery normal condition, aim the front fog lamps by turning the adjusting gear.



H1 : Height between the head lamp bulb center and ground (low beam)
H2 : Height between the head lamp bulb center and ground (high beam)
H3 : Height between the fog lamp bulb center and ground

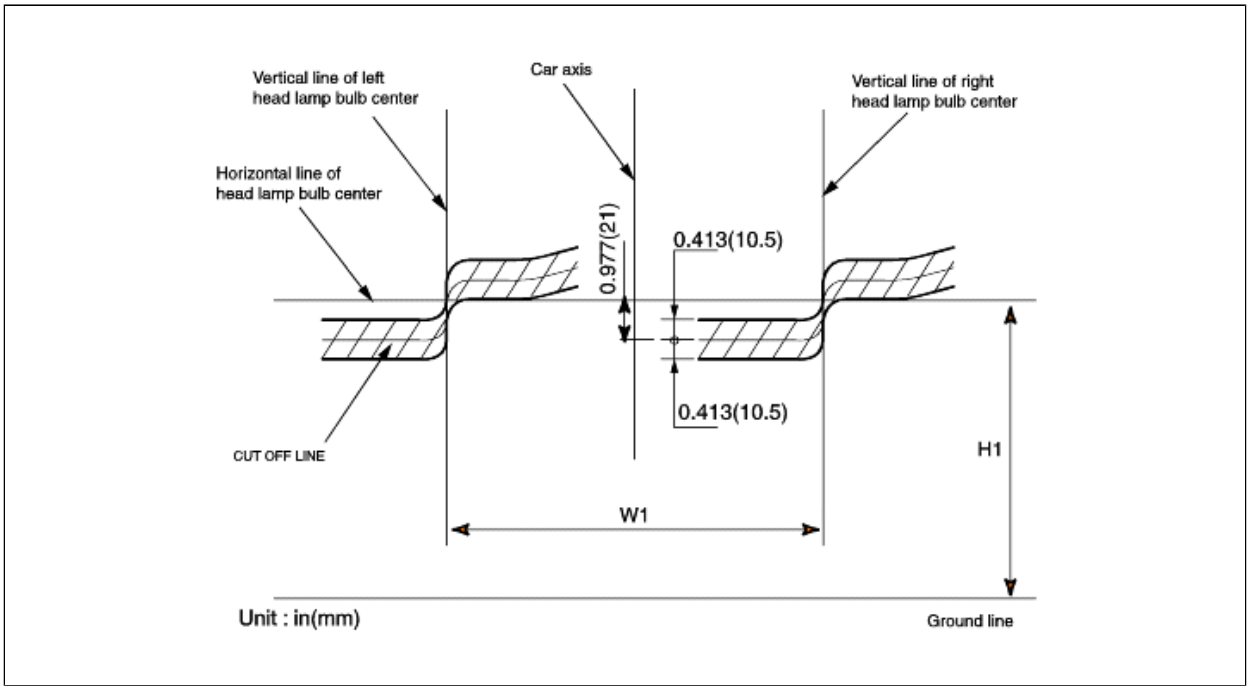
W1 : Distance between the head lamp bulb center (low beam)
W2 : Distance between the head lamp bulb center (high beam)
W3 : Distance between the fog lamp bulb center

L : Distance between the head lamp bulb center and screen.

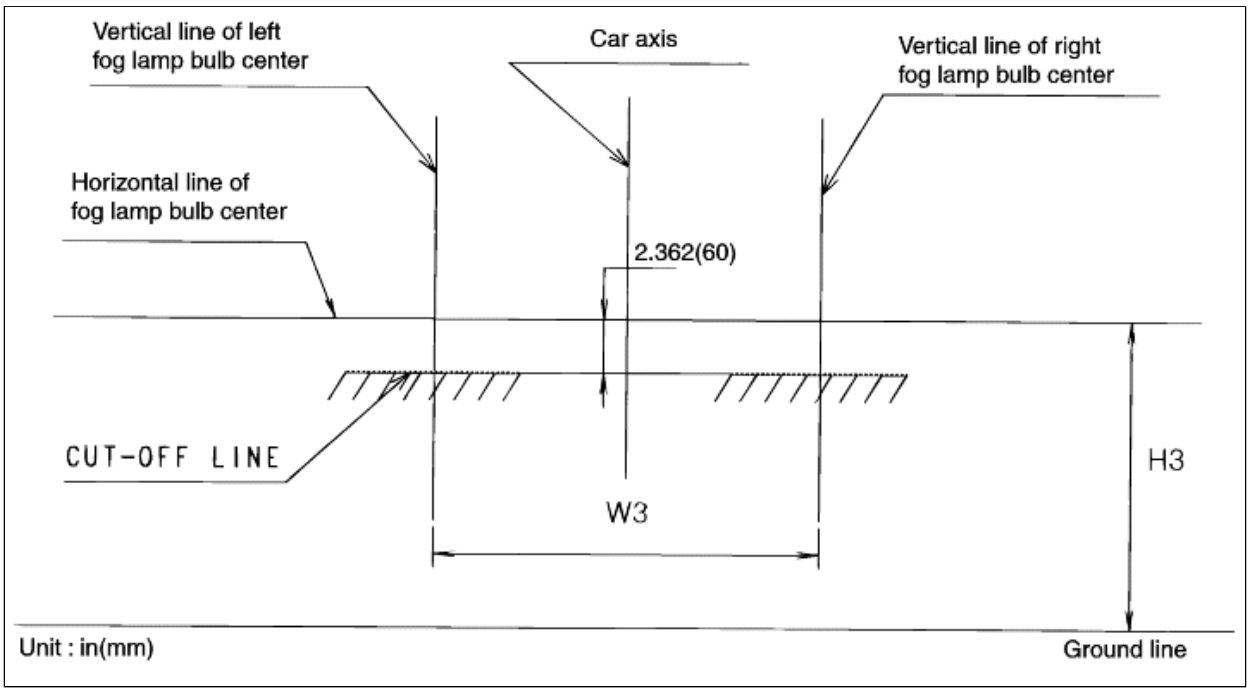
Unit : in (mm)

Vehicle condition	H1	H2	H3	W1	W2	W3	L
Without driver	27.16 (690)	26.55 (674.5)	13.41 (341)	53.81 (1,367)	42.79 (1,087)	51.77 (1,315)	118.1 (3,000)
With driver	26.97 (685)	26.36 (669.5)	12.95 (329)				

1. Turn the low beam on without the driver aboard.
   The cut-off line should be projected in the allowable range (shaded region).



2. Turn the front fog lamp on without the driver aboard.
   The cut-off line should be projected in the allowable range (shaded region).



Description

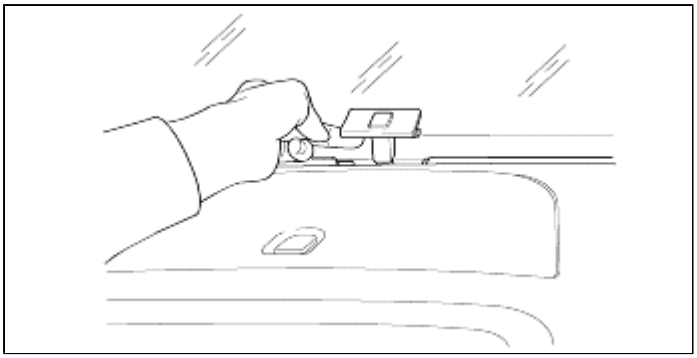
The auto light control system operates by using the auto light switch, and turns the head lamp and tail lamp on or off automatically in accordance with the detection illumination.

Specifications

Items		Specifications
Rated voltage		12 V
Load		Max. 200mA (Relay)
Detection illumination	Tail lamp	ON : 23.1 ± 1.4(Lux), 0.79 ± 0.04 (V)
		OFF : 48 ± 1.4(Lux), 1.38 ± 0.04 (V)
	Head lamp	ON : 23.1 ± 1.4(Lux), 0.79 ± 0.04 (V)
		OFF : 48 ± 1.4(Lux), 1.38 ± 0.04 (V)

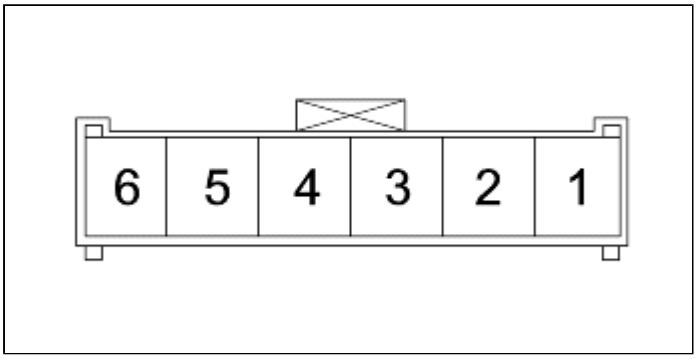
Removal

1. Removal the sensor unit from the defroster nozzel cover using the suitable tool.



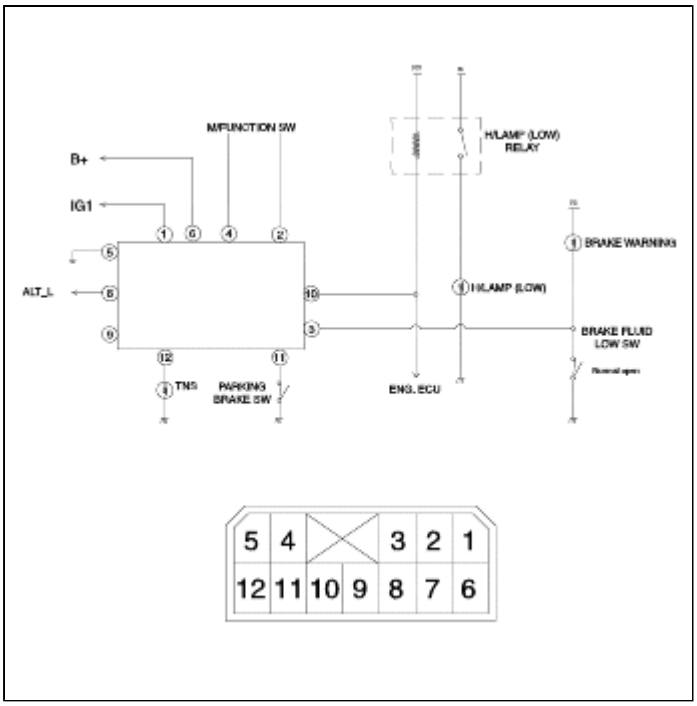
Inspection

1. Apply the battery voltage to terminal 1 and ground the terminal 6.
2. Expose the ALCS unit to the sun
3. Check the continuity between the terminals 2 & 4 and the terminals 2 & 5.



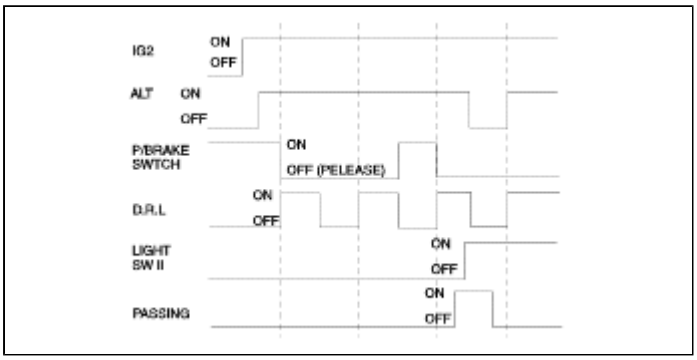
Inspection (for canada)

Circuit diagram



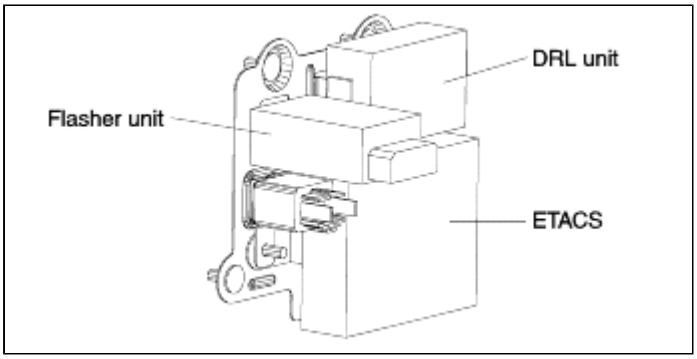
Operation check

Check that the lights operate according to the following timing chart.



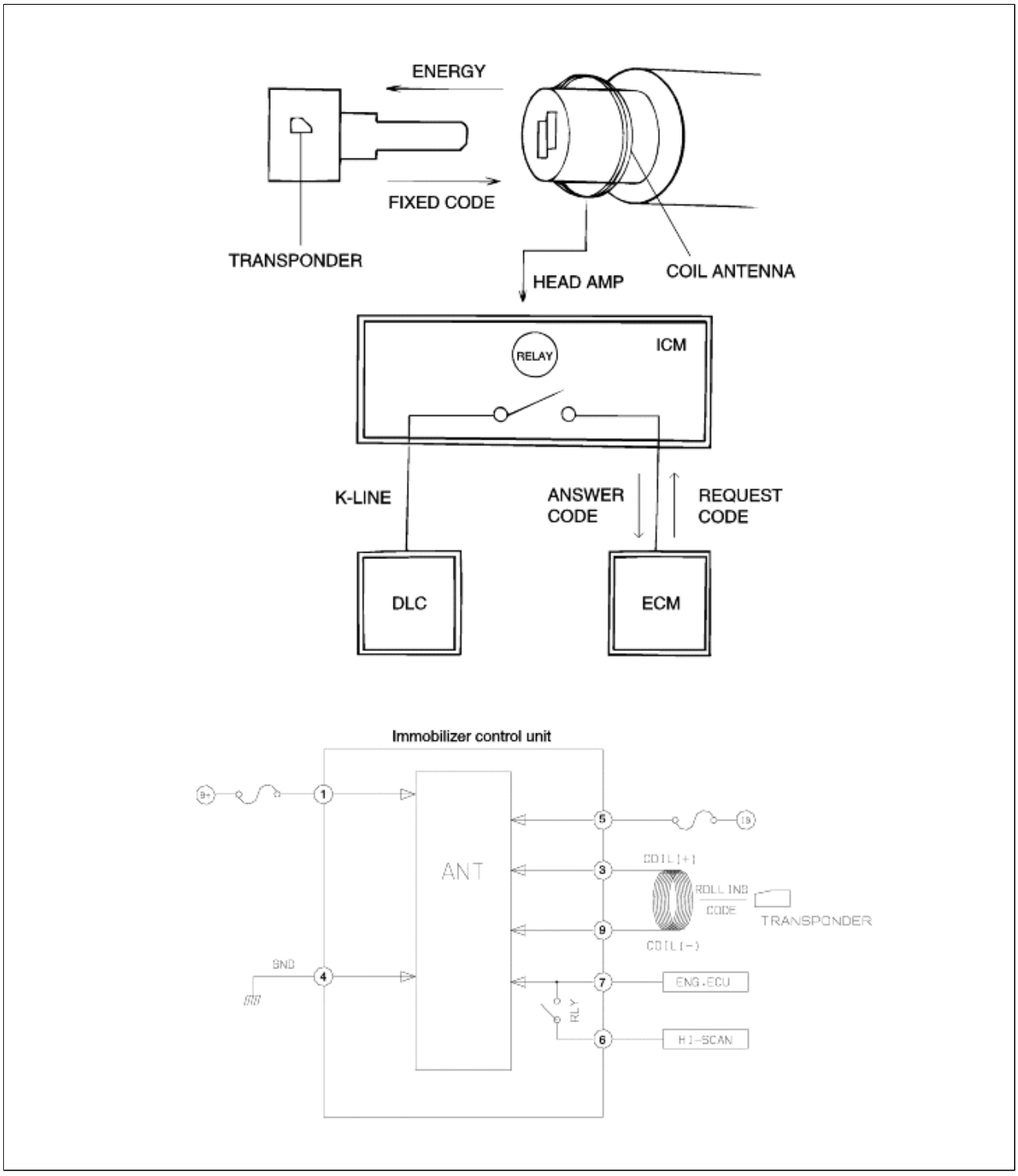
Remove and installation

1. It is installed in the center console.



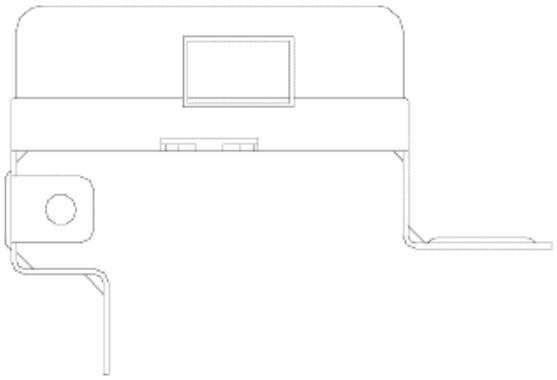
Shinchang Immobilizer (For Canada)

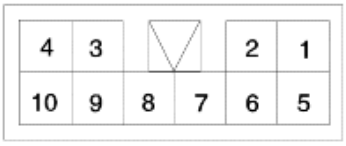
System block diagram



Shinchang Immobilizer (For Canada)

Pin connection



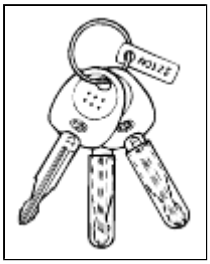
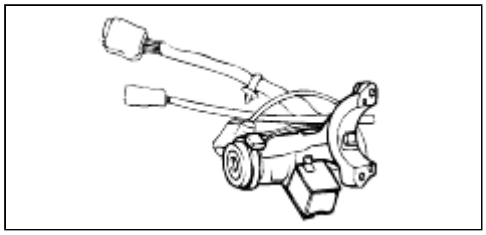
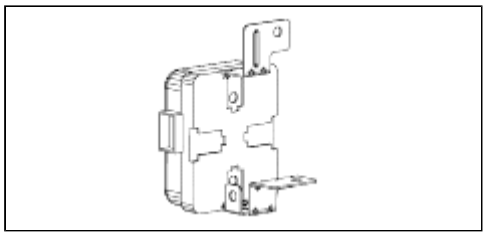
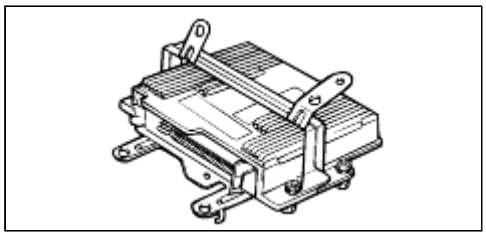
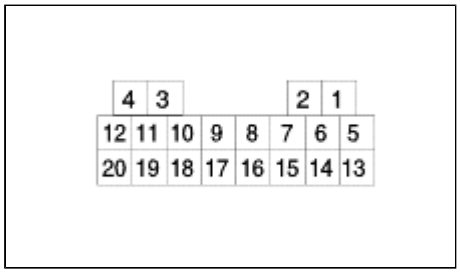


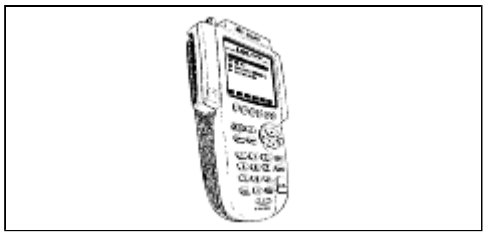
PIN CONNECTION

No.	Terminal
1	Battery
2	-
3	Coil antenna (+)
4	Ground
5	IGN. 1
6	DIAG. Tester (Hi-scan)
7	ENG - ECU
8	-
9	Coil antenna (-)
10	-

Shinchang immobilizer (For Canada)

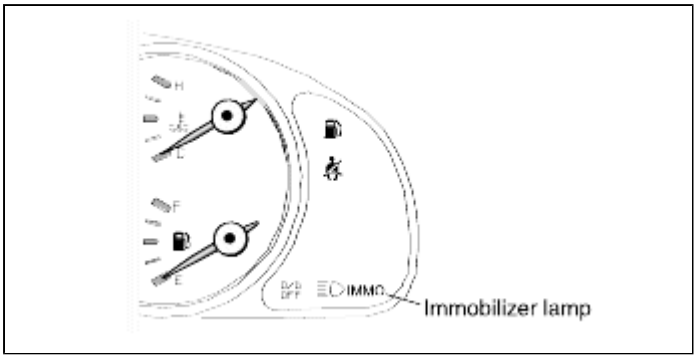
System components

<table>
<tr><th colspan="2">COMPONENT</th><th>DESCRIPTION</th></tr>
<tr><td>KEYS</td><td>ID KEY</td><td>Must be used first to register unique ID code in the ICM.
This ID code is then recorded into the master keys.</td></tr>
<tr><td rowspan="2">  </td><td>MASTER KEY</td><td>Once the ID code is recorded into the MASTER KEY, this key is for general use.</td></tr>
<tr><td>TRANSPONDER
(built-in-keys)</td><td>When ignition is ON, the coil supplies energy to the transponder, which in turn accumulates energy in the condenser.
Once the energy supplied from the coil has stopped, using the stored energy in the condenser, the transponder transmits the ID code.</td></tr>
<tr><td colspan="2">COIL ANTENNA
  </td><td>Supplies energy to the transponder.
Receives signal from the transponder.
Sends transponder signal to the ICM.</td></tr>
<tr><td colspan="2">IMMOBILIZER CONTROL MODULE
  </td><td>Supplies power to the coil antenna.
Receives and analyses signal from the coil antenna.
Transmits signal to ECM.
Stores VIN which is composed of ID code and password.</td></tr>
<tr><td colspan="2">ENGINE CONTROL MODULE
  </td><td>In the ignition ON position, the ECM receives information from the ICM and permits injection to take place.</td></tr>
<tr><td colspan="2">DATA LINK CONNECTOR
 
</td><td>By connecting the voltmeter or Hi-scan, the control module diagnostic code can be read.</td></tr>
<tr><td colspan="2">DIAGNOSTIC TESTER</td><td></td></tr>
</table>

	Has the function of ICM, ECM, and keys diagnosis and change.

IMMOBILIZER LAMP

Immobilizer lamp is indicator the state of immobilizer system.

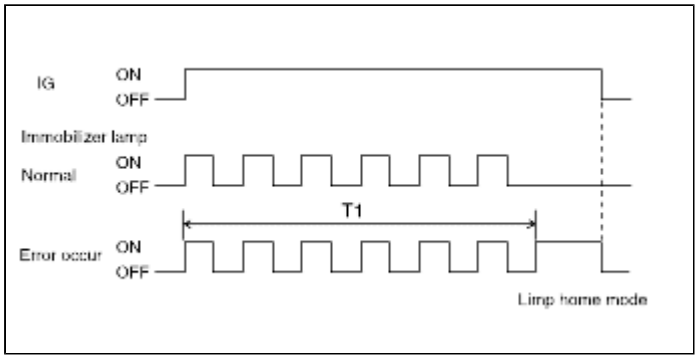


Cases of success (OK means):

1) Lamp should be blinked 5 times, when IG on, and then engine start is possible.

Cases of non-success (NG means):

1) If the transponder identification is failed or communication error is occurred, the lamp is continuously turned on and then the mode is entered into the limp home mode.
2) During limp home password entering sequence, the lamp reflects the IGN1 signal state : if IG is ON, then lamp is ON, if IG is OFF, then lamp is OFF.



Shinchang Immobilizer(For Canada)

Diagnosis of immobilizer related faults

Immobilizer related faults	Possible cause
Transponder communication error	1) Invalid transponder data
ECM communication link error	1) Invalid request from ECM or corrupted data
EEPROM communication error	1) Inconsistent data of EEPROM 2) Invalid write operation to EEPROM
ECM request signal error	1) There is no request code from ECM for 5 sec after ignition on

Diagnostic trouble codes and associated procedures

1. Locate the data link connector (DLC) in the engine compartment and install the Hi-Scan pro Tool.
2. Turn the ignition switch to ON and record any Diagnostic Trouble Codes displayed by Hi-Scan Pro Tool.
3. Refer to Diagnostic Trouble Code Chart, for fault description and actions.

Diagnostic trouble code (DTC) chart

Diagnostic Trouble Code	Fault Description	MIL
P1609	Immobilizer fault	OFF

Shinchang Immobilizer (For Canada)

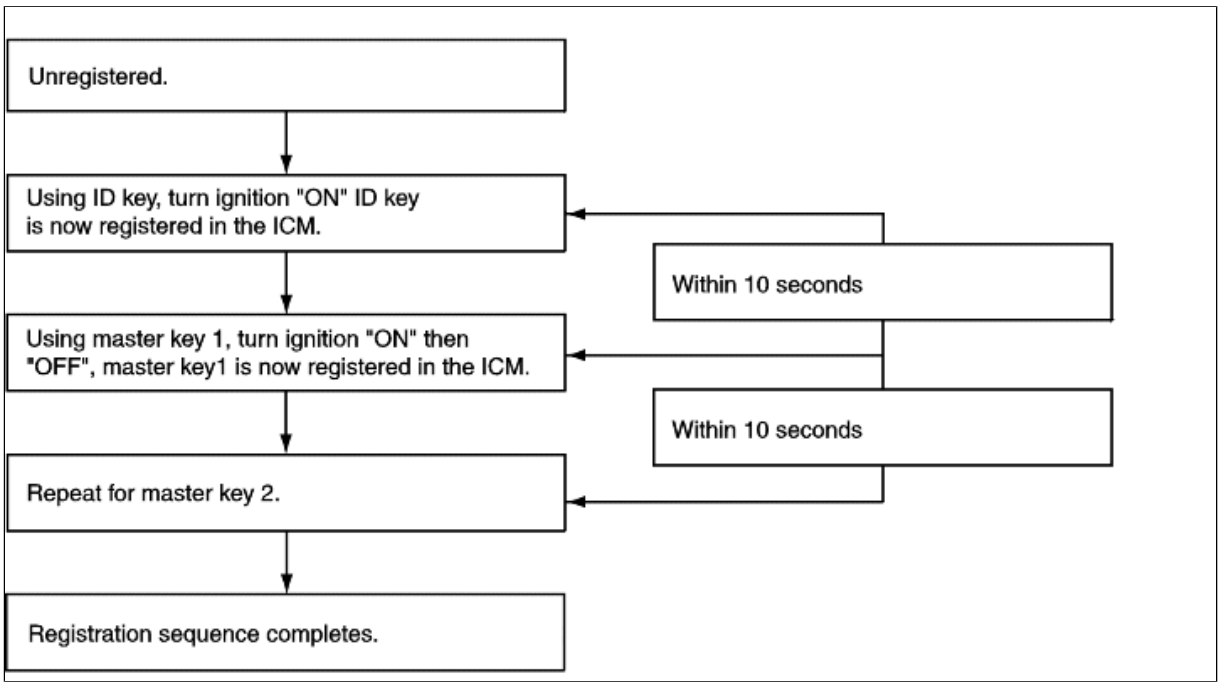
Password setting

Password can be used to register the master keys when you lost the ID key by using a tester (such as Hi-scan).

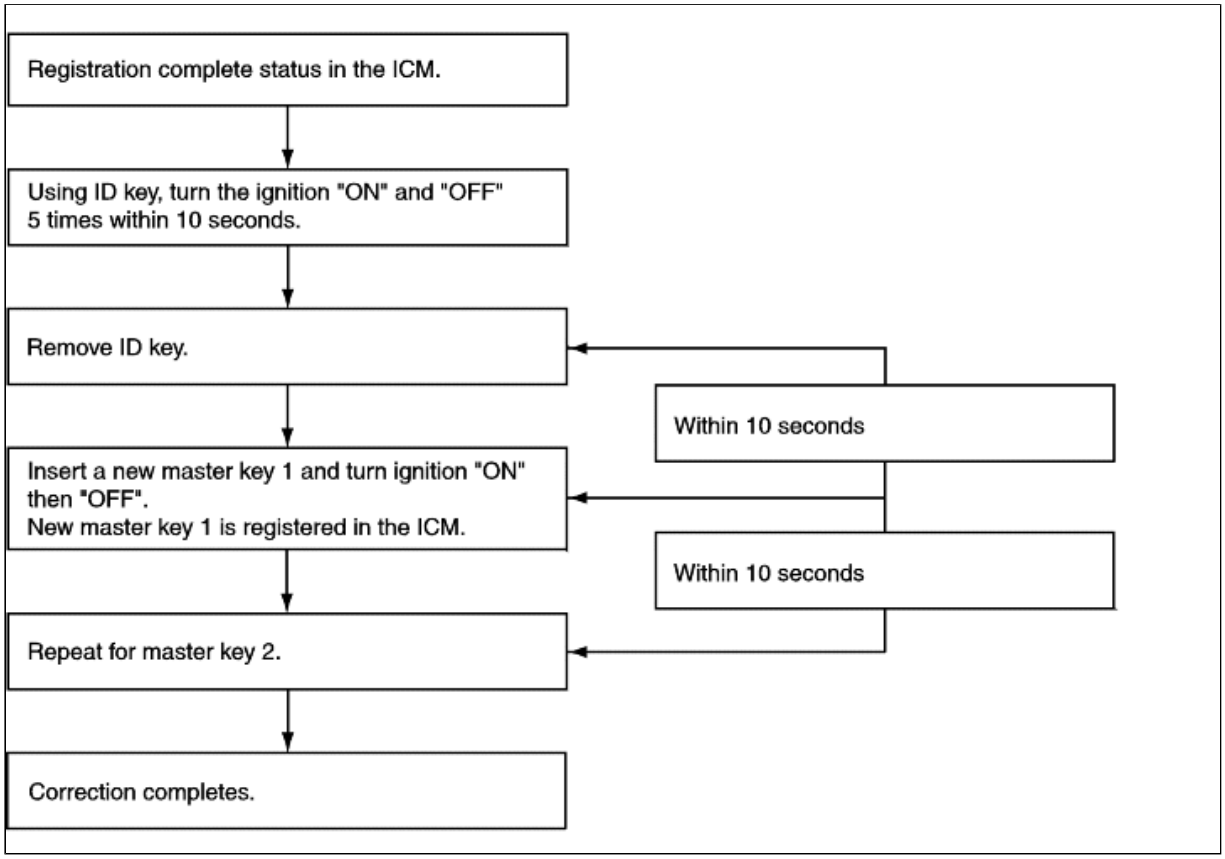
1. Initial password
   The initial password for ICM has been set by the manufacturer as 2345.
   Key can be registered and corrected by using the initial password until a new password is registered.
2. Password registration and ;change
   Using a tester(Hi-scan), the initial password(preset as2345 all) can be replaced by a new password nominated by the owner.
   4 numbers among 0-9 can be registered as password.
   Once the password has been changed from 2345, the ICM is ready to record the ID code.

Keys registration and correction

1. Initial registration method

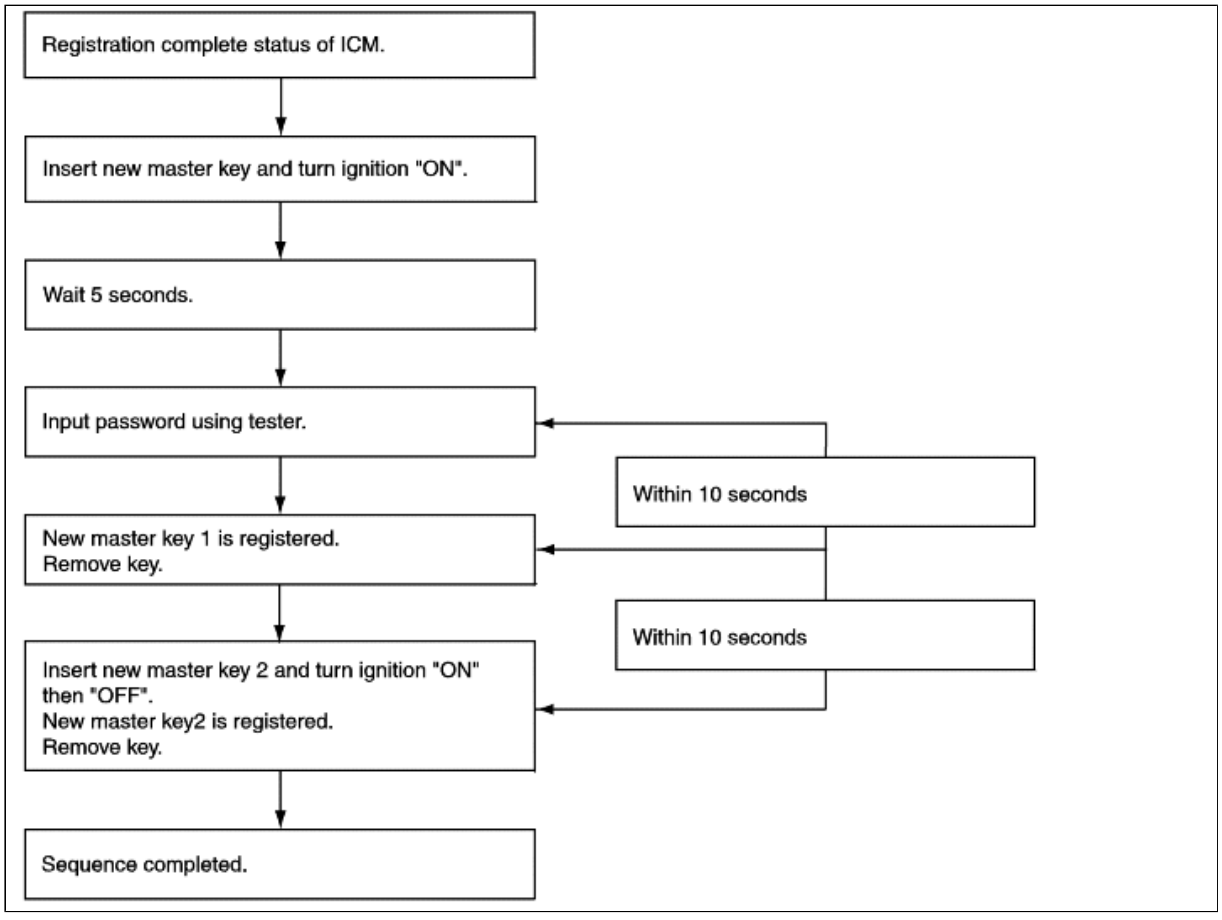


2. Registration correction for master keys
   In cases when the master key is lost or where a new set of master keys need to be produced, it can be achieved using two methods.
   (1) Using ID key



(2) Using password

When the customers lost the ID key, new master keys can be registered by using Hi-scan only.
ID key can not be corrected and reproduced.



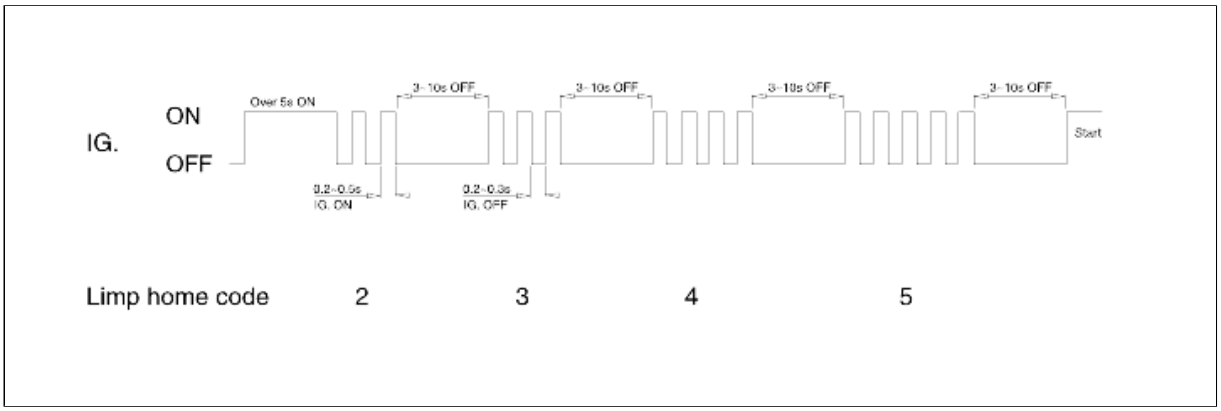
NOTE

Once the password is mis-registered, it is impossible to register new password during 10 seconds regardless of ignition ON/OFF.
When the new master keys have been registered, the codes for existing master keys are all cleared.

Limp home (override) procedure by ignition key

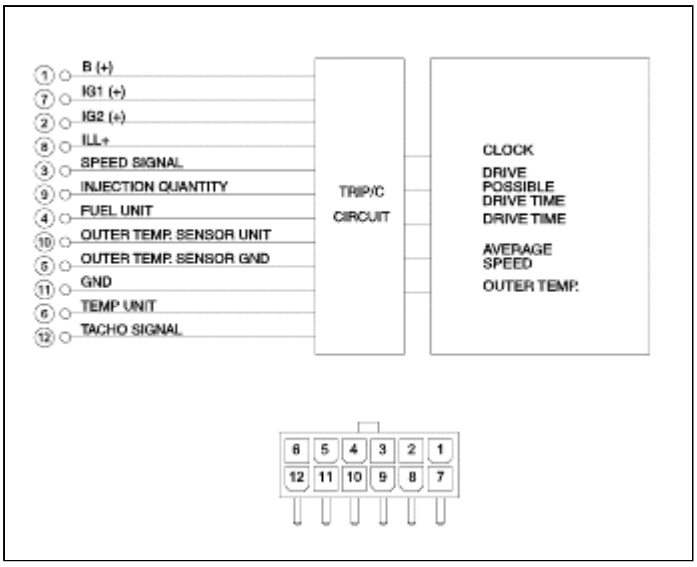
This procedure allows the unlocking of the EMS by entering the user password via the IG SW, in case the transponder code cannot be read or isunknown after ignition-ON, a valid transponder code must have been received, otherwise the EMS will remain "Locked" and the lamp will start blinking. This can happen through a malfunction of the transponder, the reading device or an unknown transponder code.
The number of IG ON/OFF must coincide with the password.

ECU Status	Is limp home procedure possible?
Learnt	Yes
Neutralized	No
Virgin	No



Only if the EMS is in status "learnt" and the user password status is "learnt" and the user password is the correct one, the EMS is unlocked for approximately 10 seconds. The engine can be started during this time. After elapsing of timer no engine start is possible. After new input of user password the time starts again.
After ignition off the EMS is locked. For next start the input of user password is requested again.

Circuit diagram



Description

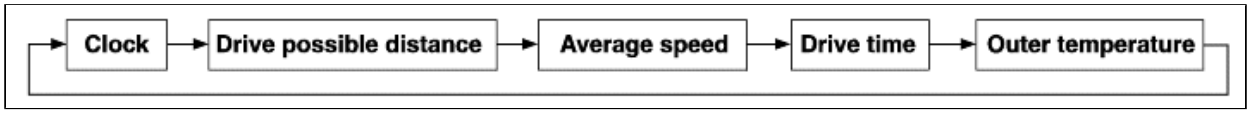
Trip computer reveives all the information related to the trip and displays various data for driving on the monitor. The trip data includes the average speed from the IGN-ON till the IGN-OFF, driving time, outside temperature, speed limit, driving distance, and distance to empty with remaining fuel.

Trip feature and related switches.

Display on monitor using related switches MODE, HOUR, MIN switches.

MODE switch

1) Pressing MODE switch shifts the mode clockwise as follows.



2) When the MODE switch is pressed for 1 second over in 29 minutes or less, the minutes will be reset to "00", and pressed for 1 second over in 30 minutes or more, the hour will be increased and the minutes will be reset to "00".
3) When the MODE switch is depressed for 1 second over in the average speed mode, the current accumulated average speed will be reset to 0.
4) When the MODE switch is depressed for 1 second over in the drive time mode, the current accumulated drive time will be reset to 0.

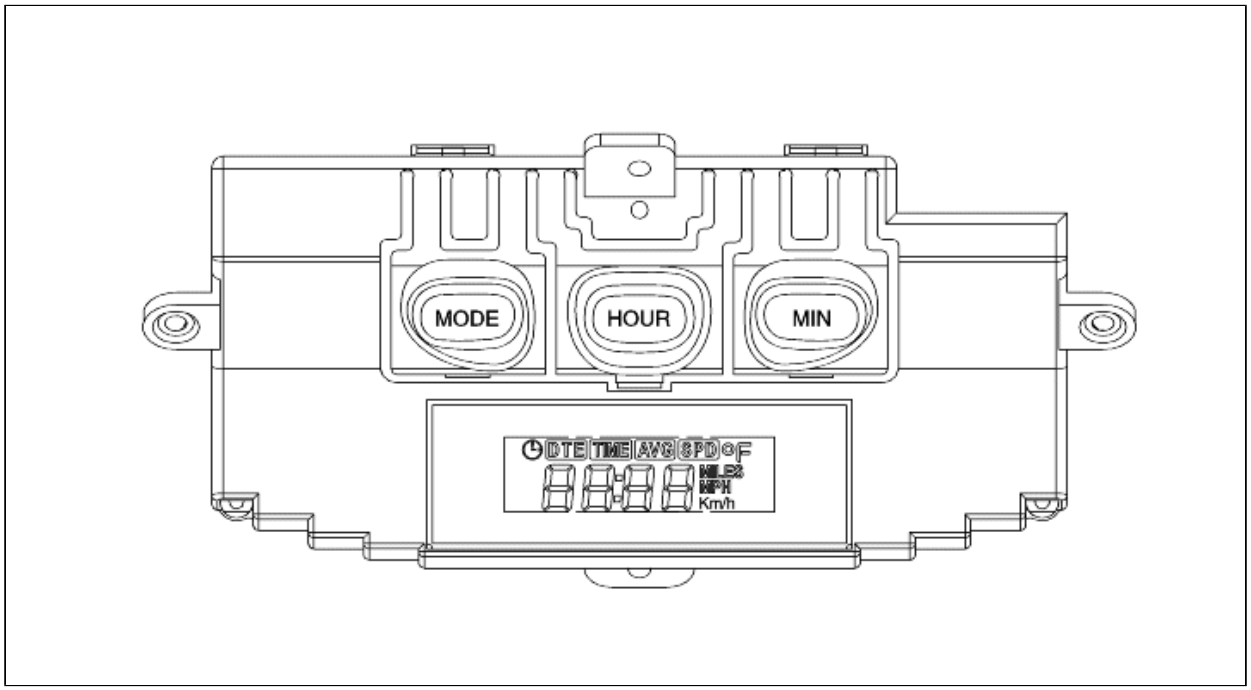
HOUR switch

1) Every time pressing "HOUR" switch, the hour will be up-counted.

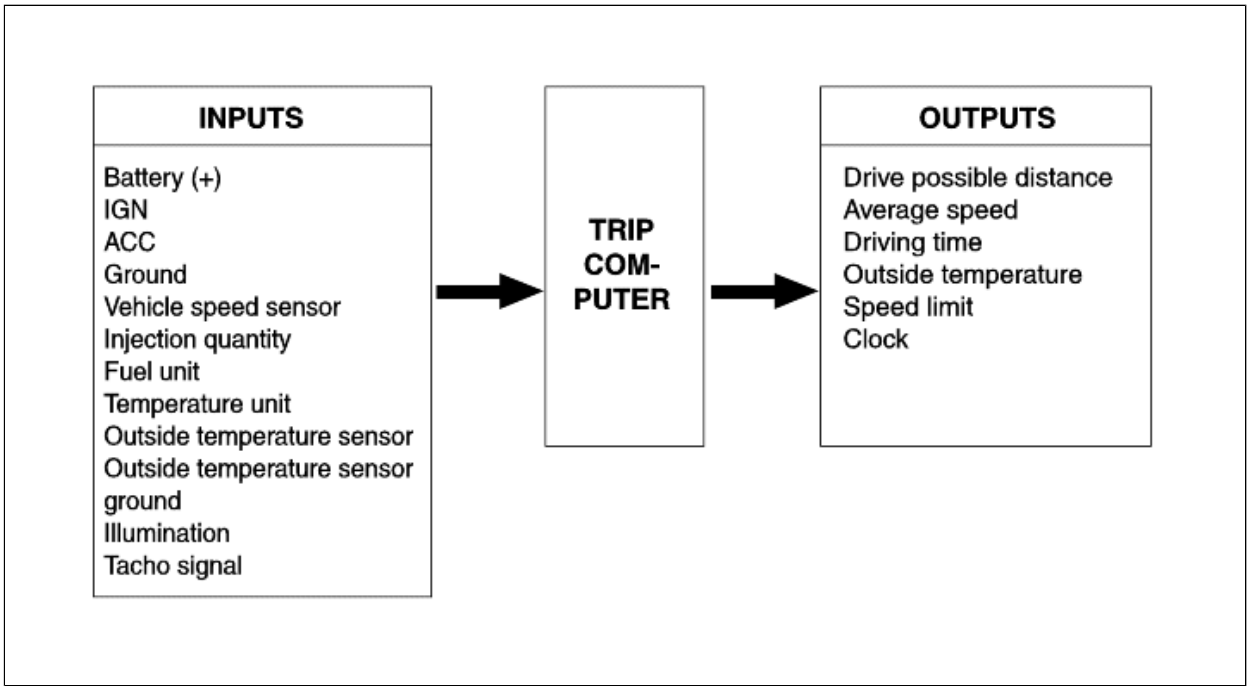
MIN switch

1) Every time pressing "MIN" switch, the minute will be up-counted.

Component



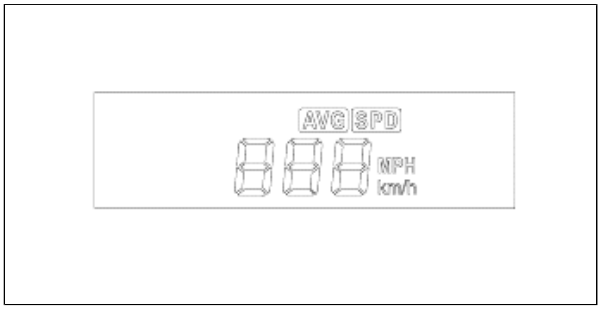
I/O diagram



Output specification

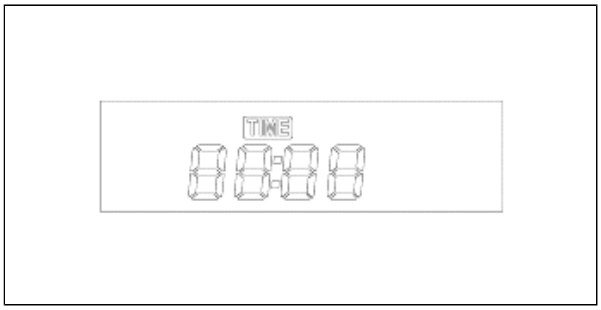
Average speed

1. Indication range : 0-999 MPH (km/h).
2. Indication average speed from detecting pulse upon the IGN ON to the IGN OFF.
3. Upon re-starting the engine, the last average speed will display.
4. When IGN OFF and the battery ground cable disconnected current accumulated value will be reset to "---".
5. Current accumulated value will be reset to "---" upon MODE switch ON for 1 second over.
6. Average speed = Accumulation driving distance/Accumulation driving time (After IGN ON)
7. Speed indication : update every 10 second.
8. Tolerance : ±0.4 %



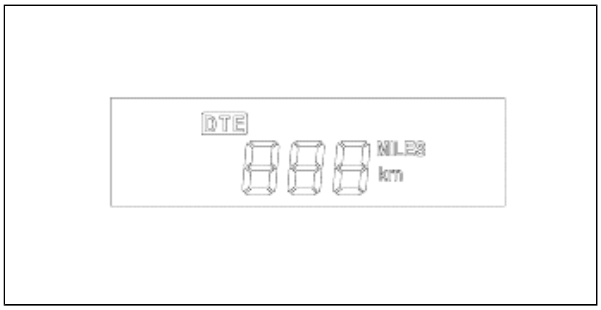
Driving time

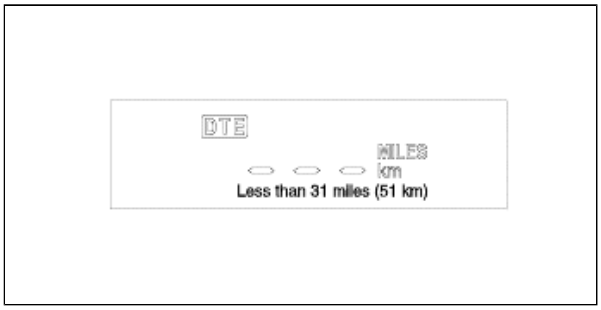
1. Indication range : 00:00~99:59
2. Indicates accumulated running time from the IGN ON to the IGN OFF.
3. Upon re-starting the engine, last running time will display.
4. Upon the MODE switch ON for 1 second over, the current accumulated value will be reset to "0".
5. When IGN OFF and the battery ground cable is disconnected, the accumulated value will be reset to "0".
6. Tolerance : 0.4%



Drive possible distance

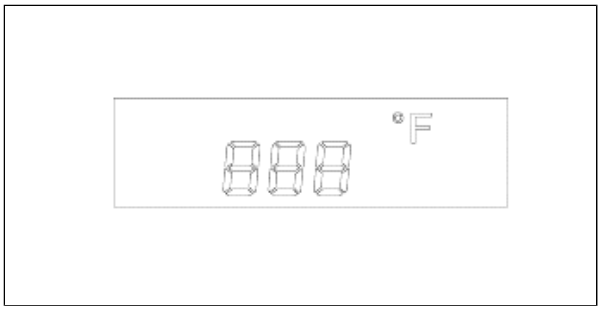
1. Indication range : 51~999 mile (31~995 km)
2. Indicates distance that the vehicle may be able to run with remaining fuel. If the drive possible distance is less than 31miles (51km), it display "---".
3. Upon re-starting the engine, the last drive possible distance will display.
4. Drive pissible distance =
   The rest amount of fuel x 32 mile (km)/The latest used amount of fuel during 32 mile driving.
5. Display interval : increase (+1mile (km)/45sec), decrease (-1mile (km)/15sec)
6. Tolerance : ±2%





Outside temperature

1. Indication range : -30°F ~ +149°F (-30~65°C)
2. Display the average outside temperature for 4 seconds using the outside temperature sensor installed on the radiator.



General

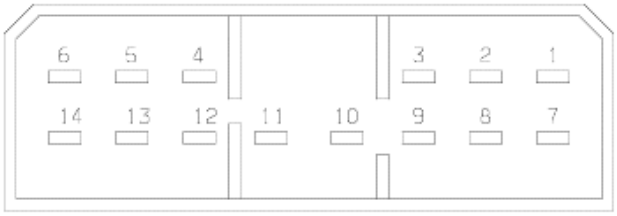
When reversing, the driver is not easy to find objects in the blind spots and to determine the distance from the object.In order to provide the driver safety and convenience, back warning system will operate upon shifting to "R". Ultrasonic sensor will emit ultrasonic wave rearward and detect the reflected wave. Control unit will calculate distance to the object using the sensor signal input and output buzzer alarm in three steps (first, second and third alarm).

Specification

Item		Specification
CONTROL UNIT	Voltage rating	DC 12V
	Operation voltage	DC 9 ~ 16 V
	Operation temperature	-30°C ~ +80°C
	Storage temperature	-40°C ~ +90°C
	Operation current	MAX 600mA
	Operation frequency	40 ± 5 KHz
	Detective method	Direct or indirect detection
ULTRASONIC SENSOR	Voltage rating	DC 8V
	Detecting range	25cm ~ 120 cm
	Operation voltage	DC 9~16
	Operation current	20 mA
	Operation temperature	-40°C ~ +90°C
	Beam width	Horizontal : 110cm, / Vertical : 50cm
	Number of sensors	4
PIEZO BUZZER	Voltage rating	DC 12V
	Operation voltage	DC 9 ~ 16 V
	Operation temperature	-30°C ~ +80°C
	Storage temperature	-40°C ~ +85°C
	Operation current	MAX 60 mA
	Sound, tone	Oscillation frequency : 2.2 ± 0.5 KHz
		Sound level : 70 dB (DC 13V, /m)

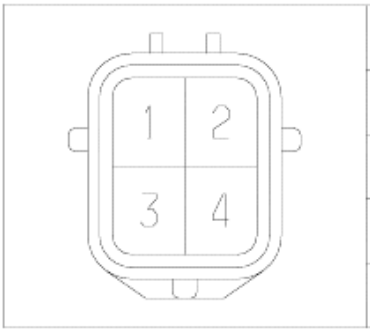
Control unit & sensor terminal alignment

Back warning unit



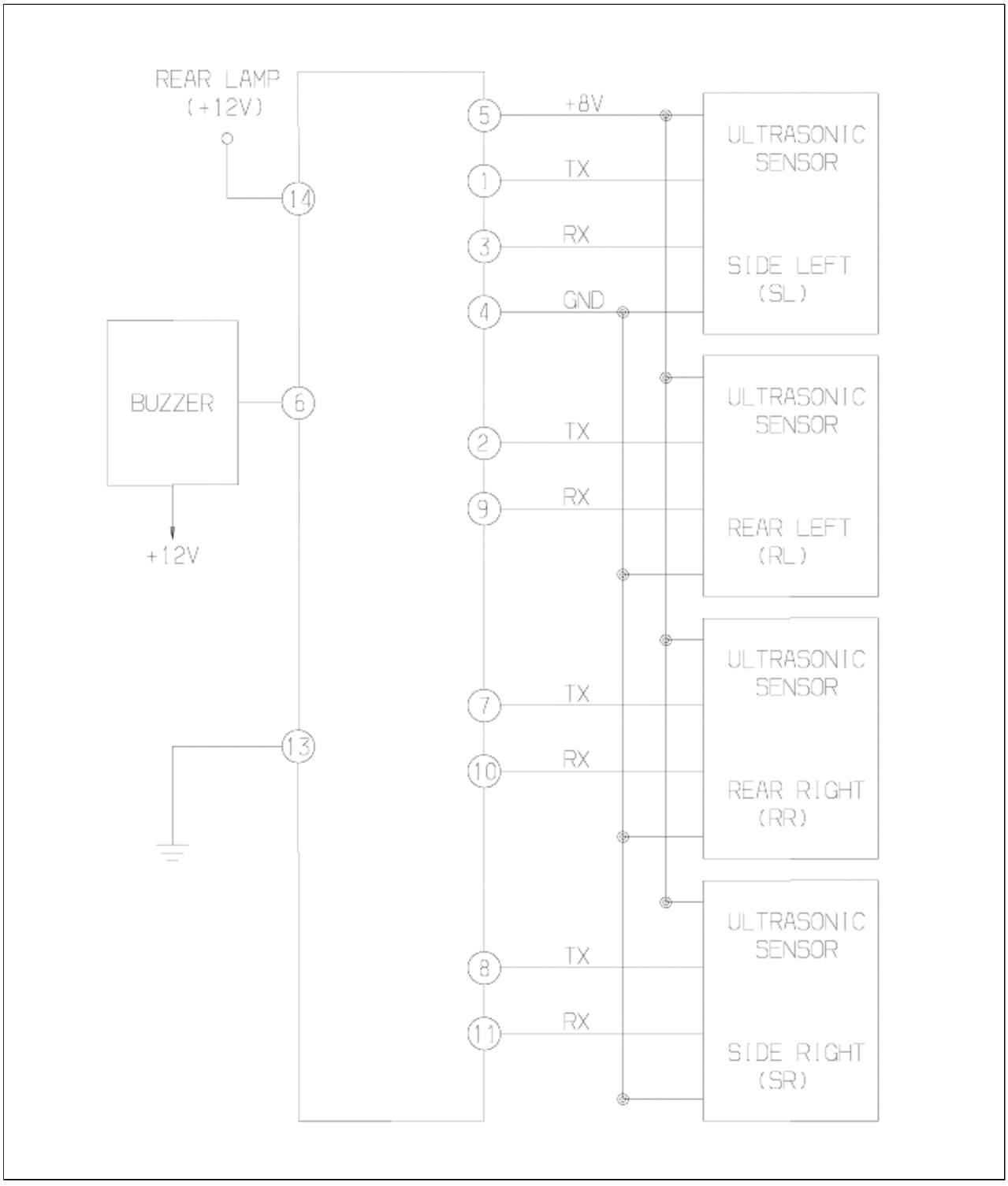
PIN	FUNCTION	PIN	FUNCTION
1	TX, SL SENSOR	8	TX, SR SENSOR
2	TX, RL SENSOR	9	RX, RL SENSOR
3	RX, SL SENSOR	10	RX, RR SENSOR
4	GND SENSOR	11	RX, SR SENSOR
5	+8V, SENSOR	12	N.C
6	BUZZER	13	GND
7	TX, RR SENSOR	14	REAR LAMP (+12V)

Back warning sensor



PIN NO	SIGNAL
1	TX
2	RX
3	8V
4	GND

Control unit outside circuit diagram

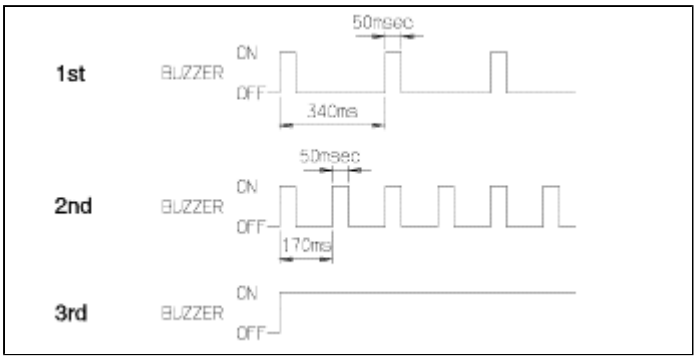

REAR LAMP
(+12V)
14
BUZZER
6
+12V
13
5
+8V
1
TX
3
RX
4
GND
ULTRASONIC
SENSOR
SIDE LEFT
(SL)
2
TX
9
RX
ULTRASONIC
SENSOR
REAR LEFT
(RL)
7
TX
10
RX
ULTRASONIC
SENSOR
REAR RIGHT
(RR)
8
TX
11
RX
ULTRASONIC
SENSOR
SIDE RIGHT
(SR)

Description

Control unit is installed in the rear washer compartment, located in the left side storage in the cargo area. Control unit will control the ultrasonic transmission and reception timing, determine the presence of objects, and detect a broken circuit.

Alarm range

Upon detecting an object at each range out of 3 ranges as stated below within the operation range, it will generate alarm.
First alarm : Object comes near to the sensor located at the rear of vehicle, within 81-120cm
Second alarm : Object comes near to the sensor located at the rear of vehicle, within 41-80cm
Third alarm : Object comes near to the sensor located at the rear of vehicle, within 40cm

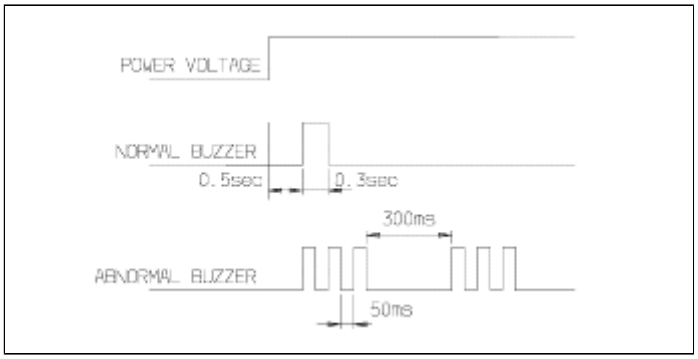


NOTE

1) Time tolerance of the above waveform : Time ± 10%
2) At nearer distance than 25cm, detection may not occur.
3) Alarm will be generated with vehicle reversing speed 5km/h or less.
   For moving target, maximum operation speed shall be target approach speed of 5km/h.
4) When the vehicle or the target is moving, sequential alarm generation or effective alarm may be failed.
5) Misalarm may occur in the following conditions.
   - Irregular road surface, gravel road, reversing toward grass.
   - Horn, motorcycle engine noise, large vehicle air brake, or other object generating ultrasonic wave is near.
   - When a wireless transmitter is used near to the sensor.
   - Dirt on the sensor.
6) Sequential alarm may not occur due to the reversing speed or the target shape.

Diagnosis and indication

1. Operate with ignition switch on and shift the lever to position "R".
2. Then it checks the system condition.
   If no trouble, it generates buzzer alarm sound for 0.065 seconds. In case of system failure, buzzer alarm is generated 3 times continuously with the interval of 0.05 seconds or it does not generate.
3. Effective operation range is 5km/h or less for the vehicle speed.
   (1) Diagnosis
   Ignition switch on and shift the lever to position "R" MICOM checks the sensor condition, and generates buzzer sound for 0.3 seconds if it is O.K.



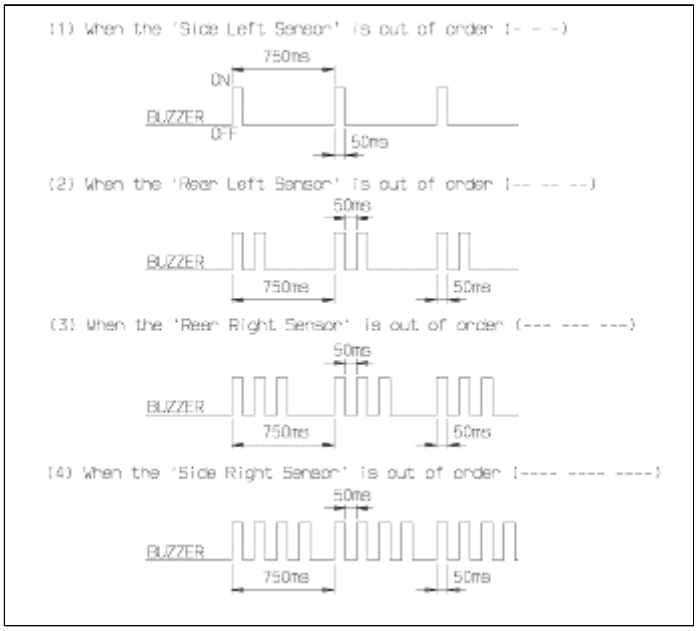
(2) Diagnosis mode

In case of system failure, turns on the repair switch that is installed at the back warning unit then it indicates the failed point as follows.

1) Side left sensor failure : beep-beep
2) Rear left sensor failure : beep beep-beep beep-beep beep-
3) Rear right sensor failure : beep beep beep-beep beep beep-beep beep beep-
4) Side right sensor failure : beep beep beep beep-beep beep beep beep

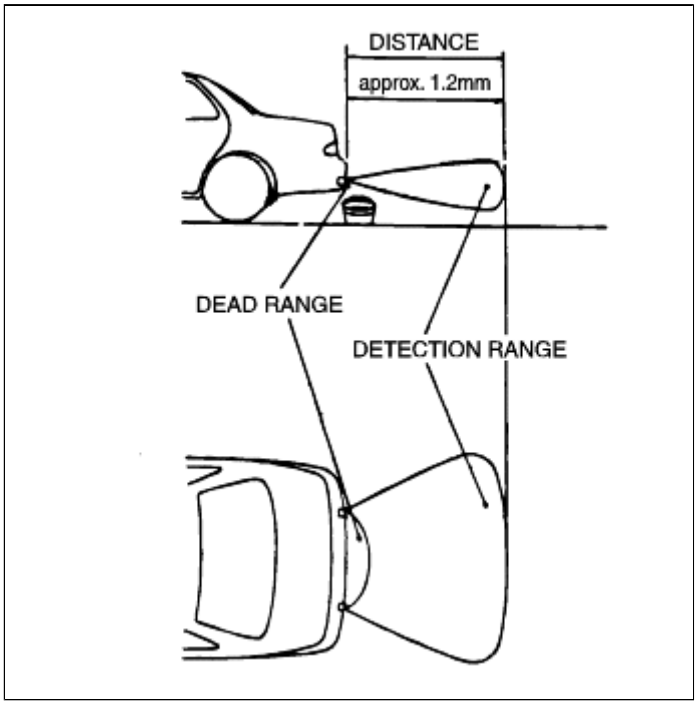
NOTE

Upon failure of two or more sensors, it generates alarm in the order of SL-RL-RR-SR sensor.

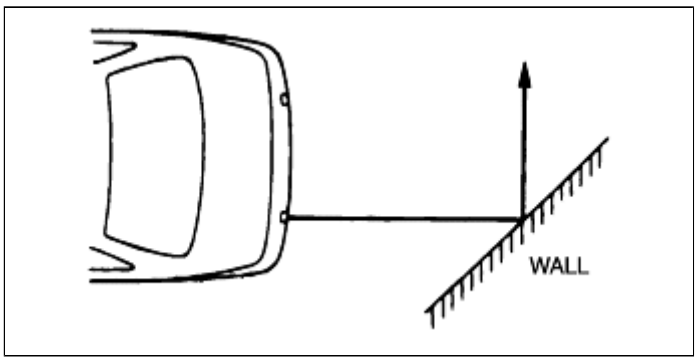


Warning

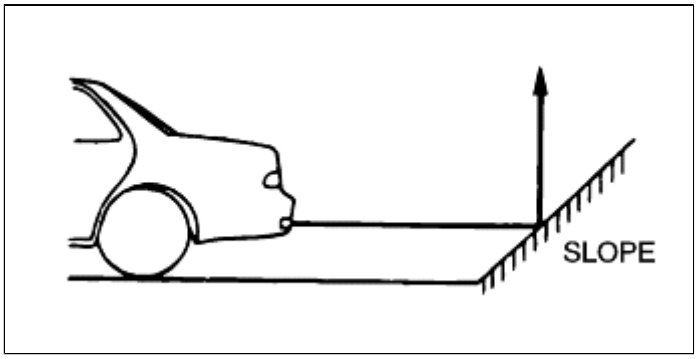
1. Range detected by back sensors is limited.
   Watch back before reversing.
2. There is a blind spot below the bumper. Low objects (for example boundary barrier) may be detected from minimum 1.2m away unable to detect at nearer.
3. Besides there are some materials unable to be detected even in detection range as follows.
   (1) Needles, ropes, rods, or other thin objects
   (2) Cotton, snow and other material absorbing ultrasonic wave
   (for example, fire extinguisher device covered with snow)



   (3) Reversing toward the sloped walls.



   (4) Reversing toward the sloped terrain.



4. False alarm may operate in the following condition : irregular road surface, gravel road, sloped road, grass. Upon alarmgeneration by grass the alarm may be generated by rock behind grass. Be sure to check for the safety.
   Back monitoring sensor cannot discriminate among glass, stake, and rock.
5. Sensors may not operate correctly in the below conditions.
   Ensure sensors clean from mud or dirt.
   When spraying the bumper, the sensor opening should be covered with something in order not to be contaminated.
   (1) If sensor opening is contaminated with mud, snow, or dirt, detection range will be reduced and alarm may not be generated under the crash condition. Dirt accumulated on the sensor opening shall be removed with water.
   Do not wipe or scrape sensor with a rod or a hard object.
   (2) If the sensor is frozen, alarm may not operate until sensor thaws.
   (3) If a vehicle stays under extremely hot or cold environment, the detection range may be reduced. It will be restored at the normal temperature.
   (4) When heavy cargo is loaded in trunk, it changes the vehicle balance, which reduces the detection range.
   (5) When other vehicle's horn, motorcycle engine noise, or other ultra-sonic wave sources are near.
   (6) Under heavy rain.
   (7) When reversing towards a vertical wall and the gap between the vehicle and the wall is 15cm. (Alarm may sound despite of no barrier)
   (8) If radio antenna is installed at the rear.
   (9) If the vehicle rear wiring is re-routed or and electrical component is added at the rear part.
   (10) Vehicle balance is changed due to the replacement of the rear spring.
   (11) The unit will operate normally when the vehicle speed is 5km/h or less. Above the speed, the unit may not operate normally.
6. Check the rear bumper for installation condition and deformation. If installed improperly or the sensor orientation is deviated, it may cause malfunction.
7. Be careful not to apply shock during sensor installation on the transmission or reception unit.
8. When adding electrical devices or modifying harness at the rear body of the vehicle, ensure not the change the transmission and reception unit wiring. Tagging the transmission side and reception side, it may cause malfunction.
9. High power radio transmitter (above 10W) may cause malfunction. Do not install it on the vehicle.
10. Be careful that heating or sharp objects shall not touch BWS ultrasonic sensor surface.
    Besides do not cover the sensor opening or press the sensor.

Ultrasonic sensor

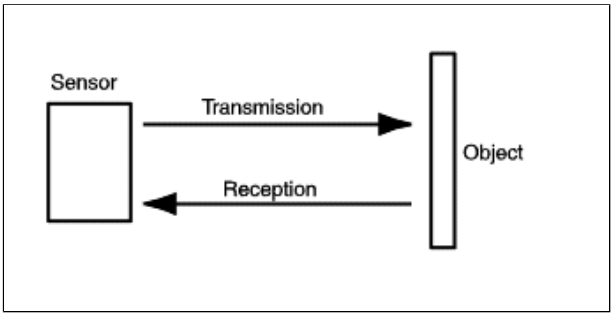
Operation principle

The sensor emits ultrasonic wave to the objects, and it measures the time until reflected wave returns, and calculates the distance to the object.

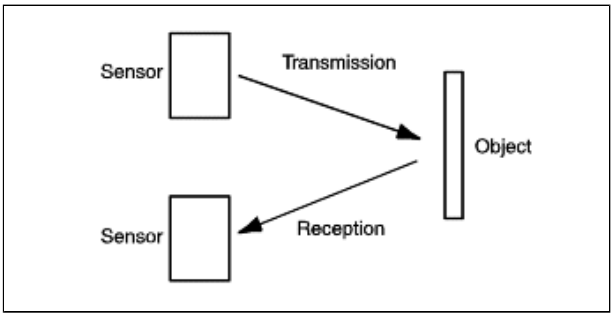
Distance detection type

Direct detection type and indirect detection type are used together for improving effectiveness of the detection.

1. Direct detection type : One sensor transmits and receives signals to measure the distance.

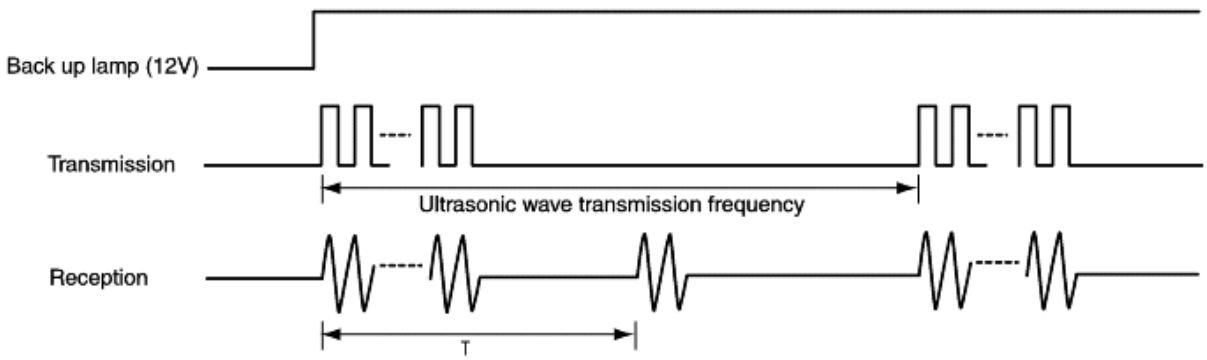


2. Indirect detection type : One sensor transmits signals and the other sensor receives the signals to measure the distance.



Measurement principle

Back warning system (BWS) is a complementary device for reversing. BWS detects objects behind vehicle and provides the driver with buzzer alarm finding objects in a certain area, using ultrasonic wave propagation speed and time.
The propagation speed formula of ultrasonic wave in air is following:
v=331.5 + 0.6t (m/s)
v=ultrasonic wave propagation speed
t=ambient temperature
The basic principle of distance measurement using ultrasonic wave is:



D = (T X V)/2[m]
D = Distance to object

V = Ultrasonic wave speed [340m/s]
T = Ultrasonic wave propagation time

NOTE

1) 14cm (dia.) plastic rod is used for the test target.
2) The test result may differ by a different target object.
3) Detection range may be reduced by dirt accumulated on sensor, and extremely hot or cold weather.
4) The following object may not be detected.
   - Sharp object or thin object like rope.
   - Cotton sponge, snow or other materials absorbing sonic wave.
   - Smaller objects than 14cm (dia.), 1m length.

Belts & Chains

KIA SEDONA 2.9 diesel

Kia say renewing the timing belt on a diesel Sedona is an engine-out job. We say it isn't. And we've proved it. Peter Simpson explains.

Overall view of the engine bay. The timing belt assembly is on the offside of the engine, very tight up against the offside inner wing. In theory the engine has to be lifted or lowered to access the belt, but as we're about to see, there is another way.

Although most Kia models are regarded as rather cheap and cheerful – an image the manufacturer does little to dispel in its advertising – the 1999-2006 Sedona MPV has a rather different image, and a very strong one. When production finished last year, entry-level for a diesel was around £16,000. That's a good £3,000 less than the comparable Galaxy, for a car with at least the same comfort and equipment levels.

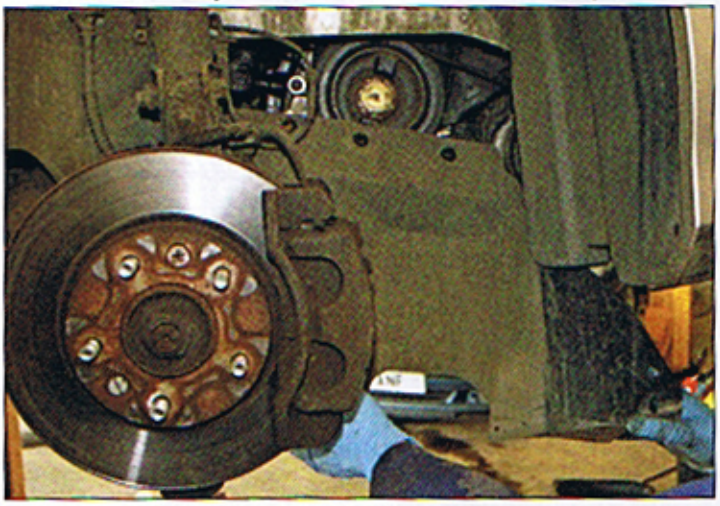
Overall durability has proved to be pretty good, too. Quite a few diesel Sedonas have been bought for taxi/private-hire work, and consequently have clocked up massive mileages. By and large, maintenance is straightforward, with just one exception – the timing belt change.

This, we believe, is meant to be an engine-out job for which the 'book' time is around ten hours. Kia dealers don't usually have massively high labour rates by main dealer standards, and they are, of course, well used to the job, but even so, you're unlikely to get the job done for much less than £600-700. The other point is that it's not always practical to extract a huge 2.9 diesel in a DIY environment – even if you've got the space and an engine crane, it might not be man enough for the job.

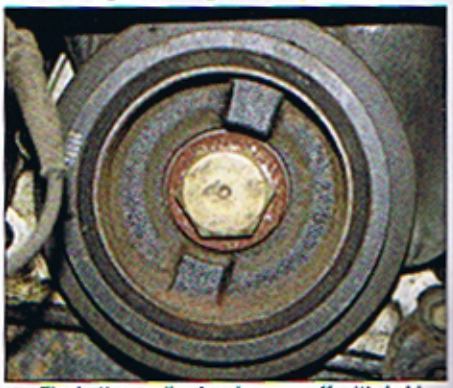
We were alerted to this problem by a Sedona-owning reader in Lincolnshire whose car was coming up to the 54,000 mile belt change and who was, understandably enough, wondering if there was another way. I in turn mentioned it to the chaps at John Sharpe Motors, who were sure that there must be, and agreed to give it a go.

1 To start, a certain amount of deck clearing is required – exactly what will vary slightly according to the precise model, but the power-steering reservoir will always need moving. No need to break into the fluid circuit. Just unbolt it and wire it out of the way.

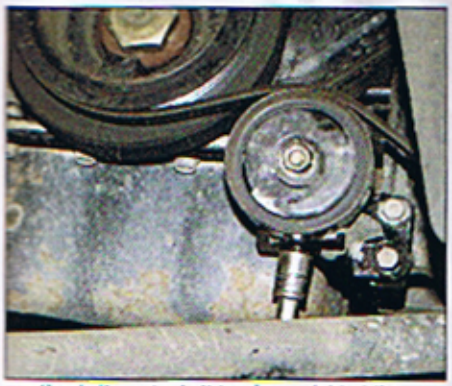
2 You'll also need to disconnect the radiator top hose which, of course, involves draining the cooling system. The garage have a hose-clip releasing tool which saves time, but this is not essential as pliers or locking grips will do.



3 There is also an access cover in the offside front wheelarch which has to come off to give access to the bottom pulley and outer drivebelt. The awkward bit is above this and blocked in by the inner wing and main chassis leg.

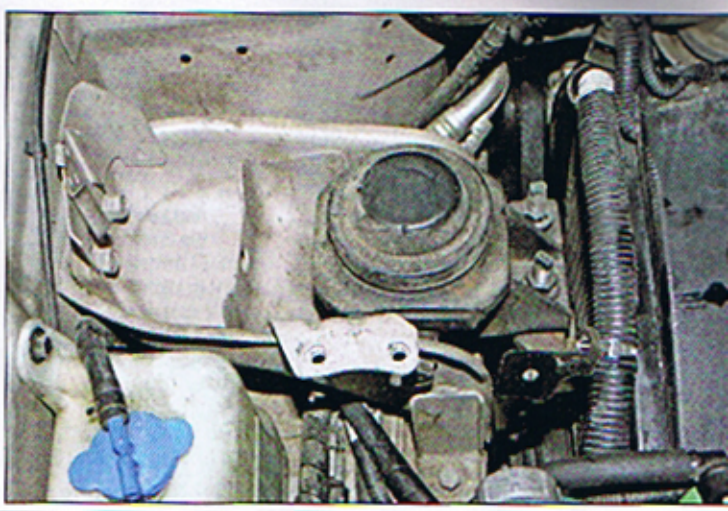


4 The bottom pulley has to come off – it's held on by a 1½in (or 38mm) headed bolt – make sure you've got one of these before you start! It's likely to be tight, and therefore I advise 'cracking' it with the outer belt still on.

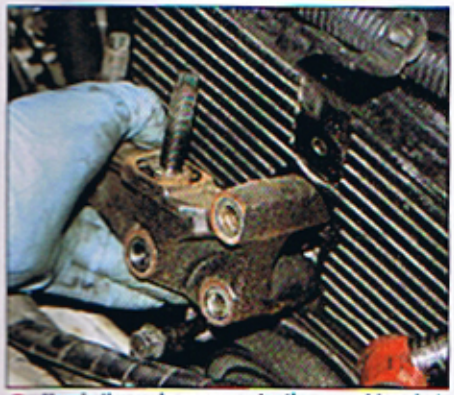


5 Here's the outer belt tensioner, right at the bottom and accessed through the offside front wheelarch. De-tension it by undoing the upward-pointing bolt until the belt is loose enough to come off, and then unthread it.

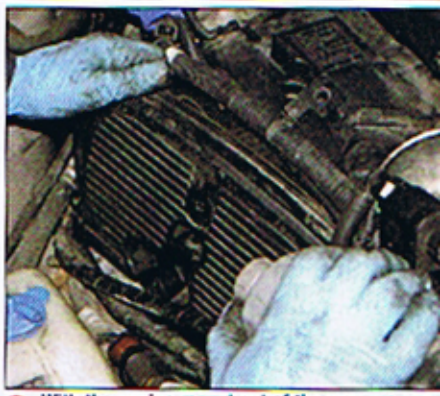
6 Now we need to tackle the top engine mount. This comes away in two stages, but obviously you need to support the engine underneath first. How you do this will depend on whether the car is on a ramp or over a pit.



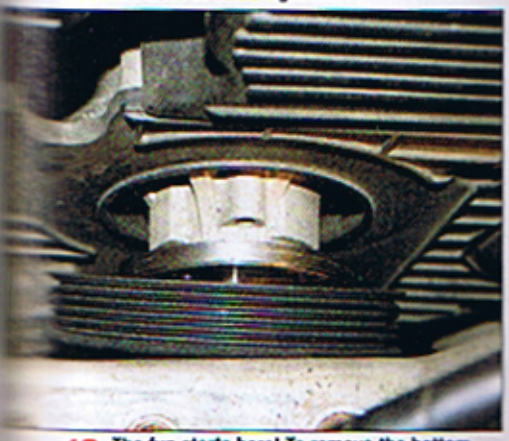
7 Then you can undo and remove the top part of the mounting followed by its mounting bracket, which needs removing for access. As you can see, the fuel filter also has to be dismounted, but again it doesn't have to come right off.



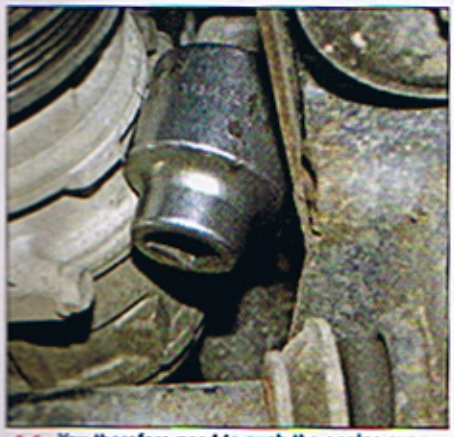
8 Here's the main reason why the mount bracket has to come off – it makes access to the engine mounting bracket that's attached to the engine far easier. That, too, has to come off as it sits over the belt cover.



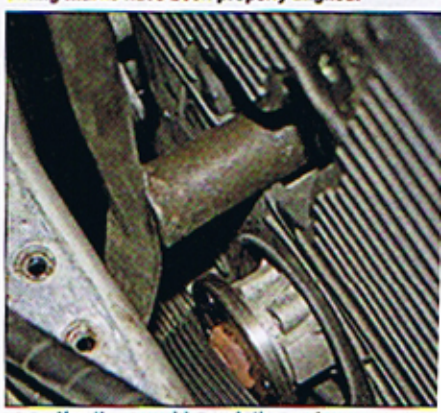
9 With the engine mount out of the way, we can now unbolt and remove the top half of the timing cover revealing the top part of the timing belt. Do not remove any of the belt until all the timing marks have been properly aligned.



10 The fun starts here! To remove the bottom half of the timing belt cover, the waterpump pulley has to come off – four 10mm headed bolts. Getting a ring spanner onto them isn't easy, but even then, there just isn't room to get the pulley off!

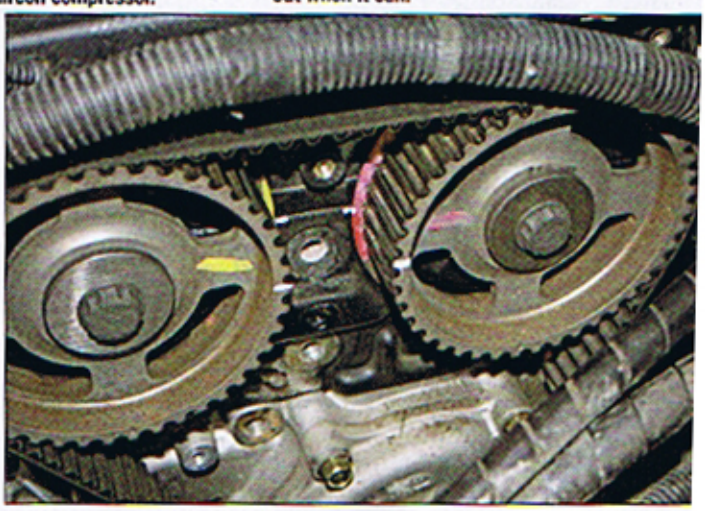


11 You therefore need to push the engine over about half an inch so it will come out. Sounds easy, but trust me, it isn't! This is what worked for us. First pop a piece of 'packing' like this in between subframe and aircon compressor.



12 You then need to push the engine across using a bar and another packing piece – a brass drift is ideal – like this. As you can see, we worked from the top at this stage, but you'll need underneath access later. The pulley will just drop out when it can.

13 Then undo the bolts holding the lower timing cover in place and pull that down and off. You'll need an assistant to pull on the bar while you do this – possibly from underneath – see pics 19/20. If it breaks that's quite usual, but do ensure you get all the bits out.



14 Before removing the belt, we must line up all the marks. You can get a made set of locking tools but they aren't strictly necessary if you are careful. Here are the camshaft marks – highlighted with the usual typists' correction fluid.

Belts & Chains

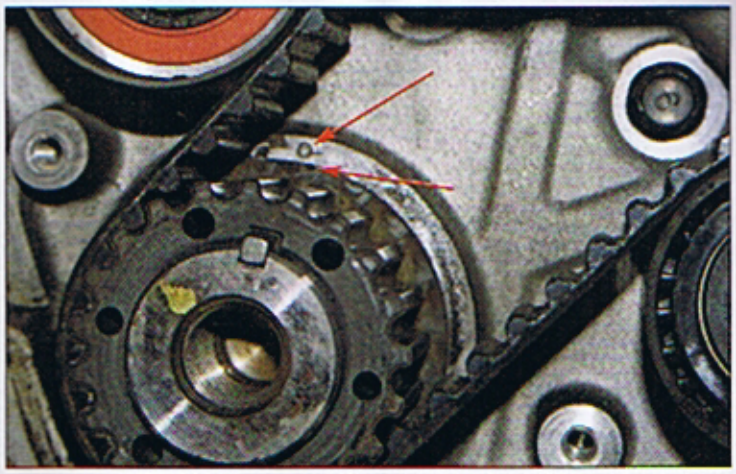
CONTINUED

KEYHOLE SURGERY!

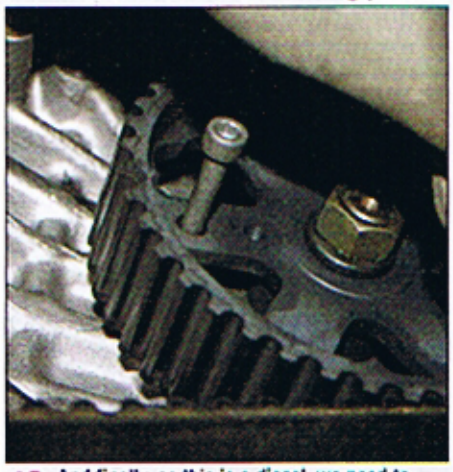
The problem, of course, is access between the belts and the inner wing. Basically with the engine in place, it's all-but impossible to get the water pump pulley off, and this has to come off before you can extract the timing belt cover. Access for the cover is tricky, too. In this situation, it's usual to provide an access hatch or two in the inner wing, but in this case, that's not possible because the main chassis leg runs directly in front of the pulley.

The overall strategy, then, is to remove as much stuff as is possible/necessary and then lever the engine as far over as you can, so the pulley and cover will come out. It is normal for the timing cover to break as it comes out. We were advised of this when we obtained the belt and accordingly bought a new one at the same time. We did not, however, renew the idler. This again, according to the Kia dealership, isn't essential at every belt change unless the old one is actually defective, and since they're around £200, it's a cost to avoid if at all possible. They apparently don't do it unless actually needed – and that was good enough for us!

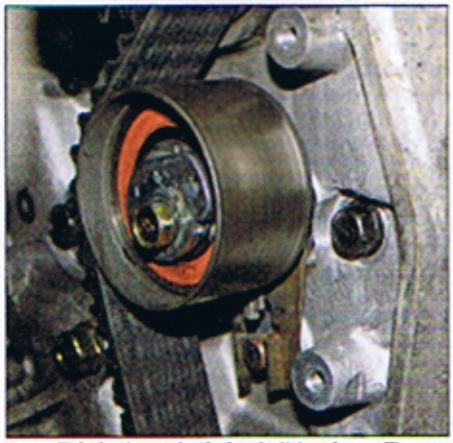
Anyway, the picture sequence shows the key stages. I've shown the difficult/unusual parts of the job in detail, but due to lack of space, haven't illustrated the actual belt change. That's because this part of the job is totally conventional – it's the usual case of keeping the timing marks aligned, fitting the belt so tension on all the untensioned parts is even, and then run it through two full revolutions to ensure it's still aligned at the end. I imagine that anyone tackling a belt change on this car will have done at least one before on a simpler installation, and therefore be familiar with all this anyway. I have, though, shown where all the timing marks are, and how to tension the new belt correctly.



15 And here are the crank marks – arrowed. In fact it is slightly 'off' in this shot as you can see the bottom one more clearly that way. The semi-circle in the bottom part has to align exactly with the circle on top.



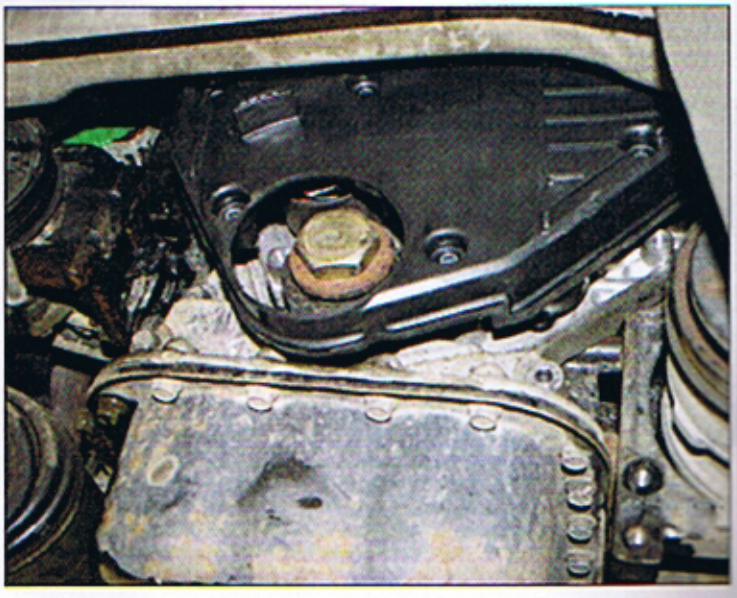
16 And finally, as this is a diesel, we need to lock the fuel injection pump in position. This is where a tool is needed, but it's only the standard 6mm pin, so substitute a 6mm drill if by any chance you don't have a pin to hand.



17 This is the main timing belt tensioner. The tension is correct when the centre of the pointer at the bottom (arrowed) is aligned with the centre of the pin below it. Move using an Allen key in the hexagon-shaped hole and secure by tightening the bolt – 15Nm max!

18 To get the new cover on, you need to move the engine over again, and here it's easiest to do it from underneath using, as you can see, a very long bar as a lever.

19 Here is where and how you need the bar to bite – between the aircon pump and the tie bar. This, again, is definitely a two-man job: one to operate the bar, the other to feed the new cover up and into place.



20 Almost there! The new cover is now in, so the next job is to repeat the bar work shown in pictures 12 and 13 to get the water pump pulley back on. And there it is, up and in!

Engine Mechanical System

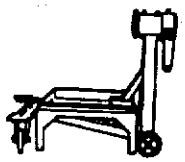
ENGINE SYSTEM EM-2
COOLING SYSTEM EM-40
LUBRICATION SYSTEM EM-44
INTAKE AND EXHAUST SYSTEM EM-48

SPECIAL SERVICE TOOLS

Engine
Special service tools

0K130 990 007

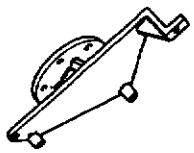
Engine stand



Used to disassemble and assemble engine.

0K410 101 004

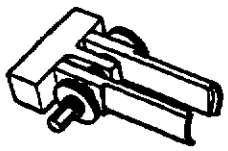
Hanger, engine stand



Used to disassemble and assemble engine.

0K993 120 004

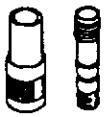
Pivot, valve spring lifter



Used to remove and install valve.

0K710 120 004

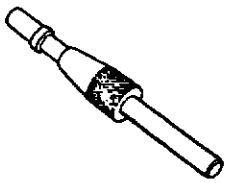
Installer, valve seal



Used to install valve seal.

0K130 160 010

Centering tool, clutch disc



Used to install clutch disc and clutch cover.

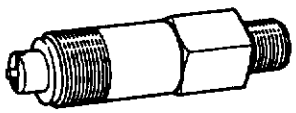
0K552 111 001

Holder, camshaft pulley

Used to install camshaft pulley.

0K552 131 002

Adapter, compression gauge



Used to measure compression pressure.

0K993 120 001

Arm, valve spring lifter

Used to remove and install valve.

Problem	Possible Cause	Action to be taken
White smoke out of exhaust	Usually caused by water vapor, which is a normal by product of combustion on cold days. Excessive white smoke with engine warmed up could be caused by a failed cylinder head or intake gasket, could also be cracked block, cylinder head or intake manifold.	None required Repair or replace
Black smoke out of exhaust	Malfunction of fuel system Malfunction of emission system	Refer to section FL, fuel system Refer to section EC, emission control system
Abnormal combustion	Sticking or burned valve Weak or broken valve spring Carbon accumulation in combustion chamber	Replace Replace Eliminate the carbon
Poor idling	Malfunction of fuel system Malfunction of emission system Uneven cylinder compression Poor valve to valve seat contact Broken valve spring Failed cylinder head gasket	Refer to section FL, fuel system Refer to section EC, emission control system Repair Repair or replace Repair Replace
Turbocharger noise	Contaminated air cleaner element Foreign material in intake duct or compressor housing Foreign material between intake manifold and compressor Foreign material in engine exhaust system Carbon deposit on turbine housing Interference between turbocharger rotating parts Loose connecting parts of intake and exhaust system	Replace Clean Clean Clean Clean Repair or replace Tighten
Engine knocks when hot and at idle **Slight noise at idle, becomes louder as engine speed is increased**	Loose or worn accessory drive belt/tensioner Improper oil viscosity Excessive piston pin clearance Connecting rod alignment Insufficient piston to bore clearance Faulty timing belt tensioner or guide Loose damper pulley Valve spring clicking on cap, off square or broken Excessive stem to guide clearance Excessive valve seat runout Holed exhaust pipe	Replace if necessary Install proper oil viscosity for expected temperature Install new piston pin and/or connecting rod Check and replace Hone and fit new pistons Replace Tighten or replace Repair or replace Repair Repair Replace
Engine knoks when cold	Excessive piston to wall clearance Loose or broken damper pulley	Replace Tighten or replace
Knock increase with torque	Excessive piston to bore clearance Bent connecting rod	Replace piston Replace
Engine has heavy knock when hot and torque is applied	Broken damper pulley Accessory belts too tight or damaged Belt tensioner damaged Flywheel cracked or loose clutch plate Excessive main bearing clearance Excessive rod bearing clearance	Replace Adjust or replace belt Replace Replace flywheel or clutch plate Repair Repair

Problem	Possible Cause	Action to be taken
Engine has light knock when hot and under light load conditions	Improper timing Piston pin and/or connecting rod Poor quality fuel Exhaust leak at manifold Excessive rod bearing clearance	Check timing Replace Replace Tighten or replace Repair
Engine knocks on initial start up and knock lasts only a few seconds	Improper oil viscosity	Install proper oil viscosity for expected temperature
Interference of turbocharger, poor rotation	Damaged compressor blades due to external cause Interference of turbine and compressor blades with housing Excessive deposit on compressor housing or wheel Excessive carbon deposit on the back of turbine blade Burn out of center housing	Repair or replace Repair or replace Clean or repair Clean or repair Replace
Leakage from turbocharger turbine shaft	Excessive initial oil applying Blocked crankcase breather Obstacle in turbocharger oil drain line Burn out of center housing Wear on turbocharger bearing, bearing bore or shaft journal Excessive crankcase oil	Burn it normally Repair Clean and repair Clean and replace Repair or replace Correct oil amount
Leakage from turbocharger compressor	Contaminated air cleaner element Blocked duct between compressor and air cleaner Loose compressor and intake system connecting duct Leakage from intake manifold Obstacle in turbocharger oil drain line Blocked blowby passage in crankcase Worn or damaged compressor blades Wear or turbocharger bearing bore, bearing or shaft journal	Replace Repair Tighten Repair Repair or replace Repair Clean or replace Replace
Wear on turbocharger bearing, bore or shaft journal	Contaminated oil Insufficient oil supply Obstacle in turbocharger oil supply line Plugged oil filter Poor oil pump operation	Replace Check Check and repair Replace Check and repair

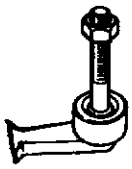
0K993 120 006

Remover, valve seal

Used to remove valve seal.

0K590 111 001

Ring gear brake set



Used to prevent engine rotation.

0K130 111 004

Holder, coupling flange

Used to remove camshaft gear.

SYMPTOM-RELATED DIAGNOSTIC PROCEDURE

Engine

Diagnostic chart

Problem	Possible Cause	Action to be taken
Insufficient power smoke generation	Insufficient compression caused by: 1. Contaminated air cleaner element 2. Loose hose connection between compressor and intercooler 3. Leakage from intake manifold 4. Leakage from exhaust manifold 5. Leakage from turbocharger mounting flange 6. Interference between turbocharger compressor turbine and case 7. Blocked duct between air cleaner and turbocharger compressor 8. Blocked duct between compressor and intake manifold 9. Interference between intake and exhaust manifolds 10. Leakage from valve seat 11. Seized valve stem 12. Weak or broken valve spring 13. Failed cylinder head gasket 14. Cracked or distorted cylinder head 15. Sticking, damaged, or worn piston ring 16. Cracked or worn piston	
	Malfunction of fuel system	Refer to section FL, fuel system
	Slipping clutch	Refer to section CH, clutch
	Wrong tire size	Refer to section SS, wheel and tires
	Restricted exhaust system	Refer to section EM-IE, exhaust system
Excessive oil consumption	Abnormal engine oil viscosity	Replace
	Leakage from turbocharger compressor (adhesion of oil to housing or wheel)	Repair
	Leakage turbocharger turbine	Repair
	Worn or sticking piston ring or groove	Replace
	Worn piston or cylinder	Repair or replace
	Bad valve seal	Replace
	Worn valve stem or guide	Replace
Engine cranks normally, but does not start	Malfunction of fuel system	Refer to section FL, fuel system
	Malfunction of electrical system	Refer to section EE, starting system
	Restricted exhaust system	Refer to section EM-IE, exhaust system
	Timing belt and/or related parts	Replace
	Low compression	
	Camshaft worn	
Blue smoke out of exhaust	Usually caused by oil burning in the combustion chamber from: worn rings, worn valve guides, worn valve seals or failed cylinder head gasket	Replace
	Contaminated air cleaner element	
	Loose hose connection between compressor and intercooler	Tighten
	Leakage from intake manifold	Repair
	Blocked oil filter	Replace
	Blocked duct between air cleaner and turbocharger compressor	Repair
	Leakage from turbocharger compressor	Repair

SPECIFICATION

Engine

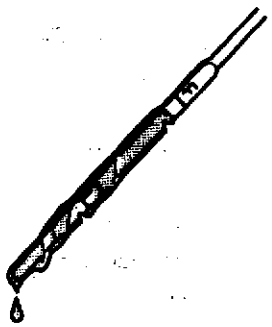
Specification

Item \ Engine model			J3 COMMON RAIL SYSTEM
Type			Diesel, 4-Cycles
Number of cylinders			4-Cylinder in-line
Combustion chamber			Re-entrant
Displacement cu. in (cc)			177 (2902)
Bore and stroke in (mm)			3.82 X 3.85 (97.1 X 98)
Compression ratio			19.3
Compression pressure psi (kPa, kg/cm²)-rpm			426.6 (2943, 30) - 200
Valve timing	Intake	Open	BTDC 26°
		Closed	ABDC 50°
	Exhaust	Open	BBDC 50°
		Closed	ATDC 29°
Valve clearance(cold engine) in (mm)		Intake	0 : Maintenance-free
		Exhaust	0 : Maintenance-free
Idle speed rpm			800 ±100
Injection order			1-3-4-2

ON-VEHICLE SERVICE PROCEDURE

Engine oil

1. Be sure the vehicle is on level ground.
2. Warm up the engine to normal operating temperature and stop it.
3. Wait for 5 minutes.
4. Remove the oil level gauge and check the oil level and condition.



AGX010A022

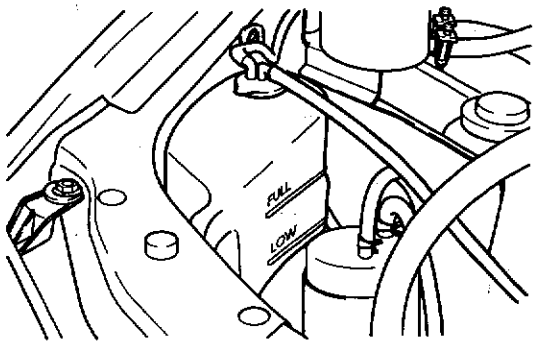
5. Add or replace oil if necessary.

Engine coolant

Coolant level

⚠ **WARNING**
A) NEVER REMOVE THE RADIATOR CAP WHILE THE ENGINE IS HOT.
B) WRAP A THICK CLOTH AROUND THE CAP WHEN REMOVING IT.

1. Verify that the coolant level is near the radiator filler neck.
2. Check that the level in the coolant reservoir is between the "Full" and "Low" marks.



AV2A10020

3. Add coolant if necessary.

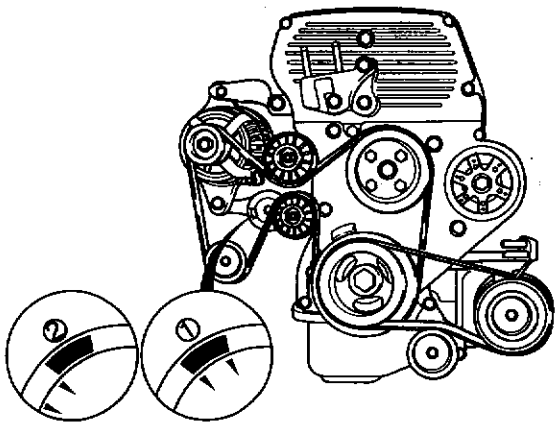
Coolant quality

1. Verify that there is no build up of rust or scale around the radiator cap of radiator filler neck.
2. Verify that the coolant is free of oil.
3. Replace the coolant if necessary.

Drive belt

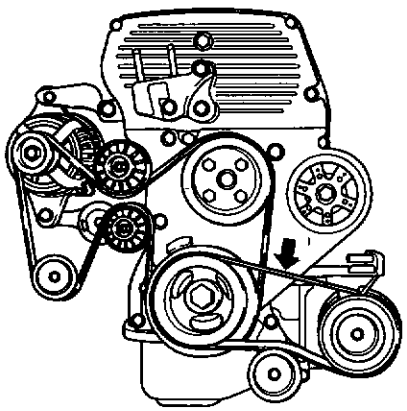
Inspection

1. Check the drive belts for wear, cracks, and fraying. Replace if necessary.
2. Verify that the drive belts are correctly mounted on the pulleys.
3. Verify that "▼" mark of auto-tensioner align "▮ ▮" mark. If two marks align as shown ①, the tension of auto-tensioner is good. If not align as shown ②, re-install the auto-tensioner or replace the drive belt.



AV2A10B001

4. Check the A/C drive belt deflection by applying moderate pressure (22 lb, 98 N, 10 kg) midway between the pulleys.



AV2A10B002

Caution

a) Measure the belt deflection between the pulleys.

b) Consider the belt as a new one if it has been used on a running engine for less than five minutes.

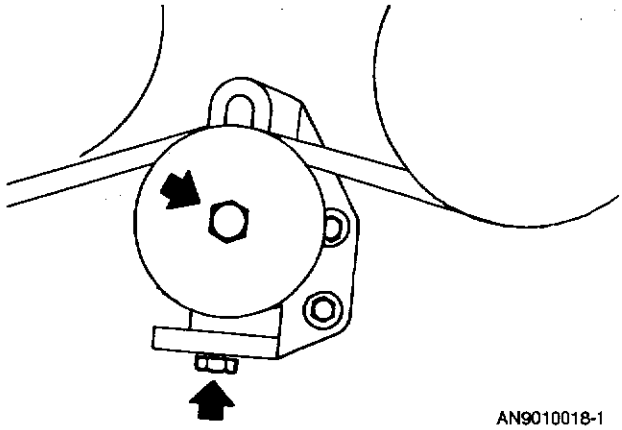
c) Check the belt deflection when the engine is cold or at least 30 minutes after the engine is stopped.

A/C belt deflection:

New one: 0.28~0.35 in (7~9 mm)

Used one: 0.35~0.43 in (9~11 mm)

Adjustment



AN9010018-1

1. Loosen the idler pulley mounting bolt.
2. Adjust the belt deflection by turning the adjusting bolt.

Deflection (When applying 22 lb, 98 N, 10 kg)

New one: 0.28~0.35 in (7~9 mm)

Used one: 0.35~0.43 in (9~11 mm)

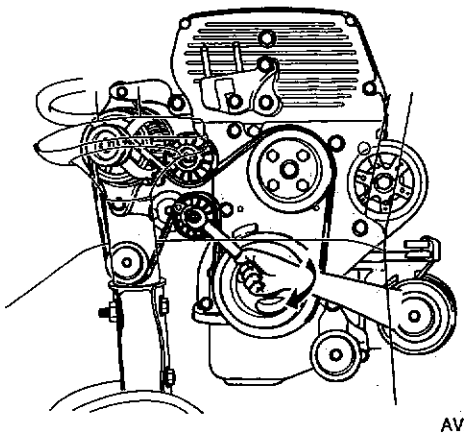
3. After making the adjustment, tighten the idler pulley mounting bolt.

Tightening torque:

28~38 lb-ft (37~52N•m, 3.8~5.3 kg-m)

Replacement

1. Raise the vehicle and support it with safety stands.
2. Remove the RH side wheel.
3. Loosen the idle pulley mounting bolt.
4. Remove the A/C drive belt.
5. Lower the auto tensioner with spanner and then remove the drive belt.



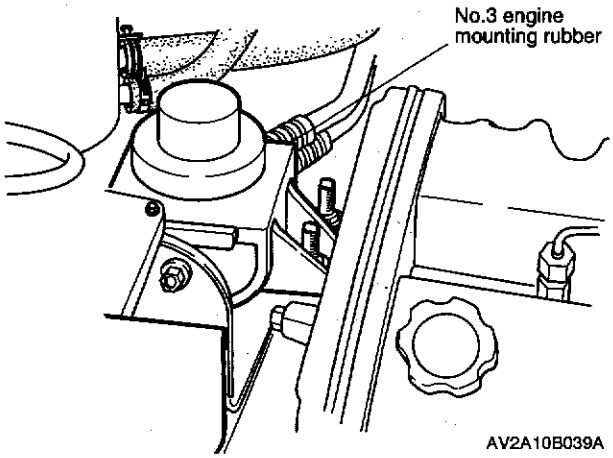
AV2A10B038

6. Lower the auto tensioner with spanner and then install the drive belt.
7. Install the A/C drive belt.
8. Check the A/C drive belt deflection. (*Refer to Inspection and Adjustment, page EM-9)*

Timing belt

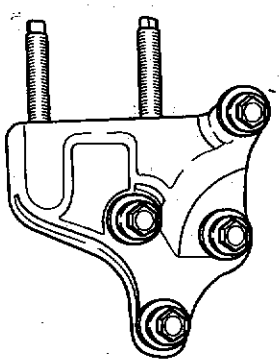
Removal

1. Raise vehicle and support it with safety stands.
2. Remove the radiator upper hose.
3. Remove the fuel filter hoses still connected.
4. Remove the No.3 engine mounting rubber.



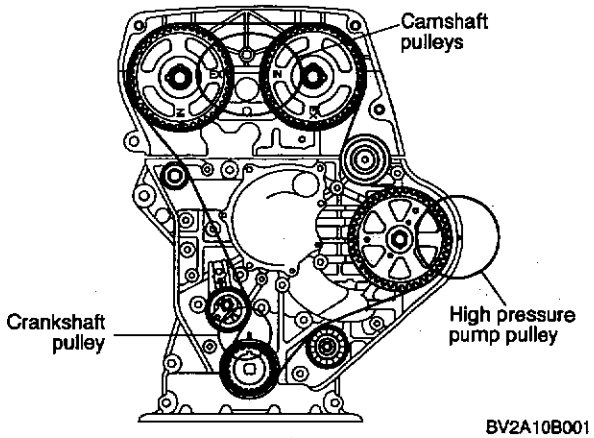
AV2A10B039A

5. Remove the No.3 engine mounting bracket.



AV2A10B040

6. Remove the RH side wheel.
7. Remove the A/C drive belt.
8. Remove the drive belt.*(Refer to Drive belt replacement, page EM-9)*
9. Remove the auto tensioner.
10. Remove the water pump pulley.
11. Remove the crankshaft pulley.
12. Remove the upper timing belt cover.
13. Remove the lower timing belt cover.
14. Rotate crankshaft and align timing mark on timing belt pulley with timing mark on engine block.

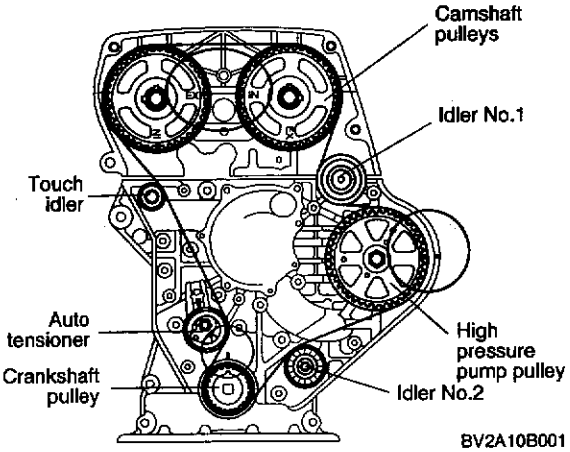


BV2A10B001

15. Remove the auto tensioner.
16. Remove the timing belt.

Replacement

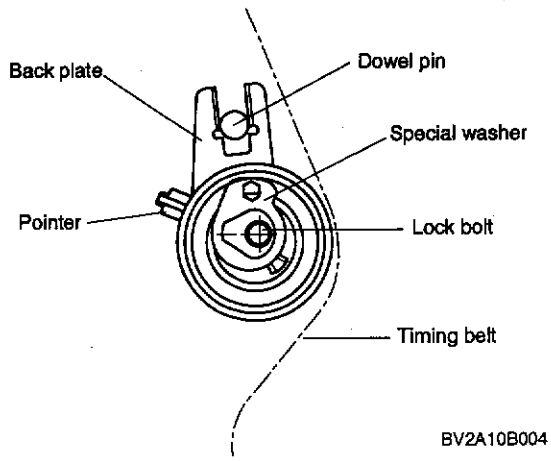
1. Check that timing mark on timing belt pulley, camshaft pulley and high pressure pump pulley is aligned with timing mark on engine.



2. Install the timing belt.
   1) The timing belt is installed in sequence crank shaft pulley, idler No.2, high pressure pump pulley, idler No.1 and camshaft pulley.

✱ *Notice*
   a) The auto-tensioner must be mounted onto the engine after the timing belt is installed.
   b) Keep the tension of timing belt when install timing belt.

3. Install the auto-tensioner.
   1) Install the auto-tensioner as shown illust. The dowel pin has to be located between the tensioner fork (back plate).



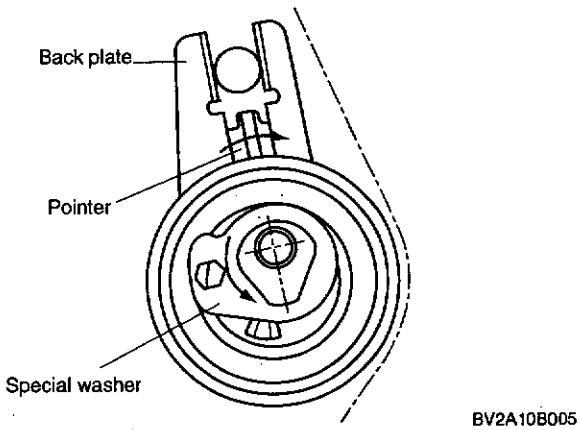
   2) Pretighten the auto-tensioner.

Tightening torque:
2.9lb-ft (3.9N•m , 0.4kg-m)

✱ *Notice*
   a) Oil must not get in contact with the tensioner. The tensioner has to be replaced by a new one, if it is oily.
   b) The positions of the pointer, the back plate and the special washer are in accordance to the illust.

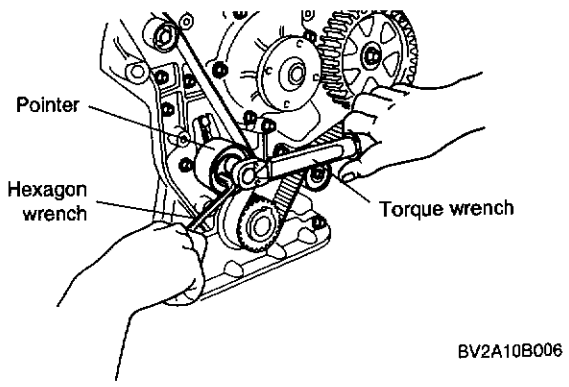
4. Check again if the alignment marks of camshafts, crankshaft and high pressure pump are aligned with the marks on the timing case.

5. Adjust the auto-tensioner, and then tighten it.
   1) Align the pointer to the back plate by rotating the special washer in counter-clockwise using the hexagon wrench as shown illust.



   2) Tighten the auto-tensioner lock bolt with holding the special washer by the hexagon wrench when the pointer is aligned with the back plate.

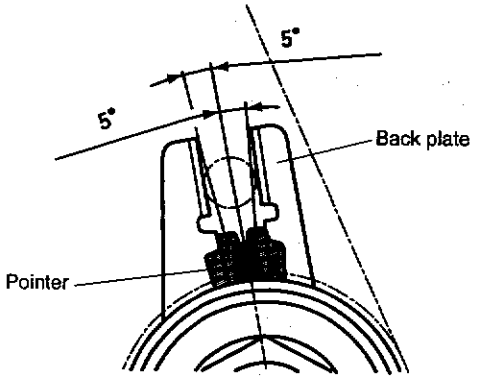
Tightening torque :
17.4lb-ft (23.5N•m , 2.4kg-m)



   3) Remove the hexagon wrench.

✱ *Notice*
If the pointer can not be aligned with the back plate, then a new belt has to be used.

6. Rotate the crankshaft two full revolutions in clockwise to align the TDC mark.
7. Check again if the alignment marks of camshafts, crankshaft and high pressure pump are aligned with the marks on the timing case.
8. Check the alignment of the pointer and back plate.



BV2A10B007

Allowance misalignment : ±5°

9. If the misalignment between pointer and back plate is bigger than ±5°, repeat step 4~8.
10. Install the upper and lower timing belt cover.

Tightening torque:
5.1~7.2 lb-ft (6.9~9.8 N•m, 70~100 kg-cm)

11. Install the crankshaft pulley.

Tightening torque:
253~289 lb-ft (343~392 N•m, 35~40 kg-m)

12. Install the water pump pulley.

Tightening torque:
13.0~20.9 lb-ft (17.6~28.4 N•m, 1.8~2.9 kg-m)

13. Install the auto tensioner.

Tightening torque:
13.0~20.9 lb-ft (17.6~28.4 N•m, 1.8~2.9 kg-m)

14. Install the drive belt and A/C drive belt.
(Refer to Drive belt, page EM-9)
15. Install the RH side wheel.

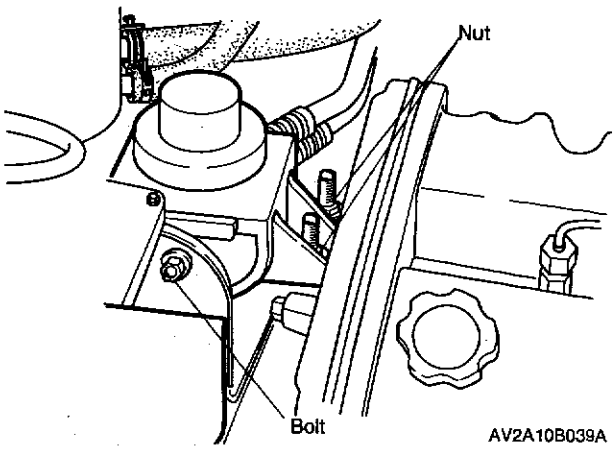
Tightening torque:
65~79 lb-ft (88~108 N•m, 9.0~11.0 kg-m)

16. Install the No.3 engine mounting bracket.

Tightening torque:
26.7~39.8 lb-ft (36.2~53.9 N•m, 3.7~5.5 kg-m)

17. Install the No.3 engine mounting rubber.

Tightening torque:
Nut: 49.1~68.7 lb-ft (66.7~93.1 N•m, 6.8~9.5 kg-m)
Bolt: 62.9~86.0 lb-ft (85.3~116.7 N•m, 8.7~11.9 kg-m)



AV2A10B039A

18. Install the fuel filter.
19. Install the radiator hose.
20. Fill engine coolant with specified type and amount.*(Refer to section EM-CL, Cooling system)*
21. Start engine and then check for leaks.

Compression pressure

Inspection

1. Warm up the engine upto the normal operating temperature, then stop the engine and disconnect the connector of fuel cut solenoid.
2. Remove all injection pipes, nozzles and washers.
3. Attach the **SST** to the nozzle hole.
4. Measure the compression pressure during cranking.

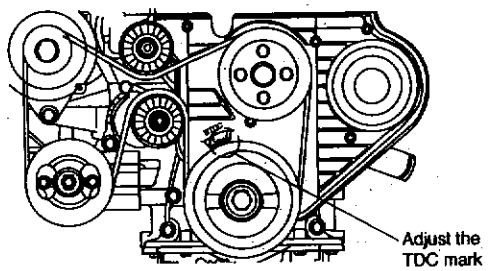
Item \ Engine model		J3 COMMON RAIL SYSTEM
Compression pressure psi (kPa, kg/cm²)-rpm	Normal	426.6(2943, 30)-200
	Limit	383.9(2649, 27)-200
Cylinder-to-cylinder pressure difference psi (kPa, kg/cm²)		below 42.7(294,3.0)

5. Do above step 3~4 again for each cylinder.
6. If the measure value is below the limit, consider it as abrasion or damage of piston and piston ring, misalignment of valve, damage of gasket, and etc..

Ladder frame

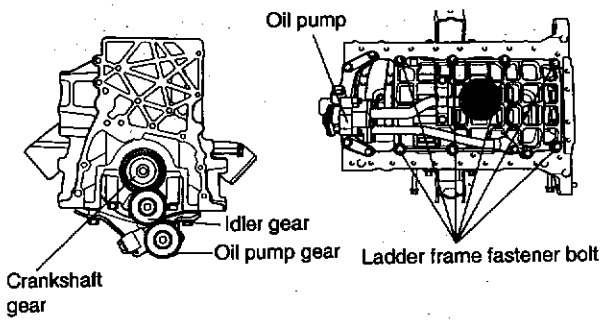
Removal

1. Remove oil pan. *(Refer to section EM-LU, Lubrication system)*
2. Adjust the V groove TDC mark on the outside of pulley to the TDC mark "T" on the timing cover, by rotating the crank shaft pulley.



AV2A10B031

3. When disassembling ladder frame, separate the oil feeding pipe from the oil pump by loosening the oil feeding pipe bolt.



AV2A10B036

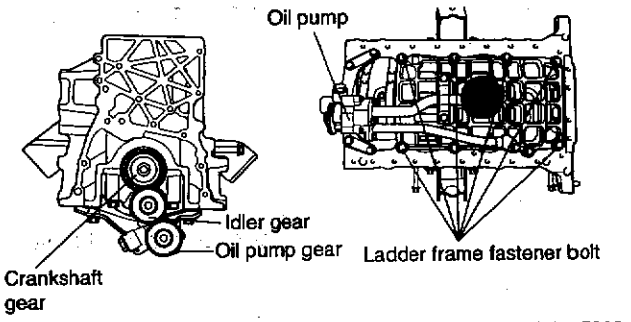
4. Loosen the ladder frame fastener bolt. Remove ladder frame.

Replacement

1. Install the ladder frame into block. Check the dowel pin of ladder frame is matched with lower surface of block and insert the oil level gauge into the ladder frame hole.

Tightening torque (ladder frame bolt):
32.5 lb-ft (44 N•m, 4.5 kg-m)

2. Install crankshaft sprocket and oil pump sprocket.
3. Install the oil feeding pipe into the ladder frame, oil pump and block and then tighten bolts.



AV2A10B036

4. Install the oil pan. *(Refer to section EM-LU, Lubrication system)*
5. Fill engine oil with specified type and amount. *(Refer to section EM-LU, Lubrication system)*
6. Start engine and then check for leaks.

DISASSEMBLY, INSPECTION AND REASSEMBLY PROCEDURE

✱ *Notice*

a) Code all identical parts(such as pistons, piston rings, connecting rods, and valve springs) so that they can be reinstalled in the cylinder from which they were removed.

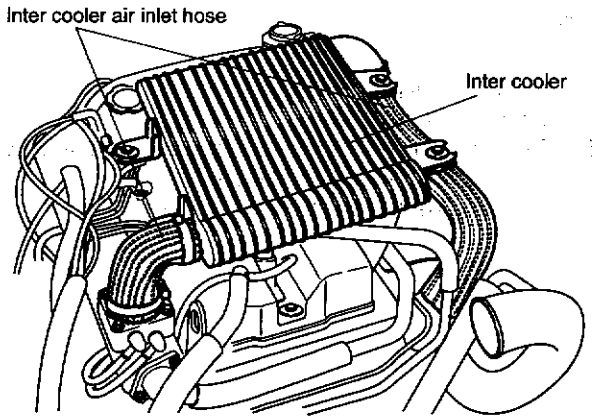
b) Clean the parts with steam, blow off any remining water with compressed air.

c) Care should be taken during the disassembly of any part or system to study its order of assembly. Any deformation, wear or damage should also be noted.

Auxiliary parts

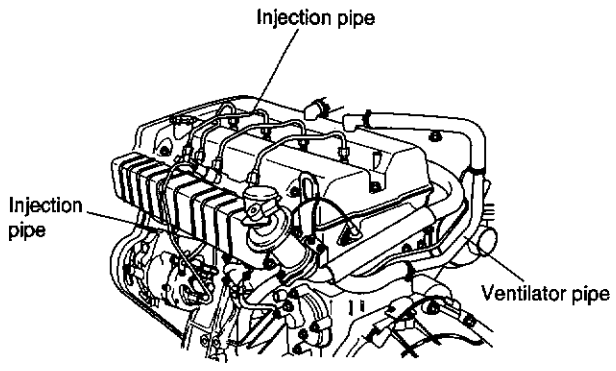
Disassembly

1. Remove inter cooler cover.
2. Remove inter cooler and inter cooler air inlet hose.



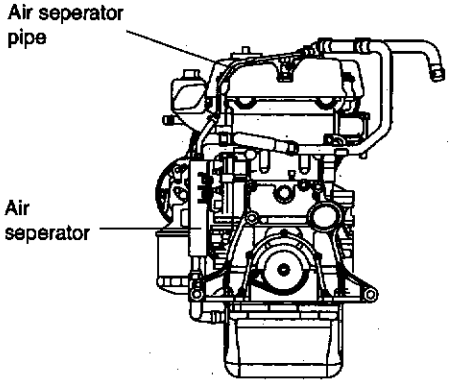
AV2A10B052

3. Remove engine harness.
4. Remove ventilator hose.
5. Remove fuel injection pipe.



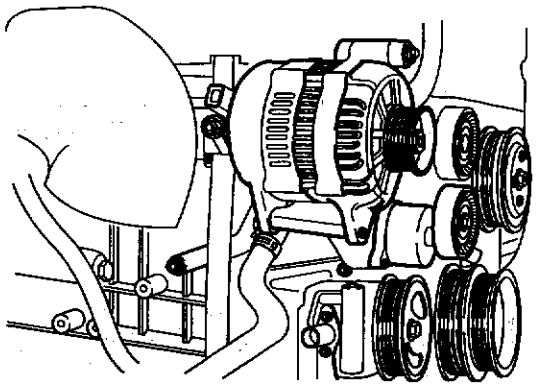
EFL0FL011

6. Remove air separator and air separator hose/pipe.



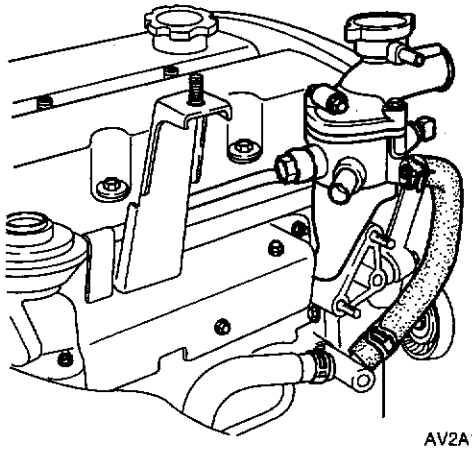
EFL0FL060

7. Remove ventilation pipe and hose.
8. Remove lower water hose from cylinder block.
9. Remove EGR pipe.
10. Remove alternator, hose, alternator bracket and auto tensioner.



AV2A10B056

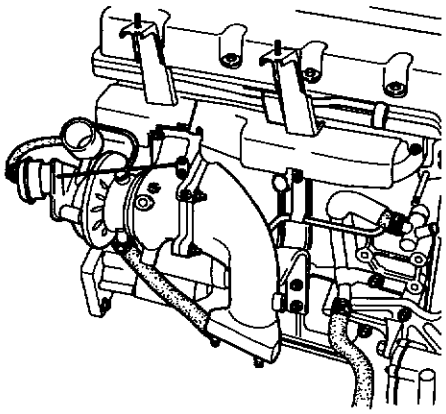
11. Remove thermostat housing assembly.



AV2A10B057

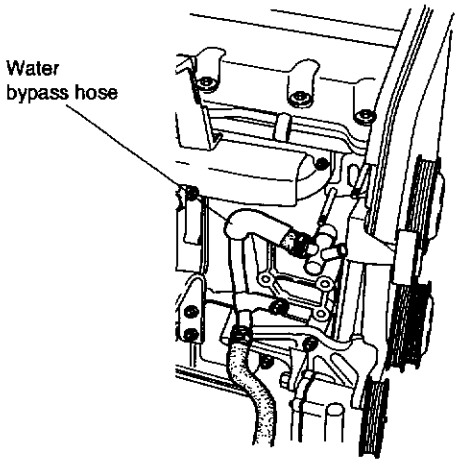
12. Remove turbo charger insulator.

13. Remove turbo charger assembly.



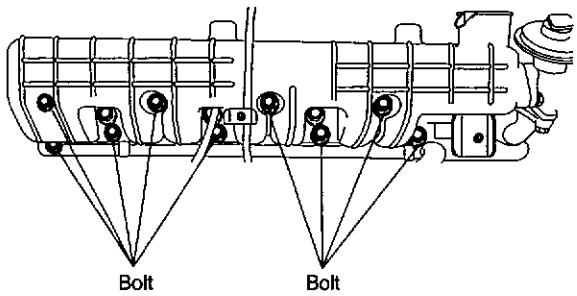
AV2A10B058A

14. Remove water bypass hose and water bypass pipe.



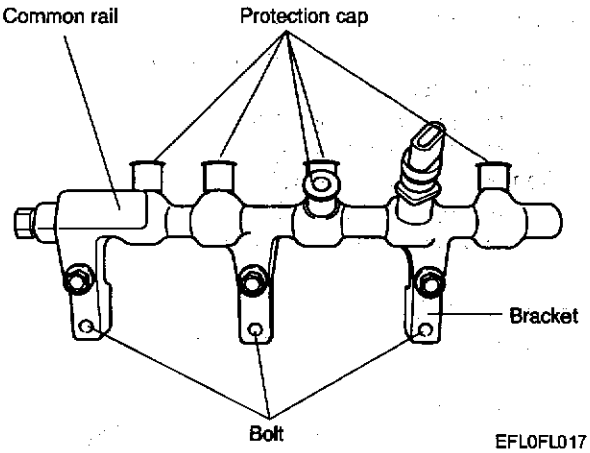
AV2A10B059

15. Remove power steering pump bracket.
16. Remove exhaust manifold insulator, exhaust manifold and gasket.
17. Remove EGR valve and gasket.
18. Remove intake manifold and gasket.



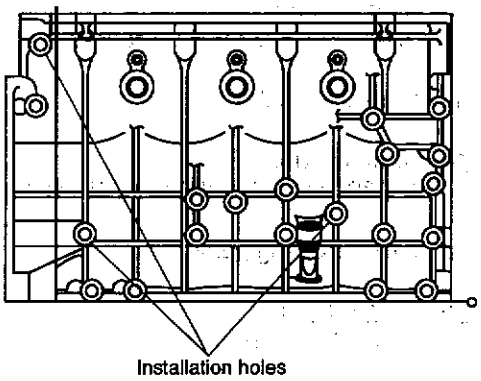
EFL0FL052

19. Remove common rail.(Refer to section FL)



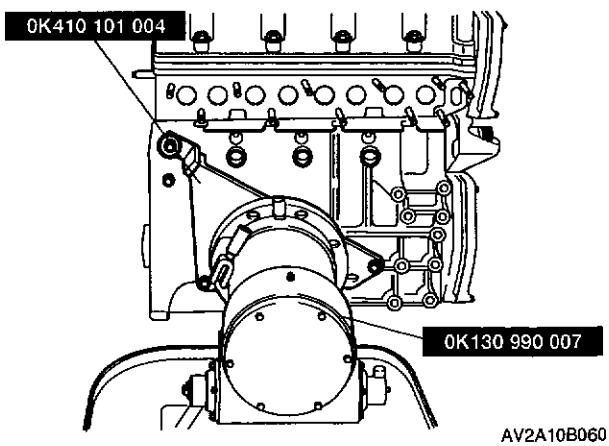
EFL0FL017

20. Install **SST (0K410 101 004)** to engine.



AV2A10B037

21. Mount engine on the **SST (0K130 990 007)**.



AV2A10B060

Reassembly

Assembly will be performed in the reverse order.

Timing belt cover

Disassembly

1. Remove No.3 engine mounting bracket.
2. Remove water pump pulley.
3. Remove power steering pump.
4. Remove crankshaft pulley.
5. Remove idler and bracket.
6. Remove upper timing belt cover.
7. Remove lower timing belt cover.

Reassembly

1. Install upper and lower timing belt cover.

   Tightening torque:
   5.1~7.2 lb-ft (6.9~9.8 N•m, 0.7~1.0 kg-m)

2. Install idler and bracket.

   Tightening torque:
   27.5~38.3 lb-ft (37.2~51.9 N•m, 3.8~5.3 kg-m)

3. Install crankshaft pulley.

   Tightening torque:
   253~289 lb-ft (343~392 N•m, 35~40 kg-m)

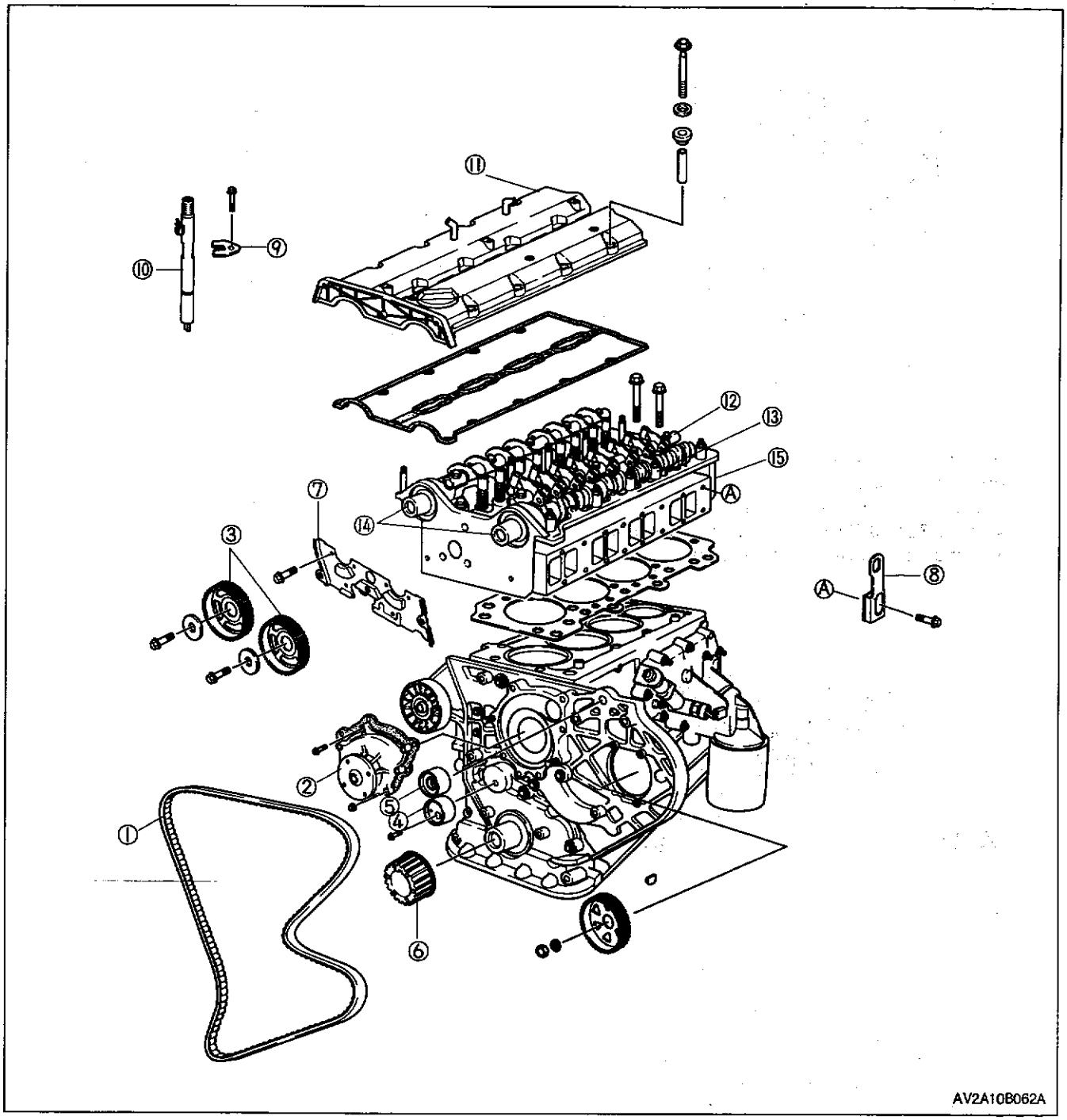
4. Install power steering pump.

   Tightening torque:
   21.7~28.9 lb-ft (29.4~39.2 N•m, 3.0~4.0 kg-m)

5. Install No.3 engine mounting bracket.

   Tightening torque:
   49.2~68.7 lb-ft (66.6~93.1 N•m, 6.8~9.5 kg-m)

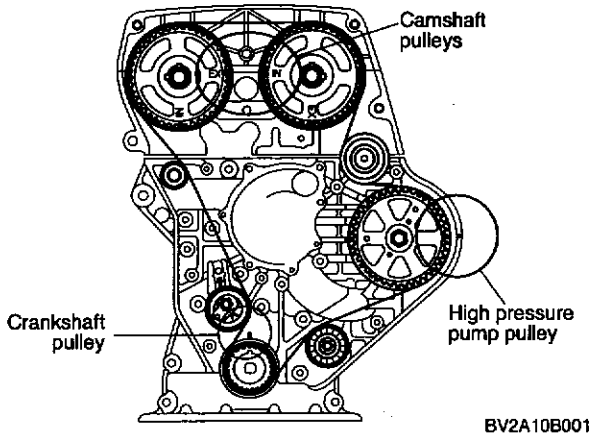
Timing belt



(1) Timing belt
(2) Water pump
(3) Camshaft pulley
(4) Tensioner
(5) Idler
(6) Timing belt pulley
(7) Upper plate assembly
(8) Engine hanger
(9) Injector bracket
(10) Injector
(11) Cylinder head cover
(12) Rocker arm shaft assembly
(13) Camshaft cap
(14) Camshaft
(15) Cylinder head

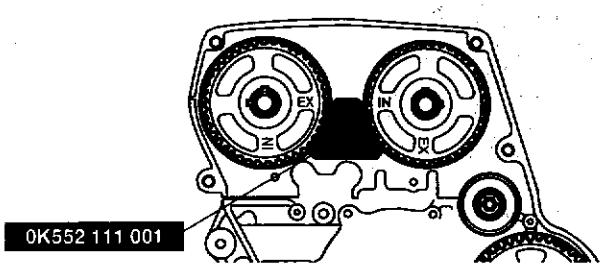
Disassembly

1. Rotate crankshaft and align timing mark on timing belt pulley with timing mark on engine block.



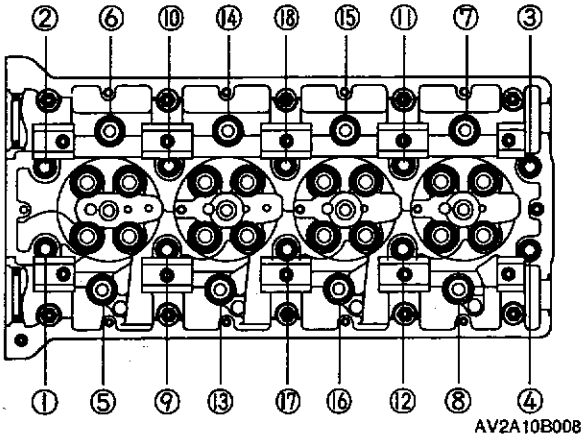
BV2A10B001

2. Remove the auto tensioner.
3. Remove the timing belt.
4. Remove the high pressure pump.
5. Install the **SST (0K552 111 001)** as shown in the figure and the remove the camshaft pulley.



AV2A10B022

6. Remove the idler.
7. Remove the timing belt pulley.
8. Remove the upper plate assembly.
9. Remove the engine hanger.
10. Remove the injector bracket and injector.
11. Remove the cylinder head cover.
12. Remove the rocker arm shaft assembly.
13. Remove the camshaft cap and camshaft.
14. Remove the cylinder head bolts in the order shown in the figure.



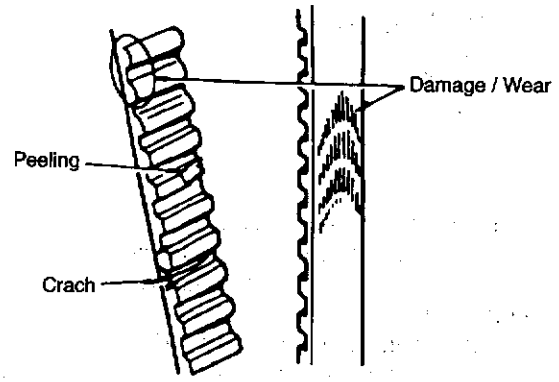
AV2A10B008

Inspection

Front timing belt

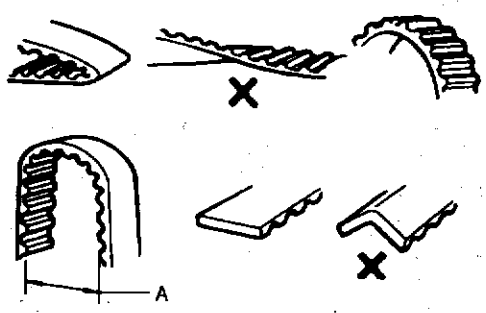
✱ *Notice*
a) Never forcefully twist, turn inside out or bend timing belt.
b) Do not allow oil or grease to come in contact with timing belt.

1. Replace timing belt if it is contaminated with oil or grease.
2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening. Replace timing belt if necessary.



ABT010217

3. Bend timing belt into a "U" shapes as shown in figure. Distance "A" must be at least 1.0 in (25 mm).



ABT010216

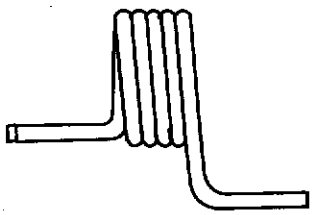
Camshaft pulleys and timing belt pulley

✱ *Notice*
Do not clean pulleys with cleaning fluids. If needed, use a soft cloth to wipe them clean, and avoid scratching the pulleys as it will affect integrity of the timing belt.

1. Check pulley teeth for wear, deformities and other damage. Replace pulleys if necessary.

Tensioner spring

1. Check the tensioner spring. Replace tensioner spring if necessary.

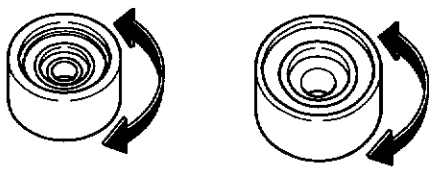


AV2A10B083

Tensioner and idler

✱ *Notice*
Do not clean tensioner pulley or idler pulley with cleaning fluids. If needed, use a soft rag to wipe them clean. Avoid scratching tensioner pulley or idler pulley as it can affect integrity of timing belt.

1. Check tensioner pulley and idler pulley for smooth rotation and proper sound. Replace tensioner pulley and idler pulley if necessary.

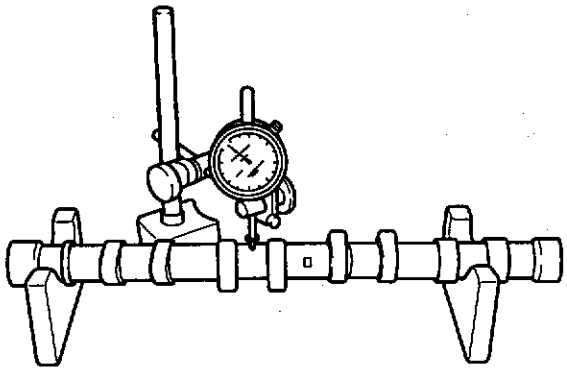


AV2A10B064

Camshaft

1. Set front and rear camshaft bearing journals on V-blocks.
2. Position a dial indicator on center bearing journal and zero dial.
3. Rotate camshaft in V-blocks and check runout.

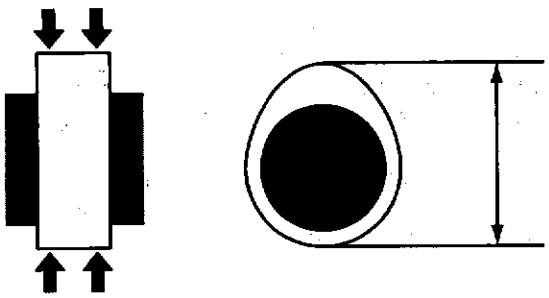
Runout: 0.0031 in (0.08 mm) maximum



AV2A10B066

4. Check camshaft for uneven wear patterns, cracks, or damage.
5. Measure cam lobe heights at two points as shown.

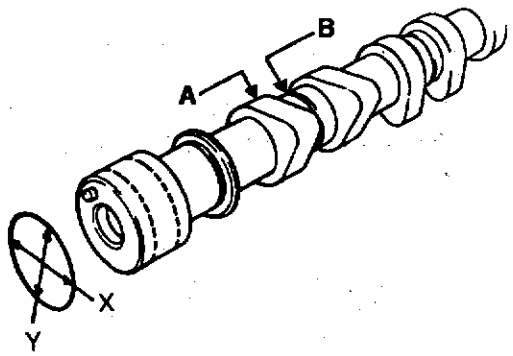
Lobe height
Intake : 0.8857 in (22.497 mm)
Exhaust : 0.8894 in (22.593 mm)



AV2A10B067

6. Check camshaft bearing journal diameter (X and Y directions) on both sides (A and B) of journal as shown in figure.

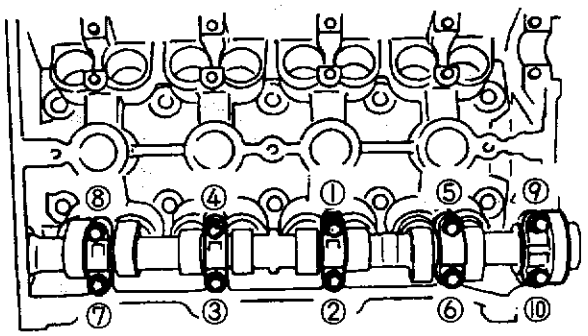
Minimum diameter:
1.1000~1.1032 in (27.941~27.960 mm)



BSX010B089A

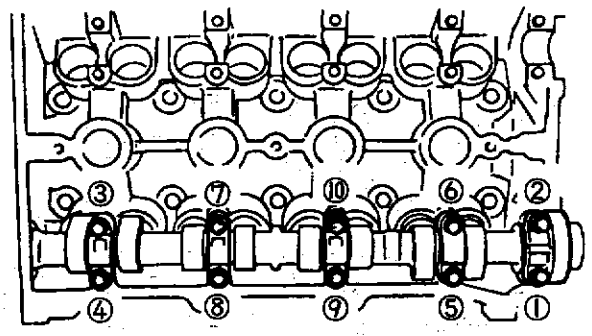
7. Replace camshafts if necessary.
8. Measure camshaft journal oil clearance.
9. Remove all foreign material and oil from journals and bearing surfaces.
10. Set camshafts onto cylinder head.
11. Position plastigage® on journals in axial direction.
12. Do not rotate camshafts.
13. Install camshaft caps according to cap number and arrow mark.
14. Install cap nuts. Tighten them in five or six steps in order shown.

Tightening torque:
13.0~19.5 lb-ft (17.6~26.5 N·m, 1.8~2.7 kg-m)



AS2A10107

15. Loosen camshaft cap nuts in five or six steps in order shown.
16. Remove camshaft caps.

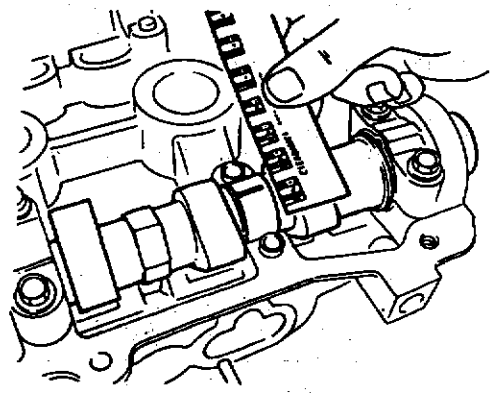


AS2A10107

17. Measure oil clearances.

Oil clearance:
0.0016~0.0031 in (0.04~0.08 mm)

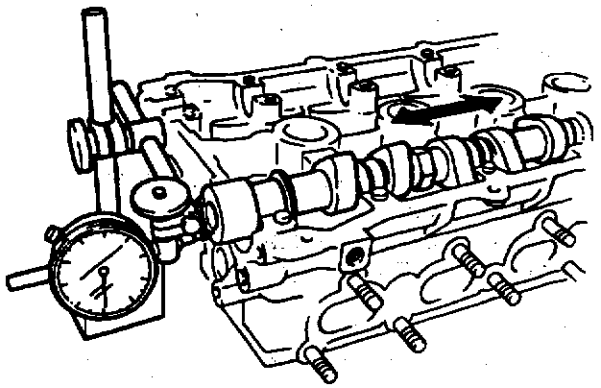
18. If oil clearance exceeds specification, replace cylinder head.



BSX010B093

19. Install camshafts.
20. Place a dial indicator against end of camshaft.
21. Using a prying tool, move camshaft as far forward as possible.
22. Zero dial.
23. Using prying tool, move camshaft as far rearward as possible.
24. Check gauge to determine how much end play is present.

End play:
0.0031~0.0046 in (0.08~0.11 mm)



BSX010B094

Rocker arm and rocker arm shaft

1. Measure the rocker arm inner diameter.

Inner diameter:
0.7862~0.7874 in (19.97~20.00 mm)

2. Measure the rocker arm shaft outer diameter.

Outer diameter:
0.7875~0.7866 in (19.959~19.980 mm)

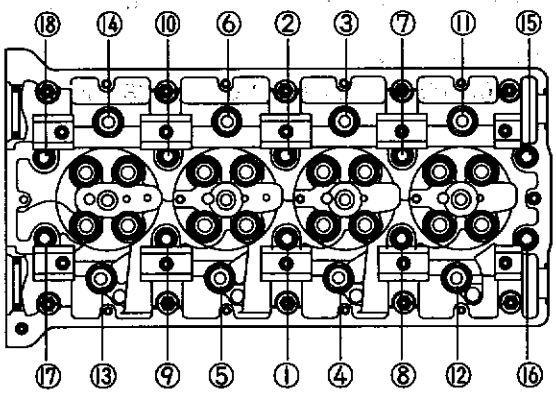
Reassembly

1. Remove all foreign material from the top of the cylinder block.
2. Place the new cylinder head gasket in position.

Caution
Measure the length of cylinder head bolt, replace if necessary.
Long bolt: 5.2 in (132 mm)
Short bolt: 3.7 in (93 mm)

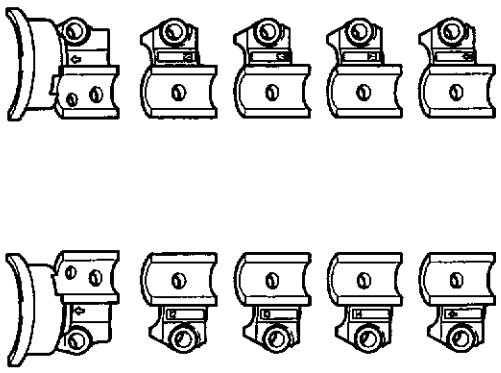
3. Install the cylinder head.
4. Apply an engine oil into the surface and thread of cylinder head bolt, and install the cylinder head bolts to the cylinder head.
5. Tighten the cylinder head bolts in the order shown in the figure.

Tightening torque:
Angle contorl
Long bolt: 25.32 lb-ft (34.3 N•m, 3.5 kg-m)+45°+70°
Short bolt: 25.32 lb-ft (34.3 N•m, 3.5 kg-m) +40°+45°



AV2A10B008

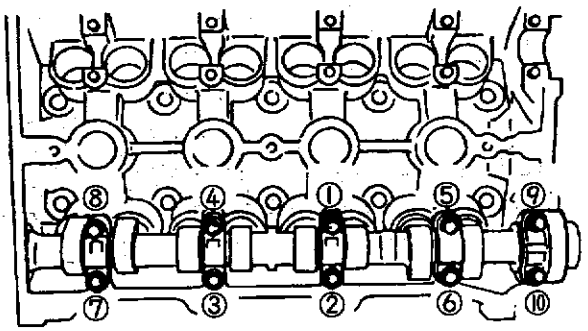
6. Remove all foreign material and oil from the journals and bearing surface.
7. Set the camshaft onto the cylinder head.
8. Install the camshaft caps according to the cap number and arrow mark.



AV2A10B065

9. Install the camshaft cap nuts and tighten them in two or three steps in the order shown in the figure.

Tightening torque:
13.0~19.5 lb-ft (17.6~26.5 N•m, 1.8~2.7 kg-m)

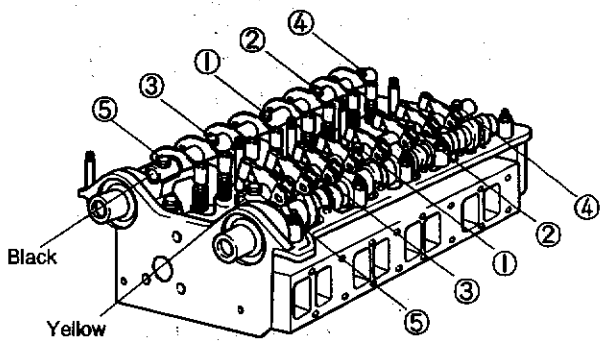


AS2A10107

✱ *Notice*
Do not exchange intake rocker arm shaft and exhaust rocker arm shaft each other.
- *Intake side: Yellow*
- *Exhaust side: Black*

10. Install the intake rocker arm shaft and exhaust rocker arm shaft and tighten them in two or three steps in the order shown in the figure.

Tightening torque:
13.0~19.5 lb-ft (17.6~26.5 N•m, 1.8~2.7 kg-m)



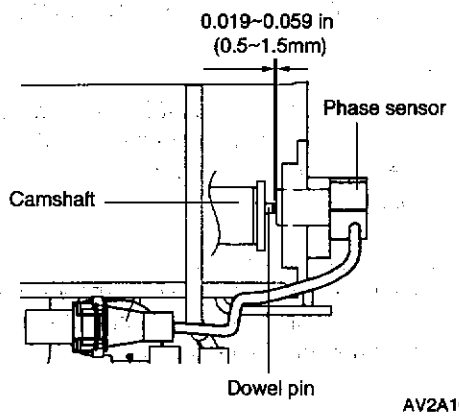
AV2A10B025

11. Install the cylinder head cover.

Tightening torque:
5.1~6.5 lb-ft (6.9~8.8 N•m, 70~90 kg-cm)

✱ *Notice*
Inspect clearance between dowel pin of camshaft end and phase sensor, before install cylinder head cover.

Clearance: 0.019~0.059in (0.5~1.5mm)



AV2A10B084

12. Install the injector and install the injector bracket. (Refer to section FL)

Tightening torque:
14.5~15.9 lb-ft (19.6~21.6 N•m, 2.0~2.2 kg-m)

13. Install the front and rear engine hanger.
14. Install the upper plate assembly.
15. Install the idlers.

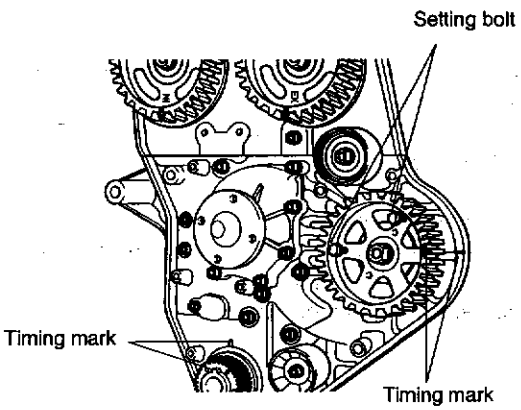
Tightening torque :
29.7lb-ft (40.2N•m , 4.1kg-m)

✱ *Notice*
Be careful that the idlers does not change.
Idler No.1(ø 2.36in(ø 60mm)),Idler No.2(ø 2.16in (ø 55mm))

16. Install the high pressure pump.
    1) Tighten the high pressure pump assembly fixing bolts after installed the high pressure pump to the timing case.

Tightening torque :
15.9~18.8lb-ft (21.6~25.5N•m , 2.2~2.6kg-m)

    2) Pre-tighten the high pressure pump pulley lock nut after installed the high pressure pump pulley to the high pressure pump shaft with key.
    3) Fix the high pressure pump pulley by used to two setting bolts, after aligned the high pressure pump pulley timing mark as shown illust.



BV2A10B002A

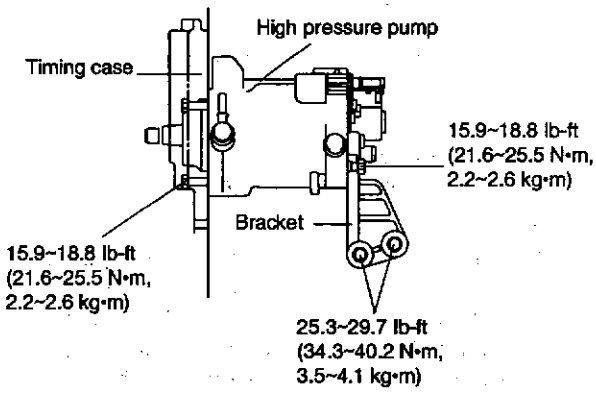
    4) Tighten the high pressure pump pulley lock nut.

Tightening torque :
47.0lb-ft (63.7N•m , 6.5kg-m)

    5) Install the high pressure pump bracket to the high pressure pump and cylinder block.

Caution
First tighten the cylinder block side bolts and then second tighten the pump side bolts after checking that there is no clearance between bracket and pump.

Tightening torque :
Pump side :
15.9~18.8lb-ft (21.6~25.5N•m , 2.2~2.6kg-m)
Cylinder block side :
25.3~29.7lb-ft (34.3~40.2N•m , 3.5~4.1kg-m)

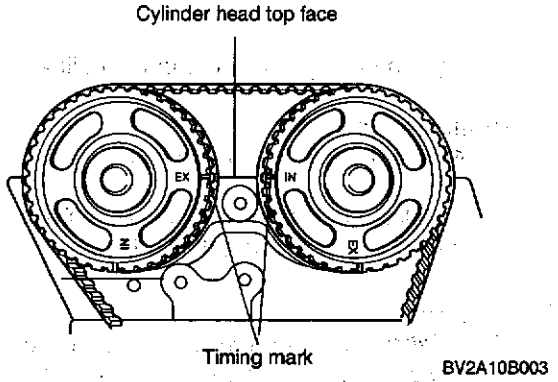


17. Align the crankshaft pulley timing mark.

Caution
When the crankshaft is rotated without timing belt, could damage piston and valve. Before assemble the cylinder head, align TDC for No.1 piston.

18. Align the camshaft pulley timing mark.
    1) Align "EX"mark of the left camshaft pulley and "IN" mark of the right camshaft pulley to the cylinder head top face as shown illust

Caution



When the camshaft is rotated without timing belt, could damage piston and valve. Before assemble the cylinder head, align the camshaft pulley timing mark

    2) Install the camshaft fixing tool (SST) between two camshaft pulleys.
    3) Tighten the camshaft pulley lock nut.

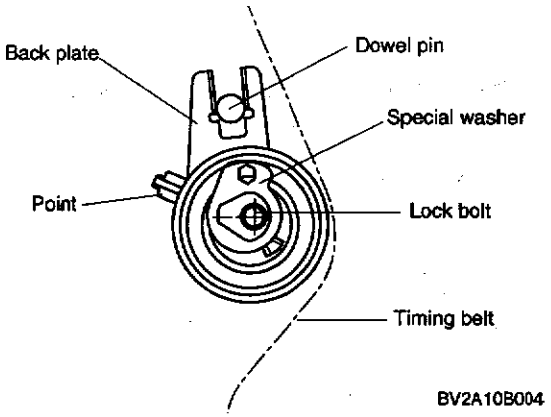
Tightening torque :
47.0lb-ft (63.7N•m , 6.5kg-m)

    4) Remove the camshaft fixing tool (SST).

19. Install the timing belt.
    1) The timing belt is installed in sequence crank shaft pulley, idler No.2, high pressure pump pulley, idler No.1 and camshaft pulley.

✱ *Notice*
a) The auto-tensioner must be mounted onto the engine after the timing belt is installed.
b) Keep the tension of timing belt when install timing belt.

20. Install the auto-tensioner.
    1) Install the auto-tensioner as shown illust. The dowel pin has to be located between the tensioner fork (back plate).



    2) Pretighten the auto-tensioner.

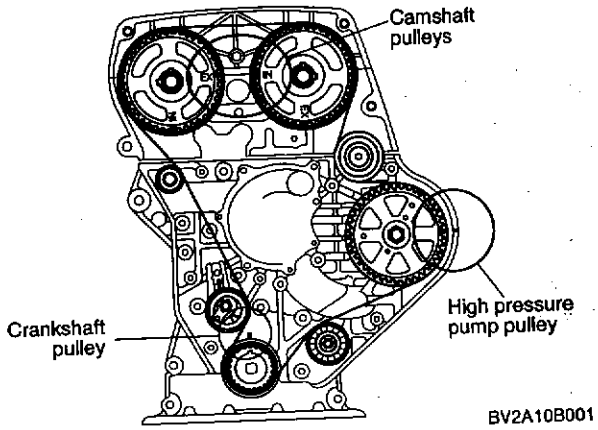
Tightening torque :
2.9lb-ft (3.9N•m , 0.4kg-m)

✱ *Notice*
a) Oil must not get in contact with the tensioner. The tensioner has to be replaced by a new one, if it is oily.
b) The positions of the pointer, the back plate and the special washer are in accordance to the illust.

21. Install the touch idler.

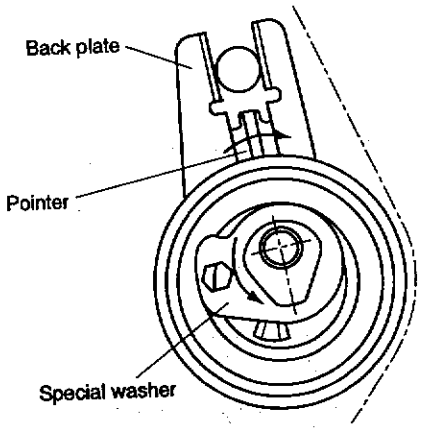
Tightening torque :
17.4lb-ft (23.5N•m , 2.4kg-m)

22. Remove two setting bolts from the high pressure pump pulley.
23. Check again if the alignment marks of camshafts, crankshaft and high pressure pump are aligned with the marks on the timing case.



BV2A10B001

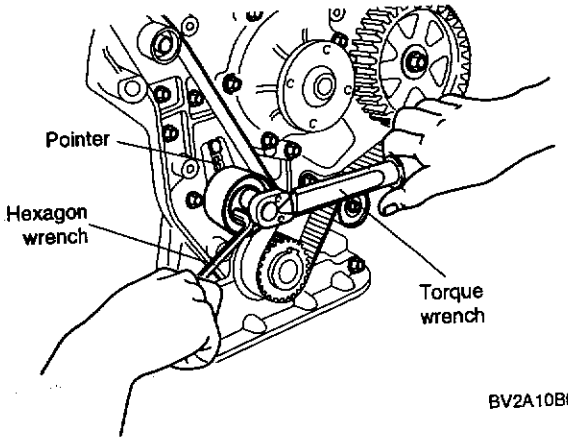
24. Adjust the auto-tensioner, and then tighten it.
    1) Align the pointer to the back plate by rotating the special washer in counter-clockwise using the hexagon wrench as shown illust.



BV2A10B005

    2) Tighten the auto-tensioner lock bolt with holding the special washer by the hexagon wrench when the pointer is aligned with the back plate.

Tightening torque :
17.4lb-ft (23.5N•m , 2.4kg-m)

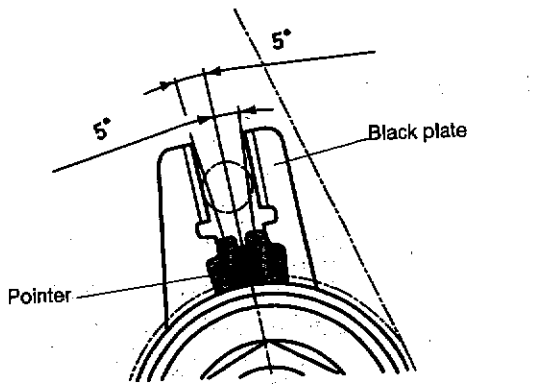


BV2A10B006

    3) Remove the hexagon wrench.

✱ *Notice*
If the pointer can not be aligned with the back plate, then a new belt has to be used.

25. Rotate the crankshaft two full revolutions in clockwise to align the TDC mark.
26. Check again if the alignment marks of camshafts, crankshaft and high pressure pump are aligned with the marks on the timing case.
27. Check the alignment of the pointer and back plate.

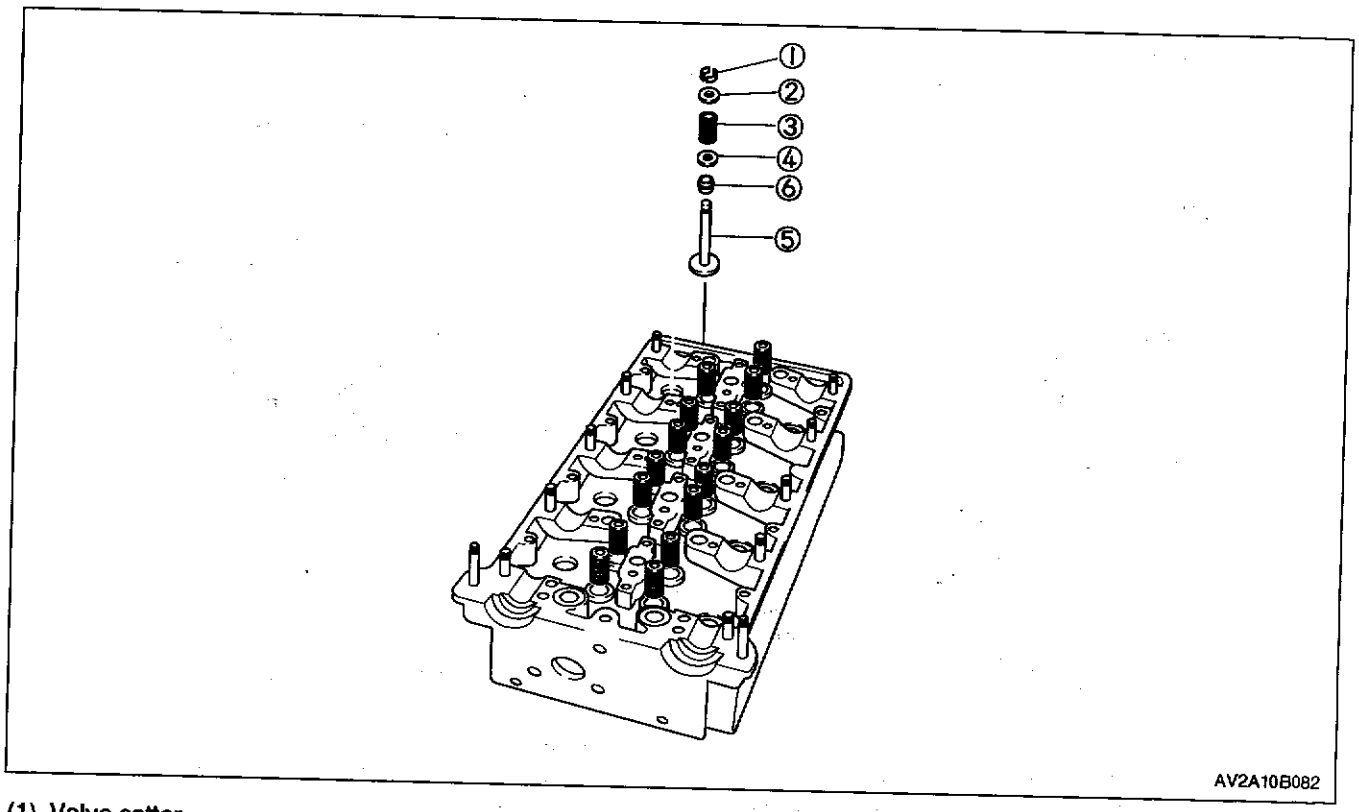


BV2A10B007

Allowance misalignment : ±5°

28. If the misalignment between pointer and back plate is bigger than (±5°), repeat step 23~27.

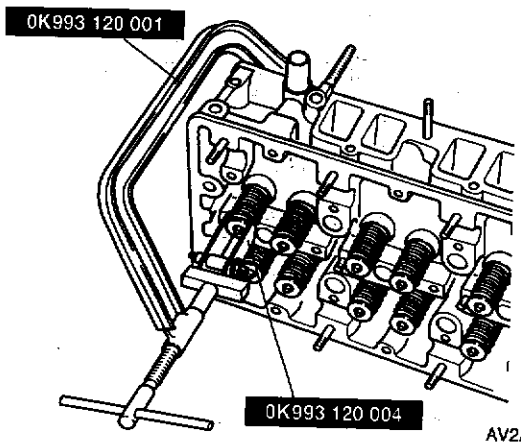
Cylinder head



(1) Valve cotter
(2) Valve spring upper seat
(3) Valve spring
(4) Valve spring lower seat
(5) Valve
(6) Valve seal

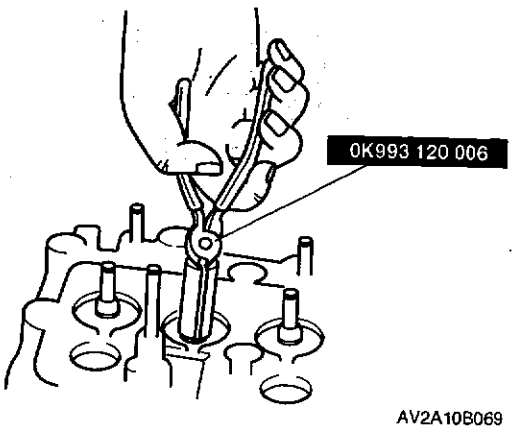
Disassembly

1. Remove the valve cotter by using the **SST (0K993 120 001 / 0K993 120 004)**.



2. Remove the valve spring upper seat, valve spring, valve spring lower seat and valve.

3. Pull the valve seal out by using the **SST (0K993 120 006)**.



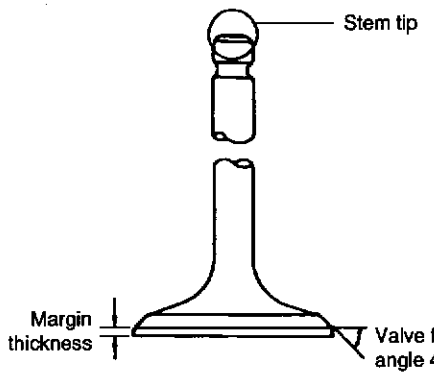
Inspection

Valve mechanism

1. Inspect each valve for following:
   a. Damaged or bent valve stem
   b. Rough or damaged face
   c. Damaged or unevenly worn stem tip

2. Resurface or replace valve as needed.

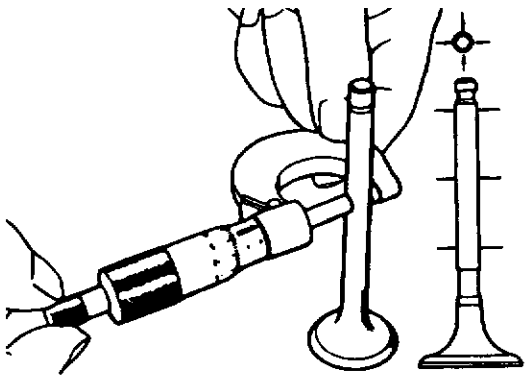
   Margin thickness
   Intake: 0.047 in (1.2 mm)
   Exhaust: 0.043 in (1.1 mm)



BSX010A110

3. Measure diameter of each valve stem.

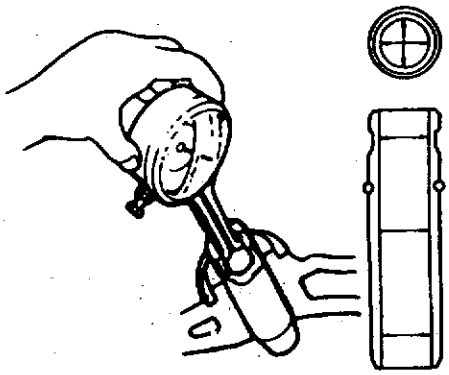
   Diameter
   Intake: 0.2742~0.2748 in (6.965~6.980 mm)
   Exhaust: 0.2734~0.2740 in (6.945~6.960 mm)



BSX010A111

4. Measure inside diameter of each valve guide at points shown in figure.

   Diameter intake and exhaust valve guide:
   0.2759~0.2767 in (7.010~7.030 mm)

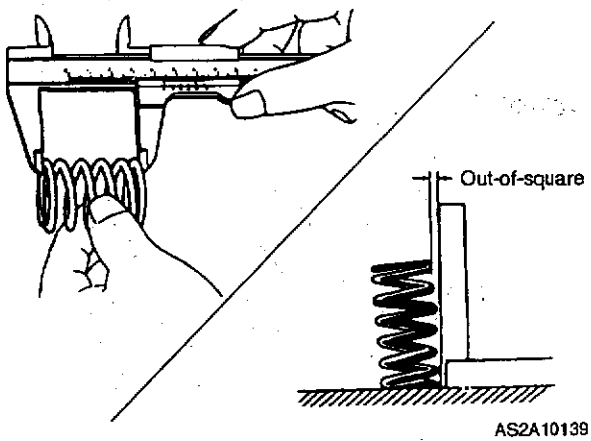


BSX010A112

Valve spring

1. Inspect each valve spring for cracks and damage.
2. Measure free length and out-of-square. Replace valve springs as needed.

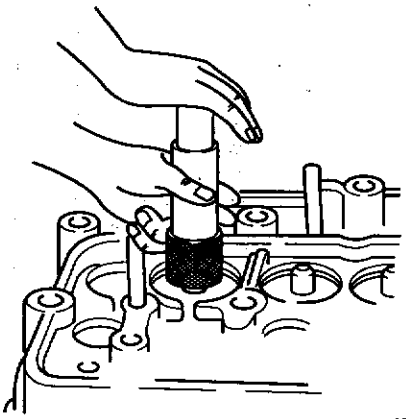
   Free length: 2.066 in (52.47 mm)
   Out-of-square: 2° maximum



AS2A10139

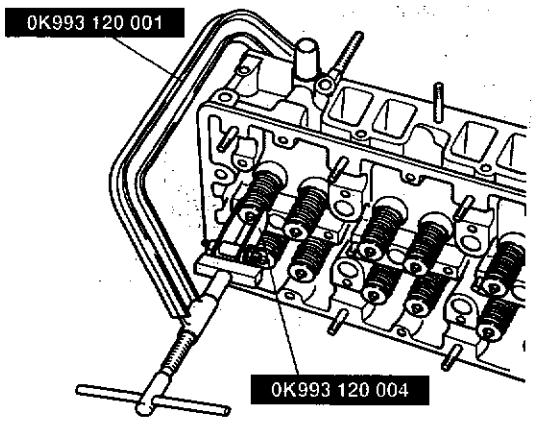
Reassembly

1. By using the proper tool, press the valve seal.



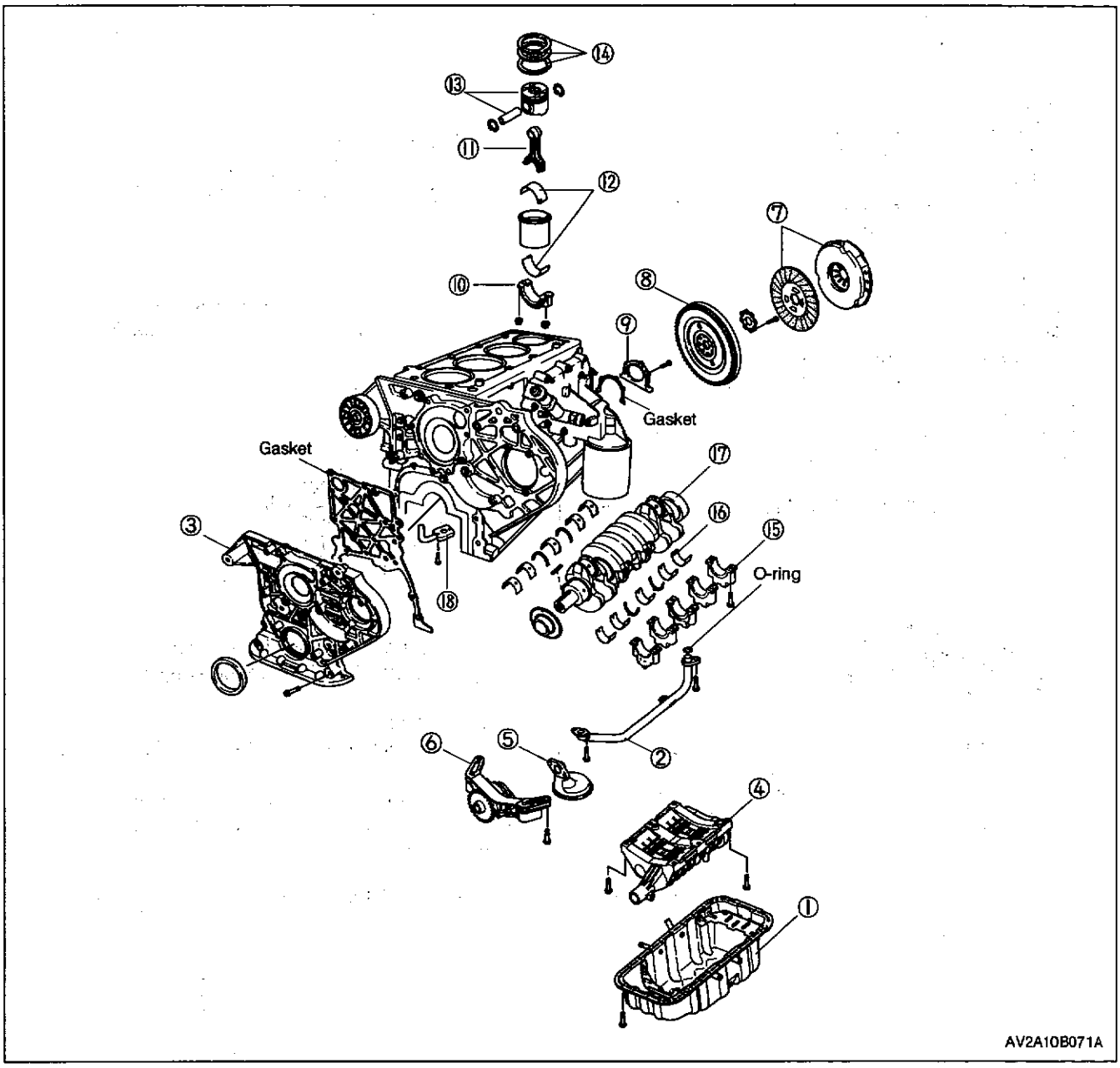
AV2A10B070

2. Install the valve, valve spring lower seat, valve spring and valve spring upper seat.
3. By using **SST (0K993 120 001 / 0K993 120 004)**, compress the valve spring and place the valve cotter securely.
4. By using a plastic hammer, tap the stem lightly to assure proper fit.



AV2A10B068

Cylinder block



(1) Oil pan
(2) Oil feed pipe
(3) Timing belt case
(4) Ladder frame
(5) Oil strainer
(6) Oil pump
(7) Clutch cover and clutch disc (MTX only)
(8) Flywheel (MTX only)
(9) Rear cover
(10) Connecting rod cap
(11) Connecting rod
(12) Main bearing
(13) Piston and piston pin
(14) Piston rings
(15) Main bearing cap
(16) Main bearing
(17) Crankshaft
(18) Oil jet

Disassembly

1. Remove the clutch cover, clutch disc and flywheel.
2. Remove the oil pan mounting bolts.
3. Remove oil pan with a screwdriver or suitable tool.

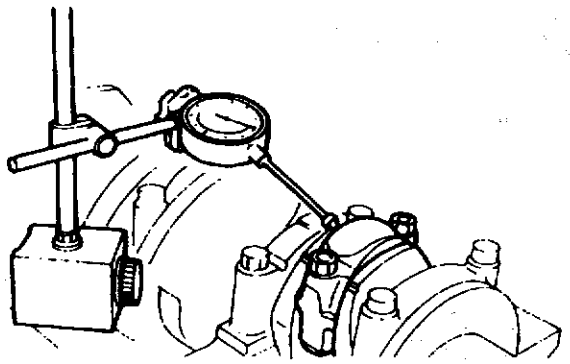
Caution

a) Do not force tools between cylinder block and oil pan as this may damage sealing surface.

b) Do not damage sealing surface when removing old sealant.

4. Remove the oil feed pipe.
5. Remove the timing belt case.
6. Remove the ladder frame.
7. Remove the oil strainer and oil pump.
8. Remove the lever, tensioner and guide.
9. Remove the rear cover.
10. Before removing the connecting rod, measure the connecting rod side clearance.

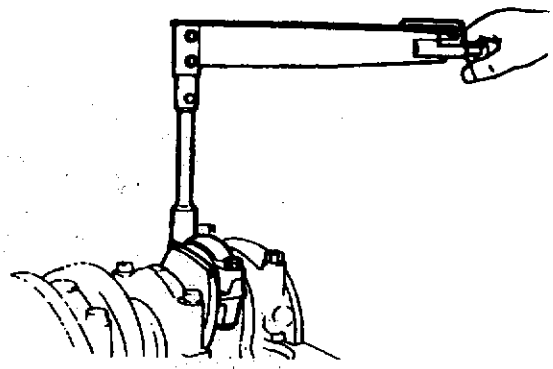
Side clearance: 0.0055~0.0153 in (0.14~0.39 mm)



AN9010052

11. Remove connecting rod cap.
12. Measure the connecting rod bearing oil clearance.
    1) Remove all foreign material and oil from the crank pin and bearing surface.
    2) Position Plastigage atop the crank pin in the axial direction.
    3) Install the connecting rod cap and tighten.

Tightening torque:
Tighten 50.6 lb-ft (68.6 N•m, 7.0 kg-m), tighten 21.7 lb-ft (29.4 N•m, 3.0 kg-m) and then tighten 90°.



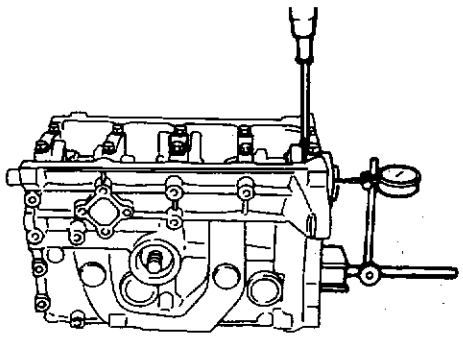
AN9010049

    4) Loosen the connecting rod cap nuts.
    5) Measure the oil clearance at each crank pin.

Oil clearance:
0.00169~0.00303 in (0.043~0.077 mm)

13. Remove the connecting rod and piston.
14. Before removing the main bearing cap, measure the crankshaft end play.

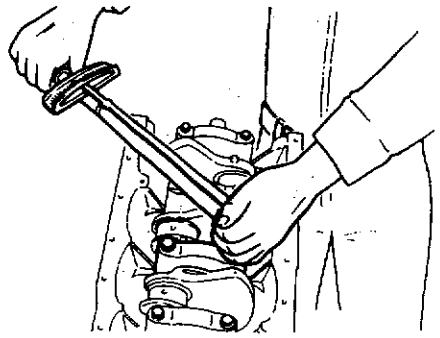
End play: 0.0055~0.0153 In (0.14~0.39 mm)



AN7010A165

15. Remove main bearing cap.
16. Measure the main bearing oil clearance
    1) Remove all foreign material and oil from the journals and bearing surface.
    2) Position Plastigage atop the journals in the axial direction.
    3) Install the main bearing cap and tighten as shown in the figure.

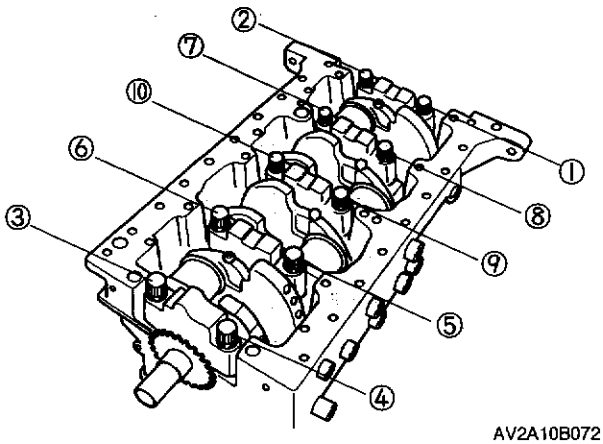
    Tightening torque:
    Pretighten 54.97 lb-ft (74.5 N•m, 7.6 kg-m), and then tighten 60°.



AN7010A164

    4) Loosen the main bearing cap bolts and remove main bearing cap.
    5) Measure the oil clearance at each journal.

    Oil clearance:
    No.1,2,4,5: 0.00177~0.00311 in (0.045~0.079 mm)
    No.3: 0.00267~0.00397 in (0.068~0.101 mm)
17. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.
18. Remove the main bearing cap, main bearing and crankshaft.



AV2A10B072

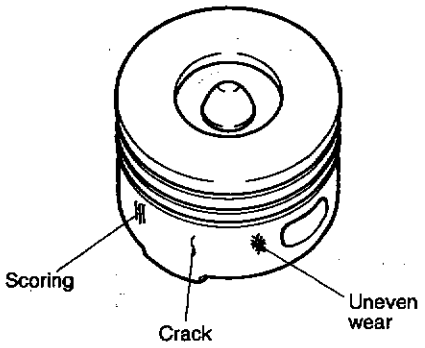
19. Remove the balance shaft and thrust plate.
20. Remove the balance gear.
21. Remove the oil jet.
22. Remove the snap ring with snap ring pliers and then remove the piston pin.
23. Using a piston ring expander, remove piston rings.

Inspection

Piston

✱ *Notice*
Replacing a piston also requires replacing piston rings.

1. Check circumference of piston for damage, scoring, or unusual wear patterns. Replace piston as needed.

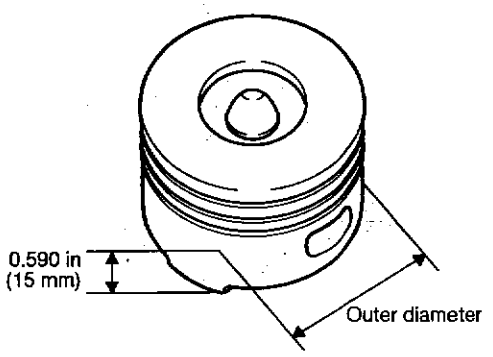


AV2A10B073

2. Check outside diameter of each piston at a 90° right angle to piston pin, 0.16 in (15 mm) above lower end of piston.

    Piston diameter
    A grade: 3.8195~3.8201 in (97.015~97.030 mm)
    B grade: 3.8201~3.8207 in (97.030~97.045 mm)

✱ *Notice*
If piston is collapsed or bell mounthed, replace piston.

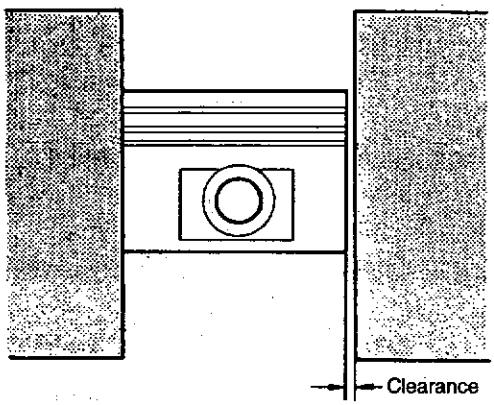


AV2A10B074

3. Check piston-to-cylinder liner wall clearance by subtracting piston diameter from the largest cylinder liner wall diameter, at each cylinder.

   Clearance: 0.0028~0.0039 in (0.070~0.098 mm)

4. If clearance exceeds maximum, replace piston or cylinder liner.

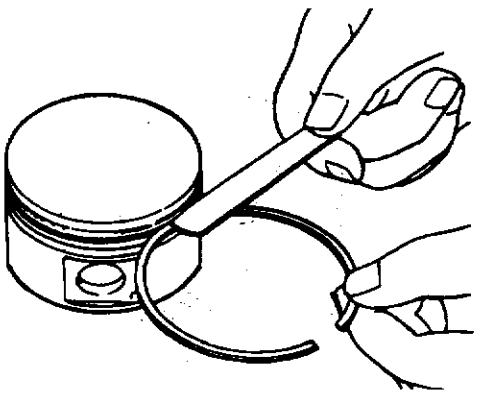


AS2A10080

Piston rings

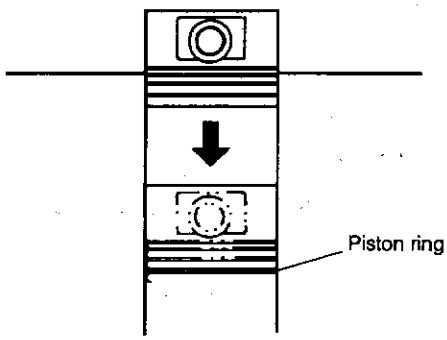
1. Insert a new piston ring into a piston ring groove and check piston ring-to-side clearance. Piston ring groove clearance.

   Piston ring groove clearance:
   Top ring: 0.0029~0.0040 in (0.076~0.102 mm)
   Second ring: 0.0016~0.0031 in (0.040~0.080 mm)
   Oil ring: 0.0012~0.0028 in (0.030~0.070 mm)
   Limit: 0.0118 in (0.30 mm)



AS2A10081

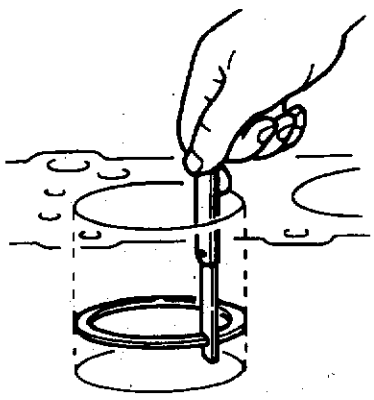
2. If clearance exceeds the limit, replace piston.
3. Inspect piston rings for damage, abnormal wear, or breakage.
4. Replace piston rings if necessary.
5. Insert piston ring into cylinder by hand.
6. Square ring in cylinder by inverting a piston into cylinder and pushing ring to the bottom of its travel in cylinder liner.



AS2A10081

7. Place a feeler gauge in end gap and check end gap clearance.

   End gap clearance:
   Top ring: 0.0118~0.0177 in (0.30~0.45 mm)
   Second ring: 0.0157~0.0217 in (0.40~0.55 mm)
   Oil rail: 0.0079~0.0157 in (0.20~0.40 mm)
   Limit: 0.0591 in (1.50 mm)



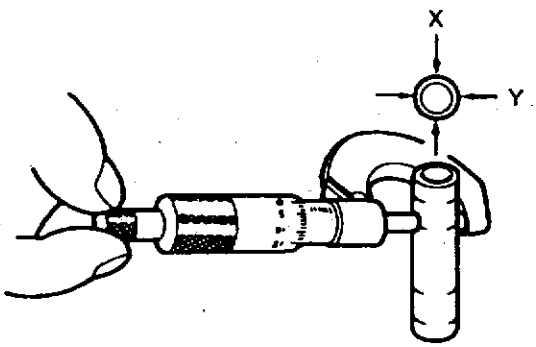
ABT010208

8. Replace piston ring if necessary.

Piston pin

1. Measure each piston pin diameter at X and Y direction at four locations shown.

   Diameter: 1.2596~1.2598 in (31.994~32.000 mm)

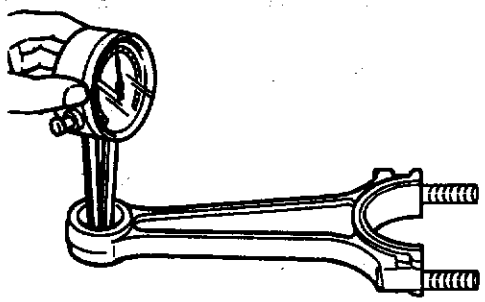


AS2A10142

Connecting rod

1. Check connecting rod bushing inside diameter.

   Inside diameter:
   1.2603~1.2611 in (32.012~32.033 mm)

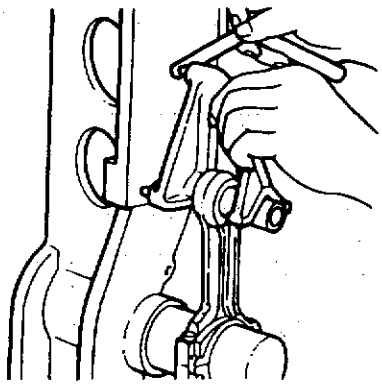


AS2A10143A

2. Subtract piston pin diameter from connecting rod bushing inside diameter to determine piston pin fit.

   Clearance: 0.0005~0.0015 In (0.012~0.039 mm)

3. If clearance is not within specification, replace connecting rod bushing.
4. Check each connecting rod for bending.



ABT010210

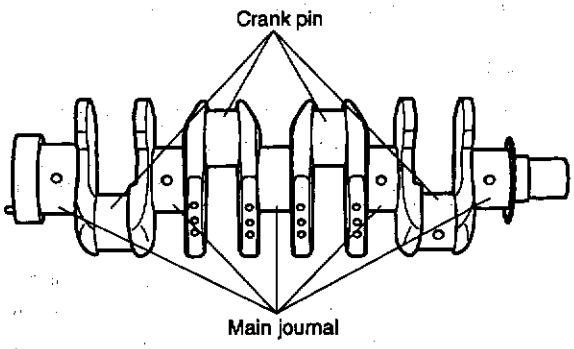
5. Replace connecting rods if necessary.

✱ *Notice*
Connecting rods must always be replaced as an assembly. Rod cap, rod, bolts and nuts are a matched set.

Crankshaft

1. Check crankshaft bearing and crank pin journals for damage and scoring.
2. Check oil holes for clogging.
3. Set crankshaft on V-blocks.
4. Measure crankshaft run-out at center journal. Replace crankshaft if it is not within specification.

   Run-out: 0.0055~0.0154 in (0.14~0.39 mm)



AV2A10B075

Pin journal bearing selection

1. Check the connecting rod big-end bore size code.

✱ *Notice*
The code is carved on connecting rod cap bolt hole side.

Connecting rod big-end bore diameter

Grade	Connecting rod big-end bore diameter
1	2.39499~2.39523 in (60.833~60.839 mm)
2	2.39523~2.39550 in (60.839~60.846 mm)

Crankshaft pin journal diameter:
2.24827~2.24898 in (57.106~57.124 mm)

2. Choose the proper pin journal bearing as below table.

Pin journal bearing clearance:
0.00138~0.00272 in (0.035~0.069 mm)

Pin journal bearing selection table

Connecting rod grade	Pin journal bearing grade	Oil clearance
1	Blue	0.00146~0.00272 in (0.037~0.069 mm)
2	Red	0.00138~0.00268 in (0.035~0.068 mm)

✱ *Notice*
Painting mark is located on the bearing side face.

Pin journal bearing thickness

Color	Pin journal bearing thickness
Blue	0.07213~0.07228 in (1.832~1.836 mm)
Red	0.07228~0.07244 in (1.836~1.840 mm)

3. Position properly upper bearing and lower bearing to connecting rod and connecting rod cap and then install connecting rod and connecting rod cap to crankshaft pin journal

Tightening torque:
Tighten 50.6 lb-ft (68.6 N•m, 7.0 kg-m), tighten 21.7 lb-ft (29.4 N•m, 3.0 kg-m) and then tighten 90°.

Main journal bearing selection

1. Check the cylinder block main bearing bore size code.

✱ *Notice*
The code is located on the side of ladder frame bolt hole.

Cylinder block main bearing bore diameter

Code	Cylinder block main bearing bore diameter
A	2.91598~2.91633 in (74.066~74.075 mm)
•	2.91633~2.91669 in (74.075~74.084 mm)
C	2.91669~2.91700 in (74.084~74.092 mm)

2. Check the crankshaft main journal size code.

✱ *Notice*
The code is located on the between main journal and pin journal.

Crankshaft main journal diameter

Code	Crankshaft main journal diameter	
	No. 1, 2, 4, 5	No. 3
A	2.75570~2.75598 in (69.995~70.002 mm)	2.75483~2.75511 in (69.973~69.980 mm)
•	2.75598~2.75625 in (70.002~70.009 mm)	2.75511~2.75539 in (69.980~69.987 mm)
C	2.75625~2.75649 in (70.009~70.015 mm)	2.75539~2.75562 in (69.987~69.993 mm)

3. Choose the proper main journal bearing in below table.

Main journal bearing selection table

		Cylinder block main bearing bore size code		
		A	•	C
Crankshaft main journal size code	A	Brown	Black	Black
	•	Green	Brown	Black
	C	Yellow	Green	Brown

Main journal bearing clearance:
No.1,2,4,5: 0.00146~0.00280 in (0.037~0.071 mm)
No.3: 0.00232~0.00366 in (0.059~0.093 mm)

Main journal bearing thickness

Color	Main journal bearing thickness
Black	0.07925~0.07945 in (2.013~2.018 mm)
Brown	0.07905~0.07925 in (2.008~2.013 mm)
Green	0.07886~0.07905 in (2.003~2.008 mm)
Yellow	0.07866~0.07886 in (1.998~2.003 mm)

4. Position properly upper bearing and lower bearing to cylinder block and main bearing cap.
5. Set crankshaft to cylinder block and then install main bearing cap to cylinder block.

Tightening torque:
Pretighten 54.97 lb-ft (74.5 N•m, 7.6 kg-m), and then tighten 60°.

Cylinder liner and piston selection

1. Check the cylinder bore inner diameter size code of cylinder block.

✱ *Notice*
The code is carved on the top of each cylinder.

Cylinder bore inner diameter

Code	Cylinder bore inner diameter
Y	3.9966~3.9971 in (101.513~101.526 mm)
X	3.9960~3.9966 in (101.500~101.513 mm)

2. Choose the proper cylinder liner as below table.

Clearance between cylinder liner and cylinder bore of cylinder block :
0.0003~0.0013 in (0.007~0.033 mm)

Cylinder liner selection table

Cylinder bore size code	Cylinder liner mark	Oil clearance
Y	3Y - Yellow	0.0003~0.0013 in (0.007~0.033 mm)
Y	3Y - Blue	0.0003~0.0013 in (0.007~0.033 mm)
X	3X - Yellow	0.0003~0.0013 in (0.007~0.033 mm)
X	3X - Blue	0.0003~0.0013 in (0.007~0.033 mm)

Piston selection table

Cylinder liner mark	Piston mark	Oil clearance
Yellow	B	0.0028~0.0039 in (0.070~0.098 mm)
Blue	A	0.0028~0.0039 in (0.070~0.098 mm)

✱ *Notice*
The mark for outer diameter is carved on the out surface of liner and for inner diameter is painted on the top of liner.

Cylinder liner outer diameter and inner diameter

Code	Outer diameter	Color	Inner diameter
3Y	3.9958~3.9963 in (101.493~101.506 mm)	Yellow	3.8234~3.8239 in (97.115~97.128 mm)
3Y	3.9958~3.9963 in (101.493~101.506 mm)	Blue	3.8228~3.8233 in (97.100~97.113 mm)
3X	3.9953~3.9958 in (101.480~101.493 mm)	Yellow	3.8234~3.8239 in (97.115~97.128 mm)
3X	3.9953~3.9958 in (101.480~101.493 mm)	Blue	3.8228~3.8233 in (97.100~97.113 mm)

Piston outer diameter

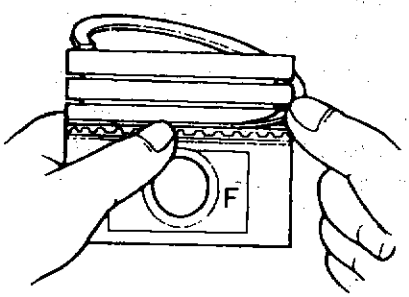
Code	Piston outer diameter
A	3.8195~3.8201 in (97.015~97.030 mm)
B	3.8201~3.8207 in (97.030~97.045 mm)

Reassembly

✱ *Notice*
a) Clean all parts before reassembly.
b) Apply new engine oil to all sliding and rotating parts.

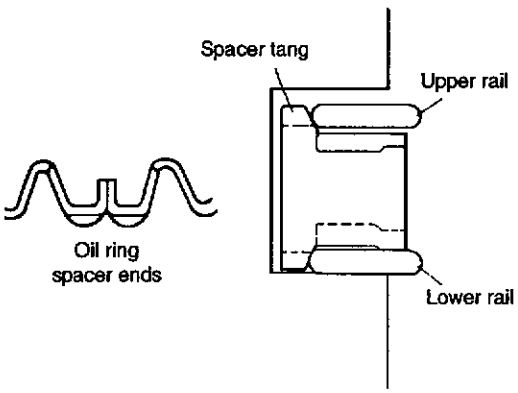
1. Install the three-piece oil rings on the pistons.
   1) Apply engine oil to the oil ring spacer and rails.
   2) Install the oil ring spacer so that the opening faces upward.
   3) Install the upper rail and lower rail.

✱ *Notice*
a) The upper rail and lower rail are the same.
b) Each rail can be installed with either face upward.



AS2A10085

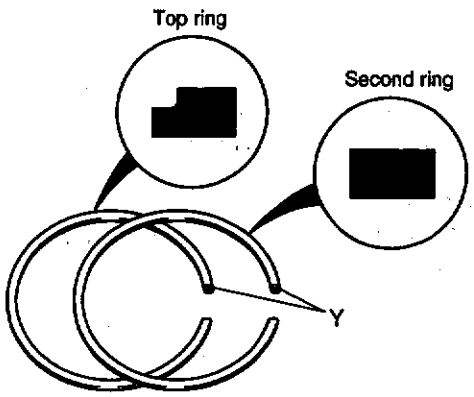
2. Check that both rails are expanded by the spacer tangs as shown in figure by checking that both rails turn smoothly in both directions.



ABT010170

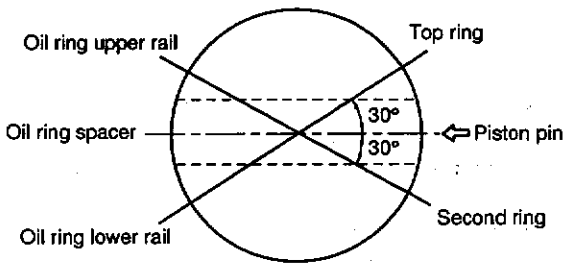
3. Install the second ring to the piston first, then install the top ring. Use piston ring expander.

✱ *Notice*
The rings must be installed with the "Y" marks facing upward.



AV2A10B076

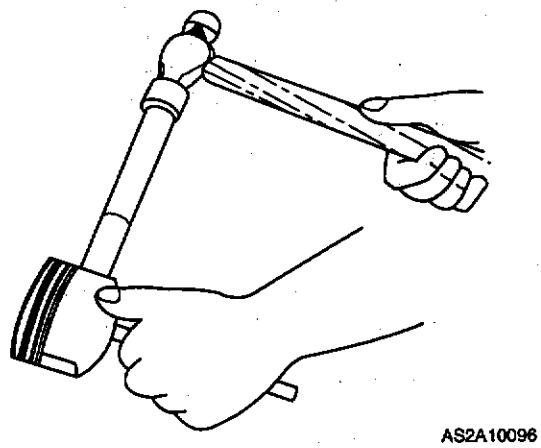
4. Apply a liberal amount of clean engine oil to the second and top piston rings.
5. Position the opening of each ring as shown in the figure.



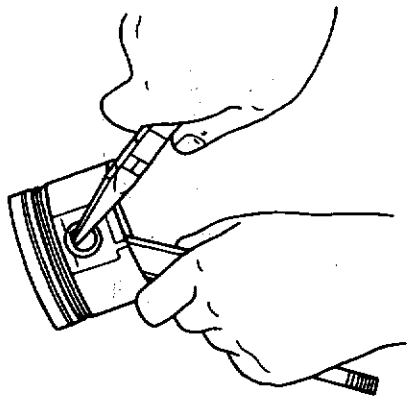
BSX010A162

6. Install one piston pin snap ring into grooves on piston.
7. Insert connecting rod into piston and slide piston pin through piston and through connecting rod until it makes contact with the piston pin snap ring already installed.

✱ *Notice*
Verify that piston and rod are assembled in same direction as they were prior to disassembly.


AS2A10096

8. Install second piston pin snap ring grooves on opposite side of piston.


AS2A10097

9. Hold piston upright and move connecting rod back and forth. Check that rod moves freely.
10. Install the oil jet.
11. Before installing the crankshaft, inspect the main bearing oil clearance as follows.

Oil clearance Inspection

(1) Remove all foreign material and oil from the journals and bearings.

Caution

a) Install the grooved upper main bearings in the cylinder block.

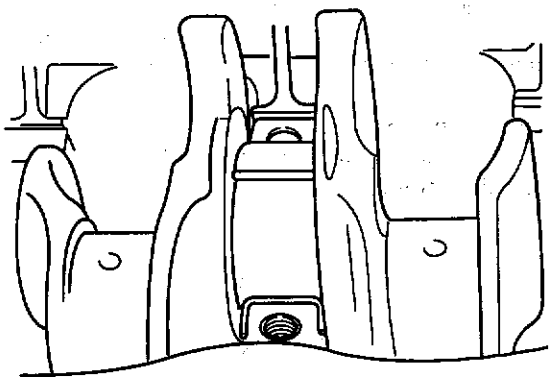
b) Install the thrust bearings with the oil groove facing the crankshaft.

(2) Install the upper main bearings and thrust bearings.
(3) Set the crankshaft in the cylinder block.

Caution

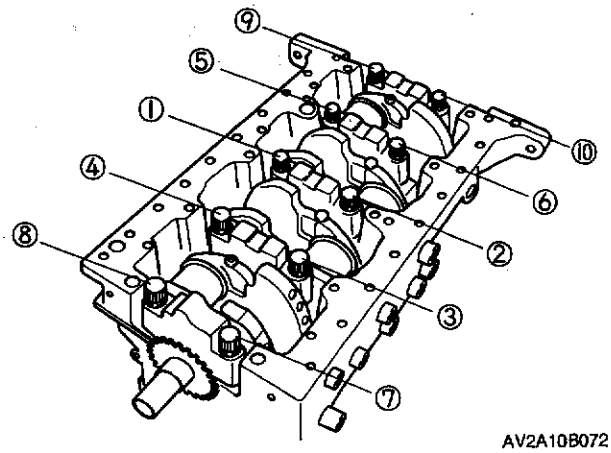
Do not rotate the crankshaft when measuring the oil clearances.

(4) Position plastigage atop the journals in the axial direction.


AV2A10B079

(5) Install the lower main bearings and the main bearing caps according to the cap number and ⇦ mark.
(6) Tighten the main bearing cap bolts in two or three steps in the order shown in the figure.

Tightening torque:
Pretighten: 54.97 lb-ft (74.5 N•m, 7.6 kg-m) and then tighten 60°



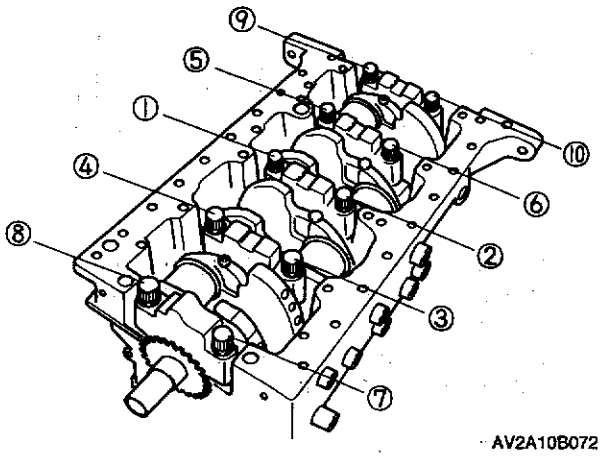
AV2A10B072

(7) Remove the main bearing caps, and measure the plastigage at each journal at the widest point for the smallest clearance and at the narrowest point for the largest clearance.
(8) If the oil clearance exceeds specification, grind the crankshaft and use undersize main bearings.

Oil clearance:
No.1,2,4,5: 0.00146~0.00280 in (0.037~0.071 mm)
No.3: 0.00232~0.00366 in (0.059~0.093 mm)

12. Apply a liberal amount of clean engine oil to the main bearings, thrust bearings and main journals.
13. Install the crankshaft and the main bearing caps according to the cap number and ⇦ mark.
14. Tighten the main bearing cap bolts in two or three steps in the order shown in the figure.

Tightening torque:
Pretighten: 54.97 lb-ft (74.5 N·m, 7.6 kg-m) and then tighten 60°.



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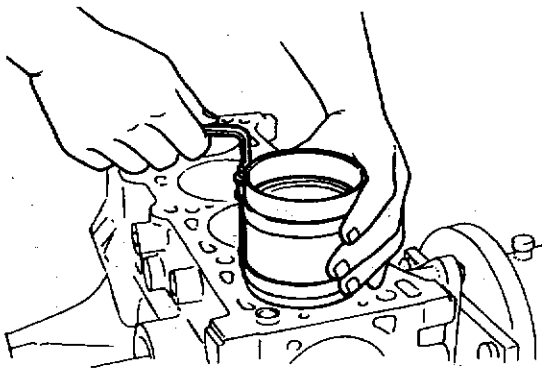
15. Before installing the connecting rod, inspect the connecting rod bearing oil clearance as follows.
    (1) Slip piston and connecting rod assembly into a piston ring compressor.
    (2) Rotate crankshaft so that crank pin journal for specific cylinder is at its lowest point(bottom dead center).
    (3) Lower piston and connecting rod assembly until piston ring compressor makes contact with dect surface of engine block.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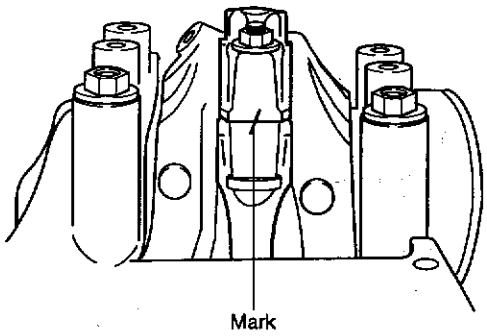
    (4) Using butt end of a hammer, tap the top of piston into cylinder and continue tapping until connecting rod makes contact with crankshaft.
    (5) Install a connecting rod bearing in each connecting rod cap.
    (6) Place a piece of Plastigage® on crank pin journals.

✱ *Notice*
Align the maching marks on the cap and connecting rod when installing the connecting rod cap.

    (7) Install connecting rod caps.

Tightening torque:
Tighten 50.6 lb-ft (68.6 N·m, 7.0 kg-m), tighten 21.7 lb-ft (29.4 N·m, 3.0 kg-m) and then tighten 90°



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    (8) Loosen and remove connecting rod caps.
    (9) Check the connecting rod bearing clearance.

Oil clearance:
0.00138~0.00272 in (0.035~0.069 mm)

    (10) If oil clearance exceeds maximum oil clearance specification, grind the crankshaft and use undersized connecting rod bearings.
    (11) Apply a coat of clean engine oil to connecting rod bearing in connecting rod cap.
    (12) Install connecting rod cap and torque to specification.

Tightening torque:
Tighten 50.6 lb-ft (68.6 N·m, 7.0 kg-m), tighten 21.7 lb-ft (29.4 N·m, 3.0 kg-m) and then tighten 90°

16. Install the oil pump and oil strainer.
17. Inatall the oil feeding pipe into the ladder frame, oil pump and block, and then tighten bolts.

    Tightening torque (oil feeding pipe bolt):
    16.6 lb-ft (23 N•m, 2.3 kg-m)

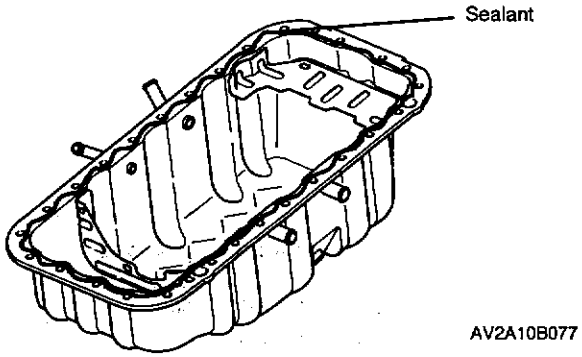
18. Install the crankshaft sprocket and oil pump sprocket.
19. Install the timing belt case.
20. Install the rear cover.

    Tightening torque:
    5.8~7.9 lb-ft (7.8~10.8 N•m, 80~110 kg-m)

21. Remove all foreign material from gasket surface.

✱ *Notice*
Install oil pan within five minutes of applying silicone sealer.

22. Apply a continuous bead of silicone sealant to oil pan contact surfaces.



23. Install the oil pan.
24. Install the flywheel, clutch disc and clutch cover.

SYMPTOM-RELATED DIAGNOSTIC PROCEDURE

Cooling system
Diagnostic chart

Problem	Possible Cause	Action
Overheating	Coolant level insufficient Coolant leakage Radiator fins clogged Radiator cap malfunction Fan motor malfunction Thermostat malfunction Water passage clogged Water pump malfunction	Add Repair Clean Replace Replace Replace Clean Replace
Corrosion	Impurities in coolant	Replace

SPECIFICATION

Cooling system
Specification

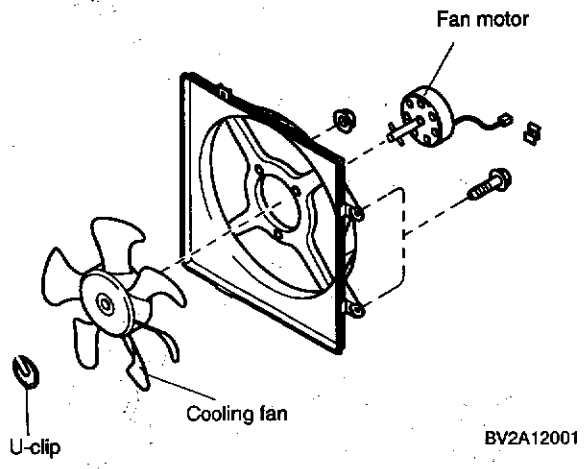
Item \ Engine model		J3 COMMON RAIL SYSTEM
Cooling system		Water-cooled, forced circulation
Coolant capacity	Us qt (liter, Imp qt)	9.93 (9.4, 8.27)
Water pump	Type	Centrifugal
Thermostat	Type	Wax
	Initial opening temperature °F (°C)	187.7~193.1 (86.5~89.5)
	Full-open temperature °F (°C)	212 (100)
	Full-open lift in (mm)	0.33 (8.5) minimum
Radiator	Type	Corrugated fin
	Cap valve opening pressure Psi (kPa, kg/cm²)	10.7~14.9 (73.6~103.0, 0.75~1.05)
Cooling fan	Type	Thermo type with plate type bimetal
	Operating temperature °F (°C)	Above 208.4 (98) - Low speed
		Above 221 (105) - High speed
	Number of blades	5
	Outer diameter in (mm)	14.4 (366)

REMOVAL AND REPLACEMENT PROCEDURE

Cooling fan motor

Removal

1. Disconnect negative battery cable.
2. Remove fresh air duct.
3. Disconnect cooling fan motor connector.
4. Remove three bolts securing cooling fan assembly.



5. Remove cooling fan assembly.
6. Remove U-clip securing cooling fan and remove cooling fan.
7. Remove nuts securing fan motor and remove fan motor.

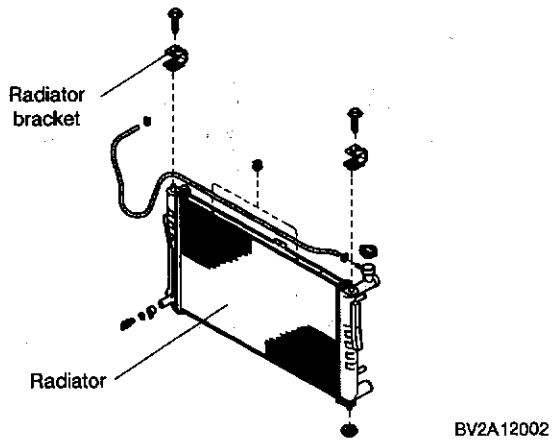
Replacement

1. Install fan motor.
2. Install cooling fan to fan motor by use of U-clip.
3. Install cooling fan assembly.
4. Reconnect cooling fan motor connector.
5. Install fresh air duct.
6. Reconnect negative battery cable.

Radiator

Removal

1. Drain engine coolant.
2. Remove cooling fan assembly.
   (Refer to cooling fan motor removal ; from step 1 to step 5.)
3. Disconnect coolant upper hose.
4. Disconnect reserve tank hose.
5. Disconnect coolant lower hose.
6. Remove radiator brackets.



7. Remove radiator.

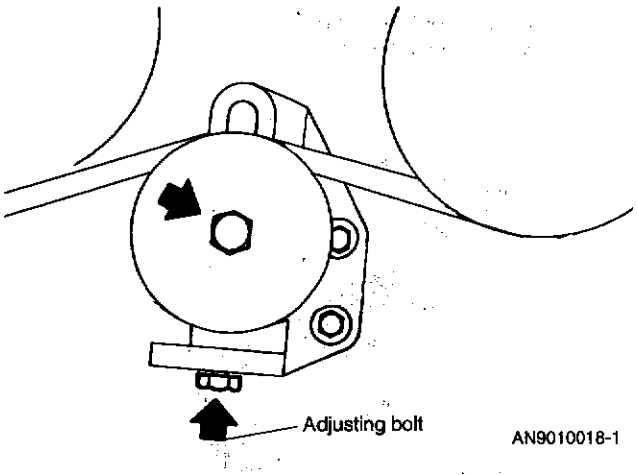
Replacement

1. Install radiator.
2. Install radiator bracket.
3. Reconnect coolant lower hose.
4. Reconnect reserve tank hose.
5. Reconnect coolant upper hose.
6. Install cooling fan assembly.
7. Refill engine coolant.

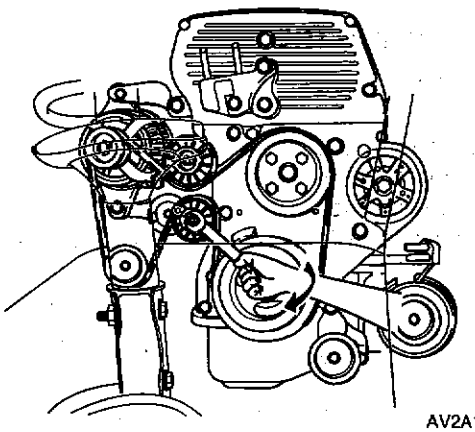
Water pump

Removal

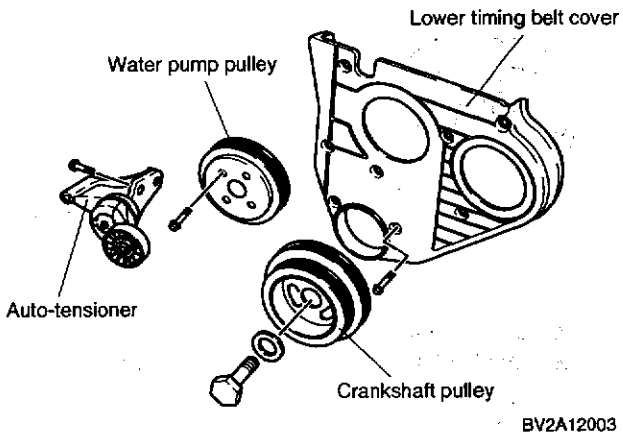
1. Drain engine coolant.
2. Raise vehicle and support it with safety stands.
3. Remove RH side wheel.
4. Loosen A/C drive belt tension by turning idler adjusting bolt.



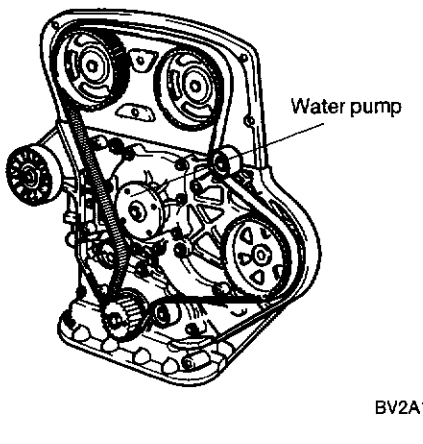
5. Remove A/C drive belt.
6. Lower auto-tensioner with spanner and then remove drive belt.



7. Remove auto-tensioner.



8. Remove water pump pulley.
9. Remove crankshaft pulley.
10. Remove lower timing belt cover.
11. Remove water pump.



Replacement

1. Install new gasket and water pump.
2. Install lower timing belt cover.

   Tightening torque:
   5.1~7.2 lb-ft (6.9~9.8 N•m, 0.7~1 kg-m)

3. Install crank shaft pulley.

   Tightening torque:
   253~289 lb-ft (343~392 N•m, 35~40 kg-m)

4. Install water pump pulley.

   Tightening torque:
   13.0~20.9 lb-ft (17.6~28.4 N•m, 1.8~2.9 kg-m)

5. Install auto-tensioner.

   Tightening torque:
   13.0~20.9 lb-ft (17.6~28.4 N•m, 1.8~2.9 kg-m)

6. Lower auto-tensioner with spanner and then install drive belt.
7. Install A/C drive belt.
8. Adjust belt deflection by turning adjusting bolt.

   Deflection (when applying 22 lb, 98 N, 10 kg)
   New one : 0.28~0.35 in (7~9 mm)
   Used one : 0.35~0.43 in (9~11 mm)

9. Install RH side wheel.

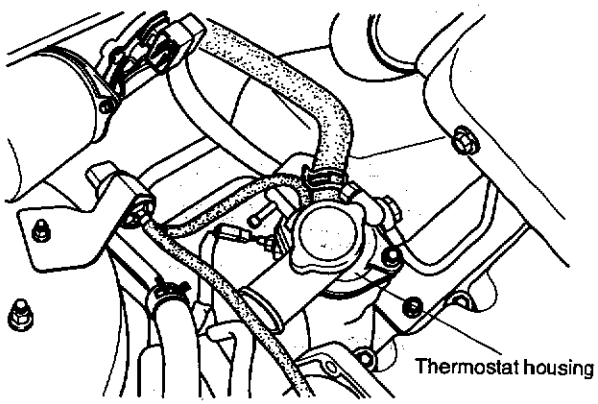
   Tightening torque:
   65~79 lb-ft (88~107 N•m, 9~11 kg-m)

10. Refill engine coolant.

Thermostat

Removal

1. Remove two bolts securing thermostat housing.



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2. Remove thermostat and gasket.
3. Replace thermostat if necessary.

Replacement

1. Install thermostat.
2. Install new gasket and thermostat housing.

HYUNDAI
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TSB-Local

Model	Terracan/SEDONA(HP)(all)
Group	Engine Mechanical System(12)
TSB No.	HT2007022216
Published	2007-02-23
Area & Distributor	West Europe & UNITED KINGDOM

Subject

CYLINDER HEAD BOLTS INFORMATION FOR J3-2.9L CRDI &TDI ENGINE(REVISED TSB : HT2007011003)

1. Description

This TSB is being issued to supersede the previous TSB #HT2007011003. On the previous TSB #HT2007011003, the tightening torque about the cylinder head bolt **"22192-4X700"** is given incorrectly. Please refer to the below revised information when servicing.

※ Correction

Part name		Part No.	Tightening torque
Cylinder head bolt	Long type	22192-4X700	**40.0N.m+45˚+120˚ ▶ 40.0N.m+90˚+120˚**

2. Effective Vehicle Information

MODEL	REMARK
Terracan(HP)	Equipped with J3-2.9L CRDI diesel engine

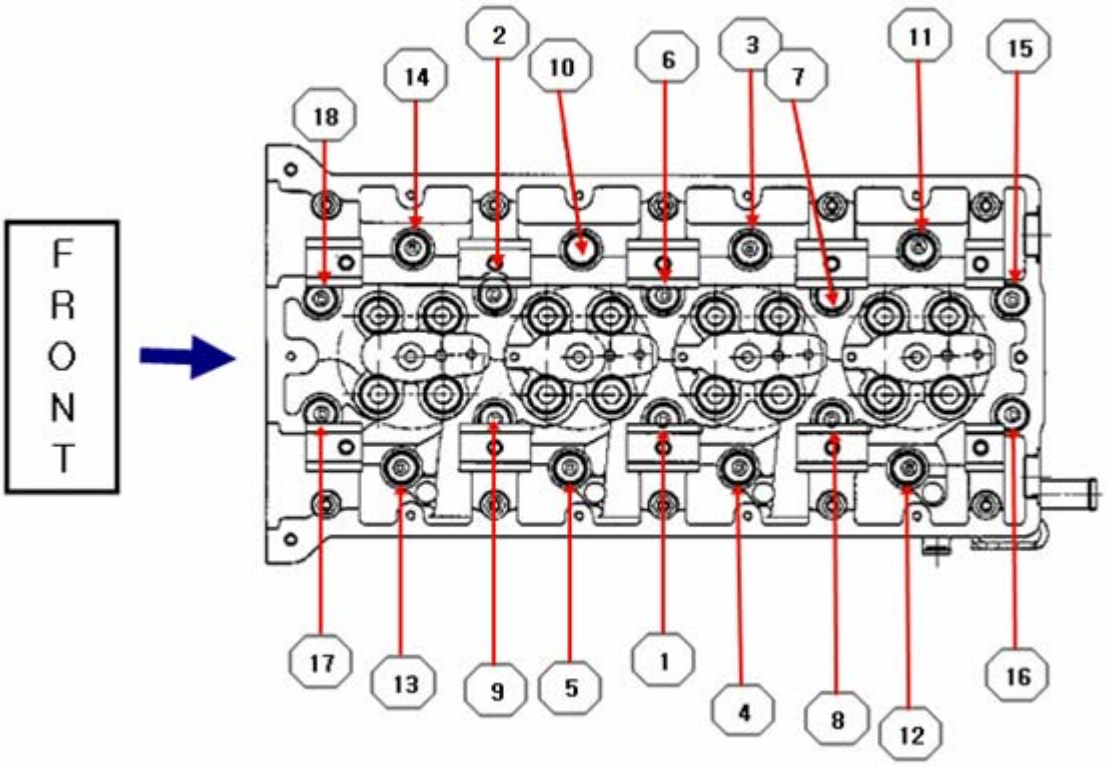
3. Parts Information

PART NAME		FOR VEHICLES WITH MECHANICAL FUEL INJECTION PUMP		FOR VEHICLES WITH HIGH PRESSURE PUMP	
		PART NUMBER	TIGHTENING TORQUE	PART NUMBER	TIGHTENING TORQUE
Cylinder head bolt	Short type	0K551-10136	34.3N.m+45˚+45˚	22191-4X700	40.0N.m+90˚+90˚
	Long type	0K551-10137	34.3N.m+45˚+70˚	22192-4X700	40.0N.m+90˚+120˚
	Bolt mark				
		J3		J	

[Caution]

Because the mechanical injection pump is not supplied to the TERRACAN(HP) vehicles, Be sure to use only. "J" marked bolt.

The early Sedona uses the J3 bolts



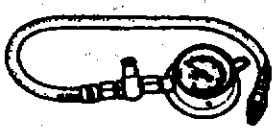
Short type	3, 4, 5, 10, 11, 12, 13, 14	8each
Long type	1, 2, 6, 7, 8, 9, 15, 16, 17, 18	10each

SPECIAL SERVICE TOOL

Lubrication system
Special service tool

0K670 140 015

Oil pressure gauge



Used to inspect oil pressure.

SYMPTOM-RELATED DIAGNOSTIC PROCEDURE

Lubrication system
Diagnostic chart

Problem	Possible Cause	Action
Engine hard starting	Improper engine oil Insufficient engine oil	Replace Add oil
Excessive oil consumption	Internal engine wear Oil leak	*Refer to Section EM* Repair
Oil pressure drop	Insufficient oil Oil leakage Worn and/or damaged oil pump gear Worn plunger (inside oil pump) or weak spring Clogged oil strainer Excessive main bearing or connecting rod bearing clearance	Add oil Repair Replace Replace Clean *Refer to Section EM*
Warning lamp illuminates while engine is running	Oil pressure drop Malfunction of oil pressure switch Malfunction of electrical system	As described above *Inspect oil pressure switch* *Inspect electrical system*

SPECIFICATION

Lubrication system

Specification

Item \ Engine model			J3 COMMON RAIL SYSTEM
Lubrication system			Force-fed type
Oil pump	Type		Trochoid gear
	Relief pressure	psi (kPa, kg/cm²)	78.2~92.4 (539~637, 5.5~6.5)
Oil filter	Type		Full-flow type, Paper element
	Relief pressure differential	psi (kPa, kg/cm²)	11.4~17.1 (78~118, 0.8~1.2)
Oil pressure switch activation pressure		psi (kPa, kg/cm²)	2.8~4.9 (20~34, 0.2~0.35)
Oil capacity	Total (dry engine)	Us qt (liter, Imp qt)	7.50 (7.1, 6.2)
	Oil pan	Us qt (liter, Imp qt)	5.92 (5.6, 4.9)
	Oil filter	Us qt (liter, Imp qt)	0.63 (0.6, 0.5)
Engine oil			API service CF-4, CG-4 SAE 10W-30

ON-VEHICLE SERVICE PROCEDURE

Engine oil replacement

⚠ WARNING
BE CAREFUL WHEN DRAINING BECAUSE OIL IS HOT AND COULD CAUSE PERSONAL INJURY.

1. Warm engine to normal operating temperature and turn engine off. Position a suitable container under oil pan.
2. Remove oil filler cap and oil pan drain plug.
3. Allow oil to be fully drained.
4. Install drain plug with new gasket.

   Tightening torque:

   23.1~30.4 lb-ft (31.4~41.2 N•m, 3.2~4.2 kg-m)

5. Refill engine with specified type and amount of engine oil.(*Refer to specification table; page EM-LU-3*)
6. Install oil filler cap.
7. Run engine and check for leaks.
8. Check oil level by level gauge and add oil if necessary.

Oil pressure check

1. Disconnect and remove oil pressure switch.
2. Install oil pressure gauge into oil pressure switch installation hole.
3. Warm engine to normal operating temperature.
4. Run engine and note gauge readings.

   Oil pressure:

   45.5~71.1 psi (314~490 kPa, 3.2~5.0 kg/cm²)-3,000 rpm

5. If pressure is not within specification, check for cause, and repair. (*Refer to Symptom-related diagnostic procedure; page EM-LU-2.*)
6. Remove oil pressure gauge and install oil pressure switch.

   Tightening torque:
   8.7~13.0 lb-ft (11.7~17.6 N•m, 1.2~1.8 kg-m)

Oil filter replacement

1. Remove oil filter with oil filter wrench. If rubber seal is stuck to engine, remove it.
2. Apply a small amount of clean engine oil to rubber seal of new filter.
3. Install oil filter and turn it by hand until rubber seal contacts base.
4. Tighten filter 1-1/6 turns with filter wrench.

   Tightening torque:

   16~18 lb-ft (21.6~24.5 N•m, 2.2~2.5 kg-m)

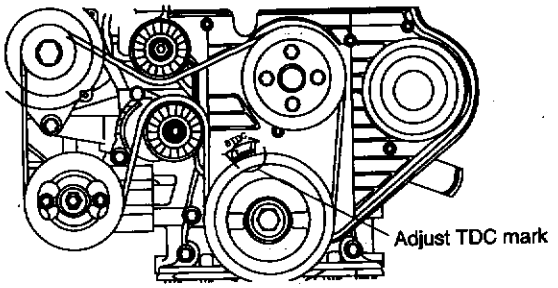
5. Start engine and check for leaks.
6. Turn engine off, and wait 5 minutes. Check oil level and add oil if necessary.

REMOVAL AND REPLACEMENT PROCEDURE

Oil pump

Removal

1. Remove oil pan.
2. Adjust V groove TDC mark on outside of pulley to TDC mark "T" on timing cover, by rotating crankshaft pulley.



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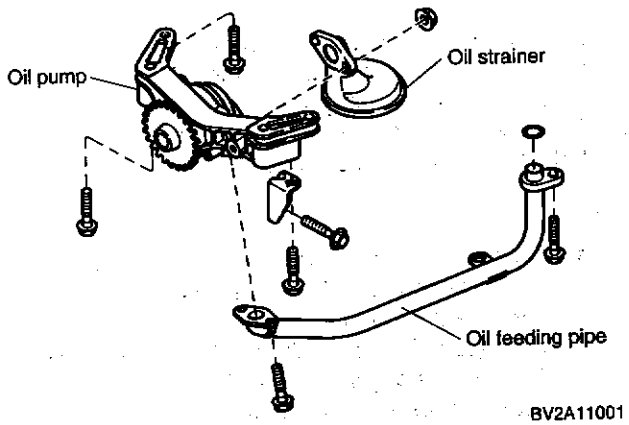
3. Remove oil feeding pipe from ladder frame.



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4. Remove oil pump with four bolts.
5. Remove oil pump.

Replacement

1. Remove oil pump after loosen the chain by push the end of chain tensioner with the chain tensioner lever.
2. Install oil feeding pipe.

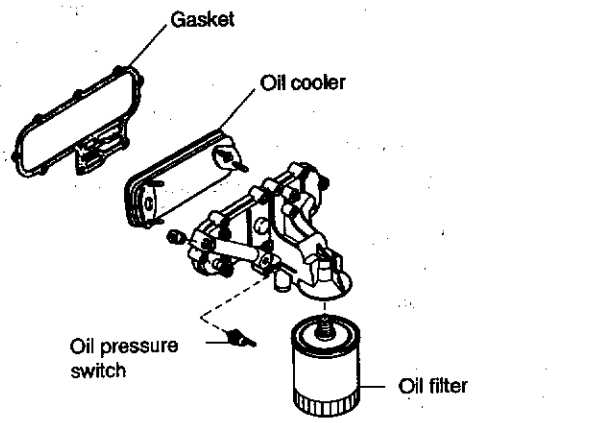
   Tightening torque:
   16.6 lb-ft (23 N·m, 2.3 kg-m)

3. Install oil pan.

Oil cooler

Removal

1. Remove fresh air duct.
2. Remove ventilator mounting bracket.



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3. Remove oil filter assembly with two nuts and eight bolts.
4. Remove four nuts securing oil cooler.
5. Remove oil cooler from oil filter assembly.

Replacement

1. Install new "O" rings and oil cooler to oil filter assembly.

   Tightening torque:
   10.8~18.0 lb-ft (14.7~24.5 N·m, 1.5~2.5 kg-m)

2. Install new gasket and oil filter assembly to cylinder block.
3. Install ventilate mounting bracket.
4. Install fresh air duct.

ON-VEHICLE SERVICE PROCEDURE

Turbocharger

After checking the turbocharger, replace the assembly in case of abnormality.

Check point	Check result	Symptom			
		Oil leak	Smoke	Abnormal noise	Lowpower, poor acceleration
Turbine rotor	Oil leakage	△	●	△	△
	Carbon deposit	△	●	○	○
	Friction with housing	△	○	●	○
	Bent or broken blade			●	●
Compressor oil	Contaminated intake inlet with oil	○	○		
	Friction with housing	△	○	●	○
	Bent or broken blade			●	●
Turbine and compressor check in both directions	Heavy or catching feeling when rotated by finger No movement when rotated		△	△	○
	Excessive looseness in bearing			○	●
	Carbon deposit in drain oil hole	△	△	○	△
Observation on oil hole	Carbon deposit in drain oil hole	△	●	△	△
Operation of waste gate valve (aircon used)	No smooth operation when applied after removing positive pressure				●

● : High possibility
○ : Medium possibility
△ : Low possibility

Turbocharger

On-vehicle Inspection

1. Warm up the engine to the normal operating temperature.
2. Disconnect the hose between the air inlet tube and the boost compensator from the air inlet side.
3. Install the pressure gauge by inserting the 3-way connector.
4. Read the maximum valve on the pressure gauge after starting the engine and increasing the engine speed.

Pressure gauge reading	Check point
No positive pressure or low pressure	• Air exhaust gas leakage • Abnormal turbocharger
Above the specified supercharging pressure (Standard value)	• Leakage by separation or breakage of actuator hose • Abnormal operation of actuator

Removal

1. Discharge the coolant.
2. After removing the air duct, keep foreign material from entering the turbocharger inlet.
3. Remove the turbocharger insulator.
4. Remove the turbocharger water outlet pipe.
5. Remove the turbocharger oil supply pipe.
6. Remove the exhaust and front pipes.
7. Remove the turbocharger inlet and outlet pipes.
8. Remove the turbocharger by loosening the turbocharger mounting bolts.

Caution

a) Don't carry the actuator by holding the actuator rod and the actuator hose.

b) Use the stud bolt of specified type when it is damaged. If one of different material is used, it may be elongated at high temperature and that can result in gas leakage.

c) The turbocharger is operated at high temperature and high speed that sufficient care should be taken on inclusion of foreign material into the oil pipe, deformation of the oil pump and etc..

d) After removing the turbocharger, attach the cap or tape on the air and exhaust gas inlets for foreign material not to be included.

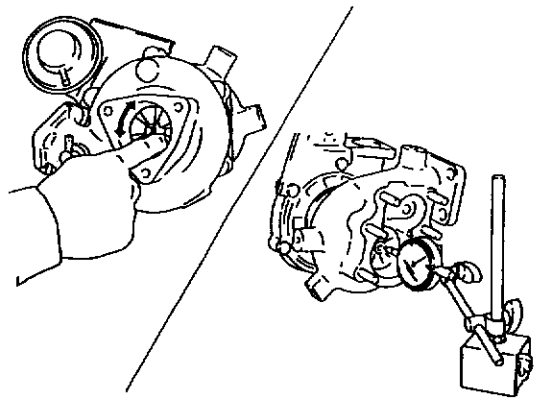
e) If the oil in the sensor housing flows out to the turbine and the compressor housing inside, it can be wrongly judged as turbocharger trouble that the turbocharger should be placed horizontally as originally mounted after removal.

Installation
Install them in the reverse order of removal.

Caution
- ***a) When installing a new turbocharger, pour small amount of oil into the lubricant inlet of the turbocharger.***
- ***b) When starting the engine, be sure to connect the lubricant supply pipe and idle it for 1~2 minutes at low speed. Then increase the engine speed after lubricant has been supplied to the turbocharger sufficiently.***

Inspection
1. Check if the rotor shaft is rotated smoothly when turned by a finger.
2. Check if there is looseness on the rotor shaft when moved up and down.
3. Install a dial gauge at the end of the shaft and check the free travel.

Free travel
0.001~0.003 in (0.026~0.074 mm)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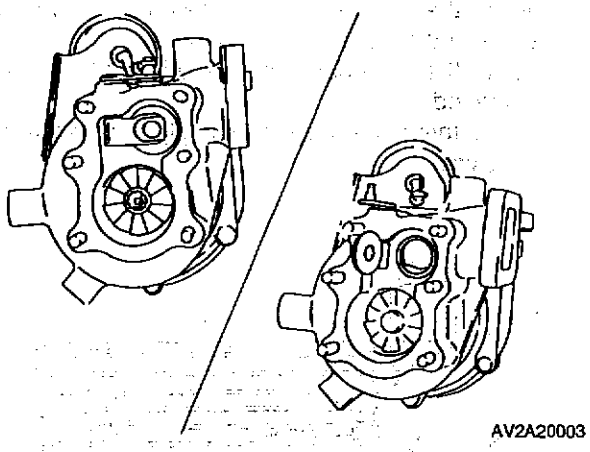
4. Check if there is oil attached or carbon deposit on the turbine or the compressor wheels.
5. Check if there is deformation or crack on the turbine or the compressor wheels.
6. Check if the turbine or the compressor wheels are interfered with housings.
7. Check if the waste gate valve is operated smoothly and if there is no deformation or crack after removing the fixing pin of the actuator rod.
8. Check if there is poor contact between the waste gate valve and the turbine housing seat.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Tuborcharger actuator
Inspection
1. Disconnect the air hose from the actuator.
2. Connect the pressure tester to one end of the actuator pipe and connect the other end to the actuator.
3. Install the dial gauge on the straight line of the actuator rod.
4. Check if the actuator is operated and if the reading of the dial gauge is moved by **0.08 in (2.0 mm)** when pressure of **1080~1170 mmHg** is applied by the pressure tester.

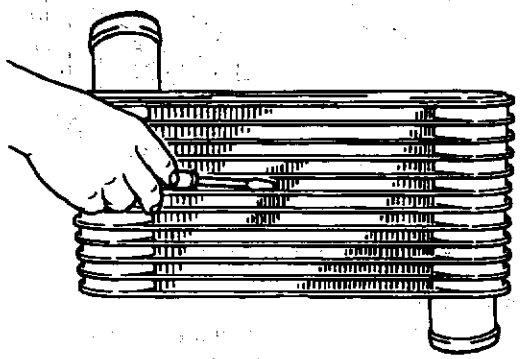
Caution
If pressure over 1.5 kg/cm² is applied, the actuator may be damaged.

5. If it is not operated or it does not reach the standard pressure, replace the actuator.

Intercooler

Inspection

1. Check if there is crack or damage on the intercooler visually and replace it if it is abnormal.
2. Check if the pin is damaged and adjust it by a driver if damaged.
3. Check if there is leakage after applying pressure of **1.5 kg/cm²**.



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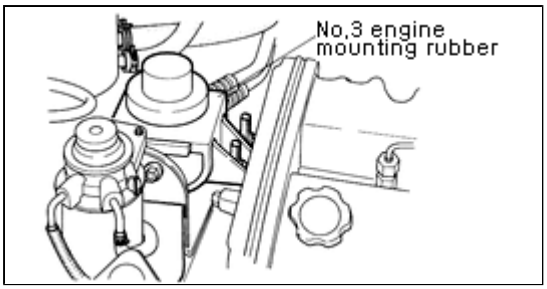
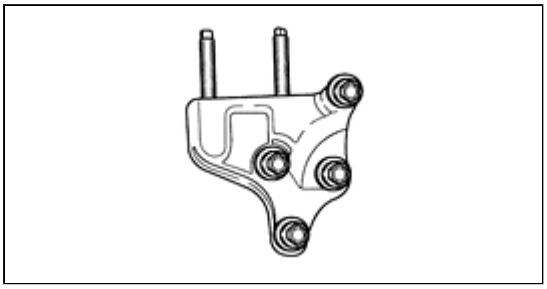
REMOVAL

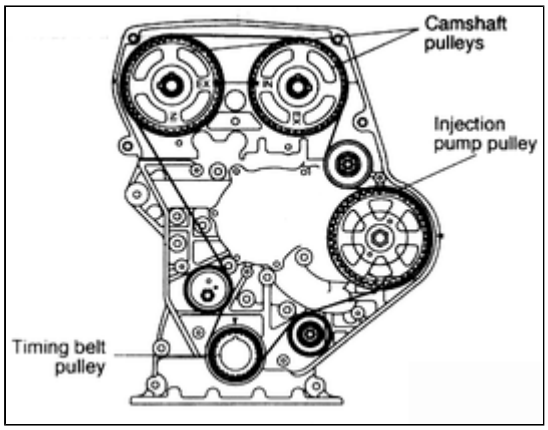
1. Raise vehicle and support it with safety stands.
2. Remove the radiator upper hose.
3. Remove the sedimenter with hoses still connected.
4. Remove the No. 3 engine mounting rubber.



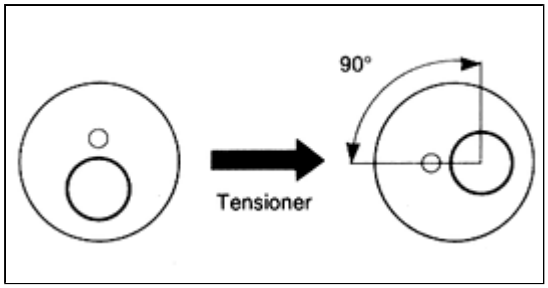
5. Remove the No. 3 engine mounting bracket.



6. Remove the RH side wheel.
7. Remove the A/C drive belt.
8. Remove the drive belt.
   (Refer to Drive belt replacement)
9. Remove the auto tensioner.
10. Remove the water pump pulley.
11. Remove the crankshaft pulley.
12. Remove the upper timing belt cover.
13. Remove the lower timing belt cover.
14. Rotate crankshaft and align timing mark on timing belt pulley with timing mark on engine block.



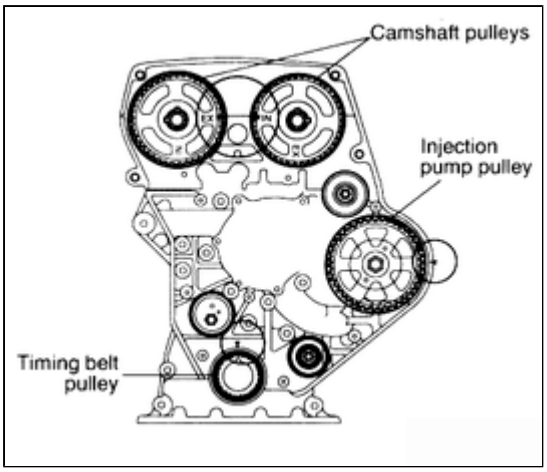
15. Rotate tensioner pulley counterclockwise to 90° and then tighten tensioner pulley bolt.



16. Remove the timing belt.

INSTALLATION

1. Check that timing mark on timing belt pulley, camshaft pulley and injection pump pulley is aligned with timing mark on engine.



2. Install the timing belt.
3. Loosen tensioner pulley lock bolt and allow tension spring to apply tension to timing belt.

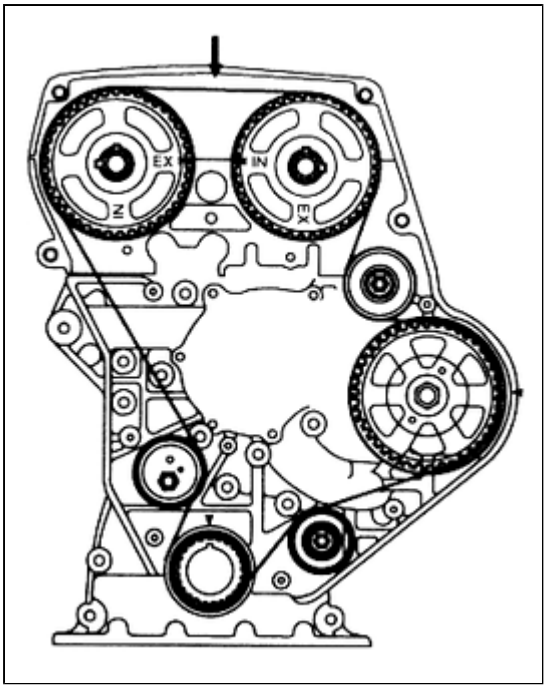
> NOTE
>
> Do not add additional tension.

4. Tighten the tensioner pulley bolt.

Tightening torque : 27.5~38.3lb-ft (37.2~51.9N·m, 3.8~5.3kg-m)

5. Rotate crank full revolutions (clock only) and align timing mark on timing belt pulley with timing mark on engine block.
6. Check that timing mark on camshaft pulley and injection pump pulley is aligned with timing mark on engine block.
7. If they are not aligned, remove timing belt and repeat step 1 and 6.
8. With clavis gauge check tension of timing belt at the position as shown in the figure.

Tension of timing belt : 123~137Hz



9. Install the upper and lower timing belt cover.

Tightening torque : 5.1~7.2lb-ft (3.9~9.8N·m, 70~100kg-m)

10. Install the crankshaft pulley.

Tightening torque : 253~289lb-ft (343~392N·m, 35~40kg-m)

11. Install the water pump pulley.

Tightening torque : 13.0~20.9lb-ft (17.6~28.4N·m, 1.8~2.9kg-m)

12. Install the auto tensioner.

Tightening torque : 13.0~20.9lb-ft (17.6~20.9lb-ft (17.6~28.4N·m 1.8~2.9kg-m)

13. Install the drive belt and A/C drive belt. (Refer to Driver belt.)
14. Install the RH side wheel.

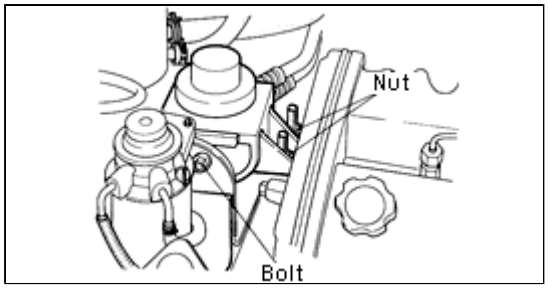
Tightening torque : 65~79lb-ft (88~108N·m, 9.0~11.0kg-m)

15. Install the No. 3 engine mounting bracket.

Tightening torque : 26.7~39.8lb-ft (36.2~53.9N·m, 3.7~5.5kg-m)

16. Install the No. 3 engine mounting rubber.

Tightening torque :Nut : 49.1~68.7lb-ft (66.7~93.1N·m, 6.8~9.5kg-m)
Bolt : 62.9~86.0lb-ft (85.3~116.7N·m, 8.7~11.9kg-m)

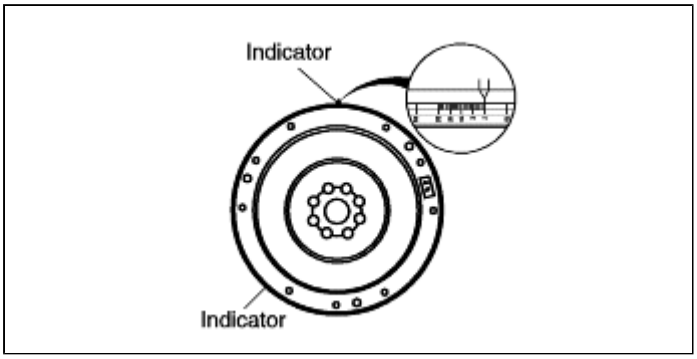


17. Install the sedimenter.
18. Install the radiator hose.
19. Fill engine coolant with specified type and amount. (Refer to section cooling system)
20. Start engine and then check for leaks.

INSPECTION

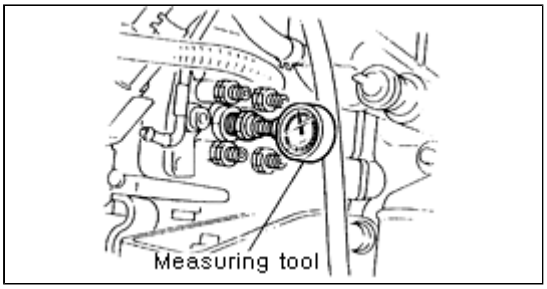
Injection timing

1. Rotate the crankshaft slowly and align white mark on crankshaft pulley to TDC mark on timing cover or align T mark on flywheel to indicatior pin.



2. Remove the injection pipe between the injection pump and the nozzle.
3. After removing the cover of hydraulic part of injection pump, install the SST (OK670 131 010).

> CAUTION
>
> 1) Be careful for fuel leak during removing the injection pump.
> 2) Install it so that the SST indicates about 0.039 ± 0.0078in (1.0 ± 0.2mm)



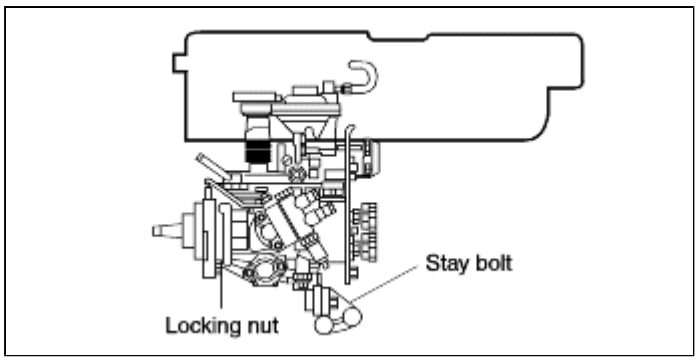
4. Rotate the crankshaft pulley in reverse to align it to BTDC 20°~30°.
5. Align the indicatior of dial gauge to 0 rotate the crankshaft pulley in left and right and then verify the position of indicator.
6. Rotate the crankshaft pulley in reverse to align it to TDC and then check the dial gauge reading. (Refer to step 1)

Lift amount : 0.039 ± 0.0078in (1.0 ± 0.2mm)

7. If the dial gauge reading exceeds the specification, loosen the stay bolt of injection pump.

8. Loosen the tightening nut for the injection pump by using a socket wrench.
9. Rotate the injection pump body so that the dial gauge indicates 0.043 ± 0.0039 in (1.1 ± 0.1mm) at TDC.
10. Tighten the stay bolt of injection pump and the tightening nut.

Tightening torqueTightening nut : 11.6~16.9lb-ft (16~22N·m, 1.6~2.2kg-m)Stay bolt : 23.8~31.1lb-ft (32~42N·m, 3.3~4.3kg-m)



11. Remove the SST (OK670 131 010).
12. Insert a cap after inserting a new gasket.

Tightening torque : 10.1~14.5lb-ft (14~20N·m, 1.4~2.0kg-m)

13. Tighten the injection pipe temporarily temporarily and tighten the nuts(4EA) on the pump side.

Tightening torque : 19.17~24.23lb-ft (25.6~32.8N·m, 2.65~3.35kg-m)

14. After starting the engine check if there is any fuel leakage.

DISASSEMBLY

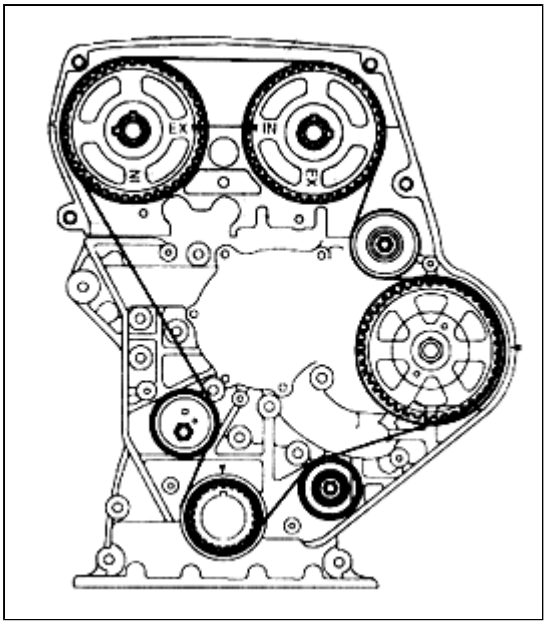
Timing belt cover

1. Remove No. 3 engine mounting bracket.
2. Remove water pump pulley.
3. Remove power steering pump.
4. Remove crankshaft pulley.
5. Remove idler and bracket.
6. Remove upper timing belt cover.
7. Remove lower timing belt cover.

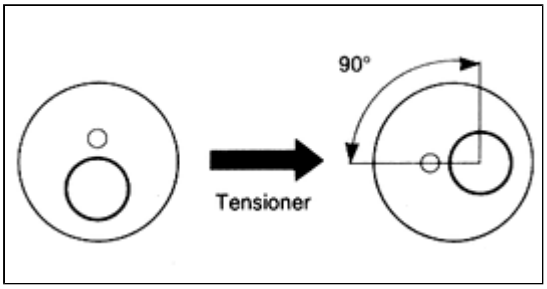
DISASSEMBLY

Timing belt and cylinder head

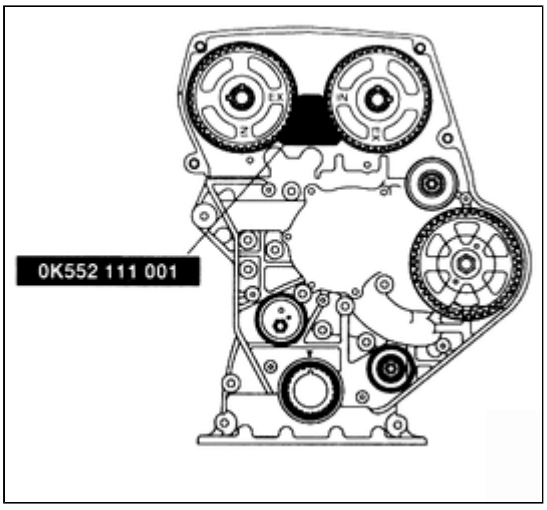
1. Rotate crankshaft and align timing mark on timing belt pulley with timing mark on engine block.



2. Rotate tensioner pulley counterclockwise to 90 and then tighten tensioner pulley bolt.

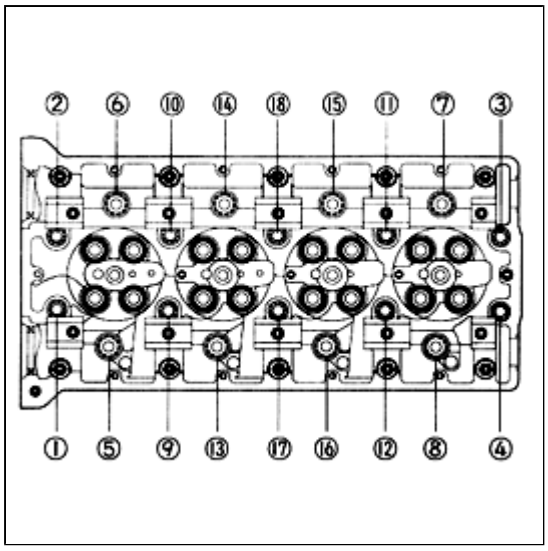


3. Remove the timing belt.
4. Remove the injection pump.
5. Install the SST (0K552 111 001) as shown in the figure and the remove the camshaft pulley.



6. Remove the tensioner and idler.
7. Remove the timing belt pulley.
8. Remove the upper plate assembly.
9. Remove the engine hanger.
10. Remove the nozzle bracket and nozzle.
11. Remove the cylinder head cover.
12. Remove the rocker arm shaft assembly.

13. Remove the camshaft cap and camshaft.
14. Remove the cylinder head bolts in the order shown in the figure.



REASSEMBLY

Timing belt cover

1. Install upper and lower timing belt cover.

Tightening torque : 5.1~7.2lb -ft (6.9~9.8N·m, 0.7~1.0kg-m)

2. Install idler and bracket.

Tightening torque : 27.5~38.3lb-ft (37.2~51.9N·m, 3.8~5.3kg-m)

3. Install crankshaft pulley.

Tightening torque : 253~289lb-ft (343~392N·m, 35~40kg-m)

4. Install power steering pump.

Tightening torque : 21.7~28.9lb-ft (29.4~39.2N·m, 3.0~4.0kg-m)

5. Install No. 3 engine mounting bracket.

Tightening torque : 49.2~68.7lb-ft (66.6~93.1N·m, 6.8~9.5kg-m)

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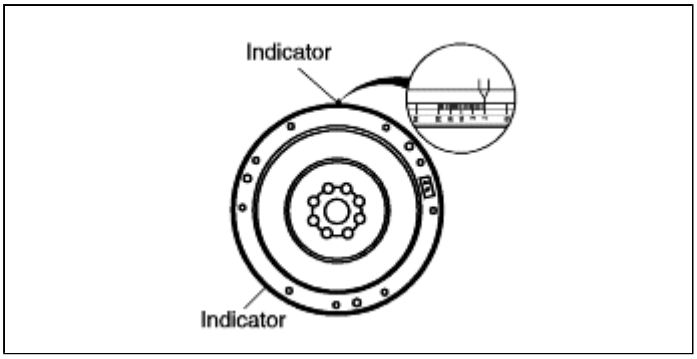

2. Remove the injection pipe between the injection pump and the nozzle.
3. After removing the cover of hydraulic part of injection pump, install the SST (OK670 131 010).

> **CAUTION**
>
> 1) Be careful for fuel leak during removing the injection pump.
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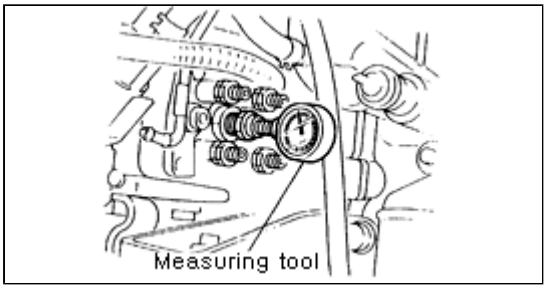

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Lift amount : 0.039 ± 0.0078in (1.0 ± 0.2mm)

7. If the dial gauge reading exceeds the specification, loosen the stay bolt of injection pump.
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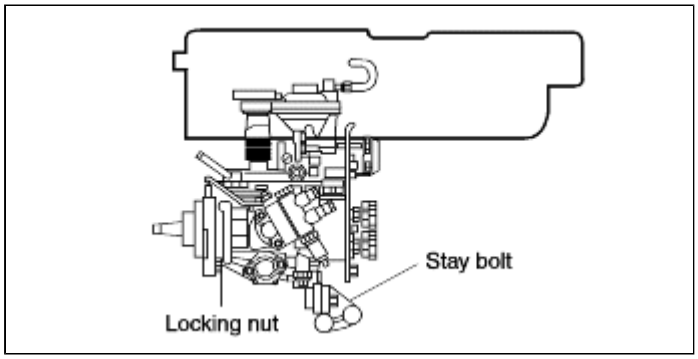

11. Remove the SST (OK670 131 010).

12. Insert a cap after inserting a new gasket.

    Tightening torque : 10.1~14.5lb-ft (14~20N·m, 1.4~2.0kg-m)

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14. After starting the engine check if there is any fuel leakage.