



FE

Service Manual

Group 10

Removal and Installation

of Engine

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

Pub No. TWSE9501-10

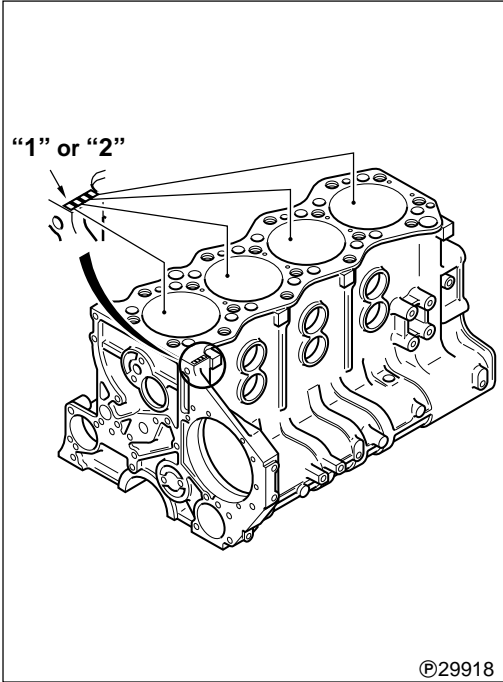
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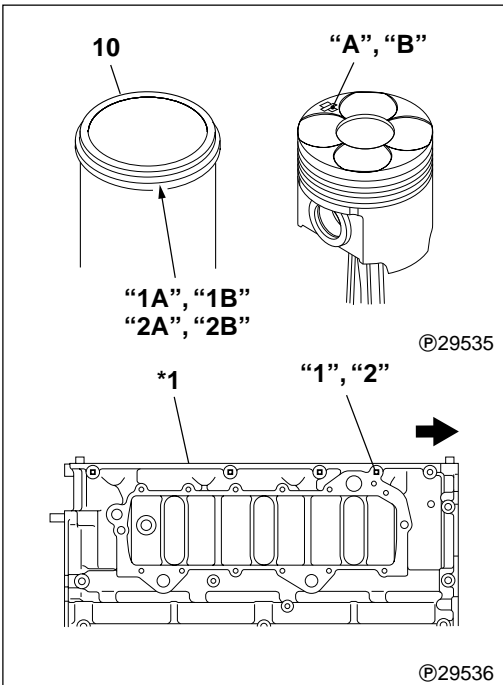


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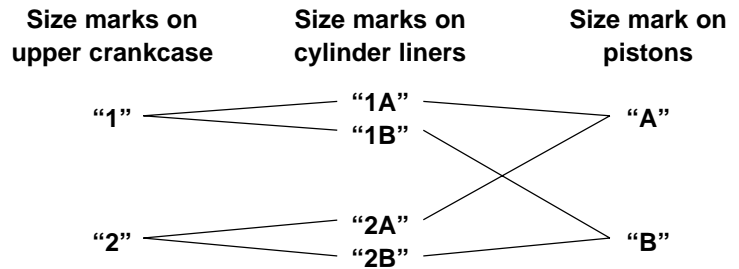


- Size mark "1" or "2" is stamped on the upper crankcase 1 for selective fitting of pistons in the crankcase.
- The size marks for the four cylinders are collectively stamped at a single location, and indicate the sizes of the respective cylinder liners as illustrated. P. 11A-7

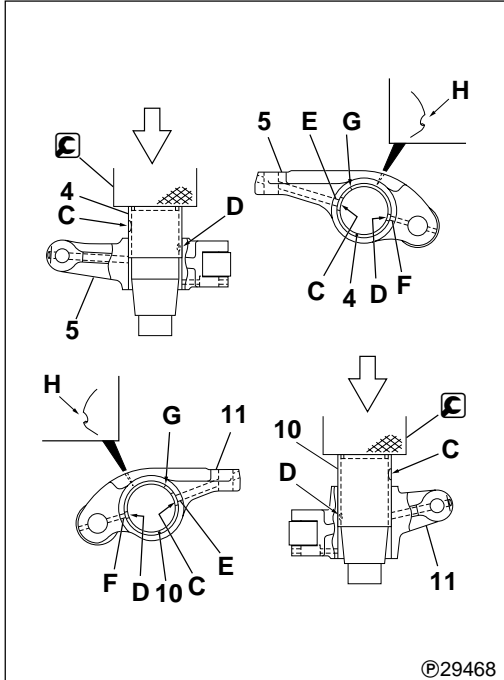


● Cylinder liner

- Select a cylinder liner 10 which has the same size mark as those stamped on the upper crankcase *1 the piston.
- The size marks on the upper crankcase *1 are arranged in the order of No. 1, 2, 3 and 4 cylinders starting from the engine front C.




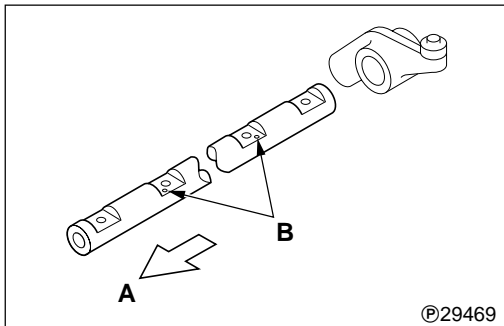
ROCKER COVER, ROCKER ASSEMBLIES AND CAMSHAFTS



[Installation]

Install the rocker bushings 4 and 10 on the rockers 5 and 11 in the illustrated direction.

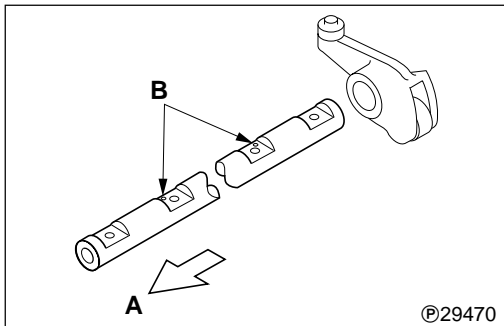
- : Rocker Bushing Puller
- C**: Rocker bushing oil hole
- D**: Rocker bushing oil hole
- E**: Rocker oil hole
- F**: Rocker oil hole
- G**: Rocker bushing clinch (seam)
- H**: Rocker bushing notch (rear side)



12 Installation of exhaust rocker shaft

Install the exhaust rocker shaft 12 in the illustrated direction.

- A**: Front of engine
- B**: Camshaft frame locating pin mounting hole



13 Installation of inlet rocker shaft

Install the inlet rocker shaft 13 in the illustrated direction.

- A**: Front of engine
- B**: Camshaft frame locating pin mounting hole

● Pre-disassembly inspection

📖 P. 11A-55

● Disassembly sequence

- | | | |
|------------------------------|------------------------------|--|
| 1 Bolt | 20 No. 1 idler shaft | 38 Thrust plate |
| 2 Thrust plate | 21 Bolt | 39 Balance shaft LH |
| 3 Idler gear assembly | 22 Oil pump assembly | 40 Bolt |
| 4 Idler gear bushing | 📦 Group 12 | 41 Injection pump bearing housing assembly |
| 5 Idler gear | 23 O-ring | 42 Bearing |
| 6 Idler shaft | 24 Bolt | 43 Injection pump bearing housing |
| 7 Bolt | 25 Balance shaft assembly RH | |
| 8 Fan shaft case assembly | 26 Nut | |
| 9 Thrust plate | 27 Balance shaft gear RH | *a: Crankshaft gear 📖 P. 11A-76 |
| 10 Fan shaft case bushing | 28 Thrust spacer | *b: Upper crankcase |
| 11 Fan shaft case | 29 Key | 📖 P. 11A-76 |
| 12 Fan shaft assembly | 30 Thrust plate | *c: Injection pump gear |
| 13 Bolt | 31 Balance shaft RH | 📦 Group 13 |
| 14 Fan gear shaft | 32 Bolt | *d: Lower crankcase |
| 15 Bolt | 33 Balance shaft assembly LH | 📖 P. 11A-76 |
| 16 Thrust plate | 34 Nut | |
| 17 No. 1 idler gear assembly | 35 Balance shaft gear LH | A: Locating pin |
| 18 No. 1 idler gear bushing | 36 Thrust spacer | ⊗: Non-reusable part |
| 19 No. 1 idler gear | 37 Key | |

CAUTION ⚠

For details on the balance shaft removal and installation procedures, refer to 📖 P. 11A-84.

● Assembly sequence

Follow the disassembly sequence in reverse.

FLYWHEEL

◆ Service procedure

[Installation]

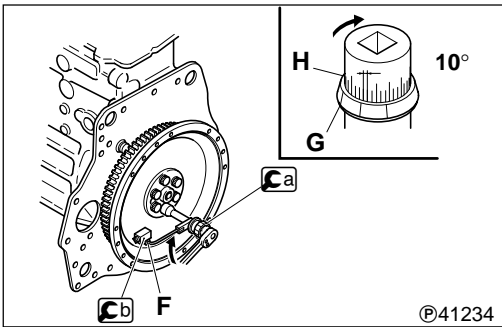
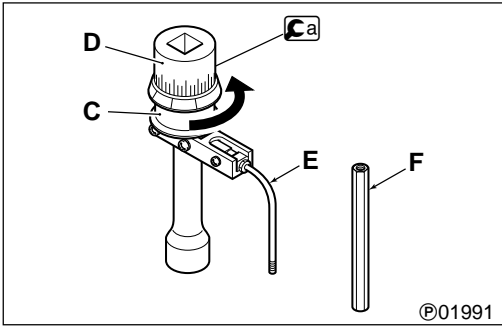
- Tighten the bolts **1** to the specified torque (39.0 N·m {29 ft.lbs, 4.0 kgf·m}). After that, turn the bolts further in accordance with the following procedure.

- Turn the holder **C** of the **Ca** Socket Wrench counterclockwise to the tension the built-in spring.

D: Socket

E: Rod

F: Rod (extension)



- Fit the **Cb** Magnet Base on the flywheel at a position where it can come in contact with the Rod **F** (for extension) as shown in the illustration.

- Set the rod **F** (for extension) such that it may be pressed against the **Cb** Magnet Base by the spring force.

- Align any inscribed line **G** on the holder **C** with any inscribed line **H** on the socket **D**. (Use this point as reference 0° position.)

- From the above reference position, turn the socket **D** clockwise by 40° to tighten the bolt further.

TROUBLESHOOTING

Symptoms	Decrease of power	Engine noise abnormal	Remarks
Oil viscosity unsuitable	○		Gr 12
Fuel incorrect or unsuitable	○		
Valve clearance faulty	○	○	
Head gasket faulty	○	○	
Valve and valve seat worn, and carbon deposits	○	○	
Valve spring fatigued	○	○	
Piston ring worn or damaged	○	○	
Piston ring grooves worn or damaged	○	○	
Injection timing faulty	○	○	Gr 13
Injection pump malfunctioning	○	○	Gr 13
Cooling system malfunctioning	○		Gr 14
Injection nozzle malfunctioning	○	○	Gr 13
Fuel system sucking air	○		Gr 13
Air cleaner mesh clogged	○		Gr 15
Muffler clogged	○		Gr 15
Pipe and hose installation faulty		○	
Ancillary equipment (injection pump, alternator, etc.) or installation faulty		○	Gr 13 Gr 54
V-belt loose or damaged		○	Gr 14
Crankshaft pulley mounted incorrectly		○	
Air cleaner or muffler malfunctioning		○	Gr 15
Rocker shaft and bracket faulty		○	
Rocker shaft bracket lubrication faulty		○	
Timing gear backlash faulty		○	
Timing gear system and idler shaft lubrication faulty		○	
Connecting rod small end bushing worn and piston pin worn		○	
Crankshaft pin and big end bearing of connecting rod worn or damaged		○	
Crankshaft journal and main bearing worn or damaged		○	
Crankshaft and camshaft end play excessive		○	
Tappet and camshaft worn		○	

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

Be sure to install key *5 when installing crankshaft pulley 2.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy	
—	Backlash of gears	Idler gear assembly and crankshaft gear	0.07 to 0.15 {0.0028 to 0.0059}	0.3 {0.012}	Replace
		Idler gear assembly and camshaft gear	0.07 to 0.17 {0.0028 to 0.0067}	0.3 {0.012}	
		Idler gear assembly and injection pump gear	0.07 to 0.17 {0.0028 to 0.0067}	0.3 {0.012}	
		Crankshaft gear and oil pump gear	0.10 to 0.18 {0.0039 to 0.0071}	0.3 {0.012}	
		Camshaft gear and power steering oil pump gear	0.08 to 0.16 {0.0031 to 0.0063}	0.3 {0.012}	
—	End play of idler gear	0.05 to 0.15 {0.0020 to 0.0059}	0.3 {0.012}	Inspect	
13, 15	Clearance between idler gear bushing and idler shaft	[45] 0.03 to 0.06 {[1.77] 0.0012 to 0.0024}	0.1 {0.0039}	Replace	

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

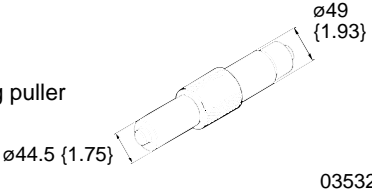
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Crankshaft pulley mounting)	590 {435, 60}	—
10	Bolt (Thrust plate mounting)	24 {17, 2.4}	—
18	Nut (Pressure hose mounting)	29 to 39 {22 to 29, 3 to 4}	—

Lubricant and sealant

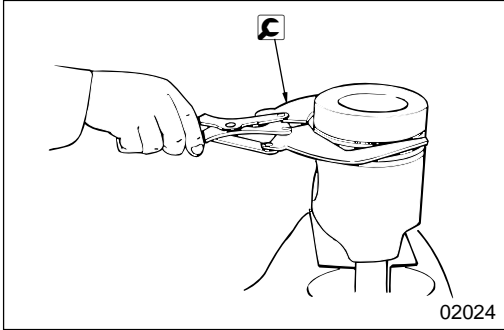
Location	Points of application	Kinds	Quantity
4, 5, 20	Entire body of O-ring	Engine oil	As required
7	Front oil seal lip	Engine oil	As required
9	Mounting surface of timing gear case	THREEBOND 1207C	As required
10	Thread area of bolt	Engine oil	As required

Special tools

Unit : mm {in.}

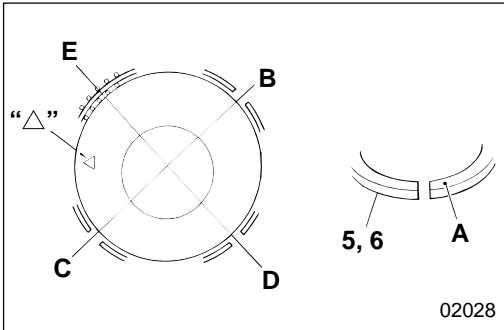
Location	Tool name and shape	Part No.	Application
13	Idler gear bushing puller 	MH062224	Removal and installation of idler gear bushing

PISTON, CONNECTING ROD AND CYLINDER SLEEVE



5 to 8 Piston ring and piston

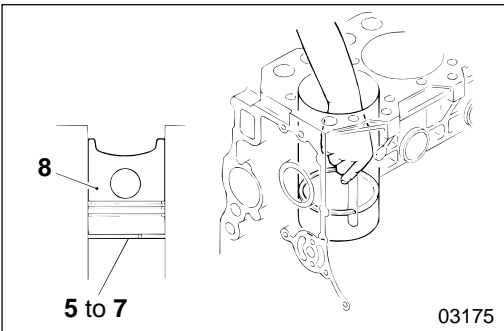
Piston ring
[Removal]



[Installation]

- Install oil ring **7** so that split **D** and the butting joint of expander spring **E** come to the points as illustrated.
- Compression rings **5** and **6** have a manufacturer's mark **A** at the split, and installation should be made with the mark outward.

B : The split of the 1st compression ring
C : The split of the 2nd compression ring
D : Oil ring slit
E : Oil ring expander spring butt joint
 △ : Front mark of piston



[Inspection]

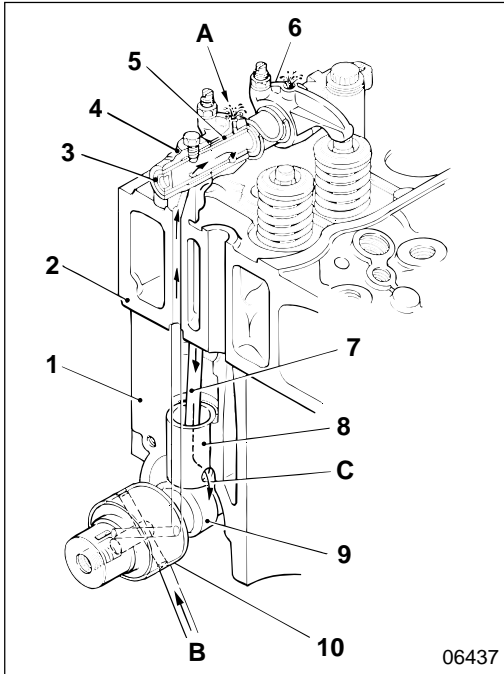
(1) Clearance of piston ring slit

- Install piston rings **5** to **7** into the crankcase cylinder sleeve using the head of piston **8** to level the piston ring.
- Measure the clearance of the piston ring split while keeping them level and stationary. If the measured value is higher than the limit, replace the piston ring.

NOTE

- Use piston **8** to ensure that piston rings **5** to **7** are kept level when inserting them into the crankcase cylinder sleeve.
- Insert piston rings **5** to **7** into the lower part of the crankcase cylinder sleeve, where the area is less worn, when measuring clearance of piston ring split **5** to **7**.
- Exchange the whole set of piston rings **5** to **7** as a set if any of the rings is faulty.

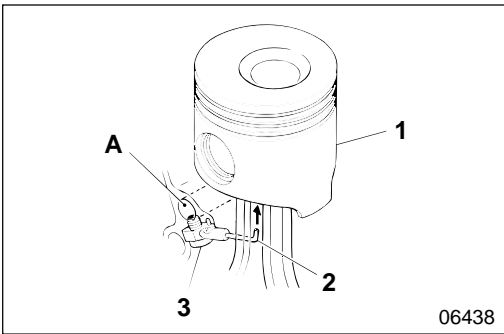
STRUCTURE AND OPERATION



● Valve mechanism

- 1 Crankcase
- 2 Cylinder head
- 3 Rocker shaft
- 4 Rocker shaft bracket
- 5 Rocker bushing
- 6 Rocker
- 7 Push rod
- 8 Tappet
- 9 Camshaft
- 10 No. 1 camshaft bushing

A : Rocker oil hole
 B : From main oil gallery
 C : To oil pan

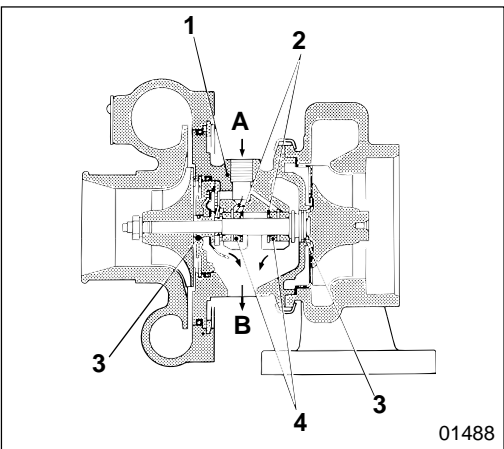


● Oil jet

- 1 Piston
- 2 Oil jet
- 3 Check valve

A : Main oil gallery

An oil jet 2 is installed, in the lower part of main oil gallery A, for each cylinder and cools piston 1 by injecting engine oil toward the inside of the piston. The oil jet is fitted with check valve 3 which opens and closes at standard oil pressure levels. This prevents a decrease of oil volume at low oil pressure as well as a decrease of oil pressure itself.



● Turbocharger

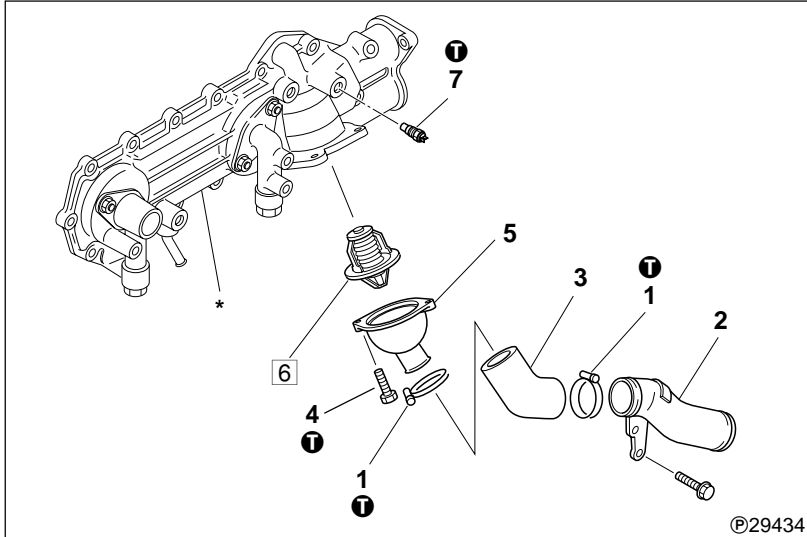
- 1 Bearing housing
- 2 Snap ring
- 3 Piston ring
- 4 Bearing

A : From main oil gallery
 B : To oil pan

Engine oil is delivered from the main oil gallery to bearing housing 1 through the oil pipe to lubricate bearing 4. Piston ring 3 installed at both ends of the turbine wheel shaft works as an oil seal.

MEMO

THERMOSTAT



● Disassembly sequence

- 1 Clamp
 - 2 Water pipe
 - 3 Rubber hose
 - 4 Bolt
 - 5 Thermostat cover
 - 6 Thermostat
 - 7 Water temperature sensor
- ELECTRICAL

*: Oil cooler GROUP 12A

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy	
6	Thermostat	Valve opening temperature	76.5±2°C {170±36°F}	—	—
		Valve lift/temperature	10 mm or more/90° {194°F}	—	—

Tightening torque

Unit: N·m {lbf.ft, kgf·m}

◆ Service procedur

6 Thermostat

[Inspection]

Place the thermostat in a container of water. Then, carry out the followin inspection procedure while stirring the water with a rod **A** to ensure that i is heated evenly. If the measurements do not comply with the standar values, replace the thermostat **6**

(1) Valve opening temperatur

Support the thermostat **6** with wire **E** to keep it away from the hea source **D**

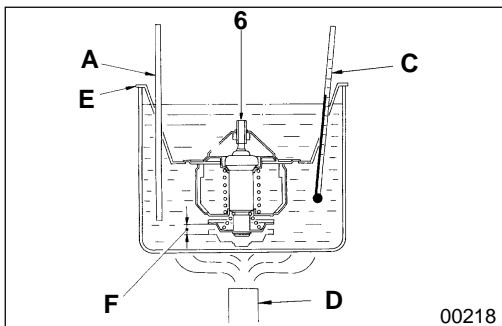
Gradually heat the water until it reaches the valve opening tempera- ture

- Maintain this temperature for approx five minutes and check that the valve **B** is open.
- When the water temperature drops below 65 °C {149 °F}, check the the valve **B** is completely closed.

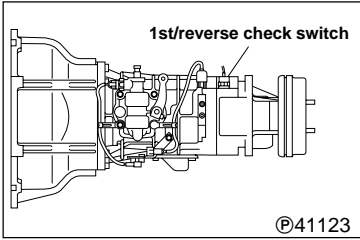
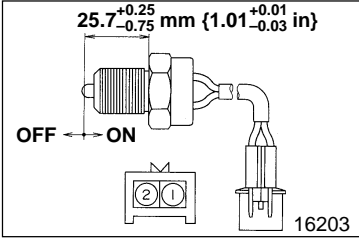


C: Thermometer

(2) Valve lift

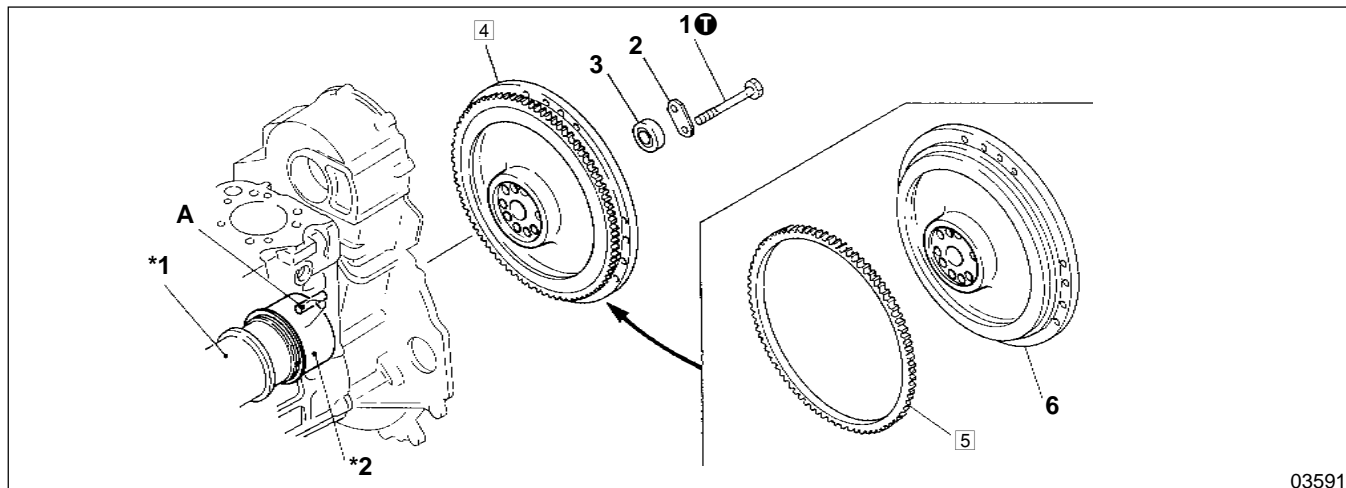
Heat the water to slightly higher than the valve opening temperature. With the valve **B** fully open, maintain this water temperature for five minutes. Measure the extent of valve lift **F**.



2001 MODEL CHANGES

Item	'01 Model	'00 Model									
<p>8. ENGINE AND TRANSMISSION ELECTRICS</p> <ul style="list-style-type: none"> • (802) additionally provided with some descriptions about 1st/reverse check switch installed on manual transmission-equipped FG. 	<div style="text-align: center;">  </div> <div style="text-align: center;">  </div>	<div style="text-align: center;"> <p>Inspection of 1st/reverse check switch</p> <ul style="list-style-type: none"> • Perform the continuity test according to the following table. <table border="1" data-bbox="1013 646 1300 764"> <thead> <tr> <th></th> <th>①</th> <th>②</th> </tr> </thead> <tbody> <tr> <th>OFF</th> <td></td> <td></td> </tr> <tr> <th>ON</th> <td>○—○</td> <td>○—○</td> </tr> </tbody> </table> <p>○—○ There must be continuity between the terminals.</p> <ul style="list-style-type: none"> • Replace the switch if any abnormality is found. </div>		①	②	OFF			ON	○—○	○—○
	①	②									
OFF											
ON	○—○	○—○									
<p>9. OTHERS</p> <ul style="list-style-type: none"> • (910) changed because of adoption of 4M5 engine. 	<ul style="list-style-type: none"> • (810) FOUR WHEEL DRIVE CIRCUIT  P54-46 	<ul style="list-style-type: none"> • (910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT <4M5>  P54-48 									

FLYWHEEL



03591

● Disassembly sequence

- 1 Bolt
- 2 Plate
- 3 Bearing
- 4 Flywheel assembly
- 5 Ring gear

6 Flywheel

*1: Crankshaft  Gr.11

*2: Crankshaft power take-off pulley

 P.11-6

A: Location Pin

● Assembly sequence

Follow the disassembly sequence in reverse.

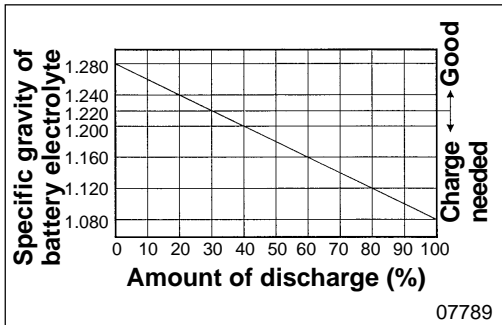
CAUTION

After the flywheel assembly 4 is installed, be sure to check the flywheel 6 for runout.

MEMO

(4) Charging

- Battery 7 must be, as a rule, charged in the off-vehicle condition. If it is charged on vehicle, however, be sure to remove the grounding cable before starting the procedure.
- The battery must be charged with its all of vent plugs removed.
- For the recommended charge time and current, see the following table to avoid overcharging.



	Charge current (A)	Charge time (H)	Upper limit of fluid temperature (°C {°F})
Normal charge	Value of 5-hour rating capacity/10	{*Amount of discharge (Ah)/Charge current (A)} × 1.2 (to 1.5)	45 {113}
Quick charge	Value of 5-hour rating capacity/1.5	0.5	55 {131}

* Amount of discharge (Ah) = 5-hour rating capacity (Ah) × [Amount of discharge (%)] / 100

- Use the graph shown left to calculate the amount of discharge (%).
- For the battery electrolyte, use diluted sulfuric acid, made up of sulfuric acid and refined or distilled water.
- The specific gravity of fully-charged battery electrolyte is 1.280 at the liquid temperature of 20°C {68°F}.

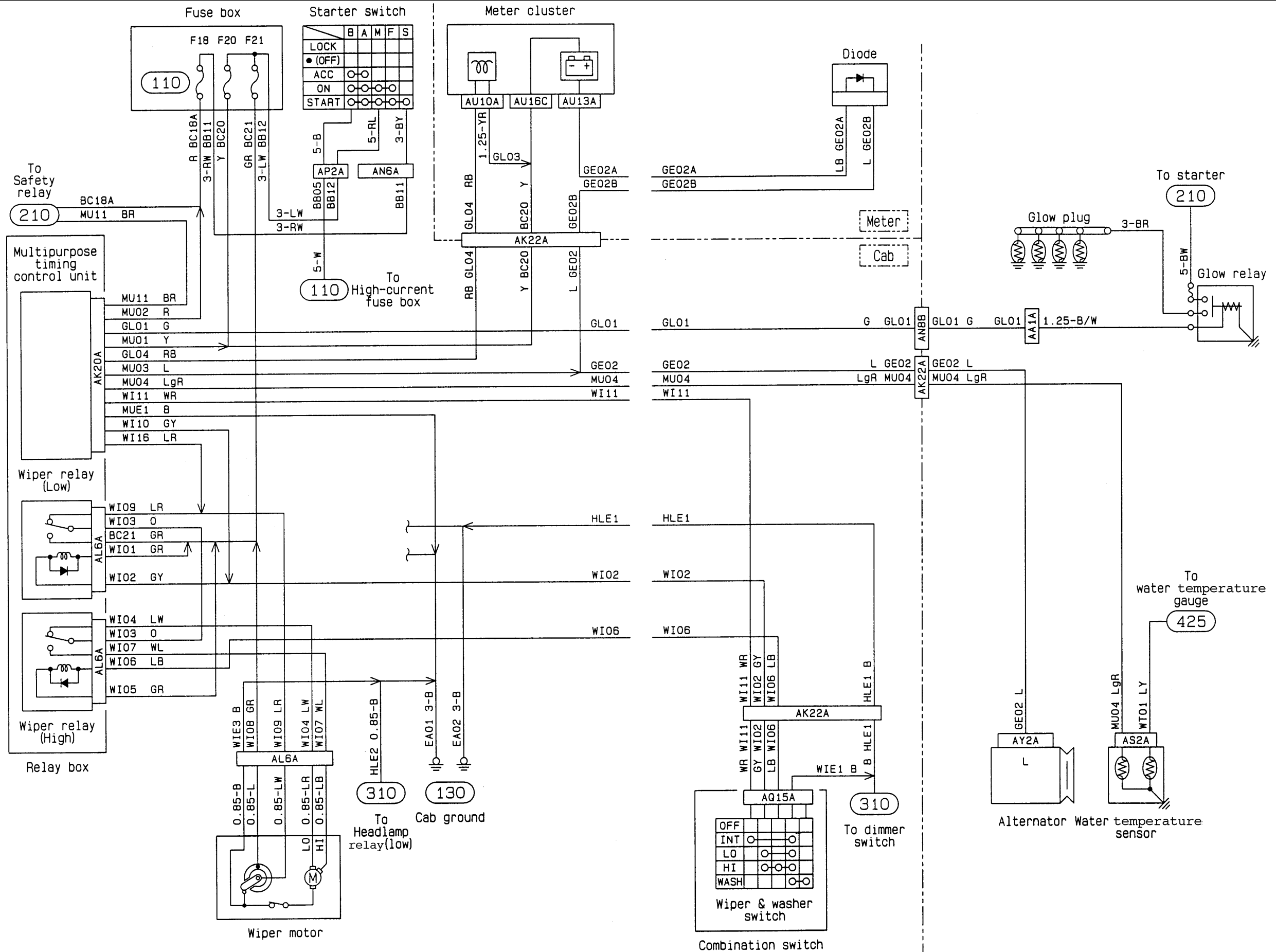
DANGER

- Do not let the battery electrolyte level rise and overflow while charging the battery.
- Keep open flame away from the battery while charging it or it might explode.
- Be careful not to generate sparks while charging the battery because it is dangerous.
- After charging the battery, tighten the vent plugs, wash away sulfuric acid from the battery using water, and dry the surface.
- Be sure to check the electrolyte level before charging the battery. Charging with the electrolyte level below the lower limit (LOWER LEVEL) can cause premature deterioration, heat generation and explosion of the battery.

Inspection of battery box

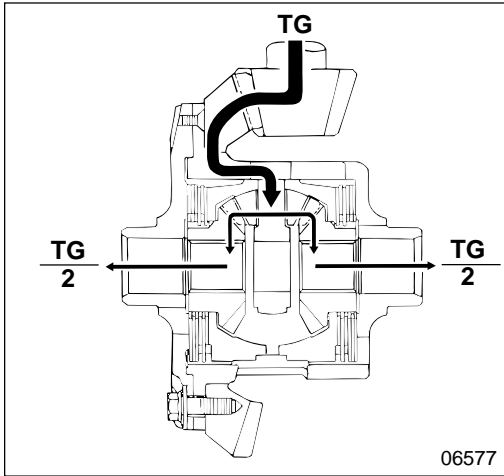
- If battery box **8** is corroded, scrub off the corrosion from it using a wire brush and apply acid resistant coating.
- If the battery box **8** is corroded excessively, deformed or cracked, replace it with new one.

MEMO



Operation mechanism

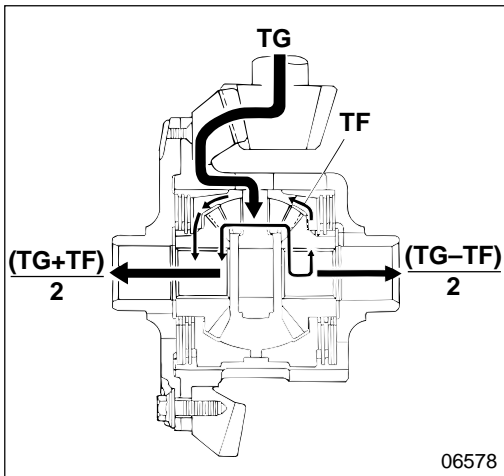
When the wheel of one side starts spinning, a rotational difference between side gear 3 and differential cases, LH 2 and RH 4 occurs. Then, friction disc 5 and friction plate 6 start rotating with a relative difference in revolution speed. This causes friction torque between the disc and plate.



● **Operation in straight movement**

In the case of straight movement, as the revolution speed of the left axle shaft and that of the right axle shaft are equal, no friction torque occurs.

TG : Torque input



● **Operation when there is a difference in revolution speed between left and right wheel**

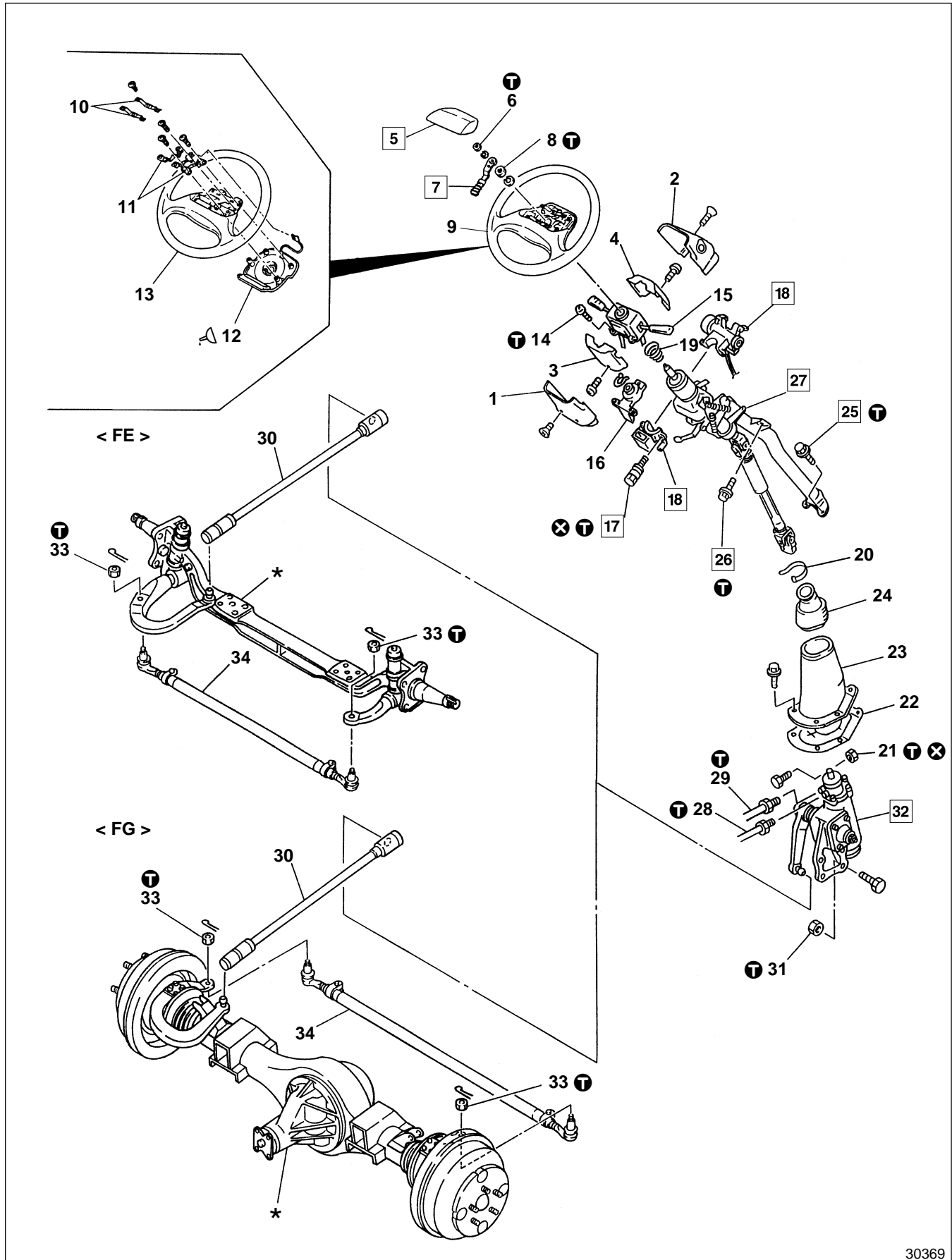
When a difference in the resistance the wheels receive from the road surface occurs, such as when the wheel of one side encounters mud, the differential function comes into play, transmitting friction torque **TF**. This exertion of friction torque reduces the revolution speed causing the high-revolution speed axle to reduce its speed and the low-revolution speed axle to increase its speed.

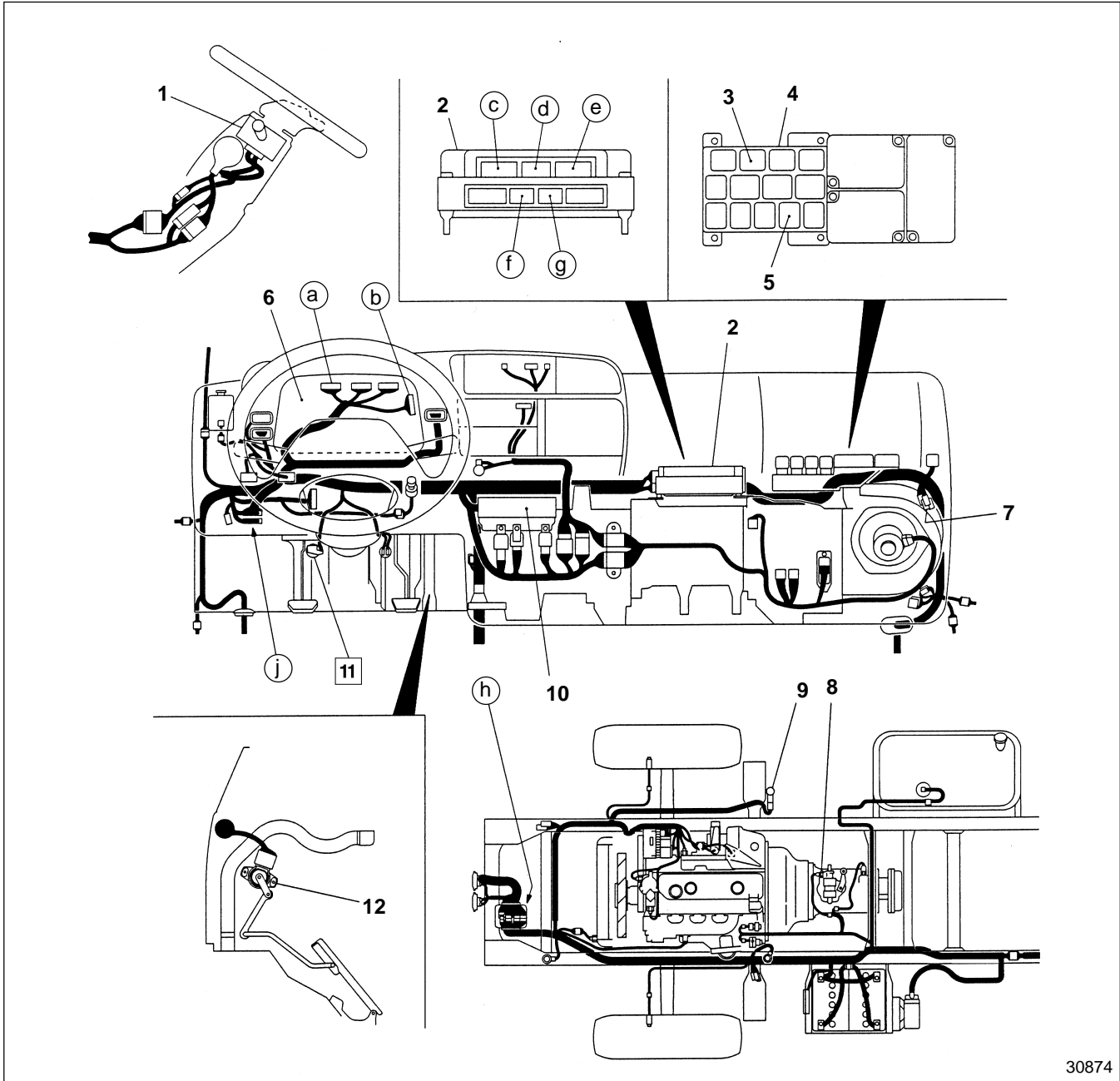
Therefore, when the wheel of one side starts spinning, when caught in mud for example, a big difference in revolution speed occurs, causing a large amount of friction torque to come into action. The differential functions in such a manner that a smaller ratio of the torque is transmitted to the axle of the wheel which is spinning while the axle of the wheel on the other side receives a greater ratio of the torque. This makes it easier for the vehicle to get out of the mud.

$$\frac{(TG-TF)}{2} \quad \text{High rotation side (spin side)}$$

$$\frac{(TG+TF)}{2} \quad \text{Low rotation side}$$

STEERING SYSTEM





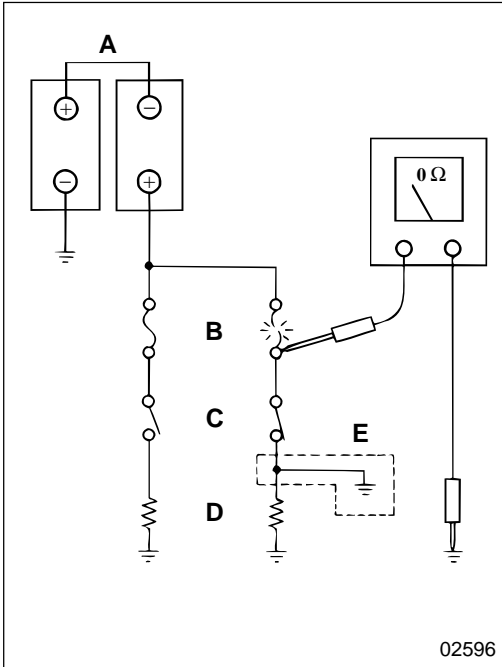
30874

- 1 Combination switch 1 (601)
- 2 Electronic governor control unit Gr 13
- 3 Transmission neutral relay 1 (604)
- 4 Relay box
- 5 Exhaust brake relay (604)
- 6 Meter cluster 1 (401)

- 7 Diode
- 8 Transmission neutral switch 1 (802)
- 9 Exhaust brake 3-way magnetic valve 1 (701)
- 10 Fuse box 1 (104)
- 11 Clutch switch
- 12 Accelerator pedal sensor Gr 13

1 : '96 Model Gr 54 (Pub No. TWSE9501-54)

PRECAUTIONS FOR MAINTENANCE OPERATION



Inspection procedures for blown fuses

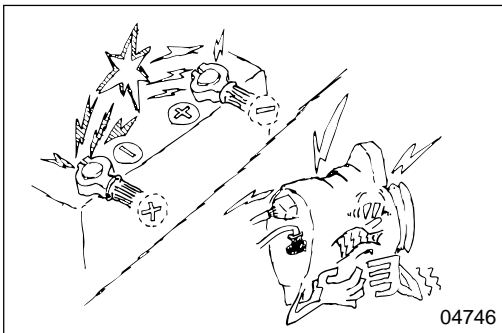
Remove fuse **B** and measure resistance between the loaded side of the fuse and ground.

Turn on all circuit switches (connected to the fuse). If the resistance value reading is approximately 0Ω , a short has occurred between the switch and the loaded point. A value of other than zero may indicate that the fuse was blown by a temporary short but the short is no longer present.

The major causes of a short circuit are as follows:

- Harness stuck onto the vehicle body.
- Harness sheath damaged by friction or heat.
- Water in connectors or circuits.
- Mistakes (accidental short circuits)

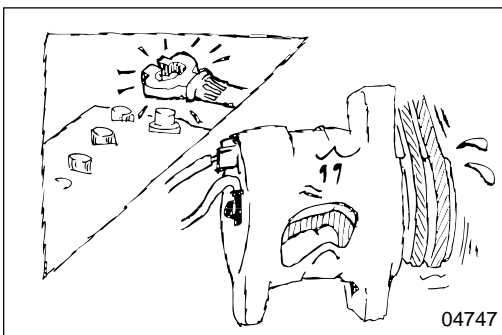
- A** : Battery
- B** : Fuse
- C** : Loaded switch
- D** : Load
- E** : Short circuit



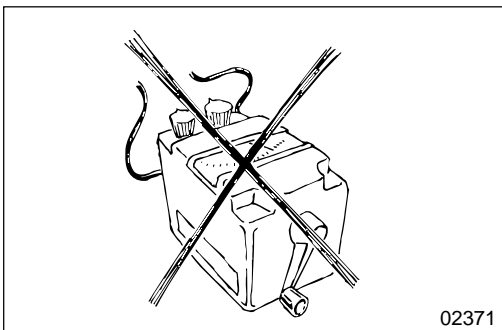
Precautions for handling alternator

When servicing the alternator, pay attention to the following :

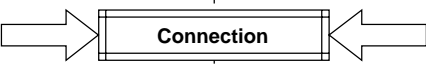
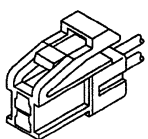


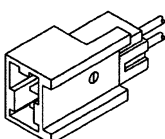
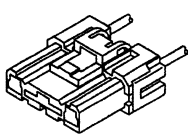


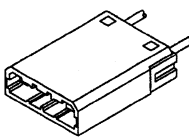
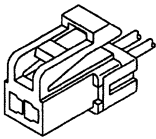


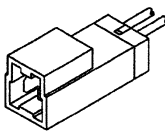
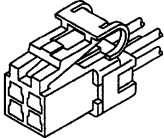




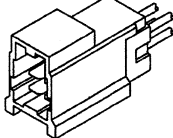
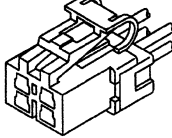




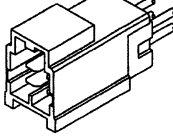
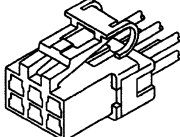






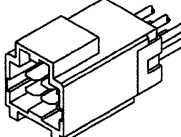
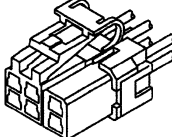






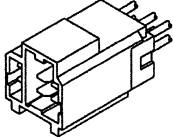
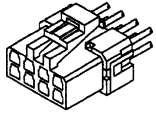








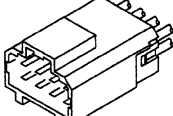
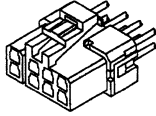








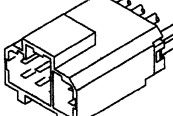
- Do not connect the alternator with battery polarities reversed. If the alternator is connected with reversed polarities, a large current flow from the battery to the alternator occurs, and the diode or regulator might be damaged.



- While the engine is running, do not remove the battery terminals. If the battery terminals are removed at that time, a surge voltage is generated and the diode or regulator might be weakened.



- Do not use a high-voltage tester such as a megger for inspection. If a high-voltage tester is used, the diode or regulator might be destroyed.

Model (Number shows number of pins)			
AM AM 2 A		 	
AM 2 B		 	
AM 2 C		 	
AM 4 A		   	
AM 4 B		   	
AM 6 A		     	
AM 6 B		     	
AM 8 A		       	
AM 8 B		       	

Tire

Service standards

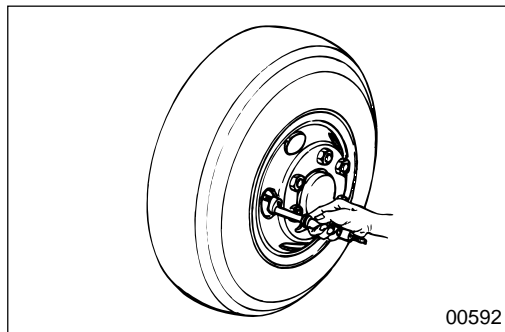
Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Depth of tire tread grooves	—	1.6 {0.063}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Wheel nut	490±49 {360±36, 50±5}	—



Air pressure

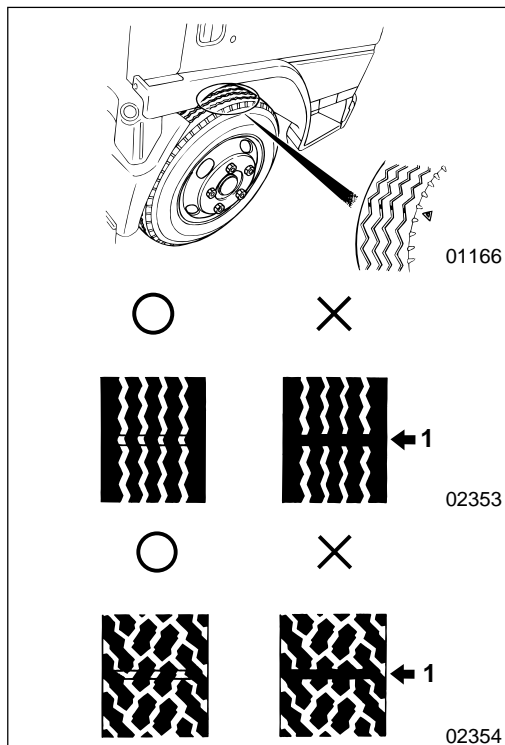
Tire air pressure should be checked before the vehicle is driven, while the tires are still cool.

Vehicle model	Item Tire size	Air pressure kPa {Psi, kgf/cm ² }	
		Front	Rear
FE639 (GVWR : 11600 lb, 5260 kg)	215/85R16(D)	450 {65, 4.50}	450 {65, 4.50}
FE639 (GVWR : 13500 lb, 6120 kg)	215/85R16(E)	550 {80, 5.50}	550 {80, 5.50}
FE649 (GVWR : 14500 lb, 6580 kg)	215/85R16(E)	550 {80, 5.50}	550 {80, 5.50}
FG639 (GVWR : 11000 lb, 5000 kg)	7.50R16(E)	550 {80, 5.50}	550 {80, 5.50}

GVWR : Gross vehicle weight rating

CAUTION ⚠

- Make certain that there is no difference in the air pressure between the inner and outer rear tires.
- Make certain you use valve caps on the air valves.
- It is not necessary to increase the air pressure for high-speed driving.



Checking tread depth

- Check all around the tire treads to make sure that the depth of the tread grooves is above the wear limit.
- If the tread grooves are not deep enough, slip sign A appears at the position of the ⚠ mark, where the tread groove has worn away.

WARNING ⚠

If the depth of the tread grooves is not adequate, the tires will slip on wet roads and present a hazard. Such tires are also extremely dangerous because they are more susceptible to hydroplaning when the vehicle is running at high speeds in the rain. Such tires must be replaced with new ones as soon as possible.

LUBRICATION

Power Steering Fluid

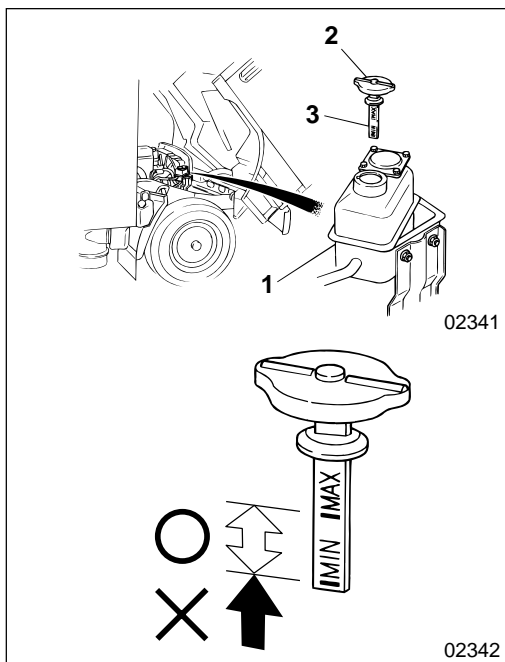
Tightening torque

Unit : N·m {lb·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Pressure tube	29 to 39 {22 to 29, 3 to 4}	—
5	Return tube	39 to 49 {29 to 36, 4 to 5}	—

Fluid

Location	Points of application	Specified fluid	Quantity
1	Power steering oil tank	Automatic transmission fluid (DEXRON or DEXRON II type)	Between MIN and MAX on filler cap dipstick



[Inspection and replenishment]

- Straighten the front wheels and stop the engine.
- Tilt the cab.
- Remove filler cap 2 of power steering oil tank 1 by turning the filler cap counterclockwise.
- Wipe off the fluid sticking to dipstick 3 on filler cap 2. Replace the filler cap.

NOTE

Check the fluid level without screwing on filler cap 2.

- Carefully lift up filler cap 2 and check the fluid sticking to dipstick 3 to make sure that the fluid is at a point between the "MAX" and "MIN" levels. If the fluid position does not reach the "MIN" level, add fluid.
- After inspection install filler cap 2 by turning it clockwise.

WARNING

Close filler cap 2 firmly; otherwise the fluid may leak and could catch fire. Also wipe up spilled fluid.

CAUTION

If the fluid level is far below the recommended range, the fluid may be leaking.

Tire

Service standards

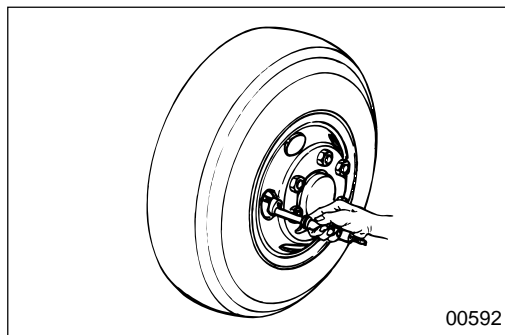
Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Depth of tire tread grooves	—	1.6 {0.063}	Replace

Tightening torque

Unit : N·m {lbf·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Wheel nut	490±49 {360±36, 50±5}	—



Air pressure

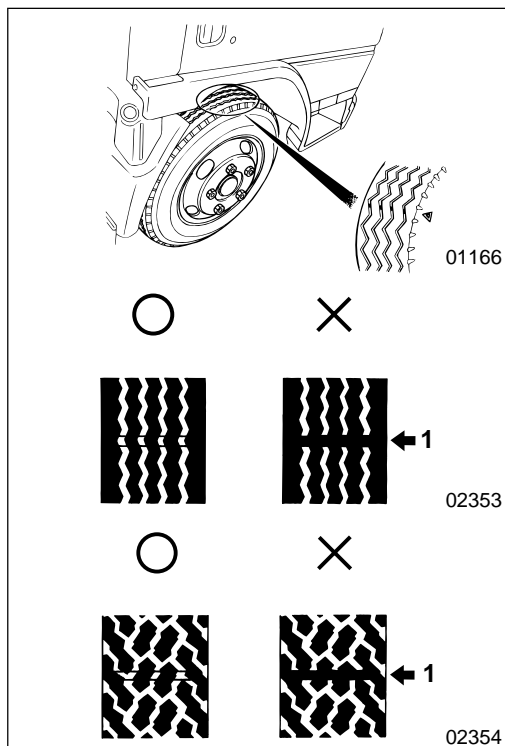
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Vehicle model	Item	Tire size	Air pressure kPa {Psi, kgf/cm ² }	
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FE639 (GVWR : 13500 lb, 6120 kg)		215/85R16(E)	550 {80, 5.50}	550 {80, 5.50}
FE649 (GVWR : 14500 lb, 6580 kg)		215/85R16(E)	550 {80, 5.50}	550 {80, 5.50}

GVWR : Gross vehicle weight rating

CAUTION ⚠

- Make certain that there is no difference in the air pressure between the inner and outer rear tires.
- Make certain you use valve caps on the air valves.
- It is not necessary to increase the air pressure for high-speed driving.



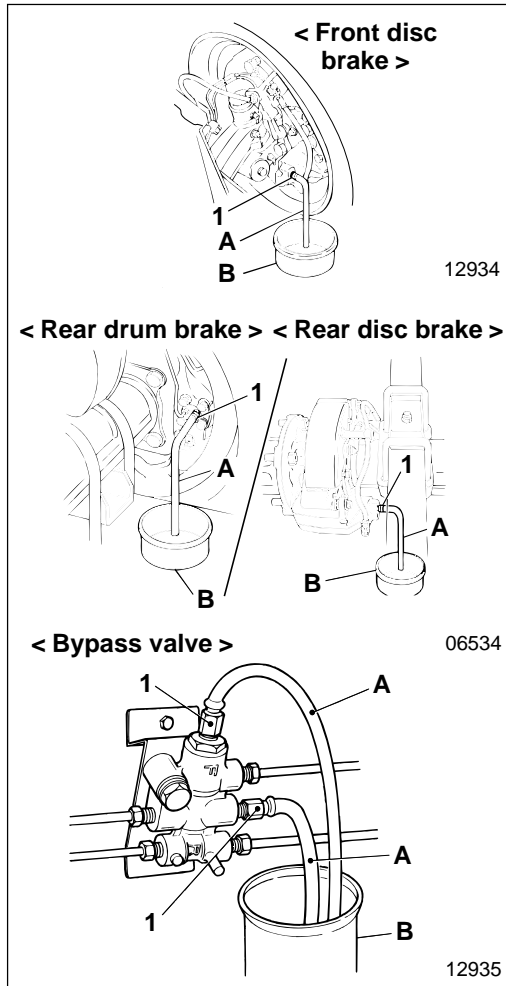
Checking tread depth

- Check all around the tire treads to make sure that the depth of the tread grooves is above the wear limit.
- If the tread grooves are not deep enough, slip sign **A** appears at the position of the **△** mark, where the tread groove has worn away.

WARNING ⚠

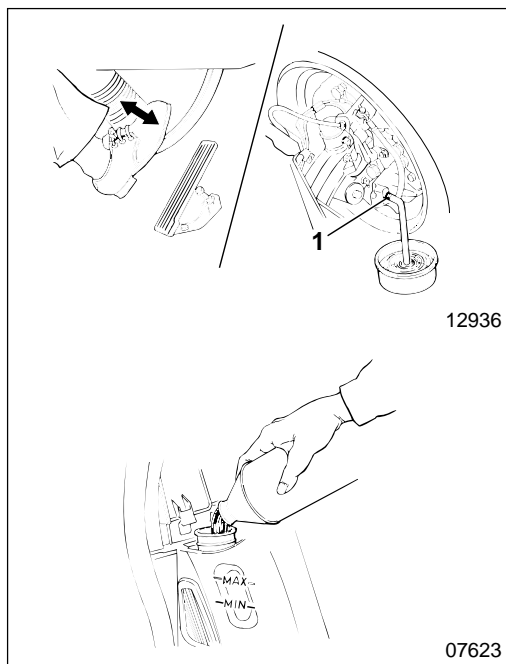
If the depth of the tread grooves is not adequate, the tires will slip on wet roads and present a hazard. Such tires are also extremely dangerous because they are more susceptible to hydroplaning when the vehicle is running at high speeds in the rain. Such tires must be replaced with new ones as soon as possible.

LUBRICATION



[Replacement]

- Start the engine and let it idle until you complete brake fluid replacement.
- Attach vinyl pipe **A** to the front disc brake, the rear drum brake < FE639 >, the rear disc brake < FE649 > and the bypass valve.
- Place the free end of vinyl pipe **A** into container **B**.



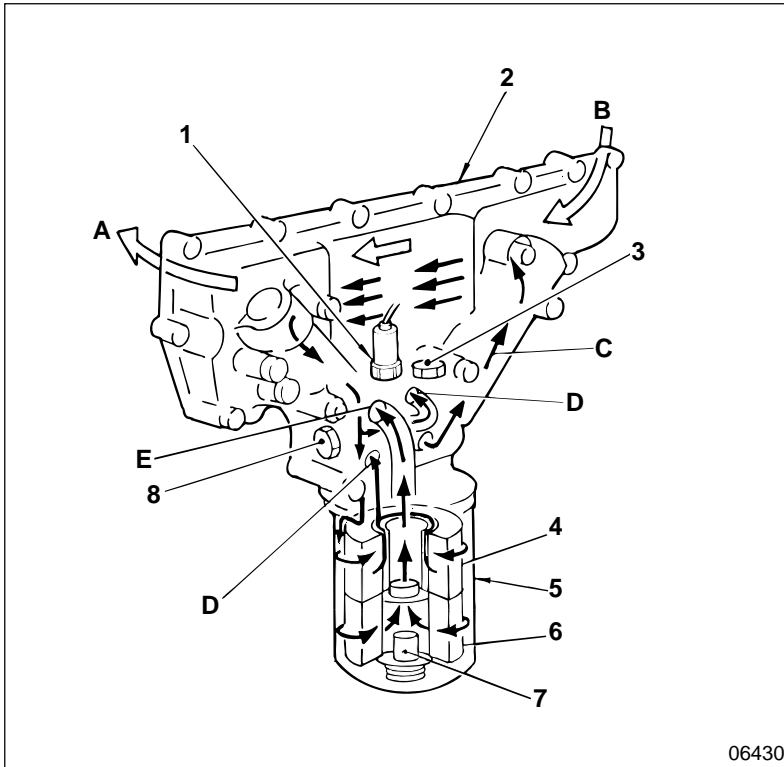
- Loosen air bleeders **1** and depress the brake pedal several times to drain brake fluid completely.
- Maintaining a supply of new brake fluid up to the "MAX" level of the fluid tank, depress the brake pedal repeatedly until the old brake fluid of the brake system is replaced with new fluid. After you complete the work, tighten each air bleeder **1** at specified torque.

NOTE

You can tell when the brake fluid has been completely replaced because the fluid coming out will be a different color.

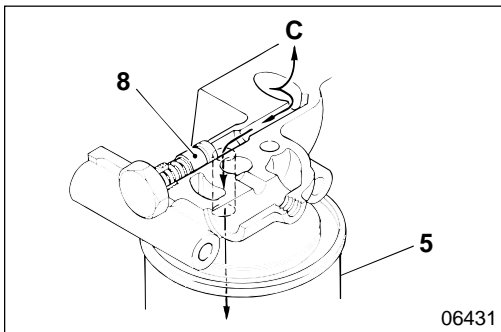
- Carry out air bleeding of the brake system.

Oil Cooler and Oil Filter



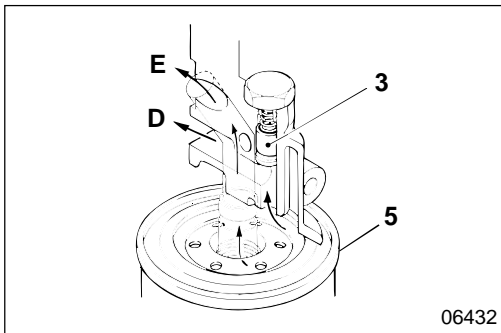
- 1 Engine oil pressure switch
- 2 Oil cooler
- 3 Regulator valve
- 4 Bypass filter element
- 5 Oil filter
- 6 Full-flow filter element
- 7 Bypass valve
- 8 Bypass valve

A : Coolant exit port
 B : Coolant entry port
 C : To oil cooler
 D : To oil pan
 E : To main oil gallery



● Operation of bypass valve

When the viscosity of the engine oil is high at low temperatures, or when oil cooler **2** element is clogged, flow resistance is high, and if this happens, bypass valve **8** opens to let the engine oil return directly to oil filter **5** without going through the oil cooler.



● Operation of regulator valve

When the oil pressure in the main oil gallery becomes higher than standard, regulator valve **3** opens to let part of the oil return to oil pan **D**, thereby regulating the oil pressure.

SPECIFICATIONS

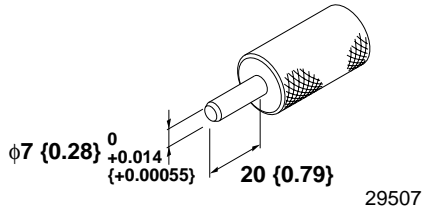
Item		Specifications	
Mode of lubrication		Oil pump type	
Oil filter type		Paper-filter, spin-on type	
Oil cooler type		Shell and plate type (multi-plate type)	
Engine oil	Grade	API CD or higher	
	Oil quantity	Oil pan	Approx.9 L {9.5 qts}
		Oil filter	Approx.1 L {1.1 qts}

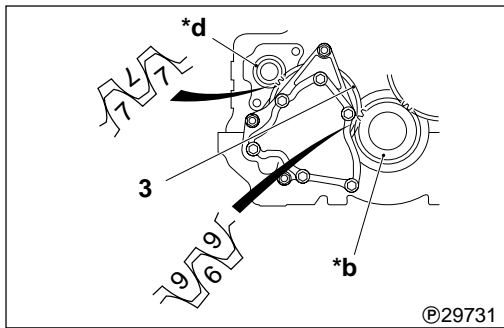
Sealant

Location	Points of application	Specified sealant	Quantity
—	Oil pump gears	Engine oil	As required
2	Entire circumference of O-ring	Engine oil	As required

Special tools

Unit: mm {in.}

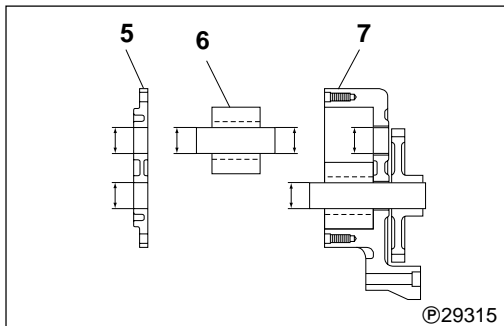
Location	Tool name and shape	Part No.	Application
5	Pump Cover Pin 	MH063431	Oil pump cover installation



Service procedure

3 Installation of oil pump assembly

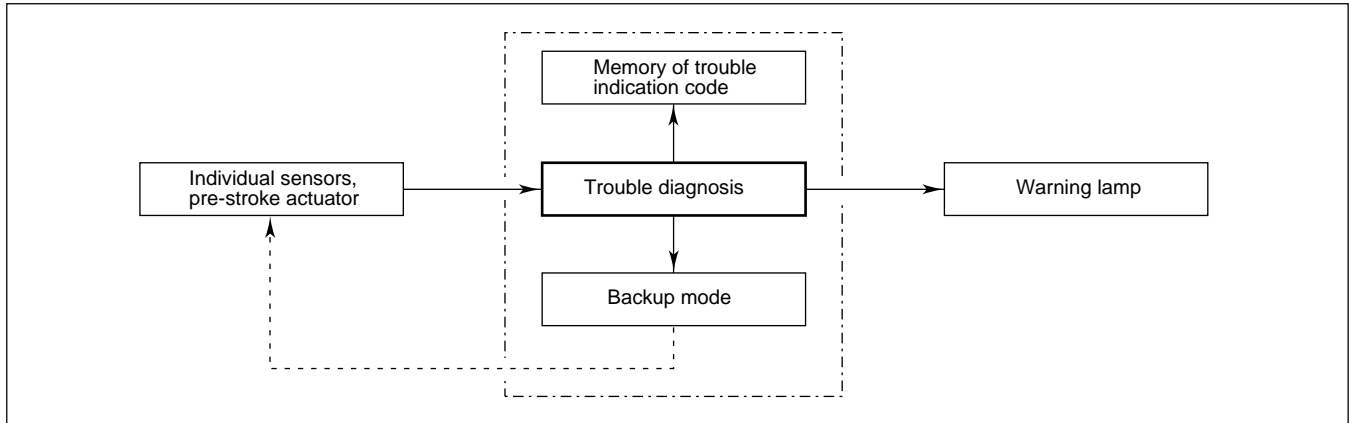
- With No. 1 cylinder set at its top dead center, position crankshaft gear *b.
- Install oil pump assembly 3 while meshing its gear with crankshaft gear *b and balance shaft gear RH *d at the match marks “6” and “7” as shown.



5 to 7 Inspection of oil pump cover, driven gear assembly and oil pump case assembly

Measure the clearance between each gear shaft and oil pump case assembly 7 or cover 5. Replace the oil pump assembly if any measurement is out of specification.

● Trouble diagnosis function, fail-safe function





- The trouble diagnosis function detects and diagnoses troubles reported by the various sensors and the pre-stroke actuator, while the engine is running. If any trouble occurs, this function warns the driver by lighting warning lamp  and at the same time stores the trouble point in memory as a diagnosis code.
- The fail-safe function is put into operation simultaneously and the trouble is treated accordingly in the backup mode.
- In the backup mode, the pre-stroke control starts when trouble occurs. If the trouble does not affect the operation of the engine, fixed data from the backup mode is used to treat the trouble. If the trouble dangerously affects the operation of the engine, the pre-stroke control stops.
- If the function goes into backup mode, the function stays in that mode until the starter switch is set to LOCK. When a normal signal is returned, control of the system returns and warning lamp  goes off.
- There are two kinds of diagnosis code, current and previous.
 - Current diagnosis code : Indicates data when the engine has been running with the starter switch set to ON since the abnormality occurred.
 - Previous diagnosis code : Indicates previous data when the engine was stopped with the starter switch set to ACC or LOCK after the abnormality occurred.

Table of diagnosis codes

Diagnosis code	Abnormal item	Countermeasures taken by pre-stroke control unit (Backup mode)
01	Normal	—
03	Pre-stroke learning function	Controls with correction value assumed to be 0
04	Pre-stroke actuator power source	Stoppage of pre-stroke control
05	Engine revolution sensor (No pulse)	Controls with engine revolution assumed to be 0
12	Pre-stroke servo system	Stoppage of pre-stroke control
13	Pre-stroke position sensor	Stoppage of pre-stroke control
15	Engine revolution sensor (Wiring breakage)	Controls with engine revolution assumed to be 0
21	Water temperature sensor	Controls with water temperature assumed to be 80°C {176°F}
22	Control rod position sensor	Controls with control rod position assumed to be full load
41	Boost air temperature sensor	Controls with boost air temperature assumed to be 80°C {176°F}

It is possible to run the vehicle even if the pre-stroke control develops an abnormality. However, do not run the vehicle for a long period of time, run it only for the time necessary to obtain repairs.

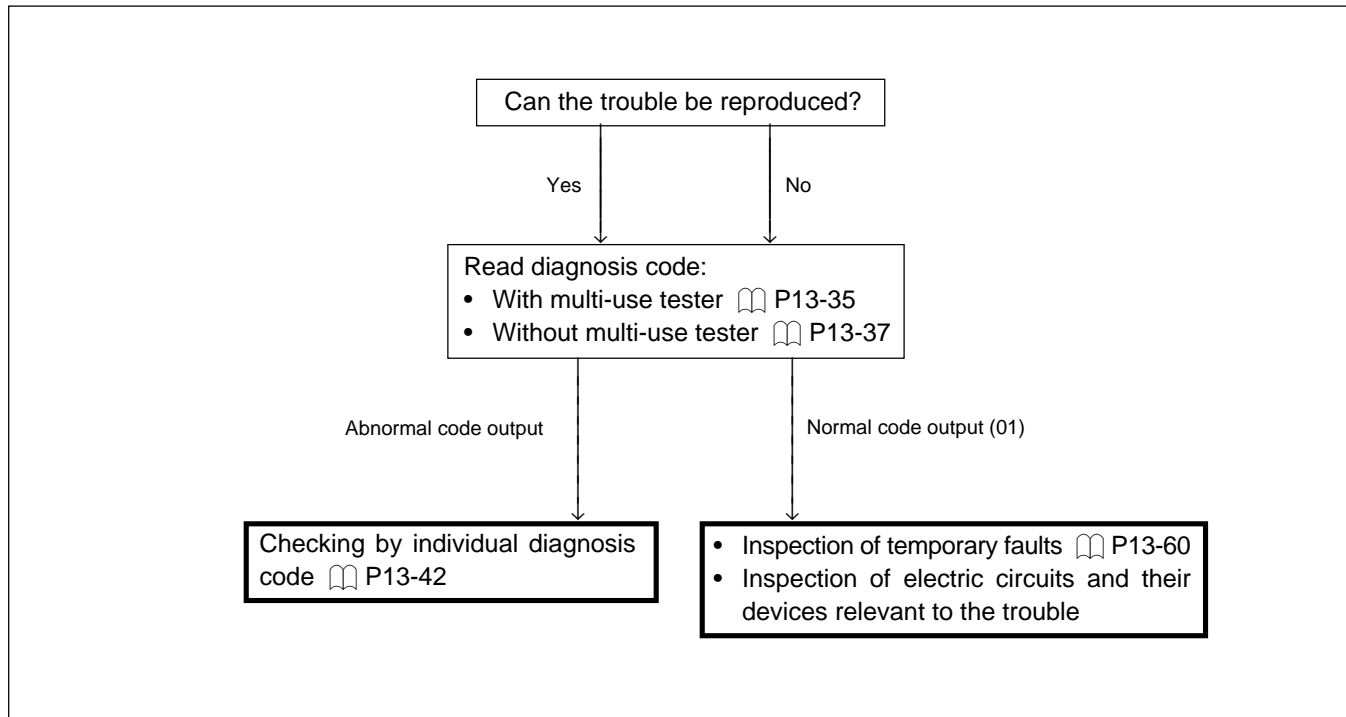
PRE-STROKE CONTROL INJECTION PUMP SYSTEM

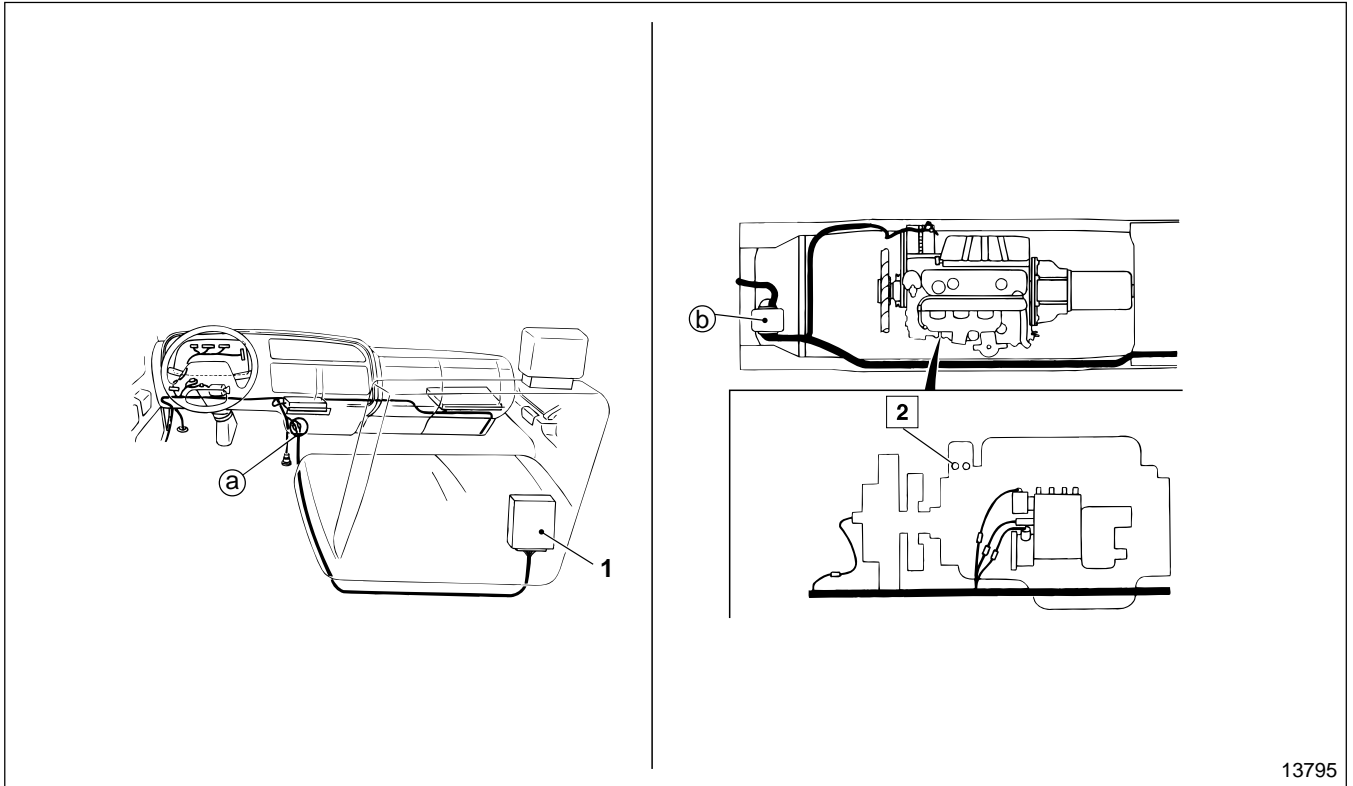
Troubleshooting Procedure

The pre-stroke control type injection pump system has a trouble diagnosis function, this function is used for troubleshooting.

This means you have to read the diagnosis code memorized in the pre-stroke control unit, and carry out an inspection based on this code. There are two ways of reading the code; with a multi-use tester, and without a multi-use tester.

In the case of trouble that does not have a diagnosis code, the normal 01 code is indicated, and it is necessary to carry out a check depending on the situation. In this case, inspect the electric circuits and their relative devices.





- 1 Pre-stroke control unit
- 2 Water temperature sensor

13795

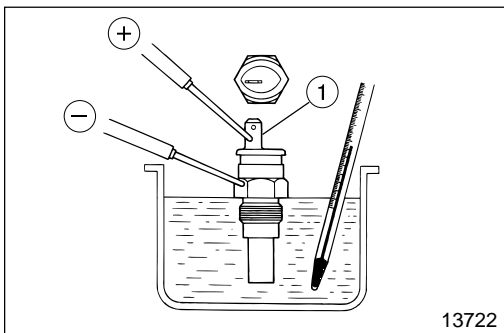
Service standards

Location	Maintenance item	Standard value	Limit	Remedy	
2	Resistance value of water temperature sensor	20°C {68°F}	3250 Ω	—	Replace
		40°C {104°F}	1500 Ω	—	Replace
		60°C {140°F}	620±62 Ω	—	Replace

◆ Service procedure

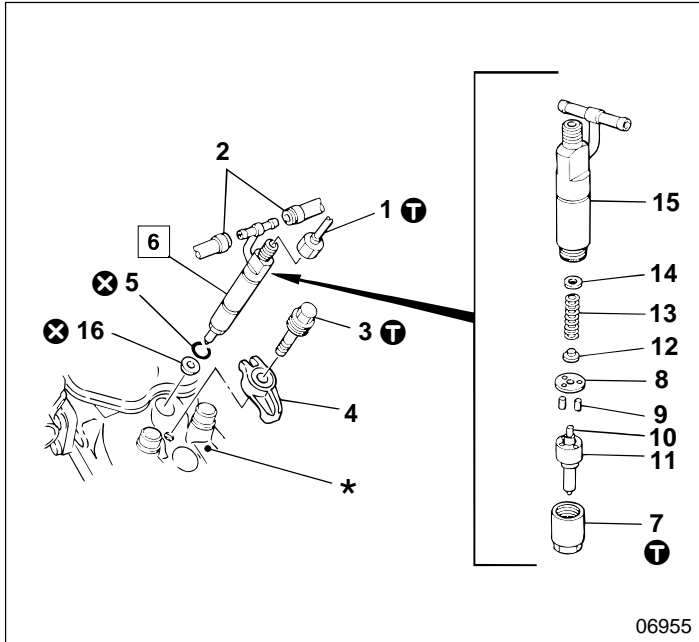
2 Inspection of water temperature sensor

- Place water temperature sensor 2 in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminal ① and the body.
- If the measured value deviates from the standard value, replace water temperature sensor 2. Gr 14



13722

INJECTION NOZZLE



● Inspection before disassembly

📖 P13-77

● Disassembly sequence

- 1 Injection pipe
- 2 Leak-off pipe
- 3 Bolt
- 4 Bridge
- 5 O-ring
- 6 Injection nozzle assembly
- 7 Retaining nut
- 8 Tip packing
- 9 Straight pin
- 10 Needle valve
- 11 Nozzle
- 12 Pressure pin
- 13 Spring
- 14 Adjusting shim
- 15 Nozzle holder
- 16 Nozzle gasket

* : Cylinder head 📖 Gr 11

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠️

Wipe up any spilled fuel because it can cause a fire.

CAUTION ⚠️

- Be sure not to touch the slide-contact area of needle valve 10 because any scratches or corrosion might spoil the airtightness of nozzle 11. It must be handled with utmost care.
- Never change the combination of needle valve 10 and nozzle 11 for each cylinder.
- Be sure to protect all openings by covering them after removal of hoses and pipes because the engine performance is adversely affected if dirt and foreign particles enter injection nozzle assembly 6.

NOTE

Remove carbon deposits and clean injection nozzle assembly 6 before working on it, then test the injection pressure and jet spray condition, and check for fuel leakage before disassembly. If no fault is found, do not disassemble.

Service standards

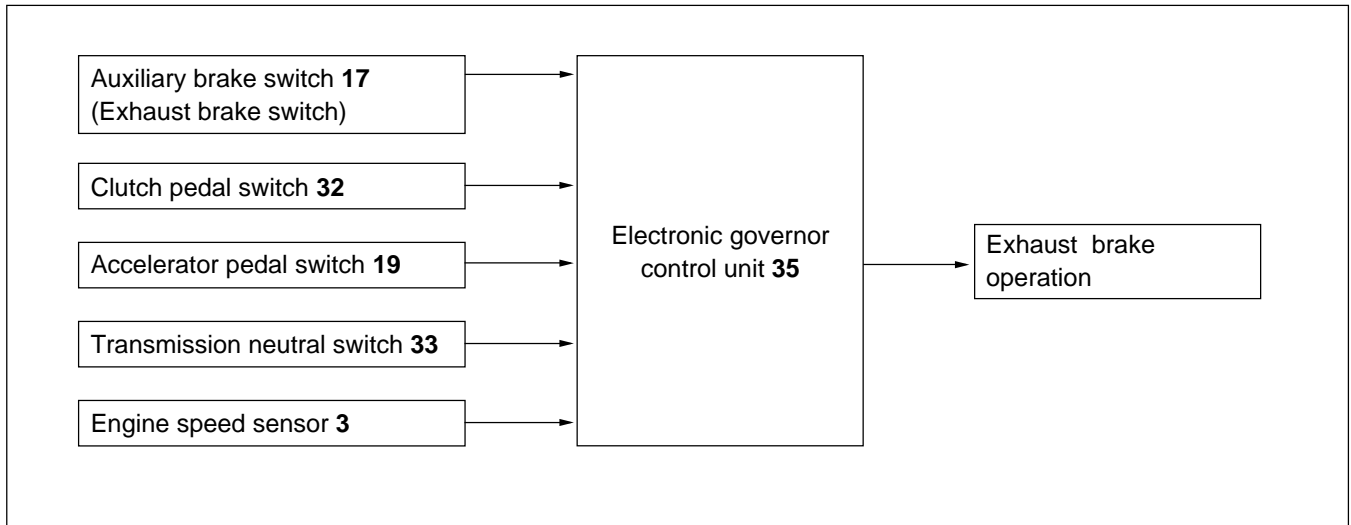
Location	Maintenance item	Standard value	Limit	Remedy
6	Valve opening pressure	21.6 MPa {3130 lbf/in ² , 220 kgf/cm ² }	—	Adjust

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Union nut (Injection pipe mounting)	25 {18, 2.5}	—
3	Bolt (Bridge mounting)	25 {18, 2.5}	—
7	Retaining nut	34 to 44 {25 to 33, 3.4 to 4.5}	—

● Auxiliary brake control function



The auxiliary brake control function acts upon the auxiliary braking devices, i.e., the exhaust brake, when the following conditions are satisfied:

- Clutch pedal switch **32**: OFF (clutch pedal released)
- Accelerator pedal switch **19**: ON (accelerator pedal released)
- Transmission neutral switch **33**: ON (transmission not in neutral)

READING AND ERASING DIAGNOSIS CODES

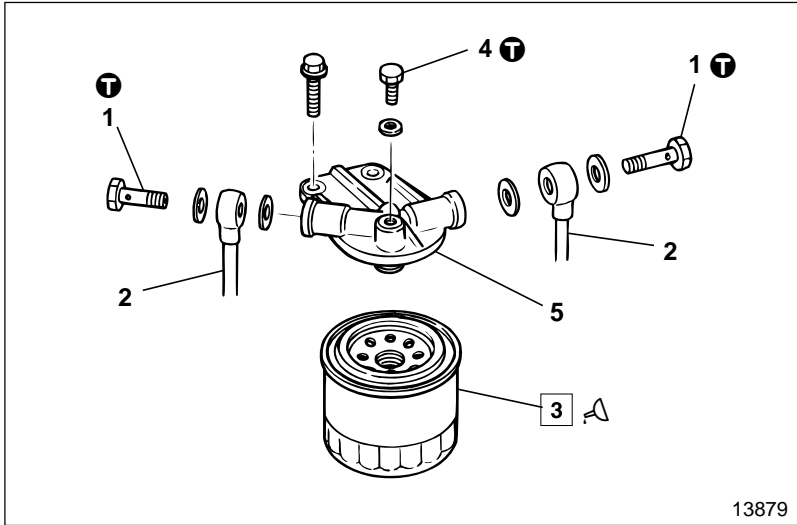
Diagnosis Codes Table

Diagnosis code	Fault location	Warning lamp	Electronic control unit countermeasure(s) in the case of failure (back-up mode)	Drive ability
01	Normal	—	—	○
03	Pre-stroke actuator learning function	Orange	Provides control with "0" as correction value.	○
06	Sub-control rack position sensor	Orange	Normal control using the main control rack position sensor	○
11	Governor servo	Red	*1 Engine stopped by the pull-down function.	×
12	Pre-stroke servo	Orange	Pre-stroke control stop engine revolution speed limit (approximately 1800 rpm)	△
13	Pre-stroke sensor	Orange	Pre-stroke control stop engine revolution speed limit (approximately 1800 rpm)	△
14	Back-up engine speed sensor	Orange	Control using the main engine speed sensor	○
15	Engine speed sensor	Orange	Calculate the engine revolution speed from the pulse count of the back-up engine speed sensor.	○
14+15	Both the back-up engine sensor and the main engine speed sensors are faulty upon start-up.	Red	Do not start the engine.	○
16	Accelerator pedal position sensor II	Orange	Control using the accelerator pedal sensor I	○
21	Water temperature sensor	Orange	Set the water temperature to 80 °C {176°F}.	○
22	Control rack position sensor	Orange	Switch to the sub-control rack position sensor control.	△
24	Accelerator pedal position sensor I	Orange	Control using the accelerator pedal position sensor II.	○
24+16	Both accelerator pedal position sensor I and accelerator pedal position sensor II are faulty	Red	Set the maximum accelerator depression angle to 30 degrees even if the accelerator pedal is depressed.	△
31	Idling adjustment volume	Orange	Set to auto idling.	○
32	Boost pressure sensor	Orange	Set the boost pressure to 0 kpa {0 mmHg, 0 in. Hg}.	△*2
33	RAM (ECU internal memory circuit)	Red	Do not start the engine.	×
41	Boost temperature sensor	Orange	Normal control assuming the boost temperature is 80 °C {176 °F}.	○
45	Reverse engine operation	Orange	*1 Engine stopped by the pull-down function.	×*2
65	Accelerator switch	Orange	Limited accelerator depressing angle (Approximately 30%)	○

*1 : The pull-down function indicates the rack pull-back action. In the event of an engine over-run or severe accident, the rack is pulled back immediately to the no-injection direction in order to protect the engine.

○ : Driveable
 △ : Back-up mode driving possible
 × : Undriveable

*2 : Driveable if the starter switch is turned OFF once and then restarted again.



● **Disassembly sequence**

- 1 Eye bolt
- 2 Fuel feed pipe
- 3 Fuel filter
- 4 Air vent plug
- 5 Fuel filter head

● **Assembly sequence**

Follow the disassembly sequence in reverse.

T **Tightening torque**

Unit : N·m {lbf.ft, kgf·m}

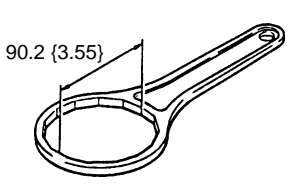
Location	Parts to be tightened	Tightening torque	Remarks
1	Eye bolt	25 to 34 {18 to 25, 2.5 to 3.5}	—
4	Air vent plug	7.8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—

L **Lubricant**

Location	Points of application	Specified lubricant	Quantity
3	Gasket contact surfaces of fuel filter and fuel filter head	Engine oil	As required

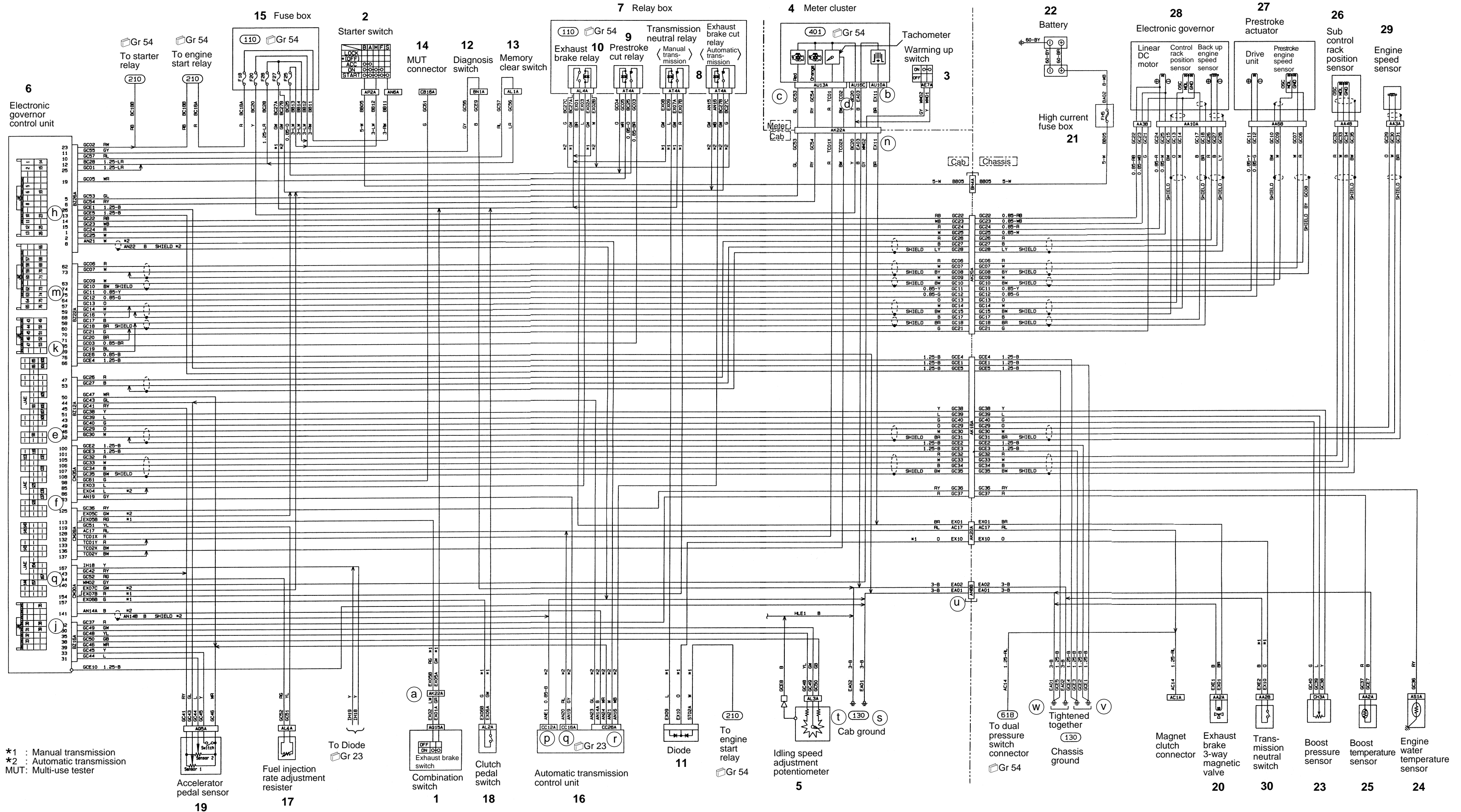
S **Special tools**

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3	Filter wrench 	MH061509	Removal of fuel filter

01882

ELECTRIC CIRCUIT AND PART INSTALLATION LOCATIONS



MEMO

MEMO

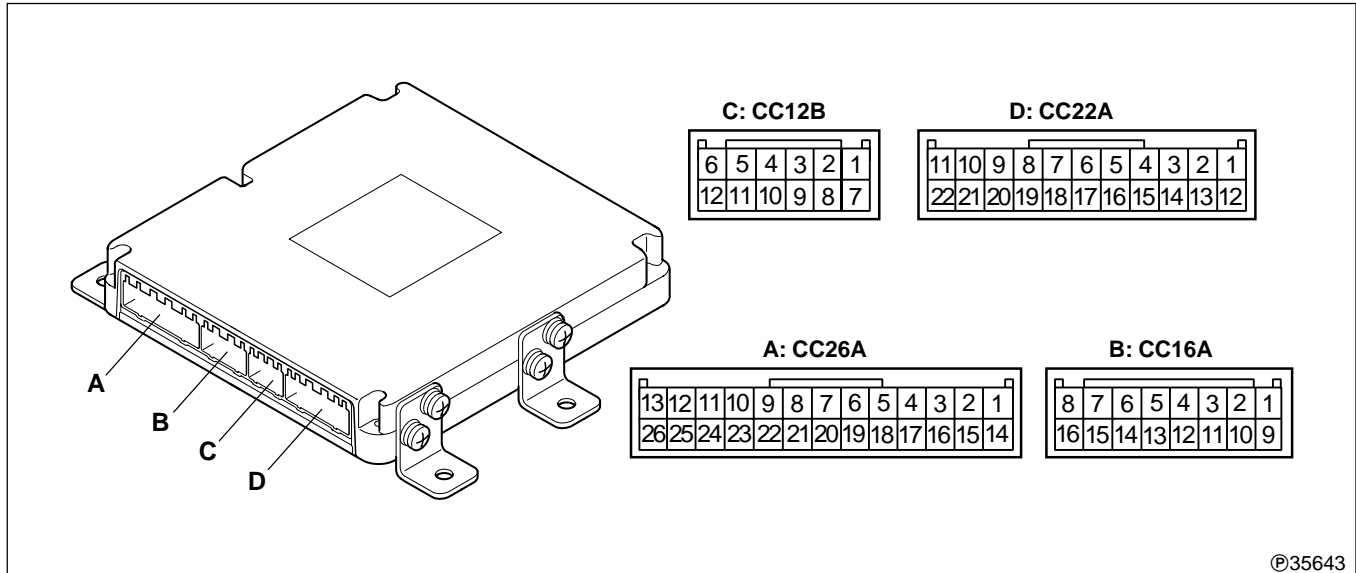
TROUBLESHOOTING

7. CHECKS AT CONNECTOR OF CONTROL UNIT

This method of checks is useful for checking whether all the signals of the control unit are transmitted without any error through the vehicle side harness and connector.

The numbers in the table correspond to the call numbers used in "4. DIAGNOSTIC TROUBLE CODES AND CHECK ITEMS" for referencing this section.

Pin Configuration of Control Unit

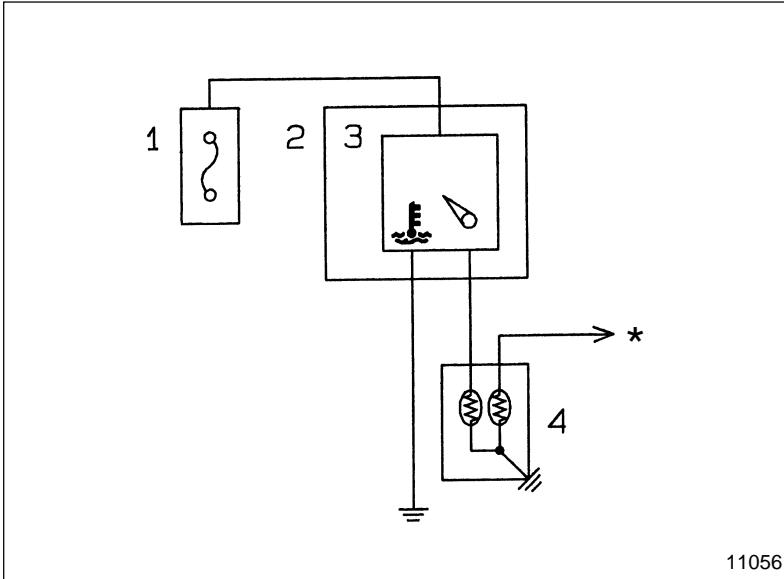


No.	Item	Reference Page
01	Resistance of TDC sensor	P13E-33
02	Resistance of engine speed sensor	
03	Output voltage of accelerator position sensor 1	
04	Output voltage of accelerator position sensor 2	
05	Signal voltage of vehicle speed sensor	
06	Output voltage of idle adjusting potentiometer	
09	Voltage of accelerator switch	P13E-34
11	Voltage of emergency engine stop switch	
12	Resistance of fuel temperature sensor	
13	Voltage of starter switch (start signal)	


STRUCTURE AND OPERATION

Cooling System Electric Circuit

● Water temperature gauge circuit

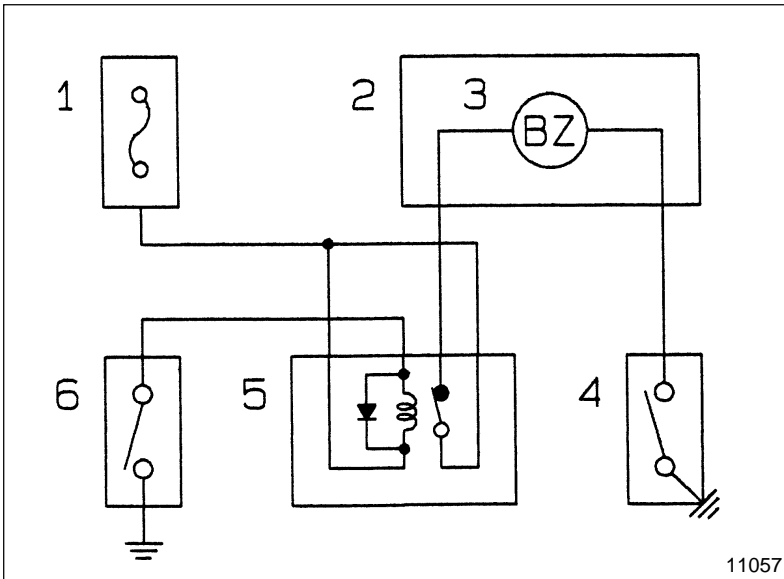


- 1 Fuse box
- 2 Meter cluster
- 3 Water temperature gauge
- 4 Water temperature sensor

* : To multipurpose control unit  Gr 54

This circuit detects the coolant temperature by changes of resistance in water temperature sensor 4 and relays the signal to water temperature gauge 3 in meter cluster 2 to indicate the temperature.

● Overheating Circuit



- 1 Fuse box
- 2 Meter cluster
- 3 Overheating buzzer
- 4 Overheating switch
- 5 Overheating relay
- 6 Parking brake switch

When this circuit detects extremely high coolant temperature, it sounds overheating buzzer 3 to warn the driver of the abnormal condition. To stop the buzzer, first stop the vehicle, then pull up the parking lever.

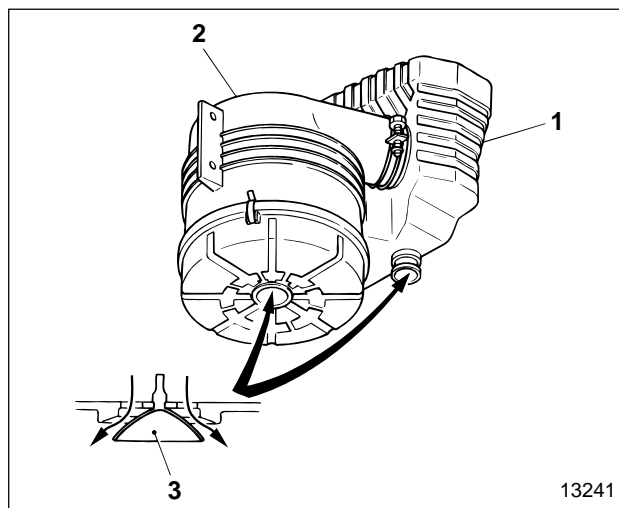
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Items		Specifications
Air cleaner element		Cyclone paper filter type
Turbocharger	Model	TD05
	Manufacturer	MITSUBISHI HEAVY INDUSTRIES
Intercooler type		Air-cooled, tube and corrugated fin type

STRUCTURE AND OPERATION

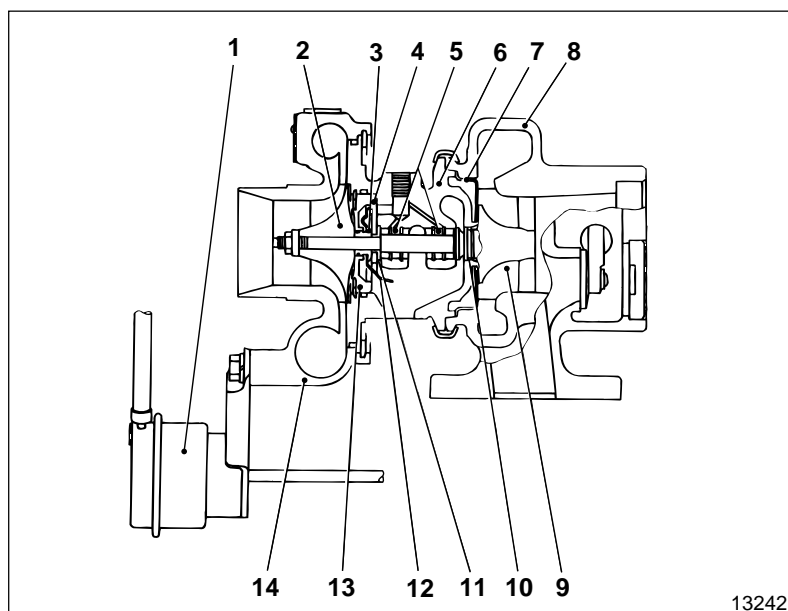
Air Cleaner



- 1 Air box
- 2 Air cleaner assembly
- 3 Unloader valve

- Air cleaner assembly 2 uses a single element.
- Air box 1 and air cleaner assembly 2 are fitted with unloader valve 3. Water, dust and dirt that collect in the unit are automatically vented by vibration caused by the change of negative pressure when the engine revolution falls below the specified revolution.

Turbocharger



- 1 Actuator
- 2 Compressor wheel
- 3 Thrust sleeve
- 4 Thrust bearing
- 5 Bearing
- 6 Bearing housing
- 7 Turbine backplate
- 8 Turbine housing
- 9 Shaft and turbine wheel
- 10 Piston ring
- 11 Thrust ring
- 12 Oil deflector
- 13 Inserter
- 14 Compressor cover

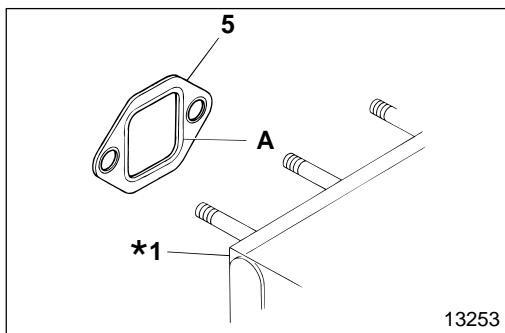
2 to 13 : Cartridge assembly

◆ Service procedure

5 Installation of gasket

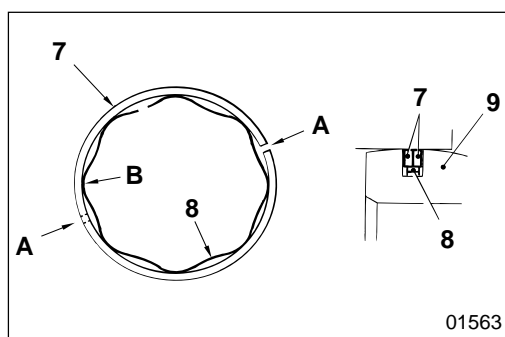
Install gasket 5 on cylinder head *1 in the direction as illustrated.

A : Grommet lip

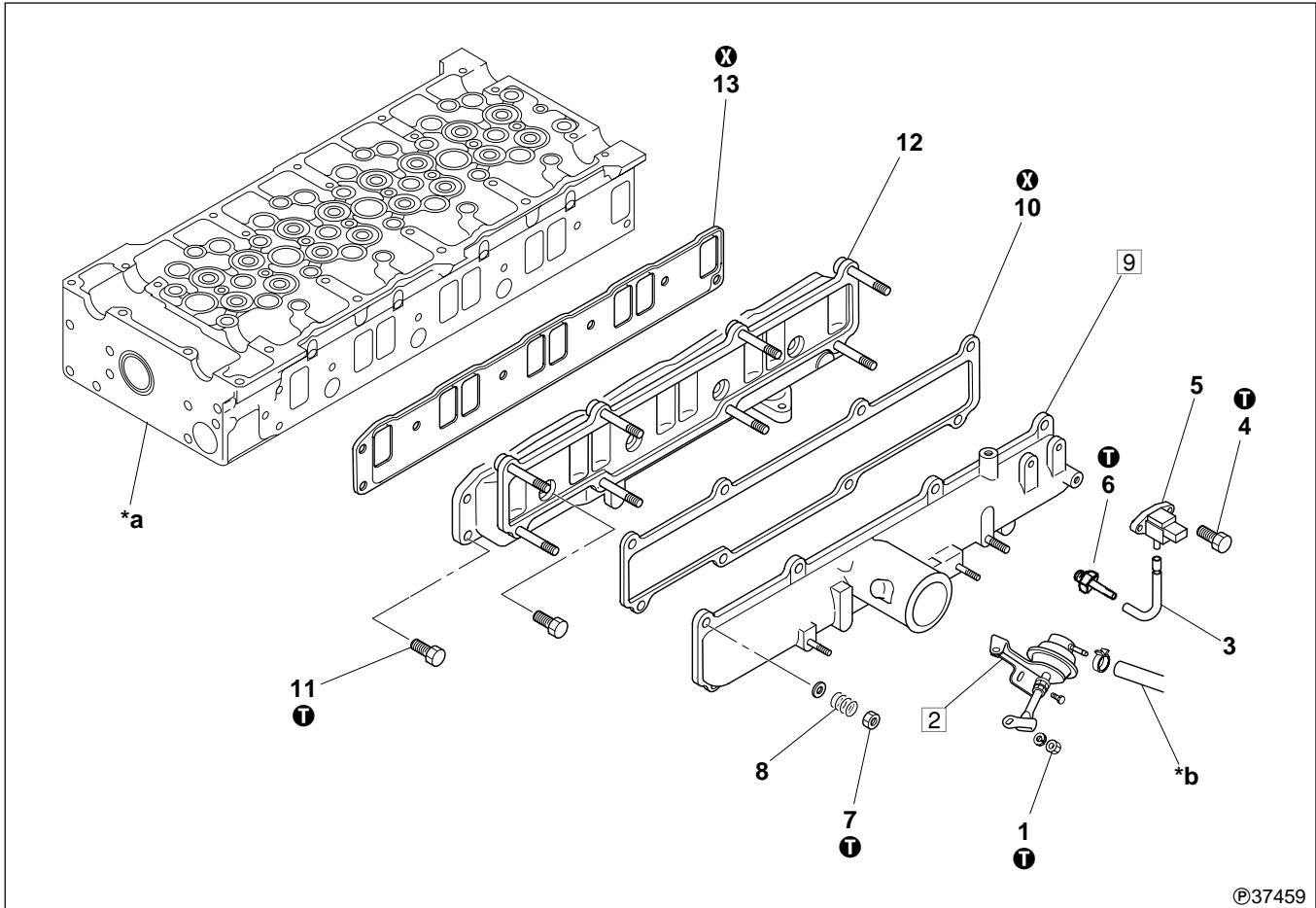


7 8 Installation of seal ring and expansion ring

- Offset splits A of seal rings 5 at 180°.
- Align so that expansion ring 8 protrusions B and splits A of seal rings 7 do not meet.



INTAKE MANIFOLD



©37459

● Disassembly sequence

- | | | |
|-------------------------|----------------------|-------------|
| 1 Nut | 7 Nut | 13 Gasket A |
| 2 Actuator assembly | 8 Spring | |
| 3 Pressure hose | 9 Intake manifold B | |
| 4 Bolt | 10 Gasket B | |
| 5 Boost pressure sensor | 11 Bolt | |
| 6 Pressure hose fitting | 12 Intake manifold A | |

*a: Cylinder head Group 11A

*b: Vacuum hose Group 17A

ⓧ: Non-reusable part

● Reassembly sequence

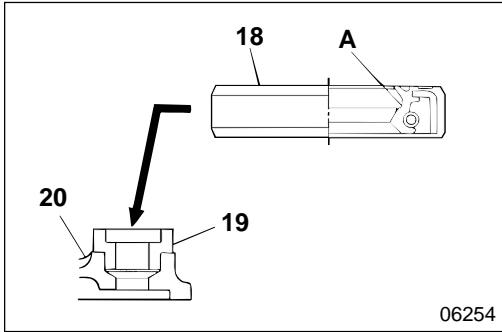
Follow the disassembly sequence in reverse.

Service standards

Unit: mm {in.}

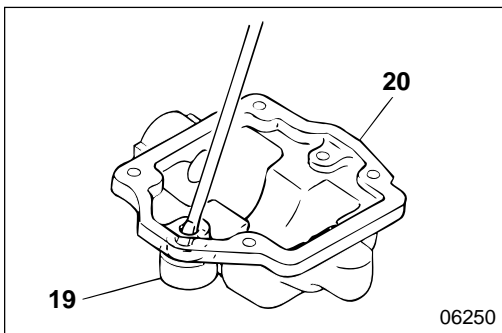
Location	Maintenance item		Standard value	Limit	Remedy
2, 9	Butterfly valve intake manifold clearance	Clearance B	$4.0^{+0.5}_0$ { $0.16^{+0.02}_0$ }	—	Replace

MEMO



18 Installation of oil seal

Apply grease to lip area **A** of oil seal **18** with bushing **19** press-fitted onto selector lever case **20**, and press-fit evenly in the direction as illustrated.



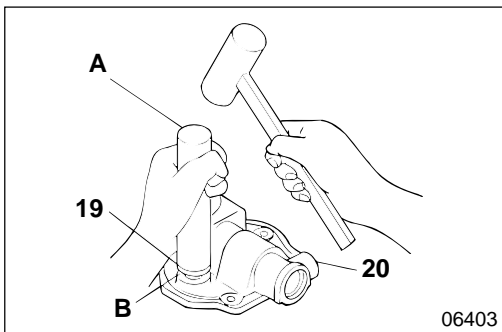
19 Bushing

[Removal]

Bushing **19** is press-fitted onto selector lever case **20**. For replacement, remove using a screwdriver.

CAUTION ⚠

Be careful not to damage selector lever case **20**.



[Press-fitting]

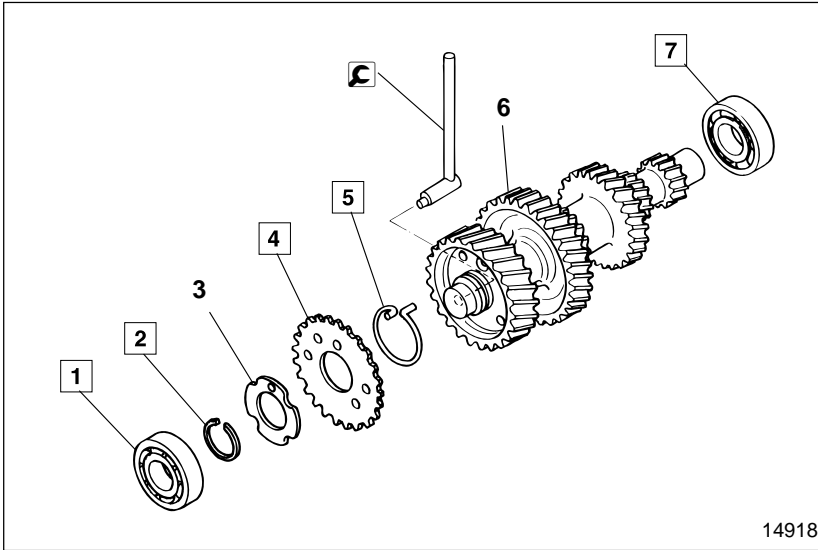
Clean the inner surface of selector lever case **20**, and drive bushing **19** evenly into the case using bar **A** (approximately $\varnothing 30$ mm {1.18 in.}) taking care not to damage the case.

After press-fitting, apply sealant to bushing outer side **B**.

CAUTION ⚠

Make sure that you prevent sealant from sticking to the inner surface of bushing **19**.

COUNTERSHAFT ASSEMBLY <NON-BACKLASH MECHANISM>



● Disassembly sequence

- 1 Countershaft front bearing
- 2 Snap ring
- 3 Sub-gear plate
- 4 Sub-gear
- 5 Sub-gear spring
- 6 Countershaft assembly
- 7 Countershaft rear bearing

WARNING ⚠

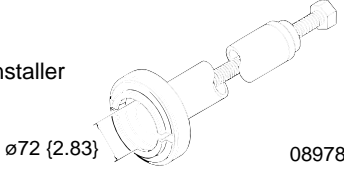
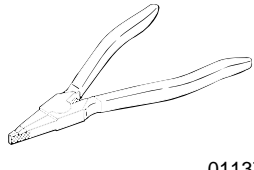
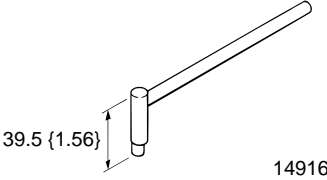
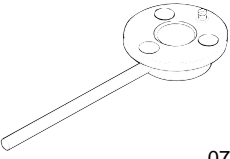
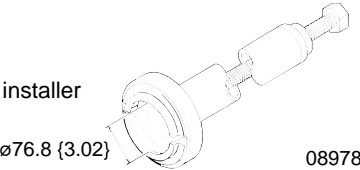
You must remove **C** set pin that was installed before disassembling countershaft assembly 6. When removing the set pin, you must be very careful not to let sub-gear spring 5 rotate sub-gear 4, or you might hurt your hand.

● Assembly sequence

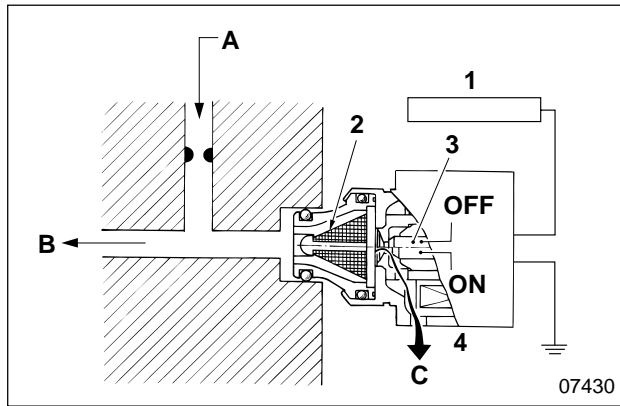
Follow the disassembly sequence in reverse.

Unit : mm {in.}

C Special tools

Location	Tool name and shape	Part No.	Application
1	Bearing puller and installer 	MH062697	Removal and installation of countershaft front bearing
2	Snap ring expander 	MH061268	Removal and installation of countershaft front bearing snap ring and sub-gear snap ring
4	Set pin 	MH063385	Securing of sub-gear
	Jig assembly 	MH063313	Installation of sub-gear
7	Bearing puller and installer 	MH062697	Removal and installation of countershaft rear bearing

STRUCTURE AND OPERATION



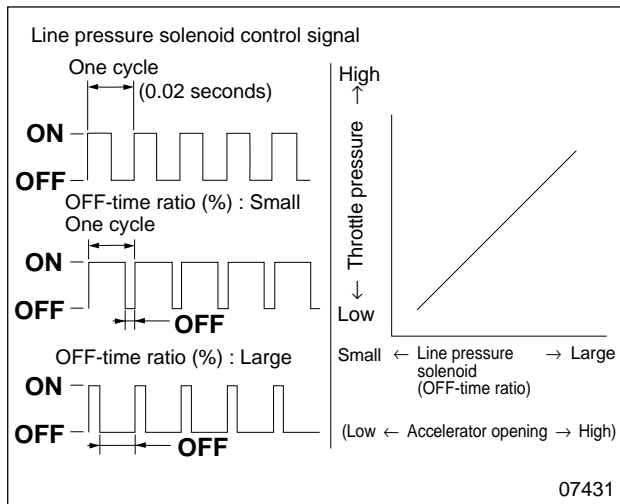
● Line pressure control

• Line pressure solenoid

- 1 Automatic transmission electronic control unit
- 2 Filter
- 3 Needle valve
- 4 Line pressure solenoid

A : Pilot pressure
 B : Throttle pressure (to pressure modifier valve)
 C : Drain

The accelerator sensor monitors the amount of the accelerator opening, and by controlling line pressure solenoid 4, pilot pressure A from the oil pump is regulated, via the pressure regulator valve, into the optimum hydraulic pressure (throttle pressure B) for driving.



The line pressure solenoid is controlled by the ON-OFF operation activated by signals transmitted from automatic transmission electronic control unit 1.

The ON-OFF signals are transmitted to line pressure solenoid 4 at 50 Hz (0.02 cycles per second). However, the ratio of ON and OFF signal time coming from the accelerator sensor, in conjunction with accelerator opening, is determined by automatic transmission electronic control unit 1.

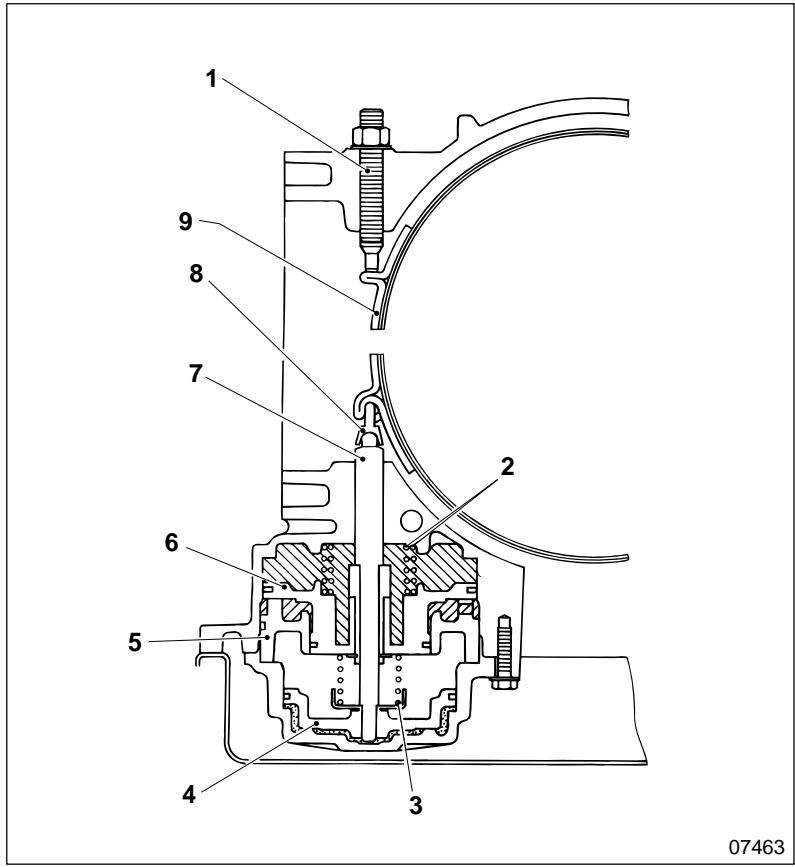
When line pressure solenoid 4 is switched OFF, needle valve 3 closes the pilot pressure (*1) drain line. When the line pressure solenoid is switched ON, the drain line opens. Accordingly, the larger the OFF-time ratio in the ON-OFF signals at 50 Hz, the longer the closing time of the drain line, and the higher the throttle pressure B (*2).

On the contrary, the smaller the OFF-time ratio, the shorter the closing time of the drain line, and throttle pressure B does not increase.

*1 : The pilot pressure is the pressure for use in the control mechanism, obtained after the line pressure has been adjusted by the pilot valve. In line pressure control, pilot pressure is supplied as a signal pressure to the pressure modifier valve and as a hydraulic pressure source.

*2 : The throttle pressure is the pressure obtained after pilot pressure has been adjusted by the activation of the line pressure solenoid.

● Brake Band



- 1 Anchor end bolt
- 2 Return spring
- 3 Return spring
- 4 Overdrive servo piston
- 5 Servo piston retainer
- 6 Servo piston
- 7 Piston stem
- 8 Band strut
- 9 Brake band

- 2nd gear shift operating chamber
- 3rd gear shift operating chamber
- 4th gear shift operating chamber

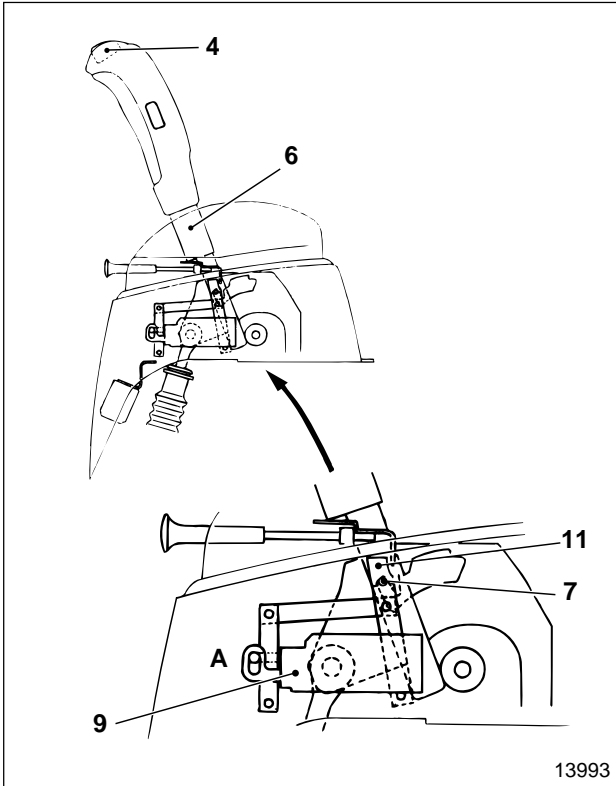
One end of brake band 9 is fixed to the transmission case by anchor end bolt 1. The servo piston assembly has three chambers each of which corresponds to a certain gear position, to which hydraulic pressure is supplied. Operating pressure is transmitted from the control valve to act on the piston for each gear shift position, and piston stem 7 is pushed up to make the brake band fix the reverse clutch drum. This operation fixes the front sun gear.

- 1st gear : As there is no delivery of hydraulic pressure to the servo piston assembly, the brake band does not act due to the repercussive force of the return spring.
- 2nd gear : Hydraulic pressure is delivered to the 2nd gear shift operating chamber, pushing up the piston stem to make the brake band fix the reverse clutch drum.
- 3rd gear : Hydraulic pressure is delivered to the 2nd gear shift operating chamber and the 3rd gear shift operating chamber. The force acting on the pressure reception area difference of the piston with the repercussive force of return spring 2, pushes the piston stem down to release the brake band.
- 4th gear : The pressure acting on the 2nd and 3rd gear shift operating chambers releases the piston. But pressure delivered to the 4th gear shift operating chamber acts on drive servo piston 4 to push up the piston stem, and this operation causes the brake band to fix the reverse clutch drum.

	2nd gear shift operating chamber	3rd gear shift operating chamber	4th gear shift operating chamber
1st gear			
2nd gear	○		
3rd gear	○	○	
4th gear	○	○	○

○ : Pressure acting

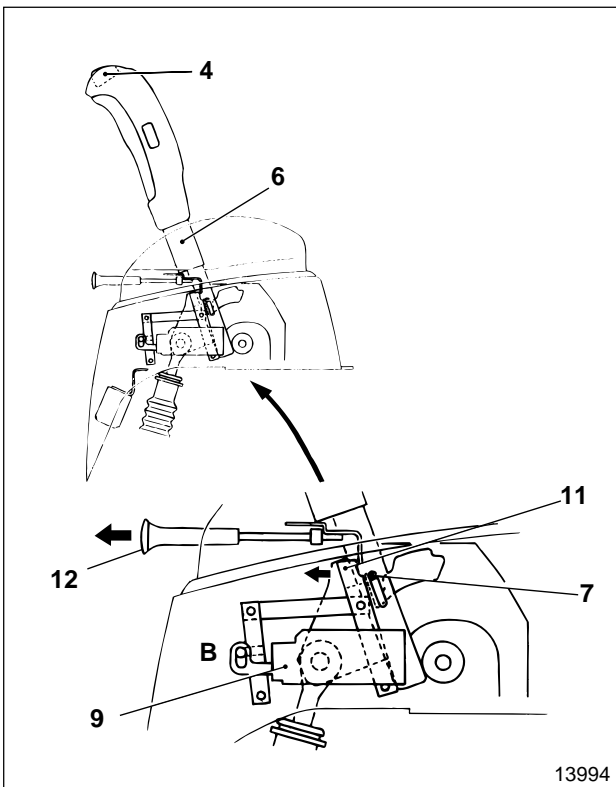
STRUCTURE AND OPERATION



Parking shift locking system

- When selector lever **6** is in the P range and shift lock actuator **9** is locked (state **A**) depending on the state of the power supply (refer to the table below) to the shift lock actuator, pin **7** is restrained by shift lock link **11** and cannot push shift button **4**, and the selector lever cannot be shifted to any position other than the P range.

Power supply		Switch		Operating mode	
IG	+B	Brake	P range	Unlock	Lock
○	○	○	○	○ ← —	
○	○		○	— → ○	
○	○	○		○	
○	○			○	
	○	○	○	— → ○	
	○		○	— → ○	
	○	○		○	
	○			○	



- When selector lever **6** is in the P range and shift lock actuator **9** is unlocked (state **B**) depending on the state of the power supply (refer to the table above) to the shift lock actuator, shift lock link **11** falls forward freeing pin **7** so that shift button **4** is pushed down, allowing the selector lever to move to positions other than the P range.
- In the event of any electrical troubles, P shift locking can be released by pulling shift lock release knob **12**.

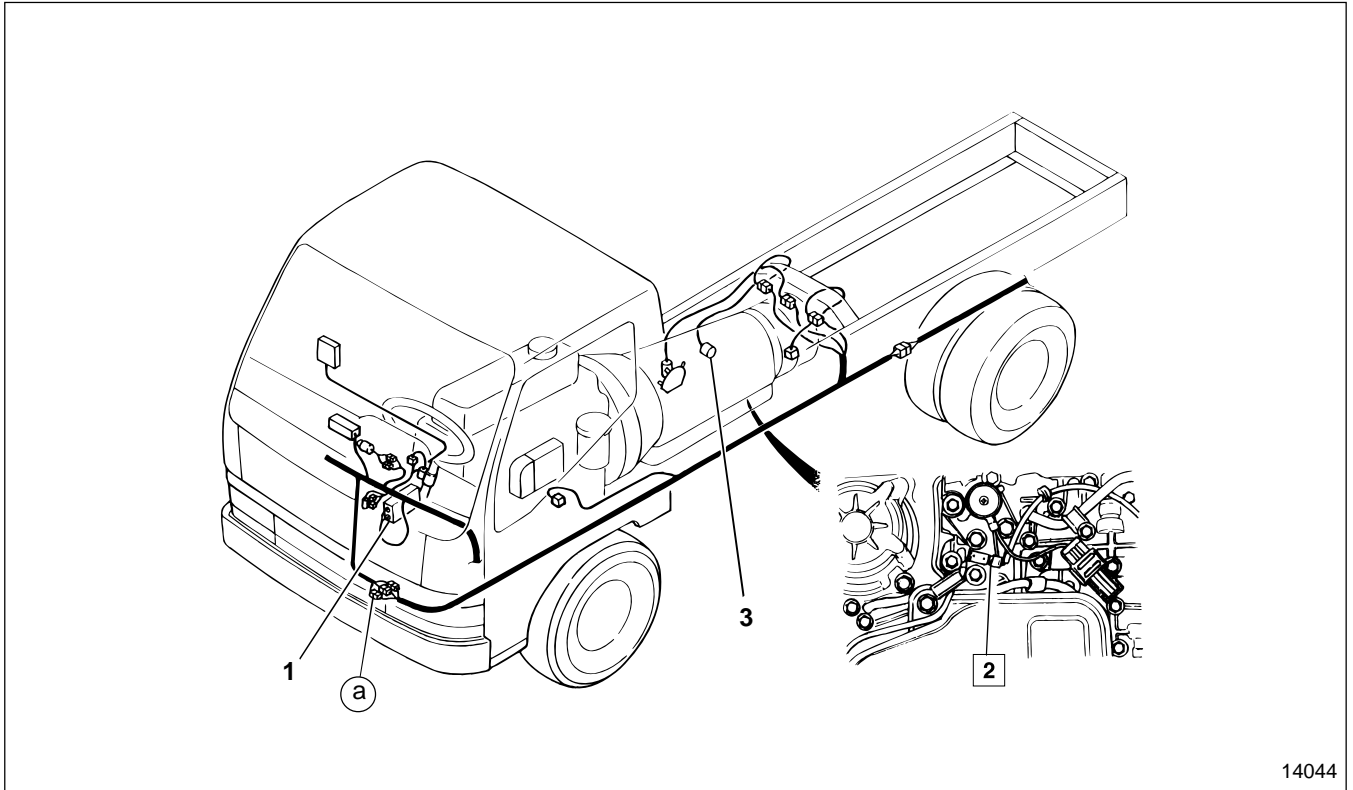
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- 1 Automatic transmission electronic control unit
- 2 Oil temperature sensor
- 3 Terminal switch

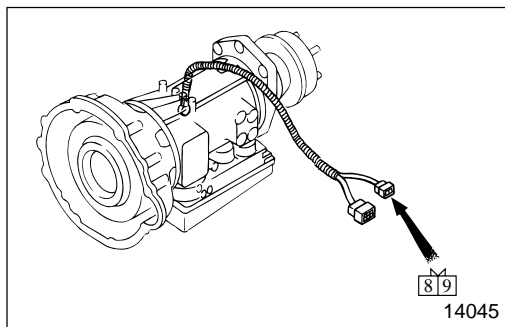
14044

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
2	Resistance of oil temperature sensor (At terminal switch connector)	20°C {68°F}	Approximately 2.5 kΩ	—	Replace
		40°C {104°F}	Approximately 1.2 kΩ	—	
		60°C {140°F}	Approximately 0.6 kΩ	—	
		80°C {176°F}	Approximately 0.3 kΩ	—	

◆ Service procedure

2 Inspection of oil temperature sensor body



14045

Standard value	Connector terminal		Oil temperature
	8	9	
Approximately 2.5 kΩ	○ — ○	○ — ○	20°C {68°F}
Approximately 1.2 kΩ			40°C {104°F}
Approximately 0.6 kΩ			60°C {140°F}
Approximately 0.3 kΩ			80°C {176°F}

When the measured value deviates extremely from the standard value or when the resistance value does not change in spite of the change in the fluid temperature, replace the oil temperature sensor body.

INSPECTION BY SYMPTOM

● Shift Control Faulty

Gear shift is possible when in the D range but cannot shift down when accelerator pedal is depressed

Stop the vehicle

Inspect faulty point using self-diagnosis function (Note 1)

Stop the engine leaving the starter switch ON

Is power supply output voltage signal of accelerator sensor from terminal 10 of automatic transmission electronic control unit normal?

Abnormal

Automatic transmission electronic control unit faulty

Replace

Normal (4.5 to 5.5 volts)

Is accelerator sensor input signal, throughout the entire range from fully closed to fully opened, to terminal 11 of automatic transmission electronic control unit normal?

Abnormal

Accelerator sensor or wiring faulty

Repair or replace

Normal (Approximately 1.0 volt when fully opened to approximately 4.0 volts when fully closed)

Is accelerator sensor connecting circuit from terminals 10, 15 of automatic transmission electronic control unit normal?

Abnormal

Normal

Replace automatic transmission electronic control unit

Road test

Is shift-down possible when accelerator pedal is depressed?

No

Inspect automatic transmission body

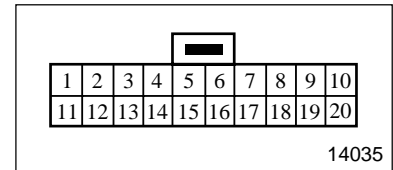
Yes

The automatic transmission electronic control unit that was used before replacement was faulty

Note 1 : • Make sure you carry out the inspection in strict accordance with the self-diagnosis procedures on vehicles that are brought in for service on account of troubles. P23-50

- Inspect for accelerator sensor faults.
- Keep written records on note pads of faulty points.

Automatic transmission electronic control unit

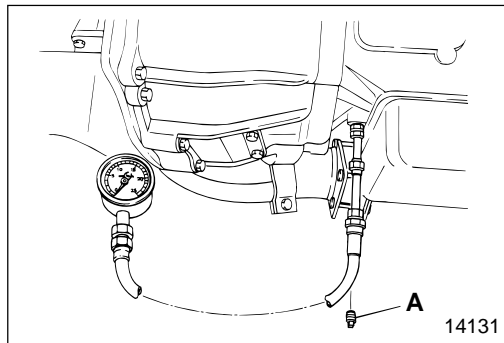


Line Pressure Test

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Pressure detector plug	4.9 to 9.8 {3.6 to 7.2, 0.5 to 1.0}	—



● Aim

The line pressure test is carried out to check the oil pump performance, the control valve functions and to check the hydraulic circuit for leakage.

● Measurement procedure

- Remove pressure detector plug 1 and install the pressure gauge in the bottom front part of the automatic transmission case.
- Measurement procedure is the same as for the stall test. Measure as you gradually open the accelerator from engine idling.
- Read the line pressure.
- After measurement is completed, tighten pressure detector plug 1 at specified torque.

NOTE

- Since pressure detector plug 1 has sealant on its threads it cannot be reused.
- Measure line pressure when the engine idling revolution is the standard value.

Thread size for pressure detector plug 1

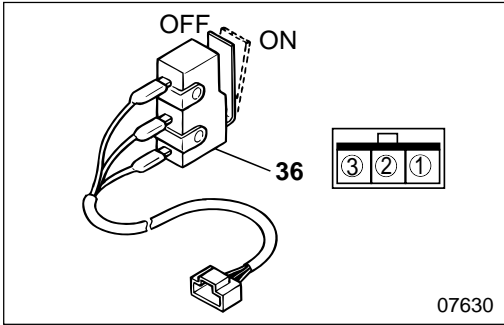
Automatic transmission case female screw (parallel pipe thread)	Plug, pressure gauge fitting male screw (taper pipe thread)
PS 1/8	PT 1/8

● Line pressure

Unit : kPa {lbf/in², kgf/cm²}

Oil pressure when engine is idling	FE639	R	470 to 745 {68 to 108, 4.8 to 7.6}
	FE649	D, 2, L	295 to 470 {43 to 68, 3.0 to 4.8}
Oil pressure when engine is stalled	FE639	R	1225 to 1520 {178 to 220, 12.5 to 15.5}
	FE649	D, 2, L	920 to 1100 {134 to 159, 9.4 to 11.2}

AUTOMATIC TRANSMISSION CONTROL



36 P-range switch

[Inspection]

	①	②	③
ON	○ — ○	○ — ○	○ — ○
OFF		○ — ○	○ — ○

○ — ○ : There is continuity between terminals ○ and ○.

Replace P-range switch **36** if it is faulty.

[Installation]

Install P-range switch **36** so that it is OFF when the range selector lever is in the P range.

STRUCTURE AND OPERATION

• Engine speed sensor

The 2-3 shift timing control becomes inactive to ensure proper vehicle operation.

• Shift solenoid 1 and shift solenoid 2

If a solenoid malfunction occurs when the transmission is in the D, 2 or L range, the operating conditions of the solenoids change as shown in the following table. The automatic transmission electronic control unit also deactivates the lock-up solenoid and timing solenoid to allow vehicle operation.

Range selector position	Normal				Malfunctioning of S1			Malfunctioning of S2			Malfunctioning of S1 and S2		
	S1	S2	ST	Gear	S1	S2	Gear	S1	S2	Gear	S1	S2	Gear
D range	○	×	×	1st	–	×→○	3rd	○	–	1st	–	–	4th
	○	○	×	2nd	–	○	3rd	○→×	–	4th	–	–	4th
	×	○	×	3rd	–	○	3rd	×	–	4th	–	–	4th
	×	×	×	4th	–	×	4th	×	–	4th	–	–	4th
2 range	○	×	×	1st	–	×→○	3rd	○	–	1st	–	–	3rd
	○	○	×	2nd	–	○	3rd	○→×	–	3rd	–	–	3rd
	×	○	×	3rd	–	○	3rd	×	–	3rd	–	–	3rd
L range	○	×	×	1st	–	×	1st	○	–	1st	–	–	1st
	○	○	×	2nd	–	○	2nd	○	–	1st	–	–	1st
	×	○	○	3rd	–	○	2nd	×	–	1st	–	–	1st

○ : Electric current supplied × : Electric current not supplied – : Malfunctioning → : Fail-safe function
 S1 : Shift solenoid 1 S2 : Shift solenoid 2 ST : Timing solenoid

• Throttle pressure solenoid

The malfunctioning solenoid is deactivated to bring the line pressure to a maximum level, thus allowing vehicle operation.

• Timing solenoid and lock-up solenoid

The malfunctioning solenoid is deactivated to allow vehicle operation.

● Self-diagnosis function

The warning lamp lights when an abnormality occurs during vehicle operation.

- The warning lamp does not light if the abnormality causes minimum effect to vehicle operation.
- The warning lamp lights in the case of the following malfunctions to indicate the abnormal condition since these malfunctions significantly reduce vehicle performance.

Malfunction of vehicle speed sensor, malfunction of throttle position PWM signal, malfunction of shift solenoid 1, malfunction of shift solenoid 2, malfunction of accelerator sensor, malfunction of timing solenoid, malfunction of inhibitor switch, malfunction of throttle pressure solenoid.

CAUTION

The warning lamp lights only when the malfunction prevents proper vehicle operation.

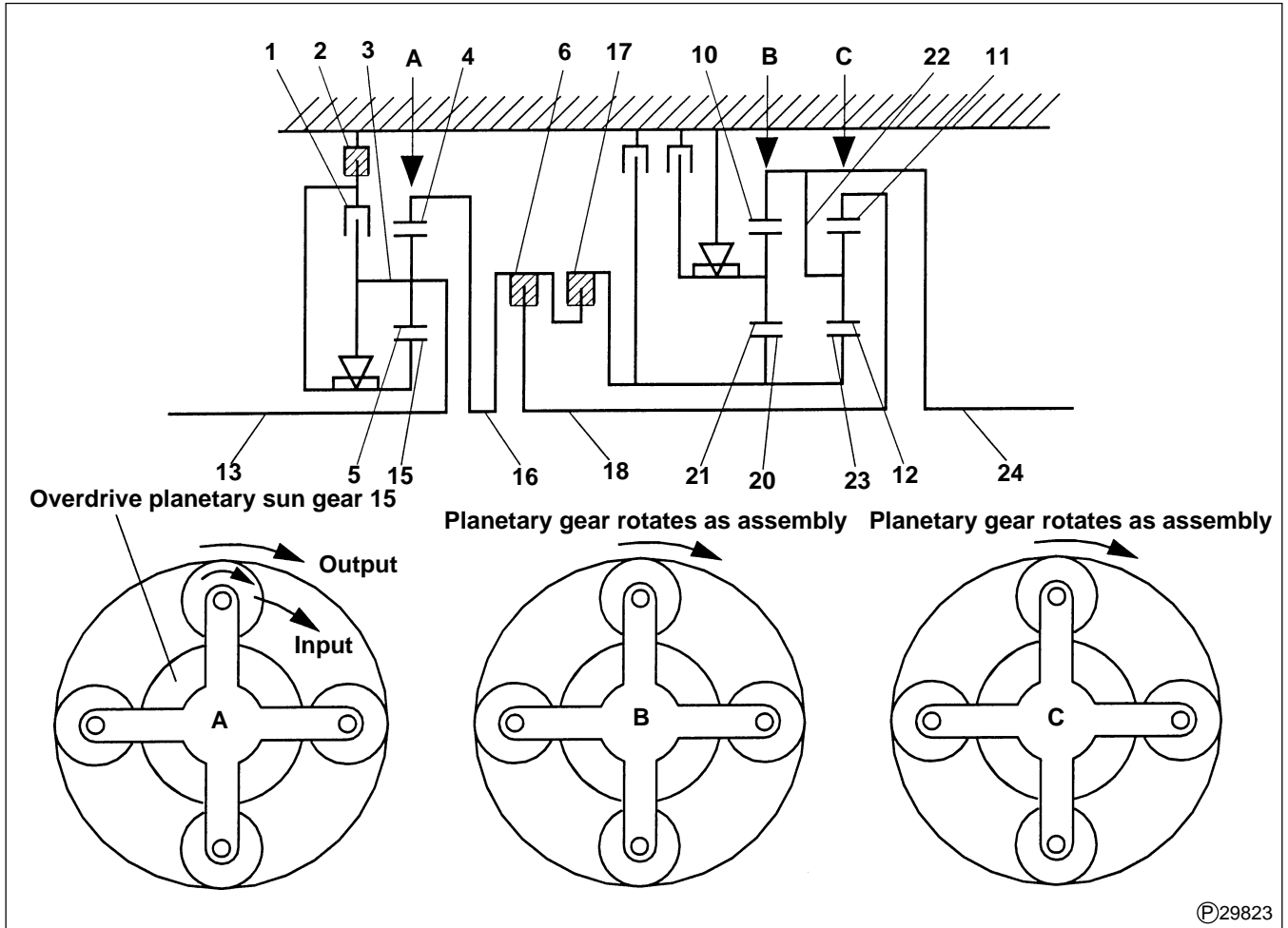
The indicator lamp provides self-diagnosis information.

- To facilitate the discovery of malfunctions that may not reproduce themselves frequently, the automatic transmission electronic control unit stores in the memory information of malfunctions that occur during vehicle operation.
- An input of a self-diagnosis start signal produces the output of the data from the memory, and causes the automatic transmission warning lamp to flash according to the data.

CAUTION

The automatic transmission electronic control unit stores information of all malfunctions that occur after the previous self-diagnosis operation.

● D Range (4th Gear)



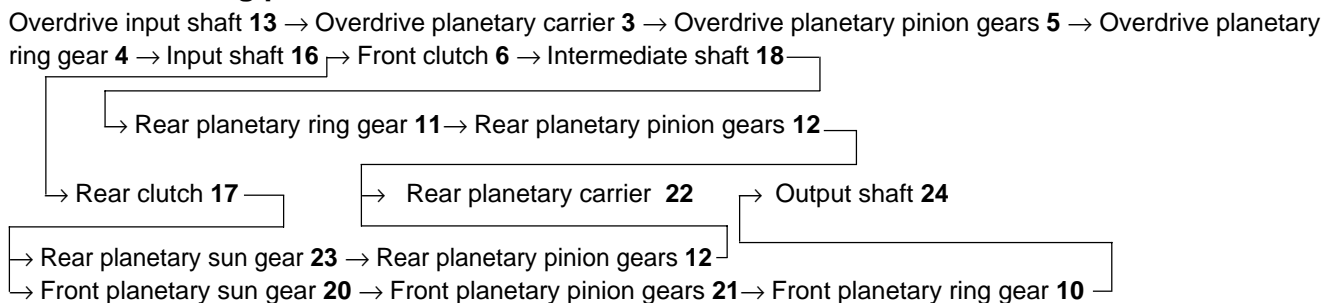
©29823

If the overdrive conditions (see the table below) are fulfilled when the transmission is in 3rd gear, overdrive direct clutch 1 disengages, and overdrive brake 2 activates at the same time to provide the overdrive gear ratio. In the overdrive gear, overdrive brake 2 is in operation, thus locking overdrive planetary sun gear 15 in position. Therefore, the rotating force transmitted from overdrive input shaft 13 to overdrive planetary carrier 3 causes overdrive planetary pinion gears 5 to revolve around the sun gear and on their own axes, which results in an increased rotating speed of overdrive planetary ring gear 4 (input shaft 16). The rotating force of input shaft 16 is transmitted to output shaft 24, in the same way as in the 3rd gear.

Overdrive conditions

Shift position	D
Overdrive OFF SW	OFF
Temperature of oil in oil pan	Approximately 0°C {32°F} or higher

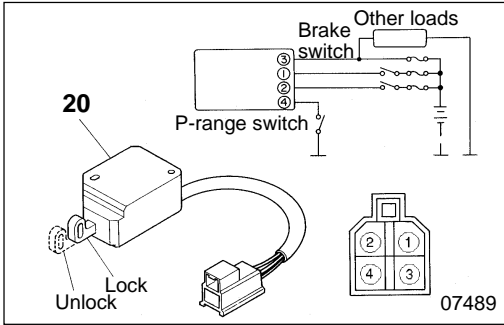
Power transmitting process



TROUBLESHOOTING

Symptoms and problems

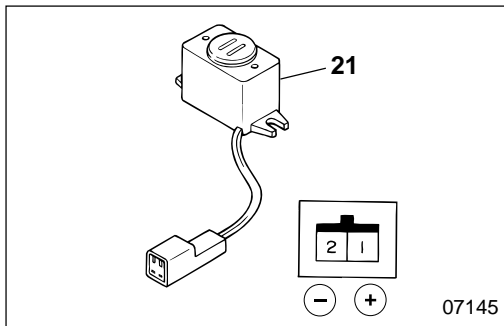
Malfunction	Abnormal movement		Abnormal shift operation																	
	Vehicle runs in N range	Parking position is still engaged when selector is moved from P range	Vehicle moves in P range	Vehicle does not move in any range	Vehicle does not move in R range	Vehicle does not move in D, 2 or L range	Lock-up point extremely high or low	Does not lock up	No engine brake in 2 range	No engine brake in L range	Kick-down does not operate	Shift point extremely high or low	Engine revs up in 2-3 shift	Does not shift down from 2nd to 1st	Does not shift down from 3rd to 2nd	Does not shift down from 4th to 3rd	Does not shift up from 3rd to 4th	Does not shift up from 2nd to 3rd	Does not shift up from 1st to 2nd	
Suspected problem factor																				
Automatic transmission fluid level and condition																				
Control linkage	○	○	○	○															○	○
Inhibitor switch																			○	○
Accelerator sensor							○	○			○	○	○							
Vehicle speed sensor							○				○	○		○	○	○	○	○	○	○
Engine speed sensor								○					○							
Engine idle speed																				
Line pressure				○				○												
Shift solenoid 1					○			○	○		○				○				○	
Shift solenoid 2					○			○	○	○			○			○				○
Timing solenoid													○							
Lock-up solenoid							○	○												
Starter circuit																				
Overdrive OFF switch																			○	
Exhaust brake switch								○												
Automatic transmission fluid temperature sensor								○											○	
Automatic transmission electronic control unit					○		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Torque converter				○				○												
Automatic transmission unit malfunction	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○



20 Inspection of shift lock actuator

Power supply		Switch		Operating mode	
IG	+B	Brake	P range	Unlock	Lock
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/> ←	
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		→ <input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	
<input type="radio"/>	<input type="radio"/>			<input type="radio"/>	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	→	<input type="radio"/>
	<input type="radio"/>		<input type="radio"/>	→	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	
	<input type="radio"/>			<input type="radio"/>	

Check to make sure that shift lock actuator **20** is in operating mode under the above power supply and switch position. Replace the shift lock actuator if it is faulty.

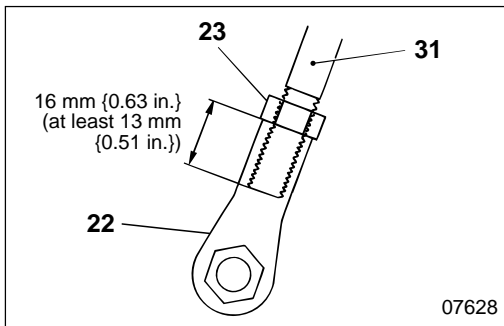


21 Inspection of automatic transmission reverse buzzer

- Check to make sure that the automatic transmission reverse buzzer sounds when 12 volts DC is loaded between terminals ① and ②.
- Replace automatic transmission reverse buzzer **21** if it is faulty.

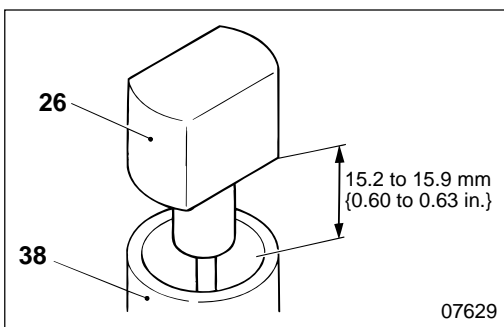
NOTE

- **Automatic transmission reverse buzzer 21 sounds continuously when you apply voltage.**
- **If you want to make automatic transmission reverse buzzer 21 sound intermittently, use the automatic transmission reverse buzzer and the back buzzer in combination.**



22 Installation of ball joint

Using ball joint **22** adjust rod **31** so that its thread ridge conforms to the dimensions as illustrated, then tighten with lock nut **23**.



26 Installation of sleeve

Shift range selector lever **38** to the P range. Install sleeve **26** by rotating it so that the dimension between the sleeve and the upper part of the lever conforms to the value as illustrated.

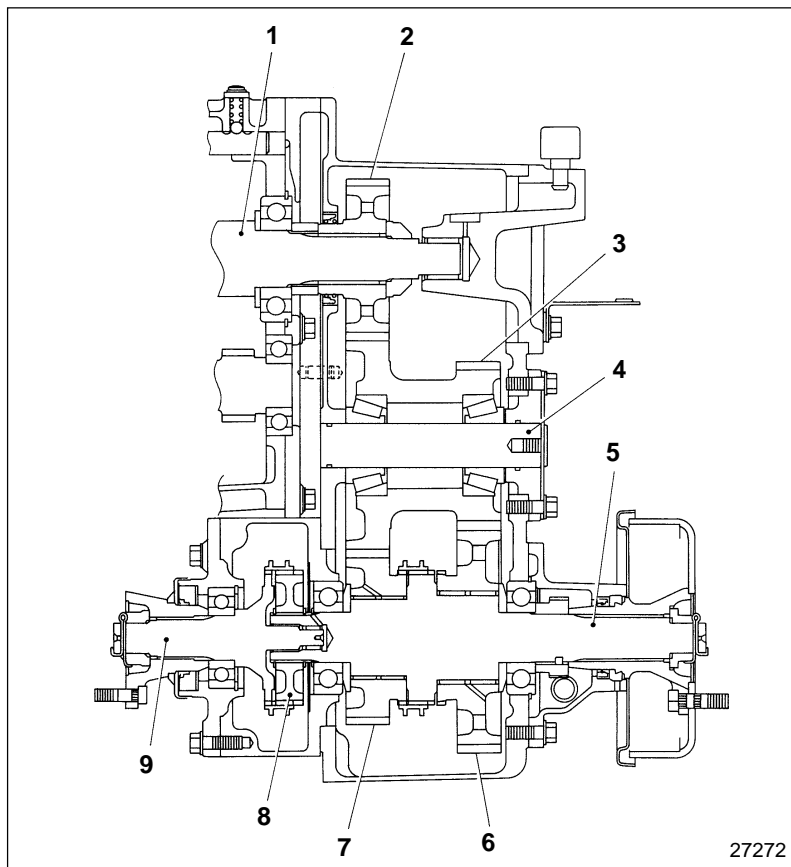
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

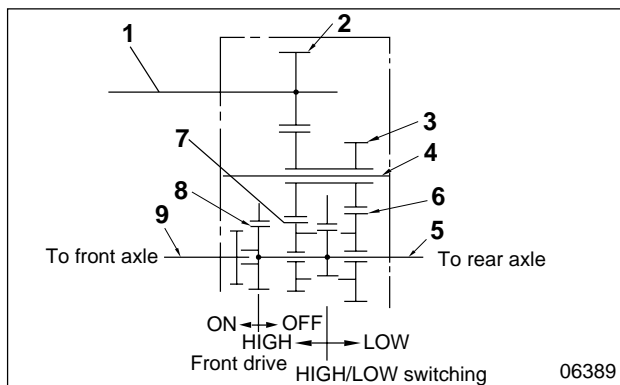
Item		Specifications
Model		TF3
Gear ratio	HIGH	1.090
	LOW	1.987
Gear oil	Oil quantity L {qts.}	3.0 {3.2}
Dry mass (including transmission body)		kg {lb}
		Approximately 190 {420}
Control		Front drive and HIGH-LOW switching floor change remote control

STRUCTURE AND OPERATION

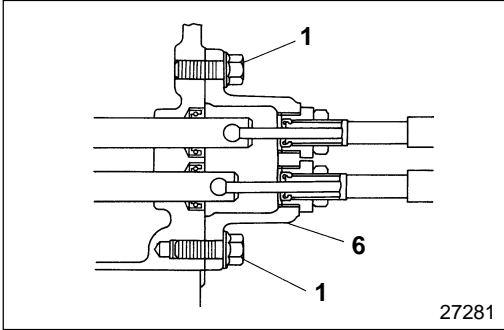
Transfer Body



- 1 Transmission main shaft
- 2 Drive shaft gear
- 3 Transfer idler gear
- 4 Transfer idler shaft
- 5 Output shaft
- 6 Output shaft LOW gear
- 7 Output shaft HIGH gear
- 8 Front drive hub and sleeve
- 9 Front drive shaft



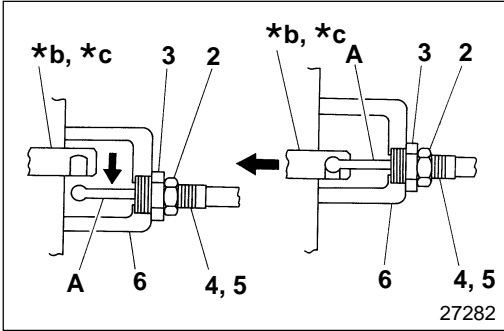
The transfer functions as both the distributor for four-wheel drive and as the sub-transmission with a reduction device. This transfer is a three-shaft constant-mesh type. HIGH/LOW changeover and front drive ON/OFF are controlled by a transfer control lever in the cab.



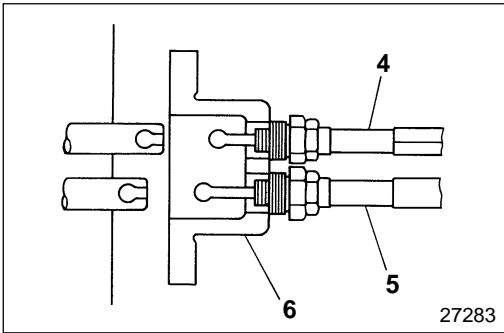
4 5 HIGH/LOW, 2H/4H Control Cable

[Removal]

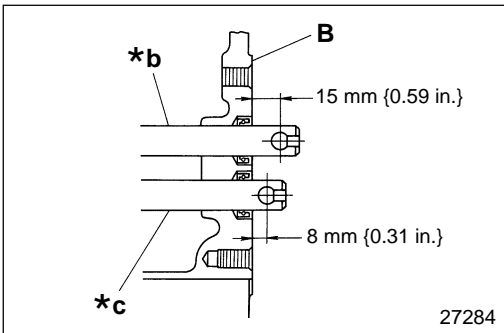
- Remove bolt 1 securing shift rail cover 6.



- Remove shift rail cover 6, and then remove inner cable A of HIGH/LOW and 2H/4H control cables 4 and 5, from HIGH/LOW shift rail *b, and front drive shift rail *c. Loosen nuts 2 and 3 to their end of their threads.

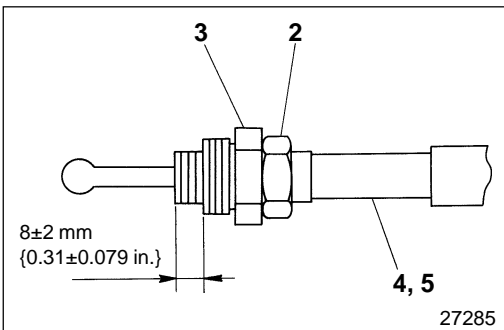


- Remove HIGH/LOW and 2H/4H control cables 4 and 5 from shift rail cover 6.



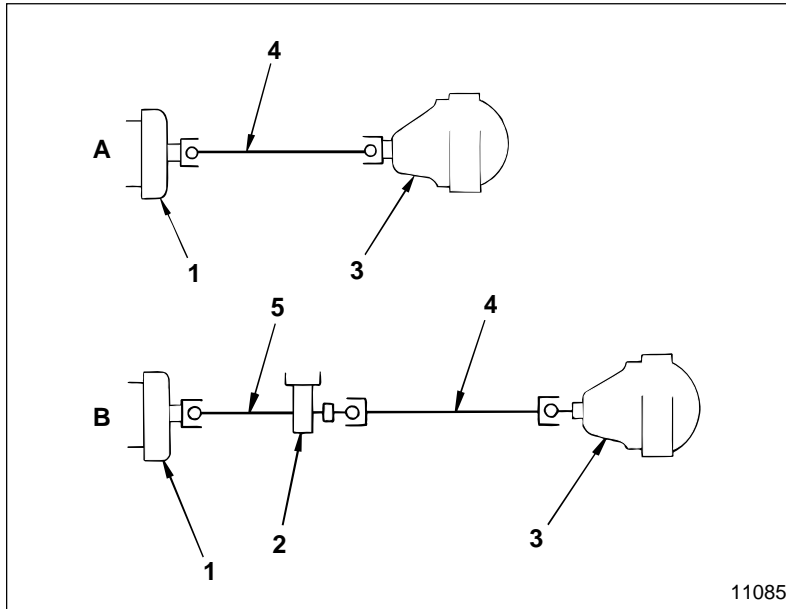
[Installation]

- Position HIGH/LOW shift rail *b and front drive shift rail *c as shown. B : Transfer end face



- Adjust nuts 2 and 3 to the end of the thread to align the end of HIGH/LOW and 2H/4H control cables 4 and 5 as shown.

Configuration of Propeller Shaft Connection



- 1 Parking brake drum
- 2 Center bearing
- 3 Rear axle
- 4 Rear propeller shaft
- 5 Front propeller shaft

A : Single-shaft connection
 B : Twin-shaft connection

11085

TROUBLESHOOTING

	Symptoms	Propeller shaft vibrating		Noise from propeller shaft		
		Vibration at high speed	Vibration at low speed	Noise when starting or while coasting	Noise while cruising	Clicking noise
Possible causes						
Flange yoke assembly direction incorrect		○				
Companion flange tightening torque excessive						○
Slip yoke joint	Lubrication insufficient				○	
	Spline play excessive		○	○		
Universal joint	Clearance in spider axial direction excessive		○		○	
	Needle bearing lubricated insufficiently				○	
	Needle bearing worn	○		○	○	
Center bearing < Twin-shaft connection >	Lubrication insufficient				○	
	Seized, worn, or rotation faulty	○			○	
	Cushion rubber deteriorating or deformed			○		
	Hanger mounting bolt loose			○		
Propeller shaft	Mounting bolt loose	○		○		
	Bent	○				
	Dynamic balance adjusted incorrectly	○				
Transmission gear selection too high			○			

MEMO

Adjustment of Wheel Alignment

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Wheel alignment	Toe-in (with tires on the ground)	0 to 6 {0 to 0.24}	—	—
		Camber	1°00'±30'	—	—
		Caster	0°30'±1°00'	—	—
		Kingpin inclination angle	9°30'	9°30'±30'	—

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

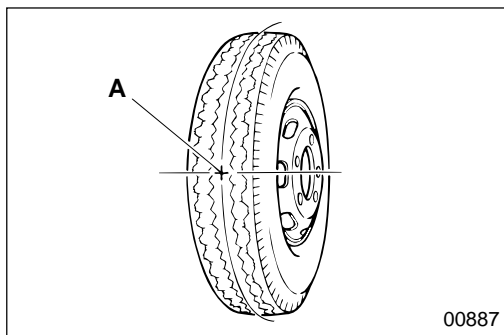
Location	Parts to be tightened	Tightening torque	Remarks
1	Clamp bolt (Tie rod end clamp fastening)	25±5 {18±3.6, 2.5±0.5}	—

NOTE

- Measure the wheel alignment when the vehicle is empty and level.
- Be sure that each part of the front axle has been serviced perfectly before adjusting the wheel alignment.

Before adjusting the wheel alignment, check for the following faults :

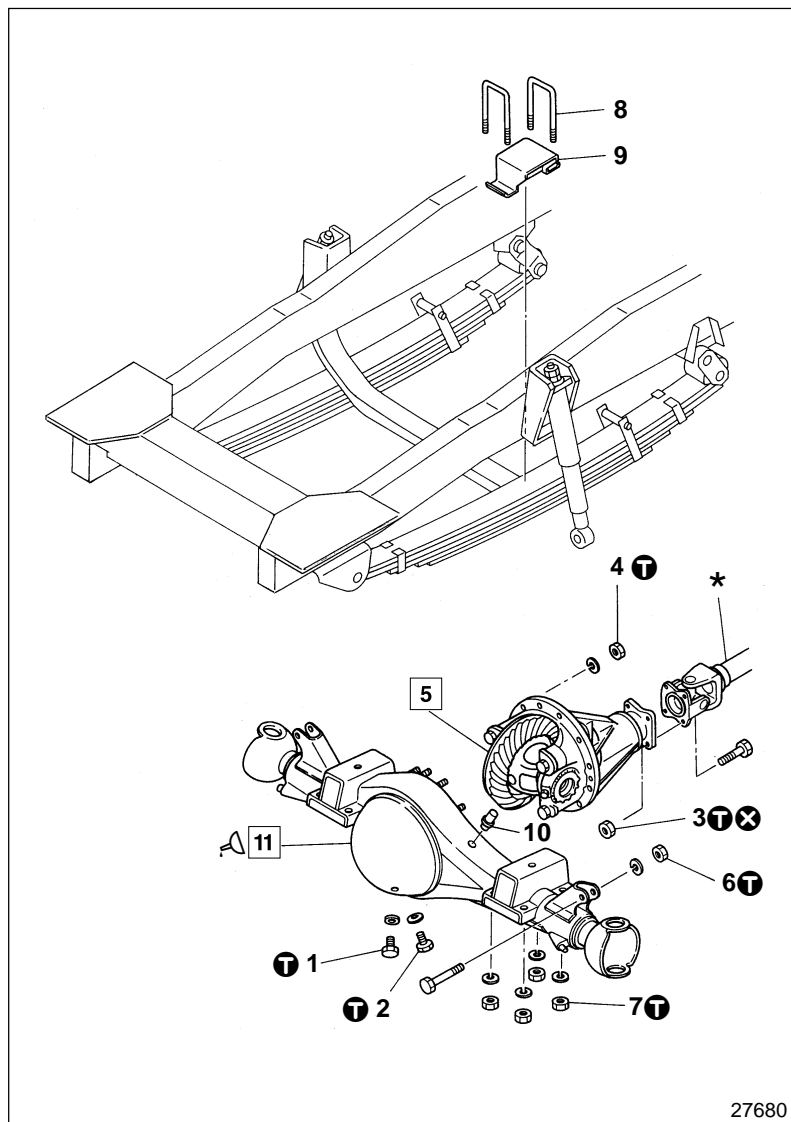
- Play in front wheel hub
- Play or looseness in kingpin
- Play or looseness in the joint between the tie rod and the knuckle arm
- Looseness of any fasteners
- Fatigued or damaged leaf springs
- Incorrect tire pressure
- Incorrect steering gear backlash



(1) Measurement and adjustment of toe-in

- Point the front wheels exactly forward.
- Put mark **A** on the left and right front tires at the height of front wheel axis and in the middle of the tire width.

AXLE HOUSING



● Disassembly sequence

- 1 Inspection plug
- 2 Drain plug
- 3 Nut
- 4 Nut
- 5 Reduction and differential assembly
P26B-30
- 6 Nut
- 7 U-bolt nut
- 8 U-bolt
- 9 Front spring pad
- 10 Vent plug
- 11 Axle housing

* : Propeller shaft Gr 25

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Do not remove axle housing 11 unless it is faulty.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
11	Deflection in axle housing	within 1.6 {0.063}	5 {0.2}	—

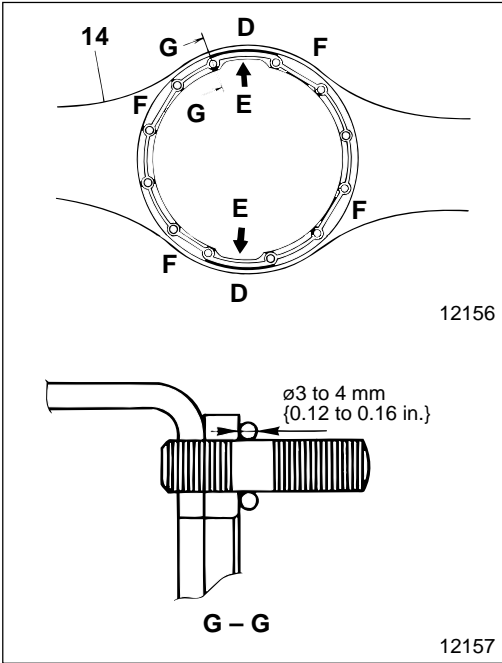
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Inspection plug	98 to 115 {72 to 87, 10 to 12}	—
2	Drain plug	98 to 115 {72 to 87, 10 to 12}	—
3	Nut (Propeller shaft mounting)	59 to 74 {43 to 54, 6.0 to 7.5}	—
4	Nut (Reduction and differential assembly mounting)	34 to 44 {25 to 33, 3.5 to 4.5}	—
6	Nut (Lower part of shock absorber mounting)	33 to 49 {25 to 36, 3.4 to 5.0}	—
7	U-bolt nut (U-bolt mounting)	105±7.8 {78±5.8, 10.8±0.8}	—

TROUBLESHOOTING

Possible causes	Symptoms			Power transmission insufficient					
	Oil leaking from companion flange assembly	Oil leaking from differential carrier and axle housing	Oil leaking from axle shaft	Propeller shaft turns but vehicle does not move	Noise when starting and when changing gear	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering
Reduction and differential	Front and rear bearings seized			<input type="radio"/>		<input type="radio"/>			
	Front and rear bearings worn					<input type="radio"/>			
	Front and rear bearings broken						<input type="radio"/>		
	Pinion pilot bearing worn					<input type="radio"/>			
	Pinion pilot bearing seized or broken						<input type="radio"/>		
	Pinion spider broken			<input type="radio"/>					
	Differential gear or differential pinion broken			<input type="radio"/>			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Differential gear or differential pinion seized			<input type="radio"/>					<input type="radio"/>
	Differential gear or differential pinion worn							<input type="radio"/>	<input type="radio"/>
	Differential gear washer worn or damaged						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Differential gear spline worn				<input type="radio"/>					



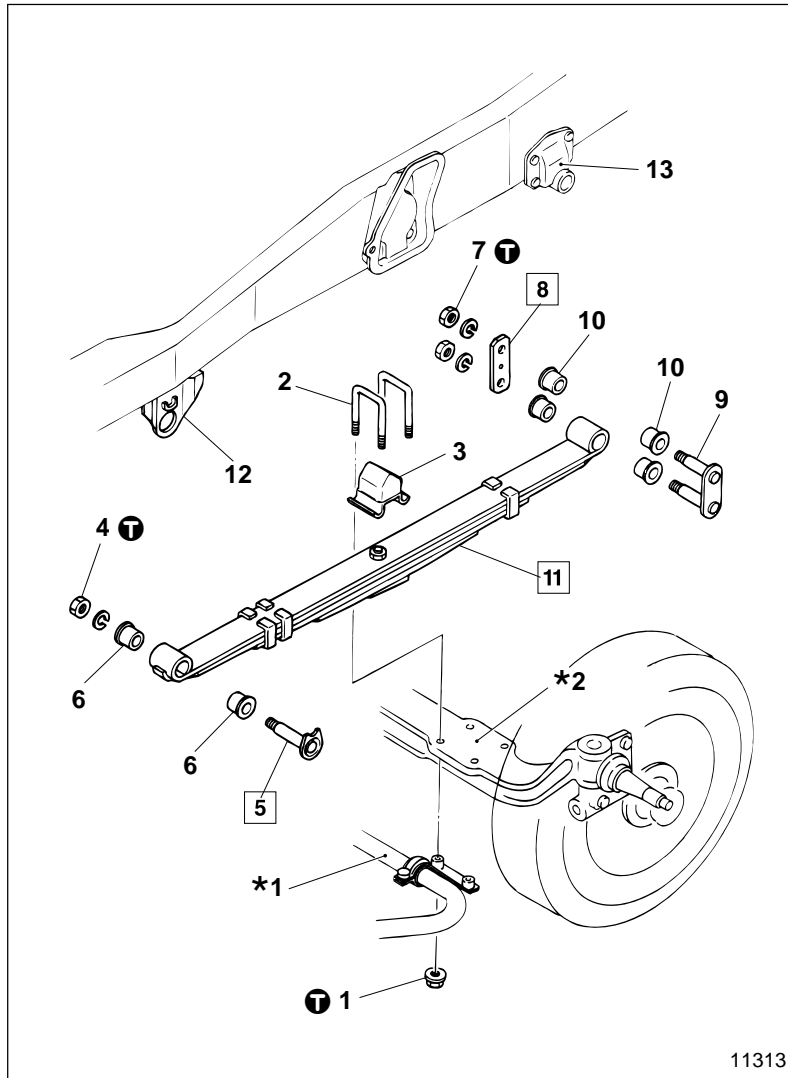
[Application of sealant]

- Apply sealant to reduction and differential assembly **10** mounting surface of axle housing **14**.
- Apply sealant around the periphery of indented area **E** for part **D**.
- Apply sealant linearly to part **F**.

NOTE

Make sure that sealant does not ooze from the mounting surface after installing reduction and differential assembly 10.

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



● Removal sequence

- 1 U-bolt nut
- 2 U-bolt
- 3 Front axle bumper
- 4 Nut
- 5 Spring pin
- 6 Rubber bushing
- 7 Nut
- 8 Shackle plate
- 9 Spring shackle
- 10 Rubber bushing
- 11 Leaf spring assembly P33-8
- 12 Front spring hanger
- 13 Front shackle hanger

*1 : Stabilizer P33-12

*2 : Front axle Gr 26

NOTE

Do not remove front spring hanger 12 or front shackle hanger 13 unless they are faulty. Gr 41

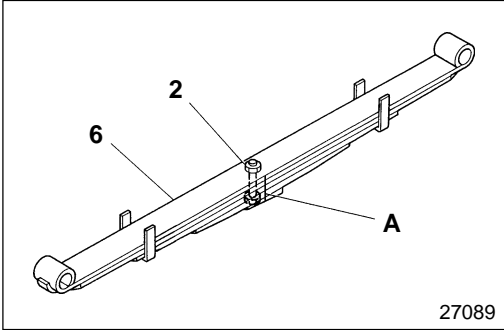
● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

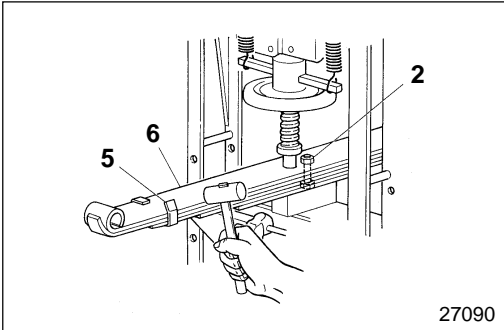
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	U-bolt nut (U-bolt mounting)	162±15 {120±11, 16.5±1.5}	—
4	Nut (Spring pin mounting)	93 to 127 {69 to 94, 9.5 to 13.0}	—
7	Nut (Spring shackle mounting)	93 to 127 {69 to 94, 9.5 to 13.0}	—

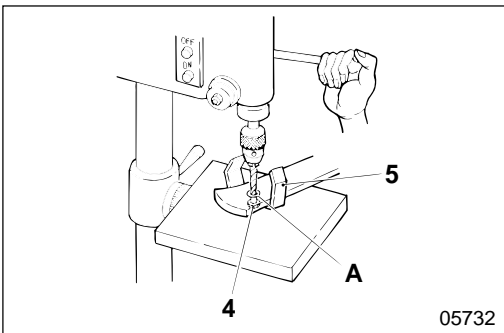


[Installation]

- Align alignment marks **A** on the side of leaf springs **6**, assemble the component leaf springs, then tighten center nut **2** temporarily.



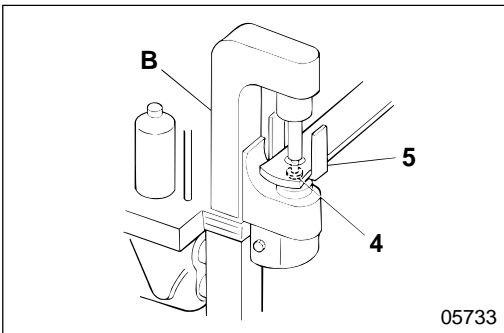
- Compress leaf springs **6** using a press, tighten center nut **2** at specified torque, then bend over clips **5**.



4 Rivet

[Removal]

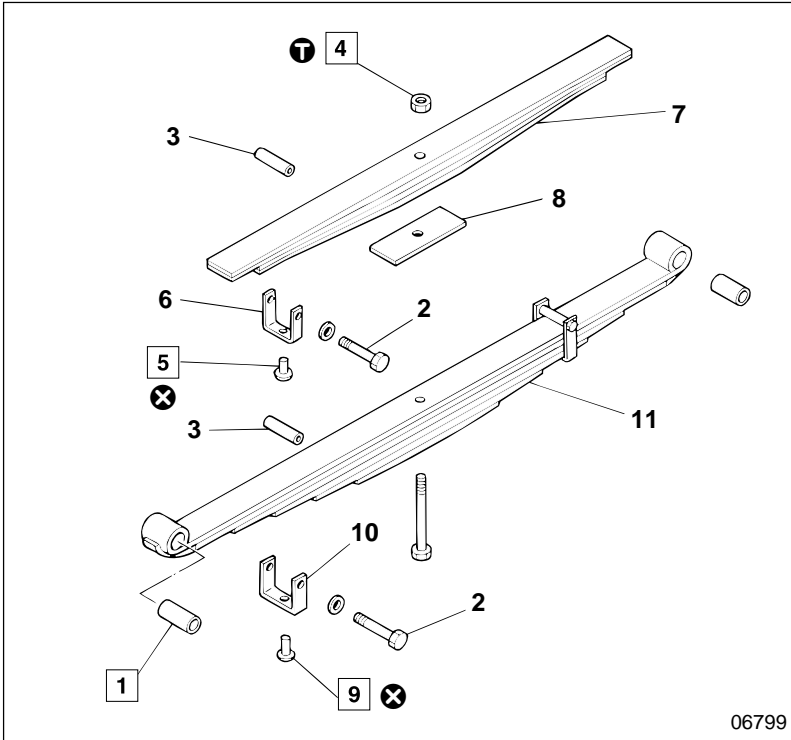
- Drill out staked end **A** of rivet **4** on a drill press, then remove clip **5**.



[Installation]

- Using riveting machine **B**, mount inner clip **5** by staking rivet **4**.

LEAF SPRING ASSEMBLY



Disassembly sequence

- 1 Bushing
- 2 Bolt
- 3 Pipe
- 4 Center nut
- 5 Rivet
- 6 Clip
- 7 Helper spring
- 8 Spacer
- 9 Rivet
- 10 Clip
- 11 Main spring

⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Center nut	69 to 93 {51 to 69, 7.0 to 9.5}	—

Special tools

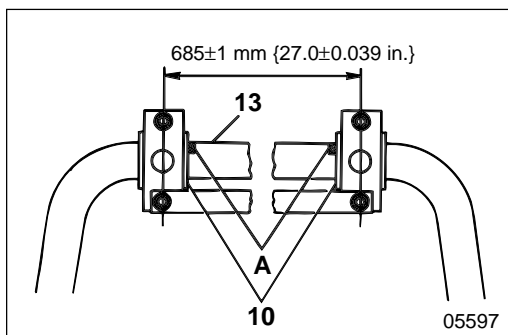
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Bushing installer A : Bushing installer A B : Bushing installer B 	MB999066 A : MB999067 B : MB999068	Removal and installation of bushing

◆ Service procedure

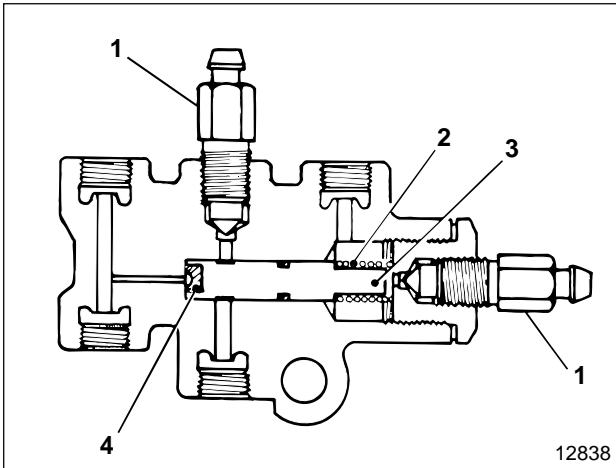
10 Stabilizer bushing

Mount stabilizer bushings **10** with their end surfaces aligned with marks **A** on stabilizer bar **13**.



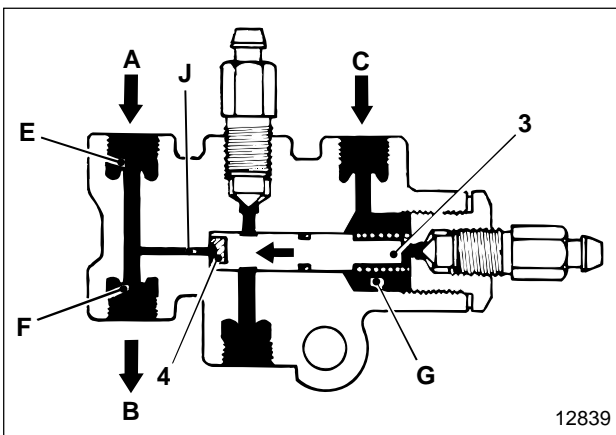
STRUCTURE AND OPERATION

Bypass Valve



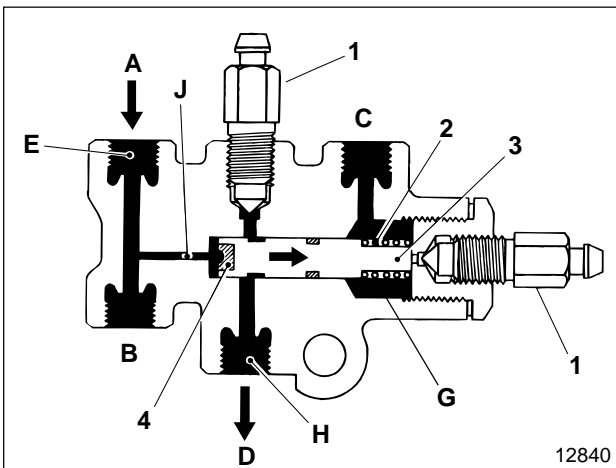
- 1 Bleeder screw
- 2 Spring
- 3 Piston
- 4 Seal

- If any failure occurred in the front brake system that decreased the hydraulic pressure, the decompression effect of the load sensing valve would affect the hydraulic pressure in the rear brake system. This would reduce the braking force of the rear brake system. The bypass valve is fitted to prevent this from happening.
- If the hydraulic pressure in the front brake system decreases, the hydraulic pressure in the rear brake system bypasses the load sensing valve and is fed directly to the rear wheel brake.



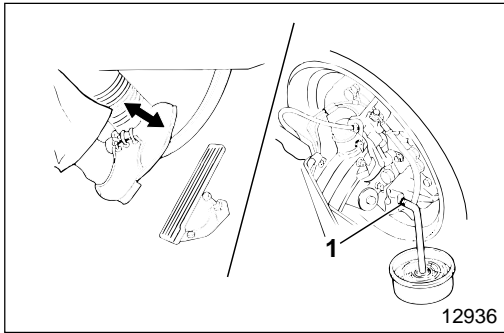
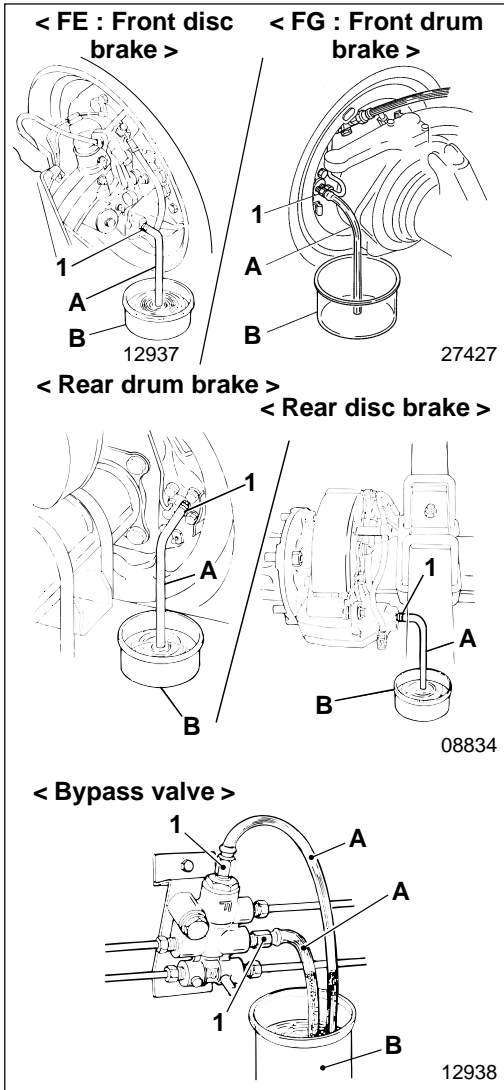
● **When the hydraulic pressure in the front brake system is normal**

- The hydraulic pressure flows through chamber G, pushes piston 3, and cuts off bypass J with seal 4.
- C : From front brake system
- The hydraulic pressure in the rear brake system flows from chamber E into chamber F.
- A : From the rear brake system of the brake master cylinder
- B : To the load sensing valve



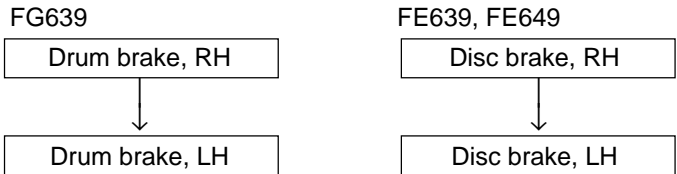
● **When the hydraulic pressure in the front brake system decreases abnormally.**

- The hydraulic pressure in chamber G decreases, reducing the force pushing piston 3.
- C : From the front brake system
- The hydraulic pressure of the rear brake system pushes seal 4, and overcomes the repulsive force of spring 2 to push piston 3, opening bypass passage J.
- The hydraulic pressure of the rear brake system flows from chamber E into chamber H.
- A : From the rear brake system of the brake master cylinder
- D : To the rear wheel brake

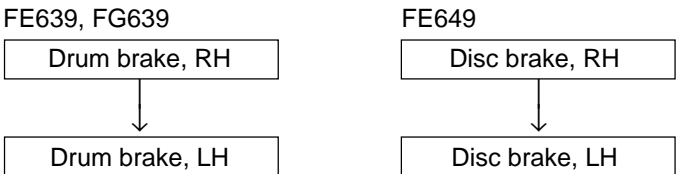


- Start the engine and let it idle until you complete air bleeding of the brake system.
- Connect vinyl pipes **A** : one to the front disc brake < FE >, the front drum brake < FG >, one to the rear drum brake < FE639, FG639 > or the rear disc brake < FE649 >, and two to the bypass valve.
- Put the free ends of vinyl pipes **A** into containers **B** and bleed the brake system as follows:

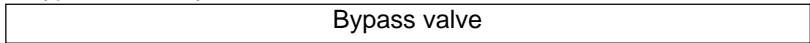
< Front brake system >



< Rear brake system >



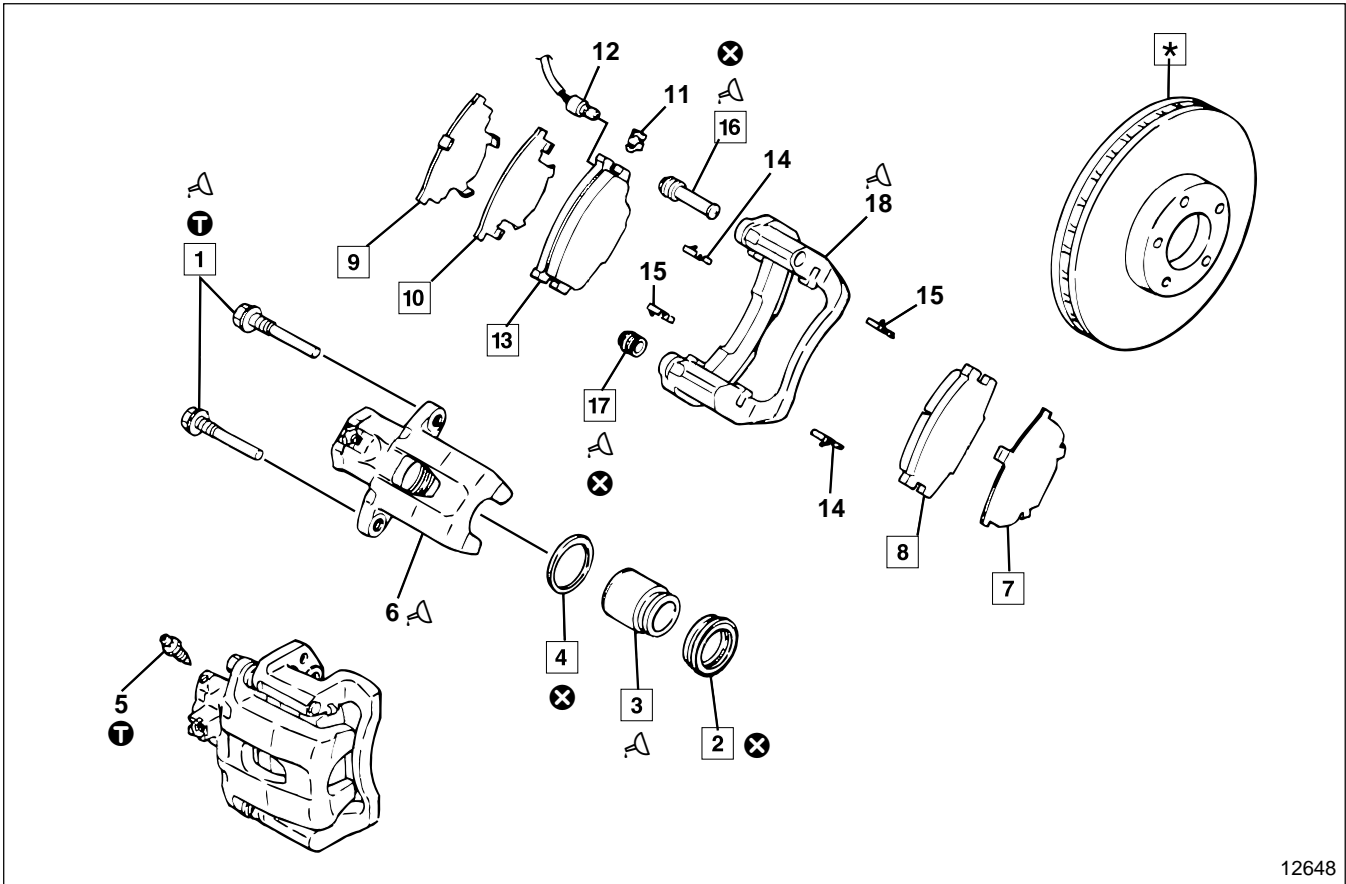
< Bypass valve system >



- Depress the brake pedal slowly several times, and with the brake pedal depressed, loosen air bleeder **1** to discharge air together with the brake fluid. After closing the air bleeder, release the brake pedal.
- Repeat the above operation until air bubbles are no longer present in the brake fluid discharged from air bleeder **1**.
- When the discharged fluid is free of air bubbles, tighten air bleeder **1** at specified torque.
- Make sure that the brake fluid level is at the "MAX" level of the fluid tank, and depress the brake pedal several times to ensure that the brake fluid does not leak from anywhere. Then, conduct a brake test.


FRONT WHEEL BRAKE < FE649 : DISC BRAKE >

This illustration shows the left side wheel disc brake viewed from the left front.



12648

● Disassembly sequence

- | | | |
|-----------------------|-------------------------------------|--|
| 1 Slide pin bolt | 9 Inner shim A | 16 Bushing |
| 2 Piston boot | 10 Inner shim B | 17 Pin boot |
| 3 Piston | 11 Clip (Upper) | 18 Torque member |
| 4 Piston seal | 12 Brake pad wear indicator (Upper) | * : Disc rotor  Gr 26 |
| 5 Air bleeder (Lower) | 13 Inner pad | ⊗ : Non-reusable parts |
| 6 Caliper | 14 Pad liner A | |
| 7 Outer shim | 15 Pad liner B | |
| 8 Outer pad | | |

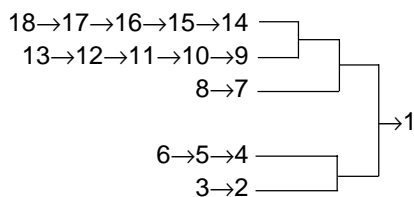
WARNING

Make sure that oil or grease does not stick to the surface of outer pad 8, inner pad 13 or disc rotor * since this will reduce brake effectiveness.

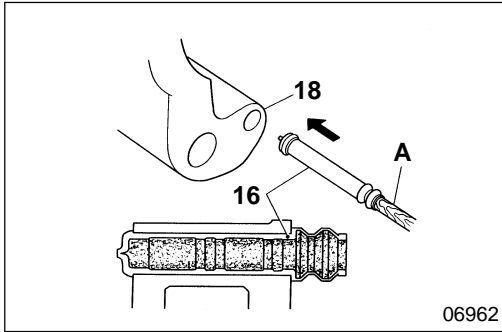
CAUTION

When assembling, use the grease contained in the seal kit.

● Assembly sequence



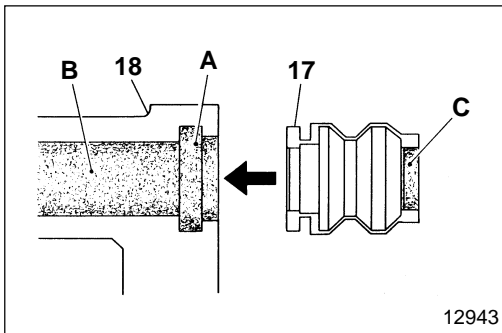
Repair kit : Pad kit
 Seal kit
 Pad wear indicator kit



16 Installation of bushing

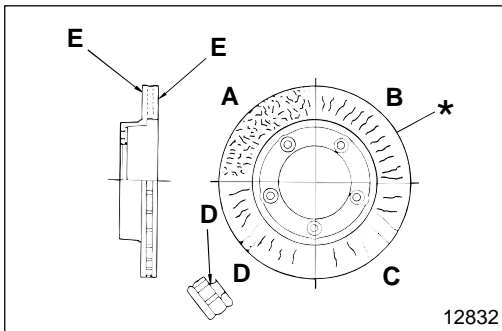
A : Push bar approximately $\varnothing 8$ mm {0.31 in.} long

After installation, apply grease to the whole inner periphery of bushing 16 and its contact surface with slide pin bolt 1.



17 Installation of pin boot

- Apply grease to pin boot groove A of torque member 18, the whole surface of guide hole B, and contact surface C between slide pin bolt 1 and pin boot 17.
- Install pin boot 17.

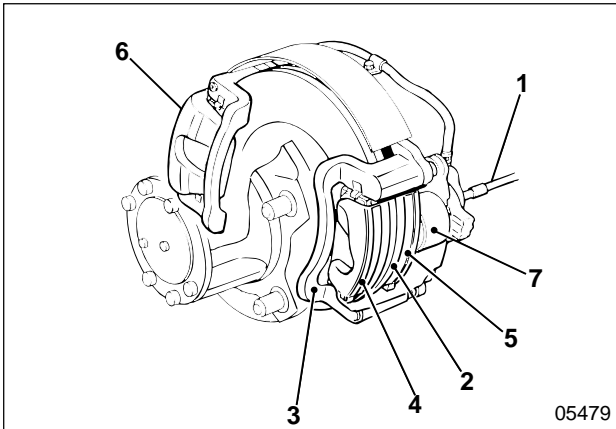


★ Inspection of disc rotor

- Inspect the friction surface E of disc rotor ★ visually.
- If any cracks are found, correct or replace disc rotor ★.
 - A : Net pattern cracks (Correct or replace)
 - B : Radial cracks that do not reach the outer periphery (Correct or replace)
 - C : Radial cracks that have reached the outer periphery (Replace)
 - D : Through cracks (Replace)

STRUCTURE AND OPERATION

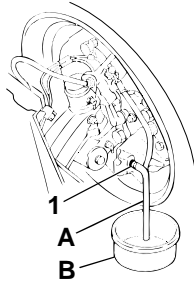
Rear Disc Brake



- 1 Brake pad wear indicator
- 2 Disc rotor
- 3 Torque member
- 4 Outer pad
- 5 Inner pad
- 6 Caliper
- 7 Piston

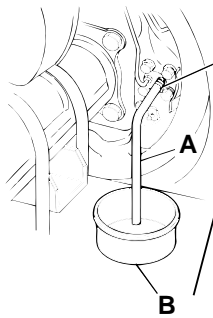
Inner pad **5** is fitted with brake pad wear indicator **1** that gives warning when it is time to replace outer pad **4** and the inner pad.

< Front disc brake >

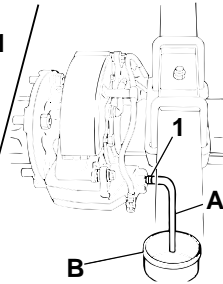


12934

< Rear drum brake >

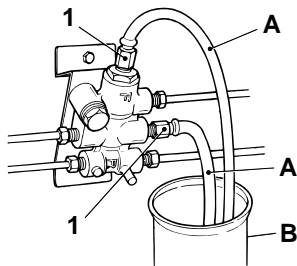


< Rear disc brake >



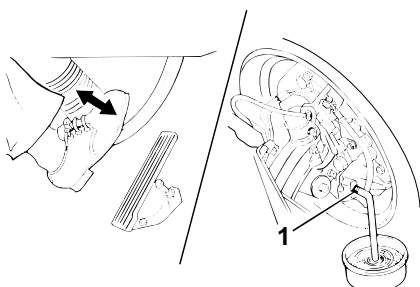
06534

< Bypass valve >



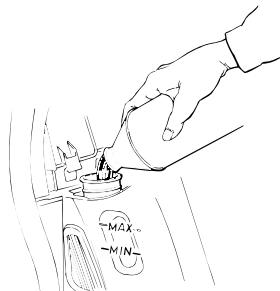
12935

- Start the engine and let it idle until you complete brake fluid replacement.
- Connect vinyl pipes **A** : one to the front disc brake, one to the rear drum brake < FE639 > or the rear disc brake < FE649 >, and two to the bypass valve.
- Put the free ends of vinyl pipes **A** into containers **B**.



12936

- Loosen air bleeders **1** and depress the brake pedal several times to drain brake fluid completely.
- Maintaining a supply of new brake fluid up to the "MAX" level of the fluid tank, depress the brake pedal repeatedly until the old brake fluid of the brake system is replaced with new fluid, and after you complete the work, tighten each air bleeder **1** at specified torque.



07623

- Bleed air from the brake system.

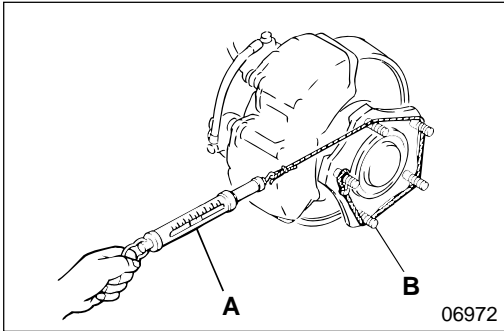
📖 P35-34

FRONT WHEEL BRAKE < FE639 : DISC BRAKE >

◆ Service procedure

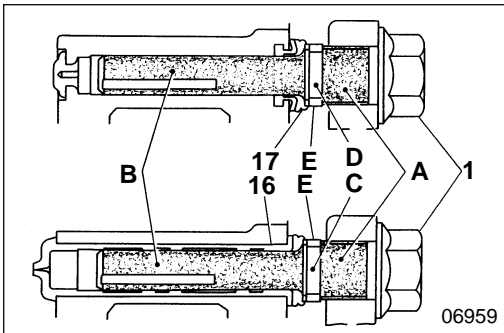
● Measurement of dragging torque

- Fasten spring balance **A** to hub bolt **B** and measure the tangential force.
- If the measured value is the specified value, the torque conforms to the standard value.
- If the measured value deviates from the specified value, inspect the friction surface between piston seal **4** and piston **3**.



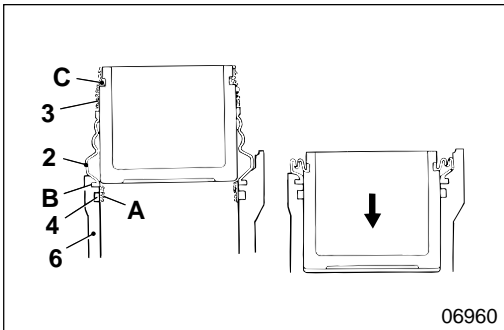
1 Installation of slide pin bolt

- Apply brake fluid to thread area **A** lightly, and apply grease to slide outer periphery **B**, bushing groove **C** or connecting surface **D** of pin boot **17**, then tighten slide pin bolt **1** at specified torque.
- Bleed bushing **16** or pin boot **17**.
- Check that seal **E** of bushing **16** or pin boot **17** is installed in bushing groove **C** of slide pin bolt **1** or connecting surface **D** of the pin boot.



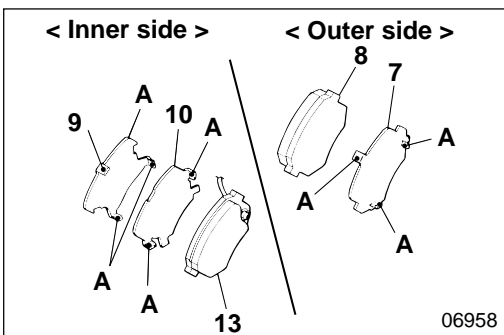
2 to 4 Installation of piston boot, piston and piston seal

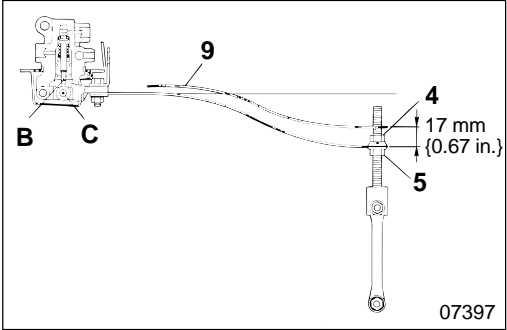
- Apply brake fluid to the periphery of piston **3** to insert piston boot **2**.
- Spread the grease applied to piston seal **4** evenly and install it into the seal groove of caliper **6**.
- Apply grease to cylinder lip area **A** of caliper **6** evenly.
- Install the caliper side seal of piston boot **2** to the boot groove **B** of caliper **6**, then press in piston **3** slowly.
- Make sure that the piston side seal of piston boot **2** is installed in the boot groove **C** of piston **3**.



7 to 10 13 Installation of pad and shim

Make sure that you install the shims with pawls **A** facing the right way.

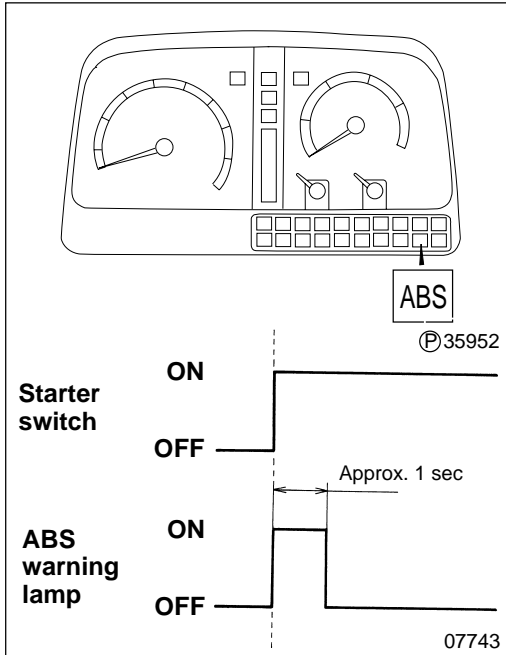




[Adjustment]

- Free leaf spring **9** to lift up the leaf spring and fit plunger **B** to roller **C**.
- In this condition, position nut **5** 17 mm {0.67 in.} below the tip of leaf spring **9**, then tighten nut **4** at specified torque.

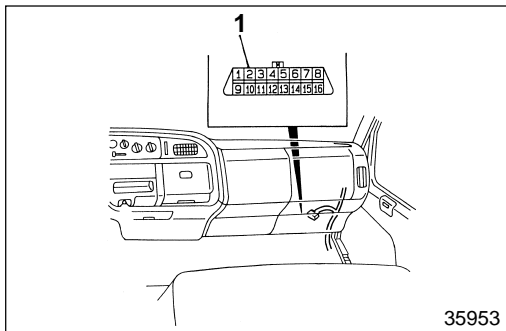
TROUBLESHOOTING



● Inspection of ABS warning lamp

Check the ABS warning lamp to make sure that the following operation turns on the lamp.

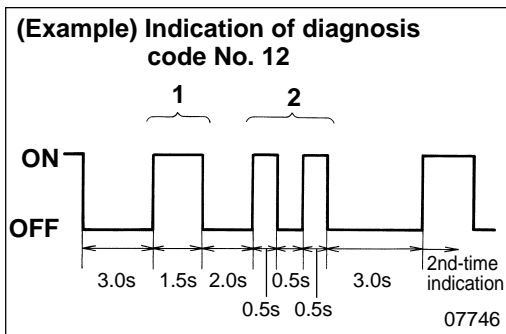
- Set the starter switch to the ON position, and check that the ABS warning lamp lights for about 1 second and turns off.
- If the lamp does not light as described above, check diagnosis codes stored in the ECU.



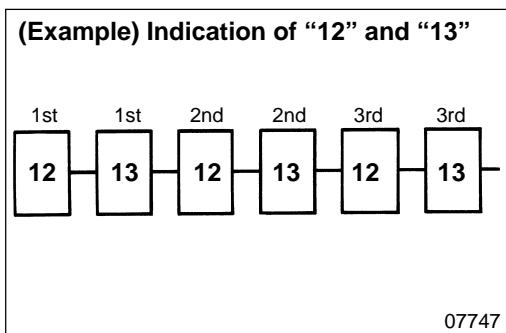
Diagnosis Code Indication

• Without MUT-II

- With the vehicle stationary, ground terminal No. 16 of MUT-II connector 1, then turn the starter switch to the ON position. The ABS warning lamp will flash to indicate a diagnosis code.
- The ABS warning lamp starts flashing 3.0 seconds after the starter switch is turned ON. The flashing pattern of the warning lamp indicates a diagnosis code.



- A diagnosis code is indicated in the following manner.
 - To indicate the tens digit (left digit), the lamp remains ON for 1.5 seconds, then remains OFF for 0.5 seconds. To indicate the ones digit (right digit), the lamp remains ON for 0.5 second, then remains OFF for 0.5 second.
 - For multiple diagnosis codes, each code is indicated one time, in sequence. When there is no other diagnosis code to indicate, the lamp repeats the diagnosis code indication from the beginning for 7 cycles.
 - When there is no diagnosis code stored in the memory (normal condition), the ABS warning lamp repeats On/Off in 0.25-second intervals.
 - When two or more diagnosis codes are stored in the ECU.



MEMO



FE.FG

Service Manual

Group 37
Steering

'98 Minor Change

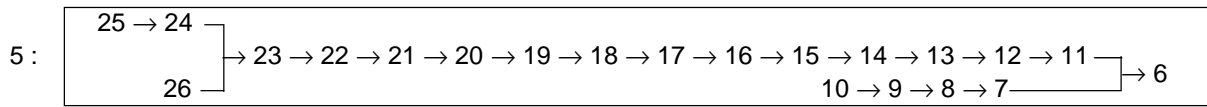
 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

● **Disassembly sequence**

- | | | |
|----------------------------|------------------|------------------------------|
| 1 Return spring | 11 Nut | 21 Lever support |
| 2 Nut | 12 Lock lever | 22 Clevis pin |
| 3 Support bracket | 13 Split pin | 23 Bolt |
| 4 Spring seat | 14 Return spring | 24 Column support upper |
| 5 Steering column assembly | 15 Return spring | 25 Telescopic shaft assembly |
| 6 Nut | 16 Snap ring | 26 Column support lower |
| 7 Stopper | 17 Cam | |
| 8 Bearing spacer | 18 Lock plate | ⊗ : Non-reusable parts |
| 9 Grease nipple | 19 Wave washer | |
| 10 Steering shaft assembly | 20 Bolt | |

● **Assembly sequence**

5 → 4 → 3 → 2 → 1



T **Tightening torque**

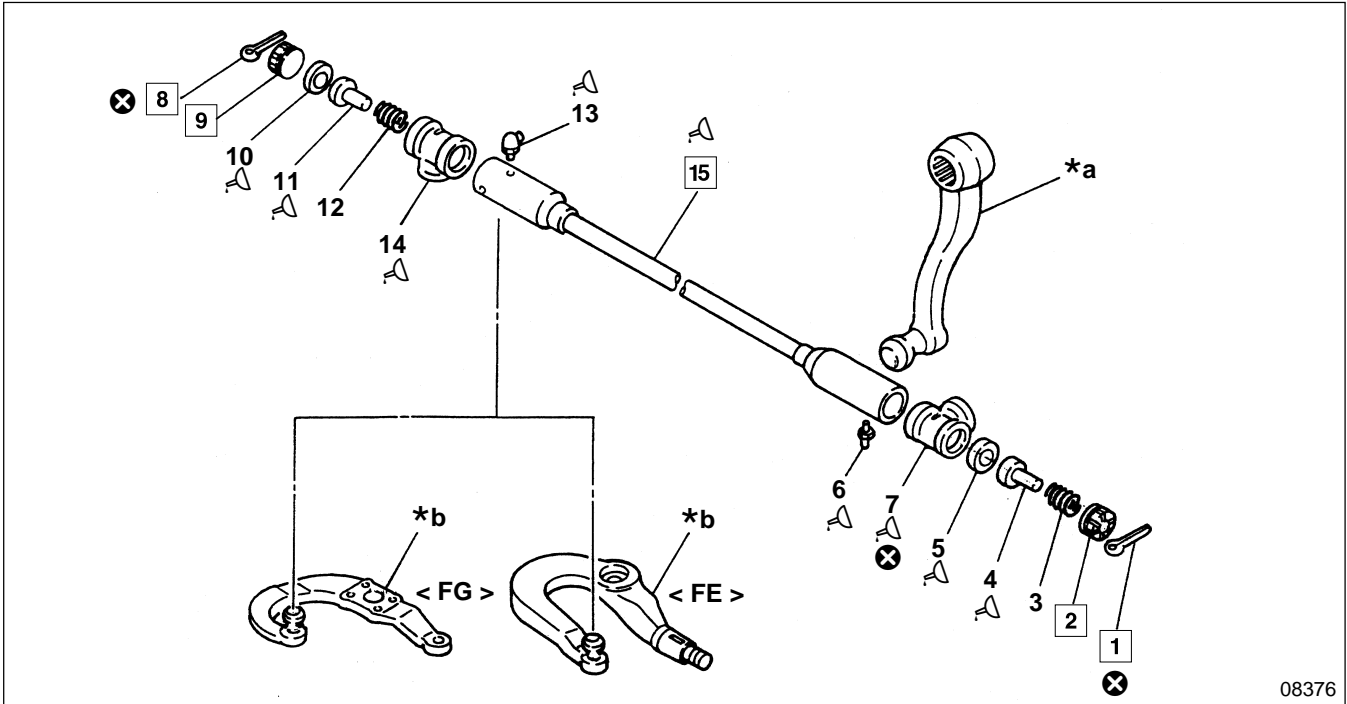
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Support bracket mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
6	Nut (Steering shaft assembly and telescopic shaft assembly mounting)	53 to 65 {39 to 48, 5.4 to 6.6}	—
11	Nut (Lock lever mounting)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—
20	Bolt (Lever support mounting)	7 to 10 {5.1 to 7.2, 0.7 to 1.0}	—
23	Bolt (Column support upper and column support lower mounting)	15 to 20 {11 to 14, 1.5 to 2.0}	—

L **Lubricant and/or sealant**

Location	Points of application	Specified lubricant and/or sealant	Quantity
9	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Friction surface of return spring and washer	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
16	Friction surfaces of lever support and snap ring	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
18	Friction surfaces of cam and lock plate return spring clevis pin	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
23	Thread area of bolt	THREEBOND thread lock super 103Q or LOCTITE 271	As required
	Friction surface of column support upper and bolt	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

DRAG LINK



08376

● Disassembly sequence

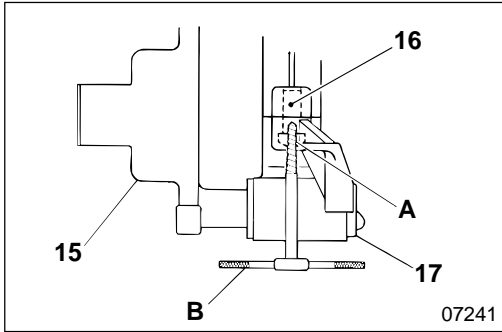
- | | | |
|------------------|-------------------|------------------------|
| 1 Split pin | 9 End plug | *a : Pitman arm |
| 2 End plug | 10 Ball stud seat | P37-24, 30 |
| 3 Spring | 11 Ball stud seat | *b : Knuckle arm |
| 4 Ball stud seat | 12 Spring | < FE > Gr 26 |
| 5 Ball stud seat | 13 Grease nipple | < FG > Gr 26B |
| 6 Grease nipple | 14 Dust cover | ⊗ : Non-reusable parts |
| 7 Dust cover | 15 Drag link | |
| 8 Split pin | | |

● Assembly sequence

Follow the disassembly sequence in reverse.

🔧 Lubricant

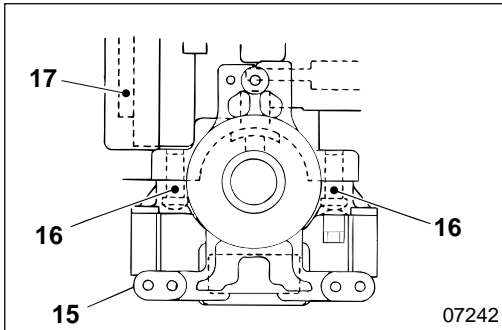
Location	Points of application	Specified lubricant	Quantity
4, 5, 10, 11	Whole area of ball stud seat	Chassis grease [NLGI No.1 (Ca soap)]	As required
6, 13	Supply via grease nipple	Chassis grease [NLGI No.1 (Ca soap)]	As required
7, 14	Arm mounting port of dust cover	Chassis grease [NLGI No.1 (Ca soap)]	As required
15	Pack interior of drag link	Chassis grease [NLGI No.1 (Ca soap)]	As required



16 17 Head cutting bolt, starter switch

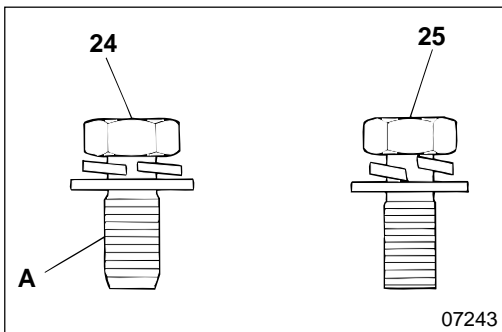
[Removal]

- After removing bracket **15**, drill a $\varnothing 5.5$ to 6.0 mm {0.22 to 0.24 in.} hole 10 to 15 mm {0.39 to 0.59 in.} deep on cutting face **A** of head cutting bolt **16** for mounting starter switch **17**.
- Screw in screw extractor **B** counterclockwise, then pull out head cutting bolt **16**.



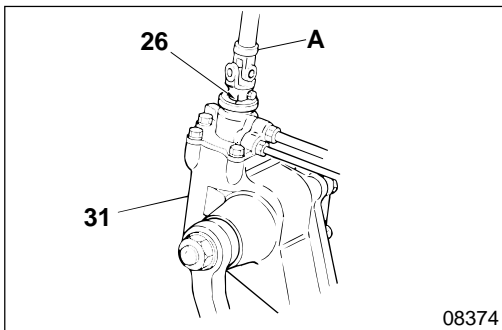
[Installation]

- With new head cutting bolt **16**, tighten starter switch **17** at specified torque to cut the head off the bolt.
- After installing bracket **15**, verify operation of the steering lock function of starter switch **17**.



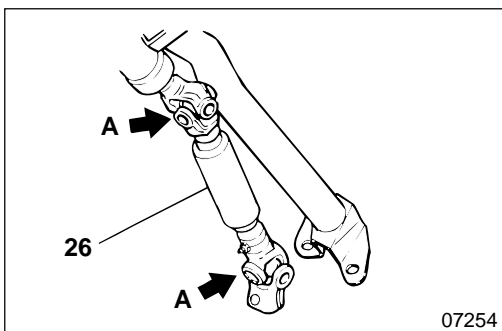
24 25 Installation of bolt

- Bolts **24** and **25**, differ in shape. Do not mix them up when installing.
- Thread area **A** of bolt **24** is elliptical to facilitate grounding of the horn circuit.



26 31 Removal and installation of steering column subassembly and power steering booster

Before removing steering column subassembly **26**, power steering booster **31**, be sure to make alignment mark **A**.



26 Steering column subassembly

When the spline of steering column subassembly **26** is disconnected, align the yokes to the same direction **A**.



FE






Service Manual

Group 41 Frame

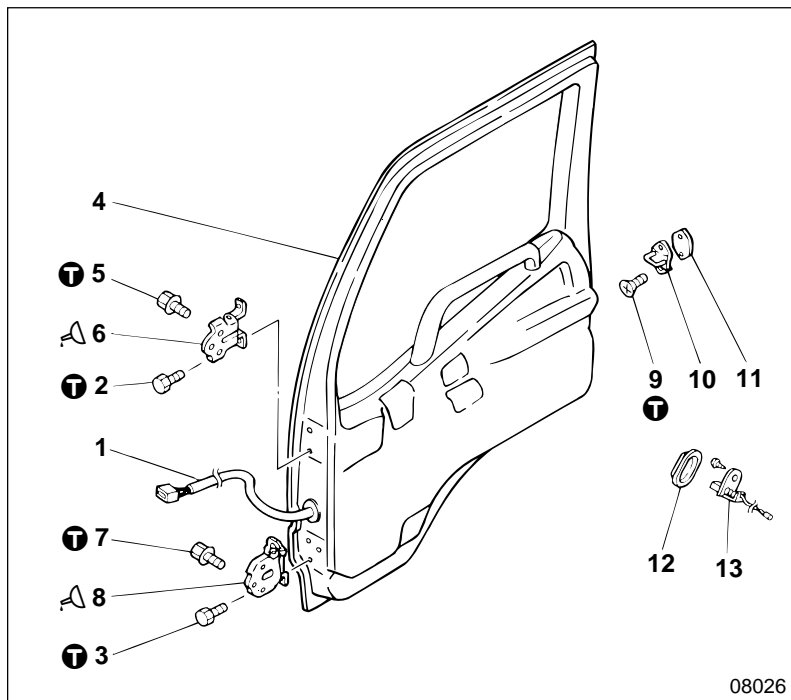
 MITSUBISHI FUSO TRUCK OF AMERICA, Inc.

Pub No. TWSE9501-41

TROUBLESHOOTING

Possible causes		Symptoms						Remarks
		Cab shimmy (pitching and rolling vibration)	Cab or steering wheel high-frequency vibration (above 20 Hz) or noise	Cab cannot be tilted up	Cab cannot be locked to rear mounting post	Cab tilt warning lamp does not light	Cab tilt warning lamp does not go out	
Front axle-related	Axle seat resonance	<input type="radio"/>						 Gr 26
Rear axle-related	Reduction gear engaged incorrectly		<input type="radio"/>					 Gr 27
	Differential gear engaged incorrectly		<input type="radio"/>					
Wheel and tire-related	Wheel and tire run-out excessive	<input type="radio"/>						 Gr 31
	Wheel and tire unbalanced	<input type="radio"/>						
	Size and kinds of tire unequal	<input type="radio"/>						
	Wheel mounting surface warped	<input type="radio"/>						
Front suspension-related	Leaf spring friction between leaves excessive	<input type="radio"/>						 Gr 33
Brake-related	Brake drum unbalanced	<input type="radio"/>						 Gr 35
	Brake drum eccentric	<input type="radio"/>						
	Rotor of disc brake eccentric	<input type="radio"/>						

Door Hinge and Striker



● Disassembly sequence

- 1 Door harness
- 2 Bolt
- 3 Bolt
- 4 Door assembly P42-36
- 5 Bolt
- 6 Upper hinge
- 7 Bolt
- 8 Lower hinge
- 9 Screw
- 10 Striker
- 11 Shim
- 12 Grommet
- 13 Door switch Gr 54

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection and adjustment after assembly

P42-18

NOTE

For adjustment of door fitting: P42-18.

Tightening torque

Unit : N·m {lbf·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2, 3	Bolt (Door assembly mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
5	Bolt (Upper hinge mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
7	Bolt (Lower hinge mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
9	Screw (Striker mounting)	8.8 to 14 {6.5 to 10, 0.9 to 1.4}	—

Lubricant

Location	Points of application	Kinds	Quantity
6	Upper hinge checker pin roller	Chassis grease [NLGI No.1 (Ca soap)]	As required
8	Lower hinge checker pin roller	Chassis grease [NLGI No.1 (Ca soap)]	As required



FG

Service Manual

Group 54
Electrical

'98 Minor Change

 **MITSUBISHI FUSO TRUCK OF AMERICA, Inc.**

GROUP 54 ELECTRICAL

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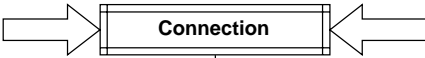
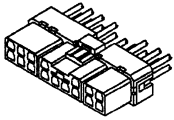
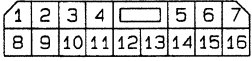
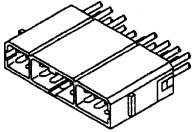
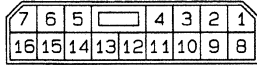
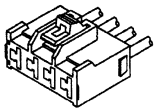
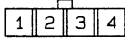
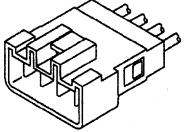
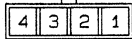
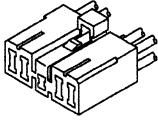
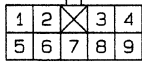
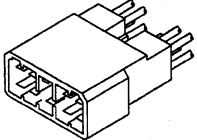
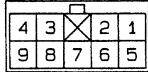
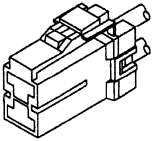

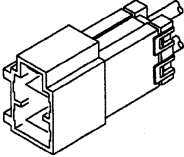

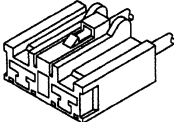

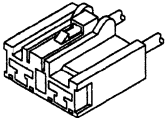

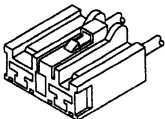

3 LIGHTING

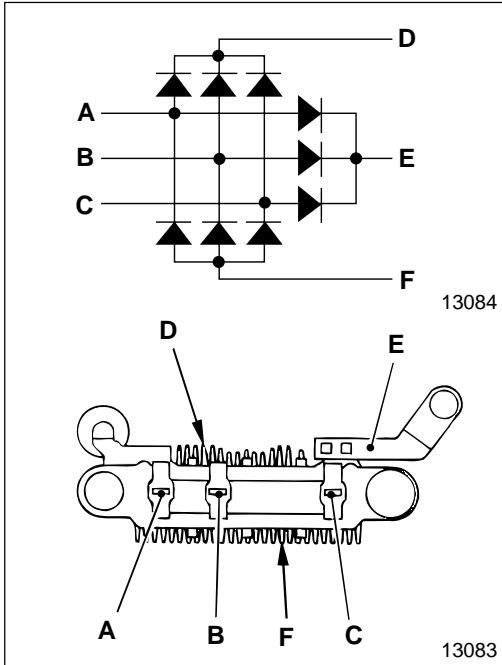
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4 METER

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(425) WATER TEMPERATURE GAUGE CIRCUIT	54-4-16

CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
BG	BG16A	 	 
BH	BH 4 A	 	 
BJ	BJ 9 A	 	 
BL	BL 2 A	 	 
BM	BM 2 A	 	
	BM 2 B	 	
	BM 2 C	 	



16 Inspection of rectifier

- Inspect whether the diode inside rectifier **16** functions properly, and if any fault is found, replace the rectifier.
A, B, C : Lead connecting area of stator coil
D, E : Heat sink area
F : Regulator connecting area
- Inspect the rectifier twice, before and after the \oplus side and \ominus side of the tester have been changed over.

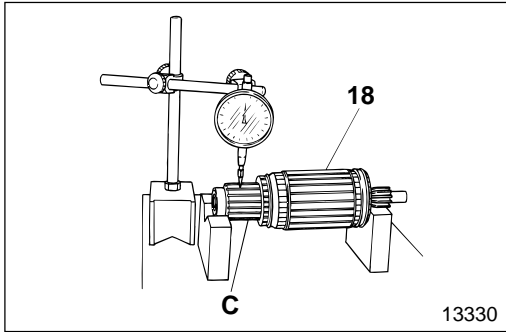
CAUTION

When inspecting using a tester, the current becomes weaker than the usual current flowing through rectifier **16**. Therefore, an incomplete resistance value might be indicated.

Also, this tendency increases as the range of the tester gets smaller. Therefore, use as big a range as possible.

SPECIFICATIONS

Item		Specifications
Starter	Manufacturer	mitsubishi electric
	Reduction gear system	Planetary gear
	Model	M8T55071
	Power V-kW	12-3.0
	Magnetic switch operating voltage V	8 or less
Starter relay	Model	U1X15072
	Voltage rating V-A	12-4
	Magnet closing voltage V	8 or less
	Magnet opening voltage V	3.5 or less
	Allowable cutoff current A	200
Glow plug	Model	Sheathed type
	Voltage-ampereage V-A	11-5.5
Glow relay	Model	U1T06296
	Voltage-ampereage V-A	12-127
	Magnet closing voltage V	8 or less
	Magnet opening voltage V	3.5 or less
	Allowable cutoff current A	200
Fuel-cut motor	Minimum operating voltage V	10 or less
	Operating ampereage A	10 or less

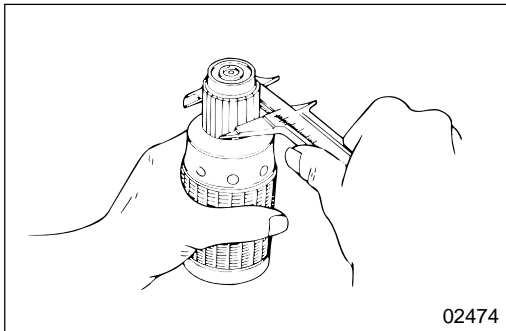


(3) Deflection of commutator

If the measured value is higher than the limit, adjust the outer diameter of commutator **C** within the limit.

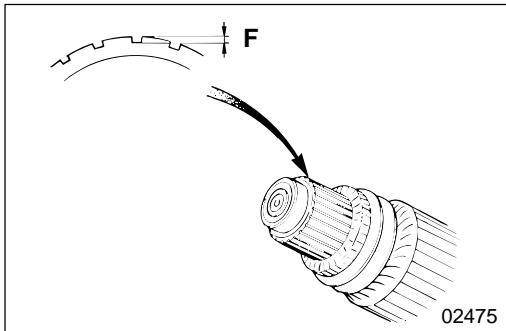
(4) Rough commutator surface

- If the surface is rough or has stepped wear, polish the surface with emery paper (300 to 500 grit).
- After polishing, check deflection of commutator **C**.



(5) Outer diameter of commutator

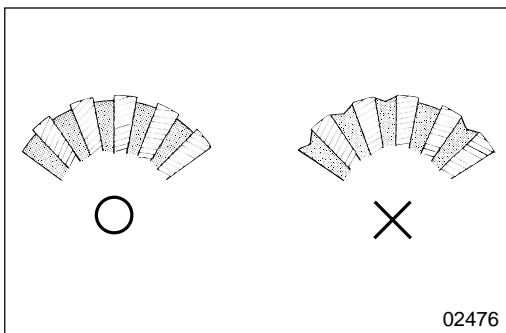
If the measured value is higher than the limit, replace armature assembly **18**.



(6) Mica depth between segments

- If the measured value is lower than the limit, correct or replace armature assembly **18**.

F : Mica depth



- If the mica is worn as illustrated, replace armature assembly **18**.

○ : Good

× : Faulty

220 ENGINE PREHEATING CIRCUIT

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
8	Resistance of glow plug (at ambient temperature)	1.0 Ω (Reference value)	—	Replace

◆ Service procedure

7 Inspection of glow relay

(1) Inspection of fuse

If any fault is found, replace fuse **A** (127 amperes).

(2) Inspection of body

- Follow the table below to inspect continuity :

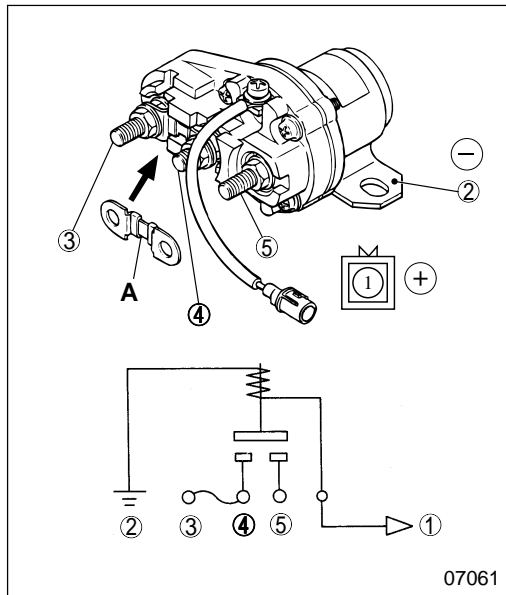
	③	④	⑤	①	②
No current	○—○				
Current	○—○	○—○	○—○	⊕—⊖	⊖—⊕

○—○ : There is continuity between terminals ○ and ○.

⊕—⊖ : Indicates that 12 volts DC is applied to the line between the terminals.

A : Fuse (127 amperes)

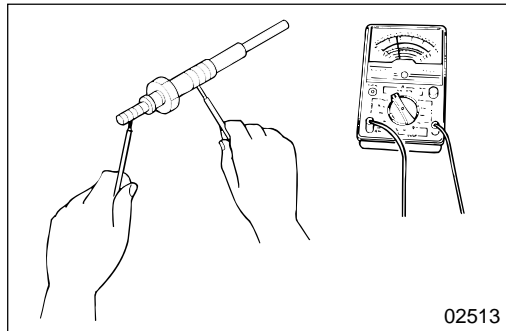
- If any fault is found, replace glow relay **7**.



07061

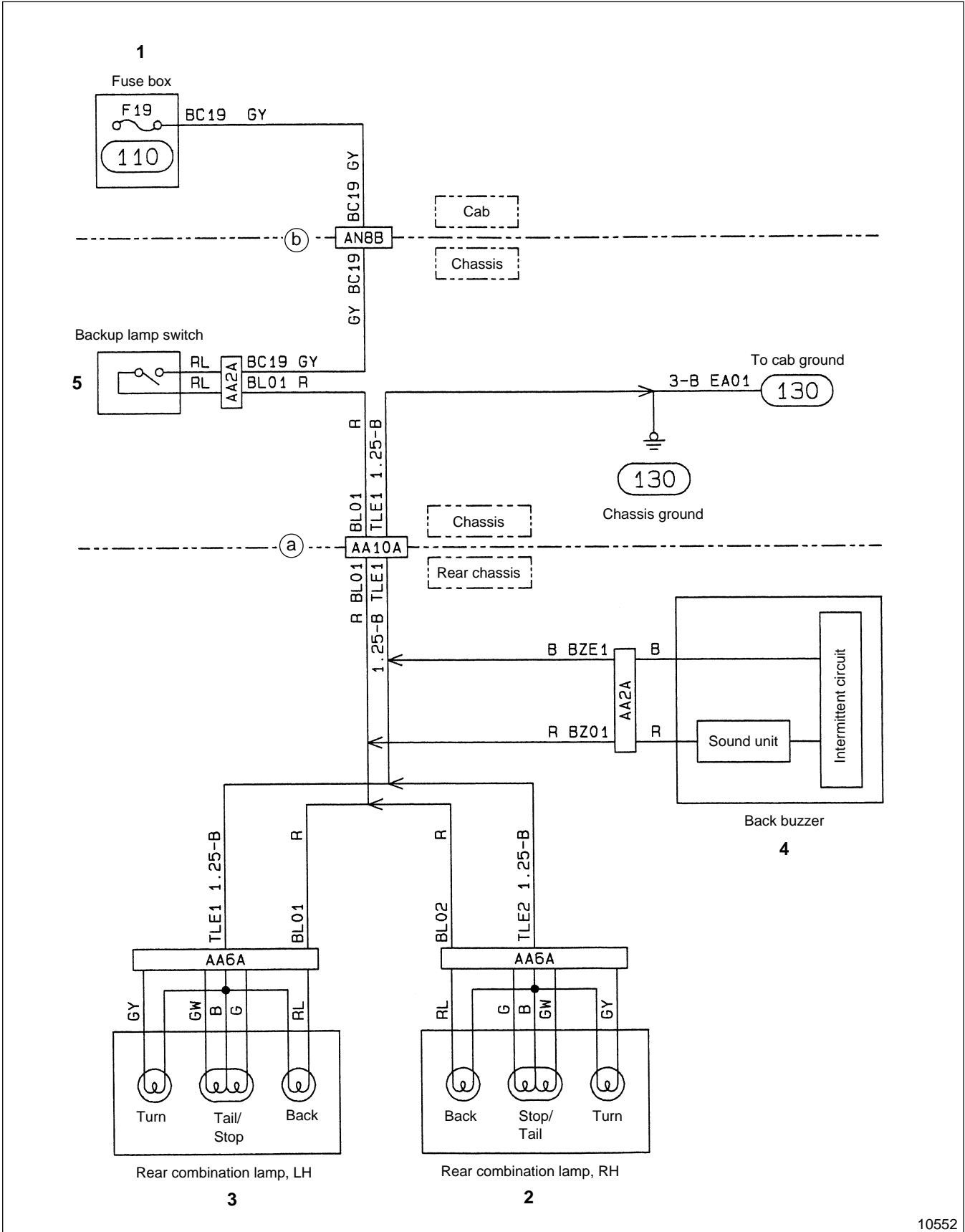
8 Inspection of glow plug

- Measure the resistance of glow plug **8** as illustrated.
- If the measured value deviates from the standard value, replace glow plug **8**.



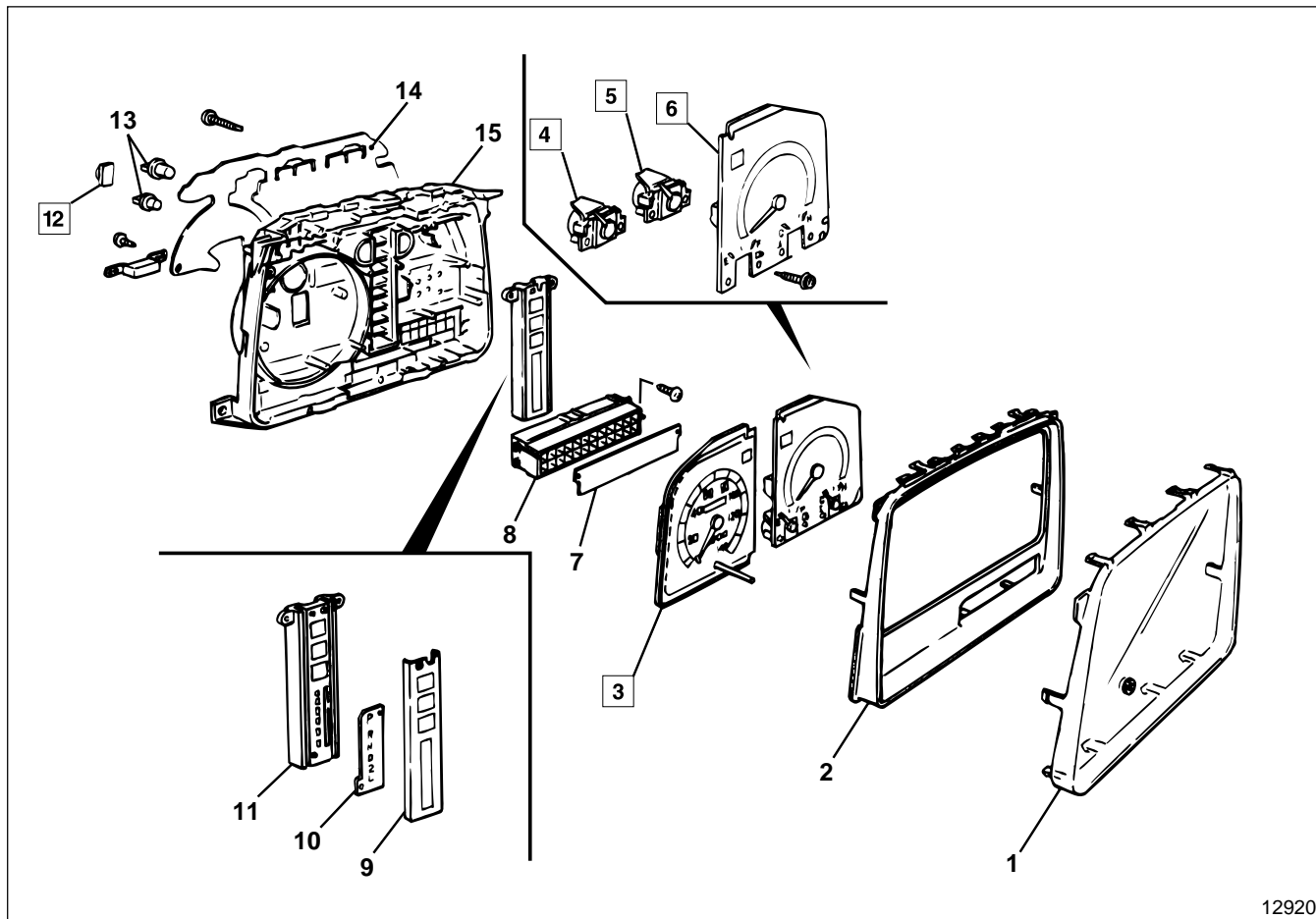
02513

340 BACKUP LAMP CIRCUIT < Manual Transmission >



10552

401 METER CLUSTER




12920

● Disassembly sequence

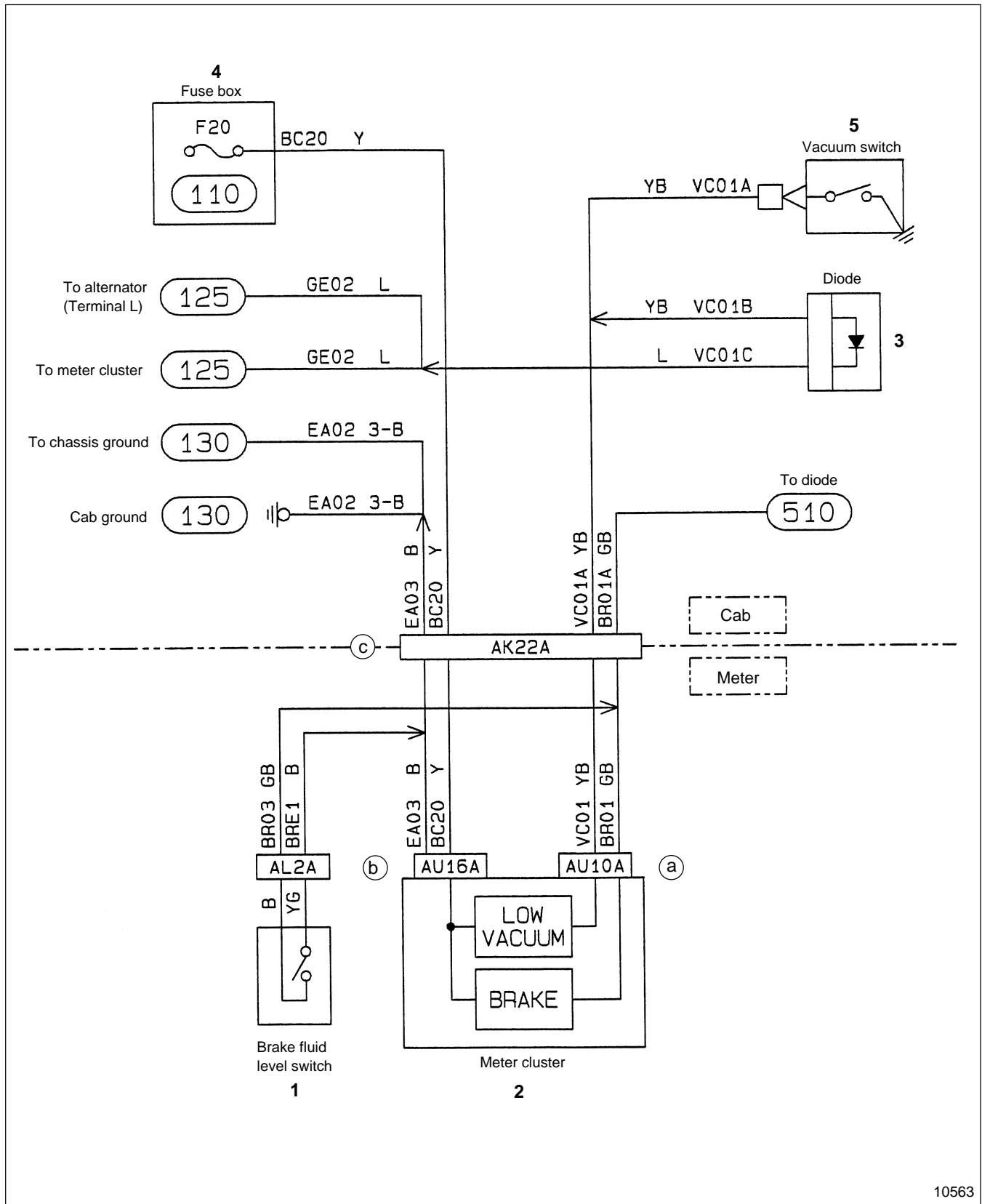
- | | |
|---------------------------|---|
| 1 Meter glass | 9 Plate cover |
| 2 Window plate | 10 Indicator plate < Automatic transmission > |
| 3 Speedometer | 11 Indicator case |
| 4 Fuel gauge | 12 Meter warning buzzer |
| 5 Water temperature gauge | 13 Bulb |
| 6 Tachometer | 14 Printed board |
| 7 Indicator plate | 15 Meter case |
| 8 Indicator case | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Removal and installation of meter cluster  Gr 42

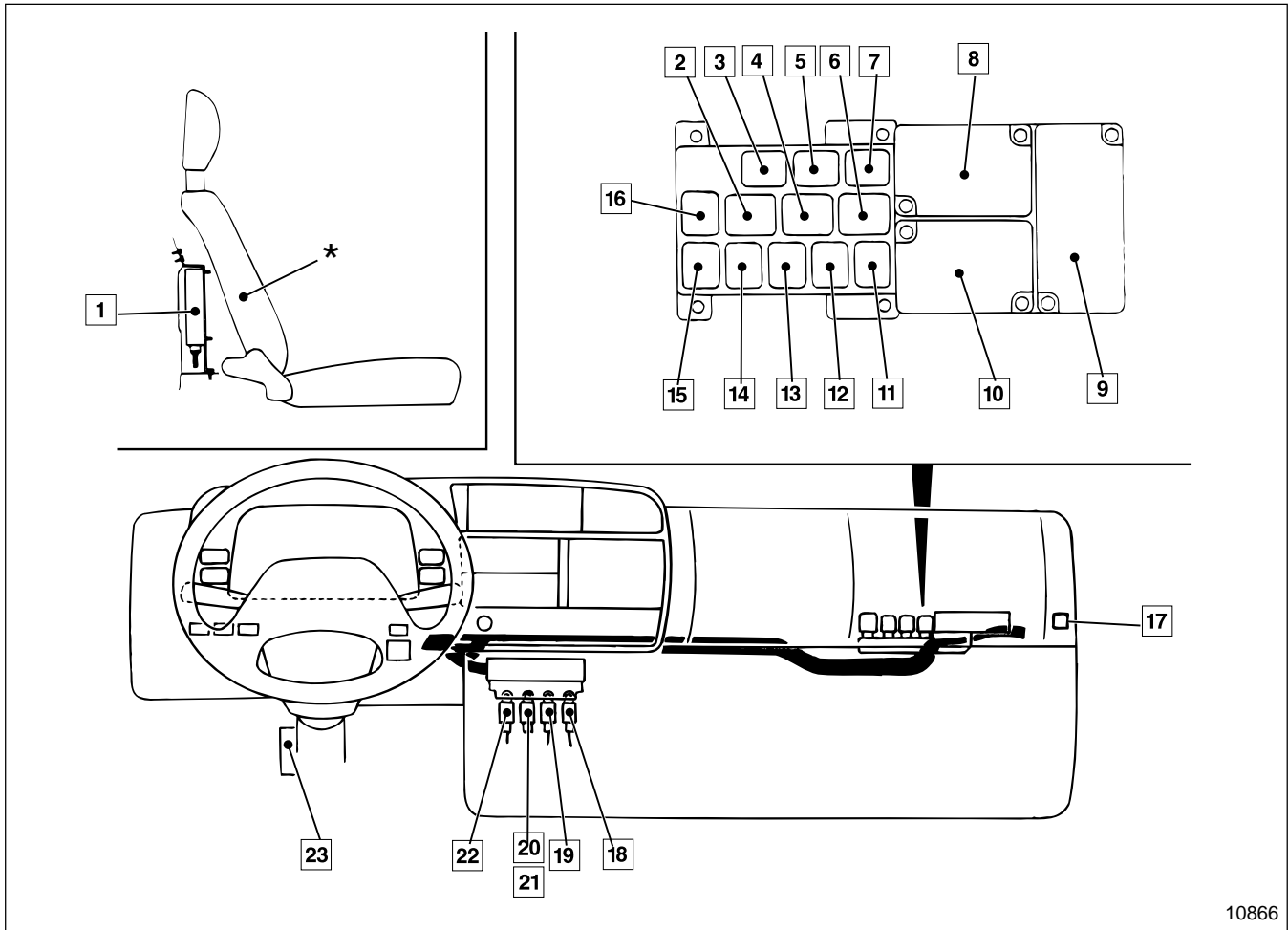
515 BRAKE WARNING CIRCUIT





10563

604 RELAY AND CONTROL UNIT

Installation Position

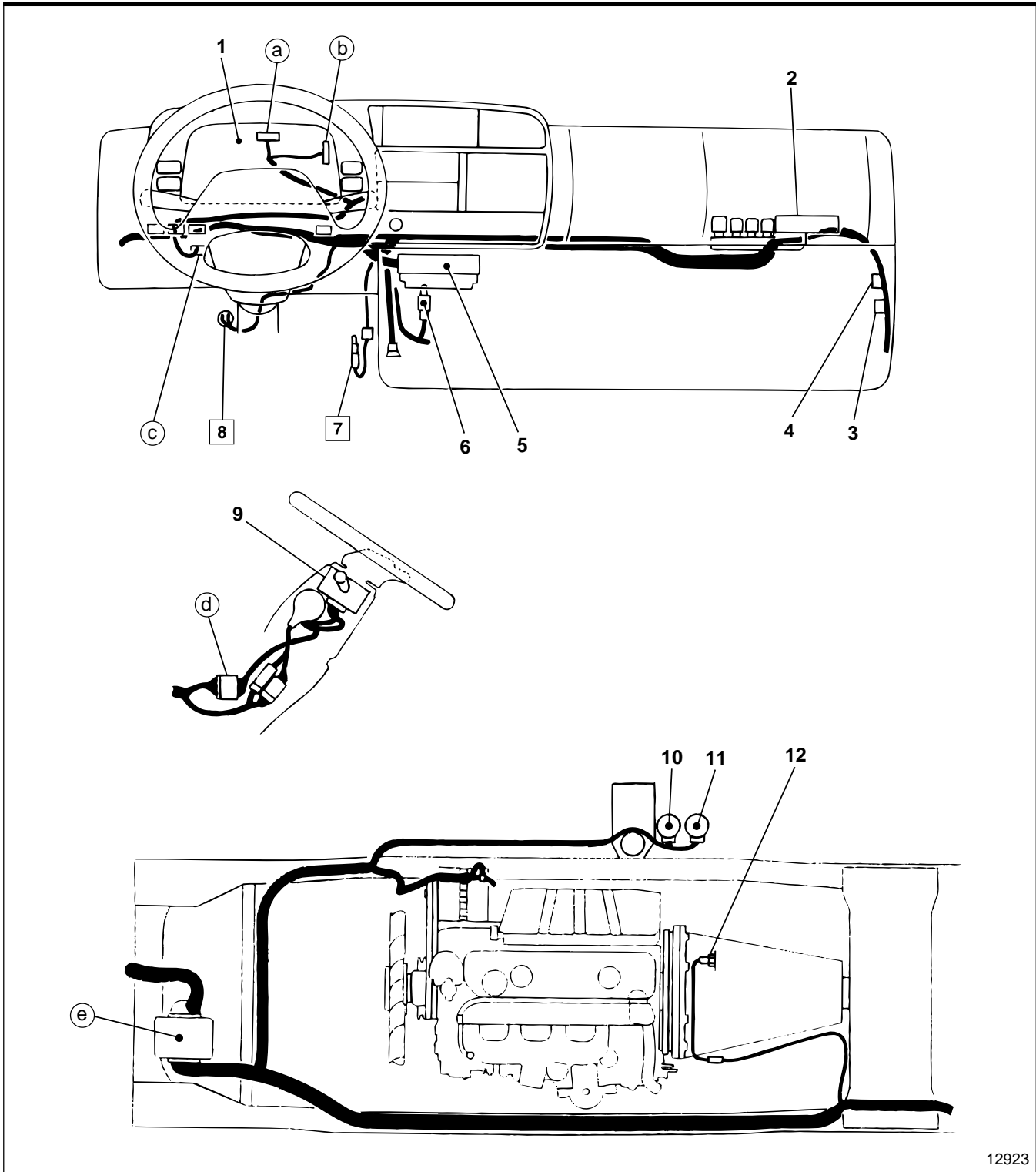


10866

- | | |
|--|---|
| <ul style="list-style-type: none"> 1 Pre-stroke control unit  Gr 13 2 Wiper relay (LOW) 3 Exhaust brake cut relay
< Automatic transmission > 4 Wiper relay (HIGH) 5 Overheating relay 6 Engine oil level relay 7 Pre-stroke cut relay 8 Flasher unit 9 Multipurpose timing control unit 10 Lighting and alarm control unit 11 Sub-starter relay 12 Thermostat relay 13 Tail lamp relay | <ul style="list-style-type: none"> 14 Headlamp relay (HIGH) 15 Headlamp relay (LOW) 16 Blower fan relay 17 Turn signal lamp relay 18 Van body dome light relay 19 Fuel-cut relay 20 Automatic transmission fluid cooler fan relay
< Automatic transmission > 21 Exhaust brake cut relay (Time lag relay)
< Manual transmission > 22 Transmission neutral relay
< Manual transmission > 23 Automatic transmission control unit  Gr 23 |
|--|---|
- *: Passenger's seat

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
21	Exhaust brake cut relay time lag (Time lag relay)	10±3.5 sec.	—	Replace



12923

- | | | | |
|---|---------|--|---------|
| 1 Meter cluster | 📖 (401) | 7 Accelerator switch | |
| 2 Relay box | 📖 (604) | 8 Clutch switch | |
| 3 Intake shutter connector | | 9 Combination switch | 📖 (601) |
| 4 Diode | | 10 Intake shutter 3-way magnetic valve | 📖 (701) |
| 5 Fuse box | 📖 (104) | 11 Exhaust brake 3-way magnetic valve | 📖 (701) |
| 6 Exhaust brake cut relay
(Time lag relay) | 📖 (604) | 12 Transmission neutral switch | 📖 (802) |

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