

BODY ELECTRICAL

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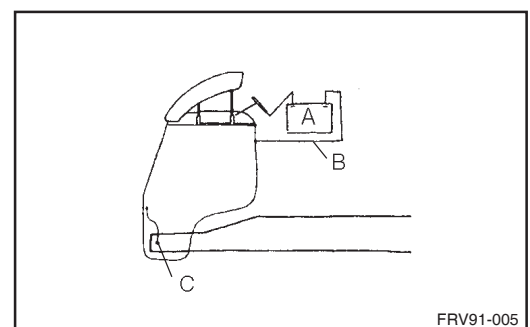
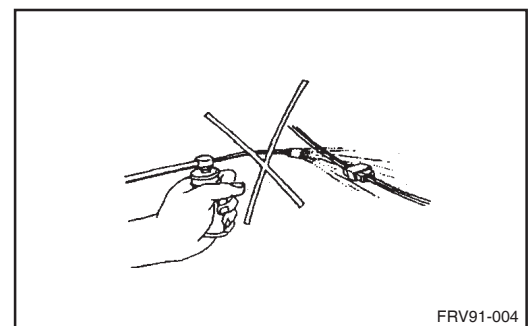
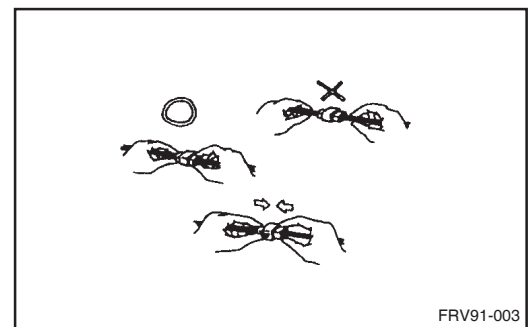
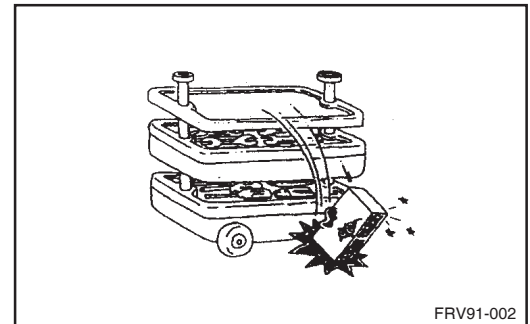
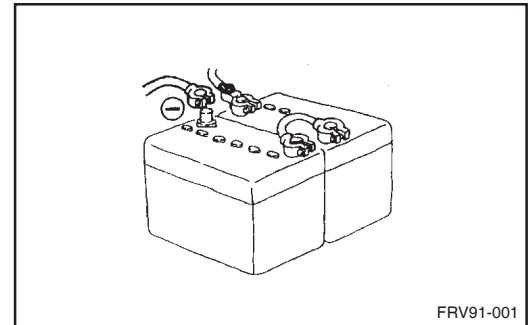
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GENERAL

1. When replacing or repairing electrical system, disconnect negative battery terminal to prevent any damage due to the short.

CAUTION

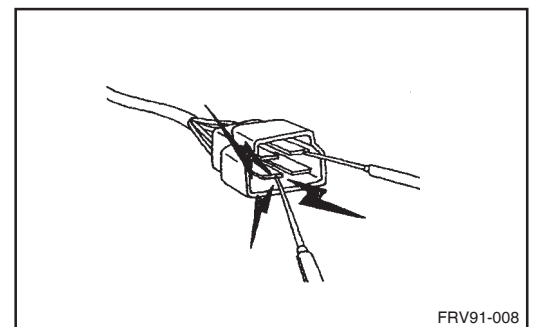
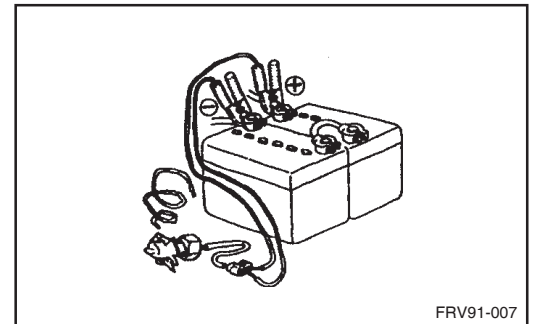
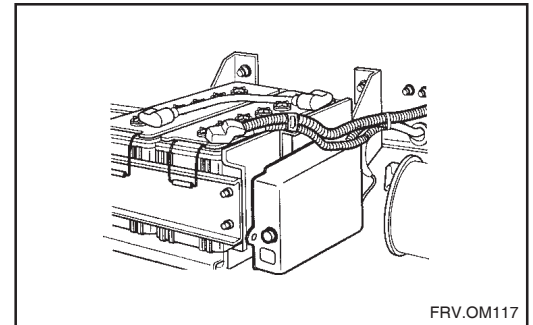
- **When negative battery terminal is disconnected, starter switch and lighting switch must be turned off to work on.**
2. Be careful in handling sensor and relays because they are prone to shock and heat. Do not uncover or paint the ECU.
 3. When removing connector, pull the connector by pulling harness at the starter lock position. When removing locking type connector, remove it by pressing to arrow direction. To connect the locking type connector, insert it until it ticks.
 4. In washing a car, perform waterproof treatment on electrical parts. (Cover them with plastic). Especially keep harness connector or sensors off the water. If they are dipped into water, take them out quickly.
 5. In performing electric welding, electrical parts connected to the battery directly may be damaged since the electricity of welding machine passes through earth unit. Even the parts pass through switch may be damaged if the switch is not turned off. So please do as shown in the figure below.
A : Welding machine
B : Earth the welding machine near to welding parts
C : Remove the earth wire between cap and chassis.



6. Disconnect the negative battery terminal. Disconnect the connector of body harness to chassis harness.

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7. In checking a voltage, positive and negative terminals should not exceed specified voltages when voltage is applied from 0 voltage. Sensors voltage should not exceed 24 voltages.
8. In continuity test, be careful so that the test bar does not touch any other terminal but to be tested.

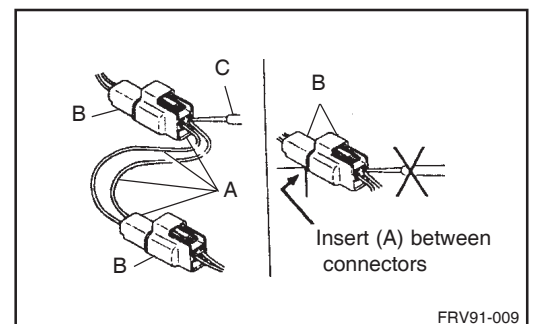


Measurement in connectors

Checked when connector is connected (circuit continuity state)

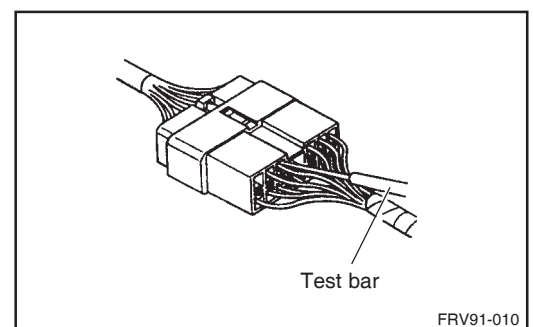
1. Waterproof connector

Prepare the testing harness and connector (A) and connect them between the connectors to be tested. Test it with the test bar at the testing connector. Do not insert the test bar at the harness side of the waterproof connector, because the waterproof capacity is deteriorated and rusted.



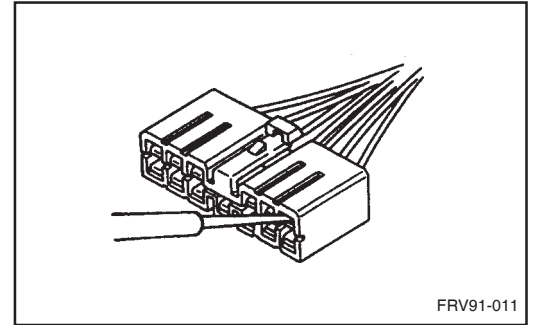
2. Non-waterproof connector.

Test bar should be inserted at the harness side. Do not apply excessive force when test bar cannot be inserted to control unit or others whose connector is small.



When checking by disconnecting the connectors.

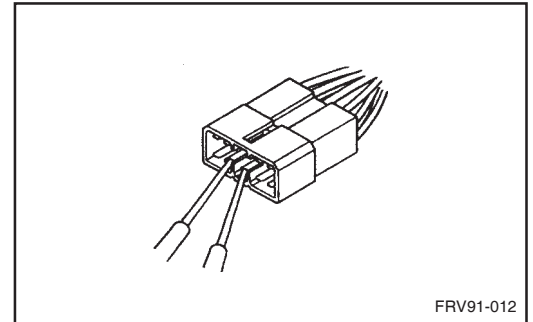
1. When checked by mess pin.
Insert the test bar into terminals. But do not apply excessive force because it may cause the poor connection.



2. When checking by oath pin.
Check the test bar directly with the pin.

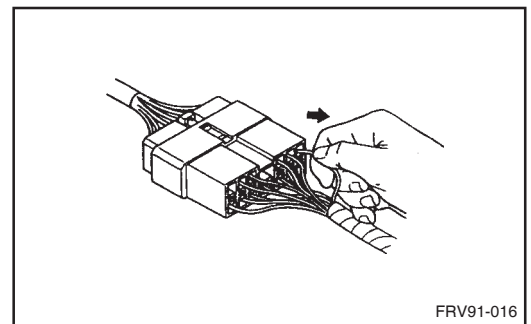
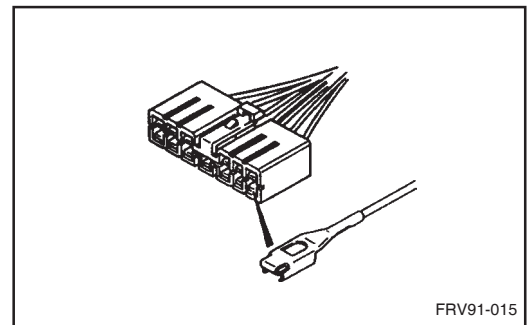
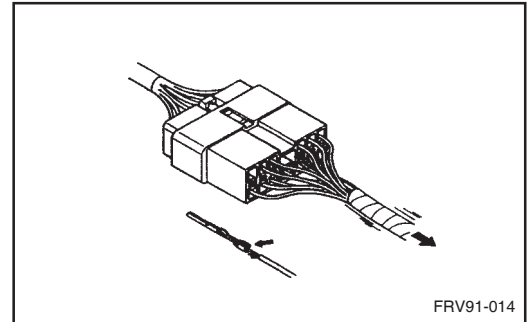
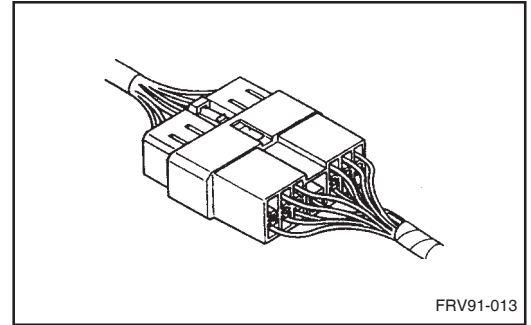
CAUTION

- Be careful so as the test bar not to be short. If short, there is a risk of internal circuit damage of sensors.



Connector check

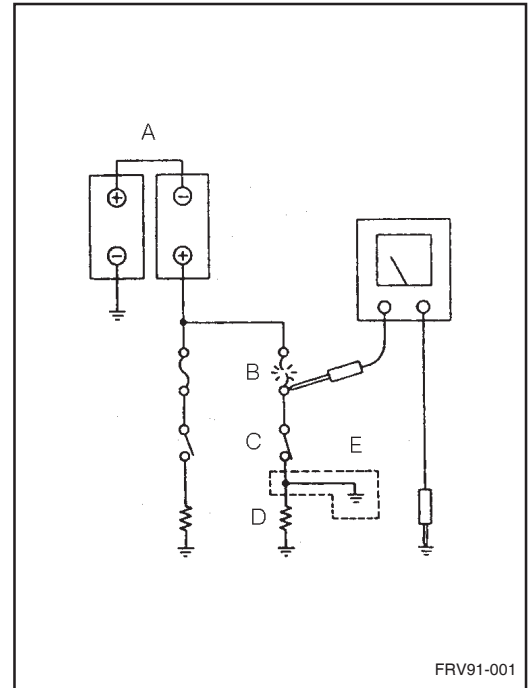
1. Eye check.
 - 1) Poor connection, consent defective.
 - 2) Pull out the harness and check whether harness is short at the terminal.
 - 3) Connection pressure drop between oath terminal and mess terminal.
Check poor connection due to the rust or residual substances of terminals by pulling out connector pin.
2. Check by pulling out the connector pin.
When pin can be pulled out because pin stopper of fuse connector is damaged and terminal (oath, mess pin) is incompletely connected so that the connector body can be connected, pull the harness one by one easily and check out whether pin is removed from the connector.



3. Check in case of blown fuse.

Remove the fuse and measure the resistance between load and earth of fuse. Put every switch of circuits connected in this fuse in continuity state. If the resistance is almost 0, there is a short place between switch and load. If the resistance is ∞, it is blown now. So consider whether fuse is blown due to the temporary disconnection. Following are the major causes for the circuit short.

- 1) Paper jammed in harness
- 2) Harness cover is damaged due to frictional forces.
- 3) Electricity cannot be flown into circuit at the connector parts.
- 4) Artificial causes (Circuit is short by mistake)
 - A) Battery
 - B) Fuse
 - C) Load switch
 - D) Load
 - E) Short

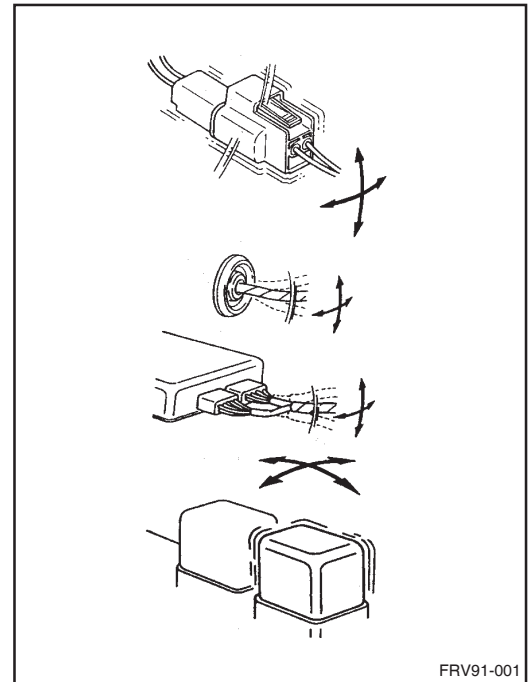


4. In case of temporary fault

Since the temporary fault usually happens under specific conditions, we can easily estimate the causes for the faults. To know the conditions of the temporary fault, ask customers in detail about driving condition, weather, frequency and symptom and then reconstruct the fault symptoms. Next, depending on the faulty condition, check causes for the fault whether it is from vibration, temperature or any other causes. If the cause is vibration, check the followings on connector unit whether the fault happens again.

- 1) Touch the connector lightly up and down and right and left.
- 2) Touch the wiring harness lightly up and down and right and left.
- 3) Touch the sensors and equipments lightly
- 4) Touch the wiring harness lightly at the operation parts like suspension

What we check here are fault diagnosis code displayed and improper causes estimated, and parts or connector while checking.



SPECIFICATIONS

ITEM			SPECIFICATIONS
Wiring system	Type		Single wiring or Wiring harness type
	Ground		Negative ground type
	Rated Voltage		24V
Battery	Voltage		12V x 2ea
	Gravity(normal temperature 25°C).		1.280
Lightings	Head lamp		Semi shield beam (75/ 70W)
	Turn signal lamp (Hazard lamp)		10W
	Side lamp		8W
	Fog lamp		70W
	Stop/ Tail lamp		21/ 5W
	Back up lamp		21W
	License plate lamp		12W
	Bed lamp		10W
	Room lamp		12W, 5W
	Fluorescent lamp		20W
	Step lamp		12W
Start switch	Type		Rotary type
Cold start switch	Type		2-position locking type
	Rated road		24V 0.8A
Assist starting switch	Type		Push type
Meter and Gauge	Speedometer	Type	Coil type
		Revolution ratio	Propeller shaft 637rev = 1km
	Odometer	Type	Coil type
		Revelation ratio	Propeller shaft 637rev = 1km

SPECIFICATIONS
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ITEM			SPECIFICATIONS
Wiper and Washer	Wiper motor	Type	Ferite magnetic
		Low speed	42±5rpm (10kg /cm ²)
		High speed	60±7rpm (10kg /cm ²)
	Washer motor and pump	Motor type	Ferite magnetic
		Pump type	Centrifugal type
		Capacity	1200 cc/min over
	Wiper controller	Rated load	100mA (L-terminal)
		Operating interval	2±0.5 ~ 11±2sec
	Washer nozzle	Diameter	2.5mm
		Quantity	2 x 2 ea
	Washer tank	Capacity	4ℓ
Horn	Electric horn	Type	Flat Type
		Frequency	High : 420 ± 20 Low : 360 ± 20
		Volume	100 ~ 112dB
		Rated voltage	24V
Audio	H630	Speaker impedonce	4Ω x 2(24V)
		Output	15 x 2W
	H818	Speaker impedonce	8Ω x 4(24V)
		Output	25 x 2W
Cigar lighter	Type		Bi-metal Type
	Rated voltage		24V, 5A
	Return time		13±5 sec

TROUBLE SHOOTING**CHARGING SYSTEM (BATTERY AND ALTERNATOR)**

Symptoms		Fast reduction of battery liquid	High battery temperature	Excessive discharge though battery is normal.	Charging lamp doesn't turn on when engine stopped and starter switch is on.	Alternator discharges excessively though alternator is normal.	Remarks
Probable Cause							
Poor connection of harness				☐		☐	
Weak tension of V-belt.				☐		☐	
V-belt damage				☐		☐	
Wiring defective of high current fuse				☐		☐	
Battery defective		☐				☐	
Alternator	Stator coil disconnection			☐			
	Stator coil and core are short			☐			
	Field coil defective			☐			
	Rectifier defective			☐			
	Regulator defective		☐	☐	☐		
	Wiring defective			☐			
Meter cluster defective					☐		

CIGAR LIGHTER

Symptoms		Cigar lighter is not heated	Cigar lighter doesn't pop out.	Illumination lamp doesn't turn on	Remarks
Probable Cause					
Poor connector connection, blown harness, Poor earth		☐		☐	
Fuse Blown		☐		☐	
Cigar lighter defective		☐	☐	☐	
Tail lamp relay defective				☐	

TROUBLE SHOOTING

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AUDIO

Symptoms	Probable Cause							
	Radio make no sound	Poor radio reception	Tape makes no sound	No sound at the specific range of frequency.	Noisy (except radio reception)	Noisy (Accessory noise)	Poor sound	Only one speaker works.
Poor connector connection, blown harness	☐	☐	☐					☐
Poor earth	☐	☐	☐		☐	☐		
Fuse Blown	☐		☐					
Poor connection of antenna or antenna wire.	☐	☐			☐			
Partly malfunction of radio amp	☐		☐		☐		☐	☐
Radio tuner malfunction		☐		☐			☐	
Malfunction of tape deck or pinch roller			☐		☐		☐	
Speaker malfunction	☐		☐	☐			☐	☐

System	Accessory	Noise	Description
Source of accessory noise	Alternator	Beeping noise	High squealing noise, when accelerator pedal is depressed suddenly. (It stops immediately after engine stop.)
	Water temperature gauge	Scratching noise	It happens while engine is running. (It continues just for a while after engine stop.)
	Oil pressure switch	Sounds "dulkung"	It happens by engine rpm. (It does not happen while idling.)
	Fuel level sensor	Scratching noise	When turned at high speed, driving on a rugged road, or starter switch is at "ON" position.
	Flasher unit	Sounds "dulkung"	It happens when turn signal is operating.
	Horn	Sounds "sheet"	It happens when horn button is depressed or released.
	Wiper motor Washer motor	Whistle noise Whistle noise	It happens depending on the speed of front glass wiper. It happens when front glass washer is operating.

STARTING SYSTEM (STARTER AND SUB STARTER)

Symptoms		Starter doesn't work	Engine doesn't start though starter works.		Engine does not start at sub starter ON position	Remarks
			Pinion doesn't touch ring gear	Pinion touches ring gear but doesn't work		
Probable Cause						
Poor connector connection, blown harness, Poor earth		☐			☐	
Battery defective or poor capacity		☐		☐	☐	
Starter	Magnet switch defective	☐				
	Motor defective	☐				
	Over running clutch defective	☐		☐		
	Insufficient voltage of switch terminal of magnet switch		☐			
	Worn out or damage of pinion		☐			
Starter relay defective		☐			☐	
Insufficient voltage of switch terminal of starter relay			☐			
Glow relay defective		☐				
Starter switch defective		☐			☐	
Worn out or damage of flywheel ring gear			☐			
Transmission is not in neutral position.					☐	
Starter switch is not in ACC nor ON position					☐	
Fuse blown					☐	
Poor connection of sub starter switch					☐	
Transmission neutral switch defective					☐	
Safety relay defective		☐			☐	

TROUBLE SHOOTING

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PRE HEATING

Symptoms			Remarks
	Unable to pre-heat	Engine start is not good though cold start works (Pre-heating is not enough)	
Probable Cause			
Poor connector connection, blown harness, Poor earth	☐		
Cold start switch defective	☐		
Glow plug defective	☐	☐	
Glow relay defective	☐		
Water temperature sensor defective	☐	☐	
High capacity fuse of glow relay is blown	☐		
Exhaust brake system defective	☐		
Poor connection of connecting plate	☐	☐	

ENGINE STOP

Symptoms			Remarks
	Engine does not stop	Engine does not start	
Probable Cause			
Poor connector connection, blown harness, Poor earth	☐	☐	
Fuse blown	☐	☐	
Starter switch defective	☐	☐	
Engine stop relay defective	☐	☐	
Fuel cut motor defective	☐	☐	

GENERAL INFORMATION ON LAMPS

Symptoms	Lamp does not turn on	Lamp is not bright enough	Remarks
Probable Cause			
Bulb defective	☐	☐	
Battery discharged	☐	☐	
Switch defective	☐	☐	
Poor connector connection, poor earth	☐	☐	
Harness blown, connectors are misaligned.	☐	☐	
Alternator defective (charging function defective)	☐	☐	
Fuse blown	☐	☐	

HEAD LAMP

Symptoms	Lamp does not turn on	Lamp does not turn on (Hi-beam)	Lamp does not turn on (Low-beam)	Remarks
Probable Cause				
Lighting switch defective	☐	☐	☐	
Dimmer switch defective	☐	☐	☐	
Head lamp relay defective	☐	☐	☐	

TROUBLE SHOOTING
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FOG LAMP

Symptoms	Fog lamp does not turn on	Remarks
Probable Cause		
Fog lamp switch defective	☐	
Fog lamp relay defective	☐	
Fuse blown	☐	

TAIL LAMP, LICENSE PLATE LAMP AND POSITION LAMP

Symptoms	Tail lamp does not turn on	Warning lamp doesn't turn on when tail lamp is blown	Master caution indicator does not turn on when tail lamp bulb is blown	License number plate lamp does not turn on	Position lamp does not turn on	Remarks
Probable Cause						
Lighting switch defective	☐			☐	☐	
Stop lamp, tail lamp sensor defective	☐	☐	☐	☐	☐	
Overhead warning indicator defective		☐	☐			
Meter cluster defective		☐	☐			
Tail lamp defective	☐	☐	☐	☐	☐	

STOP LAMP

Symptoms	Lamp doesn't turn on	Warning lamp does not turn on when bulb is blown	Master caution indicator does not turn on when bulb is blown	Remarks
Probable Cause				
Stop lamp switch defective	☐	☐	☐	
Stop lamp, tail lamp sensor defective	☐	☐	☐	
Stop lamp relay defective	☐	☐	☐	
Overhead warning, indicator defective	☐	☐	☐	
Meter cluster defective	☐	☐	☐	

TURN SIGNAL LAMP, HAZARD LAMP

Symptoms	Not blinking	Lamp is on all the time.	Slow blinking	Fast blinking	Unstable blinking interval	Remarks
Probable Cause						
Turn signal lamp, hazard lamp switch defective	☐	☐	☐	☐	☐	
Flasher relay defective	☐	☐	☐	☐	☐	
Bulb watt is smaller than the spec.	☐	☐	☐	☐	☐	
Bulb watt is bigger than the spec.	☐	☐	☐	☐	☐	

TROUBLE SHOOTING
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ROOM LAMP, SPOT LAMP, STEP LAMP, MAP LAMP AND FLUORESCENT LAMP

Symptoms	Remarks				
	Room lamp and spot lamp do not turn on	Step lamp does not turn on.	Map lamp does not turn on	Fluorescent lamp does not turn on.	Fade-out function of room lamp does not work.
Probable Cause					
Room lamp and spot lamp switch defective	☐			☐	
Door switch defective	☐	☐			☐
Map lamp switch defective			☐		
Starter switch defective					☐
Oil pressure switch defective					☐

BACK-UP LAMP

Symptoms	Lamp does not turn on.	Remarks
Probable Cause		
Back-up lamp switch defective	☐	
Power harness blown.	☐	

METER ILLUMINATION

Symptoms	Illumination does not working	Remarks
Probable Cause		
Tail lamp relay defective	☐	

SPEEDOMETER AND TACHO GRAPH

Symptoms	Indicator does not work	Unstable indicator movement	Big indication error	Abnormal sound	Odometer is not working	Remarks
Probable Cause						
Poor connector connection, poor earth		☐				
Harness blown, connectors misalignment	☐				☐	
Vehicle speed sensor defective	☐	☐	☐		☐	
Improper sized tires			☐			
Speedometer defective	☐	☐	☐	☐	☐	

TACHOMETER

Symptoms	Indicator does not work	Unstable indicator movement	Big indication error	Remarks
Probable Cause				
Poor connector connection, poor earth		☐		
Harness blown, connectors misalignment	☐			
Tachometer sensor defective	☐	☐	☐	
Engine RPM output circuit of meter cluster is defective	☐	☐	☐	
Tachometer defective	☐	☐	☐	

TROUBLE SHOOTING
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FUEL SYSTEM

Symptoms	Indicator does not move	Unstable movement or big error of indicator turn on (Fuel gauge positionis E)	Fuel remaining warning lamp does not turn on (Fuel gauge position is above E)	Fuel remaining warning lamp does not	Remarks
Probable Cause					
Poor connector connection, poor earth		☐			
Harness blown, misaligned connectors	☐		☐		
Fuel gauge unit defective	☐	☐	☐	☐	
Fuel gauge defective	☐	☐	☐	☐	

COOLANT TEMPERATURE GAUGE

Symptoms	Indicator does not move	Unstable movement or big error of indicator turn on (Fuel gauge positionis E)	Remarks
Probable Cause			
Poor connector connection, poor earth		☐	
Harness blown, misaligned connectors	☐		
Coolant temperature sensor defective	☐	☐	
Coolant temperature gauge defective	☐	☐	

PARKING BRAKE INDICATOR LAMP

Symptoms	Indicator lamp does not turn on when parking brake is on	Indicator lamp does not turn off.	Buzzer never stops though the parking brake is on.	Remarks
Probable Cause				
Poor connector connection, poor earth, blown harness	☐		☐	
Harness blown		☐	☐	
Parking brake switch defective (sensor parking brake)	☐	☐	☐	
Parking brake air switch defective (wheel parking brake)	☐	☐		
Parking brake release air switch defective (wheel parking brake)			☐	
Meter cluster defective	☐			

HORN

Symptoms	Horn does not work	Horn does not stop	Horn sound is weak	Remarks
Probable Cause				
Poor connector connection, poor earth			☐	
Blown harness, misaligned connectors	☐			
Fuse blown	☐			
Horn switch defective	☐	☐		
Horn relay defective	☐	☐		
Excessive battery discharging	☐		☐	
Installation defective			☐	

INSPECTION AND ADJUSTMENT

BATTERY

NOTE

- Since battery contains the combustible hydrogen gas, do not short the positive terminal of the battery with negative terminal and keep the spark or cigarette away from the battery.
- Since the battery contains corrosive thin sulfuric acid, wear safety glasses and gloves to protect eyes and hands in handling battery.
- Do not attach metals around arms and do not crouch on the battery.

REMOVAL

NOTE

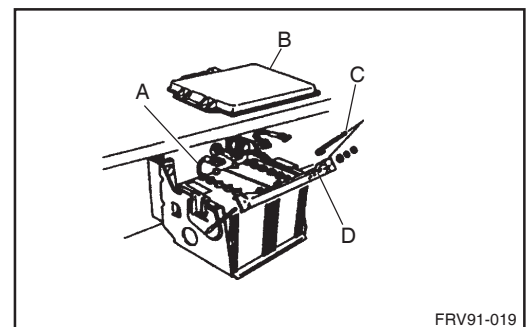
- Remove the cable from the negative terminal first.
- Be careful, as the disassembled battery cable does not touch battery terminal not to be short.

A : Negative battery cable

B : Cover

C : Set bolt

D : Angle frame



ASSEMBLY

NOTE

- Before installing battery cable, make sure every switch of the vehicle electrical system is off. Connect the positive cable first and then connect negative at last.

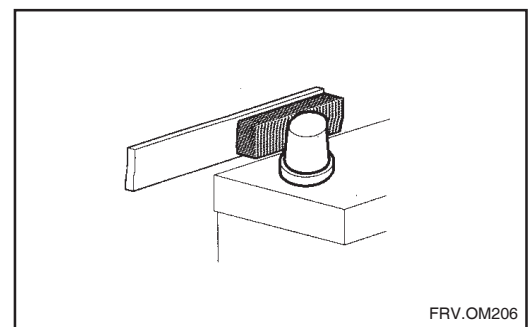
CHECK

1. Eye check

- 1) When battery box is corroded, clean with wire brush and apply anti-acid paint. And replace the battery in case of serious corrosion or deformation.
- 2) If terminal is corroded, clean it with wire brush. If battery is cracked or damaged, replace it because there is a risk of leakage.

NOTE

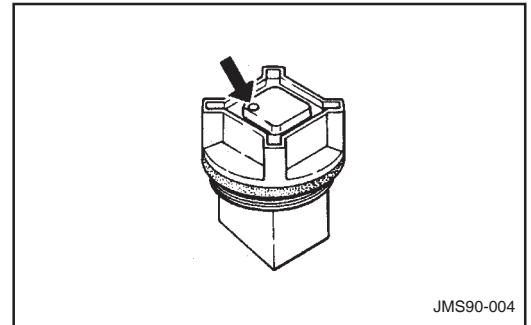
- Take care positive terminal, which is easily corroded.



INSPECTION AND ADJUSTMENT

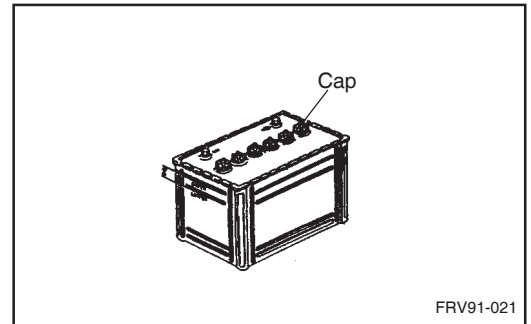
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- 3) If the air-breathing hole of vent plug is clogged, clean it out.



2. Battery liquid level check

Check whether battery liquid level lies between upper and lower marks. When battery liquid level is low, uncover the cap and refill it to the upper position with distilled water or battery refill liquid.



3. Gravity check

Check the gravity of the battery and charge it if it is below the limit.

NOTE

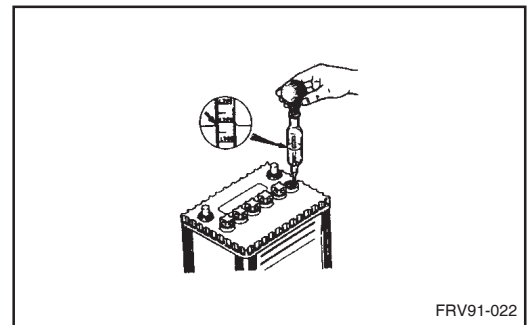
- Battery gravity varies with the temperature of the liquid. So calculate the gravity at 20°C with the following formula and then judge the condition.

$$S_{20} = S_t \times 0.0007 \times (t - 20)$$

S_{20} : Standard Gravity of liquid at 20°C

S_t : Actual gravity measured at t°C

t : temperature of electrolyte



4. Charging

Though battery is to be charged one by one in principle, charge the battery after stopping the engine and disconnecting the earth terminal when the battery is installed on the vehicle.

Charge the battery after removing the vent plug. Charge it referring to the following table. Be careful not to over charge. Charge the battery referring to the charging time and current shown on the table below

	Charging current(A)	Charging time Liquid(H)	temperat- ure(°C)
Normal charging	Charging capa- city for 5 hours 10	Discharged amount Charging current(A) $\times 1.2$	45
Rapid charging	Charging capa- city for 5 hours 10	0.5	55

Discharged amount B (Ah) = 5 hour rate capacity (Ah) x discharged amount (%) / 100

In addition, discharged amount B can be obtained from the graph on the left side. Battery liquid is mixed sulfuric acid with purified water or distilled water. The gravity of battery liquid is 1,280 at 20°C in fully charged state.

A ; gravity of battery liquid

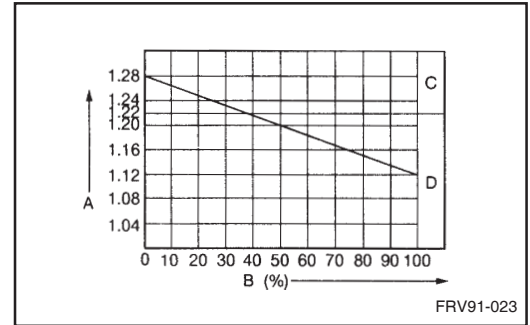
B : Discharging amount

C : Good

D : needs charging

NOTE

- In charging, be careful of the battery liquid because it may overflow.
- Since the battery may explode, keep the fire away while charging.
- Be especially careful not to make any spark or any other dangerous causes while charging.
- Cover the vent plug and clean it with the water and dry the battery after charging.



FUSE

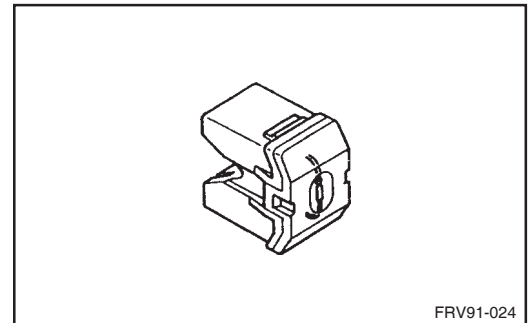
NOTE

- In case blown fuse, replace the fuse after checking out the causes and repairing the fault thoroughly.
- Use only the designated fuse after repair.

1. Check of high capacity fuse

NOTE

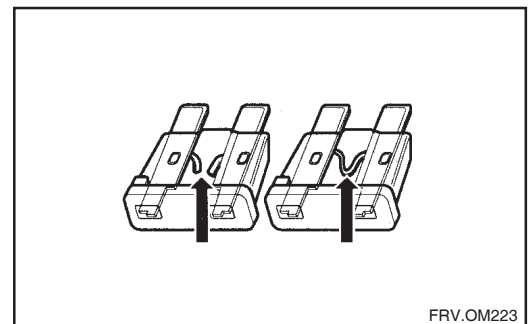
- Before removing high capacity fuse, remove the battery cable terminal first. If no continuity is confirmed with eye check or continuity check, replace the fuse.



2. Fuse check of relay and fuse box

NOTE

- If no continuity is confirmed with eye check or continuity check, replace the fuse.



START SWITCH AND COLD START SWITCH

General information

1. Start switch

Start switch is used to start or stop the engine or to supply electricity to various electrical parts from battery.

- 1) Lock

When key is off, handle is locked.

- 2) ACC

Radio and cigar lighter operate in this position. Sub start operates.

- 3) ON

Intake air heater, meter and gauge operate that were not operating in ACC position.

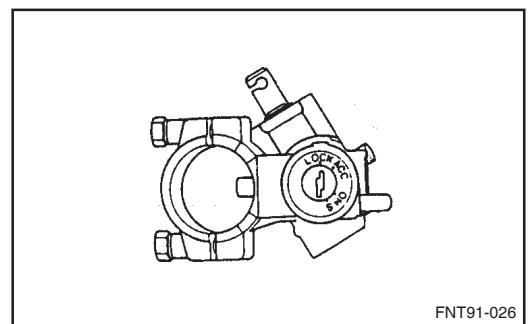
- 4) START

Start circuit is connected, which is not operating in ON position.

2. Cold start switch

Cold start switch is used to pre-heat the engine in cold weather.

This switch operates intake air heater unit and exhaust brake unit to reduce the engine warming up time.



CHECK

Remove the negative battery cable before checking.

1. Start switch check.

Remove the wiring connector of start switch. Perform continuity test with the tester by changing the start key to various positions.

Connection table

Terminal Key position	B	ACC	M	S	H
LOCK					
ACC	○	○			
ON	○	○	○		
HEAT	○		○		○
START	○		○	○	○

NOTE

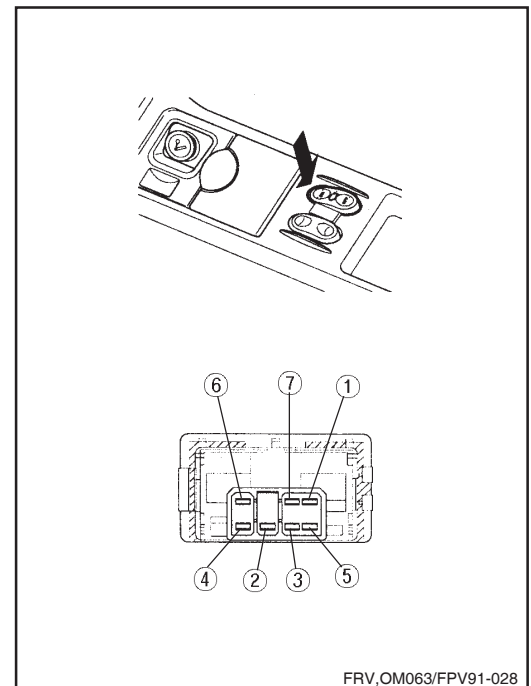
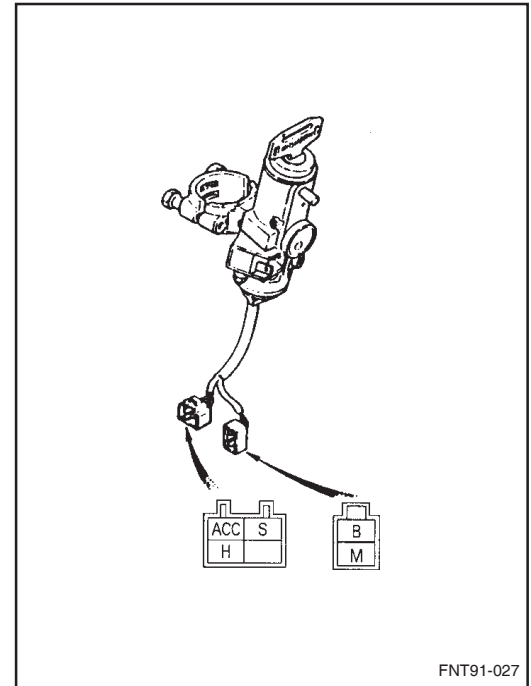
- If there is no or little continuity, replace the start switch because it is defective.

2. Cold start switch check

Check the continuity of each terminals referring to table below.

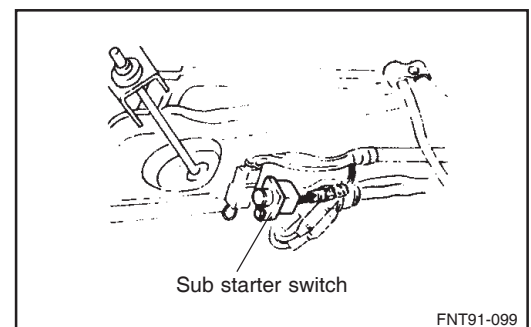
Terminal number	1	2	3	5	7	
OFF	○	○		○	○	
ON	○		○			

Terminal number	4		6
ON	○	○	○



REMOVAL AND INSTALLATION

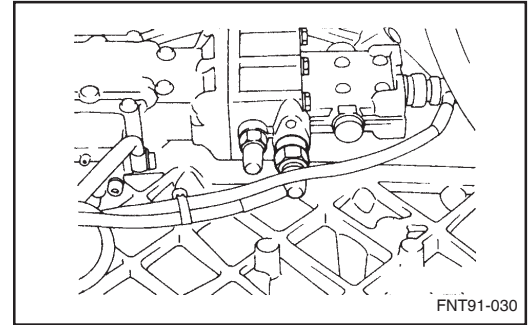
1. Sub Starter Switch



INSPECTION AND ADJUSTMENT

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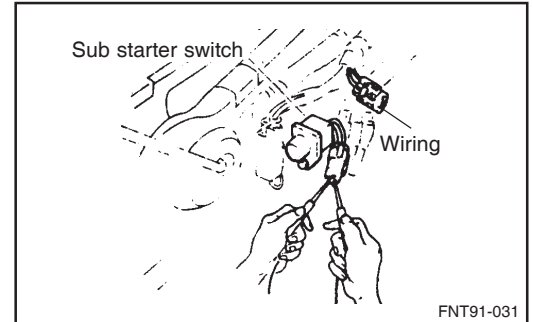
2. Interlock switch



CHECK

1. Sub Starter Switch

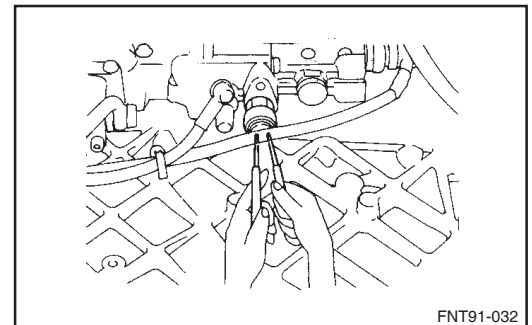
Put the switch in ACC position and check the continuity. Replace it if there is no continuity.



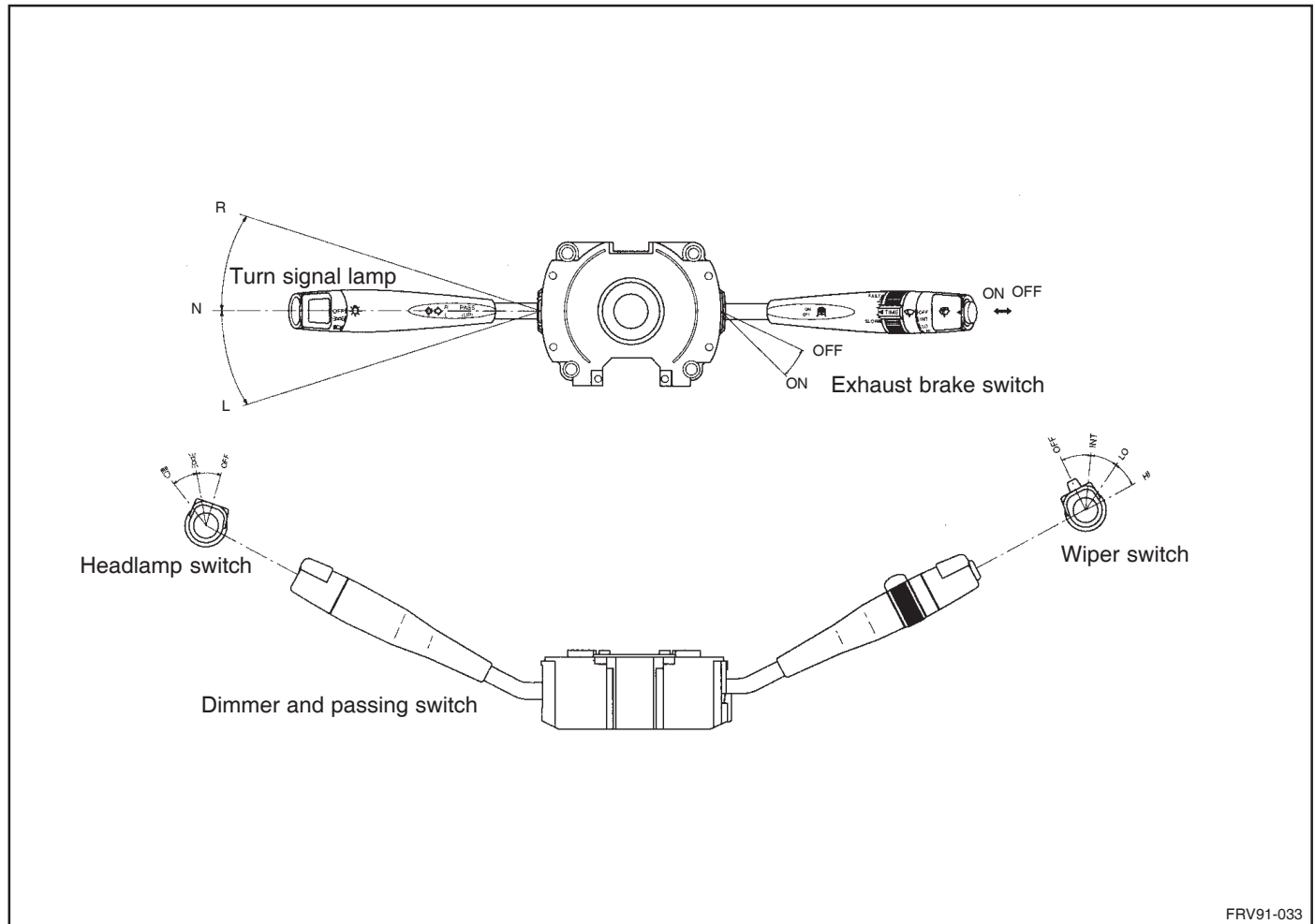
2. Interlock switch

Move the gearshift lever to change the interlock switch on and off. And then check the continuity between each terminal as shown below.

Gear shift lever position	Switch position	Continuity
Neutral	ON	Yes
Besides neutral position	OFF	No



MULTIFUNCTION SWITCH



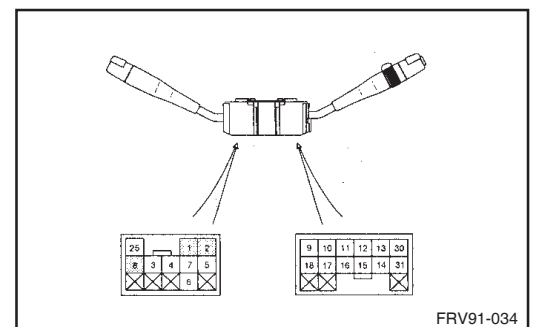
FRV91-033

General information

Multifunction switch is an integrated switch consists of turn signal lamp, horn, dimmer, passing, wiper, washer, headlamp and exhaust brake. When the switch lever is controlled up and down and left and right, it makes the current flow to motor circuit and lamp circuit by controlling more than 2 contacts operation.

Check

Check the continuity between connectors by operating the multifunction switch as shown on the table. If it does not meet the specification, replace the switch.



FRV91-034

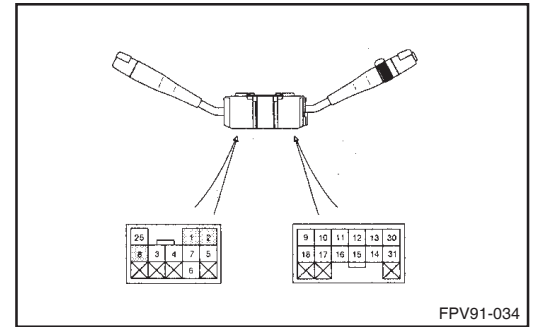
INSPECTION AND ADJUSTMENT

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MULTIFUNCTION SWITCH

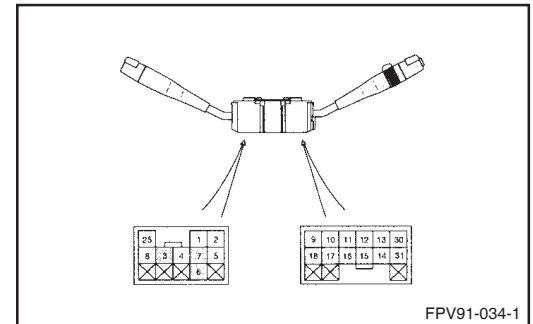
1. Turn signal switch

Terminal Switch position	1	2	8
L			
N			
R			



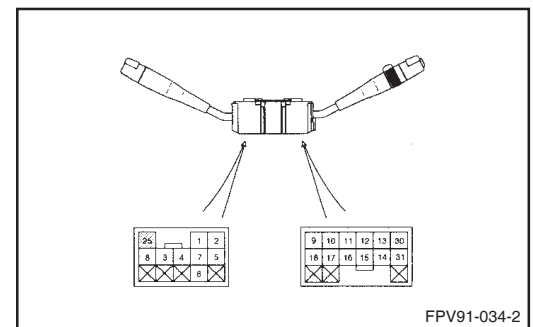
2. Head lamp switch

Terminal Switch position	6	7	3
OFF			
			
			



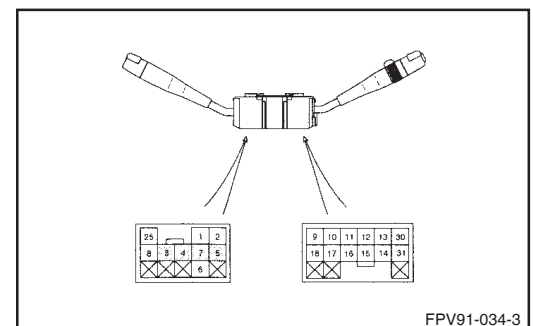
3. Horn switch

Terminal Switch position	25	
OFF		
ON		



4. Dimmer and passing switch

Terminal Switch position	4	7	5	3
MAIN				
DIMMER				
PASSING				

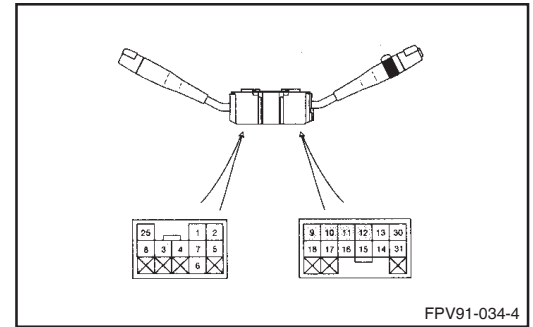


BE-30

BODY ELECTRICAL

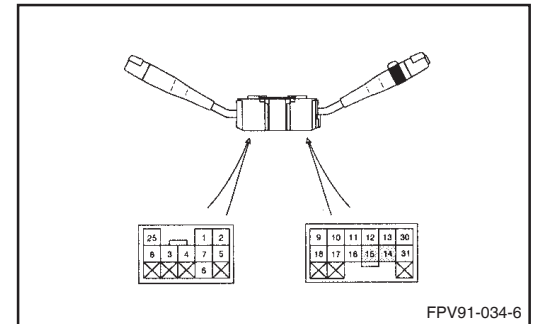
5. Wiper and Washer switch

Terminal Switch position	9	10	11	12	13
INT.					
LOW					
HIGH					
WASHER					



6. Exhaust brake switch

Terminal Switch position	14	15
OFF		
ON		

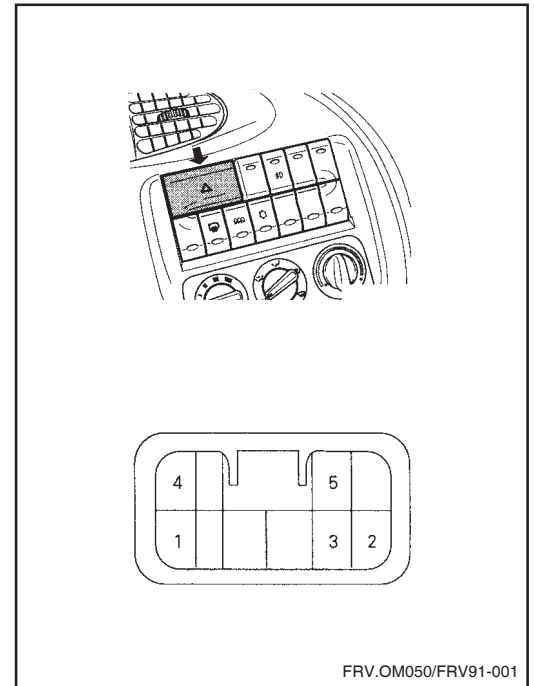
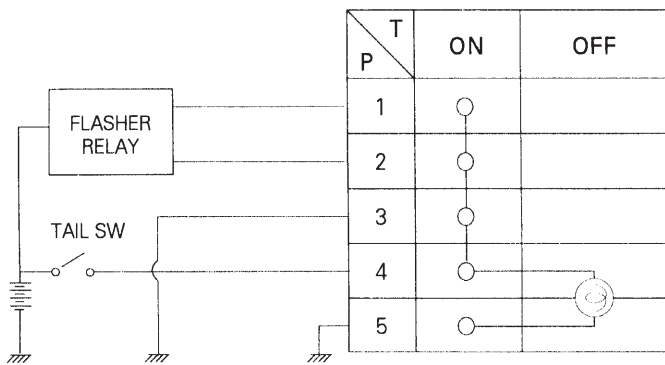


INSPECTION AND ADJUSTMENT

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INSTRUMENT

Hazard warning switch



SWITCHES

Name	Circuit diagram and layout																								
Heat mirror switch	<table><tr><th>P</th><th>T</th><th>ON</th><th>OFF</th></tr><tr><td>1</td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td></tr><tr><td>3</td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td></tr><tr><td>5</td><td></td><td></td><td></td></tr></table>	P	T	ON	OFF	1				2				3				4				5			
P		T	ON	OFF																					
1																									
2																									
3																									
4																									
5																									
PTO switch																									
Fog lamp switch																									
Air conditioner switch																									
Switch location	Hazard warning switch Fog lamp switch Heat mirror switch Air conditioner switch P.T.O switch																								

5TBE-104

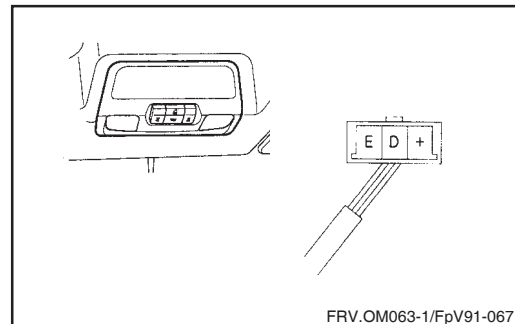
FRV.OM050/FRV.OM057

5TBE-104

1. Room lamp and spot lamp switch check

- 1) Check the continuity of each terminal as operating room lamp and spot lamp. If it exceeds specification, replace the switch.

Terminal Switch position	①	②	③
On	○	○	
Door	○		○
ON+Door	○		○
Spot	○	○	
Spot+ON	○	○	



2) Bulb check

Replace the bulb if it is blown.

NOTE

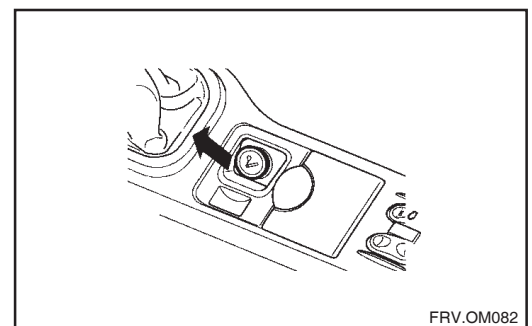
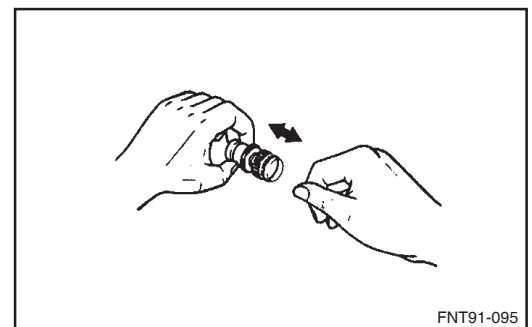
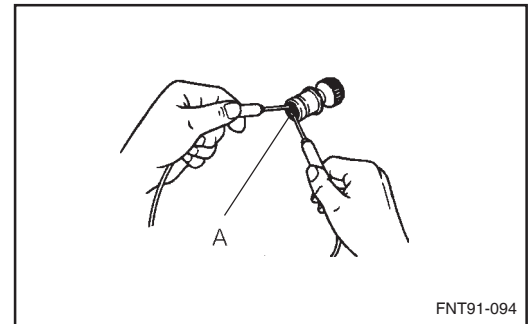
- **Broken lens causes not only improper light dispersion but also electric circuit short due to the water inflow.**

CIGAR LIGHTER**Maintenance standard**

Check points	Standard	Limit	Actions
Return time of cigar lighter plug	8~18sec		Replace

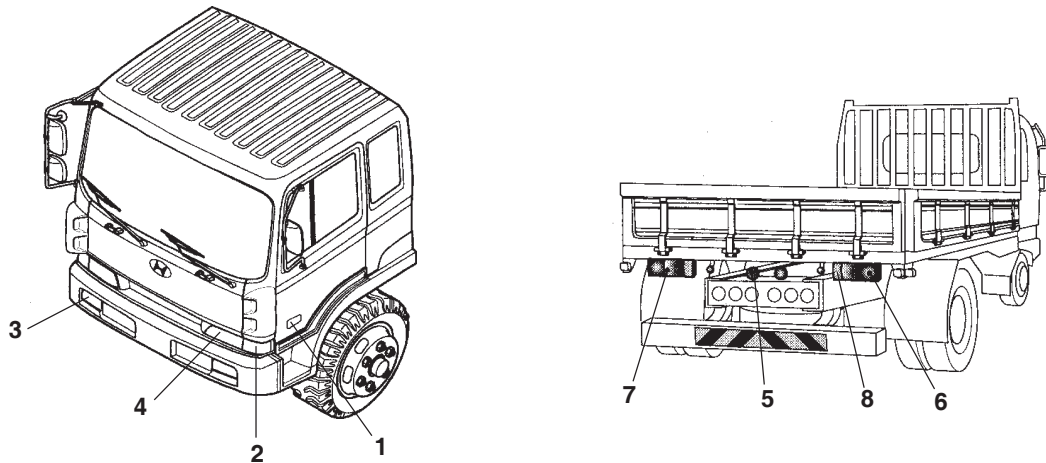
CIGAR LIGHTER CHECK

1. Check the continuity of the heating part A, and replace the cigar lighter if there is no continuity.
2. Press and release the plug as shown in the figure. Check whether the plug returns to its original position. If it fails to return fully, replace it with the new one.
3. Install the plug on the vehicle and measure the returning time. If it exceeds the limit, recheck the plug. Besides, check whether heating parts glows red. If not, replace it with new one.



LAMP

Exterior lamp



1. Side turn signal lamp
2. Front turn signal lamp
3. Fog lamp
4. Headlamp

5. License plate lamp
6. Rear turn signal lamp
7. Rear stop lamp
8. Back-up lamp

5TBE-102/FRV.OM227

Headlamp aiming

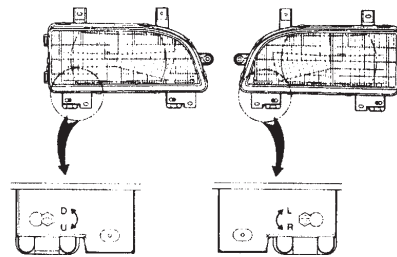
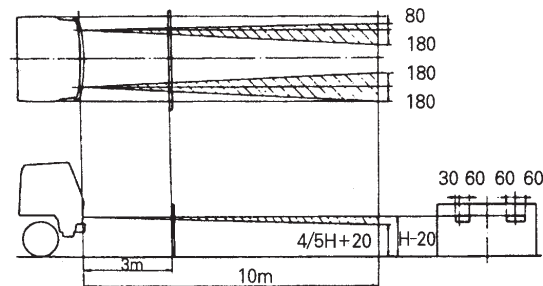
1. Preparation before aiming
 - 1) Adjust the tire pressure with the specified value.
 - 2) Load one person or weight of 60 Kg on a driver's seat.
 - 3) Remove the front lower grille. And then, pull it lightly to disassemble by depressing front grille as shown on the figure. (It may be damaged if pulled or distorted with excessive force)
 - 4) Start the engine and let the battery charged.

2. Aiming procedures

NOTE

- Aim the headlamp according to the regulation.
- Align the bulb center to the tester lens center before aiming.

SEMI SHIELD BEAM (STYLED 2 BULBS HEADLAMP)



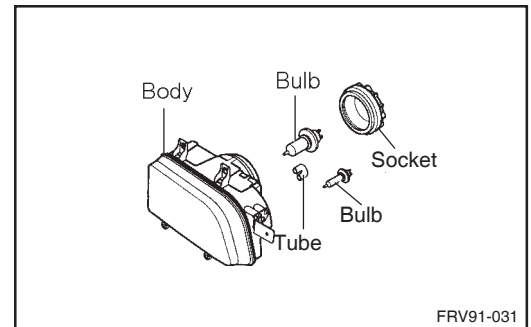
Vertical aiming adjusting screw

Horizontal aiming adjustment screw

FPV91-045

1. Vehicle state when aiming
 - Check whether tire pressure is normal
 - Maintain the vehicle empty state. (Driver is seated or equivalent weight is put on the driver's seat)
2. Adjust the one headlamp by one time, and cover the other headlamp. (Do not cover more than 10 minutes)
3. Install the tester at 10 meters away and in front of the vehicle as the light receiving part faces headlamp.
4. Adjust the aiming screw so that the main lighting reaches the shaded part in the figure.

DISASSEMBLY

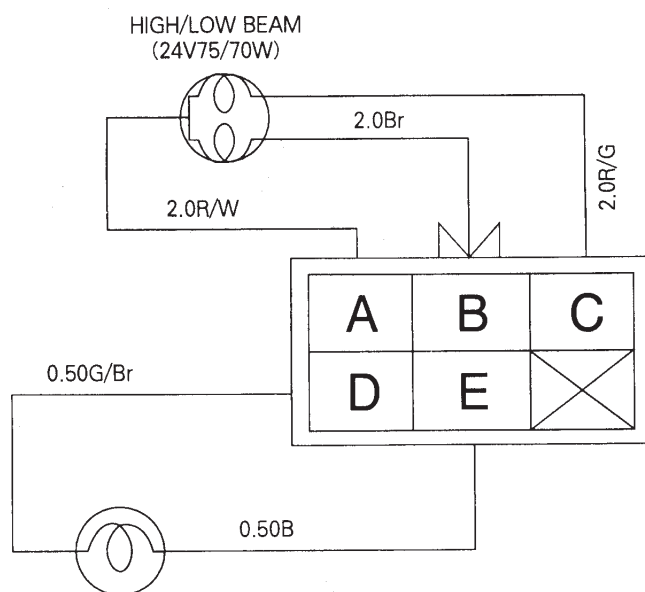


ASSEMBLY

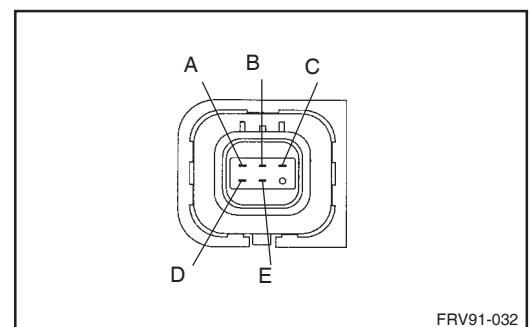
Assembly is the reverse of disassembly procedure.

NOTE

- Don't touch the bulb when treating

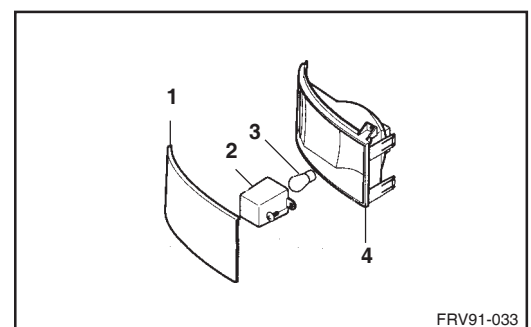


5tbe-105



1. Front turn signal and hazard warning lamp.

- Outer lens
- Inner lens
- Bulb
- Body

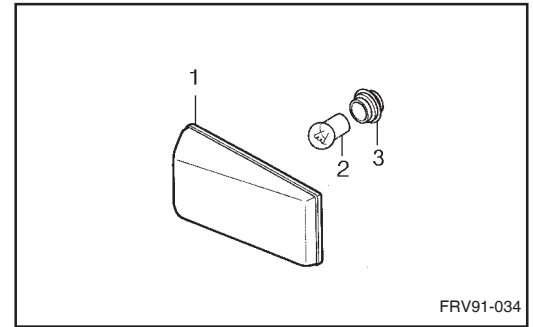


INSPECTION AND ADJUSTMENT

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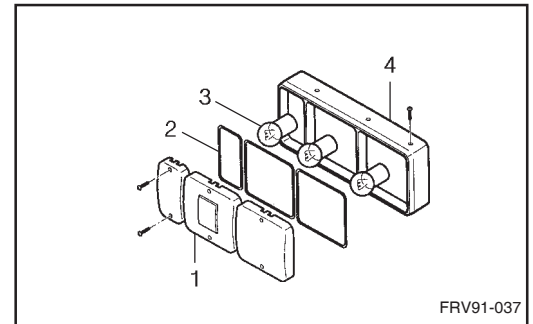
2. Front side turn signal lamp

- 1) Lens
- 2) Bulb
- 3) Socket



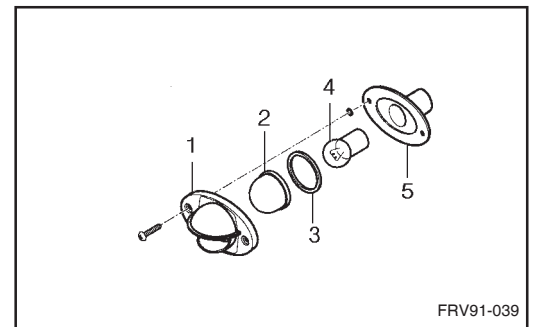
3. Rear combination lamp

- 1) Lens
- 2) Gasket
- 3) Bulb
- 4) Body



4. License plate lamp

- 1) Cover
- 2) Lens
- 3) Gasket
- 4) Bulb
- 5) Socket

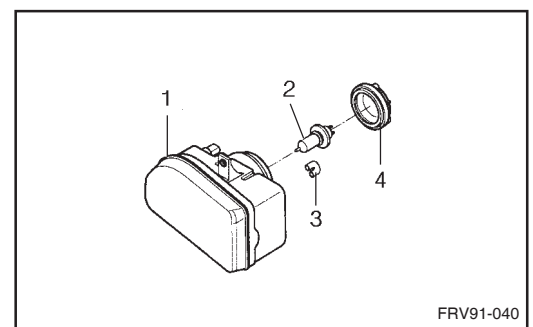


5. Fog lamp

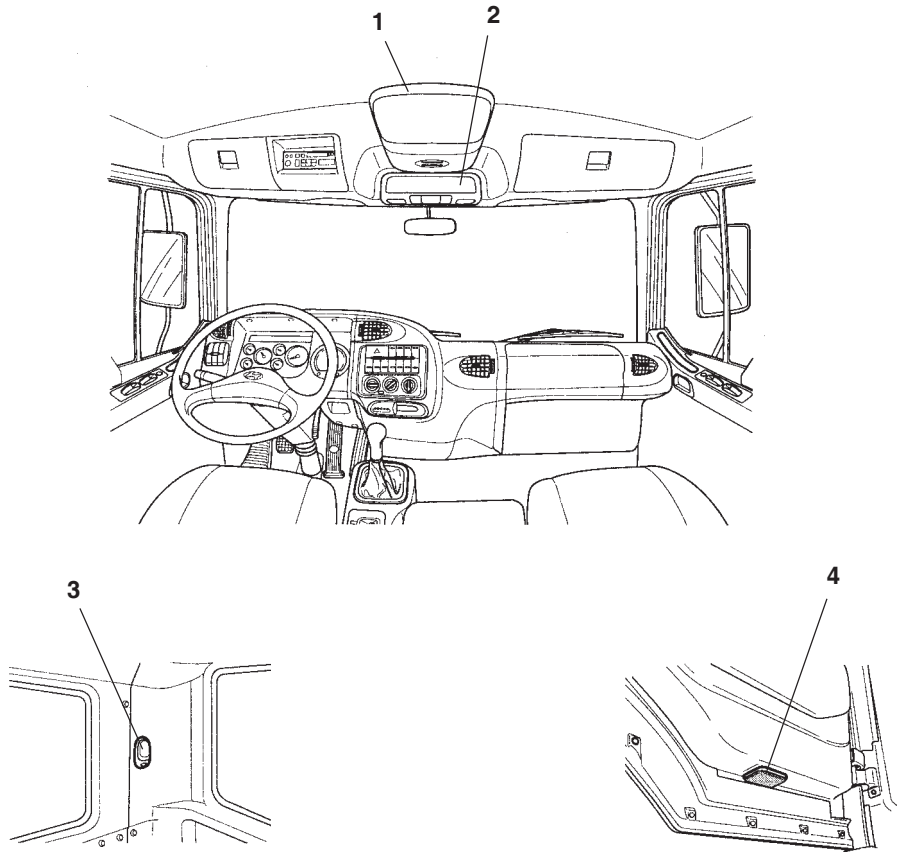
- 1) Body
- 2) Bulb
- 3) Tube
- 4) Dust cover

NOTE

- Don't touch the bulb when exchanging



INTERIOR LAMP



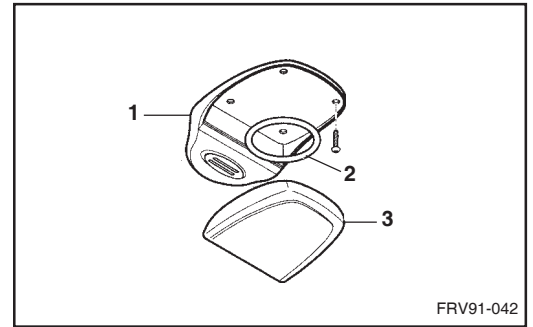
1. Fluorescent
2. Room lamp and spot lamp
3. Bed room lamp
4. Step lamp

INSPECTION AND ADJUSTMENT

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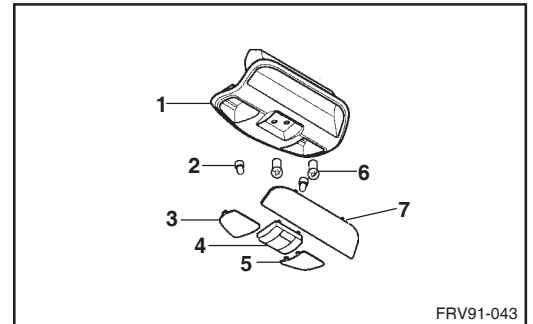
1. Fluorescent lamp

- 1) Body
- 2) Fluorescent lamp
- 3) Lenz



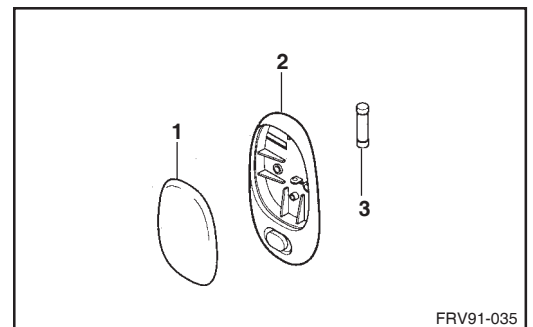
2. Room lamp and map lamp

- 1) Body
- 2) Bulb
- 3) Lenz
- 4) Knob
- 5) Lenz
- 6) Bulb
- 7) Room lens

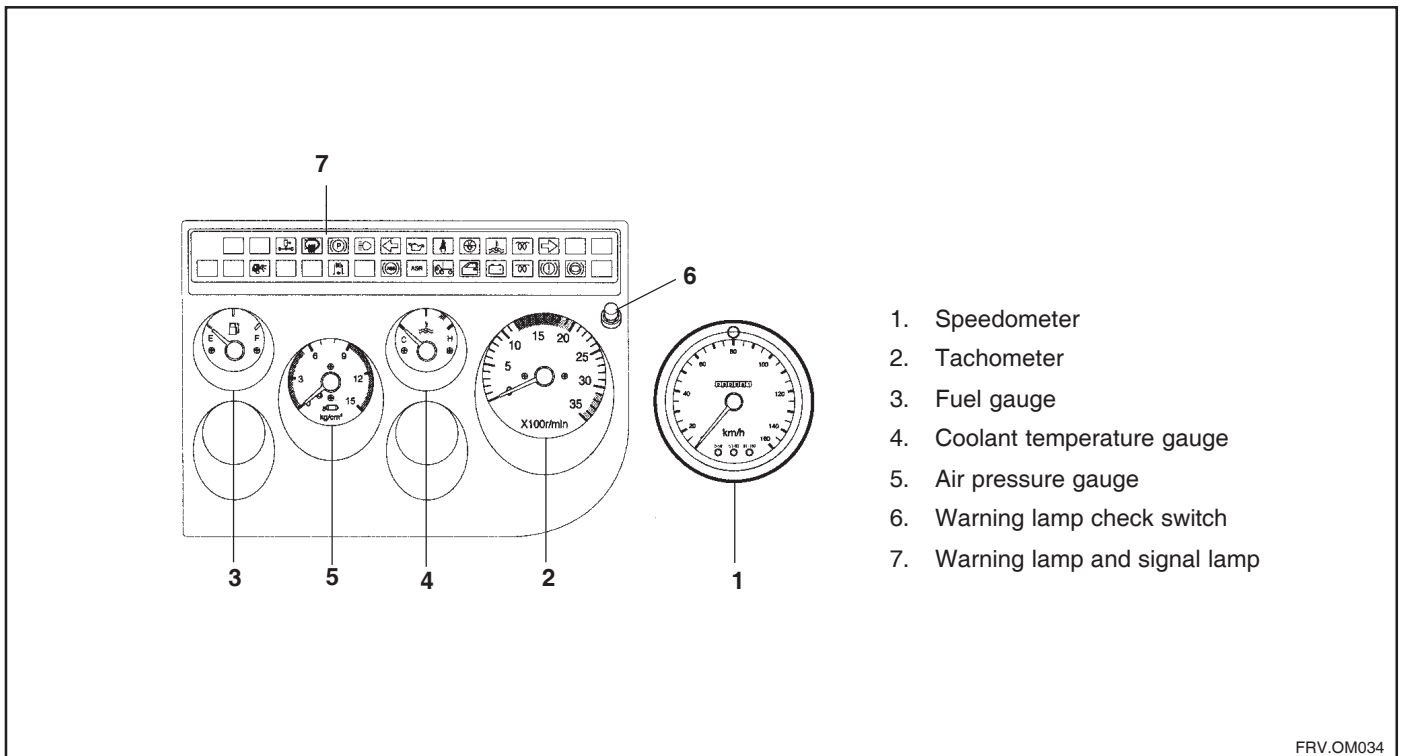


3. Bed room lamp

- 1) Lenz
- 2) Body
- 3) Bulb



INSTRUMENT CLUSTER



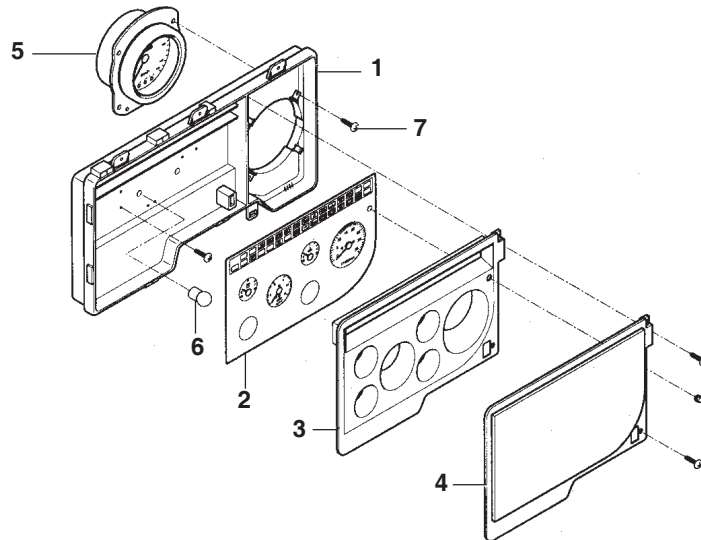
FRV.OM034

1. Speedometer, tacho-graph

Check points		Standard	Limit	Remedy
Speedometer range	20km/h	20 ± 3km/h	-	Replace
	40km/h	40 ⁺⁵ ₀ km/h	-	
	60km/h	60 ⁺⁵ ₀ km/h	-	
	80km/h	80 ⁺⁵ ₀ km/h	-	
	100km/h	100 ⁺⁵ ₀ km/h	-	
	120km/h	120 ⁺⁵ ₀ km/h	-	
	140km/h	140 ⁺⁵ ₀ km/h	-	

2. Speedometer check

Check whether indication range of speedometer in each speed is within the specification using the speedometer tester. If it exceeds the specification, replace the speedometer or tacho-graph



Disassembly procedure

1. Cluster body
2. Indicator lens plate
3. Window plate
4. Cluster lens
5. Speedometer
6. Bulb
7. Bolt

FRV70-045

SERVICE STANDARD

ITEM		Standard	Limit	Remedy
Tachometer range	500rpm	500 ±100rpm	—	Replace
	1000rpm	1000±100rpm	—	
	1500rpm	1500±150rpm	—	
	2000rpm	2000±200rpm	—	
	2500rpm	2500±250rpm	—	
	3000rpm	3000±300rpm	—	
Air pressure gauge range	3kg/cm ²	3±0.5kg/cm ²	—	Replace
	5.3kg/cm ²	5.3±0.3kg/cm ²	—	
	6kg/cm ²	6±0.5kg/cm ²	—	
	9kg/cm ²	9±0.3kg/cm ²	—	
Coolant temperature gauge range	81.8Ω (65°C)	16°±3.5°	—	Replace
	26.5Ω (100°C)	57.5°	—	
Fuel gauge range	E(135Ω)	E±3°	—	Replace
	1/2(50Ω)	1/2±5°	—	
	F(4Ω)	F±3°	—	

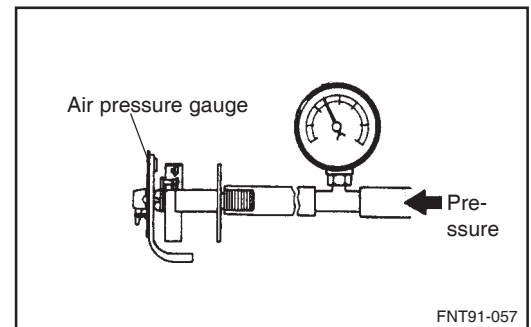
MAINTENANCE POINTS

1. Tachometer check

Check whether indication range of tachometer is within the specification in each rotations using engine rotation gauge. If it exceeds the specification, replace the tachometer.

2. Air pressure gauge check

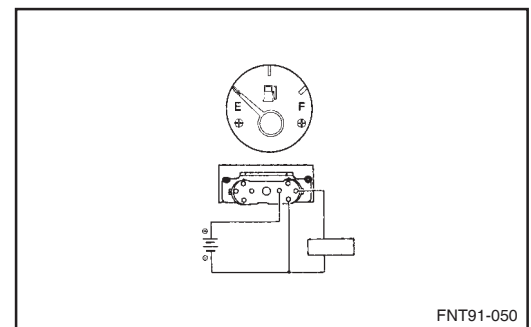
Apply the air pressure to air pressure gauge, and check whether air pressure gauge indication is within the specification with a regular pressure. If it exceeds the specification, replace the air pressure gauge.



3. Fuel gauge and coolant temperature gauge check

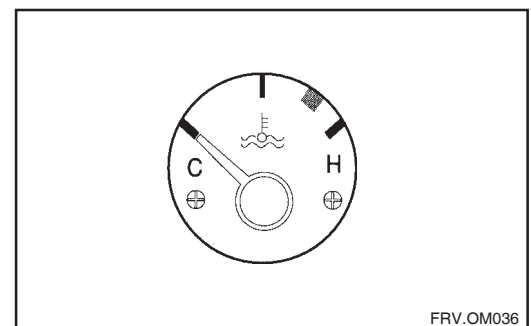
1) Fuel gauge

Check the needle vibration under the specified resistance between the terminals shown in the figure. If it exceeds the specification, replace the fuel gauge.

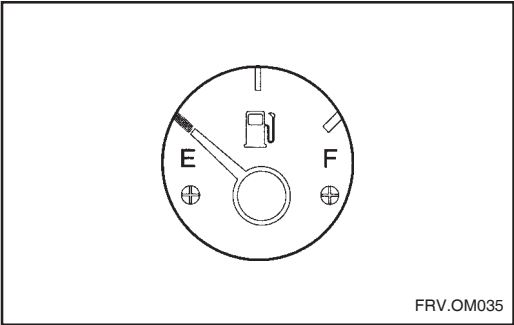


2) Coolant temperature gauge

Check the needle vibration under the specified resistance between the terminals shown in the figure. If it exceeds the specification, replace the water temperature gauge.



FUEL GAUGE

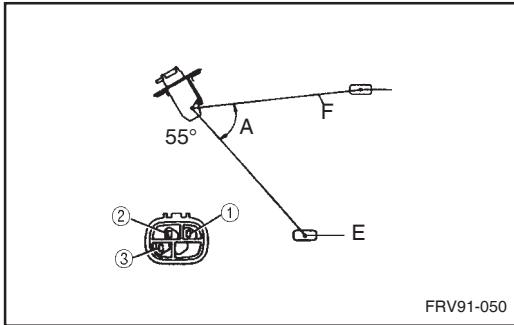


Service standard

Check points			Standard	Limit	Remedy
Resistance of fuel gauge unit	Float position	E	135Ω	—	Replace
		F	4Ω		
	Warning point of remaining fuel		120±4Ω		

Maintenance points

1. Fuel gauge unit check
- Check in full or empty position.
- Measure the resistance between terminal ① and ②, when float arm A reaches stopper (E and R position).
- If the measured valued exceeds specification, replace the unit.
2. Full amount V point check
- Lower the float arm slowly, and check continuity of unit D between terminal (1) and (3) (In shim type tank unit, between (2) and (3)), when the resistance value between terminal (1) and (2) exceeds the nominal value. If there is no continuity, replace the unit.



COOLANT TEMPERATURE GAUGE

Check points			Standard	Limit	Remedy
Resistance of water temperature sensor.	Coolant temperature	50°C	135.9Ω	—	Replace
		85°C	38Ω		
		105°C	23.4Ω		

Maintenance points

1. Coolant temperature sensor check

Dip the coolant temperature sensor into the vessel with water, and measure the resistance of sensor connector by changing the water temperature. If it exceeds the specification, replace the sensor.

PARKING BRAKE INDICATOR

Check points		Standard	Limit	Remedy
Air switch operation pressure when parking brake release is detected		135.9Ω	—	Replace
Parking brake air switch and pie rod lamp	On pressure	38Ω		
	Off pressure	23.4Ω		

Maintenance points

1. Continuity between terminals

Terminals	①	②	Remedy
Condition			
No air pressure			—
Apply air pressure slowly			Check air pressure in continuity



Replace the switches if it is not proper.

INSPECTION AND ADJUSTMENT

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2. Parking brake air switch check

Condition \ Terminals	①	②	Remedy
No air pressure			—
Apply air pressure slowly (On pressure)	○	○	Check air pressure in continuity
After applying the air pressure of 8 kg/cm ² , lower the air pressure slowly. (Off pressure)	○	○	

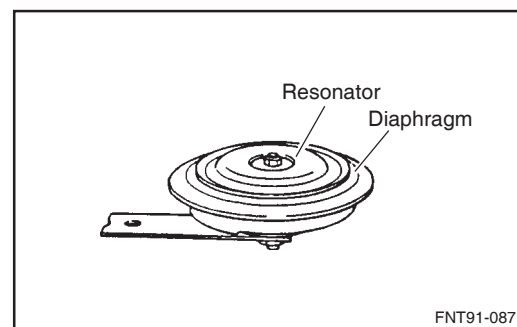
If it is not proper, replace the switch.

HORN

Check points	Standard	Limit	Remedy
Electric horn operation voltage	8~18volt	-	Replace

1. Horn

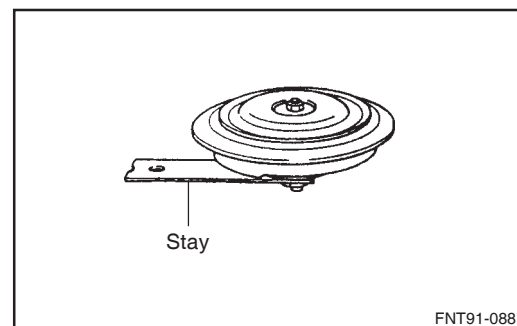
Clean the dust away off the resonator and diaphragm.



If horn stay is deformed or damaged, replace it with the new one.

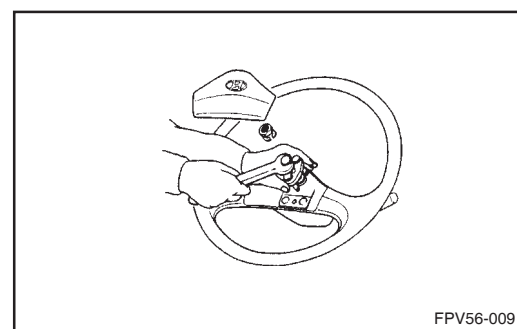
NOTE

- Do not replace the stay but replace the new horn assembly instead.



2. Horn switch

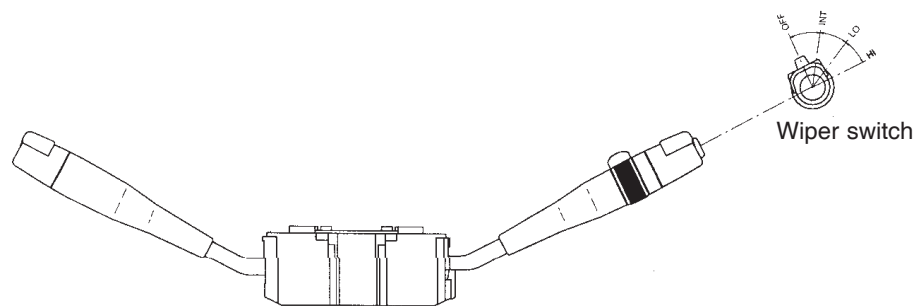
Depress and release the horn pad and check whether it immediately returns. If there is any fault, replace the switch.



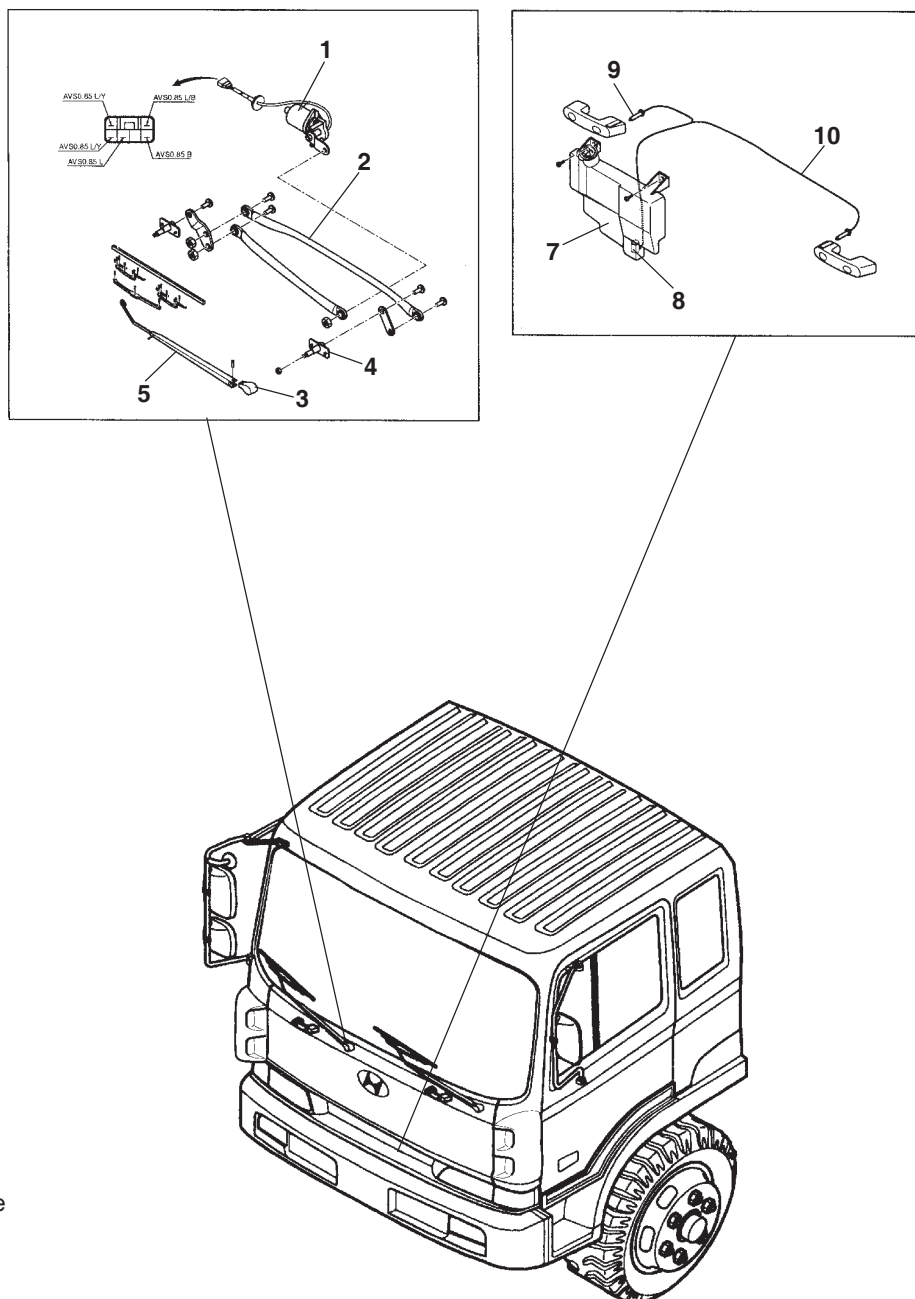
WIPER AND WASHER

Removal and Installation

1. Switch



2. Wiper and washer



1. Wiper motor
2. Wiper linkage
3. Pivot cam
4. Pivot
5. Wiper arm
6. Wiper blade
7. Reservoir tank
8. Washer motor
9. Washer nozzle
10. Hose

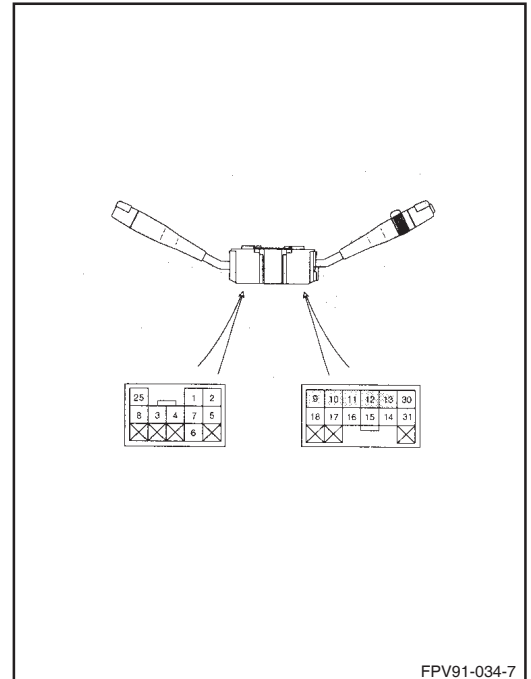
CHECK

1. Wiper and washer switch

Turn on the wiper and washer switch of multi-function switch, and check the continuity as shown on the table below. If there is any fault, replace it with the new one.

[Checking table]

Terminals Switch position	9	10	11	12	13
OFF					
INT	○			○	
LO		○		○	
HI		○	○	○	
WASH				○	○

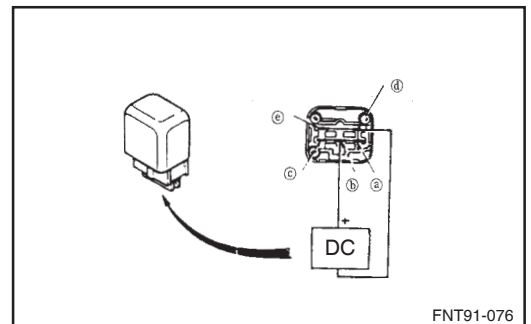


FPV91-034-7

2. Wiper relay

- 1) Check the continuity between c and e, if there is continuity, replace the relay.
- 2) Apply the voltage to terminal b and d starting from 0. Check the voltage when there is continuity between c and e. If the measured value exceeds specification, replace the relay.

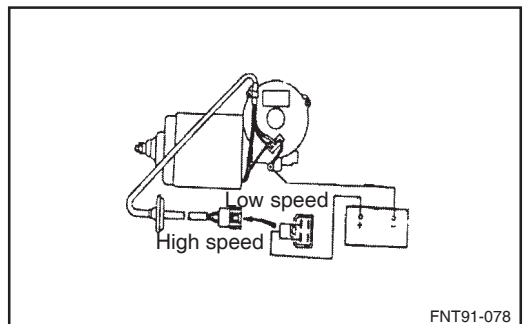
Standard	Below 32 V (at 20 °C)
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FNT91-076

3. Wiper motor

- 1) Install the motor as shown in the figure, and apply the voltage. If the motor does not rotate, replace the motor. If the motor is normal, check wiper switch and wiring.



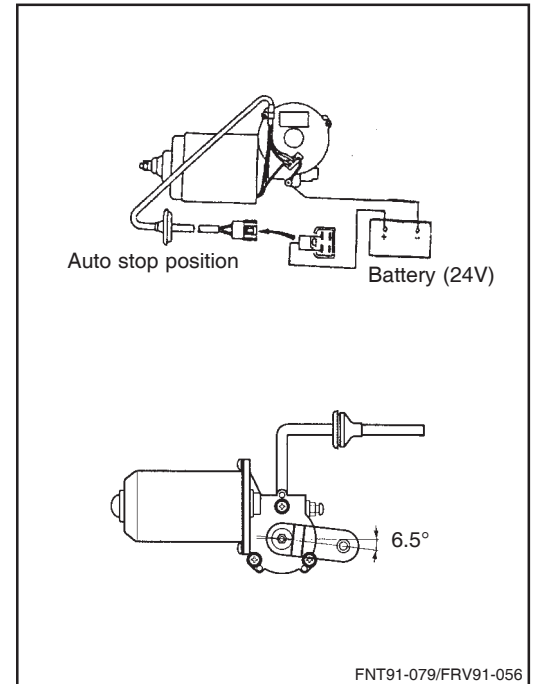
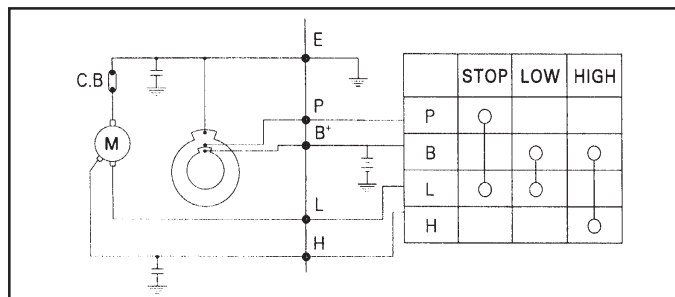
FNT91-078

2) Auto stop equipment check

Apply the voltage and check whether motor stops at the specified position as shown in the figure. If not, replace the motor.

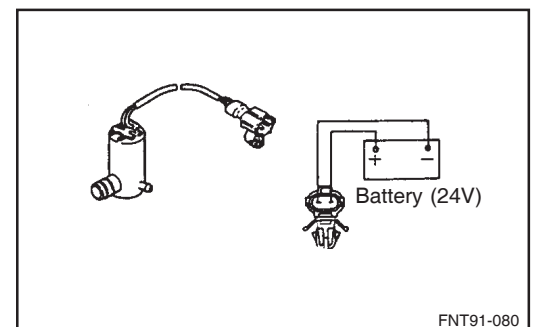
NOTE

- When motor cam is at stop position, motor does not rotate if the current is applied. And then rotate the motor by hands before checking. Motor cam is at stop position, when motor rotates or stops.



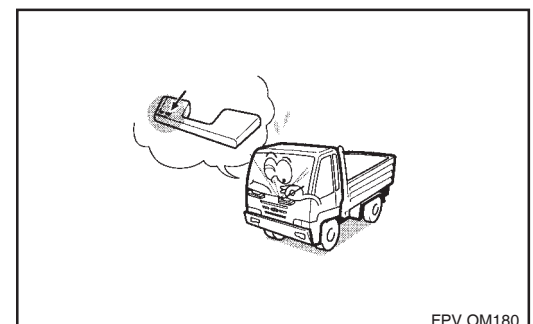
4. Washer tank motor

Apply the current to terminals and check whether motor rotates as shown in the figure. If it is not good, replace it.



5. Washer nozzle

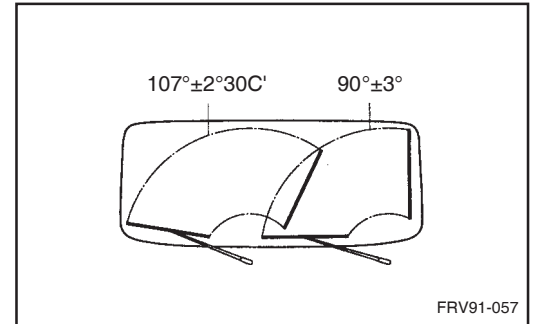
If washer nozzle is clogged, clean the injection orifice using the steel rod of 1 mm or thinner. And clean the nozzle inside using compressed air.



CHECK AND ADJUSTMENT AFTER INSTALLATION

1. Wiping angle

Operate the wiper and check whether the wiping angle coincides with the specification. If not, adjust the wiper at the fixing points.

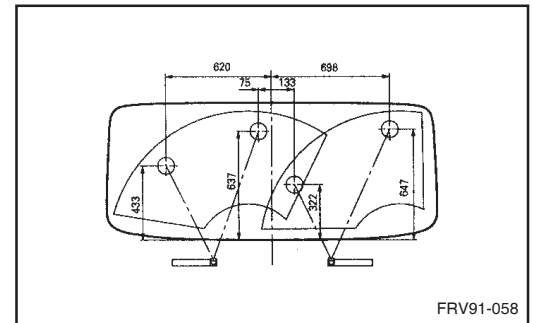


2. Washer injection points

- 1) Move the washer injection points with windshield washer and check whether it injects as shown in the figure. If it goes out the specified injection spots, adjust the washer nozzle.
- 2) Insert the wire of 1 mm or thinner into orifice of washer nozzle to adjust the orifice angle.

NOTE

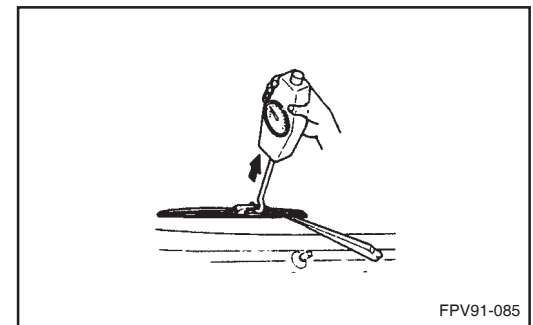
- Do not damage the nozzle orifice.



3) Wiper arm pressure check

Check the wiper arm pressure as shown in the figure left. If it exceeds specification, replace the arm.

Standard	700 ±50`g
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FRAME

GENERAL	BDa - 2
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GENERAL

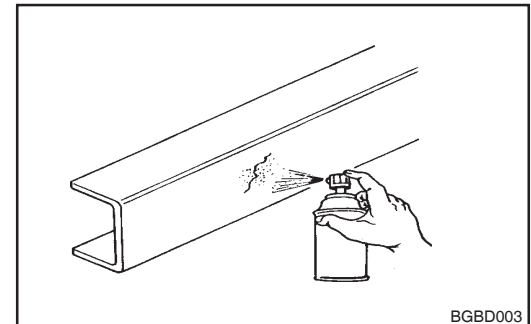
FRAME

The frame provides a base for structure and assembly of chassis. Mounted with the engine, axle, cab, springs, and other chassis parts, it not only carries loads from these elements but also receives reaction from the wheels.

SERVICE PROCEDURE

CRACKS

1. Frame cleaning
Remove thoroughly all dirt, grease and rust on the inside and outside surfaces of the frame.
2. Frame deformation check
Visually inspect the frame for deformation, and adjust it if found.
3. Frame crack check
Visually inspect for cracks. For areas that appear as if they may be cracked, remove paint and inspect carefully. If visual inspection is not adequate, use dyeing test or the magnaflux inspection to check for cracks. Repair all cracks.
4. Frame crack repair



NOTE

1. **For electrical welding, the welding current may destroy electrical components through the ground circuit, so be sure to :**
 - a. **Disconnect the minus terminal of the battery,**
 - b. **ground the welder as close to the welding spot as possible,**
 - c. **always use heat protection when welding is near piping, wiring, rubber parts, or the fuel tank.**
2. **Gas welding's high temperatures may deform materials and make them brittle, so always use electrical welding.**
3. **Use a low-hydrogen type welding rod, without undercuts, blowholes or other defects.**
4. **When welding below freezing or 0°C, first preheat the weld area to 50 to 350°C. Where heat expansion in other members, such as main sill is a problem, use heat insulating materials.**

GENERAL

BDa-3

- 1) Empty the vehicle, set the frame level, and drill a hole about 6 to 9mm in diameter.

NOTE

1. Drill a hole about 10 mm from the start of the crack.
If the start of the crack is not clear, use dyeing test to locate it.
2. When the crack is on the inside of the frame, drill holes at the start and end of the crack.

- 2) If the sides of the crack are stepped, first bring them flush.

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- 3) Use a grinder to cut a 3mm wide V-groove, and then weld.

Next, cut a V-groove into the other side with grinder and weld, filling in the hole at the same time.

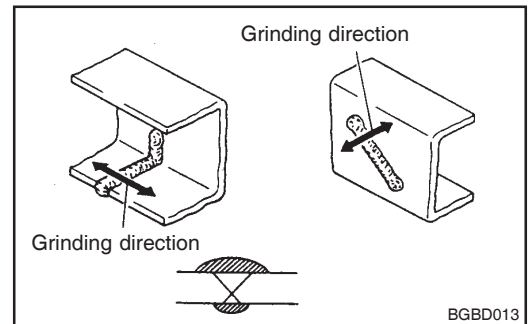
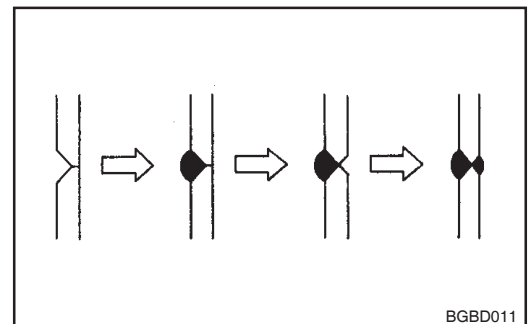
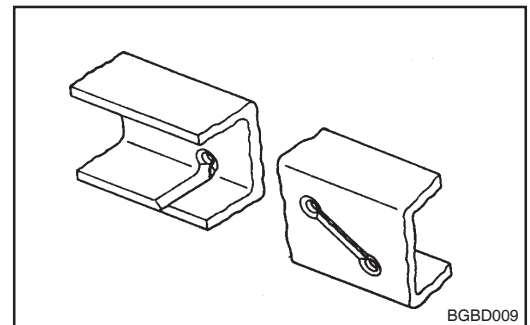
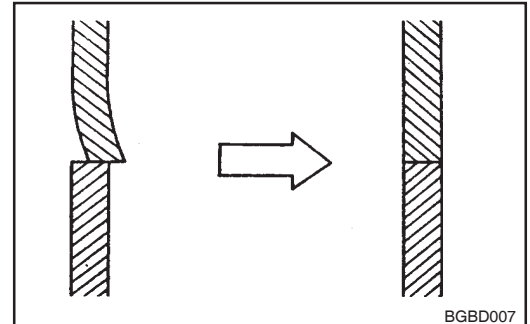
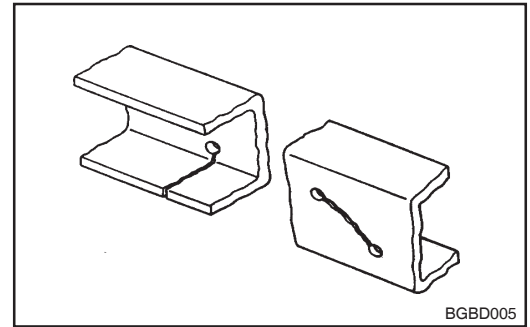
NOTE

Always post heat the spot following welding.

- 4) After welding, apply a grinder at right angles to the weld to grind the surface flat.

NOTE

Finish the weld position to the same thickness as the base material.



BDa-4

FRAME

- 5) Where the crack occurs at a rivet or bolt hole, welding is performed by following procedure.
 - (1) Temporarily install a bolt to the hole.
 - (2) Weld the area outside the radius 20mm circle from the bolt hole center.
 - (3) Remove the bolt and weld the area inside the 20mm circle from the bolt hole center, and also weld the bolt hole.
 - (4) Drill a new hole, and attach the rivet or bolt.
 - (5) Welding method is as indicated in steps (1) to (4) above.
- 6) Where reinforcement is used, open the ends no more than 30 degrees to prevent stress. Allow sufficient margin for cracks in the reinforcement.

NOTE

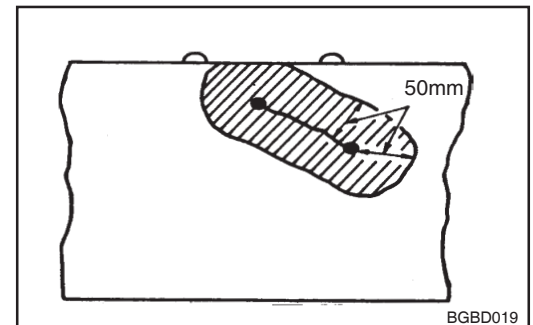
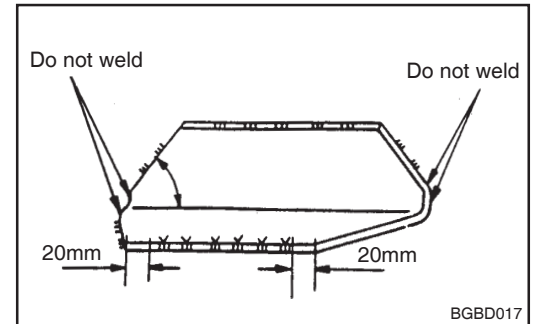
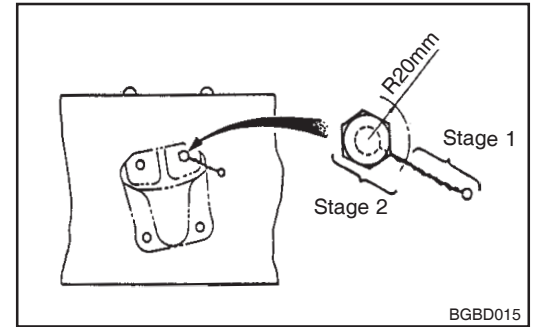
Reinforcement thickness: 4.5 to 6.0 mm

Material : SAPH45 (hot-rolled automobile steel) or SS41 (Rolled steel for general structures).

After welding, post heat the area 50mm around the welded point to 600 to 700°C.

NOTE

Where heat expansion in other members, such as main sill is a problem, use heat insulating materials.



RIVETS

1. Inspect for rivet looseness.
Tap the rivet heads lightly with a test hammer, and judge rivet tightness from the sound or feel. Replace loose rivets.

NOTE

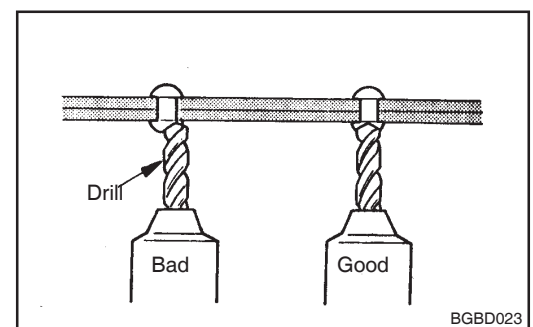
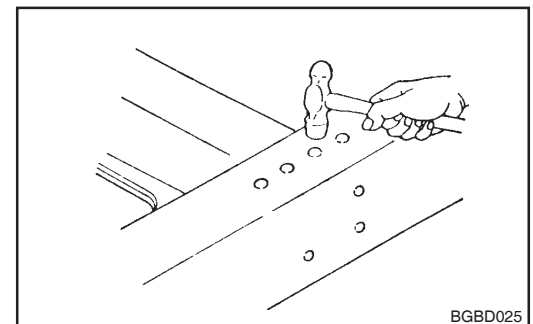
If it is not repaired, loose rivets will break or lead to cracks in the frame from the rivet holes, causing accidents. Be sure to repair using a new rivet.

2. Rivet repair

To remove loose rivets, apply a punch, etc., to the center of the rivet head to make a notch and then drill out.

NOTE

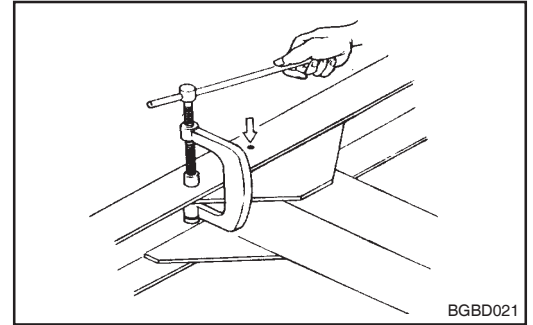
Use of a chisel may damage the rivet hole and should be avoided.



GENERAL

BDa-5

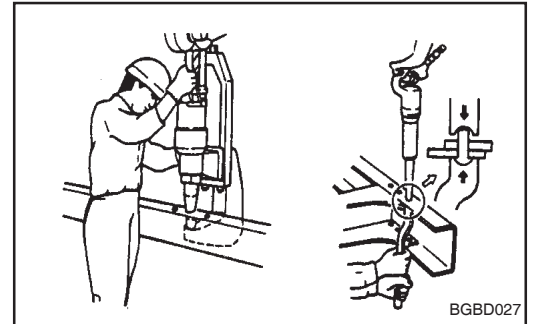
When driving rivets, be sure to press the both plates near the rivet hole using a "C" clamp to ensure that no gap is left.



Use a riveting machine to press the rivets.

NOTE

Where riveting is impossible, ream out the rivet hole, insert a reamer bolt, and weld after tightening the nut thoroughly.



BODY

GENERAL	BDb - 2
CAB	BDb - 6
BUMPER	BDb-17
FRONT END TRIM	BDb-18
INSTRUMENT PANEL AND FLOOR CONSOLE	BDb-19
HEADLINING AND INTERIOR TRIM	BDb-22
DOOR	BDb-25
WINDSHIELD GLASS AND WINDOWS	BDb-28
SEAT AND SEAT BELT	BDb-30



GENERAL SPECIFICATIONS

Items			Remarks
Cab	Type		Cab over the engine type (forward control type)
	Cab mounting type	Front	Cab hinge locking
		Rear	Cab bridge locking
	Tilt mechanism		Manual type
	Tilt angle		45°
Front panel			Upper hinged, lower opening type
Door	Construction		Front hinged, full door construction
	Regulator system		Single arm type
	Locking system		Pin-fork type
Glass thickness mm (in.)	Windshield glass		6.76 (0.266)
	Door glass		3.2 (0.126)
	Rear window		4.0 (0.157)
	Side window		3.5 (0.138)
Seat belt	Driver & Passenger side		E.L.R type
	Center seat		2 point static type

E.L.R : Emergency Locking Retractor

GENERAL**BDb-3****TIGHTENING TORQUE**

Items		Torque : kgf·m (ft·lb)
Front panel	Gas spring to body	0.7-1.1 (5-8)
	Front panel to gas spring	0.7-1.1 (5-8)
	Front panel to hinge	0.7-1.1 (5-8)
Door	Door hinge to body	3.5-4.2 (25.3-30.4)
	Door hinge to door	1.3-2.6 (9.4-18.7)
Seat belt	Upper anchor mounting bolt	4.0-5.5 (29-39.7)
	Seat belt height adjust mounting bolt	4.0-5.5 (29-39.7)
	Retractor mounting bolt	4.0-5.5 (29-39.7)
Seat support to body	Bolt	3.5-5.5 (25.3-39.7)
	Nut	2.1-3.1 (15.2-22.4)
Seat to seat support nut		0.9-1.4 (6.5-10.1)
Cab hinge lower bracket mounting bolt (M14 x 35)		9.9 (71.6)
Cab hinge cap bracket mounting bolt (M14 x 35)		9.9 (71.6)
Torsion bar supporter mounting bolt (M10 x 45)		3.4 (24.6)
Stay upper bracket mounting bolt (M12 x 25)		2 (14.5)
Stay lower bracket mounting bolt (M12 x 30)		2 (14.5)

TROUBLESHOOTING**Manual Cab Tilt Mechanism**

Symptom	Probable cause	Remedy
Cab does not tilt up	Main hook not disengaged	Check
	Safety hook not disengaged	Check
	Torsion bar not functioning properly	Replace
	o Damaged torsion bar	
	o Torsion bar arms improperly angled	Correct
Cab does not lock into cab bridge	Main hook not being caught in hook pin bracket	Check
	Bottom bracket not properly seating on cushion	Adjust
The warning lamp does not light up when the main hook is disengaged from the hook pin bracket or the lamp does not goes out when the main hook is locked into position	Cab tilt unlock sensor improperly adjusted	Adjust
	Defective cab tilt unlock sensor	Replace

Miscellaneous

Symptom	Probable cause	Remedy
Cab shimmy (horizontal and vertical vibrations)	Large wheel and tire vibration	Adjust
	Poorly balanced wheel and tire	
	Poorly balanced brake drum	
	Different size or type of tires in use	Use same size and type of tires
	Loose cab mount section	Retighten
	Large friction between suspension leaf springs	Correct or replace
	Resonance from axle seat section	Correct
Cab vibrates at braking	Brake drum is out of round	Correct or replace
	Distorted wheel mounting surface	
Cab and steering wheel produce high frequency vibrations (over 20 Hz)	Abnormal sound from cab	Correct or replace
	o Power steering oil pump, etc. pulsating	
	o Cab installed incorrectly	
	o Engine, transmission, etc. installed incorrectly	
	o Intake and exhaust system installed incorrectly	

GENERAL

BDb-5

Symptom	Probable cause	Remedy
Cab and steering wheel produce high frequency vibrations (over 20Hz) or abnormal sound	Cab vibration caused by propeller shaft o Large propeller shaft runout	Correct balance or replace
	o Large friction in universal joint	Replace
	o Large center bearing play	
	o Large play in slip joint spline	
	o Increased propeller shaft cross angle due to increased inclination of drive shaft caused by overloading	Never overload
	o Increased propeller shaft cross angle due to increased inclination caused by weakened engine mounting o Increased cross angle of center bearing installed dimensions due to deterioration of center bearing rubber etc.	Replace
Door fails to close correctly	Incorrect door installation	Adjust
	Strikers adjusted poorly	Adjust with shim
	Faulty door lock	Adjust or replace
Door does not lock when inside lock knob is pushed	Deformed rod	Replace
	Disengaged rod	Correct
	Faulty door lock	Replace
Door does not lock when key is turned	Deformed key cylinder	Replace
	Disengaged rod	Correct
	Faulty door lock	Replace
Door does not open when door outer handle is operated	Joint screw poorly adjusted	Adjust
	Faulty door lock	Replace
Door does not open when door inside handle is operated	Door inside handle poorly installed	Adjust
	Deformed rod	Replace
	Disengaged rod	Correct
	Faulty door lock	Replace
Door inside handle does not return normally	Rod interfering	Correct
	Weak spring	Replace
Window glass fails to operate up and down	Incorrect window glass installation	Adjust position
	Runchannel lip caught by window glass	Correct
	Damaged or faulty window regulator arm or motor	Replace

CAB

FRONT CAB MOUNTING

The front cab is directly fitted to the frame and the torsion bar is inserted to the cab hinge bracket. In the cab which has a manual tilt mechanism, torsion bars and torsion bar arms are installed in the front cab mounting.

REAR CAB MOUNTING

The rear cab mounting of the cab is constructed so that the main hook of the tilt link fitted to the rear of the cab locks the hook pin bracket located at the center of the cab bridge and is supported by the side cushion and compression cushion on right and left sides.

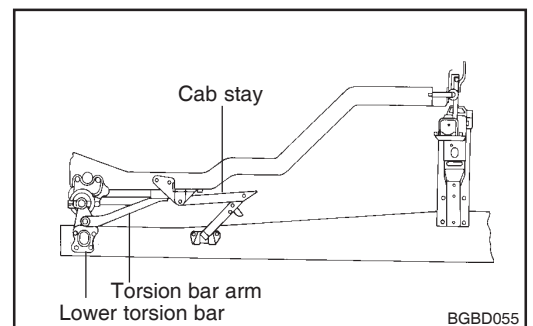
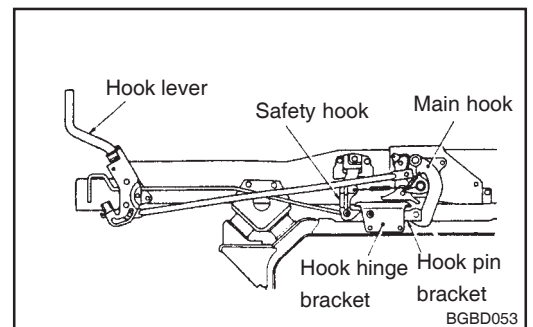
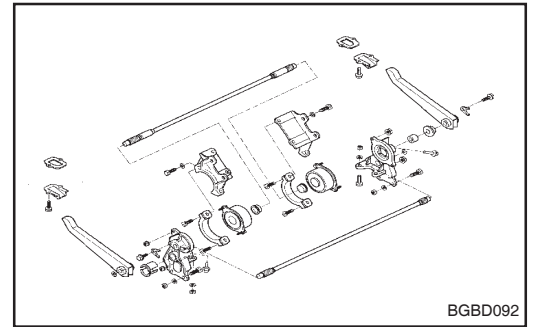
CAB TILT SYSTEM

The manual cab tilt consists of the tilt link including the main hook and hook lever, cab stay, torsion bar, and other parts.

Pulling the hook lever causes the main hook to leave off the hook pin bracket of cab bridge, allowing the cab to be disconnected from the rear cab mounting.

Torsion bars are built into the floating cab mounting, allowing the cab to be tilted manually with a light force. The two torsion bars are installed in position, being twisted when the cab is lowered. When the hook is released to tilt up the cab, the resistance of the torsion bars to the torsional stress acts via the torsion bar arms.

A safety hook is provided that prevents the cab from being tilted even when the main hook is disengaged from the hook pin bracket. The safety hook is designed to be caught in the hook hinge bracket. The cab stay is locked into position when the cab has been fully tilted up, thereby preventing the cab from falling down in fore-aft direction.



SERVICE PROCEDURE

REMOVAL OF CAB

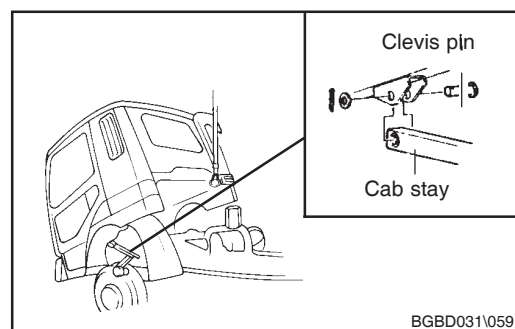
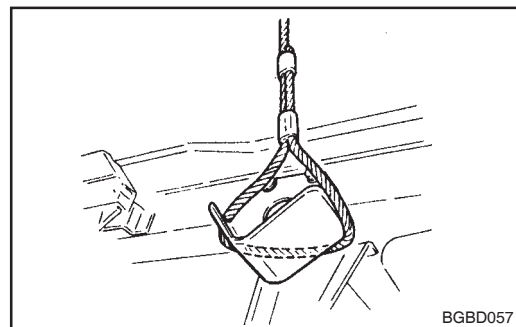
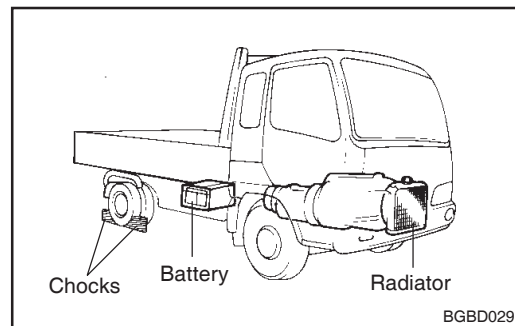
Key points for removal

1. Preparation before removal
 - 1) Place chocks to tires and disconnect battery ground.
 - 2) On vehicles with heater, remove coolant from the radiator.
2. Work performed inside the cab
 - 1) Disconnect the body harness from the chassis harness.
 - 2) Remove the parking brake cable. (Except vehicles with wheel parking brake)
3. Work performed from front of cab
 - 1) Remove the radiator grille and front panel.
 - 2) Disconnect the speedometer cable connections on the cab and chassis sides.
 - 3) Disconnect the brake hose, clutch hose, heater water hose, and air gauge hose (vehicles with air over hydraulic brake).
 - 4) Remove the cab ground
 - 5) On vehicles with air conditioner, remove refrigerant and disconnect hoses.
4. Work performed with the cab tilted

Remove the accelerator cable, engine stop cable, transmission control linkage.

5. Removal of cab mounting

- 1) With the cab tilted up, catch crane wire at the part of the cab shown.
- 2) Lower the cab to a position immediately before the cab stay locks and support the cab at the position with the crane.
- 3) Remove the clevis pin from the cab stay and remove the cab stay.



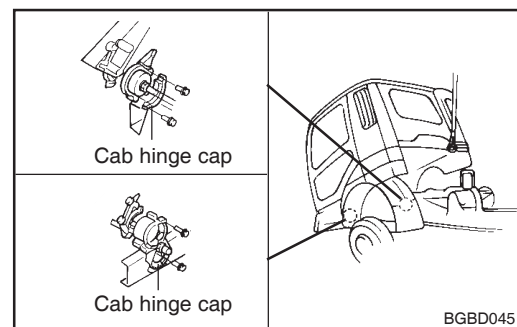
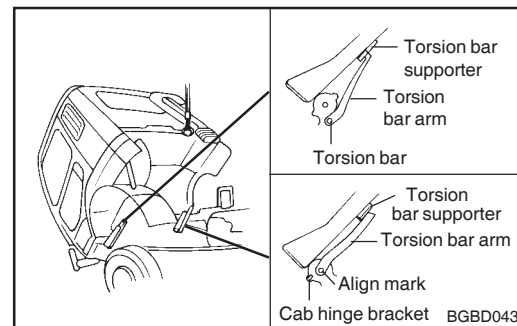
- 4) Make an alignment mark on the arms and cab hinges before removing the torsion bar arms.

To remove the torsion bar arm, tilt the cab with the crank until the arm leaves the support.

NOTE

1. **Do not tilt the cab excessively to prevent it from toppling down forward.**
2. **After the arms have been removed, tilt down the cab as soon as possible.**

- 5) When removing the cab hinge cap, tilt the cab to a position which provides the minimum essential work space.



6. Hoisting the cab

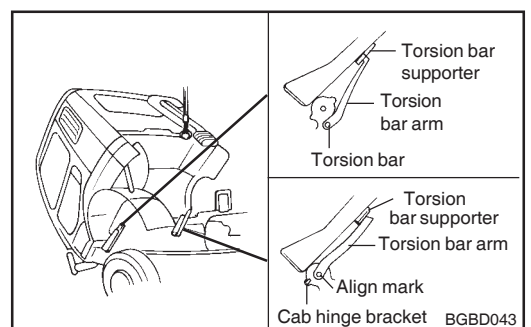
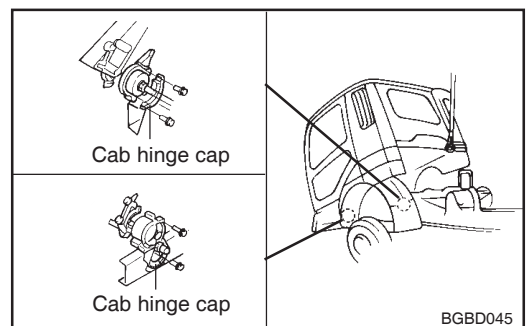
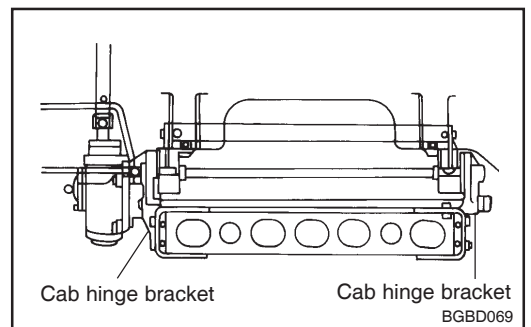
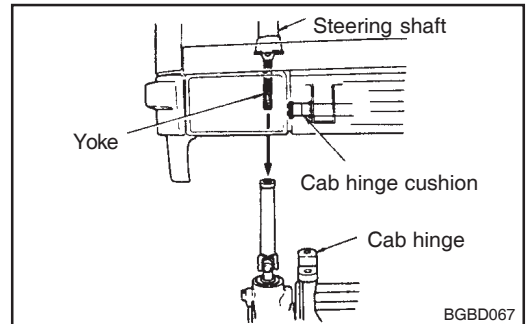
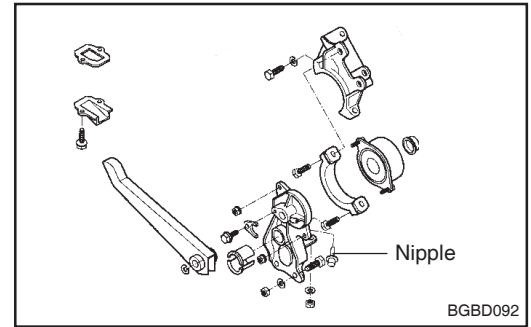
- 1) To prevent the drip rail from being deformed during hoisting, place rubbers with a wide contacting area with the drip rail. If the rubber is wider than the lifting bracket, add plate.
- 2) Locate the lifting bracket at the center of gravity of the cab and lift the cab straight upward very slowly. Lift the cab until the yoke comes out of the steering shaft.

NOTE

1. **Be sure to make an alignment mark on the yoke and steering shaft before hoisting.**
2. **Determine the center of gravity of the cab before attempting to locate the lifting bracket.**
3. **When hoisting the cab, lift it up a little and check that the wires, cables and related parts have been disconnected/removed.**
4. **Never go under the cab when hoisting the cab.**

Key points for installation

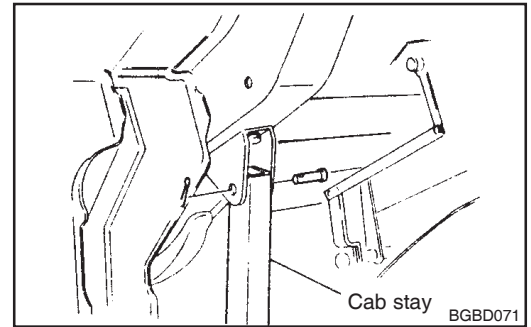
1. Fit the cab hinge cushions and plate to the location in cab to which cab hinge is mounted and tighten bolt to specification.
Before installation, apply grease to the nipple in the cab hinge bracket.
2. Insert the steering shaft yoke into the steering shaft, making sure that the alignment marks are aligned. Then, fit the cab hinge to the cab, ensuring that the cab hinge cushion is aligned with the cab hinge.
3. Check cab hinges for irregularity between right and left, and correct as required.
4. Tilt the cab with the crane to a position which allows installation of cab hinge cap.
Mount the cab hinge cap and tighten bolt to specification.
5. When installing the torsion bar arms, make sure that the alignment on the arm is aligned with that on the cab hinge.



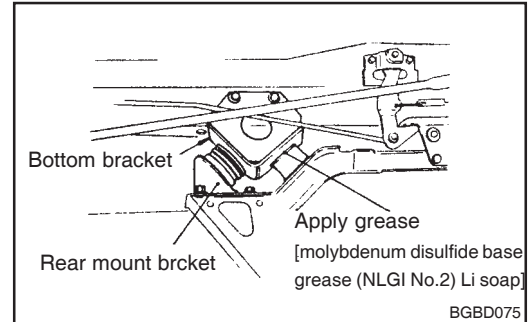
BDb-10

BODY

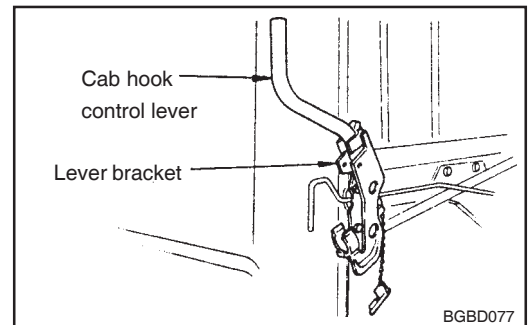
6. Install the cab stay.



7. Lower and lock the cab
8. Move the rear mount bracket until it comes into contact with the bottom bracket.
If the adjustment is impossible by only moving the rear mount bracket, use shims.



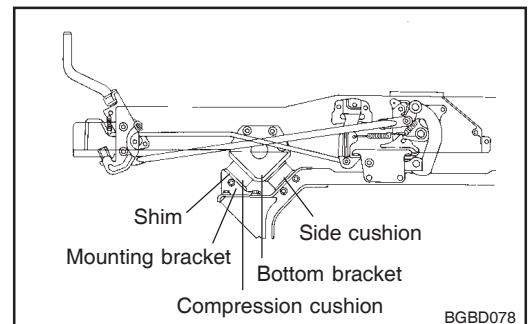
9. Operate the cab hook control lever and verify if both the stoppers on main hook side and control lever side make contact at the same time. If any adjustment is required, reinstall the lever bracket.



10. Check the safety hook dimension shown and adjust as necessary.
Reinstall the removed cable, hose, linkage, etc.

Inspection and adjustment after installation

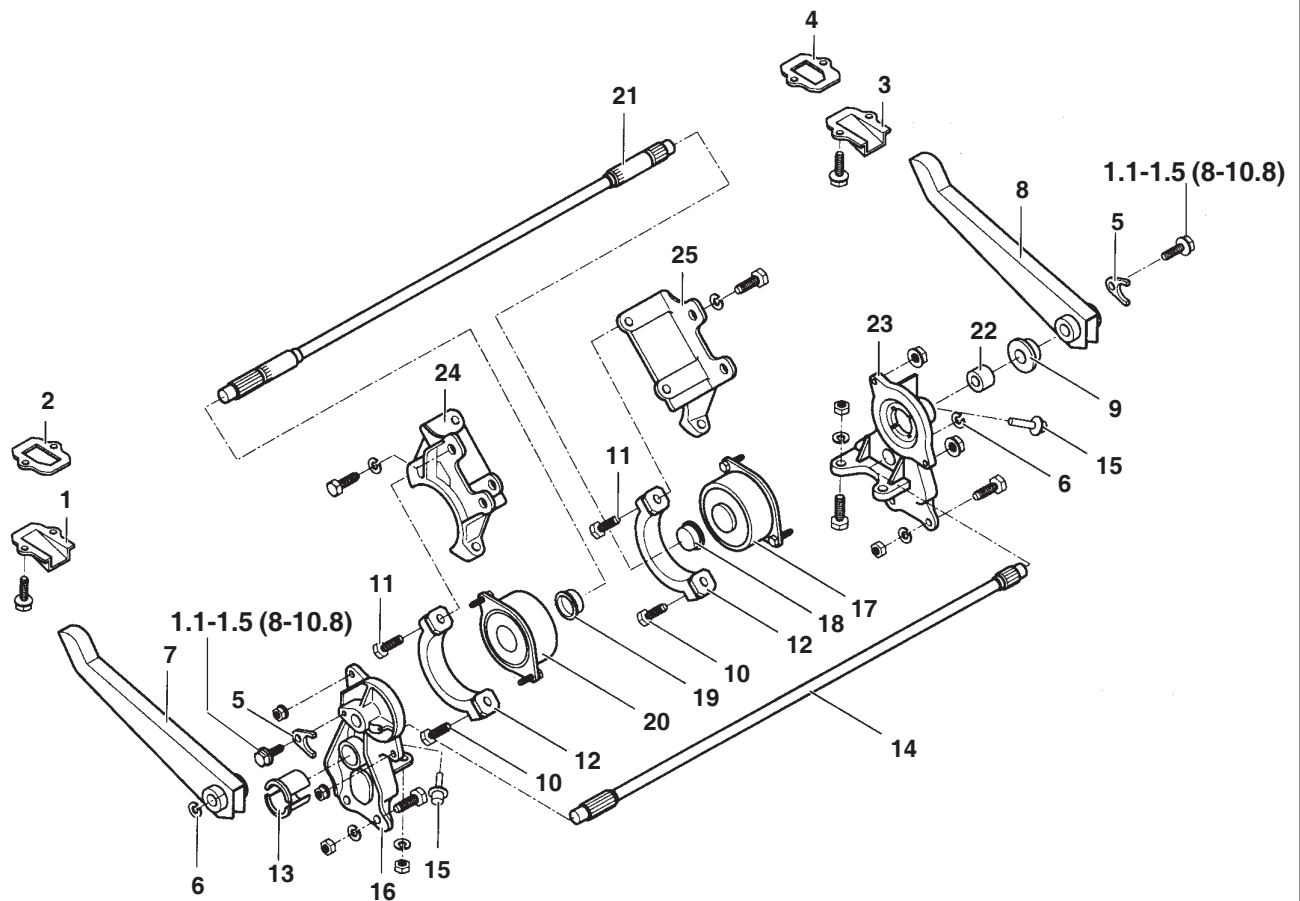
Check to see if the warning lamp on the meter cluster lights up when the main hook is removed from the hook pin bracket and if the lamp goes out when the main hook locks into position.
If any defect is evident, adjust the cab tilt lock sensor.



MANUAL CAB MOUNTING

Front cab mounting

Disassembly and inspection



Disassembly sequence

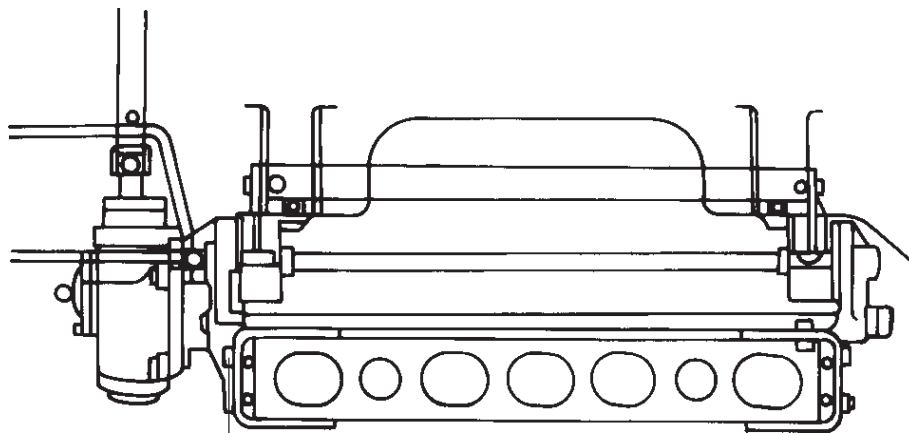
1. Torsion bar shaft, LH
2. Shim
3. Torsion bar shaft, RH
4. Shim
5. Stopper plate
6. Snap ring
7. Torsion bar arm, LH
8. Torsion bar arm, RH
9. Dust cover

10. Bolt
11. Bolt
12. Cab hinge cap
13. Bushing
14. Lower torsion bar
15. Grease nipple
16. Cab hinge bracket
17. Cab hinge cushion
18. Dust cover

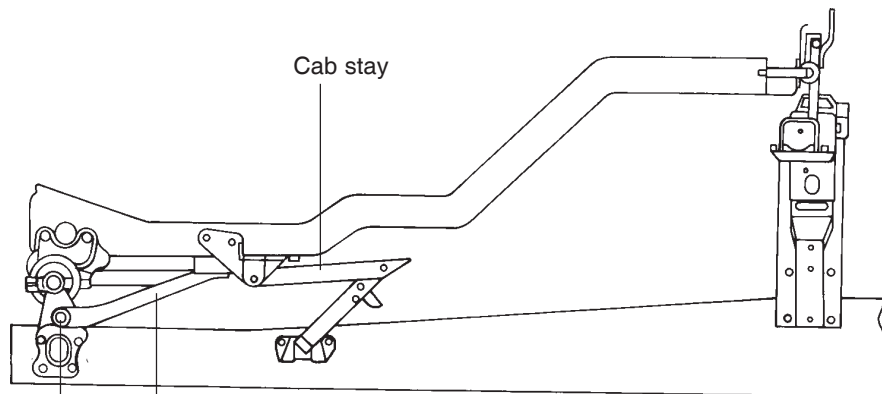
19. Dust cover
20. Cab hinge cushion
21. Upper torsion bar
22. Bushing
23. Gear box bracket
24. Cab hinge upper bracket, LH
25. Cab hinge upper bracket, RH

TORQUE : kgf·m (ft·lb)

Reassembly



Cab hinge bracket



Cab stay

Torsion bar arm

Torsion bar

CAB STAY

Disassembly and reassembly

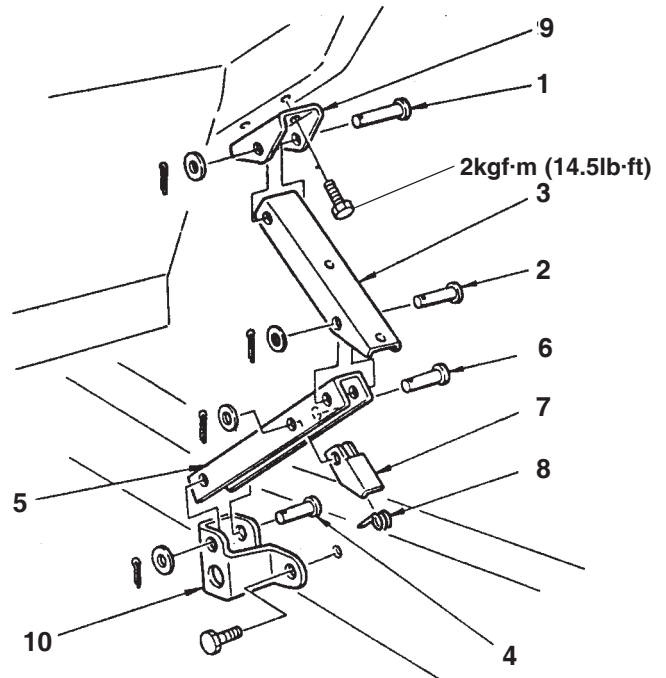
Disassembly sequence

1. Clevis pin
2. Clevis pin
3. Stay
4. Clevis pin
5. Stay
6. Clevis pin
7. Lock stay
8. Return spring
9. Upper bracket
10. Lower bracket

*To reassemble, reverse order of disassembly.

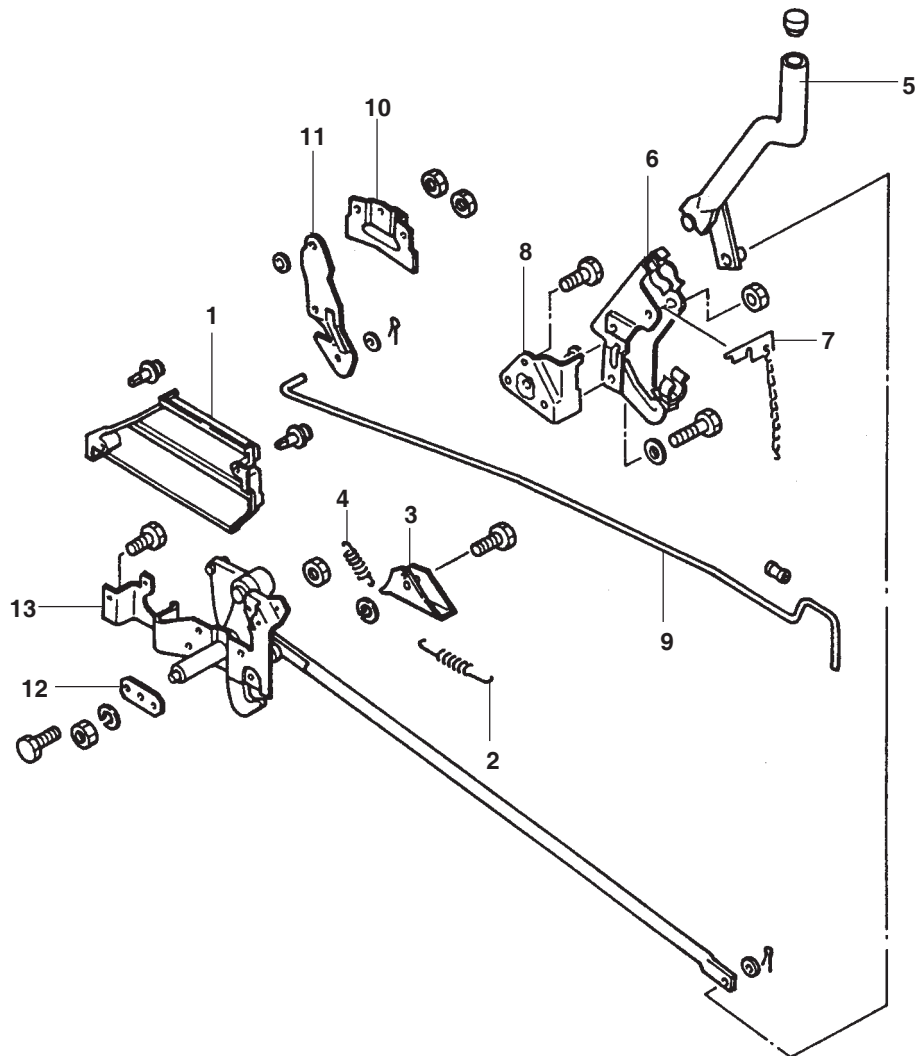
NOTE

When removing and reinstalling the cab stay, be sure to use a crane to support the cab.



CAB TILT LINK

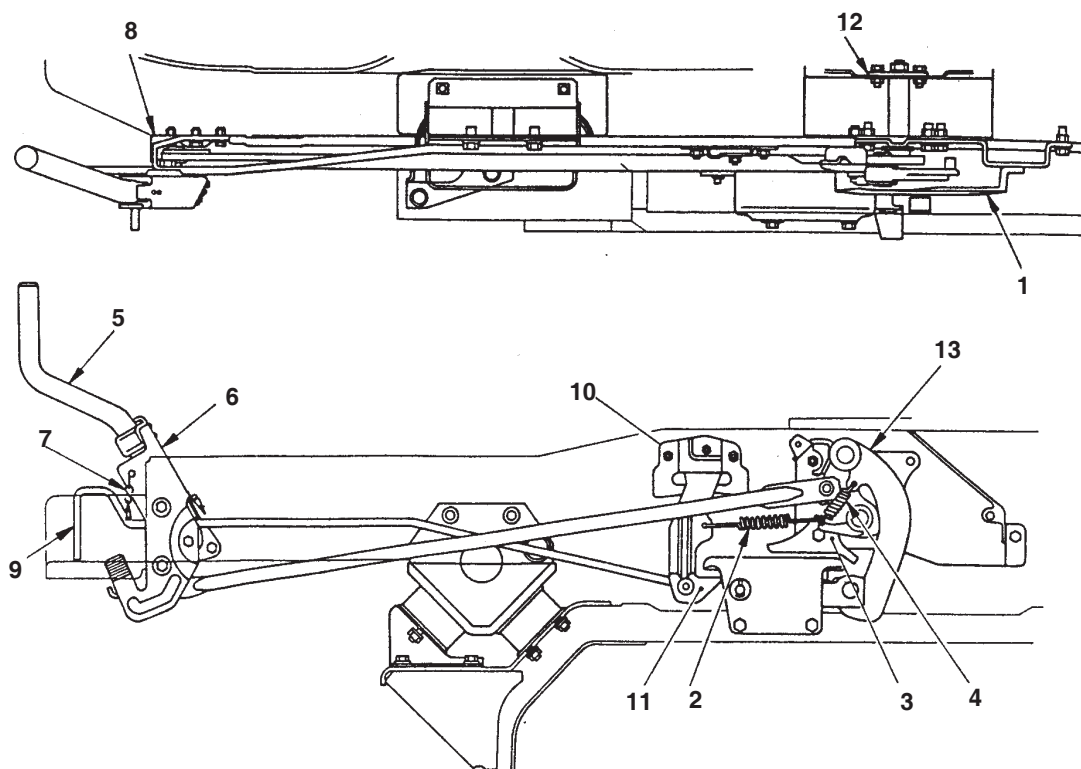
Disassembly and inspection



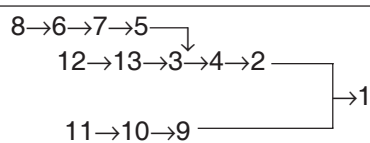
Disassembly sequence

- | | |
|-----------------------|-------------------------|
| 1. Main hook cover | 6. Hook lever bracket |
| 2. Return spring | 7. Key |
| 3. Lock lever | 8. Hinge bracket |
| 4. Return spring | 9. Safety hook rod |
| 5. Hook control lever | 10. Safety hook bracket |
| | 11. Safety hook |
| | 12. Hook plate |
| | 13. Main hook assembly |

Reassembly

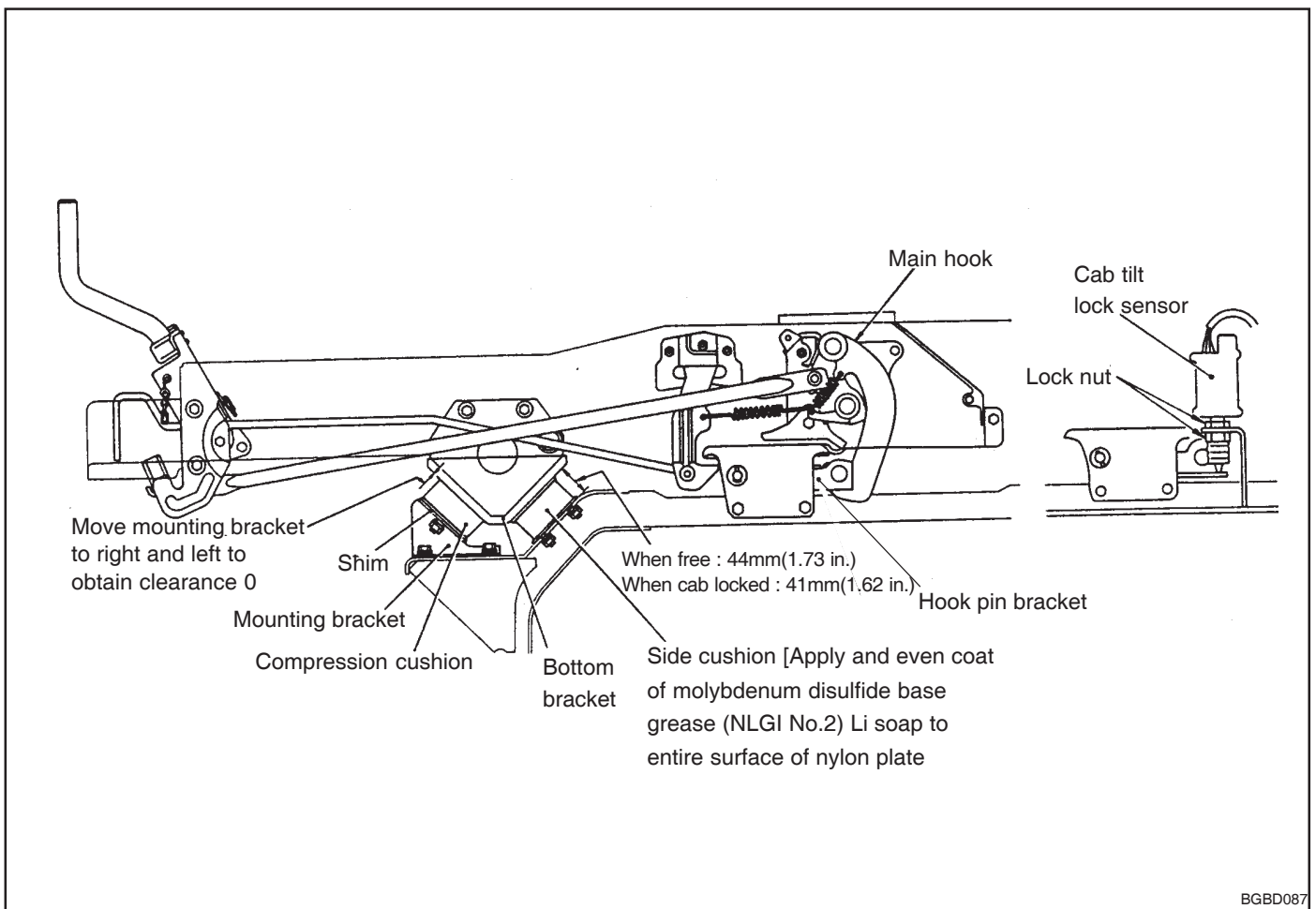


Assembly sequence



Adjustment after installation

1. Move the bottom bracket to the right and left to obtain the side cushion dimension shown with the cab in locked position.
2. Vary shim combinations or move mounting bracket to right and left to obtain clearance 0 between the compression cushion and bottom bracket with the cab in locked position.
3. Adjust the cab tilt lock sensor as follows with the lock nut loosened.
 - o The warning lamp in meter cluster must be off when the cab is locked.
 - o The lamp must come on when the cab is unlocked (main hook disconnected from the hook pin bracket).



BUMPER

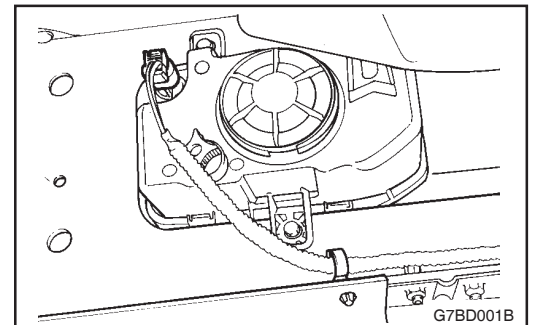
COMPONENTS



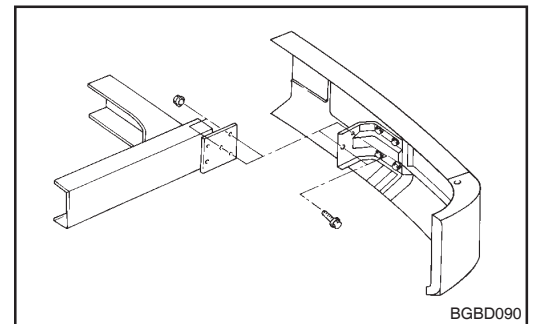
BGBD089

REMOVAL

1. Disconnect the fog lamp connector.



2. Loosen the bolts and remove the front bumper.

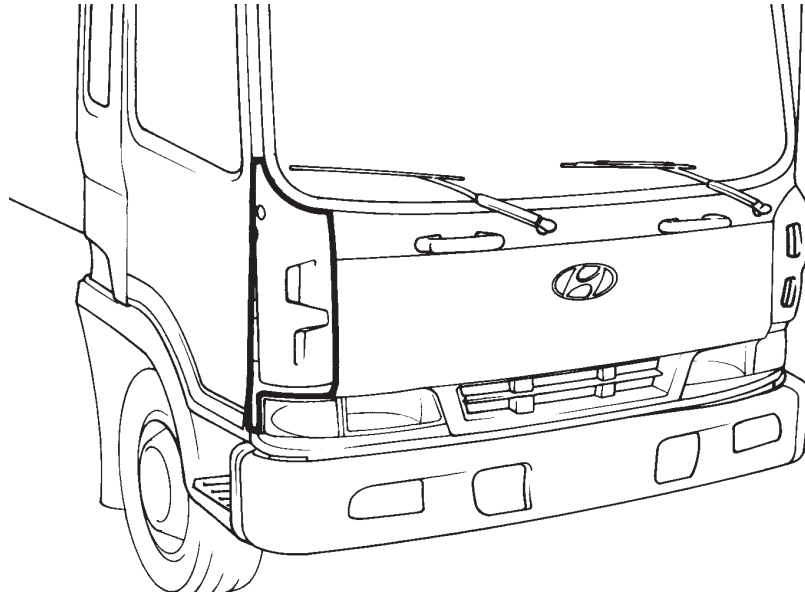


INSTALLATION

Installation is the reverse of removal procedure.

FRONT END TRIM

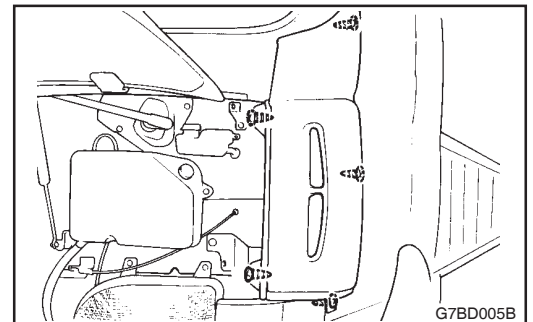
COMPONENTS



BGBD091

REMOVAL

1. Remove screw (5EA).

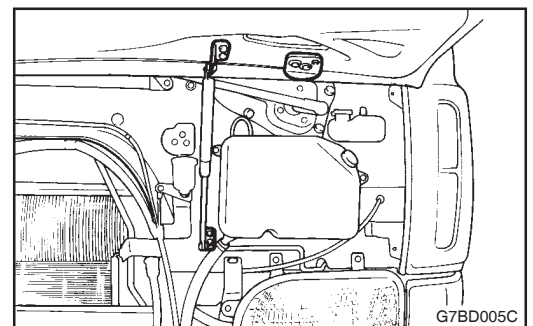


G7BD005B

2. Loosen bolts and remove the front panel.

Tightening torque

Gas spring to body.....	0.7-1.1 kgf·m
Front panel to gas spring..	0.7-1.1 kgf·m
Front panel to hinge.....	0.7-1.1 kgf·m

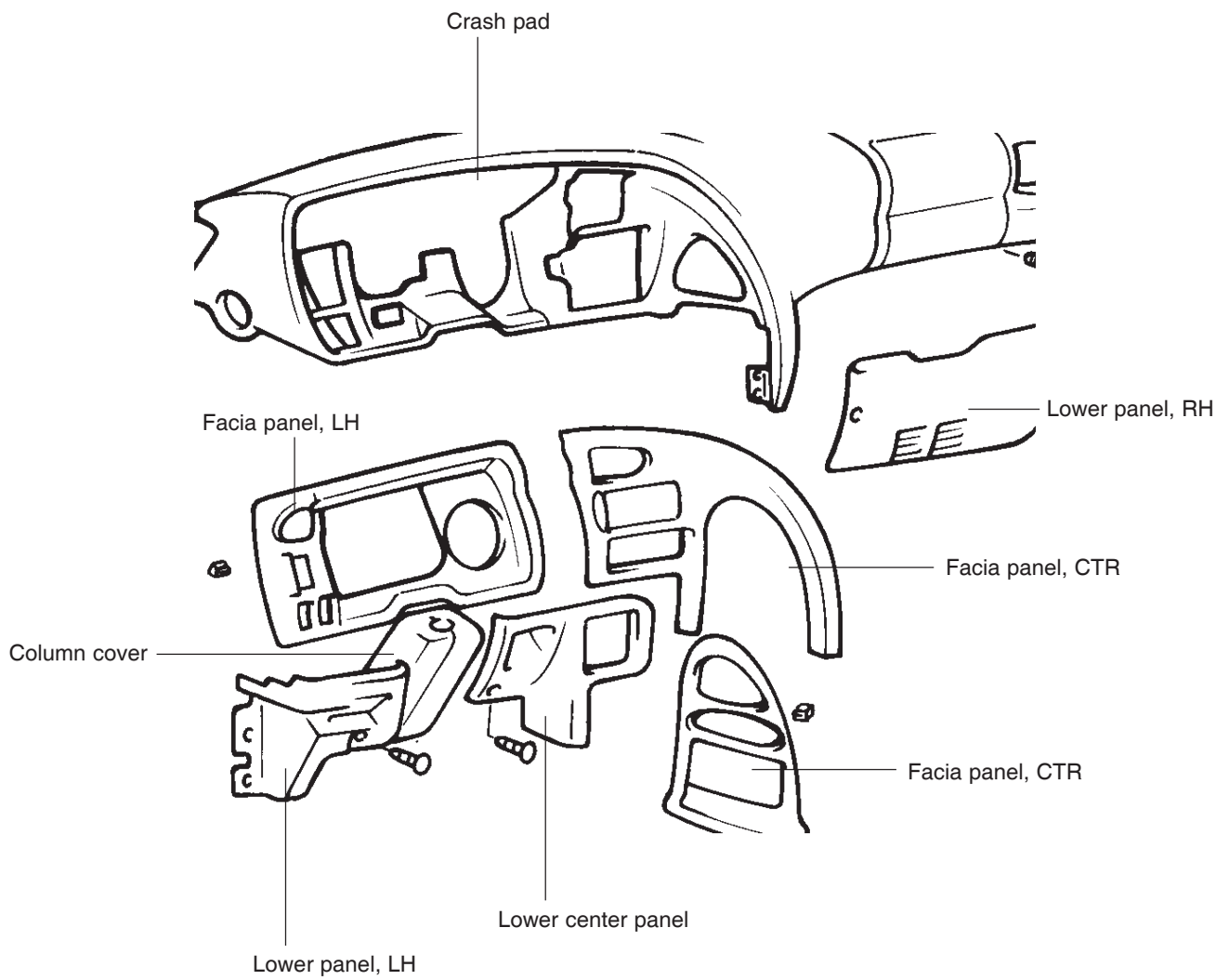


G7BD005C

INSTALLATION

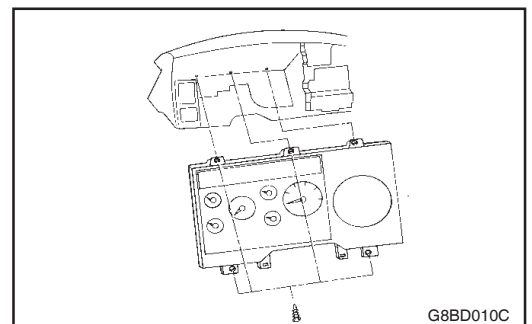
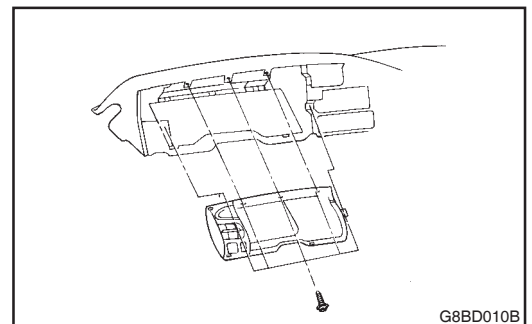
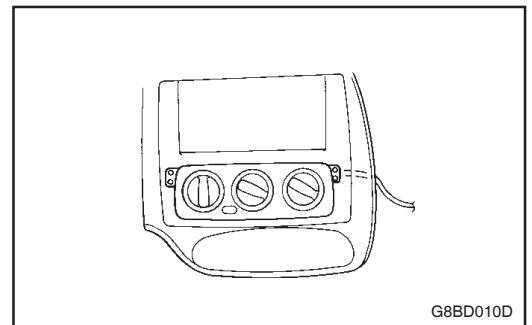
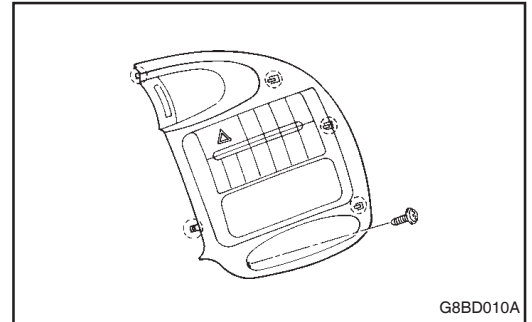
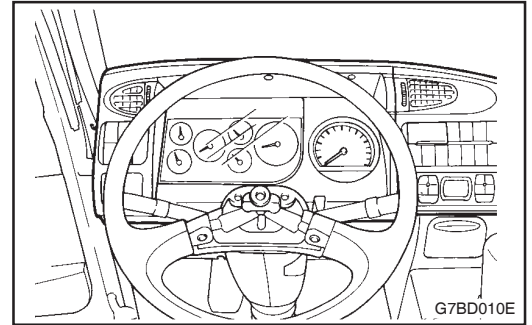
Installation is the reverse of removal procedure.

INSTRUMENT PANEL AND FLOOR CONSOLE



REMOVAL

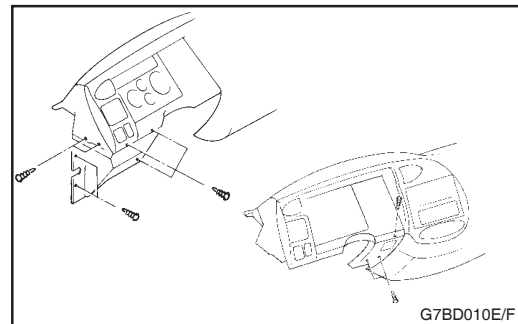
1. Remove the steering wheel.
2. Remove the digital clock by prying out with a (-) screwdriver and disconnect wire from clock.
Remove the screw in the RH-facia panel and disconnect the connectors.
3. Remove the heater control switch.
4. Remove the LH-facia panel.
5. Remove the meter cluster and gauges.



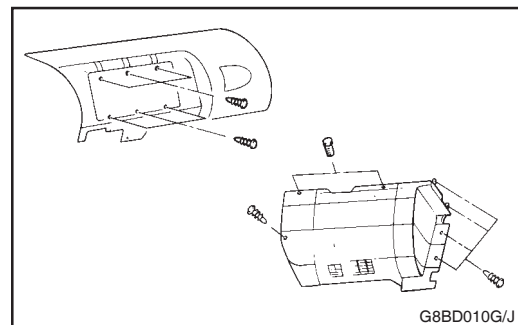
INSTRUMENT PANEL AND FLOOR CONSOLE

BDb-21

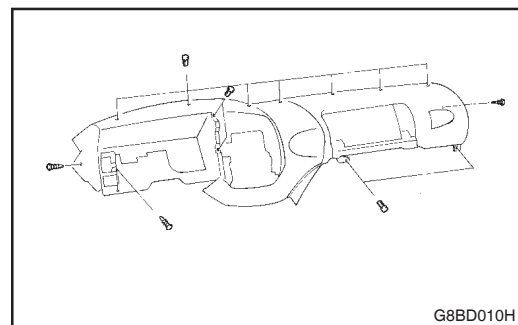
6. Remove the LH-lower panel and instrument center lower panel.



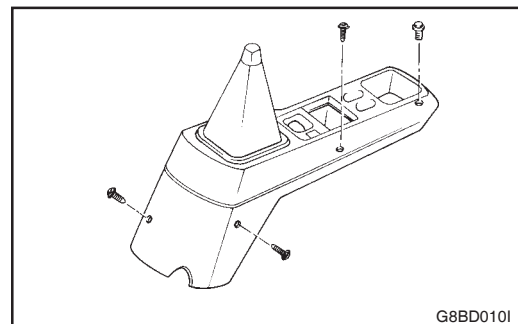
7. Remove the fuse box lid and fuse box assembly and RH-lower panel.



8. Remove the crash pad main assembly.



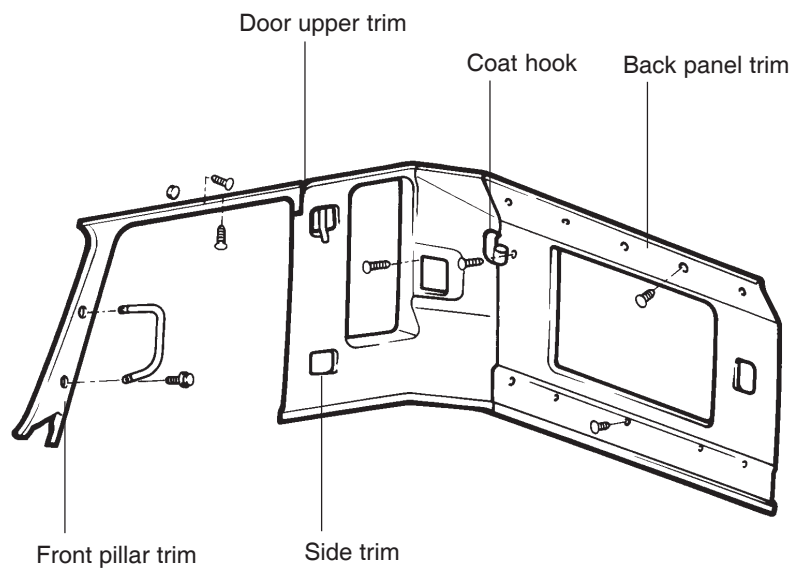
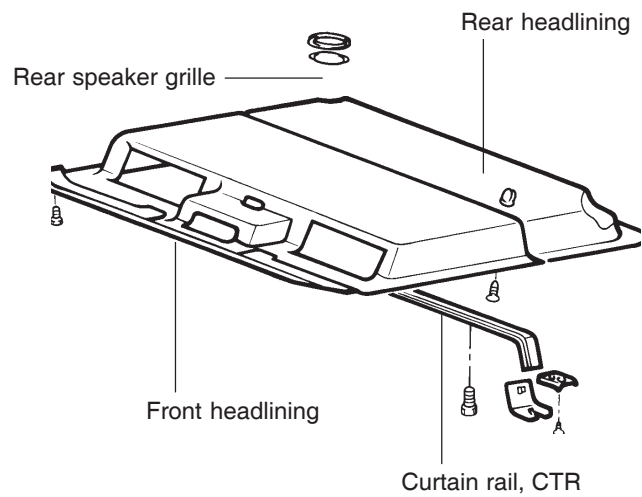
9. Remove the floor console.



INSTALLATION

Installation is the reverse of removal procedure.

HEADLINING AND INTERIOR TRIM



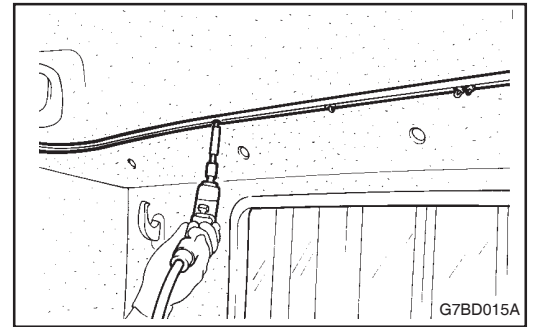
HEADLINING AND INTERIOR TRIM

BDb-23

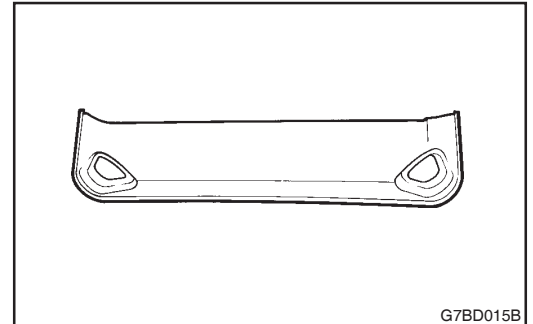
REMOVAL

HEADLINING

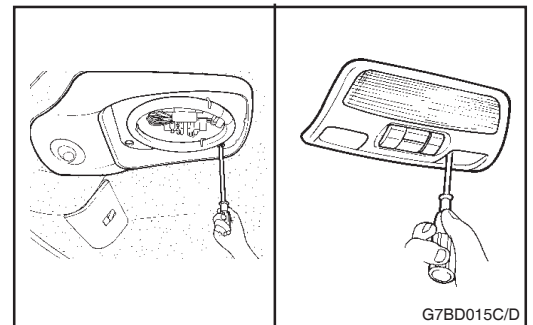
1. Loosen the screw and remove the curtain rails.



2. Remove the rear head lining.

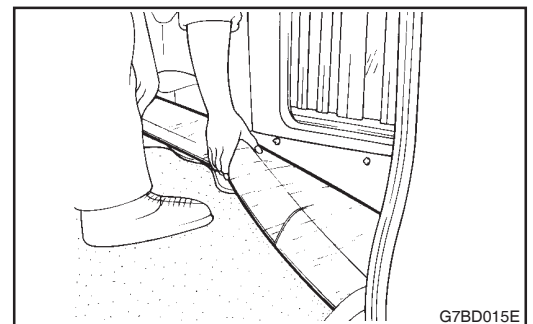


3. Remove the grip, sun visor, room mirror, map lamp, overhead console lamp and overhead console.

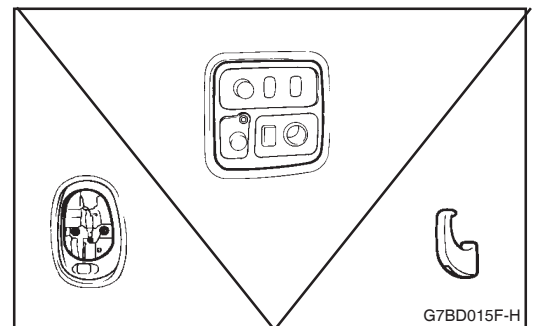


INTERIOR TRIM

1. Remove the scuff trim and disconnect the bed heating connect and remove the bed.



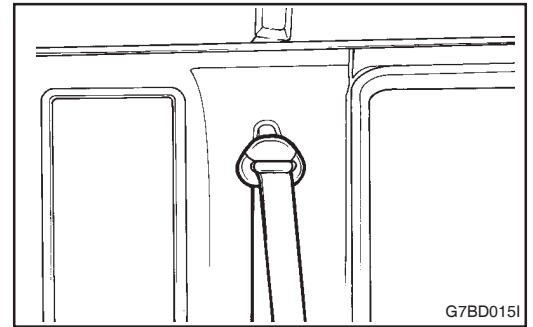
2. Remove the room lamp, remote switch, coat hooker and rear interior trim panel.



BDb-24

BODY

3. Remove the seat belt upper anchor mounting bolt.



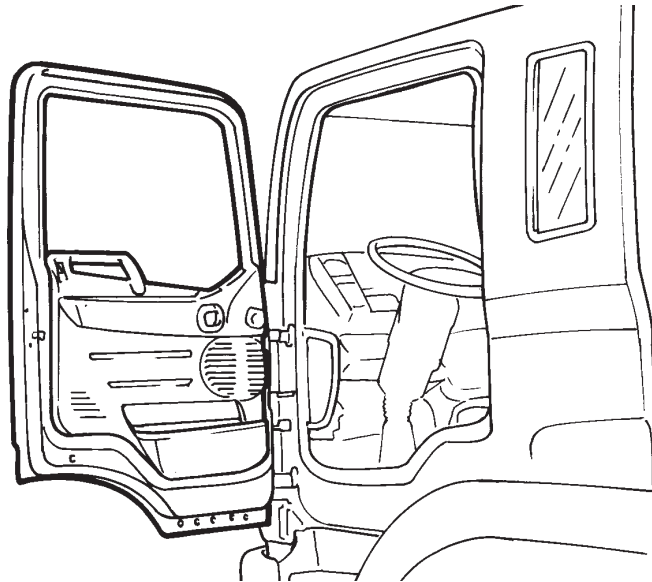
4. Remove the grab-handle.
5. Remove the side trim and front pillar trim.

INSTALLATION

Installation is the reverse of removal procedure.

DOOR

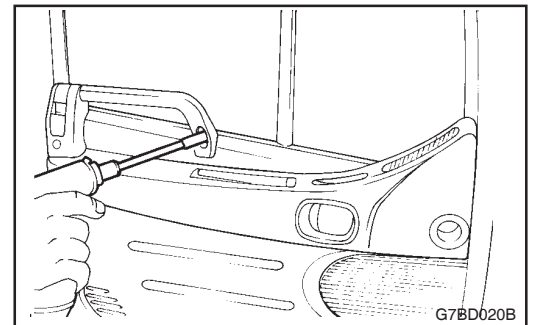
COMPONENTS



G7BD020A

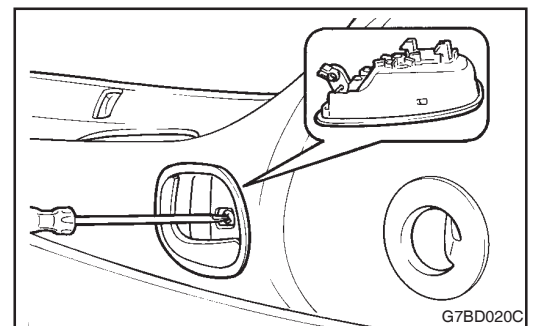
REMOVAL

1. Remove the door pull handle and power window switch.



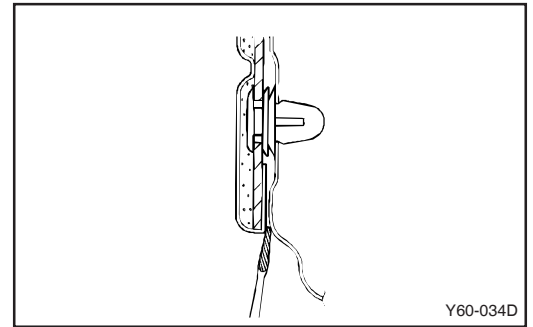
G7BD020B

2. Remove the door inside handle.

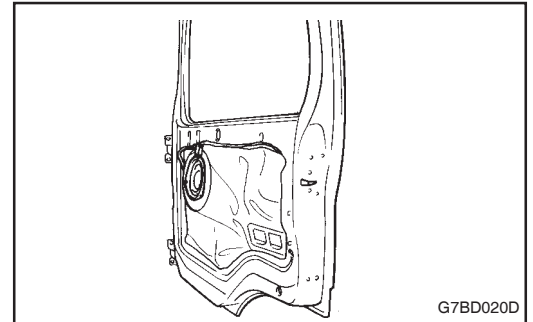


G7BD020C

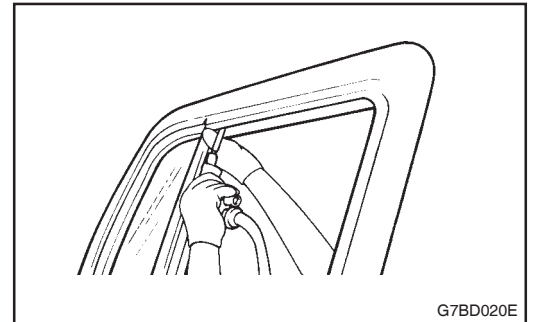
3. Remove the door trim panel.



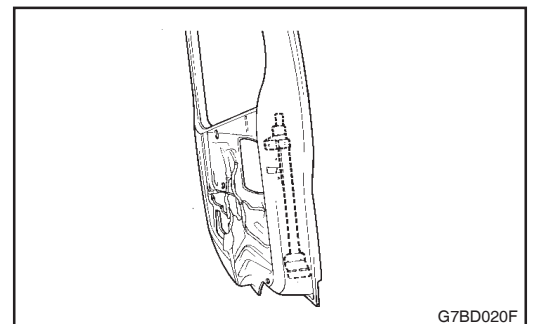
4. Remove speaker and door trim seal and weatherstrip.



5. Remove the door center sash (Upper : 2EA, Lower : 1EA).



6. Remove the window glass and lower sash.



7. Remove the fixed glass and glass regulator.

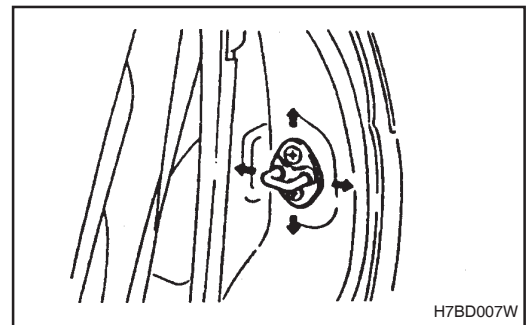


INSTALLATION

Installation is the reverse of removal procedure.

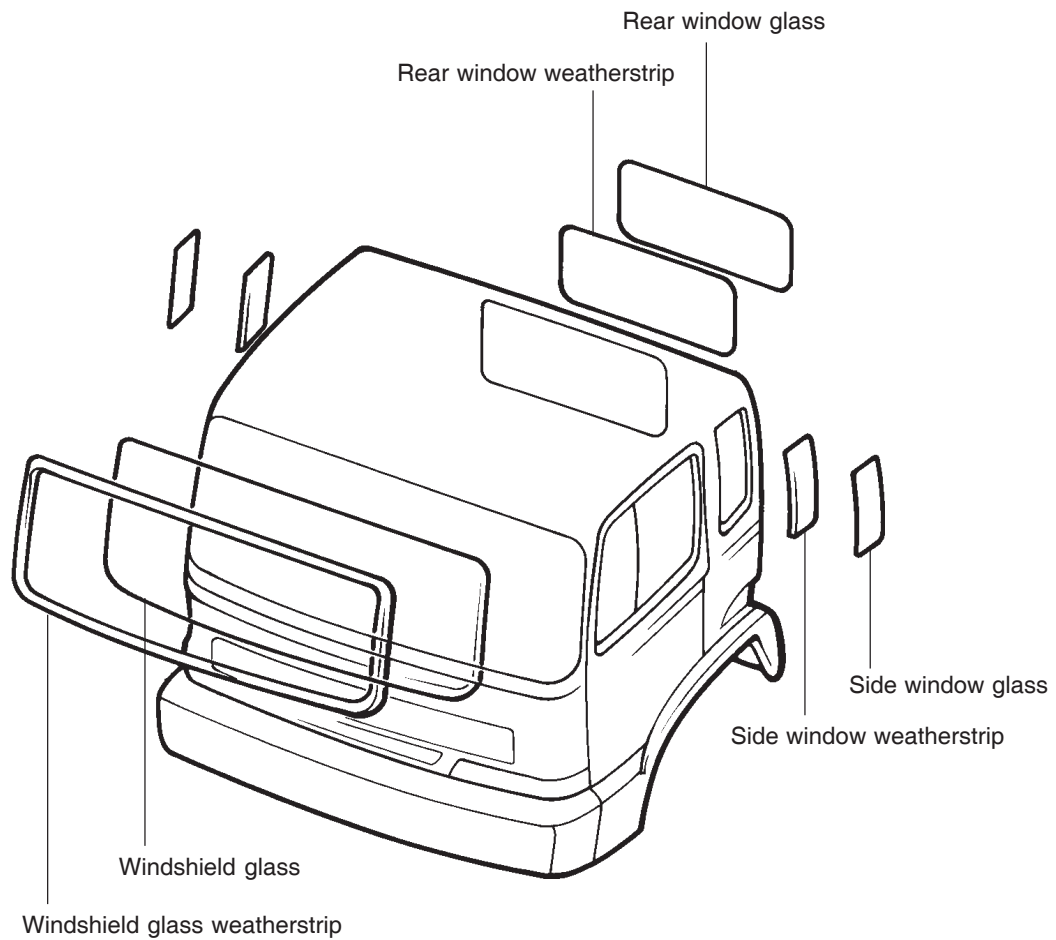
ADJUSTMENT

1. If the clearance between the door and the vehicle body is uneven, affix protective tape around the hinge and to the edge of the door. Loose the door hinge mounting bolts on the door and adjust the clearance around the door so that it becomes even.
2. If the striker and latch do not mesh properly, adjust the position of the striker.



WINDSHIELD GLASS AND WINDOWS

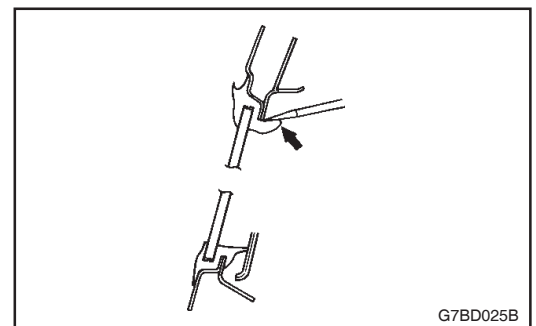
COMPONENTS



BGBD039

REMOVAL

1. Use screwdriver or the like to pry up the lip of weatherstrip and remove the windshield glass or rear window glass.



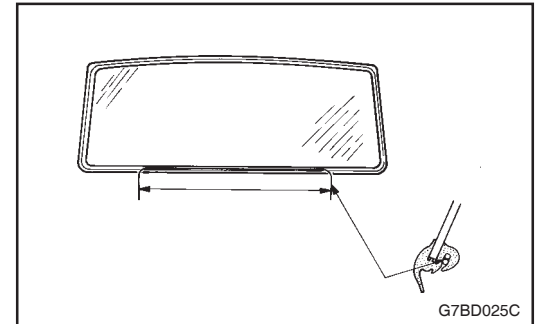
G7BD025B

INSTALLATION

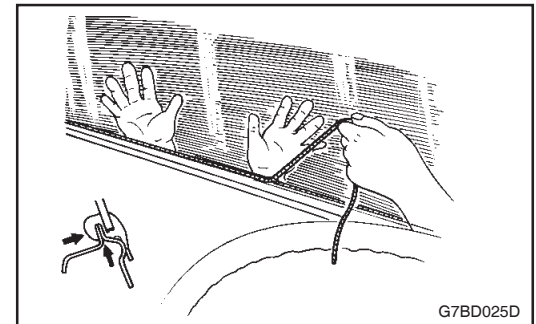
1. Set around strings in the weatherstrip groove.

NOTE

Make certain that the strings overlap each other at both ends.



2. Apply soap solution to the entire surface of the body flange.



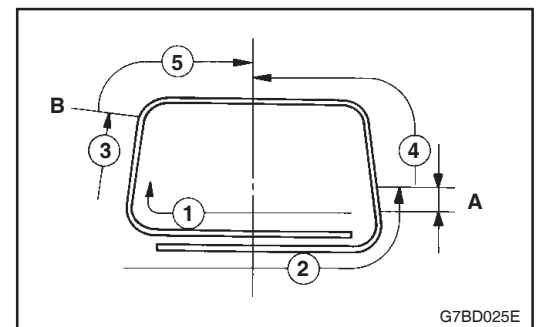
3. With the aid of an assistant to push the windshield from outside, slowly pull one end of the string at right angles to the windshield as the order of illustration and fit the weatherstrip correctly on the flange.

A : To the 100 mm of straight portion.

B : The end of straight portion.

NOTE

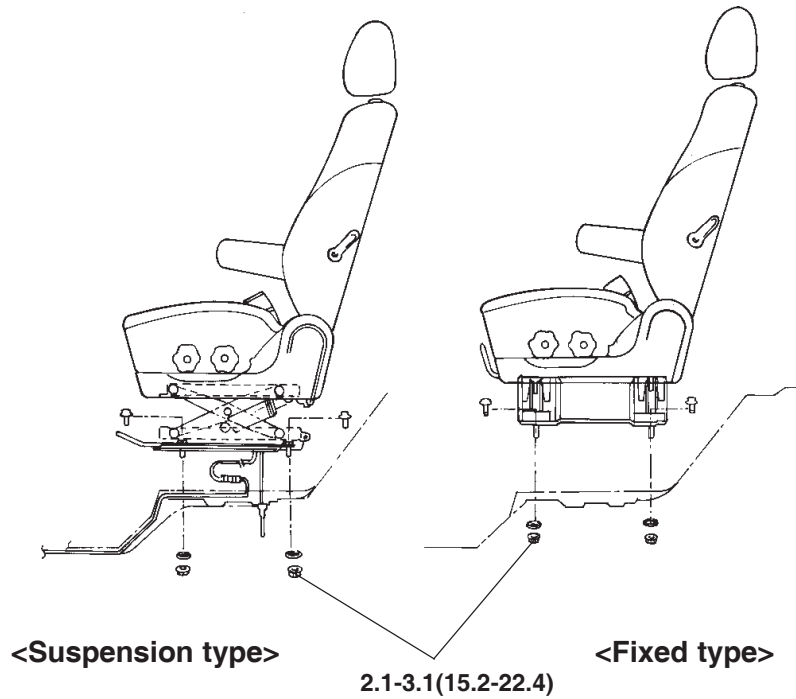
Pull the strings, working from both sides of the windshield toward the center and pushing from the outside of the glass.



SEAT AND SEAT BELT SEAT

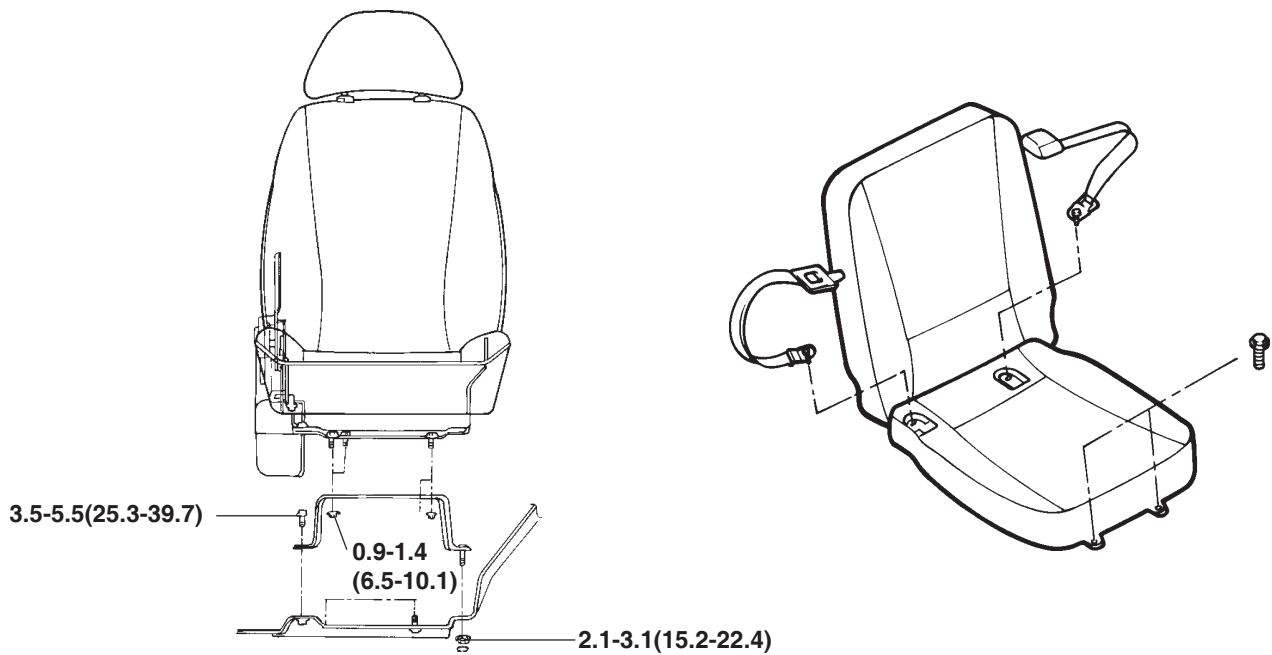
COMPONENTS

[LH SEAT]



[RH SEAT]

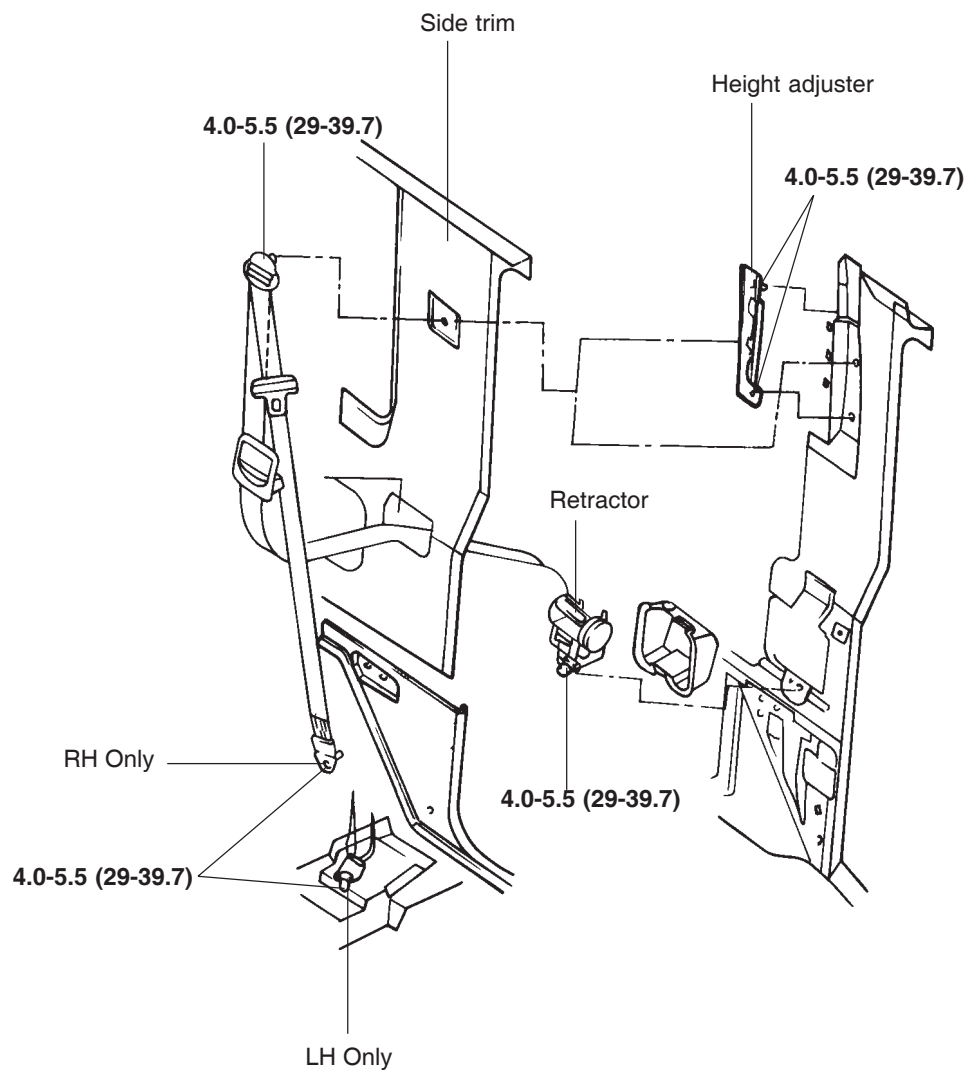
[CENTER SEAT]



TORQUE : kgf·m (ft·lb)

SEAT BELT

COMPONENTS



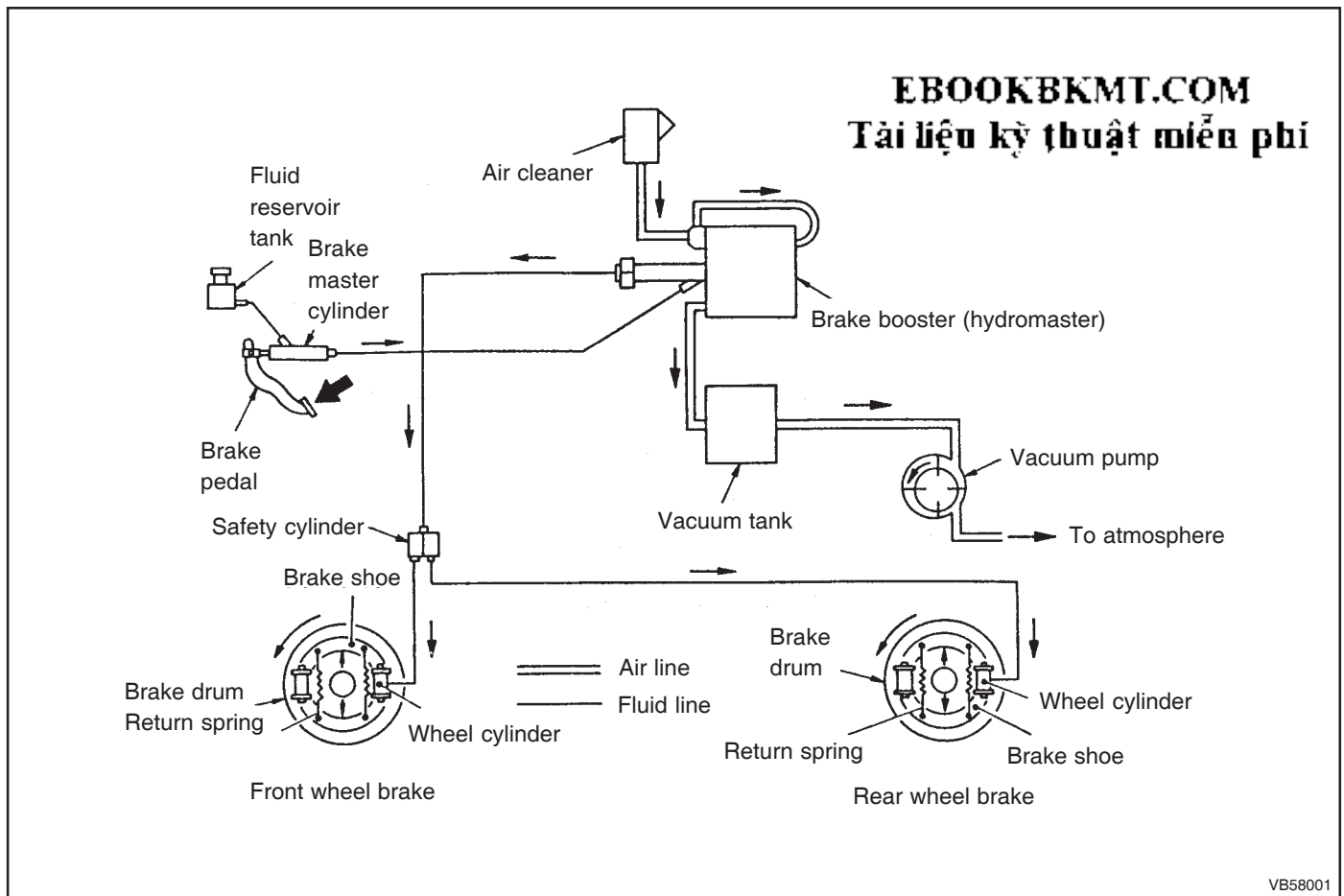
TORQUE : kgf·m (ft·lb)

BRAKE SYSTEM

GENERAL	BRa - 2
SPECIFICATIONS	BRa - 5
SERVICE STANDARDS	BRa - 6
SERVICE PROCEDURE	BRa - 9
TROUBLESHOOTING	BRa-56

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GENERAL SERVICE BRAKE

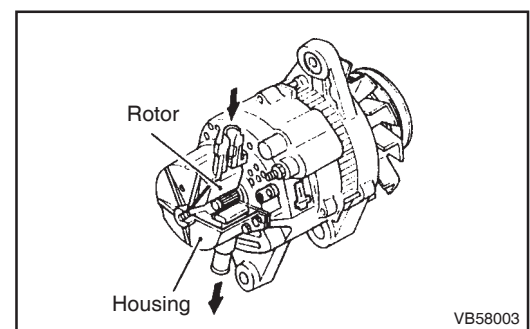


The service brakes are vacuum servo hydraulic brake consisting of devices such as brake master cylinder, brake booster (hydromaster) and wheel cylinders and are used to decelerate or stop the traveling vehicle.

When the pedal is depressed, the depression force is converted into a hydraulic pressure, which is then amplified by the brake booster (hydromaster) and acts on the wheel cylinders. The wheel cylinders press the brake shoes against the brake drums to produce a frictional force

Vacuum Pump

- 1) The vacuum pump which is installed on the back of the alternator has its rotor coupled with the alternator shaft so that it rotates with the alternator. Within its cylindrical housing, as the rotor rotates, its three movable vanes are made to move toward the housing inside surface by centrifugal force, thereby producing pumping action. The resultant vacuum pressure keeps the inside of the vacuum tank at vacuum.



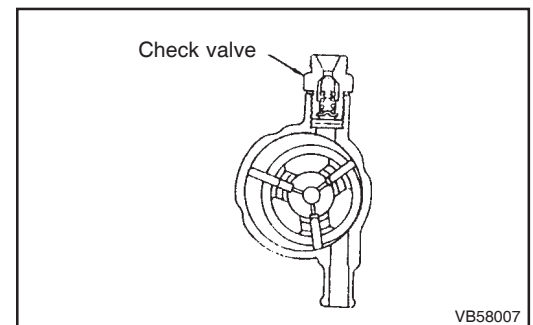
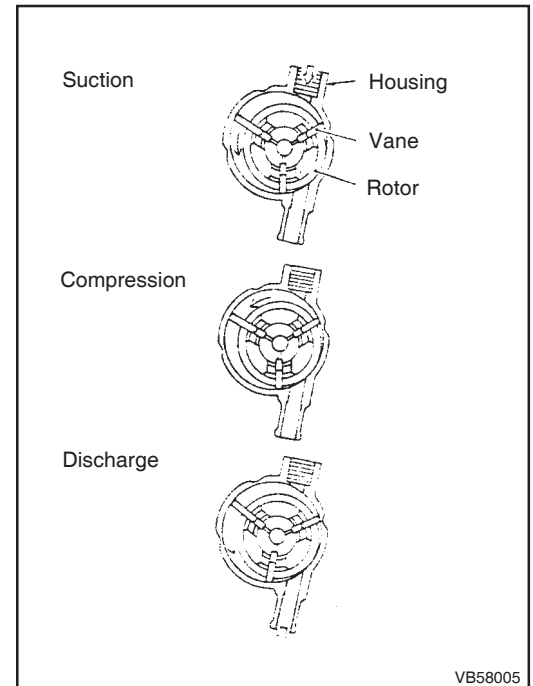
GENERAL

BRa-3

- 2) The rotor and housing cylinder are eccentrically arranged and air from the vacuum tank is taken through the inlet port into the pump and gradually compressed before it is discharged from the outlet port. Engine oil enters the pump through the oil port and keeps the housing oil tight and lubricates and cools the housing inside. The oil is then discharged from the outlet port with compressed air and returns to the oil pan.

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- 3) A check valve is provided at the inlet port to prevent air and engine oil from flowing back from the vacuum pump to the vacuum tank when the engine is stopped.



BRAKE BOOSTER (Hydromaster)

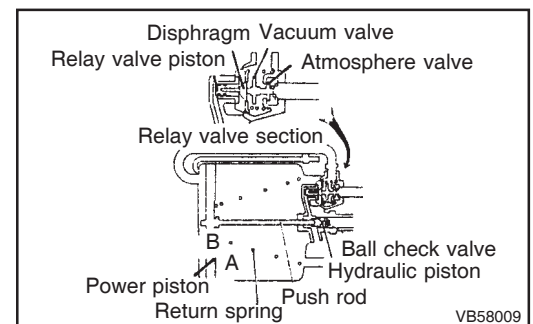
- 1) When brake booster is not operated

Since no fluid pressure acts on the relay valve piston, the vacuum valve is in opened position and the atmosphere valve is in closed position.

Since the diaphragm air hole is clear, both chambers A and B of the power cylinder are evacuated and the power piston pressed toward the chamber B by the return spring.

With the hydraulic piston also pulled an the ball check valve opened, the brake fluid passes through the center hole of the hydraulic piston and flows into the hydraulic cylinder.

When the brake booster is not in operation, therefore, the hydraulic piston serves only as a fluid path.

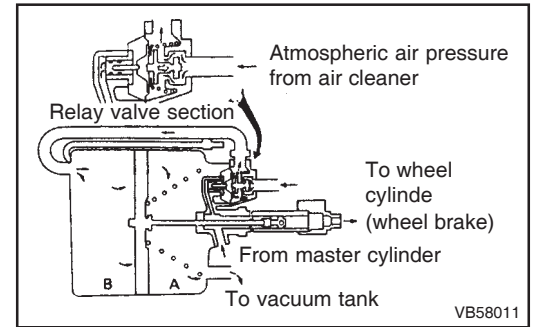


2) When brake booster is operated

When the pedal is depressed, the fluid pressure from the master cylinder acts on the relay valve piston and hydraulic piston. The diaphragm, pushed by the fluid pressure acting on the back surface of the relay valve piston, closes the vacuum valve. As soon as the vacuum valve is closed, the atmosphere valve is opened, so the atmospheric air from the air cleaner enters the power cylinder.

At the time, a pressure difference is produced between the chambers A and B. The force produced by the pressure difference overcomes the return spring and the power piston moves the push rod to push the hydraulic piston.

When the hydraulic piston operates, the ball check valve is closed and the brake fluid passage between the master cylinder and the hydraulic cylinder is closed, preventing backflow of the high pressure fluid generated in the hydraulic cylinder to the master cylinder and instead transmitting the hydraulic pressure to the wheel cylinder. The hydraulic pressure developing in the hydraulic cylinder is the sum of the thrust transmitted from the power piston to the hydraulic piston and the pressure acting directly on the hydraulic piston from the brake master cylinder.



SPECIFICATIONS

BRa-5

SPECIFICATIONS

Unit:mm

Item	Vehicle model	HD120
Brake type		Hydro-vacuum servo hydraulic brake acting on all wheels, internal expansion type
Front		2-leading type
Rear		Dual 2-leading type
Vacuum pump		
Type		Vane type
Delivery rate		120 cc
Brake booster (hydromaster)		
Power cylinder		
I.D. x stroke		241.3 x 163
Hydraulic cylinder		
I.D. x stroke		19.05 x 159
Relay valve piston		
O.D.		25.4
Safety cylinder		
I.D. x stroke		30 x 32
Vacuum tank		
Capacity		30lit.
Wheel brake		
Brake drum I.D. (limit)		320 (322)
Brake lining width x thickness (limit)		
Front		120 x 11.6 (5.0)
Rear		150 x 11.6 (5.0)
Brake shoe clearance		0.2 ~ 0.3
Wheel cylinder I.D.		
Front		36.51°
Rear		38.1

SERVICE STANDARDS**SERVICE STANDARDS TABLE****Service brakes**

Maintenance item			Nominal (Basic diameter in [])	Limit	Remedy and remarks
Brake pedal	Free travel of brake pedal		3.5 to 9.2		Adjust by push rod of brake master cylinder
	Pedal shaft to bushing clearance		[20] 0.06 to 0.24	0.4	Replace bushing
	Return spring	Load/installed length	45 N (4.6 kgf)/124.2	38 N (3.9 kgf)/124.2	Replace
Brake master cylinder	Cylinder to piston clearance		[38.1] 0.05 to 0.14	0.2	Replace piston
	Return spring	Free lenngth	125	100	Replace
Brake booster (hydro-master)	Valve seat spring	Load N (kgf)/ installed length	54 to 64 (5.5 to 6.5)/30.2	49 (5.0)/30.2	Replace
	Piston return spring		160 to 195 (16.2 to 19.8)/181	140 (14.5)/181	
	Valve fitting to relay valve piston clearance		[25.4] 0.04 to 0.11	0.13	Replace piston
	Hydraulic piston to cylinder clearance		[19.5]0.05 to 0.13	0.15	Replace piston
	Valve body guide wear depth		-	0.5	Replace
	Bend of push rod		0.13 or less	0.3	Replace
	Fluid tightness	Apply 11.8 MPa (120 kgf/cm²) fluid pressure to hydraulic cylinder and measure amount fluid pressure falls in 15 seconds	1.47MPa (15kgf/cm²) or less		Check and replace related parts
	Air tightness when not operating	Set vacuum pressure in brake booster to 67 kPa (500 mmHg), close cock, and measure amount vacuum pressure falls in 15 seconds	3.3kPa (25mmHg) or less		
	Operation starting pressure	Set vacuum pressure in brake booster to 67 kPa (500mmHg). Slowly apply presure from master cylinder and read pressure indicated by master cylinder pressure gauge when pointer of vacuum gauge deflects	125 to 225 kPa (1.3 to 2.3 kgf/cm²)	105 to 245 kPa (1.1 to 2.5 kgf/cm²)	

SERVICE STANDARDS

BRa-7

Maintenance item			Nominal (Basic diameter in [])	Limit	Remedy and remarks	
Brake booster (hydro-master)	Operation at full load	Set vacuum pressure in brake booster to 67 kPa (500mmHg). Slowly depress pedal of master cylinder and read pressure indicated by hydraulic cylinder pressure gauge for master cylinder pressure gauge	1.57 kPa (16 kgf/cm²)/ 10.1 to 11.1 kPa (103 to 113kgf/cm²)	1.57 kPa (16 kgf/cm²)/ 9.81 to 11.4 kPa (100 to 116 kgf/cm²)		
	Air tightness at full load	Block vacuum supply at full load and read amount vacuum pressure falls in 15 seconds thereafter	3.3 kpa (25mmHg) or less			
	Residual pressure	Set master cylinder pressure to 490 kPa (5 kgf/cm²), loosen air bleeder screw at end of hydraulic cylinder to release master cylinder pressure, and read pressure indicated by wheel cylinder pressure gauge	78 to 125 kPa (0.8 to 1.3 kgf/cm²)	59 to 155 kPa (0.6 to 1.6 kgf/cm²)	Check and replace related parts	
Safety cylinder	Return spring	Load/installed length	18 to 2 N (1.81 to 2.21 kgf)/48	15 N (1.5 kgf)/48	Replace	
	Cylinder to piston clearance		[30] 0.06 to 0.12	0.17	Replace piston	
Brake drum	Inside diameter	Vehicle with 320 drum	320	322 *321	Replace Mark * shows standard inside diameter when oversize lining is used	
	Cylindricity		0.05	0.2	Correct	
Brake shoe return spring	Front	Load/installed length	325 N (33 kgf)/192	If gaps between coils or between coil and cover are evident	Free length 180.5	Re-place
			380 N (39 kgf)/228.4		Free length 215.2	
	Rear	Load/installed length	390 N (40 kgf)/217	If gaps between coils or between coil and cover are evident	Replace	
			380 N (39 kgf)/228.4			
			420 N (43 kgf)/266.5			
Brake shoe	Brake lining thickness		12.0	5	Replace linings Side shoulder means wear limit	

BRa-8
BRAKE SYSTEM

Maintenance item			Nominal (Basic diameter in [])	Limit	Remedy and remarks	
Wheel cylinder	Piston to body clearance	Front	[34.93] 0.03 to 0.09	0.2	Replace	
		Rear	[36.51] 0.03 to 0.09			
	Piston to body clearance	Load/installed length	15 N (1.5 kgf)/14.2	12 N (1.2 kgf)/14.2	Free length 47.5	Re- place
Brake shoe clearance			0.2	1.0	Adjust	

TIGHTENING TORQUE TABLE
Service brakes

Location tightened			Screw size O.D. x pitch(mm)	Tightening torque Nm (kgfm)	
Brake pedal	Brake pedal shaft bolt and nut		M12 x 1.25	48 (4.9)	
	Brake pedal to master cylinder attaching bolt and nut		M12 x 1.25	72 (7.3) 60 (6.1)	
	Brake master cylinder bolt		M12 x 1.25	48 (4.9)	
	Brake master cylinder push rod adjusting nut		M12 x 1.25	25 to 34 (2.5 to 3.5)	
Brake master cylinder nipple			M12 x 1.5	44 to 64 (4.5 to 6.5)	
Brake booster (hydromaster)	Valve fitting		M36 x 1.5	3.9 to 9.8 (0.4 to 1)	
	Hook bolt and nut		M10 x 1.25	1 to 2 (0.1 to 0.2)	
	Valve body screw		M4 x 10.7	145 to 245 (15 to 25)	
	Cylinder cap		M33 x 1.5	59 to 98 (6 to 10)	
	Cylinder lock nut		M33 x 1.5	39 to 54 (4 to 5.5)	
	Power piston nut		M14 x 1.5	15 to 39 (1.5 to 4)	
	Elbow assembly		PT 1/2	15 to 39 (1.5 to 4)	
	Hose connector		PT 1/2	0.3 to 0.8 (0.03 to 0.08)	
	Poppet valve assembly nut		M3.5 x 0.6	6.9 to 8.8 (0.7 to 0.9)	
	Air bleeder screw		M10 x 1.25	235 to 265 (24 to 27)	
Safety cylinder	Cylinder cap		-	78 to 98 (8 to 10)	
	Check bolt and nut		M20 x 1.5	35 to 53 (3.6 to 5.4)	
Wheel brake	Wheel cylinder bolt	Front	M10 x 1.5	63 to 94 (6.4 to 9.6)	
			M12 x 1.75	63 to 94 (6.4 to 9.6)	
		Rear	M12 x 1.75	63 to 94 (6.4 to 9.6)	
	Pipe assembly tightening		M10 x 1.0	12 to 16 (1.2 to 1.6)	
	Pipe connector bolt	Front	M8 x 1.25	7.8 to 12 (0.8 to 1.2)	
	Pipe clamp bolt		Vehicle with 320 drum	M6 x 1.0	3.9 to 5.9 (0.4 to 0.6)
	Bleeder screw		M10 x 1.0	7.8 to 12 (0.8 to 1.2)	

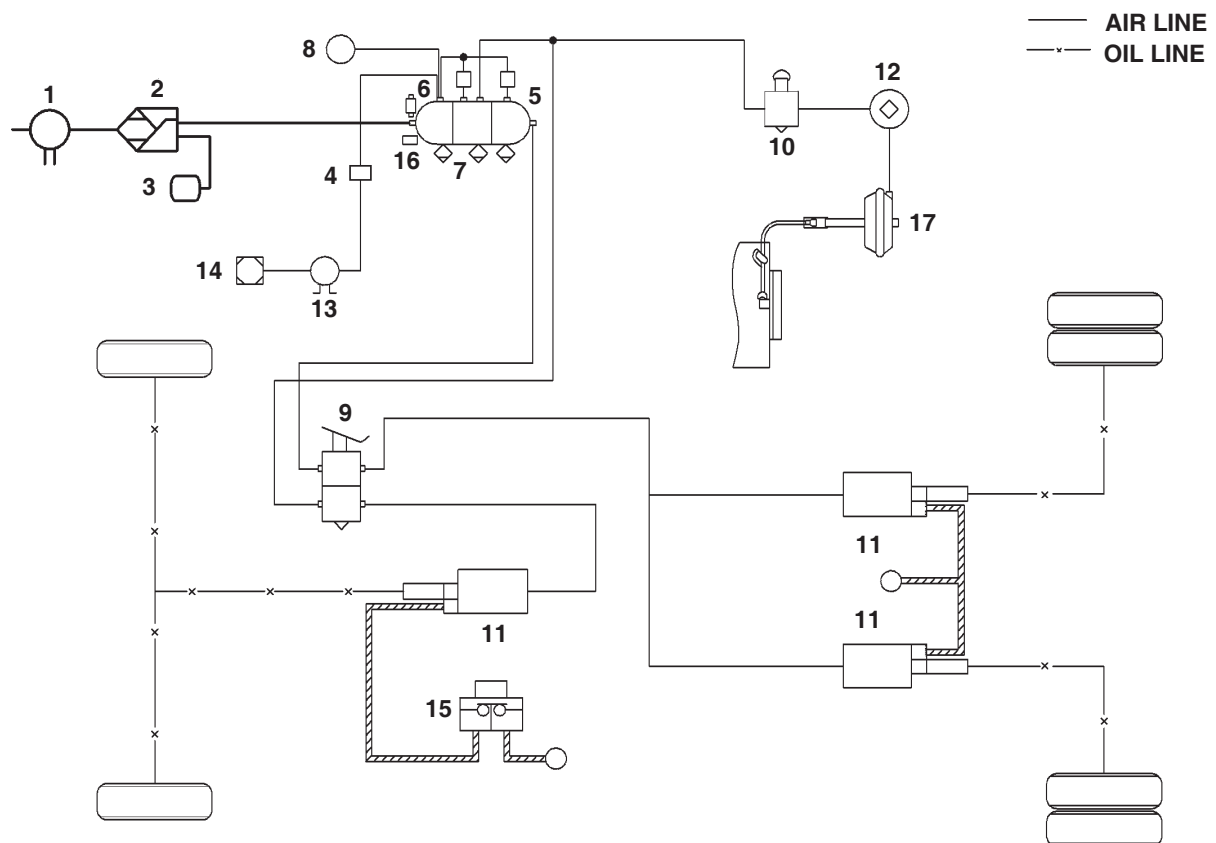
SERVICE PROCEDURE

BRa-9

Location tightened			Screw size O.D. x pitch (mm)	Tightening torque Nm (kgfm)
Wheel brake	Wheel cylinder	Stop perspring screw	M6 x 1.0	5.9 to 9.8 (0.6 to 1)
	Brake pipe tightening	4.76	M10 x 1.0	12 to 16 (1.2 to 1.6)
		6.35	M12 x 1.0	19 to 25 (1.9 to 2.6)

SERVICE PROCEDURE

BRAKE SYSTEM DIAGRAM



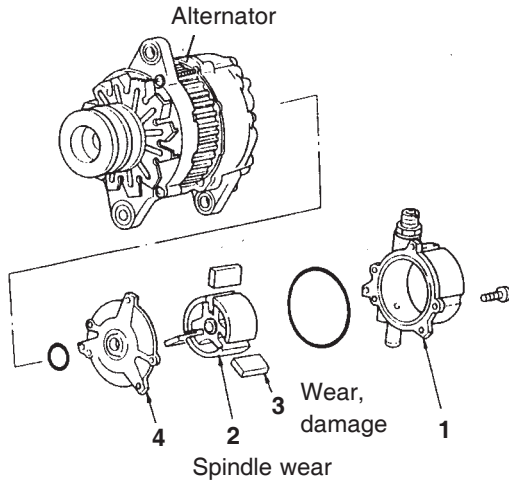
1. Air compressor
2. Air drier
3. Fuzzy tank
4. Protection valve
5. Air reservoir
6. Safety valve

7. Drain valve
8. Air gauge
9. Dual brake valve
10. Parking brake valve
11. Air master
12. Quick release valve

13. Magnetic valve
14. Exhaust brake valve
15. Oil reservoir
16. Low air pressure switch
17. Remote chamber

VACUUM PUMP

Disassembly, inspection and reassembly



1. Vacuum housing
2. Rotor
3. Vane
4. Plate

Reverse the disassembly procedure to assemble.

NOTE

When reassembling, check the parts for metal dust and other foreign matter.

VB58015

Testing

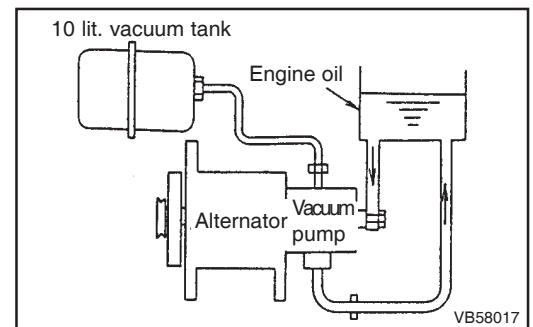
- a) Set up as illustrated and turning the alternator pulley, measure performance of the vacuum pump. If the measured value is less than the nominal value, disassemble and check for vane damage, housing, rotor and plate contact surface damage. Replace if any defect is found.

Ultimate vacuum

Nominal value	Vacuum	91 kPa (680 mmHg) or more
	Speed	3000 rpm

Evacuation characteristic after 20 seconds (with 10 lit. tank load)

Nominal value	At low speed	Vacuum	73 kPa (550 mmHg) or more
		Speed	1500 rpm
	At low speed	Vacuum	80 kPa (600 mmHg) or more
		Speed	3000 rpm



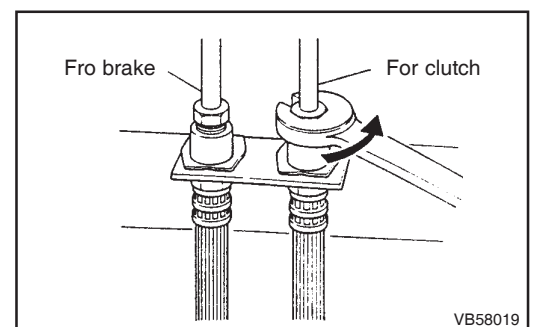
BRAKE FLUID TANK

Inspection of reed switch function

- 1) Draining of brake fluid
 - a) Remove the radiator grille from the front of the cab and remove the brake fluid pipes for brake and clutch.

NOTE

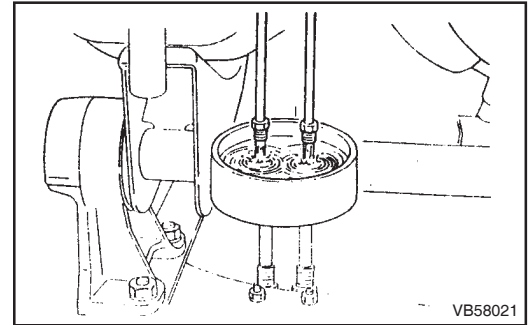
Brake fluid will mar the paint. Wipe out quickly if spilled.



SERVICE PROCEDURE

BRa-11

- b) With one end of the removed pipes placed in a container, depress the brake pedal repeatedly until the fluid level in the brake fluid tank falls to "L" level line.

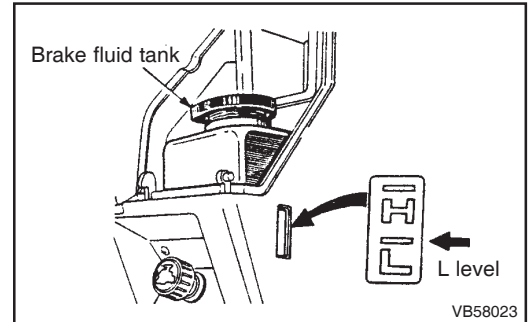


2) Inspection

Check that the warning lamp in the meter cluster lights up when the brake fluid level falls to the "L" level. If not, replace the brake fluid tank assembly.

NOTE

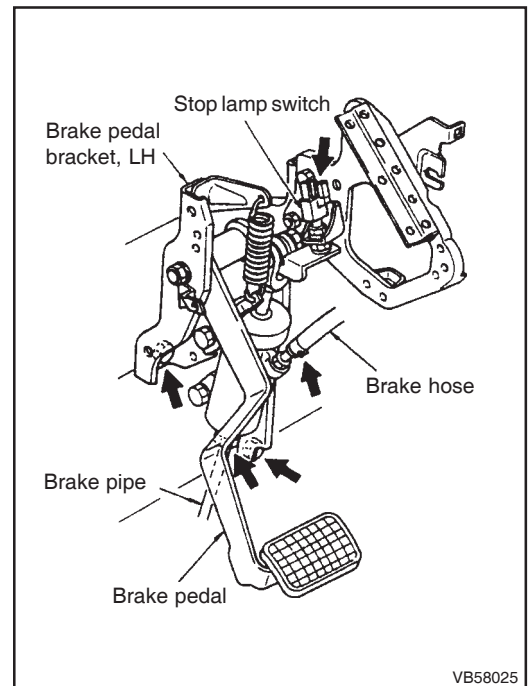
Check with the engine running.



BRAKE PEDAL

Removal

- 1) Depress the brake pedal and clutch pedal repeatedly to drain brake fluid from the brake fluid tank.
- 2) Remove the meter hood, meter cluster, instrument corner, panel and instrument control panel side cover.

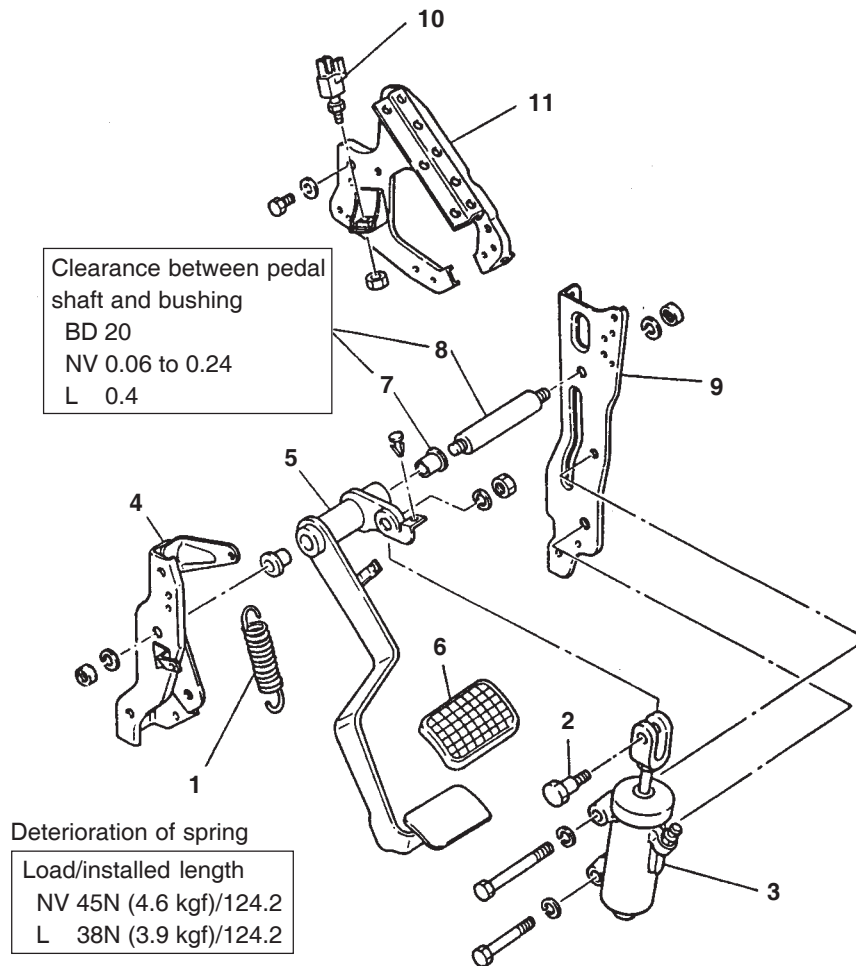


Disassembly, inspection and correction

BD ... Basic Diameter

NV ... Nominal Value

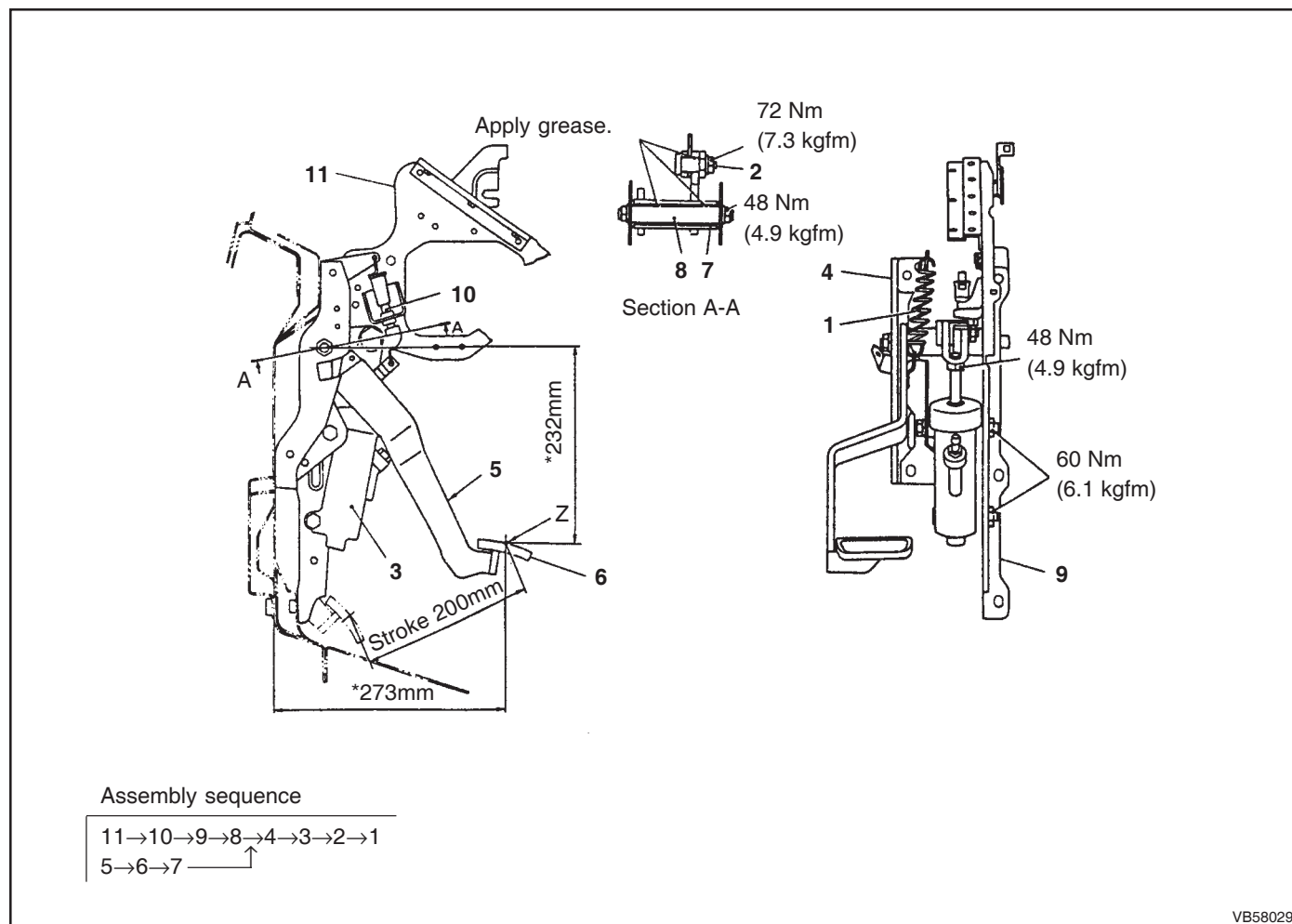
L ... Limit



Disassembly sequence

1. Return spring
2. Bolt
3. Brake master cylinder
4. Brake pedal
5. Brake pedal
6. Pedal pad
7. Bushing
8. Pedal shaft
9. Brake pedal bracket, RH
10. Stop lamp switch
11. Meter cluster bracket

Reassembly and adjustment



VB58029

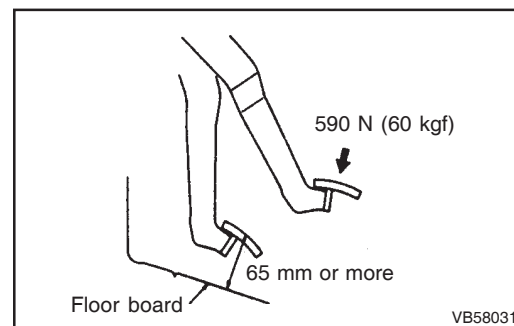
- 1) Rotate the stop lamp switch to adjust the brake pedal pad center position (point Z) to the dimension marked *, and then secure it with the lock nut.

At this point, check to ensure that the stop lamp switch is in the OFF state.

- 2) Check to ensure that when the brake pedal is depressed all the way, the full stroke is 200mm.
- 3) Rotate the brake master cylinder push rod to adjust the free travel of the brake pedal pad center position (point Z) to 3 to 9mm, and tighten the lock nut to the specified torque.
- 4) After adjustments, remove the air from inside the brake system and clutch system (refer to Group 41 clutch). After bleeding, depress the brake pedal several times to check for air leaks from the brake pipe and brake hose connections.

- 5) Clearance between brake pedal and floor board

Start the engine and depress the brake pedal by 590N (60kgf) to check that the clearance between the brake pedal and floor board is 65mm or more.



VB58031

BRAKE MASTER CYLINDER

Disassembly and Inspection

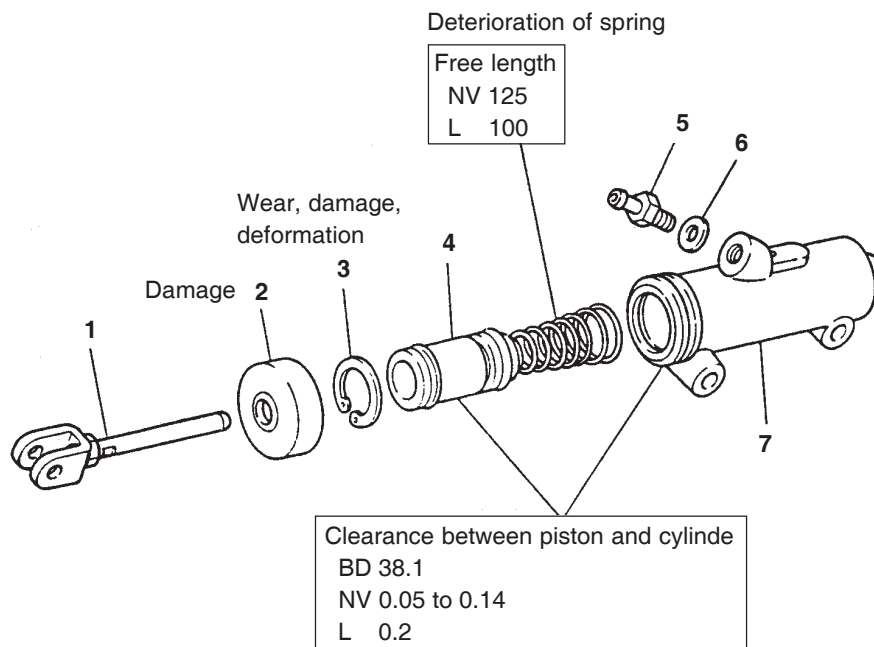
BD ... Basic Diameter

NV ... Nominal Value

L ... Limit

Disassembly sequence

1. Push rod complete
2. Boot
3. C-ring
4. Piston complete
5. Nipple
6. Gasket
7. Cylinder

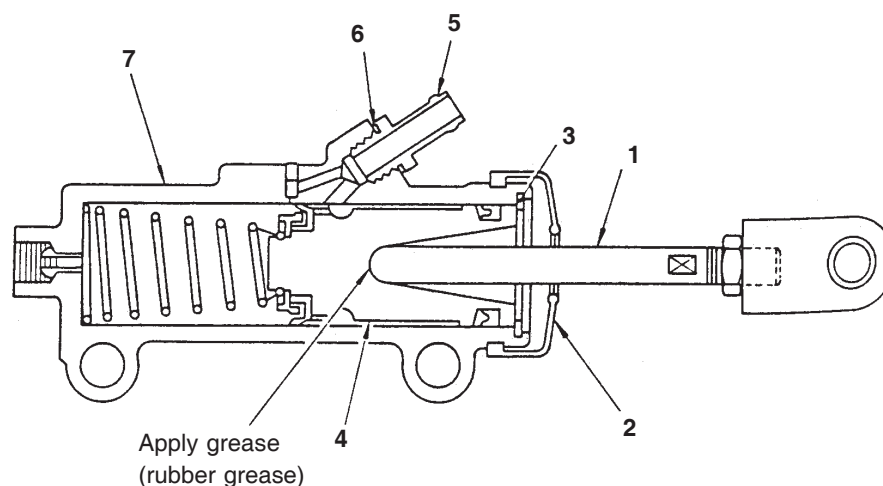


VB58033

Reassembly

Repair kit:
Brake master cylinder kit.

25 to 34 Nm
(2.5 to 3.5 kgfm)



Assembly sequence

7→6→5→4→3→2→1

NOTE

Apply an ample amount of assembling oil (NA-166M or equivalent) to cylinder bore and the entire periphery of secondary cup of piston complete.

VB58035

Removal and installation

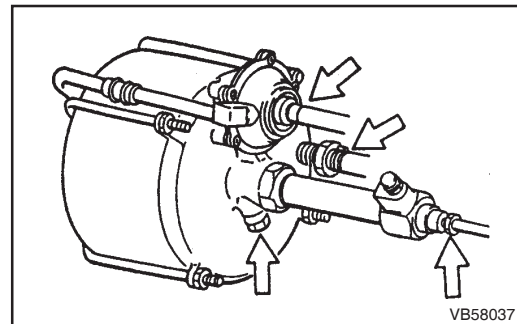
NOTE

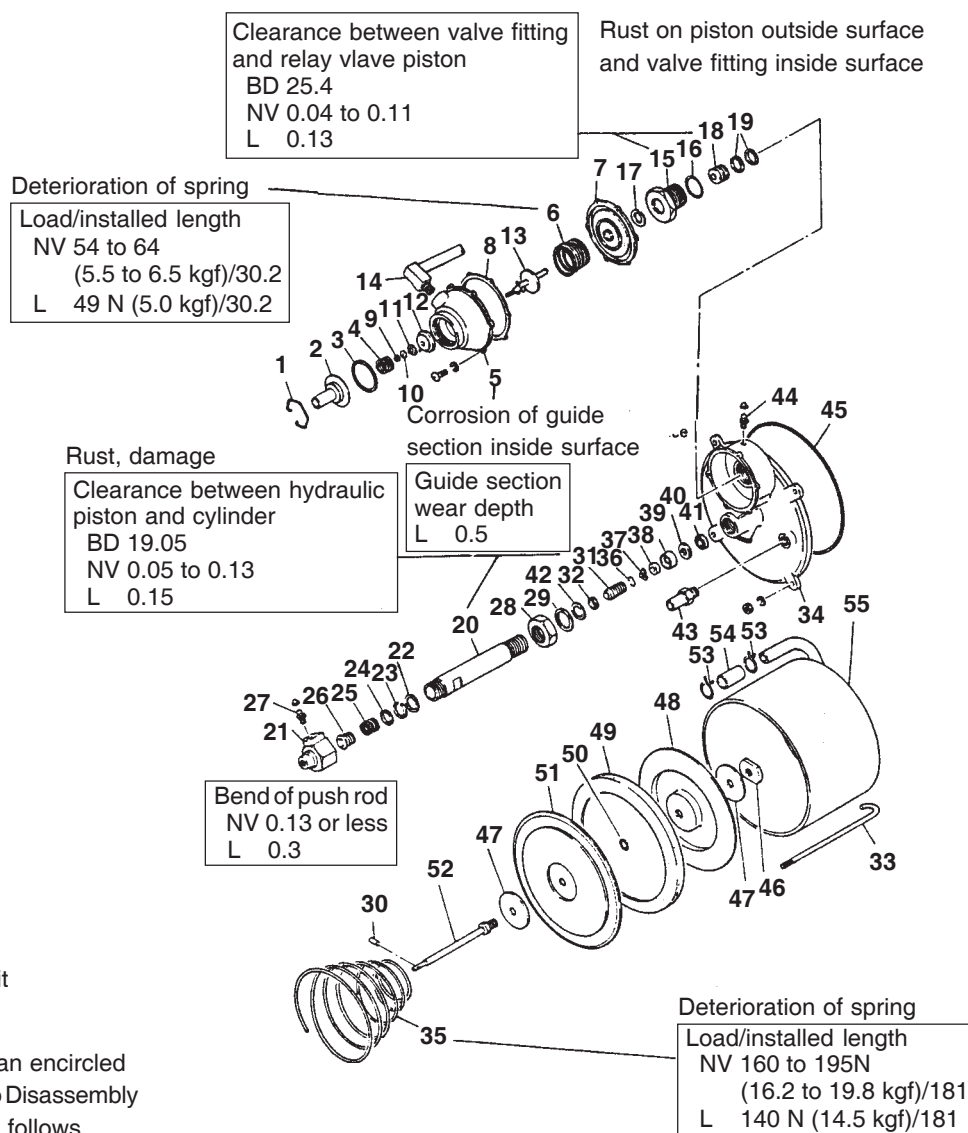
When the oil pipe is removed, use care to make sure that brake fluid is not split on the frame or bracket.

Disassembly, inspection and correction

NOTE

1. Before disassembly, remove dirt and dust from the surface and use care not to allow foreign matter, dust, dirt or water to enter.
 2. Put alignment marks before disassembly.
 3. Never immerse rubber parts in cleaning solvent.
- 1) For inspection and correction, disassemble the brake booster into the relay valve piston section, the hydraulic cylinder section, the power cylinder section and the end plate section.
 - 2) Wipe or wash to clean to disassembled parts as described below.
 - a) Rubber parts or parts containing rubber parts
Wipe with cloth wetted by brake fluid or alcohol.
 - b) Metallic parts
Clean with cleaning fluid (trichlene or metal cleanser), dry with compressed air and completely remove cleaning fluid.





Disassembly sequence

- | | | | |
|----------------------------|---------------------------|-------------------------------|-----------------------------|
| 1. Retaining ring | 15. Valve fitting | 29. Gasket | 43. Hose connector |
| 2. Pipe and cover assembly | 16. O-ring | 30. Straight pin | 44. Plug |
| 3. Gasket | 17. Retaining ring | 31. Hydraulic piston assembly | 45. O-ring |
| 4. Spring | 18. Relay valve piston | 32. Cup packing | 46. Push rod nut |
| 5. Valve body | 19. Cup packing | 33. Hook bolt | 47. Washer |
| 6. Valve seat spring | 20. Cylinder | 34. End plate assembly | 48. Piston plate |
| 7. Diaphragm assembly | 21. Cap | 35. Return spring | 49. Rubber packing |
| 8. Gasket | 22. Gasket | 36. Retaining ring | 50. Gasket |
| 9. Nut | 23. Retaining ring | 37. Washer | 51. Piston plate |
| 10. Gasket | 24. Washer | 38. Retainer | 52. Push rod assembly |
| 11. Poppet | 25. Spring | 39. Cup packing | 53. Clamp |
| 12. Air valve | 26. Outlet valve assembly | 40. Washer | 54. Hose |
| 13. Vacuum valve assembly | 27. Plug | 41. Oil seal | 55. Cylinder shell assembly |
| 14. Elbow assembly | 28. Lock nut | 42. Gasket | |

SERVICE PROCEDURE

BRa-17

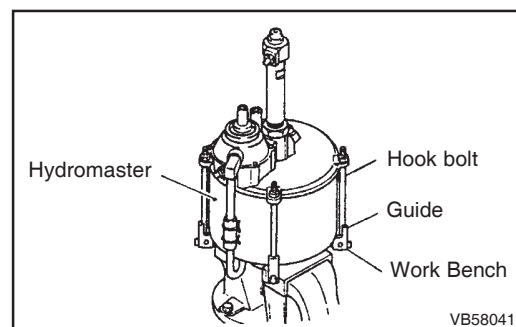
NOTE

1. Before disassembly, remove dirt thoroughly from the outside of the hydromaster.
2. Before disassembly, put matching marks on mating sections.
3. Wipe or wash clean the disassembled parts as described below.
 - a) Rubber parts and components with rubber parts.
Wipe the parts using cloth wetted with brake fluid or alcohol.
 - b) Metal parts
Wash in cleaning agent (trichlene or metachlene) and remove cleaning agent completely using the compressed air and dry.
4. Check rubber parts visually for damage, wear, swelling, etc. and replace them if any defect is found.

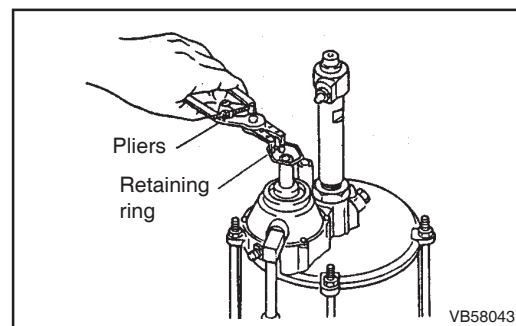
Disassembly Procedure

1) Fixing of brake booster

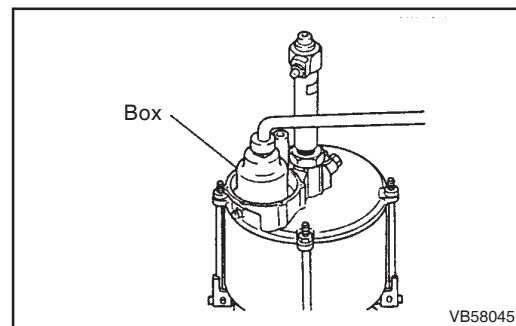
Hold the special tool, Work Bench, in a vice and install four hook bolts of the brake booster, aligning with the guide position of the work bench.



2) Remove and installation of relay valve section retaining ring



3) Removal and installation of relay valve section valve fitting

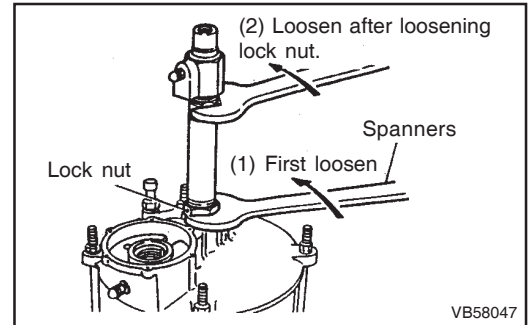


BRa-18

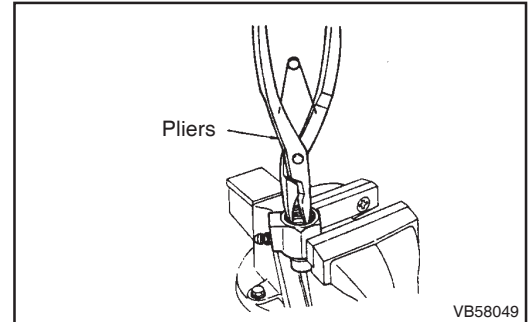
BRAKE SYSTEM

4) Removal of hydraulic cylinder

Loosen the lock nut and then loosen the cylinder by holding it with the special tool, Spanner, on flats.



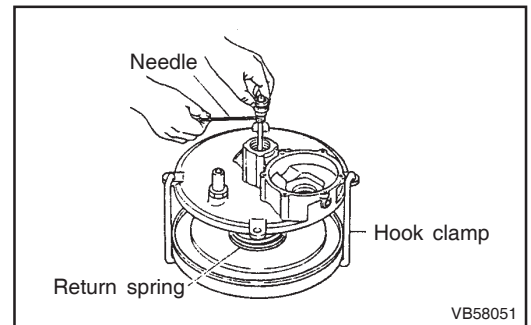
5) Removal of retaining ring from outlet valve



6) Removal of hydraulic piston

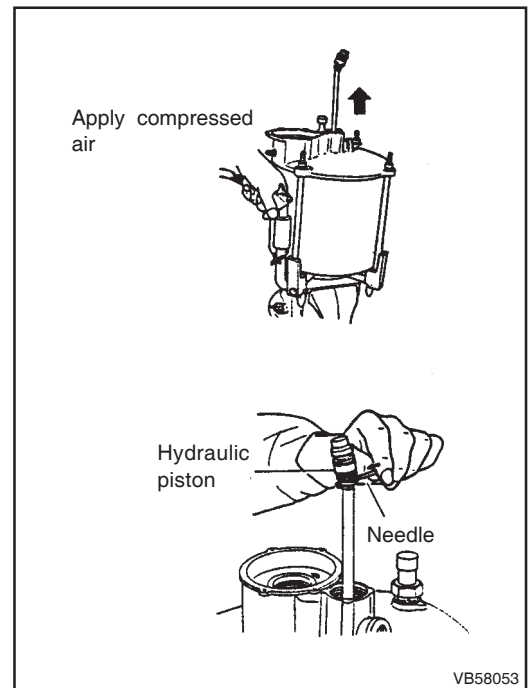
a) When compressed air is not used

With the return spring compressed using the special tool, Hook Clamp. Remove the straight pin from the hydraulic piston using a needle or the like.



b) When compressed air is used

With compressed air supplied through the cylinder shell pipe to push to the hydraulic piston, remove the straight pin from the hydraulic piston using a needle or the like.

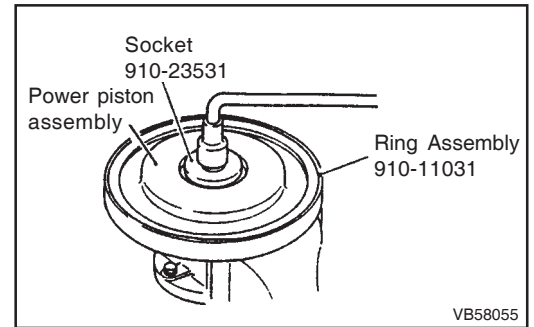


SERVICE PROCEDURE

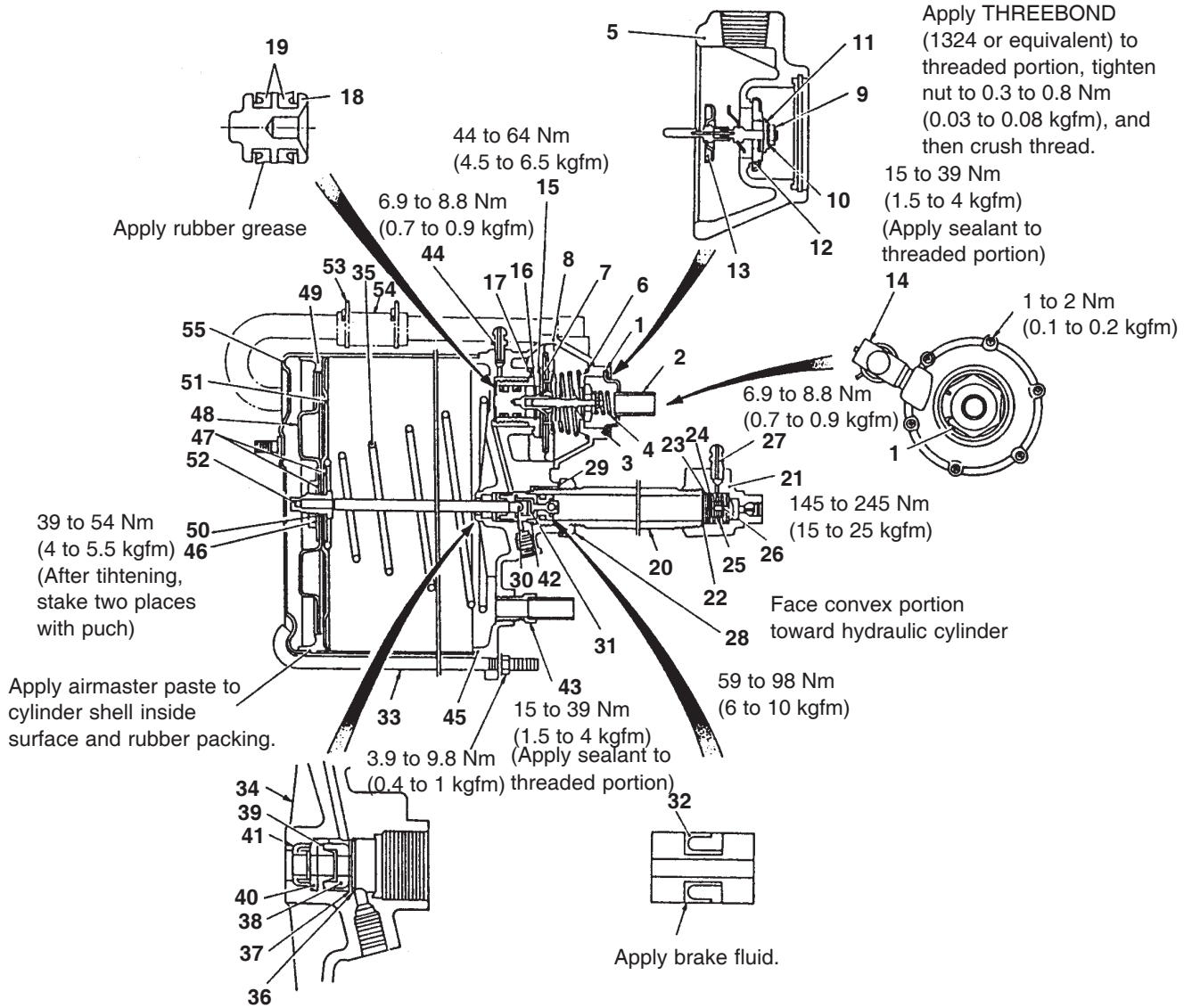
BRa-19

7) Remove of push rod nut from power piston

With the special tool, Ring Assembly, held in a vice, install the power piston, aligning its push rod nut with the flat portion of the ring assembly. Then align the push rod nut with the flat portion of the special tool. Socket, and remove the push rod nut.



Reassembly



Assembly sequence

⑤ → ⑬ → ⑫ → ⑪ → ⑩ → ⑨
 18 → 19 → 15 → 17 → 16
 21 → 27 → ②⑥ → ②⑤ → ②④ → ②③ → 22 → ②⑩ → 28 → 29
 ③① → ③②
 34 → 44 → ④① → 40 → 39 → 37 → 36 → 42 → 43 → 45
 52 → 47 → 51 → 50 → 49 → 48 → 47 → ④⑥
 55 → 33 → 35 → ③⑤ → ⑦ → ⑧ → ⑥ → 14 → 54 → 53 → 3 → 4 → 2 → 1

For parts with an encircled number, refer to Reassembly Procedure that follows.

SERVICE PROCEDURE

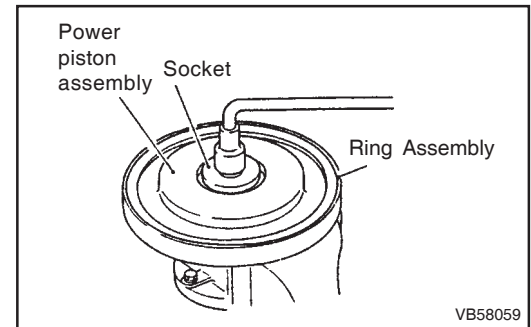
BRa-21

Reassembly Procedure

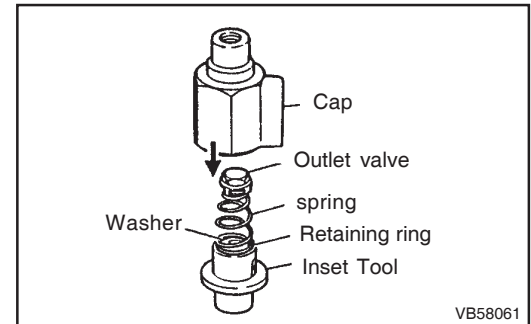
1) Installation of power piston section push rod nut

With the special tool, Ring Assembly, held in a vice, install the power piston, aligning its push rod nut with the flat portion of the ring assembly.

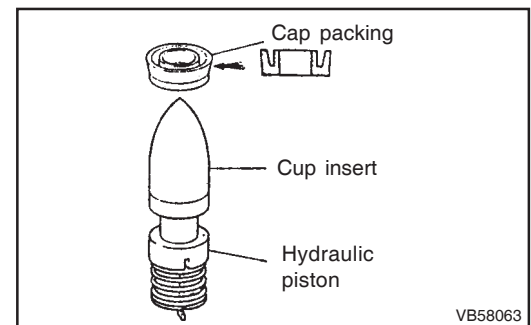
Install the washer, piston plate, rubber packing, piston plate and washer over the push rod and tighten the push rod nut to specified torque using the special tool, Socket.



2) Installation of outlet valve retaining ring



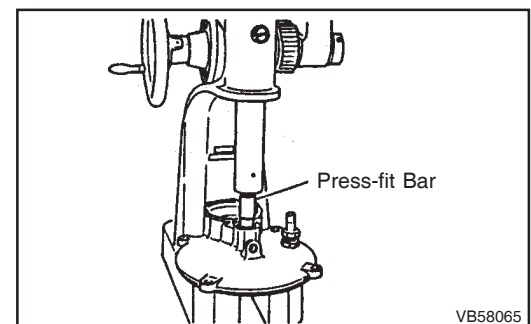
3) Insertion of cup packing into hydraulic piston



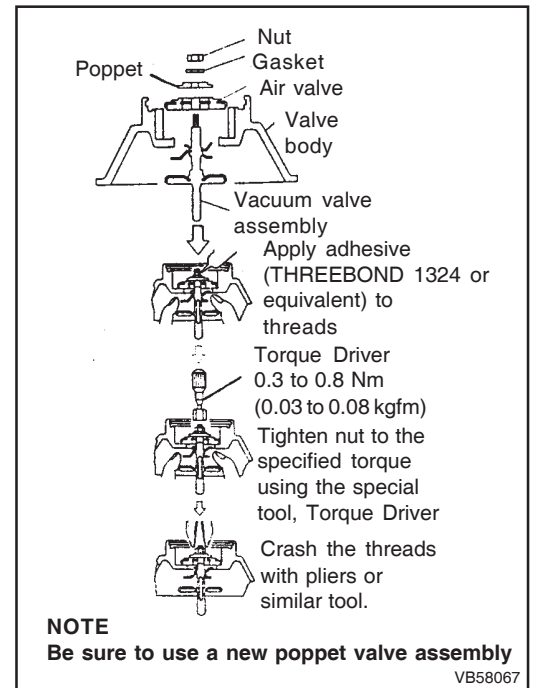
4) Installation of end plate oil seal

NOTE

When installing, face the oil seal lip toward the hydraulic cylinder.



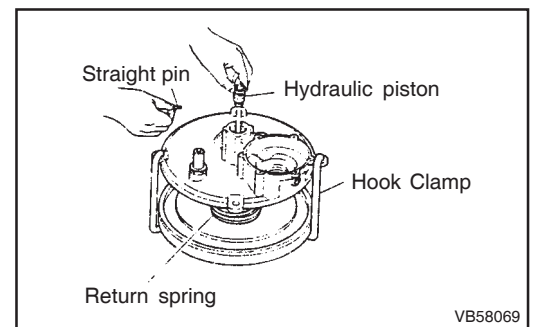
5) Installation of poppet valve to relay valve section



6) Installation of hydraulic piston

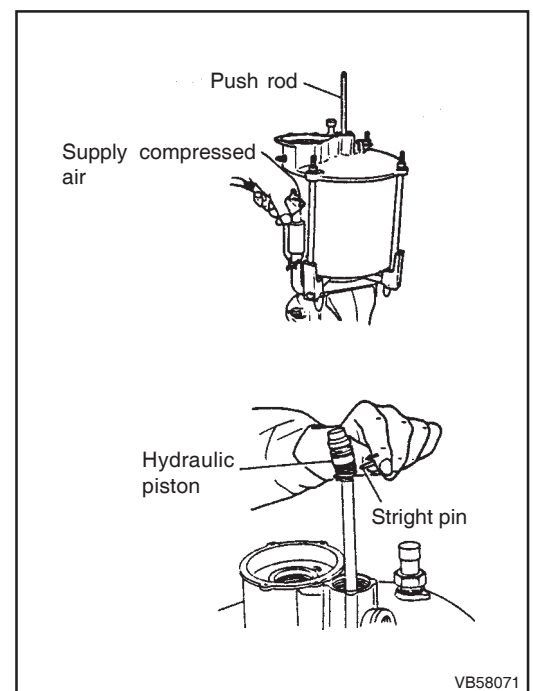
a) When compressed air is not used

With the return spring compressed by the special tool, Hook Clamp, and the hydraulic piston and push rod holes aligned, insert the straight pin.



b) When compressed air is used

With the push rod pushed up by compressed air supplied through the cylinder shell pipe, align the hydraulic piston and push rod holes and insert the straight pin.

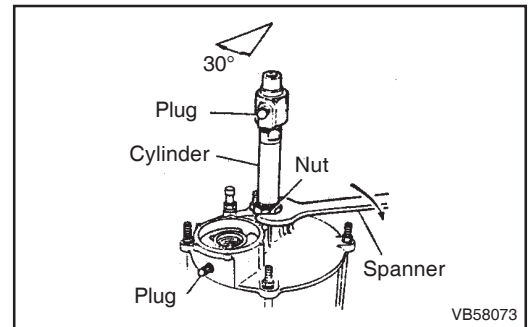


SERVICE PROCEDURE

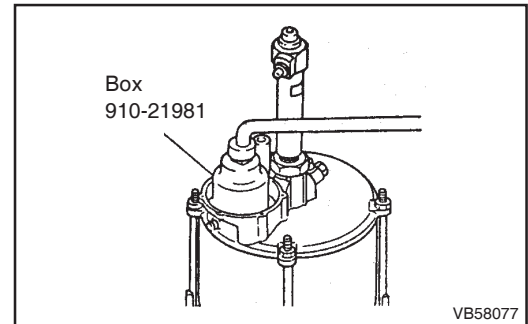
BRa-23

7) Installation of hydraulic cylinder

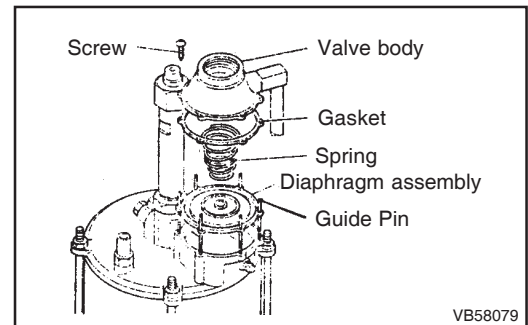
Tighten the lock nut, making sure that the cap plug and the end plate plug are 30° out of alignment.



8) Installation of valve fitting



9) Installation of valve body



Inspection after installation

1) Performance check □

Simple Test as installed on Vehicle

This is a check method without use of instruments. If there is any doubt to the test results, check performance of individual units using a tester.

a) Overall check

With the brake booster negative pressure set at 0, depress the brake pedal as you would in ordinary braking and start the engine and run idle. If the brake pedal moves down slightly after about two or three seconds, the brake booster is performing well.

b) Oil tightness check

With the engine running at idle, depress the brake pedal fully, if the pedal is pushed back, the hydraulic piston cup and ball check valve are not oil tight.

c) Air tightness check of poppet valve (atmospheric air valve)

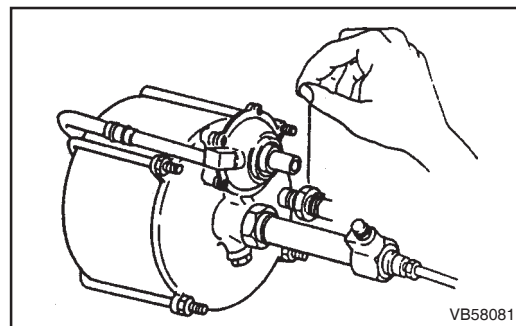
With the engine running at idle, put a thread near the poppet valve atmosphere side pipe without depressing the brake pedal.

If the thread is drawn in, the poppet valve atmospheric air valve is leakly.

Then depress the brake pedal. If the thread is rapidly drawn in at the moment, the relay valve piston and poppet valve are performing well.

d) Poppet valve (vacuum valve) and rubber packing check

With the engine running at idle, depress the brake pedal. If you feel suction at your finger applied to the end of atmospheric air valve side pipe of the poppet valve, the poppet valve vacuum valve or the power cylinder rubber packing is not air tight.



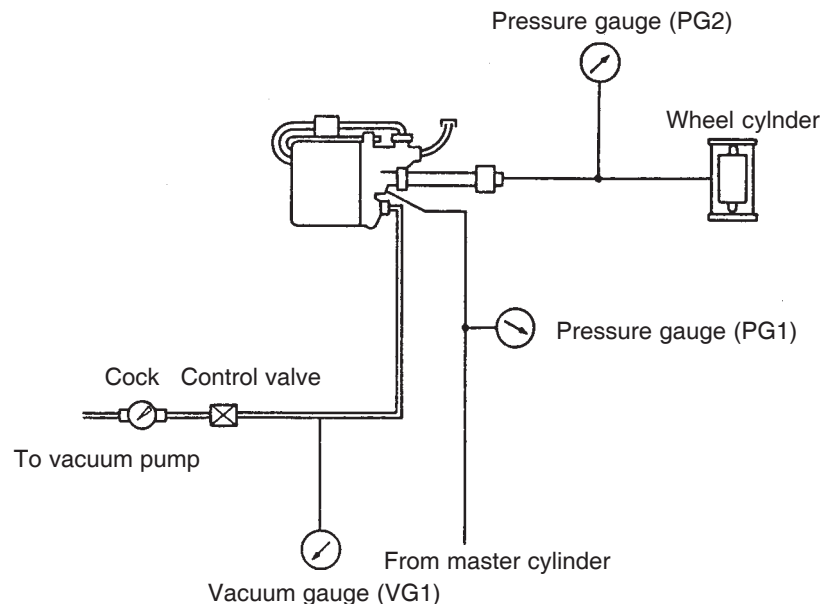
SERVICE PROCEDURE**BRa-25****2) Performance check □□**

Performance check of brake booster proper

Check the body performance in details using the Stationary Tester (Jidosha Kiki Part No.911-0020).

After all preparations for the test have been completed, bleed the fluid pressure system and test the following items.

If the results of tests show values out of the assembly standard or limit, check and replace related parts.

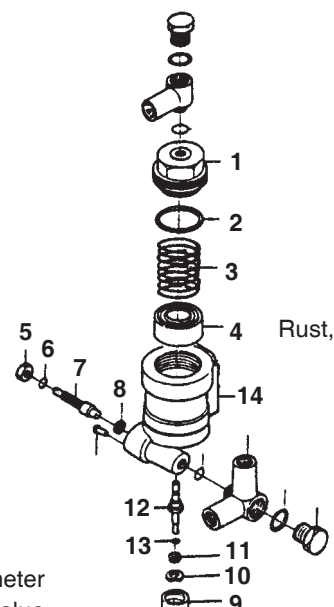


VB58075

Test item	Test condition	Assembly standard	Limit
Fluid tightness	Apply fluid pressure of 11.8 MPa (120 kgf/cm ²) (PG2) to hydraulic cylinder and measure the amount of pressure drop in 15 seconds. (In this test no vacuum state is created in brake booster.)	1470 kPa (15 kgf/cm ²) or less	-
Air tightness when not in operation	Set vacuum pressure in brke booster to 67 kPa (500 mmHg), close cock, and measure amount of vacuum pressure falls in 15 seconds. Vacuum gauge (VG1)	3.3 kPa (25 mmHg) or less	-
Operation start pressure	Set vacuum pressure in brake booster to 67 kPa (500 mmHg). Gradually apply pressure from master cylinder and read pressure indicated by mastr cylinder side pressure gauge (PG1) when pointer of vacuum gauge (VG1) swings.	125 to 225 kPa (1.3 to 2.3 kgf/cm ²)	105 to 245 kPa (1.1 to 2.5 kgf.cm ²)
Operation at full load	Set vacuum pressure in brake booster to 67 kPa (500 mmHg). Slowly depress pedal of master cylinder and read pressure indicated by hydraulic cylinder side pressure gauge (PG2) for master cylinder side pressure gauge (PG1).	1570 kPa (16 kgf/cm ²) 10.1 to 11.1 MPa (103 to 113 kgf/cm ²)	1570 kPa (16 kgf/cm ²) 9.81 to 11.4 MPa (100 to 116 kgf/cm ²)
Air tightness at full load	During operation at full load, cut off vacuum supply and read amount of vacuum pressure falls in 15 seconds thereafter. Vacuum gauge (VG1)	3.3 kPa (25 mmHg) or less	-
Residual pressure	Set pressure of master cylinder to 490 kPa (5 kgf/cm ²) (PG1), loosen air bleeder screw at end of hydraulic cylinder, release master cylinder side pressure, and read pressure indicated by wheel cylinder side pressure gauge (PG2).	78 to 125 kPa (0.8 to 1.3 kgf.cm ²)	59 to 155 kPa (0.6 to 1.6 kgf/cm ²)

SAFETY CYLINDER

Disassembly and Inspection



Deterioration of spring

Load/installed length
NV 18 to 22 N (1.81 to 2.21 kgf)/48
L 15 N (1.5 kgf)/48

Cylinder to piston clearance

BD 30
NV 0.06 to 0.12
L 0.17

Disassembly sequence

1. Cylinder cap
2. Cylinder packing
3. Spring
4. Piston
5. Check bolt nut
6. O-ring
7. Packing
8. Check bolt
9. Boot
10. Snap ring
11. Stopper
12. Bleeder
13. O-ring
14. Cylinder

Repair kit:
Safety cylinder kit

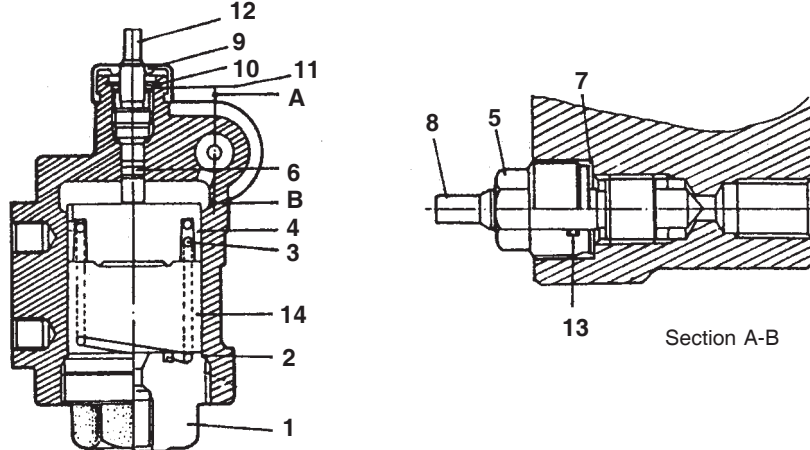
o Corroded metal stopper
o Rust, damage on inner surfaces

BD ... Basic Diameter
NV ... Nominal Value
L ... Limit

Rust, damage

VB58083

Reassembly



Assembly sequence

```

14 → 11 → 10 → 9 → 8 → 7 → 4 → 3 → 2 → 1
12 → 13
5 → 6

```

NOTE
Before reinstallation, apply brake fluid to cylinder bore and piston external surfaces.

235 to 265 Nm
(24 to 27 kgfm)

Section A-B

VB58085

SERVICE PROCEDURE

BRa-27

WHEEL BRAKE

Front wheel brake

1) Brake hose

To remove the brake hose, first disconnect the bracket side end (frame side) and then disconnect the wheel brake side end. To install, reverse this procedure.

NOTE

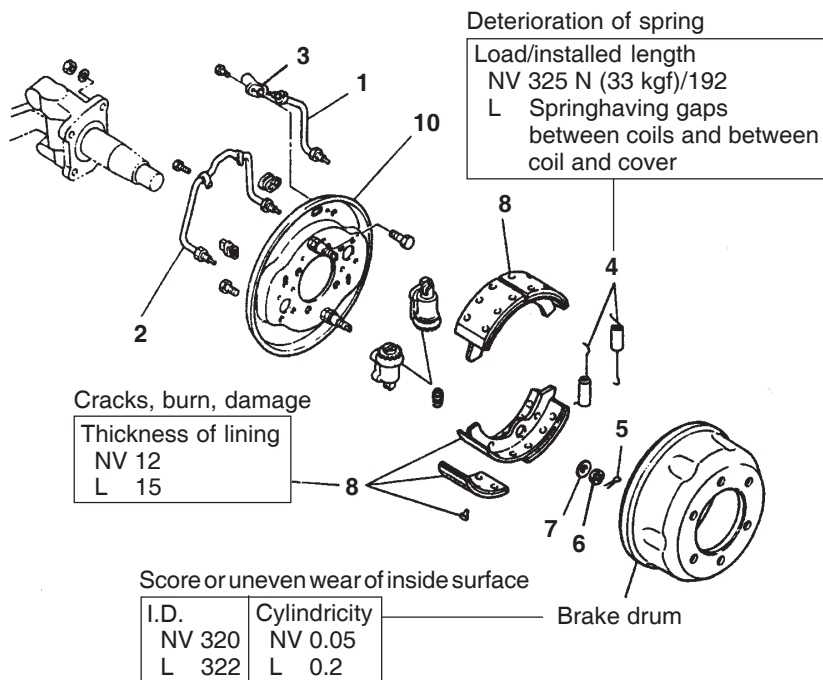
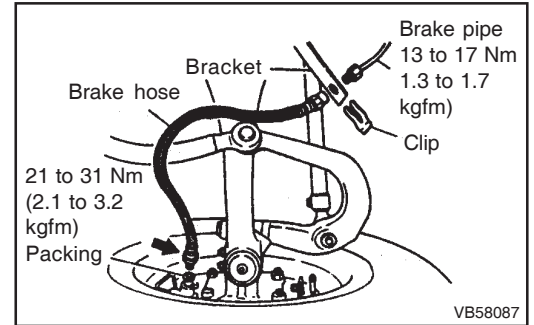
Install the brake hose taking care not to twist it.

2) Removal and installation

3) Disassembly, inspection and correction

NOTE

1. Wash the disassembled metallic parts in a cleaning solvent or gas oil. Wash the rubber parts in an alcohol solution (do not immerse for more than 30 seconds) and blow dry with compressed air.
2. Never immerse the rubber parts in a cleaning solvent or gas oil.
3. If the brake lining required replacement, replace as a brake lining kit.



Disassembly sequence

1. Pipe assembly
2. Pipe assembly
3. Hose and pipe joint assembly
4. Return spring
5. Split pin
6. Nut
7. Washer A
8. Brake shoe assembly
9. Wheel cylinder
10. Backing plate assembly

For parts with an encircled number, refer to Disassembly Procedure that follows.

NOTE

1. For repair limit of the brake drum, see 3) Correction of drum, Disassembly Procedure.
2. The shoe squareness adjust bolt of the backing plate maintains shoe squareness. Do not loosen this bolt.

VB58089

Disassembly procedure

1) Removal of return spring

Using a screwdriver, remove the return spring.

2) Replacement of brake lining

a) Service points of removal

When drilling out the brake lining rivets, use care not to enlarge or damage the brake shoe hole by the drill.

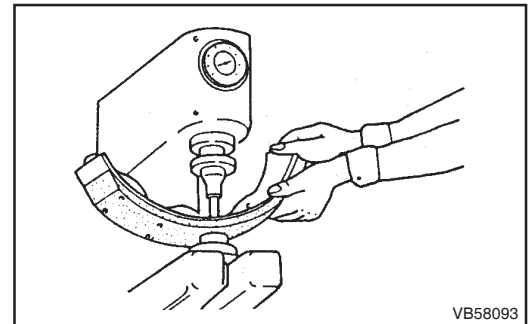
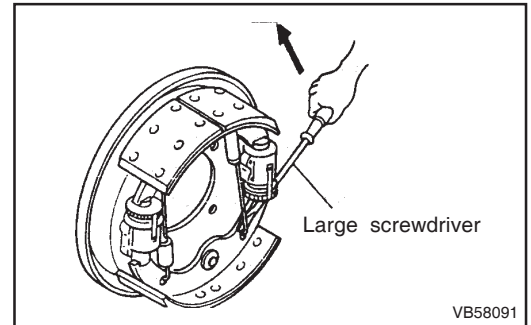
b) Service points of installation

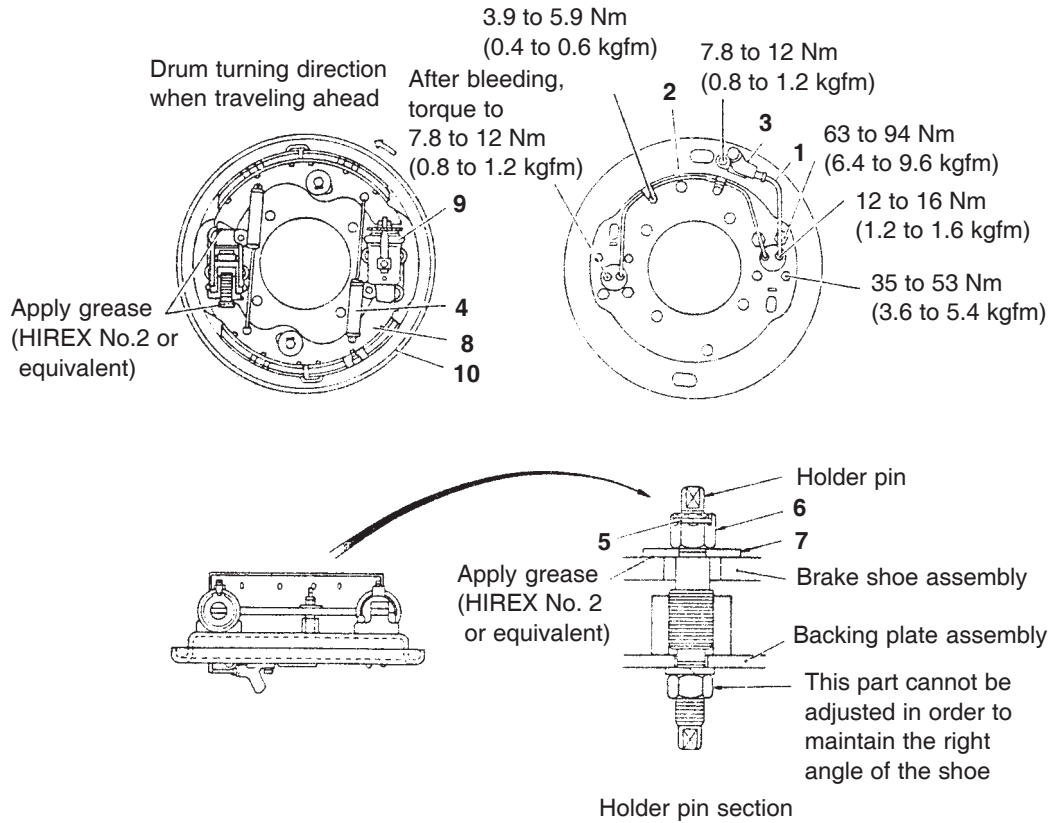
- o Rivet starting from the center portion and working toward the ends. Make sure that no gap is produced between the shoe and lining.
- o Stake the rivets to 17 to 19 kN (1700 to 1900 kgf).
- o Select the lining according to the operating conditions of the vehicle. Use linings of the same size and paint color on right and left wheels of the same axle.
- o After relining, check contact with the drum inside and correct poor contact if any. Correct the lining as incorporated into the wheel and brake assembly.

3) Correction of drum

If the drum has a cylindricity of 0.2 mm or poorer or is scratched, correct to the repair limit. After machining, use an oversize lining.

Drum diameter	Repair limit	Service limit
320	321	322



SERVICE PROCEDURE**BRa-29****4) Reassembly****a) Vehicle with 320 drum brake****NOTE****Keep the lining surface free of oil and grease.****Installation of Brake Shoe Assembly**

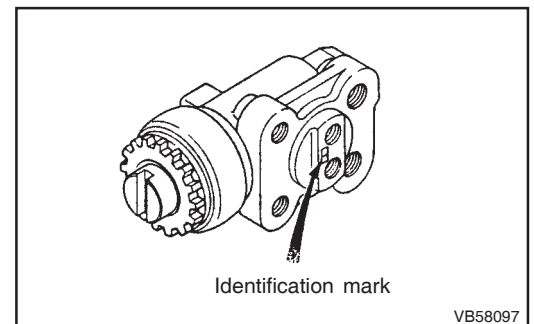
Fit the nut over the holder pin and tighten until the washer A is forced lightly against the stepped portion of the holder pin. Then back off the nut (0 to 60°) to the split hole of the first fit of the holder pin and lock with a split pin. Then, install the return spring.

VB58095

Reassembly procedure**1) Wheel cylinder installation position**

The wheel cylinder body has an identification mark to indicate the installation position. Install according to the mark

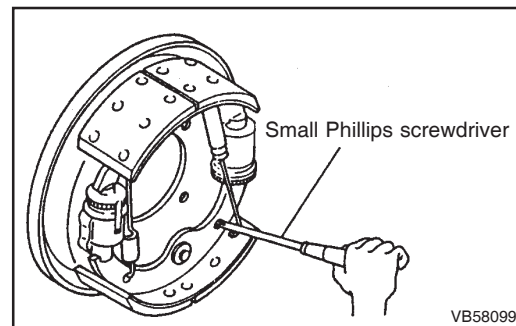
Identification mark	Installation position
RF	Right front wheel
RR	Right rear wheel
LF	Left front wheel
LR	Left rear wheel



VB58097

2) Installation of return spring

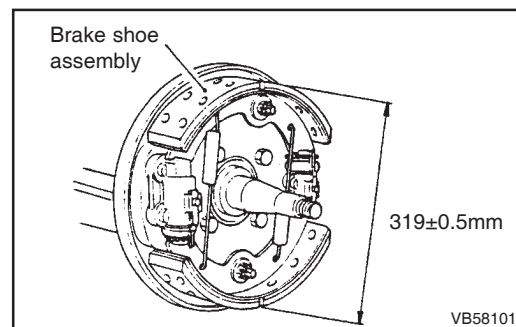
Using a screwdriver, fit the return spring.



3) Adjustment of holder pin

This adjustment is not required under normal circumstances. When the holder pin has been replaced and when the brake drags despite the adjustment of correct brake shoe clearance performed immediately after the lining has been replaced, the following adjustment is necessary as brake shoe squareness is probably incorrect.

- Accessing from the back of backing plate, turn the wheel cylinder adjust so that the O.D. of brake shoe assembly measures about 319 ± 0.5 mm. Also, centrally align the brake shoe assembly.
- Referring to Front Axle, install the wheel hub and brake drum.



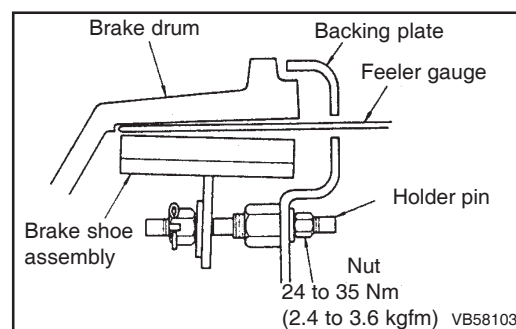
NOTE

If the wheel hub and brake drum is hard to install all the way into position because of the brake shoe assembly excessively tilted, turn the holder pin to correct the tilt.

- Bleed the brake system of air.
- Through the check hole, insert a 0.2-mm feeler gauge into the space between the drum and lining. Then, turn the wheel cylinder adjuster in the direction indicated by the stamped arrow to expand the brake shoe assembly so that the feeler gauge cannot be removed easily.
- Loosen the nut on the holder pin. Turn the holder pin clockwise or counterclockwise so that the feeler gauge can easily be removed and inserted.
- Repeat steps d) and e) until the feeler gauge becomes hard to remove.
- Lightly depress the brake pedal two to three times to center the brake shoe assembly.
- Repeat steps d) and e) again.
- Remove the feeler gauge when it contacts the lining to the full width. Then, reinsert it and adjust the holder pin so that you feel the gauge binding in the depths. Now, tighten the nut to specification.

NOTE

In step h), when the feeler gauge becomes hard to remove or insert indicates that the gauge contacts the lining to the full width.

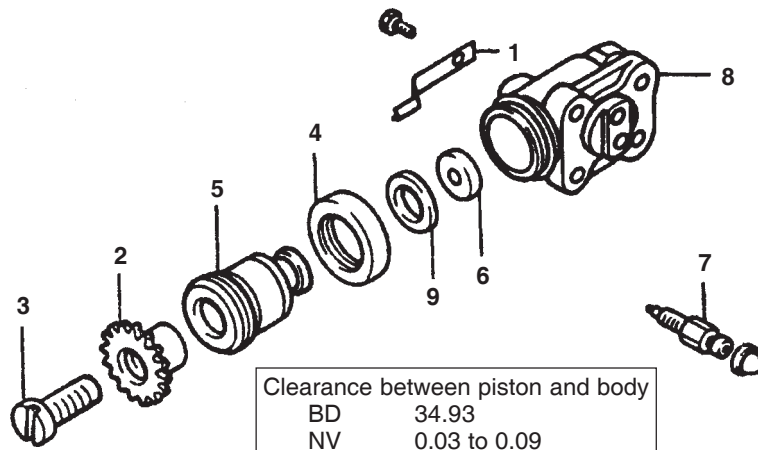


SERVICE PROCEDURE

BRa-31

Front wheel cylinder

1) Disassembly and inspection



BD ... Basic Diameter
NV ... Nominal Value
L ... Limit

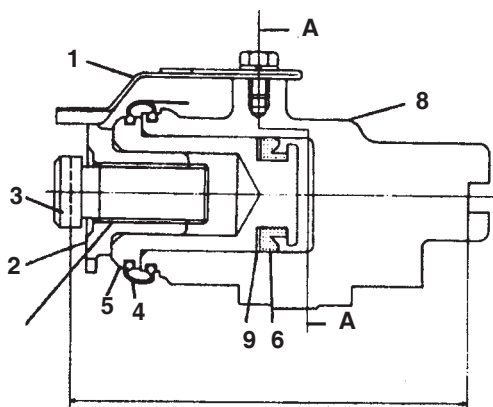
Repair kit:
Wheel cylinder kit

Disassembly sequence

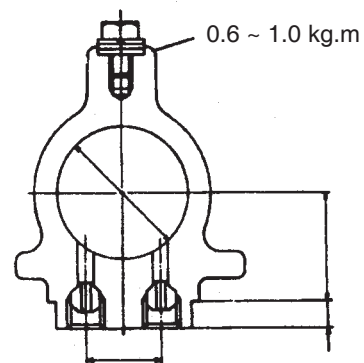
1. Adjuster stopper
2. Adjuster
3. Adjuster screw
4. Boot
5. Piston
6. Piston cup
7. Bleeder screw
8. Body
9. Backup ring

VB58105

2) Reassembly



Apply rubber grease
(NIGLUBE RX-2 or
equivalent).



Section A-A

Assembly sequence

9→8→6→5→4→3→2→1

VB58107

BRa-32**BRAKE SYSTEM****Rear wheel brake****1) Brake hose**

To remove the brake hose, first disconnect the bracket side end (frame side) and then disconnect the rear axle housing side end.

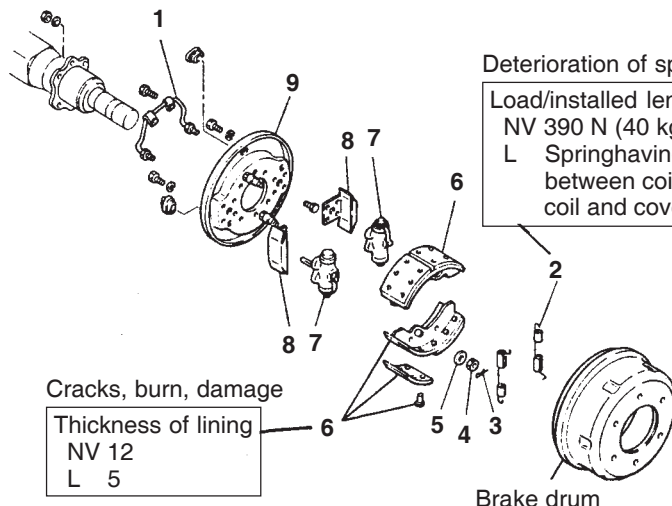
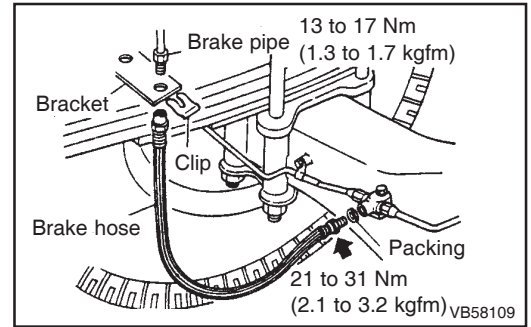
To install, reverse this procedure.

NOTE

Install the brake hose taking care not to twist it.

2) Removal and installation**3) Disassembly, inspection and correction****NOTE**

1. Wash the disassembled metallic parts in a cleaning solvent or gas oil. Wash the rubber parts in an alcohol solution (do not immerse for more than 30 seconds) and blow dry with compressed air.
2. Never immerse the rubber parts in a cleaning solvent or gas oil.
3. If the brake lining required replacement replace as a brake lining kit.

**Deterioration of spring**

Load/installed length
NV 390 N (40 kgf)/217
L Spring having gaps
between coils and between
coil and cover

Cracks, burn, damage
Thickness of lining
NV 12
L 5

Score or uneven wear
of inside surface

I.D.	Cylindricity
NV 320	NV 0.05
L 322	L 0.2

Brake drum

Disassembly sequence

1. Pipe assembly
2. Return spring
3. Split pin
4. Nut
5. Washer A
6. Brake shoe assembly
7. Wheel cylinder
8. Wheel cylinder cover
9. Backing plate assembly

For parts with an encircled number, refer to Disassembly Procedure that follows.

NOTE

1. For the repair limit of the brake drum, see 3) Correction of drum, Disassembly Procedure.
2. The shoe squareness adjust bolt of the backing plate maintains shoe squareness. Do not loosen this bolt

NV ... Nominal Value
L ... Limit

SERVICE PROCEDURE

BRa-33

Disassembly procedure

1) Removal of return spring

Using a screwdriver, remove the return spring.

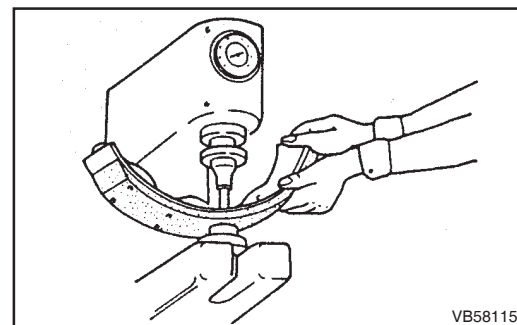
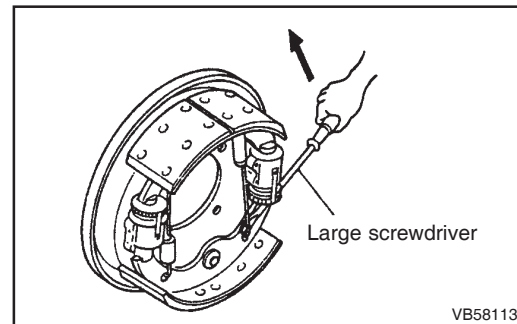
2) Replacement of brake lining

a) Service points of removal

When drilling out the brake lining rivets, use care not to enlarge or damage the brake shoe hole by the drill.

b) Service points of installation

- o Rivet starting from the center portion and working toward the ends. Make sure that no gap is produced between the shoe and lining.
- o Stake the rivets to 17 to 19 kN (1700 to 1900 kgf).
- o Select the lining according to the operating conditions of the vehicle. Use linings of the same size and paint color on right and left wheels of the same axle.
- o After relining, check contact with the drum inside and correct poor contact if any. Correct the lining as incorporated into the wheel and brake assembly.



NOTE

On FL series, never use the lining other than the standard lining. (LP1023)

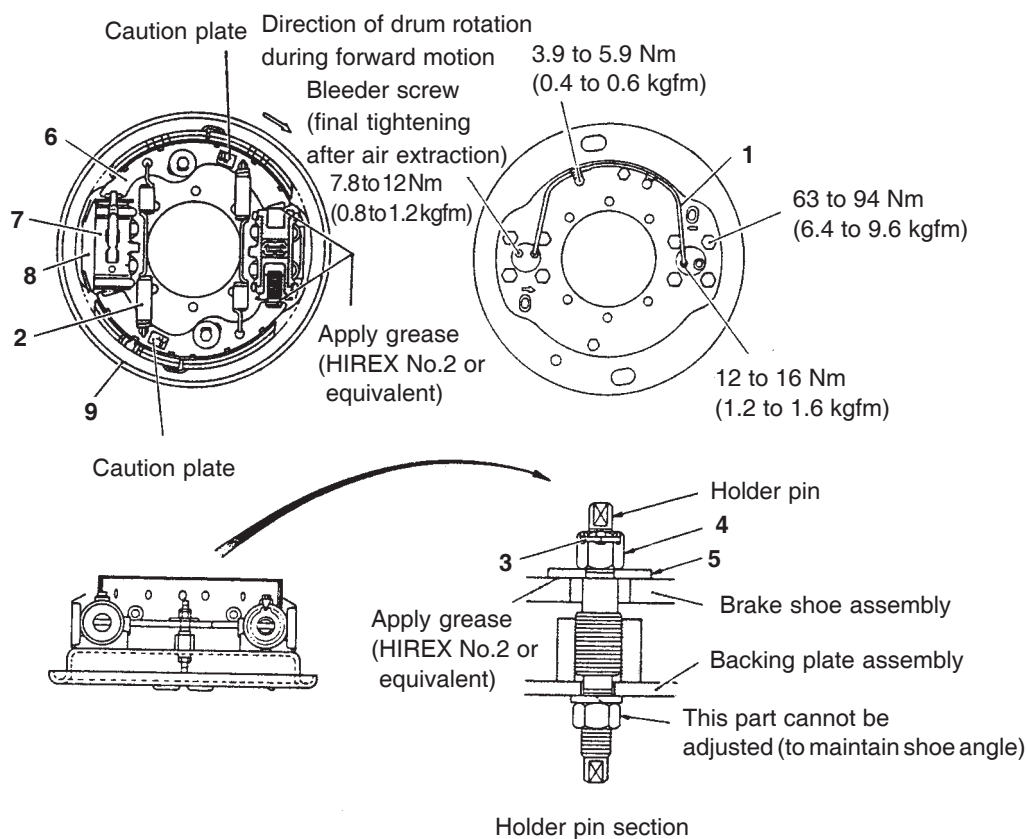
3) Correction of drum

If the drum has a cylindricity of 0.2 mm or poorer or is scratched, correct to the repair limit. After machining, use an oversize lining.

Drum diameter	Repair limit	Service limit
320	321	322

4) Reassembly

a) Vehicle with 320 drum brake



Assembly sequence

9→8→8→1→6→5→4→3→④

For parts with an encircled number, refer to Reassembly Procedure that follows.

NOTE

Keep the lining surface free of oil and grease.

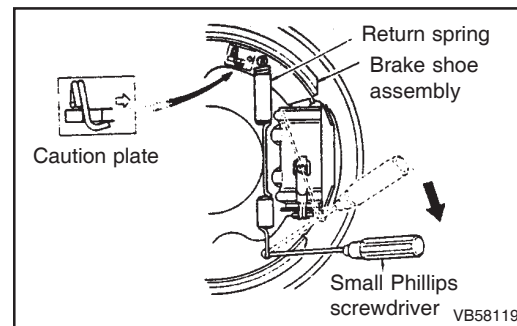
Installation of Brake Shoe Assembly

Fit the nut over the holder pin and tighten until the washer A is forced lightly against the stepped portion of the holder pin. Then back off the nut (0 to 60°) to the split hole of the first fit of the holder pin and lock with a split pin. Then, install the return spring.

Reassembly procedure

1) Installation of return spring (drum dia. 320)

Catch the shorter hook of the return spring onto the brake shoe assembly as shown on the caution plate attached to the brake shoe assembly. Catch the other hook with a small Phillips screwdriver and insert the tip of the screwdriver into the return spring mounting hole in the brake shoe assembly. Then, pry the hook into the hole.

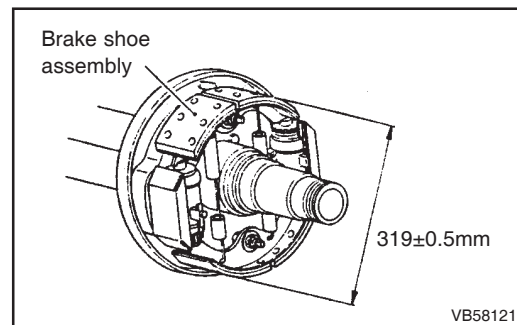


2) Adjustment of holder pin <Vehicles with 320 drum brake only>

This adjustment is not required under normal circumstances. When the holder pin has been replaced and when the brake drags despite the adjustment of correct brake shoe clearance performed immediately after the lining has been replaced, the following adjustment is necessary as brake shoe squareness is probably incorrect.

a) Accessing from the backing plate, turn the wheel cylinder adjuster so that the O.D. of brake shoe assembly measures about 319 ± 0.5 mm. Also, centrally align the brake shoe assembly.

b) Install the wheel hub and brake drum.

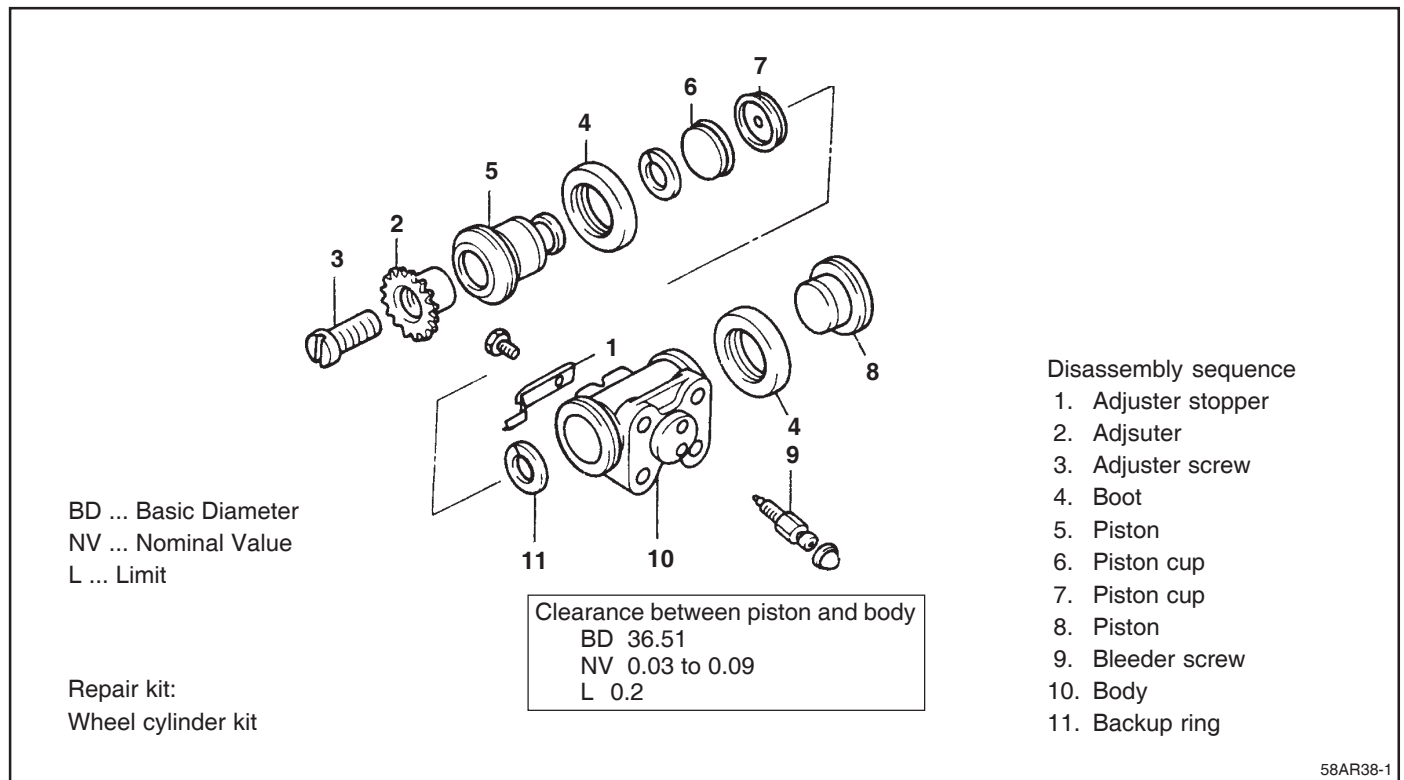


NOTE

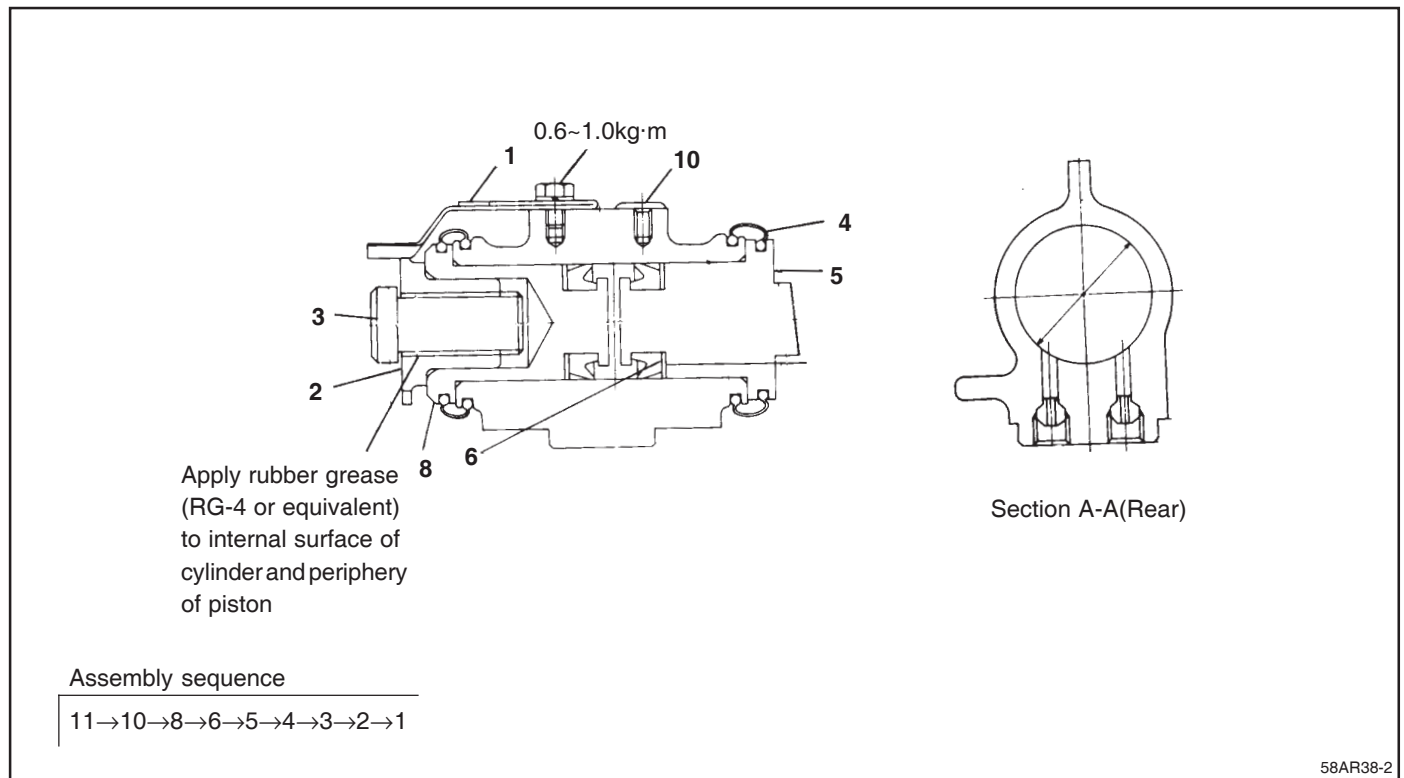
If the wheel hub and brake drum is hard to install all the way into position because of the brake shoe assembly excessively tilted, turn the holder pin to correct the tilt.

Rear wheel cylinder

1) Disassembly and inspection



2) Reassembly



SERVICE PROCEDURE

BRa-37

Inspection and Adjustment after Installation

Shoe clearance adjustment

Before adjustment, referring to Item (2).

- 1) Jack up the axle and check to ensure that the hub is free from looseness.
- 2) Remove the adjusting hole plug from the backing plate. Using Shoe Gap Adjuster, turn the adjuster of the wheel cylinder in the direction of an arrow stamped on the backing plate, until the tire drags a little when turned by hand.

NOTE

1. The arrow is stamped on the area near the adjusting hole plug of the backing plate.
 2. Make adjustment at two places on each wheel.
- 3) After depressing the brake pedal several times, make sure that the tire drags a little when turned by hand. If the tire turns lightly repeat the above procedures beginning with step 2).
 - 4) Back off the adjuster of the wheel cylinder 8 to 9 notches in the direction opposite to that of the arrow.

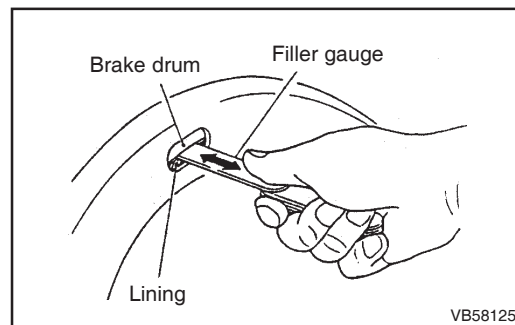
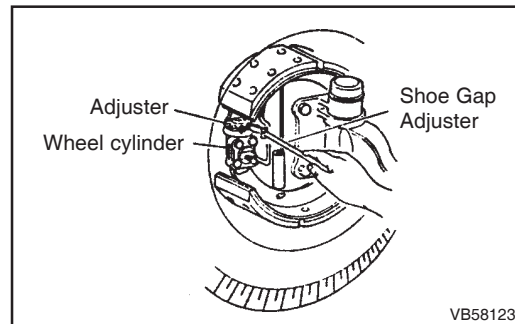
NOTE

Make adjustment at two places on each wheel.

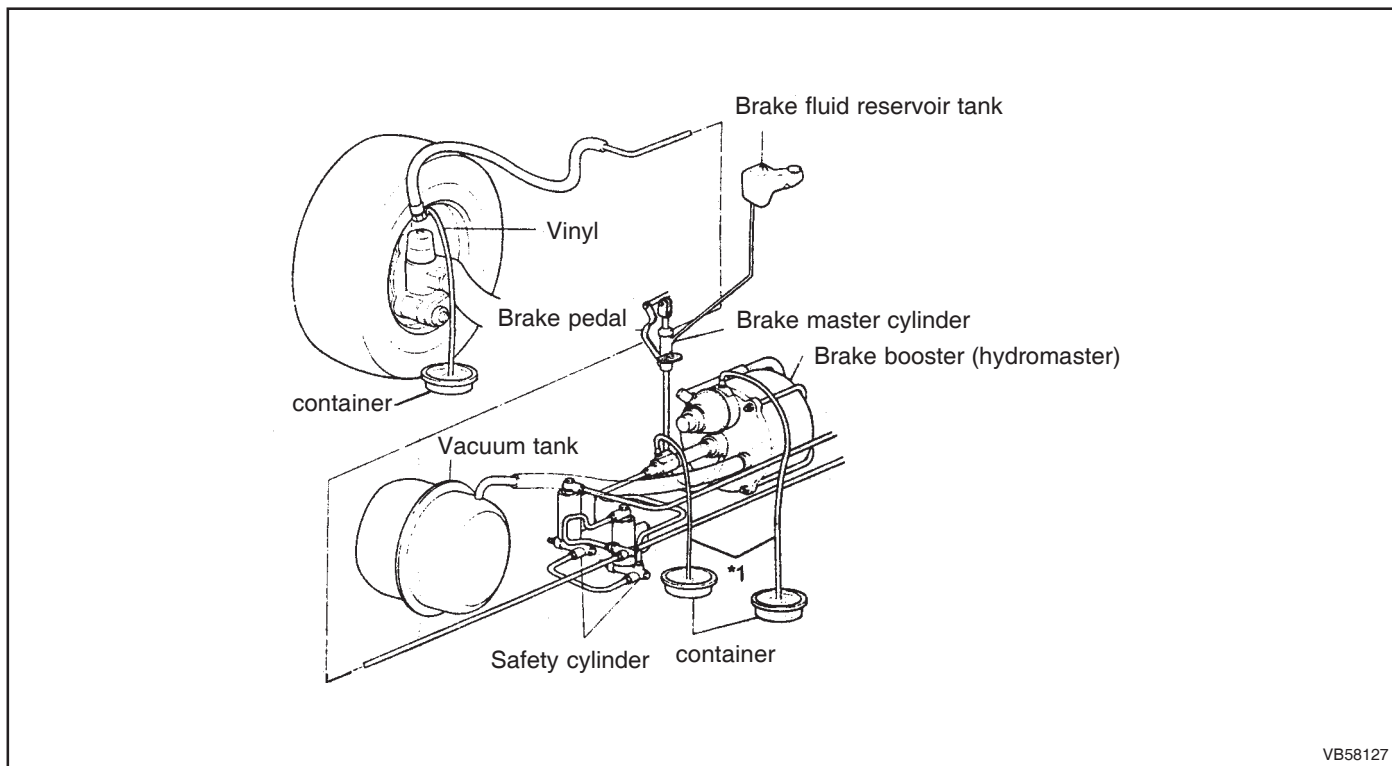
- 5) Turn the tire by hand and make sure that the tire does not drag. If the tire drag, repeat the procedure beginning with steps (2).
- 6) Remove the check hole plug from the backing plate. Insert a filler gauge between the brake drum and the lining. Make sure that the clearance when slight resistance is left while withdrawing the gauge is 0.2 mm.

NOTE

Make the check at two places on each wheel.



Replacement of brake fluid and bleeding of brake system



VB58127

NOTE

Before replacing the brake fluid or bleeding the brake system, stop the engine and depress the brake pedal several times to reduce the negative pressure in the vacuum tank until warning lamp lights.

1) Replacement of brake fluid

- a) Mount the special tool, vinyl Pipe to the bleeder screw of the wheel cylinder.
- b) Loosen the air bleeder and depress the brake pedal several times until brake fluid ceases to run out.
- c) Mount a vinyl pipe to the air bleeder of the brake booster.
- d) Loosen the air bleeder and depress the brake pedal repeatedly several times until there is no more brake fluid in the reservoir tank and brake fluid ceases to run out from the air bleeder.
- e) Bleed the clutch system by the same procedures.
- f) While pouring in fresh brake fluid (fluid in fully-enclosed container free from water, dust, etc.) into the reservoir tank, depress the pedal repeatedly until the fluid in the brake system is replaced with the fresh fluid.

NOTE

1. Use brake fluid that conforms to SAE J1703f or FMVSS No. 116 DOT3. Never mix different kinds of brake fluid as such a mixture can cause brake drag.
2. If the fluid in the brake system is replaced with fresh fluid, the fluid that runs out will change in color. Keep close watch on the fluid that runs out.

At the time, thread the air bleeder valve of the safety cylinder back until the valve is lightly blocked by the stopper.

- g) Tighten all the air bleeders, fill the reservoir tank with the specified quantity of brake fluid, and bleed the brake and clutch.

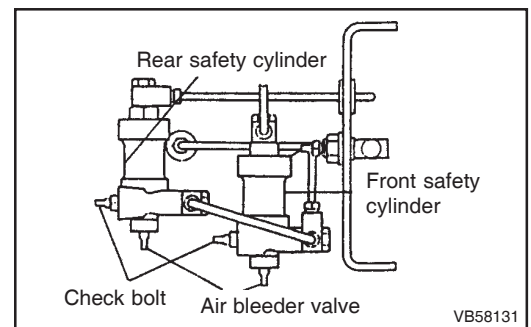
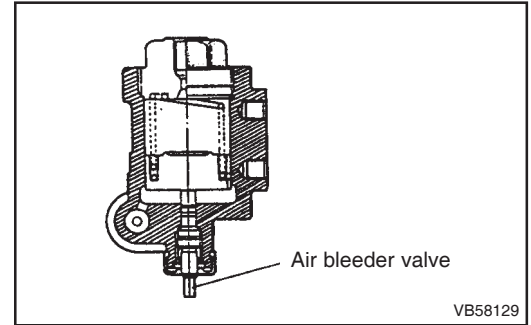
2) Bleeding of brake system

- a) Make sure that the brake fluid in the fluid reservoir tank is at H level.

NOTE

The brake fluid level will fall during bleeding operation. Perform bleeding operation while pouring fresh brake fluid (which is kept in the fully-enclosed container and is free of dust, water, etc.) into the fluid reservoir tank.

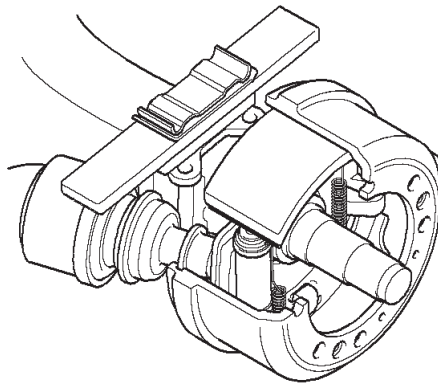
- b) Tighten the front and rear check bolts of safety cylinder to block up the fluid passages from the brake booster.
- c) Install one end of transparent vinyl pipe to the air bleeder of hydraulic cylinder of brake booster and place the other end of the vinyl pipe in the container filled with brake fluid.
- d) Depress the brake pedal all the way several times. Then, with the pedal kept depressed, loosen the air bleeder to bleed air together with brake fluid. Immediately after bleeding, close the air bleeder and release the pedal.
- e) Repeat this operation until there is no more air bubble in brake fluid flowing out from the air bleeder.
- f) Bleed air from the air bleeder of relay valve of brake booster in the same manner as described in d) and e).
- g) Return the front check bolt of safety cylinder to the original position and back off the front air bleeder valve until it comes in contact with the stopper.
- h) Bleed air from the air bleeder of front wheel cylinder in the same manner as described in d) and e).



- i) Depress the brake pedal all the way repeatedly (Depress the pedal 5 to 6 times continuously until the pedal cause a reaction. Then, depress the pedal three times repeatedly). Repeat the air bleeding of master cylinder until there is no more air bubble produced in fluid reservoir tank. (It takes 4 to 8 seconds between releasing of pedal and formation of air bubble at the surface of fluid in the fluid reservoir tank.)
- j) Return the rear check bolt of safety cylinder to the original position and back off the rear air bleeder valve until it comes in contact with the stopper.
- k) Bleed air from the air bleeder of rear wheel cylinder in the same manner as described in d) and e).
- l) Make sure that wheel brake shoe clearance has been adjusted to 0.2mm. Then, depress the brake pedal with a force of about 590N (60 kgf) and make sure that a clearance of 65mm or more is provided between the pedal and toeboard.
- m) If a pedal-to-toeboard clearance is not within the nominal value, bleed air again from the following parts in the order of mention until the clearance is within the nominal value.
 - 1) Brake booster relay valve
 - 2) Front wheel cylinder
 - 3) Brake booster hydraulic cylinder
 - 4) Rear wheel cylinder
- n) After completion of air bleeding, tighten the front and rear air bleeder valves until they come in contact with the respective stoppers.
- o) Check the fluid level in the fluid reservoir tank and add brake fluid until the fluid reach the H level.
- p) Start the engine and increase negative pressure until warning lamp goes out. Then, depress the brake pedal and check each part for fluid leaks.

Tightening of brake pipes

Mouthpiece shape	Pipe diameter (mm)	Thread diameter (mm)	Pitch (mm)	Tightening torque
	4.76	10	1.0	12 to 16 Nm (1.2 to 1.6 kgfm)
	6.35	12	1.0	19 to 25 Nm (1.9 to 2.6 kgfm)

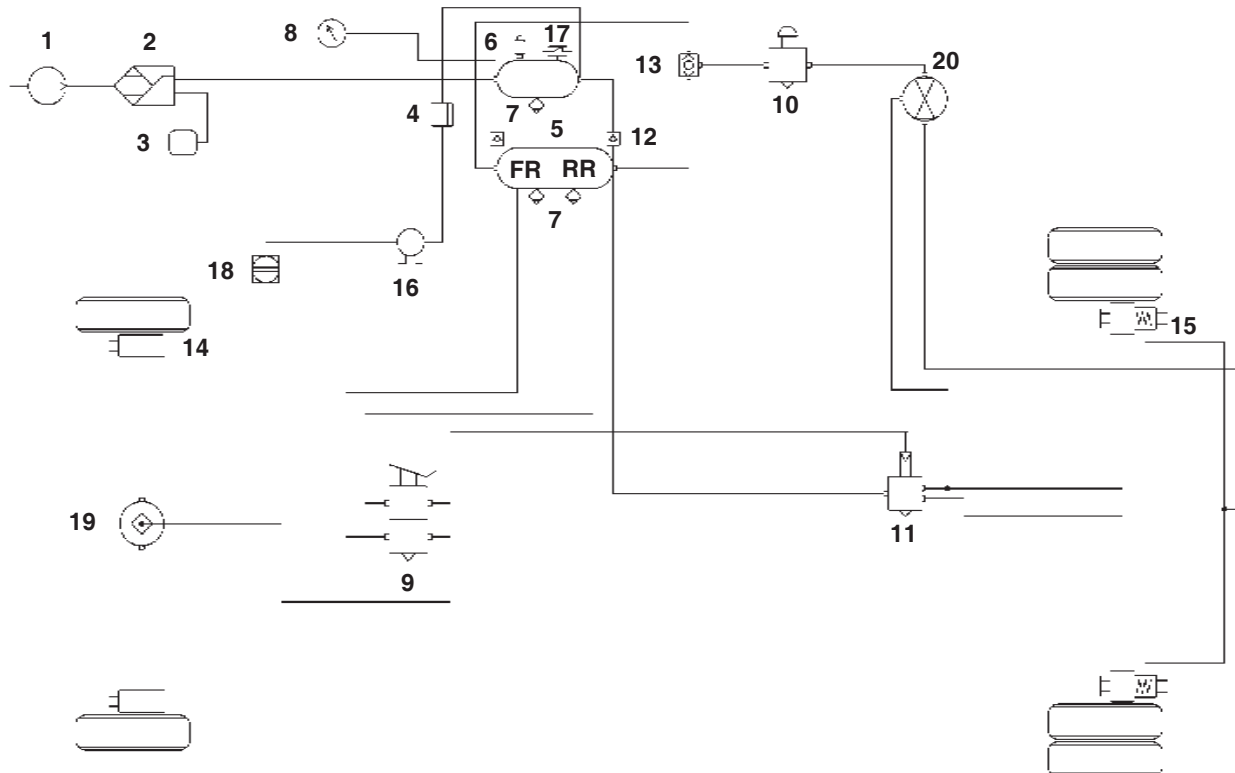
FULL AIR BRAKE (WEDGE BRAKE)**General**

ATBR-700

Specification

Item	Front	Rear
Specification	360 X 160	←
Brake type	Leading & Trailing	←
Effective radius	180 mm	←
Lining usable thickness	10 mm	←
Lining area	1106 cm ²	←
Brake chamber	Type 12	
Spring chamber		Type 12 / 16

Schematic diagram

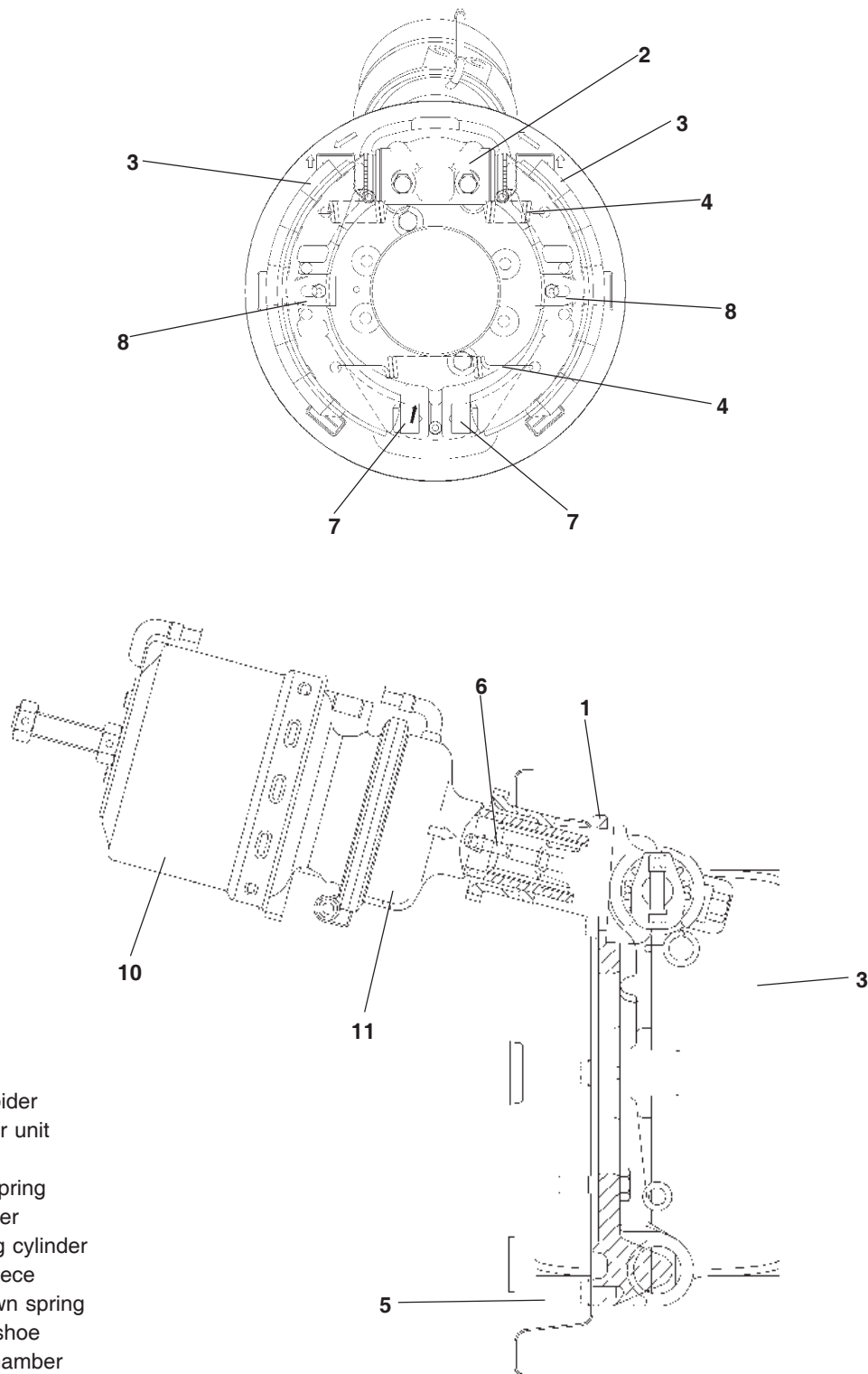


1. Air compressor
2. Air drier
3. Air tank
4. 4-circuit protection valve
5. Air reservoir
6. Safety valve
7. Drain valve

8. Air gauge
9. Dual brake valve
10. Parking brake valve
11. R-12 relay valve
12. R-14 relay valve
13. Double check valve
14. Brake chamber

15. Brake chamber spring
16. Magnetic valve
17. Low air pressure switch
18. Exhaust brake valve
19. Quick release valve
20. Quick release one way valve

Description of operation



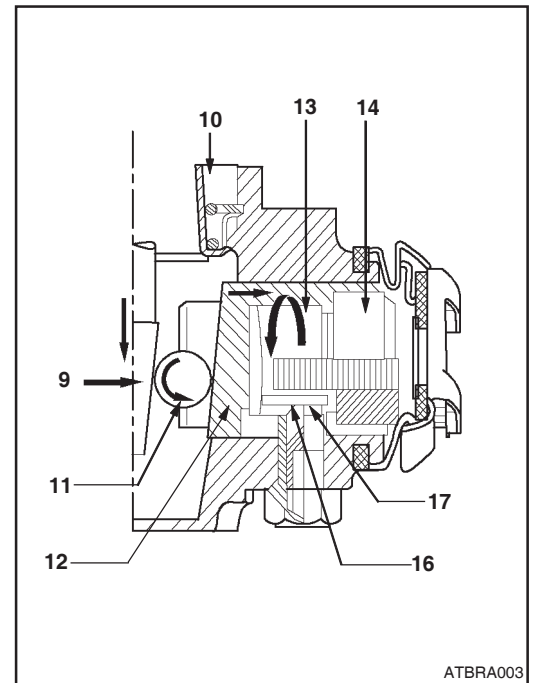
1. Brake spider
2. Expander unit
3. Shoe
4. Return spring
5. Dust cover
6. Actuating cylinder
7. Thrust piece
8. Hold-down spring
9. Trailing shoe
10. Brake chamber
11. Spring chamber

Brake actuation

Activation of the brake, see illustration, is by the actuation cylinder which pushes the wedge (9) down between the two cage guided rollers (11) and the pistons (12), thereby displacing them sideways and so pushing the brake shoes (3) against the brake drum. The brake drum drags the brake shoes by the forward driving direction in the turning direction, see illustration. Thereby the front brake shoe or leading shoe and the rear brake shoe or trailing shoe are supported by the thrust pieces (7) in the abutment. Both brake shoes air sliding shoes, i. e. they glide on the abutment thrust pieces (7).

The brake force ratio for the leading and trailing shoes is approximately 3:1. The brake performance in the forward and the reverse directions is virtually the same.

When the braking operation is ended the wedge (9) is pushed back to its initial position by the spring (10). At the same time the shoe return springs (4) pull the brake shoes (3) back from the brake drum and the piston (12) into the housing (2) are pushed back into the idle position.



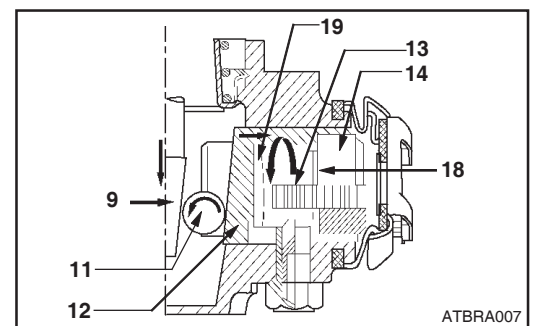
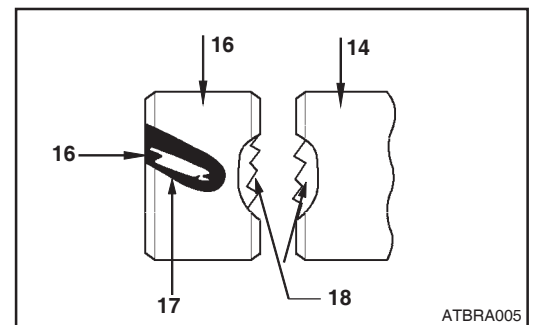
Automatic adjuster

Each piston (12) in the expander unit is provided with an automatic adjustment mechanism, which individually and continually adjusts, thereby ensuring adequate clearance between the brake drum and lining.

Upon actuating, see above, the wedge (9) is pushed between the rollers (11) against the preloaded spring (10) and the rollers (11) roll on the wedge incline and the piston (12). Thereby each piston (12) with the adjuster ring (13) and the adjuster nut (14) are pushed outwards, thus beginning the braking operation.

Through the sideways displacement of the pistons (12), the spring loaded pin (16) comes against the flank of the spiral groove (17) in the adjuster ring (13), see above, causing the adjuster ring (13) to turn by a degree corresponding to the travel of the piston (12).

By termination of the braking operation, the wedge (9) is pushed back to its initial position by spring (10). The shoe return springs (4) via the brake shoes (3) push the adjuster nut (14), adjuster ring (13), and piston (12) back into their initial position.



SERVICE PROCEDURE

BRa-45

An increase in clearance resulting from lining wear in accordance with above increases the stroke of the wedge (12) and the piston (12) is pushed further outwards. Automatic adjustment occurs as soon as the rotation of the adjuster ring (13) is greater as the pitch of the serration's (18)-saw tooth from-between the adjuster ring (13) and the adjuster nut (14). Thereby the engagement of the serration's 18, loaded by curved wire spring (19), jump on tooth.

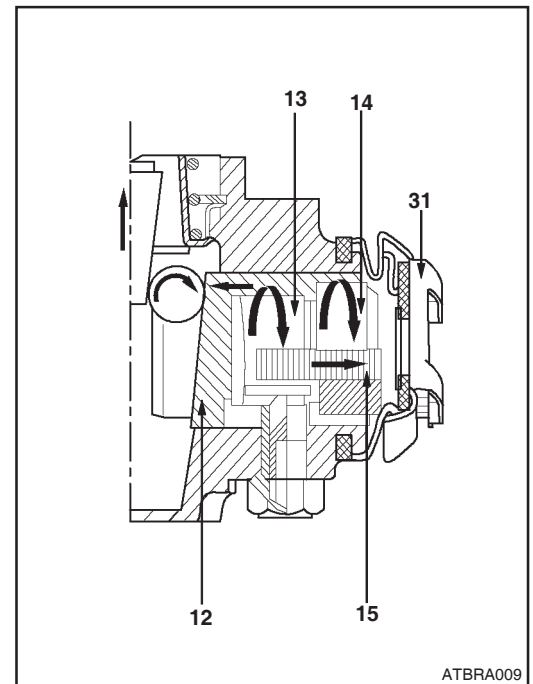
Upon releasing the brake, see right illustration, the adjuster screw (15), adjuster nut (14), adjuster ring (13) and piston (12) are pushed back by the shoe return springs (4).

The pin (16) is then pushed against the flank of the spiral groove (17) causing the adjuster nut (14) and the adjuster ring (13) to turn by a degree corresponding to the tooth pitch.

Through the thread in the adjuster nut (14), the adjuster screw (15) moves outwards thereby compensating the lining wear.

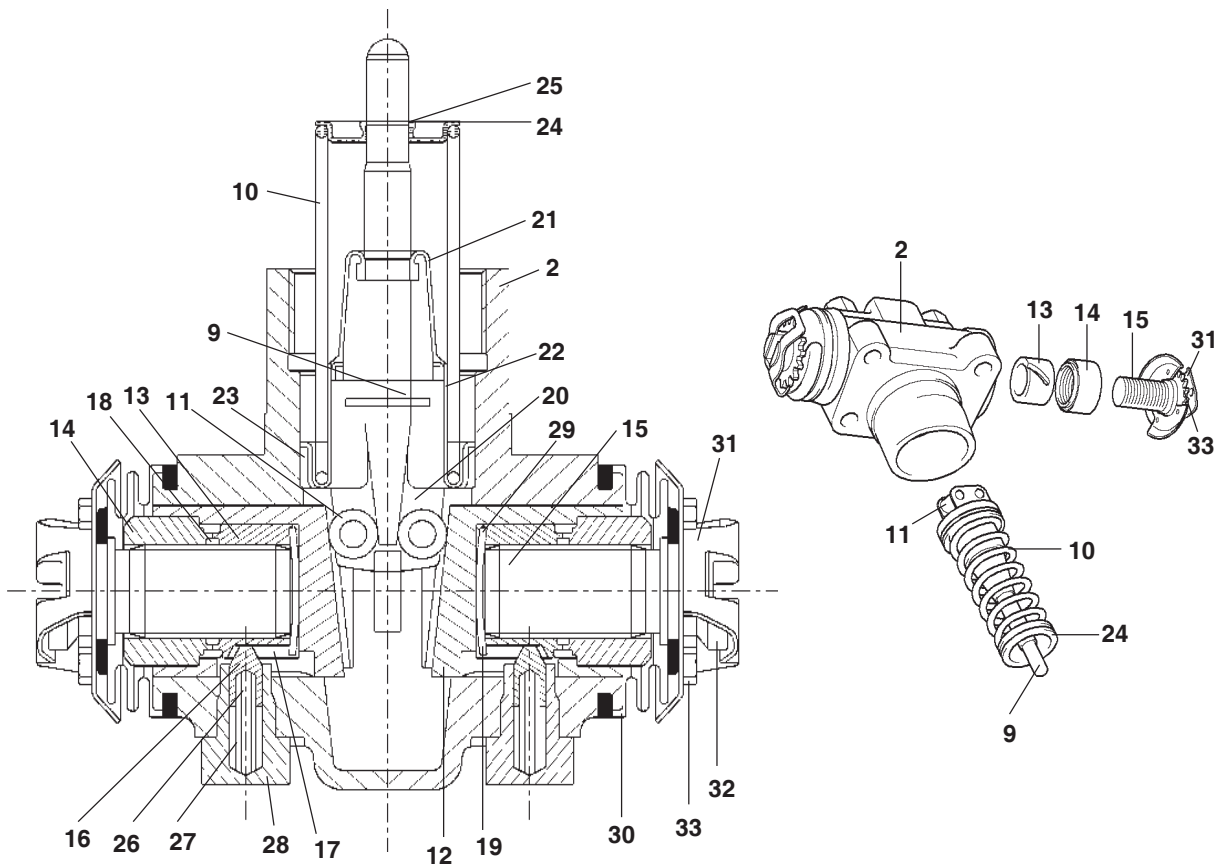
The adjuster screw (15) is fixed by leaf spring (31) and the brake shoe (3).

The optimized tooth pitch of the serration's (18) provide adjustment in very small-almost infinitesimal-uniform steps of 0.03 mm



Installation

Expander unit



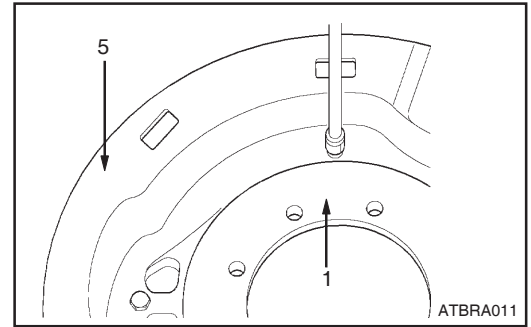
- | | |
|------------------------|-----------------------------|
| 2. Housing | 21. Roll below |
| 9. Wedge | 22. Spring retainer |
| 10. Pressure spring | 23. O-ring |
| 11. Roller | 24. Spring retainer |
| 12. Piston | 25. Snap ring |
| 13. Adjuster ring | 26. Pressure spring (long) |
| 14. Adjuster nut | 27. Pressure spring (short) |
| 15. Adjuster screw | 28. Spigoted screw |
| 16. Pin | 29. Washer |
| 17. Spiral groove | 30. Protective cap |
| 18. Serration | 31. Leaf spring |
| 19. Curved wire spring | 32. Concave seat |
| 20. Roller cage | 33. Toothed wheel |

SERVICE PROCEDURE

BRa-47

1. Dissambly is the reverse of installation.
2. Fasten cover 5 to brake spider 1 with M8 bolts.

Tightening torque $22 \pm 2 \text{ Nm}$.

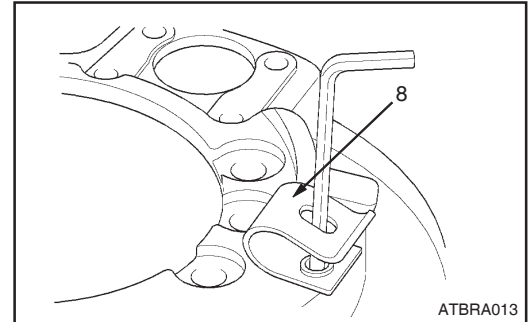


3. Set hold-down springs 8 and so that they are against the brake spider 1, and fasten with screw with hexagonal recessed hole M10 and washer.

Tightening torque $70 \pm 5 \text{ Nm}$.

NOTE

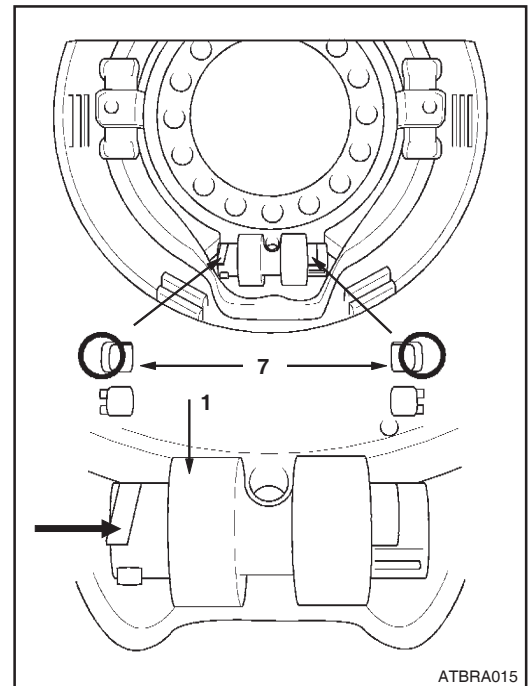
- ? The opening of the hold-down spring must face brake shoe.



4. Install thrust pieces 7 in brake spider 1.

NOTE

- ? Lubricate thrust pieces before installation. ○
The plane surface of the thrust pieces and the brake spider must be non-lubricated
- ? The thrust piece with the angled shoe abutment (arrow) must be fitted to the leading shoe side.
The slope of the abutment must point towards the centre of the brake.
- ? The thrust piece with the straight shoe abutment must be fitted to the trailing shoe.



BRa-48

BRAKE SYSTEM

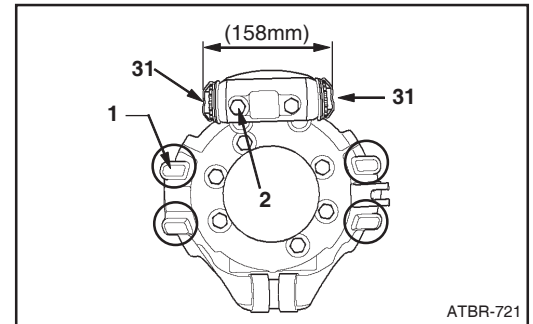
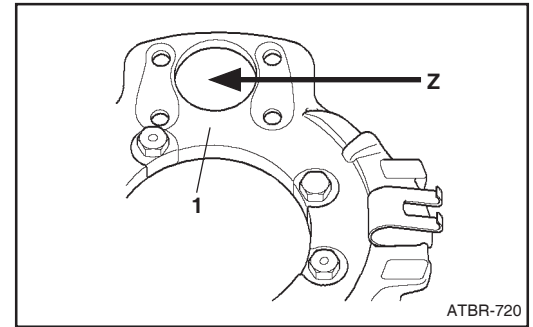
5. Moisten seat "Z" before installation, point 4.
Set expander unit 2 in the brake spider 1, and fasten with M12 bolts.

Tightening torque $135 \pm 11 \text{ Nm}$.

NOTE

- ? The opening of the leaf spring 31 must face to the centre of the brake.
- ? Head expander dimension "S" see below illustration.

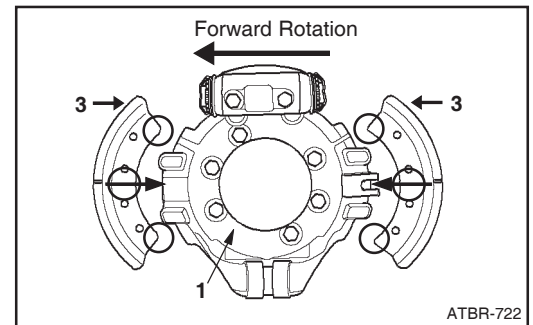
6. Smear the brake shoe contact areas  of the brake spider with grease.



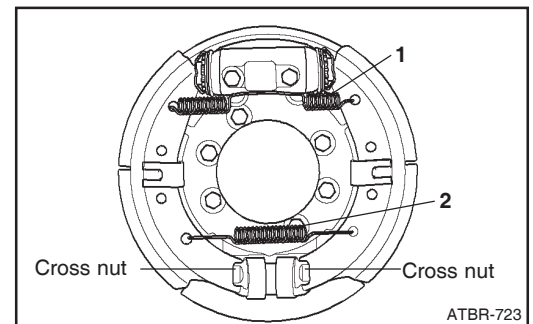
7. Place the brake shoes 3 on the brake spider 1, and slide them under the hold-down springs.

NOTE :

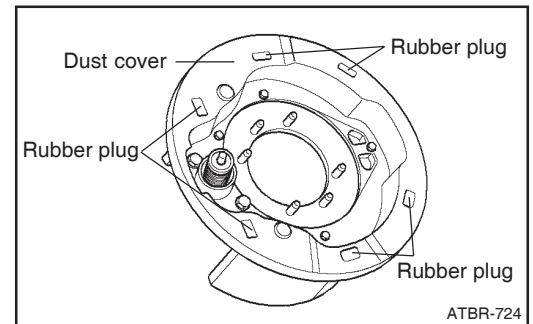
- ? Before assembly smear the brake shoe contact areas and the shoe webs in the area of the hold-down springs with  grease.



8. Fit shoe return springs 4 ensuring they are positioned correctly.



9. Fit the plugs (arrow) in the cover 5 openings.



Maintenance and servicing

General remarks

Brakes and brake drums must be maintained in good working conditions to ensure safe and proper vehicle operation.

It is very important that vehicle manufacturer preventive maintenance schedules be followed and that wear parts be replaced when needed. The replacement of wear parts is described in the following sections concretely.

- **The replacement of wear parts should be axle-wise, i.e. in both brakes.**
- **Only use original spare parts from the vehicle manufacturer.**
- **Repair and service functions to be carried out only by vehicle manufacturer authorized repair facilities employing trained and qualified personal.**

Only common shop tools are necessary for the servicing and repair.

Bedding procedure

A new brake lining must be bedded in carefully in order that optimal brake effectiveness is attained. During the bedding period when the lining is not fully match with the drum, it is important to avoid heavy and continuous use of the brakes, particularly from high speeds, otherwise local overheating the lining and the drum will a consequent detraction in brake performance.

Other brake parts

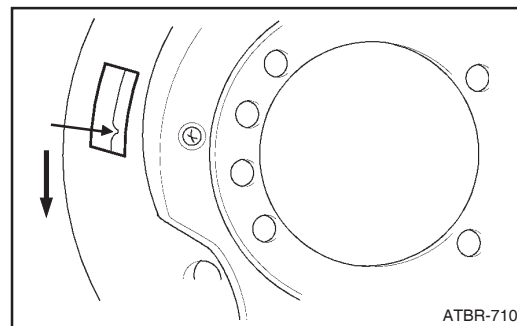
All rubber parts are to be renewed not later than every 2 years. This also applies to the shoe return and hold-down springs (4,8). Should the springs become damaged, e.g. over extended, corroded, overheated etc. beforehand, an earlier replacement is necessary.

Brake lining replacement

The brake lining must be renewed when its remaining thickness has reached 4,5 mm or the wear indicator step in the lining, or when they have become burned, glazed or contaminated with oil.

The visual control should be carried out in defined intervals according to duty levels, the leading shoe lining has the higher wear rate.

- **Only brake lining material which is approved by the vehicle manufacturer may be used.**
- **When replacement is necessary then all linings in the brakes or the axle must be used.**



Should the drum wear be greater than the lining to drum clearance thus preventing renewal of the drum, de-adjustment of the brake shoes will be necessary. This is carried out by engaging a screwdriver, in the toothed wheel 33 via the opening (arrow) in cover 5 and turning the toothed wheel 33 in the clockwise direction until sufficient clearance is attained.

Upon renewal of the drum the resetting of the adjuster screw 15 can be done by hand.

Remove the upper and lower return spring 4 with a suitable tool (Screwdriver) and withdraw the shoes from the hold-down spring 8. De-rivet the lining by removing the peened end of the rivet with a drill tacking care not to enlarge the rivet holes in the shoe. Clean shoe and ensure it is not damaged or deformed. Fit new linings holohedral to the shoes.

Before assembly of the brake the new lining should be turned or ground to a diameter of 359,5-1,5 mm by a drum diameter of 360mm, to ensure a correct lining/drum fit and facilitate the bedding process. By overturning observe the expander unit distance "S" of 158 mm. The thickness of the standard size lining is dimensioned accordingly. If machine equipment is not available, the thinner service lining should be used.

Actuating cylinder replacement

Release lock nut and remove cylinder. Screw lock nut onto new cylinder by at least 27mm, smear cylinder thread with TEROSON-ATMOSIT. Screw the cylinder in to the thread of the expander unit until abutment and then return so far to obtain the requisite position of the air connection.

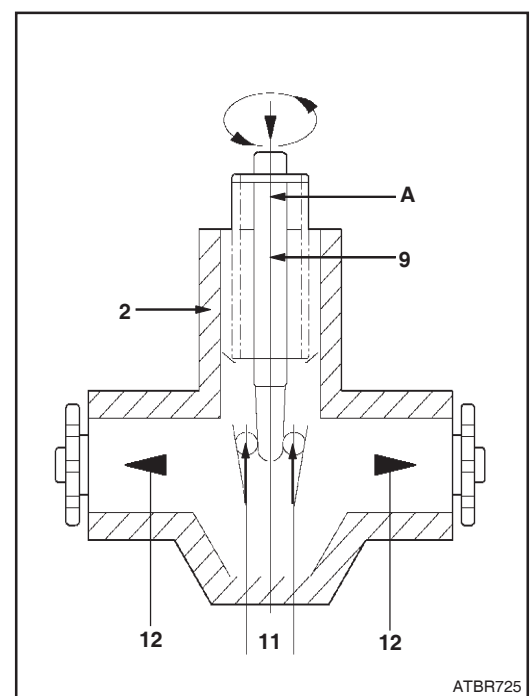
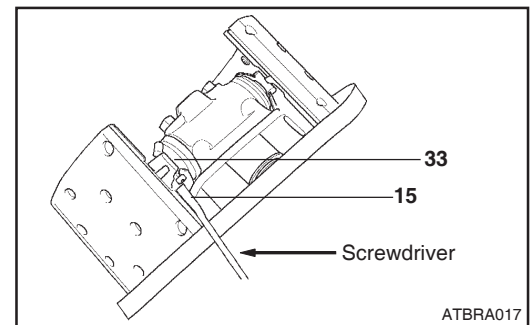
The lowest drainage hole must be open and point as near as possible vertical to the ground.

It is very important that the lowest hole remains open and the other holes are sealed with a plug.

Tighten lock nut with a tightening torque $300 \pm 20 \text{ Nm}$.

During the assembly of the operation cylinder it has to be generally noted, that the free end of the wedge, which reaches out of the wedgd assembly housing is aligned according to the housing center A - see illustration and not sloping. If it is sloping it is possible, that the wedge is not in it's correct position, i.e. the rollers 11 are not in contact with the pistons 12.

To avoid mistakes during the reassembly of the operation cylinder, it is necessary to follow the work sequences and notes below.



SERVICE PROCEDURE

BRa-51

1. Align the wedge 9 with the axle A of the wedge assembly housing.
2. Push the wedge 9 in this position in the direction of the arrow into the housing 2. The rollers 11 must point in the direction of the pistons 12.
3. It has to be noted, that the rollers with their cage are not allowed to rest on the guide at the side of the housing.
4. Place the rollers carefully between the pistons. The roller cage shall not abut at the edge of the piston.

NOTE

- ? **It is possible to check the original position of the wedge. With a slight pressure of the hand rotate the outer end of the wedge. Does it move more into the housing, the correct position was not reached.**

Continuing the assembly of the brake system, i.e. fixing of the operation cylinder at the brake, it must be sure, that the wedge keeps in its original position.

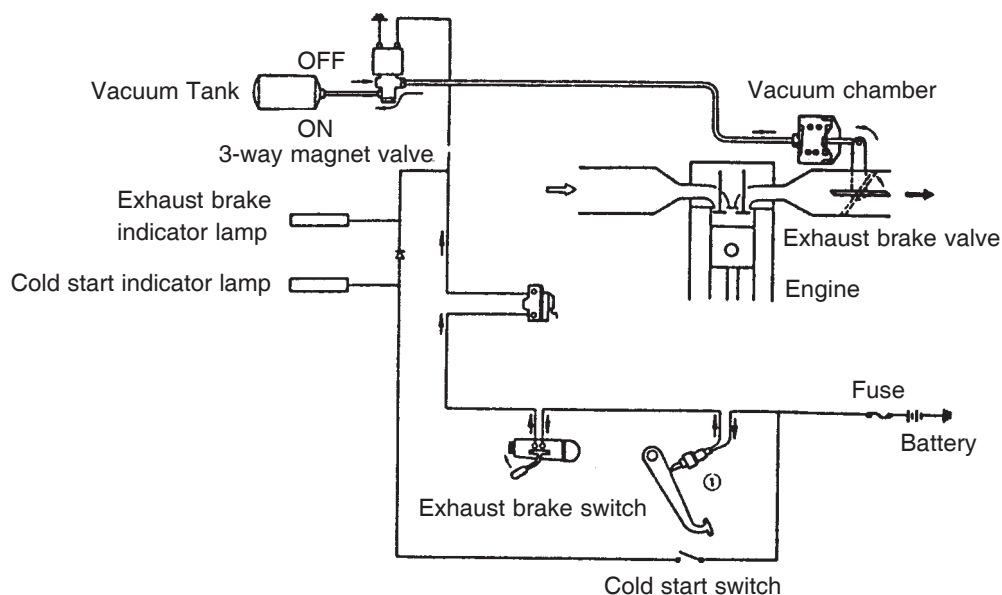
Maintenance and assembly of the expander unit

The adjuster is in principle maintenance free. The expander unit should be inspected for damage and wear after not more than 2 years in service. Should damage occur beforehand, or the expander unit or adjuster mechanism fail, then these parts should be replaced completely.

In any case the rubber parts must be renewed every 2 years.

Damaged rubber parts must be replaced directly.

Exhaust Brake

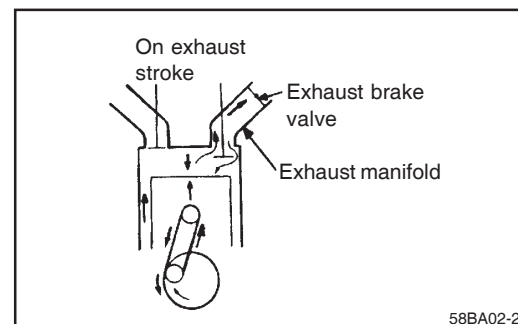


VB58133

The exhaust brake system, functioning as an auxiliary brake for the foot brake, consists of the butterfly valve type exhaust brake unit and the intake silencer that minimizes intake noise occurring when the exhaust brake is activated.

When the exhaust brake switch is turned ON, the 3-way magnet valve actuates causing air pressure in the air tank to be delivered to the control cylinder of the exhaust brake unit. This closes the exhaust brake valve, thus activating the exhaust brake. At the same time, the air pressure is delivered to the control cylinder of the intake silencer, which closes the intake silencer valve. Depression of either clutch pedal or accelerator pedal, or shifting into natural turns OFF the electric circuit temporarily, deactivating the exhaust brake system.

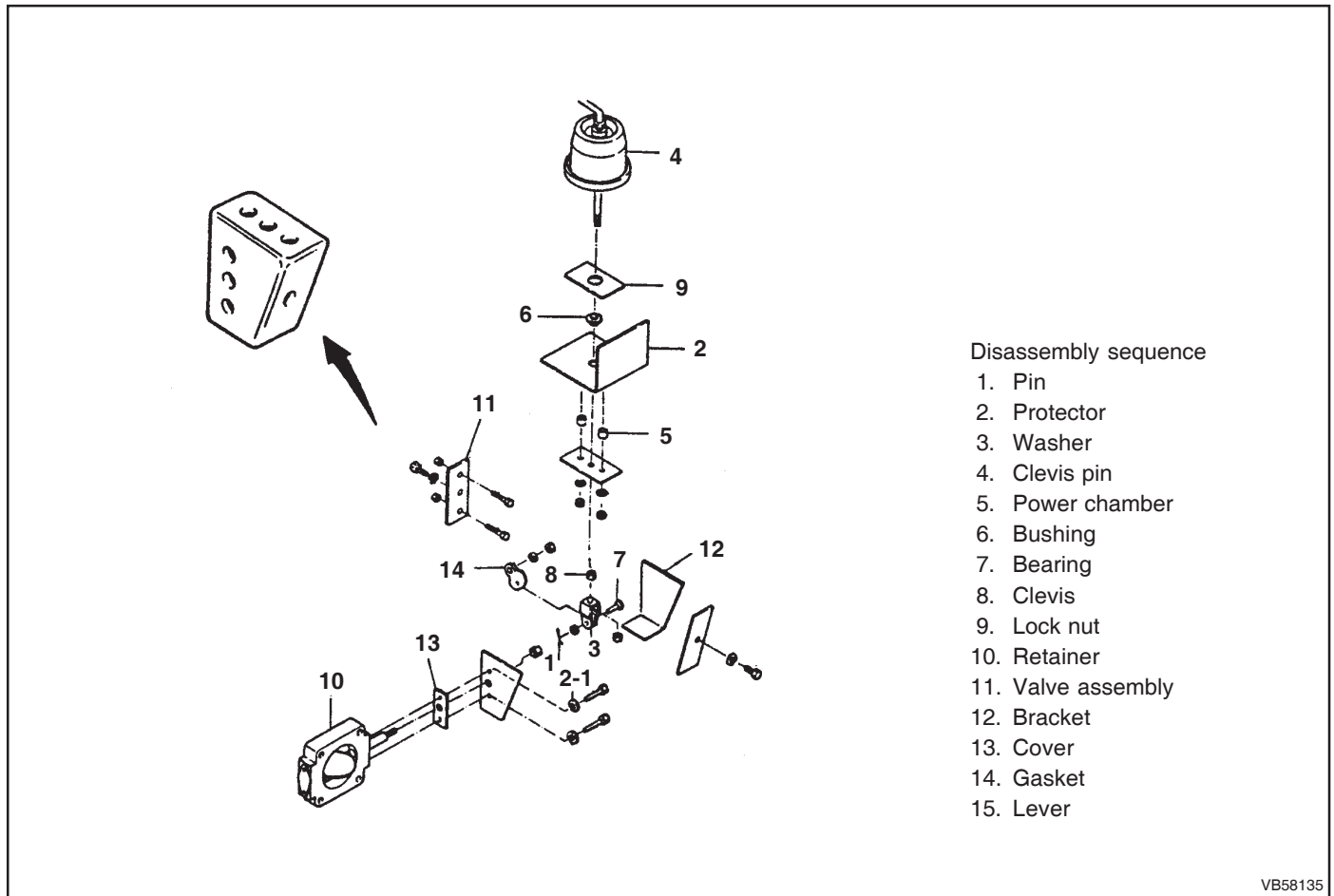
The pressure inside the exhaust pipe building up when the exhaust pipe is closed is applied to the piston as a counteracting force during the exhaust stroke, which offers the braking force.



58BA02-2

EXHAUST BRAKE

Exhaust brake valve



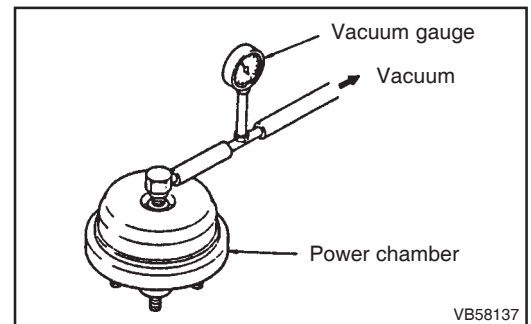
VB58135

Inspection

Airtightness check

- 1) Apply vacuum of -500mmHg or more to power chamber and check wheather the vacuum gauge indicates nominal vlue after 15 seconds

Nominal value	-475mmHg or more
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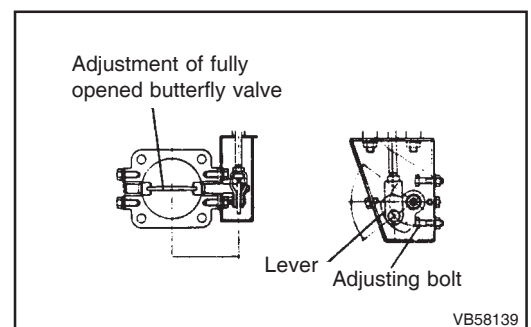


VB58137

Assembly procedure

- 1) Adjustment of fully opened butterfly valve.

Turn the adjusting bolt until the adjusting bolt head reaches the same height as of lever and tighten the bolt with lock nut.



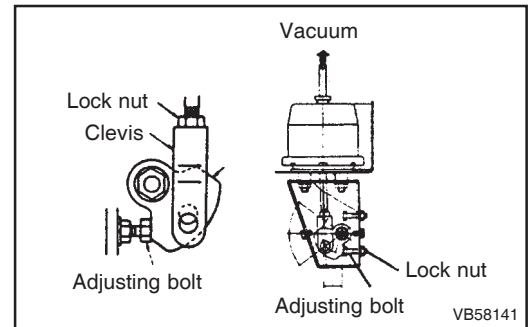
VB58139

BRa-54

BRAKE SYSTEM

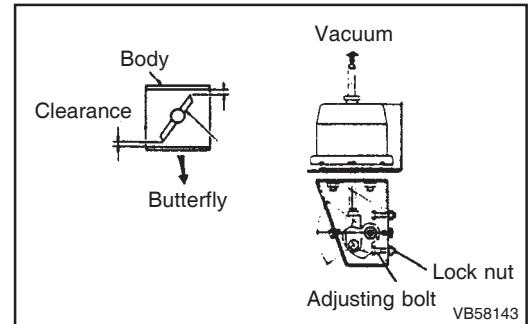
2) Adjustment of clevis length

Depress the power chamber to the adjusting bolt (of fully opened position) contacts with lever then adjust the clevis position as shown is illustration beside and tighten with lock nut.

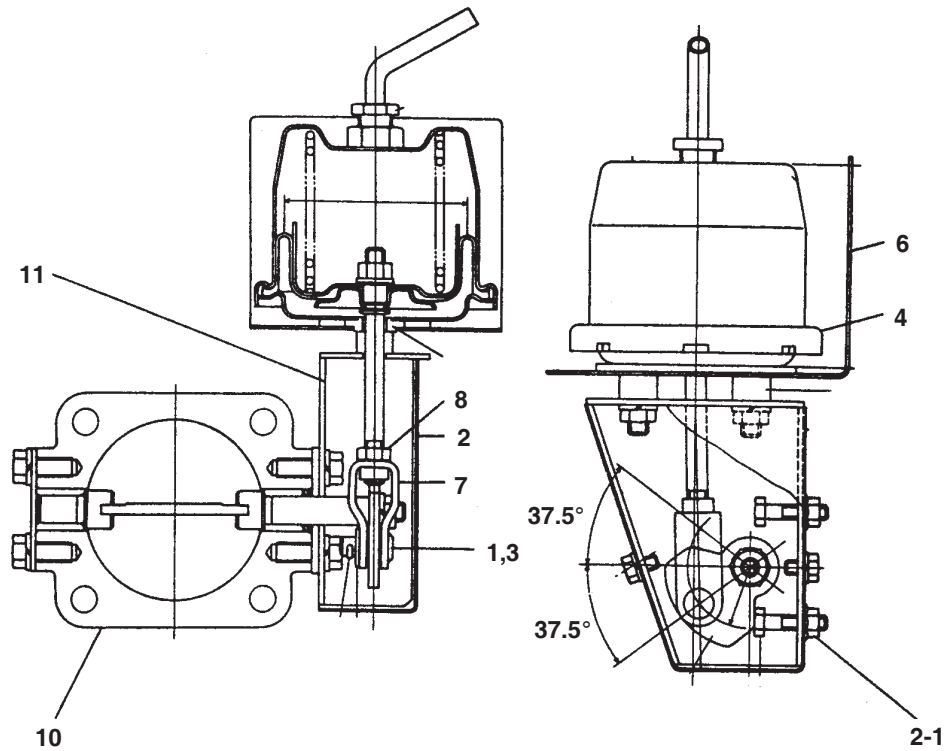


3) Adjustment of closed butterfly valve

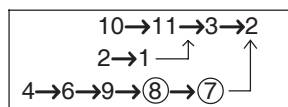
While applying -650mmHg of vacuum pressure, turn the adjusting bolt and make sure that the clearance between butterfly valve and body is to 0.4~0.6 mm then tight the lock nut.



Reassembly



Reassembly sequence



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Poor braking action	Loosen of brake fluid	Check for brake fluid leaks, correct and add brake fluid
	Air in system	Bleed the system
	Leaks in brake fluid line	Correct the leaks and add brake fluid
	Leaky brake master cylinder and wheel cylinder	Correct or replace the assembly
	Excessive brake shoe clearance	Adjust shoe clearance. If brake lining wears exceeding the limit, replace the lining.
	Worn brake lining	Replace brake lining
	Defective master cylinder, wheel cylinder, and hydromaster	Check the parts and replace as necessary
	Water or grease between the brake drum and brake lining	Clean, or replace brake lining
	Burnt brake lining	Replace brake lining
	Poorly lubricated brake booster power cylinder or air leaking due to damaged rubber packing	Replace defective parts and lubricate power cylinder
Excessive pedal travel	Excessive brake shoe clearance	Adjust shoe clearance. If brake lining wears exceeding the limit, replace the lining.
	Loss of brake fluid	Check for brake fluid leaks, correct and add brake fluid
	Leaks in brake fluid line	Correct the leaks and add brake fluid
	Leaky brake booster	Check the parts and replace as necessary
	Defective brake master cylinder piston cup	Replace piston complete
	Air in system	Bleed the system
	Excessive brake pedal play	Check and replace parts as necessary
Vehicle pulls to one side when braking	Improper brake shoe clearance or brake lining contact	Adjust shoe clearance. Replace linings.
	Grease on linings or drum internal surfaces	Remove contaminants or replace linings
	Brake drum runout or left loose	Correct runout. Tighten drum to specification.

TROUBLESHOOTING
BRa-57

Symptom	Probable cause	Remedy
Vehicle pulls to one side when braking	Tires not uniformly inflated	Inflate correctly
	Mismatched lining materials	Use same linings
	Brake shoe return spring lost tension or broken	Replace return spring
	Chassis spring U-bolt left loose	Tighten U-bolt nut to specification
	Distorted backing plate	Replace backing plate
	Defective wheel cylinder	Disassemble wheel cylinder, check body, piston, and cup, and replace parts as necessary
All brakes drag	Small brake shoe clearance	Adjust shoe clearance on four wheels
	No play in brake pedal; poor brake pedal return action	Adjust play in brake pedal. Lubricate collar and bushing internal surfaces for smooth brake pedal action.
	Weak or broken brake pedal and brake master cylinder return springs	Check and replace as necessary
	Plugged brake master cylinder return port	Disassemble and clean
	Brake master cylinder piston cup deformed	Replace piston complete
	Defective brake booster relay valve	Replace binding relay valve piston
	Defective brake booster power piston	Lubricate rubber packing as necessary
One brake drags	Small brake shoe clearance	Adjust shoe clearance
	Weak or broken brake shoe return spring	Replace
	Restricted oil pipe	Clean or replace
	Brake shoe assembly installed improperly	Correct
	Defective wheel cylinder	Check piston and piston cup and replace as necessary
Brakes squeak	Brake drum dragging	Check and correct by referring to above
	Brake linings are worn causing the drum to come into contact with rivet heads	Replace linings
	Hardened lining surfaces	Replace linings
	Rough or worn brake drum internal surfaces	Correct surfaces or replace
	Brake drum becoming loose	Tighten to specification
	Brake shoe not in tight contact with lining	Replace linings
	Brake shoe assembly installed improperly	Poor braking action or sticking brake pedal

Symptom		Probable cause	Remedy
Poor braking action or sticking brake pedal		Complete vacuum in not created	Check connections and pipings and replace as necessary. Or check vacuum pump.
		Vacuum is not held properly	Check connections and pipings and replace as necessary. Or, check the vacuum tank check valve, brake booster poppet valves (vacuum valve, air valve), power piston packing, and diaphragm and replace as necessary
		Defective brake booster relay valve	Check the brake booster fluid line and clean and replace as necessary
Poor braking action		Brake booster not airtight	Check poppet valve (air valve), power piston packing, and diaphragm for airtightness and replace as necessary
Pedal springs back		Brake fluid on the wheel cylinder side flows back to the master cylinder side at the hydraulic cylinder of brake booster	Replace hydraulic piston assembly or cup packing
Starting the engine produces braking		Defective brake booster relay valve	Check for relay valve piston's return motion and valve seals and replace as necessary
Exhaust brake	Exhaust brake ineffective	Abnormal air pressure	Check for air compressor performance and piping and correct as required Check and repair clutch switch, microswitch, and exhaust brake harness
		Faulty electrical circuit	Replace
		Air piping crushed	Replace
		3-way magnet valve inoperative	Clean
		Exhaust brake valve inoperative	Replace
		Exhaust brake valve shaft sticking	Disassemble control cylinder and replace defective parts
		Control cylinder inoperative	Replace
	Exhaust brake cannot be released	3-way magnet valve inoperative	Clean
		Exhaust brake valve inoperative	Replace
		Exhaust brake valve shaft sticking	Check and repair clutch switch, microswitch, and exhaust brake harness
		Faulty electrical circuit	Replace

TROUBLESHOOTING

BRa-59

(1) Wheel brakes

Symptom		Probable cause	Remedy
Poor braking action	Air leaks when brake pedal is depressed	Loosen connectors	Tighten connectors
		Leaky primary and secondary valves of dual brake valve	Disassemble dual brake valve to remove foreign matter or replace inlet valve
		Damaged dual brake valve O-ring	Disassemble dual brake valve and replace O-ring
	Air leaks when brake pedal is released	Loosen connectors	Tighten connectors
		Leaky primary and secondary valves of dual brake valve	Disassemble dual brake valve to remove foreign matter or replace inlet valve
	Low air pressure	Air leak	Check air line and correct air leaks
		Air pressure governor improperly adjusted	Adjust air pressure governor
		Air compressor malfunctioning	Overhaul air compressor
	No air leaks	Brake booster power cylinder poorly lubricated or rubber parking damaged	Apply grease to cylinder shell inner surface and rubber packing. Replace damaged rubber parking
		Poor sealing by the brake booster hydraulic piston valve seal	Replace the valve seal
		Damage or wrong cup packing in brake booster hydraulic piston. Or foreign matter deposited on packing.	Replace and reinstall correctly the cup packings
		Excessive brake shoe clearance	Adjust shoe clearance. Replace brake lining if it has worn to limit.
		Oil or grease on brake lining	Wash deposits off the surface or replace brake lining
		Hardended lining surface	Machine brake lining surface or replace lining
		Brake fluid leak from fluid circuit or loss of brake fluid	Correct the leaks and bleed the system. Or add brake fluid up to "H" level.
		Air in fluid line	Bleed the line
		Worn wheel cylinder cup resulting in brake fluid leak	Replace cup

BRa-60
BRAKE SYSTEM

Symptom		Probable cause	Remedy
Brake drum over-heats	The brake shoes are not moving away from the brake drum when the brake pedal is released (brake dragging)	Improper return motion of the primary or secondary valve of the dual brake valve, or exhaust port being plugged with foreign matter	Disassemble, check, and clean dual brake valve and correct problem or replace
		Brake booster exhaust port plugged with foreign mater	Disassemble, check, and clean brake booster and correct problem or replace
		Bent brake booster push rod	Replace push rod
		Brake booster power cylinder rubber packing poorly lubricated	Apply grease to rubber packing
		Small brake shoe clearance	Adjust shoe clearance
		Weak or broken brake shoe return spring	Replace return spring
		Poor return motion of wheel cylinder piston and cup	Replace piston and cup
		Brake fluid not returning due to blocked brake pipe and joint	Remove and flush with brake fluid, or replace
Brakes are noisy when pedal is depressed		Brake lining worn to allow rivet head to be exposed	Replace brake lining
		Hardened brake lining	Replace brake lining
		Unevenly worn brake drum inner surface	Machine or replace drum
		Brake shoe not in tight contact with brake lining	Replace brake lining
		Brake drum left loose	Retighten
Vehicle pulls to one side when brake pedal is depressed		Improper brake shoe clearance or brake lining in poor contact	Adjust shoe clearance. Correct poor contact or reline brake lining
		Oil or grease on brake lining and brake drum inner surface	Completely remove deposits or reline brake lining
		Brake drum runout, or left loose	Correct runout. Retighten
		Uneven right and left inflation pressures	Adjust to specified inflation pressure
		Different brake lining materials used	Reline brake lining or pad of the same material
		Weak or broken brake shoe return spring	Replace return spring
		Chassis spring U-bolt left loose	Retighten
		Deformed backing plate	Replace backing plate
		Wheel cylinder piston malfunctioning	Disassemble when cylinder, check body, piston, and cup, and replace any defective part
Abrupt braking action of wheel brakes		Small brake shoe clearance	Adjust shoe clearance
		Large brake shoe clearance	Adjust shoe clearance
(①) indicator lamp lights up		Air in brake system	Bleed system
		Brake fluid leak from fluid circuit	Correct leaks

TROUBLESHOOTING

BRa-61

(2) Air dryer

Symptom		Probable cause	Remedy
Air dryer	Air tank drain cock drains	Desiccant becoming ineffective	Replace desiccant, oil filter, and filter
	Exhaust port does not drain	Heater fails to operate and air dryer is frozen	Replace heater if defective. Replace thermostat if defective
	Air dryer interior is frozen	Valve inoperative due to foreign matter trapped	Disassemble and check valve and replace valve complete as necessary
		An open-circuited heater aggravating heat insulating effect	Check heater for continuity with a multimeter and replace heater if there is an open circuit
		Heater inoperative due to defective thermostat	Use following procedure to check thermostat and replace if found defective o Leave thermostat under environment 0°C or below and check for continuity using a multimeter. o heat thermostat to make sure that it turns OFF at temperature between 0°C and 20°C.
		Snow being packed on air dryer, lowering temperature to an abnormal low	Remove snow and ice with care not to damage air dryer and heater wires
		Heater inoperative due to heater and thermostat wires left disconnected	Connect heater and thermostat wires properly
	Air leaks from exhaust port	Valve fails to seat properly due to foreign matter	Disassemble and check valve and replace valve complete. Or replace valve body if its sliding surface is damaged.
	Engine oil is discharged from exhaust port	Oil working up in air compressor	Replace piston rings an cylinder liner

ANTI-LOCK BRAKE SYSTEM

GENERAL	BRb - 2
SERVICE PROCEDURE	BRb - 8
TROUBLESHOOTING	BRb-12

GENERAL

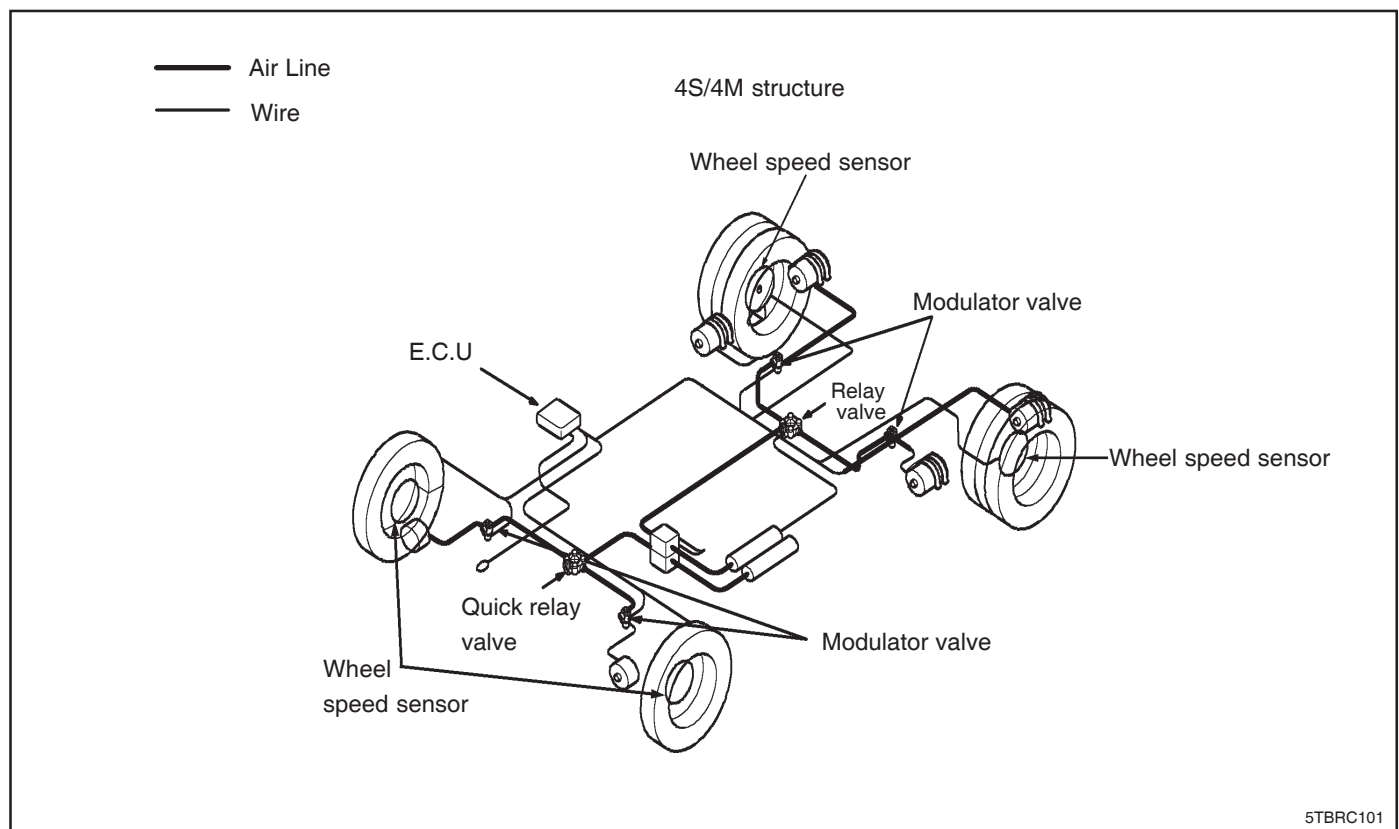
A.B.S

1. A.B.S Function

When vehicle is braked while driving, or braked suddenly, or road is slippery due to rain or snow, skid happens easily. When skid happens, braking force is reduced and stopping distance is lengthened. Or it may cause an accident because the vehicle slips to the wrong direction and handle steering is worsened. So ABS is a safety seeking system that prevents wheel stuck or slips to maintain the vehicle direction stability and ensures the steering control and achieves optimum stopping distance.

2. Structure of A.B.S

- 4S/3M (4 Wheel speed sensors, 3 Modulator valves) : AOH BRAKE
- 4S/4M (4 Wheel speed sensors, 4 Modulator valves) : FULL AIR BRAKE



4S/4M is a basic structure diagram in this book.

GENERAL**BRb-3****3. A.B.S Warning lamp**

ABS warning lamp operates as follows.

Ignition Switch ON. 	Normal operation	A.B.S warning light turns off after flashing instantly.	System is in normal operation
	After repairs of A.B.S system	A.B.S warning light remains on when ignition switch in the ON position	Lamp turns off if the vehicle drives faster than 7 km/h and system is in normal operation.
	Defective.	A.B.S warning light remains on when ignition switch in the ON position	Warning light remains on when the vehicle drives faster than 7 km/h. ABS system is defective.

SPBR-005

If the ECU senses a fault when driving a vehicle, ABS warning light turns on.

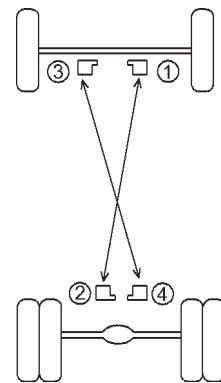
4. ABS modulator valve

ABS modulator valve controls air pressure of corresponding brake. 2 modulator valves of rear axle wheel are installed at the right side frame of rearward, and 2 A.B.S modulator valves are installed at front axle frame. And relay valve is used to deliver air pressure to the A.B.S modulator valve.

* Easy detection by sound

We can check ABS operation by the air breathing sound coming from ABS modulator valves.

1. Brake pedal is depressed
2. Turn on the Ignition switch
3. Wait for ABS warning light turns on
4. Listen to the valve cycle one by one at the diagonal direction.

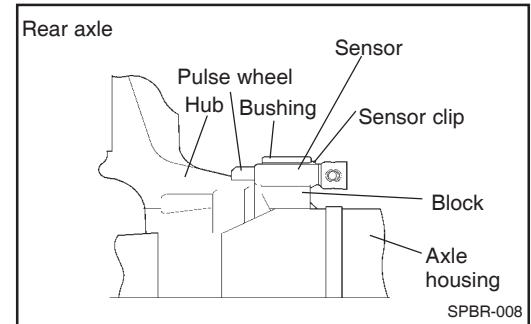
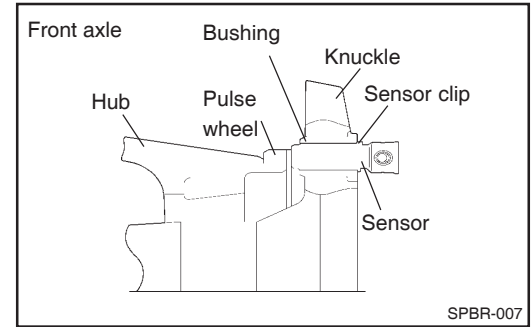


5TBRC-102

5. ABS sensor

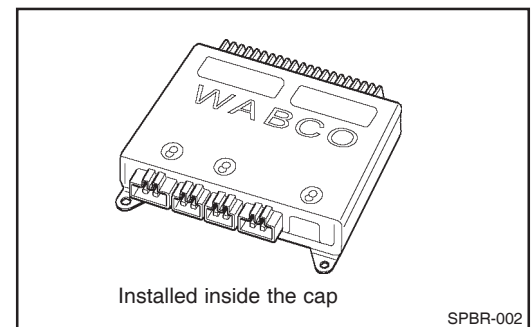
ABS system consists of pulse wheel installed at the wheel hub, and sensor at the opposite direction of the pulse wheel. Sensor feedback the information on the wheel speed to the ECU continuously. The shape of shafts sets sensor position.

- Steering shaft sensor is installed at the steering knuckle.
- Drive shaft sensor is installed at the shaft-housing block.



6. Structure of E.C.U system

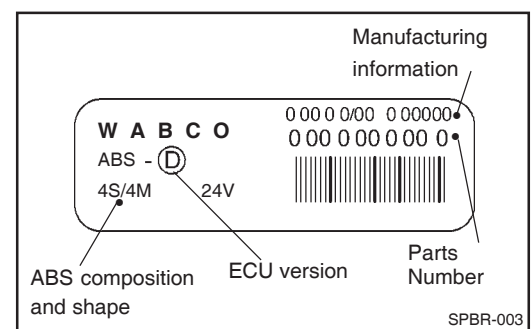
ECU corresponds to the brain of ABS system. This system receives the information from sensors and remits the signals to ABS modulator valve.



ECU version is displayed on the part number identification tag.

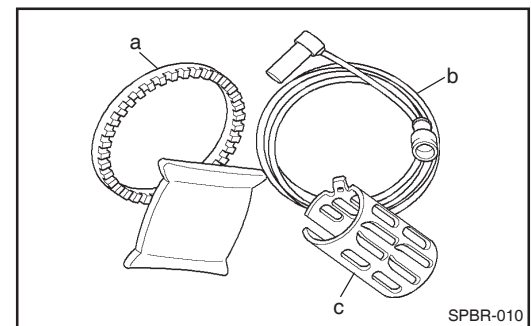
4S/4M (F/AIR) : 446 004 411 0

4S/3M(AOH) : 446 004 413 0



WHEEL SPEED SENSOR

Pulse wheels (a) are installed at the wheel hubs facing the ends of sensors (b). Sensor is fixed with sensor clip (c).



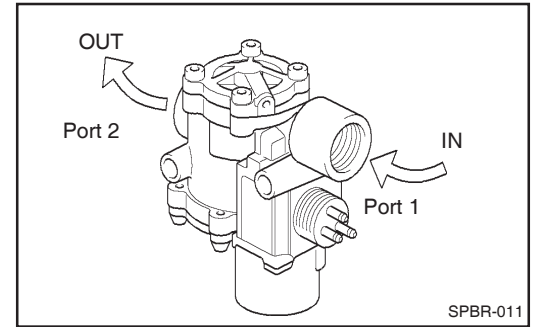
GENERAL

BRb-5

A.B.S modulator valve

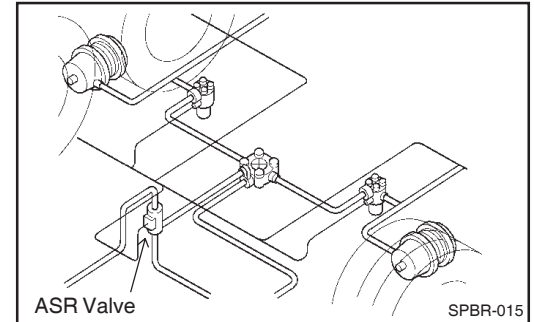
ABS modulator valve controls the air pressure of the corresponding brake in ABS operation.

Generally speaking, modulator valve is placed on the cross member or frame side rail near brake chamber.

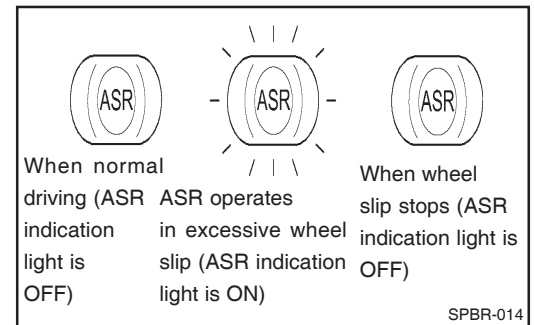


ASR operation principle

1. This system reduces the slips of driving wheel when driving on a slippery road, and improves the towing capability. If one driving wheel starts slip, ASR applies air pressure to brake the wheel and then engine torque is delivered to the better towing wheel.



2. Since ASR operates by itself, driver doesn't have to select on/off mode. When driving wheel slips in acceleration, ASR indication light turns on and it stops when slip stops.

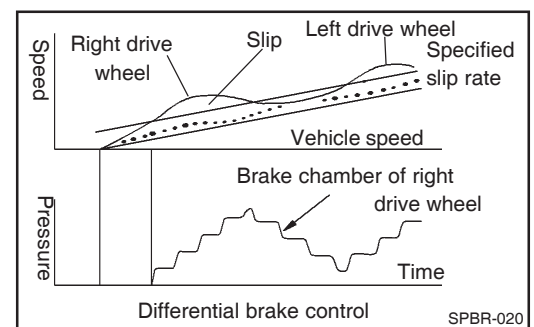


3. When ASR is installed, ASR is displayed on the meter set as "ASR".

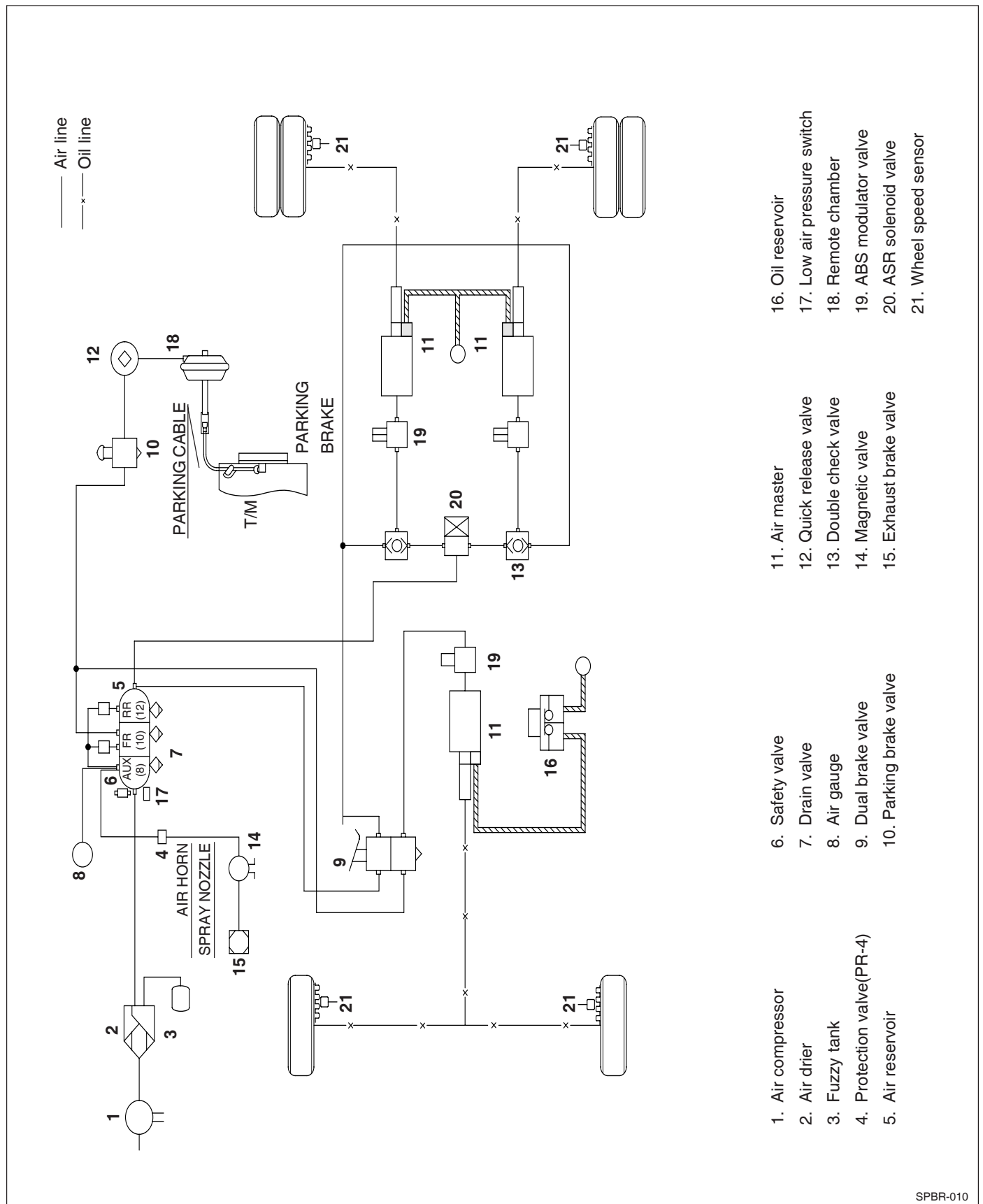
ASR OPERATION

1. Differential Brake Control

If the slip rate of one drive wheel exceeds specified slip rate, ECU controls ASR valve and ABS modulator valve to brake the slipping wheel. If the slip rate lies within the specification, brake is released.



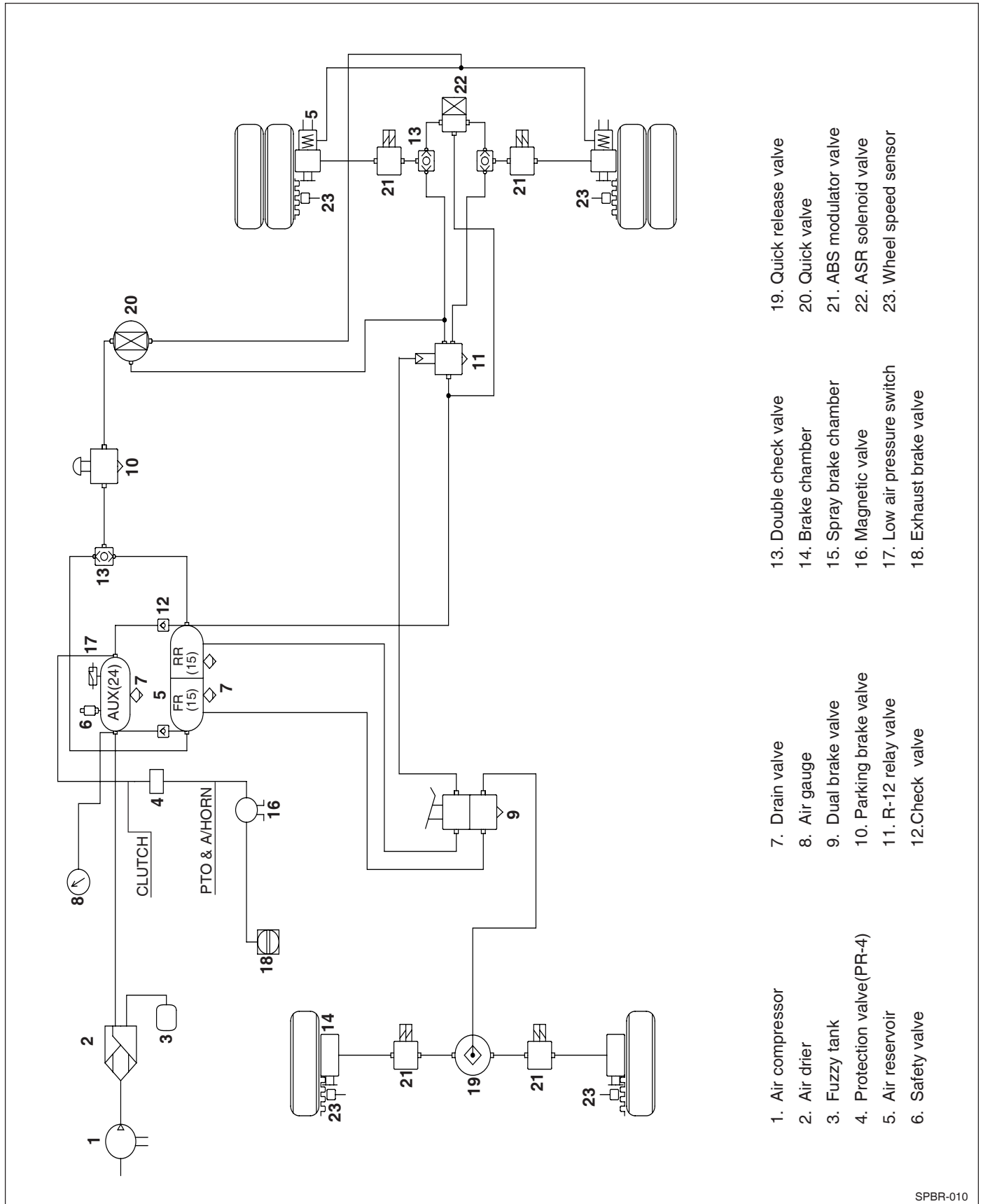
Air over hydraulic brake



GENERAL

BRb-7

Full air brake



SPBR-010

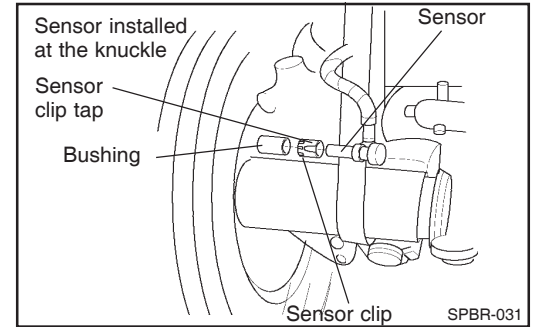
SERVICE PROCEDURE

WHEEL SPEED SENSOR

1. Removal of wheel speed sensor-Front Axle
 - Block both the rear tires and apply the parking brake firmly.
 - Lift up the tire and put a safety support beneath the axle if needed.
 - Remove the wire clamp, which holds the sensor cable.
 - Remove the sensor cable from chassis wires.
 - Remove the sensor from sensor holder and rotate to remove if needed. Do not pull the cable
2. Installation of wheel speed sensor – Front axle
 - Connect the sensor cable to chassis wires.
 - Install the wire clamp to fix the sensor cable.
 - Apply the lubricant recommended by WABCO on the sensor spring clip and sensors.
 - Install the clip onto the sensor spring. Check the spring clip tap to face inside of the vehicle.
 - Push to insert sensor spring clip to bushing of the steering knuckle until the clip stops.

[Caution]

- **Push by hands without using the tools.**
3. Push the sensor fully inside the sensor spring clip until it touches pulse wheel.
 4. Remove the block and supports.



Removal of the wheel speed sensor – Rear axle

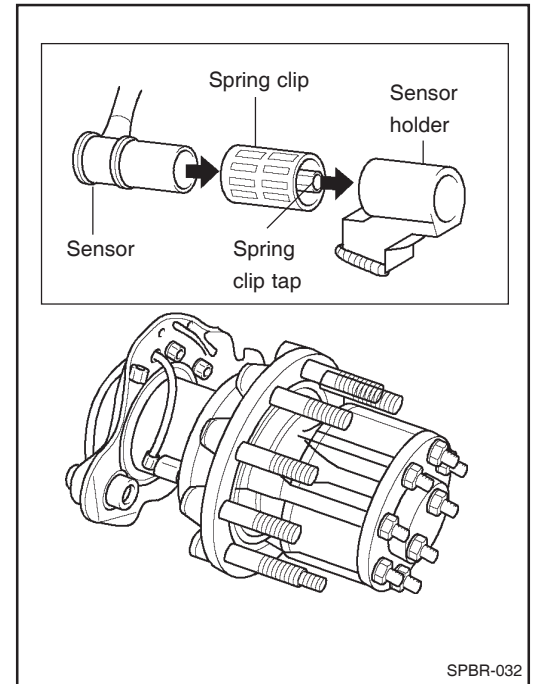
1. Block the tires so that the vehicle won't move
2. Lift up the rear tire and put a safety support beneath the axle
3. Release the parking brake, and rotate the slack adjuster to lengthen the lining clearance.
4. Remove wheel and tire assembly from the shaft.
5. Remove the brake drum and hub.
6. Remove sensor from the mounting block of the axle housing. Rotate it to remove if needed. Do not pull the cable.
7. Remove the sensor spring clip from mounting block.
8. Remove sensor cable clamp.
9. Remove the sensor cable from chassis wire.

SERVICE PROCEDURE

BRb-9

Installation of wheel speed sensor - Rear Axle

1. Apply the lubricant recommended by WABCO on the sensor spring clip and sensor.
2. Install sensor spring clip. Check whether spring tap clip faces inside vehicle.
3. Push to insert sensor spring clip to sensor holder until the clip stops.
4. Push the sensor fully inside the sensor spring clip until it touches pulse wheel.



5. Be careful with the sensor cable not to interfere with brake shoe.
6. Note that cable shouldn't be tightened too much nor cut off, and enough space should be assured for the moving of suspension system.
7. Connect sensor cable to chassis wire.
8. Install sensor cable clamp.
9. Install wheel hub and brake drum assembly.

CAUTION

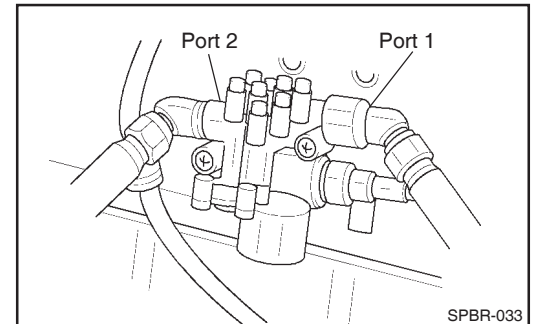
- Be careful not to shock to the wheel speed sensor.

10. Adjust the sensor using flange hole of axle if needed with the rod of $\varnothing 5$. When the adjustment is not enough, readjust it after removing drum assembly.

A.B.S MODULATOR VALVE

Removal of A.B.S modulator valve

1. Set the ignition switch at "OFF" position and apply the parking brake firmly
2. Block both front and rear tires so that the vehicle do not move.
3. Lift up the tires and put a safety support beneath the axle if needed.
4. Remove the wire connector from ABS valve
5. Remove the air-line from ABS valve port 1 (inlet) and port 2 (outlet).
6. Remove 2 mounting screws and nuts.
7. Remove ABS valve.



Installation of ABS modulator valve

1. Install ABS valve with 2 mounting screws and nuts. Tighten the screw with the specified torque.
2. Connect the brake chamber line to ABS port 2. Connect the air supply to ABS valve port 1.
3. Connect the wire connector to ABS valve and tighten it with bare hands.
4. Remove the block and safety support.
5. Check the installation state.

Installation check

1. Apply the brake and listen to the air outlet sound from ABS modulator valve.
2. Check the electrical cable connection, when something is wrong with ABS modulator valve cycle after key switch on.
3. Check whether ABS warning light works properly while driving the vehicle.

ASR VALVE

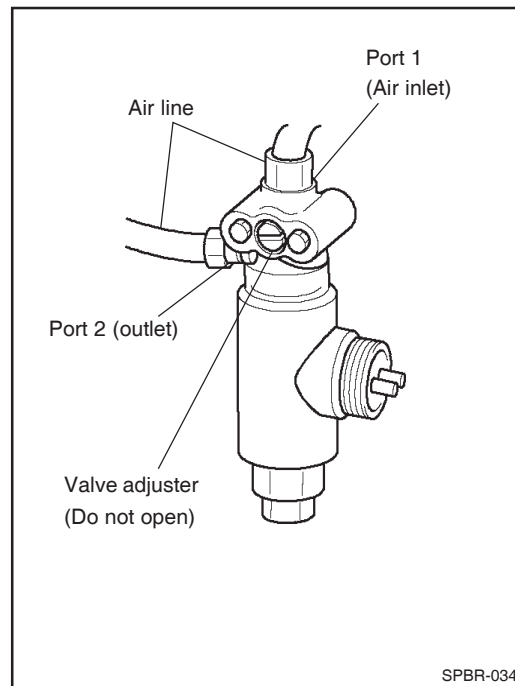
Working principle of ASR valve

1. Turn the key switch "off:" and apply the parking brake.
2. Block the front and rear tires so that the vehicle won't move anyway.
3. Lift up the vehicle and safety support beneath the shaft, if needed.
4. Reduce the air pressure by releasing air from the air pressure tank.
5. Remove the key switch from ASR valve.

SERVICE PROCEDURE

BRb-11

6. Remove the air-line from the port 1 (inlet) and port 2 (outlet) of ASR valve.
7. Remove 2 mounting screws and nuts. Remove ASR valve.



Installation of ASR valve

1. Install ASR valve with 2 mounting screws and nuts and tighten the screws with the specified torques.
2. Connect the air inlet line and air outlet line to port 1 and port 2 respectively.
3. Connect the wire connector to ASR valve and tighten with the bare hand.
4. Remove the block and safety support.
5. Check the installation state.

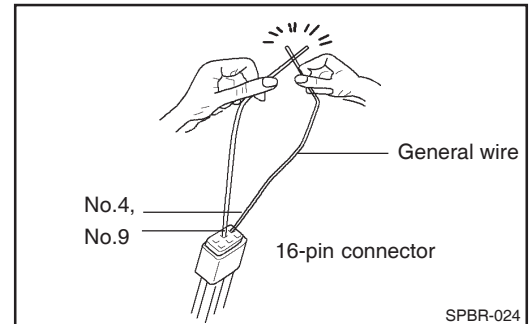
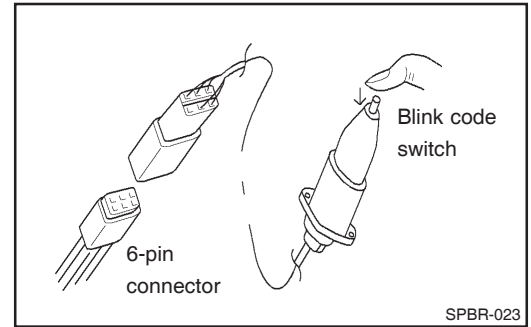
Installation check(Check for diagnostic device)

1. Start the engine.
2. Fill the air tank fully and park the car.
3. Press the brake pedal.
4. Operate and check the ASR valve.
5. Listen to the exhaust sound of ASR valve.
6. Release the brake pedal.
7. Remove the diagnostic device.
8. Check whether ABS warning lamp turns off while driving.

FAULT DIAGNOSIS AND TROUBLESHOOTING

1. Diagnosis

- **Blink code diagnostic**
Connect the connector under the instrument panel to the blink code switch. Diagnose any fault by operating the switch button as specified.
- **Scan tool diagnostic**
Diagnose as the operation manual by connecting connector under the instrument panel to the connector of the diagnostic tool.
- **When no tool is available.**
Connect the 2 wires to the connector as shown in the figure. Then you can diagnose by the blink code.



* KET TYPE

1	2	3	4	5	6	7	8	
Vehicle Speed	CAN(L) SAE J 1939	LINK(-),B SAE J 1708/1587	ABS CHECK	CAN - L (Low speed)	L-LINE ISO-9141	K/ENTRY CODE SAVING		
9	10	11	12	13	14	15	16	
GND	CAN(H) SAE J 1939	LINK(+),A SAE J 1708/1587		CAN-H (Low speed)	K-LINE ISO-9141		BATT (12V,24V)	

□ : RESERVED

5TBE-101

2. Operation of blink code

Press the blink code switch for a second and release it for the diagnosis.

One of the Following state can be the case in blink code diagnostic.

Symptom	Cause	Troubleshooting
ABS warning lamp doesn't turn on when the engine starts.	Bulb is not tightened enough or blown. Is the bulb blown?	Is the bulb blown? Is the bulb disconnected?
	Improper battery voltage (it must be within 22 and 32v)	Check ECU electrical wire of battery connector. Measure the voltage.
Blink code diagnostic failure (ABS warning lamp is on after the operation of blink code diagnostic)	Improper switch operation time Diagnosis = press it for a second Fault deletion = press it for 3 seconds.	Press the switch as specified.
	Wire connection is wrong.	Check the wire connection
Warning lamp doesn't blink for 8 times quickly after pressing the blink code switch for a minimum 3 seconds.	Fault still remains.	Find out and repair the fault.

TROUBLESHOOTING

BRb-13

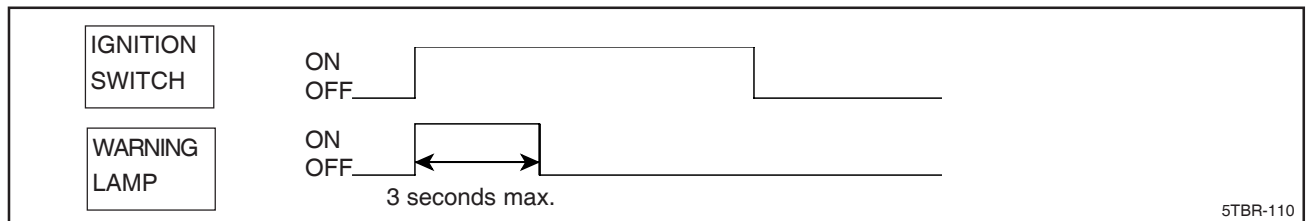
3. Diagnostic procedures

Description	Procedure	Warning lamp blinking	Troubleshooting
Diagnosis	Stage 1 Turn the ignition key on	1. Normal if warning lamp turns on and turns off after a while.	Normal (no troubleshooting is needed)
		2. When warning lamp does not turn on, wire has fault or fuse is blown.	Check wire or bulb.
		3. If the warning lamp is on continuously, one of the following is the case, a. Fault b. Wheel speed sensor fault before engine off. c. Vehicle is not driven after ECU troubleshooting. d. ECU connector is disconnected.	a. Proceed to stage 2 b. Proceed to stage 2. c. It's normal if the warning lamp turns off after driving the vehicle with 7 km/h (no troubleshooting is needed) d. Connect the connector
	Stage 2 Ground the terminal No 4 of diagnosis connector for 0.5 or 3.0 seconds or connect it to the terminal No 9.	Warning lamp blinks with 2-digit blink code.	Judge whether it is actual fault or memorized fault. In case of actual fault. - Repeat the one blink code cycle. In case of memorized fault - Blinking stops after showing the memorized faults. (Displayed only once)
	Stage 3 Check the blink code by counting the blinking	First unit blinking = blinking 1 to 8 times After 1.5 seconds 2nd unit blinking = blinking 1 to 6 times Repeat the first unit blinking after 4 seconds	Find out the faulty position reading the fault codes.
	Stage 4 Turn the ignition key off and shoot the fault.	In case of actual fault In case of memorized fault	Shoot the trouble and Repeat stage 1, 2 and 3 until it shows the normal code (1-1) Record the trouble for later use. (The last fault is displayed first code)
Fault deletion	Stage 5 Turn the ignition key on and ground the terminal No 4 of diagnosis connector for 3.0 or 6.3 seconds or connect it to the terminal No 9.	System code is displayed after warning lamp blinking for 8 times. In case it won't blink 8 times. (System code is displayed)	All faults are deleted. Actual fault remains. (Repeat the stage 1 through stage 5)

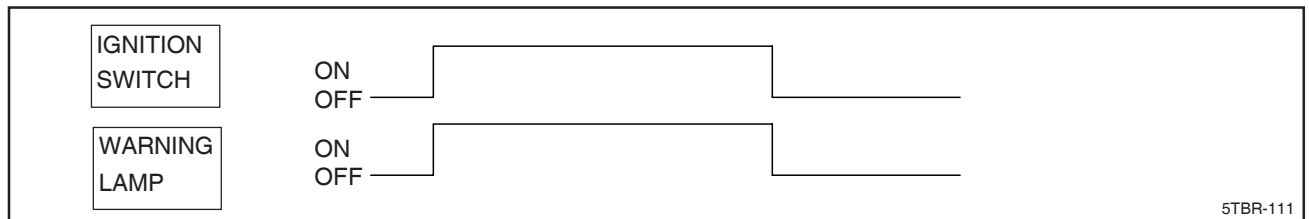
ABS warning lamp mode and blink mode

1. Warning lamp operation

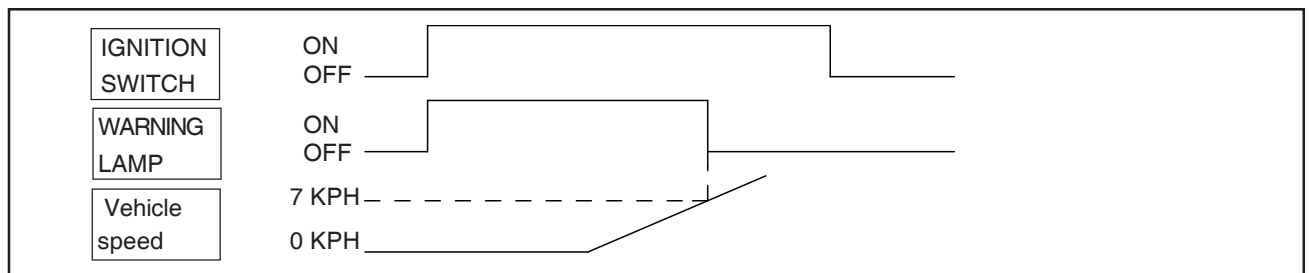
1) When system is normal



2) When system is abnormal (now)



3) When sensor is abnormal in previous ignition on (normal now)



2. Fault diagnosis and fault code deletion using warning lamp

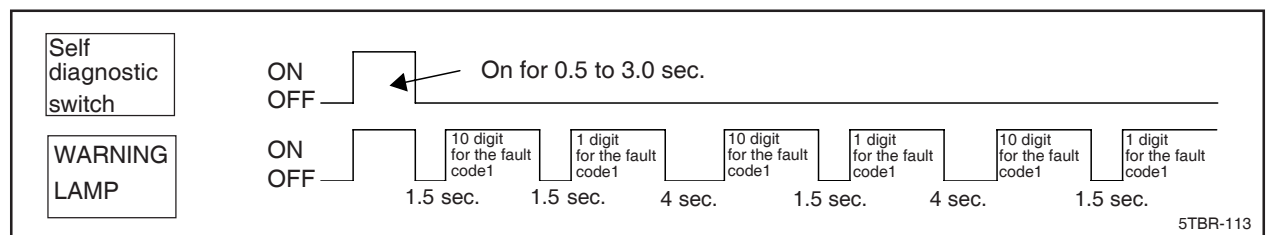
1) Diagnosis mode

a. Self-diagnostic mode start

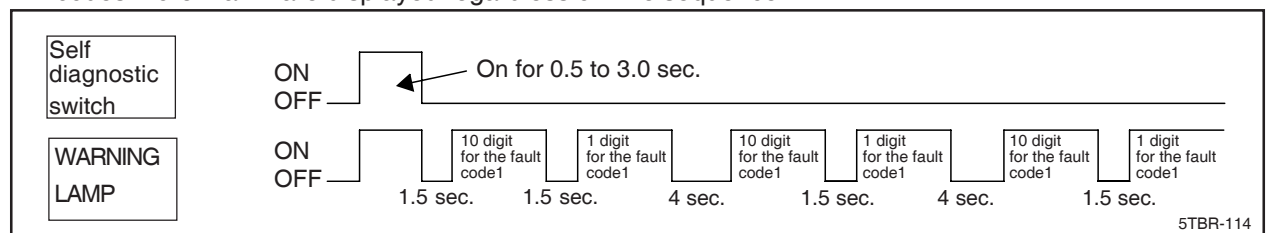
Turn on the self-diagnostic switch on for 0.5 to 3.0 seconds

- If it is faulty now, it displays only 1 fault that happened lately.

※ Turning on the self-diagnostic switch is the same as connecting the terminal No 4 and terminal No 9 of the KET type diagnosis connector.



- If it is not faulty now, it displays the latest 4 fault codes in sequence from the latest one and the other fault codes more than 4 are displayed regardless of time sequence.



- Self-diagnostic mode terminates once ignition switch is turned off or vehicle speed is detected.

- Self diagnostic switch
- ON for 0.5 to 3.0 sec.
- ON for 6.3 to 15 sec.
- WARNING LAMP
- ON
- OFF
- 10 digits for the fault code1
- 1 digits for the fault code1
- 10 digits for the fault code2
- 1 digits for the fault code2
- 1.5 sec. 1.5 sec. 4 sec. 1.5 sec.
- 5TBR-115

- Self diagnostic switch
- ON
OFF
- On for 3 to 6 sec.
- WARNING LAMP
- ON
OFF
- 1.5 sec.
- 4 sec.
- 4 sec.
- 4 sec.
- SYSTEM CODE
- 5TBR-116

-
- Self diagnostic switch
- ON
OFF
- On for 3 to 6 sec.
- WARNING LAMP
- ON
OFF
- 1.5 sec.
- 4 sec.
- 4 sec.
- 4 sec.
- 8XFAST: CLEAR ALL
- 5TBR-117

The timing diagram illustrates the sequence of events during a system check:

- Self diagnostic switch:** This signal starts ON, followed by a series of pulses with durations of 0.5 sec, 3sec., 0.5 sec., 3sec., and 0.5 sec. It then remains OFF.
- WARNING LAMP:** This signal starts ON, then turns OFF during the first 0.5 sec pulse. It remains OFF until the end of the third 0.5 sec pulse, after which it turns ON and stays ON through the final 0.5 sec pulse.
- SYSTEM CODE:** A series of four short pulses occurs while the warning lamp is ON.
- 4XFAST: RETARDER RECONFIGURATION:** An arrow indicates this event occurs during the fourth short pulse of the SYSTEM CODE.

5TBR-118

On for 0.5 sec. Off for 0.5 sec. NORMAL

On for 0.1 sec. Off for 0.2 sec. FAST

3. Specification of fault codes

1st digit (Fault type)	2nd digit (Fault location)
1=No faulty	1=No faulty
2=ABS Modulator 3=Too much air gap (Clearance between sensor and pulse wheel) 4=Short or disconnection of sensor harness 5=Sensor signal poor 6=Pulse ring defect	1=FRT STEER AXLE RH 2=FRT STEER AXLE LH 3=REAR DRIVE AXLE RH 4=REAR DRIVE AXLE LH
7=System faulty	1=Data communication poor 2=ASR valve faulty 3=Exhaust brake relay faulty 4=ABS warning lamp faulty 5=Poor set up ASR 6=Poor ASR engine control valve
8=ECU	1=Too low voltage 2=Too high voltage 3=Internal faulty 4=System faulty 4=Ground faulty

TROUBLESHOOTING

BRb-17

Fault location	Faulty Description	Fault Code	System reaction	Remedy type	Remarks
WSS FRT LH	Air gap	32	ABS :	1	
	Tire size	52	Doesn't active at specific	2	
	Short at power supply	42	wheel	3	
	Short at ground	42		4	
	Circuit cut	42	ATC :	5	
	Circuit short	42	Doesn't active	6	
	Pulse ring	62		7	
	Slip	32		8	
	Circuit problem	52		9	
	Speed signal poor	32		10	
	Abnormal speed(Chattering)	52		11	
	Abnormal frequency	52		12	
WSS FRT RH	Air gap	31	ABS :	1	
	Tire size	51	Doesn't active at specific	2	
	Short at power supply	41	wheel	3	
	Short at ground	41		4	
	Circuit cut	41	ATC :	5	
	Circuit short	41	Doesn't active	6	
	Pulse ring	61		7	
	Slip	31		8	
	Circuit problem	51		9	
	Speed signal poor	31		10	
	Abnormal speed(Chattering)	51		11	
	Abnormal frequency	51		12	
WSS REAR LH	Air gap	34	ABS :	1	
	Tire size	54	Doesn't active at specific	2	
	Short at power supply	44	wheel	3	
	Short at ground	44		4	
	Circuit cut	44	ATC :	5	
	Circuit short	44	Doesn't active	6	
	Pulse ring	64		7	
	Slip	34		8	
	Circuit problem	54		9	
	Speed signal poor	34		10	
	Abnormal speed(Chattering)	54		11	
	Abnormal frequency	54		12	
WSS REAR RH	Air gap	36	ABS :	1	
	Tire size	56	Doesn't active at specific	2	
	Short at power supply	46	wheel	3	
	Short at ground	46		4	
	Circuit cut	46	ATC :	5	
	Circuit short	46	Doesn't active	6	
	Pulse ring	66		7	
	Slip	36		8	
	Circuit problem	56		9	
	Speed signal poor	36		10	
	Abnormal speed(Chattering)	56		11	
	Abnormal frequency	56		12	

Fault location	Faulty Description	Fault Code	System reaction	Remedy type	Remarks
WSS 3RD LH	Air gap	35	ABS :	1	
	Tire size	55	Doesn't active at specific wheel	2	
	Short at power supply	45		3	
	Short at ground	45		4	
	Circuit cut	45	ATC :	5	
	Circuit short	45	Doesn't active	6	
	Pulse ring	65		7	
	Slip	35		8	
	Circuit problem	55		9	
	Speed signal poor	35		10	
	Abnormal speed(Chattering)	55		11	
	Abnormal frequency	55		12	
WSS 3RD RH	Air gap	33	ABS :	1	
	Tire size	53	Doesn't active at specific wheel	2	
	Short at power supply	43		3	
	Short at ground	43		4	
	Circuit cut	43	ATC :	5	
	Circuit short	43	Doesn't active	6	
	Pulse ring	63		7	
	Slip	33		8	
	Circuit problem	53		9	
	Speed signal poor	33		10	
	Abnormal speed(Chattering)	53		11	
	Abnormal frequency	53		12	
MODULATOR FRT LH	Inlet,outlet valve circuit cut	22	ABS :	13	
	Circuit cut	22	Doesn't active at specific wheel	15	
	Short at ground	22		16	
	Short at power supply	22	Does'nt active at FRT RH, REAR LH(3RD LH),ATC	14	
MODULATOR FRT RH	Inlet,outlet valve circuit cut	21	ABS :	13	
	Circuit cut	21	Doesn't active at specific wheel	15	
	Short at ground	21		16	
	Short at power supply	21	Does'nt active at FRT RH, REAR LH(3RD LH),ATC	14	
MODULATOR REAR LH	Inlet,outlet valve circuit cut	24	ABS :	13	
	Circuit cut	24	Doesn't active at specific wheel	15	
	Short at ground	24		16	
	Short at power supply	24	Does'nt active at FRT RH, REAR LH(3RD LH),ATC	14	
MODULATOR REAR RH	Inlet,outlet valve circuit cut	23	ABS :	13	
	Circuit cut	23	Doesn't active at specific wheel	15	
	Short at ground	23		16	
	Short at power supply	23	Does'nt active at FRT RH, REAR LH(3RD LH),ATC	14	
MODULATOR 3RD LH	Inlet,outlet valve circuit cut	26	ABS :	13	
	Circuit cut	26	Doesn't active at specific wheel	15	
	Short at ground	26		16	
	Short at power supply	26	Does'nt active at FRT RH, REAR LH(3RD LH),ATC	14	

TROUBLESHOOTING

BRb-19

Fault location	Faulty Description	Fault Code	System reaction	Remedy type	Remarks
MODULATOR 3RD LH	Inlet,outlet valve circuit cut	25	ABS :	13	
	Circuit cut	25	Doesn't active at specific	15	
	Short at ground	25	wheel	16	
	Short at power supply	25	Does'nt active at FRT RH, REAR LH(3RD LH),ATC	14	
Retardar (DBR circuit)	Short at power supply	73	Doesn't active at DBR	17	
	Circuit cut	73		59	
	Short at ground	73		19	
Power	DIAGONAL1 GND is disconnected from power	85	ABS :	20	
	Low voltage (DIAGONAL1 POWER)	81	Does'nt active at FRT RH,	21	
	DIAGONAL1 POWER CUT	85	REAR LH,3RD LH	22	
	Abnormal valve relay DIAGONAL1 Power	83	Doesn't active at ATC	23	
	DIAGONAL1 GND is disconnected	85	ABS: Active,Warning lamp: ON	24	
	DIAGONAL2 GND is disconnected from power	85	ABS :	25	
	Low voltage (DIAGONAL2 POWER)	81	Does'nt active at FRT RH,	26	
	DIAGONAL2 POWER CUT	85	REAR LH,3RD LH	27	
	Abnormal valve relay DIAGONAL2 Power	83	Doesn't active at ATC	23	
	DIAGONAL2 GND is disconnected	85	ABS: Active,Warning lamp: ON	29	
	DIAGONAL 1,2 Over voltage	82	Doesn't active at ATC,ABS	49	
Diff Brake Valve	Short at power supply	72	ABS :	17	
	Circuit cut	72	Does'nt active at FRT RH,	18	
	Short at ground	72	REAR LH,3RD LH	19	
Diff Lock	Short at power supply	76	ABS :	17	
	Circuit cut	76	Does'nt active at FRT RH,	18	
	Short at ground	76	REAR LH,3RD LH	19	
PROP Valve	Short at power supply	76	Doesn't active at DIFF.LOCK	17	
	Circuit cut	76		18	
	Short at ground	76		19	
Warning lamp	Abnormal warning lamp	74	Always light on	40	
CAN	Abnormal	71	ATC : Active	41	
	Cut	71	Doesn't active at ATC	42	
	Short at ground	71		43	
	Too much time	71		44	
	Internal error	83		45	
CONFIGURA- TION	Abnormal ATC	75	Doesn't active at ATC,ABS	50	
	Abnormal ABS	84		51	
EEPROM	Abnormal wheel parameter	84	Doesn't active at ATC,ABS	52	
	Abnormal check sum	84		53	
ECU	Internal error	83	Doesn't active at ATC,ABS	54	
	Short at load	84		55	
	Over slip/ dienumo test	71		56	
	Modulater valve operating time	21		57	
	Internal error	83		58	

SID : Subsystem IDentifier

FMI : Fault mode IDentifier

WSS : Wheel Speed Sensor

Code	Fault cause / repair
1	Vehicle speed amplitude is too low. Check axle bearing, pulse ring teeth and push the sensor fully once again.
2	Tire size or the number of pulse ring teeth is different from other wheels.
3	Check wire ring. DC power is detected at sensor wire.
4	Check sensor wiring. Replace the sensor if needed. Ground short is detected. Normal value is approximately 1.6 k Ω .
5	Check sensor wiring. Replace the sensor if needed. Circuit short is detected.
6	Check sensor wiring. Replace the sensor if needed. Short between 2 sensor wires (IG/IGM) is detected.
7	Check any damage of pulse ring with the tester. Replace it if it gets faulty repeatedly. If air gap code is detected along with this code, adjust the air gap. Air gap is displayed periodically with its rotations.
8	Adjust the air gap. This code is displayed when the slip is detected more than 16 seconds. (In case of dynamo test)
9	Check the inconsistency with other sensors. IG or IGM of other sensors is detected. Repair the circuit.
10	Check the air gap. Check any poor connection between wire and connector. Measure the amplitude of sensor signals and compare it with the specified value. Fault code due to wrong signals of the temporary wheel speed sensor.
11	Check any poor connection between wire and connector. Check any damage on pulse ring. Measure the amplitude of sensor signals and compare it with the specified value. No countermeasure is available if it is due to brake squeeze or chattering.
12	Check any poor connection between wire and connector. Replace ECU, if the fault repeats.
13	Check the modulator wire. Common mode of inlet (EV) or outlet (AV) is disconnected temporarily or permanently. In case of normal, the value of AV to common and EV to common is approximately 5.5 Ω , and the value from AV to EV is about 1.1 Ω .
14	Check the modulator wire. Inlet (EV) or outlet (AV) circuit is short form the power.
15	Check the modulator wire. Inlet (EV) or outlet (AV) circuit is blown. It's identical with code. 13.
16	Check the modulator wire. Inlet (EV) or outlet (AV) circuit is disconnected from GND.
17	Check wire. Output is disconnected from power.
18	Check wire. Output is disconnected.
19	Check wire. Output is disconnected from GND.
20	Check front LH, rear RH, 3rd RH modulator wire. Common mode of modulator is disconnected from the power.
21	Check power wire and fuse. Voltage is too low.
22	Check terminal 12 (GND) of 18P connector. It's not connected to GND.
23	If this fault repeats, replace ECU. Inner relay of ECU is wrong.
24	Check front LH, rear RH, 3rd RH modulator wire. Common mode of modulator is disconnected from GND
25	Check front RH, rear LH, 3rd LH modulator wires. Common mode of modulator is disconnected from the power
26	Check power wire and fuse. Voltage is too low.
27	Check terminal 11 (GND) of 19P connector. It's not connected to GND.
29	Check front RH, rear LH, 3rd LH modulator wires. Common mode of modulator is disconnected from GND.
40	Check wire and IND bulb. Have you ever pressed ABS check switch more than 16 seconds? Output mode cannot detect the load. Adjust wheel speed sensor signal or check tire size.
41	Adjust wheel speed sensor signal or check tire size.

TROUBLESHOOTING**BRb-21**

Code	Fault cause / repair
42	Check wire. More than one SAE J1939 data link wire is not connected.
43	Check wire. More than one SAE J1939 data link wire is disconnected.
44	Check other ECU, which uses SAE J1939. That ECU transmits wrong signals.
45	If this fault repeats, replace ECU.
49	Check alternator and battery. It shows too high voltage more than 5 seconds.
50	Check the parameter setting. Diff valve is detected under the condition of no Engine Control Unit (CAN, PWM, PROP)
51	Wrong ECU
52	Check the parameter setting. If this fault repeats, replace ECU.
53	Check the parameter setting. Didn't you remove the connector while diagnosing with diagnostic equipment? Reset the parameter.
54	Replace ECU if this fault repeats.
55	Modulator is not connected. This fault is not memorized. It is normal if this code shows up in the EOL test where CAB is only assembled.
56	Check air gap. One axle rotated faster than the other axle. It is normal if it shows up in the speed test of R/T.
57	Modulator keeps operating more than 3 minutes. It comes back to normal after some delay.
58	Replace ECU if this fault repeats.
59	Check wire. No load on the DBR output mode. Load was detected before. Reset the parameter setting if there is no actual load.

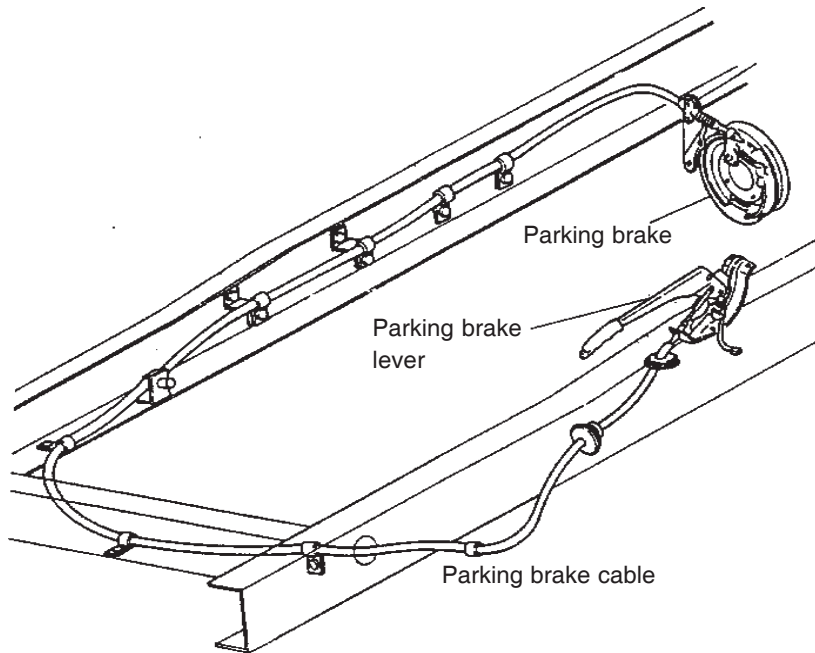
PARKING BRAKE

GENERAL	BRc - 2
SPECIFICATIONS	BRc - 3
SERVICE STANDARDS	BRc - 3
SERVICE PROCEDURE	BRc - 4
TROUBLESHOOTING	BRc - 9



GENERAL

When the parking brake lever inside the cab is pulled up, the shoes of the parking brake located behind the transmission press against the drum to bring the vehicle to a stop.

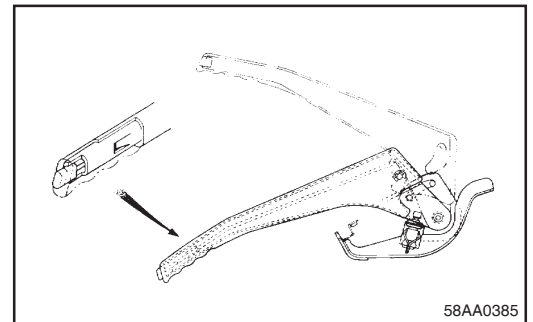


58AA0001

Parking Brake Lever

The parking brake lever incorporates a lock mechanism which holds the lever in the raised position.

Pressing the knob at the end of the lever disengages the pawl of the lock plate from the tooth of the bracket, the lever becomes unlocked, and can return to its original position.



58AA0385

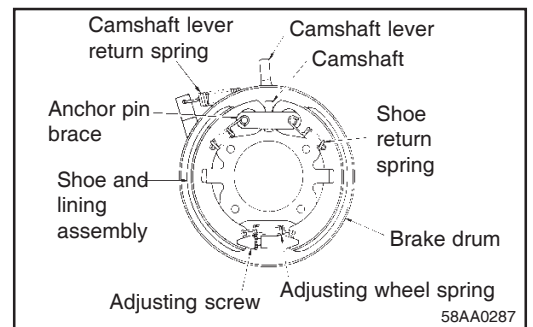
Parking Brake

When the parking brake lever is pulled up, the control wire pulls on the camshaft lever and the camshaft rotates. This expands the shoe and lining assembly.

The expanded shoes press against the drum, and the friction applied to the drum surface controls the rotation of the propeller shaft that is connected to the brake drum.

If the parking brake lever is released, the return spring pulls the camshaft lever back to its original position.

The shoe and lining assembly separates from the brake drum surface by the force of the shoe return springs, and the brake drum and propeller shaft are freed.



58AA0287

SPECIFICATIONS**BRc-3****SPECIFICATIONS**

Description	Transmission model	KH10, M6S6
Parking brake type	Internal expansion type acting on propeller shaft	
Brake drum I. D.	203.2 mm	
Brake lining width x thickness	50 x 40 mm	
Control	Mechanical control with wire	
	Air control type	

SERVICE STANDARDS**Service Standards Table**

Maintenance item			Nominal value (Basic diameter in [])	Limit	Remedy and remarks
Parking brake lever stroke (number of detents)			7 to 10	-	Adjust
Brake drum			$\varnothing 203.2 \begin{smallmatrix} +0.3 \\ 0 \end{smallmatrix}$	205	Repair if the service limit has not yet been reached; replace if the limit has been exceeded
	Static rotational imbalance		0.88 Ncm (90 gfcmm) or less	-	Replace
Brake lining thickness			4.0	1.4	Replace
Shoe clearance			0.1 to 0.25	-	Adjust
Shoe return spring	Load/installed length	M5S	145 N (15 kgf)/57.5	115 N (12 kgf) /57.5	Replace
Adjusting wheel return spring	Load/installed length		78 N (8 kgf)/59	63 N (6.4 kgf) /59	Replace

Tightening Torque Table

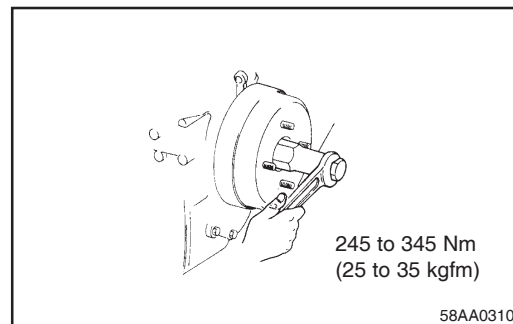
Location tightened	Screw size O.D. x pitch (mm)	Tightening torque Nm (kgfm)
Camshaft lever fastening nut	M8 x 1.25	6.9 to 13 (0.7 to 1.3)
Transmission main shaft and transfer driver shaft rear lock nuts	M27 x 1.5	245 to 345 (25 to 35)

SERVICE PROCEDURE

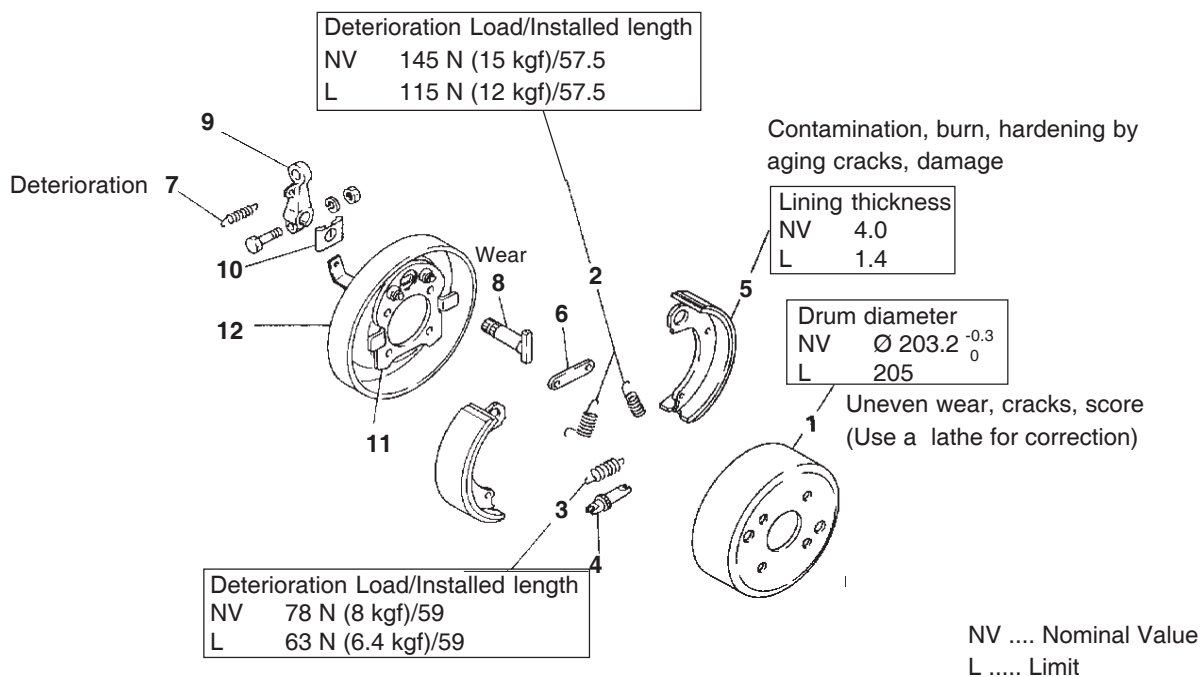
Parking Brake

Removal and installation

- (1) Before removing the parking brake, apply chocks to the front wheels.
- (2) For removal of the propeller shaft, refer to Propeller shaft section.
- (3) When removing the companion flange, use care not to cause damage to the oil seal.
- (4) Remove the parking brake control.
- (5) Removal and installation of the transmission main shaft rear lock nut.



Disassembly and inspection



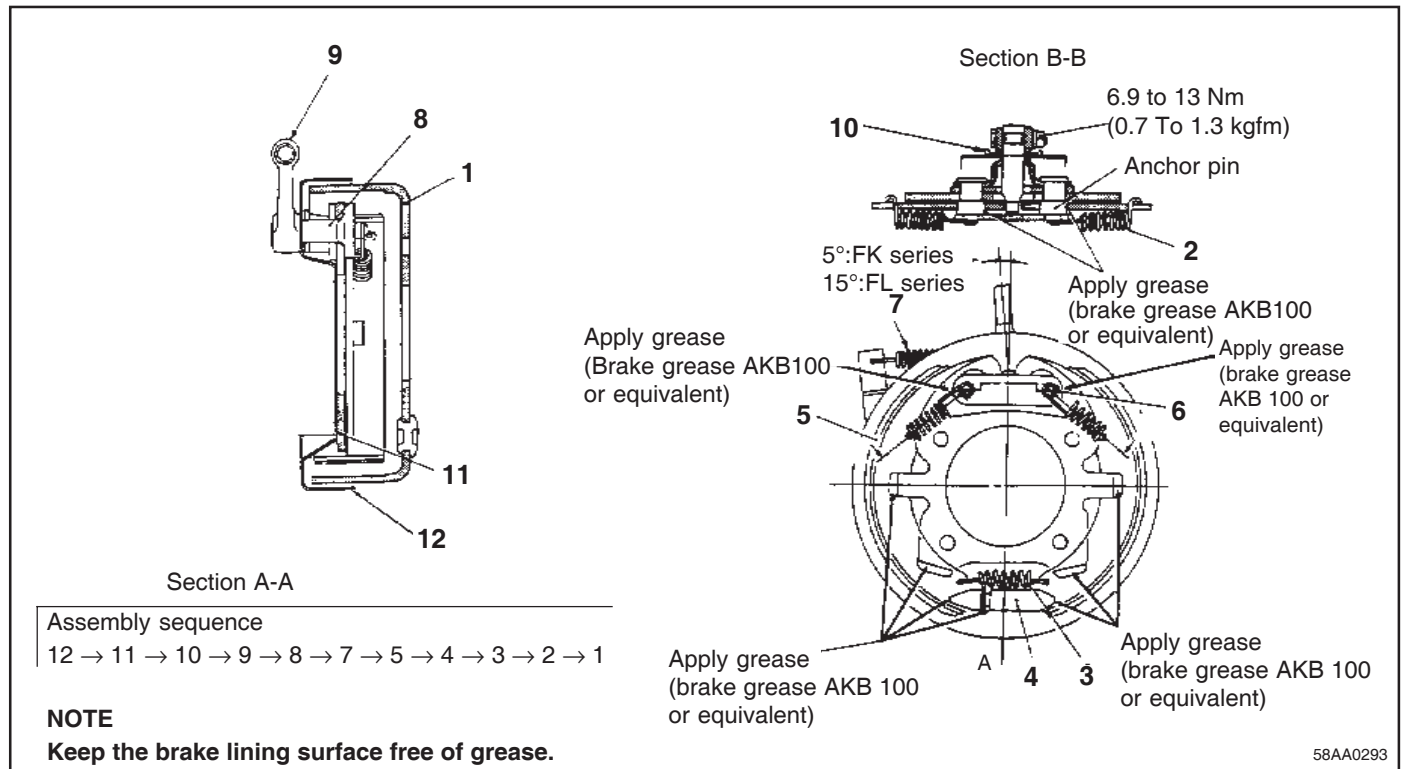
Disassembly sequence

- | | |
|-------------------------------------|----------------------------------|
| 1. Parking brake drum | 7. Cam shaft lever return spring |
| 2. Shoe return spring | 8. Cam shaft |
| 3. Adjusting wheel return spring | 9. Cam shaft lever |
| 4. Adjusting screw and nut assembly | 10. Spring spacer |
| 5. Shoe and lining assembly | 11. Support plate |
| 6. Anchor pin brace | 12. Dust cover |

SERVICE PROCEDURE

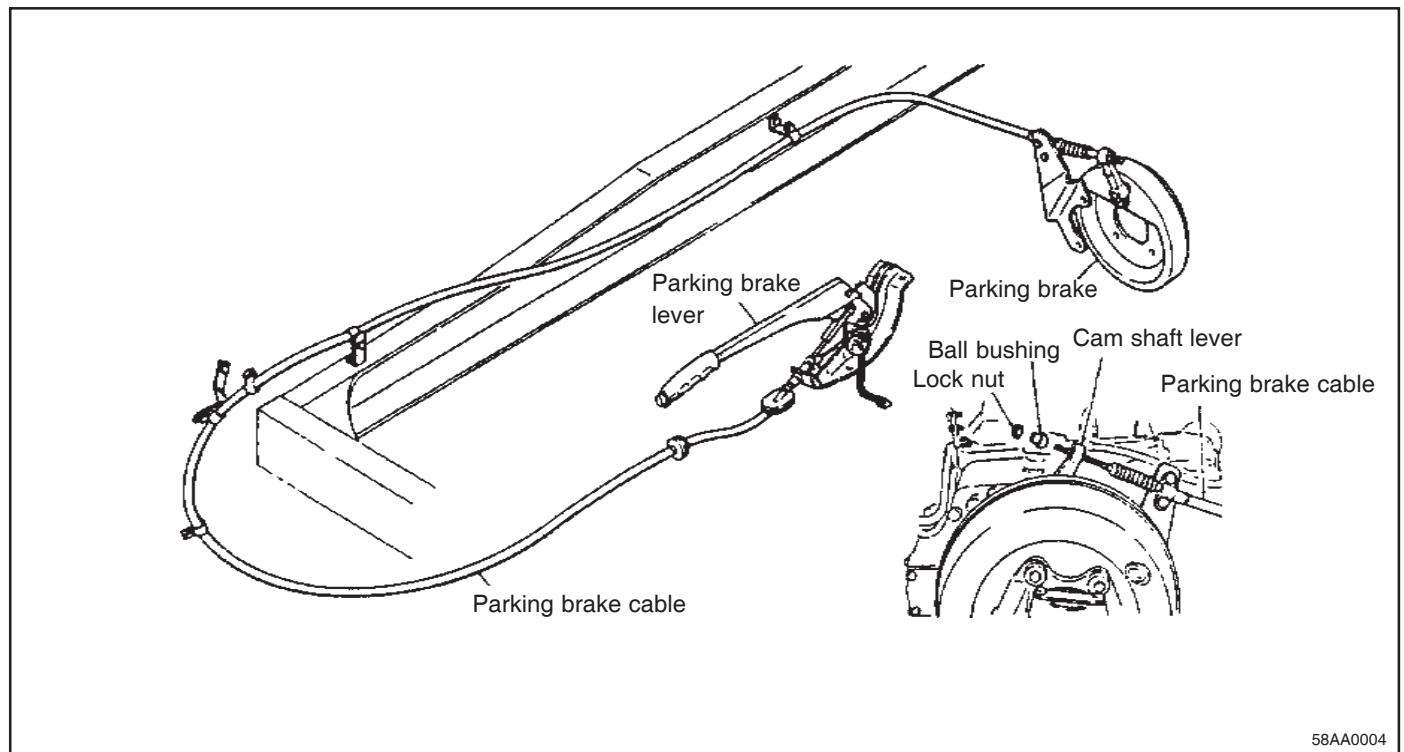
BRc-5

Reassembly



Parking Brake Control

Removal and installation



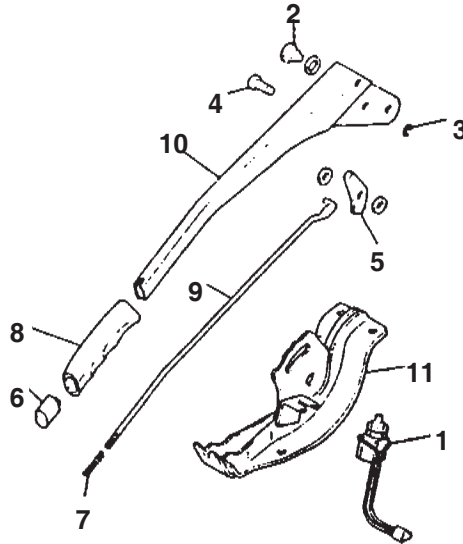
Parking brake lever

Disassembly

Deterioration
Reassembly

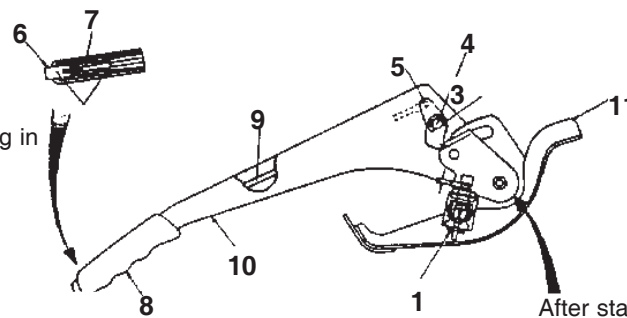
Removal procedure

1. Pilot switch
2. Pin
3. Snap ring
4. Pin
5. Lock latch
6. Knob
7. Return spring
8. Grip
9. Release rod
10. Parking brake lever
11. Parking brake bracket



58AA0127

Apply adhesive when screwing in
Stroke



Before staking

	Without spacer	With spacer
Nominal value	Less than 0.6	0.6~0.96

After staking

Spacer

2
B

Lever
Spacer
Striker plate

Before staking

After staking

	Without spacer	With spacer
Nominal value	0.06 to 0.6	0 to 0.36

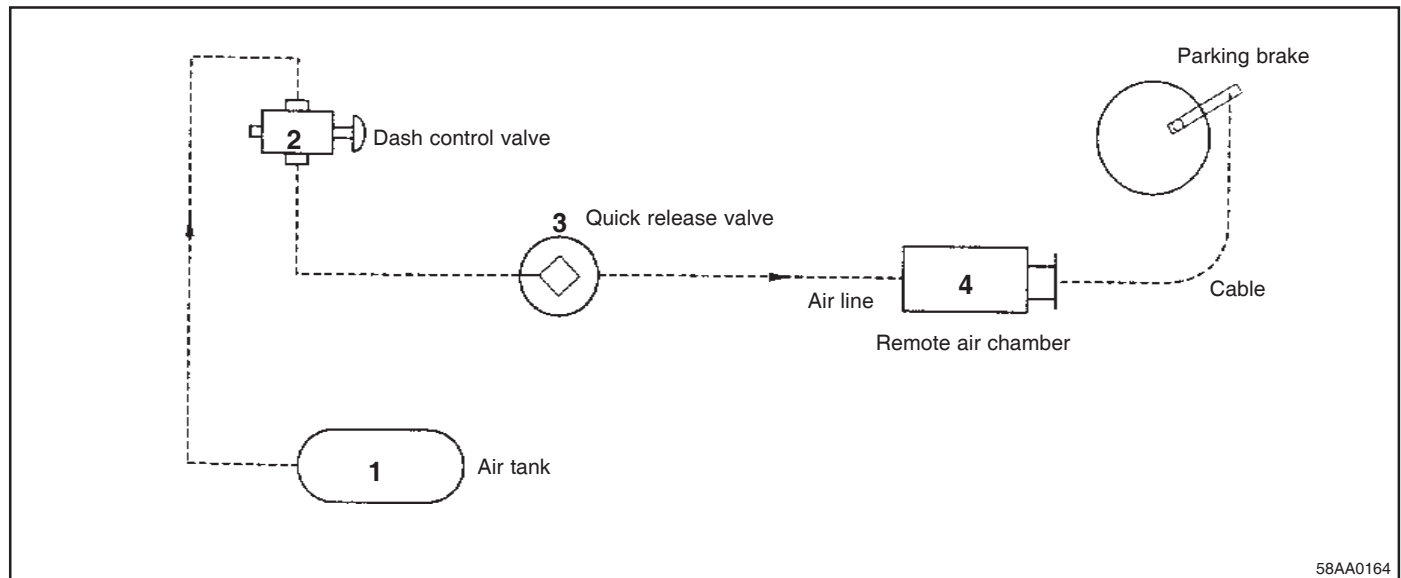
58AA0007

SERVICE PROCEDURE**BRc-7****Air Parking Brake**

The air parking brake uses compressed air generated by air compressor to operate parking brake.

When the parking brake is released, the compressed air is sent to remote air chamber through dash control valve and quick release valve to overcome the spring tension inside the remote air chamber causing the parking cable to be loosened.

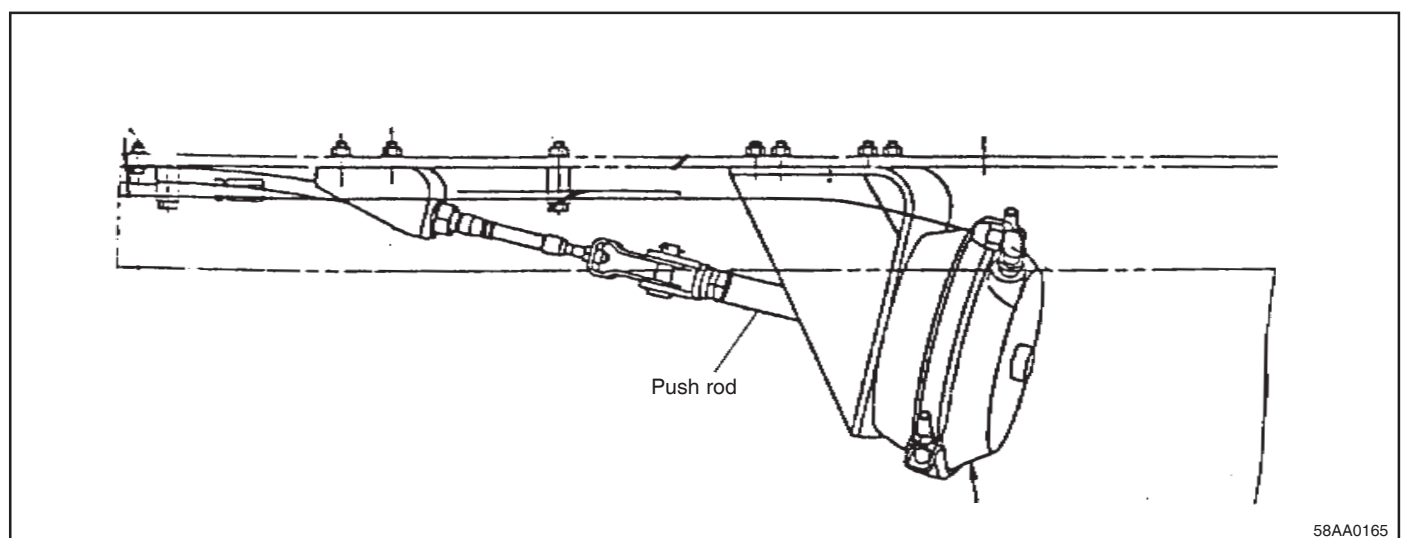
When the parking brake is applied, the dash control valve makes the compressed air to be extracted through quick release valve, thereby the parking brake cable is pressed by spring tension of remote chamber to tighten the propeller shaft.

**Air parking brake adjustment**

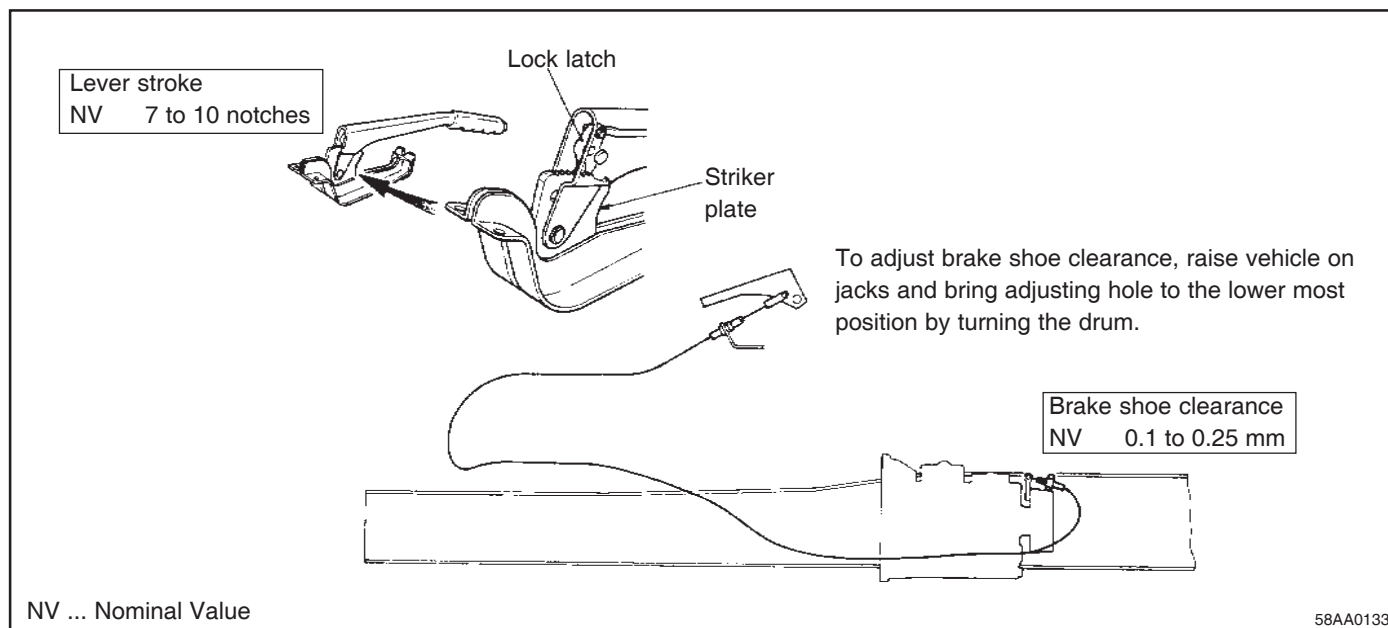
- 1) Fill the air tank with compressed air (6 kgf/cm² or more) and push the CAB control valve to actuate the remote air chamber.
- 2) Connect the clevis of parking brake to remote chamber.
- 3) Hard-tight the parking brake assembly ball so that the play of lever is to 1~2 mm.
- 4) Adjust the remote air chamber stroke to be 30~33 mm with ball while pulling the CAB control valve and tighten the nut.
- 5) Adjust the brake lining clearance to be nominal value (0.1~0.25 mm) if occurs slipping in parking brake.

Inspection of parking brake.

If the stroke of remote chamber push rod is 25 mm or more, adjust the lining clearance so that the stroke of chamber is 30~33 mm.

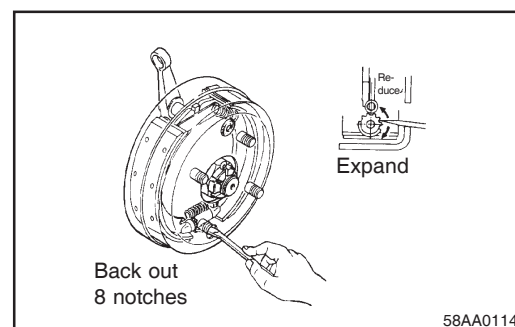


Adjustment



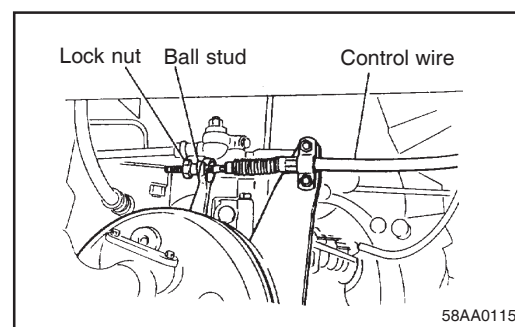
Place the camshaft lever in its released position.

Turn the adjusting screw by using a screwdriver through the shoe clearance adjusting hole in the drum until the shoes firmly contact the drum, and then back off the screw 8 notches. The shoe clearance then should be the nominal value of 0.1 to 0.25 mm.



Adjust the parking brake lever stroke by turning the cam shaft lever lock nut so that the number of the clicks produced when the lever is pulled up all the way from its released position with a force of 295 N (30 kgf) corresponds to the nominal value (7 to 10 notches).

After making the adjustment, operate the parking brake lever two or three times to make sure that the stroke is correctly adjusted, the parking brake operates normally and the brake drum does not drag.



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Parking brake does not work	Problems with the parking brake control mechanism	
	o No shoe clearance and no play in lever stroke when the parking brake lever is pulled up with a force of 295 N (30 kgf).	Adjust shoe clearance and control wire
	o Poor engagement between parking brake lever assembly lock plate pawl and bracket tooth	Correct bracket installation for proper engagement or replace part which is defective
	o Elongated or broken parking brake control wire	Replace control wire
	Problems with shoe and drum assembly	
	o Excessive shoe clearance and resultant increase of parking brake lever stroke	Adjust brake shoe clearance
	o Deformed or distorted drum	Correct by grinding drum inner surface or replace drum
	o Unevenly worn shoe lining due to uneven contact with drum	Replace shoe and lining assembly
Inadequate release of parking brake	o Oil or grease on drum inner surface or shoe lining	Clean drum inner surface and replace shoe and lining assembly
	Problems with parking brake control mechanism	
	o Weakened or broken return spring of parking brake lever assembly	Replace return spring
	o Incorrect parking brake lever stroke	Adjust stroke
	o Parking brake control wire does not move smoothly	Adjust or replace control wire
	o Elongated control wire inner cable	
	o Excessive sliding resistance due to broken control wire inner cable	
	Problems with shoe and drum assembly	
	o Weakened or broken shoe return spring or camshaft lever return spring	Replace shoe return spring and/or camshaft lever return spring
	o Too small brake shoe clearance	Adjust brake shoe clearance

CLUTCH

GENERAL	CH - 2
SPECIFICATIONS	CH - 5
SERVICE STANDARDS	CH - 6
SPECIAL TOOLS	CH - 9
SERVICE PROCEDURE	CH - 9
TROUBLESHOOTING	CH-30

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GENERAL

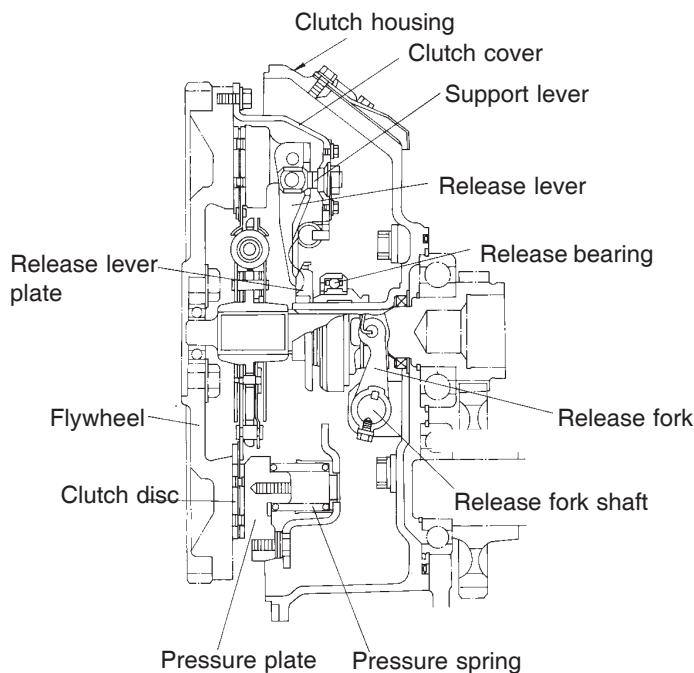
The clutch system consists of a clutch proper and control. The clutch proper transmits power from the engine to the transmission and performs the following functions when the clutch pedal is operated.

- 1) Transmitting engine power smoothly to the transmission as the vehicle is started.
- 2) Connecting and disconnecting engine power by transmission gear shifting.

CLUTCH PROPER

When the clutch pedal is depressed, the power cylinder (or clutch booster) is operated by the hydraulic pressure from the clutch master cylinder. This causes the release bearing to push the release lever via the clutch release fork and fork shaft. The release lever, operating on a force being applied with the support lever pin as the fulcrum, compresses the pressure spring. As a result, the pressure plate is pulled back, cutting off power from the engine.

When the clutch pedal is released, the clutch disc is compressed against the flywheel by the pressure spring force, thus transmitting engine power to the transmission.



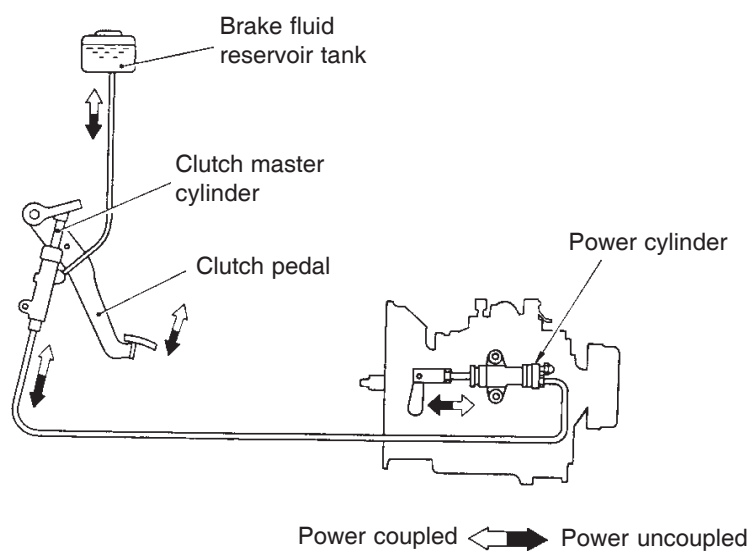
CLUTCH CONTROL

The clutch pedal mechanism is the pendant type.

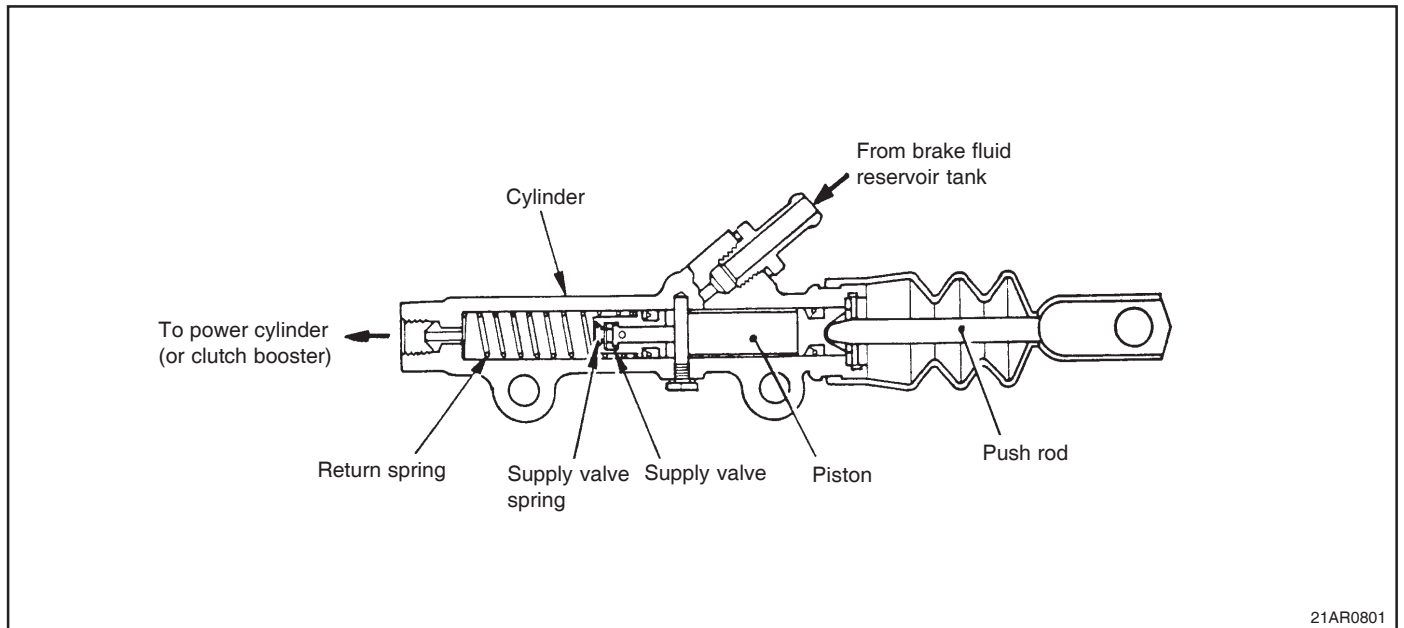
When the pedal is depressed, the push rod is forced down into the master cylinder, causing pressurized fluid to move the power cylinder (or clutch booster).

The power cylinder (or clutch booster) doubles the hydraulic pressure which moves the clutch release bearing, thereby operating the clutch proper.

<Vehicle with power cylinder>

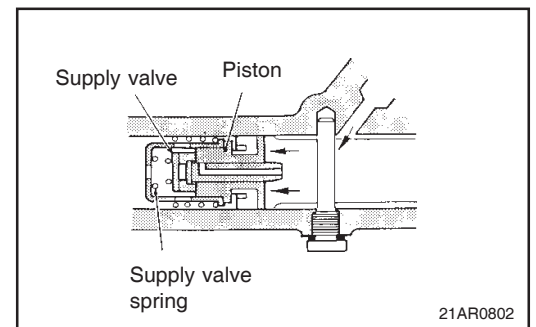


CLUTCH MASTER CYLINDER



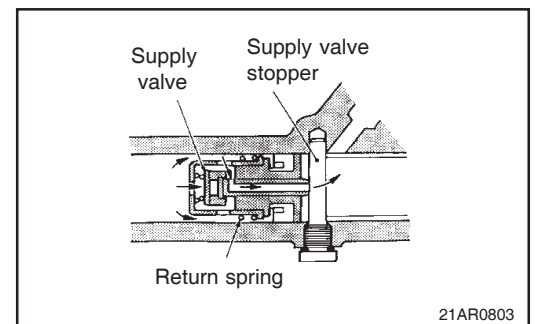
1. When clutch pedal is depressed

As the push rod pushes the piston, the supply valve is moved by the tension of supply valve spring, thus closing the gap. As the piston is pushed further, the pressure in the cylinder is increased and is transmitted to the power cylinder (or clutch booster).



2. When clutch pedal is released

The pressure built up in the cylinder, together with the tension of the return spring, forces the piston back causing the supply valve rod to come into contact with the supply valve stopper. Then, the supply valve is opened to release fluid, thus eliminating hydraulic pressure.



SPECIFICATIONS**CH-5****SPECIFICATIONS**

Unit : mm

Vehicle model		HD120
Item		
Type		Push type
Drive system		Strap drive
Clutch disc type		Single dry plate
Facing material		Non asbestos
O.D. x I.D.		350 x 220 (Low) / 380 x 240 (High)
Pressure plate		Coil spring type
Control system		Hydraulic control (Air pressure assist)
Clutch pedal maximum stroke		210
Master cylinder	Diameter x stroke	20.64 x 35
Clutch power cylinder	Diameter x stroke	105 x 66
Hydraulic cylinder	Diameter x stroke	19.8 x 66
Relay valve piston	Diameter x stroke	16 x 3.6

SERVICE STANDARDS

Service Standards Table

Unit: mm

Maintenance item				Nominal value (Basic diameter in [])	Limit	Remedy and remarks	
Clutch	Clutch disc	Depth from facing surface to rivet head			1.8 to 2.4	0.2	Replace
		Flatness			0.5 or less	-	Correct or replace
		Runout	Lateral runout		1.1 or less	-	
			Vertical runout		1.0 or less	1.5	
		Hob spline play in turning direction			0.06 to 0.21	0.5	Replace
					0.07 to 0.23		
	Pres- sure plate	Thickness			23.6 ± 0.1	21	Replace
					30.8 ± 0.1		
		Strap bolt fitting hole			10.2 to 10.25	10.5	Replace
		Strap plate to bolt clearance			0.01 to 0.16	0.3	Replace
					0 to 0.15		
		Clearance between release lever pin and pressure plate bushing			[10] 0.02 to 0.11	0.4	Replace bushing
		Clearance between release lever pin and pressure plate bushing			[10] 0.02 to 0.11	0.4	Replace bushing
	Pres- sure sp- ring	Free length			76.5	-	Replace
					92.4		
		Load/installed length			835 N (85 kgf)/ 49.1	710 N (72.3 kgf)/ 49.1	Replace
					955 N (97.5 kgf)/ 54.8		
Clutch pedal	Pedal play			30 to 40	-	Adjust	
	Pedal shaft bushing clearance			[20.6] 0.06 to 0.24	0.4	Replace	
	Return spring	Load / installed length	Vehicle with power cylinder	48 N (4.9 kgf)/ 166.1	41 N (4.2 kgf)/ 166.1	Replace	
				64 N (6.5 kgf)/ 124.2	57 N (5.8 kgf)/ 124.2		

SERVICE STANDARDS
CH-7

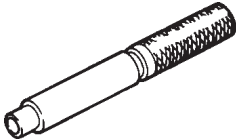
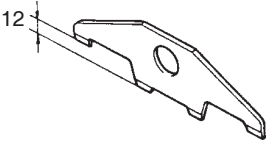
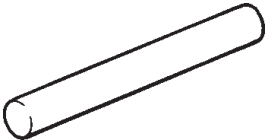
Unit: mm

Maintenance item			Nominal value (Basic diameter in [])	Limit	Remedy and remarks
Clutch master cylinder	Return spring	Free length	94	89.3	Replace
	Cylinder to piston clearance		[15.87] 0.03 to 0.10	0.2	
Power cylinder	Piston to cylinder clearance		[19.05] 0.04 to 0.125	0.24	Replace
Clutch booster	Power cylinder return spring	Free length	84	79	Replace
		Load/installed length	69 N (7 kgf)/55	58 N (5.9 kgf)/55	
	Poppet spring	Free length	21	19	Replace
		Load/installed length	2.6 N (0.27 kgf)/13	2.3 N (0.23 kgf)/13	
	Valve spring	Free length	17	15.5	Replace
		Load/installed length	12 N (1.25 kgf)/10	10 N (1.06 kgf)/10	
	Fitting to relay valve piston clearance		[16] 0.04 to 0.10	0.11	Replace
	Hydraulic piston to hydraulic cylinder clearance		[22.22] 0.01 to 0.06	0.08	Replace
			[19.05] 0.01 to 0.06	0.08	Replace
	Power piston to cylinder shell clearance		[70] 0.20 to 0.75	-	Replace if excessively worn or damaged
	Power cylinder push rod bend		-	0.1	Replace

Tightening Torque Table

Location tightened		Screw size O.D. x pitch (mm)	Tightening torque Nm (kgfm)
Clutch	Pressure plate and lever assembly mounting bolt	M10 x 1.5	32 to 49 (3.3 to 5.0)
	Strap plate bolt	M10 x 1.25	39 to 59 (4 to 6)
		M10 x 1.25	39 to 49 (4 to 5)
	Lock plate mounting bolt	M6 x 1.0	5.9 to 7.8 (0.6 to 0.8)
		M8 x 1.25	9.8 to 15 (10 to 1.5)
Clutch pedal	Offset bolt	M12 x 1.25	38 to 58 (3.9 to 5.9)
	Pedal shaft mounting nut	M12 x 1.5	38 to 58 (3.9 to 5.9)
	Clutch switch	M10 x 1.25	15 (1.5)
Master cylinder	Nipple	M12 x 1.5	25 to 34 (2.5 to 3.5)
	Supply valve stopper	M5 x 0.5	1.5 to 2.9 (0.15 to 0.3)
Power cylinder	Power cylinder mounting bolt	M10 x 1.25	47 (4.8)
	Air bleeder	M10 x 1.25	25 to 34 (2.5 to 3.5)
Clutch booster	Fitting valve	M22 x 1.5	1.5 to 2.9 (0.15 to 0.3)
	Air bleeder plug	-	6.9 to 13 (0.7 to 1.3)
	Exhaust cover	PT1/4	9.8 to 49 (1 to 5)
	Power piston tightening nut	M14 x 1.5	20 to 29 (2 to 3)
	Cylinder shell and end plate mounting bolt	M8 x 1.25	15 to 20 (1.5 to 2)
	Cylinder shell pipe bushing	-	7.8 to 9.8 (0.8 to 1.0)
	Hydraulic cylinder	M32 x 1.5	29 to 39 (3 to 4)
	Connector	M24 x 2	29 to 39 (3 to 4)
	Valve body mounting bolt	M6 x 1.5	3.9 to 5.9 (0.4 to 0.6)
	Clutch booster mounting bolt	M10 x 1.5	40 (4.1)
Clutch housing	Clutch housing mounting bolt (to transmission case or splitter case)	M16 x 2	190 (19.2)
	Clutch housing cover mounting bolt	M8 x 1.25	9.8 to 15 (1.0 to 1.5)
		M8 x 1.25	21 (2.1)

SPECIAL TOOLS

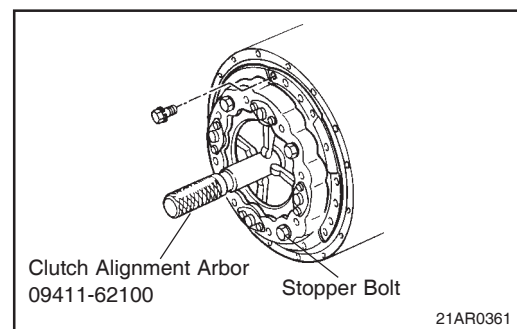
Tool (Number and name)	Illustration	Use
09411-62100 Clutch Alignment Arbor	 ASST0040	Support during removal and centering during installation of clutch disc
09411-62200 Adjustment of release lever height	 21AR0008	Adjustment of release lever height
09517-83300 Drift	 ASST0050	Removal of oil seal and Bearing

SERVICE PROCEDURE

CLUTCH

Remove and installation

1. Removal
 - (a) Disconnect the control rods and associated parts around the transmission.
 - (b) Remove the propeller shaft.
 - (c) Remove the transmission.
 - (d) Remove the pressure plate and lever assembly
 When removing the pressure plate and lever assembly, secure the pressure plate with the, Stopper Bolt and Plain Washer.
 Before removing the pressure plate and lever assembly, install the special tool, Clutch Alignment Arbor, to prevent the clutch disc from dropping.
 Then, remove the clutch disc and the special tool, Clutch Alignment Arbor, from the flywheel.

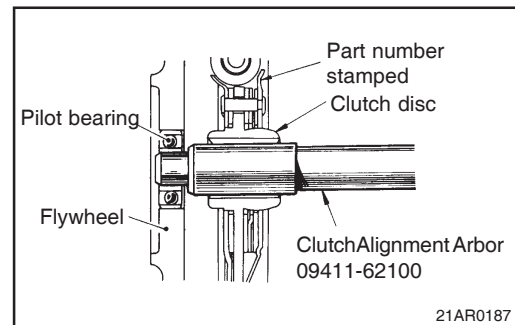


2. Installation

- (a) To install the clutch disc, use the special tool, Clutch Alignment Arbor.

NOTE:

Make sure of the correct installation direction of the clutch disc: the side on which the part number is stamped must be visible.

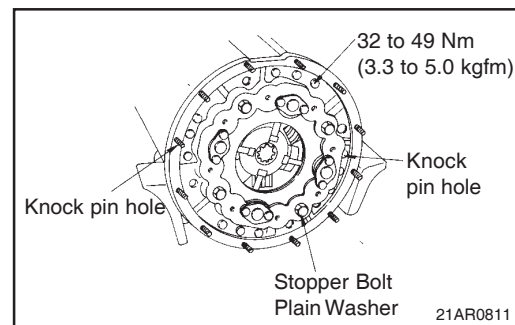


- (b) Install the pressure plate and lever assembly, aligning the knock pin holes with knock pin holes with knock pins on flywheel.

In case of CLUTCH, first hold the assembly using the Stopper Bolts and Plain Washers, and then install it on the flywheel.

NOTE:

1. Before mounting the clutch, check and clean the flywheel. If defects are evident, correct or replace the flywheel.
2. Bolts must be tightened in several steps in diagonal order.
3. After installation, be sure to remove the Stopper Bolt and Plain Washer.
4. After installation, never adjust the release lever even if their height is not the same. If adjustment is to be made, remove the clutch again and adjust.

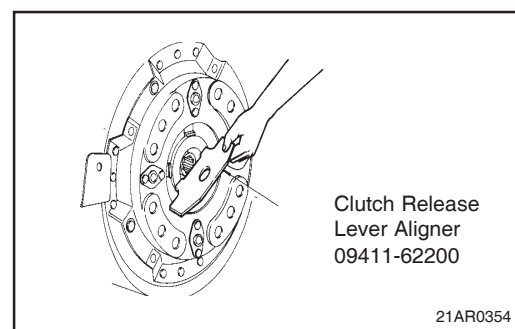


- (c) Inspection of release lever plate height (only when the clutch disc is replaced)

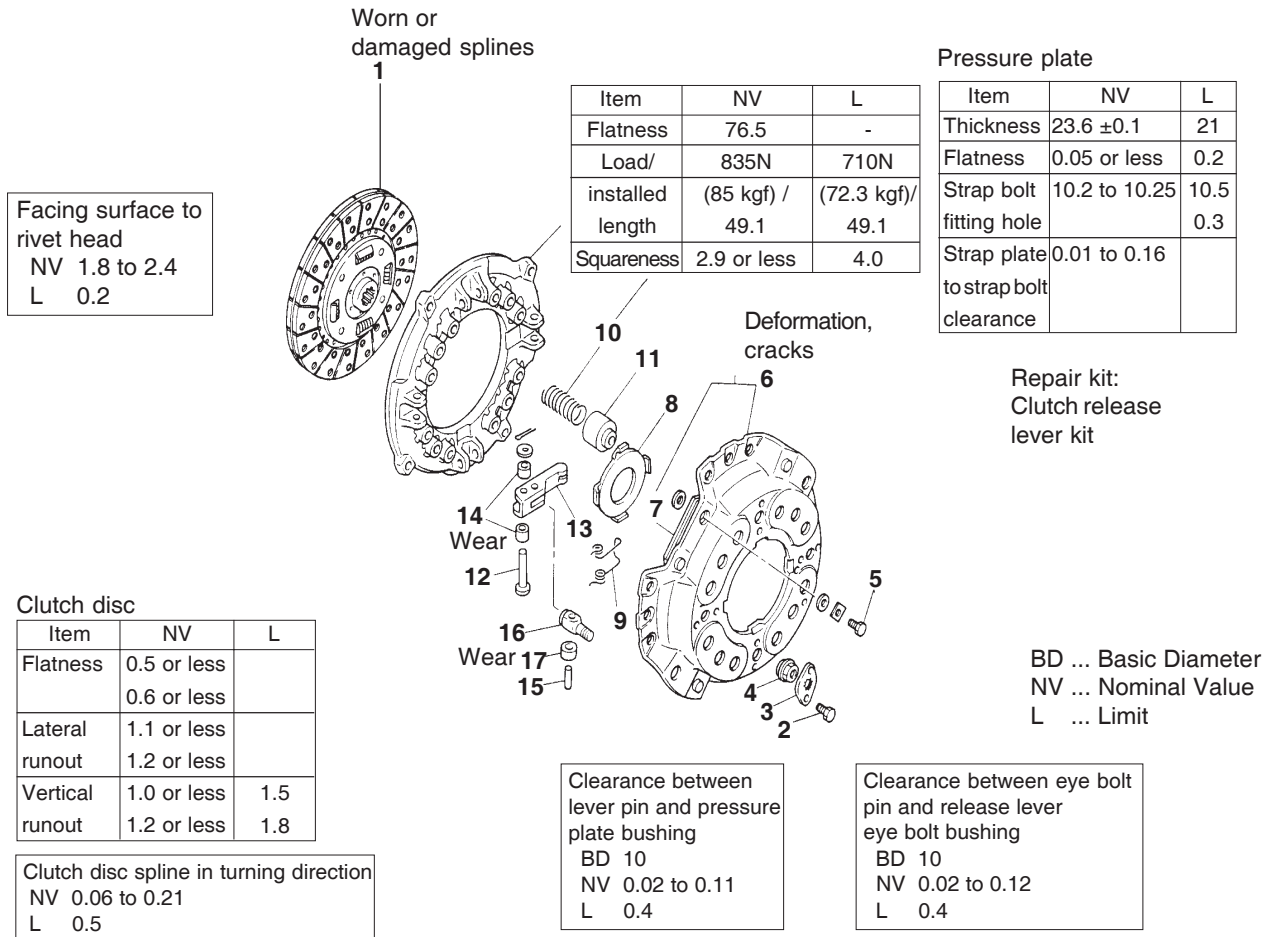
To check the height of clutch cover and release lever plate, use the special tool, Clutch Release Lever Aligner.

NOTE:

In case the pressure plate and lever assembly has been replaced with a new one, do not adjust the height of the release lever plate or release lever.



Disassembly and Inspection



Disassembly sequence

- | | | |
|-----------------|-------------------------|----------------------------|
| 1. Clutch disc | 7. Strap plate | 13. Release lever |
| 2. Lock bolt | 8. Release lever plate | 14. Bushing |
| 3. Lock plate | 9. Return spring | 15. Eye bolt pin |
| 4. Eye bolt nut | 10. Pressure spring | 16. Release lever eye bolt |
| 5. Strap bolt | 11. Pressure spring cap | 17. Bushing |
| 6. Clutch cover | 12. Release lever pin | 18. Pressure |

For parts with an encircled number, refer to disassembly and Inspection Procedure that follows.

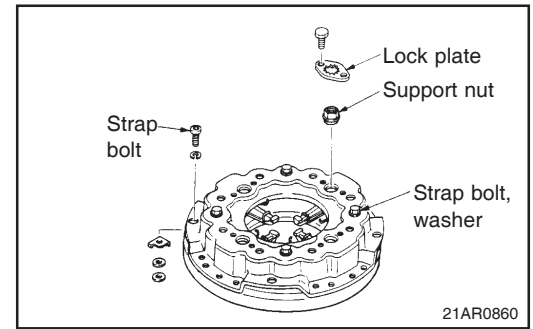
NOTE:

- The clutch cover and pressure plate are balanced and alignment marks should be put on them before disassembly.
- Do not remove the strap plate.

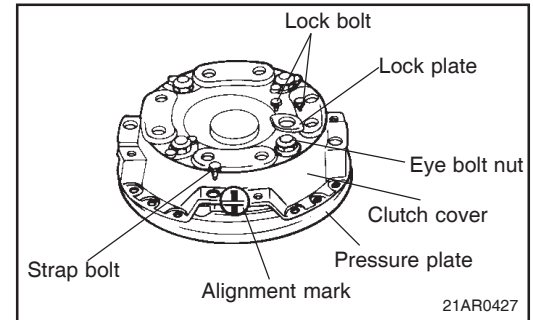
Disassembly and Inspection Procedure

1. Removal of clutch cover

- (a) With the stopper bolt as installed, remove the support nut and strap bolt.



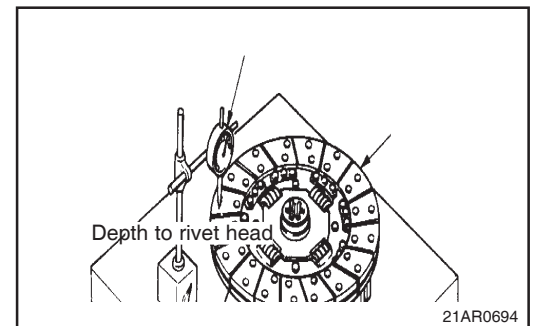
- (b) Put alignment marks on the clutch cover and pressure plate.
- (c) Gradually loosen the handle of Clutch Installer to remove the clutch cover.



2. Inspection of clutch disc

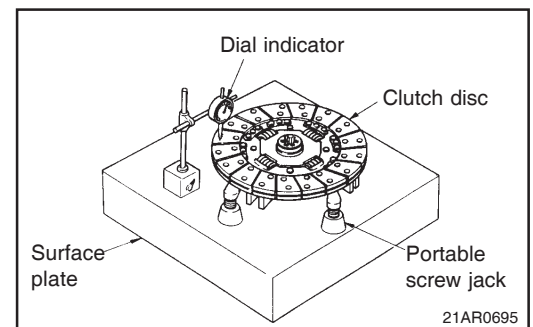
(a) Facing wear

Measure the assembly thickness of facing and the depth from facing surface to rivet head. If the measurement is below the limit, replace the clutch disc assembly.



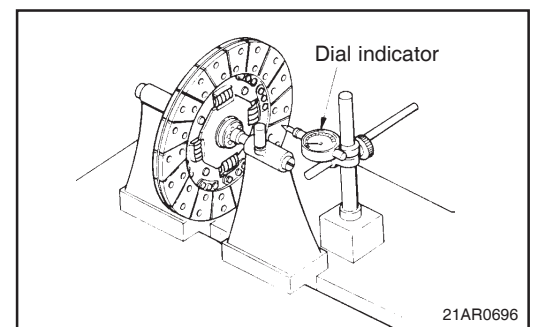
(b) Flatness of clutch disc

Measure flatness of the facing surface. If the limit is exceeded, correct or replace.



(c) Clutch disc runout

Using the runout tester, measure the clutch disc runout. If the measurement exceeds specification, correct or replace the clutch disc.

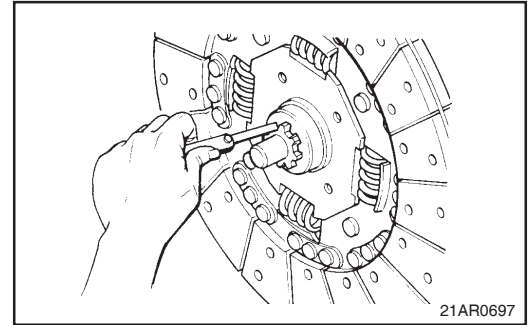


SERVICE PROCEDURE

CH-13

(d) Spline play in turning direction

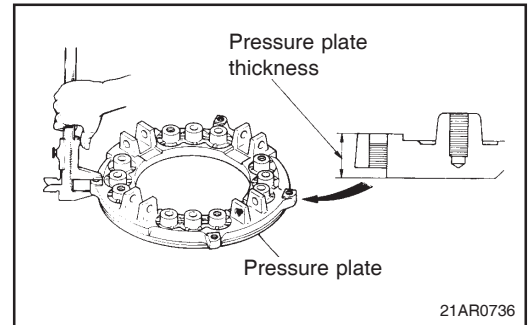
Using a piano wire, measure the play in the turning direction of the clutch disc boss splines and transmission drive pinion splines. If the limit is exceeded replace the clutch disc.



(3) Inspection of pressure plate

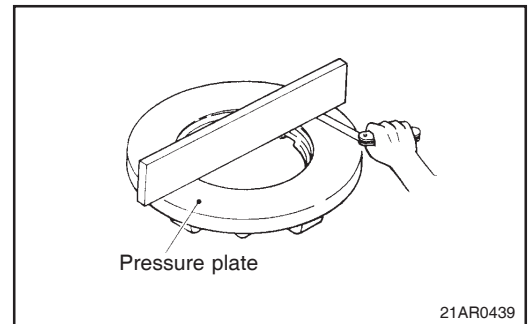
(a) Pressure plate thickness

Measure the pressure plate thickness and, if it is below the limit, replace.



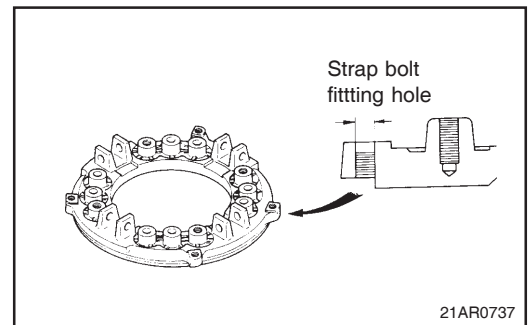
(b) Pressure plate flatness

Measure the flatness of the pressure plate friction surface. Regrind or replace if the limit is exceeded.



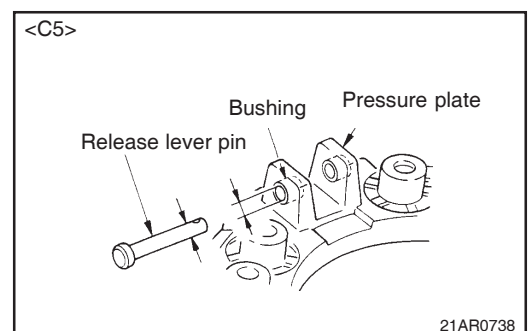
(c) Strap bolt fitting hole I.D.

Measure the I.D. or strap bolt fitting hole in the pressure plate and, if the limit is exceeded, replace.



(4) Release lever pin to bushing clearance

Measure the release lever pin O.D. and bushing I.D.. Replace if clearance exceeds specification.

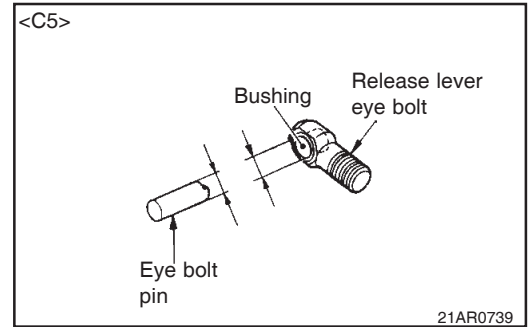


CH-14

CLUTCH

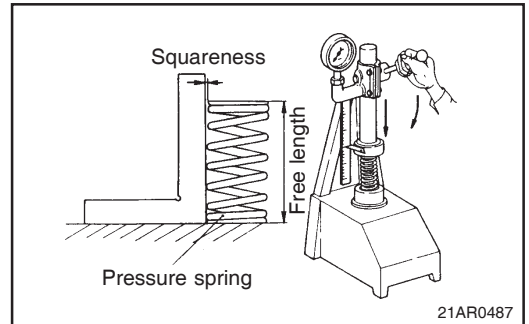
(5) Support lever pin to bushing clearance

Measure the support lever pin O.D. and bushing I.D. and replace if clearance exceeds specification.

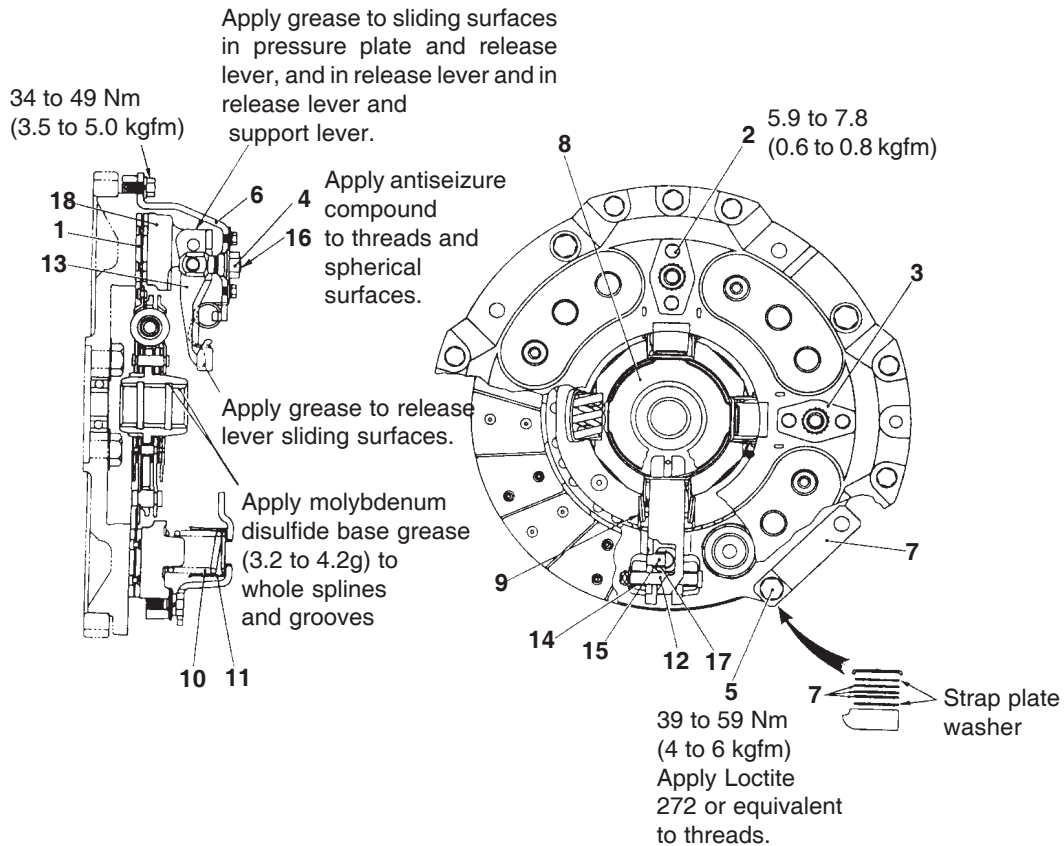


(6) Inspection of pressure spring

Measure the free length, squareness, and installed load of the pressure spring. If the measurement is below the limit, replace the spring



Reassembly



Grease: Molybdenum disulfide base grease
(NLGI No.2) Li soap

Assembly sequence

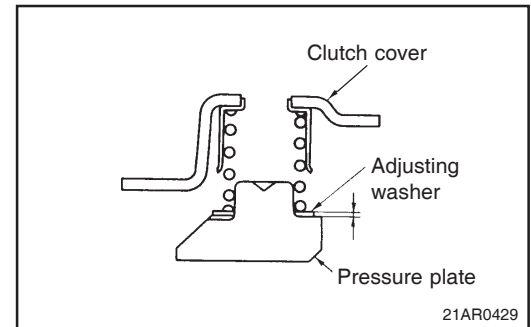
14 → ⑬ → 12 → 19 → 16 → 17 → 15 → 11 → 10 → ⑥ → 5 → 4 → 3 → 2 → 1
9 → 8 → ⑧

For parts with an encircled number, see reassembly procedure that follows.
Item No. 7 is the strap plate which is nonmaintainable.

Reassembly Procedure

1. Whenever the pressure plate friction surface is corrected, insert adjusting washers of thickness equivalent to correction amount.

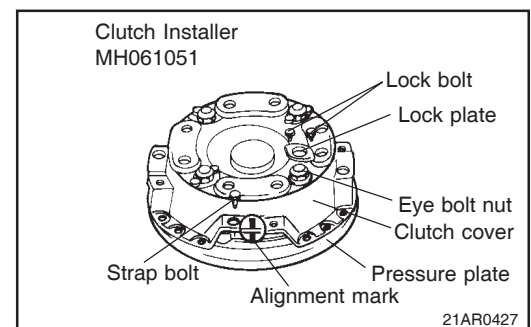
Friction surface correction amount	Adjusting washer thickness
Less than 1 mm	None required
1 mm or more and less than 2 mm	One 1.2
2 mm or more and less than 3 mm	Two 1.2 mm or one 2.3 mm



2. Installation of clutch cover
To install the clutch cover.

NOTE:

Install the clutch cover and pressure plate so that the alignment marks on them are aligned.



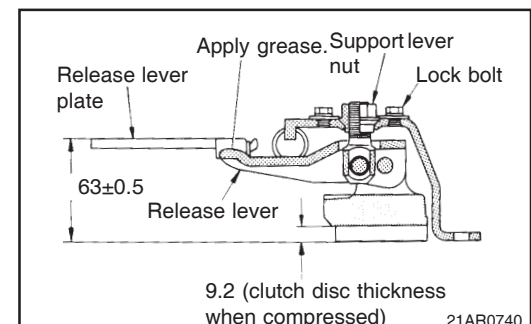
3. Adjustment of release lever height

To adjust the release lever height, compress the pressure spring using the special tool, Clutch Installer, and, at the same time, tighten or loosen the support lever nut to obtain the specified distance between the flywheel friction surface and the release lever plate end. As the specified dimension is obtained, tighten the lock bolt temporarily.

The final adjustment of the release lever height after the replacement of the clutch disc must be made using the special tool, Clutch Release Lever Aligner, with the clutch mounted on the engine flywheel.

NOTE:

Adjust the release lever height only when the clutch disc is new.



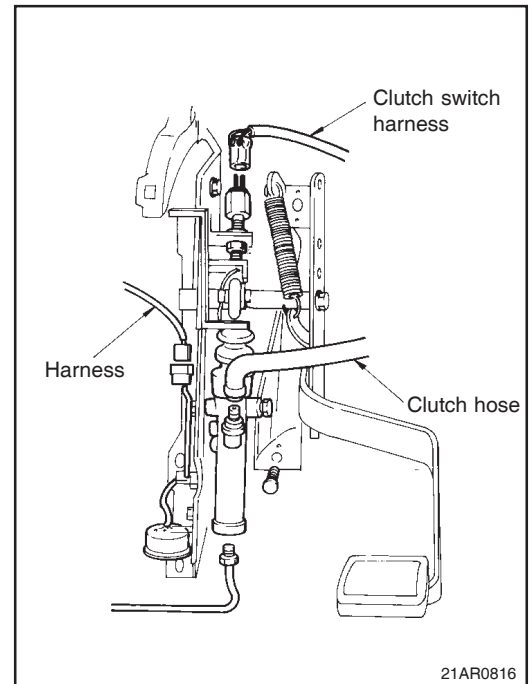
Clutch Pedal

Removal and installation

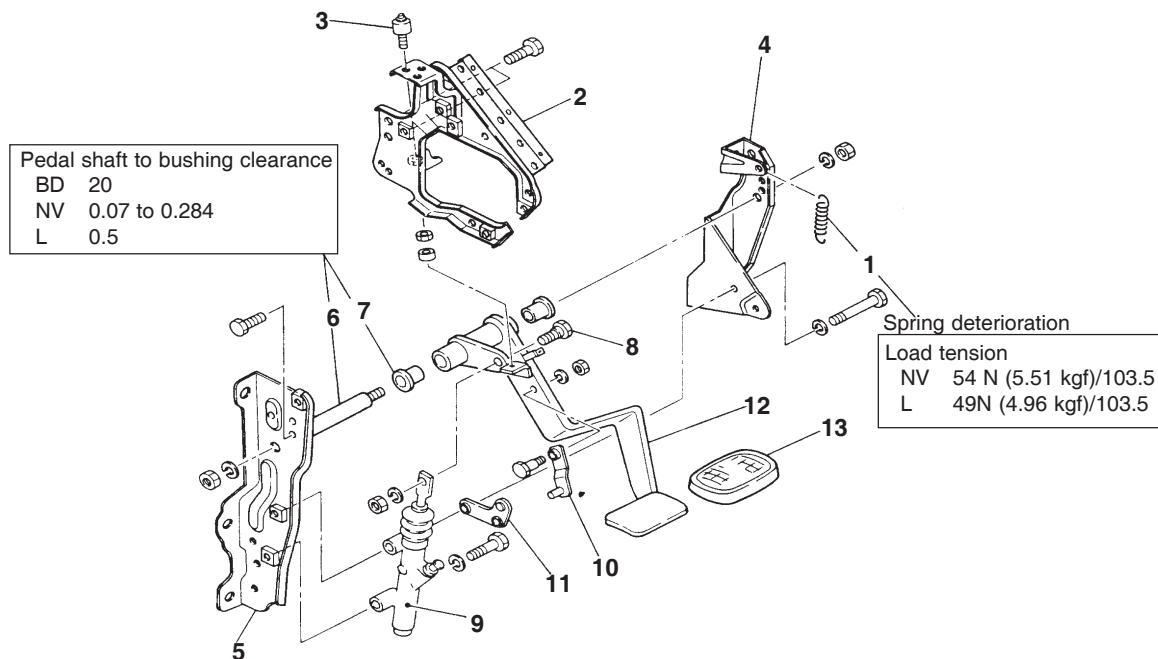
NOTE:

Before removing the clutch pedal, plug the oil hose and pipe to prevent brake fluid from running out.

1. After installing the clutch pedal, add brake fluid.
2. Bleed the clutch system of air.



Disassembly and Inspection



BD ... Basic Diameter
NV ... Nominal Value
L ... Limit

Disassembly sequence

- | | |
|---------------------------|--------------------|
| 1. Clutch switch | 7. Bushing |
| 2. Return spring | 8. Clutch pedal |
| 3. Stiffener | 9. Pedal pad |
| 4. Bracket (R.H.) | 10. Bushing |
| 5. Clevis pin | 11. Pedal shaft |
| 6. Clutch master cylinder | 12. Bracket (L.H.) |

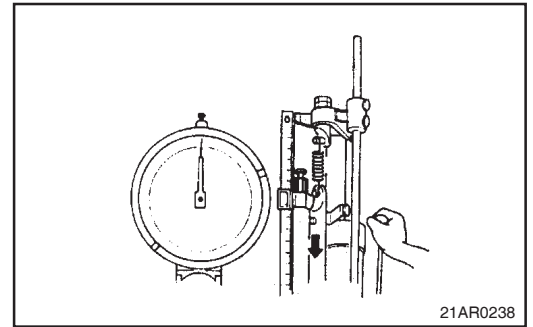
NOTE:

To loosen the offset bolt, loosen the nut with the bolt head secured in position.

Inspection Procedure

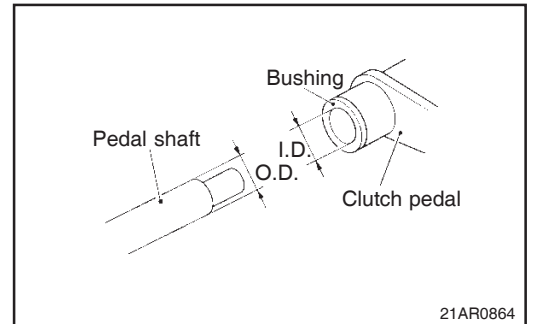
1. Inspection of return spring

Using the spring tester (for tensile load), measure the load (tensile load) when the spring is set to the installed length. If it is less than the limit, replace the spring.



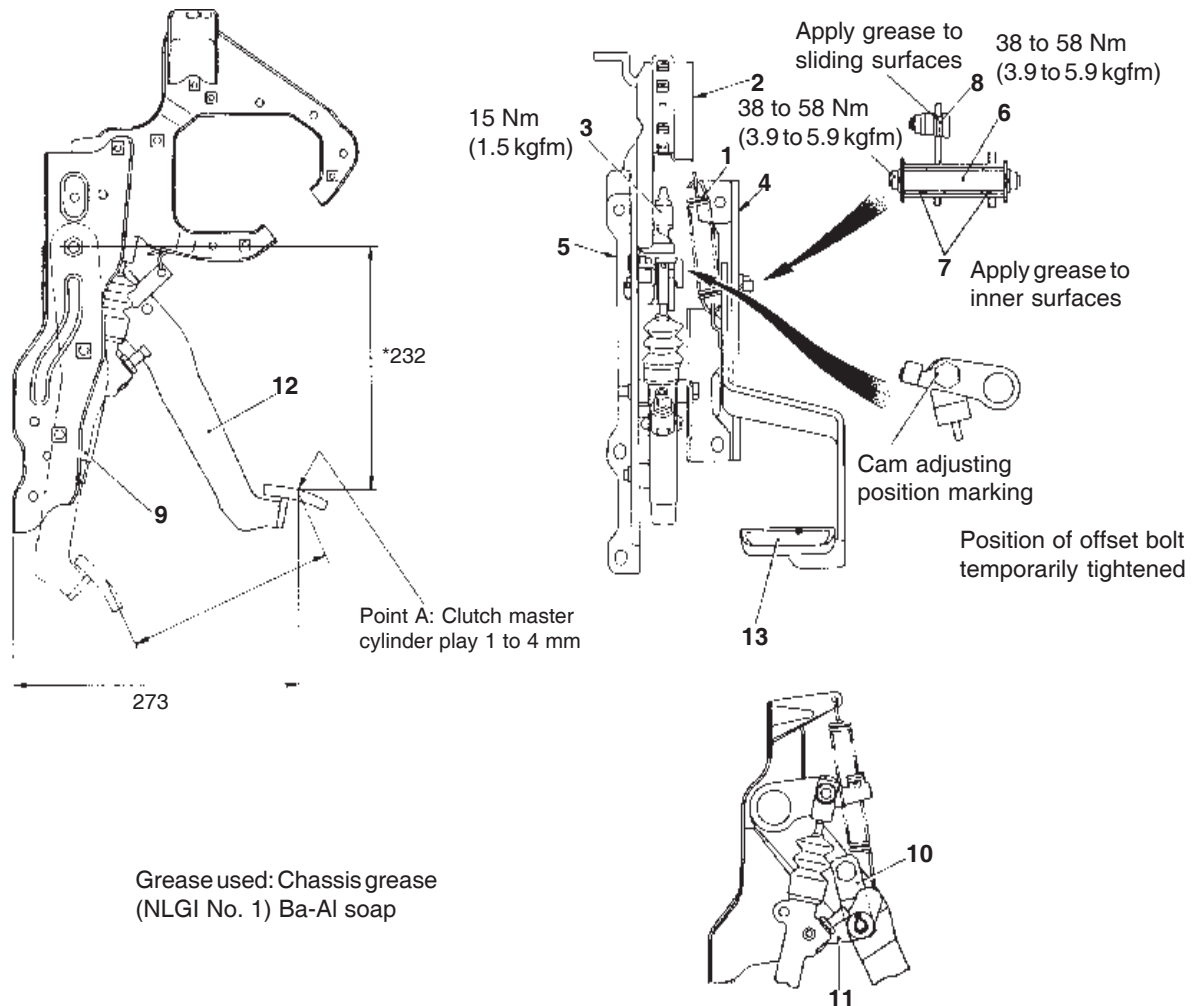
2. Measurement of clearance

As installed to the clutch pedal, measure the I.D. of the bushing and O.D. of the pedal shaft. If the clearance exceeds the limit, replace the bushing.



Reassembly and adjustment

<Vehicles with power cylinder>



Assembly sequence

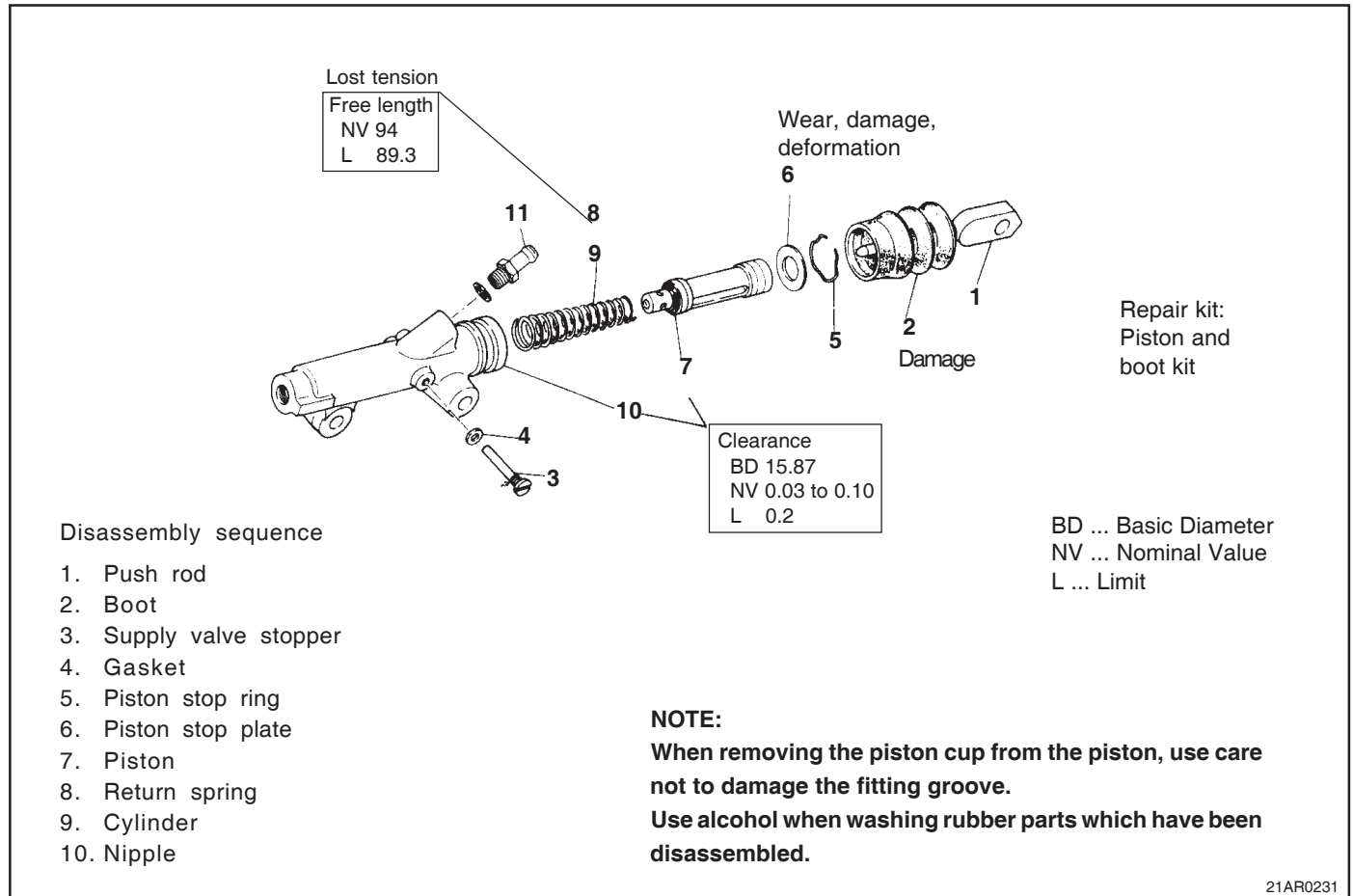
$$13 \rightarrow 12 \rightarrow 10 \rightarrow 11 \rightarrow 9 \rightarrow 8 \rightarrow 7 \rightarrow 4 \rightarrow 1$$

$$3 \rightarrow 2 \rightarrow 6 \rightarrow 5$$

NOTE:

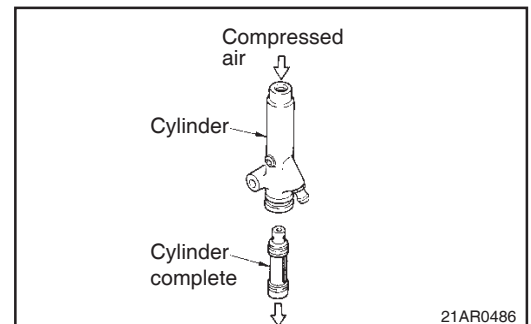
To tighten or loosen the offset bolt, be sure to turn the nut with the bolt head secured in position.

Clutch Master Cylinder Disassembly and Inspection



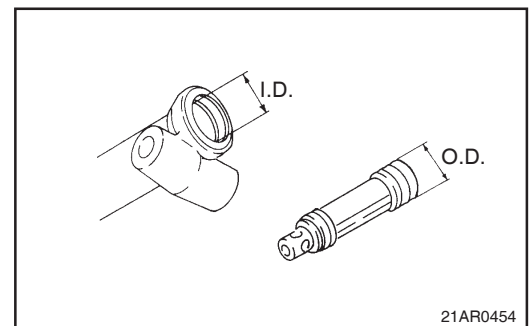
Disassembly Procedure

When removing the piston from the cylinder, plug the nipple and apply compressed air from the union at the end of the cylinder to remove the piston complete.



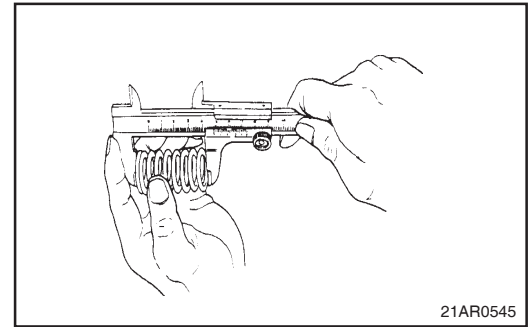
Inspection Procedure

1. Inspection of piston and cylinder
Measure the cylinder I.D. and piston O.D. and if the clearance exceeds the limit, replace the assembly.

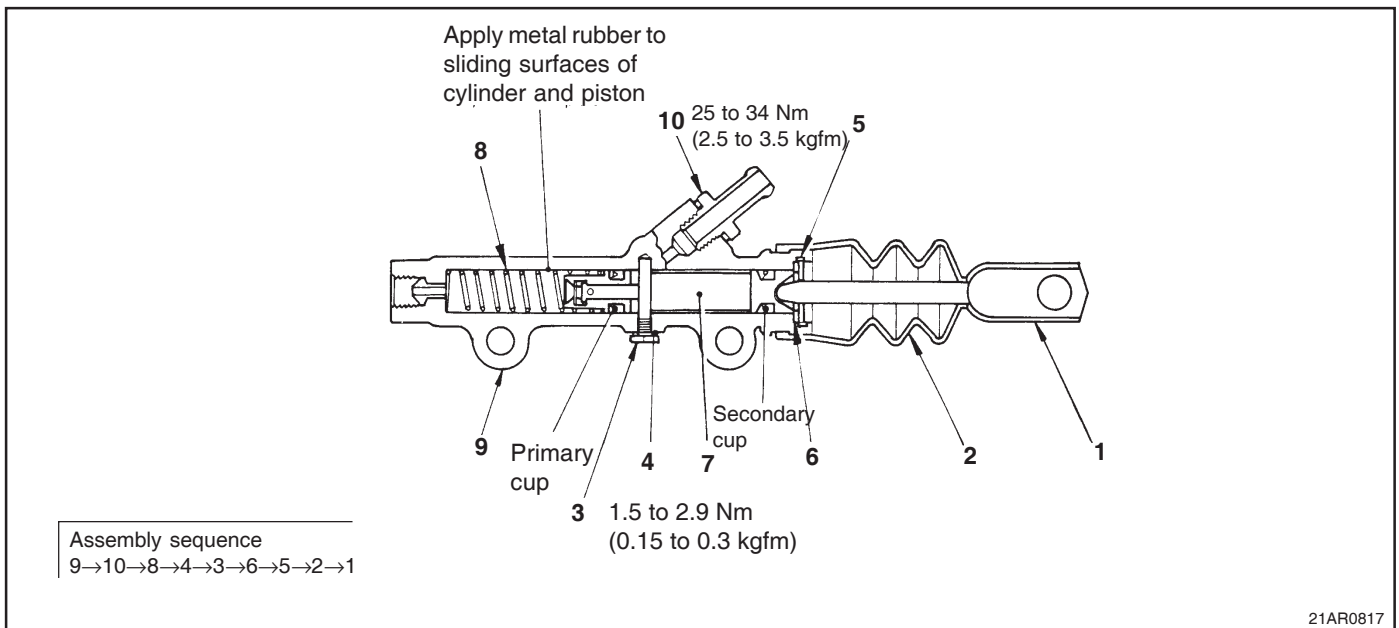


2. Inspection of springs

Measure the free length of return spring. If it is shorter than the limit, replace the return spring.



Reassembly



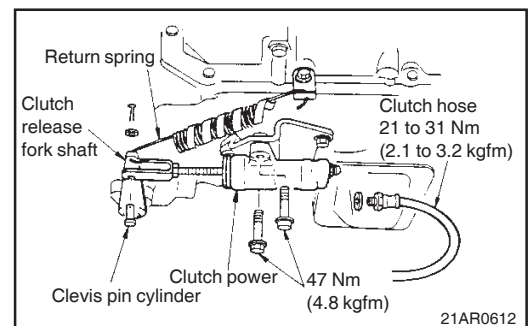
POWER CYLINDER

Removal and installation

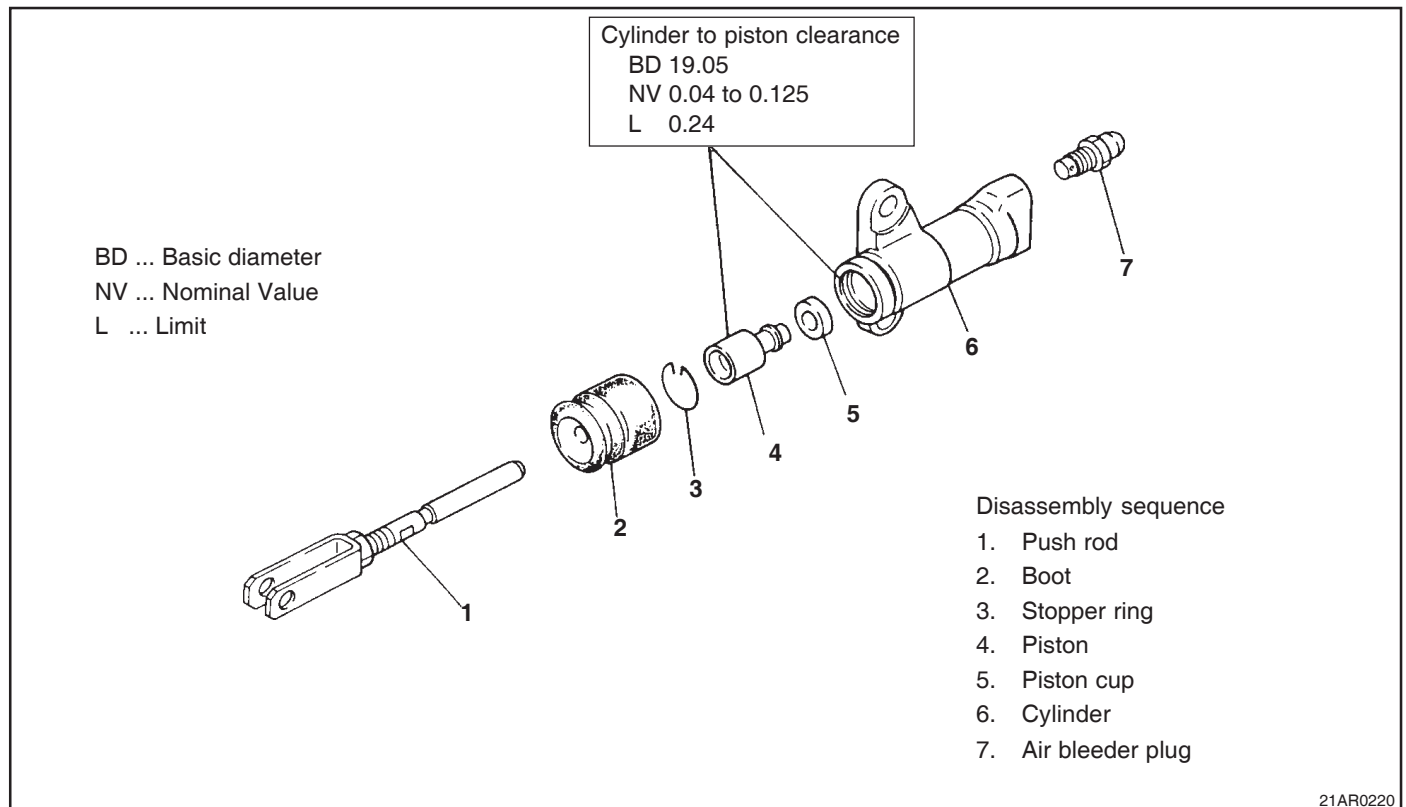
NOTE:

Before initiating removal procedure, be sure to plug the fluid pipes to prevent brake fluid from flowing out.

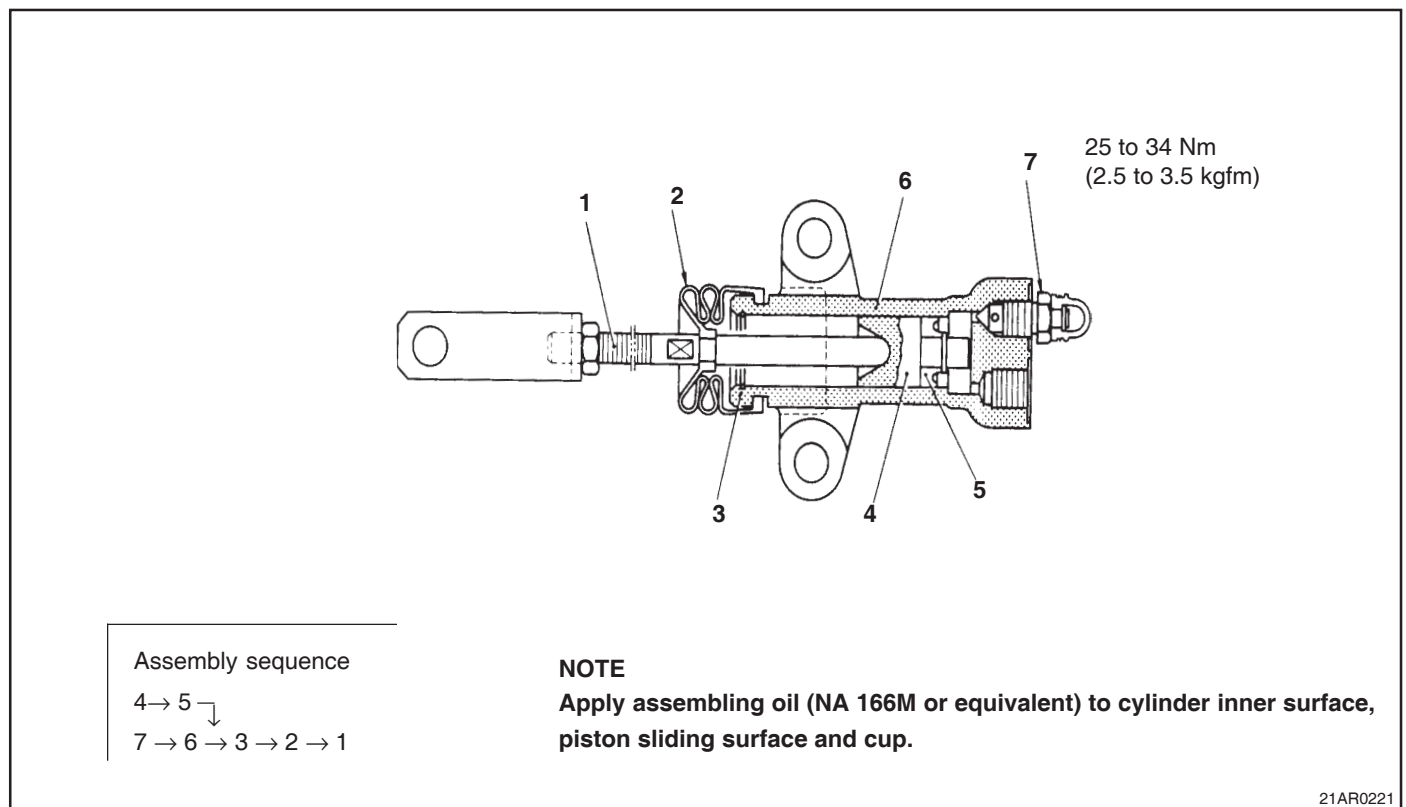
1. After installing the clutch power cylinder, add brake fluid.
[Refer to Section 5.7 Replacement of Brake fluid in Clutch System.]
2. Bleed the clutch system of air.
[Refer to Section 5.8 Bleeding the Clutch System.]



Disassembly and Inspection

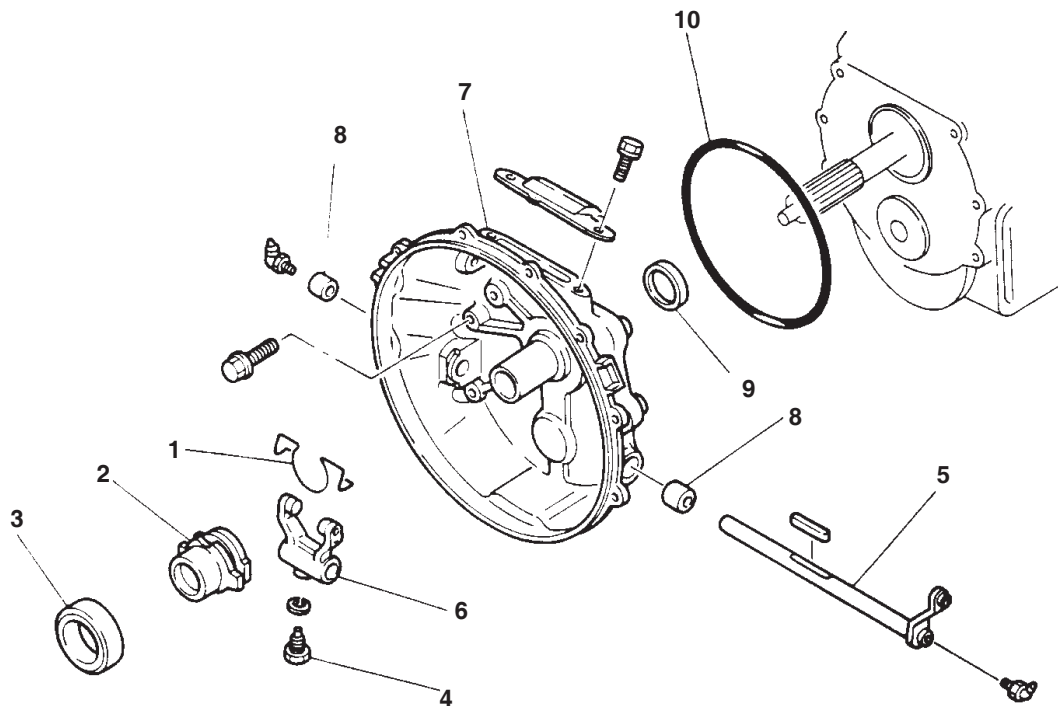


Reassembly



Clutch Housing

Disassembly



Disassembly sequence

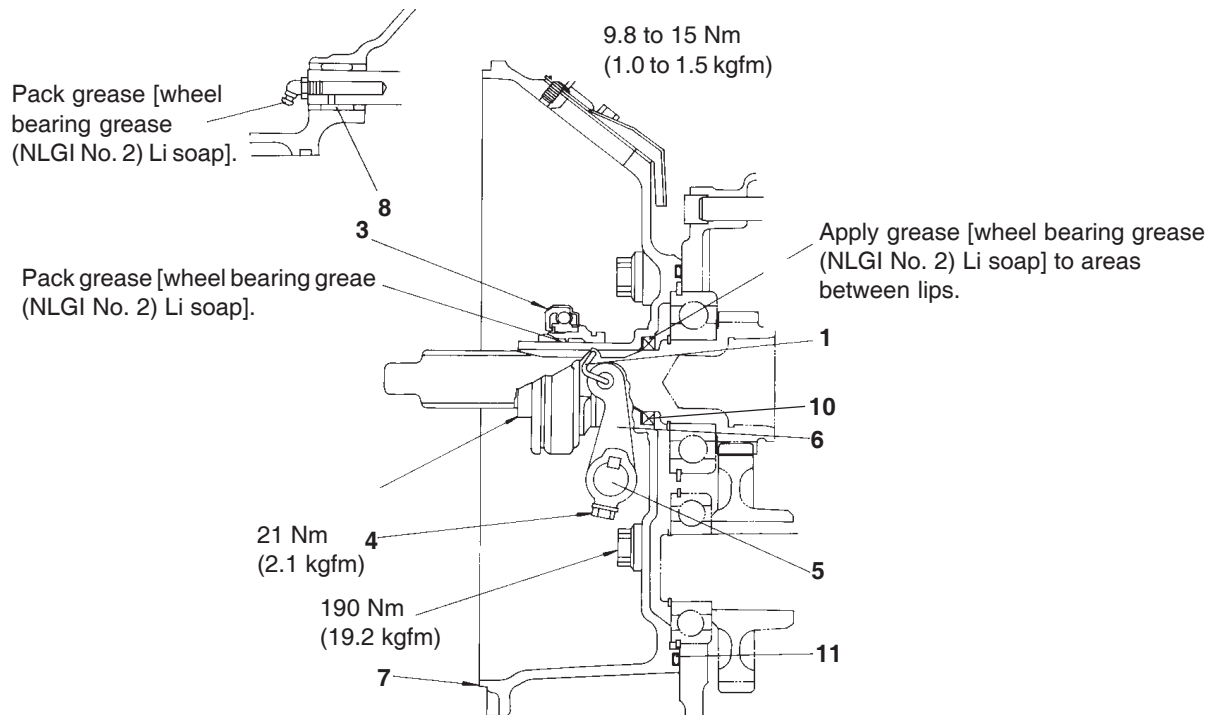
- | | |
|---------------------------|--------------------------|
| 1. Return spring | 6. Clutch release fork |
| 2. Clutch shifter | 7. Clutch housing |
| 3. Clutch release bearing | 8. Needle roller bearing |
| 4. Release fork set screw | 9. Oil seal |
| 5. Release fork shaft | 10. O-ring |

NOTE:

Do not remove the clutch release bearing, needle roller bearing, and oil seal unless defects are evident.

Reassembly

Vehicles with M5S, M6S transmission <C5>



Assembly sequence

5 → 3 → 10 → ⑧ → 6 → 4 → 2 → 1 → 11 → 7

[Vehicles with M5S, M6S transmission <C6>]

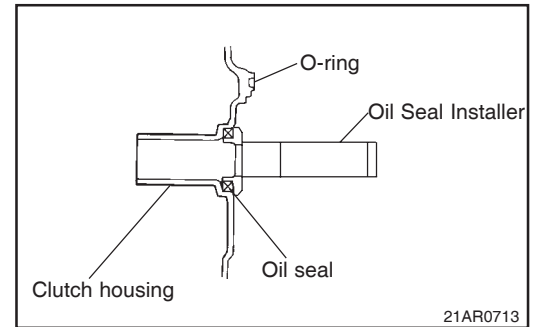
5 → 3 → 10 → ⑧ → 6 → 4 → 2 → 1 → 11 → 7

For parts with an encircled number, refer to Reassembly Procedure that follows.

Reassembly Procedure

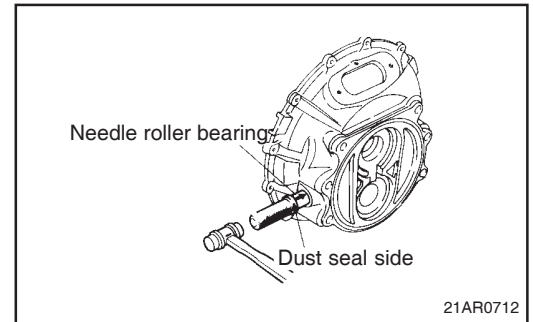
1. Installation of oil seal

To install the oil seal, use the special tool.



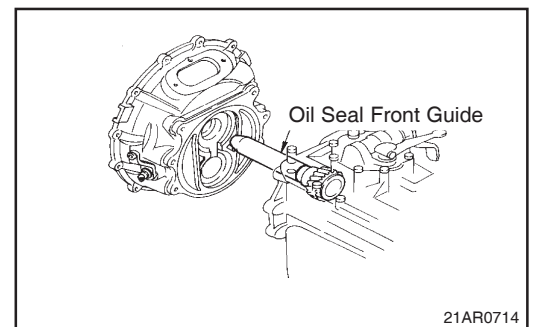
2. Installation of needle roller bearing

To replace the needle roller bearing of the clutch housing, install a new one by hammering, using a special tool (Drift). When it is installed, face to marked side (the yellow seal side) of the needle roller bearing outward.



3. Installation of clutch housing

When installing the clutch housing to the transmission case, be sure to cover the drive pinion with the vinyl tape, to prevent damage to oil seal.



Replacement of Brake Fluid in Clutch System

NOTE:

The clutch system on vehicles with vacuum servo hydraulic brake uses the brake fluid line and tank.

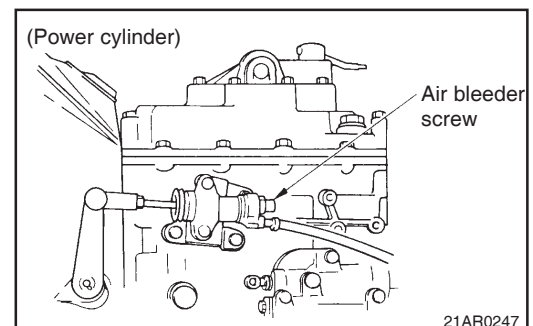
This means that the brake fluid must be discharged also from the brake system whenever the brake fluid in the clutch system is to be replaced.

1. Fit vinyl pipe to the air bleeder of the power cylinder (or clutch booster) and put the other end of the vinyl pipe in an empty container. Loosen the air bleeder of the power cylinder (or clutch booster) and depress the clutch pedal until no more brake fluid flows out.
2. While pouring in fresh brake fluid into the reservoir tank, continue to depress the clutch pedal until the fluid of the clutch system is replaced with the fresh fluid (the fluid flowing out changes in color).

NOTE:

Do not feed brake fluid until its level exceeds "H" on the brake fluid reservoir tank.

Never use brake fluid of different kind.



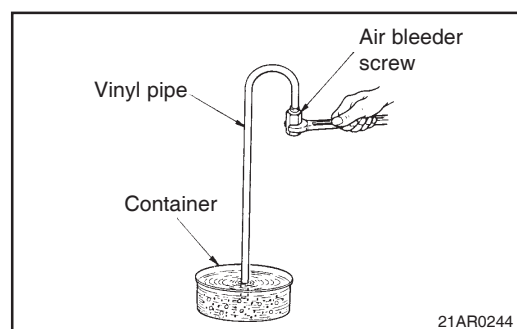
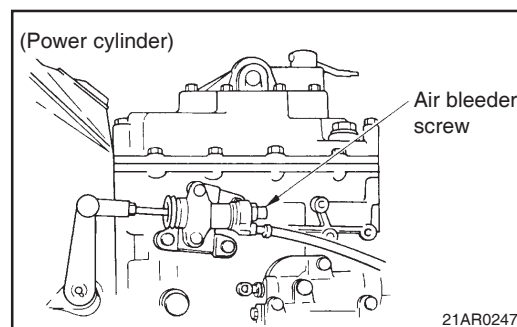
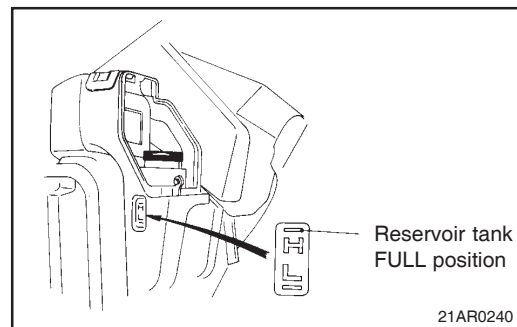
3. Tighten the air bleeder, remove the vinyl hose and install the protector.
4. Bleed the clutch system referring to the following section

Bleeding the Clutch System

When the oil hose was removed, or the oil reservoir tank emptied, or there is air in the clutch piping, bleed the clutch system.

The following bleeding operation should be done with an assistant.

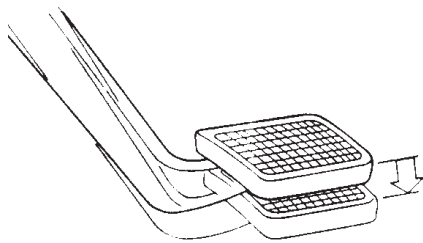
1. Fill the reservoir tank with brake fluid.
If the level falls during bleeding operations, add.
2. Remove the cap from the air bleeder screw of the power cylinder or clutch booster (air type), mount a vinyl pipe, and put the other end of the vinyl pipe in a transparent container filled with brake fluid.
3. Two persons are required for bleeding operations.
Let one person slowly depress the clutch pedal and keep it depressed. In this condition, loosen the air bleeder screw, let the brake fluid run out together with the air, and tighten the bleeder screw. Thereafter, have the clutch pedal released. Repeat this until there are no more air bubbles in the brake fluid that runs out.
As a final step, firmly tighten the bleeder screw and install the cap.



Adjustment of Clutch Pedal

After air bleeding of clutch piping adjust the clutch pedal play.

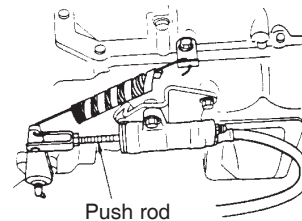
Item	NV	Remarks
No. of turns of push rod being backed off	Approx. 2-1/2 turns	Vehicles with power cylinder
	Approx. 2-1/8 turns	Vehicles with clutch booster
Push rod play (free travel)	3	Vehicles with power cylinder
	2.7	Vehicles with clutch booster



Overall play in clutch pedal

NV	Remarks
30 to 40	Vehicles with power cylinder

(Power cylinder)



21AR0853

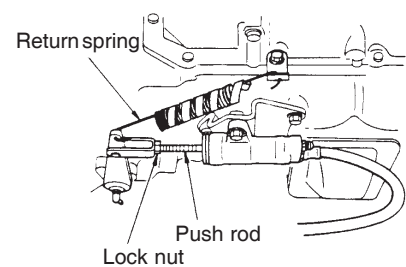
Adjustment Procedure

1. Remove the return spring, fully loosen the lock nut, and extend the push rod until there is no play in the rod.
2. Back off the push rod the specified number of turns to shorten the length.
3. Tighten the lock nut.

NOTE:

If the push rod cannot be backed off the specified number of turns, it indicates that the clutch disc is worn. Replace the disc with a new one.

(Power cylinder)

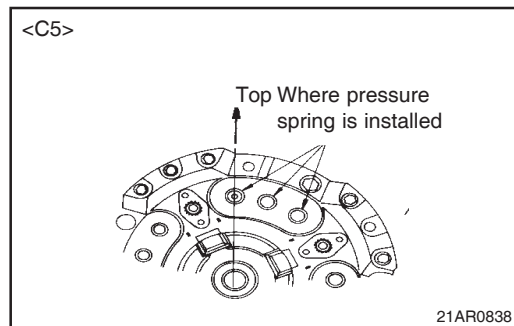


21AR0854

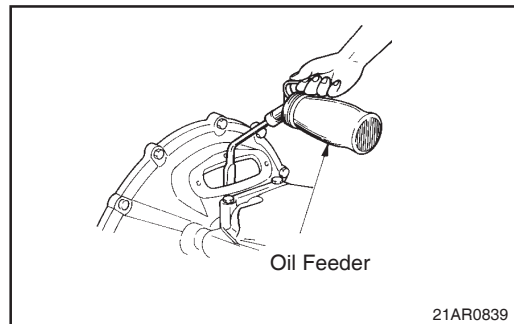
Lubrication of Drive Pinion Splines

If the clutch is not releasing properly due to a sticking clutch disc, lubricate the splines using the following procedure.

1. Remove the inspection window on top of the clutch housing.
2. Crank the engine until the places where pressure spring are visible through the inspection hole as shown in illustration.



3. Fill the Oil Feeder, with engine oil or gear oil insert its nozzle along the clutch cover into position.



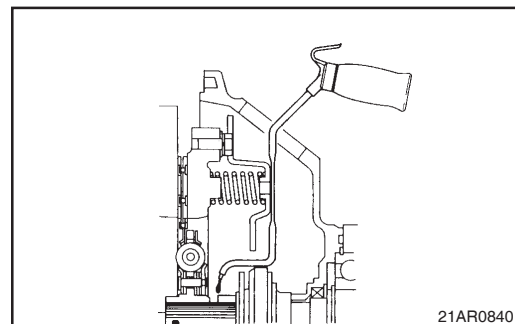
4. Feed oil approx. 0.7 cc as shown.

NOTE:

In an excessive amount of oil is fed, the oil splashes resulting in the clutch slipping.

Feel the pot being pressed to know the oil flow.

5. Crank the engine 180° and feed oil in the same way.
6. Before actually lubricating, use the nozzle of the special tool to flush splines with volatile cleaner, which helps improve the effect of lubrication.



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Clutch not releasing properly	Defective control mechanism	
	o Leaks from oil line	Repair or relace defective parts
	o Air trapped in oil line	Bleed system of air
	o Improper clutch pedal play	Adjust
	o Clutch master cylinder malfunctioning	Reair or replace
	o Clutch booster malfunctioning	
	Defective clutch (Disassemble and check clutch assembly)	
	o Damaged or poorly lubricated pilot bearing	Replace and lubricate
	o Damaged release bearing	Replace
	o Irregular release lever heights and damaged release lever	Adjust height or replace
	o Defective clutch disc	Replace clutch disc assembly
	o Damaged or deformed clutch disc	
	o Worn or rusted splines in transmission drive pinion, and clutch disc hub	Replace or repair defective parts
	o Distorted or damaged pressure plate	Regrind or replace
	Distorted or damaged flywheel plate	
Clutch slipping	Defective control mechanism	
	o Improper clutch pedal play	Adjust
	o Clutch pedal return spring losing tension	Replace
	o Clutch master cylinder malfunctioning	Replace defective parts
	o Poor sliding motion of piston or piston cup	
	o Plugged fluid inlet/outlet	Disassemble and clean
	o Return spring losing tension	Replace
	o Power cylinder return spring losing tension	
	o Power cylinder malfunctioning	Replace defective parts
	o Poor sliding motion of piston or piston cup	
	o Plungged fluid inlet/outlet	Disassemble and clean

Symptom	Probable cause	Remedy
Clutch slipping	Defective clutch mechanism (Disassemble and check clutch assembly)	
	o Irregular release lever heights	Adjust
	o Pressure spring losing tension	Replace
	o Defective clutch disc mechanism	Replace clutch disc assembly
	o Worn facing	
	o Deformed clutch disc	
	o Hardened facing surface	Remove hardened surface or replace clutch disc assembly
	o Oil on facing	Clean or replace clutch disc assembly
Clutch not engaging smoothly	o Distorted or damaged pressure plate	Regrind or replace
	Distorted or damaged flywheel	
	Defective control mechanism	Lubricate or repair
	o Clutch pedal malfunctioning	Replace
	o Clutch pedal return spring losing tension	
	o Clutch master cylinder malfunctioning	
	o Poor sliding motion of piston or piston cup	Replace defective parts
	o Plugged fluid inlet/outlet	Disassemble and clean
	o Return spring losing tension	Replace
	o Power cylinder return spring losing tension	
	o Power cylinder malfunctioning	
	o Poor sliding motion of piston or piston cup	Replace defective parts
	o Plugged fluid inlet/outlet	Disassemble and clean
	Defective clutch mechanism (Disassemble and check clutch assembly)	
	o Defective clutch disc mechanism	Replace clutch disc assembly
	o Distorted facing	
	o Hardened facing surface	
	o Rivet left loose	Replac clutch disc assembly
	o Oil on facing	Remove oil or replace clutch disc assembly
	o Poor sliding motion of clutch disc splines	Correct or lubricate splines

Symptom	Probable cause	Remedy
Clutch not engaging smoothly	o Clutch disc torsion spring losing tension or broken	Replace clutch disc assembly
	o Irregular release lever heights	Adjust
	o Pressure spring losing tension	Replace
	o Distorted or damaged pressure plate	Regrind or replace
	Distorted or damaged flywheel	
Clutch develops noise when disengaged	Worn, damaged, or poorly lubricated pilot bearing	Replace or lubricate
	Worn, damaged, or poorly lubricated release bearing	
	Defective clutch disc mechanism	Replace clutch disc assembly
	o Worn clutch disc splines	
	o Clutch disc torsion spring losing tension or broken	Replace clutch cover
	Bent thrust plate	
Clutch develops noise when engaging	Defective clutch disc mechanism	Replace clutch disc assembly
	o Clutch disc torsion spring losing tension or broken	
	o Worn clutch disc hub splines	
	Worn splines is transmission drive pinion or input shaft (M8S2x5)	Replace
	Pressure spring losing tension	Replace
Judder at startup	Low idle speed	Adjust
	Poor greasing of clutch control system	Apply grease to clutch shifter
	Deteriorated engine mount rubber	Replace
	Defective clutch housing assembly (Remove transmission assembly)	Apply grease or replace
	o Defective clutch release bearing	
	Poor sliding motion or damage of clutch shifter	Apply grease or replace
	Deformed or damaged clutch release fork	Replace
	Defective clutch proper	Adjust height or replace
	o Uneven release lever plate height or damage	
	o Pressure plate poorer than limit	Correct or replace
	o Defective clutch disc	Remove grease or oil, or replace clutch disc assembly
	o Grease or oil on facing	
	o Flatness or runout poorer than limit	Correct or replace clutch disc assembly
	o Uneven facing contact	
	Worn splines	Grease splines or replace clutch disc assembly
	Poor flatness of flywheel assembly	Correct or replace

ENGINE ELECTRICAL

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Tài liệu kỹ thuật miễn phí

GENERAL	EE- 2
SPECIFICATIONS	EE- 2
SERVICE STANDARD	EE- 3
SERVICE PROCEDURE	
Starter Motor	EE- 4
Alternator	EE- 9
TROUBLESHOOTING	EE-15

GENERAL

Starter

The stater is a device which rotates the crankshaft through the flywheel ring gear to start the engine.

When the starter is activated by the starter switch, the magnetic switch operates and meshes the pinion with the outer ring gear of the flywheel through level action. The engine is then rotated by the motor and starts.

When the starter switch is returned to ON after the engine has started, the pinion release the ring gear and motor revolution stop. Major parts in the assembly are the motor to generate torque, the overrunning clutch to transmit power and to prevent starter overrun, the magntic switch to turn on/off motor current and mesh the pinion with the ring gear and the internal gear to amplify armature torque.

Alternator

The alternator with a built-in IC regulator (abbreviated to the built-in alternator) is used.

The alternator consists of the IC regulator and brush holder accommodated in the rear bracket.

SPECIFICATIONS

Item		D6DA	
Battery	Type x Quantity	PT-120 x 2 : STD, PT-150 x 2 : OPT	
	Voltage (V)	12	
	Capacity (AH)	120(20 time rate) = 96(5 time rate) : STD	
		150(20 time rate) = 120(5 time rate) : OPT	
Starter	Type	Electric pinion shift type	
	Rated output	24V-5.5KW	
Glow plug	Type	Intake air heating type	
	Voltage-current	22V-75A	
Alternator	Type	Alternative	
		With cooler	Without
		24-120A	24-120A
Model		37300-8Y000	37300-8Y000
Type		Electric forced fitling	
Output		24V, 5.5KW	
Rotation		Clock wise from viewed pinion side	

SERVICE STANDARD

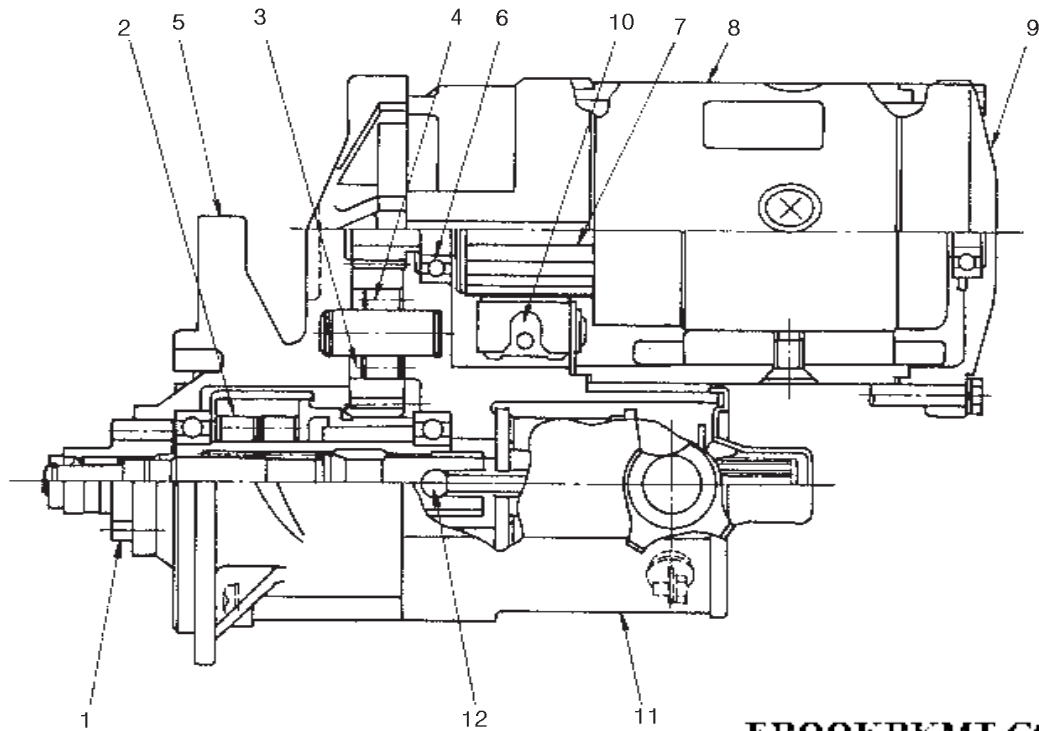
Unit : mm

Item		D6DA		Remedy
		Standard	Limit	
Starter	Length of brush	17	11	Replace
	Spring constant of brush spring	2.55~3.45kg	1.8kg	
	Coil resistance of starter relay	10.4Ω		
Alternator	Length of brush	23	8	Replace
	Spring constant of brush spring	0.32~0.44kg	0.2kg	
	Voltage adjusting of regulator	28~29V		
Glow plug	Heating time	18~22sec		When coolant below -5°C

SERVICE PROCEDURE

Starter Motor

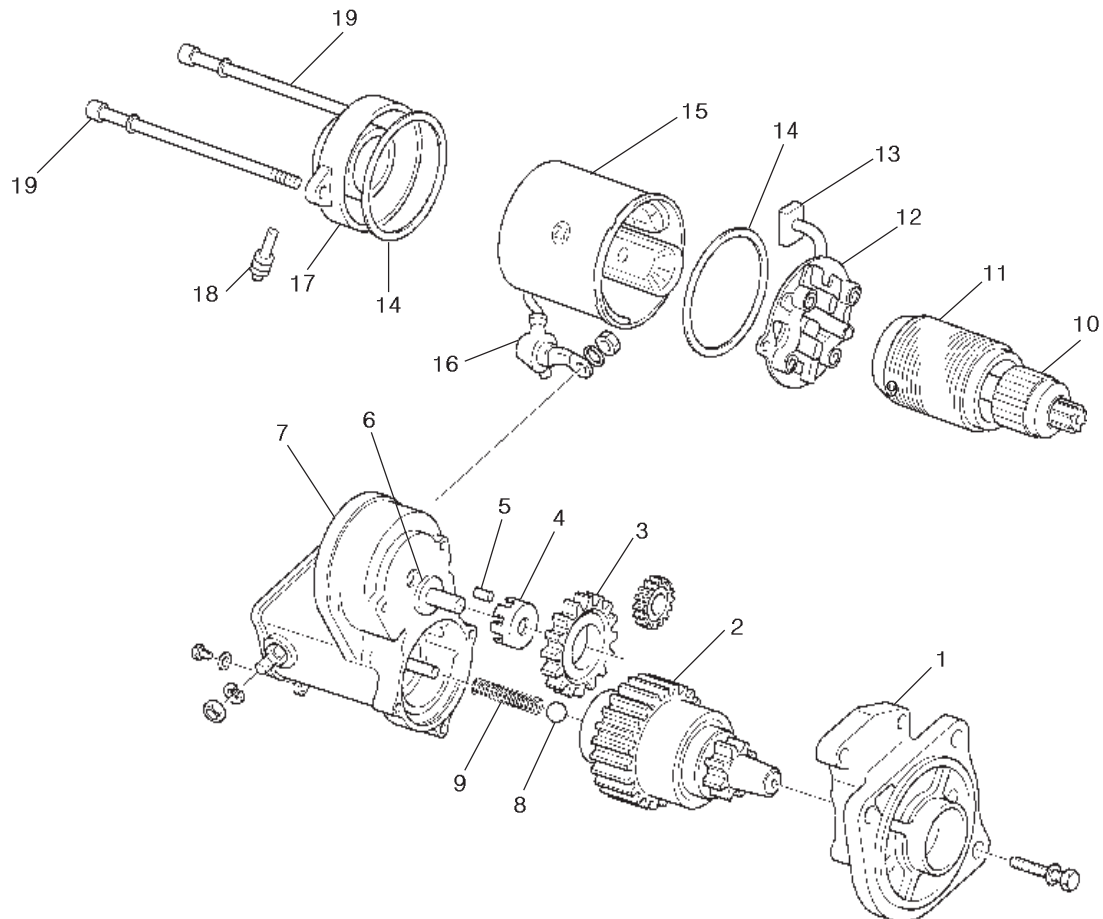
DESCRIPTION



EBOOKBKMT.COM
Tài liệu kỹ thuật miễn phí

- | | |
|-----------------------|---------------------|
| 1. Pinion | 7. Armature |
| 2. Overrunning clutch | 8. Yoke |
| 3. Retainer | 9. Rear end cover |
| 4. Roller | 10. Brush |
| 5. Drive end frame | 11. Magnetic switch |
| 6. Ball bearing | 12. Steel ball |

OVERHAUL



1. Drive end frame
2. Clutch and pinion
3. Idle gear
4. Retainer
5. Roller
6. Washer
7. Magnetic switch

8. Steel ball
9. Return spring
10. Ball bearing
11. Armature
12. Brush holder
13. Brush
14. O-ring

15. Yoke
16. Lead wire
17. Rear end frame
18. Boots
19. Through bolt

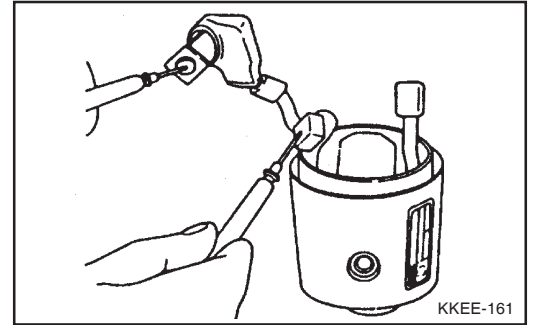
Inspection

Check the Field Coil

1. Continuity test

Check the continuity between brush (+) and M terminal.

Maintenance criteria: Resistance ∞

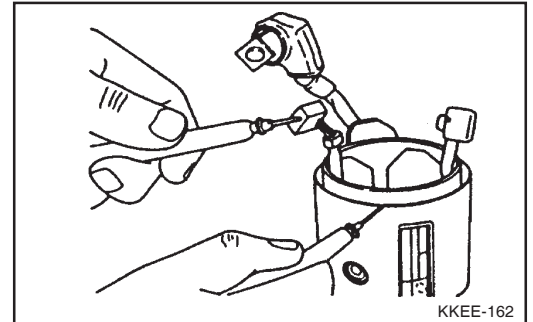


2. Insulation test

Check the continuity test between wire harness and case.

(M Ω)

Maintenance criteria	Capacity
More than 1	Less than 0.5

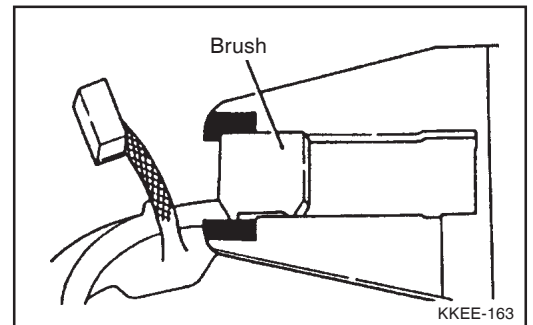


3. Measurement of brush height

Measure the height using a vernier calipers.

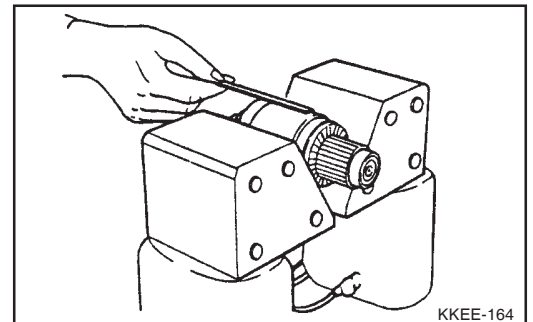
(mm)

Maintenance criteria	Capacity
22	15



4. Measure the armature circuit short test.

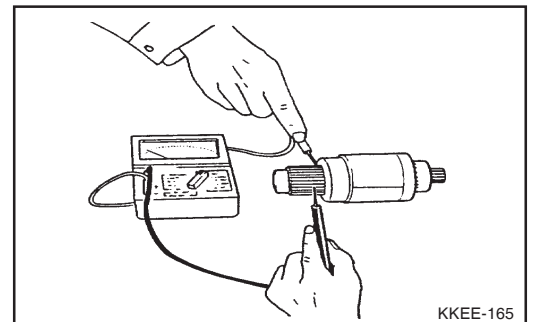
Put the steel plate on the armature core softly and rotate it when the power switch is "ON". If there is any coil short, steel plate is suctioned or vibrating.



5. Armature coil continuity test (disconnection test)

Test by touching both sides of commutator bar with armature lead wire.

Measurement value 0 Ω : Good ∞ : Bad

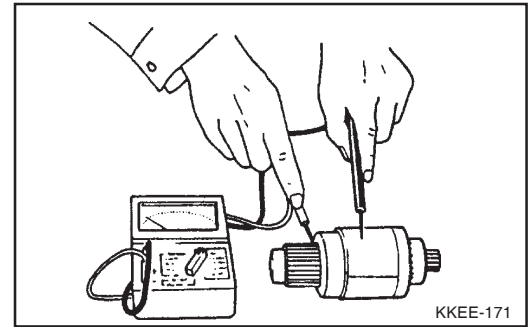


SERVICE PROCEDURE**EE-7****6. Insulation test**

Measure the continuity with tester lead wire between commutator and rotor face.

(MΩ)

Maintenance criteria	Capacity
More than 1	Less than 0.5



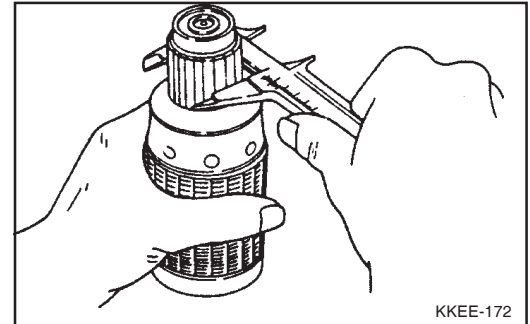
KKEE-171

7. Measurement of commutator outer diameter

Measure the outer diameter with vernier calipers.
(If the face is coarse, scrub the face with #500 –600 sand paper and then measure it)

(mm)

Maintenance criteria	Capacity
44	Less than 42



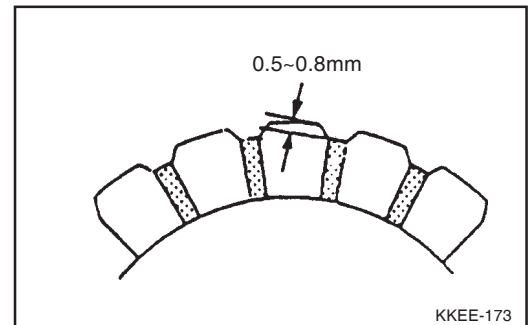
KKEE-172

8. Depth of Intercut of commutator

If the depth of indented parts becomes less than 0.2 mm, adjust the depth using special tool or saw.

(mm)

Maintenance criteria	Capacity
0.5-0.8	Less than 0.2



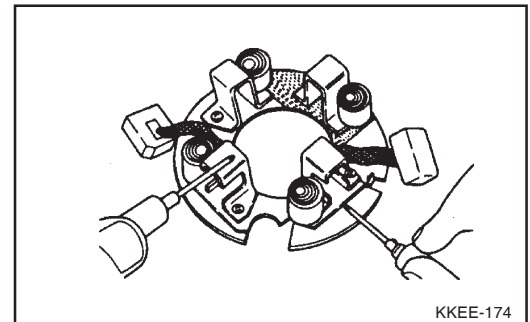
KKEE-173

9. Britter holder insulation test

Check the continuity between brush and brush holder.
(Measure it after cleaning)

(MΩ)

Maintenance criteria	Capacity
More than 1	Less than 0.5



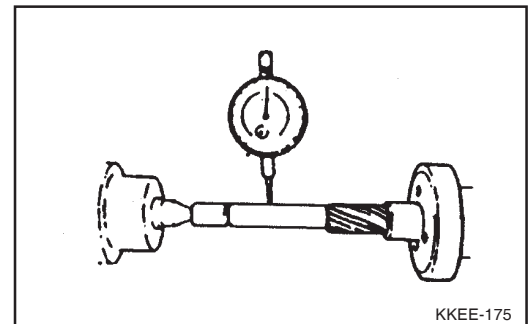
KKEE-174

10. Bend of drive shaft

Measure the bending of center parts of drive shaft with dial gauge.

(mm)

Maintenance criteria	Capacity
Within 0.02	Less than 0.1



KKEE-175

EE-8

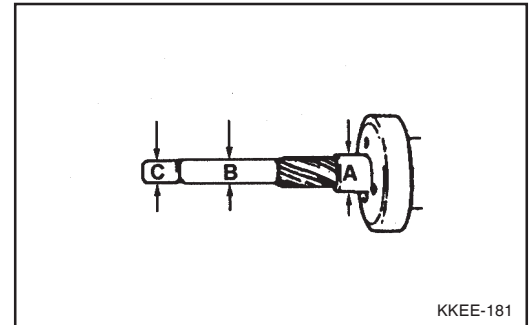
ENGINE ELECTRICAL

11. Outer diameter of driveshaft

Measure the outer diameter of A, B and C points.

(mm)

Items	Criteria	Capacity
A point	35	Less than 34.89
B, C point	20	Less than 19.90

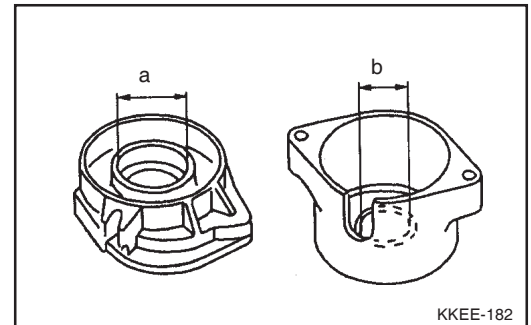


12. Internal diameter of each shaft

a. End frame

(mm)

Maintenance criteria	Capacity
62	More than 62.1



b. Holder (rear bracket)

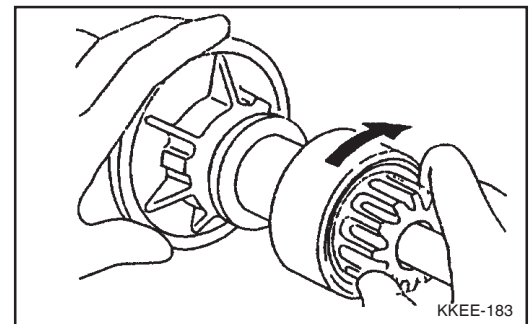
(mm)

Maintenance criteria	Capacity
35	More than 35.1

13. Pinion gear

Check the clutch effects.

As assembled to the drive shaft, try to rotate the pinion gear. (It rotates clockwise but does not rotate counterclockwise)



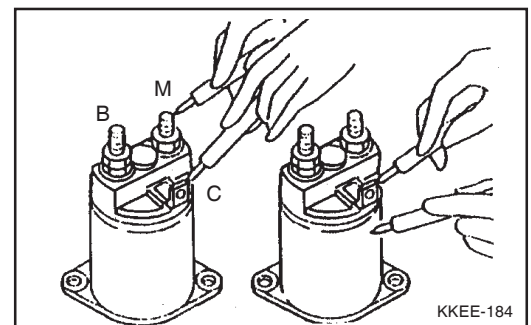
14. Magnetic coil

Pull-in coil: 0.12 ~ 0.15 Ω

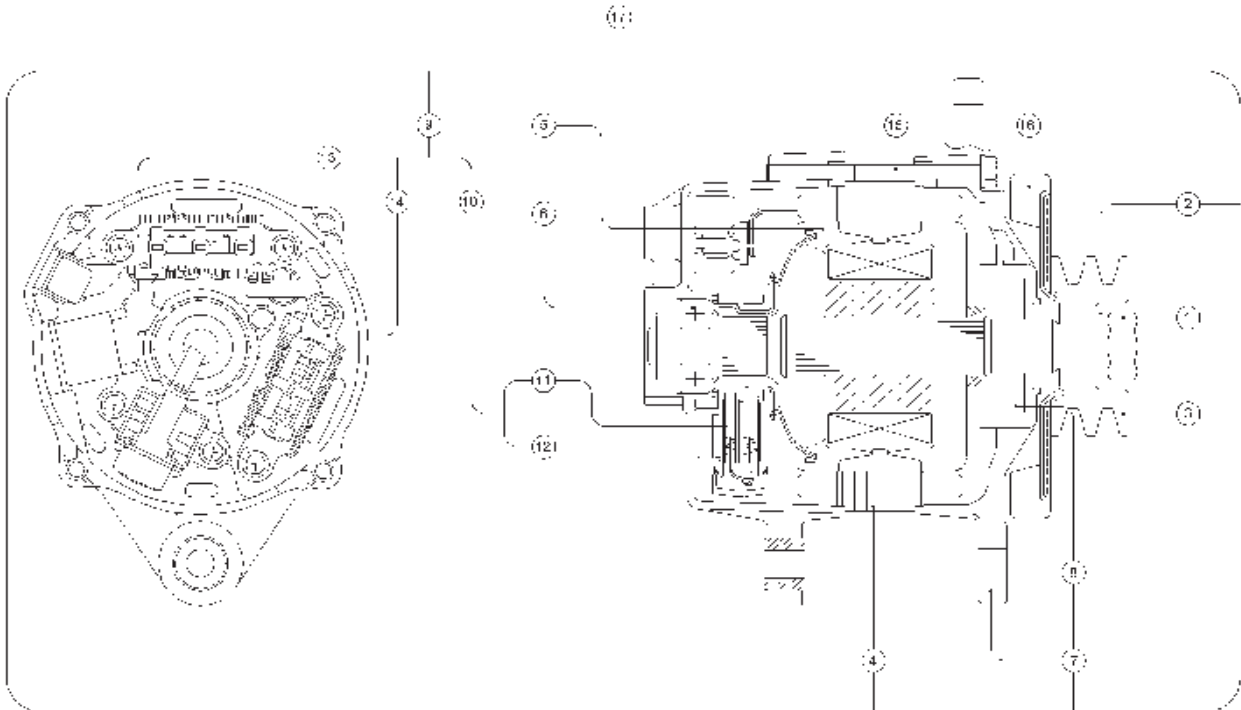
Measure the resistance between M terminal and C terminal.

Hold-in coil resistance: 0.3 ~ 0.5 Ω

Measure the resistance between C terminal and case.



Alternator



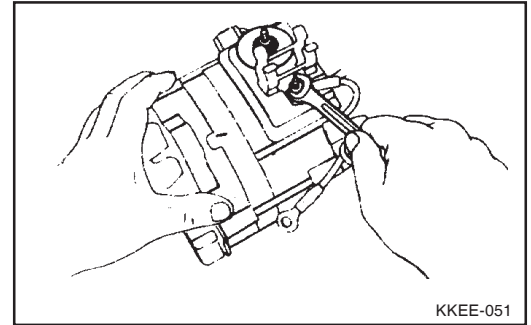
1. Nut
2. Spring washer
3. Pulley
4. Stator assembly
5. Rotor
6. Bearing
7. Front bracket assembly
8. Bearing
9. Rear Bracket assembly

10. Regulator assembly
11. Brush
12. Brush spring
13. Rectifier
14. Rectifier
15. Through bolt
16. Pan
17. Alternator assembly

Disassembly and Assembly

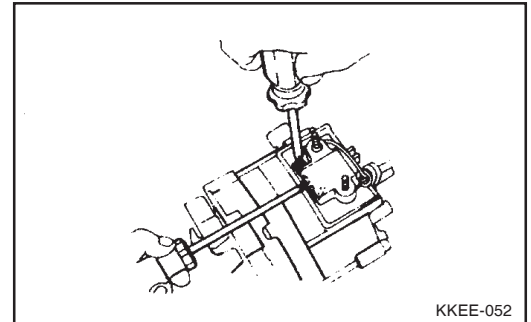
1. Disassembly of brush holder cover

- 1) Remove nut, earth wire and clamp from terminal E.
- 2) Remove nut, insulator and rubber washer from terminal B.



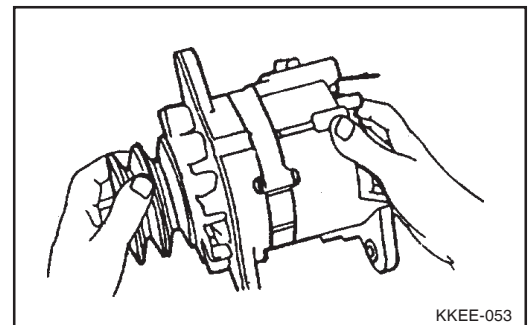
2. Brush holder removal

- 1) Remove the screw.
- 2) Pull out the brush holder.
- 3) Remove the brush holder by loosening the screws.



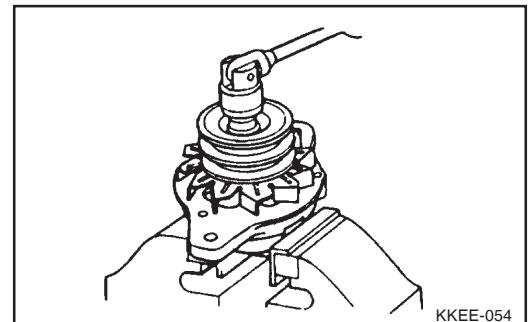
3. Removal of front bracket assembly from the stator

- 1) Remove the through-bolts.
- 2) Pull out the front bracket assembly from the stator.
Tap the rotor shaft lightly with a plastic faced hammer if necessary.



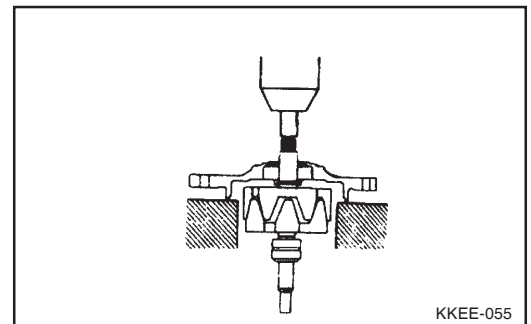
4. Pulley and fan removal

- 1) Place the rotor in a soft jaw vise. Take care not to damage rotor.
- 2) Remove the pulley nut, spring washer, pulley and fan etc.



5. Rotor removal from the front bracket assembly

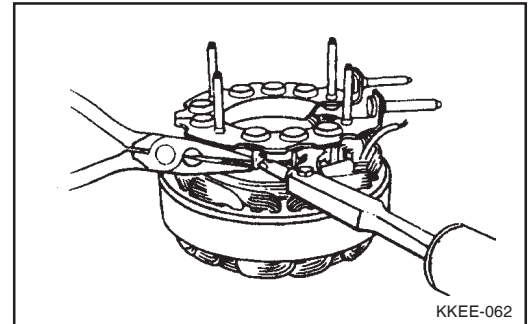
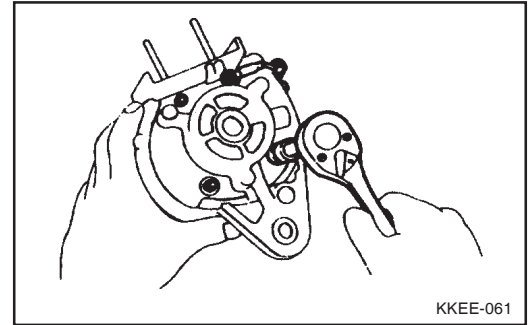
Using a press and socket wrench, remove the rotor and spacer collars.



SERVICE PROCEDURE

EE-11

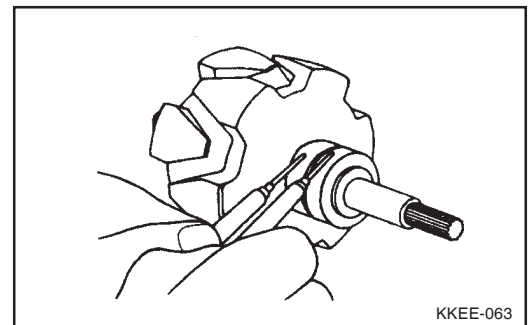
6. Remove rectifier rear bracket assembly from stator
 - 1) Remove the rubber cap.
 - 2) Remove the nuts and insulators.
 - 3) Remove rectifier rear bracket assembly from stator.
 - 4) Remove the insulators and collars from the rectifier holder studs.
7. Remove the stator soldering leads from rectifier holder
Hold the rectifier terminal with long nose plier and remove the soldering lead.
To protect rectifiers from heat, do not the soldering.



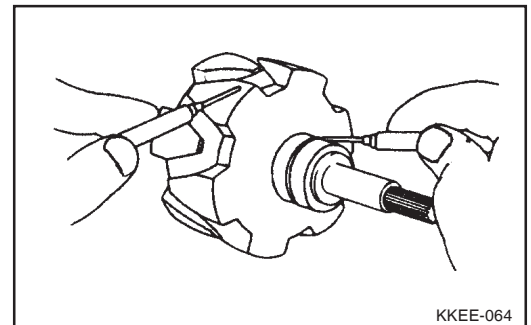
Inspection and repair

1. Inspect rotor for open circuit
Using an ohmmeter, check for continuity between the slip rings.
If there is no continuity, replace the rotor.

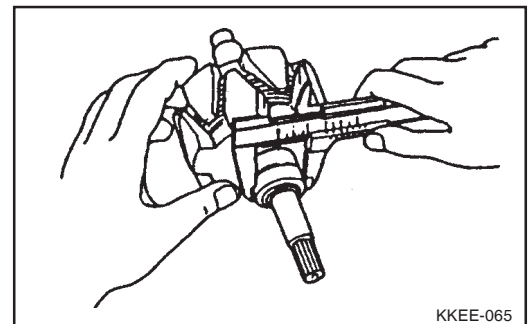
Standard resistance: 3-4Ω



2. Check whether rotor is grounded
Using an ohmmeter, check that there is no continuity between the slip ring and rotor.
If there is continuity, replace the rotor.
3. Check the slip ring
Check that the slip rings are damaged or deformed.
If damaged or deformed, replace the rotor.



4. Measure the slip ring outer diameter

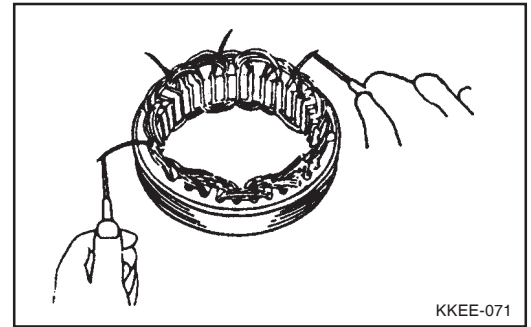


EE-12

ENGINE ELECTRICAL

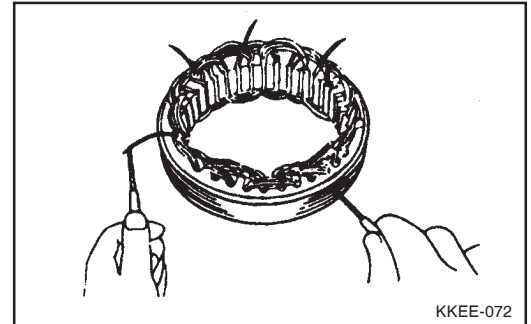
5. Inspect stator for open circuit

Using an ohmmeter, check all coil leads for continuity.
At this time, the connecting wires should be connected to the shoulder.
If there is no continuity, replace the stator.



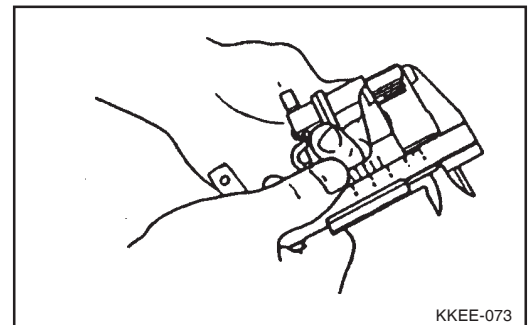
6. Check whether the stator is grounded

Using an ohmmeter, check the continuity between the coil leads and stator core.
If there is continuity, replace the stator.



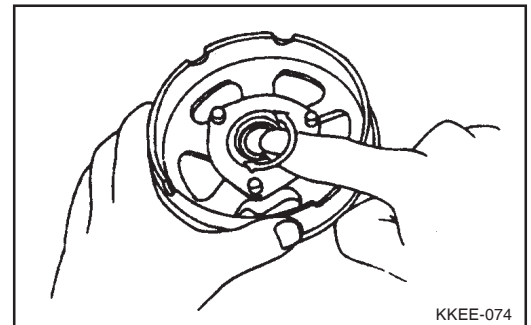
7. Measure brush length

If the brush length is less than 6.5mm, replace the brush.
Service Limit: 6.5mm



8. Bearing inspection

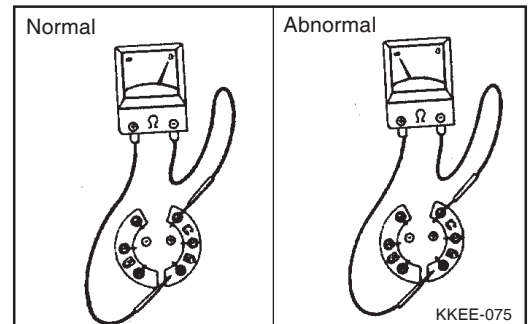
Check whether the bearing is damaged or deformed.
Replace it, if necessary.



9. Rectifier inspection

1) Positive side of rectifier holder

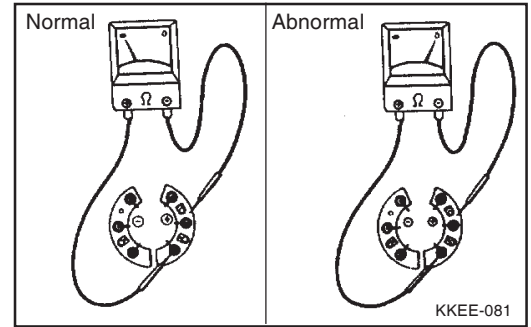
Connect an ohmmeter $\ominus$ lead to rectifier holder, and $\ominus$ lead of meter to rectifier terminal.
If there is no continuity, replace the rectifier assembly.



SERVICE PROCEDURE

EE-13

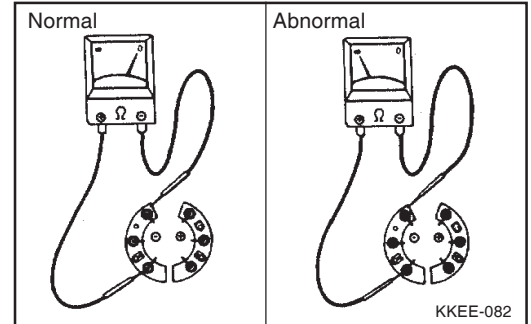
Perform the continuity test again by switching the test lead.
If there is continuity, replace the rectifier assembly.



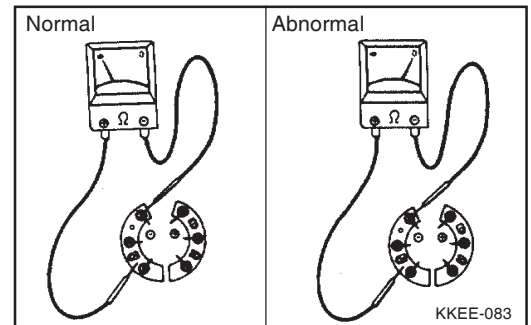
2) Negative side of rectifier holder

Connect $\oplus$ lead of ohmmeter to rectifier terminal, and $\ominus$ lead of meter to rectifier holder.

If there is no continuity, replace the rectifier assembly must be replaced.



Perform the continuity test again by switching the test lead.
If there is continuity, replace the rectifier assembly.



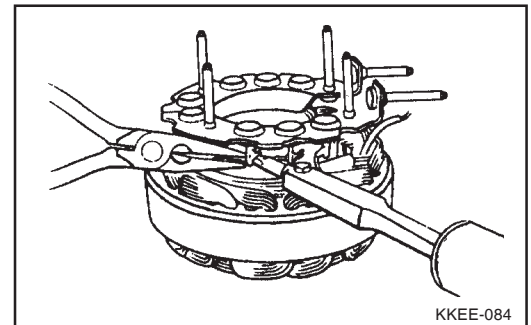
Assembly

Assemble by the reverse order of disassembly. However, attention should be paid to the following.

1. Alternator assembly

Soldering each stator lead to rectifier holders.

Hold the rectifier terminal with the long nose pliers while soldering the leads.

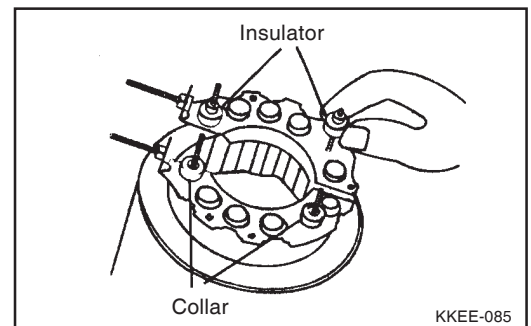


CAUTION

To protect the rectifiers from heat, do not overheat.

2. Assembly of rectifier rear bracket and rectifier holder

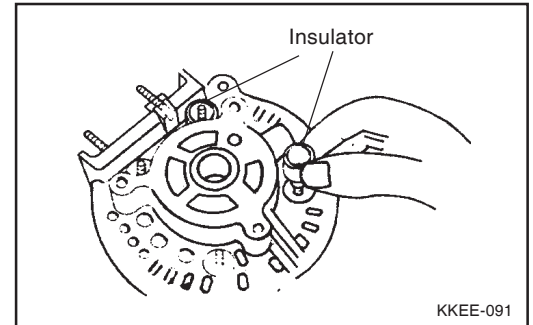
- 1) Place insulator on the positive side studs.
- 2) Place collars on the negative side studs.
- 3) Install the rectifier end frame on the rectifier holder. Check the wires whether to touch the case or not.



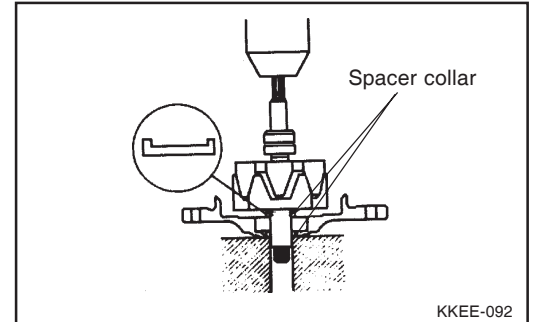
EE-14

ENGINE ELECTRICAL

- 4) Place insulators on the positive side studs.
- 5) Install nuts on the studs and fasten.

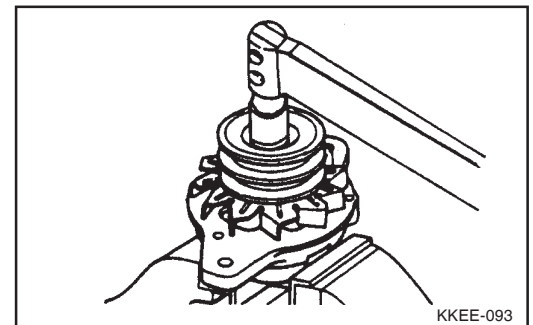


3. Installation of front bracket assembly
 - 1) Slide the thin spacer collar on the rotor shaft with the cup side facing the rotor.
 - 2) Using a press, install the front bracket assembly together with a thick spacer collar.



4. Fan and pulley installation
 - 1) Place the rotor in a soft jaw vise.
 - 2) Slide the fan, pulley and spring washer on the rotor shaft gently.
 - 3) Install and fasten the pulley nut.

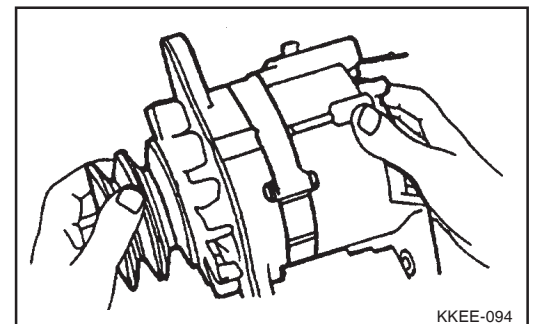
Tightening torque: 800 – 1000 kg-cm



5. Assembly of front bracket assembly and rectifier rear bracket assembly
 - 1) Install front bracket assembly and rectifier rear bracket assembly with a through-bolt.

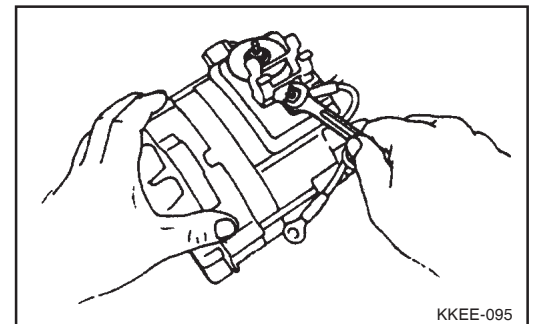
Tightening torque: 70 – 100 kg-cm

 - 2) Make sure the rotor rotates smoothly.



6. Brush holder installation
 - 1) Place brush holder cover on the rectifier rear bracket assembly.
 - 2) Install the insulator and rubber washer to terminal B.
 - 3) Install the clamp and earth wire to terminal E.

Tightening torque: 30 – 50 kg-cm



TROUBLESHOOTING

Symptom	Possible cause	Remedy
Engine does not crank, or cranks slowly.	Key switch Poor contact	Polish or replace contacts
	Battery - Discharged battery - Short circuited between electrodes - Poor contact at battery terminal	- Charge - Replace battery - Plish or retighten
	Engine oil Improper viscosity oil	Change oil
	Magnetic switch - Poor contact caused by burnt contact plate - Contact plate worn out - Holding-coil disconnected (Overrunning clutch moves back and forth) - Pull-in coil disconnected or short circuited	- Plish or replace contact plate - Repair - Replace field coil - Replace
	Starter relay Defective or poor contact	Repair or replace
	Starter - Brush worn out - Commutator burnt out - Commutator worn out - Field winding shorted or grounded - Armature winding shorted or grounded - Insufficient brush spring tension - Poor contact between magnetic switch and field windings - Armature contacts pole core because of worn bearing bush or bent armature shaft - Overrunning clutch malfunction	- Replace - Correct on lathe - Correct by undercutting - Rewind or replace - Replace armature - Replace brush spring - Repair - Replace bearing brush or armature - Replace
Engine does not crank while starter is running in good condition.	Overrunning clutch - Overrunning clutch malfunction - Pinion teeth worn out - Poor sliding of spline teeth	- Replace - Replace - Remove foreign materials, dirt, or replace
Starter does not stop running	Key switch - Contacts keep closing - Key switch sticks - Overrunning clutch sticks to armature	- Replace - Replace - Repair or replace overrunning clutch or ramature
	Starter relay Contacts keep closing	Repair or replace

Symptom	Possible cause	Remedy
Though starter motor rotate but engine doesn't start	Low battery capacity - Faulty quick start system - Faulty control unit - Faulty glow plug relay - Faulty glow plug	- Battery Charge - Replace - Replace - Replace
Though starter motor rotate but pinion ring gear doesn't engage	- Abrasion of over running clutch pinion teeth head - Faulty of over running clutch drive spring - Idling of over running clutch - Poor spline sliding - Abrasion bush - Abrasion ring gear	- Replace - Replace - Replace - Grinding, correction - Replace - Replace
Does not stop starter motor	- Stick of connector plate in magnetic switch - Short of magnetic switch coil - Faulty of ignition switch return	- Replace - Replace - Replace
Battery discharge	- Extend V-belt - Cut or short of stator coil - Cut of rotor coil - Poor contact of brush and slip ring - Faulty rectifier - Faulty regulator - Low of battery fluid - Internal faulty battery - Poor contact of battery terminal - Over load of current	- Adjust V-belt - Replace - Replace - Clean or replace - Replace - Replace - Fill the battery fluid - Replace - Clean and tighten - Check rated load
Battery over charge	Faulty regulator	Replace

ENGINE MECHANICAL

GENERAL	EM- 2
SERVICE STANDARD	EM- 7
SPECIAL TOOLS	EM-17
SERVICE PROCEDURE	
Engine Disassembly Check Standard	EM-22
Engine Dismounting and Installation	EM-24
Engine	EM-26
Crank Shaft Pulley	EM-34
Flywheel and Flywheel Housing	EM-36
Timing Gear and Camshaft	EM-39
Piston, Crankshaft, Cylinder Block and oil Pan ..	EM-45
Liquid Gasket and Oil Application Points	EM-57
TROUBLESHOOTING	EM-59

GENERAL

Construction and Operation

Engine Proper

1. Combustion Chamber

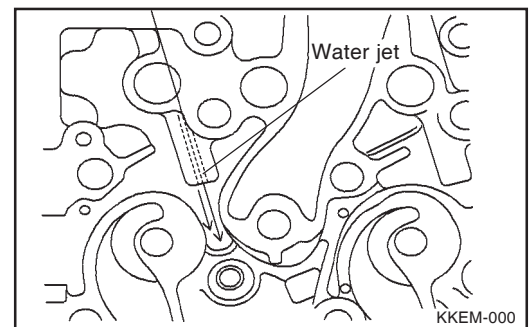
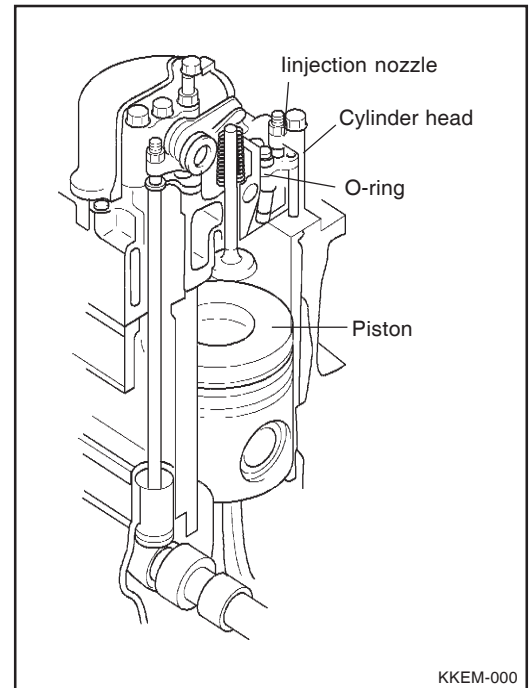
The combustion chamber is made up of the cylinder head and toroidal piston. The hole type injection nozzle is mounted to the cylinder head together with the nozzle tube.

The nozzle tube accomplishes the function of holding the nozzle in position and cooling it. Since the outside of the nozzle tube is exposed to the water jacket, the top end of the tube is sealed off with an O-ring and the bottom is staked to prevent water leakage.

Combustion is accomplished by direct injection of fuel into the combustion chamber.

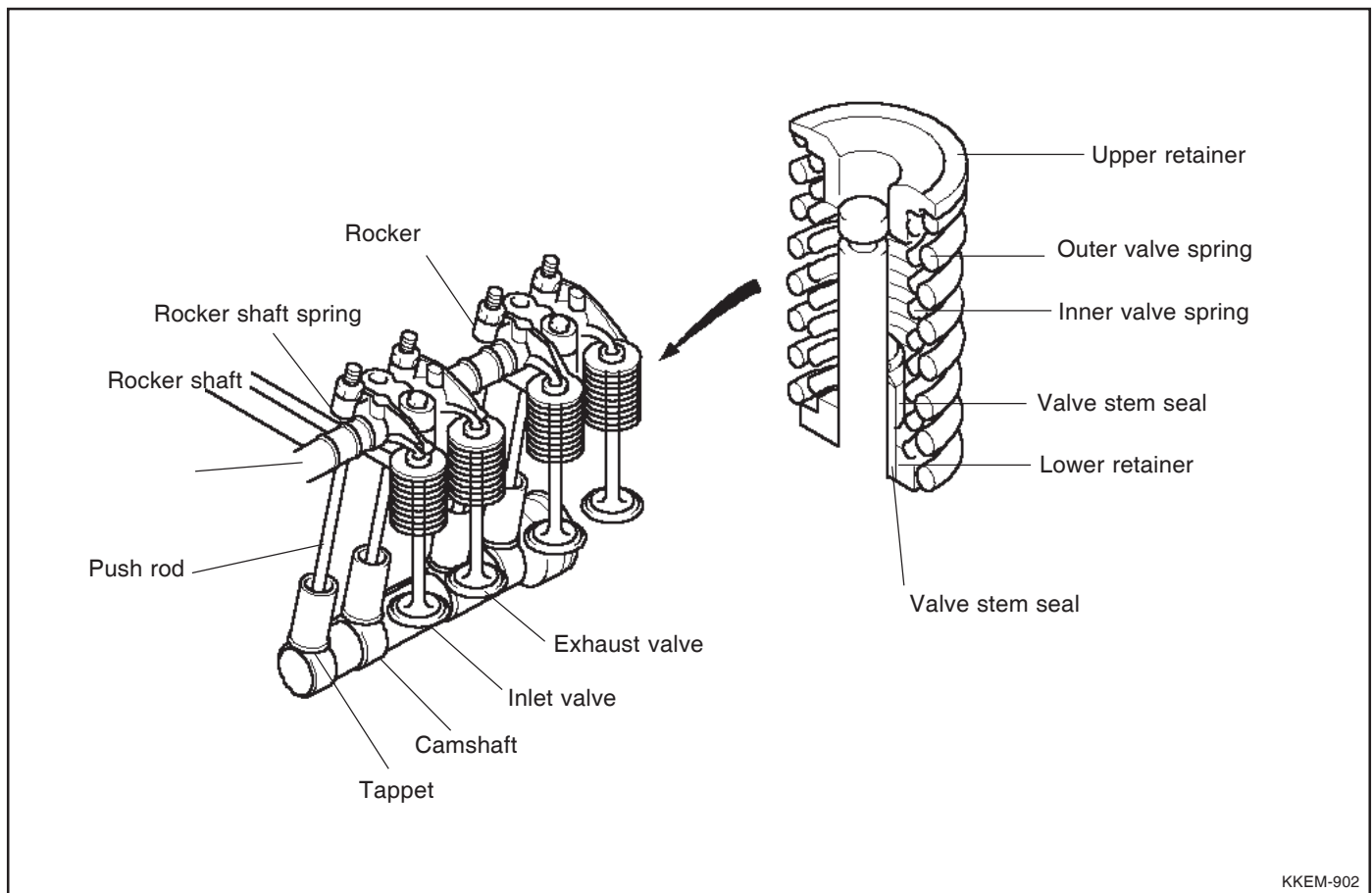
A valve recess is machined on the top of the piston for providing a clearance between the piston and exhaust valve.

For more effective cooling of the combustion chamber, water directors that direct coolant flow are pressed into the bottom of the cylinder head.



2. Valve Mechanism

The valve mechanism is an overhead valve type and is constructed as shown.



KKEM-902

- (a) Both intake and exhaust valves are made of surface treated heat-resistant steel to increase durability.

The valve seat angle of both valves is 45°

A valve stem seal is provided on the stem of valve to control the quantity of lubricant of the valve and valve guide sliding portions. The inner and outer springs are different in coiled direction.

- (b) To prevent abnormal vibration during high speed operation, two unevenly pitched springs are provided as valve springs.

The inner and outer springs are different in coiled direction.

- (c) The rocker is a precision forged carbon steel product.

The rocker end sliding portion is quenched.

The rocker shaft is a hollow round rod with expansion plugs at both ends to seal off the rod. The inside of the shaft constitutes an engine oil passage.

- (d) A steel ball is welded to the bottom end taper side of the push rod, whereas a spherical concave type end cap is welded to the top end rocker side. Both ends are carburized and hardened.

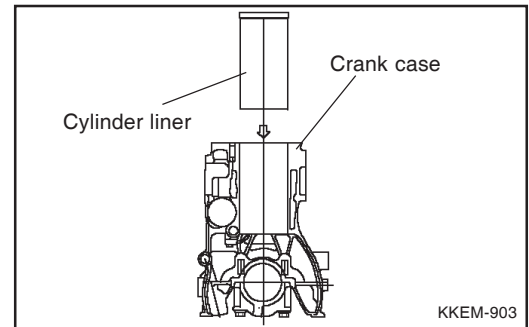
- (e) The tappet is a cylindrical type and has a spherical surface which makes contact with the camshaft. The tappet can be removed without removing the camshaft, provided that the cylinder head is removed.

- (f) Because of the high cam design, the push rod is shorter, assuring higher rigidity and higher dependability against high speed rotation.

- (g) To facilitate insertion and removal of the camshaft from the rear end of the crankcase, the diameter of the camshaft bearing is smaller toward the front.

3. Crankcase and Cylinder Liner

- (a) The coolant enters the water jacket to flow around each cylinder and cool it, and then flows to the cylinder head.
- (b) The dry type cylinder liner is adopted and the liner is pressfitted to the crankcase in such a way as to facilitate removal.

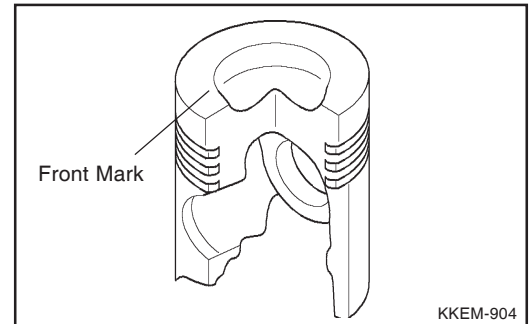


4. Piston and piston ring

(a) Piston

Stamped on the top surface of the piston are a size mark (or oversize dimension on oversize pistons) for selection fit with the cylinder liner, a piston weight mark, part number, and the "F" with an arrow for the front mark showing the piston installing direction.

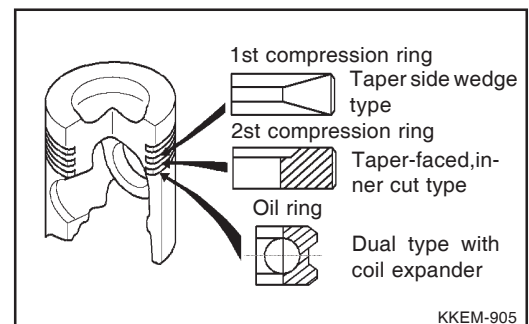
Piston pin for connecting piston to connecting rod is of full-floating type and is prevented from moving out by means of a snap ring type and is prevented from moving out by means of a snap ring installed on each end of the pin ends. On D6AU, a cavity is provided in the piston for colling.



(b) Piston ring

The piston rings are three in total; two compression rings and one oil ring. The sliding surface of each piston ring is hard chrome plated to improve wear resistance.

The piston rings are shaped as shown in the figure.



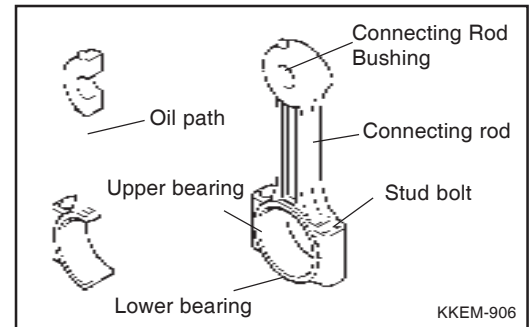
GENERAL

EM-5

5. Connecting Rod Bearing

The connecting rod is an I-section stamp forging. A lead bronze bushing is press-fitted into small end. The connecting rod bearing for the big end is a split type plain bearing. This bearing is soft copper backed kelmet metal, the inside surface of which is plated with an alloy of lead, tin and copper. The whole bearing is then plated with tin.

The connecting rod and connecting rod cap are coupled by knurled connecting rod bolts.



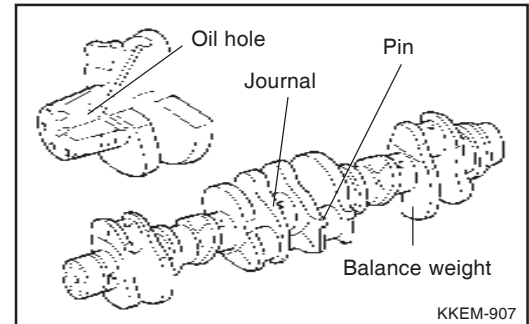
6. Crankshaft and Main Bearing

(a) Crankshaft

The crankshaft is a highly-rigid die forging integral with the balance weights. The pins, journals, and rear oil seal sliding surfaces are induction-hardened for improved wear resistance.

By means of oil passages drilled through the pins and journals, part of the main bearing lubricating oil is fed to pins for lubrication of the connecting rod bearing

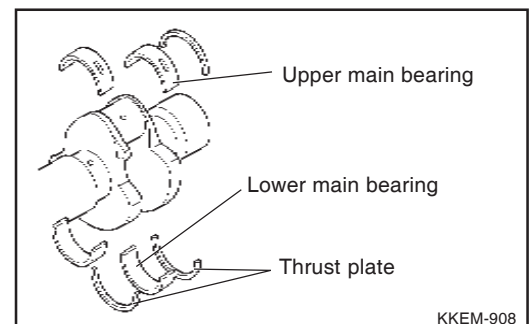
An oil hole in each journal is through to that in pin, feeding some of the main bearing lubricating to the pin for lubricating to the pin for lubrication of the connecting rod bearing.



(b) Main bearing

The main bearing is a split type plain bearing and is made of the same material as the connecting rod bearing.

The upper bearing has an oil groove, but the lower bearing has no oil groove. Split type thrust plates are mounted to the bearing to support the thrust of the crankshaft.



7. Timing Gear

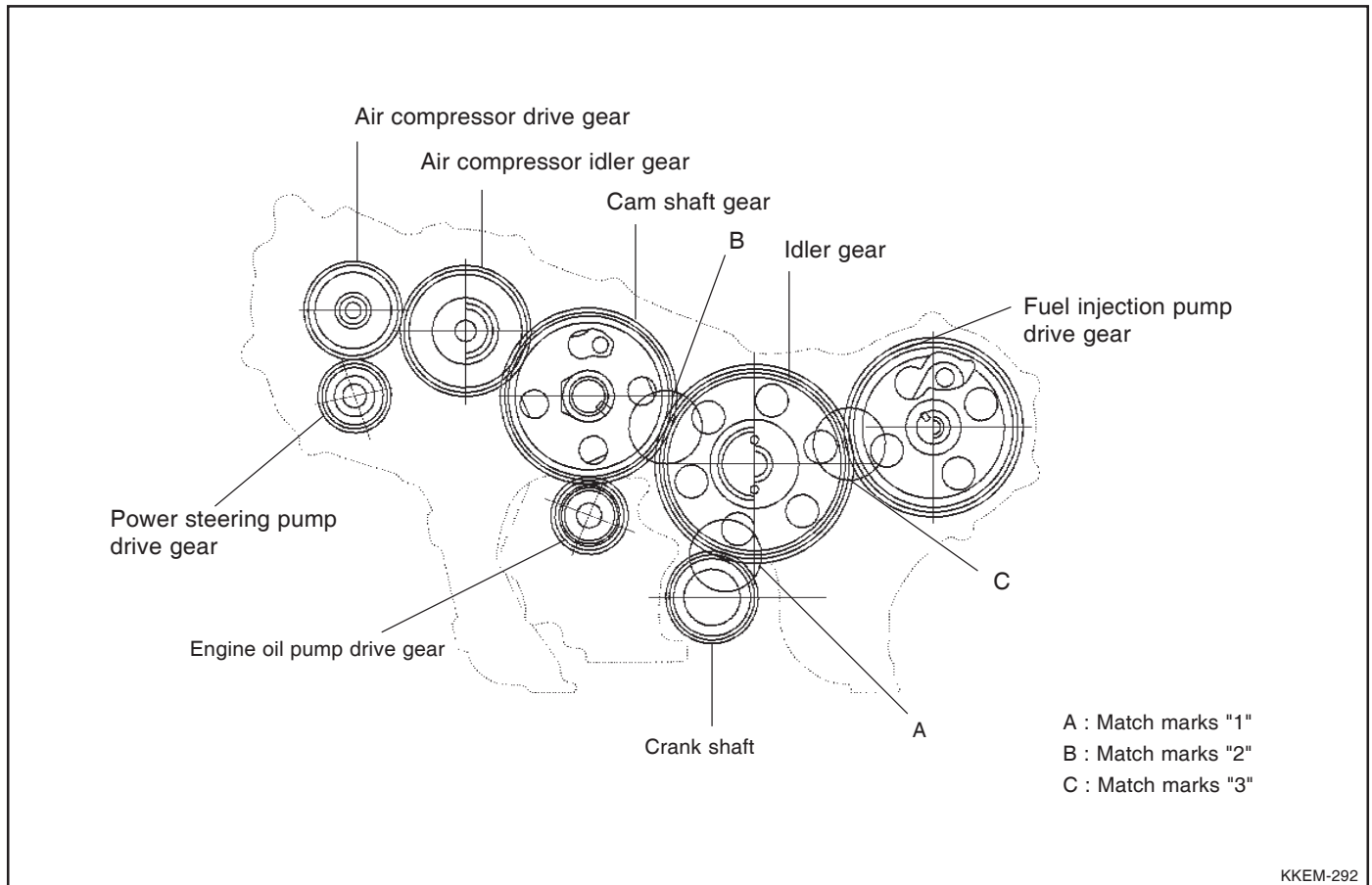
The timing gears are housed in the timing gear case at the front of the engine. Illustration shows the gear train.

Each gear is a helical gear machined by a shaving machine to high precision and surface-treated for enhanced durability.

A timing mark is stamped on each gear.

At resassembly, correct meshing can be achieved by aligning these marks.

On D4A, an oil pipe is installed in the idler shaft that is used for forced lubrication of the injection pump gear.



A bushing is press-fitted into the idler gear which turns on the idle shaft.

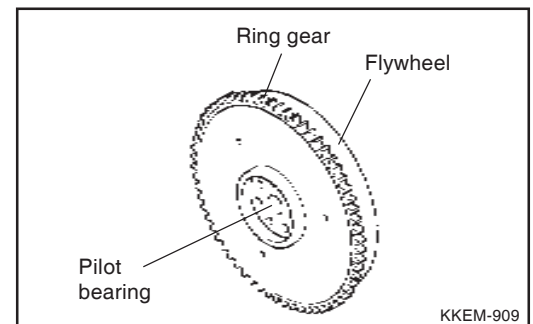
The oil hole drilled through the idler shaft and gear provides an oil passage for lubrication of bushing and gears.

8. Flywheel

The flywheel is made of cast iron. The pilot bearing of the transmission drive pinion is installed at its center. On its periphery, the ring gear is shrink-fitted that meshes with the starter pinion.

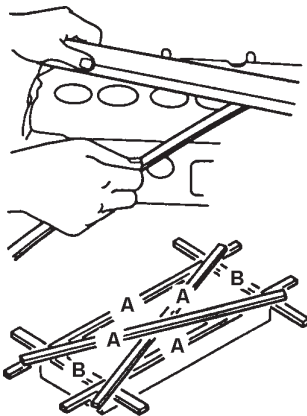
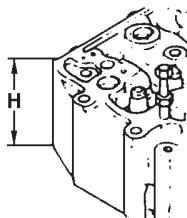
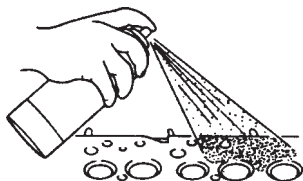
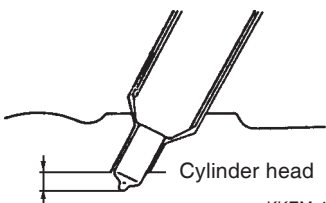
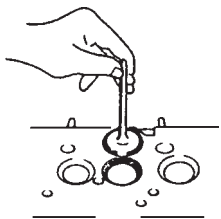
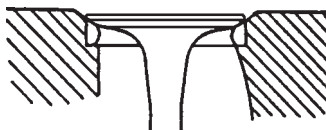
The ring gear tooth crests are induction-hardened for greater durability.

At the same time, one side of the crests is chamfered to ensure that the starter pinion meshes easily when starter is operated.



SERVICE STANDARD
EM-7
SERVICE STANDARD

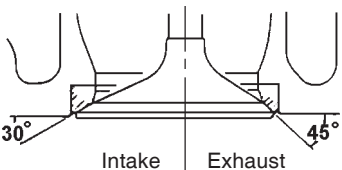
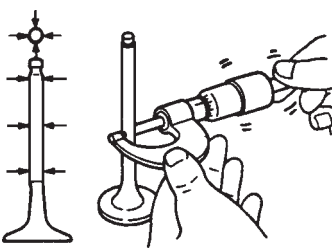
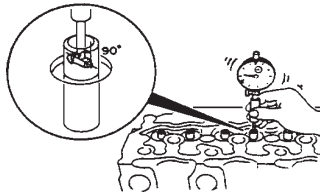
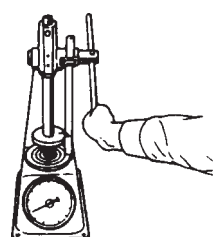
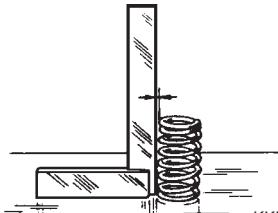
Unit : mm

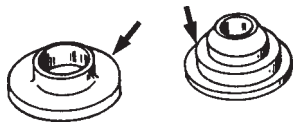
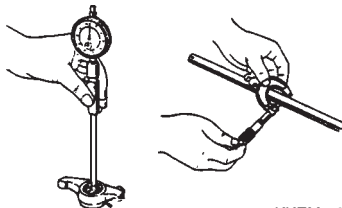
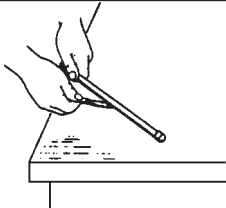
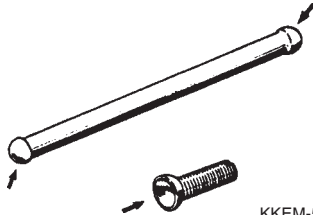
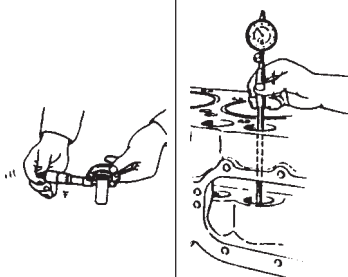
Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Cylinder head flatness		Less than 0.05 (0.0019) at direction A	0.1	Grinding or replace	 KKEM-44
		Less than 0.03 (0.0012) at direction B			
Cylinder head height		94.9-95.1	94.7	Replace	 KKEM-45
Cylinder head cracks and Damage * Using a dye penetrant		-	-	Replace if necessary	 KKEM-46
Nozzle protrusion from cylinder head surface		2.1-2.7	-	Replace Nozzle sleeve	 KKEM-47
Valve seating condition * Using red lead marking compound		There should be good contact around entire circumference of valve head.	-	Hand lapping using lapping compound	 KKEM-48
Valve sink	Intake	0.65-0.95	1.2	Replace valve or valve seat if necessary	 KKEM-49
	Exhaust	1.15-1.45	1.7		

EM-8

ENGINE MECHANICAL

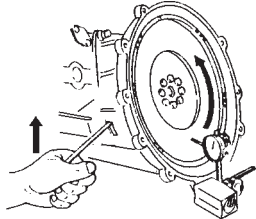
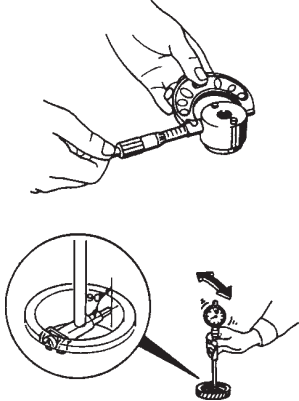
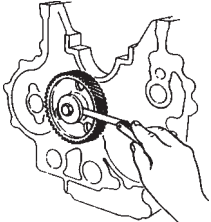
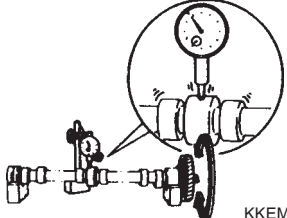
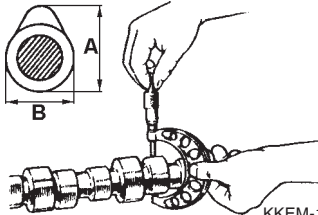
Unit : mm

Inspection Item			Standard	Limit	Remedy	Inspection Procedure
Valve seat angle	Intake		29°45′-30°	-	Regrind or replace valve and /or valve seat	 Intake Exhaust KKEM-50
	Exhaust		44°15′-45°45′			
Valve face angle	Intake		29°45′-30°			
	Exhaust		44°45′-45°			
Intake valve stem diameter			8.947-8.965	8.90	Replace valve guide and/or valve	 KKEM-51
Exhaust valve stem diameter			8.932-8.950	8.80		
Intake and exhaust valve guide diameter			9.020-9.035	9.1		
Side clearance between valve stem and valve guide	Intake		0.055-0.085	0.18	Replace valve guide and/or valve stem	 KKEM-52
	Exhaust		0.070-0.103	0.23		
Valve spring setting load	Inner	IN	14.4kgf at 47.2	-	Replace if necessary	 KKEM-53
		Ex	14.2kgf at 47.4			
	Outer	IN	41.3kgf at 50.2	-	Replace	
		Ex	40.6kgf at 50.4			
Squareness of valve spring			-	2.00	Replace if necessary	 KKEM-54

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Valve spring seat for wear	-	-	Replace, if necessary	Visual check  KKEM-55
Rocker arm shaft diameter	24.159-24.180	24.14	Replace rocker arm bushing and/or shaft	 KKEM-56
Clearance between rocker arm shaft and bushing	0.030-0.101	0.15		
Rocker arm and valve step cap wear or damage	-	-	Resurface or replace	 KKEM-57
Push rod bend	-	0.25	Replace	 KKEM-58
Adjusting screws and push rods damage	-	-	Replace	 KKEM-59
Valve lifter diameter	31.950-31.975	31.92	Replace valve lifter	 KKEM-60 KKEM-61
Valve lifter guide deformation	32.000-32.025	32.05		
Clearance between valve lifter and valve lifter guide	0.025-0.075	0.10		
Valve lifter	Should not be worn unevenly	-	Replace, if necessary	Visual check

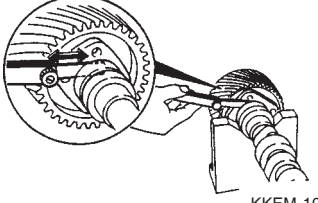
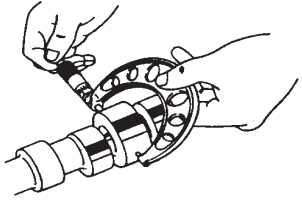
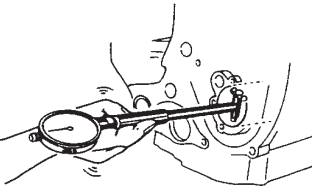
EM-10
ENGINE MECHANICAL

Unit : mm

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Flatness of flywheel		-	0.04	Replace or grind	 KKEM-76
Gear teeth for pitting or wear		-	-	Replace if necessary	Visual check  KKEM-97
Oil clearance between idle gear shaft and bearing		0.030-0.080	0.20	Replace gear and shaft	 KKEM-98
Idler gear end play		0.070-0.125	0.30	Replace thrust bearing	 KKEM-99
Camshaft bend		-	0.05	Replace	 KKEM-100
camshaft, camlift (A-B)	Intake	6.66	6.58	Replace	 KKEM-101
	Exhaust	9.03	8.95		

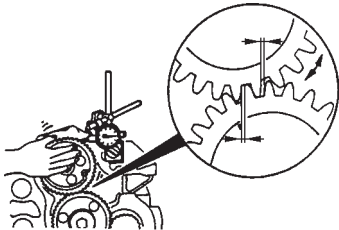
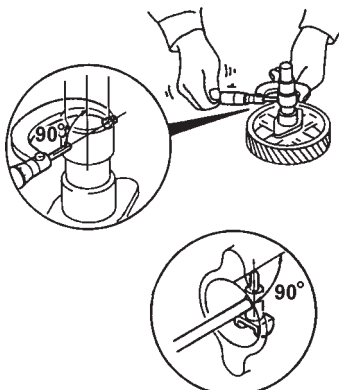
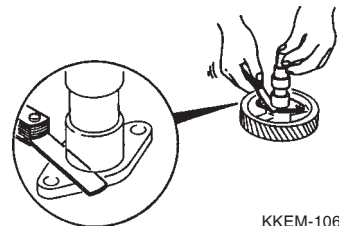
SERVICE STANDARD
EM-11

Unit : mm

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Camshaft end play		0.100-0.178	0.30	Replace thrust plate	 KKEM-102
Camshaft journal diameter journal No.	No.1	61.45-61.47	61.6	Replace camshaft	  KKEM-103
	No.2	61.05-61.07	61.2		
	No.3	60.65-60.67	60.7		
	No.4	58.25-58.27	58.4		
Oil clearance between camshaft journal and bearing		0.03-0.08	0.15	Replace camshaft and/or bearing	

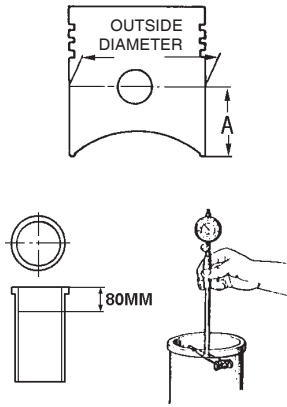
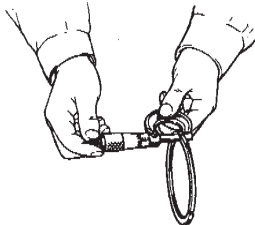
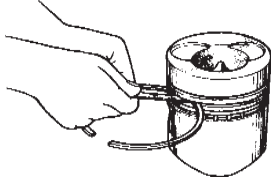
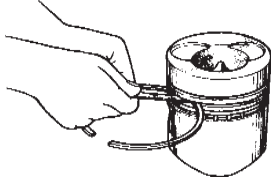
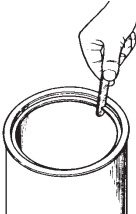
EM-12
ENGINE MECHANICAL

Unit : mm

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Timing gear backlash		-	-	Replace gear	
Full air brake	Crankshaft gear - idle gear	0.038-0.13	0.30		
	Idle gear - injection pump gear	0.03-0.12	0.30		
	Idle gear - camshaft gear	0.027-0.26	0.30		
	Camshaft gear - engine oil pump gear	0.07-0.18	0.30		
	Camshaft gear - air compressor idle gear	0.027-0.26	0.40		
	Air compressor gear - Air compressor idle gear	0.049-0.147	0.30		
	Air compressor gear- power steering oil pump gear (If so fitted)	0.046-0.173	0.30		
Clearance between injection pump drive shaft and bearing		0.030-0.072	0.30	Replace bearing and/or shaft	
Injection pump drive gear end play		0.100-0.200	0.30	Replace thrust bearing	

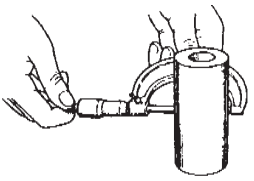
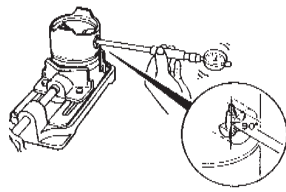
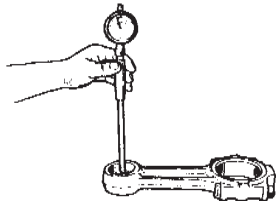
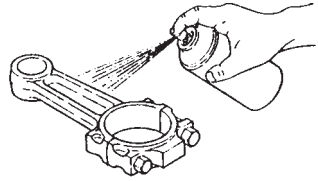
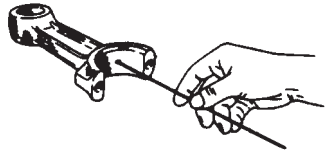
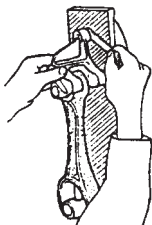
SERVICE STANDARD
EM-13

Unit : mm

Inspection Item		Standard	Limit	Remedy	Inspection Procedure
Piston diameter		109 at A:21	-	Replace piston and/or liner	 KKEM-167
Cylinder liner inside diameter		109	109.05		
Clearance between piston and cylinder liner		0.093-0.125	-		
Cylinder liner protrusion		0.01-0.08			
Piston ring breadth	Top	3.00	2.90	Replace	
	2nd	2.5	2.4		
	Oil	4.00	3.90		
Piston ring grooves breadth	Top	3.00	3.20	Replace piston	 KKEM-168
	2nd	5.0	2.70		
	Oil	4.00	4.10		
Clearance between piston ring and piston ring breadth	Top	0.06-0.10	-	Replace piston ring and/or piston	 KKEM-168
	2nd	0.04-0.08	-		
	Oil	0.02-0.06	-		
Piston ring gap * Insert the piston rings Where the wear of the liner is small	Top	0.30-0.40	1.5	Replace	 KKEM-169
	2nd	0.30-0.45	1.20		
	Oil	0.25-0.45	1.20		

EM-14
ENGINE MECHANICAL

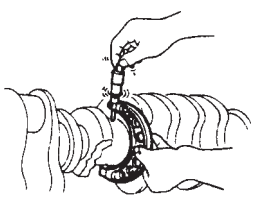
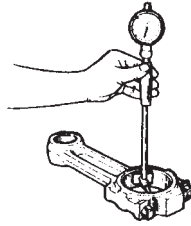
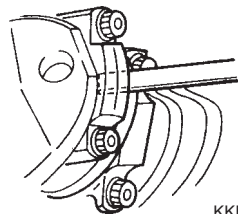
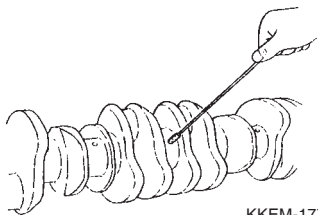
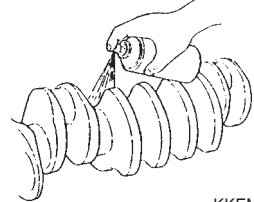
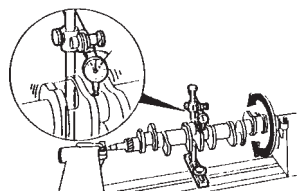
Unit : mm

Inspection Items	Standard	Limit	Remedy	Inspection Procedure
Piston pin diameter	38.987-39.000	36.96	Replace piston, piston pin and/or connecting rod	
Piston pin hole inside diameter	36.987-37.003	39.05		
Clearance between piston pin and piston pin hole T:Tight L:Clearance	39.015-39.025	39.10		
Connecting rod small end bushing inside diameter	37.015-37.025	37.10	Replace bushing and/or piston pin	
Clearance between piston ring and connecting rod small end bushing	0.15-0.036	0.08		KKEM-170
Connecting rod cracks or damage	-	-	Replace , if necessary	
Connecting rod oil hole clogged	-	-	Clean	
Connecting rod squareness		0.1 Par 200	Replace	

KKEM-173

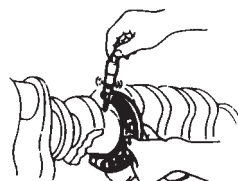
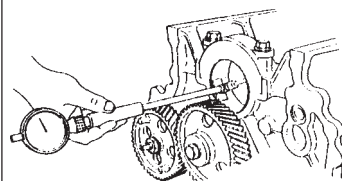
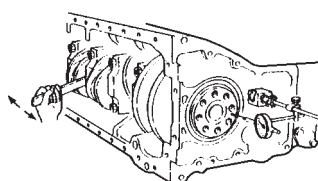
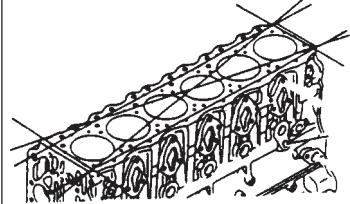
SERVICE STANDARD
EM-15

Unit : mm

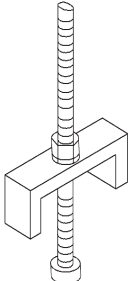
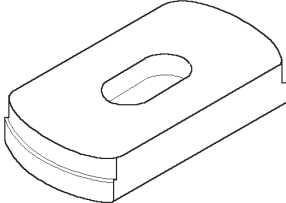
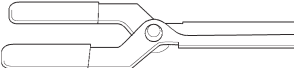
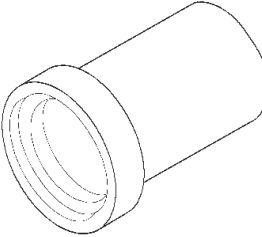
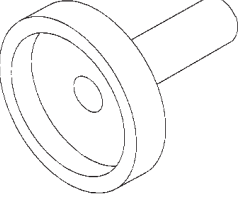
Inspection Items	Standard	Limit	Remedy	Inspection Procedure
Crankshaft pin diameter	64.94-64.96	64.80	Regrind crankshaft and use undersize bearings	
		63.80	Replace crankshaft	
Clearance between connecting rod and crank pin	0.031-0.082	0.20	Replace bearing	 KKEM-175
Connecting rod end play	0.20-0.52	1.00	Replace connecting rod	 KKEM-176
Crankshaft oil hole clogged	-	-	Clean	 KKEM-177
Crankshaft cracks and damage	-	-	Replace	 KKEM-178
Crankshaft bend	-	0.09	Replace	 KKEM-179

EM-16
ENGINE MECHANICAL

Unit : mm

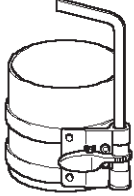
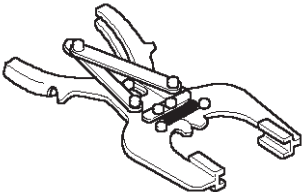
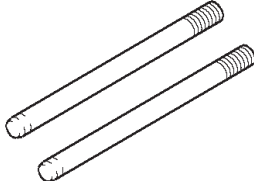
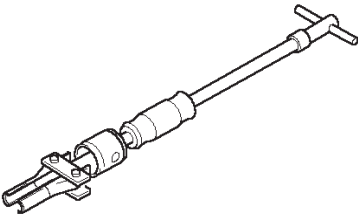
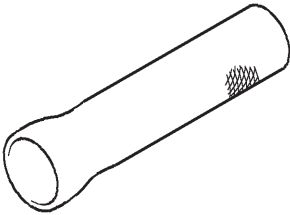
Inspection Items	Standard	Limit	Remedy	Inspection Procedure
Crankshaft journal diameter	79.940-79.960	79.8	Regrind crankshaft and use undersize bearings	
		78.8	Replace crankshaft	
Clearance between crankshaft journal and main bearing	0.051-0.102	0.30	Replace bearing	 KKEM-180
Crankshaft end play	0.050.219	0.50	Replace thrust bearing	 KKEM-181
Cylinder block flatness	Less than 0.05	0.10	Regrind and/or replace	 KKEM-182

SPECIAL TOOLS**EM-17****SPECIAL TOOLS**

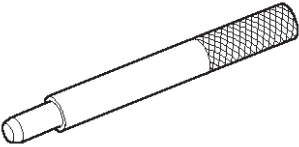
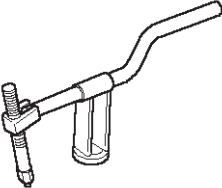
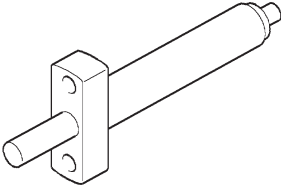
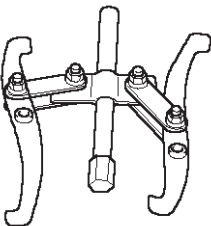
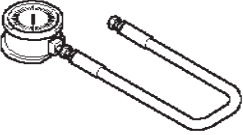
NAME	PART NO	ILLUSTRATON	USE
Cylinder liner Puller A	09222-62100	 KKST-001	Removal of cylinder liner
Cylinder liner Puller B	09222-8Y000	 KKST-002	Removal of cylinder liner
Valve tappet remover and installer	09221-8Y000	 KKST-003	Removal or Installation of valve tappet
Front oil seal installer	09231-8Y000	 KKST-004	Installation of oil seal
Rear oil seal Installer	09231-8Y100	 KKST-005	Installation of rear oil seal

EM-18

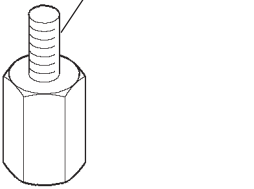
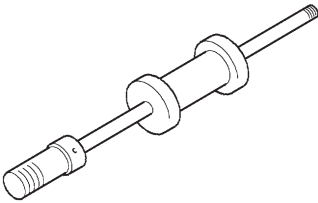
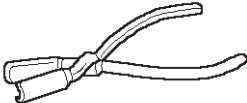
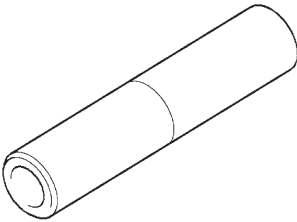
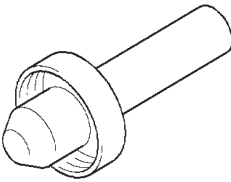
ENGINE MECHANICAL

NAME	PART NO	ILLUSTRATON	USE
Piston guide clamp	09222-88200	 KKST-006	Installation of piston
Piston ring tool	09222-83200	 KKST-007	Removal and Installation of piston ring
Flywheel guide bar	09231-8Y200	 KKST-008	Remove and Installation of flywheel
Ball bearing puller	09432-8Y000	 KKST-009	Removal of ball bearing
Valve stem seal installer	09222-93000	 KKST-010	Installation of valve stem seal

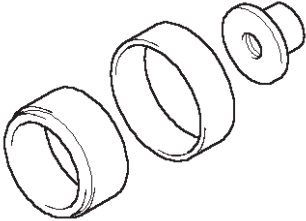
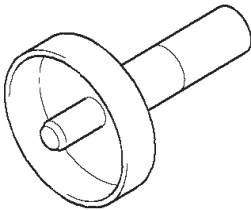
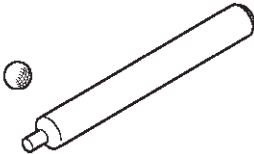
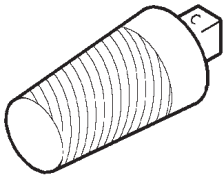
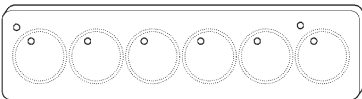
SPECIAL TOOLS**EM-19**

NAME	PART NO	ILLUSTRATON	USE
Valve guide remover	09211-8Y000	 KKST-011	Removal of valve guide
Valve spring compressor	09222-8Y100	 KKST-012	Removal and installation of intake valve spring and exhaust valve spring
Compression gauge adaptor	09353-8Y000	 KKST-013	For adaptor when checking the nozzle pressure
Rear oil seal sleeve remover	09231-8Y300	 KKST-014	Removal of rear oil seal sleeve
Compression gauge	09351-8Y000	 KKST-015	Checking nozzle compression

EM-20
ENGINE MECHANICAL

NAME	PART NO	ILLUSTRATON	USE
Sliding hammer adaptor	09450-75400	 KKST-016	Removal and Installation of idler gear shaft
Sliding hammer	09450-8Y000	 KKST-017	Removal and Installation of idler gear shaft (use with sliding hammer adaptor)
Valve stem seal remover	09222-29000	 KKST-018	Remove or valve stem seal
Valve guide installer	09211-8Y100	 KKST-020	Installation of valve guide
Front oil seal sleeve installer	09231-8Y400	 KKST-021	Installation of front oil seal sleeve

SPECIAL TOOLS**EM-21**

NAME	PART NO	ILLUSTRATON	USE
Front oil seal sleeve remover	09231-8Y500	 KKST-022	Removal of front oil seal sleeve
Rear oil seal sleeve installer	09231-8Y600	 KKST-023	Installation of rear oil seal sleeve
Nozzle sleeve installer	09222-8T300	 KKST-025	Installation of nozzle tube
Nozzle tube remover	09222-8Y400	 KKST-026	Removal of nozzle tube
Target plate	09222-8Y500	 KKST-027	For checking of piston cooling jet position

SERVICE PROCEDURE

Engine Disassembly Check Standard

Engine overhaul criteria

1. When compression pressure is low.
 - a. Before the measurement
 - a) Correctly adjust the valve clearance.
 - b) Warm up engine. (Until the coolant temperature reaches around 80°C)
 - c) Charge the battery fully.
 - d) Remove the air cleaner.
 - b. Measurement
 - a) Remove the nozzle holders completely.
 - b) Install the gauge adapter in the nozzle holder hole.
 - c) For the vehicles installed manual engine stop control;
Remove the engine stop cable from the engine stop lever connected to engine stop position by tape or string.
 - d) For the vehicles installed electric engine stop control;
Remove the engine stop motor harness after turning the engine starter key to "OFF" position.
 - e) Connect a compression gauge to the gauge adapter.
 - f) Drive the engine with the starter and read the compression pressure.

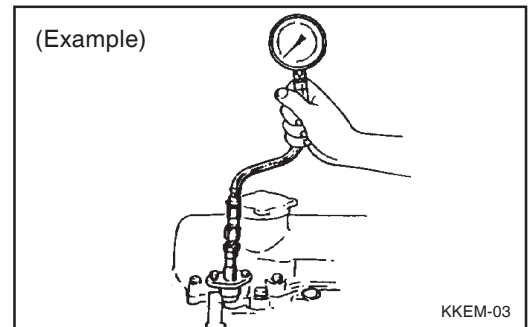
CAUTION

Do not operate the starter for more than 15 seconds at once.

- g) Measure the compression pressure for each cylinder.
If compression pressure is low, be sure to repeat the measuring.

CAUTION

Make sure no pressure leaks through sealing face.



SERVICE PROCEDURE**EM-23**

- c. For the model installed electric engine stop control:
Check whether the engine starter is at the "OFF" position
and then connect engine stop motor harness.

WARNING

Do not connect electric harness to engine stop motor, when engine starter key is at "ON" position.

If starter key is at "ON" position, engine stop motor operates simultaneously then the link of engine stop motor and engine stop lever of fuel injection pump operate resulting in possible damages of hand.

Unit : kg/cm²

Engine model	Compression pressure		Difference between each cylinder	Engine speed(rpm)
	Standard	Limit		
D6DA	36-39	28	Less than 3	280

2. When oil pressure decreases

Check the oil pressure warning lamp when the oil and coolant temperature are heated enough (about 80°C).

- If the warning lamp is on, check the oil level.
- Check oil deterioration
If oil quality is poor, replace with suitable grade oil.
- Remove the oil pressure switch and install the oil pressure gauge.
- Measure the oil pressure at coolant temperature of 80°C or above.

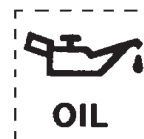
Standard oil pressure : 0.5-5.0 kg/cm²

Service limit : Below 0.5 kg/cm² (Idle condition)

3. Other factors

- The blow-by gas increases
- The engine does not start easily.
- Engine power decreases
- Fuel consumption increases
- Engine makes greater noise
- Excessive consumption of engine oil

(Example)



KKEM-04

Engine Dismounting and Installation

Dismounting

1. Park the vehicle on level ground and prop the wheels.
2. Remove coolant from radiator and cylinder block, and release the engine oil from the oil pan.

WARNING

Do not drain coolant or engine oil while engine or radiator is hot because it may cause burn.

3. Disconnect the oil pressure line of power steering and drain oil.

CAUTION

Please refer power steering maintenance section for the details.

4. Disconnect the engine stop cable.
 - a) Turn the engine starter key to "ON" position.

CAUTION

Do not operate engine.

- b) Check whether engine stop lever of fuel injection pump is at engine operation position, and disconnect the connector of engine stop motor harness.
 - c. Turn the engine starter key to "OFF" position.
5. Disconnect electric line, fuel line, air line, speedometer cable, accelerator control cable and parking brake cable.

CAUTION

- **Disconnect battery cable from the (-) terminal of the battery and remove electric line.**
- **Cover the hole of pipe, hose and pump so that no dust inflow.**

6. Disconnect all hoses (coolant, heater and air intake) and disconnect the radiator.

CAUTION

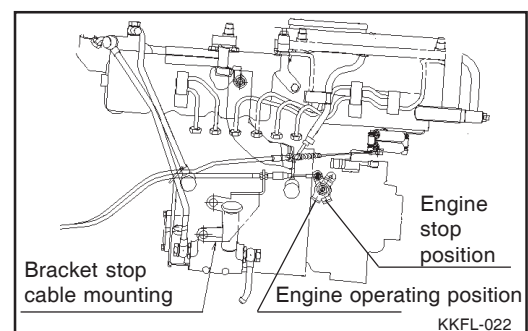
Be careful not to damage the radiator core.

7. Disconnect air intake and exhaust lines.
8. Disconnect clutch housing, transmission control and transmission from flywheel housing.

CAUTION

Please refer "transmission and transmission control" maintenance section for the details.

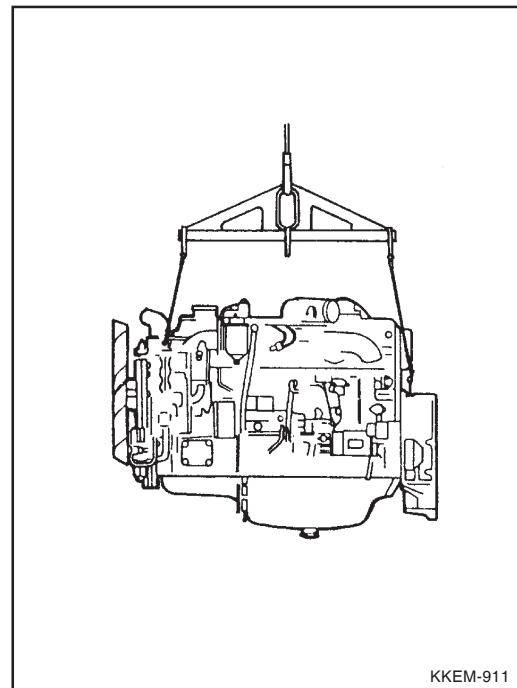
9. Disconnect cap mounting member from the frame.



SERVICE PROCEDURE

EM-25

10. Connect cable from the engine hanger to the hanger bracket at the front of the engine and to the hanger brackets at the upper flywheel housing at the rear of the engine. Loose the cable a bit and raise the hanger by using the hoist.
11. Remove the engine mounting nuts (both sides of front and rear).
12. Lift the engine hanger so that the cables are fully tightened, and then after checking that the cables are securely hooked on the hanger brackets, lift the engine assembly gently and remove it from the vehicle.



Installation

Install engine assembly.

Install engine assembly by reversed order of dismounting.

CAUTION

Check the leaks of oil, fuel, coolant or air.

Connect the engine stop cable.

1. Turn the ignition key at "ON" position.

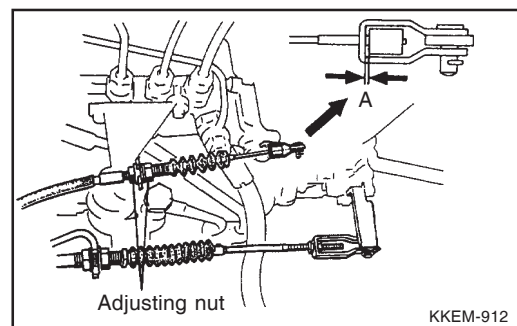
CAUTION

Do not start the engine yet.

2. Check the connector of engine stop motor harness
3. Connect the engine stop cable adjust the adjusting nut to make the gap "A" be 1-3mm, which is the distance between crevis and cable stopper.
4. Turn the ignition key to "OFF" position.

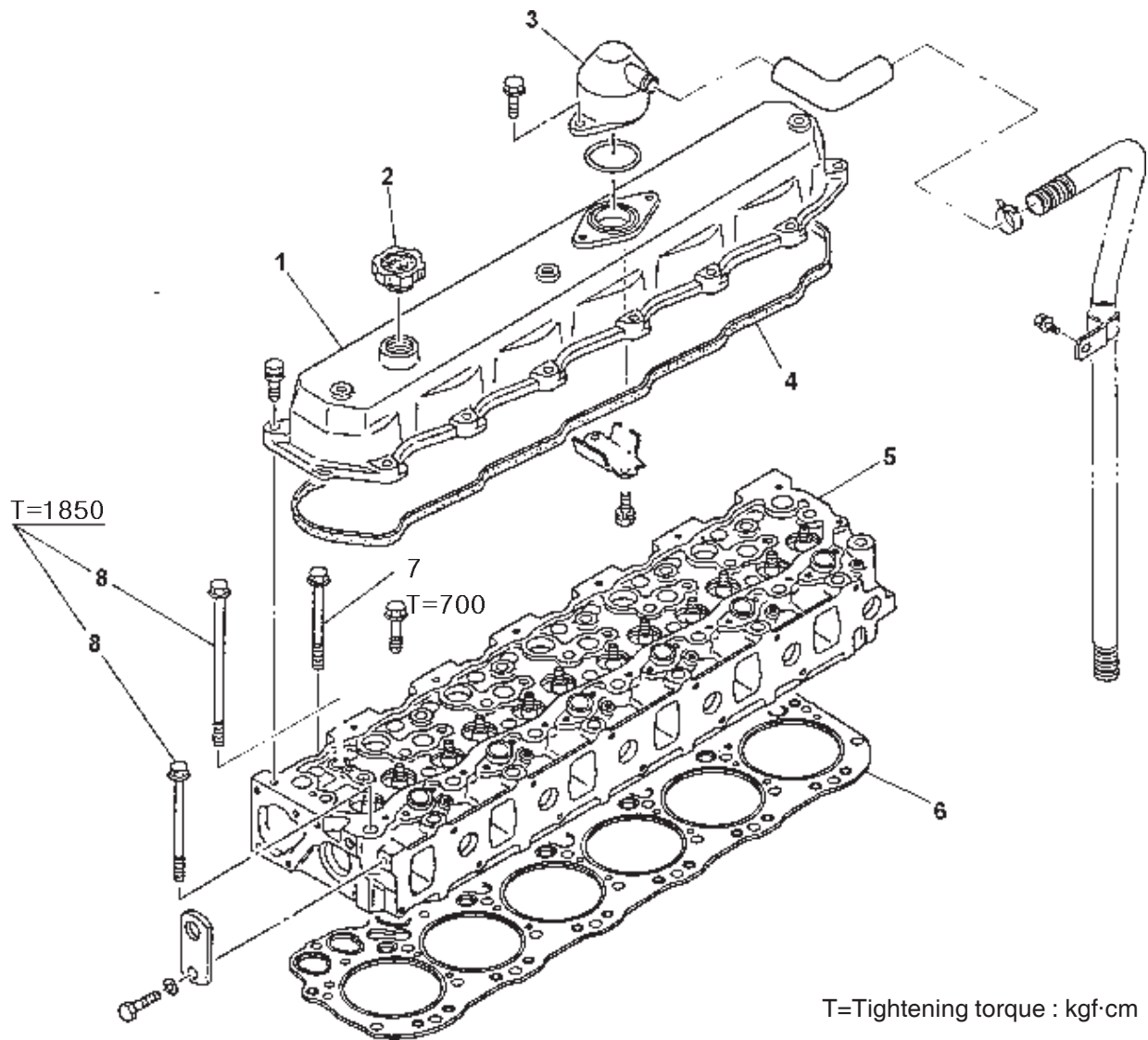
CAUTION

Check engine stop and start after adjustment.



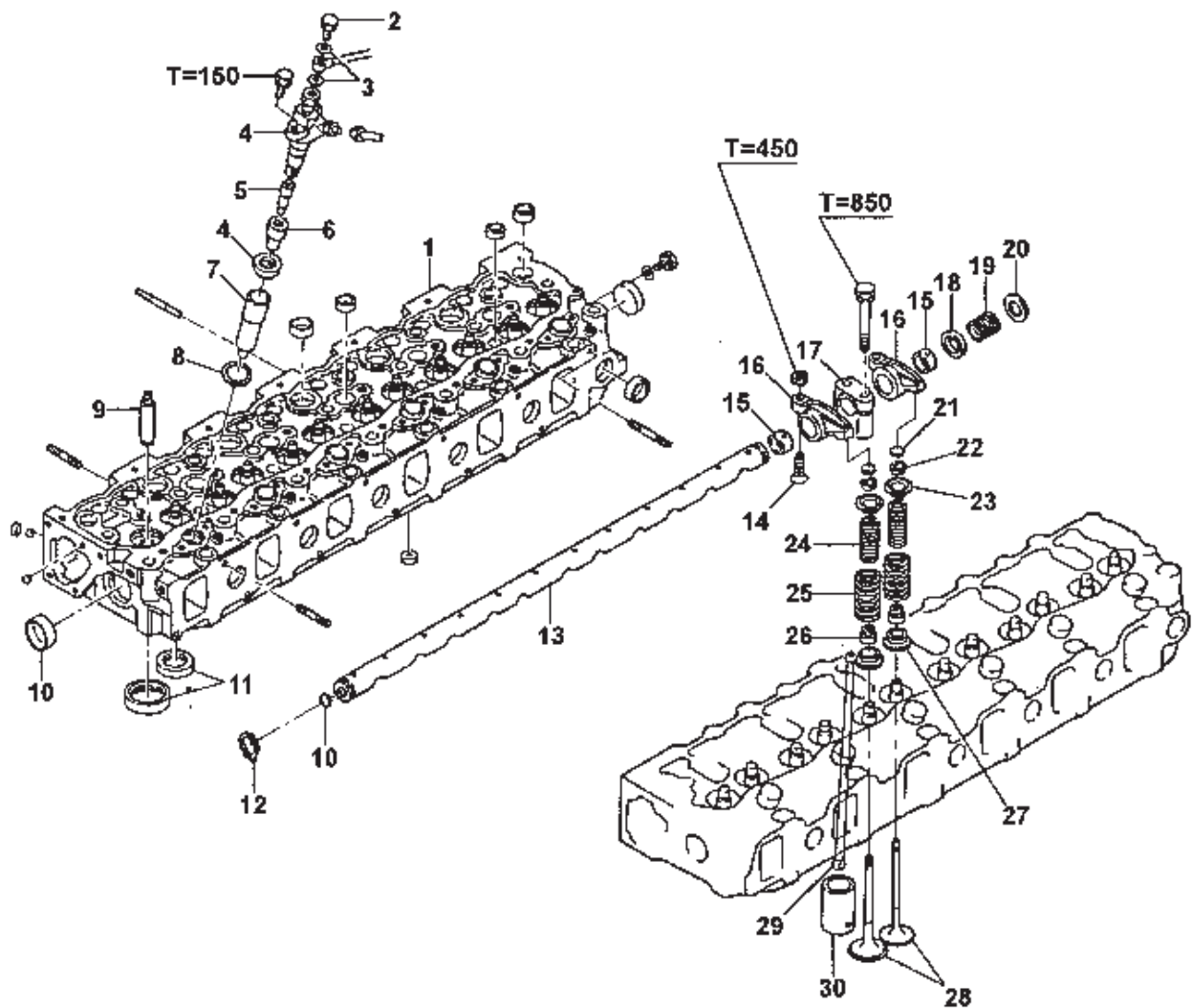
Engine Cylinder Head

OVERHAUL



T=Tightening torque : kgf-cm

- | | |
|-------------------------------|------------------------------|
| 1. Cylinder head cover | 5. Cylinder head |
| 2. Oil filler cap | 6. Cylinder head gasket |
| 3. Ventilator | 7. Cylinder head assist bolt |
| 4. Cylinder head cover gasket | 8. Cylinder head bolt |



T=Tightening torque : kgf-cm

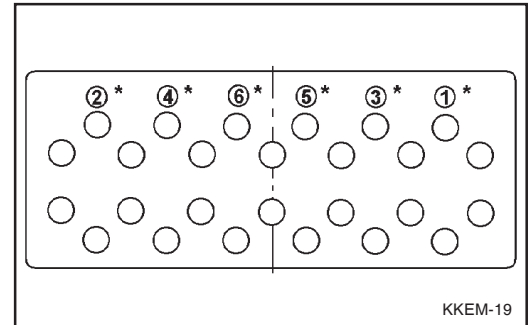
- | | | |
|------------------|----------------------------|-----------------------------|
| 1. Cylinder head | 11. Valve seat | 21. Valve stem cap |
| 2. Connect bolt | 12. Retainer ring | 22. Valve stem key |
| 3. Soft washer | 13. Valve lock shaft | 23. Valve spring upper seat |
| 4. Nozzle holder | 14. Valve gap adjust screw | 24. Inner valve spring |
| 5. Nozzle | 15. Bushing | 25. Outer valve spring |
| 6. Packing ring | 16. Rocker arm | 26. Valve stem seal |
| 7. Nozzle sleeve | 17. Valve lock support | 27. Valve spring lower seat |
| 8. O-ring | 18. Spacer | 28. Valve |
| 9. Valve guide | 19. Spring | 29. Push rod |
| 10. Plug | 20. Plain washer | 30. Valve lifter |

Disassembly

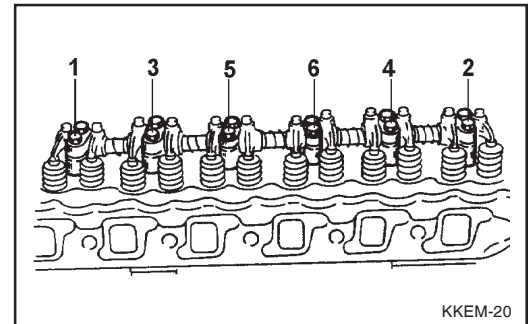
Disconnect fuel pipe and nozzle assembly.

Disconnection of cylinder head and rocker arm assembly.

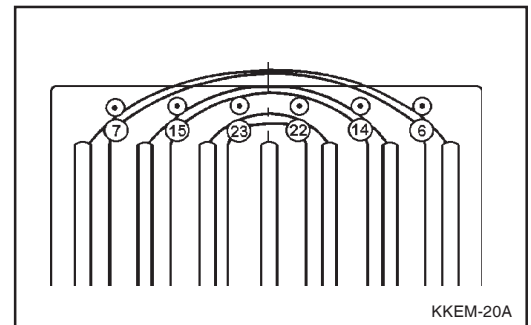
1. Remove the cylinder head additional bolts by loosening the bolts in the numerical order shown in the figure.



2. Removal of rocker arm support bolts
Remove the rocker arm assembly by the loosening the bolts in the numerical order shown in the figure.



3. Removal of cylinder head bolts
Remove the cylinder head bolts in the numerical order shown in the figure.

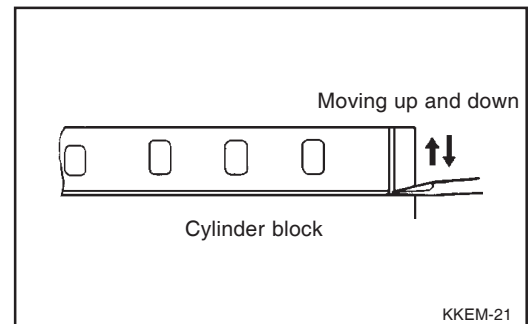


Lift the cylinder head from the dowels and place it on the wooden block.

1. If the cylinder head is difficult to lift, insert the chisel between the cylinder head and block to leverage.

CAUTION

Do not damage the machined surface of the head and block when removing the cylinder head.

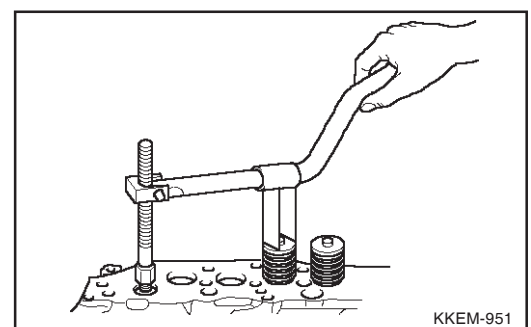


Disassembly of valve spring

1. Remove valve stem key, upper spring seat inner valve spring and outer valve spring from cylinder head.

Special tool: Valve spring compressor (09222-8Y100)

2. Disassemble intake and exhaust valves.
3. Tag valves to identify the cylinder numbers and to eliminate valve lapping.



SERVICE PROCEDURE

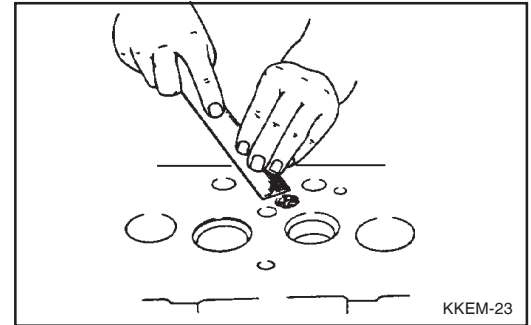
EM-29

Assembly

Clean the cylinder head completely with the solvent.

CAUTION

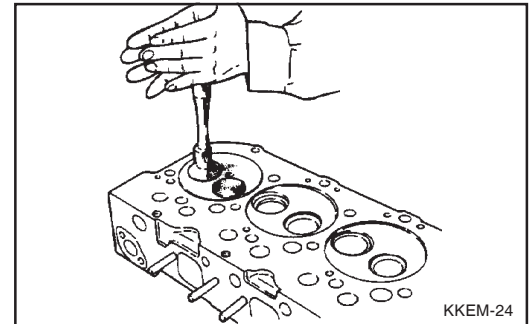
Be careful not to damage the cylinder head surface.



Hand-lap the valve and valve seat if needed.

Apply lapping compound lightly to the valve face. Install the valve using a special tool, tap and rotate the valve against the seat.

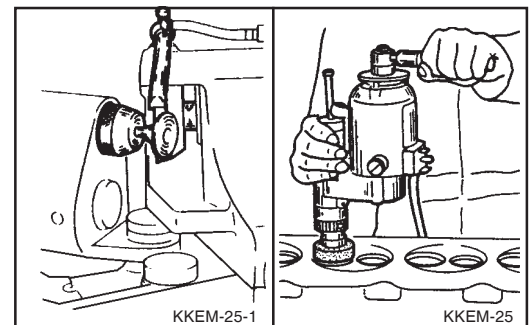
Special tool: Valve-lapping tool



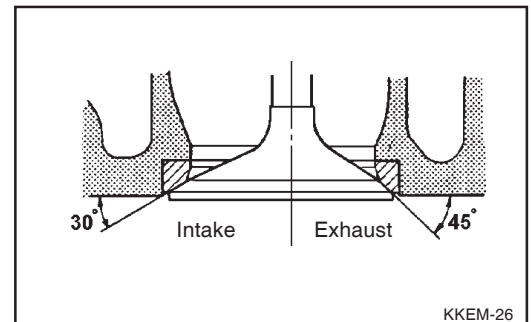
Grind the valve and valve seat, if needed.

CAUTION

- Grinding of valves and valve seats should only be performed when hand lapping does not result in proper seating.
- Recheck the valve sink after grinding at all times.



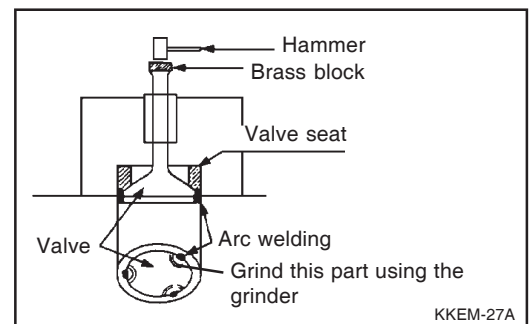
Angles of valve face and valve seat ;
please refer the service standards.



Replace the valve seat, if needed.

1. Cut the circumference of a valve head at three places with a grinder and, install it into the seat as shown and weld the valve to the seat.

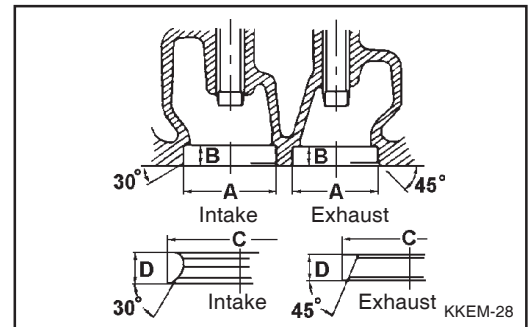
Then push the valve and the seat out with a hammer and a brass bar.



2. Specifications of valve seat surface machining

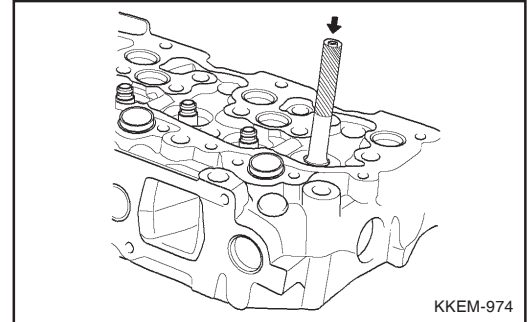
Unit: mm

		Intake	Exhaust
Cylinder head dimension	A	52.000-52.019	45.500-45.516
	B	10.1-10.3	10.4-10.6
Valve seat dimension	C	52.085-52.100	45.63-45.645
	B	7.6-7.8	8.0-8.2



3. Valve seat installation

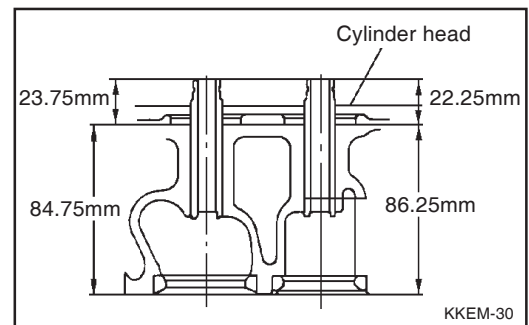
Heat the cylinder head to about 80°C - 100°C with hot water. On the other hand, cool the valve seat with dry ice or liquid freon for approximately 30 minutes. Hold the seat with pincers and place it into the heated cylinder head.

**Replace the valve guide, if needed.**

1. Remove the valve stem seal.
2. Remove the valve guide using a special tool. (Valve guide remover: 09211-8Y000)
3. Install the valve guide. (Valve guide installer: 09211-8Y100)

CAUTION

Apply engine oil lightly to the outer circumference of valve guide before installation.

**Replace the valve stem seal, if needed.**

1. Remove the valve stem seal.
(valve stem seal remover: 09222-8Y000)

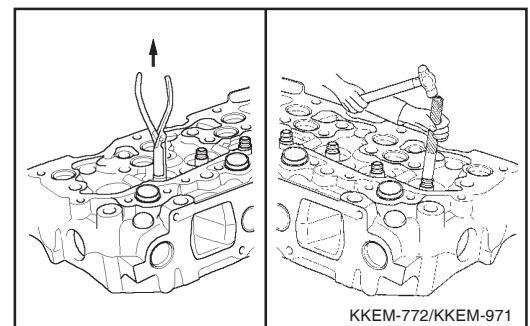
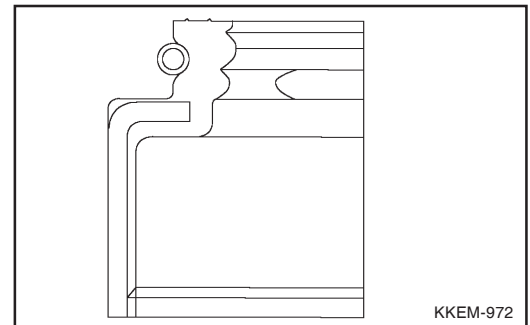
2. Install the valve stem seal.

Install the lower spring seat and valve first. Then apply engine oil to the lip of the stem seal and push the guide with a special tool.

Special tool: valve stem seal installer(09222-93000)

CAUTION

- Check for any cracks or damages of rubber, after valve stem seal installation.
- If the tip that touches the lower spring seat is worn or deformed, do not use the special tool.

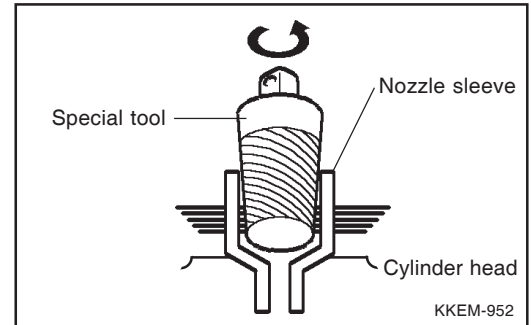


SERVICE PROCEDURE

EM-31

Replace the nozzle sleeve, if needed.

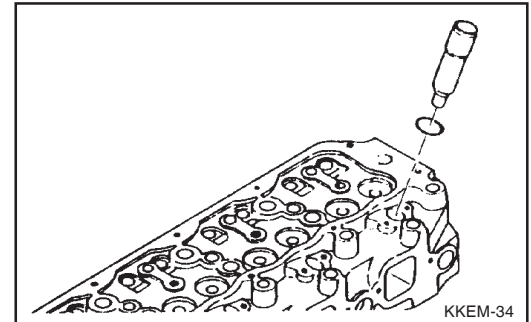
1. Remove the nozzle sleeve.
(Nozzle tube remover: 09222-8Y400)



2. Install nozzle sleeve.
Install O-ring to the cylinder head. Apply the adhesive (super three bond No. 1210 or equivalents) at the lower part of new copper nozzle sleeve and insert sleeve into the cylinder head.

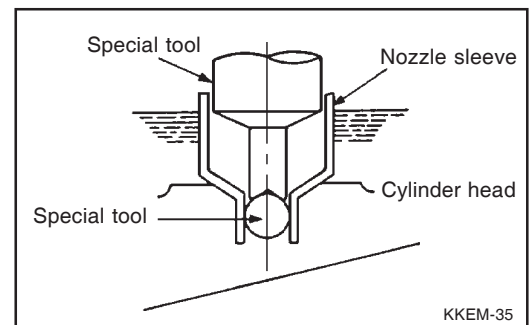
CAUTION

Damaged O-ring cause oil leaks, overheating or crack of head.



3. Stick the nozzle sleeve into the cylinder head tight using a special tool. Insert the seat press (special tool) into nozzle sleeve. Push the ball slowly through the hole with the special tool so that the end of nozzle sleeve be fastened tight to the cylinder head.

Special tool: (nozzle sleeve installer: 09222-8Y300)



Assemble the cylinder head.

CAUTION

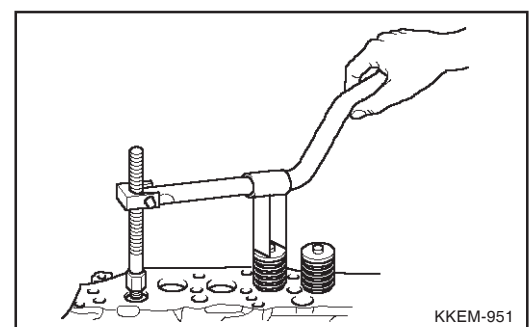
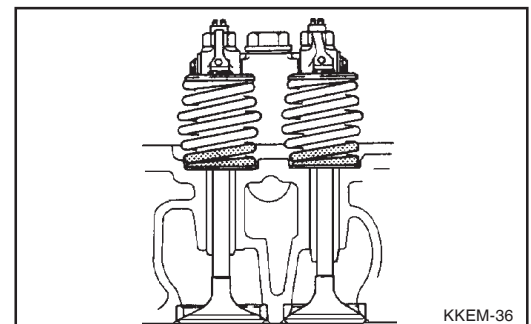
- Apply the engine oil to the contact points of all parts.
- Check the valves whether they are installed to the right cylinders.
- Since the valve spring has various pitches, install them as the painted parts facing downward.

Pressing the upper spring seat, install the valve stem key tight to the valve spring seat.

Special tool: Compressor (valve spring compressor: 09222 – 8Y100)

CAUTION

- When pressing with valve spring press, be careful not to damage the stem seal by the touch with upper seat.
- Push the valve stem gently by the hammer for the precise installation of valve stem key.

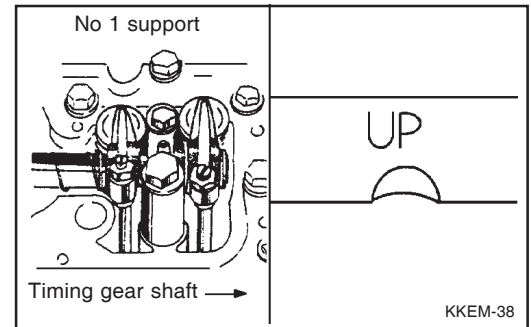


Rocker arm assembly

Apply the engine oil to the rocker arm shaft and bushing.

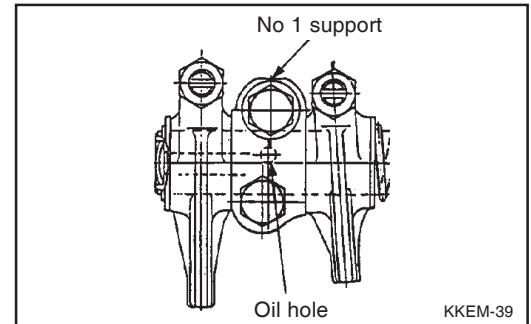
CAUTION

Check whether the rocker arm shaft is installed as the “UP” mark facing upward. Disassemble may cause the melting of valve stem.



CAUTION

Check whether the oil hole of rocker arm assembly number 1 support coincides with the shaft oil hole. Incorrect installation may cause the burning of whole valve assembly.

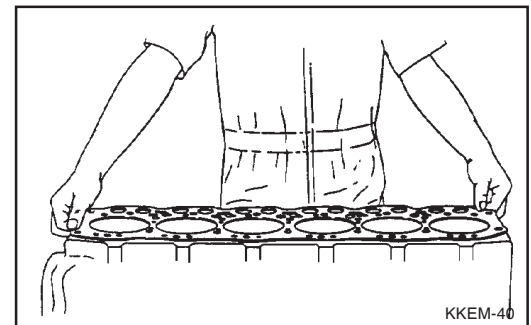


Installation of cylinder head and rocker arm assembly

1. Apply the engine oil to the valve lifter face and valve lifter guide, and then install the valve lifter guide.
2. Install the cylinder head gasket.

CAUTION

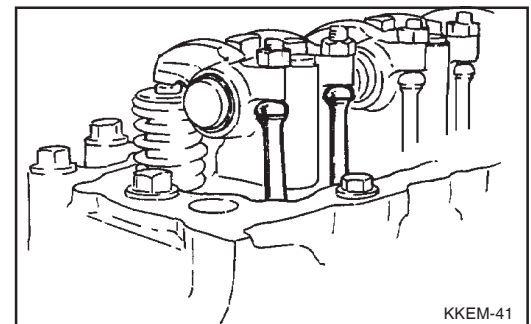
When using the new cylinder head gasket, clean the surface of the cylinder head, cylinder block and head gasket free of all dirt, water and grease.



3. Install the cylinder head over the dowels on the cylinder block.
4. Apply the engine oil to the both ends of push rods and install in the right order.
5. Install rocker arm assembly to the cylinder head and check whether push rod contacts adjusting screws.

CAUTION

Unfasten the lock nut loose and raise the adjusting screw fully to the maximum.



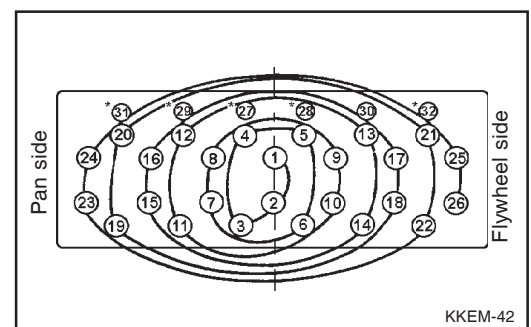
6. Fasten the cylinder head bolts and additional bolts (marked *) in three steps by the order shown in the figure.

CAUTION

Apply engine oil at the thread of bolts and at the lower part of bolt head.

1-26 bolts (at the cylinder head bolts)

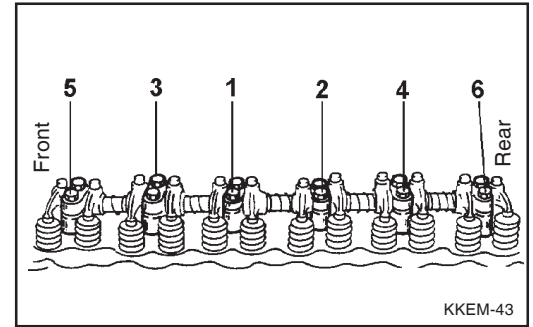
27-32 bolts (additional bolts)



SERVICE PROCEDURE

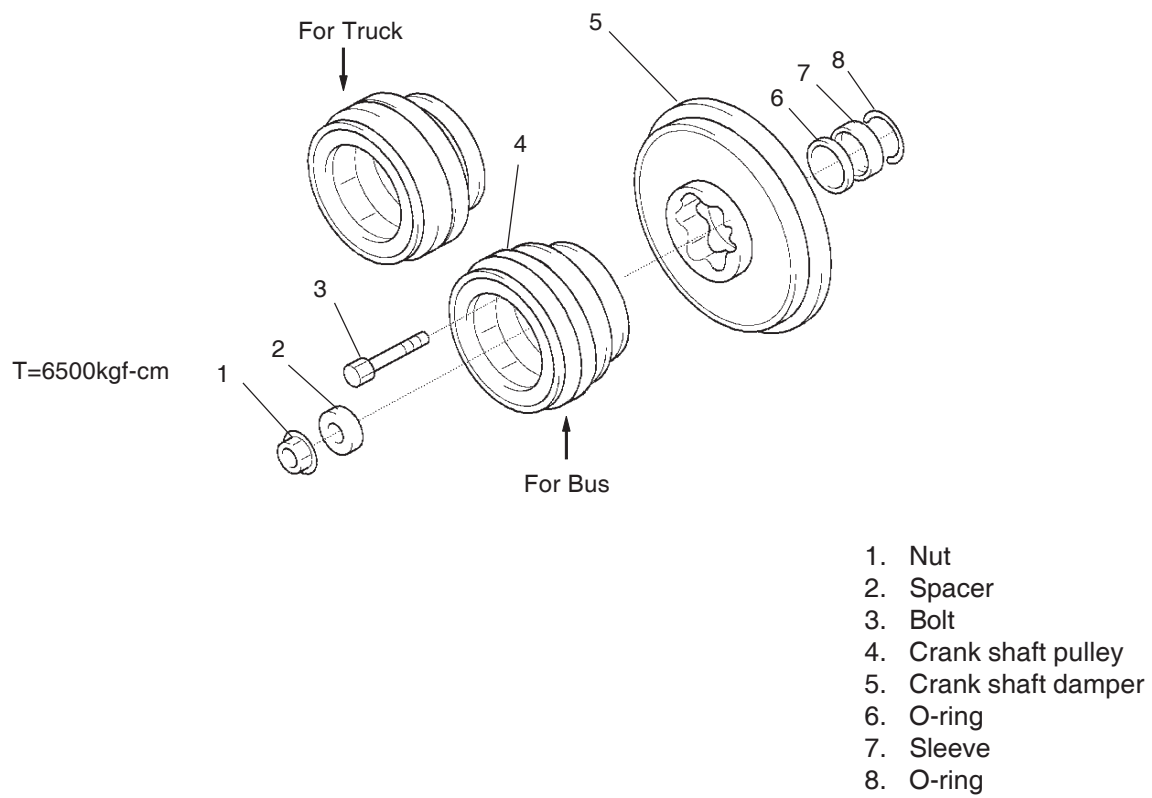
EM-33

7. Fasten the rocker arm support bolts in three steps in the numerical order shown in the figure. Fasten the bolts by the specified torques at the final step.



Crank Shaft Pulley

COMPONENTS



SERVICE PROCEDURE

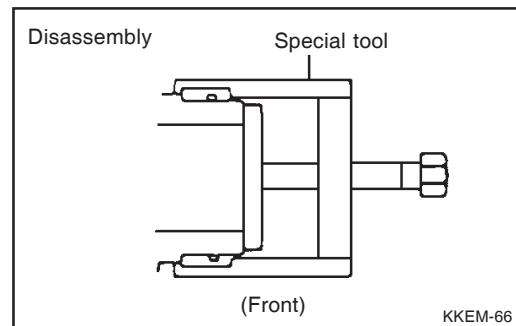
EM-35

Disassembly

Remove the crankshaft pulley.

CAUTION

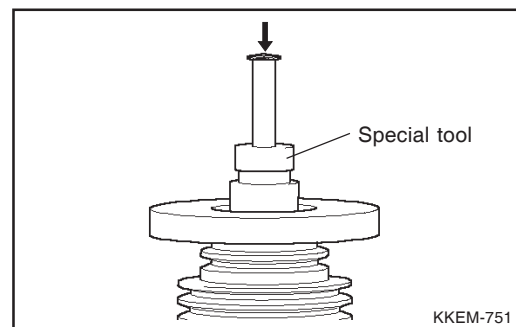
- **Use the plug, if needed.**
- **Do not remove the crankshaft pulley, if it is not necessary.**



Assembly

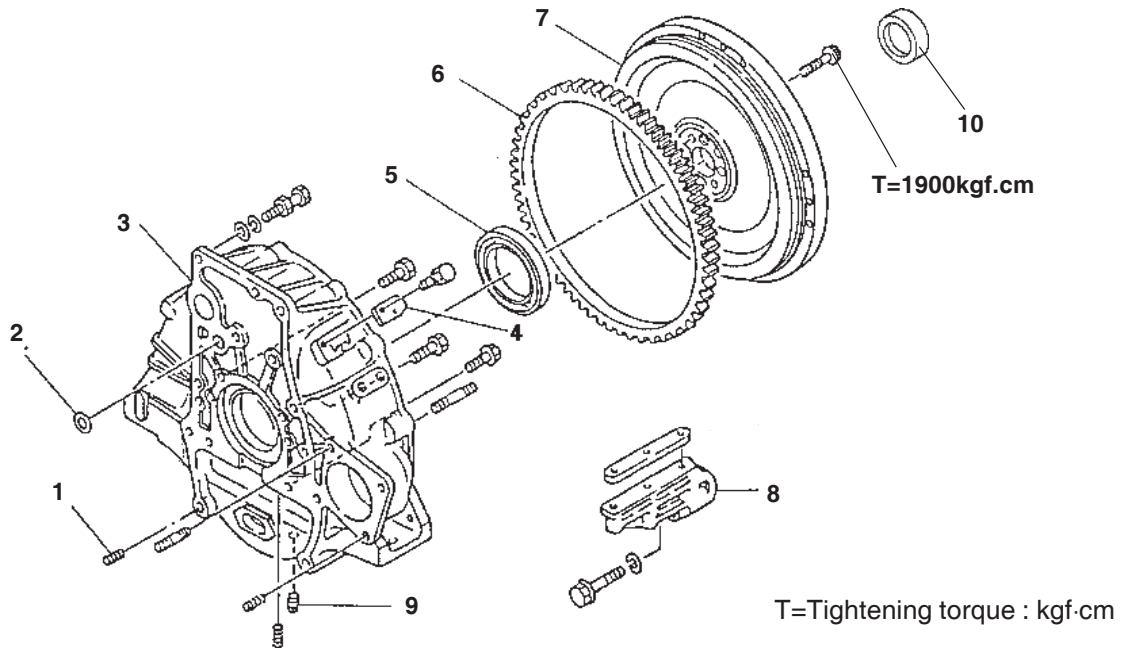
Replace the crankshaft front oil seal sleeve, if needed.

1. Remove the oil seal sleeve by using the special tool (Front oil seal remover: 09231-8Y500, sliding hammer: 09450-8Y000).
2. Install the new sleeve (Special tool: front oil seal sleeve installer: 09231-8Y400) Install the new O-ring to the sleeve, apply the enough oil to the center part of the pulley. Use the crankshaft sleeve press to insert the crankshaft sleeve. Then take care not to damage or wear out the O-ring.



Flywheel and Flywheel Housing

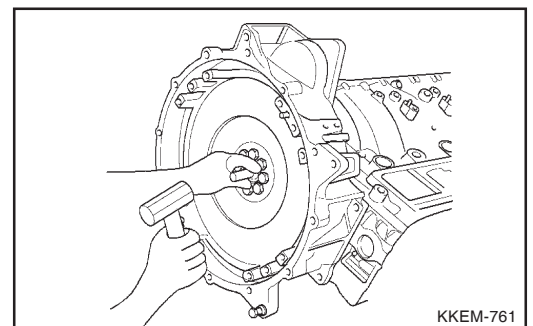
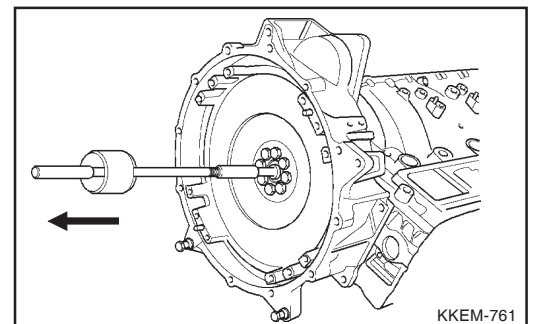
COMPONENTS



- | | |
|------------------------------|------------------|
| 1. Helicert | 6. Ring gear |
| 2. O-ring | 7. Flywheel |
| 3. Flywheel housing | 8. Stay |
| 4. Dust cover | 9. Plug |
| 5. Crank shaft rear oil seal | 10. Ball bearing |

KKEM-761

1. Replace the bal bearing if necessary.
SST : Ball bearing puller (09432-8Y000)



SERVICE PROCEDURE

EM-37

Assembly

Replace the oil seal, if needed.

1. Remove the oil seal.
2. Lightly apply the engine oil to the outer circumference of oil seal, and install the oil seal to the flywheel housing. (Special tool: 09231-8Y100). Check whether the oil seal is securely installed to the flywheel housing.

CAUTION

Apply the oil seal lubrication grease (Lithium based) to the oil seal rib.

Replace the O-ring, if needed.

1. Install the O-ring.

CAUTION

Apply the adhesive to the flywheel housing so that the O-ring is not detached. Install the flywheel housing.

2. Assemble the rear oil seal sleeve.

Special tool: Rear oil seal sleeve installer (09231-8Y600)

Replace the flywheel ring gear, if needed.

1. Remove the ring gear.
 - a. Heat the ring gear around 200°C.
 - b. Tap the ring gear evenly around the circumference to remove the ring gear with the metal rod.

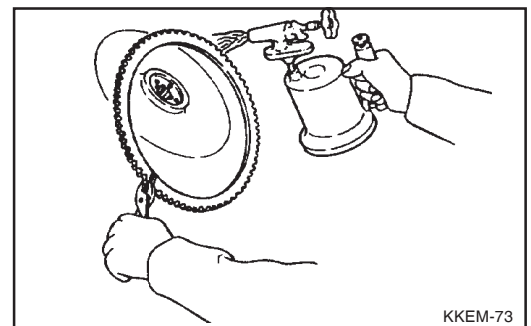
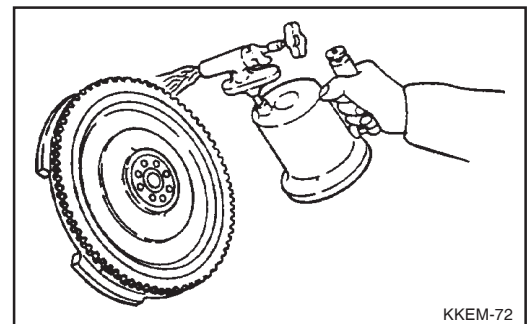
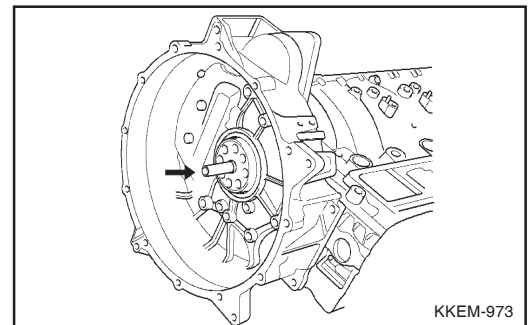
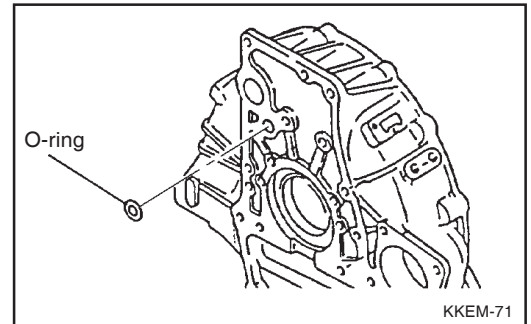
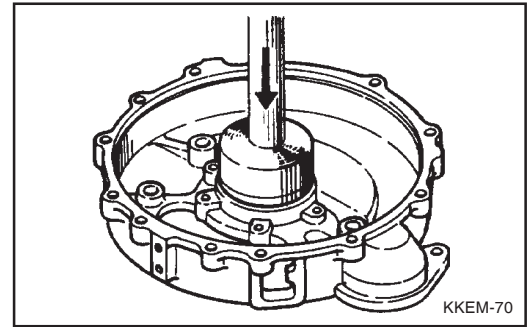
CAUTION

Do not overheat the ring gear.

2. Install the ring gear.
 - a. Heat the ring gear evenly about 200°C.
 - b. Insert the ring gear using the metal rod so that the chamfered gear faces the block of the flywheel.

CAUTION

Do not overheat the ring gear.



Install the flywheel.

1. Make sure that there is no dust or coarse parts at the holes of crankshaft and flywheel and each contact points. Insert the guide bar to the crankshaft.

Special tool: Flywheel guide bar (09231-8Y200)

CAUTION

Insert one of the bars to the collar knock and insert the other bar to the other side of collar knock.

2. Insert the flywheel into the guide bar gently as flywheel touches the collar knock, and push it fully to be securely installed.
3. Apply the engine oil to the surface of flywheel bolt bearing and threads of flywheel bolts. Fasten the flywheel bolts tentatively by hands.
4. Remove the bars, and fasten the remaining two flywheel bolts tentatively as described in no 3.
5. When fastening the bolts, fasten them gradually and slowly with the specified torques. And then loosen them a little bit and fasten them again by the specified order and torques.

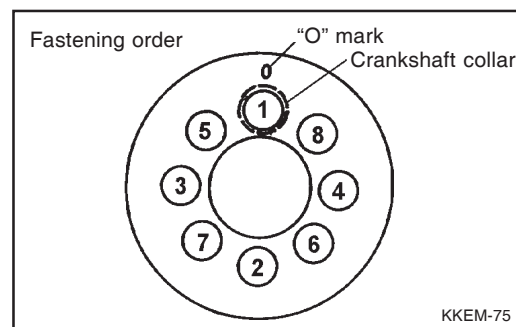
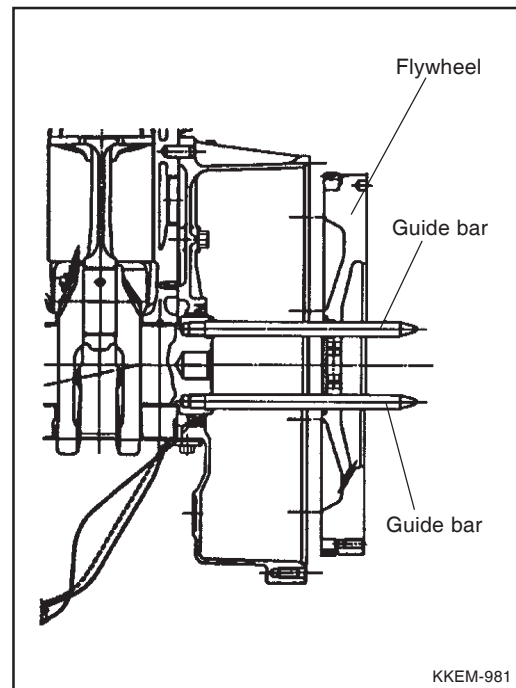
WARNING

Be careful not to drop the flywheel, since it is heavy.

CAUTION

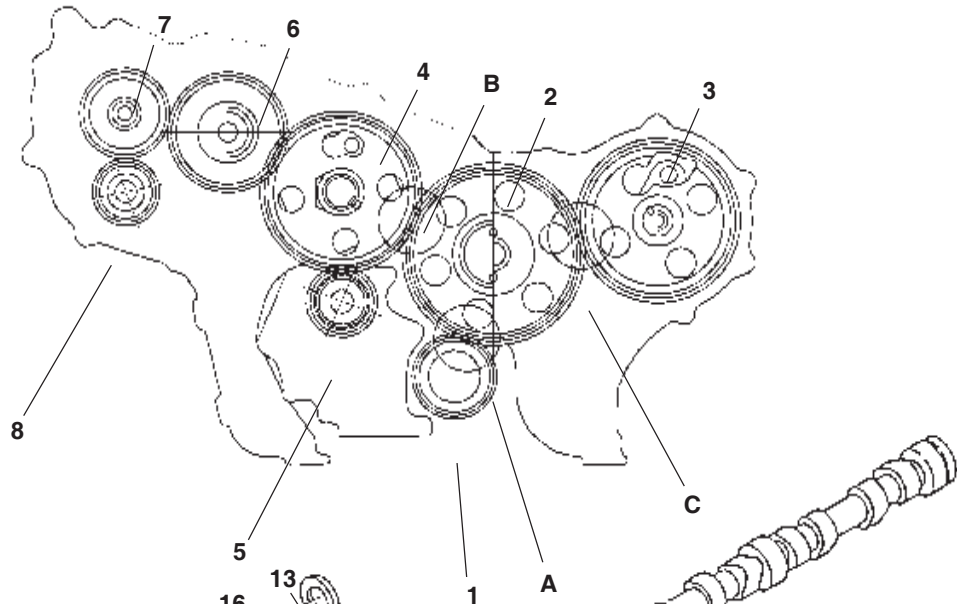
- Align the “O” marks of flywheel and crankshaft collar knock to be coincided.
- When fastening bolts, apply the engine oil the bolts threads and flywheel face.

Fastening torques: 1900kgf-cm

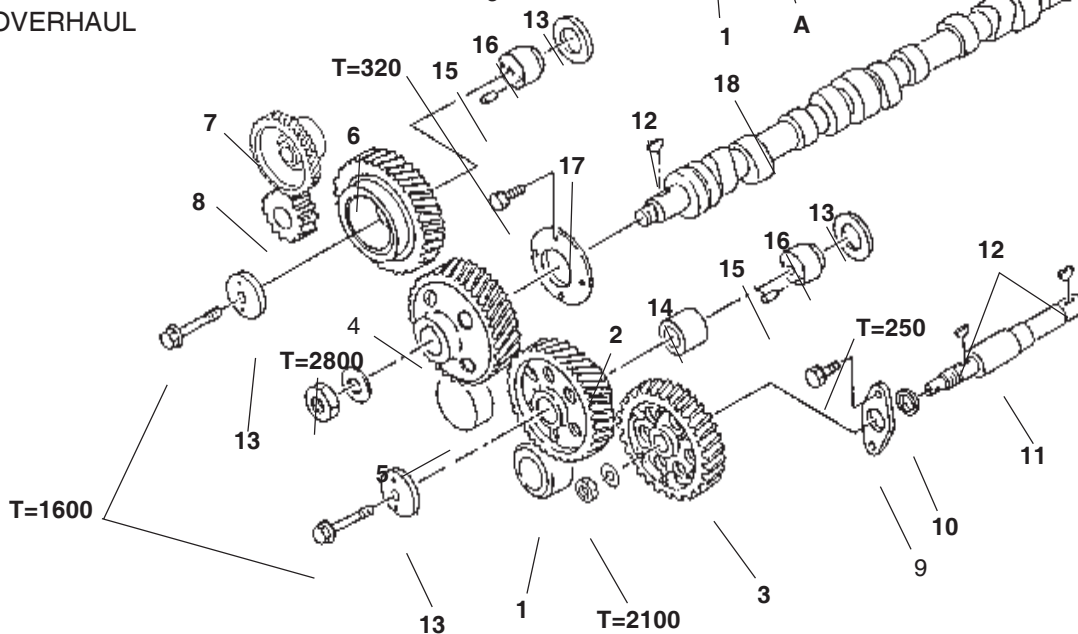


Timing Gear and Camshaft

DESCRIPTION



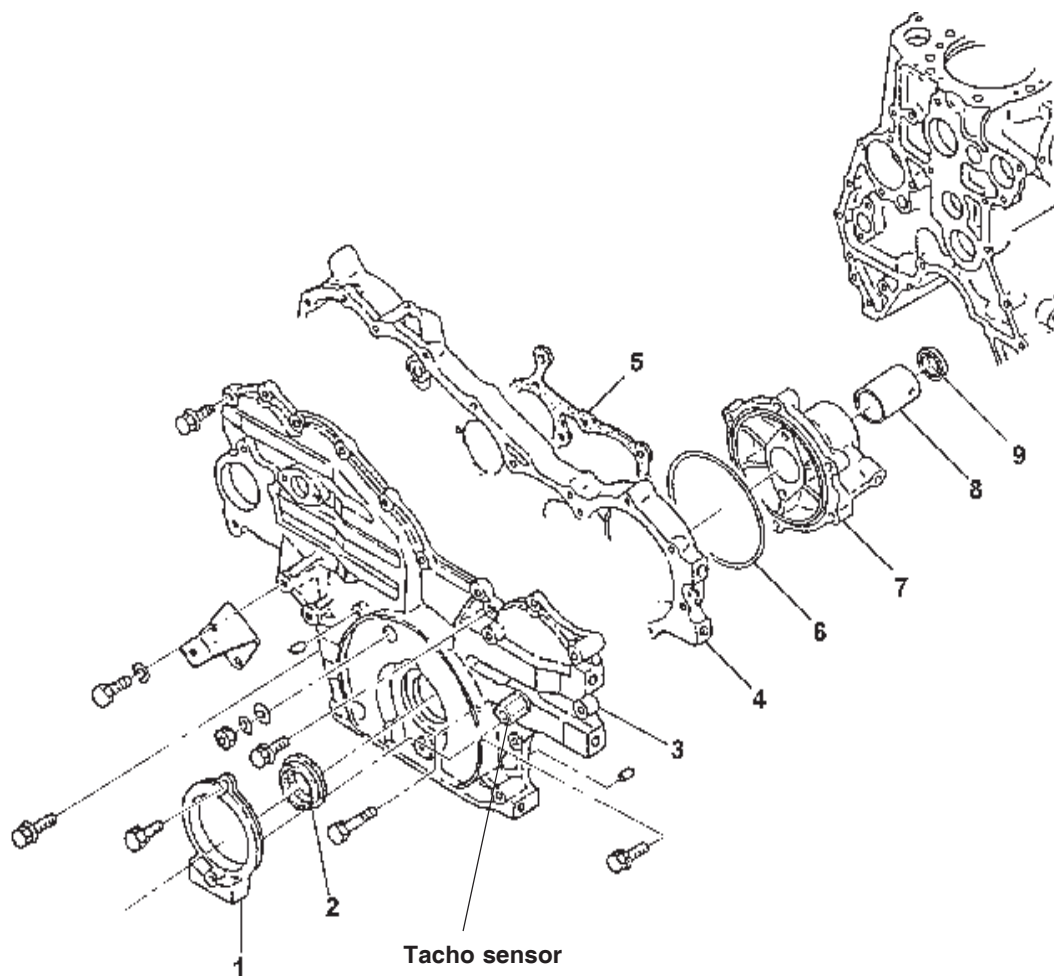
OVERHAUL



T=Tightening torque : kgf.cm

- | | | |
|---|-------------------------------------|--------------------|
| 1. Crank shaft gear | 9. Injection pump gear thrust plate | 18. Camshaft |
| 2. Idler gear | 10. Collar | A. Match marks "1" |
| 3. Fuel injection pump drive gear | 11. Injection pump drive shaft | B. Match marks "2" |
| 4. Camshaft gear | 12. Key | C. Match marks "3" |
| 5. Engine oil pump drive gear | 13. Thrust plate | |
| 6. Air compressor idler gear | 14. Bushing | |
| 7. Air compressor drive gear | 15. Pin | |
| 8. Power steering pump drive gear
(If so fitted) | 16. Idler gear shaft | |
| | 17. Camshaft thrust plate | |

OVERHAUL



1. Seal sub assembly
2. Crank shaft front oil seal
3. Timing gear case cover
4. Timing gear case
5. Gasket

6. O-ring
7. Bearing holder case
8. Bearing
9. Oil seal

SERVICE PROCEDURES

EM-41

Disassembly

Disassemble crankshaft pulley.

Caution: Use the puller, if needed.

Remove idler gear shaft.

Remove idler gear shaft using special tool.

Special tool: Sliding hammer (09450-75400)

Sliding hammer adapter (09450-75400)

Removal of camshaft

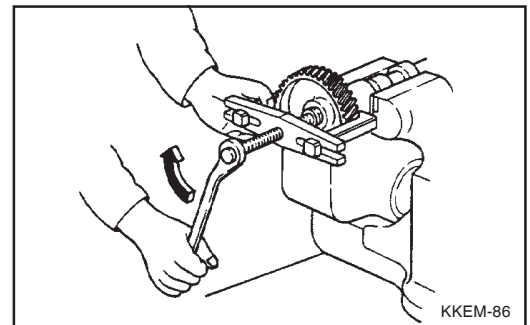
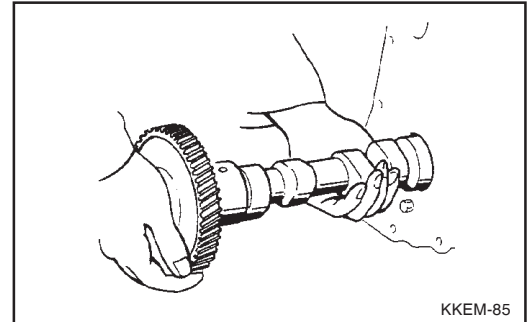
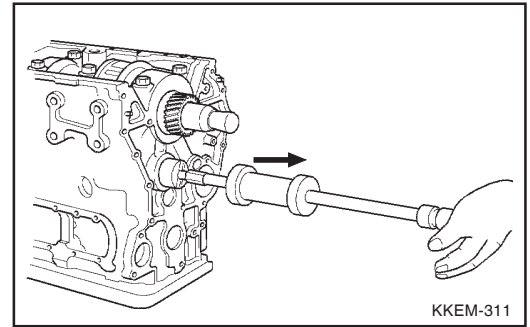
Remove thrust plate set bolts, and remove camshaft and gear.

CAUTION

Rotate the camshaft slowly so that the bearing should not be damaged.

Remove camshaft gear and injection pump drive gear, if needed.

Place the shaft assembly on the wooden plate and fix it with vise.
Remove the nut, and remove the gear by using gear puller.

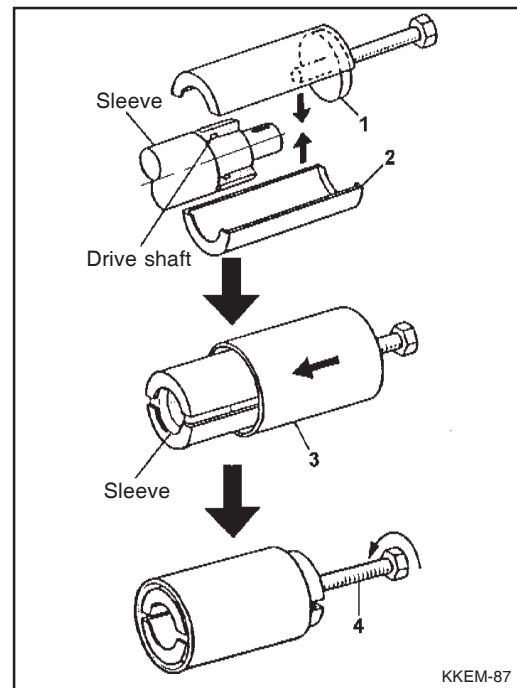


Assembly

Replace drive shaft oil seal sleeve of fuel injection pump, if needed.

1. Remove sleeve by using special tools.
 - a. Place the puller (1) and (2) on sleeves.
 - b. Hook the puller between shaft and sleeve.
 - c. Insert the puller (3).
 - d. Fasten the center bolt (4) after inserting puller, and remove sleeve.

Special tool: Puller

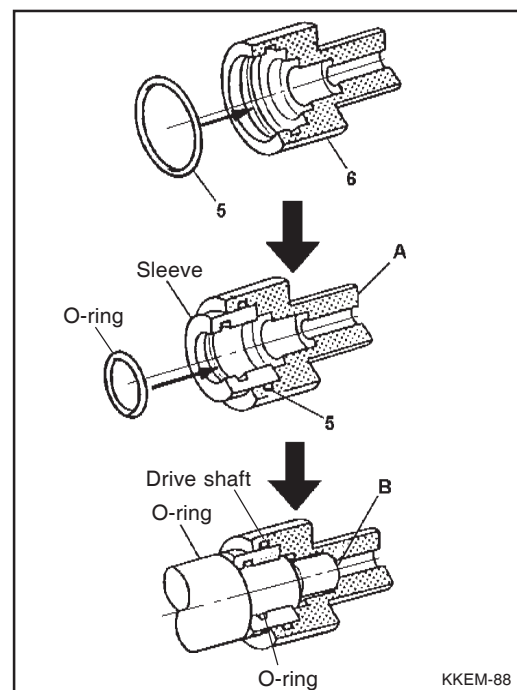


2. Insert shaft sleeve along with the new O-ring by using special tool.
 - a. Install O-ring (5) inside of the press (6).
 - b. Insert oil seal sleeve into press with new O-ring and insert it into drive sleeve.
 - c. Tap the part (A) lightly with hammer to connect the edge of the press with shaft edge (B) and then oil sleeve is positioned.

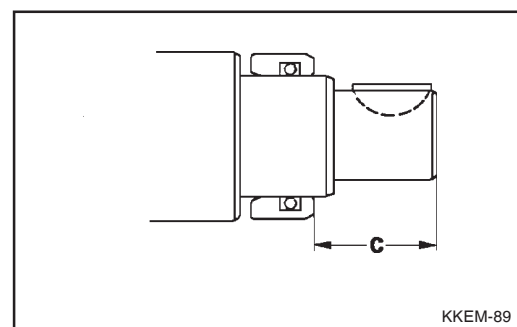
CAUTION

- Install O-ring on sleeve and apply the oil on the shaft.
- When installing shaft sleeve, be careful no to damage the O-ring.
- Do not reuse the sleeve once it is removed.

Special tool: Press



Distance from the shaft edge to sleeve end (c): 85.2 – 85.8 mm



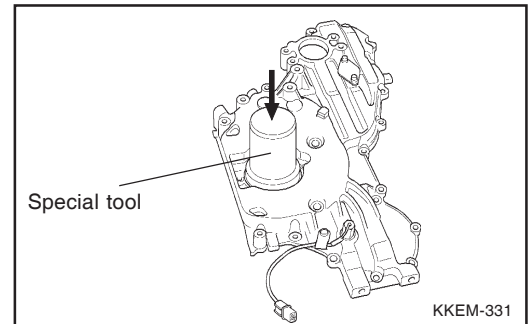
SERVICE PROCEDURES

EM-43

Replace oil seal of timing gear cover, if needed.

1. Remove oil seal using screwdriver.
2. Install the new oil seal.

Special tool: Front oil seal installer (09231- 8Y000)

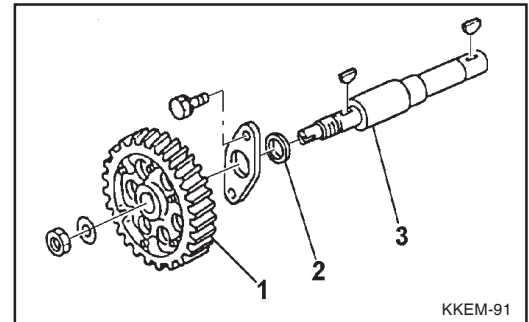


Install drive gear of fuel injection pump to the shaft.

1. Install collar thrust bearing and key to the shaft.
2. Install the preheated gear (1) about 100°C to the shaft.

CAUTION

Check whether gear (1) is securely installed to collar (2) and shaft (3).

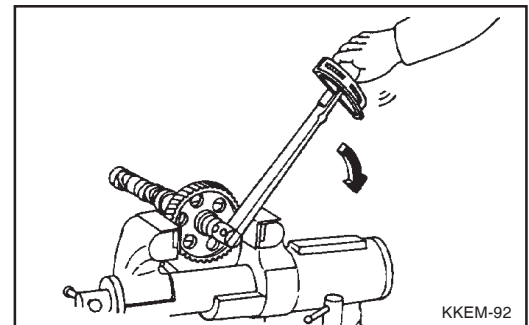


Install camshaft gear to shaft.

Install camshaft gear along with thrust plate.

CAUTION

- When installing gear to camshaft,
- Heat the gear with the hot water (approximately 100°C) and install gear to camshaft by using the press.
- When fastening the bolts, apply the engine oil to the bolts thread and nut surfaces.

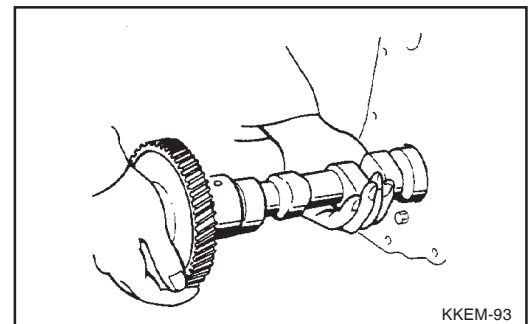


Install camshaft.

Lubricate the camshaft and install the camshaft assembly to cylinder block.

CAUTION

When installing camshaft, rotate the camshaft slowly so that the bearing is not damaged.

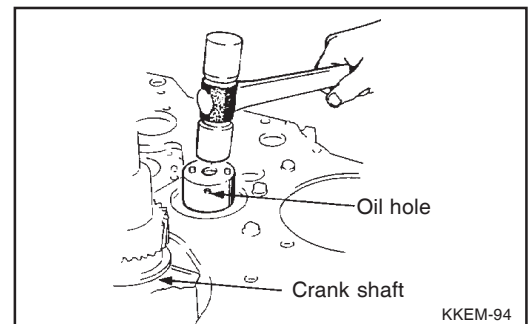


Install idler gear shaft.

Install idler gear shaft with thrust plate using plastic hammer.

CAUTION

Make sure that oil hole faces downward. If it doesn't, idler gear shaft and bushing will be damaged.



Installation of Idler Gear

When installing idler gear, coincide the assembly marks of crankshaft, camshaft gear, fuel injection pump drive gear and idler gear.

CAUTION

- If installed wrong, it may cause improper injection timing and finally engine damage or engine performance deterioration will be resulted.
- When fastening bolts, apply the engine oil to the bolts threads and surface.

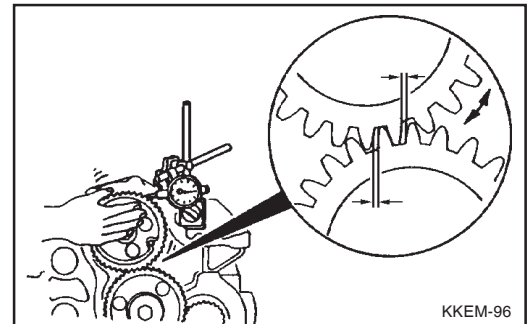
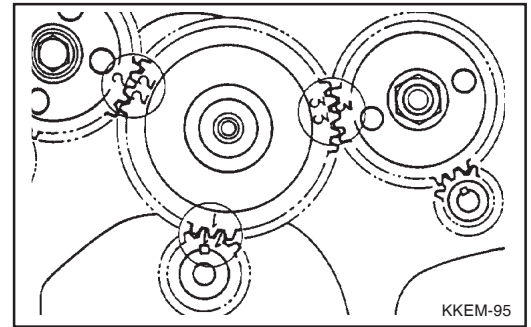
Measurement of gear backlash

Measure the backlash of each gear using dial indicator.
Replace gear, when needed. (Refer the maintenance standard)

Timing gear cover installation

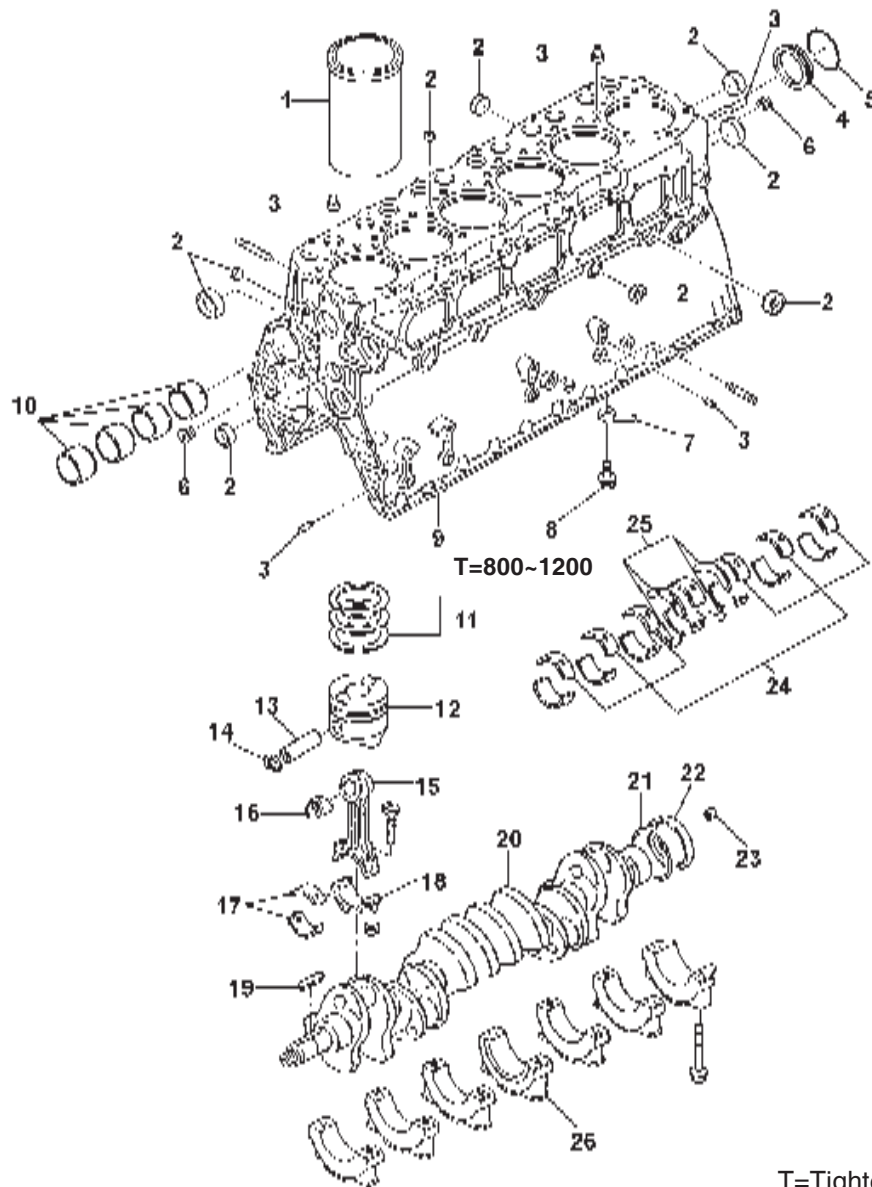
Install oil pump and oil strainer.

Install crankshaft pulley.



Piston, Crankshaft, Cylinder Block and Oil Pan

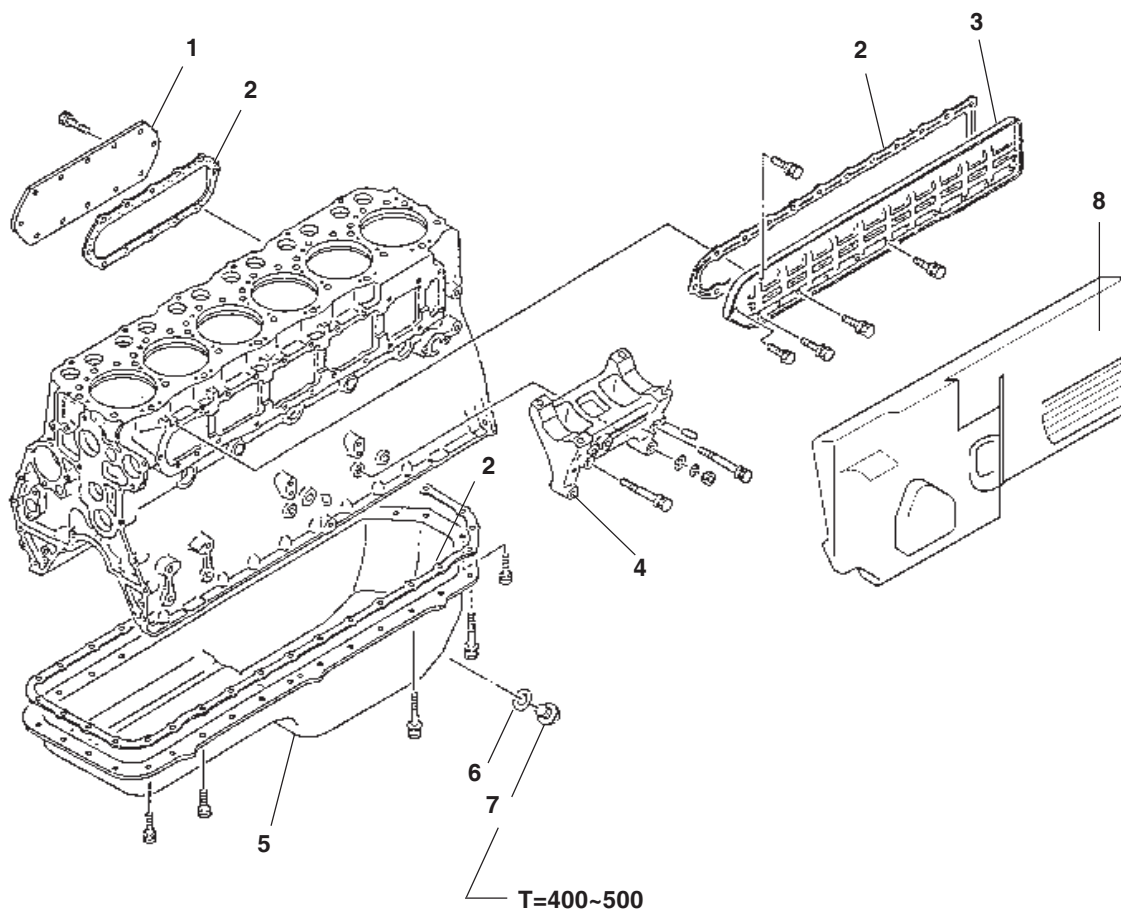
OVERHAUL



T=Tightening torque : kgf·cm

- | | | |
|--|----------------------------|--------------------------------|
| 1. Cylinder liner | 9. Cylinder block | 18. Connecting rod bearing cap |
| 2. Plug | 10. Camshaft bearing | 19. Key |
| 3. Pin | 11. Piston ring | 20. Crank shaft |
| 4. Seal plate | 12. Piston | 21. O-ring |
| 5. O-ring | 13. Piston pin | 22. Sleeve |
| 6. Plug | 14. Retainer ring | 23. Collar |
| 7. Oil jet pipe for piston cooling | 15. Connecting rod | 24. Crankshaft main bearing |
| 8. Connector bolt
(Oil check valve) | 16. Bushing | 25. Crankshaft thrust bearing |
| | 17. Connecting rod bearing | 26. Crankshaft bearing cap |

OVERHAUL



T=Tightening torque : kgf·cm

1. Push rod cover
2. Gasket
3. Water gallery cover
4. Injection pump bracket
5. Oil pan
6. Soft washer
7. Plug
8. Sound insulator

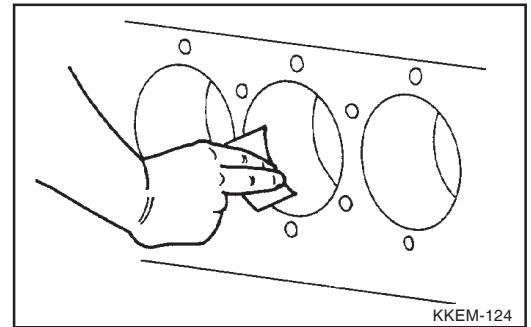
SERVICE PROCEDURES

EM-47

Disassembly

Disassemble piston along with connecting rod.

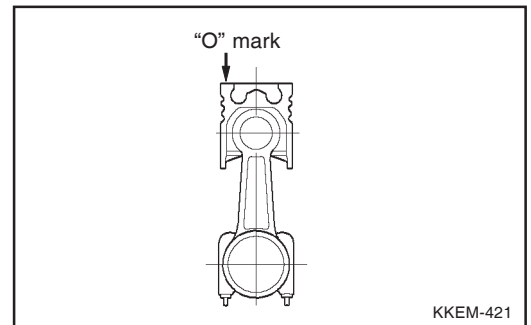
1. Remove the carbon dirt of the cylinder liners by scrubbing the liner edges to the circumference direction by scraper or sand paper (No. 150).



2. Pull out the piston and connecting rod assembly out of upper cylinder.

CAUTION

- Disassemble connecting rod, as connecting rod do not touch the cooling jet.
- Arrange the piston and connecting rod caps orderly.

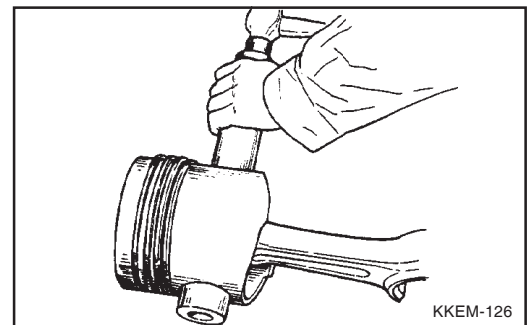


Remove the connecting rod.

Remove the retainer rings that installed at both ends of pistons by using retainer ring pliers.

CAUTION

Preheat the piston for about 5 minutes by soaking in the hot water of 80 - 90°C, before disassembling pins.

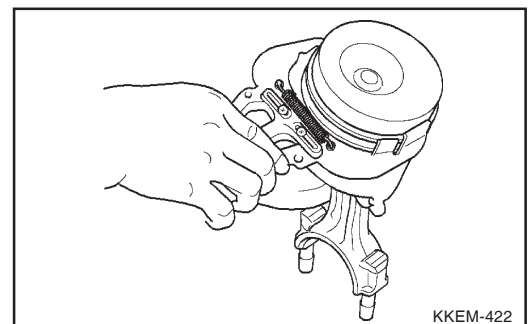


Remove piston rings.

Special tool: Piston ring tool (09222 - 83200)

CAUTION

- Since piston rings are made of special forgery and brittle, handle them with special care.
- Distinguish the rings by the equivalent cylinders and separate them each other.

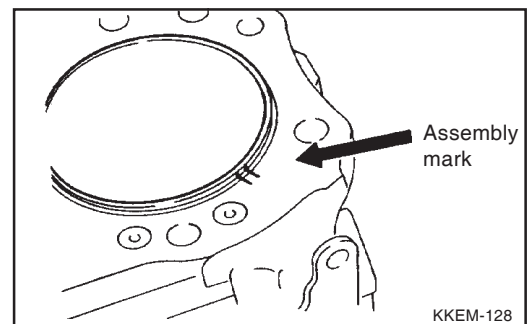


Remove cylinder liners.

Draw assembly mark at the cylinder block and liner flange, before disassembling cylinder liners.

CAUTION

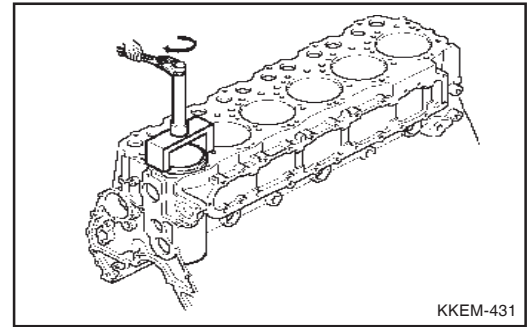
- Do not draw assembly mark with punch.
- After disassembling cylinder liners, write down numbers at the circumference or arrange them orderly.



EM-48

ENGINE MECHANICAL

Special tool : Cylinder liner puller A(09222-62100)
Cylinder liner puller B(09222-8Y100)



SERVICE PROCEDURES

EM-49

Assembly

Check piston cooling jet position.

CAUTION

- Do not disassemble cooling jet except disassembly inspection or when it is necessary.
- When cooling jet is disassembled, replace the cooling jet check valve of cylinders.

Cooling jet position checks are as follows.

1. Remove connector bolts of piston cooling jet, and install the special tools.
2. Use the oil pump; whose pressure is approximately 2kgf/cm² and oil speed is 2.5 L/min.
3. Prepare the new engine oil.
4. Connect the oil line. Connect the outlet of oil pump to special tool (connector bolts).
5. Install special tool on the cylinder block.

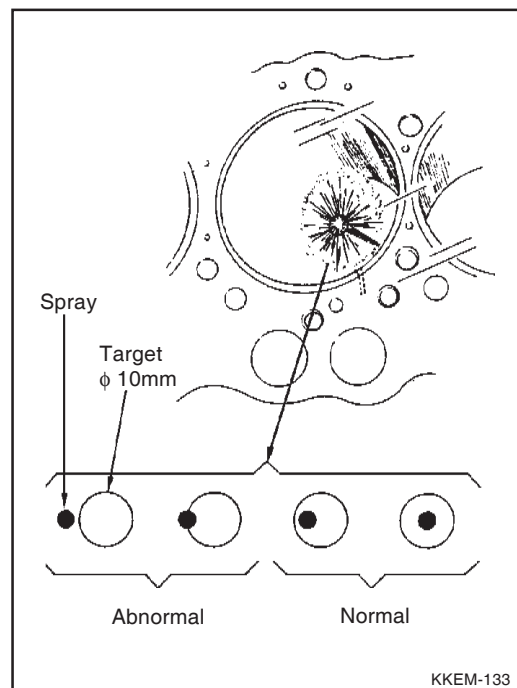
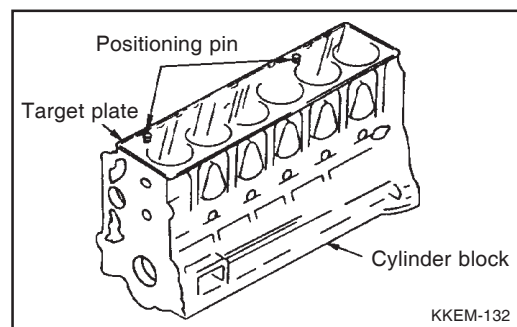
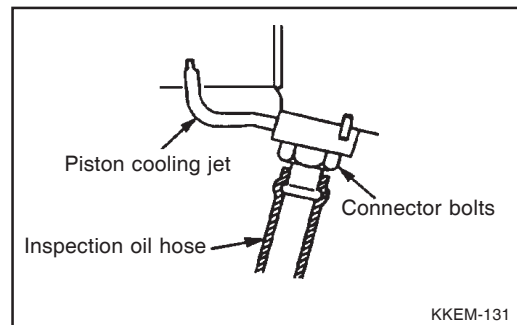
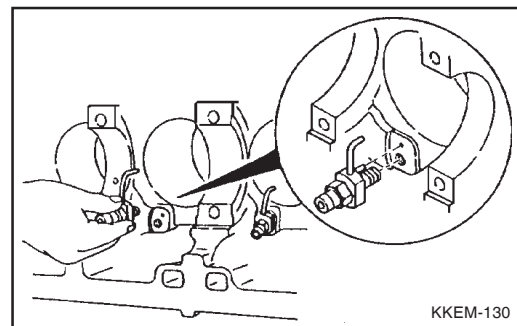
Special tool: Target plate (09222 – 8Y500)

6. Perform an injection test by operating the oil pump to maintain the oil pressure as approximately 2kgf/cm² and by pumping the new oil from jet. It is normal, if the spray of the injection is centered at around ϕ 10mm of the plate.

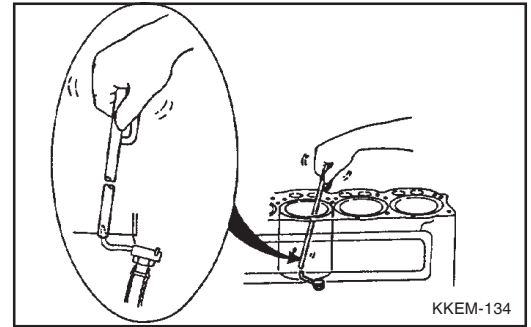
WARNING

Engine oil is extremely flammable.

Spray test should be performed at the places where ventilation is excellent.



7. If the spray of the cooling jet is scattered around the target plate, readjust the nozzle.

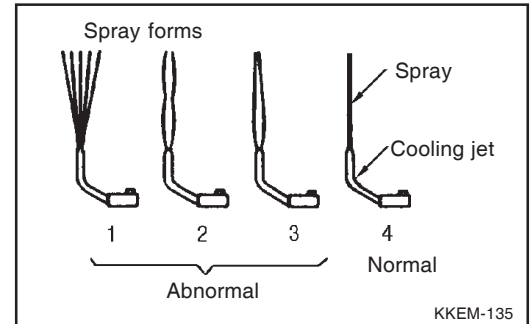


8. Spray form

When checking the piston cooling jet position, make sure that spray is like number 4 in the figure not like the other 1,2 and 3.

CAUTION

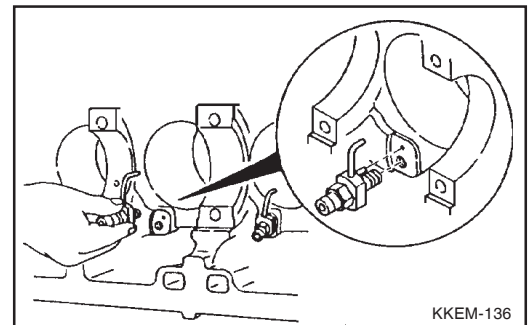
If the end of jet is damaged, spray is poor, so replace it with the new one. Whenever replacing the cooling jet, check the piston cooling jet position of the new one always.



9. After checking piston cooling jet position, install the cooling jet on the cylinder block by using the right bolts (with soft washer).

Fastening torque: 270 ~ 320kgf-cm

10. After installing piston, check the interference of cooling jet and piston when the piston is at the bottom dead center position.



SERVICE PROCEDURES

EM-51

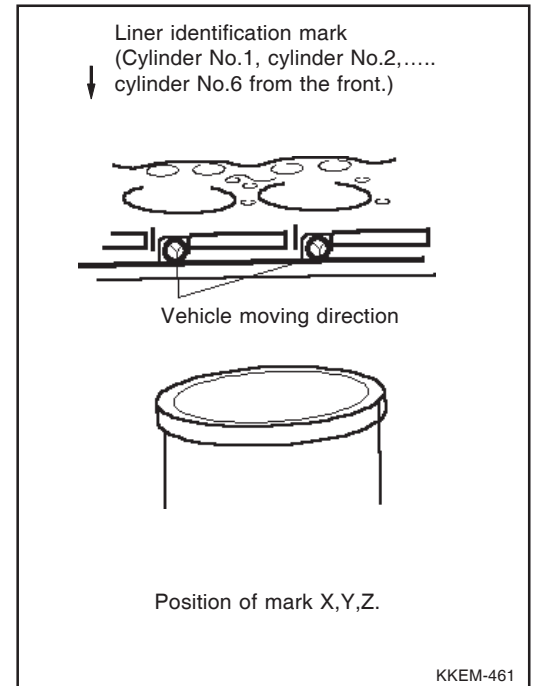
Insert the cylinder liners into the cylinder block.

1. When installing the new cylinder liner, check the mark of cylinder block with mark of liner.

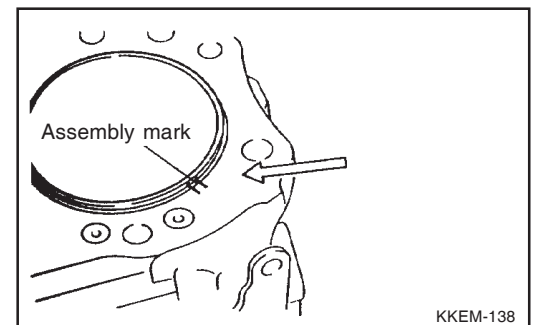
CAUTION

When installing the cylinder liner and block, be careful to choose the right ones.

In case of using the new cylinder liner, check the X,Y and Z mark of cylinder liner flange with the same marks of upper cylinder block.



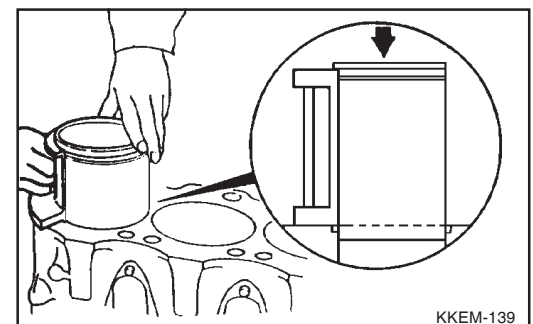
2. When reusing the liner, install the liner at the right position by coinciding the assembly marks that was drawn before the disassembly.



3. Lightly apply the engine oil around the outer circumference of liner, and install the liner by pressing the whole flange. If it is hard to install by hand, use the cylinder liner guide.

CAUTION

- Use the new one, if the liner has been dropped.
- Handle with care so that the liner is not damaged.



Replace the camshaft seal plate, if needed.

1. Remove the seal plate.
2. Install the seal plate.
Install O-ring to end plate and install this assembly to the cylinder block.

CAUTION

- Take care not to damage the cylinder block and end plate in installing. Besides, apply the liquid gasket around the O-ring (three bond 1215).
- Don't reuse the O-ring after removal.

Replace the crankshaft rear oil seal sleeve, if needed.

1. Remove the crankshaft sleeve using special tool.
(Rear oil seal sleeve remover: 09231 – 8Y300)

CAUTION

Do not disassemble the crankshaft, if necessary.

2. Install the new sleeve.
(Special tool – rear oil seal sleeve installer: 09231 – 8Y600)
Install the new O-ring to the sleeve and apply enough oil to crankshaft.
Use the crankshaft sleeve press in installing crankshaft sleeve.
Take care not to damage the O-ring.

Special tool: Press

Dimension: 4.3 – 4.7 mm

Grind the crankshaft pin or journal and use the undersize bearing, if necessary.

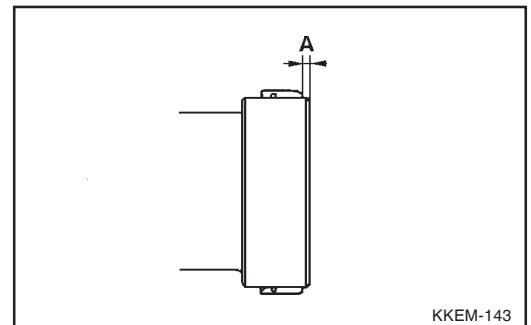
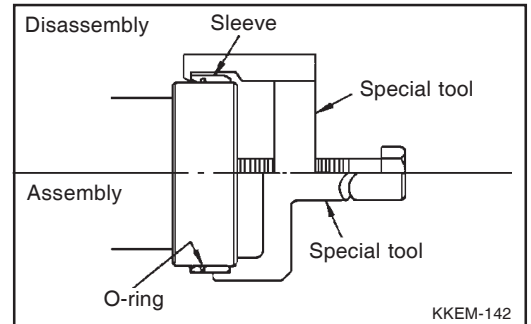
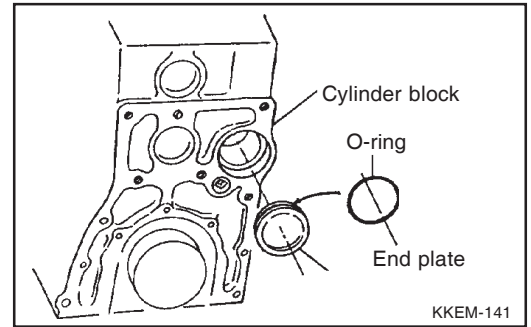
CAUTION

- When crankshaft pin or journal is worn out, 4 different types of under size bearing can be used.
0.25 mm, 0.50 mm, 0.75 mm, 1.00 mm
- Bearing set consists of upper and lower bearing. So it should be replaced by the set.

Filler dimension (R)

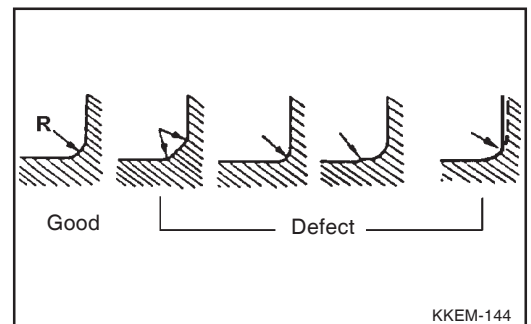
Crank pin: 3.75 – 4.25 mm

Journal: 3.00 – 3.50 mm



Unit: mm

Undersize	Outer diameter	
	Pin	Journal
0.25US	64.69-64.71	79.69-79.71
0.50US	64.44-64.46	79.44-79.46
0.75US	64.19-64.21	79.19-79.21
1.00US	63.94-63.96	78.94-78.96



SERVICE PROCEDURES

EM-53

Install the crankshaft.

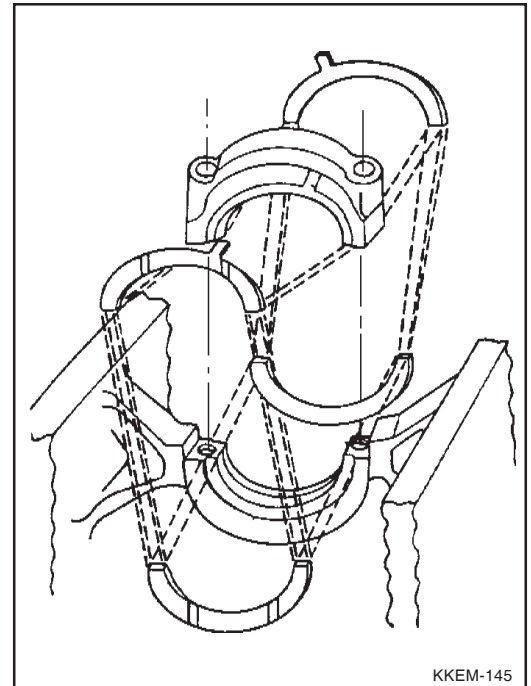
1. Install the crankshaft bearing to the cylinder block and bearing cap.

CAUTION

- Install the bearing with oil hole to the block side, and bearing without the oil hole to the bearing cap side.
 - Apply the clean engine oil to the bearing surface.
2. Install the crankshaft to the cylinder block.
 3. Insert the crankshaft thrust bearing to the cylinder block groove.
 4. Insert the thrust bearing at the side of number 4 bearing.

CAUTION

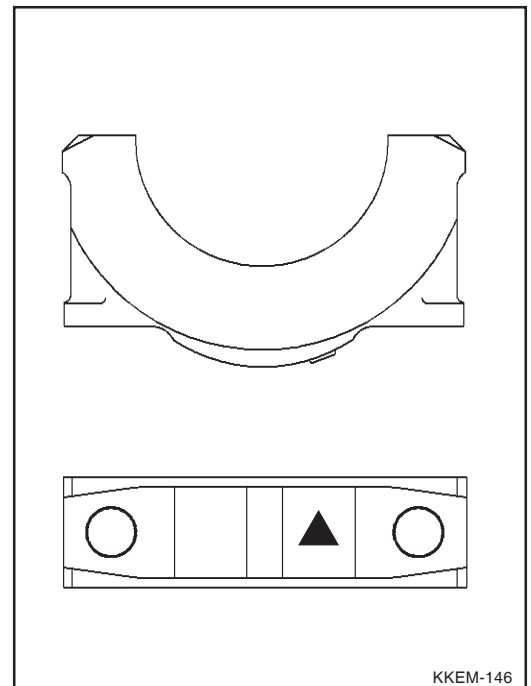
Apply the engine oil to each thrust bearing surface.



KKEM-145

5. Install the crankshaft-bearing cap.

Install the bearing caps by the numerical order from the timing gear side by placing the arrow mark of the bearing cap face the timing gear side.



KKEM-146

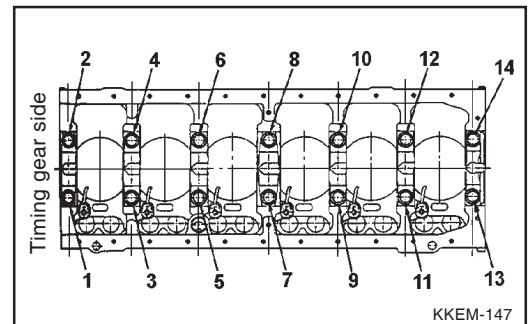
6. Fasten the cap bolts by the following order.

Unit: kgf-cm

#1, #2, #3, #5, #6, #7	# 4
$700 + 57^{+2}_{-0}$	$700 + 52^{+2}_{-0}$

CAUTION

- Apply the engine oil to the lower part of bolt thread and head.
- Check whether the crankshaft rotates smoothly.
- Check the clearance of crankshaft end.



KKEM-147

Replace the piston pin bushing, if needed.

1. Remove the bushing using hydraulic press.

CAUTION

Operate the press slowly and gently.

2. Assemble the piston bushing.

Grind the one side of bushing hole at the connecting rod homogenously wide 0.5 – 1.0 mm.

CAUTION

- **Unbalance chamfering cause the wrong grinding of pressed bushing, and finally results in the melting during installation.**
- **Remove the dust from the inside of the hole.**

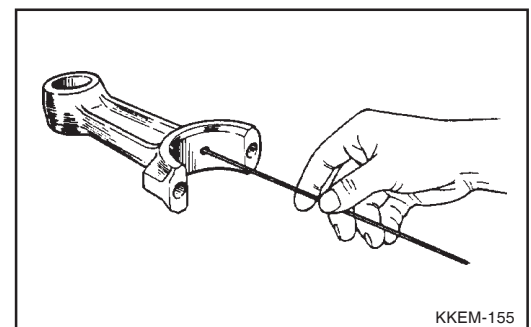
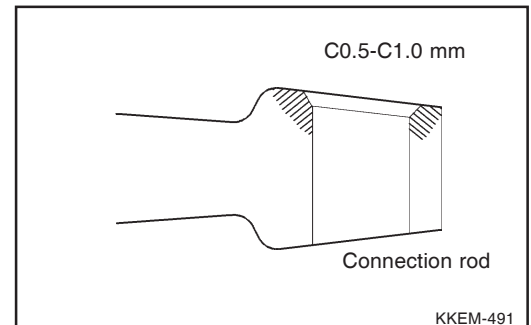
3. Check the bushing position after installation.

- a. Check the oil hole of bushing and oil passage of connecting rod whether they are arranged as the rod of 6 mm in diameter can be inserted.

CAUTION

Misalignment of oil holes may cause insufficient lubrication and melting.

- b. The new piston pin inserted to the piston pin bushing must be rotated easily without shaking.



SERVICE PROCEDURES

EM-55

Assemble the piston and connecting rod.

Let the O-mark of upper piston be opposite direction of connection rod assembly mark.

CAUTION

- Use the new retainer ring.
- Heat the piston for about 5 minutes by soaking it into the water of 80 –90°C.

Install the piston ring.

1. When installing the piston rings, install by the order of oil ring, No. 2 ring and top ring, and identification mark of ring end should face upward.

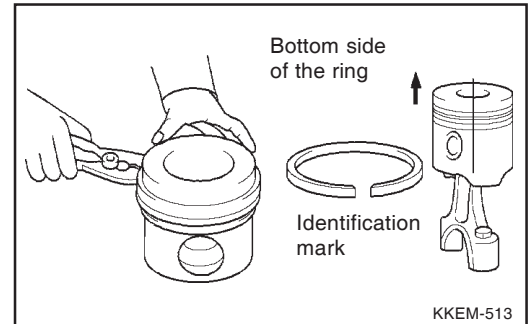
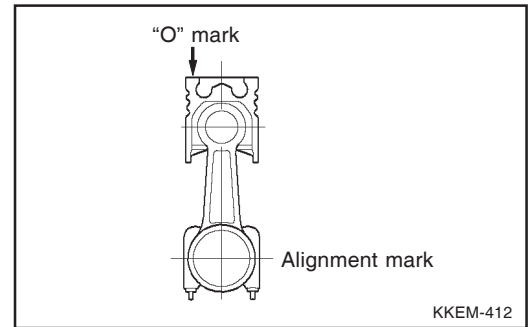
CAUTION

Apply the engine oil to piston ring.

Special tool: piston ring tool (09222 – 83200)

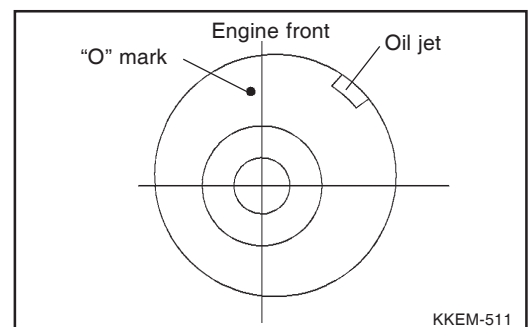
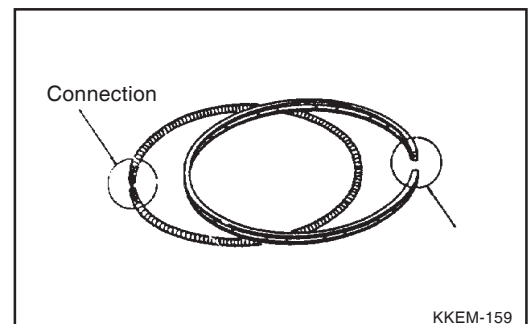
2. Connect the end of coil expander, and install the coil inside the piston ring by letting the gap of piston ring should be at the 180° distant from the joint part of the coil.

3. Align the piston ring, as the gap positions of rings are equal.



Ring number	Shape
Top	
Number 2	
Oil	

KKEM-512



EM-56

ENGINE MECHANICAL

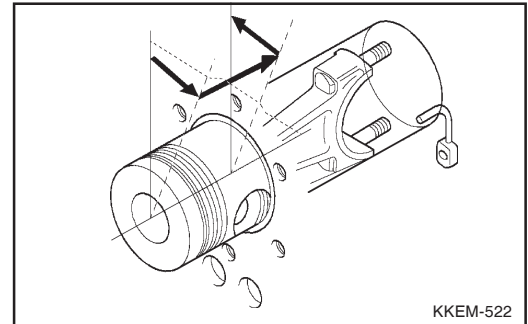
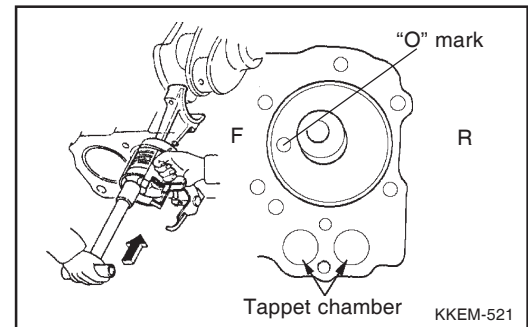
Install the connecting rod and piston to cylinder liners.

1. Apply the engine oil to piston, cylinder liner and connecting rod bearing surface.
2. Fix the piston ring using the special tool and insert the piston and connecting rod assembly using wooden rod.

CAUTION

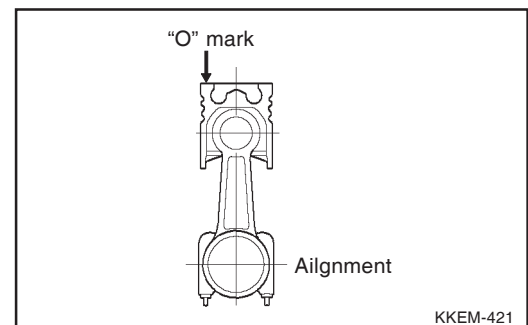
- Check whether the O-mark of upper piston is at the engine front (crank pulley) side.
- Align the oil holes when installing bearing on connecting rod and cap.
- When assembling connecting rod assembly to piston, take care not to damage the piston cooling jet by the connecting rod. If piston-cooling jet is hit, then adjust or replace it.

Special tool: Piston guide clamp (09222 – 88200)



Install the connecting rod cap.

1. Apply the engine oil to the bearing surface.
2. Coincide the assembly mark of connecting rod and cap.



Fasten the cap bolts.

1. Measure the total length of bolt. If the length is more than 8.5 mm, replace it with the new bolt.

Fastening torque (1650 ~ 1850 kgf.cm)

Dimension (A): 83.5 mm

2. Fasten the bolts by the following order.
 - a. Fasten the nut by the force of 700kfg-cm
 - b. Fasten the nut again around 1/4 rotation(90°)
 - c. Fasten the nut again around 1/8 rotation(45°)

CAUTION

- Apply the engine oil at the lower part of bolt threads and nuts.
- Fasten the nut again, even if the nut is fully fastened.

Liquid Gasket and Oil Application Points

General gaskets and liquid gaskets are used in engine. Apply the liquid gasket considering the following facts.

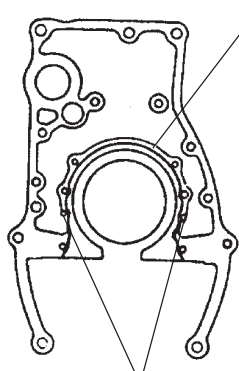
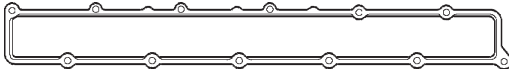
1. Application points and width of liquid gasket.

Liquid gaskets in use.

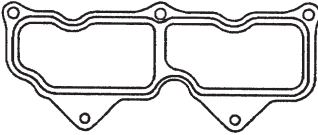
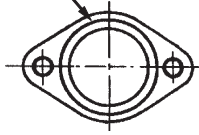
Three bond TB1207D or general electric NO. 2992 – 10: 04132 – 1207 (a), (b), (c) silver color

Three bond TB1207B: 04132 – 1217 (c), (d) black color

Unit: mm

Part name	Application points	Application width
(a) Timing gear cover	Where contacts the cylinder block Liquid gasket  Liquid gasket KKEM-571	1.5-2.5
(b) Flywheel housing	Flange face where contacts cylinder block Liquid gasket  Bolt holes of cylinder block KKEM-573	1.5-2.5
(c) Intake manifold	Flange face where contacts cylinder head Liquid gasket  KKEM-572	1.5-2.5

Unit: mm

Parts name	Application points	Application width
(d) Intake air pipe	Flange face where contacts intake air-fold Liquid gasket  KKEM-581	1.5-2.5
(e) Coolant pipe (for the model, which adopts air compressor)	Flange face where contacts coolant pump Liquid gasket  KKEM-582	1.5-2.5

2. Application of liquid gasket and assembly order of components

- 1) Remove the old liquid gaskets completely among junction parts, and also remove the oil, water and dirt by the cloth.
- 2) Apply the proper amount of liquid gasket only. Let the beginning and end of the gasket be overlapped.
- 3) When assembling the liquid gasket applied parts, align the parts orderly. If not, apply the gasket again.
- 4) Assemble the parts within 20 minutes after applying the liquid gasket. If 20 minutes have passed, remove the applied gasket and apply the new gasket again. (Adhesion is weak due to the hardening)
- 5) Wait for more than 15 minutes to engine start after assembly.

3. Components disassembly

When disassembling each component, try to lift various parts in turn instead of lifting only one side of the flange.

CAUTION

Oil pan flange are deformed sometimes in removing oil pan.

Therefore, insert several plates along the circumference and remove the oil pan using screwdrivers.

THOUBLESHOOTING

Symptom	Possible cause	Remedy/Prevention
Engine overheating	Coolant • Insufficient coolant • Defective thermostat • Overflow of coolant due to leakage of exhaust into cooling system • Coolant leakage from cylinder head gasket • Defective coolant pump	• Add coolant. • Replace the thermostat. • Repair. • Repair gasket. • Repair or replace.
	Radiator • Clogged with rust and scale • Clogged with iron oxide due to leakage of exhaust into cooling system • Clogged radiator core due to mud or other debris • Defective radiator cap pressure valve	• Clean radiator. • Clean coolant passage and correct exhaust leakage. • Clean radiator. • Replace radiator cap
	Abnormal combustion • Incorrect injection timing • Reduced injection pressure • Poor fuel • Poor nozzle spray • Unsatisfactory automatic timer true angle	• Adjust injection timing • Adjust injection pressure. • Use good quality fuel. • Adjust or replace nozzle. • Repair or replace timer.
	Other problems • Defective or deteriorated engine oil • Unsatisfactory operation of oil pump • Insufficient oil	• Change engine oil. • Replace or repair. • Add oil.
Excessive oil consumption	Pistons, cylinder liners, and piston rings • Wear of piston ring and cylinder liner • Worn, sticking or broken piston rings • Insufficient tension on piston rings • Unsuitable oil (viscosity too low) • Incorrectly fitted piston rings (upside down) • Gaps of piston rings in line with each other	• Replace piston rings and cylinder liner. • Replace piston rings and cylinder liner. • Replace piston rings and cylinder liner. • Change oil as required. • Replace piston rings. • Reassemble piston rings.
	Valve and valve guides • Worn valve stem • Worn valve guide • Incorrectly fitted valve stem seal • Excessive lubricant on rocker arm	• Replace valve and valve guide. • Replace valve guide. • Replace stem seal. • Check clearance between rocker arm and shaft.

Symptom	Possible cause	Remedy/Prevention
Excessive oil consumption	Excess oil feed • Defective oil level gauge • Oil level too high	• Replace oil level gauge. • Drain excess oil.
	Other problems • Over cooled engine (low temperature wear) • Oil leakage from miscellaneous parts	• Warm up engine before moving vehicle. Check cooling system. • Repair.
Piston stick	Operation • Abrupt stoppage of engine after running at highspeed • Hill climbing using unsuitable gear	• Operate engine properly. • Select suitable gear.
	Oil • Insufficient oil • Dirty oil • Poor quality oil • High oil temperature • Low oil pressure • Defective oil pump • Reduced performance due to worn oil pump • Suction strainer sucking air	• Add oil. • Change oil. • Replace with proper engine oil. • Repair. • Repair. • Repair oil pump. • Replace oil pump. • Add oil and/or repair strainer.
	Abnormal combustion	• See Symptom : "Engine overheating"
	Coolant	• See Symptom : "Engine overheating"
Lack of power	Intake • Clogged air cleaner	• Clean element or replace element.
	Overheating	• See Symptom " Engine overheating"
	Fuel and nozzle • Poor nozzle spray	• Adjust or replace injection nozzle.
	• Clogged nozzle with carbon • Wear or seizure of nozzle • Air in fuel system • Clogged fuel filter • Use of poor fuel	• Clean nozzle. • Replace nozzle. • Repair and bleed air from fuel system. • Replace element. • Use good quality fuel.
	Abnormal combustion	• See Symptom : "Engine overheating."
	Piston, cylinder liners, and piston rings	• See Symptom : "Engine overheating."
	Other problems • Breakage of turbine or blower (If so equipped turbocharger)	• Replace turbine, blower or/and turbocharger

TROUBLESHOOTING

EM-61

Symptom	Possible cause	Remedy/Prevention
Difficult starting engine	Electrical system • Discharged battery • Defective wiring in starter circuit. • Loose or open-circuit battery cable • Break of glow plug or intake air heater (If so equipped)	• Charge battery. • Repair wiring of starter. • Tighten battery terminal connections or replace battery cable. • Replace.
	Air cleaner • Clogged element	• Clean or replace the element.
	Fuel system • No fuel in tank • Clogged fuel line. • Air sucked into fuel system through fuel line connections. • Clogged fuel filter • Loose connection in high-pressure line • Water in fuel	• Supply fuel or bleed of fuel system. • Clean fuel line. • Tighten fuel line connections. • Replace element. • Tighten sleeve nut of high pressure line. • Drain and clean fuel system
Difficulty starting engine	Nozzles • Seized nozzle • Broken or fatigued nozzle spring	• Replace nozzle. • Replace spring.
	Oil system • Oil viscosity too high	• Use proper viscosity oil, or install an oil immersion heater and warm up oil.
	Other problems • Seized piston • Seized bearing • Reduced compression pressure • Ring gear damaged or worn • Improperly adjusted or broken accelerator cable	• Replace piston, piston rings, and liner. • Replace bearing and/or crankshaft. • Overhaul engine. • Replace the ring gear and/or starter pinion. • Adjust or replace the accelerator cable.
Rough idling	Injection pump	• Refer to "FUEL INJECTION PUMP".
	Nozzles • Uneven injection pressure • Poor nozzle spray • Carbon deposit on nozzle tip • Seized needle valve	• Adjust. • Adjust or replace nozzle. • Remove carbon. • Replace nozzle.

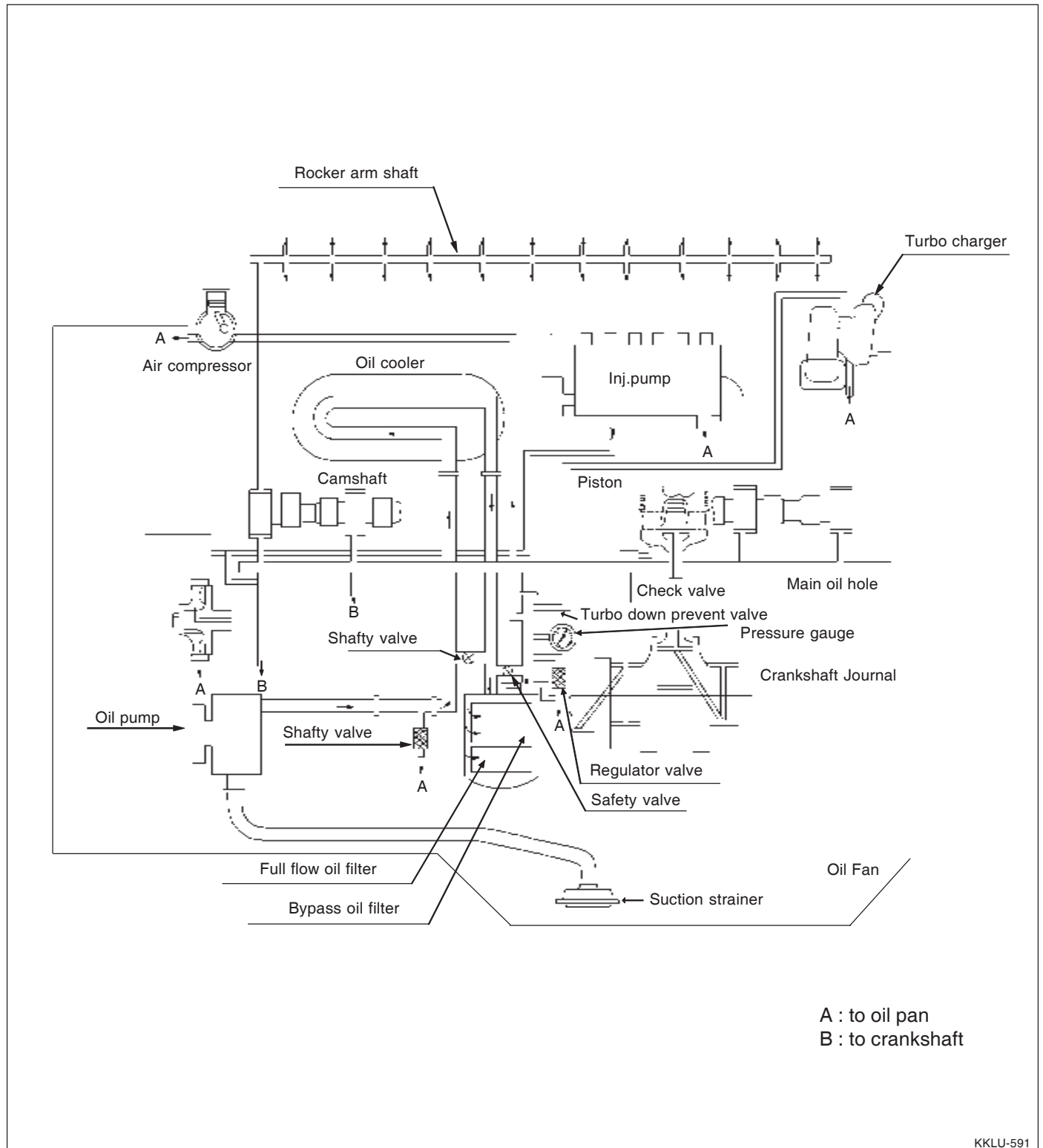
Symptom	Possible cause	Remedy/Prevention
Rough idling	Engine body • Improper valve clearance • Improper contact of valve seat • Idling speed too low • Compression pressure of cylinders markedly different from one another	• Adjust valve clearance. • Replace or repair valve and valve seat. • Warm up engine. • Overhaul engine.
	Cylinder head gasket • Fatigued gasket (aging) • Damage • Improper installation	• Replace gasket. • Replace gasket. • Replace gasket.
Leakage of exhaust gas	Cylinder head bolts • Loose bolts • Elongated bolts • Improper tightening torque or tightening sequence	• Tighten bolt. • Replace bolt. • Tighten properly.
	Cylinder block • Cracking • Surface distortion • Fretting of cylinder liner insertion portion (insufficient projection of cylinder liner)	• Replace cylinder block. • Repair or replace. • Replace cylinder liner or cylinder block.
	Cylinder head • Cracking • Surface distortion	• Replace cylinder head. • Repair or replace.
	Cylinder liners • Cracking • Corrosion • Insufficient protrusion of cylinder liner	• Replace cylinder liner. • Replace cylinder liner. • Replace cylinder liner.
	Other problems • Incorrect injection timing	• Adjust injection timing.

LUBRICATION SYSTEM

GENERAL	LU- 2
SPECIFICATIONS	LU- 3
SERVICE STANDARD	LU- 4
SERVICE PROCEDURES	
Oil Pump and Oil Strainers	LU- 7
Oil Filter and Oil Cooler	LU- 9
TROUBLESHOOTING	LU-11

GENERAL

Engine lubrication is accomplished by forced lubrication system using gear pump. The engine oil in the oil pan is drawn up through the oil strainer by the oil pump and force-fed to the filter and oil cooler to lubricate all parts.

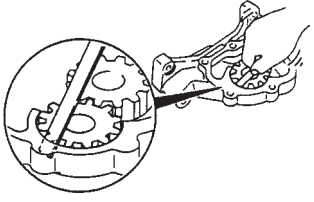
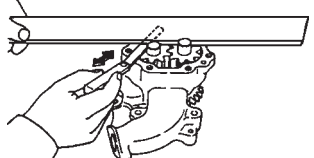
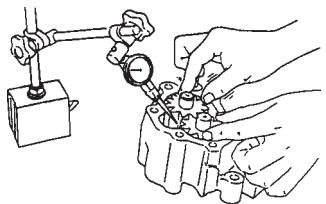
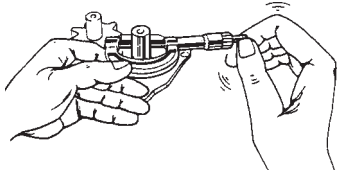
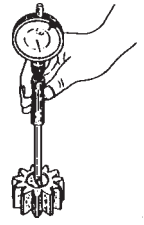


SPECIFICATIONS**LU-3****SPECIFICATIONS**

Items	Specification	Remarks
Lubricating type	Forced circulation with oil pump	
Oil pump	Gear pump	
Relief valve	Plunger valve	
Oil filter	One-piece, element filter	
Oil cooler	Shell and plate type	
Regulator valve	Plunger valve	

LU-4
LUBRICATION SYSTEM
SERVICE STANDARD

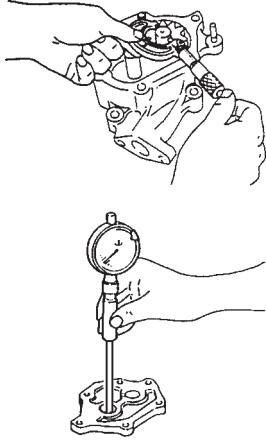
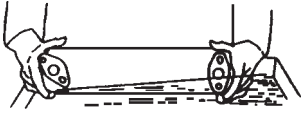
Unit : mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Cleaerance between gear and case	0.075-0.135	0.17	-	 KKLU-194
Gear end play	0.050-0.095	0.15	-	 KKLU-195
Gear backlash	0.073-0.207	0.40	-	 KKLU-196
Clearance between driven gear and shaft	0.040-0.083	-	-	  KKLU-197

SERVICE STANDARD

LU-5

Unit : mm (in)

Inspection Item	Standard	Limit	Remedy	Inspection Procedure
Clearance between drive shaft and oil pump cover	0.040-0.085	-	-	 KKLU-198
Oil cooler air tightness air pressure : 6kg/cm ² (85.3 lb/sq.in)	-	-	Replace, if necessary	 KKLU-202

LU-6

LUBRICATION SYSTEM

Tightening torque

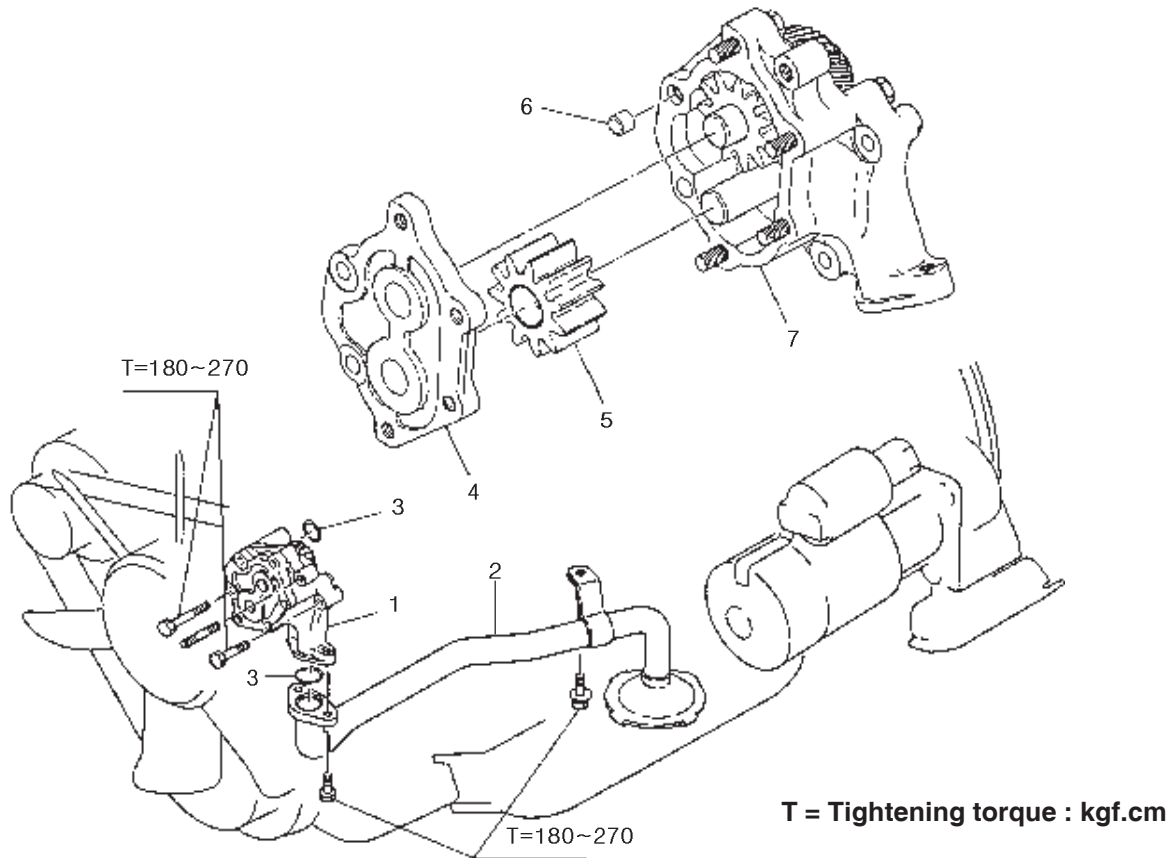
Unit : kg·m

Items	D6DA		Remarks
	Size	Torque	
Oil pump cover bolt	M8 x 1.25	1.8~2.7	
Oil cooler nut	M8 x 1.0	1.0~1.5	
Oil filter cartridge	M38 x 1.5	4.0~5.0	
Oil cooler bypass valve	M22 x 1.5	3.0~4.0	
Oil jet check valve	M12 x 1.5	2.7~3.2	
Main relief valve cylinder (Cylinder block side)	M28 x 1.5	8.0~12.0	
Regulator valve	M22 x 1.5	3.0~4.0	
Oil cooler plug	M20 x 1.5	2~3	

SERVICE PROCEDURES

Oil Pump and Oil Strainers

COMPONENTS



1. Oil pump
2. Oil strainer
3. O-ring
4. Oil pump cover

5. Rotor
6. Collar
7. Oil pump body assembly

KKLU-189

Installation

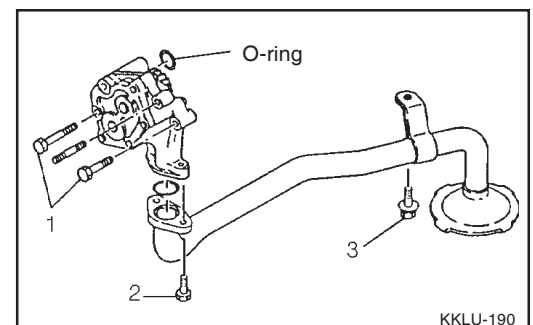
Oil strainer installation

Oil strainer

1. Fasten bolts 1,2 and 3 tentatively.
2. Center cylinder block with the bolt hole of the bracket.
3. Fasten the bolt 3 tentatively.
4. Fasten the bolts 1,2 and 3 with the specific torques.

CAUTION

Make sure whether the O-ring is installed securely.
Apply the oil when inserting O-ring.



KKLU-190

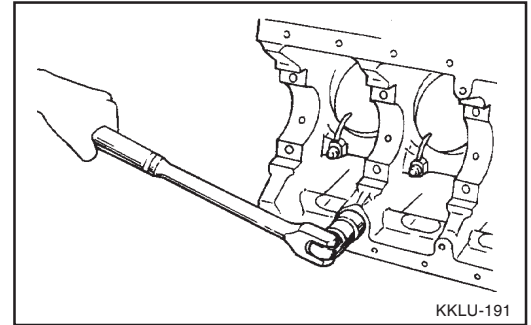
LU-8

LUBRICATION SYSTEM

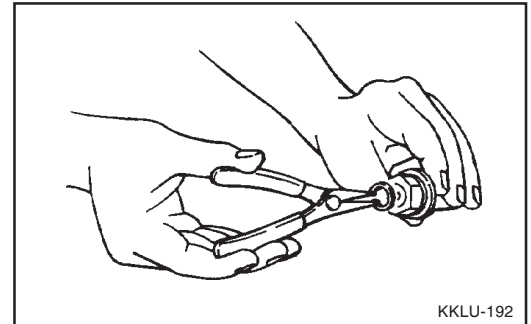
Assembly

Disassemble and inspect the safety valve of oil pump, if needed.

1. Remove safety valve from the cylinder block.

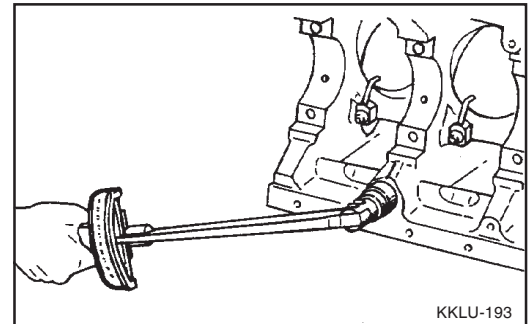


2. Disassemble safety valve after removing retainer ring.



3. Install the valve, spring, seat and retainer ring orderly.
4. Install the safety valve to the cylinder block.

Tightening torque: 800-1200

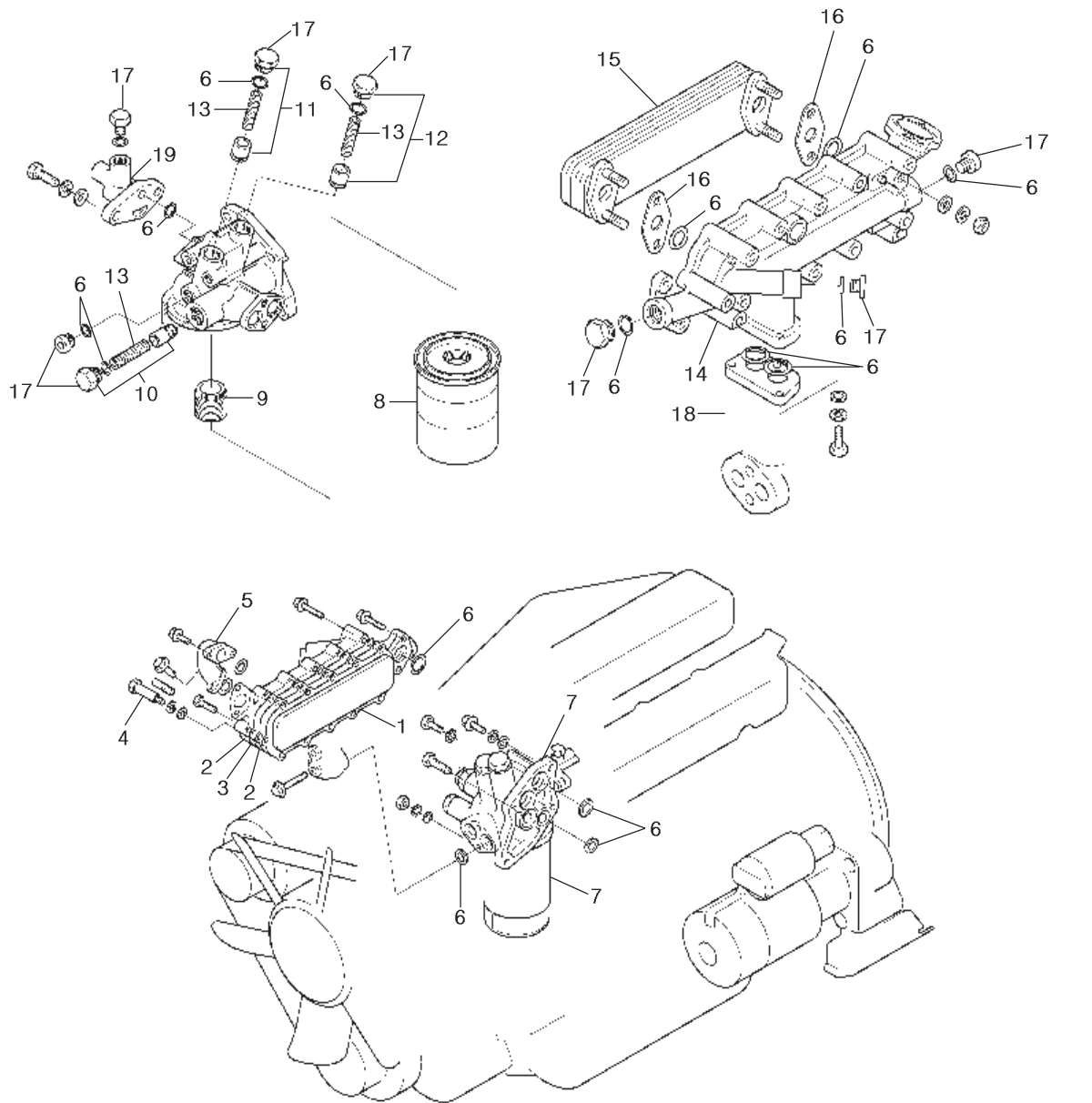


SERVICE PROCEDURES

LU-9

Oil Filter and Oil Cooler

OVERHAUL



- | | | |
|---------------------------|------------------------------|------------------------------------|
| 1. Oil cooler | 8. Oil filter element | 15. Oil cooler element |
| 2. Oil cooler case gasket | 9. Center Bolt | 16. Gasket |
| 3. Water gallery color | 10. Oil cooler safety valve | 17. Plug |
| 4. Reamer bolt | 11. Oil filter safety valve | 18. Oil pipe |
| 5. Coolant pipe | 12. Pressure regulator valve | 19. Turbocharger oil one-way valve |
| 6. O-ring | 13. Spring | |
| 7. Oil filter assembly | 14. Oil cooler case | |

LU-10

LUBRICATION SYSTEM

Disassembly

Remove the oil filter element

Using special tool, loosen the nuts of oil filter and oil cooler.

Special tool: Wrench

Assembly

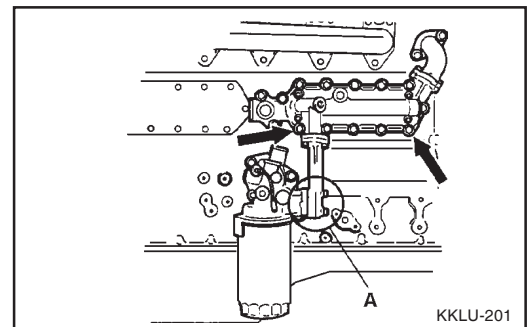
Oil filter element installation.

1. Apply some oil to the new filter gasket.
2. Fasten the new filter by hand until the gasket touches the cover.
Then, using special tool, fasten it again by 1/4 – 1 rotation.

Special tool: Wrench

Install the oil cooler assembly.

1. Fasten the 2 reamer bolts.
2. When the gap between oil pipe and oil filter (A) becomes 0.5 mm or less, fasten another bolts.



TROUBLESHOOTING

Symptom	Probable cause	Remedy	Remarks
Does not increase oil pressure	Low oil level • Oil leakage in the cooling system • Oil leakage	Repair and add oil	
	Poor oil viscosity • Oil aging • Fuel added in oil	Replace	
	Faulty oil pressure switch	Replace	
	Clogged oil filter element	Replace element	
	Clogged oil strainer, Loosen oil line connector, pipe crack faulty of relief valve and by pass valve	Repair or replace	
	Abrasion or damage in oil pump	Replace	
Excessive oil consumption	Oil leakage in engine	Repair or replace	Refer Engine Body
	Oil leakage in crankshaft oil seal	Repair or replace	
	Oil leakage in cooling system • Defect of water jacket in oil cooler	Repair or replace	
	Abnormal compression	Check compression	Refer Engine Body

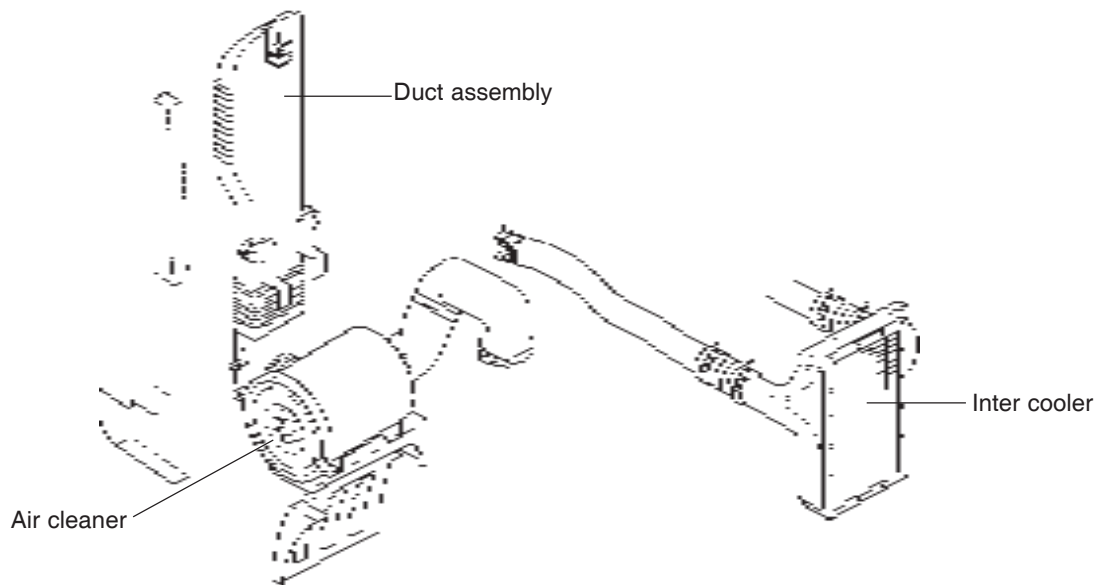
INTAKE AND EXHAUST

GENERAL	IE - 2
SPECIFICATIONS	IE - 5
SERVICE STANDARD	IE - 6
SPACIAL TOOLS	IE - 7
SERVICE PROCEDURES	
Air Intake and Exhaust System	IE - 8
Air Cleaner and Duct	IE-11
Muffler	IE-15
Turbo Charger	IE-17
TROUBLE SHOOTING	IE-21

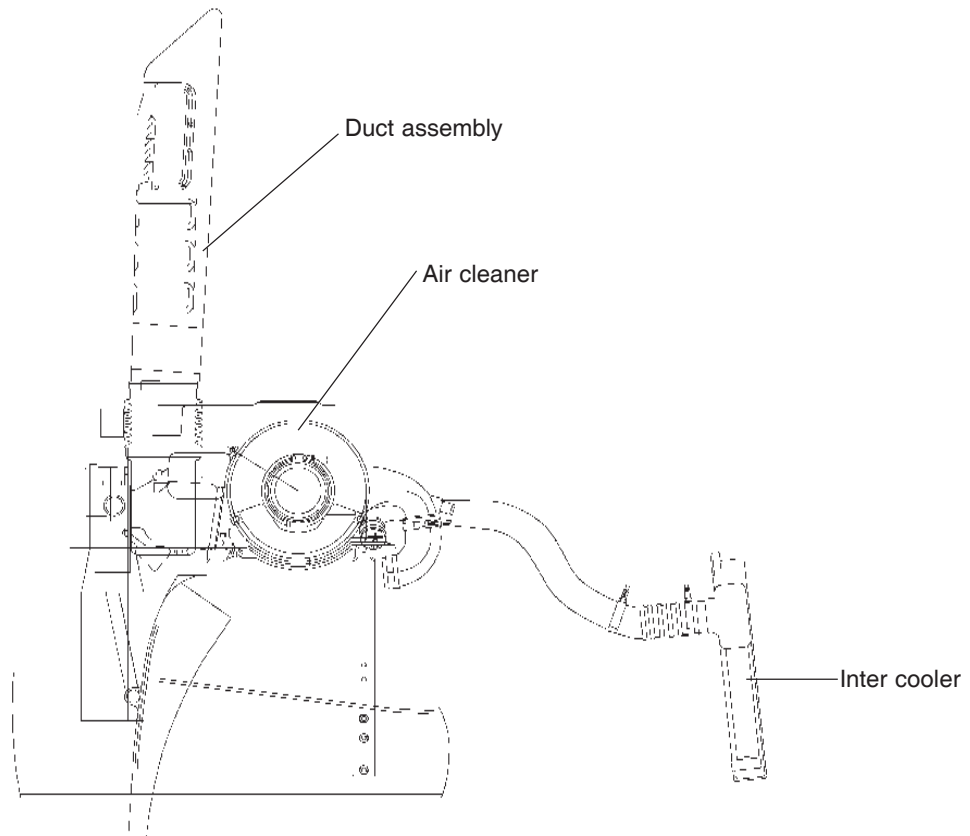
GENERAL

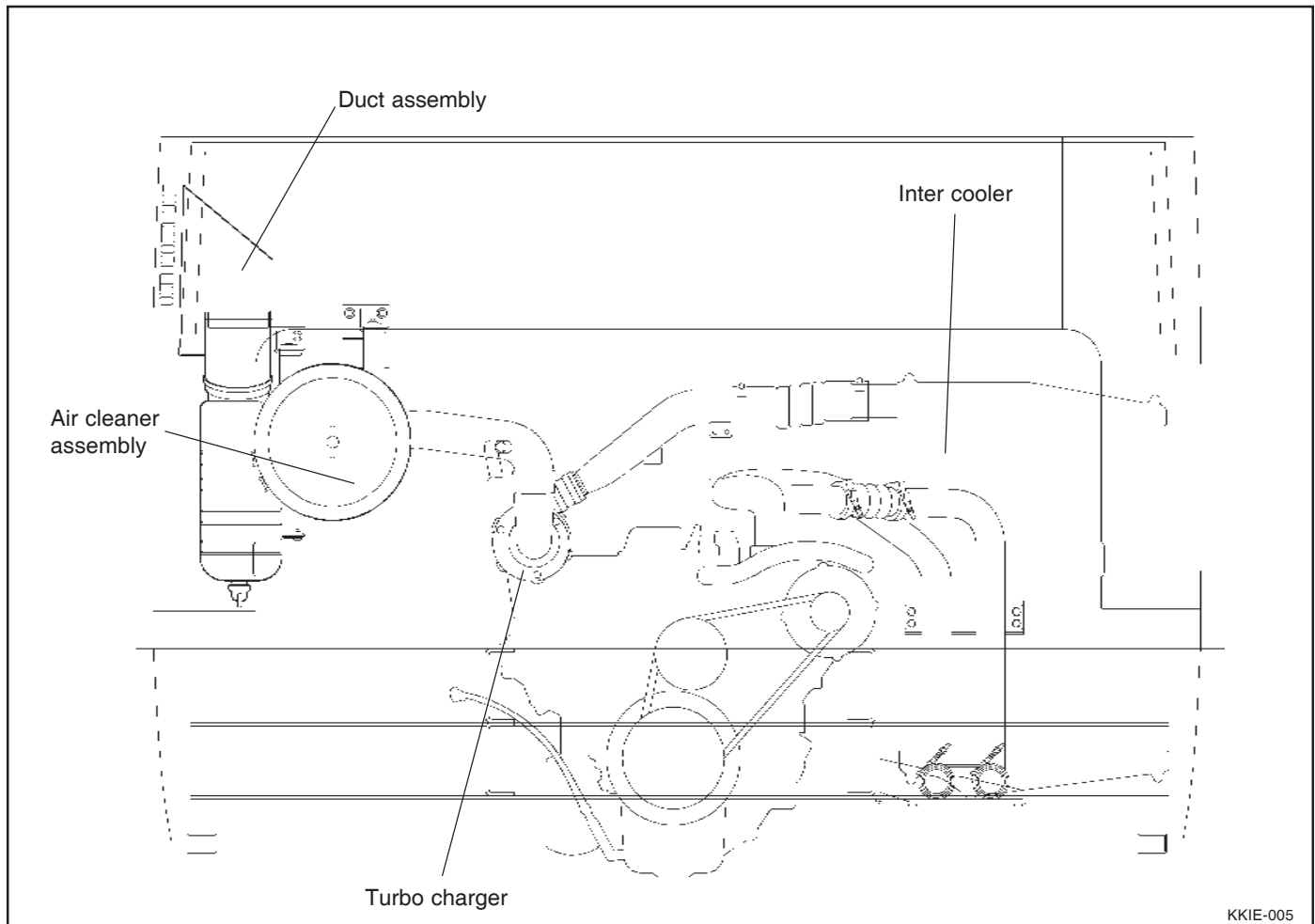
Air Intake System

<5ton>



<8ton>

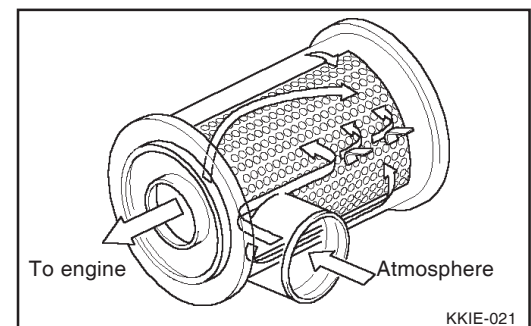


Aero town**Paper element type**

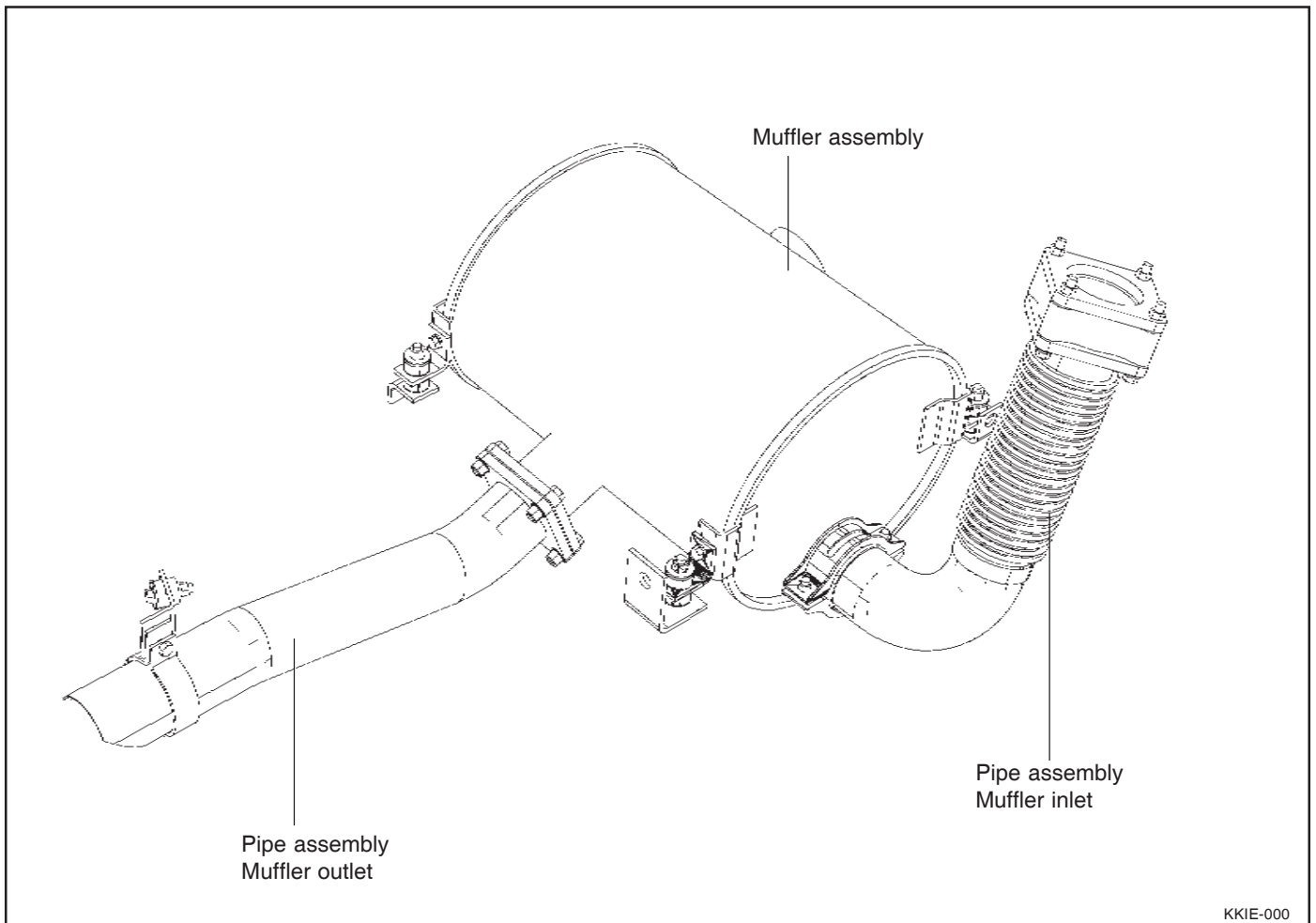
The paper filter is plastic coated and heat treated for better water and oil resistance.

The incoming air is whirled by the guide vanes or blades at a high speed and the larger particles of dusts are centrifugally separated by the "cyclone effect". The smaller particles of dusts are eliminated by the filter paper element, and the air filtered clean is sucked by the engine.

The double-element type of paper element air filter is optionally available. The inner element of this type should not be removed unless the filter replaced. The air cleaner for buses has a resonant chamber at its top to reduce noise.



Aero town



SPECIFICATIONS

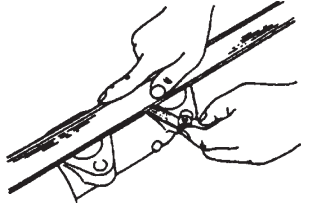
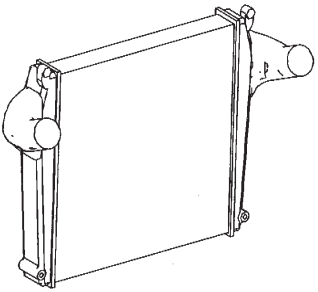
IE-5

SPECIFICATIONS

Engine model	D6DA	Remarks
Air cleaner type	Dry air cleaner type	
Element type	Paper type	
Super charger	Turbo charger	Water cooled

SERVICE STANDARDS

Unit : mm

ITEM	STANDARD	LIMIT	REMEDY	REMARK
Flatness of intake manifold	Less than 0.1	0.50	Grind or replace : Grind limit : 0.05mm each flange	
Abrasion or damage of exhaust manifold	-	-	Grind or replace	
Air leakage in inter cooler	Doesn't have any air leakage in 2.0kg/mm ² air pressure	-	Replace intercooler	
Clogged intercooler pin	-	-	Clean	

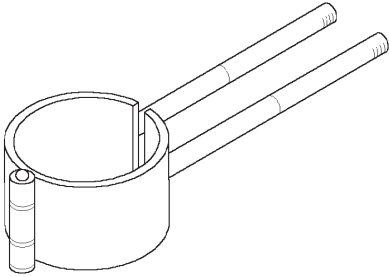
KKIE-248

KKIE-771

SPECIAL TOOLS

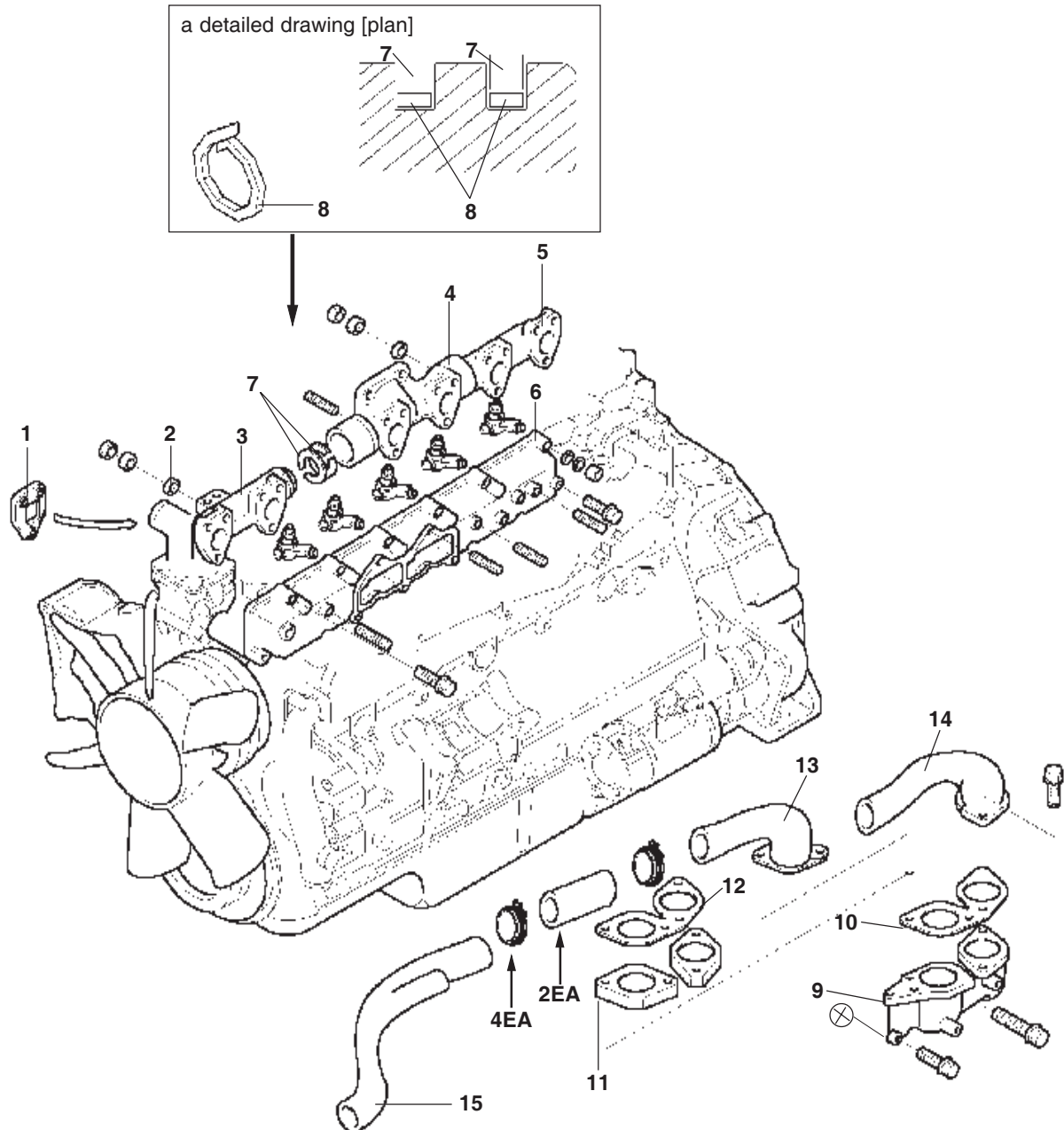
IE-7

SPECIAL TOOL

NAME	PARTS	ILLUSTRATION	USE
Exhaust manifold compression ring clamp	09285-8Y000	 KKST-024	Using exhaust manifold ring compression

SERVICE PROCEDURE

Air Intake and Exhaust System



1. Exhaust manifold gasket
2. Spacer
3. Exhaust manifold front
4. Exhaust manifold middle
5. Exhaust manifold rear
6. Intake manifold

7. Exhaust manifold seal ring
8. Expand ring
9. Intake pipe joint
10. Air heater gasket (wire mesh)
11. Air heater
12. Air heater gasket

13. Intake elbow 1
14. Intake elbow 2
15. Intake elbow pipe

SERVICE PROCEDURE

IE-9

Installation

Intake Pipe Installation

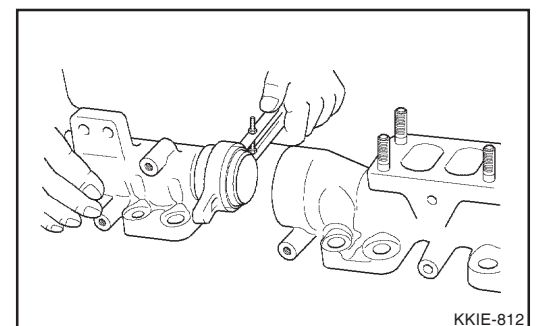
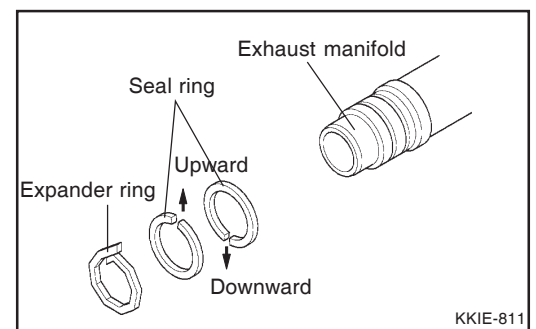
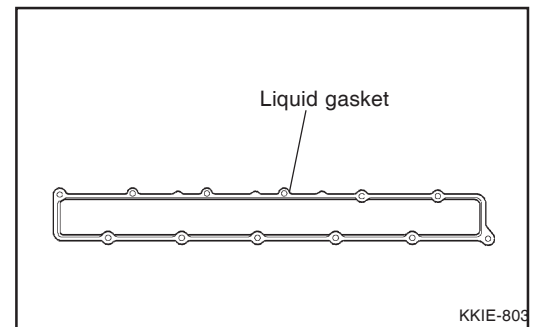
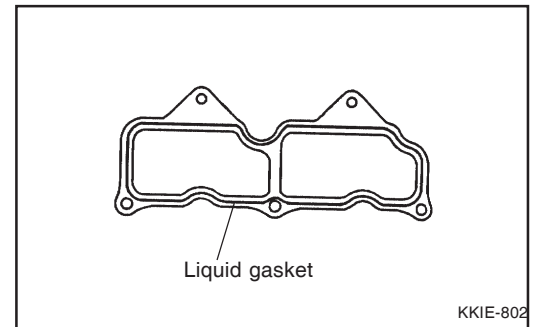
Install the intake manifold.

Exhaust Manifold Assembly (Assembly Type)

1. As shown in the seal ring installation to the exhaust manifold, install them by keeping the same distance between seal rings to prevent the leak of gas and oil.

Special tool: Exhaust manifold compression ring clamp (09285 – 8Y000)

- Assemble expander ring and seal ring to the ring groove.
(The expander ring to inside and the seal ring to outside)



IE-10

INTAKE AND EXHAUST

Exhaust manifold Installation

1. Install the gasket at the right place of exhaust manifold.

CAUTION

Put the gasket as the “HEAD” mark faces the opposite direction of exhaust manifold.

2. Install the spacer at the right place as shown in the figure.
Corresponding cylinder number.

Manifold Combination	Assembling method
I	Except 7 and 9
II	7, 9

3. Fasten the flange nut by hands.

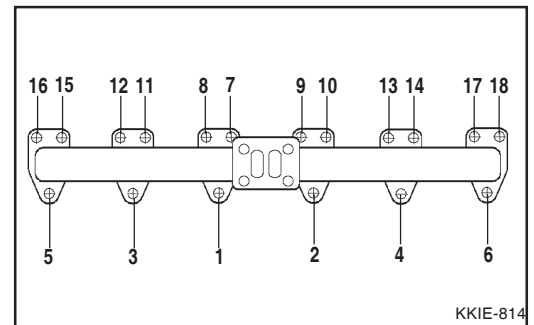
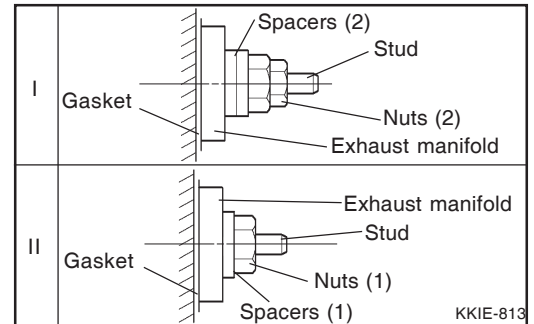
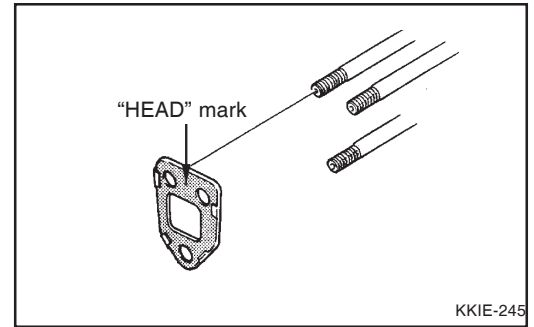
CAUTION

When fastening flange nut, assemble the spacer carefully not to touch the machined parts of the flange (A).

4. Fasten the flange nuts orderly and gradually (3 steps) and fasten the nuts with the specified torque at the final stage.

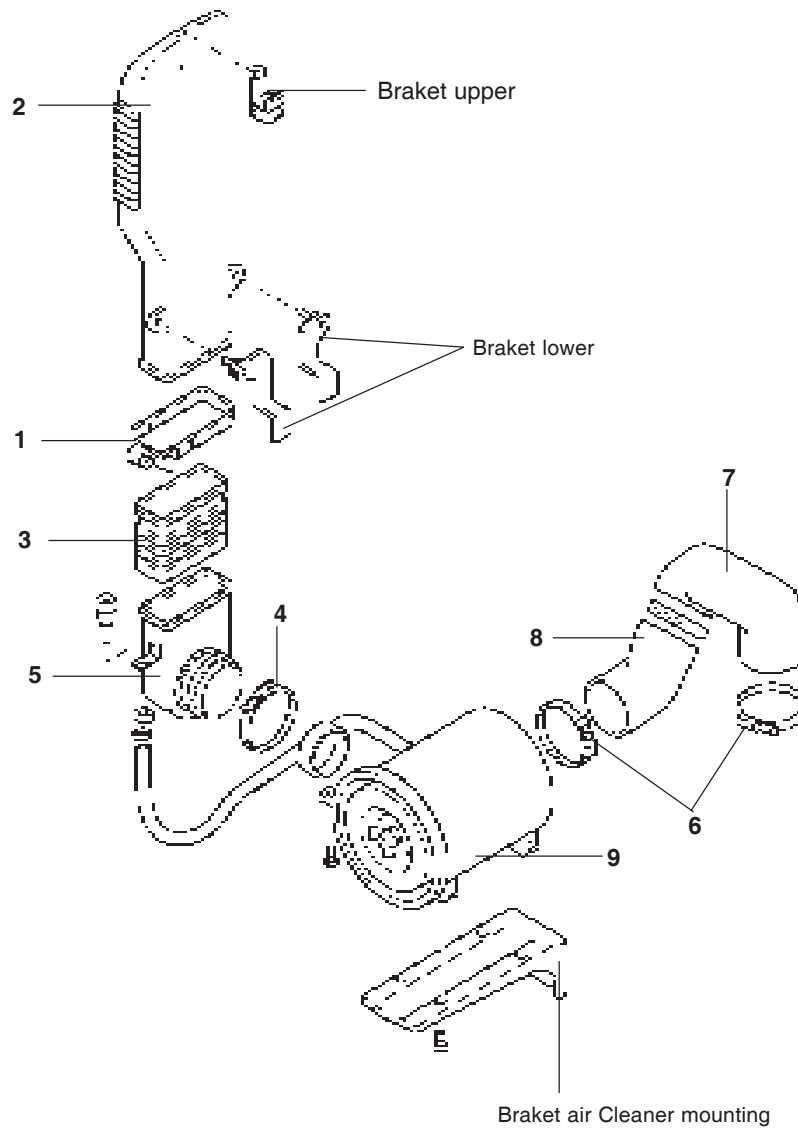
Tightening torque: 300-350 kgf-cm

5. Fasten lock nuts.



Air Cleaner and Duct

<5ton>

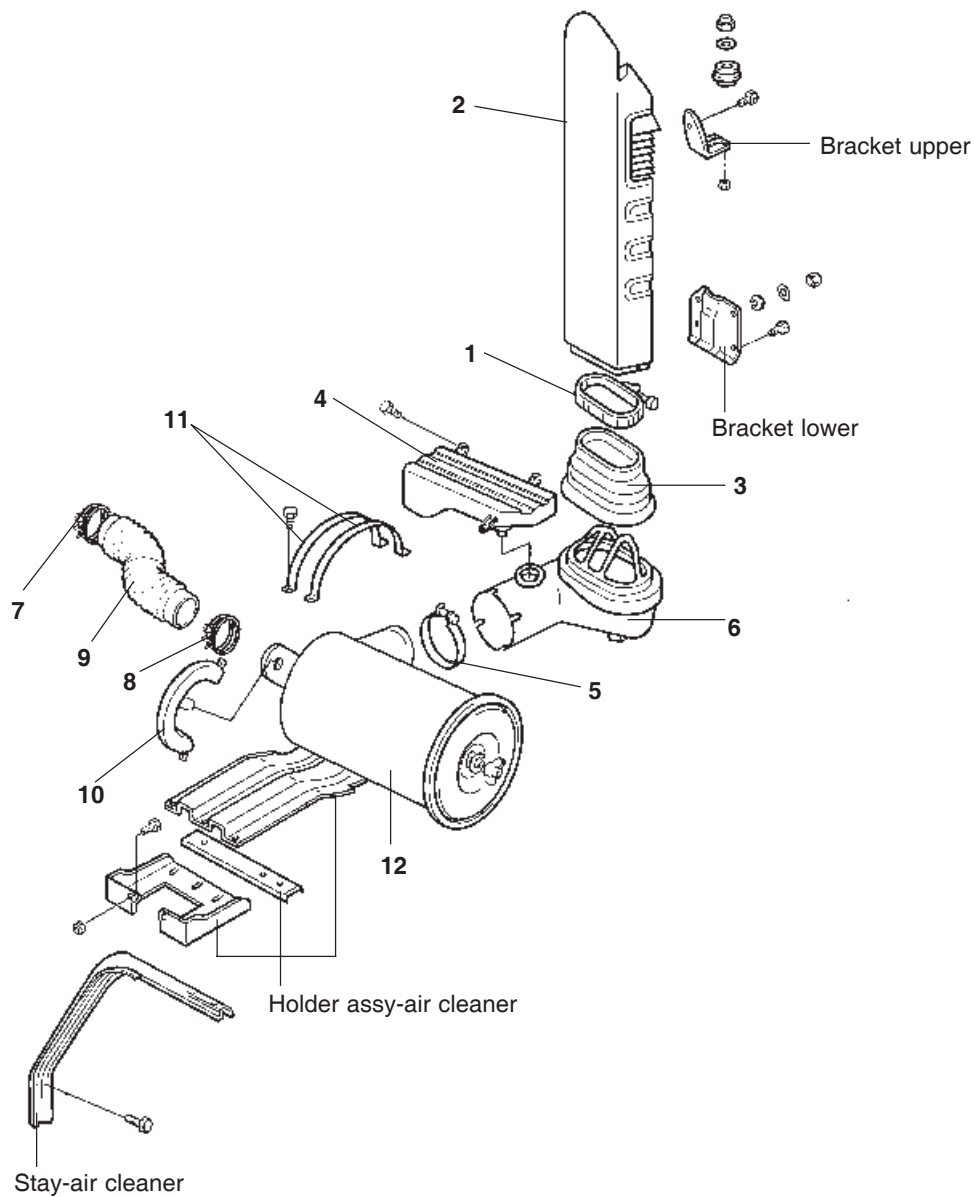


Disassembly

1. Clamp-Boot
2. Duct assembly
3. Rubber-Boot
4. Clamp
5. Duct assembly air Cleaner lower
6. Clamp
7. Duct hose turbo charger
8. Hose-air cleaner duct
9. Air cleaner assembly

*Reassembly is the reverse of disassembly procedure.

<8.5ton>

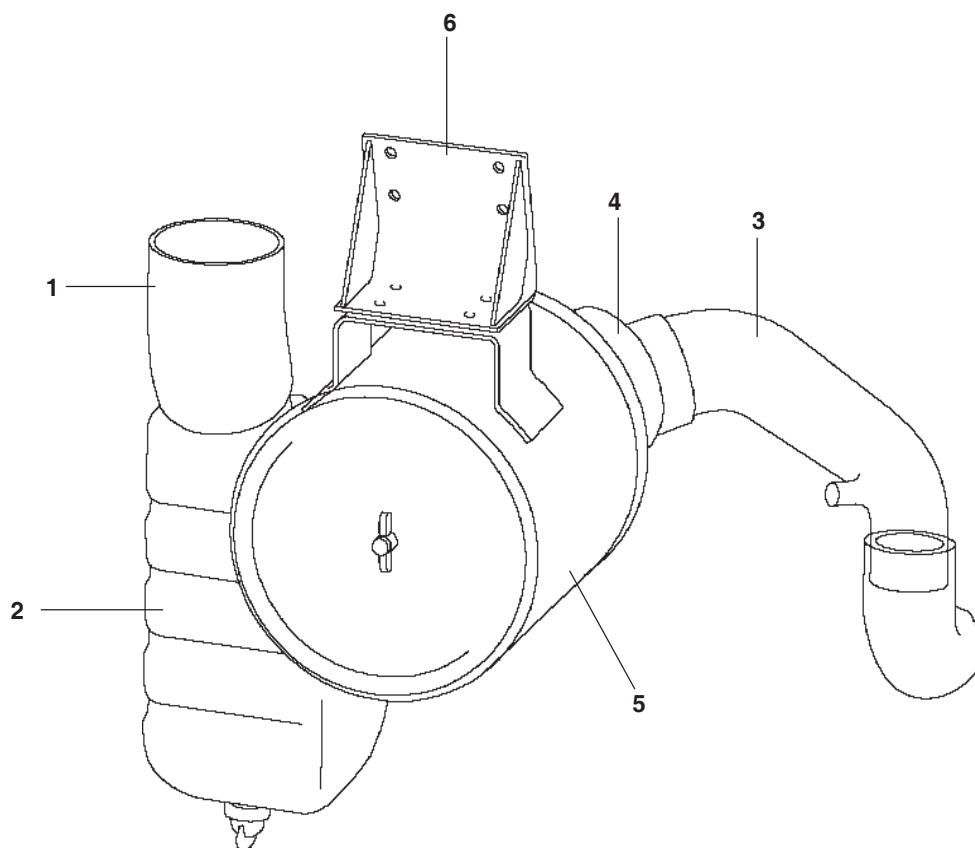


Disassembly

- | | |
|------------------------|-------------------------------|
| 1. Clamp-boot | 8. Clamp hose |
| 2. Duct assembly upper | 9. Hose-air cleaner to engine |
| 3. Rubber-boot | 10. Resonator-rear |
| 4. Resonator front | 11. Band air cleaner |
| 5. Clamp hose | 12. Air cleaner assembly |
| 6. Duct assembly lower | |
| 7. Clamp hose | |

*Reassembly is the reverse of disassembly procedure.

<Aero Town>

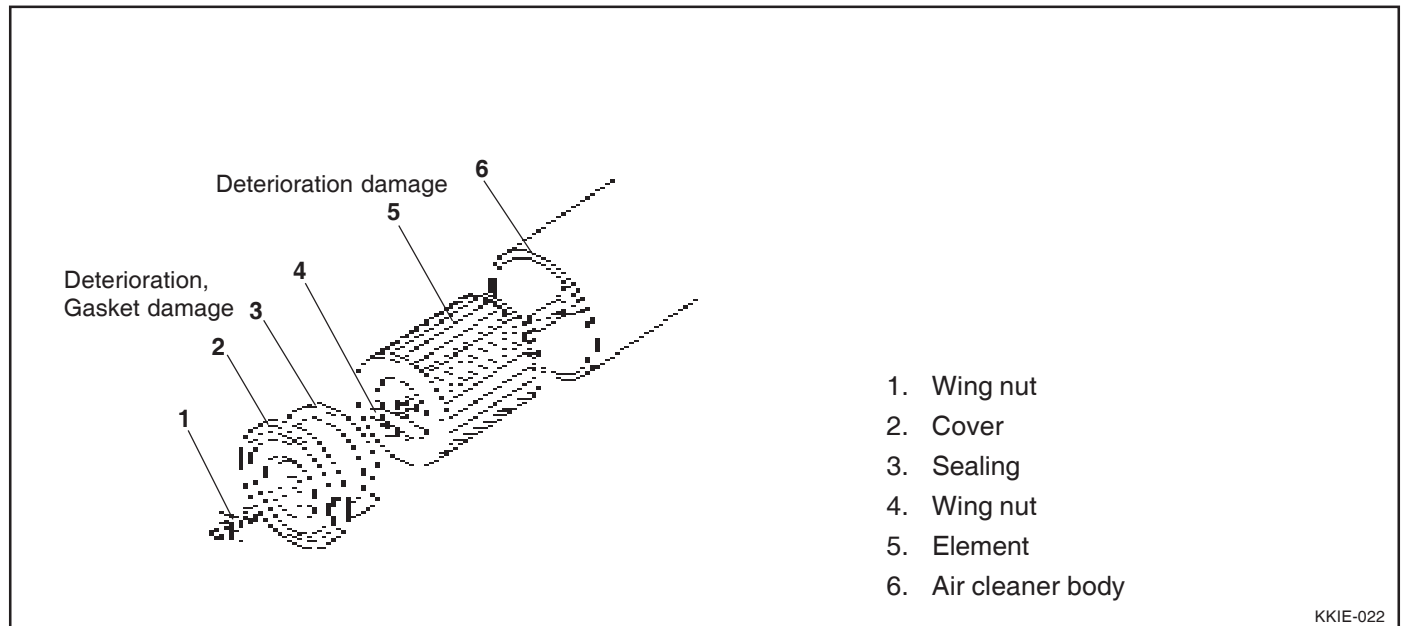


Disassembly Procedure

1. Hose-duct to free cleaner
2. Free cleaner assembly
3. Duct air outlet
4. Hose-air cleaner to engine
5. Air cleaner assembly
6. Holder-air cleaner

*Assembly is the reverse of disassembly.

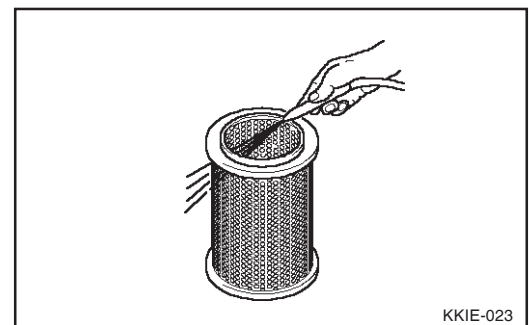
Air Cleaner



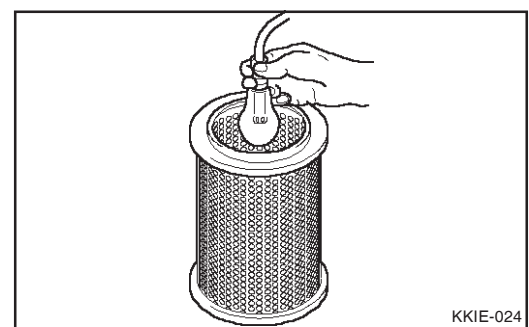
- When there is dry dust on the element
If there is dry dust on the element, clean the dust by blowing 100 PSI {7 kgf/cm²} or lower compressed air against the element. Blow the compressed air from inside the element up and down along the frills of the filter paper and clean the whole element evenly.

NOTE:

- Do not strike the element or strike it against other object to remove dust.
 - Do not blow compressed air from outside the element.
- When there is moist dust on the element
If the element is contaminated with moist soot, replace it regardless of the specified replacement frequency.

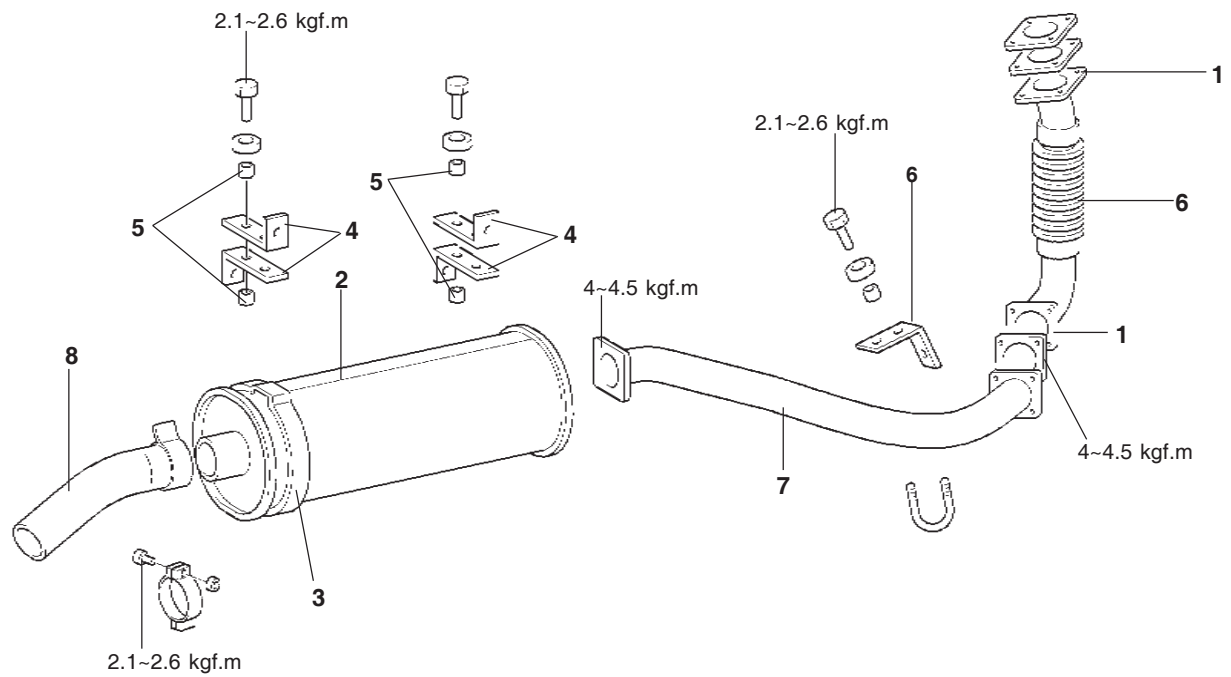


- Inspection of element
After the element has been cleaned, put an electric lamp inside the element to check for damage and pin holes. If there are thin portions in the filter paper, replace the element. If the packing on the top surface of the element is broken, replace the packing.
- Cleaning of air cleaner body
Clean the inside of the air cleaner body and discharge the deposited dust.



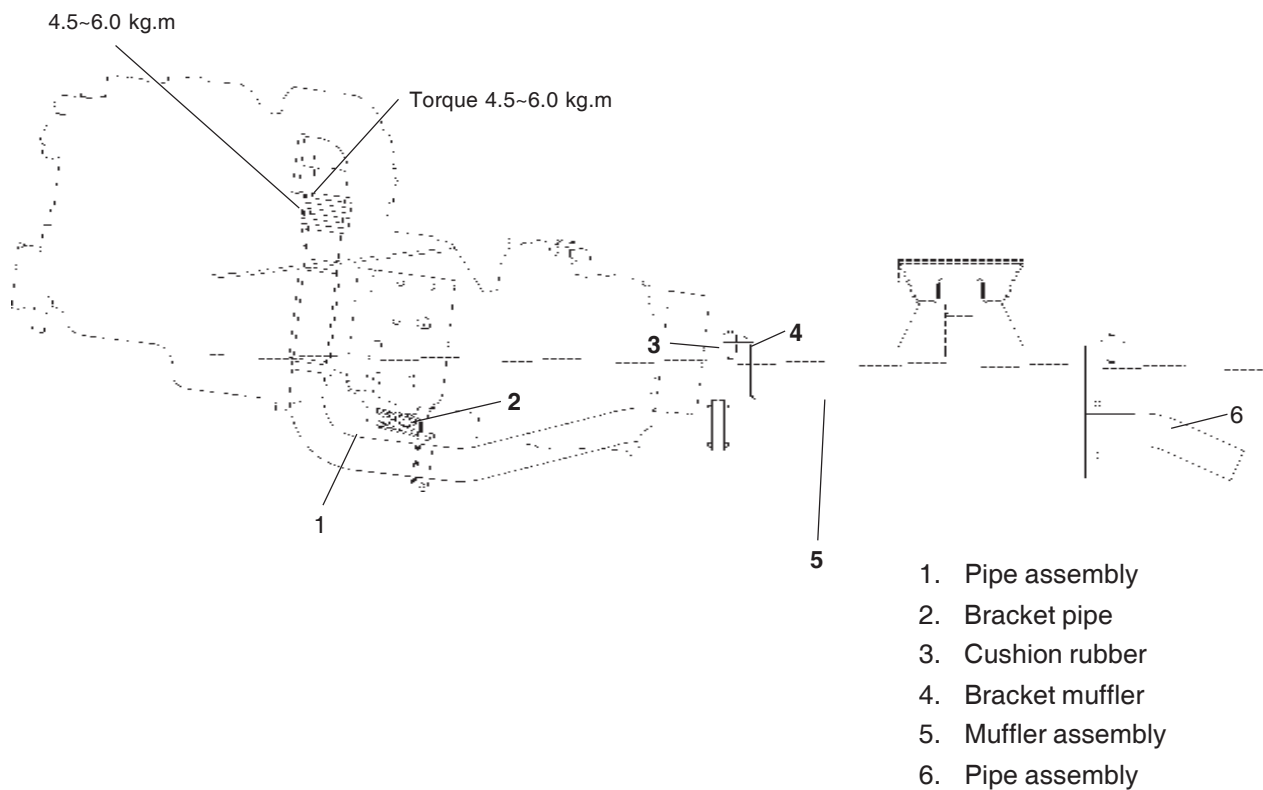
Muffler

<5ton>

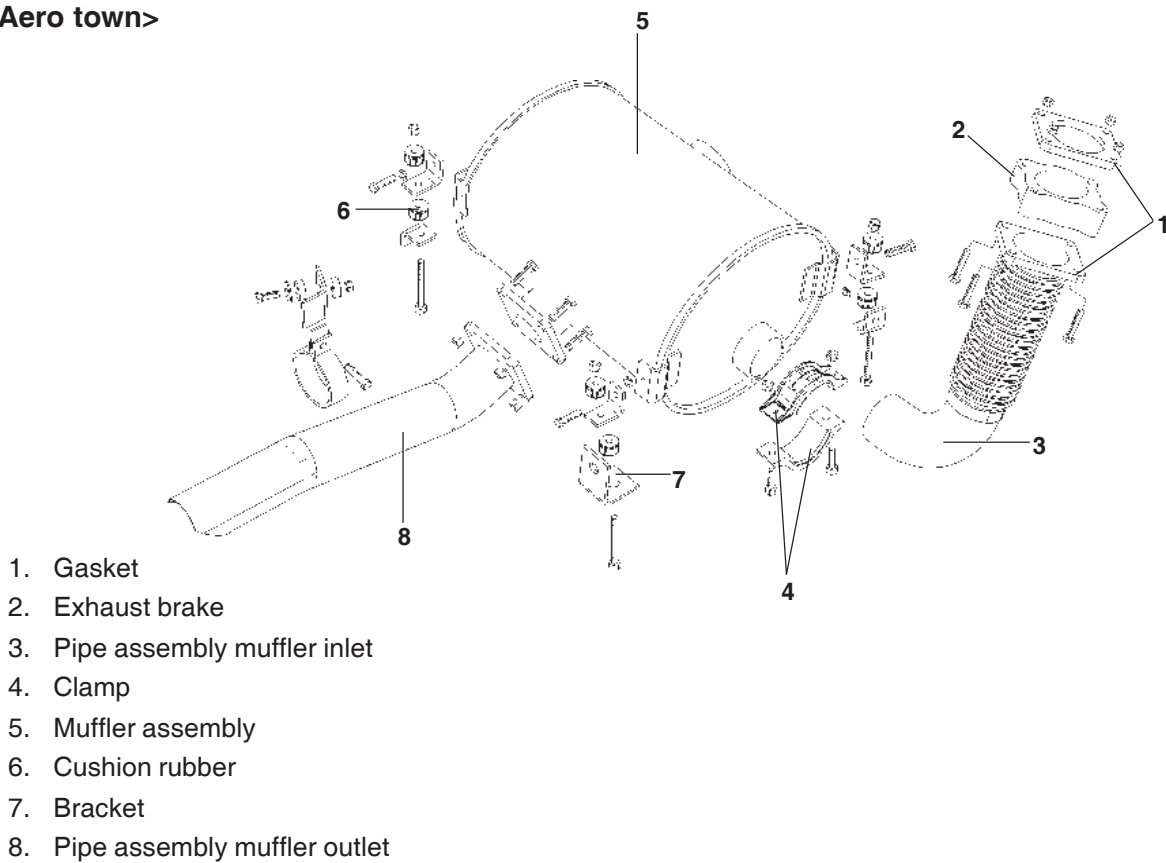


- | | |
|----------------------------|--------------------------------------|
| 1. Gasket exhaust pipe | 6. Pipe assembly - exhaust front "A" |
| 2. Muffler assembly | 7. Pipe assembly - exhaust front |
| 3. Strap muffler | 8. Pipe assembly - tail |
| 4. Bracket-muffler support | |
| 5. Cushion rubber | |

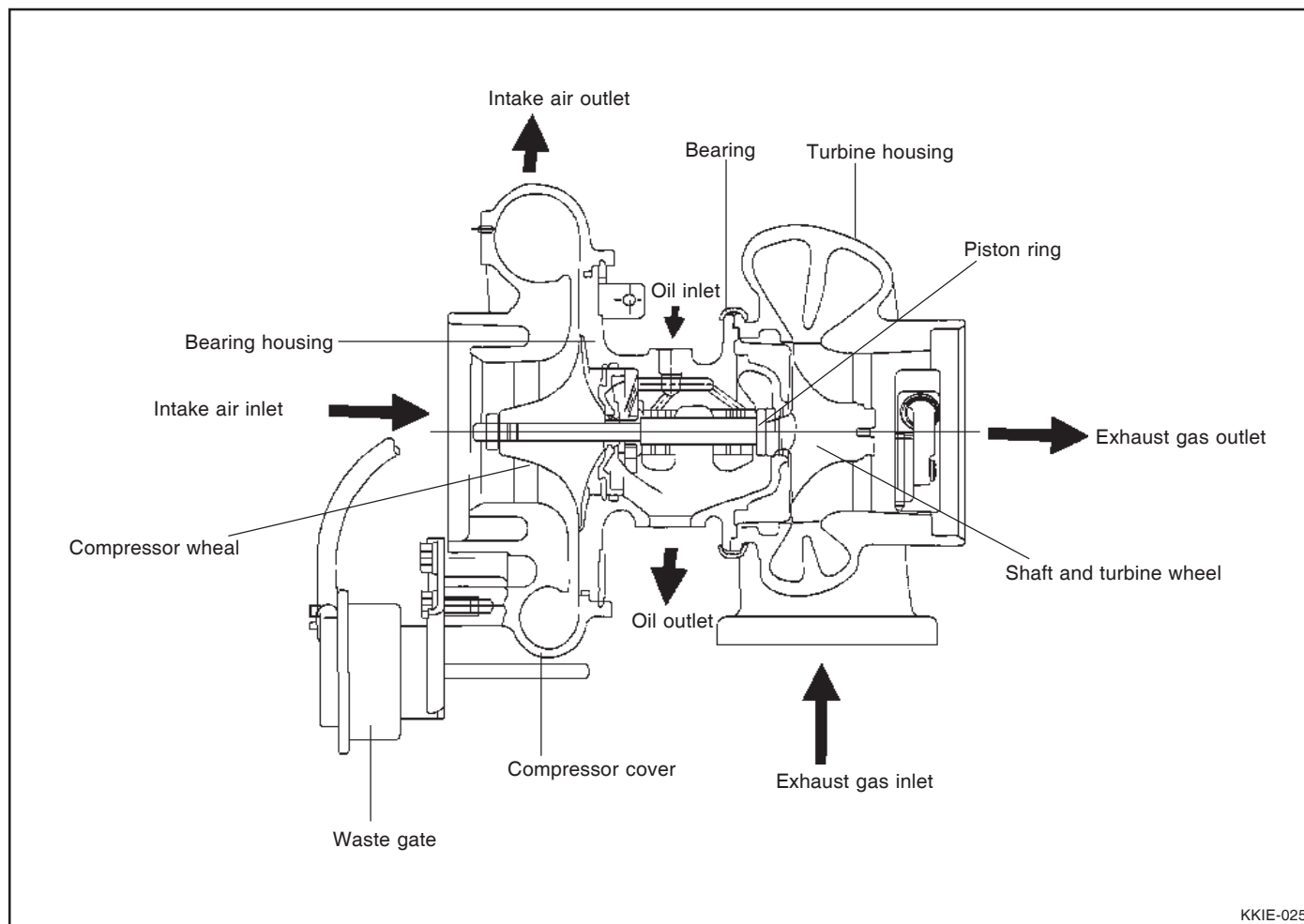
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Turbo Charger



KKIE-025

The turbocharger uses the energy of the exhaust gases to feed more air under pressure into the engine.

The exhaust gases are accelerated in the turbine housing and directed onto the turbine wheel to turn it.

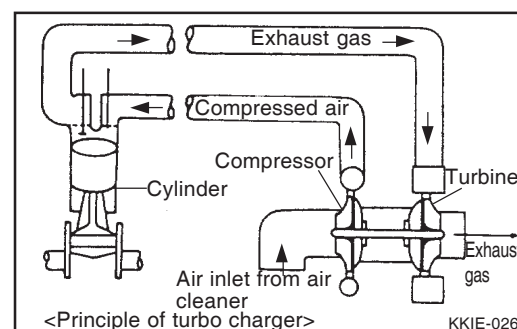
This spins the compressor wheel, which results in the intake air being forced into the engine cylinders.

The turbocharger can be divided into two basic sections: the turbine wheel that is driven by the exhaust gases and the compressor wheel which forces intake air into cylinders.

The shaft connecting the turbine wheel with the compressor wheel is supported in floating type bearings, which absorb vibrations during high speed operation that are caused by slight imbalance of the shaft.

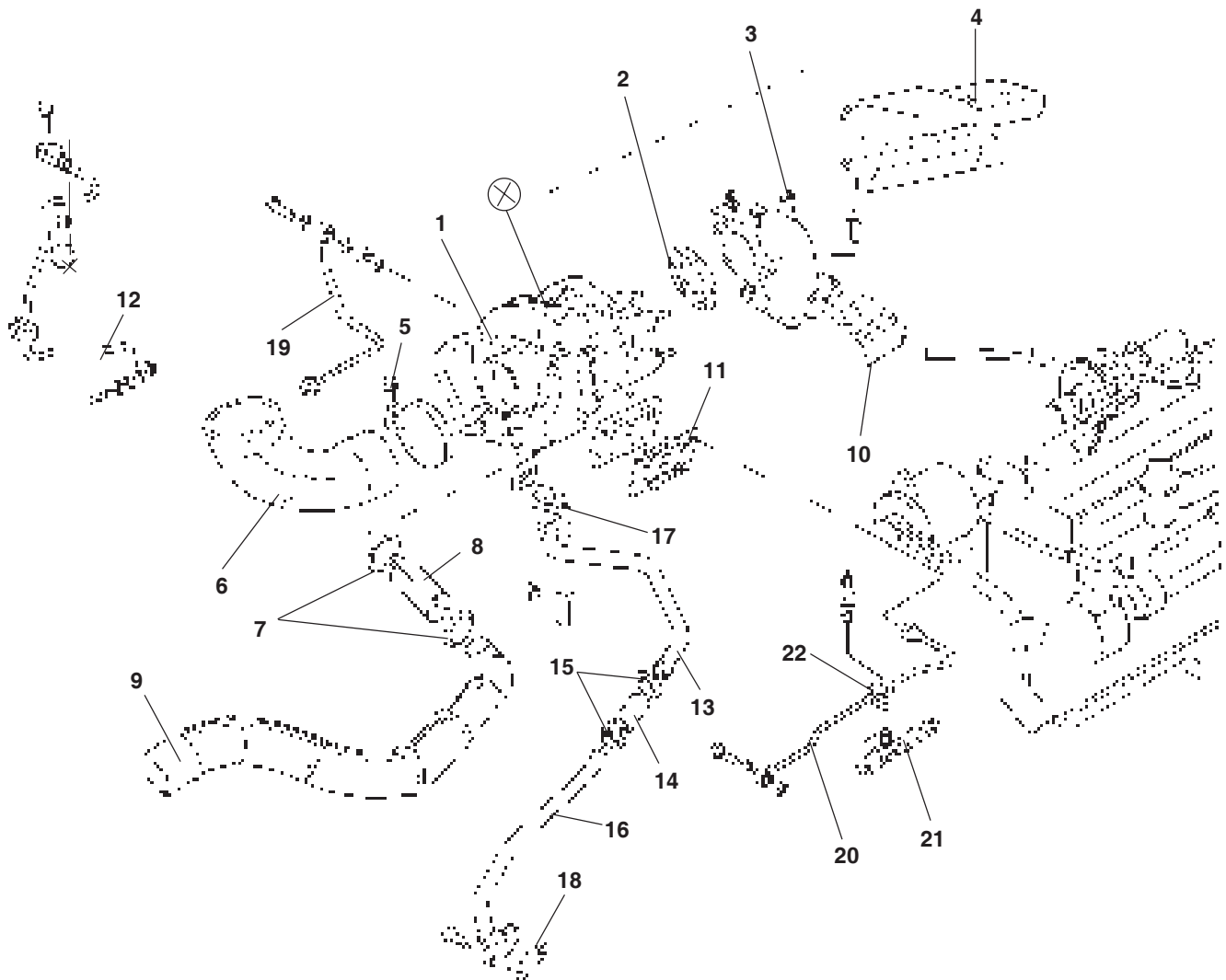
The shaft axial load is borne by the thrust bearing.

The bearing housing has its inside cooled and lubricated by engine oil to prevent seizure and other troubles of the sliding parts.



KKIE-026

Turbo Charger Disassembly



- | | | |
|----------------------------|--------------------------|--------------------|
| 1. Turbo charger | 10. Bracket-joint pipe | 19. Pipe-water in |
| 2. Gasket-joint pipe | 11. Turbo gasket-charger | 20. Pipe-water out |
| 3. Joint pipe | 12. Pipe-oil inlet | 21. Bracket-pipe |
| 4. Insulator turbo charger | 13. pipe-oil out No.1 | 22. Holder-pipe |
| 5. Clamp hose | 14. Hose-oil pipe | |
| 6. Air inlet hose | 15. Clamp | |
| 7. Clamp-hose | 16. Pipe-oil out No.2 | |
| 8. Hose-turbo charger | 17. Gasket-upper | |
| 9. Pipe-inter cooler in | 18. Gasket-lower | |

Management Instructions

Attentions in driving

1. Check the engine oil level, and check whether the oil pressure increases normally after engine start.
2. Avoid from sudden start or acceleration immediately after engine start and drive the vehicle after enough idling.
3. If abnormal conditions like strange noise, vibration, output decrease or excessive smoke, pull over the car and check the car.
4. Stop the engine after enough idling instead of stopping the engine immediately after pull over. (Sudden engine stop may damage the turbo charger)

CAUTION

If the car is driven without air-cleaner filter, dust and dirt may cause a detrimental damage to engine and turbo-charger. Check and replace the oil periodically since oil deficiency, oil deterioration and pollution are critical causes of engine and turbocharger defect. If the car is started or accelerated suddenly after start, or engine is stopped immediately after pull over, oil supply to the turbocharger is discontinued to cause the bearing melting inside the turbocharger, which rotates with high speed (90,000 – 100,000 rpm). Therefore, perform enough idling.

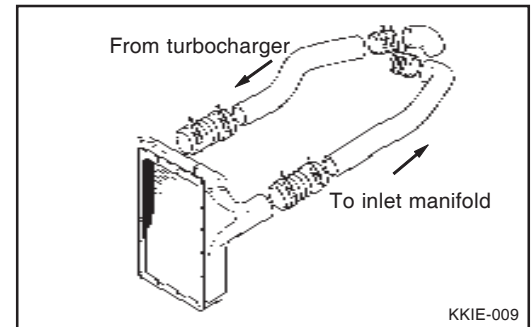
Treatment instruction

1. Use the genuine parts when replacing air cleaner and engine oil filter.
2. Clean and change the air cleaner filter periodically.
3. As for the engine oil, use the standard oil recommended by our company, which is better or equivalent to API C, D class.
4. Check engine oil leaks or any abnormal noise from turbo-charger frequently.
5. Check the exhaust pipe periodically to prevent gas leak.

Intercooler

The intercooler is the air-to-air heat exchange system using a corrugated-fin heat exchanger installed in front of the radiator. The intake air compressed by the turbocharger to have high temperature is cooled through heat exchange with the atmosphere. The resultant high-density air is sent into the engine cylinders.

This improves the combustion efficiency and as a result, the fuel economy and power output, while reducing harmful exhaust gases to a minimum.



TROUBLE SHOOTING

Sympton	Probalbe cause	Remedy
Low output	Insufficient intake air	
	o Loaded air cleaner element	Clean
	o Air suction (with dust and other foreign matter) from intake system	Repair
	o Defective turbocharger	
	o Intake shutter kept closed	Check
	Low exhaust efficiency	
Whitish and much ex-haust gas	o Deformed front pipe, muffler and/or tail pipe (large exhaust resistance)	Replace
	o Exhaust brake valve kept closed	Adjust
	Incorrect injection timing	Adjust
	Low compression pressure	Check
	Low quality fuel	Replace
	Defective turbocharger	
Dark and much exhaust gas	o Oil leaks due to worn piston ring, and/or insert	Replace
	o Damaged oil seal due to clogged oil return pipe	Replace
	Loaded air cleaner element	Clean
	Trouble in engine proper	Check
	Nonuniform fuel injection amount to cylinders	Adjust
Abnormal noise and/or vibration from intake and exhaust system	Incorrect injection timing	Adjust
	Poor connection of intake and exhaust systems	Correct
	Deformed front pipe, mufler or tail pipe (large exhaust resistance)	Replace
Turbo charger makes abnormal noises and vibration	Rotor rubbing on adjacent parts beacause of worn bearings :	
	o Failure of oil supply-clogged or damaged oil screen and oil line.	Check oil line, condition of oil and oil filter
	o Unadequate oil filtering or solid matter in oil line.	
	o Contaminated oil	
	Unbalaced rotor	Disassemble and repair. Also check air inlet system.
	o Foreign material in air inlet system or exhaust manifold and striking wheel	
	o Bent shaft	

IE-22

INTAKE AND EXHAUST

Sympton	Probalbe cause	Remedy
Engine output decreases.	Excessive exhaust gas leaks	Check specifically exhaust manifold at turbocharger inlet and cylinder head.
	Restricted or deformed muffler	Repair or replace.
	Air leaks from compressor outlet side	Repair or replace.
	Restricted air cleaner	Clean or replace element.
	Dirt accumulation in compressor cover and wheel	Clean.
	Carbon build-up behind turbine wheel	Clean.
Oil leaks in exhaust or air inlet manifolds (white exhaust smoke)	Clogged or crashed oil drain system	Replace.
	Excessive piston ring or ring groove wear	Repair or replace.
	Restricted air cleaner	Clean or replace element.
	Damaged piston rings under operation with worn bearings	Replace.

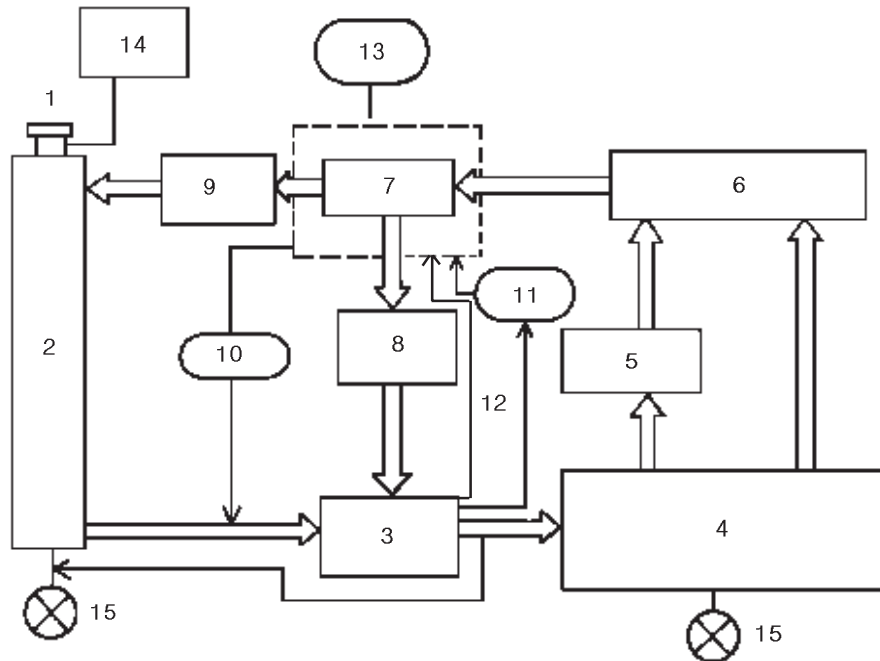
COOLING SYSTEM

GENERAL	CL- 2
SPECIFICATION	CL- 3
SERVICE STANDARD	CL- 4
SERVICE PROCEDURES	
Cooling Pump	CL- 6
Thermostat	CL- 9
Radiator	CL-10
Cooling Fan	CL-11
TROUBLESHOOTING	CL-12

GENERAL

The engine is cooled by forced circulation of coolant by the water pump.

COOLING SYSTEM DIAGRAM



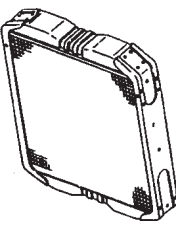
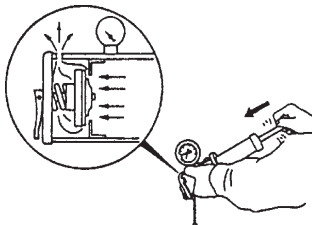
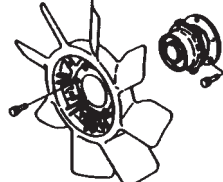
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|-------------------|-------------------------------|-----------------------------------|
| 1. Radiator cap | 6. Cylinder head | 11. Air compressor (If so fitted) |
| 2. Radiator | 7. Thermostat | 12. Turbo charger |
| 3. Coolant pump | 8. Bypass hose | 13. Coolant temperature gauge |
| 4. Cylinder block | 9. Thermostat cover | 14. Reservoir tank |
| 5. Oil cooler | 10. Car heater (If so fitted) | 15. Drain flug |

SPECIFICATION**CL-3****SPECIFICATION**

Item		Specification	Remark
Engine model		D6DA	
Cooling method		Water cooled	
Water pump		Centrifugal type	
Thermostat	Type	Wax pillet type	
	Valve opening temperature	82°C	
Fan operating oil		Silicon oil	

SERVICE STANDARD

Unit : kgf-cm²

Maintenance items		Nominal value	Limit	Remedy	Inspection procedure
Coolant leak		-	-	Radiator replacement	 KKCL-236
Pin clog		-	-	Cleaning	
Opening pressure of radiator cap valve	0.5	0.4-0.6	-	Replacement	 KKCL-237
	0.9	0.75-1.05	-		
Deformation and damage of cooling fan and clutch		-	-	Replacement if necessary	 KKCL-239

CAUTION

Check the opening pressure of coolant filter cap valve written on the cap.

If the cap pressure is not correctly controlled, due to the abnormal high pressure of coolant system, hoses may be disconnected and burnt and engine may be damaged.

SERVICE STANDARD**CL-5****Tightening torque**

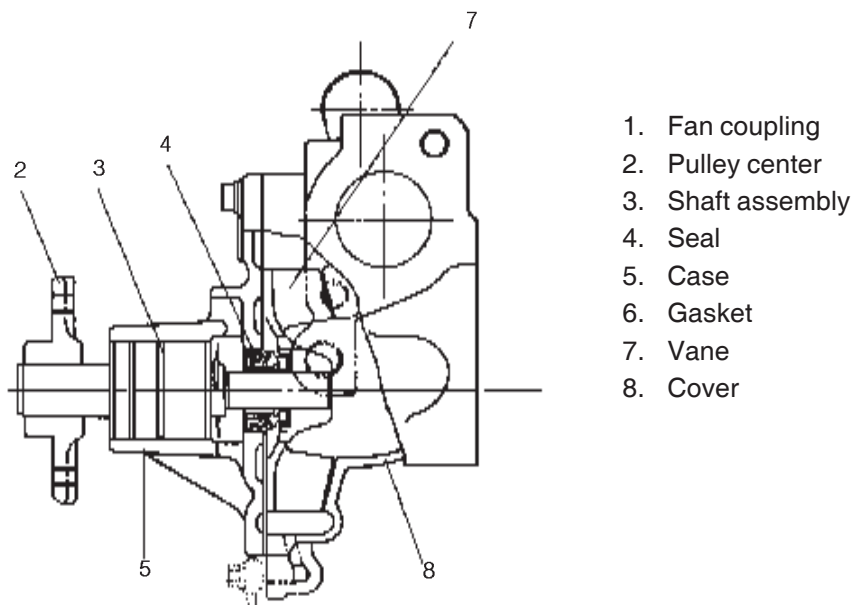
Unit : kg·m

Item	D6DA		Remark
	Size	Torque	
Cooling fan nut and bolt	M8 x 1.25	2.2	
Cooling fan coupling nut and bolt	M10 x 1.5	4.4	
Water pump pulley and nut	M10 x 1.5	4.8	

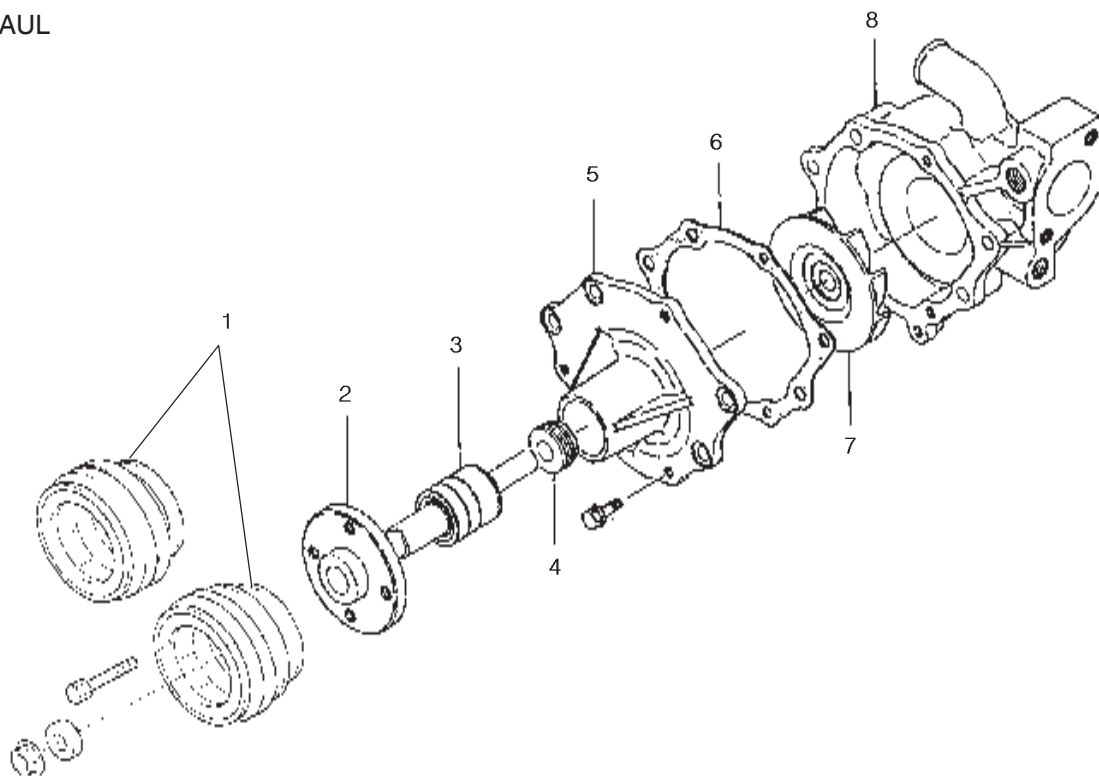
SERVICE PROCEDURE

Cooling Pump

COMPONENTS



OVERHAUL



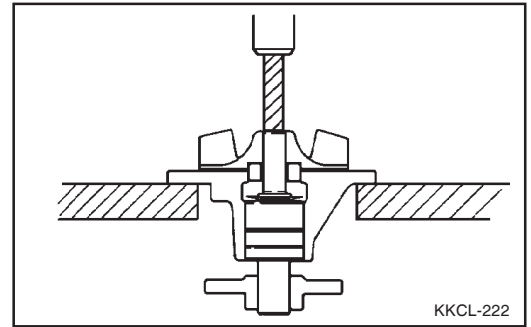
SERVICE PROCEDURE

CL-7

Disassembly

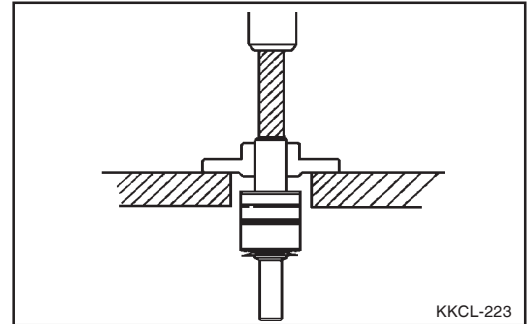
Vane and shaft removal

Using the press, push the shaft end.



Pulley center removal

Using the press, push the shaft end which touches pulley center.

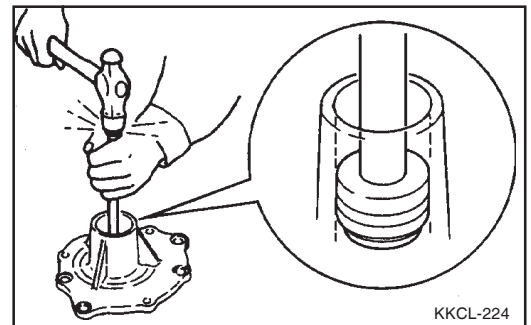


Seal removal from case

Tap the seal with the brass bar.

CAUTION

After removing seal from case, replace it with the new one.
(Do not reuse)



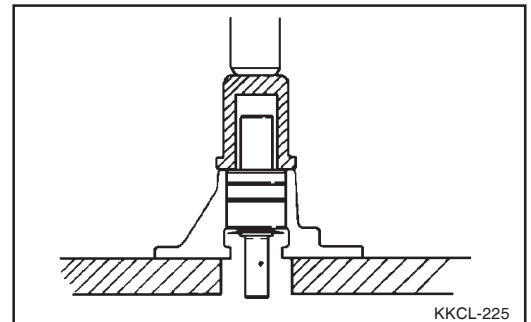
Assembly

Shaft assembly installation

Insert shaft assembly into the case.

CAUTION

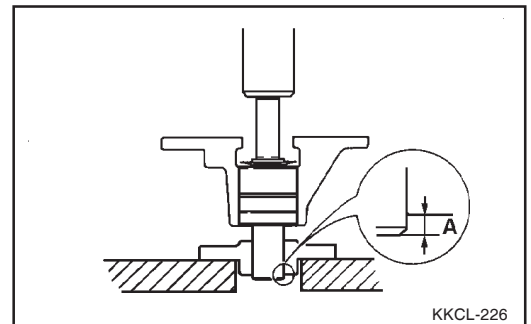
Let the bearing side coincides with shaft fringe.



Pulley center installation

Insert the pulley center into the shaft.

A: 18mm

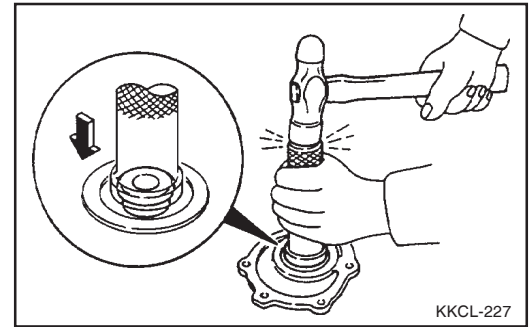


Seal Installation

1. Apply some liquid seal around the cooling seal and case
2. Install the seal.

CAUTION

Replace the seal with the new one.

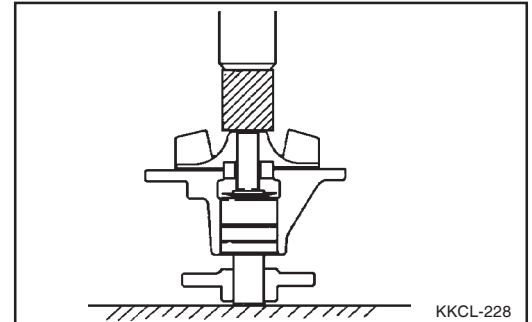


Vane assembly

Insert the vane into the shaft.

CAUTION

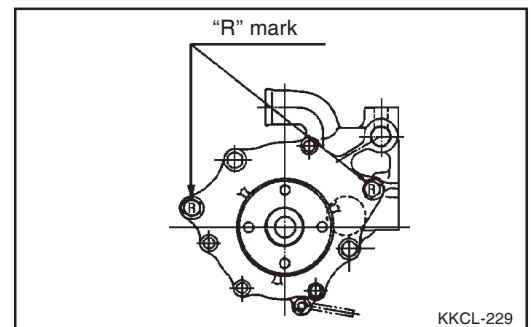
Push the vane until the vane face touches the shaft end.



Installation

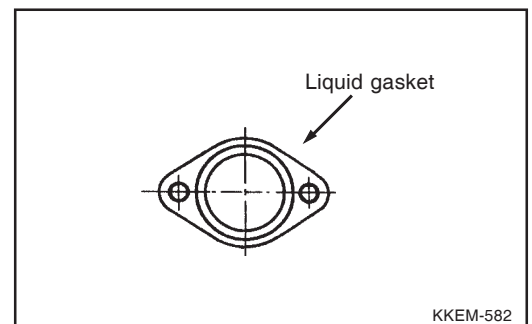
Cooling pump assembly installation

Reamer bolt installation position



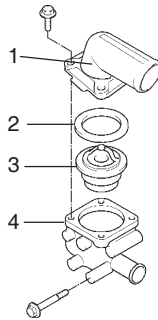
Installation of cooling pump suction pipe

Refer "liquid gasket application position" section of Engine maintenance.



Thermostat

Assembly chart



1. Thermostat cover
2. Gasket
3. Thermostat
4. Thermostat case

KKCL-761

Inspection and Maintenance

Thermostat function check

1. Check the valve opening temperature (T1) and valve lift by soaking into the hot water.

CAUTION

Check the valve opening temperature (T1) written on the thermostat seat.

Thermostat valve opening temperature

Temperature to start open valve(T1)	Service standard
71 °C	69-70 °C (125-195 °F)
82 °C	80-84 °C (145-215 °F)

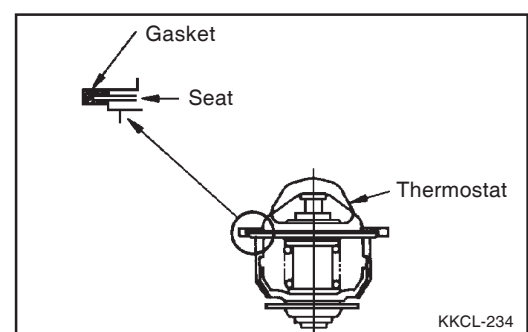
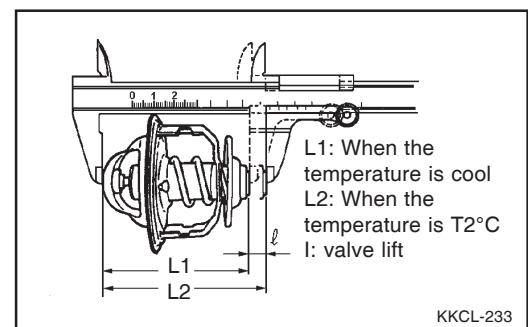
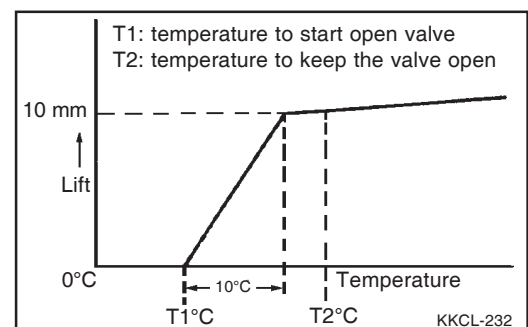
Thermostat valve lift

Temperature to start open valve(T1)	Measured temperature(T2)	Valve lift(l)
71 °C	85 °C (185 °F)	100mm or more
82 °C	95 °C (203 °F)	

2. Soak the heated thermostat into the normal temperature water. It is normal, if it closes completely within 5 minutes. If not, it is defective to be replaced.

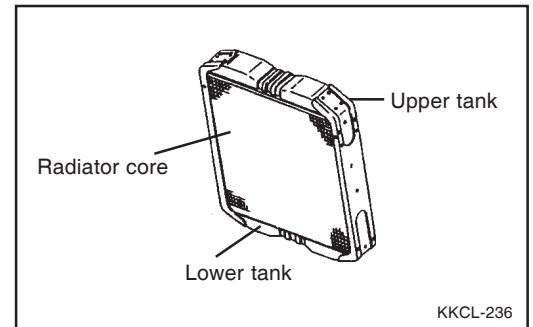
Assembly

1. Remove water and dust from the thermostat case.
2. If the gasket is corroded, damaged or deformed, then replace it with the new one.
3. Before installing hoses, apply the liquid gasket on the thermostat case.
4. To prevent radiator clogging, do not use too much liquid gasket.



Radiator

Radiator consists of the upper tank, radiator core, lower tank and other components. It functions to cool down the heated coolant through circulating inside the engine. Coolant passes through the radiator core, which consists of many tubes and pins and goes back to the water pump by way of upper tank and lower tank. The external air cool coolant as it passes the radiator core.



Disassembly

Remove the radiator.

WARNING

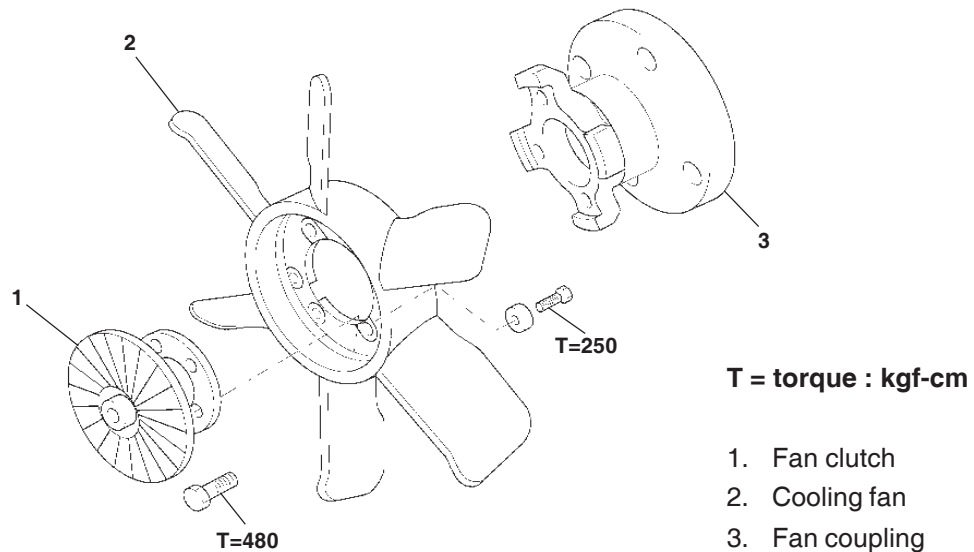
To prevent the risk of burn, do not drain the coolant when the engine and radiator are hot.

CAUTION

When disassembling or reassembling radiator, take care not to damage the radiator core.

Cooling Fan

COMPONENTS



KKCL-781

1. Impact the fan clutch and fan

Take care not to damage the fan and fan clutch while maintenance and inspection. If damaged, it may hurt the cooling capacity. Besides, since the fan is made of plastic, it may be damaged or deformed when excessive force is applied.

2. Replace the fan

Fan does not have to be replaced, if it is free from defect. When replacing the fan, use the same type fan. If the fan is replaced with the bigger or smaller one in terms of capacity, it may cause over-cooling or overheating respectively. Then cooling capacity and durability deteriorate in the end.

3. Other factors

Check whether the temperature sensor (bimetal) contains dust or mud. If it is the case, it may cause inconstant cooling, overheating or overcooling. Remove the mud or dust from the bimetal surface using brush or equivalents. Do not apply the excessive force. Do not paint the fan or fan clutch.

TROUBLESHOOTING

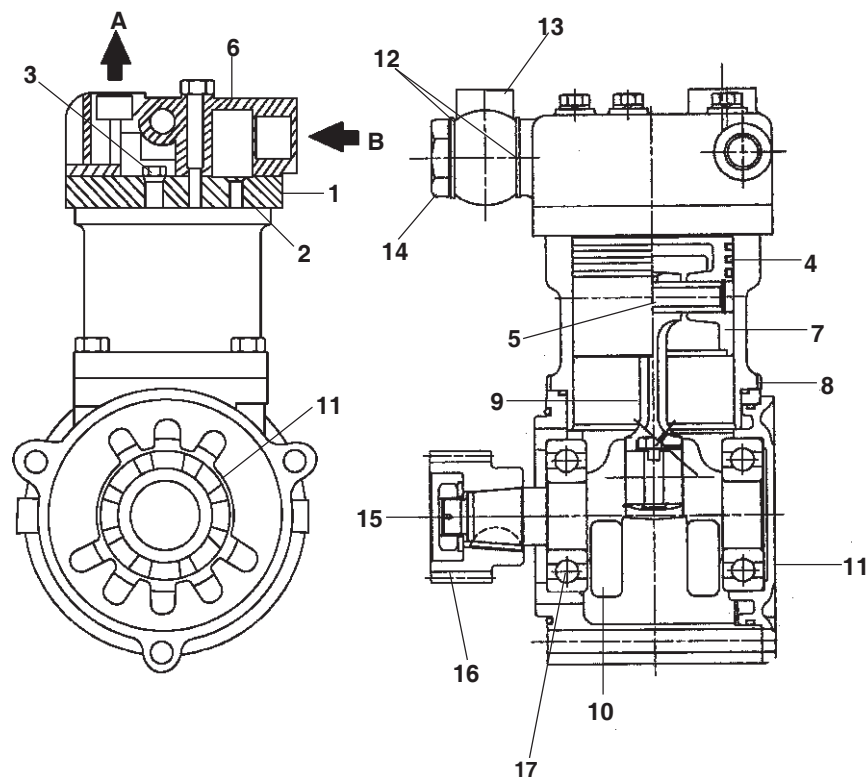
Symptom	Probable cause	Remedy	Remarks
Over heat	Defection V-belt		
	• Defective tension	Adjust	
	• Belt cut	Replace	
	Clogged cooling pipe	Clean	
	Faulty thermostat	Replace	
	Faulty water pump		
	• Loosen water pump shaft with flange	Replace	
	• Loosen water pump shaft with impeller		
	• Defect impeller		
	• Poor clearance impeller and case		
	Clogged radiator fin	Clean	
	Faulty auto cooling fan coupling		
	• Faulty bi-metal	Replace	
	• Faulty auto cooling fan coupling body		
	• Clogged bi-metal	Clean	
	Faulty cooling fan	Replace	
	Low coolant	Add	
Over cool	Faulty thermostat	Replace	
Coolant is very fast deminish	Faulty radiator hose		
	• Loosen hose connection	Retighten	
	• Crack or damage cooling hose	Replace	
	Faulty radiator		
	• Loosen radiator core from body	Replace	
	• Loosen pressure cap		
	Faulty water pump		
	• Faulty seal	Replace	
	• Faulty oil seal		
	• Defective pump gasket		
	Faulty oil cooler	Replace	Refer Lubrication system
	Defective thermostat gasket	Replace	
	Faulty heater hose		
	• Loosen hose connection	Retighten	
	• Crack or damage hose	Replace	
	Faulty cylinder head gasket	Replace	Refer Engine

AIR COMPRESSOR

GENERAL	AC - 2
SPECIFICATIONS	AC - 3
SERVICE STANDARD	AC - 3
SERVICE PROCEDURE.....	AC - 6
TROUBLE SHOOTING	AC-11

GENERAL

Description



1. Valve seat
2. Suction valve
3. Delivery valve
4. Piston ring
5. Piston pin
6. Cylinder head

7. Piston
8. Cylinder block
9. Connecting rod
10. Crank shaft
11. Bearing hold
12. Soft washer

13. Air intake pipe
15. Bolt
16. Air compressor
17. Bearing
- A. To tank
- B. Air suction

SPECIFICATIONS

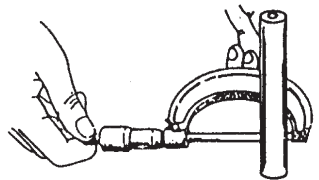
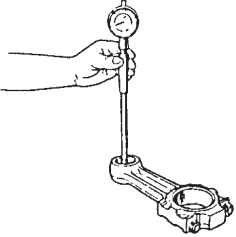
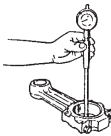
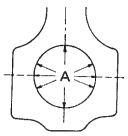
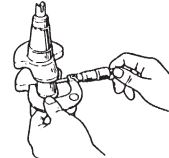
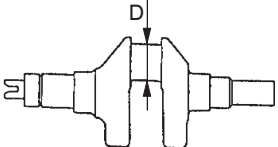
AC-3

SPECIFICATIONS

ITEM		SPECIFICATION	REMARKS
Air compressor	Type	Water cooled	
	Cylinder bore X stroke	85 X 50	
	Cylinder capacity	285cc	

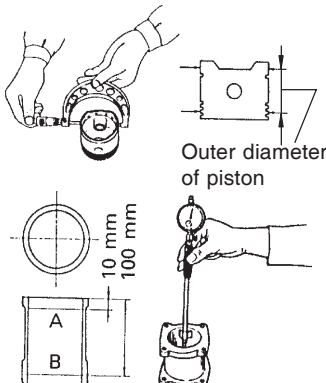
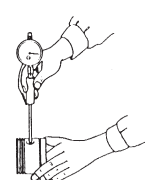
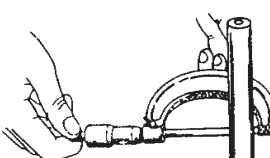
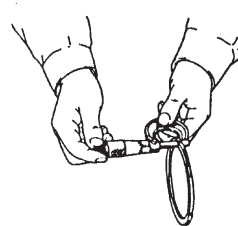
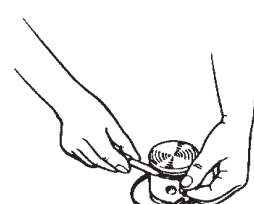
SERVICE STANDARDS

Unit : mm

ITEM	STANDARD	LIMIT	REMEDY	REMARKS
Outer diameter of piston	18.0		Replace bushing or piston pin	
Clearance between piston pin and connecting rod	0.016-0.044	0.08		 KKAC-103
Inner diameter connecting rod	37.0	-	Replace	 
Thickness of connecting rod bearing	1.51	-		 B and C KKAC-111
Outer diameter of crank pin	34.0	-		 KKAC-112
Clearance between connecting rod and crank pin	0.017-0.083	0.1		 D KKAC-113

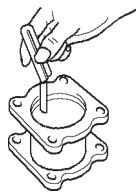
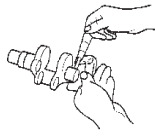
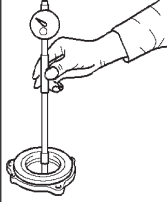
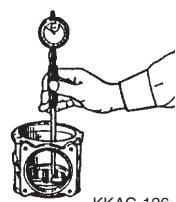
AC-4
AIR COMPRESSOR

Unit : mm

ITEM		STANDARD	LIMIT	REMEDY	REMARKS
Piston outer diameter (skirt part)		84.940-84.960	-	Replace	 Outer diameter of piston 10 mm 100 mm A B KKAC-115
Inner diameter of cylinder liner		90.00-90.022			
Clearance between piston and liner		0.0400-0.0820	0.18		
Clearance piston pin hole and piston pin T=tightening L=Loosening		0.012T-0.16L	0.08	Replace	 KKAC-116
Outer diameter of piston pin					 KKAC-121
Thickness of piston ring	Compression ring	2.0	1.92	-	 KKAC-122
	Oil ring	4.0	-		
Gap of piston ring	Compression ring	2.0	2.07	Replace	 KKAC-123
	Oil ring	4.0	-		
Clearance between ring and ring groove	Compression ring	0.005-0.040	0.08	-	 KKAC-123
	Oil ring	-	-		

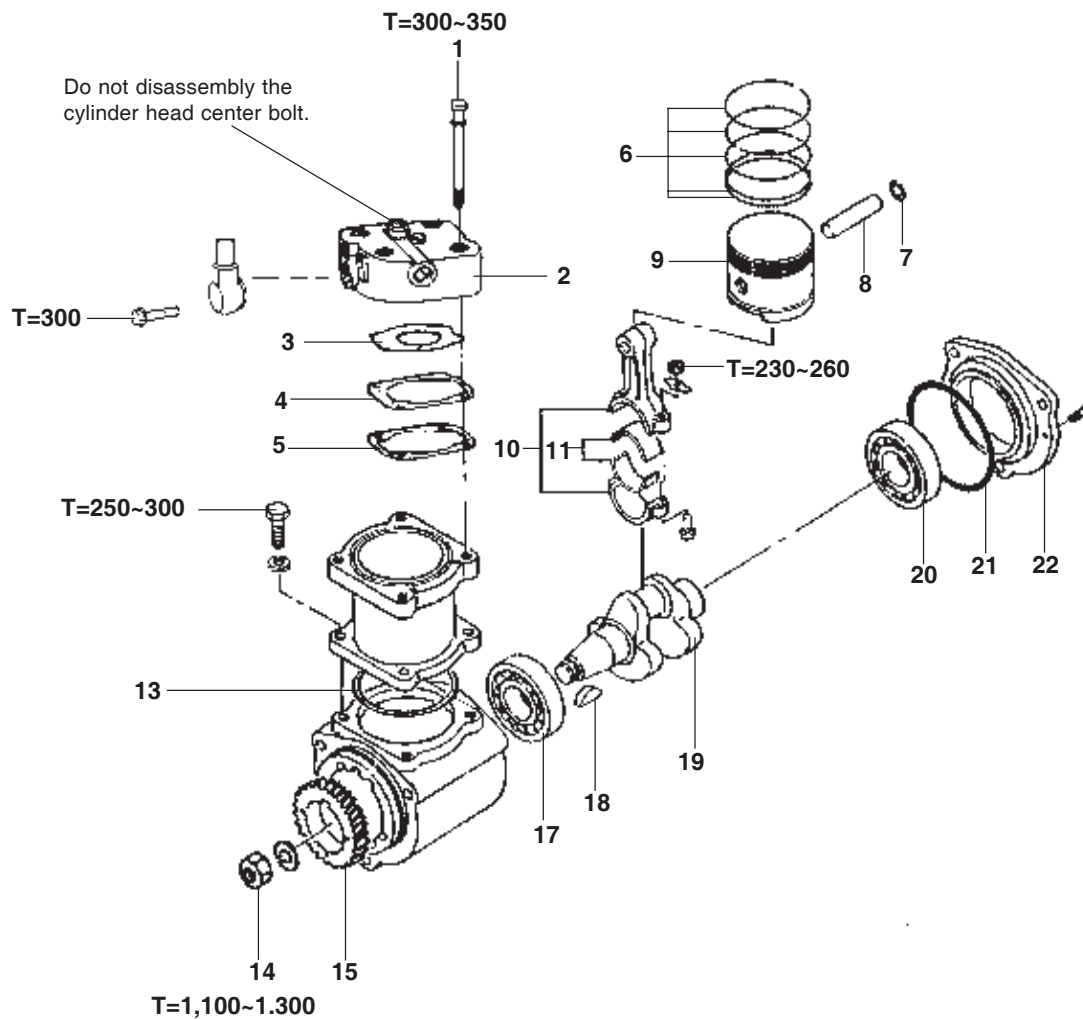
SERVICE STANDARD
AC-5

Unit : mm

ITEM		STANDARD	LIMIT	REMEDY	REMARKS	
Piston ring cap	Compression ring	0.15-0.30	1.0		 KKAC-124	
	Oil ring	0.2-0.70	1.0			
Outer diameter of crank shaft journal		40.002-40.013	39.98	Replace	 KKAC-125	
Inner diameter of bearing holder	Cylinder block	89.975-90.010	90.030	Replace		 KKAC-126
	Bearing holder					

SERVICE PROCEDURE

Disassembly and Assembly



- | | | |
|-----------------------------|-----------------------------|------------------|
| 1. Cylinder head bolt | 9. Piston | 17. Ball bearing |
| 2. Cylinder head assembly | 10. connecting rod assembly | 18. Woodruff key |
| 3. Suction valve | 11. connecting rod bearing | 19. Crank shaft |
| 4. Cylinder packing (Upper) | 12. Cylinder liner | 20. Ball bearing |
| 5. Cylinder packing (Lower) | 13. O-ring | 21. O-ring |
| 6. Piston set | 14. Rod nut | 22. Bearing hold |
| 7. Retainer ring | 15. Drive gear | |
| 8. Piston pin | 16. Cylinder block | |

SERVICE PROCEDURE

AC-7

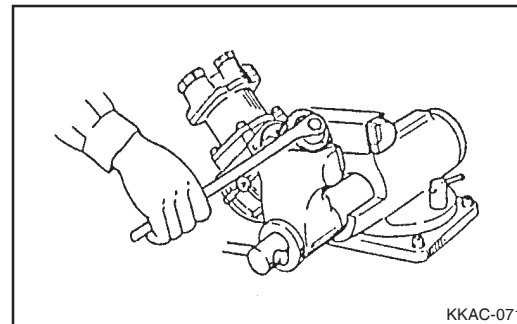
Disassembly

Remove the drive gear.

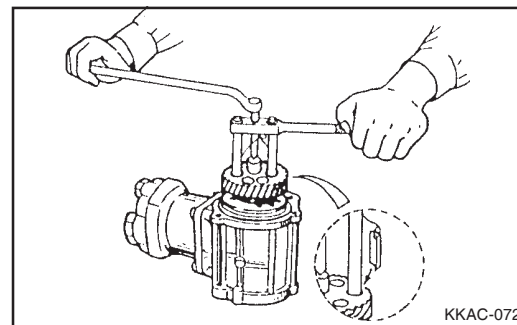
1. Remove the lock nut from the compressor drive gear.

CAUTION

Drive gear may be damaged, if lock nut is not fully loosened.

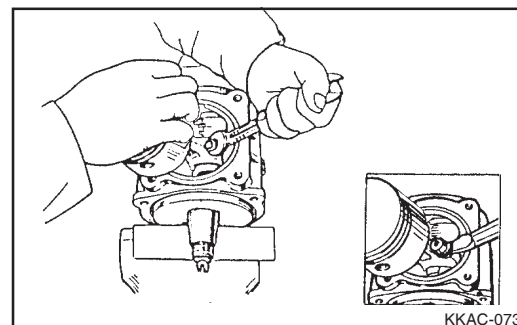


2. Pull the gear from the shaft, and remove the woodruff key.



Remove the connecting rod and piston.

1. Rotate the crankshaft to the top dead center position.
2. Fully open the nut staking by the chisel, and loosen the nut.
3. Remove the connecting rod and piston.

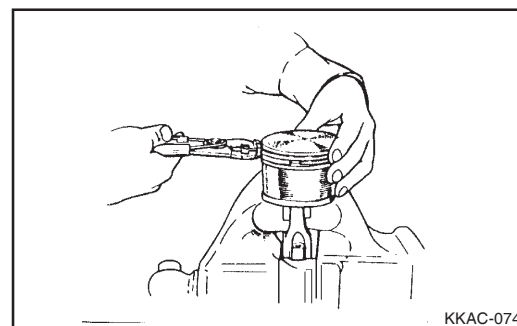


Remove the piston ring.

Special tool: Piston ring tool (09222-83200)

CAUTION

- Since the piston rings are so brittle, which are made by special forgery, handle with special care.
- When reusing the piston rings, align the parts orderly to prevent the mis-assembly first of all.

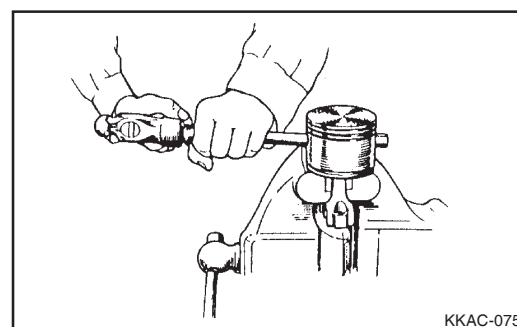


Remove the connecting rod.

1. Using the retainer ring pliers, remove the retainer ring installed at both ends of the spring.
2. Put the metal pad to the pin, and tap it with the special tool and hammer.

CAUTION

Before disassembling pin, heat the piston for about 5 minutes with the hot water of 80-90°C (176°F ~ 194°F).



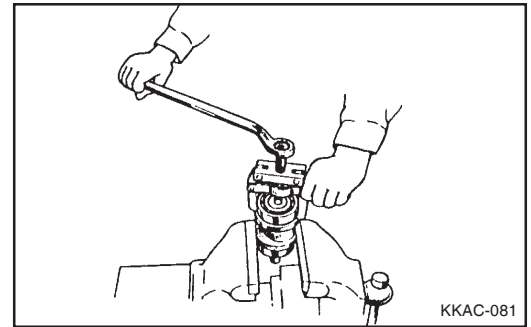
AC-8

AIR COMPRESSOR

Remove the ball bearing.

Using the special tool, remove the ball bearing from the end of crankshaft.

Disassembly



CAUTION

Before assembly, make sure to apply the engine oil to every frictional part and replace the O-ring and gaskets with the new ones.

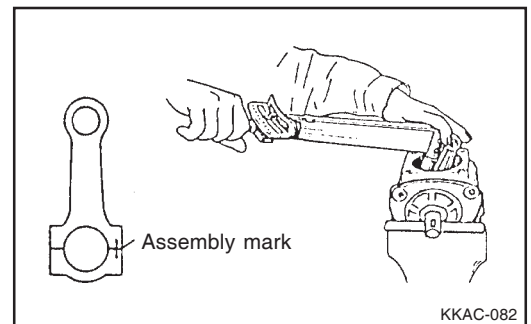
Install the connecting rod and measure end play.

1. Install connecting rod.

CAUTION

Check whether the assembly marks coincide.

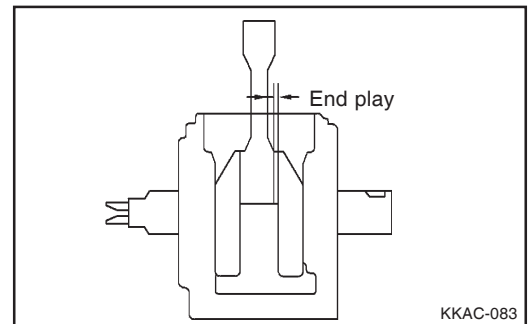
2. Apply the enough engine oil to the connecting rod bolts and threads, and fasten the bolts.



3. Measure the endplay of connecting rod. If the clearance exceeds the service limit, replace the connecting rod.

Assembly standards: 0.2 – 0.4 mm

Service limit: 0.50 mm



SERVICE PROCEDURE

AC-9

4. Fasten nut with the lock washer.

If the clearance exceeds the limit, replace the crankshaft bearing or cylinder block.

Assembly standard: 0.30 mm – 0.84 mm

Limit: 1.0 mm

Assemble piston

CAUTION

Apply the engine oil to the slippery places of the parts, and then assemble them.

1. Assemble the piston ring. When assembling piston ring to piston, check whether the skirt is at the bottom and use special tool. Assemble the piston ring as the ring face identification mark faces upward.

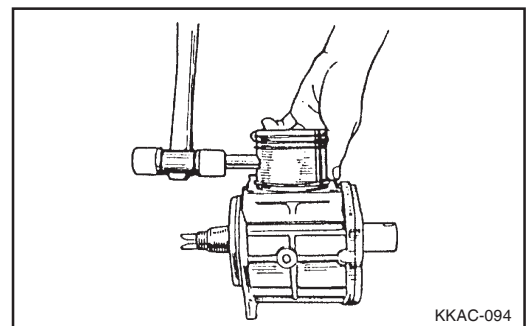
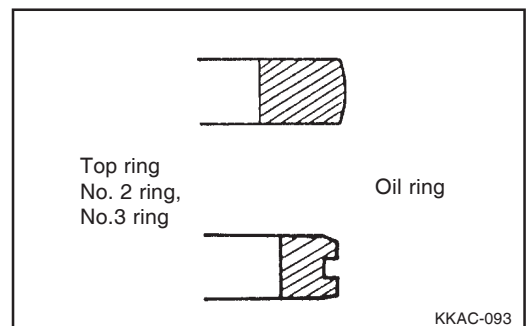
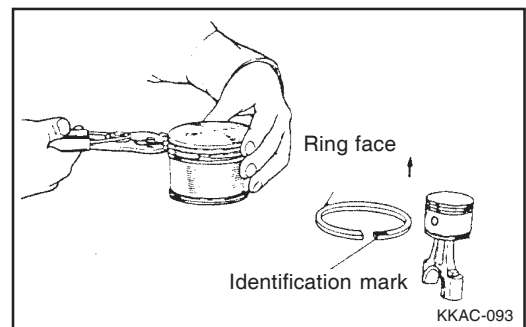
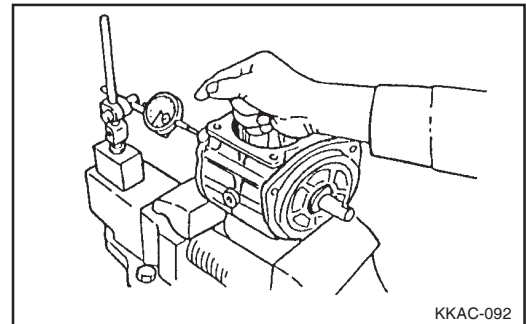
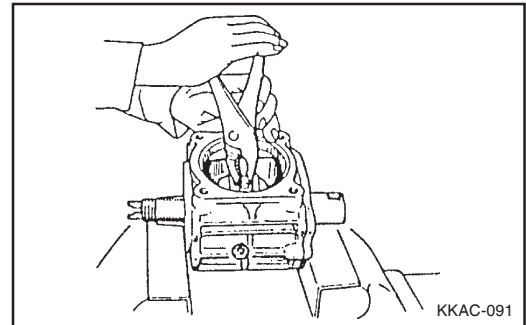
Special tool: Piston ring tool (09222- 83200)

Assemble the piston and connecting rod.

When inserting piston pin into piston, install the retainer one ring to the end of piston and then apply the oil to the piston pin. Fix the piston and connecting rod and insert the new retainer ring to the other end.

CAUTION

Heat the piston for about 5 minutes with the hot water of approximately 80-90°C (176-194°F).



AC-10

AIR COMPRESSOR

Assemble cylinder liner and cylinder head.

1. Rotate the crankshaft to the top dead center position.
2. Align the pistons with the same distance between rings.
3. Assemble the cylinder liner and cylinder head.

CAUTION

When assembling O-ring to cylinder liner and cylinder head, be careful not to be twisted.

Assemble the cylinder head assembly.

1. Assemble the suction valve of cylinder head assembly.
2. Assemble the cylinder packing.

CAUTION

Packing thickness (upper part, lower part).

Packing must be replaced after used once.

3. Assemble the valve seat pin smoothly to the upper part of cylinder by aligning the center.

CAUTION

Do not apply the excessive force in assembling pin to the holes.

Take care so that dust and dirt are not included.

Do not disassemble the cylinder head assembly (center bolt).

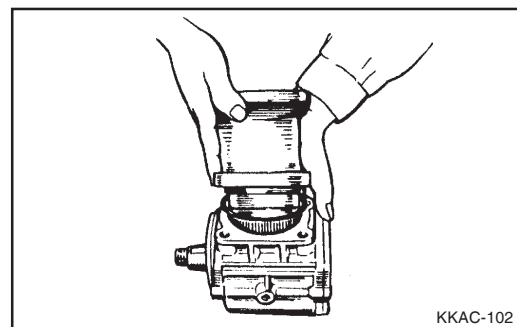
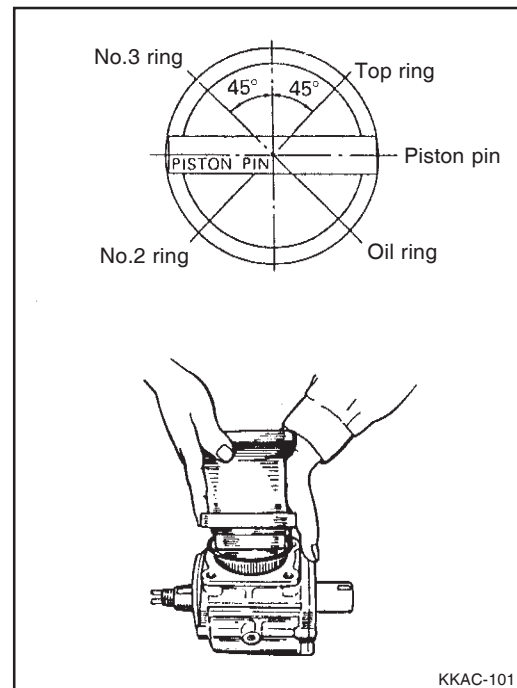
4. Connect the cylinder head bolt.

CAUTION

Abide by the fastening torque (300 – 350kg-cm).

Abide by the fastening torque of center bolt (250 – 300 kg-cm).

(Do not disassemble the center bolt nor apply any torque).



TROUBLE SHOOTING

Symptom	Probably cause	Remedy
Malfunction of unloader valve	Unloader valve - o Stickly - o Deflection or wear	Clean or replace
	Air pipe and joints o Air leakage	Repair or replace unloader valve assembly
	Pressure regulator o Function	Replace or tighten pipe joints
		Adjust and/or repair pressure regulator.
Noisy operation	Piston - o Wear of piston pin boss or piston pin - o Seized, damaged or worn connecting rod small end - o Worn piston or liner - o Damaged or seized piston - o Inclusion of foreign matter on top surface of the piston - o Carbon deposit	Replace it
		Replace it
		Replace it
		Replace it
		Replace piston
		Clean piston
	Valve - o Inlet valve is lowered excessively - o Loosened discharge valve holder	Repair or replace
		Tighten it
	Bearing o Damaged or worn ball bearing and/or connecting rod metal	Replace bearing
Charging efficiency dropped	Valve o Abnormal wear, damage, or poor contact	Replace valve assembly
	Piston, liner, and piston rings - o Worn piston and liner - o Seized piston	Replace
		Replace piston, piston rings and liner
	o Worn or broken piston ring	Replace it
	Air pipe and joints - o Leakage of high pressure air - o Clogged air pipe	Replace or tighten pipe joint
		Replace
	Air cleaner o Clogged element	Clean or replace element

AC-12**AIR COMPRESSOR**

Sympton	Probably cause	Remedy
Excessive carbon or oil in the compressor cylinder head or discharge line	Piston rings Worn, sticking or broken piston rings	Replace piston rings and/or cylinder liner
	Insufficient piston ring tension	Replace piston rings and/or cylinder liner
	Unsatisfactory piston rings	Replace piston rings and/or cylinder liner
	Cylinder liner, piston, and rings Wear of liner, piston, or rings	Replace

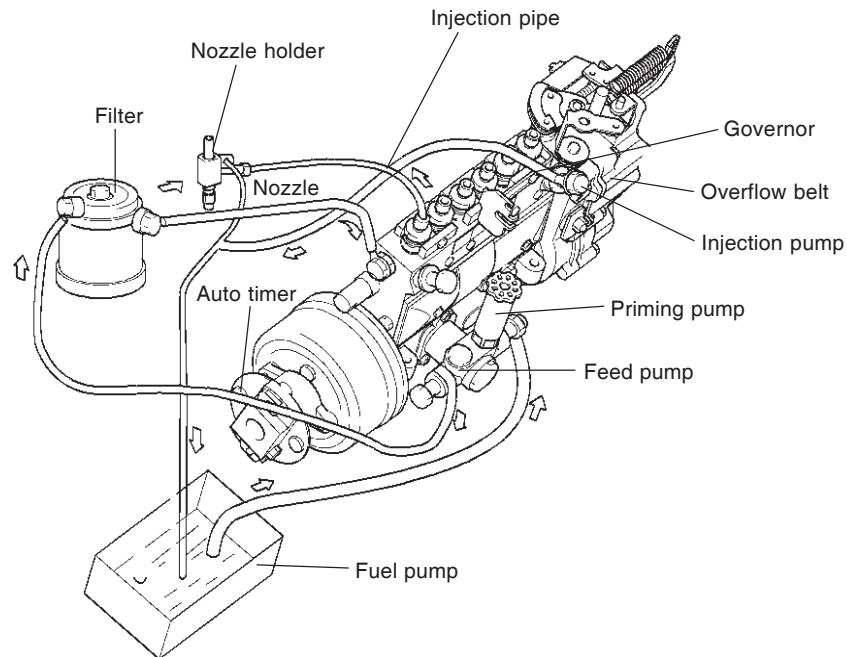
FUEL AND ENGINE CONTROL

EBOOKBKMT.COM
Tài liệu kỹ thuật miễn phí

GENERAL	FL - 2
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OPERATION OF GOVERNOR	FL - 7
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Governor	FL-20
Timer	FL-30
Supply pump	FL-32
Spray nozzle	FL-34
Engine control	FL-50
TROUBLE SHOOTING	FL-55

GENERAL

Fuel System



KKFL-662

In general, fuel injection system of diesel engines is designed as above. The rotation of the engine is delivered to camshaft through coupling or operating gear.

Feed pump is activated by the rotation of camshaft and it takes in fuel from the fuel tank to deliver it to the filter with pressure of $1.8\sim 2.5\text{kg/cm}^2$.

Fuel filtrated by the filter is sent to the oil chamber then through injection pump via injection pipe finally it is injected from the nozzle of nozzle holder to the combustion chamber of engine.

The amount of fuel sent from feed pump is more than double the amount of maximum injection of injection pump and the residual fuel return to the fuel tank when it exceeds the pressure of valve set by the overflow valve.

Also, the fuel circulated through overflow nipple of nozzle holder via inside of nozzle holder returns to the fuel tank or filter.

GENERAL

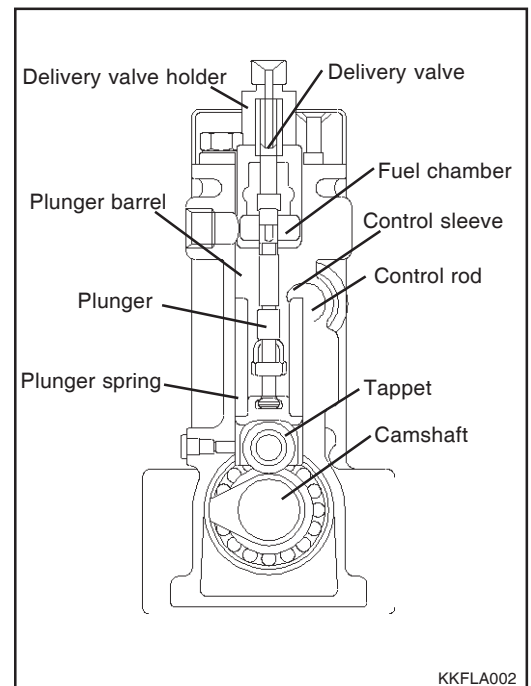
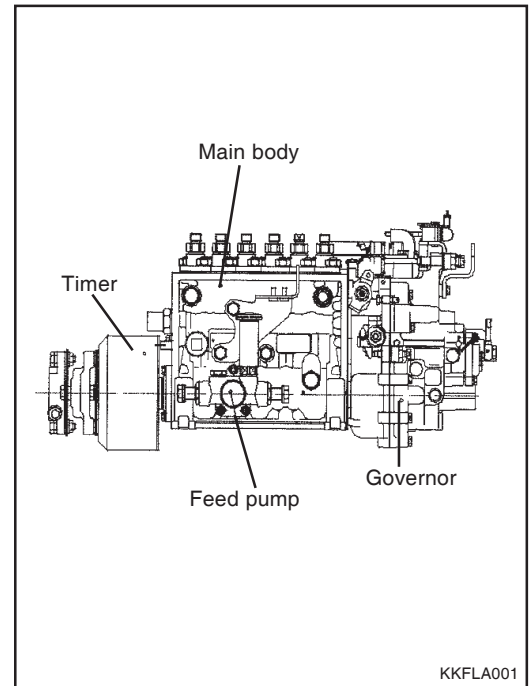
FL-3

Fuel Pump

Fuel pump consists of feed pump, timer, main body, governor.

It is a thermo-type(BOSCH PS3S) of fuel pump and is considered most important part over all the other part used in fuel system of diesel engine for it determines the performance of diesel engine.

This pump, unlike other conventional AD type pump, does not have cover plate in pump housing that it becomes an airtight type pump to make it durable against high pressure injection. Plunger and delivery valve are installed independently in each cylinder and it makes easy to control the injecting quantity between each cylinder, especially for the combination with specified fuel system because of accurate injection period.



1. Description of Pump Operation

There is fuel chamber in pump housing and it is filled with fuel of low pressure filtrated by fuel filter at all times that the exhaust and suction hole is connected to the fuel chamber. Pump is operated by camshaft and when it is at its fall stroke, it starts sucking fuel into plunger barrel that when the plunger reaches its bottom dead center, the suction is completed.

When the camshaft is at its rise stroke, it compresses the spring of plunger and pushes it up then the front part of plunger blocks exhaust and suction hole. That is when the fuel begins to flow and block and this moment is called still injection start.

When the plunger rises and the pressure of fuel raises the power of delivery valve spring and the residual pressure of fuel inside injection pipe, it pushes delivery valve to initiates fuel delivery to nozzle holder and injection continues by the rise of plunger.

2. Fuel increase and decrease harness

Decrease and Increase of fuel delivered from plunger changes effective stroke of plunger.

Harness which changes effective stroke is as shown in the right.

Plunger barrel is fixed on flange sleeve by knock pin and it does not move. Plunger is assembled in a way it could perform upward and downward motion and rotation.

Control sleeve is assembled on the "T" shaped part of wing of plunger, the ball in control sleeve is assembled in the groove of key of "L" shaped control rod.

Plunger in electric barrel is rotated by moving control rod and it causes changes in effective stroke to increase injection quantity.

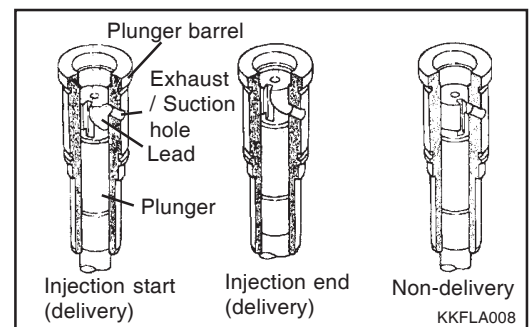
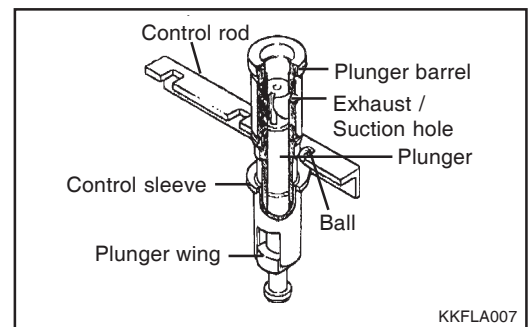
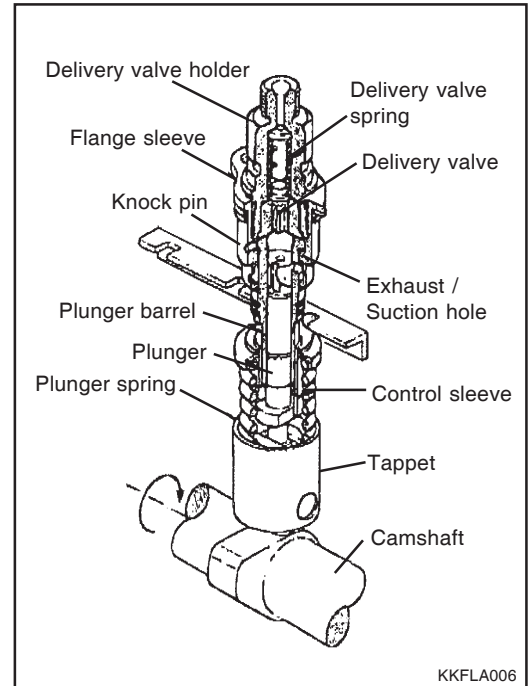
An effective stroke defines as a period of delivering fuel from the moment still injection begins to inject to the moment it finishes and it is proportional to the injecting quantity.

3. Function of Plunger

Plunger makes fuel become of high pressure and it deceases and increases of injecting quantity and it is most important part out of all the other parts in injection pump.

Also, moving parts of plunger and its barrel are made and assembled with a high degree of precision. Plunger barrel is fixed on pump housing that it is not supposed to move. It has one exhaust and suction hole.

When the upper part of plunger blocks exhaust and suction hole, injection begins and it ends when incision groove (lead) meets exhaust and suction hole and this period is called effective stroke.



GENERAL

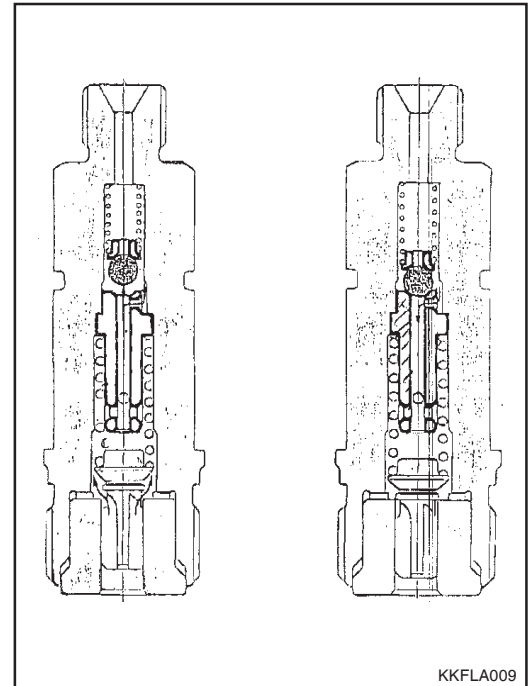
FL-5

4. Delivery valve(iso-pressure valve)

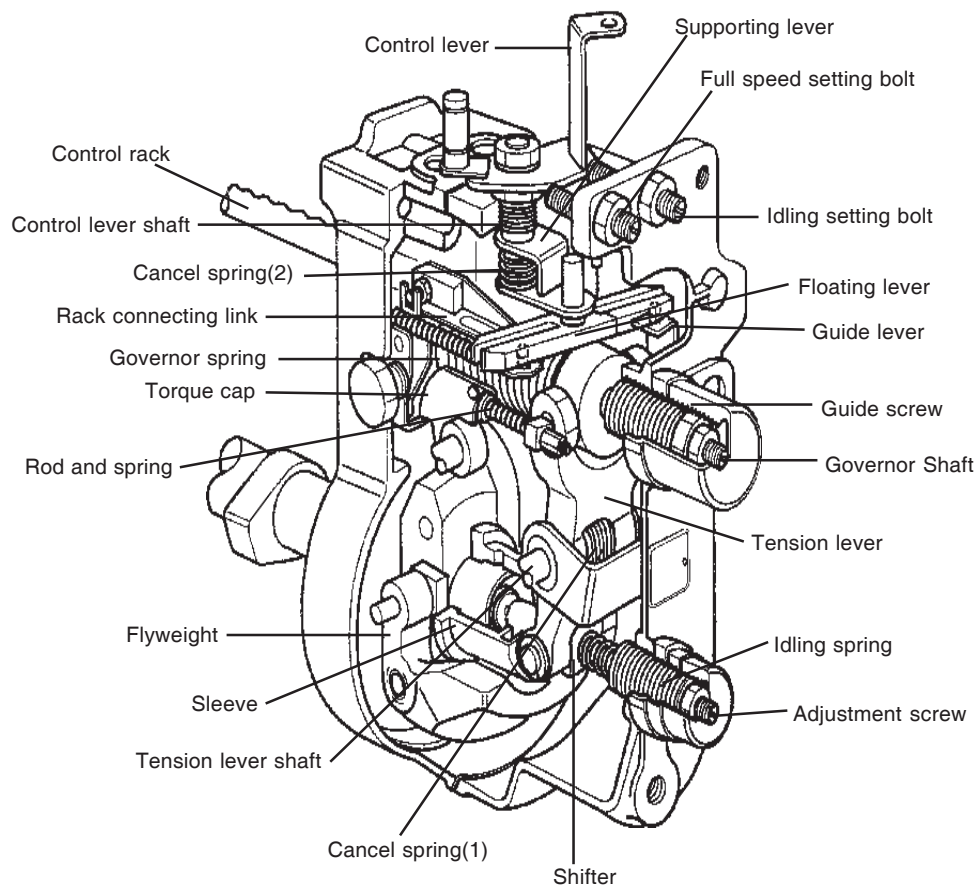
When the pressure of fuel becomes higher than residual pressure and the pressure of delivery valve spring of fuel inside injection pipe, it compresses delivery valve spring that it opens delivery valve and fuel is delivered to nozzle from nozzle holder via injection pipe.

Then, when the lead of plunger meet exhaust and suction hole of plunger barrel, delivery of fuel stops by delivery valve spring shutting delivery valve in a moment and the injection is completed. And to make it fast for next injection, the residual pressure inside injection pipe is accumulated.

Therefore, for the prevention of abnormal injection by changes of residual pressure, a valve which regulates residual pressure of injection nozzle(is- pressure valve) should be installed inside main body to regulate residual pressure of injection nozzle and set the level of residual pressure to be open valve pressure of iso-pressure valve.



Structure of RLD governor



KKFLA010

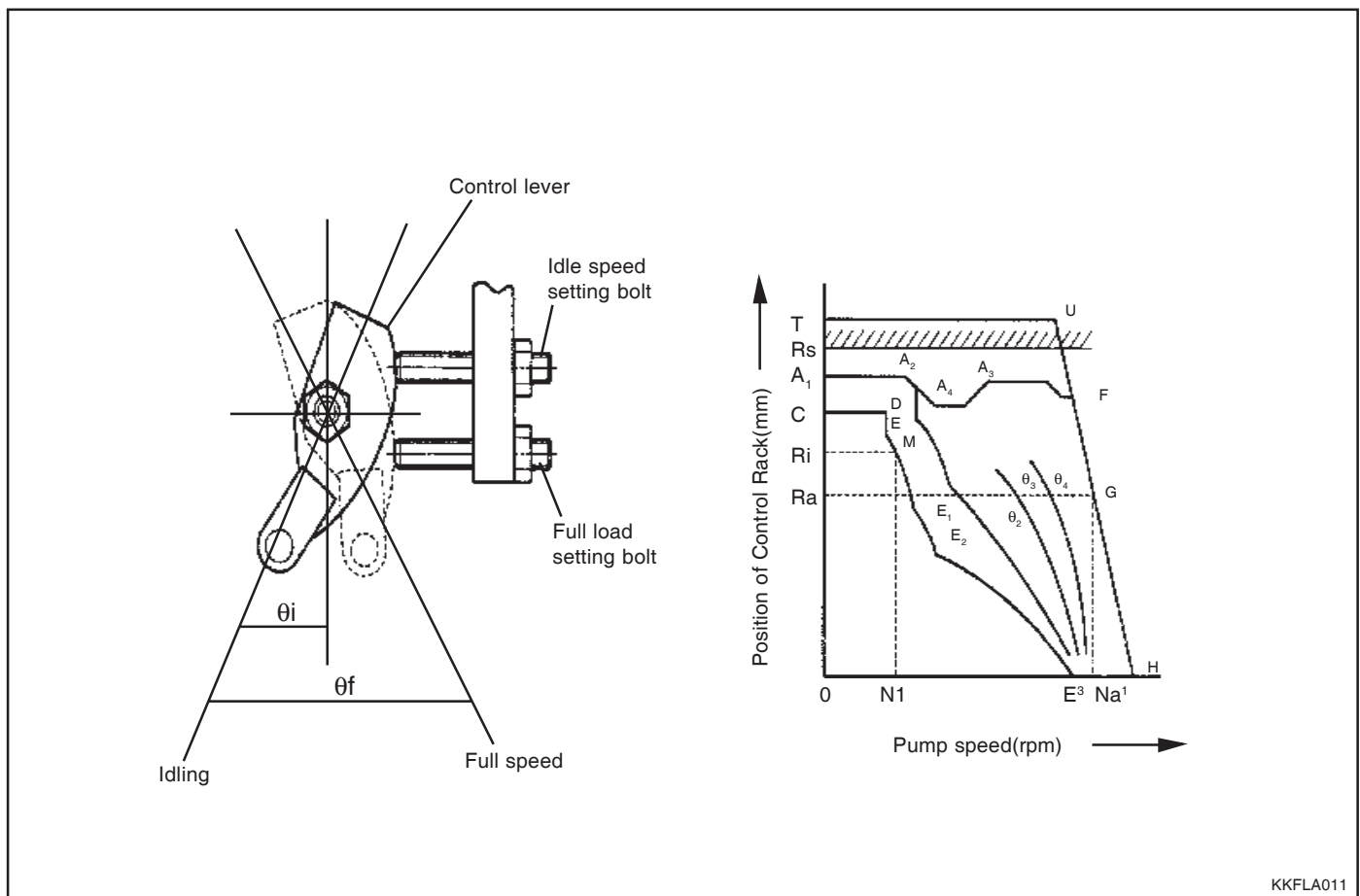
SPECIFICATIONS

Unit : mm

Item		Specification	Remark
Engine Model		D6DA	
Injection pump	Type	Bosch "DE" Type	
	Rotation	Clock wise	Viewed from drive shaft
Plunger diameter		φ12	
Governor		RLD-J (Mechanical)	
Automatic timer		SPG (Mechanical)	
Injection nozzle	Type	Hole type	
	Injection hole No	6	
	Diameter	φ0.24	
	Injection anlge	4-150°, 2-146°	
	Injection pressure	Primary valve opening pressure	160kg/cm²
		Secondary valve opening pressure	220kg/cm²
Fuel filter		Catridge type	
Water Separator		Sediment trap type	

OPERATION OF GOVERNOR

Performance graph of RLD governor



KKFLA011

Lever setting position at idling

Section C-D : A section where the setting force of start spring is bigger than centrifugal force of flyweight (quantity of flyweight lift:0)

Section D-E : A section where it operates control rack exceeding the setting force of start spring by centrifugal force of flyweight

Section E-E₁ : Engine rotation speed control section by idling spring(idling section)

Section E-E₃ : Engine rotation speed control section by idling spring and governor spring

Curve θ_2 , θ_3 and θ_4 may be obtained when the control levers are at all different position. The more the control lever gets close to maximum speed, the lower the performance graph gets

Lever setting position at maximum speed

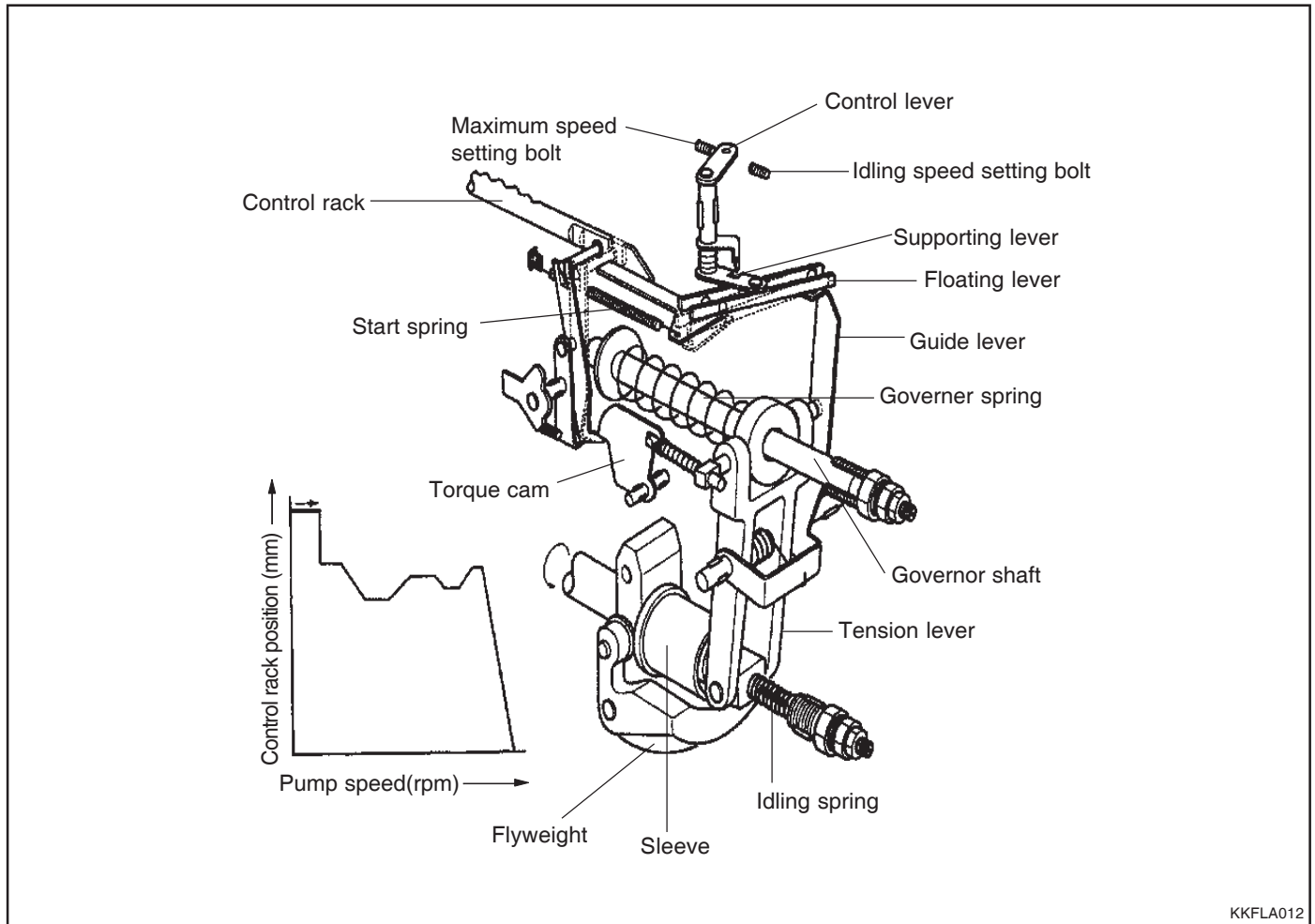
Section A₁-A₂-F : Engine rotation speed control section by torque cam

Section F-G-H : Engine rotation speed control section by governor spring. Point G has no load and has maximum speed.

Increase of start fuel injection quantity

Speed of engine increases after setting control lever at maximum speed while the engine is not running.

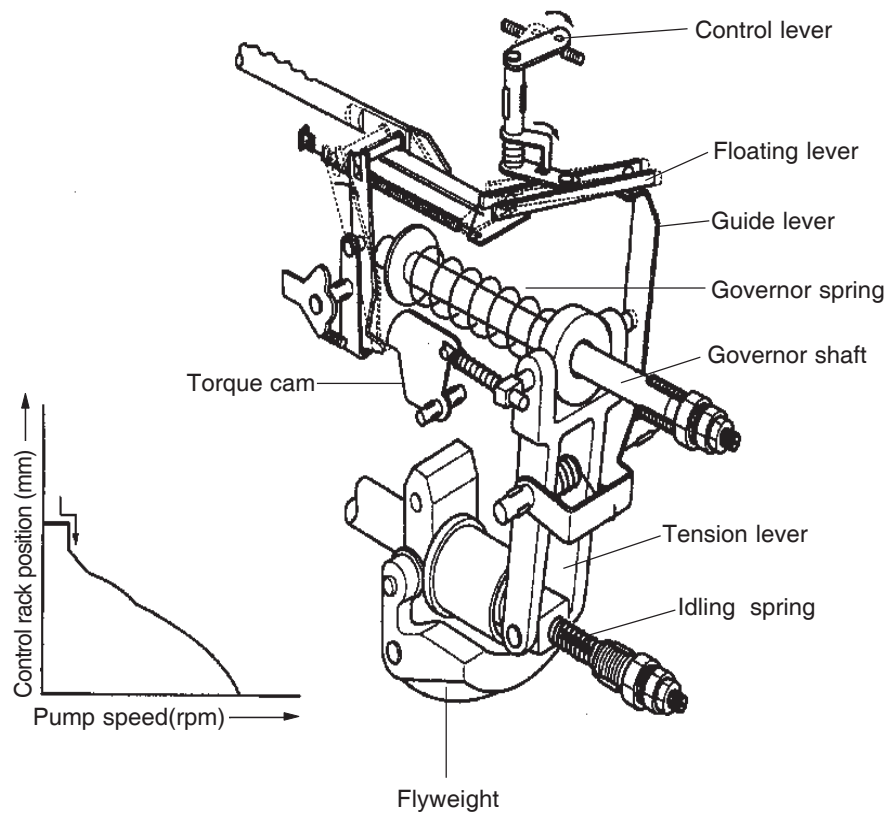
Section T-U : It shows the range of start engine injection quantity. This is when the sensor lever fits in cam notch of torque. However, regular control rack is maintained at Rs by rack limiter

Engine Start

KKFLA012

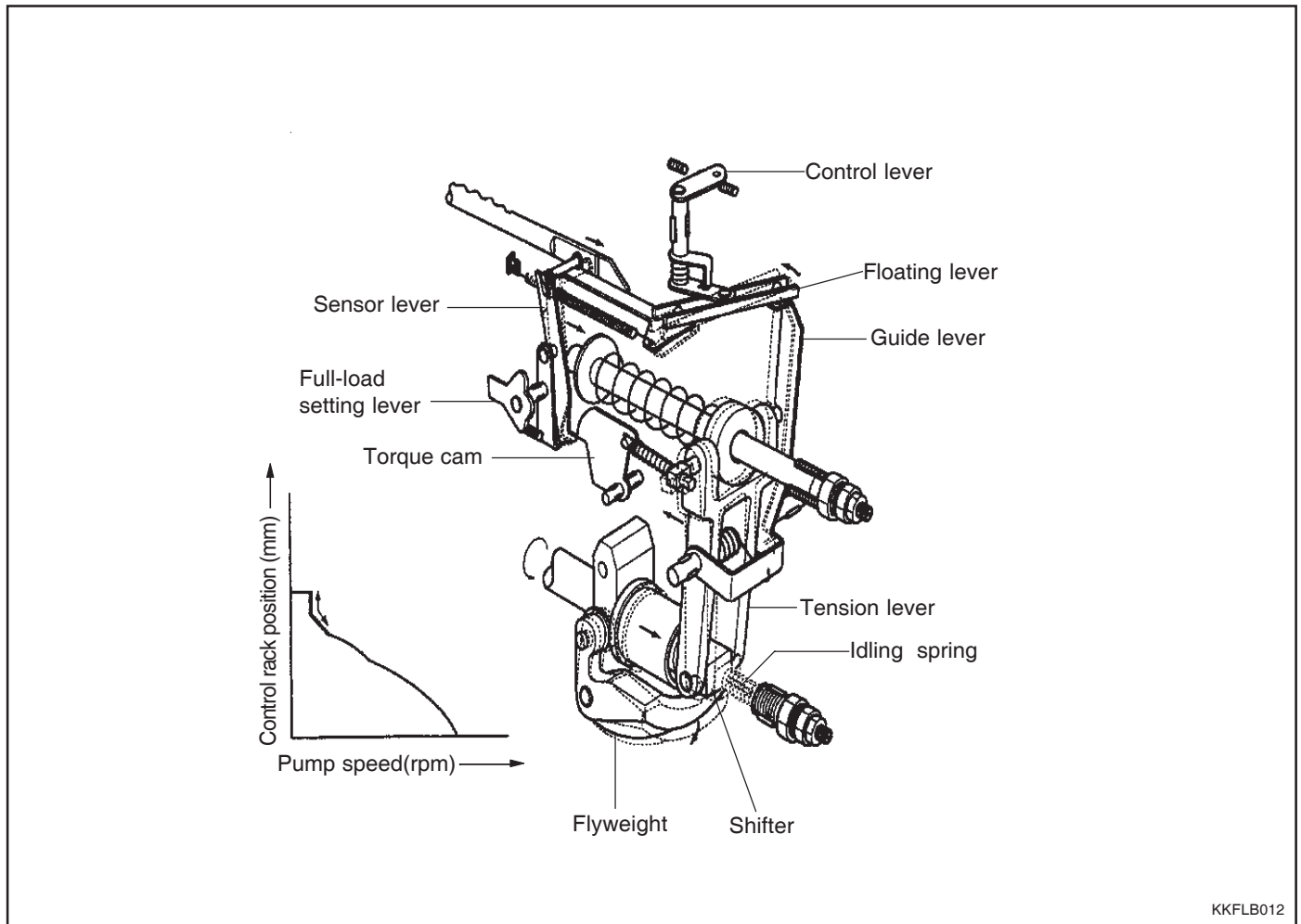
With the engine stationary, the flyweights are in closed position and the idling and governor springs remain in the free-length state free from set tension. Placing the adjusting lever in the full position moves the adjusting lever shift, which causes the cancel spring B force to move the supporting lever.

This in turn causes the control rack to move in the direction of greater fuel delivery. At the time, the sensor lever gets into the groove cut in the torque cam provided to increase the amount of fuel for startup, and the control rack, past the full load position, reaches the point to increase the amount of fuel for startup that is limited by the rack limiter.



KKFLB011

By returning the adjusting lever to the idle position after the engine has started, the control rack is pulled to allow the sensor lever to leave off the groove in the torque cam. Thereafter, no fuel delivery increase can be obtained for start up even by moving the adjusting lever to the full position.

Idling Speed Control

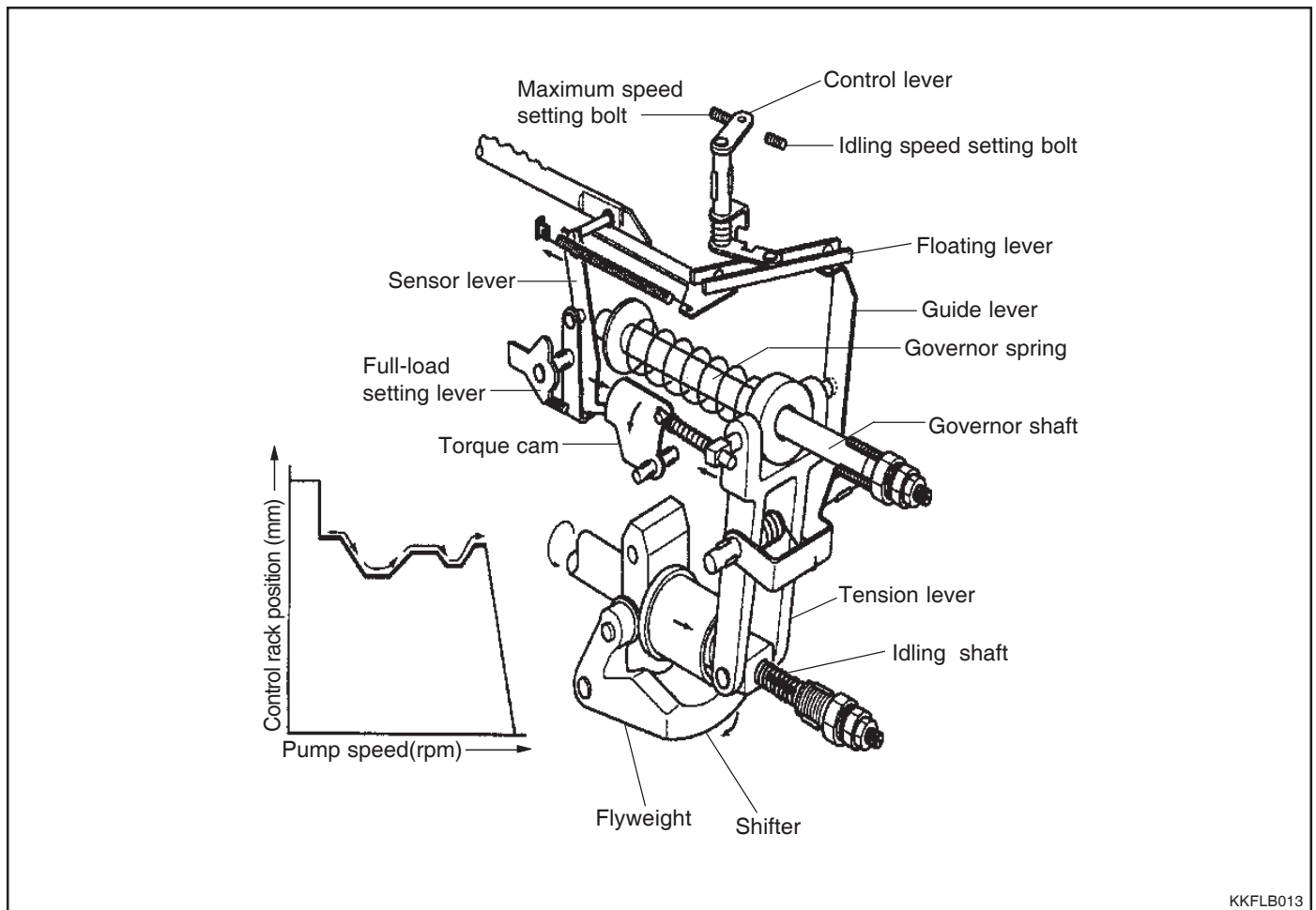
KKFLB012

Placing the adjusting lever in the idle position with the engine started makes Q the fulcrum of the floating lever. As engine speed decreases, the centrifugal force of flyweights yields to the tension of idling spring, closing the flyweights. This causes the floating lever to pivot about Q, moving the control in the direction of greater fuel delivery, thus preventing the engine from stalling.

As engine speed increases, on the other hand, the idling spring tension yields to the flyweight centrifugal force, causing the control rack to move in the direction of smaller fuel delivery, thereby decreasing the speed (Condition indicated by dotted line)

An idle speed is thus maintained at a point where the flyweight centrifugal force balances with the set tension of the start and idling springs.

The torque cam and sensor lever are not in contact with each other while the engine runs at idle.

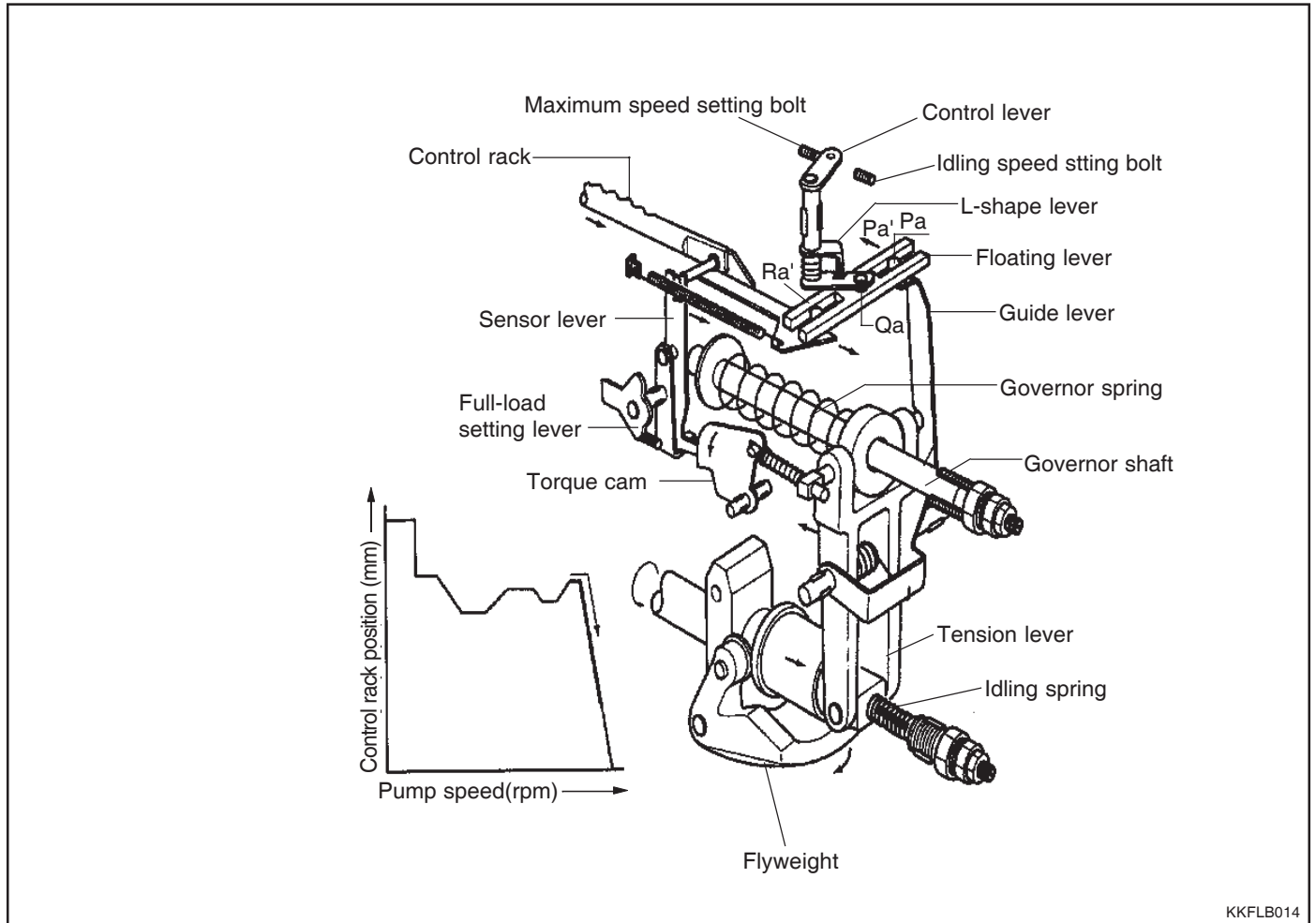
Control of Fuel Injection Rate at Full Load by Torque Cam

KKFLB013

When the adjusting lever is placed in the full position under load, the floating lever pivots about P to move the control rack in the direction of greater fuel delivery. The sensor lever, at the same time, comes in contact with the torque cam. As speed varies, the shifter moves in the axial direction, which causes the tension lever to be pushed forward and backward around the tension lever shaft, making the torque cam to rotate around its shaft.

The sensor lever movement tracing along the cam surface displaces the control rack, thereby increasing or decreasing the fuel injection rate.

The tension lever movement from varying speeds does not, however, move the point R; it moves only P of guide lever Q of supporting lever. The control rack is therefore moved through the sensor lever by the movement of torque cam.

Full Speed Control

When the adjusting lever at full position, the engine speed increase while the fuel injection rates under full load are controlled by the torque cam and sensor lever. As speed further builds up and as the supporting lever contacts the L lever on the adjusting lever shaft by the cancel spring B, the floating lever pivots about Q to move the control rack in the direction of smaller fuel delivery, thus controlling the full speed. The sensor lever, on the other hand, leaves the torque cam surface as this control advances.

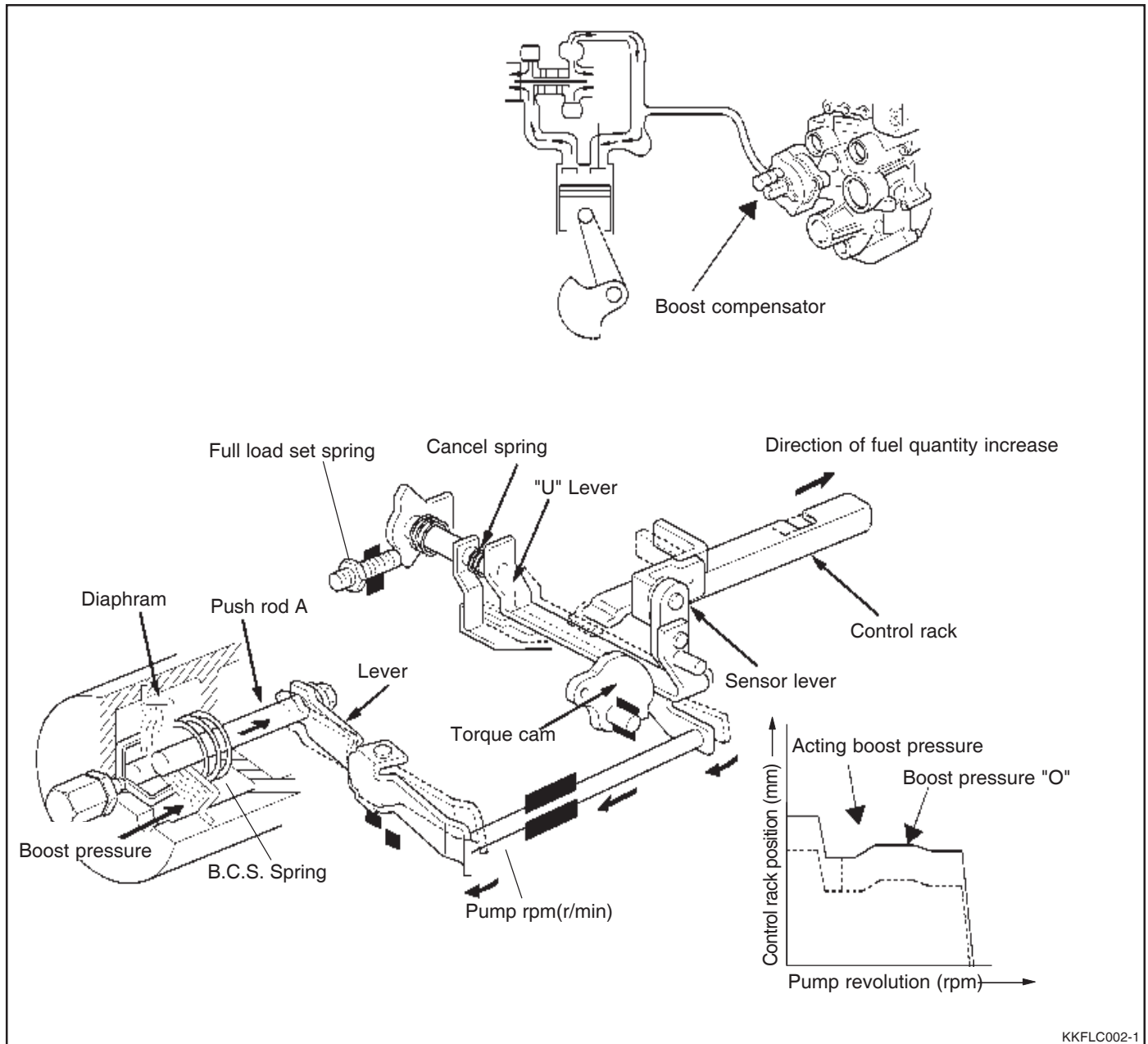
OPERATION OF GOVERNOR

FL-13

Boost Compensator

When the boost pressure in the engine intake manifold rises by turbo charger operation, it acts on the compression chamber of the boost compensator.

As the boost pressure overcomes the boost compensator spring tension, the diaphragm and push rod A move to the right. The motion of push rod A causes the lever to turn clockwise with the push rod B following the lever by the return spring. At the time, the U-lever in governor housing turns clockwise by the cancel spring force in accordance with the push rod B motions, which moves the center fulcrum of sensor lever to right. Since the sensor lever is in contact with the torque cam at its bottom, the control rack moves in the direction of greater fuel delivery as the fulcrum moves of the sensor lever at the center.

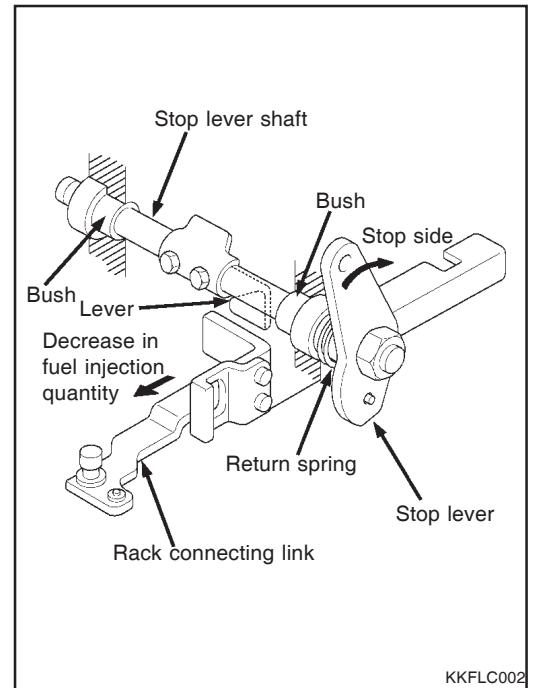


KKFLC002-1

Engine is stopped

Generally, lever in shaft part does not stay contacted with rack connecting link when stop lever is not being manipulated(normal position).

Lever of shaft part shifts rack connection link by manipulating stop lever so that injection quantity of fuel decreases and it becomes possible to stop engine.



SPG

True angle of fuel injection timing is needed to maintain effectiveness of fuel as the RPM of engine increases.

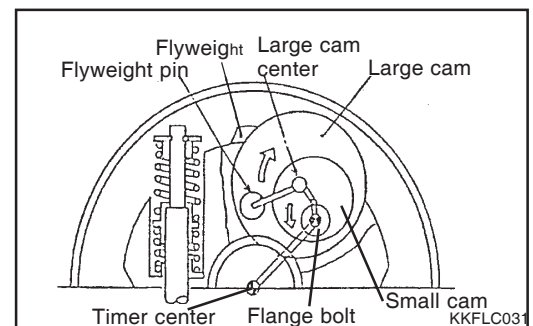
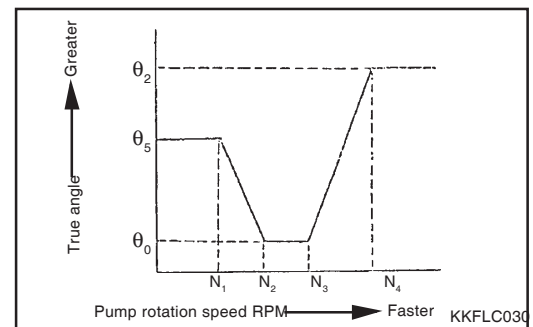
It is injection timing regulator that changes such things as above according to RPM of engine.

Timer rub is placed in camshaft and operated between centrifugal pendulum by operating flange.

Timer spring is installed in between bearing pin fixed in centrifugal pendulum holder and journal of operating flange and the journal of flange is in contact with special curved surface of centrifugal pendulum. Also, centrifugal pendulum is to vibrate with respect to the center of bearing pin.

At a low speed rotation of engine, centrifugal pendulum can not be vibrated by force of timer spring set. Centrifugal pendulum vibrates as a result of overcoming the force of timer spring set as the centrifugal force increases by increased engine rotation. Therefore, large cam and small cam begins to move. Large cam is attached to a hole in flange that the shift of big cam is delivered to timing flange to form true angle.

Especially for the timer that is in use currently is SPG timer and it is intended to improve starting ability and decrease white smoke in starting engine besides the foregoing.



Fuel

For diesel engines, fuel of good quality should be used.

Use of fuel of poor quality deteriorates engine performance and shorten the life of injection pump and nozzle inside injection system as well as engine.

1. Fuel serves as lubricant for nozzle, plunger and delivery valve.
2. Poor quality of fuel accelerates wear and tear of each part.
3. Fuel with poor viscosity causes unstable operation of nozzle, plunger, delivery valve.
4. Reversely for the fuel with high viscosity, good combustion can not be achieved because small amount of fuel which is injected from nozzle gets bigger than its size that it mixes with air unstably.
5. Combustion of great amount of fuel containing sulfur produces great amount of sulfur carbon dioxide containing water inside combustion chamber where sulfur acid is generated that it causes corrosion of nozzle or the other parts.
6. Fuel containing water causes unstable operation and rusty of nozzle, plunger, delivery valve.
7. Fuel containing great amount of carbon cinders erodes carbon at the end of nozzle and it deteriorate injection.

Fuel Filter

Generally, fuel filter contains many kinds of impurities which is invisible with the eyes and if it is used as fuel, it may cause difficulties in starting vehicles. That is why filtration of fuel is important.

1. Cleaning of fuel tank
If fuel tank gets rusty, it contaminates fuel. So, fuel tank should be cleaned with gasoline regularly.
2. Filter of each part of engine should be cleaned and replaced according to its specified running mileage or time.

A/S

Fuel injector is considered of great importance that one might compare this to the heart of a man.

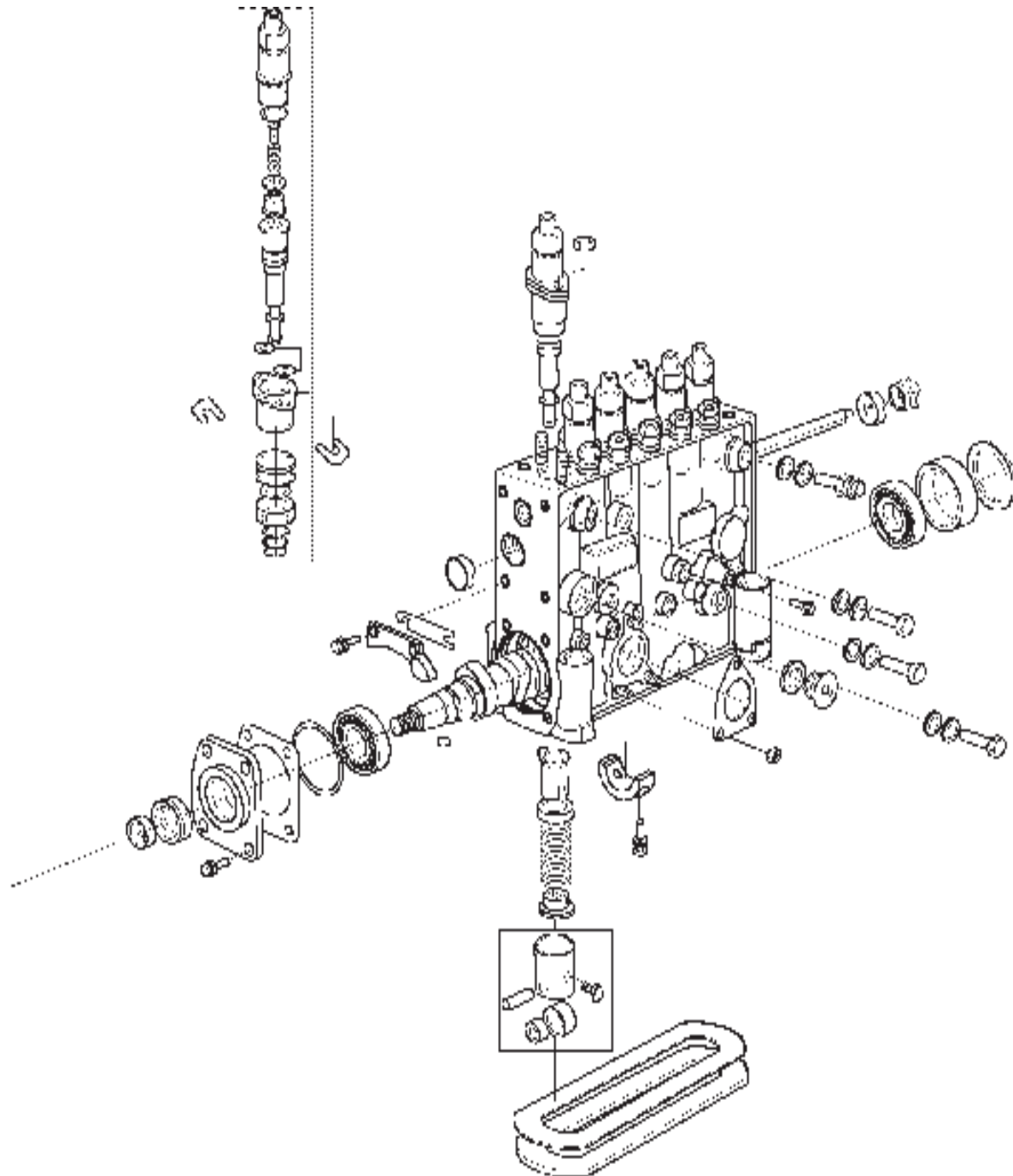
High quality of fuel must be injected with highly proper amount and at most appropriate time and should be controlled according to the capability of engine.

Those primal parts must be assembled and finished with high degree of quality and precision.

SERVICE PROCEDURE

Injection Pump

<COMPONENTS>



SERVICE PROCEDURE

FL-17

Disassembly

Disassemble the fuel injection pump.

1. Disassemble the fuel line, oil line and engine control line.
2. Disassemble the through bolt "B" and two flange bolts "A"(in slot hole).
3. Disassemble the pump installation bolt then disassemble the pump.

CAUTION

Cover the ends of pipe and pump for possible incoming of foreign matters.

Installation

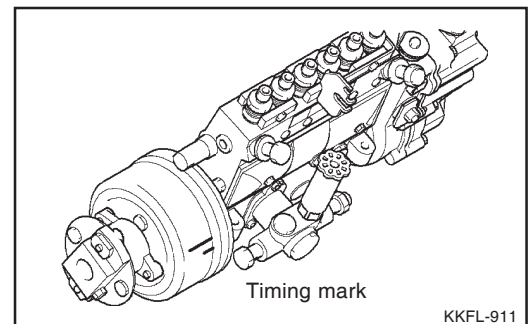
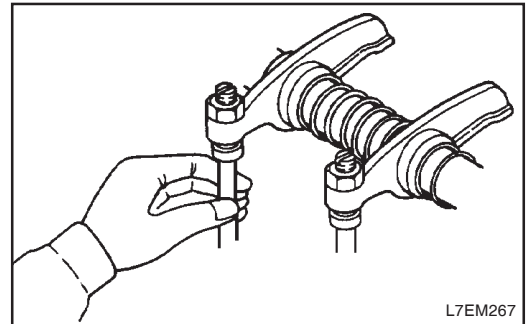
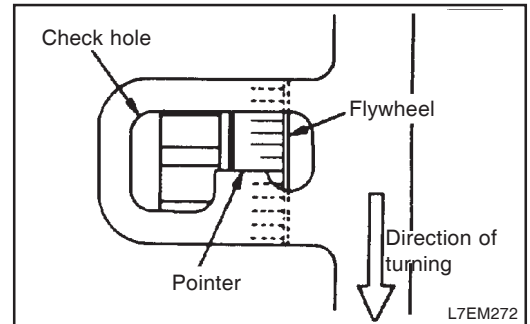
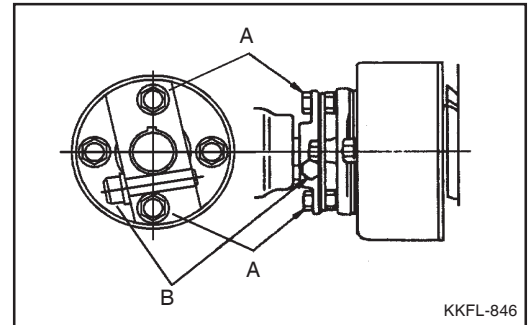
Assemble the fuel injection pump.

1. Adjust injection timing
Turn the crankshaft counterclockwise from flywheel's side so that injection timing mark on flywheel and pointer of flywheel housing can meet before A° of top dead center of compression stroke.
2. Check if the push rod of first cylinder is loose or 6th cylinder is tight.

CAUTION

If not, turn the crankshaft 360° and accord the marks with each other as described above.

3. Turn the auto flange timer clockwise slowly until the injection timing mark (a long mark, mark on the left viewed from crank side)on auto timer meets pump body pointer.



FL-18

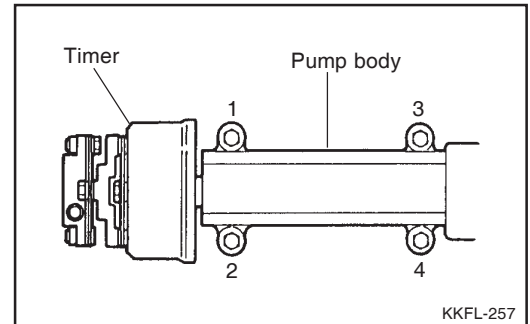
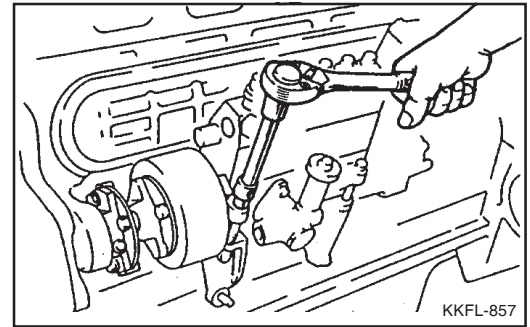
FUEL AND ENGINE CONTROL

4. Place pump on pump bracket and adjust the position of pump so that the installation hole and bracket hole be in a line then tighten the bolts as the table shown below with even force.

Order of tightening : 1-2-3-4

Unit: kgf-cm

	Tightening torque
1 st stage	20 - 50
2 nd stage	100 - 150
3 rd stage	190 - 260



5. Tighten two flange bolts on coupling with special tools.

CAUTION

There should be no space between two thin plates and no deformation of flange due to the pressure of thin plates.

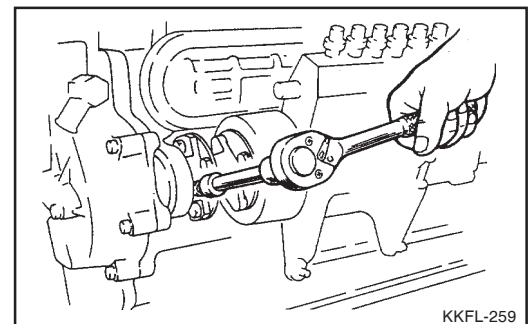
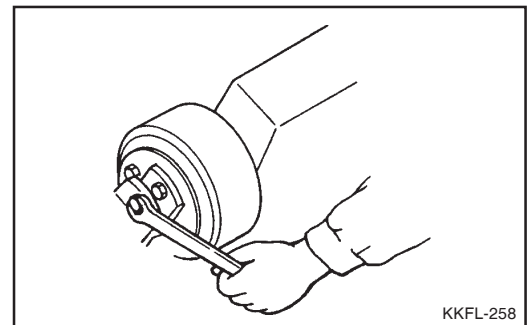
Special tool: Injection pump coupling wrench

6. Tighten the through bolt on the flange.

CAUTION

Do not tighten the through bolt before two flange bolts are tightened.

7. Connect fuel line, oil line and engine control line.



CAUTION

Be careful when handling laminate coupling in assembling.

- Do not bend the laminate plate pump or push it in to install by force.

When it is installed with the foregoing way, the operation of time may be modified (modification of injection timing) or coupling may be damaged.

SERVICE PROCEDURE

FL-19

- **Laminate coupling bolt should be tightened with specified torque uniformly and precisely.**
If not, it may cause damages to each part and modifications to timing.

Tightening torque

Unit: kg-cm

Coupling plate bolt(A)	Coupling driver bolt(B)
6 ~ 6.5	7.5 ~ 8.5

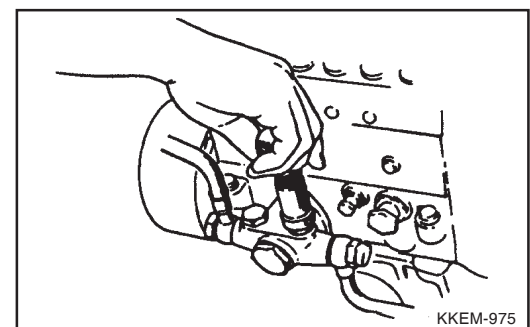
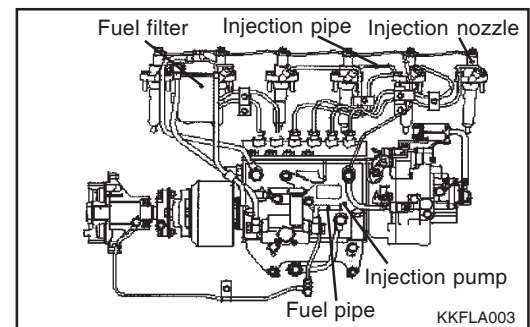
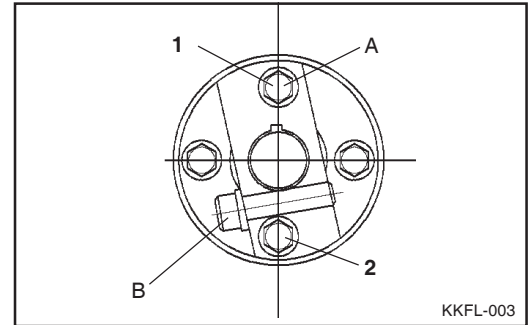
- **When linking coupling bolt after the timing is adjusted, follow the order of 1-2 not to cause laminate plate to curve over shaft side.**

Installation and check of each part

1. Connecting injection pipe
 - First, loosen the injection pipe placed injection pump's side a little bit and tighten the injection nozzle holder completely then assemble the pipe nut.
 - Flange nut tightening torque : 4.0~5.0 kg.cm**
2. Use new gasket in connecting injection pump oil pipe and fuel pipe.
3. Bleed of fuel line
 - Fuel may be stopped sometimes if it is mixed with air while engine is operating or if some part of fuel pipe is clogged in installing injection pump. As a result, it may be difficult to start vehicles or enough amount of fuel may not be obtained while engine is operating. Also, idling RPM becomes unstable.
 - In this case, the air in between fuel tank and feed pump can be eliminated as feed pump operates.
 - Eliminate air in fuel filter
 - Loosen the overflow valve on fuel filter
 - Loosen the priming pump knob
 - Operate the pump until the fuel flow over from overflow valve without vaporation.
 - Tighten the overflow

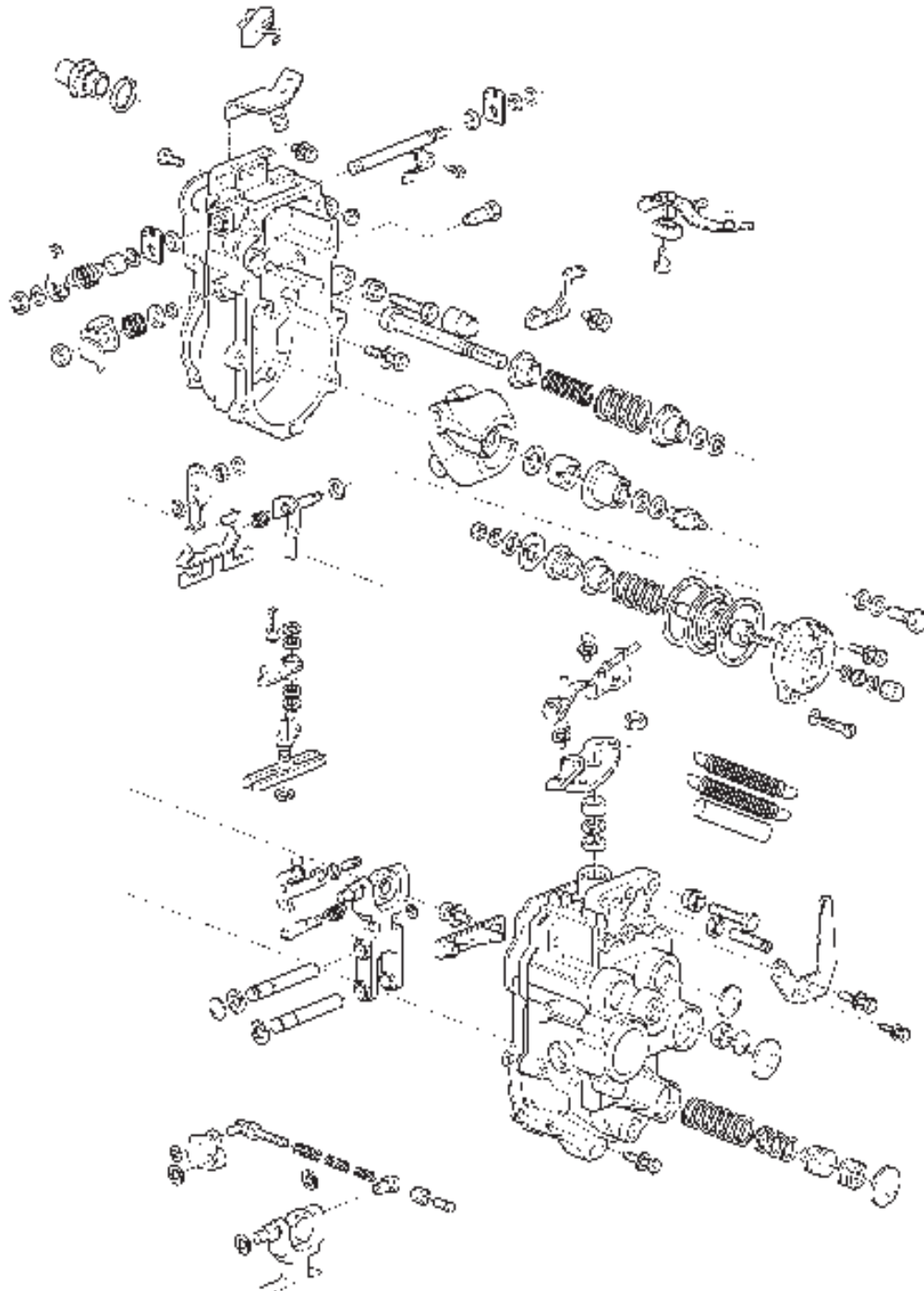
CAUTION

- **Breather plug must be closed while operating priming pump knob**
- **Operate priming pump knob several times**

CAUTION**Wipe up splashed fuel**

Governor

<COMPONENTS>



KKFLB017

SERVICE PROCEDURE

FL-21

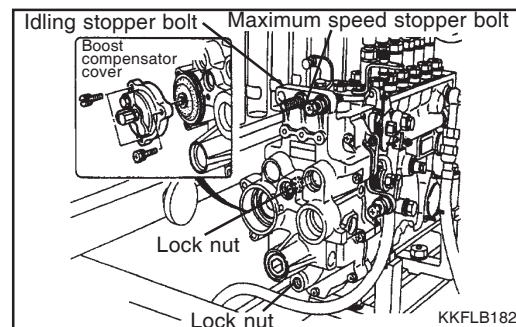
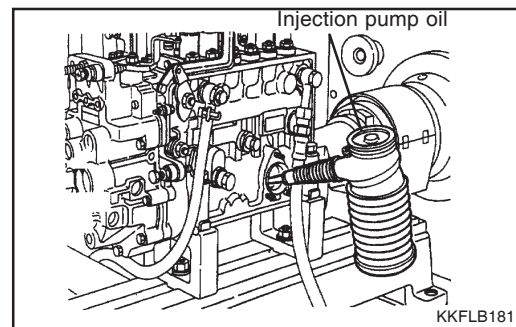
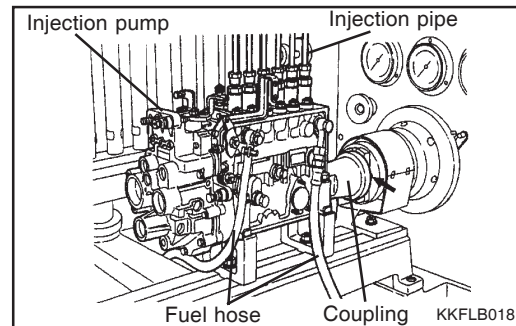
Adjustment of Governor Attachment of Injection Pump

1. Attach injection pump to pump tester.

CAUTION

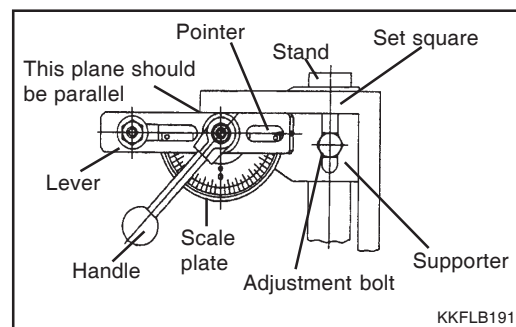
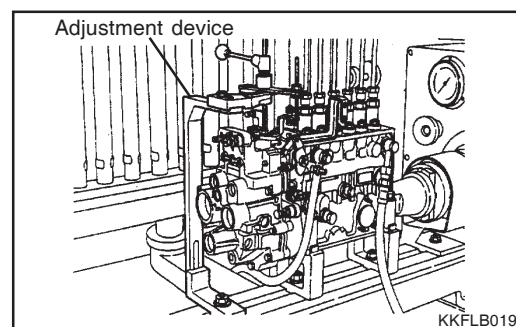
Turn the flywheel 2~3 times with lever and see if the center of coupling is in the right place then connect link bolt(Marked as an arrow) of pump tester.

2. Connect fuel hose and injection pipe to injection pump.
3. Provide cam chamber and governor chamber with oil of injection pump. Put the cap on where the feed pump is detached after provision of oil.
4. Loosen the maximum speed stopper bolt, idling stopper bolt and full load set bolt.
5. Loosen the idling spring and lock nut of governor shaft.
6. Separate the cover of boost compensator.



Attachment of adjustment device(harness)

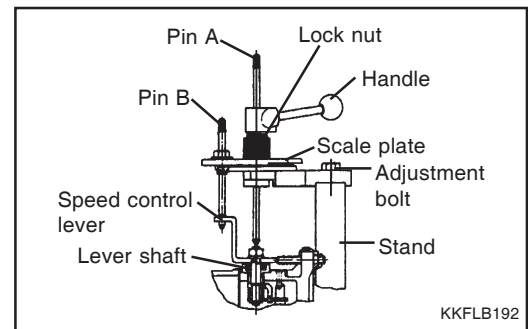
1. Attach adjusting device to pump tester.
2. Set the lever perpendicular to the supporter.
3. Set "0" position of scale plate on the pointer of lever and fix it with lock nut under the handle.



FL-22

FUEL AND ENGINE CONTROL

4. Set the pin "A" in the center of lever shaft.
5. Put the pin "B" in the hole of speed control lever.
6. Check if the operation and link occur smoothly when speed control lever is adjusted to its maximum speed position and if control rack is operated without any problems.



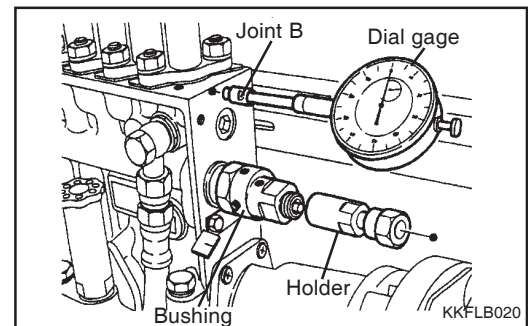
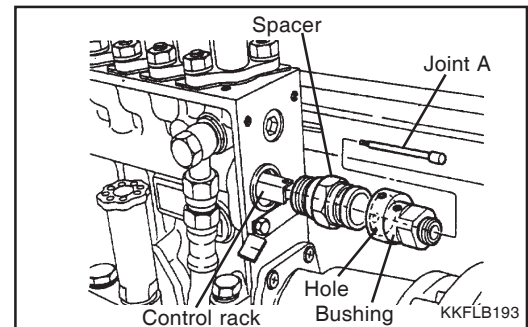
Attachment of measuring harness

1. Attach the spacer to pump housing.
2. Attach assembled parts to control rack after assembly of joint A and bushing.
3. Assemble the bushing temporarily to spacer.

CAUTION

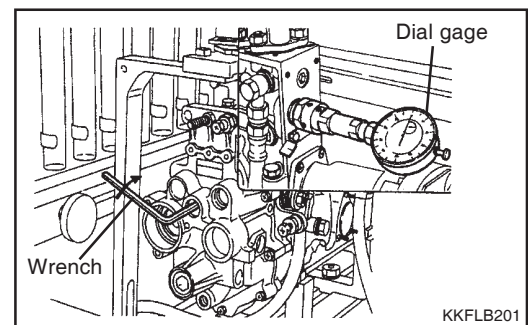
Bushing hole for joint A is eccentric. So, fixate the bushing for joint A to move smoothly.

4. Attach joint B to dial gage.
5. Assemble dial gage to holder and attach holder to bushing.



Setting zero point of control rack

1. Set the speed control lever at idle position.
2. Turn the governor shaft lightly and tighten nut in it.
3. Raise pump RPM up to 1000~1200r/min and pull the control rack completely to set and fixate zero position of dial gage.



Adjustment

Adjustment notes

1. Fixation of control rack

Adjust the injection timing and quantity of injection pump before adjusting governor. At this moment, fixation of control rack is required, that is, maintain the position of speed control lever at idling and raise the RPM of pump up to 500~600r/min then switch speed control lever to maximum speed position(full speed) and then set control rack to +3mm position from full load position using full load set bolt.

Adjust quantity of injection under this condition.

2. Adjustment of torque cam

Fix the torque cam adjustment nut using lock screw.

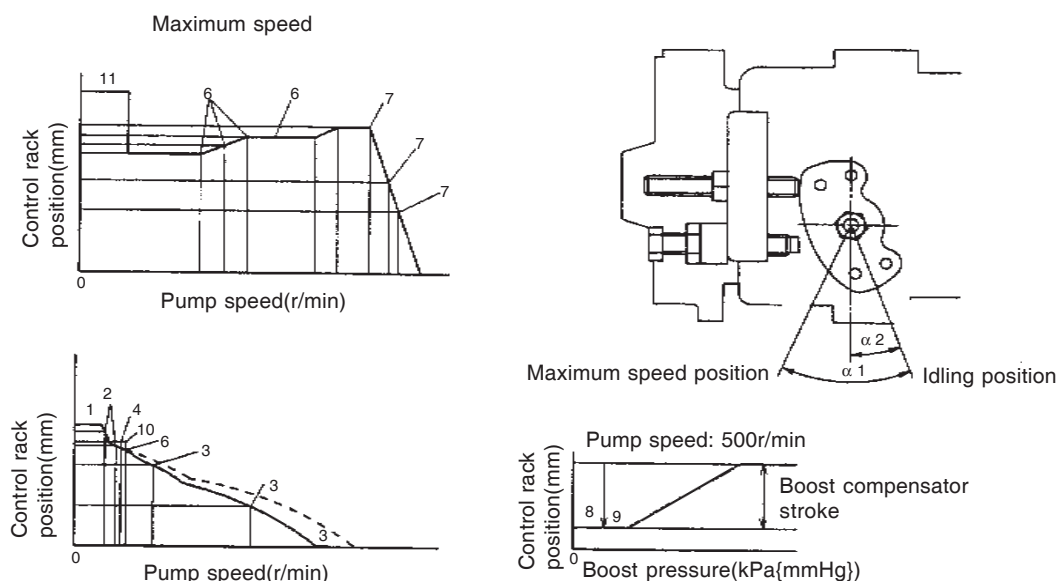
3. Manipulation of speed control lever

In case of manipulating speed control lever to maximum speed position(full speed), it is necessary to raise the RPM of pump up to 500~600r/min at idling lever position.

This keeps sensor lever from separating from torque cam.

4. Adjustment of idling and full load

In adjusting idling, attach the return spring to speed control lever for speed control lever to contact idling stopper bolt and for speed control lever to contact speed stopper bolt in adjusting full load.



Adjustment	Adjustment point
Governor spring setting	
• Temporary idling lever setting	1
• Adjustment of idling spring	2
• Governor spring setting	3
• Adjustment of Idling	4
Full load rack position	
• Adjustment of full load rack position	5
• Torque cam adjustment	6
Adjustment of maximum speed control	7
Adjustment of boost compensator	
• Adjustment of operating stroke	8
• Adjustment of operating initiation position	9

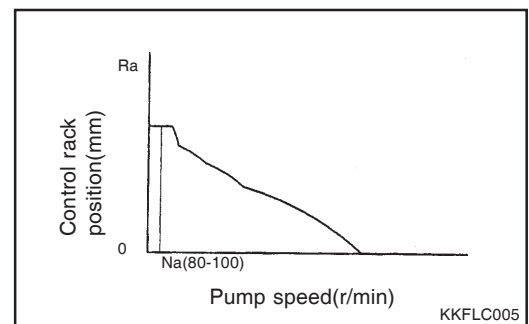
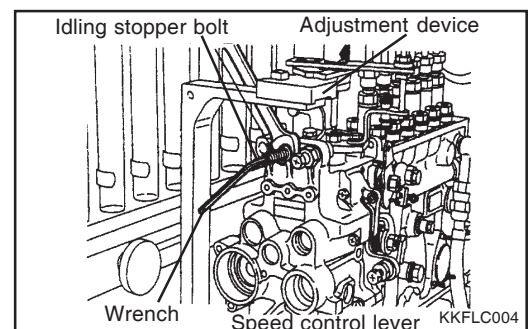
Governor spring setting

Temporary setting of idling lever

1. Maintain the position of speed control lever where it touches idling stopper bolt.
2. Operate the pump at the RPM of N_a r/min(80~100r/min) and adjust the position of control rack until it reaches R_a mm position with idling stopper bolt then fix the idling stopper bolt using lock nut.

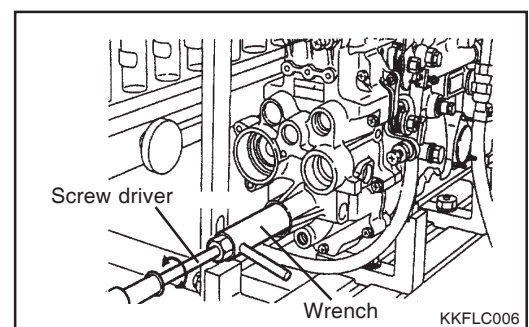
CAUTION

In this case, check if the angle of speed control lever is within the range of predetermined angle as written in the data sheet with scale plate of adjustment harness.



Adjustment of idling spring

1. Maintain the speed control lever where it touches idling stopper bolt.
2. Operate the pump at the RPM of N_c r/min and adjust the idle spring until it reaches R_a mm position then fix the lock nut using wrench.



3. Operate the pump at the RPM of Nb r/min. Check the position of control rack if it is at Rb mm.

CAUTION

If not, adjust the idle spring adjustment rest and repeat the adjustment No.2 as above.

Adjustment of governor spring setting.

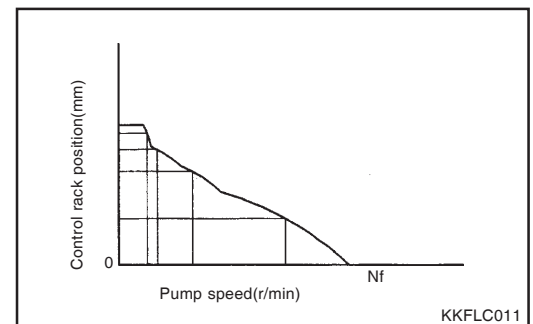
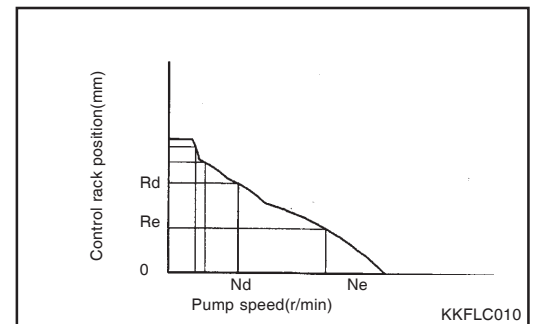
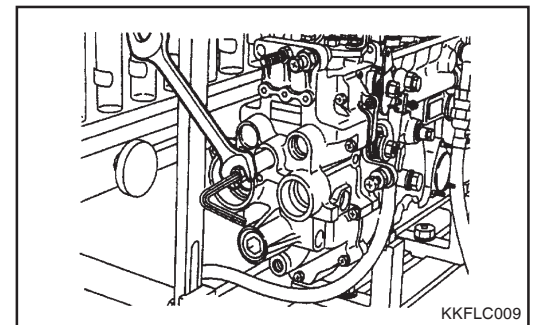
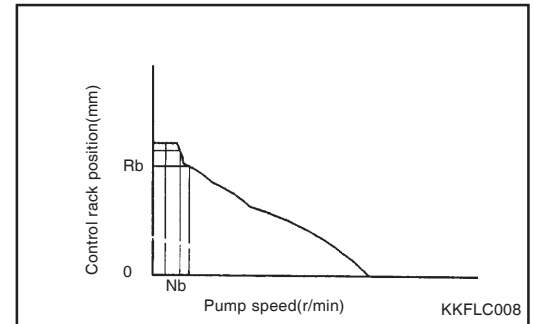
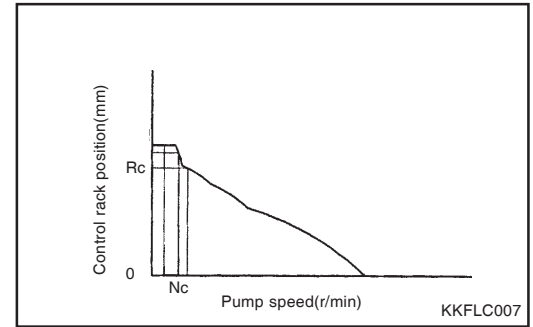
1. Maintain the position of speed control lever where it touches idling stopper bolt.
2. Adjust the governor shaft so that the position of control rack at Nd r/min become Rd mm, then fix the lock nut using wrench.

3. Operate the pump at the RPM of Ne r/min. Check the position of control rack if it is at Re mm.

CAUTION

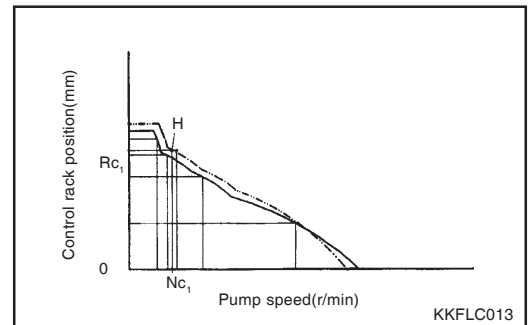
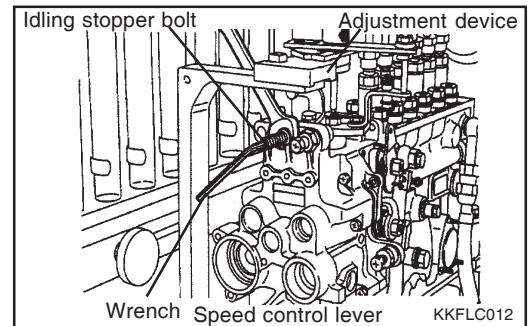
It not, repeat adjustment No. 2 until it becomes Re mm within a tolerance range.

4. Raise the RPM of pump and check if the RPM indicates "Nf" when the position of control rack reaches "0".



Adjusting Idler

1. Keep speed control lever touched on idling stopper bolt.
2. Make pump work at N_{c1} r/min, and adjust the idling stopper bolt until control rack moves to the range of R_{c1} mm. Next, fix the idling stopper bolt with lock nut. (point H)
3. Keep up the rotational frequency of the pump and check it when control rack reaches to "0".
4. After finishing adjusting, see if the angle of idling speed control lever ranges within the standard angles written on data sheet by referring to scale plate of the control device.

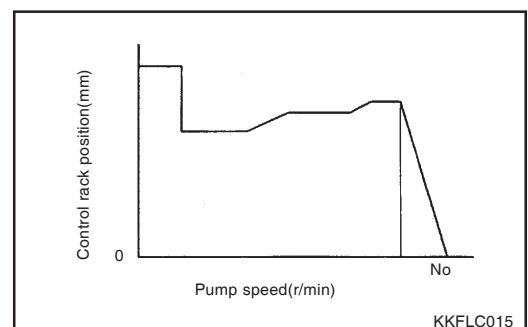
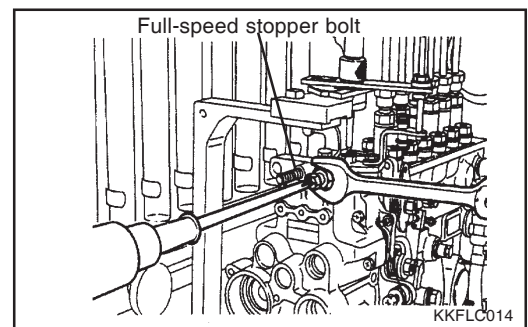


Adjusting Full Load Rack

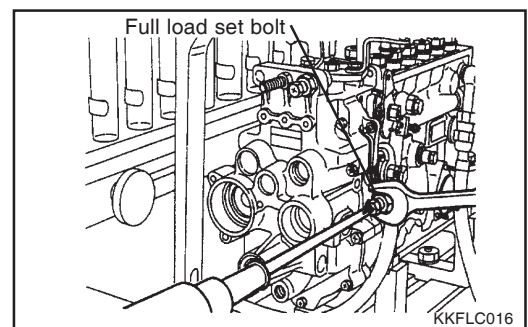
Regulate the position of full load rack within the control rack position, while the boost compensator working.

Adjusting the position of full load rack

1. Get the speed control lever contacted on full-speed stopper bolt.
2. Adjust the full-speed stopper bolt at the pump speed a little bit lower than N_o r/min, and pre-tighten the lock nut.



3. Get the pump working at N_l r/min, adjust the full load bolt until the position of control rack comes to R_{H3} mm, and then fix the full load bolt with lock nut.
 - If you tighten the full-load set bolt, control rack position will come down.
 - If you loosen the full-load set bolt, control rack position will go up.



Adjusting Torque Cam

1. Keep the speed control lever contacted on stopper bolt.
2. Operate the pump at N_j r/min, screw torque cam-adjusting nut until the control rack position reaches R_{h2} , and then fix up the adjusting nut with special wrench.

CAUTION

Adjusting point varies depending on the type of injection pump; therefore, it must be fixed on the basis of injection pump test sheet.

[Procedures of adjusting torque cam]

- Unfasten torque cam lock screw with a screw driver.
- Adjust torque cam using a wrench.
- After the adjustment, fix the torque cam lock screw with a screw driver.

3. Keep up the pump rotation from N_i r/min-100 r/min to N_{nr} /min, and see if control rack position and pump speed match with the governor-capacity graph.
4. If the pump speed does not match with control rack position, repeat the 2 above.

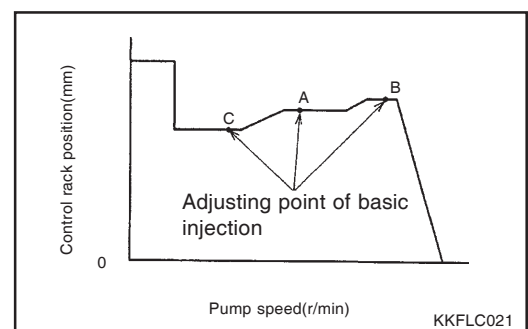
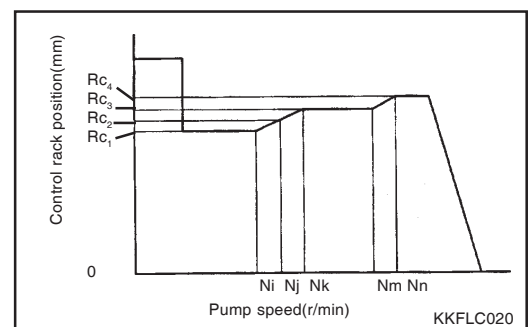
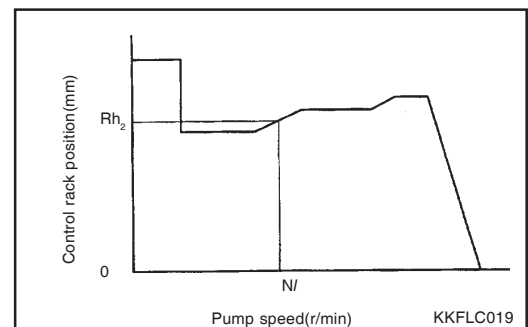
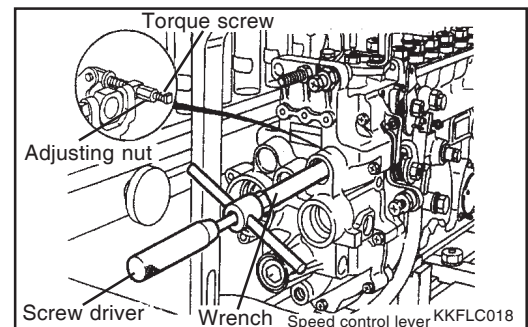
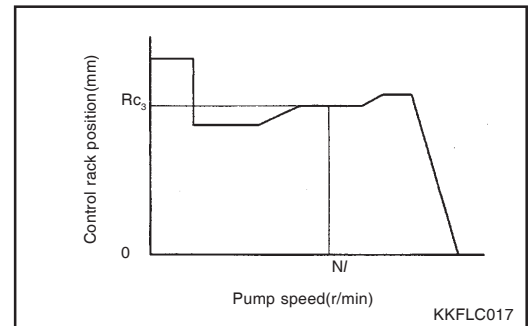
CAUTION

In case that pump speed does not satisfy the standard range of control rack position, replace the torque cam and re-adjust it.

5. Check if injection satisfies the standard range on each adjusting point (A~C) of standard lever setting. When the injection does not reach the standard, adjust full-load set bolt and torque cam by minutely screwing the adjust nut.

CAUTION

If this adjustment fails to be properly conducted and injection rate does not range within the standard, it will cause the lack of engine power and emission of gray smoke.

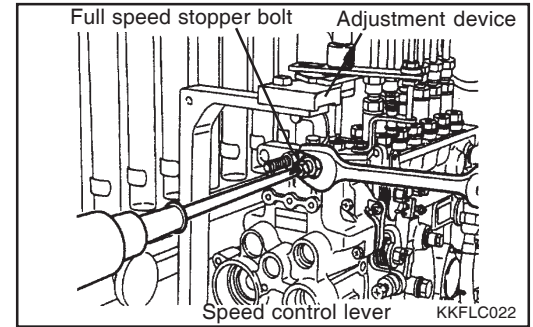


Adjusting Full Speed Control

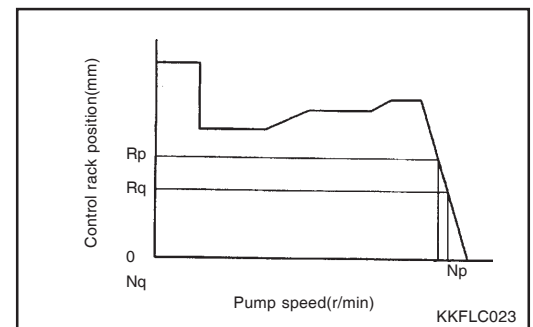
1. Keep the speed control lever touched on full speed stopper bolt.
2. Get the pump working at N_p r/min, adjust the full speed stopper bolt until control rack position reaches R_{pmm} , and then fix the full speed stopper bolt with lock nuts.
3. Get the pump working at N_q r/min, and check if the control rack position comes to R_{qmm} .

CAUTION

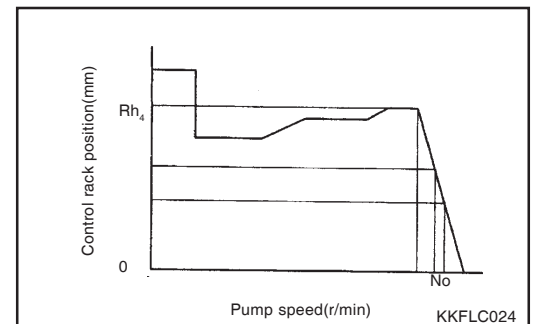
If control rack position does not reach “ R_q ”, repeat 2 above and re-adjust R_p until it reaches R_q within the accepted range.



4. Increase the rotational frequency of pump, and make the control rack return to “0”.



5. Keep up the rotation gradually from N_o r/min or below, and see if control rack at N_o r/min begins to come down from R_{h4} .
6. After adjustment, check it out from adjustment device scale that the angle of the control lever at full load ranges within the standard of data sheet.



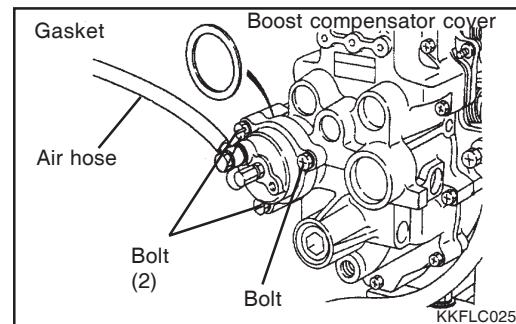
SERVICE PROCEDURE

FL-29

Adjustment of Boost compensator

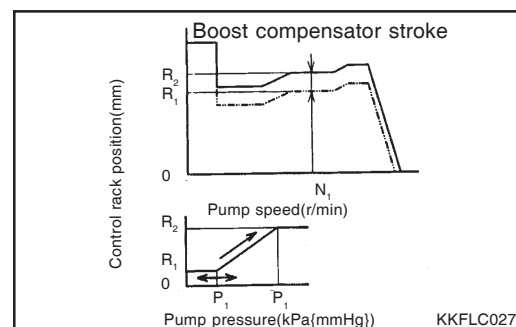
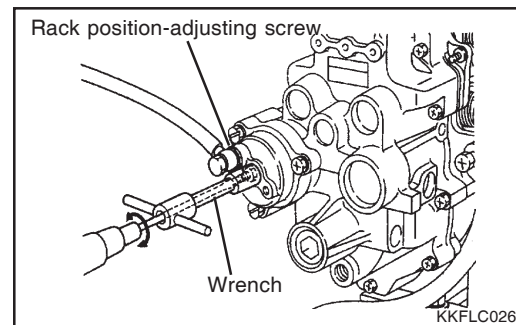
Installation of Air Hose

1. Install boost compensator cover and governor cover gasket.
2. Link air hose into boost compensator.



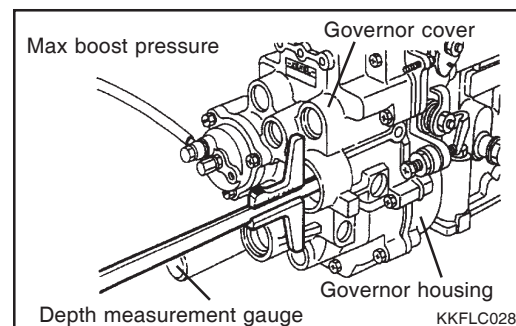
Adjustment of operation stroke

1. Keep speed control lever contacted on stopper bolt.
2. Get the pump working from "0" up to N1 rpm.
3. Adjust the screw for adjusting control rack position with a wrench, in order that control rack position could move from R2 to R1.
4. Increase the pressure up to that of data sheet, and check if rack position for P2 falls on R2.



Selection of Push Road

1. Keep the boost pressure up to the maximum pressure of injection control sheet.
2. Check the depth from the surface of housing to lever, using a gauge. In case the depth overreaches the prescription, replace the push road. When replacing the push road, governor cover needs to be taken out.



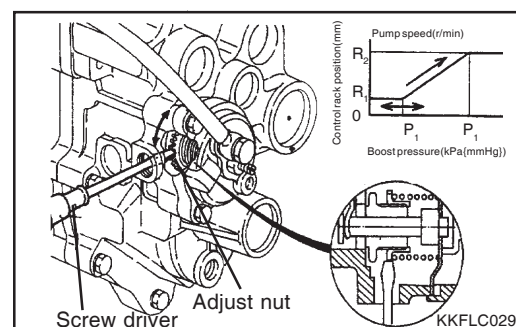
Adjustment of Start Position

1. Keep the speed control lever contacted on full speed stopper bolt.
2. Remove plug from the adjust hole.
3. Increase the boost pressure, and adjust the nut so that control rack can start to move from R1mm at boost pressure P1.

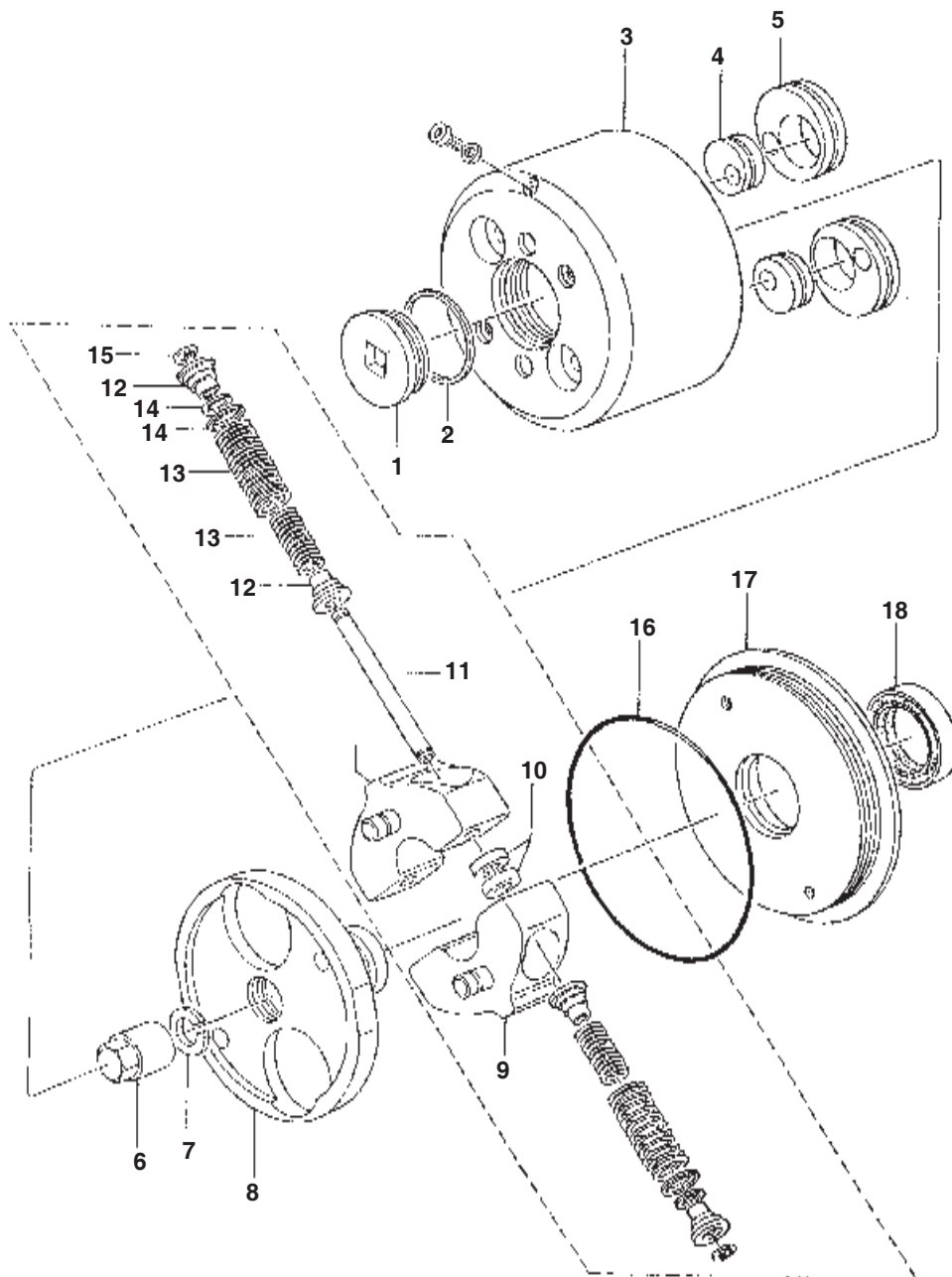
CAUTION

When using a screw driver, be careful not to damage the adjusting nut.

4. After the adjustment, cover plug and cap onto its respective appropriate position.



Timer (SPG)



- | | | |
|--------------------------|------------------|------------------|
| 1. Plug | 7. Spring washer | 13. Timer spring |
| 2. Gasket | 8. Holder | 14. Shim |
| 3. Timer housing | 9. Flyweight | 15. Snap ring |
| 4. Eccentric cam (Small) | 10. Spacer | 16. O-ring |
| 5. Eccentric cam (Large) | 11. Pilot pin | 17. Cover |
| 6. Nut | 12. Spring seat | 18. Oil seal |

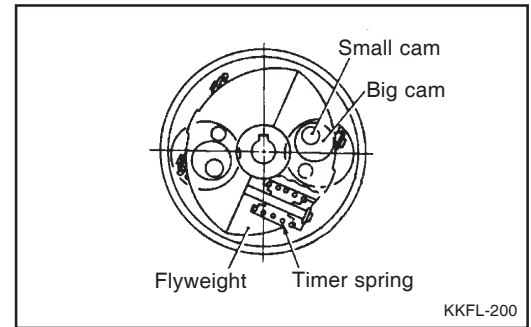
SERVICE PROCEDURE

FL-31

SPG-type auto-timer, a kind of mechanical auto-timers, changes automatically the fuel injection timing according to the rotation of engine.

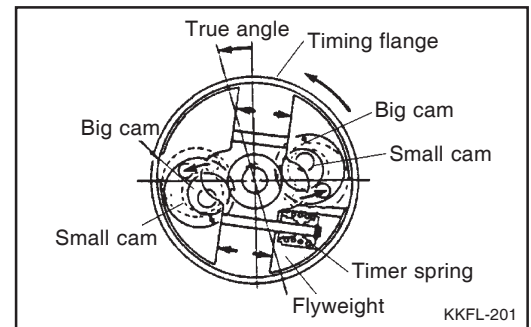
1. When stopped

Flyweight stays under oppression of timer spring set.

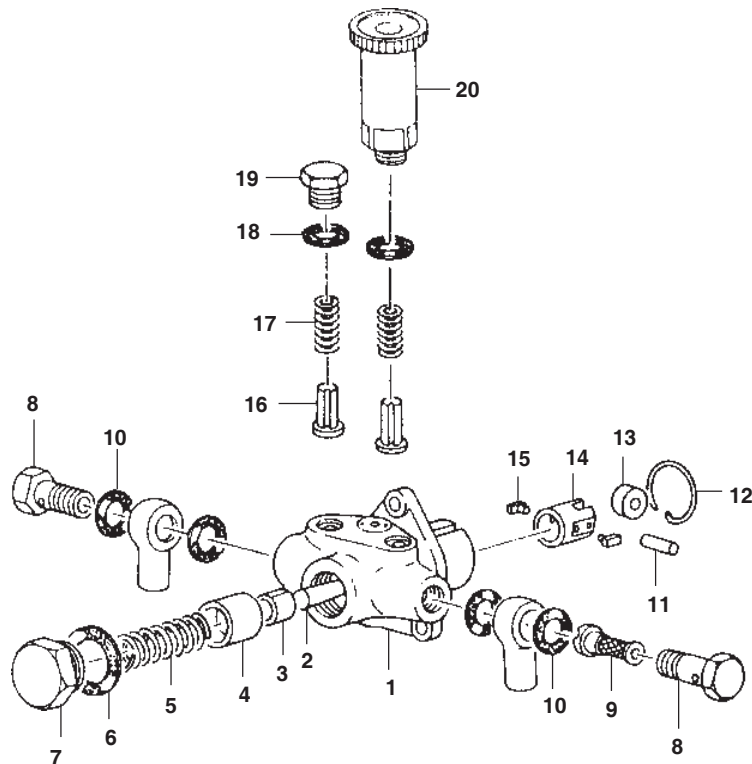


2. When in operation

As the spin of the engine goes up, centrifugal force gets bigger. Flyweight, after resisting the oppression, gets lifted up. Because of it, small and big cams move in the rotational direction. Because big cam is installed in the hole of timing flange, its movement affects the timing flange, which makes true angle.



Supply Pump



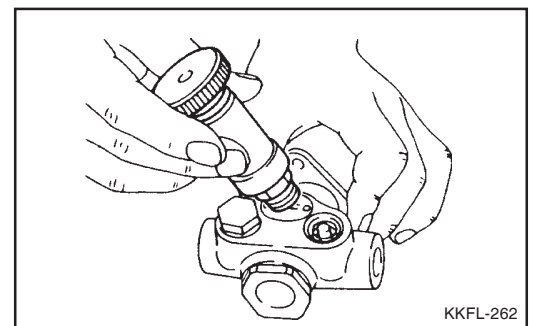
- | | | | |
|------------------------|---------------|-------------------|------------------|
| 1. Supply pump housing | 6. Gasket | 12. Retainer ring | 17. Spring |
| 2. Push rod | 7. Plug | 13. Roller | 18. Gasket |
| 3. Oil seal | 8. Joint bolt | 14. Tappet | 19. Plug |
| 4. Piston | 9. Filter | 15. Sliding block | 20. Priming pump |
| 5. Spring | 10. Gasket | 16. Check valve | |
| | 11. Pin | | |

KKFL-261

Disassembly

Disassemble priming pump from check valve.

1. Loosen priming pump and disjoint spring and inlet check valve.
2. Disjoin outlet check valve and spring.



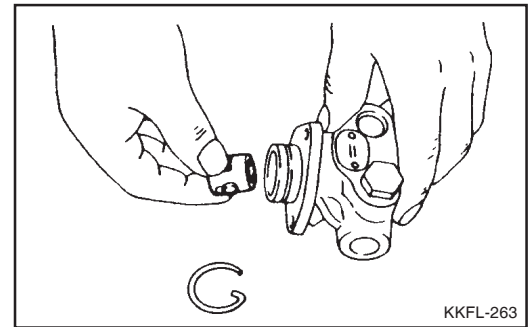
KKFL-262

SERVICE PROCEDURE

FL-33

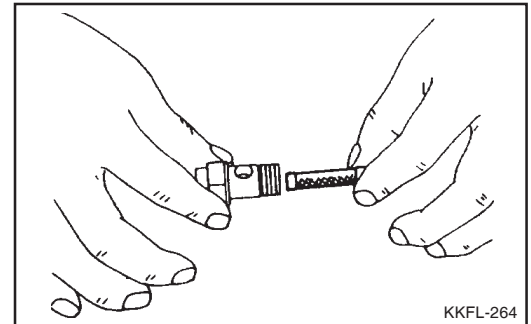
Separate tappet.

Disjoin snap ring and pull the tappet out.



Disassemble filter from inlet pipe joint.

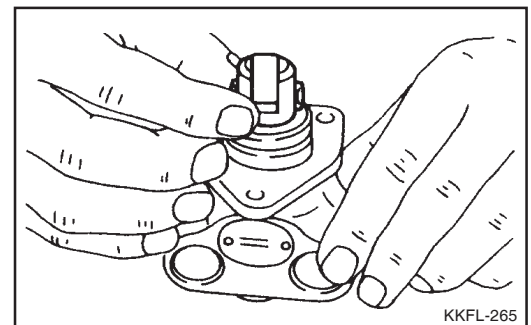
Cleanse the filter with pure diesel fuel.



Assembly

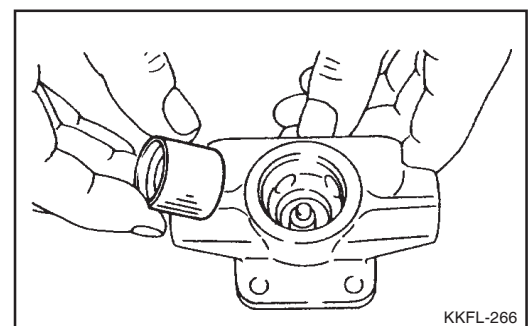
Fit the tappet in.

Insert snap ring.

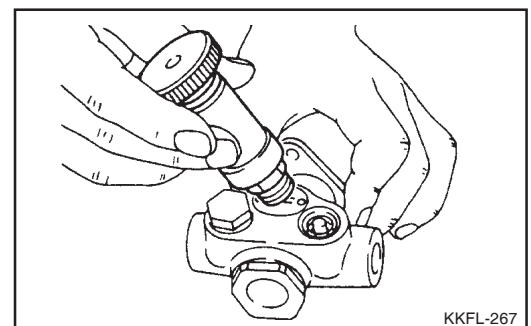


Fit in the piston.

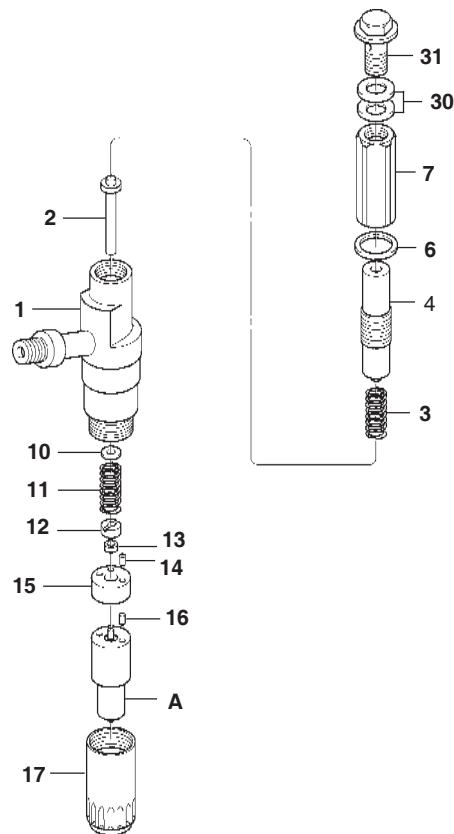
Put the piston and spring in the housing and screw the new gasket and the plug into the chamber.



Fit in priming pump and check valve.



Spray Nozzle (KBL 2.3-S type 2nd Spring) Disassembly



- | | | |
|---------------------------|----------------------------|-------------------|
| 1. Nozzle holder body | 7. Cap nut | 16. Pin |
| 2. Push rod | 11. 2 nd spring | 17. Retaining nut |
| 3. 1 st spring | 12. Spring sheet | 30. Gasket |
| 4. Adjusting screw | 13. Lift piece | 31. Eye bolt |
| 5. Nozzle | 14. Pin | |
| 6. Gasket | 15. Spacer | |

KK 200 001

After removing the carbon attached to nozzle and nozzle holder, proceed with disassembly, assembly and adjustment.

Order of disassembly:

17 → 5, 16, 15, 13, 14 → 12 → 11 → 10

Socket wrench(SW 19mm)

7 → 6, 4 → 3 → 2

Socket wrench(SW 19mm)

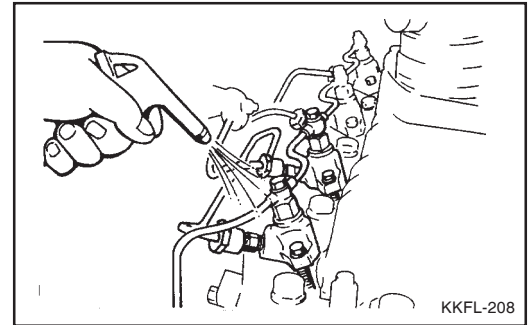
SERVICE PROCEDURE

FL-35

1. Clean the surroundings of nozzle and fuel line connector.

CAUTION

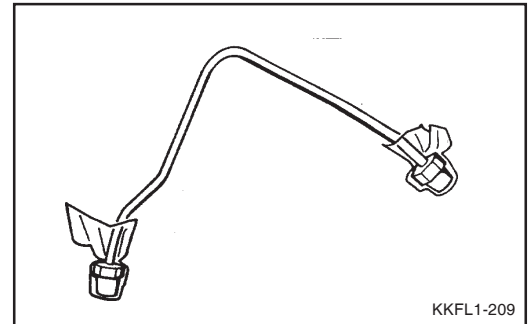
Letting the alien substance into combustion chamber may bring problems to the engine.



2. Take fuel-spraying pipe out.

CAUTION

Cover the ends of pipe and fuel-spraying pump, to prevent alien material from penetrating in.



3. Remove nozzle holder.

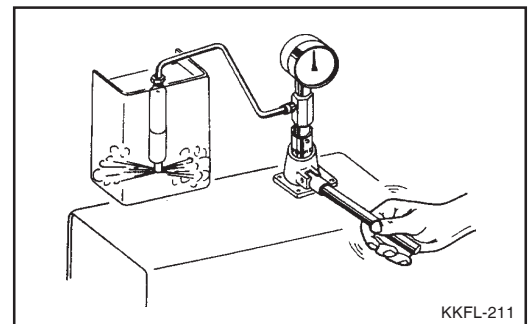
CAUTION

After removing the nozzle holder, cover it with cloth. Also, cover the cylinder head to prevent dust from going through the head.

4. Check out the nozzle operation pressure and then adjust it.
 - 1) Set assembled nozzle holder on the nozzle tester, and operate the lever 50 to 60 times per minute.

WARNING

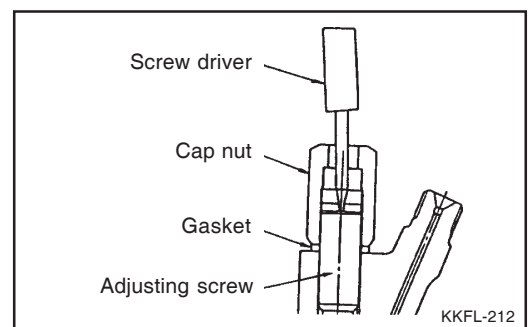
- Diesel oil is flammable. Adjusting the nozzle must be done in a well-ventilated place without any source of flame and electric spark.
- Pay special attention to keep the fuel spray off the eyes or skin.



- 2) At the same time, see if the nozzle pressure is in the prescribed range. If not, adjust the pressure to prescribed figure, using adjusting screw.

CAUTION

Replace gasket with a new one.



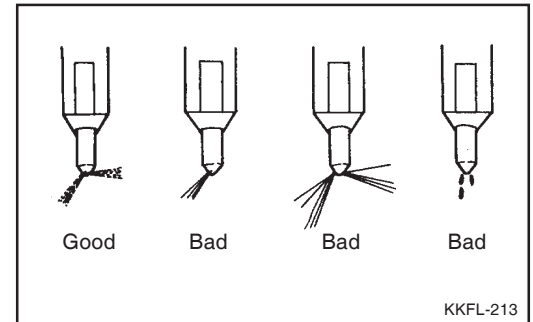
Altered Pressure

 Unit: kgf.cm²

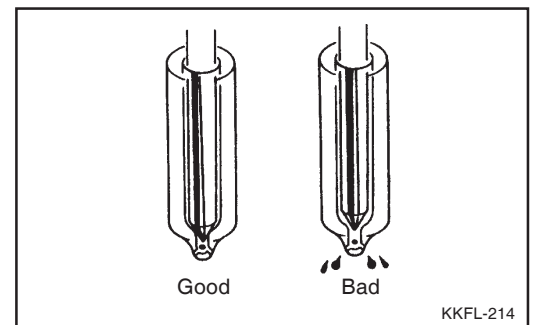
Engine Model	Pressure	
D6DA	1 st Opening Pressure (nominal)	160
	1 st Regulated Pressure	165~173
	2 nd Opening Pressure (nominal)	220
	2 nd Regulated Pressure	235~245
	(nozzle cover type stroke 0.11mm)	(2 nd Opening Pressure : 225~235kgf.cm ²)

Test of Injection Form:

In case of a new nozzle, operate the lever at the rate of 30~60 strokes a minute. And in case of a used nozzle, operate the lever 15~60 strokes a minute.


5. Test of oil leakage

When checking the oil leaks from the nozzle, apply the pressure which is 0.98~1.96MPa(10~20kgf/cm²) lower than the nozzle controlling pressure(N.C.P).



Assembly/Adjustment of KBL2.3-S type 2nd spring nozzle holder

In the event of adjusting, follow the procedures below, assembling parts. Also, as this 2nd spring nozzle holder is adjusted in 1/100mm, the foreign matters like dust must be thoroughly cleared, using clean oil (e.g. diesel fuel, etc.). The number in the () following the nomenclature of each part signifies the number in the pictures of KK 200 001 series.

Operation Procedures

- | | | |
|---|--|--|
| 1 | Adjusting 1 st opening pressure | Adjust the 1 st opening pressure of the nozzle with adjusting screw. (4) |
| | C: | |
| 2 | Checking the maximum lift of needle valve | Check it in the method of nozzle cover. |
| | C: | |
| 3 | Checking free lift | Apply the nozzle cover method.
CAUTION
In the case of non-standardized parts, replace nozzle assembly, lift piece and spacer with “nozzle service kit”. |
| | C: | |
| 4 | Checking 2 nd opening pressure | Apply the nozzle cover method. |
| | C: | |
| 5 | Adjusting 2 nd opening pressure | Adjust the 2 nd opening pressure of nozzle to adjusting seam. (10) |
| | C: | |
| 6 | Replacing retaining nut | Replace the retaining nut for adjustment with standard retaining nut. |
| | C: | |
| 7 | Final test | Check the injection with nozzle and nozzle holder assembly. |
| | C: | |

Adjustment of 1st opening pressure

1. Attach the plate of the plate assembly on vice.

CAUTION

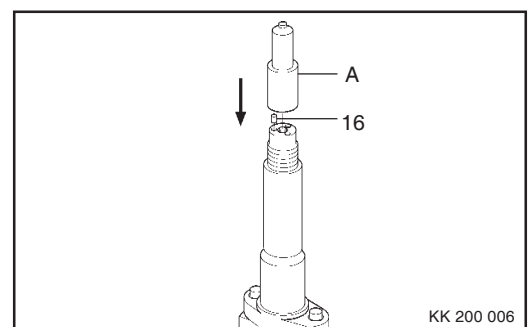
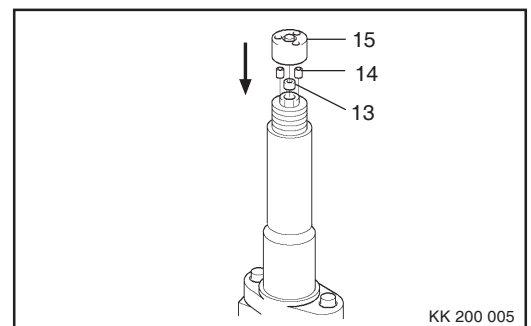
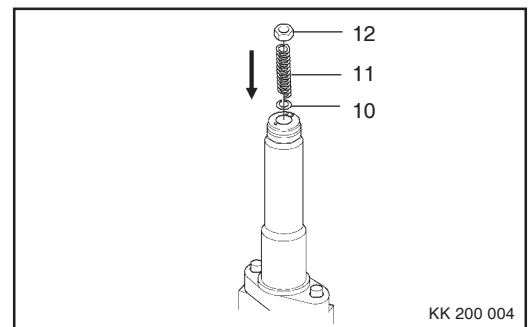
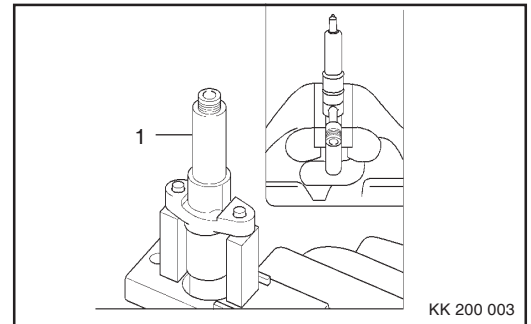
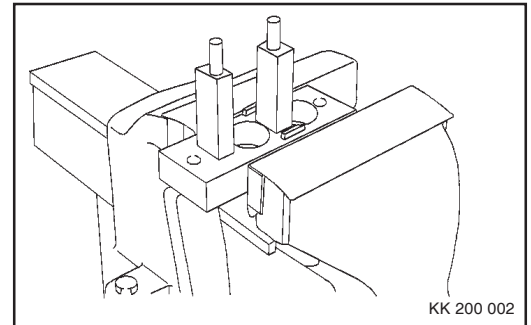
Plate assembly is used to fix nozzle holder with flange. Set directly on vice the nozzle holder without flange.

2. Fix 2 pins on plate with nuts.
3. Put the nozzle holder body(1) on plate, with the cap nut downward.
4. Assemble adjusting seam(10) and 2nd spring sheet(12) (in this order) into the nozzle holder body.

CAUTION

2nd spring is the same one as 1st spring.

5. Put together pin(14), lift piece(13) and spacer(15) into the nozzle holder.
6. Assemble pin(16) and nozzle(A) into spacer.



SERVICE PROCEDURE

FL-39

- After capping gasket on the head of nozzle, fit the nozzle in nozzle holder body with retaining nut for adjustment.

CAUTION 1

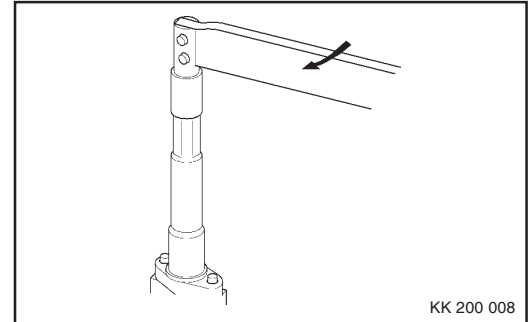
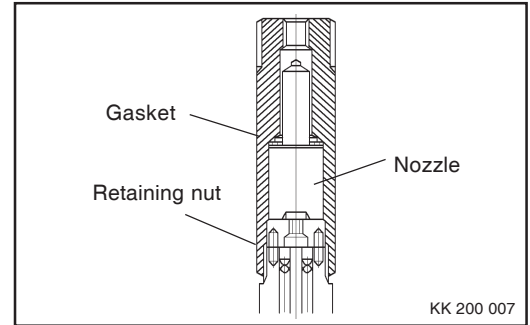
Tighten retaining nut after seeing if lock pin falls fully into the nozzle.

CAUTION 2

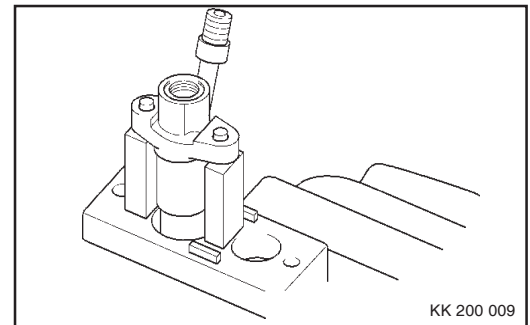
After tightening the retaining nut using fingers, tighten it again with torque wrench to the specified torque level.

- You need to follow the specified torque when tightening the retaining nut for adjustment.

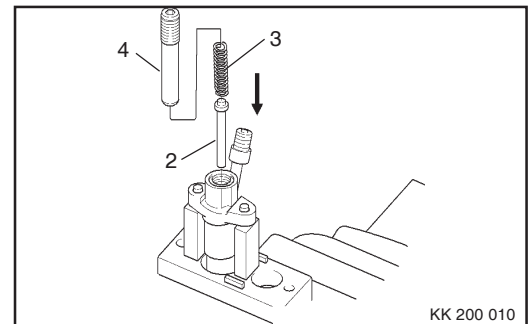
Specified torque: 59~78Nm(6.0~8.0kgf-m)



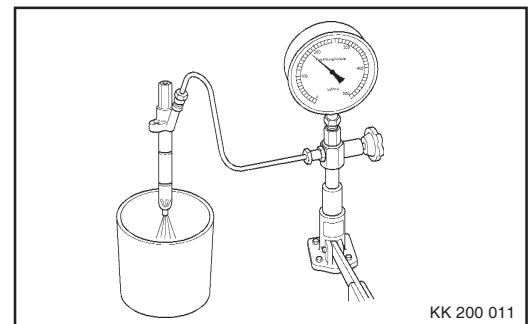
- Attach the nozzle holder on the plate, with cap nut upward.



- Insert push rod(2), 1st spring(3) and adjusting screw(4) (in this order) into the nozzle holder.
- Attach gasket(6) and cap nut(7) to adjusting screw(4).



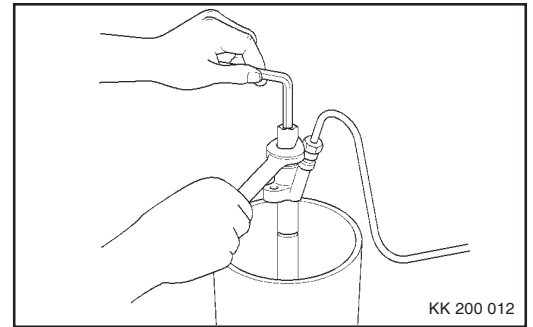
- Attach nozzle and nozzle holder to nozzle tester.



FL-40

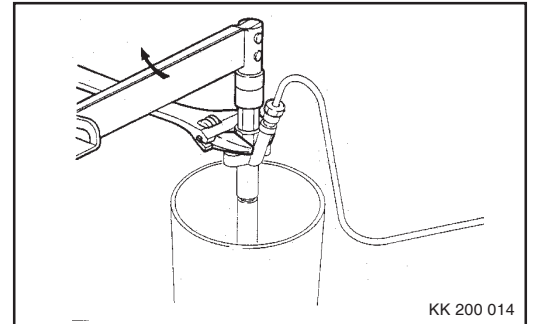
FUEL AND ENGINE CONTROL

13. Adjust the assembly with adjusting screw(4) until 1st opening pressure reaches the specified level.



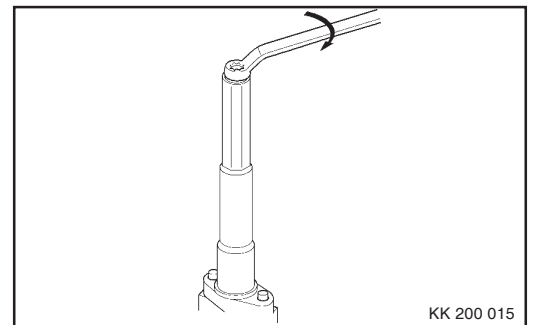
14. Fix the nozzle holder body with spanner, and tighten cap nut (SW19mm) to the level of specified torque.

Torque for tightening cap nut:
29~39Nm(3.0~4.0kg-m)

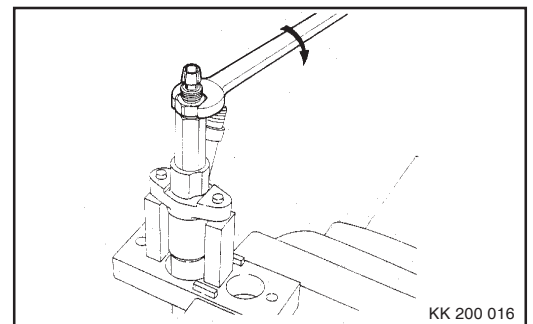


Checking the maximum lift of needle valve

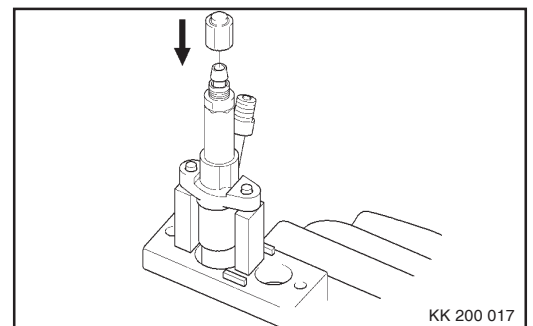
1. Attach gasket and plug to the retaining nut for adjustment.



2. Attach nozzle holder on plate, with cap nut upward.
3. Attach the holder(SW12mm) to cap nut.



4. Fit a nut(17mm) in the holder.



SERVICE PROCEDURE

FL-41

5. Insert pin haul into the dial gauge.

CAUTION

Below is the length excluding the screw part.

Part number	(mm)
157892-4200	160
157892-4300	110

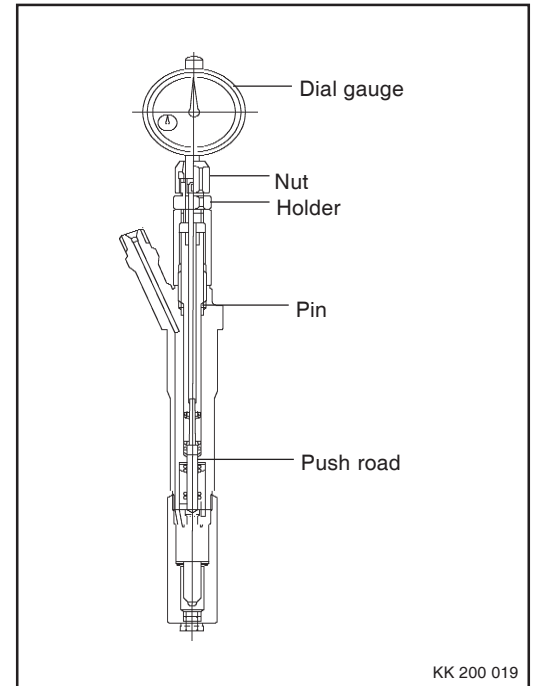
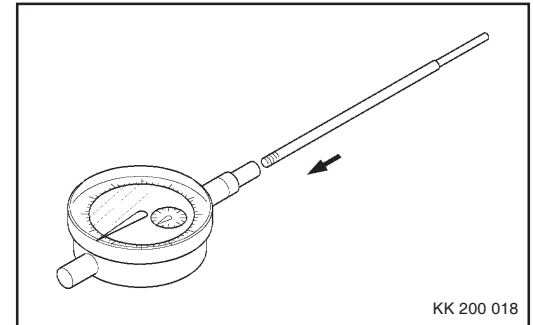
6. Insert dial gauge into nozzle holder assembly with the pin contacting the top of push road(2), and fix it with a nut.

CAUTION 1

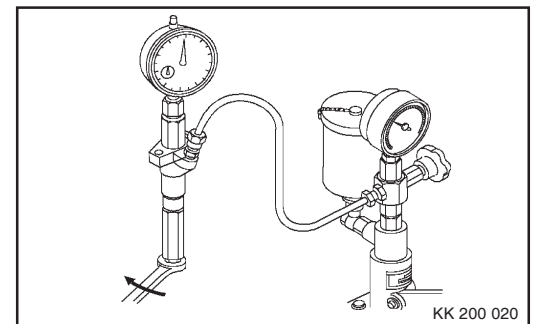
Fix the dial gauge within the range of 2mm.

CAUTION 2

If the nut is tightened too hard, shift of the dial gauge may get stuck.



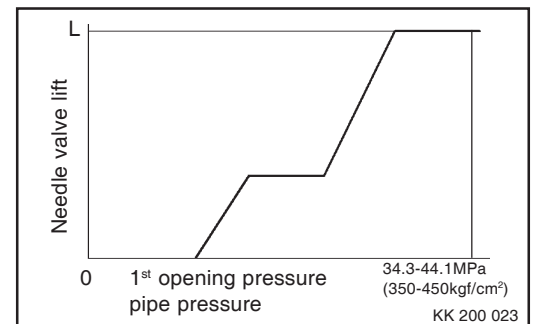
7. Attach the nozzle and nozzle holder assembly to nozzle tester, and set the gauge to "0"
8. Check fuel leakage, turning the nozzle tester on and bleeding air inside of the retaining nut.



9. When the pipe pressure is lifted up to 34.3~44.1MPa (350~450kgf/cm²) after the operation of the nozzle tester, needle valve will reach the maximum. Maximum lift records "L" at this time.

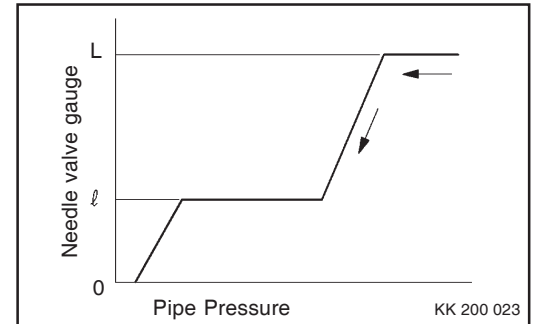
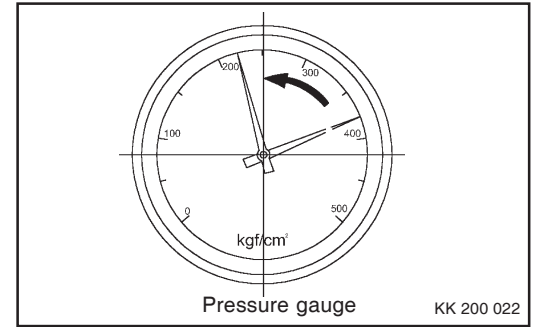
CAUTION

This test is conducted in order to determine whether the nozzle sheet is irregularly frayed and/or whether nozzle assembly is the specified part.

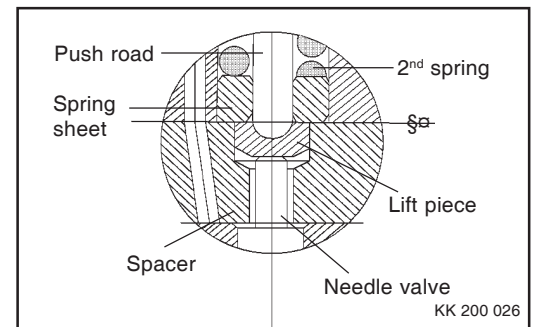


Checking pre-lift

1. Keep the handle of nozzle tester still with the needle valve lifted to the max, and the pressure inside the cylinder will be lowered and the lift of the needle valve (numerical indication of the dial gauge) will also be lowered.



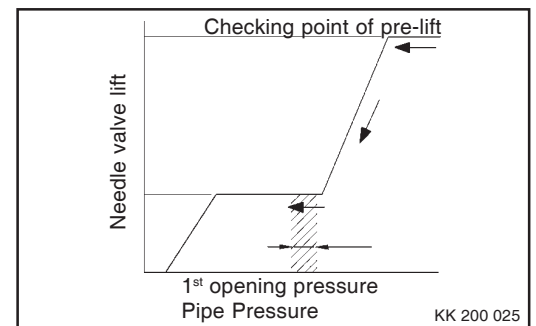
2. By reading the numerical indication after the operation of the 2nd spring and of the needle valve is finished (the point of needle valve lift in the pictures KK200 022 and KK 200 023), you can see if the indication stays within the specified range.



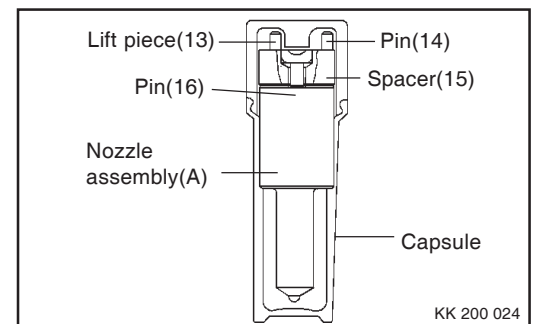
Gauging point of pre-lift

Read the indicator of the dial gauge as when 1st opening pressure +1MPa is applied.

Find the point of 1st opening pressure+1MPa(10kg/cm²), lowering pressure.



3. In case that pre-lift stays beyond the specified range, replace pin(14,16) lift piece(13), spacer(15) and nozzle assembly(A) with nozzle service kit.

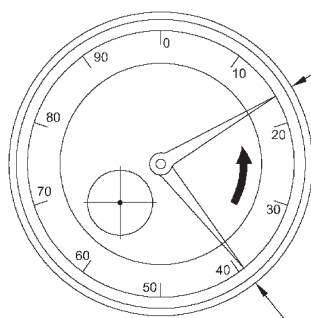
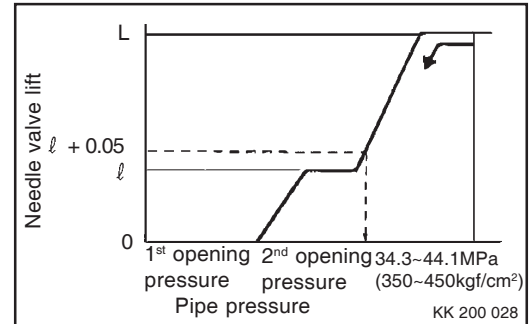
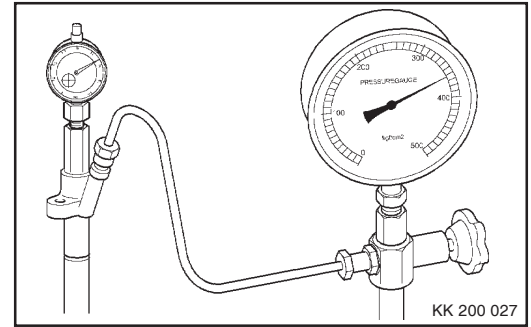


SERVICE PROCEDURE

FL-43

Checking the 2nd opening pressure

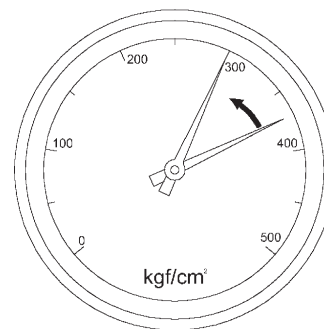
1. Check the pre-lift and get the nozzle tester to function. After that, increase the chamber pressure up to 34.2~44.1MPa (350~450kgf/cm²), which will cause needle valve to be lifted to the maximum point.
2. At the time the pipe pressure goes down by leaving the handle as it moves, check the movement of the dial gauge pointer.
3. Reading needle valve lift and checking 2nd opening pressure. Read the indication of the pressure gauge at the moment dial gauge pointer indicates the specified lift (usually, pre-lift "i"+0.05mm). Read needle valve lift and check out the 2nd opening pressure.



Dial gauge

Max lift of needle valve

Read the indication of the pressure gauge.

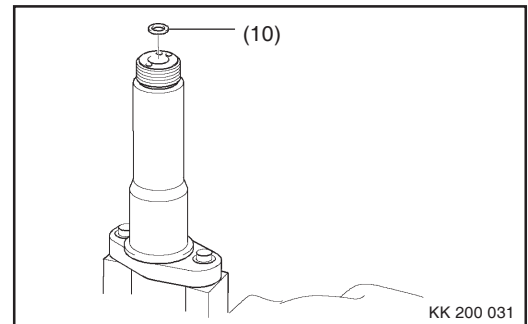
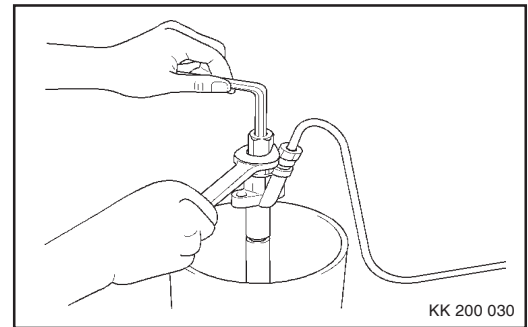


Pressure gauge

KK 200 028/KK 200 029

Adjustment of 2nd opening pressure

1. When the indication goes beyond the specified range, and it makes little difference, re-adjust the 1st opening pressure. (within the specified range of 1st opening pressure)
 - In case of low 2nd opening pressure below the specification: Elevate the 1st opening pressure over the specification and check the 2nd opening pressure.
 - In case of higher 2nd opening pressure: Decrease 1st opening pressure below the specification.
2. In case that the 2nd opening pressure does not fit within the specified range despite the re-adjustment of the 1st opening pressure, disassemble the nozzle from the nozzle holder and take out the adjusting seam (10).
3. In case that 2nd opening pressure goes over the specification, replace the adjusting seam with the thinner one.
4. After replacing the adjusting seam, check again the 2nd opening pressure and adjust the indication until it meets the specification.



2nd opening pressure adjusting seam (D=9.5 : d=4.4)

Part number	Thickness(mm)
150538-4900	0.40
150538-5000	0.50
150538-5100	0.52
150538-5200	0.54
150538-5300	0.56
150538-5400	0.58
150538-5500	0.60
150538-5600	0.70

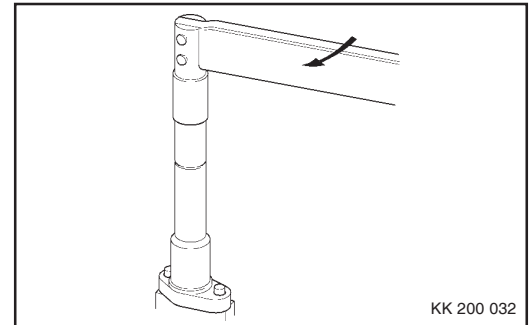
SERVICE PROCEDURE

FL-45

Changing Retaining Nuts

1. Pull out dial gauge, nut, holder, and gasket from the cap nut(7).
2. Disassemble retaining nut for adjustment and gasket, and put the approved retaining nut(17:SW19mm) in.

Torque for retaining nuts:
59~78Nm(6.0~8.0kgf-m)

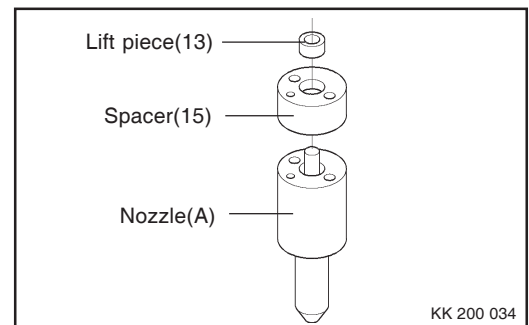
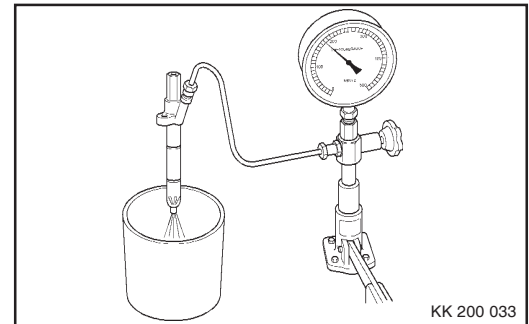


Examining the Finished Device

1. Attach nozzle holder to nozzle tester, and check the 1st altered pressure, injection, sealing around sheet, and oil leakage from each part.
2. When the nozzle needs to be replaced, use “nozzle service kit,” which has the assembly of nozzle, lift piece and spacer.

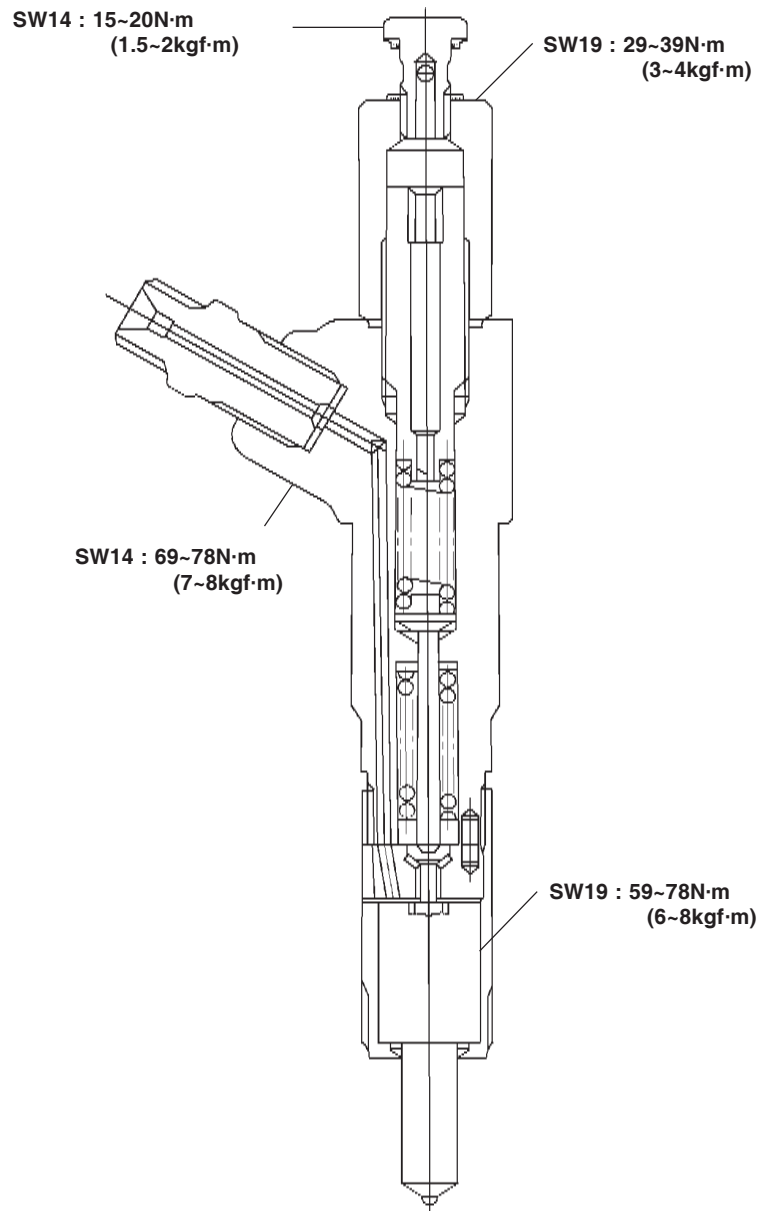
CAUTION

If only the nozzle is replaced, free lift will range beyond the specification.



Torque-Nozzle

KBL2.3 - S



SERVICE PROCEDURE

FL-47

Installation

Install the assembled nozzle holder.

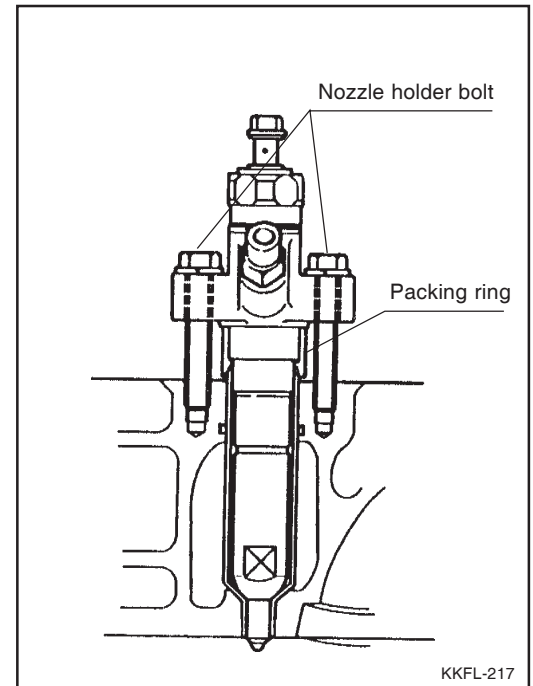
CAUTION

Screw the right nozzle holder bolt and left one in turn, and evenly screw the bolt until it reaches the specified torque.

Torque: 150~180 kgf-cm

WARNING

If one bolt is already screwed until the specification, actual torque will be excessive upon screwing the other one and also it might cause damage to nozzle holder or bolt. On the other hand, if bolts are not completely tightened, it will cause gas leaks and soot in the nozzle.



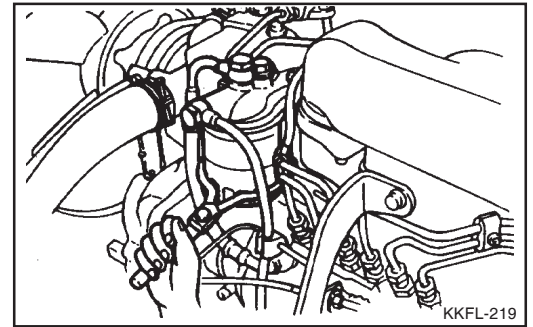
Fuel Filter Disassembly

Disconnect the fuel filter.

Loosen the screw of fuel filter with special tools.

CAUTION

- Pay attention to diesel leaks.
- On disconnecting fuel filter, cover the alternator to prevent the inflow of diesel fuel.



Installation

Install fuel filter.

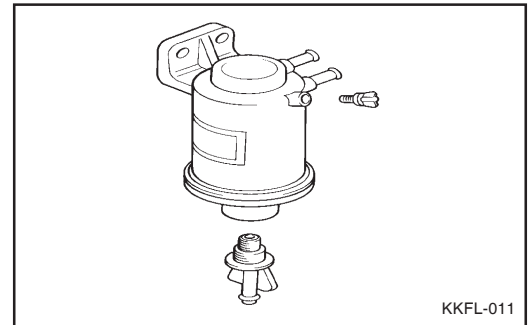
1. Smear a little bit of diesel fuel around the gasket of new filter.
2. Tighten fuel filter with fingers until the gasket touches the cover, and then screw it 2/3 round with special tools.

Water Separator

If red floater in the transparent case goes up to the level of red line marked around outside surface, unscrew immediately the drain plug and drain water. Because the water spontaneously drains out of the drainage hole, you don't have to completely separate the drain plug.

CAUTION

Before fuel comes out after the complete water drainage, screw the drain plug.



Fuel Tank

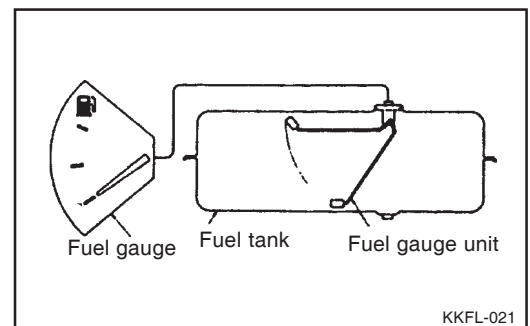
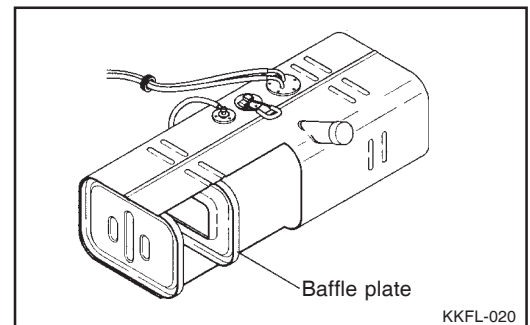
Baffle plate, located inside the fuel tank, protects fuel in the tank from shaking and gives stability to the fuel tank. In this tank installed are an air-vent tube which allows air into the tank and an fuel gauge unit which shows the fuel level.

1. Breather tube:

When a feed pump breathes in fuel, some float pressure may be caused, which might destroy the tank and pipes. Breather tube lets air in the tank and so, it helps the air pressure regular. Also, a fuel cut valve is installed in the air breather pipe of 5-ton dump truck, which easily allows air in when the float pressure occurs inside the tank, thus balances the air pressure. It also prevents oil leak in case of the tank tilting.

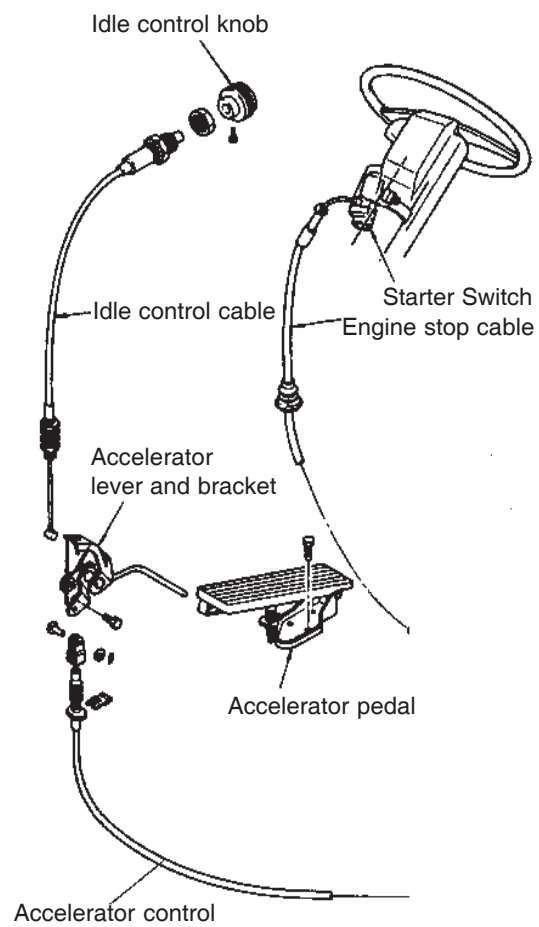
2. Fuel gauge unit:

Fuel gauge unit, installed in the upper side of fuel tank, lets the fuel gauge of dashboard show the fuel level.

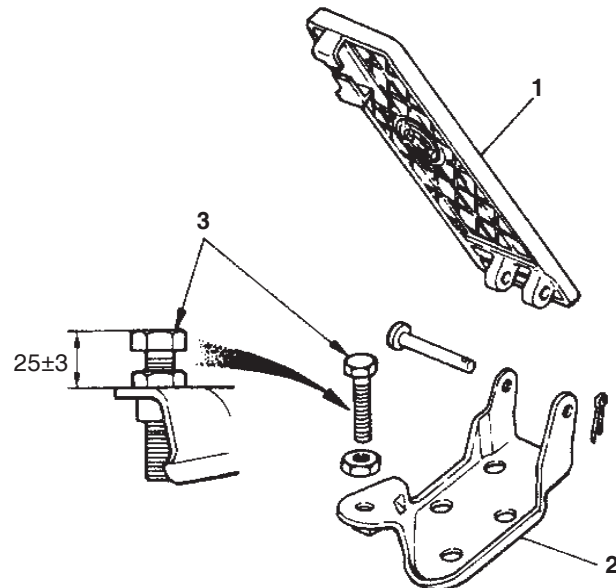


Engine Control

<Components>



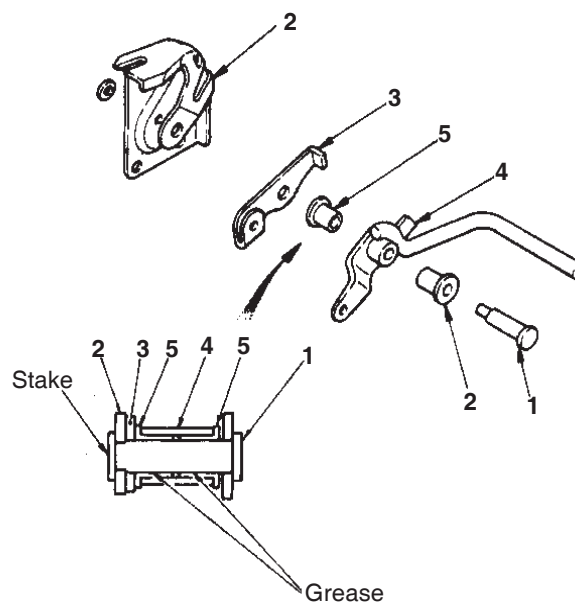
Disassembly and Assembly Accelerator Pedal



1. Accelerator pedal
2. Accelerator pedal bracket
3. Stopper bolt

KKFL-013

Accelerator lever and bracket



1. Rivet
2. Accelerator lever bracket
3. Idle control lever
4. Accelerator lever
5. Bushing

KKFL-014

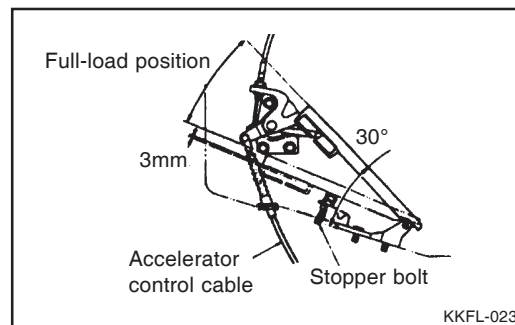
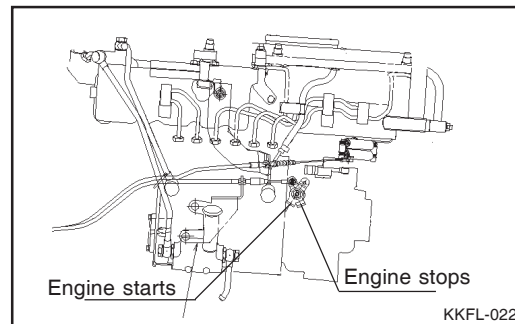
Installation and Adjustment of Cable

CAUTION

Keep the cable off the sharp edges.

1. Accelerator pedal

- (1) When the cable from engine comes to the idle position, adjust the accelerator-controlling cable until the pedal is fixed 30° from the floor.
- (2) Get the cable from engine to touch the full load stopper bolt when you stepped on the accelerator to the bottom, and then adjust stopper bolt until the interval between stopper bolt and the bottom of pedal comes to 3mm or so.



2. Engine stopper cable

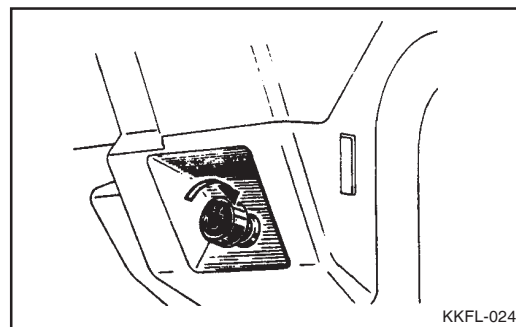
After you move the start switch to LOCK and get the governor stop lever touched on stopper bolt by opening the cap, start the engine and check it.

CAUTION

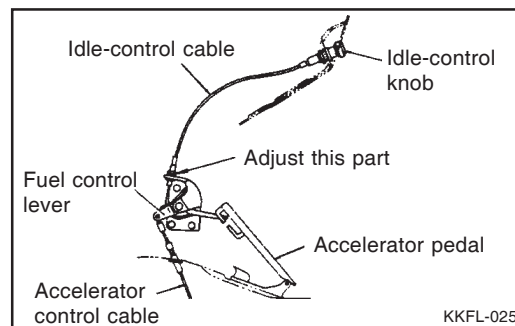
Adjust the fly wheel to the lowest level.

3. Idle-control cable

- (1) Turn the idle-control knob clockwise and let the internal cables fully exposed.

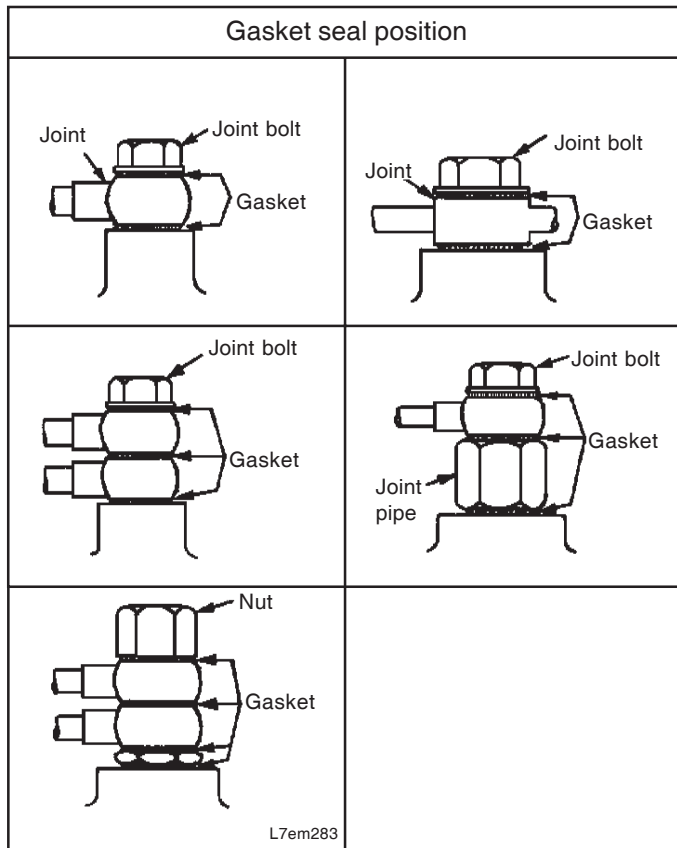


- (2) Install the idle-control cable to the fuel control lever and fix the accelerator pedal tight by tightening the cable.



Installation Procedure of Joint and Gasket

1. Gasket seal type (Al+Rubber+Asbestos+Copper)

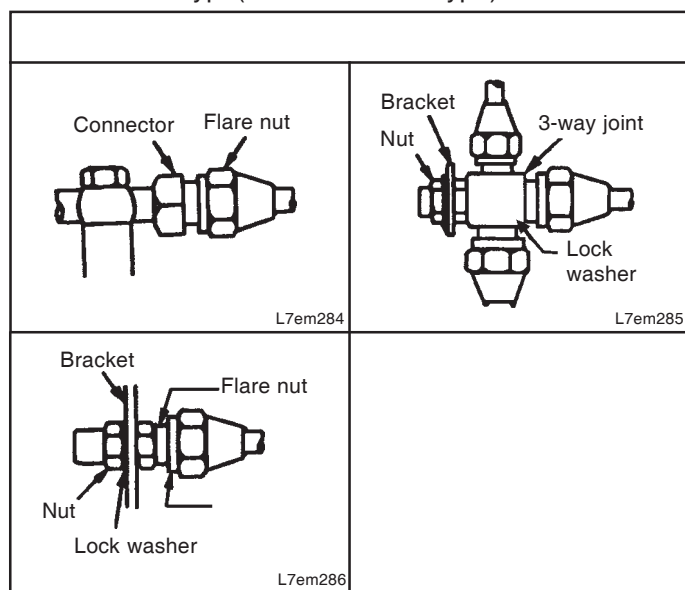


Tighten torque

kgf-cm

Clamping screw(Diameter)	Tighten torque
8	130
10	200
12	250
14	250
16	300
18	400
20	400
24	700
28	1,300

2. Metal seal type(Flare connector type)

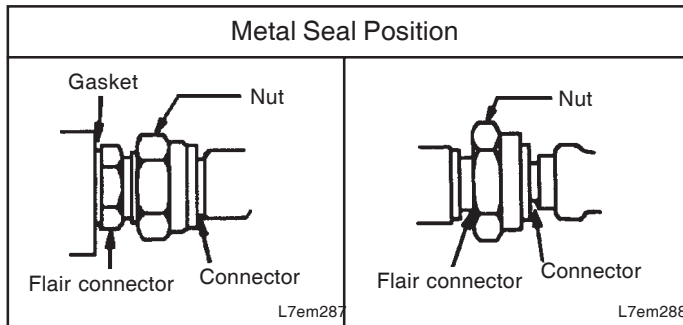


Tighten torque

kgf-cm

Clamping screw (Diameter)	Tighten torque
12	200
14	320
16	400
18	600
20	650

3. Metal Seal Type (Nipple Connector Type)



Torque for tightening		kgf-cm
Clamping screw (diameter)	Torque for tightening	
10	110	
20	220	

CAUTION

- Before assembling joints, check the surface of each sheet (e.g. pipe joint, gasket, etc.) for dust or any dirty material.
- Pipes are likely to move somewhat easily while sheet surface are easy to tilt, so firstly tighten the pipes temporarily and after that, screw them at the specified torque. Check any leakage, too.
- Get the two pipes not to rotate when fixed up.
- After assembling all the pipes, check any leaks by putting reasonable pressure into each pipe.
- See if various types of torque match with the figures above.
- If soft washer (aluminum + rubber + carbon press) gets loose or be removed, replace it with new soft washer. If the washer doesn't need to be replaced, tighten it again at the normal torque.

TROUBLE SHOOTING

Symptom	Probalbe cause	Remedy
Engine will not start	Defective feed pump	
	o Loaded gauze filter	Clean
	o Check valve inoperative	Replace
	o Seized or worn piston	Replace
	o Seized push rod	Replace
	o Worn tappet	Replace
	Defective injection pump	
	o Seized or worn plunger	Replace
	o Seized control rack	Replace
	o Seized delivery valve	Replace
	o Worn tappet	Replace
	o Worn camshaft	Replace
	Defective injection nozzle	
	o Seize need valve	Replace
	o valve opening pressure too low	Adjust
Engine starts but soon stops	o Clogged injection orifice	Clean
	o Nozzle no airtight	Correct or replace
	Fuel tank empty	Supply fuel
Engine knocks	Clogged fuel pipe of fuel leaks from connection	Correct or replace
	Air or water trapped in fuel system	Bleed or replace
	Loaded fuel filter	Replace
	Clogged fuel pipe	Correct or replace
Smoky engine exhaust and knocking	Air or water trapped in fuel system	Bleed or replace
	Defective feed pump	Check
	Injection timing too advanced	Adjust
	Defective injection nozzle	
	o Valve opening pressure too high	Adjust
Engine starts but soon stops	o Clogged injection orifice	Clean
	o Nozzle not airtight	Correct or replace
	Low quality fuel in use	Replace
	Defective injection pump	
	o Incorrect injection timing	Adjust
	o Worn plunger	Replace
	o Defective delivery valve seat	Replace
	Low quality fuel in use	Replace
Engine knocks	Defective injection nozzle	
	o Valve opening pressure too low	Adjust
	o Broken spring	Replace
	o Clogged injection orifice	Clean

Sympton	Probalbe cause	Remedy
Unstable engine output	Defective injection pump	
	o Insufficient plunger sliding stroke	Replace
	o Broken plunger spring	Replace
	o Poor control rack sliding	Correct
	o Worn tappet poor sliding	Replace
	o Broken delivery valve spring	Replace
	o Poor tightness duet to loose delivery valve holder	Correct
	o Delivery valve not functioning properly	Replace
	Defective injection nozzle	
	o Poor sliding of needle valve	Replace
	o Broken spring	Replace
	o Incorrect valve opening pressure	Adjust
	Defective feed pump	
	o Check valve not functioning properly	Replace
	o Worn piston	Replace
Insufficient engine output	Air or water trapped in fuel system	Bleed or replace
	Loaded fuel filter	Replace
	Incorrect injection timing	Adjust
	Control lever not in contact with full load stopper	Adjust
	Defective injection nozzle	
	o Nozzle not airtight	Correct or replace
	o Broken spring	Replace
	o Clogged injection orifice	Clean
	Defective injection pump	
	o Worn plunger	Replace
	o Broken delivery valve	Replace
	o Defective delivery valve seat	Replace
	o Poor tightness due to loose delivery valve holder	Correct
	Defective governor	
	o Timing control is performed at low speed due to Weak governor spring	Adjust
	o Faulty full load stopper position	Adjust
	o Control lever incorrectly adjusted	Adjust
	Poor adjusted injection timing	Adjust
	Insufficient advance angle of automatic timer	Replace
	Poor quality fuel in use	Adjust
	Poorly adjusted accelerator pedal stopper bolt	Replace

TROUBLE SHOOTING

FL-57

Sympton	Probalbe cause	Remedy
Engine not reaching max. speed	Defective governor	
	o Governor spring tension too weak	Adjust
	o Incorrect control lever position	Adjust
	Poorly adjusted acceleerator pedal stopper bolt	Adjust
	Defective injection nozzle	
	o Clogged injection orifice	Clean
Engine max. speed too high	o Nozzle not airtight	Correct or replace
	o Valve opening pressure to low	Adjust
	Poor sliding of injection pump control rack	Correct
	Defective governor	
	o Governor spring tension too high	Adjust
	o Flyweight not functioning effectively	Correct
Unstable engine idling	Defective injection pump	
	o Seized, binding or worn plunger	Replace
	o Loose control pinion	Correct
	o Plunger spring not seated corrcctlly	Replace
	o Delivery valve holder too tight	Correct
	o Uneven injection amount to cylinders	Adjust
	o Broken plunger spring	Replace
	o Air or water trapped in fuel system	Bleed or replace
	Defective governor	
	o Idling spring tension too weak	Adjust
	o Bend link	Correct
	o Large friction or play of link	Replace
	o Loose round nut	Correct
	o Incorrectly adjusted idling stopper bolt	Adjust
	Defective feed pump	
	o Defective check valve	Replace
	o Worn piston	Replace
	o Loaded gauze filter	Clean
	Loaded fuel filter	Replace
	Incorrect injection timing	Adjust
	Defective automatic timer	Correct
	Defective injection nozzle	
	o Clogged injection orifice	Clean
	o Deteriorated spring	Replace
	o Nozzle not airtight	Correct or replace

FL-58**FUEL AND ENGINE CONTROL**

Sympton	Probalbe cause	Remedy
Large accelerator pedal operating effort	Rusted accelerator pedal arm	Correct
	Incorrect accelerator control cable routing	Correct
	Poorly sliding accelerator control cable	Replace
	Poorly sliding governor adjusting lever	Correct
Engine cannot be stoped	Broken or stretched engine stop cable	Replace
	Poorly adjusted engine stop cable	Adjust
	Damaged governor stop mechanism	Replace
Fuel supply failure	Cracked fuel hose, pipe	Replace
	Loose water separator connection	Correct

GENERAL INFORMATION

EBOOKBKMT.COM

Tài liệu kỹ thuật miễn phí

ENGINE SPECIFICATIONS	GI- 2
GENERAL	GI- 3
STANDARD BOLTS AND NUTS	GI- 8
ENGINE NUMBER	GI- 9

ENGINE SPECIFICATIONS

Model			D6DA
Type			Disel, 4cycle, Inline 6 cylinder,water cooled,direct injection
Aspiration Type			Turbo charge Type
Cylinder Bore x Stroke			Ø 109 x 118mm
Displacement			6.606
Compression ratio			17.6 : 1
Firing order			1-4-2-6-3-5
Direction of rotation			Counter-clockwise viewed from fly wheel
Compression pressure			36-39kgf/cm²(280rpm)
Idle rpm			640±25rpm
Weight			Approx. 580kg
Value seat angle	Intake		30°
	Exhaust		45°
Value face angle	Intake		30°
	Exhaust		45°
Value Timing (flywheel travel)	Intake	Open	BTDC 12°
		Close	ABDC 32°
	Exhaust	Open	BBDC 59°
		Close	ATDC 13°
Value clearance (cold)	Intake		0.30mm
	Exhaust		0.50mm
Oil pump			Gear pump Type
Oil collar			Water cooled plate fin type
Injection nozzle	Type		Multi hole
	Valve opening		160/220kgf·cm2
Water pump	Type		Forced circulation by volute pump
	Drive		V-belt, Centrifugal type
Thermostat			Wax pellet and bbottom bypass type
Injection timing			BTDC 6° ± 1° (when compression stroke No.1 cylinder)

GENERAL

How to Read Disassembly and Reassembly Drawings

1. The part names and numbers in the drawings correspond to those in the text. The parts are numbered in the order of disassembly.
2. The inspection items to be performed during disassembly operations are shown in the disassembly drawings.
3. All tightening torque specifications in the reassembly drawings may be considered "dry" unless "wet" is specified.

Definition of Terms

Unless otherwise specified, all dimensional presentation in illustrations representing the following values or limits is in mm although the unit is not indicated.

1. Nominal Value (Abbr.: NV)
Shows dimension of an individual part, mutual clearance between parts of standard performance. Values however, do not necessarily coincide with design value as they are rounded off to fall within limits necessary for inspection.
2. Repair Limit (Abbr.: RL)
Shows that when specified value is reached, repair is necessary. Repair means adjustment, grinding replacement of bushings, metals and the like, selection of oversize, selection of shim thickness, etc.
3. Service Limit (Abbr.: SL)
Shows that when specified value is reached, replacement of the parts with new one is necessary.
4. Basic Diameter (Abbr.: BD)
Shows nominal diameter of part to be measured.
5. Tightening Torque (Abbr.: T)
Shows tightening torque of bolts or nuts.

UNIT

The SI unit is used. Metric notation is jointly shown in parentheses.

NOTE, WARNING AND CAUTION

1. Note

A Point of information for the customer.

2. Caution

Information about an activity that could cause damage to the vehicle.

3. Warning

Information about an activity that could cause injury or damage to the driver, occupants or other personnel.

Table of Conversion Rate for Foot-pound Units into SI Units

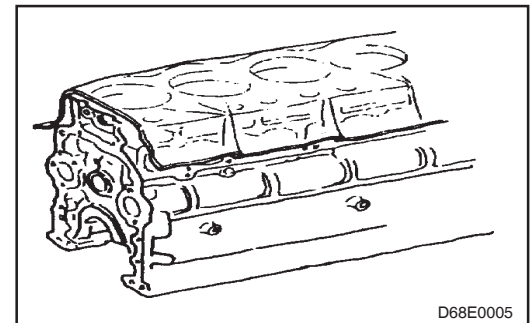
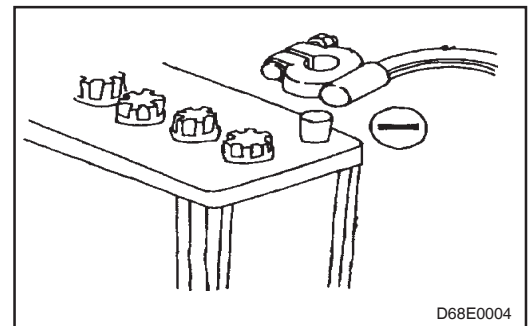
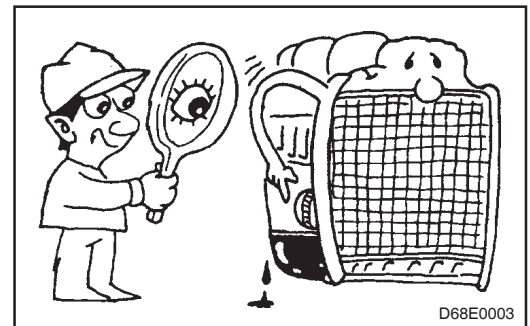
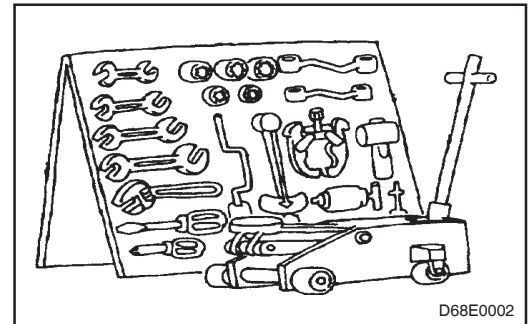
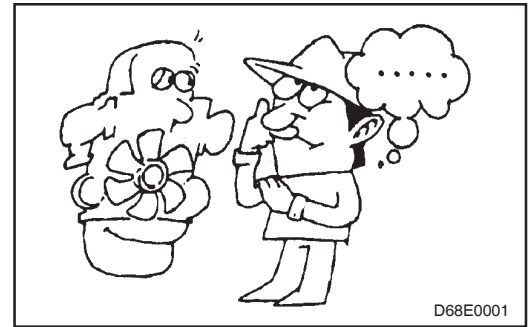
Unit	Sign of unit	Sign of Foot-pound unit	Conversion rate
Mass quantity of matter	kg	lbs	1 kg = 2.2046 lbs
	g	oz	1 g = 0.035274 oz
Dimension	m	ft.	1 mm = 3.2808 ft.
	mm	in.	1 mm = 0.03937 in.
Capacity	lit.	gal.	1 lit. = 0.2642 gal. (U.S.) 0.220 gal. (Imp.)
	cc	oz	1 cc = 0.033814 oz (U.S.) 0.035195 oz (Imp.)
Force	N (Newton)	lbf	1 N = 0.2248 lbf
Pressure	kPa (kilopascal)	lbf/in. ²	1 kPa = 0.145 lbf/in. ²
			1 kPa = 0.2953 in.Hg
Stress	N/cm ²	lbf/in. ²	1 N/cm ² = 1.45 lbf/in. ²
Moment of force	Nm	lbf.ft	1 Nm = 0.7375 lbf.ft
Output	kW (kilowatt)	HP	1 kW = 1.34 HP
Temperature	°C	°F	T°C = (1.8 t°C + 32)°F

General Precautions For Servicing

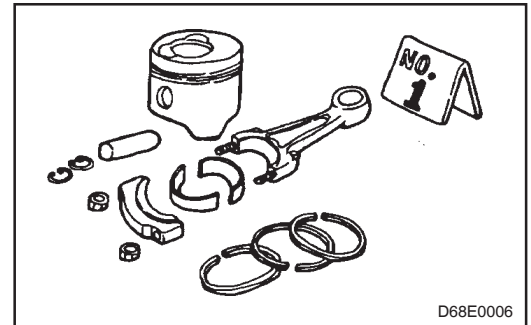
Before starting the service procedures, check the vehicle for total distance driven, use conditions, and user's complaints and requests to know exactly the engine conditions. Record information where necessary.

To ensure you are doing correct and efficient service jobs, observe the following precautions:

- (1) Before performing the service procedures given in this manual, know the trouble spots and isolate the possible cause to determine whether the removal or disassembly procedure is required.
- (2) Select a flat surface for the service job.
- (3) Ready and make the most of the special tools required for servicing. Use the right tools (specified special tools) in the right place to prevent damages to parts and personal injury.
- (4) Carefully check parts for oil leaks before cleaning. After cleaning, it may become difficult to spot defective areas.
- (5) When servicing the electrical system, be sure to disconnect the negative cable from the battery.



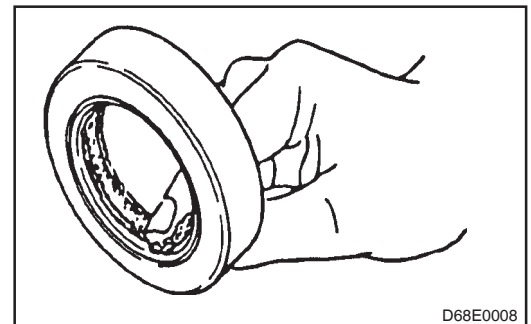
- (6) Cover areas from which parts have been removed to protect entry of dust and dirt.



- (7) Make alignment marks and keep disassembled part neatly arranged to ensure that they are reassembled into the right positions.
- o Special care must be taken for assemblies involving a number of parts, similar parts, or parts identical at right- and left-hand sides to ensure correct reassembly.
 - o For alignment and punching markings, select a position that would not mar the appearance and function.
 - o Clearly distinguish parts to be replaced from those re used.



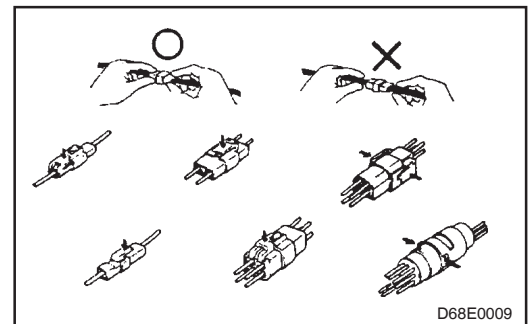
- (8) The oil seals, packings, O-rings, and other rubber parts, gaskets, and split pins must be replaced with a new one whenever they are removed. For replacement, use HMC Genuine parts.



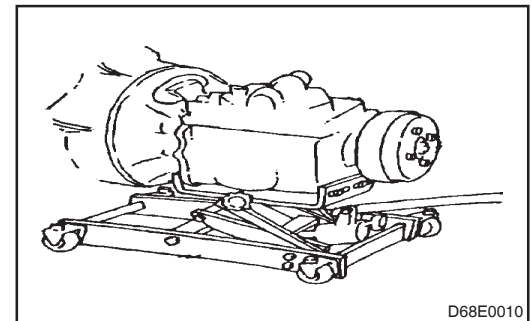
- (9) Apply the specified grease to U-packings, oil seals, dust seals, and bearings before installation.

- (10) Special care must be taken in handling sensors and relays which are susceptible to shocks and heat.

- (11) Connector handling precautions
When disconnecting the connectors, never pull the harness. Hold the connectors. To disconnect locking connectors, push in the direction indicated by an arrow.



- (12) From a safety viewpoint, use utmost caution when handling the engine, transmission and other heavy items.



- (13) When work requires an assistant or two, always make sure of the safety each other. Never play with switches and levers.
- (14) When checking or changing lubricants, wipe off grease and oil from parts immediately with a waste.
- (15) Use care so that hands and fingers are not injured by sharp edges or corners of the parts.

STANDARD BOLTS AND NUTS

Unless otherwise specified, the parts and equipment of vehicle must be tightened by the following standard bolts nuts. Tightening torques for these bolts and nuts are shown below.

NOTE:

Threads and seat surfaces must be in dry state.

When there is a difference between the nut and bolt (stud) identification marks, tighten to the torque corresponding to the bolt (stud) identification mark.

Standard bolts and nuts

Unit: Nm (kgf m)

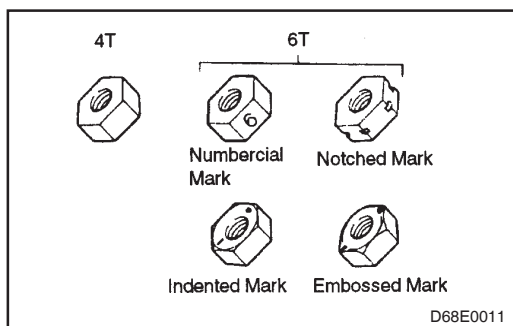
Dia. mm	Pitch mm	4T (Head mark 4 or O)	7T (Head mark 7 or Θ)	8T (Head mark 4 or ⊕)
5	0.8	2.0 to 2.9 (0.2 to 0.3)	3.9 to 5.9 (0.4 to 0.6)	4.9 to 6.9 (0.5 to 0.7)
6	1.0	3.9 to 5.9 (0.4 to 0.6)	6.9 to 10.8 (0.7 to 1.1)	7.8 to 11.8 (0.8 to 1.2)
8	1.25	8.8 to 13.7 (0.9 to 1.4)	16.7 to 25.5 (1.7 to 2.6)	19.6 to 29.4 (2.0 to 3.0)
10	1.25	18.6 to 27.5 (1.9 to 2.8)	34.3 to 53.9 (3.5 to 5.5)	44.1 to 58.8 (4.5 to 6.0)
	1.5	17.7 to 26.5 (1.8 to 2.7)	32.4 to 49.0 (3.3 to 5.0)	42.1 to 58.8 (4.3 to 6.0)
12	1.25	33.3 to 49.0 (3.4 to 5.0)	68.6 to 93.2 (7.0 to 9.5)	83.4 to 108 (8.5 to 11)
	1.75	30.4 to 46.1 (3.1 to 4.7)	63.7 to 83.4 (6.5 to 8.5)	73.5 to 98.1 (7.5 to 10)
14	1.5	58.8 to 83.4 (6.0 to 8.5)	118 to 157 (12 to 16)	127 to 177 (13 to 18)
	2.0	53.9 to 73.5 (5.5 to 7.5)	108 to 137 (11 to 14)	118 to 167 (12 to 17)
16	1.5	93.2 to 127 (9.5 to 13)	177 to 235 (18 to 24)	196 to 265 (20 to 27)
	2.0	88.3 to 118 (9.0 to 12)	157 to 216 (16 to 22)	186 to 255 (19 to 26)

Flange bolts and nuts

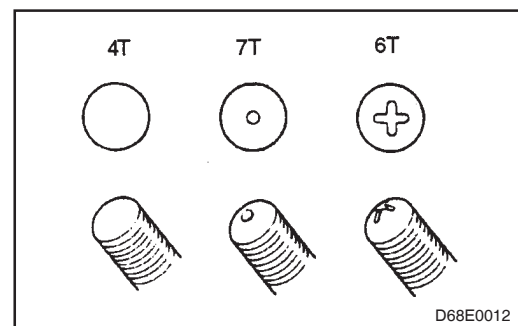
Unit: Nm (kgf m)

Dia. mm	Pitch mm	4T (Head mark 4 or O)	7T (Head mark 7 or Θ)	8T (Head mark 8 or ⊕)
6	1.0	3.9 to 5.9 (0.4 to 0.6)	7.8 to 11.8 (0.8 to 1.2)	8.8 to 13.7 (0.9 to 1.4)
8	1.25	9.8 to 14.7 (1.0 to 1.5)	18.6 to 27.5 (1.9 to 2.8)	21.6 to 32.4 (2.2 to 3.3)
10	1.25	20.6 to 30.4 (2.1 to 3.1)	38.2 to 58.8 (3.9 to 6.0)	49.0 to 63.7 (5.0 to 6.5)
	1.5	18.6 to 28.4 (1.9 to 2.9)	35.3 to 53.0 (3.6 to 5.4)	44.1 to 63.7 (4.5 to 6.5)
12	1.25	37.3 to 53.9 (3.8 to 5.5)	78.5 to 108 (8.0 to 11)	88.3 to 118 (9.0 to 12)
	1.75	33.3 to 51.0 (3.4 to 5.2)	68.6 to 93.2 (7.0 to 9.5)	83.4 to 108 (8.5 to 11)

Identification marks of nut

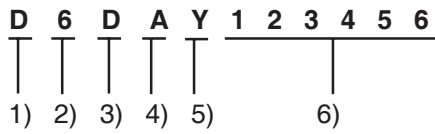


Identification marks of stud



ENGINE NUMBER

Example :



- 1) D: DIESEL ENGINE
G: GASOLINE ENGINE
- 2) 6: 4 CYCLE 6 CYLINDER
8: 4 CYCLE 8 CYLINDER
- 3) Engine development order
- 4) Engine development version
- 5) Product year
X : 1999 Y : 2000, 1 : 2001, 2 : 2002, 3 : 2003
- 6) Production sequence number
000001-999999

HEATER AND AIR CONDITIONER

EBOOKBKMT.COM

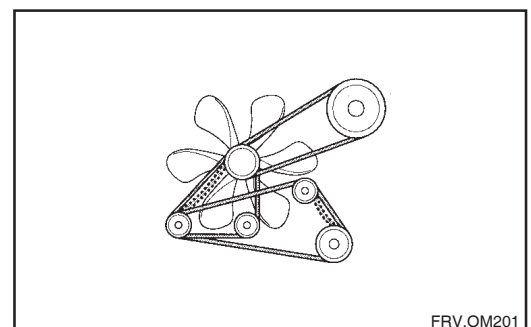
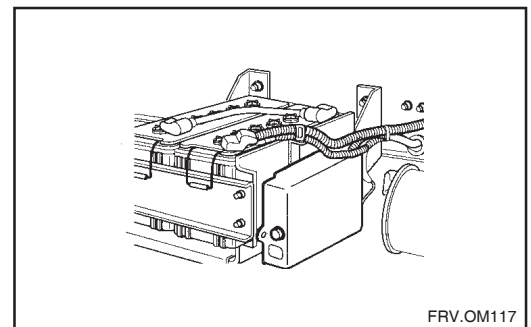
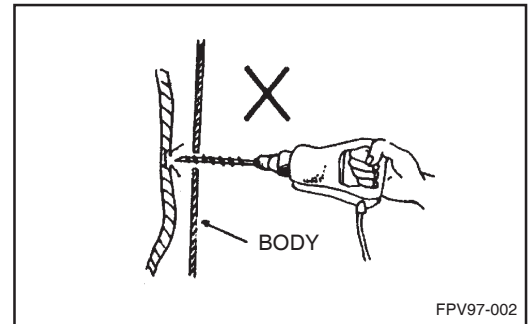
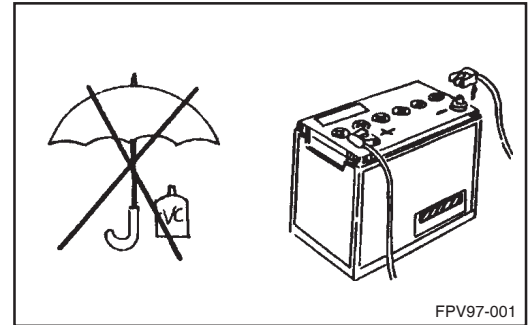
Tài liệu kỹ thuật miễn phí

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HEATER AND VENTILATION SYSTEM	HA - 5
STRUCTURE AND OPERATION OF	
AIR-CON AND HEATER	HA - 7
MAIN COMPONENTS	HA - 9
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GENERAL

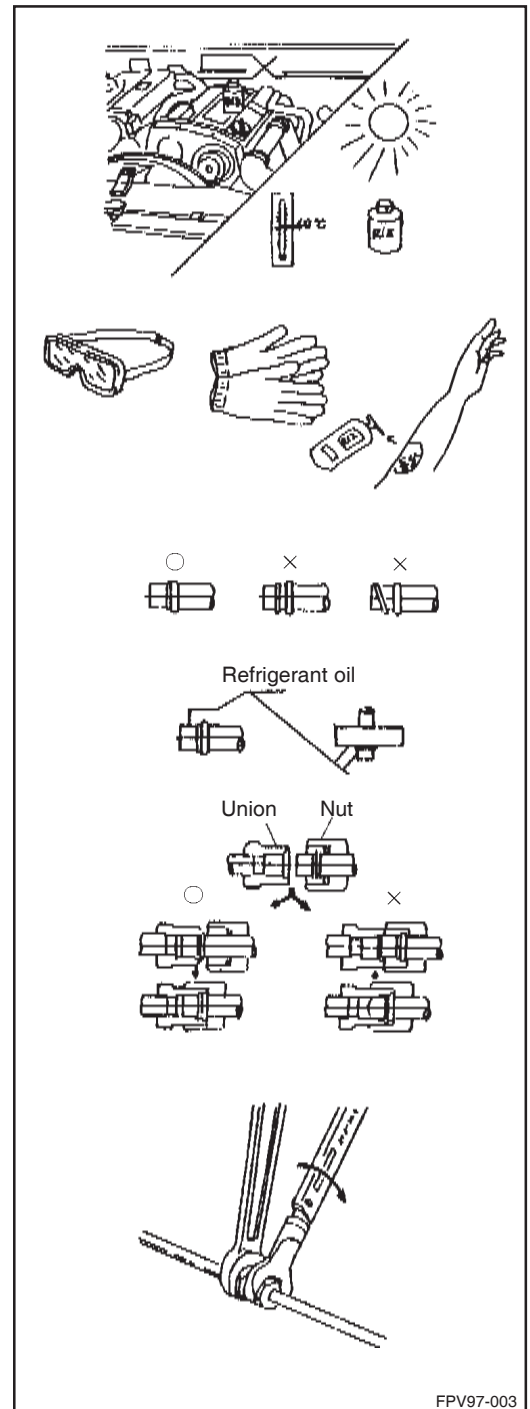
CAUTIONS IN HANDLING AIR-CONDITIONER AND HEATER.

- Handle these items indoors where ventilates well and are no combustible substances.
- Since moisture does harm to air-conditioner, refrain from working in a rainy day.
- While working on these items, do not touch the parts of brake system, fuel system, and power steering system.
- Put the protection cover on the body so that the body is not scratched or damaged.
- When you have to work underneath the vehicle, be sure to put the safety support.
- Be sure to remove the earth (-) wire before the work to prevent electric damage.
- Put the key switch at "off" position or key off while working on the vehicle.
- Put the gearshift in neutral position, and apply the parking brake.
- When engine is on, do not work close to rotating part like fan, belts etc.
- While working, do not touch the heated parts like radiator, exhaust manifold, exhaust pipe, muffler and catalytic converter.
- Smoking is prohibited while working.



PRECAUTIONS IN HANDLING REFRIGERANT.

- Refrigerant, having low freezing point, is highly volatile. A drop on the skin of your hand may result in localized frostbite. Therefore, be sure to wear protection goggles and gloves when handling refrigerant.
- Since refrigerant is stored in high-pressure vessel, keep it away from the engine or light.
- Do not remove refrigerant pipe before draining the refrigerant fully.
- Air-con parts are sealed with protection cap to prevent the inflow of dirt, dust and moisture. Be sure to remove this cap just before the work and close it immediately after the work.
- Especially 'O' ring parts of hose and pipe should be free from dirt and deformation. Check these parts before assembly and replace it in case of defective.
- Never reuse the "O" ring and apply refrigerant oil on to "O" ring before assembly.
- As for the bolting, assemble them with bare hands first and tighten it with 2 spanners.
- When replacing evaporator, compressor, or refrigerant pipes, make sure to replace receiver drier too.
- When tightening connector, bolts and nuts, tighten them with the tightening torques shown in the table below.



FPV97-003

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HEATER AND AIR CONDITIONER
TIGHTENING TORQUE

 Unit : kg/cm²G

Diameter	Pitch	Bolt, Nut		Flange bolt/ Nut	
		4T	7T	4T	7T
M6	1.0	0.4~0.6	0.7~1.1	0.5~0.7	0.8~1.2
M8	1.25	0.9~1.4	1.7~2.6	1.0~1.5	1.8~2.8
M10	1.25	1.9~2.8	3.5~5.5	2.1~3.1	3.9~6.0

TIGHTENING TORQUE

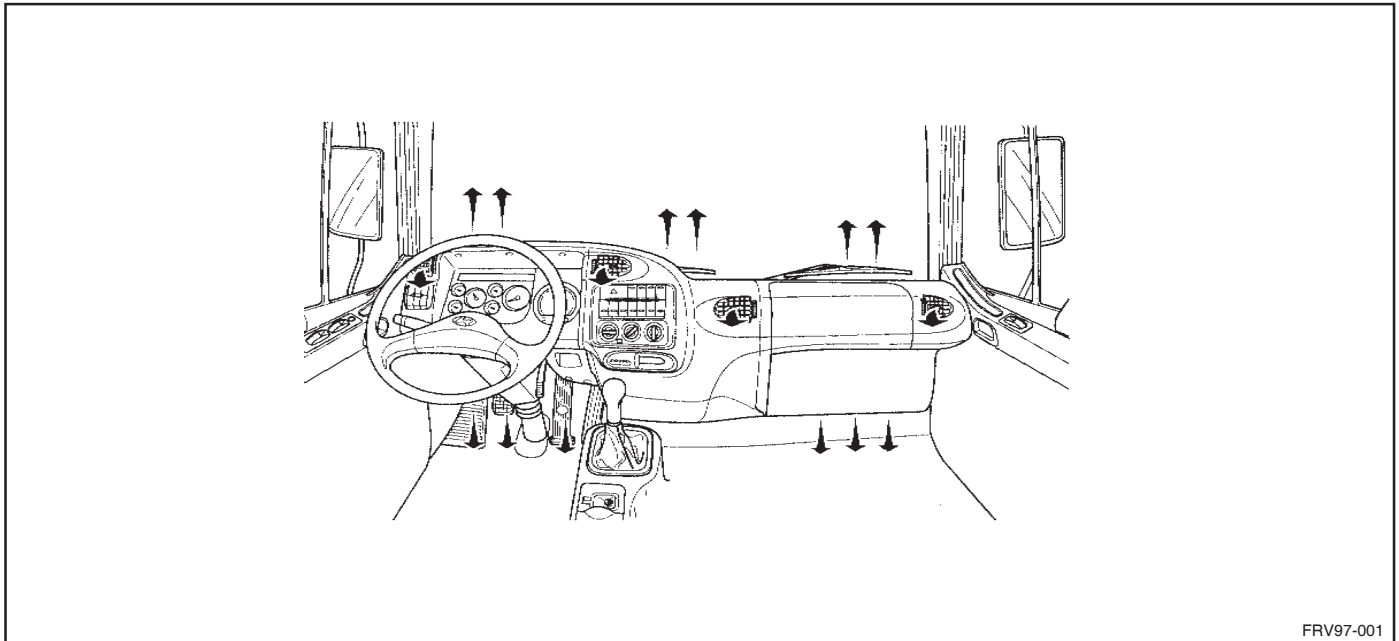
 Unit : kg/cm²G

Type \ Items \ Diameter			5/16(0)	3/8	1/2(12)	5/8(16)	3/4(19)
Swival nut		Torque	1.2~1.5		2.0~2.5	3.0~3.5	3.5~4.0
Joint Flange	Body side	Torque	0.4~0.6		1.0~1.5		
	Engine side	Torque			2.0~3.0		
	Bolt		M6		M8		

HEATER AND VENTILATION SYSTEM

OPERATION OVERVIEW

Ventilation outlets are defroster, heating floor and cooling vents on the whole as shown in the figure. In case of bi-level and mix mode, blower and temperature are controlled properly and blown through these ventilation outlets for amicable climate control.



VENT

1. This mode is mainly used in air-con operation and interior air ventilation.
2. Blower is coming from vent register grille and it can be directed anywhere easily by adjusting the louver angle.
3. Fresh outside air, recirculation of inside air, temperature, airflow can be controlled arbitrarily. However recirculation of inside air mode is used for the quick cooling and fresh outside air mode is chosen otherwise.

FLOOR

1. This mode is mainly used in heating.
2. Blower is directed outside the seat through the floor duct inside the car, and small quantity of air is directed toward windshield glass.
3. Fresh outside air, recirculation of interior air, temperature, airflow can be controlled arbitrarily. However, fresh outside air is used mainly.

BI-LEVEL (IT IS DISTINGUISHED INTO COOLING RANGE AND HEATING RANGE)

1. This mode is mainly used for the combined use of cooling and heating in spring or fall.
2. Blower is directed through floor duct, vent register grille and defroster (in case of heating range).
3. Though air intake, temperature and blower are arbitrarily chosen, as for the temperature, middle range is usually selected.

MIX

1. This mode is mainly used to do heating and defrosting the front windshield at the same time.
2. Air is blown from floor duct and front windshield glass (defroster) outlet at the same time.
3. Fresh outside air mode is selected and temperature and blower is arbitrarily controlled. As for the temperature warming (red zone) is usually selected.

DEFROSTER

1. This mode mainly used to defrost front windshield glass.
2. Air is blown from front windshield glass outlet.
3. Fresh outside air mode is selected and temperature and blower is arbitrarily controlled.

RECIRCULATION / FRESH

1. When recirculation is selected, air inside the vehicle recirculates. This mode is mainly used for quick cooling.
2. When fresh outside air mode is selected, fresh outside air is flown inside to ventilate.

TEMPERATURE CONTROL

As for the temperature control of the air from each outlet, temperature switches and buttons are properly selected to control the temperature. Temperature control switch is dial type, and dial is distinguished into heating (red color) and cooling (blue color). If the temperature control dial is set blue color range, air-mix door shuts airflow to heater core and cold air passing evaporator is directly blown. If it is set at the red color range, air-mix door opens and heated air is blown passing heater core. If the dial is set at in-between of red and blue, air mix door is located at the center of the passage to control and mix the cold air and hot air.

BLOWER CONTROL

Blower control is selected by controlling blower button in the control.

STRUCTURE AND OPERATION OF AIR-CON AND HEATER.

Air passed the evaporator is divided into the air to heater core and the air to elsewhere.

So this different air is mixed right before the outlet and sent to the outlet. Temperature is controlled by the air quantity by the air mix damper. In other words, warm air and cold air are mixed properly. So temperature can be controlled continuously from cooling to heating along with demohisturization. Since this is mixing control of warm and cold air, it is called air-mixing type.

AIR-CON OPERATION.

When air-con switch is turned on, compressor operates cycling by repeating on and off by the evaporator pin temperature sensor, which is to prevent evaporator core freezing. Air-con operates only when blower operates first.

SPECIFICATIONS

Items		Specifications	Remarks
Heater	Heating capacity	5000±10% kcal/h	
	Flow capacity	500±10% m³/h	
	Power consumption	240±10% W	
	Blower rev.	3100±10% rpm	
	Blower control step	4step(REISTER)	
Air Conditioner	Cooling capacity	4700±10% kcal/h	
	Flow capacity	500±10% m³/h	
	Power consumption	240±10% W	
	Blower rev.	3100±10% rpm	
	Blower control step	4step(REISTER)	
Compo- nents	Heater core	Copper and Brass	
	Blower motor	O.D. Ø76	
	Compressor	HS-17 1700cc DC24V	
	Evaporator	Laminated tank	
	Condenser	Super compact condenser	
	Condenser fan	2000±10% m³/h, 24V	
	Safety system	High/Low pressure switch, Fuse	
		Coolant temperature switch	
	Refrigerant	(R-12) about 650g	
		(R134a) about 650g	
	Receiver drier	Aeperated Drier and Sight glass	
		Capacity : 250 cc	

MAIN COMPONENTS

HEATER UNIT ASSEMBLY

It is assembled at the center of vehicle inside instrument panel, whose housing is made of plastic case. And it consists of heater core, in which engine coolant flows through the fascia, and mode door, which controls airflow, and temperature door, which controls temperature. Heater coolant temperature sensor is installed at the lower side of heater core, which senses engine coolant temperature flowing inside heater core.

EVAPORATOR UNIT

Evaporator unit is installed at the right side of heater assembly, whose housing is made of plastic case. It consists of evaporator core and thermal expansion valve. Evaporator core evaporates refrigerant flown into case and thermal expansion valve expands liquid refrigerant. And evaporator core pin sensor is inserted between core pins to prevent the evaporator core freezing.

NOTE

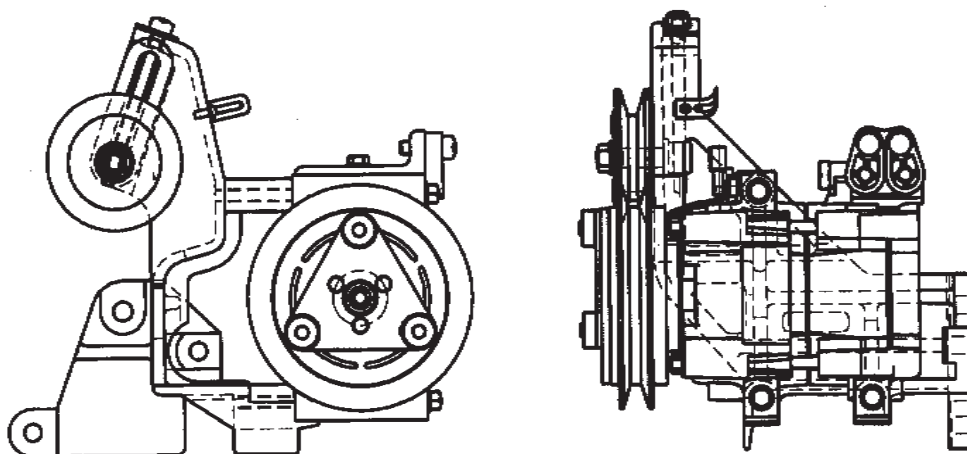
- **Do not adjust the thermal expansion valve since it is set to optimal performance when delivered. It may cause a deterioration of cooling performance.**
- **Do not change the insertion point of evaporator core pin. It may cause the bad influence on the air-con system.**

BLOWER UNIT

Its housing is made of plastic case. It consists of blower motor and wheels. Besides, there are conversion door between circulation and fresh air inside modes, which is operated by electrically driven motor, and outside air temperature sensor, which senses outside air temperature. Besides, HI blower relay is installed for air-con.

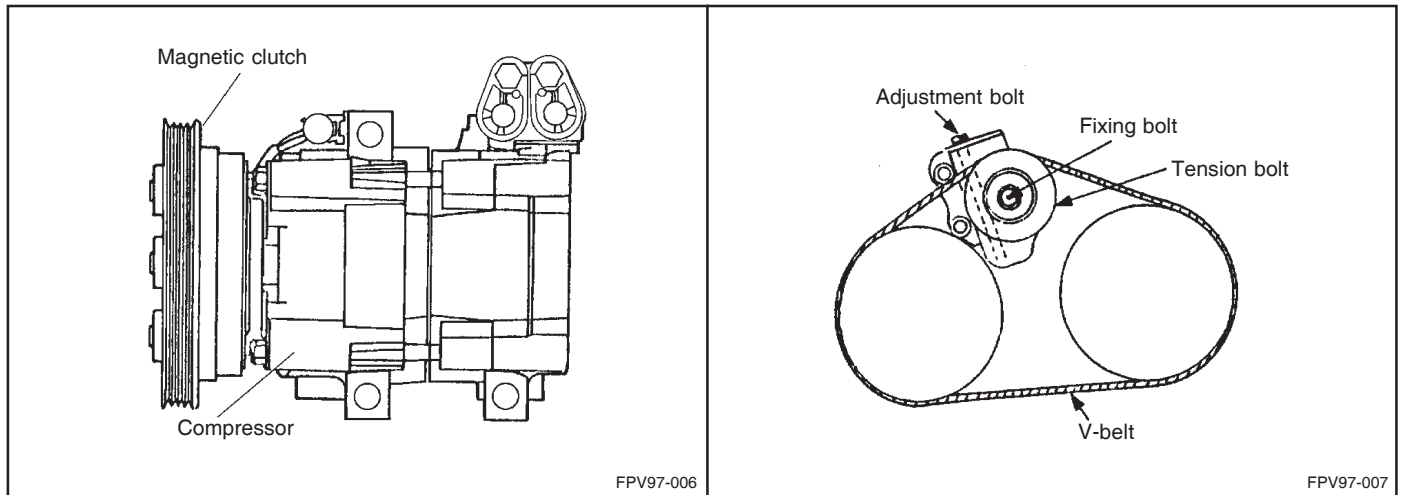
COMPRESSOR

Air-con is installed onto the engine, which intakes and compresses air-con refrigerant to recirculate the refrigerant. Magnetic clutch operates and connected to engine pulley and belts by air-con switch operation



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HEATER AND AIR CONDITIONER

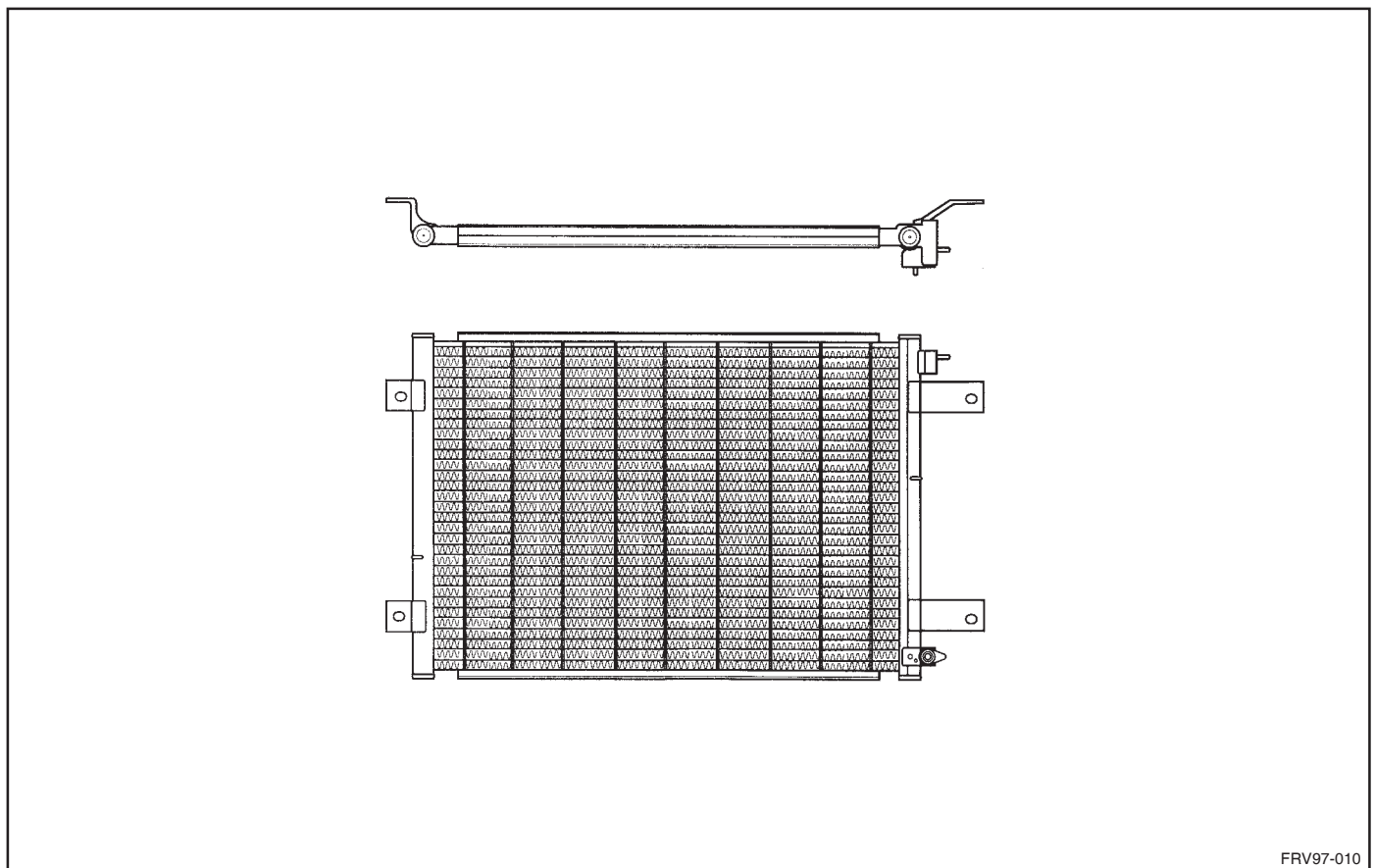


CONDENSER

It is installed at the front of radiator, whose function is to compress the refrigerant after receiving from compressor. And it is made of aluminum for the efficiency improvement and weight reduction.

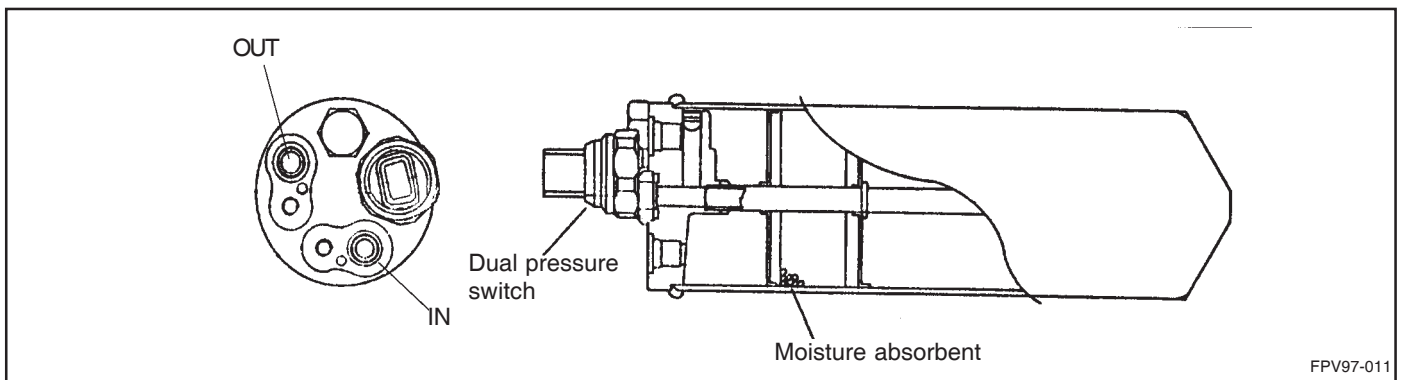
NOTE

- Since it is made of aluminum, be careful not to damage and tear fins in handling.

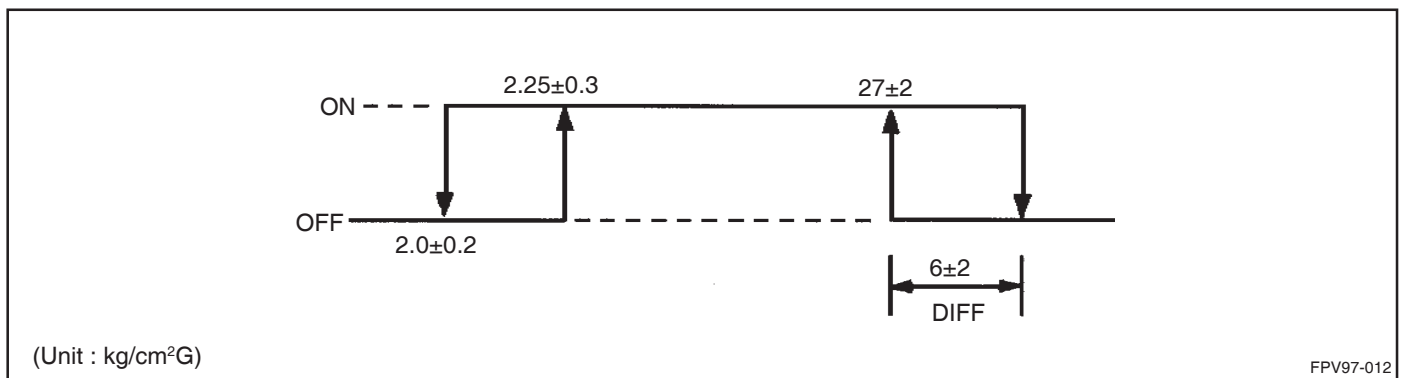


RECEIVER DRIER

It filters dirt and moisture in the refrigerant, which recirculating air-con system, stores refrigerant temporarily before refrigerant flows into evaporator. It is installed between condenser and expansion valve. Besides, receiver tank consists of Hi-low pressure switch, which shuts the system automatically in abnormally high or low pressure, and sight glasses, in which we can check refrigerant filling and pressure outlet, which prevents high pressure in temperature increase.

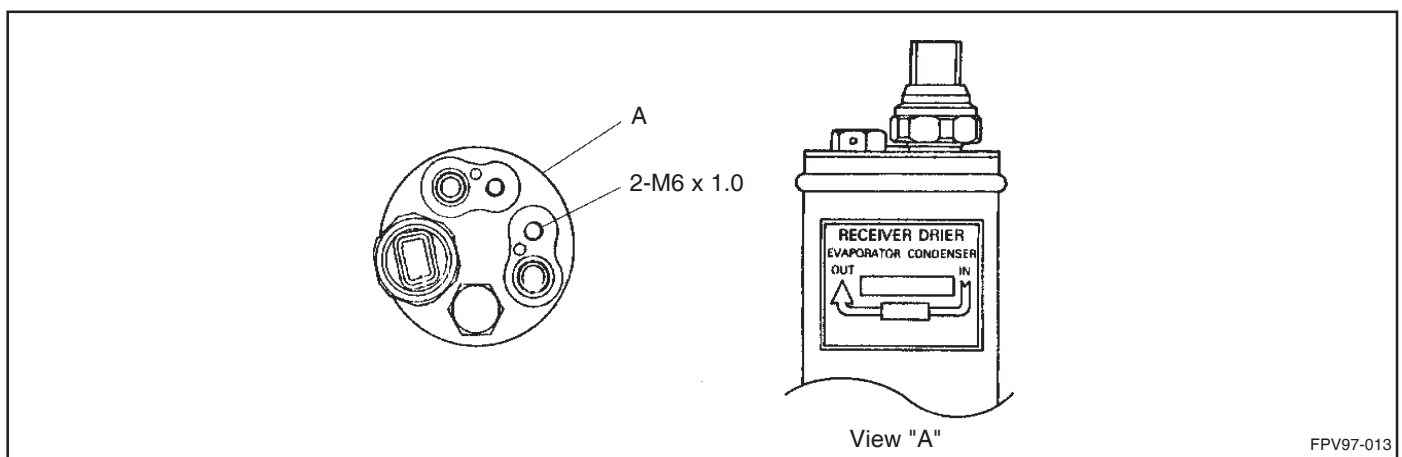


High-pressure switch operation diagram



NOTE

- Since receiver tank inlet and outlet are distinguished, assemble it between tube and liquid by checking in and out marked on the label.



RELAY

Blower off relay, Hi

1. Blower off relay

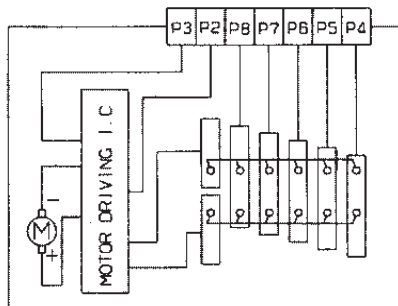
As a relay to supply power to blower fan motor, it is installed to blower unit case.

Compressor relay, condenser fan relay

1. Compressor relay

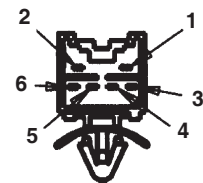
Mode actuator

Installed to the front heater unit, it controls 5th mode control from vent to defroster by selecting mode switch.



LEAD WIRE NO	P1	P2	P3	P4	P5	P6	P7	P8
LEAD WIRE COLOR		B	L/G	Y	B/D	B/W	B/Y	G/W
MODE		M-	M+	DEF	D/F	FOOT	BI-L	VENT

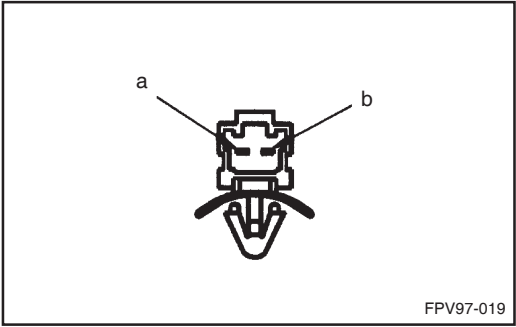
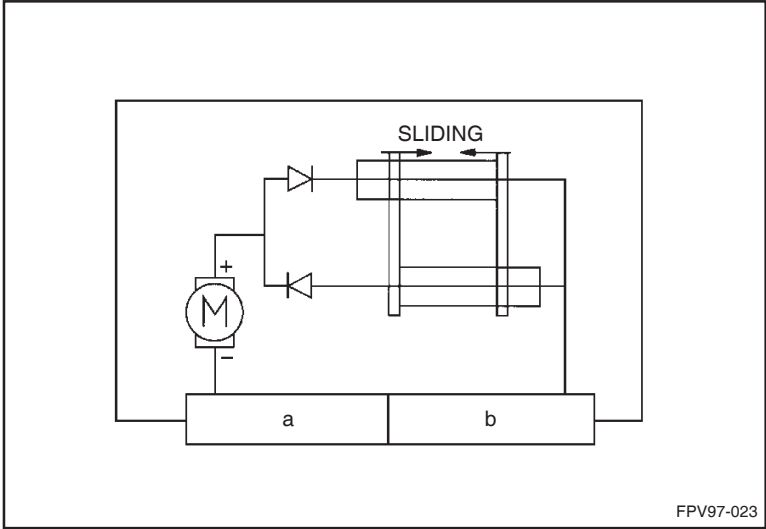
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FPV97-018

Fresh air and recirculation actuator

Installed to the right side of blower unit, it operates damper to select air intake (Fresh air, recirculation) by operating heater control push button.



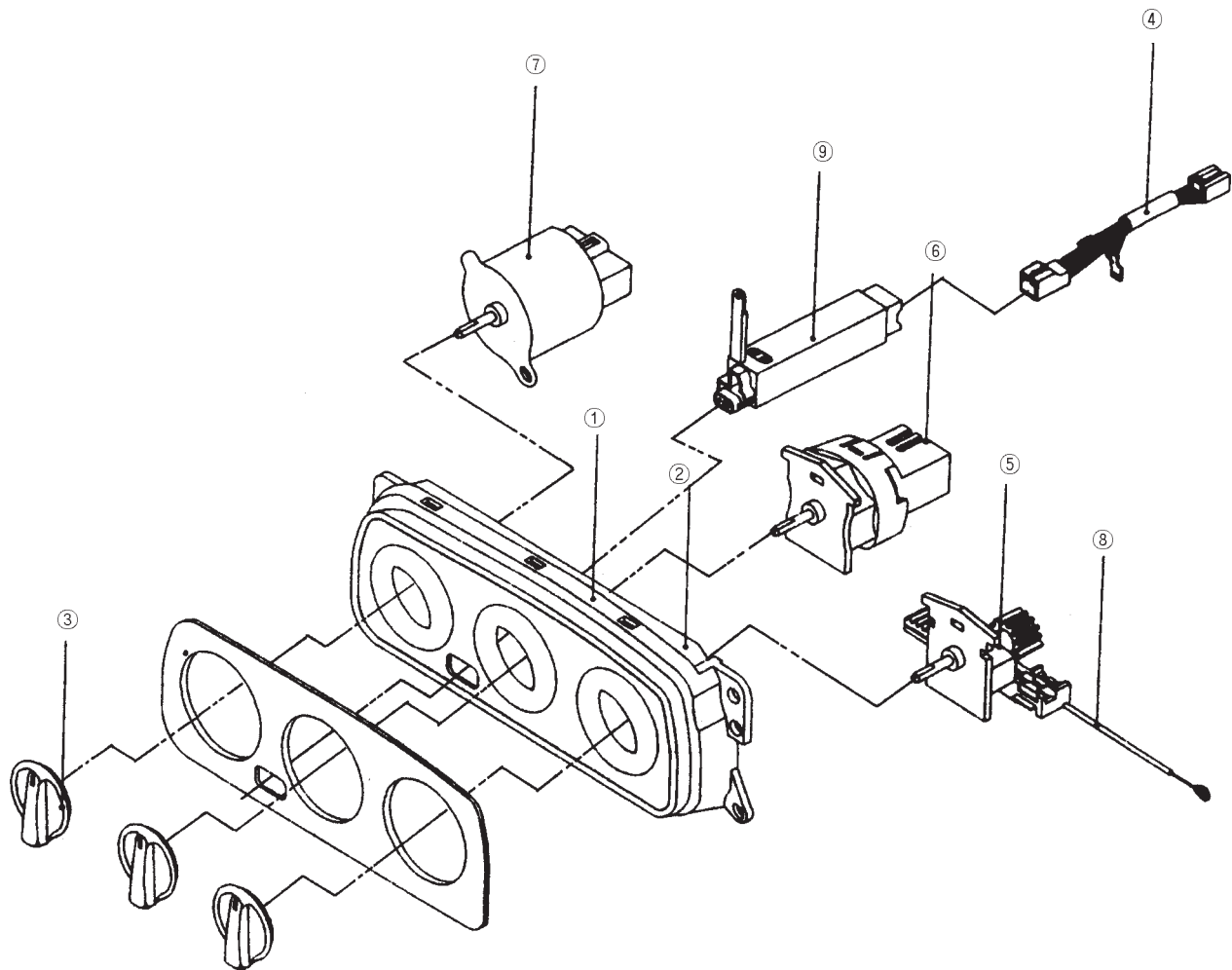
INPUT		OUTPUT
a	b	POSITION
+	-	FRESH
-	+	RECIRCULATION

HEATER CONTROLLER (MANUAL)

Rotary and push button type.

Vent mode selection and switching between fresh outside air and recirculation are decided by damper motor operation, and temperature is controlled by operating air-mix damper by the cable movement with rotary operation, which is installed to the heater unit.

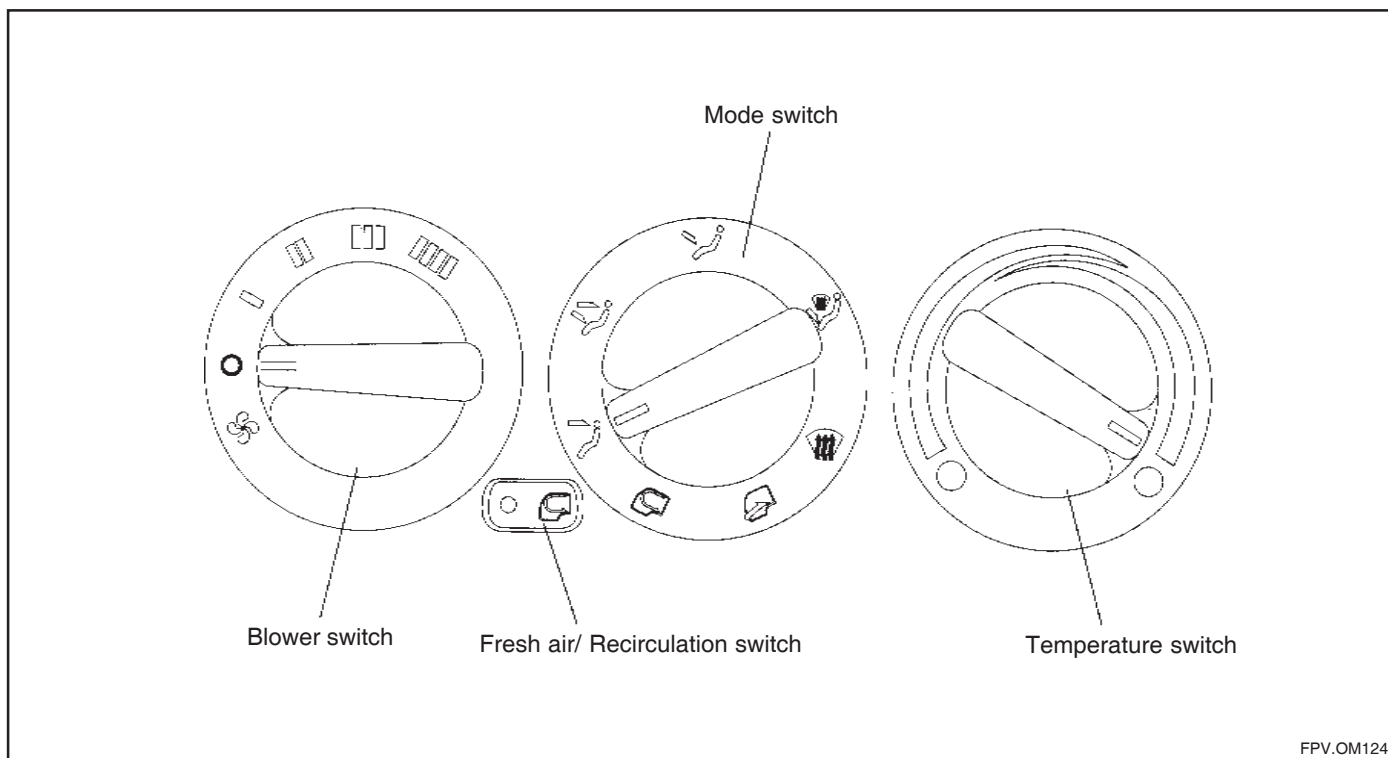
Control structure diagram



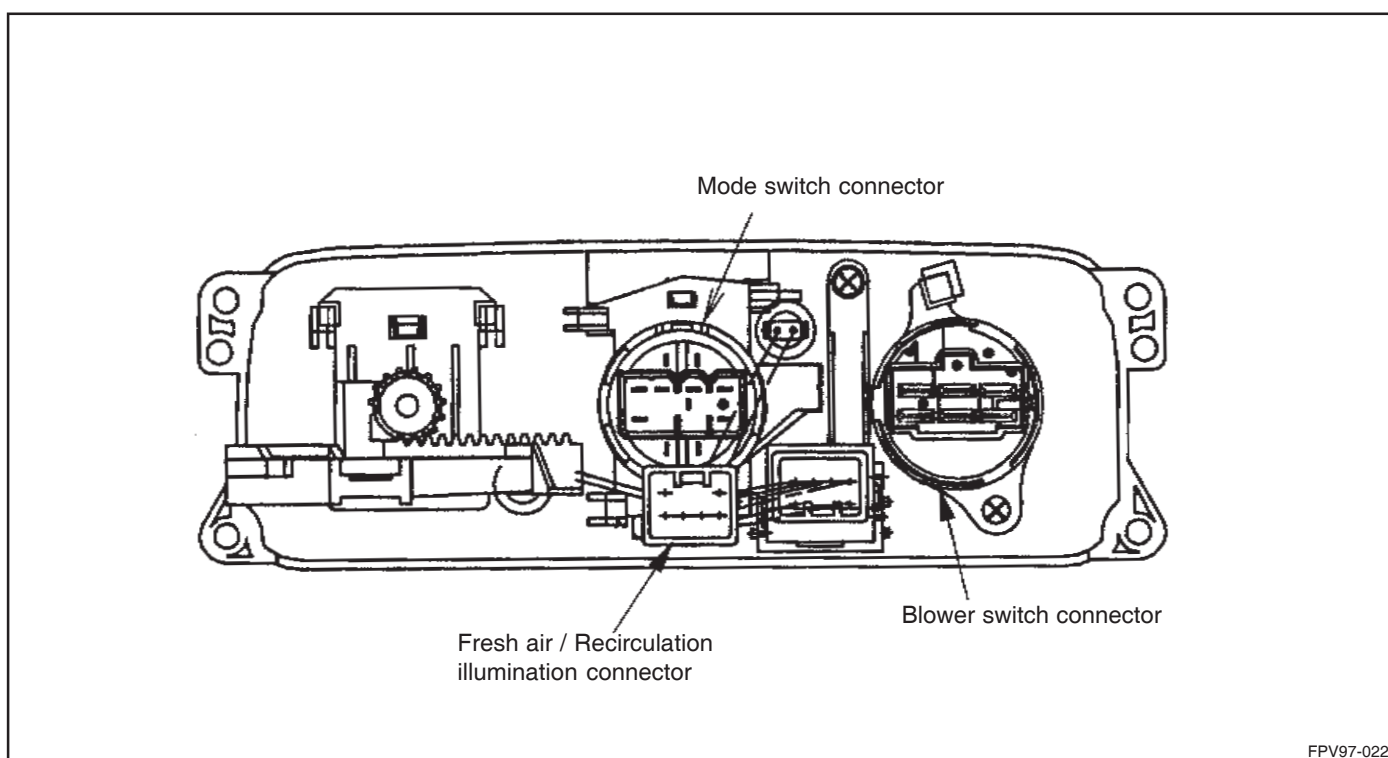
- | | |
|-----------------------|--|
| 1. Control panel | 6. Mode switch |
| 2. Housing | 7. Blower switch |
| 3. Knob | 8. Cable assembly |
| 4. Wiring | 9. Mode control switch(Fresh air, recirculation) |
| 5. Temperature switch | |

SWITCHES

1. Control panel(Front)



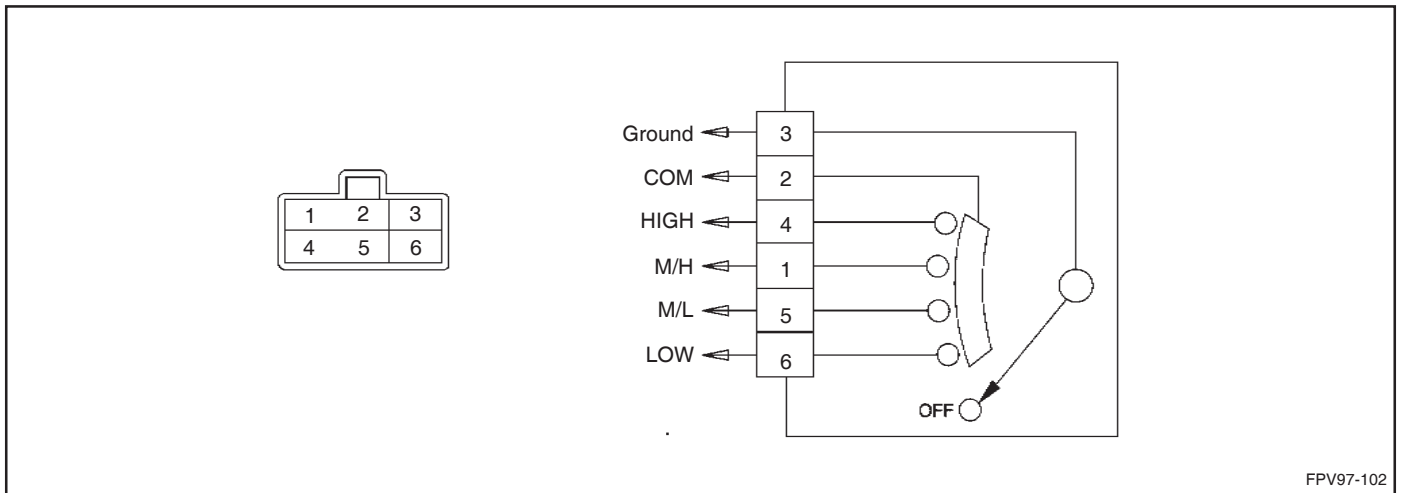
2. Control panel(Back)



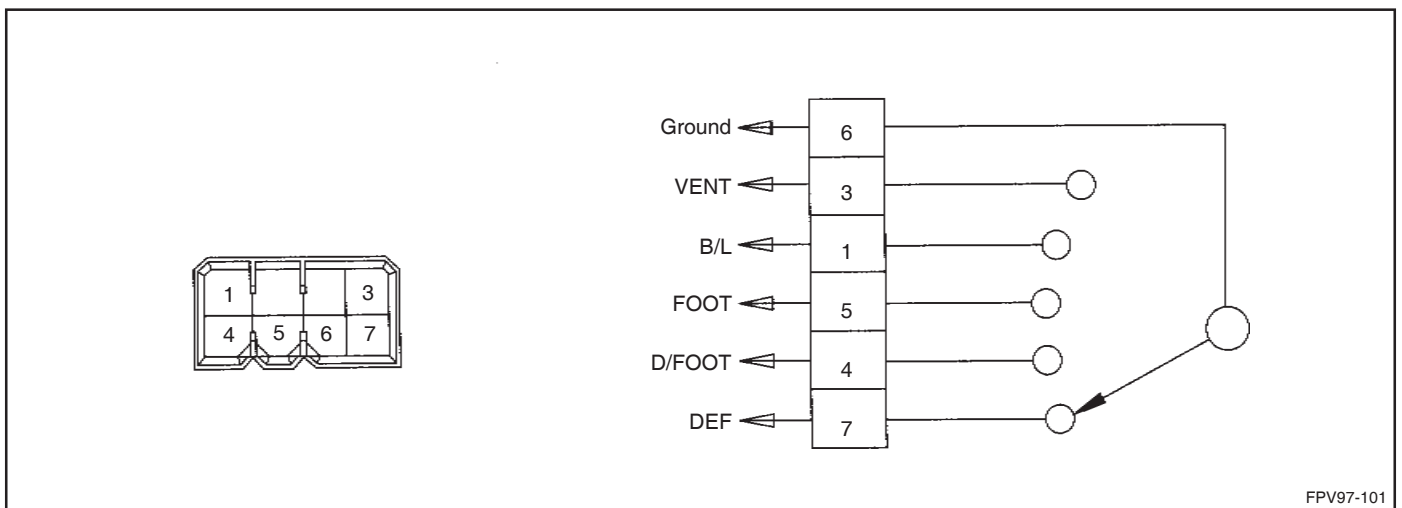
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HEATER AND AIR CONDITIONER

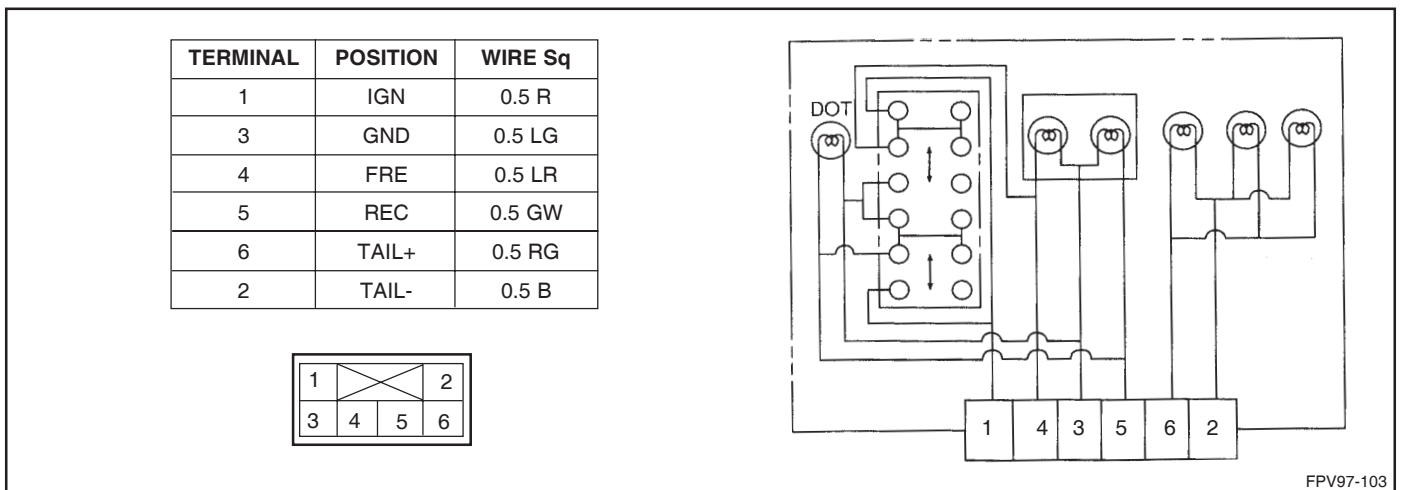
3. Blower switch terminal



4. Mode select switch



5. Fresh, recirculation switch



TROUBLE SHOOTING

MANUAL TYPE

Check points	Symptoms				
	Air-con is not working when ignition switch is on.	Temperature does not drop when air-con is working	Blower fan and motor is not rotating	Vent mode selection is impossible.	Air intake mode is not controlled
Fuse	1		1	1	1
Connector	2		2	2	2
Refrigerant volume	3	1			
Compressor relay	4	4			
Magnetic clutch	5	5			
Dual pressure switch	6	2			
Air-con switch	7				
Blower relay			3		
Blower motor			4		
Switch	8		5		
Blower resistance			6		
Air intake control mode damper motor	10				3
Mode selection damper motor	11			3	

Number means the checking points by sequence.

Symptoms	Possible causes	Repair
Air-con is not working when ignition switch is on.	- Fuse blown	Fuse replacement
	- Harness or connector defective	Repair harness or connector
	- Refrigerant leakage or over charging	Refrigerant refill or repair or leakage or discharge
	- Compressor relay defective	Replacement
	- Magnetic relay defective	Amateur plate, rotor or clutch oil replacement
	- Dual pressure switch defective	Replacement
	- Front air-con switch defective	Replacement
	- Front blower switch defective	Replacement
Temperature does not drop when air-con is working	- Refrigerant leakage	Refrigerant refill or repair leakage points
	- Dual pressure switch defective	Replacement
	- Compressor relay defective	Replacement
	- Magnetic clutch defective	Replacement
Blower fan and motor is not rotating	- Fuse blown	Replacement
	- Harness or connector defective	Replacement
	- Blower motor relay defective	Replacement
	- Front blower motor defective	Replacement
	- Front blower switch defective	Replacement
	- Blower resistance defective	Replacement
Vent mode selection is impossible.	- Fuse blown	Replacement
	- Harness or connector defective	Replacement
	- Mode selection damper motor defective	Replacement
Air intake mode is not controlled (Fresh air and recirculation)	- Fuse blown	Replacement
	- Harness or connector defective	Replacement
	- Air intake mode switch damper motor defective	Replacement

FAULT DIAGNOSTIC TABLE

Check points Symptoms	Fuse	Air-con control unit	Wiring	Heater link	Blower relay	Register	Blower motor	Compressor relay	Magnetic clutch	Air intake damper actuator (Fresh air outside, recirculation)	Vent mode damper actuator	Dual pressure switch	Condenser fan motor	Refrigerant volume
Air-con is not working when ignition switch is on.	①	②	③					④	⑤			⑥		⑦
Inside temperature is not going up (Warm air is not coming)		①	③	②										
Inside temperature does not drop (Cold air is not coming)		⑤	⑥					②	③				④	①
Blower motor is not rotating	①	⑥	⑤		④	③	②							
Blower motor does not stop.		③	②			①								
Air intake mode is not controlled		③	②							①				
Vent mode damper is not working		③	②								①			
Condenser fan is not working	①	④	③										②	

※ "○" represents the parts which needs repair, and the number means the priority number.

TROUBLE SHOOTING

No	Symptoms	Possible causes	Repair
1	Air-con is not working when ignition switch is on.	Wire short or disconnection	Wire repair
		Air-con control unit is damage	Air-con control unit replacement
2	Inside temperature is not going up (Warm air is not coming)	Temp damper stuck	Temp damper repair and replacement
		Wire short or disconnection	Wire repair
		Air-con control unit is damage	Air-con control unit replacement
3	Inside temperature does not drop (Cold air is not coming)	Damage of temp damper operation lever and damper connector	Connector repair
		Temp damper stuck	Temp damper repair and replacement
		Wire short or disconnection	Wire repair
		Compressor relay damage	Relay replacement
		Refrigerant leakage	Refrigerant refill or leakage repair
		Magnetic clutch damage	Replacement
		Air-con control unit is damage	Air-con control unit replacement
4	Blower motor is not rotating	Blower motor damage	Blower motor replacement
		Blower relay damage	Relay replacement
		Wire short or disconnection	Wire repair
		Air-con control unit is damage	Air-con control unit replacement
5	Blower motor does not stop.	Blower motor damage	Power transistor replacement
		Wire short or disconnection	Wire repair
		Air-con control unit is damage	Air-con control unit replacement
6	Air intake mode is not controlled (Fresh air and recirculation)	Air intake mode actuator damage	Air intake mode actuator replacement
		Linkage or damper damage	Connector repair
		Wire short or disconnection	Wire repair
		Air-con control unit is damage	Air-con control unit replacement
7	Vent mode damper is not working	Vent mode damper actuator damage	Vent mode damper actuator replacement
		Vent mode actuator linkage damage	Connector repair
		Air-con control unit is damage	Air-con control unit replacement
8	Condenser fan is not working while air-con operating	Condenser fan motor relay damage	Relay replacement
		Condenser fan motor damage	Condenser fan motor replacement

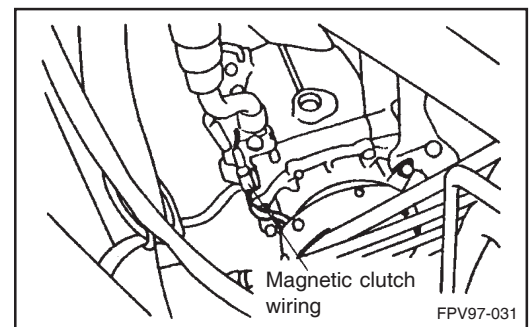
Maintenance procedures

1. Test procedures

- 1) Refrigerant charging level test of sight glass is done with the refrigerant level indicator. To check the refrigerant charging level, start the engine after cleaning sight glass. Operate the compressor by pressing air-con button. Put the blower switch at the high position put and temperature level at the coldest position and check the sight glass.
 - a. When sight glass is cleaned, operate magnetic clutch. If the compressor discharge line is warm and compressor inlet is cold, it means that system is fully charged.
 - b. When sight glass is cleaned, operate magnetic clutch. If there is no temperature difference between compressor inlet and discharge line, it means that system lacks refrigerant.
 - c. When a bubble is seen at the sight glass, charge the system again.

2) Magnetic clutch

- a. Remove the wiring from magnetic clutch.
- b. Connect positive voltage of battery directly to magnetic clutch wiring.
- c. When magnetic clutch is normal, it will display "click". If the pulley or amateur is not connected to "click", system is in malfunction.

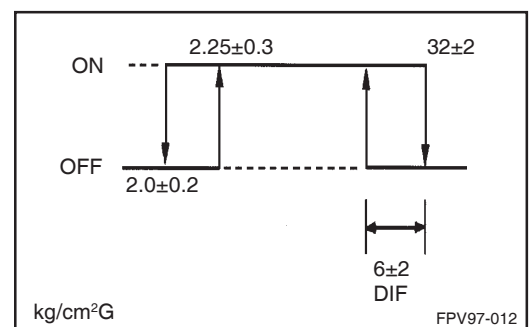


3) Receiver drier

- a. Receiver drier test
- b. Hold receiver drier outlet and inlet, and check the pipe temperature after operating the unit.
- c. If there is temperature difference, check the receiver drier and replace it, if needed.

4) Dual pressure switch (low pressure switch)

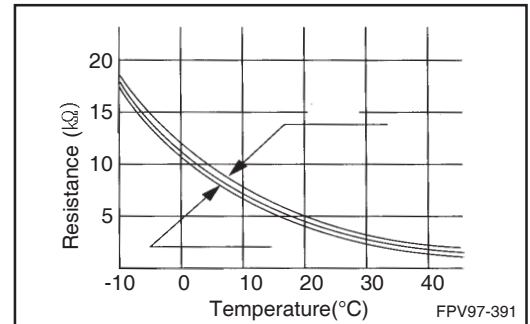
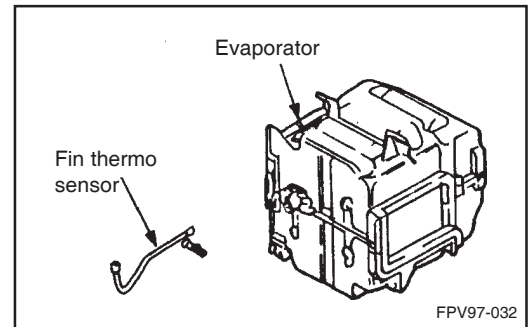
- a. Close the valve by rotating the adaptor valve handle fully, and install it to the low-pressure service valve.
- b. Close the gauge manifold low-pressure maintenance valve, and connect gauge manifold high-pressure side charging hose to adaptor valve.
- c. Tighten the adaptor valve handle and open the service valve.
- d. When the side pressure of low-pressure is "on" level of dual pressure switch, and if there is continuity between dual pressure switch terminals, switch is normal. Replace the switch otherwise.



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HEATER AND AIR CONDITIONER

- 1) Fin thermo sensor
 - a. Remove the sensor connector from evaporator case and then measure the resistance using resistance tester. If the sensor value lies within plus minus 10 % range, sensor is in normal operation.
 - b. Even if the sensor is normal, replace it when the air-con control unit is in malfunction.



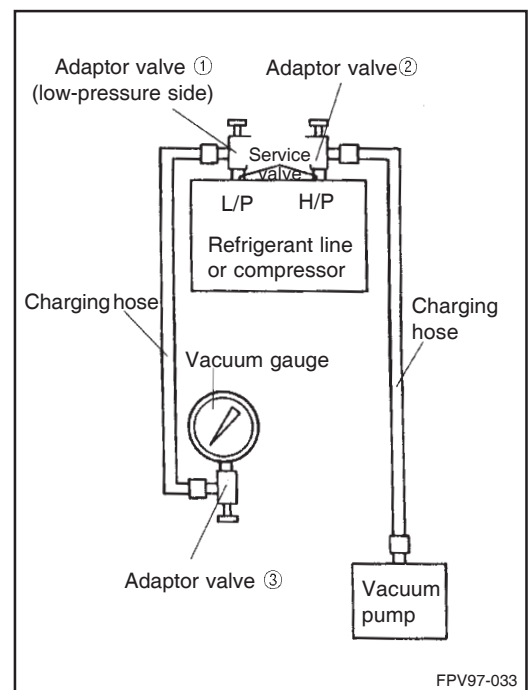
2. Charging procedures

1) Installation of charging equipments

- ① When using vacuum gauge.
 - a. Rotate the handle of adaptor valve ① and ② fully, and then install adaptor valve ① and ② to low pressure valve and high pressure valve respectively.
 - b. Tighten the adaptor valve ① and ② fully (valve open), and then open low-pressure valve and high pressure valve.
 - c. Connect charging hoses to adaptor valve ① and ②.
 - d. Tighten the adaptor valve ③ fully (valve open), and then install it to the low pressure charging hose.
 - e. Install the vacuum gauge to adaptor valve ①.
 - f. Install vacuum pump to high-pressure charging hose.

NOTE

- Be careful not to be confused in connecting low-pressure and high-pressure. (Connect the high pressure to condenser and then connect the low-pressure to evaporator)
- “DIS” and “SUC” of compressor stands for high pressure and low pressure respectively.

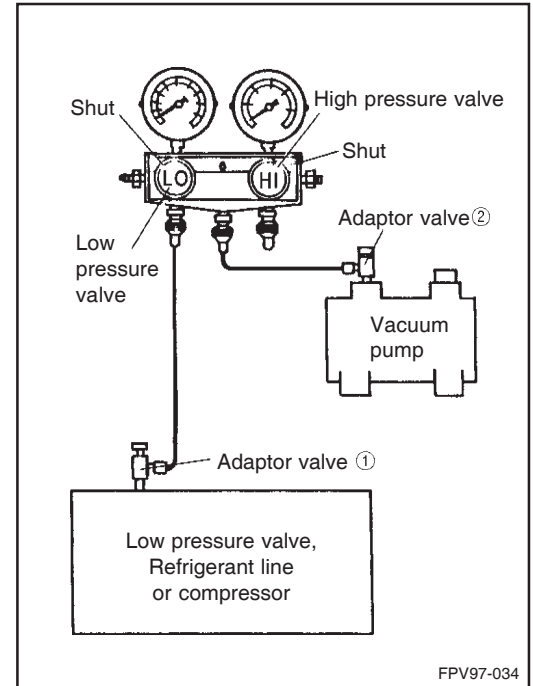


② When using gauge manifold.

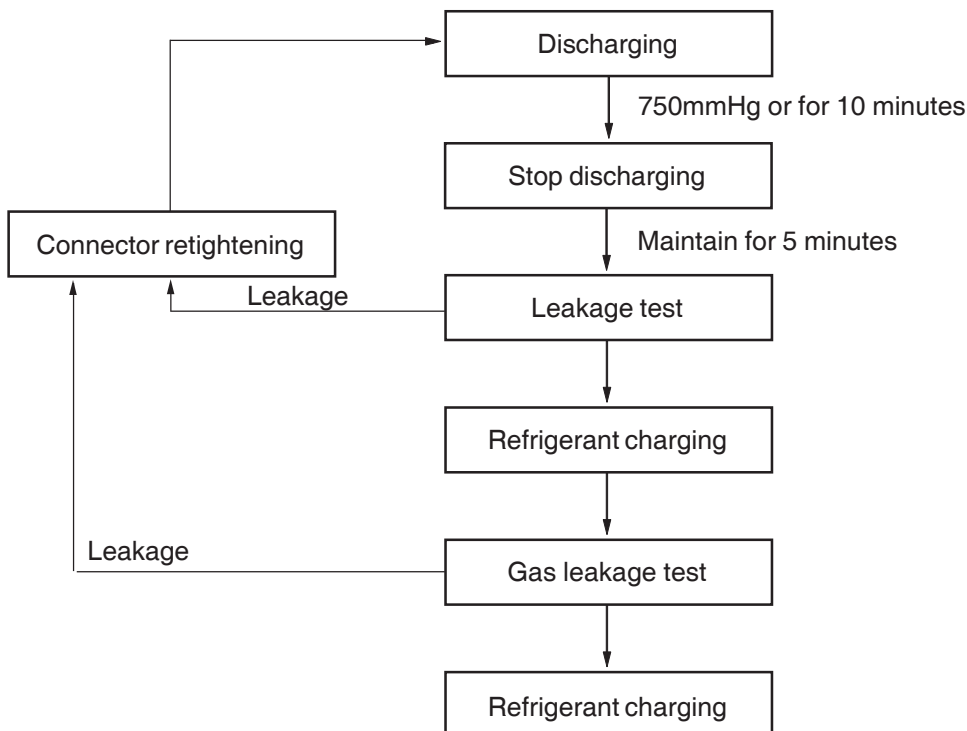
- Turn adaptor valve handle counterclockwise, and then install adaptor valve ① and ② to low-pressure maintenance valve and vacuum valve.
- Install gauge manifold to low pressure and high pressure.
- Connect charging hoses to each adaptor.
- Open maintenance valve and vacuum pump by rotating handle of adaptor ① and ② clockwise.

[REFERENCE]

- Be careful not to be confused in connecting low-pressure and high-pressure. (Connect the high pressure to condenser and then connect the low-pressure to evaporator)
- “DIS” and “SUC” of compressor stands for high pressure and low pressure respectively.



2) Charging unit



Refrigerant is discharged through outlet.

Charge with only R-134a.

R-134a can be used in a bulk tank and small can as well.

Please follow the preventive safety measures when handling substances like R-134a.

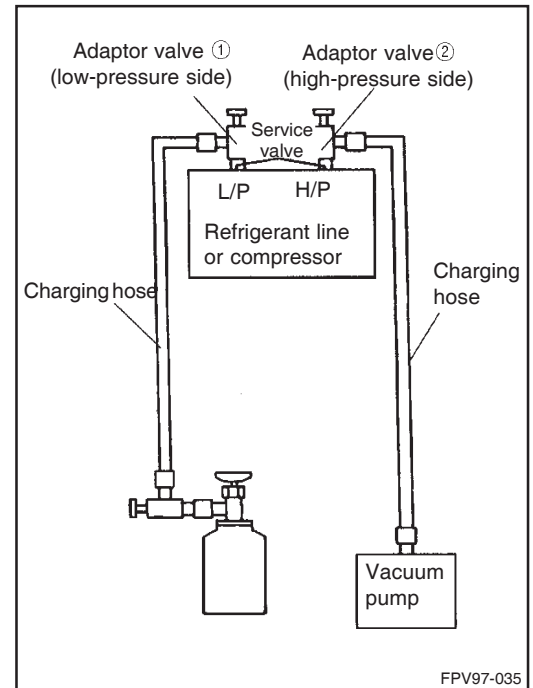
3. Refrigerant charging

1) Charging a small can.

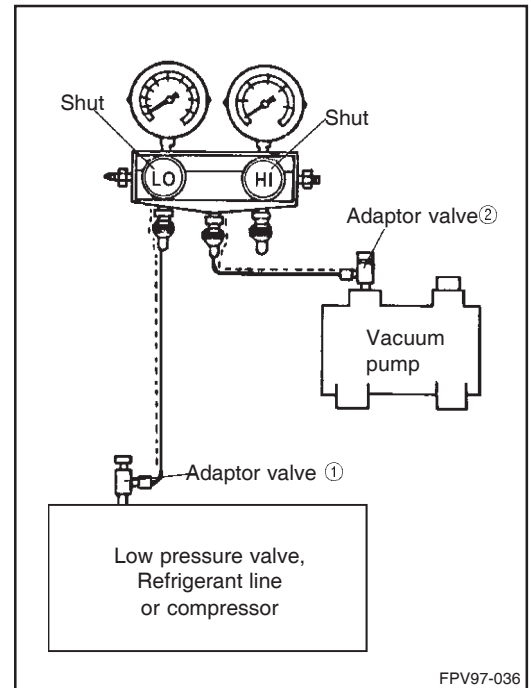
- ① When using a vacuum gauge.
 - a. Operate vacuum pump.
 - b. Keep the vacuum pressure more than 750 mmHg (discharging for more than 10 minutes)
 - c. Turn clockwise the handle of high pressure adaptor valve ② (valve closed)
 - d. Maintain the vacuum state for 5 minutes while vacuum pump operation is stopped.
 - e. Check the leakage. (Good condition if vacuum state is kept)
 - f. Turn the handle of charging valve ④ backward (valve open) and install it to charging can
 - g. Turn the handle of charging valve ③ fully backward (valve closed) and install charging can after removing vacuum meter.
 - h. Tighten the charging valve handle ④ to pierce a hole.
 - i. Turn the charging valve handle ④ backward (valve open), and tighten adaptor valve handle ③ completely (valve open) and then charge the refrigerant.
 - j. When refrigerant is not circulating, turn the handle of adaptor valve ① counterclockwise. (Valve closed)
 - k. Check the gas leakage using leak tester.
 - l. Start the engine
 - m. Turn the air-con on and put the switch at max cool position.
 - n. Fix the engine speed at 1,500 rpm
 - o. Charge the refrigerant as needed by turning the handle of adaptor valve ① completely clockwise (valve open)

NOTE

- If the maintenance can is put upside down, liquid refrigerant may flow down and damage the compressor with the liquid compression. Put the maintenance can upright so that the refrigerant can be filled as a gas.
- p. After charging, turn the adaptor valve handle ① fully counterclockwise (valve closed)



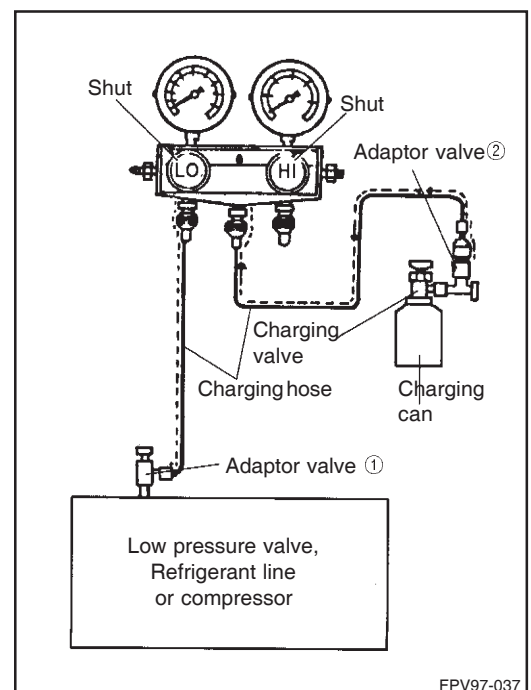
- ① When using gauge manifold
 - a. Operate vacuum pump
 - b. Keep the vacuum pressure more than 750 mmHg (discharging for more than 10 minutes)
 - c. Turn the handle of adaptor valve ② fully clockwise (valve closed).
 - d. Stop vacuum pump operation and keep the vacuum state for more than 5 minutes.
 - e. Check the leakage.



- f. Tighten the handle of charging valve ③ to the maintenance can.
- g. Tighten the handle of adaptor valve ② fully and open the charging valve.
- h. Charge the refrigerant to the low-pressure valve of manifold gauge through charging hose.

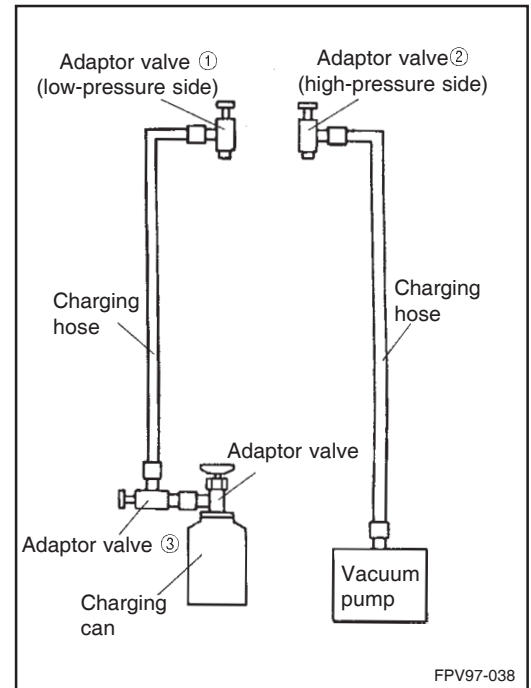
NOTE

- If the maintenance can is put upside down, liquid refrigerant may flow down and damage the compressor with the liquid compression. Put the maintenance can up-right so that the refrigerant can be filled as a gas.
- i. When the refrigerant is not charging, turn the handle of adaptor valve ① counterclockwise. (Valve closed)
 - j. Check the gas leakage using gas leakage tester.
 - k. Start the engine.
 - l. Turn the air-con on and put the switch at max cool position.
 - m. Fix the engine speed at 1,500 rpm
 - n. Charge the refrigerant as needed by turning the handle of adaptor valve completely clockwise (valve open)
 - o. After charging, turn the adaptor valve handle ① fully backward (valve closed)



2) Removal of charging equipments

- ① Close the charging valve ④ (valve closed)
- ② Remove adaptor valve ① and ② from each service valve.
- ③ Remove maintenance valve
- ④ Remove charging valve ④.
- ⑤ Remove adaptor ③
- ⑥ Remove adaptor ①
- ⑦ Remove adaptor ②
- ⑧ Remove vacuum pump.

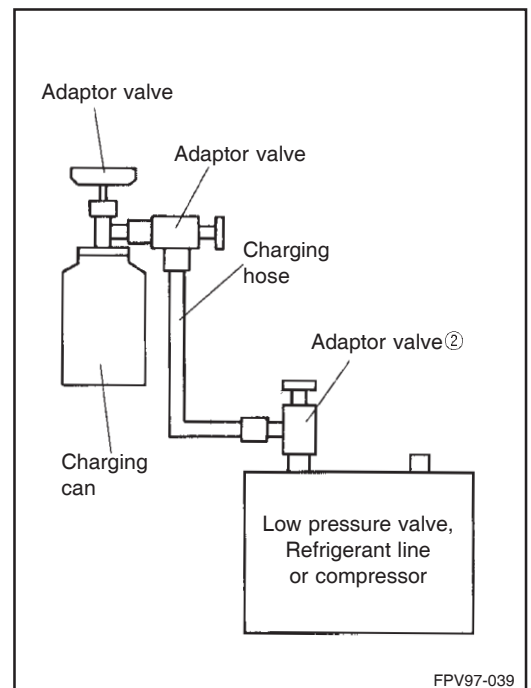


2) Refill of low refrigerant level.

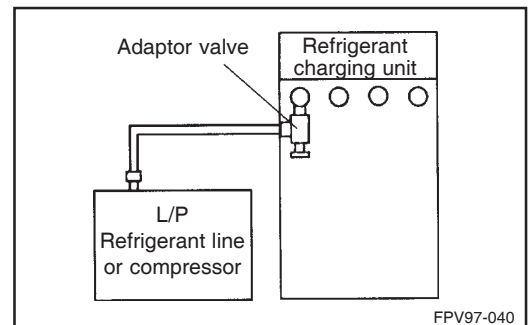
- ① Turn the charging valve handle backward (valve open) and install it to the maintenance can.
- ② Tighten the handle and install the adaptor valve ① to charging valve. (Valve open)
- ③ Install the charging hose to adaptor valve ①
- ④ Turn the adaptor valve "è backward (valve closed) and install the charging hose.
- ⑤ Turn the charging valve handle and pierce a hole in a can.
- ⑥ Turn the handle of charging valve ③ backward (valve open), and operate it as the air should not leak from adaptor valve.

(Operation)

- **Do not use high-pressure side. There is a risk of refrigerant backward flow and subsequent damage on charging can and hoses.**



- ⑦ Install adaptor valve ② to low pressure maintenance valve.
- ⑧ Start the engine
- ⑨ Turn the air-con on and put the switch at max cool position.
- ⑩ Fix the engine speed at 1,500 rpm
- ⑪ After tightening handle of adaptor valve ② (valve open), charge the refrigerant as checking refrigerant charging level with sight glass.
- ⑫ After charging, turn the adaptor valve handle ② fully backward (valve closed)
- ⑬ Remove the adaptor valve "è from maintenance valve.



TROUBLE SHOOTING**HA-27**

4) Charging equipment

Please refer to the unit operation manual for the use of refrigerant recovery unit equipment and recycling unit equipment.

5) Proper refrigerant quantity of air-con system.

In charging, do not overcharge nor undercharge.

NOTE

- **Charge properly, since overcharging or undercharging may cause air-con performance deterioration or system malfunction.**

Air-con specification	Refrigerant quantity(g)
Manual	650±20g

6) Refill of refrigerant oil in air-con system.

When refrigerant oil is insufficient, compressor lubrication is not proper and causes malfunction accordingly. On the contrary, if there is too much refrigerant oil, discharging temperature goes up and weaken the air-con performance. When assembled in factory, 200 cc of refrigerant oil is charged. While air-con is in operation, refrigerant oil flows throughout the system with the refrigerant. Since the refrigerant oil remains in many places, refill the system with the proper quantity of refrigerant oil when the system components are replaced.

Refill quantity of refrigerant oil when replacing air-con system components

Items	Quantity (cc)
Condenser	8
Evaporator	72
Receiver drier	6.4

4. Performance test

- 1) Park the vehicle to be tested in the shaded place.
- 2) Connect the tachometer
- 3) Turn the adaptor valve handle backward and then install the adaptor valve to high-pressure and low-pressure maintenance valve respectively.
- 4) Connect the gauge manifold to adaptor valve.
- 5) Tighten adaptor valve handle and then open the service valve.
- 6) Start the engine.

7) Put the control at the following positions.

Items	Position
Air-con switch	Air-con on position
Mode selection	Vent position
Temperature control	Max cooling (max, cool position)
Air mode	Recirculation position
Blower switch	Hi position

8) Set the engine speed at 1,000 rpm so that air-con compressor turns on and off.

9) Warm up the engine after closing door and windows.

10) Install the thermometer at the center of air-con outlet (center of center vent grille) and start the engine for about 20 minutes.

11) Measure the discharging temperature

<Temperature table>

Ambient temperature(°C)	21	26.7	32.2	37.8	43.3
Discharging temperature(°C)	0.0~3.0	0.0~3.3	0.0~4.0	0.0~4.0	0.0~4.0
Compressor discharge pressure(kg/cm ² G)	6.5~7.0	7.4~7.9	9.8~10.2	11.5~12.0	13.2~13.7
Compressor suction pressure(kg/cm ² G)	1.3~1.9	1.3~1.9	1.3~1.9	1.3~1.9	1.3~1.9

5. Repairing procedures of refrigerant leakage

1) Refrigerant leakage

When all refrigerant leaked away

- ① Vacuum the system. (Refer to the vacuuming procedures)
- ② Charge the system with about 1 pound of refrigerant
- ③ Check the leakage
- ④ Discharge the refrigerant
- ⑤ Repair the leaking point
- ⑥ Replace the receiver drier.

NOTE

- **Receiver drier should be sealed when stored. Receiver drier, which is used in air-con system, absorbs water quickly when exposed to the air. When installing the receiver drier, reassemble it as quickly as possible without leaving it open for a long while.**

- ⑦ Vacuum the system and charge it with refrigerant.

2) Insufficient charging

Repair the leakage if refrigerant charging is impossible. Since only small quantity of refrigerant is left in the system, charge the refrigerant to increase the system pressure.

When repairing the leakage without discharging the remaining refrigerant in the system, follow the repair procedures of low refrigerant charging level.

6. Tubing and fittings procedures

Refrigerant tubing or sharp bending in the refrigerant hose lines will greatly reduce the overall system performance. System pressure becomes high, while operating. Make sure that all connections are tightened with proper torque. Be careful so that any dirt and moisture contaminate the system when it is open for repair or replacement of lines or components. Discharge the fitting completely before connecting it to the refrigerant system. The following precautions must be observed. The system must be completely discharged before opening any fitting or connection in the refrigeration system. Open fittings with caution even after the system has been discharged. If any pressure is detected when disconnecting a fitting, allow trapped pressure to bleed off very slowly.

Never attempt to rebind formed lines to fit. Use the correct line for the installation you are servicing. A good rule for the flexible hose lines is keeping the radius of all bends at least 10 times of the hose outer diameter.

Sharper bends will reduce the flow of refrigerant.

The flexible hose lines should be routed so that they are at least 80 mm from the exhaust manifold. It is good practice to inspect all flexible hose lines at least once a year to make sure they are in good condition and properly routed.

O-rings used on connections are not reusable.

7. Compressor noise check

You must first know the conditions when the noise occurs. These conditions are: weather, vehicle speed, in gear or neutral, engine temperature or any other special conditions. Noises that develop during A/C operation can often be misleading. For example: what sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets or a loose clutch assembly. Verify accessory drive belt tension (power steering or alternator).

Improper accessory drive belt tension can cause a misleading noise when the compressor is engaged and little or no noise when the compressor is disengaged.

Drive belts are speed-sensitive. In other words, at different engine speeds, and depending upon belt tension, belts can develop unusual noises that are often mistaken for mechanical problems within the compressor.

a. Adjustment

- 1) Select a quiet area for testing. Duplicate conditions as much as possible. Turn compressor on and off several times to clearly identify compressor noise. To duplicate high ambient conditions (high head pressure), restrict airflow through condenser. Install manifold gauge set to make sure discharge pressure doesn't exceed 21.4 kg/cm².
- 2). Tighten all compressor mounting bolts, clutch mounting bolt, and compressor drive belt. Check to assure clutch coil is tight (no rotation or wobble).
- 3). Check refrigerant hoses for rubbing or interference that can cause unusual noises.
- 4). Check refrigerant charge.
- 5). Recheck compressor noise as in Step 1.
- 6). If noise still exists, loosen compressor mounting bolts and re-torque. Repeat Step 1.
- 7). If noise continues, replace compressor and repeat Step 1.

SERVICE PROCEDURE

UNIT ASSEMBLY

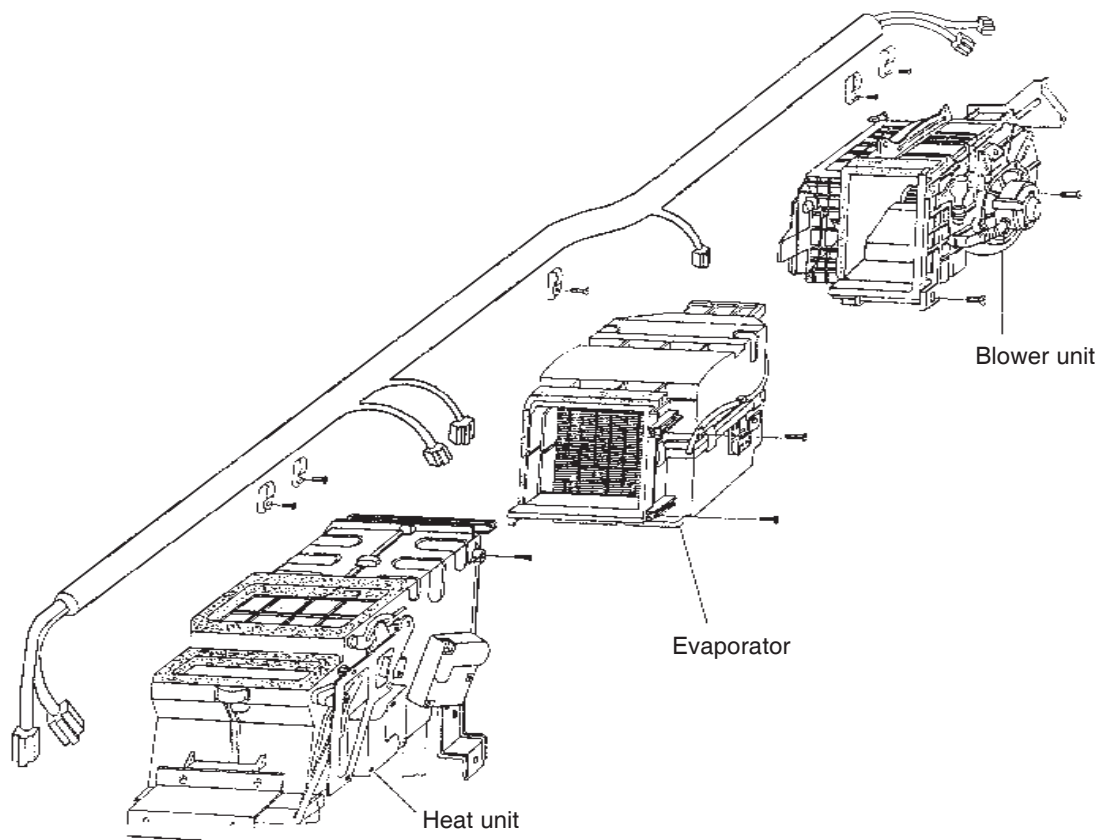
Removal

1. Heater hose
2. In-outlet refrigerant pipe
3. Mounting nut
4. Control assembly
5. Audio assembly
6. Control panel
7. Passenger side under cover
8. Instrument assembly
9. Mounting bracket

Installation

Installation is the reverse of removal.

Disassembly and assembly



HEATER UNIT

Removal

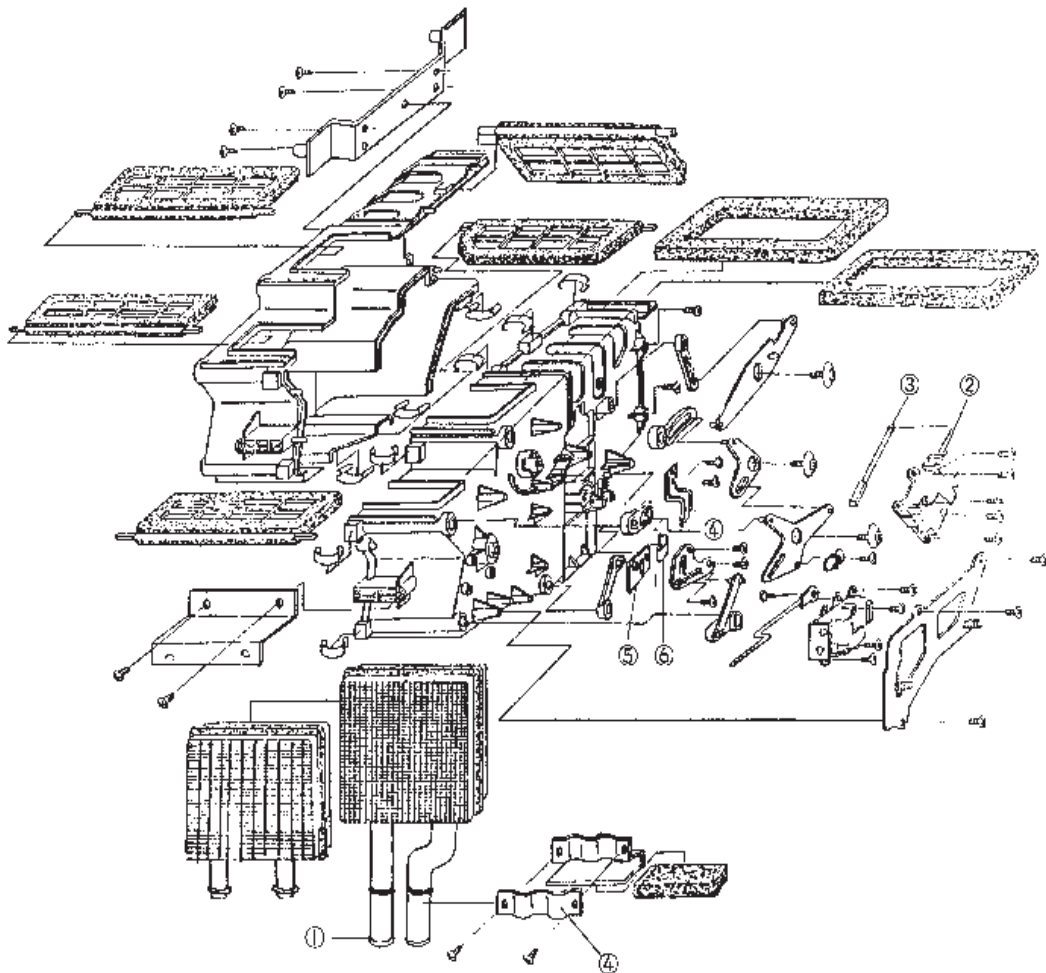
Disassemble after that heater unit removal

Installation

Installation is the reverse of removal.

Disassembly and assembly

1. Disassemble as below illumination.
2. Assembly is the reverse of disassembly.



- ①④ Heater core and mounting bracket
- ②③ Temperature actuator and coolant temperature sensor
- ⑤⑥ Wire clamp and bracket

EVAPORATOR UNIT

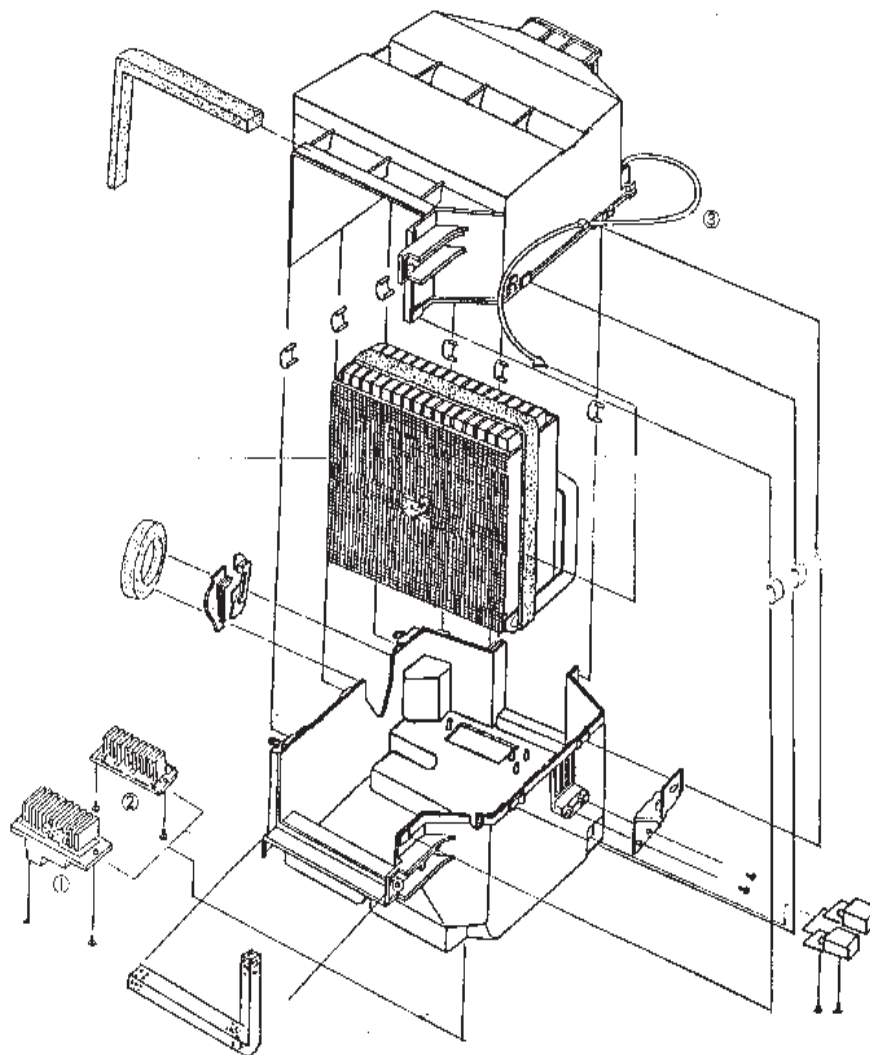
Removal

Disassemble after that evaporator unit removal

Installation

Installation is the reverse of removal.

Disassembly and assembly



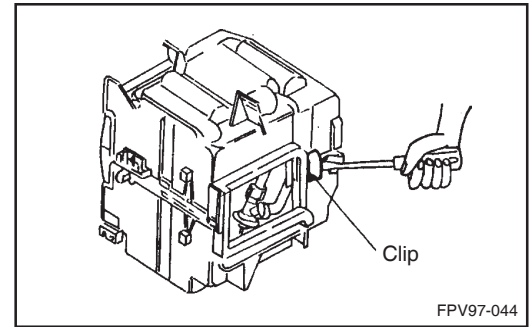
- ① Power transistor(for Automatic Air-con)
- ② Resistor (for Manual A-con)
- ③ Thermist (for Automatic), Resistor(for Manual)

SERVICE PROCEDURE

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1. Removal of case clip

To remove the case clip, insert the “-“ type screwdriver inside the clip and pull it slowly not to damage the case.

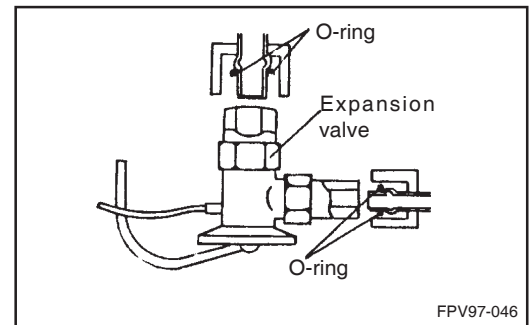
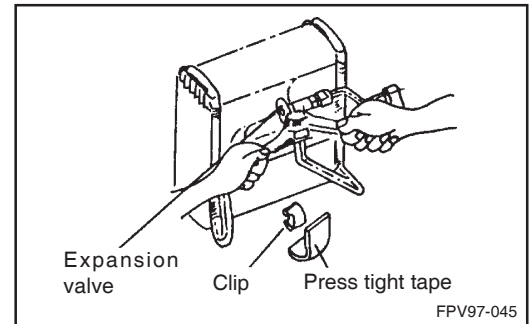


2. Removal of expansion valve

Loosen the swivel nut using 2 wrenches.

NOTE

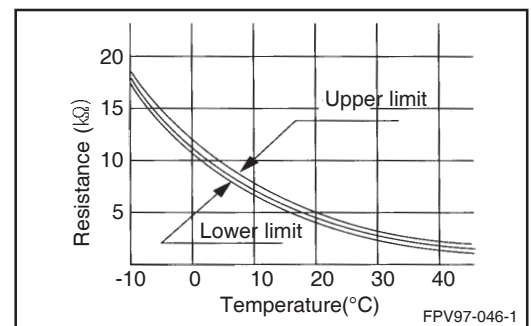
- When installing an expansion valve, be careful with the temperature sensor.
- Wrap it thoroughly with press-tight tape after fastening the clips.



3. Check any damage of O-ring and apply the refrigerant oil before connecting hose and pipes to the inlet and outlet of evaporator.

NOTE

- Check of evaporator pin thermo sensor.
Measure the resistance values of terminals more than 2 times at a different temperatures. If the value lies within the specification, sensor is normally operating.



※ When measuring resistance values, temperature condition should not exceeds the temperature range of the graph.

BLOWER UNIT

Removal

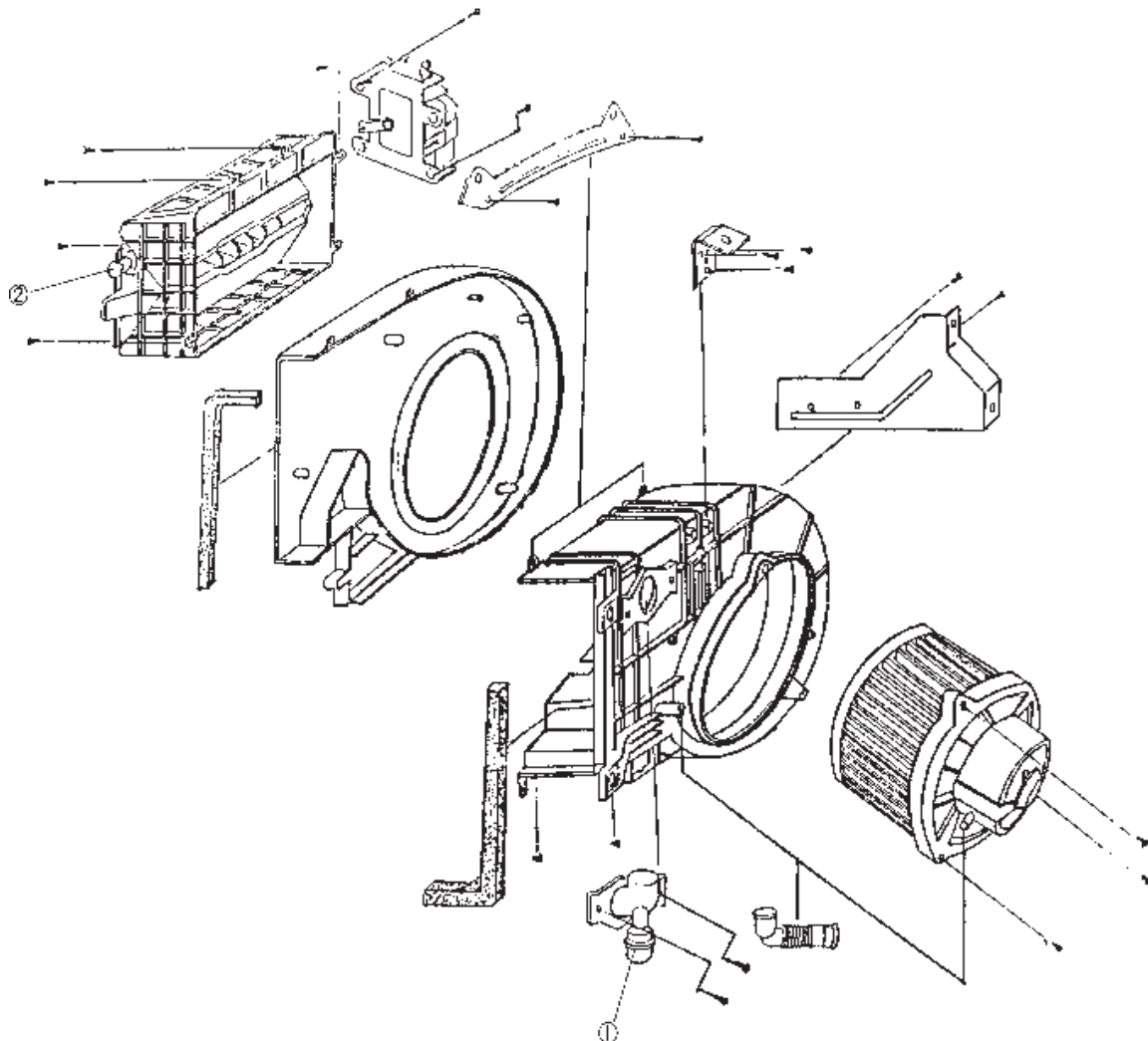
Disassemble after that blowr unit removal

Installation

Installstion is the reverse of removal.

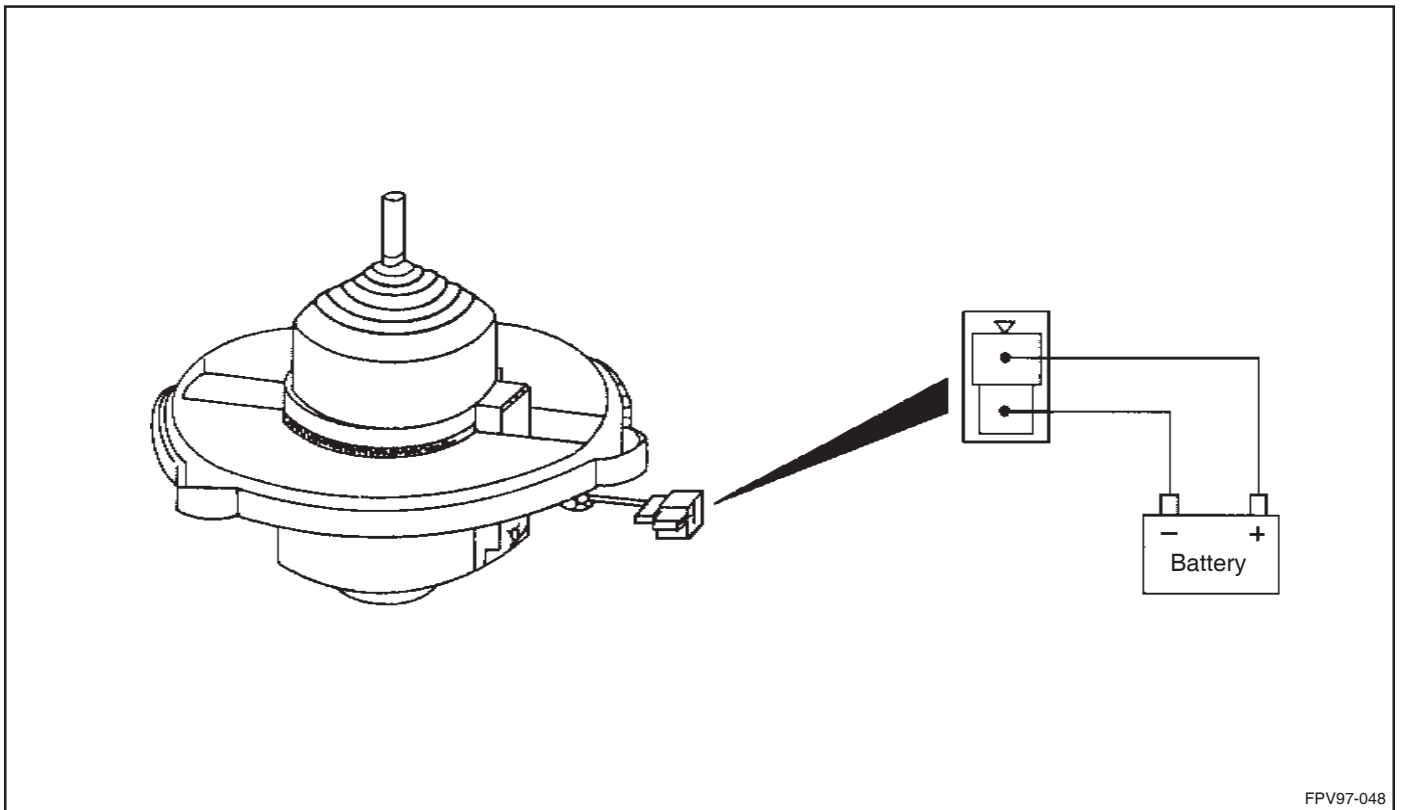
Disassembly and assembly

1. Disassemble as below illumination.
2. Assembly is the reverse of disassembly.



- ① Aspiration (for Automatic Air-con)
② Ambient sensor (for automatic A-con)

Check



FPV97-048

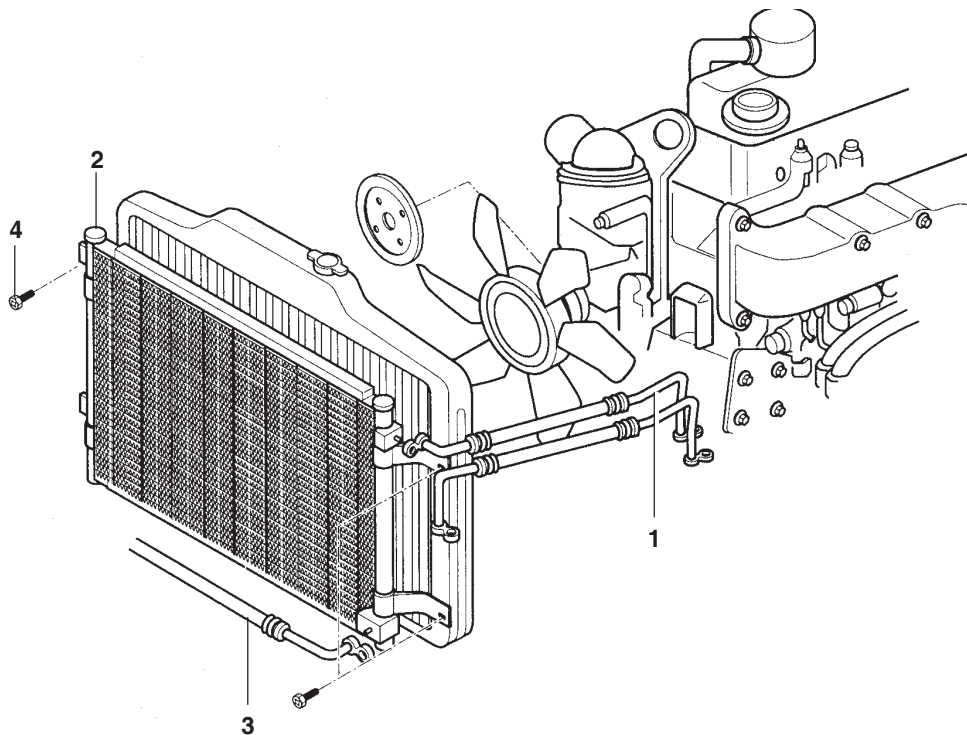
1. General check

- ① Any deformation or bending of blower motor shaft
- ② Any damage of wheel and blower case.
- ③ Operation state of air intake switch door motor.
- ④ Any malfunction of power relay

2. Blower motor assembly check

- ① Remove the connector of blower motor.
- ② Connect the connector to the blower motor directly and check whether blower motor turns smoothly.
- ③ Connect by changing the electrode and check whether the motor turns smoothly to the reverse direction.
- ④ Replace the motor if any fault is found.

CONDENSER



FPV97-050

Disassembling order.

1. Discharge hose and liquid tube (A)
2. Condenser bolts (4 ea)
3. Condenser

NOTE

- Discharge the refrigerant completely before disassembling condenser. Remove the radiator grille.

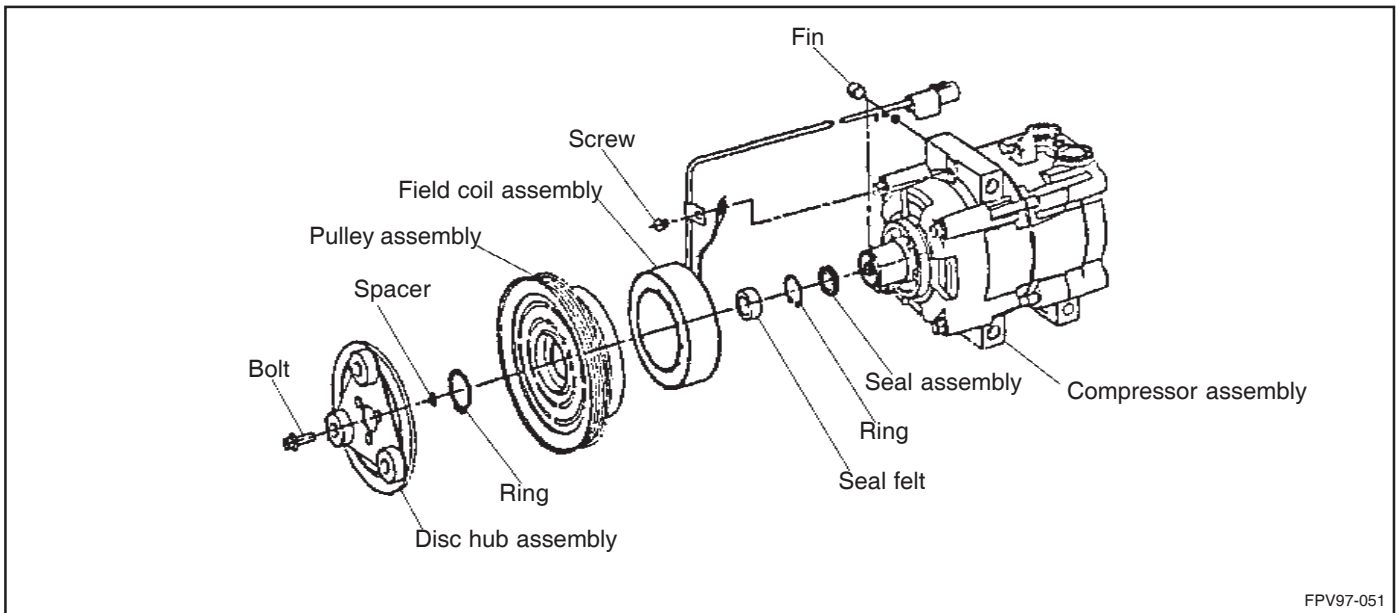
Assembly order

Assembly is done by the reverse order of disassembly.

NOTE

- Recharge the refrigerant to the specification after installing the condenser.

COMPRESSOR UNIT

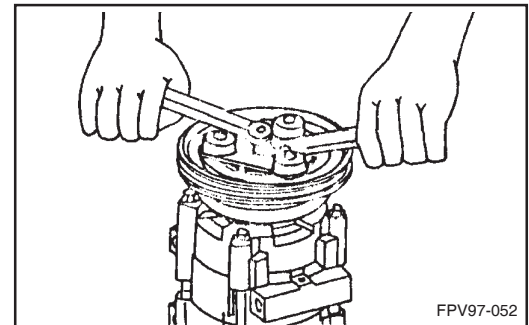


Assembly and disassembly of compressor unit

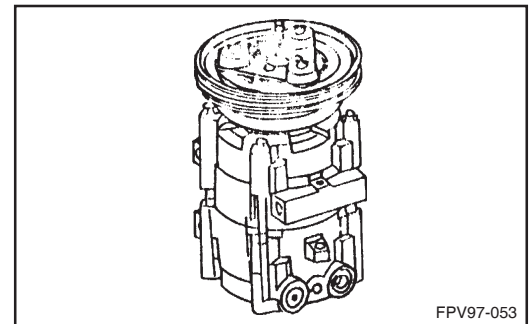
1. Clutch and hub pulley

1) Removal

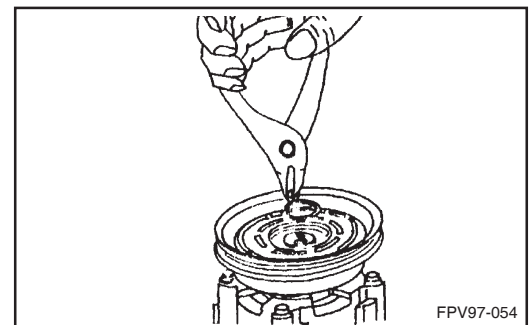
- ① Remove the clutch hub supporting bolts with the spanner wrench.



- ② Pull the clutch hub and shim from the compressor shaft. When the hub is not pulled from compressor shaft, insert the bolt of 8 mm into the hub shaft hole and remove the shaft.

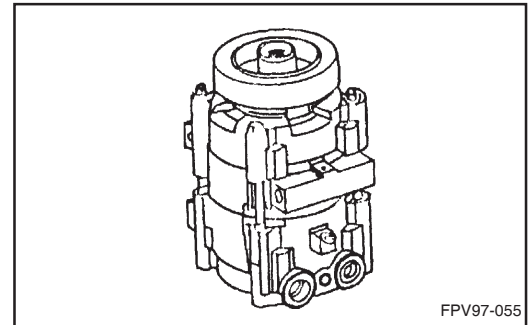


- ③ Remove the pulley supporting snap ring
- ④ Remove compressor pulley and bearing assembly

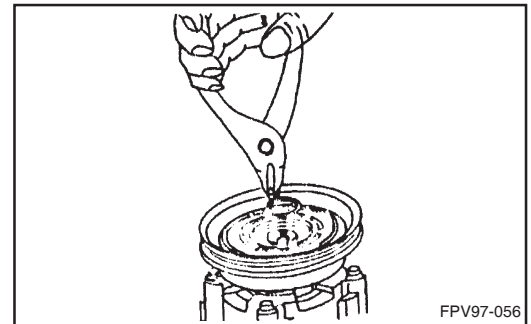


2) Installation

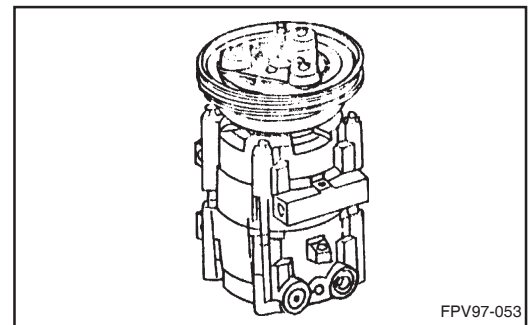
- ① Clean pulley bearing of compressor head to remove any dirt or rust.
- ② Install the compressor pulley and bearing



- ③ Install the pulley snap ring as the slanted part faces outer direction.



- ④ Put one spacer shim of specified thickness inside hub spool line opening, and slide down the hub to compressor shaft end



- ⑤ Put the new hub-supporting bolt on the compressor shaft end and tighten it with the specified torques.

Tightening torque	1.1~1.4kg·m
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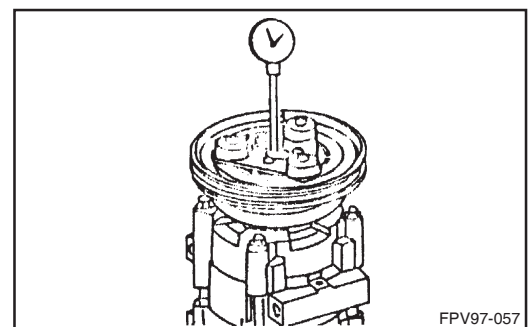
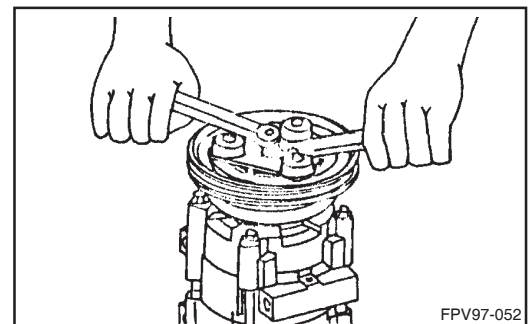
NOTE

- **Do not turn on the air-con.**

- ⑥ Check the clutch air gap between clutch hub and pulley faces with dial gauge, and compare it with the specification. Check it 3 times around pulley.

Items	Standard
Clutch air clearance	0.4~0.7mm

- ⑦ If the clutch air gap exceeds the specification, adjust the air clearance to the specification by trying the different shims.



SERVICE PROCEDURE

HA-39

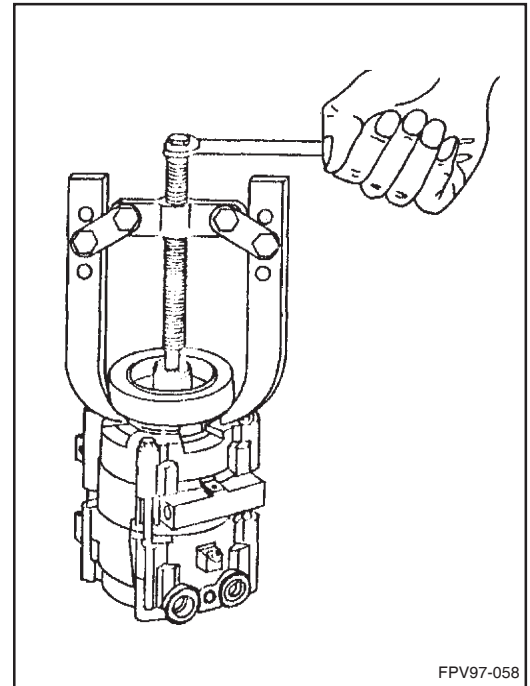
2. Clutch field coil

1) Removal

- ① Remove clutch hub and pulley
- ② Install the shaft protection tool at the compressor opening
- ③ Install the compressor pulley as shown in the figure. Position the puller screw end at the concave part of shaft protector and position the pulley jaw around the bottom of the field coil.
- ④ Remove the coil out of compressor rotating the screw with wrench.

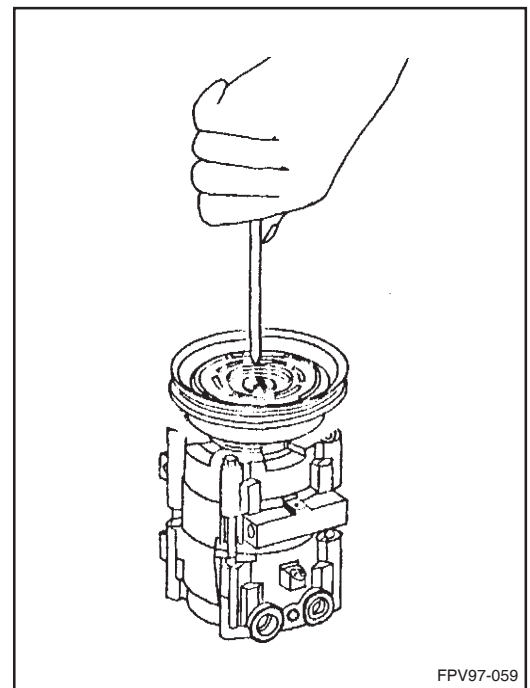
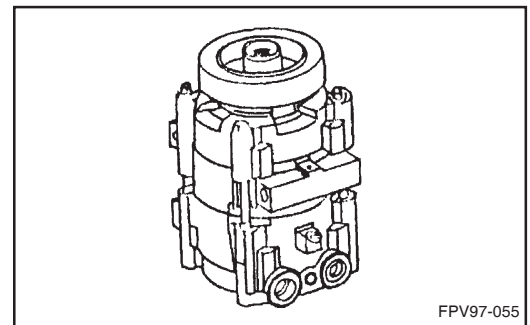
NOTE

- Do not turn on the air-con.



2) Installation

- ① Clean the coil installation part of front head.
- ② Position the compressor upright and put the coil at the original position of the compressor front head. Check whether electric connector of clutch coil is positioned correctly.
- ③ Put the coil compression tools at the inner circle of compressor nose and field coil.
- ④ Put the 2 pullers of 8 inches at the compressor and compression tool respectively. Puller jaw should hold tight the back of the installation part of front compressor, and screw should be positioned at the center of compression tool.
- ⑤ Tighten the screw with wrench as installing the coil tight at the compressor front head.
- ⑥ Install clutch hub and pulley to the compressor.

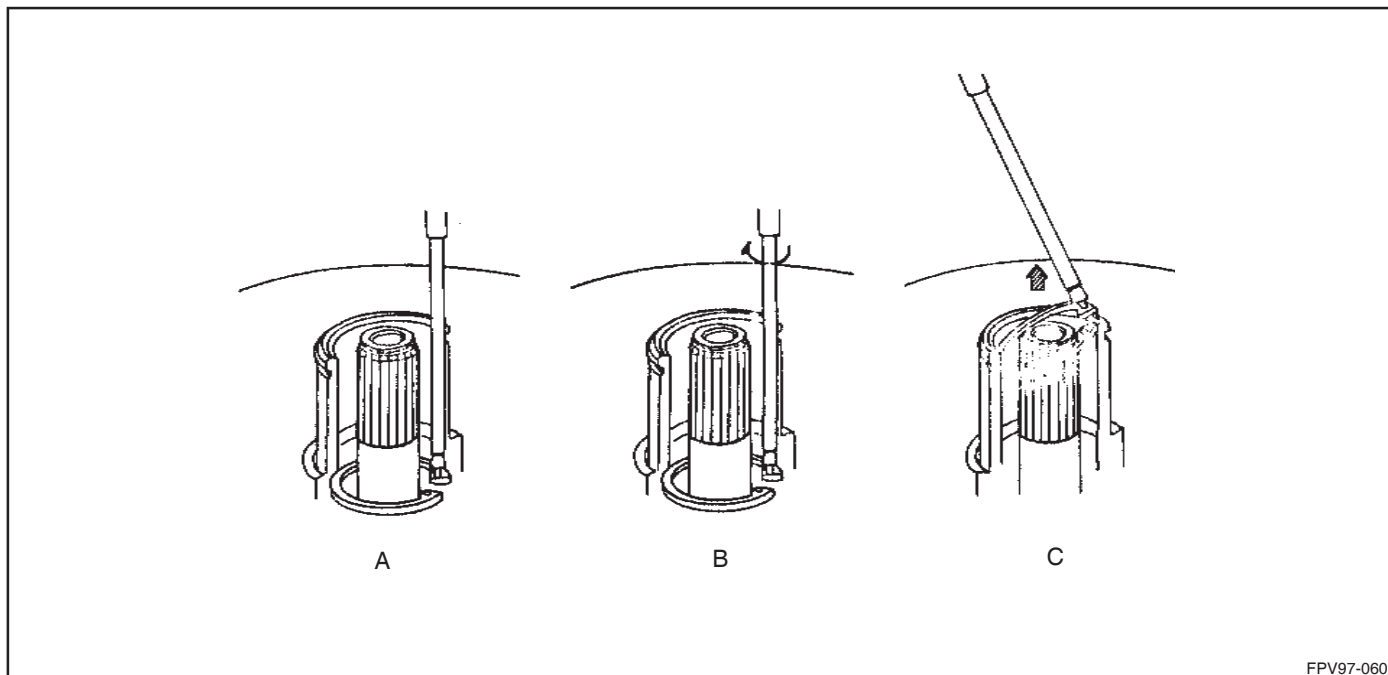


3. Shaft seal

Before replacing the compressor seal, remove the compressor from the vehicle and then discharge the refrigerant.

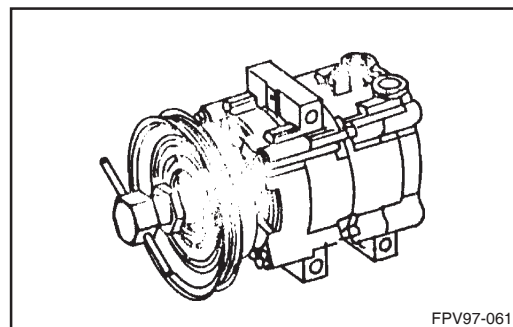
1) Removal

- ① Remove the clutch hub from the compressor
- ② Remove shaft seal felt from the compressor nose using proper equipment.
- ③ Blow out the dirt using the low-pressure compressed air, and wipe off the compressor nose in and out with no shaggy clothe.
- ④ Remove shaft seal supporting snap ring from inside of compressor nose with snap ring remover as shown below.



- a. Insert one end of the snap ring remover into a hole of the snap ring.(Figure A)
- b. Turn the ring remover as the tool end snap ring hole approach to the compressor shaft.(Figure B)
- c. Lift the snap ring remover quickly by leveraging the end onto the nose, and remove the snap ring. (Figure C)

- ⑤ Put shaft seal remover at the compressor shaft and slide it into compressor nose and down to shaft seal. Grip the hexagonal part with bare hand and turn the tool handle clockwise and insert tool end into inside the seal. And then pull out the shaft seal form the compressor.



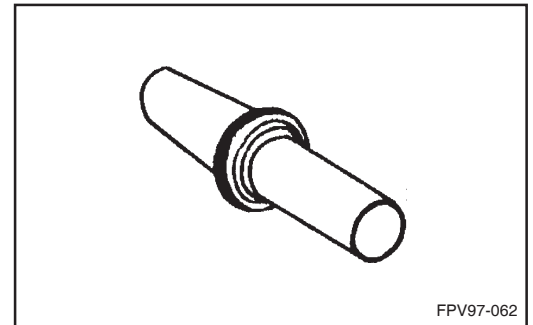
SERVICE PROCEDURE

HA-41

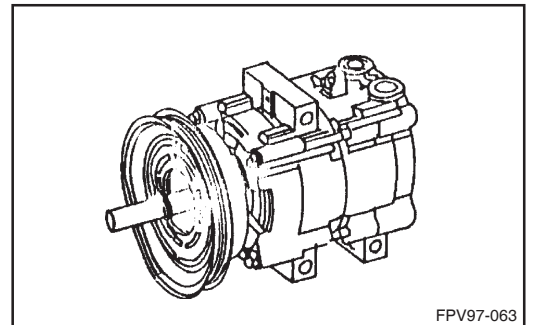
2) Installation

- ① Prepare the new shaft seal kit. Unpack it with care and check the plastic shaft seal protector whether machined parts are damaged or rough.
- ② Wipe off the shaft and seal pocket inside the compressor nose with no shaggy clothe.

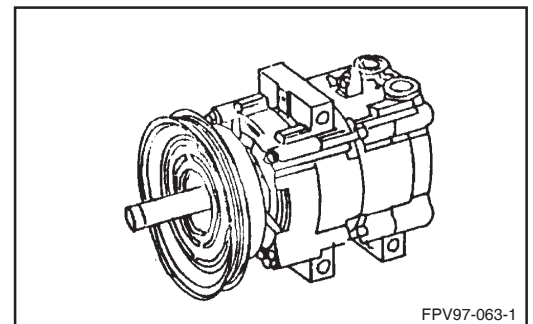
- ③ Dip the shaft seal protector and seal into the clean refrigerant oil, and then put the seal onto the protector as the seal rib faces bigger end of the protector.



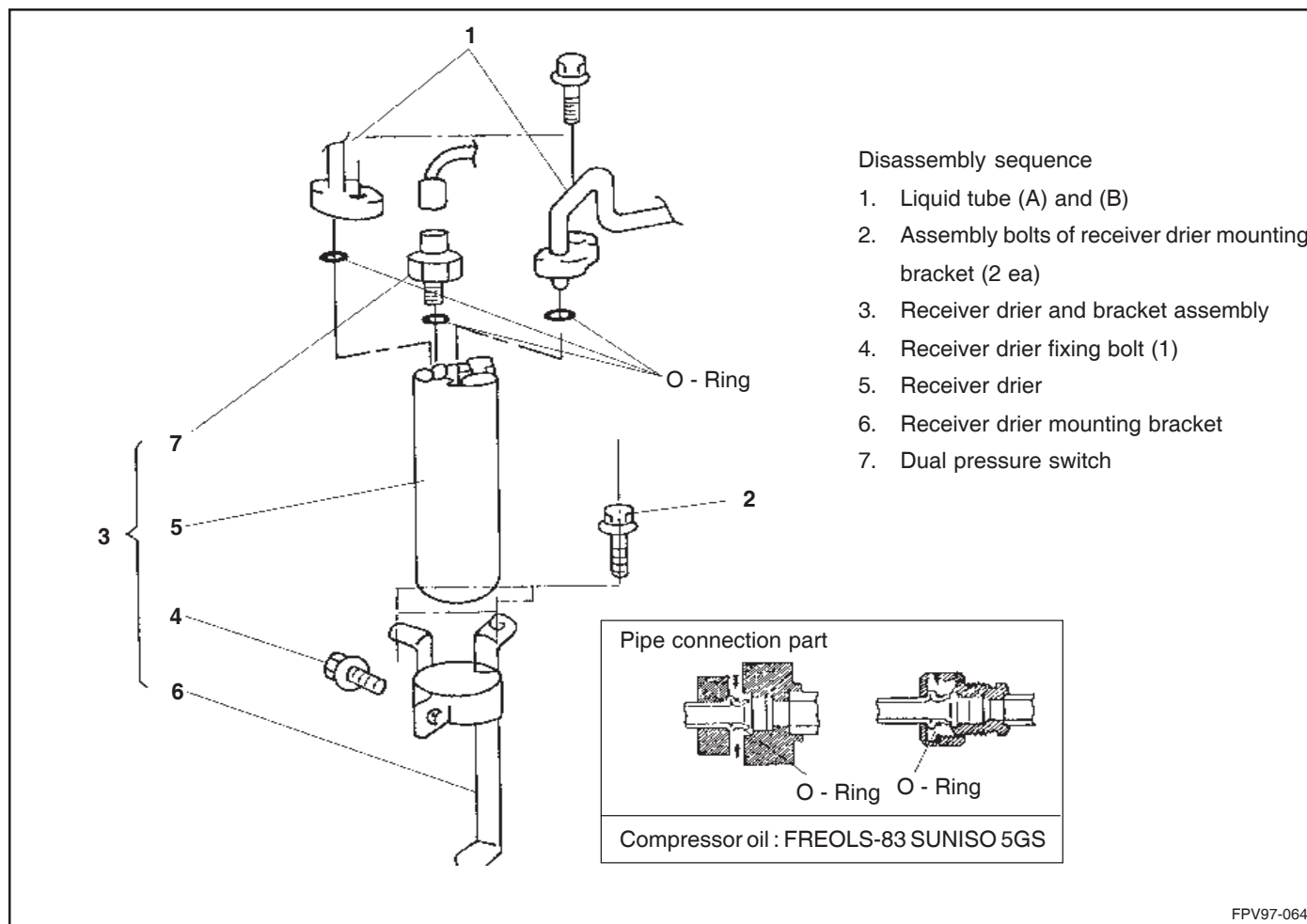
- ④ Install the seal protector installed with shaft seal at the compressor shaft end.



- ⑤ Install the shaft seal installer at the shaft seal protector end, and then slide the shaft seal slowly into compressor to be in a place.
- ⑥ Remove the seal installer and seal protector from the compressor
- ⑦ Put a new seal supporting snap ring on the compressor nose, and then insert the snap ring into the groove with the remover.
- ⑧ Turn the shaft about 10 revolutions with clutch hub, and perform leak test the seal installation part.
- ⑨ Install the new felt at the compressor nose.
- ⑩ Install the compressor clutch hub



RECEIVER DRIER ASSEMBLY



NOTE

- **Discharge the refrigerant thoroughly, before the disassembly of receiver drier.**

Check

Assembly order is the reverse of disassembly order

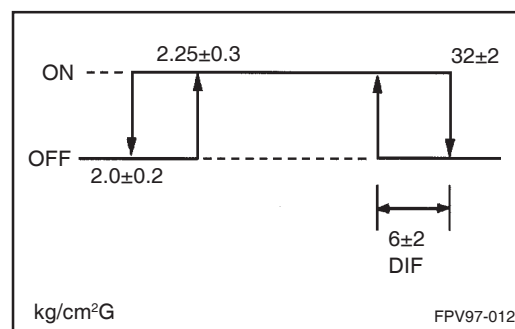
NOTE

- **Recharge the refrigerant with the specified quantity after receiver drier installation.**

Check

1. Dual pressure switch check

Measure the pressure at the high-pressure side. When dual pressure switch is "On" as shown in the figure, if there is continuity between pressure switch terminals, then the system is normal. If there is no continuity, replace the switch.



REFRIGERANT LINE

Removal and installation method

1. When removing, please refer to the cautions in removal below
2. When installing, please refer to the cautions in installation below.

(Cautions in removal)

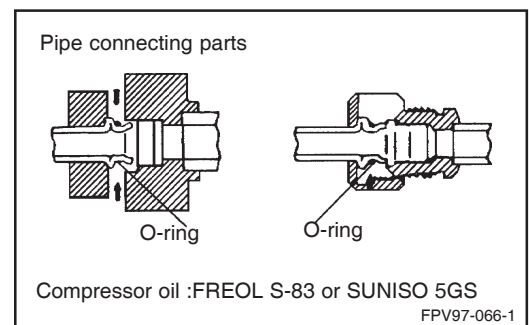
- **Discharge the refrigerant thoroughly**
- **When removing the tubes and hoses, cover the hole so that no dust and dirt get into them.**
- **When removing, be careful not to damage the other parts like wiring and so on.**

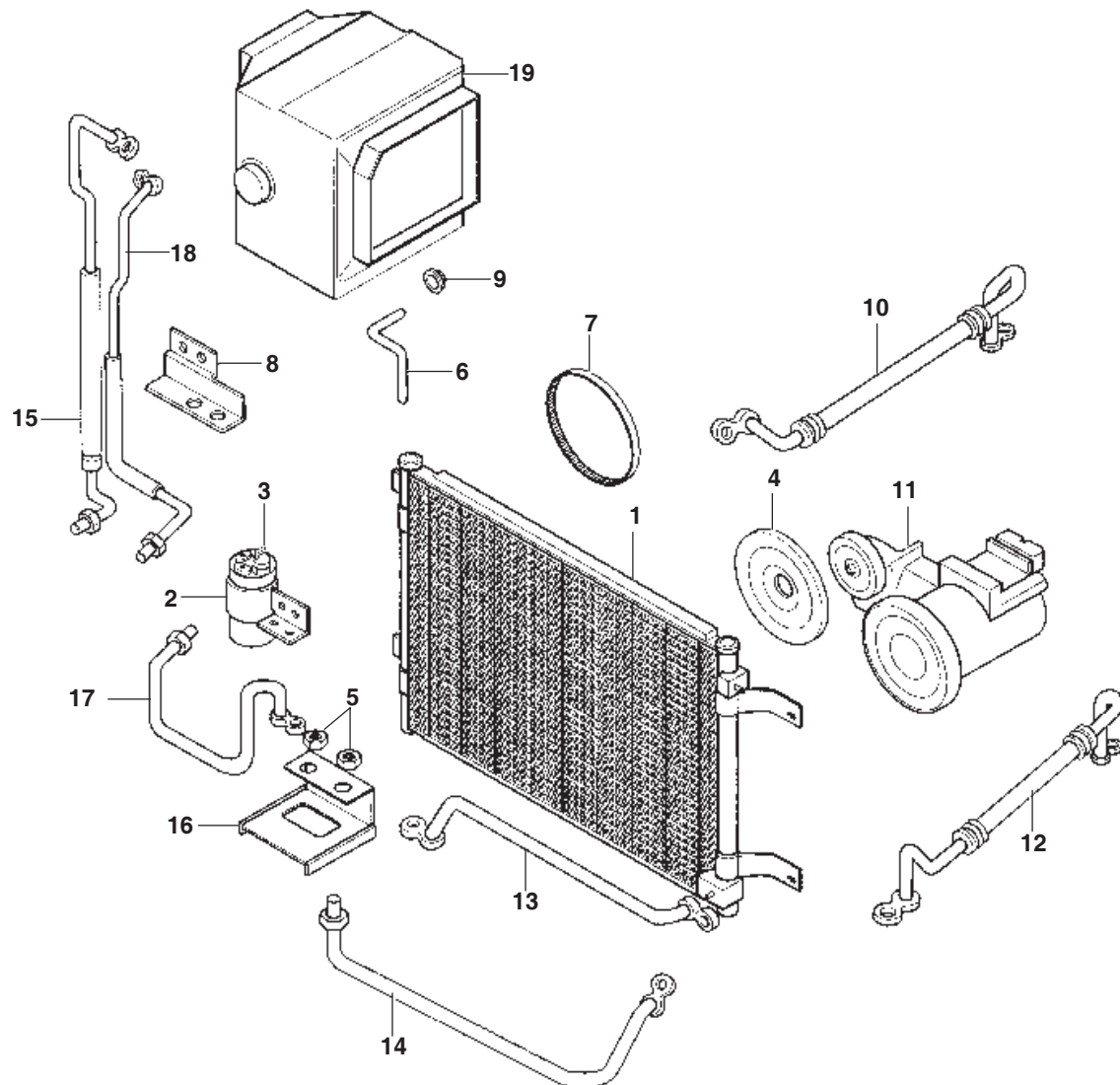
(Cautions in installation)

- **Replace the O-ring at the connecting parts with new one, and apply the refrigerant oil.**
- **Check the O-ring whether it is at the right place and assemble.**
- **The designated torque on “P” must be applied.**
- **Swivel nut and joint flange type should be tightened tentatively with bare hands first, and then fastened tight with the tool.**
- **Tighten the connecting part first and then clamp it.**
- **Be careful not to cause any deformation, and check any interference with other parts after installation.**
- **Recharge the refrigerant with the specified quantity after installation.**
- **Check the air-con performance.**

Removal order

1. Discharge hose
2. Liquid tube (A)
3. Suction hose
4. Liquid tube (B)
5. Liquid tube (C)
6. Receiver drier and bracket assembly
7. Receiver drier mounting bracket
8. Receiver drier
9. Dual pressure switch





- | | | |
|---------------------------|--------------------------|---------------------------|
| 1. Condenser unit | 8. Pipe mounting bracket | 15. Suction pipe |
| 2. Receiver drier bracket | 9. Hose grommet | 16. Pipe mounting bracket |
| 3. Receiver drier | 10. Discharge hose | 17. Liquid hose |
| 4. Crank pulley | 11. Compressor | 18. Liquid pipe |
| 5. Nut | 12. Suction hose | 19. Evaporator unit |
| 6. Drain hose | 13. Liquid pipe | |
| 7. V-belt | 14. Suction hose | |

TRANSMISSION (M6S6)

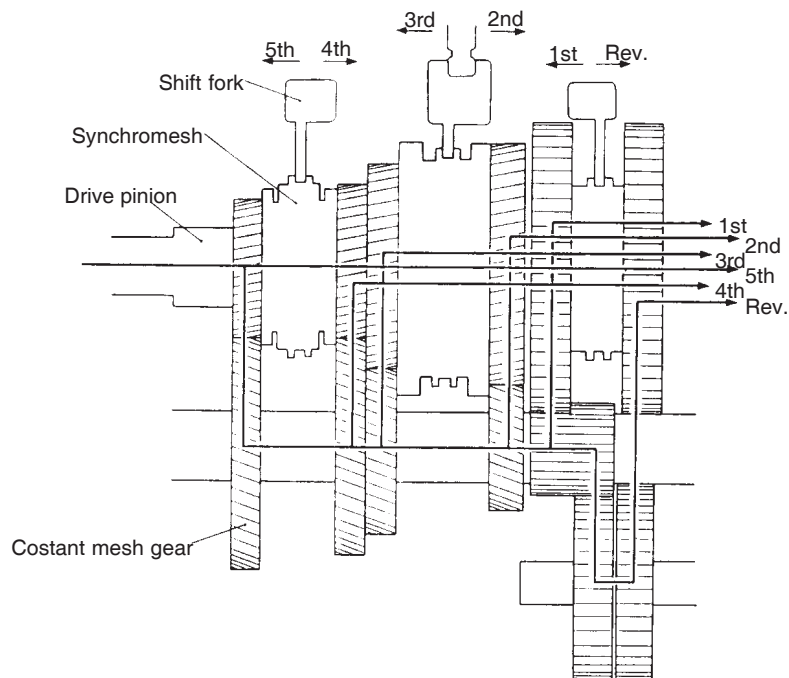
GENERAL	TMa - 2
SPECIFICATIONS	TMa - 3
SERVICE STANDARDS	TMa - 4
SPECIAL TOOLS	TMa - 7
SERVICE PROCEDURE	TMa - 8
TROUBLESHOOTING	TMa-42

GENERAL

TRANSMISSION PROPER

The transmission changes the torque produced by the engine to a torque the vehicle requires. The torque, or drive power, is increased or decreased by shifting several groups of gears.

Since the engine always turns in one direction, the transmission also performs the function of changing the direction of rotation so the vehicle can be backed.

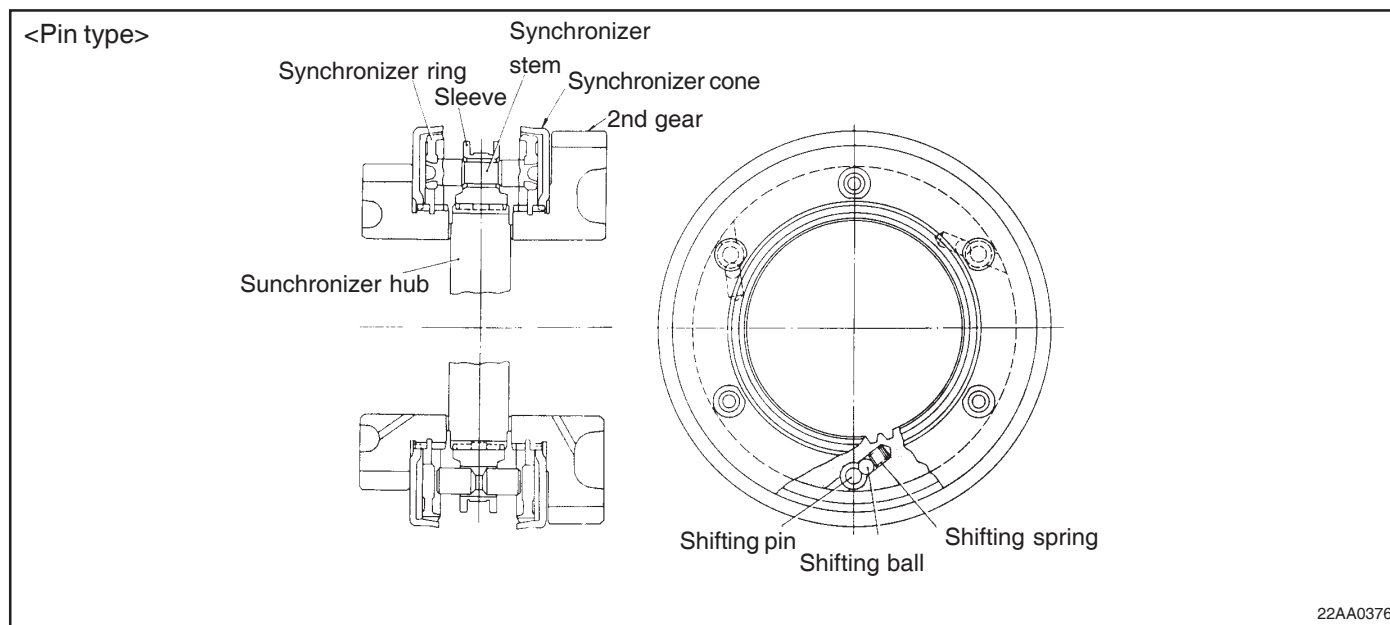
**NOTE:**

This illustration shows a 5-speed transmission.

SPECIFICATIONS

TMa-3

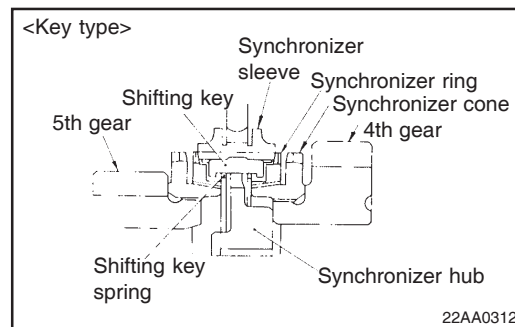
SYNCHRONIZER ASSEMBLY



The transmission gears are kept in constant mesh with the drive pinion by the constant-mesh gears, main shaft gears, and counter shaft gears.

The rotating motion imparted by the drive pinion to the constantmesh gears is transmitted to all main shaft gears which turn freely. When the gearshift lever, the synchromesh function causes the synchronizer sleeve to mesh with a gear to change the speed of rotation from the pinion and transmit it to the rear axle.

The constant-mesh slide design is employed between the 1st and reverse gear.



SPECIFICATIONS

TRANSMISSION PROPER

Type		K360
GEAR RATIO	1st	6.453
	2nd	3.604
	3rd	1.813
	4th	1.000
	5th	0.803
	6th	-
	Rev.	6.453
Oil capacity (with P.T.O)	5.5 ℓ	
Transmission control	Floor shift, remote control type	

SERVICE STANDARDS

SERVICE STANDARDS TABLE

Unit: mm

Maintenance item			Nominal value (Basic diameter in [J])	Limit	Remedy and remarks	
Backlash	1st gear		0.08 to 0.20	0.5	Replace Check for damaged tooth surface	
	2nd gear		0.08 to 0.20			
	3rd gear		0.09 to 0.21			
	4th gear		0.09 to 0.21			
	5th gear (drive pinion and constant-mesh gear)		0.04 to 0.17			
	Reverse gear	Counter shaft	0.08 to 0.20			
		Main shaft	0.09 to 0.21			
End play	1st gear (main shaft)		0.15 to 0.35	0.5	Replace gear or washer	
	2nd gear (main shaft)					
	3rd gear (main shaft)					
	4th gear (main shaft)					0.25 to 0.40
	Reverse gear (main shaft)					0.15 to 0.35
	Reverse gear (reverse gear shaft)		0.2 to 0.9	1.2		
Play in diametric direction after assembly of reverse gear needle bearing			-	0.12	Replace defective parts	
Main shaft	Play in diametric direction after assembly of pilot bearing		-	0.12	Replace defective parts	
	Syn- chro- mesh key type	Synchronizer ring keyway to shifting key clearance	4.75 to 4.95	5.8	Replace	
		Synchronizer hub keyway to shifting key clearance	0.05 to 0.20	0.5		
		Fit between synchronizer hub and main shaft in turning direction	T0.0069 to L0.088	0.2		
		Play between synchronizer hub and synchronizer sleeve in turning direction	0.052 to 0.148	0.3		
		Synchronizer ring to main shaft 4th gear assembly gear cone clearance	1.45 to 1.85	0.2		
		Syn- chro- mesh key type	2nd and 3rd synchronizer assembly synchronizer ring to main shaft 3rd	0		1.5
	2nd gear assembly synchronizer cone clearance		0.052 to 0.148	0.3		
	Fit between 2nd and 3rd synchronizer hub and main shaft in turning direction		T0.005 to L0.107	0.2		

SERVICE STANDARDS
TMa-5

Maintenance item			Nominal value (Basic diameter in [μm])	Limit	Remedy and remarks
Main shaft	2nd gear bearing sleeve	O.D.	[68] -0.030 -0.043	-0.10	Replace
	3rd gear bearing sleeve				
	4th gear bearing sleeve		[55] -0.030 -0.043		
	Clearance in diametric direction after assembly of main shaft needle roller bearing	1st gear		-	0.12
		2nd gear			
		3rd gear			
		4th gear			
		Reverse gear			
	Play between synchronizer sleeve and main shaft in turning direction		0.052 to 0.148	0.3	Replace
Lower gear shift	Shift fork to synchronizer sleeve clearance	1st and Rev.	0.3 to 0.5	1.0	Replace
		2nd and 3rd			
		4th and 5th			
	Tilt of shift fork claw	1st and Rev.	0.1 or less	0.2	Replace
		2nd and 3rd			
		4th and 5th			
	Alignment or bend of shift rail	1st and Rev.	0.03 or less	0.06	Corret or replace
		4th and 5th			
		2nd and 3rd	0.02 or less	0.04	
Upper gear shifter	1st and Rev. return spring	Load/installed length	85 N (8.7kgf)/ 27.6	7.3 N (7.4 kgf)/ 27.6	Replace
Speedometer gear	Speedometer gear bushing to speedometer gear clearance		[12] 0.02 to 0.07	0.15	Replace
	Backlaha between speedometer gear and speedometer worm		0.13 to 0.29	0.36	Replace
Transmission control	Ball stud to housing clearance		0.10 to 0.40	1.0	Replace ball stud or housing, whichever is worn
	Housing bushing to pipe A clearance		0.07 to 0.17	0.6	Replace bushing
	Front cross shaft to bushing clearance		0.07 to 0.17	0.6	Replace bushing
	Rear cross shaft to bushing		0.02 to 0.25	0.6	Replace bushing
	Spring	Load/installed length	52 N (5.3 kgf)/ 45.4	42 N (4.3 kgf)/ 45.4	Replace

TIGHTENING TORQUE TABLE

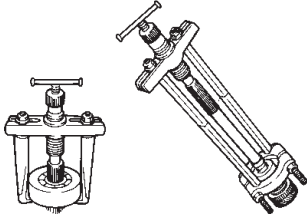
Location tightened		Screw size O.D. x pitch (mm)	Tightening torque Nm (kgfm)
Transmission proper	Clutch housing bolt	M16 x 2.0	190 (19.2)
	Gearshift upper mounting bolt	M8 x 1.25	23 (2.3)
	Gearshift lower mounting bolt	M8 x 1.25	23 (2.3)
	Gearshift fork set bolt	M10 x 1.25	29 (3.0)
	Drain plug and level plug	M20 x 1.5	54 to 83 (5.5 to 8.5)
	Main shaft front lock nut	M36 x 1.5	245 (25)
	Main shaft rear lock nut	M27 x 1.5	245 to 345 (25 to 35)
	Reverse shaft lock piece bolt	M10 x 1.5	40 (4.1)
	Rear cover and extension housing bolt	M10 x 1.5	40 (4.1)
	Backup lamp switch	M18 x 1.5	49 (5.0)
	Speedometer gear bushing	M27 x 1.5	145 (15)
	Mounting bolt of transmission (clutch housing) onto engine (flywheel housing)	M10 x 1.5	40 (4.1)
	Counter shaft rear lock nut	M36 x 1.5	345 (35)
	Rear bearing retainer mounting	M10 x 1.5	40 (4.1)
	Jaw set bolt	M14 x 1.5	135 (13.6)
	Lock pin mounting nut	M8 x 1.25	17 (1.7)
	Support plate and shoe assembly or dust cover mounting bolt	M10 x 1.5	40 (4.1)
Transmission control	Front mechanism housing bolt	M12 x 1.25	48 (4.9)
	Select lever bolt	M12 x 1.25	37 to 54 (3.8 to 5.5)
	Gearshift lever bolt	M12 x 1.25	36 (3.7)
	Select rod and shift rod ball joint nut	M8 x 1.25	8.8 to 14 (0.9 to 1.4)
	Tighten ball joints	M8 x 1.25	19 to 27 (1.9 to 2.8)
		M10 x 1.25	38 to 59 (3.9 to 6.0)

SPECIAL TOOLS

TMa-7

SPECIAL TOOLS

Unit: mm

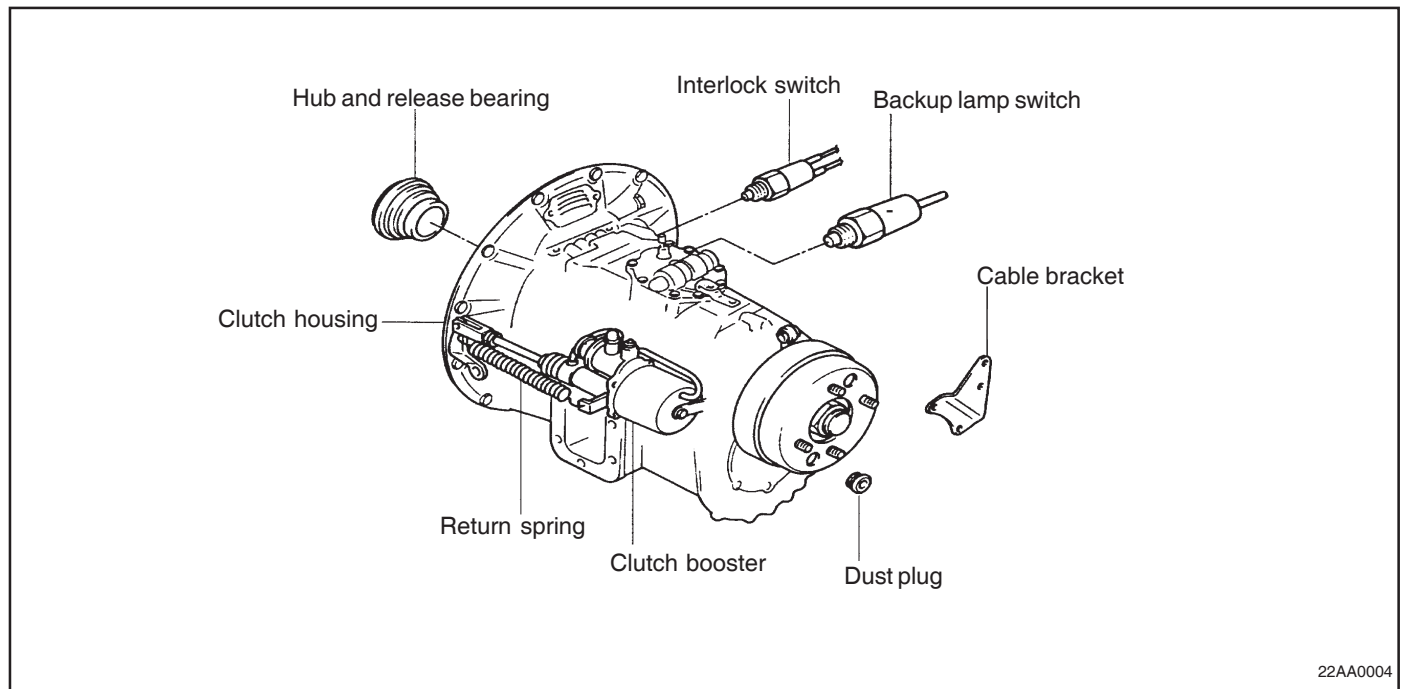
Tool name	Part No.	Shape	Use
Puller set	09431-83100	 ASST0030	Removal of drive pinion and reverse shaft

SERVICE PROCEDURE

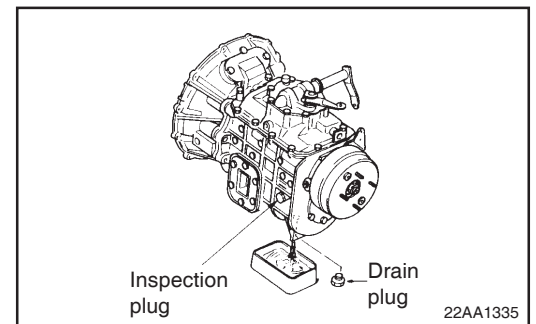
REMOVAL AND INSTALLATION OF TRANSMISSION

Key points for removal

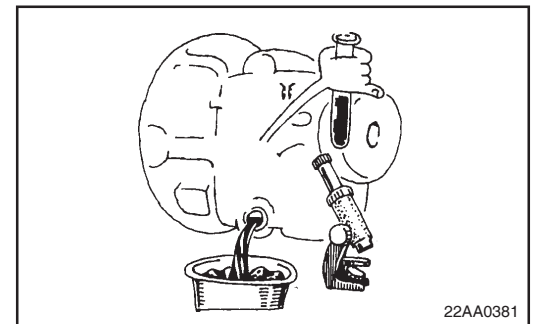
- 1) Detach the control rod and associated parts around the transmission.
- 2) Remove the power cylinder with hoses and pipes left attached.
- 3) Remove the propeller shaft.



- 4) Remove the drain plug and inspection plug to remove transmission oil. On vehicles with full-power PTO, remove transmission oil also from the PTO case.



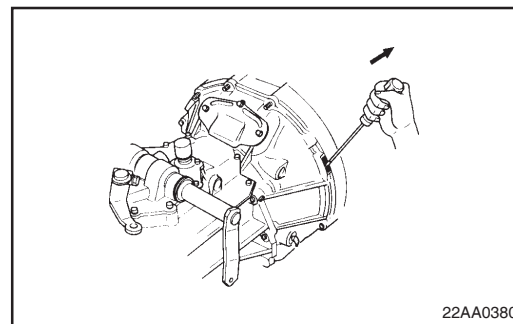
- 5) When draining the transmission oil, check the oil for quantity, quality, and metal chips and particles. The drain plug is magnet and metal particles adhering to it should be removed after the inspection.



SERVICE PROCEDURE

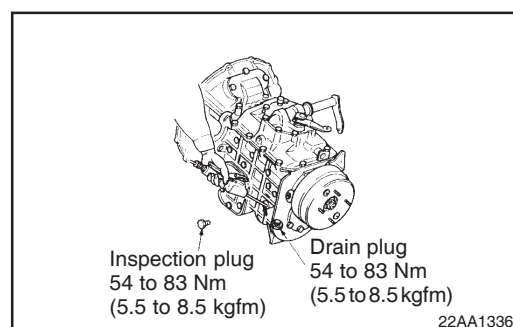
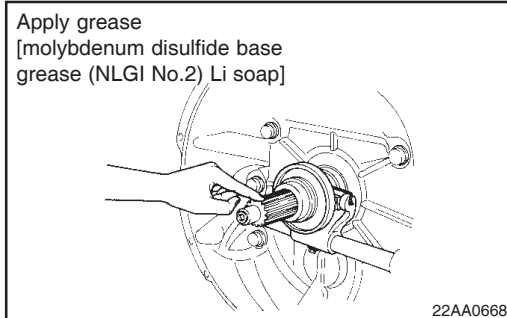
TMa-9

- 6) Support the transmission proper with a jack.
Then, loosen the clutch housing attaching bolts to separate the transmission from the engine. There are grooves at three locations in the clutch housing provided for easy removal of the transmission. To remove, insert a screwdriver into the grooves.
- 7) Move the transmission rearward until the drive pinion splines come out of position. Never jerk the transmission.



Key points for installation

- 1) Check the drive pinion splines for rust. If rust gathers, use a wire brush to clean of rust. Then, apply grease by hand to the surfaces of the drive pinion over which the clutch slides.
- 2) Check the clutch release lever for proper height.
- 3) Using a jack or crane, carefully insert the transmission assembly into the pilot bearing of the engine flywheel, with care not to damage the spline shaft.
Then, secure the clutch housing by tightening mounting bolts on its periphery. [32 Nm (3.3 kgfm)]
- 4) After ensuring that the drain plug has been torqued to specification, pour in transmission oil through the inspection port.
- 5) Install the control rod and associated parts around the transmission.
- 6) Install the power cylinder
- 7) Install the propeller shaft.

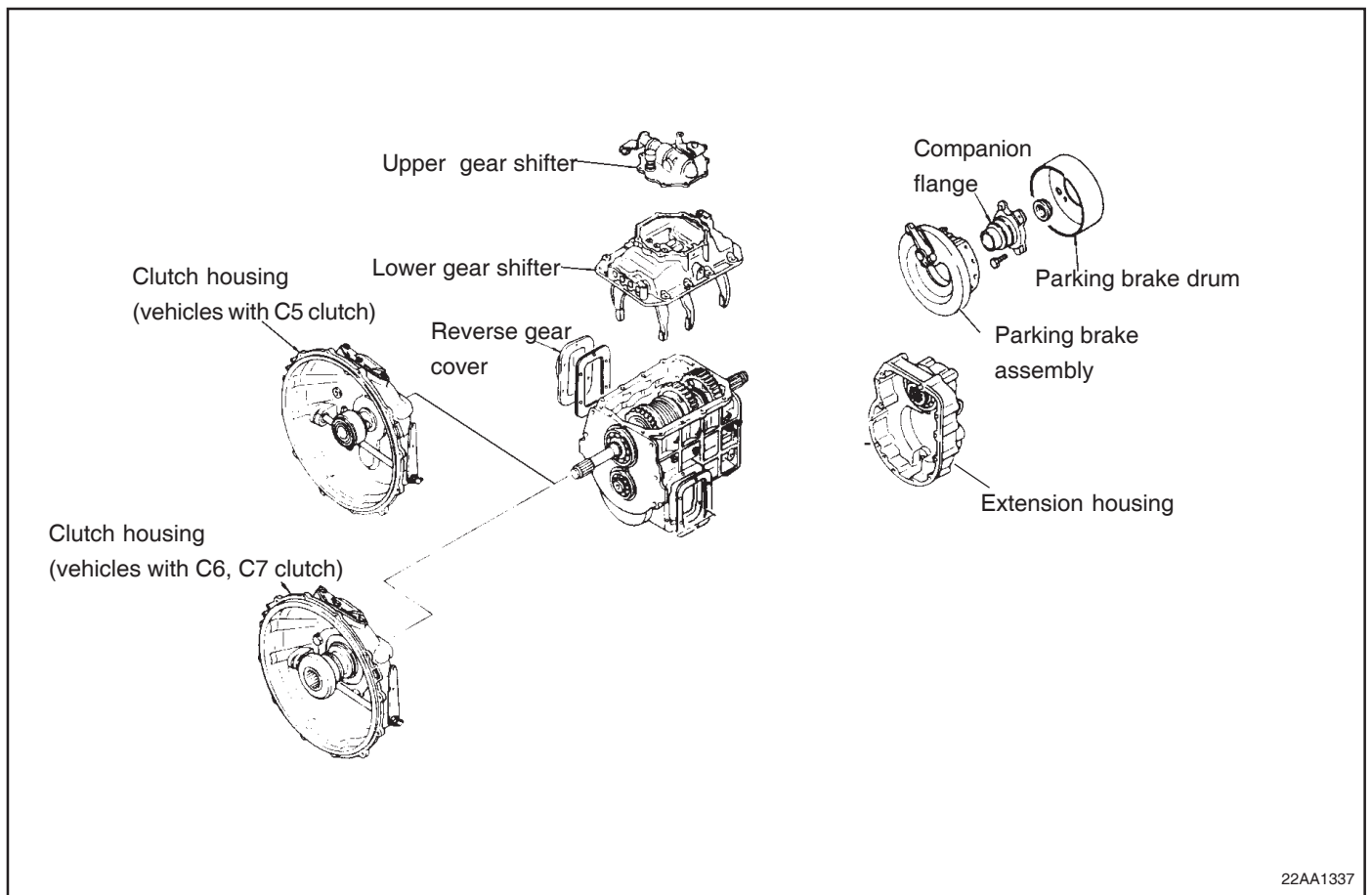


Inspection and adjustment after installation

- 1) Adjust the transmission control.
- 2) Check the clutch pedal.
- 3) Adjust the parking brake.

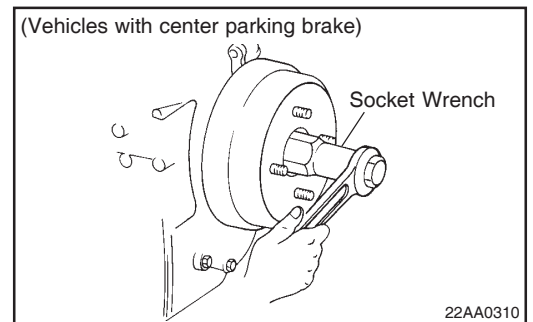
TRANSMISSION ASSEMBLY

Disassembly

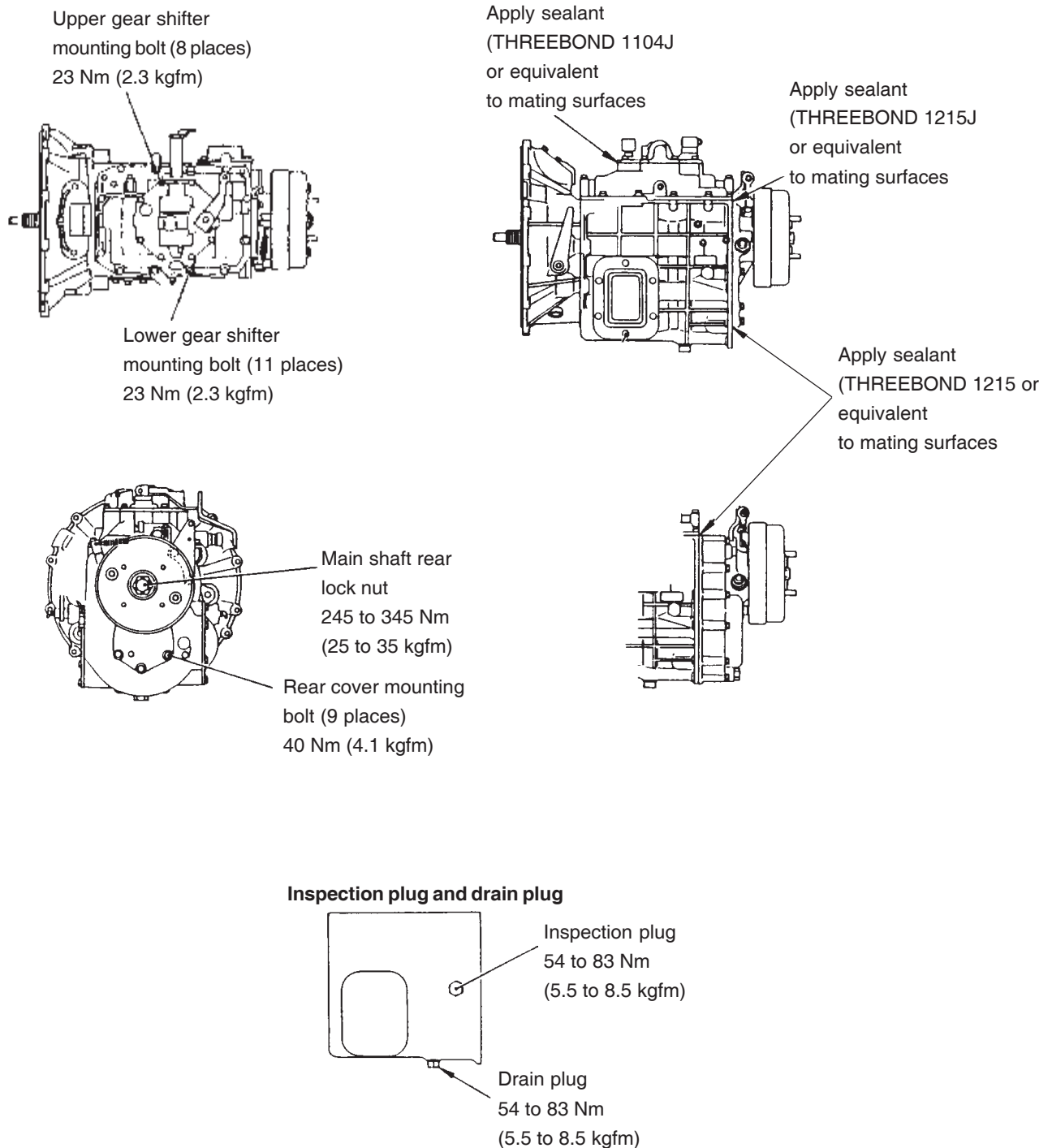


Disassembly Procedure

Using the Socket Wrench, remove the main shaft rear lock nut.



Reassembly

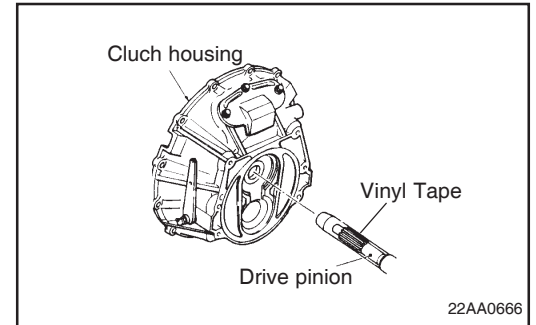


NOTE

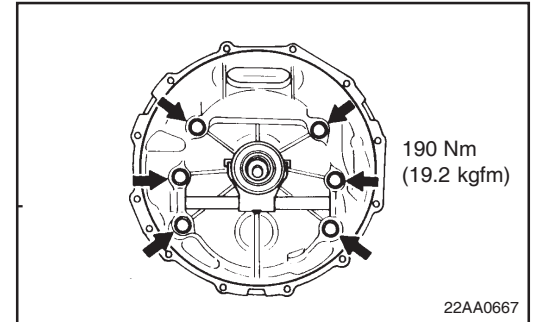
Apply sealant (THREEBOND 1105D or equivalent) to threads in inspection and drain plugs.

Reassembly Procedure

- 1) To mount the clutch housing to the transmission case, using the Vinyl Tape.



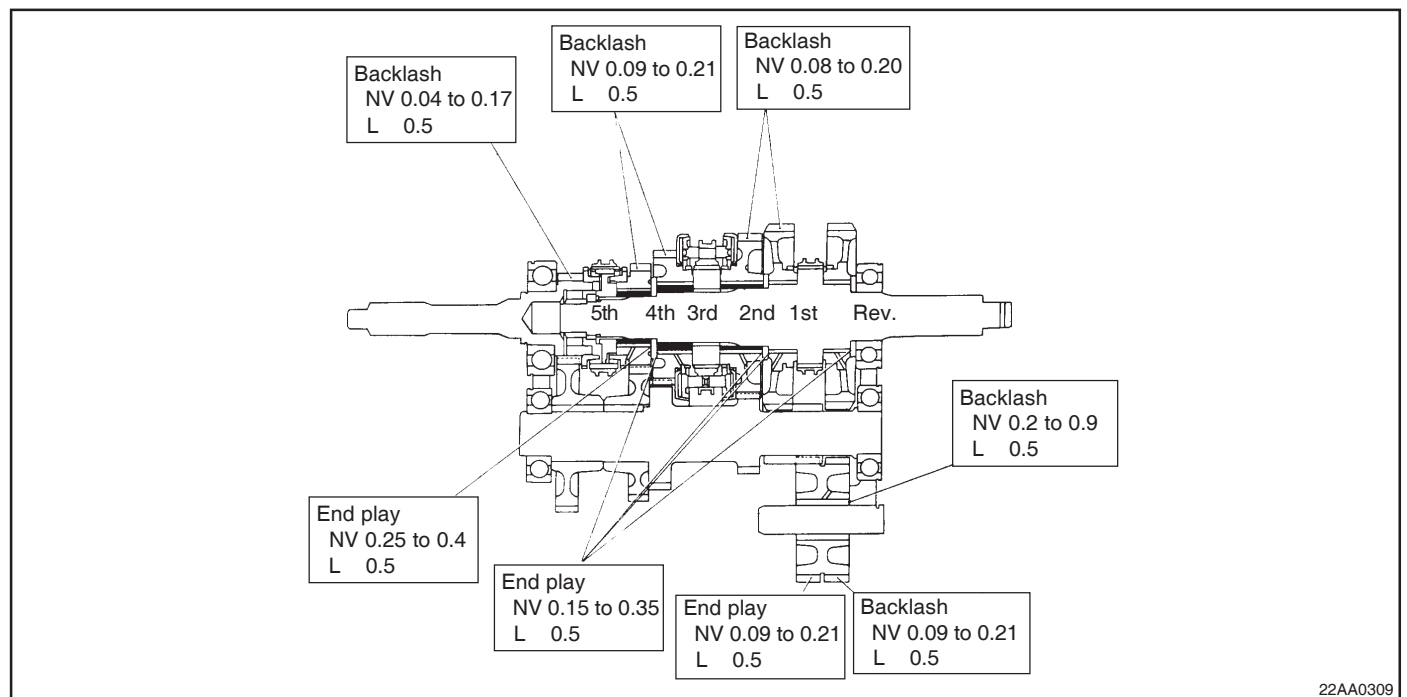
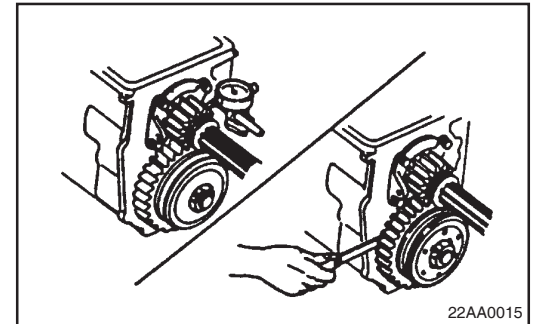
- 2) Tighten the clutch housing mounting bolts in diagonal order and uniformly, and finally tighten to specified torque.



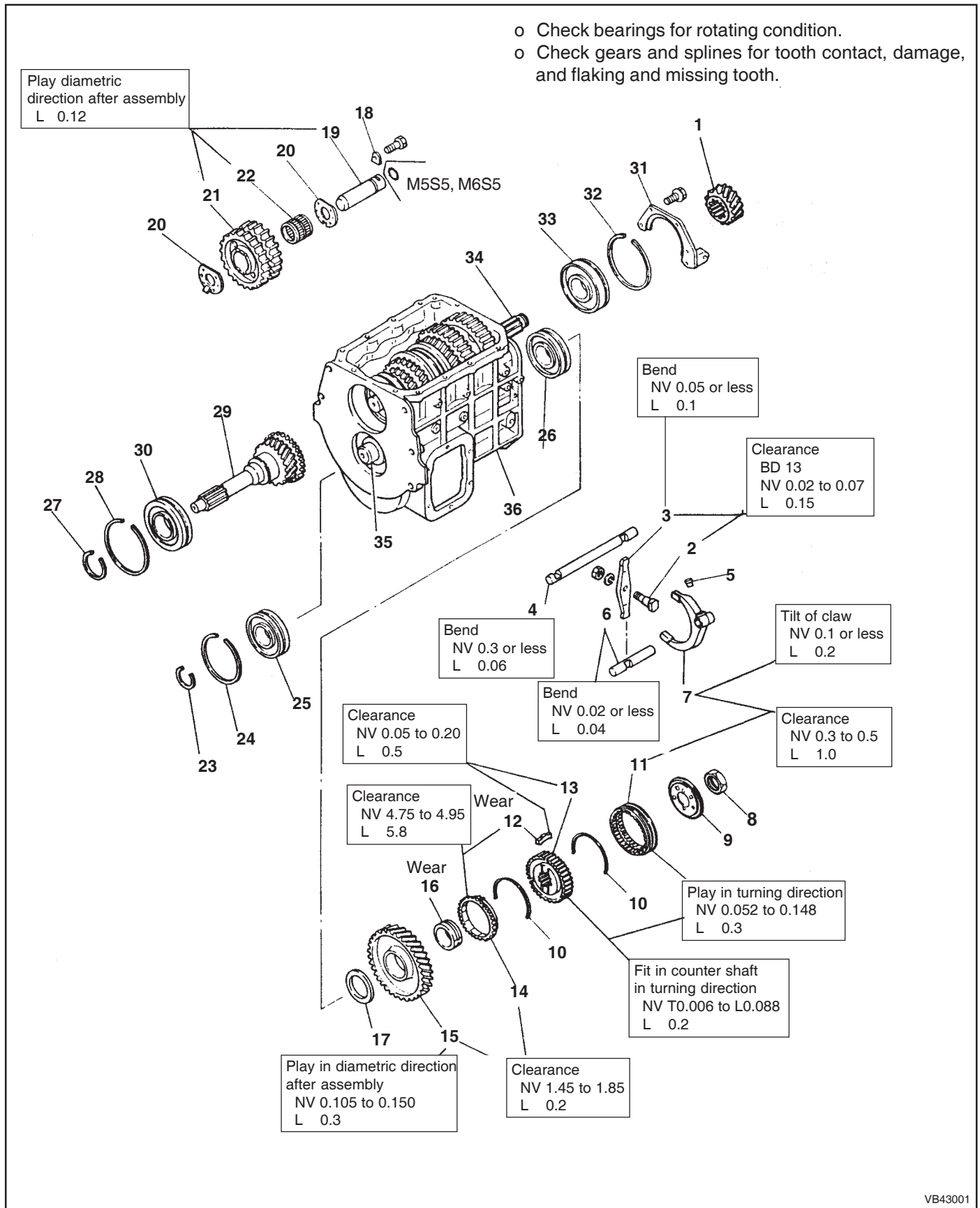
Transmission

Inspection before disassembly

Before attempting to disassemble the transmission, measure the backlash between gears and end play in each gear. If the measurement exceeds the limit, replace the defective parts.



Disassembly and inspection



Disassembly sequence

- | | | |
|--------------------------|------------------------------------|----------------------------|
| 1. Main shaft O.D. gear | ⑬ Synchronizer hub | ②⑤ Bearing |
| 2. O.D. shift shaft | ⑭ Synchronizer ring | ②⑥ Bearing |
| ③ O.D. shift lever | ⑮ Counter shaft O.D. gear assembly | ②⑦ Snap ring |
| ④ O.D. shift rail B | 16. O.D. gear sleeve | ②⑧ Snap ring |
| 5. Set bolt | 17. Thrust washer | ②⑨ Drive pinion assembly |
| ⑥ O.D. gearshift rail C | 18. Reverse shaft lock piece | ③⑩ Bearing |
| ⑦ O.D. gearshift fork | ⑰ Reverse gear shaft | 31. Rear bearing retainer |
| ⑧ Lock nut | 20. Reverse gear side washer | ③② Snap ring |
| 9. Shifting key retainer | ⑳ Reverse gear | ③③ Bearing |
| 10. Shifting key spring | ②① Needle bearing | 34. Main shaft assembly |
| ⑪ Synchronizer sleeve | ②② Snap ring | 35. Counter shaft assembly |
| ⑫ Shifting key | ②③ Snap ring | 36. Transmission case |

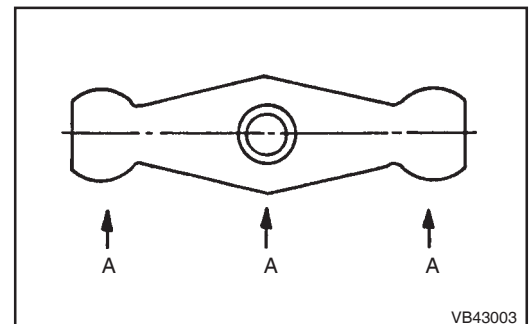
For parts with an encircled number, refer to Disassembly and Inspection Procedure that follows.

NOTE

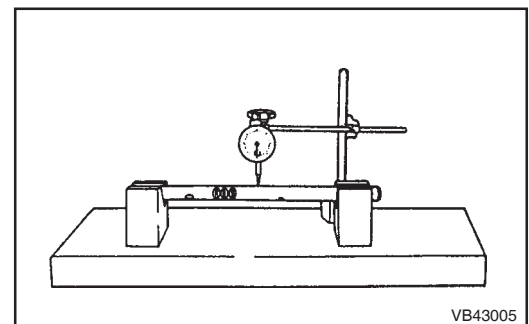
1. Before disassembling the key type synchronizer, put matching mark at one location each in the synchronizer hub and synchronizer sleeve where a key is inserted.
2. Before removing the main shaft assembly, extract the ball bearings at front and rear of the counter shaft and let it fall down into the transmission case.

Disassembly and Inspection Procedure

- 1) Check the O.D. shift lever for alignment or bend.
If B is misaligned or bent exceeding the limit with reference to A-A, replace the lever



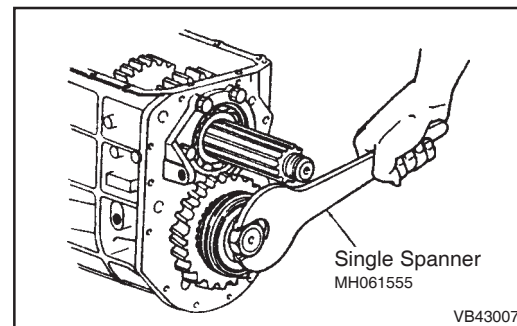
- 2) Check O.D. shift rail B and O.D. gearshift rail C for alignment or bend. (Half of the dial indicator reading is the bend.)
If the limit is exceeded, correct or replace the part.



SERVICE PROCEDURE

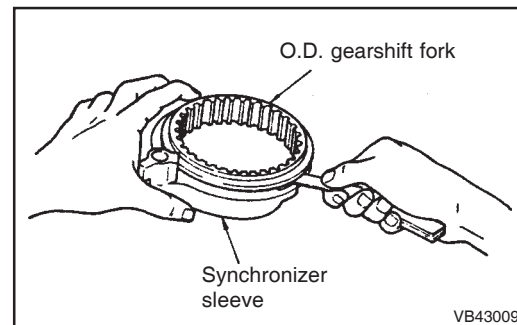
TMa-15

- 3) Using the special tool, Single Spanner, remove the lock nut.
<M5S6, M6S6>

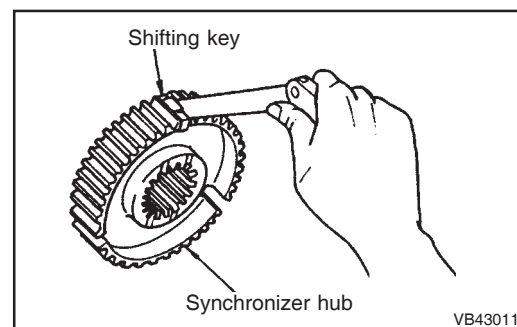


- 4) Measure the clearance between the O.D. gearshift fork and synchronizer sleeve and replace the parts if the clearance exceeds the limit.

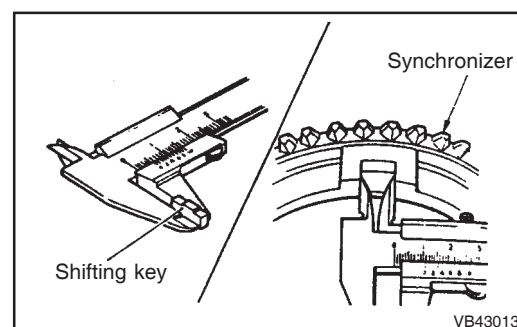
At the same time, check the shift fork claw for tilt.
If defects are evident, correct or replace the parts.



- 5) Measure the clearance between the synchronizer hub keyway and shifting key. If the clearance exceeds the limit, replace the parts.



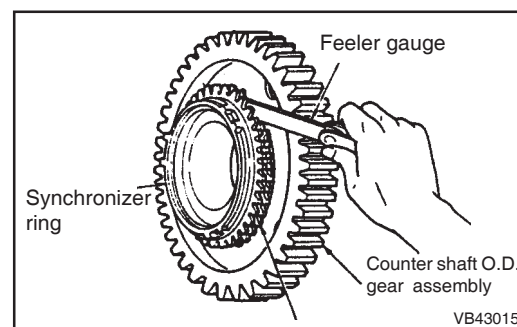
- 6) Measure the synchronizer ring keyway width and shifting key width to calculate the clearance. If the clearance exceeds the limit, replace the parts



- 7) Measure the clearance between the synchronizer ring and gear cone of the counter shaft O.D. gear assembly. If the limit is exceeded, replace the parts.

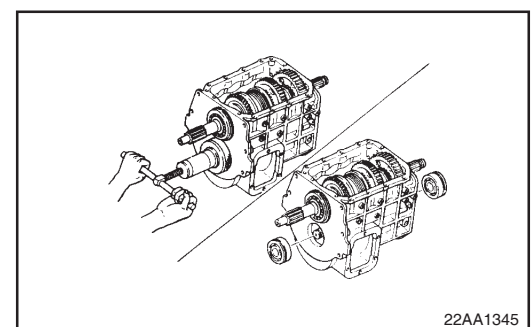
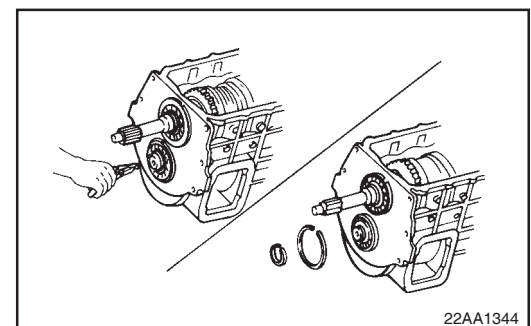
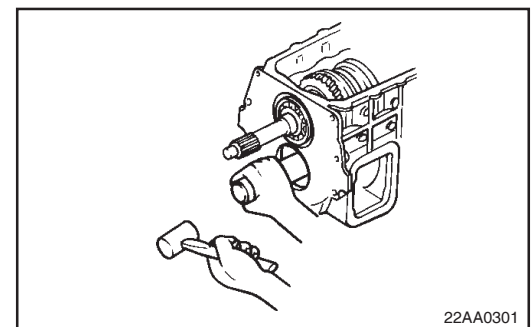
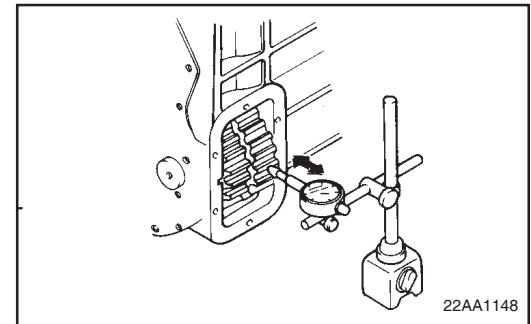
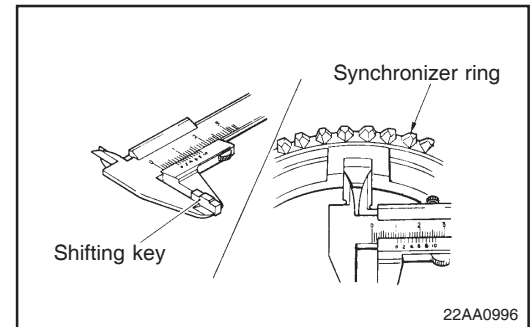
NOTE

Press the synchronizer ring evenly and take measurement throughout the entire circumference.



Disassembly and Inspection Procedure

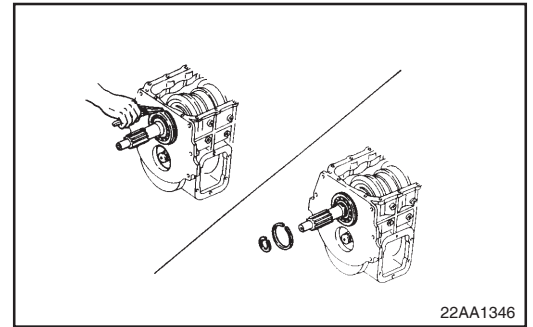
- 1) Measure the synchronizer ring keyway width and shifting key width to calculate the clearance. If the clearance exceeds the limit, replace the parts.
- 2) Before disassembling the reverse gear, check it for play in diametric direction. If the play exceeds the limit, replace the defective parts.
- 3) Remove the reverse gear shaft.
- 4) Remove the snap rings from the front end of the counter shaft.
- 5) Remove bearings from the front and rear ends of the counter shaft.



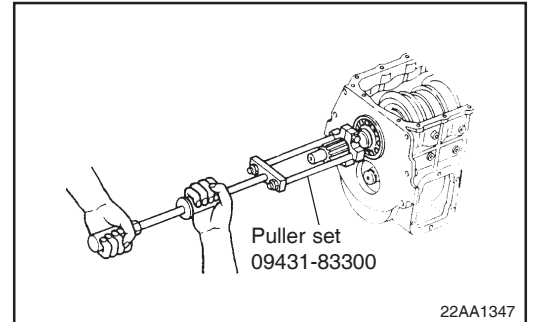
SERVICE PROCEDURE

TMa-17

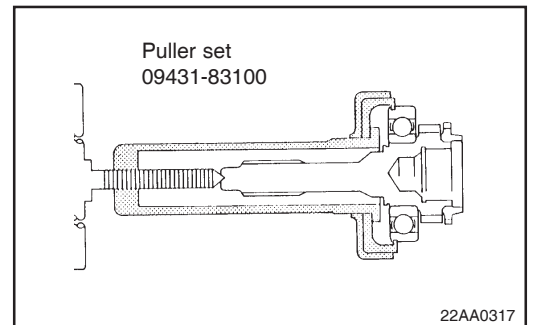
- 6) Remove the snap rings on the drive pinion side.



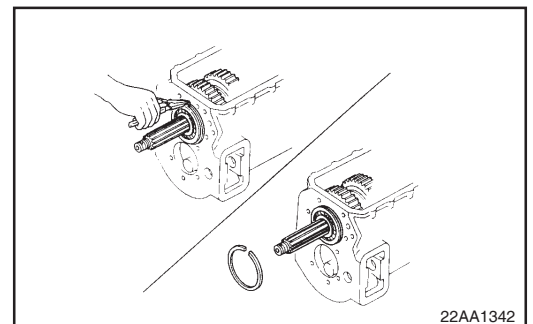
- 7) Remove the drive pinion assembly together with the bearings.



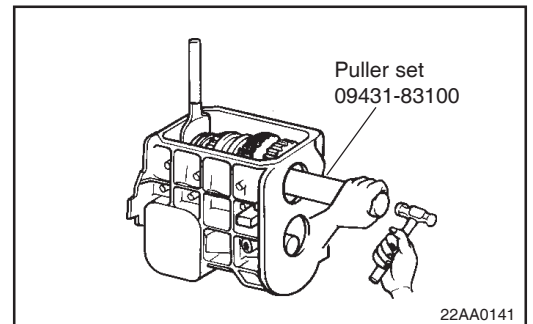
- 8) Remove the bearings from the drive pinion.



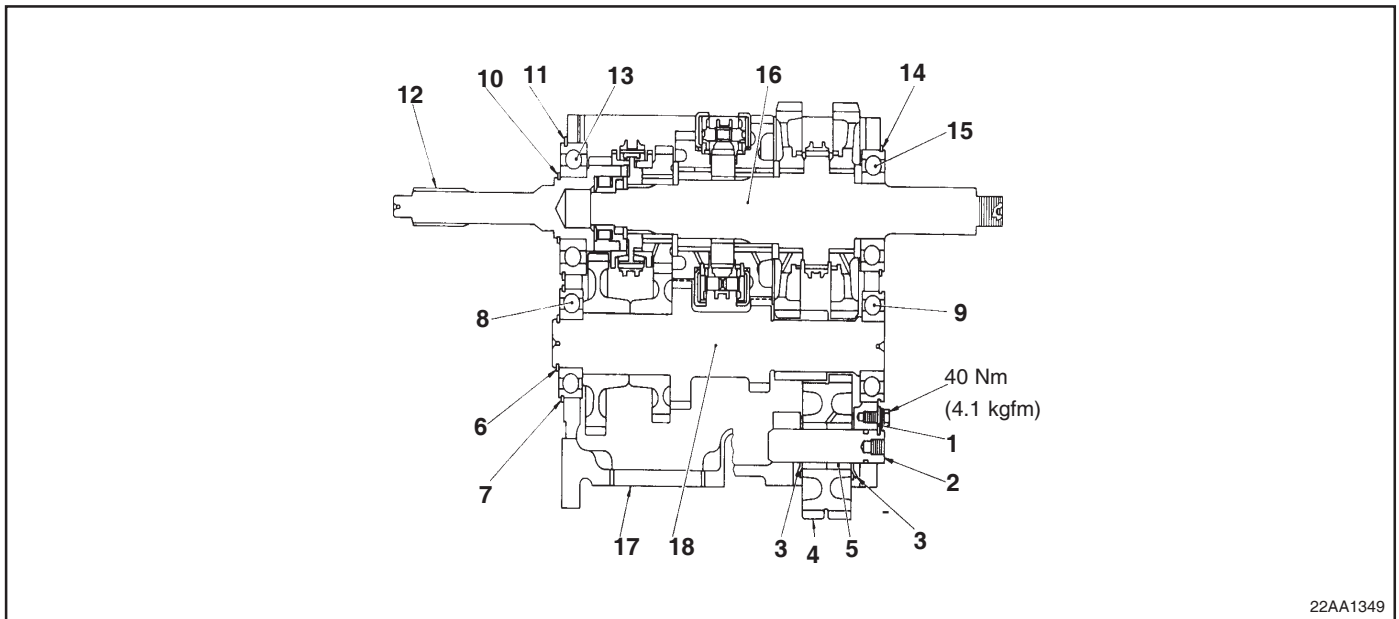
- 9) Remove the snap ring from the rear end of the main shaft.



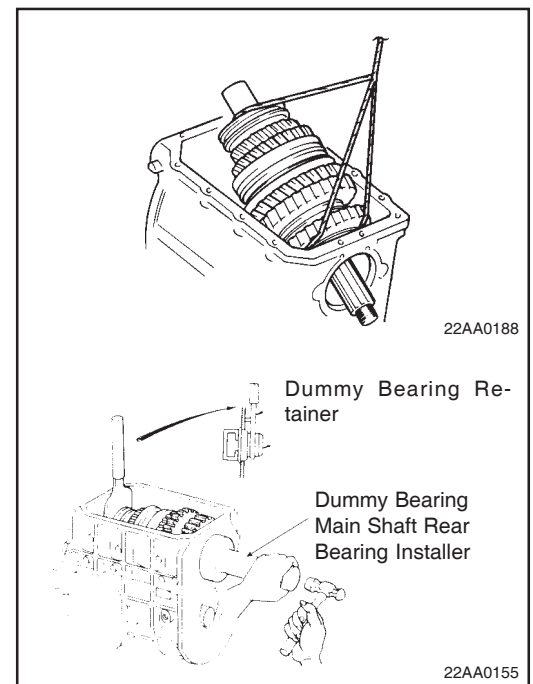
- 10) Remove the bearing from the rear end of the main shaft.



Reassembly



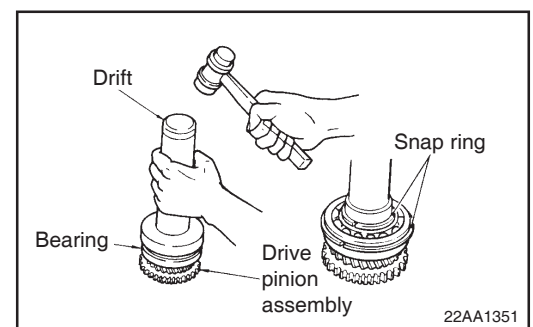
- 1) With supporting the front end of the main shaft drive the bearings, to which snap rings have been attached, into the rear end of the main shaft using special tool.



- 2) Drive the bearing into the drive pinion assembly. Then, fit the snap rings into position.

NOTE:

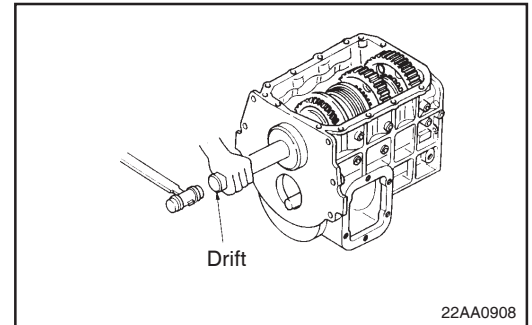
Place the drive pinion assembly on a flat surface when installing the bearing into it to prevent the drive pinion assembly from being damaged.



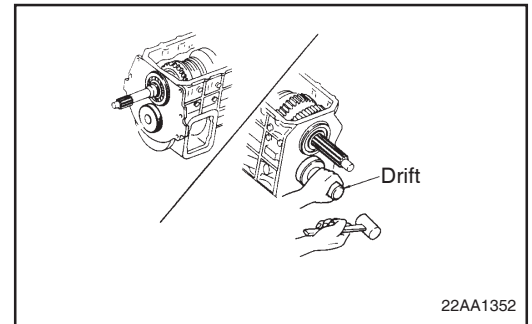
SERVICE PROCEDURE

TMa-19

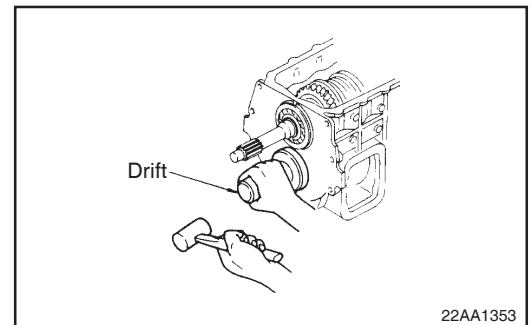
- 3) Drive the bearing together with the drive pinion assembly into position.



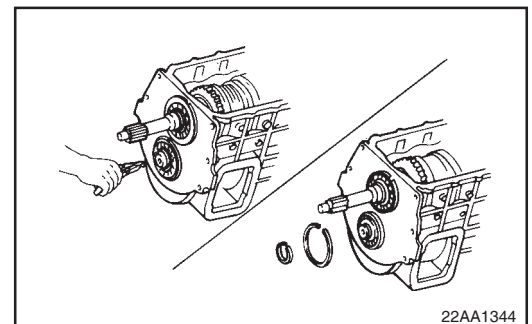
- 4) Hold the front end of the counter shaft with tools. Then, install the bearing on the rear end with the grooves outward.



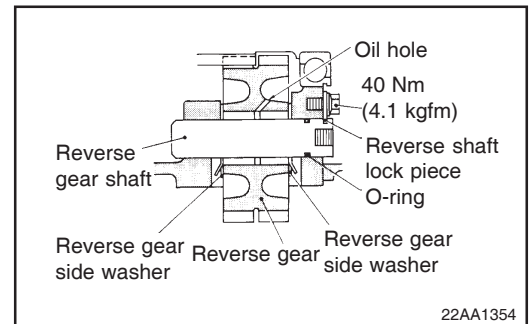
- 5) Remove the tool from the front end of the counter shaft. Then drive bearing, to which snap rings have been attached, into position.



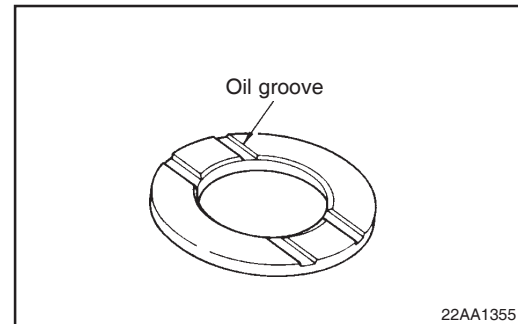
- 6) Fit the snap ring to secure the bearing in position.



- 7) Insert the reverse gear, to which the needle bearing and reverse gear side washer have been installed, from the side washer have been installed, from the side and drive the reverse gear shaft into position with a plastic hammer. Then, secure the shaft with the reverse shaft lock piece.



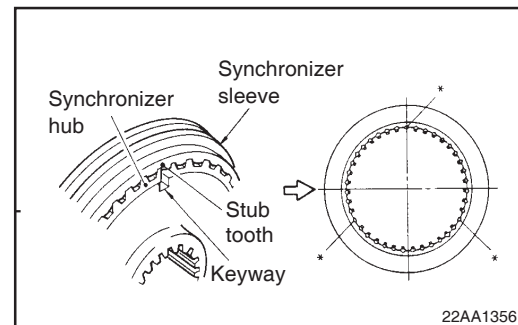
- 8) Install the thrust washer so that its side having the oil groove faces gear.



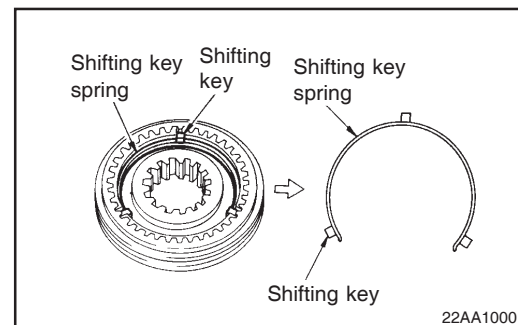
- 9) Mate the synchronizer hub with the synchronizer sleeve, ensuring that the keyways at three places in the synchronizer hub are aligned with stub teeth at three places (indicated by * in Fig.) of the synchronizer sleeve.

NOTE

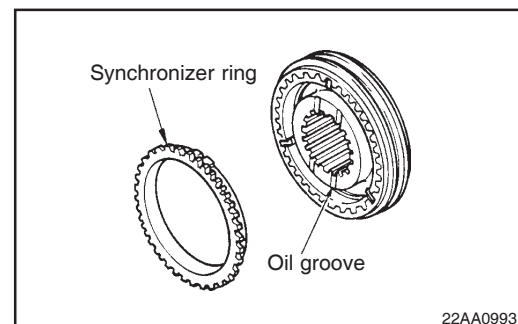
If the synchronizer hub and synchronizer sleeve are reused, be sure to align the alignment marks when they are reassembled together.



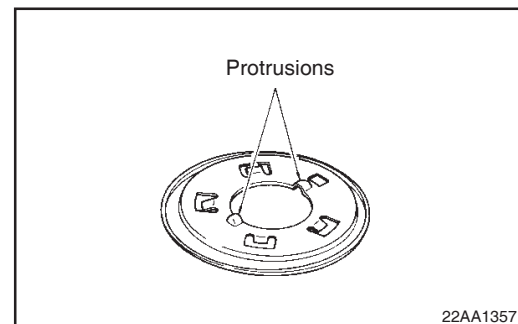
- 10) Fit shifting keys into keyways. Then, install the shifting key spring so that gap between its ends is not located at the shifting key position.



- 11) Face the synchronizer ring to the synchronizer hub side having oil grooves. Then, align keyway and fit synchronizer ring to synchronizer hub.
Next, mount the assembly onto the counter shaft.



- 12) Install the shifting key retainer to the synchronizer hub, making sure that the protrusions at two places in the retainer are fitted into the slots in hub.



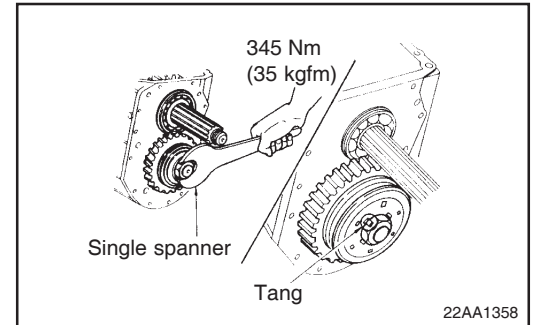
SERVICE PROCEDURE

TMa-21

13) Tighten lock nut to specification.

NOTE

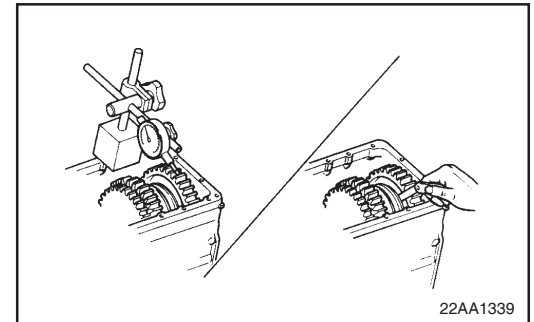
After torquing the lock nut, bend tangs at four places of the shifting key retainer over the lock nut.



14) After reassembly, check gears for backlash and end play.

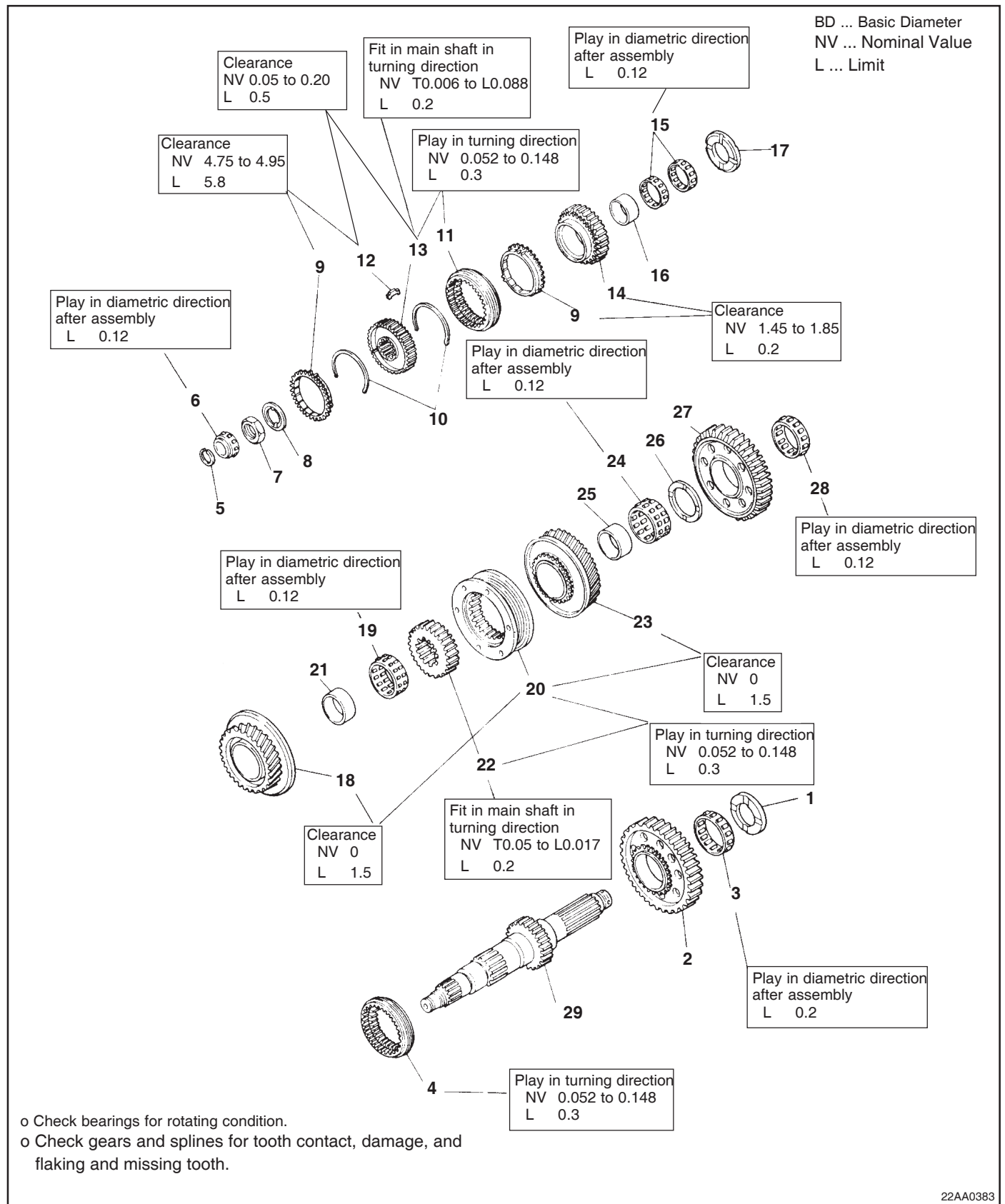
NOTE

Check gears also for rotating condition.



MAIN SHAFT

Disassembly and Inspection



SERVICE PROCEDURE

TMa-23

Disassembly sequence

1. 1st gear thrust washer
2. Main shaft 1st and reverse gear
3. Needle bearing
4. Synchronizer sleeve
5. Snap ring
6. Pilot bearing
7. Lock nut
8. Lock washer
9. Synchronizer ring
10. Shifting key spring
11. Synchronizer sleeve
12. Shifting key
13. Synchronizer hub
14. Main shaft 4th gear assembly
15. Needle bearing
16. Main shaft 4th gear bearing sleeve
17. 4th gear thrust washer
18. Main shaft 3rd gear assembly
19. Needle bearing
20. 2nd and 3rd synchronizer assembly
21. Main shaft 3rd gear bearing sleeve
22. 2nd and 3rd synchronizer hub
23. Main shaft 2nd gear assembly
24. Needle bearing
25. Main shaft 2nd gear bearing sleeve
26. 2nd gear thrust washer
27. Main shaft 1st and reverse gear
28. Needle bearing
29. Main shaft

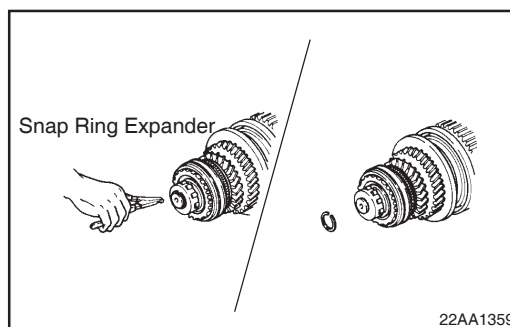
For parts with an encircled number, refer to Disassembly and Inspection procedure that follows.

NOTE

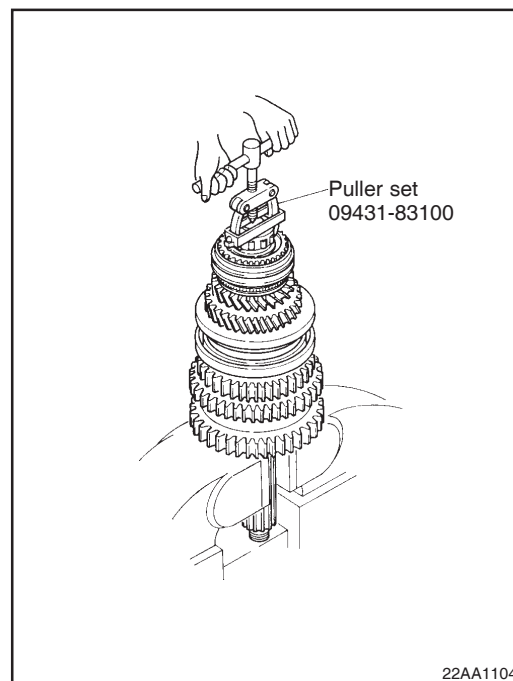
1. **Before disassembling the key type synchronizer, put matching mark at one location each in the synchronizer hub and synchronizer sleeve where a key is inserted.**
2. **Do not disassemble the 2nd and 3rd synchronizer assembly of the pin type synchronizer, as its stem has been staked over the ring. If it needs replacement, replace it as an assembly.**

Disassembly Procedure

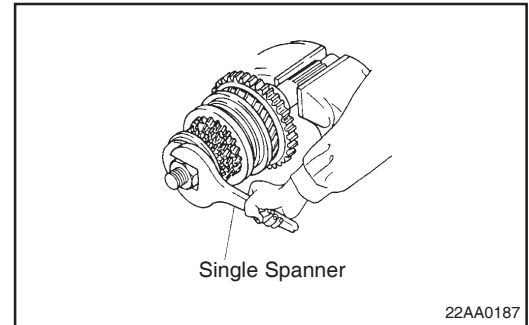
- 1) Using the Snap Ring Expander, remove the snap ring.



- 2) Using the special tool, Puller set, remove the pilot bearing.



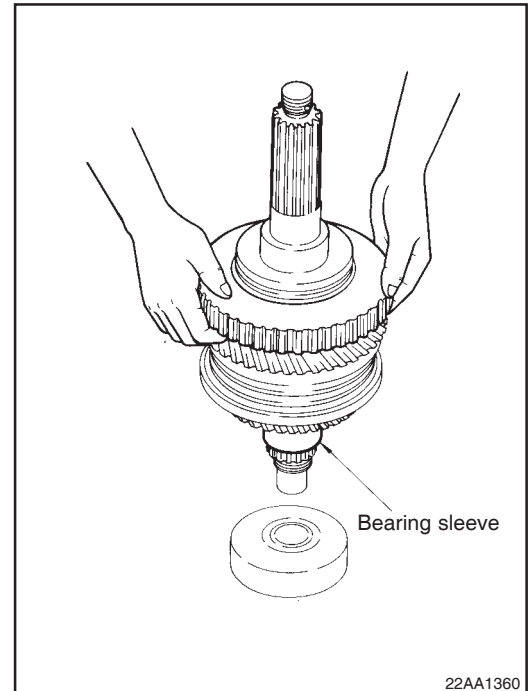
- 3) Using the Single Spanner, loosen and remove the lock nut.



- 4) To remove each bearing sleeve, make use of the weight of gear; i.e., lightly hit the main shaft against a lead plate.

NOTE

Be sure to use a lead plate to prevent main shaft end from being damaged.

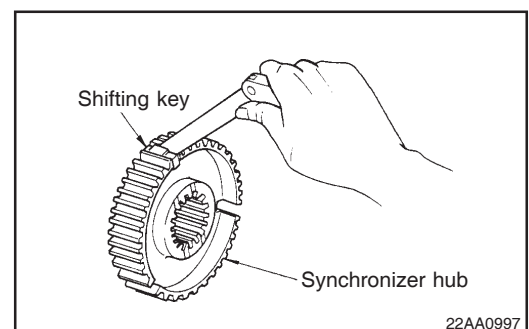
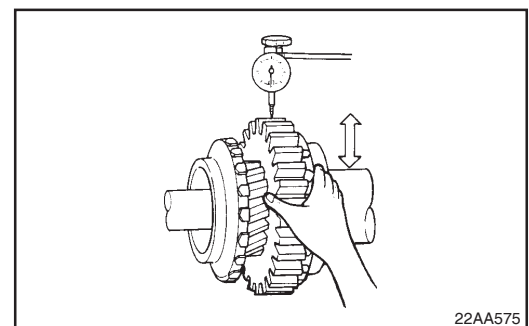


Inspection Procedure

- 1) Measure the play in diametric direction in each main shaft gear and needle bearing.
If the play exceeds the limit, replace the needle bearing.

NOTE

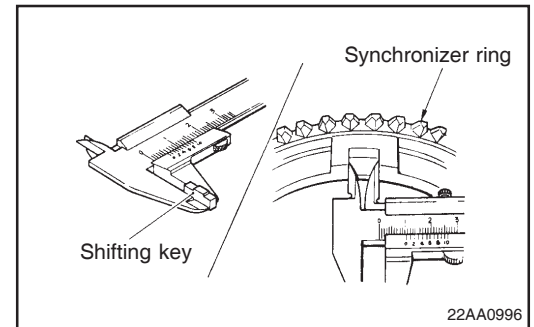
1. If two needle bearings are used for one gear, use ones of the same package color for replacement.
 2. If replacement of the needle bearing does not correct the excessive diametric play, check each bearing sleeve (except those in 1st and reverse gear) and main shaft gear and replace any defective parts.
- 2) Measure the clearance between the synchronizer hub keyway and shifting key. Replace parts if the clearance exceeds the limit



SERVICE PROCEDURE

TMa-25

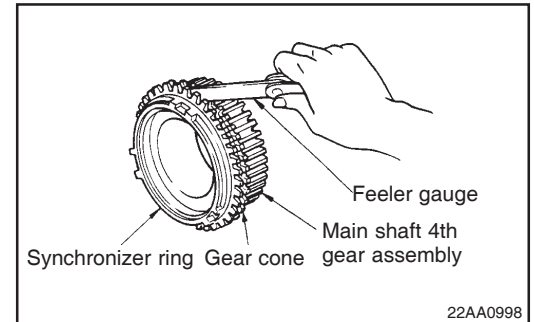
- 3) Measure the synchronizer ring keyway width and shifting key width to calculate the clearance between the two. If the limit is exceeded, replace parts.



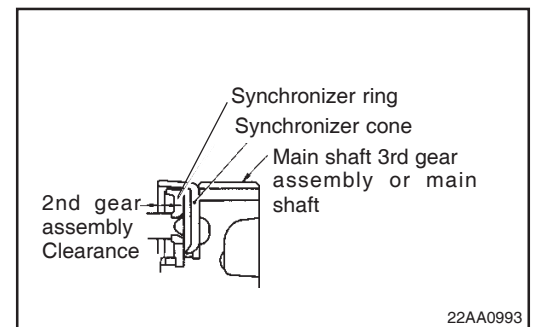
- 4) Measure the clearance between the synchronizer ring and the gear cone of main shaft 4th gear assembly. If the clearance exceeds the limit, replace parts.

NOTE

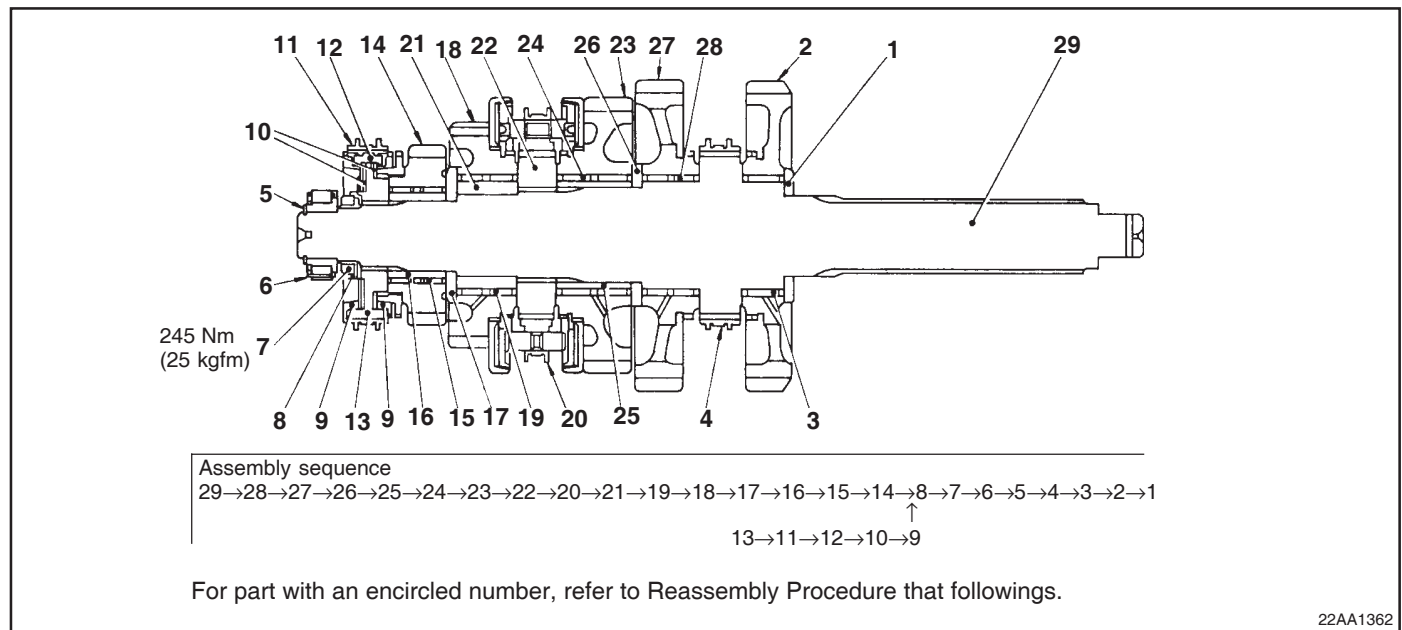
Press synchronizer ring evenly and take measurement throughout the entire circumference.



- 5) Measure the clearance between the synchronizer ring of 2nd and 3rd synchronizer assembly and the synchronizer cone of main shaft 3rd/2nd gear assembly. Replace parts if the clearance exceeds the limit.

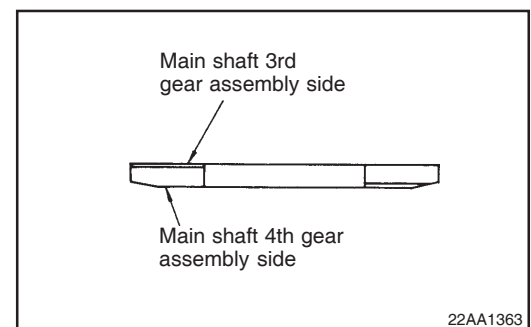


Reassembly



Reassembly Procedure

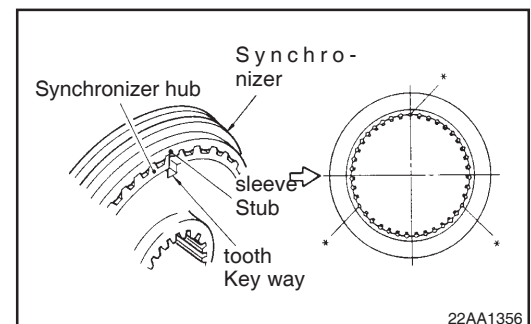
- 1) Install the 4th gear thrust washer so that its side with a greater contacting area faces the main shaft 3rd gear assembly.



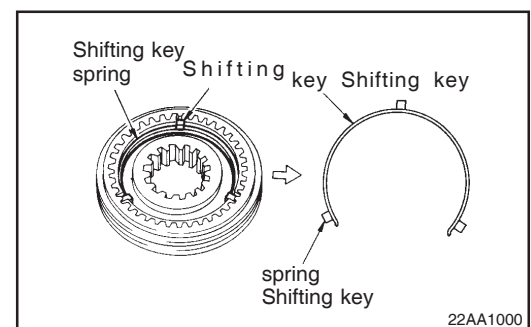
- 2) Mate the synchronizer hub with the synchronizer sleeve, ensuring that the keyways at three places in the synchronizer hub are aligned with stub teeth at three places (indicated by * in Fig.) of the synchronizer sleeve.

NOTE

If the synchronizer hub and synchronizer sleeve are reused, be sure to align the alignment marks when they are reassembled together.



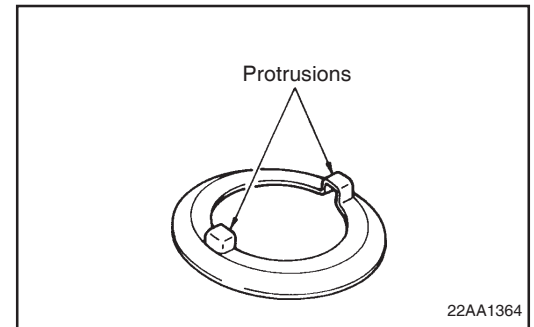
- 3) Fit shifting key into keyways. Then, install the shifting key spring so that the gap between its ends is not located at the shifting key positions.



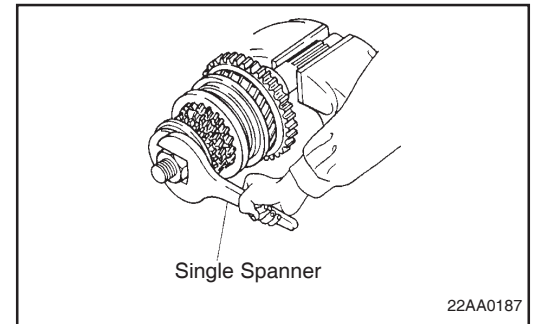
SERVICE PROCEDURE

TMa-27

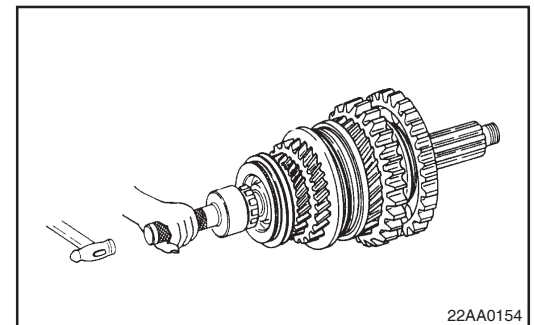
- 4) Install the lock washer to the synchronizer hub, making sure that the protrusions at two places in the lock washer are fitted into the slots in the hub.



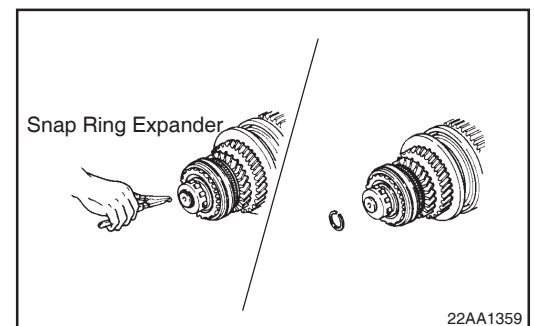
- 5) After assembling gears, use the Single Spanner, to tighten lock nut to specification.



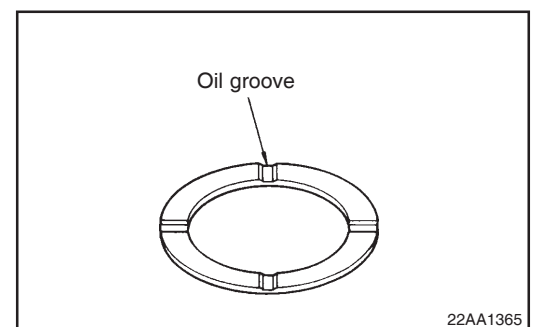
- 6) Drive the pilot bearing onto main shaft.



- 7) Fit the snap ring into position.

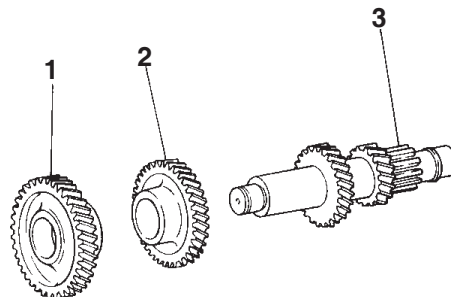


- 8) Install the 1st gear thrust washer so that its side with oil grooves faces gear.



COUNTER SHAFT

Disassembly



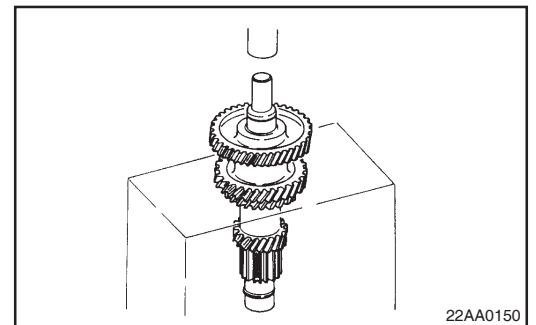
Disassembly sequence

1. Counter shaft constant-mesh gear
2. Counter shaft 4th gear
3. Counter shaft

22AA0384

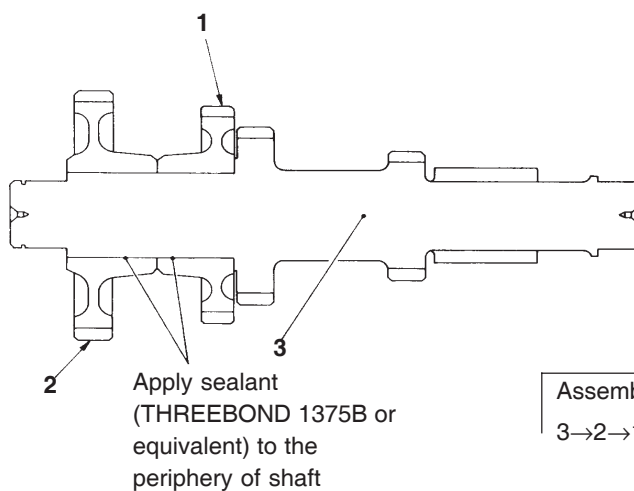
Disassembly Procedure

Remove the counter shaft gear.



22AA0150

Reassembly



Assembly sequence

3→2→1

22AA0315

SERVICE PROCEDURE

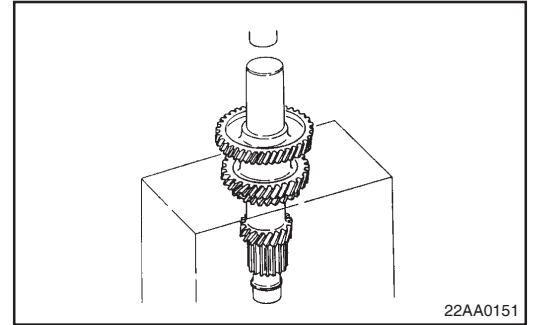
TMa-29

Reassembly Procedure

Using a hydraulic press, install the counter shaft gear onto the counter shaft then, press-fit the gear.

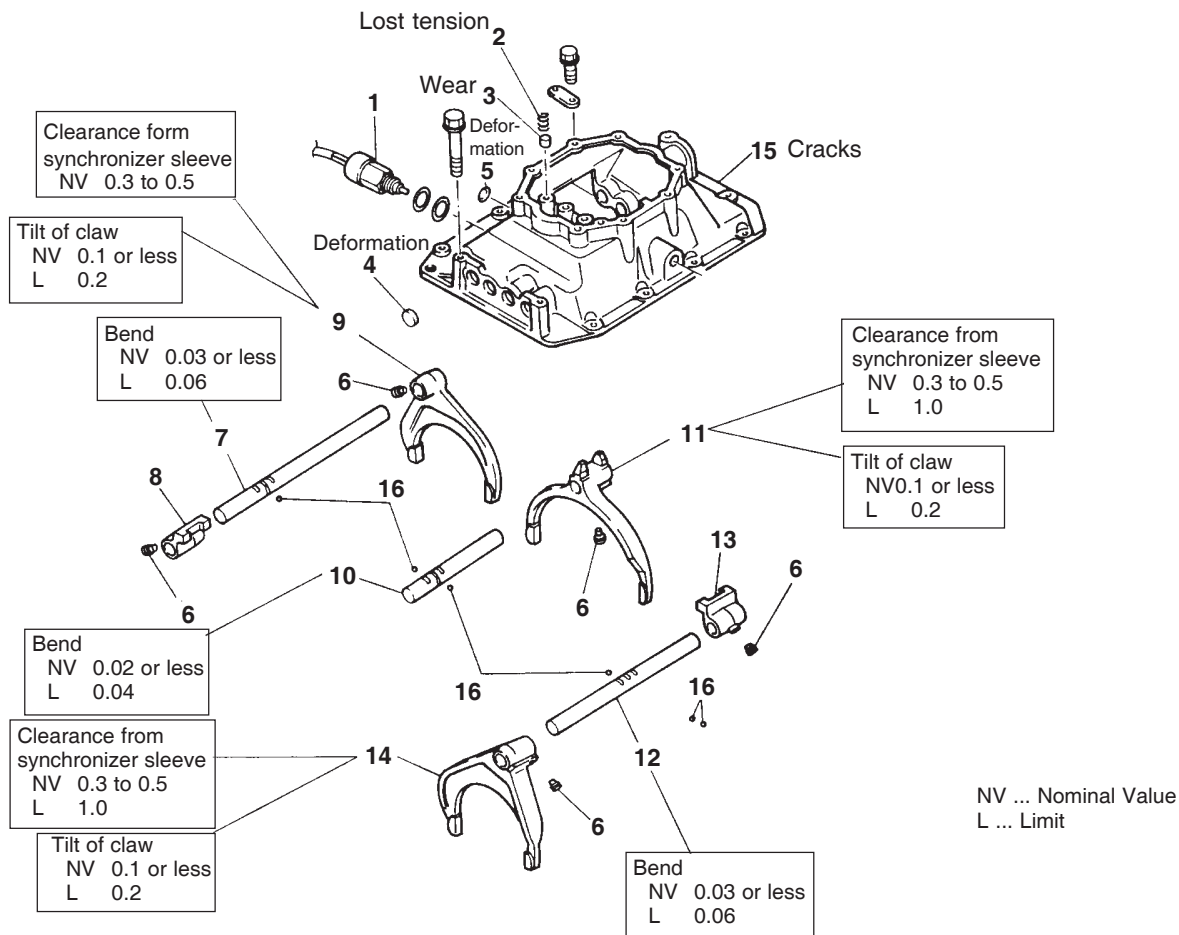
NOTE

Before installing the gears, apply sealant (THREEBOND 1375B or equivalent) to the portions of the counter shaft over which they are installed.



LOWER GEAR SHIFTER

Disassembly and Inspection



Disassembly sequence

1. Backup lamp switch
2. Poppet spring
3. Interlock pin
4. Dust plug
5. Expansion plug
6. Set bolt
7. 1st and reverse shift rail
8. 4th and 5th gear shift rail jaw
9. 1st and reverse shift fork
10. 2nd and 3rd shift rail assembly
11. 2nd and 3rd gear shift fork
12. 4th and 5th shift rail

13. 4th and 5th gear shift rail jaw
14. 4th and 5th gear shift fork
15. Gearshift lower case
16. Steel ball

For parts with an encircled number, refer to Disassembly and Inspection procedure that follows.

NOTE

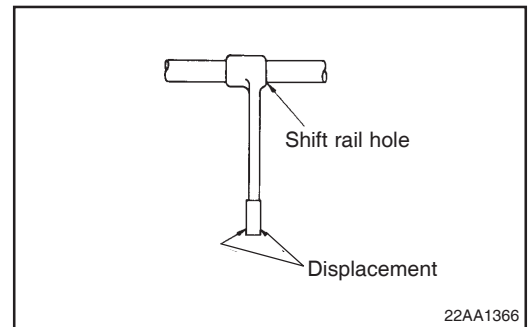
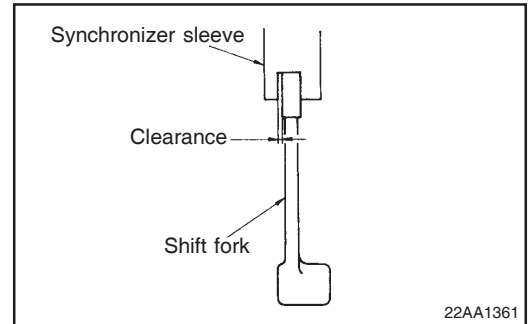
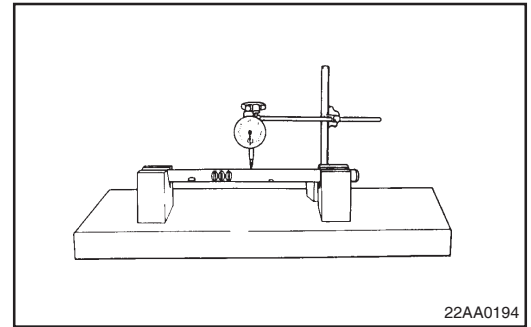
1. Do not disassemble the lower case except when replacing the shift fork, shift rail, or shift rail jaw.
2. when disassembling the shift rail, use care not to lose the interlock pin, steel ball, and poppet spring.

SERVICE PROCEDURE

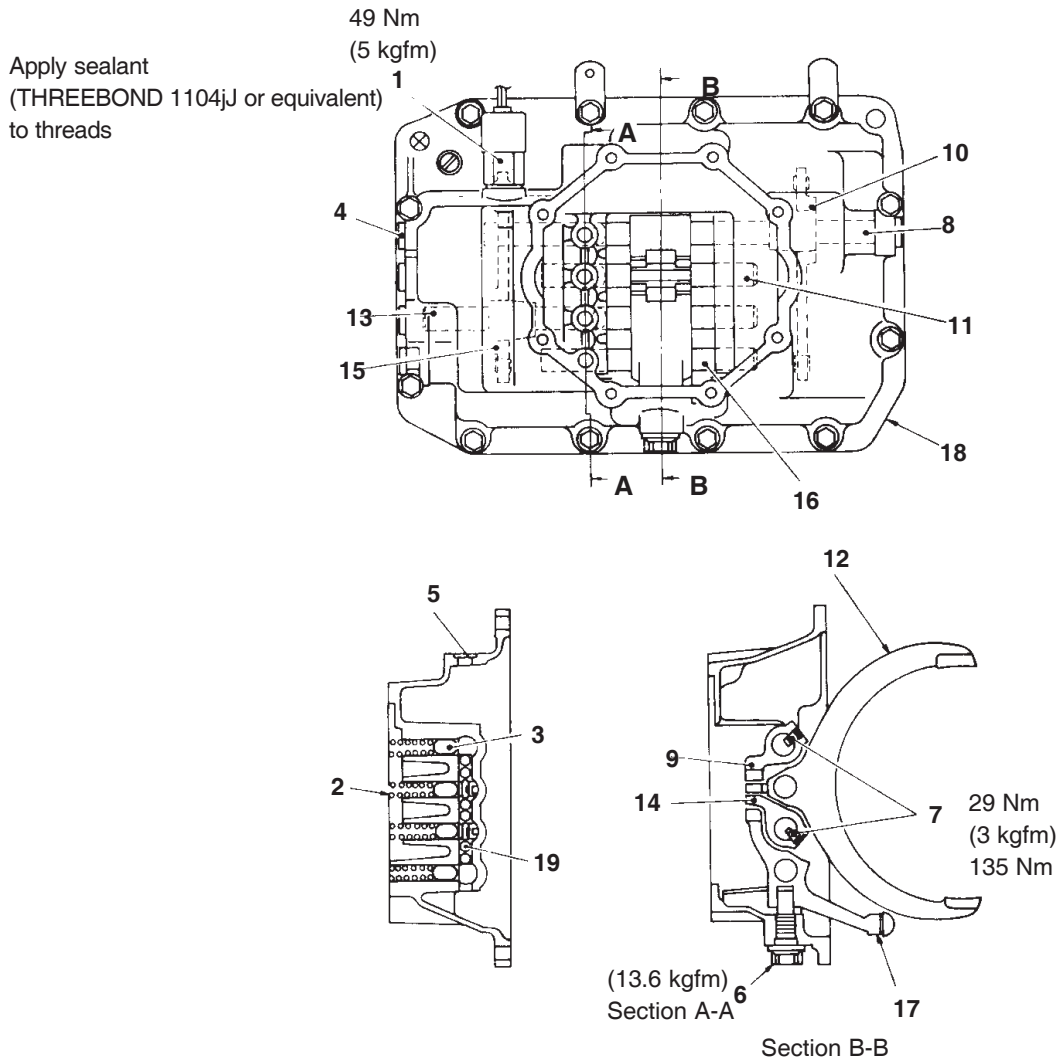
TMa-31

Inspection Procedure

- 1) Check the shift rail for bend (A half of the dial gauge pointer deflection is the bend). If the bend exceeds the limit, correct or replace the parts.
- 2) Measure the clearance between the shift fork and synchronizer sleeve and, if it exceeds the limit, replace the parts.
- 3) Measure the displacement or tilt of claw of each shift fork with reference to shift rail hole. Replace parts if the limit is exceeded.



Reassembly



Assembly sequence

```

16→17  11→12
  ↓      ↓
18→19→19→19→7→6→5→4→3→2→1
  ↑      ↑
13→15→14  9←10←8
    
```

For parts with an encled number, refer to Reassembly procedure that follows.

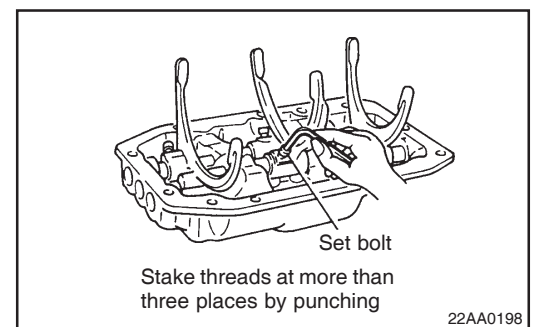
NOTE

During reassembly, make sure of the correct installation direction of each shift fork.

22AA1367

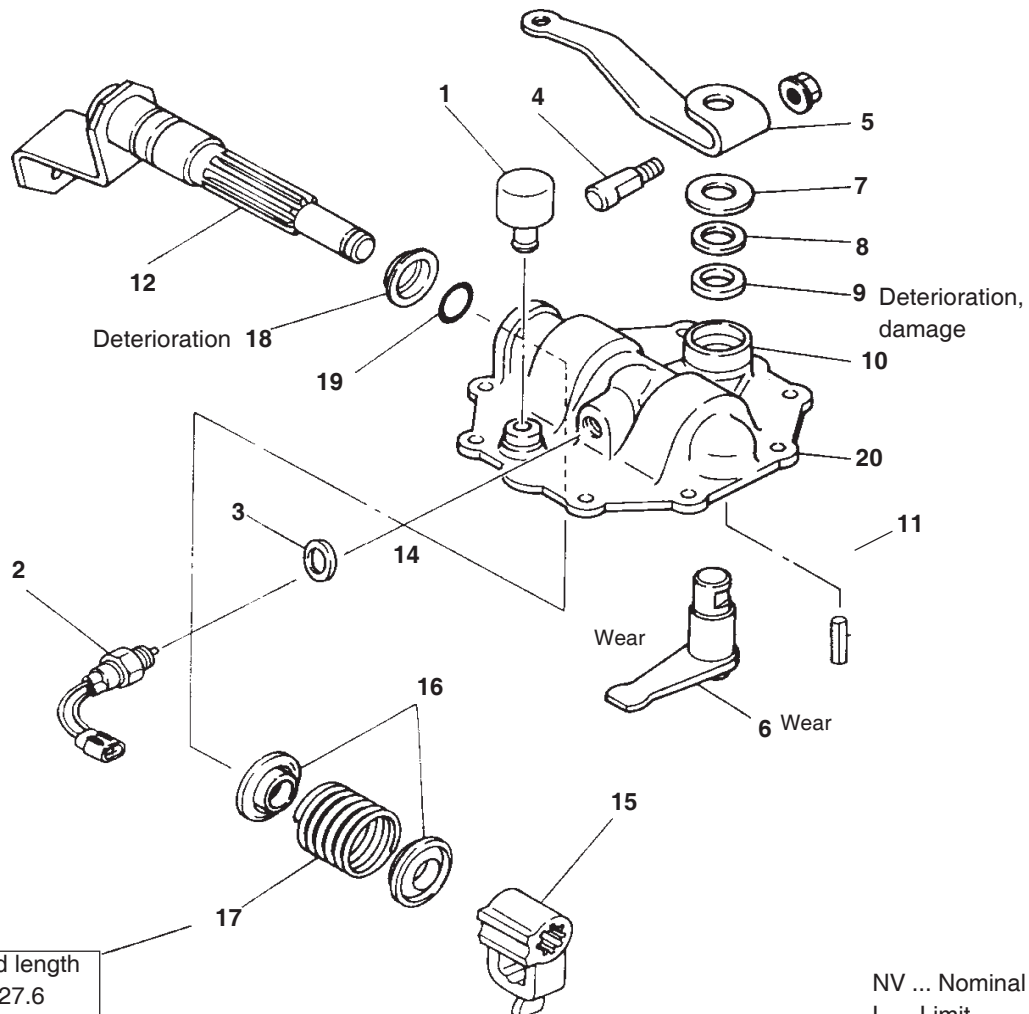
Reassembly Procedure

Install the shift rail set bolt. After installation, stake threads at more than three places by punching.



UPPER GEAR SHIFT

Disassembly and Inspection



Disassembly sequence

- | | |
|---|-----------------------------|
| 1. Air breather | 10. Bushing |
| 2. Interlock switch
(vehicles with turbocharger) | 11. Spring pin |
| 3. Gasket | 12. Gearshift lever |
| 4. Lock pin | 13. Spring retainer |
| 5. Gear selecting lever B | 14. Return spring |
| 6. Gear selecting lever A | 15. Gearshift sliding lever |
| 7. Shim | 16. Return spring retainer |
| 8. Washer | 17. Return spring |
| 9. Oil seal | 18. Dust seal |
| | 19. O-ring |
| | 20. Selector lever case |

For parts with an encled number, refer to Reassembly procedure that follows.

NOTE

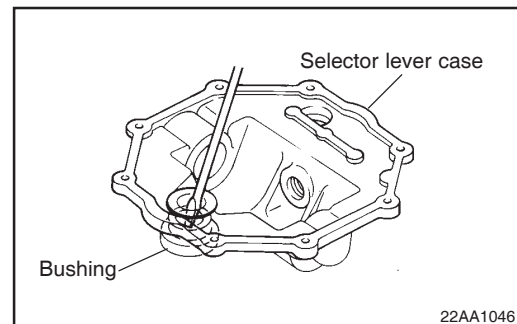
Do not remove bushing unless for replacement.

Disassembly Procedure

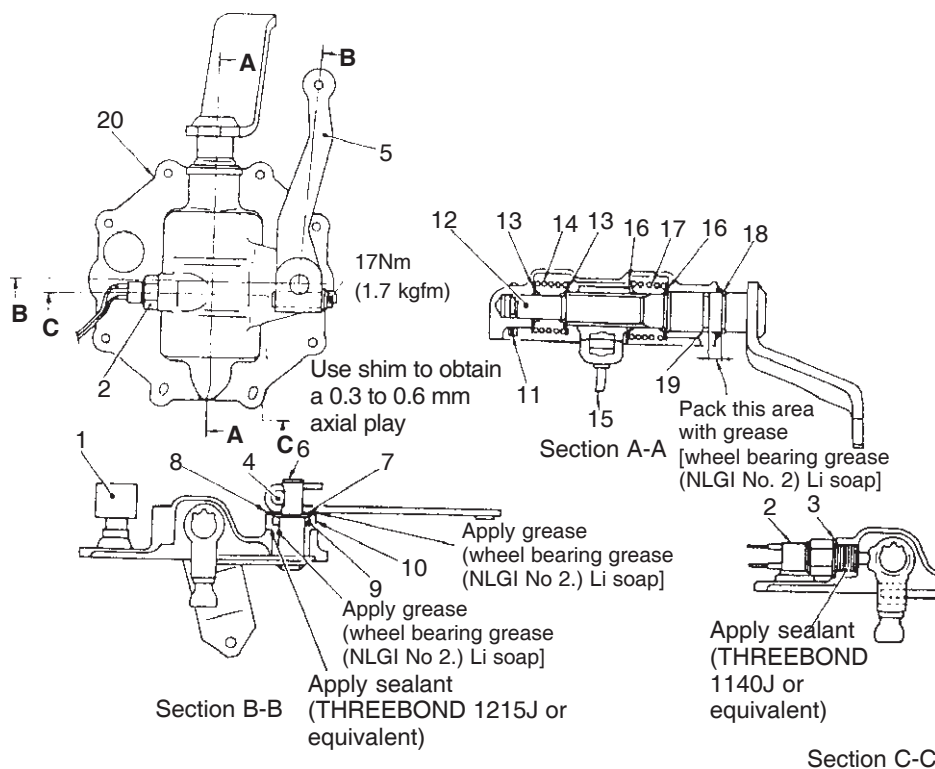
To remove the bushing press-fitted into the selector lever case, use a screwdriver.

NOTE

When removing the bushing, use utmost care to prevent damage to the selector lever case.



Reassembly



Assembly sequence

20→10→9→16→17→16→15→13→14→13→11→6→8→7→5→4→3→2→1
12→18→19

For part with an encircled number, refer to Reassembly Procedure that followings.

NOTE

When installing gear selecting lever A, turn the lever as may be required to prevent oil seal lips from being damaged.

SERVICE PROCEDURE

TMa-35

Reassembly Procedure

- 1) After cleaning the inner surfaces of the selector lever case, press-fit the bushing into position.

At the time, using the special tool, Drift to the bushing and tap the bar evenly with care not to gall the case. Also, coat the facing side of the bushing with sealant before installation.

NOTE

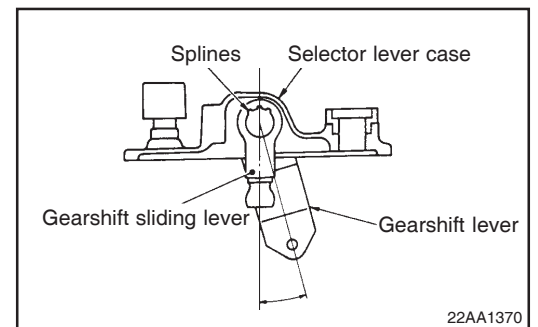
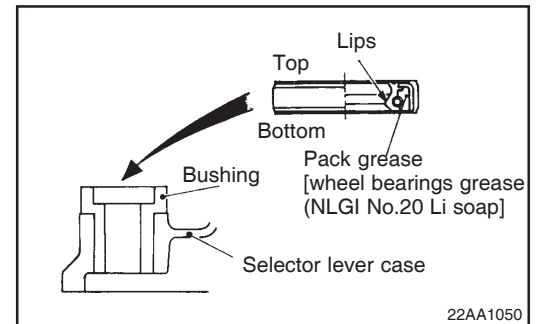
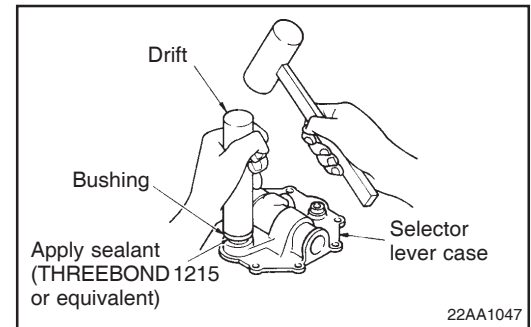
When applying sealant, keep the inside of the bushing free of sealant.

- 2) Apply grease to oil seal lips and press the oil seal evenly into position, its lips facing down.

NOTE

Pack areas between lips with grease and make sure that the oil seal is installed in the correct direction.

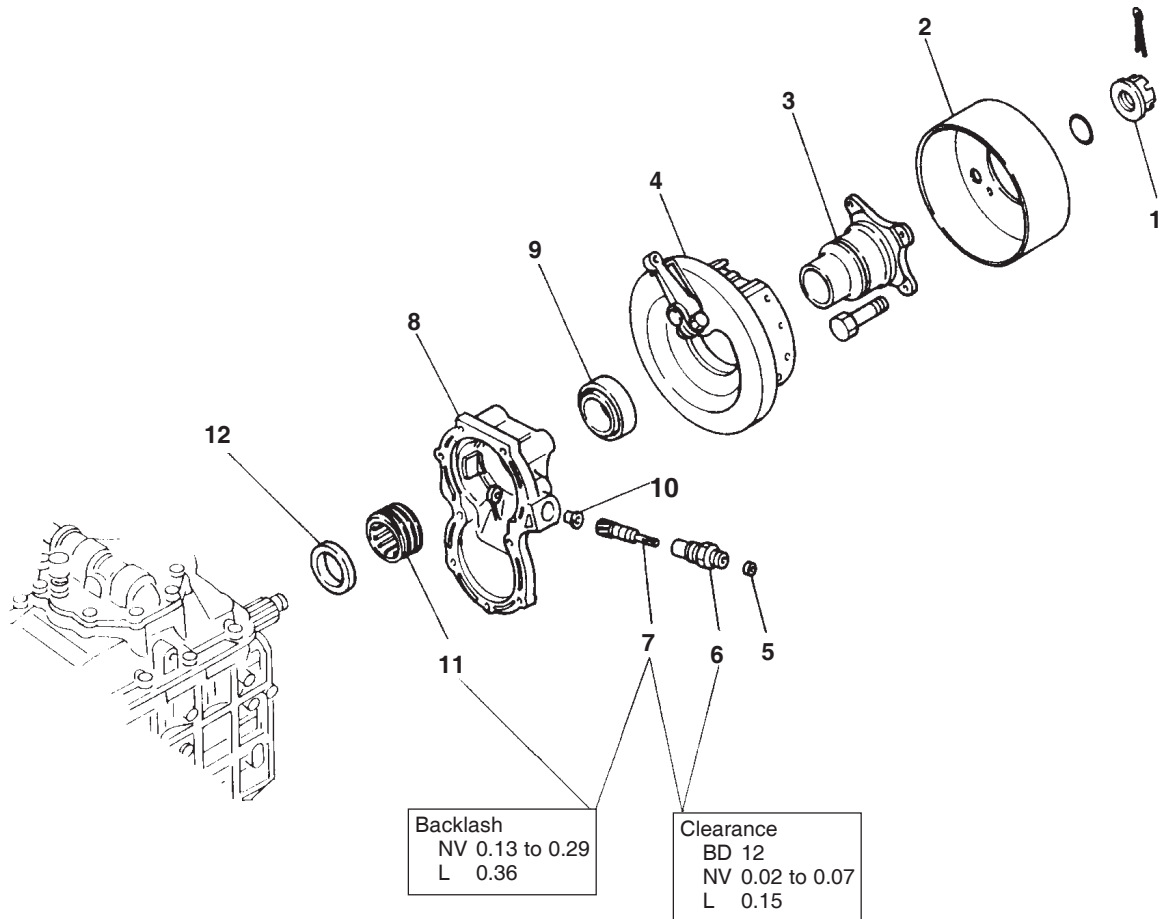
- 3) When installing the gearshift sliding lever to the gearshift lever, align splines so that the two parts make the angle as shown.



REAR COVER

Disassembly and inspection

Vehicles with Center Park Brake



Disassembly sequence

1. Lock nut
2. Parking brake drum
3. Companion flange
4. Support plate and shoe assembly
5. Speedometer gear bushing
6. Oil seal
7. Speedometer gear
8. Rear cover
9. Oil seal
10. Speedometer gear bushing A
11. Speedometer worm
12. Washer

BD ... Basic Diameter
NV ... Nominal Value
L ... Limit

For parts with an encircled number, refer to Disassembly procedure that follows.

NOTE

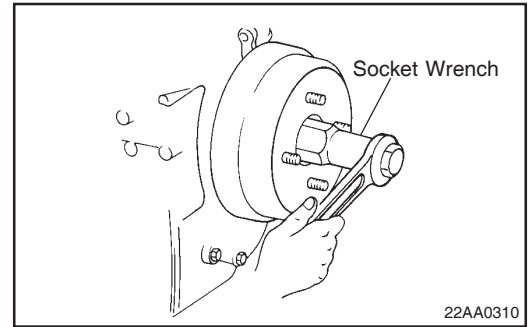
Do not remove the oil seal and speedometer gear bushing A unless for replacement.

SERVICE PROCEDURE

TMa-37

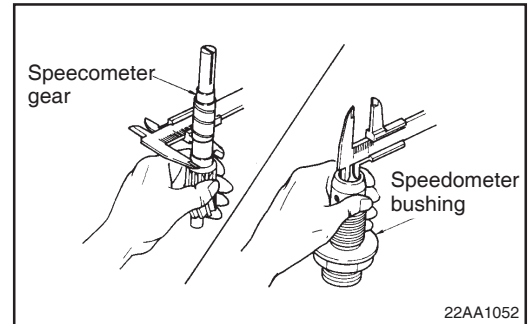
Disassembly Procedure

Using the Socket Wrench, remove the lock nut.



Inspection Procedure

Measure the speedometer gear shaft O.D. and speedometer gear bushing I.D. to calculate the clearance between the two. Replace parts if the clearance exceeds the limit.



Reassembly

Vehicles with Center parking Brake

Apply sealant (THREEBOND 1215 or equivalent) to entire mating surfaces

245 to 345 Nm (25 to 35 kgfm)

40 Nm (4.1 kgfm)

Apply grease [molybdenum disulfide base grease (NLGi No.2) Li soap]

40 Nm (4.1 kgfm)

145 Nm (15 kgfm)

Assembly sequence

12→11→7→4→3→2→1
↑ ↑
8→10→9 6←5

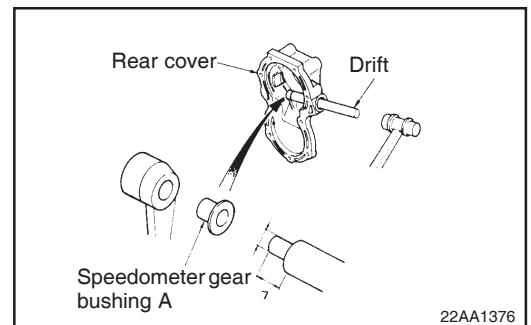
NOTE

When inserting bushing the speedometer gear, use care not to damage the oil seal.

22AA1374

Reassembly Procedure

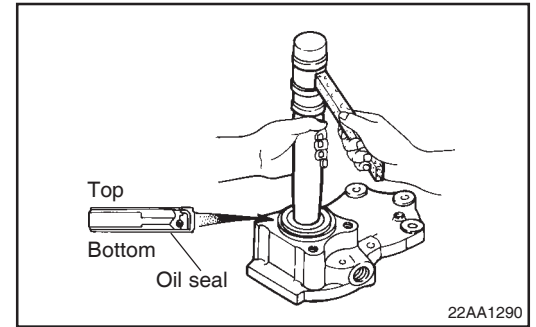
- 1) To install speedometer gear bushing a into the rear cover, use the special tool, Drift which has been machined to dimensions shown.



- 2) Drive oil seal evenly into the rear cover.

NOTE

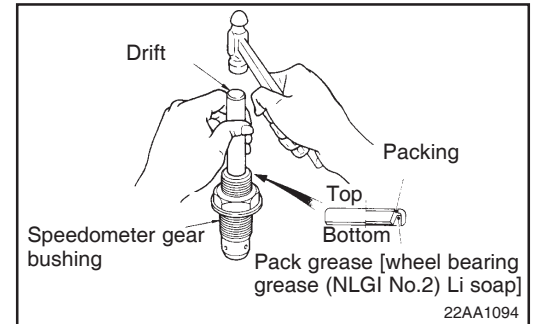
Make sure that the oil seal is installed in the correct direction.



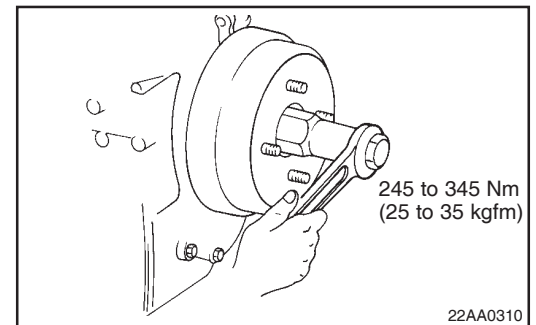
- 3) To install oil seal into the speedometer gear bushing, using the special tool, Drift round bar.

NOTE

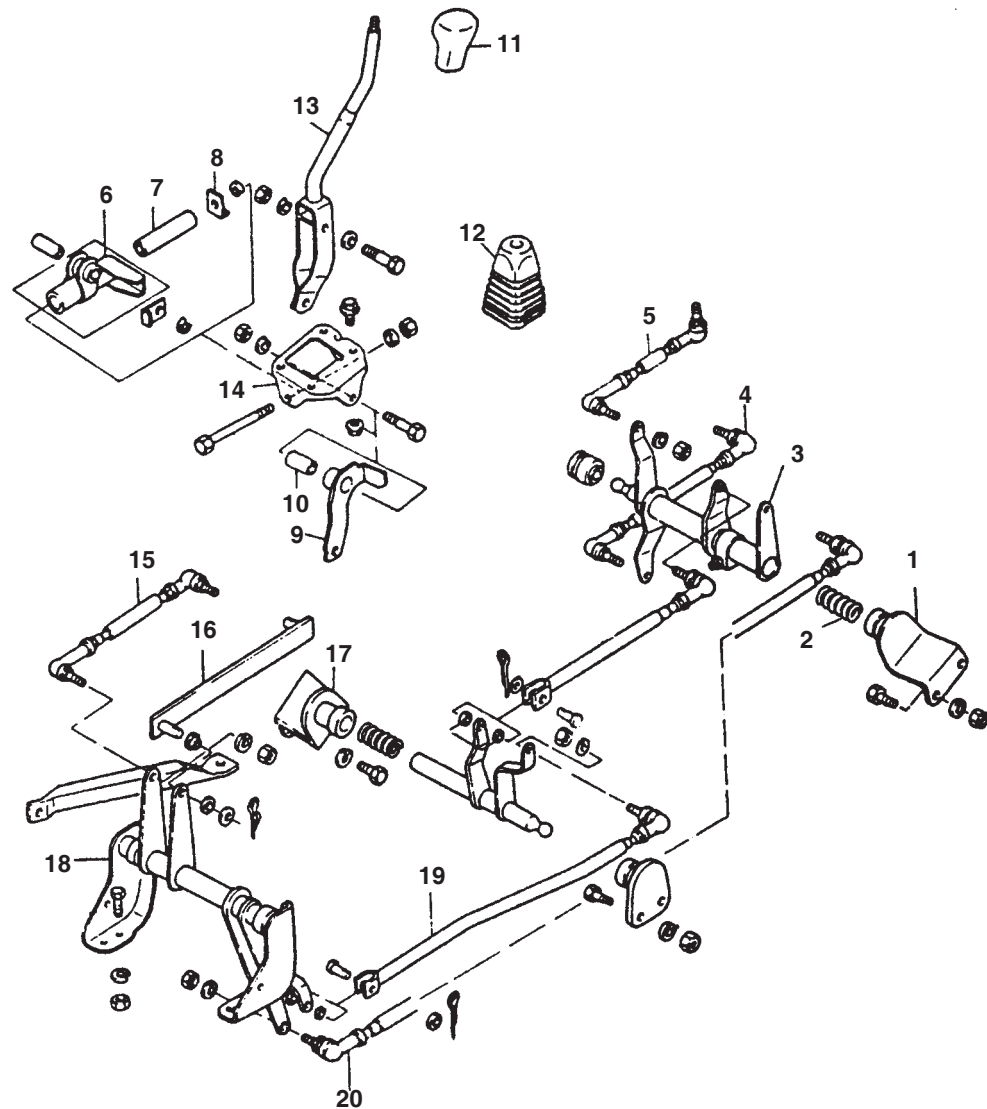
Before installing the oil seal, pack the area indicated with grease. Make sure of correct installation direction. Also apply grease to inner circumference of the packing.



- 4) Tighten the lock nut to specification.



Transmission Control Disassembly and Inspection



Disassembly sequence

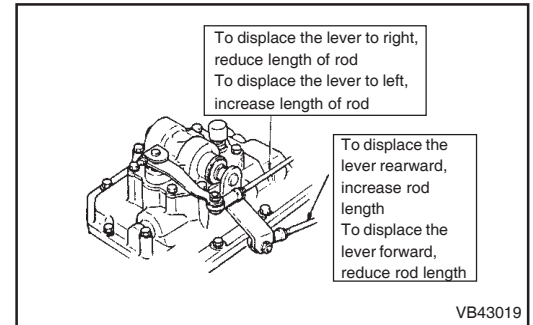
- | | |
|-----------------------------|---------------------------|
| 1. Rear cross shaft bracket | 11. Knob |
| 2. Return spring | 12. Boot |
| 3. Rear cross shaft | 13. Change lever |
| 4. Shift D rod assembly | 14. Change lever bracket |
| 5. Select C rod assembly | 15. Shift A rod assembly |
| 6. Sleeve | 16. Select rod A |
| 7. Collar | 17. Cross shaft bracket |
| 8. Plate | 18. Front cross shaft |
| 9. Select lever | 19. Shift B rod assembly |
| 10. Collar | 20. Select A rod assembly |

Adjusting after installation

1) Adjustment of control rod

If the gearshift lever is displaced too far forward or backward, or to right or left, adjust the length of the rod.

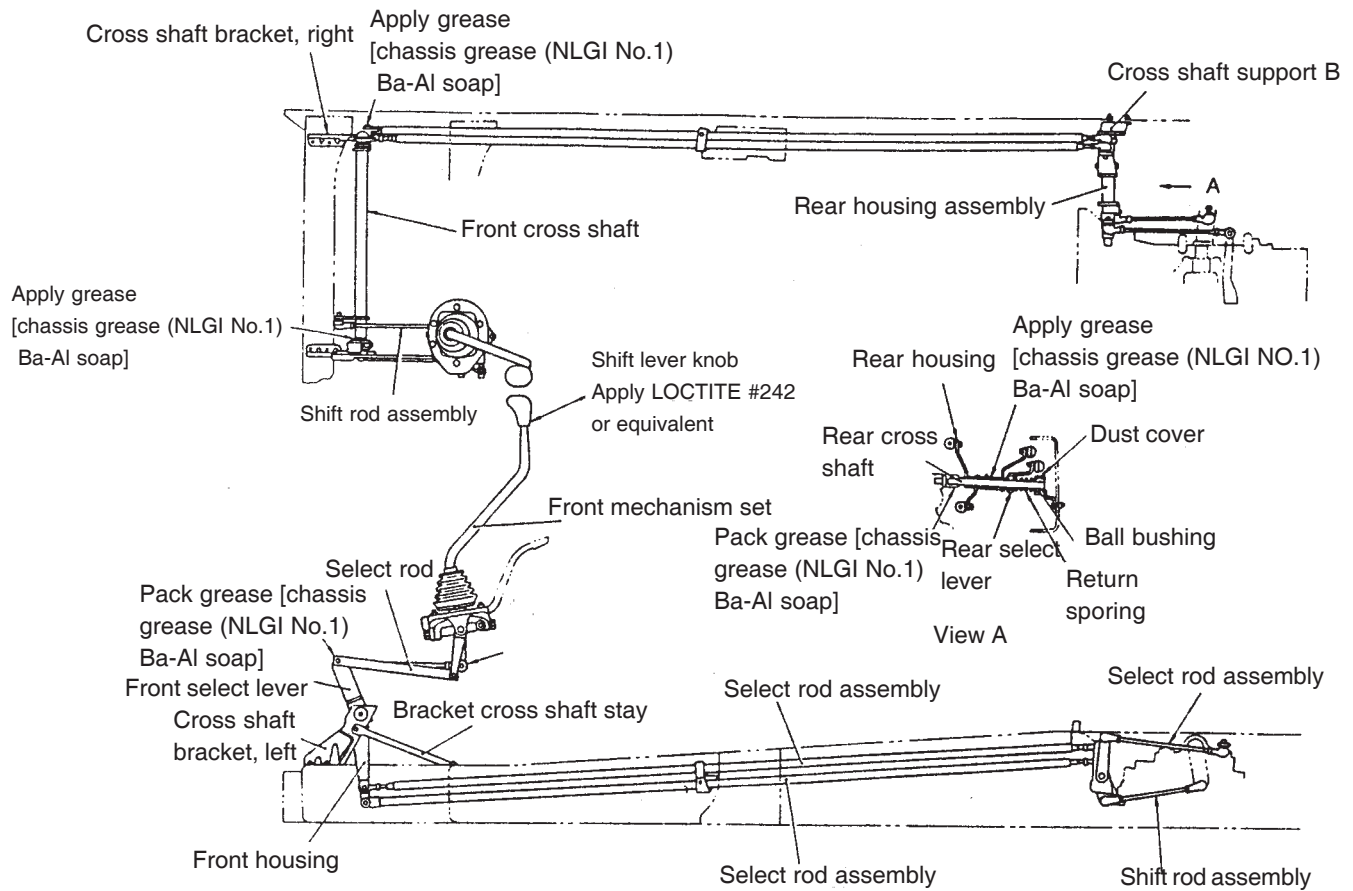
After adjustment, tighten the lock nut on each control rod to specification.



2) Installation of shift lever knob

The shift lever knob is provided with a self-tapping screw. The knob has been removed, remount it by driving into position by hand.

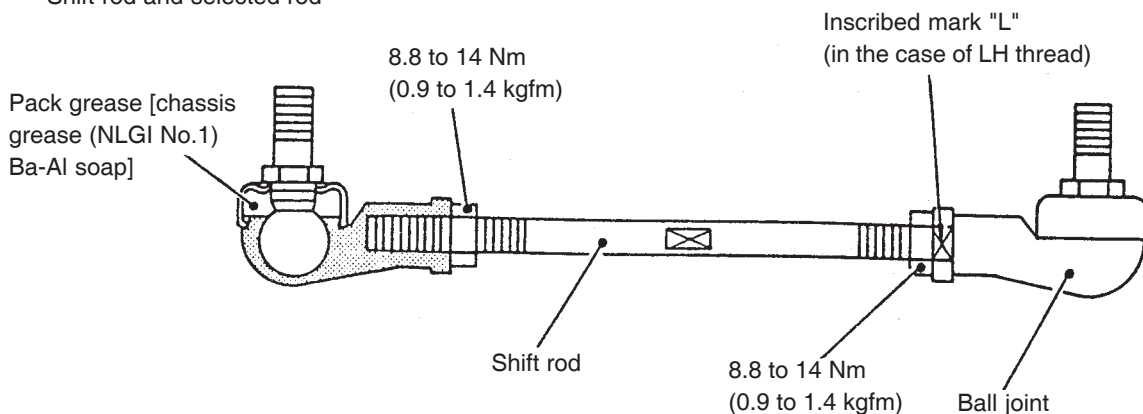
Reassembly



Tightening of ball joints

Screw dimension	Tightening torque
M8 x 1.25	19 to 27 Nm (1.9 to 2.8 kgfm)
M10 x 1.25	38 to 59 Nm (3.9 to 6.0 kgfm)

Shift rod and selected rod



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Transmission slips out of gear	Defective control mechanism (insufficient shift stroke on transmission side)	
	o Play in ball joint	Replace ball joint
	o Worn bushing	Replace
	o Bend rod	Correct bend or replace
	o Worn steel ball or groove in shift rail	Replace worn part
	o Insufficient shift rail poppet spring tension or broken spring	Replace
	Defective transmission (Disassemble and check transmission assembly)	
	o Main shaft rear lock nut left loose	Retighten to specification
	o Worn main shaft thrust washer	Replace
	o Worn or damaged main shaft bearing	Replace
	o Worn splines in synchronizer ring and synchronizer sleeve	Replace worn part
Hard shifting into gear	Defective control mechanism (insufficient shift stroke on transmission side)	
	o Play in ball joint	Replace ball joint
	o Ball joint insufficiently lubricated	Lubricate
	o Improper rod length	Adjust
	o Worn bushing	Replace
	o Shift rail not sliding smoothly	Replace shift rail or gearshift lower case
	o Worn shift fork jaws	Replace
	o Bend shift fork	Correct bend or replace
	Defective transmission (Disassemble and check transmission assembly)	
	o Main shaft rear lock nut left loose	Retighten to specification
	o Worn main shaft thrust washer	Replace
	o Worn or damaged main shaft bearing	Replace
	o Worn taper cone in synchronizer ring and gears	Replace the worn part
	o Defective clutch	Adjust
	o Clutch not releasing properly	
	o Improper clutch pedal free play	

TROUBLESHOOTING
TMa-43

Symptom	Probable cause	Remedy
Unusual noise in neutral	Worn or damaged main shaft pilot bearing	Replace or lubricate
	Worn or damaged drive pinion bearing	Replace
	Excessive backlash between drive pinion and counter shaft constant-mesh gear	Replace
	Worn or damaged counter shaft bearing	Replace
	Worn or damaged needle bearing in gears	Replace
	Excessive backlash between counter shaft 4th gear and PTO idler gear	Adjust with adjusting gasket in PTO case or replace gear
Unusual noise in gear	Worn or damaged main shaft and counter shaft bearings	Replace
	Worn or damaged main shaft pilot bearing	Replace
	Worn or damaged needle bearing in gears	Replace
	Excessive backlash between gears in main shaft and counter shaft	Replace gears
	Worn or damaged synchronizer sleeve	Replace
	Insufficient gear oil	Add
	Damaged gear	Replace
Unusual noise in shifting	Defective synchronizer	Replacd worn part
	o Worn taper cone in synchronizer ring and gears	
	o Worn shifting key	
	o Damaged shifting key splines	Replace
	Worn splines in gears	Replace gear
	Worn synchronizer sleeve	Replace
	Clutch not releasing properly	Adjust

TRANSMISSION (KH10)



SPECIFICATIONS	TMb - 2
SERVICE STANDARDS	TMb - 2
SERVICE PROCEDURES	TMb - 3
Gear Shift Housing	TMb - 8
Input and Output Shaft, Gears	TMb-16
Counter Shaft, Reverse Idler Shaft and Gear	TMb-41
Transmission Control	TMb-49
TROUBLESHOOTING	TMb-51

SPECIFICATIONS

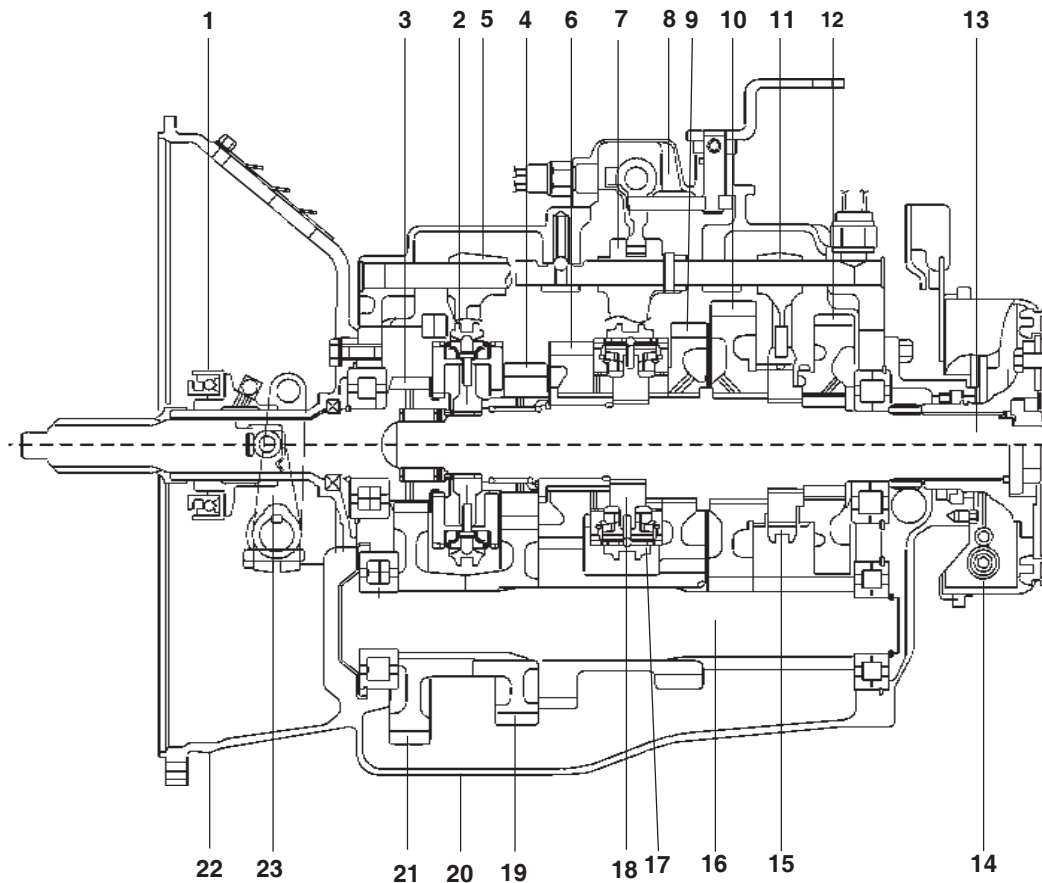
Model		KH-10
Transmission control type		Floor shift, remote control type
Gear ratio	1st	6.967
	2nd	4.247
	3rd	2.454
	4th	1.471
	5th	1.000
	rev.	6.492
Oil capacity		7.8 ℓ (without PTO)
		8.3 ℓ (with PTO)

SERVICE STANDARDS

Maintenance item		Normal value	Service limit	Remedy and remarks
Back lash	1st gear	0.023~0.101	0.016~0.055	Replace or check for damaged tooth surface
	2nd gear	0.022~0.071		
	3rd gear	0.020~0.070		
	4th gear	0.020~0.064		
	reverse gear	0.019~0.064		
End play	1st gear	0.15~0.3	0.15~0.60	Replace gear or washer
	2nd gear			
	3rd gear			
	4th gear			
	reverse gear	0.20~0.60		

SERVICE PROCEDURES

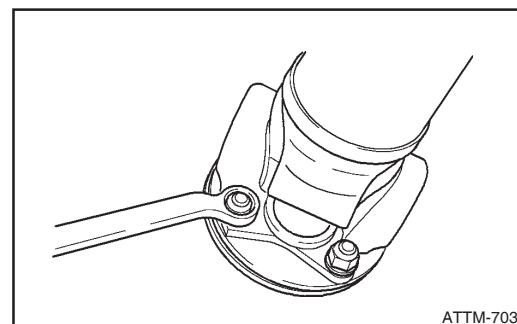
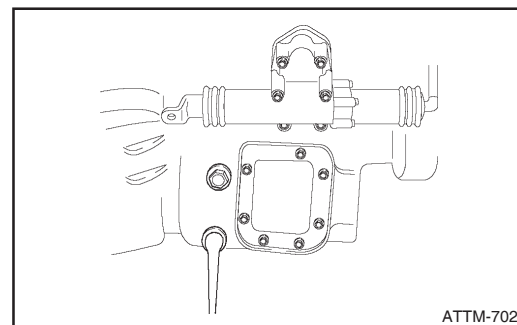
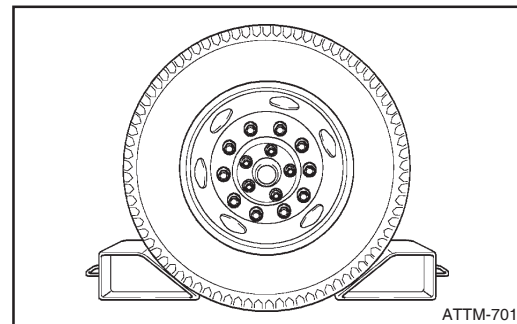
COMPONENTS



- | | |
|-----------------------------|--------------------------------------|
| 1. Clutch release bearing | 13. Main shaft |
| 2. Synchronizer sleeve | 14. Parking brake drum |
| 3. 5th and input shaft | 15. 1st, reverse synchronizer sleeve |
| 4. 4th gear | 16. Counter shaft |
| 5. 4th, 5th shift fork | 17. 2nd, 3rd synchronizer sleeve |
| 6. 3rd gear | 18. 3rd, 4th clutch hub |
| 7. 2nd, 3rd shift fork | 19. Counter 4th gear |
| 8. Control cover | 20. Transmission case |
| 9. 2nd gear | 21. Counter shaft drive gear |
| 10. 1st gear | 22. Clutch housing |
| 11. 1st, reverse shift fork | 23. Clutch release fork |
| 12. Reverse gear | |

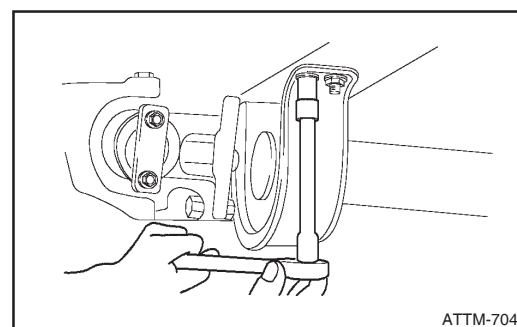
Removal

1. Park the car on level ground.
2. Block the wheels with wooden block.
3. Remove the drain plug and drain the transmission oil to the suitable container.
4. Mark assembly sign on flange and yoke.
5. Disassemble 4 nuts.
6. Remove center bearing fixing bolts and nuts.
7. Remove the propeller shaft.



WARNING

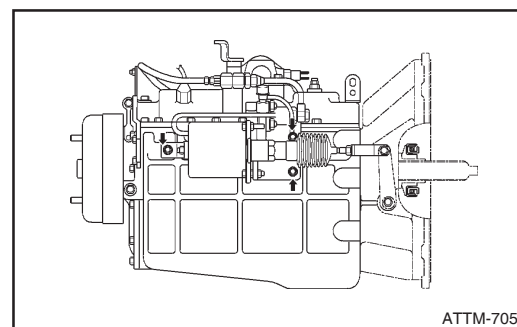
- After removing propeller shaft, hold the parking brake drum securely together with propeller shaft fixing bolt and nut. Otherwise, parking brake drum may drop suddenly to result in the personal damage.



8. Remove parking brake cable, speedometer cable and related electric harnesses.
9. Remove the shift rod and select rod.
10. Remove the clutch booster.

CAUTION

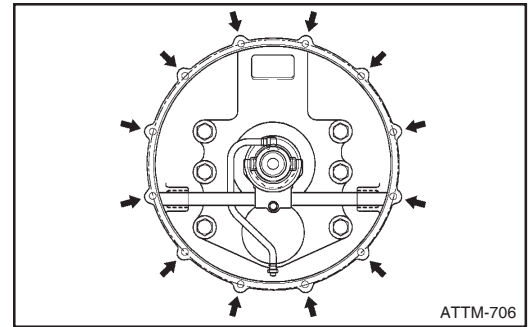
- Place the plug on the removed clutch booster port and pipes to prevent influx of dusts.
- Do not remove air tube or oil hose of clutch booster not to do air bleeding in reassembling.



SERVICE PROCEDURES

TMb-5

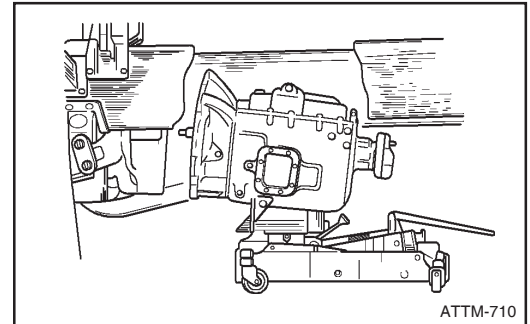
11. Remove the clutch-housing bolt.



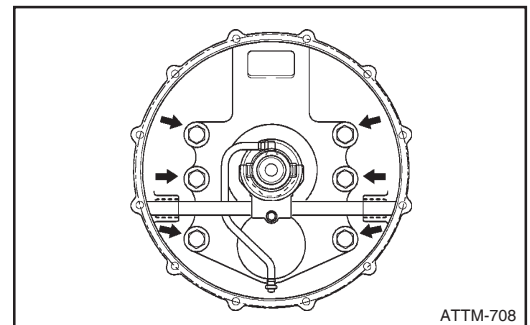
12. Place the jack under transmission.

13. Remove the remaining bolts of clutch housing.

14. Pull the transmission backward. Lower the jack slowly and remove the transmission.

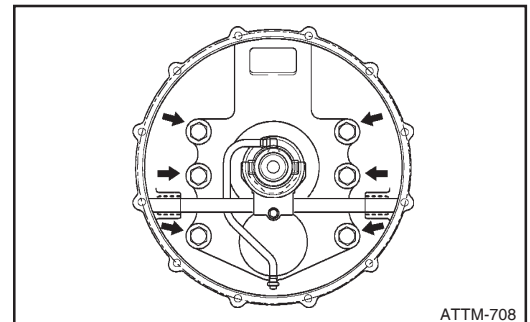


15. Remove the clutch housing.

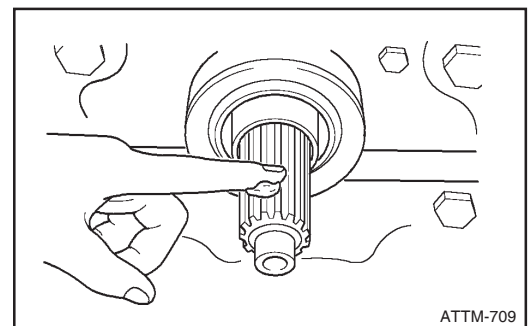


Installation

1. Install the clutch housing to the transmission.
Tightening torque : 2,200 ~ 3,200 kg.cm



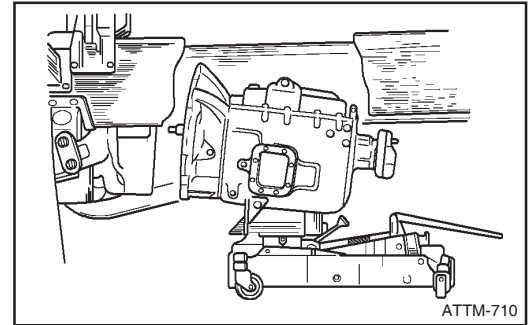
2. Apply the grease on the input shaft spline.



TMb-6

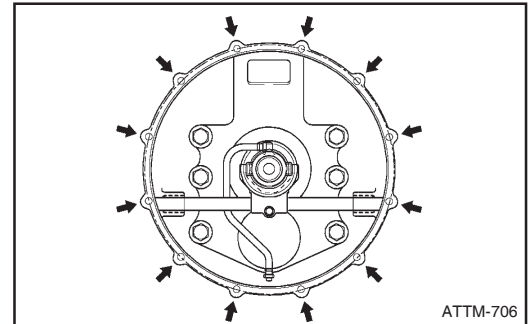
TRANSMISSION (KH10)

3. Jack up the transmission, until main drive gear spline and clutch disc spline aligns.

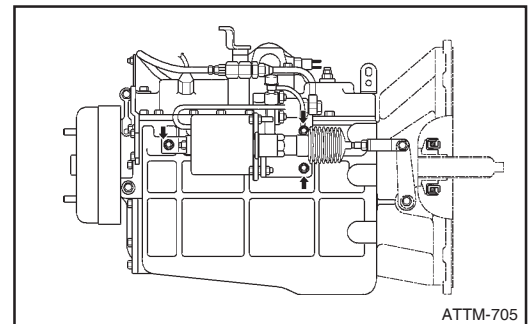
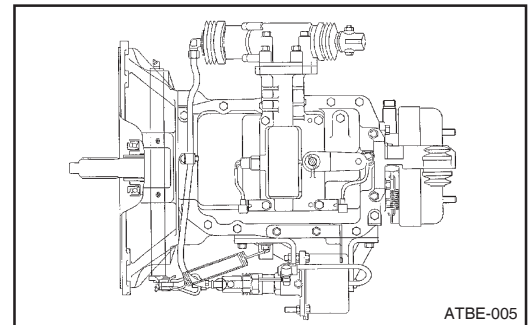


4. Attach the transmission to the clutch housing.
5. Assemble the bolts around the clutch housing.
6. Lower the jack and put it aside.
7. Assemble the remaining bolts around clutch housing.
8. Tighten the transmission installation bolts.

Tightening torque : 380 ~ 500kg.cm

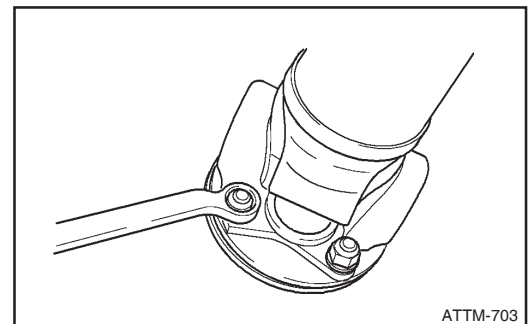


9. Install shift rod and select rod.
10. Connect parking brake, speedometer cable and related electric harnesses.



11. Tighten the 4 nuts.

Tightening torque : 650 ~ 870kg.cm

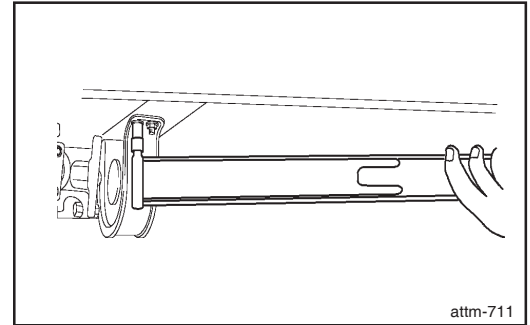


SERVICE PROCEDURES

TMb-7

12. Install propeller shaft to the center bearing holder.
13. Tighten the fixing bolts and nuts.

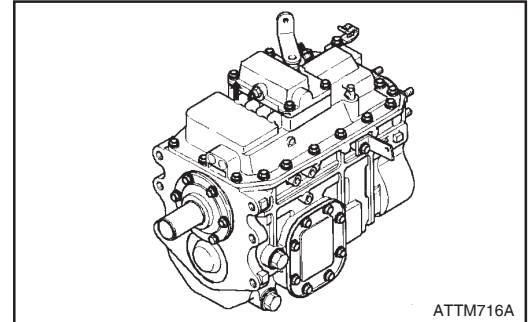
Tightening torque : 380 ~ 500 kg.cm



14. Fill the oil to the level of filler plug hole of transmission.
15. Clean the drain plug and replace the gasket with new one and tighten the plug.

Oil quantity : 6.8 liter

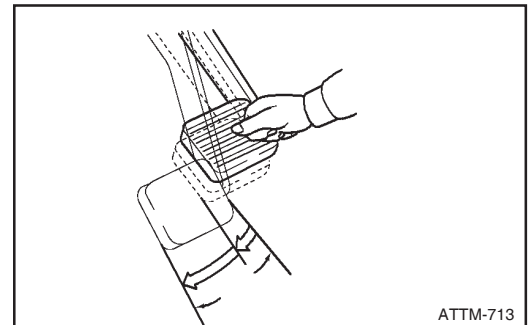
Tightening torque : 600 ~ 900 kg.cm



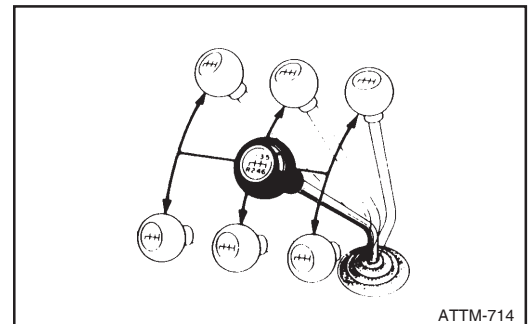
16. Press the pedal and measure the distance that pedal travels until resistance is felt.

Standard : 32 ± 5 mm

Limit : 30 mm

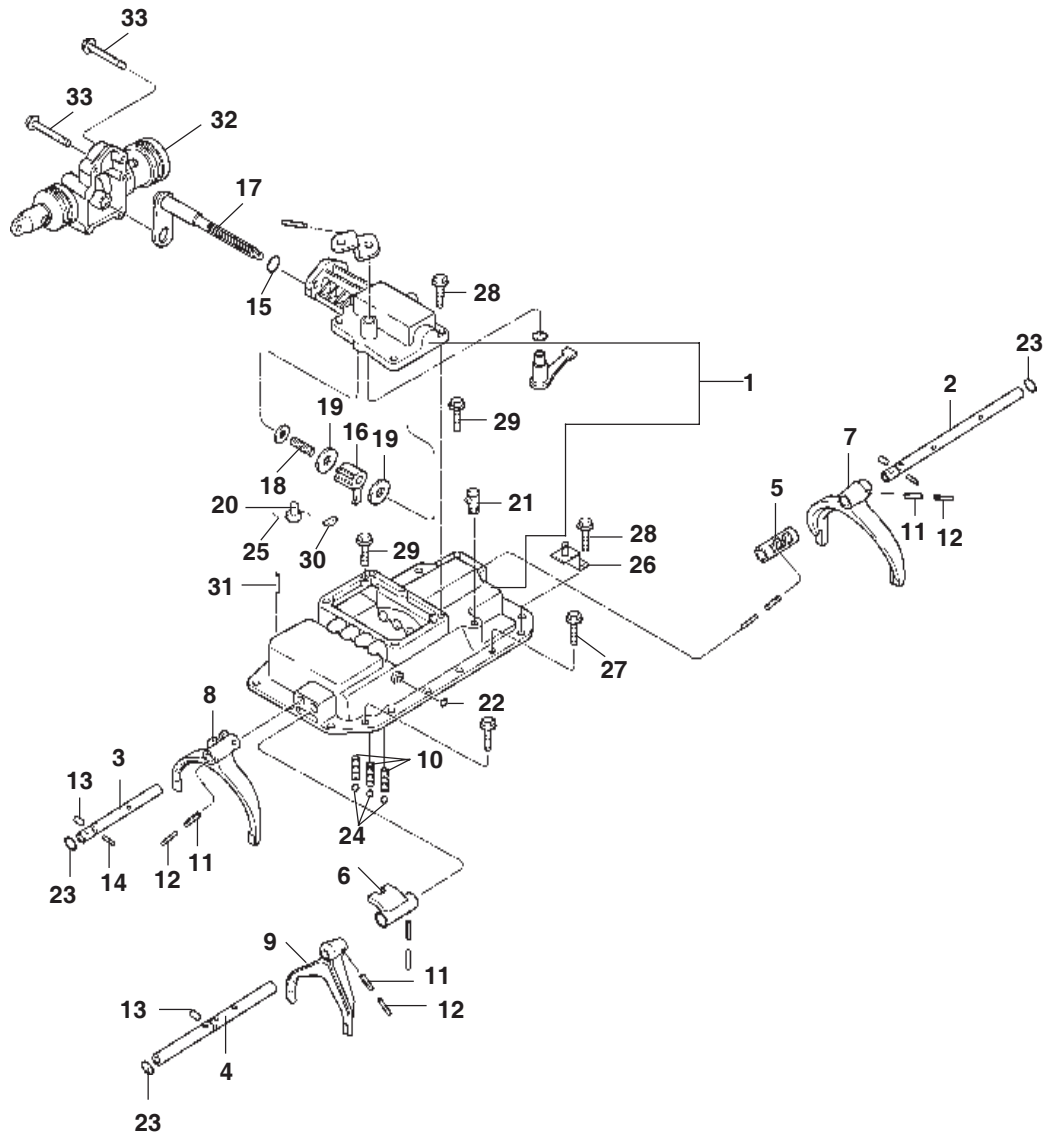


17. Check every gear shift positions.



Gear Shift Housing

COMPONENTS



- | | | |
|------------------------------|---------------------------|-------------------------|
| 1. Transmission case cover | 13. Lockout plunger | 25. Wire |
| 2. 1st & reverse shift shaft | 14. Pin | 26. Shift lever |
| 3. 2nd & 3rd shift shaft | 15. Oil seal | 27. Oil flange bolt |
| 4. 4th & 5th shift shaft | 16. Inner shift lever | 28. Oil flange bolt |
| 5. 1st & reverse shift head | 17. Shift lever sub Ass'y | 29. Bolt |
| 6. 4th & 5th shift head | 18. Compression spring | 30. Key |
| 7. 1st & reverse shift fork | 19. Spacer | 31. Dowel pin |
| 8. 2nd & 3rd shift fork | 20. Screw set | 32. Power gear assembly |
| 9. 4th & 5th shift fork | 21. Air bleeder | 33. Bolt |
| 10. Compression spring | 22. Expansion plug | |
| 11. Pin | 23. Expansion plug | |
| 12. Spring pin | 24. Steel ball | |

SERVICE PROCEDURES

TMb-9

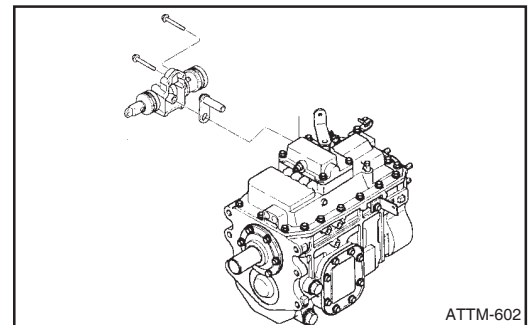
DISASSEMBLY

NOTE

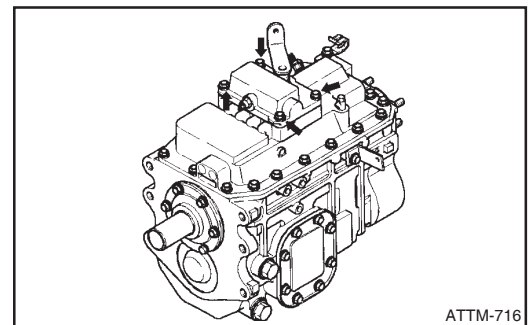
- Move each shift fork to see if any part is worn or abnormally operating. Replace faulty part if any.
- Make sure that no pin and spring is left inside the gear shift housing.

1. Remove air hose connected to power shift assembly.

2. Remove power shift assembly from control cover.



3. Remove control cover from gear shift housing.

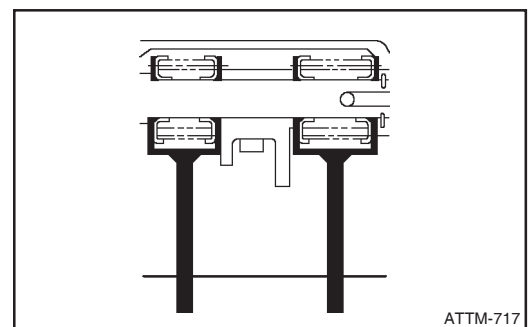


4. After removing spring pin fixed to shift lever, remove shift lever shaft from the control cover.

NOTE

- Take care so that the oil seal is not damaged by shift lever shaft key.

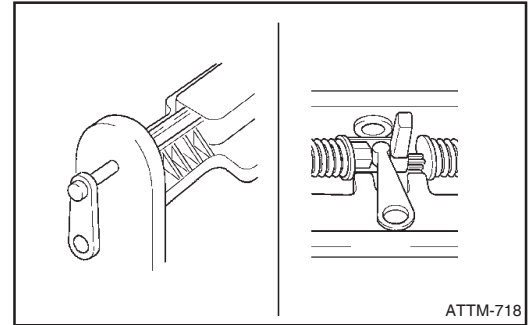
5. Install the spacer and compression spring by using the special tool.



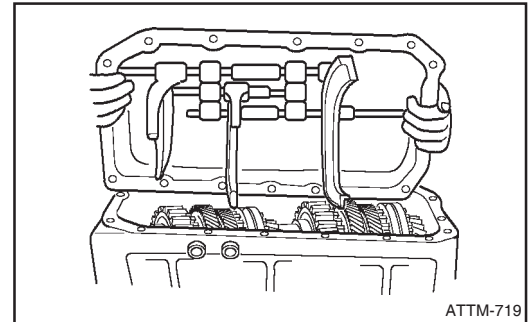
TMb-10

TRANSMISSION (KH10)

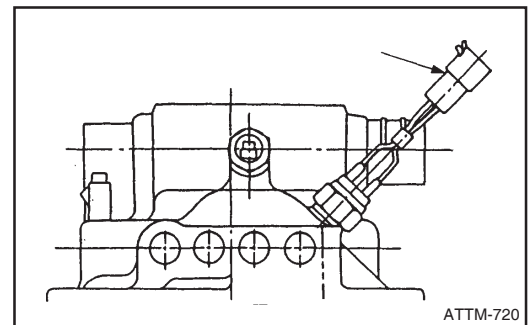
6. Remove selector lever and selection assembly after removing the spring pin fixed to selector lever assembly.



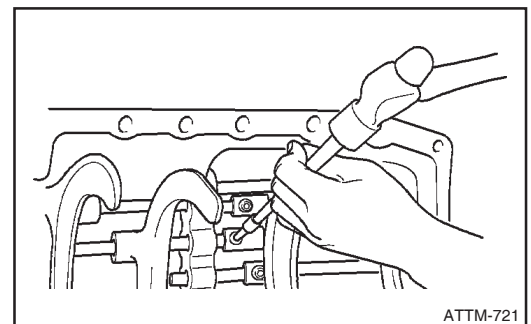
7. Remove compression spring, play washer, O-ring and spacer.



8. Remove gearshift housing fixing bolts.



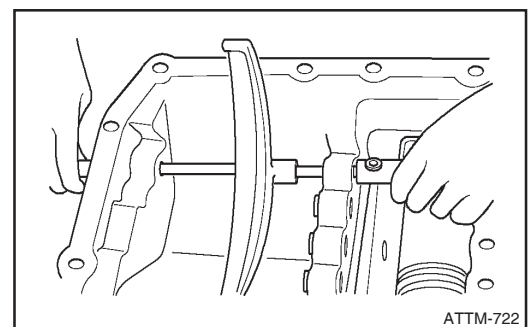
9. Remove the gearshift housing.
10. Remove the back-up lamp switch.
11. Install the transmission case cover to the vise.
12. Remove the shift fork fixing pin and shift head by using tapping rod of diameter 5 mm.



13. Set the shift shaft into the neutral position.
14. Hold a copper rod against the end of the shift shaft and tap the rod lightly to remove the shaft and its expansion plug. When removing the shift shaft, remove the shift head and shift fork.

NOTE

- Take care not to damage the sliding surface of the inside gear shift housing.



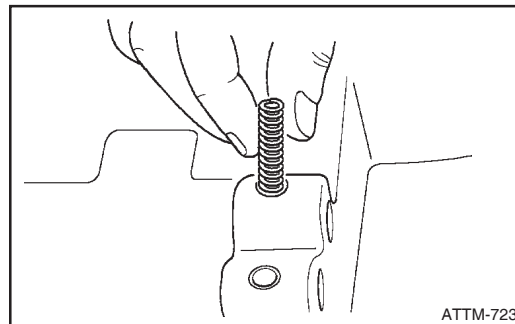
SERVICE PROCEDURES

TMb-11

15. Remove the lock ball and compression spring.

NOTE

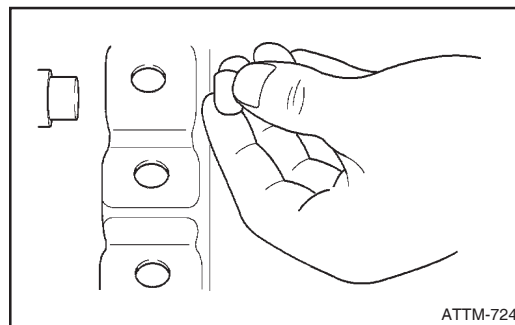
- **Steel ball may pop up from the hole in removal of the shift shaft. Install the safety glass and take care not to lose lock ball and compression spring.**



16. Remove the inter-lock key plunger.

NOTE

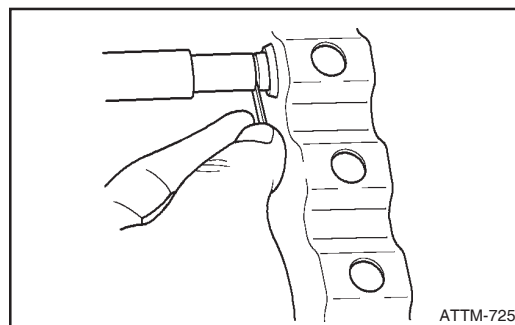
- **Take care not to lose the inter-lock plunger.**



17. Remove the inter-lock pin.

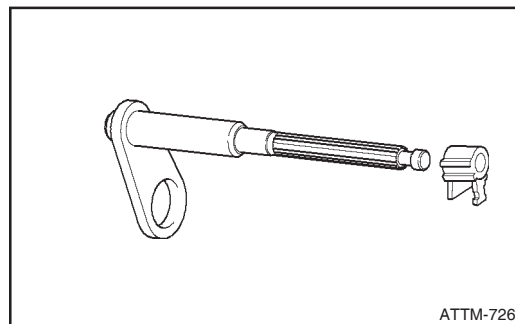
NOTE

- **Take care not to lose inter-lock pin.**
- **Remove the other shift shaft, shift fork and shift head with the same procedure.**



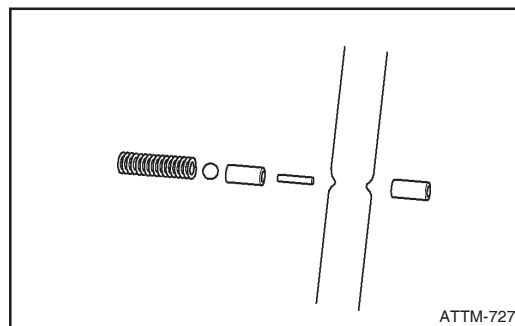
Inspection

1. Check the shift lever shaft and inner shift lever for any damage or worn-out. Replace them if any damage or worn-out.



2. Check any damage or worn-out for the following parts and replace them if any damage is detected.

Inter-lock pin, inter-lock plunger, compression spring, ball



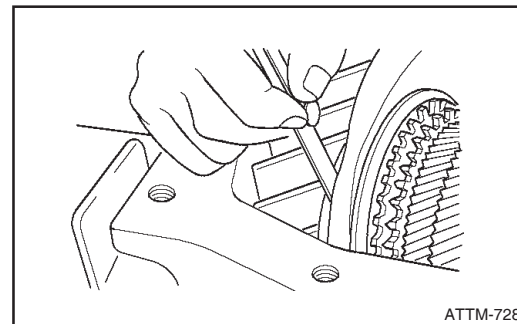
TMb-12

TRANSMISSION (KH10)

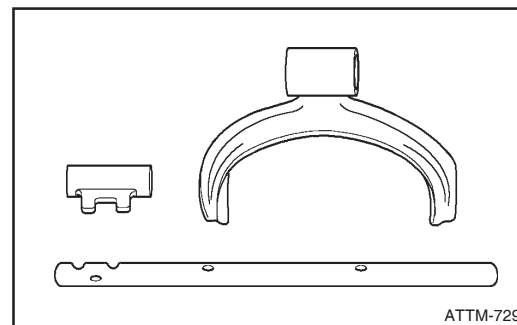
3. Check the clearance between the shift fork and shift sleeve.
4. If the clearance is bigger than the service limit, replace the shift fork or shift sleeve with the new one.

Standard : 0.082 ~ 0.137 mm

Service limit : 1.0 mm



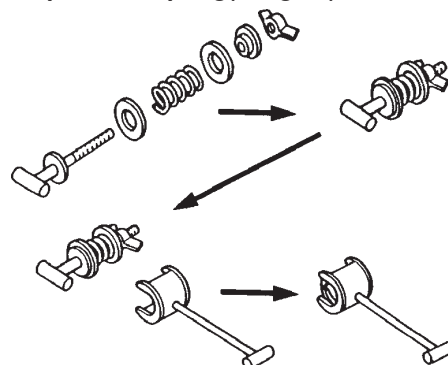
5. Check the shift head, shift fork and shift shaft for the damage and worn-out. Replace the part if any damage or worn-out is detected.



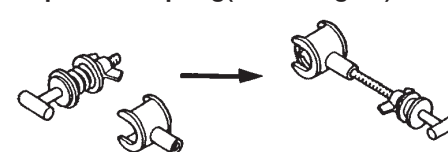
Assembly

1. Fix spacer, shift lever and shaft compression spring, and compress them by using special tool.
2. Align the key groove of spacers with the special tool. (Reverse side)
3. Assemble the key into key groove of shift shaft.
4. Clean the control cover and apply the grease lightly on the sliding surface inside control cover.

Compression spring(5th gear)

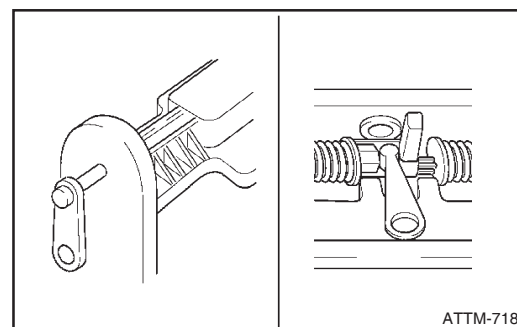


Compression spring(Reverse gear)



ATTM-730

5. Apply gear oil lightly on the gear shift lever shaft, and insert the shaft into control cover. When the end of shift lever shaft is inserted fully into the control cover, perform next operation.



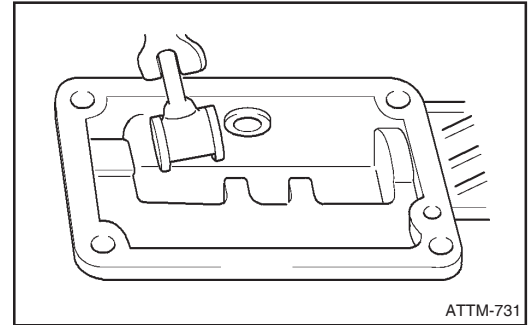
SERVICE PROCEDURES

TMb-13

6. Assemble the compression spring and spacers. (Reverse side)

NOTE

- Assemble the spring and spacer while holding them securely with the special tool (09703-1030).

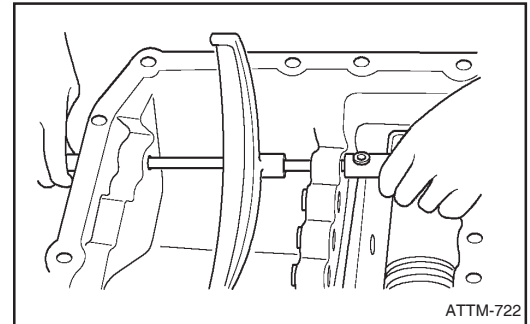


7. Assemble the inner shaft lever.
8. Assemble the compression spring and spacer (5th side)

NOTE

- Assemble the spring and spacer while holding them securely with the special tool (09703-1010).

9. Install selection, O-ring, inner shift lever to control cover.
10. Install power shift assembly onto the control cover.
11. Apply the gear oil on shift shaft.



12. Align the shift fork and head and push to insert shift shaft.

NOTE

- Pay attention to the direction and position of shift fork and shift head.
- Refer to the diagram below for the relative position of component parts.
- Assemble the shift shaft, fork and head with the following procedures.

A : 5th ~ 6th shift fork

B : 2nd ~ 3rd shift fork

C : 1st ~ reverse shift fork

E : steel ball shift fork

F : compression spring

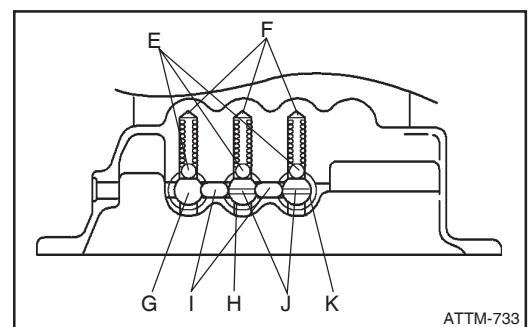
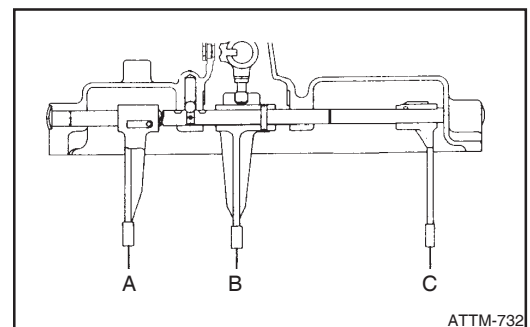
G : 4th ~ 5th shift shaft

H : 2nd ~ 3rd shift shaft

I : inter-lock plunger

J : inter-lock pin

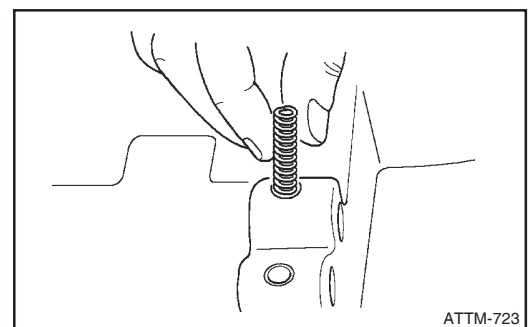
K : 1st ~ reverse shift shaft



13. Install ball and spring into the hole.
14. Depress the spring and ball by using the special tool and slide shift shaft over the ball.

NOTE

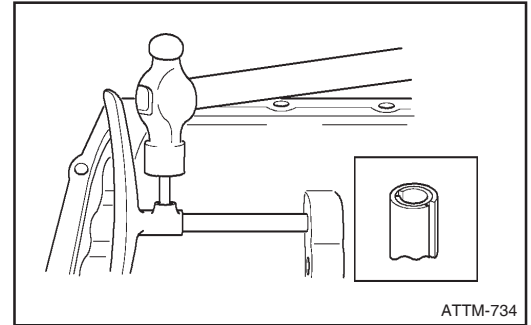
- Shift shaft must be in the neutral position.



TMb-14

TRANSMISSION (KH10)

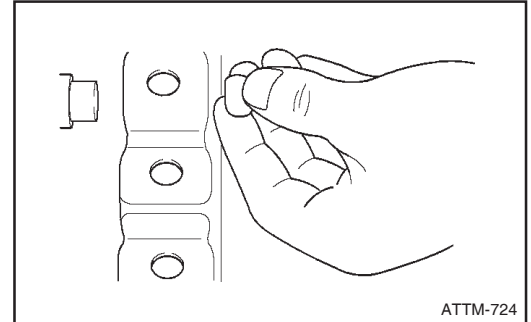
15. Fix the shift head and fork with cotter pins. Use 2 pins. Drive both the large and the small pin into the fork and the head with their slits positioned on opposite side.



16. Install the inter-lock plunger.

NOTE

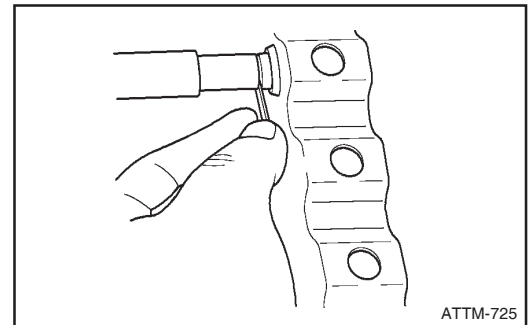
- Do not forget to install the inter-lock plunger.



17. Install the inter lock pin.

NOTE

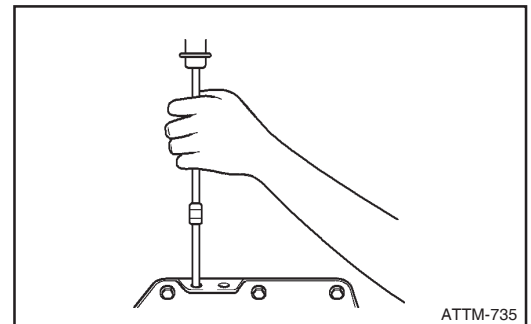
- Apply grease to the inter-lock pins and insert pins to the shift shaft of 1st – 2nd and 3rd – 4th



18. Install the expansion plugs in the shift shaft openings at each end of the housing.

NOTE

- Apply sealing compound.

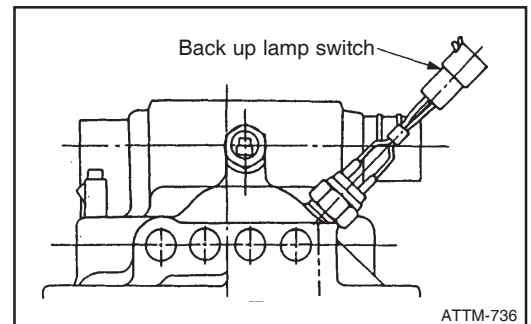


19. Tighten the back-up lamp switch.

Tightening torque : 350 ~ 400 mm

NOTE

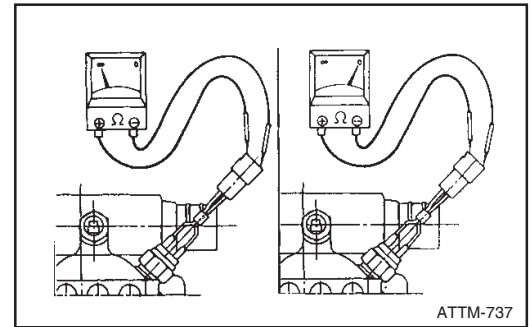
- Apply thread-locking agent.



SERVICE PROCEDURES

TMb-15

20. Using an ohmmeter, check the continuity between the terminals with in the neutral position (infinity) and with the gear shift shaft in the reverse position (0 ohm). If faulty, replace the switch.

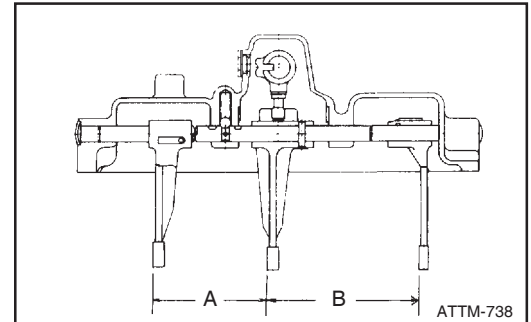


21. Check the relative position and direction of each shift fork and shift head and check the interlock operations.

Distance :

A : $114.9 \pm 0.5\text{mm}$

B : $114.1^{+0.55}_{-0.45}\text{mm}$

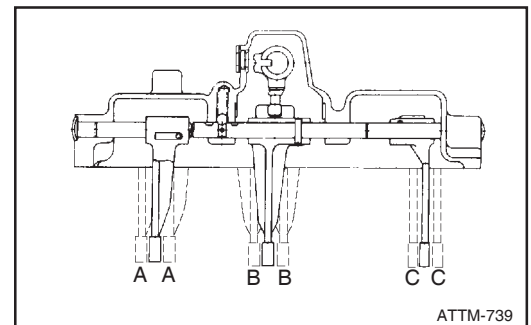


22. Measure the shift stroke.

Shift Stroke :

(4th – 5th) A : 12.5mm

(2nd-3rd, Reverse-1st) B : 12.0mm



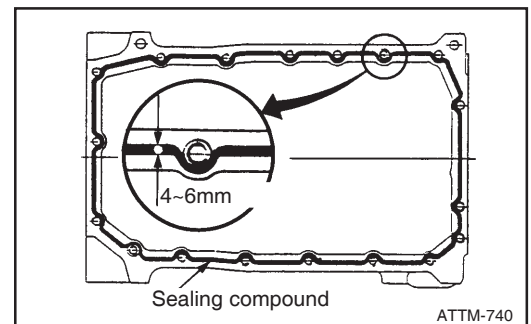
23. Apply a sealing compound to the face of the transmission case.

NOTE

- The trace of the sealing compound should be continuous. The sealing compound should be “THREE BOND #1215” or equivalent.

24. Install the gear shift housing and tighten the bolts using a torque wrench.

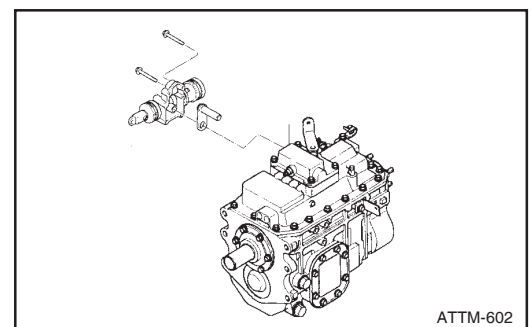
Tightening Torque : 400~500 kg·cm



25. Install the control cover to the gear shift housing.

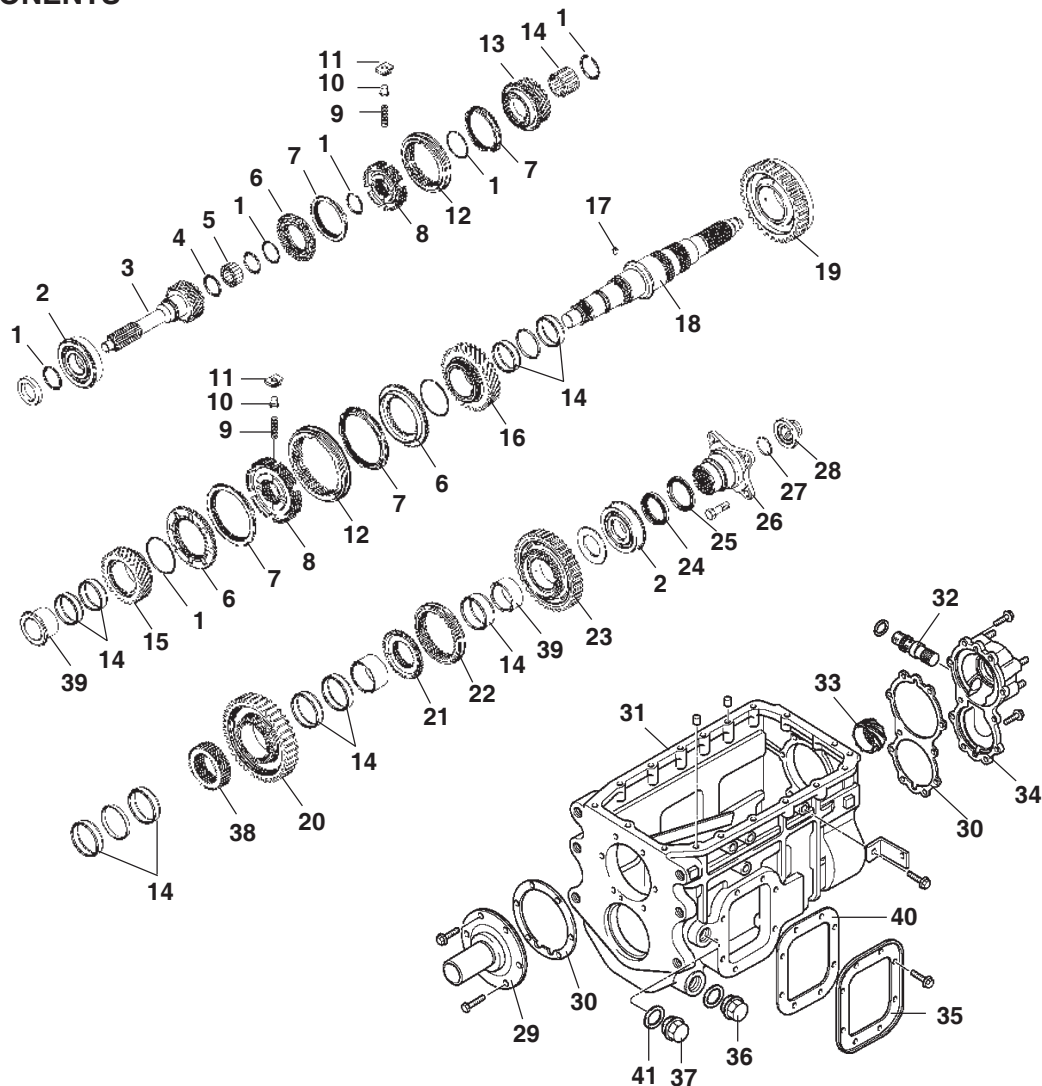
Tightening Torque : 400~500 kg·cm

26. Install the power gear assembly to the control cover.



Input And Output Shaft, Gears

COMPONENTS



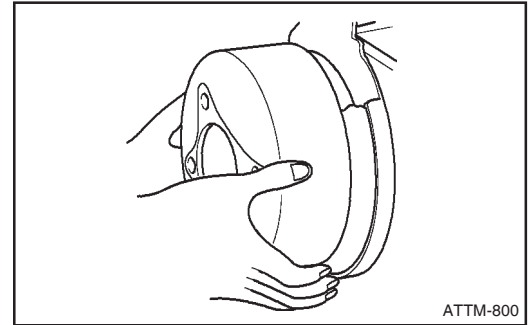
- | | | |
|---------------------------|-------------------------------------|------------------------------|
| 1. Retainer ring | 15. 4th gear | 29. Bearing retainer(front) |
| 2. Cylindrical bearing | 16. 3rd gear | 30. Retainer gasket |
| 3. Input shaft | 17. Pin | 31. Transmission case |
| 4. Spacer | 18. Output shaft | 32. Speed gear bush |
| 5. Roller bearing | 19. 2nd gear | 33. Speed drive gear |
| 6. Synchronizer cone | 20. 1st gear | 34. Bearing retainer(rear) |
| 7. Synchronizer ring | 21. Constant hub | 35. P.T.O cover |
| 8. Synchronizer hub | 22. 1st gear, reverse clutch sleeve | 36. plug |
| 9. Compression spring | 23. Reverse gear | 37. Magnetic plug |
| 10. Synchronizer head | 24. Oil seal | 38. 1st, 2nd gear clutch hub |
| 11. Synchronizer key | 25. Dust deflector | 39. Bushing |
| 12. Synchronizer sleeve | 26. Universal joint flange | 40. Gasket |
| 13. Synchronizer cone | 27. O-ring | 41. Soft washer |
| 14. Needle roller bearing | 28. Nut | |

SERVICE PROCEDURES

TMb-17

DISASSEMBLY

1. Remove the drum fixing nuts.
2. Remove the drum

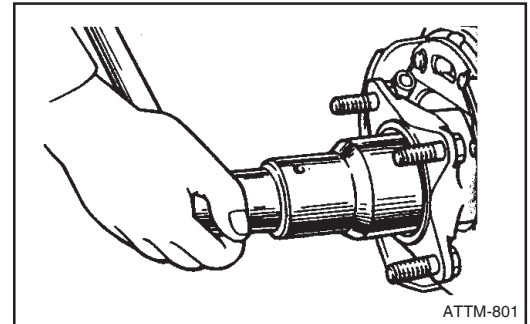


3. Lift the caulked part of lock nut completely out of the shaft groove.
4. Using a special tool, remove the lock nut.

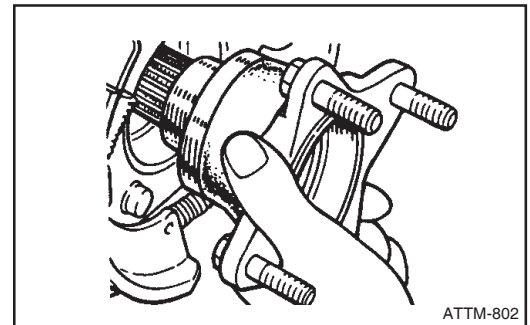
NOTE

- Before loosening the lock nut, engage two gears so that the output shaft cannot be turned.

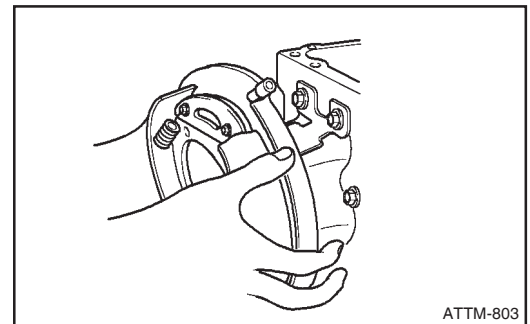
Special tool : Socket wrench (09839-4601)



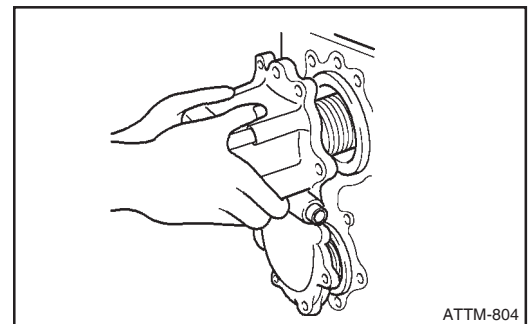
5. Remove the joint flange.



6. Remove the parking brake assembly bolts.
7. Remove the parking brake assembly.



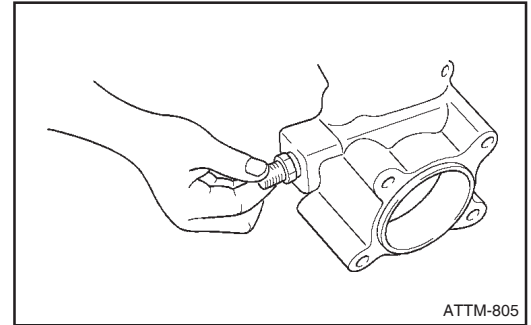
8. Remove the rear-bearing retainer.
 - 1) Remove assembly bolt of bearing retainer.
 - 2) Remove bearing retainer.



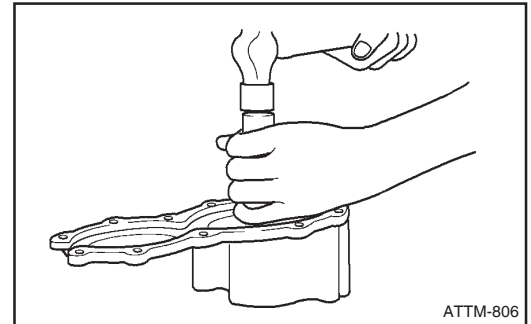
TMb-18

TRANSMISSION (KH10)

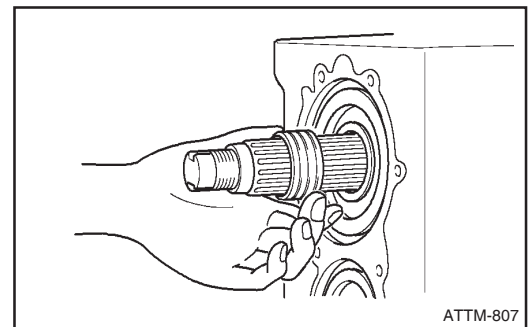
9. Remove the speedometer driven gear.
- 1) Remove bushing setting bolts of driven gear.
 - 2) Remove the driven gear as the removal of bushing.



10. Remove oil seals.



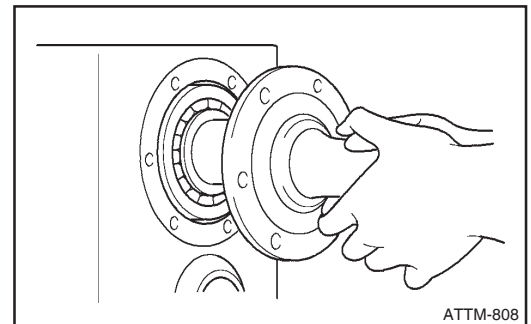
11. Remove the speedometer drive gear.



12. Remove the fixing bolts.
13. Remove the front bearing retainer.

NOTE

- Oil seal is attached inside the front bearing retainer. Cover (e.g. with aluminum foil) the spline of the input shaft so as not to damage the lip of the oil seal when removing retainer.

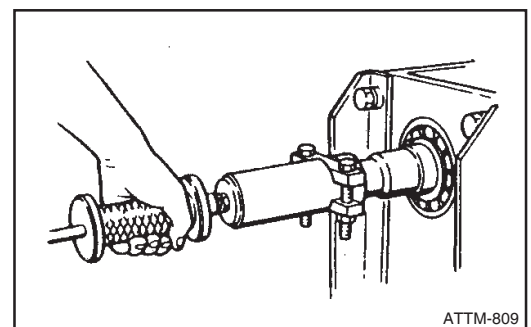


14. Using special tool, remove the input shaft together with bearing.

Special tool :

Input shaft pulley (09650-2070)

Sliding Hammer (09420-1442)



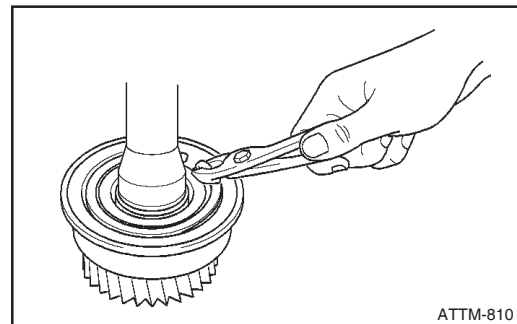
SERVICE PROCEDURES

TMb-19

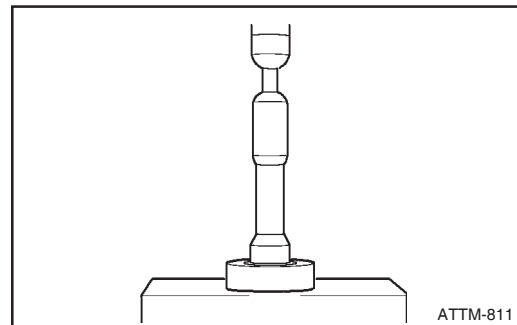
15. Using retainer ring flyer, remove the retainer ring from the input shaft.

NOTE

- Be careful with the retainer ring that may pop up while removal.



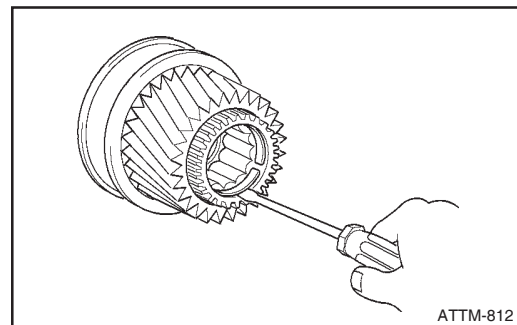
16. Using a press, remove the cylindrical bearing.



17. Using a screwdriver, remove the retainer ring from the groove of the input shaft, and then remove the roller bearing from the input shaft.

NOTE

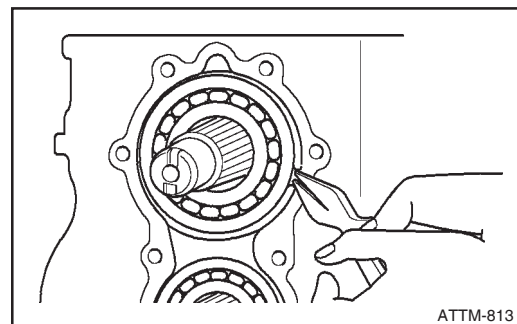
- Be careful with the retainer ring that may pop up while removal.



18. Remove the retainer ring from the output shaft rear bearing.

NOTE

- Be careful with the retainer ring that may pop up while removal.



19. Install the special tool to the bearing.

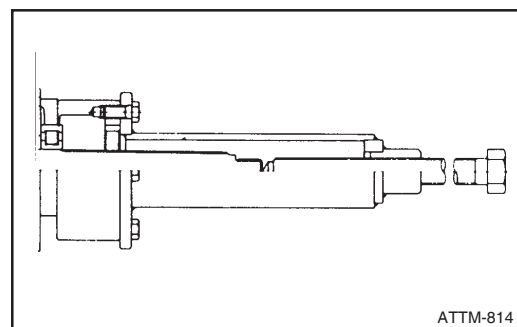
Special tool :

Hook (096530-1190)

Puller (09650 – 1880)

NOTE

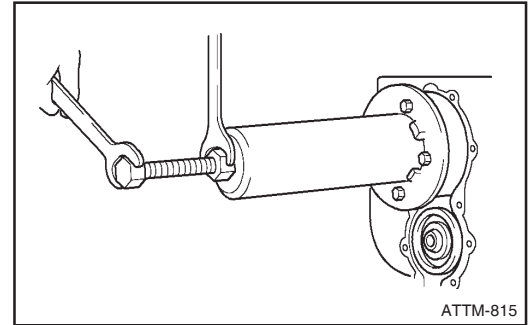
- Insert the hook's click into the groove for the retainer ring, and then fix the puller to the hook with bolts so that bearing does not turn. Then rotate the bolt to pull the bearing out.



TMb-20

TRANSMISSION (KH10)

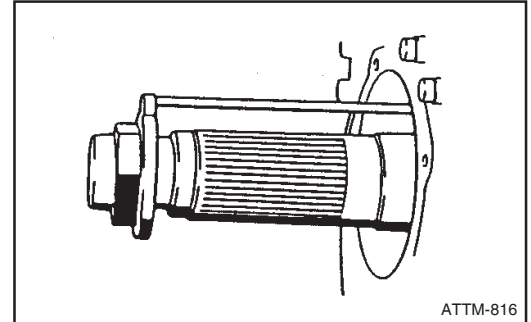
20. Remove the rear bearing.



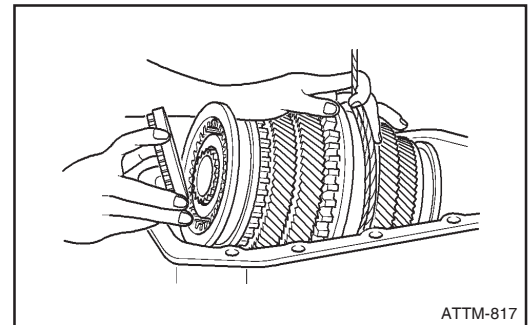
21. Attach a jig to the end of the output shaft.

NOTE

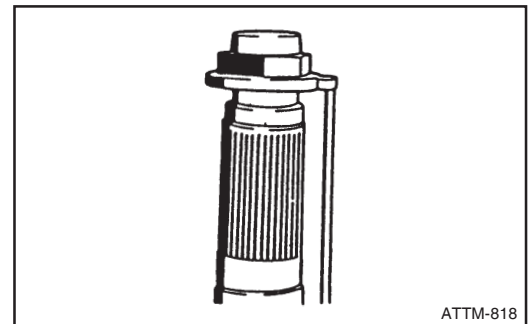
- If the output shaft assembly is removed from the transmission without jig, the reverse gear will drop from the shaft and possibly result in personal injury.



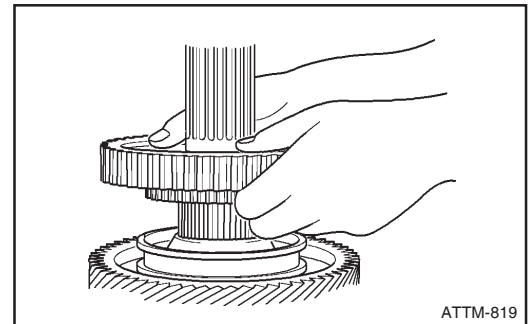
22. Remove the output shaft assembly from the transmission case. When removing output shaft assembly, remove the synchronizer ring and the cone of the input shaft gear.



23. Remove the jig from the end of output shaft.



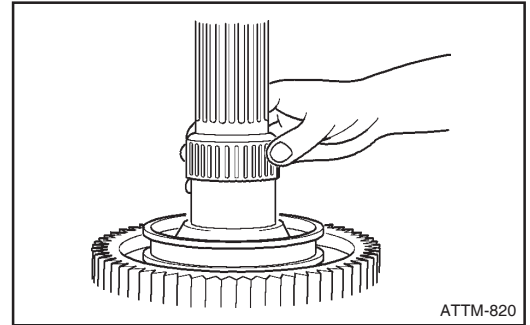
24. Remove the reverse gear.



SERVICE PROCEDURES

TMb-21

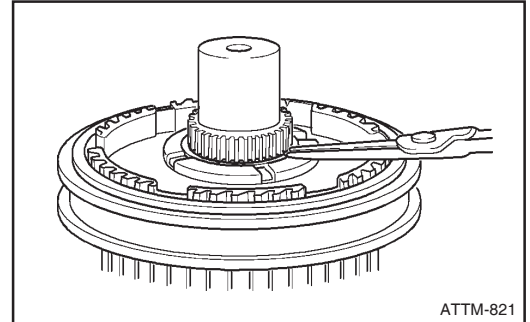
25. Remove the reverse gear needle roller bearing.



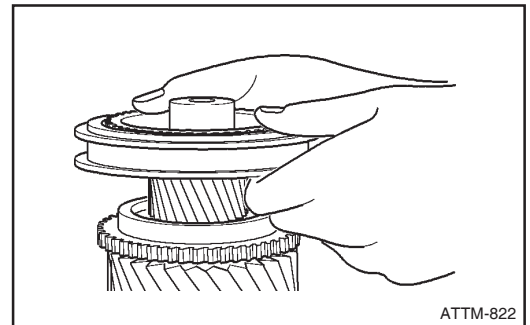
26. Remove the retainer ring at the front face of output shaft.

NOTE

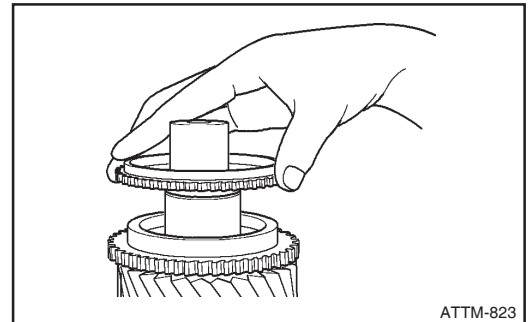
- Be careful with the retainer ring that may pop up while removal.



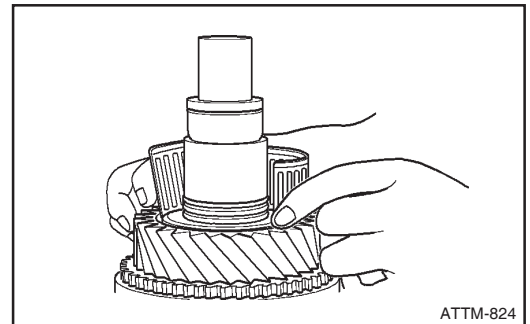
27. Remove the 4th – 5th synchronizer unit.



28. Remove the synchronizer cone.



29. Remove the needle roller bearing.



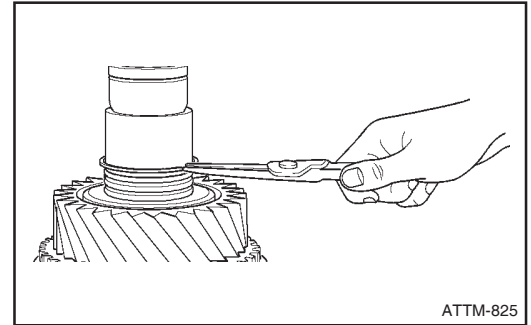
TMb-22

TRANSMISSION (KH10)

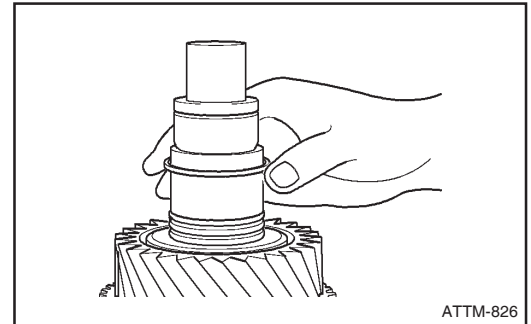
30. Remove the retainer ring that fixes the 4th gear bushing to the output shaft.

NOTE

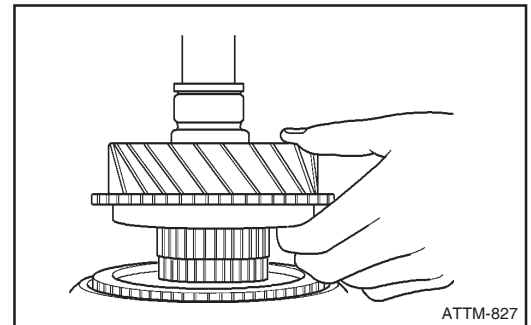
- **Be careful with the retainer ring that may pop up while removal.**



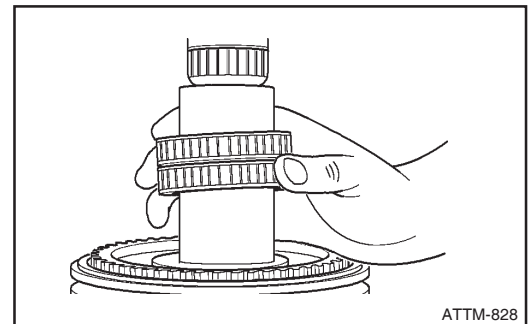
31. Remove the 4th gear housing.



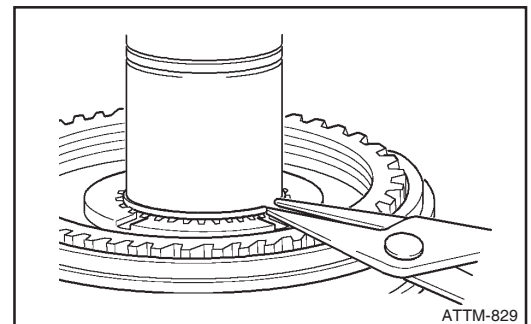
32. Remove the 4th gear.



33. Remove the 4th gear needle roller bearing.



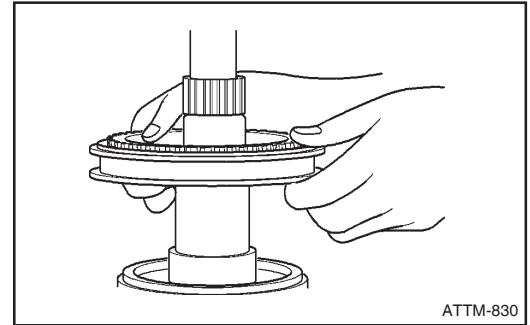
34. Remove the pin.



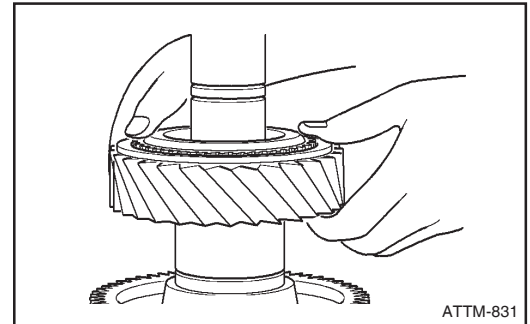
SERVICE PROCEDURES

TMb-23

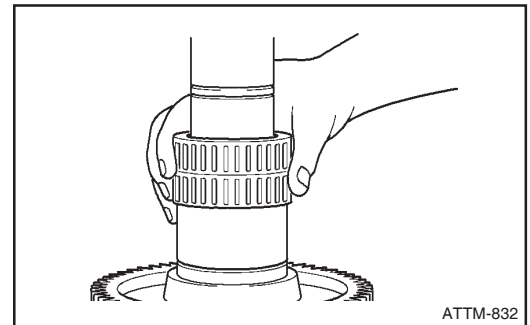
35. Remove the 3rd – 4th synchronizer unit.



36. Remove the 3rd gear together with synchronizer ring.



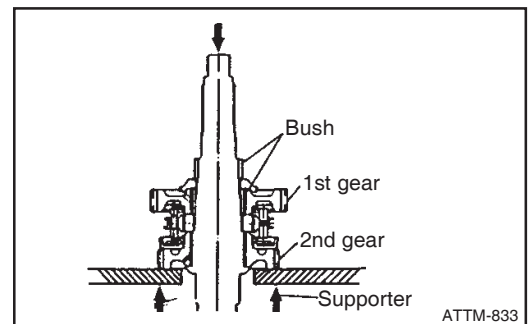
37. Remove the 3rd gear needle roller bearing and spacer.



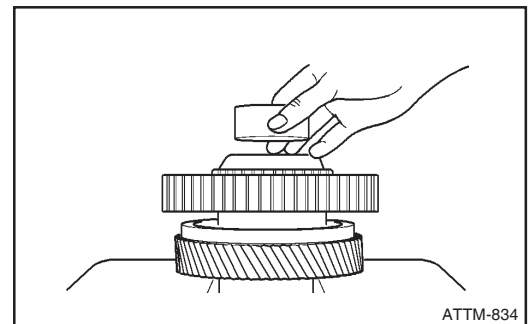
38. Press the main shaft rear end through the bushing and gears by supporting the assembly on front face of the 2nd gear.

NOTE

- Stay away from the shaft. The shaft may drop suddenly resulting in personal injury



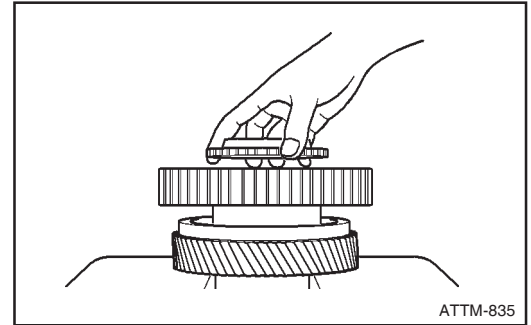
39. Remove the reverse gear bushing.



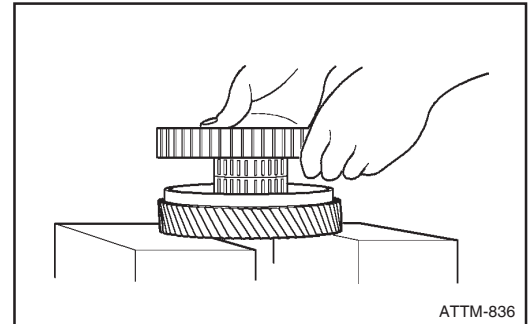
TMb-24

TRANSMISSION (KH10)

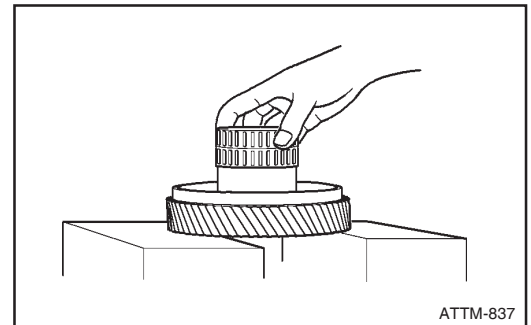
40. Remove the constant hub.



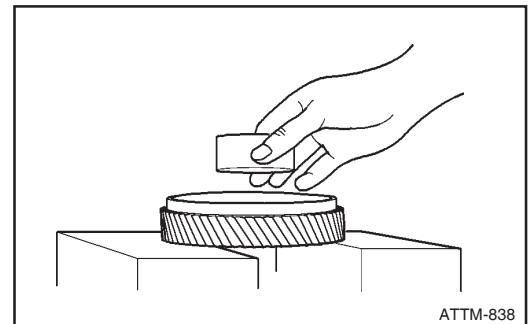
41. Remove the 1st gear.



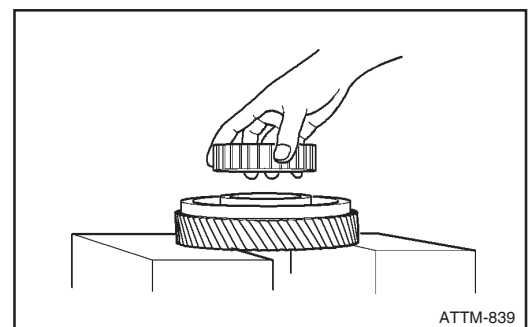
42. Remove the 1st needle roller bearing.



43. Remove the 1st gear bushing.



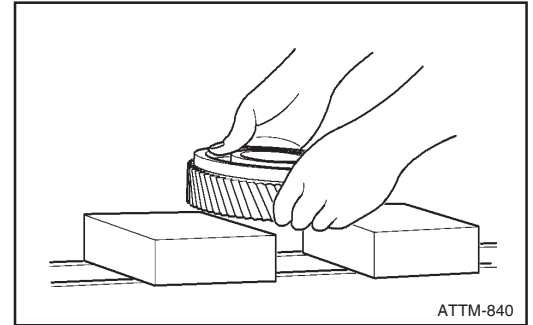
44. Remove the constant hub.



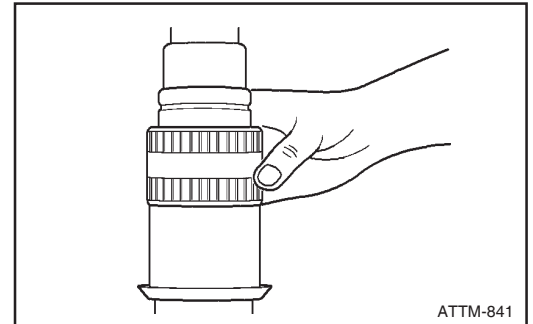
SERVICE PROCEDURES

TMb-25

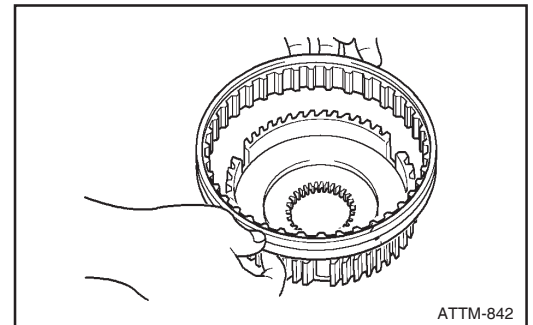
45. Remove the 2nd gear.



46. Remove the 2nd gear needle roller bearing and spacer.



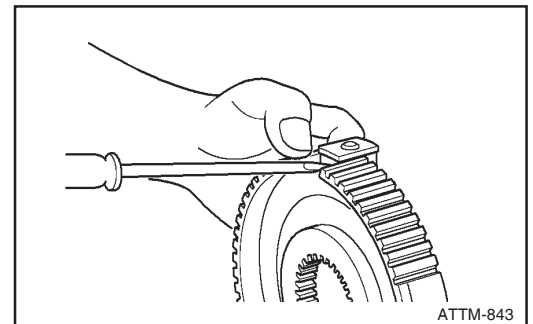
47. Remove the sleeves.



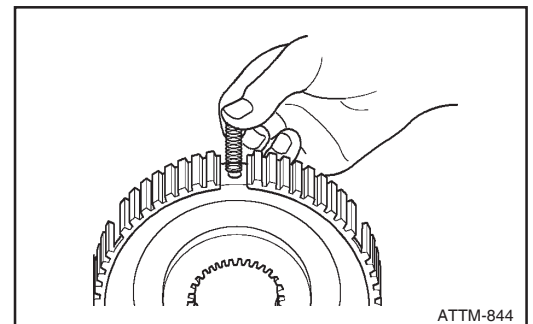
48. Remove the synchronizer key and head.

NOTE

- Be careful with the spring that may pop up while removal.



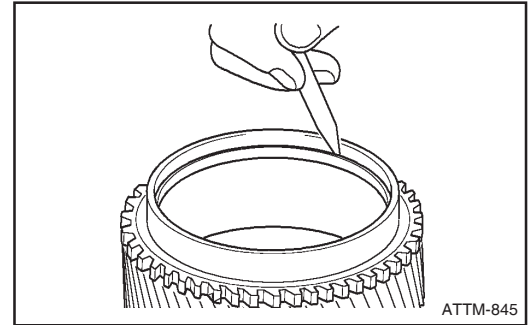
49. Remove the compression spring.



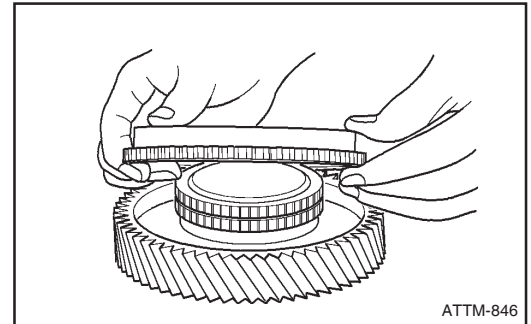
50. Remove the retainer that fixes the synchronizer ring to gear (3rd, 4th gear)

NOTE

- Be careful with retainer ring that may pop up in removal.



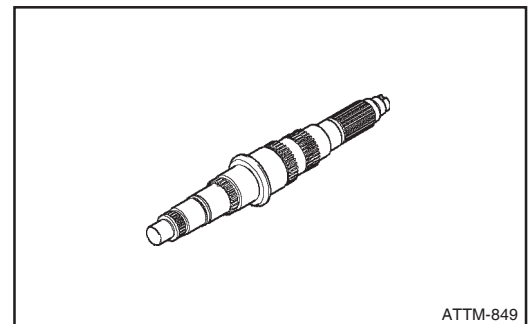
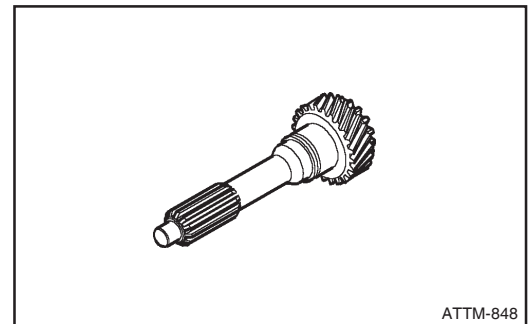
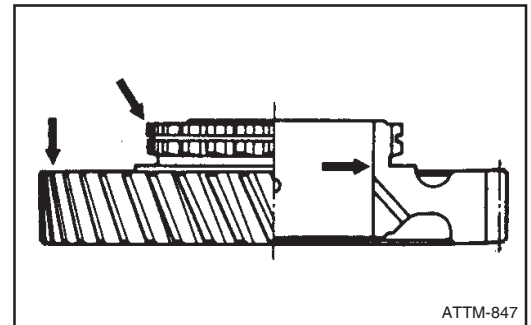
51. Remove the synchronizer cone from the gear.



Inspection

Gear and shaft inspection

1. Inspect crack and defect of every gear, and replace it if any defect is found.
2. Inspect damage and worn-out of input shaft and replace it if any defect is found.
3. Inspect damage and worn-out of output shaft and replace it if any defect is found

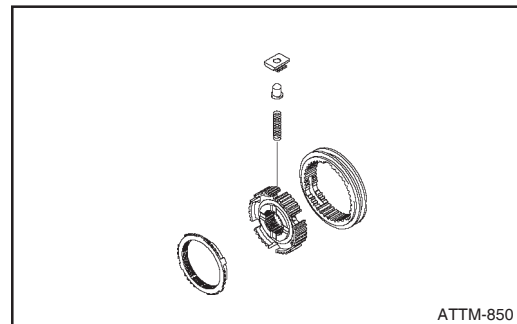


SERVICE PROCEDURES

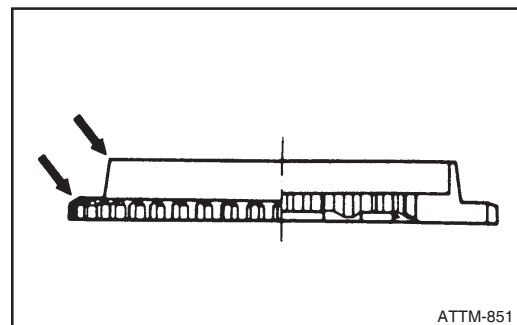
TMb-27

Synchronizer unit inspection

1. Inspect any damage or worn-out of assembling parts of synchronizer unit. If any damage is found, replace the assembling part.



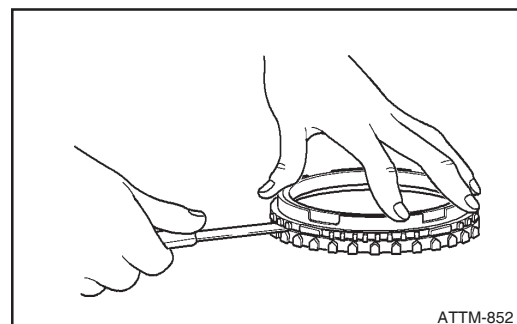
2. Inspect any damage or worn-out of the slanted parts and synchronizer cone gear. And replace it if any damage is found.



3. Measure the clearance between synchronizer ring and the slanted part of synchronizer cone. If the measured clearance lies within the service limit, replace the synchronizer ring and cone.

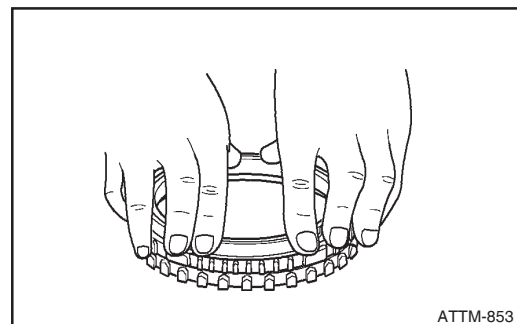
Assembly standard : 1.2 ~ 1.8 mm

Maintenance criteria : 0.2 mm



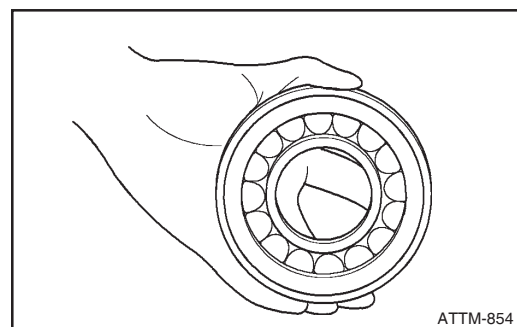
4. Inspect the contact between synchronizer ring and slanted part of synchronizer cone. If the contact area is less than 90%, replace the synchronizer ring and cone.

Total contact : more than 90%

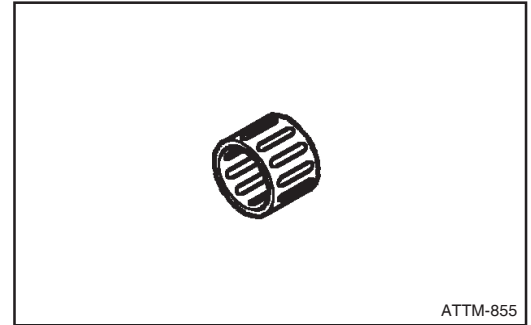


Bearing inspection

1. Inspect any damage or worn-out of cylindrical bearing, and replace if any defect is found.

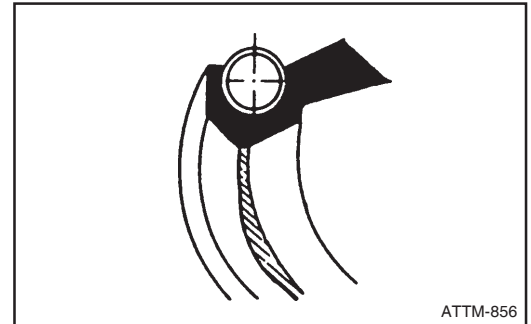


2. Check the needle bearing for any damage or worn-out. If any defect is found, replace the bearing.



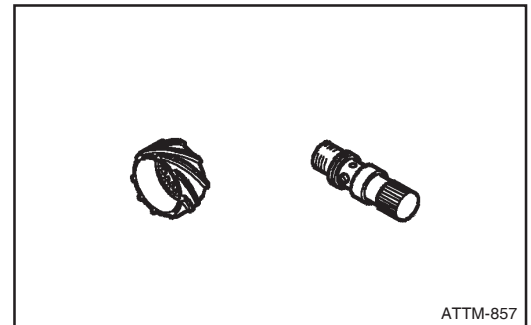
Oil seal inspection

Check the oil seal for any damage or worn-out. If any defect is found, replace the oil seal.



Speedometer gear inspection

Check speedometer drive gear and driven gear. If any damage or worn-out is found, replace it.

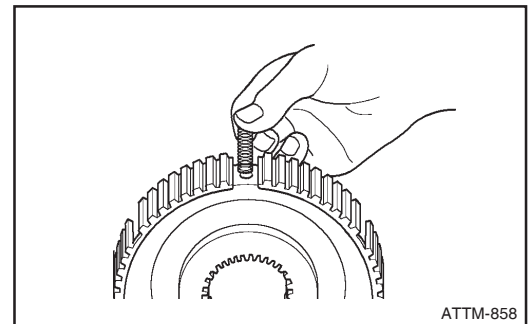


Assembly

1. Install compression spring.

NOTE

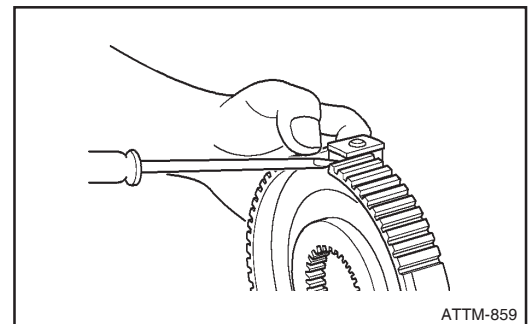
- **Assemble the synchronizer unit.**



2. Install synchronizer key and head.

NOTE

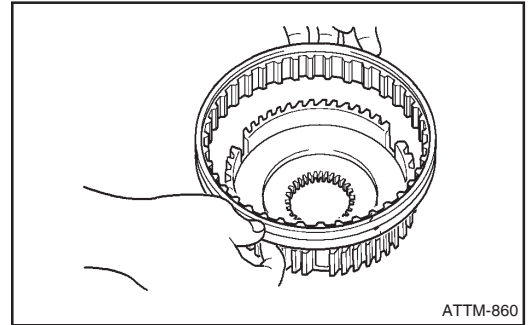
- **Be careful with compression spring that may pop up during the assembly.**



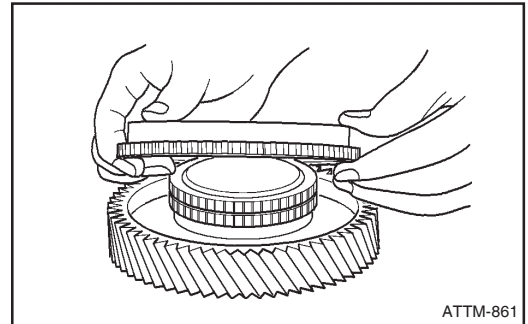
SERVICE PROCEDURES

TMb-29

3. Assemble the synchronizer sleeve.



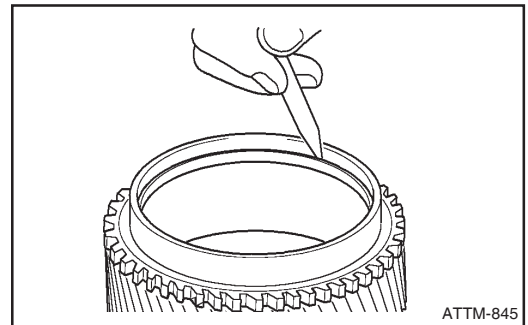
4. Install synchronizer cone on the 3rd and 4th gear.



5. Fix the gear and synchronizer with the retainer ring.

NOTE

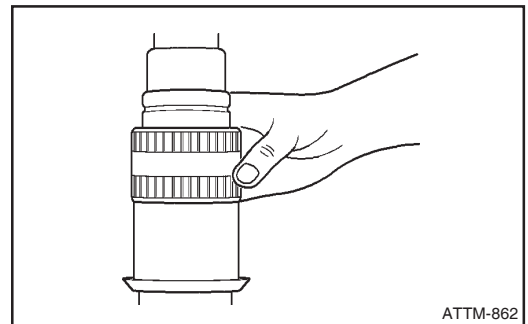
- **Make sure to align the retainer ring to the groove of gear.**
- **Be careful with the retainer ring that may pop out during installation.**



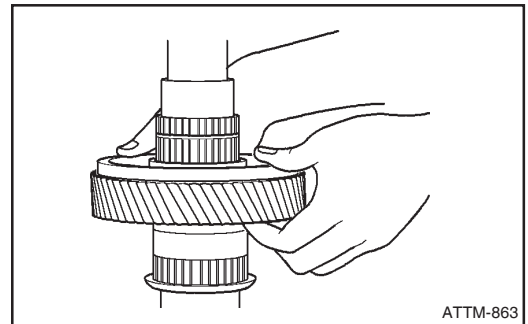
6. Install spacer and 2nd gear needle roller bearing on output shaft.

NOTE

- **Insert the spacer to each bearing.**
- **Apply the gear oil to each needle roller bearing and gear.**



7. Install the 2nd gear.



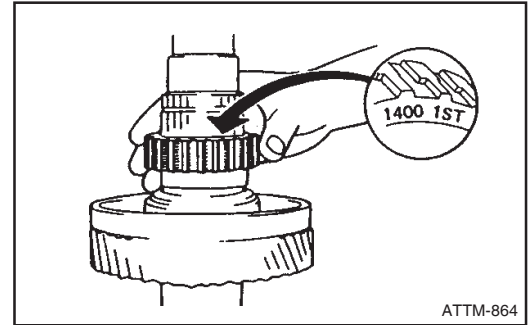
TMb-30

TRANSMISSION (KH10)

8. Assemble the 1st – 2nd synchronizer hub.

NOTE

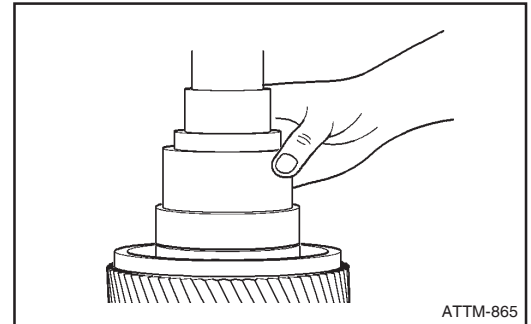
- When assembling hub, place the side with the larger chamfering close to the gear spline face of 1st gear. (Chamfering : 1.5 mm). Besides, numbers are marked at the hub side to prevent the mistake in assembly.



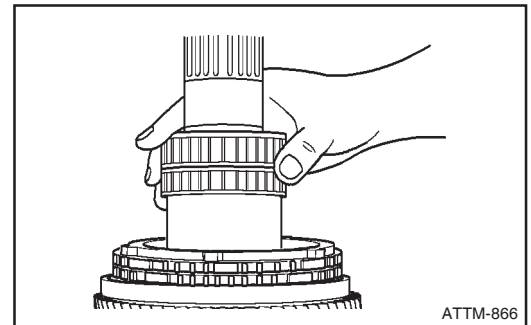
9. Install the 1st gear bushing. Heat the bushing around 85C° with heater and assemble it to the shaft end.

NOTE

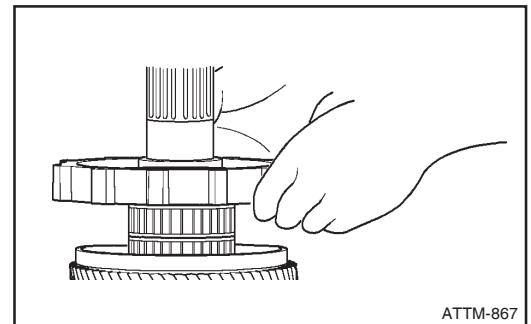
- Do not touch the heated bushing with hands.



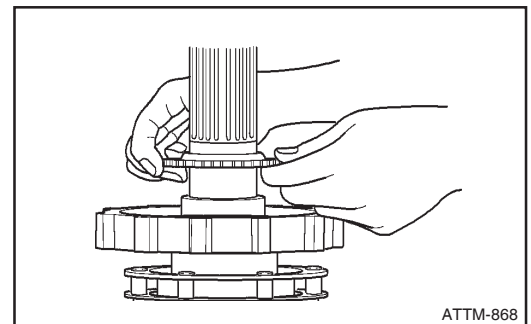
10. Install the needle roller bearing for 1st gear.



11. Install the 1st gear.



12. Install the constant hub.



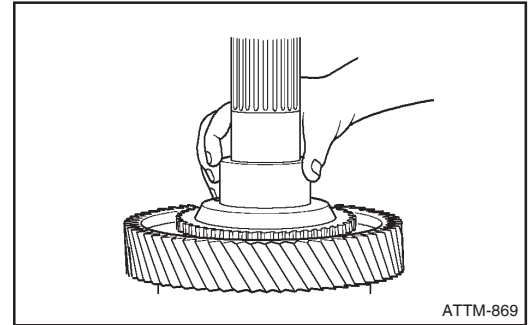
SERVICE PROCEDURES

TMb-31

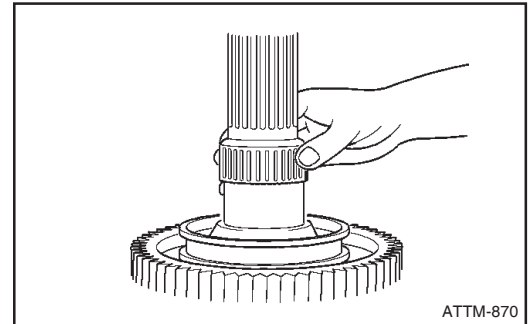
13. Install reverse gear bushing. Heat the bushing around 85 °C with heater and insert it to the output shaft end.

NOTE

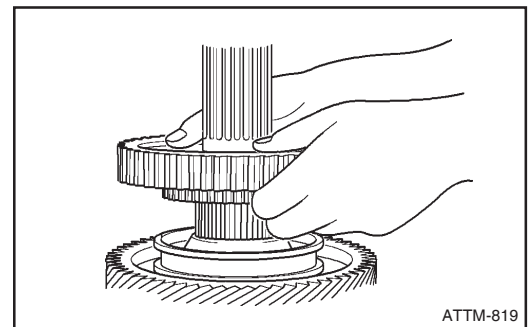
- Do not touch the heated bushing with hands.



14. Install the needle roller bearing for reverse gear.



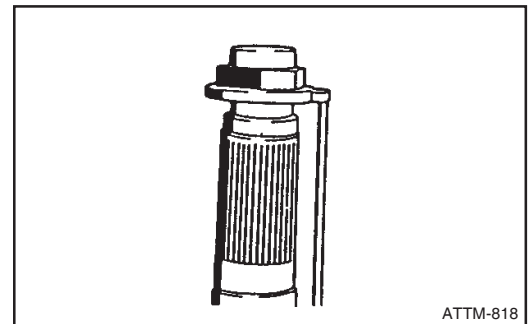
15. Install the reverse gear.



16. Hold the thrust washer with the jig

NOTE

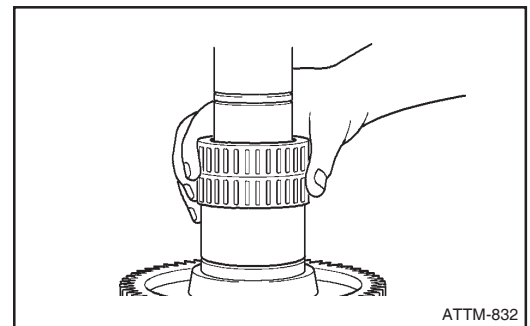
- If output assembly is assembled to transmission without using the jig, reverse gear may drop.



17. Install the needle roller bearing and spacer for 3rd gear.

NOTE

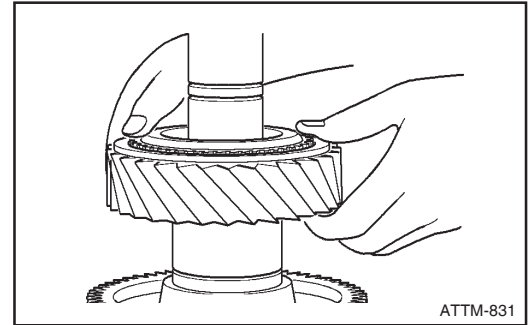
- Place the spacer between 2 bearings.



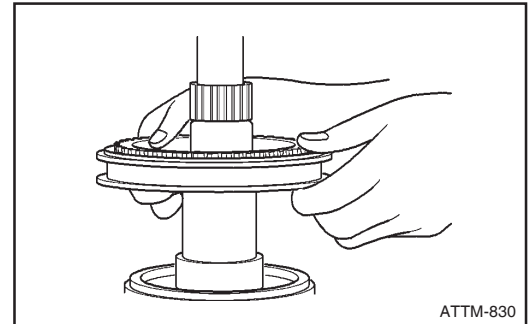
TMb-32

TRANSMISSION (KH10)

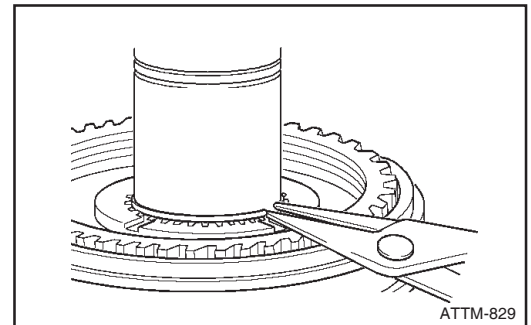
18. Install the 3rd gear.



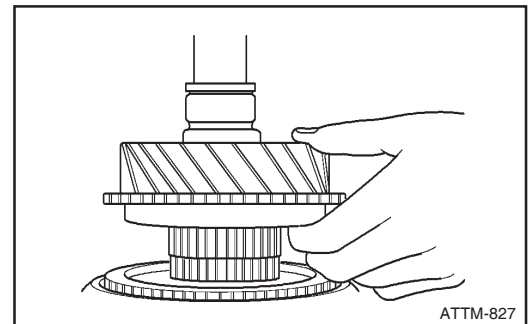
19. Install the synchronizer unit of 3rd – 4th gear.



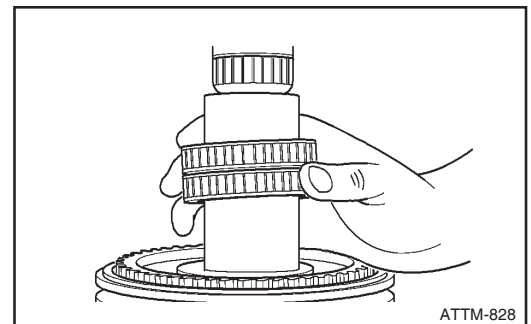
20. Install the pin.



21. Install the 4th gear.



22. Install the needle roller bearing for 4th gear.



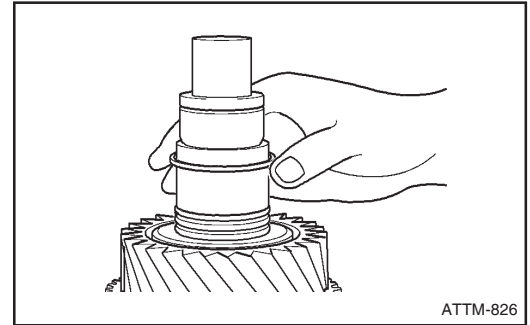
SERVICE PROCEDURES

TMb-33

23. Install the bushing for the 4th gear.

NOTE

- Align the bushing grooves with pin.



24. Install the retainer ring.

- 1) Select the retainer ring.
- 2) Install the retainer ring and make sure to be correctly positioned.

NOTE

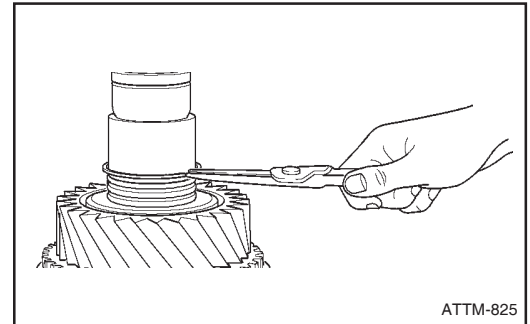
- Be careful with the retainer ring that may pop out during installation.

- 3) Check the clearance.

Assembly standard : 0

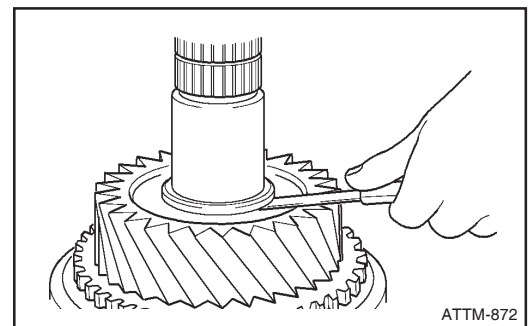
Following types of retainer rings are available.

Thickness	Color
2.35 mm	-
1.45mm	White
2.55 mm	Green
2.65 mm	Brown

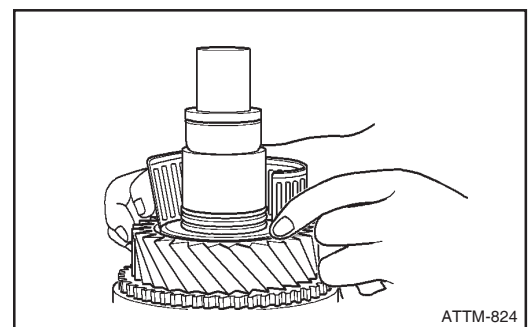


NOTE

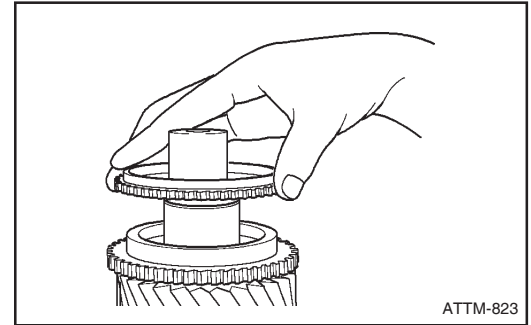
- Use only the new retainer rings.



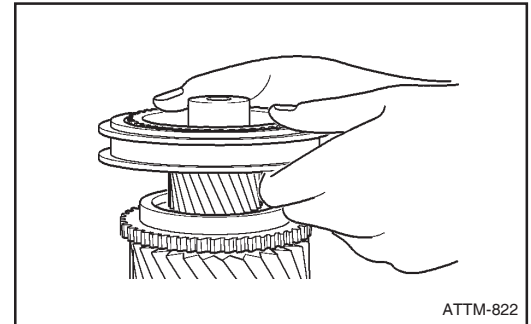
25. Install the gear needle roller bearing.



26. Install the synchronizer cone.



27. Assemble synchronizer unit for 4th – 5th gear.

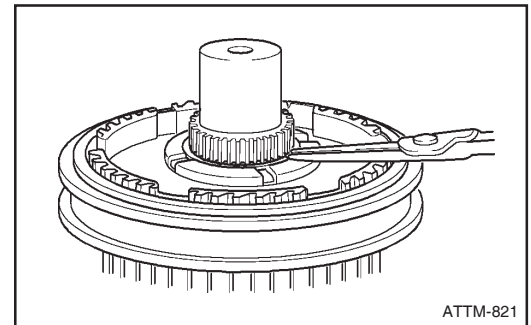


28. Install the retainer ring.

- 1) Select the retainer ring.
- 2) Install the retainer ring and make sure to be correctly positioned.

NOTE

- **Be careful with the retainer ring that may pop out during installation.**



- 3) Check the clearance.

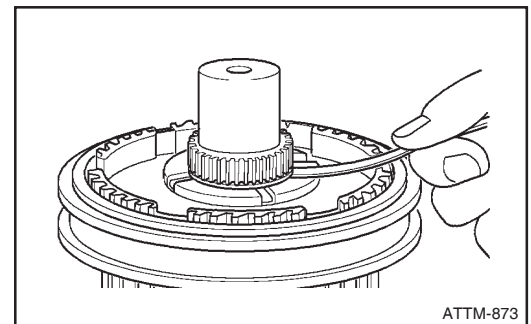
Assembly standard : 0

There are 2 types of retainer rings

Thickness	Color
1.9 mm	-
2.00 mm	White

NOTE

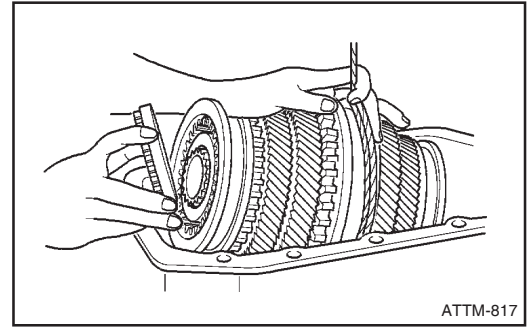
- **Use only the new retainer rings.**



SERVICE PROCEDURES

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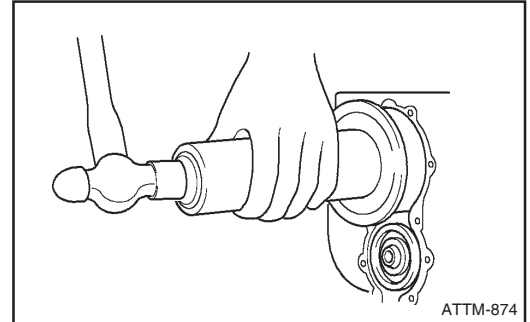
29. Install output shaft assembly to the transmission case. When assembling output shaft, assemble the synchronizer ring and 6th gear cone.



30. Install the retainer ring to the bearing before installing rear bearing.
 31. Insert the bearing after installing the bearing side ring to output shaft.
 32. Apply the gear oil to the outer and inner race.

NOTE

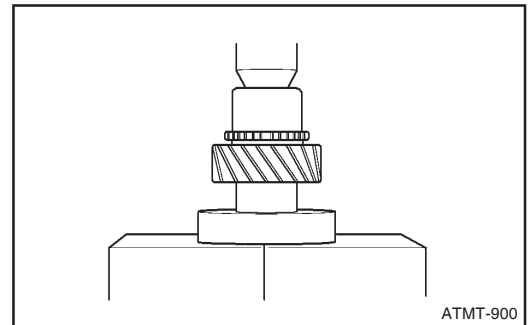
- **Be careful not to damage the inner race surface.**



33. Install the cylindrical bearing by using press.
- 1) Assemble the bearing after installing bearing side ring to input shaft. When installing bearing side ring, place the large chamfered side close to gear.
 - 2) Apply the gear oil to the outer and inner race. Align it with the correct angle and do not apply the pressure to the outer race.

Note

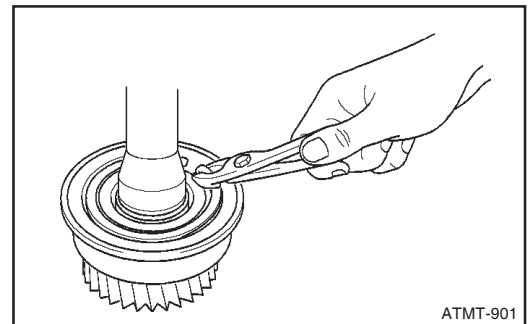
- **Be careful not to damage the inner race surface.**



34. Install the retainer ring.
- 1) Select the retainer ring.
 - 2) Install the retainer ring and make sure to be correctly positioned.

Note

- **Be careful with the retainer ring that may pop out during installation.**



- 3) Check the clearance.

Assembly standard : 0

Following types of retainer rings are available.

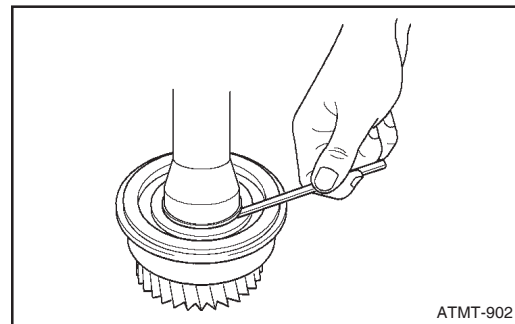
Thickness	Color
2.4mm	-
2.5mm	White
2.6mm	Green
2.7mm	Brown

NOTE

- Use only the new retainer rings.

35. Install the cylindrical bearing.

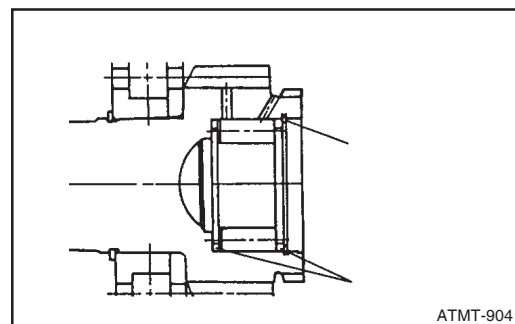
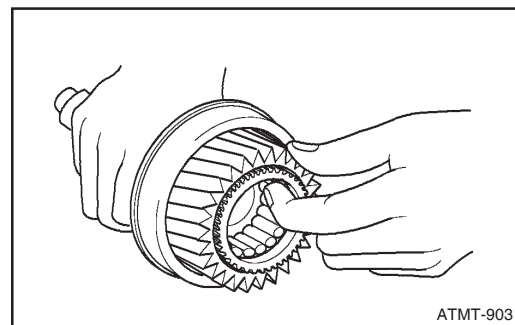
- 1) Apply the gear oil to the bearing.



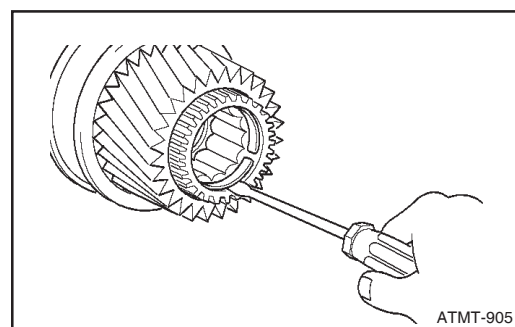
- 2) Install the spacers at both ends of bearing.

NOTE

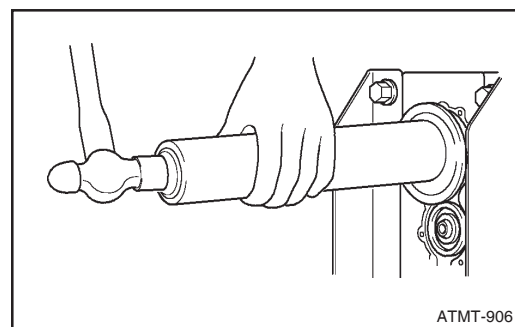
- ? If needed, replace the bearing by unit of set.



36. Be careful with the retainer ring that may pop out during installation



37. Install the input shaft assembly.



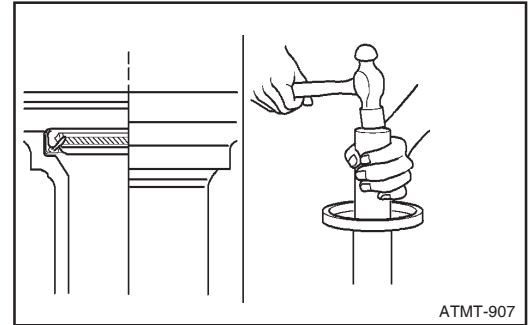
SERVICE PROCEDURES

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38. Install the oil seal.

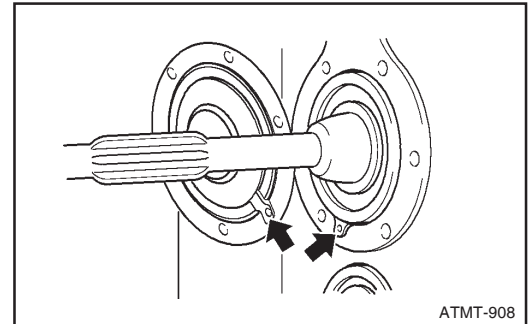
NOTE

- Check whether oil seal is correctly installed.



39. Install the front bearing retainer.

- 1) When installing bearing retainer, align the gasket notch with oil drain hole to assemble the gasket.
- 2) Apply the grease to the oil seal and input shaft.
- 3) Apply the sealer to the both ends of gasket.

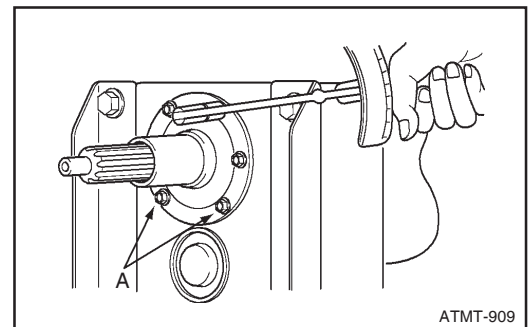


40. Tighten the bolts.

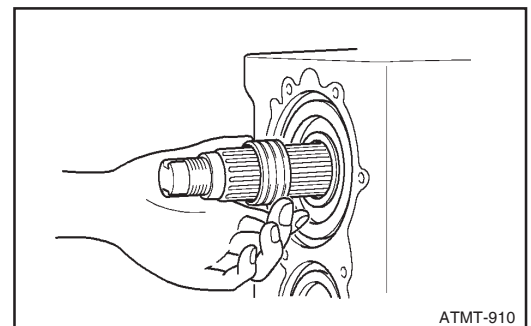
Tightening torque : 380 ~ 500kg.cm

NOTE

- Apply sealing tape or sealer to the bolt thread.
(A : bolt)



41. Install the speedometer drive gear.

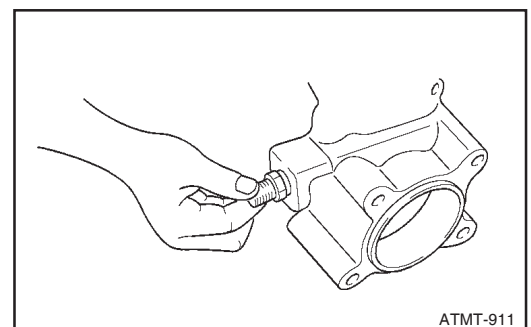


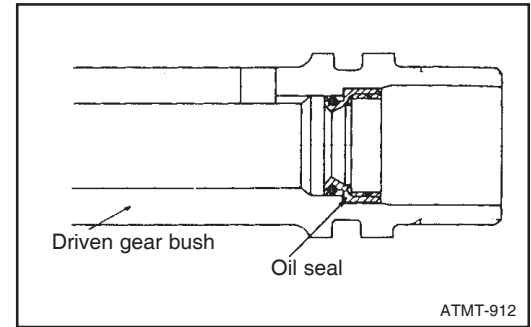
42. Install the speedometer driven gear.

- 1) Apply grease to the O-ring, oil seal and driven gear shaft.
- 2) Assemble driven gear shaft to the bushing.
- 3) Install the speedometer driven gear together with bushing.

Note

- Be careful not to damage of O-ring and seal lip.
- Install the oil seal to its original position.





43. Speed gear set

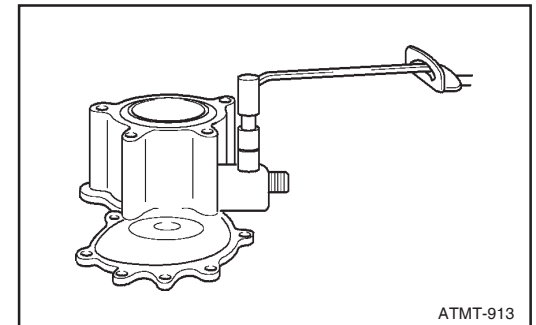
Speed gear set is selected according to the final gear ratio of the car.

Drive gear	Driven gear	Final gear ratio
9	19	4.333
7	15	3.636
	16	3.909
6	15	4.333

44. Tighten the set screw

- 1) Align the speedometer driven gear bushing hole with the hole of the rear bearing retainer
- 2) Tighten the screw.

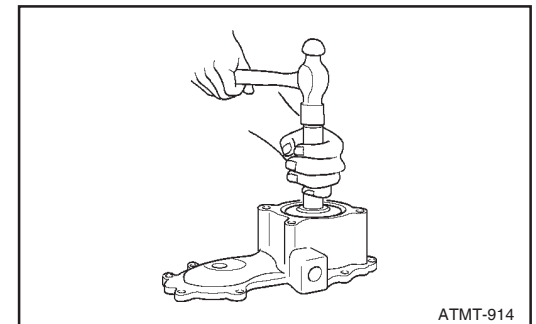
Tightening Torque : 83~110 kg.cm



45. Install the oil seal

NOTE

- When installing the oil seal, check right angle alignment and take care not to damage the seal lip. Apply grease to the lip

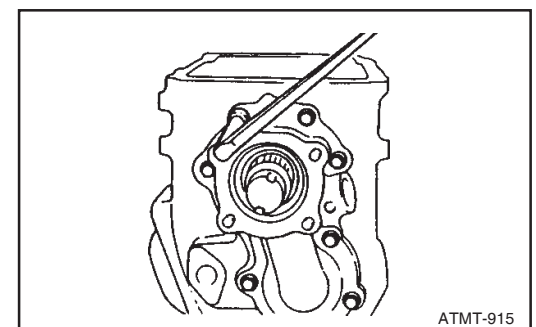


46. Install the rear-bearing retainer, and tighten the fitting bolts.

Tightening Torque : 400~500 kg.cm

NOTES

- Apply liquid sealer or sealing tape to the bolt threads.
- Apply liquid sealer to both sides of the gasket.



SERVICE PROCEDURES

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47. Check the output shaft.

- 1) Measure the backlash

Assembly standard :

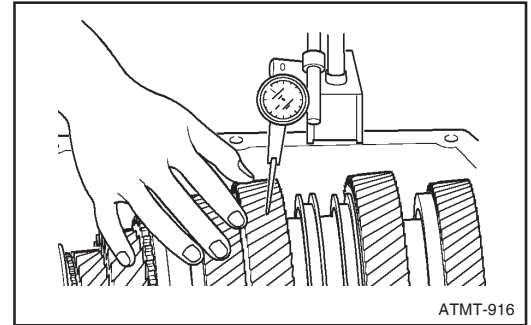
1st, reverse gears : 0.08 – 0.16mm

2nd, 3rd gears : 0.1 – 0.2mm

4th, 5th gears : 0.04 – 0.12mm

Service Limit

All gears : 0.4mm



- 2) Measure the free play

Assembly standard :

1st gear : 0.023 – 0.101mm

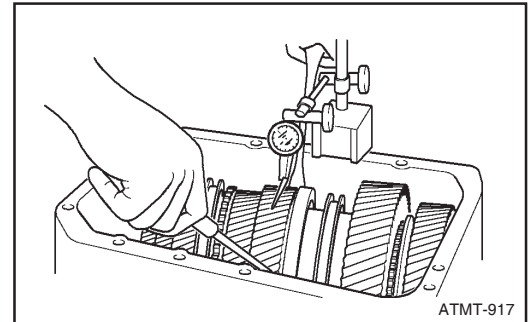
2nd gear : 0.022 – 0.071mm

3rd gear : 0.020 – 0.070mm

4th gear : 0.020 – 0.119mm

Reverse gear : 0.019-0.064mm

Service Limit : 0.016-0.055mm



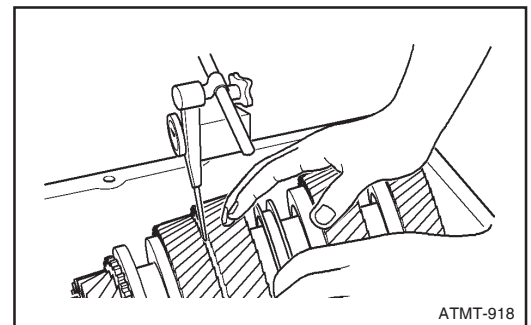
- 3) Measure the endplay

Assembly standard :

1st, 2nd, 3rd and 4th gears : 0.15 – 0.3mm

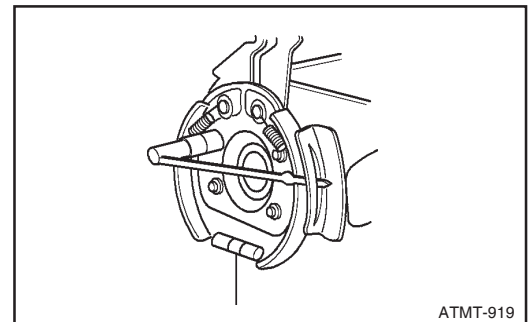
Reverse gear : 0.20 – 0.35mm

Service Limit : All gears : 0.15 – 0.60mm

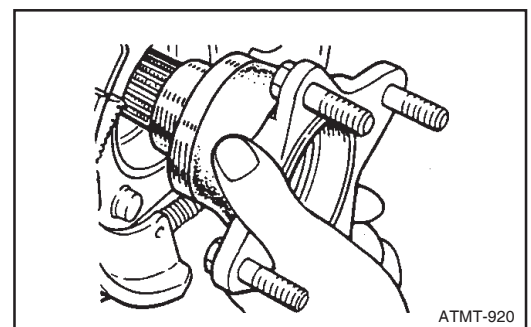


48. Install the parking brake to the transmission and tighten the fitting nuts.

Tightening Torque : 900~1,200 kg.cm



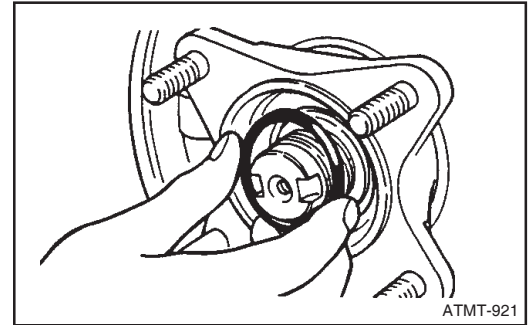
49. Install the flange coupling to the output shaft



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TRANSMISSION (KH10)

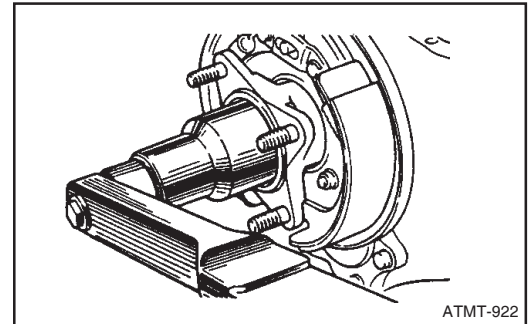
50. Install the O-ring to the flange coupling.



51. Install the lock nut on the output shaft and tighten it.

NOTE

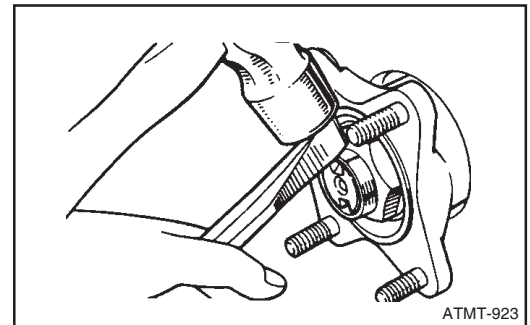
- **Before tightening the lock nut, engage two gears so that the shaft can not be turned**
- **Do not damage the O-ring.**
Tightening Torque : 6,000~8,000 kg.cm
Special Tool : Socket wrench (09389-4601)



52. Using a hammer and chisel, caulk the lock nut.

Follow the procedure below when caulking the lock nut

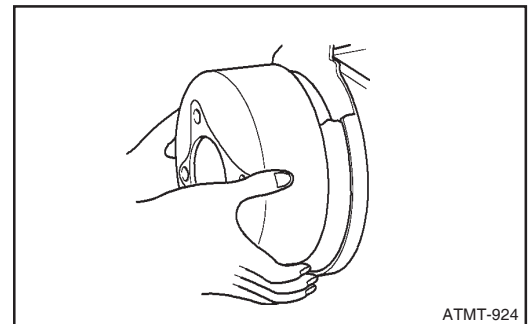
- 1) Caulk deeper than 1.5mm.
- 2) The caulking should fill the groove thoroughly.
- 3) The caulking should be done without rift



53. Install the parking brake drum and adjust the drum with the propeller shaft fitting nuts.

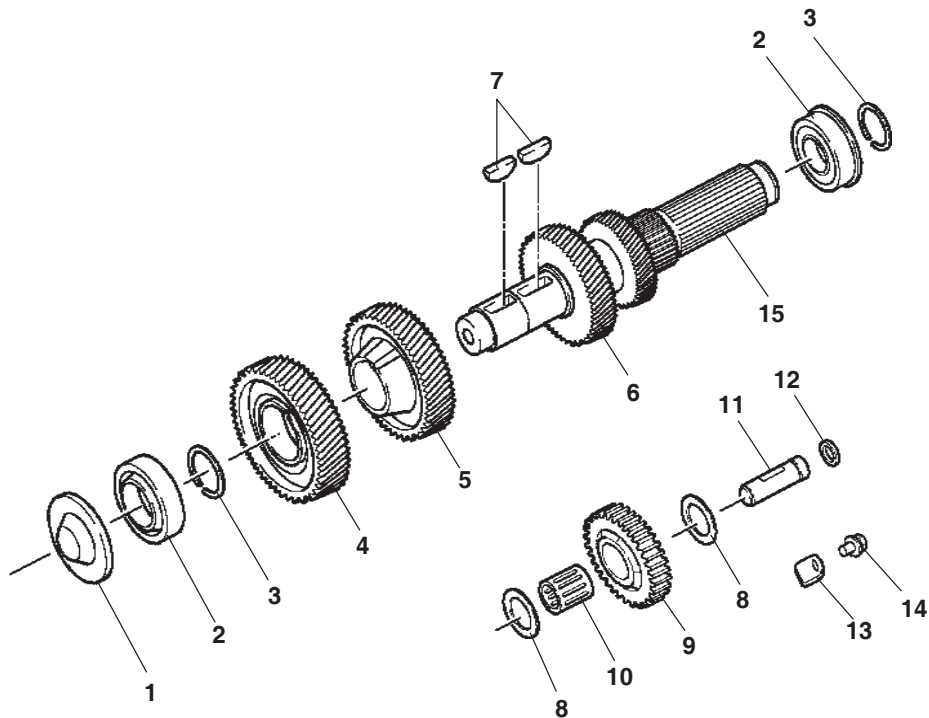
NOTE

- **Be sure to secure the parking brake drum to the transmission flange. Be careful not to drop the parking brake drum.**



Counter Shaft, Reverse Idler Shaft And Gear

COMPONENTS



1. Seal cover
2. Cylindrical bearing
3. Retainer ring
4. Counter drive gear
5. Counter 4th gear
6. Counter 2nd & 3rd gear

7. Woodruff key
8. Thrust washer
9. Reverse idler gear
10. Needle roller bearing
11. Reverse idler shaft
12. O-ring

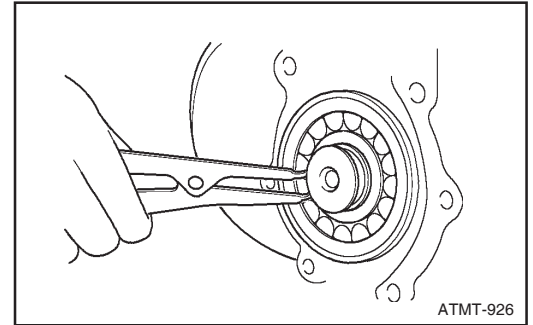
13. Rock plate
14. Bolt
15. Counter shaft

DISASSEMBLY

1. Remove the retainer ring from the counter shaft.

NOTE

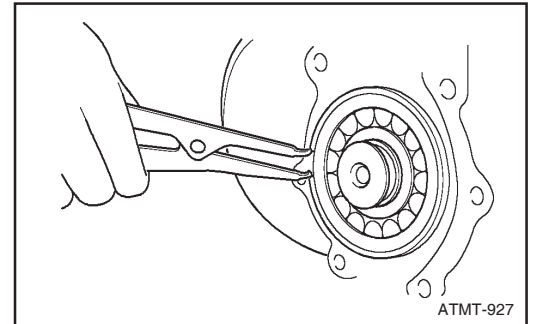
- The retainer ring may pop out of the groove during removal.



2. Remove the retainer ring from the rear cylindrical bearing.

NOTE

- The retainer ring may pop out of the groove during removal.



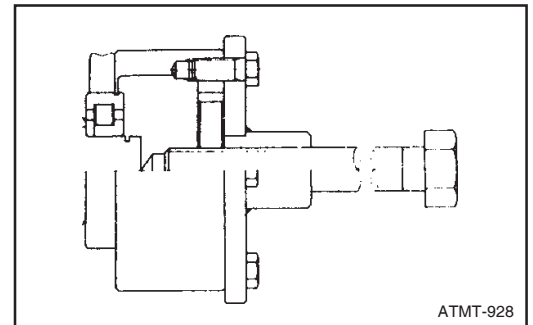
3. Install special tools on the rear cylindrical bearing.

Special Tool : Hook (09653-1160)

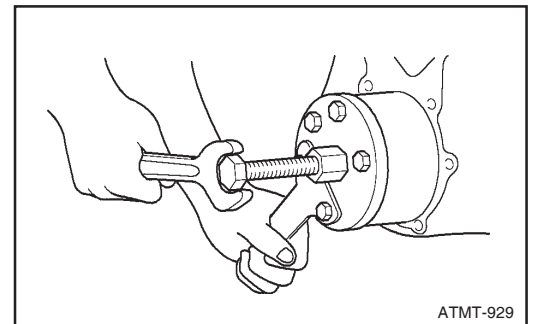
Puller (09650-2080)

NOTE

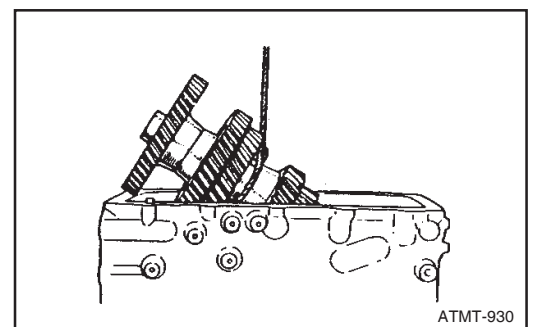
- Insert the hook's click into the groove for the retainer ring then secure the puller to the hook with bolts. Secure the puller so that it does not turn, then rotates the bolt to pull the bearing out.



4. Pull out the cylindrical bearing.



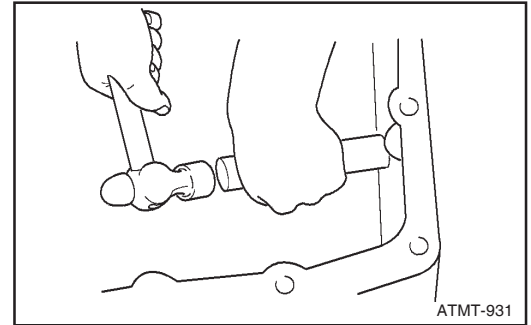
5. Tie a rope or hook around the counter shaft (between 3rd and 4th counter gear) and carefully pry the countershaft assembly rearward until the front end of the shaft is clear of the front cylindrical bearing.
6. Carefully lift the counter shaft assembly from the case.



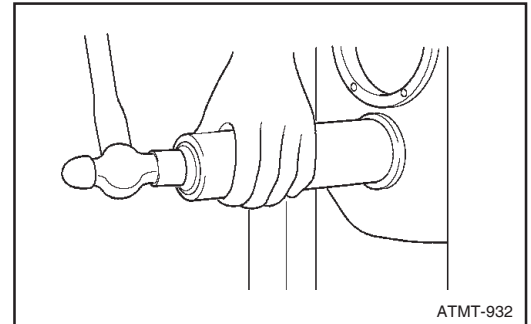
SERVICE PROCEDURES

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7. Using a tapping rod and a hammer, remove the bearing cover.

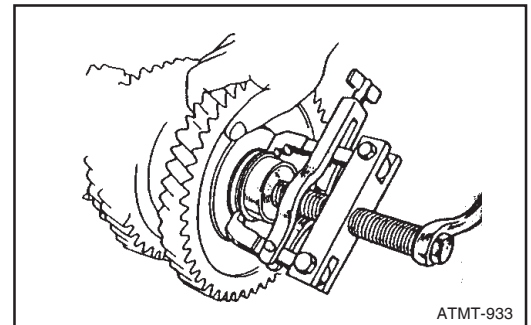


8. Remove the front cylindrical bearing.



9. Remove the inner race.
Using a special tool, pull out the cylindrical bearing inner race.

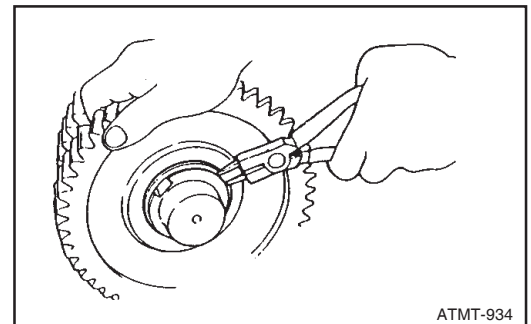
Special Tool : Puller (09650-1101)



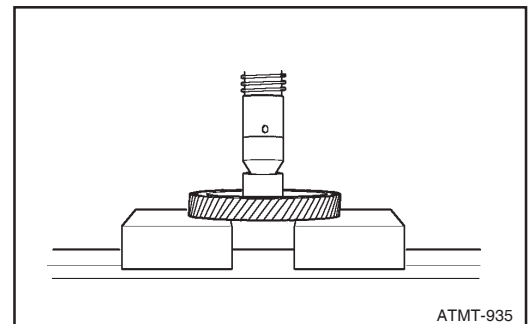
10. Remove the retainer ring

NOTE

- The retainer ring may pop out of the groove during removal.



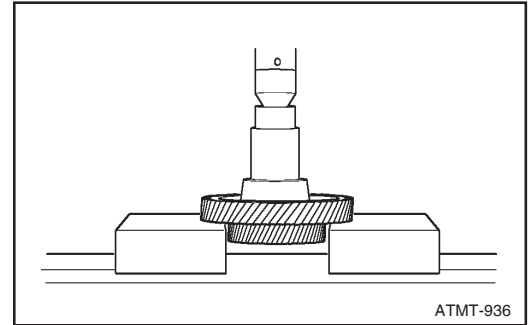
11. Using a press, remove the counter shaft drive gear.



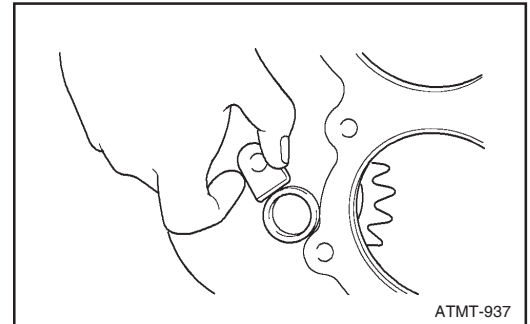
TMb-44

TRANSMISSION (KH10)

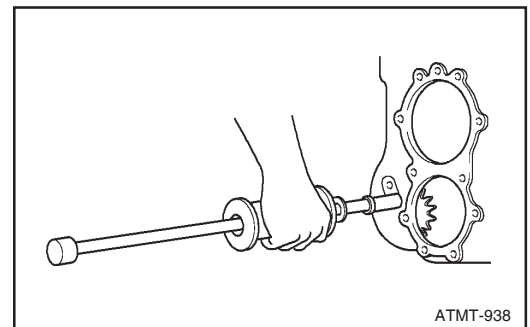
12. Using a press, remove the 5th gear.



13. Remove the idle shaft lock bolt and lock plate from the case.



14. Using a special tool, pull out the reverse idle shaft.
Special Tool : Sliding hammer (09420-1442)



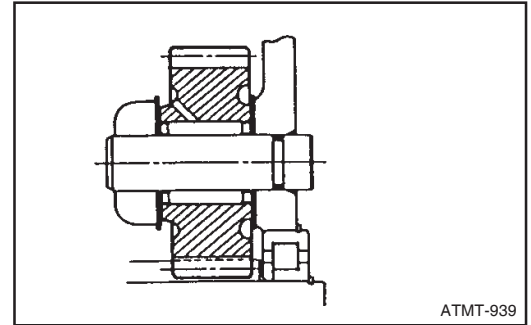
15. Remove the reverse idle gear, thrust washer and needle roller bearing.

ASSEMBLY

1. Install needle roller bearing into reverse idle gear and install thrust washers to both sides and place gear into case.

NOTE

- Apply gear oil lightly on needle roller bearing and thrust washers before installation.
- Install the gear at the original position.



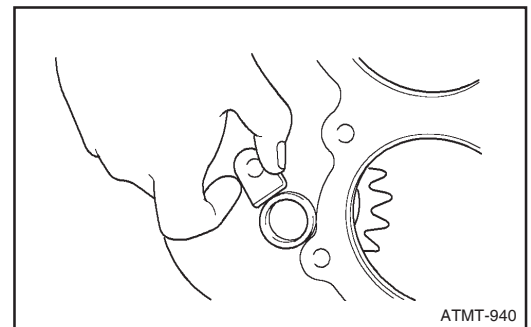
2. Install O-ring into gear shaft groove and install gear shaft into case by hammer.

NOTE

- Apply grease on O-rings.
- Make sure that O-ring is installed into shaft groove.

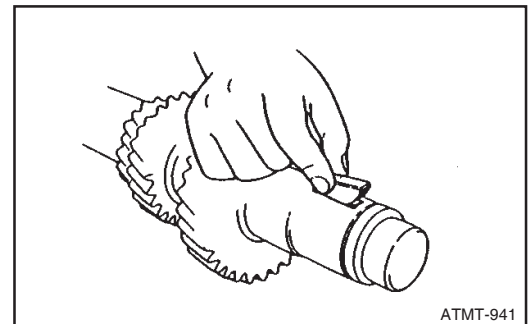
3. Install lock plate on shaft and tighten it to the case by bolts.

Tightening torque : 190 ~ 360 kg.cm

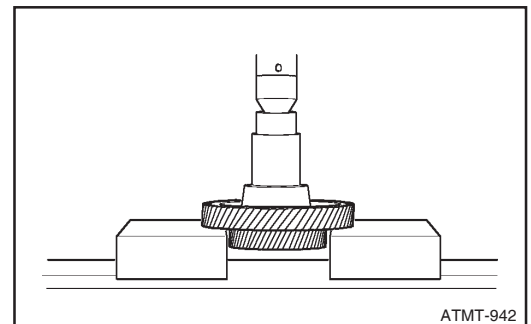


4. Select the suitable key according to the condition of the key groove, and install the key in the groove.

Thickness(T): 10.015 ~ 10.024 mm
10.080 ~ 10.090 mm



5. Using press, install counter shaft gear.



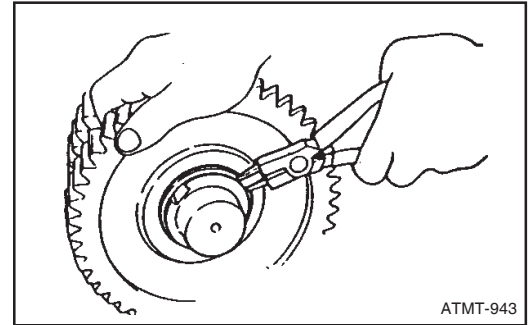
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TRANSMISSION (KH10)

6. Install the retainer ring on the counter shaft.
 - 1) Select the retainer ring.
 - 2) Install the retainer ring and make sure to be correctly positioned.

NOTE

- Take care with the retainer ring that may pop out during installation.



- 3) Check the clearance.

Assembly standard : 0

Following types of retainer rings are available.

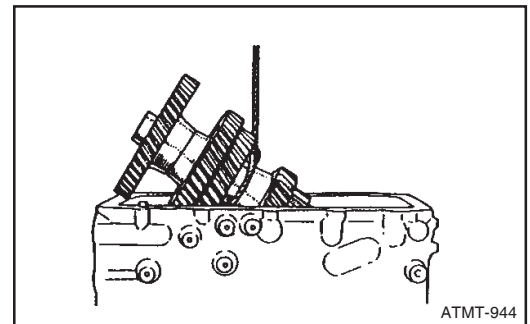
Thickness	Color
2.4mm	-
2.5mm	White
2.6mm	Green
2.7mm	Brown
2.8mm	Blue

NOTE

- Use only the new retainer rings.

7. Install the front bearing inner race. Using the press, insert front bearing inner race against the stepped part of the counter shaft.

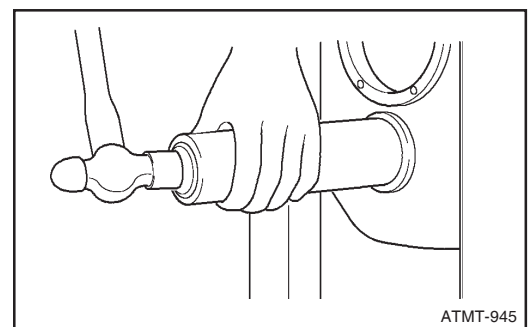
8. Install the counter shaft in the gear case.



9. Install the front bearing

NOTE

- Apply gear oil on inner and outer race.
- Be careful not to damage the inner race together with roller bearing.

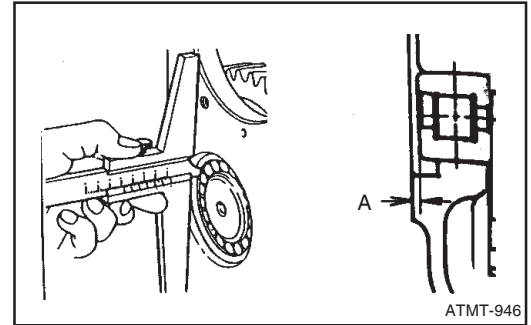


SERVICE PROCEDURES

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10. "A" position distance check

Assembly standard : 1.6 ~ 2.1 mm



11. Install retainer ring first to the bearing before the assembling rear bearing.

12. Insert bearing next to bearing side ring to the counter shaft.
When installing the bearing side ring, place the side with the larger chamfering close to the reverse gear.

13. Apply the gear oil to outer and inner race.

NOTE

- **Be careful not to damage the surface of inner race.**

14. Installation of retainer ring.

Install the retainer ring to the counter shaft.

- 1) Select the retainer ring.
- 2) Install the retainer ring and make sure to be correctly positioned.

NOTE

- **Take care with the retainer ring that may pop out during installation.**

- 3) Check the clearance.

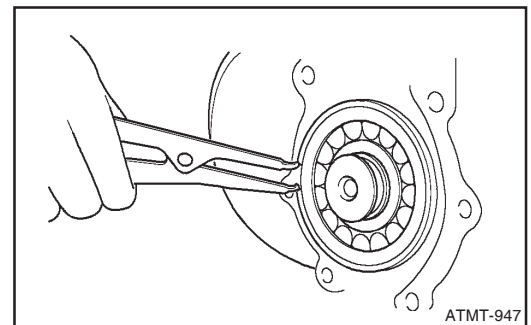
Assembly standard : 0

Following types of retainer rings are available.

Thickness	Color
2.4mm	-
2.5mm	White
2.6mm	Green
2.7mm	Brown

NOTE

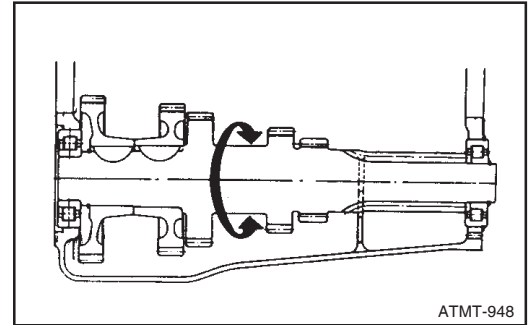
- **Use only the new retainer rings.**



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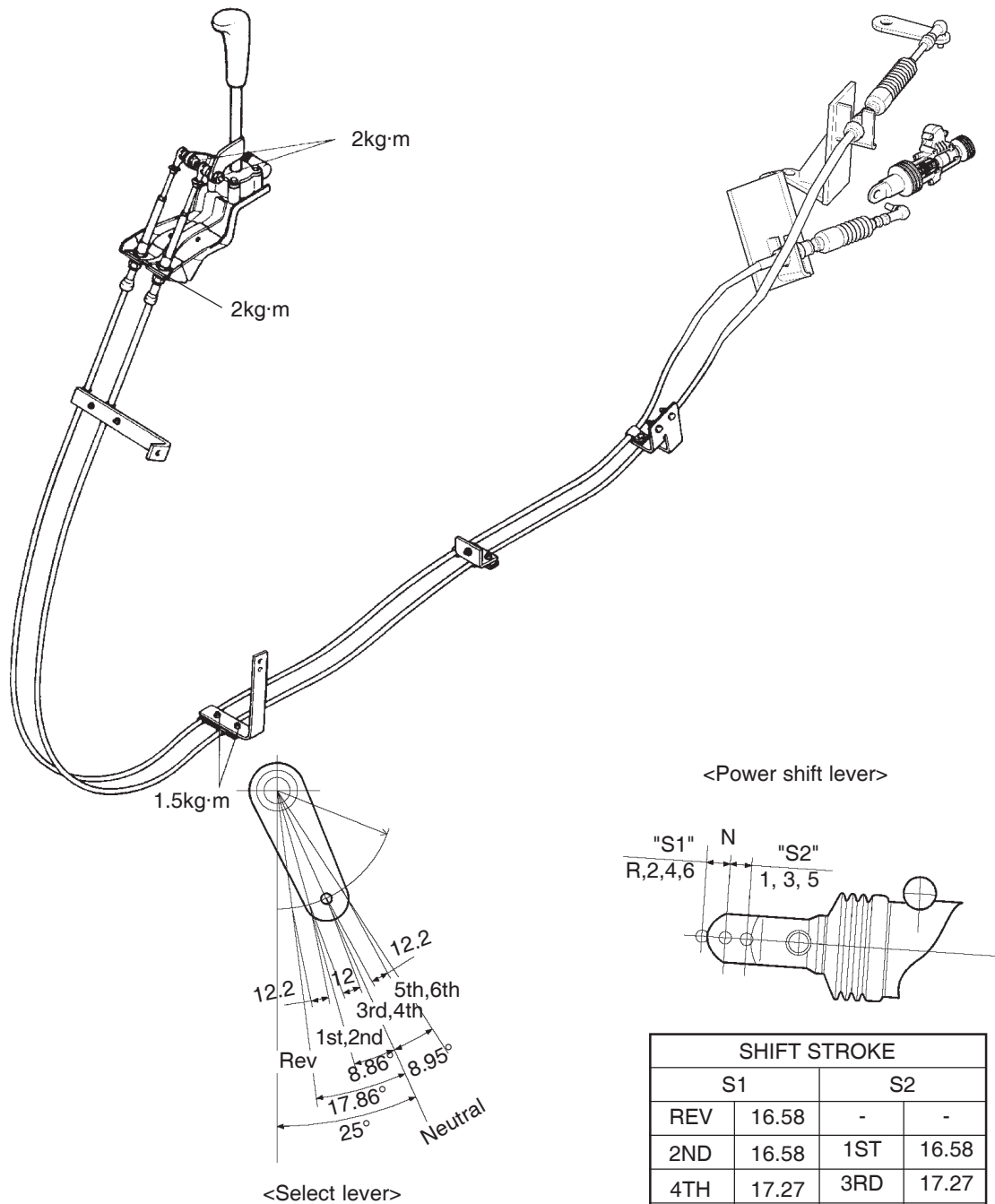
TRANSMISSION (KH10)

15. Press the counter front cover and align it with the bearing.
16. Rotate the counter shaft by hands to check whether it turns smoothly.



17. Inspection of counter shaft and reverse idle gear.
 - 1) Measure the backlash between reverse idle gear and counter shaft reverse gear.
Assembly standard : 0.08 ~ 0.16 mm
Service limit : 0.4 mm
 - 2) Measure the endplay of reverse idle gear.
Assembly standard : 0.15 ~ 0.6 mm
Service limit : 0.7 mm

Transmission Control



LEVER RATIO AND TIGHTENING TORQUE

1. Refill the grease on the fitting parts.
(Fitting parts : roller assembly, guide)

2. Lever ratio

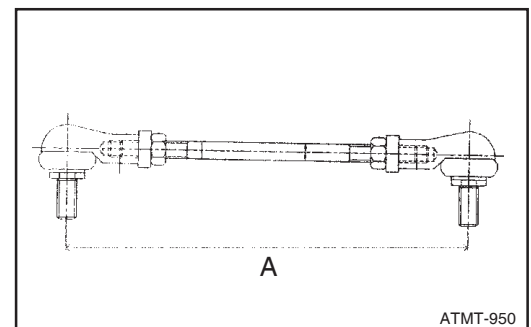
	Shift	Select	Remark
Lever ratio	7.44	5.52	
Stroke	54	46	Max

3. Adjust the roller gap to be 0.2 ~ 0.6 mm by using the bias of lower roller and upper roller of roller assembly.
4. Install the boot freely that assembled to roller assembly. Put the shift lever in neutral.
5. Refer to the following table for the tightening torque of bolts and nuts.

Model	M8X1.0	M10X1.25	M12X1.5
Tightening torque	2.7~3.6	3.8~5.0	6.5~8.7

6. Adjust the position distance "A" of the select rod assembly.

Assembly standard : 147 mm



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Abnormal noise The noise can be considered to be from the transmission if the noise is heard with the vehicle stopped and the engine idling, and then disappears when the clutch pedal is depressed, or if the noise is heard when the transmission is shifted.	Insufficient oil Deterioration of oil quality Worn bearing Wear of sliding surfaces of counter shaft gear. Wear of sliding surface of gears Excessive gear backlash Damaged gear teeth Influx of dust.	Add oil Replace with oil of specified quality. Adjust or replace. Replace Replace Replace Replace Correct or replace
Hard to shift change	Bent change rod Insufficient grease in transmission control system Insufficient oil Deterioration of oil quality Wear or play of shift fork or shift rod Wear of synchronizer ring Wear of synchronizer cone of gear. Bad contact of synchronizer ring and cone of gear Excessive longitudinal play of gears Wear of bearing Wear of synchronizer key spring Improper disengagement of clutch	Replace Lubricate with grease Add oil Replace oil with specified quality. Replace Replace Replace Replace Replace Adjust or replace Replace Refer to CH group
Change release	Bent change rod Weak or broken lock ball spring Wear of shift fork Wear of clutch hub Wear of gear sliding parts Excessive gear backlash Wear go bearing Incorrect installation of engine mounts or transmission mounts.	Replace Replace Replace Replace Replace Replace Replace Replace
Rough or difficult operation of change rod	Sticking of control rod Malfunction of ball joint of change rod Bent change rod	Replace Replace Replace

Symptom	Probable cause	Remedy
Sub transmission is not working	Shift cable broken	Change
	Insufficient oil	Refill
	Oil seal defected	Change oil seal
	Worn-out or loosening of shift fork and shift rod	Change or tightening
	Worn-out or damage of synchronizer ring	Change
	Worn-out of input clutch cone and gear	Change
	Poor connection between synchronizer ring and cone	Change
	Cut or missing of snap ring	Refer or change
	Worn-out of bearing	Change
	Defect of synchronizer spring	Change
	Poor clutch release	Refer to CH group

FRONT AXLE

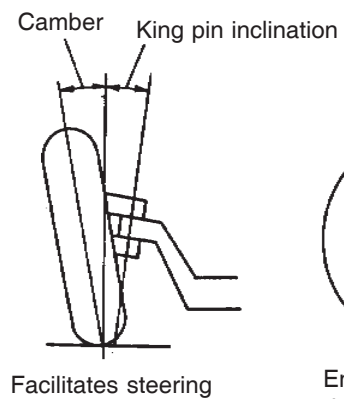
GENERAL	FA - 2
SPECIFICATIONS.....	FA - 2
SERVICE STANDARDS	FA - 3
SPECIAL TOOLS	FA - 4
SERVICE PROCEDURE	FA - 5
TROUBLESHOOTING	FA-18

GENERAL

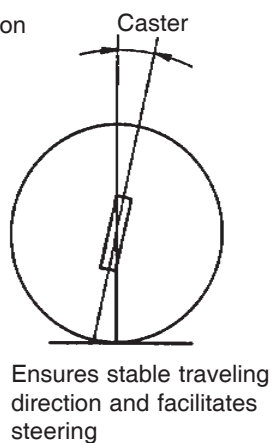
The front axle supports and transmits the weight of the front portion of vehicle to the tires and also serves as part of the steering system and brake system. The front axle also has proper wheel alignment for stabilizing the vehicle as it is driven.

Wheel alignment

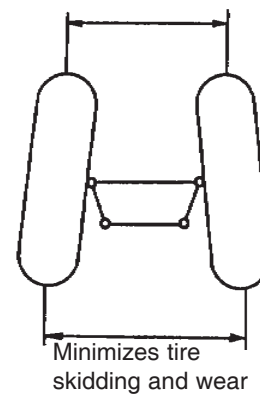
King pin inclination and camber



Caster



Toe-in (B-A)



59AR0058

SPECIFICATIONS

Maintenance item \ Vehicle model	HD120
Front axle Type	"I" beam, reverse Elliot
Tie rod Length between ball studs	1493 mm
Steering angle Inside	49°
Outside	36°
Wheel alignment Toe-in	1~3 mm
Camber	1°30'
Caster	30' ± ^{30'} ₁₀
King pin inclination	7°
Tread 8.25~16	1805(Full air brake) / 1795 (A.O.H Brake)

SERVICE STANDARDS

SERVICE STANDARDS TABLE

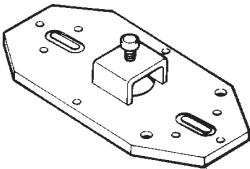
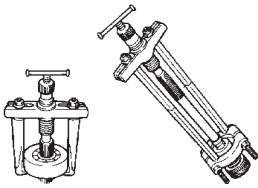
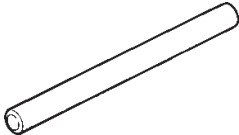
Maintenance item			Nominal value (Basic diameter in [])	Limit	Remedy and remarks
Front axle	King pin inclination		7°	-	Replace
	Bend	Vertical	3	7	Replace
		Fore/aft direction	2.5	7	
Knuckle front axle clearance in vertical direction			0.1 or less	-	Adjust with thrust washer
King pin	O.D.		-0.02 [35]-0.015	34.9	Replace
	Bushing I.D. (after press fittin)		+0.045 [35]+0.018	-	
King pin to bushing clearance			0.02 to 0.06	0.15	Replace bushing
Hub bearing starting torque			10 ~ 40kg·cm	-	Targential force at wheel bolt position 0.9~3.6kg

TIGHTENING TORQUE TABLE

Location tightened	Screw size O.D. x pitch (mm)	Tightening torque kg·m
Wheel hub to brake drum attaching nut	M22 x 1.5	32.8
Backing plate attaching bolt	M14 x 1.5	13.8
Wheel hub Lock nut (back off 30° after tightening)	M36 x 1.5	20
Knuckle arm attaching castle nut	M27 x 1.5	60~80
Tie rod arm attaching castle nut	M27 x 1.5	60~80
Tie rod to knuckle arm attaching castle nut	M16 x 1.5	10.4~17.3
Tie rod end bolt	M12 x 1.25	8
King pin set bolt tightening nut	M10 x 1.25	3

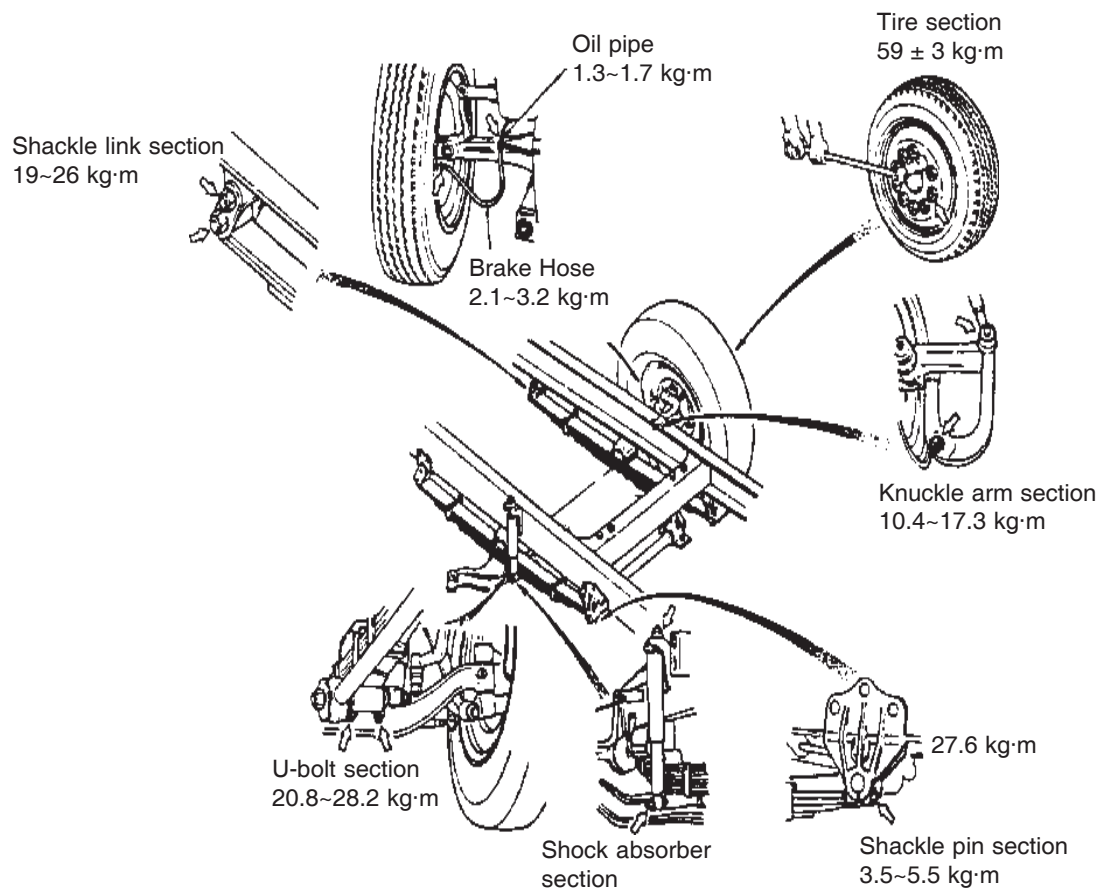
SPECIAL TOOLS

Unit : mm

Tool (Number and name)	Illustration	Use
Wheel hub puller 09517-83200	 ASST0951	Removal of wheel hub
Puller set 09431-83100	 ASST0030	Removal of inner bearing and knuckle retainer
Drift 09517-83300	 ASST0020	Removal of oil seal and bearing

SERVICE PROCEDURE

REMOVAL AND INSTALLATION

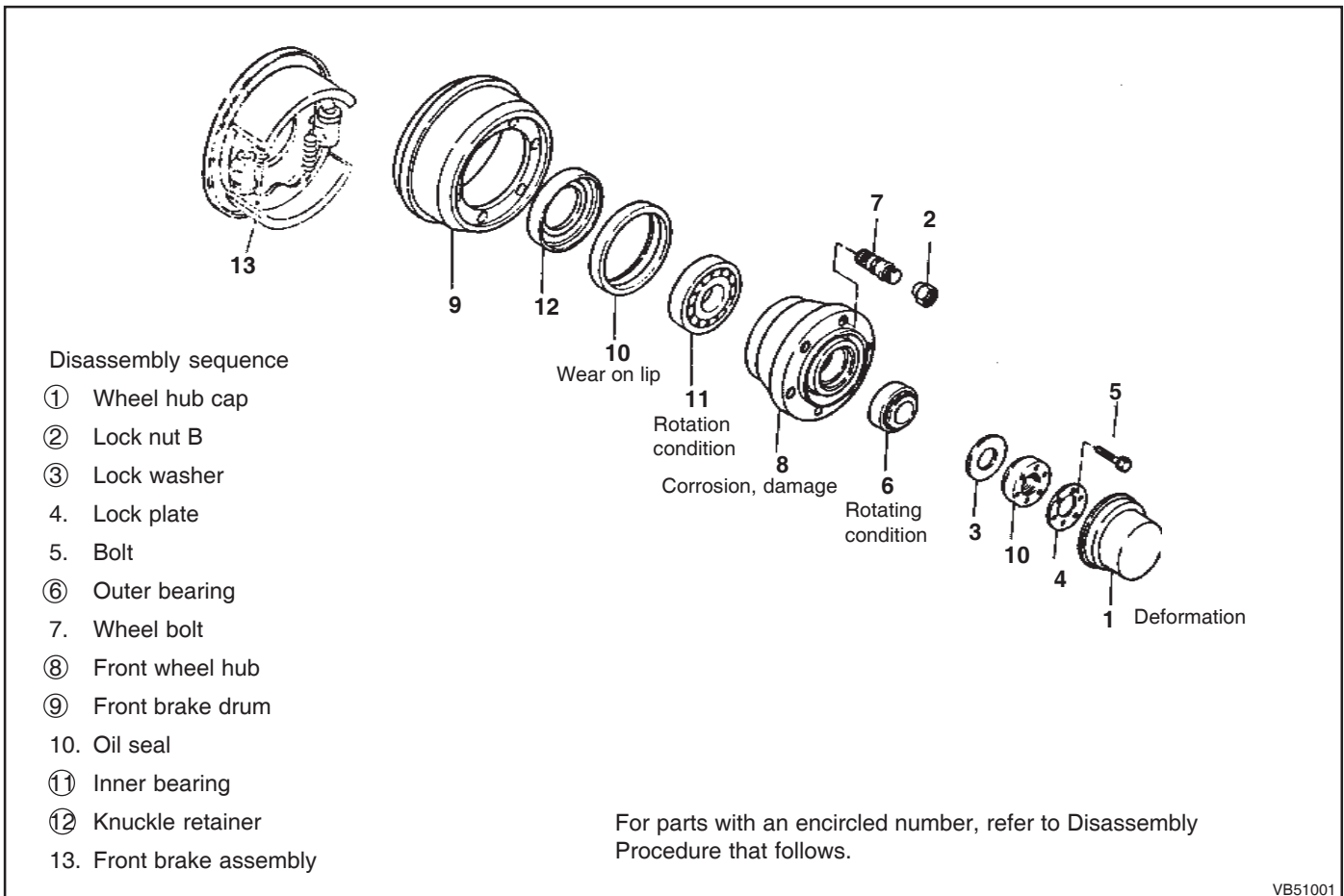


NOTE:

1. Disconnect the brake hose at the frame side first. Install the brake hose at the brake side first. Use care not to kink the brake hose.
2. Plug the removed brake hose to prevent entry of dust and dirt.
3. After installation, bleed brake system according to Group.

WHEEL HUB AND BRAKE DRUM

Disassembly, inspection and corrections

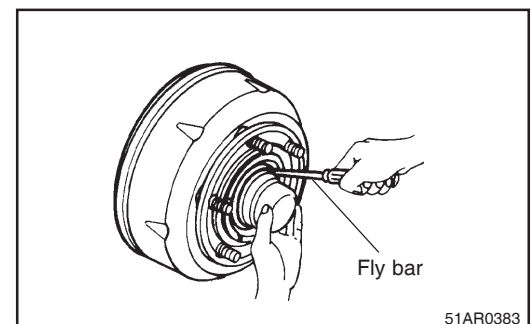


VB51001

Disassembly Procedure

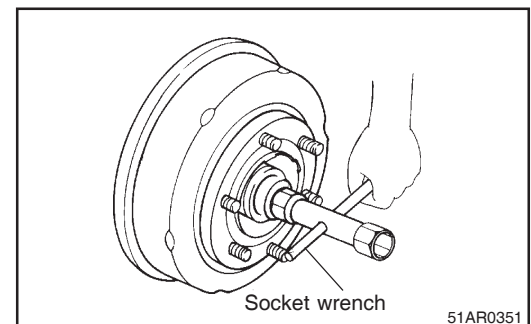
(1) Removal of wheel hub cap

Pry to remove the wheel hub cap using the Fly Bar.



(2) Removal of lock nut

Remove the lock nut using the, Socket Wrench.

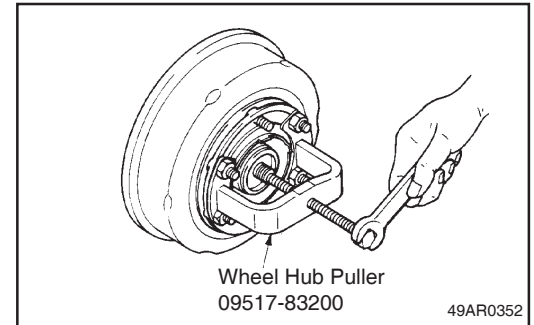


SERVICE PROCEDURE

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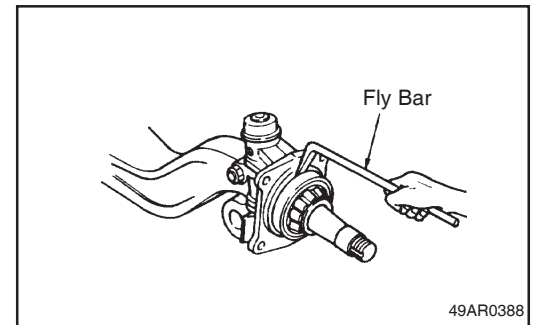
(3) Removal of front wheel hub

Remove the wheel hub and brake drum as a unit. Do not disassemble them unless it is necessary for replacement.

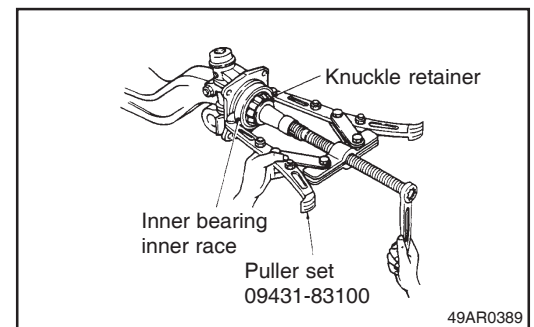


(4) Removal of inner bearing inner race and knuckle retainer

(a) Pry up the knuckle retainer slightly using the Fly Bar.

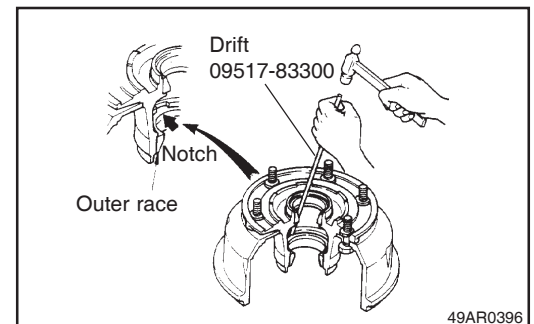


(b) Remove the knuckle retainer together with the inner bearing inner race using the special tool, puller set.

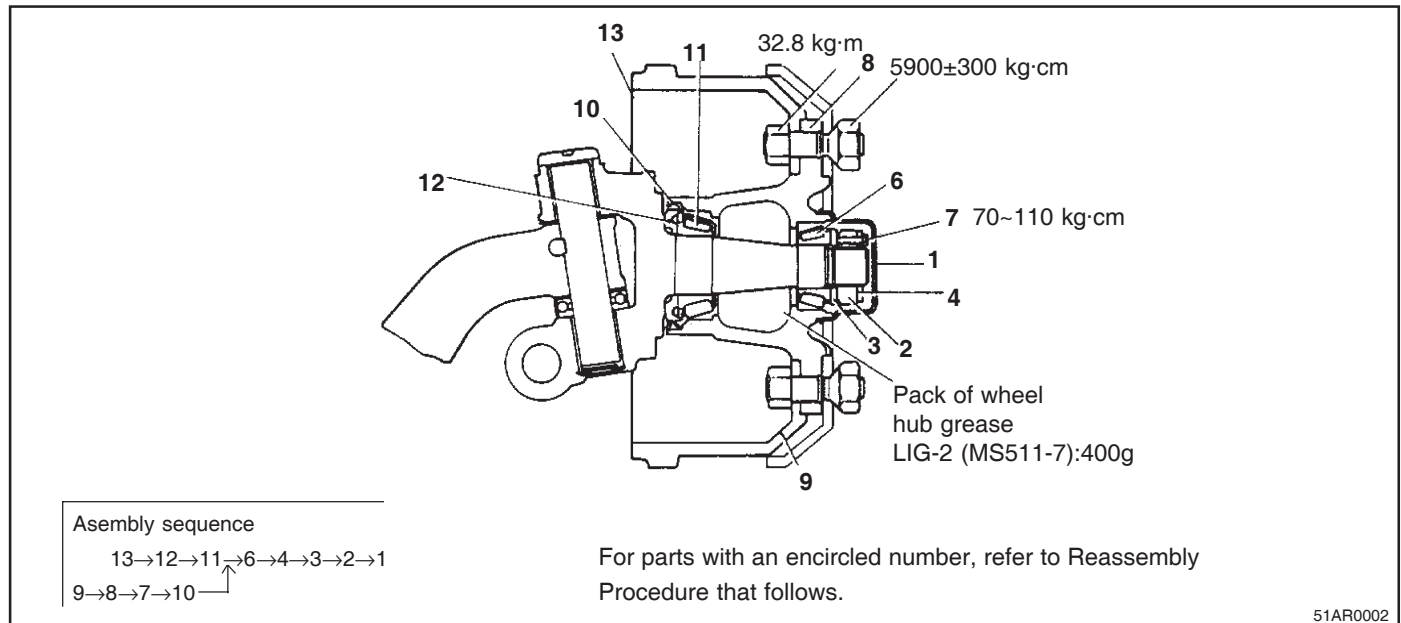


(5) Removal of wheel bearing outer race

Apply a rod to notches in two places on the inside of the wheel hub and strike the outer race with even strokes to force it out.



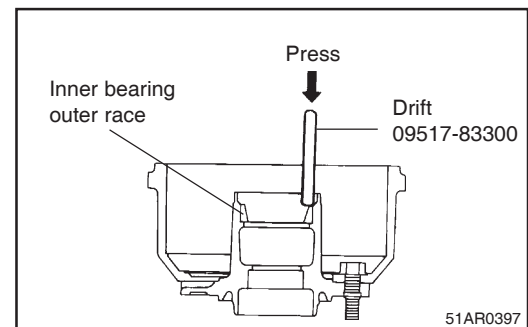
Reassembly



Reassembly Procedure

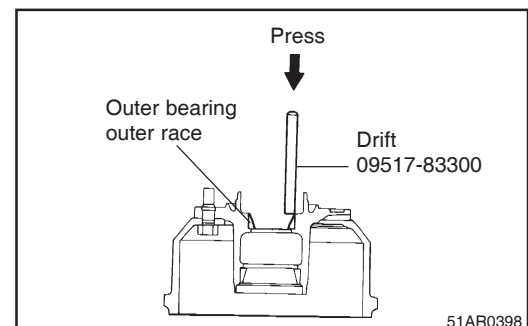
(1) Installation of inner bearing outer race

Press fit the inner bearing outer race into the wheel hub using the special tool, Drift.



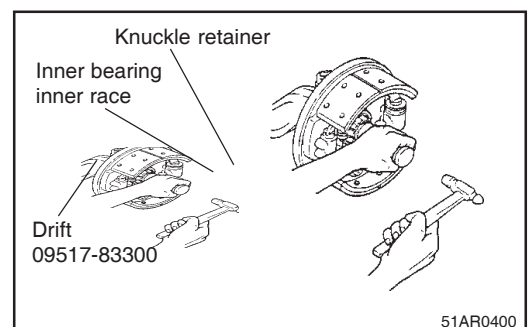
(2) Installation of outer bearing outer race

Press fit the outer bearing outer race into wheel hub using the special tool, Drift.



(3) Installation of inner bearing inner race

Set the knuckle retainer and inner bearing inner race into the knuckle and press fit them using the special tool, Drift.

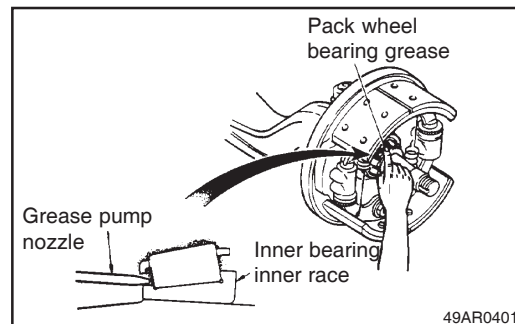


SERVICE PROCEDURE

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(4) Greasing

Pack sufficient wheel bearing grease between the rollers of the bearing inner race.



(5) Adjustment of hub bearing starting torque

- (a) Turn the wheel hub three or more turns to the clockwise and using the socket Wrench, tighten the lock nut to specified torque, and back it off 30° (1/21 turn)

Specified torque	20 kg·m
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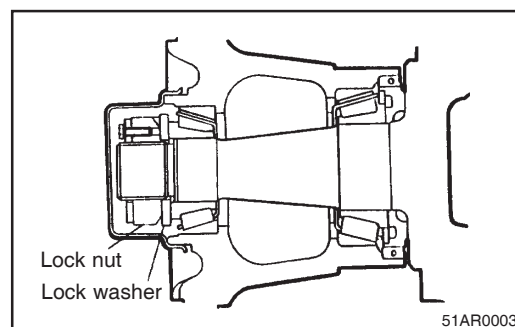
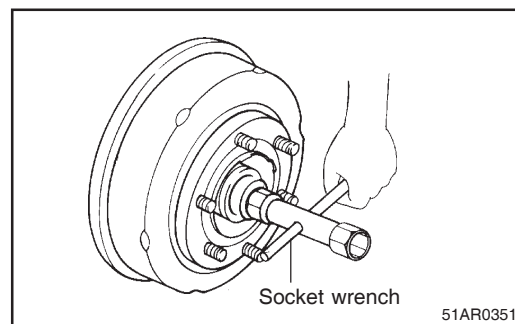
NOTE

When striking the end of knuckle face.

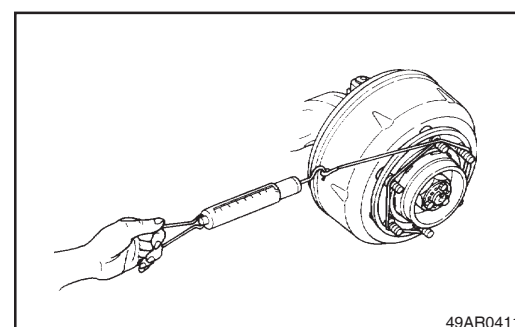
With a copper hammer, the hub bearing inner race is moved to outer side.

Remove the clearance when turning the lock nut.

- (b) After installing the lock washer, tighten the lock nut to the specified torque.
- (c) Measurement of wheel hub starting torque
Wind a string around the wheel hub bolts and pull the string tangentially and slowly with a spring balancer and check if the tangential force is within specification.

**NOTE**

- If the tangential force is within specification, the starting torque is also within specification.**
If the tangential force is out of specification, adjust the starting torque again.
- The starting torque should not exceed the upper limit of the specified tangential force.**



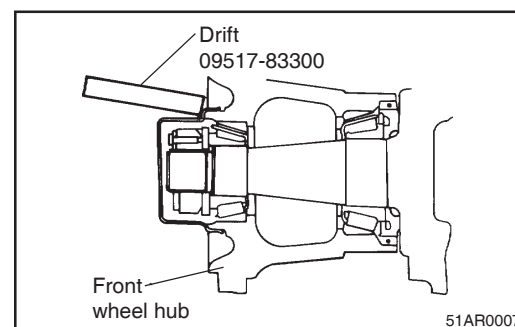
(6) Installation of wheel hub cap

Pack wheel bearing grease into wheel hub cap and apply sealant to its hub contact surface.

Set the hub cap into the special tool, Drift and press fit the hub cap into the front wheel hub.

NOTE

When installing the hub cap, be sure to use the special tool, Drift. If the hub cap is driven into position by striking with a hammer or similar tool without using the special tool the engaging portion could become deformed, losing its water sealing effect.

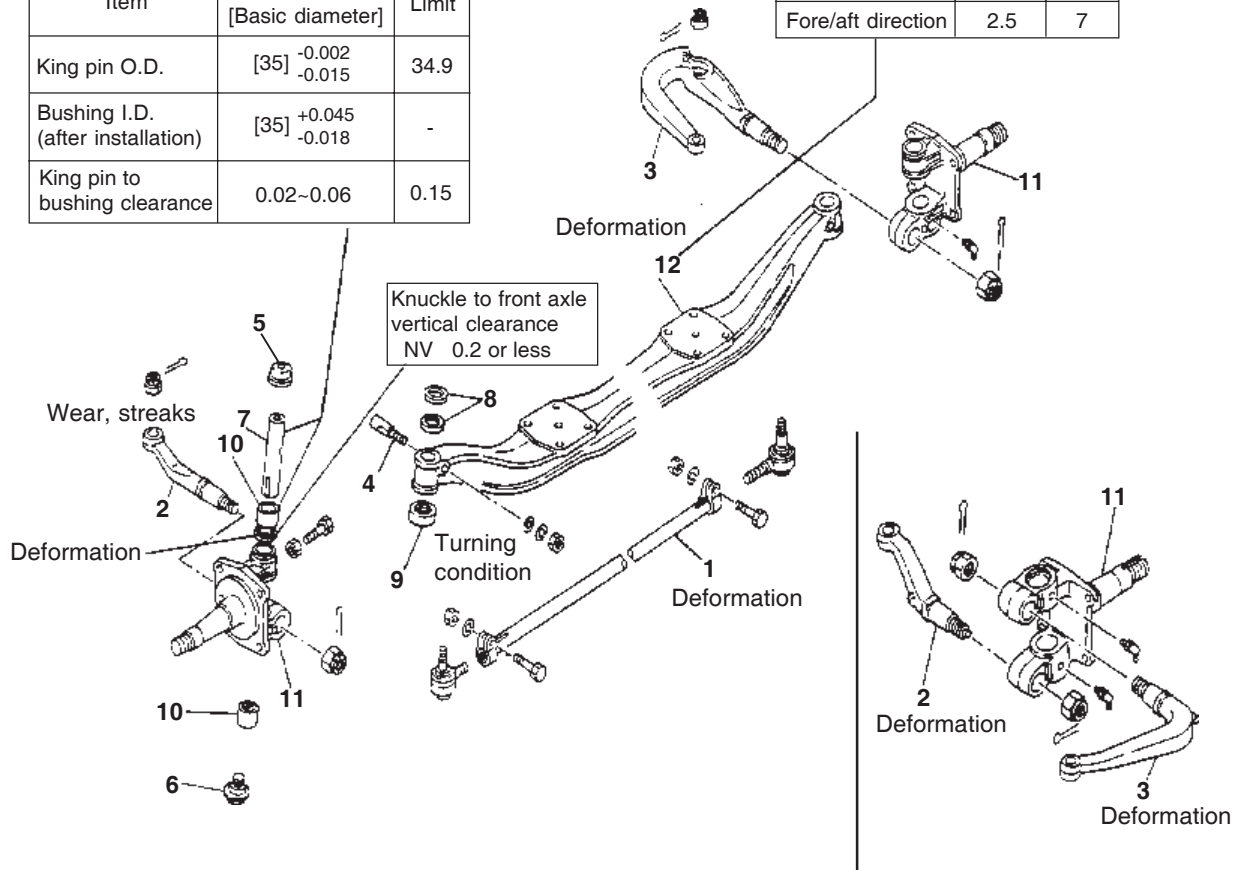


Front Axle, Knuckle and King Pin Disassembly and inspection

King pin and bushing

Item	Nominal value [Basic diameter]	Limit
King pin O.D.	[35] -0.002 -0.015	34.9
Bushing I.D. (after installation)	[35] $+0.045$ -0.018	-
King pin to bushing clearance	0.02~0.06	0.15

Item	NV	L
Vertical direction	3	7
Fore/aft direction	2.5	7



Disassembly sequence

1. Tie rod assembly
2. Tie rod arm
3. Knuckle arm
4. Set bolt
5. King pin cup
King pin cover
6. Lower cover
7. King pin
8. Thrust washer
9. Ball bearing
10. Bushing
11. Knuckle
12. Front axle

NV ... Nominal Value
L ... Limit

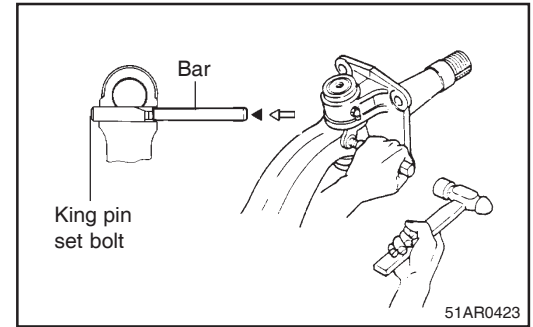
SERVICE PROCEDURE

FA-11

Disassembly Procedure

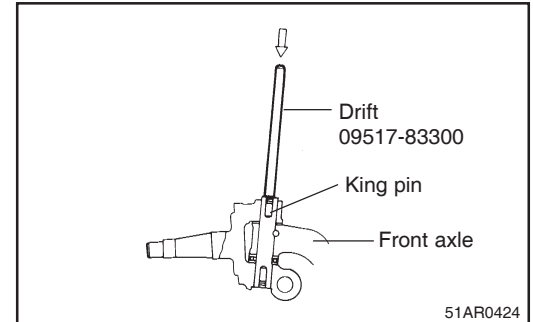
(1) Removal of set bolt

Remove the nut and washer from the set bolt and then remove the set bolt using the Bar.



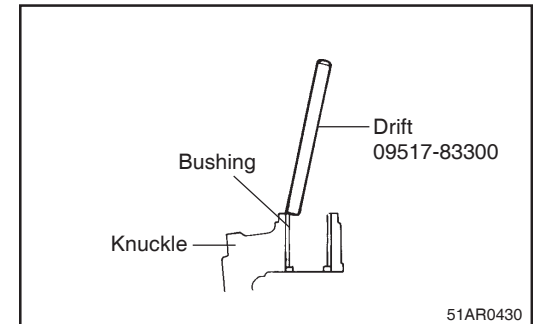
(2) Removal of king pin

Remove the king pin using the special tool, Drift.



(3) Removal of king pin bushing

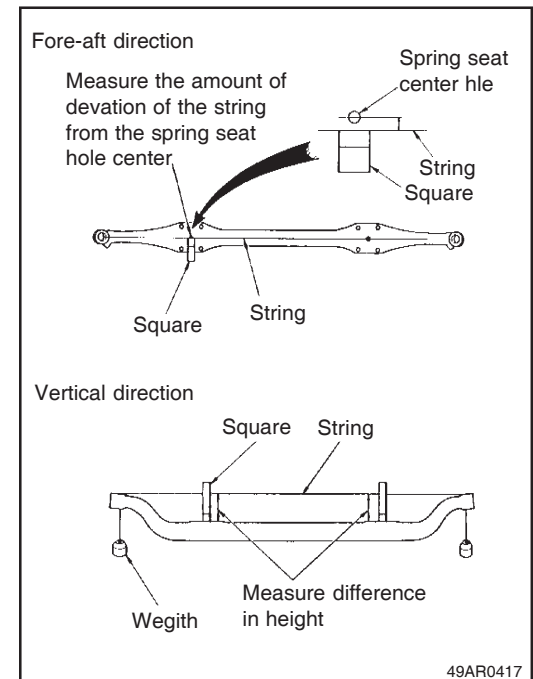
Using the special tool, Drift remove the bushing.



(4) Measurement of front axle deflection

Thread a string through the king pin holes of the front axle and put a weight on each end. Measure the vertical and fore-aft deflection of the front axle.

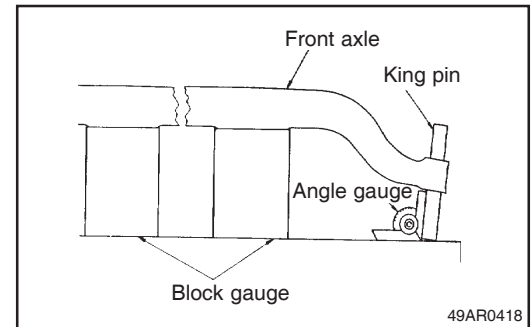
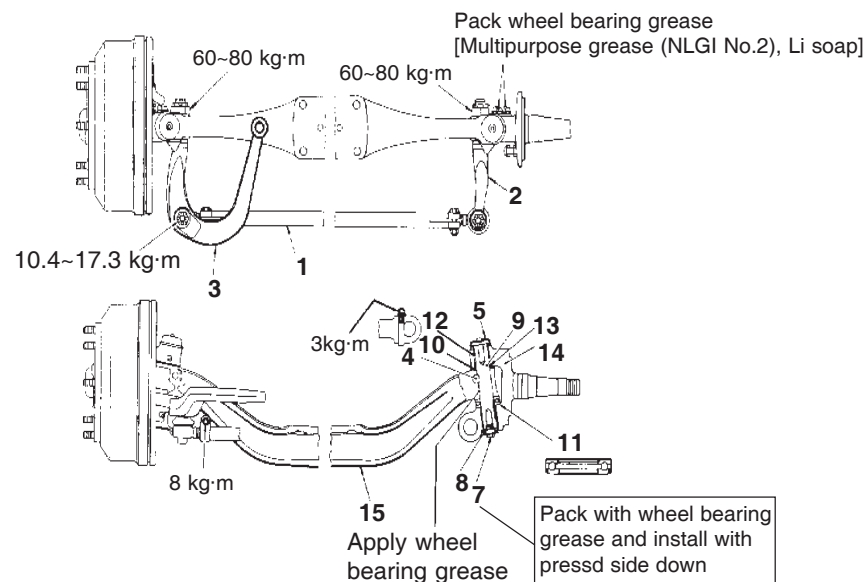
Item	Nominal Value	Limit
Vertical direction	3	7
Fore-aft direction	2.5	7



FA-12**FRONT AXLE****(5) Measurement of king pin angle**

Install the king pin to the front axle and place the front axle upside down on the block gauge. Measure the king pin angle using the angle gauge.

Nominal value	7°
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(6) For the tie rod assembly, refer to Group Steering System.**Reassembly****Assembly sequence**

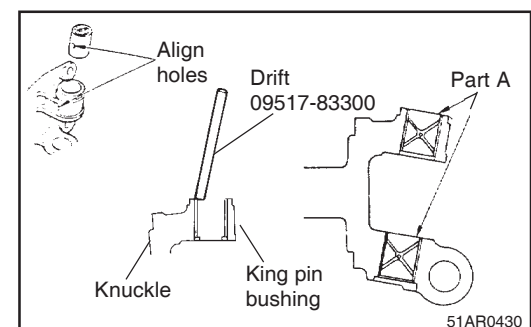
15 → 11 → 10 → 9 → 4 → 8 → 7 → 5 → 3 → 2 → 1
 14 → 12 → 13

51AR0759

Reassembly Procedure**(1) Installation of king pin bushing**

Press fit the king pin bushing into the knuckle using the special tool, Drift.

At this time, one end of each bushing should be flush with the surface A and the nipple holes in the knuckle should be aligned with the oil holes in the bushing.



SERVICE PROCEDURE**FA-13****(2) Adjustment of knuckle vertical clearance**

Install the king pin and ball bearing temporarily and turn the knuckle two or three times to ensure smooth operation. Measure the clearance between the upper surface of the front axle and knuckle. Based on this value, select a king pin thrust washer which gives the specified clearance

Nominal Value	0.1 or less
Thrust washer thickness	2.1 ~ 2.8 (8 types in 0.1 mm increments)

NOTE

Select a thrust washer that gives the minimum clearance.

(3) Greasing

Fill the knuckle with grease through the grease nipples until the grease overflows from the dust plug of upper cap and around the thrust washer and the ball bearing.

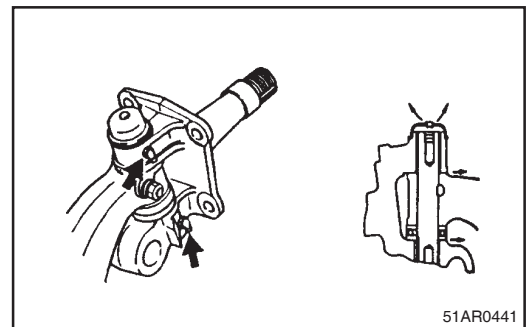
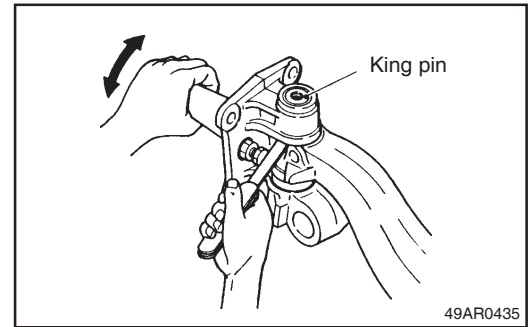
(4) Installation of knuckle arm

(a) In case existing knuckle and/or knuckle arm are to be reassembled:

- 1) Polish the entire taper surfaces of the knuckle and knuckle arm with #120 or finer abrasive paper uniformly so that sandpaper marks are left. (This is unnecessary when using new part.)
- 2) Clean and wash the taper surfaces of knuckle and knuckle arm and the threads of the knuckle arm. (Use acetone, cleaning solvent for liquid penetrant test or the like.)
- 3) Apply grease to the threads of the knuckle arm and install it. (When installing, keep the taper surfaces of knuckle and knuckle arm free from grease.)
- 4) Tighten new castle nut to specified torque. Be sure to align the pin holes by turning the nut in the tightening direction and then insert the split pin.

(b) In case both knuckle and knuckle arm are new:

Clean the taper surfaces of knuckle and knuckle arm and without applying grease to the threads, perform step 4) of (a) above.



Inspection and Adjustment after Installation

Adjust the wheel alignment and steering angle.

Make sure that when making measurement, the vehicle is unloaded and kept in the horizontal position.

In addition, every part of the front axle has been thoroughly maintained before the adjustment described here.

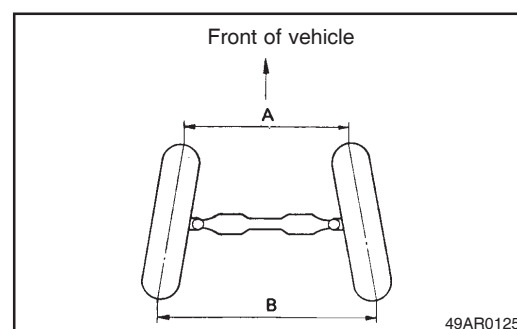
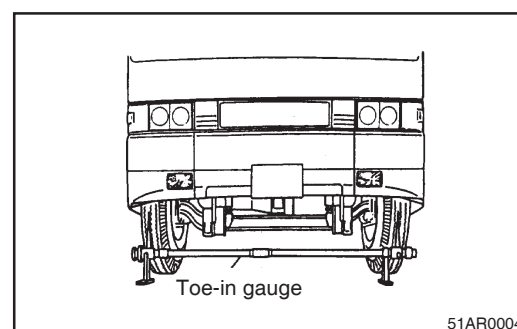
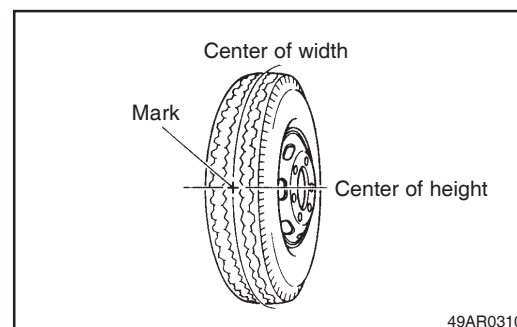
NOTE

Before adjustment, make one more check to be sure that the front axle is free from the following defects.

1. Loose front wheel hub
2. Loose knuckle
3. Lose connection between knuckle flange and knuckle arm
4. Loose bolts, crews and nuts
5. Leaf spring broken or set in fatigue
6. Overinflated or underinflated tire
7. Improperly adjusted steering gear backlash

(1) Measurement and adjustment of toe-in

- (a) Place the front wheels in straight ahead position.
- (b) Make a mark on the front side of each front tire, at the center of the tire width and height.
- (c) Adjust the heights of the needle ends of the toe-in gauge to the same height as the marks made on the right and left front tires, and measure the distance between the marks.
- (d) Drive the vehicle slowly forward until the marks go round to the rear side and reach the same height previously measured by the toe-in gauge (180° of tire rotation), and measure the distance between the marks on the rear side of the tires.
- (e) The difference between the front and rear side measurements (dimension B on rear side-dimension A on front side) is the toe-in.

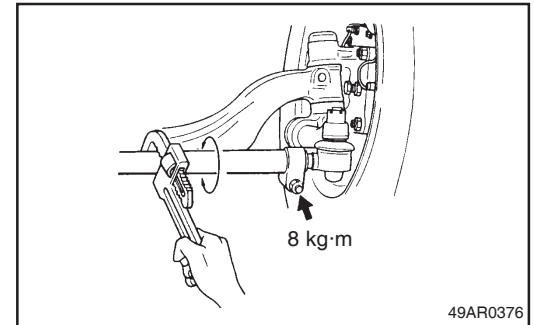


SERVICE PROCEDURE

FA-15

- (f) To adjust toe-in, loosen the right and left clamp bolts of the tie rod.
 With the vehicle placed in a straight-forward position, tilt the tie-rod forward or reward to allow the right and left tie-rod end ball joint cases to make contact with the respective ball studs.
 Then use pipe wrench or the like to turn the tie rod.
 After adjustment, tighten the clamp bolts to specified torque.

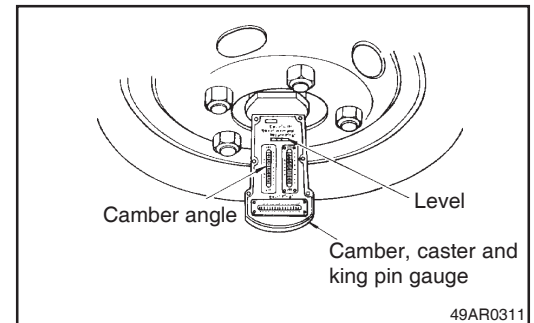
Toe-in (with tires on the ground)	1~3
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(2) Measurement of camber

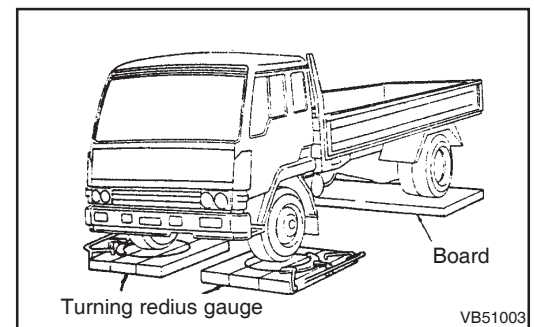
- (a) Place the front wheels in straight ahead position.
 (b) Remove the wheel hub cap.
 (c) Wipe away grease from the end of the knuckle, and attach the camber, caster and king pin gauge tightly against the front wheel hub.
 (d) Place the air bubble of the level at the center. In this condition, read the center of the air bubble on the camber scale to measure the camber. Measure the right and left cambers by the same procedure.

Camber	1° 30'
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(3) Measurement of caster and king pin angle

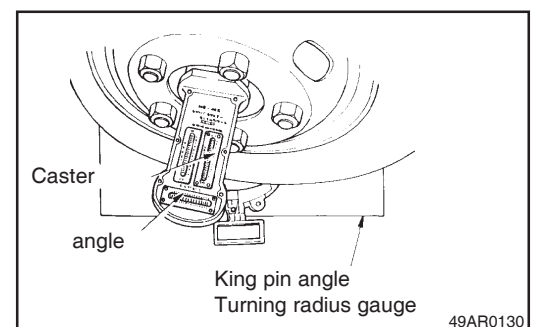
- (a) Obtain boards equal in height to the turning radius gauges to hold the vehicle in a level position.
 (b) Place the turning radius gauges in the locked state.
 (c) Slowly drive the vehicle in the straight ahead direction until the centers of the right and left front tires are placed at the centers of the turntables of the right and left turning radius gauges, and apply parking brake.

**NOTE**

If the vehicle is hard to move, raise it on jacks, and set the turning radius gauges and boards by the above-mentioned procedure.

With the vehicle on the jacks, take complete steps to prevent the vehicle from moving.

- (d) Unlock the turning radius gauges and adjust the scales to 0°.
 (e) Following the same procedure as for measurement of camber, remove the hub cap, attach the camber, caster and king pin gauge tightly against the front wheel hub, and set it at a position where the air bubble of the level stays at the center.



- (f) Depress the brake pedal to apply brakes to the front wheels and slowly turn the steering wheel until the scale of the turning radius gauge changes its direction 20° in the right direction for the right front wheel or 20° in the left direction for the left front wheel, from the position adjusted to 0° .

NOTE

Without applying brakes to the front wheel accurate measurements cannot be made, because the tires might slightly turn.

- (g) After the tires have turned 20° , rotate the adjusters to adjust the centers of the air bubbles of the caster and king pin scales to 0° .

NOTE

The king pin scale has RIGHT and LEFT.

For the right front wheel, adjust the king pin scale to RIGHT. For the left front wheel, adjust the king pin scale to LEFT.

- (h) Slowly turn the steering wheel in the reverse direction until the scale of the turning radius gauge leaves the position adjusted to 0° and changes its direction 20° in the left direction for the right front wheel or 20° in the right direction for the left front wheel. At this position, read the centers of the air bubbles of the caster and king pin scales to measure the caster and king pin angle

Caster	$30' \begin{smallmatrix} +30' \\ -10' \end{smallmatrix}$
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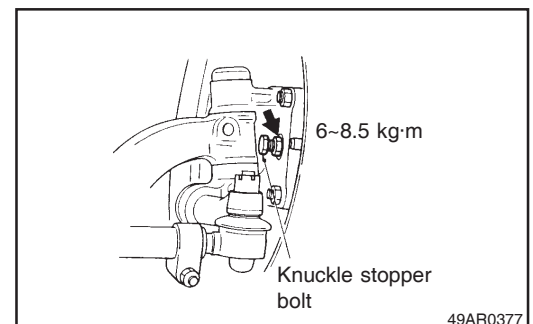
- (i) Install the wheel hub cap.

(4) Adjustment of steering angle

NOTE

Completely finish adjustment of wheel alignments before attempting adjustment of the steering angle.

- (a) Following the same procedure as for measurement of caster and king pin angle, set the turning radius gauges and boards the vehicle.
- (b) Turn the steering wheel fully to the right or to the left. Adjust the knuckle stopper bolt on each side so that the inside turning angle, right wheel angle when turned to right and left wheel angle when turned to left, is the standard angle.



(5) Measurement of side slip

NOTE

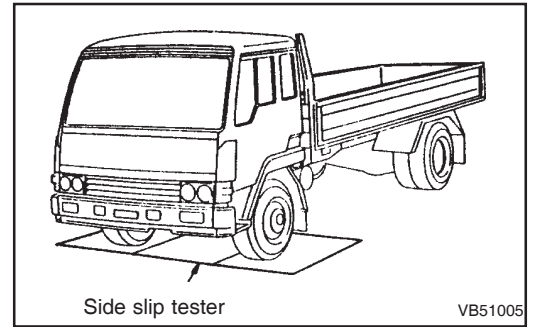
Completely finish adjustment of wheel alignment before measurement of side lip.

- (a) Place the front wheels in straight ahead position.
- (b) While maintaining the front wheels in straight ahead position, drive over the side slip tester as slowly as possible.

NOTE

Make sure that the side slip tester is completely passed with the wheels in straight ahead position. Do not allow the wheels to steer or fall down from the sides of the tester.

- (c) The value indicated by the tester is the side slip.
If the side slip is over 3 mm for 1m, readjustment of wheel alignment is necessary.



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Steering wheel vibrates	Worn king pin	Replace
	Clearance between king pin and king pin bushing too large	Replace king pin bushing
	Seized, worn or poorly turning wheel hub bearing	Replace
	Wheel misalignment	Adjust
	Excessively worn tie rod end ball stud	Replace tie rod end assembly
	Uneven tire inflation pressure	Adjust
	Loose knuckle arm and tie rod arm tightening castle nut	Tighten to specified torque
	Loose tie rod ball stud tightening nut	Tighten to specified torque
	Loose front suspension U-bolt tightening nut	Tighten to specified torque
	Vertical clearance between knuckle and front axle too large	Adjust with king pin thrust washer
Steering wheel movement is hard	Clearance between king pin and king pin bushing too large	Replace king pin bushing
	Seize, worn or poorly turning thrust ball bearing	Replace thrust ball bearing
	Wheel misalignment	Adjust
	Insufficient grease on king pin	Apply grease
Steering wheel does not return properly	Front axle parts overtightened	Retighten to specified torque
	Wheel misalignment	Adjust
Steering wheel cannot be turned	Turning angle poorly adjusted	Adjust turning angle
	Bent tie rod	Replace

REAR AXLE

GENERAL	RA - 2
SPECIFICATIONS	RA - 2
SERVICE STANDARDS	RA - 3
SPECIAL TOOLS	RA - 5
SERVICE PROCEDURE	RA - 6
TROUBLESHOOTING	RA-25

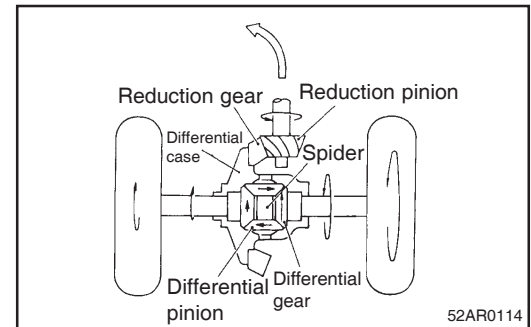
GENERAL

Differential

The rear axle is a final reduction unit consisting of final reduction gear and differential gear installed as a unit. The final reduction gear reduces the rotating speed transmitted from the engine to deliver a larger torque wheel the differential adjusts the different amounts between the outer and inner wheels are made to rotate when the vehicle makes turn.

The reduction gear changes the direction of transmission output rotation and drive force by 90 degrees and distributes it to the drive wheels.

While the vehicle is running straight, the differential pinion does not turn on the spider but turns with the differential case. When the vehicle makes a turn, the outer wheel turns faster than the inner wheel and as a result, the inner wheel and as a result, the inner wheel is decelerated while the outer wheel is accelerated. To cope with this, the differential pinion, while turning on its spider, revolve round the larger resistance differential gear, thereby driving the other differential gear to perform differential action. In this manner tire drag and resultant wear are prevented.



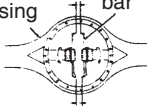
SPECIFICATIONS

Item \ Vehicle model	HD120
Rear axle type	Hypoid bevel gear, Banjo type full floating
Reduction type	Single reduction type
Reduction ratio	3.909, 4.111, 4.333
Oil capacity (gear oil)	6.5ℓ
Hub grease (one side)	0.33 kg

SERVICE STANDARDS

SERVICE STANDARDS TABLE

Unit : mm

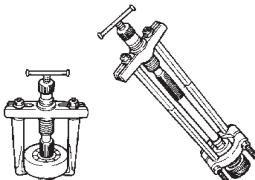
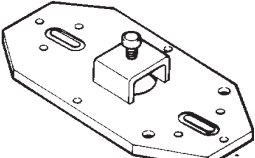
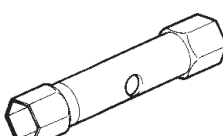
Maintenance item			Nominal value (Basic diameter in [])	Limit	Remedy and remarks
Reduction	Gear backlash		0.25~0.33	0.6	Adjust by shim and adjusting screw
	Rear back surface runout		0.15 or less	0.2	Check side bearing and tightening
	Pinion bearing starting torque	When new arts are used	20~30 kg·m		o Adjust by collar o Tangential force at bearing retainer outside circumference (3~4 kg·m)
		When oil parts are reused	16~24 kg·cm		
Differential	Gear backlash		0.19~0.25	0.5	Replace thrust washer
	Pinion to spider clearance		[26] 0.02~0.07	0.3	
	Side bearing starting torque		20~30 kg·cm		o Adjust by adjusting screw o Tangential force at differential case outside (2.4~3.5 kg)
Rear axle housing	Runout	When independent	0	4	Replace
	Bend	When installed	L2 - L1 = 0.2	L2-L1 ≥ 2.5	Rear axle housing Measurement bar  52AR0001
Rear axle shaft	Spline play in rotating direction		0.10~0.18	0.5	Replace
	Bend of flange surface (surface runout)		0.04	0.5	Replace
	Bend of shaft		1.0 or less	2.0	Replace
Hub bearing starting torque			10~40 kg·cm		Tangential force at wheel stud upside (0.9~3.6 kg·m)

Tightening Torque Table

Location tightened		Screw size O.D. x pitch (mm)	Tightening torque kg·m
Wheel hub and brake drum	Hub bearing lock nut tightening (67.5° or 3/16 turn back off after tightening lock nut A)	M85 x 2.00	(30)
	Wheel hub to rear axle shaft tightening bolt	M16 x 1.50	(27.7)
	Wheel hub to brake drum tightening nut	M20 x 1.50	(32.8)
	Anchor bracket attaching bolt	M14 x 1.50	17~21
Reduction pinion companion flange castle nut		M33 x 1.50	(55~75)
Reduction gear to differential case attaching bolt		M16 x 1.50	(30)
Differential case bolt		M14 x 1.50	(17~23)
Differential carrier to reduction pinion bearing retainer attaching bolt		M14 x 1.50	(12)
Bearing cap tightening bolt		M22 x 1.50	(45.5)
Adjusting screw lock pawl bolt		M10 x 1.25	(3.5)
Rear axle housing to differential carrier attaching bolt		M10 x 1.25	16~18
Drain plug		M30 x 1.50	(18~20)
Oil filler plug		M30 x 1.50	(18~20)

SPECIAL TOOLS**RA-5****SPECIAL TOOLS**

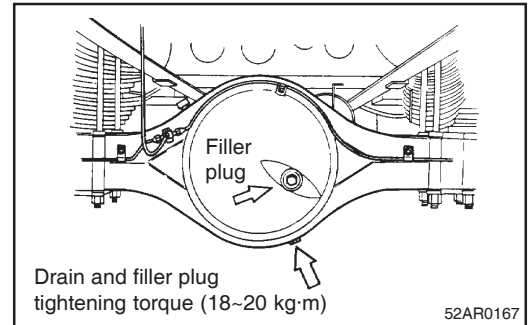
Unit : mm

Tool (Number and name)	Illustration	Use
Puller set 09431-83100	 ASST0030	Removal of gear and bearing
Wheel hub puller 09517-83200	 ASST0951	Removal of wheel hub
Hub socket wrench 09517-83100	 ASST0010	Removal and installation of bearing lock nut
Drift 09517-83300	 ASST0020	Removal of oil seal and bearing

SERVICE PROCEDURE

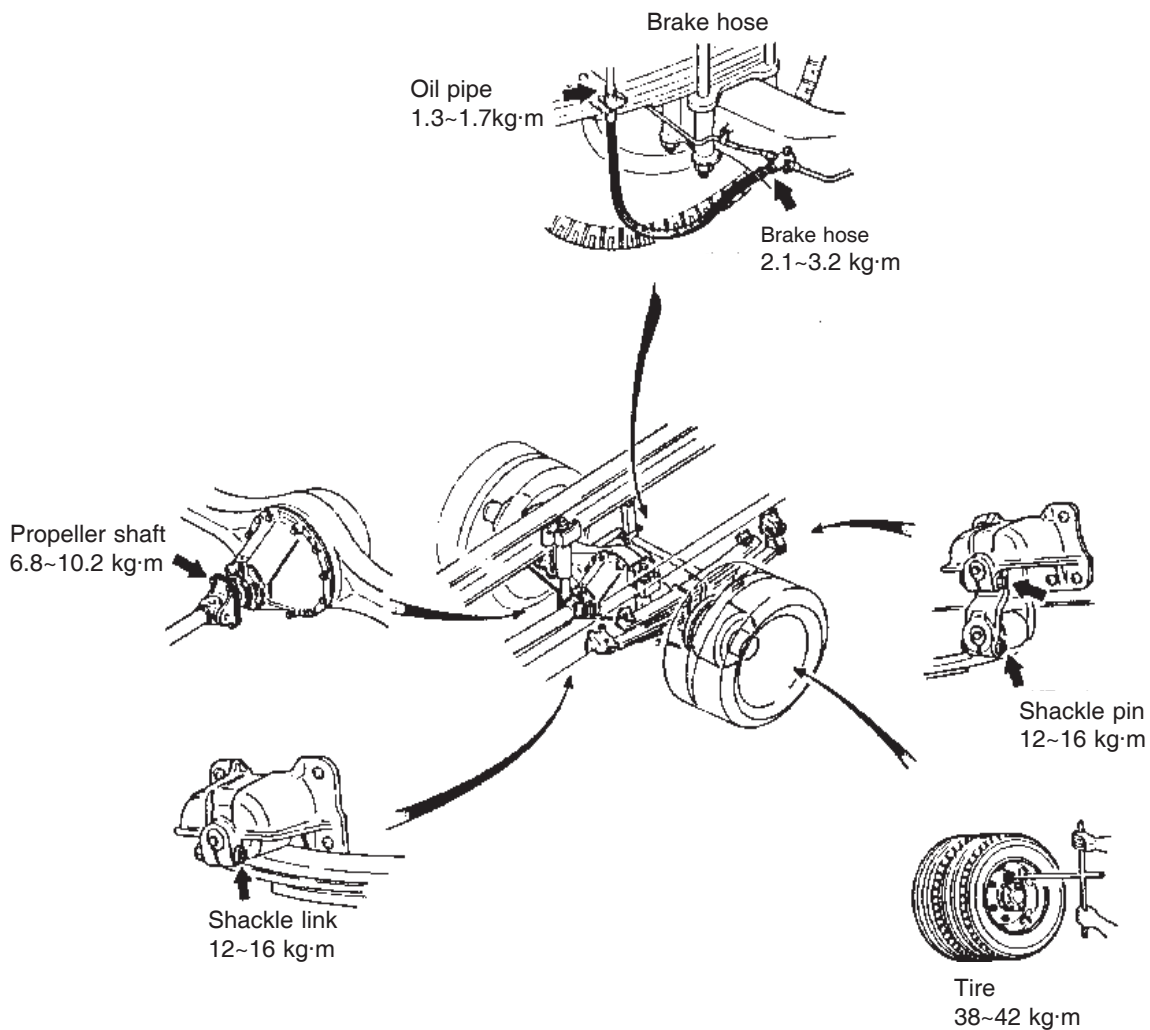
REMOVAL AND INSTALLATION

DRAINING THE REAR DIFFERENTIAL OIL



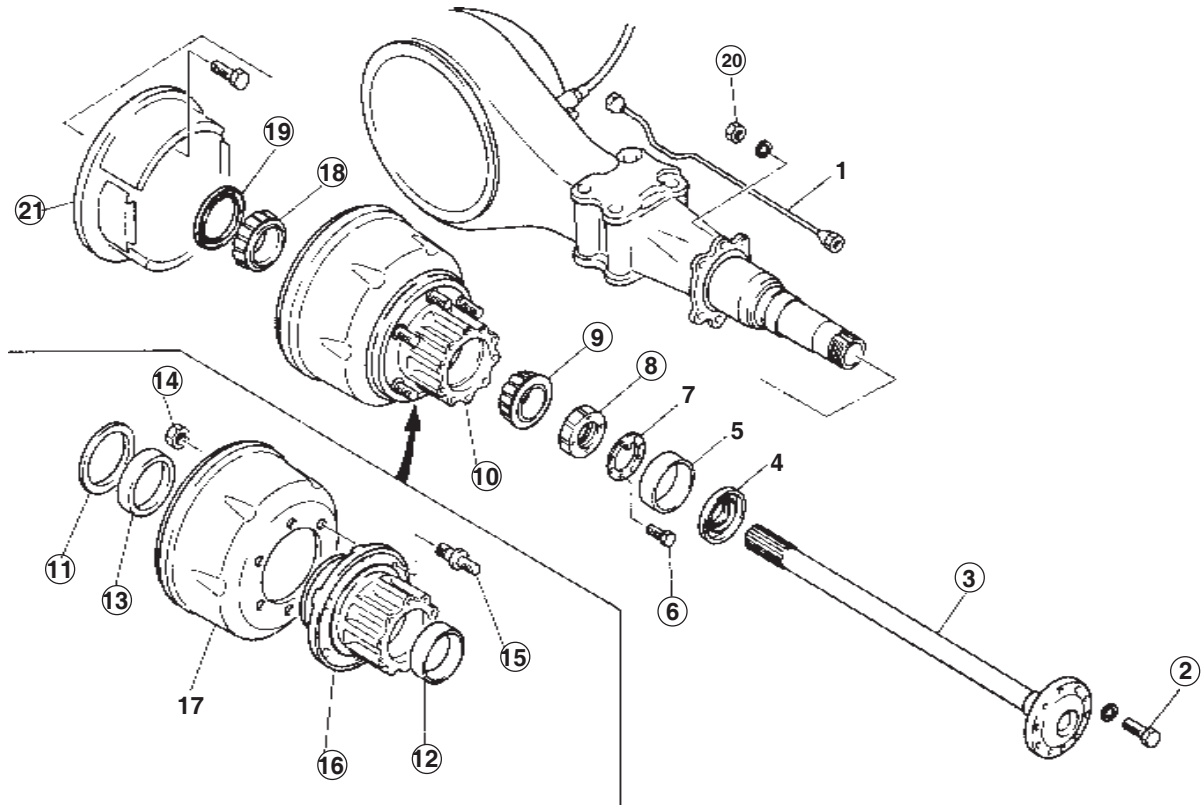
NOTE

- Remove the brake hose from the frame side first. When remounting it, install the rear axle housing side first. Take care not to twist it.
- Plug disconnected pipe to prevent the entry of dust or other foreign matter.
- After reassembly, bleed the brake system.



WHEEL HUB AND BRAKE DRUM

Disassembly, inspection and corrections



Disassembly sequence

1. Brake pipe
2. Bolt
3. Rear axle
4. Outer oil seal
5. Wheel hub oil seal distance piece
6. Bolt
7. Lock plate
8. Lock nut
9. Wheel hub outer bearing inner race
10. Wheel hub and drum assembly
11. Inner oil seal
12. Wheel hub outer bearing outer race
13. Wheel hub inner bearing outer race
14. Nut
15. Hub bolt
16. Rear wheel hub
17. Rear brake drum
18. Wheel hub inner bearing inner race
19. Oil seal retainer
20. Nut
21. Rear brake assembly

For disassembly of parts with an encircled number, see Disassembly Procedure given later.

RA-8

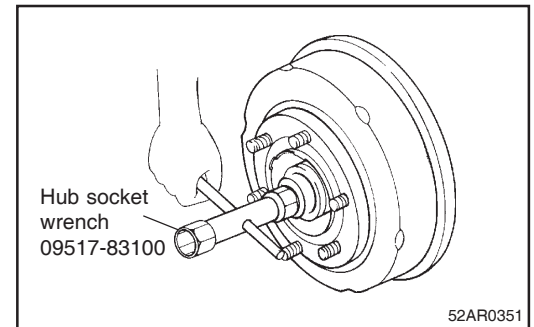
REAR AXLE

Disassembly procedure

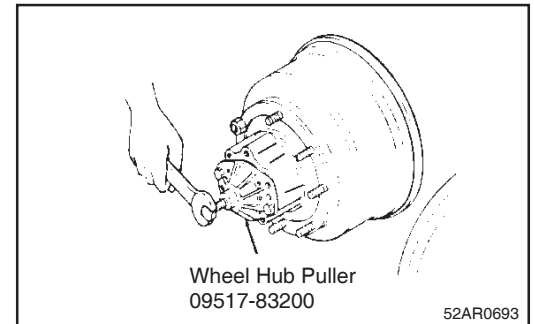
(1) Removal of lock nut

NOTE

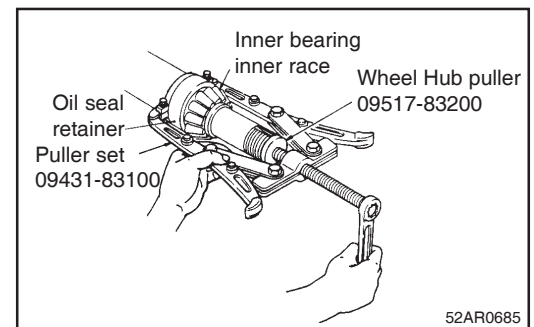
A right-handed screw is used for R.H wheel, and a left-handed screw is used for L.H wheel.



(2) Removal of rear wheel hub.

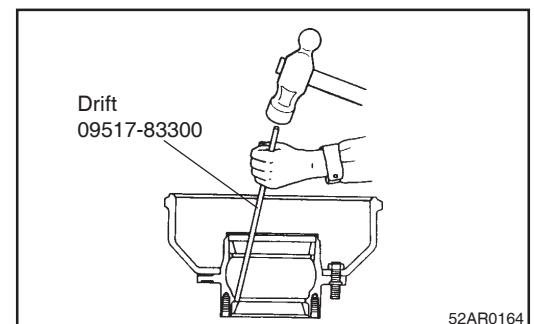


(3) Removal of inner bearing inner race and oil seal retainer.



(4) Removal of outer inner bearings outer race.

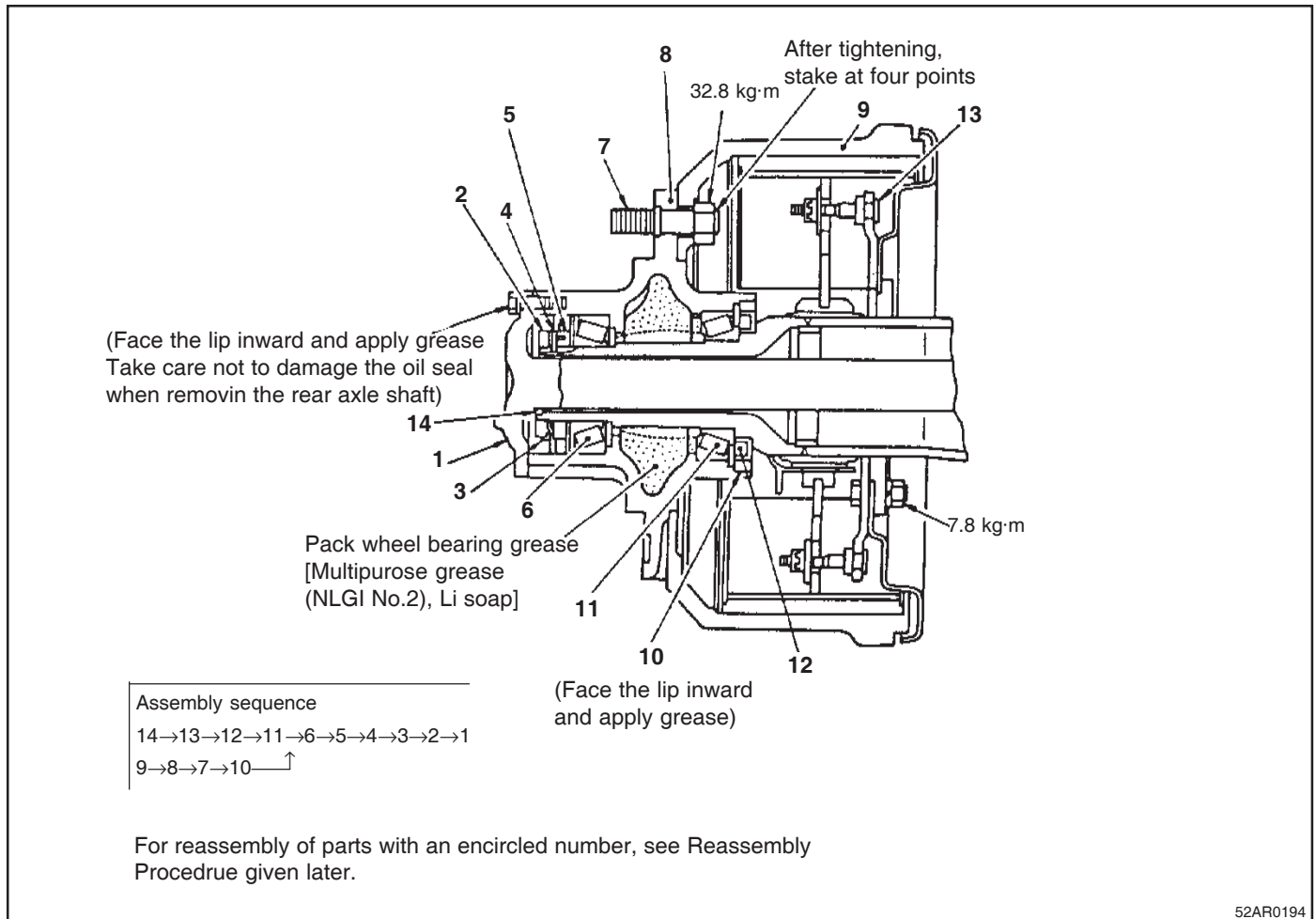
Using a rod, hammer the inside notched portion evenly to force the outer race out.



SERVICE PROCEDURE

RA-9

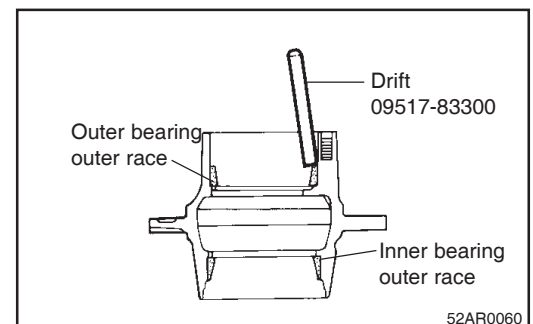
Reassembly



52AR0194

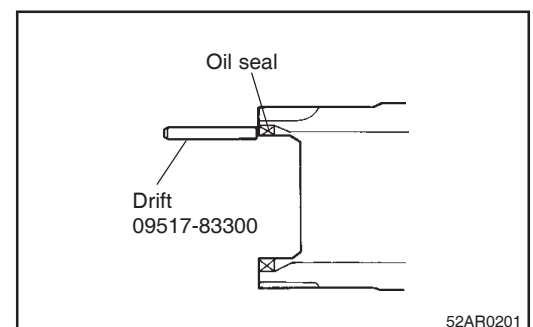
Reassembly procedure

(1) Installation of inner/outer bearing outer race



52AR0060

(2) Installation of oil seal (end of rear axle tube).

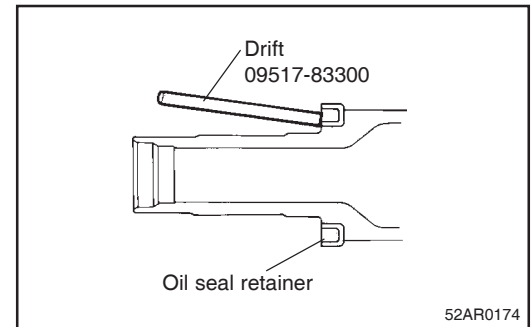


52AR0201

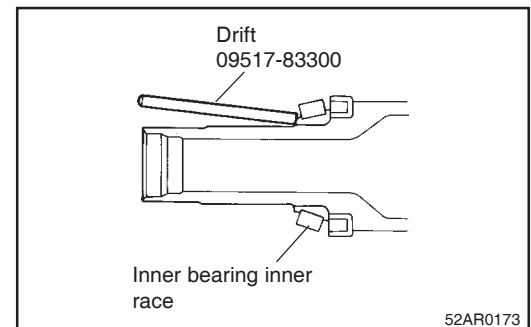
RA-10

REAR AXLE

(3) Installation of oil seal retainer

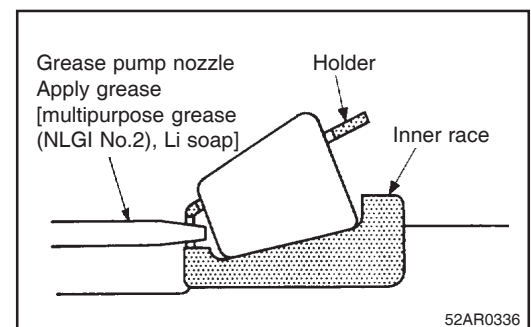


(4) Installation of inner/outer bearing inner race.



(5) Greasing

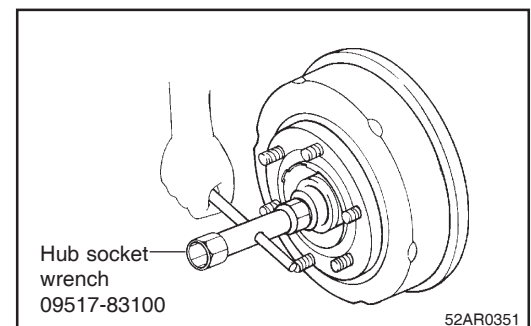
Packing sufficient grease between rollers of the inner race.



(6) Adjustment of hub bearing stating torque.

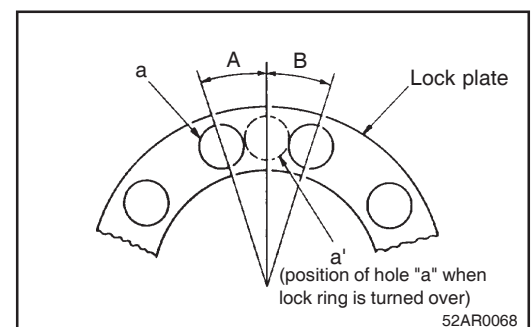
- (a) Turn the wheel hub three or more turns to the clockwise and using the special tool Hubsocket wrench, tighten the lock nut A to specified torque and back it off 30° (1/12 turn).

Tightening torque	Counter-clockwise rotation
14 kg·m	1/4 (90°)

**NOTE**

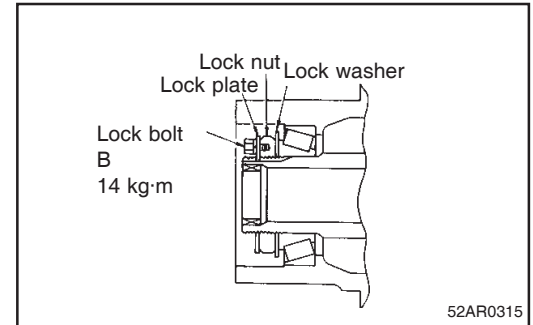
When striking the end of knuckle face with a copper hammer the hub bearing inner race is moved to outer side. Remove the clearance when turning the lock nut A.

- (b) If the alignment of the pin of lock nut A and the hole of the lock plate is impossible, then proceed followings
- ① When the center of the pin is within the range of A, loosen the lock nut A and align the pin with the hole "a".
 - ② When the center of the pin is within the range of B, turn over the lock plate and loosen the lock nut A and then align the pin with the hole "a".



SERVICE PROCEDURE**RA-11**

- (c) After Installing the lock washer, tighten the lock nut B to the specified torque.



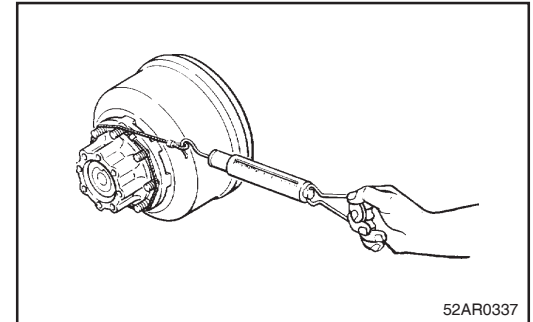
(7) Measurement of wheel hub starting torque

Wind a string around the wheel hub bolts and pull the string tangentially and slowly with a spring balancer and check if the tangential force is within specification.

Tangtial force	Starting torque
0.9~3.6	10~40 kg·m

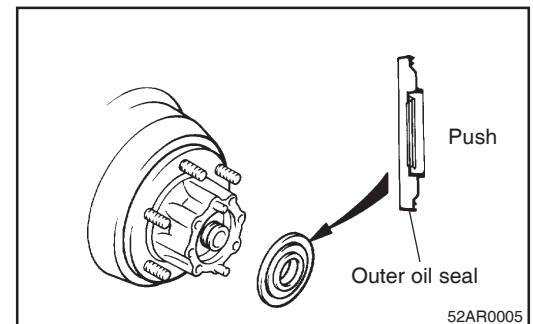
NOTE

1. If the tangential force is within specification, the starting torque is also within specification consequentially.
2. The starting torque should not exceed 40 kg.cm (or upper limit of the tangential force).
3. If the tangential force is out of specification, adjust the starting torque again.



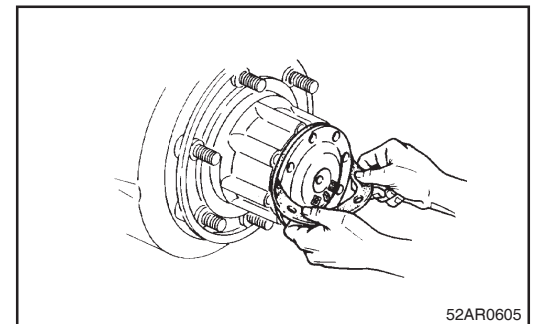
(8) Outer oil seal

Installation of the outer oil seal install the outer oil seal by pushing in the direction as shown in the illustration.



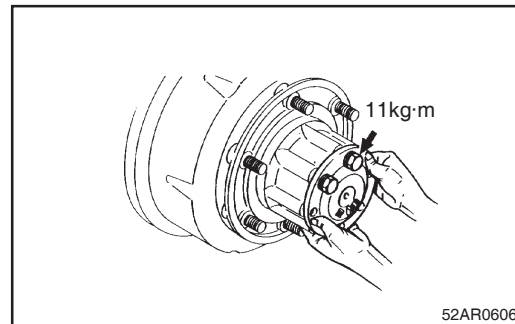
(9) Installation of rear axle shaft

- (a) Install the packing on the rear axle shaft.



RA-12**REAR AXLE**

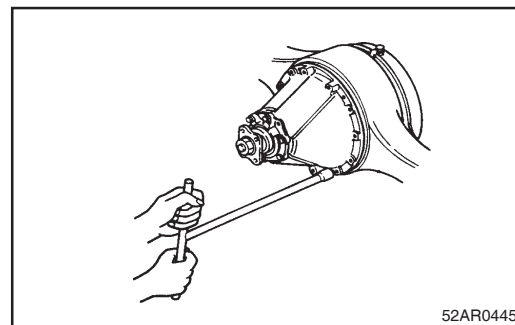
- (b) Align the bolt holes of the rear axle shaft and packing, and install the shaft on the rear wheel hub.

**Reduction and differential**

Starting torque	Tangential force
10~40 kg.m	0.9~3.6 kg

Removal

- (1) Removal of differential carrier assembly
- (a) Screw a bolt (M12 x 1.25) into the threaded hole of the differential carrier (provided for disassembly) alternately to remove the carrier assembly.

**Inspection before disassembly**

- (1) Reduction gear backlash

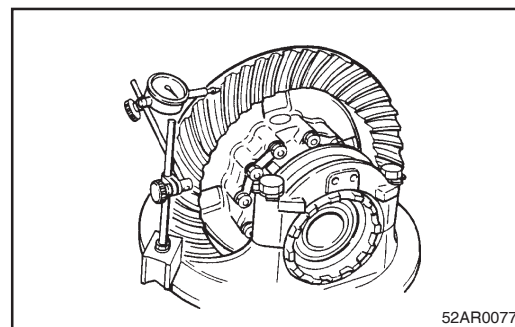
NV : Nominal Value

SL : Standard Limit

Reduction gear backlash

NV : 0.25 - 0.33 mm

SL : 0.6 mm



- (2) Reduction gear back surface runout

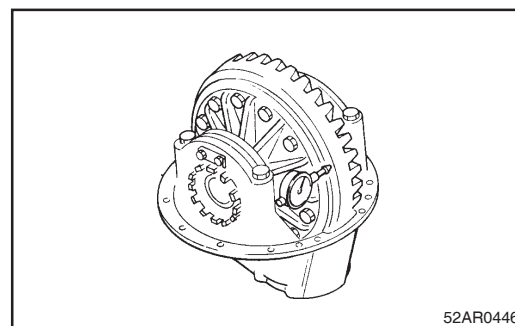
Runout of reduction gear back surface

NV : 0.15 or less

SL : 0.2 mm

NV : Nominal Value

SL : Standard Limit

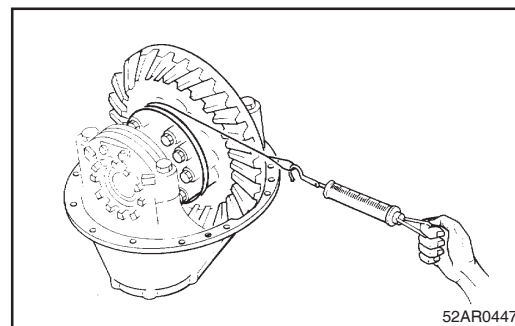


- (3) Side bearing starting torque

Norminal Value	Tangential force
20-30 kg·cm	2.4~3.5 kg

NOTE

Measurement should be performed within the backlash range.



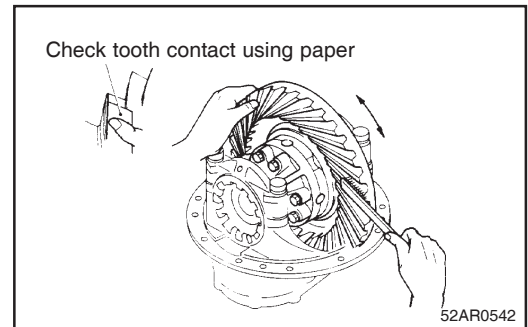
SERVICE PROCEDURE

RA-13

(4) Reduction gear tooth contact

NOTE

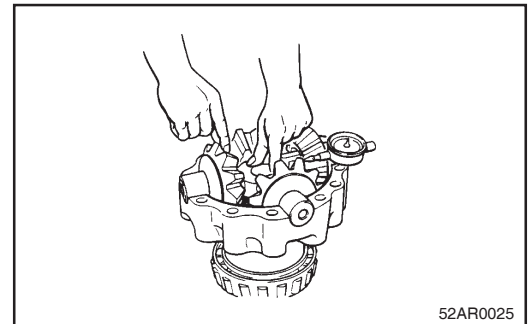
1. Put alignment marks on the differential carrier, bearing cap and right and left differential cases.
2. Record the thickness of adjusting shims and collars and the number of shims used.



(5) Backlash of differential gear and differential pinion.

Backlash between differential gear and differential pinion.

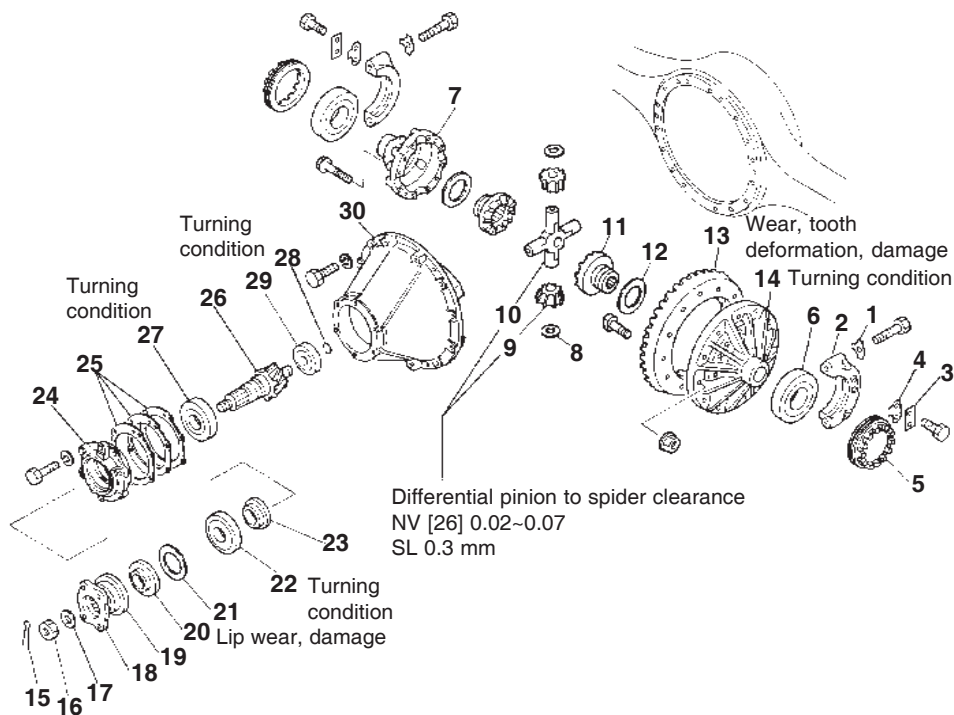
Nominal Value	Limit
0.19~0.25	0.8 mm



Disassembly and inspection

Disassembly sequence

1. Lock plate
2. Bearing cap
3. Lock plate
4. Lock pawl
5. Adjusting screw
6. Side bearing
7. Differential case R.H.
8. Differential pinion washer
9. Differential pinion
10. Pinion spider
11. Differential gear
12. Differential gear washer
13. Reduction gear
14. Differential case L.H.
15. Split pin
16. Castle nut
17. Flat washer
18. Companion flange
19. Dust cover
20. Oil seal



21. Oil separator
22. Outer bearing
23. Collar
24. Bearing retainer
25. Shim
26. Reduction pinion
27. Inner bearing
28. Lock ring
29. Pinion pilot bearing
30. Differential carrier

NV ... Nominal Value
SL ... Standard Limit

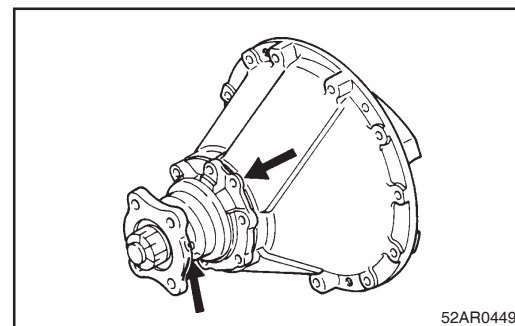
For parts with an encircled number, refer to Disassembly Procedure that follows.

52AR0757

Disassembly procedure

(1) Removal of bearing retainer

Screw two bolts (M12 x 1,25) into the threaded holes for disassembly to remove the bearing retainer.

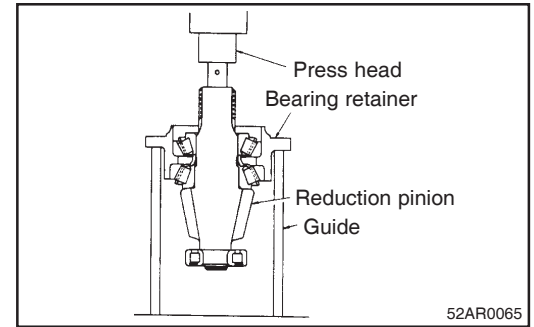


52AR0449

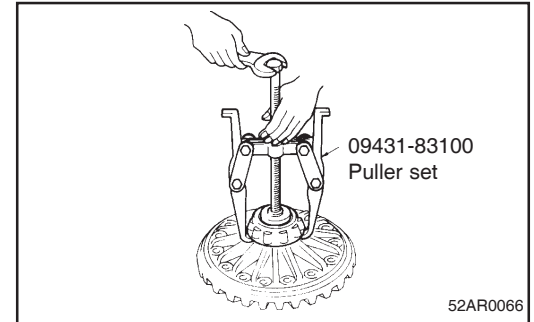
SERVICE PROCEDURE

RA-15

(2) Removal of reduction pinion

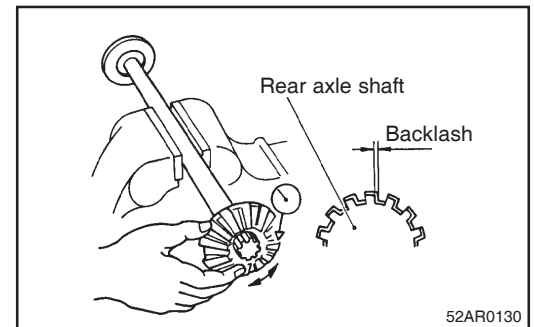


(3) Removal of side inner race



(4) Check for backlash between rear axle shaft and differential gear

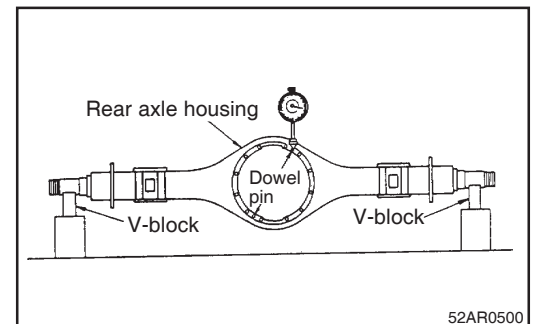
Nominal Value	Limit
0.1~0.18 mm	0.5 mm



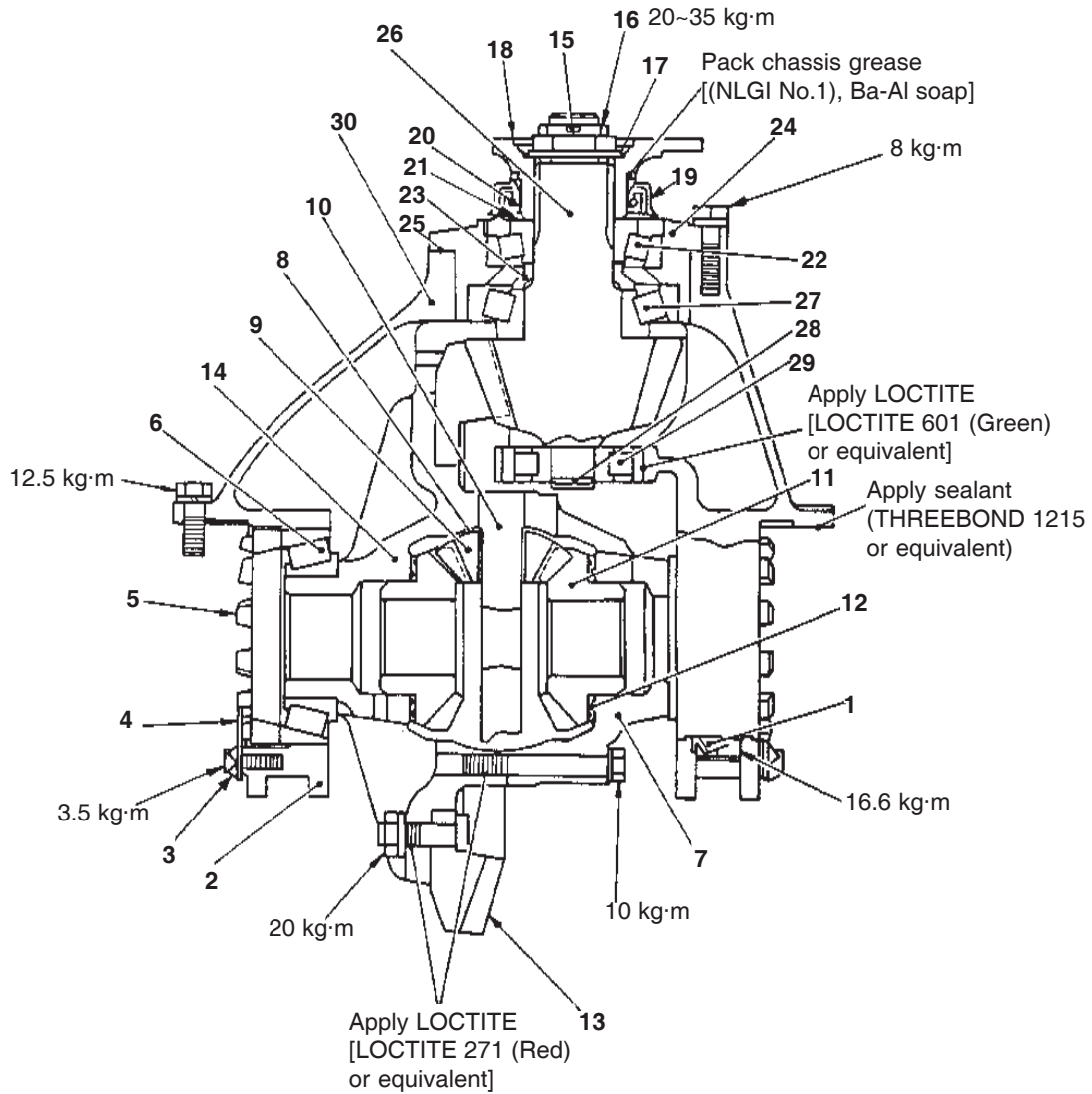
(5) Check for runout of rear axle housing proper (as a unit)

Hold the outer bearing fitting portions at both ends of the housing tube in level position on V-blocks and measure the dowel pin height. Then, turn the tube 180 degrees and measure again the dowel pin height. The difference between both measurements represents the rear axle housing runout.

Nominal value	0 mm
Limit	4 mm



Reassembly



Assembly sequence

26→27→24→23→22→29→28→21→20→17→16→15→25→30→⑤→2→1→4→3

19→18

⑦→⑥→12→11
(Inner race)

10→9→8

13→14→12→11

6
(Outer race)

For parts with an encircled number, refer to Reassembly Procedure that follows.

SERVICE PROCEDURE**RA-17**

Reassembly with mating marks aligned.

NOTE

1. When the following parts are to be replaced, replace always as a set.

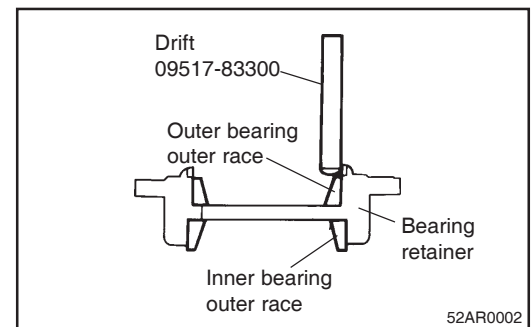
Set parts

Set name	Set composition	Remarks
Reduction gear set	Reduction pinion and reduction gear	Let serial numbers of alignment marks coincide.
Differential carrier set	Differential carrier and bearing cap	-
Differential case set	Differential case R.H. and L.H.	-

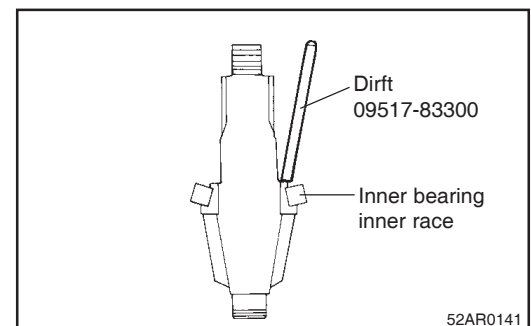
2. When the reduction and differential assembly is installed to the housing, be sure to apply silicone liquid packing uniformly to the mounting surface of the differential carrier.

Reassembly procedure

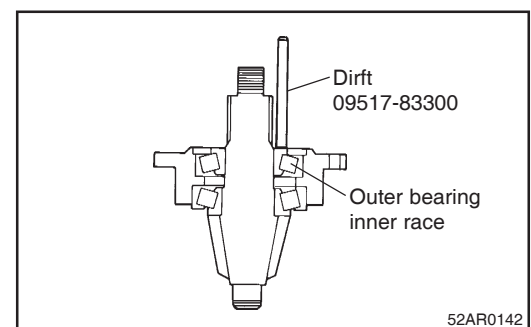
- (1) Installation of inner, outer bearing outer race.



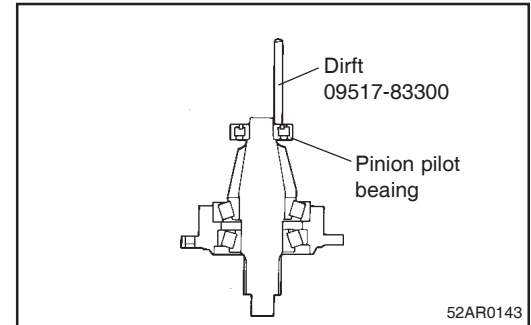
- (2) Installation of inner bearing inner race



- (3) Installation of outer bearing inner race

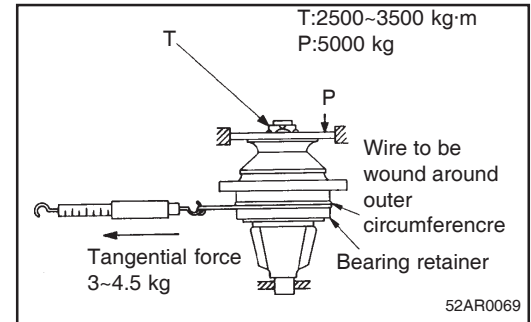


(4) Installation of pinion pilot bearing



(5) Adjustment of starting torque of reduction pinion bearing

Choose a proper adjusting collar from the table below and apply the load (P) or tighten the castle nut to the specified torque so that the tangential force specified in the table will be obtained.

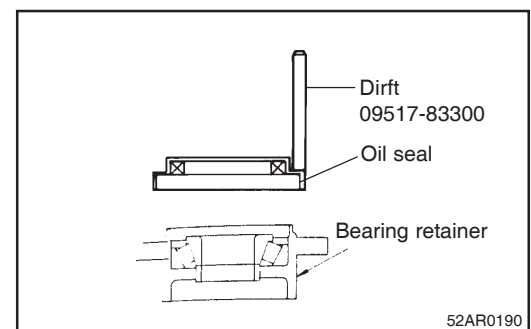


Adjusting collar		Newpart in use		Old part in use	
		Tangential force (kg)	Starting torque (kg·cm)	Tangential force (kg)	Starting torque (kg·cm)
D4H	12020-25300 t=15.875~16.475 (30 kinds in 0.025 in crements)	3~4.5	20~30	2.4~3.6	16~24

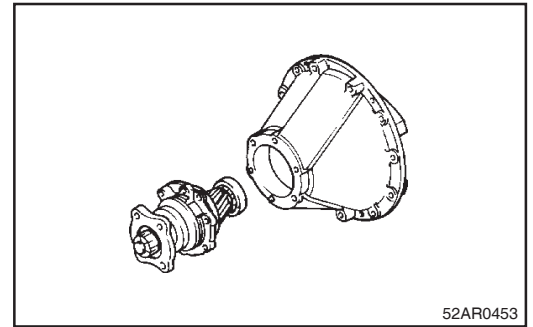
NOTE

1. The oil separator must be in its installed position when measuring the starting torque.
2. The oil seal must not be in its installed position when measuring the starting torque.

(6) Press-fitting of oil seal into bearing retainer



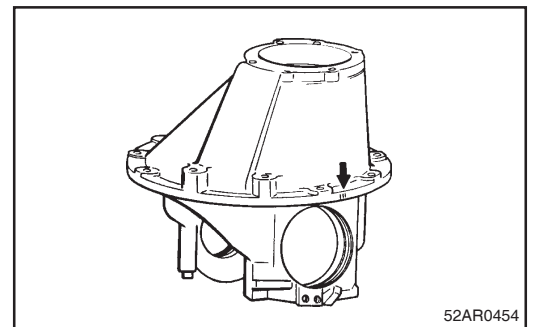
(7) Installation of bearing retainer



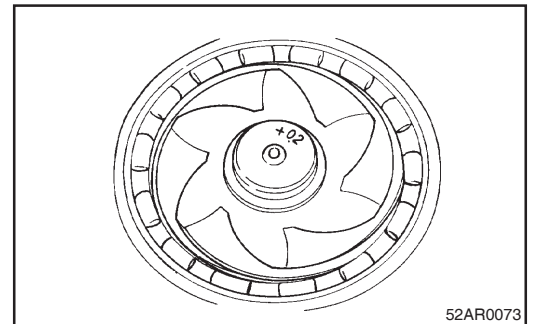
(8) Selection of reduction pinion mounting adjusting shim

Based on the stamped dimension shown the machining errors of the reduction pinion and the differential carrier, calculate the shim thickness required to attain the assembly standard dimensions by the equation shown below and select shims accordingly.

Position of error value stamped on differential carrier.



Position of error value stamped on reduction pinion.



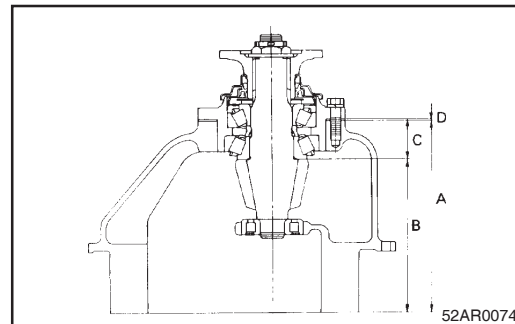
RA-20**REAR AXLE****Calculation Equation**

Shim thickness $D = 0.5 - a + b + c$

where a = Difference from nominal dimension A

b = Difference from nominal dimension B

c = Difference from nominal dimension C



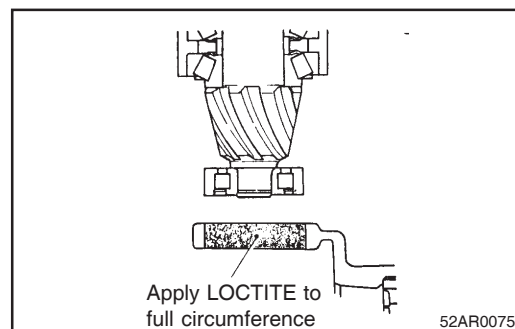
Location	Nominal dimension	How to find error
	D10H	
Shim thickness	0.5 mm	-
A	227 mm	Error multiplied by 100 is stamped on outside circumference of flange of differential carrier
B	175 mm	Error shown on end of reduction pinion
C	52.5 mm	Measure error with respect to C dimension, using dial indicator. Generally this error is hard to measure, so it is assumed to be between 0~0.2 mm.

Select shims that give thickness D from the table below

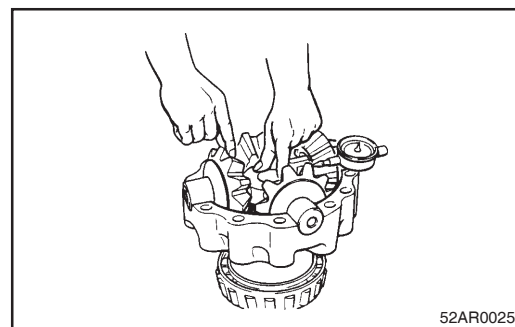
Part name	Thickness	Standard number of shims to be used (shim thickness 0.5)
Shim B	0.2 mm	2
Shim C	0.1 mm	1

(9) Installation of pinion pilot bearing

- Allow to stand for 30 minutes to two hours after installation.
Allow three hours or more before starting the vehicle in motion.
Allow preferably 24 hours.
- LOCTITE brand: Ushio Loctite 601 (Green) or equivalent.

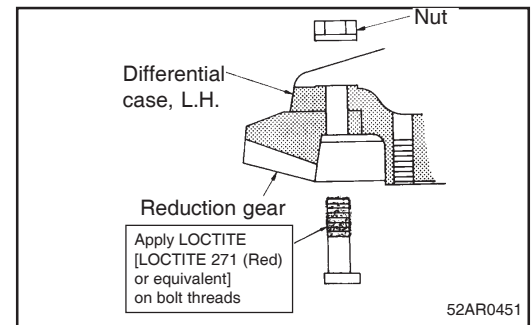
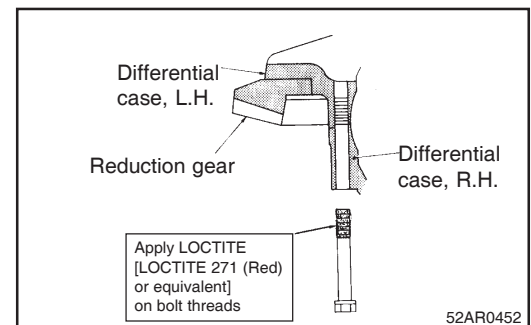
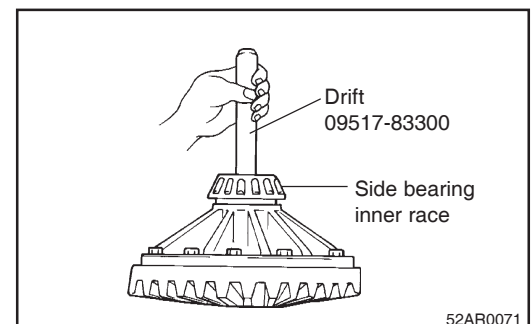
**(10) Backlash between differential gear and differential pinion.**

Nominal Value	Limit
0.19~0.25 mm	0.5 m



SERVICE PROCEDURE**RA-21****(11) LOCTITE application procedures****NOTE**

1. Apply antirust evenly to the entire bolt before application of LOCTITE.
2. After application of LOCTITE, allow a hardening period of one hour or more before starting the vehicle in motion. Before full torque operation, let the LOCTITE harden for four hours or more after application.
3. **LOCTITE brand**
Nihon Loctite LOCTITE 271 (red) or equivalent.

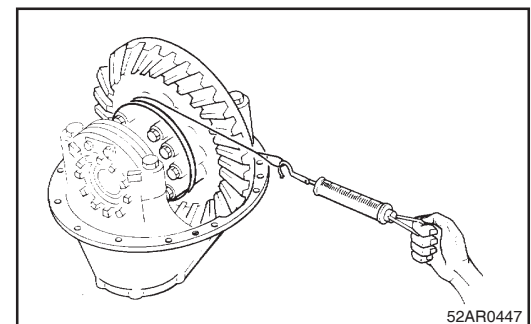
(a) Reduction gear**(b) Differential case****(12) Installation of side bearing inner race****(13) Measurement of side bearing starting torque**

Tighten the right and left adjusting screws for the starting torque specified below.

NOTE

When installing the bearing cap, pay attention to the right and left alignment marks.

Nominal Value	Tangential force
Outside 20~30 kg.cm	2.4~3.5 kgf at 170 dia. position on outside circumference of differential case



(14) Reduction gear backlash

Adjust with the right and left adjusting screws while using care not to change the starting torque that has been adjusted.

NOTE

When one adjusting screw was loosened, be sure to turn down the other screw the same amount.

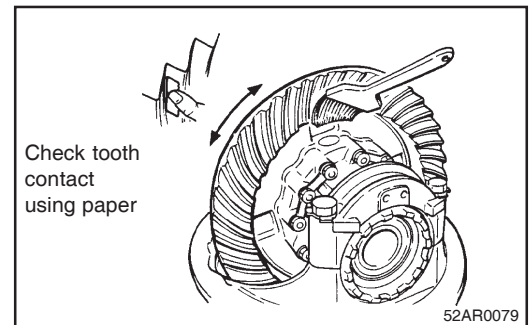
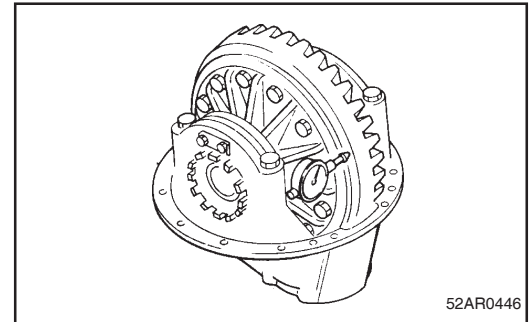
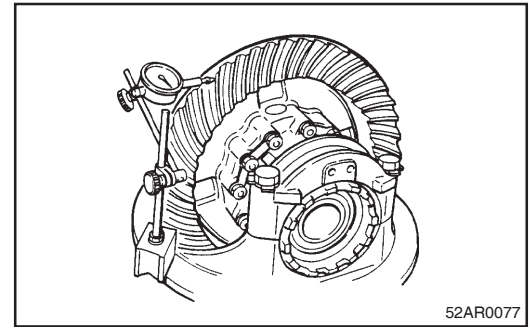
Nominal Value	Limit
0.25~0.33 mm	0.6 mm

(15) Reduction gear back surface runout

Nominal value	0.15 or less
Limit	0.2

(16) Reduction gear tooth contact

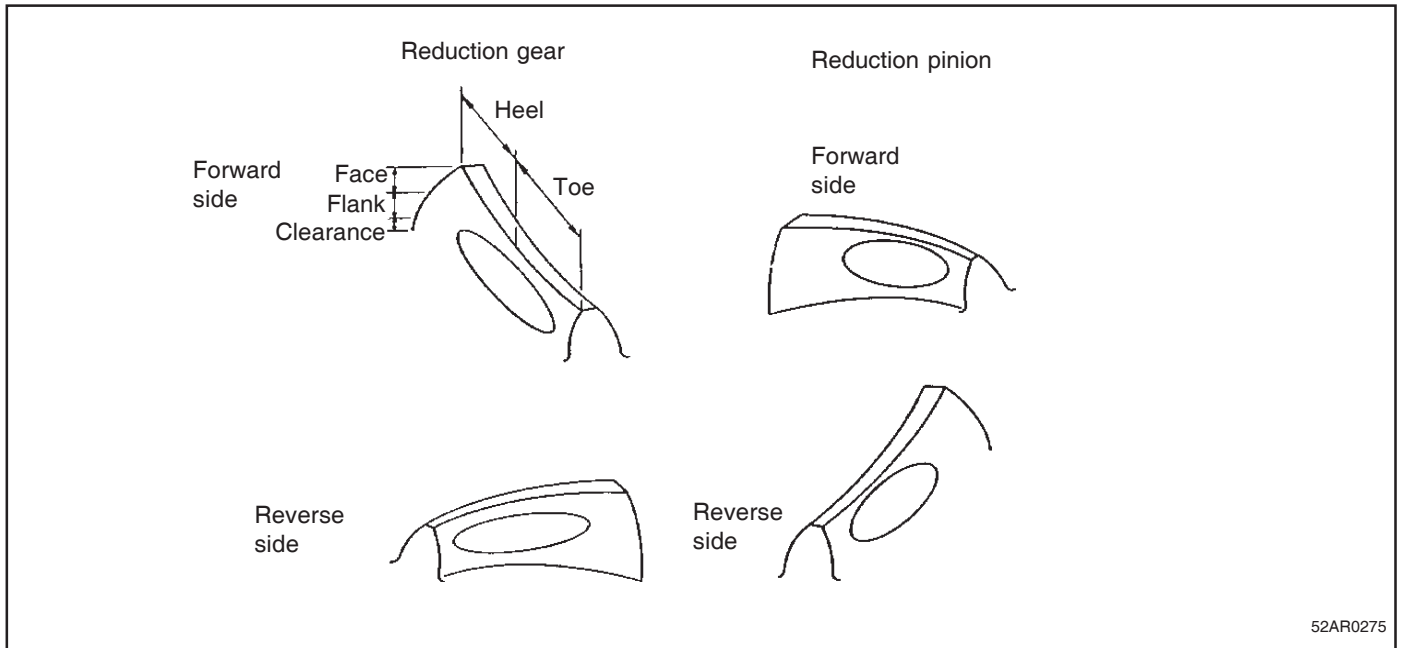
Apply red lead to three or four teeth of the reduction gear and turn the gear several times to check tooth contact. If tooth contact excessively out of position is evident, adjust by adding or removing reduction pinion mounting adjusting shims and increasing or decreasing the backlash. If the gear has to be replaced due to abnormally worn teeth, be sure to replace the reduction gear and reduction pinion as a set.



SERVICE PROCEDURE

RA-23

Correct tooth contact under no-load condition



52AR0275

Check item			Assembly standards
Unloaded	Tooth contact position	Lengthwise direction of tooth	From center toward toe
		Vertical direction	From center toward top of tooth for reduction gear and the center of tooth for reduction pinion
	Tooth contact shape	Length	Approx. 50 to 70% of face width
		Width	Approx. 50 to 70% of tooth depth
	Degree of tooth contact		Becomes weaker as it comes nearer to root or top

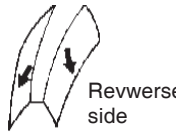
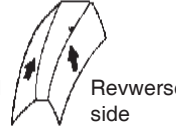
NOTE

When the tooth contact is nearer to the tow under no load condition, contact takes place at about center under loaded condition.

RA-24

REAR AXLE

Tooth contact adjusting procedures

Adjusting procedures		Moving direction
Adjustment by adding or removing shims	Move pinion toward reduction gear (reduce shim thickness).	Forward side  Reverse side Tooth contact moves toward root of tooth.
	Move pinion away from reduction gear (increase shim thickness).	Forward side  Reverse side Tooth contact moves toward top of tooth.
Adjustment by adjusting screws	Move reduction gear toward pinion center (backlash to be reduced)	 Forward side: Nearer to heel and slightly nearer to top of tooth Reverse side: Nearer to heel and slightly nearer to root of tooth.
	Move reduction gear away from pinion center (backlash to be increased)	 Forward side: Nearer to heel and slightly nearer to top of tooth Reverse side: Nearer to heel and slightly nearer to root of tooth.

52AR0102

Even if good tooth contact is obtained by adjustment of reduction gear tooth contact, correction of the backlash at the pinion could result in poor tooth contact. In such a case, the tooth contact should be given priority and the backlash need not be adjusted to fall within the specified limit provided that there is a backlash of 0.15 mm or more.

TROUBLESHOOTING

Symptom		Probable cause	Remedy
Oil leak	Oil leak from companion flange	Overfilled gear oil	Adjust oil level
		Worn or damaged oil seal	Replace
	Oil leak from differential carrier and rear axle housing	Loose reduction and differential assembly mounting bolts	Retighten
		Faulty sealant	Recoat sealant
		Cracked or damaged differential carrier	Replace carrier assembly
	Oil leak from rear axle shaft	Loose rear axle shaft mounting bolt	Retighen
		Worn or damaged oil seal	Replace
		Cracked, damaged or clogged air breather	Replace
Faulty power transmission	Propeller shaft turns but vehicle does not move	Broken rear axle shaft	Replace
		Rear axle shaft disconnected	Tighten to specified torque
		Damaged or seized reduction gear or reduction pinion	Replace reduction gear set
		Damaged or seized differential gear or differential pinion	Replace
	Noise produced when starting or when shifting gear	Reduction gear backlash too large	Adjust
		Differential gear backlash too large	Adjust (if meshing is bad after adjustment, replace differential gear set)
		Low reduction pinion starting torque	Adjust
		Loose reduction pinion lock nut	Tighten to specified torque
		Loose reduction gear and differential case tightening bolts	Retighten
		Noise from propeller shaft	Repair
	Continuous noise while driving	Worn or damaged reduction gear or reduction pinion	Replace reduction gear set
		Poorly adjusted reduction gear backlash or tooth contact	Adjust
		Seized, worn or badly turning side bearing	Replace
		Seized, worn or badly turning inner or outer bearing of reduction pinion	Replace
		Improperly adjusted side bearing preload	Adjust
		Seized, worn or badly turning wheel hub bearing	Replace

Symptom		Probable cause	Remedy
Faulty power transmission	Irregular noise while driving	Damaged wheel hub bearing	Replace
		Damaged side bearing	Replace
		Damaged inner or outer bearing of reduction pinion	Replace
		Damaged differential gear or differential pinion	Replace differential gear set
		Damaged or worn differential gear washer	Replace
		Damaged reduction gear reduction pinion	Replace reduction gear set
		Loose rear axle shaft mounting bolt	Retighten
		Loose differential carrier assembly mounting nut	Retighten
	Noise when turning	Damaged or worn reduction gear or reduction pinion	Replace reduction gear set
		Damage or worn differential gear or differential pinion	Replace
		Damaged or worn differential gear washer	Replace
		Seized, worn or badly turning side gearing	Replace

PROPELLER SHAFT



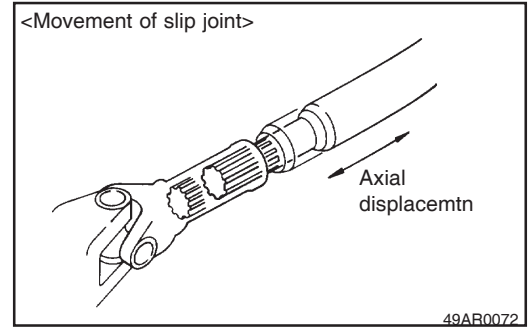
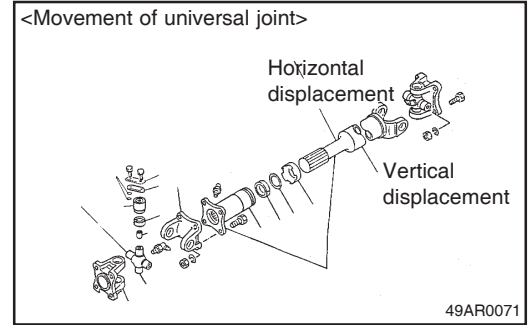
GENERAL	PS - 2
SPECIFICATIONS	PS - 2
SERVICE STANDARDS	PS - 3
SPECIAL TOOLS	PS - 3
SERVICE PROCEDURE	PS - 4
TROUBLESHOOTING	PS-13

GENERAL

The propeller shaft, installed between the transmission and rear axle, transmits the engine power(rotation) changed by the transmission to the final gear of the rear axle.

The propeller shaft consists of two sections; the front and rear propeller shafts. Two or more sections are coupled together depending on the wheel base. A propeller shaft consisting of two or more sections has a center bearing at the center, supported by the frame.

The positional relationship between the transmission and rear axle varies with road surface irregularities, vibration during operation and load changes. To cope with the variations, the propeller shaft has a universal joint and slip joint absorb such variations.



SPECIFICATIONS

Item	Model	HD120
Universal joint		
Spider O.D		27.75/30.5 mm
Needle roller bearing		
O.D		3 mm
Length		21.55/25.5 mm
Quantity		32/35
Slip joint		
Spline diameter		48/mm
Pipe		
O.D x Thickness		Ø88.9 x 4 / Ø101.6 x 5

SERVICE STANDARDS**PS-3****SERVICE STANDARDS****SERVICE STANDARDS TABLE**

Unit : mm

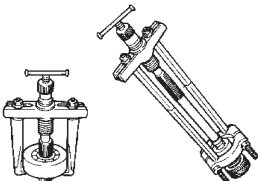
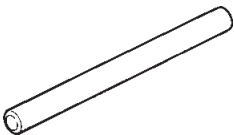
Maintenance item	Nominal value (Basic diameter [μ])	Limit	Remedy and remarks
Bend of propeller shaft (measured at center of shaft)		0.6	Correct or replace
Spline play in rotating direction (rear propeller shaft and yoke sleeve)	0.07 to 0.17	0.3	Replace
Spider to needle bearing clearance	[28.56] 0.02 to 0.074	0.2	Replace
Spider play in axial direction	0 to 0.15		Adjust by shim (t=0.1, t=0.2)

TIGHTENING TORQUE TABLE

Location tightened	Screw size O.D. x pitch (mm)	Tightening torque kg·m
Flange yoke to propeller shaft flange tightening attaching bolt	M12 x 1.25	7.3 to 9.7
Needle roller bearing mounting bolt	M8 x 1.25	1.8 to 2.7
Companion flange castle nut (For center bearing attachment)	M33 x 1.5	55 to 75
Center bearing bracket attaching bolt	M12 x 1.25	8.0 to 11

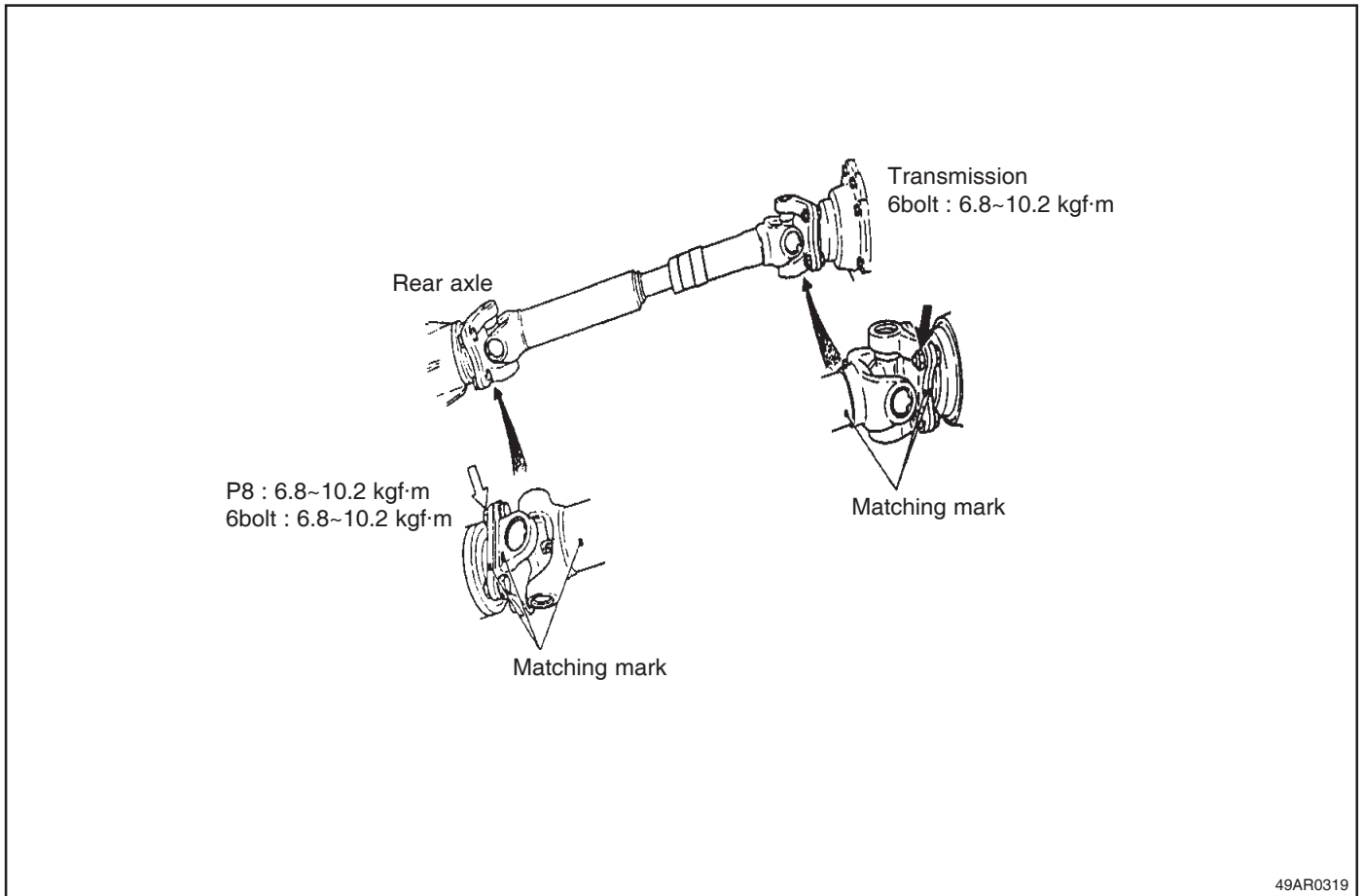
SPECIAL TOOLS

Unit : mm

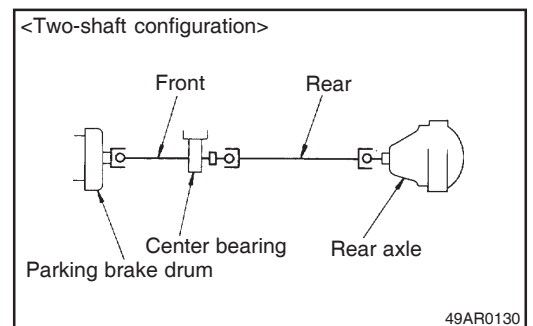
Tool (Number and name)	Illustration	Use
Puller set 09431-83100	 ASST0030	Removal of center bearing and installation of needle roller bearing
Drift 09517-83300	 ASST0020	Removal of oil seal and bearing

SERVICE PROCEDURE

REMOVAL AND INSTALLATION



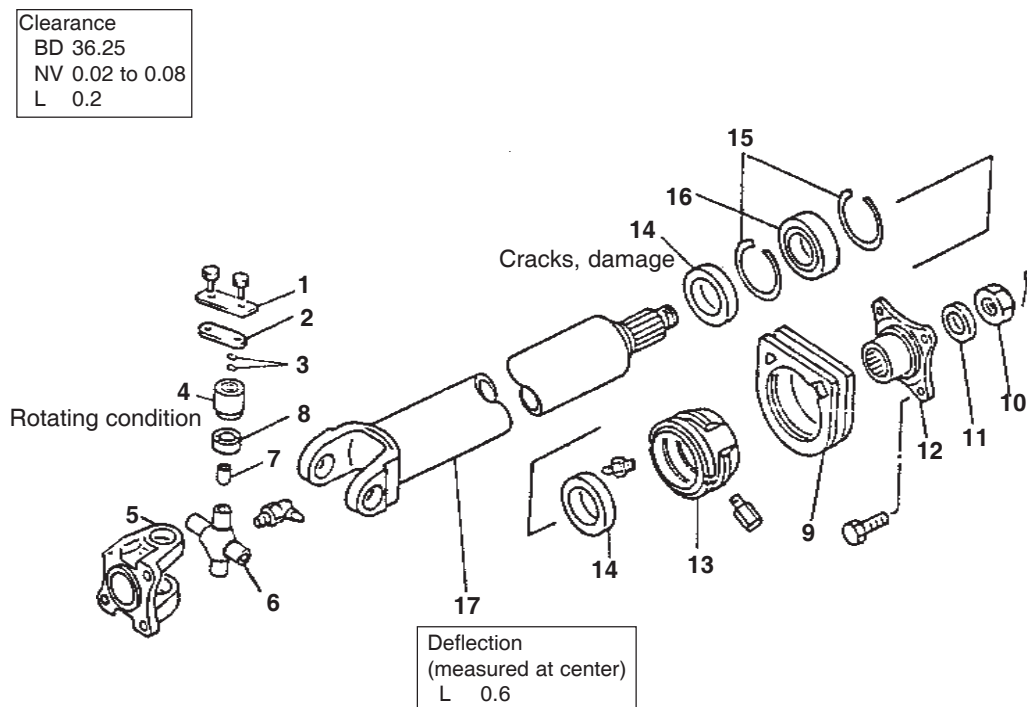
49AR0319



49AR0130

FRONT PROPELLER SHAFT

Disassembly and inspection



Disassembly sequence

- | | |
|--------------------------|---------------------------|
| 1. Lock plate | 9. Cushion rubber |
| 2. Retainer | 10. Castle nut |
| 3. Shim | 11. Flat washer |
| 4. Needle roller bearing | 12. Companion flange |
| 5. Flange yoke | 13. Center bearing case |
| 6. Spider | 14. Oils seal |
| 7. Grease keeper | 15. Snap ring |
| 8. Dust seal | 16. Ball bearing |
| | 17. Front propeller shaft |

For parts with an encircled number, refer to Disassembly and Inspection procedure that follow.

NOTE

1. When disassembling universal joint, match mark on flanges.
2. Do not reuse snap rings.

BD ... Basic Diameter
NV ... Nominal Value
L ... Limit

PS-6**PROPELLER SHAFT****Disassembly and Inspection procedure****(1) Measurement of axial play**

At disassembly or installation, adjust the axial play of spider using shim.

The shim should never protrude from the flange yoke surface.

Types of shims

Name	Thickness (t: mm)
Shim A	0.1
Shim B	0.2

NOTE

Use the shim of a thickness on the opposite ends of trunnion.

(2) Removal of needle roller bearing <except spicer>

Tap the shoulder of the yoke with a wooden hammer to remove the needle roller bearing.

NOTE

Matchmark on needle bearing and spider.

(3) Removal of center bearing

Remove the cushion rubber from the center bearing case. Then, remove the center bearing case, ball bearing and oil seal as a unit using the special tool, puller set.

(4) Measurement of clearance between spider and needle roller bearing

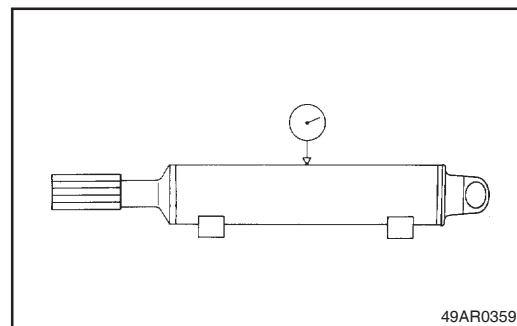
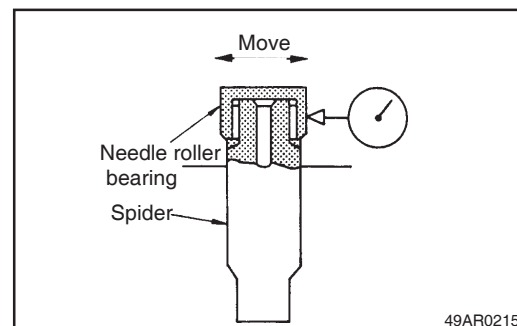
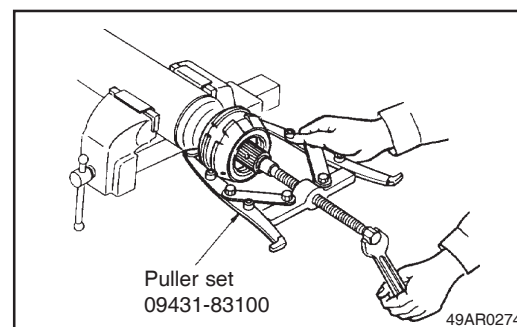
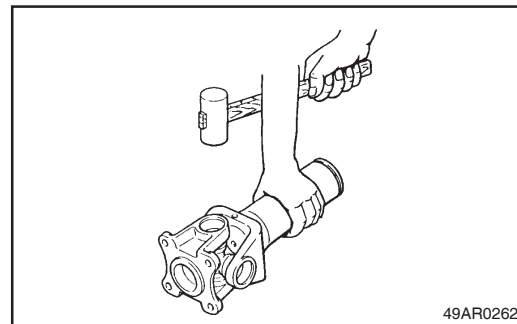
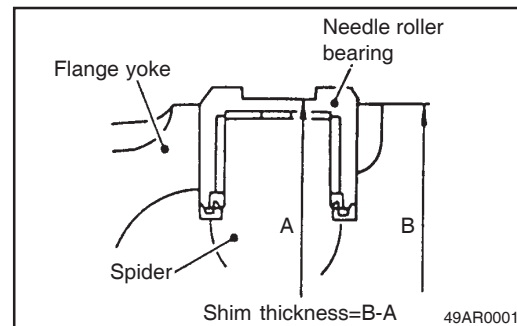
Measure the radial clearance between spider and needle roller bearing. If it exceeds the limit, replace.

(5) Deflection of the propeller shaft

Measure the deflection at the center of the propeller shaft. If it exceeds the limit, correct or replace.

NOTE

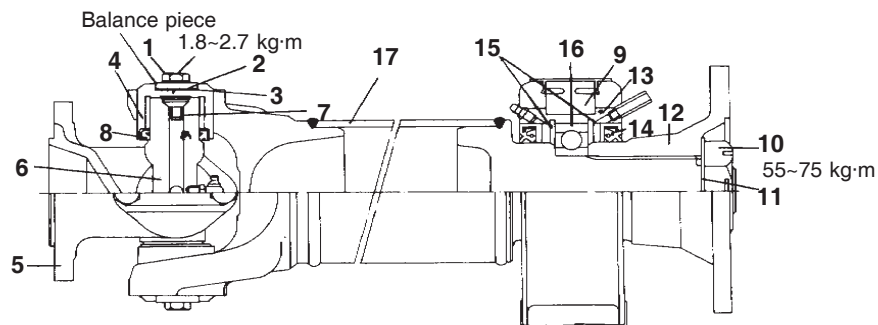
- 1. Read the dial indicator Pointer deflection while the propeller shaft is turned one turn. A half of the indicator reading is the propeller shaft deflection.**
- 2. If the deflection is corrected using a press, check the welded portions for cracks after correction.**



SERVICE PROCEDURE

PS-7

Reassembly



Assembly Sequence

8→7→6→4→5→3→2→1
 17→4→3→2→1→12→11→10
 13→16→15→14→9

For parts with an encircled number, refer to Reassembly Procedure that follows.

NOTE

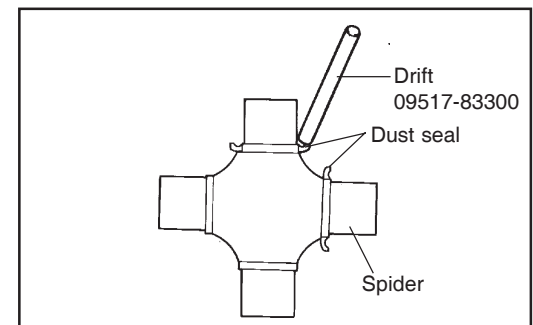
1. Align matching marks put at time of disassembly.
2. After greasing, wipe off any excessive grease completely.

49AR0002

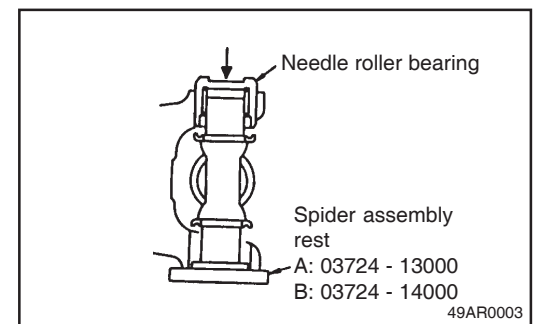
Reassembly Procedure

(1) Installation of dust seal

Install the dust seal using the special tool, Drift.

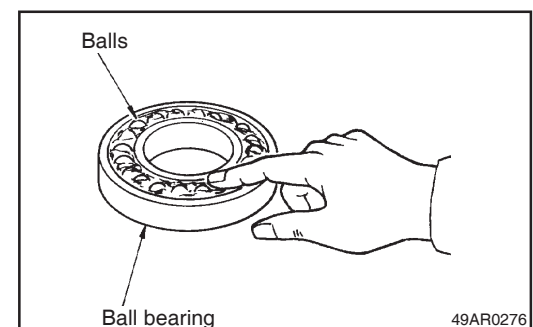


(2) Reassembly of needle roller bearing



(3) Installation of center bearing

- (a) Before installing the ball bearing into the bearing case, pack grease between balls.



49AR0276

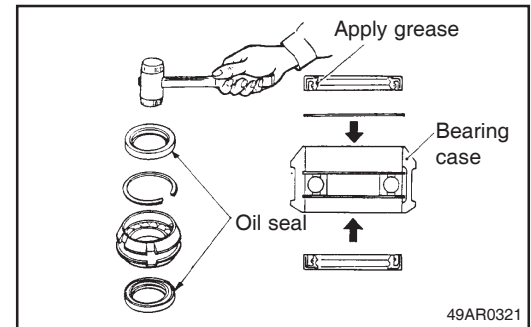
PS-8

PROPELLER SHAFT

- (b) Install the snap ring and ball bearing into the bearing case, then install the oil seals as shown in the illustration.

NOTE

Each oil seal should be flush with the bearing case end.

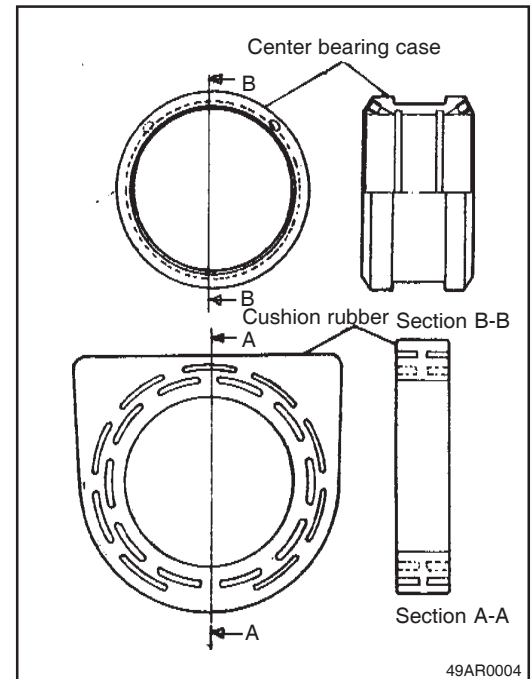


- (4) Installation of bearing case

Fit section B in the cushion rubber into cutout A in the center bearing case as illustrated. If it is hard to press the center bearing case into cushion rubber apply soapsuds on cushion rubber.

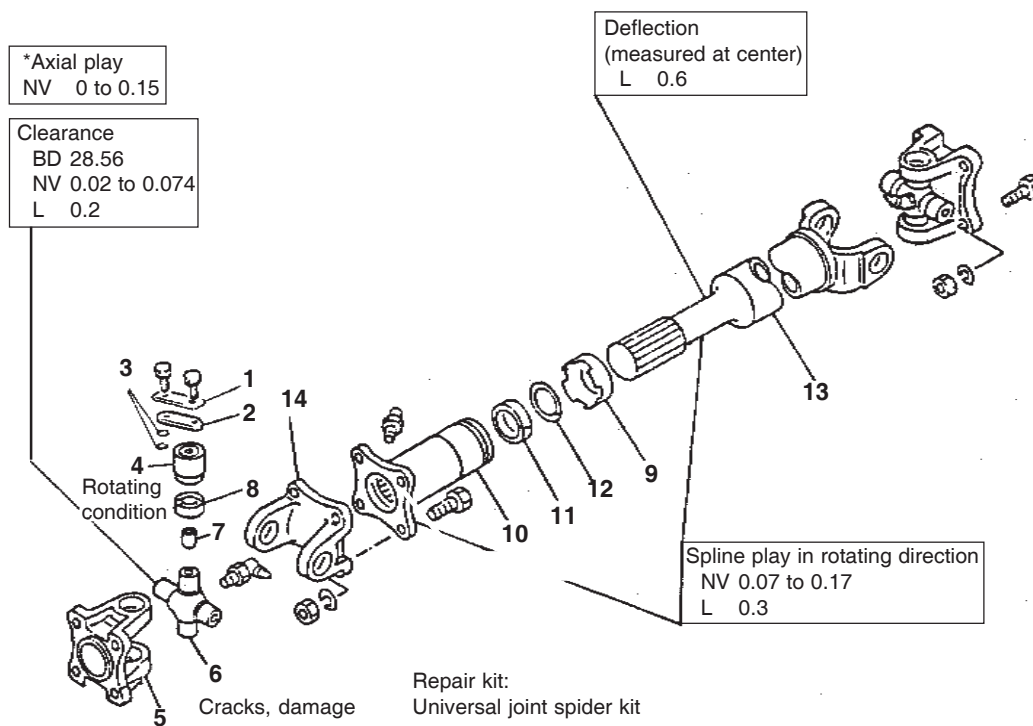
NOTE

The grease nipple hole of the bearing case must face downward when installed.



REAR PROPELLER SHAFT

Disassembly and inspection



Disassembly sequence

1. Lock plate
2. Retainer
3. Shim
4. Needle roller bearing
5. Flange yoke
6. Spider
7. Grease keeper

8. Dust seal
9. Dust cap
10. Sleeve yoke
11. Cork seal
12. Retainer
13. Rear propeller shaft
14. Flange yoke

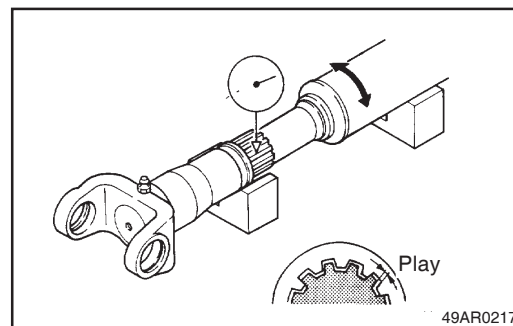
NOTE:

1. When disassembling the universal, matchmark on flanges.
2. Never reuse the snap ring.

BD...Basic Diameter
NV...Nominal Value
L...Limit

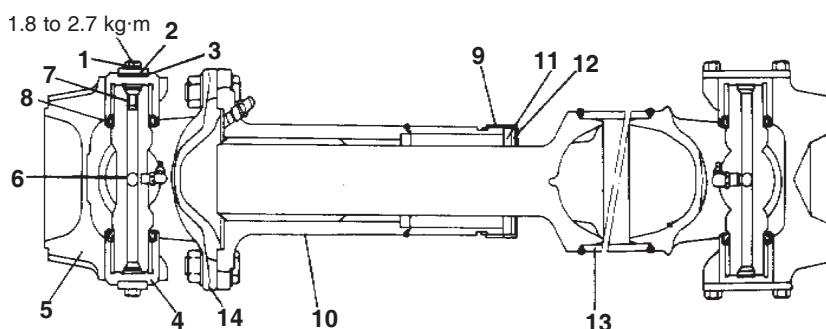
Disassembly procedure

- (1) Measurement of spline play in rotating direction play.



49AR0217

Reassembly



Assembly sequence

8→7→6→4→5→3→2→1
13→9→12→11→10→14→4→3→2→1

For parts with an encircled number, refer to Reassembly Procedure that follows.

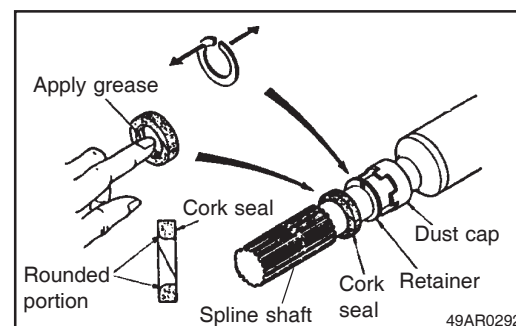
NOTE

1. Align matching marks put at time of disassembly.
2. After greasing, wipe off any excessive grease completely.

49AR0005

Reassembly Procedure

- (a) Install the dust cap to the spline shaft. Then, expand the retainer and install it to the shaft.
- (b) Apply grease to the inner surface of the cork seal and install the cork seal in the same way as the retainer with rounded portion facing the spline.

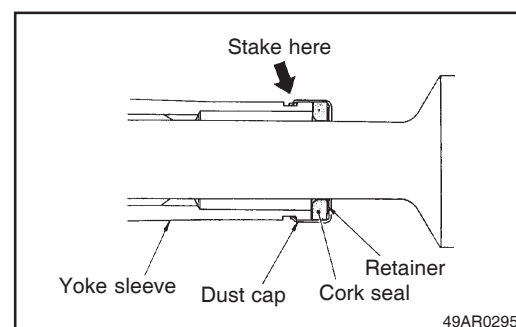


49AR0292

- (c) Press the dust cap to the yoke sleeve to keep the cork seal compressed approximately 1 to 2 mm, stake the end of the dust cap.

NOTE:

Never reuse the dust cap, retainer and cork seal.



49AR0295

Adjustment after Reassembly

When the deflection of the propeller shaft is corrected, or yoke, universal joint, etc. are replaced with new ones, measure the dynamic balance of the propeller shaft assembly with the balancing machine and adjust the balance to the specification using balance piece.

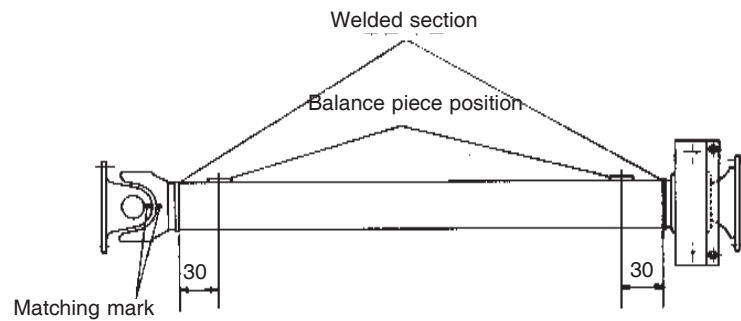
SERVICE PROCEDURE

PS-11

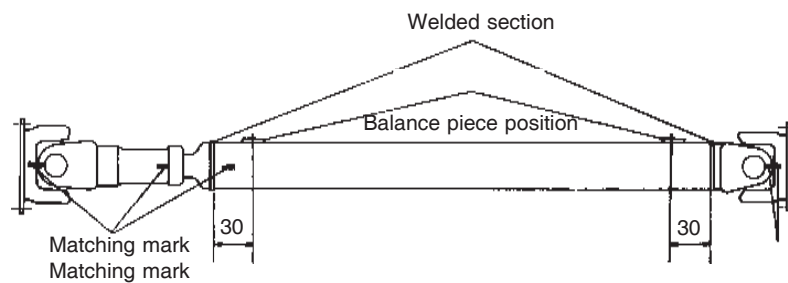
(1) Correction procedure, using polar coordinate method

(a) Installation position of balance piece

Front propeller shaft



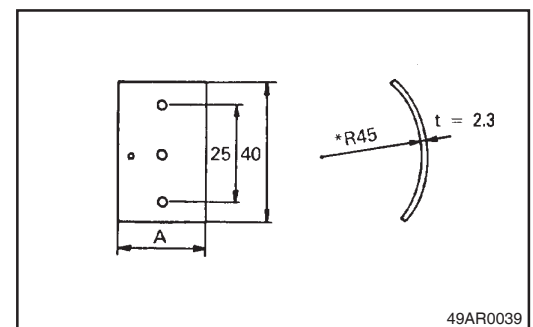
Rear propeller shaft



49AR0006

(b) Shape of balance piece

Name	Weight (g)	Dimension A (mm)
Balance piece G	10	14
Balance piece A	20	28
Balance piece B	40	55.7
Balance piece C	80	83.5
Balance piece H	30	42



49AR00039

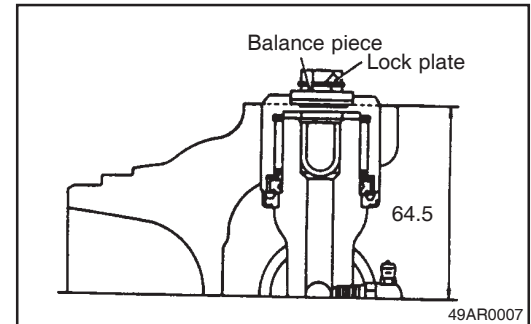
NOTE:

1. The maximum tolerance on balance pieces installed in a single place should be limited to 120g.
2. The number of balance pieces to be combined should be limited to a minimum.

(2) Correction procedure using 90° force decomposition method

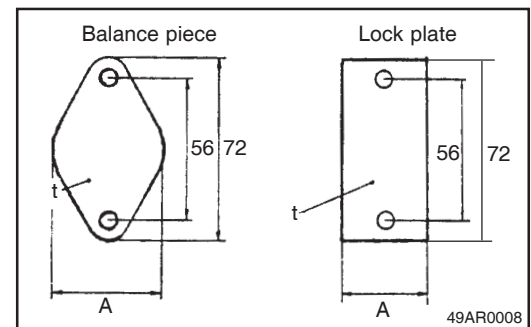
(a) Installation of balance piece

Matchmark on the same positions as in the case of the polar coordinate method.



(b) Shape of balance piece

Part name	Weight (g)	Dimension A	Thickness t
Lock plate	7	18	0.8
Balance piece A	20	34	1.6
Balance piece B	35	26	3.2
Balance piece C	50	50	3.2



NOTE:

1. The maximum tolerance on balance pieces installed in single place should be limited to 120 g.
2. The number of balance pieces to be combined should be limited to a minimum.

TROUBLE SHOOTING

Symptom		Probable cause	Remedy
Propeller shaft vibrates	At high speed	Yoke installed in wrong direction	Realign the match marks
		Worn universal joint needle roller bearing	Replace as a spider repair kit
		Bent propeller shaft	Replace the propeller shaft
		Propeller shaft out of dynamic balance	Adjust the dynamic balance
		Flange coupling bolts left loose	Retighten to specification
		Seized, worn, or binding ball bearing	Replace the ball bearing
	At low speed	Transmission in the high speed range	Shift to the proper gear
		Excessive axial play in the spicer of universal joint	Adjust the clearance with snap ring or shim
		Excessive play in the slip joint splines	Replace the yoke sleeve or propeller shaft
Propeller shaft develops unusual noise	When the vehicle is started or coasting	Flange coupling bolts left loose	Retighten to specification
		Center bearing mounting bolts left loose	Retighten to specification
		Center bearing cushion deteriorated or deformed	Replace the cushion
		Worn universal joint needle roller bearing	Replace as a spider kit
		Excessive play in the slip joint splines	Replace the yoke sleeve or propeller shaft
	At cruising speeds	Excessive axial play in the spider of universal joint	Adjust the clearance with snap ring or shim
		Worn universal joint needle roller bearing	Replace as a spider repair kit
		Seized, worn, or binding ball bearing	Replace the ball bearing
		Bearings and splines improperly lubricated	Lubricate

STEERING

GENERAL	ST - 2
SPECIFICATIONS	ST - 5
SERVICE STANDARDS	ST - 6
SPECIAL TOOLS	ST - 9
SERVICE PROCEDURE	ST-10
TROUBLESHOOTING	ST-29

GENERAL

The steering system allows the driver to freely change the traveling direction of the vehicle. The steering force of the steering wheel is transmitted through the steering shaft, power steering booster, pitman arm and drag link to the knuckle arm to steer the vehicle.

The system has an integral type power steering booster installed in the gear box to reduce the steering effort.

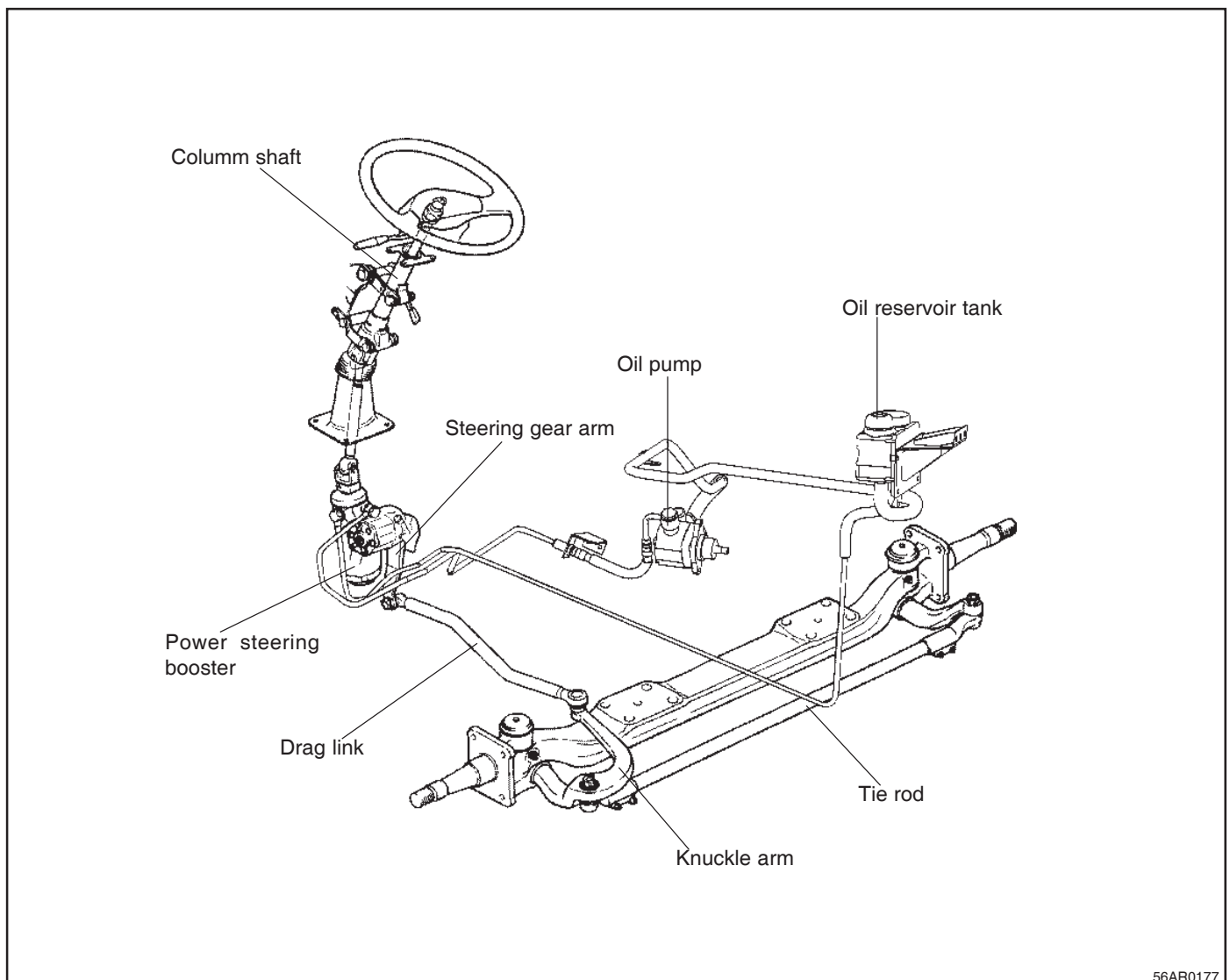
The power steering system hydraulic pressure circuits are as shown below.

Oil tank → Oil pump → Power steering booster



Integral power steering booster

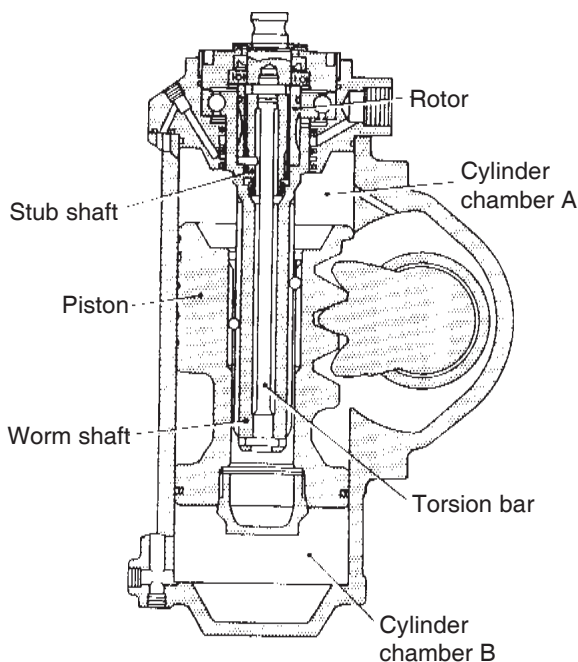
The integral power steering booster to reduce the steering effort consists of the power cylinder section (output section) serving also as the steering gear and the control valve section (control section).



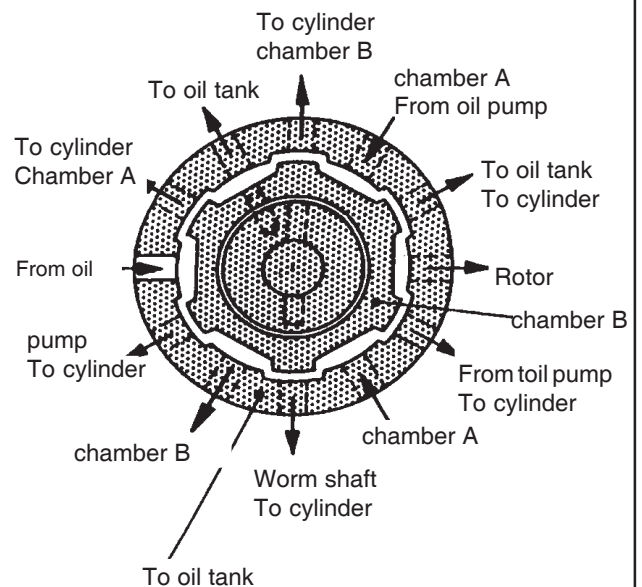
(1) When traveling straight ahead

Operation of integral power steering booster
(when traveling straight ahead)

When there is no steering torque from the steering wheel, no relative displacement occurs between the stub shaft and worm shaft, so that the rotor remains in the neutral position of the worm shaft. Therefore, the hydraulic fluid delivered from the oil pump directly passes through the worm shaft groove to return to the oil tank. In other words, no operating pressure difference is produced between the cylinder chambers A and B and as a result, the piston remains in the neutral position and does not move.



56AR0149



56AR0150

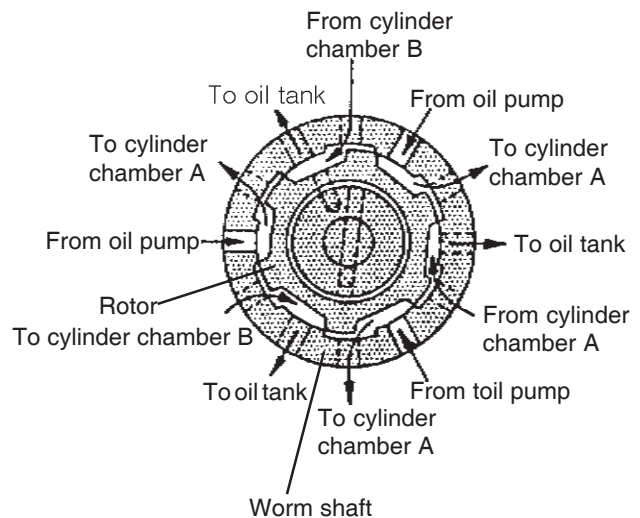
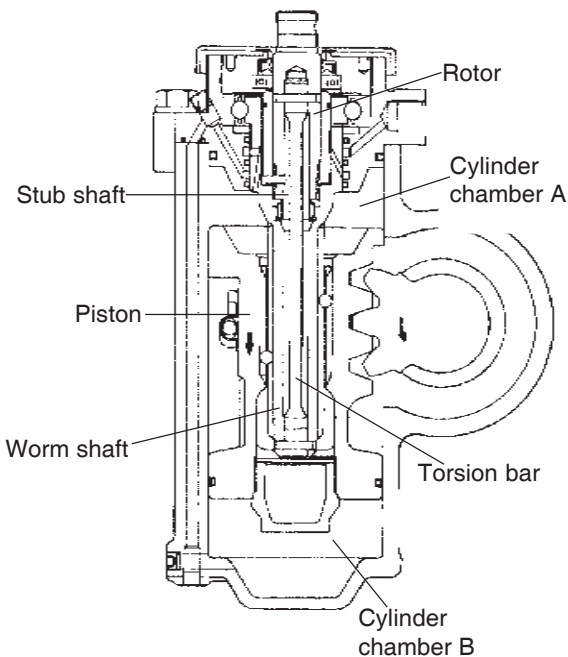
(2) Right turn

Operation of integral power steering booster
(when right turn is made)

When the steering wheel is turned clockwise, the load from the tires acts on the worm shaft to twist the torsion bar. As a result, the rotor turns clockwise with respect to the worm shaft, decreasing the axial direction groove clearance. This limits flow of the hydraulic oil to the oil tank and now the hydraulic oil from the oil pump enters the cylinder chamber A to cause the piston to move to the cylinder chamber B.

The hydraulic oil in the cylinder chamber moves, the torsion bar that has been twisted returns to the neutral position. The force that has caused twisting of the torsion bar during steering is transmitted to the steering wheel as a steering reaction force which gives the driver a sense of steering response.

A left turn is also made on the same operating principles as the right turn but in opposite direction.



SPECIFICATIONS**ST-5****(3) Manual steering**

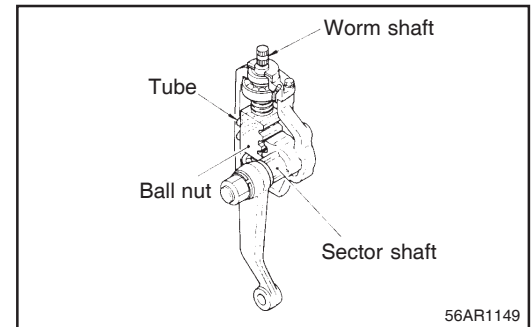
Even if the hydraulic pressure ceases to act on the power steering booster due to a stalled engine, defective oil pump, oil leaks or other causes, the mechanical power is directly transmitted from the stub shaft to the worm shaft by the stopper mechanism provided between the stub shaft and worm, allowing manual steering.

Steering gear assembly (recirculating ball type)

In this steering gear assembly, many balls are interposed between the worm shaft screw and the ball nut to transmit the turning effort of the worm shaft through the ball nut to the sector shaft.

The ball nut is fitted with a pair of tubes. Each end of the tube is tongue-shaped and is connected to the end of ball passage to recirculate the balls.

Sliding friction is replaced by rolling friction by interposing the balls between the worm shaft and the ball nut, allowing the driver to operate the steering gear with a light steering effort.

**SPECIFICATIONS**

Item \ Vehicle model	HD120
Steering wheel	
Type	2-spoke type
Steering shaft	Universal joint type (Telescopic-Tilt type)
Power steering booster	
Type	Integral type
Cylinder inner diameter	Ø90
Piston operating area	63.6cm ²
Regulated pressure	105kg/cm ²
Oil capacity	1ℓ
Power steering oil pump	
Type	Vane type
Delivery rate	15cc/rev.
Fluid flow rate	12ℓ /min.
Relief set pressure	105 kg/cm ²
Allowable rpm range	500~6000 rpm
Power steering oil tank	
Type	Oil pump separating type
Capacity	1.4ℓ

SERVICE STANDARDS

SERVICE STANDARDS TABLE

Unit:mm

Maintenance item			Nominal Value (Basic diameterine)	Limit	Remedy
Steering wheel and shaft	Steering wheel play		20-40		Adjust
	Steering upper shaft	Play in axial direction (vertical)	0.2 or less		Correct or replace assembly
	Play of joint in turning direction (play of needle bearing and spider)		1.5' or less		Replace assembly
	Play of yoke spline tube and steering lower shaft (spline shaft) in turning direction		30' or less		Replace assembly
Steering linkage	Sleeve lever shaft and bushing to clearance (Brg type)		0.015 to 0.111	0.4 [38]	Replace
	Conecting link pin and bushing to clearance		0.045 to 0.175 [42]	0.4	Replace
Steering gear sector	Sector shaft O.D.	Pitman arm side	38	37.9	Replace
		Side cover side			
	Ball nut rack spline and sector shaft to clearance			0.2 to 0.5	
	Worn shaft starting torque kg·cm	After sector shaft installation	4 to 8		Lower cover Bending adjusting
		Before sector shaft installation	4 to 7		Adjust of Adjustment screw
Intergral power steering booster	Play of ball nut assembly in axial direction			0.04	Replace
	Body to ball nut clearance		0.11 [90]	0.16	Replace
	Rotor to worm shaft clearance		0.01 to 0.03 [35.5]	0.03 more than	Replace
	Sector shaft O.D.	Pitman arm side	57.975	57.875	Replace
		Side cover side	47.975	47.875	Replace
	Backlash between ball nut rack and sector shaft gear		0.1 to 0.35		Adjust
Power steering	Ridge wear on pressure plate and side plate surfaces in friction with rotor and vane			0.01	No sticking wear and streaks Replace

SPECIFICATIONS**ST-7**

Unit:mm

Maintenance item		Nominal Value (Basic diameterine)	Limit	Remedy
Power steering	Flow control valve to rear body clearance		0.03	No sticking wear and streaks Replace as flow control valve assembly or rear body assembly
	Pump relief set pressure Mpa (kg/cm ²) at 1,800 rpm	105		Replace as flow control valve assembly or rear body assembly

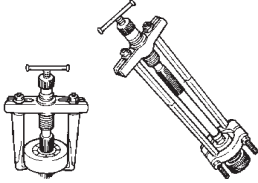
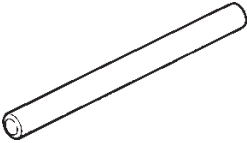
Tightening Torque Table

Location tightened		Screw size O.D. x pitch (mm)	Tightening torque (kg.m)
Steering shaft	Steering wheel nut	M20 x 1.5	5.5
	Worm shaft and yoke mounting bolt	M10 x 1.25	5 to 5.5
	Lock plate bolt	M5 x 0.8	0.4 to 6.0
	Grease nipple	M6 x 0.75	0.3 to 0.5
Link and bracket	Steering shaft	M12 x 1.25	3.7
	Lock lever bolt	M18 x 1.25	1
	Steering lever	M12 x 1.25	2
Linkage	Ball stud castle nut	M20 x 1.5	20.7 to 34.5
Integral power steering booster	Pitman arm nut	M36 x 1.5	40 to 45
	Ball tube screw	M6 x 1.0	0.45 to 0.55
	Taper plug	PT 1/8	0.9 to 1.3
	Retainer	M32 x 1.5	Tighten fully, turn back by 180°, tighten again to 39 (4), then turn back by 20° and stake.
	Adjusting screw lock nut	M14 x 1.5	12 to 13
	Side cover bolt	M12 x 1.25	5.5 to 6.5
	Adjusting plug	M80 x 1.5	23 to 25
	Valve housing bolt	M16 x 1.5	12 to 13
	Lock ring	M80 x 1.5	Tighten lock ring with 12kg·m, and secure 2 points not to be removed.
	Plug	M48 x 1.5	30 to 40
Power steering oil pump	Cartridge assembly screw	-	0.6 to 0.9
	Rear body bolt		5 to 6
	Flow control valve plug		5 to 6
	Hose connector bolt		1.8 to 2.5
	Oil pump gear tighten nut		9
Power steering oil tank	Plate screw	M6 x 1.0	0.4 to 0.5

SPECIAL TOOLS

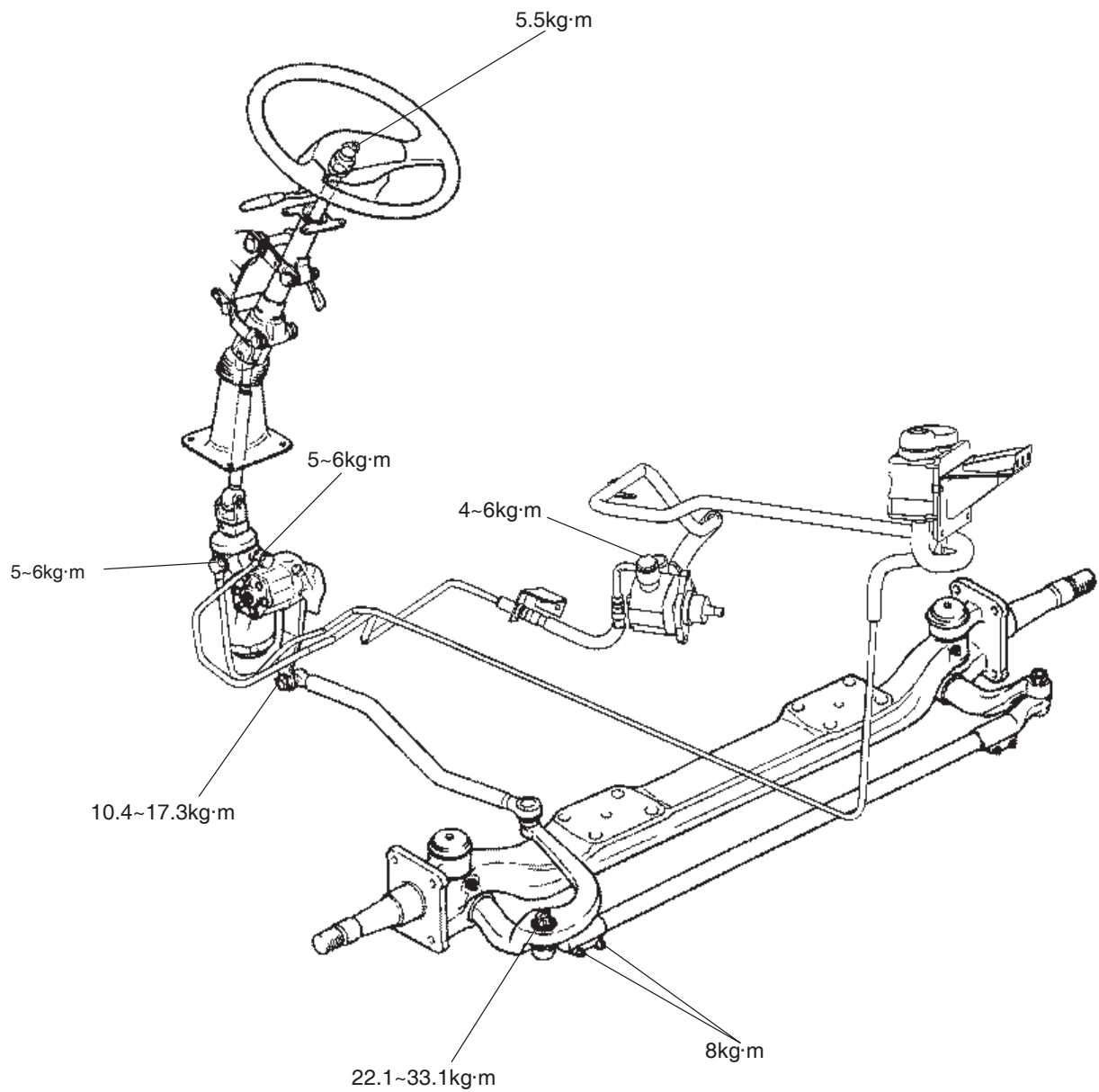
ST-9

SPECIAL TOOLS

Tool (Number and name)	Illustration	Use
Puller set 09431-83100	 ASST0030	Removal of gear and bearing
Drift 09517-83300	 ASST0020	Removal of oil seal and bearing

SERVICE PROCEDURE

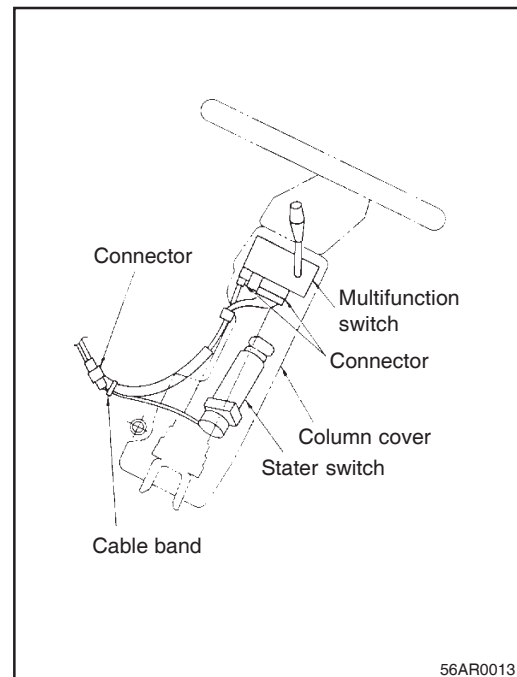
REMOVED AND INSTALLATION



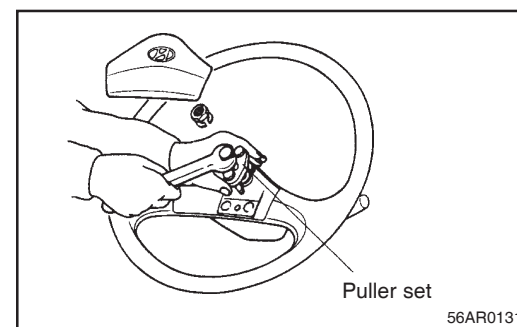
STEERING SHAFT

Removal

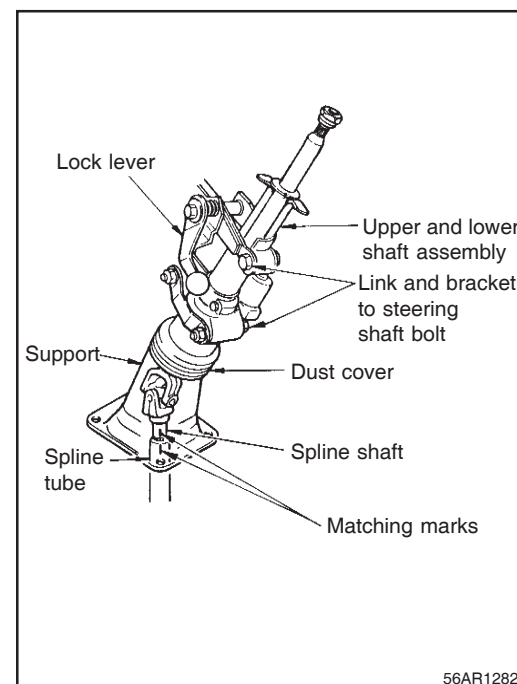
- (1) Remove the negative terminal of the battery.
- (2) Remove the column cover.
- (3) Remove the cable band and remove all starter switch connectors.
- (4) Remove the multifunction switch connector.
- (5) Insert the key and turn to the ON position.
Remove the engine stop cable from the starter switch.



- (6) Remove the steering wheel using the special tool, puller set.
- (7) Remove the multifunction switch.



- (8) Fix the steering using lock lever and put matching marks to the spline shaft and spline tube.
- (9) Remove the dust cover from the column end and remove the support attaching bolts.
- (10) Remove the link and bracket to steering shaft bolts.



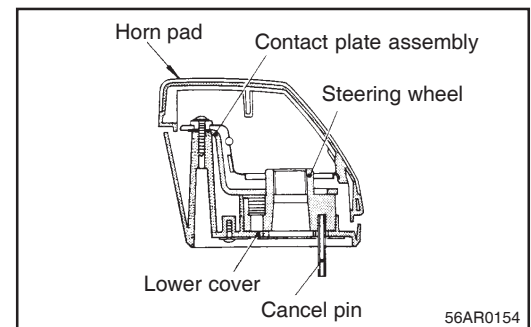
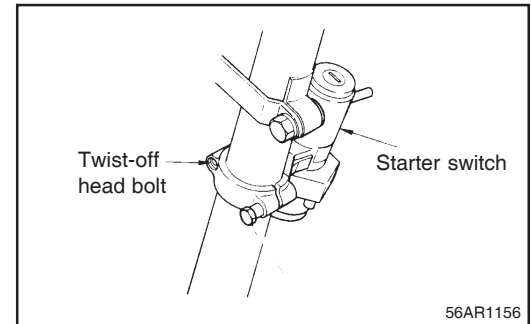
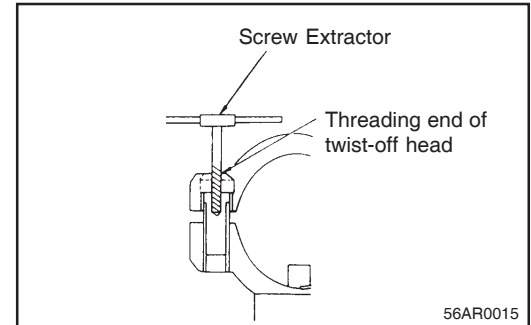
ST-12

STEERING

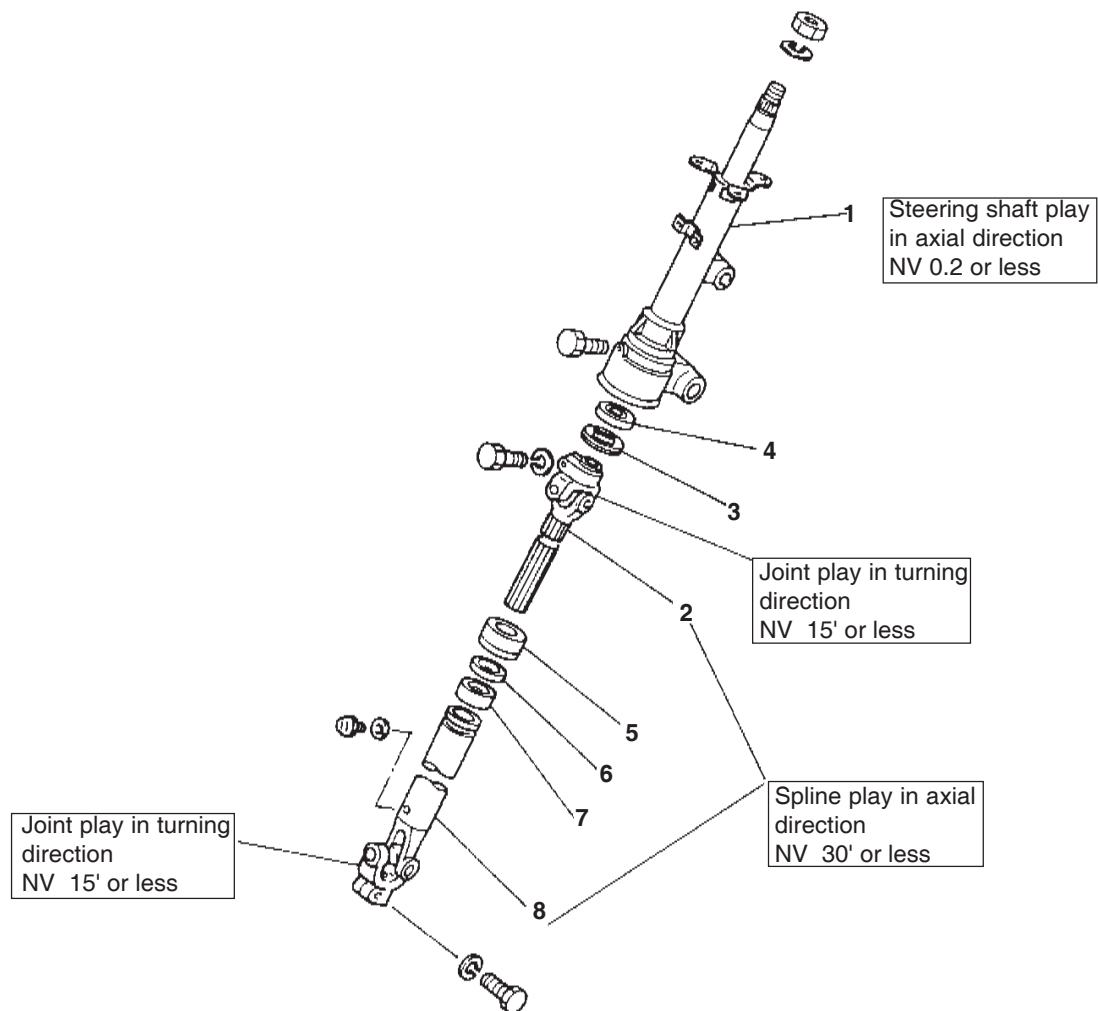
- (11) Remove the steering upper shaft assembly and spline shaft assembly together with the starter switch.
- (12) Hold the column end in a vise and drill a 5.5 to 6.0 mm diameter, 10 to 15 mm deep hole in the end of the twist-off head bolt from which the head has been removed.
- (13) Turn the special tool, Screw Extractor, counterclockwise to thread it into the hole until the bolt is removed.
- (14) Remove the starter switch from the steering column.

Installation

- (1) Install a new twist off head bolt and tighten it to 13 to 15 Nm (1.3 to 1.5 kgfm) to twist off the bolt head.
 - (2) After installation, make sure that the steering lock functions properly.
 - (3) If no abnormality is found, reverse the removal procedure to make installation.
- (4) Install the steering wheel as shown in the illustration.



Disassembly, inspection and correction

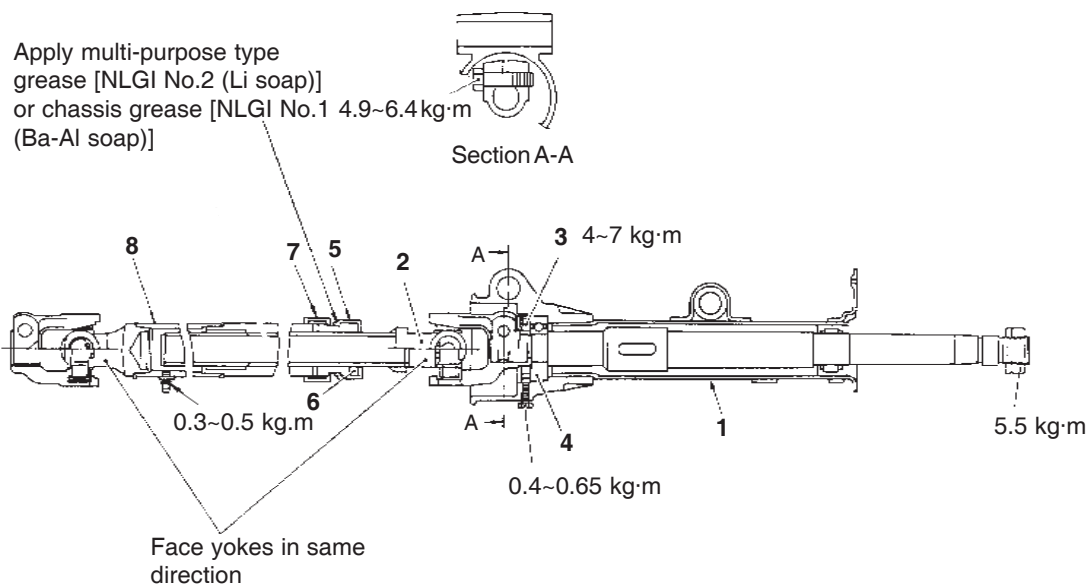


NV ... Nominal Value

Disassembly sequence

1. Steering upper shaft assembly
2. Spline shaft assembly
3. Lock plate
4. Bearing
5. Dust cover
6. Dust seal
7. Rubber cover
8. Spline tube assembly

Reassembly

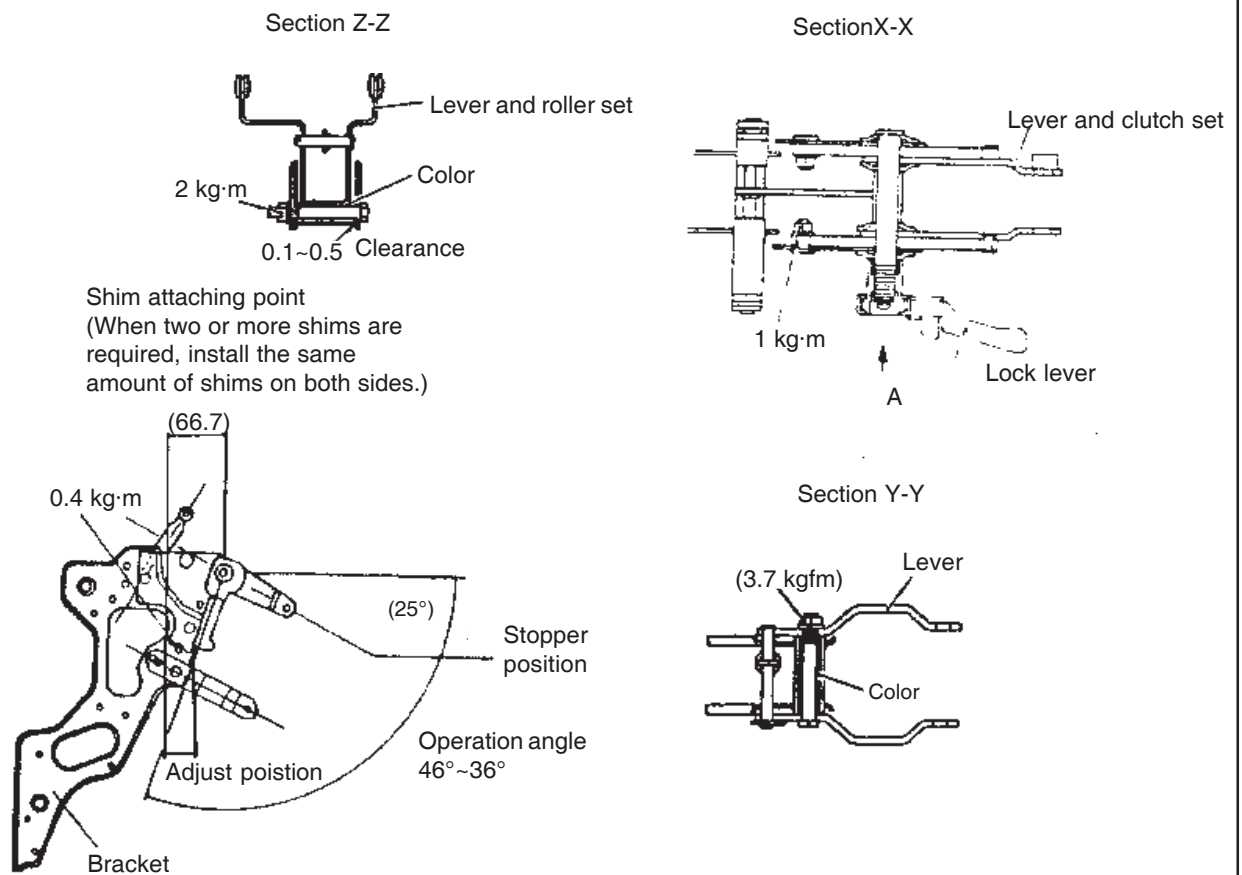


Assembly sequence

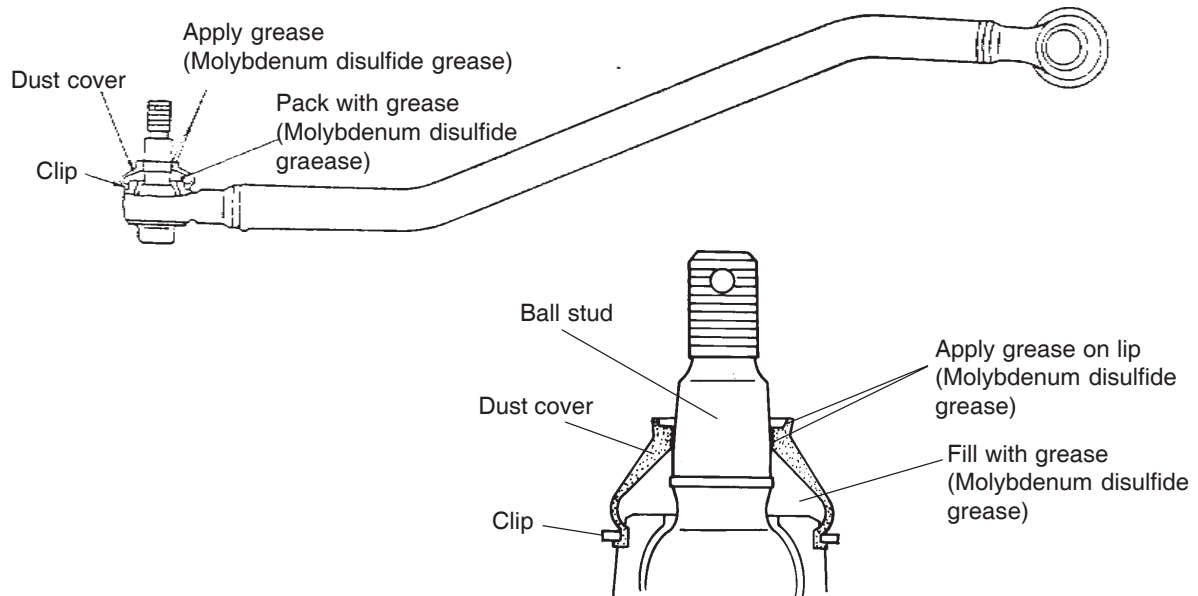
8→7→6→5→2

1→4→3↑

Link and Bracket Section



DRAW LINK



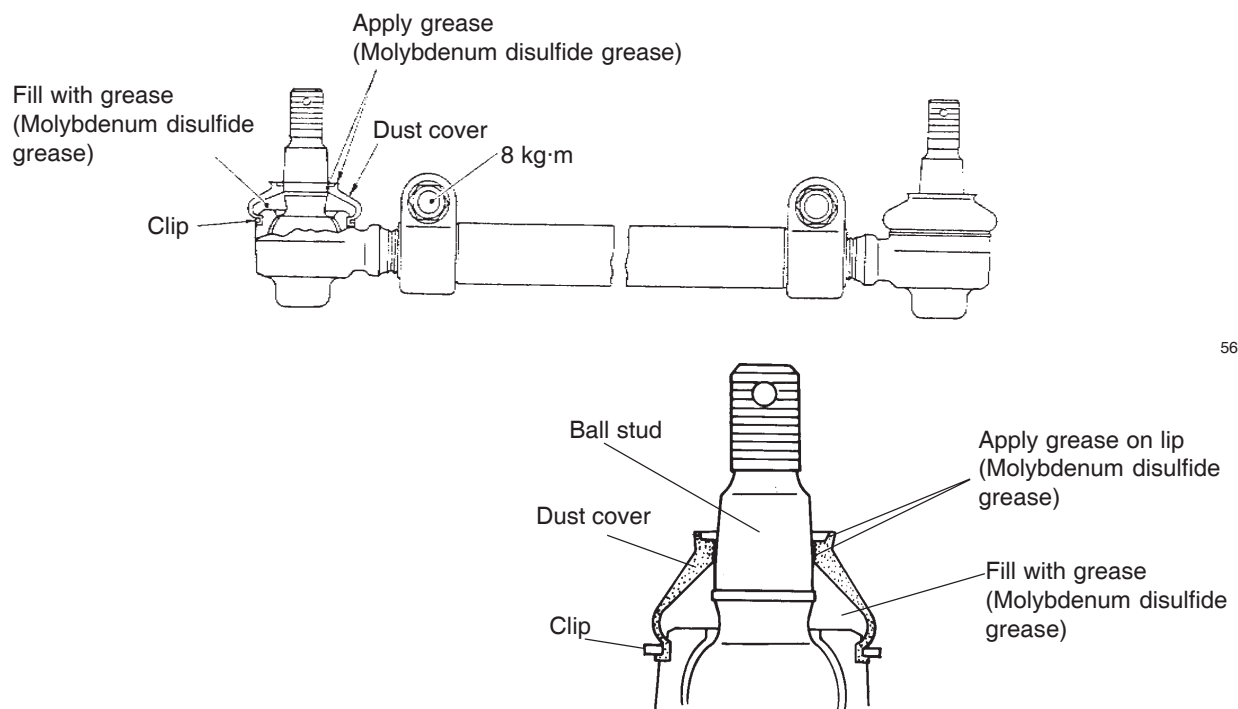
56AR0003

NOTE

Do not remove parts other than dust cover and clip.

56AR1229

TIE ROD



56AR0004

NOTE

Do not remove parts other than dust cover and clip.

56AR1229

ADJUSTMENT AFTER INSTALLATION

Steering wheel play

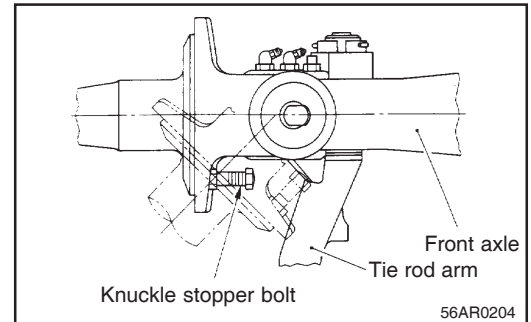
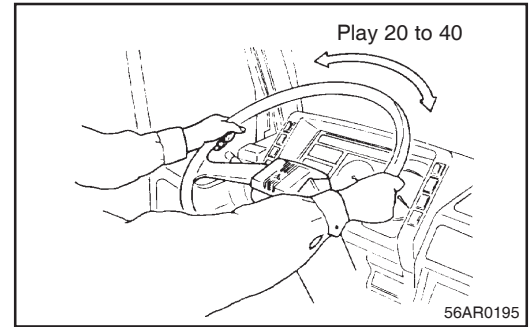
Place the vehicle in straight ahead position and start the engine. Lightly turn the steering wheel clockwise and counter-clockwise and check that the outside circumference play does not exceed the nominal value range.

NOTE

If the steering wheel play is out of the range, adjust installation of parts and backlash.

Adjustment of steering angle

Set the front wheels on the turning radius gauges and adjust the steering angle to the specified value by knuckle stopper bolt.



Integral power steering booster

Disassembly, inspection and correction

Ball nut assembly axial play
L 0.04

Body (cylinder) to ball nut (piston) clearance
BD 0.11
NV 0.11
L 0.16

Sector gear backlash
NV 0.10~0.35
L 0.6 or less

Turning condition

Turning condition

Deterioration damage

Turning condition

Rotor (outside) to worm shaft clearance
NV 0.01 to 0.03
L More than 0.03

BD ... Basic Diameter
NV ... Nominal Value
L ... Limit

Sector shaft O.D.

Item	Nominal diameter	Limit
Packing section	47.975	47.875
Bearing section	47.975	47.875

Disassembly sequence

1. Taper plug
2. Pitman arm
3. Lock nut
4. Side cover
5. Sector shaft
6. Retainer
7. Adjusting screw
8. Y-packing
9. Backup ring
10. Needle bearing
11. Dust cover
12. Valve housing
13. Piston (Ball nut)
14. Adjusting plug
15. Ball bearing
16. Y-packing
17. Side rail
18. Steel ball
19. Bearing cage
20. Worm shaft
21. Rotor
22. Seal ring
23. Stub shaft assembly
24. Seal ring
25. Seal ring
26. Plug
27. Oil seal
28. Y-packing
29. Backup ring
30. Needle bearing
31. Body

For parts with an encircled number, refer to Disassembly Procedure that follows.

56AR0185

NOTE

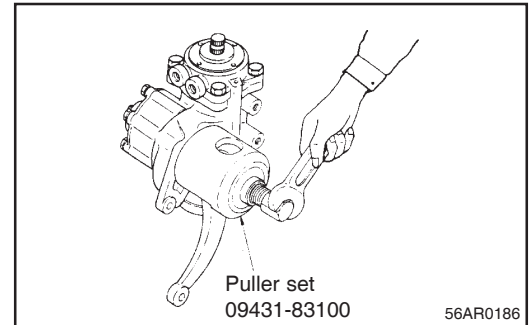
1. Align the stamped mark on the sector shaft end with the body center mark to place the sector shaft in the neutral position.
2. Loosen the lock nut of the adjusting screw beforehand.
3. Do not disassembly the ball nut assembly, adjusting screw, needle nut bearing, etc. except when necessary.

SERVICE PROCEDURE

ST-19

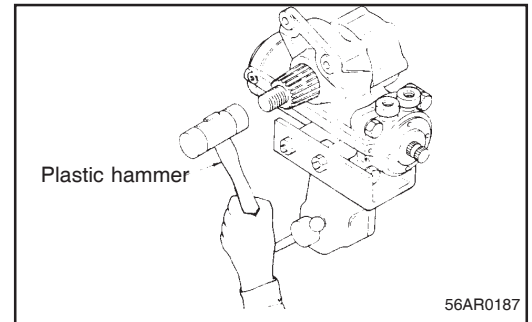
(1) Removal of pitman arm

Remove the pitman arm from the steering gear using the special tool, puller set.



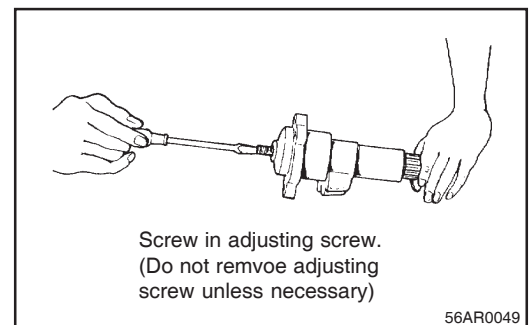
(2) Removal of side cover and sector shaft

Drive out the sector shaft and side cover as a unit from the body, lightly striking with a plastic hammer.



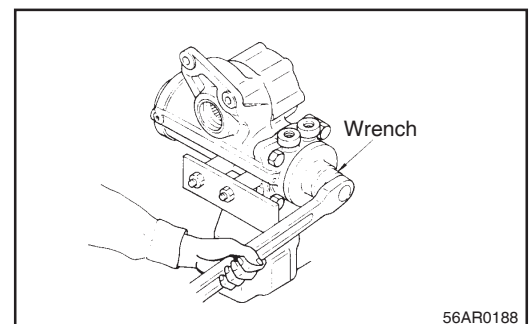
(3) Separation of sector shaft from side cover

Screw in the adjusting screw to remove the side cover from the sector shaft.



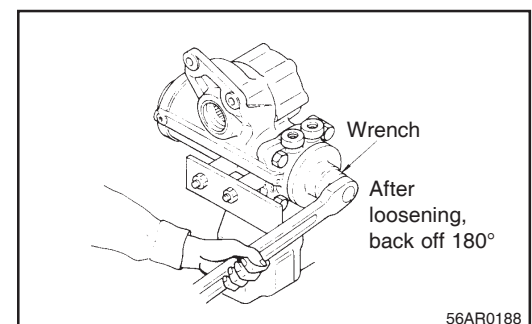
(4) Removal of ring nut

Remove the lock ring, using the wrench.



(5) Removal of adjusting plug

Remove the adjusting plug, using the Wrench.

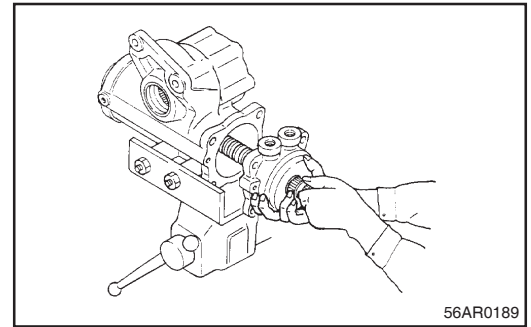


(6) Removal of ball nut assembly

Remove the ball nut assembly as a unit from the body. When removing, make sure that the assembly is slowly removed to prevent the piston from turning to cause damage to the inside surface of the body.

NOTE

1. **Thoroughly clean the disassembled metallic parts in a cleaning oil. Handle carefully the piston section to prevent damage.**
2. **To remove the adjusting screw, loosen the staken retainer and remove the screw.**



ST-22

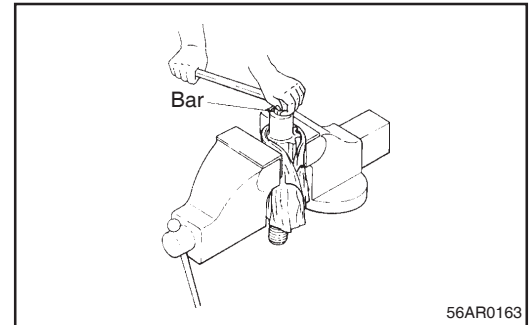
STEERING

(1) Tightening of retainer

Fully tighten and then back off 180°.

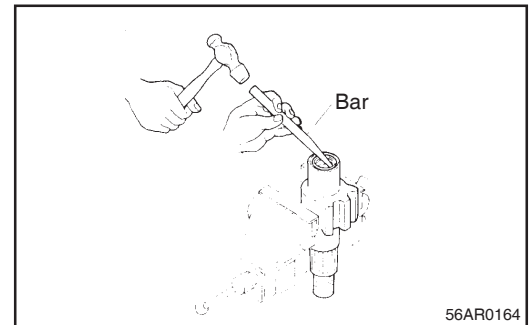
Retorque to 39 Nm (4kgfm).

Back off 20° and make sure that the adjusting screw turns smoothly.



(2) Staking of retainer end portion (2 places)

To press-fit the Y-packing to the adjusting plug, use the Bar.

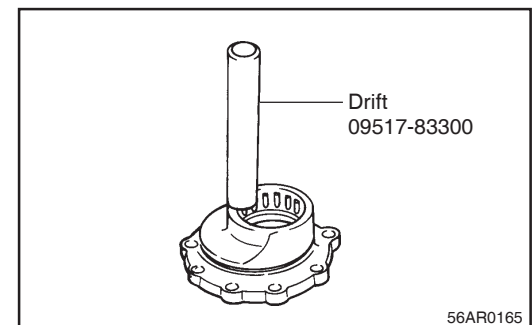


(3) Installation of Y-packing and backup ring

Insert the Y-packing and backup ring and then insert the special tool, Drift, to correct the bend of the backup ring.

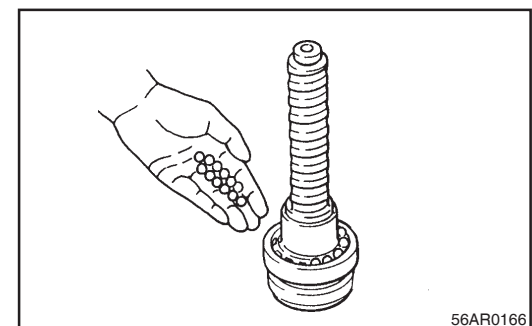
NOTE

When the body section is installed, use the special tool, Drift for correction.



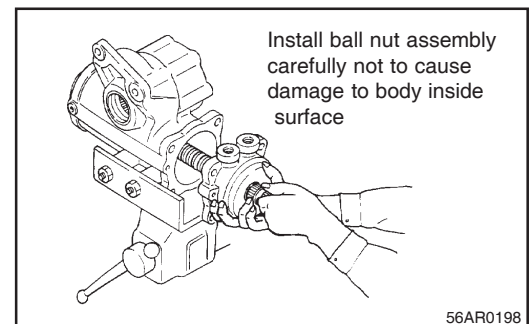
(4) Assembly of thrust bearing

Insert the side race, bearing cage and steel balls.



(5) Installation of O-ring and seal ring.

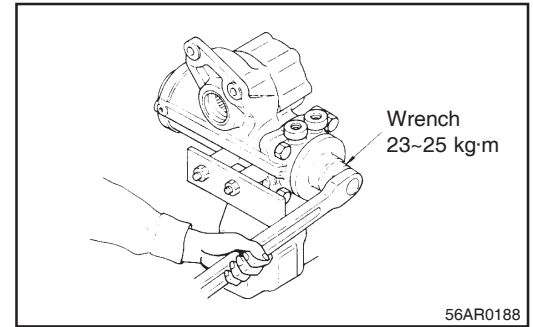
(6) Installation of ball nut assembly



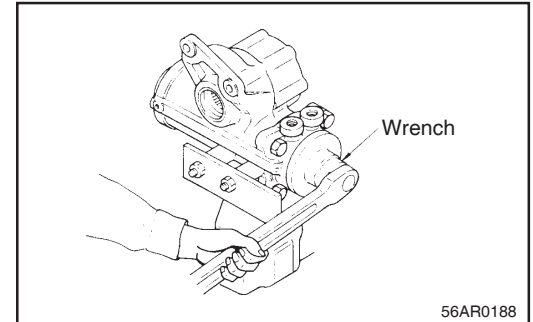
SERVICE PROCEDURE

ST-23

(7) Tightening of adjusting plug

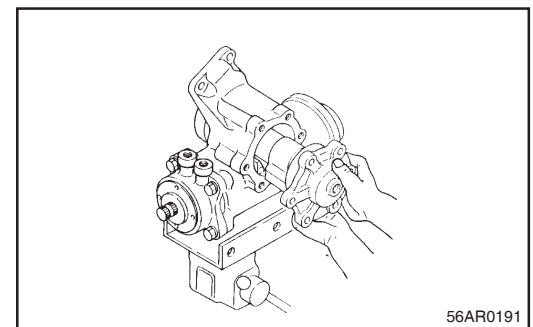


(8) Tightening of ring nut.



(9) Installation of sector shaft.

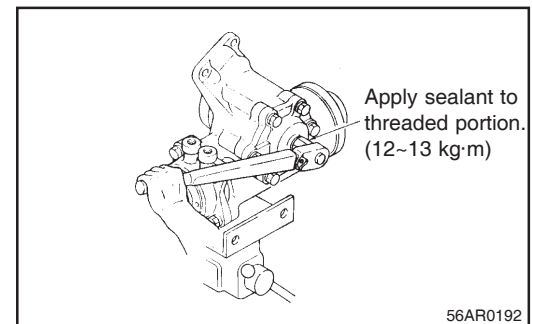
Put the rack (ball nut) and gear (sector shaft) in mesh in the neutral position.



(10) Tightening of lock nut

NOTE

Apply grease to the Y-packing and backup ring at installation.

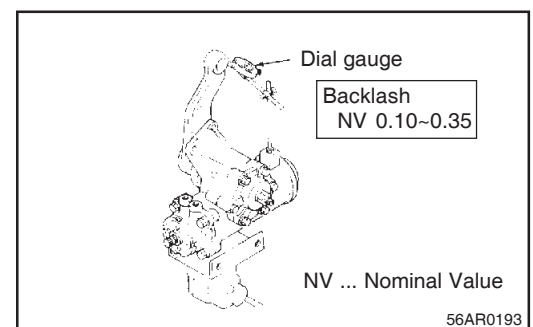


(11) Adjustment of sector gear backlash

Place the gears in the neutral meshing position and measure the backlash at the pitman arm end (L=250 mm). If necessary, adjust by the adjusting screw.

NOTE

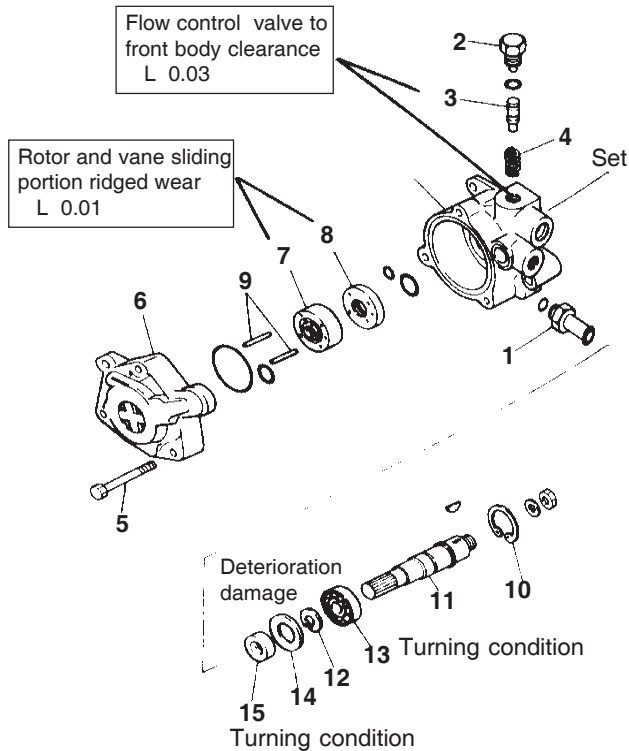
1. After adjustment, move the pitman arm again to make sure that the piston (ball nut) moves smoothly over the entire operating angle range (pitman arm).
2. The starting torque of the sector gear is less than 145 Ncm (15 kg·m) when the pump delivery rate is 12 lit./min, (Adjust by the adjusting plug.)



POWER STEERING OIL PUMP

Disassembly, inspection and correctin

L ...Limit



Disassembly sequence

1. Hose connector
2. Plug
3. Flow control valve assembly
4. Flow control spring
5. Bolt
6. Rear body
7. Cartridge assembly
8. Pressure plate
9. Straight pin
10. Retaining ring (snap ring)
11. Drive shaft
12. Retaining ring (snap ring)
13. Ball bearing
14. Retaining ring (snap ring)
15. Oil seal
16. Front

For parts with an encircled number, refer to Disassembly Procedure that follows.

NOTE

1. Do not disassemble the flow control vlive but reuse unless defective.
2. Do not remove the oil seal except for replacement. If removed, repalce with a new one.

56AR1204

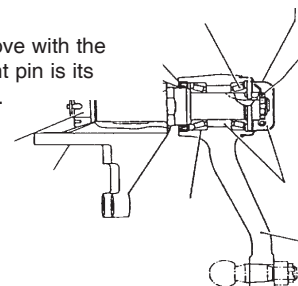
Disassembly procedure**Removal of cartridge assembly**

- (1) Before disassembly, put matching marks on the periphery.
- (2) Remove the cartridge assembly, pressure plate and straight pin and put matching marks on the periphery of the cartridge assembly.

NOTE

The rotor, vane and cam ring have been precision machined as a unit. Take care not to damage them. If replacement is necessary, replace as a cartridge assembly.

Remove with the straight pin is its place.



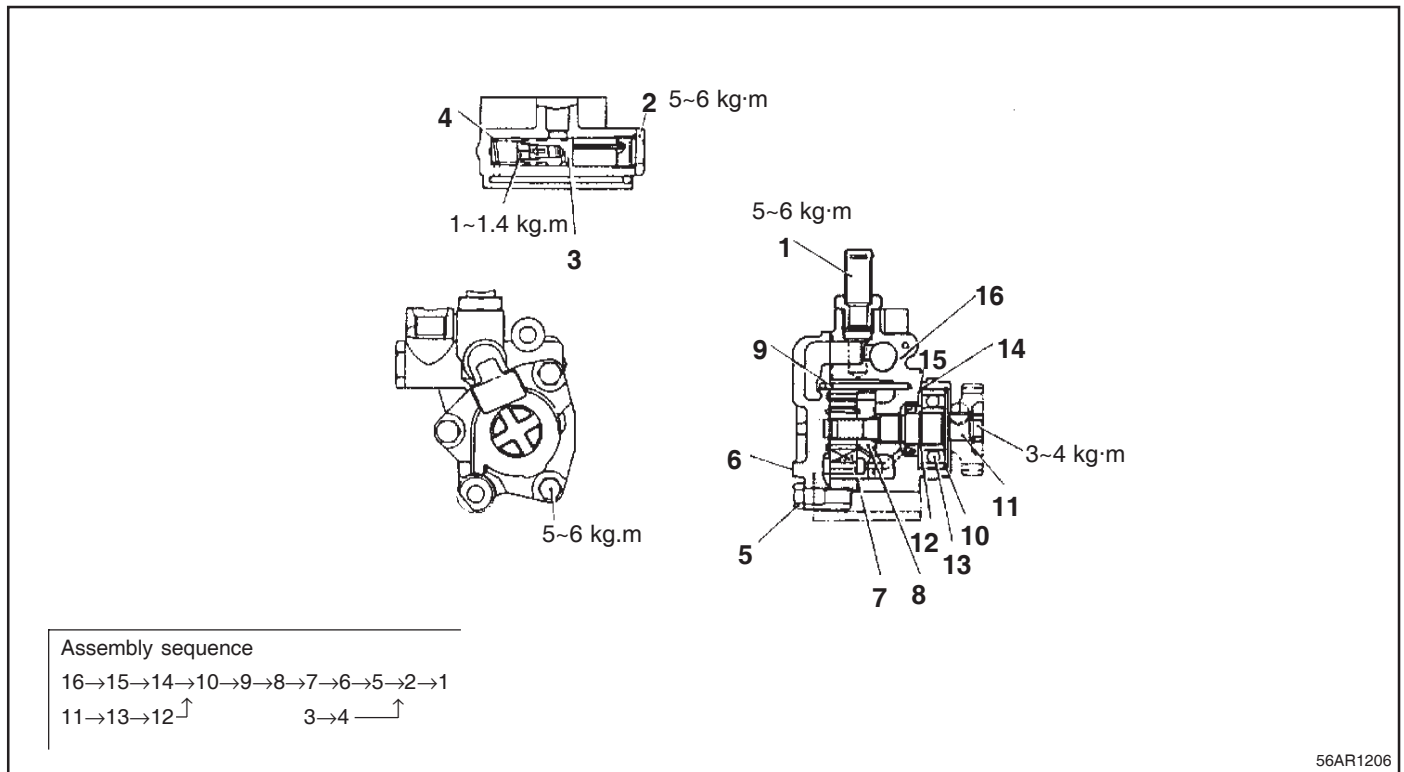
56AR5629

SERVICE PROCEDURE

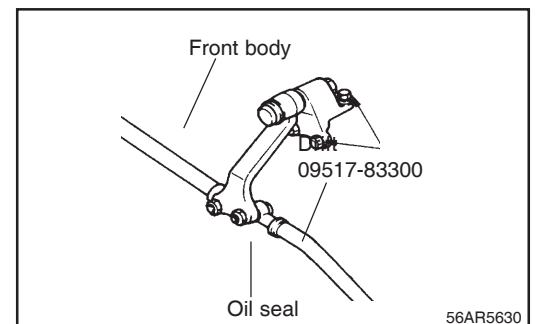
ST-25

Reassembly

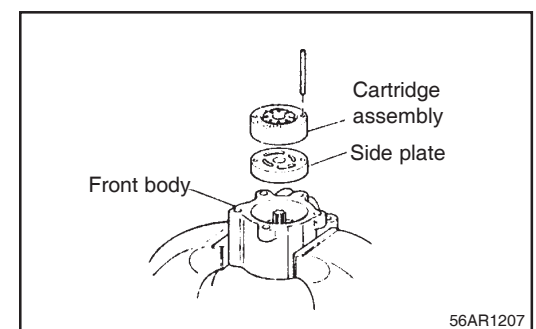
- (1) On occasion of periodic maintenance, replace the oil seals.
O-rings and other rubber parts, using a repair kit.
- (2) Install parts, aligning the alignment marks put at disassembly
and noting the rotor direction and vane turning direction.
Check to see that the rotor and vane slide smoothly without
excessive play



Pressing of oil seal



Installation of cartridge



NOTE

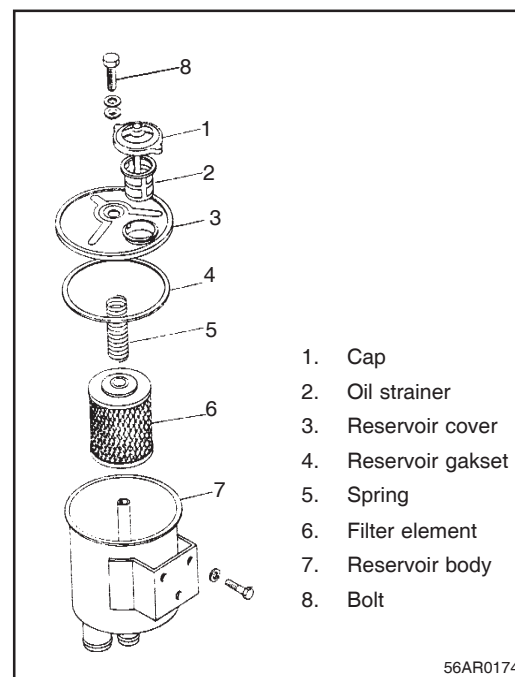
1. When installing the parts. Check correct matching of pin holes.

Pressure change by shims
Approx. 605 kPa (6.2 kg/cm ²) per 0.5 mm thick shim
Approx. 245 kPa (2.5 kg/cm ²) per 0.2 mm thick shim

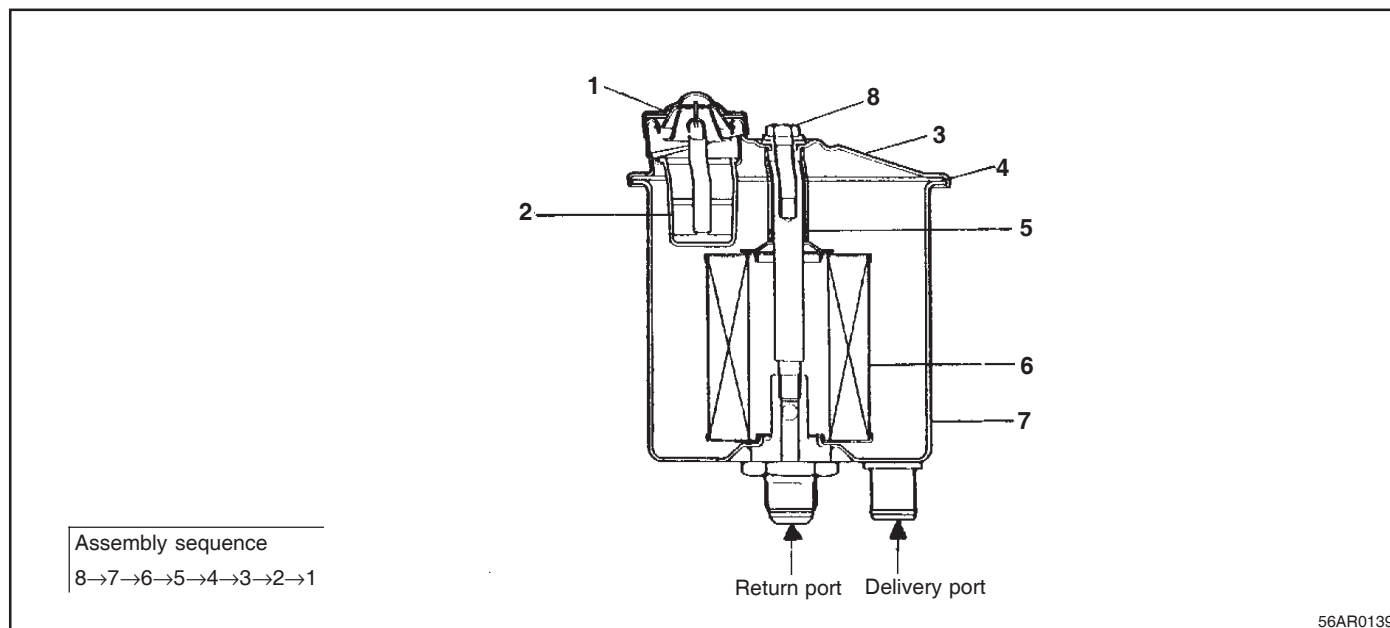
Adjustment

Adjustment of Relief Set Pressure of Flow Control Valve Assembly.
When the valve assembly was disassembled, be sure to adjust the relief pressure by the following procedures after reassembly.
Adjust by adding or removing shims. Addition of shims will lower the pressure.

Standard value of valve assembly relief pressure
9.3~11.3 Mpa (95~115 kg/cm ²) (pump speed 1,800 rpm)

POWER STEERING OIL TANK**Disassembly**

Reassembly



Adjustment after Installation

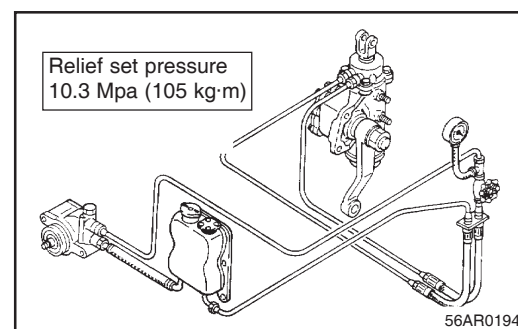
Bleeding

- (1) Fill the oil tank with hydraulic fluid to the brim of the filler cap.
- (2) With the front wheels reised on jacks and the engine running at idle, turn the steering wheel clockwise and counterclockwise and add the fluid if the level is low.
- (3) After the tank fluid level established, increase the engine speed and repeatedly turn the steering wheel until no more air bubbles come out in the tank.
- (4) After bleeding, check each section for leaks and check that the oil tank is filled up to the level mark.

Peformance Verification tests

To make sure that the power steering booster and oil pump are working well, perform tests on the floolwing.

- (1) If the fluid pressure when the steering wheel is released with the engine running at idle is (5 kg.cm²) or more, check the power steering booster, oil pump and oil circuit for clogging.
- (2) If the relief pressure readings are beyond the values given below, the relief valve is in faulty operation. If the reading is below the assembly standard value, the relief valve or spring is defective.



ST-28**STEERING**

Test item	Test procedure	Assembly standard
Checking smooth operation	Raise front wheels and turns steering wheel fully clockwise and counterclockwise several times.	Steering wheel to operate smoothly on entire stroke.
Measuring hydraulic pressure	1) Mount combination of an oil pressure gauge capable of measuring more than (135 kg/cm²) and a stop valve between the pump delivery port and booster inlet and bleed the system. 2) With the engine running at idle, turn the steering wheel clockwise and counterclockwise to raise the fluid temperature to 50~60°C. 3) With the engine running at idle, fully open the stop valve. 4) Release the steering wheel and measure the fluid pressure.	5 kg/cm ² or less
Measuring relief pressure	1) Slowly increase the engine speed to 1000 to 1200 rpm, close the stop valve and measure the maximum fluid pressure. 2) Do not keep the stop valve fully closed for more than 15 seconds.	Relief set pressure 105 kg/cm ²

TROUBLESHOOTING

Symptom	Probable cause	Remdy
Hard steering	Steering ger mechanism defective	
	o Angular contact bearing damaged	Replace
	o Worm and ball nut worn	Replace
	o Insufficient oil quantity	Add oil
	o Improper oil viscosity	Replace oil
	o Incorrect rear cover hsim adjustment	Adjust rear cover shim
	o Incorrect rack starting torque adjustment	Adjust worm and ball nut starting torque
	Powser steering booster gear mechanism defective	
	o Thrust bearing damaged	Replace screw and housing assembly
	o Ball of ball scre worn	Replace screw and housing assembly
	o Low fluid level in oil tank	Add fluid
	o Air not compeletely bled	Bleed air
	o Improper fluid viscosity	Replace fluid
	o Trouble in power steering booster system	Repair or repalce
	o Incorrect pipe connections	Correct
	o Defective oil pump	Repair or replace
	o Flow control valve in faulty operation	Correct
	o Oil pump malfunctioning	Correct or replace
	Steering linkage defective	
	o Universal joint abnormally worn, damaged or poorly lubricated	Replace steering shaft assembly or apply grease
	o Deformed link	Replace link
	Front axle defective	
	o King pin poorly lubricated	Apply grese
	o Poor front wheel alignments (toe-in, camber, caster)	Correct wheel alignments
	o Front wheel tires underinflated	Adjust
	o Thrust bearings damaged	Replace
	Other troubles	
	o Cargo one-sided toward the front of the bed	Distribute cargo evenly throughout the bed
Unstable steering because of excessive free play of steering wheel	Steering gear mechanism defective	
	o Worn rack and gear unit of worm and ball nut	Replace
	o Sector shaft worn	Replace sector shaft
	o Worm and ball nut worn	Replace
	o Loosen steering gear mounting bolts	Tighten to the specified torue

Symptom	Probable cause	Remdy
Unstable steering because of excessive free play of steering wheel	Power steering booster gear mechanism defective	Replace screw and housing sector shaft
	o Worn rack and rear in ball screw unit	Replace bearing
	o Worn bearing in sector shaft	Replace screw and housing assembly
	o Worn ball in ball screw	Tighten to the specified torque
	o Loose power steering booster mounting bolts	Add fluid, retighten all parts, and bleed air
	o Air trapped and air not completely bled	
	Steering linkage defective	
	o Looseness in universal joint	Pack with grease if the problem still persists, replace steering shaft assembly
	o Looseness in drag link ball stud	Replace knuckle arm, pitman arm or drag link
	o Looseness in tie rod end ball stud	Replace tie rod end
	Front axle defective	
	o Worn wheel hub bearing	Replace
	o Worn king pin or bushing	Replace king pin or bushing
	Other troubles	
	o Uneven brake application	Readjust or replace lining
	o Cargo one-sided toward the front of the bed	Distribute cargo evenly throughout the bed
Vehicle pulls to one side	Front axle steering system defective	
	o Improper wheel alignment	Correct
	o Deformed front axle	Replace
	o Worn or damaged wheel hub bearing	Replace
	o Worn or damaged king pin	Replace king pin or bushing
	o Steering wheel is off-center	Correct
	o Steering gear defective	Repair or replace
	o Power steering booster defective	Correct or replace
	Other troubles	
	o Cargo one-sided	Distribute cargo evenly
	o Sagging or broken leaf spring	Replace
	o Uneven brake application	Correct
	o Right and left tires unevenly inflated	Adjust

TROUBLESHOOTING
ST-31

Symptom	Probable cause	Remdy
Vehicle pulls to one side	o Right and left tires greatly different in the degree of wear	Replace tires
	o Right and left tires different in outer diameter	Replace with equal diameter tires
	o Right and left wheel bases greatly different	Correct wheel base
	o Bent rear axle housing	Replace axle housing
Steering wheel jerks	Front axle assembly defective	
	o Excessive clearance between king pin and bushing	Replace king pin or bushing
	o Worn or deteriorated wheel hub bearing	Replace
	o Improper wheel alignment (particularly camber and caster)	Correct wheel alingment
	o Looseness in knuckle arm or tie rod ball stud	Replace knuckle arm or tie rod end
	o Excessively uneven tire pressure	Adjsut tire pressure
	o Knuckle arm, tie rod arm, backing plate and knuckle, etc. improperly tightened	Tighten to specified torque
	o U-bolt, nut, etc. of front spring loose	Tighten to specified torue
	o Lateral and radial runouts of front tires, and incorrect static and dynamic balance	Correct wheel balance
	Steering gear steering system defective	
	o Improper play in worm and ball nut and sector shaft	Adjust
	o Angular contact bearing worn	Replace
	o Loosen drag link ball stud	Replace knuckle arm, pitman arm or drag link
	o Sector shaft worn	Replace sector shaft
	o Worm and ball nut worn	Replace
	Power steering booster steering system defective	
	o Improper play in ball screw unit and sector shaft	Adjust
	o Worn thrust bearing	Replace
	o Defective power steering booster	Correct or replace
	o Looseness in ball stud of drag link	Replace knuckle arm, pitman arm or drag link
	o Worn sector shaft and bearing	Replace sector shaft and bearing
	o Worn ball and groove in ball screw	Replace screw and housing assembly

Symptom	Probable cause	Remdy
Steering wheel jerks	Other troubles	
	o Excessive runout of propeller shaft	Correct or replace
	o Reduction pinion and gear damaged and in poor tooth contact	Replace pinion and gear or correct tooth contact
	o Excessive tire runout	Correct or replace
Power steering booster system defective		
Hard steering in both clockwise and counter-clockwise directions	Low pressure due to fluid leaks	Retighten leaky parts or replace seal ring, O-ring, etc.
	Valve malfunctioning	Check and correct valve or repalce screw and housing assembly
	Piston damaged or foreign substance trapped	Check for foreign substance in hydraulic fluid, and check and correct inside surface of body and sliding surface of piston, or replace screw and housing assembly
Hard steering particularly in middle	Rack mesh torque out of adjustment	Adjust stub shaft rotating torque
Great difference in steering effort between clockwise and counter-clockwise rotations	Clogged hydraulic circuit	Check and correct hydraulic circuit or repalce screw and housing assembly
Hard steering particularly during idling	Air trapped due to low fluid level	Bleed air and then add fluid
Hard steering particularly at beginning	Valve malfunctioning	Check and correct valve or replace screw and hosuing assembly
Hard steering due to problems not in power steering booster	Defective oil pump	Correct or replace oil pump
	Clogged hydraulic piping	Correct or replace piping
	Insufficient grease in steering linkage joints	Pack joints with grease
	Insufficient front tire inflation pressure	Adjust to the specified air pressure
	Incorrect front wheel alignments	Measure wheel alignments if incorrect, adjust to the specified values

TROUBLESHOOTING
ST-33

Symptom	Probable cause	Remdy
Hard steering due to problems not in power steering booster	King pin thrust bearing damaged	Correct or replace
	King pin short of grease	Apply grease to king pin
	Cargo one-sided toward front	Distribute cargo evenly
Steering wheel oscillations	Power steering booster defective o Valve and roll edge damaged or control seal ring or O-ring damaged	Replace screw and housing assembly
	o Improper fluid in power steering system	Replace with the specified hydraulic fluid
	Problems not in power steering booster o Uneven tire pressure	Adjust to specified pressure
	o Incorrect front wheel alignment	Measure wheel alignment If incorrect, adjust to specified values
	o Front wheels out of balance	Replace with wheel balancer or replace tires or wheels
	o Worn drag link or tie rod end ball joint	Replace drag link assembly or tie rod end
	o Worn king pin and king pin bushing	Disassembly and replace If defective
Poor returnability of steering wheel	Incorrect steering gear rack starting torque adjustment	Adjust main shaft starting torque
	Power steering booster defective o Rack torque out of adjustment	Adjust stub shaft torque
	o Clogged hydraulic circuit	Check and correct circuit or replace screw and housing assembly
	o Clogged hydraulic piping	Correct or replace piping
	Front wheel alignment off	Measure wheel alignment If incorrect, adjust to specified values
Vehicle wanders due to excessive free play of steering wheel	Steering gear defective o Sector shaft gear worn	Adjust steering wheel free play with adjusting screw or replace cross shaft
	o Damaged or worn worm and ball nut serrating	Replace worm and ball nut

Symptom	Probable cause	Remdy
Vehicle wanders due to excessive free play of steering wheel	Problems in power steering booster o Worm sector shaft gear	Adjust with adjusting screw or replace sector shaft
	o Damaged or worn stub shaft serrations	Replace screw and housing assembly
	Other problems o Worn front wheel bearings	Replace
	o Mounted or joined parts loose	Retighten to specified torque or replace defective parts
Insufficient steering angle or clockwise and counterclockwise steering angles differ	Incorrect pitman arm mounting angle	Mount at correct position
	Knuckle stopper bolt out of adjustment	Using tuning radius gauge, adjust clockwise and counterclockwise steering angles with knuckle stopper bolts
Fluid leaks	Fluid leaks from steering gear	Retighten leaky parts to specified torque, or replace oil seal and apply liquid packing
	Fluid leaks from power steering booster	Retighten leaky parts to specified toque or replace O-ring, seals, etc.
	Fluid leaks from oil pump o Defective oil pump housing	Disassemble, check and replace if defective
	o Defective gasket, oil seal	Disassemble, check and replace if defective
	o Loose bolts	Retighten to specified torque
	Fluid leaks from oil tank o Fluid leaks from oil tank due to overfilling	Adjust to specified level
	o Fluid leaks from oil tank due to trapped air	Bleed air and adjust to specified level
	o Improperly welded pipes	Braze or replace
	Loose hydraulic piping and connections	Retighten to specified torque or replace

TROUBLESHOOTING**ST-35**

Symptom	Probable cause	Remdy
Abnormal hydraulic pressure in oil pump	Maximum generated hydraulic pressure insufficient due to defective oil pump	Disassemble, check, correct, or replace defective parts
	Excessively high generated pressure at engine idling due to crushed or clogged hydraulic line	Correct o replace hose or pipe
Strange sound, vibration or noise from oil pump * The oil pump poduces some howling sound which is not an indication of any functional problem (particularly when turning the steering wheel while the vehicle in standstill)		
Grinding noise	Air in oil pump	Check fluid level and hose clip, bleed air, or replace oil pump
	Seizure of parts in oil pump	Replace oil pump
Squeaking noise	Seizure of parts in oil pump	Replace oil pump
Low whirring noise	Loose pump bracket and mounting bolts and nuts	Retighten to specified torque
	Defective pump	Replace oil pump

FRONT SUSPENSION

GENERAL	FS - 2
SPECIFICATIONS	FS - 2
SERVICE STANDARDS	FS - 2
SPECIAL TOOLS	FS - 3
SERVICE PROCEDURE	FS - 4
TROUBLESHOOTING	FS-10

GENERAL

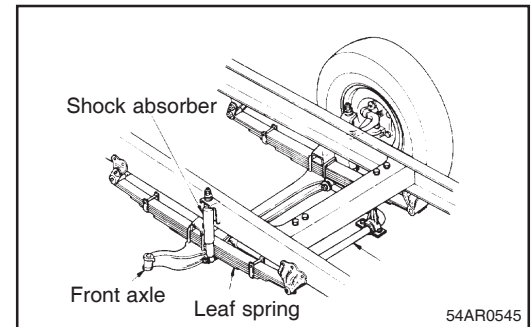
The suspension consists of semi-elliptical piled leaf springs and shock absorbers. The suspension supports the weight of the body and absorbs the vibration and shock from the road surface, thereby preventing their direct transmission to the body for effective protection of the body, passengers and cargo. The suspension also suppresses irregular vibrations of the wheels to assure stable operation.

Construction and operation

Depending on the road surface condition and load weight, the leaf springs deflect to provide buffering function. Any change in the span caused by the load is coped with by movement of the spring shackle at the rear end.

Shock absorber adequately damps axle vibration.

In addition, stabilizers are provided to reduce the rolling which occurs when the vehicle makes a turn.



SPECIFICATIONS

Vehicle model		HD120	
Item			
Leaf spring			
L x Width x t - No. of leaves		1300 x 70 x 11 - 7	
Shock absorber			
Model		SA301	SA401
Max. O.D.		54	63.5
Cylinder I.D.		30	35
Stroke		210	210
Damping force when extended		1960N (200kgf)	

SERVICE STANDARDS

Service Standards Table

Unit:mm

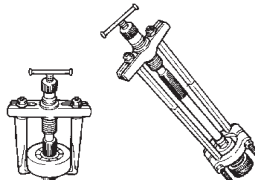
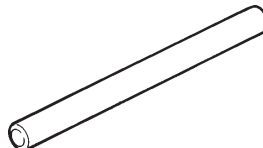
Maintenance item		Nominal Value (Basic diameter in [mm])	Limit	Remedy
Leaf spring suspension	Spring bracket to shackle pin clearance (Front side)	0 to 0.05	0.3	Replace shackle pin
	Spring bushing to shackle pin clearance	0.075 to 0.15	0.3	Replace bushing
	Spring bracket to shackle pin clearance (Rear side)	0 to 0.05	0.3	Replace shackle pin
	Shackle bushing to shackle pin clearance (Rear side)	0.025 to 0.15	0.3	Replace bushing
	Shackle link to shackle pin clearance	0.025 to 0.15	0.3	Replace shackle link or shackle pin
	Spring bushing to shackle pin clearance (Front side)	0.075 to 0.15	0.3	Replace bushing

SPECIAL TOOLS**FS-3****TIGHTENING TORQUE TABLE**

Unit: mm

Location tightened	Screw size O.D,x pitch (mm)	Tightening torque kg·m
U-bolt mounting bolt	M16 x 1.50	20.8 to 28.2
Shackle pin lock blt Mounting nut	M12 x 1.25	3.5 to 5.5
Shock absorber lower bracket pin nut	M24 x 1.50	36 to 44

SPECIAL TOOLS

Tool (Number and name)	Illustration	Use
Puller set 09431-83100	 ASST0030	Removal of gear and bearing
Drift 09517-83300	 ASST0020	Removal of oil seal and bearing

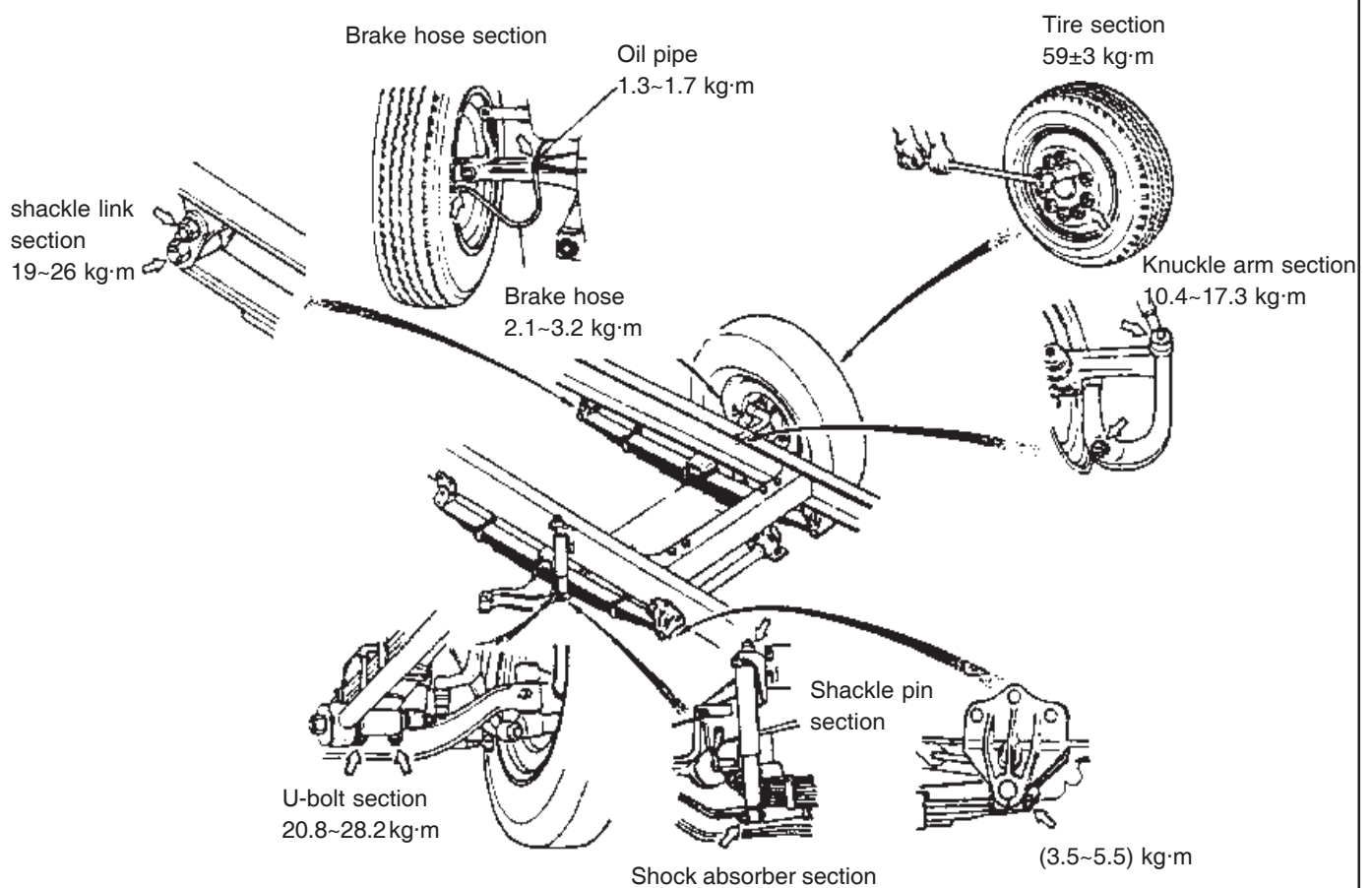
SERVICE PROCEDURE

REMOVAL

Removal of front suspension

NOTE

- o Remove the brake hose from a side first.
Install to brake side first and use care not to twist the brake hose.
- o Plug removed brake hose to prevent entry of dust and dirt.
- o After installation, bleed brake system.



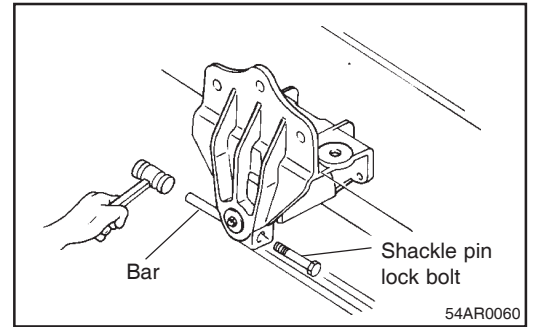
SERVICE PROCEDURE

FS-5

Removal Procedure

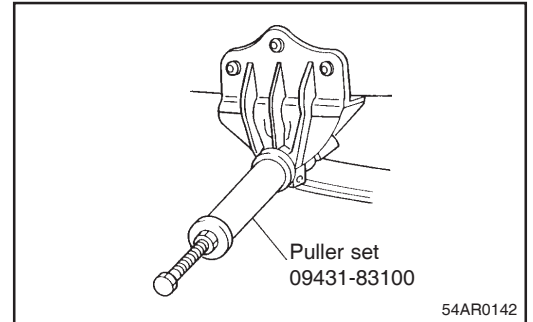
(1) Removal of shackle pin lock bolt

Remove the nut from the spring bracket and, using the Bar remove the lock bolt.



(2) Removal of shackle pin

Remove the grease nipple from the shackle pin and, using the special tool, puller set, remove the shackle pin. Be sure to remove the nut first for the back side.



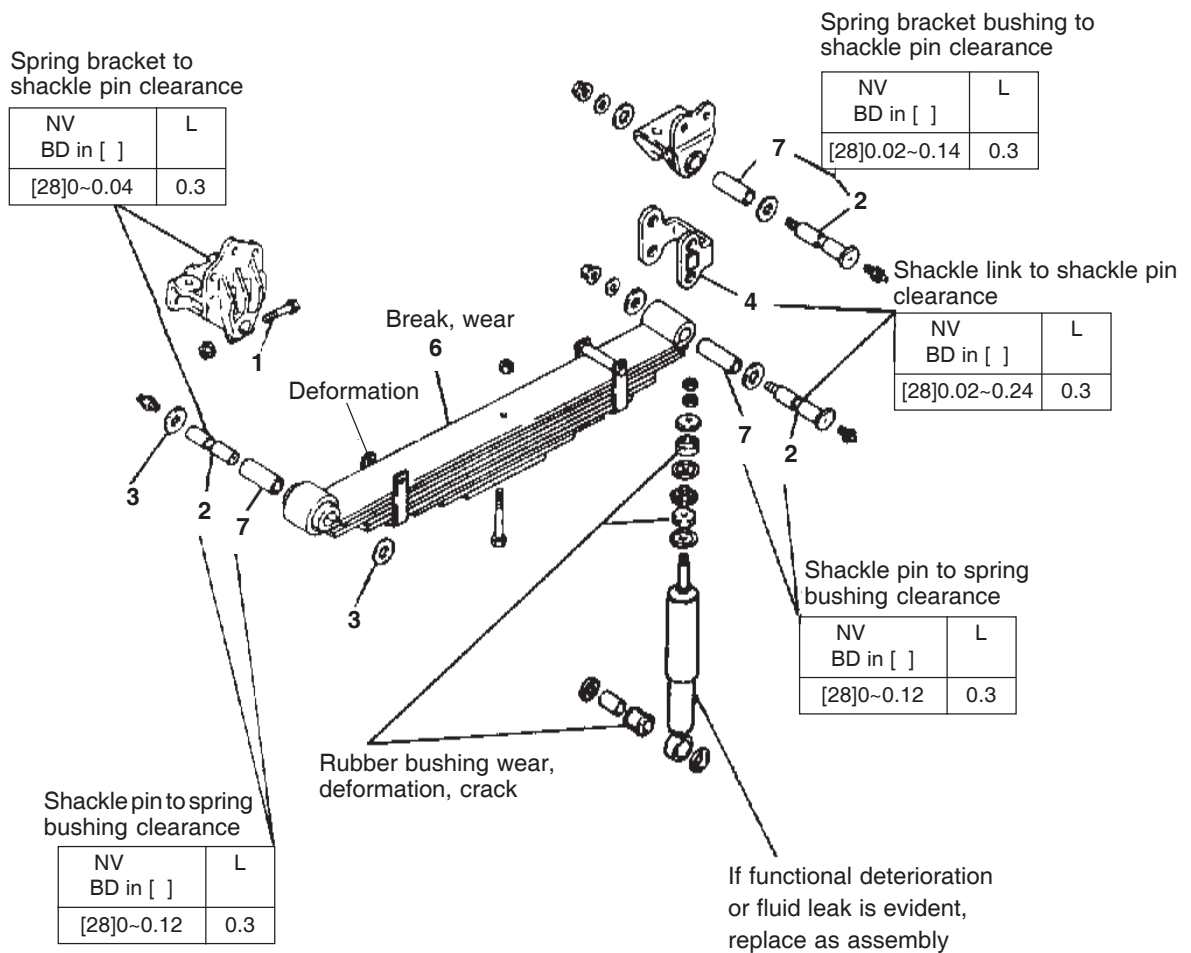
Disassembly, Inspection and Correction

Disassembly of front suspension

BD ... Basic Diameter

NV ... Nominal Value

L ... Limit



Disassembly sequence

1. Lock bolt
2. Shackle pin
3. Side washer
4. Shackle link
5. Clip
6. Front leaf spring
7. Bushing

For parts with an encircled number, refer to Disassembly and Reassembly Procedure that follows.

NOTE

To reassemble, reverse the order of disassembly.

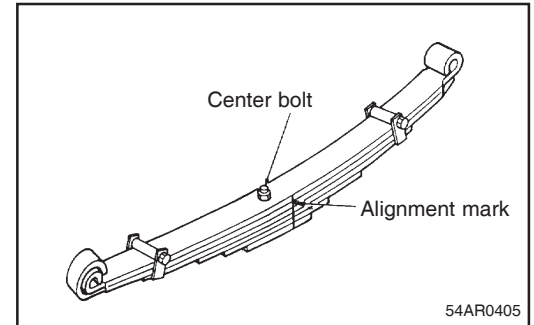
SERVICE PROCEDURE

FS-7

Disassembly Procedure

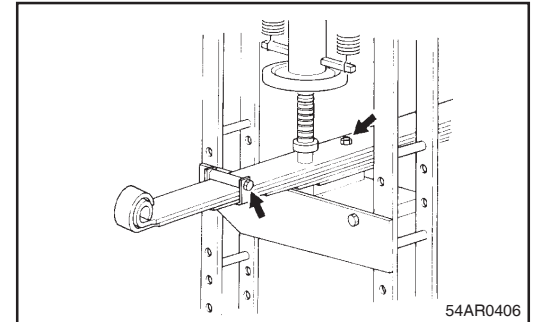
(1) Alignment marking

Make an alignment mark on the leaf spring.



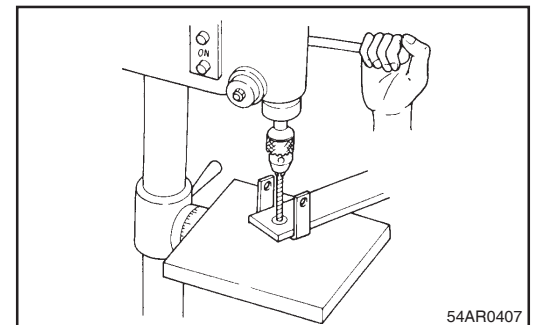
(2) Disassembly of leaf spring

Compress the leaves with a press and remove the center bolt and clip bolts.



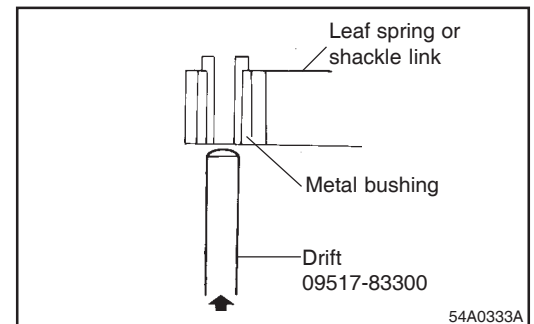
(3) Removal of clips

Using a drill press, countersink the rivet where it is staked and remove the clip.



(4) Removal of bushings

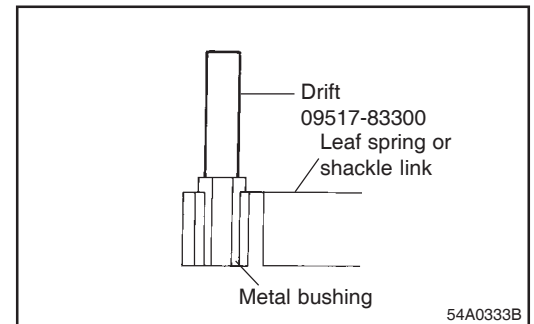
Using the special tool, Drift, remove bushing from the wound-up ends of the leaf spring and shackle link.



Reassembly Procedure

(1) Installation of bushings

Using the special tool, Drift press-fit the bushing into the wound-up ends of the leaf spring and into the shackle link.

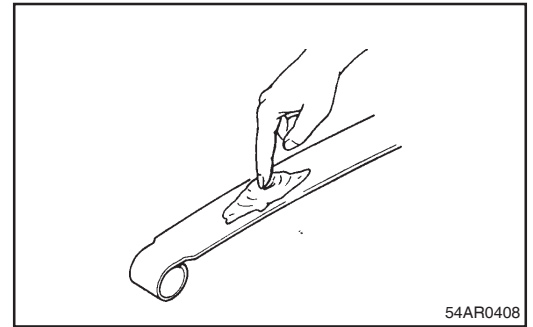


FS-8

FRONT SUSPENSION

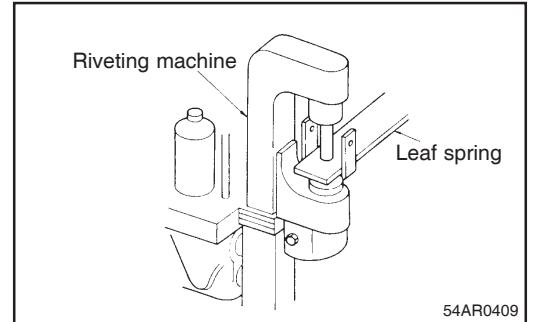
(2) Application of grease

Clean leaf surfaces and apply chassis grease between leaves.



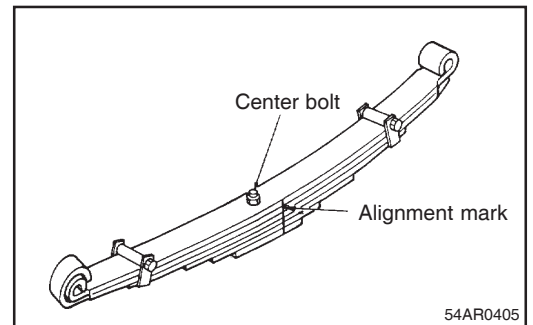
(3) Installation of clips

Using a riveting machine, fit clips into position.

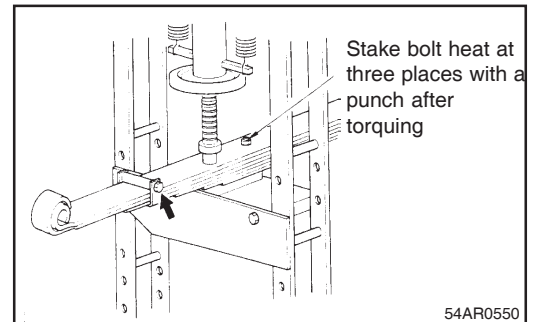


(4) Reassembly of leaf springs

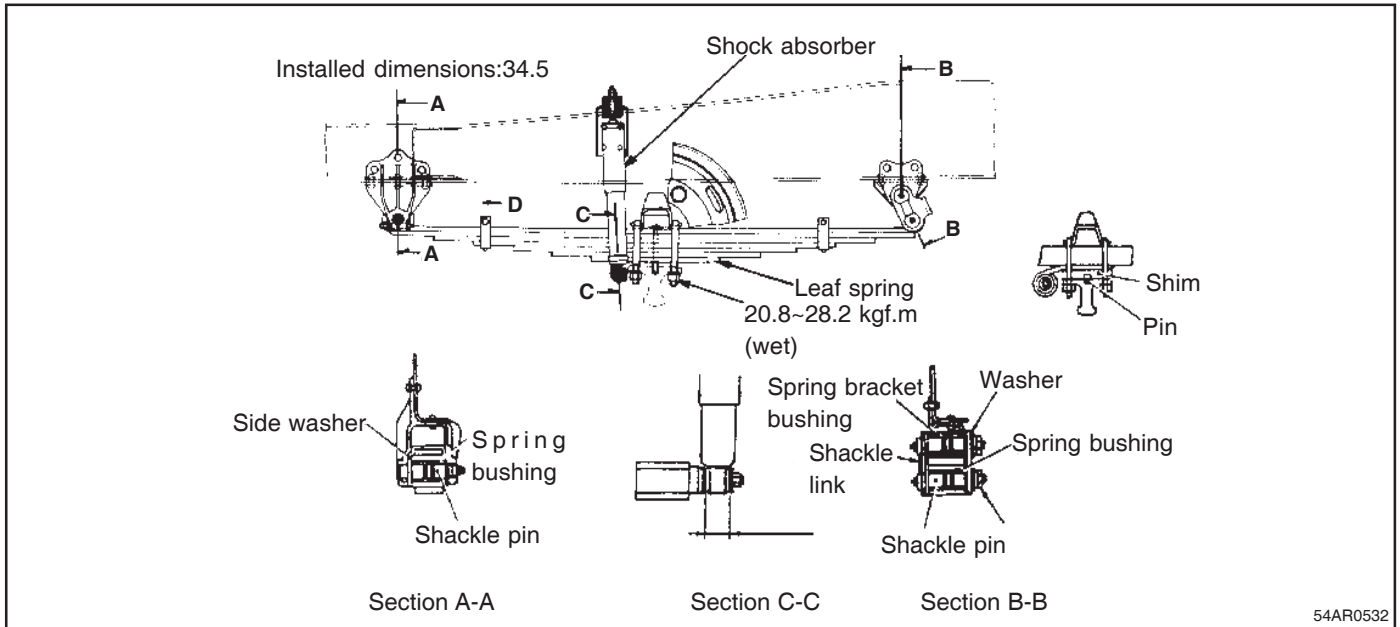
(a) Line up the alignment marks on all leaves and assemble the leaves together by temporarily tightening the center bolt.



(b) With the leaves compressed with a press, tighten center bolt and clip bolts.



Installation



Installation Procedure

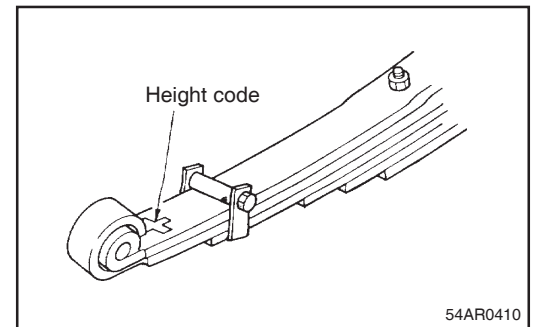
(1) Combination of right and left leaf springs

When the leaf spring assembly is replaced, select an assembly so that the combination of the height codes on right and left springs conforms to any one of the combinations shown below.

NOTE

Install the spring according to the classification symbols of the camber as follows.

(The camber classification symbols are marked on the upper side of the spring as +, O or -).

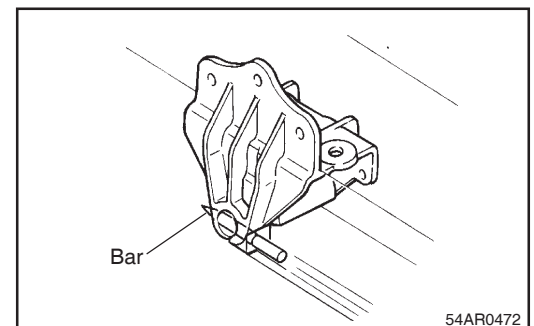


Item	Combination of leaves						
	1	2	3	4	5	6	7
Leaf spring assembly, LH	+	+	O	O	-	O	-
Leaf spring assembly, RH	+	O	+	O	O	-	-

(2) Locating the shackle pin

Using the Bar, align the lock bolt holes in spring bracket and shackle link with shackle pin lock bolt groove.

(3) After installation, feed chassis grease into each grease nipple.



TROUBLESHOOTING

NOTE

Inspection the front and rear suspensions at the same time.

Symptom	Probable cause	Remedy
Spongy feel	Defective shock absorber	Replace
Cyclic bounce	Tire unevenly worn	Replace
	Wheels and tires out of balance	Correct balance
Bumps directly received	Tire inflation pressure too high	Adjust
	Cracked or broken leaf spring	Replace
Vehicle tends to develop noise when not loaded	Broken leaf spring	Replace
	Worn spring metal bushing	Replace
	Worn shock absorber rubber bushing	Replace
	Shock absorber left loose	Retighten
Vehicle tends to develop noise when loaded	Damaged spring bracket	Replace
	U-bolt left loose	Retighten

REAR SUSPENSION

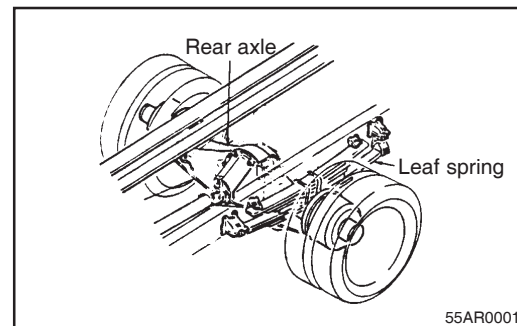
GENERAL	RS - 2
SPECIFICATIONS	RS - 2
SERVICE STANDARDS	RS - 2
SPECIAL TOOLS	RS - 3
SERVICE PROCEDURE	RS - 4
TROUBLESHOOTING	RS-10

RS-2

REAR SUSPENSION

GENERAL

The leaf springs mounted between the frame and rear axle, not only support the weight of vehicle body, but also absorb any vibration and shock from the road surface, thereby preventing their direct transmission to the body for effective protection of the body, passengers, and cargo. They also help suppress irregular vibrations of the wheels to ensure road stability.



SPECIFICATIONS

Vehicle model		HD120
Item		
Leaf spring	Main	1300 x 70 x 11 - 10
L x Width x t - No. of leaves	Helper	1020 x 70 x 11 - 6

SERVICE STANDARDS

SERVICE STANDARDS TABLE

Unit:mm

Maintenance item	Nominal Value (Basic diameter in [])	Limit	Remedy
Spring bracket bushing to shackle pin clearance	[32] 0 to 0.05	0.3	Replace spring bracket or shackle pin
Spring bushing to shackle pin clearance	[32] 0.025 to 0.15	0.5	Replace bushing or shackle pin
Shackle link to shackle pin clearance	[32] 0 to 0.05	0.3	Replace shackle link or shackle pin
Shackle link bushing to shackle pin clearance	[32] 0.025 to 0.15	0.5	Replace bushing or shackle pin

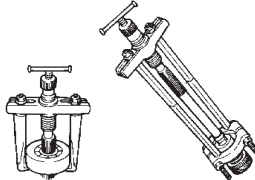
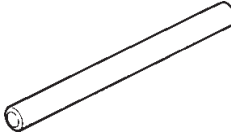
TIGHTENING TORQUE TABLE

Location tightened	Screw size O.D, x pitch (mm)	Tightening torque kg·m
U-bolt	M20 x 2	45 to 47
Shock absorber i bolt tighten nut	M22 x 1.5	26 to 35
Shackle pin lock bolt	M10 x 1.25	3.5 to 5.5
Rubber bumper tighten nut	M12 x 1.25	3.4 to 5.0

SPECIAL TOOLS

RS-3

SPECIAL TOOLS

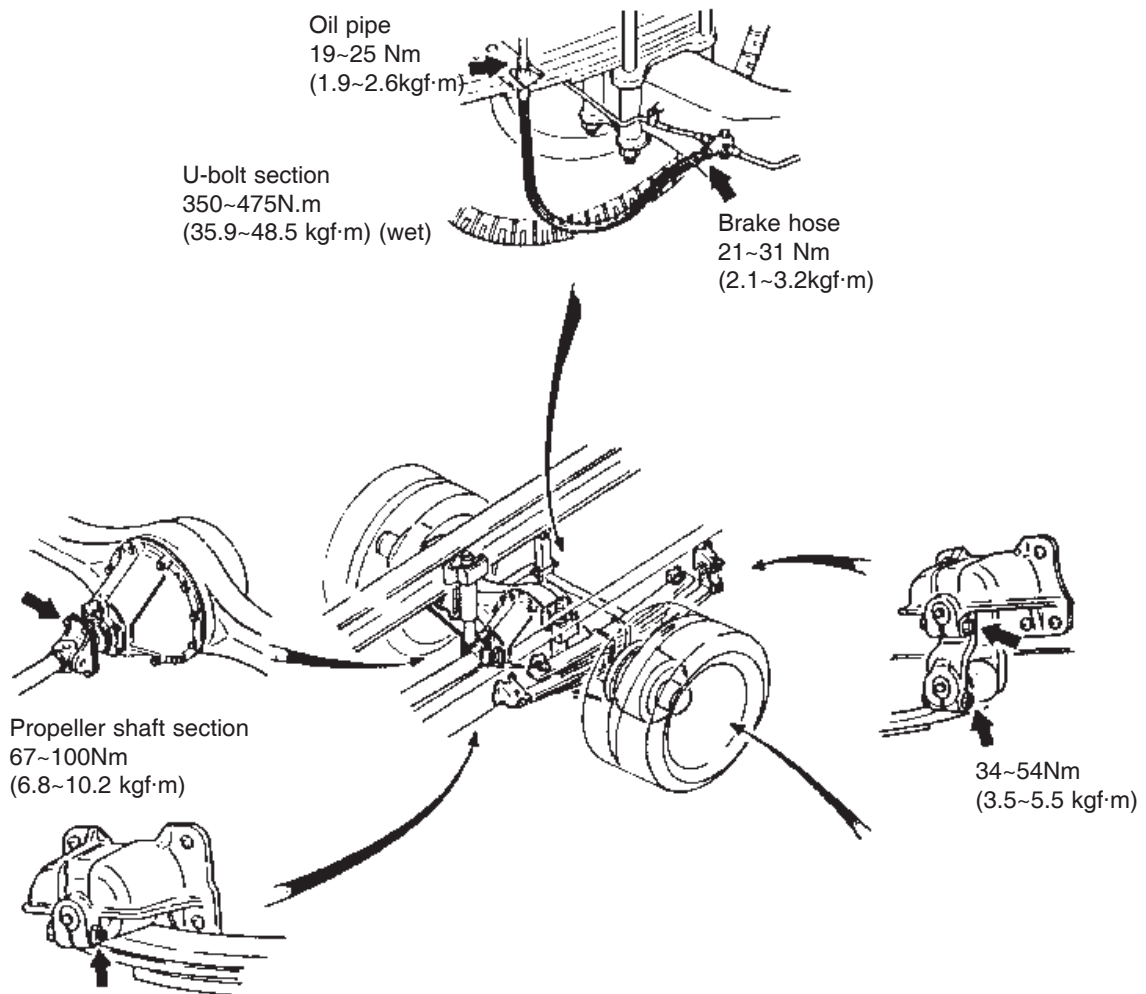
Tool (Number and name)	Illustration	Use
Puller set 09431-83100	 ASST0030	Removal of gear and bearing
Drift 09517-83300	 ASST0020	Removal of oil seal and bearing

SERVICE PROCEDURE

REMOVAL

Removal of front suspension

Brake hose section



NOTE

- o Remove the brake hose from frame side first and reinstall it from the rear axle housing first, use care not to twist the brake hose.
- o Plug removed brake hose to prevent entry of dust and dirt.
- o After installation, bleed brake system.

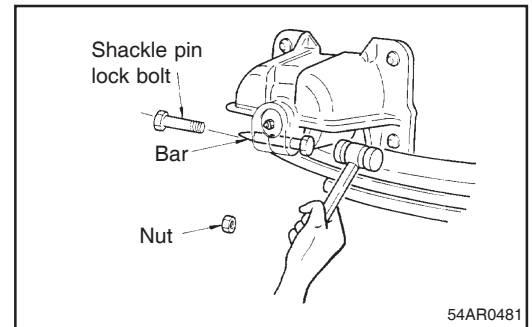
SERVICE PROCEDURE

RS-5

Removal Procedure

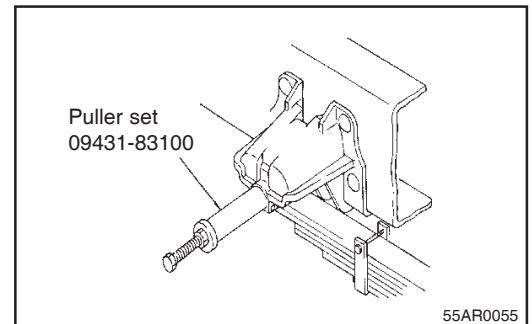
(1) Removal of shackle pin lock bolt

Remove the nut from the spring bracket, one at front and two in the rear, and remove the lock bolt using the Bar.



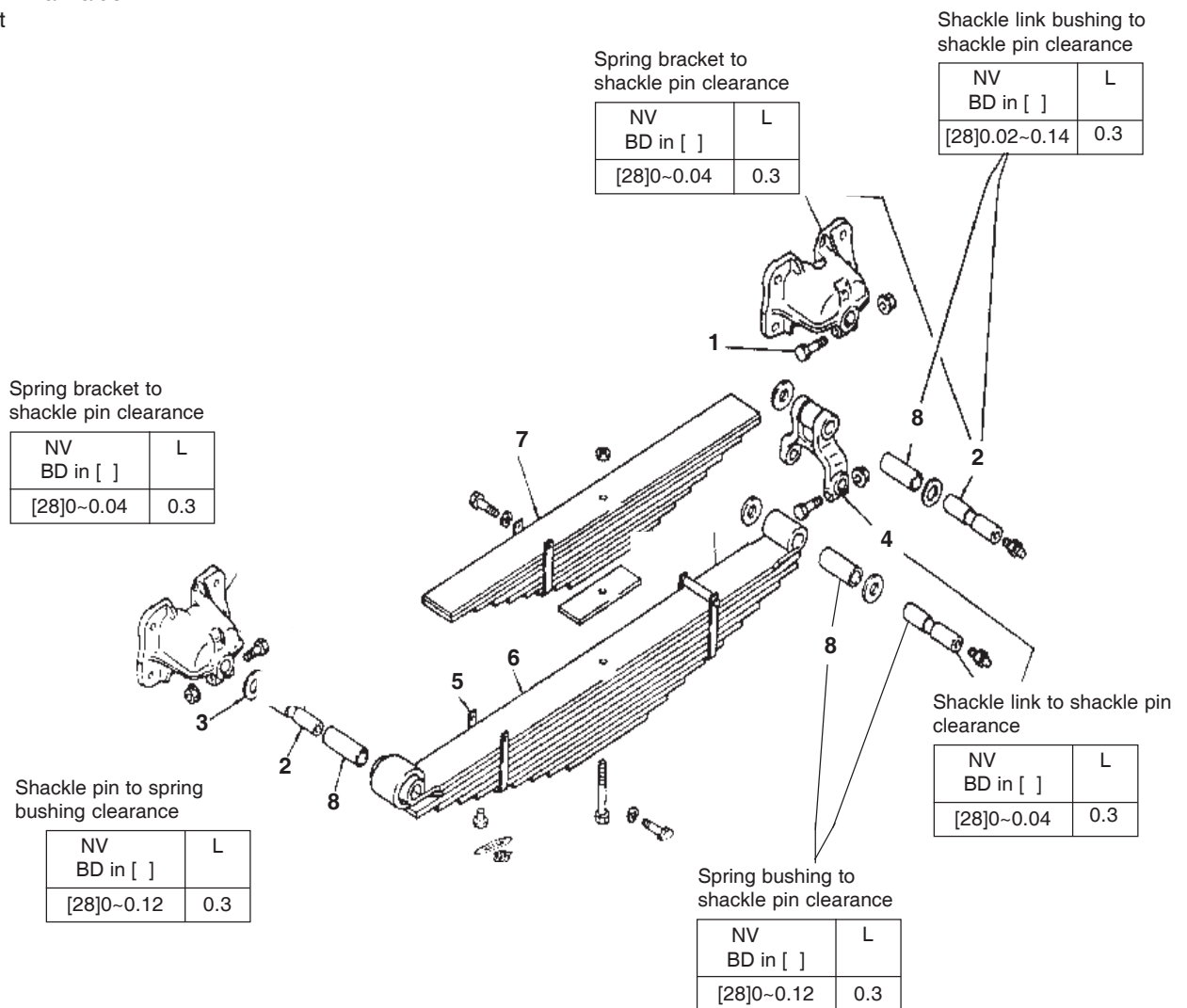
(2) Removal of shackle pin

Remove the grease nipple from the shackle pin and, using the special tool, puller set, remove the shackle pin.



Disassembly, Inspection and Correction

BD ... Basic Diameter
 NV ... Norminal Value
 L ... Limit



Disassembly sequence

1. Lock bolt
2. Shackle pin
3. Side washer
4. Shackle link
5. Clip
6. Rear main leaf spring
7. Rear helper leaf spring
8. Spring bushing

For parts with an encircled number, refer to
 Disassembly and Reassembly Procedure that follows.

NOTE

To reassemble, reverse the order of disassembly.

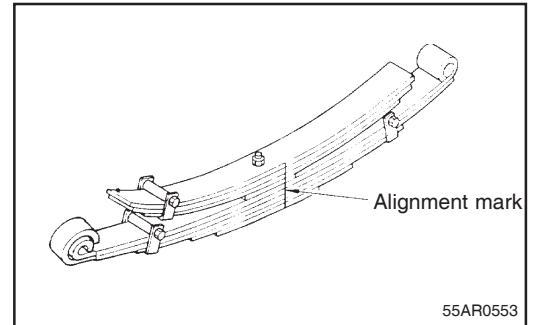
SERVICE PROCEDURE

RS-7

Disassembly Procedure

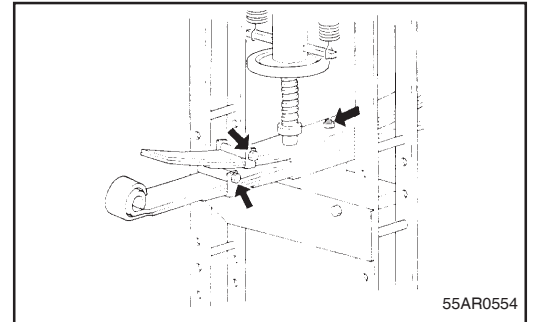
(1) Alignment marking

Make an alignment mark on the leaf spring.



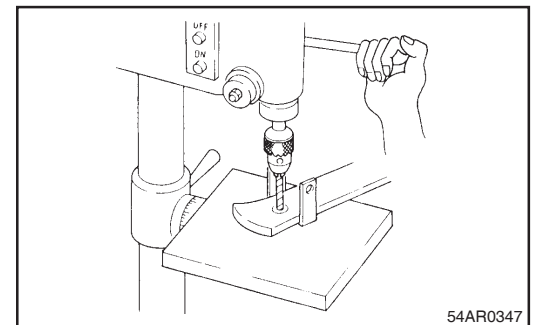
(2) Disassembly of leaf spring

Compress the leaves with a press and remove the center bolt and clip bolts.



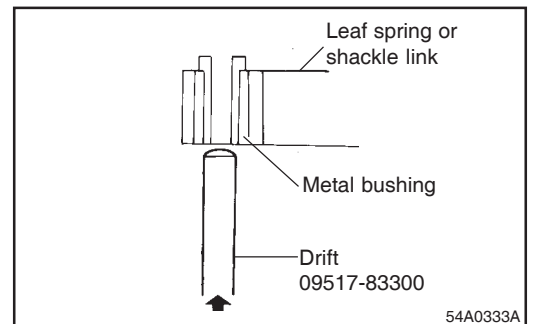
(3) Removal of clips

Using a drill press, countersink the rivet where it is staked and removed the clip.



(4) Removal of bushings

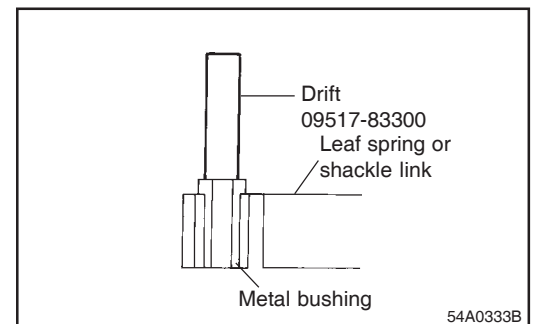
Using the special tool, Drift, remove bushing from the wound-up ends of the leaf spring and shackle link.



Reassembly Procedure

(1) Installation of bushings

Using the special tool, Drift press-fit the bushing into the wound-up ends of the leaf spring and into the shackle link.

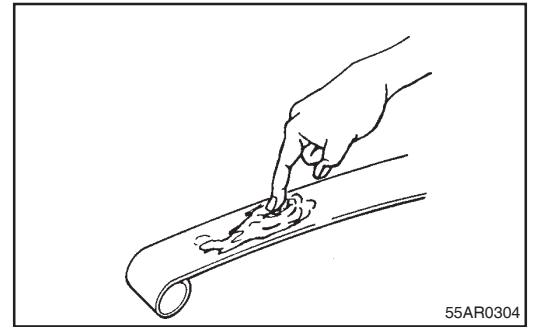


RS-8

REAR SUSPENSION

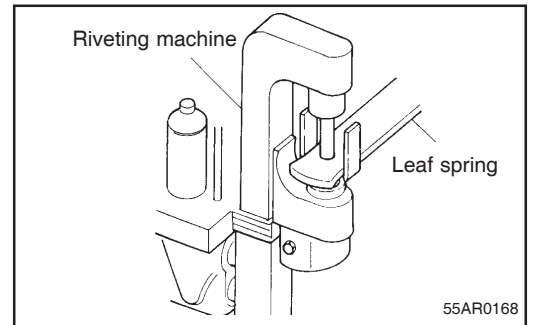
(2) Application of grease

Clean leaf surfaces and apply chassis grease between leaves.



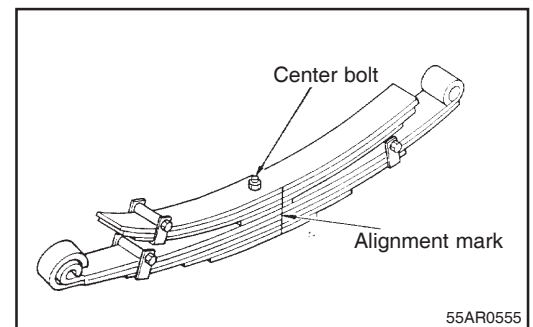
(3) Installation of clips

Using a riveting machine, fit clips into position.

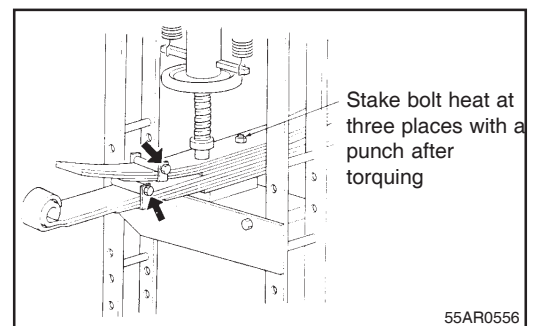


(4) Reassembly of leaf springs

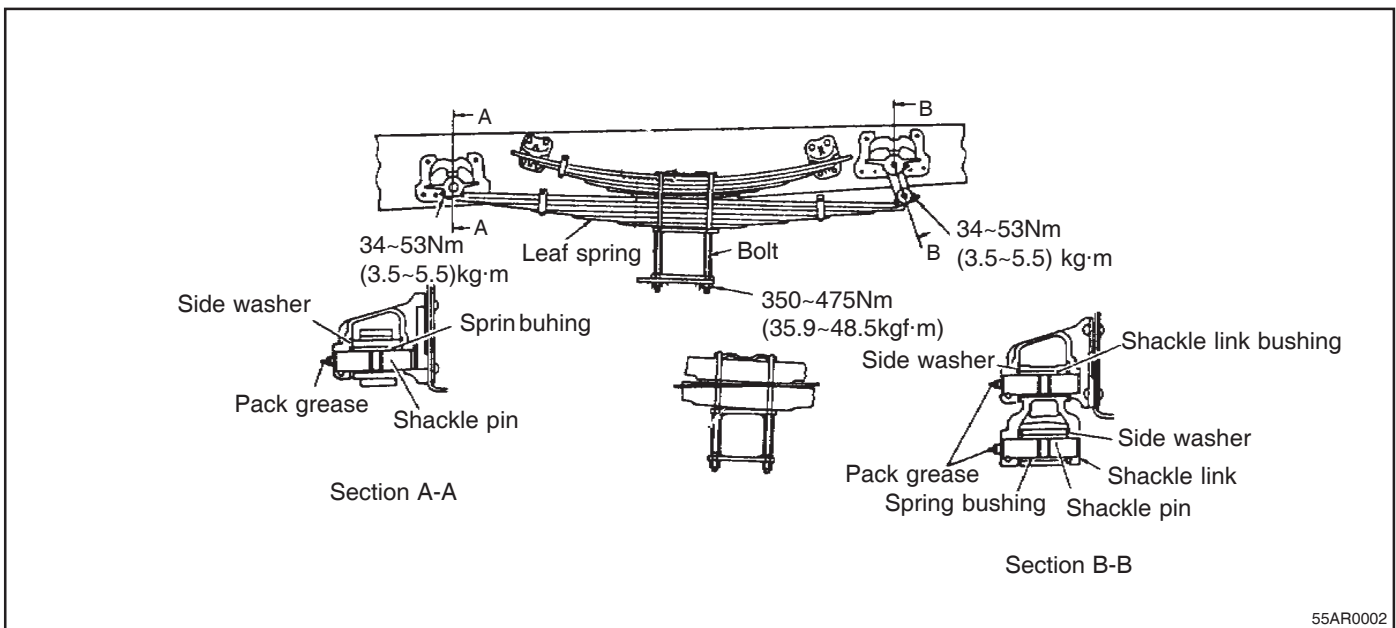
(a) Line up the alignment marks on all leaves and assemble the leaves together by temporarily tightening the center bolt.



(b) With the leaves compressed with a press, tighten center bolt and clip bolts.



Installation



55AR0002

Installation Procedure

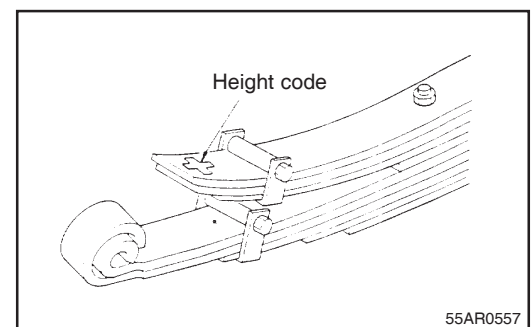
- (1) Combination of right and left leaf springs
When the leaf spring assembly is replaced, select an assembly so that the height codes on the right leaf spring is identical to that on the left spring.
- (2) Locating the shackle pin
Using the Bar, align the lock bolt hole in spring bracket and shackle link with the lock bolt groove in shackle pin.
- (3) After installation, feed chassis grease into each grease nipple.

NOTE

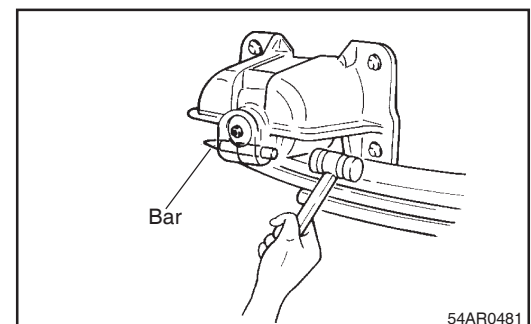
Install the spring according to the classification symbols of the camber as follows.

(The camber classification symbols are marked on the upper side of the spring as +, O or -).

Item	Combination of leaves						
	1	2	3	4	5	6	7
Leaf spring assembly, LH	+	+	O	O	-	O	-
Leaf spring assembly, RH	+	O	+	O	O	-	-



55AR0557



54AR0481

TROUBLESHOOTING

NOTE

Inspection the front and rear suspensions at the same time.

Symptom	Probable cause	Remedy
Cyclic bounce	Tire unevenly worn	Replace
	Wheels and tires out of balance	Correct balance
Bumps directly received	Tire inflation pressure too high	Adjust
	Cracked or broken leaf spring	Replace
Vehicle tends to develop noise when not loaded	Broken leaf spring	Replace
	Worn spring metal bushing	Replace
Vehicle tends to develop noise when loaded	Damaged spring bracket	Replace
	U-bolt left loose	Retighten

WHEEL AND TIRE

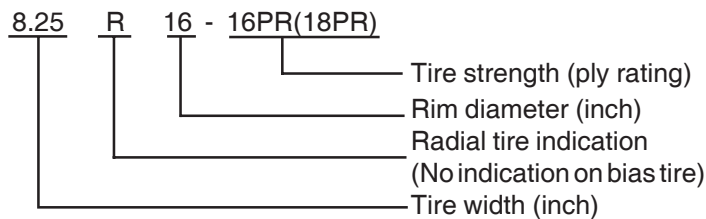
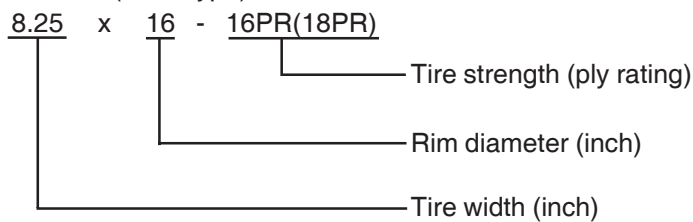
GENERAL	WT - 2
SPECIFICATIONS	WT - 3
SERVICE STANDARDS	WT - 3
SERVICE PROCEDURE	WT - 3
TROUBLESHOOTING	WT-18

GENERAL

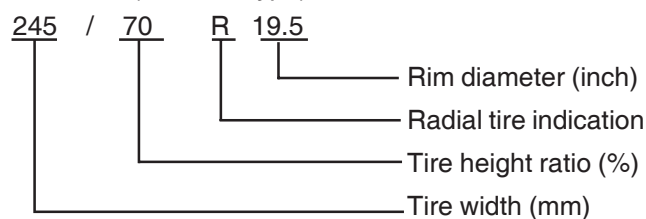
The wheel and the tire rotate integrally. The tires support the full load of the vehicle and give cushioning effect by their inflation pressure while their treads transmit power and direct the vehicle as it is steered.

(1) Tire size designation

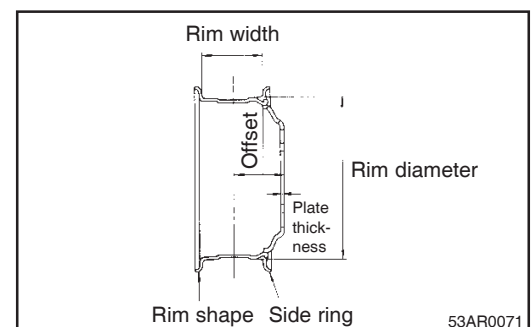
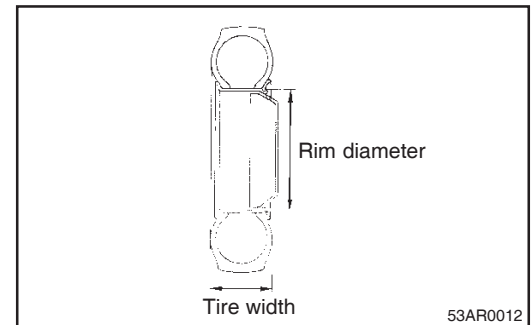
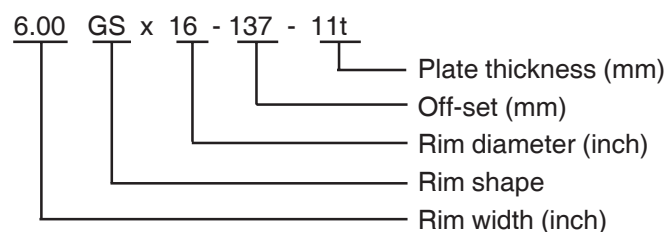
(a) Bias tire (Tube type)



(b) Radial tire (Tubless type)



(2) Wheel size designation



SPECIATIONS**WT-3****SPECIATIONS**

Vehicle model	Tire size	Wheel size	Remarks
HD120	8.25 x 16 - 16 PR (BIAS)	6.00 GS x 16 - 127	

SERVICE STANDARDS**SERVICE STANDARDS TABLE**

Unit : mm

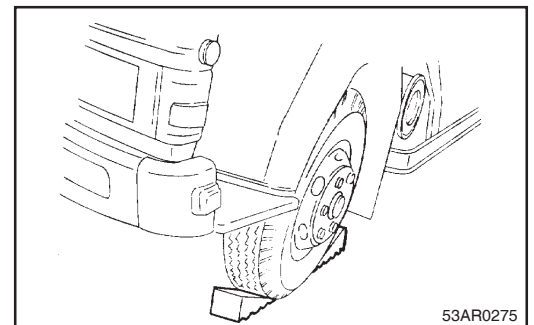
Maintenance item		Nominal Value	Limit	Remedy
Flatness of disc wheel (hub surface)	6.00GS x 16 - 127	0.5 or less		Replace
Vertical and lateral runout of disc wheel	6.00GS x 16 - 127	1.5 or less		Replace
Side ring end gap	16" wheel tire	2~7		Inspect

TIGHTENING TORQUE TABLE

Location tightened		Screw size O.D. x pitch (mm)	Tightening torque kg·m
Front wheel nut		M24 x 2.5	38~42
Rear wheel nut	Inner	M20 x 2.5	
	Outer	M30 x 1.5	

SERVICE PROCEDURE**REMOVAL**

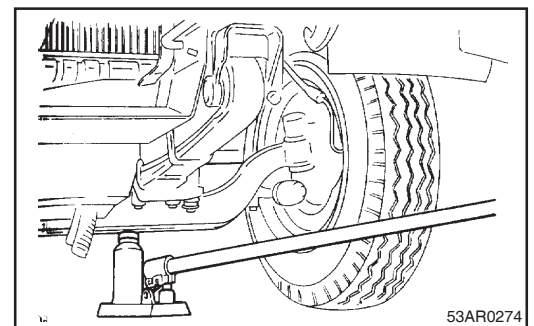
- (1) Apply chocks to the tire that is diagonally opposed to the tire to be replaced.



- (2) Removal of front tires

- (a) Set a jack under the front axle.

For details of the jacking-up, refer to the Owner's Manual.



WT-4

WHEEL AND TIRE

- (b) Using the socket wrench and wrench handle, loosen the wheel nuts little by little in diagonal order. Do not remove the nuts yet.

NOTE

1. **Set the socket wrench fully over the wheel nut. Otherwise, the wrench could disengage from the nut, causing hazard.**
2. **Loosen the R.H. wheel nuts counterclockwise and L.H. wheel nuts clockwise in the case of 6 or 8 wheel nut. The right-hand thread, wheel nut is identified by "R" mark and the left-hand thread wheel nut is identified by "L" mark.**

- (c) Jack up gently until the tire clears off the ground.
(d) Remove all wheel nuts and then remove the wheel gently.

NOTE

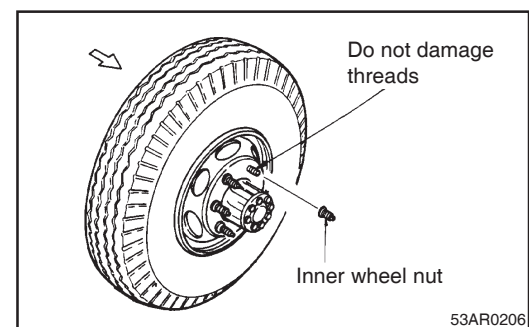
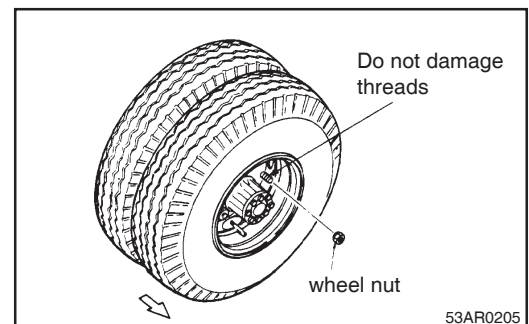
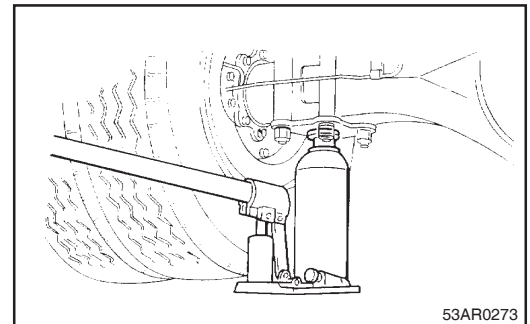
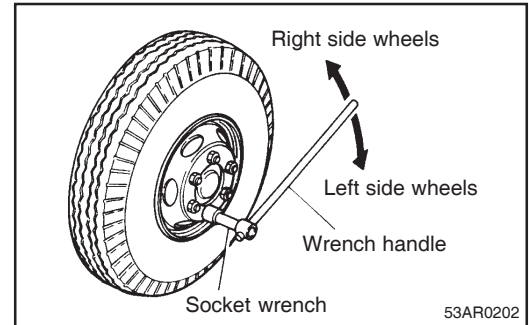
Rough handling of wheel may cause damage on hub bolt threads.

- (3) Removal of rear tires.

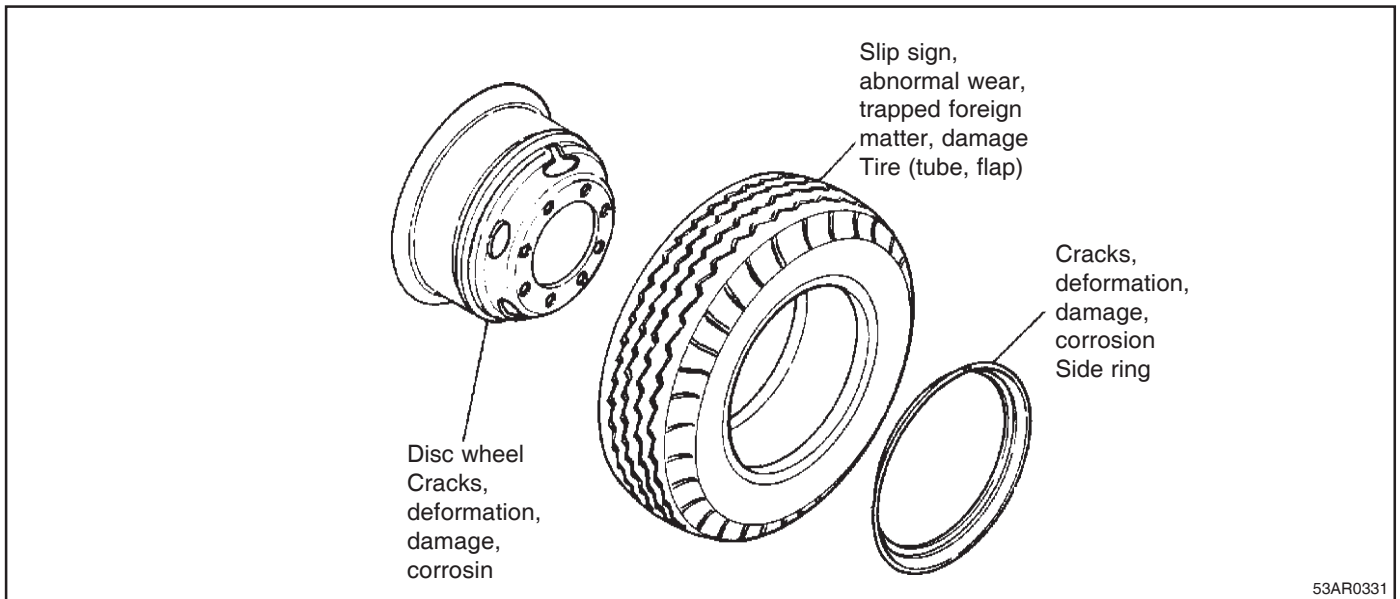
- (a) Set a jack under the rear axle.
(b) Prior to jacking-up, loosen the wheel nuts little by little diagonal order. Do not remove the nuts yet.
(c) Jack up gently until the tire clears off the ground.

- (d) Remove the outer wheel nuts and remove the tire gently, taking care not to damage the threads on inner wheel nuts.
(e) Lower the jack and loosen the inner wheel nuts little by little in diagonal order.
Do not remove the nuts yet.

- (f) Jack up vehicle again and remove the inner wheel nuts and then remove the inner wheel gently, taking care not to damage the threads of the hub bolts.

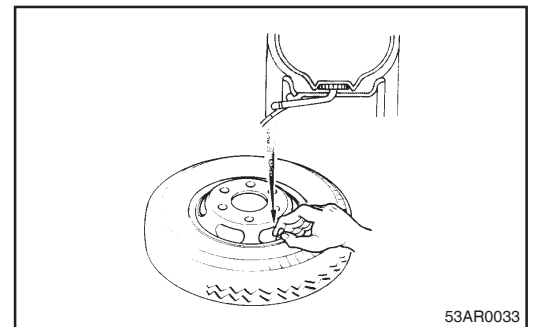


Disassembly and Reassembly Tire with Tube



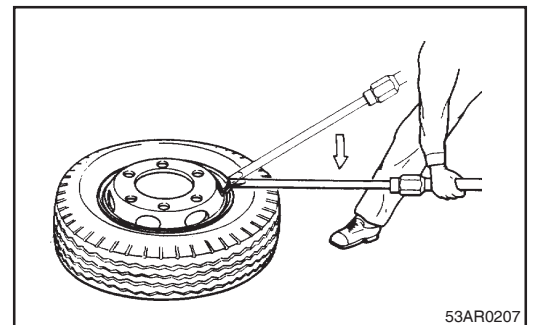
Disassembly procedure

- (1) Deflate the tire completely

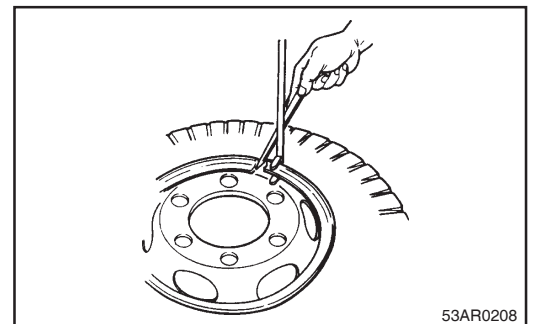


- (2) Set the bead hammer end between the tire bead and side ring at location slightly off the side ring ends and drive the hammer into position.

Then, press hard the bead hammer down. Perform these procedures at several locations between the side ring and bead. Repeat the same procedures on the back of wheel.



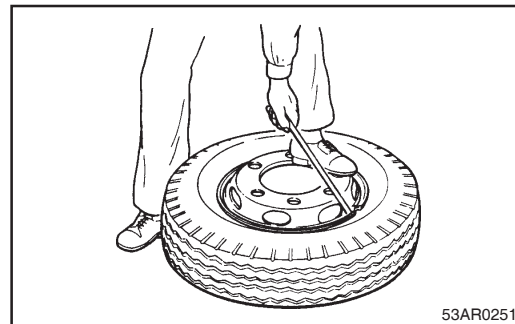
- (3) Set the lever at the side ring ends and insert it deep into the lever groove.



WT-6

WHEEL AND TIRE

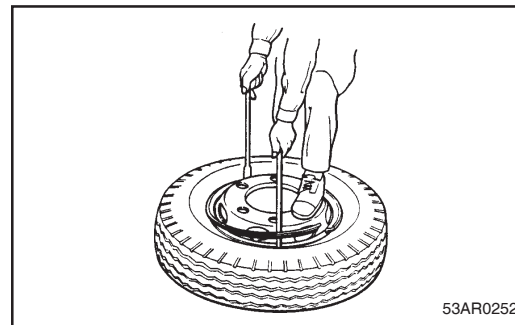
- (4) Lower the lever down toward the center of tire.



- (5) Fit another lever into position between the side ring and rim at a location slightly off the first one.
Pry off the side ring with the second lever.
Repeat these steps at several other locations.

NOTE

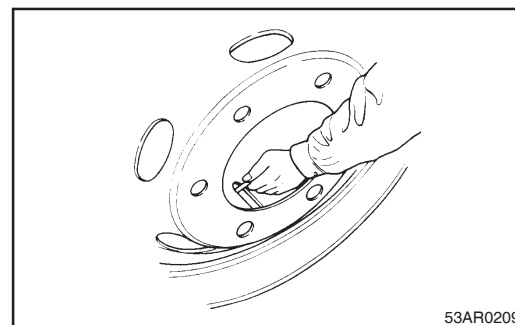
Pry off the side ring half round, and the entire side ring will be removed. At this time, however, be careful about the possible sudden jumping up of the side ring.



- (6) Remove the side ring and then push in the valve through the valve hole in the rim.

NOTE

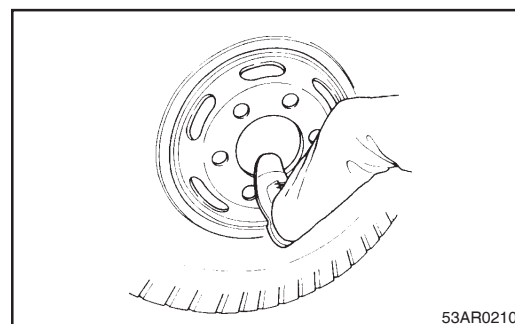
Prior to this operation, mount the valve cap on valve to prevent damage to the valve threads.



- (7) Holding the tire vertically, carefully depress the center of wheel with a foot.

NOTE

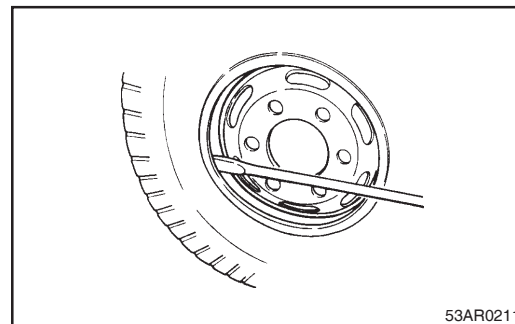
Be careful about sudden removal of the wheel.



- (8) Insert the lever between bead and rim at a location near the valve and push out the rim.

NOTE

Be careful about sudden removal of the wheel.



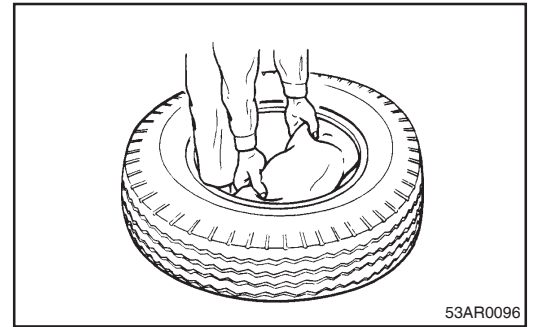
SERVICE PROCEDURE

WT-7

- (9) Lay down the tire, remove the flap and pull out the tube.

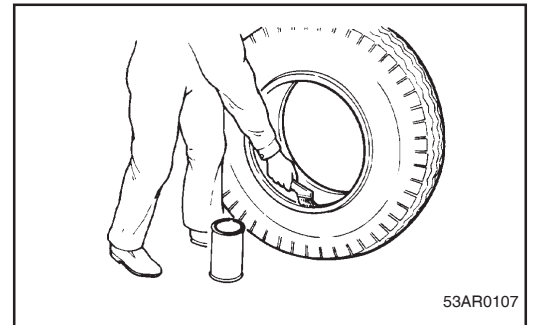
NOTE

If the tube is in close contact with the tube, use tire lever to remove the tube carefully.

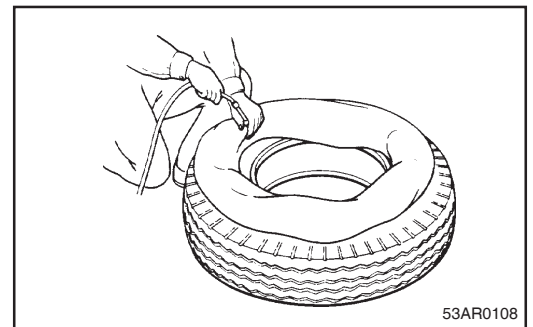


Reassembly procedure

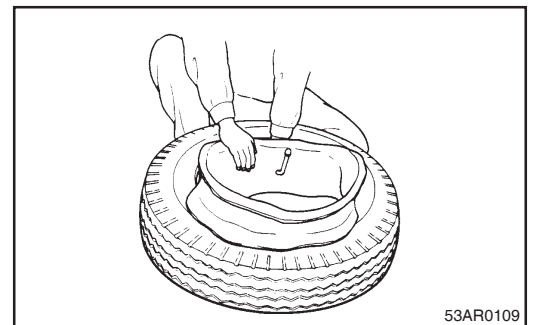
- (1) Apply talcum powder to the tube, flap and tire inside to prevent adhesion between these parts.



- (2) Slightly inflate the tube and insert it into the tire.



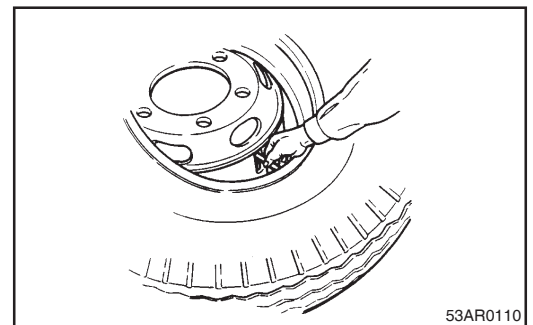
- (3) Insert the valve the into the valve hole in flap and insert flap into the tire little by little.



- (4) Place the wheel horizontally and insert the valve into the valve hole.

NOTE

Prior to this operation, mount the valve cap on valve to prevent damage to the valve threads.



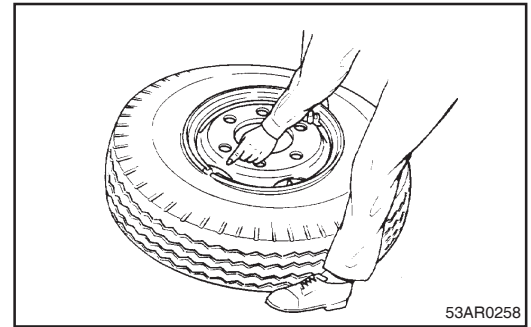
WT-8

WHEEL AND TIRE

- (5) Place the wheel in the tire and set the side ring in the rim groove.

NOTE

The side ring ends should be positioned at least 150 mm away from the valve.

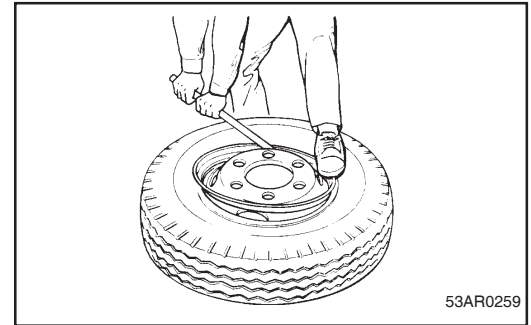


- (6) Depress near the side ring ends with a foot and, using the lever, fit the side ring in position more than half of the ring.

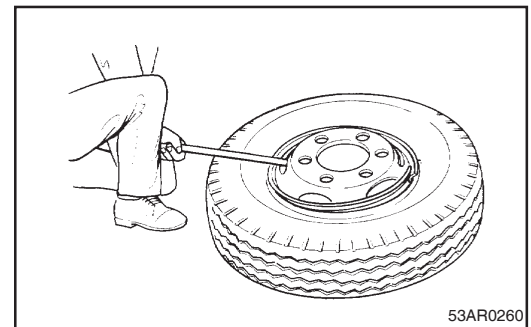
NOTE

The side ring not fitted deep enough is very hazardous as it may jump up from its seat.

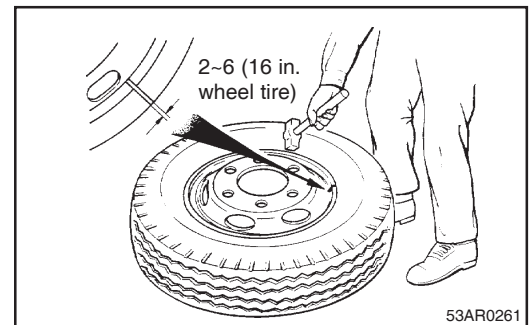
Be sure to press the side ring well with a foot.



- (7) Fit the remaining portion of the ring into position with the lever.



- (8) Check to see if the side ring is in position throughout and make sure that the ring end gap is within the specification.



- (9) Inflate the tire as follows.

NOTE

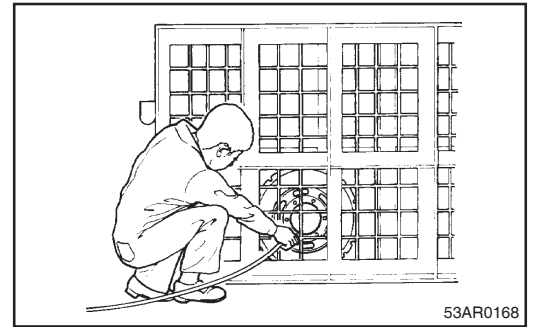
It is very dangerous to inflate the tire without the tube fully inserted. Use every caution to avoid incomplete tube insertion.

SERVICE PROCEDURE

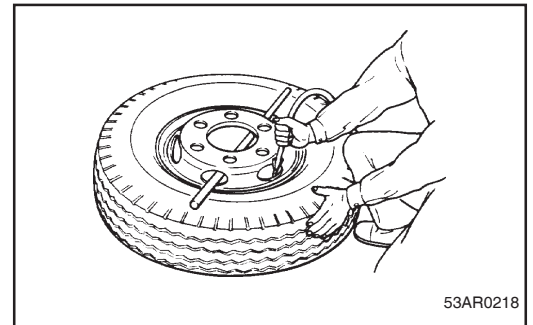
WT-9

- (a) With the tire accommodated in the safety cage, inflate properly.

For tire air pressure, refer to Section 2. Specifications.

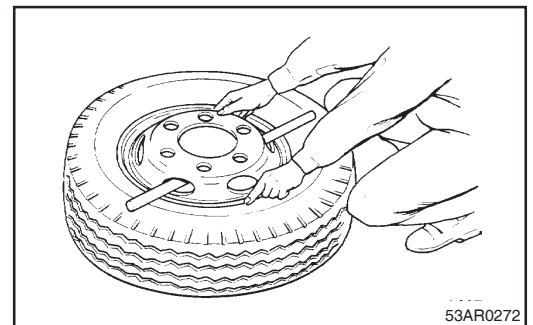


- (b) If the safety cage is not available, insert an iron rod into the ornamental holes and keep yourself away from the tire before attempting to inflate it.



- (10) Check for rim line. (Engagement between side ring and wheel).
Check also the valve for air leak.

- (11) Adjust the wheel and tire balance.



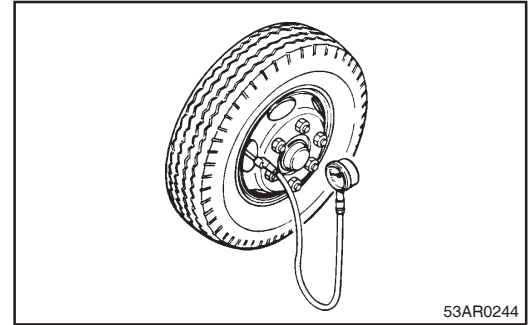
Inspection and Correction

(1) Inspection of tire air pressure

Measure the tire pressure and adjust if it is not as specified.

NOTE

1. When handling the tire, use good care as it is filled with compressed air of high pressure.
2. Check the air pressure when the tire is cold.
3. The rear wheel inner and outer tires must have the same pressure.
4. Do not intermix radial and bias tires.
5. Be sure to fit the air cap to the air valve.
6. There is no need to increase the tire pressure before driving at high speed.

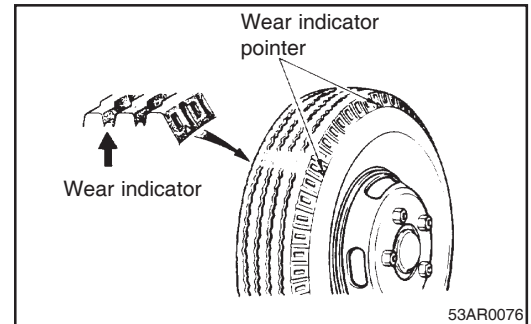


(2) Inspection of tire wear

- (a) Check the wear indicator to make sure that the tire groove depth is at the nominal level or deeper.

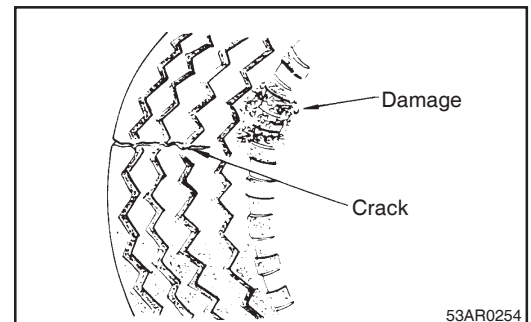
The six wear indicator locations are shown by the D marks put on both sides of the tires.

- (b) If the tire treads have been worn to the wear indicator (tire groove depth 1.6 mm or less), replace the tire with a new one. Even if the groove depth is still more than the limit, replace the tire if it has been worn too unevenly, has ridged wear or other abnormal wears.



(3) Inspection of tire cracks and damage

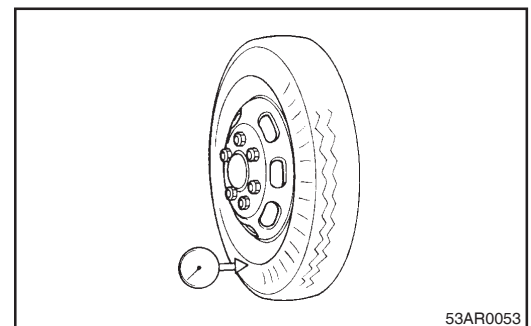
Check the tire tread for severe damage and cracks and replace with a new one as necessary.



(4) Tire lateral runout

Apply a dial gauge to the tire side and measure tire lateral runout.

Nominal	3.5 mm or less
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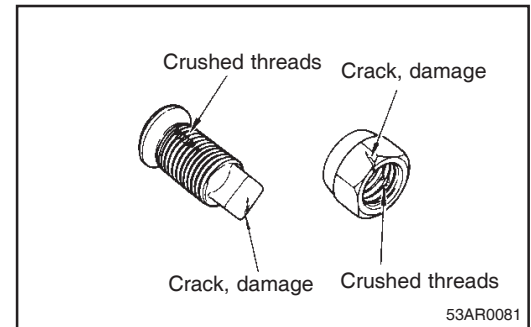


SERVICE PROCEDURE

WT-11

(5) Inspection of wheel nut and hub bolt

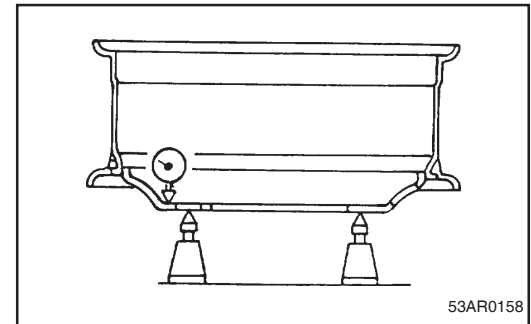
Check the wheel nut and hub bolt for stripped threads, cracks and damage and replace if defective.



(6) Flatness of disk wheel

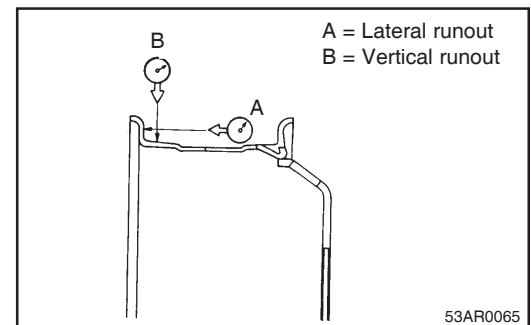
Place four portable jacks on a surface plate and lay the disc wheel on the jacks as illustrated above. On the 170 and 270 mm diameter circles, measure the flatness using a dial gauge. If it exceeds the nominal value, replace the disc wheel.

The flatness is the difference between the minimum and maximum values measured at 12 points equally spaced on a circle.



(7) Lateral and vertical runout of disc wheel

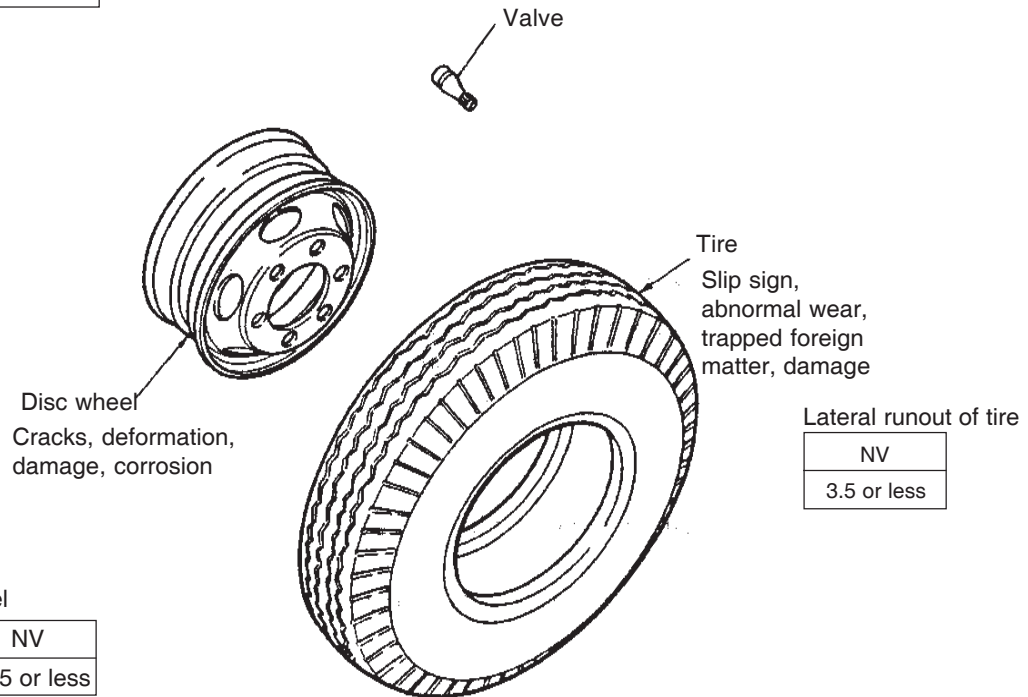
Using a dial gauge, measure the lateral and vertical runouts of the disc wheel. If they exceed the limit value, replace the disc wheel.



Tubeless Tire

Vertical and lateral runout of disc wheel

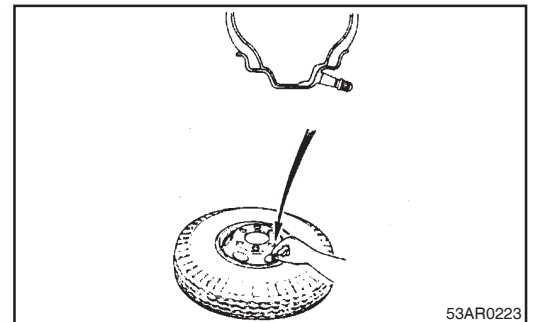
Type	NV
245/70 R19.5	1.5 or less



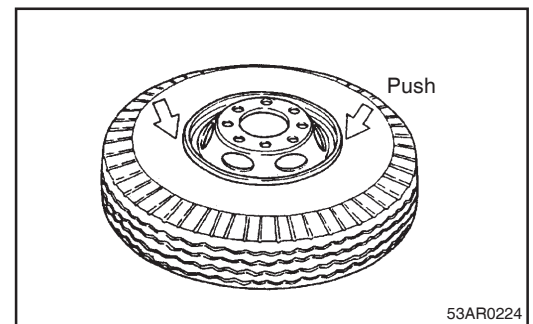
53AR0231

(1) Disassembly

- a) Deflate the tire completely.



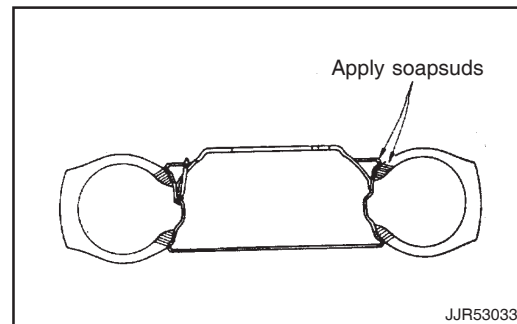
- b) Push the tire side wall at the beads to produce a space between the wheel rim and tire beads.
(Pushing with feet will facilitate separation.) Perform on both sides.



SERVICE PROCEDURE

WT-13

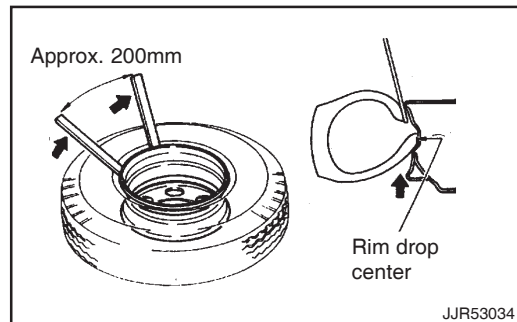
Apply soapsuds to the rim flange and tire beads for better sliding.



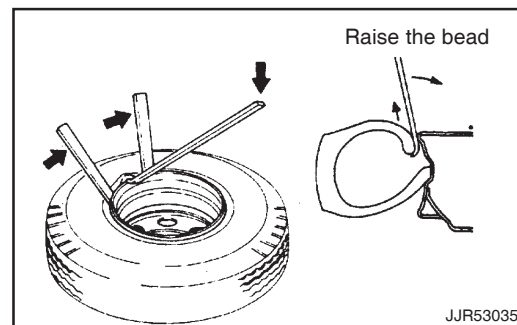
- c) Set the wheel with the disc side down and drive two or three tire levers at about 200 mm spacing into the space between the rim and beads.

NOTE

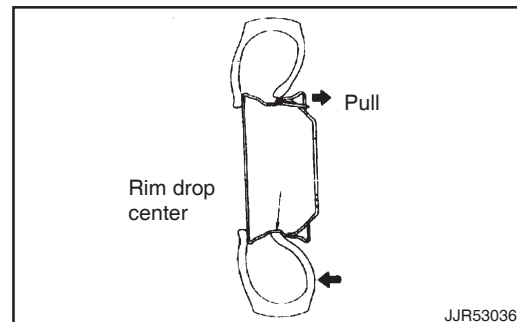
Force the opposite side of bead section (where levers are not inserted) fully into the rim drop center.



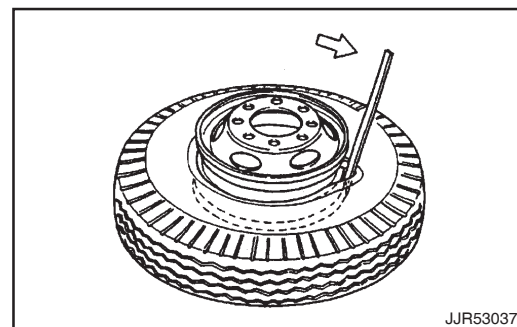
- d) Apply force to the inserted levers in such direction as to compress the bead section. Then, insert another tire lever between the two levers and push up the bead section to disengage it little by little. Repeat this operation moving successively along the circumference to disengage full circumference on one side.



- e) Set the tire vertically on edge and pull the wheel top (near the air valve) toward you to seat the lower bead into the rim drop center.



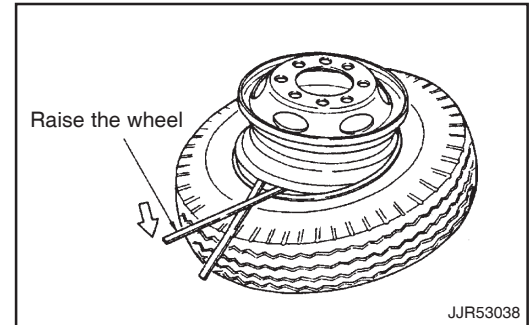
- f) Lay the tire flat with the wheel disc surface facing up. Insert the tire lever between the bead and rim and apply force to push up the wheel.



WT-14

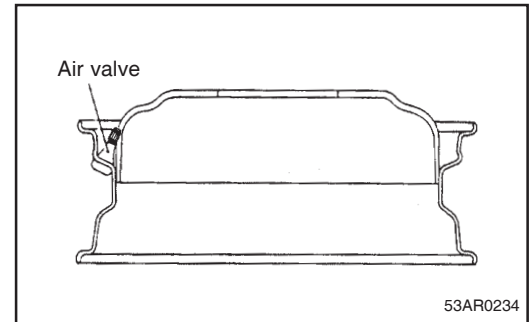
WHEEL AND TIRE

- g) Insert another tire lever near the one that has been inserted and pry up the wheel and disengage it little by little. Repeat this operation successively along the circumference to remove the wheel from the tire.

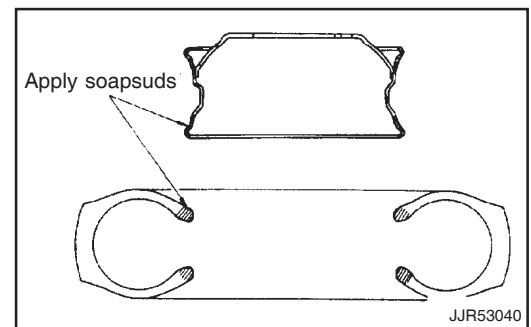


(2) Reassembly

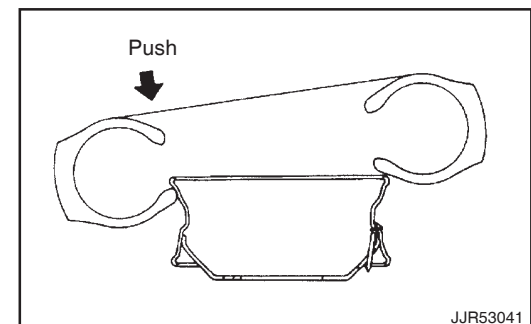
- a) Install the air valve.



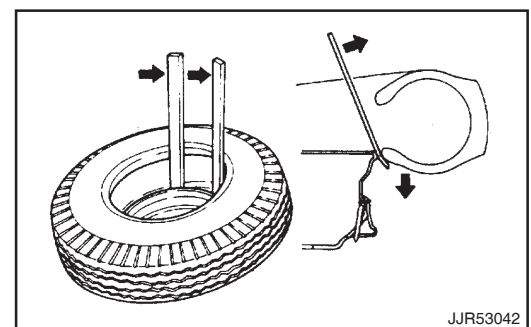
- b) Apply soapsuds to the full circumference of tire bead, wheel rim flange and bead seat for better smoothness to facilitate assembly.



- c) Set the wheel with the disc side down and push the tire down to engage about a half of circumference of bead with the wheel.



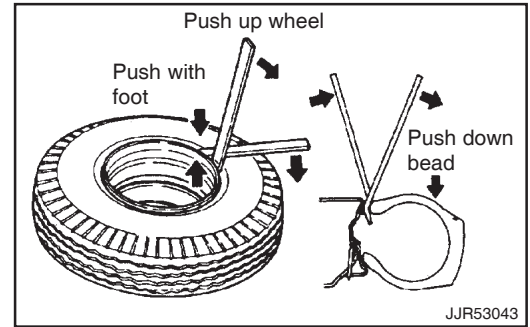
- d) Engage the remaining half of circumference of bead by inserting tire levers between the rim and bead and prying the lever to the tire sides.



SERVICE PROCEDURE

WT-15

- e) For engagement of the bead with the tire top side, use tire levers. While pushing down the bead with one tire lever (also pushing with a foot), force up the wheel, prying up with the other tire lever to push it into the rim drop center little by little. Repeat this operation moving along the circumference until the tire is completely installed over the wheel.
- f) Install the valve cap.

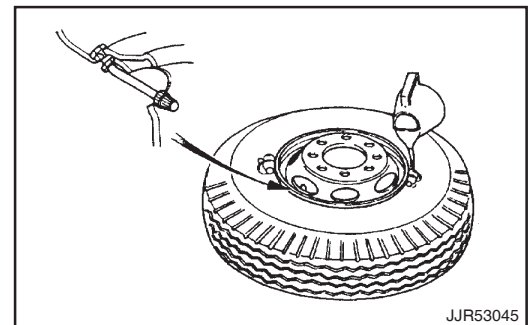
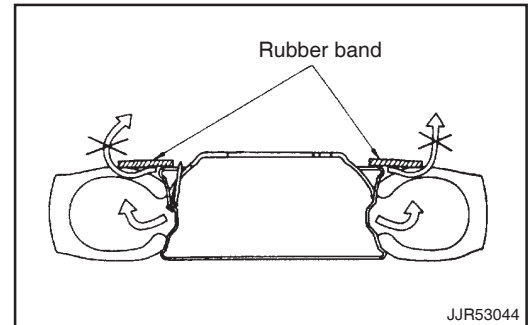


- g) When the tire is inflated, there is case in which air leaks from between the rim and bead so that the tire does not contact firmly with the wheel. In such a case, close the gap between the rim and bead with a rubber band and apply air pressure so that the bead will be made to move up by the tire internal pressure. When the bead moves up to normal position, remove the rubber band.

NOTE

Air to inflate the tire must be dry. Dehumidify the compressor enough before supplying air.

- h) Pour soapsuds into space between the rim flange and bead and check for air leaks. (Check both sides of the tire.) Also apply soapsuds to the surrounding of the air valve to check for air leaks.



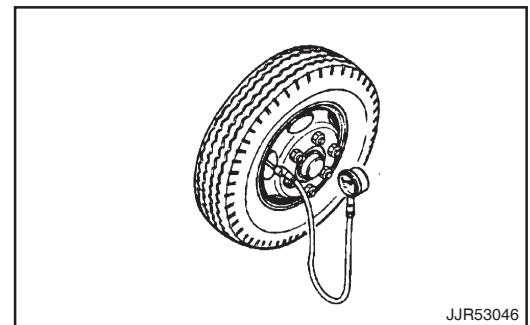
Inspection and Correction

(1) Inspection of Tire Inflation Pressure

Measure the tire pressure and adjust if it is not as specified.

NOTE

1. When handling the tire, use good care as it is filled with compressed air of high pressure.
2. Check the air pressure when the tire is cold.
3. The wear wheel inner and outer tires must have the same pressure.
4. Do not intermix radial and bias tires.
5. Be sure to fit the air cap to the air valve.
6. There is no need to increase the tire pressure before driving at high speed.



(2) Inspection of Tire Wear

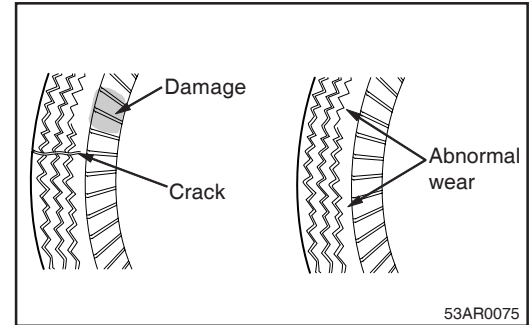
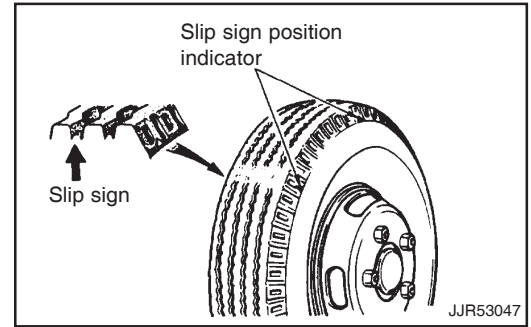
- Check the wear indicator to make sure that the tire groove depth is at the nominal level or deeper. The six wear indicator locations are shown by the marks put on both sides of the tire.
- If the tire treads have been worn to the wear indicator [tire groove depth 1.6mm or less], replace the tire with a new one. Even if the groove depth is still more than the limit, replace the tire if it has been worn too unevenly, has ridged wear or other abnormal wear.

(3) Inspection of Tire Cracks and Damage

Check the tire tread for severe damage and cracks and replace with a new one as necessary.

NOTE

If pebbles, nails, etc. are trapped, remove them and check for damage.

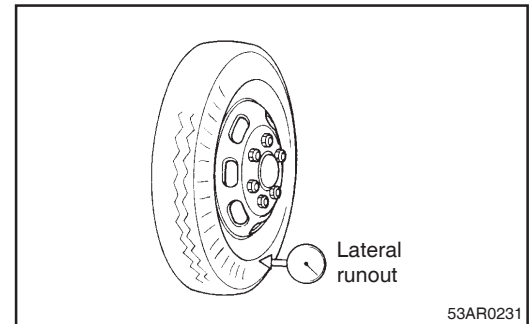


(4) Tire Lateral Runout

Apply a dial gauge to the tire side and measure tire lateral runout.

Nominal value	3.5 mm or less
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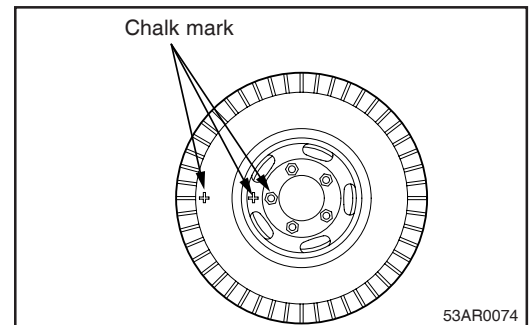
If the lateral runout exceeds the nominal value, reduce the runout by the procedures given below.



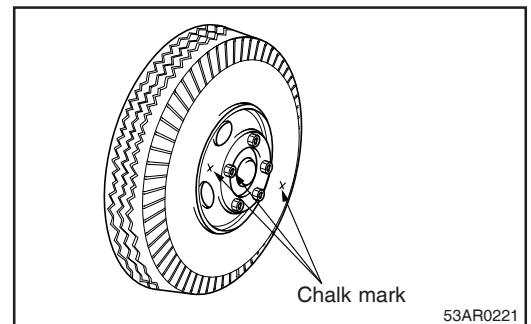
(5) Correction of Tire Lateral Runout

The following is a simple method to reduce lateral runout.

- Put chalk marks on the tire side, disc wheel and hub bolts.
- Remove the tire from the disc wheel and refit, aligning with chalk marks.



- Measure the disc wheel runout. If the position at which the runout is the largest is close to original chalk mark, install the tire at the position 180° rotated from the chalk mark.
- Measure again the tire runout.
- If the runout still exceeds the nominal value after the correction, replace the tire and wheel as an assembly.



SERVICE PROCEDURE

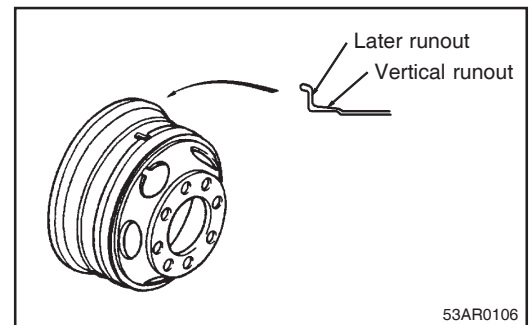
WT-17

(6) Inspection of Wheel Nut and Hub Bolt

Check the wheel nut and hub bolt for stripped threads, cracks and damage and replace if defective.

(7) Lateral and Vertical Runout of Disc Wheel

Using a dial gauge, measure the lateral and vertical runouts of the disc wheel. If they exceed the nominal value, replace the disc wheel.



TROUBLESHOOTING

Symptom	Probable cause	Remedy
Tire worn unevenly	Tire worn in center of tread o Air pressure too high	Correct air pressure
	Tire worn in both sides of tread o Air pressure too low	Correct air pressure
	o Overload	Correct load
	Wheel out of alignment	Align
Tire deflated	Valve core faulty	Replace
	Tube damaged	Repair or replace
Tire damaged	Tire cracked o Air pressure incorrect	Replace
	o Tire deteriorated	
	o Tire bumped too much on extremely rough road	
	Inner wall of tire peeled o Tire overheated (Continuous high speed running with overload over long distance makes tires so hot due to friction heat that their inner wall becomes easy to peel off.)	Replace
	o Air pressure incorrect	
	o Tire deteriorated	
	Tire not rimmed properly o Rim flange crooked	Replace
	o Bead of tire distorted	
	Tire burst o Foreign matters in tire	Replace
	o Tire deteriorated	