



FH

Service Manual

Group 00

General

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

GROUP 00 GENERAL

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MODEL CODING SYSTEM

Equipment Model Code

Equipment name	Model description	Code description
Engine	6 D 3 4 - 0 A T2	With turbocharger Stands for automobile Remodeling sequence Version number Series number Stands for diesel engine No. of cylinders (6 : Six cylinders) These are omitted in the Service Manual
Clutch	C 5 M 33	Disc outer diameter Facing material (M : Cera-metallic) Loading capacity of major type (tonnage) Stands for clutch
Transmission	M 050 S 5	No. of forward speeds Meshing (S : Synchromesh, A : Automatic) Loading capacity of major type (tonnage) Stands for transmission
Propeller shaft	P 4	Loading capacity of major type (tonnage) Stands for propeller shaft
Reduction and differential	D 040 H	Teeth shape (H : hypoid gear) Loading capacity of major type (tonnage) Stands for reduction and differential

POWER TRAIN TABLE/CHASSIS NUMBER AND ENGINE NUMBER

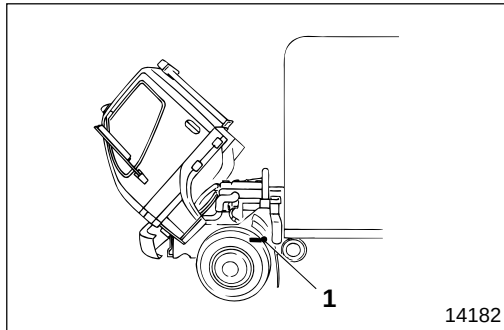
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POWER TRAIN TABLE

Model	Engine model	Clutch model	Transmission model	Propeller shaft	Rear axle model	Final reduction and gear ratio
FH211C, E, G, H, J G.V.W. 8160 kg {17995 lb}	6D34T2 175 HP/2900 rpm 325 lbf.ft/2000 rpm (SAE, Gross)	C5M33 Torque converter (TC290-1.72)	M050S5 6.875/1.000 M4A4 (Allison) AT542 3.454/1.000	P4	R040T	D040H 4.111

CHASSIS NUMBER AND ENGINE NUMBER

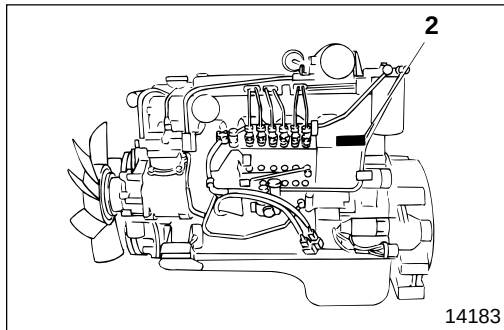
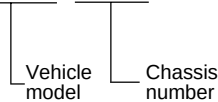
The serial numbers for chassis and engines are assigned to the respective vehicles and engines in manufacturing sequence: every vehicle and engine has its own numbers. These numbers are required for registration and incidental inspection of the vehicle. Please do not fail to mention these numbers to the dealers when ordering spare parts.



Chassis number

Chassis number 1 is punch-marked on the frame by the left-side front wheel.

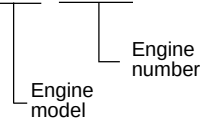
Example : FH211C-□□□□□□



Engine number

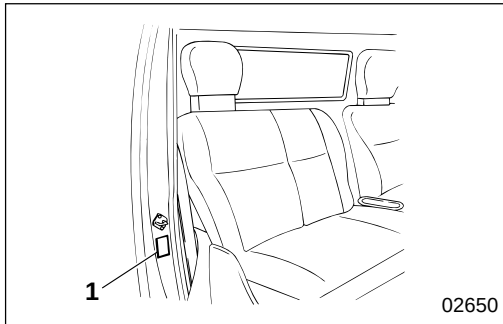
Engine number 2 is punch-marked on the left of the crankcase.

Example : 6D34-□□□□□□



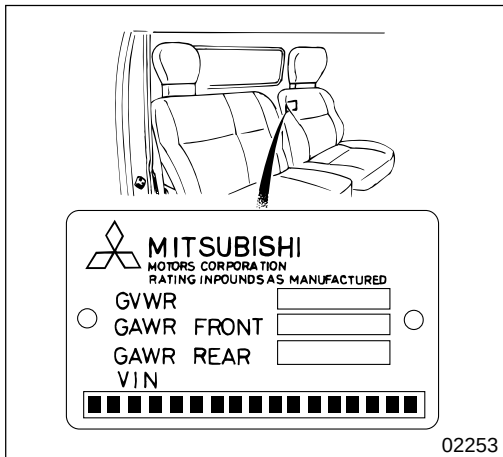
POWER TRAIN LABEL/VEHICLE IDENTIFICATION NUMBER

POWER TRAIN LABEL



Power train label **1** located in the position illustrated indicates the vehicle model, chassis number and information relevant to the vehicle's power transmission components.

VEHICLE IDENTIFICATION NUMBER



The vehicle identification number is punch-marked on the plate, which is attached in the position as illustrated.

The vehicle identification number consists of a 17-digit set of alphanumeric characters. Each digit represents the following specifications.

J W 6 C C C 1 G □ T L □ □ □ □ □ □

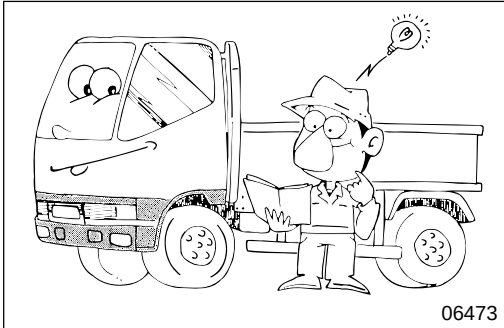
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

- | | |
|-------------------------------------|--|
| ① Country | J : Japan |
| ② Make | W : Mitsubishi Fuso |
| ③ Vehicle type | 6 : Incomplete Vehicle |
| ④ Gross vehicle weight/Brake system | C : 7258 to 8845 kg {16001 to 19500 lbs} /Air over hydraulic |
| ⑤ Line | C : FH211 |
| ⑥ Series (Wheelbase) | C : 2.6 to 2.9 m {8.6 to 9.5 ft.} |
| | E : 3.2 to 3.5 m {10.5 to 11.5 ft.} |
| | G : 3.8 to 4.1 m {12.5 to 13.4 ft.} |
| | H : 4.1 to 4.4 m {13.5 to 14.4 ft.} |
| | J : 4.4 to 4.7 m {14.5 to 15.4 ft.} |
| ⑦ Cab chassis type | 1 : Chassis cab |
| ⑧ Engine | G : 358 CID Diesel turbocharged and charge air cooled |
| ⑨ Check digit | |
| ⑩ Model year | T : 1996 |
| ⑪ Plant | L : Kawasaki-2 |
| ⑫ Plant sequential number | |

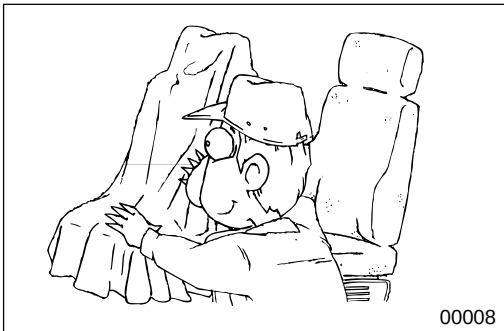
MEMO

PRECAUTIONS FOR MAINTENANCE OPERATION

In order to determine the condition of the vehicle adequately, attend the vehicle beforehand to find and keep record of the accumulated mileage, operating condition, what the customer's demand is, and other information that may be necessary. Prepare the steps to be taken and perform efficient and wasteless maintenance procedure.



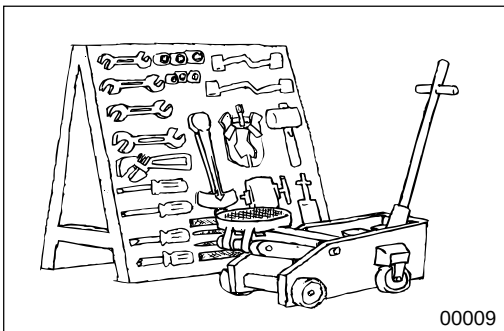
Determine where the fault exists and check for the cause to see whether removal or disassembly of the part is necessary. Then follow the procedure specified by this manual.



Perform maintenance work at a level area.

Prepare the following.

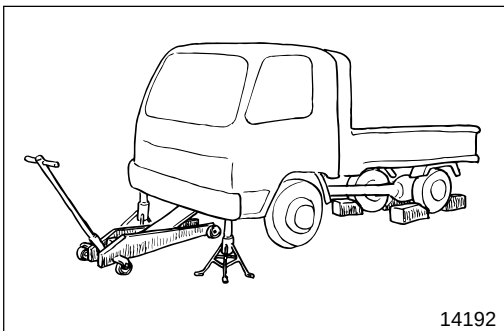
- To prevent the seats, upholstery, floor and bodywork from being spoiled or scratched, cover with workshop sheet cover(s).



- Prepare general and special tools necessary for the maintenance work.

WARNING ⚠

Do not attempt to use tools other than special tools where use of special tools is specified in this manual. This will avoid injury or damage.

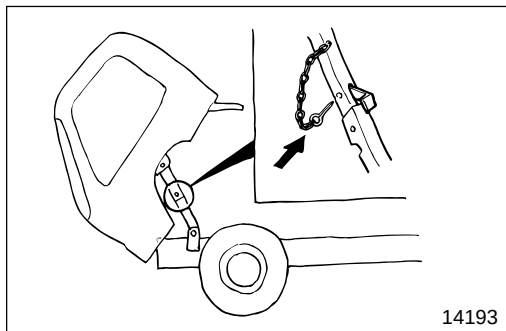


When jacking up the vehicle to work under the vehicle, carry out the following preparatory work:

- Chock the wheels on both sides.
- Jack up the vehicle using a garage jack.
- Support the frame on rigid racks.

WARNING ⚠

- **Chock the wheels securely so the vehicle does not move.**
 - **Do not remove the chocks until the entire operation is completed.**
 - **Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.**
 - **Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.**
-

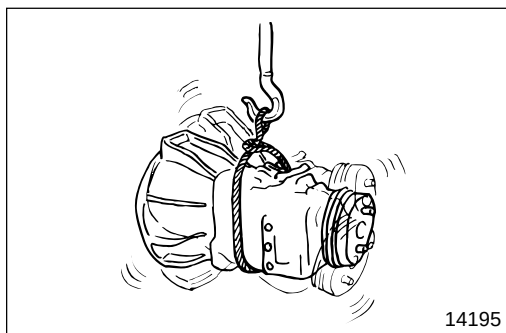
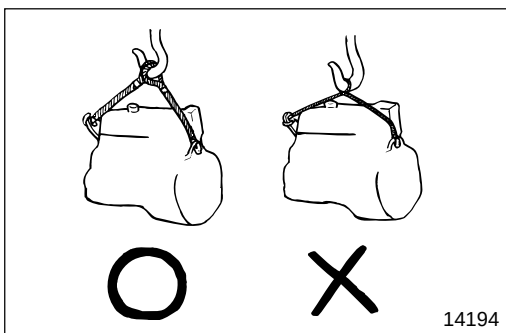


When tilting the cab, be sure to insert the safety pin into the cab stay so that the cab stay remains locked and is not released when the cab is tilted.

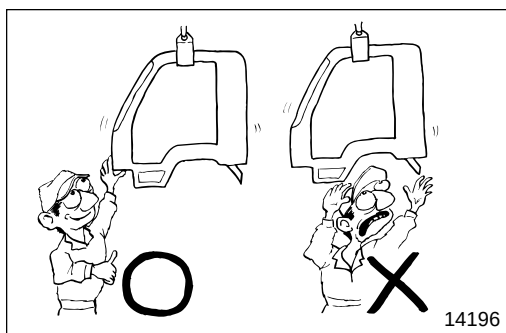
Pay special attention to safety when removing or installing heavy items such as engines, transmissions and axles.

When lifting up heavy items using cables, pay special attention to the following points:

- Check the mass of the item to be lifted and use a cable capable of lifting that mass.



- If you do not have the specified lifting hanger, secure the item using cable taking the point-of-balance of the item into consideration.

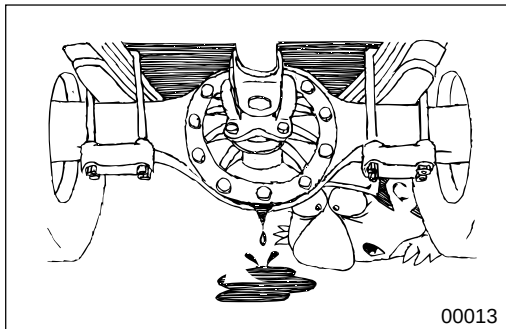


- You must work in a position where you will not be injured even if the cable comes undone and the lifted item falls.

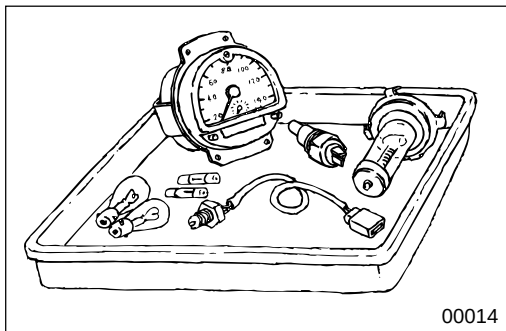
PRECAUTIONS FOR MAINTENANCE OPERATION



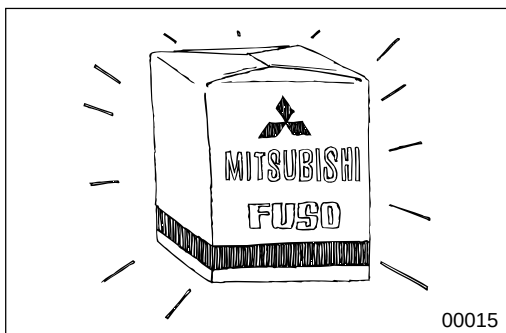
Be particularly careful not to work in shoes that have oily soles and are slippery. When working as a team of two or more, arrange signals in advance and keep confirming safety. Be careful not to accidentally bump switches or levers.



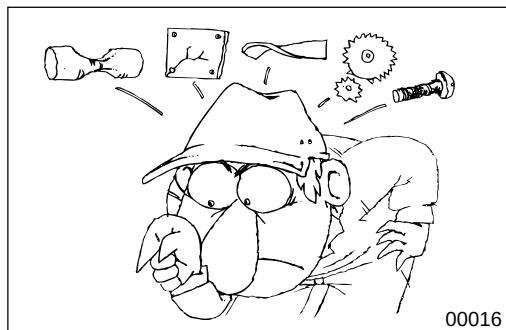
Check for oil leakage before cleaning the area having the fault otherwise you might miss detecting the leakage.



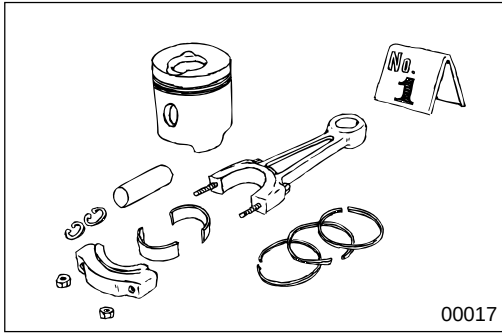
Prepare replacement part(s) beforehand.



Replace oil seals, packing, O-rings and other rubber parts; gaskets and split pins with new parts whenever any of them has been removed. Use only genuine MITSUBISHI replacement parts.



On disassembly, visually inspect all parts for wear and tear, cracks, damage, deformation, degradation, rust, corrosion, smoothness in rotation, fatigue, clogging and any other possible defect.



00017

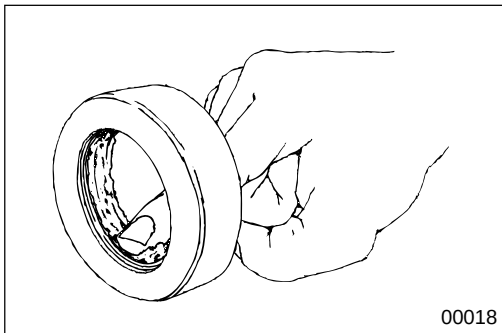
Put alignment marks on part combinations before disassembly and arrange the disassembled parts neatly. This will help avoid mismatching of the parts later.

Put the alignment marks, punch marks, etc. where performance and appearance will not be affected.

Cover the area left open after removal of parts to keep it free from dust.

CAUTION ⚠

- Take care to avoid mixing up numerous parts, similar parts, left and right, etc.
- Keep new parts for replacement and original (removed) parts separate.



00018

Apply the specified oil or grease to U-packings, oil seals, dust seals and bearings during assembly.

Use only the specified oil, grease, etc. for lubricant, remove the excess immediately after application with a piece of waste, etc.

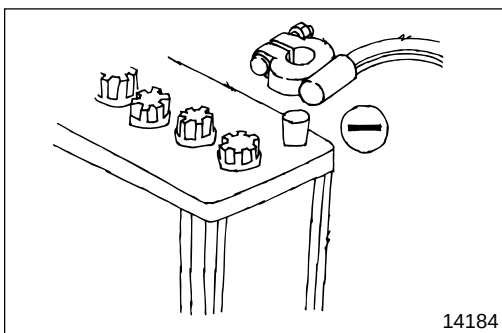
CAUTION ⚠

When the specified lubricant, fluid and sealant is not available, you may use an equivalent.



00019

Wear goggles when using a grinder or welder. Pay full attention to safety by wearing gloves when necessary. Watch out for sharp edges, etc. that might injure your hands or fingers.



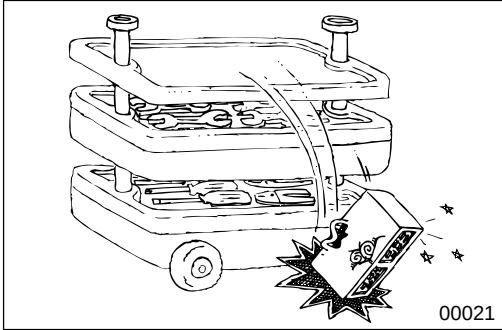
14184

Before carrying out maintenance work on the electric system, disconnect the negative terminals of the batteries to prevent them from short-circuiting and burning-out.

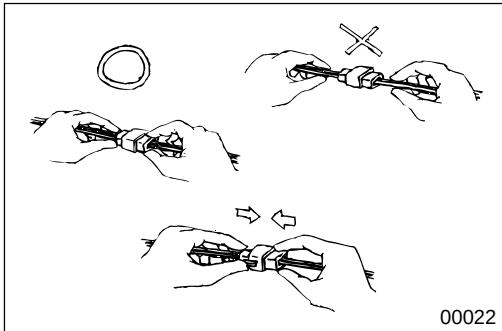
CAUTION ⚠

Be sure to turn starter and lighting switches, etc. off before disconnecting or connecting battery terminals, because the semi-conductors can be damaged.

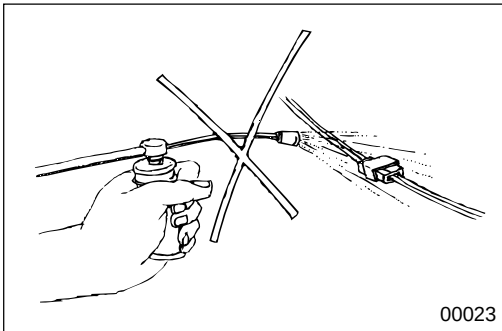
PRECAUTIONS FOR MAINTENANCE OPERATION



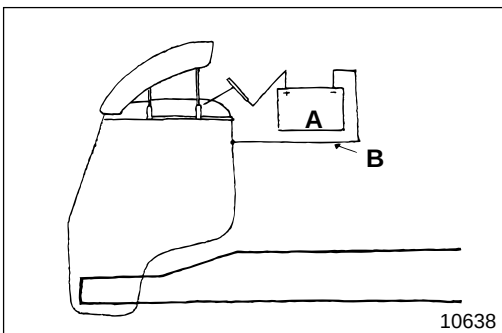
Take care when handling sensors, relays, etc. which are vulnerable to shock and heat. Do not attempt to remove the cover from, or apply paint to, the electronic control unit.



Pull the connector, and not the harness lead, to separate connectors. To separate a lock-type connector, first push toward arrow mark. To reconnect a lock-type connector, press the separated parts until they click together.



When washing the vehicle, cover the electric system parts and instruments with waterproof material beforehand (Cover with vinyl sheet or the like). Keep water away from harness wire connectors and sensors. If any of them should get wet, wipe them off immediately.

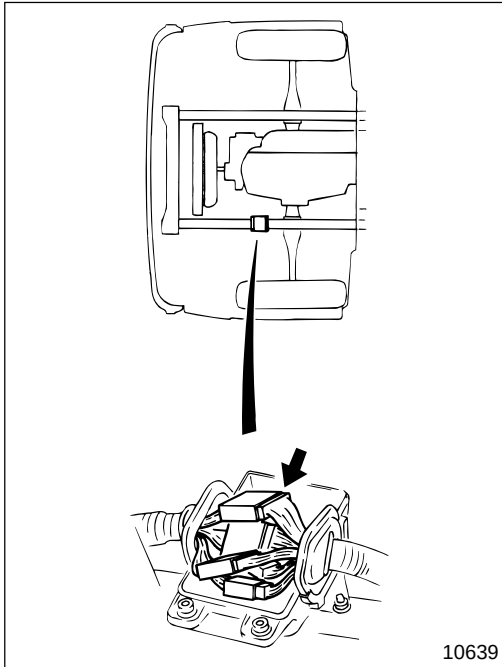


When using an electric welder, such electronic parts that are directly connected to the batteries might be damaged due to the flow of current from the welder that flows through the negative circuit. Parts that have switches might be subject to the same danger if the switches are left on. Therefore, do not fail to observe the following.

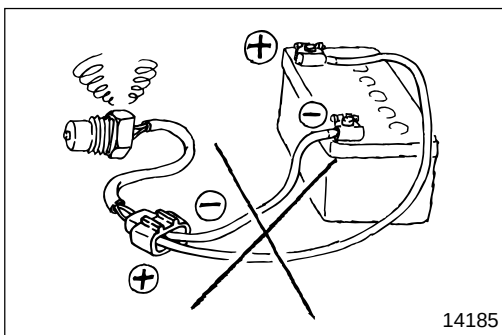
A : Welder

B : Connect the negative terminal of the welder as near as possible to

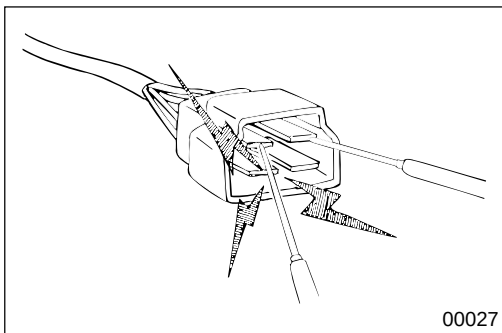
the area that is to be welded.



- Disconnect the negative terminals of batteries.
- Disconnect connections between the cab harness wires and the chassis harness wires.

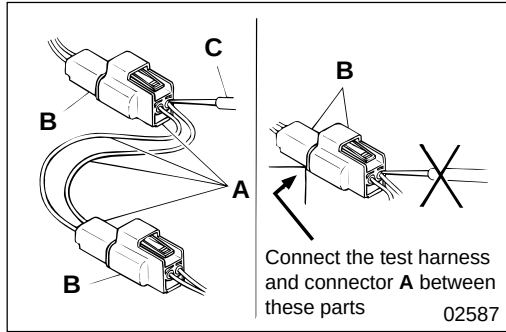


To apply voltage for testing, check that the positive and negative cables are connected properly, then increase voltage gradually from 0 volt. Do not apply voltage higher than the specified value. In particular, pay close attention to the electronic control unit and sensors, since they are not always fed the battery voltage.



When using testers or the like for continuity tests, be careful not to allow test probes to touch the wrong terminals.

PRECAUTIONS FOR MAINTENANCE OPERATION



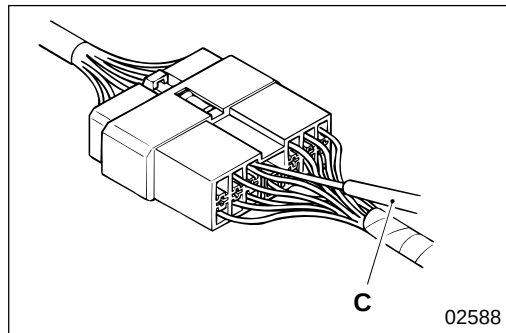
Measurement procedures using connectors

- **Test with connectors engaged (continuity through circuit obtained)**

< Waterproof connector >

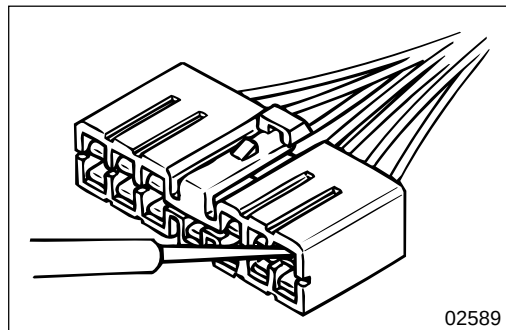
Prepare a test harness and connectors **A**, then connect it between the two parts of harness **B** that is to be tested. Check the circuit by touching test probe **C** to the test connector.

Never insert the test probe from the harness side of the waterproof connection, or waterproof performance might be diminished causing corrosion of the connector.



< Non-waterproof connector >

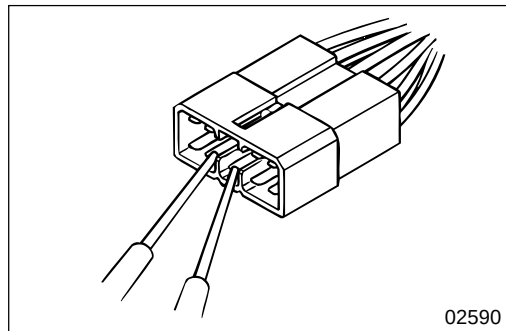
Insert test probe **C** from the harness side of the connector. Where control units, etc. have connectors that are too small to accept the test probe, do not force the test probe into them.



- **Test with connectors disengaged**

Using female pins

Insert a test probe into a terminal. However, do not force the probe into the terminal, or it will cause a poor contact.

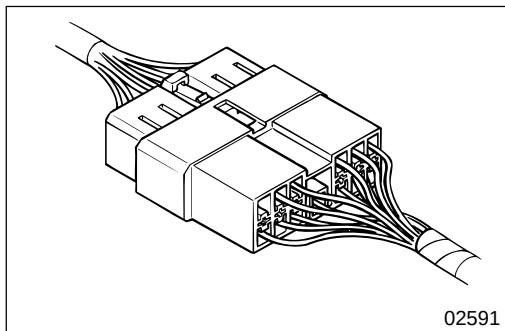


Using male pins

Touch the pins directly using test probes.

CAUTION ⚠

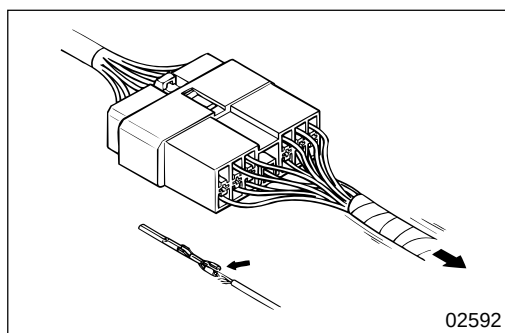
Be sure that you do not short circuit the connector pins when you use the test probe because this could damage the internal circuit of the electronic control unit.



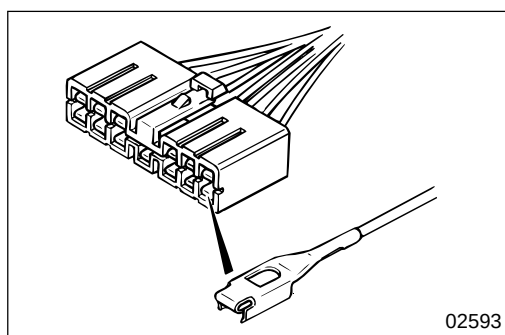
Connector inspection procedures

- **Visual inspection**

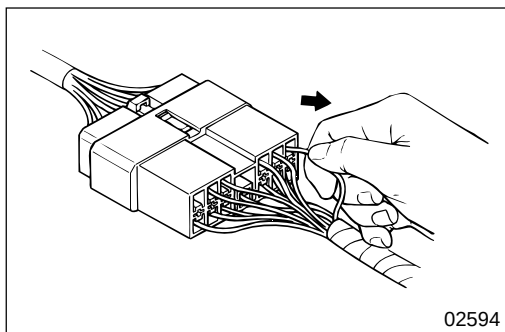
Check for loose connection and poor engagement.



Check if harnesses are broken by pulling gently around the terminals.



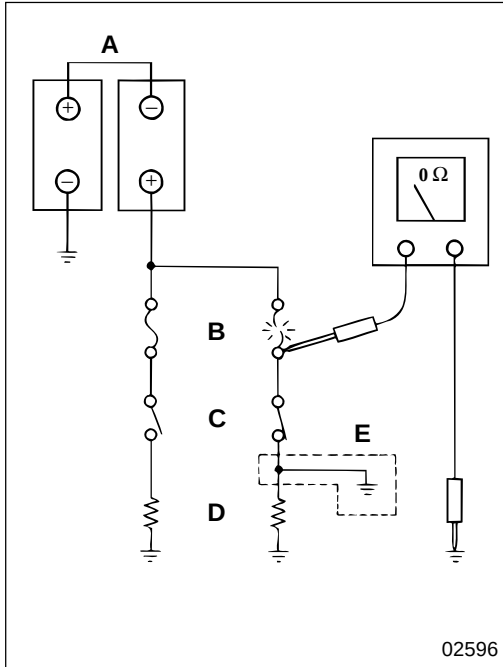
Check for a decrease in contact pressure between the male and female terminals.



- **Connector pin fall out inspection**

Damaged connector pin stoppers can cause poor engagement of the terminals (male and female pins) even if the connector body is secured, and might cause some pins to fall out. Check if the pins have fallen out from the connector by pulling each harness gently.

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 $0\ \Omega$, 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)

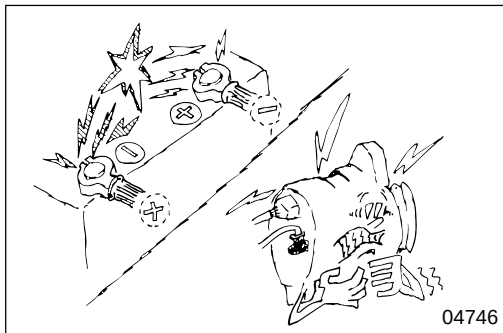
A : Battery

B : Fuse

C : Loaded switch

D : Load

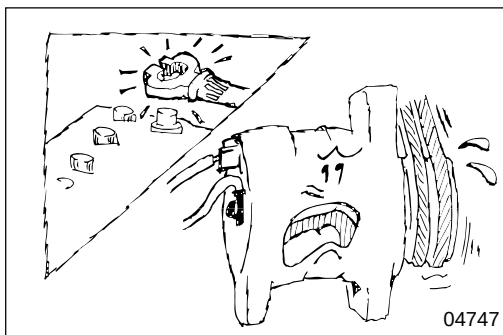
E : Short circuit



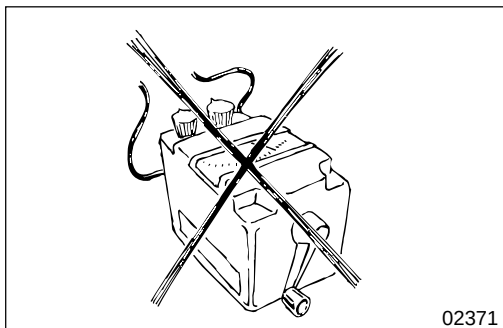
Precautions for handling alternator

When servicing the alternator, pay attention to the following :

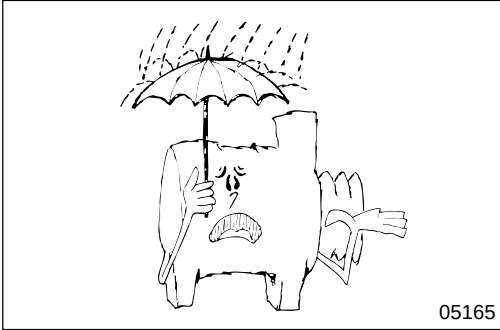
- Do not connect the alternator with battery polarities reversed. If the alternator is connected with reversed polarities, a large current flow from the battery to the alternator occurs, and the diode or regulator might be damaged.



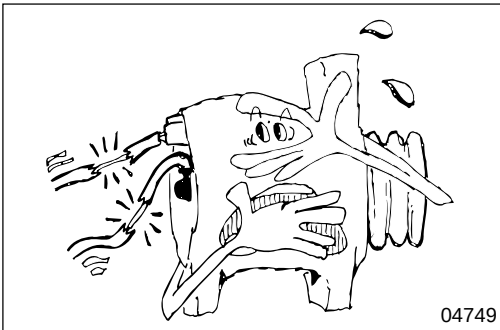
- While the engine is running, do not remove the battery terminals. If the battery terminals are removed at that time, a surge voltage is generated and the diode or regulator might be weakened.



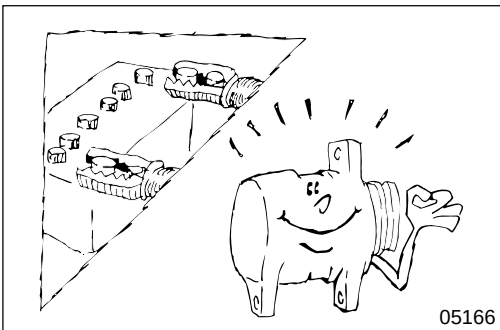
- Do not use a high-voltage tester such as a megger for inspection. If a high-voltage tester is used, the diode or regulator might be destroyed.



- Do not splash water over the alternator.
If water is directly splashed over the alternator, individual components will be short-circuited and might be destroyed.

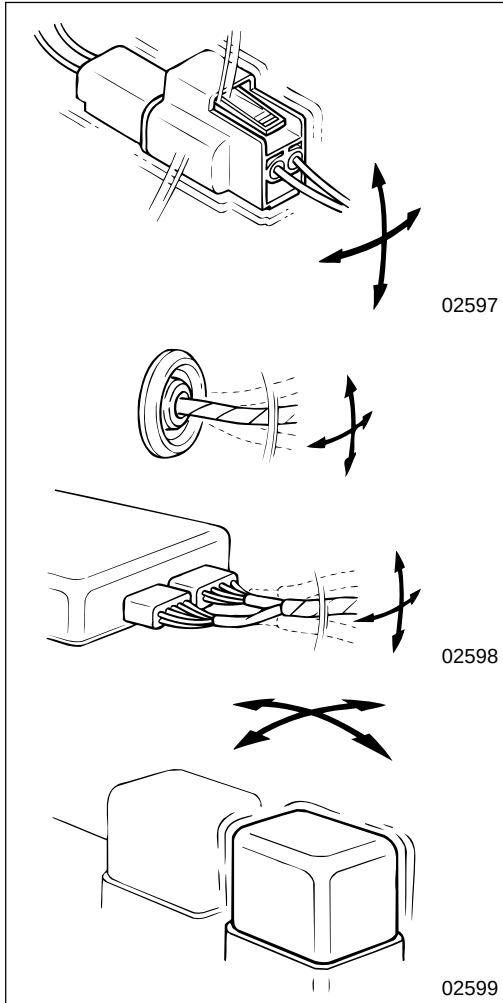


- Do not short-circuit terminal B and terminal L while running the alternator.
If the terminals are short-circuited while the alternator is running, the diode trio might be destroyed.



- Disconnect the battery terminals before quick-charging the battery.
Quick-charging without disconnecting the battery terminals might damage the diode or regulator.

PRECAUTIONS FOR MAINTENANCE OPERATION



Measures for temporary faults

Temporary faults often occur under certain conditions. So identifying those conditions helps to find possible causes. To find the conditions under which temporary faults occurred, you need to reproduce the faults after interviewing customers in detail about actual driving conditions, weather, frequency of occurrence and fault phenomena.

Then determine if the faults were caused by vibration, temperature or other possible elements depending on the actual conditions identified. If vibration is suspected as a possible cause, inspect individual connectors as follows to check if the fault will occur:

- Shake the connector gently in all four directions of the arrows as illustrated.
- Shake the wiring harness gently in all four directions of the arrows as illustrated.
- Wiggle each sensor or piece of equipment by hand.
- Gently shake the wiring harnesses near movable parts such as suspensions.

The inspection subjects include possible causes related to the diagnosis code outputs and faults, as well as the connectors and other parts in the inspection procedure.

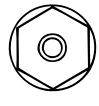
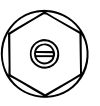
MEMO

TABLE OF STANDARD TIGHTENING TORQUES

- Use specified bolts and nuts and tighten them at specified torques according to the following table, unless otherwise specified.
- Threads and contact seats shall be dry.
- Where there is a difference in strength classification between the nut and bolt (or stud bolt), the torque specified for the bolt shall apply.

Hex-head Bolt and Stud Bolt

Unit : N·m {lbf.ft, kgf·m}

Strength classification	4 T		7 T		8 T	
Repre- sentation Diameter symbol	 (Stud)		 (Stud)		 (Stud)	
M 5	2 to 3 {1.4 to 2.2, 0.2 to 0.3}	—	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—	5 to 7 {3.6 to 5.1, 0.5 to 0.7}	—
M 6	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—	7 to 11 {5.1 to 8.0, 0.7 to 1.1}	—	8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—
M 8	9 to 14 {6.5 to 10, 0.9 to 1.4}	—	17 to 26 {12 to 19, 1.7 to 2.6}	—	20 to 29 {14 to 22, 2.0 to 3.0}	—
M 10	19 to 28 {14 to 20, 1.9 to 2.8}	18 to 26 {13 to 20, 1.8 to 2.7}	36 to 52 {25 to 40, 3.5 to 5.5}	33 to 49 {25 to 36, 3.5 to 5.0}	45 to 60 {33 to 43, 4.5 to 6.0}	41 to 59 {31 to 50, 4.3 to 6.9}
M 12	35 to 50 {25 to 36, 3.4 to 5.0}	31 to 46 {22 to 34, 3.1 to 4.7}	70 to 95 {51 to 69, 7.0 to 9.5}	65 to 85 {47 to 61, 6.5 to 8.5}	85 to 110 {61 to 80, 8.5 to 11}	75 to 100 {54 to 72, 7.5 to 10}
M 14	60 to 85 {43 to 61, 6.0 to 8.5}	55 to 75 {40 to 54, 5.5 to 7.5}	120 to 160 {87 to 115, 12 to 16}	110 to 140 {80 to 100, 11 to 14}	130 to 180 {94 to 130, 13 to 18}	120 to 160 {87 to 120, 12 to 17}
M 16	90 to 130 {69 to 94, 9.5 to 13}	90 to 120 {65 to 87, 9.0 to 12}	180 to 240 {130 to 175, 18 to 24}	160 to 220 {115 to 160, 16 to 22}	200 to 270 {145 to 195, 20 to 27}	190 to 260 {135 to 190, 19 to 26}
M 18	140 to 190 {100 to 135, 14 to 19}	120 to 160 {87 to 115, 12 to 16}	260 to 340 {180 to 255, 25 to 35}	220 to 290 {160 to 215, 22 to 30}	290 to 390 {215 to 290, 30 to 40}	260 to 340 {190 to 255, 26 to 35}
M 20	190 to 260 {135 to 190, 19 to 26}	170 to 230 {120 to 165, 17 to 23}	350 to 470 {260 to 345, 36 to 48}	320 to 420 {230 to 310, 32 to 43}	410 to 550 {295 to 405, 41 to 56}	370 to 490 {265 to 360, 37 to 50}
M 22	260 to 340 {190 to 255, 26 to 35}	230 to 300 {165 to 225, 23 to 31}	470 to 640 {345 to 470, 48 to 65}	430 to 570 {310 to 420, 43 to 58}	550 to 740 {405 to 540, 56 to 75}	490 to 670 {360 to 490, 50 to 68}
M 24	340 to 450 {255 to 330, 34 to 46}	290 to 390 {210 to 290, 29 to 40}	630 to 840 {455 to 620, 63 to 86}	540 to 730 {395 to 535, 55 to 74}	730 to 980 {535 to 725, 74 to 100}	630 to 840 {460 to 620, 64 to 86}

Hex-head Flange Bolt

Unit : N·m {lbf.ft, kgf·m}

Strength classification	4 T		7 T		8 T	
Repre- sentation Diameter symbol						
M 6	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—	8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—	9 to 14 {6.5 to 10, 0.9 to 1.4}	—
M 8	10 to 15 {7.0 to 11, 1.0 to 1.5}	—	19 to 28 {14 to 20, 1.9 to 2.8}	—	22 to 32 {16 to 24, 2.2 to 3.3}	—
M 10	21 to 30 {15 to 22, 2.1 to 3.1}	20 to 28 {14 to 21, 1.9 to 2.9}	39 to 58 {28 to 43, 3.9 to 6.0}	37 to 53 {26 to 39, 3.6 to 5.4}	50 to 65 {36 to 47, 5.0 to 6.5}	45 to 65 {33 to 47, 4.5 to 6.5}
M 12	38 to 54 {27 to 40, 3.8 to 5.5}	35 to 51 {25 to 38, 3.4 to 5.2}	80 to 110 {58 to 80, 8.0 to 11}	70 to 95 {51 to 69, 7.0 to 9.5}	90 to 120 {65 to 87, 9.0 to 12}	85 to 110 {61 to 80, 8.5 to 11}

Hex-head Nut

Unit : N·m {lb.ft, kgf·m}

Strength classification	4 T		6 T			
Repre- sentation						
Diameter symbol	Standard screw	Coarse screw	Standard screw		Coarse screw	
M 5	2 to 3 {1.4 to 2.2, 0.2 to 0.3}	—	4 to 6 {2.9 to 4.3, 0.4 to 0.6}		—	
M 6	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—	7 to 11 {5.1 to 8.0, 0.7 to 1.1}		—	
M 8	9 to 14 {6.5 to 10, 0.9 to 1.4}	—	17 to 26 {12 to 19, 1.7 to 2.6}		—	
M 10	19 to 28 {14 to 20, 1.9 to 2.8}	18 to 26 {13 to 20, 1.8 to 2.7}	36 to 52 {25 to 40, 3.5 to 5.5}		33 to 49 {25 to 36, 3.5 to 5.0}	
M 12	35 to 50 {25 to 36, 3.4 to 5.0}	31 to 46 {22 to 34, 3.1 to 4.7}	70 to 95 {51 to 69, 7.0 to 9.5}		65 to 85 {47 to 61, 6.5 to 8.5}	
M 14	60 to 85 {43 to 61, 6.0 to 8.5}	55 to 75 {40 to 54, 5.5 to 7.5}	120 to 160 {87 to 115, 12 to 16}		110 to 140 {80 to 100, 11 to 14}	
M 16	90 to 130 {69 to 94, 9.5 to 13}	90 to 120 {65 to 87, 9.0 to 12}	180 to 240 {130 to 175, 18 to 24}		160 to 220 {115 to 160, 16 to 22}	
M 18	140 to 190 {100 to 135, 14 to 19}	120 to 160 {87 to 115, 12 to 16}	260 to 340 {180 to 255, 25 to 35}		220 to 290 {160 to 215, 22 to 30}	
M 20	190 to 260 {135 to 190, 19 to 26}	170 to 230 {120 to 165, 17 to 23}	350 to 470 {260 to 345, 36 to 48}		320 to 420 {230 to 310, 32 to 43}	
M 22	260 to 340 {190 to 255, 26 to 35}	230 to 300 {165 to 225, 23 to 31}	470 to 640 {345 to 470, 48 to 65}		430 to 570 {310 to 420, 43 to 58}	
M 24	340 to 450 {255 to 330, 34 to 46}	290 to 390 {210 to 290, 29 to 40}	630 to 840 {455 to 620, 63 to 86}		540 to 730 {395 to 535, 55 to 74}	

Hex-head Flange Nut Unit : N·m {lb.ft, kgf·m}

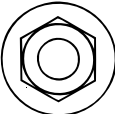
Strength classification	tion	
Repre- sentation		
4 T	Standard screw	Coarse screw
M 6	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—
M 8	10 to 15 {7.0 to 11, 1.0 to 1.5}	—
M 10	21 to 30 {15 to 22, 2.1 to 3.1}	20 to 28 {14 to 21, 1.9 to 2.9}
M 12	38 to 54 {27 to 40, 3.8 to 5.5}	35 to 51 {25 to 38, 3.4 to 5.2}

TABLE OF STANDARD TIGHTENING TORQUES

Tightening torque for flair nut for general purpose

Unit : N·m {lbf.ft, kgf·m}

Pipe diameter	ø4.76 mm {0.19 in.}	ø6.35 mm {0.25 in.}	ø8 mm {0.31 in.}	ø10 mm {0.39 in.}	ø12 mm {0.47 in.}	ø15 mm {0.59 in.}
Tightening torque	17 {12, 1.7}	25 {19, 2.6}	39 {29, 4.0}	59 {43, 6.0}	88 {65, 9.0}	98 {72, 10.0}

Tightening torque for air piping nylon tube for general purpose {DIN type} Unit : N·m {lbf.ft, kgf·m}

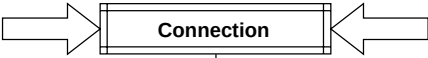
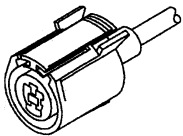
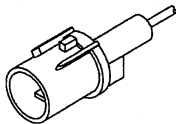
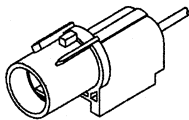
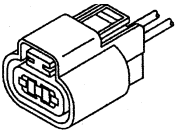
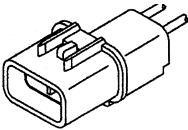
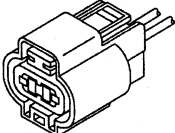
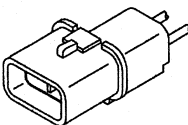
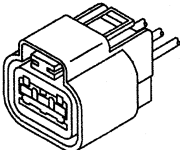
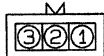
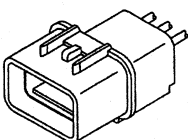
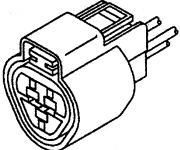
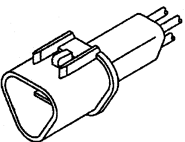
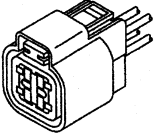
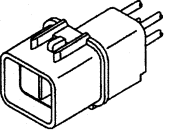
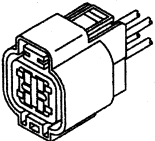
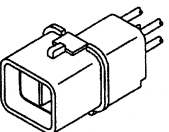
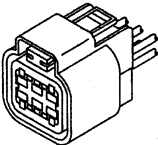
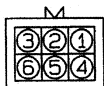
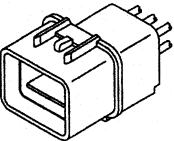
Standard diameter	6×1 mm {0.24×0.039 in.}	10×1.25 mm {0.39×0.049 in.}	12×1.5 mm {0.47×0.059 in.}	15×1.5 mm {0.59×0.059 in.}
Tightening torque	$20^{+5.9}_{-0} \left\{ 14^{+4.3}_{-0}, 2.0^{+0.6}_{-0} \right\}$	$29^{+9.8}_{-0} \left\{ 22^{+7.2}_{-0}, 3.0^{+1.0}_{-0} \right\}$	$49^{+9.8}_{-0} \left\{ 36^{+7.2}_{-0}, 5.0^{+1.0}_{-0} \right\}$	$54^{+4.9}_{-0} \left\{ 40^{+7.2}_{-0}, 5.5^{+1.0}_{-0} \right\}$

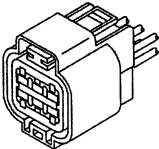
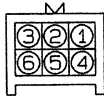
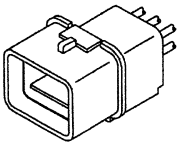
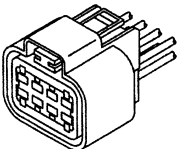
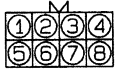
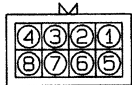
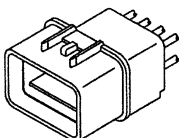
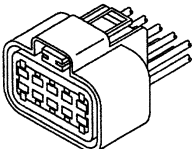
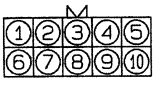
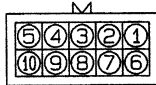
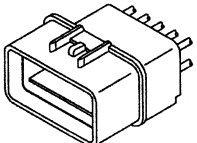
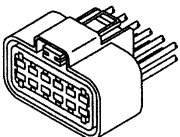
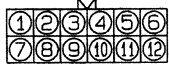
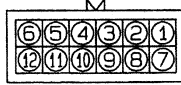
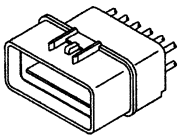
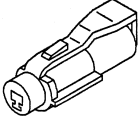
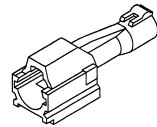
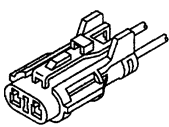
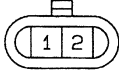
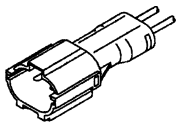
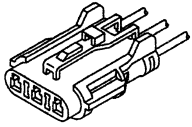
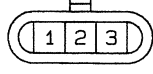
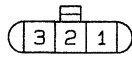
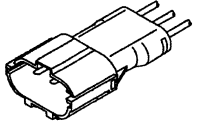
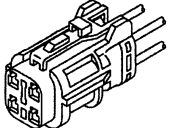
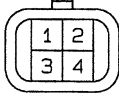
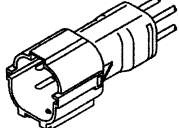
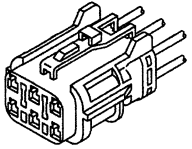
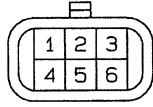
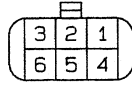
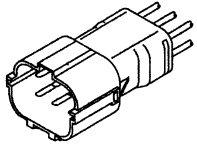
Tightening torque for air piping nylon tube for general purpose {SAE type} Unit : N·m {lbf.ft, kgf·m}

Standard diameter	1/4 in.	3/8 in.	1/2 in.	5/8 in.
Tightening torque	$13^{+3.9}_{-0} \left\{ 9.4^{+2.9}_{-0}, 1.3^{+0.4}_{-0} \right\}$	$29^{+4.9}_{-0} \left\{ 22^{+3.6}_{-0}, 3.0^{+0.5}_{-0} \right\}$	$49^{+4.9}_{-0} \left\{ 36^{+3.6}_{-0}, 5.0^{+0.5}_{-0} \right\}$	$64^{+4.9}_{-0} \left\{ 47^{+3.6}_{-0}, 6.5^{+0.5}_{-0} \right\}$

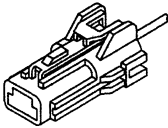
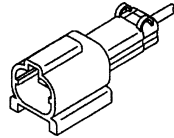
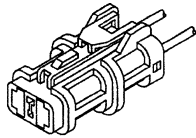
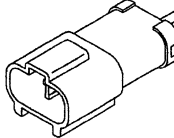
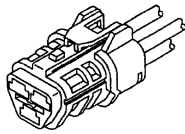
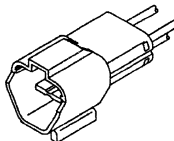
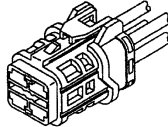
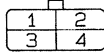
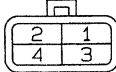
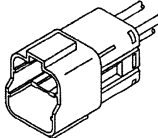
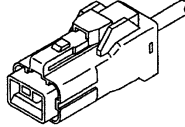
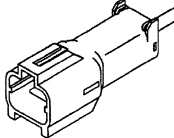
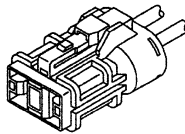
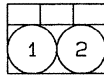
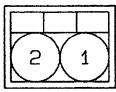
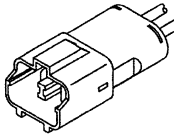
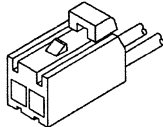
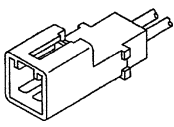
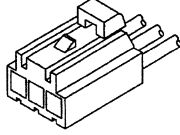
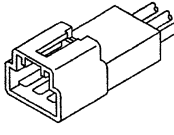
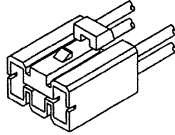
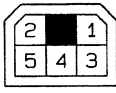
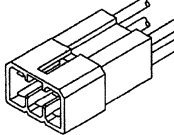
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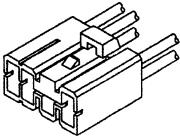
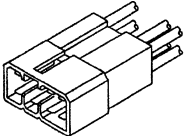
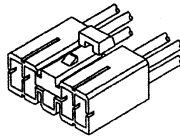
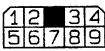
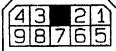
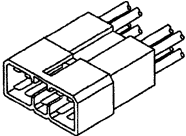
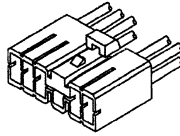
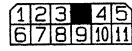
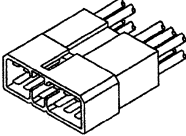
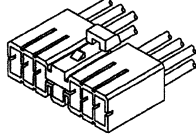
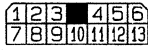
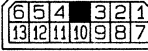
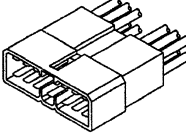
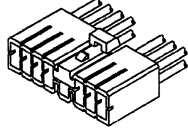
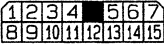
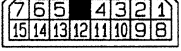
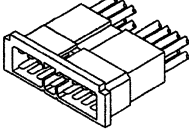
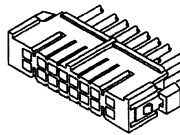
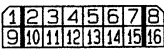
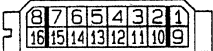
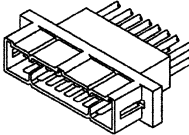
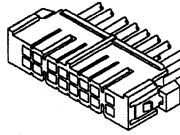
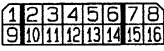
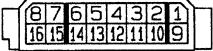
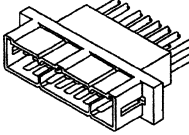
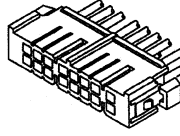
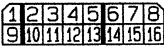
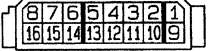
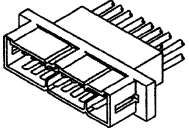
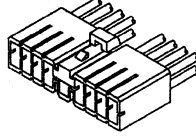
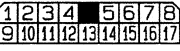
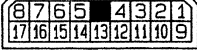
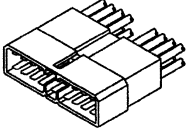
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)					
AA	AA 1 A				
					
	AA 2 A				
	AA 2 B				
	AA 3 A				
	AA 3 B				
	AA 4 A				
	AA 4 B				
	AA 6 A				

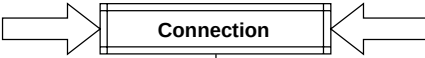
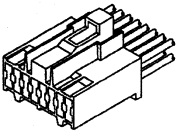
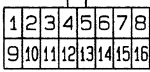
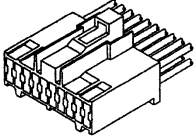
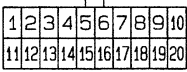
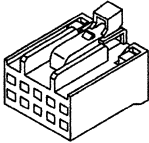
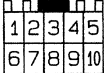
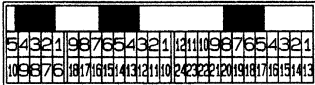
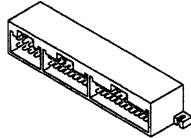
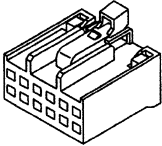
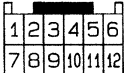
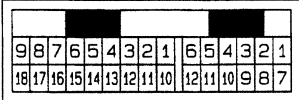
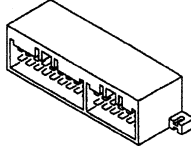
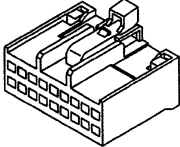
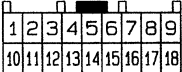
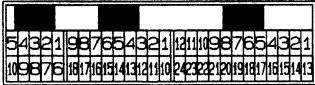
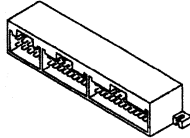
Model (Number shows number of pins)					
AA	AA 6 B				
	AA 8 A				
	AA10A				
	AA12A				
AB	AB 1 A				
	AB 2 A				
	AB 3 A				
	AB 4 A				
	AB 6 A				

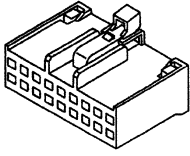
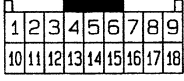
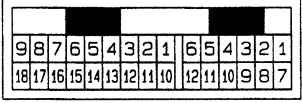
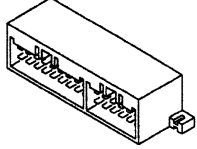
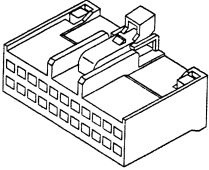
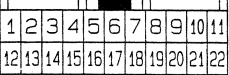
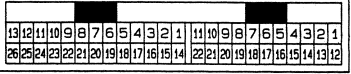
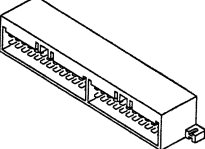
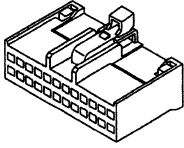
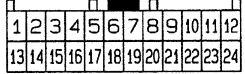
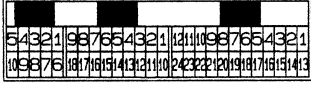
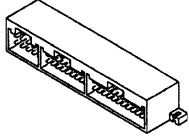
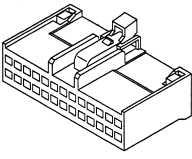
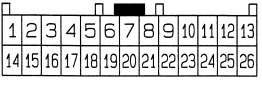
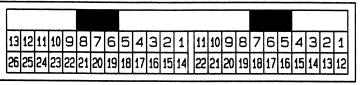
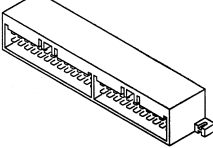
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		 Connection 			
AC	AC 1 A				
	AC 2 A				
	AC 3 A				
	AC 4 A				
AD	AD 1 A				
	AD 2 A				
AE	AE 2 A				
	AE 3 A				
	AE 5 A				

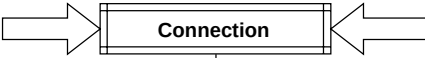
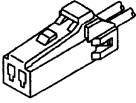
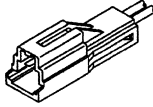
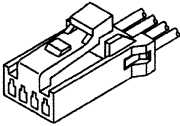
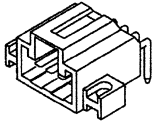
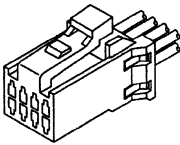
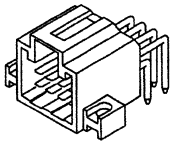
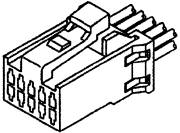
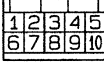
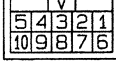
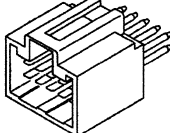
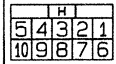
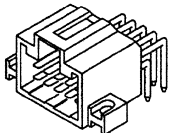
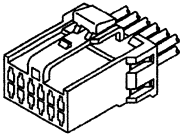
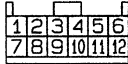
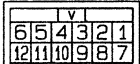
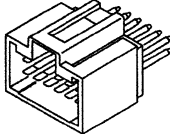
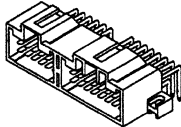
Model (Number shows number of pins)			
AE	AE 7 A	   	
	AE 9 A	   	
	AE11A	   	
	AE13A	   	
	AE15A	   	
	AE16A (White, Gray, Black)	   	
	AE16B (Green)	   	
	AE16C (Blue)	   	
	AE17A	   	

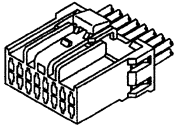
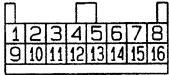
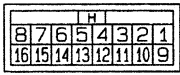
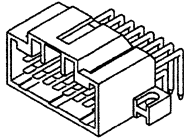
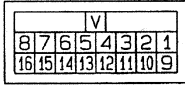
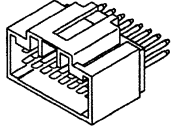
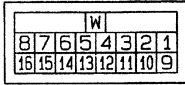
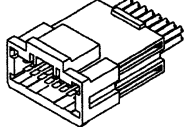
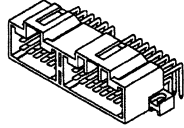
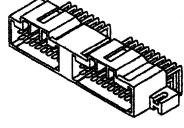
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AG	AG16A	 	
	AG20A	 	
AH	AH10A	 	 AH10A (AH18A) (AH24A) 
	AH12A	 	 (AH18A) AH12A 
	AH18A	 	 (AH10A) AH18A AH24A 

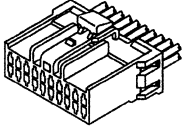
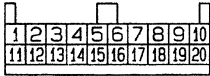
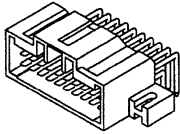
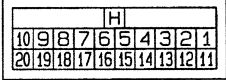
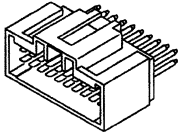
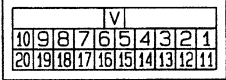
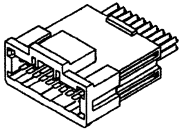
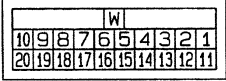
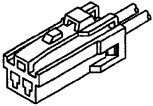
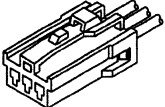
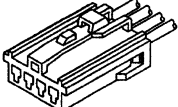
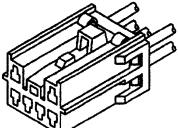
Model (Number shows number of pins)			
AH	AH18B	 	 AH18A (AH12A) 
	AH22A	 	 (AH26A) AH22 
	AH24A	 	 (AH10A) (AH18A) AH24A 
	AH26A	 	 AH26A (AH22) 

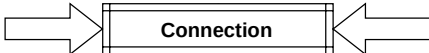
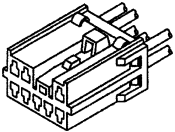
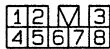
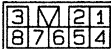
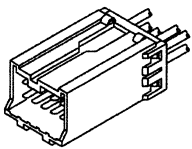
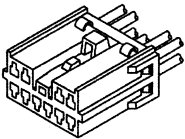
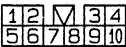
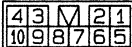
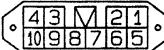
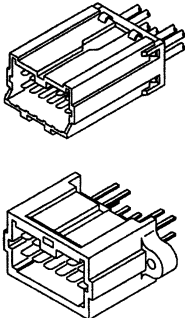
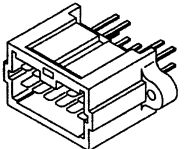
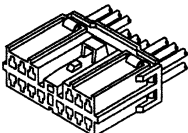
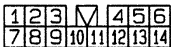
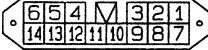
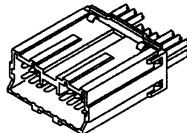
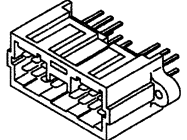
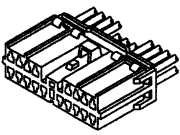
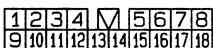
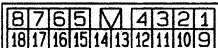
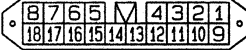
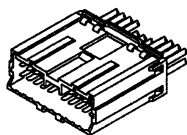
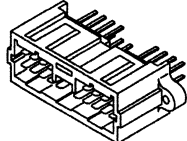
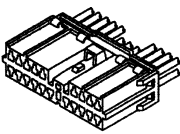
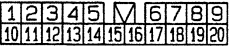
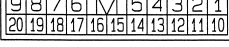
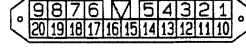
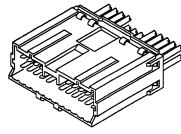
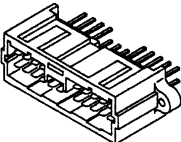
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AJ	AJ 2 A	   	
	AJ 4 A	   	
	AJ 8 A	   	
	AJ10A	     	
	AJ12A	       AJ12 (AJ16)	

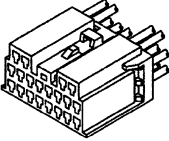
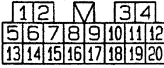
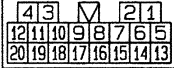
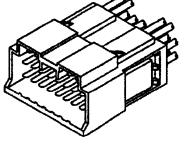
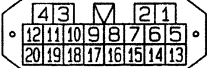
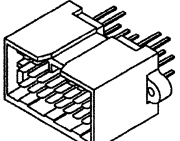
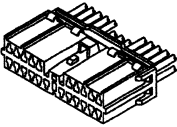
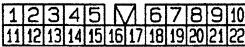
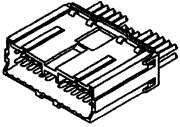
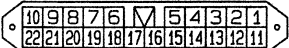
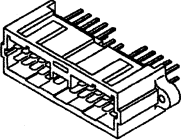
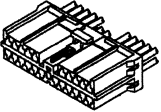
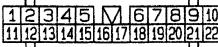
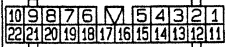
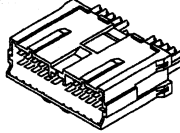
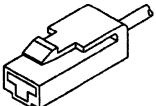
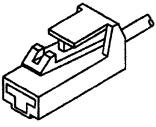
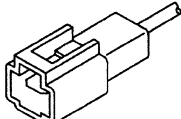
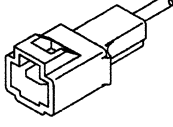
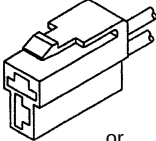
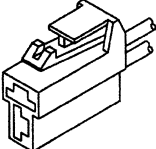
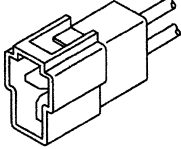
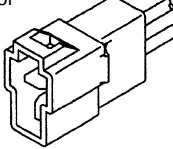
	Model (Number shows number of pins)		
AJ	AJ16A	 	       (AJ12A)  AJ16A   AJ16A  (AJ20A) 

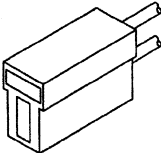
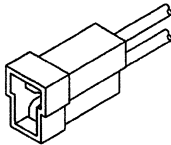
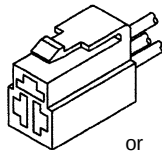
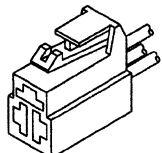
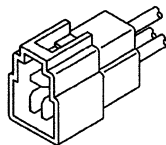
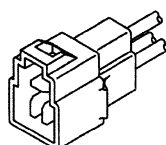
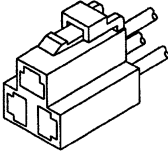
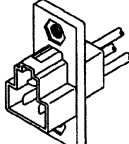
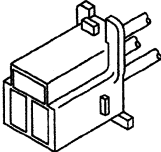
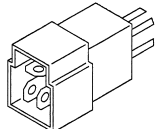
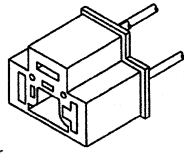
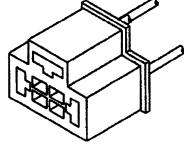
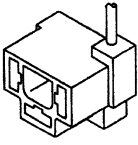
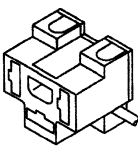
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		Connection	
AJ	AJ20A		
			
			
			
AK	AK 2 A		
	AK 3 A		
	AK 4 A		
	AK 6 A		

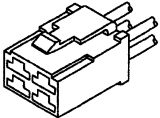
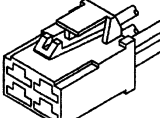
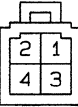
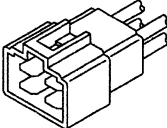
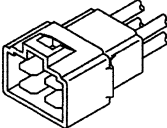
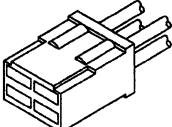
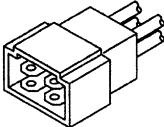
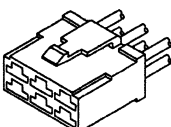
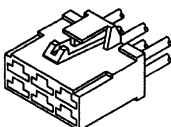
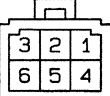
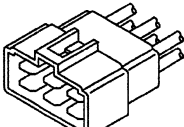
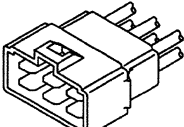
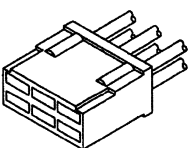
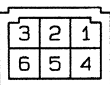
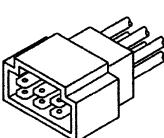
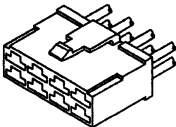
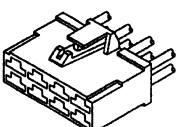
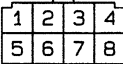
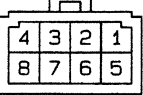
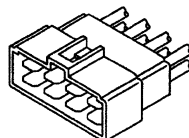
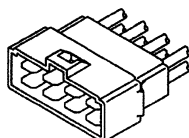
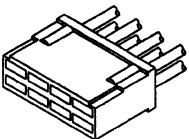
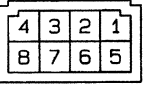
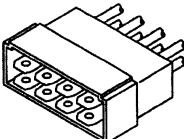
Model (Number shows number of pins)			
AK	AK 8 A	   	
	AK10A	     	
	AK14A	     	
	AK18A	     	
	AK20A	     	

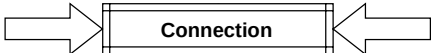
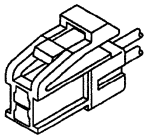
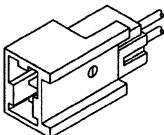
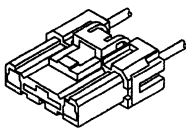
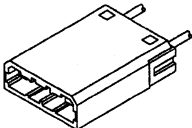
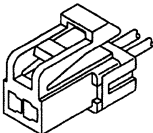
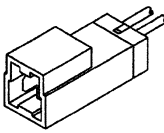
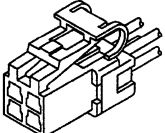
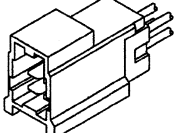
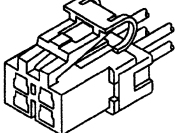
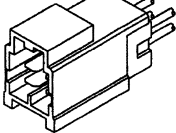
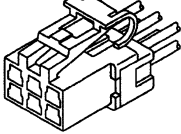
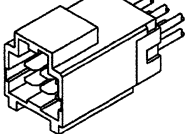
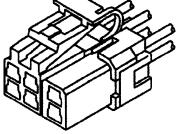
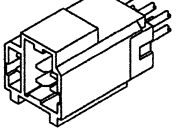
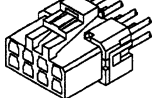
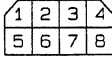
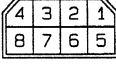
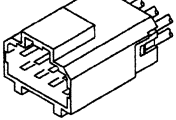
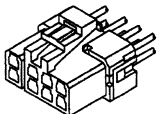
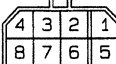
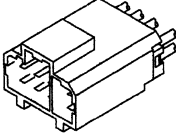
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		Connection	
AK	AK20B	 	   
	AK22A	 	   
	AK22B	 	 
AL	AL 1 A	 or  	  or 
	AL 2 A	 or  	  or 

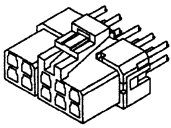
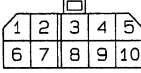
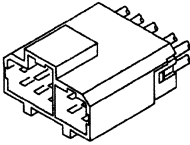
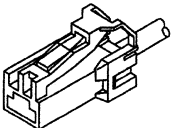
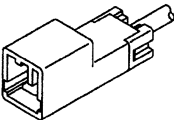
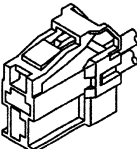
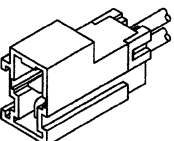
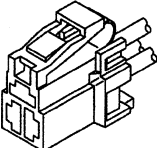
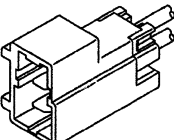
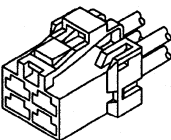
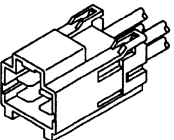
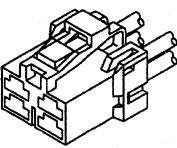
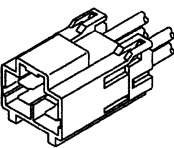
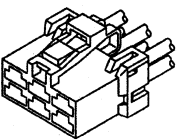
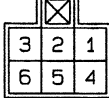
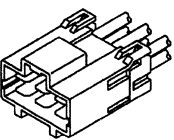
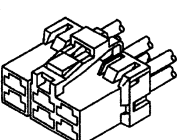
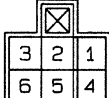
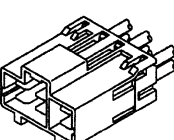
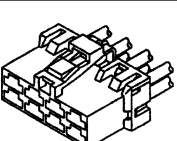
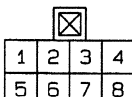
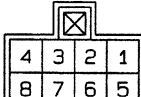
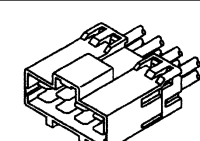
Model (Number shows number of pins)		➔ Connection ➔	
AL	AL 2 B		1 2 1 2 
	AL 3 A	 or 	1 2 3 1 3 2  or 
	AL 3 B		1 2 3 1 3 2 
	AL 3 C		1 3 2 
	AL 3 D	 or 	1 2 3
	AL 3 E	 or 	1 2 3

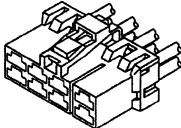
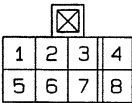
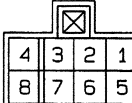
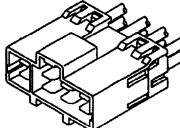
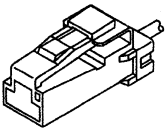
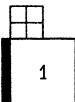
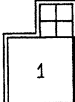
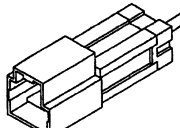
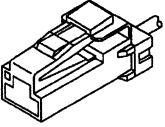
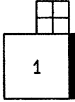
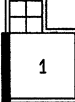
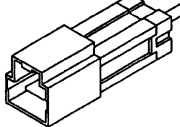
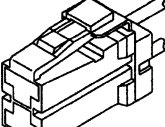
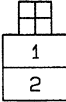
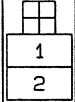
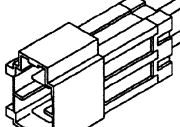
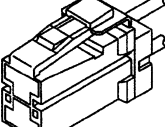
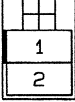
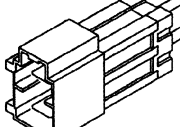
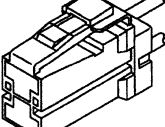
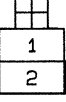
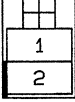
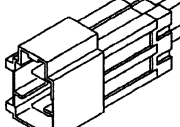
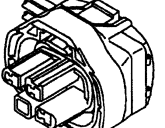
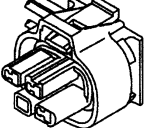
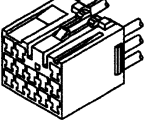
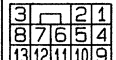
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		 Connection 			
AL	AL 4 A	 or 			 or 
	AL 4 B				
	AL 6 A	 or 			 or 
	AL 6 B				
	AL 8 A	 or 			 or 
	AL 8 B				

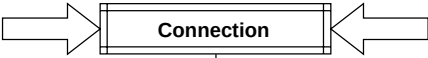
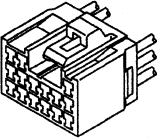
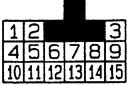
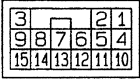
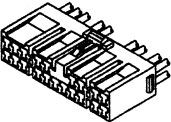
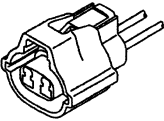
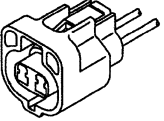
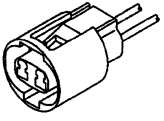
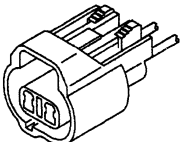
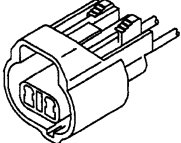
Model (Number shows number of pins)					
AM	AM 2 A				
	AM 2 B				
	AM 2 C				
	AM 4 A				
	AM 4 B				
	AM 6 A				
	AM 6 B				
	AM 8 A				
	AM 8 B				

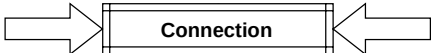
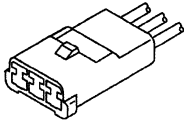
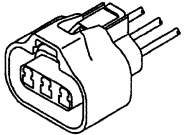
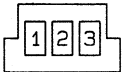
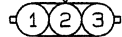
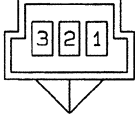
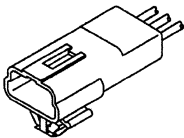
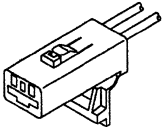
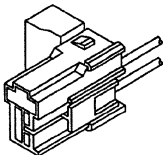
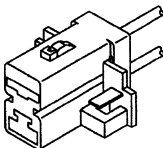
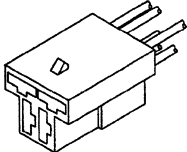
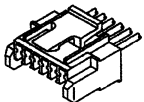
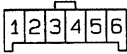
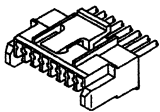
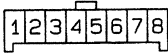
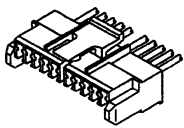
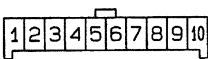
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		 Connection 			
AM	AM10A				
AN	AN 1 A				
	AN 2 A				
	AN 3 A				
	AN 4 A				
	AN 4 B				
	AN 6 A				
	AN 6 B				
	AN 8 A				

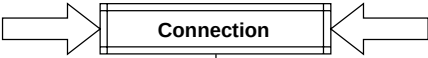
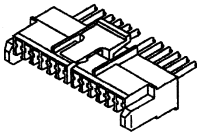
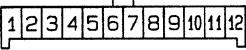
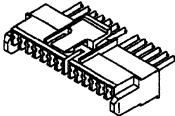
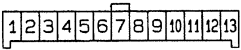
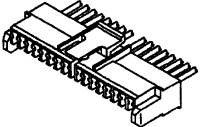
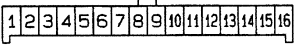
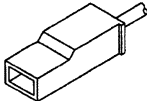
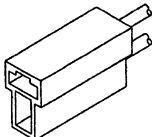
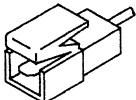
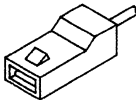
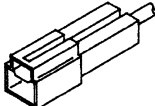
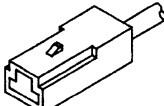
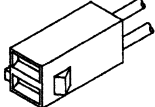
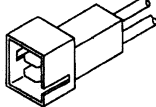
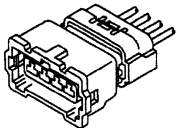
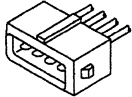
Model (Number shows number of pins)			
AN	AN 8 B	 	 
	AN 8 B		
AP	AP 1 A	 	 
	AP 1 B	 	 
	AP 2 A	 	 
	AP 2 B	 	 
	AP 2 C	 	 
AQ	AQ 3 A	 	
	AQ 3 B	 	
	AQ13A	 	

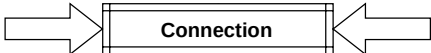
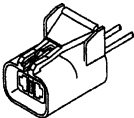
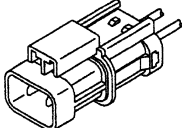
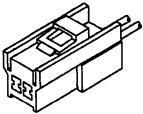
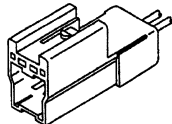
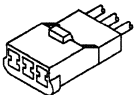
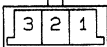
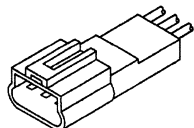
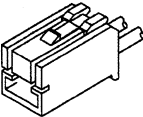
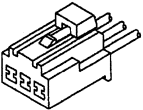
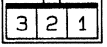
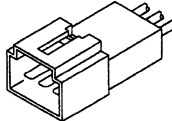
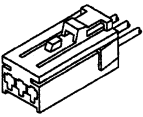
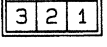
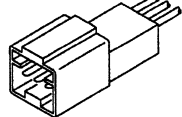
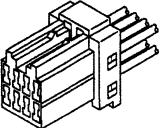
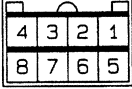
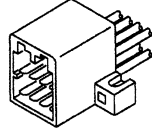
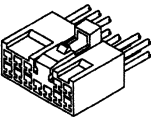
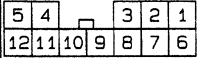
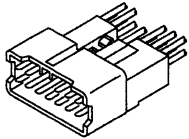
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AQ	AQ15A	  	
	AQ20A	 	
AR	AR 2 A	 	
	AR 2 B	 	
	AR 2 C	 	
	AR 2 D	 	
	AR 2 E	 	
	AR 2 F		

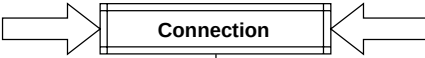
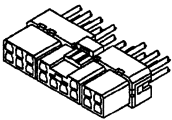
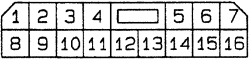
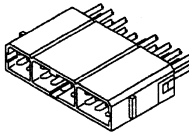
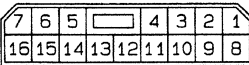
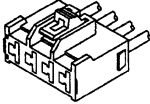
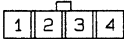
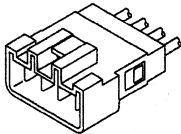
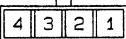
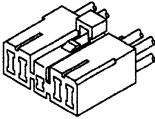
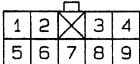
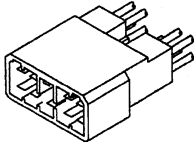
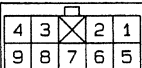
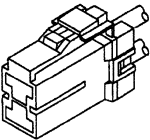
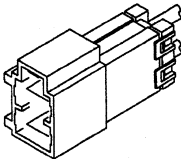
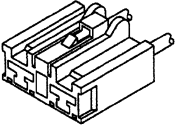
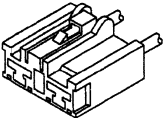
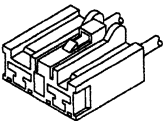
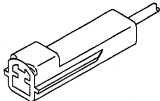
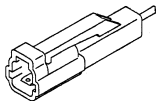
Model (Number shows number of pins)			
AR	AR 3 A	     	
AS	AS 1 A	 	
	AS 2 A	 	
	AS 2 B	 	
AT	AT 4 A	 	
AU	AU 6 A	 	
	AU 8 A	 	
	AU10A	 	

CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AU	AU12A	 	
	AU13A	 	
	AU16A	 	
AV	AV 1 A	 	
	AV 2 A	 	
AW	AW 1 A	 	 
	AW 1 B	 	 
	AW 2 A	 	 
AX	AX 4 A	 	 

Model (Number shows number of pins)			
AY	AY 2 A	   	
AZ	AZ 2 A	   	
BA	BA 3 A	     	
BB	BB 2 A	   	
	BB 3 A	     	
BC	BC 3 A	     	
BD	BD 8 A	          	
BE	BE 6 A	       	
BF	BF12A	              	

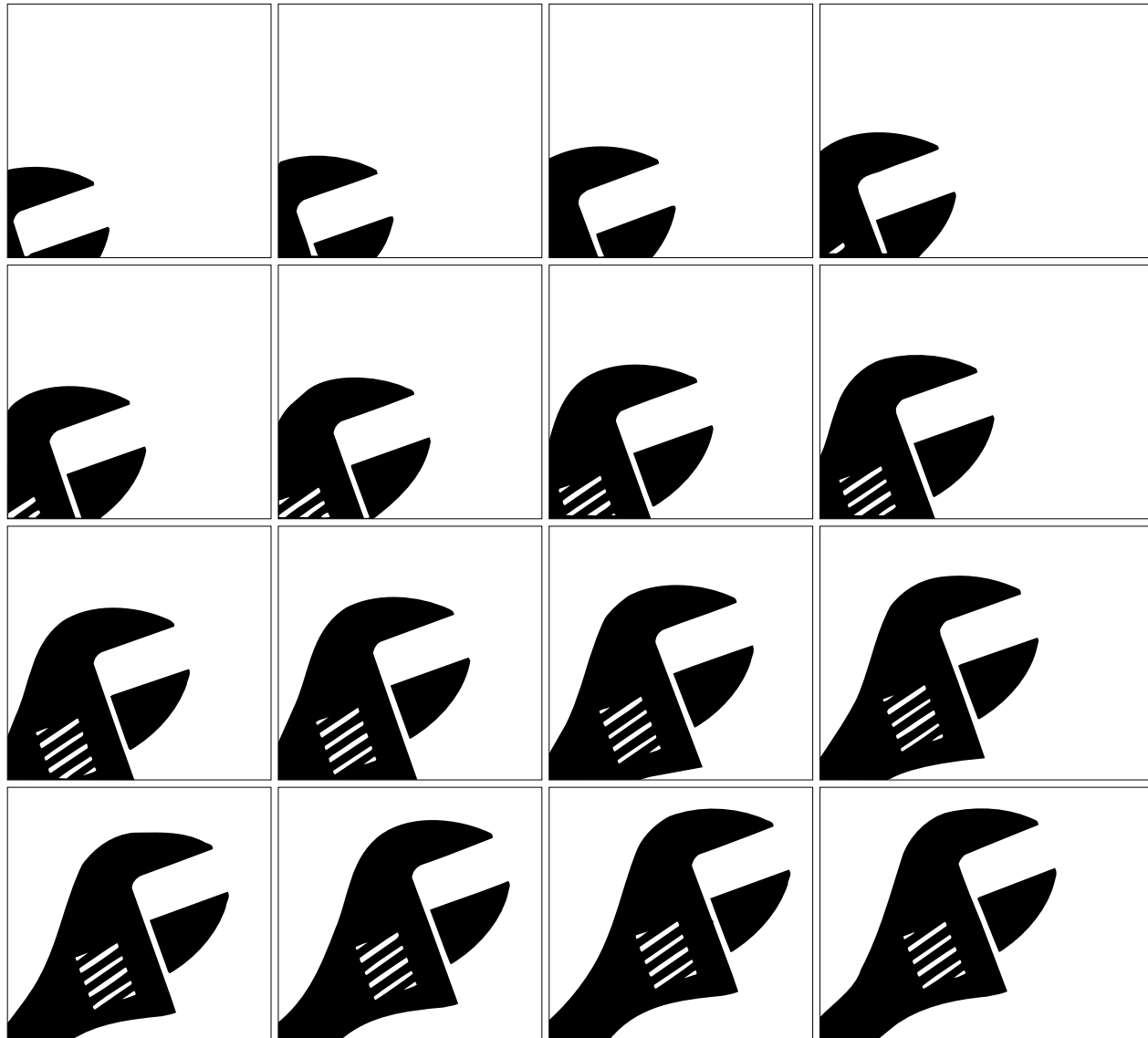
CONNECTOR CONFIGURATION CHART

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	 	
BN	BN 1 A	 	 



Service Manual

FH 2000 Model Year Changes



FH

SERVICE MANUAL

FOREWORD

This Service Manual contains maintenance and repair methods for personnel involved in the maintenance and repair of 2000 model Mitsubishi Fuso Truck FH Series.

Read this manual carefully as an aid to providing correct, efficient and fast maintenance.

Please note, however, that due to continuous improvements on the specifications, numbers and description for maintenance might change without prior notice.

If you have any question, or encounter a problem, please do not hesitate to contact your nearest Mitsubishi Fuso dealer or distributor.

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MITSUBISHI FUSO TRUCK OF AMERICA, Inc.

GROUP INDEX

2000 MODEL CHANGES

GENERAL 00

CAB 42

ELECTRICAL 54

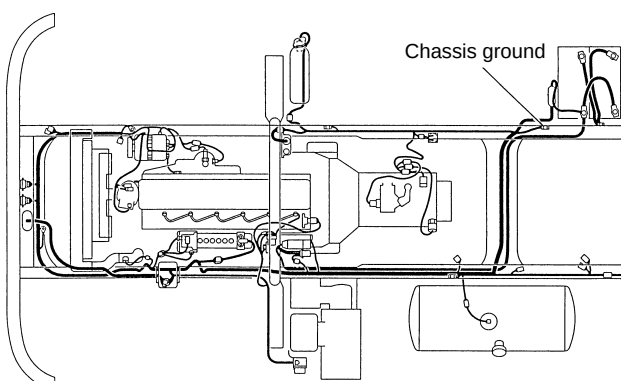
2000 MODEL CHANGES

2000 MODEL CHANGES

Item	'00 Model	'99 Model																
Gr 00 General - Manual transmission of FH211 E, G, H, J, K has been changed to 6-speed, and differential gear ratio has also been changed accordingly. - The vehicle identification number has changed.	Gr 00 General	—																
Gr 13 Fuel and engine control Components of throttle position sensor assembly have been changed.	< '00 Model > ⒫ 37123 ● Removal sequence 1 Return spring 2 Shaft cover 3 Spring 4 Accelerator control arm 5 Bushing 6 Throttle position sensor 7 Accelerator control extension 8 Bushing 9 Bracket ● Installation sequence Follow the removal sequence in reverse. Lubricant <table><tr><th>Location</th><th>Points of application</th><th>Specified lubricant</th><th>Quantity</th></tr><tr><td>5, 8</td><td>Slide-contacting surfaces of bushing and support assembly</td><td>Chassis grease [NLGI No.1 (Ca soap)]</td><td>As required</td></tr></table> < '99 Model > ⒫ 31483 ● Removal sequence 1 Return spring 2 Accelerator control arm 3 Bushing 4 Bushing 5 Accelerator control extension 6 Throttle position sensor 7 Bracket ● Installation sequence Follow the removal sequence in reverse. Lubricant <table><tr><th>Location</th><th>Points of application</th><th>Specified lubricant</th><th>Quantity</th></tr><tr><td>3, 4</td><td>Slide-contacting surfaces of bushing and support assembly</td><td>Chassis grease [NLGI No.1 (Ca soap)]</td><td>As required</td></tr></table>	Location	Points of application	Specified lubricant	Quantity	5, 8	Slide-contacting surfaces of bushing and support assembly	Chassis grease [NLGI No.1 (Ca soap)]	As required	Location	Points of application	Specified lubricant	Quantity	3, 4	Slide-contacting surfaces of bushing and support assembly	Chassis grease [NLGI No.1 (Ca soap)]	As required	Part No. and type of ROM pack have been changed.
Location	Points of application	Specified lubricant	Quantity															
5, 8	Slide-contacting surfaces of bushing and support assembly	Chassis grease [NLGI No.1 (Ca soap)]	As required															
Location	Points of application	Specified lubricant	Quantity															
3, 4	Slide-contacting surfaces of bushing and support assembly	Chassis grease [NLGI No.1 (Ca soap)]	As required															
	MK 344606 (MRT-E6)	MK 327927 (MRT-E4)																

Item	'00 Model	'99 Model
Gr 22 Manual Transmission 6-speed transmission has been added.	 Gr 22 Manual Transmission < M050S5, S6 > '00 Minor Change (Pub. No. TWME9502-422)	—
Gr 35 Brake System Procedures for bleeding brake system are added because of anti-lock brake system (ABS).	[Procedure for bleeding hydraulic unit] - Ordinary bleeding procedure is used for the primary side (non-hydraulic system). However, when the solenoid valve of the hydraulic unit operates (ABS operation) with air mixed in the primary side, air enters the secondary side (hydraulic system). Therefore, be sure to bleed air from the secondary side using the MUT-II by following the procedures described below. - Regarding the use of the MUT-II, refer to  Gr 35A. < Bleeding front brakes > - Bleed the primary side of the front brake system. (Ordinary bleeding procedure) - Depress the brake pedal, and select the actuator drive mode, "FL ABS MV ON," on the MUT-II to force-drive the brake. - Bleed air from the secondary side of the front left wheel brake system. - Repeat the above two steps until air is completely removed. - Depress the brake pedal, and select the actuator drive mode, "FR ABS MV ON," on the MUT-II to force-drive the brake. - Bleed air from the secondary side of the front right wheel brake system. - Repeat the above two steps until air is completely removed. < Bleeding rear brakes > - Bleed the primary side of the rear brake system. (Ordinary bleeding procedure) - Depress the brake pedal, and select the actuator drive mode, "RL ABS MV ON," on the MUT-II to force-drive the brake. - Bleed air from the secondary side of the rear left wheel brake system. - Repeat the above two steps until air is completely removed. - Depress the brake pedal, and select the actuator drive mode, "RR ABS MV ON," on the MUT-II to force-drive the brake. - Bleed air from the secondary side of the rear right wheel brake system. - Repeat the above two steps until air is completely removed.	
Gr 35A Anti-lock Brake System Anti-lock brake system (ABS) is added.	 Gr 35A Anti-lock brake system (ABS) '00 Minor Change (Pub. No. TWME9502-435A)	—
Gr 42 Cab Power window system equipped with central door lock switch is used for door windows.	 Gr 42 Cab	—

2000 MODEL CHANGES

Item	'00 Model	'99 Model						
Gr 54 Electrical								
1 POWER, CHARGE AND GROUND Capacities of main high-current fuses main load specifications have changed.	140A 50A (for ABS) (104) FUSE P54-4 (110) POWER CIRCUIT P54-12	120A —						
High-current fuse box main load specifications have changed or added.	FH3 (30A Brake booster) (104) FUSE P54-4 FH6 (140A 100A Alternator) (104) FUSE P54-4 FH8 (40A ABS hydraulic unit) (104) FUSE P54-4							
Capacities of fuses listed on the right and main load specifications have changed.	F10 Power window 25A F17 — F20 Meter cluster, DRL 10A F24 ABS 10A F25 Option (main) 10A F34 Tail lamp 20A	F10 — F17 Spare 10A F20 Meter cluster 10A F24 — F25 — F34 Tail lamp 15A						
Alternator capacity has been increased.	100A Alternator (106) ALTERNATOR P54-6	80A Alternator						
- Spare DC output (main) has been added. - Chassis grounding wire has been added.	(115) RESERVE POWER CIRCUIT P54-14 Chassis ground <table><tr><th>Circuit No.</th><th>Wire diameter - wire color</th></tr><tr><td>ABE1</td><td>2 - B</td></tr><tr><td>ABE3</td><td>2 - B</td></tr></table> 		Circuit No.	Wire diameter - wire color	ABE1	2 - B	ABE3	2 - B
Circuit No.	Wire diameter - wire color							
ABE1	2 - B							
ABE3	2 - B							

36600

36600

Item	'00 Model	'99 Model
2 STARTING, PREHEATING AND STOPPING ENGINE • Overrun prevention circuit has been added to engine starting circuit.	(210) ENGINE STARTING CIRCUIT	P54-16, 18
3 LIGHTING • Daytime running light system is added.	(313) DAYTIME RUNNING LIGHT CIRCUIT	P54-20
4 METER • Meter cluster has been changed, including addition of indicator.	(401) METER CLUSTER	P54-24
6 CAB SIDE ELECTRICAL • Power window and auto door lock circuit is added.	(622) POWER WINDOW AND AUTO DOOR LOCK CIRCUIT	P54-26
7 CHASSIS SIDE ELECTRICS • Exhaust brake circuitry has been changed due to addition of anti-lock brake system (ABS).	(710) EXHAUST BRAKE CIRCUIT	P54-30
9 OTHERS • Circuitry of multipurpose timing control unit has been changed due to addition of starter overrun prevention circuit.	(210) ENGINE STARTING CIRCUIT	P54-16, 18

GROUP 00 GENERAL

POWER TRAIN TABLE00 - 2

VEHICLE IDENTIFICATION NUMBER00 - 2

POWER TRAIN TABLE/VEHICLE IDENTIFICATION NUMBER

POWER TRAIN TABLE

Model	Engine model	Clutch model	Transmission model	Propeller shaft	Rear axle model	Final reduction and gear ratio
FH211C G. V. W. 8160 kg {17995 lb}	6D34T2 175 HP/2900 rpm 325 lb.ft/2000 rpm (SAE, Gross)	C5M33	M050S5 6.875/1.000	P4	R040T	D040H 4.111
FH211E, G, H, J, K G. V. W. 8160 kg {17995 lb}			M050S6 6.523/0.803			D040H 4.625
FH211C, E, G, H, J, K G. V. W. 8160 kg {17995 lb}		Torque converter (TC290-1.72)	M4A4 (Allison AT542 or AT545) 3.454/ 1.000			D040H 4.111

IDENTIFICATION NUMBER

J W 6 C C C 1 G **Y**

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

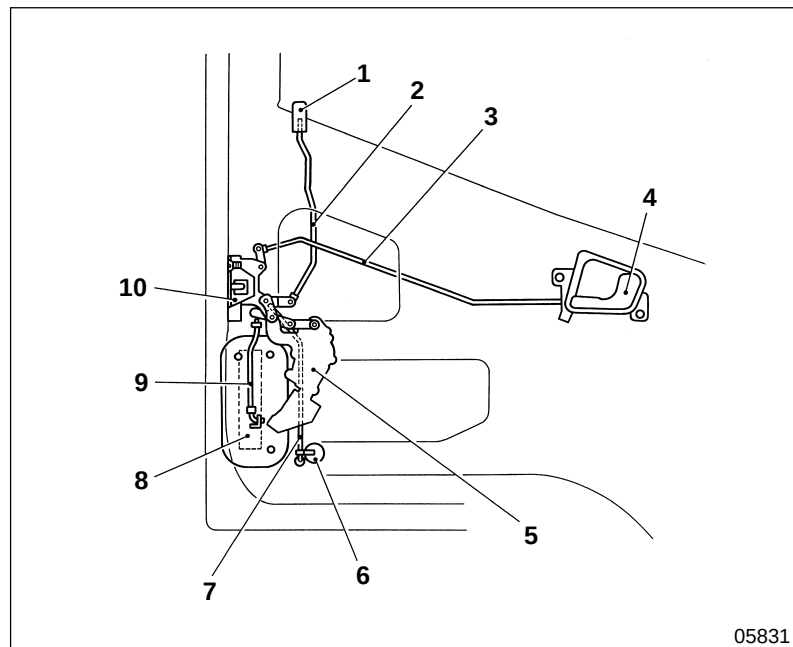
- | | |
|-------------------------------------|---|
| ① Country | J : Japan |
| ② Make | W : Mitsubishi Fuso |
| ③ Vehicle type | 6 : Incomplete Vehicle |
| ④ Gross vehicle weight/Brake system | C : 16001 to 19500 lbs/Hydraulic |
| ⑤ Line | C : FH211 |
| ⑥ Series (Wheelbase) | C : 2.6 to 2.89 m {8.53 to 9.48 ft.} |
| | E : 3.2 to 3.49 m {10.49 to 11.44 ft.} |
| | G : 3.8 to 4.09 m {12.46 to 13.41 ft.} |
| | H : 4.1 to 4.39 m {13.45 to 14.40 ft.} |
| | J : 4.4 to 4.69 m {14.43 to 15.38 ft.} |
| | K : 4.7 to 4.99 m {15.41 to 16.37 ft.} |
| ⑦ Cab chassis type | 1 : Chassis cab |
| ⑧ Engine | G : 5.861 l Diesel turbocharged and charge air cooled |
| ⑨ Check digit | |
| ⑩ Model year | Y : 2000 |
| ⑪ Plant | K : Kawasaki-1 |
| | L : Kawasaki-2 |
| | M : Kawasaki-3 |
| | N : Nakatsu |
| ⑫ Plant sequential number | |

GROUP 42 CAB

STRUCTURE AND OPERATION	42 - 2
TROUBLESHOOTING	42 - 4
DOOR	42 - 6

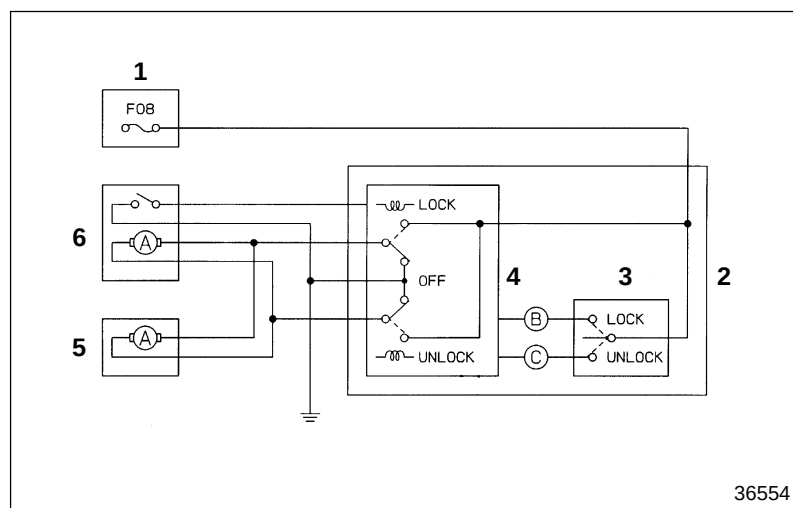
STRUCTURE AND OPERATION

Door Locking System



- 1 Door lock knob
- 2 Door lock rod
- 3 Door opening rod
- 4 Inside handle
- 5 Door lock actuator
- 6 Door lock cylinder
- 7 Door lock cylinder rod
- 8 Outside handle
- 9 Door opening rod
- 10 Door lock latch

Auto Door Lock Electric Circuit



- 1 Fuse box
- 2 Driver's side power window switch
- 3 Auto door lock switch
- 4 Door lock relay
- 5 Passenger's side door lock actuator
- 6 Driver's side door lock actuator

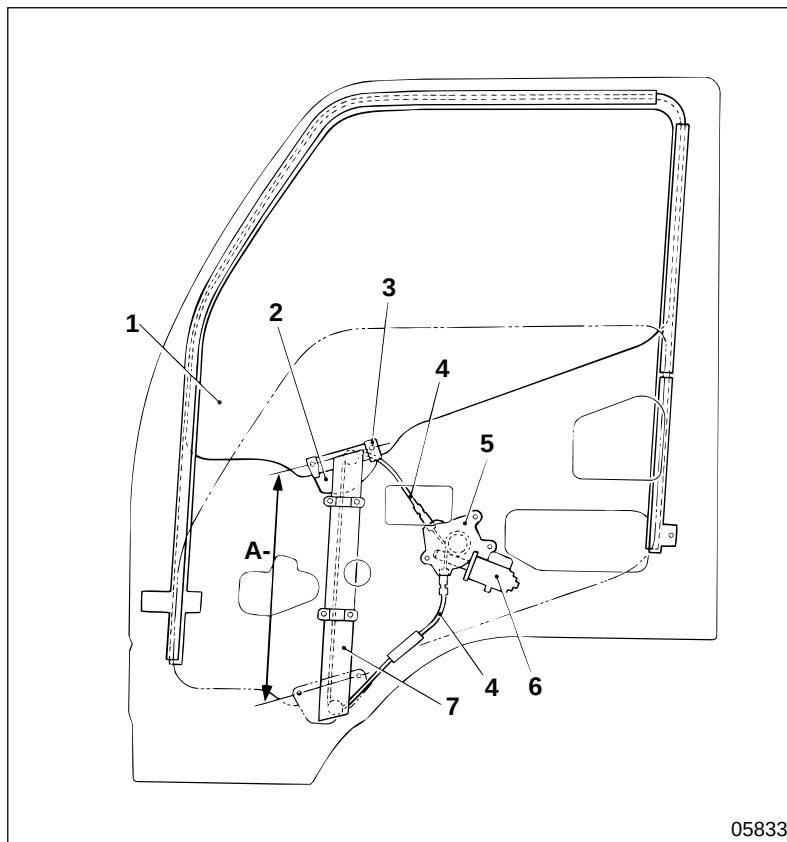
A : Actuator

Ⓑ : Lock signal

Ⓒ : Unlock signal

From the driver's side, the doors can be locked and unlocked by auto door lock switch 3 as well as by door lock actuator 6.

Door Glass Opening System

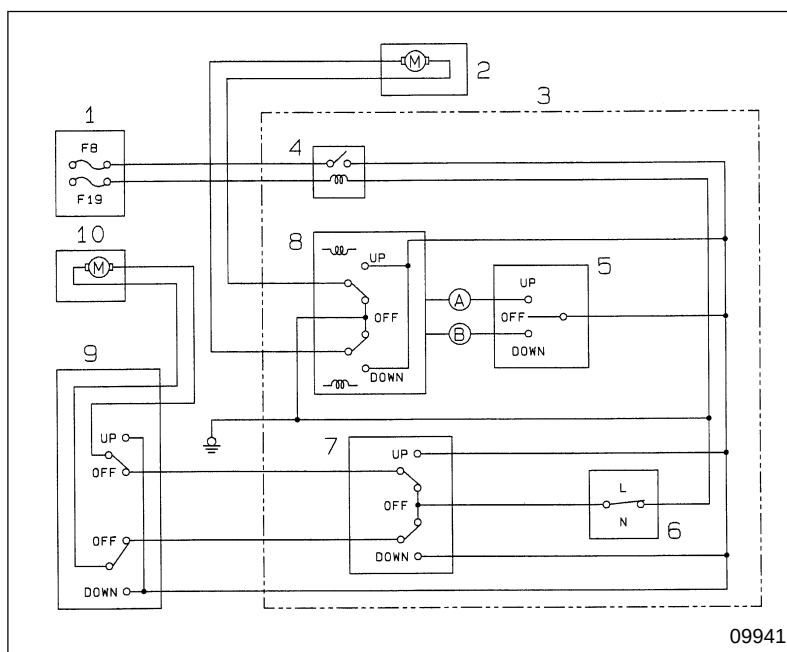


- 1 Door glass
- 2 Carrier plate
- 3 Glass holder
- 4 Cable
- 5 Regulator
- 6 Power window motor
- 7 Rail

A : Carrier plate moving range

- Both ends of cable 4 are secured to carrier plate 2, and regulator 5 is installed to the wire at a midpoint.
- Regulator 5 rotates, thus winding cable 4 and moving carrier plate 2 in a vertical direction to raise or lower door glass 1.

Power Window Electric Circuit



- 1 Fuse box
- 2 Driver's side power window motor
- 3 Driver's side power window switch assembly
- 4 Relay
- 5 Driver's side power window switch
- 6 Power window lock switch
- 7 Driver's side power window switch (for opening and closing passenger's side door glass)
- 8 Power window relay
- 9 Passenger's side power window switch
- 10 Passenger's side power window motor

M : Motor

- Ⓐ : UP signal
Ⓑ : DOWN signal

- Power window switch assembly 3 on the driver's side is integrated with power window switches 5, 7 and power window lock switch 6.
- When power window lock switch 6 is set to the LOCK position, the door glass on the passenger's side cannot be operated by power window switches 7, 9.

TROUBLESHOOTING

Door Lock

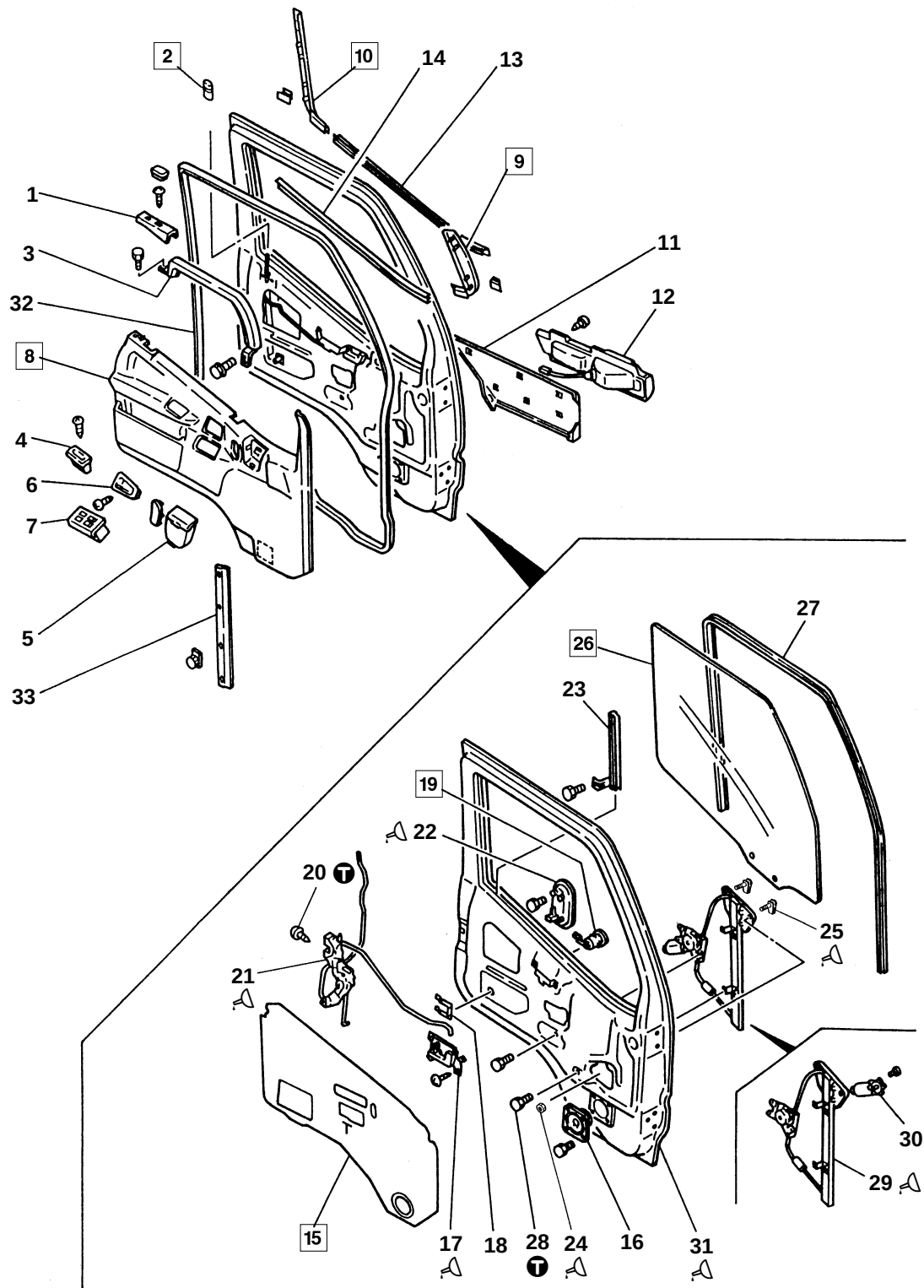
Possible causes	Symptoms								Remarks
	Door latch does not engage, and door does not close	Door does not lock when door lock knob is pressed	Door does not lock when key is turned	Remote door lock does not operate	Door does not open when outside door handle is operated	Door does not open when inside door handle is operated	Inside door handle does not return properly to original position	There is interference between door and cab	
Door installation faulty	☐							☐	
Striker installation faulty	☐								
Faulty door locking mechanism of door latch	☐	☐	☐		☐	☐			
Door latch rod deformed		☐				☐			
Door latch rod disconnected		☐	☐			☐			
Door latch rod interference							☐		
Door lock cylinder deformed			☐						
Faulty auto door lock switch in power window & door lock switch				☐					 Gr 54
Door lock actuator faulty				☐					
Fuse or high-current fuse blown				☐					
Open circuit or faulty connection of wire				☐					
Left-side outside door handle faulty					☐				
Inside door handle installation faulty						☐			
Spring fatigue in inside door handle							☐		

Power Window

Possible causes	Symptoms							Remarks
	Door window glass drops of its own accord while cruising	Abnormal noise from power window regulator while cruising	Power window does not operate	Power window does not stop	Abnormal noise while power window operating	After the starter switch has been turned OFF the window does not operate within 30 seconds of the power window switch being operated	After the starter switch has been turned OFF and although the doors have been opened within 30 seconds, the window does not operate within 30 seconds of the power window switch being operated	
Power window switch faulty			☐	☐		☐	☐	Gr 54
Power window regulator faulty	☐		☐	☐	☐			
Power window regulator mounting faulty					☐			
Fuse and high-current fuse burnt-out			☐					
Wiring broken or connection faulty			☐					
Power window glass and door belt line molding rattling		☐						

DOOR

Door Assembly



● Disassembly sequence

- | | | |
|--|---|---|
| 1 Cover | 13 Outer weather strip | 24 Nut |
| 2 Door lock knob | 14 Inner weather strip | 25 Glass holder |
| 3 Guard bar | 15 Waterproof cover | 26 Door glass |
| 4 Pull handle cover | 16 Speaker | 27 Run channel |
| 5 Ashtray | 17 Inside handle | 28 Bolt |
| 6 Inside handle cover | 18 Clip | 29 Regulator & rail assembly |
| 7 Power window switch  Gr 54 | 19 Door lock cylinder | 30 Power window motor  Gr 54 |
| 8 Door trim | 20 Screw | 31 Door panel |
| 9 Front garnish | 21 Door lock actuator  Gr 54 | 32 Weather strip |
| 10 Rear garnish | 22 Outside handle | 33 Weather strip |
| 11 Outer garnish | 23 Lower sash | |
| 12 Side combination lamp  Gr 54 | | |

● Reassembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

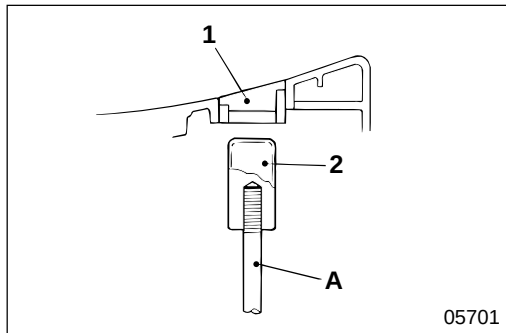
Location	Parts to be tightened	Tightening torque	Remarks
20	Screw (Door lock actuator mounting)	4 to 6 {2.9 to 4.3, 0.4 to 0.6}	—
28	Bolt (Regulator & rail assembly mounting)	6.9 to 10.8 {5.1 to 8.0, 0.7 to 1.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
17	Rotating surface of inside handle	Multipurpose grease [NLGI No.2 (Li soap)]	As required
21	Sliding surface of door lock actuator	Multipurpose grease [NLGI No.2 (Li soap)]	As required
22	Sliding surface of outside handle	Multipurpose grease [NLGI No.2 (Li soap)]	As required
24	Threads of nut	Loctite (Japan) Drylock No. 203	As required
25	Threads of glass holder bolt	Loctite (Japan) Drylock No. 203	As required
29	Sliding surfaces of regulator & rail assembly	Dynamic GB	As required
31	Waterproof cover installation surface of door panel	Butyl tape	As required

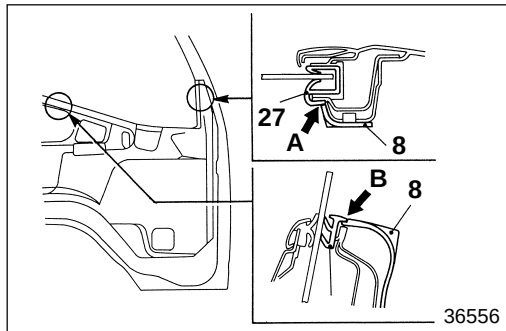
DOOR

◆ Service procedure



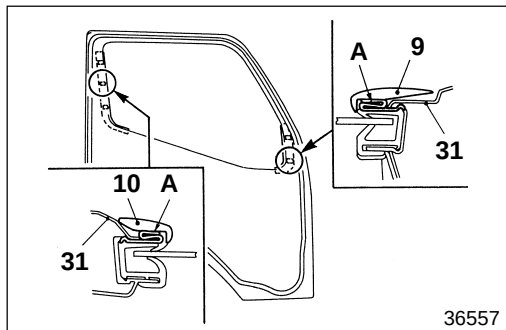
2 Installation of door lock knob

- Install door lock knob **2** to door lock rod **A** of door lock actuator **21**, and turn the knob fully in clockwise direction.
- Back off door lock knob **2** by turning it 1 or 2 turns in counterclockwise direction.
- Position cover **1** to prevent door lock knob **2** from turning.



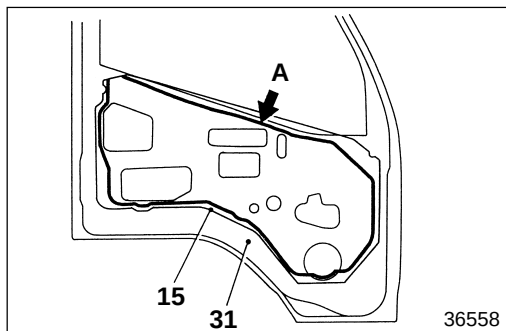
8 Installation of door trim

- On the front pillar section, install door trim **8** by pressing it to lip section **A** of run channel **27**.
- On the belt line section, install door trim **8** by pressing it to lip section **B** of inner weather strip **14**.



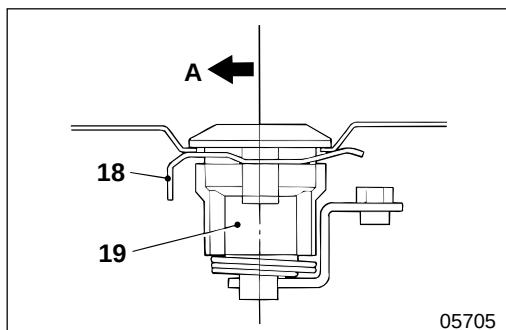
9 10 Installation of front and rear garnishes

- Install clips **A** to door panel **31** prior to the installation of the garnishes.
- Install front garnish **9** and rear garnish **10** to clips **A**.



15 Installation of waterproof cover

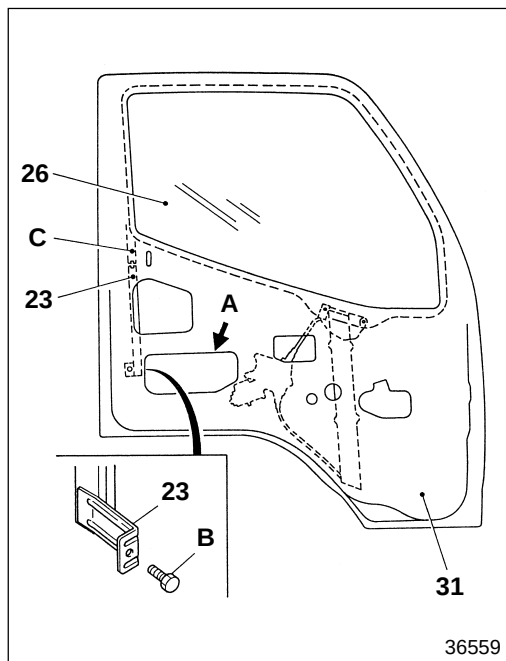
- Apply butyl tape **A** to door panel **31**, as indicated in the illustration.
- Install waterproof cover **15** by pasting onto butyl tape **A**.



19 Installation of door lock cylinder

Install door lock cylinder **19** to clip **18** in the direction indicated in the illustration.

A : Vehicle front side

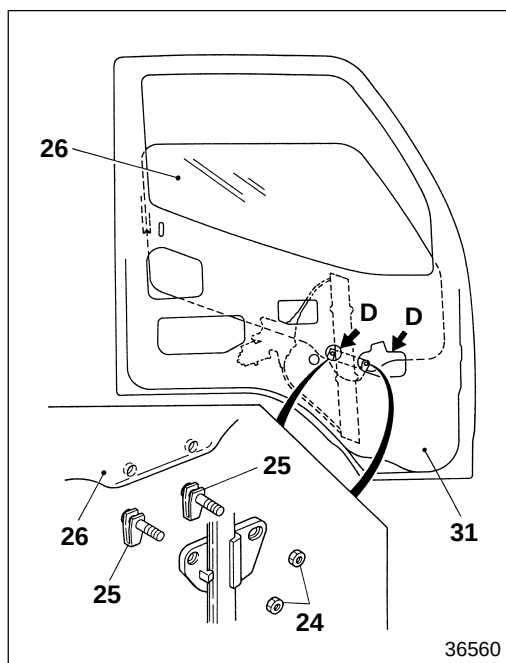


26 Removal and installation of door glass

Remove all parts supporting door glass **26**, then remove the door glass through the open space in the door.

- Pull door glass **26** all the way to the top.
- Remove bolt **B** through hole **A** in door panel **31**, and remove lower sash **23**.

Note that the lower sash is inserted in upper sash **C**.



- Lower door glass **26** until nut **24** becomes visible through hole **D** in door panel **31**.
- Support door glass **26** by hand, then remove glass holder **25**.
- Remove door glass **26** through the open space in the door.
- To install door glass **26**, follow the removal procedure in reverse.

MEMO

GROUP 54 ELECTRICAL

1 POWER, CHARGE AND GROUND

SPECIFICATIONS	54-3
STRUCTURE AND OPERATION	54-3
TROUBLESHOOTING	3
(100) ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection of Alternator	3
• Inspection of Regulator	3
(101) BATTERY	1
(104) FUSE	54-4
(106) ALTERNATOR	54-6
(110) POWER CIRCUIT	54-12
(115) RESERVE POWER CIRCUIT	54-14
(125) BATTERY CHARGING CIRCUIT	3
(130) GROUND	3

2 STARTING, PREHEATING AND STOPPING ENGINE

SPECIFICATIONS	1
STRUCTURE AND OPERATION	1
TROUBLESHOOTING	1
(200) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Inspection of Engine Preheating System	1
(201) STARTER	1
(210) ENGINE STARTING CIRCUIT	
< Manual Transmission >	54-16
< Automatic Transmission >	54-18
(220) ENGINE PREHEATING CIRCUIT	
< Manual Transmission >	3
< Automatic Transmission >	2

3 LIGHTING

SPECIFICATIONS	1
STRUCTURE AND OPERATION	1
TROUBLESHOOTING	1
(300) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Headlamp Aiming	1
(310) HEADLAMP CIRCUIT	1
(313) DAYTIME RUNNING LIGHT CIRCUIT	54-20
(320) TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS	3
(325) STOP LAMP CIRCUIT	3
(330) TURN SIGNAL LAMP AND HAZARD LAMP CIRCUITS	1
(340) BACKUP LAMP CIRCUIT	1
(345) CAB LAMP CIRCUIT	4
(348) ILLUMINATION LAMP CIRCUIT	1
(349) MARKER LAMP AND IDENTIFICATION LAMP CIRCUITS	1
(352) VAN BODY DOME LIGHT CIRCUIT	3

4 METER

SPECIFICATIONS	1
TROUBLESHOOTING	1
(401) METER CLUSTER	54-24
(410) SPEEDOMETER AND TACHOMETER CIRCUIT	1
(420) FUEL GAUGE CIRCUIT	1
(425) WATER TEMPERATURE GAUGE CIRCUIT	1

5 INDICATOR AND WARNING

TROUBLESHOOTING	3
(500) ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection of Brake Fluid Level Switch	3
• Inspection of Power Steering Fluid Level Sensor	3
(510) PARKING BRAKE INDICATOR CIRCUIT 	4
(515) BRAKE WARNING CIRCUIT 	4
(530) WATER LEVEL WARNING CIRCUIT 	3
(536) ENGINE OIL PRESSURE WARNING CIRCUIT 	4
(537) OVERHEATING WARNING CIRCUIT 	3
(547) AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT 	3
(549) POWER STEERING FLUID LEVEL WARNING CIRCUIT 	3
(550) CAB TILT WARNING CIRCUIT 	1

6 CAB SIDE ELECTRICAL

SPECIFICATIONS	3
TROUBLESHOOTING	3
(601) SWITCH	1
(604) RELAY AND CONTROL UNIT	1
(606) WARNING BUZZER	1
(610) CIGARETTE LIGHTER CIRCUIT	1
(612) AUDIO CIRCUIT	1
(614) WIPER AND WASHER CIRCUIT	1
(616) HORN CIRCUIT	3
(618) HEATER CIRCUIT	1
(622) POWER WINDOW AND AUTO DOOR LOCK CIRCUIT	54-26

- 1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
- 2 : '97 Model Gr 54 (Pub. No. TWME9502-1)
- 3 : '98 Model Gr 54 (Pub No. TWME9502-254)
- 4 : '99 Model Gr 54 (Pub No. TWME9502-3)

7 CHASSIS ELECTRICAL

(701) MAGNETIC VALVE	
< Manual Transmission >	3
(710) EXHAUST BRAKE CIRCUIT	
< Manual Transmission >	54-30

8 ENGINE AND TRANSMISSION ELECTRICS

(801) ENGINE ELECTRICS	1
(802) TRANSMISSION ELECTRICS	
< Manual Transmission >	1
< Automatic Transmission >	1
(850) TRANSMISSION POWER TAKE-OFF CIRCUIT	
< Option >	1

9 OTHERS

STRUCTURE AND OPERATION	2
(905) JOINT CONNECTOR	3
(910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT	2

SPECIFICATIONS/STRUCTURE AND OPERATION

54

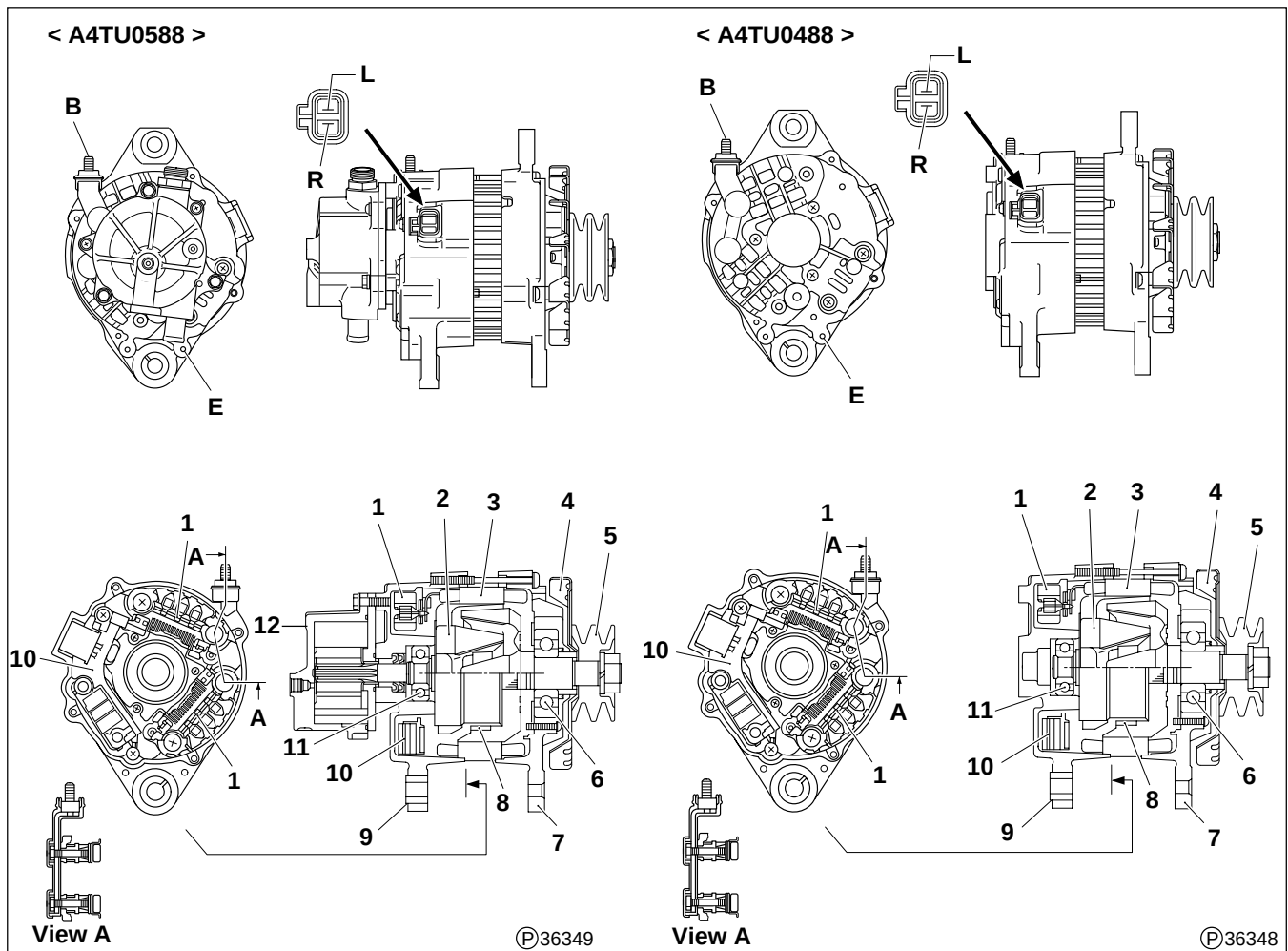
This chapter contains information on the alternator. Items not covered in this chapter are the same as those of '99 model.

SPECIFICATIONS

Item		Specifications	
Alternator	Manufacturer	MITSUBISHI ELECTRIC	
	Type	Alternator with built-in regulator (without brush external fan)	
	Vacuum pump	Without	With
	Model	A4TU0488	A4TU0588
	Output	V-A	12-100

STRUCTURE AND OPERATION

Alternator



104 FUSE

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	—
	For ABS	★ 140 A
		★ 50 A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50 A
FH2	Fuse box (F5 to F8, F11)	40 A
FH3	Brake booster (Hydraulic booster)	★ 30 A
FH4	Starter switch (Terminal B)	50 A
FH5	Glow relay	50 A
FH6	Alternator	★ 140 A
FH7	Fuse box (F31 to F34)	40 A
FH8	★ ABS hydraulic unit	★ 40 A

Fuse box

Fuse No.	Main load	Capacity
F1	Headlamp, LH	15 A
F2	Headlamp, RH	15 A
F3	Stop lamp, horn	15 A
F4	Turn signal lamp	15 A
F5	—	—
F6	Cab lamp	10 A
F7	Van body dome light	10 A
F8	A/T fluid cooler fan relay	20 A
F9	—	—
F10	★ Power window	★ 25 A
F11	Reserve power (BATT)	10 A
F12	—	—
F13	★ Cigarette lighter	15 A
F14	Radio	10 A
F15	Reserve power (ACC)	10 A
F16	—	—
F17	★ —	★ —

Fuse No.	Main load	Capacity
F18	Starter	10 A
F19	Backup lamp	10 A
F20	Meter cluster, ★ DRL	10 A
F21	Wiper	10 A
F22	Engine control (ECU)	★ 10 A
F23	—	—
F24	★ ABS	★ 10 A
F25	★ Option (MAIN)	★ 10 A
F26	—	—
F27	Exhaust brake, A/T	10 A
F28	Transmission PTO	10 A
F29	Pre-stroke cut relay (Engine control)	10 A
F30	★ Air-conditioner control	10 A
F31	★ Air-conditioner compressor	10 A
F32	★ Condenser fan	15 A
F33	Blower fan	25 A
F34	Tail lamp	★ 20 A

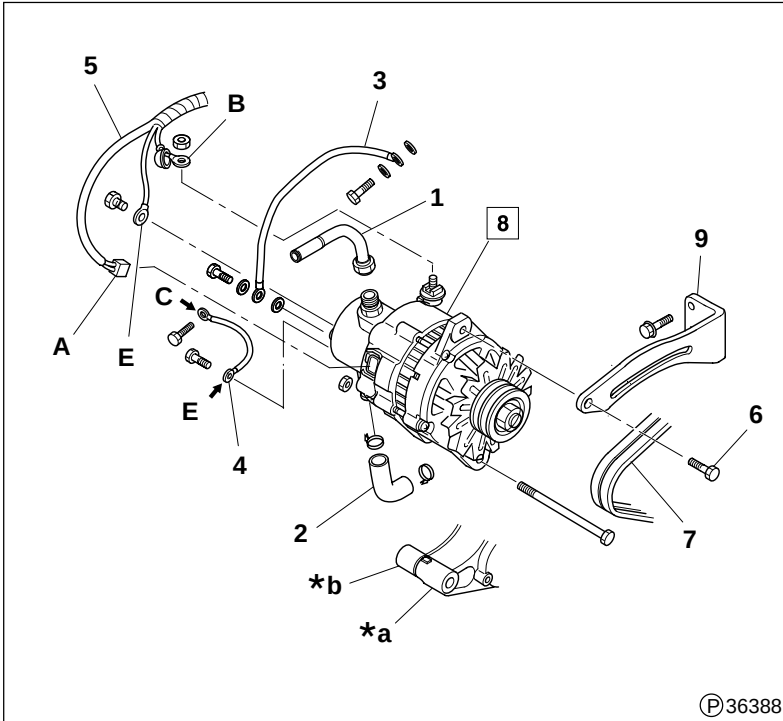
★ : Fuses are provided for these pieces of equipment only where they are installed.

PTO : Power take-off
A/T : Automatic transmission
DRL : Daytime running light
ABS : Anti-lock brake system

★ marks indicate changed parts or added parts.

MEMO

106 ALTERNATOR



● Removal sequence

- 1 Vacuum pipe
- 2 Oil return hose
- 3 Oil inlet hose
- 4 Ground cable
- 5 Chassis harness
- 6 Adjusting bolt
- 7 V-belts
- 8 Alternator P54-8
- 9 Adjusting plate

*a : Timing gear case and front plate

Gr 11

*b : Power steering oil pump

A : To terminals L and R

B : To terminal B

C : Connected to crankcase

E : To terminal E

WARNING

- Terminal B is always loaded with voltage from the battery, supplied via chassis harness 5. Therefore when you remove the harness from terminal B, make sure that tools do not touch any adjacent parts because this would cause a short-circuit.
- Make sure that you disconnect terminal of the battery before removing the harness and insulate the terminal with tape.

● Installation sequence

Follow the removal sequence in reverse.

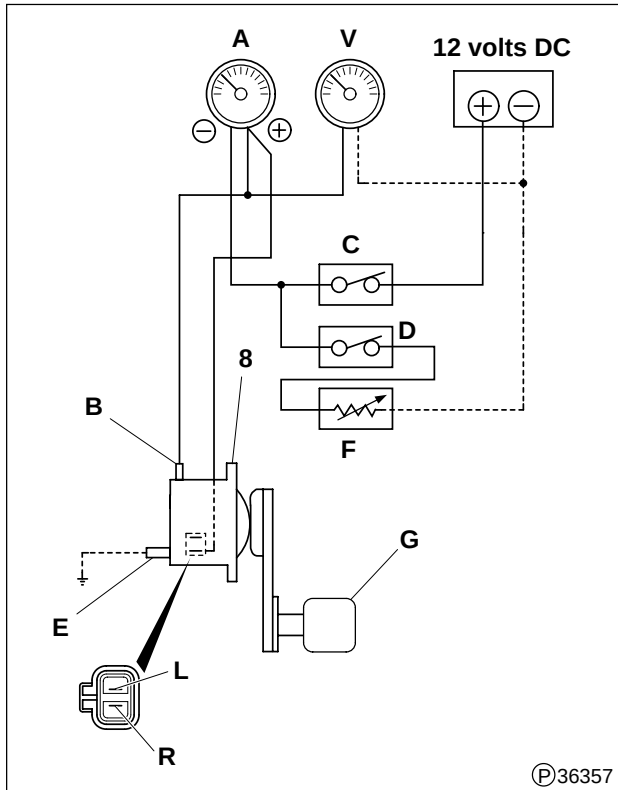
● Adjustment after installation

Adjustment of V-belt 7 tension Gr 14

Service standards

Location	Maintenance item			Standard value	Limit	Remedy
8	Output current (★ When engine is hot and 13.5 V is loaded)	Without vacuum pump	At 1500 rpm	53 A or more	—	Inspect
			At 2500 rpm	84 A or more	—	
			At 5000 rpm	102 A or more	—	
		With vacuum pump	At 1500 rpm	51 A or more	—	Inspect
			At 2500 rpm	81 A or more	—	
			At 5000 rpm	98 A or more	—	
	Adjustment voltage of regulator (At 5000 rpm, 5 A is loaded)			14.7±0.3 V	—	Replace

* : The value of the ambient temperature is measured after running the alternator drive motor at maximum power (5000 rpm) for 30 minutes.



8 Inspection of alternator

(1) Inspection of alternator performance (bench test)

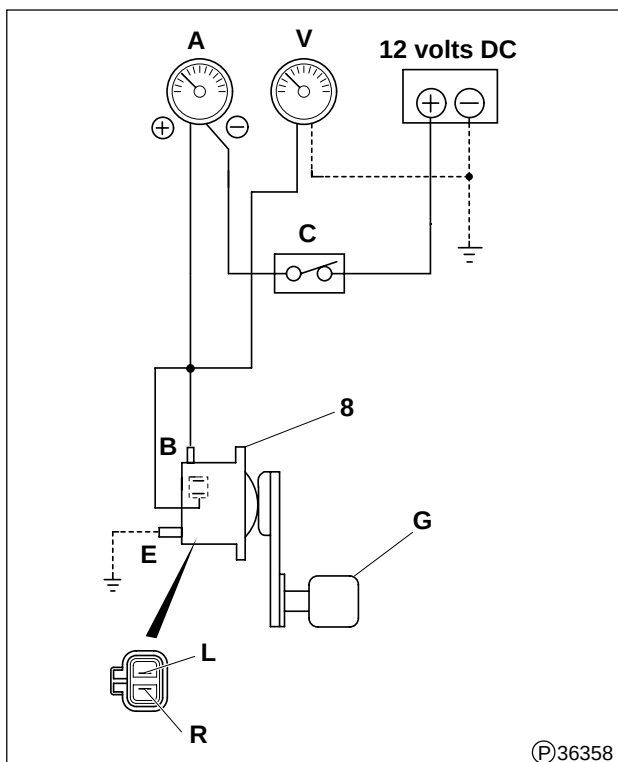
- Connect each unit to alternators **8** as illustrated.

CAUTION ⚠

Use sufficiently thick wires for the wiring and make sure all connecting parts are securely connected.

- A : Ammeter
- B : Terminal B on alternator
- C : Switch
- D : Switch
- E : Terminal E on alternator
- F : Load resistance (variable resistance)
- G : Alternator drive motor
- L : Terminal L on alternator
- R : Terminal R on alternator
- V : Voltmeter

- Maximize load resistance **F** (load current hardly flows).
- Turn switches **C**, **D** ON.
With the alternator **8** rotating at 5000 rpm, adjust load resistance **F** to the current specified in the Service Standards table. Then, operate the alternator for 30 minutes.
Specified output of the alternator : Approx. 100 A
- Increase the rotation of alternator **8** gradually and measure current at specified rpm.
- If the measured value deviates from the standard value, disassemble and inspect alternator **8**. 📖 P54-8



(2) Inspection of regulator (bench test)

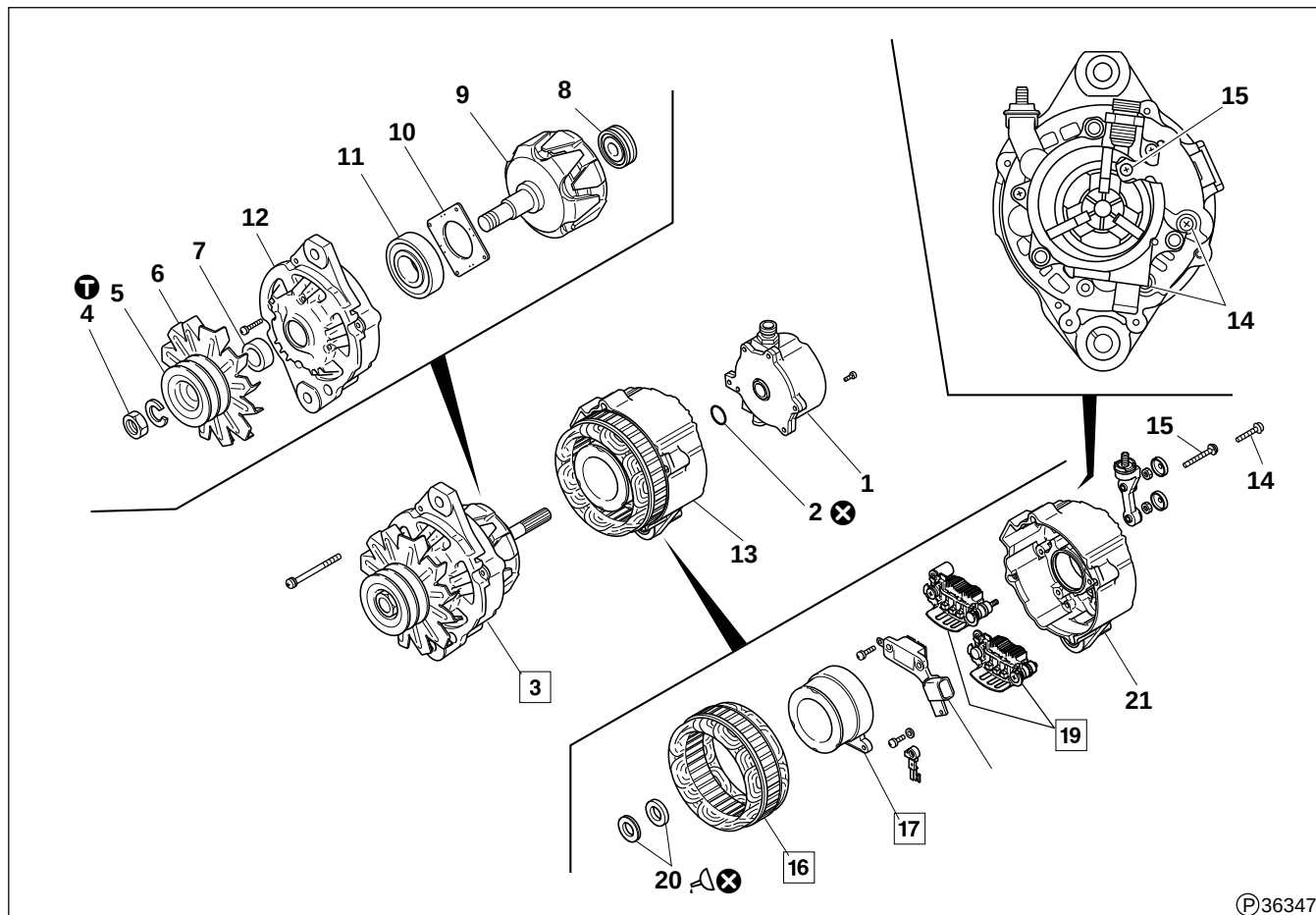
- Connect each unit to the alternators as illustrated.

- A : Ammeter
- B : Terminal B on alternator
- C : Switch
- E : Terminal E on alternator
- G : Alternator drive motor
- L : Terminal L on alternator
- R : Terminal R on alternator
- V : Voltmeter

- Turn switch **C** ON.
- Run alternator **8** at low speed.
- Measure the voltage (adjustment voltage) when alternator **8** has reached a speed of 5000 rpm. Make sure at such time that the value of the current is five amperes or less.
- If the measured value deviates from the standard value, perform either of the following.
 - If the measured value is higher than the standard value : Replace the regulator
 - If the measured value is lower than the standard value : Before replacing the regulator check the alternator area.

106 ALTERNATOR

Alternator



Ⓟ36347

● Disassembly sequence

- | | |
|---|-------------------------------------|
| 1 Vacuum pump  Gr 35 | 13 Stator and rear bracket assembly |
| 2 O-ring | 14 Screw |
| 3 Rotor and front bracket assembly | 15 Screw |
| 4 Nut | 16 Field coil |
| 5 Pulley | 17 Stator assembly |
| 6 Fan | 18 Regulator |
| 7 Spacer | 19 Rectifier |
| 8 Rear bearing | 20 Oil seal |
| 9 Rotor assembly | 21 Rear bracket |
| 10 Cover | |
| 11 Front bearing | |
| 12 Front bracket | |
- ⊗ : Non-reusable parts

CAUTION

When removing field coil 16, support the field coil by hand or with a stand to prevent it from falling due to its own weight.

NOTE

Do not remove parts 8, 11, 16 unless they are faulty.

Alternator without vacuum pump is not equipped with parts 1 and 2.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
16	Field coil resistance (20°C {68°F})	2.0 to 2.4 Ω	—	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (Pulley mounting)	132 to 162 {98 to 120, 13.5 to 16.5}	—

Lubricant

Location	Points of application	Specified lubricant	Quantity
20	Oil seal lip area	Idemitsu Autolux or lubricant supplied with oil seal	As required

Service procedure

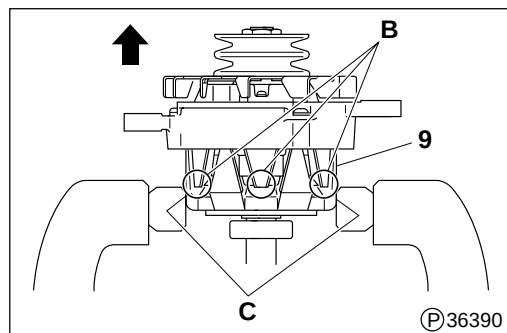
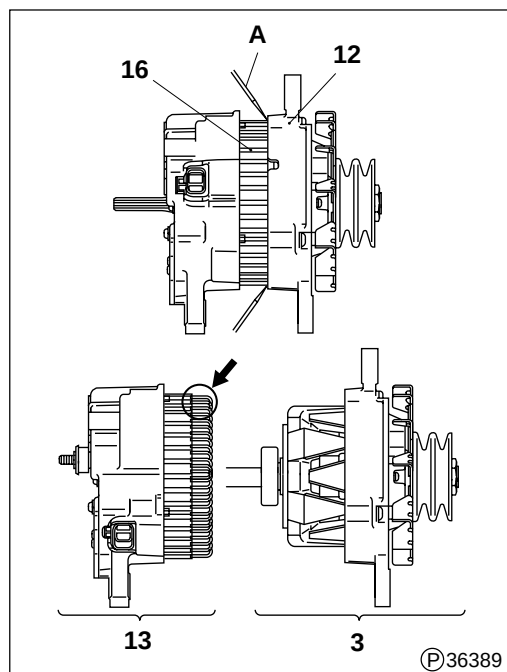
3 Rotor and front bracket assembly

[Removal]

- Insert screwdriver **A** between front bracket **12** and stator assembly **17**.
- Use screwdriver **A** to pry rotor and front bracket assembly **3** away from stator and rear bracket assembly **13**.

CAUTION

Be careful not to insert the screwdriver too deep or it will damage coil **B** of stator assembly **17** and might cause a short-circuit.

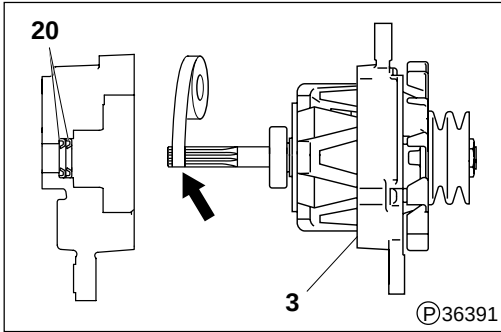


[Disassembly]

CAUTION

Make sure, when you hold rotor assembly **9** in a vise, to grip root **C** of the core claws. Gripping claws **D** can damage them.

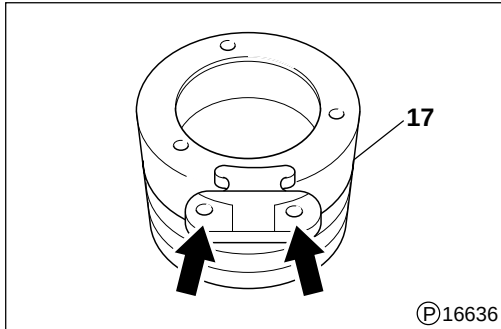
106 ALTERNATOR



[Installation]

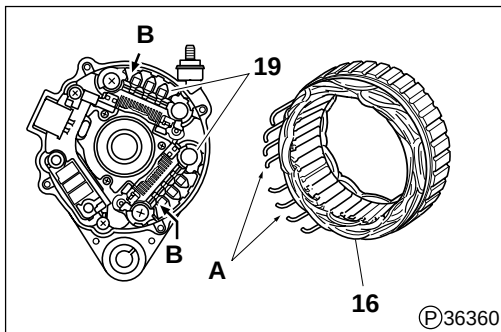
CAUTION ⚠

To prevent damaging oil seal 20 during assembly, cover spline area E of the shaft of rotor and front bracket assembly 3 with tape.



17 Inspection of stator

- Measure the resistance between the terminals of field coil 17.
- If the measured value deviates from the standard value, replace stator 17.



16 Field coil assembly

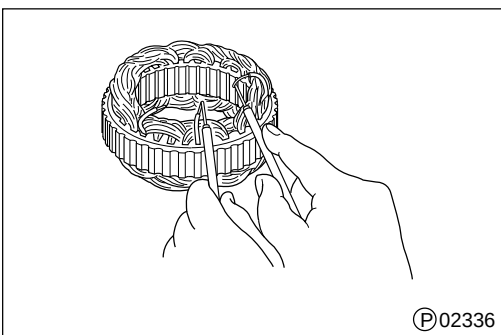
[Removal and installation]

- Disconnect lead A of field coil assembly 16 from rectifier 19. The lead is soldered to diode B of rectifier 19 at eight points. (Each of the two rectifiers has 4 soldered sections.)

CAUTION ⚠

Make sure that you desolder within five seconds because the diode is heat sensitive.

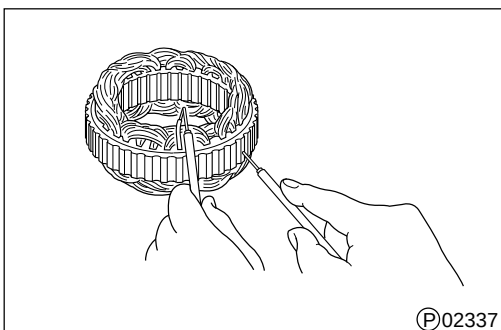
- To install, follow the removal sequence in reverse.



[Inspection]

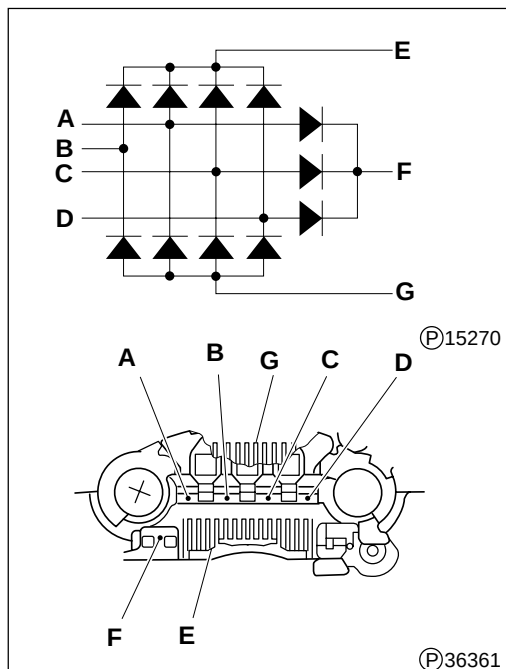
(1) Continuity of each lead wire

- Check electrical conductivity between individual lead wires of the four wires soldered to each rectifier.
- If there is no continuity, the lead wire is broken. Replace field coil assembly 16.



(2) Continuity between lead wires and the core

- Make sure that there is no continuity between all lead wires and the core.
- If there is continuity, replace field coil assembly 16, since it might be short-circuited.



19 Inspection of rectifier

- Inspect whether the diode inside rectifier **19** functions properly, and if any fault is found, replace the rectifier.
 Infinite resistance in both.....Open circuit
 Near-zero Ω resistance in both.....Short circuit
A, B, C, D : Lead connecting area of stator coil
E, G : 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.

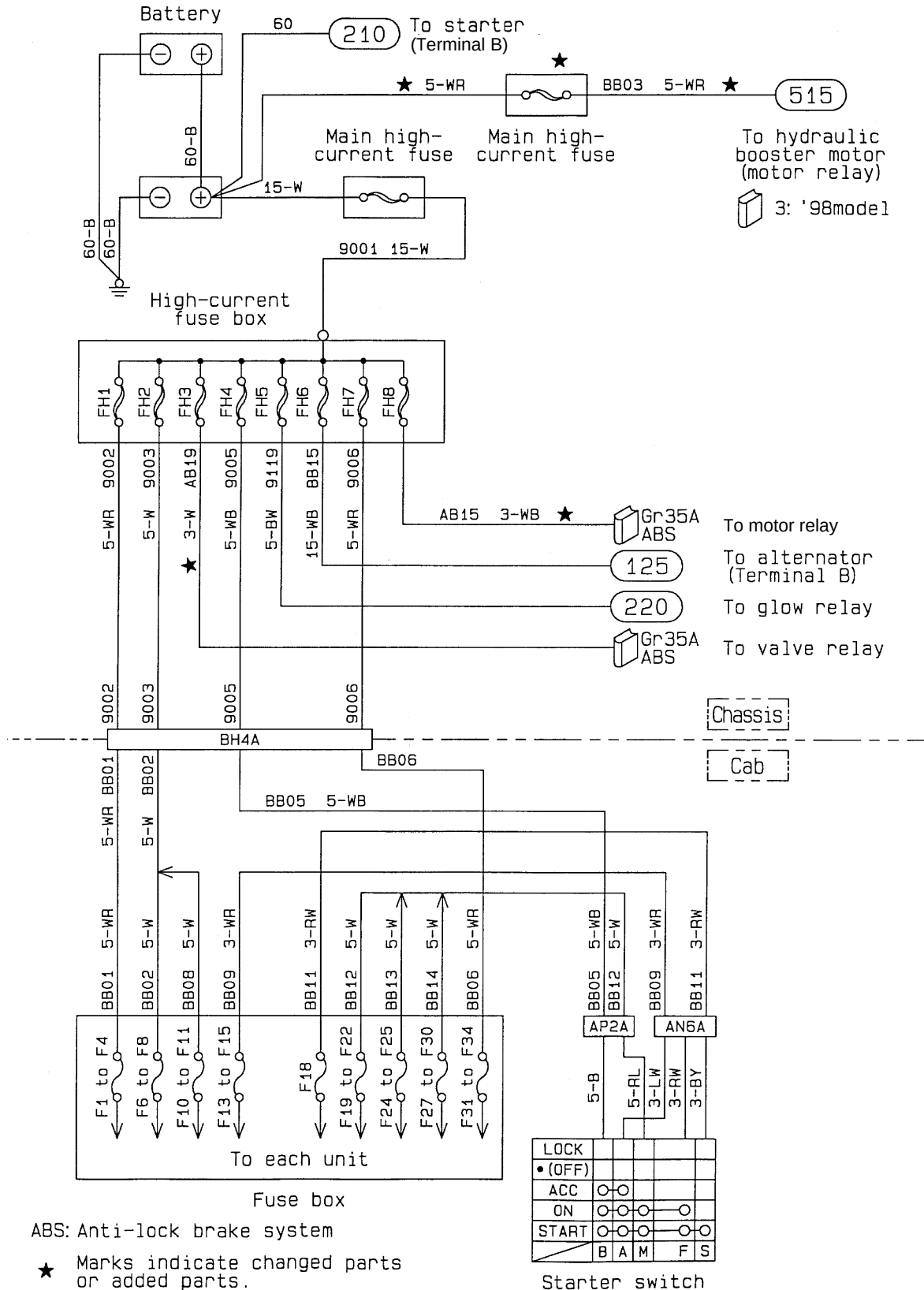
CAUTION

When inspecting using a tester, the current becomes weaker than the usual current flowing through rectifier **19**. Therefore, an incomplete resistance value might be indicated.

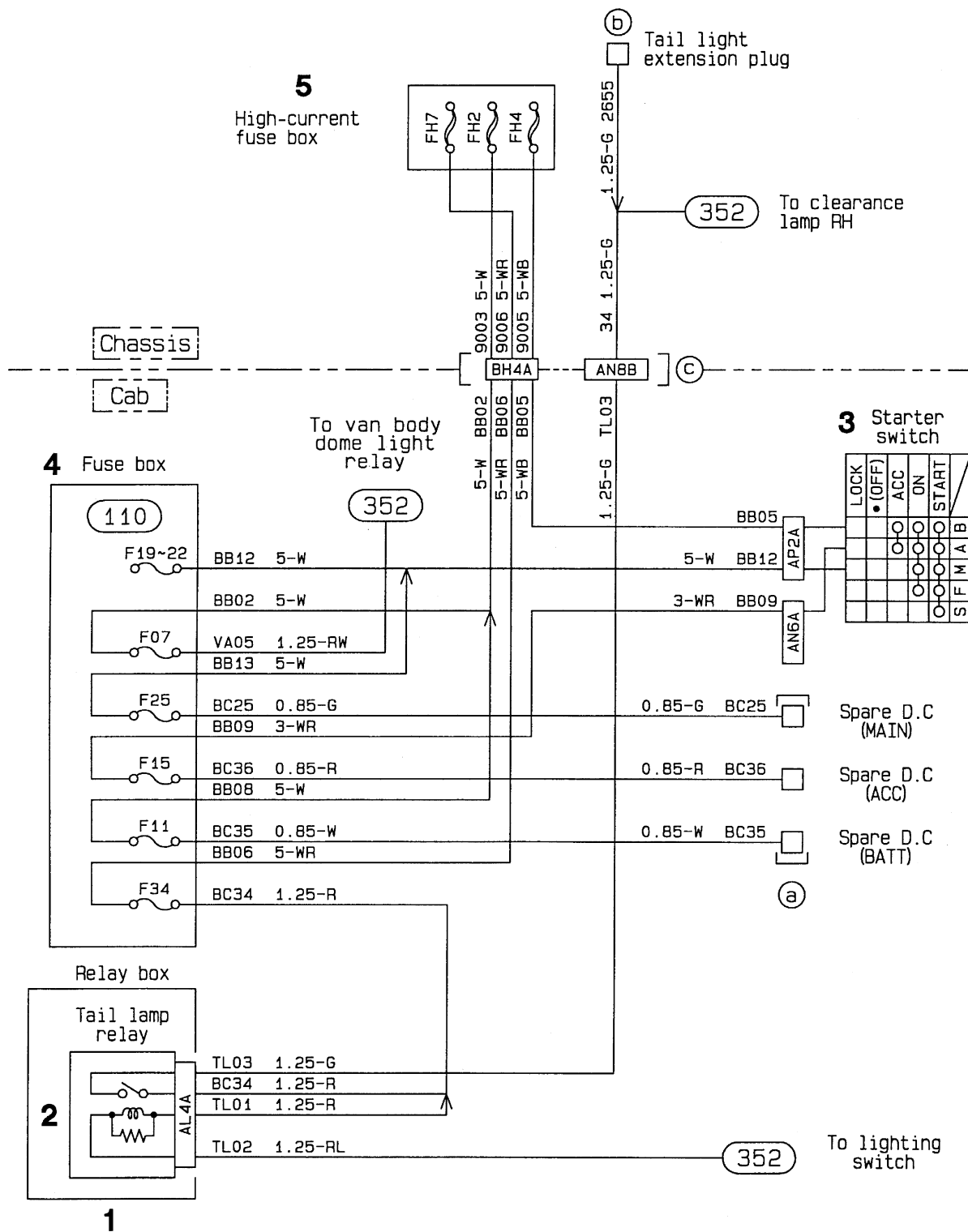
Also, this tendency increases as the range of the tester gets smaller. Therefore, use as large range as possible.

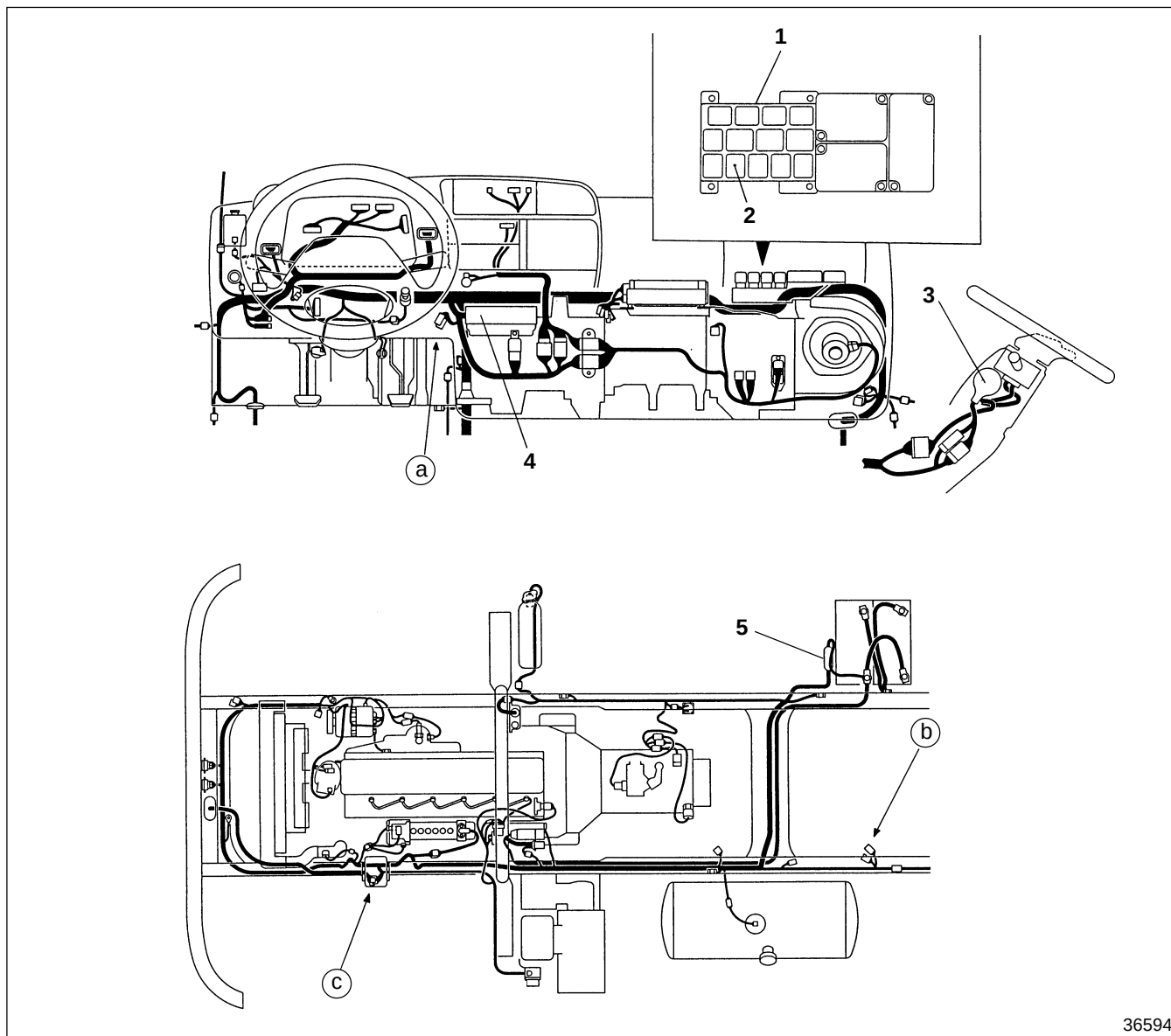
110 POWER CIRCUIT

Power Supply (Battery to High-current Fuse Box and Fuse Box)



MEMO

115 RESERVE POWER CIRCUIT



36594

- 1 Relay box  1 (604)
- 2 Tail lamp relay  1 (604)
- 3 Starter switch  1 (210)
- 4 Fuse box  (104)
- 5 Main high-current fuse box  (104)
- 6 Battery  1 (101)
- 7 High-current fuse box  (104)

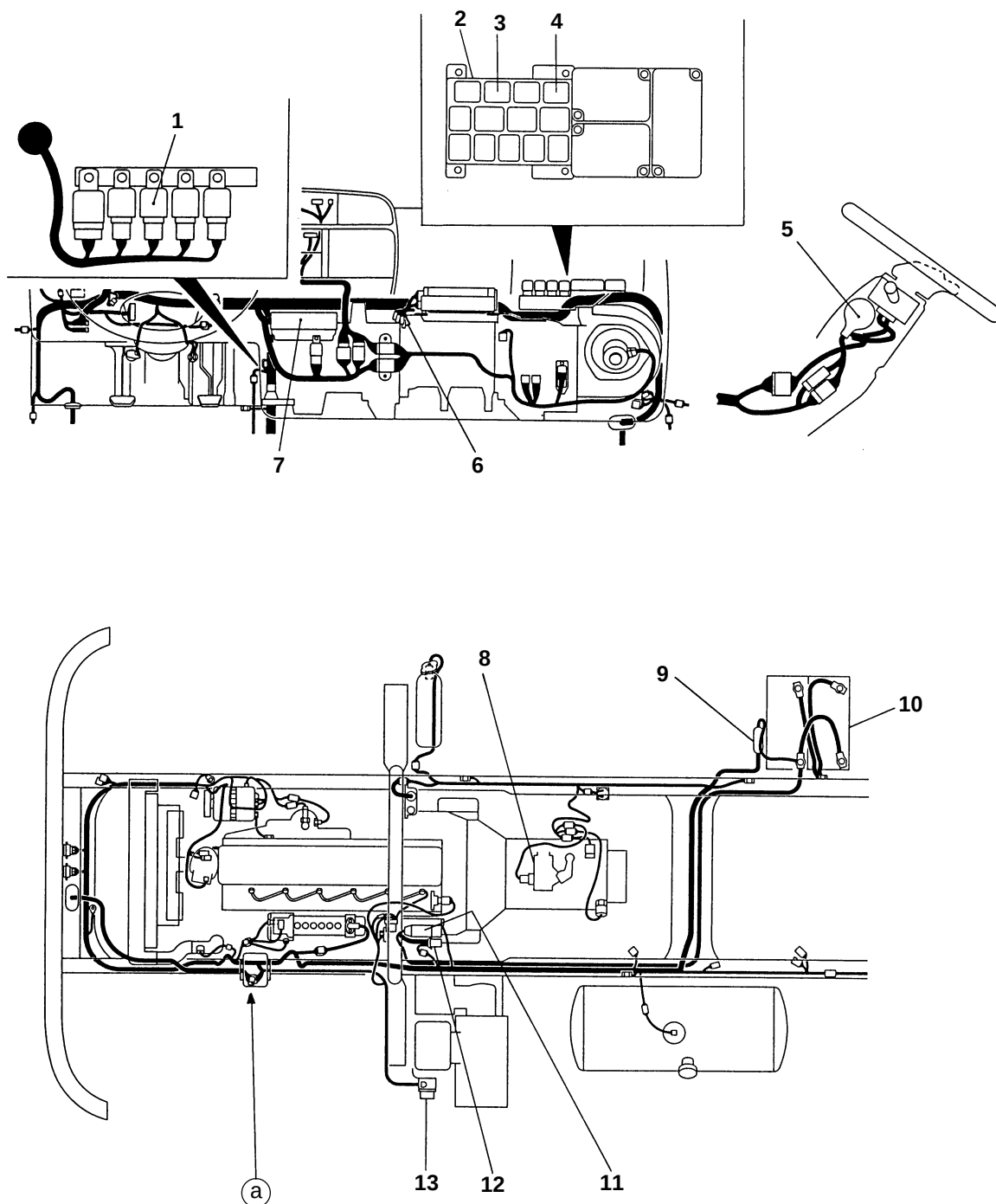
For information on the following equipment, refer to the manuals indicated.

- Transmission power take-off  1 (850)
- Van body dome light  3 (352)
- Air-conditioner  1 (618)

 1 : '96 model Gr 54 (TWME 9502-54)

 3 : '98 model Gr 54 (TWME 9502-254)





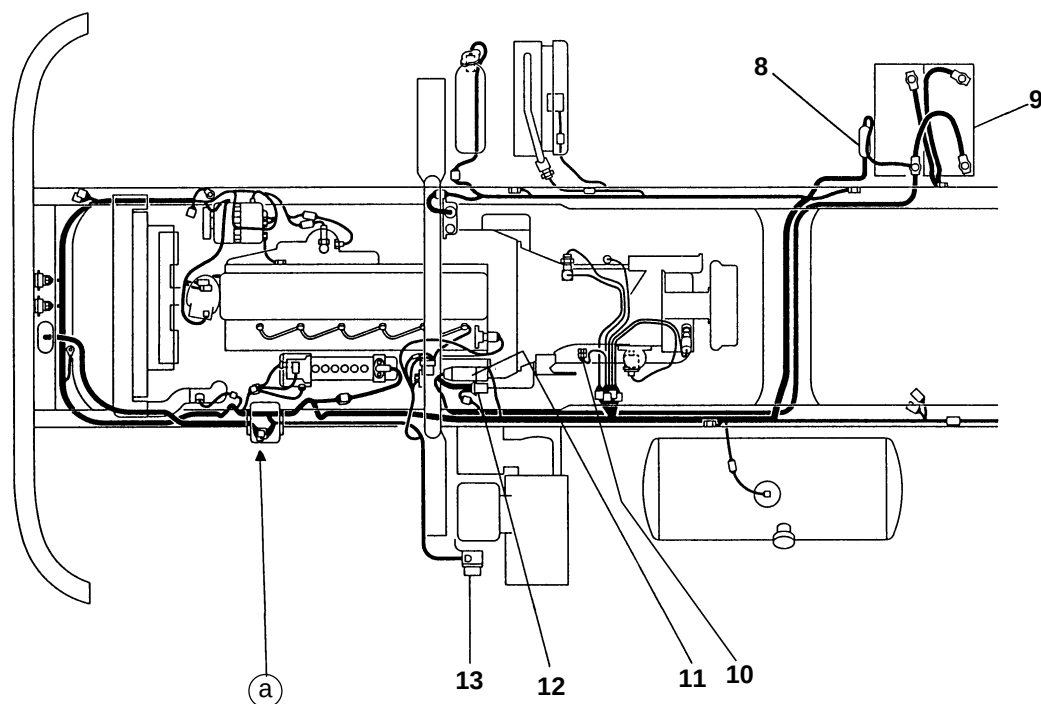
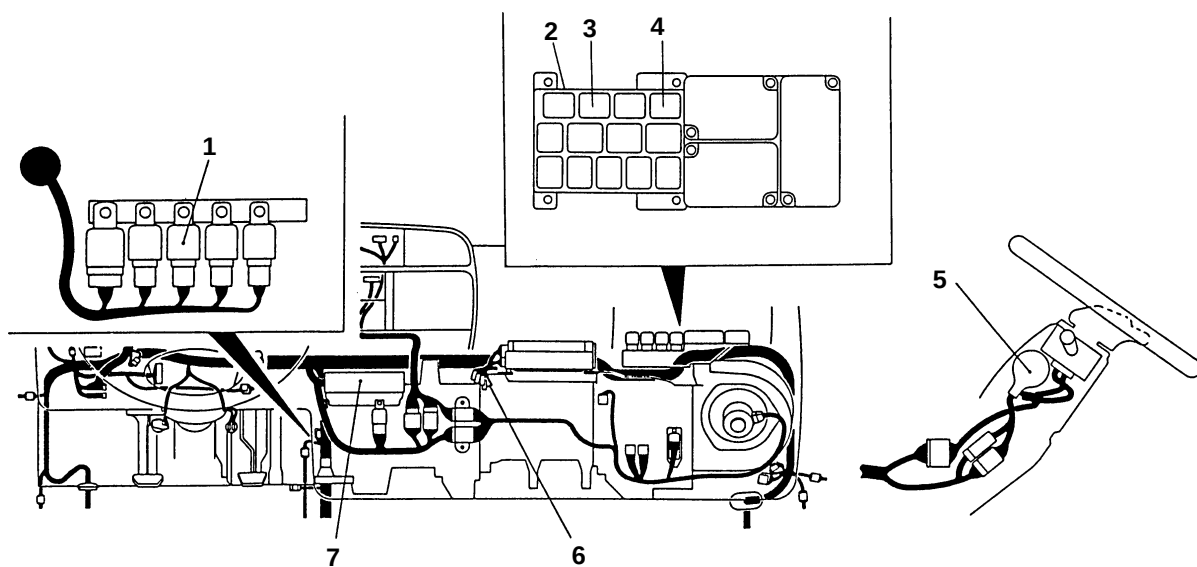
36595

- 1 Neutral start relay 1 (604)
- 2 Relay box 1 (604)
- 3 Transmission neutral relay 1 (604)
- 4 Over run relay 1 (604)
- 5 Starter switch 1 (210)
- 6 Diode
- 7 Fuse box 104

- 8 Transmission neutral switch 1 (802)
- 9 Main high-current fuse box 104
- 10 Battery 1 (101)
- 11 Starter 1 (201)
- 12 Starter relay 1 (210)
- 13 High-current fuse box 104

1 : '96 Model Gr 54 (Pub. No. TWME9502-54)



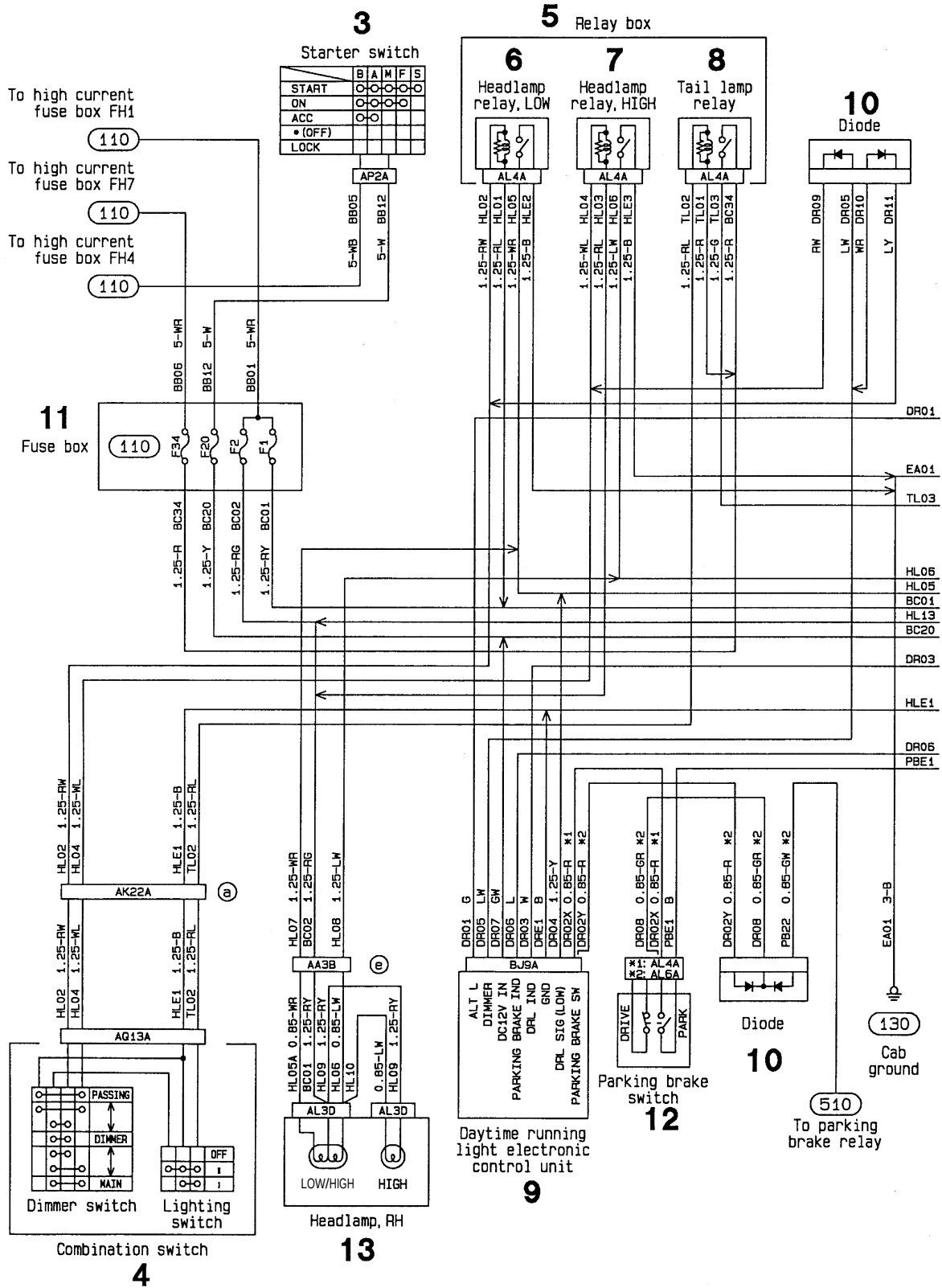


36596

- | | |
|--------------------------------------|--|
| 1 Neutral start relay 1 (604) | 8 Main high-current fuse box 1 (104) |
| 2 Relay box 1 (604) | 9 Battery 1 (101) |
| 3 Transmission neutral relay 1 (604) | 10 Transmission neutral switch 1 (802) |
| 4 Over run relay 1 (604) | 11 Starter 1 (201) |
| 5 Starter switch | 12 Starter relay |
| 6 Diode | 13 High-current fuse box 1 (104) |
| 7 Fuse box 1 (104) | |

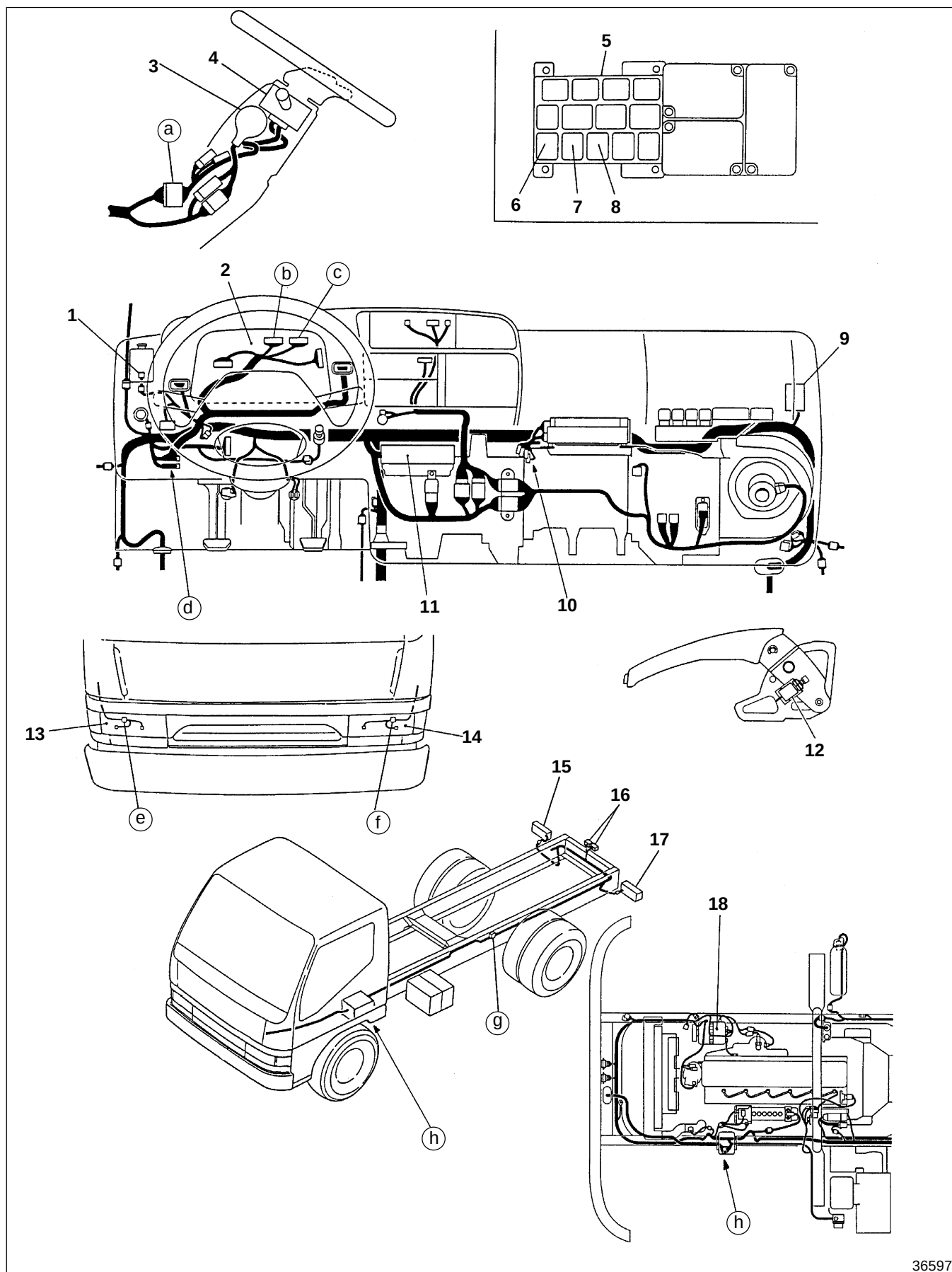
1 : '96 Model Gr 54 (Pub. No. TWME9502-54)

313 DAYTIME RUNNING LIGHT CIRCUIT





313 DAYTIME RUNNING LIGHT CIRCUIT

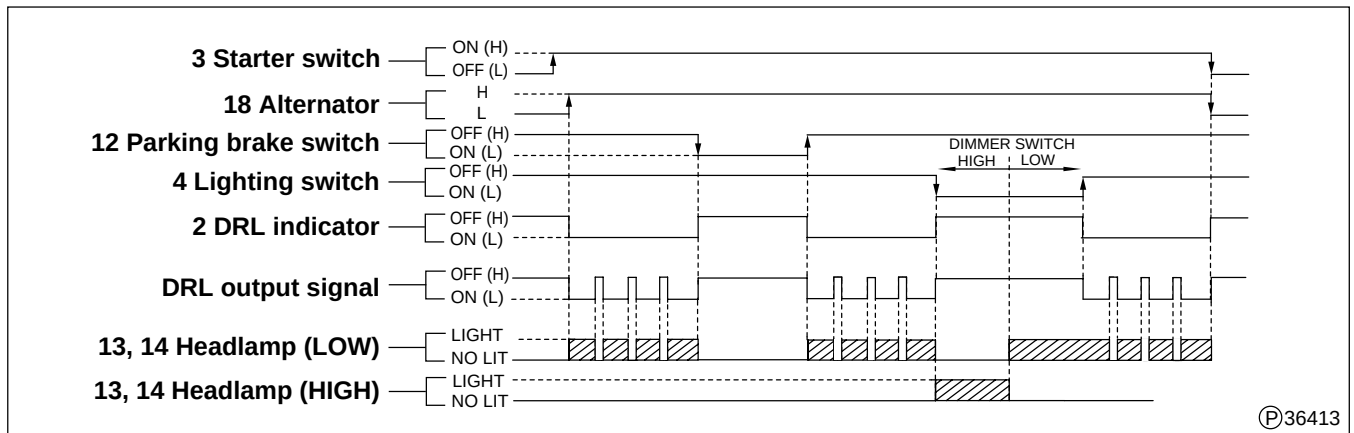


36597

- 1 Brake fluid level switch  1 (515)
- 2 Meter cluster  (401)
- 3 Starter switch  1 (210)
- 4 Combination switch  1 (601)
- 5 Relay box  3 (604)
- 6 Headlamp relay, LOW  3 (604)
- 7 Headlamp relay, HIGH  3 (604)
- 8 Tail lamp relay  3 (604)
- 9 Daytime running light control unit
- 10 Diode
- 11 Fuse box  (104)
- 12 Parking brake switch  1 (510)
- 13 Headlamp, RH
- 14 Headlamp, LH
- 15 Rear combination lamp, RH
- 16 License plate lamp
- 17 Rear combination lamp, LH
- 18 Alternator  (106)

 1 : '96 Model Gr 54 (Pub No. TWME9502-54)

 3 : '99 Model Gr 54 (Pub No. TWME9502-3)



[Outline]

The daytime running light system (DRL) turns on head lamps **13, 14** in low beam as soon as the engine starts even if the light switch is in the OFF position.

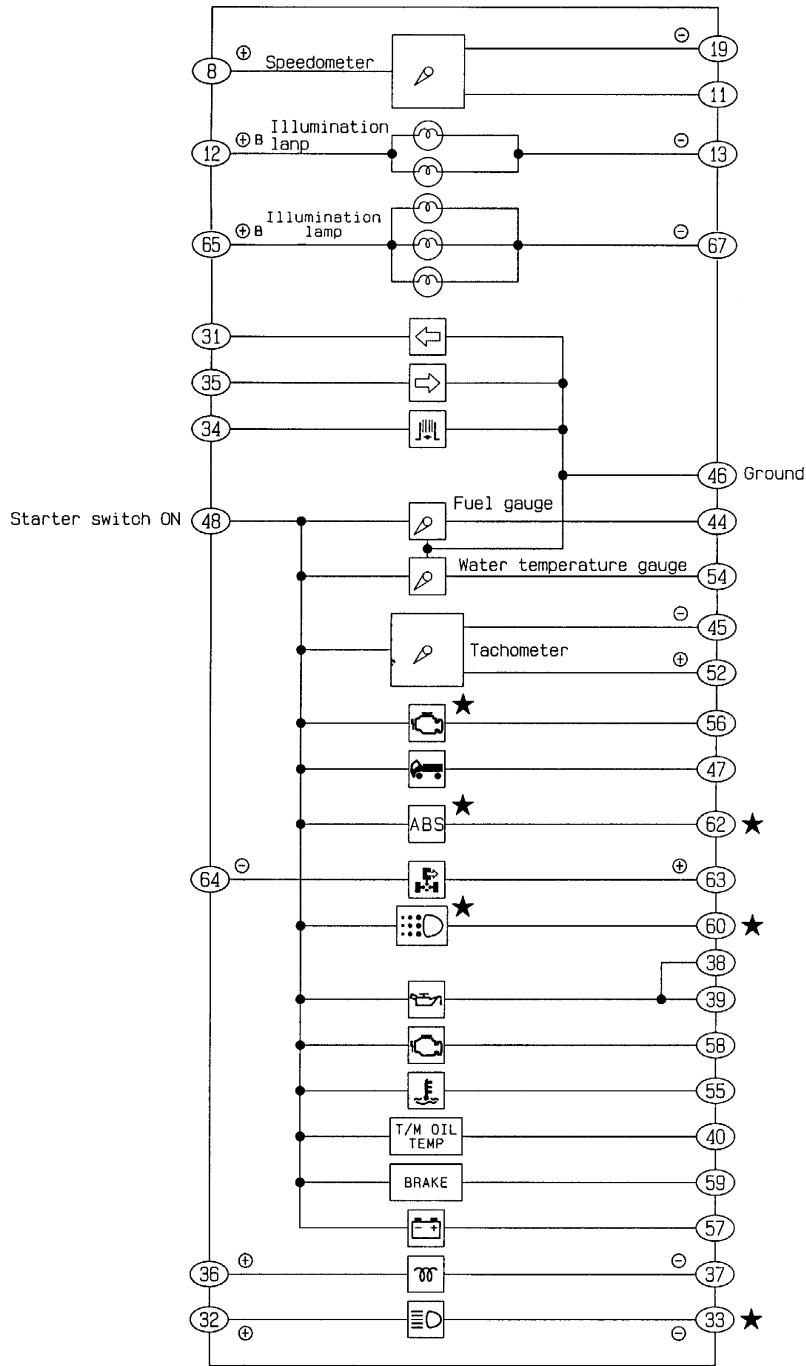
Headlamps **13, 14** repeat On/Off operations at 120 Hz according to the above timing chart. Because of the cyclic On/Off operations, the headlamps are dimmer than when the headlamp switch is ON.

Explanation of timing chart

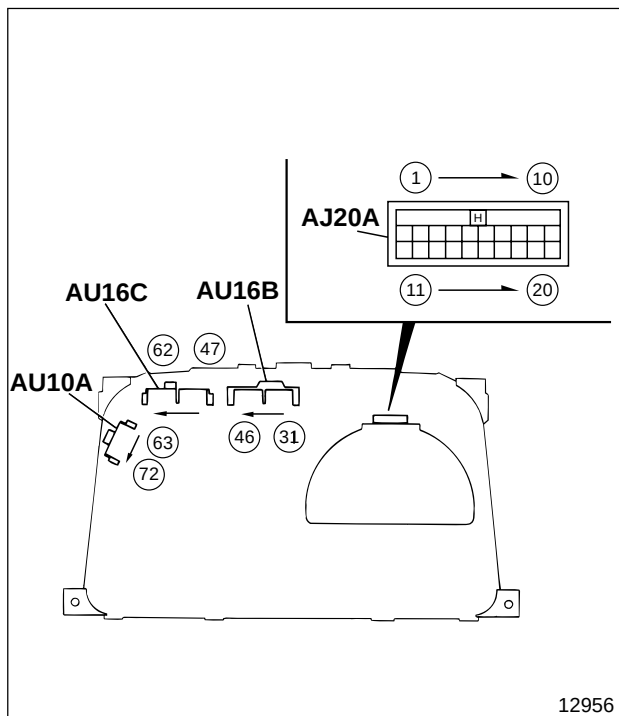
- After the engine starts, when alternator **18** begins generating electricity with starter switch **3** in the ON position, headlamps **13, 14** light.
- When parking brake switch **12** is ON, the DRL turns off to switch off the headlamps.

401 METER CLUSTER

Meter Cluster Internal Circuit



★ Marks indicate changed parts or added parts.



ABS : Anti-lock Brake System
 DRL : Daytime Running Light
 ★ marks indicate added parts.

12956

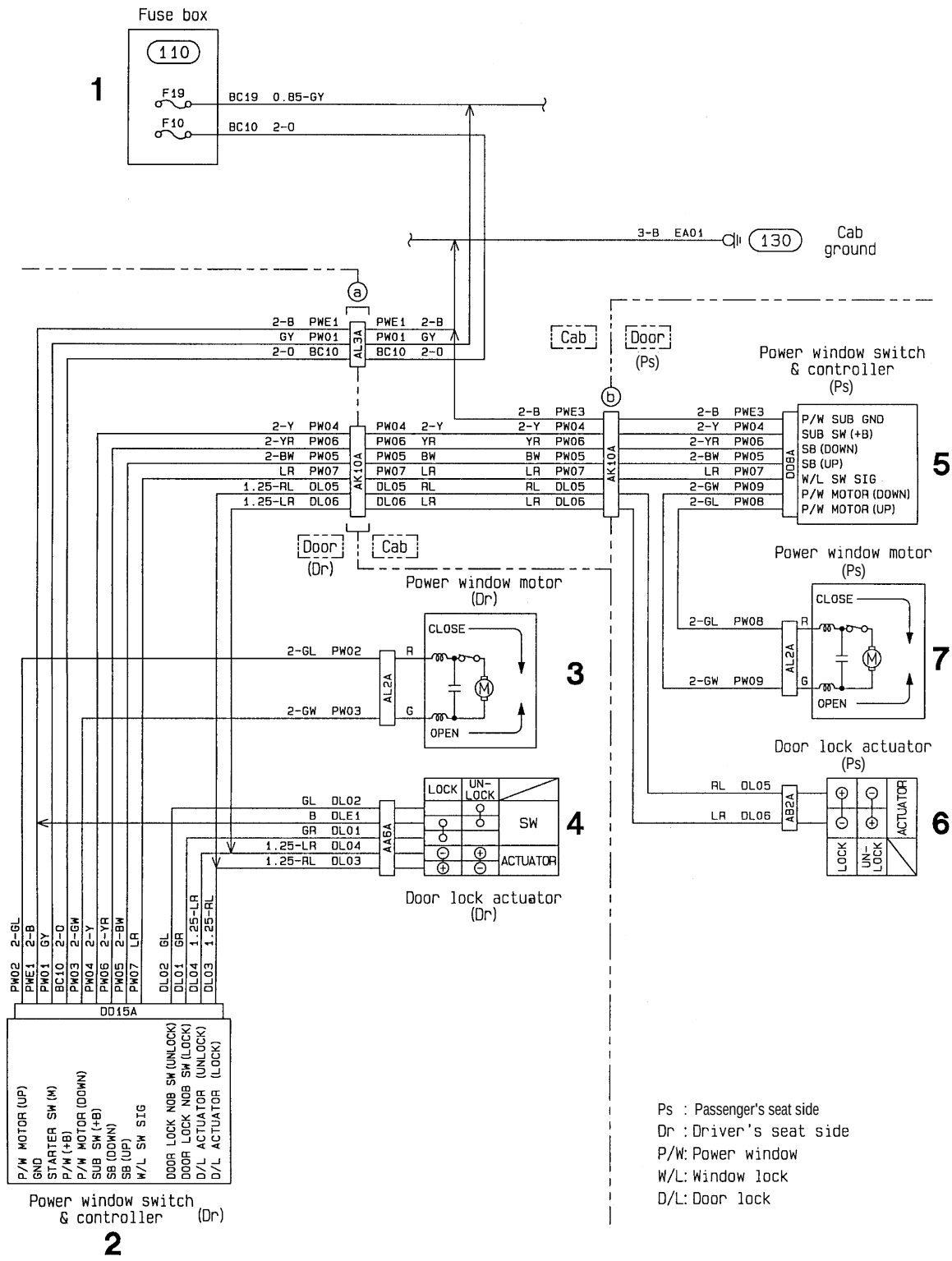
Terminal No.	AJ20A
1	—
2	—
3	—
4	—
5	—
6	—
7	—
8	Speedometer (+)
9	—
10	—
11	Vehicle speed sensor (+)
12	Illumination (+) (Speedometer)
13	Illumination (−) (Speedometer)
14	—
15	—
16	—
17	—
18	—
19	Speedometer (−)
20	—

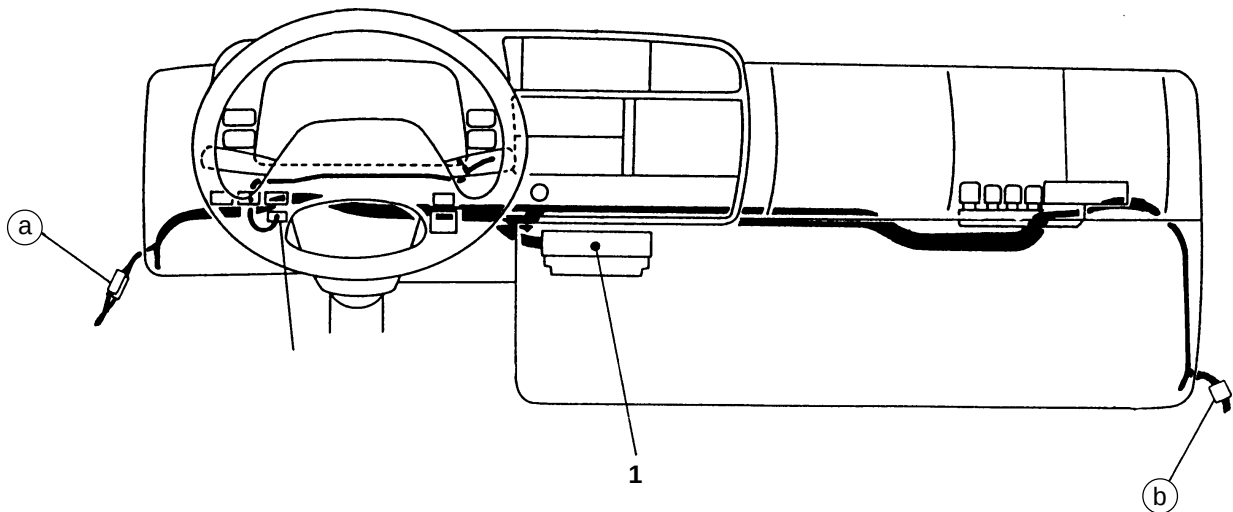
Terminal No.	AU16B
31	Turn signal (LH)
32	HIGH beam (+)
33	HIGH beam (−)
34	Exhaust brake < Manual transmission >
35	Turn signal (RH)
36	Glow (+)
37	Glow (−)
38	Engine oil filter
39	Engine oil pressure level
40	Automatic transmission fluid temperature
41	—
42	—
43	—
44	Fuel gauge
45	Tachometer (−)
46	Ground

Terminal No.	AU10A
63	Power take-off (+)
64	Power take-off (−)
65	Illumination (+)
66	—
67	Illumination (−)
68	—
69	—
70	—
71	—
72	—

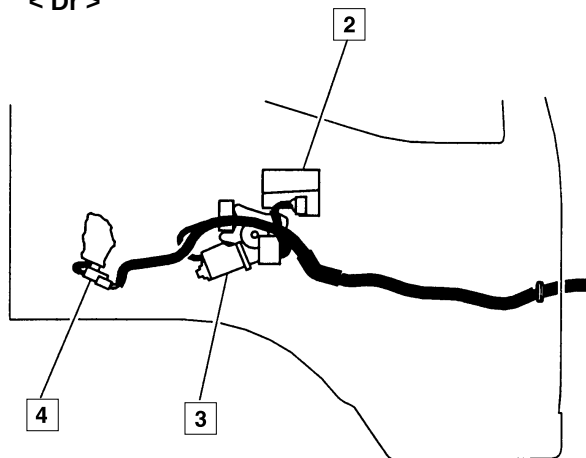
Terminal No.	AU16C
47	Cab tilt
48	Power
49	—
50	—
51	—
52	Tachometer (+)
53	—
54	Water temperature gauge
55	•Engine coolant level •Engine coolant temperature
56	Pre-stroke control
57	Battery charge
58	Electronic control governor
59	Brake •Parking brake •Brake booster (Hydraulic booster) •Brake fluid level •Power steering fluid level
60	★ DRL
61	—
62	★ ABS

622 POWER WINDOW AND AUTO DOOR LOCK CIRCUIT





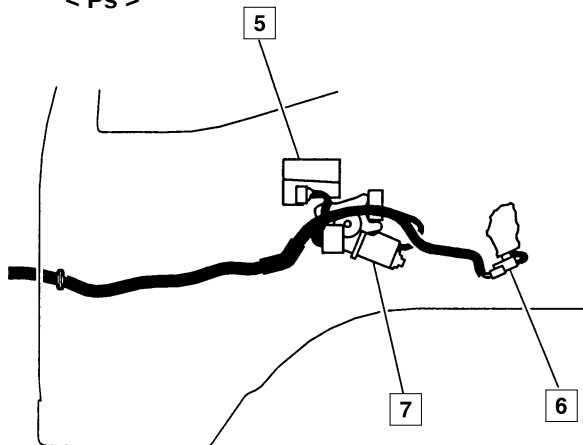
< Dr >



- 1 Fuse box  (104)
- 2 Power window switch & controller (Dr)
- 3 Power window motor (Dr)
- 4 Door lock actuator (Dr)
- 5 Power window switch & controller (Ps)
- 6 Door lock actuator (Ps)
- 7 Power window motor (Ps)

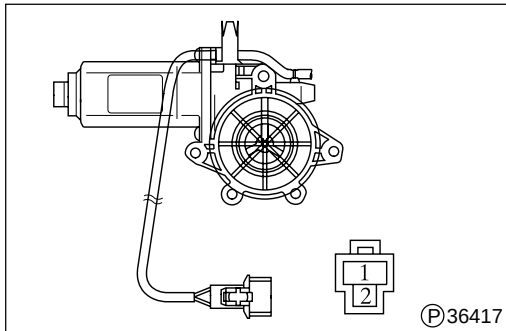
Ps : Passenger's seat side
Dr : Driver's seat side

< Ps >



◆ Service procedure**2 5 Inspection of power window switch & controller**

- Since the units alone cannot be readily checked in the off-vehicle state, check the harness, switch and other related parts in each system.
- If any fault is not found in the related parts, and the problem still remains in the system, replace the control unit or other units.

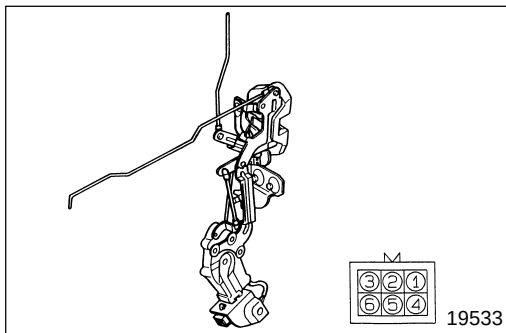
**3 7 Inspection of power window motors**

- Follow the table below to check for operation.

	①	②
UP (Close)	⊕ — ⊖	⊖ — ⊕
Down (Open)	⊖ — ⊕	⊕ — ⊖

⊕ — ⊖ : Indicates the terminals where 12 volts DC is to be applied.

- If any fault is found, replace power window motors **3, 7**. Gr42

**4 Inspection of door lock actuator (driver's seat side)**

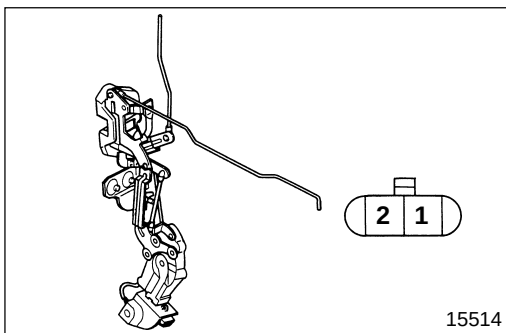
- Follow the table below to check for continuity and operation.

	①	②	③	④	⑤
LOCK		○ — ○		⊖ — ⊕	
UNLOCK	○ — ○			⊕ — ⊖	

○ — ○ : There is continuity between terminals.

⊕ — ⊖ : Indicates the terminals where 12 volts DC is to be applied

- If any fault is found, replace door lock actuator (driver's seat side) **4**. Gr42

**6 Inspection of door lock actuator (passenger's seat side)**

- Follow the table below to check for operation.

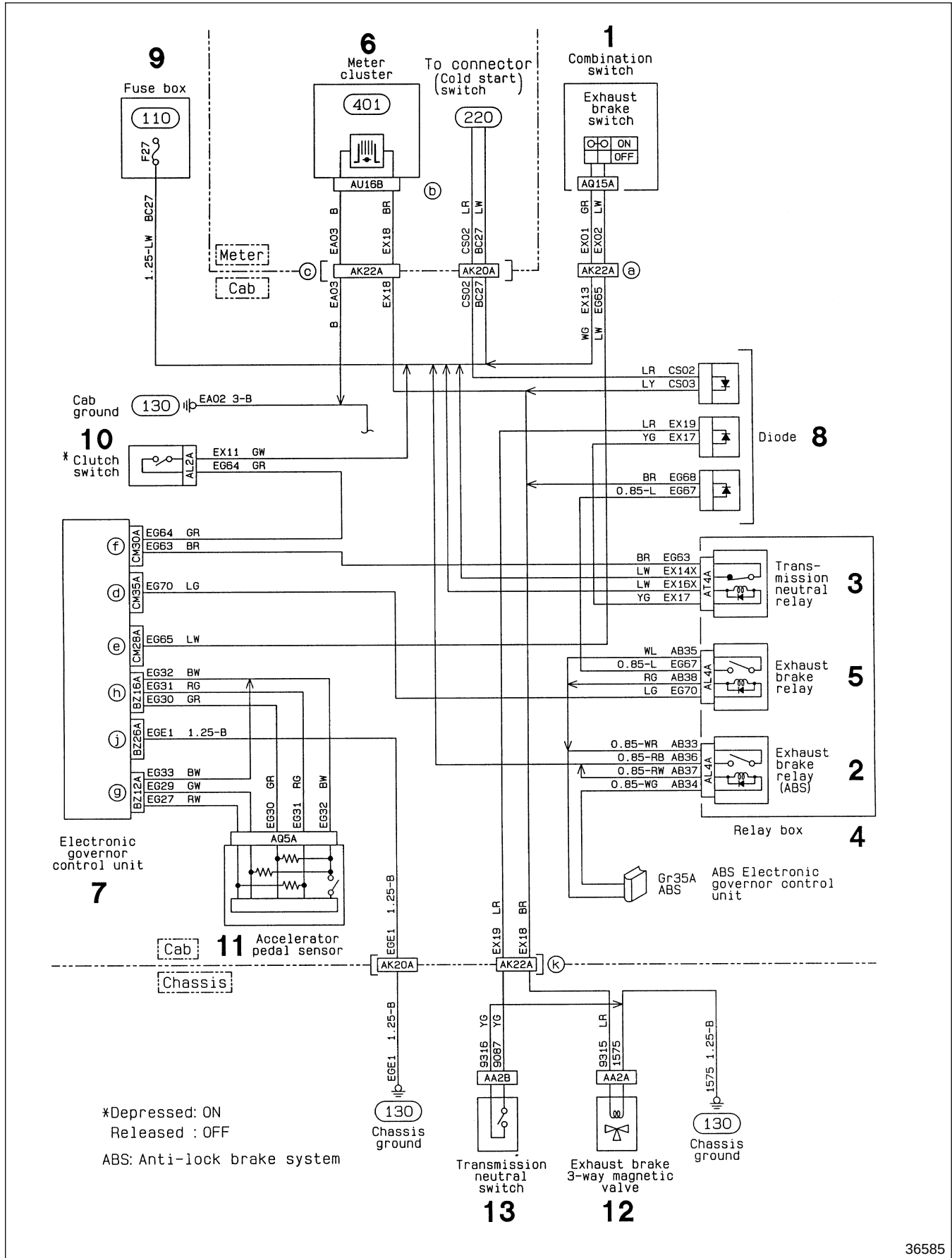
	①	②
LOCK	⊖ — ⊕	⊕ — ⊖
UNLOCK	⊕ — ⊖	⊖ — ⊕

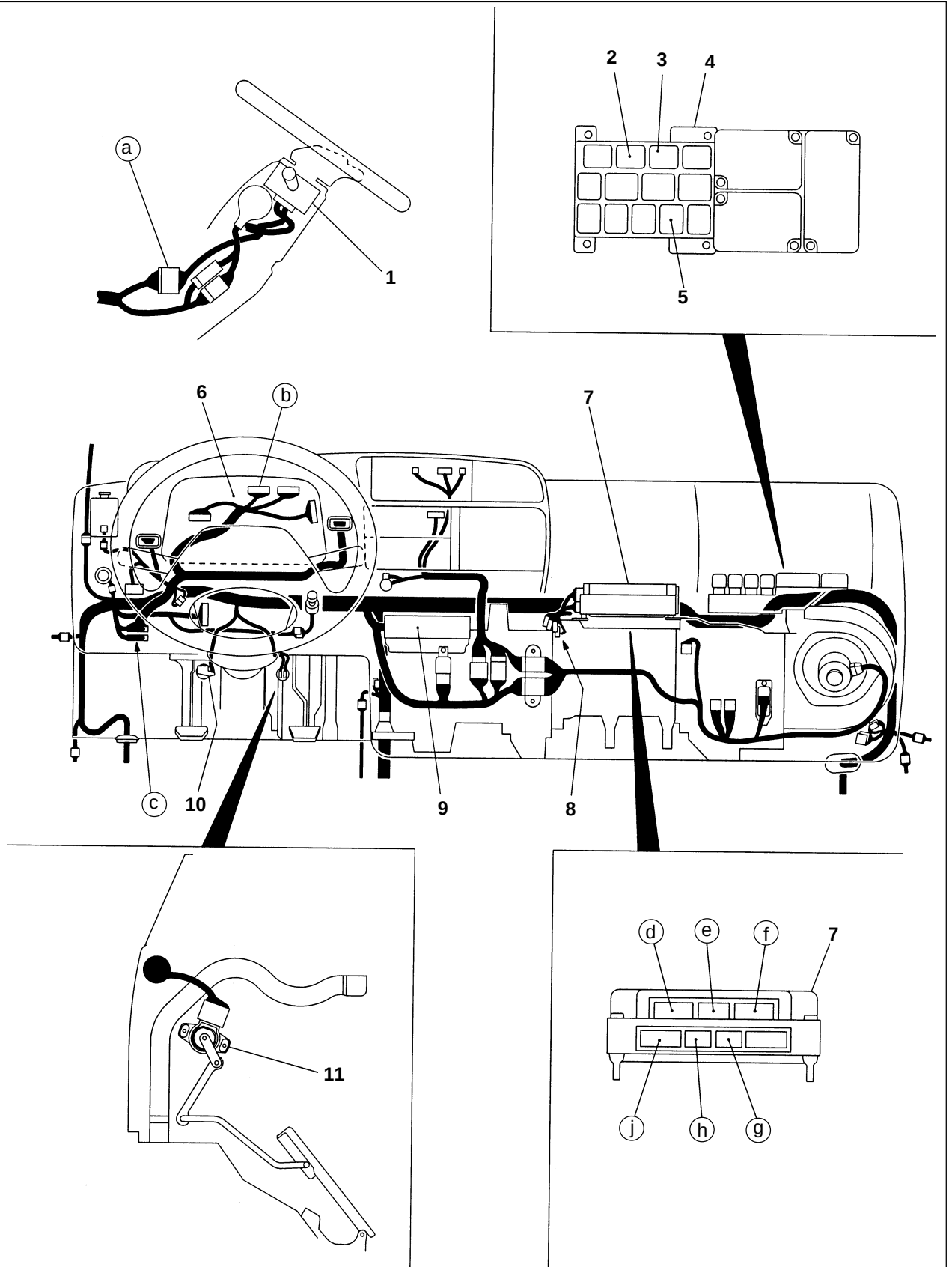
⊕ — ⊖ : Indicates the terminals where 12 volts DC is to be applied.

- If any fault is found, replace door lock actuator (passenger's seat side) **6**. Gr42

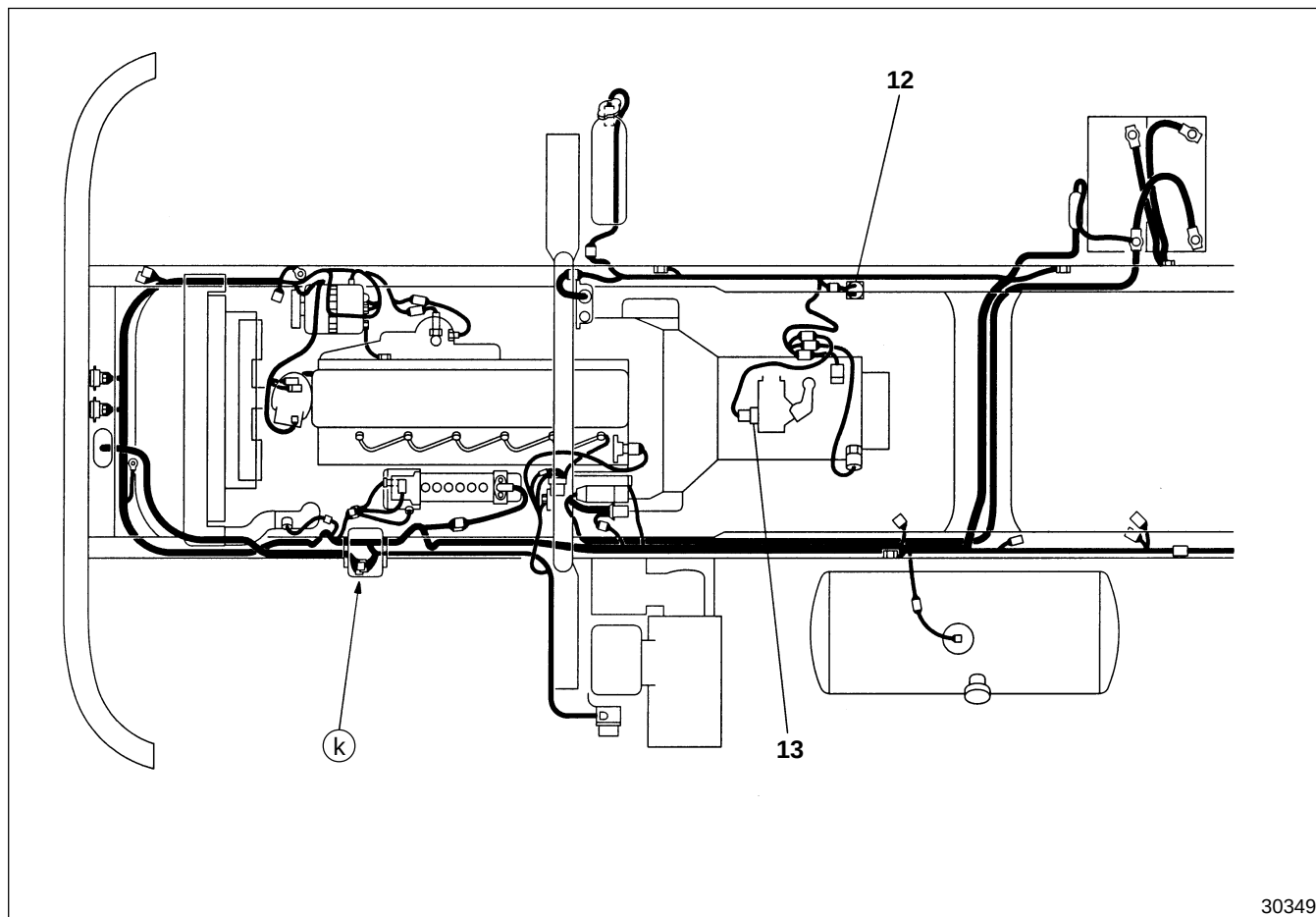
MEMO

710 EXHAUST BRAKE CIRCUIT < Manual Transmission >





710 EXHAUST BRAKE CIRCUIT < Manual Transmission >



- | | |
|---|---|
| 1 Combination switch 1 (601) | 8 Diode |
| 2 Exhaust brake cut relay (ABS) 3 (604) | 9 Fuse box 104 |
| 3 Transmission neutral relay | 10 Clutch switch 1 (710) |
| 4 Relay box 3 (604) | 11 Throttle position sensor 4 |
| 5 Exhaust brake relay | 12 Exhaust brake 3-way magnetic value 1 (701) |
| 6 Meter cluster 401 | 13 Transmission neutral switch 1 (802) |
| 7 Electronic governor control unit 4 | |

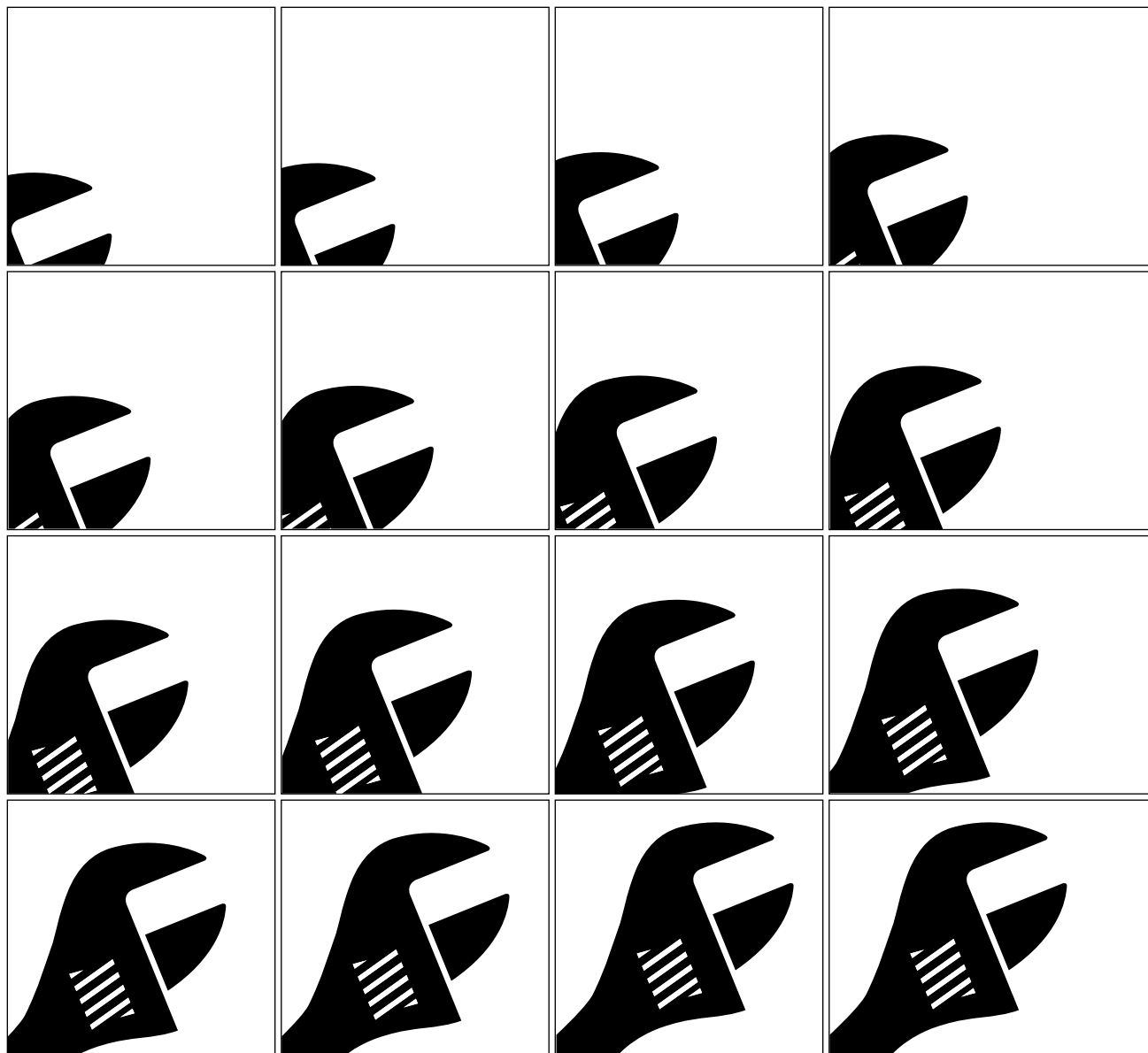
- 1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
 3 : '98 Model Gr 54 (Pub. No. TWME9502-254)
 4 : '99 Model Gr 13 (Pub. No. TWME9502-313)



Service Manual

FH 2001

Model Year Changes



FH

SERVICE MANUAL

FOREWORD

This Service Manual contains maintenance and repair methods for personnel involved in the maintenance and repair of 2001 model Mitsubishi Fuso Truck FH series.

Read this manual carefully as an aid to providing correct, efficient and fast maintenance.

Please note, however, that due to continuous improvements on the specifications, numbers and description for maintenance might be changed without prior notice.

If you have any question, or encounter a problem, please do not hesitate to contact your nearest Mitsubishi Fuso dealer or distributor.

© Mitsubishi Motors Corporation, May 2000

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

GROUP INDEX

2001 MODEL CHANGES

GENERAL **00**

MAINTENANCE SCHEDULE **01**

COOLING **14**

ELECTRICAL **54**

2001 MODEL CHANGES

Item	'01 Model	↔ '00 Model
Gr 00 General Power Train Table and Vehicle Identification Number updated	📖 Gr 00	—
Gr 01 Maintenance Schedule Maintenance Operations revised as required	📖 Gr 01	—
Gr 13 Fuel and engine control Part No. and type of Read Only Memory (ROM) pack are different.	MK 386562 (MRT-E7)	MK 344606 (MRT-F6)
Gr 14 Cooling Radiator replaced with new type	📖 Gr 14	—
Gr 35 Brake Brake pedal-to-floor clearance changed	32 mm {1.26 in.}	52 mm {2.05 in.}
Standard value of brake pedal mounting height	254 mm {10.0 in.}	264 mm {10.4 in.}
Gr 54 Electrical ① POWER, CHARGING AND GROUND • Fuse box changed in construction due to adoption of mirror heater	(104) FUSE 📖 P.54-7	
⑥ CAB SIDE ELECTRICS • Mirror heater circuit is added.	(629) MIRROR HEATER CIRCUIT 📖 P.54-8	

GROUP 00 GENERAL

POWER TRAIN TABLE	00-2
VEHICLE IDENTIFICATION NUMBER	00-2
PRECAUTIONS FOR MAINTENANCE OPERATION	00-3

POWER TRAIN TABLE/VEHICLE IDENTIFICATION NUMBER

Power Train Table

Model	Engine model	Clutch model	Transmission model	Propeller shaft	Rear axle model	Final reduction and gear ratio
FH211C G. V. W. 8160 kg {17955 lb}	6D34T2 175 HP/2900 rpm 325 ft.lbs/2000 rpm (SAE, Gross)	C5M33	M050S5 6.875/1.000	P4	R040T	D040H 4.111
FH211E, G, H, J, K G. V. W. 8160 kg {17955 lb}			M050S6 6.523/0.803			D040H 4.625
FH211C, E, G, H, J, K G. V. W. 8160 kg {17955 lb}		Torque converter (TC290-1.72)	M4A4 (Allison AT542 or AT545) 3.454/ 1.000			D040H 4.111

Identification Number

J W 6 C C C 1 G **1**

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

- ① Country
- ② Make
- ③ Vehicle type
- ④ Gross vehicle weight/Brake system
- ⑤ Line
- ⑥ Series (Wheelbase)

- ⑦ Cab chassis type
- ⑧ Engine
- ⑨ Check digit
- ⑩ Model year
- ⑪ Plant

- ⑫ Plant sequential number

J : Japan
 W : Mitsubishi Fuso
 6 : Incomplete Vehicle
 C : 16001 to 19500 lbs/Hydraulic
 C : FH211
 C : 2.6 to 2.89 m {8.53 to 9.48 ft.}
 E : 3.2 to 3.49 m {10.49 to 11.44 ft.}
 G : 3.8 to 4.09 m {12.46 to 13.41 ft.}
 H : 4.1 to 4.39 m {13.45 to 14.40 ft.}
 J : 4.4 to 4.69 m {14.43 to 15.38 ft.}
 K : 4.7 to 4.99 m {15.41 to 16.37 ft.}
 1 : Chassis cab
 G : 5.861 ℓ Diesel turbocharged and charge air cooled
 1 : 2001
 K : Kawasaki-1
 L : Kawasaki-2
 M : Kawasaki-3

PRECAUTIONS FOR MAINTENANCE OPERATION

00

DANGER

This product contains or emits chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

GROUP 01 MAINTENANCE SCHEDULE

MAINTENANCE OPERATIONS

- Battery 01-2
- Fuse 01-6

MAINTENANCE OPERATIONS

Battery

DANGER

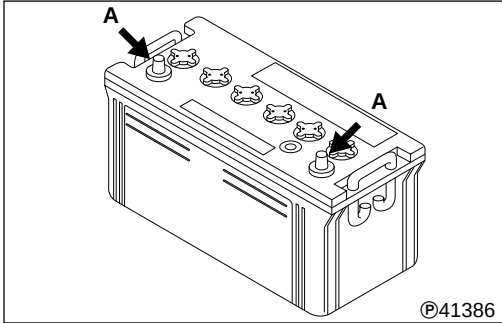
- Since flammable hydrogen gas is generated by the battery, be sure to obey the following warnings:
 - Do not short-circuit the $\oplus$ and $\ominus$ terminals on the battery.
 - Keep sparks and lit cigarettes away from the battery.
 - Do not wear metal objects on your arms and lean over the battery.
 - Because the battery electrolyte is diluted sulfuric acid and is corrosive, when handling the battery wear safety glasses and rubber gloves to protect the eyes and hands.
 - Battery posts, terminals and related accessories contain lead and lead compounds. Wash hands after handling.
-

WARNING

To prevent a short-circuit be sure that the disconnected the battery cables do not accidentally touch the battery terminals.

CAUTION

- Make sure that you disconnect the battery cable $\ominus$ first when you disconnect the battery cables.
 - Make sure that all electrical switches of the vehicle are OFF before connecting the battery cables.
 - Make sure that you connect the battery cable $\oplus$ before you connect the battery cable $\ominus$.
-

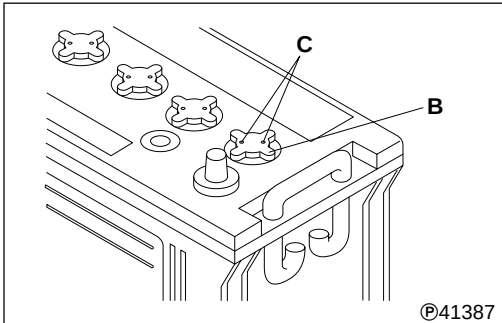


Visual inspection

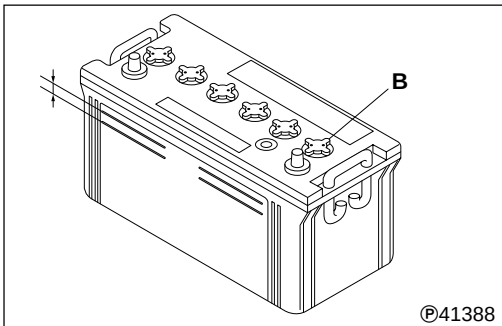
- If terminal **A** is corroded, scrub the corrosion off of it using a wire brush.
- If cracks or defects are found on the battery, replace it since the cracks or defects can cause liquid spills.

CAUTION

Make sure you grease the $\oplus$ side of terminal **A** because it is easily corroded.

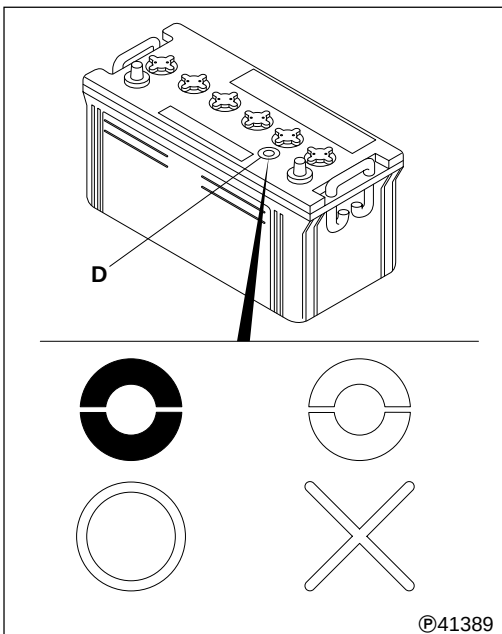


- If bleed hole **C** of vent plug **B** is clogged, clean the hole.



Inspection of fluid level

- Make sure that the battery electrolyte level is between the UPPER and LOWER level lines.
- If the level is below the LOWER level line, remove vent plug **B** and fill the battery with distilled water or battery replenisher to the UPPER level.



Measurement of specific gravity

You can tell the specific gravity of the battery electrolyte by the color shown in indicator **D**.

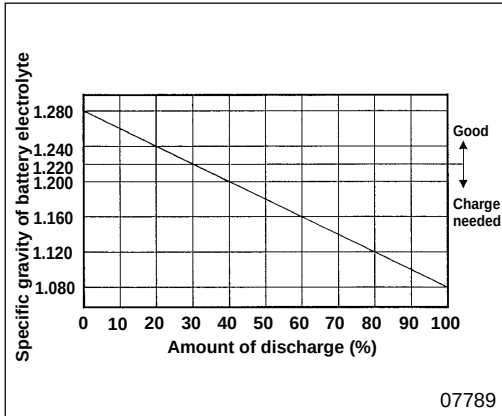
Blue : Good

White : Charge or replace

MAINTENANCE OPERATIONS

Charging

- Although, as a rule, charging of the battery should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect the battery cable $\ominus$.
- Remove vent plug **B** before charging the battery.
- 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) $\times 1.2$ (to 1.5)	45 {113}
Quick charge	Value of 5-hour rating capacity 1.5	0.5	55 {131}

$$\text{* Amount of discharge (Ah)} = \text{5-hour rating capacity (Ah)} \times \frac{\text{Amount of discharge (\%)}}{100}$$

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

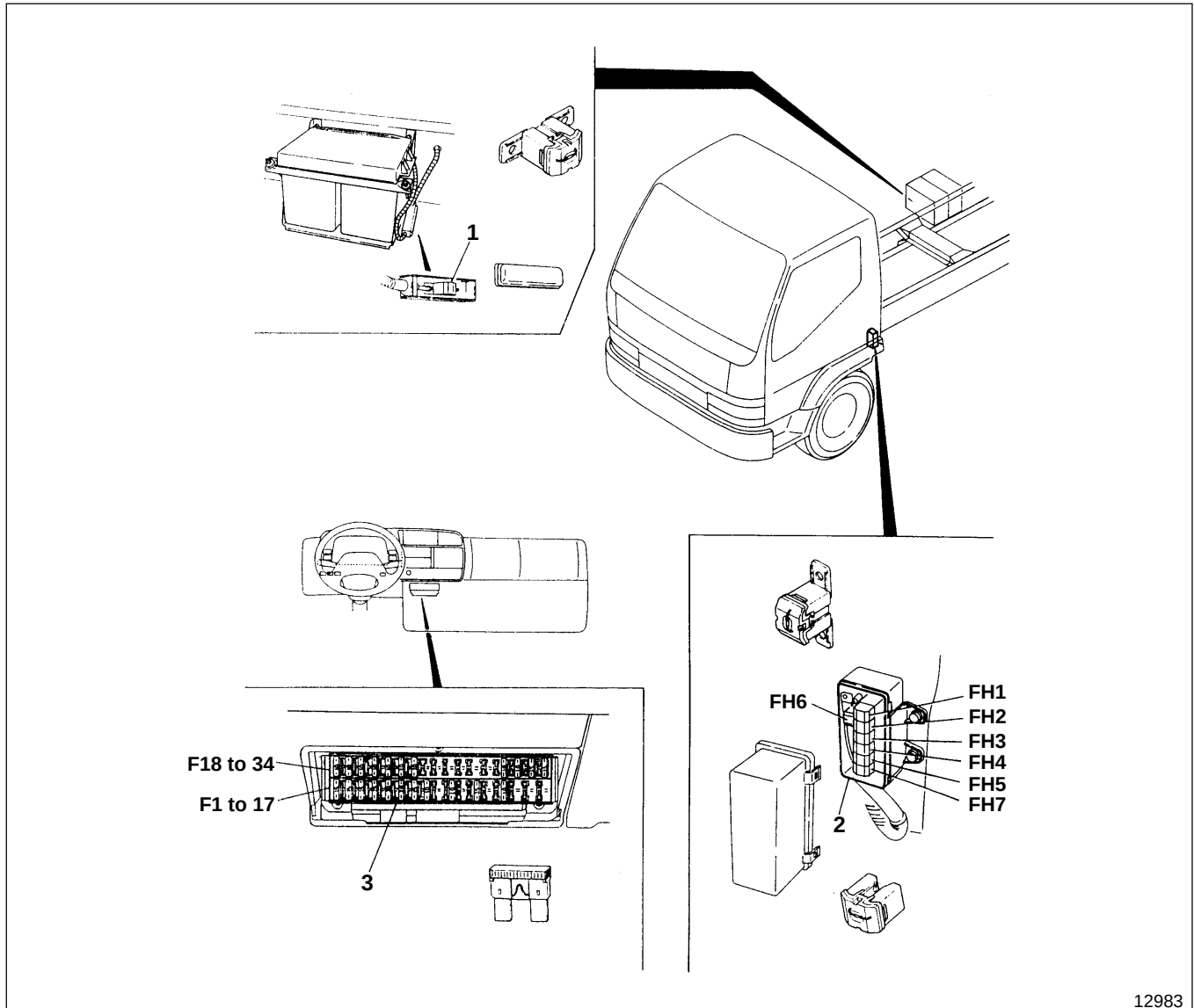
DANGER

- Do not let the battery electrolyte level rise and overflow while charging the battery.
- Keep unprotected lights 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 vent plug B, 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.

MEMO

MAINTENANCE OPERATIONS

Fuse



12983

- 1 Main high-current fuse
- 2 High-current fuse box
- 3 Fuse box

CAUTION

- If a fuse blows, make sure you identify and remedy the cause, then replace the fuse.
- Make sure that you replace the fuse with one having the same rating.
- Make sure that you remove the $\ominus$ terminal of the battery cable before removing main high-current fuse 1 and high-current fuses FH1 to 7.

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	—
	For ABS	50A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50A
FH2	Fuse box (F5 to F8, F11)	40A
FH3	Brake booster (Hydraulic booster)	30A
FH4	Starter switch (Terminal B)	50A
FH5	Glow relay	50A
FH6	Alternator	140A
FH7	Fuse box (F31 to F34)	40A
FH8	ABS hydraulic unit	40A

Fuse box

Fuse No.	Main load	Capacity
F1	Headlamp, LH	15A
F2	Headlamp, RH	15A
F3	Stop lamp, horn	15A
F4	Turn signal lamp	15A
F5	—	—
F6	Cab lamp	10A
F7	Van body dome light	10A
F8	A/T fluid cooler fan relay	20A
F9	—	—
F10	Power window	25A
F11	Reserve power (BATT)	10A
F12	—	—
F13	Cigarette lighter	15A
F14	Radio	10A
F15	Reserve power (ACC)	10A
F16	—	—
F17	Mirror heater	10A

Fuse No.	Main load	Capacity
F18	Starter	10A
F19	Backup lamp	10A
F20	Meter cluster, DRL	10A
F21	Wiper	10A
F22	Engine control (ECU)	10A
F23	—	—
F24	ABS	10A
F25	Option (MAIN)	10A
F26	Mirror heater	10A
F27	Exhaust brake, A/T	10A
F28	Transmission PTO	10A
F29	Pre-stroke cut relay (Engine control)	10A
F30	* Air-conditioner control	10A
F31	* Air-conditioner compressor	10A
F32	* Condenser fan	15A
F33	Blower fan	25A
F34	Tail lamp	20A

* : Fuses are provided for these pieces of equipment only where they are installed.

PTO : Power take-off

A/T : Automatic transmission

DRL : Daytime running light

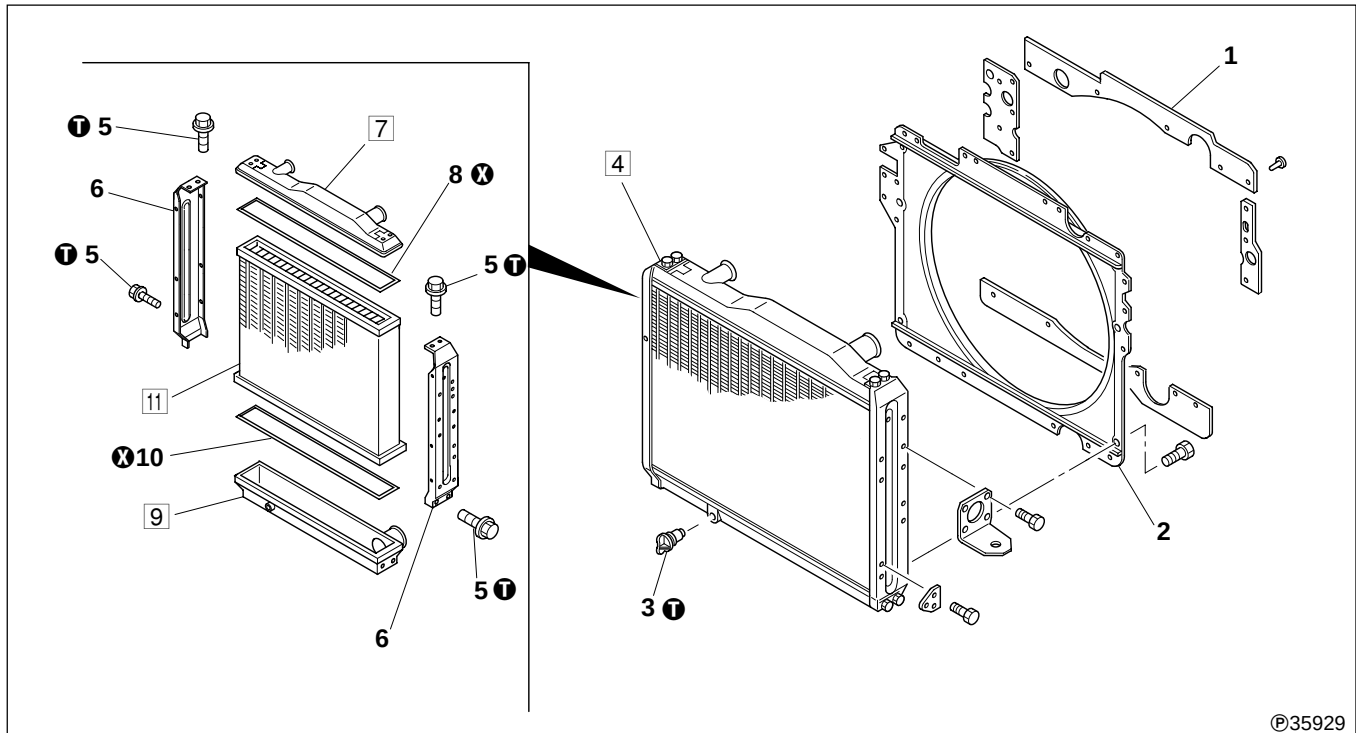
ABS : Anti-lock brake system

GROUP 14 COOLING

RADIATOR, FAN SHROUD	14-2
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RADIATOR, FAN SHROUD

Radiator Assembly



©35929

● Disassembly sequence

- | | |
|---------------------|--------------|
| 1 Baffle plate | 7 Upper tank |
| 2 Radiator shroud | 8 O-ring |
| 3 Drain cock | 9 Lower tank |
| 4 Radiator assembly | 10 O-ring |
| 5 Bolt | 11 Core |
| 6 Side member | |

ⓧ : Non-reusable part

CAUTION

- Do not disassemble the radiator assembly 4 unless defects are evident.
- The upper tank 7 and lower tank 9 are made of plastic and could crack if subjected to undue shock. Handle them with care.
- Replace the core 11 if the clinching tabs that hold the upper tank 7 or lower tank 9 have two paint marks, showing that the tabs have been bent back twice.  P.14-3

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
4	Radiator assembly air leakage (with air pressure of 150 kPa {21 psi, 1.5 kgf/cm ² })	0 cm ³ {0 cu. in.}	—	Rectify or replace

ⓘ Tightening torque

Unit: N·m{ft.lbs, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Drain cock	2 {1.4, 0.2}	—
5	Bolt (side member mounting)	13 {9, 1.3}	—

🔧 Special tool

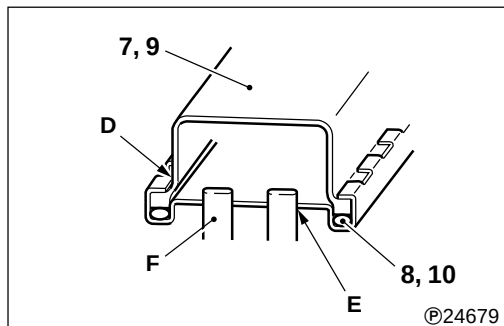
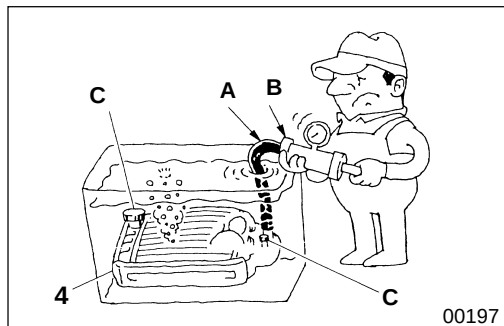
Location	Tool name and shape	Part No.	Application
7, 9	Lock & break tool	Obtain locally or use sublet repair	Upper tank, lower tank removal

The part number given is Toyo Radiator's one.

◆ Service procedure

4 Radiator inspection

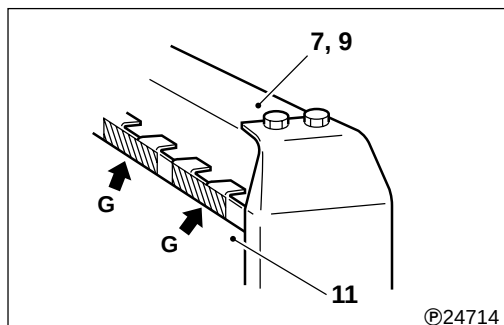
- Fit a hose **A**, radiator cap tester **B** and plug **C** onto the radiator upper tank **7**.
- Fit a plug **C** onto the radiator lower tank **9**, then immerse the radiator in a tank of water.
- Using the radiator cap tester **B**, apply the specified air pressure of 150 kPa {21 psi, 1.5 kgf/cm²}, and check for air leakage.
- If air leakage is apparent, repair or replace the radiator assembly **4**.



- Replace the following parts according to the leaking locations.

Leaking location	Part to replace
Tank root D	O-ring 8 or 10
Tank 7	Tank 7 , O-ring 8
Tank 9	Tank 9 , O-ring 10
Tube fitted area E	Core 11 , O-ring 8 , 10
	* Tube F (TIG welded), O-ring 8 , 10
Tube F	Core 11 , O-ring 8 , 10

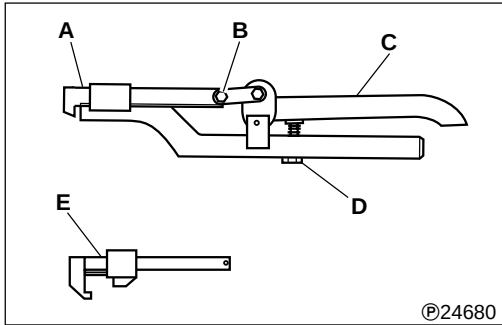
* : When repaired



CAUTION ⚠

- Replace the core **11** if its clinching tabs that hold the upper tank **7** or lower tank **9** have two paint marks **G**, evidence of the tabs having been bent back twice.
- The tabs are provided with one paint mark each time they are bent back. Count the paint marks on each of upper and lower tabs separately.

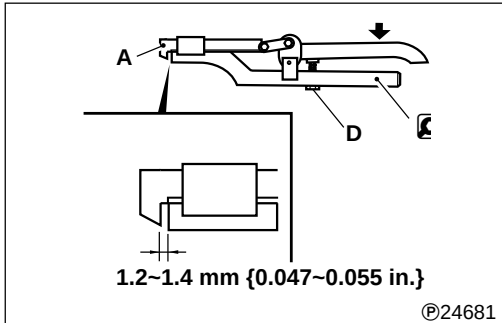
RADIATOR, FAN SHROUD



7 9 Upper tank and lower tank

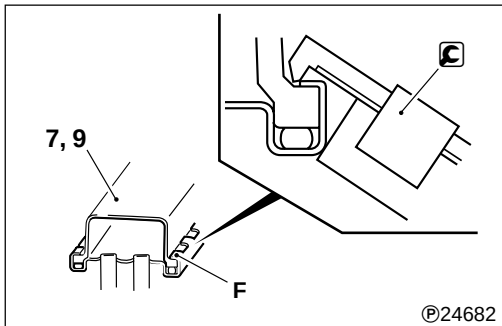
Remove and reinstall the tanks using the Lock and Break Tool.

- A: Attachment (for tank removal)
- B: Attachment locking bolt
- C: Slide handle
- D: Stopper/adjuster bolt
- E: Attachment (for tank installation)

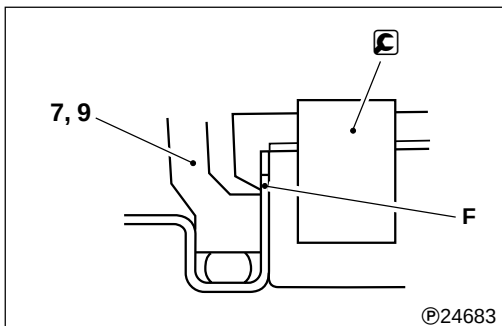


[Removal]

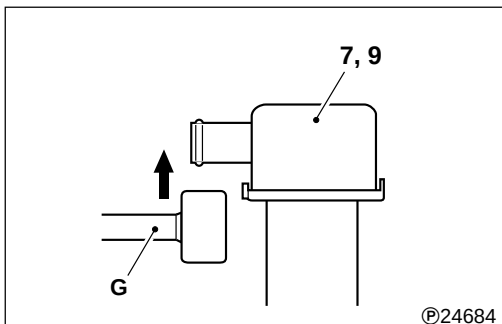
- Fit attachment **A** onto the end of the Lock and Break Tool, set it to the illustrated dimension and lock it in position with the stopper/adjuster bolt **D**.



- Using the Lock and Break Tool, bend up the tabs **F** of the core **11** that hold the tank **7, 9**.



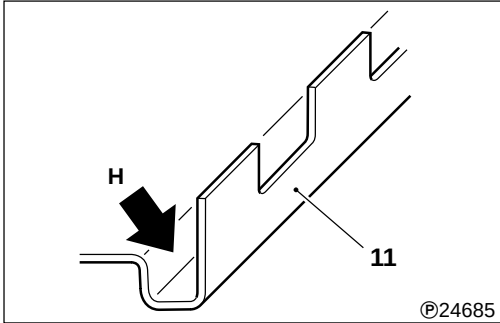
- Straighten the tabs **F** completely as shown by gripping the Lock and Break Tool.
- After straightening all the tabs **F**, grasp the inlet or outlet pipe and remove the tank **7, 9**.



- If the tank **7, 9** is difficult to remove, tap it with a rubber or plastic hammer **G**.

CAUTION

The tanks **7** and **9** are made of plastic and may crack if subjected to undue shock. Handle them with care.

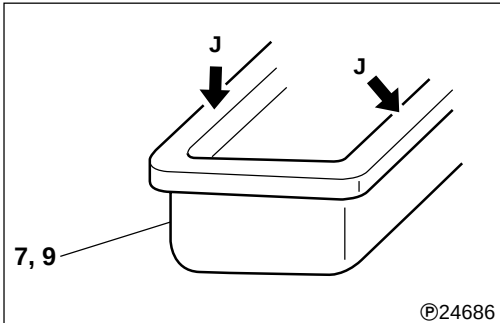


[Inspection]

- Check the tank mounting channels **H** of the core **11** for foreign matter.
- If foreign matter is stuck inside the mounting channels, rub it away with sandpaper (approx. #1000) or blow it out with compressed air.

CAUTION ⚠

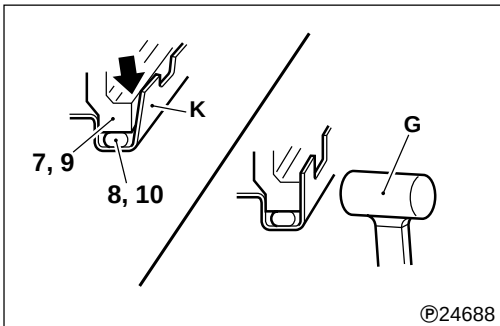
If any foreign matter (even a single hair) remains when the O-ring **8, 10** and tank **7, 9** are fitted, leakage can occur. Carefully inspect and clean each tank mounting channel **H** entirely.



- Clean the core contacting surface **J** of the tank **7, 9** and inspect it for damage. Replace the tank if any defect is evident.

CAUTION ⚠

Perform works with bare hands to prevent foreign matter from sticking to the surface **J**.

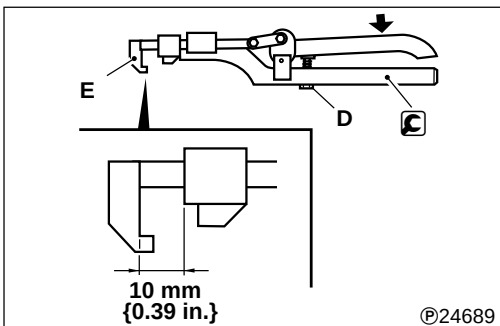


[Installation]

- Install the tank **7, 9** in position. Check that the sub-plate **K** of the core is in close contact with the tank. If there is any space, tap the sub-plate lightly with a rubber or plastic hammer to eliminate space.

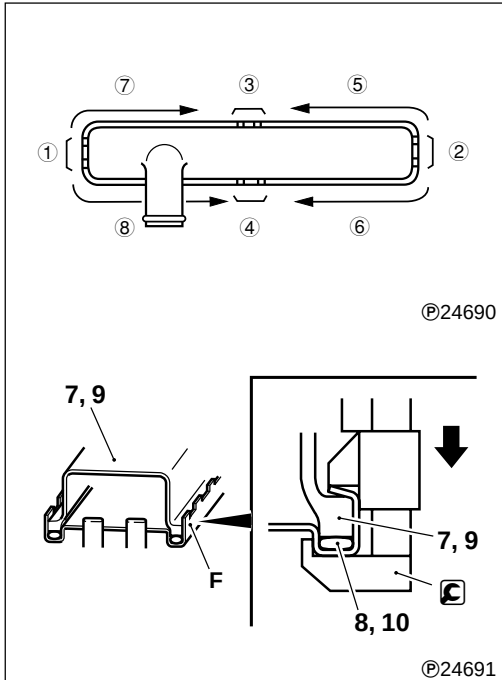
CAUTION ⚠

Handle the parts with bare hands to prevent foreign matter from sticking to the O-ring **8, 10** and tank **7, 9**.



- Fit attachment **E** onto the end of the  Lock and Break Tool, set it to the illustrated dimension and lock it in position with the stopper/adjuster bolt **D**.

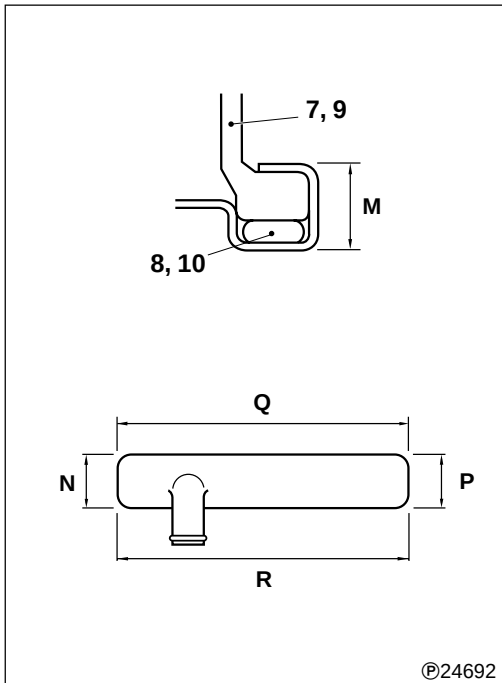
RADIATOR, FAN SHROUD



- Clinch the tabs **F** of the core **11** to hold the tank **7, 9** in the illustrated order.
 - ① ~ ④ : Two center tabs on each side
 - ⑤ ~ ⑧ : Remaining tabs in illustrated sequence
 - ☐ : Lock and Break Tool (with attachment **E**)

CAUTION ⚠

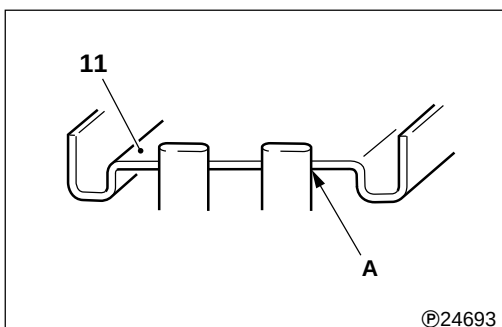
The sides ① and ② do not allow the ☐ Lock and Break Tool to be used for clinching. Clinch these sides using a pair of pliers with tape wrapped around its jaws.



- Check that the tabs have been clinched to the following dimensions.
 - M** : 14.65 ~ 15.05 mm {0.576 ~ 0.592 in.} (Sides **N** and **P**)
 - 10.05 ~ 10.45 mm {0.395 ~ 0.411 in.} (Sides **Q** and **R**)
- Check for leaks. 📖 P.14-3
- Provide a paint mark to the sub-plate **K** of the core **11** to indicate that the tabs have been bent up and then down. 📖 P.14-3

CAUTION ⚠

Provide one paint mark after each removal of the tank.



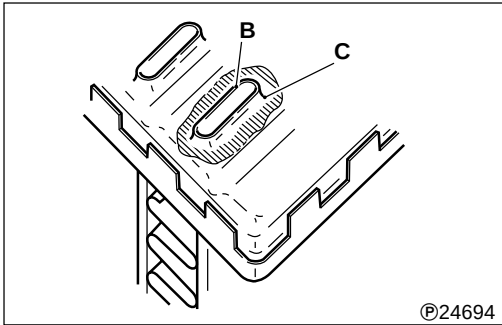
11 Core

If water leaks from the tube fitted area **A**, replace the core **11** or repair it by the following method.

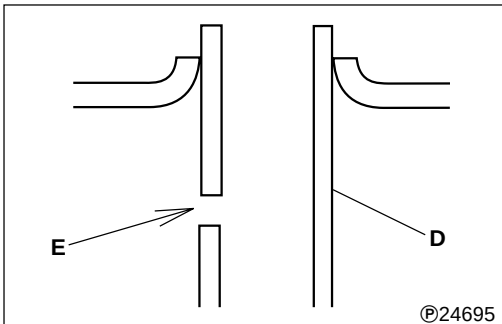
[Repair]

WARNING ⚠

- Repair is carried out by tungsten inert gas arc (TIG) welding, which requires the skill of a trained welder.
- To avoid danger, dry the core 11 completely before welding.



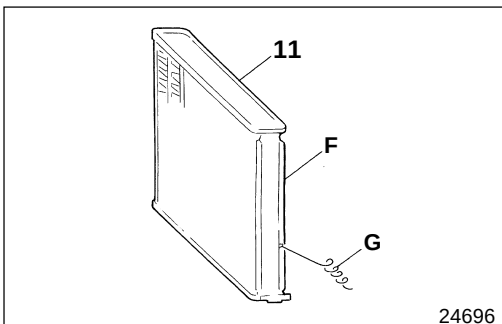
- Clean both edges **B** of the leaky tube and their surroundings **C** using a stainless steel wire brush. Scrub the surface until it glistens with exposed aluminum.



- Since both ends of the tube are covered with weld metal, make a small hole **E** in the tube **D** to allow air venting.

CAUTION ⚠

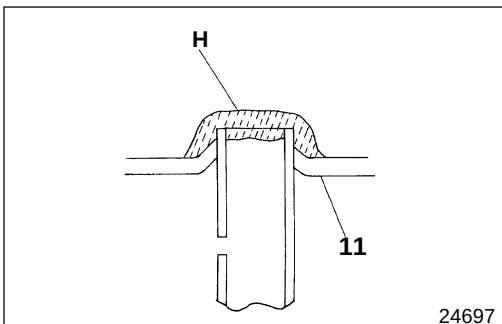
Absence of the small hole **E** causes escaping air to produce small pin holes in the weld.



- Connect a grounding wire **G** from the support **F** of the core **11** to an appropriate object.

CAUTION ⚠

Improper connection of the grounding wire **G** causes a short circuit during welding work and the core could be fused at the welded portion.



- Cover both ends of the tube with welding metal.

H : Tungsten inert gas arc weld (TIG)

Welding conditions:

Welding rod: A4043 (approx. 2 mm {0.0079 in.} in diameter)

Welding current: 80A AC

- After welding, check for the following defects. Rectify the weld or replace the core **11** if any of the defects is evident.

- Undercut
- Bead crack
- Crack in base metal

CAUTION ⚠

Weld with sufficient care. Poor welding may cause leakage to re-occur.

GROUP 54 ELECTRICAL

1 POWER, CHARGE AND GROUND

SPECIFICATIONS	5
STRUCTURE AND OPERATION	5
TROUBLESHOOTING	3
(100) ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection of Alternator	3
• Inspection of Regulator	3
(101) BATTERY	54-4
(104) FUSE	54-7
(106) ALTERNATOR	5
(110) POWER CIRCUIT	5
(115) RESERVE POWER CIRCUIT	5
(125) BATTERY CHARGING CIRCUIT	3
(130) GROUND	3

2 STARTING, PREHEATING AND STOPPING ENGINE

SPECIFICATIONS	1
STRUCTURE AND OPERATION	1
TROUBLESHOOTING	1
(200) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Inspection of Engine Preheating System	1
(201) STARTER	1
(210) ENGINE STARTING CIRCUIT	
<Manual Transmission>	5
<Automatic Transmission>	5
(220) ENGINE PREHEATING CIRCUIT	
<Manual Transmission>	3
<Automatic Transmission>	2

3 LIGHTING

SPECIFICATIONS	1
STRUCTURE AND OPERATION	1
TROUBLESHOOTING	1
(300) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Headlamp Aiming	1
(310) HEADLAMP CIRCUIT	1
(313) DAYTIME RUNNING LIGHT CIRCUIT	5
(320) TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS	3
(325) STOP LAMP CIRCUIT	3
(330) TURN SIGNAL LAMP AND HAZARD LAMP CIRCUITS	1
(340) BACKUP LAMP CIRCUIT	1
(345) CAB LAMP CIRCUIT	4
(348) ILLUMINATION LAMP CIRCUIT	1
(349) MARKER LAMP AND IDENTIFICATION LAMP CIRCUITS	1
(352) VAN BODY DOME LIGHT CIRCUIT	3

4 METER

SPECIFICATIONS	1
TROUBLESHOOTING	1
(401) METER CLUSTER	5
(410) SPEEDOMETER AND TACHOMETER CIRCUIT	1
(420) FUEL GAUGE CIRCUIT	1
(425) WATER TEMPERATURE GAUGE CIRCUIT	1

5 INDICATOR AND WARNING

TROUBLESHOOTING	3
(500) ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection of Brake Fluid Level Switch	3
• Inspection of Power Steering Fluid Level Sensor	3
(510) PARKING BRAKE INDICATOR CIRCUIT	4
(515) BRAKE WARNING CIRCUIT	4
(530) WATER LEVEL WARNING CIRCUIT	3
(536) ENGINE OIL PRESSURE WARNING CIRCUIT	4
(537) OVERHEATING WARNING CIRCUIT	3
(547) AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT	3
(549) POWER STEERING FLUID LEVEL WARNING CIRCUIT	3
(550) CAB TILT WARNING CIRCUIT	1

6 CAB SIDE ELECTRICAL

SPECIFICATIONS	3
TROUBLESHOOTING	3
(601) SWITCH	1
(604) RELAY AND CONTROL UNIT	1
(606) WARNING BUZZER	1
(610) CIGARETTE LIGHTER CIRCUIT	1
(612) AUDIO CIRCUIT	1
(614) WIPER AND WASHER CIRCUIT	1
(616) HORN CIRCUIT	3
(618) HEATER CIRCUIT	1
(622) POWER WINDOW AND AUTO DOOR LOCK CIRCUIT	5
(629) MIRROR HEATER CIRCUIT	54-8

7 CHASSIS ELECTRICAL

(701) MAGNETIC VALVE	
<Manual Transmission>	3
(710) EXHAUST BRAKE CIRCUIT	
<Manual Transmission>	5

8 ENGINE AND TRANSMISSION ELECTRICS

(801) ENGINE ELECTRICS	1
(802) TRANSMISSION ELECTRICS	
<Manual Transmission>	1
<Automatic Transmission>	1
(850) TRANSMISSION POWER TAKE-OFF CIRCUIT	
<Option>	1

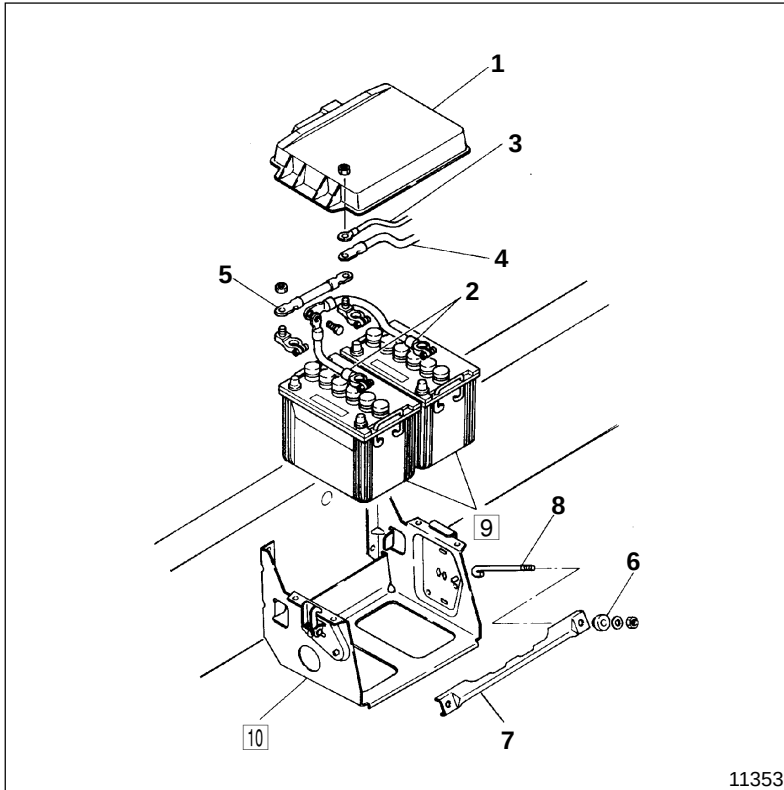
9 OTHERS

STRUCTURE AND OPERATION	2
(905) JOINT CONNECTOR	3
(910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT	2

- 1: '96 Model Gr 54 (Pub No. TWME9502-54)
- 2: '97 Model Gr 54 (Pub No. TWME9502-1)
- 3: '98 Model Gr 54 (Pub No. TWME9502-254)
- 4: '99 Model Gr 54 (Pub No. TWME9502-3)
- 5: '00 Model Gr 54 (Pub No. TWME9502-4)

MEMO

101 BATTERY



● Removal sequence

- 1 Battery cover
- 2 Battery cable $\ominus$
- 3 Harness (Main high-current fuse)
- 4 Starter cable
- 5 Battery cable $\oplus$
- 6 Rubber grommet
- 7 Angle frame
- 8 Set bolt
- 9 Battery
- 10 Battery box

● Installation sequence

Follow the removal sequence in reverse.

DANGER

- Because flammable hydrogen gas is generated from battery 9, be sure to obey the following.
 - Never attempt to short-circuit the positive and negative terminals of battery 9, and generate sparks, or smoke a cigarette near it.
 - Do not wear metal objects on your arms or do not lean over battery 9.
- Sulfuric acid of the electrolyte is very corrosive. Whenever handling battery 9, wear safety goggles and rubber gloves to protect your eyes and hands.
- Battery posts, terminals and related accessories contain lead and lead compounds. Wash hands after handling.

WARNING

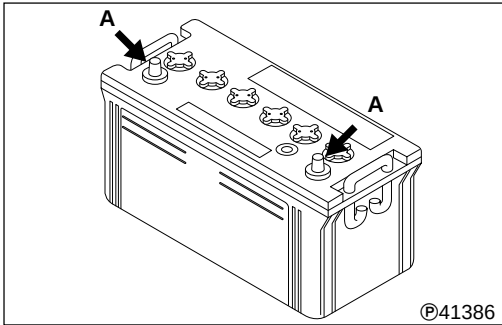
When you disconnect battery cables 2 to 5, disconnect battery cable $\ominus$ 2 first.

CAUTION

- Make sure that all electrical switches of the vehicle are off before connecting battery cables 2 and 5.
- Be sure to connect battery cable $\oplus$ 5 first before you connect battery cable $\ominus$ 2.
- To prevent a short-circuit, take care that disconnected battery cables 2 and 5 do not accidentally touch the battery terminals.

Service standards

Location	Inspection item	Standard value	Limit	Remedy
9	Specific gravity of battery electrolyte (20°C {68°F})	1.220 to 1.290	—	Charge or replace



◆ Service procedure

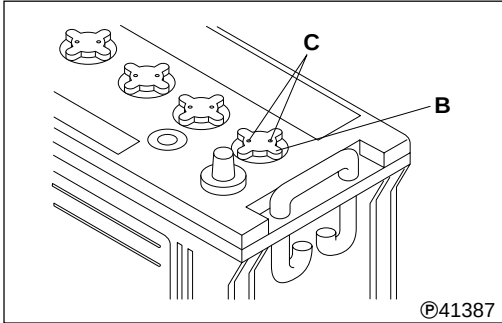
9 Inspection of battery

(1) Visual inspection

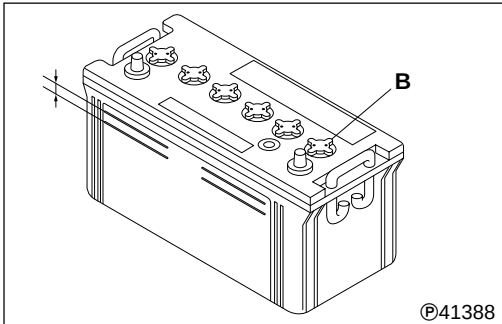
- If terminal A is corroded, scrub the corrosion off of it using a wire brush.
- If cracks or defects are found on battery 9, replace it because the cracks or defects can cause liquid spills.

CAUTION

Be sure to apply grease to the ⊕ side of terminal A because it is easily corroded.

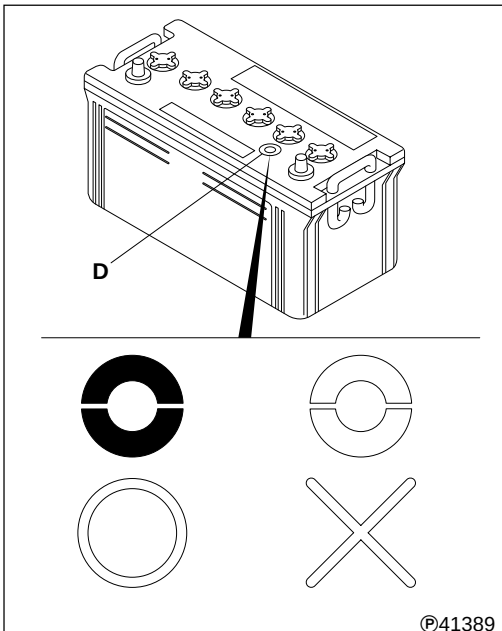


- If the air bleed hole C of vent plug B is clogged, clean the hole.



(2) Inspection of fluid level

- Confirm that the level of battery electrolyte is between the UPPER and LOWER LEVEL lines.
- If the level is below the LOWER LEVEL line, remove vent plug B and replenish the distilled water or battery fluid to the UPPER LEVEL.



(3) Specific gravity measurement

You can tell the specific gravity of the battery electrolyte by the color shown in indicator D.

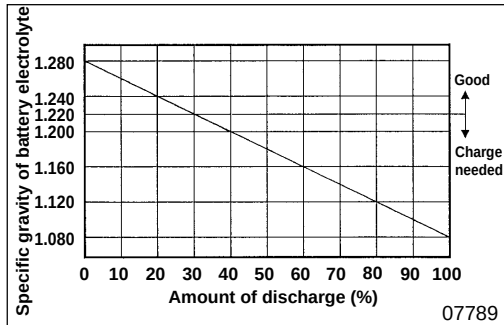
Blue : Good

White : Charge or replace

101 BATTERY

(4) Charging

- Battery **9** 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 on the 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 **10** is corroded, scrub the corrosion off of it using a wire brush and apply acid resistant coating.
- If the battery box **10** is corroded excessively, deformed or cracked, replace it with a new one.

Main high-current fuse

Fuse No.	Main load		Capacity
—	High-current fuse box	—	140A
		For ABS	50A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50A
FH2	Fuse box (F5 to F8, F11)	40A
FH3	Brake booster (Hydraulic booster)	30A
FH4	Starter switch (Terminal B)	50A
FH5	Glow relay	50A
FH6	Alternator	140A
FH7	Fuse box (F31 to F34)	40A
FH8	ABS hydraulic unit	40A

Fuse box

Fuse No.	Main load	Capacity
F1	Headlamp, LH	15A
F2	Headlamp, RH	15A
F3	Stop lamp, horn	15A
F4	Turn signal lamp	15A
F5	—	—
F6	Cab lamp	10A
F7	Van body dome light	10A
F8	A/T fluid cooler fan relay	20A
F9	—	—
F10	Power window	25A
F11	Reserve power (BATT)	10A
F12	—	—
F13	* Cigarette lighter	15A
F14	Radio	10A
F15	Reserve power (ACC)	10A
F16	—	—
F17	* Mirror heater	* 10A

* marks indicate changed parts or added parts.

Fuse No.	Main load	Capacity
F18	Starter	10A
F19	Backup lamp	10A
F20	Meter cluster, DRL	10A
F21	Wiper	10A
F22	Engine control (ECU)	10A
F23	—	—
F24	ABS	10A
F25	Option (MAIN)	10A
F26	* Mirror heater	* 10A
F27	Exhaust brake, A/T	10A
F28	Transmission PTO	10A
F29	Pre-stroke cut relay (Engine control)	10A
F30	* Air-conditioner control	10A
F31	* Air-conditioner compressor	10A
F32	* Condenser fan	15A
F33	Blower fan	25A
F34	Tail lamp	20A

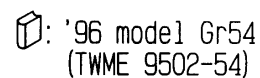
* : Fuses are provided for these pieces of equipment only where they are installed.

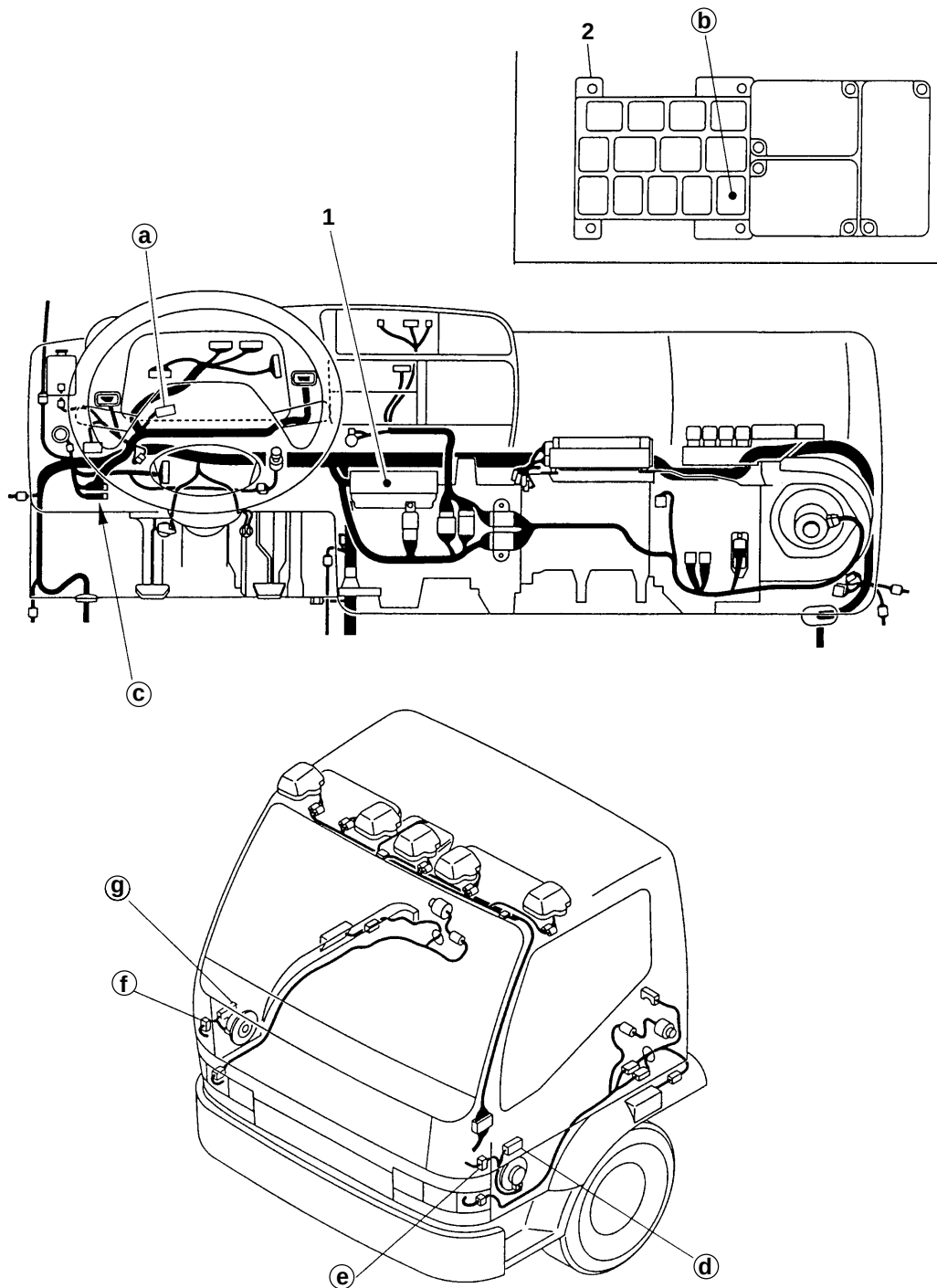
PTO : Power take-off

A/T : Automatic transmission

DRL : Daytime running light

ABS : Anti-lock brake system





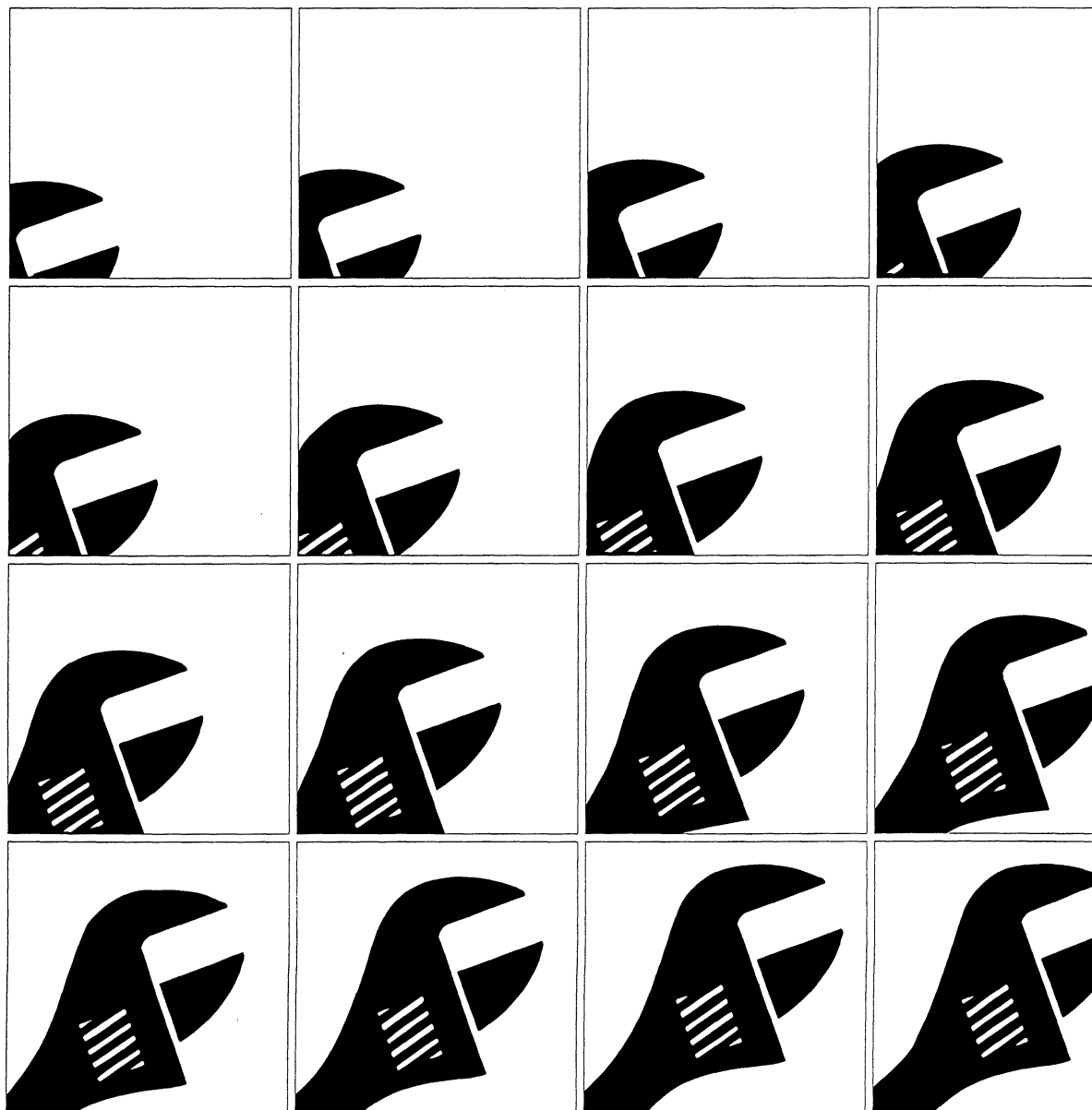
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- 1 Fuse box  104
2 Relay box



Service Manual

MODEL CHANGES FH 1997



FH

SERVICE MANUAL

FOREWORD

This Service Manual contains maintenance and repair methods for personnel involved in the maintenance and repair of 1997 model Mitsubishi Fuso Truck FH series.

Read this manual carefully as an aid to providing correct, efficient and fast maintenance.

Please note, however, that due to continuous improvements on the specifications, numbers and description for maintenance might be changed without prior notice.

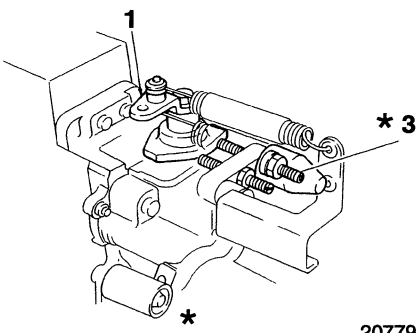
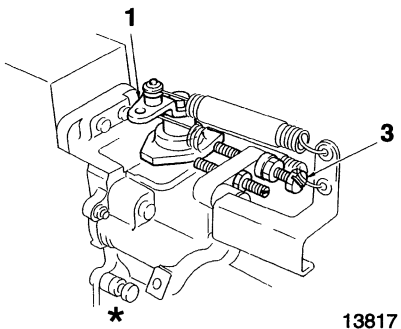
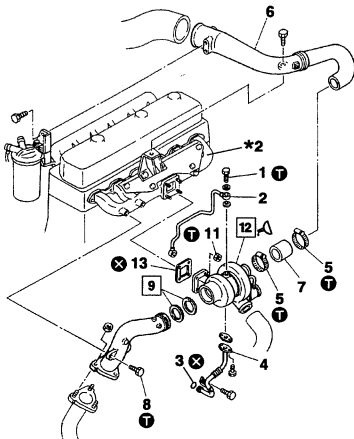
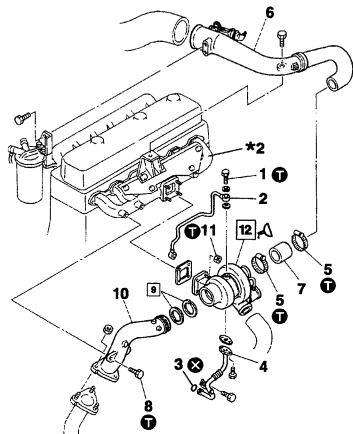
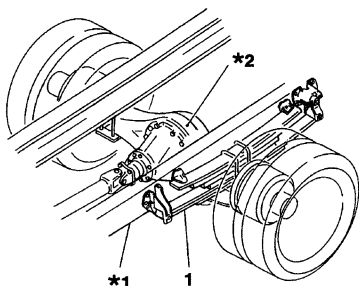
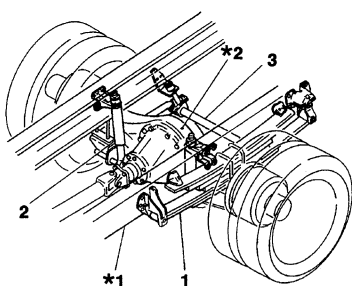
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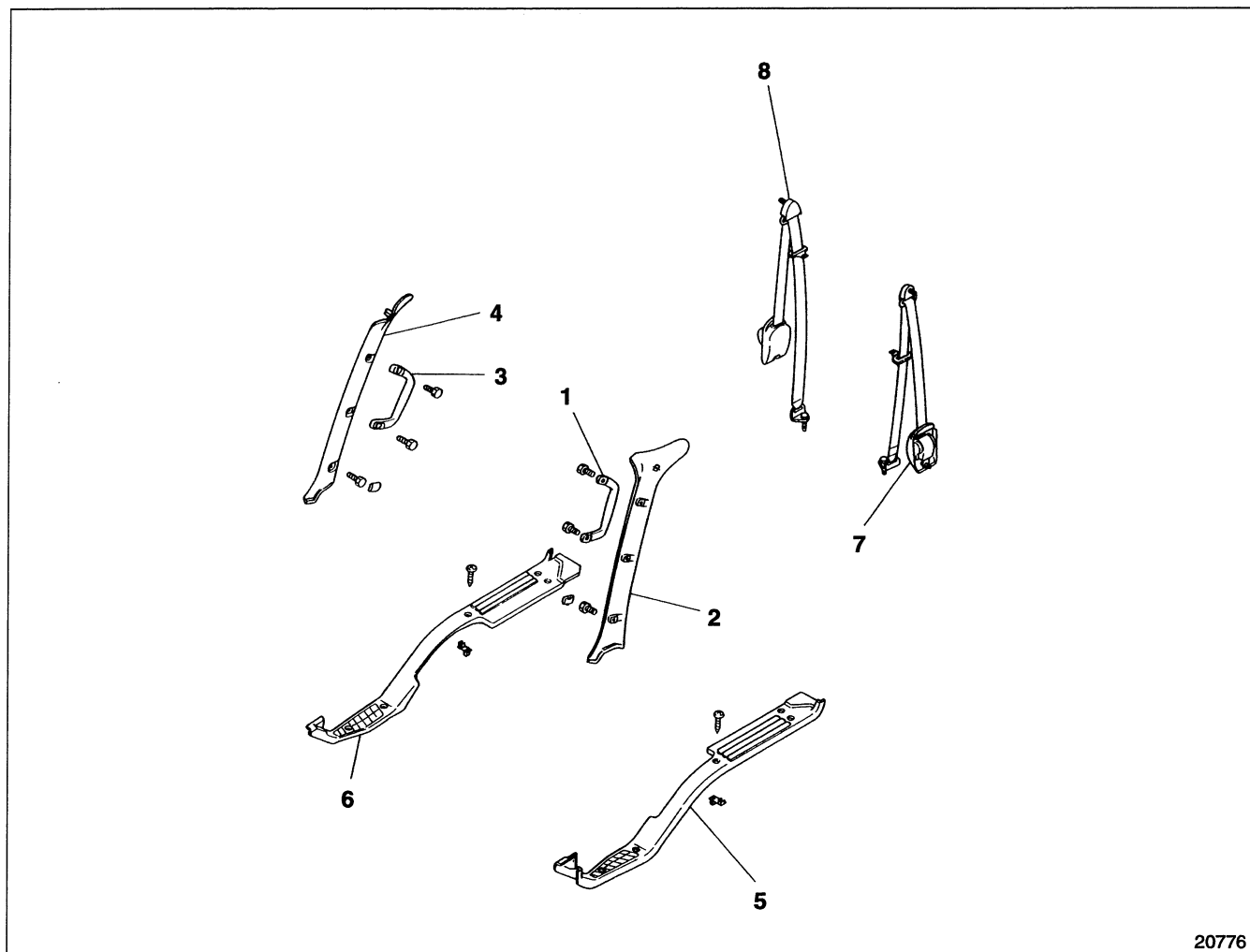
1997 MODEL CHANGES

Item	'97 Model	'96 Model
Gr 13 Fuel and engine control Seals have been added to injection pumps to fit within the legal restriction. CAUTION  Injection pumps should not be adjusted by anyone other than the specified ZEXEL service stations.	 * : Sealed part	 * : Sealed part
Gr 15 Intake and exhaust The intake silencer on the air inlet pipe assembly has been eliminated.	 6 Air inlet pipe assembly (without intake silencer)	 6 Air inlet pipe assembly (with intake silencer)
Gr 34 Rear suspension The shock absorber and stabilizer on the rear suspension have been eliminated.		 2 Shock absorber 3 Stabilizer

Item	'97 Model	'96 Model
Gr 42 Cab The trim inside the cab has been changed from the full trim type to the semi trim type.	See pages 4 to 5 in this manual	—
Gr 54 Electrical The sub-starter switch and circuit have been eliminated.	The circuit now is the same as the engine starter circuit described in Gr 54 ('96 Model).	—
The cold starter switch, cold starter 3-way magnetic valve (automatic transmission only), and cold start indicator lamp have been eliminated.	See pages 6 to 9 in this manual	

CAB INTERIOR FITTING

Trim ('97 model)



20776

● Removal sequence

- | | | |
|-------------------------|-------------------------|--------------------------|
| 1 Front pillar grip, LH | 4 Front pillar trim, RH | 7 Seat belt assembly, LH |
| 2 Front pillar trim, LH | 5 Scuff plate, LH | 8 Seat belt assembly, RH |
| 3 Front pillar grip, RH | 6 Scuff plate, RH | |

CAUTION

Do not disassemble seat belt assemblies 7, 8 because this might cause malfunction of the emergency locking reactor.

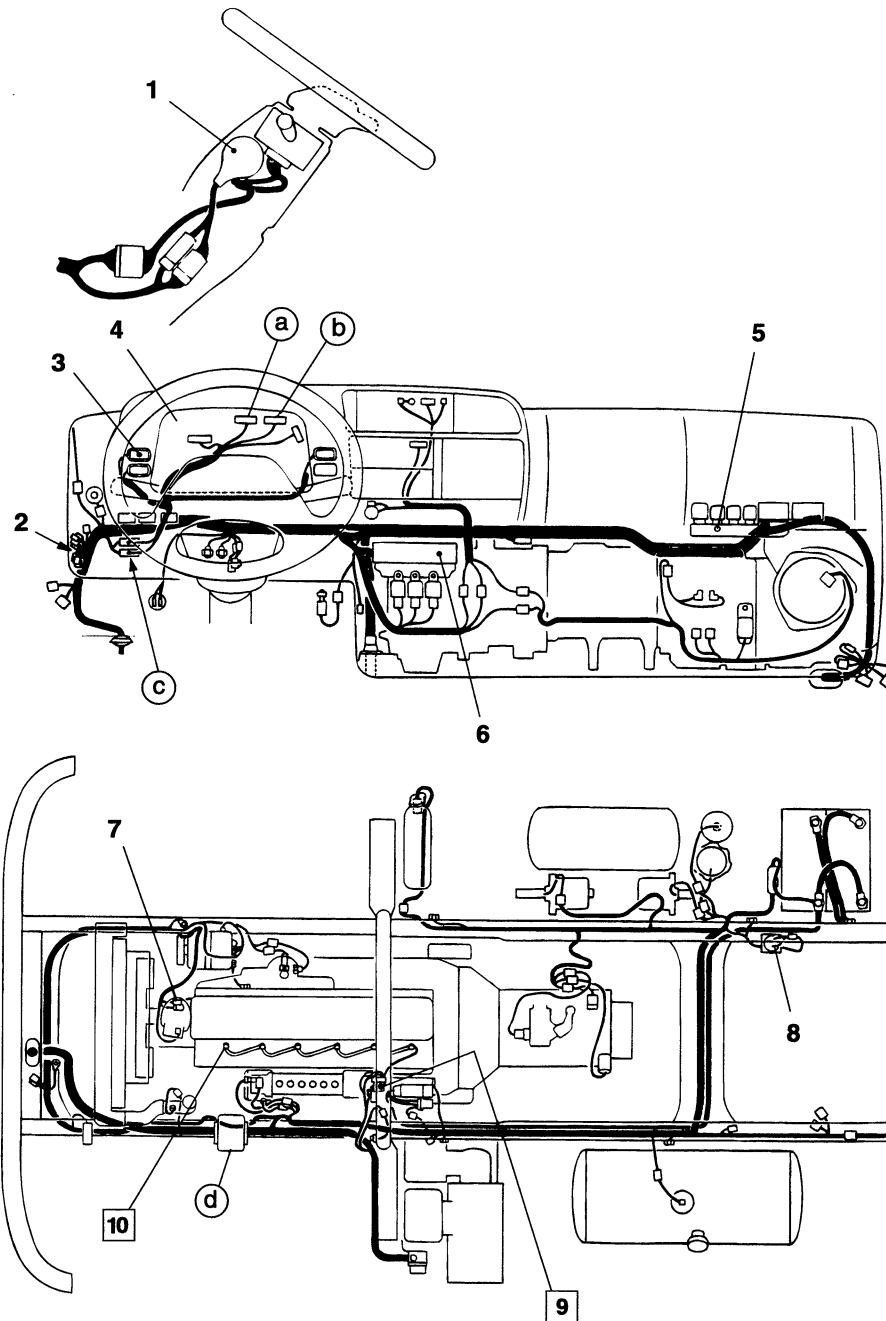
● Installation sequence

Follow the removal sequence in reverse.

('96 model) → 42-49

M E M O



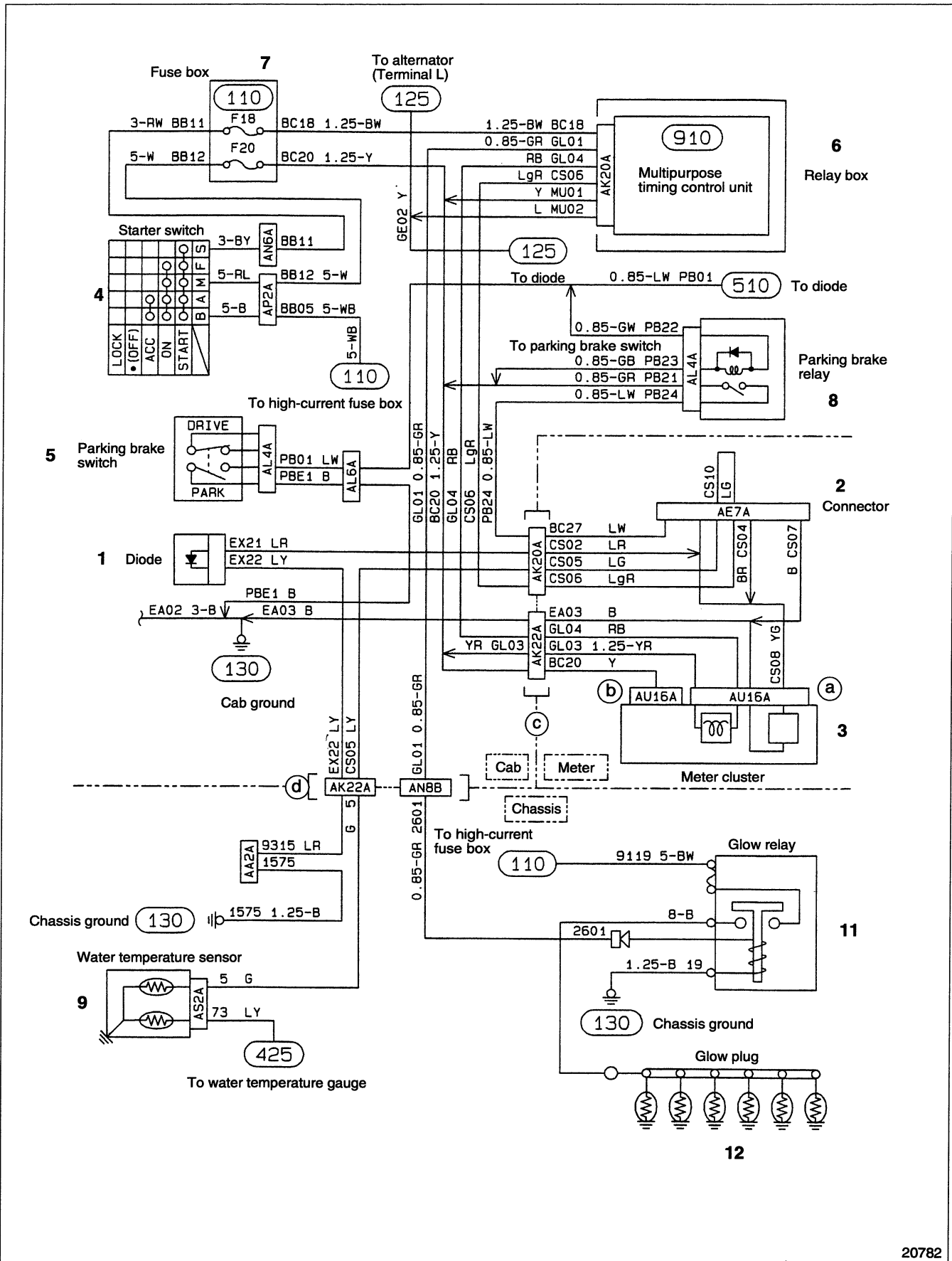


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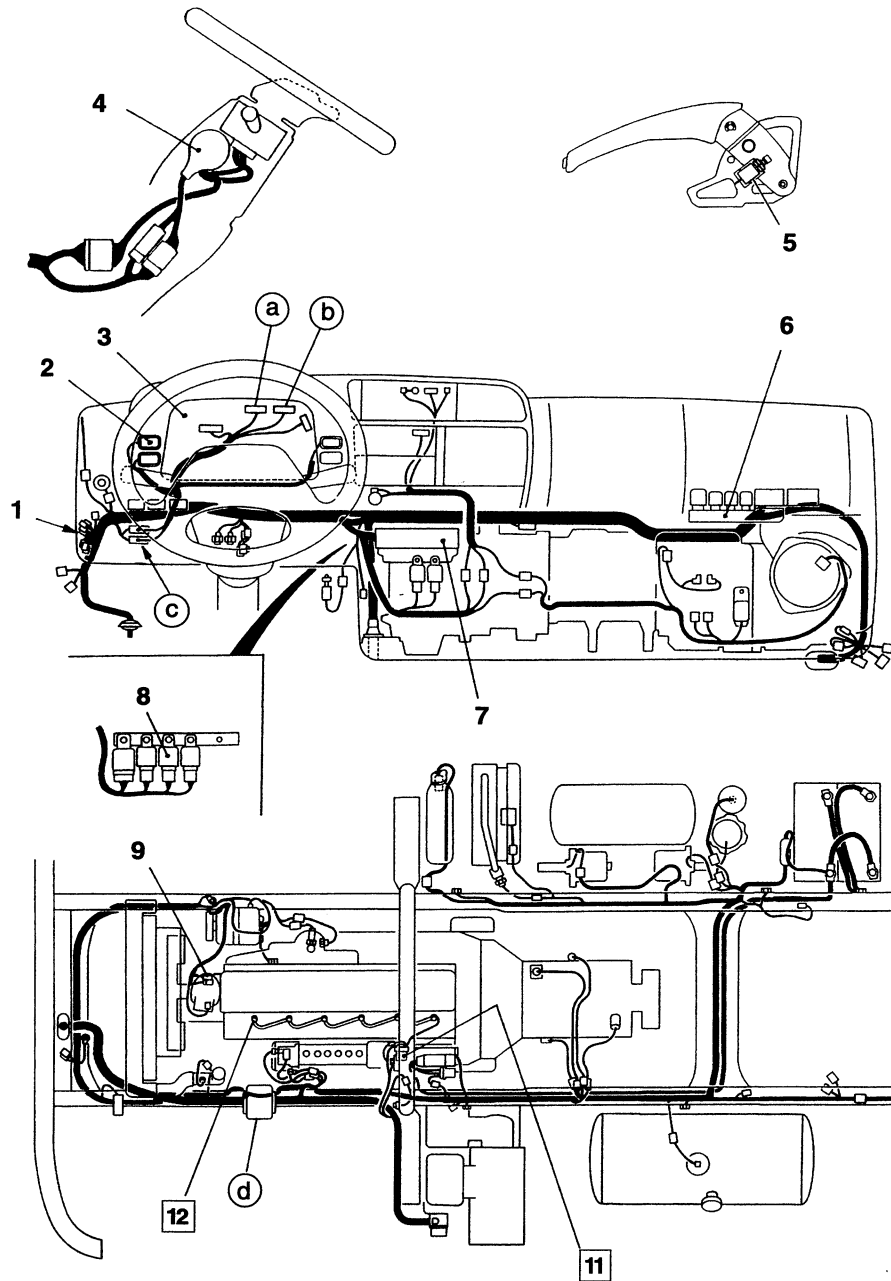
- 1 Starter switch (210)
- 2 Diode
- 3 Connector
- 4 Meter cluster (401)
- 5 Relay box (604)

- 6 Fuse box (104)
- 7 Water temperature sensor (801)
- 8 Exhaust brake 3-way magnetic valve (701)
- 9 Glow relay
- 10 Glow plug

220 ENGINE PREHEATING AND COLD START CIRCUIT : '97 MODEL < Automatic Transmission >



20782



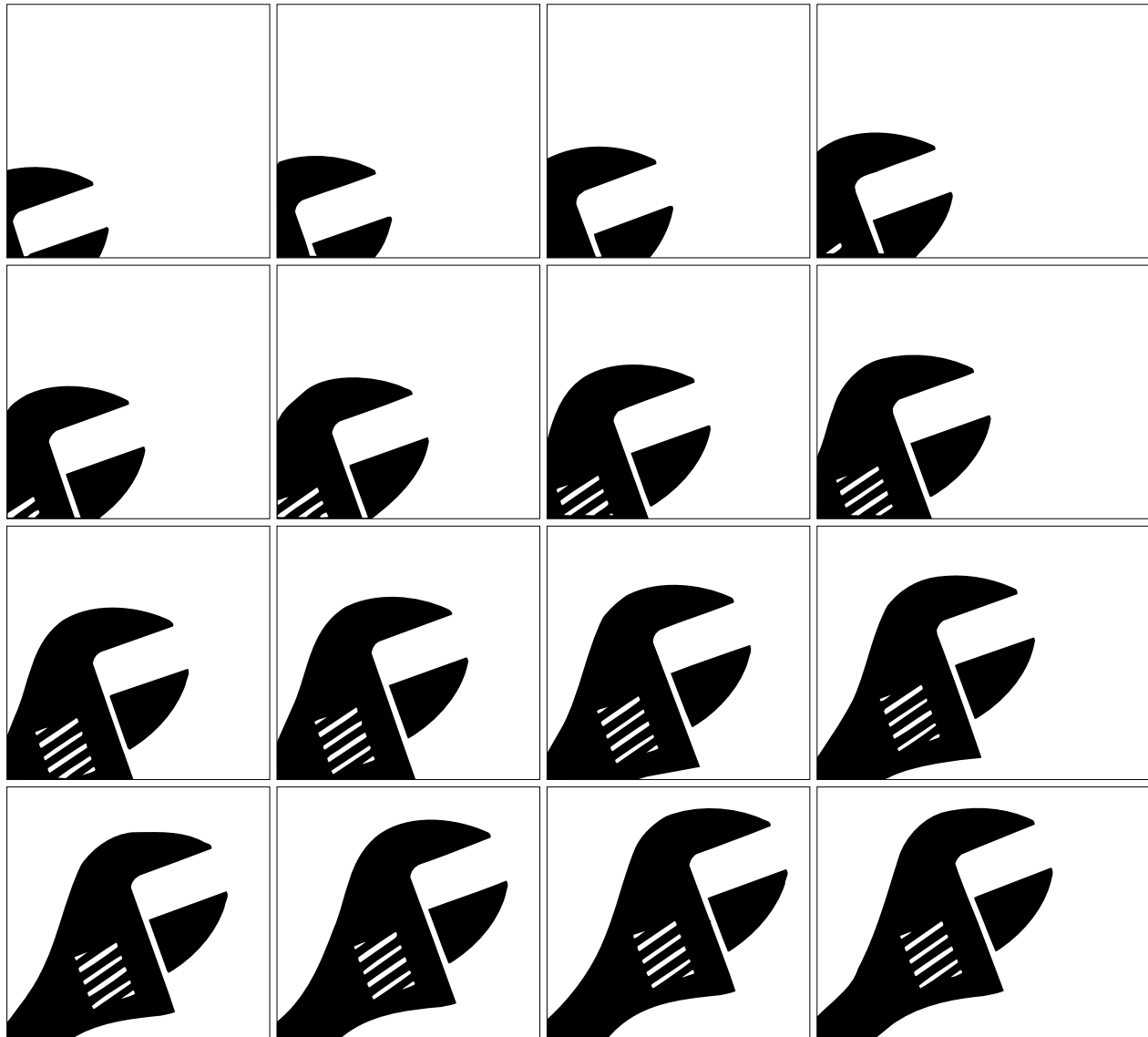
20783

- | | |
|-------------------------------|-----------------------------------|
| 1 Diode | 7 Fuse box (104) |
| 2 Connector | 8 Parking brake relay (604) |
| 3 Meter cluster (401) | 9 Water temperature sensor (801) |
| 4 Starter switch (210) | 11 Glow relay |
| 5 Parking brake switch (510) | 12 Glow plug |
| 6 Relay box (604) | |



Service Manual

FH 1998



FH

SERVICE MANUAL

FOREWORD

This Service Manual contains maintenance and repair methods for personnel involved in the maintenance and repair of 1998 model Mitsubishi Fuso Truck FH Series.

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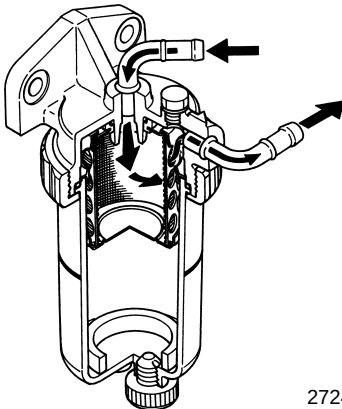
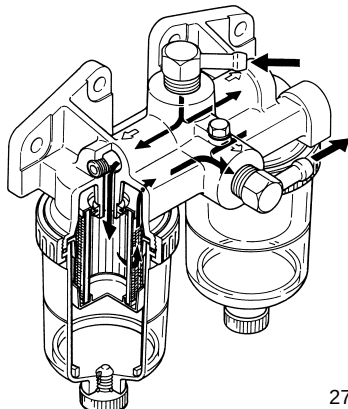
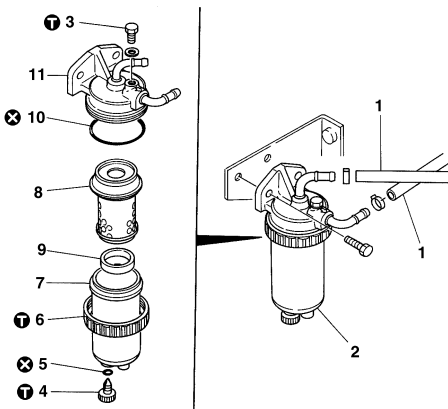
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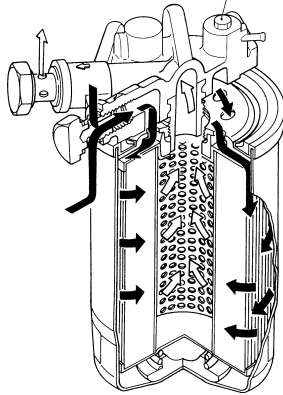
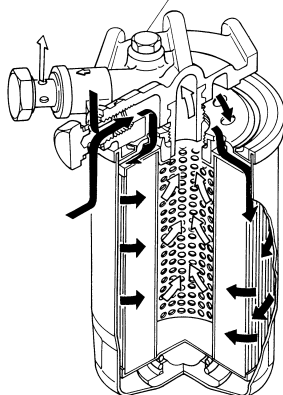
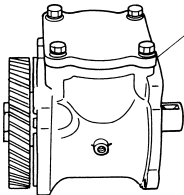
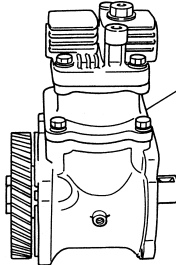
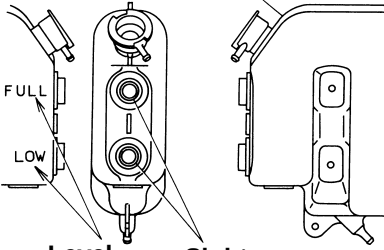
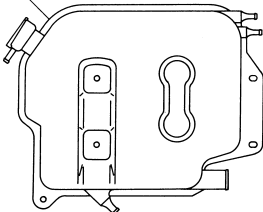
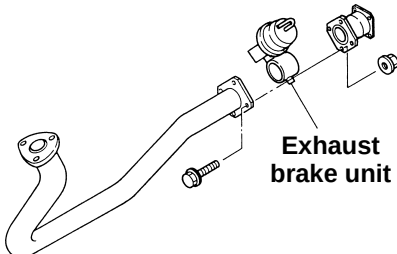
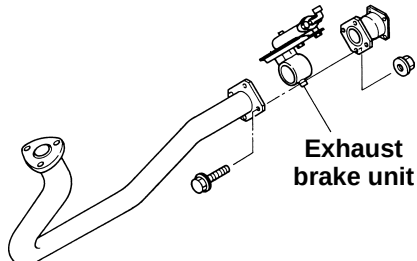
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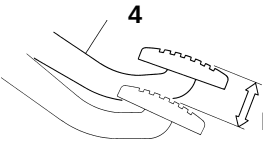
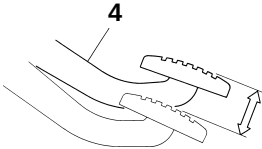
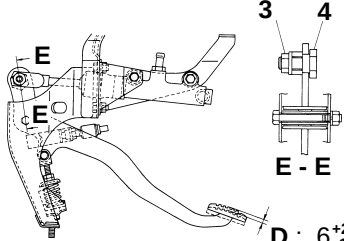
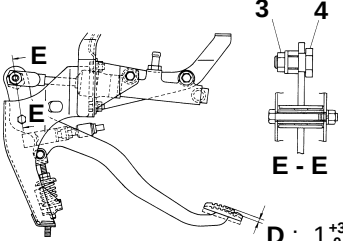
MITSUBISHI FUSO TRUCK OF AMERICA, Inc.

1998 MODEL CHANGES

Item	'98 Model	'97 Model																
Gr 00 General The vehicle identification number has changed.	See page 11 in this manual.	—																
Gr 01 Maintenance Schedule The brake is changed from an air over hydraulic brake type to a hydraulic brake type using the fluid pressure of the power steering system.	 Gr 01 Maintenance schedule '98 Minor change (Pub. No. TWME9502-201)	—																
Gr 13 Fuel and Engine control Water separator is changed from a dual type to a single type.	 27241	 27242																
 27169 ● Disassembly sequence - Fuel feed hose - Water separator assembly - Air vent plug - Drain plug - O-ring - Ring nut - Case - Screen assembly - Water level ring - O-ring - Head ⊗ : Non-reusable parts WARNING  - Fuel ignites easily. Do not get it near flame or heat. - Wipe up any spilled diesel fuel because it can cause a fire. ● Assembly sequence Follow the disassembly sequence in reverse.																		
 Tightening torque Unit : N·m {lb·ft, kgf·m} <table><tr><th>Location</th><th>Parts to be tightened</th><th>Tightening torque</th><th>Remarks</th></tr><tr><td>3</td><td>Air vent plug</td><td>8 to 12 {5.8 to 8.7, 0.8 to 1.2}</td><td>—</td></tr><tr><td>4</td><td>Drain plug</td><td>3 to 4 {2.2 to 2.9, 0.3 to 0.4}</td><td>—</td></tr><tr><td>6</td><td>Ring nut</td><td>23 to 27 {17 to 20, 2.3 to 2.8}</td><td>—</td></tr></table>			Location	Parts to be tightened	Tightening torque	Remarks	3	Air vent plug	8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—	4	Drain plug	3 to 4 {2.2 to 2.9, 0.3 to 0.4}	—	6	Ring nut	23 to 27 {17 to 20, 2.3 to 2.8}	—
Location	Parts to be tightened	Tightening torque	Remarks															
3	Air vent plug	8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—															
4	Drain plug	3 to 4 {2.2 to 2.9, 0.3 to 0.4}	—															
6	Ring nut	23 to 27 {17 to 20, 2.3 to 2.8}	—															

Item	'98 Model	'97 Model
Air vent cock is added to fuel filter head.	T 7.8 to 12 N·m {5.8 to 8.7 lbf·ft, 0.8 to 1.2 kgf·m}  27991	T 7.8 to 12 N·m {5.8 to 8.7 lbf·ft, 0.8 to 1.2 kgf·m}  27306
Injection pump drive is changed from an air compressor drive to an injection pump drive case.	Injection pump drive case  See page 12 to 15 in this manual. 27552	Air compressor  27553
Gr 14 Cooling Level marks and sight glasses have been added to the surge tank.	Surge tank  Level marks Sight glasses 27554	Surge tank  27555
Gr 15 Intake and exhaust The exhaust brake unit is changed from an air type to a vacuum type. (For details on the exhaust brake unit refer to  Gr 35 Brake)	Exhaust brake unit  27606	Exhaust brake unit  27607

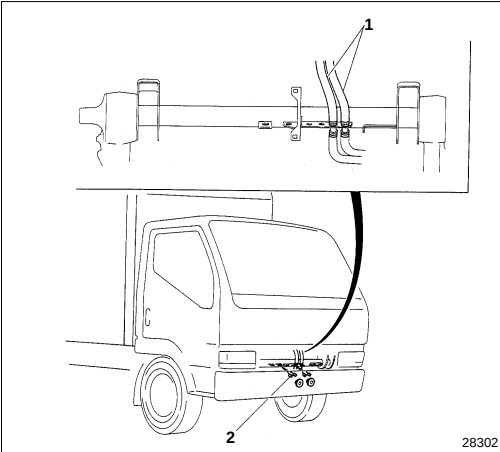
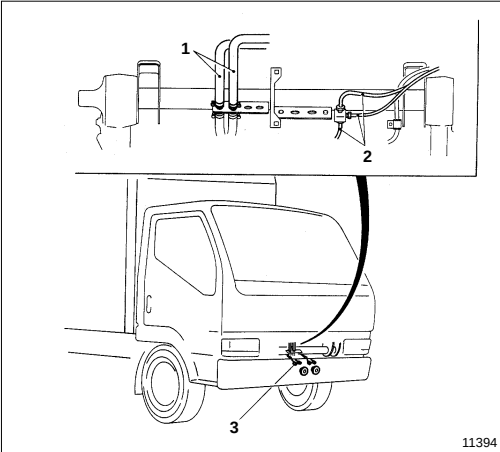
1998 MODEL CHANGES

Item	'98 Model	'97 Model																																		
Gr 21 Clutch Clutch pedal lever ratio is changed. Also clutch pedal free play is changed.	Clutch pedal free play (INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE Section)  B : 37 to 52 mm {1.46 to 2.05 in.} 11064	Clutch pedal free play (INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE Section)  B : 32 to 44 mm {1.26 to 1.73 in.} 11064																																		
	Clutch pedal free play (CLUTCH PEDAL Section)  D : 6^{+2}_{-1} mm {0.236^{+0.079}_{-0.039} in.} 11525	Clutch pedal free play (CLUTCH PEDAL Section)  D : 1^{+3}_0 mm {0.039^{+0.12}₀ in.} 11525																																		
Gr 22 Manual Transmission Oil specification and viscosity have been added to specifications section. (Applies to '96 model and later)	SPECIFICATIONS <table border="1"> <thead> <tr> <th colspan="2">Item</th><th>Specifications</th></tr> </thead> <tbody> <tr> <td colspan="2">Mode of control</td><td>Floor shift remote control</td></tr> <tr> <td colspan="2">Transmission model</td><td>M050S5</td></tr> <tr> <td rowspan="7">Gear ratio</td><td>1st</td><td>6.875</td></tr> <tr> <td>2nd</td><td>4.189</td></tr> <tr> <td>3rd</td><td>2.311</td></tr> <tr> <td>4th</td><td>1.409</td></tr> <tr> <td>5th</td><td>1.000</td></tr> <tr> <td>6th</td><td>—</td></tr> <tr> <td>Reverse</td><td>6.875</td></tr> <tr> <td rowspan="3">Oil</td><td>Gear oil</td><td>General : API GL-3 SAE80 Warm region : API GL-3 SAE90 Tropical region : API GL-4 SAE90</td></tr> <tr> <td>Engine oil</td><td>Long period of high-speed driving : API CC SAE30 or SAE40 : API CC/SF SAE 30 or SAE40</td></tr> <tr> <td>Quantity L {qts}</td><td>5.7 {6.0}</td></tr> <tr> <td colspan="2">Mass kg {lb}</td><td>120 {265}</td></tr> </tbody> </table>		Item		Specifications	Mode of control		Floor shift remote control	Transmission model		M050S5	Gear ratio	1st	6.875	2nd	4.189	3rd	2.311	4th	1.409	5th	1.000	6th	—	Reverse	6.875	Oil	Gear oil	General : API GL-3 SAE80 Warm region : API GL-3 SAE90 Tropical region : API GL-4 SAE90	Engine oil	Long period of high-speed driving : API CC SAE30 or SAE40 : API CC/SF SAE 30 or SAE40	Quantity L {qts}	5.7 {6.0}	Mass kg {lb}		120 {265}
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	6th	—																																		
	Reverse	6.875																																		
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	Quantity L {qts}	5.7 {6.0}																																		
Mass kg {lb}		120 {265}																																		
Gr 35 Brake - Brakes have been changed from an air over hydraulic brake type to a hydraulic brake type using the fluid pressure of the power steering oil pump. - Exhaust brake is changed from an air type to a vacuum type utilizing the vacuum pump.	 Gr 35 Brake '98 Minor change (Pub. No. TWME9502-235)																																			

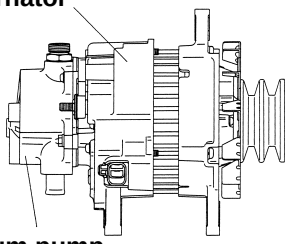
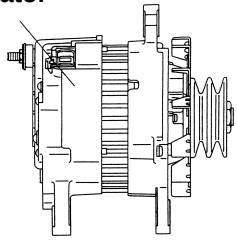
Item	'98 Model	'97 Model
Gr 37 Steering Steering is changed to a power steering system in which the fluid pressure from the oil pump is also used by the brake booster (hydraulic booster).	 Gr 37 Steering '98 Minor change (Pub. No. TWME9502-237)	—

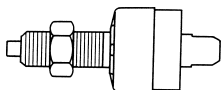
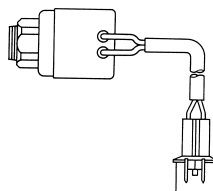
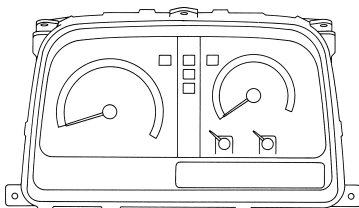
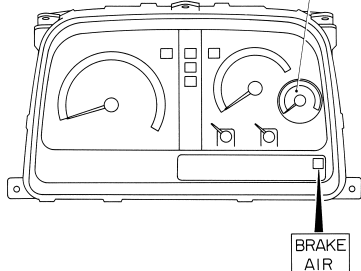
1998 MODEL CHANGES

Item	'98 Model	←	'97 Model
Gr 42 Cab For the changes of brake and power steering fluid line, preliminary work and work from front of cab in removal and installation of cab section are changed.	Preliminary Work < '98 Model > 28301 ● Disassembly sequence 1 Battery (negative terminal) Gr 54 2 Front grille Gr 42 3 Pressure cap Gr 14 4 Radiator drain plug Gr 14 5 Crankcase drain plug Gr 14 6 Clutch fluid pipe < Manual transmission > Gr 21 7 Brake fluid pipe Gr 35 8 Power steering oil pipe Gr 37 A : Wheel chock ↑ Preliminary Work < '97 Model > 11393 ● Disassembly sequence 1 Battery (negative terminal) Gr 54 2 Front grille Gr 42 3 Pressure cap Gr 14 4 Radiator drain plug Gr 14 5 Crankcase drain plug Gr 14 6 Clutch fluid pipe < Manual transmission > Gr 21 7 Brake tube Gr 35 A : Wheel chock Work items • Draining, filling, and air bleeding of clutch fluid, brake fluid and power steering fluid Gr 21, Gr 35, Gr 37 • Draining, filling, and air bleeding of coolant Gr 14		

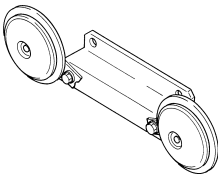
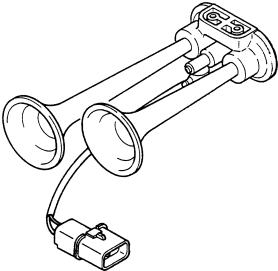
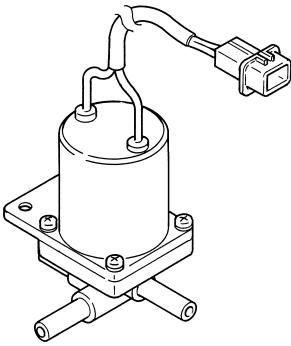
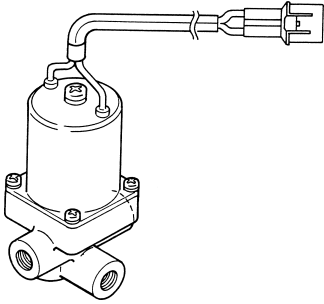
Item	'98 Model	'97 Model
	Work from Front of Cab < '98 Model >  ↑ Work from Front of Cab < '97 Model> 	● Disassembly sequence 1 Heater hose  Gr 55B 2 Horn harness ● Assembly sequence Follow the disassembly sequence in reverse. ● Disassembly sequence 1 Heater hose  Gr 55B 2 Air hose  Gr 35 3 Horn harness ● Assembly sequence Follow the disassembly sequence in reverse.

1998 MODEL CHANGES

Item	'98 Model	'97 Model
Gr 54 Electrical 1 POWER, CHARGING AND GROUND As the brake type has been changed, the alternator is changed to a type with vacuum pump.	★mark indicates page numbers in Gr 54 Electrical '98 Minor Changes (Pub.No. TWME9502-254) Alternator  Vacuum pump (Refer to pages *54-1-2 to 5 and page *54-1-8) 26202	Alternator  26203
A high-current fuse for the brake booster (hydraulic booster) has been added.	Fuse capacity : 50 A Refer to page *54-1-6	—
- The following circuits have been changed or have been added (marked ★). (110) POWER CIRCUIT ★(115) RESERVE POWER CIRCUIT (125) BATTERY CHARGING CIRCUIT (130) GROUND	Refer to page *54-1-14 Refer to page *54-1-22 Refer to page *54-1-24 Refer to page *54-1-26	—
2 STARTING, PREHEATING AND STOPPING ENGINE - The following circuits have been changed. (210) ENGINE STARTING CIRCUIT < Manual transmission > (220) ENGINE PREHEATING CIRCUIT < Automatic transmission >	Refer to page *54-2-2 Refer to page *54-2-4	—
3 LIGHTING (320) TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS have been changed.	Refer to page *54-3-2	—

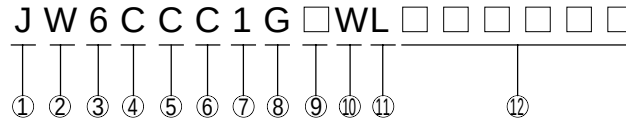
Item	'98 Model	'97 Model
(325) STOP LAMP CIRCUIT has been changed and the stop lamp switch is changed from an air type to a vacuum type.	 Refer to page *54-3-4 26204	 26205
(352) VAN BODY DOME LIGHT CIRCUIT is changed.	Refer to page *54-3-6	—
4 METER As a result of changes in the brake type, air pressure gauge and  warning lamp are eliminated.	 Refer to page *54-4-2 26206	 Air pressure gauge  26207
5 INDICATOR AND WARNING Accompanying changes in the brake type (500), on-vehicle inspection and adjustment item has been changed. Instead of the procedure for the inspection of brake fluid level switch the inspection procedure for power steering fluid level sensor is described.	Refer to page *54-5-6 to 7	—
- The following circuits have been changed or have been added (marked ★). (510) PARKING BRAKE INDICATOR CIRCUIT (515) BRAKE WARNING CIRCUIT (530) WATER LEVEL WARNING CIRCUIT (536) ENGINE OIL PRESSURE WARNING CIRCUIT (537) OVERHEATING WARNING CIRCUIT	Refer to page *54-5-8 Refer to page *54-5-10 Refer to page *54-5-14 Refer to page *54-5-16 Refer to page *54-5-18	—
(547) AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT ★ (549) POWER STEERING FLUID LEVEL WARNING CIRCUIT	Refer to page *54-5-20 Refer to page *54-5-22	—

1998 MODEL CHANGES

Item	'98 Model	⇐ '97 Model
⑥ CAB SIDE ELECTRICS Accompanying the changes in the brake type, the horn is changed from an air type to an electric type and the (616) HORN CIRCUIT has also been changed.	 Refer to page *54-6-4 26208	 26209
⑦ CHASSIS ELECTRIC Accompanying changes in the brake type, the exhaust brake 3-way magnetic valve is changed from an air type to a vacuum type valve.	 Refer to page *54-7-2 26210	 26968
(710) EXHAUST BRAKE CIRCUIT < Manual transmission > is changed.	Refer to page *54-7-4	—
⑨ OTHERS (905) Joint connector has been changed.	Refer to page *54-9-2	—

VEHICLE IDENTIFICATION NUMBER : '98 MODEL

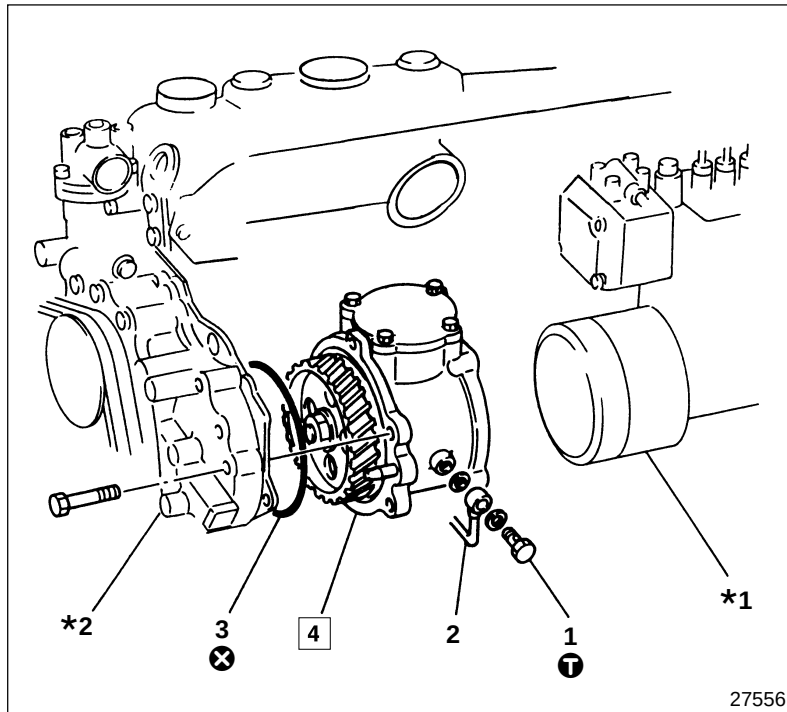
00



- | | |
|-------------------------------------|---|
| ① Country | J : Japan |
| ② Make | W : Mitsubishi Fuso |
| ③ Vehicle type | 6 : Incomplete Vehicle |
| ④ Gross vehicle weight/Brake system | C : 7258 to 8845 kg {16001 to 19500 lbs}/Hydraulic |
| ⑤ Line | C : FH211 |
| ⑥ Series (Wheelbase) | C : 2.6 to 2.9 m {102.4 to 114.2 in.} |
| | E : 3.2 to 3.5 m {126.0 to 137.8 in.} |
| | G : 3.8 to 4.1 m {149.6 to 161.4 in.} |
| | H : 4.1 to 4.4 m {161.4 to 173.2 in.} |
| | J : 4.4 to 4.7 m {173.2 to 184.9 in.} |
| ⑦ Cab chassis type | 1 : Chassis cab |
| ⑧ Engine | G : 358 CID Diesel turbocharged and charge air cooled |
| ⑨ Check digit | |
| ⑩ Model year | W : 1998 |
| ⑪ Plant | L : Kawasaki-2 |
| ⑫ Plant sequential number | |

00-4 ← ('96 model)

INJECTION PUMP DRIVE CASE



● Removal sequence

- 1 Eye bolt
- 2 Oil pipe
- 3 O-ring
- 4 Air injection pump drive case assembly P14

*1 : Injection pump assembly Gr 13

*2 : Timing gear case

⊗ : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

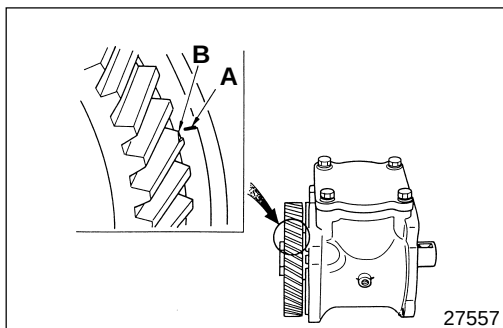
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Eye bolt	21 {15, 2.1}	—

◆ Service procedure

4 Installation of injection pump drive case assembly

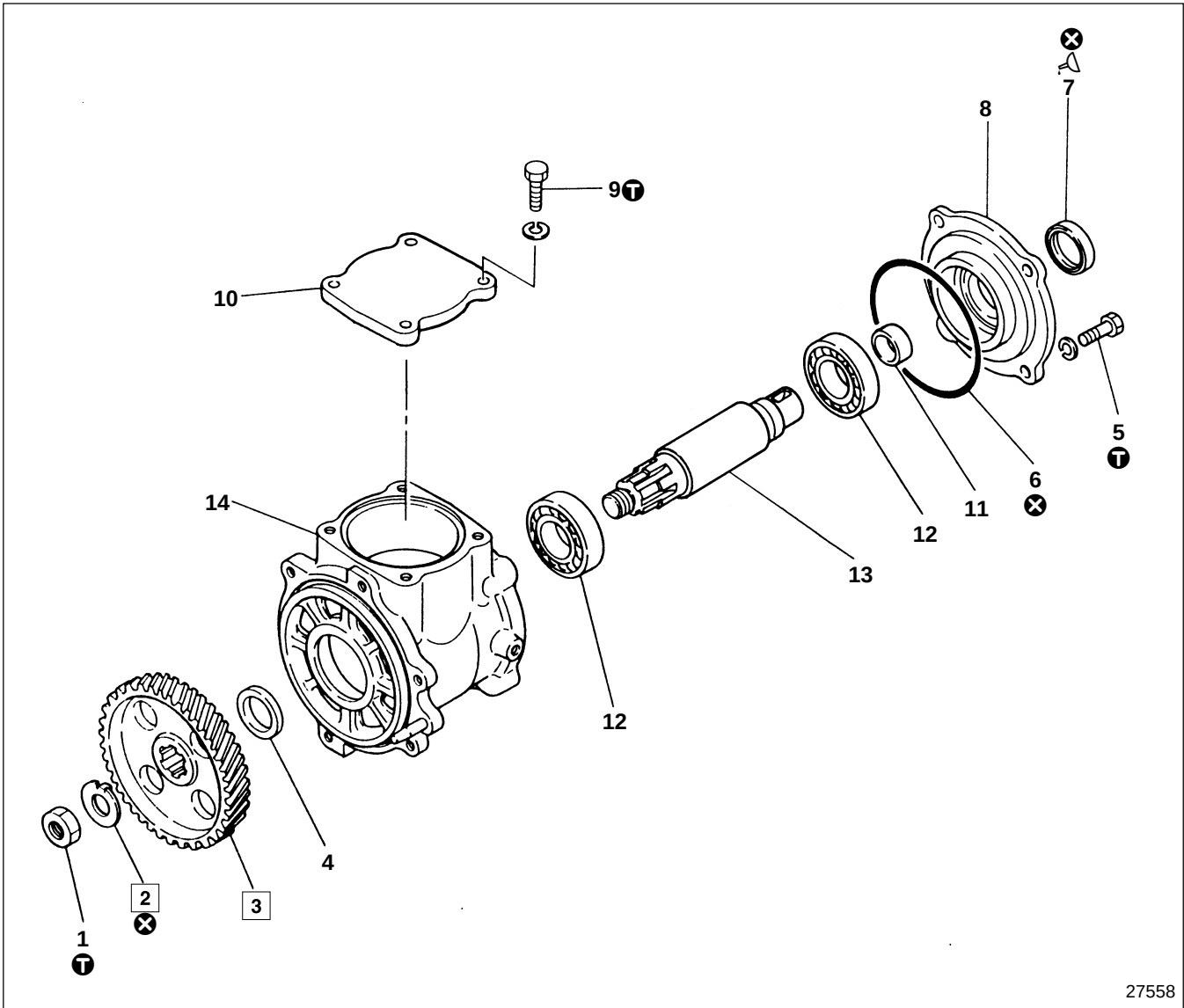
- Position No.1 cylinder of the engine at top dead center in the compression cycle. Gr 11
- Align marking line **A** with notch **B**, then install injection pump drive case assembly **4** on timing gear case ***2**.



MEMO

INJECTION PUMP DRIVE CASE

Injection Pump Drive Case Assembly



27558

● Disassembly sequence

- | | | |
|---------------|------------------|------------------------|
| 1 Nut | 7 Oil seal | 13 Shaft |
| 2 Lock washer | 8 Bearing holder | 14 Crankcase |
| 3 Drive gear | 9 Bolt | |
| 4 Collar | 10 Cover | ⊗ : Non-reusable parts |
| 5 Bolt | 11 Sleeve | |
| 6 O-ring | 12 Bearing | |

● Assembly sequence

Follow the disassembly sequence in reverse.

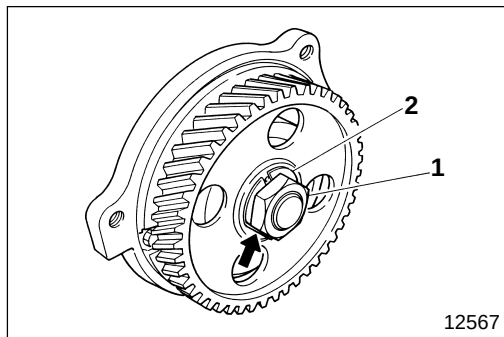
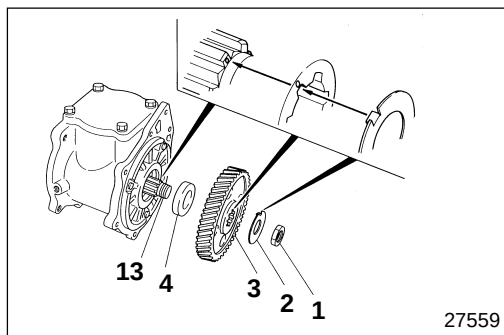
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Drive gear mounting)	166.7 to 210.8 {120 to 155, 17.0 to 21.5}	—
5	Bolt (Bearing holder mounting)	13.7 to 17.7 {10 to 13, 1.4 to 1.8}	—
9	Bolt (Cylinder head assembly mounting)	24.5 to 29.4 {18 to 22, 2.5 to 3.0}	—

L Lubricant

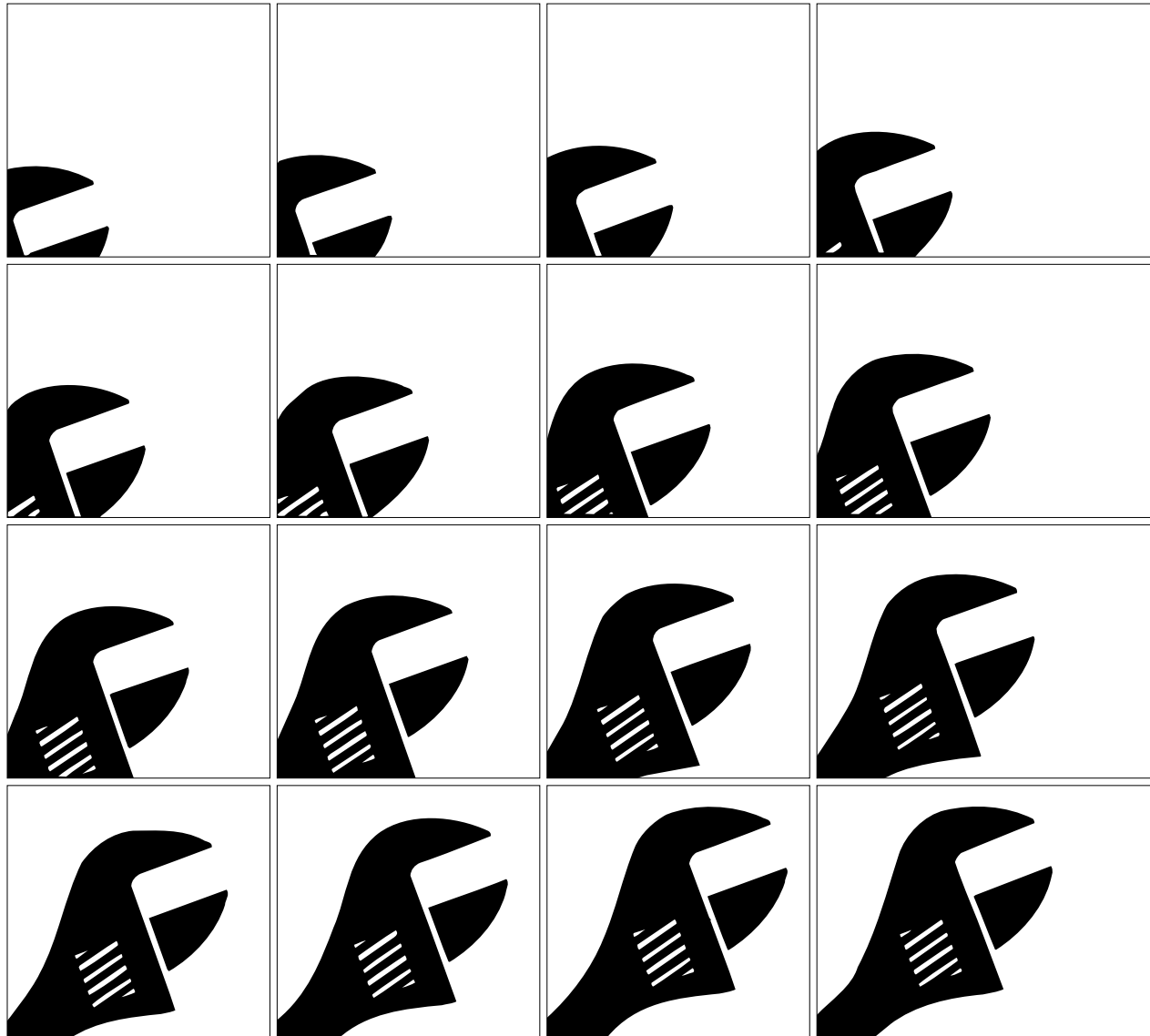
Location	Points of application	Specified lubricant	Quantity
7	Oil seal lip	Engine oil	As required

◆ Service procedure**2 3 Installation of lock washer and drive gear**After installation, bend lock washer **2** to nut **1** side.



Service Manual

FH 1999 Model Changes



FH

SERVICE MANUAL

FOREWORD

This Service Manual contains maintenance and repair methods for personnel involved in the maintenance and repair of 1999 model Mitsubishi Fuso Truck FH Series.

Read this manual carefully as an aid to providing correct, efficient and fast maintenance.

Please note, however, that due to continuous improvements on the specifications, numbers and description for maintenance might change without prior notice.

If you have any question, or encounter a problem, please do not hesitate to contact your nearest Mitsubishi Fuso dealer or distributor.

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MITSUBISHI FUSO TRUCK OF AMERICA, Inc.

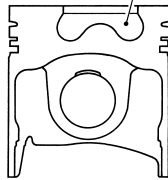
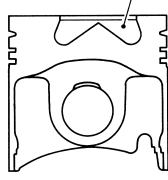
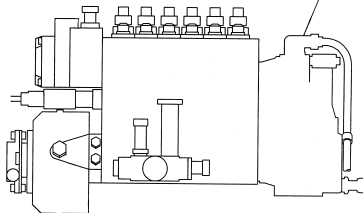
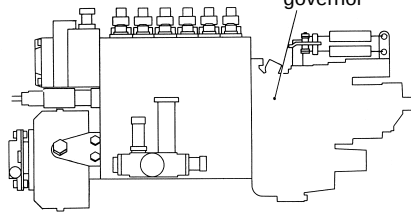
GROUP INDEX

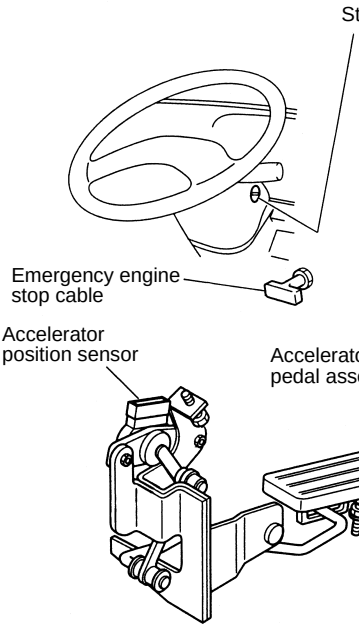
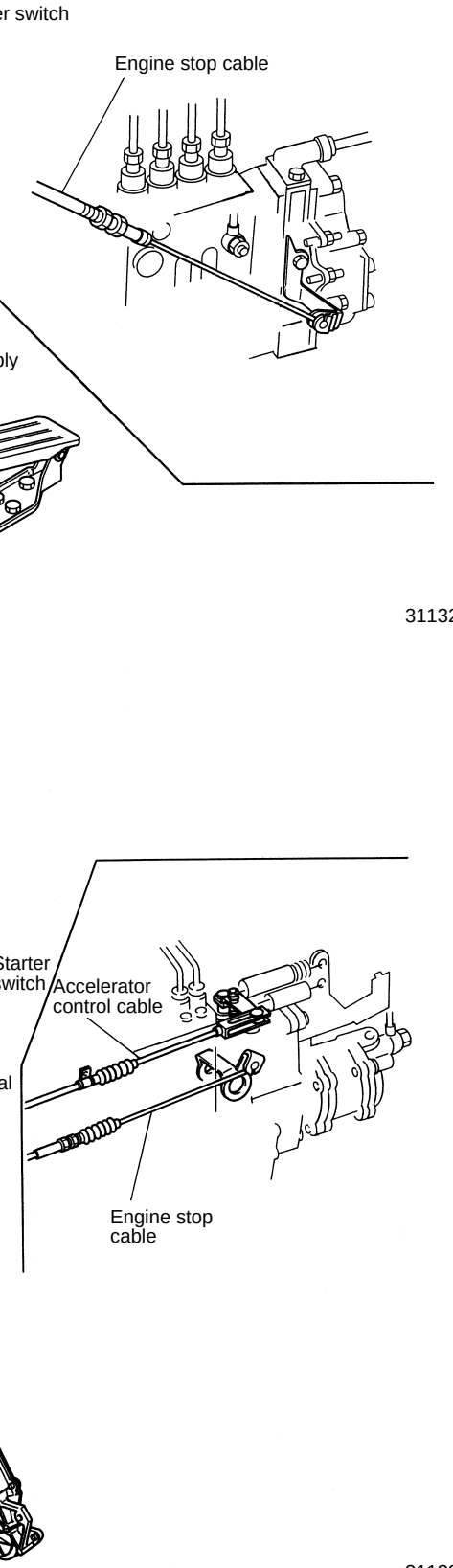
1999 MODEL CHANGES

GENERAL	00
STEERING	37
ELECTRICAL	54

1999 MODEL CHANGES

1999 MODEL CHANGES

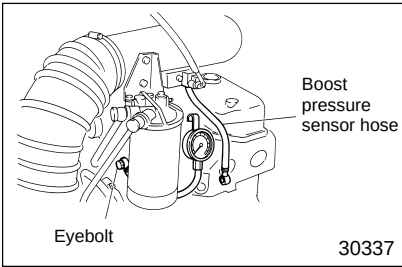
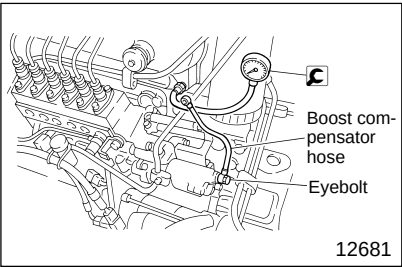
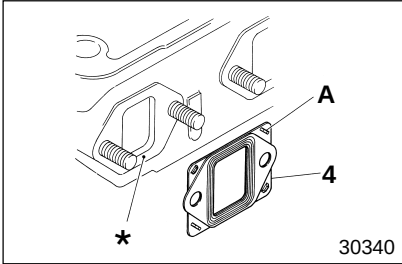
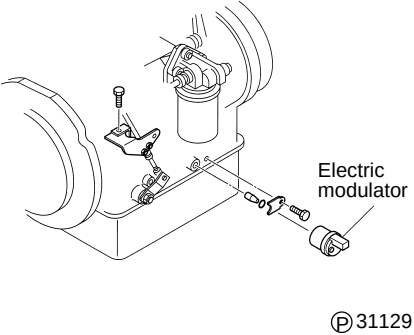
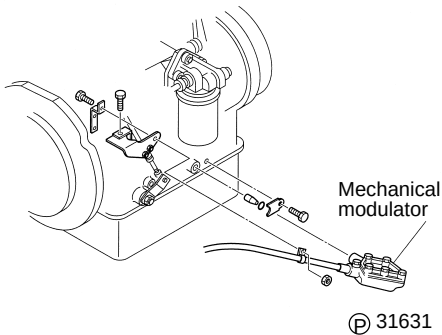
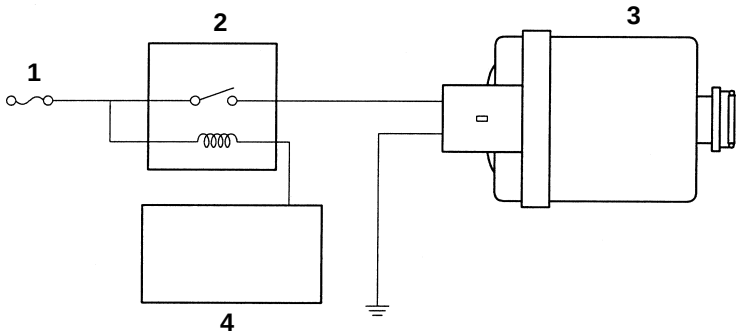
Item	'99 Model	'98 Model										
Gr 00 General - The vehicle identification number has changed. - Model with K-specification wheelbase is added. - Maximum GCW has changed. < Automatic transmission > - Engine type has changed.	00-2 Setting of K-specification vehicle 00-2 10000 kg {22050 lbs} 6D34-1AT2	— No K-specification vehicle 10885 kg {24000 lbs} 6D34-0AT2										
Gr 11 Engine Combustion chamber configuration and service standard value are different.	Combustion chamber  30330	Combustion chamber  30331										
Service standards Unit : mm {in.} <table><tr><th>Location</th><th>Maintenance item</th><th>Standard value</th><th>Limit</th><th>Remedy</th></tr><tr><td>—</td><td>Gap between piston and connecting rod assembly and cylinder sleeve</td><td>[104] 0.10 to 0.14 {[4.094] 0.0039 to 0.0055}</td><td>—</td><td>Correct, or replace with oversize parts</td></tr></table>			Location	Maintenance item	Standard value	Limit	Remedy	—	Gap between piston and connecting rod assembly and cylinder sleeve	[104] 0.10 to 0.14 {[4.094] 0.0039 to 0.0055}	—	Correct, or replace with oversize parts
Location	Maintenance item	Standard value	Limit	Remedy								
—	Gap between piston and connecting rod assembly and cylinder sleeve	[104] 0.10 to 0.14 {[4.094] 0.0039 to 0.0055}	—	Correct, or replace with oversize parts								
Gr 13 Fuel and Engine Control Electronic injection pump system is different. Gr 13 Fuel and Engine Control '99 Minor change (Pub. No. TWME9502-313)	Electronic governor and pre-stroke control injection pump system	Mechanical governor and pre-stroke control injection pump system										
Governor has changed from mechanical type to electronic type. Gr 13 Fuel and Engine Control '99 Minor change (Pub. No. TWME9502-313)	Electronic governor  31130 <table><tr><td>Governor type</td><td>RED-III electronically controlled governor</td></tr></table>	Governor type	RED-III electronically controlled governor	Mechanical governor  31131 <table><tr><td>Governor type</td><td>RLD-J all-speed mechanical governor with boost compensator</td></tr></table>	Governor type	RLD-J all-speed mechanical governor with boost compensator						
Governor type	RED-III electronically controlled governor											
Governor type	RLD-J all-speed mechanical governor with boost compensator											
Fuel injection timing is different.	3° ± 0.5° BTDC	5° ± 0.5° BTDC										

Item	'99 Model	'98 Model
Engine control system has been changed due to the use of new electronic governor system. Gr 13 Fuel and Engine Control '99 Minor change (Pub. No. TWME9502-313)	<'99 Model>  Starter switch Emergency engine stop cable Accelerator position sensor Accelerator pedal assembly	<'98 Model>  Idle control knob Idle control cable Accelerator arm assembly Accelerator pedal assembly Accelerator control cable Engine stop cable Fuel cut-off motor

31132

31133

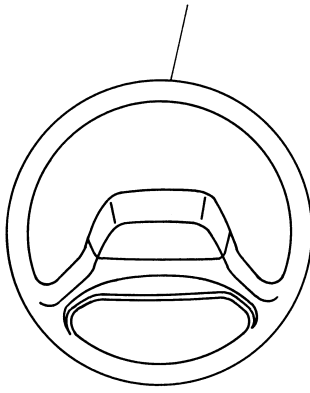
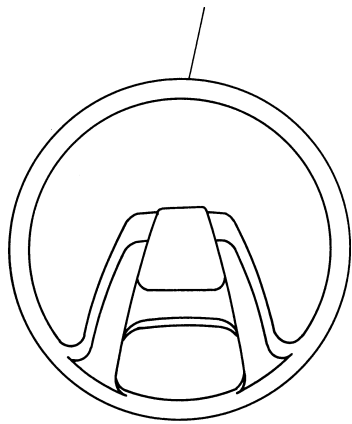
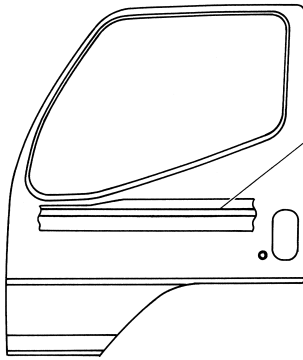
1999 MODEL CHANGES

Item	'99 Model	'98 Model
Gr 15 Intake and Exhaust Boost compensator hose was replaced by boost pressure sensor hose due to the installation of boost pressure sensor.	 Boost pressure sensor hose Eyebolt 30337	 Boost compensator hose Eyebolt 12681
Because exhaust manifold gasket has been changed, installation procedure is added.	 A 4 * 30340	4 Installation of gasket Install gasket 4 on cylinder head * in the direction as illustrated. A: Protrusion
Gr 23 Automatic Transmission Modulator has changed from mechanical type to electric type.	 Electric modulator Ⓔ 31129	 Mechanical modulator Ⓔ 31631
Operating system  1 Fuse 2 Relay 3 Modulator 4 Electric governor ECU Ⓔ 31632 - Outline of operating system Electronic governor ECU 4 sends a signal via relay to modulator 3 for switching between closed-throttle shift and full-throttle shift. - Operating conditions Throttle opening of 80% or more : ON (Full-throttle shift) Throttle opening of 65% or less after ON : OFF (Closed-throttle shift)		

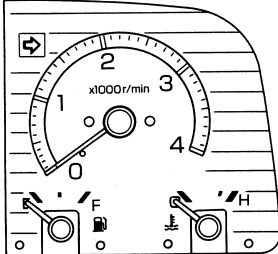
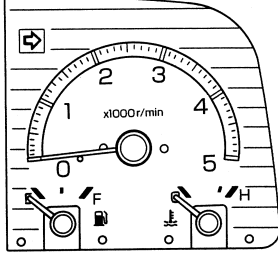
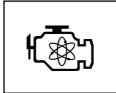
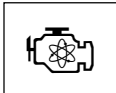
Item	'99 Model		'98 Model																													
• Type M4A4 (Allison AT545) automatic transmission is made available as an option.	The following shows the differences between the standard Type M4A4 (Allison AT542) automatic transmission and the new optional Type M4A4 (Allison AT545) automatic transmission.																															
	Item		Specifications																													
	Type		M4A4 (Allison AT542)	M4A4 (Allison AT545)																												
	Torque converter	Type	3-element, 1-stage, 2-phase	←																												
		Stall torque ratio	1.72																													
	Transmission	Type	Planetary gear type 4 forward speeds, 1 reverse speed		←																											
		Gear ratio	1st	3.454	←																											
			2nd	2.253	←																											
			3rd	1.407	←																											
			4th	1.000	←																											
Reverse			5.024	←																												
Range selector pattern		R—(N)—D—3—2—1 (Engine can be started in N position only)		←																												
Recommended fluid	Fluid quantity (except oil cooler piping)		Automatic transmission fluid (DEXRON or DEXRON II type) 14 {15} When oil is replaced: 8.5 {9.0}	Automatic transmission fluid (DEXRON or DEXRON II type) 20.8 {22} When oil is replaced: 15 {16}																												
	L {qts} Kg {lb}		167 {368}	173 {381}																												
Mass < Wet >																																
Transmission control		Floor shift remote control, cable type		←																												
AT542 13962 AT545 13963 ● Removal sequence 1 Drain plug 2 Dipstick and dipstick guide 3 Dipstick guide connector 4 Bolt 5 Oil pan 6 Gasket 7 Bolt 8 Oil filter 9 Seal ring 10 Intake pipe ⊗ : Non-reusable parts ● Installation sequence Follow the removal sequence in reverse. Repair kit : Oil filter and gasket kit Ⓣ Tightening torque Unit : N·m {lbf.ft, kgf·m} <table><tr><th>Location</th><th>Parts to be tightened</th><th>Tightening torque</th><th>Remarks</th></tr><tr><td>1</td><td>Drain plug</td><td>20 to 27 {15 to 20, 2.05 to 2.75}</td><td>—</td></tr><tr><td>3</td><td>Dipstick guide connector</td><td>125 to 135 {91 to 100, 12.55 to 13.76}</td><td>—</td></tr><tr><td>4</td><td>Bolt (Oil pan mounting)</td><td>14 to 18 {10 to 13, 1.4 to 1.8}</td><td>—</td></tr><tr><td>7</td><td>Bolt (Oil filter mounting)</td><td>14 to 18 {10 to 13, 1.4 to 1.8}</td><td>—</td></tr></table> ⚙ Fluid <table><tr><th>Location</th><th>Points of application</th><th>Specified fluid</th><th>Quantity</th></tr><tr><td>9</td><td>Seal ring</td><td>Automatic transmission fluid (DEXRON or DEXRON II type)</td><td>As required</td></tr></table>					Location	Parts to be tightened	Tightening torque	Remarks	1	Drain plug	20 to 27 {15 to 20, 2.05 to 2.75}	—	3	Dipstick guide connector	125 to 135 {91 to 100, 12.55 to 13.76}	—	4	Bolt (Oil pan mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—	7	Bolt (Oil filter mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—	Location	Points of application	Specified fluid	Quantity	9	Seal ring	Automatic transmission fluid (DEXRON or DEXRON II type)	As required
Location	Parts to be tightened	Tightening torque	Remarks																													
1	Drain plug	20 to 27 {15 to 20, 2.05 to 2.75}	—																													
3	Dipstick guide connector	125 to 135 {91 to 100, 12.55 to 13.76}	—																													
4	Bolt (Oil pan mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—																													
7	Bolt (Oil filter mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—																													
Location	Points of application	Specified fluid	Quantity																													
9	Seal ring	Automatic transmission fluid (DEXRON or DEXRON II type)	As required																													

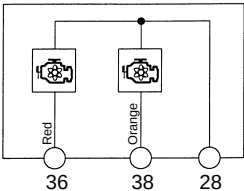
1999 MODEL CHANGES

Item	'99 Model	⇐	'98 Model
Gr 25 Propeller Shaft Three-piece propeller shaft is used in K-wheelbase models.	39 to 59 N·m {28 to 43 lbf·ft, 3.9 to 6.0 kgf·m} 36 to 52 N·m {25 to 40 lbf·ft, 3.5 to 5.5 kgf·m} Front propeller shaft No.1 Front propeller shaft No.2 Rear propeller shaft Ⓔ 32407		
Gr 36 Parking Brake Shape and mounting method of parking brake cable bracket have been changed.	Ⓔ 31127		Ⓔ 31128

Item	'99 Model	'98 Model
Gr 37 Steering Diameter of steering wheel is different.	Steering wheel assembly  ø 400 mm {ø15.7 in.}	Steering wheel assembly  ø 450 mm {ø17.7 in.} 30366
Steering system is different.	Gr 37 Steering	—
Gr 42 Cab Changed to full trim.	Gr 42 Cab (Pub. No. TWME 9502-42)	—
Side door beams are added in doors.	 Side door beam 30546	

1999 MODEL CHANGES

Item	'99 Model	'98 Model
1 POWER CHARGING AND GROUND Battery has changed.	115E41R	95E41R
Capacities of fuses listed on the right and main load specifications have changed. A/T : Automatic transmission M/T : Manual transmission	Discontinued F17 Spare 5A F22 Electronic governor ECU 5A F27 Exhaust brake < M/T > 10A Accelerator relay < A/T > 10A F29 Pre-stroke cut-off relay 10A	F5 Fuel cut-off motor 10A F17 Fuel cut-off relay 10A — F27 Exhaust brake < M/T > 10A F29 Pre-stroke cut-off relay 15A
2 ENGINE STARTING, PREHEATING AND STOPPING Engine starting circuit has been changed due to the use of neutral start relay .	(210) ENGINE STARTING CIRCUIT P54-4	
Engine shut-down circuit has been changed due to the use of electronic governor system. (Fuel cut-off relay and fuel cut-off motor have also been changed accordingly.)	Electronically controlled engine shut-down Gr13 Fuel and engine control	Electric-and-mechanical engine shut down device (215) Engine Stopping Circuit
3 LIGHTING Circuit indicated on the right has been changed due to the discontinued use of joint connector.	(345) CAB LAMP CIRCUIT P54-8	
4 METER Maximum revolution indication and scale of tachometer are different due to the use of electronic governor system.	 <Maximum engine speed indication: 4000 rpm> 13.5±0.1 V 550±35 rpm 1000±50 rpm 1500±60 rpm 2000±65 rpm 2500±70 rpm 3000±75 rpm —	 <Maximum engine speed indication: 5000 rpm> 13±0.2 V 550±50 rpm 1000±70 rpm 1500±110 rpm 2000±110 rpm 2500±110 rpm 3000±110 rpm 4500±125 rpm
Warning lamp is added due to the use of electronic governor system	 (ORANGE) Electronic governor warning lamp (vehicle driveable)  (RED) Electronic governor warning lamp (vehicle not driveable)	

Item	'99 Model	'98 Model
	<Internal Circuit of meter cluster> Meter cluster  <Back side of meter cluster>	

GROUP 00 GENERAL

POWER TRAIN TABLE	00 - 2
IDENTIFICATION NUMBER	00 - 2
CONNECTOR CONFIGURATION CHART	00 - 3

POWER TRAIN TABLE/VEHICLE IDENTIFICATION NUMBER

POWER TRAIN TABLE

Model	Engine model	Clutch model	Transmission model	Propeller shaft	Rear axle model	Final reduction and gear ratio
FH211C, E, G, H, J, K G. V. W. 8160 kg {17995 lb}	6D34T2 175 HP/2900 rpm 325 lb.ft/2000 rpm (SAE, Gross)	C5M33	M050S5 6.875/1.000	P4	R040T	D040H 4.111
		Torque converter (TC290-1.72)	M4A4 (Allison AT542 or AT545) 3.454/1.000			

IDENTIFICATION NUMBER

J W 6 C C C 1 G ☐ **X** ☐ ☐ ☐ ☐ ☐ ☐ ☐

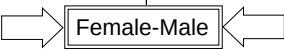
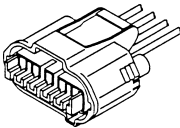
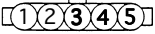
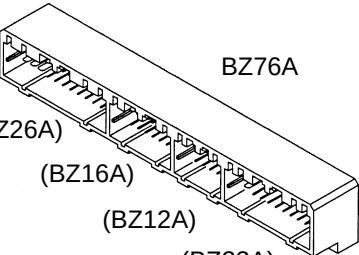
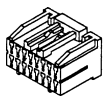
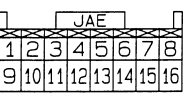
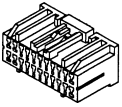
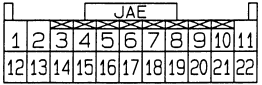
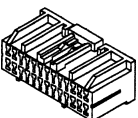
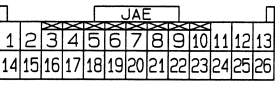
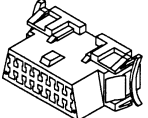
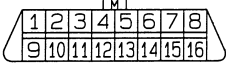
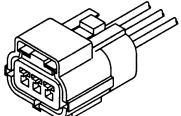
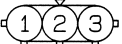
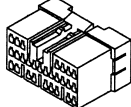
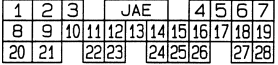
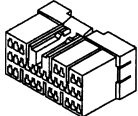
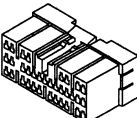
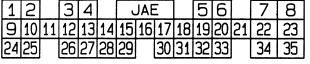
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

- | | |
|-------------------------------------|---|
| ① Country | J : Japan |
| ② Make | W : Mitsubishi Fuso |
| ③ Vehicle type | 6 : Incomplete Vehicle |
| ④ Gross vehicle weight/Brake system | C : 16001 to 19500 lbs/Hydraulic |
| ⑤ Line | C : FH211 |
| ⑥ Series (Wheelbase) | C : 2.6 to 2.89 m {114.6 in.} |
| | E : 3.2 to 3.49 m {130.3 in.} |
| | G : 3.8 to 4.09 m {150.0 in.} |
| | H : 4.1 to 4.39 m {169.7 in.} |
| | J : 4.4 to 4.69 m {181.5 in.} |
| | K : 4.7 to 4.99 m {191.7 in.} |
| ⑦ Cab chassis type | 1 : Chassis cab |
| ⑧ Engine | G : 5.861 ℓ Diesel turbocharged and charge air cooled |
| ⑨ Check digit | |
| ⑩ Model year | X : 1999 |
| ⑪ Plant | K : Kawasaki-1 |
| | L : Kawasaki-2 |
| | M : Kawasaki-3 |
| | N : Nakatsu |
| ⑫ Plant sequential number | |

CONNECTOR CONFIGURATION CHART

00

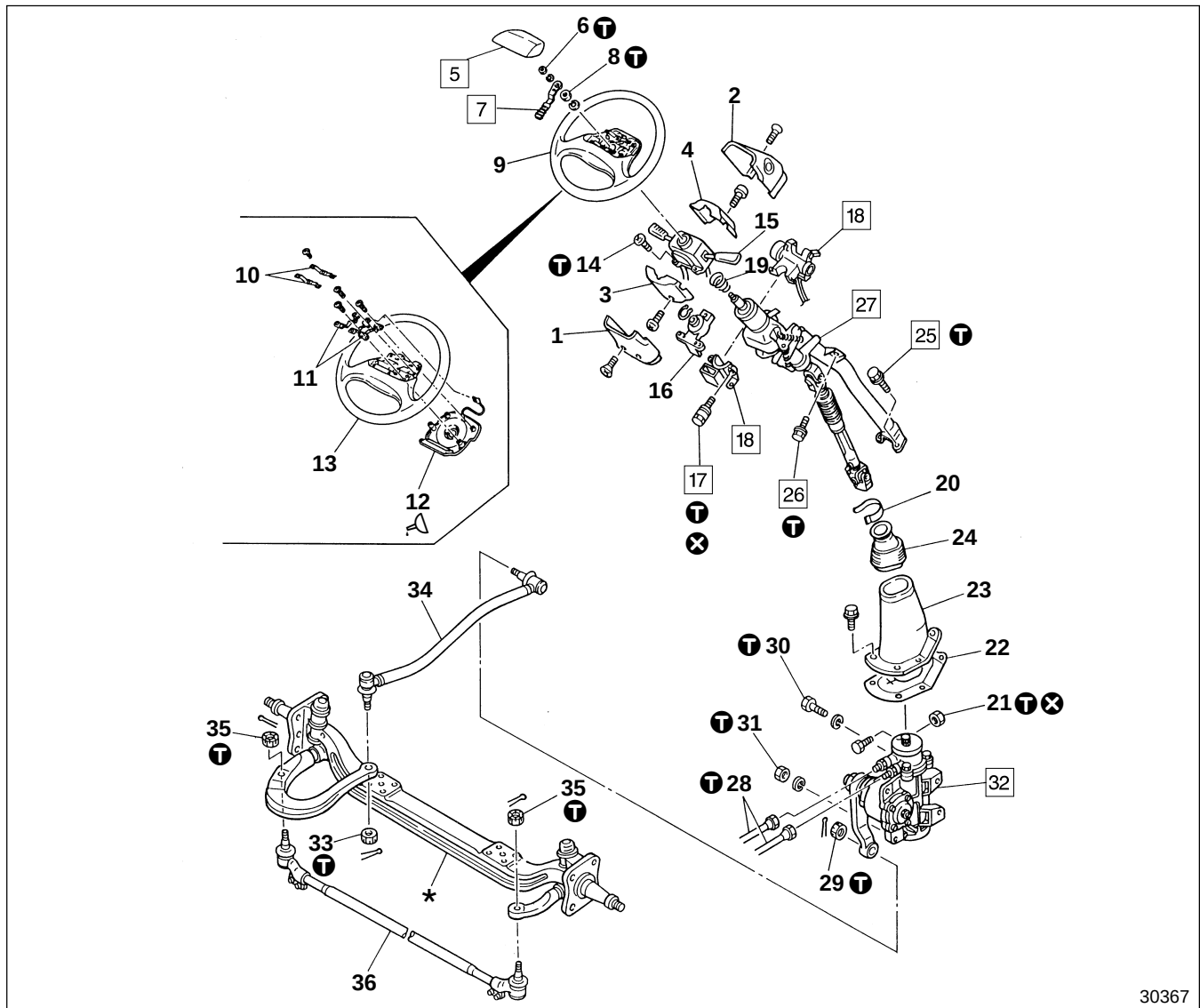
Connector is added due to the use of electronic governor.

Type (numeral indicates number of terminal)			
AQ	AQ5A	 	
BZ	BZ12A	 	 BZ76A (BZ26A) (BZ16A) (BZ12A) (BZ22A)
	BZ16A	 	
	BZ22A	 	
	BZ26A	 	
CB	CB16A	 	
CH	CH3A	 	
CM	CM28A	 	
	CM30A	 	
	CM35A	 	

GROUP 37 STEERING

STEERING SYSTEM	37 - 2
------------------------------	---------------

STEERING SYSTEM



30367

● Removal sequence

- | | | |
|----------------------------|---------------------------------------|----------------------------------|
| 1 Column cover outer lower | 15 Combination switch Gr 54 | 28 Oil pipe Gr 37 |
| 2 Column cover outer upper | 16 Bracket | 29 Nut |
| 3 Column cover inner lower | 17 Head cutting bolt | 30 Bolt |
| 4 Column cover inner upper | 18 Starter switch Gr 54 | 31 Nut |
| 5 Horn pad | 19 Spring | 32 Power steering booster Gr 37 |
| 6 Nut | 20 Band | 33 Nut |
| 7 Telescopic lever | 21 Nut | 34 Drag link Gr 37 |
| 8 Nut | 22 Dust cover | 35 Nut |
| 9 Steering wheel assembly | 23 Dust cover | 36 Tie rod assembly Gr 37 |
| 10 Horn spring | 24 Dust cover | |
| 11 Contact plate | 25 Bolt | |
| 12 Cover assembly | 26 Bolt | |
| 13 Steering wheel | 27 Steering column subassembly Gr 37 | |
| 14 Screw | | |
- * : Front axle assembly Gr 26
 X : Non-reusable parts

CAUTION

Be sure to clean the port area of oil pipe 28 when disconnecting the oil pipe, so as to keep it free from dust and foreign particles.

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

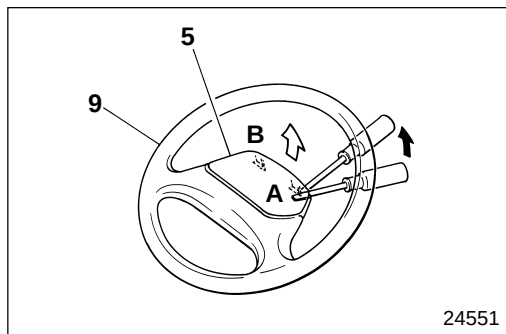
Location	Parts to be tightened	Tightening torque	Remarks
6	Nut (Telescopic lever mounting)	8.8 to 9.8 {6.5 to 7.2, 0.9 to 1.0}	—
8	Nut (Steering wheel assembly mounting)	39 to 49 {29 to 36, 4 to 5}	—
14	Screw (Combination switch mounting)	2.5±0.5 {1.8±0.36, 0.25±0.05}	—
17	Head cutting bolt (Starter switch mounting)	14.2±1.5 {10±1.1, 1.45±0.15}	—
21	Nut (Steering column subassembly and power steering booster mounting)	51.45±2.45 {38±1.8, 5.25±0.25}	—
25	Bolt (Steering column at floor side mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
26	Bolt (Steering column subassembly to instrument panel side mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
28	Oil pipe	66.69±12.75 {49±9.4, 6.8±1.3}	—
29	Nut (Drag link and power steering booster mounting)	190±47.5 {140±35, 19.4±4.85}	—
30	Bolt (Power steering booster mounting)	175.4±26.5 {130±20, 17.9±2.7}	—
31	Nut (Power steering booster mounting)	175.4±26.5 {130±20, 17.9±2.7}	—
33	Nut (Drag link and front axle assembly mounting)	190±47.5 {140±35, 19.4±4.85}	—
35	Nut (Tie rod assembly and front axle assembly mounting)	190±47.5 {140±35, 19.4±4.85}	—

L Lubricant

Location	Points of application	Specified lubricant	Quantity
12	Contact area between combination switch of cover assembly and horn contact	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

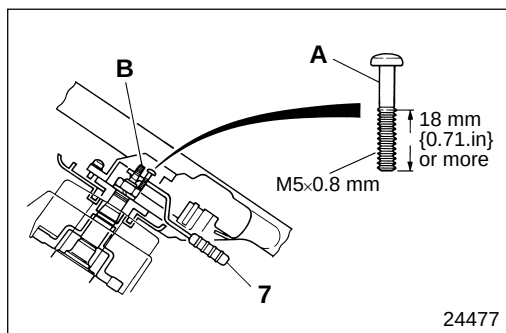
STEERING SYSTEM

◆ Service procedure



5 Removal of horn pad

- Insert a flat-tip screwdriver into the space between steering wheel assembly **9** and shoulder sections **A**, **B** of horn pad **5**, and disengage the latch by prying open the horn pad with the screwdriver until a clicking sound is produced.
- Insert a finger into the space behind horn pad **5** and remove the horn pad.



7 Telescopic lever

[Removal]

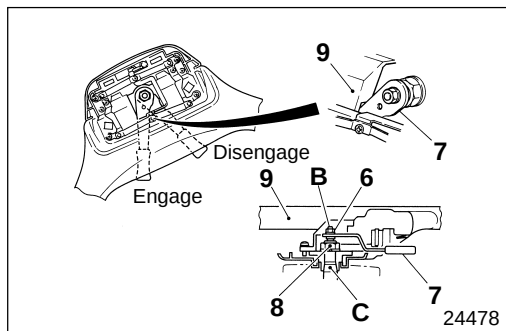
Secure screw **A** (M5×0.8 mm) in tapped hole in telescopic lever **7** and remove telescopic lever from telescopic shaft **B**.

[Installation]

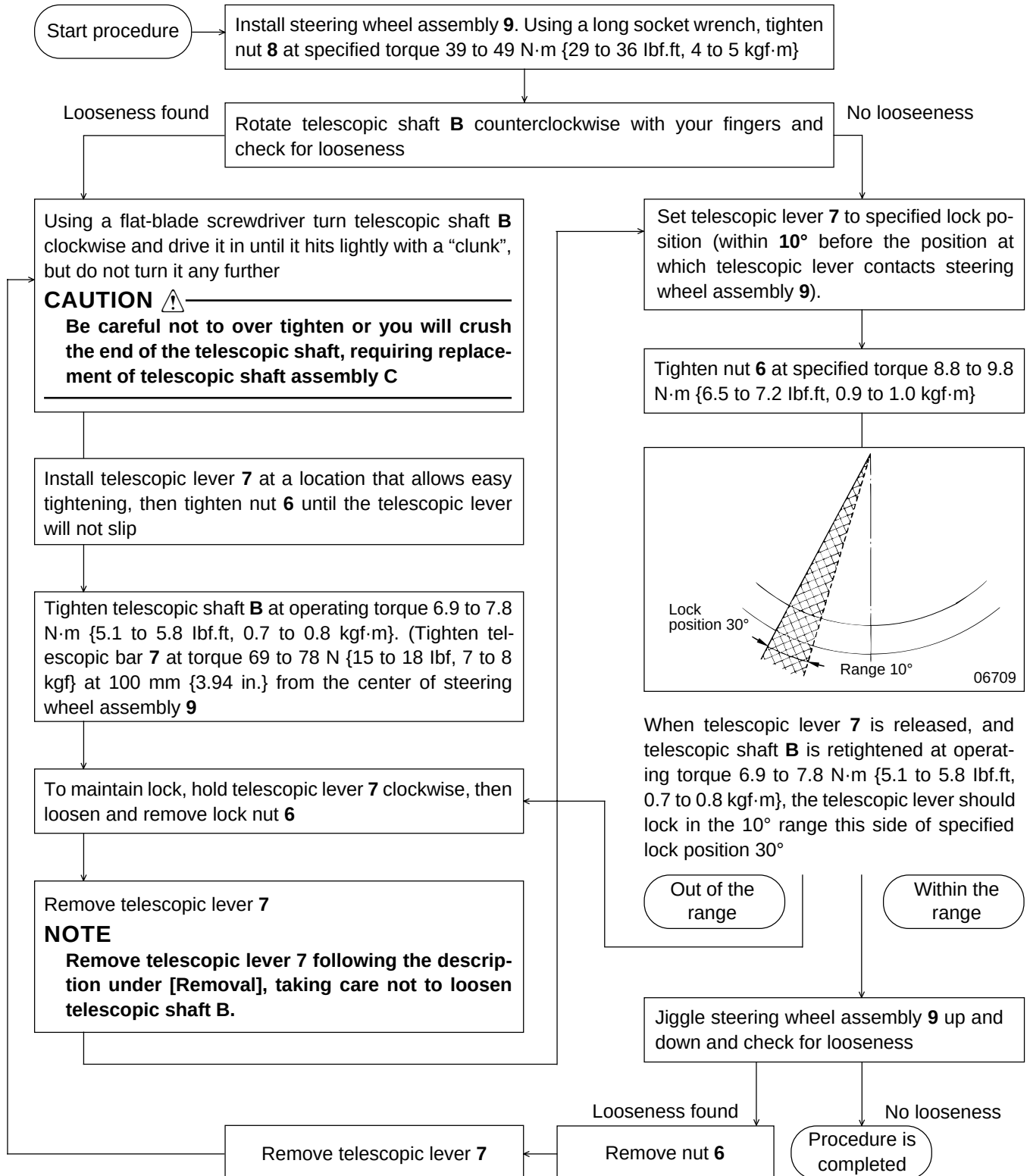
- Make adjustment so that telescopic lever **7** positioned at the designated location applies the specified torque on telescopic shaft **B**.

CAUTION ⚠

Be careful not to damage the threads on the tip of telescopic shaft **B**.



C : Telescopic shaft assembly

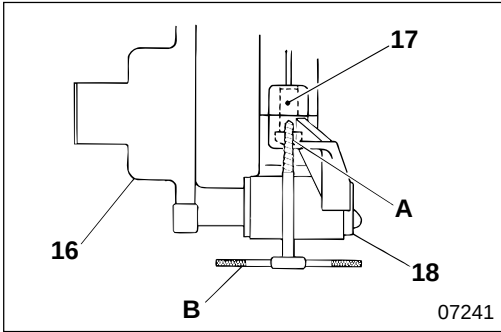
**CAUTION** ⚠

Be sure not to operate telescopic shaft **B** while steering wheel assembly **9** is removed.

NOTE

Be sure to assemble telescopic lever **7** only after steering wheel assembly **9** has been installed.

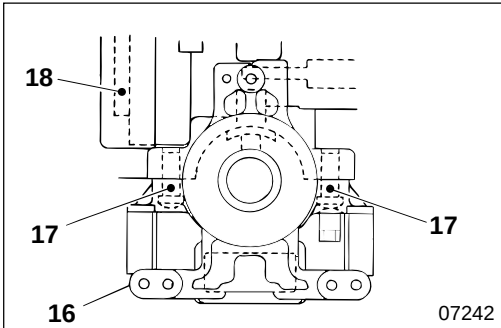
STEERING SYSTEM



17 18 Head cutting bolt, starter switch

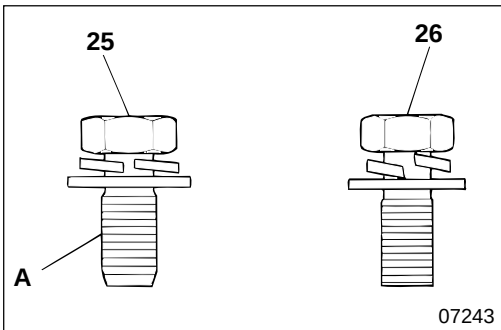
[Removal]

- After removing bracket **16**, drill a 5.5 to 6.0 mm {0.22 to 0.24 in.} hole 10 to 15 mm {0.39 to 0.59 in.} deep in surface **A** of head cutting bolt **17** for mounting starter switch **18**.
- Screw in screw extractor **B** counterclockwise, then remove head cutting bolt **17**.



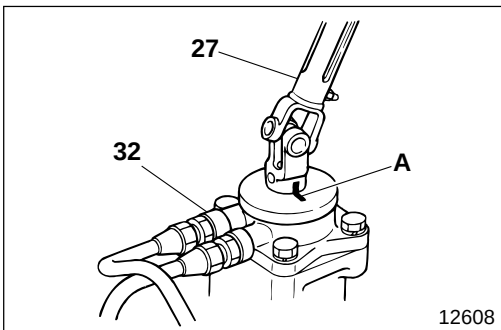
[Installation]

- With new head cutting bolt **17**, tighten starter switch **18** at specified torque to cut the head off the bolt.
- After installing bracket **16**, verify operation of the steering lock function of starter switch **18**.



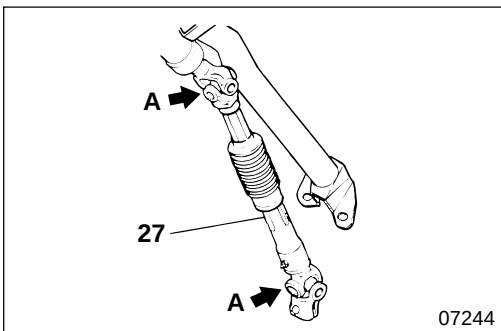
25 26 Installation of bolt

- Bolts **25** and **26**, differ in shape. Do not mix them up when installing.
- Thread area **A** of bolt **25** is elliptical to facilitate grounding of the horn circuit.



27 32 Removal and Installation of steering column subassembly, and power steering booster

Before removing steering column subassembly **27** or power steering booster **32**, be sure to make alignment mark **A**.



27 Steering column subassembly

When the spline of steering column subassembly **27** has been disconnected, align marks **A** on the yokes to face the same direction.

MEMO

GROUP 54 ELECTRICAL

1 POWER, CHARGE AND GROUND

SPECIFICATIONS	3
STRUCTURE AND OPERATION	3
TROUBLESHOOTING	3
(100) ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection of Alternator	3
• Inspection of Regulator	3
(101) BATTERY	1
(104) FUSE	3
(106) ALTERNATOR	3
(110) POWER CIRCUIT	3
(115) RESERVE POWER CIRCUIT	3
(125) BATTERY CHARGING CIRCUIT	3
(130) GROUND	3

2 STARTING, PREHEATING AND STOPPING ENGINE

SPECIFICATIONS	1
STRUCTURE AND OPERATION	1
TROUBLESHOOTING	1
(200) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Inspection of Engine Preheating System	1
(201) STARTER	1
(210) ENGINE STARTING CIRCUIT	
<Manual Transmission >	54-4
<Automatic Transmission>	54-4
(220) ENGINE PREHEATING CIRCUIT	
< Manual Transmission >	3
<Automatic Transmission>	2

3 LIGHTING

SPECIFICATIONS	1
STRUCTURE AND OPERATION	1
TROUBLESHOOTING	1
(300) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Headlamp Aiming	1
(310) HEADLAMP CIRCUIT	1
(320) TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS	3
(325) STOP LAMP CIRCUIT	3
(330) TURN SIGNAL LAMP AND HAZARD LAMP CIRCUITS	1
(340) BACKUP LAMP CIRCUIT	1
(345) CAB LAMP CIRCUIT	54-8
(348) ILLUMINATION LAMP CIRCUIT	1
(349) MARKER LAMP AND IDENTIFICATION LAMP CIRCUITS	1
(352) VAN BODY DOME LIGHT CIRCUIT	3

4 METER

SPECIFICATIONS	1
TROUBLESHOOTING	1
(401) METER CLUSTER	3
(410) SPEEDOMETER AND TACHOMETER CIRCUIT	1
(420) FUEL GAUGE CIRCUIT	1
(425) WATER TEMPERATURE GAUGE CIRCUIT	1

5 INDICATOR AND WARNING

TROUBLESHOOTING	3
(500) ON-VEHICLE INSPECTION AND ADJUSTMENT	
• Inspection of Brake Fluid Level Switch	3
• Inspection of Power Steering Fluid Level Sensor	3
(510) PARKING BRAKE INDICATOR CIRCUIT 	54-10
(515) BRAKE WARNING CIRCUIT ...	54-12
(530) WATER LEVEL WARNING CIRCUIT 	3
(536) ENGINE OIL PRESSURE WARNING CIRCUIT 	54-14
(537) OVERHEATING WARNING CIRCUIT 	3
(547) AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT 	3
(549) POWER STEERING FLUID LEVEL WARNING CIRCUIT 	3
(550) CAB TILT WARNING CIRCUIT 	1

6 CAB SIDE ELECTRICAL

SPECIFICATIONS	3
TROUBLESHOOTING	3
(601) SWITCH	1
(604) RELAY AND CONTROL UNIT	1
(606) WARNING BUZZER	1
(610) CIGARETTE LIGHTER CIRCUIT	1
(612) AUDIO CIRCUIT	1
(614) WIPER AND WASHER CIRCUIT	1
(616) HORN CIRCUIT	3
(618) HEATER CIRCUIT	1

- 1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
 2 : '97 Model Gr 54 (Pub. No. TWME9502-1)
 3 : '98 Model Gr 54 (Pub. No. TWME9502-254)

7 CHASSIS ELECTRICAL

(701) MAGNETIC VALVE	
< Manual Transmission >	3
(710) EXHAUST BRAKE CIRCUIT	
< Manual Transmission >	54-16

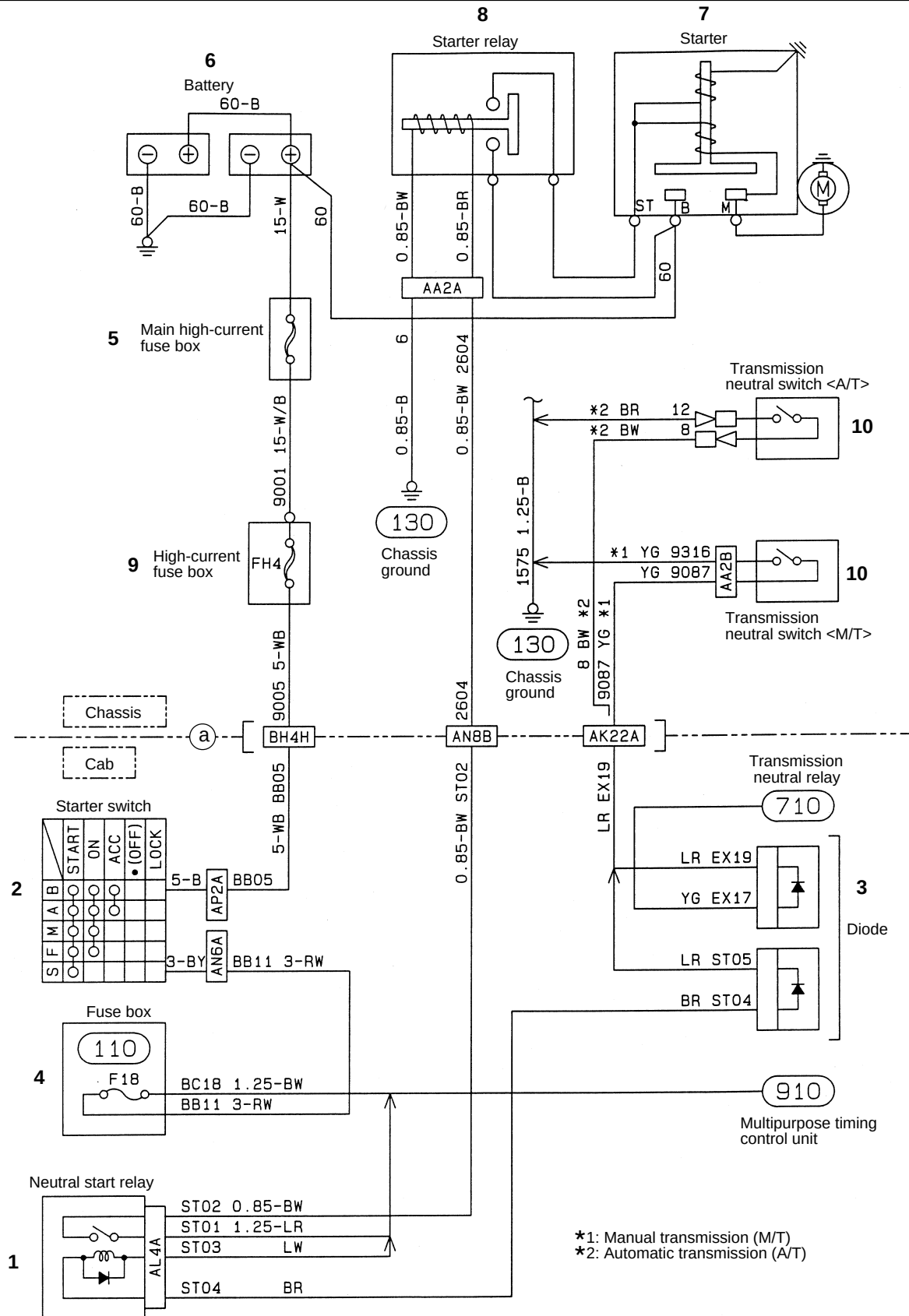
8 ENGINE AND TRANSMISSION ELECTRICS

(801) ENGINE ELECTRICS	1
(802) TRANSMISSION ELECTRICS	
< Manual Transmission >	1
< Automatic Transmission >	1
(850) TRANSMISSION POWER TAKE-OFF CIRCUIT	
< Option >	1

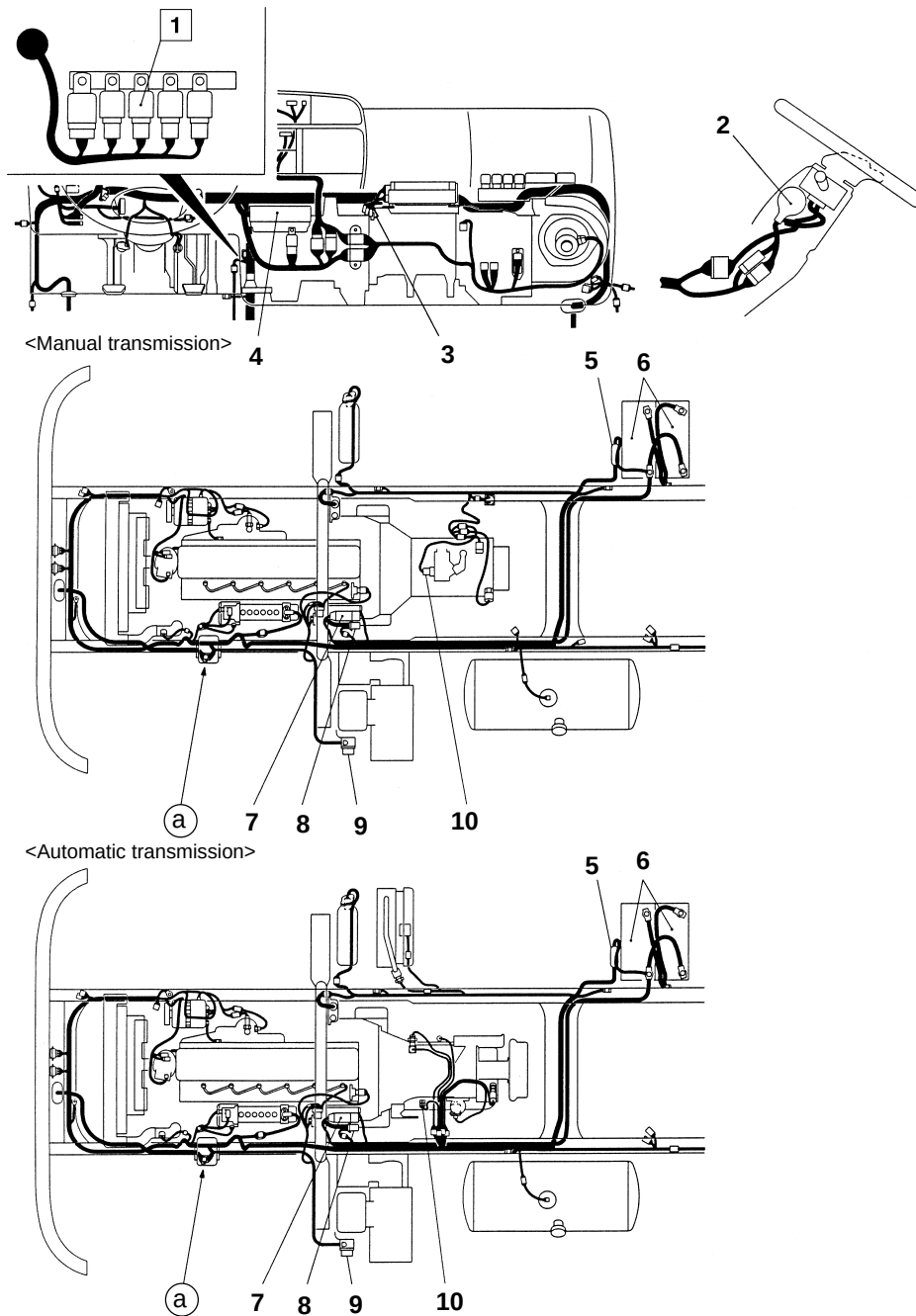
9 OTHERS

STRUCTURE AND OPERATION	2
(905) JOINT CONNECTOR	3
(910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT	2

210 ENGINE STARTING CIRCUIT



*1: Manual transmission (M/T)
*2: Automatic transmission (A/T)



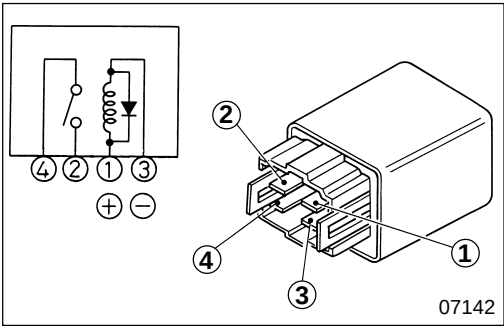
31753

- | | |
|--------------------------------------|--|
| 1 Neutral start relay | 6 Battery 1 (101) |
| 2 Starter switch 1 (210) | 7 Starter 1 (201) |
| 3 Diode | 8 Starter relay 1 (210) |
| 4 Fuse box 2 (104) | 9 High-current fuse box 2 (104) |
| 5 Main high-current fuse box 2 (104) | 10 Transmission neutral switch 1 (802) |

1 : '96 Model Gr54 (Pub. No. TWME9502-54)

2 : '96 Model Gr54 (Pub. No. TWME9502-254)

210 ENGINE STARTING CIRCUIT



◆ Service procedure

1 Inspection of relay (Open type 4-pin)

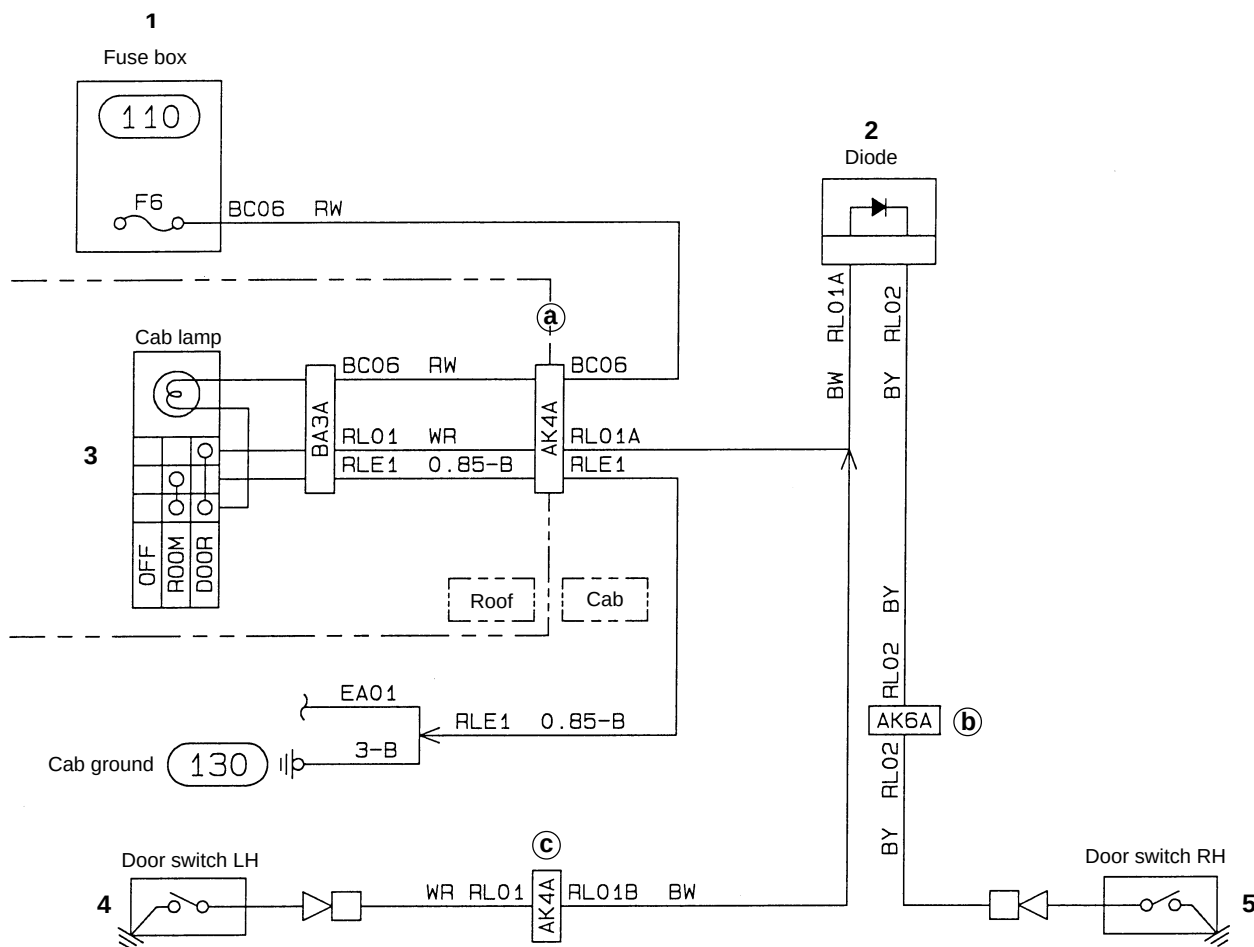
- Follow the table below to check for continuity and operation.

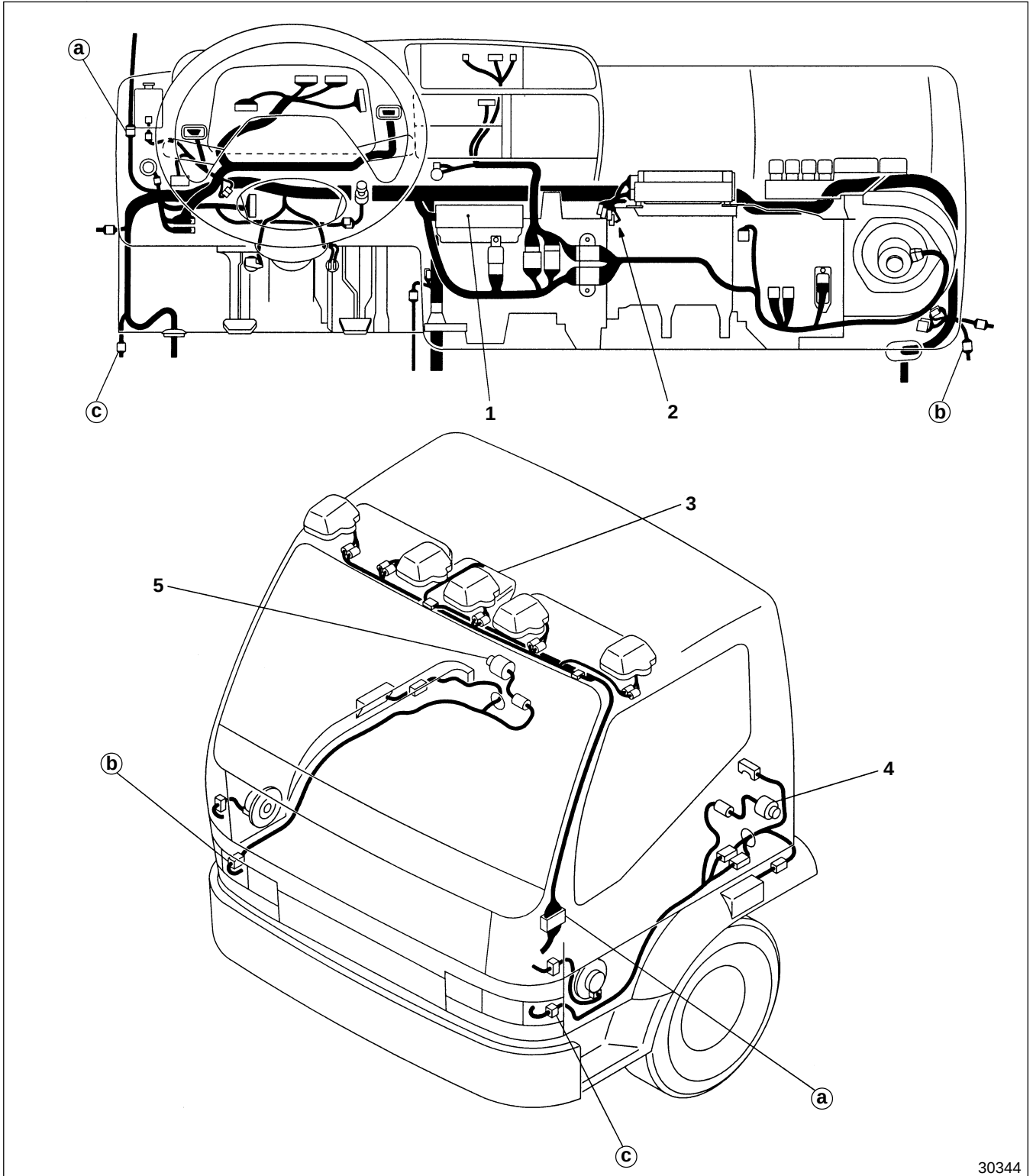
	①	②	③	④
No current	○	—	○	
Current	+	○	—	○

- : There is continuity between terminals ○ and ○.
- ⊕—⊖ : Indicates that 12 volts DC is applied to the line between the terminals.
- If any fault is found, replace the relay.

MEMO

345 CAB LAMP CIRCUIT



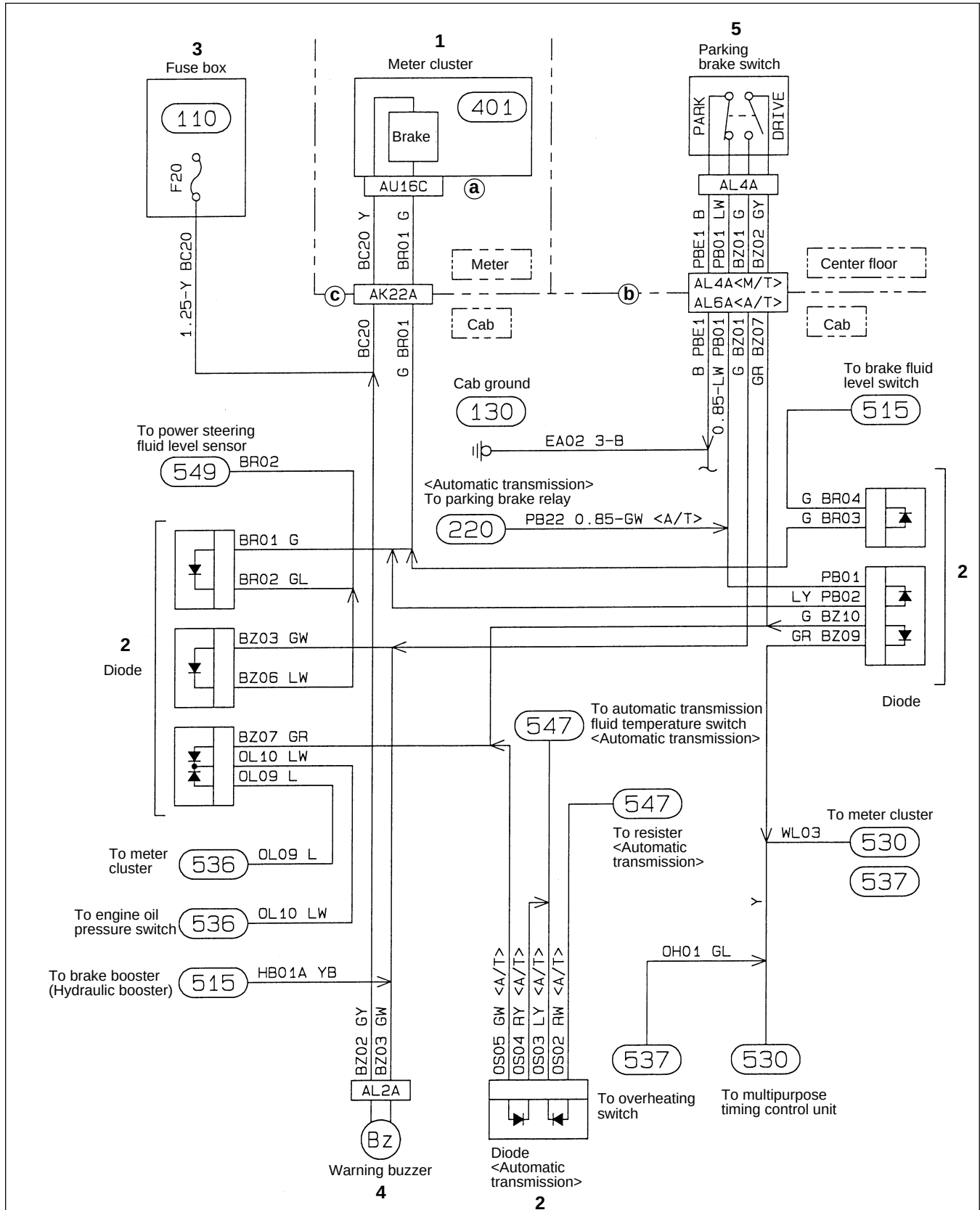


30344

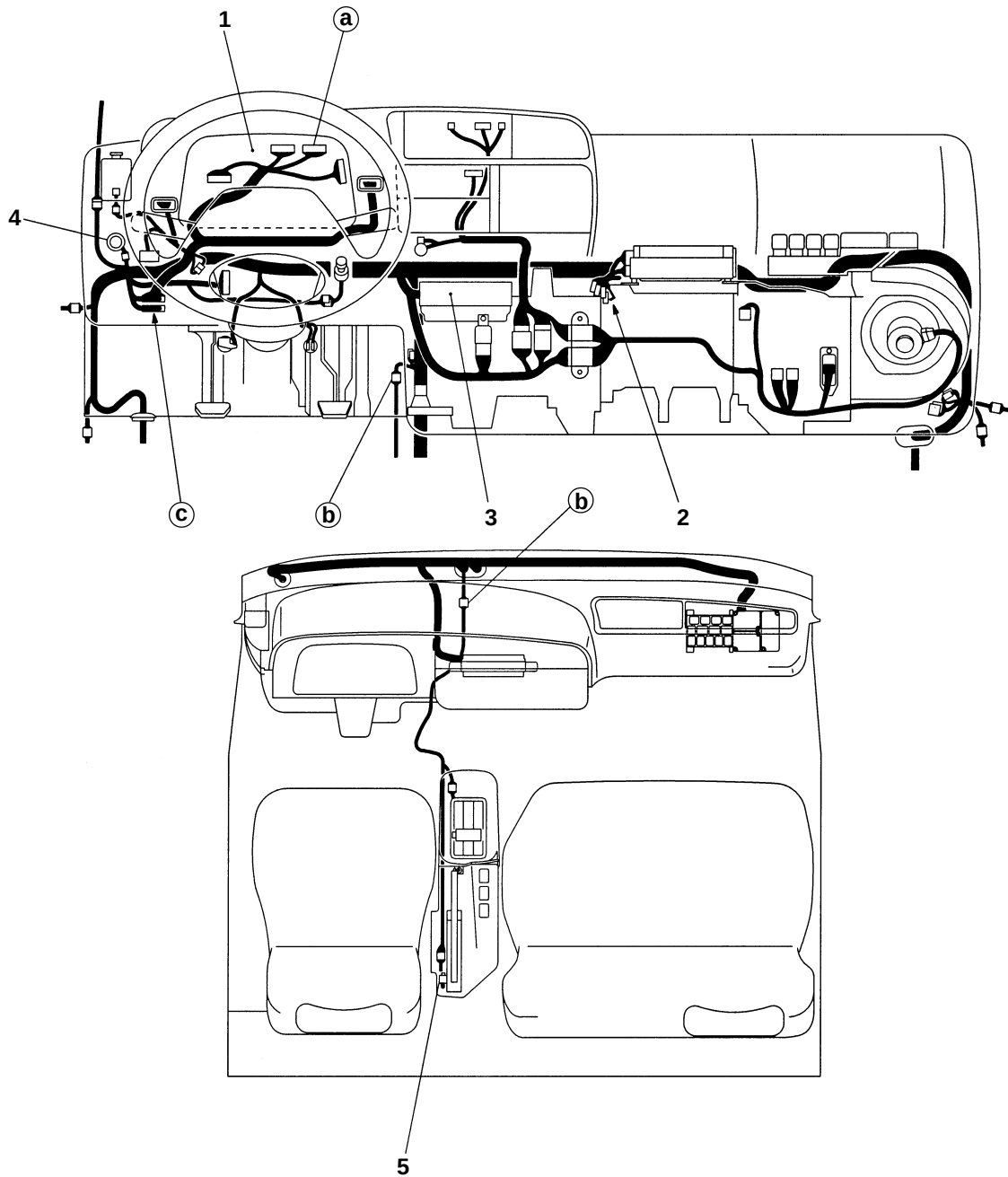
- 1 Fuse box 2 (104)
- 2 Diode
- 3 Cab lamp 1 (345)
- 4 Door switch, LH 1 (345)
- 5 Door switch, RH 1 (345)

- 1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
- 2 : '98 Model Gr 54 (Pub. No. TWME9502-254)

510 PARKING BRAKE INDICATOR CIRCUIT



A/T: Automatic transmission
M/T: Manual transmission

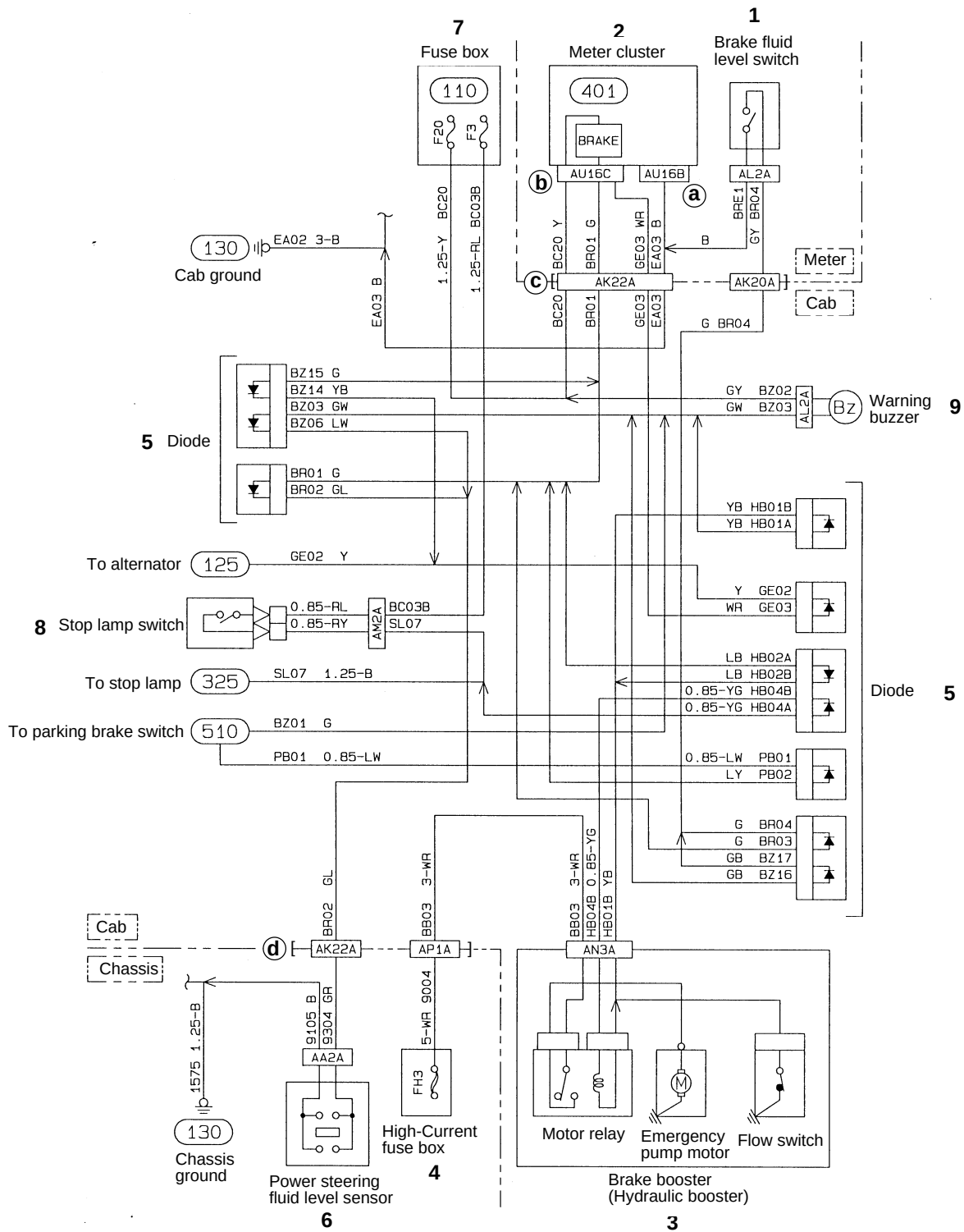


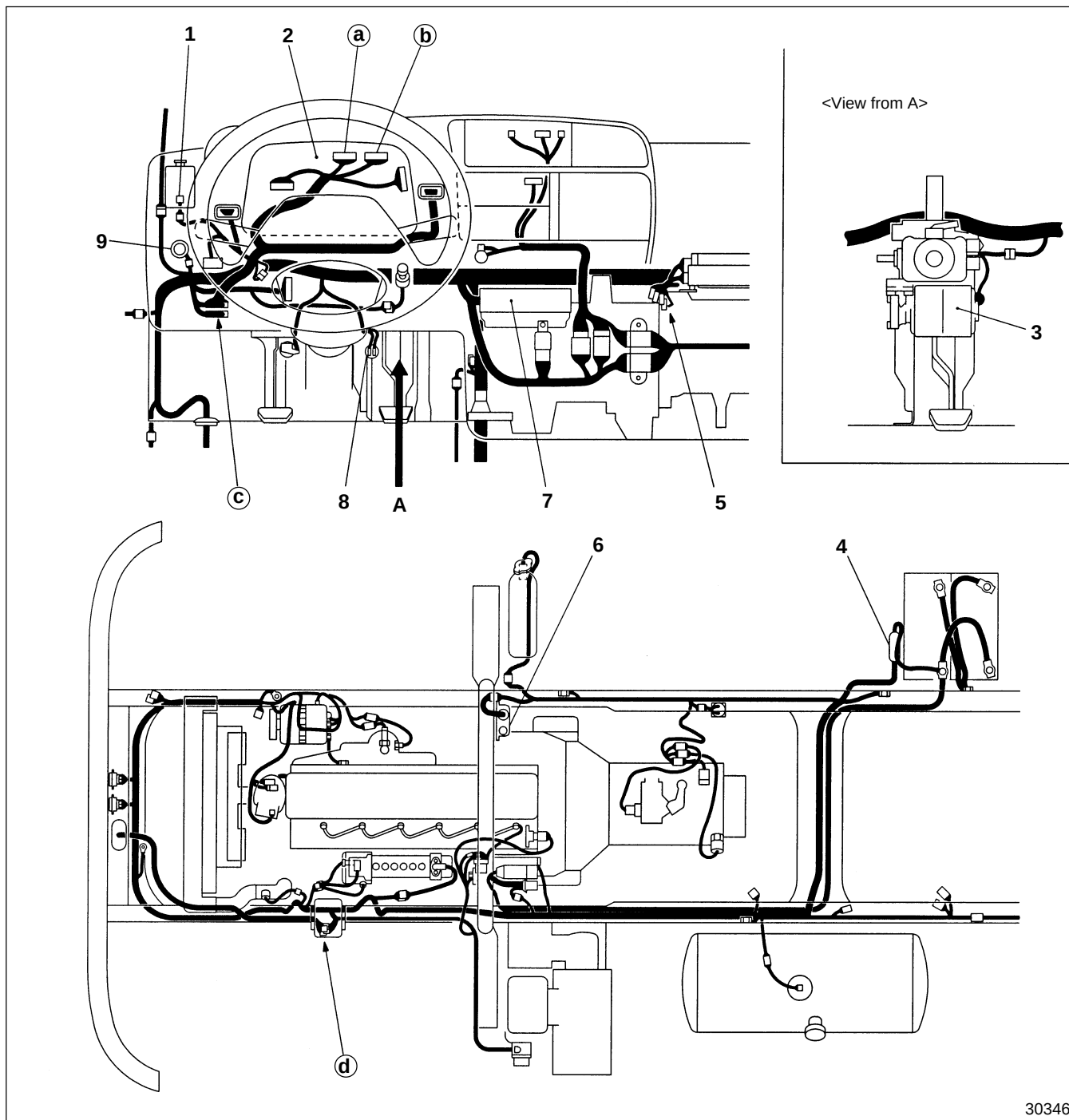
30345

- 1 Meter cluster 2 (401)
- 2 Diode
- 3 Fuse box 2 (104)
- 4 Warning buzzer 1 (606)
- 5 Parking brake switch 1 (510)

1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
 2 : '98 Model Gr 54 (Pub. No. TWME9502-254)

515 BRAKE WARNING CIRCUIT

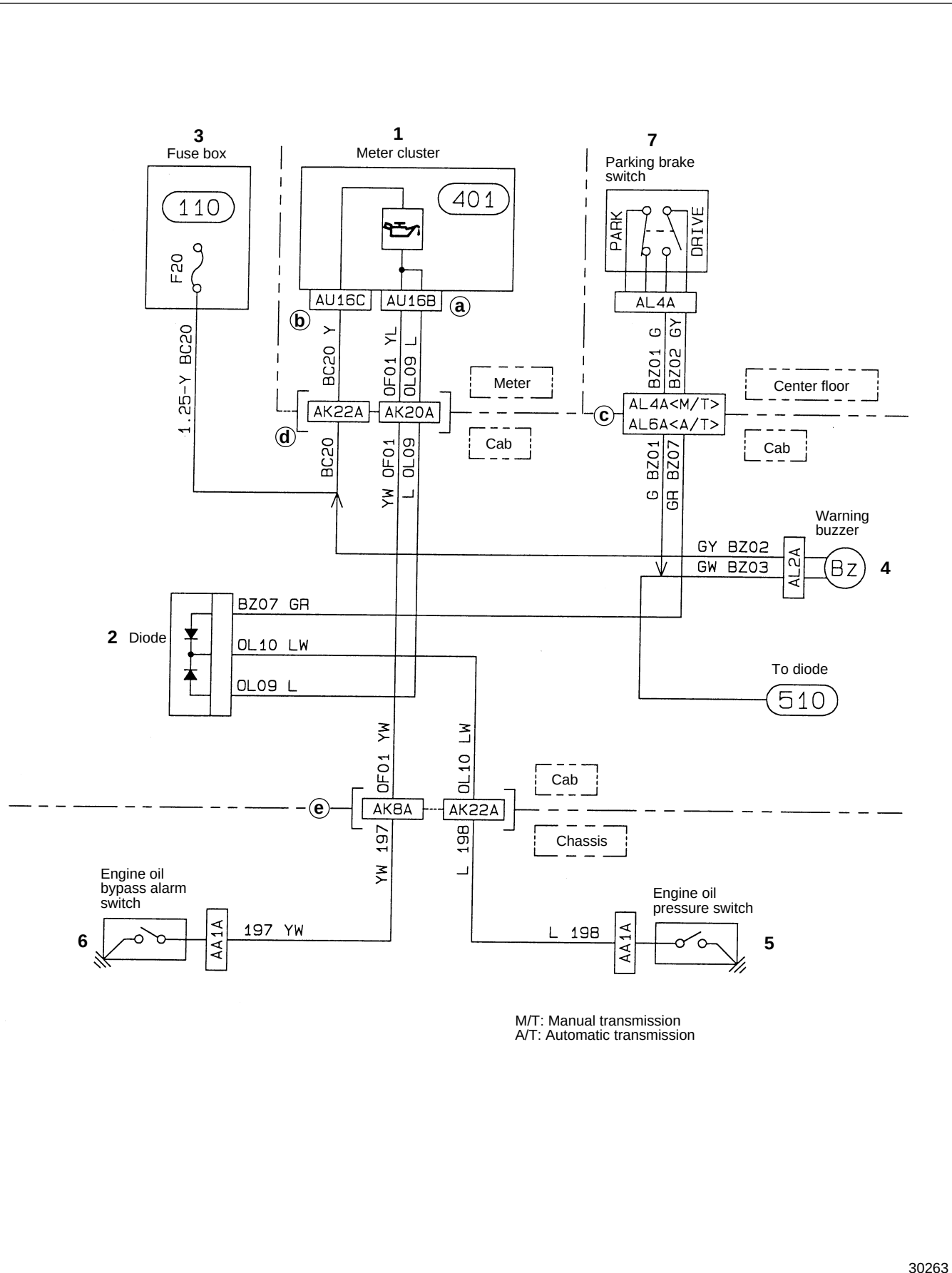


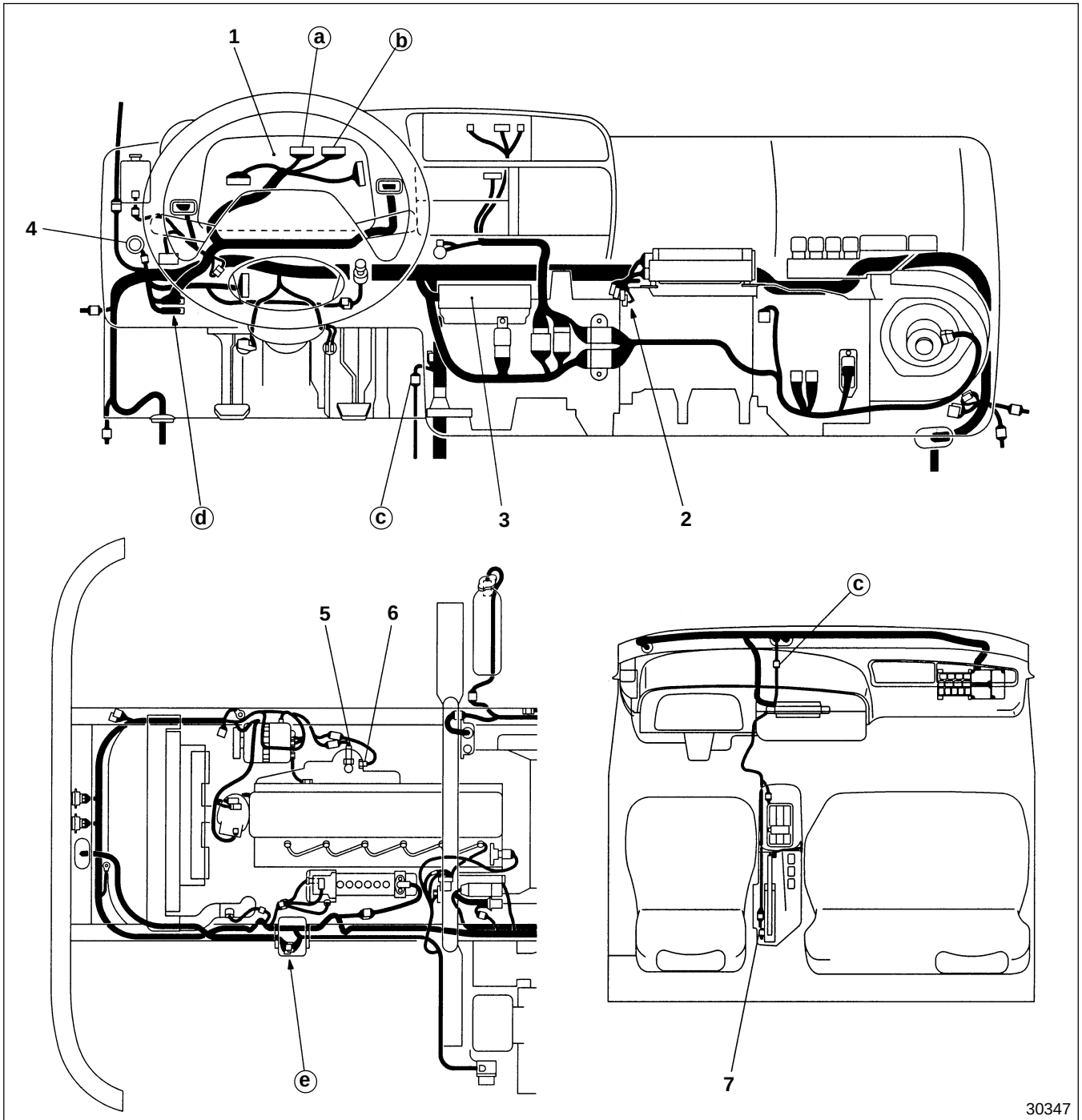


30346

- | | |
|---------------------------------------|---|
| 1 Brake fluid level switch 2 (515) | 6 Power steering fluid level sensor 2 (549) |
| 2 Meter cluster 2 (401) | 7 Fuse box 2 (104) |
| 3 Brake booster (Hydraulic booster) 3 | 8 Stop lamp switch 2 (325) |
| 4 High-current fuse box 2 (104) | 9 Warning buzzer 1 (606) |
| 5 Diode | |

- 1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
- 2 : '98 Model Gr 54 (Pub. No. TWME9502-254)
- 3 : '98 Model Gr 35 (Pub. No. TWME9502-235)





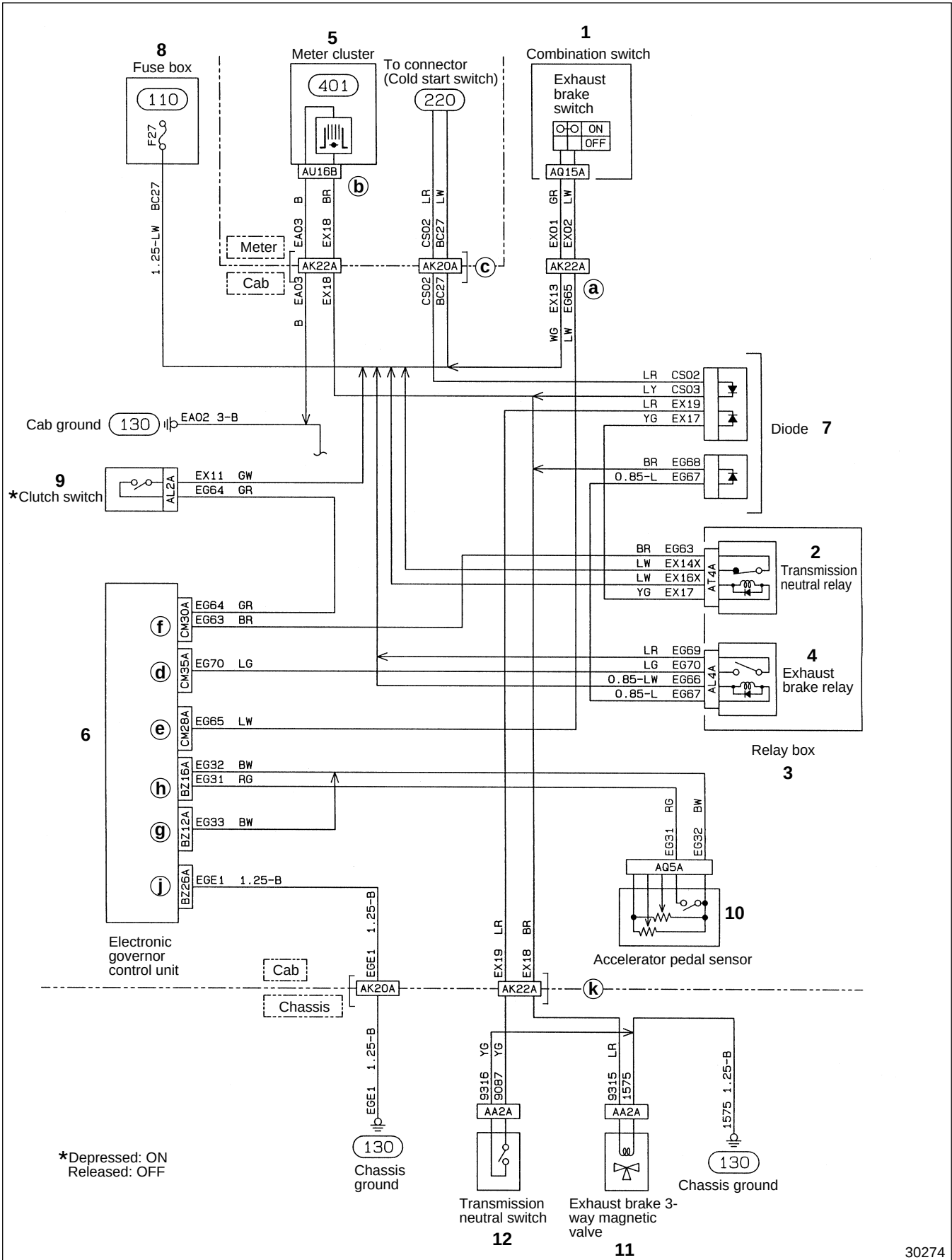
30347

- 1 Meter cluster 2 (401)
- 2 Diode
- 3 Fuse box 2 (104)
- 4 Warning buzzer 1 (606)

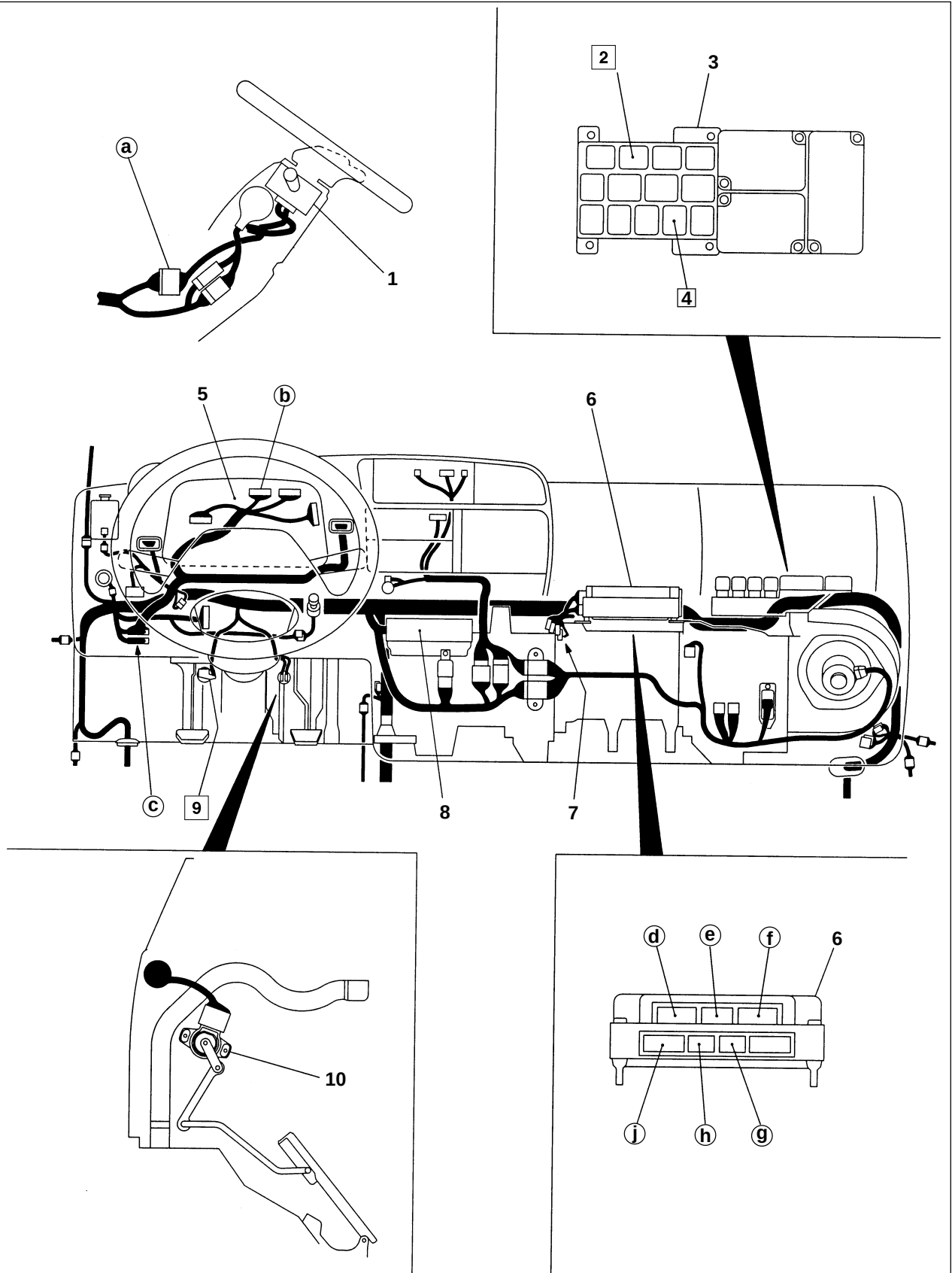
- 5 Engine oil pressure switch 1 (801)
- 6 Engine oil by pass alarm switch 1 (801)
- 7 Parking brake switch 1 (510)

1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
 2 : '98 Model Gr 54 (Pub. No. TWME9502-254)

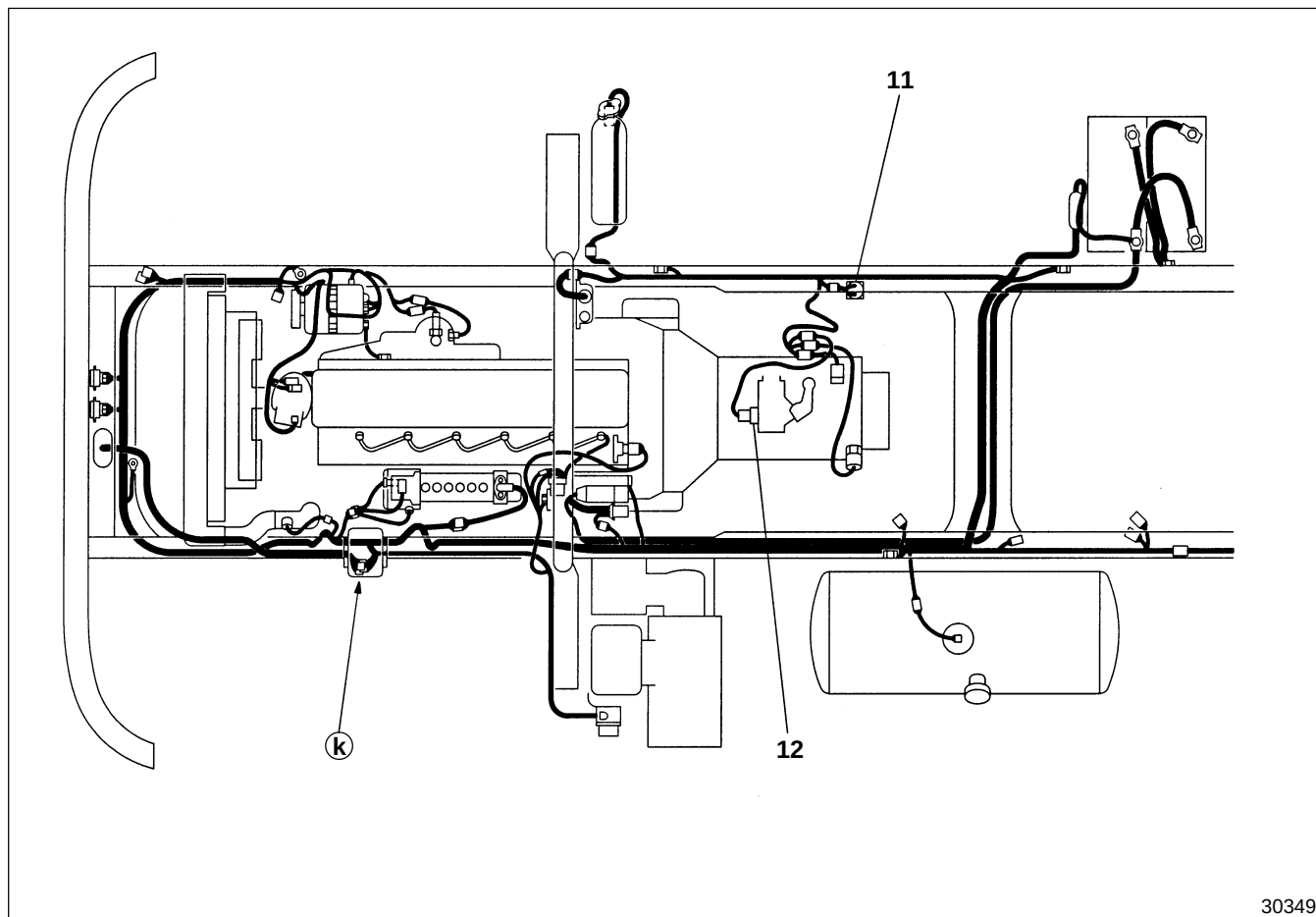
710 EXHAUST BRAKE CIRCUIT <MANUAL TRANSMISSION>



30274



710 EXHAUT BRAKE CIRCUIT <MANUAL TRANSMISSION>



30349

- | | |
|--------------------------------------|---|
| 1 Combination switch 1 (601) | 7 Diode |
| 2 Transmission neutral relay | 8 Fuse box 2 (104) |
| 3 Relay box | 9 Clutch switch 1 (710) |
| 4 Exhaust brake relay | 10 Accelerator sensor 3 |
| 5 Meter cluster 2 (401) | 11 Exhaust brake 3-way magnetic value 1 (701) |
| 6 Electronic governor control unit 3 | 12 Transmission neutral switch 1 (802) |

- 1 : '96 Model Gr 54 (Pub. No. TWME9502-54)
 2 : '98 Model Gr 54 (Pub. No. TWME9502-254)
 3 : '99 Model Gr 13

◆ Service procedure

2 Inspection of relay (Close type 4-pin)

- Follow the table below to check for continuity and operation.

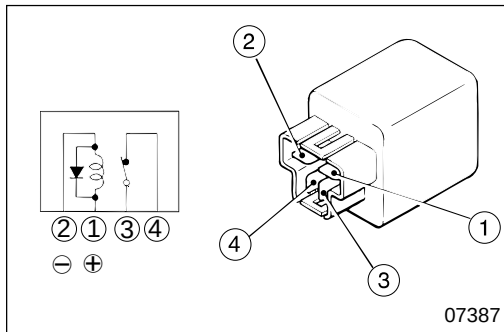
	①	②	③	④
No current	○—○		○—○	
Current	⊕—⊖		⊖—⊕	

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

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

○---○ : Indicates that continuity between the terminals is lost.

- If any fault is found, replace the relay.



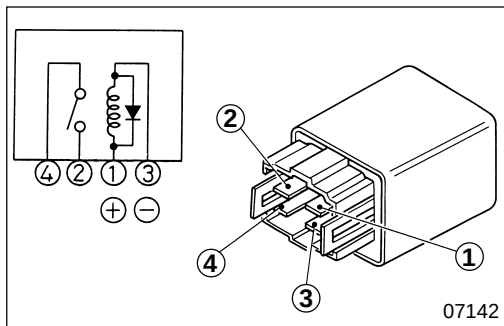
4 Inspection of relay (Open type 4-pin)

- Follow the table below to check for continuity and operation.

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

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

⊕—⊖



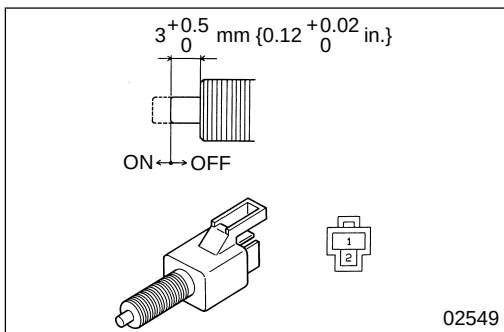
9 Inspection of clutch switch

- Follow the table below to check for continuity.

	①	②
OFF		
ON	○—○	

○—○: There is continuity between terminals.

- If any fault is found, replace the clutch switch.





FH

Service Manual

Group 01

Maintenance Schedule

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

MAINTENANCE SCHEDULE

HOW TO READ THE MAINTENANCE SCHEDULE TABLES	2
MAINTENANCE SCHEDULE TABLES	3
MAINTENANCE OPERATIONS	7
• Replacement of Oil Filter	7
• Replacement of Fuel Filter	8
• Draining of Water Separator Condensation	9
• Cleaning of Fuel Feed Pump Gauze Filter	9
• Bleeding of Air from Fuel Line	10
• Adjustment of V-Belt Tension	11
• Cleaning and Replacement of Air Cleaner Element	13
• Inspection of Clutch Pedal Free Play	14
• Tire	14
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HOW TO READ THE MAINTENANCE SCHEDULE TABLES

Example Table :

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.
 *2 : 60000 km/36000 miles or 12 months, whichever occurs first.
 (E) : Exhaust emission items
 (N) : Noise control items

Inspection and maintenance (1)		Time of inspection and maintenance (2)					Working procedures (3)	Remarks (4)
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/6000 miles	Every 30000 km/18000 miles *1	Every 60000 km/36000 miles *2		
ENGINE								
1	Air, fuel, oil or coolant leakage from engine			×			Check engine for air, fuel, oil and coolant leakage	 Gr 11, 12, 13, 14
2	Ⓔ Ⓝ Engine starting performance, speed, noise and exhaust gas conditions			×			Check for engine starting performance, idling speed, abnormal engine noise, dark smoke or other abnormal exhaust gas during idling and acceleration. Check engine speed on tachometer	 Gr 11, 13, 15
3	Retightening of inlet and exhaust manifold bolts					×	Check manifold bolts for looseness	 Gr 15
4	Ⓔ Valve clearance		×			×	Check valve clearance with feeler gauge	 Gr 11
5				Every 20000 km /12000 miles			Replace element	

(1) This column contains the maintenance and inspection items.

(2) The periods between inspection and service are based on the assumption that the vehicle will be driven approximately 60000 kilometers (36000 miles) per year.

Inspections which must be made are indicated by an "×" or by the appropriate period between servicing.

(3) This column provides a simplified explanation of the operational procedures involved for each inspection or maintenance item.

(4) The Gr. No. refers to the "group number" in this vehicle Service Manual. For visual checks and simple inspections, see the sections labelled "Working Procedures".

MAINTENANCE SCHEDULE TABLES

01

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

(E) : Exhaust emission items

(N) : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles +1	Every 60000 km/ 36000 miles +2		
ENGINE								
1	Air, fuel, oil or coolant leakage from engine			×			Check engine for air, fuel, oil and coolant leakage	Gr 11, 12, 13, 14
2	Ⓔ Ⓝ Engine starting performance, speed, noise and exhaust gas conditions			×			Check for engine starting performance, idling speed, abnormal engine noise, dark smoke or other abnormal exhaust gas during idling and acceleration. Check engine speed on tachometer	Gr 11, 13, 15
3	Retightening of inlet and exhaust manifold bolts					×	Check manifold bolts for looseness	Gr 15
4	Ⓔ Valve clearance		×			×	Check valve clearance with feeler gauge	Gr 11
5	Ⓔ Oil filter replacement			Every 20000 km/ 12000 miles On new vehicles, replace the first filter at 10000 km/6000 miles			Replace element	Gr 12
6	Ⓔ Ⓝ Check injection nozzles			Every 90000 km/ 54000 miles			Check injection nozzles	Gr 13
7	Ⓔ Ⓝ Fuel injection pressure and spray pattern of injection nozzles			Every 250000 km/ 150000 miles			Remove injection nozzle and check with nozzle tester	Gr 13
8	Ⓔ Ⓝ Fuel injection timing					×	Turn crankshaft in normal running direction and check injection starting timing of No.1 cylinder	Gr 13
9	Ⓔ Cleaning fuel feed pump filter					×	Remove connector from fuel feed pump inlet and clean filter inside connector with gas oil	
10	Ⓔ Fuel filter replacement				×		Replace element	Gr 13
11	Ⓔ Water separator water discharge	×					Loosen water separator drain plug to discharge water	Gr 13
12	Ⓔ Removal of water and sediment from fuel tank			Every 24 months			Remove fuel tank drain plug and remove water and sediment	Gr 13
13	Retightening of fuel tank bracket bolts			×			Check mounting bolts for looseness and retighten to a torque of 34 to 54 N·m {25 to 40 lbf.ft, 3.5 to 5.5 kgf·m}	Gr 13
14	Ⓔ Replacing fuel line in engine compartment			Every 24 months			Replace fuel line in engine compartment	Gr 13
15	Ⓔ Check fuel line outside of engine compartment			Every 24 months			Check fuel line outside of engine compartment. Replace if necessary	Gr 13
16	Ⓔ Ⓝ V-belt tension and damage	×		×			Press midpoint of V-belt firmly with your finger to measure deflection and check for belt damage	Gr 14
17	Coolant level and leakage from cooling system	×					Check coolant level and if level is low, check for coolant leakage	Gr 14
18	Coolant replacement			Every 24 months			Replace with new coolant	Gr 14
19	Installed condition of surge tank cap			×			Check surge tank cap for sealing and mounting condition	Gr 14
20	Ⓔ Cooling system hose clamp position and clamping condition			×			Check clamp position and clamping condition of cooling system hose	Gr 14
21	Ⓔ Turbocharger rotor play			Every 250000 km/ 150000 miles			Check whether rotor has excessive end play using a dial indicator	Gr 15
22	Ⓔ Ⓝ Cleaning of air cleaner	×					Check air cleaner dust indicator. If the red signal appears, clean the element	Gr 15
23	Ⓔ Ⓝ Air cleaner element replacement			Every 50000 km/ 30000 miles			Replace element	Gr 15
24	Ⓔ Ⓝ Damage of inlet system, looseness of clamp and loss of parts			×			Check inlet system for damage and check that all parts are installed	Gr 15
25	Ⓝ Looseness and damage of exhaust pipe and muffler			×			Check installation and connections for looseness and damage, check for exhaust gas leakage	Gr 15
26	Starter function					×	Operate starter switch and check the switch functions properly	Gr 54
27	Alternator function					×	Check function with a circuit tester	Gr 54

MAINTENANCE SCHEDULE TABLES

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.
 *2 : 60000 km/36000 miles or 12 months, whichever occurs first.
 (E) : Exhaust emission items
 (N) : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
POWER TRAIN								
28	Air or oil leakage from power train			×			Check power train for air and oil leakage	
29	Clutch pedal play			×			Press clutch lightly and check that play is adequate	Gr 21
30	Clutch function			×			(1) Press the clutch pedal to check for unusual noise or stiffness. Also check if gearshift engages quietly (2) Check the clutch does not slip and engages smoothly	Gr 21
31	Manual transmission gearshift control looseness				×		In NEUTRAL position, check shift lever for looseness. With shift lever in each gear position, check engagement condition and degree of looseness. Also check if control cable is damaged	Gr 22
32	Automatic transmission range selector linkage and throttle (modulator) linkage condition					×	Shifting to each shift range must be done firmly and securely	Gr 23
33	Propeller shaft couplings and bearings looseness		×	×			(1) Check flange yoke bolt and center bearing attaching bolt for looseness (2) Turn propeller shaft manually to check for spline looseness (3) Check looseness between spider and needle roller bearing	Gr 25
FRONT AND REAR AXLES								
34	Axle shaft torsion and cracks					×	Remove axle shaft and check for torsion, bending, and cracks	Gr 27
35	Front wheel hub bearing looseness				×		With front axle jacked up, move the wheel up and down holding the top and bottom of the tire to check for bearing looseness	Gr 26
36	Rear wheel hub bearing damage					×	Disassemble rear wheel and check for hub bearing wear and damage	Gr 27
37	Retightening wheel nuts		×	×			Check wheel nuts for looseness after replacing tires, also after 1000 km/600 miles	Gr 31
38	Disc wheel damage			×			Check disc wheel for corrosion, deformation and cracks	Gr 31
39	Tire inflation pressure, cracking, tread groove depth, abnormal wear, etc.	×		×			(1) Measure inflation pressure with tire gauge, and check that tire tread groove is deep enough (2) Check tire tread and side walls for cracks, damage, uneven wear, stepped wear and other abnormal wear	Gr 31
40	Tire rotation			×			Rotate all tires	Gr 31
SUSPENSION SYSTEM								
41	Looseness, play and damage of suspension system				×		Check suspension system for looseness, play and damage	Gr 33, 34
42	Damage and looseness of leaf springs	×			×		Check leaf springs for damage and looseness	Gr 33, 34
43	Retightening U-bolts		×		×		Check U-bolts for looseness	Gr 33, 34
44	Oil leakage and damage of shock absorbers				×		Check for oil leakage and damage of cylinder, etc.	Gr 33, 34
BRAKING SYSTEM								
45	Discharge of condensed water from air tank	×					Discharge condensed water from air tank by opening drain cock	Gr 35
46	Air pressure and its charging speed	×					After discharging air from air tank, start and run the engine at idle and measure time taken to charge air to specified pressure in air tank	Gr 35
47	Air and fluid leakage from braking system			×			Check braking system for air and fluid leakage	Gr 35
48	Looseness, play and damage of braking system parts			×			Check braking system parts for looseness, play and damage	Gr 35

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

Ⓔ : Exhaust emission items

Ⓖ : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/6000 miles	Every 30000 km/18000 miles *1	Every 60000 km/36000 miles *2		
49	Operation of brake pedal			×			Depress the brake pedal and release it, checking for the sound of air being released from the brake valve and to ensure that the pedal returns normally without catching	Gr 35
50	Service brake effectiveness	×		×			While driving the vehicle at low speed, check braking effect and check for uneven braking	Gr 35
51	Operation of exhaust brake	×		×			Check exhaust brake operation	Gr 35
52	Exhaust brake control cylinder packing replacement			Every 12 months			Check exhaust brake control cylinder packing; replace if necessary	Gr 35
53	Operation of air dryer			×			Open drain cock of air tank and make sure there is no drainage	Gr 35
54	Check drain from air dryer exhaust port			×			Check to see that oil is not discharged abnormally from exhaust port of air dryer	Gr 35
55	Air dryer disassembly and inspection					×	Disassemble the air dryer and inspect its components. When more than 1/5 of the desiccant is discolored, replace it	Gr 35
	Air dryer desiccant replacement			Every 24 months			Disassemble the air dryer and replace the desiccant and rubber parts	Gr 35
56	Brake shoe clearance				×		Measure clearance with feeler gauge	Gr 35
57	Brake lining wear				×		Check lining wear	Gr 35
58	Brake drum wear					×	Disassemble and check drum for wear, cracks and damage	Gr 35
59	Parking brake effectiveness			×			On a slope, check that vehicle can be held stationary	Gr 36
60	Parking brake lever stroke	×		×			With lever fully pulled, check that lever is locked completely and that there is allowance in pulling stroke	Gr 36
61	Parking brake drum and lining wear					×	Disassemble and check drum for wear, cracks and damage and check lining for wear	Gr 36
62	Wheel cylinder piston cup and dust seal replacement			Every 12 months			Check wheel cylinder piston cup and dust seal; replace if necessary	Gr 35
63	Brake booster packing, cup and rubber parts replacement			Every 12 months			Check brake booster packing, cup and rubber parts; replace if necessary	Gr 35
64	Brake hose replacement			Every 12 months			Check brake hose; replace if necessary	Gr 35
65	Check valve packing and rubber parts replacement			Every 12 months			Check the check valve packing and rubber parts; replace if necessary	Gr 35
66	Brake valve packing and rubber parts replacement			Every 12 months			Check brake valve packing and rubber parts; replace if necessary	Gr 35
67	Air compressor and pressure gauge hoses replacement			Every 24 months			Replace air compressor and pressure gauge hoses	Gr 35
68	Brake booster power cylinder packing replacement			Every 24 months			Replace brake booster power cylinder packing	Gr 35
69	Brake fluid reservoir tank tube replacement			Every 24 months			Check and replace brake fluid reservoir tank tube	Gr 35
STEERING SYSTEM								
70	Fluid leakage from steering system			×			Check steering system for fluid leakage	Gr 37
71	Steering wheel play	×		×			Turn steering wheel right and left to measure play at steering wheel rim. Measure while engine is running	Gr 37
72	Steering operating condition	×		×			Check steering wheel to see if it vibrates, pulls to one side or requires unusual steering effort	Gr 37
73	Looseness and play of steering system (including hoses and pipes)			×			(1) Check steering system for looseness and play (2) Check power steering hoses and pipes for looseness	Gr 37
74	Wheel alignment					×	Measure toe-in, camber, caster and kingpin inclination angles	Gr 26

MAINTENANCE SCHEDULE TABLES

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.
 *2 : 60000 km/36000 miles or 12 months, whichever occurs first.
 (E) : Exhaust emission items
 (N) : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
75	Right and left turning angles and power steering function					×	Check that stopper bolt is sufficiently tight, without damage, and that steering linkage operates smoothly until blocked by stopper bolt. Also check that steering wheel does not make contact with other parts	 Gr 26
76	Power steering booster and oil pump internal rubber parts replacement			Every 24 months			Replace internal rubber parts	 Gr 37
77	Power steering hose replacement			Every 24 months			Replace power steering hose	 Gr 37
CAB AND FRAME								
78	Looseness and damage of chassis and body			×			(1) Check frame, cross members and other parts for loose rivets (2) Also check for body damage and loose mounting bolts	 Gr 41, 42
79	Heater and defroster operation			×			Check operation and installation of defroster	 Gr 55
80	Reflection of rearview mirrors and reflectors	×					Check for reflecting condition, stains and damage	 Gr 42
81	Door lock function			×			Check door lock mechanism functions properly	 Gr 42
82	Seat belt mounting condition			×			Check seat belt for damage, buckle and retracting function and mounting condition	 Gr 42
ELECTRICAL SYSTEM								
83	Looseness and damage of electrical wiring and connections			×			Check wiring, connectors and battery terminals for looseness and corrosion	 Gr 54
84	Battery electrolyte level and specific gravity			Every 20000 km/ 12000 miles			(1) Check electrolyte level (2) Measure electrolyte specific gravity with hydrometer	 Gr 54
85	Operation and damage of lighting system	×		×			Check operation, damage and installation of each lighting unit	 Gr 54
86	Operation of horn and turn signal lamps	×		×			Check operation, damage and mounting condition. Also check turn signal lamps are operated by turn signal switch	 Gr 54
87	Operation and fluid level of windshield wiper and washer	×		×			Check operation, damage and mounting condition. Check if fluid level in washer tank is okay	 Gr 42
88	Gauges and pilot lamps function	×		×			Check function of gauges and pilot lamps	 Gr 54
89	Switch function					×	Check operation, damage and installation of each switch	 Gr 54
OTHER								
90	Road test of vehicle			×			Drive the vehicle to check for overall vehicle operating condition	

MAINTENANCE OPERATIONS

01

This section explains simple maintenance procedures. See the relevant Group in this manual for further details.

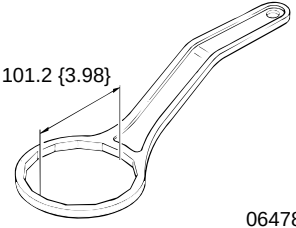
Replacement of Oil Filter

Lubricant

Location	Points of application	Kinds	Quantity
2	Inside oil filter	Engine oil	Approximately 1 L {1.1 qts}
	Gasket area of oil filter with thin application	Engine oil	As required

Special tools

Unit : mm {in.}

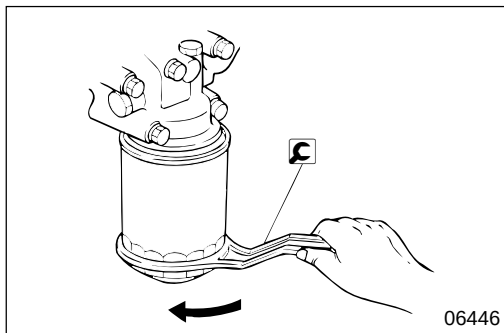
Location	Tool name and shape	Part No.	Application
2	Oil filter wrench 	MH061587	Removal of oil filter

WARNING

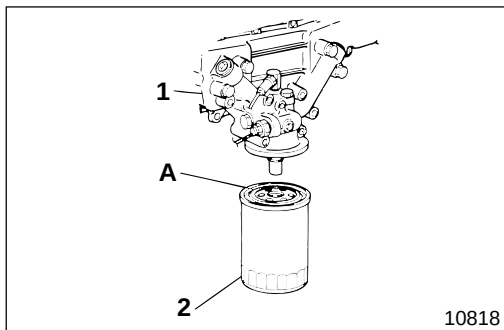
- Wipe up any engine oil that has been spilled because it can cause a fire.
- Do not touch the engine while it is hot because it will burn you.

CAUTION

Take care not to spill engine oil on the V-belts, because this would cause them to slip, reducing service life.



[Removal]



[Installation]

- Clean the surface of oil cooler body **1** that makes contact with oil filter **2**.
- Apply engine oil thinly and evenly to gasket area **A** of oil filter **2**.
- Screw oil filter **2** into oil cooler body **1** until gasket area **A** sits on the body. From this position, tighten further by rotating by three quarters of a turn.
- After installation, run the engine and check that there is no oil leakage from gasket area **A**.
- Check the oil level and if it is low, top it up.

MAINTENANCE OPERATIONS

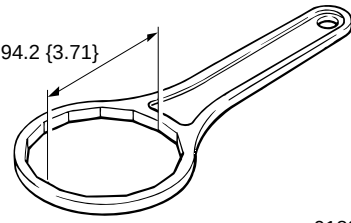
Replacement of Fuel Filter

Lubricant

Location	Points of application	Kinds	Quantity
2	Gasket contact surfaces of fuel filter and fuel filter head	Engine oil	As required

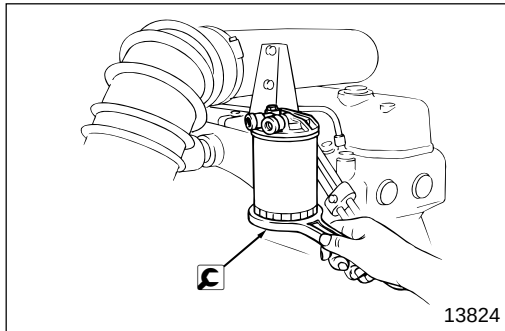
Special tools

Unit : mm {in.}

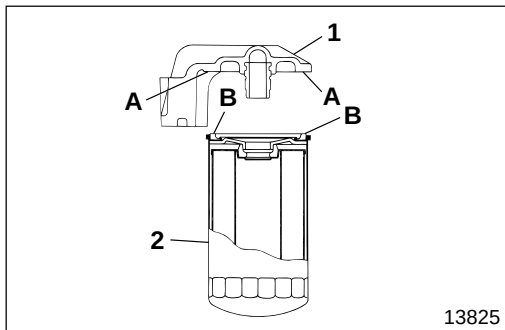
Location	Tool name and shape	Part No.	Application
2	 01882	MH061572	Removal of fuel filter

WARNING

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any gas oil that has been spilled because it can cause a fire.
- Do not use an unsuitable filter because it can cause a fire.



[Removal]



[Installation]

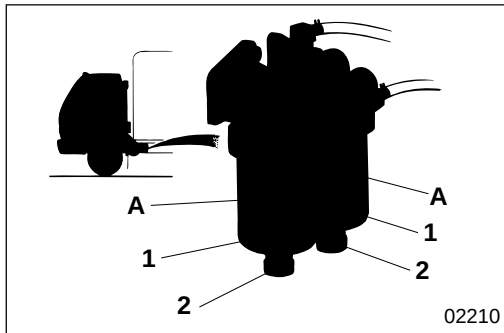
- Install by tightening three quarters to one full turn after contact surface **A** of fuel filter head **1** makes contact with gasket **B** of fuel filter **2**. Be sure to tighten by hand.
- After installation, run the engine and check for fuel leakage.

Draining of Water Separator Condensation

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Drain plug	2.9 to 3.9 {2.2 to 2.9, 0.3 to 0.4}	—



Visually inspect the water separator before driving.

When float **1** reaches red line **A**, drain the condensation as follows:

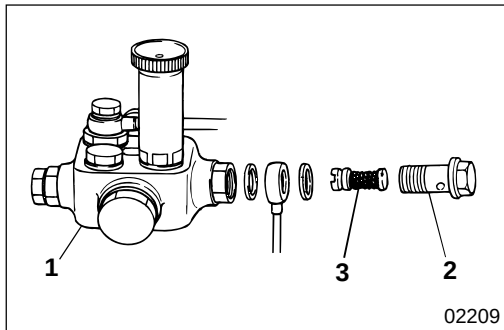
- Loosen drain plug **2** and drain out the condensation.
- When float **1** has dropped to the bottom, tighten drain plug **2**.
- Carefully wipe the water separator and the surrounding area.
- Check for fuel leakage.

Cleaning of Fuel Feed Pump Gauze Filter

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Eye bolt	25 to 29 {18 to 22, 2.5 to 3}	—



WARNING

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any gas oil that has been spilled because it can cause a fire.

- Remove eye bolt **2** on the inlet side of fuel feed pump **1**.
- Remove gauze filter **3** from eye bolt **2**.
- Clean gauze filter **3** with gas oil.
- Follow the removal sequence in reverse and reinstall gauze filter **3**.
- Install eye bolt **2** in the fuel feed pump.
- Bleed the air from the fuel line.
- Start the engine and check for fuel leakage.

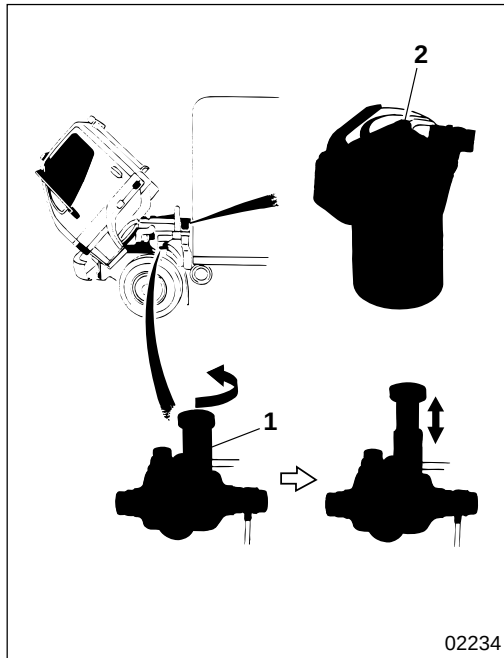
MAINTENANCE OPERATIONS

Bleeding of Air from Fuel Line

T Tightening torque

Unit : N·m {lb·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Air vent plug	7.8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—



WARNING ⚠

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any gas oil that has been spilled because it can cause a fire.

- Turn the top of priming pump 1 of the injection pump counterclockwise and pull it up so the top protrudes.
- Loosen air vent plug 2 of the fuel filter and move the top part of priming pump 1 up and down.
- Move priming pump 1 up and down repeatedly until air bubbles are no longer present in the fuel drained from air vent plug 2.
- When the fuel being drained is free of air bubbles, tighten air vent plug 2.
- After moving priming pump 1 up and down another five or six times, push the top down and turn clockwise to drive it in fully.
- After bleeding the air, carefully wipe up spilled fuel and start the engine.
- Check for fuel leakage.

Adjustment of V-Belt Tension

Newly installed V-belts can stretch during their initial running-in period. To prevent this from becoming a problem, run the engine for several minutes after installing the V-belt, then readjust. Perform this cycle several times.

WARNING

You must take special precautions to prevent the engine from rotating while a V-belt is being inspected or adjusted.

CAUTION

- Make sure that you turn off the engine before attempting to inspect or adjust the V-belts.
- Make sure that you fasten all bolts and nuts securely after adjusting the V-belts. Remember that too much tension can damage the V-belts and bearings.
- Do not grease V-belts. This causes them to slip, which reduce service life.

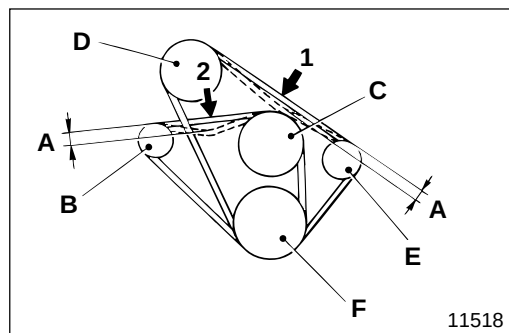
Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
1, 2	V-belt tension (Each one)	Fan	12 to 16 {0.47 to 0.63}	—	Adjust
		Air-conditioner	16 to 20 {0.63 to 0.79}		

Special tools

Location	Tool name and shape	Part No.	Application
1, 2	Belt tension gauge  03612	MH062345	Measurement of tension of V-belt

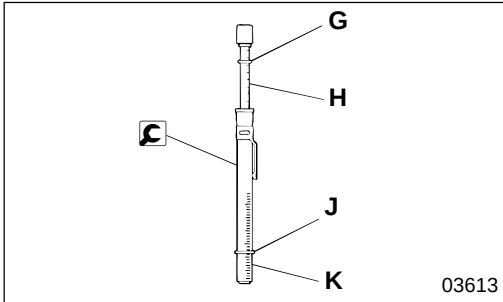


[Inspection]

Measure the extent of flex **A** when the center of V-belts **1, 2** as illustrated is depressed with a force of 98 N·m {72 lbf.ft, 10 kgf·m}.

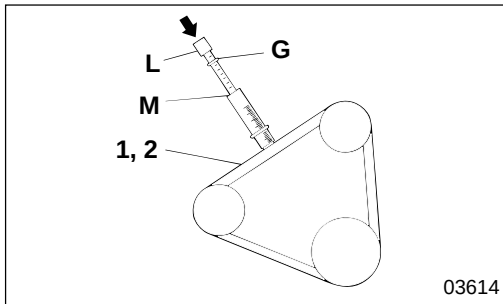
- B** : Alternator pulley
- C** : Water pump pulley
- D** : Cooler compressor pulley (Air-conditioner)
- E** : Tension pulley
- F** : Crankshaft pulley

MAINTENANCE OPERATIONS

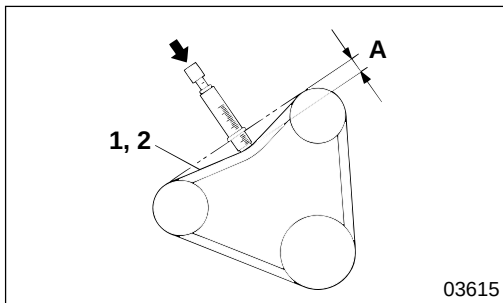


Use of special tool belt tension gauge

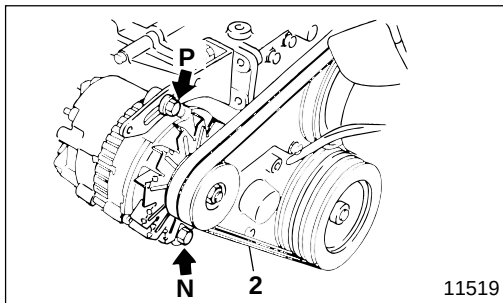
- Set upper O-ring **G** of belt tension gauge to 98 N·m {72 lbf.ft, 10 kgf·m} (push load) on graduation **H**.
- Set lower O-ring **J** of belt tension gauge to graduation **K** (maximum flex of belt).



- Place belt tension gauge at the center of V-belts **1, 2** perpendicularly as illustrated and push top **L** all the way down until upper O-ring **G** hits upper edge **M**.



- Measure the extent of flex **A** of V-belts **1, 2** at this point, and if the measured value deviates from the standard value, adjust as follows:



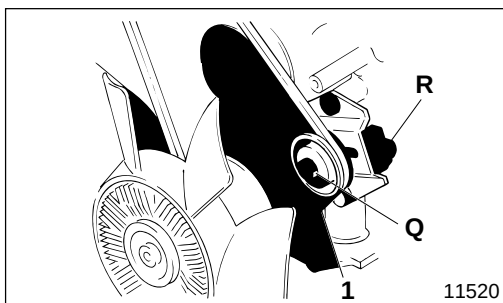
[Adjustment]

(1) Adjustment of tension of V-belt for fan

- Loosen alternator mounting bolts **N** (two points), and adjust the tension of V-belts **2** by moving adjusting bolt **P**.
- After adjustment, tighten the bolts **N, P** securely.

CAUTION

- Bear in mind that excessive tension of V-belts **2** might damage the belts and bearings that engage with the V-belts.
- Be sure to replace V-belts **2** as a set to maintain even tension between them.
- Be careful not to let oil stick to V-belts **2**. If oil gets onto the belts, it causes slipping, resulting in overheating and insufficient battery charging.



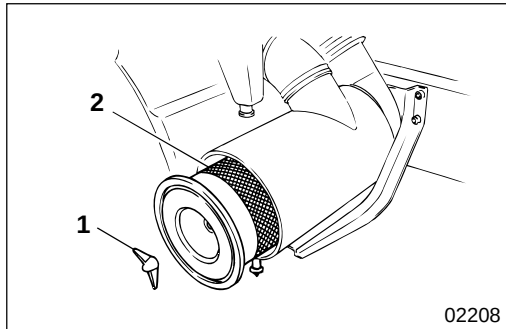
(2) Adjustment of tension of V-belt for air-conditioner

- Loosen tension pulley mounting nut **Q**, and adjust the tension of V-belt **1** moving adjusting bolt **R**.
- After adjustment, tighten mounting nut **Q** securely.

CAUTION

- Bear in mind that excessive tension of V-belt **1** might damage the belt and bearings that engage with the V-belt.
- Be careful not to let oil stick to V-belt **1**. If oil gets onto the belt, it causes slipping, resulting in poor performance of the air conditioner.

Cleaning and Replacement of Air Cleaner Element

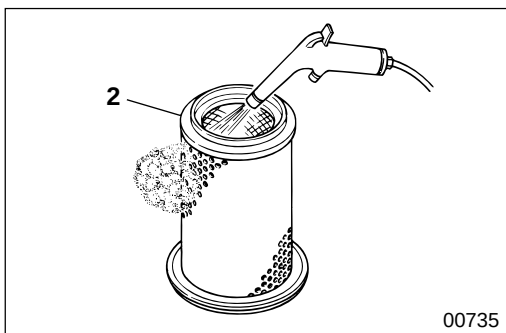


[Removal]

Remove wing nut **1** to remove element **2**.

[Installation]

Install element **2** securely.

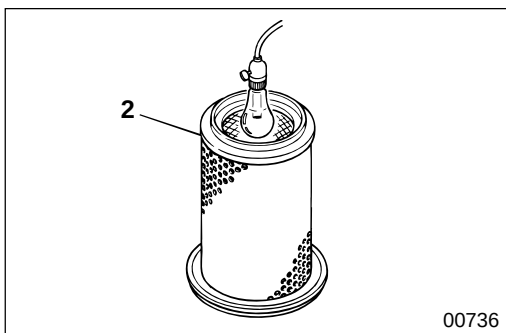


[Cleaning]

- Blow compressed air of 685 kPa {100 lbf/in², 7 kgf/cm²} or less through air cleaner element **2** from the inside.
- When using compressed air, move the blower's nozzle up and down along the pleats of air cleaner element **2** evenly.

CAUTION

- Do not tap or hit air cleaner element **2** to remove dust.
- Do not blow compressed air through air cleaner element **2** from the outside.



[Inspection]

- Illuminate the inside of air cleaner element **2**.
- If parts of the filter paper are torn or thin, or if the packing of the upper surface of air cleaner element **2** is damaged, replace the air cleaner element.

NOTE

If the dust on air cleaner element **2** is wet due to oil smoke or soot, replace the air cleaner regardless of the scheduled replacement interval.

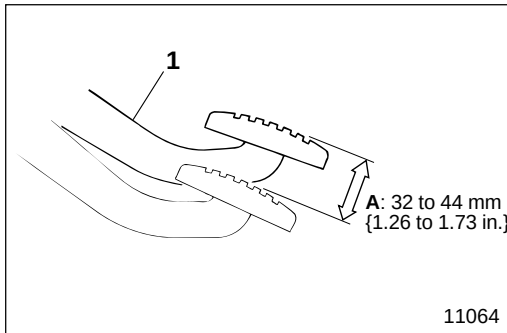
MAINTENANCE OPERATIONS

Inspection of Clutch Pedal Free Play

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Clutch pedal free play	32 to 44 {1.26 to 1.73}	—	Adjust or replace



[Confirmation]

Push clutch pedal **1** with your hand and measure the amount of movement **A** (free play) until you meet resistance. If the measured value does not conform to the standard value, adjust by stroke of clutch power cylinder push rod, or replace the clutch disc.

[Clutch operation]

- Check for unusual noises when clutch pedal **1** is pressed while the engine is idling, and also for abnormally heavy clutch operation. Also check to be certain that it is not difficult to shift the vehicle into first and reverse gears.
- Gradually release clutch pedal **1** to set the vehicle in motion. Check to be sure there is no slippage, and that the clutch engages smoothly.

Tire

Service standards

Unit : mm {in.}

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

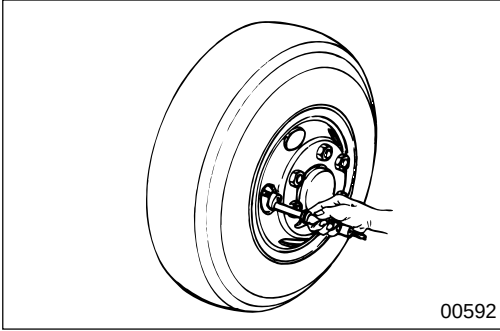
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Wheel nut	370 to 410 {275 to 305, 38 to 42}	Wet

L Lubricant

Location	Points of application	Kinds	Quantity
2	Wheel nut spherical area	Chassis grease [NLGI No.1 (Ca soap)] or Wheel bearing grease [NLGI No.1 (Li soap)]	As required
4	Wheel nut (inner) at thread area and spherical area		
6	Thread area of hub bolt		



00592

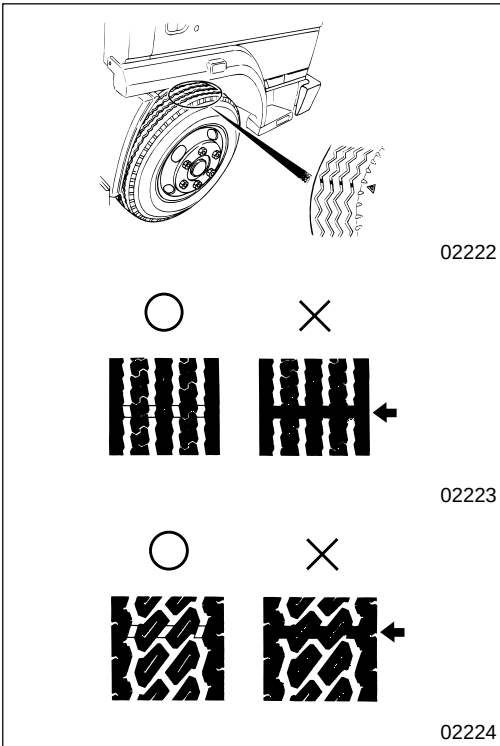
Air pressure

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

Tire Size	Air Pressure kPa {Psi, kgf/cm ² }
215/75R 17.5 124/123L	700 {100, 7.00}

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.



02222

02223

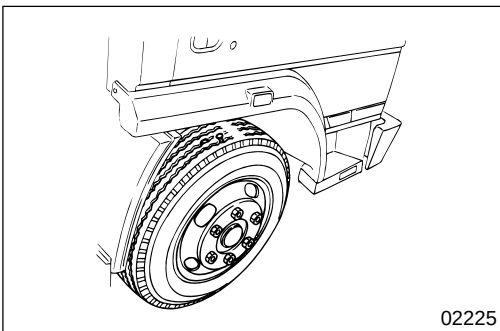
02224

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.



02225

Checking for cracks, damage, and objects embedded in the treads

- Check the tire treads and walls for cracks and damage.
- Check tire treads for uneven wear or other abnormal wear.
- Check if metal objects or nails have penetrated the tires.
- Check for stones embedded between double tires.

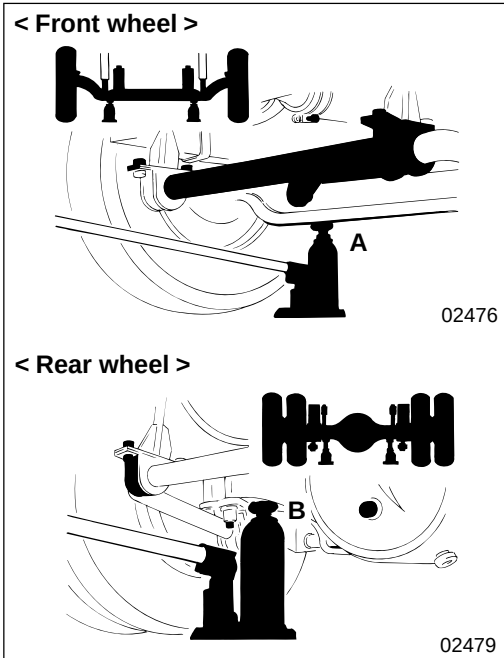
WARNING

Badly damaged or worn tires are extremely dangerous, because they can be punctured more easily when the vehicle is running, they must be replaced with new ones as soon as possible.

MAINTENANCE OPERATIONS

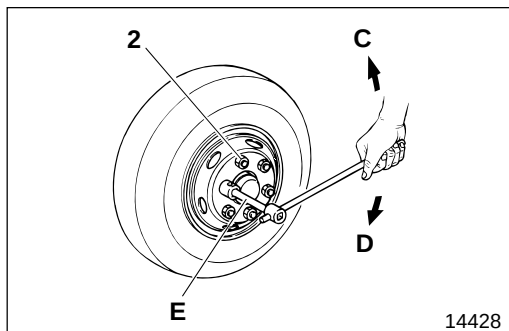
Removing tires

- Jacking up point
 - For front wheels : Front axle bottom A
 - For rear wheels : Rear axle tube bottom B



WARNING

- The jack should be placed on flat, solid ground, and should not be used to raise the vehicle higher than necessary.
- Do not use the jack at vehicle locations other than those illustrated.
- Keep in mind the danger of a slipping jack. Never crawl under the vehicle while the jack is in use or rock the vehicle. Also, do not start the engine while the vehicle is jacked up.
- To increase safety, use supports for the vehicle when it is necessary to leave it jacked up for long periods.
- Chock both the tire to be removed and the tire diagonally opposite to it so that they will not rotate when you are removing the tire.



- Loosen wheel nuts **2** slightly. The wheel nuts for right tires **C** have right-hand threads "R", and the wheel nuts for left tires **D** have left-hand threads "L".

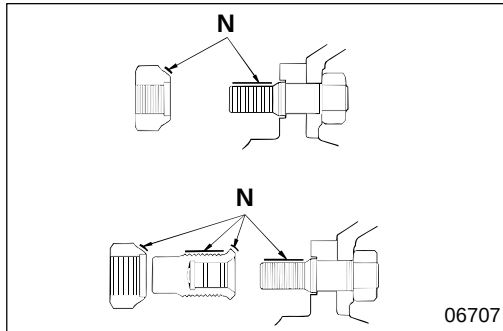
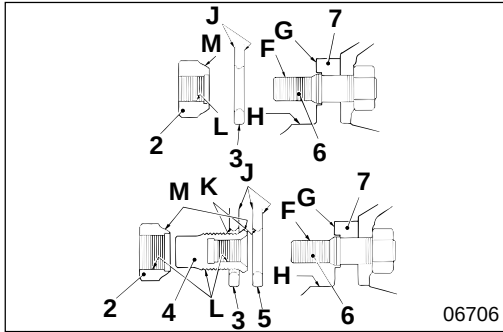
WARNING

Make certain that wheel nut wrench **E** is fully engaged, all the way to the back of nuts **2**. If it is not, it could slip.

CAUTION

Only loosen wheel nuts **2** slightly. Do not remove them.

- Jack up the vehicle carefully, until the tire is slightly off the ground. Remove wheel nuts **2**, then remove the tire.
- When working on the double tires at the rear of the vehicle, first remove the outside tire, then lower the vehicle and loosen the nuts on the inside tire. After doing this, jack the vehicle back up and remove the tire.



Mounting tires

- To prevent wheel nuts **2**, **4** and hub bolt **6** from becoming loose and to prevent mounting parts (tire assemblies **3**, **5** and hub **7**) from being damaged, remove rust, dust, additional coatings of paint, and foreign particles from the following areas:

F : Hub bolt thread area

G : Wheel mounting surface of hub

H : Wheel alignment area of hub

J : Disc wheel mating surface

K : Disc wheel nut mounting surface

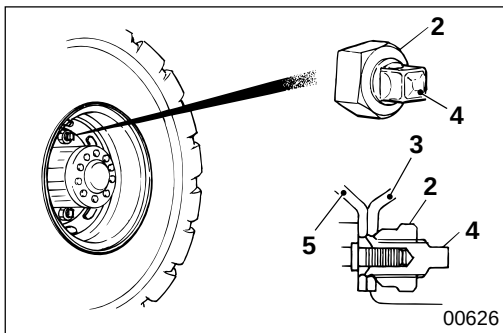
L : Wheel nut thread area

M : Wheel nut spherical area

N : Grease application area

WARNING

Never use grease containing molybdenum disulfide, since it can cause loosening of fitted screws.



- Put on the double rear tires as follows:

- After mounting inner tire **5** and fully tightening inner wheel nuts **4**, jack the vehicle up and mount on outer tire **3**, then tighten outer wheel nuts **2**.
- Even if only outside tire **3** is to be changed, do not mount it until inner wheel nuts **4** have been fastened at the specified torque.
- Slide the air valves on the inside and outside tires down when mounting the tires.

WARNING

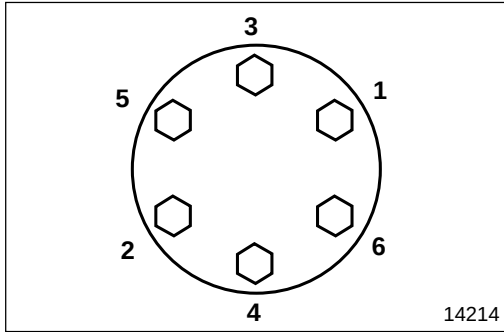
If the threads are scored, or the disc wheel is deformed or cracked, change bolts **6**, nuts **2**, **4** and disc. Driving the truck before correcting such problems can cause the tire in question to come loose, which could be the source of major accidents.

CAUTION

Check hub bolt **6** threads carefully for scratches before putting the tire on.

- Place the tapered end of wheel nuts **2**, **4** towards the disc wheel and fasten temporarily. Center so that there is no eccentricity between bolts **6** and the disc wheel bolt holes.
- Lower the vehicle.

MAINTENANCE OPERATIONS



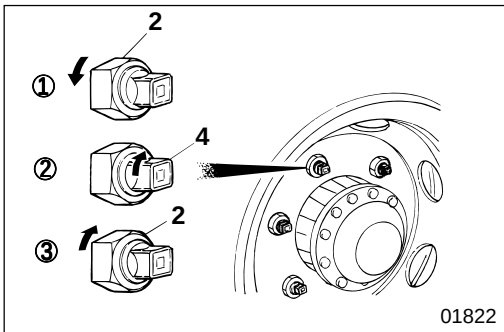
- Tighten the nuts in the order as illustrated, tightening each nut two or three times. To finish, tighten each nut at the specified torque.

WARNING

Always use the specified torque when tightening the wheel nuts. If the wheel nuts are not tightened properly, the wheels could come loose while the vehicle is being driven, which could result in life threatening accidents or the truck being disabled.

CAUTION

Over-tightening the wheel nuts can damage them.



Checking the wheel nuts for looseness

The wheel nuts should be checked for looseness every 10000 km (6000 miles). All nuts should be tightened at the specified torque.

- Check the double rear tires for looseness as follows:

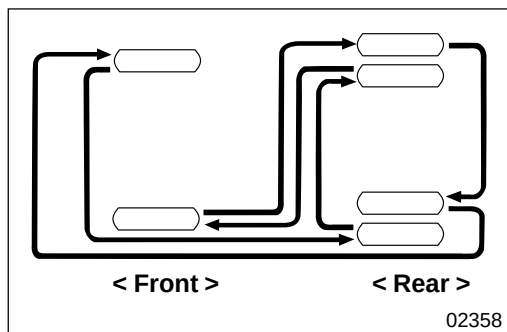
- ① Loosen outer wheel nuts 2.
- ② Tighten inner wheel nuts 4 at specified torque.
- ③ Tighten outer wheel nuts 2 at specified torque.

CAUTION

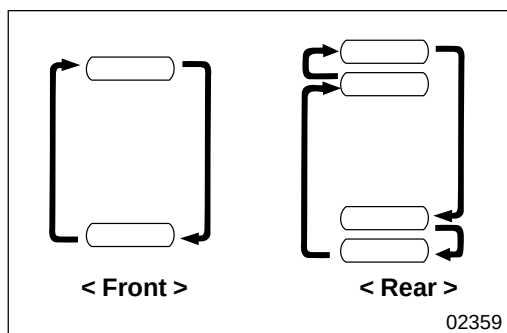
If outer wheel nuts 2 are tightened without first being loosened, it might not be possible to tighten them at the specified torque.

Tire rotation

Tires wear differently, according to the location where they are mounted. To make this wear uniform and prolong the life of your tires, they should be rotated every 10000 km (6000 miles) in the rotation order shown below:



- When the tread patterns for all tires are identical:



- When the tread patterns are different for the front and rear tires:

CAUTION

- Always adjust air pressure after running-in new tires.
- When using tires of different tread patterns, use rib-type patterns for the front tires and traction type patterns for the rear tires.
- Avoid using both radial and biased tires on the same vehicle.

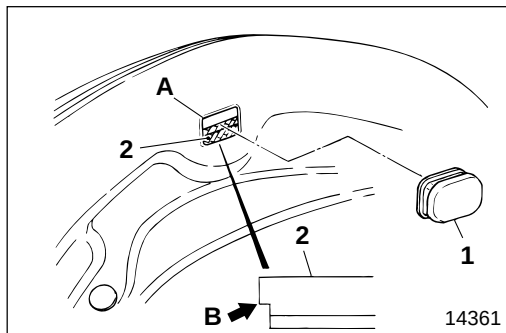
MAINTENANCE OPERATIONS

Inspection of Brake Lining Thickness

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Thickness of brake lining	—	5 {0.20} (Wear limit at side step)	Replace



NOTE

Be sure to inspect at two points for each wheel per side.

- Remove check hole plug **1** from the packing plate.
- Inspect through check hole **A** whether brake lining **2** is worn to the point of side shoulder **B** of the brake lining (the limit).
- If the measured value is lower than the limit, replace brake lining **2** on the same axle as a unit.
- After inspection, be sure to reinstall check hole plug **1**.

Battery

DANGER ⚠

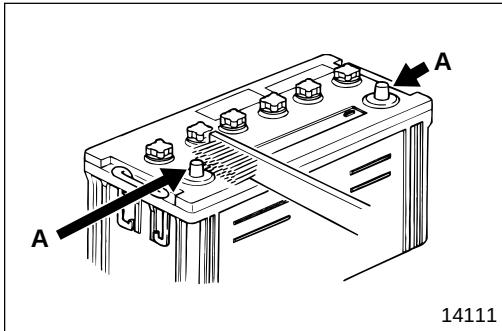
- Since flammable hydrogen gas is generated by the battery, be sure to obey the following warnings :
 - Do not short-circuit the $\oplus$ and $\ominus$ terminals on the battery.
 - Keep sparks and lit cigarettes away from the battery.
 - Do not wear metal objects on your arms and lean over the battery.
- Because the battery electrolyte is diluted sulfuric acid and is corrosive, when handling the battery wear safety glasses and rubber gloves to protect the eyes and hands.

WARNING ⚠

To prevent a short-circuit be sure that disconnected the battery cables do not accidentally touch the battery terminals.

CAUTION ⚠

- Make sure that you disconnect the battery cable $\ominus$ first when you disconnect the battery cables.
- Make sure that all electrical switches of the vehicle are OFF before connecting the battery cables.
- Make sure that you connect the battery cable $\oplus$ before you connect the battery cable $\ominus$.

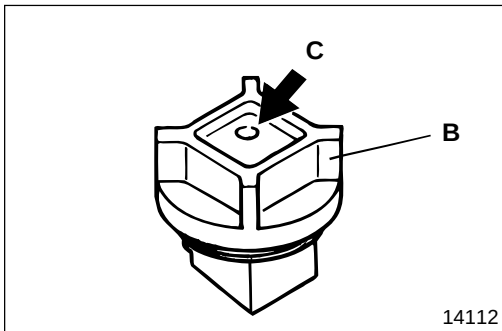


Visual inspection

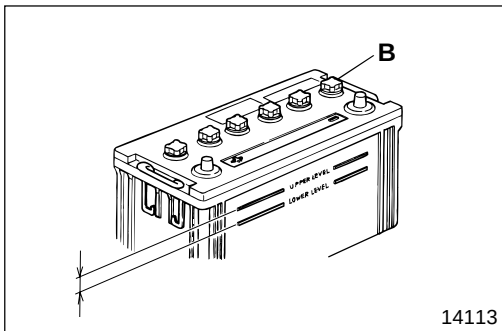
- If terminal **A** is corroded, scrub off the corrosion from it using a wire brush.
- If cracks or defects are found on the battery, replace it since the cracks or defects can cause liquid spills.

CAUTION

Make sure you grease the $\oplus$ side of terminal **A** because it is easily corroded.

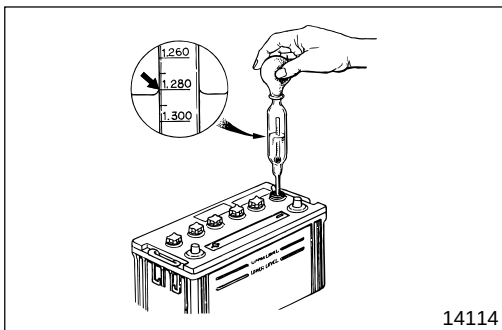


- If bleed hole **C** of vent plug **B** is clogged, clean the hole.



Inspection of fluid level

- Make sure that the battery electrolyte level is between UPPER and LOWER.
- If the level is below LOWER, remove vent plug **B** and fill the battery with distilled water or battery replenisher to UPPER.



Measurement of specific gravity

Measure the specific gravity of the battery electrolyte. If the measured value is lower than the limit, charge the battery.

NOTE

The specific gravity of the battery electrolyte depends on the liquid temperature. Use the following formula to convert the actual value to the value were the temperature 20°C {68°F}.

$$S_{20} \{68\} = S_t + 0.0007 (t - 20\{68\})$$

$S_{20} \{68\}$: Specific gravity were the temperature 20°C {68°F}

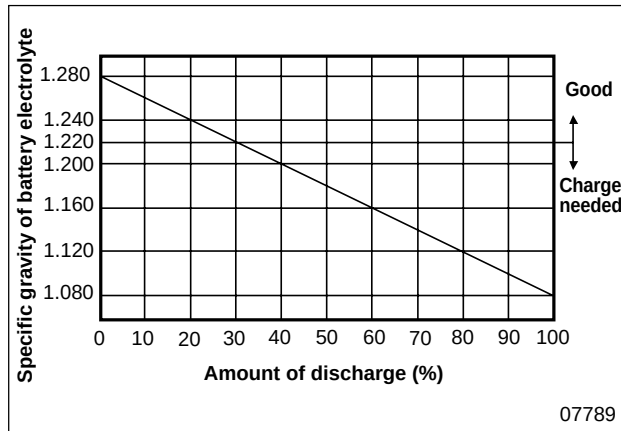
S_t : Specific gravity actually measured with the temperature at t°C {t°F}

t : Temperature of battery electrolyte

MAINTENANCE OPERATIONS

Charging

- Although, as a rule, charging of the battery should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect the battery cable $\ominus$.
- Remove vent plug **B** before charging the battery.
- 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 $\frac{10}{\{113\}}$	$\frac{\text{★Amount of discharge (Ah)}}{\text{Charge current (A)}} \times 1.2 (\text{to } 1.5)$	45
Quick charge	Value of 5-hour rating capacity $\frac{15}{\{131\}}$	0.5	55

$$\text{★ Amount of discharge (Ah)} = \text{5-hour rating capacity (Ah)} \times \frac{\text{Amount of discharge (\%)}}{100}$$

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

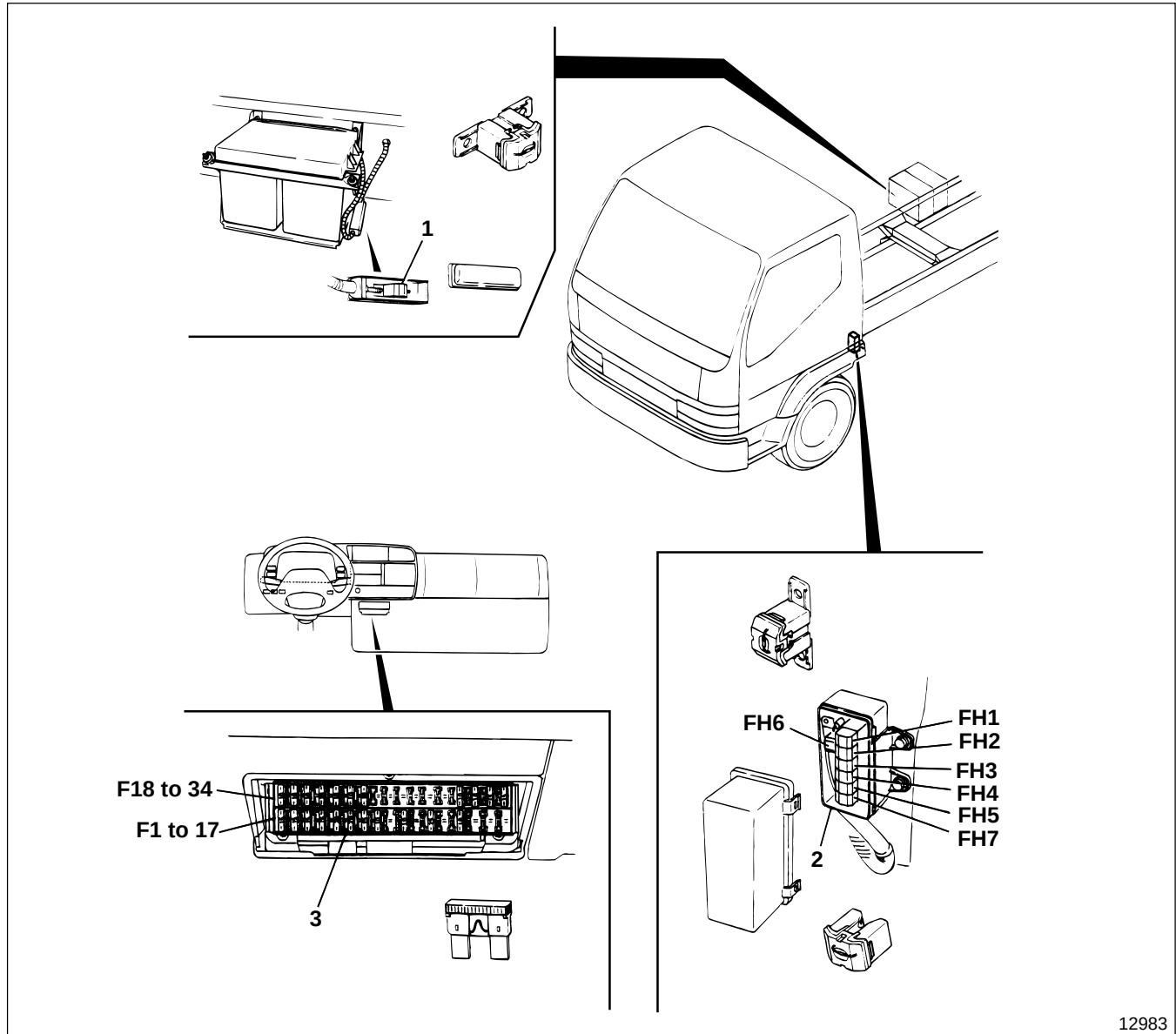
DANGER ⚠

- Do not let the battery electrolyte level rise and overflow while charging the battery.
- Keep naked lights away from the battery while charging it or it might explode.
- Be careful not to generate sparks while charging the battery because its dangerous.
- After charging the battery, tighten vent plug B, wash away sulfuric acid from the battery using water, and dry the surface.

MEMO

MAINTENANCE OPERATIONS

Fuse



12983

CAUTION

- If a fuse blows, make sure you identify and remedy the cause, then replace the fuse.
- Make sure that you replace the fuse with one having the same rating.
- Make sure that you remove the $\ominus$ terminal of the battery cable before removing main high-current fuse 1 and high-current fuses FH1 to 7.

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	120 A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50 A
FH2	Fuse box (F5 to F8)	50 A
FH3	Fuse box (F9 to F12)	40 A
FH4	Starter switch (Terminal B)	40 A
FH5	Glow relay	50 A
FH6	Alternator	120 A
FH7	Fuse box (F31 to F34)	40 A

Fuse box

Fuse No.	Main load	Capacity
F1	Headlamp, LH	15 A
F2	Headlamp, RH	15 A
F3	Stop lamp, horn	15 A
F4	Turn signal lamp	15 A
F5	Fuel-cut motor	10 A
F6	Cab lamp	10 A
F7	Reserve power (BATT)	10 A
F8	—	—
F9	—	—
F10	—	—
F11	—	—
F12	—	—
F13	* Cigarette lighter	15 A
F14	Radio	10 A
F15	—	—
F16	—	—
F17	Fuel-cut relay	10 A

Fuse No.	Main load	Capacity
F18	Starter	10 A
F19	Backup lamp	10 A
F20	Meter cluster	10 A
F21	Wiper	10 A
F22	Air dryer	10 A
F23	—	—
F24	—	—
F25	—	—
F26	—	—
F27	Exhaust brake	10 A
F28	Transmission PTO	10 A
F29	Pre-stroke cut relay	15 A
F30	* Air-conditioner control	10 A
F31	* Air-conditioner compressor	10 A
F32	* Condenser fan	15 A
F33	Blower fan	25 A
F34	Tail lamp	15 A

* : Fuses are provided for these pieces of equipment only where they are installed.

PTO : Power take-off

LUBRICATION

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

Ⓔ : Exhaust emission items

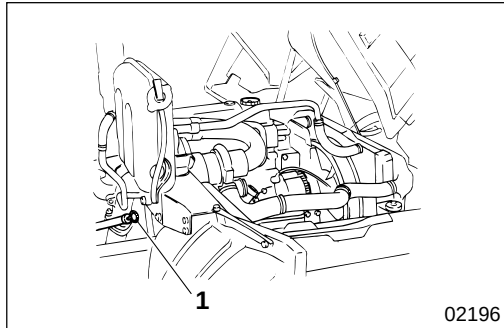
Inspection and maintenance		Time of inspection and maintenance					Lubrication procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
1	Ⓔ Engine oil contamination and oil level	×					Engine oil API classification CD, CD/SF, CE, CE/SF or CF-4 Over 30°C {86°F} SAE 40 40 to -5°C {104 to 23°F} SAE 30 15 to -15°C {59 to 5°F} SAE 20W-20 Over -15°C {5°F} SAE 15W-40 Below 0°C {32°F} SAE 10W-30	📦 Gr 12
	Ⓔ Engine oil replacement		×	×				
2	Clutch fluid tank fluid level	×		×			Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	📦 Gr 21
	Clutch fluid tank fluid replacement					×		
3	Lubrication of clutch fork shaft				×		Wheel bearing grease [NLGI No.2 (Li soap)]	📦 Gr 21
4	Lubrication of clutch shifter			When replacing clutch disc assembly				
5	Manual transmission oil level			×			Gear oil, API classification GL-3 SAE 80 (General) GL-3 SAE 90 (Warm region) GL-4 SAE 90 (Tropical region)	📦 Gr 22
	Manual transmission oil replacement		×		×			
6	Automatic transmission fluid level			×			Automatic transmission fluid (DEXRON, DEXRON II type)	📦 Gr 23
	Automatic transmission fluid and filter replacement			Every 40000 km/ 25000 miles Replace the fluid at the first 10000 km/6000 miles inspection				
7	Axle housing gear oil level			×			Gear oil API classification GL-5 Below 40°C {104°F} SAE 90 Over 40°C {104°F} SAE 140 Use SAE 140 when operating vehicle at high load such as continuous ascent on slopes and when the outside temperature is 10°C {50°F} or more	📦 Gr 27
	Axle housing gear oil replacement		×			×		
8	Hub bearing grease and oil seal replacement					×	Wheel bearing grease [NLGI No.2 (Li soap)]	📦 Gr 26, 27
9	Brake fluid tank fluid level	×		×			Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	📦 Gr 35
	Brake fluid tank fluid replacement					×		
10	Power steering fluid level			×			Automatic transmission fluid (DEXRON, DEXRON II type)	📦 Gr 37
	Power steering fluid replacement					×		
11	Lubrication of propeller shaft (universal joint, slip joint, center bearing)			×			Wheel bearing [NLGI No.2 (Li soap)]	📦 Gr 25
12	Lubrication of kingpins			×			Chassis grease [NLGI No.1 (Ca soap)]	📦 Gr 26
13	Lubrication of all chassis parts			×				

Engine Oil

Tightening torque

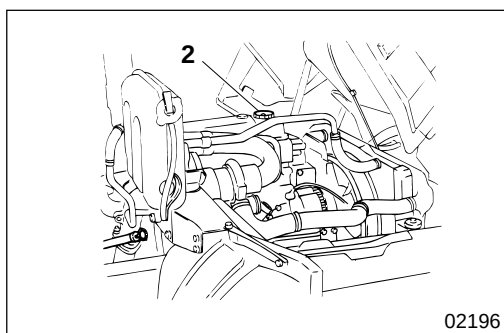
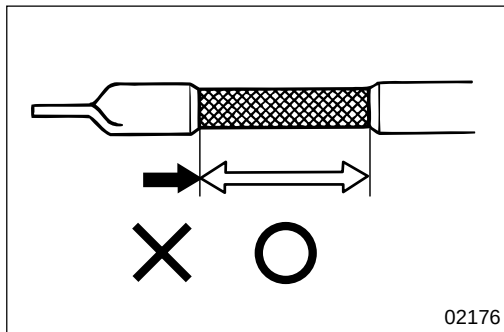
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Oil pan drain plug	69 {51, 7}	—



[Inspection]

- Pull out dipstick **1**, wipe off the oil with a cloth.
- Reinsert dipstick **1**, then pull it out carefully.
- Oil level is correct if there is oil sticking to dipstick **1** within the hatched area.
- If the level is low, top it up.
- Tilt the cab.



[Replenishment]

- Clean the area surrounding oil filler cap **2** and prevent dust from entering through the filler.
- Remove oil filler cap **2** and top up with engine oil.
- Wait five minutes before checking the oil level.
- Replace filler cap **2**.

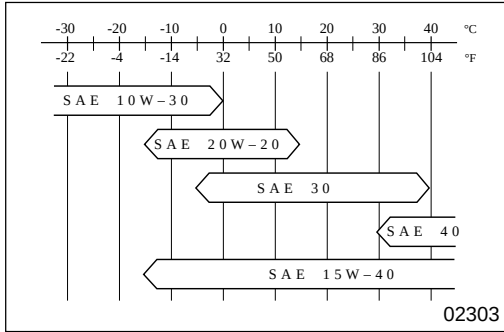
WARNING

- Wipe up any engine oil that has been spilled because it can cause a fire.
- Do not touch the engine while it is hot as it will burn you.

CAUTION

Take care not to spill engine oil on the V-belts, because this would cause them to slip, reducing service life.

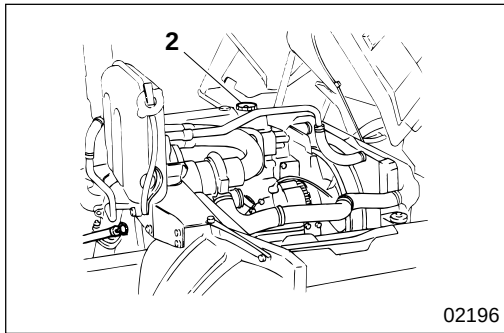
LUBRICATION



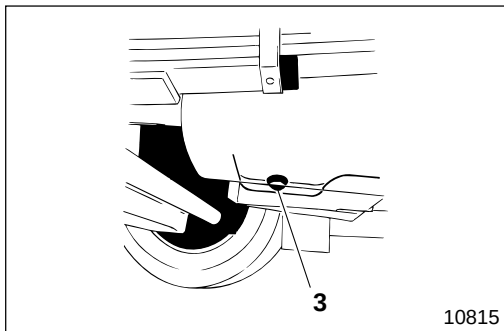
[Replacement]

Since engine oil greatly influences the performance, the life expectancy, and the ability to start the engine, use only oil of the specified grade and viscosity.

The chart illustrates the relationship between oil viscosity and the ambient air temperature.



- Clean the area surrounding oil filler cap **2** and prevent dust from entering through the filler.
- Remove oil filler cap **2**.
- Remove oil pan drain plug **3**, and drain the oil. At the same time replace the oil filter.
- After reinstalling drain plug **3**, slowly add engine oil through the oil filler.
- Using the dipstick, check the oil level after more than six minutes have passed.
- Start the engine and let it idle. When the oil has reached all parts, stop the engine. Let 30 minutes pass before checking the oil level again.



Clutch Fluid (Brake Fluid)

Tightening torque

Unit : N·m {lb·ft, kgf·m}

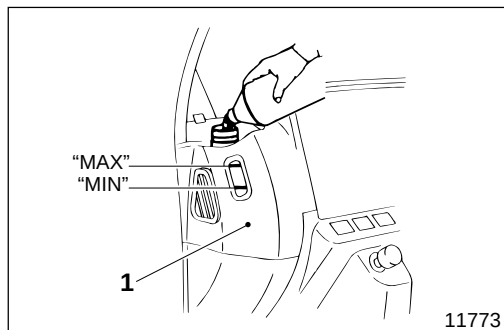
Location	Parts to be tightened	Tightening torque	Remarks
2	Air bleeder	25 to 34 {18 to 25, 2.5 to 3.5}	—

Fluid

Location	Points of application	Kinds	Quantity
1	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

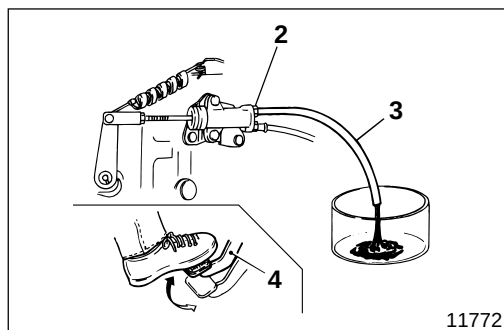
CAUTION

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.
- You must use new brake fluid (SAE J1703f or FMVSS No.116 DOT3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system to swell, resulting in faulty clutch operation.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will cause faulty clutch operation.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oils.



[Inspection and replenishment]

- Inspect the level of the brake fluid in fluid tank 1. It should fall between the "MAX" and "MIN" levels.
- If it is below the "MIN" level, lift up the lid flap and remove the cap from fluid tank 1, then supply the specified brake fluid until the level has come up to the "MAX" level. Do not fill above the "MAX" level.

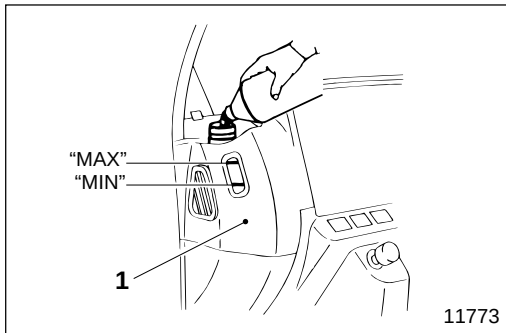
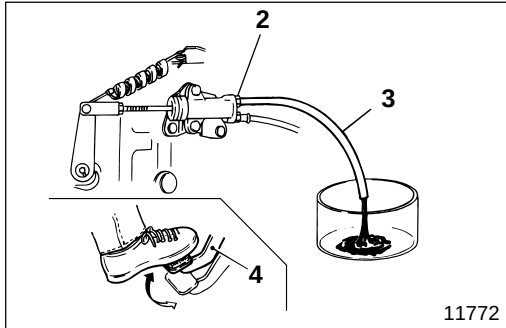


[Replacement]

- Attach vinyl pipe 3 to air bleeder 2 of the clutch power cylinder.
- Loosen air bleeder 2 and depress clutch pedal 4 several times to drain brake fluid completely.

LUBRICATION

- Supply new brake fluid to the “MAX” level of fluid tank **1**. Depress clutch pedal **4** repeatedly until the old brake fluid discharged from vinyl pipe **3** is replaced by the new brake fluid.



NOTE

Carry out this operation maintaining the brake fluid level in fluid tank **1** between “MAX” and “MIN”.

- Attach vinyl pipe **3** to air bleeder **2** of the clutch power cylinder as in the replacement procedure.
- Fill fluid tank **1** with brake fluid, and loosen air bleeder **2** of the clutch power cylinder then depress clutch pedal **4** continuously.
- Keep depressing clutch pedal **4**, and tighten air bleeder **2** when air is bled completely.
- Depress clutch pedal **4** several times again, then keep it depressed at its fullest extent.
- With clutch pedal **4** depressed, loosen air bleeder **2** to drain brake fluid containing air. Release the pedal after tightening the air bleeder.
- Repeat this operation until air is no longer present in the fluid being drained.
- When this operation is completed, tighten air bleeder **2** at specified torque.
- Check that brake fluid is at the “MAX” level of fluid tank **1**, and supply new brake fluid if necessary.
- Check for brake fluid leakage from each of the parts with clutch pedal **4** depressed.

Manual Transmission Gear Oil

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

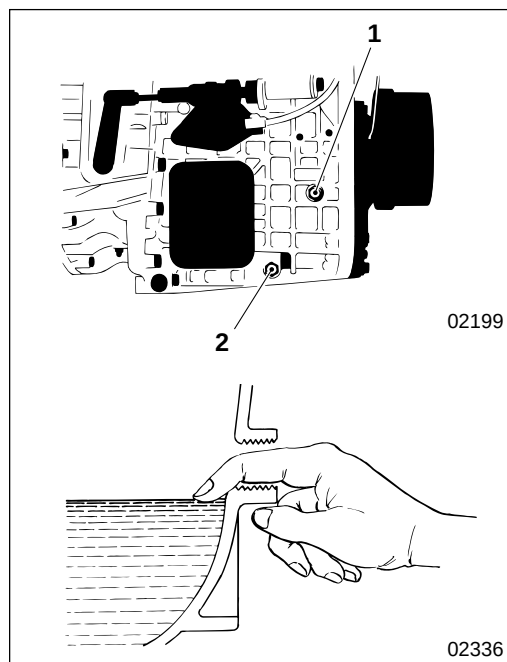
Location	Parts to be tightened	Tightening torque	Remarks
1	Inspection plug	69±15 {51±11, 7±1.5}	—
2	Drain plug	69±15 {51±11, 7±1.5}	—

Sealant

Location	Points of application	Kinds	Quantity
1	Thread area of inspection plug	THREEBOND 1105D	As required
2	Thread area of drain plug	THREEBOND 1105D	As required

WARNING

The engine is hot immediately after the vehicle stopped, so take care not to burn yourself.



[Inspection and replenishment]

- Remove inspection plug **1** and check whether the oil level is up to the edge of the entrance.
- If the level is low, add oil through the inspection plug hole until the level comes up to the edge of the entrance.

[Replacement]

- Drain the oil after removing inspection plug **1** and drain plug **2**.
- Remove any metal particles sticking to the magnetic part of drain plug **2** before reinstalling the plug.
- Add oil through the inspection plug hole until the level comes up to the edge of the entrance.
- Insert inspection plug **1**.

LUBRICATION

Automatic Transmission Fluid and Oil Filter

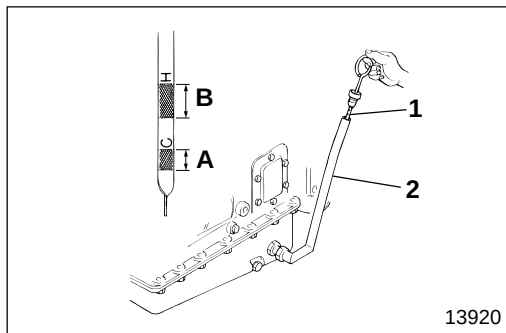
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Drain plug	20 to 27 {15 to 20, 2.05 to 2.75}	—
5	Dipstick guide connector	125 to 135 {91 to 100, 12.55 to 13.76}	—
6	Bolt (Oil pan mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—
8	Bolt (Oil filter mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—
12	Oil filter	9.8 to 20 {7 to 14, 1 to 2}	—

Fluid

Location	Points of application	Kinds	Quantity
11	Body of O-ring	Automatic transmission fluid (DEXRON or DEXRON II type)	As required
12	Gasket of oil filter with thin application	Automatic transmission fluid (DEXRON or DEXRON II type)	As required



[Inspection and replenishment]

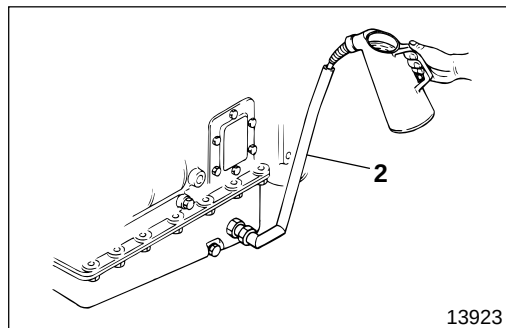
- Park the vehicle on level ground, make sure that the parking brake is fully activated and chock the wheels to keep them from rolling.
- Start the engine and let it idle. To fill the hydraulic circuit with automatic transmission fluid, shift the range selector lever from N → R → N → D → 2 → D → N. Repeat this process five times, finally shifting to N.
- While the engine is still idling, pull out dipstick **1** and wipe off the fluid sticking to it. Reinsert the dipstick, then pull it out again and check the fluid level.
- If the fluid level is inspected right after the engine is started and the fluid temperature is still low (approximately 15 to 49°C {60 to 120°F}), the level should be within area **A** marked COLD on dipstick **1**.
- If the fluid level is inspected after the vehicle has been driven and the fluid temperature is high (approximately 71 to 93°C {160 to 200°F}), the level should be within area **B** marked HOT on dipstick **1**.

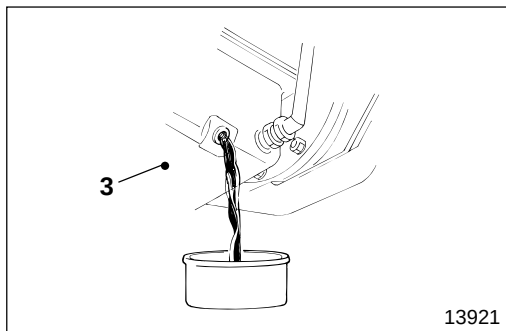
WARNING ⚠

Take care during the inspection because the engine will be running. Take sufficient care to avoid burns or injuries resulting from contact with moving parts.

NOTE

- Make sure the vehicle is parked on level ground when you are checking the fluid level.
- Make sure the range selector lever is in the N position and the engine is idling when you are checking the fluid level. When the engine is stopped, the fluid level appears higher than it actually is.
- Be sure to wipe off the dust from the safety cap and the upper part of dipstick guide **2** before you pull out dipstick **1**.
- To ensure the fluid is correct, reinspect the fluid level after an actual drive.
- If the fluid level is low, add automatic transmission fluid (DEXRON or DEXRON II type) through dipstick guide **2** until the correct level on dipstick **1** is reached.





[Replacement]

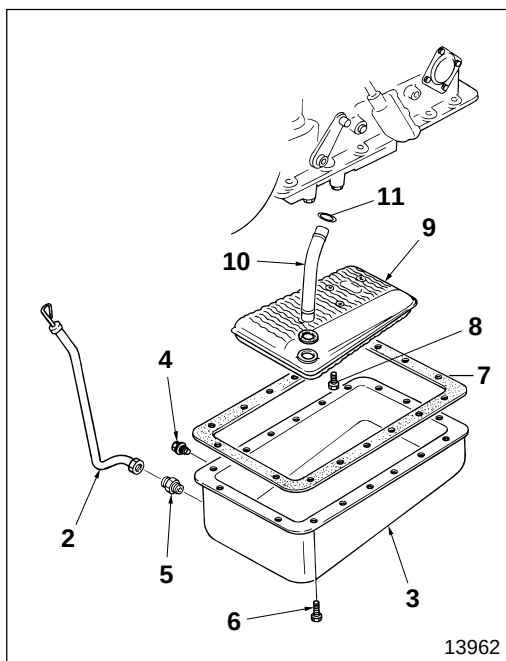
- Park the vehicle on level ground, chock the wheels and shift the range selector lever to the N position.
- Place a container under oil pan **3**, remove drain plug **4** and drain the fluid.

WARNING ⚠

Take care because the fluid temperature immediately after the engine has stopped is very high. To avoid scalds, wait until a safe temperature has been reached before draining the fluid.

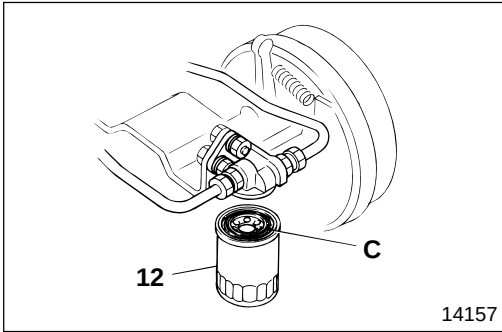
NOTE

- The fluid will drain faster if the engine is first run to raise the fluid temperature.
- The fluid cannot be drained from the hydraulic circuit, the torque converter or the oil cooler.
- Check the drained fluid for dirt, metal particles and metal fragments.

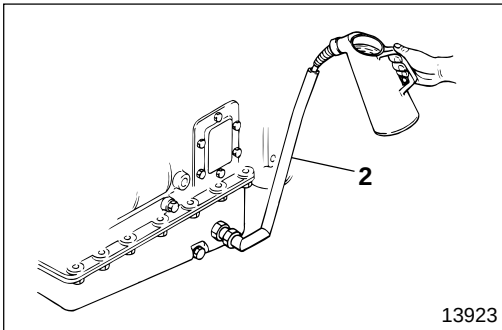


- Remove oil pan **3**, intake pipe **10**, O-ring **11**, gasket **7** and oil filter **9**.
- Clean oil pan **3**.
- Replace O-ring **11**, gasket **7** and oil filter **9**.

LUBRICATION



- Remove oil filter **12** (for oil cooler) by turning it counterclockwise.
- Lightly coat gasket **C** with the fluid before installing oil filter **12**. Then tighten the oil filter.



- Supply fluid through dipstick guide **2**.

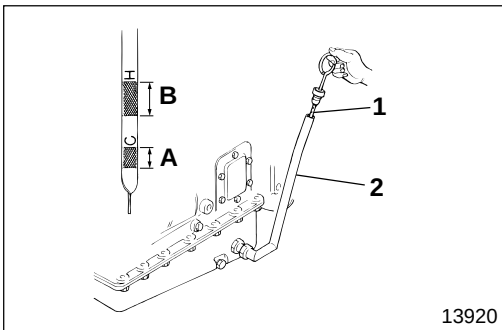
CAUTION

Make sure that dirt and foreign particles do not become mixed in with the fluid when it is added.

- Shift the range selector lever to the N position, start the engine and let it idle for about one minute.
- After shifting the lever through all positions once, shift it back to N position.

CAUTION

To prevent burning out the interior of the automatic transmission assembly, make sure that the engine is not allowed to race when you do the above.



- Check and adjust so that the fluid level is within the specified area on dipstick **1**.

NOTE

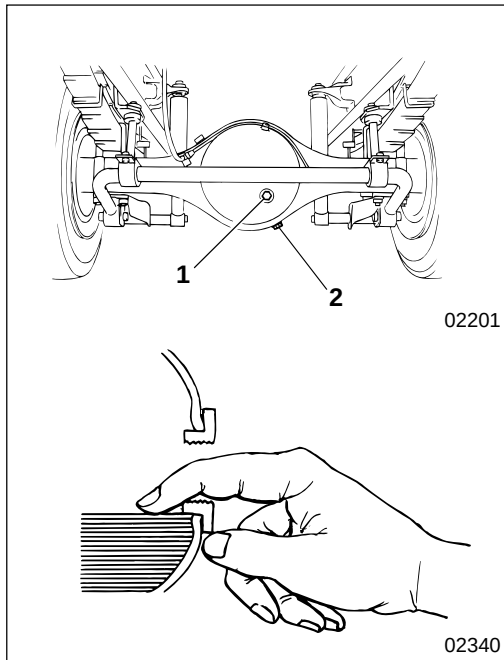
- As the temperature of the fluid rises, so does the fluid level. If you add fluid while the temperature is still low (approximately 15 to 49°C {60 to 120°F}), make sure that the level stays within area **A**, marked **COLD** on dipstick **1**.
- Let the engine idle and, while paying attention to the fluid level, pour in the fluid slowly.
- It is sometimes hard to check the fluid level, immediately after supplying fluid, because of the fluid adhering to the interior of dipstick guide **2**. If this is the case, check the fluid level several times at intervals.
- Be careful not to supply too much fluid because you might mistake the fluid that overflows from the air breather for fluid leakage.

Rear Axle Gear Oil

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}	—



[Inspection and replenishment]

WARNING

The oil temperature is high immediately after the vehicle stopped, so take care not to scald yourself.

- Remove inspection plug **1**, check the oil level and make sure it is up to the edge of the entrance.
- If the oil level is low, add oil through the inspection plug hole until the level comes up to the edge of the entrance.
- Insert inspection plug **1**.

[Replacement]

- Drain the oil after removing inspection plug **1** and drain plug **2**.
- Remove any metal particles sticking to the magnetic part of drain plug **2** before reinstalling the plug.
- Supply oil through the inspection plug hole until the level comes up to the edge of the entrance.
- Reinstall the inspection plug.

LUBRICATION

Power Steering Fluid

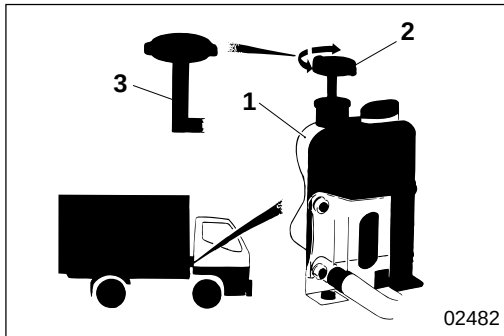
Tightening torque

Unit : N·m {lb·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Oil pipe	66.69±12.75 {49±9.4, 6.8±1.3}	—

Fluid

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



[Inspection and replenishment]

- Straighten the front wheels and stop the engine.
- 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.

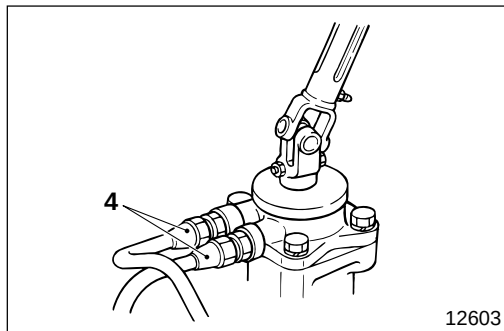
- Carefully lift up filler cap 2 and check the fluid sticking to dipstick 3 to make sure that the fluid is at a point between the end and F on the dipstick. If the level is low, add fluid.
- After inspection install filler cap 2 by turning it clockwise.

WARNING ⚠

Close filler cap 2 firmly; otherwise power steering fluid will leak and could catch fire. Also wipe up spilled fluid.

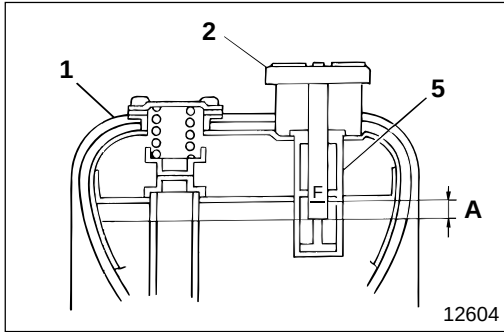
CAUTION ⚠

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



[Replacement]

- Drainage
 - Jack up the front wheels.
 - Disconnect oil pipe 4 connected to the power steering booster.
 - Turn the steering wheel fully left and right repeatedly, and drain the fluid from the power steering booster.
 - After draining the fluid, tighten oil pipe 4 at specified torque.



[Supply]

- Pour fluid into power steering oil tank **1** up to the inner port of strainer **5**.
- With the engine stopped, jack up the front wheels and turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**.

NOTE

Check the fluid level without screwing on filler cap **2.**

- Start the engine and letting it idle, turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**. Repeat these steps until the fluid level does not drop.
- If there is an abnormal noise, air is still in the system. Turn the steering wheel several times to raise the fluid temperature to approximately 60 to 80°C {140 to 176°F}, then stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times. If there is no noise, bleeding is completed.
- When bleeding is finished, check fluid level of power steering oil tank **1**, and pipe and hose connections for fluid leakage.

LUBRICATION

Brake Fluid

Tightening torque

Unit : N·m {lb·ft, kgf·m}

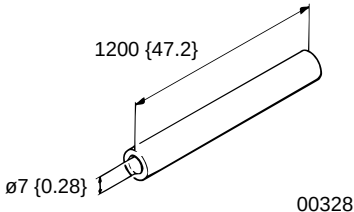
Location	Parts to be tightened	Tightening torque	Remarks
—	Air bleeder (Airmaster)	6.9 to 12.7 {5.1 to 9.4, 0.7 to 1.3}	—
—	Air bleeder (Wheel brake)	7.8 to 12 {5.8 to 8.5, 0.8 to 1.2}	—

Fluid

Location	Points of application	Kinds	Quantity
—	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	Vinyl hose 	MH033102	Air bleeding

WARNING

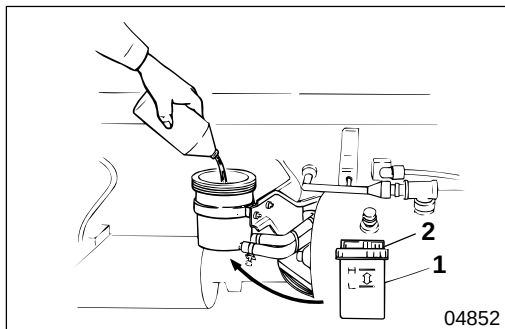
- You must use new brake fluid (SAE J1703f or FMVSS No.116 DOT3).
- Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the brake system, because this will cause the rubber parts of the brake system to swell, resulting in brake dragging or ineffective braking.
- Be sure not to allow dirt or water to become mixed into brake fluid when refilling, because this will cause the brake to malfunction.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oils.

CAUTION

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

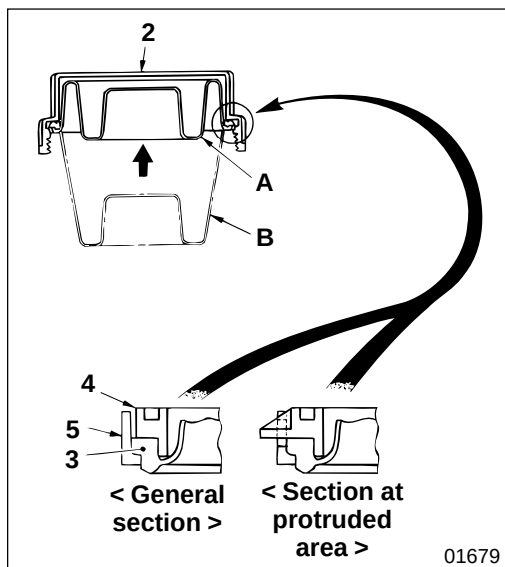
NOTE

Supply brake fluid to maintain the “H” level of the brake fluid tank always.



[Inspection and replenishment]

Inspect the level of the brake fluid in fluid tank **1**. It should fall between the "L" and "H" levels. If it is below the "L" level, remove cap **2** from the fluid tank, then supply the specified brake fluid until the level comes up to the "H" level. Do not fill above the "H" level.



- If diaphragm **3** is not in its normal posture when the brake fluid is supplied, correct it to its normal posture, and install cap **2**. If brake fluid leaks from the cap area after you have supplied brake fluid, check whether the diaphragm is assembled as illustrated.

4 : Slide ring

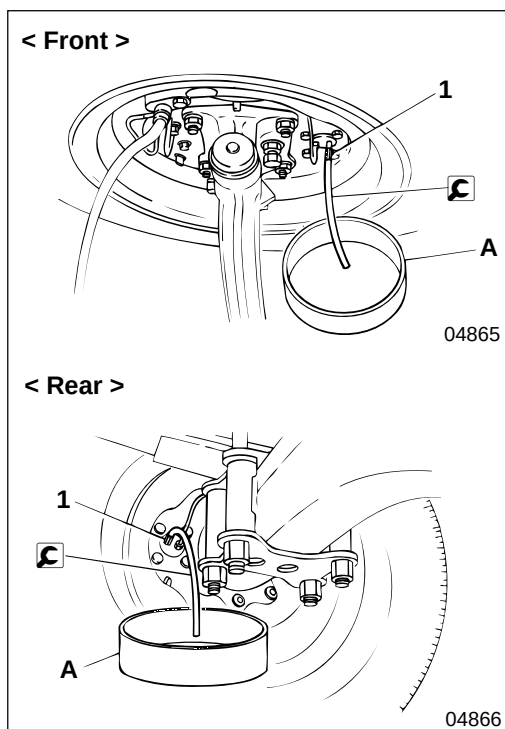
5 : Ring cover

A : Correct condition of diaphragm when brake fluid is being supplied

B : Condition when diaphragm is extended when brake fluid has decreased

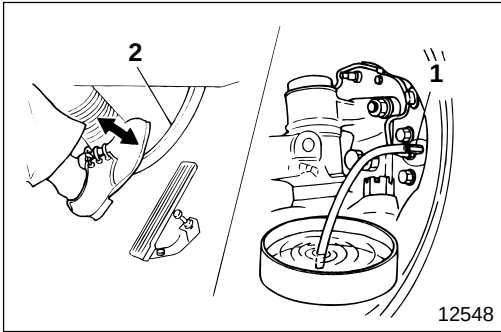
[Replacement]

- Start engine and let it idle until brake fluid replacement is completed.

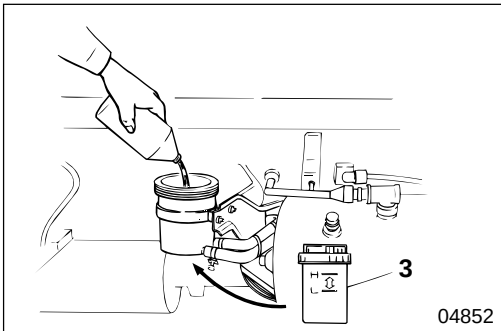


- Attach one end of  vinyl hose to air bleeder **1** and place the other end in container **A**.

LUBRICATION

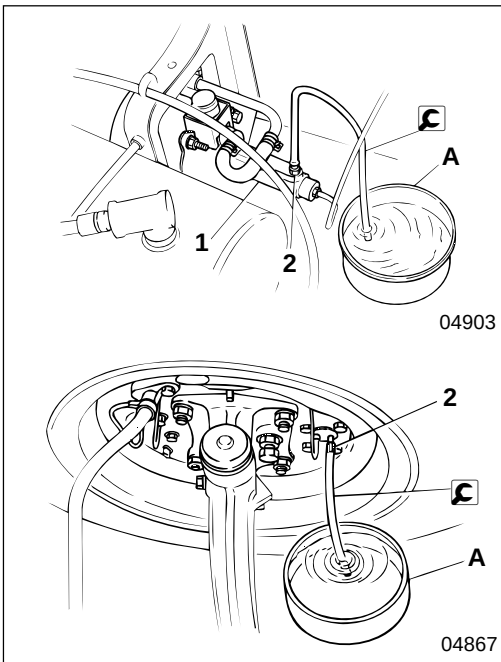


- Loosen air bleeders **1** and depress brake pedal **2** several times to drain brake fluid completely.



- Maintaining a supply of new brake fluid up to the "H" level of fluid tank **3**, depress the brake pedal repeatedly until the old brake fluid of the brake system is replaced with new fluid.
- Carry out air bleeding of the brake system.

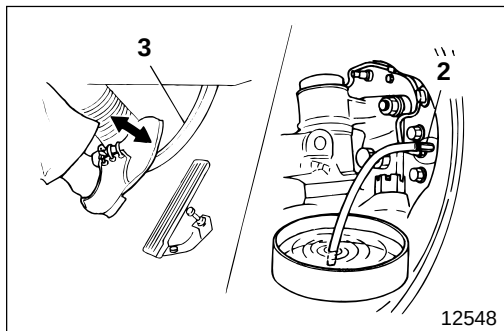
[Air bleeding]



- Start the engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to front or rear airmaster **1**. Then, attach one end of another vinyl hose to air bleeder **2** of the wheel brake. Finally, place both free ends in container **A** filled with brake fluid.

- Carry out air bleeding in the following sequence:

Front brake system	Rear brake system
	
Airmaster for front	Airmaster for rear
	
Right-hand side wheel brake	Right-hand side wheel brake
	
Left-hand side wheel brake	Left-hand side wheel brake

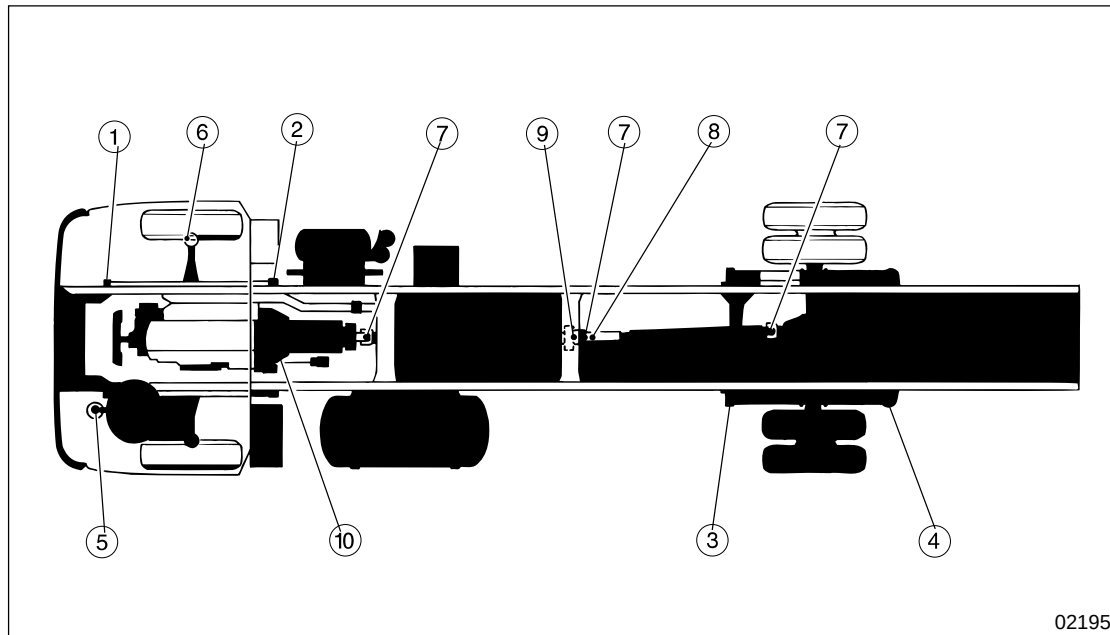


- Depress brake pedal **3** slowly a few times, and with the brake pedal depressed, loosen air bleeder **2** to drain brake fluid containing air.
- Tighten air bleeder **2**, and release brake pedal **3**.
- Repeat this service procedure until air is no longer present in the fluid being drained.
- Tighten air bleeder **2** at specified torque as soon as brake fluid flowing out is free of air bubbles.
- Adjust brake shoe clearance when you have finished air bleeding.
- Check that brake fluid comes up to level "H" of the fluid tank. If it does not, refill with new brake fluid.
- Depress brake pedal **3** a few times and check for any leakage of brake fluid, then test the brakes.
- When you test the brakes, if the brake warning lamp within the meter cluster lights, it means that air has not been bled completely. Redo air bleeding.

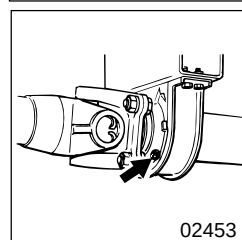
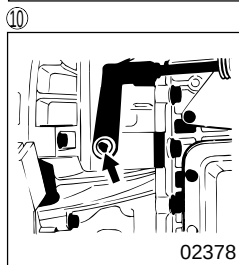
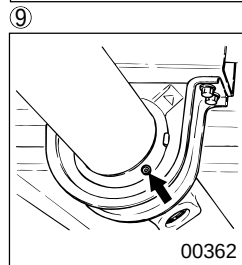
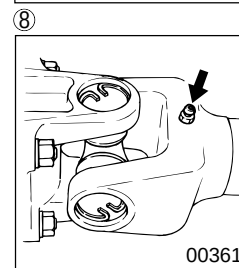
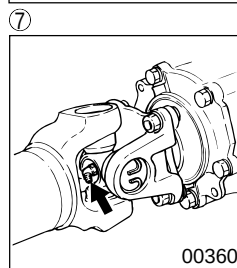
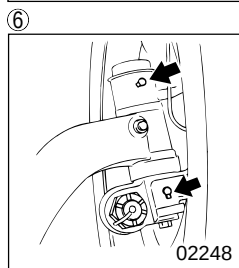
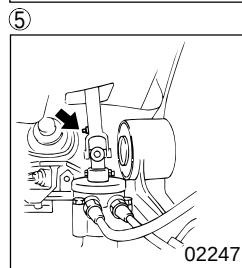
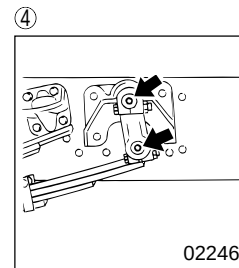
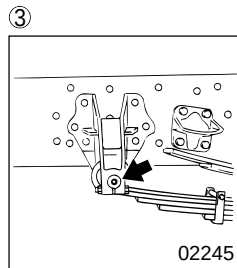
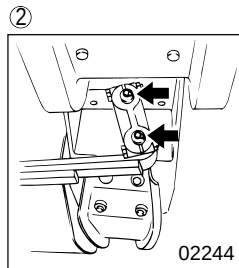
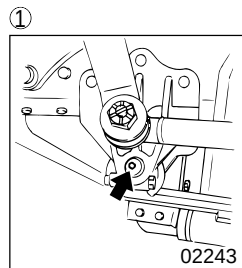
LUBRICATION

● Greasing Various Areas of Chassis

Carefully clean away all dust and dirt from the grease nipples, and use the specified type of grease. The areas to be greased are shown in the following illustration.

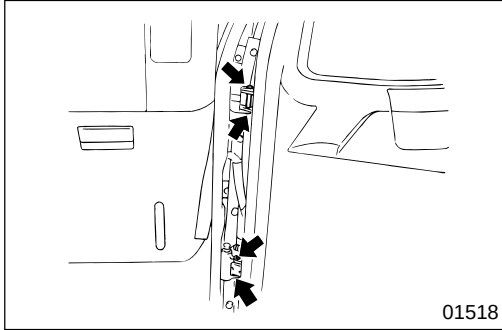


02195



- ① Front spring pin front (left and right, 2 points)
- ② Front spring pin rear (left and right, 4 points)
- ③ Rear spring pin front (left and right, 2 points)
- ④ Rear spring pin rear (left and right, 4 points)
- ⑤ Steering shaft
- ⑥ Kingpin bearing (left and right, 4 points)
- ⑦ Universal joint of propeller shaft
- ⑧ Slip joint of propeller shaft
- ⑨ Center bearing of propeller shaft
- ⑩ Clutch fork shaft (left and right, 2 points)

Supply grease to the center bearing until grease overflows from the escape valve at the back of the grease nipple.



● Door hinge



FH

Service Manual

Group 01

Maintenance Schedule

'98 Minor Change

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

MAINTENANCE SCHEDULE

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MAINTENANCE SCHEDULE TABLES	01- 3
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HOW TO READ THE MAINTENANCE SCHEDULE TABLES

Example Table :

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.
 *2 : 60000 km/36000 miles or 12 months, whichever occurs first.
 (E) : Exhaust emission items
 (N) : Noise control items

Inspection and maintenance (1)		Time of inspection and maintenance (2)					Working procedures (3)	Remarks (4)
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
ENGINE								
1	Air, fuel, oil or coolant leakage from engine			×			Check engine for air, fuel, oil and coolant leakage	 Gr 11, 12, 13, 14
2	Ⓔ Ⓝ Engine starting performance, speed, noise and exhaust gas conditions			×			Check for engine starting performance, idling speed, abnormal engine noise, dark smoke or other abnormal exhaust gas during idling and acceleration. Check engine speed on tachometer	 Gr 11, 13, 15
3	Retightening of inlet and exhaust manifold bolts					×	Check manifold bolts for looseness	 Gr 15
4	Ⓔ Valve clearance		×			×	Check valve clearance with feeler gauge	 Gr 11
5				Every 20000 km /12000 miles			Replace element	

- (1) This column contains the maintenance and inspection items.
- (2) The periods between inspection and service are based on the assumption that the vehicle will be driven approximately 60000 kilometers (36000 miles) per year.
Inspections which must be made are indicated by an "x" or by the appropriate period between servicing.
- (3) This column provides a simplified explanation of the operational procedures involved for each inspection or maintenance item.
- (4) The Gr. No. refers to the "group number" in this vehicle Service Manual. For visual checks and simple inspections, see the sections labelled "Working Procedures".

MAINTENANCE SCHEDULE TABLES

01

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

(E) : Exhaust emission items

(N) : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks	
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval					
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2			
ENGINE									
1	Air, fuel, oil or coolant leakage from engine			×			Check engine for air, fuel, oil and coolant leakage	Gr 11, 12, 13, 14	
2	Ⓔ Ⓝ Engine starting performance, speed, noise and exhaust gas conditions			×			Check for engine starting performance, idling speed, abnormal engine noise, dark smoke or other abnormal exhaust gas during idling and acceleration. Check engine speed on tachometer	Gr 11, 13, 15	
3	Retightening of inlet and exhaust manifold bolts					×	Check manifold bolts for looseness	Gr 15	
4	Ⓔ Valve clearance		×			×	Check valve clearance with feeler gauge	Gr 11	
5	Ⓔ Oil filter replacement			Every 20000 km/ 12000 miles On new vehicles, replace the first filter at 10000 km/6000 miles			Replace element	Gr 12	
6	Ⓔ Ⓝ Check injection nozzles			Every 90000 km/ 54000 miles			Check injection nozzles	Gr 13	
7	Ⓔ Ⓝ Fuel injection pressure and spray pattern of injection nozzles			Every 250000 km/ 150000 miles			Remove injection nozzle and check with nozzle tester	Gr 13	
8	Ⓔ Ⓝ Fuel injection timing					×	Turn crankshaft in normal running direction and check injection starting timing of No.1 cylinder	Gr 13	
9	Ⓔ Cleaning fuel feed pump filter					×	Remove connector from fuel feed pump inlet and clean filter inside connector with gas oil		
10	Ⓔ Fuel filter replacement				×		Replace element	Gr 13	
11	Ⓔ Water separator water discharge	×					Loosen water separator drain plug to discharge water	Gr 13	
12	Ⓔ Removal of water and sediment from fuel tank			Every 24 months			Remove fuel tank drain plug and remove water and sediment	Gr 13	
13	Retightening of fuel tank bracket bolts			×			Check mounting bolts for looseness and retighten to a torque of 34 to 54 N·m {25 to 40 lbf.ft, 3.5 to 5.5 kgf·m}	Gr 13	
14	Ⓔ Replacing fuel line in engine compartment			Every 24 months			Replace fuel line in engine compartment	Gr 13	
15	Ⓔ Check fuel line outside of engine compartment			Every 24 months			Check fuel line outside of engine compartment. Replace if necessary	Gr 13	
16	Ⓔ Ⓝ V-belt tension and damage	×		×			Press midpoint of V-belt firmly with your finger to measure deflection and check for belt damage	Gr 14	
17	Coolant level and leakage from cooling system	×					Check coolant level and if level is low, check for coolant leakage	Gr 14	
18	Coolant replacement			Every 24 months			Replace with new coolant	Gr 14	
19	Installed condition of surge tank cap			×			Check surge tank cap for sealing and mounting condition	Gr 14	
20	Ⓔ Cooling system hose clamp position and clamping condition			×			Check clamp position and clamping condition of cooling system hose	Gr 14	
21	Ⓔ Turbocharger rotor play			Every 250000 km/ 150000 miles			Check whether rotor has excessive end play using a dial indicator	Gr 15	
22	Ⓔ Ⓝ Cleaning of air cleaner	×					Check air cleaner dust indicator. If the red signal appears, clean the element	Gr 15	
23	Ⓔ Ⓝ Air cleaner element replacement			Every 50000 km/ 30000 miles			Replace element	Gr 15	
24	Ⓔ Ⓝ Damage of inlet system, looseness of clamp and loss of parts			×			Check inlet system for damage and check that all parts are installed	Gr 15	
25	Ⓝ Looseness and damage of exhaust pipe and muffler			×			Check installation and connections for looseness and damage, check for exhaust gas leakage	Gr 15	
26	Starter function					×	Operate starter switch and check the switch functions properly	Gr 54	
27	Alternator function					×	Check function with a circuit tester	Gr 54	

MAINTENANCE SCHEDULE TABLES

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

Ⓔ : Exhaust emission items

Ⓔ : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
POWER TRAIN								
28	Oil leakage from power train			×			Check power train for oil leakage	
29	Clutch pedal play			×			Press clutch lightly and check that play is adequate	Gr 21
30	Clutch function			×			(1) Press the clutch pedal to check for unusual noise or stiffness. Also check if gearshift engages quietly (2) Check the clutch does not slip and engages smoothly	Gr 21
31	Manual transmission gearshift control looseness				×		In NEUTRAL position, check shift lever for looseness. With shift lever in each gear position, check engagement condition and degree of looseness. Also check if control cable is damaged	Gr 22
32	Automatic transmission range selector linkage and throttle (modulator) linkage condition				×		Shifting to each shift range must be done firmly and securely	Gr 23
33	Propeller shaft couplings and bearings looseness		×	×			(1) Check flange yoke bolt and center bearing attaching bolt for looseness (2) Turn propeller shaft manually to check for spline looseness (3) Check looseness between spider and needle roller bearing	Gr 25
FRONT AND REAR AXLES								
34	Axle shaft torsion and cracks					×	Remove axle shaft and check for torsion, bending, and cracks	Gr 27
35	Front wheel hub bearing looseness				×		With front axle jacked up, move the wheel up and down holding the top and bottom of the tire to check for bearing looseness	Gr 26
36	Rear wheel hub bearing damage					×	Disassemble rear wheel and check for hub bearing wear and damage	Gr 27
37	Retightening wheel nuts		×	×			Check wheel nuts for looseness after replacing tires, also after 1000 km/600 miles	Gr 31
38	Disc wheel damage			×			Check disc wheel for corrosion, deformation and cracks	Gr 31
39	Tire inflation pressure, cracking, tread groove depth, abnormal wear, etc.	×		×			(1) Measure inflation pressure with tire gauge, and check that tire tread groove is deep enough (2) Check tire tread and side walls for cracks, damage, uneven wear, stepped wear and other abnormal wear	Gr 31
40	Tire rotation			×			Rotate all tires	Gr 31
SUSPENSION SYSTEM								
41	Looseness, play and damage of suspension system				×		Check suspension system for looseness, play and damage	Gr 33, 34
42	Damage and looseness of leaf springs	×			×		Check leaf springs for damage and looseness	Gr 33, 34
43	Retightening U-bolts		×		×		Check U-bolts for looseness	Gr 33, 34
44	Oil leakage and damage of shock absorbers				×		Check for oil leakage and damage of cylinder, etc.	Gr 33, 34
BRAKING SYSTEM								
45	Fluid leakage from braking system and power steering system			×			Check braking system and power steering system for fluid leakage	Gr 35, 37
46	Looseness, play and damage of braking system parts			×			Check braking system parts for looseness, play and damage	Gr 35
47	Brake pedal play and stroke	×		×			Depress the brake pedal lightly and check that play is not as specified. While the engine is idling, fully depress the brake pedal and check the distance between pedal and floor	Gr 35
48	Brake booster (hydraulic booster) emergency pump	×					With the engine stopped, depress the brake pedal and check the operating sound of the emergency pump	Gr 35

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

Ⓔ : Exhaust emission items

Ⓖ : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles ⁺¹	Every 60000 km/ 36000 miles ⁺²		
49	Service brake effectiveness	×		×			While driving the vehicle at low speed, check braking effect and check for uneven braking	 Gr 35
50	Operation of exhaust brake	×		×			Check exhaust brake operation	 Gr 35
51	Exhaust brake vacuum chamber diaphragm replacement			Every 12 months			Check exhaust brake vacuum chamber diaphragm; replace if necessary	 Gr 35
52	Brake shoe clearance				×		Measure clearance with feeler gauge	 Gr 35
53	Brake lining wear				×		Check lining wear	 Gr 35
54	Brake drum wear					×	Disassemble and check drum for wear, cracks and damage	 Gr 35
55	Parking brake effectiveness			×			On a slope, check that vehicle can be held stationary	 Gr 36
56	Parking brake lever stroke	×		×			With lever fully pulled, check that lever is locked completely and that there is allowance in pulling stroke	 Gr 36
57	Parking brake drum and lining wear					×	Disassemble and check drum for wear, cracks and damage and check lining for wear	 Gr 36
58	Wheel cylinder piston cup and dust seal replacement			Every 12 months			Check wheel cylinder piston cup and dust seal; replace if necessary	 Gr 35
59	Brake hose replacement			Every 12 months			Check brake hose; replace if necessary	 Gr 35
60	Brake fluid reservoir tank tube replacement			Every 24 months			Check and replace brake fluid reservoir tank tube	 Gr 35
STEERING SYSTEM								
61	Fluid leakage from steering system			×			Check steering system for fluid leakage	 Gr 37
62	Steering wheel play	×		×			Turn steering wheel right and left to measure play at steering wheel rim. Measure while engine is running	 Gr 37
63	Steering operating condition	×		×			Check steering wheel to see if it vibrates, pulls to one side or requires unusual steering effort	 Gr 37
64	Looseness and play of steering system (including hoses and pipes)			×			(1) Check steering system for looseness and play (2) Check power steering hoses and pipes for looseness	 Gr 37
65	Wheel alignment					×	Measure toe-in, camber, caster and kingpin inclination angles	 Gr 26
66	Right and left turning angles and power steering function					×	Check that stopper bolt is sufficiently tight, without damage, and that steering linkage operates smoothly until blocked by stopper bolt. Also check that steering wheel does not make contact with other parts	 Gr 26
67	Power steering booster and oil pump internal rubber parts replacement			Every 48 months			Replace internal rubber parts	 Gr 37
68	Power steering hose replacement			Every 48 months			Replace power steering hose	 Gr 37
CAB AND FRAME								
69	Looseness and damage of chassis and body			×			(1) Check frame, cross members and other parts for loose rivets (2) Also check for body damage and loose mounting bolts	 Gr 41, 42
70	Heater and defroster operation			×			Check operation and installation of defroster	 Gr 55
71	Reflection of rearview mirrors and reflectors	×					Check for reflecting condition, stains and damage	 Gr 42
72	Door lock function			×			Check door lock mechanism functions properly	 Gr 42
73	Seat belt mounting condition			×			Check seat belt for damage, buckle and retracting function and mounting condition	 Gr 42
ELECTRICAL SYSTEM								
74	Looseness and damage of electrical wiring and connections			×			Check wiring, connectors and battery terminals for looseness and corrosion	 Gr 54

MAINTENANCE SCHEDULE TABLES

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

Ⓔ : Exhaust emission items

Ⓔ : Noise control items

Inspection and maintenance		Time of inspection and maintenance					Working procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
75	Battery electrolyte level and specific gravity			Every 20000 km/ 12000 miles			(1) Check electrolyte level (2) Measure electrolyte specific gravity with hydrometer	 Gr 54
76	Operation and damage of lighting system	×		×			Check operation, damage and installation of each lighting unit	 Gr 54
77	Operation of horn and turn signal lamps	×		×			Check operation, damage and mounting condition. Also check turn signal lamps are operated by turn signal switch	 Gr 54
78	Operation and fluid level of windshield wiper and washer	×		×			Check operation, damage and mounting condition. Check if fluid level in washer tank is okay	 Gr 42
79	Gauges and pilot lamps function	×		×			Check function of gauges and pilot lamps	 Gr 54
80	Switch function					×	Check operation, damage and installation of each switch	 Gr 54
OTHER								
81	Road test of vehicle			×			Drive the vehicle to check for overall vehicle operating condition	

MAINTENANCE OPERATIONS

01

This section explains simple maintenance procedures. See the relevant Group in this manual for further details.

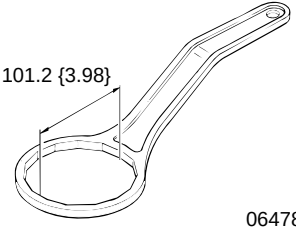
Replacement of Oil Filter

Lubricant

Location	Points of application	Specified lubricant	Quantity
2	Inside oil filter	Engine oil	Approximately 1 L {1.1 qts}
	Gasket area of oil filter with thin application	Engine oil	As required

Special tools

Unit : mm {in.}

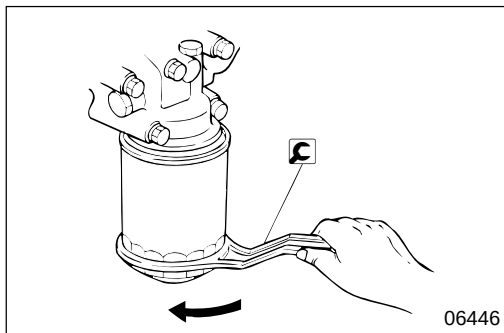
Location	Tool name and shape	Part No.	Application
2	Oil filter wrench 	MH061587	Removal of oil filter

WARNING

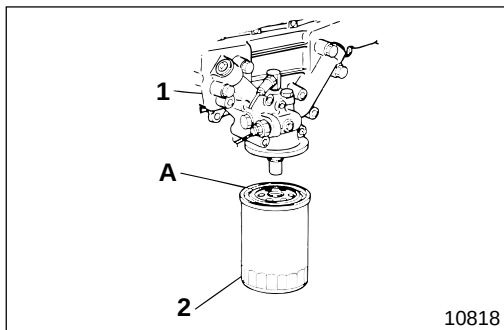
- Wipe up any engine oil that has been spilled because it can cause a fire.
- Do not touch the engine while it is hot because it will burn you.

CAUTION

Take care not to spill engine oil on the V-belts, because this would cause them to slip, reducing service life.



[Removal]



[Installation]

- Clean the surface of oil cooler body **1** that makes contact with oil filter **2**.
- Apply engine oil thinly and evenly to gasket area **A** of oil filter **2**.
- Screw oil filter **2** into oil cooler body **1** until gasket area **A** sits on the body. From this position, tighten further by rotating by three quarters of a turn.
- After installation, run the engine and check that there is no oil leakage from gasket area **A**.
- Check the oil level and if it is low, top it up.

MAINTENANCE OPERATIONS

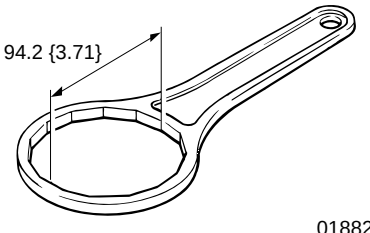
Replacement of Fuel Filter

Lubricant

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

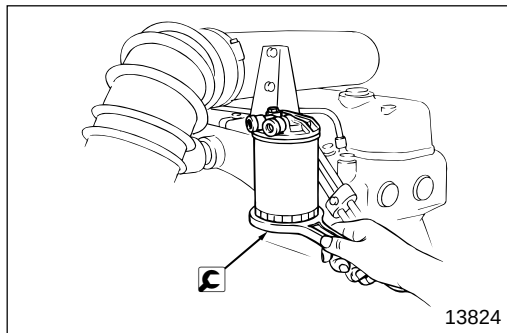
Special tools

Unit : mm {in.}

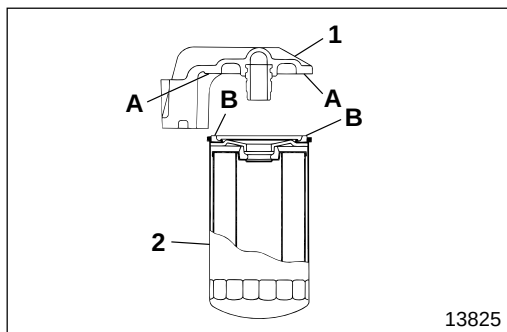
Location	Tool name and shape	Part No.	Application
2	 Filter wrench	MH061572	Removal of fuel filter

WARNING

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any diesel fuel that has been spilled because it can cause a fire.
- Do not use an unsuitable filter because it can cause a fire.



[Removal]



[Installation]

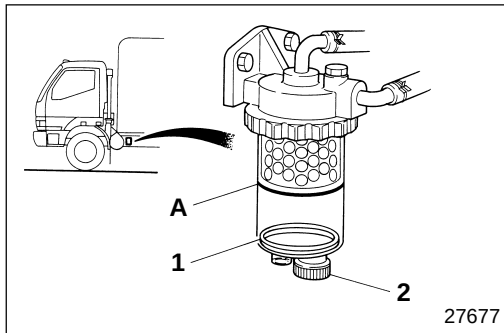
- Install by tightening three quarters to one full turn after contact surface **A** of fuel filter head **1** makes contact with gasket **B** of fuel filter **2**. Be sure to tighten by hand.
- After installation, run the engine and check for fuel leakage.

Draining of Water Separator Condensation

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Drain plug	3 to 4 {2.2 to 2.9, 0.3 to 0.4}	—



Visually inspect the water separator before driving.

When float **1** reaches red line **A**, drain the condensation as follows:

- Loosen drain plug **2** and drain out the condensation.
- When float **1** has dropped to the bottom, tighten drain plug **2**.
- Carefully wipe the water separator and the surrounding area.
- Check for fuel leakage.

Cleaning of Fuel Feed Pump Gauze Filter

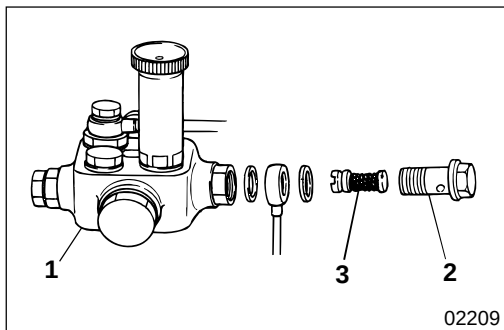
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Eye bolt	25 to 29 {18 to 22, 2.5 to 3}	—

WARNING

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any diesel fuel that has been spilled because it can cause a fire.



- Remove eye bolt **2** on the inlet side of fuel feed pump **1**.
- Remove gauze filter **3** from eye bolt **2**.
- Clean gauze filter **3** with gas oil.
- Follow the removal sequence in reverse and reinstall gauze filter **3**.
- Install eye bolt **2** in the fuel feed pump.
- Bleed the air from the fuel line.
- Start the engine and check for fuel leakage.

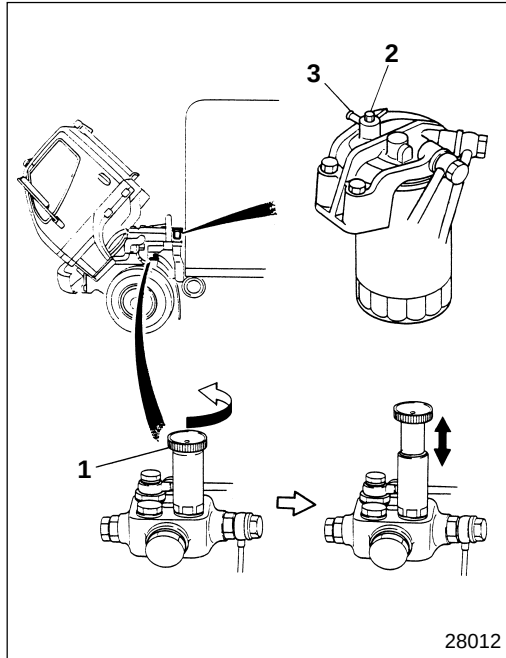
MAINTENANCE OPERATIONS

Bleeding of Air from Fuel Line

Tightening torque

Unit : N·m {lb·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Air vent plug	7.8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—



WARNING

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any diesel fuel that has been spilled because it can cause a fire.

- Turn the top of priming pump 1 of the injection pump counterclockwise and pull it up so the top protrudes.
- Loosen air vent plug 2 of the fuel filter and move the top part of priming pump 1 up and down.
- Move priming pump 1 up and down repeatedly until air bubbles are no longer present in the fuel drained from air vent cock 3.
- When the fuel being drained is free of air bubbles, tighten air vent plug 2.
- After moving priming pump 1 up and down another five or six times, push the top down and turn clockwise tighten.
- After bleeding the air, carefully wipe up spilled fuel and start the engine.
- Check for fuel leakage.

Adjustment of V-Belt Tension

Newly installed V-belts can stretch during their initial running-in period. To prevent this from becoming a problem, run the engine for several minutes after installing the V-belt, then readjust. Perform this cycle several times.

WARNING

You must take special precautions to prevent the engine from rotating while a V-belt is being inspected or adjusted.

CAUTION

- Make sure that you turn off the engine before attempting to inspect or adjust the V-belts.
- Make sure that you fasten all bolts and nuts securely after adjusting the V-belts. Remember that too much tension can damage the V-belts and bearings.
- Do not grease V-belts. This causes them to slip, which reduce service life.

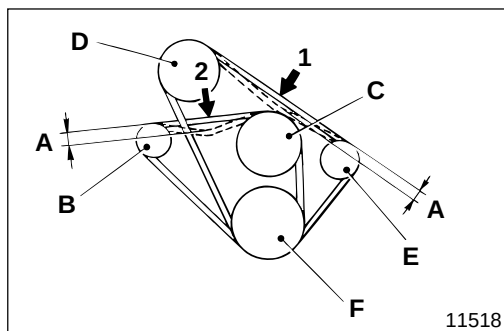
Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
1, 2	V-belt tension (Each one)	Fan	12 to 16 {0.47 to 0.63}	—	Adjust
		Air-conditioner	16 to 20 {0.63 to 0.79}		

Special tools

Location	Tool name and shape	Part No.	Application
1, 2	Belt tension gauge  03612	MH062345	Measurement of tension of V-belt

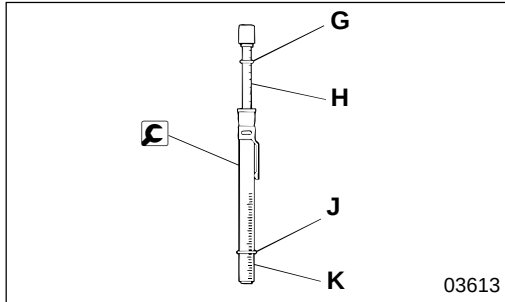


[Inspection]

Measure the extent of flex **A** when the center of V-belts **1, 2** as illustrated is depressed with a force of 98 N·m {72 lbf.ft, 10 kgf·m}.

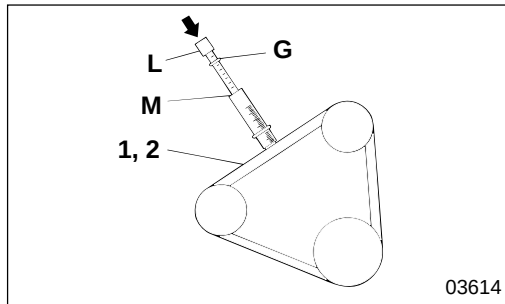
- B** : Alternator pulley
- C** : Water pump pulley
- D** : Cooler compressor pulley (Air-conditioner)
- E** : Tension pulley
- F** : Crankshaft pulley

MAINTENANCE OPERATIONS

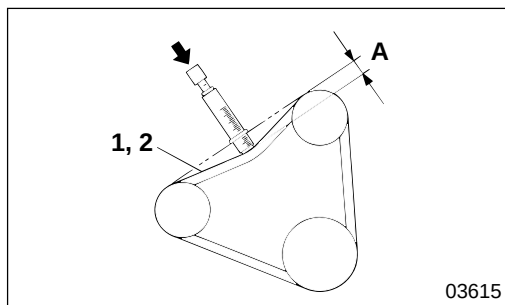


Use of special tool belt tension gauge

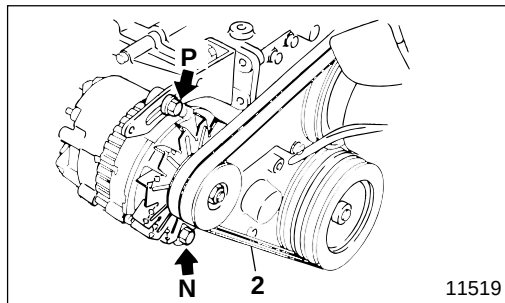
- Set upper O-ring **G** of belt tension gauge to 98 N·m {72 lbf.ft, 10 kgf·m} (push load) on graduation **H**.
- Set lower O-ring **J** of belt tension gauge to graduation **K** (maximum flex of belt).



- Place belt tension gauge at the center of V-belts **1, 2** perpendicularly as illustrated and push top **L** all the way down until upper O-ring **G** hits upper edge **M**.



- Measure the extent of flex **A** of V-belts **1, 2** at this point, and if the measured value deviates from the standard value, adjust as follows:



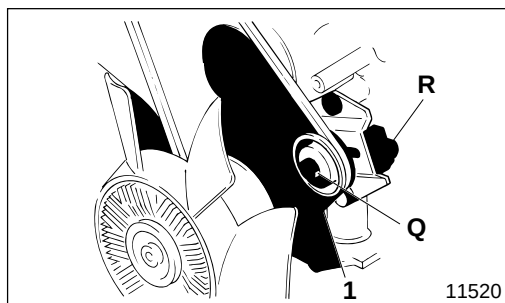
[Adjustment]

(1) Adjustment of tension of V-belt for fan

- Loosen alternator mounting bolts **N** (two points), and adjust the tension of V-belts **2** by moving adjusting bolt **P**.
- After adjustment, tighten the bolts **N, P** securely.

CAUTION

- Bear in mind that excessive tension of V-belts **2** might damage the belts and bearings that engage with the V-belts.
- Be sure to replace V-belts **2** as a set to maintain even tension between them.
- Be careful not to let oil stick to V-belts **2**. If oil gets onto the belts, it causes slipping, resulting in overheating and insufficient battery charging.



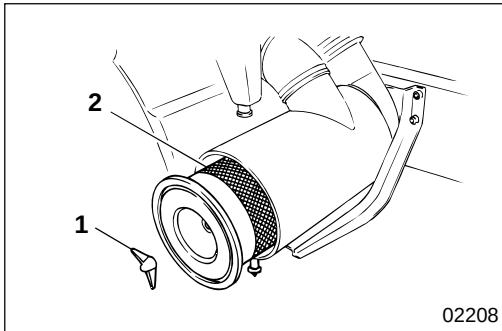
(2) Adjustment of tension of V-belt for air-conditioner

- Loosen tension pulley mounting nut **Q**, and adjust the tension of V-belt **1** moving adjusting bolt **R**.
- After adjustment, tighten mounting nut **Q** securely.

CAUTION

- Bear in mind that excessive tension of V-belt **1** might damage the belt and bearings that engage with the V-belt.
- Be careful not to let oil stick to V-belt **1**. If oil gets onto the belt, it causes slipping, resulting in poor performance of the air conditioner.

Cleaning and Replacement of Air Cleaner Element

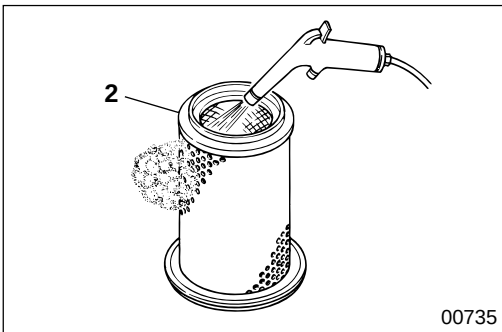


[Removal]

Remove wing nut **1** to remove element **2**.

[Installation]

Install element **2** securely.

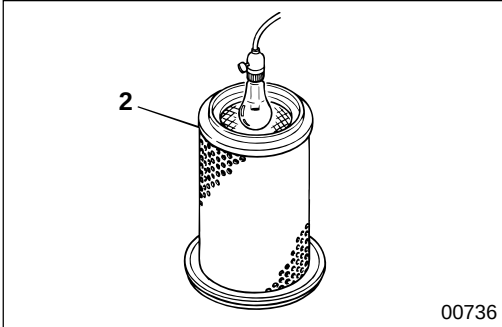


[Cleaning]

- Blow compressed air of 685 kPa {100 lbf/in², 7 kgf/cm²} or less through air cleaner element **2** from the inside.
- When using compressed air, move the blower's nozzle up and down along the pleats of air cleaner element **2** evenly.

CAUTION

- Do not tap or hit air cleaner element **2** to remove dust.
- Do not blow compressed air through air cleaner element **2** from the outside.



[Inspection]

- Illuminate the inside of air cleaner element **2**.
- If parts of the filter paper are torn or thin, or if the packing of the upper surface of air cleaner element **2** is damaged, replace the air cleaner element.

NOTE

If the dust on air cleaner element **2** is wet due to oil smoke or soot, replace the air cleaner regardless of the scheduled replacement interval.

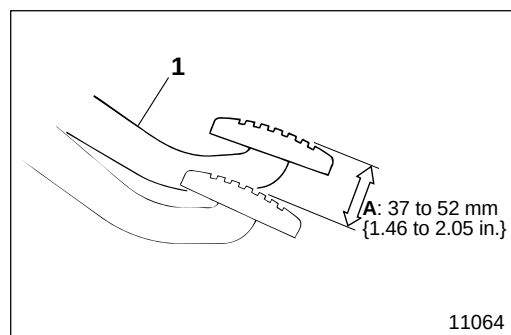
MAINTENANCE OPERATIONS

Inspection of Clutch Pedal Free Play

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Clutch pedal free play	37 to 52 {1.46 to 2.05}	—	Adjust or replace



[Confirmation]

Push clutch pedal **1** with your hand and measure the amount of movement **A** (free play) until you meet resistance. If the measured value does not conform to the standard value, adjust by stroke of clutch power cylinder push rod, or replace the clutch disc.

[Clutch operation]

- Check for unusual noises when clutch pedal **1** is pressed while the engine is idling, and also for abnormally heavy clutch operation. Also check to be certain that it is not difficult to shift the vehicle into first and reverse gears.
- Gradually release clutch pedal **1** to set the vehicle in motion. Check to be sure there is no slippage, and that the clutch engages smoothly.

Tire

Service standards

Unit : mm {in.}

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

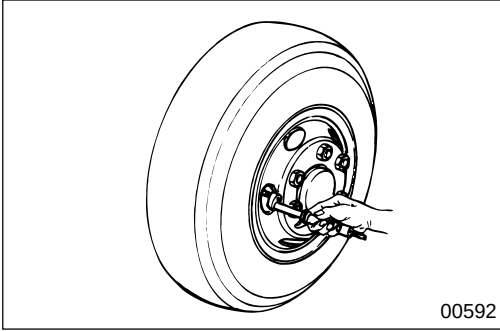
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Wheel nut	370 to 410 {275 to 305, 38 to 42}	Wet

Lubricant

Location	Points of application	Specified lubricant	Quantity
2	Wheel nut spherical area	Chassis grease [NLGI No.1 (Ca soap)] or Wheel bearing grease [NLGI No.1 (Li soap)]	As required
4	Wheel nut (inner) at thread area and spherical area		
6	Thread area of hub bolt		



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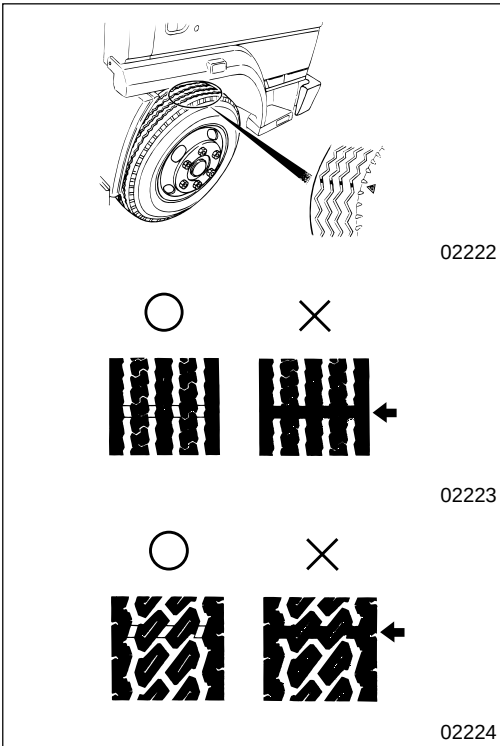
Air pressure

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

Tire Size	Air Pressure kPa {Psi, kgf/cm ² }
215/75R 17.5 124/123L	700 {100, 7.00}

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.



02222

02223

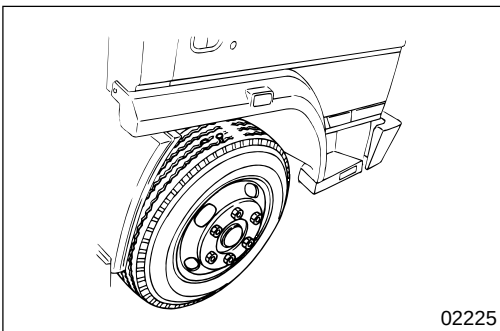
02224

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.



02225

Checking for cracks, damage, and objects embedded in the treads

- Check the tire treads and walls for cracks and damage.
- Check tire treads for uneven wear or other abnormal wear.
- Check if metal objects or nails have penetrated the tires.
- Check for stones embedded between double tires.

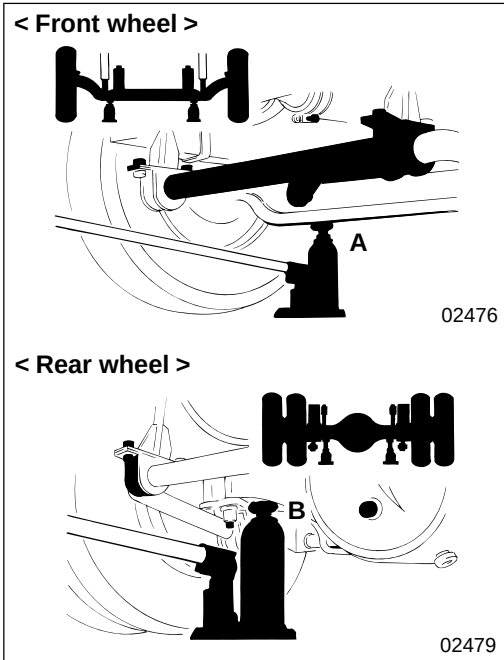
WARNING

Badly damaged or worn tires are extremely dangerous, because they can be punctured more easily when the vehicle is running, they must be replaced with new ones as soon as possible.

MAINTENANCE OPERATIONS

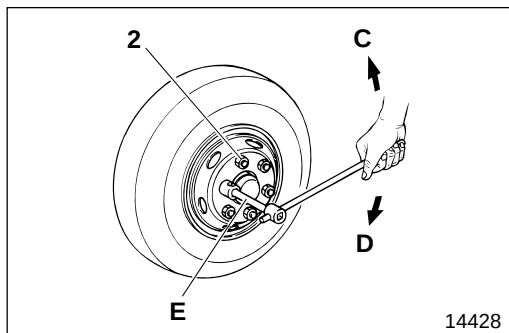
Removing tires

- Jacking up point
 - For front wheels : Front axle bottom A
 - For rear wheels : Rear axle tube bottom B



WARNING

- The jack should be placed on flat, solid ground, and should not be used to raise the vehicle higher than necessary.
- Do not use the jack at vehicle locations other than those illustrated.
- Keep in mind the danger of a slipping jack. Never crawl under the vehicle while the jack is in use or rock the vehicle. Also, do not start the engine while the vehicle is jacked up.
- To increase safety, use supports for the vehicle when it is necessary to leave it jacked up for long periods.
- Chock both the tire to be removed and the tire diagonally opposite to it so that they will not rotate when you are removing the tire.



- Loosen wheel nuts **2** slightly. The wheel nuts for right tires **C** have right-hand threads "R", and the wheel nuts for left tires **D** have left-hand threads "L".

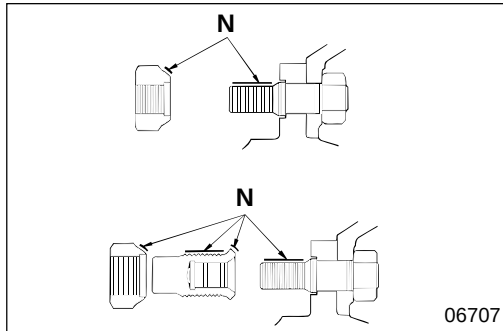
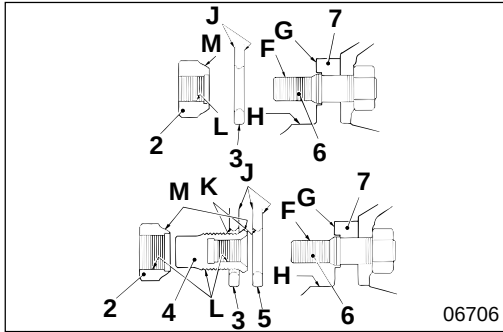
WARNING

Make certain that wheel nut wrench **E** is fully engaged, all the way to the back of nuts **2**. If it is not, it could slip.

CAUTION

Only loosen wheel nuts **2** slightly. Do not remove them.

- Jack up the vehicle carefully, until the tire is slightly off the ground. Remove wheel nuts **2**, then remove the tire.
- When working on the double tires at the rear of the vehicle, first remove the outside tire, then lower the vehicle and loosen the nuts on the inside tire. After doing this, jack the vehicle back up and remove the tire.



Mounting tires

- To prevent wheel nuts **2, 4** and hub bolt **6** from becoming loose and to prevent mounting parts (tire assemblies **3, 5** and hub **7**) from being damaged, remove rust, dust, additional coatings of paint, and foreign particles from the following areas:

F : Hub bolt thread area

G : Wheel mounting surface of hub

H : Wheel alignment area of hub

J : Disc wheel mating surface

K : Disc wheel nut mounting surface

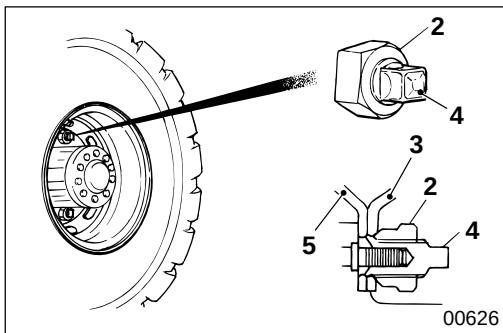
L : Wheel nut thread area

M : Wheel nut spherical area

N : Grease application area

WARNING

Never use grease containing molybdenum disulfide, since it can cause loosening of fitted screws.



- Put on the double rear tires as follows:

- After mounting inner tire **5** and fully tightening inner wheel nuts **4**, jack the vehicle up and mount on outer tire **3**, then tighten outer wheel nuts **2**.
- Even if only outside tire **3** is to be changed, do not mount it until inner wheel nuts **4** have been fastened at the specified torque.
- Slide the air valves on the inside and outside tires down when mounting the tires.

WARNING

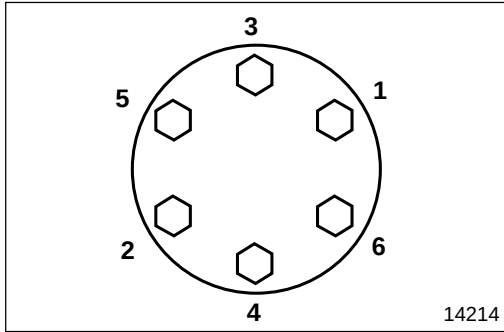
If the threads are scored, or the disc wheel is deformed or cracked, change bolts **6**, nuts **2, 4** and disc. Driving the truck before correcting such problems can cause the tire in question to come loose, which could be the source of major accidents.

CAUTION

Check hub bolt **6** threads carefully for scratches before putting the tire on.

- Place the tapered end of wheel nuts **2, 4** towards the disc wheel and fasten temporarily. Center so that there is no eccentricity between bolts **6** and the disc wheel bolt holes.
- Lower the vehicle.

MAINTENANCE OPERATIONS



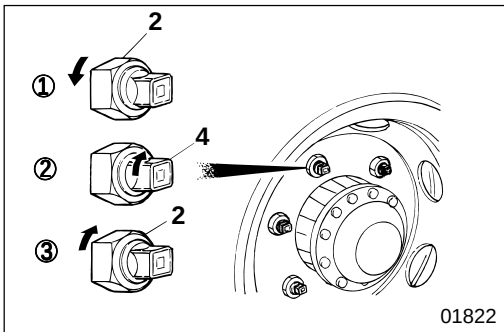
- Tighten the nuts in the order as illustrated, tightening each nut two or three times. To finish, tighten each nut at the specified torque.

WARNING

Always use the specified torque when tightening the wheel nuts. If the wheel nuts are not tightened properly, the wheels could come loose while the vehicle is being driven, which could result in life threatening accidents or the truck being disabled.

CAUTION

Over-tightening the wheel nuts can damage them.



Checking the wheel nuts for looseness

The wheel nuts should be checked for looseness every 10000 km (6000 miles). All nuts should be tightened at the specified torque.

- Check the double rear tires for looseness as follows:

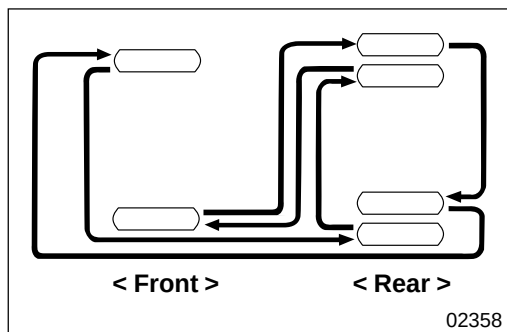
- ① Loosen outer wheel nuts 2.
- ② Tighten inner wheel nuts 4 at specified torque.
- ③ Tighten outer wheel nuts 2 at specified torque.

CAUTION

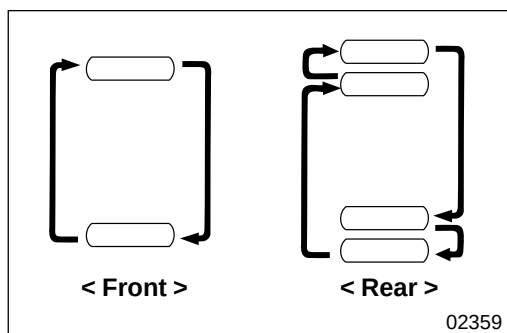
If outer wheel nuts 2 are tightened without first being loosened, it might not be possible to tighten them at the specified torque.

Tire rotation

Tires wear differently, according to the location where they are mounted. To make this wear uniform and prolong the life of your tires, they should be rotated every 10000 km (6000 miles) in the rotation order shown below:



- When the tread patterns for all tires are identical:



- When the tread patterns are different for the front and rear tires:

CAUTION

- Always adjust air pressure after running-in new tires.
- When using tires of different tread patterns, use rib-type patterns for the front tires and traction type patterns for the rear tires.
- Avoid using both radial and biased tires on the same vehicle.

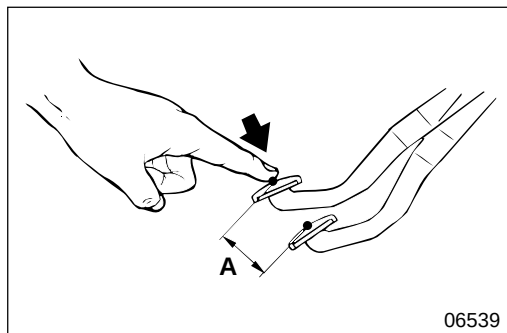
MAINTENANCE OPERATIONS

Inspection of Brake Pedal Free Play

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Free play of brake pedal	10 to 15 {0.39 to 0.59}	—	Adjust



[Inspection]

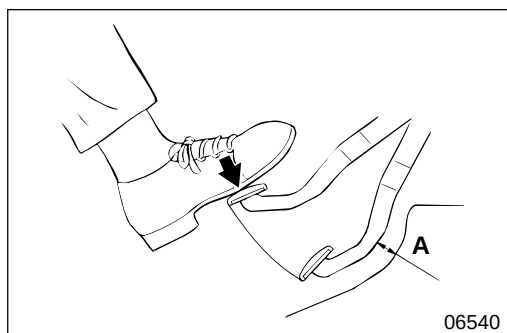
Check if brake pedal free play **A** confirms to the standard value with starter switch OFF. If the measured value deviates from the standard value, adjust the position of the brake pedal.

Inspection of Clearance between Brake Pedal and Floor Panel

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Clearance between brake pedal and floor panel (with pedal depressed at 490 N {110 lbf, 50 kgf})	52 {2.05} or more	—	Adjust



[Inspection]

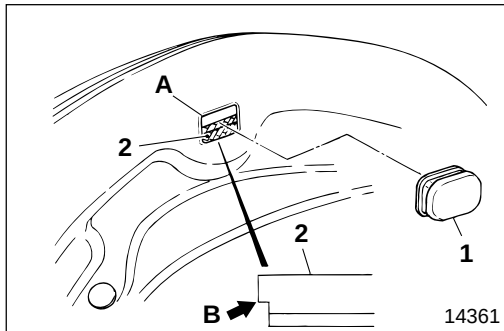
Depress the brake pedal using 490 N {110 lbf, 50 kgf} when the engine is idling to check if clearance **A** between the brake pedal and the floor panel conforms to the standard value. If the measured value deviates from the standard value, adjust the position of the brake pedal.

Inspection of Brake Lining Thickness

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Thickness of brake lining	—	5 {0.20} (Wear limit at side step)	Replace



NOTE

Be sure to inspect at two points for each wheel per side.

- Remove check hole plug **1** from the packing plate.
- Inspect through check hole **A** whether brake lining **2** is worn to the point of side shoulder **B** of the brake lining (the limit).
- If the measured value is lower than the limit, replace brake lining **2** on the same axle as a unit.
- After inspection, be sure to reinstall check hole plug **1**.

Battery

DANGER ⚠

- Since flammable hydrogen gas is generated by the battery, be sure to obey the following warnings :
 - Do not short-circuit the $\oplus$ and $\ominus$ terminals on the battery.
 - Keep sparks and lit cigarettes away from the battery.
 - Do not wear metal objects on your arms and lean over the battery.
- Because the battery electrolyte is diluted sulfuric acid and is corrosive, when handling the battery wear safety glasses and rubber gloves to protect the eyes and hands.

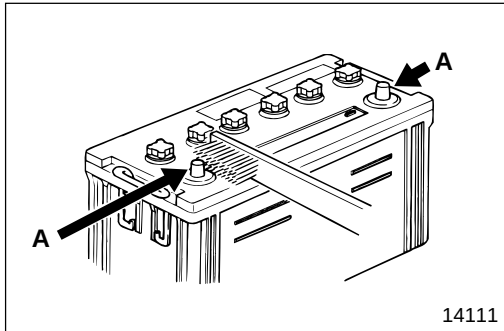
WARNING ⚠

To prevent a short-circuit be sure that disconnected the battery cables do not accidentally touch the battery terminals.

CAUTION ⚠

- Make sure that you disconnect the battery cable $\ominus$ first when you disconnect the battery cables.
- Make sure that all electrical switches of the vehicle are OFF before connecting the battery cables.
- Make sure that you connect the battery cable $\oplus$ before you connect the battery cable $\ominus$.

MAINTENANCE OPERATIONS

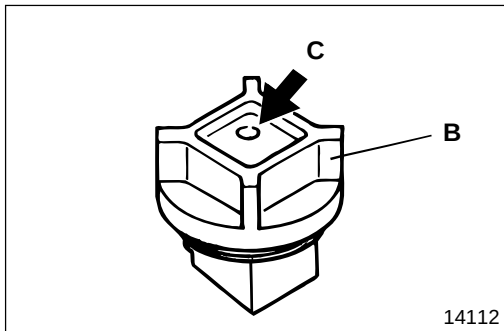


Visual inspection

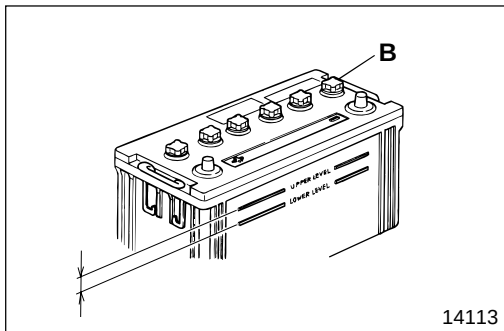
- If terminal **A** is corroded, scrub off the corrosion from it using a wire brush.
- If cracks or defects are found on the battery, replace it since the cracks or defects can cause liquid spills.

CAUTION

Make sure you grease the ⊕ side of terminal **A** because it is easily corroded.

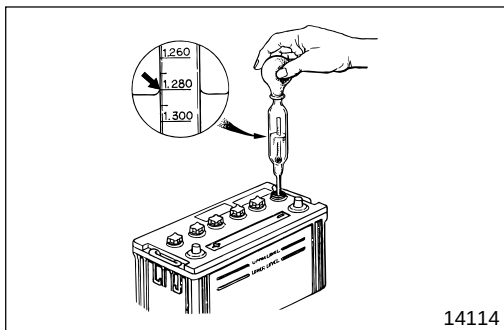


- If bleed hole **C** of vent plug **B** is clogged, clean the hole.



Inspection of fluid level

- Make sure that the battery electrolyte level is between UPPER and LOWER.
- If the level is below LOWER, remove vent plug **B** and fill the battery with distilled water or battery replenisher to UPPER.



Measurement of specific gravity

Measure the specific gravity of the battery electrolyte. If the measured value is lower than the limit, charge the battery.

NOTE

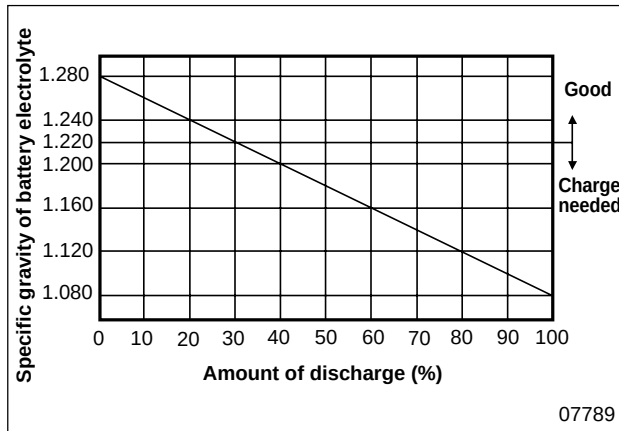
The specific gravity of the battery electrolyte depends on the liquid temperature. Use the following formula to convert the actual value to the value were the temperature 20°C {68°F}.

$$S_{20} \{68\} = S_t + 0.0007 (t - 20 \{68\})$$

$S_{20} \{68\}$: Specific gravity were the temperature 20°C {68°F}

S_t : Specific gravity actually measured with the temperature at t°C {t°F}

t : Temperature of battery electrolyte



Charging

- Although, as a rule, charging of the battery should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect the battery cable ⊖.
- Remove vent plug **B** before charging the battery.
- 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	$\frac{\text{*Amount of discharge (Ah)}}{\text{Charge current (A)}} \times 1.2 \text{ (to 1.5)}$	45 {113}
	10		
Quick charge	Value of 5-hour rating capacity	0.5	55 {131}
	1.5		

$$\text{* Amount of discharge (Ah)} = \frac{\text{5-hour rating capacity (Ah)} \times \text{Amount of discharge (\%)}}{100}$$

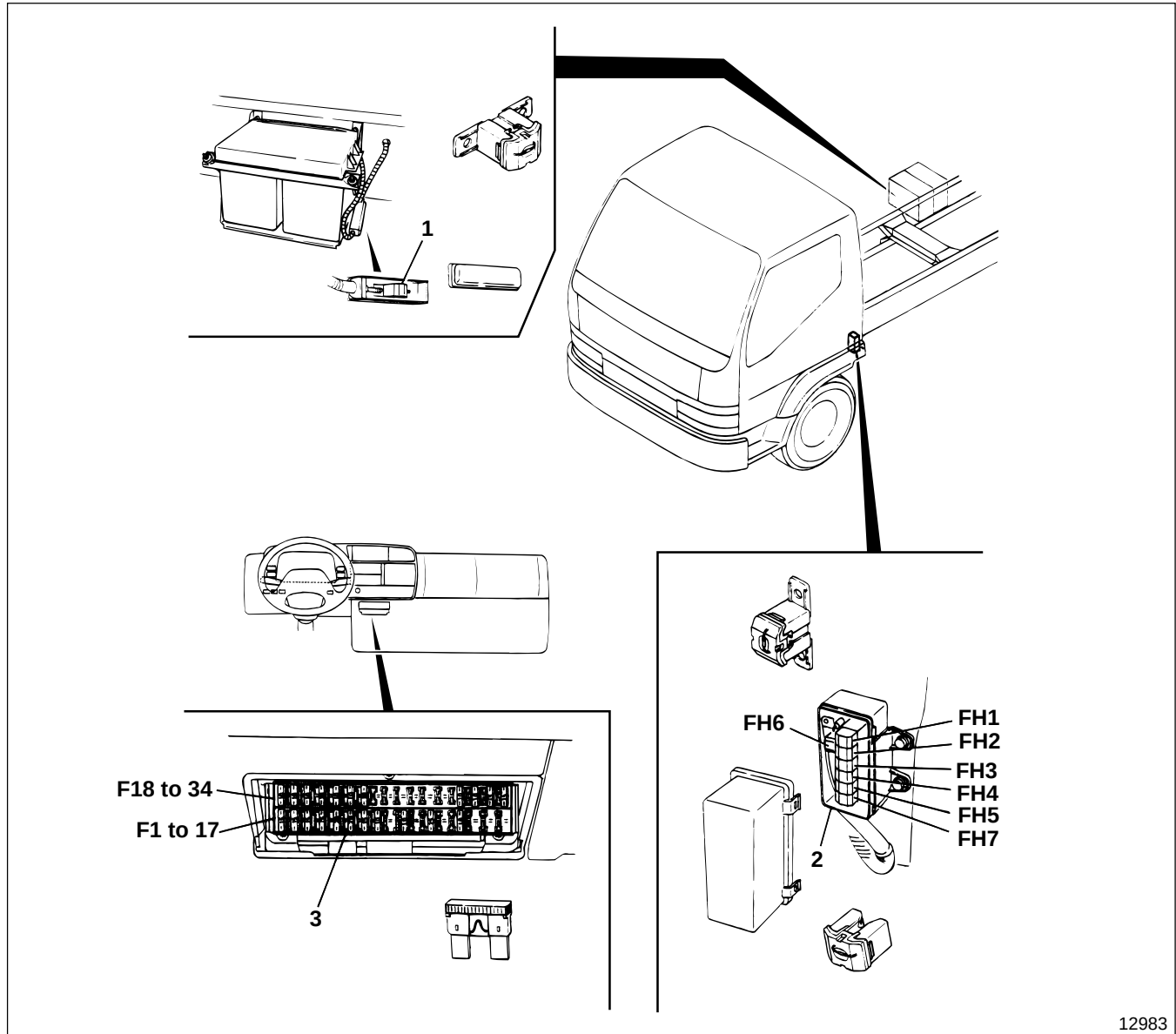
- Use the graph shown on the left to calculate the amount of discharge (%).
- Use diluted sulfuric acid, made up of sulfuric acid and refined or distilled water, as the battery electrolyte.
- The specific gravity of fully-charged battery electrolyte is 1.280 with the temperature at 20°C {68°F}.

DANGER ⚠

- Do not let the battery electrolyte level rise and overflow while charging the battery.
- Keep naked lights away from the battery while charging it or it might explode.
- Be careful not to generate sparks while charging the battery because its dangerous.
- After charging the battery, tighten vent plug **B**, wash away sulfuric acid from the battery using water, and dry the surface.

MAINTENANCE OPERATIONS

Fuse



12983

- 1 Main high-current fuse
- 2 High-current fuse box
- 3 Fuse box

CAUTION

- If a fuse blows, make sure you identify and remedy the cause, then replace the fuse.
- Make sure that you replace the fuse with one having the same rating.
- Make sure that you remove the $\ominus$ terminal of the battery cable before removing main high-current fuse 1 and high-current fuses FH1 to 7.

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	120 A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50 A
FH2	Fuse box (F5 to F8, F11)	40 A
FH3	Brake booster (Hydraulic booster)	50 A
FH4	Starter switch (Terminal B)	50 A
FH5	Glow relay	50 A
FH6	Alternator	120 A
FH7	Fuse box (F31 to F34)	40 A

Fuse box

Fuse No.	Main load	Capacity
F1	Headlamp, LH	15 A
F2	Headlamp, RH	15 A
F3	Stop lamp, horn	15 A
F4	Turn signal lamp	15 A
F5	Fuel-cut motor	10 A
F6	Cab lamp	10 A
F7	Reserve power (BATT)	10 A
F8	A/T fluid cooler fan relay	—
F9	—	—
F10	—	—
F11	Reserve power (BATT)	10 A
F12	—	—
F13	* Cigarette lighter	15 A
F14	Radio	10 A
F15	Reserve power (ACC)	—
F16	—	10 A
F17	Fuel-cut relay	10 A

Fuse No.	Main load	Capacity
F18	Starter	10 A
F19	Backup lamp	10 A
F20	Meter cluster	10 A
F21	Wiper	10 A
F22	—	—
F23	—	—
F24	—	—
F25	—	—
F26	—	—
F27	Exhaust brake < M/T >	10 A
F28	Transmission PTO	10 A
F29	Pre-stroke cut relay	15 A
F30	* Air-conditioner control	10 A
F31	* Air-conditioner compressor	10 A
F32	* Condenser fan	15 A
F33	Blower fan	25 A
F34	Tail lamp	15 A

* : Fuses are provided for these pieces of equipment only where they are installed.

PTO : Power take-off

A/T : Automatic transmission

M/T : Manual transmission

LUBRICATION

*1 : 30000 km/18000 miles or 6 months, whichever occurs first.

*2 : 60000 km/36000 miles or 12 months, whichever occurs first.

(E) : Exhaust emission items

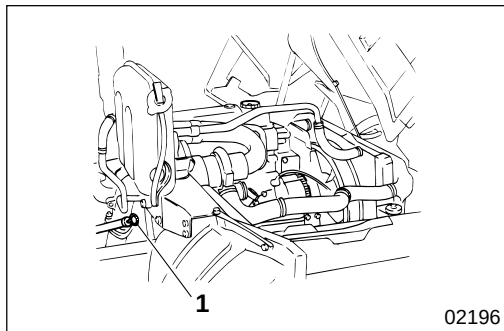
Inspection and maintenance		Time of inspection and maintenance					Lubrication procedures	Remarks
		Pre-operation checks	New vehicle at 4000 km/2500 miles	Inspection interval				
				Every 10000 km/ 6000 miles	Every 30000 km/ 18000 miles *1	Every 60000 km/ 36000 miles *2		
1	Ⓔ Engine oil contamination and oil level	×					Engine oil API classification CD, CD/SF, CE, CE/SF or CF-4 Over 30°C {86°F} SAE 40 40 to −5°C {104 to 23°F} SAE 30 15 to -15°C {59 to 5°F} SAE 20W-20 Over -15°C {5°F} SAE 15W-40 Below 0°C {32°F} SAE 10W-30	📦 Gr 12
	Ⓔ Engine oil replacement		×	×				
2	Brake fluid tank fluid level	×		×			Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	📦 Gr 21, 35
	Brake fluid tank fluid replacement					×		
3	Lubrication of clutch fork shaft				×		Wheel bearing grease [NLGI No.2 (Li soap)]	📦 Gr 21
4	Lubrication of clutch shifter			When replacing clutch disc assembly				
5	Manual transmission oil level			×			Gear oil, API classification GL-3 SAE 80 (General) GL-3 SAE 90 (Warm region) GL-4 SAE 90 (Tropical region) Engine oil Long period of high-speed driving API classification CC or CC/SF SAE 30 or SAE 40	📦 Gr 22
	Manual transmission oil replacement		×		×			
6	Automatic transmission fluid level			×			Automatic transmission fluid (DEXRON, DEXRON II type)	📦 Gr 23
	Automatic transmission fluid and filter replacement			Every 40000 km/ 25000 miles Replace the fluid at the first 10000 km/6000 miles inspection				
7	Axle housing gear oil level			×			Gear oil API classification GL-5 Below 40°C {104°F} SAE 90 Over 40°C {104°F} SAE 140 Use SAE 140 when operating vehicle at high load such as continuous ascent on slopes and when the outside temperature is 10°C {50°F} or more	📦 Gr 27
	Axle housing gear oil replacement		×			×		
8	Hub bearing grease and oil seal replacement					×	Wheel bearing grease [NLGI No.2 (Li soap)]	📦 Gr 26, 27
9	Power steering fluid level			×			Automatic transmission fluid (DEXRON, DEXRON II type)	📦 Gr 37
	Power steering fluid replacement					×		
10	Lubrication of propeller shaft (universal joint, slip joint, center bearing)			×			Wheel bearing [NLGI No.2 (Li soap)]	📦 Gr 25
11	Lubrication of kingpins			×			Chassis grease [NLGI No.1 (Ca soap)]	📦 Gr 26
12	Lubrication of all chassis parts			×				

Engine Oil

Tightening torque

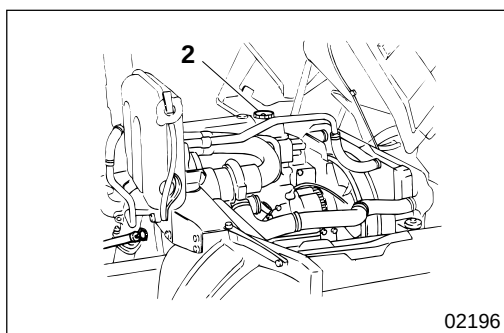
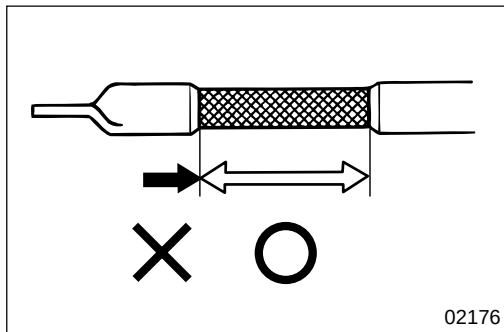
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Oil pan drain plug	69 {51, 7}	—



[Inspection]

- Pull out dipstick **1**, wipe off the oil with a cloth.
- Reinsert dipstick **1**, then pull it out carefully.
- Oil level is correct if there is oil sticking to dipstick **1** within the hatched area.
- If the level is low, top it up.
- Tilt the cab.



[Replenishment]

- Clean the area surrounding oil filler cap **2** and prevent dust from entering through the filler.
- Remove oil filler cap **2** and top up with engine oil.
- Wait five minutes before checking the oil level.
- Replace filler cap **2**.

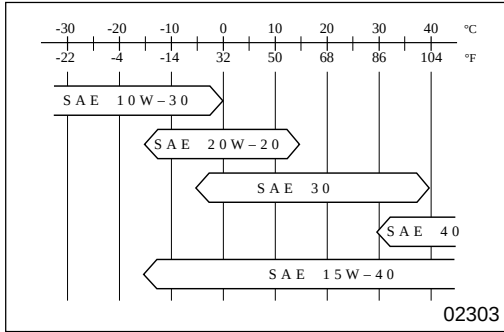
WARNING

- Wipe up any engine oil that has been spilled because it can cause a fire.
- Do not touch the engine while it is hot as it will burn you.

CAUTION

Take care not to spill engine oil on the V-belts, because this would cause them to slip, reducing service life.

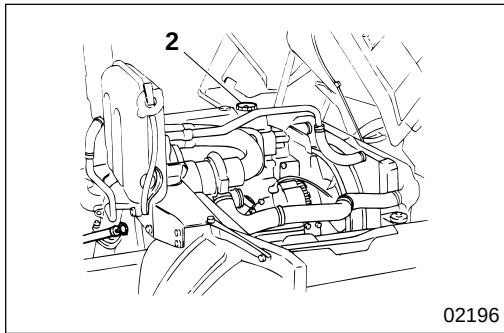
LUBRICATION



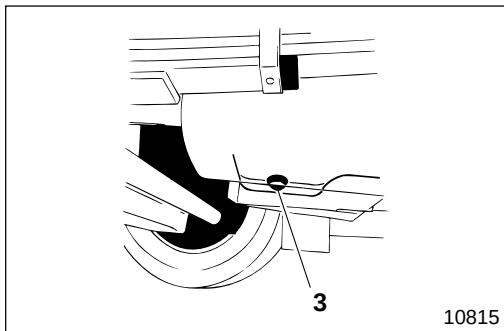
[Replacement]

Since engine oil greatly influences the performance, the life expectancy, and the ability to start the engine, use only oil of the specified grade and viscosity.

The chart illustrates the relationship between oil viscosity and the ambient air temperature.



- Clean the area surrounding oil filler cap **2** and prevent dust from entering through the filler.
- Remove oil filler cap **2**.
- Remove oil pan drain plug **3**, and drain the oil. At the same time replace the oil filter.
- After reinstalling drain plug **3**, slowly add engine oil through the oil filler.
- Using the dipstick, check the oil level after more than six minutes have passed.
- Start the engine and let it idle. When the oil has reached all parts, stop the engine. Let 30 minutes pass before checking the oil level again.



Clutch Fluid (Brake Fluid)

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Air bleeder	25 to 34 {18 to 25, 2.5 to 3.5}	—

Fluid

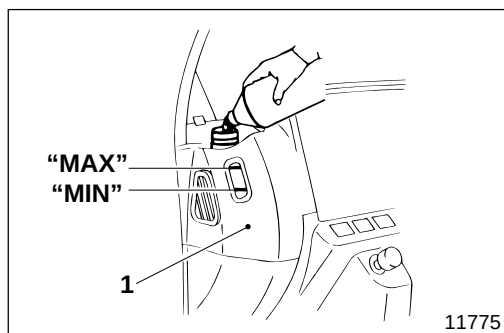
Location	Points of application	Specified fluid	Quantity
1	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

WARNING

- The clutch fluid system and the brake fluid system use the fluid tank in common.
- You must use new brake fluid (SAE J1703f or FMVSS No.116 DOT3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system and brake system to swell, resulting in faulty clutch operation, as well as ineffective braking and brake dragging.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will result in ineffective clutch and brake operations.
- If you use a mug for adding brake fluid, keep it solely for that purpose.

CAUTION

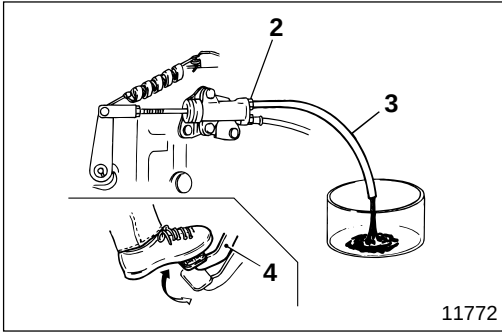
- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.



[Inspection and replenishment]

- Inspect the level of the brake fluid in fluid tank 1. It should fall between the "MAX" and "MIN" levels.
- If it is below the "MIN" level, lift up the lid flap and remove the cap from fluid tank 1, then supply the specified brake fluid until the level has come up to the "MAX" level. Do not fill above the "MAX" level.

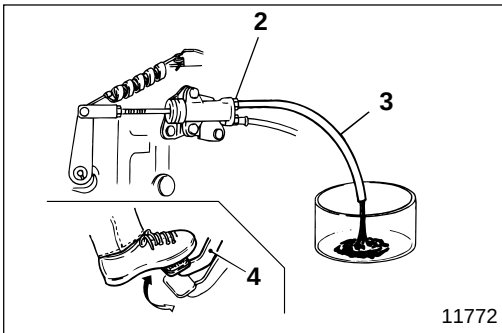
LUBRICATION



[Replacement]

- Attach vinyl pipe **3** to air bleeder **2** of the clutch power cylinder.
- Loosen air bleeder **2** and depress clutch pedal **4** several times to drain brake fluid completely.

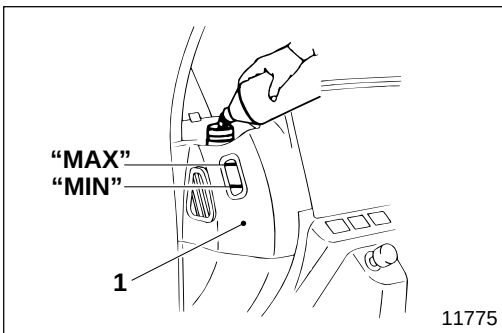
- Supply new brake fluid to the “**MAX**” level of fluid tank **1**. Depress clutch pedal **4** repeatedly until the old brake fluid discharged from vinyl pipe **3** is replaced by the new brake fluid.



NOTE

Carry out this operation maintaining the brake fluid level in fluid tank **1** between “**MAX**” and “**MIN**”.

- Attach vinyl pipe **3** to air bleeder **2** of the clutch power cylinder as in the replacement procedure.
- Fill fluid tank **1** with brake fluid, and loosen air bleeder **2** of the clutch power cylinder then depress clutch pedal **4** continuously.
- Keep depressing clutch pedal **4**, and tighten air bleeder **2** when air is bled completely.
- Depress clutch pedal **4** several times again, then keep it depressed at its fullest extent.
- With clutch pedal **4** depressed, loosen air bleeder **2** to drain brake fluid containing air. Release the pedal after tightening the air bleeder.
- Repeat this operation until air is no longer present in the fluid being drained.
- When this operation is completed, tighten air bleeder **2** at specified torque.
- Check that brake fluid is at the “**MAX**” level of fluid tank **1**, and supply new brake fluid if necessary.
- Check for brake fluid leakage from each of the parts with clutch pedal **4** depressed.



Manual Transmission Gear Oil

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

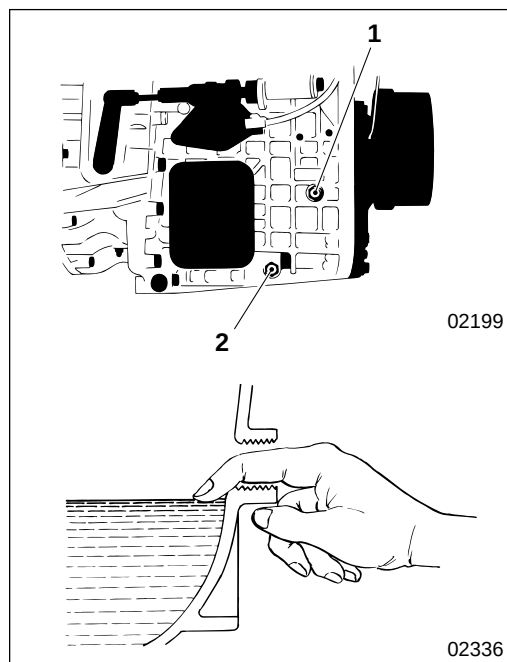
Location	Parts to be tightened	Tightening torque	Remarks
1	Inspection plug	69±15 {51±11, 7±1.5}	—
2	Drain plug	69±15 {51±11, 7±1.5}	—

Sealant

Location	Points of application	Specified sealant	Quantity
1	Thread area of inspection plug	THREEBOND 1105D	As required
2	Thread area of drain plug	THREEBOND 1105D	As required

WARNING

The engine is hot immediately after the vehicle stopped, so take care not to burn yourself.



[Inspection and replenishment]

- Remove inspection plug **1** and check whether the oil level is up to the edge of the entrance.
- If the level is low, add oil through the inspection plug hole until the level comes up to the edge of the entrance.

[Replacement]

- Drain the oil after removing inspection plug **1** and drain plug **2**.
- Remove any metal particles sticking to the magnetic part of drain plug **2** before reinstalling the plug.
- Add oil through the inspection plug hole until the level comes up to the edge of the entrance.
- Insert inspection plug **1**.

LUBRICATION

Automatic Transmission Fluid and Oil Filter

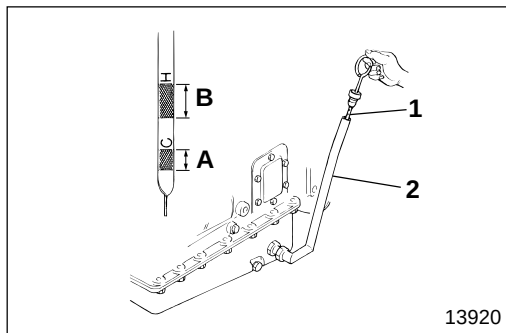
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Drain plug	20 to 27 {15 to 20, 2.05 to 2.75}	—
5	Dipstick guide connector	125 to 135 {91 to 100, 12.55 to 13.76}	—
6	Bolt (Oil pan mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—
8	Bolt (Oil filter mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—
12	Oil filter	9.8 to 20 {7 to 14, 1 to 2}	—

Fluid

Location	Points of application	Specified fluid	Quantity
11	Body of O-ring	Automatic transmission fluid (DEXRON or DEXRON II type)	As required
12	Gasket of oil filter with thin application	Automatic transmission fluid (DEXRON or DEXRON II type)	As required



[Inspection and replenishment]

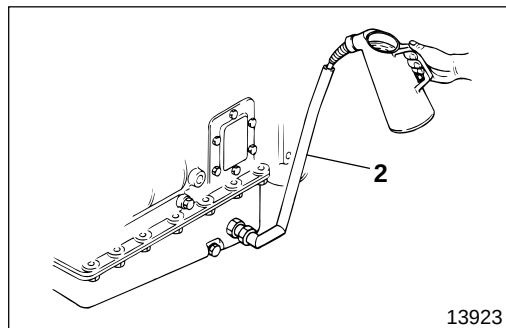
- Park the vehicle on level ground, make sure that the parking brake is fully activated and chock the wheels to keep them from rolling.
- Start the engine and let it idle. To fill the hydraulic circuit with automatic transmission fluid, shift the range selector lever from N → R → N → D → 2 → D → N. Repeat this process five times, finally shifting to N.
- While the engine is still idling, pull out dipstick **1** and wipe off the fluid sticking to it. Reinsert the dipstick, then pull it out again and check the fluid level.
- If the fluid level is inspected right after the engine is started and the fluid temperature is still low (approximately 15 to 49°C {60 to 120°F}), the level should be within area **A** marked COLD on dipstick **1**.
- If the fluid level is inspected after the vehicle has been driven and the fluid temperature is high (approximately 71 to 93°C {160 to 200°F}), the level should be within area **B** marked HOT on dipstick **1**.

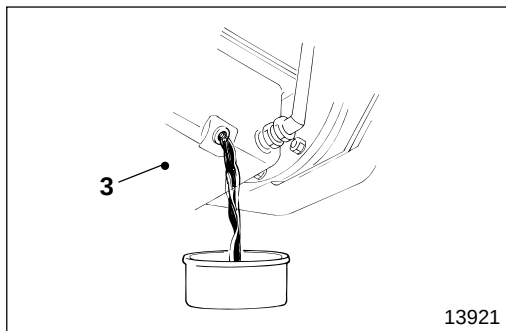
WARNING

Take care during the inspection because the engine will be running. Take sufficient care to avoid burns or injuries resulting from contact with moving parts.

NOTE

- Make sure the vehicle is parked on level ground when you are checking the fluid level.
- Make sure the range selector lever is in the N position and the engine is idling when you are checking the fluid level. When the engine is stopped, the fluid level appears higher than it actually is.
- Be sure to wipe off the dust from the safety cap and the upper part of dipstick guide **2** before you pull out dipstick **1**.
- To ensure the fluid is correct, reinspect the fluid level after an actual drive.
- If the fluid level is low, add automatic transmission fluid (DEXRON or DEXRON II type) through dipstick guide **2** until the correct level on dipstick **1** is reached.





[Replacement]

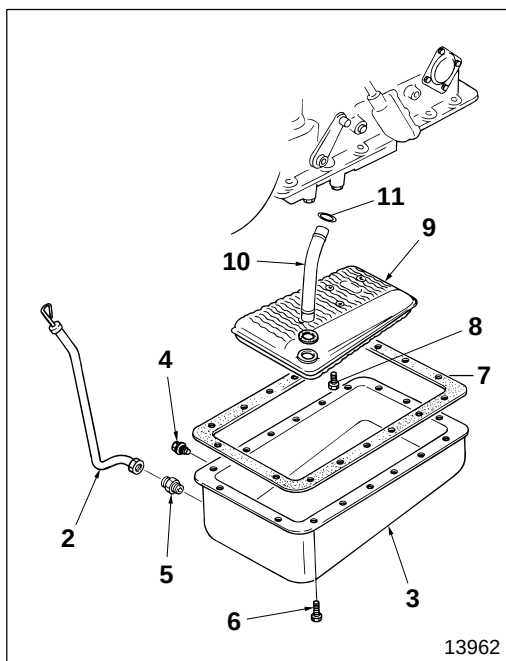
- Park the vehicle on level ground, chock the wheels and shift the range selector lever to the N position.
- Place a container under oil pan 3, remove drain plug 4 and drain the fluid.

WARNING ⚠

Take care because the fluid temperature immediately after the engine has stopped is very high. To avoid scalds, wait until a safe temperature has been reached before draining the fluid.

NOTE

- The fluid will drain faster if the engine is first run to raise the fluid temperature.
- The fluid cannot be drained from the hydraulic circuit, the torque converter or the oil cooler.
- Check the drained fluid for dirt, metal particles and metal fragments.



- Remove oil pan 3, intake pipe 10, O-ring 11, gasket 7 and oil filter 9.
- Clean oil pan 3.
- Replace O-ring 11, gasket 7 and oil filter 9.

2 : Dipstick guide

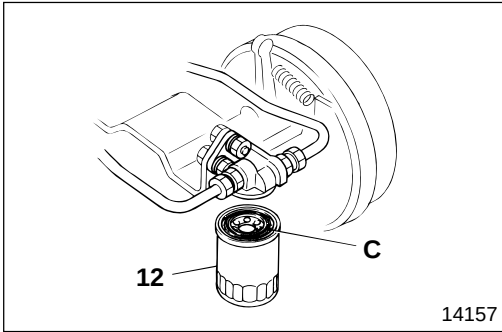
4 : Drain plug

5 : Dipstick guide connector

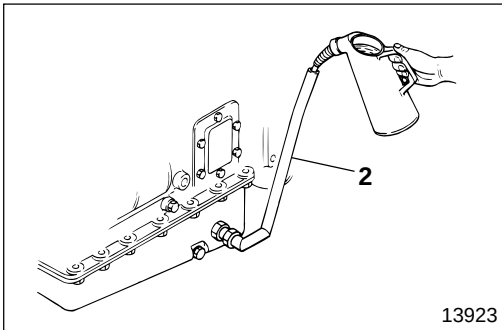
6 : Bolt

8 : Bolt

LUBRICATION



- Remove oil filter **12** (for oil cooler) by turning it counterclockwise.
- Lightly coat gasket **C** with the fluid before installing oil filter **12**. Then tighten the oil filter.



- Supply fluid through dipstick guide **2**.

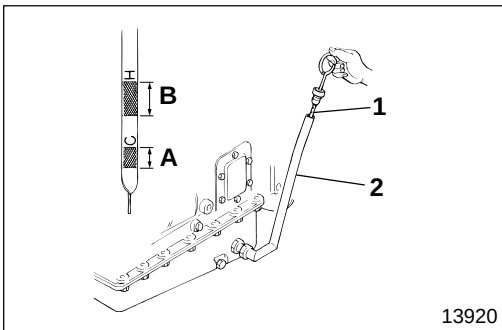
CAUTION

Make sure that dirt and foreign particles do not become mixed in with the fluid when it is added.

- Shift the range selector lever to the N position, start the engine and let it idle for about one minute.
- After shifting the lever through all positions once, shift it back to N position.

CAUTION

To prevent burning out the interior of the automatic transmission assembly, make sure that the engine is not allowed to race when you do the above.



- Check and adjust so that the fluid level is within the specified area on dipstick **1**.

NOTE

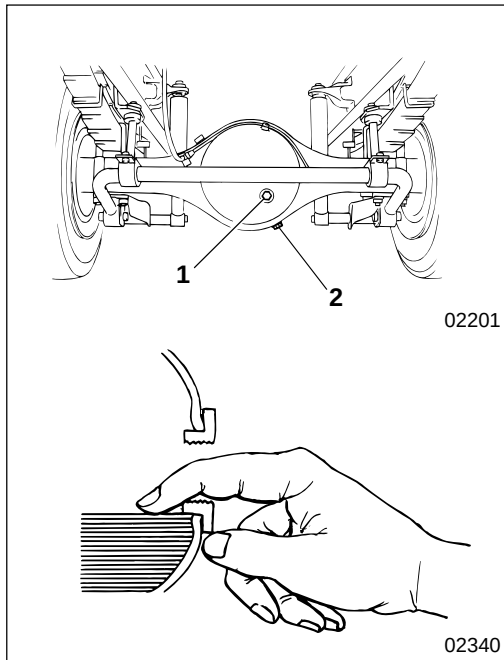
- As the temperature of the fluid rises, so does the fluid level. If you add fluid while the temperature is still low (approximately 15 to 49°C {60 to 120°F}), make sure that the level stays within area **A**, marked **COLD** on dipstick **1**.
- Let the engine idle and, while paying attention to the fluid level, pour in the fluid slowly.
- It is sometimes hard to check the fluid level, immediately after supplying fluid, because of the fluid adhering to the interior of dipstick guide **2**. If this is the case, check the fluid level several times at intervals.
- Be careful not to supply too much fluid because you might mistake the fluid that overflows from the air breather for fluid leakage.

Rear Axle Gear Oil

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}	—



[Inspection and replenishment]

WARNING ⚠

The oil temperature is high immediately after the vehicle stopped, so take care not to scald yourself.

- Remove inspection plug **1**, check the oil level and make sure it is up to the edge of the entrance.
- If the oil level is low, add oil through the inspection plug hole until the level comes up to the edge of the entrance.
- Insert inspection plug **1**.

[Replacement]

- Drain the oil after removing inspection plug **1** and drain plug **2**.
- Remove any metal particles sticking to the magnetic part of drain plug **2** before reinstalling the plug.
- Supply oil through the inspection plug hole until the level comes up to the edge of the entrance.
- Reinstall the inspection plug.

LUBRICATION

Power Steering Fluid

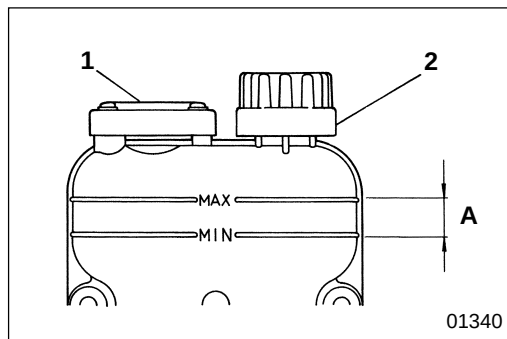
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Oil pipe	66.69±12.75 {49±9.4, 6.8±1.3}	—

Fluid

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



WARNING

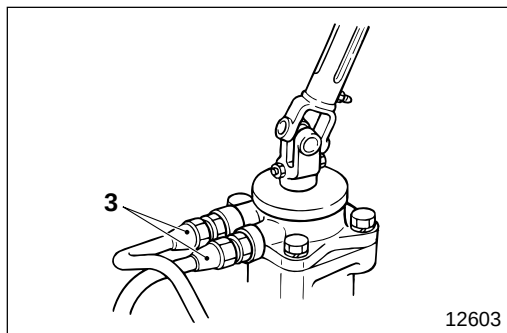
Because the brake booster (hydraulic booster) uses power steering fluid, do not let other fluids such as brake fluid, etc. get mixed with the power steering fluid inside the power steering oil tank.

[Inspection and replenishment]

- Straighten the front wheels and stop the engine.
- Inspect the level of the fluid in power steering oil tank 1. It should fall between fluid level range A.
- If it is below the "MIN" level, remove filler cap 2 from power steering oil tank 1, then supply the specified fluid until the level has come up to the "MAX" level. Do not fill above the "MAX" level.

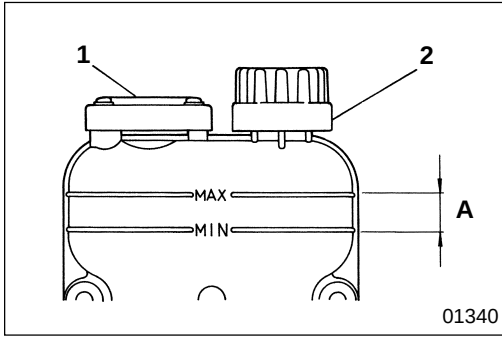
CAUTION

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



[Replacement]

- Drainage
 - Jack up the front wheels.
 - Disconnect oil pipe 3 connected to the power steering booster.
 - Turn the steering wheel fully left and right repeatedly, and drain the fluid from the power steering booster.
 - After draining the fluid, tighten oil pipe 3 at specified torque.



[Supply]

- Supply fluid into power steering oil tank **1** up to filler cap **2**.
- With the engine stopped, jack up the front wheels and turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**.
- Start the engine and letting it idle, turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**. Repeat these steps until the fluid level does not drop.
- Depress the brake pedal fully several times repeatedly, until as in the case of the steering wheel, the fluid level does not drop anymore. (The steering wheel at such time does not need to be operated)
- If there is an abnormal noise, air is still in the system. Turn the steering wheel several times, next depress the brake pedal several times to raise the fluid temperature to approximately 60 to 80°C {140 to 176°F}, then stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times to make sure there is no abnormal noise.
- With the engine stopped, depress the brake pedal several times, activate the brake booster (hydraulic booster) emergency pump and bleed air.
- When there is no abnormal noise after the above procedure has been performed, bleeding is completed. Check oil tank **1** fluid level, and pipe and hose connections for fluid leakage.
- After bleeding is completed, inspect brake booster (hydraulic booster) performance (input and output characteristics).  Gr 35

LUBRICATION

Brake Fluid

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

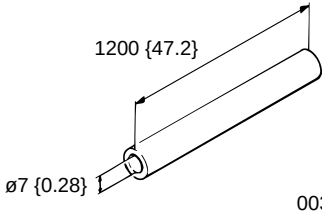
Location	Parts to be tightened	Tightening torque	Remarks
2	Air bleeder	7.8 to 12 {5.8 to 8.5, 0.8 to 1.2}	—

Fluid

Location	Points of application	Specified fluid	Quantity
1	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Vinyl hose 	MH033102	Air bleeding

WARNING

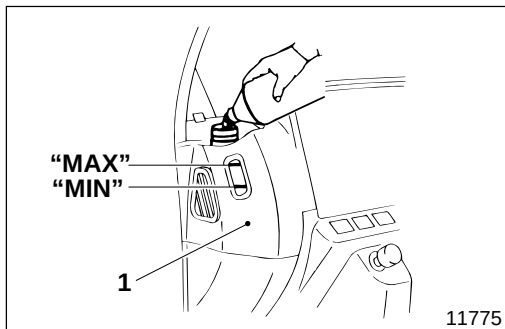
- The clutch fluid system and the brake fluid system use the fluid tank in common.
- You must use new brake fluid (SAE J1703f or FMVSS No.116 DOT3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system and brake system to swell, resulting in faulty clutch operation, as well as ineffective braking and brake dragging.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will result in ineffective clutch and brake operations.
- If you use a mug for adding brake fluid, keep it solely for that purpose.

CAUTION

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

NOTE

Supply and maintain brake fluid level to the "MAX" level of the fluid tank .

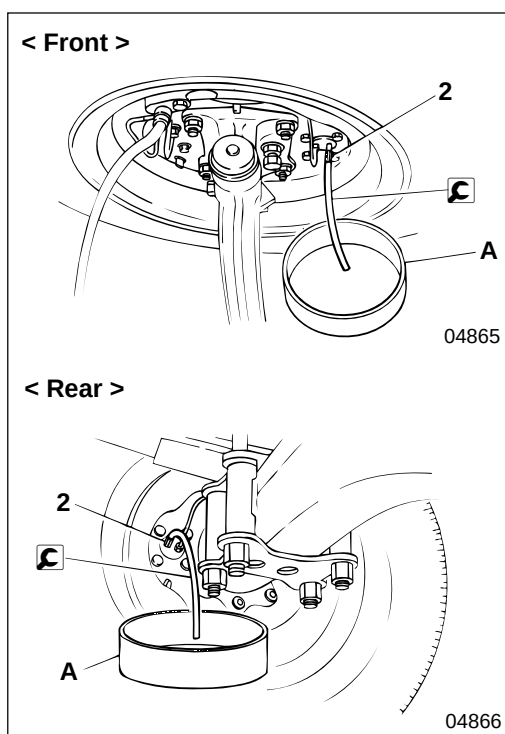


[Inspection and replenishment]

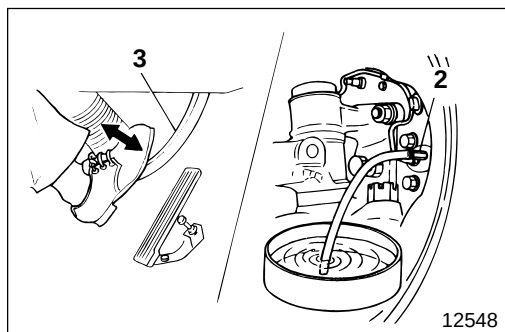
- Inspect the level of the brake fluid in fluid tank **1**. It should fall between the "**MAX**" and "**MIN**" levels.
- If it is below the "**MIN**" level, remove the cap from fluid tank **1**, then supply the specified brake fluid until the level comes up to the "**MAX**" level. Do not fill above the "**MAX**" level.

[Replacement]

- Start engine and let it idle until brake fluid replacement is completed.

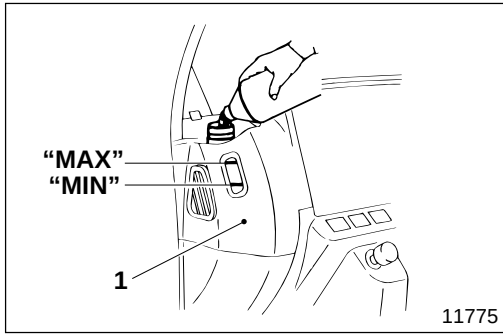


- Attach one end of  vinyl hose to air bleeder **2** and place the other end in container **A**.



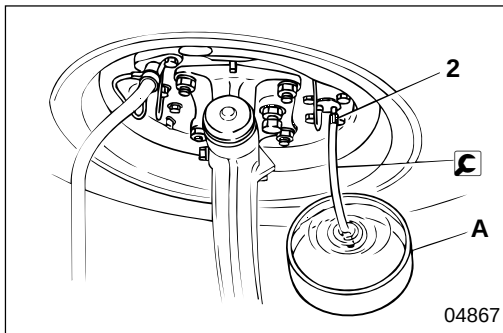
- Loosen air bleeders **2** and depress brake pedal **3** several times to drain brake fluid completely.

LUBRICATION



- Maintaining a supply of new brake fluid up to the **"MAX"** level of fluid tank **1**, depress brake pedal **3** repeatedly until the old brake fluid of the brake system is replaced with new fluid.
- Carry out air bleeding of the brake system.

[Air bleeding]



- Start the engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to air bleeder **2** of the wheel brake. Place free end in container **A** filled with brake fluid.
- Carry out air bleeding in the following sequence:

Front brake system

Right-hand side wheel brake



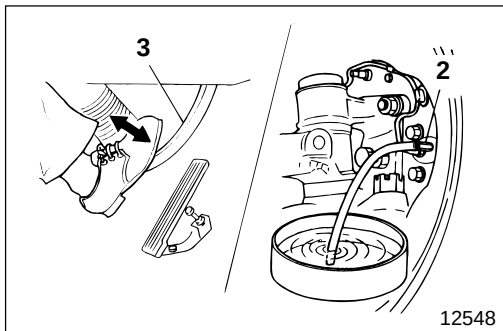
Left-hand side wheel brake

Rear brake system

Right-hand side wheel brake



Left-hand side wheel brake



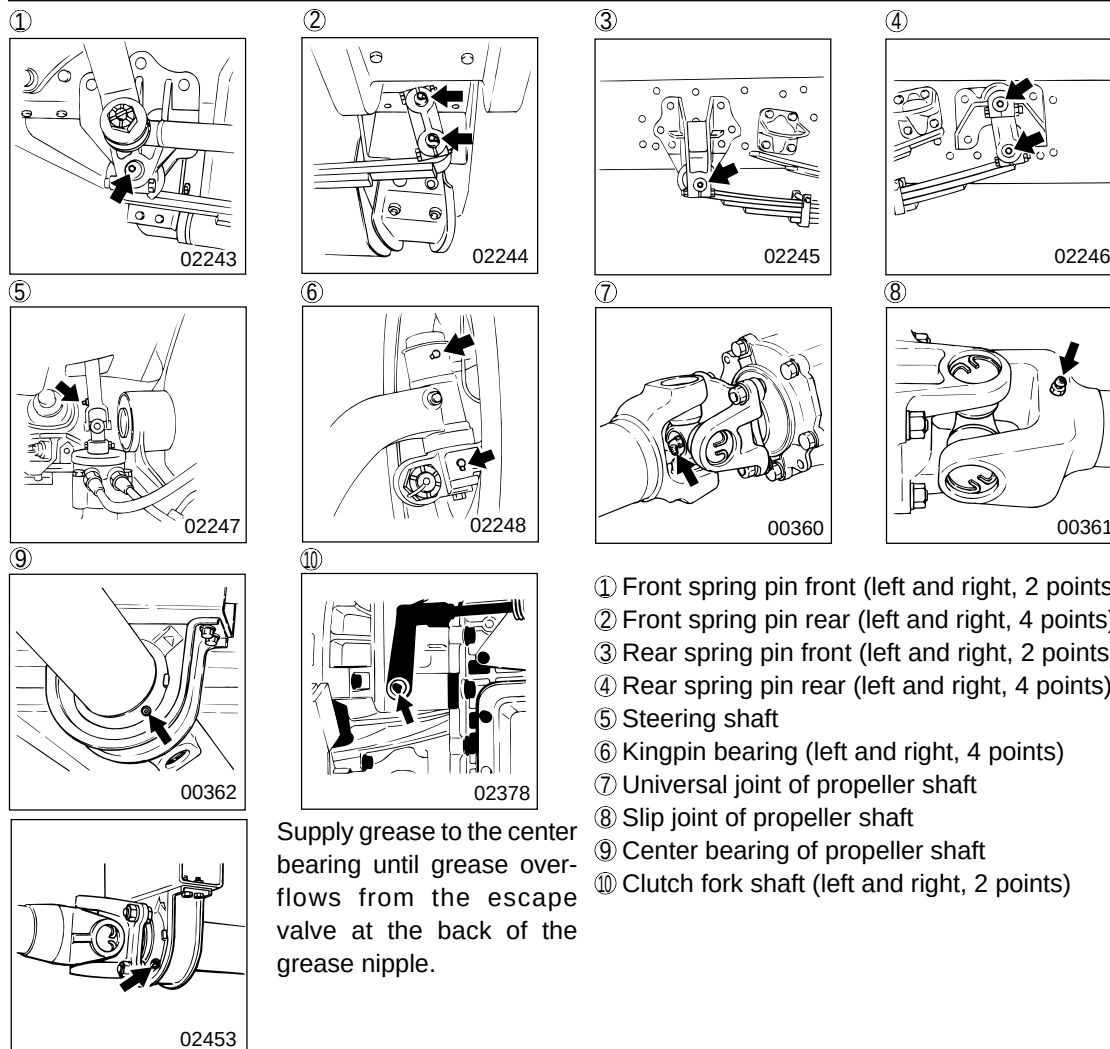
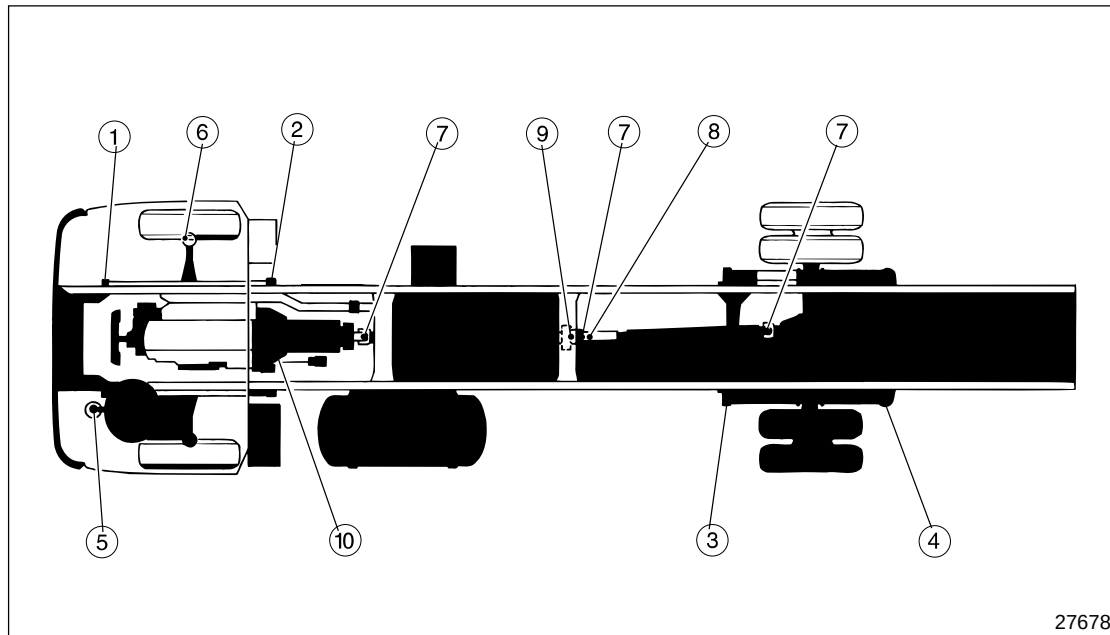
- Depress brake pedal **3** slowly a few times, and with the brake pedal depressed, loosen air bleeder **2** to drain brake fluid containing air.
- Tighten air bleeder **2**, and release brake pedal **3**.
- Repeat this service procedure until air is no longer present in the fluid being drained.
- Tighten air bleeder **2** at specified torque as soon as brake fluid flowing out is free of air bubbles.
- Adjust brake shoe clearance when you have finished air bleeding.
- Check that brake fluid comes up to level **"MAX"** of fluid tank **1**. If it does not, refill with new brake fluid.
- Depress brake pedal **3** a few times and check for any leakage of brake fluid, then test the brakes.

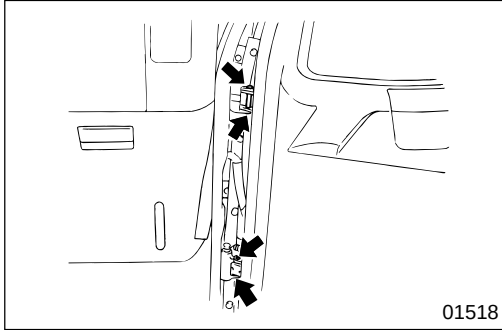
MEMO

LUBRICATION

● Greasing Various Areas of Chassis

Carefully clean away all dust and dirt from the grease nipples, and use the specified type of grease. The areas to be greased are shown in the following illustration.





● Door hinge



FH

Service Manual

Group 10

Removal and Installation

of Engine

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

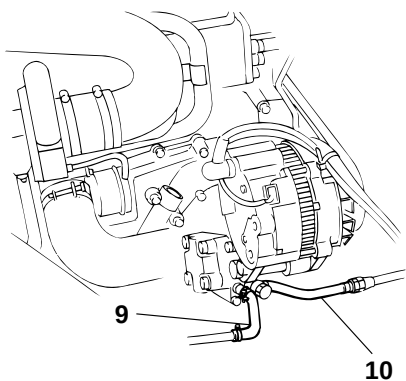
GROUP 10 REMOVAL AND INSTALLATION OF ENGINE

REMOVAL AND INSTALLATION OF ENGINE

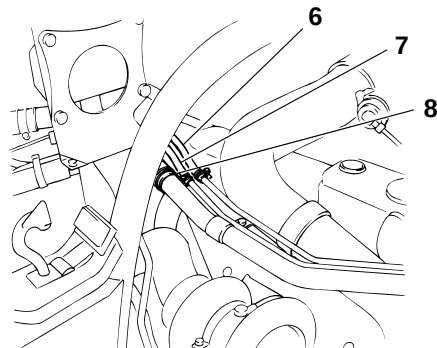
- Charge and Discharge of Engine Coolant,
Removal and Installation of Hoses 2
- Removal and Installation of Engine Related Parts 4
- Removal and Installation of Engine 6

REMOVAL AND INSTALLATION OF ENGINE

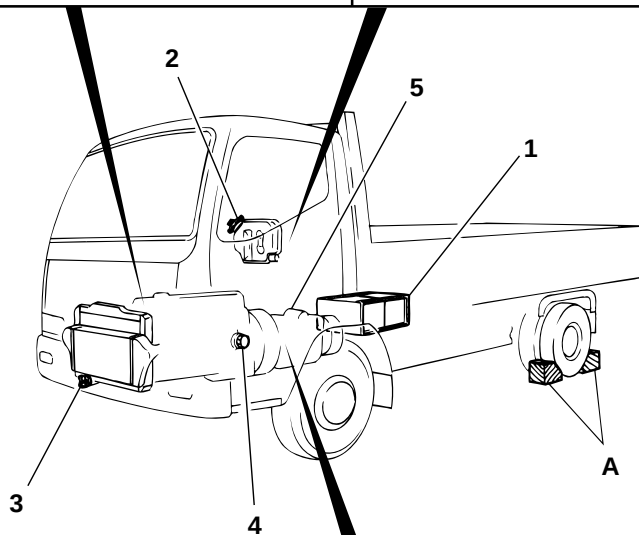
Charge and Discharge of Engine Coolant, Removal and Installation of Hoses



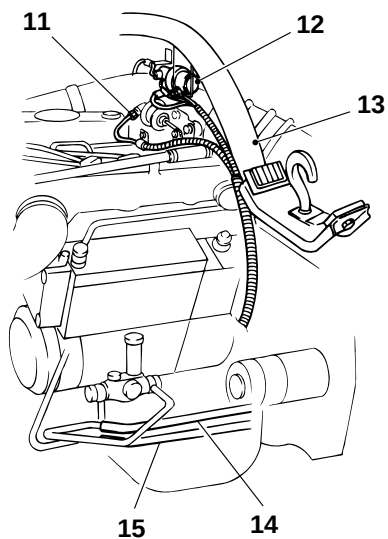
13257



13258



13259



13260

● Work before removal and after installation

📖 P10-3

● Removal sequence

- 1 Battery cable ⊖
- 2 Pressure cap (Surge tank)
- 3 Radiator drain plug 📦 Gr 14
- 4 Crankcase drain plug 📦 Gr 14
- 5 Transmission assembly 📦 Gr 22, 23
- 6 Air hose 📦 Gr 14
- 7 Suction hose 📦 Gr 14
- 8 Supply hose 📦 Gr 14
- 9 Power steering oil hose
- 10 Power steering oil hose
- 11 Nylon tube (Intake silencer)
- 12 Glow relay
- 13 Cab bridge 📦 Gr 42
- 14 Fuel feed hose
- 15 Fuel return hose

A : Wheel chock

WARNING ⚠️

- You must insert blanking plugs into fuel feed hose 14 and fuel return hose 15 after you remove them and secure them at a higher level than the fuel tank to prevent fuel from flowing out of them. Otherwise a fire might be caused.
- You must make sure that the engine coolant is cold before draining it so as not to scald yourself.
- It is dangerous to open pressure cap 2, when the coolant temperature is high, without taking due care because the hot water would spray out. Be sure to cover the pressure cap with a cloth and loosen slowly to bleed the pressure before opening fully.

● Installation sequence

Follow the removal sequence in reverse.

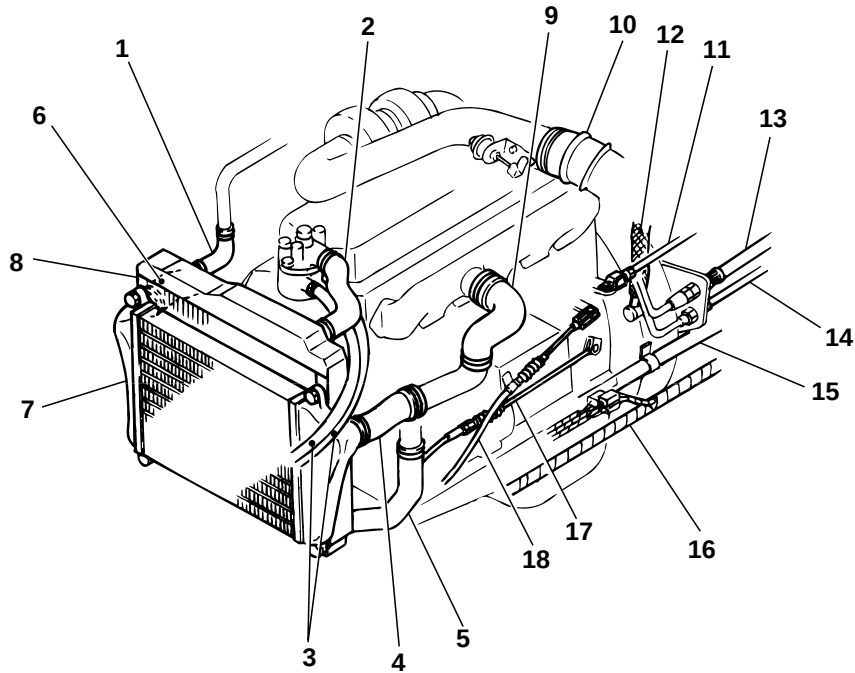
◆ Service procedure

● Work before removal and after installation

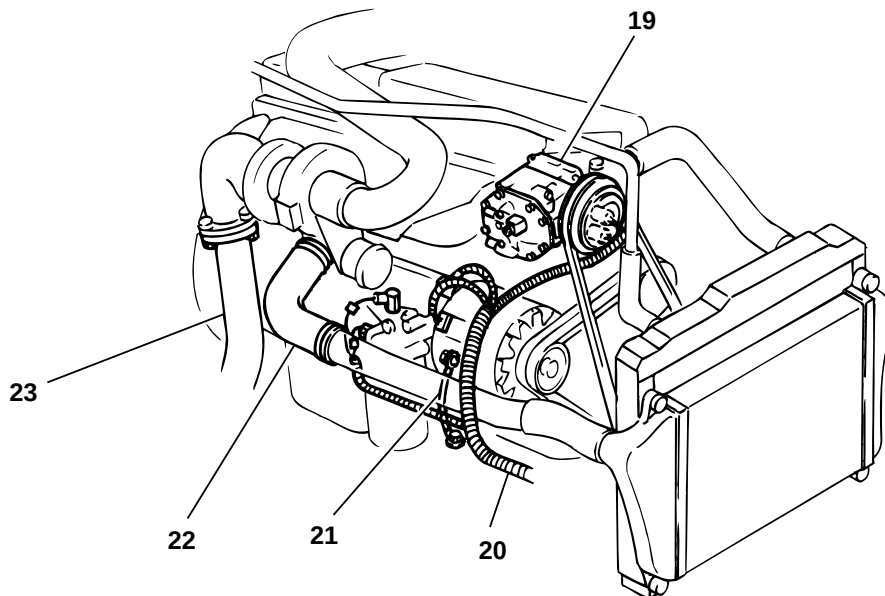
- Discharge, charge, and air bleeding of engine coolant 📦 Gr 14
- Discharge, charge, and air bleeding of oil 📦 Gr 37
- Air bleeding of fuel system 📦 Gr 13

REMOVAL AND INSTALLATION OF ENGINE

Removal and Installation of Engine Related Parts



13261



13262

● Removal sequence

- 1 Supply hose  Gr 14
- 2 Inlet hose  Gr 14
- 3 Heater hose  Gr 55B
- 4 Air intake hose  Gr 15
- 5 Outlet hose  Gr 14
- 6 Air intake hose  Gr 15
- 7 Intercooler  Gr 15
- 8 Radiator  Gr 14
- 9 Air intake hose  Gr 15
- 10 Air intake hose  Gr 15
- 11 Modulator cable  Gr 23
- 12 Harness (Ground)
- 13 Air outlet hose
- 14 Air unloader hose
- 15 Harness (Starter)
- 16 Harness (Chassis harness)
- 17 Engine stop cable  Gr 13
- 18 Accelerator control cable  Gr 13
- 19 Cooler compressor  Gr 55A
- 20 Harness (Chassis harness)
- 21 Harness (Ground)
- 22 Air intake hose  Gr 15
- 23 Front pipe  Gr 15

NOTE

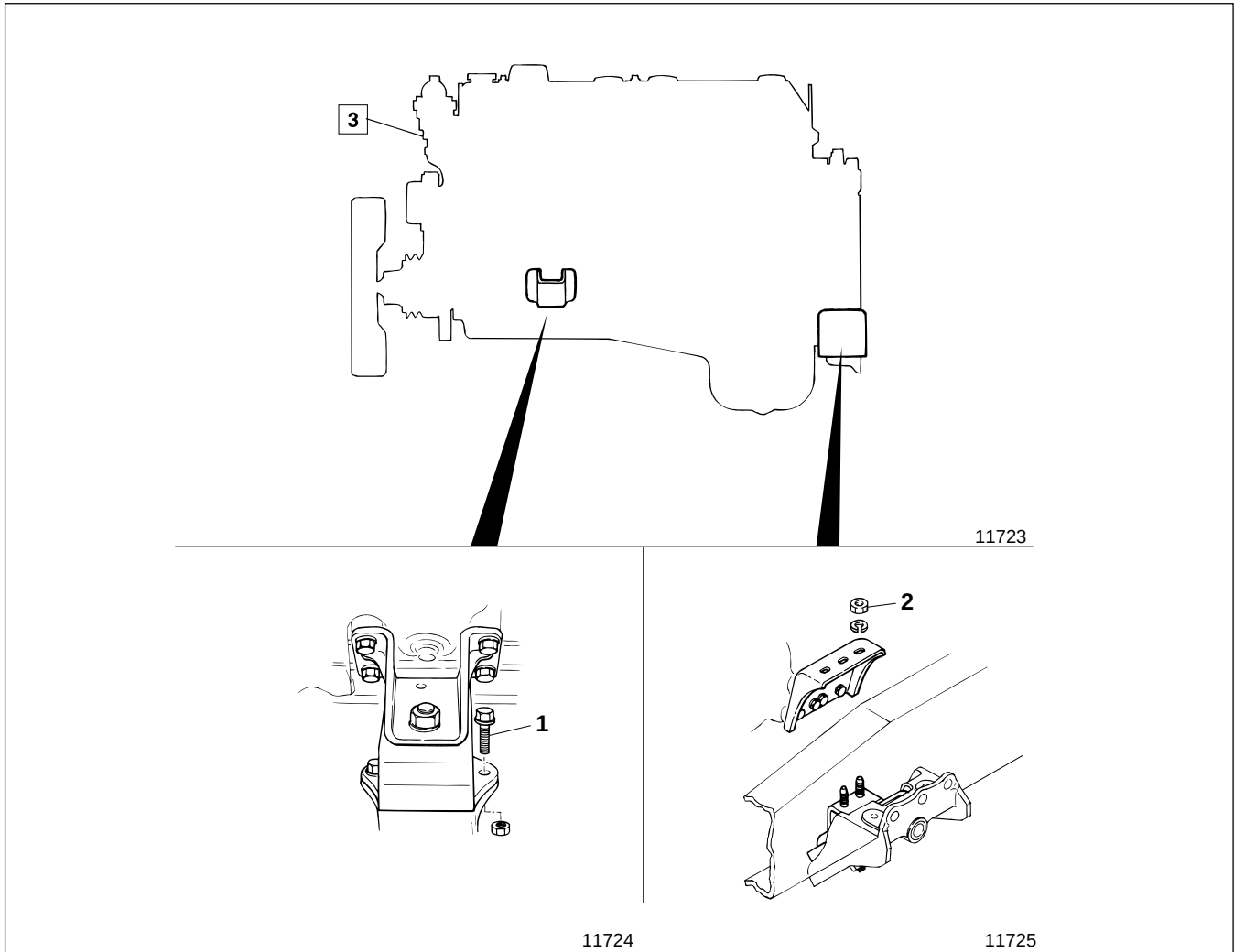
- For vehicles fitted with an air-conditioner do not disconnect the hose that goes to the air-conditioner from cooler compressor 19 when you remove it otherwise you will have to recharge the air-conditioner with refrigerant.
- After removing cooler compressor 19 tie it to the frame temporarily.

● Installation sequence

Follow the removal sequence in reverse.

REMOVAL AND INSTALLATION OF ENGINE

Removal and Installation of Engine



● Removal sequence

- 1 Bolt
- 2 Nut
- 3 Engine assembly

WARNING

When you lift engine assembly 3, you must use lifting gear that is strong enough to lift the mass of the engine (approximately 550 kg {1210 lb}).

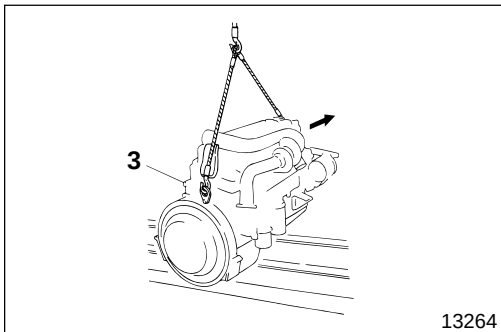
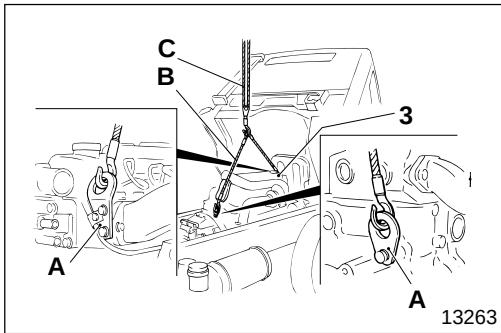
● Installation sequence

Follow the removal sequence in reverse.

◆ Service procedure

3 Removal of engine assembly

- Hook lifting gear **B** to two hangers **A** on engine assembly **3** and lift the engine using crane **C** until the lifting gear becomes taut.
- Make sure that wiring and hoses are disconnected.



- Lower engine assembly **3** slowly so that it does not hit the frame or cab.
- When the lower part of engine assembly **3** appears from the frame, turn the engine assembly 90° to remove it.



FH

Service Manual

Group 11

Engine

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

GROUP 11 ENGINE

SPECIFICATIONS	2
STRUCTURE AND OPERATION	3
TROUBLESHOOTING	6
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Inspection of Engine Compression	7
• Inspection and Adjustment of Valve Clearance	9
CYLINDER HEAD AND VALVE MECHANISM	10
TIMING GEAR	24
CAMSHAFT	28
PISTON, CONNECTING ROD AND CYLINDER SLEEVE	34
FLYWHEEL	48
CRANKSHAFT AND CRANKCASE	52

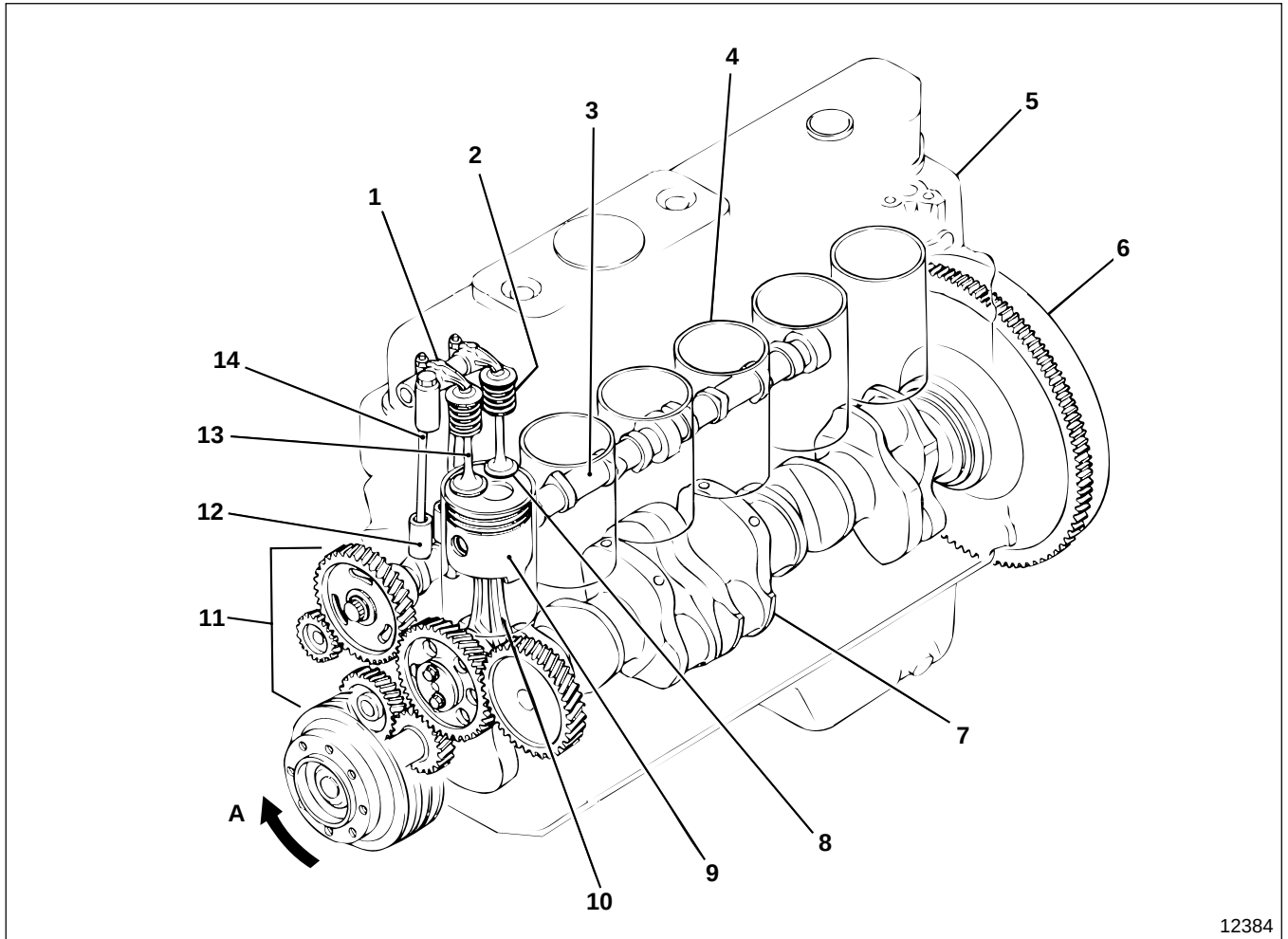
SPECIFICATIONS

Item		Specifications
Engine model		6D34T2
Type		6-cylinder in-line, water-cooled 4-cycle diesel
Combustion chamber type		Direct injection type
Valve mechanism		Overhead valve (OHV) type
Maximum output	HP/rpm (SAE Gross)	175/2900
Maximum torque	lbs.ft/rpm (SAE Gross)	325/2000
Bore×stroke	mm {in.}	ø104×115 {4.09×4.53}
Total displacement	cm ³ {cu. in.}	5861 {357.7}
Compression ratio		18

STRUCTURE AND OPERATION

11

Engine Body



12384

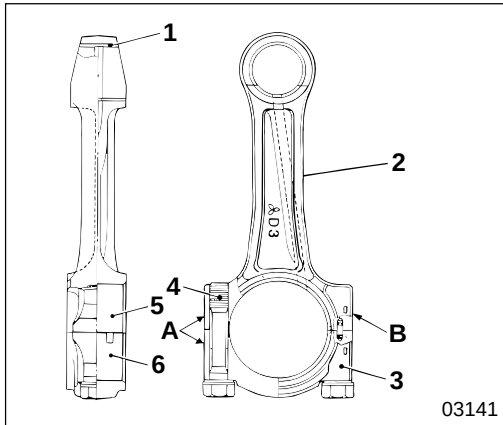
- 1 Rocker arm
- 2 Valve spring
- 3 Camshaft
- 4 Cylinder sleeve
- 5 Cylinder head
- 6 Flywheel
- 7 Crankshaft
- 8 Exhaust valve

- 9 Piston
- 10 Connecting rod
- 11 Timing gear
- 12 Tappet
- 13 Inlet valve
- 14 Push rod

A : Direction of rotation

STRUCTURE AND OPERATION

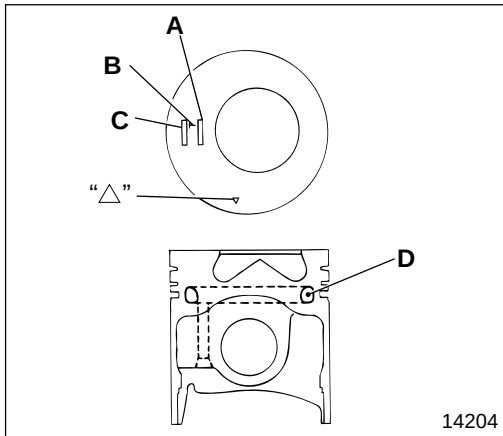
Connecting Rod



- 1 Connecting rod bushing
- 2 Connecting rod
- 3 Connecting rod cap
- 4 Connecting rod bolt
- 5 Upper connecting rod bearing
- 6 Lower connecting rod bearing

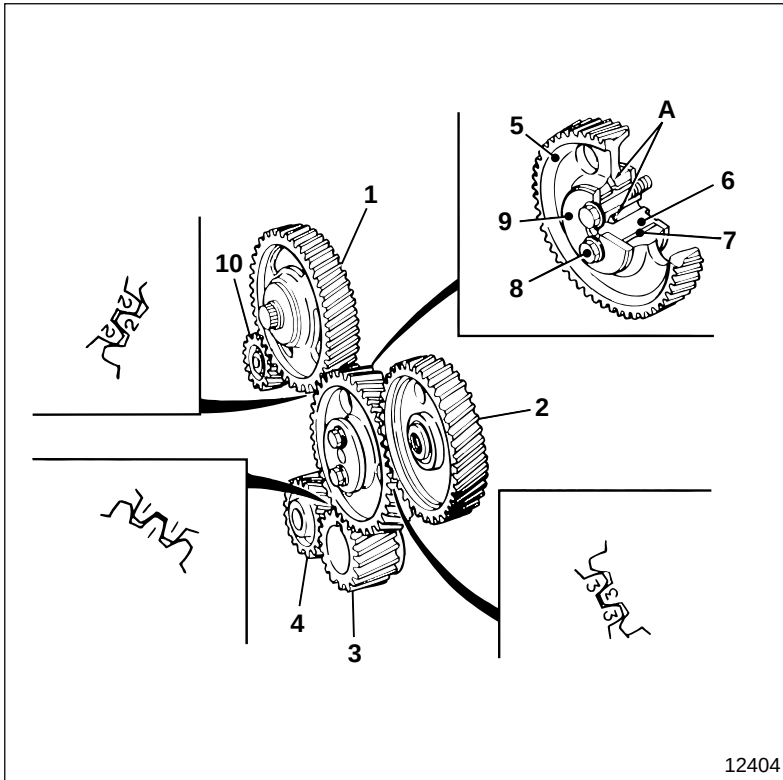
A : Alignment mark
B : Mass mark
(A, B, C, D, E, F, G)

Piston



A : Stamped mass
B : Stamped "T"
C : Part number
D : Free space for piston cooling
△ : Front mark

Timing Gear



- 1 Camshaft gear
- 2 Injection pump gear
- 3 Crankshaft gear
- 4 Oil pump gear
- 5 Idler gear
- 6 Idler shaft
- 7 Idler bushing
- 8 Bolt
- 9 Thrust plate
- 10 Power steering oil pump gear

A : Oil hole

Alignment marks "1", "2", "3" are punch-marked on each timing gear to ensure proper engagement of the gears at installation.

TROUBLESHOOTING

Symptoms	Decrease of power	Engine noise abnormal	Remarks
Possible causes			
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		☐	

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE 11

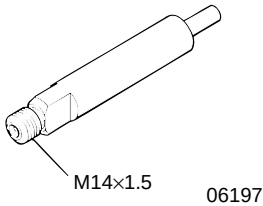
Inspection of Engine Compression

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Engine Compression	Each cylinder (200 rpm)	2550 kPa {370 lbf/in ² , 26 kgf/cm ² }	1960 kPa {285 lbf/in ² , 20 kg/cm ² }	Inspect
		Pressure difference between each cylinder	—	within 390 kPa {57 lbf/in ² , 4 kgf/cm ² }	Inspect

Special tools

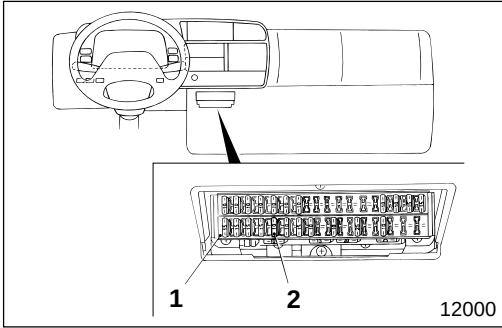
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	Compression gauge adapter 	MH061460	Measurement of engine compression

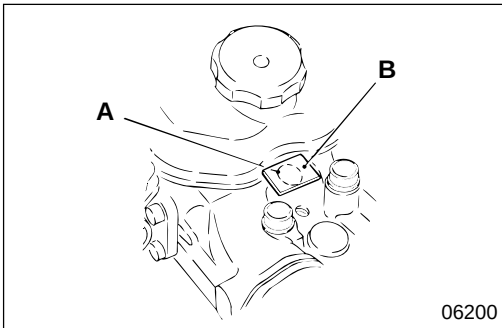
The decrease of engine compression is a signal that it is time to overhaul the engine. It is strongly recommended that this item is inspected periodically and that you record the history of deterioration in engine performance as this will help you to diagnose causes of future irregularities. When the vehicle is still new or immediately after installation of new parts, there may be a slight increase in engine compression, but normal performance will be restored soon.

- Before inspection make sure that engine oil, starter and battery are in normal condition.
- Before inspecting the vehicle do the following:
 - Run the engine to bring the temperature of the coolant up to approximately 75 to 85°C {167 to 185°F}.
 - Turn all the lights and accessory equipment OFF.
 - Put transmission in neutral. (N range for automatic transmission)
 - Set the steering wheel at center and straight position.

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE



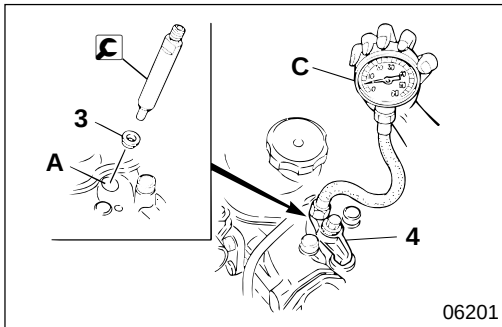
- Remove fuse 2 for the fuel-cut motor from fuse box 1 inside the cab to prevent the fuel from being injected when the engine is cranked by the starter.



- Remove all the injection nozzles. Gr 13
- Check that no foreign particles are sticking to waste cloth B covering injection nozzle mounting hole A after cranking the engine.

WARNING

You must stay clear of injection nozzle mounting hole A when you crank the engine during this inspection. Assume that all cylinders have cracked, and that coolant, engine oil, fuel, etc. have seeped into the cylinder chambers. If this is the state when the engine is cranked, there is an extreme danger of these substances being injected out of the injection nozzle mounting hole at high temperature.



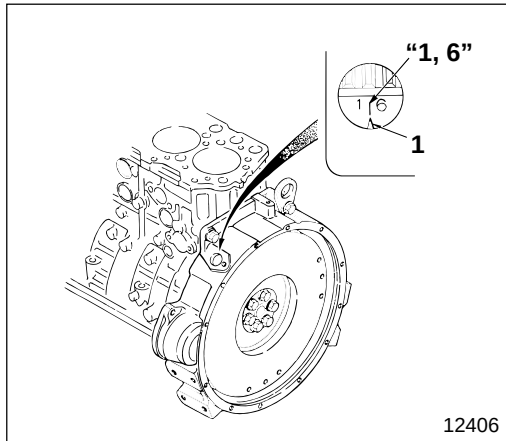
- Mount gasket 3 and compression gauge adaptor in injection nozzle mounting hole A and fasten them with nozzle bridge 4, then mount compression gauge C.
- Measure engine compression while cranking the engine.
- Measure engine compression of cylinders and calculate the difference among the cylinders.
- If the engine compression and pressure difference between each cylinder deviate from the limit, reinspect by pouring a small amount of engine oil into injection nozzle mounting hole A.
 - When pressure is high : It is likely that either wear or damage of the slide-contact area of both the piston ring and the cylinder inner surface has taken place.
 - When pressure is low : It is likely that burning of the valve, faulty contact of valve surfaces and/or faults in the cylinder head gasket have developed.

Inspection and Adjustment of Valve Clearance

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Valve clearance (When engine is cold)	0.4 {0.016}	—	Adjust



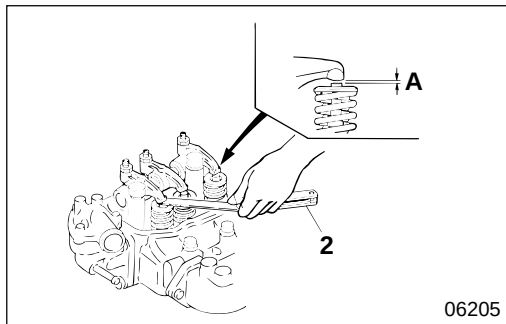
Inspect and adjust the valve clearance while the engine is cold in the following way.

[Inspection]

- Crank the engine to move No.1 or No.6 piston to top dead center, and align stamped marks "1, 6" on the flywheel with pointer 1 on the flywheel housing.

NOTE

The cylinder whose push rod is not pushing up the inlet/outlet rocker is the one whose piston is at top dead center.



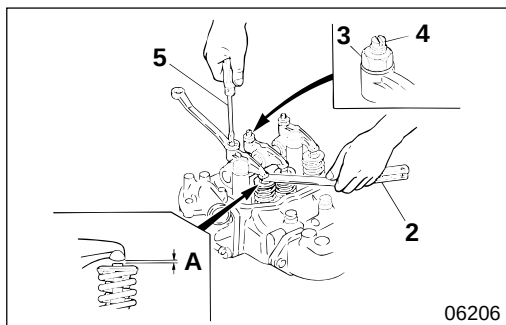
- Measure valve clearance **A** when either No.1 or No.6 piston is at top dead center in accordance with the following tabulated sequence of each valve.

Piston No.	1		2		3		4		5		6	
Valve arrangement	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust
No.1 piston at top dead center	○	○	○	×	×	○	○	×	×	○	×	×
No.6 piston at top dead center	×	×	×	○	○	×	×	○	○	×	○	○

NOTE

Be sure when taking measurements using feeler gauge 2 that some resistance is felt when inserting the gauge. If the gauge can be inserted freely without any resistance, an accurate measurement cannot be obtained.

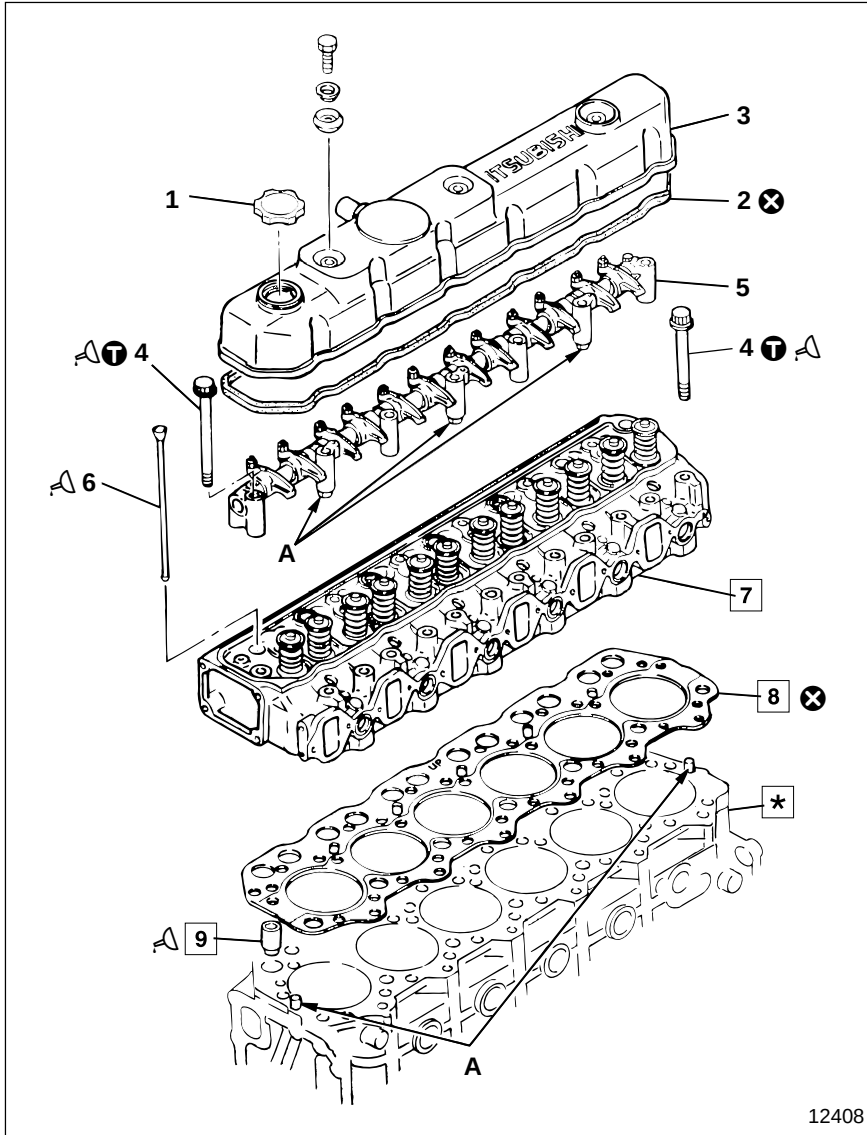
- If the measured value deviates from the limit, adjust as follows:



[Adjustment]

- Adjust valve clearance **A** so that feeler gauge 2 encounters some resistance when it is inserted. Do this by loosening lock nut 3 and turning adjusting screw 4.
- After adjusting, tighten adjusting screw 4 using screwdriver 5 and tighten lock nut 3. Reinspect valve clearance **A** using feeler gauge 2.

CYLINDER HEAD AND VALVE MECHANISM



● Disassembly sequence

- 1 Oil filler cap
- 2 Rocker cover gasket
- 3 Rocker cover
- 4 Cylinder head bolt
- 5 Rocker and bracket assembly
P11-14
- 6 Push rod
- 7 Cylinder head and valve assembly
P11-16
- 8 Cylinder head gasket
- 9 Tappet

* : Crankcase P11-52

A : Positioning pin

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
6	Push rod deflection	—	0.4 {0.016}	Replace
9, *	Clearance between tappet and crankcase tappet hole	[28] 0.05 to 0.09 {[1.10] 0.0020 to 0.0035}	0.2 {0.0079}	Replace

ⓘ Tightening torque

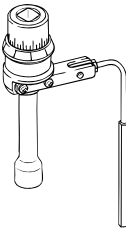
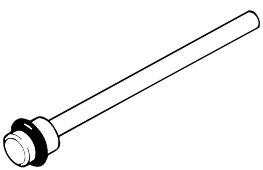
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Cylinder head bolt	145 {110, 15}+90°	Wet Reuse up to three times

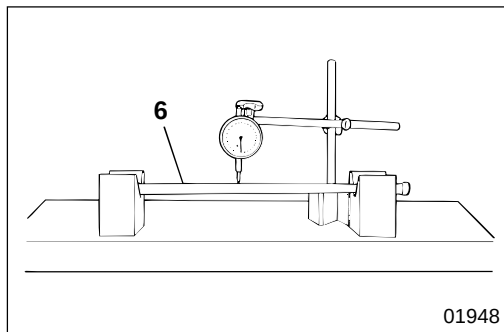
🔧 Lubricant

Location	Points of application	Kinds	Quantity
4	Thread area of cylinder head bolt	Engine oil	As required
6	Both ends of push rod	Engine oil	As required
9	External periphery of tappet	Engine oil	As required

Special tools

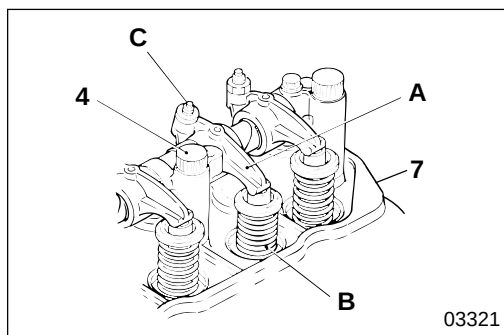
Location	Tool name and shape	Part No.	Application
7	Socket wrench  01984	MH061560	Installation of cylinder head and valve assembly
9	Tappet extractor  03320	MH063329	Removal of tappet

◆ Service procedure



6 Push rod deflection

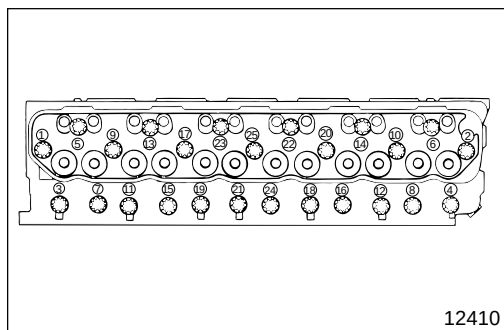
If the measured value is higher than the limit, replace push rod 6.



7 Cylinder head and valve assembly

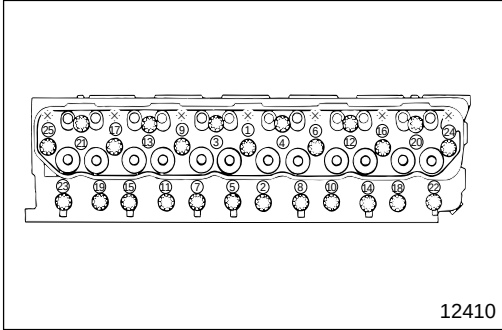
[Removal]

- Before undoing cylinder head bolts 4, first loosen adjusting screw C of rocker A that pushes down valve spring B.



- First loosen cylinder head bolts 4 in the numbered order as illustrated, then remove them.

CYLINDER HEAD AND VALVE MECHANISM

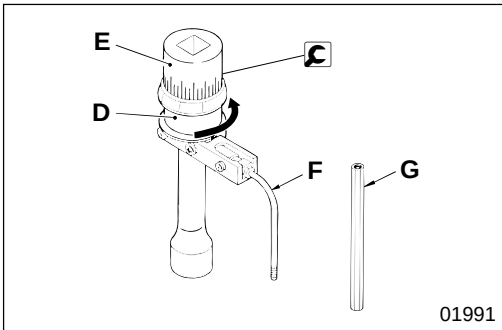


[Installation]

- Center punch the heads of cylinder head bolts **4** before installation.

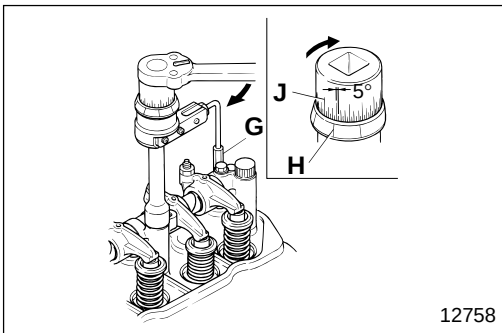
CAUTION

If there are already three center-punch marks, replace the cylinder head bolt with a new one.

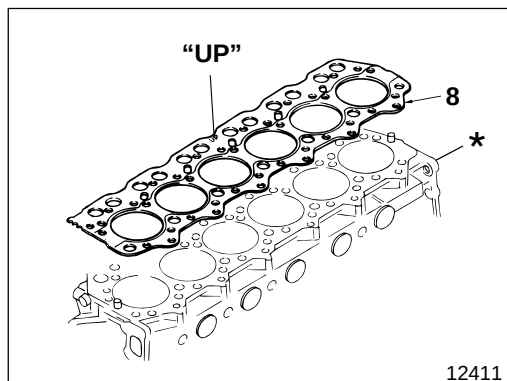


- After tightening cylinder head bolts **4** at specified torque in the numbered order as illustrated, tighten further as follows:
 ✕ : Tightened simultaneously with rocker and bracket assembly

- Turn socket wrench holder **D** counterclockwise and keep the spring in the wrench compressed.
E : Socket
F : Rod
G : Rod (for connection)



- Set socket wrench holder **D** so that the percussive force of the spring presses rod **G** (for connection) against adjacent parts such as, the rocker shaft bracket or the injection pipe.
- Select a scale that is convenient for reading graduation **H** on holder **D**.
- Tighten further by turning socket **H** clockwise by 90° (setting is in 5° increments), referring to graduation **J** on the selected scale.



8 Cylinder head gasket

[Removal]

CAUTION ⚠

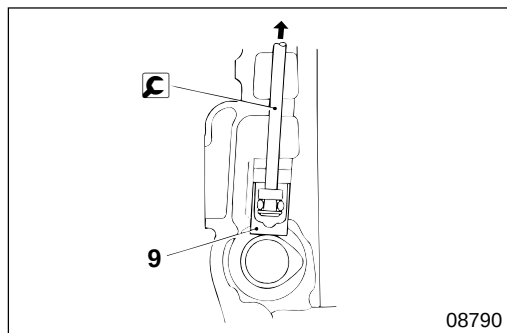
Be careful not to scratch the cylinder head or crankcase * when you remove cylinder head gasket 8.

[Installation]

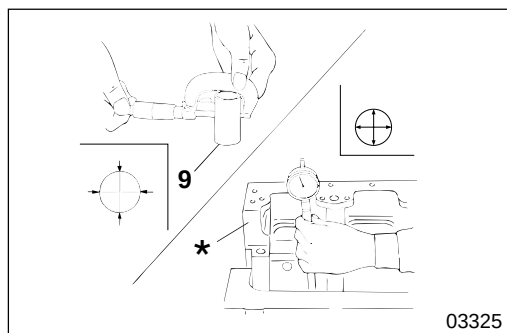
- Install cylinder head gasket 8 onto crankcase * in the direction as illustrated.

CAUTION ⚠

Be sure to measure the amount of protrusion whenever a piston or connecting rod is replaced, since replacement changes the amount of protrusion.



9 Removal of tappet

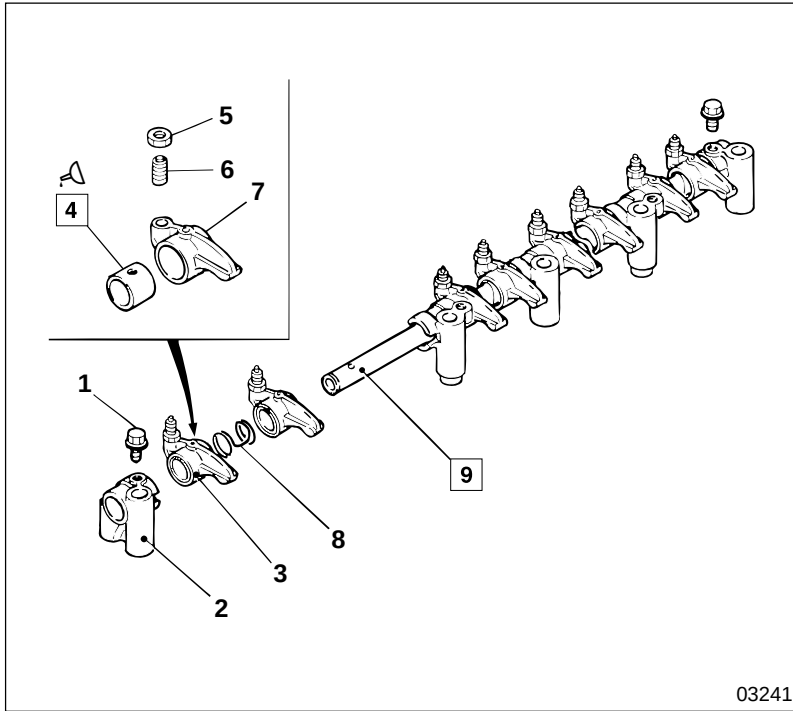


9 * Clearance between tappet and crankcase tappet hole

If the measured value is higher than the limit, replace the faulty parts.

CYLINDER HEAD AND VALVE MECHANISM

Rocker and Bracket Assembly



● Disassembly sequence

- 1 Set bolt
- 2 Rocker shaft bracket
- 3 Rocker assembly
- 4 Rocker bushing
- 5 Lock nut
- 6 Adjusting screw
- 7 Rocker
- 8 Rocker shaft spring
- 9 Rocker shaft

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

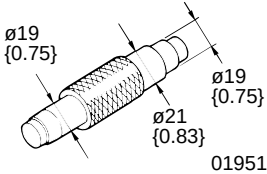
Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
4, 9	Clearance between rocker bushing and rocker shaft	[19] 0.06 to 0.11 {[0.75] 0.0024 to 0.0043}	0.2 {0.0079}	Replace

Lubricant

Location	Points of application	Kinds	Quantity
4	Inner surface of rocker bushing	Engine oil	As required

Special tools

Unit : mm {in.}

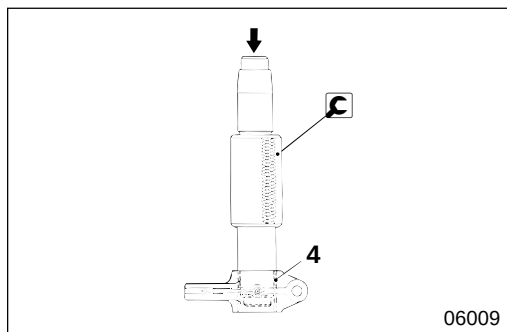
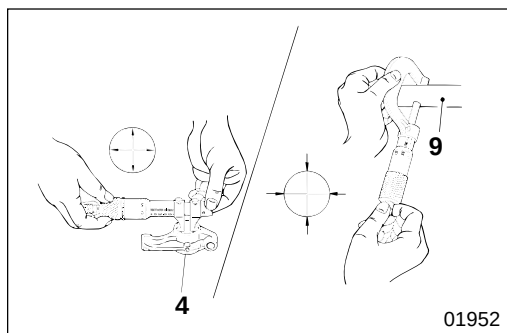
Location	Tool name and shape	Part No.	Application
4	Rocker bushing puller 	MH061378	Removal and installation of rocker bushing

◆ Service procedure

4 9 Rocker bushing and rocker shaft

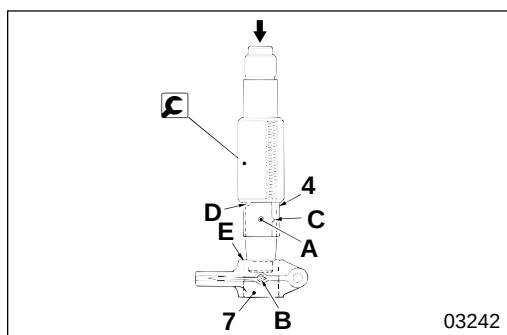
[Inspection]

If the clearance is higher than the limit, replace the faulty parts.



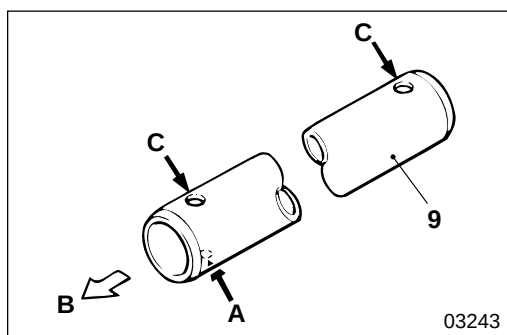
Rocker bushing

[Removal]



[Press-fitting]

- Align oil hole **A** of rocker bushing **4** with oil hole **B** of rocker **7**.
- Position clinch **C** and split **D** of rocker bushing **4** in the direction as illustrated.
- Press-fit rocker bushing **4** from chamfered side **E** of rocker **7**.



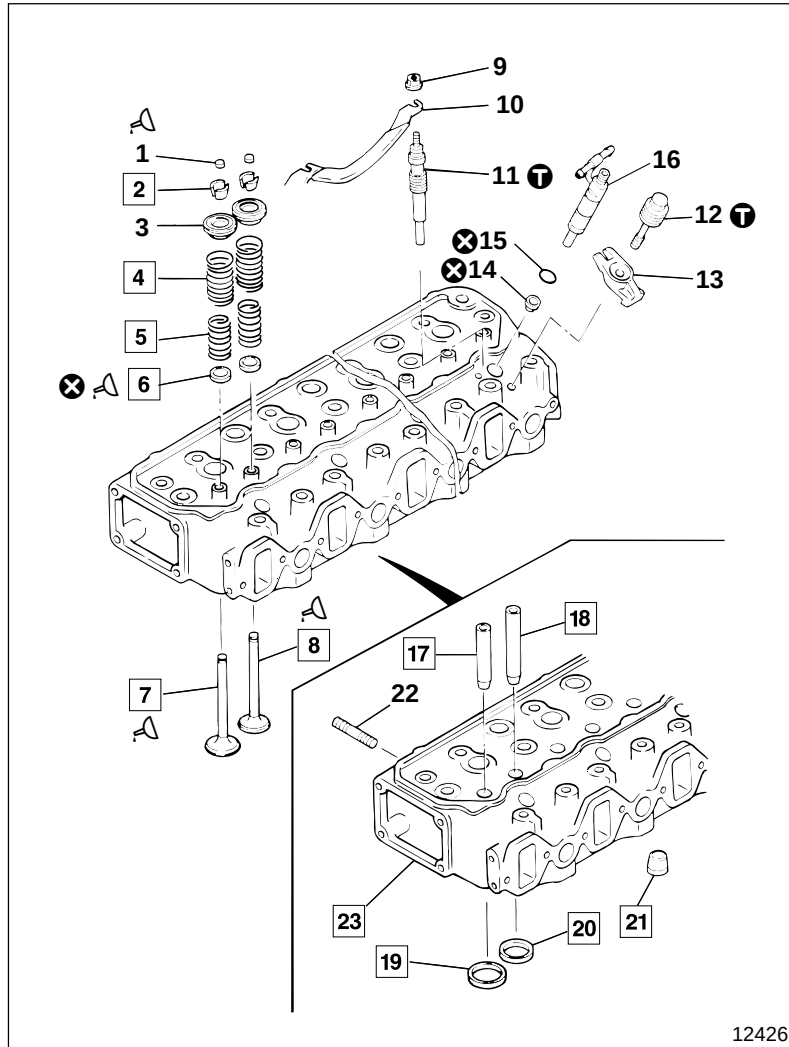
9 Installation of rocker shaft

When installing rocker shaft **9**, bring oil passage hole for lubrication **A** to front side **B**.

C : Fixing hole of the set bolt.

CYLINDER HEAD AND VALVE MECHANISM

Cylinder Head and Valve Assembly



● Disassembly sequence

- 1 Valve cap
- 2 Valve cotter
- 3 Upper retainer
- 4 Outer valve spring
- 5 Inner valve spring
- 6 Valve stem seal
- 7 Inlet valve
- 8 Exhaust valve
- 9 Nut
- 10 Connecting plate
- 11 Glow plug  Gr 54
- 12 Bolt 
- 13 Nozzle bridge
- 14 Nozzle tip gasket
- 15 O-ring
- 16 Injection nozzle  Gr 13
- 17 Inlet valve guide
- 18 Exhaust valve guide
- 19 Inlet valve seat
- 20 Exhaust valve seat
- 21 Water director
- 22 Stud
- 23 Cylinder head

⊗ : Non-reusable parts

CAUTION

Be careful of the protrusion of glow plug 11 and injection nozzle 16 from the bottom surface of cylinder head 23.

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

When inlet valve 7 and exhaust valve 8 have been removed, replace valve stem seal 6.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
4	Outer valve spring	Without load	66.1 {2.60}	63.0 {2.48}	Replace
		Installed load (Installed length 47.25 {1.86})	273±12 N {62±2.6 lbf, 27.9±1.2 kgf}	230 N {52 lbf, 23.7 kgf}	Replace
		Tilt	—	2.5 {0.098}	Replace
5	Inner valve spring	Without load	60.0 {2.36}	52.1 {2.05}	Replace
		Installed load (Installed length 40.3 {1.59})	119±4.4 N {27±1.0 lbf, 12.1±0.45 kgf}	79 N {18 lbf, 8.1 kgf}	Replace
		Tilt	—	2 {0.079}	Replace
7	Inlet valve	Stem diameter	8.96 to 8.97 {0.3529 to 0.3531}	8.85 {0.348}	Replace
		Valve recess from the cylinder head bottom surface	0.75 to 1.25 {0.030 to 0.049}	1.5 {0.059}	Inspect each part
		Valve margin	1.5 {0.059}	1.2 {0.047}	Correct or replace
		Valve seat angle	45°±15'	—	Correct or replace
7, 17	Clearance between inlet valve stem and inlet valve guide		[9] 0.04 to 0.06 {[0.35] 0.0016 to 0.0024}	0.15 {0.0059}	Replace
8	Exhaust valve	Outer diameter of stem	8.93 to 8.94 {0.3515 to 0.3519}	8.85 {0.348}	Replace
		Valve recess from the cylinder head bottom surface	0.75 to 1.25 {0.030 to 0.049}	1.7 {0.067}	Inspect each part
		Valve margin	1.5 {0.059}	1.2 {0.047}	Correct or replace
		Valve seat angle	45°±15'	—	Correct or replace
8, 19	Clearance between exhaust valve stem and exhaust valve guide		[9] 0.07 to 0.1 {[0.35] 0.0028 to 0.0039}	0.2 {0.0079}	Replace
19	Seat width of inlet valve seat		2±0.2 {0.079±0.0079}	2.8 {0.11}	Correct or replace
20	Seat width of exhaust valve seat		2±0.2 {0.079±0.0079}	2.8 {0.11}	Correct or replace
23	Cylinder head	Distortion of bottom	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Height from top to bottom	95±0.1 {3.74±0.0039}	94.6 {3.72}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
11	Glow plug	15 to 20 {11 to 14, 1.5 to 2.0}	—
12	Bolt (Nozzle bridge mounting)	25 {18, 2.5}	—

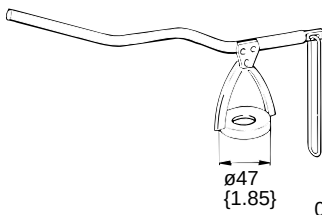
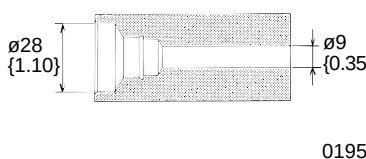
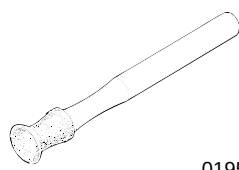
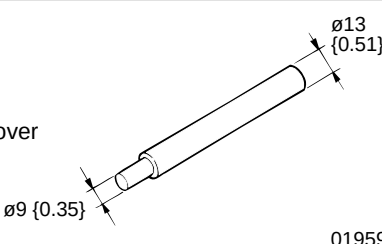
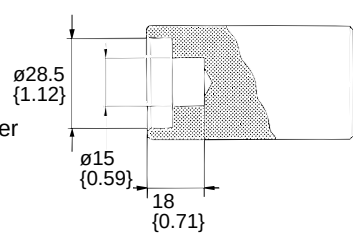
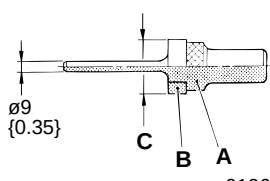
L Lubricant

Location	Points of application	Kinds	Quantity
1	Slide contact areas of valve cap and rocker	Engine oil	As required
6	Lip of valve stem seal	Engine oil	As required
7, 8	Valve stem	Engine oil	As required

CYLINDER HEAD AND VALVE MECHANISM

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application						
2	Valve lifter 	30091-08500	Removal and installation of valve cotter						
6	Valve stem seal installer 	MH061293	Installation of valve stem						
7, 8	Valve lapper 	30091-07500	Fitting of valve and valve guide						
17, 18	Valve guide remover 	MH061066	Removal of valve guide						
	Valve guide installer 	MH061998	Press-fitting of valve guide						
19, 20	A : Caulking tool body B : Caulking ring <table><tr><th></th><th>C dimension</th></tr><tr><td>Inlet</td><td>47.6 {1.87}</td></tr><tr><td>Exhaust</td><td>40.6 {1.60}</td></tr></table> 		C dimension	Inlet	47.6 {1.87}	Exhaust	40.6 {1.60}	A : MH061067 B : MH061275 (Inlet) MH061069 (Exhaust)	Press-fitting of valve seat
	C dimension								
Inlet	47.6 {1.87}								
Exhaust	40.6 {1.60}								

◆ Service procedure

2 Valve cotter

[Removal]

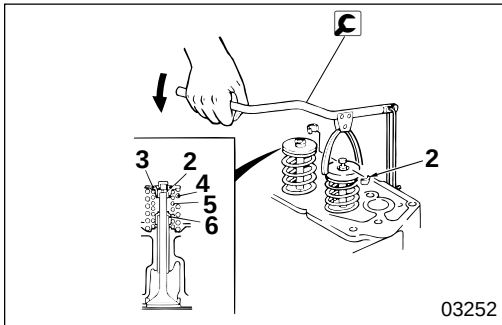
Remove valve cotter **2** making sure that valve springs **4**, **5** are squarely and evenly pressed down by  valve lifter.

[Installation]

Follow the removal procedure in reverse.

CAUTION

Be sure not to press down on valve springs **4**, **5** too hard because this would cause upper retainer **3** to contact valve stem seal **6** and damage it.

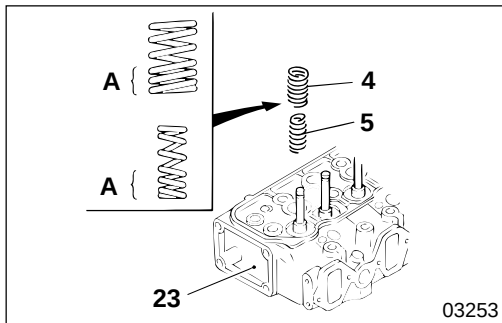


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4 5 Installation of outer and inner valve springs

Install outer springs **4** and inner springs **5** in cylinder head **23** in the direction as illustrated.

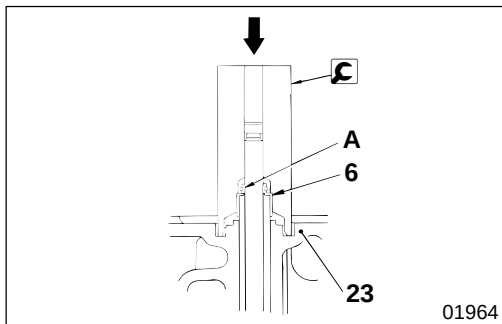
A : Closely wound area



03253

6 Installation of valve stem seal

- Apply engine oil to lip **A** of valve stem seal **6**.
- Tap down  valve stem seal installer until it hits cylinder head **23**.



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7 8 Inlet valve and exhaust valve

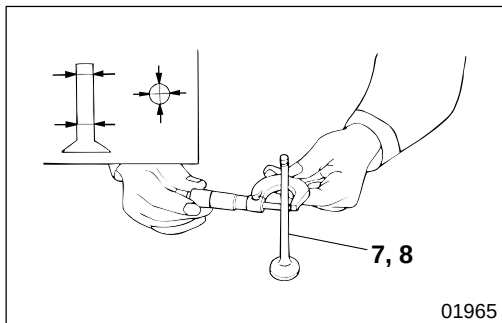
[Inspection]

(1) Inspection of stems

If the measured value is lower than the limit or in the case of excessive wear, replace valves **7**, **8**.

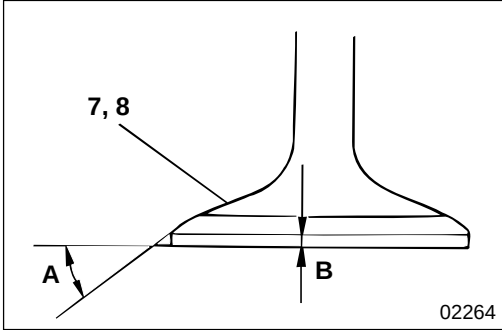
CAUTION

Be sure to lap valve seats **19**, **20** when valves **7**, **8** are replaced with new ones.  P11-21



01965

CYLINDER HEAD AND VALVE MECHANISM

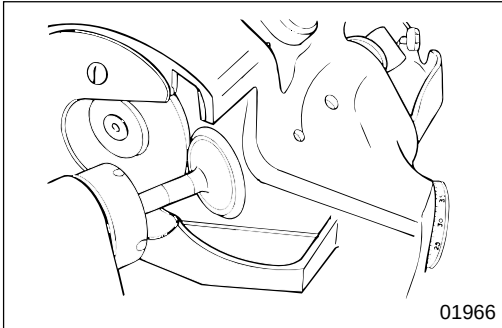


(2) Valve seat angle and valve margin

If the measured value is higher than the limit, correct or replace valves 7, 8.

A : Valve seat angle

B : Valve margin

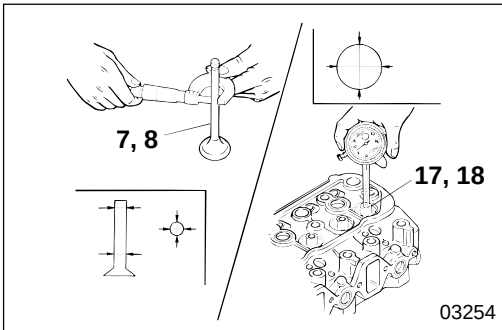


[Correction]

NOTE

- Be sure to keep the grinding work as light as possible.
- Be sure to replace valves 7, 8 after grinding if valve margin deviates from the limit.
- Be sure to lap valve 7, 8 and valve seats 19, 20 after grinding.

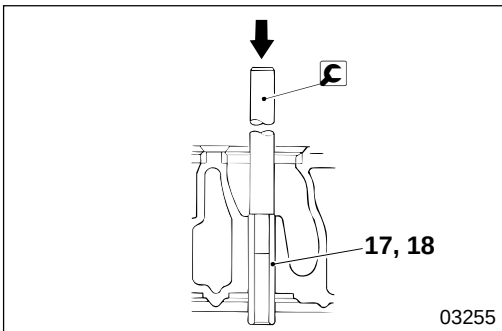
📖 P11-21



7 8 17 18 Valve and valve guide

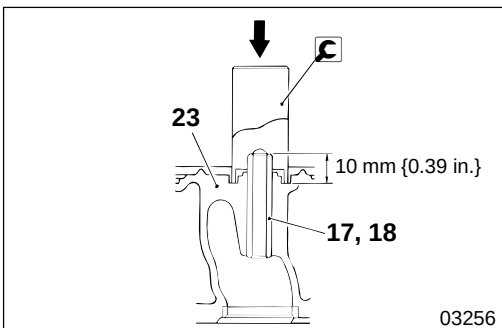
[Inspection]

When the clearance is higher than the limit, replace the faulty parts.



Valve guide

[Removal]

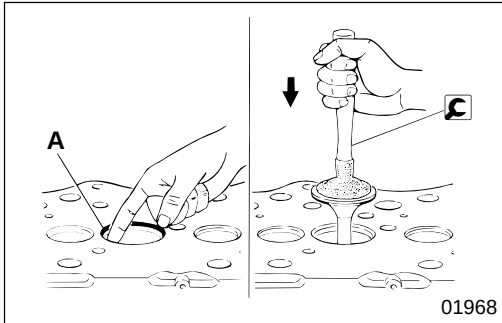


[Installation]

- Tap down valve guides 17, 18 with  valve guide installer until it hits cylinder head 23.

CAUTION ⚠

- The length of fit of valve guides 17, 18 is standardized. Be sure to use  valve guide installer.
- Be sure to distinguish between valve guides 17, 18. Exhaust valve guide 18 is longer.



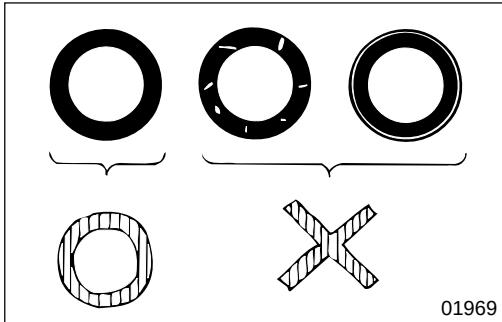
7 8 19 20 Valve and valve seat

[Inspection]

- Apply red lead evenly to entire surface **A** of valve seats **19, 20** that contact valves **7, 8**.
- Fit valves **7, 8** to valve seats **19, 20** and tap once without rotating.

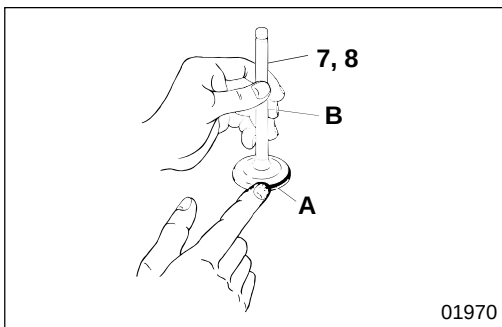
NOTE

Be sure to carry out inspection under the condition that valves **7, 8 and all parts of valve guides **17, 18** are normal.**



- Check how much red lead has transferred to valves **7, 8** to determine the contact of the valve and the seat. According to the degree of abnormality, take proper measures to correct it.

Contact conditions	Correction measures
Minor fault	Valve lapping
Major fault	Repair of valve and seat or replacement of both



[Correction]

Valve polishing is done in the following manner:

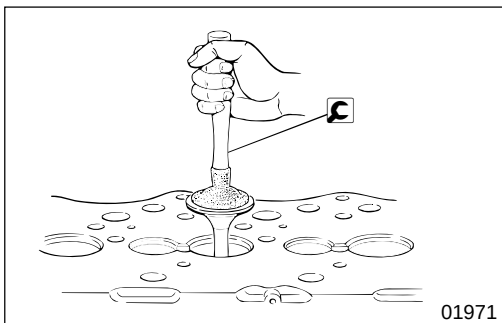
- Apply valve lapping compound thinly to contact surface **A** of valves **7, 8** with valve seats **19, 20**.

CAUTION ⚠

Take care not to smear stems **B of valves **7, 8** with the compound.**

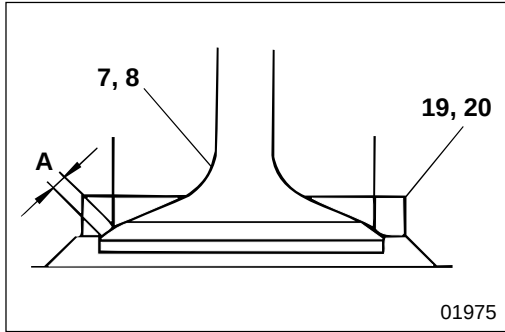
NOTE

- **Start with medium grit compound (120 to 150 grit) and for finishing up, use finer grit (200 grit or finer).**
- **Mixing with a small amount of engine oil will make the compound consistent and make even application easier.**



- Tap valves **7, 8** against valve seats **19, 20** several times while rotating the valves slightly at each strike.
- Clean off the compound with gas oil.
- Apply engine oil to contact surface **A** of valve seats **19, 20** and smooth the surface.
- Check the contact of valves **7, 8** and valve seats **19, 20**.
- If contact does not take place completely around the seat, replace valve seats **19, 20**.

CYLINDER HEAD AND VALVE MECHANISM



19 20 Valve seat

[Inspection]

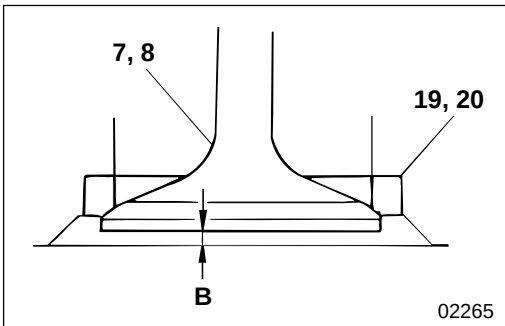
(1) Valve seat width

If the measured value is higher than the limit, replace valve seats 19, 20.

A : Valve seat width

NOTE

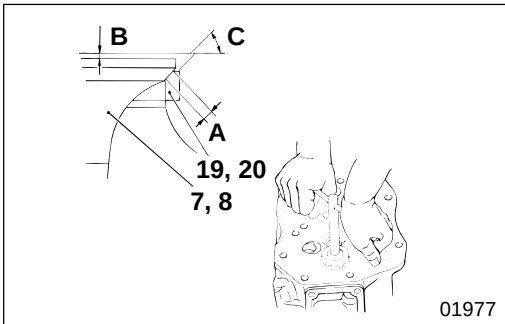
Be sure to lap and fit valves 7, 8 and valve seats 19, 20 after correction or replacement.



(2) Extent of valve recess from the bottom surface of cylinder head

If the measured value is higher than the limit, correct or replace the faulty parts.

B : Extent of valve recess



[Correction]

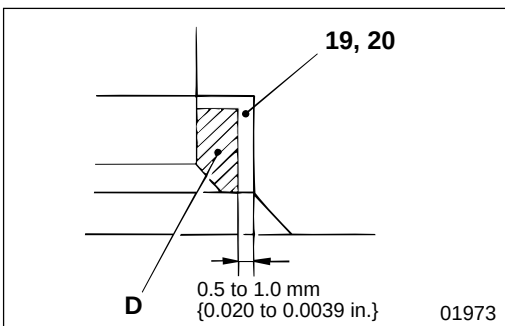
- Grind valve seats 19, 20 using valve seat cutter or valve seat grinder.
- After grinding, do another light abrasion using 400 grit emery paper placed between the cutter and the seat.
- Adjust the seat width A of valves 7, 8 using 15° or 75° cutter to make seat width conform to the standard value.

C : Valve seat angle

CAUTION ⚠

Be sure that as a result of grinding, recess B of valves 7, 8 does not become higher than the limit.

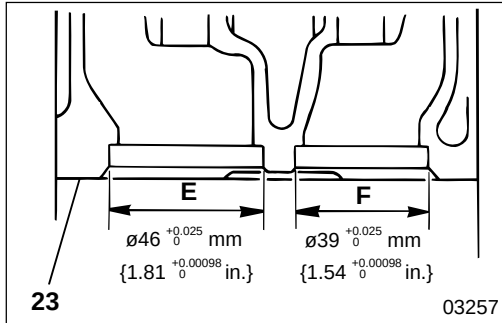
- After correction is done, be sure to carry out lapping and fitting on valves 7, 8 and valve seats 19, 20.



[Removal]

- Valve seats 19, 20 have been set in by the cooling-off-process, and have to be thinned by grinding off the inner side for removal under normal temperature.

D : Part to be ground

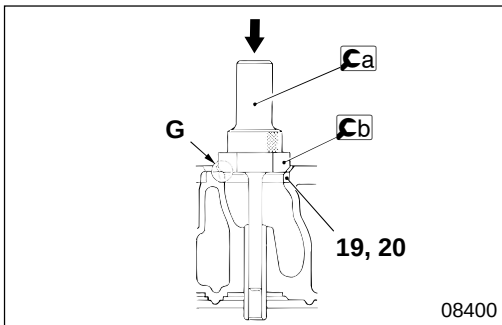


[Installation]

- Make sure that the diameter of valve seat hole of cylinder head **23** conforms to the standard value.

E : Inlet valve seat hole diameter

F : Exhaust valve seat hole diameter

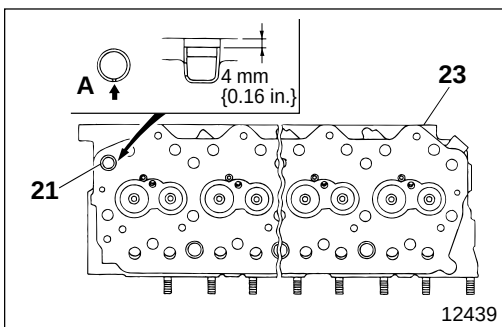


- Immerse valve seats **19**, **20** in liquid nitrogen and cool them substantially. Press-fit into the cylinder head using **Ca** caulking tool body and **Cb** caulking rings inlet and exhaust.

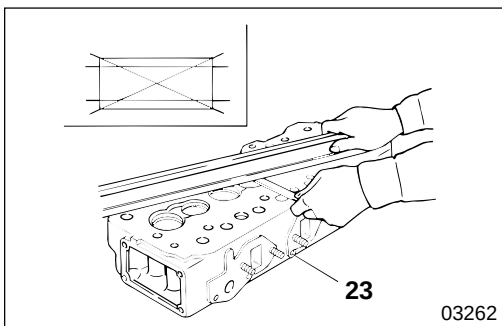
CAUTION ⚠

Be sure, when press-fitting, to place the chamfered side **G** of **Cb** caulking rings inlet and exhaust against valve seats **19**, **20**.

- After installation of valve seats **19**, **20**, work until they contact valves **7**, **8** smoothly.

**21** Installation of water director

- With indent **A** set in the direction as illustrated, press-fit water director **21** into cylinder head **23** to the specified depth.

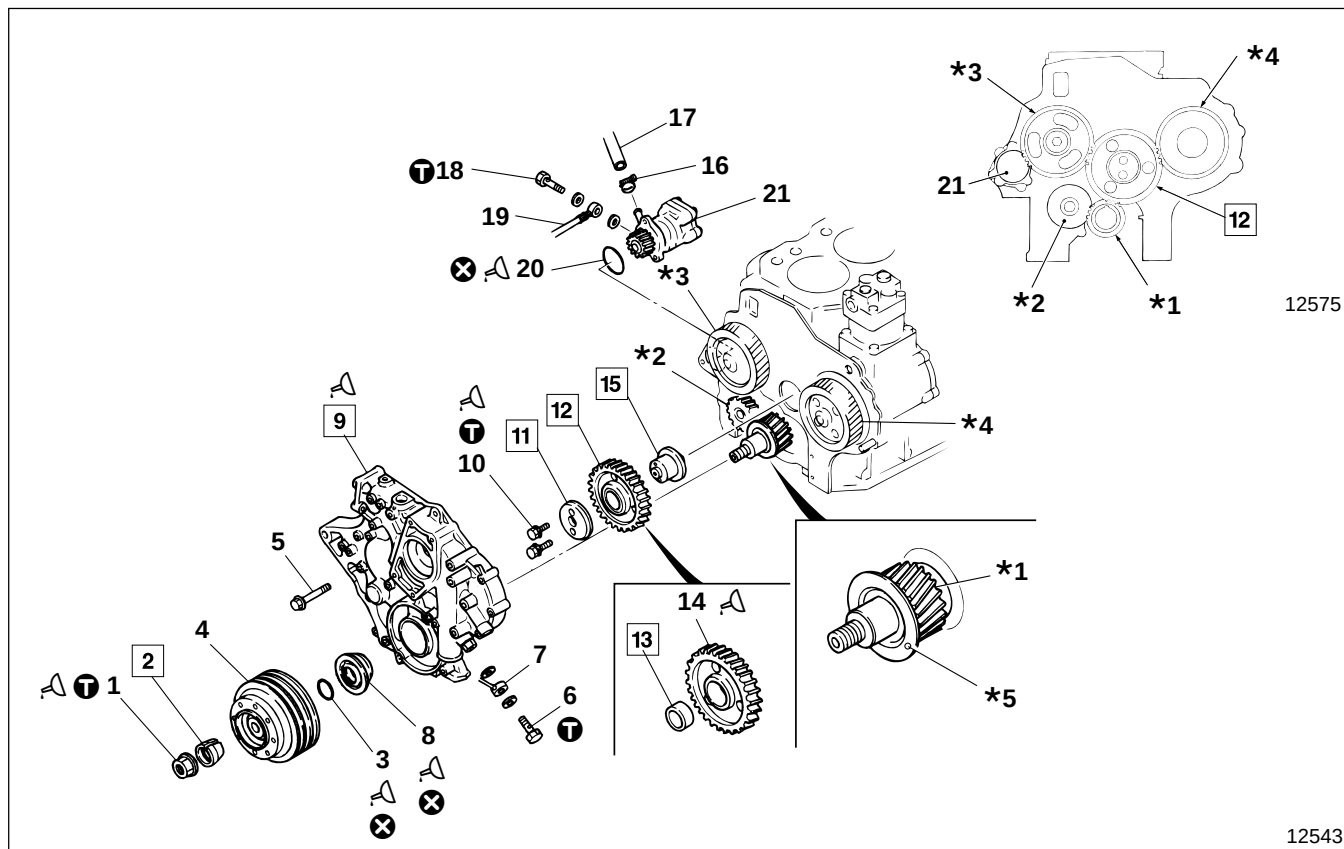
**23** Inspection of cylinder head

Measure the extent of distortion of the bottom of cylinder head **23**, and if the measured value is higher than the standard value, grind using a surface grinder.

CAUTION ⚠

Be sure to keep the amount of grinding within the limit of the height of cylinder head **23**.

TIMING GEAR



● Inspection before disassembly

📖 P11-26

● Disassembly sequence

- | | |
|------------------------------|----------------------------|
| 1 Nut | 12 Idle gear assembly |
| 2 Taper cone | 13 Idle gear bushing |
| 3 O-ring | 14 Idle gear |
| 4 Crankshaft pulley | 15 Idle gear shaft |
| 5 Bolt | 16 Clamp |
| 6 Eye bolt | 17 Oil hose 📦 Gr 37 |
| 7 Air and water suction pipe | 18 Bolt |
| 📦 Gr 12 | 19 Oil hose 📦 Gr 37 |
| 8 Front oil seal | 20 O-ring |
| 9 Timing gear case | 21 Power steering oil pump |
| 10 Bolt | 📦 Gr 37 |
| 11 Thrust plate | |

- *1 : Crankshaft gear 📖 P11-52
 *2 : Oil pump gear 📦 Gr 12
 *3 : Camshaft gear 📖 P11-28
 *4 : Air compressor gear 📦 Gr 35
 *5 : Front oil seal slinger 📖 P11-52

⊗ : Non-reusable parts

NOTE

Do not remove front oil seal 8, unless it is faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

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 {0.0023 to 0.0059}	0.3 {0.012}	Replace
		Idler gear assembly and camshaft gear	0.07 to 0.17 {0.0023 to 0.0067}	0.3 {0.012}	
		Idler gear assembly and injection pump gear	0.07 to 0.17 {0.0023 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

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

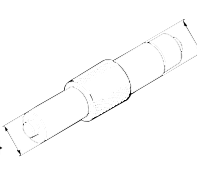
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Taper cone mounting)	490 {360, 50}	Wet
6	Eye bolt (Air and water suction pipe mounting)	25 {19, 2.6}	—
10	Bolt (Thrust plate mounting)	24 {17, 2.4}	—
18	Bolt (Oil hose mounting)	125 {94, 13}	—

L Lubricant and sealant

Location	Points of application	Kinds	Quantity
1	Thread area of nut	Engine oil	As required
3, 20	Entire body of O-ring	Engine oil	As required
8	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

C Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Cone puller  M44×1.5 12708	MH062496	Removal of taper cone
13	Idler gear bushing puller  ø49 {1.93} ø44.5 {1.75} 03532	MH062224	Removal and installation of idler gear bushing

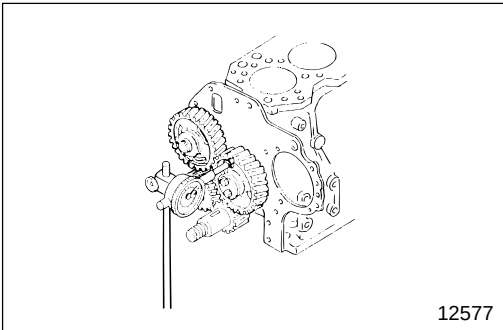
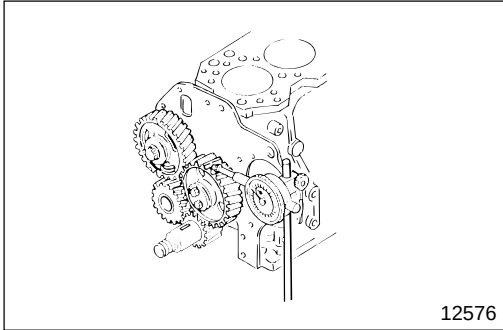
TIMING GEAR

◆ Service procedure

● Inspection before disassembly

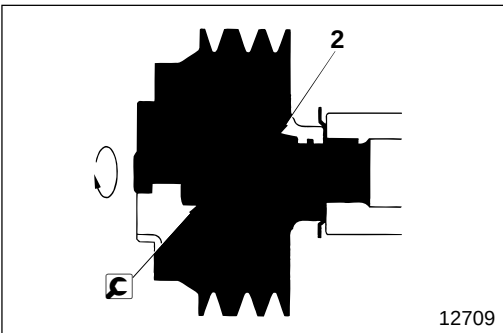
(1) Backlash of each gear

Measure three or more locations on the pairing gears and if the measurements are higher than the limit, replace the faulty parts.

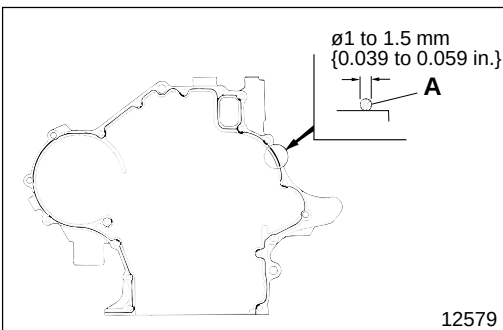


(2) End play of idler gear

If the measured value is higher than the limit, replace the faulty parts.



2 Removal of taper cone

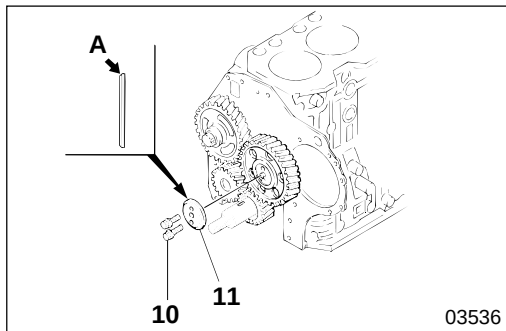


9 Installation of timing gear case

Apply sealant **A** to the mounting surface of timing gear case **9** evenly without break. After applying sealant, within three minutes, mount to the front plate.

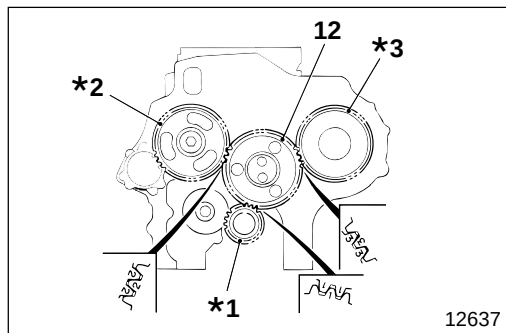
CAUTION ⚠

- Be sure to clean and wipe off oily substances from the surface where sealant **A** is to be applied.
- Make sure that sealant **A** is not transferred to other areas while the mounting work is being done.
- Be sure to reapply sealant **A** if the bolts are loosened or removed by any cause whatsoever after mounting.
- Do not start the engine within an hour of mounting.



11 Installation of thrust plate

A : Chamfered side



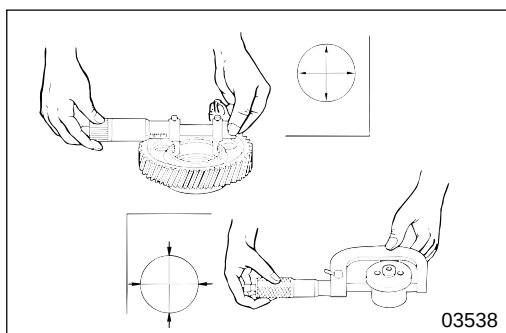
12 Installation of idler gear assembly

Install idler gear assembly **12** by matching alignment marks “**1**”, “**2**”, “**3**” on the gears that engage with those on the assembly.

- *1 : Crankshaft gear
- *2 : Camshaft gear
- *3 : Air compressor gear

NOTE

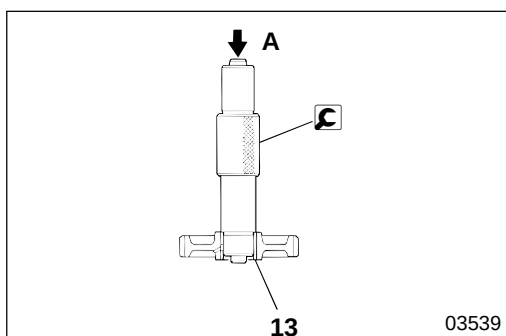
When aligning each gear with its alignment mark, make sure that pistons No.1, 6 are higher than top dead center.



13 15 Idler gear bushing and idler shaft

[Inspection]

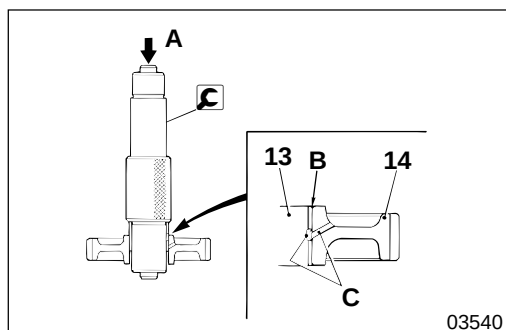
If the clearance is higher than the limit, replace the faulty parts.



Idler gear bushing

[Removal]

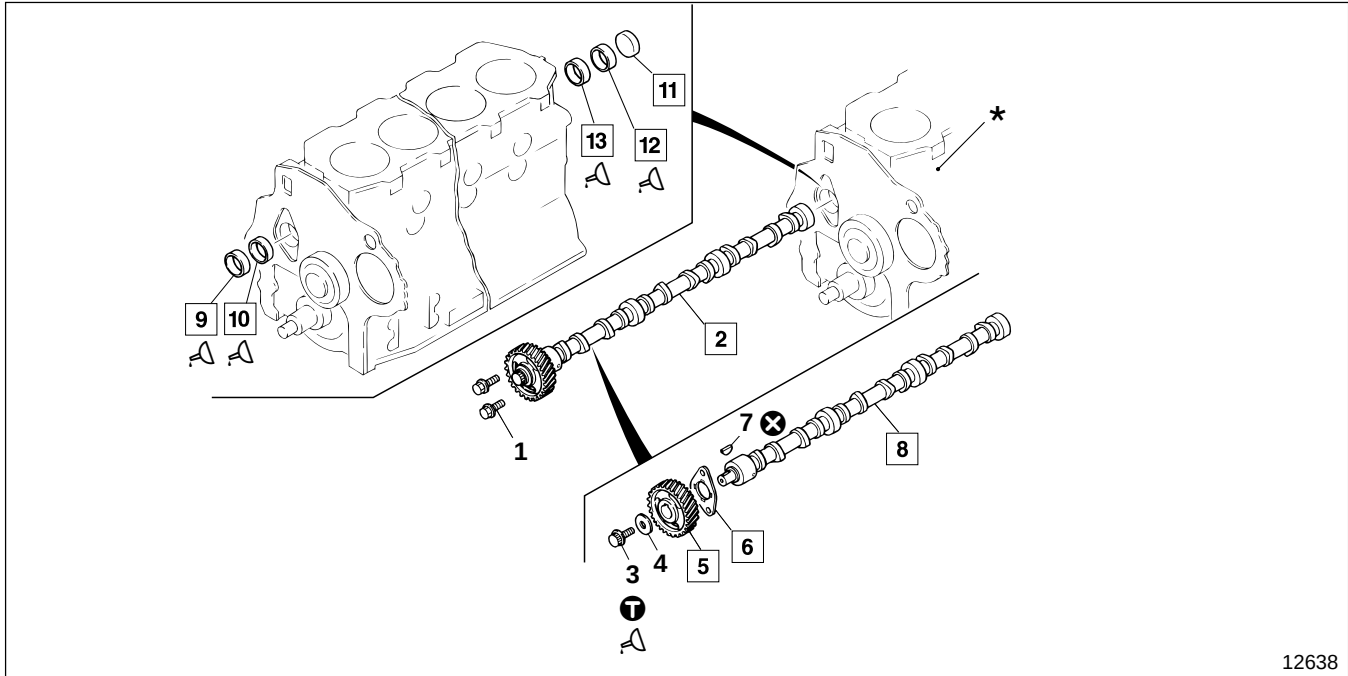
A : Press



[Press-fitting]

- Press-fit idler gear bushing **13** from chamfered side **B** of idler gear **14** and align oil holes **C** of the idler gear and the bushing.
- After press-fitting, finish the fitting by bringing the clearance between idler gear bushing **13** and the idler shaft to the standard value.

CAMSHAFT



12638

● Disassembly sequence

- | | | |
|---------------------|--------------------------|--------------------------|
| 1 Bolt | 6 Thrust plate | 11 Sealing cap |
| 2 Camshaft assembly | 7 Key | 12 No.4 camshaft bushing |
| 3 Bolt | 8 Camshaft | 13 No.3 camshaft bushing |
| 4 Washer | 9 No.1 camshaft bushing | |
| 5 Camshaft gear | 10 No.2 camshaft bushing | |

* : Crankcase P11-52

⊗ : Non-reusable parts

NOTE

Do not remove camshaft gear 5 unless it is faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value (Basic diameter in [])	Limit	Remedy
—	End play of camshaft			0.05 to 0.22 {0.0020 to 0.0087}	0.3 {0.012}	Inspect
8	Camshaft	Difference between diameters	Inlet long and short	7.195±0.05 {0.28±0.0020}	6.70 {0.26}	Replace Long diameter 47.105 {1.85} Short diameter 39.910 {1.57}
			Exhaust	7.321±0.05 {0.29±0.0020}	6.82 {0.27}	
	Bend			0.02 {0.00079} or less	0.05 {0.0020}	Replace
9, 10, 12, 13	Clearance between camshaft and camshaft bushing		No.1 to No.3	[54.5] 0.03 to 0.08 {[2.15] 0.0012 to 0.0031}	0.15 {0.0059}	Repair or replace
			No.4	[53] 0.03 to 0.08 {[2.09] 0.0012 to 0.0031}	0.15 {0.0059}	

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

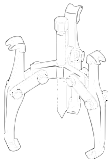
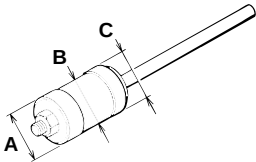
Location	Parts to be tightened	Tightening torque	Remarks
3	Bolt (Camshaft gear mounting)	175 {130, 18}	Wet

Lubricant

Location	Points of application	Kinds	Quantity
3	Thread area of bolt	Engine oil	As required
9, 10 12, 13	Inner surface of camshaft bushing	Engine oil	As required

Special tools

Unit : mm {in.}

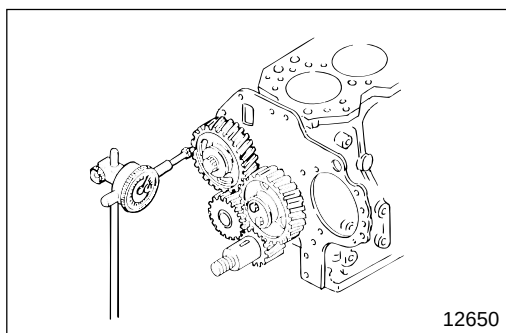
Location	Tool name and shape	Part No.	Application															
5	Gear puller  02065	MH061326	Removal of camshaft gear															
	Plug  M14x1.5 03543	MF665004	Blind plug for removal of camshaft gear															
9, 10, 12, 13	Camshaft bushing installer and extractor <table border="1"><thead><tr><th></th><th>A, C Dimension</th><th>B Dimension</th></tr></thead><tbody><tr><td>No. 1</td><td>ø58.5 {2.30}</td><td>ø54.5 {2.15}</td></tr><tr><td>No. 2</td><td>ø58 {2.28}</td><td>ø54.5 {2.15}</td></tr><tr><td>No. 3</td><td>ø58 {2.28}</td><td>ø54.5 {2.15}</td></tr><tr><td>No. 4</td><td>ø57 {2.24}</td><td>ø53 {2.09}</td></tr></tbody></table>  02083		A, C Dimension	B Dimension	No. 1	ø58.5 {2.30}	ø54.5 {2.15}	No. 2	ø58 {2.28}	ø54.5 {2.15}	No. 3	ø58 {2.28}	ø54.5 {2.15}	No. 4	ø57 {2.24}	ø53 {2.09}	MH061276	Removal and press-fitting of camshaft bushing
	A, C Dimension	B Dimension																
No. 1	ø58.5 {2.30}	ø54.5 {2.15}																
No. 2	ø58 {2.28}	ø54.5 {2.15}																
No. 3	ø58 {2.28}	ø54.5 {2.15}																
No. 4	ø57 {2.24}	ø53 {2.09}																

Service procedure

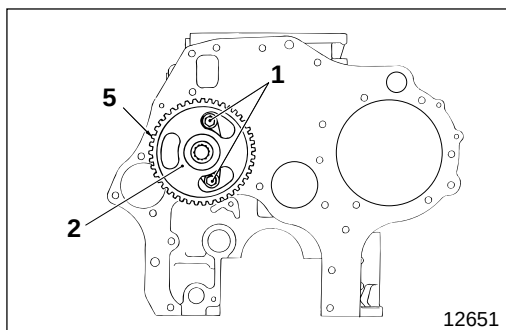
● Inspection before disassembly

Camshaft end play

If the measured value is higher than the limit, replace the faulty parts.



12650



12651

2 Camshaft assembly

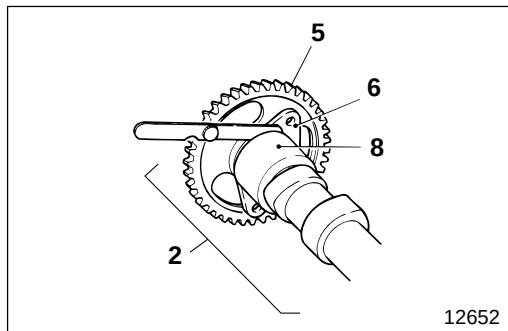
[Removal]

Remove camshaft assembly 2 by undoing bolts 1 through the holes in camshaft gear 5.

CAUTION

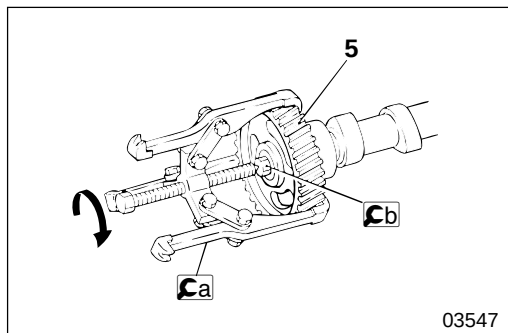
Be careful not to damage the camshaft bushings when you remove camshaft assembly 2.

CAMSHAFT



[Installation]

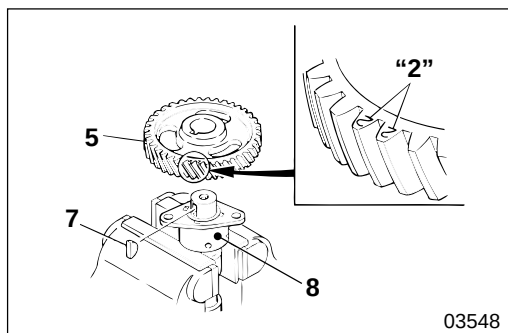
- Before installing camshaft assembly 2, measure the end play between thrust plate 6 and camshaft 8.
- If the measured value is higher than the limit, replace the faulty parts.
- Install the camshaft assembly by matching the alignment mark on camshaft gear 5 with the alignment mark on the idler gear. P11-



5 Camshaft gear

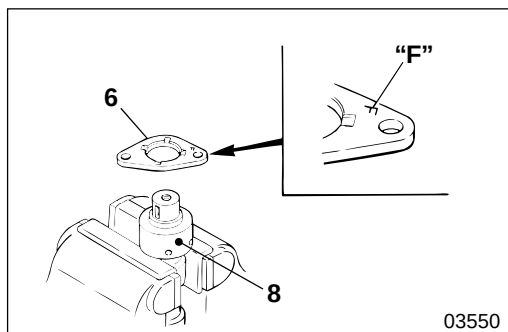
[Removal]

- Never remove camshaft gear 5 by striking, hitting, or hammering it.



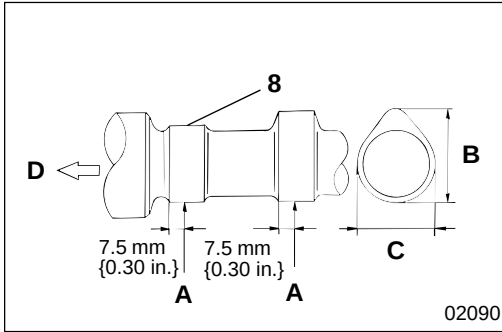
[Installation]

- Install camshaft gear 5 onto camshaft 8 in the direction as illustrated.
- Be sure when finishing the installation to install key 7.



6 Installation of thrust plate

Install thrust plate 6 onto camshaft 8 in the direction as illustrated.



8 Inspection of camshaft

(1) Difference between long diameter and short diameter

If the measured value is lower than the limit, replace camshaft 8.

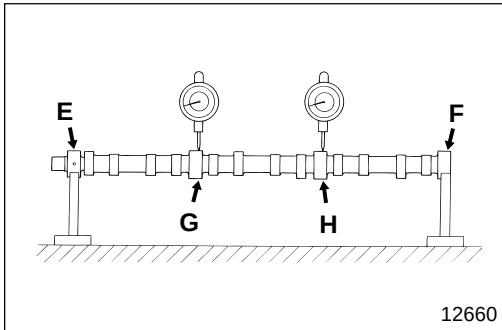
NOTE

Measure at point A, as illustrated, because the cam is tapered.

B : Long diameter

C : Short diameter

D : Front of the engine

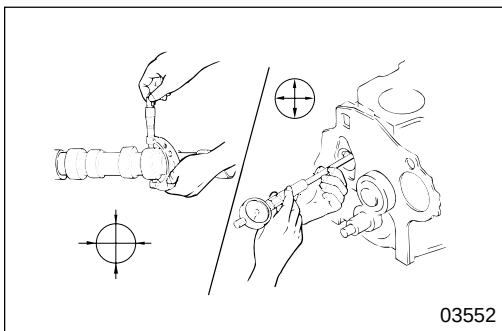


(2) Degree of bend

To measure deflection, support camshaft 8 at area E of No.1 journal, and area F of No.4 journal. Then, measure the amount of deflection at area G of No.2 journal, and area H of No.3 journal. If any of the measured values is higher than the limit, replace the camshaft.

NOTE

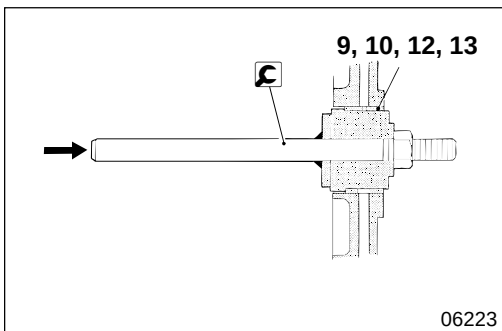
Degree of bend of camshaft 8 is a half of the indicated value of the gauge after rotating the shaft 360°.



8 to 10 12 13 Camshaft and camshaft bushing

[Inspection]

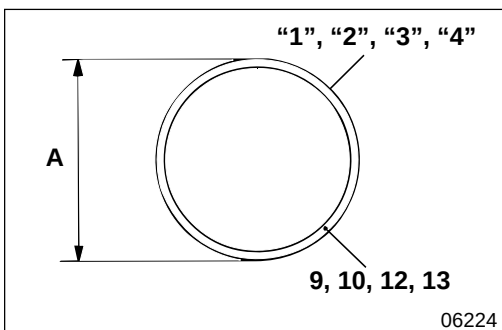
If the clearance is greater than the limit, replace the faulty parts.



Camshaft bushing

[Removal]

Remove No.3 camshaft bushing 13, and No.4 camshaft bushing 12 from the rear end of the crankcase.

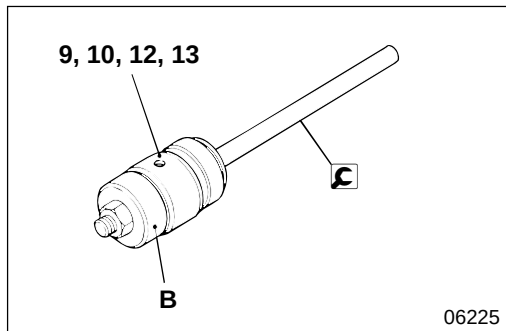


[Press-fitting]

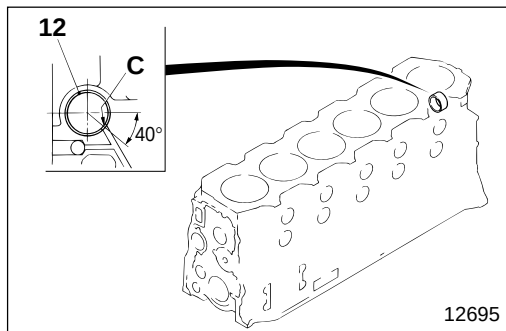
- Identify, by referring to the table below, No.1 to No.4 camshaft bushings by noting marks "1", "2", "3", "4" on camshaft bushings 9, 10, 12, 13. If you cannot identify the mark, measure outer diameter A of the bushing and refer to the table below.

Bushing No. (from the front of the engine)	Mark	Outer diameter A (mm {in.})
No.1	1	ø58.50 {2.30}
No.2	2	ø58.06 {2.28}
No.3	3	ø57.5 {2.26}
No.4	4	ø57.06 {2.25}

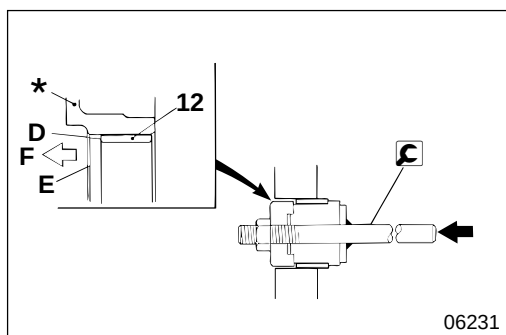
CAMSHAFT



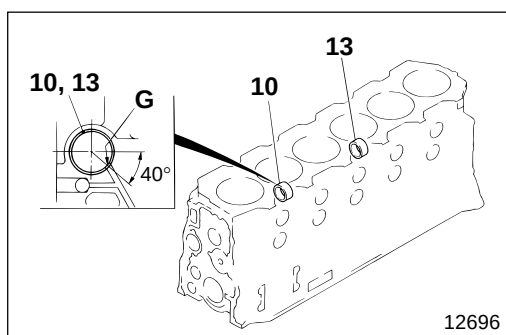
- For press-fitting, mount guide **B** to  camshaft bushing installer and extractor.
- Install camshaft bushings **9, 10, 12, 13** in descending order, from No.4 to No.1.
- Install No.4 camshaft bushing **12** from the rear end of the engine, and No.3 to No.1 camshaft bushings **9, 10, 13** from the front end of the engine.



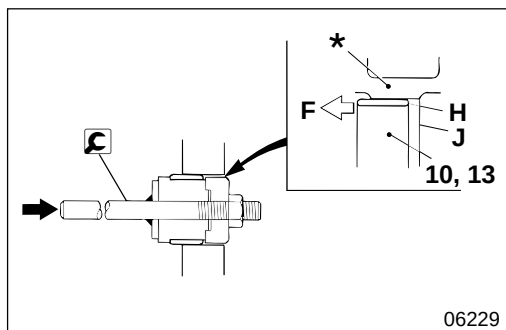
- Align oil hole **C** of No.4 camshaft bushing **12** in the direction as illustrated.



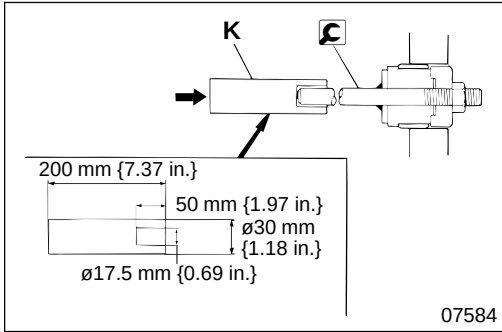
- Press in until surface **D** of No.4 camshaft bushing **12** is flush with chamfered part **E** of crankcase *****.
F : Front of the engine



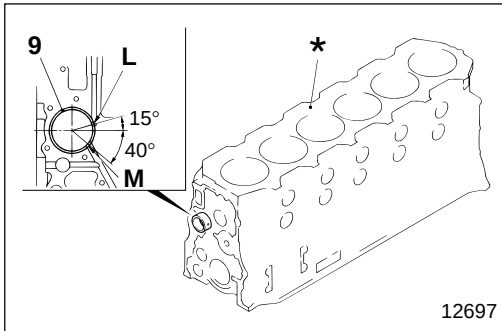
- Align oil hole **G**, of No.2 to No.3 camshaft bushings **10, 13**, in the direction as illustrated, and press-fit in the order of No.3, 2.



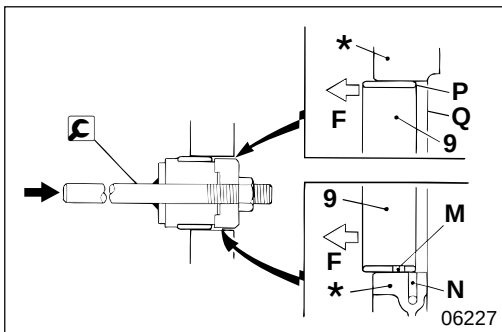
- Press in until surface **H** of No.2 to No.3 camshaft bushings **10, 13** is flush with surface **J** of crankcase *****.
F : Front of the engine



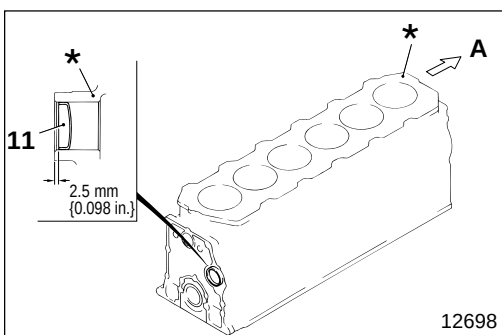
- For press-fitting of No.3 camshaft bushing **13**, use tool **K** as illustrated.



- Align oil holes **L**, **M** of No.1 camshaft bushing **9** in the direction as illustrated.
L : $\varnothing 3$ mm {0.11 in.}
M : $\varnothing 8$ mm {0.31 in.}
***** : Crankcase



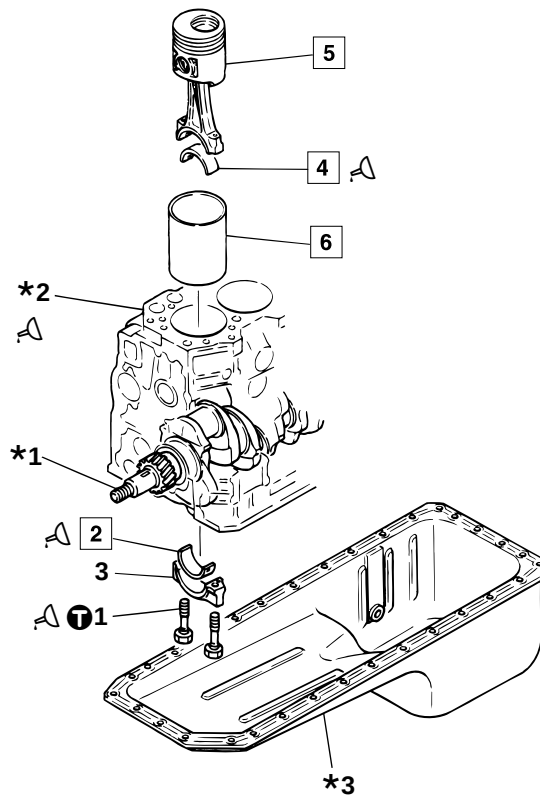
- Align oil hole **M** of No.1 camshaft bushing **9** with oil hole **N** of crankcase ***** and press in until camshaft bushing surface **P** is flush with crankcase surface **Q**.
F : Front of the engine



11 Installation of sealing cap

- Press-fit sealing cap **11** into crankcase ***** to the specified depth.
A : Front of the engine

PISTON, CONNECTING ROD AND CYLINDER SLEEVE



12702

● Disassembly sequence

- 1 Bolt
- 2 Lower connecting rod bearing
- 3 Connecting rod cap
- 4 Upper connecting rod bearing
- 5 Piston and connecting rod assembly
P11-42
- 6 Cylinder sleeve

- *1 : Crankshaft P11-52
 *2 : Crankcase P11-52
 *3 : Oil pan Gr 12

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
—	Extent of piston protrusion		0.43 to 0.69 {0.017 to 0.027}	—	Inspect
—	End play of connecting rod		0.15 to 0.45 {0.0059 to 0.018}	0.6 {0.024}	Inspect
2, 4	Connecting rod bearing	Oil clearance	[60] 0.04 to 0.09 {[2.36] 0.0016 to 0.0035}	0.2 {0.0079}	Replace
		Expansion	—	Upper : less than 64.5 {2.54} Lower : less than 64.27 {2.53}	
5, 6	Clearance between piston and connecting rod assembly and cylinder sleeve		[104] 0.07 to 0.11 {[4.094] 0.0028 to 0.0043}	—	Adjust or replace with oversizes
6	Cylinder sleeve	Inner diameter	104 to 104.03 {4.094 to 4.095}	104.25 {4.10}	Adjust or replace with oversizes
		Circular accuracy	0.01 {0.00039} or less	—	
		Cylindrical accuracy	0.03 {0.0012} or less	—	
6, *2	Interference between cylinder sleeve and crankcase	Standard	0.17 to 0.23 {0.0067 to 0.0091}	—	Replace with oversizes
		Oversize	0.19 to 0.21 {0.0075 to 0.0083}	—	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt	30 {22, 3}+90°±5°	Wet

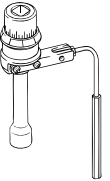
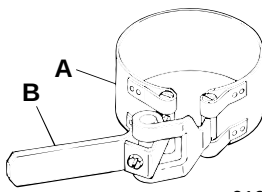
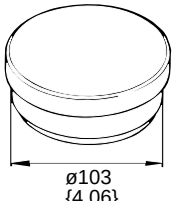
Lubricant

Location	Points of application	Kinds	Quantity
1	Thread area of bolt	Engine oil	As required
2, 4	Inner surface of bearing	Engine oil	As required
*2	Sleeve hole of crankcase	Spindle oil (ISO VG 32)	As required

PISTON, CONNECTING ROD AND CYLINDER SLEEVE

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
5	Socket wrench  01984	MH061560	Installation of piston and connecting rod assembly
	A : Piston guide clamp B : Piston guide lever  01981	A : MH061890 B : MF061658	
6	Cylinder sleeve installer  ø103 {4.06} 03377	MH062228	Installation of cylinder sleeve

Service procedure

Inspection before disassembly

(1) Extent of piston protrusion from the upper surface of crankcase *2

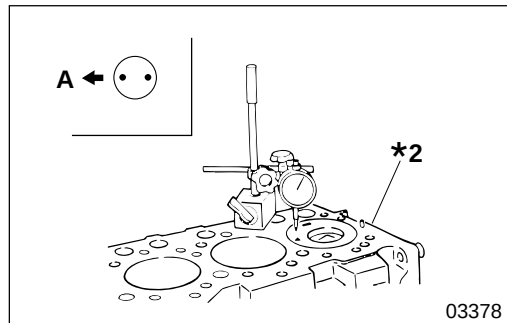
NOTE

Always inspect the extent of piston protrusion because it affects the engine performance greatly.

- Measure piston protrusion at two points on the top of the piston, and produce the average value.

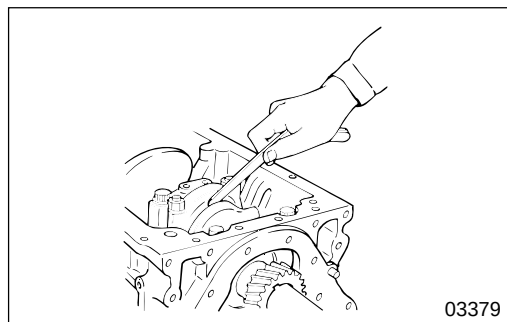
A : Front of the engine

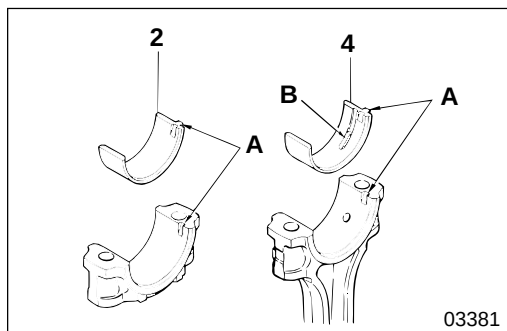
- If the average value deviates from the limit, inspect clearance of the related parts.



(2) End play of connecting rod

- Measure the end play of each connecting rod.
- If the measured value is higher than the limit, replace the faulty parts.





2 4 Connecting rod bearing

[Installation]

Install connecting rod bearings 2, 4 by matching lugs A to the connecting rods.

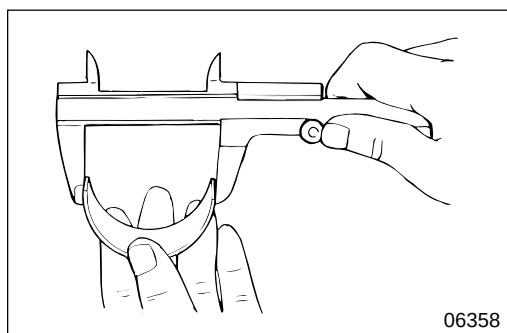
CAUTION ⚠

Be sure to distinguish between upper and lower connecting rod bearings 2, 4. The upper bearing has oil opening B while the lower bearing has no oil opening.

[Inspection]

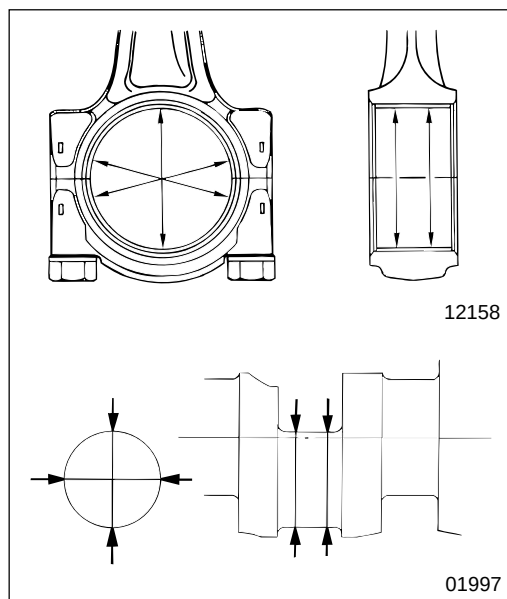
CAUTION ⚠

- Do not forcibly open or expand connecting rod bearings 2, 4.
- When either upper or lower connecting rod bearings 2, 4 needs replacing, replace as a set.



(1) Expansion at free state

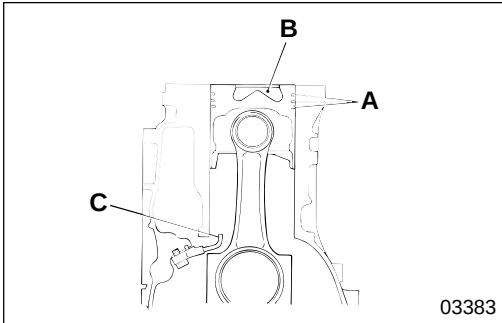
If the measured value is lower than the limit, replace connecting rod bearings 2, 4.



(2) Clearance between connecting rod bearing and crankshaft

If the clearance between connecting rod bearing 2, 4 and crankshaft *1 is lower than the limit, replace the faulty parts.

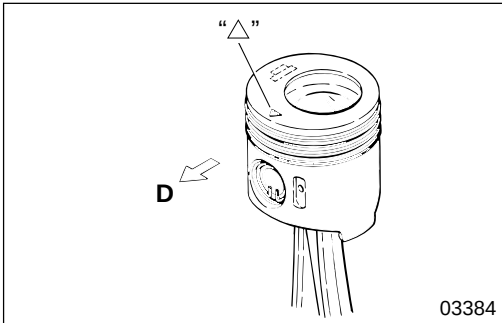
PISTON, CONNECTING ROD AND CYLINDER SLEEVE



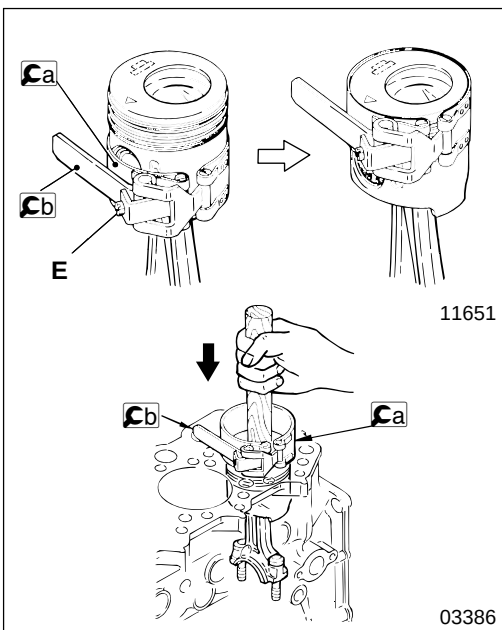
5 Installation of piston and connecting rod assembly

CAUTION

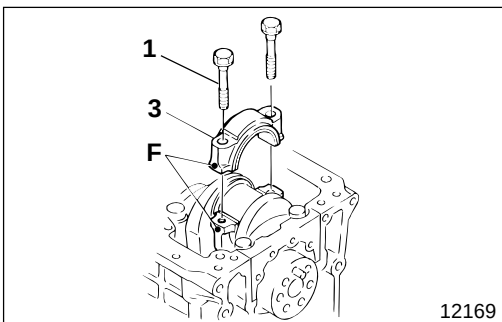
- Be sure to fit piston ring A in the correct position.
 P11-46
- Be careful not to scratch or damage head B of the piston (a part of the combustion chamber).
- Make sure that the connecting rod does not hit oil jet C.



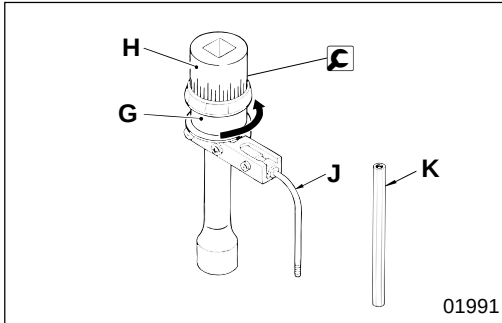
- Install piston front mark "△" directed towards the front of the engine using the following procedure.
D : Front of the engine



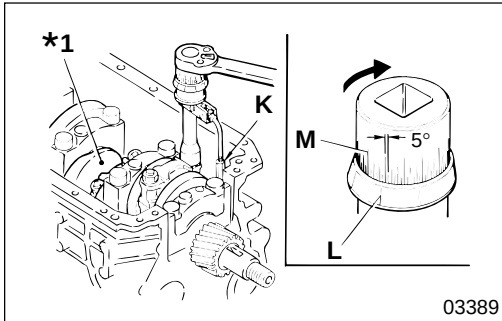
- Match the inner diameter of Ca piston guide clamp to the outer diameter of the piston skirt by turning adjusting bolt E of Cb piston guide lever.
- After adjusting, set Ca piston guide clamp and Cb piston guide lever at the top of the piston so that the clamp is flush with the top of the piston.



- After the piston is inserted, align alignment marks F on the connecting rod with the alignment marks on connecting rod cap 3 and tighten bolt 1 at specified torque. Then tighten the bolt further as follows:



- Turn socket wrench holder **G** counterclockwise and keep the spring in the wrench compressed.
- H** : Socket
- J** : Rod
- K** : Rod (for connection)

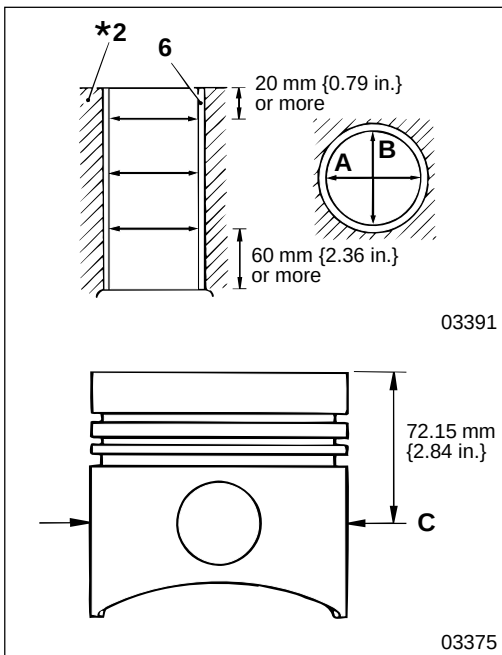


- Set socket wrench holder **G** so that the repercussive force of the spring presses rod **K** (for connection) against crankshaft ***1**.
- Select a scale that is convenient for reading graduation **L** on holder **G**.
- Tighten further by turning socket **H** clockwise by $90^\circ \pm 5^\circ$ (setting is in 5° increments), referring to graduation **M** on the selected scale.

NOTE

After installation of connecting rod cap 3, inspect the following points :

- End play of the connecting rod : P11-36
- Piston protrusion : P11-36



5 6 Piston and connecting rod assembly, and cylinder sleeve

[Inspection]

- If the inner diameter of cylinder sleeve **6** is higher than the limit, bore the cylinder sleeve oversize and use an oversized piston.
- A** : In the direction of the crankshaft axis
- B** : At right angles to the crankshaft axis
- If the clearance between piston **5** and cylinder sleeve **6** deviates from the standard value, even when the inner diameter of the cylinder sleeve is within the limit, replace the piston.

[Selection of oversized piston]

Extent of oversize : 0.50, 1.00 mm {0.020, 0.039 in.}

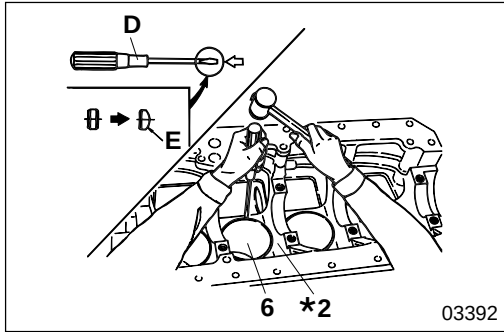
- Determine the extent of oversize by measuring the inner diameters of all the cylinders and calculating the maximum wear amount of all the cylinders.
- Measure the outer diameter of the oversized piston to be used.
- C** : Position to measure the outer diameter of the piston

- Bore cylinder sleeve **6** and hone it to make the clearance between piston **5** and the cylinder sleeve conform to the standard value.

NOTE

- Even if only one cylinder sleeve **6** requires boring, all the other cylinder sleeves must be bored to the identical oversize.
- Piston rings must be replaced with the corresponding oversized ones.

PISTON, CONNECTING ROD AND CYLINDER SLEEVE



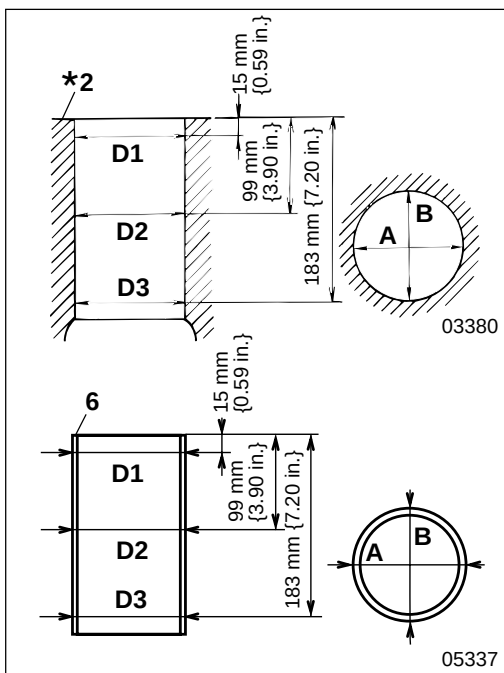
Cylinder sleeve

[Removal]

- Mount a boring machine on crankcase ***2** and center. Centering must be done at the lower part of cylinder sleeve **6** which is less unevenly worn.
- Bore until the thickness of cylinder sleeve **6** is approximately 0.5 mm {0.020 in.}.
- Insert tool **D** (a modified screwdriver) between crankcase ***2** and cylinder sleeve **6**, break the sleeve by tapping it gently, then remove.

CAUTION

Make sure when inserting tool **D** that round part **E** is facing crankcase ***2**.



[Installation]

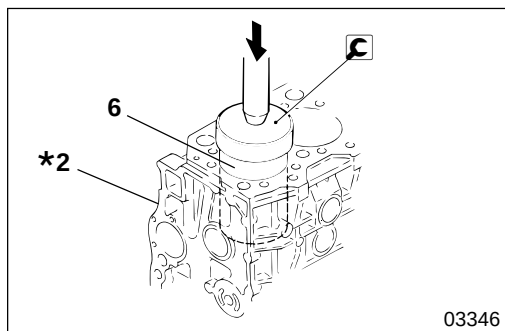
- Inspect sleeve hole of crankcase ***2** before installing cylinder sleeve **6**. If there are irregularities, such as defects or insufficient interference, correct them by boring.

NOTE

- Pull out cylinder sleeve **6** of all cylinders and bore the sleeve holes perfectly round when you bore the sleeve holes of crankcase ***2**.
- Apply spindle oil (ISO VG 32) when you push cylinder sleeve **6** into the sleeve hole of crankcase ***2**.

Inspection of interference must be carried out as follows.

- Measure the inner diameter of the sleeve hole of crankcase ***2** and the outer diameter of cylinder sleeve **6** at the specified positions illustrated.
- Take the average value at the top, middle and bottom (**D1**, **D2**, **D3**) and across the diameter (**A**, **B**). If the interference is lower than the limit, bore the sleeve hole of crankcase ***2** oversize.



< If interference is sufficient >

- Press-fit cylinder sleeve **6** into crankcase ***2** from the chamfered end using  cylinder sleeve installer.

NOTE

Align the top of cylinder sleeve 6 with the top of crankcase *2 when press-fitting.

- After press-fitting, make the inner diameter of cylinder sleeve **6** conform to the standard value by honing the surface.

< If interference is insufficient >

- Prepare cylinder sleeve **6** which is 0.5 mm {0.020 in.} oversize in diameter.
- Hone crankcase ***2**, making the clearance between the outer diameter of cylinder sleeve **6** and the sleeve hole of crankcase ***2** conform to the standard value.
- Press-fit cylinder sleeve **6** into crankcase ***2** from the chamfered end using  cylinder sleeve installer.

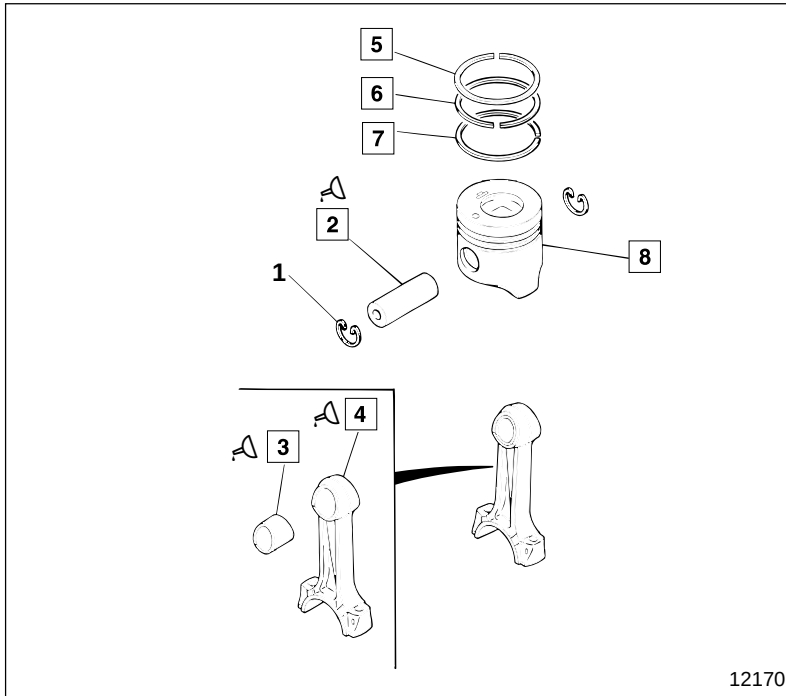
NOTE

Align the upper face of cylinder sleeve 6 with the upper face of crankcase *2 when press-fitting.

- After press-fitting, make the inner diameter of cylinder sleeve **6** conform to the standard value by honing the surface.

PISTON, CONNECTING ROD AND CYLINDER SLEEVE

Piston and Connecting Rod Assembly



● Disassembly sequence

- 1 Snap ring
- 2 Piston pin
- 3 Connecting rod bushing
- 4 Connecting rod
- 5 1st compression ring
- 6 2nd compression ring
- 7 Oil ring
- 8 Piston

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

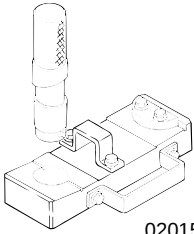
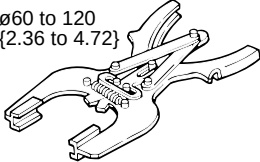
Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
2, 3	Clearance between piston pin and connecting rod bushing		[36] 0.03 to 0.04 {[1.42] 0.0012 to 0.0016}	0.1 {0.0039}	Replace
2, 8	Clearance between piston and piston pin		[36] 0.007 to 0.021 {[1.42] 0.00028 to 0.00083}	0.05 {0.0020}	Replace
4	Degree of bend and distortion of connecting rod		—	0.05 {0.0020}	Repair or replace
5 to 7	Deviation of piston ring fitted position	1st compression ring	0.3 to 0.45 {0.012 to 0.018}	1.5 {0.059}	Replace
		2nd compression ring	0.4 to 0.55 {0.016 to 0.022}		
		Oil ring	0.25 to 0.45 {0.0098 to 0.018}		
5 to 8	Clearance between piston ring and piston ring groove	1st compression ring	0.02 to 0.10 {0.00079 to 0.0039}	0.2 {0.0079}	Replace
		2nd compression ring	0.05 to 0.08 {0.0020 to 0.0031}	0.15 {0.0059}	
		Oil ring	0.03 to 0.06 {0.0012 to 0.0024}		

Lubricant

Location	Points of application	Kinds	Quantity
2	Exterior of piston pin	Engine oil	As required
3	Exterior of connecting rod bushing	Engine oil	As required
4	Bushing attachment area of connecting rod	Engine oil	As required

Special tools

Unit : mm {in.}

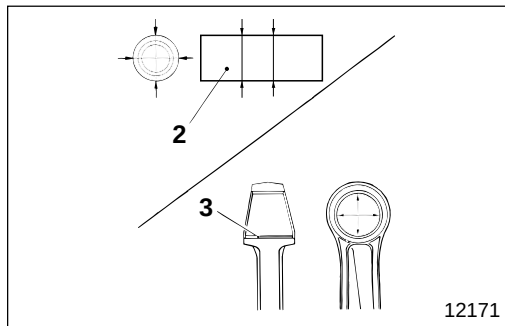
Location	Tool name and shape	Part No.	Application
3	Connecting rod bushing puller kit  02015	MH062225	Removal and installation of connecting rod bushing
5 to 7	Piston ring tool  02013	MH060014	Removal and installation of piston ring

◆ Service procedure

Piston pin and connecting rod bushing

[Inspection]

If the clearances are higher than the limit, replace the faulty parts.



Connecting rod bushing

Use  connecting rod bushing puller kit to replace connecting rod bushing 3.

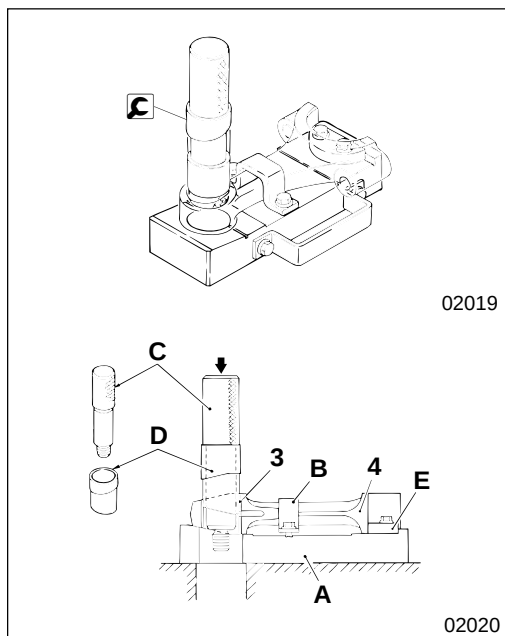
(Components of  connecting rod bushing puller kit)

A : Base B : Bracket C : Puller D : Collar
E : Plate F : Collar G :

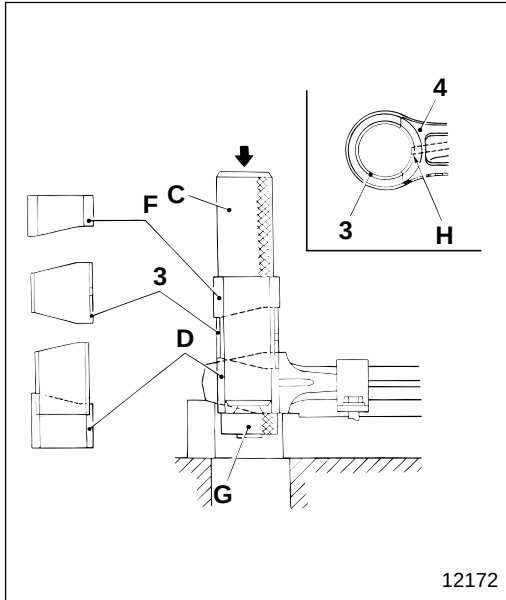
Nut

[Pulling-out]

- Remove upper connecting rod bearing from the big end of connecting rod 4.
- Place connecting rod 4 on base A and fix it to the base at two points, bracket B and plate E.
- Fit collar D in puller C in the direction as illustrated, and pull out connecting rod bushing 3 with a gradual load of approximately 49 kN {11020 lbf, 5000 kgf}.



PISTON, CONNECTING ROD AND CYLINDER SLEEVE

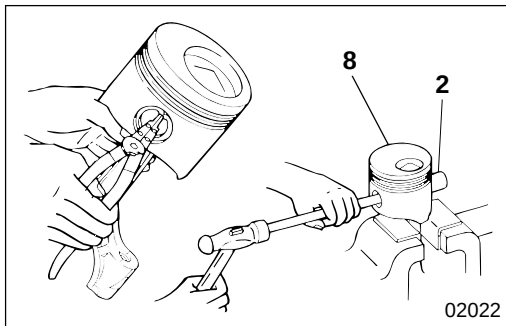


[Press-fitting]

- Apply engine oil to the exterior peripheral area of connecting rod bushing 3 and the inner area of the bushing fitting ring of connecting rod 4.
- Fit collar F, connecting rod bushing 3 and collar D in puller C in the arrangement and direction as illustrated and mount them with nut G.
- Align oiling holes H of connecting rod bushing 3 and connecting rod 4, and gradually press in the bushing with approximately 49 kN {11023 lbf, 5000 kgf} load.
- After press-fitting, ream connecting rod bushing 3 to make its clearance with piston pin 2 conform to the standard value.

NOTE

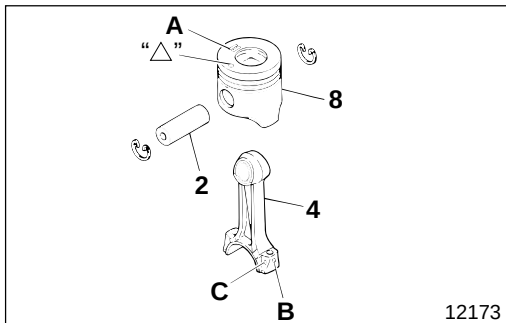
After press-fitting bushing 3, insert piston pin 2 and make sure that the rod moves smoothly without any excessive play.



2 4 8 Piston pin and connecting rod and piston

[Disassembly]

- Drift out piston pin 2 using a rod.
- When removal of piston pin 2 is difficult, warm piston 8 using a piston heater or hot water.



[Installation]

- Apply engine oil to piston pin 2 and assemble connecting rod 4 and piston 8 in the direction as illustrated.

A : Piston mass (Mass of piston is marked)

B : Connecting rod mass mark (Alphabetical: A, B, C, D, E, F, G)

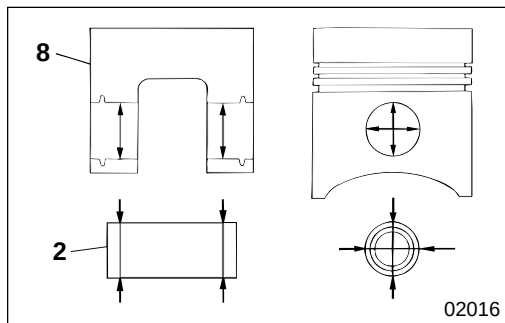
C : Mounting base of connecting rod cap

Δ : Front mark

- When piston pin 2 insertion is difficult, warm piston 8 using a piston heater or hot water.

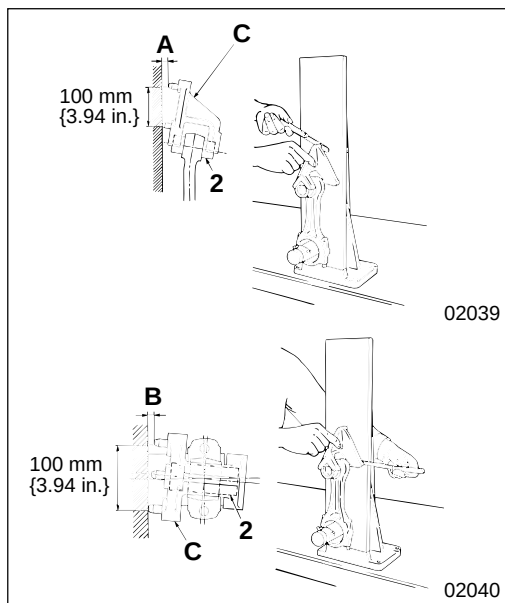
CAUTION ⚠

- Make sure that the total mass error of all pistons 8 in one engine is 10 g {0.35oz} or less.
- Be sure to install connecting rods 4, to be used in one engine, that have identical mass mark B.
- Be sure that after inserting piston pin 2 the connecting rod operates smoothly without excessive play.



2 8 Clearance between piston pin and piston

If the clearance is higher than the limit, replace the faulty parts.



4 Degree of bend or distortion of connecting rod

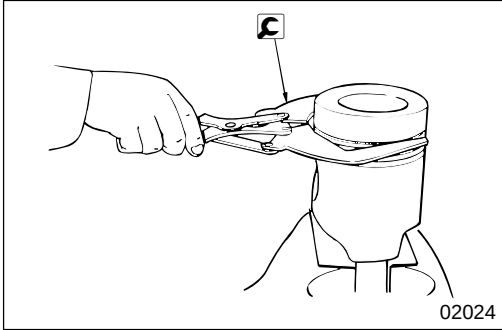
- Mount connecting rod bushing 3 and piston pin 2 to connecting rod 4.
- Measure degree of bend A and distortion B of connecting rod 4. If the measured value is higher than the limit, repair or replace the connecting rod.

C : Connecting rod aligner (Measuring instrument)

NOTE

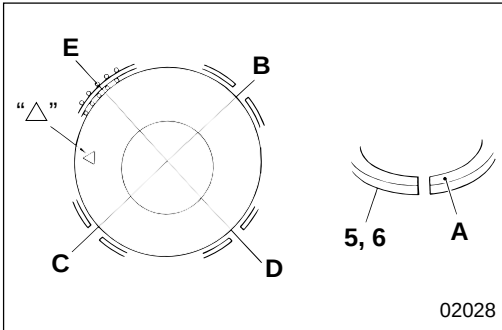
- When making measurements by mounting connecting rod 5 to connecting rod aligner C, make sure that the upper connecting rod bearing and the lower connecting rod bearing are mounted on the rod.
- Mount the connecting rod cap by tightening the bolt at specified torque. P11-34

PISTON, CONNECTING ROD AND CYLINDER SLEEVE



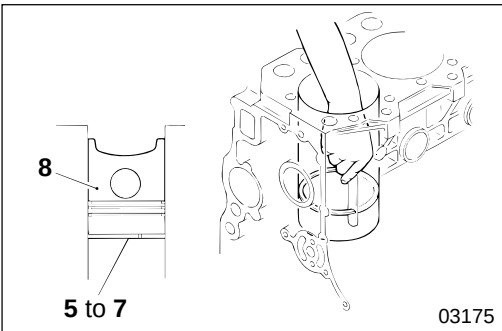
5 to 8 Piston ring and piston

Piston ring
[Removal]



[Installation]

- Install oil ring **8** 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
Δ : Front mark of piston



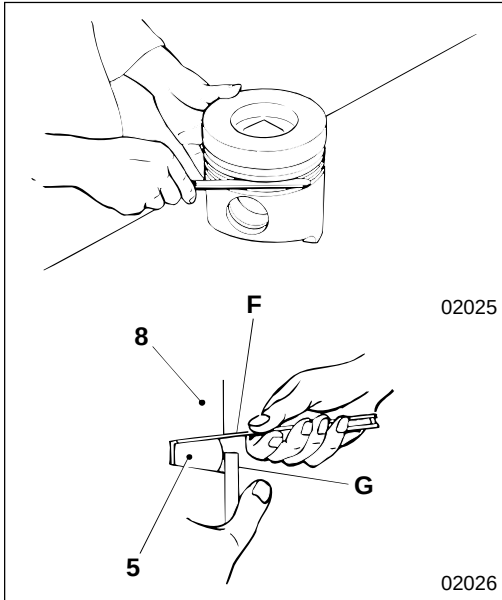
[Inspection]

(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.



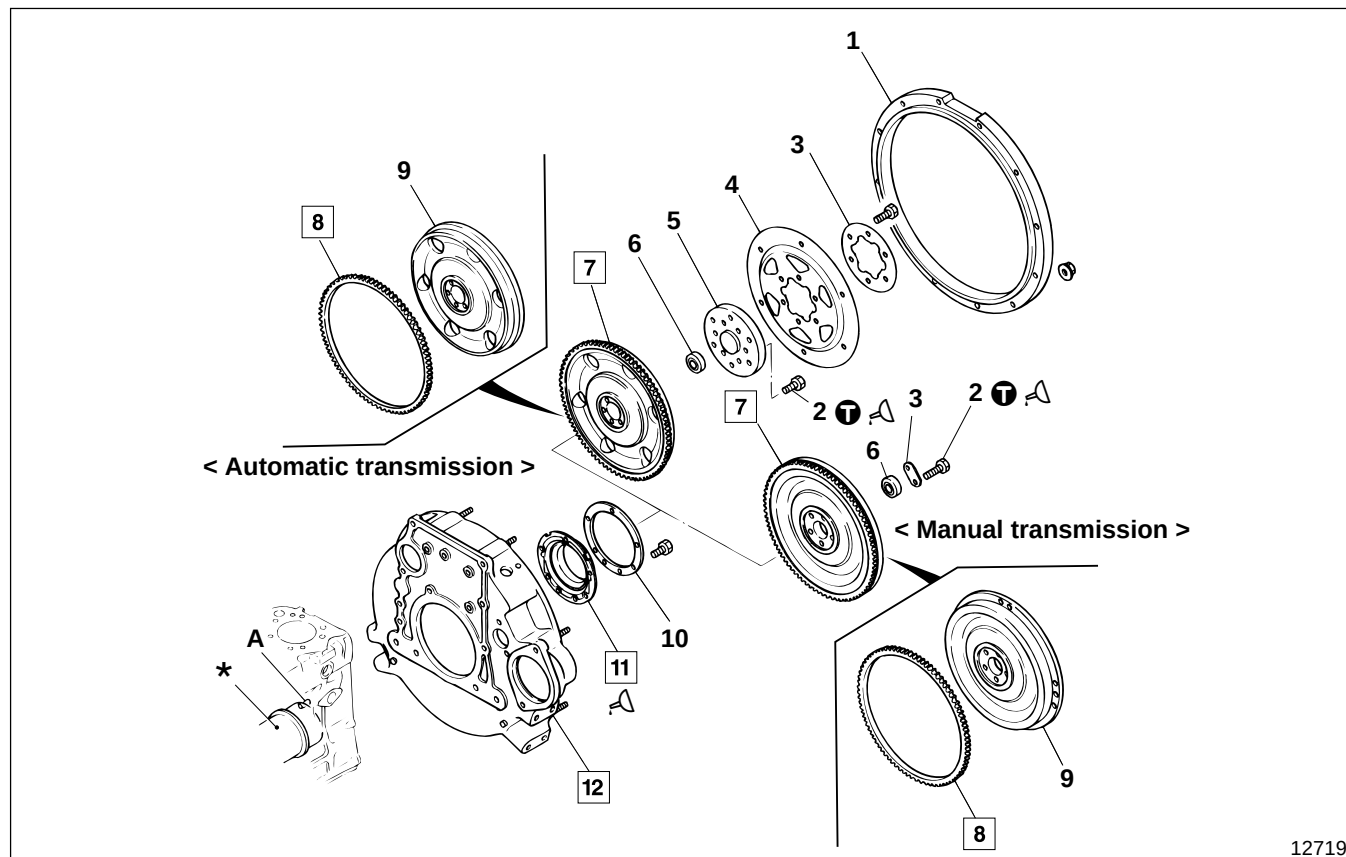
(2) Clearance between piston ring and ring groove

- If the measured value is higher than the limit, replace the faulty parts.
- Measure using feeler gauge **F**, by pressing 1st compression ring **5** against piston **8** with straight edge **G**.

NOTE

- Measurement has to be conducted around the whole periphery of piston **8** after removing carbon deposits.
- Be sure to exchange the whole set of piston rings 5 to 7 as a set if any of the rings is faulty.

FLYWHEEL



12719

● Disassembly sequence

- | | | |
|---|--|---------------------------------|
| 1 Flywheel housing adaptor
< Automatic transmission > | 5 Flywheel adaptor
< Automatic transmission > | 11 Rear oil seal |
| 2 Bolt | 6 Bearing | 12 Flywheel housing |
| 3 Plate < Manual transmission >
Wear plate
< Automatic transmission > | 7 Flywheel assembly | * : Crankshaft assembly P11-52 |
| 4 Flex plate
< Automatic transmission > | 8 Ring gear | A : Positioning pin |
| | 9 Flywheel | |
| | 10 Washer plate | |

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Be sure to check wobble of flywheel 9 after installing flywheel assembly 7. P11-49

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
7	Flywheel assembly < Manual transmission >	Height from bolt mounting surface to friction surface	24.5 {0.96}	23.5 {0.93}	Correct or replace
		Distortion of friction surface	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Wobble of friction surface when installed	—	0.2 {0.0079}	Correct or replace
12	Eccentricity of spigot when installed		—	0.2 {0.0079}	Inspect or replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Flywheel mounting)	39 {29, 4} +45° ±5°	Wet

L Lubricant and sealant

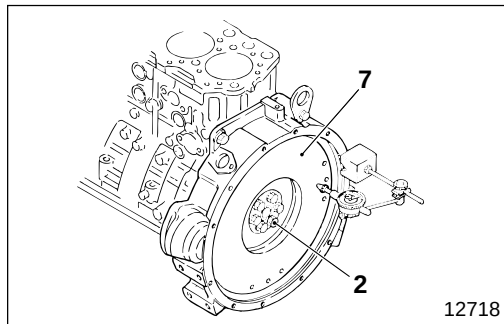
Location	Points of application	Kinds	Quantity
2	Thread area of bolt	Engine oil	As required
11	Lip area of rear oil seal	Engine oil	As required
	Crankcase mounting surface of rear oil seal	THREEBOND 1207C	As required

◆ Service procedure**7 Flywheel assembly**

[Inspection]

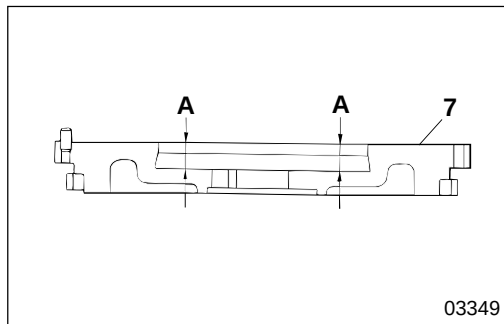
(1) Wobble

If the measured value is higher than the limit, check the fastening of bolt **2**, the attachment surface of crankshaft assembly, and depending on the condition found, either repair or replace flywheel assembly **7**.

**(2) Height of friction surfaces**

If the measured value is lower than the limit, repair or replace flywheel assembly **7**.

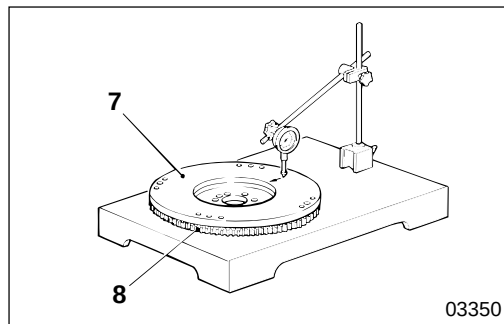
A : Height from bolt mounting surface to friction surface

**(3) Distortion of friction surface**

If the measured value is lower than the limit, repair or replace flywheel assembly **7**.

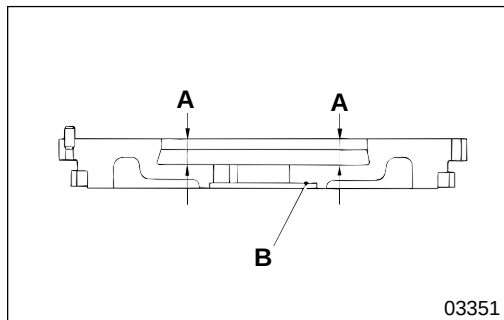
NOTE

If any fault is found in ring gear **8**, replace it first, then begin the inspection.

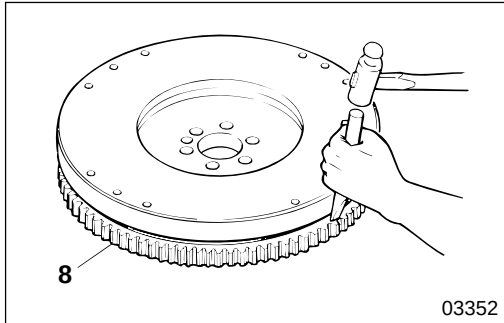


[Correction]

Make sure when grinding the friction surfaces for correction, that height **A** is not lower than the limit while maintaining the degree of parallel with surface **B** within 0.1 mm {0.0039 in.}.



FLYWHEEL



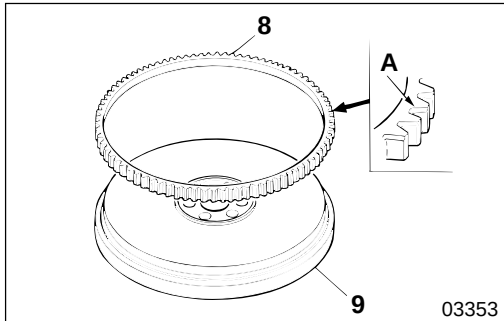
8 Ring gear

[Inspection]

Check and see if there is any damage, wear or other fault, and if any fault is found, replace ring gear 8.

[Removal]

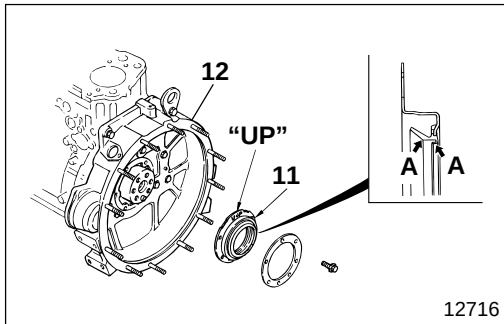
- Heat up ring gear 8 evenly using an acetylene torch.
- Hammer the outer edge of ring gear 8 evenly until it drops off.



[Installation]

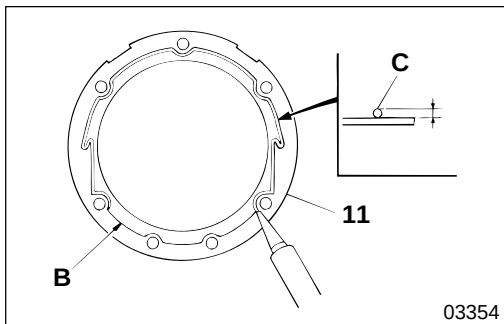
- Heat up ring gear 8 using a piston heater to approximately 100°C {212°F} for three minutes.
- With the side of the chamfered teeth of ring gear 8 facing you, mount it on flywheel 9.

A : Chamfered ring gear side



11 Mounting of rear oil seal

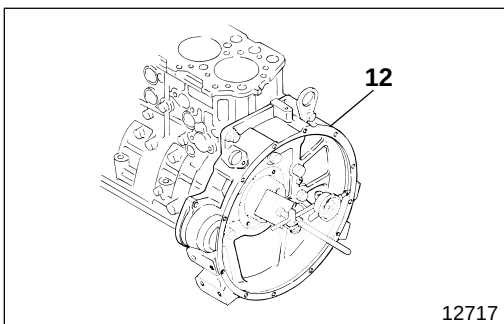
- Apply engine oil to lip area A of rear oil seal 11.
- Install rear oil seal 11 in flywheel housing 12 in the direction as illustrated.



- Apply sealant C along line B on rear oil seal 11 evenly without break
- After applying sealant C, within three minutes, mount rear oil seal 11.

CAUTION ⚠

- Do not start the engine within an hour of installing rear oil seal 11.
- Be sure to reapply sealant C if the bolts (for mounting rear oil seal 11) are loosened or removed by any cause whatsoever after mounting.



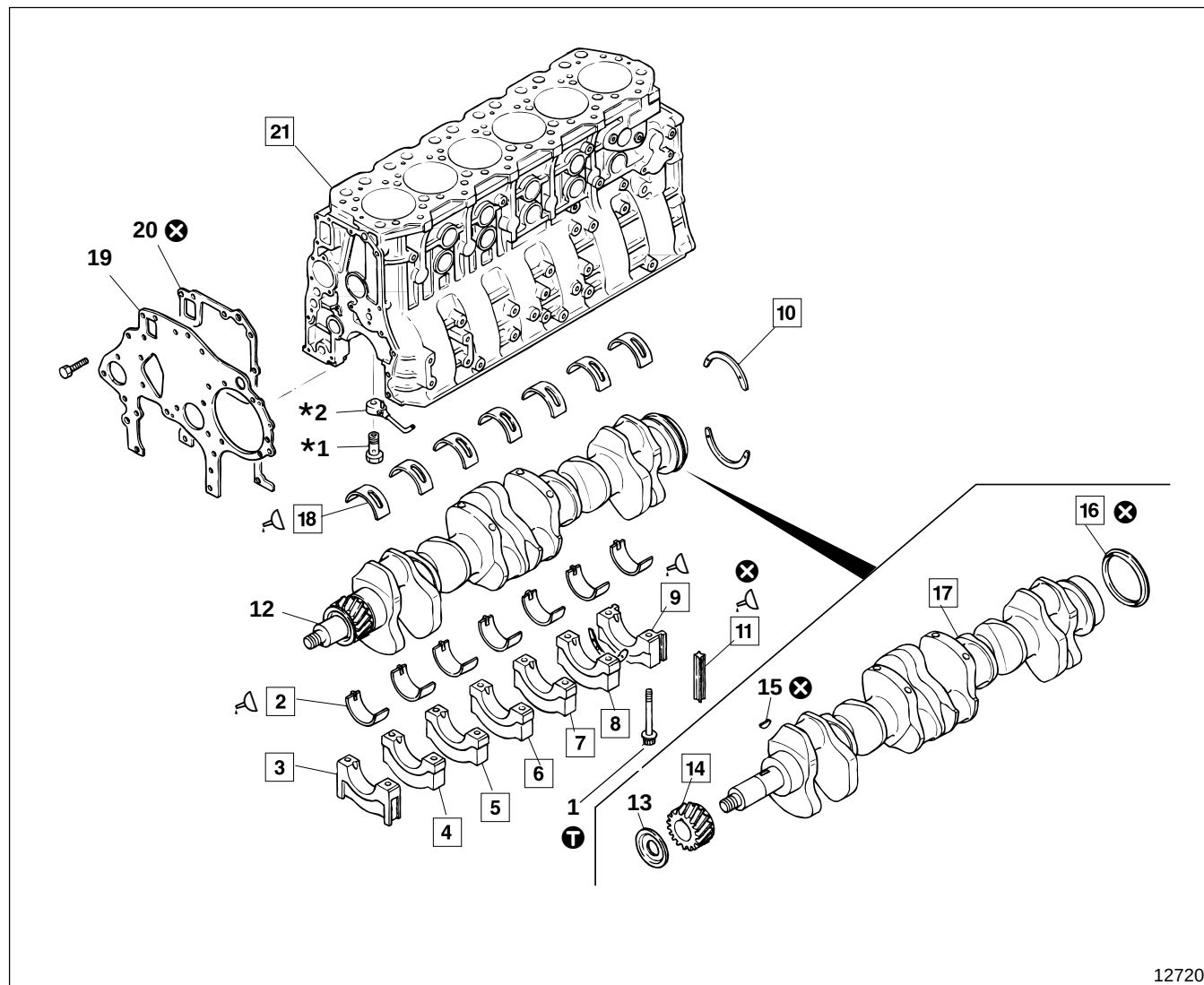
12 Inspection of flywheel housing

Mount of eccentricity

- If the measured value is higher than the limit, reassemble flywheel housing 12.
- After reassembly, if the measured value is still higher than the limit, replace the faulty parts.

MEMO

CRANKSHAFT AND CRANKCASE



12720

● Inspection before disassembly

📖 P11-54

● Disassembly sequence

- | | | |
|-----------------------|---------------------------|--------------------------|
| 1 Bolt | 10 Thrust plate | 18 Main bearing, upper |
| 2 Main bearing, lower | 11 Side seal | 19 Front plate |
| 3 No.1 main bearing | 12 Crankshaft assembly | 20 Gasket |
| 4 No.2 main bearing | 13 Front oil seal slinger | 21 Crankcase |
| 5 No.3 main bearing | 14 Crankshaft gear | |
| 6 No.4 main bearing | 15 Key | *1 : Check valve 📦 Gr 12 |
| 7 No.5 main bearing | 16 Rear oil seal slinger | *2 : Oil jet 📦 Gr 12 |
| 8 No.6 main bearing | 17 Crankshaft | ⊗ : Non-reusable parts |
| 9 Rear main bearing | | |

CAUTION ⚠️

Do not remove crankshaft gear 14, check valve *1 or oil jet *2 unless it is faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value (Basic diameter in [J])	Limit	Remedy
—	Camshaft end play			0.10 to 0.26 {0.003 to 0.010}	0.4 {0.010}	Inspect
2, 18	Main bearing	Oil clearance		[78] 0.03 to 0.09 {[3.07] 0.0012 to 0.0035}	0.15 {0.0059}	Replace
		Free tension		—	less than 82.5 {3.25}	Replace
17	Crankshaft	Bend		0.02 {0.00079} or less	0.05 {0.0020}	Replace
		Pin and journal	Circular accuracy	0.01 {0.00039} or less	0.03 {0.0012}	Correct or replace
			Cylindrical accuracy	0.006 {0.00024} or less	—	Correct or replace
21	Distortion of crankcase top surface			0.07 {0.0028} or less	0.2 {0.0079}	Correct or replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

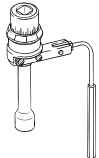
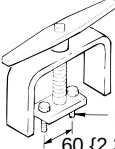
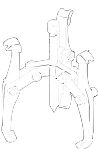
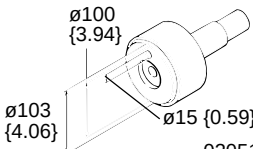
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Main bearing cap mounting)	59 {43, 6}+90°	Wet Reuse up to three times

Lubricant and sealant

Location	Points of application	Kinds	Quantity
2, 18	Interior of main bearing	Engine oil	As required
9	Pack side seal driving-in groove of rear main bearing	THREEBOND 1207C	As required
11	Side seal tip	THREEBOND 1207C	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3 to 9	Socket wrench 	MH061560 01984	Installation of main bearing cap
9	Bearing cap extractor 	MH061083 M8×1.25 60 {2.36} 03516	Removal of rear main bearing cap
14	Gear puller 	MH061326 02065	Removal of crankshaft gear
16	Rear oil seal slinger installer 	MH062677 ø100 {3.94} ø103 {4.06} ø15 {0.59} 02051	Installation of rear oil seal slinger

CRANKSHAFT AND CRANKCASE

◆ Service procedure

● Inspection before disassembly

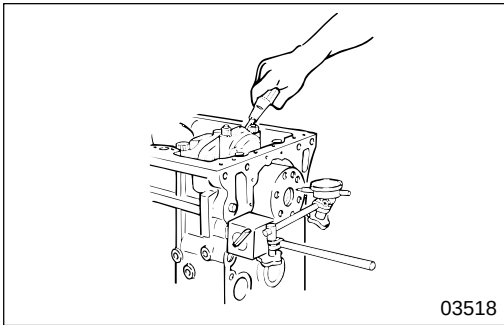
Crankshaft assembly end play

If the measured value is higher than the limit, replace thrust plates **10** with oversized ones. P11-56

< Available oversize ones >

+0.15, +0.30, +0.45 mm

{+0.0059, +0.012, +0.018 in.}



03518

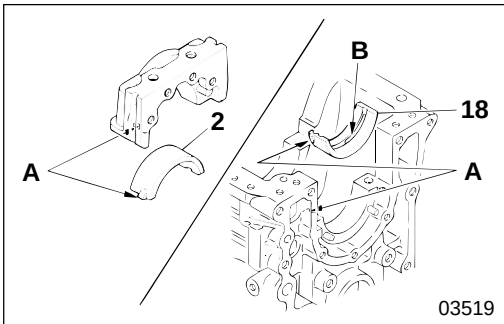
2 **18** Main bearing

[Installation]

When installing main bearings **2**, **18**, align lugs **A**.

CAUTION

Be sure to distinguish between main bearings **2**, **18**. The upper bearing has oil opening **B** while the lower bearing has no oil opening.

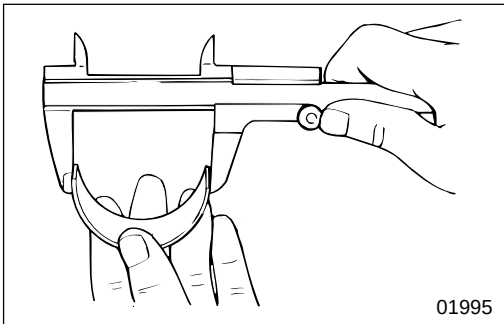


03519

[Inspection]

CAUTION

- Do not forcibly expand main bearings **2**, **18**.
- Be sure to replace both upper and lower main bearings **2**, **18** as a pair when replacement is necessary.



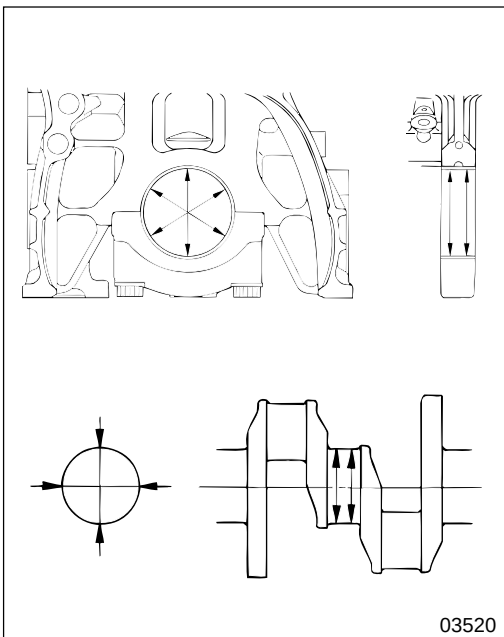
01995

(1) Expansion at free state

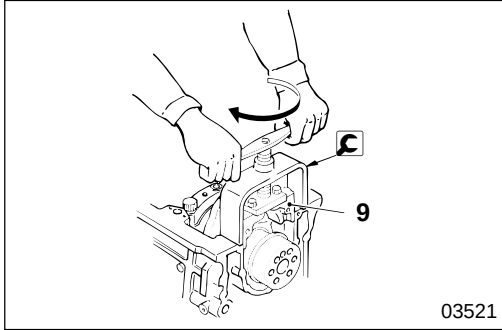
If the measured value is lower than the limit, replace main bearings **2**, **18**.

(2) Clearance between main bearing and crankshaft

If the measured value is lower than the limit, replace faulty parts.



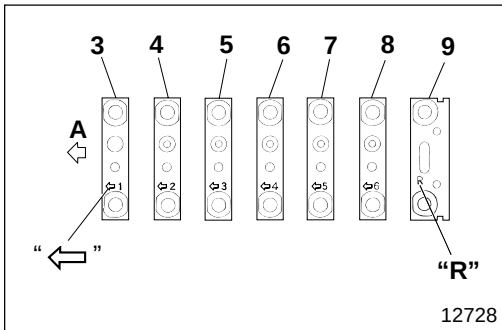
03520



3 to 9 Main bearing cap

[Removal]

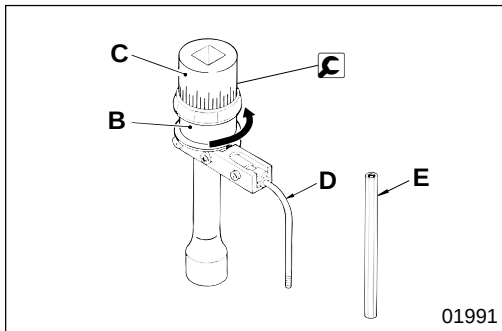
Use bearing cap extractor to remove rear main bearing cap **9** because side seal **11** is installed between crankcase **21** and the rear main bearing.



[Installation]

- Install main bearing caps **3** to **9** in the direction as illustrated.

A : Front of engine



- Center punch the head of bolt **1** before installation.

CAUTION

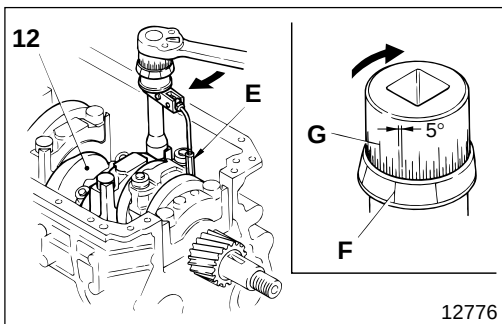
If there are already three center-punch marks, replace the cylinder head bolt with a new one.

- After tightening bolt **1** at specified torque, tighten further as follows:
- Turn socket wrench holder **B** counterclockwise and keep the spring in the wrench compressed.

C : Socket

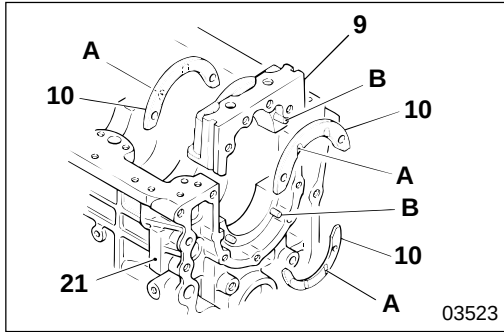
D : Rod

E : Rod (for connection)



- Set socket wrench holder **B** so that the percussive force of the spring presses rod **E** (for connection) against crankshaft assembly **12**.
- Select a scale that is convenient for reading graduation **F** on holder **B**.
- Tighten further by turning socket **C** clockwise by 90° (setting is in 5° increments), referring to graduation **G** on the selected scale.
- After installation, check the following points :
 - Crankshaft assembly **12** can be rotated easily by hand.
 - The end play of crankshaft assembly **12**. P11-54

CRANKSHAFT AND CRANKCASE



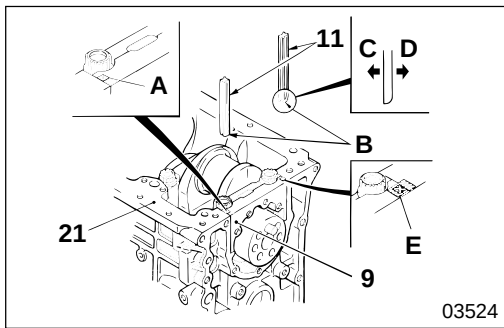
10 Installation of thrust plate

Install thrust plates **10** on both ends of rear main bearing **9** and the rear end of crankcase **21** in the direction as illustrated.

- A : Oil groove
- B : Positioning pin

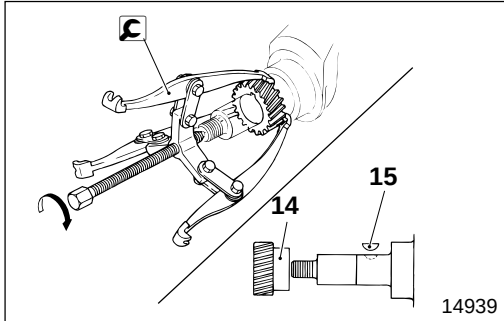
CAUTION ⚠

When installing oversized thrust plates **10**, mount them on the front and rear of rear main bearing cap **9**. It is not necessary that the thrust plates used are all of the same size, but use the same-size-combination of thrust plates for mounting on the rear of crankcase **21** and on the rear of the rear bearing cap.



11 Installation of side seal

- Supply sealant in side seal mounting groove **A** of rear main bearing cap **9**.
- Apply sealant at end **B** of side seal **11**.
- Press in side seal **11** between rear main bearing cap **9** and crankcase **21** in the direction as illustrated.
- C : Rear main bearing cap side
- D : Crankcase side
- After pressing in, apply sealant to side seal mounting **E** of rear main bearing cap **9**.



14 Crankshaft gear

[Removal]

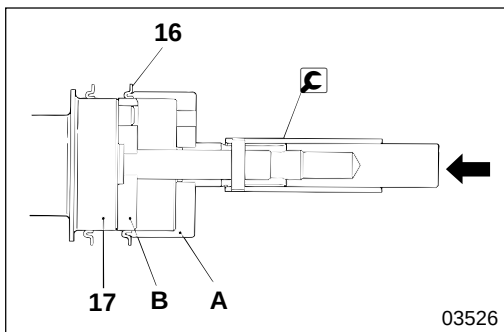
Never remove crankshaft gear **14** by striking, hitting or hammering it.

[Installation]

Before installing heat up crankshaft gear **14** using a piston heater or similar device to approximately 100°C {212°F}.

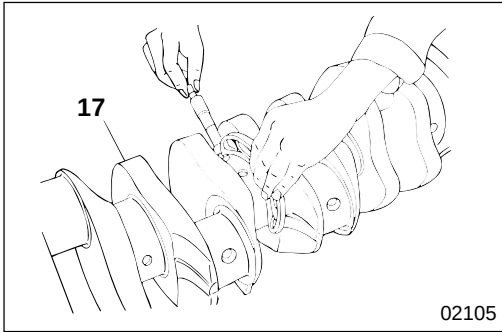
NOTE

Install key **15** to prevent rotation.



16 Installation of rear oil seal slinger

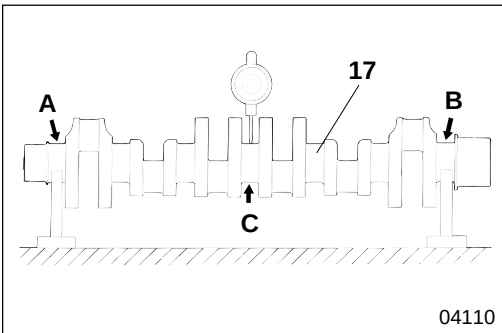
Install rear oil seal slinger **16** using  oil seal slinger installer. Strike installer **A** until it hits guide **B** positively.

**17 Crankshaft**

[Inspection]

(1) Cylindrical and circular accuracy of the journal and the pin

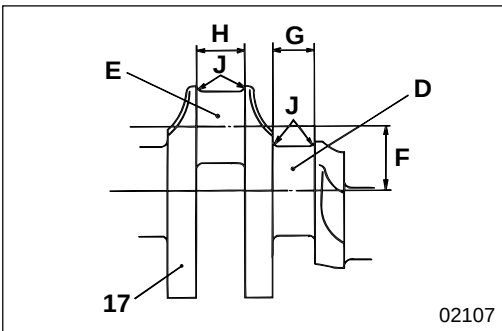
If the measured value is higher than the limit, grind and correct crankshaft **17** to convert it to the undersize specifications or replace it.

**(2) Degree of bend**

The degree of bend of crankshaft **17** is measured at No.4 journal **C** by supporting No.1 journal **A** and No.7 journal **B**. If the measured value is higher than the limit, replace the crankshaft.

NOTE

The degree of bend of crankshaft **17** is half of the indicated value of the gauge after rotating the shaft 360°.

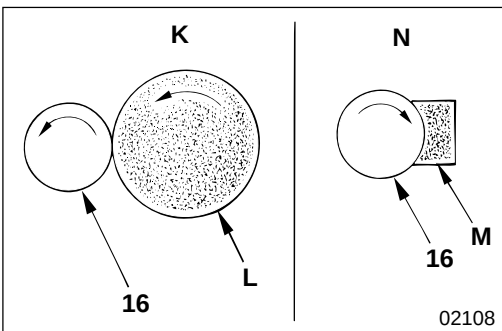


[Correction]

NOTE

Be sure to replace main bearings **2, 18** with those that meet the undersize specifications after crankshaft **17** is corrected by grinding.

- Set **F**, distance between the center line of the journal **D** and that of the pin **E**, constant.
F : 57.5 ± 0.075 mm { 2.26 ± 0.0030 in.}
- Set the width of journal **G** and pin **H** so they are constant.
G : 35 mm {1.38 in.} (32 mm {1.26 in.} for No.1 journal)
H : $41^{+0.2}_0$ mm
{ $1.61^{+0.0079}_0$ in.}
- Finish the fillet **J** smoothly.
J : $R4 \pm 0.2$ mm { 0.0079 in.}
- Check and confirm that there has been no cracking caused by grinding using the magnetic particle inspection method (Magnafluxing). Also make sure the surface hardness has not deteriorated (Shore hardness to be maintained at not less than Hs 75).
- When grinding **K**, set crankshaft **17** and grinder **L** so that they both rotate counterclockwise as viewed from the front of the crankshaft.
- To finish grinding **M** using a grindstone or emery paper **N**, rotate crankshaft **17** clockwise.

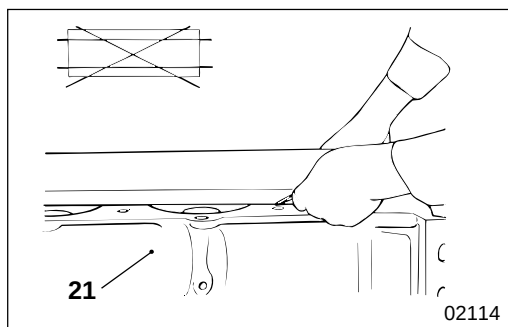


CRANKSHAFT AND CRANKCASE

Undersize specifications of crankshaft

Unit : mm {in.}

	Undersize scales			
	0.25 {0.0098}	0.50 {0.020}	0.75 {0.030}	1.00 {0.039}
Finish outer diameter of journal	77.69 to 77.70 {3.058 to 3.059}	77.44 to 77.45 {3.048 to 3.049}	77.19 to 77.21 {3.038 to 3.039}	76.94 to 76.95 {3.0291 to 3.0295}
Finish outer diameter of pin	64.69 to 64.71 {2.546 to 2.547}	64.44 to 64.46 {2.5370 to 2.5377}	64.19 to 64.21 {2.5271 to 2.5279}	63.94 to 63.96 {2.517 to 2.518}
Circular accuracy	0.01 {0.00039} or less			
Cylindrical accuracy	0.006 {0.00024} or less			



21 Crankcase top surface distortion

If the measured value is higher than the limit, grind and correct using a surface grinder.

CAUTION ⚠

When grinding crankcase 21 be sure that the extent of piston protrusion does not deviate from the standard value.

Piston protrusion : 📖 P11-36



FH

Service Manual

Group 12

Lubrication

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

GROUP 12 LUBRICATION

SPECIFICATIONS	2
STRUCTURE AND OPERATION	3
TROUBLESHOOTING	11
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Replacement of Oil Filter	12
• Replacement of Engine Oil	13
• Measurement of Oil Pressure	14
OIL PAN, OIL STRAINER AND OIL JET	16
OIL PUMP	18
OIL COOLER AND OIL FILTER	22

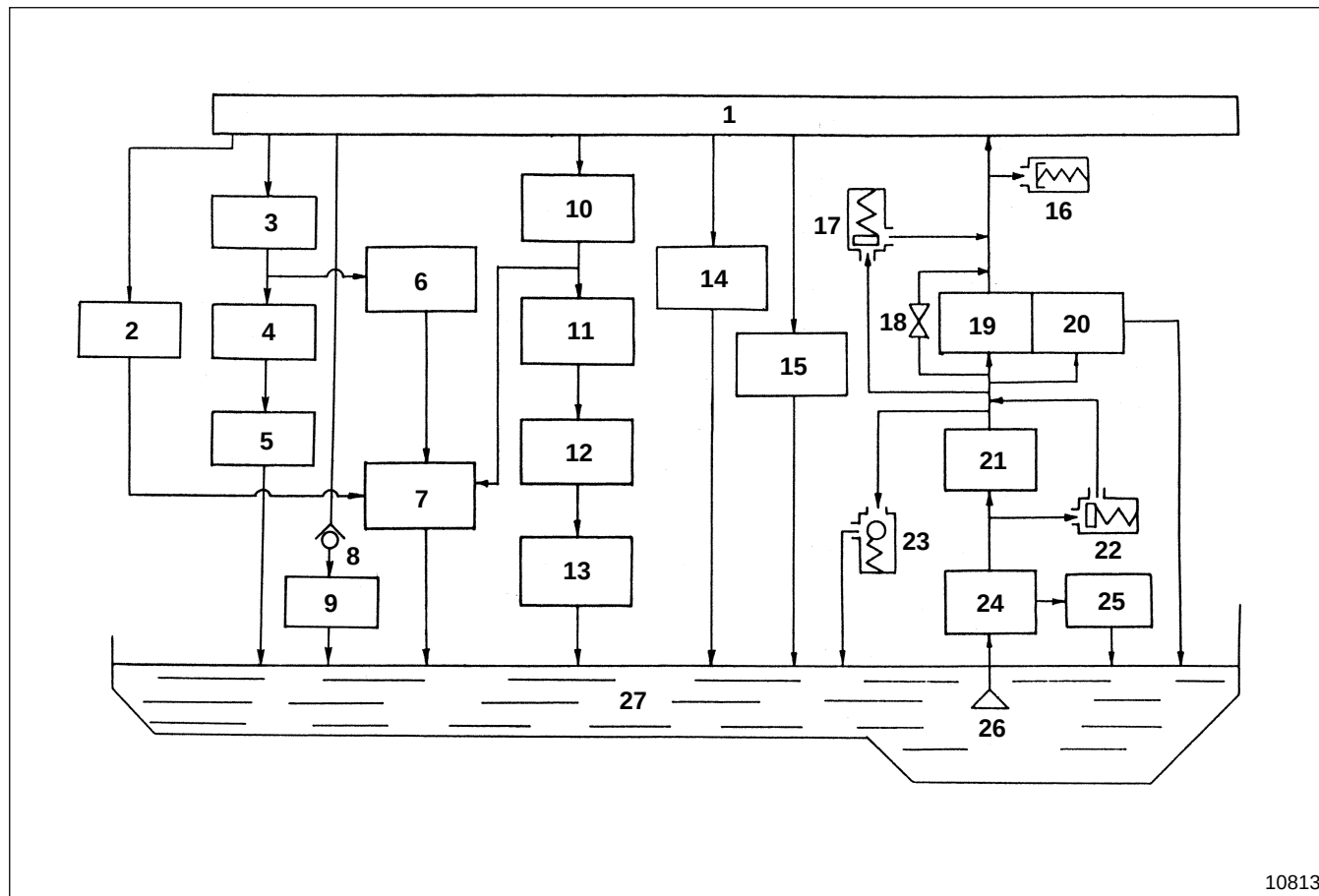
SPECIFICATIONS

Item			Specifications
Mode of lubrication			Oil pump type
Oil filter type			Spin-on filter paper type
Oil cooler type			Shell and plate type (Multiple-plate type)
Engine oil	Grade		Grade CD or above as per API classification
	Quantity of oil	Oil pan	Approximately 9.5 {10}
	L {qts}	Oil filter	Approximately 1 {1.1}

STRUCTURE AND OPERATION

12

Lubrication System (Flow of Oil)

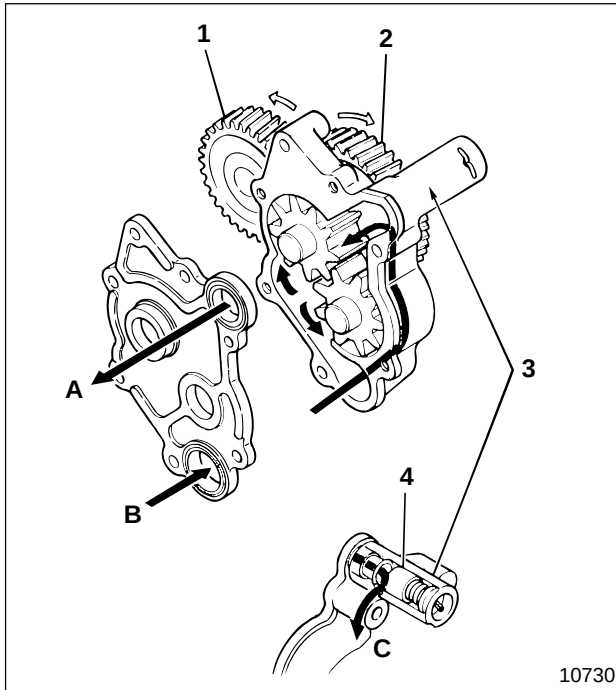


10813

- | | |
|---------------------------|--|
| 1 Main oil gallery | 15 Turbocharger |
| 2 Air compressor | 16 Engine oil pressure switch |
| 3 Crankshaft main bearing | 17 Engine oil bypass alarm switch |
| 4 Connecting rod bearing | 18 Bypass valve (Built-in within oil pump) |
| 5 Connecting rod busing | 19 Full-flow filter element |
| 6 Idler gear bushing | 20 Bypass filter element |
| 7 Timing gear | 21 Oil cooler |
| 8 Check valve for oil jet | 22 Bypass valve |
| 9 Piston | 23 Regulator valve |
| 10 Camshaft bushing | 24 Oil pump |
| 11 Rocker bushing | 25 Relief valve (Built-in within oil pump) |
| 12 Push rod | 26 Oil strainer |
| 13 Tappet | 27 Oil pan |
| 14 Injection pump | |

STRUCTURE AND OPERATION

Oil Pump

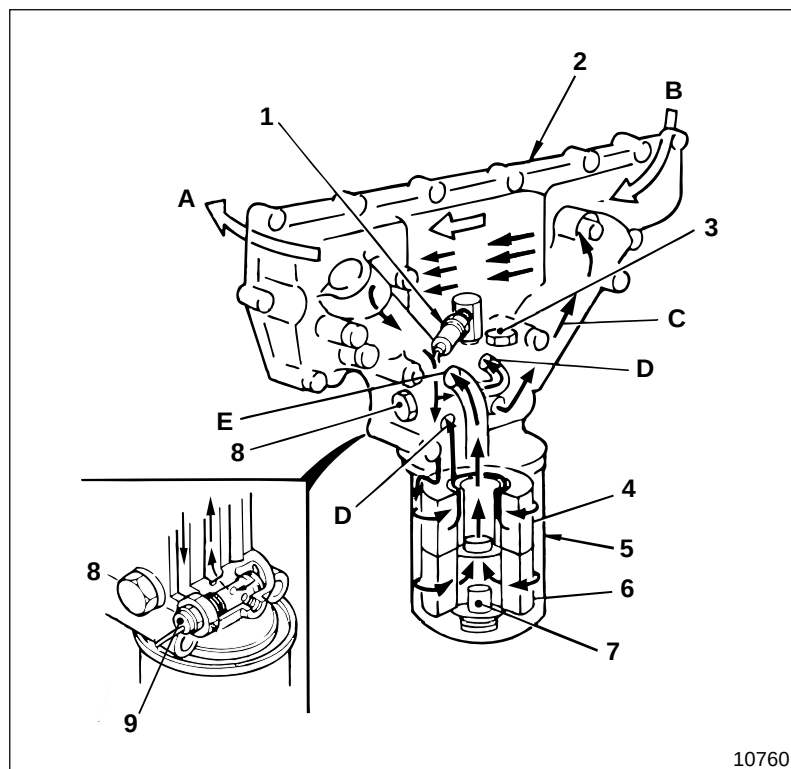


- 1 Crankshaft gear
- 2 Oil pump gear
- 3 Oil pump
- 4 Relief valve

A : To oil cooler
B : From oil strainer
C : To oil pan

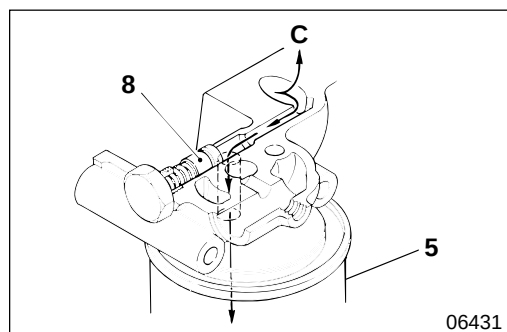
Oil pump 3 is a gear type, driven by rotation of the crankshaft transmitted by crankshaft gear 1 that engages oil pump gear 2. Relief valve 4 is installed on the oil pump and when the oil pump discharge pressure becomes higher than the standard pressure level, part of the engine oil is returned to the oil pan by relief action of the valve, protecting the lubricating system from breakdown caused by excessive oil pressure.

Oil Cooler and Oil Filter



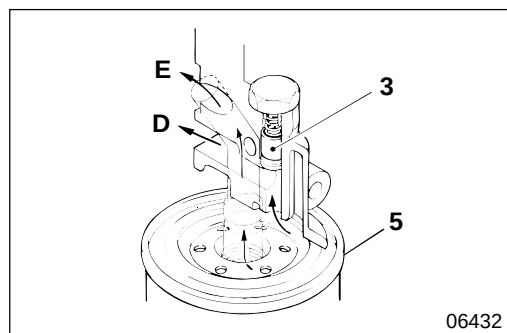
- 1 Engine oil pressure switch
- 2 Oil cooler
- 3 Regulator valve
- 4 Bypass filter element
- 5 Oil filter
- 6 Full-flow filter element
- 7 Bypass valve
- 8 Bypass valve
- 9 Engine oil bypass alarm switch

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

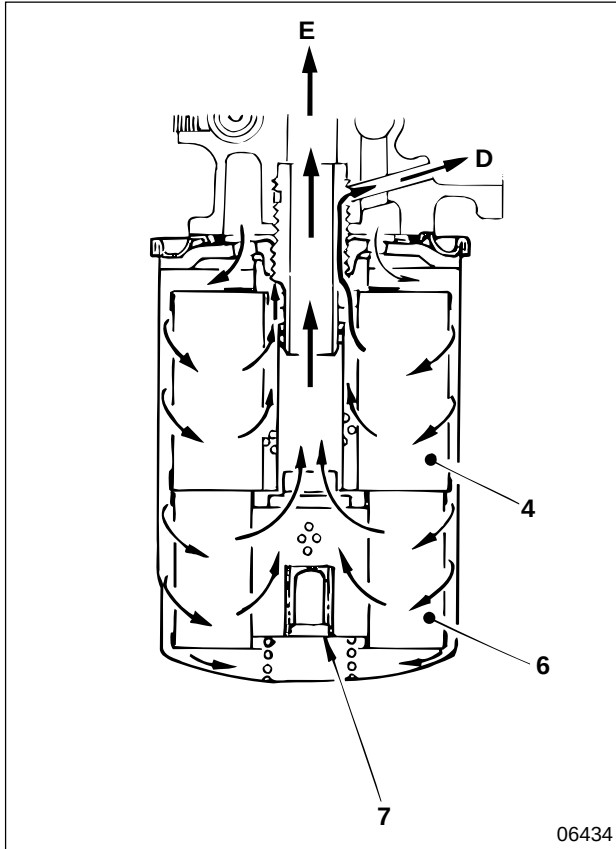
When the viscosity of the engine oil is high at low temperatures, or when oil cooler 2 element is clogged, flow resistance is high, and if this happens, bypass valve 8 opens to let the engine oil return directly to oil filter 5 without going through the oil cooler.



Operation of regulator valve

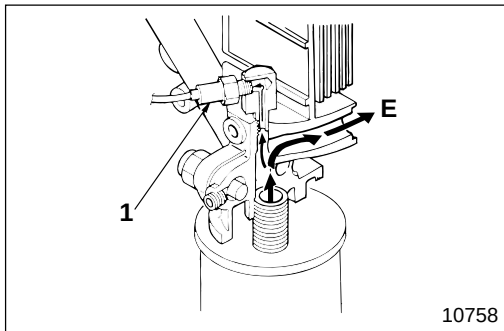
When the oil pressure in the main oil gallery becomes higher than standard, regulator valve 3 opens to let part of the oil return to oil pan D, thereby regulating the oil pressure.

STRUCTURE AND OPERATION



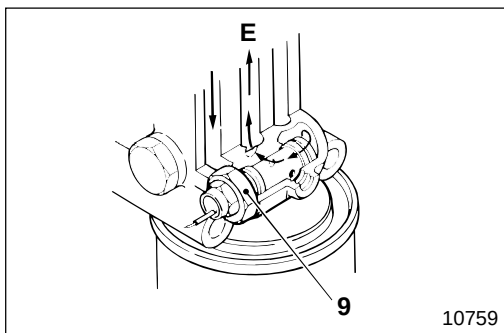
● Oil filter element

This oil filter uses a spin-on, filter paper type element, that integrates full-flow filter element **6** and bypass filter element **4**. When the filter element is clogged, bypass valve **7**, installed at the base of the filter, opens to let the oil bypass the element and flow directly to main oil gallery **E**, preventing engine seizure.



Operation of engine oil pressure switch

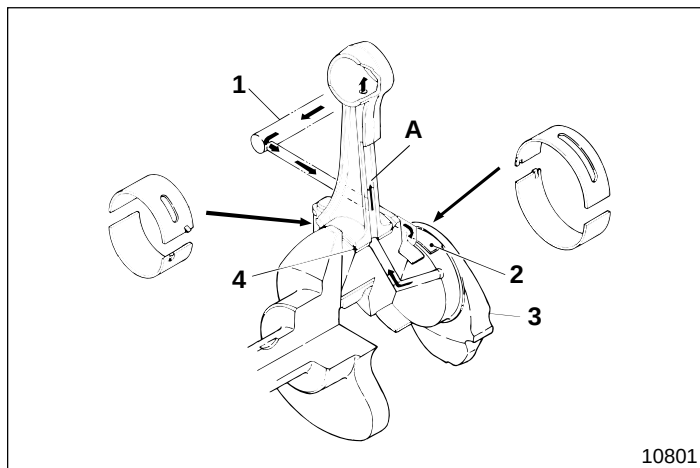
When pressure for delivering the oil to main oil gallery **E** becomes lower than standard, the built-in electric contact point of engine oil pressure switch **1** closes to light warning lamp in the meter cluster, warning the driver that the oil pressure is abnormal.



Operation of engine oil bypass alarm switch

- When the oil filter element is clogged, the engine oil level becomes low and might cause seizure of engine parts, engine oil bypass alarm switch **9** is installed to prevent this.
- When the oil filter element is clogged, engine oil bypass alarm switch **9** lets the oil flow directly to main oil gallery **E**, bypassing full-flow filter element **6**. When the engine oil bypass alarm switch is activated it lights the warning lamp, warning the driver that the oil filter element is clogged.

Lubrication of Related Parts

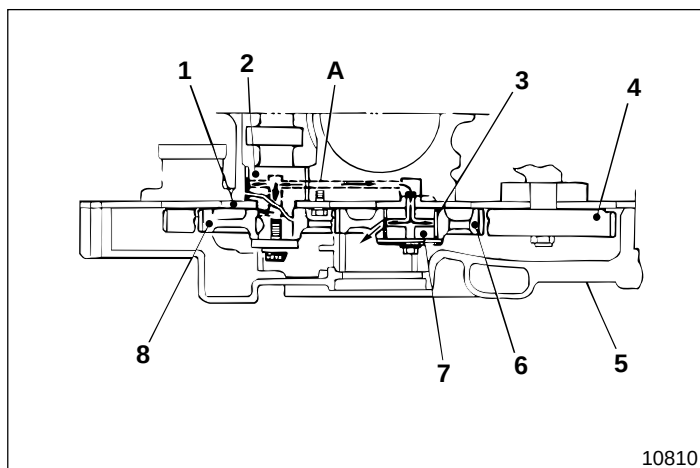


● Main bearing and connecting rod bearing

- 1 Main oil gallery
- 2 Main bearing
- 3 Crankshaft
- 4 Connecting rod bearing

A : Connecting rod oil passage

Engine oil supplied through the oil passage drilled in crankshaft **3** flows through connecting rod oil passage **A** to lubricate the small end of the connecting rod.



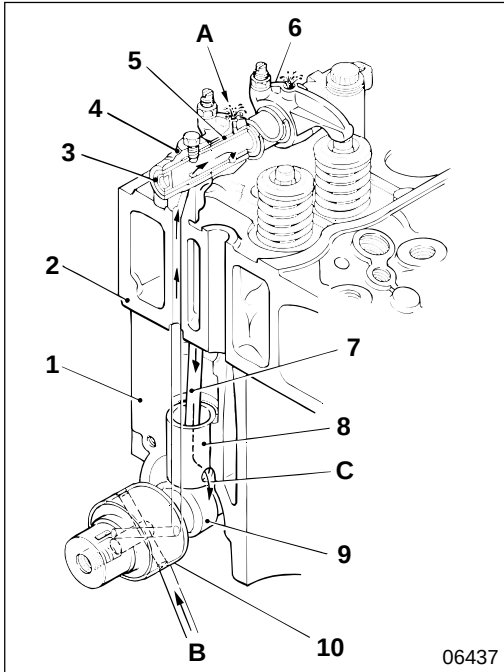
● Timing gear

- 1 Thrust plate
- 2 Camshaft
- 3 Idler gear bushing
- 4 Air compressor gear
- 5 Timing gear case
- 6 Idler gear
- 7 Idler shaft
- 8 Camshaft gear

A : From main oil gallery

Engine oil from main oil gallery **A** flows through the inside of camshaft **2** and idler shaft **6** and lubricates each gear.

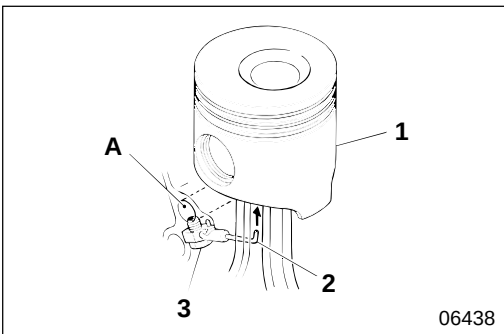
STRUCTURE AND OPERATION



● 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

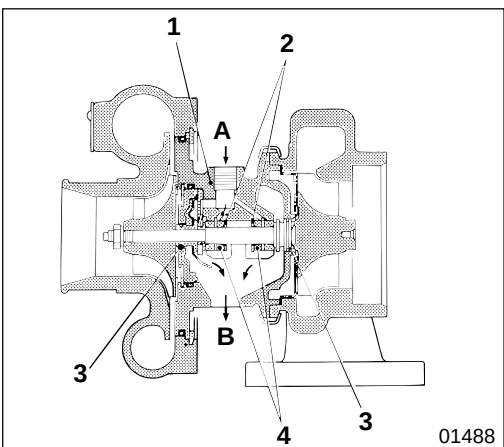


● Oil jet

- 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.

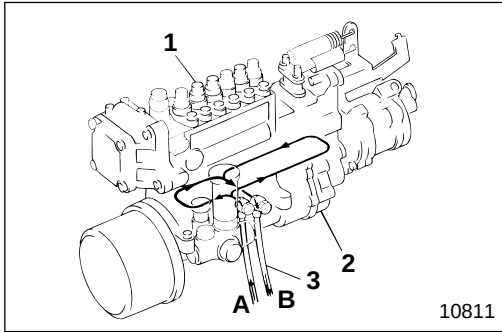


● Turbocharger

- 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.



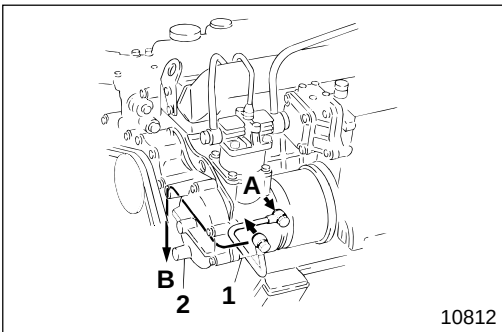
● **Injection pump**

- 1 Injection pump
- 2 Governor
- 3 Oil return pipe

A : From main oil gallery

B : To oil pan

Engine oil that has lubricated injection pump **1** and governor **2** returns to the oil pan through oil return pipe **3**.



● **Air compressor**

- 1 Air compressor
- 2 Timing gear case

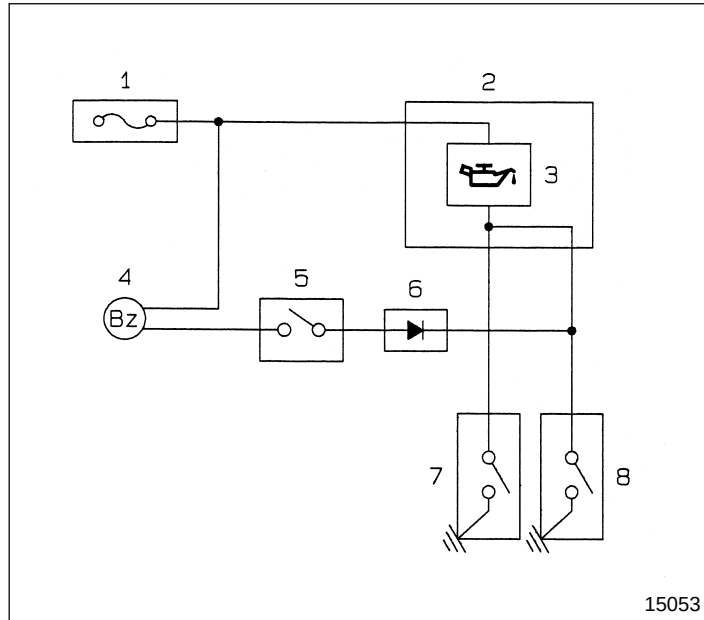
A : From main oil gallery

B : To oil pan

Engine oil from the main oil gallery lubricates the inside of air compressor **1** and returns to the oil pan through timing gear case **2**.

STRUCTURE AND OPERATION

Lubrication System Electric Circuit



- 1 Fuse box
- 2 Meter cluster
- 3 Engine oil pressure/clogged oil filter warning lamp
- 4 Warning buzzer
(Buzzer does not work when parking brake is engaged.)
- 5 Parking brake switch
- 6 Diode
- 7 Engine oil bypass alarm switch
- 8 Engine oil pressure switch

TROUBLESHOOTING

12

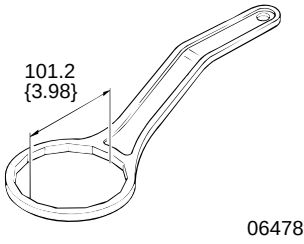
Symptoms		Engine hard to start	Overheating	Oil pressure low	Oil consumption excessive (Oil leakage)	Remarks
Oil cooler	Oil cooler element installation faulty		☐	☐	☐	
	Gasket faulty		☐	☐	☐	
	O-ring faulty		☐	☐	☐	
	Oil cooler element clogged		☐	☐		
	Oil cooler element damaged		☐	☐	☐	
	Bypass valve spring fatigued		☐			
	Regulator valve spring fatigued			☐		
Oil pump	Malfunctioning		☐	☐		
	Oil pump gear interfering with oil pump case or cover	☐		☐		
	Relief valve spring fatigued			☐		
Oil filter	Installation faulty				☐	
	Element clogged		☐	☐		
	Gasket faulty			☐		
Oil strainer installation faulty or clogged			☐	☐		
Crankshaft front oil seal faulty					☐	 Gr 11
Crankshaft rear oil seal faulty					☐	 Gr 11
Timing gear case installation faulty					☐	 Gr 11
Oil jet for piston cooling faulty			☐			
Oil working its way up into combustion chamber					☐	
Oil working its way down into combustion chamber					☐	
Oil viscosity too high		☐				
Oil quality unsuitable			☐			
Oil deteriorated			☐			
Fuel mixed with oil			☐			

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Replacement of Oil Filter

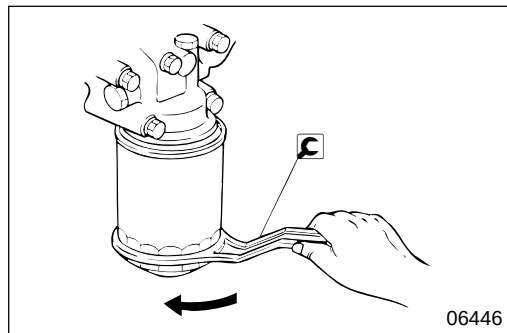
Special tools

Unit : mm {in.}

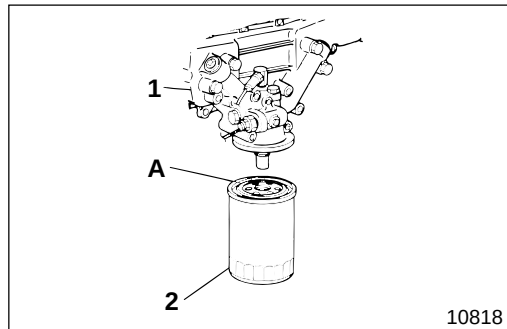
Location	Tool name and shape	Part No.	Application
2	Oil filter wrench 	MH061587	Removal of oil filter

WARNING

- Wipe up any engine oil that has been spilled because it can cause a fire.
- Do not touch the engine while it is hot because it will burn you.
- When replacing oil filter 2, take care not to spill oil on the V-belt.



[Removal]



[Installation]

- Clean the surface of oil cooler body 1 that makes contact with oil filter 2.
- Apply engine oil thinly and evenly to gasket area A of oil filter 2.
- Screw in oil filter 2 to oil cooler body 1 until gasket area A sits on the body. From this position, tighten further by rotating by five eighths of a turn.
- After installation, run the engine and check that there is no oil leakage from gasket area A.
- Check the oil level and if it is low, top it up.

Replacement of Engine Oil

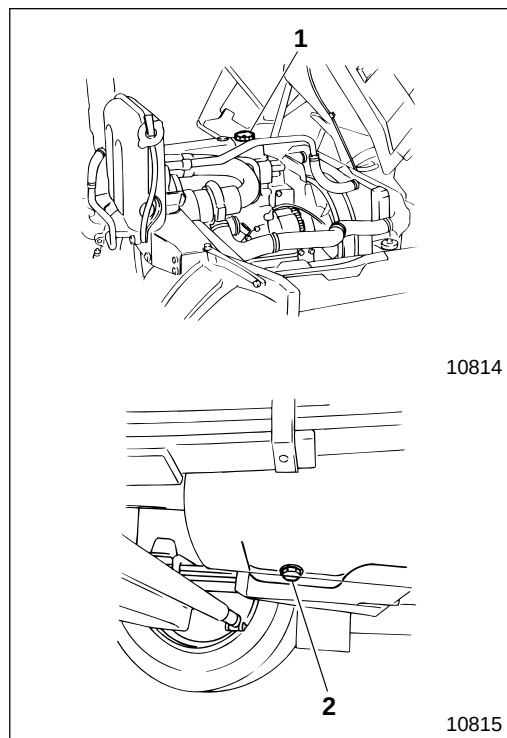
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Oil pan drain plug	69 {51, 7}	—

Lubricant

Location	Points of application	Kinds	Quantity
—	Oil pan	Engine oil (Grade CD or above as per API Classification)	Approximately 9.5 L {10 qts}
—	Oil filter	Engine oil (Grade CD or above as per API Classification)	Approximately 1 L {1.1 qts}



[Draining]

After warming-up the engine, remove oil filler cap **1** and remove drain plug **2** of the oil pan and drain the engine oil.

[Refilling]

Tighten drain plug **2** of the oil pan at specified torque and fill with the specified quantity of engine oil.

WARNING

- Wipe up any engine oil that has been spilled because it can cause a fire.
- Do not touch the engine while it is hot because it will burn you.
- When replacing engine oil take care not to spill oil on the V-belt.

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Measurement of Oil Pressure

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Oil pressure (Oil temperature 70 to 90°C {158 to 194°F})	At no-load minimum revolution	145 kPa {21 lbf/in ² , 1.5 kgf/cm ² }	49 kPa {7.1 lbf/in ² , 0.5 kgf/cm ² }	Inspect
		At no-load maximum revolution	295 to 490 kPa {43 to 71 lbf/in ² , 3 to 5 kgf/cm ² }	195 kPa {28 lbf/in ² , 2 kgf/cm ² }	

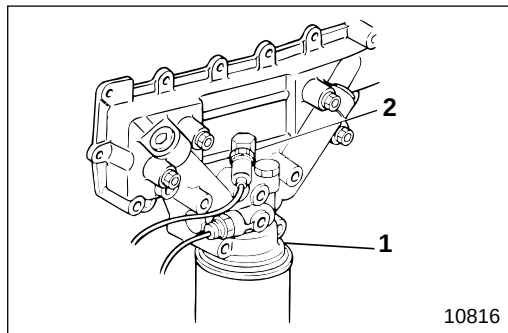
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Engine oil pressure switch	15 to 22 {11 to 16, 1.5 to 2.2}	When engine is cold

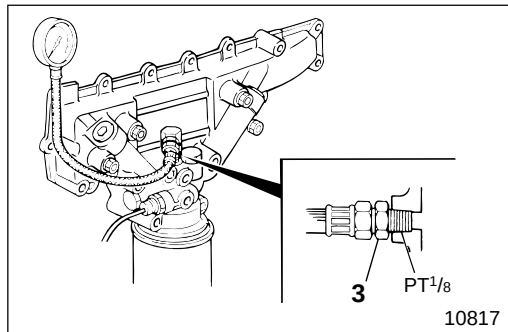
A Sealant

Location	Points of application	Kinds	Quantity
2	Thread area of engine oil pressure switch	Teflon tape	3 ¹ / ₂ turns



10816

- Remove oil pressure switch **2** from oil cooler **1**.
- Mount the oil pressure gauge after installing adaptor **3** onto oil cooler **1**.
- Warm up the engine until the oil temperature reaches 70 to 90°C {158 to 194°F}.
- Measure oil pressure at no-load minimum revolution and at no-load maximum revolution. If the measured values are lower than the limit, overhaul the lubricating system.



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- After measurement, install engine oil pressure switch **2** and tighten at specified torque.

CAUTION

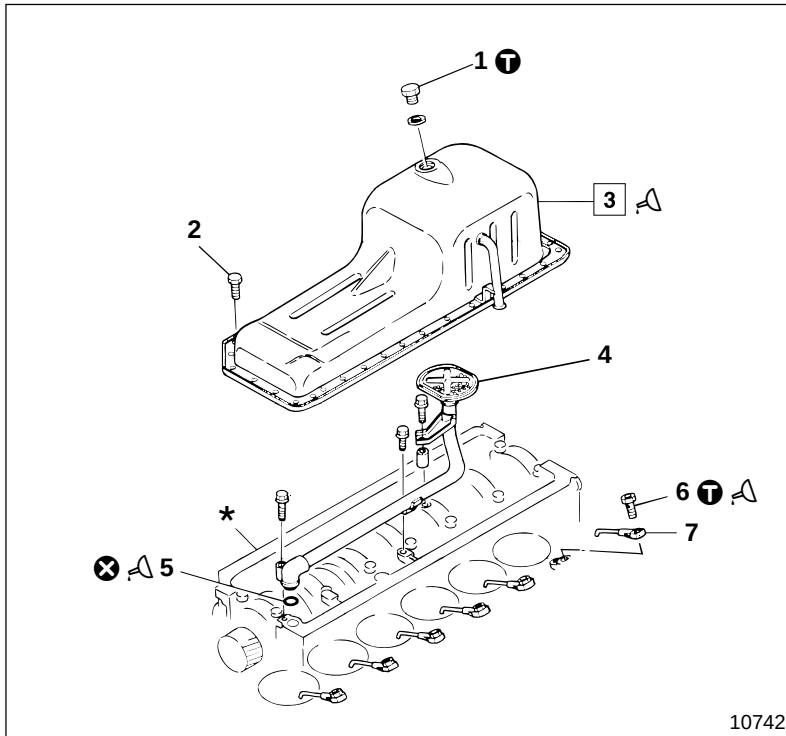
Be sure to install oil pressure switch **2** when the engine is cold.

Inspection of engine oil pressure switch

 Gr 54

MEMO

OIL PAN, OIL STRAINER AND OIL JET



● Disassembly sequence

- 1 Drain plug
- 2 Bolt
- 3 Oil pan
- 4 Oil strainer
- 5 O-ring
- 6 Check valve
- 7 Oil jet

* : Crankcase

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

Make sure that you do not tighten check valve 10 higher than the specified torque. Overtightening will cause damage to the check valve, resulting in serious overheating damage to the engine.

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Drain plug	69 {51, 7}	—
6	Check valve	29 {22, 3}	Wet

🔧 Lubricant and sealant

Location	Points of application	Kinds	Quantity
3	Oil pan to crankcase connecting surface	THREEBOND 1207C	As required
5	Body of O-ring	Engine oil	As required
6	Thread area of check valve	Engine oil	As required

◆ Service procedure

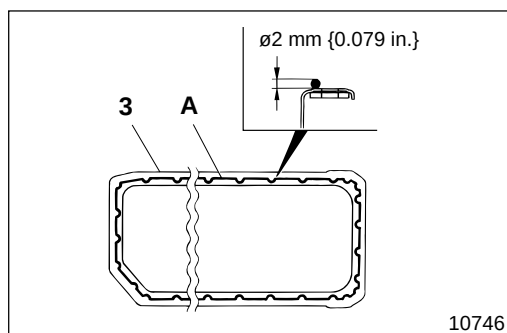
3 Installation of oil pan

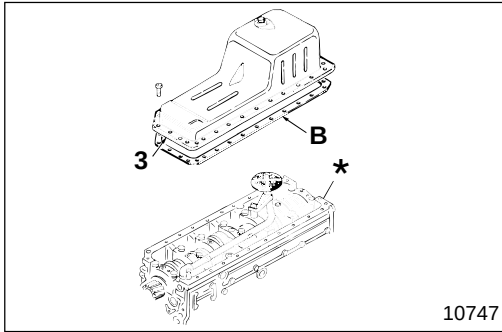
< When using sealant >

- Apply sealant A to lower connecting surface of oil pan 3 as illustrated evenly without break.
- After applying sealant A, within three minutes, mount oil pan 3 to crankcase *.

CAUTION ⚠

- Be sure to clean and wipe off oily substances from the surface where sealant A is to be applied.
- Make sure that sealant A is not transferred to other areas while the mounting work is being done.
- Do not start the engine within an hour of mounting oil pan 3.
- Be sure to reapply sealant A if bolts 2 (for mounting oil pan 3) are loosened or removed by any cause whatsoever after mounting.



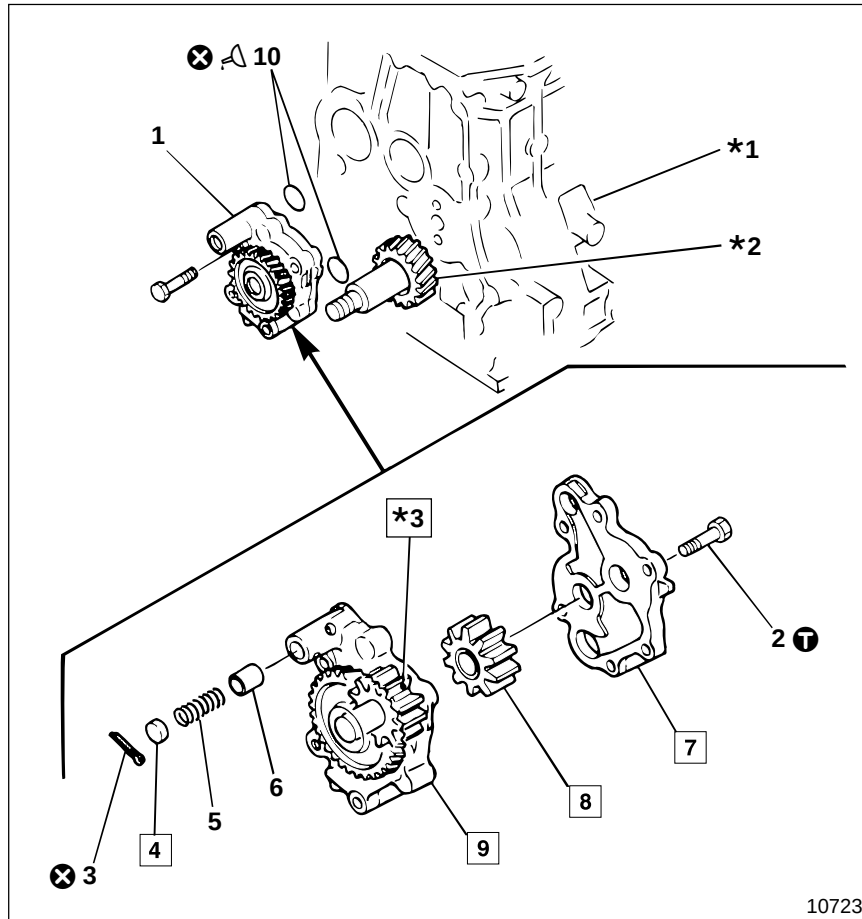


< When not using sealant >

NOTE

If sealant is not available, install oil pan 3 to crankcase * using sheet gasket B.

OIL PUMP



Disassembly sequence

- 1 Oil pump assembly
- 2 Bolt
- 3 Split pin
- 4 Seat
- 5 Spring
- 6 Relief valve
- 7 Oil pump cover
- 8 Driven gear assembly
- 9 Oil pump case assembly
- 10 O-ring

*1 : Crankcase Gr 11

*2 : Crankshaft gear

*3 : Drive gear

⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
—	Backlash between oil pump gear and crankshaft gear Gr 11	0.09 to 0.18 {0.0035 to 0.0071}	0.3 {0.012}	Replace
5	Relief valve spring load (Installed length 38 {1.50})	225 N {51 lbf, 23.15 kgf}	—	Replace
6	Relief valve opening pressure	1080±98 kPa {155±14 lbf/in ² , 11±1.0 kgf/cm ² }	—	—
7, *3	Clearance between gear shaft and oil pump cover	[20] 0.04 to 0.07 {[0.79] 0.0016 to 0.0028}	0.15 {0.0059}	Replace
8, 9	Clearance between gear shaft and driven gear	[20] 0.04 to 0.07 {[0.79] 0.0016 to 0.0028}	0.15 {0.0059}	Replace
8, 9, *3	Difference between height of each gear and depth of oil pump case	0.01 to 0.07 {0.00039 to 0.0028}	0.18 {0.0071}	Replace
	Clearance between tooth tip of each gear and oil pump case	0.10 to 0.19 {0.0039 to 0.0075}	0.2 {0.0079}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Oil pump cover mounting)	9.8±2.0 {7.2±1.4, 1.0±0.2}	—

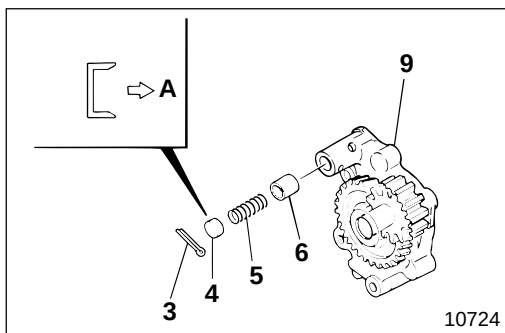
Lubricant

Location	Points of application	Kinds	Quantity
10	Body of O-ring	Engine oil	As required

◆ Service procedure

4 Installation of seat

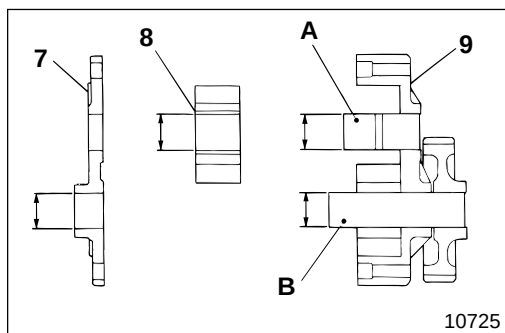
A : Oil pump case assembly side



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7 to 9 Inspection of oil pump cover, driven gear assembly, and oil pump case assembly

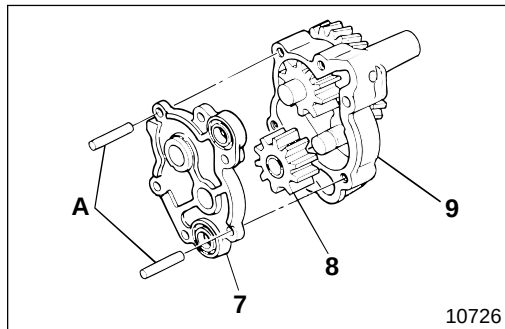
- Measure the clearance between oil pump cover 7 and drive gear shaft B, and between driven gear assembly 8 and driven gear shaft A.
- If the measured value is lower than the limit, replace the faulty parts.



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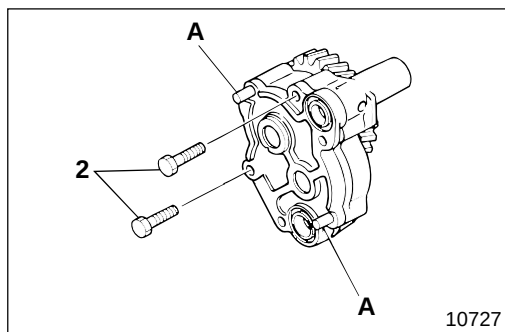
7 9 Installation of oil pump cover and oil pump case assembly

- Prepare two pins A of 9 mm {0.35 in.} in outer diameter and position oil pump cover 7 and oil pump case assembly 9 as illustrated.



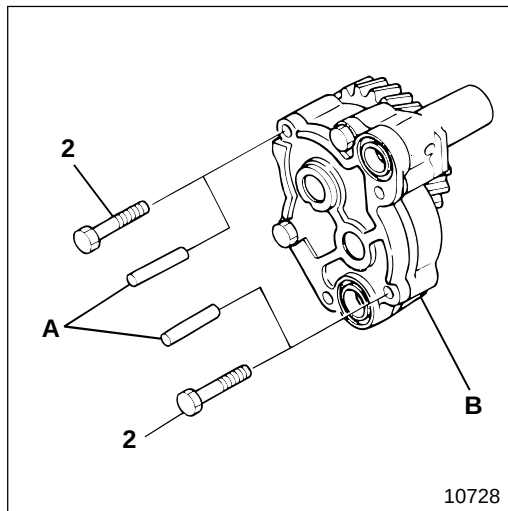
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- Tighten the illustrated bolts 2 at specified torque.



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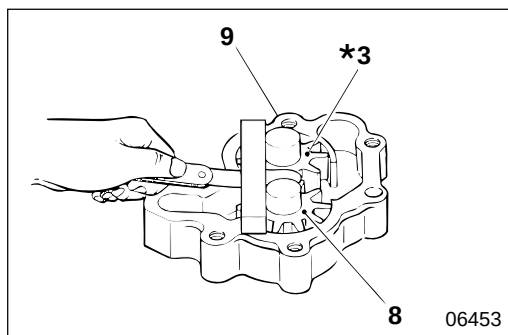
OIL PUMP



- Remove pins **A**, replacing them with bolts **2** and tighten at specified torque.

NOTE

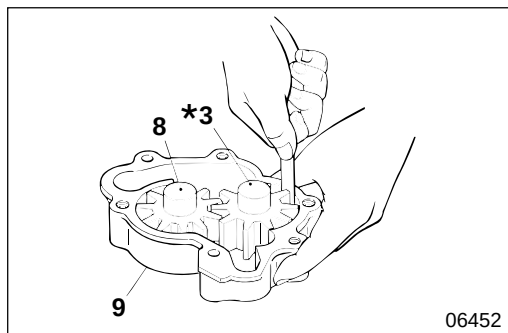
Confirm smooth movement by rotating oil pump gear **B** by hand. If it catches, disassemble and reassemble it.



8 9 *3 Inspection of driven gear assembly, and oil pump case assembly

(1) Difference between height of each gear and depth of oil pump case

If the measured value is higher than the limit, replace the faulty parts.



(2) Clearance between tooth tip and oil pump case

If the measured value is higher than the limit, replace the faulty parts.

MEMO

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
5	Oil cooler element air leakage (Air pressure 980 kPa {140 lbf/in ² , 10 kgf/cm ² }, 15 seconds)	0 cm ³ {0 cu. in.}	—	Replace
10	Regulator valve opening pressure	440±29 kPa {64±4.3 lbf/in ² , 4.5±0.3 kgf/cm ² }	—	Replace
15	Bypass valve opening pressure	390±29 kPa {57±4.3 lbf/in ² , 4.0±0.3 kgf/cm ² }	—	Replace
16	Engine oil bypass alarm switch	190+60/-0 kPa {27+8.3/-0 lbf/in ² , 1.9+0.6/-0 kgf/cm ² }	—	Replace

Tightening torque

Unit : N-m {lbf.ft, kgf-m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Nut (oil cooler element mounting)	19.5±5 {14±3.6, 2.0±0.5}	—
6	Engine oil pressure switch	15 to 22 {11 to 16, 1.5 to 2.2}	When engine is cold
7	Plug (Regulator valve spring mounting)	19.5±5 {14±3.6, 2.0±0.5}	—
11	Drain plug (Oil cooler)	34 {25, 3.5}	—
12	Plug (Bypass valve spring mounting)	19.5±5 {14±3.6, 2.0±0.5}	—
16	Engine oil bypass alarm switch	12 to 18 {8.7 to 13, 1.2 to 1.8}	—

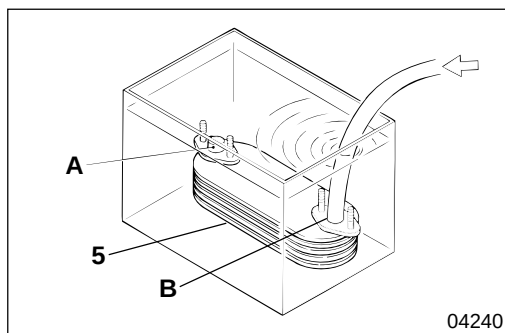
Lubricant and sealant

Location	Points of application	Kinds	Quantity
1	Gasket area of oil filter with thin application P12-12	Engine oil	As required
4	Body of O-ring	Engine oil	As required
6	Thread area of engine oil pressure switch	Teflon tape	3½ turns

Service procedure

Cleaning

- Check and see if any carbon deposits or sludge have developed in the oil passage of oil cooler element **5** or its bypass. Clean any deposits off thoroughly with cleaning solvent.
- Also clean any water scale or fur found in oil cooler element **5** or oil cooler body **17**.



5 Inspection of oil cooler element

- Immerse oil cooler element **5** in a water tank after plugging exit port **A** and connecting the hose to engine oil entry port **B**.
- Apply air pressure of 980 kPa {140 lbf/in², 10 kgf/cm²} via the hose and see if there is any air leakage from any part of oil cooler element **5**.
- If you see any leakage, replace oil cooler element **5**.



FH

Service Manual

Group 13

Fuel and Engine Control

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

GROUP 13 FUEL AND ENGINE CONTROL

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SPECIFICATIONS

Injection Pump

Item	Specifications
Manufacturer	ZEXEL
Body model	MD-TICS (Pre-stroke control type)
Governor type	RLD all-speed mechanical governor with boost compensator
Feed pump model	KD
Automatic timer model	SPG mechanical timer

Injection Nozzle

Item	Specifications
Manufacturer	ZEXEL
Model and type	DLLA hole type 1-spring model
Number of orifices	5
Orifice diameter	mm {in.} $\varnothing 0.25$ {0.0098}

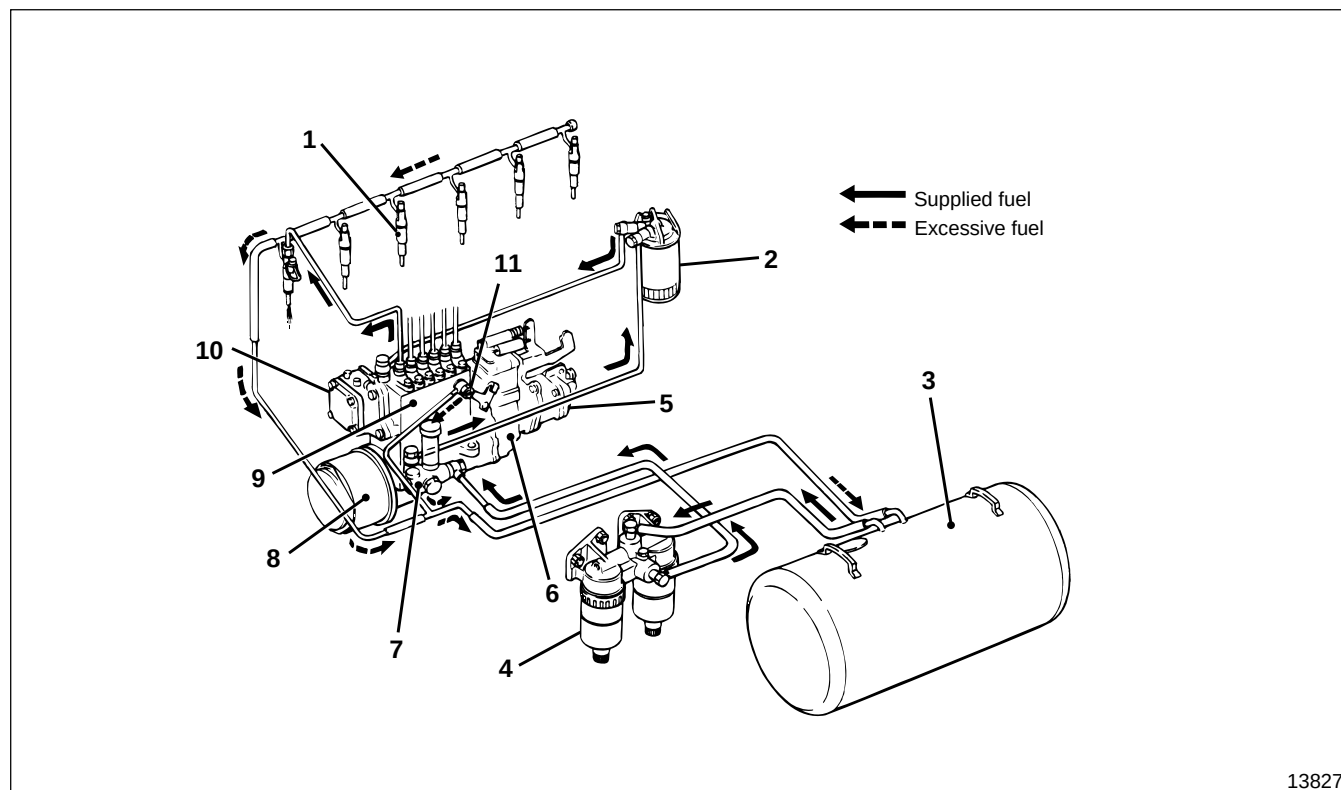
Fuel Filter Type

Item	Specifications
Filter type	Spin-on type

MEMO

STRUCTURE AND OPERATION

Fuel System (Flow of Fuel)



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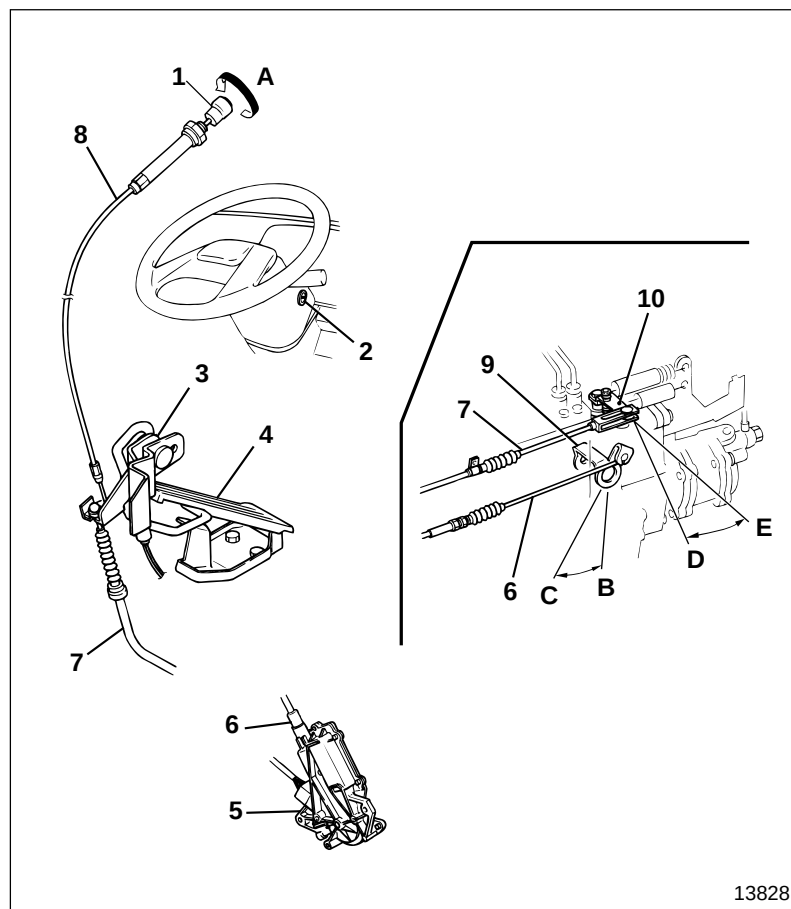
- | | |
|---------------------|------------------------|
| 1 Injection nozzle | 7 Feed pump |
| 2 Fuel filter | 8 Automatic timer |
| 3 Fuel tank | 9 Injection pump |
| 4 Water separator | 10 Pre-stroke actuator |
| 5 Boost compensator | 11 Overflow valve |
| 6 Governor | |

Fuel in fuel tank **3** is sucked up by feed pump **7** which is driven by the cam action of injection pump **9** and is filtered through fuel filter **2** which removes dirt and other foreign particles.

Filtered fuel is sent to the injection pump where the fuel pressure is boosted and injected through injection nozzle **1** into the combustion chamber.

When fuel pressure is higher than the specified value, overflow valve **11** opens to let the fuel return to the fuel tank.

Engine Control



- 1 Idling control knob
- 2 Starter switch
- 3 Accelerator arm assembly
- 4 Accelerator pedal assembly
- 5 Fuel-cut motor
- 6 Engine-stop cable
- 7 Accelerator control cable
- 8 Idling control cable
- 9 Engine-stop lever
- 10 Idling control lever

- A : Idling revolution rising
- B : Engine-stop position
- C : Engine start-up position
- D : Full-load position
- E : Idling position

(1) Idling control knob

Idling control knob **1** is for making fine adjustment to the idling revolution of the engine. Turning the knob clockwise raises the revolution. It works in the same way as accelerator pedal assembly **4** does when it is depressed.

(2) Fuel-cut motor

Fuel-cut motor **5** is connected to starter switch **2**, and it is activated by the starter switch being turned ON (or to S). This brings engine-stop lever **9** of the governor to engine-stop position **B** (or engine start-up position **C**), and stops (or starts) the engine. P13-6

(3) Accelerator pedal

When accelerator pedal assembly **4** is freed from foot pressure, the governor return spring forces idling control lever **10** to idling position **E**, restoring the pedal to its original position.

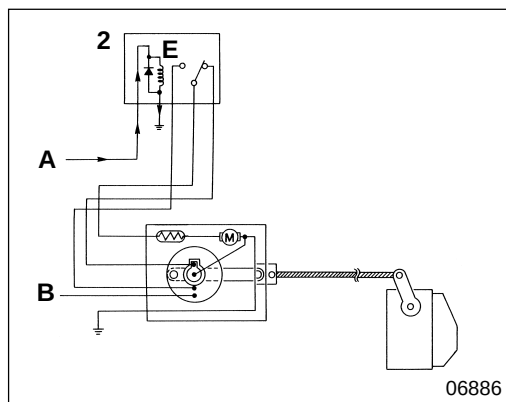
The diagram illustrates a mechanical control system for a machine tool. It consists of the following components and connections:

- 1. Control Panel:** A panel with a grid of buttons labeled LOCK, (OFF), ACC, ON, and START. The grid has columns labeled B, A, M, F, S. The START row has buttons in columns B, A, M, F, and S.
- 2. Relay:** A relay with a coil and a switch. It is connected to the START button and the ground.
- 3. Motor:** A motor with a winding and a switch. It is connected to the relay and the ground.
- 4. Mechanical Linkage:** A linkage mechanism consisting of a rod (4) and a lever (5) pivoted on a base (6). The rod is connected to the motor and the lever.
- 5. Lever:** A lever pivoted on a base (6). It is connected to the rod (4) and the motor.
- 6. Base:** The base of the lever mechanism.

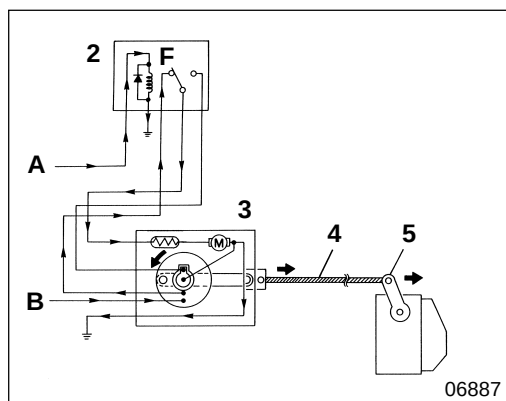
The connections are as follows:

- The START button is connected to the relay coil.
- The relay switch is connected to the motor winding.
- The motor winding is connected to the ground.
- The lever (5) is pivoted on the base (6).
- The rod (4) is connected to the lever (5) and the motor.

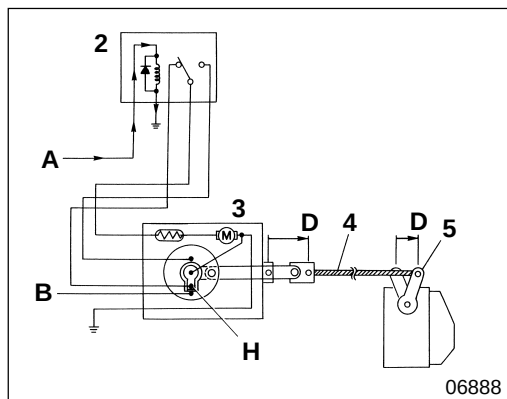
- A** : Power source
B : Power source
C : Engine-stop position
D : Engine start-up position



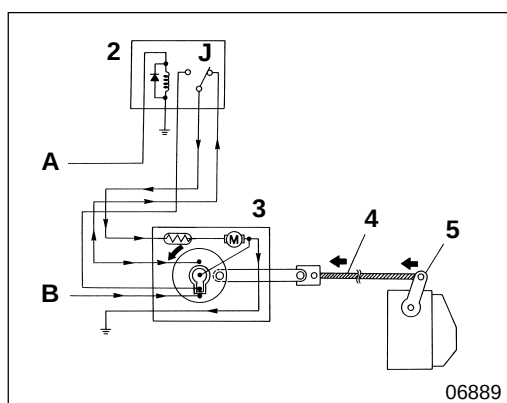
- **At engine start-up (starter switch ON)**
 - Electric current flows as illustrated, and coil **E** of fuel-cut relay **2** is magnetized.



- Contact point **F** of fuel-cut relay **2** closes, and fuel-cut motor **3** is activated.
- Engine-stop cable **4** is pushed out, and engine-stop lever **5** moves to engine start-up position.

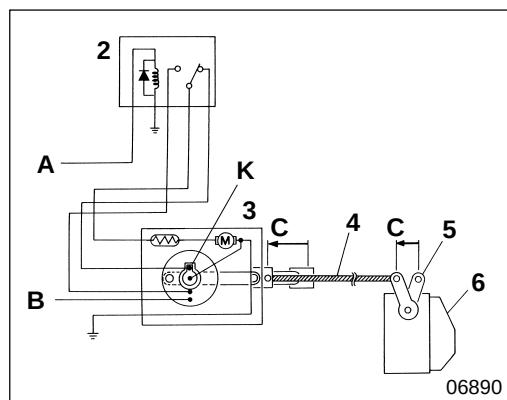


- Engine-stop lever **5** moves to engine start-up position **D**, and fuel is ready to flow. Contact point **H** of fuel-cut motor **3** opens, and the fuel-cut motor stops.



● **When engine is at standstill (starter switch OFF)**

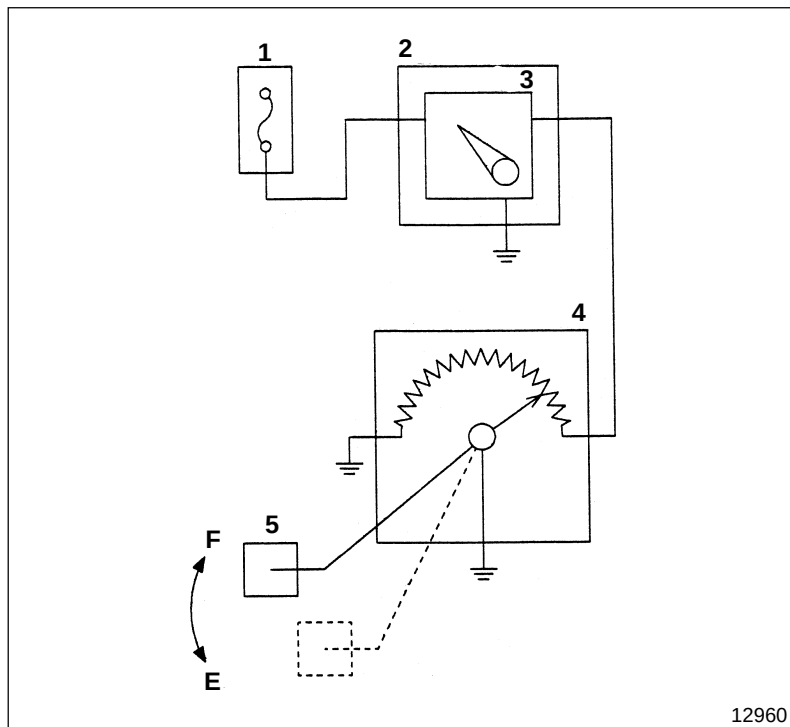
- Electric current from the starter switch is broken, and contact point **J** of fuel-cut relay **2** closes, and fuel-cut motor **3** is activated.
- Engine-stop cable **4** is pulled to bring engine-stop lever **5** to engine-stop position.



- When engine-stop lever **5** reaches engine-stop position **C**, fuel flow stops and the engine stops. Simultaneously, contact point **K** of fuel-cut motor **3** opens, and the fuel-cut motor stops.

STRUCTURE AND OPERATION

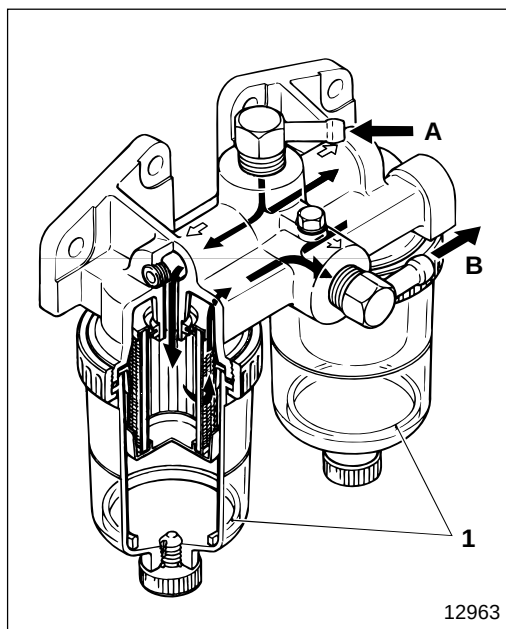
Fuel Gauge Electric Circuit



- 1 Relay and fuse box
- 2 Meter cluster
- 3 Fuel gauge
- 4 Fuel gauge unit
- 5 Float

The fuel gauge circuit indicates the amount of fuel remaining by means of a gauge.

Water Separator

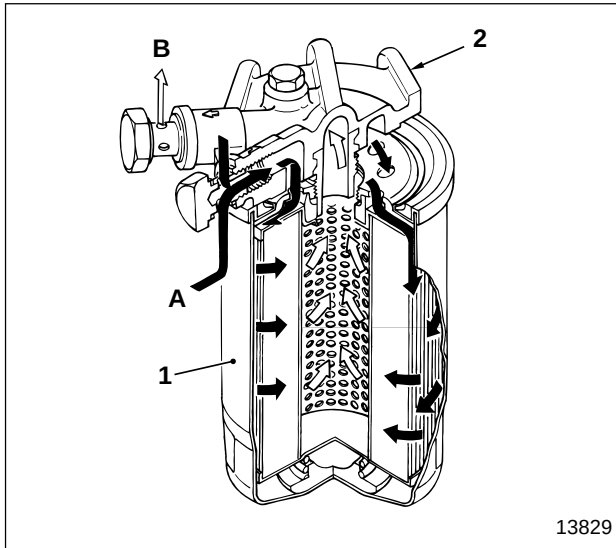


- 1 Water level ring

A : From fuel tank
B : To feed pump

The water separator is installed between the fuel tank and the feed pump. Any water present in the fuel is separated by the baffle plate and the screen assembly.

Fuel Filter



- 1 Fuel filter
- 2 Fuel filter head

A : From feed pump

B : To injection pump

Pressurized fuel is delivered from the feed pump of the injection pump to the fuel filter which separates water from the fuel. Dirt and other foreign particles are removed from the fuel by fuel filter **1**.

12 volts DC

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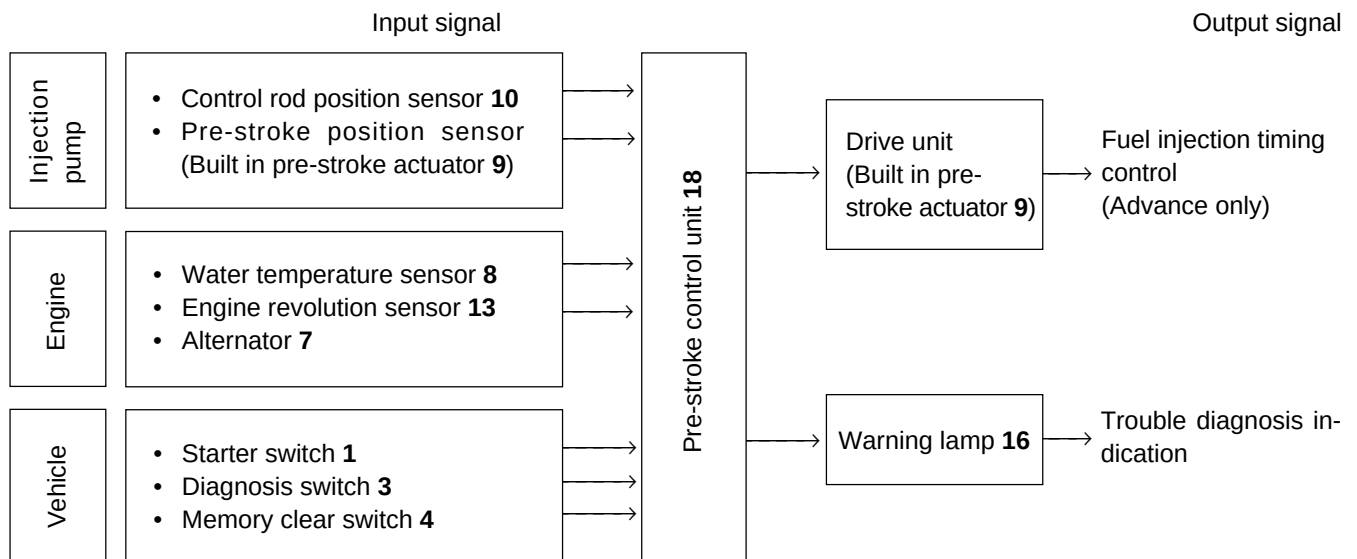
Part name	Main function	Main signal
1 Starter switch	Detection of start signal	Ⓐ : Start signal
2 Fuse box		
3 Diagnosis switch	Transmission of diagnosis code signal	Ⓕ : Diagnosis code signal
4 Memory clear switch	Clearing of diagnosis code	Ⓜ : Diagnosis code clearing signal
5 Multi-use tester connector	Connection of multi-use tester	
6 Boost air temperature sensor	Detection of engine intake air temperature	Ⓒ : Boost air temperature signal
7 Alternator	Detection of engine revolution	Ⓓ : Alternator L terminal signal
8 Water temperature sensor	Detection of engine coolant temperature	Ⓑ : Engine coolant temperature signal
9 Pre-stroke actuator • Pre-stroke position sensor • Drive unit		Ⓔ : Pre-stroke position signal ⓗ : Actuator drive signal
10 Control rod position sensor	Detection of control rod position	Ⓔ : Control rod position signal
11 Mechanical governor	Control of fuel injection quantity (Mechanical control)	
12 Pre-stroke control injection pump	Change of pre-stroke (Advance fuel injection timing)	
13 Engine revolution sensor	Detection of engine revolution	Ⓕ : Engine revolution signal
14 Mechanical timer	Retards fuel injection timing (Mechanical control)	
15 Meter cluster		
16 Warning lamp	Indication of system abnormality, indication of diagnosis code	Ⓙ : Lamp lighting signal
17 Tachometer		Ⓚ : Tachometer drive signal
18 Pre-stroke control unit	Control of entire system	

- The pre-stroke control injection pump system uses, in the injection pump body, electronically controlled pre-stroke control injection pump **12**, mechanical governor **11**, and mechanical timer **14**.
- The lifting speed of the plunger in the injection pump varies with the engine revolution. Because of this, the pressure in the injection pipe also changes.
- This change of pressure in the injection pipe means the appropriate state of fuel injection and air/fuel mixture from the injection nozzle is no longer obtainable.
- In low- and medium-range engine revolution, the amount of pre-stroke is made larger so that the fuel is injected at the point the plunger lifting speed increases during the second half of cam lift. P13-18
- On the other hand, in high-range engine revolution, the amount of pre-stroke is made smaller so that the fuel is injected while the plunger lifting speed remains low during the first half of cam lift. This prevents the pressure in the injection pipe from becoming excessively high.
- Because of this variation in the amount of pre-stroke, pre-stroke control injection pump **12** can obtain the appropriate injection state and air/fuel mixture for combustion.
- Thus, engine torque is larger than engines that use a normal injection pump. Also, the exhaust gas emission is cleaner.
- Control is achieved by making the pre-stroke adjustable in conjunction with the drive of pre-stroke actuator **9**, which is mounted on the rear of the injection pump body. This pre-stroke actuator is activated by commands received from pre-stroke control unit **18**, which processes data signals received from the various sensors installed on the engine and vehicle body.

This system also has a trouble diagnosis function and a fail-safe function. The following table shows control items.

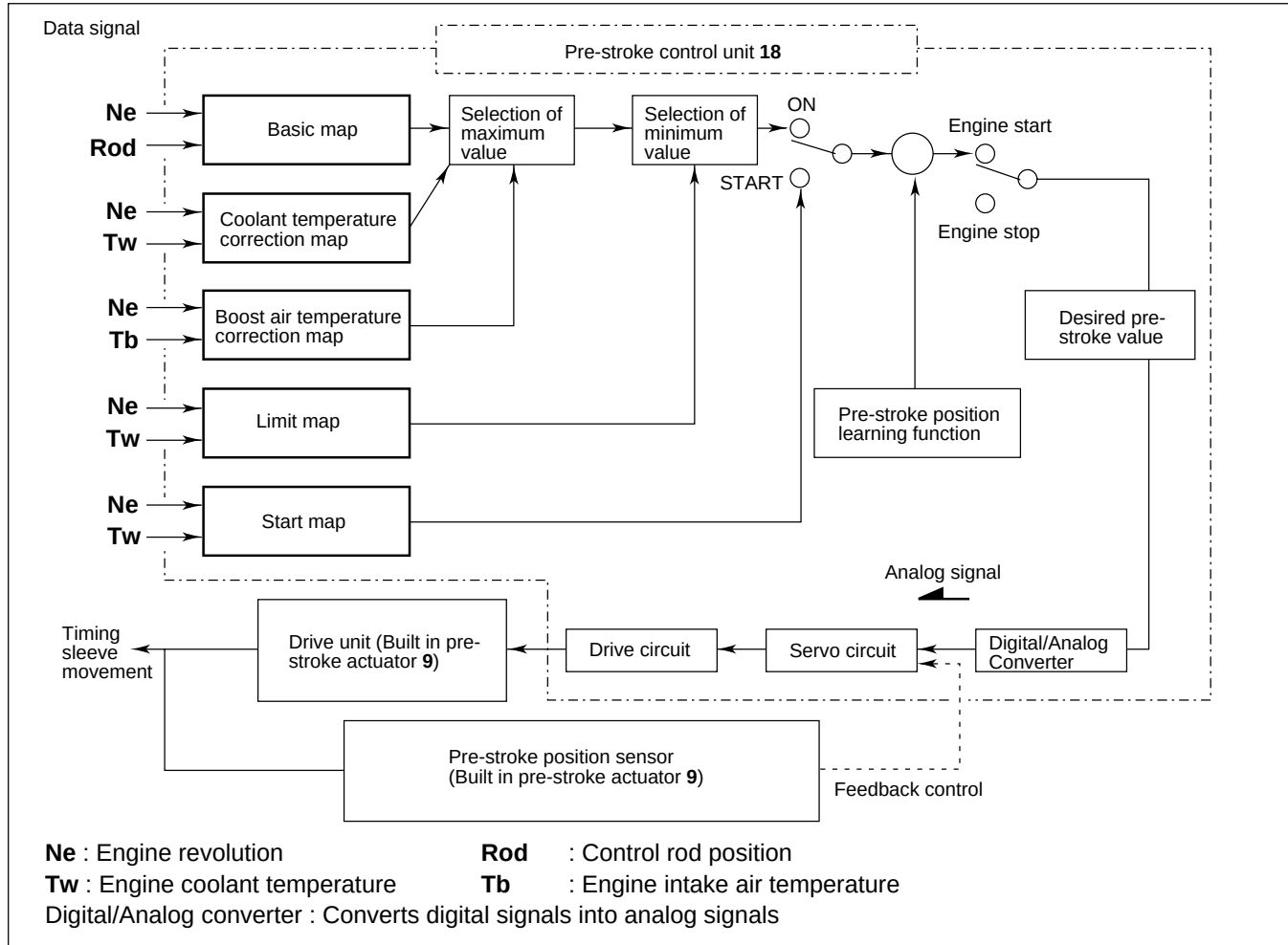
Control item	Control description	Information source	
		Sensor	Data signal
Pre-stroke control	Adjusts the fuel injection timing by changing the timing sleeve position to change the pre-stroke	6 to 10, 13	Ⓐ to Ⓜ
Trouble diagnosis function	Checks and diagnoses the status of the sensors of the pre-stroke control injection pump system while the engine is running. Warns the driver, via warning lamp 16 , if any trouble occurs, and memorizes the data on the trouble P13-13	ALL	ALL
Fail-safe function	When trouble occurs, backup mode is activated and countermeasures for the trouble are taken P13-13	ALL	ALL
* Fuel injection quantity control	Controlled by mechanical governor 11 P13-20	—	—
* Fuel injection timing control (retard)	Controlled by mechanical timer 14 P13-22	—	—

* : This is not controlled by the pre-stroke control injection pump system but by ordinary mechanical control.



STRUCTURE AND OPERATION

● Pre-stroke control



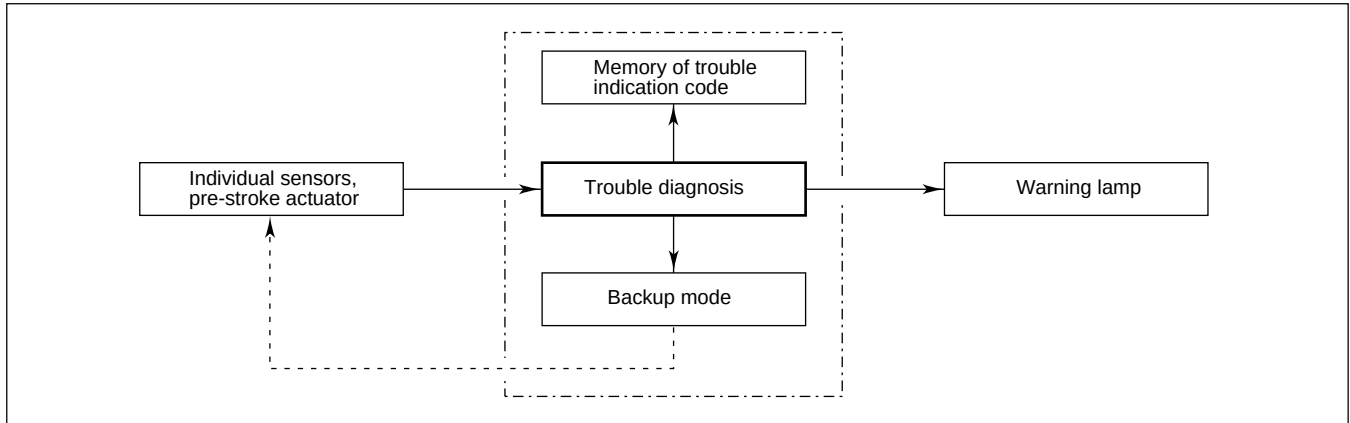
Control by Pre-stroke Control Unit 18

- The control unit commands the system while the engine is running, and selects the maximum value of the desired pre-stroke value based on data signals received from the basic map, coolant temperature correction map, and boost air temperature correction map.
- After the maximum value has been selected, the limit map selects and processes the minimum value so that the desired pre-stroke value does not exceed the maximum value.
- The desired pre-stroke value is further determined by the pre-stroke position learning function. This corrects any deviation in positional adjustment by the pre-stroke position sensor and any deviation by the injection pump, correcting the output voltage of the pre-stroke position sensor.
- The pre-stroke thus determined is converted into continuous analog signals by the Digital/Analog converter and transmitted through the servo circuit and drive circuit to actuate the drive unit. The drive unit moves the timing sleeve position to change the pre-stroke.
- Control at the time of engine start up is handled by the start map.

Control by Pre-stroke Position Sensor (built in pre-stroke actuator 9)

- The pre-stroke position sensor monitors the operating condition of the drive unit by feeding back signals to pre-stroke control unit 18 and judging whether the pre-stroke is controlled in accordance with the desired value by noting the timing sleeve position.
- When pre-stroke control unit 18 receives the feedback signals, it computes the actual measured value of the timing sleeve position, and if there is any difference between the desired and actual values, it issues a correction command.
- This operation is repeated to constantly maintain the timing sleeve position at the desired position, thus determining the final pre-stroke.

● 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.

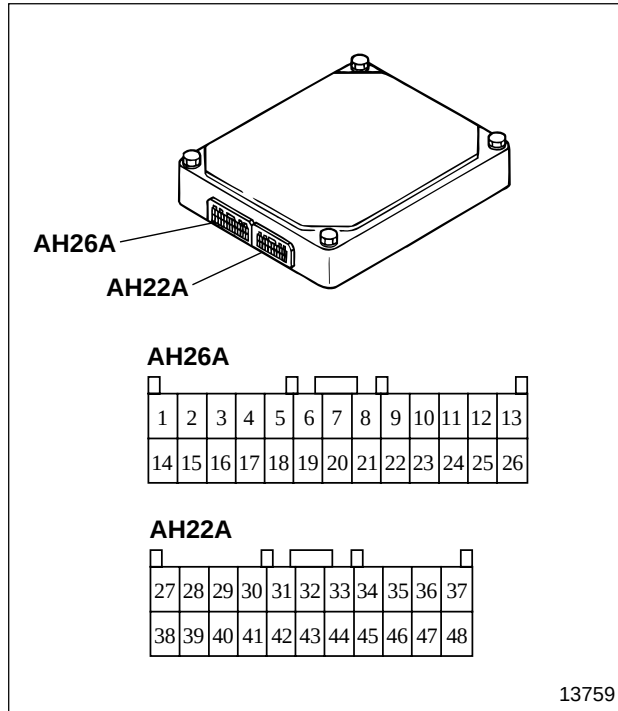
Table of diagnosis codes

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.

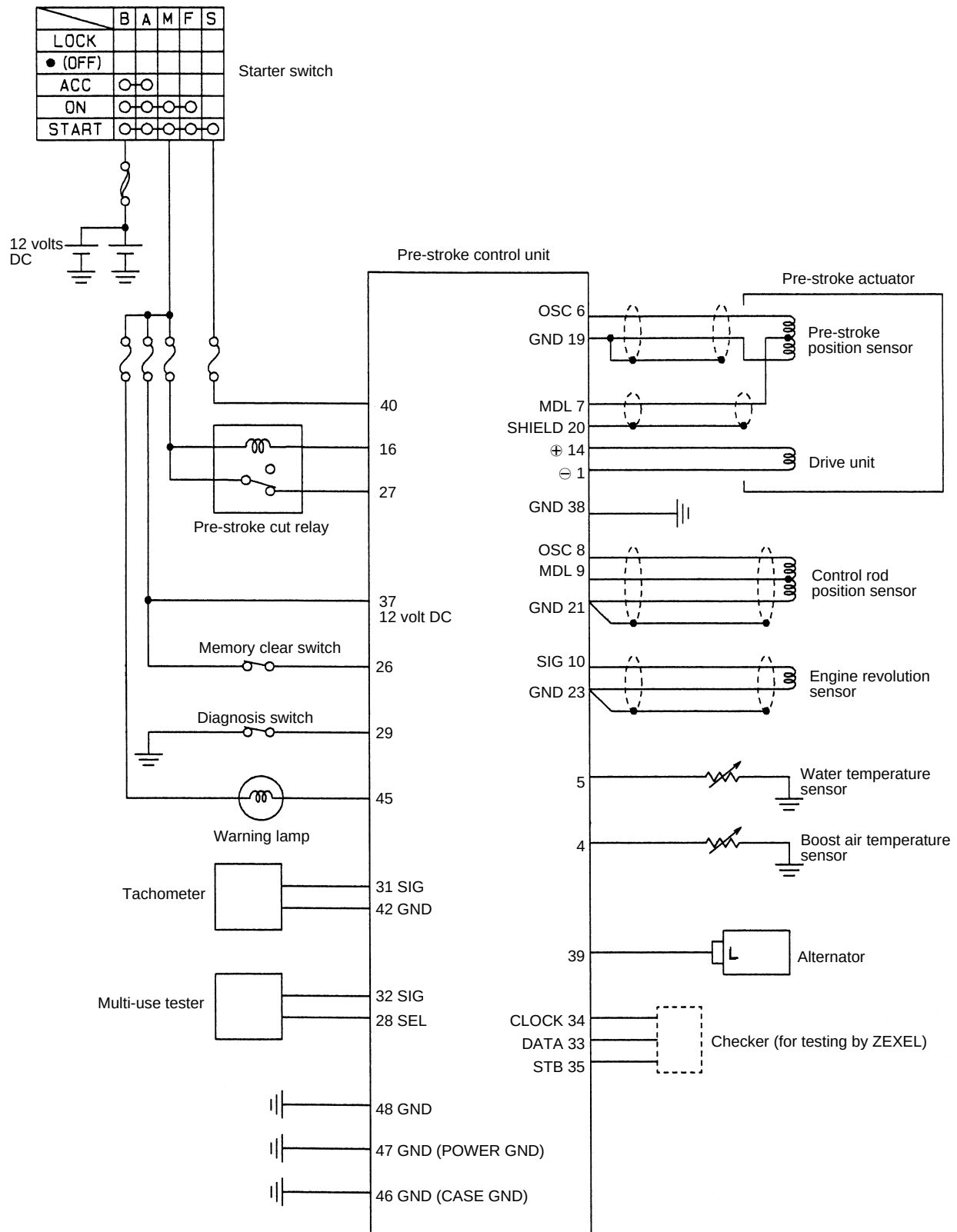
STRUCTURE AND OPERATION

Pre-stroke Control Unit



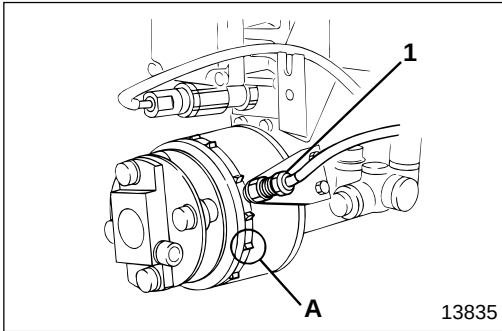
- The pre-stroke control unit monitors and computes data signals received from the various sensors and, using its internal computer, converts the computed results into control signals (pre-stroke actuator drive signals).
- These signals operate the various instruments to control the system.

Connector AH26A		Connector AH22A	
Terminal No.	Connecting destinations	Terminal No.	Connecting destinations
1	Drive unit ⊖	27	Pre-stroke cut relay (Contact point)
2	—	28	Multi-use Tester (SEL)
3	—	29	Diagnosis switch
4	Boost air temperature sensor	30	—
5	Water temperature sensor	31	Tachometer (SIG)
6	Pre-stroke position sensor (OSC)	32	Multi-use tester (SIG)
7	Pre-stroke position sensor (MDL)	33	DDS-III (DATA)
8	Control rod position sensor (OSC)	34	DDS-III (CLOCK)
9	Control rod position sensor (MDL)	35	DDS-III (STB)
10	Engine revolution sensor (SIG)	36	—
11	—	37	Control unit power source (12 volts DC)
12	—	38	Pre-stroke actuator power source ⊖
13	—	39	Alternator terminal L
14	Drive unit ⊕	40	Starter switch terminal S
15	—	41	—
16	Pre-stroke cut relay (Coil)	42	Tachometer (GND)
17	—	43	—
18	—	44	—
19	Pre-stroke position sensor (GND)	45	Warning lamp
20	Pre-stroke position sensor (SHIELD)	46	Ground
21	Control rod position sensor (GND)	47	Ground (CASE GND)
22	—	48	Ground (POWER GND)
23	Engine revolution sensor (GND)	—	—
24	—	—	—
25	—	—	—
26	Memory clear switch	—	—



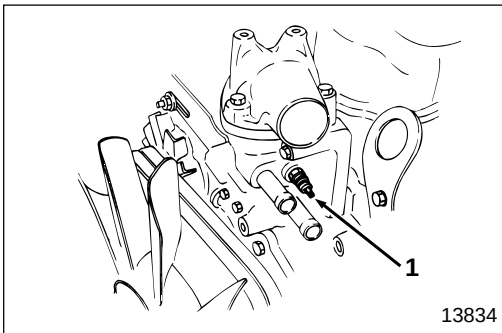
STRUCTURE AND OPERATION

Engine Revolution Sensor



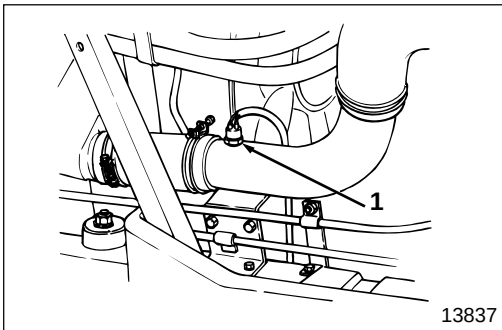
- Engine revolution sensor **1** is a pick-up type that detects the revolution of the injection pump and converts the revolution value into an electric signal.
 - This electric signal is transmitted to the pre-stroke control unit as the engine revolution signal, which is used as the correction value by the control unit to determine the desired pre-stroke position value.
- A : Timer housing protrusion

Water Temperature Sensor



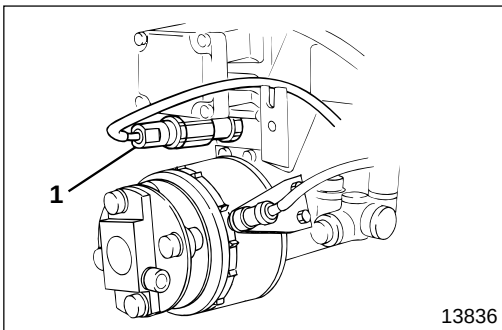
- Water temperature sensor **1** is a thermistor type that converts the coolant temperature into an electric signal.
- This electric signal is transmitted to the pre-stroke control unit as the engine coolant temperature signal, which is used as the correction value by the control unit to determine the desired pre-stroke position value.

Boost Air Temperature Sensor



- Boost air temperature sensor **1** is a thermistor type that converts the intake air temperature, immediately after its passage through the intercooler, into an electric signal.
- This electric signal is transmitted to the pre-stroke control unit as the boost air temperature signal, which is used as the correction value by the control unit to determine the desired pre-stroke position value.

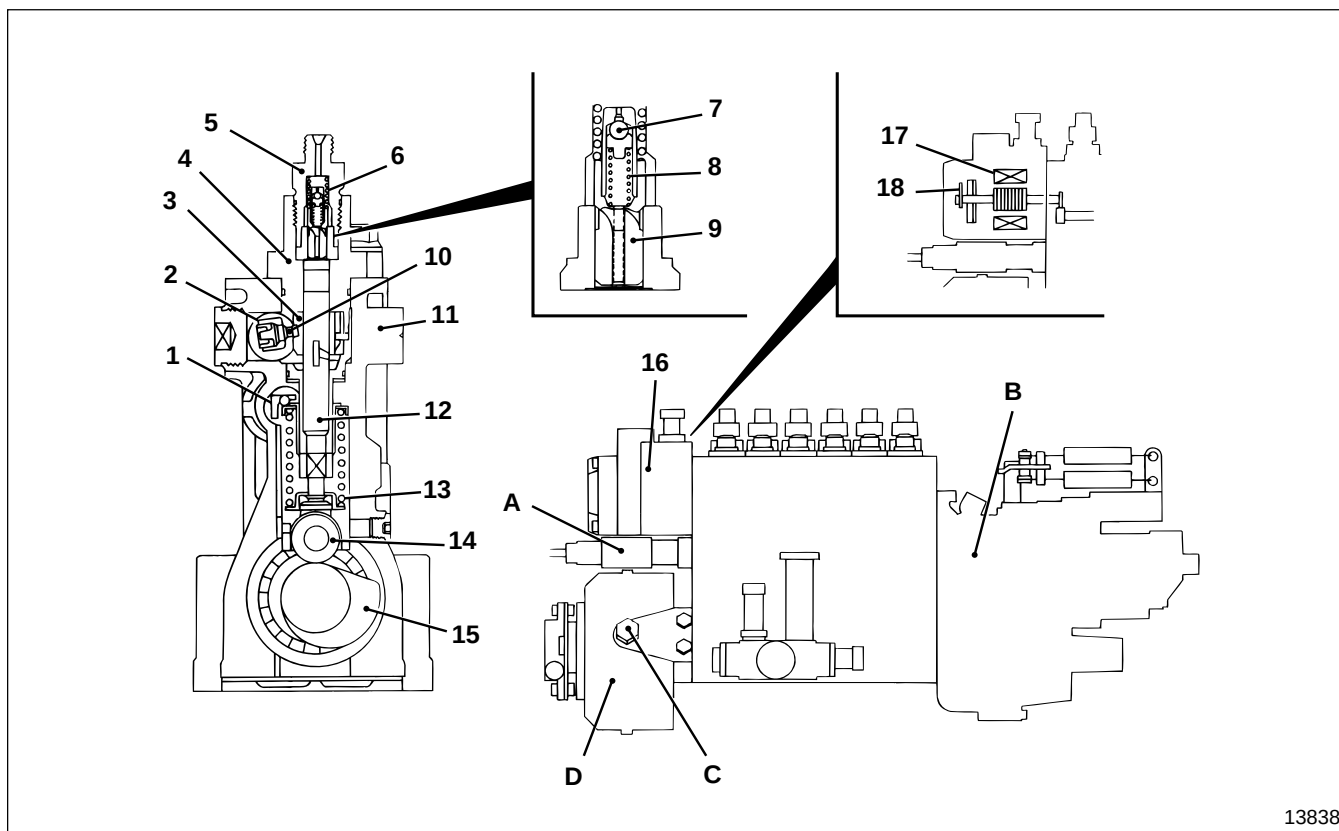
Control Rod Position Sensor



- Control rod position sensor **1** is a resistor type that converts the amount of movement of the control rod into an electric signal.
- This electric signal is transmitted to the pre-stroke control unit as the control rod position signal, which is used as the correction value by the control unit to determine the desired pre-stroke position value.

Pre-stroke Position Sensor P13-10, 12

Injection Pump Body

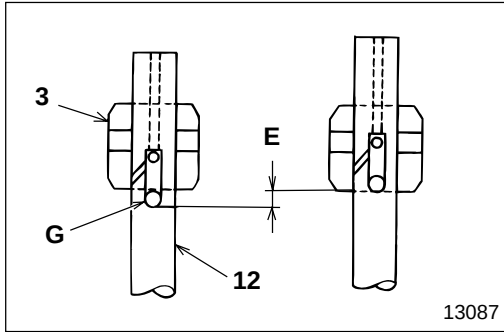


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- | | |
|-------------------------|---|
| 1 Control rod | 13 Plunger spring |
| 2 Timing rod | 14 Tappet |
| 3 Timing sleeve | 15 Camshaft |
| 4 Plunger barrel | 16 Pre-stroke actuator |
| 5 Delivery valve holder | 17 Drive unit |
| 6 Delivery valve spring | 18 Pre-stroke position sensor |
| 7 Ball | |
| 8 Spring | |
| 9 Delivery valve | |
| 10 Pin | |
| 11 Pump housing | |
| 12 Plunger | |
| | A : Control rod position sensor P13-16 |
| | B : Mechanical governor P13-20 |
| | C : Engine revolution sensor P13-16 |
| | D : Mechanical timer P13-22 |

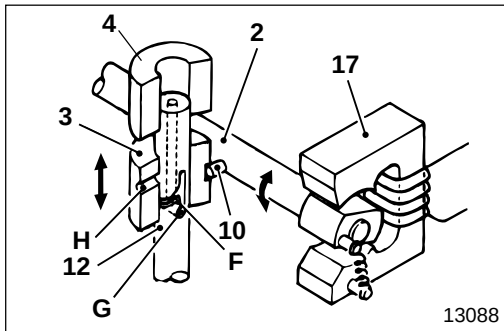
- The injection pump has a variable pre-stroke mechanism.
- Because of the variation in the amount of pre-stroke, the appropriate injection state and air/fuel mixture for combustion can be obtained, thus the engine torque is larger than when a normal injection pump is used and the exhaust gas emission is cleaner.

STRUCTURE AND OPERATION



Pre-stroke

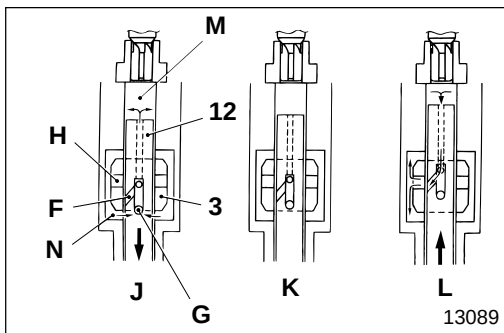
Pre-stroke is stroke **E** whose range is from the bottom dead point of plunger **12** to the starting point of pressurized delivery of fuel, at which point suction port **G** is closed by timing sleeve **3**. An ordinary injection pump has a fixed stroke length.



Pre-stroke variable mechanism

- F** : Indent
- G** : Suction port
- H** : Exhaust port

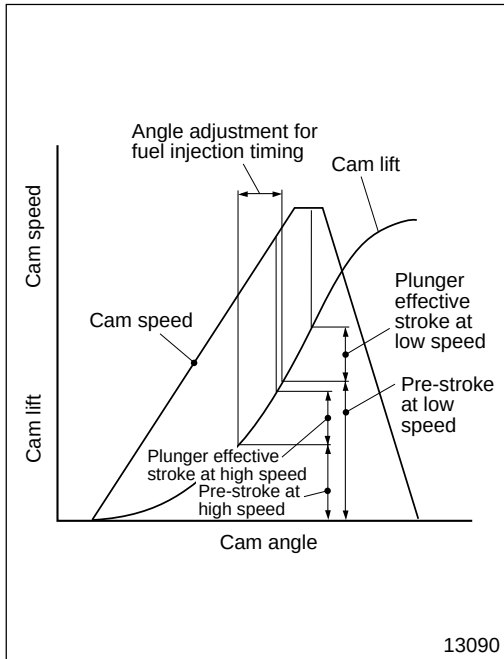
- In a conventional injection pump, plunger barrel **4** is fixed. In the pre-stroke control injection pump system, vertically movable timing sleeve **3** is fitted in the fixed plunger barrel.
- Timing rod **2**, pin **10** and drive unit **17** are installed to operate timing sleeve **3**.
- The operation of drive unit **17** rotates timing rod **2**, causing pin **10** to move timing sleeve **3** vertically.
- As timing sleeve **3** is fitted with fuel exhaust port **H**, the pre-stroke changes in accordance with the movement of the timing sleeve.



Pressurized fuel delivery

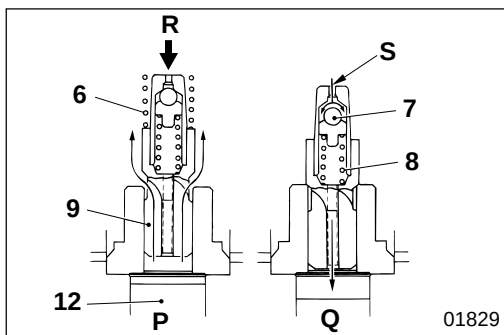
- J** : Ongoing suction
- K** : Start of pressurization
- L** : Delivery ends

- When suction port **G** opens as plunger **12** moves down from the top dead point, fuel is delivered into pressure chamber **M** by both the negative pressure caused by the downward movement of the plunger and the pressure of the fuel itself delivered by the feed pump.
- When the lift of plunger **12** is low enough, the pressure in pressure chamber **M** does not increase as the fuel in pressure the chamber flows via suction port **G** into fuel reservoir **N**, even if the plunger lifts.
- As plunger **12** lifts further and suction port **G** is closed by timing sleeve **3**, pressurization of the fuel starts. The pressure increases as the plunger lifts further, making the injection pump start pressurized fuel delivery.
- When indent **F** on plunger **12** meets exhaust port **H** of timing sleeve **3**, the fuel in pressure chamber **M** is pushed back to fuel reservoir **N**, stopping pressurized fuel delivery.
- Adjustment of the fuel quantity to be injected is made by changing the relative meeting position of exhaust port **H** of timing sleeve **3** and indent **F**, by the rotation of plunger **12**.



Fuel injection timing and fuel injection characteristics

- The pre-stroke changes according to changes in the position of timing sleeve **3**, whereby the fuel injection timing can be advanced or retarded.
- By making the pre-stroke smaller, suction port **G** of plunger **12** closes early, making the fuel injection timing quicker accordingly. Retard of fuel injection timing is not controlled by the variable pre-stroke mechanism, but by mechanical timer **D**.
- By making the pre-stroke larger, suction port **G** of plunger **12** closes late, making the fuel injection timing slower accordingly. The quick response of the fuel injection timing improves engine start-up performance at low temperatures.



Delivery valve

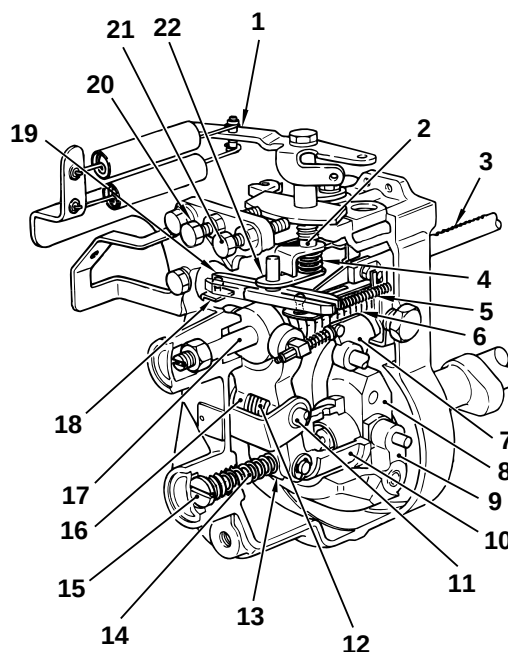
P : Start of pressurized delivery

Q : End of pressurized delivery

- Delivery valve **9** keeps residual pressure **R** in the injection pipe at a certain level throughout the entire engine revolution range preventing cavitation and allowing high-pressure injection.
- When the fuel pressure on plunger **12** side, as the plunger is lifted, overcomes the combined force of residual pressure **R** in the injection pipe and the repercussive force of delivery valve spring **6** of the plunger, delivery valve **9** is pushed up and pressurized fuel delivery starts.
- Fuel in the injection pipe returns quickly to plunger **12** side the moment pressurized delivery from the plunger ends, and the delivery valve is closed.
- The excess fuel is returned slowly through orifice **S**, reducing the pressure in the injection pipe.
- When the repercussive force of spring **8** in delivery valve **9** equalizes with the pressure in the injection pipe, ball **7** closes orifice **S** and residual pressure **R** in the injection pipe is kept at a specified level.

STRUCTURE AND OPERATION

Governor

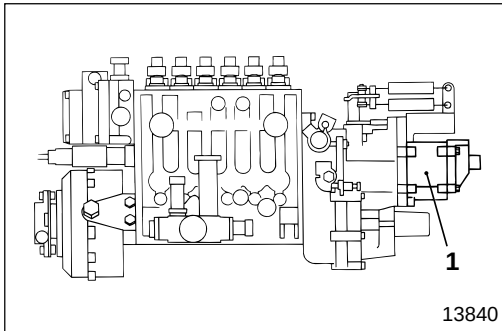


13839

- | | |
|-------------------------|------------------------|
| 1 Control lever | 12 Cancel spring A |
| 2 Adjusting lever shaft | 13 Shifter |
| 3 Control rod | 14 Idling spring |
| 4 Cancel spring B | 15 Idling screw |
| 5 Start spring | 16 Tension lever |
| 6 Governor spring | 17 Governor shaft |
| 7 Torque cam | 18 Guide lever |
| 8 Flyweight holder | 19 Floating lever |
| 9 Flyweight | 20 Idling set bolt |
| 10 Sleeve | 21 Full-speed set bolt |
| 11 Tension lever shaft | 22 Supporting lever |

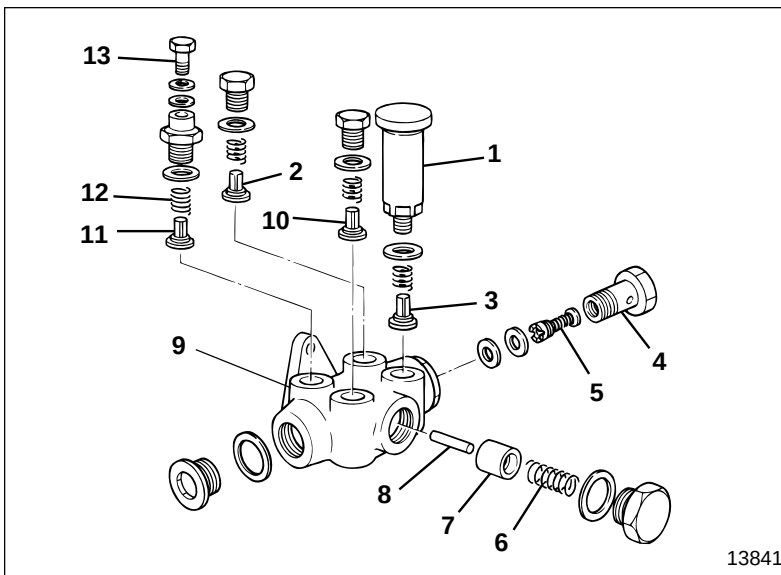
The governor is a mechanical type that uses centrifugal force generated by flyweights **9**, its characteristics are between those of a minimum/maximum speed governor and those of an all-speed governor. Because there is no repercussive force from governor spring **6** or control lever **1**, when the accelerator pedal is depressed, the repercussive force transmitted to the accelerator pedal, via the control lever, is quite light, making accelerator pedal operation easy.

Boost Compensator



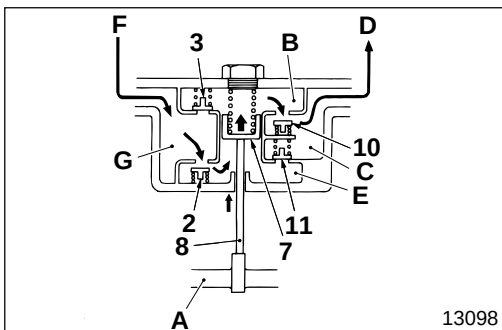
Boost compensator **1** is a device that automatically adjusts the quantity of fuel to be injected to suit the increase in the intake air mass delivered into the engine cylinders by the turbocharger.

Feed Pump



- 1 Priming pump
- 2 Check valve
- 3 Check valve
- 4 Eye bolt on fuel inlet side
- 5 Gauze filter
- 6 Piston spring
- 7 Piston
- 8 Push rod
- 9 Feed pump housing
- 10 Check valve
- 11 Check valve
- 12 Check valve spring
- 13 Eye bolt on fuel outlet side

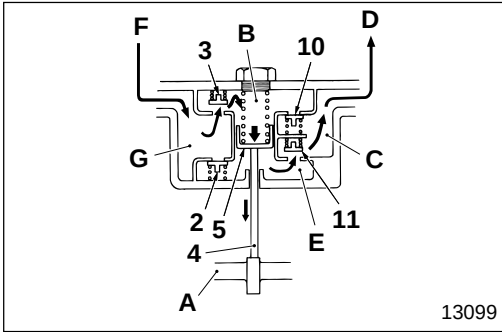
- The feed pump is a double-action type pump which, with four check valves operating, sucks and discharges fuel during both strokes of pistons **7**.
- Push rod **8** makes contact with the injection pump camshaft directly, moving piston **7**.
- Priming pump **1** can be manually operated, when the injection pump is not operating, to suck up fuel and thus can be used for air bleeding.
- Gauze filter **5** eliminates large foreign particles from the fuel sucked up from the fuel tank to prevent clogging of the feed pump. This gauze filter must be cleaned with gas oil periodically.



The rotation of injection pump camshaft **A**, pushes up push rod **8** and piston **7**, and the pressure in inner chamber **B** increases. This closes check valve **3**, and check valve **10** opens to let the fuel in inner chamber **B** flow through outer chamber **C** to fuel filter **D**.

When the pressure in inner chamber **E** decreases, check valve **11** closes, and check valve **2** opens to let fuel flow from fuel tank **F** through outer chamber **G** to inner chamber **E**.

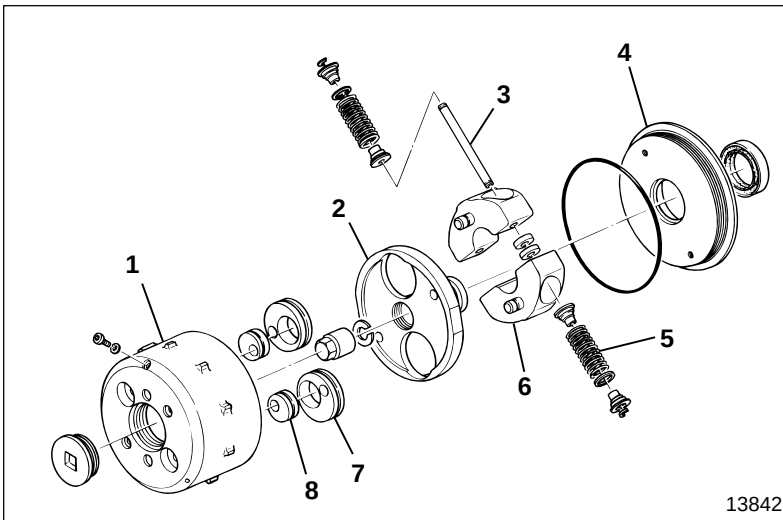
STRUCTURE AND OPERATION



When injection pump camshaft **A** rotates further, it pushes down push rod **4** and piston **5**, and the pressure in inner chamber **E** increases. This closes check valve **2**, and check valve **11** opens to let the fuel in inner chamber **E** flow through outer chamber **C** to fuel filter **D**.

When the pressure in inner chamber **B** decreases, check valve **10** closes, and check valve **3** opens to let fuel from fuel tank **F** flow through outer chamber **G** to inner chamber **B**.

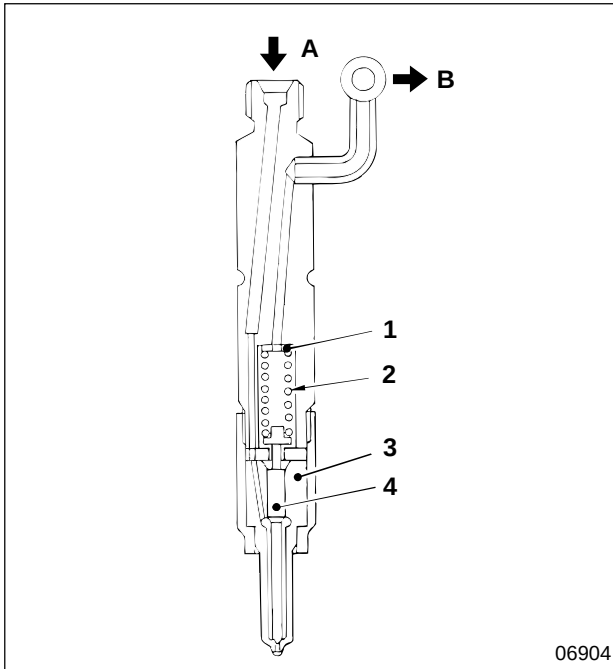
Automatic Timer



- 1 Timer housing
- 2 Timer holder
- 3 Pilot pin
- 4 Cover
- 5 Timer spring
- 6 Flyweight
- 7 Eccentric cam (Large)
- 8 Eccentric cam (Small)

- The mechanical type automatic timer changes fuel injection timing automatically when the engine revolution reaches the specified rate.
- The automatic timer controls the retard of fuel injection timing. The pre-stroke control unit controls the advance of fuel injection timing.

Injection Nozzle



- 1 Washer
- 2 Spring
- 3 Nozzle tip
- 4 Needle valve

A : From injection pump

B : To fuel tank

- As the pressure of the fuel delivered from the injection pump overcomes the repercussive force of spring **2**, needle valve **4** is pushed up to allow the fuel to spray out the opening at the tip of the nozzle.
- Injection pressure can be adjusted by increasing or decreasing the number of washers **1**.

TROUBLESHOOTING

Symptoms		Engine does not start	Engine hard to start	Engine knocks	Engine output inconsistent	Engine output does not develop full power	Engine maximum revolution too high	Engine idling unstable	Engine starts but stalls	Engine revolution does not reach specified maximum speed	Engine does not stop	Accelerator pedal hard to depress	Fuel supply insufficient
Possible causes													
Injection pump body	Pre-stroke control faulty (Warning lamp  lights)  P13-30		○	○	○	○							
	Plunger stuck	○											
	Control rod stuck	○											
	Delivery valve stuck	○											
	Tappet worn	○											
	Camshaft worn	○											
	Injection timing adjusted incorrectly		○		○	○		○					
	Plunger worn					○		○					
	Delivery valve seated incorrectly					○							
	Injection timing too fast			○									
	Plunger sliding stroke short				○								
	Plunger spring damaged				○			○					
	Control rod not moving smoothly	○	○		○		○	○					
	Tappet worn, not moving smoothly				○								
	Delivery valve spring damaged				○	○							
	Airtightness incorrect due to delivery valve holder loosened				○	○							
	Control pinion loosened							○					
	Plunger spring setting faulty							○					
	Delivery valve holder tightened excessively							○					
	Injection amount of each cylinder uneven		○					○					
	Overflow valve stuck	○	○		○								
Fuel feed pump	Gauze filter clogged	○						○	○				
	Check valve malfunctioning	○											
	Piston stuck	○											
	Push rod stuck	○											
	Push rod worn	○											
	Check valve sliding movement faulty		○		○			○					
	Piston worn		○		○			○					

Symptoms													
		Engine does not start	Engine hard to start	Engine knocks	Engine output inconsistent	Engine output does not develop full power	Engine maximum revolution too high	Engine idling unstable	Engine starts but stalls	Engine revolution does not reach specified maximum speed	Engine does not stop	Accelerator pedal hard to depress	Fuel supply insufficient
Possible causes													
Governor	Full-speed stopper position short of standard value					○							
	Governor spring weak					○				○			
	Control lever position adjusted incorrectly				○	○				○			
	Flyweight malfunctioning						○						
	Idling spring weak							○					
	Linkage bent							○					
	Linkage friction excessive or linkage too loose							○					
	Round nut loosened							○					
	Idling set bolt adjusted incorrectly							○					
	Control lever sliding movement faulty										○		
	Stop mechanism damaged										○		
Injection nozzle	Needle valve stuck	○											
	Valve opening pressure too low	○								○			
	Injection nozzle clogged	○		○		○		○		○			
	Nozzle airtightness incorrect	○		○		○		○		○			
	Valve opening pressure too high			○									
	Spring fractured				○	○							
	Needle valve sliding movement faulty				○								
	Valve opening pressure faulty				○								
	Spring fatigued							○					
Fuel filter	Filter clogged	○			○			○	○				
No fuel in fuel tank		○											
Fuel pipe clogged or fuel leakage from connections		○											
Air or water in fuel system		○			○			○	○				
Low-quality fuel being used			○	○		○		○					

TROUBLESHOOTING

Symptoms		Engine does not start	Engine hard to start	Engine knocks	Engine output inconsistent	Engine output does not develop full power	Engine maximum revolution too high	Engine idling unstable	Engine starts but stalls	Engine revolution does not reach specified maximum speed	Engine does not stop	Accelerator pedal hard to depress	Fuel supply insufficient
Possible causes													
Engine control	Accelerator pedal stopper bolt adjusted incorrectly					○				○			
	Accelerator pedal arm rusted											○	
	Accelerator control cable connection faulty											○	
	Accelerator control cable sliding movement faulty											○	
	Engine stop cable damaged or stretched										○		
	Engine stop cable adjusted incorrectly										○		
Fuel pipe cracked													○
Fuel tank airtightness incorrect													○
Oil viscosity unsuitable  Gr 12			○										
Valve clearance incorrect  Gr 11			○					○					
Head gasket faulty  Gr 11			○					○					
Valve and valve seat worn and carbon deposits  Gr 11			○					○					
Valve spring fatigued  Gr 11			○					○					
Piston ring worn or damaged  Gr 11			○					○					
Piston ring groove worn or damaged  Gr 11			○					○					
Piston and cylinder worn  Gr 11			○										
Cooling system malfunctioning  Gr 14			○					○					
Starter switch faulty  Gr 54			○										
Glow relay faulty  Gr 54			○										
Multipurpose timing control unit faulty  Gr 54			○										
Fuel-cut motor faulty  Gr 54		○									○		
Fuel-cut relay faulty  Gr 54		○									○		

MEMO

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Inspection and Adjustment of Fuel Injection Timing

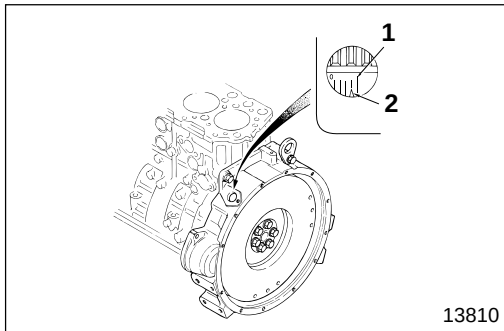
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Fuel injection timing (BTDC)	$5^{\circ} \pm 0.5^{\circ}$	—	Adjust

Tightening torque

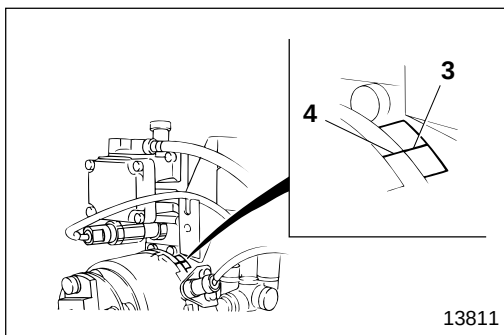
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Adjusting bolt	59 to 64 {43 to 47, 6 to 6.5}	—

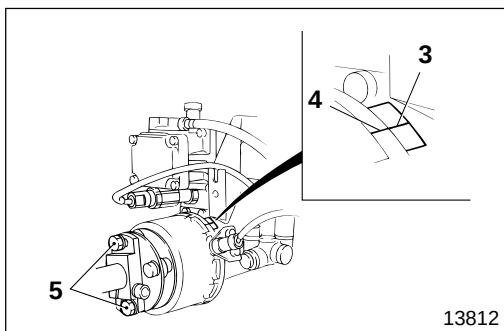


[Inspection]

- Crank the crankshaft more than 180° in the forward running direction. Check if notch 1 on the flywheel and pointer 2 on the flywheel housing show the standard fuel injection timing.



- When pointer 3 on the injection pump and notch 4 on the automatic timer align, the fuel injection timing is standard.
- If the fuel injection timing is not standard, adjust as follows.



[Adjustment]

- Loosen adjusting bolts 5 and turn the automatic timer to align pointer 3 and notch 4.
- Tighten adjusting bolts 5 at specified torque.
- Reinspect the fuel injection timing.

CAUTION ⚠

Do not loosen any bolts other than adjusting bolts 5.

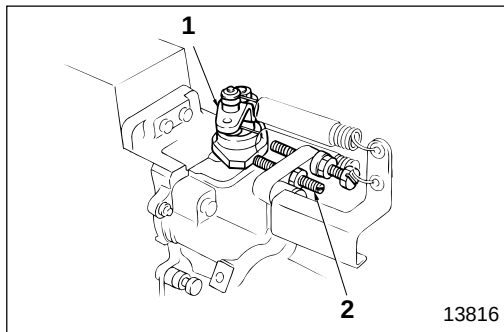
Inspection and Adjustment of No-load Minimum and Maximum Revolution

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	No-load minimum revolution (Idling revolution)	Manual transmission	650 to 700 rpm	—	Adjust
		Automatic transmission	700 to 750 rpm	—	Adjust
—	No-load maximum revolution		3650 to 3750 rpm	—	Adjust

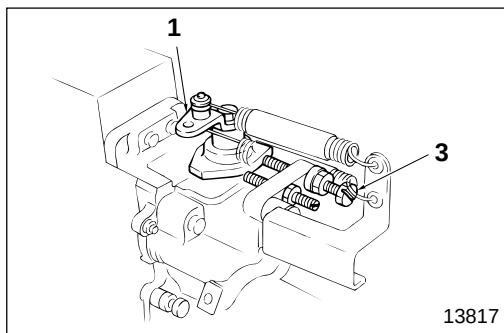
● Before inspecting the vehicle do the following :

- Run the engine to bring the coolant temperature up to approximately 80 to 90°C {176 to 194°F}.
- Turn all the lights and accessory equipment OFF.
- Put transmission in neutral. (For automatic transmission, put transmission in **N** range.)
- Set the steering wheel at center and straight position.



(1) No-load minimum revolution (Idling revolution)

- Make sure that control lever **1** strikes idling set bolt **2**, and in this state, check and see if the minimum revolution is within the standard value.
- If the minimum revolution deviates from the standard value, adjust using idling set bolt **2**.
- After adjustment increase the revolution from between 2800 rpm to 3400 rpm once, and check the minimum revolution.



(2) No-load maximum revolution

- Make sure that control lever **1** strikes full-speed set bolt **3**, and in this condition, check and see if the maximum revolution is within the standard value.
- If the maximum revolution deviates from the standard value, adjust using full-speed set bolt **3**.

NOTE

Ensure that the engine does not stall or hunt when control lever **1** is moved from the full-speed position to the idling position quickly. If performance is faulty, adjust it to within standard values.

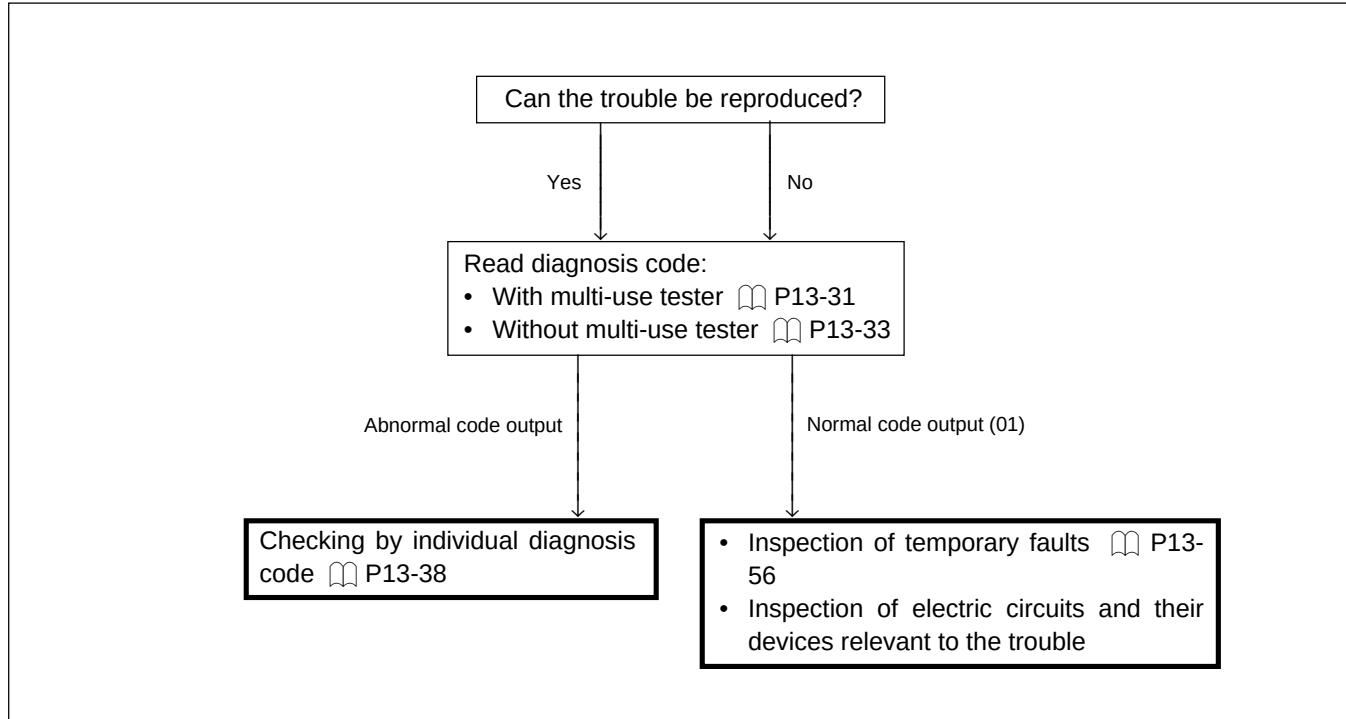
PRE-STROKE CONTROL INJECTION PUMP SYSTEM

Troubleshooting Procedure

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

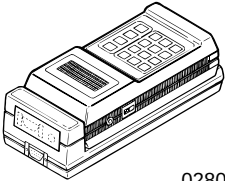
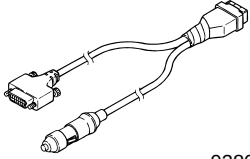
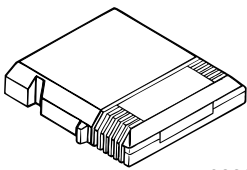
This means you have to read the diagnosis code memorized in the pre-stroke control unit, and carry out an inspection based on this code. There are two ways of reading the code; with a multi-use tester, and without a multi-use tester.

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.

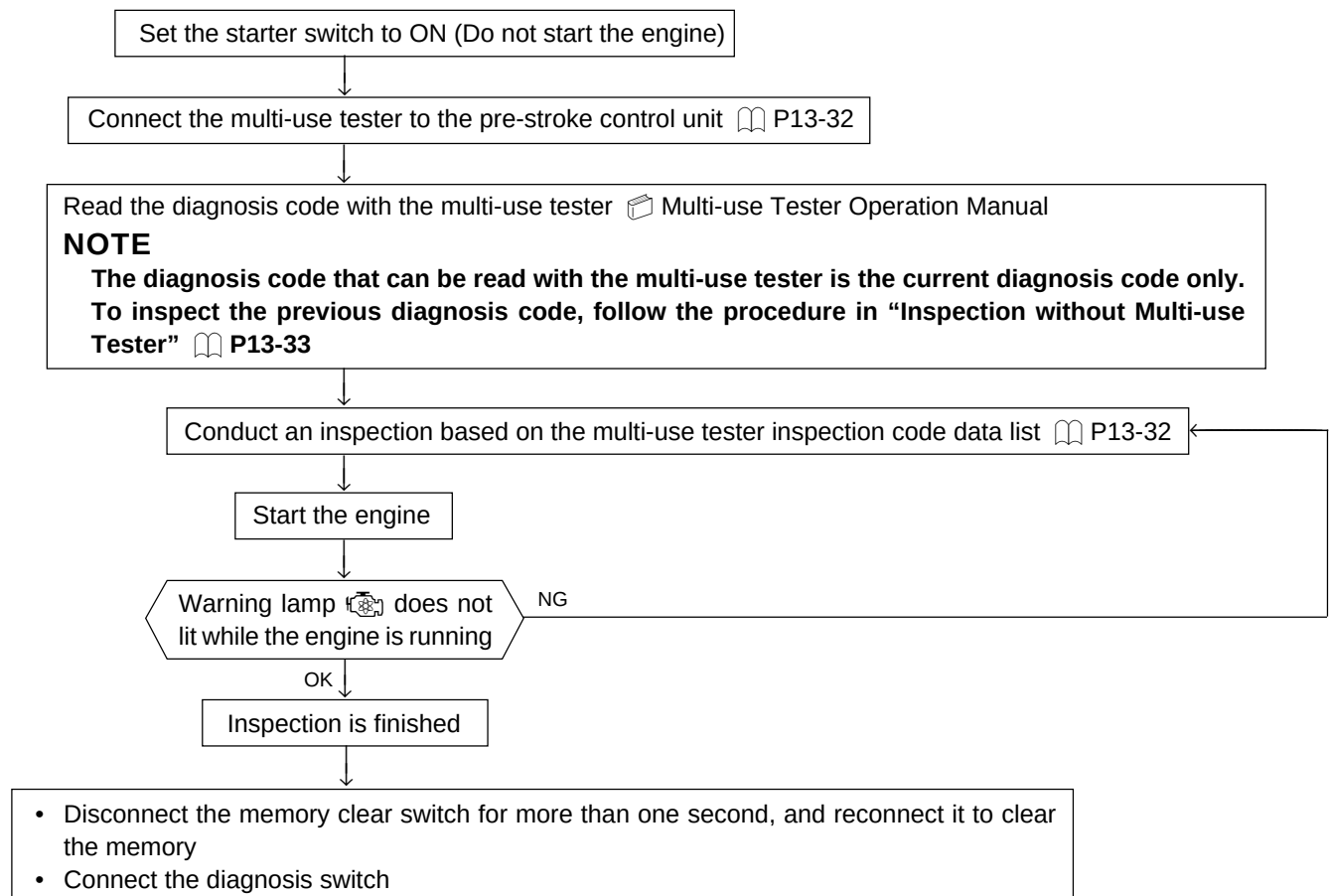


● Inspection with multi-use tester

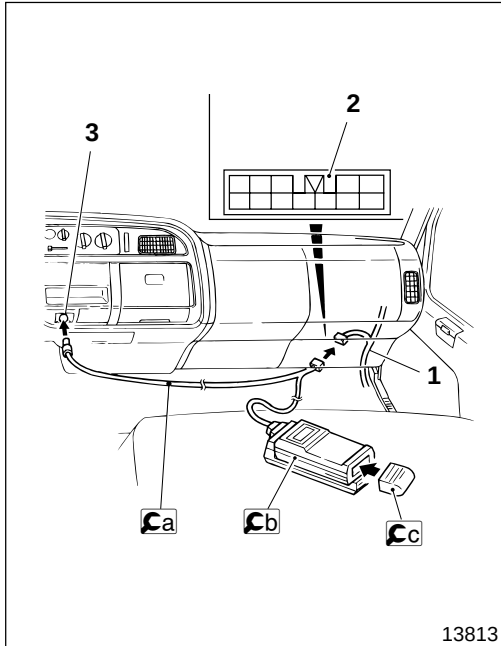
Special tools

Tool name and shape	Part No.	Application
Multi-use tester sub-assembly  02803	MC858999	Inspection of system
Multi-use tester harness  02804	MB991231	
ROM pack  02805	MC858989	

● Inspection flow chart



PRE-STROKE CONTROL INJECTION PUMP SYSTEM



● Connection of Multi-use Tester to Pre-Stroke Control Unit

- Set the starter switch to LOCK.
- Connect **Ca** multi-use tester harness to multi-use tester connector 2 of cab harness 1 and to cigarette lighter socket 3.
- Connect **Ca** multi-use tester harness to **Cb** multi-use tester sub-assembly.
- Connect **Cc** ROM pack to **Cb** multi-use tester sub-assembly.

NOTE

Refer to the Multi-use Tester Operation Manual for details regarding the operation of the multi-use tester.

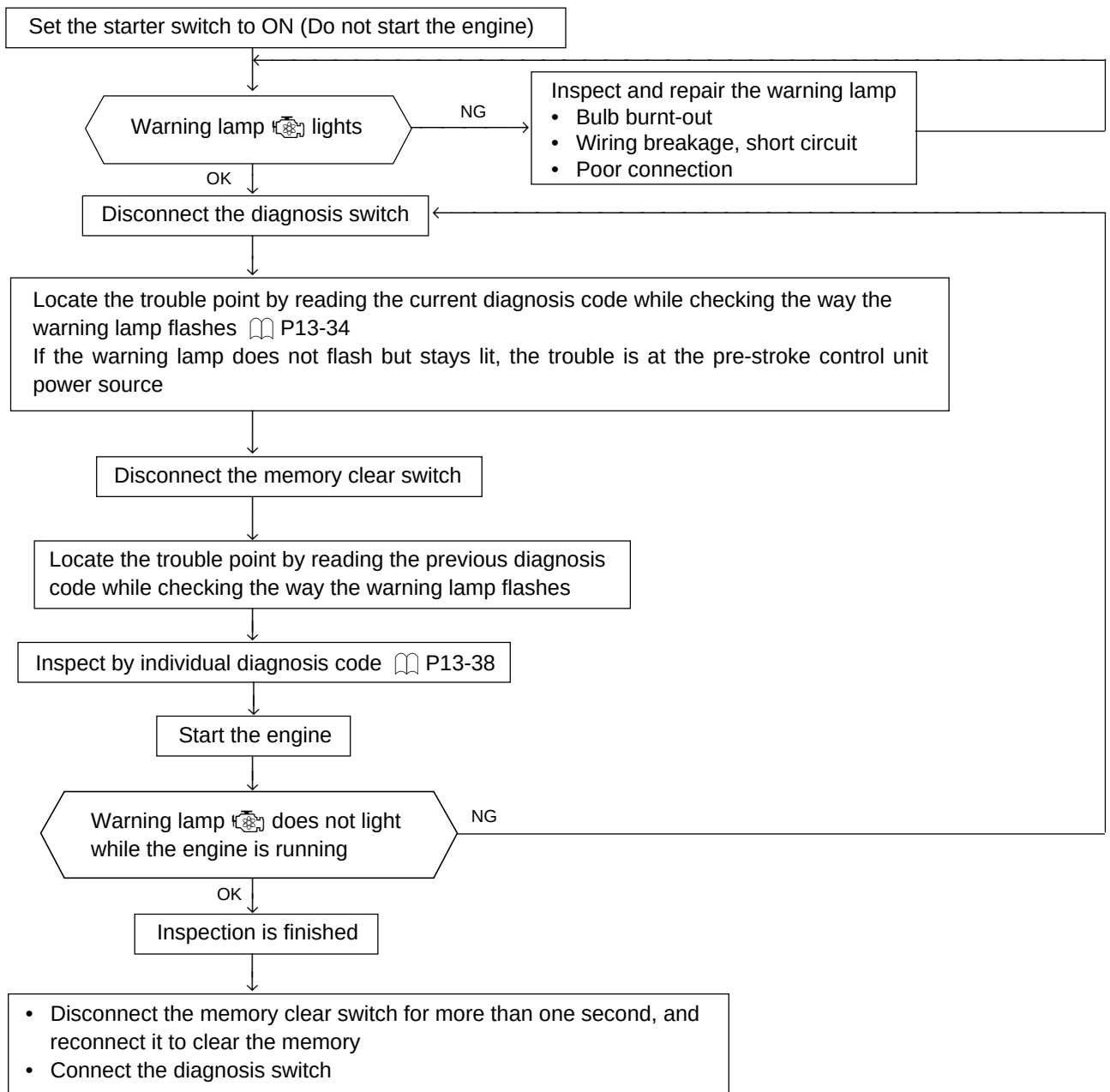
● Inspection with Multi-use Tester

Inspection using service data is possible as well as by diagnosis code indication (self-diagnosis) using the multi-use tester. This enables you to compare the indicated figures (service data) that represent the data signals from the various sensors on the vehicle with the judgement standards, and judge whether they are good or bad. The service data code is indicated as well as the diagnosis code.

Self-diagnosis			Inspection using Service Data				
Indicated on multi-use tester			Indicated on multi-use tester		Inspection procedure		
Diagnosis code	Trouble item (Inspected instrument)	Inspection procedure	Service data code	Data signal name	Service data	Condition at inspection	Judgement standard
03	PS OFFSET	P13-38	—				
04	PS VOLTAGE		—				
05	NE NO PULS		—				
12	PS SERVO		12	PS ANG DIFF	■■.■■ deg	Engine running	Within ±5.5 deg
13	PS SNSR		—			400<Ne≤2000 Ne : Engine revolution	Within ±2°C
15	NE SNSR		15	ENGINE SPEED	■■ rpm	Racing	Synchronization with tachometer
—			16	CTRL ROD ADJ	■■ V	Starter switch set to ON	Within ±0.04 V
21	WTR TEMP SNSR		21	WATER TEMP	■■ °F	While engine is cool While engine is warmed up Engine is stopped after warming up	Equivalent to ambient temperature Gradually rising temperature Gradual falling temperature
22	CTRL ROD SNSR		22	CTRL ROD VOLT	■■ V	Engine running	3 V or less
41	BST TEMP SNSR		41	BOOST TEMP	■■ °F	At high idling	4.9 V or less

● Inspection without multi-use tester

● Inspection flow chart

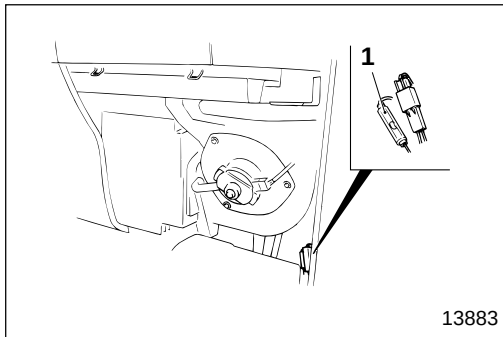


PRE-STROKE CONTROL INJECTION PUMP SYSTEM

● Reading of Diagnosis Code with Warning Lamp

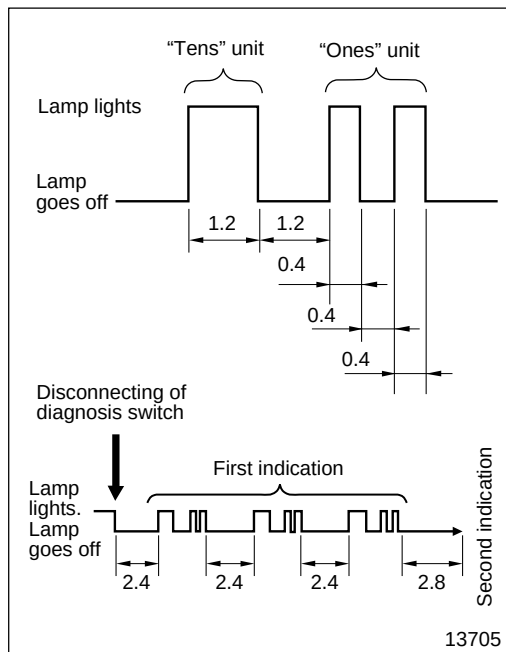
CAUTION

- Make sure you read the current diagnosis codes first, then read the previous diagnosis codes.
- You must take care not to disconnect memory clear switch 2 (1-pin connector) before removing diagnosis switch 1 (1-pin connector without locking device) because this would make it impossible for the system to indicate the current diagnosis code.
- Note that if memory clear switch 2 is reconnected after being disconnected, it will clear all the diagnosis codes.



Current diagnosis code

- When diagnosis switch 1 is disconnected, the pre-stroke control unit starts diagnosis of the trouble and indicates the current diagnosis codes by flashing warning lamp  within the meter cluster.



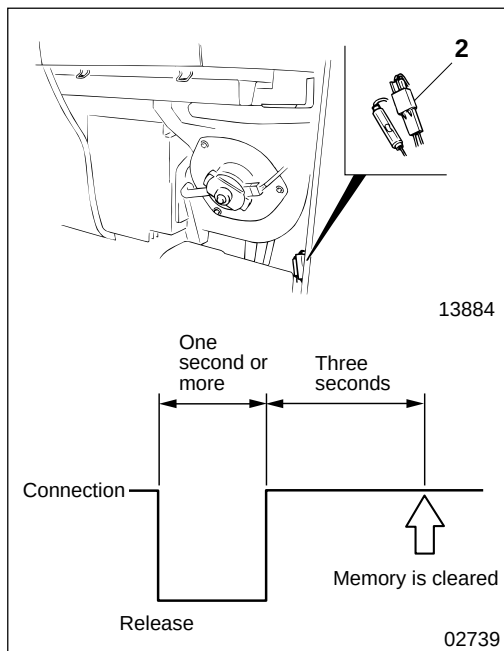
- The diagnosis codes are read by the number of flashes and the duration of flashes of warning lamp .
- The flash duration differs for the "tens" unit and the "ones" unit.
 - "Tens" unit : Every 1.2 seconds
 - "Ones" unit : Every 0.4 seconds
- The number of flashes indicates the numeral for each unit.
- The diagnosis code indication shows the "tens" unit first, then the "ones" unit. However, when the "tens" unit begins with a zero, only the "ones" unit is shown.
- A diagnosis code is shown by the repetition of three consecutive indications. After the code indication, if another code does not exist, the indication returns to the first code and is again shown three times.
- When diagnosis switch 1 is connected, the pre-stroke control unit immediately terminates code indication.

Previous diagnosis code

After reading the current diagnosis codes (with diagnosis switch 1 disconnected), disconnect memory clear switch 2. Warning lamp  starts flashing again. This flashing indicates the previous diagnosis codes, and by interpreting these codes, the location of the trouble is determined.

Diagnosis code	Warning lamp  flashing pattern
01 (Normal)	
03 (Pre-stroke learning faulty)	
04 (Pre-stroke actuator power source faulty)	
05 (Engine revolution sensor no pulse faulty)	
12 (Pre-stroke servo system faulty)	
13 (Pre-stroke position sensor faulty)	
15 (Engine revolution sensor wiring breakage faulty)	
21 (Water temperature sensor faulty)	
22 (Control rod position sensor faulty)	
41 (Boost air temperature sensor faulty)	

13970

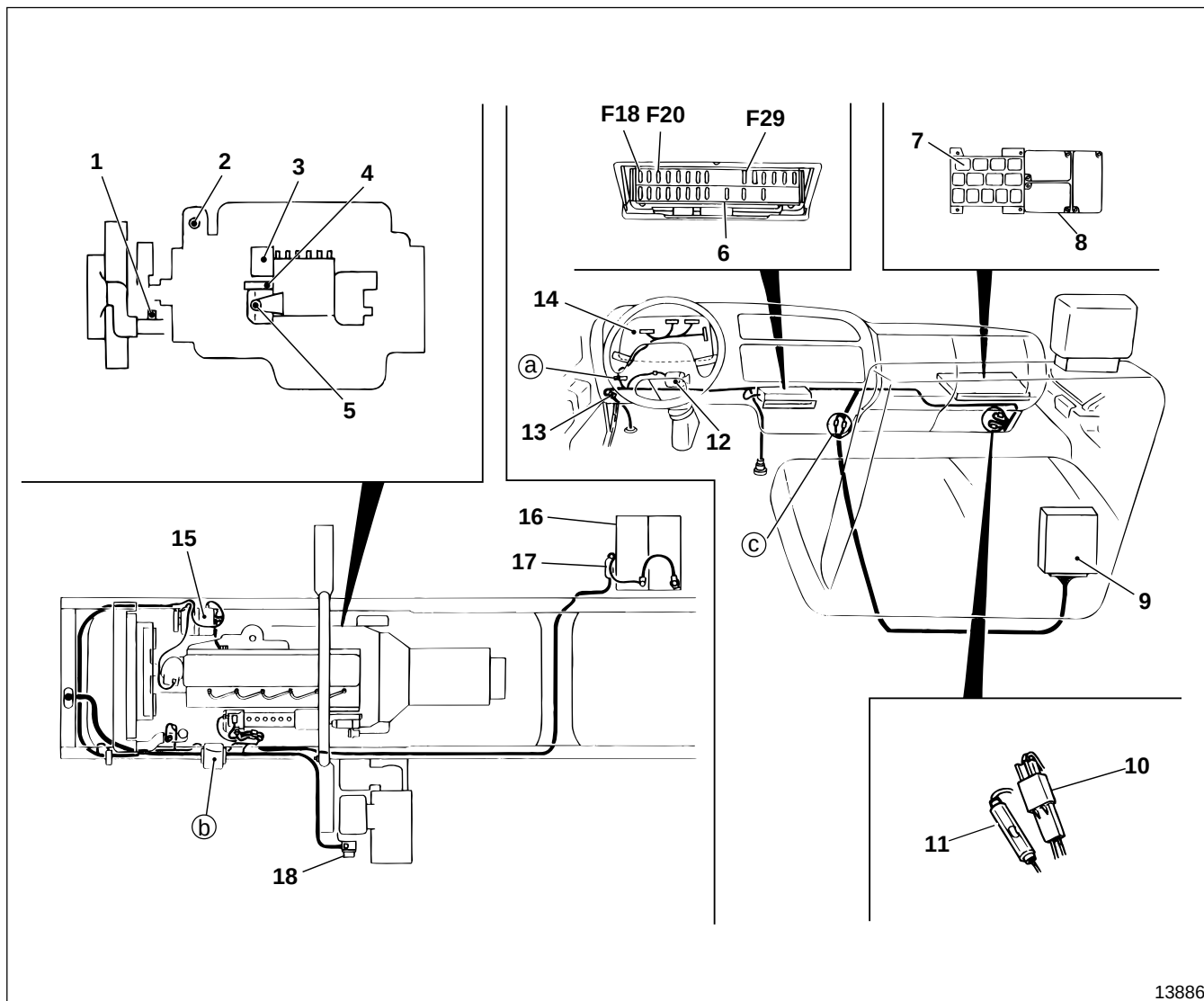


Clearing diagnosis codes

By disconnecting memory clear switch 2 once and reconnecting it, all the diagnosis codes memorized in the pre-stroke control unit are cleared.

CAUTION

Clearing of diagnosis codes must be done using memory clear switch 2.

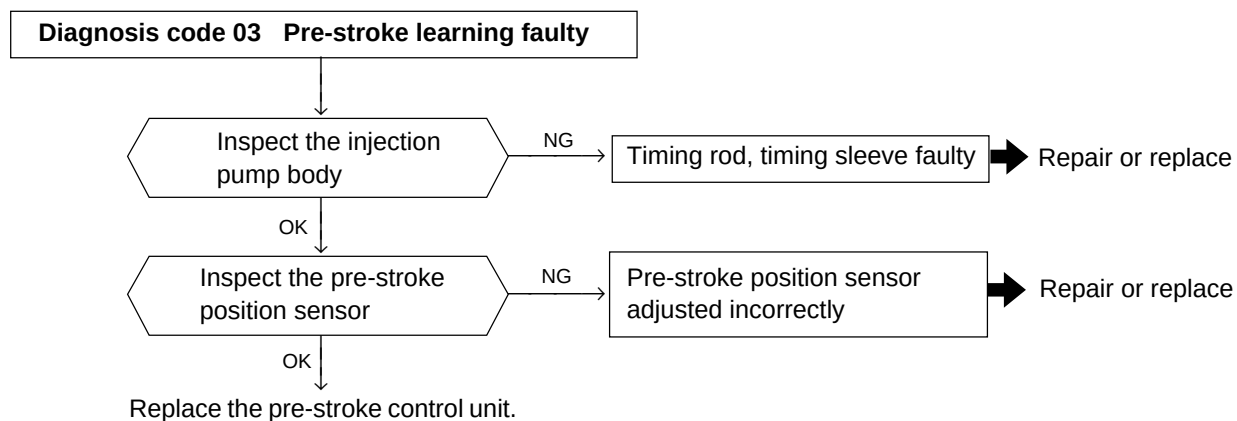


13886

- | | |
|--|---------------------------|
| 1 Boost air temperature sensor | 10 Diagnosis switch |
| 2 Water temperature sensor | 11 Memory clear switch |
| 3 Pre-stroke actuator (Pre-stroke position sensor is built in) | 12 Starter switch |
| 4 Control rod position sensor | 13 Diode |
| 5 Engine revolution sensor | 14 Meter cluster |
| 6 Fuse box | 15 Alternator |
| 7 Pre-stroke cut relay | 16 Battery |
| 8 Relay box | 17 Main high-current fuse |
| 9 Pre-stroke control unit | 18 High-current fuse box |

PRE-STROKE CONTROL INJECTION PUMP SYSTEM

Inspection by Individual Diagnosis Code

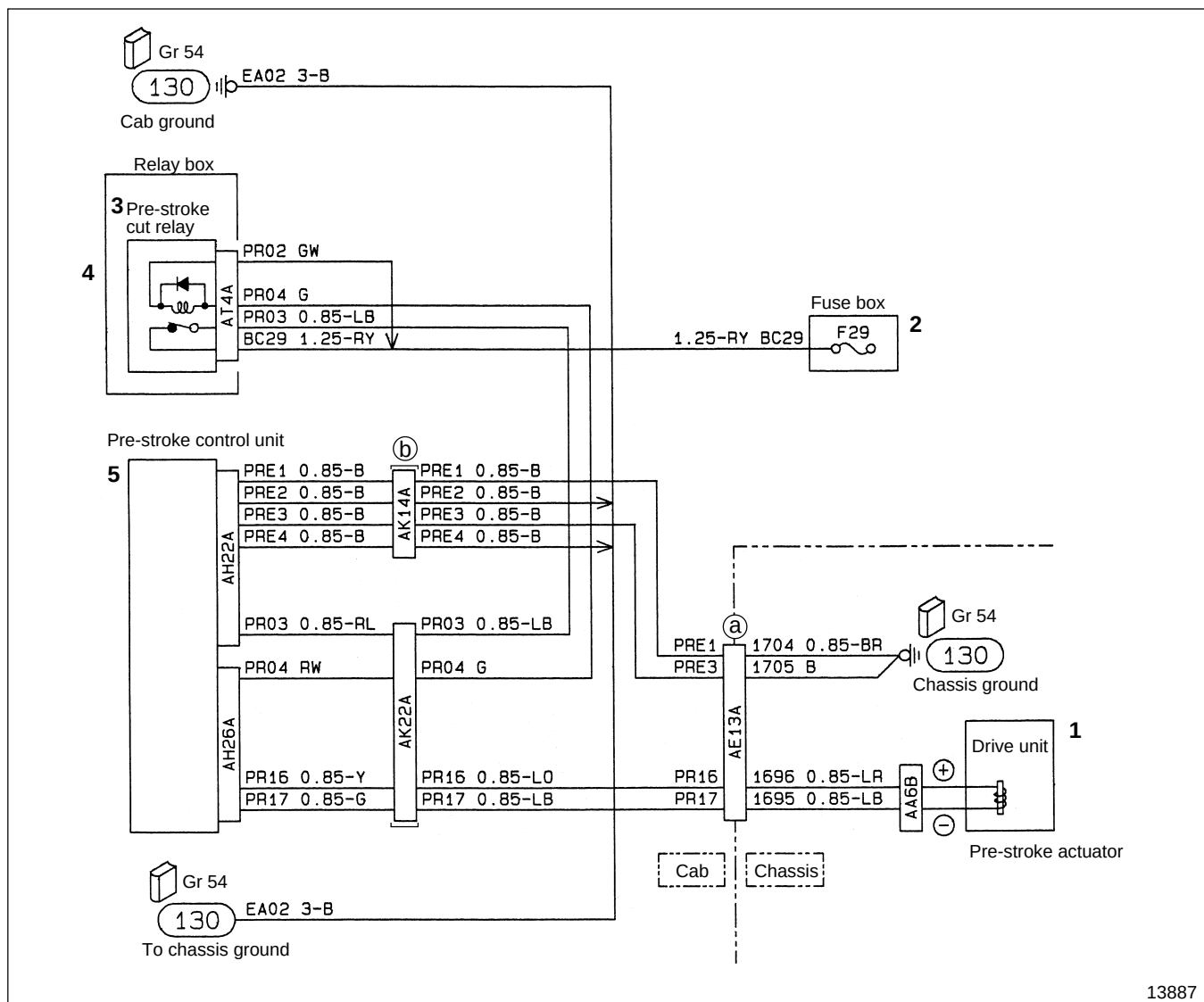
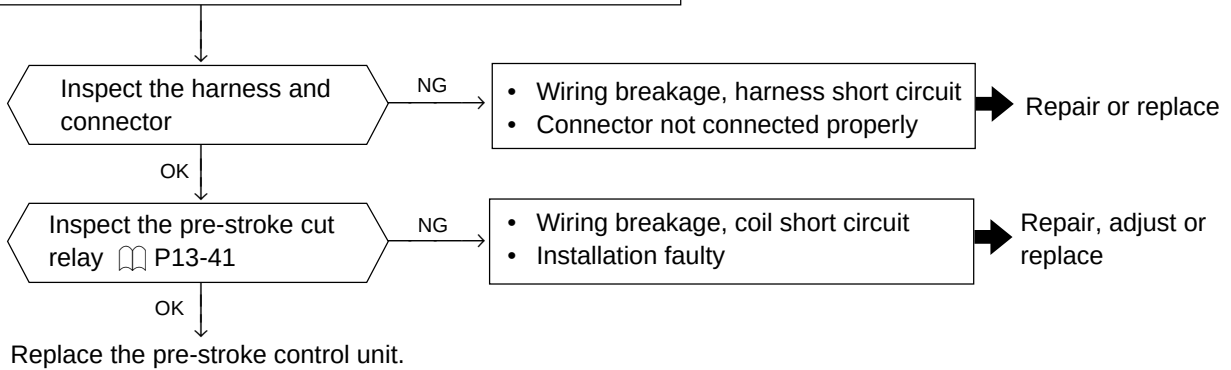


When diagnosis code 03 is indicated, inspect the injection pump body and the pre-stroke position sensor. However, special tools and equipment are necessary for this work, so it is recommended that the work be carried out by a ZEXEL service station. If the inspection result shows normal, replace the pre-stroke control unit.

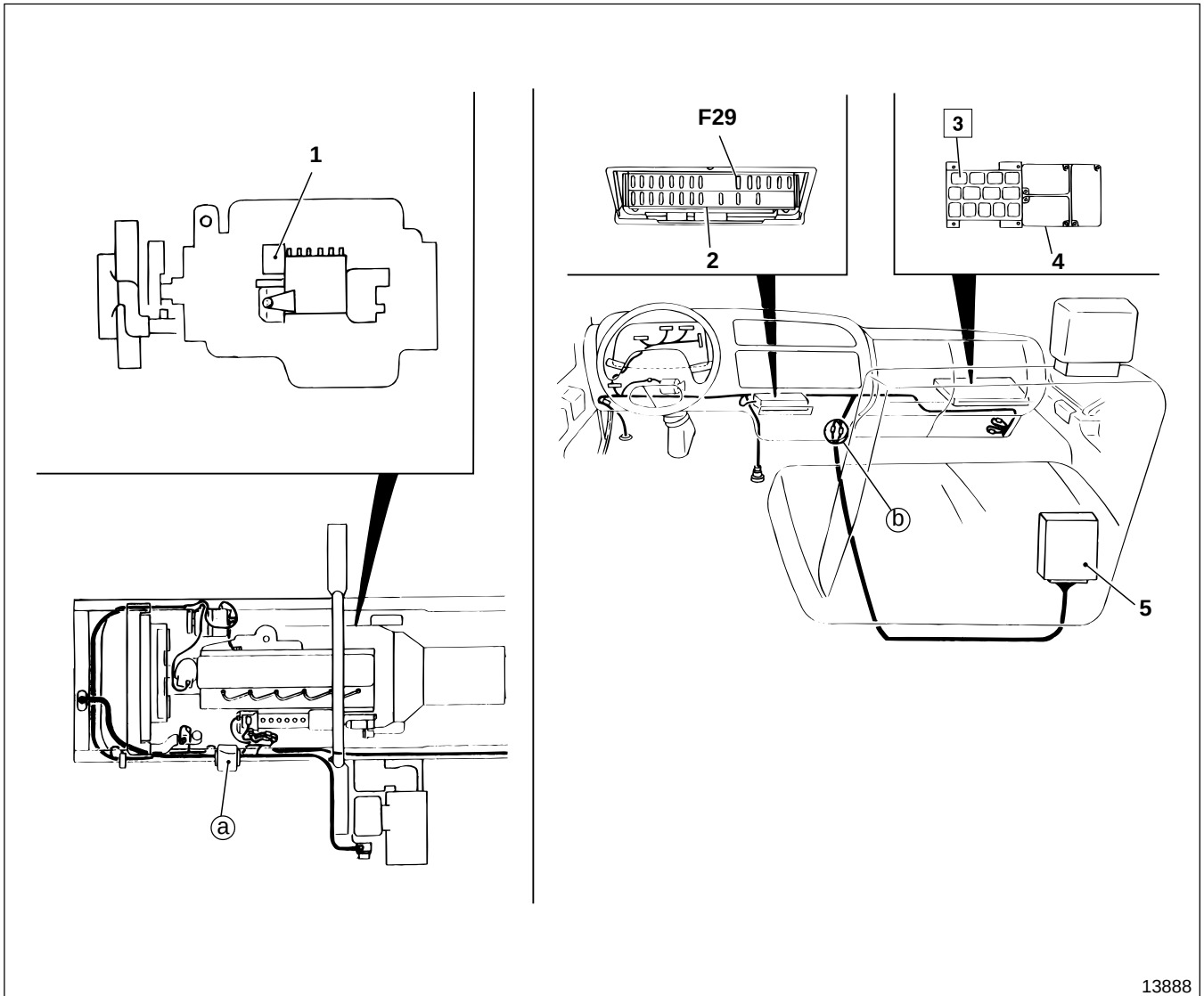
MEMO

PRE-STROKE CONTROL INJECTION PUMP SYSTEM

Diagnosis code 04 Pre-stroke actuator power source faulty



13887



13888

- 1 Pre-stroke actuator
- 2 Fuse box
- 3 Pre-stroke cut relay

- 4 Relay box
- 5 Pre-stroke control unit

◆ Service procedure

3 Inspection of pre-stroke cut relay

- Follow the table below to inspect continuity.

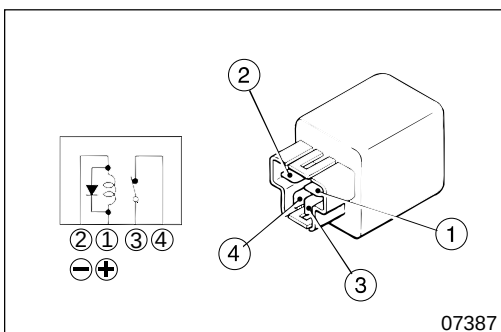
	①	②	③	④
No current	○ — ○		○ — ○	
Current	⊕ — ⊖		⊖ — ⊕	

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

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

⊖ — ⊕ : Indicates that continuity is lost between the terminals.

- If any fault is found, replace pre-stroke cut relay 3.

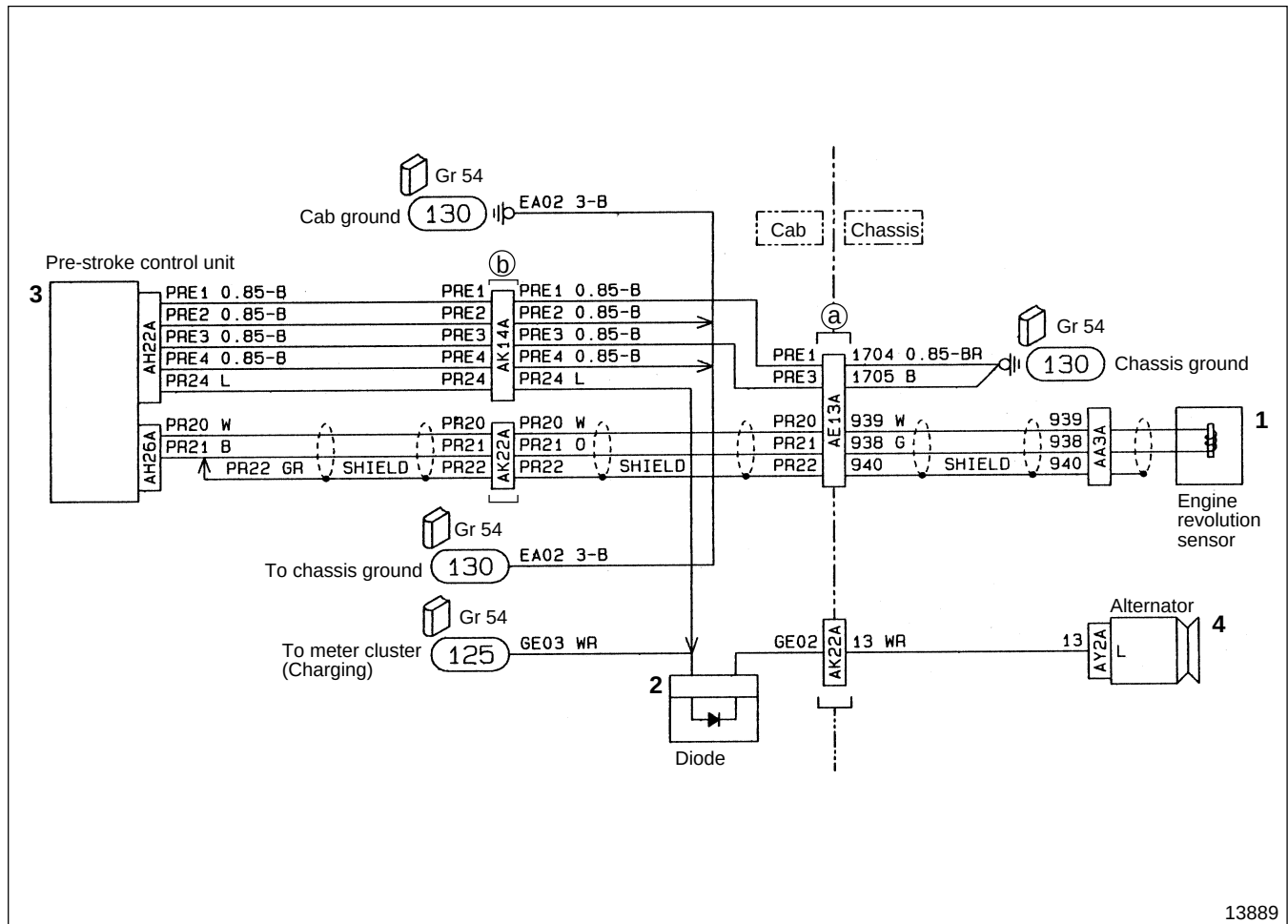
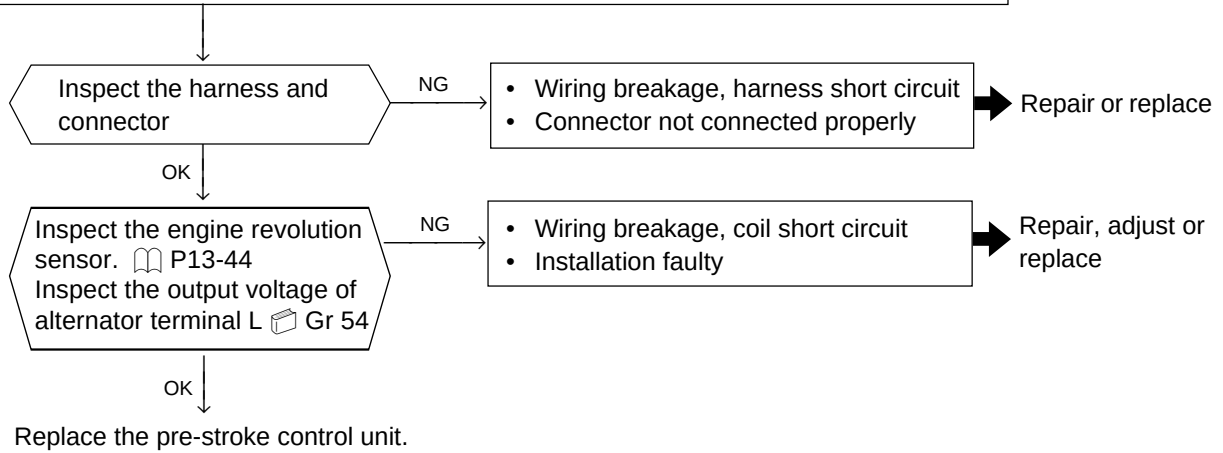


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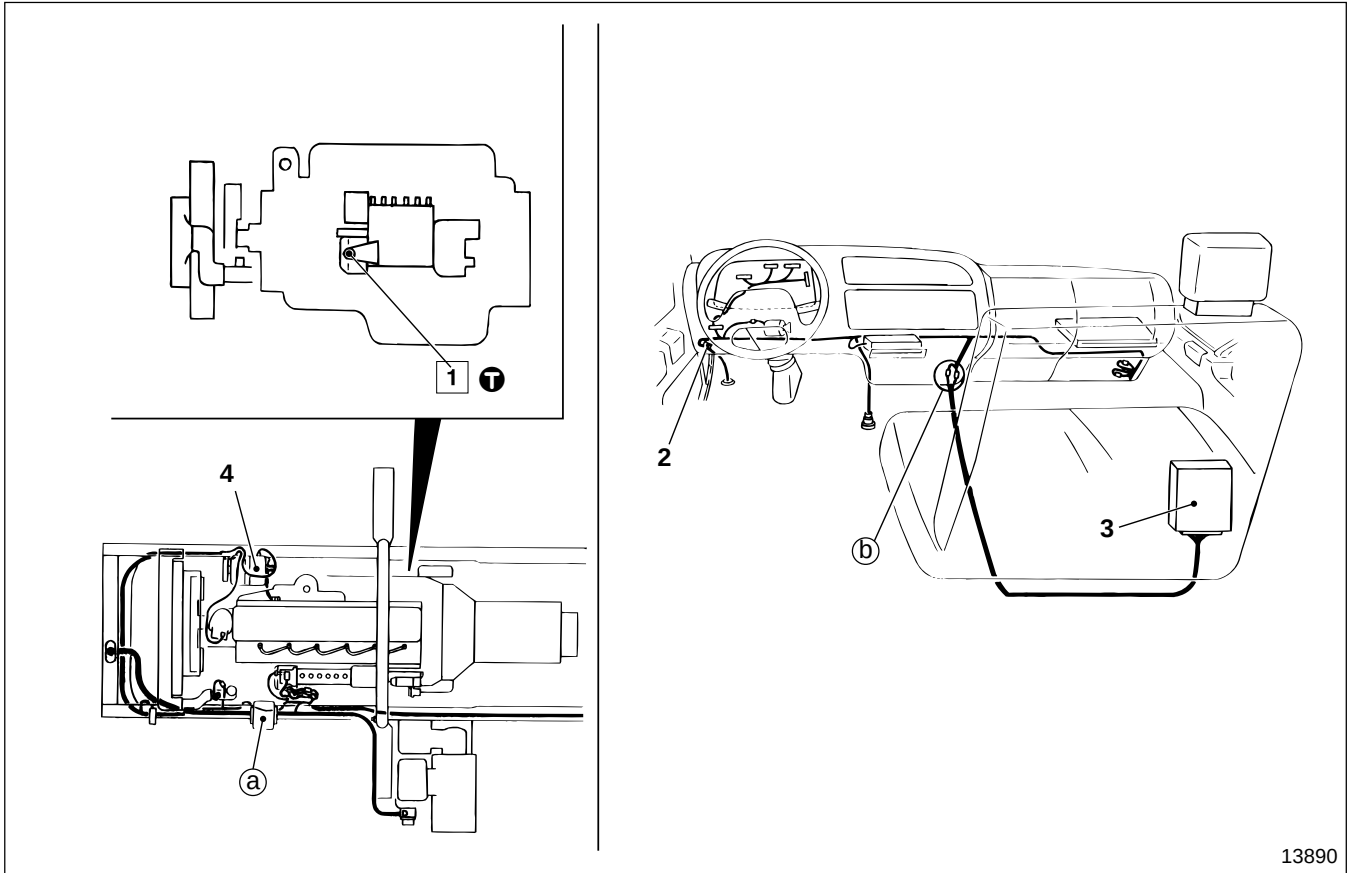
PRE-STROKE CONTROL INJECTION PUMP SYSTEM

Diagnosis code 05 Engine revolution sensor faulty

(No pulse error : Output signal from the sensor is weak or unstable)



13889



- 1 Engine revolution sensor
2 Diode

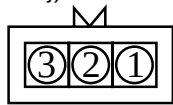
- 3 Pre-stroke control unit
4 Alternator

13890

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
1	Resistance value of engine revolution sensor (at 25°C {77°F})	①-②	2.3±0.2 kΩ	—	Replace
	Clearance between engine revolution sensor and timer housing protrusion		0.5 to 2.0 {0.02 to 0.079}	—	Adjust



14013

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut of engine revolution sensor	24 to 35 {17 to 26, 2.4 to 3.6}	—

PRE-STROKE CONTROL INJECTION PUMP SYSTEM

◆ Service procedure

1 Engine revolution sensor

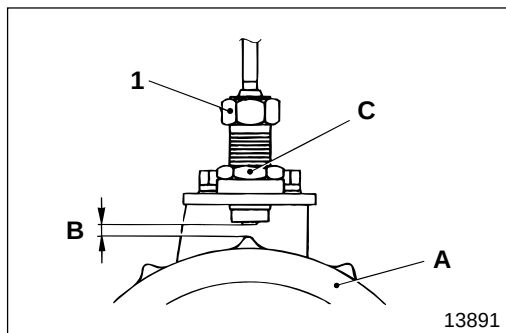
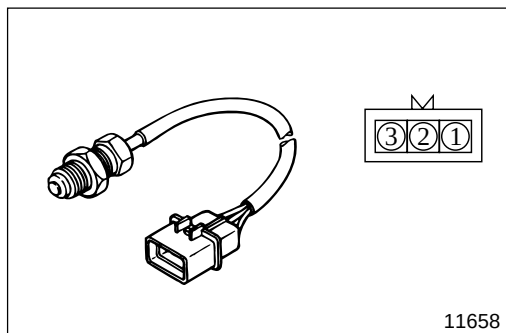
[Inspection]

(1) Sensor body

- Measure the resistance between terminals ① and ②.
- If the measured value deviates from the standard value, replace engine revolution sensor 1.

CAUTION ⚠

Be sure to adjust the clearance between engine revolution sensor 1 and the protrusion on the timer housing after replacing the engine revolution sensor.



(2) Clearance to protrusion

If clearance **B** between engine revolution sensor **1** and protrusion **A** on the timer housing deviates from the standard value, adjust the clearance as follows.

[Adjustment]

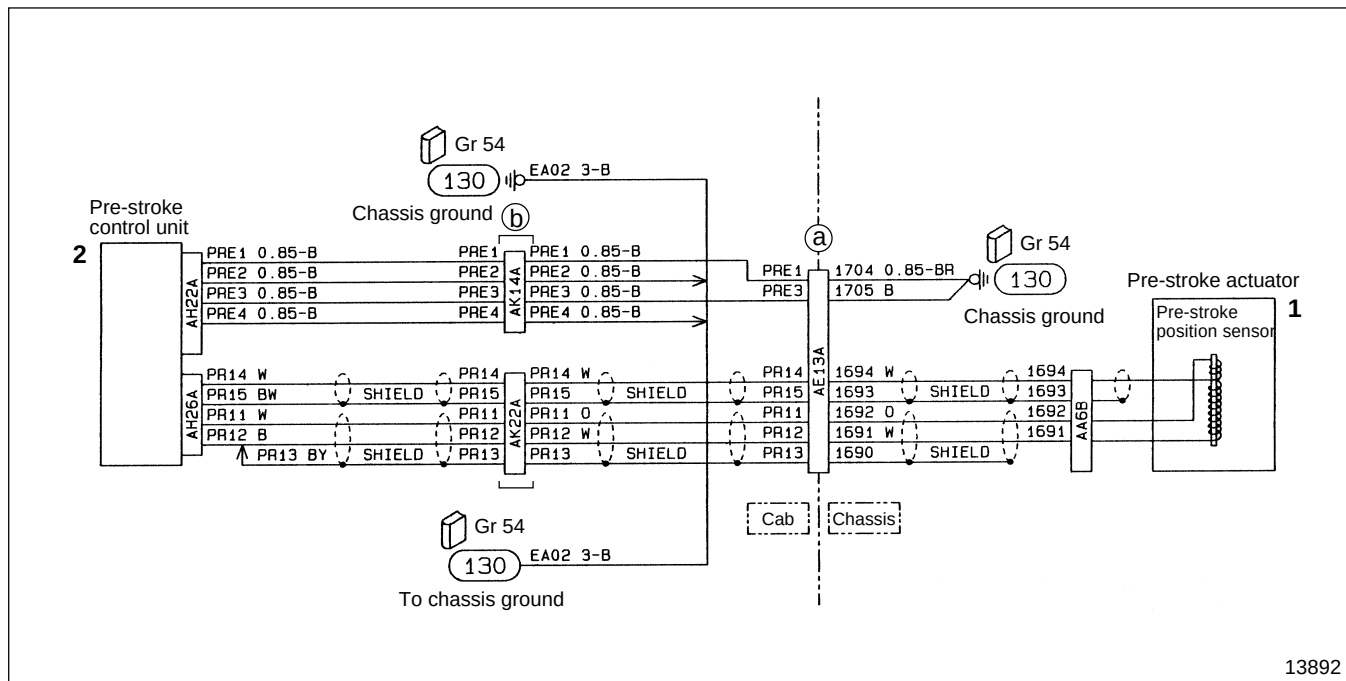
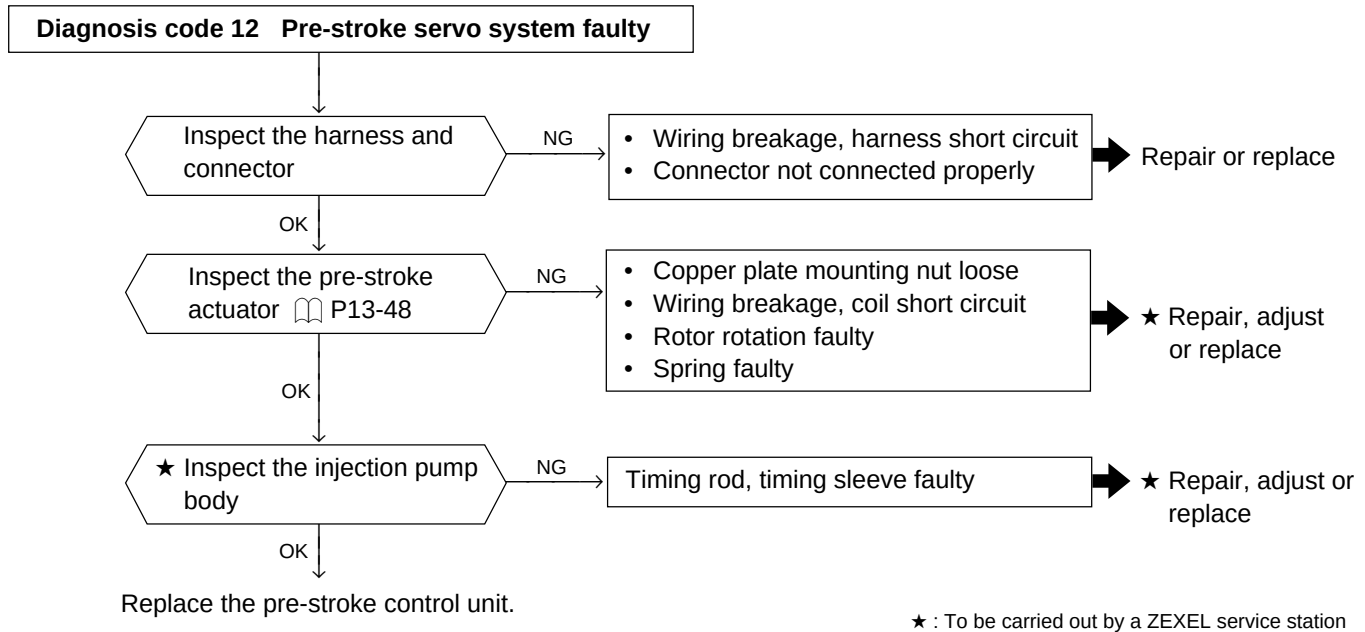
- Loosen lock nut **C** and rotate engine revolution sensor **1** to adjust.
- After adjustment, fix by tightening lock nut **C** at specified torque.

NOTE

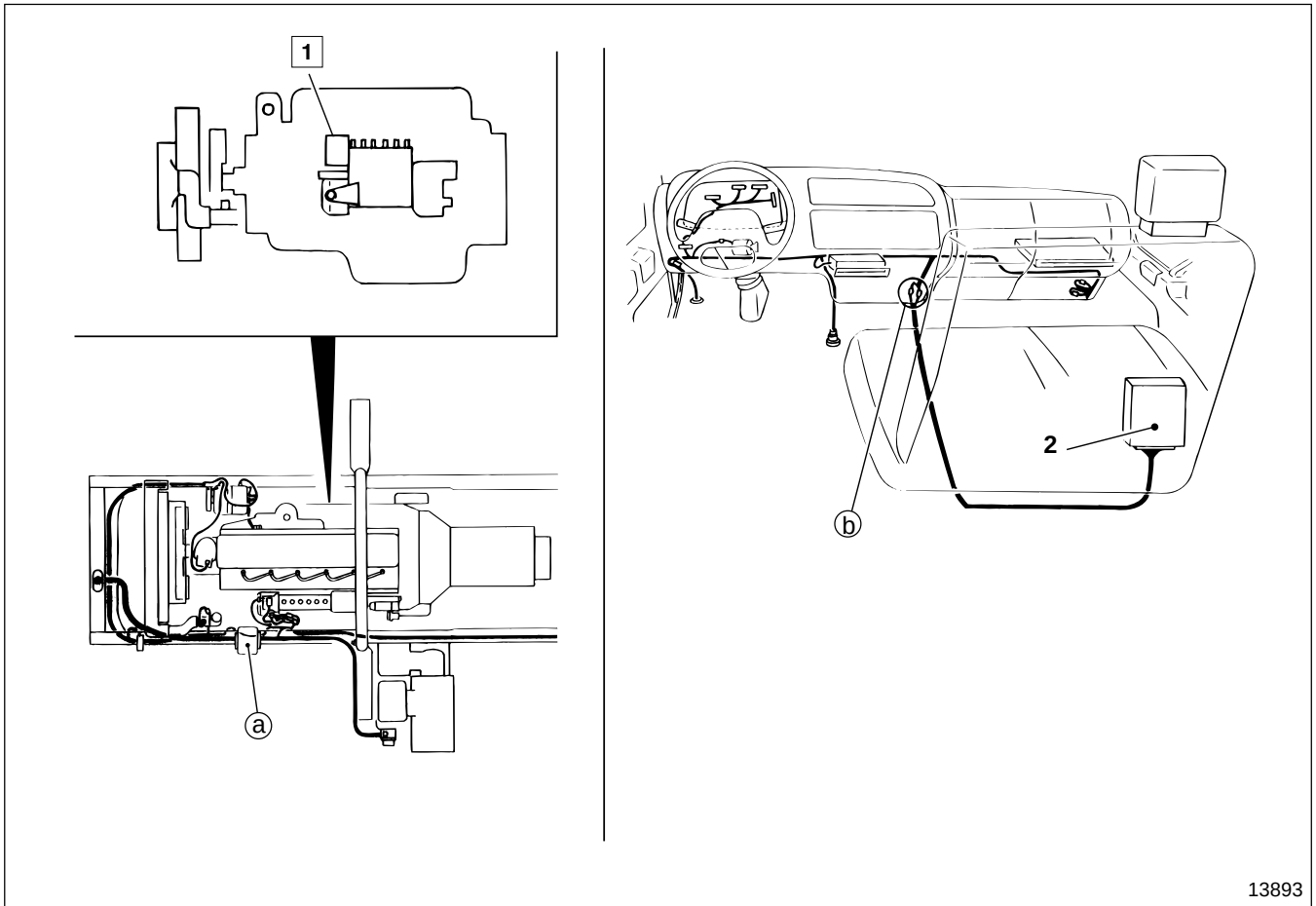
If the clearance between engine revolution sensor **1** and protrusion **A** on the timer housing is too large, the signal might not be output. If the clearance is too small, the engine revolution sensor might hit the protrusion.

MEMO

PRE-STROKE CONTROL INJECTION PUMP SYSTEM



13892



13893

- 1 Pre-stroke actuator
2 Pre-stroke control unit

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
1	Resistance value of pre-stroke actuator (at connector point)	②-③	5.5 to 6.1 Ω	—	Replace (to be carried out by a ZEXEL service station)
		①-③	11.0 to 12.2 Ω	—	
		①-②	5.5 to 6.1 Ω	—	
		④-⑤	1.0 to 1.3 Ω	—	
	Resistance value of pre-stroke actuator (Actuator body)	ⒶⒸ	11.0 to 12.2 Ω	—	Replace (to be carried out by a ZEXEL service station)
		ⒷⒸ	5.5 to 6.1 Ω	—	
		ⒶⒷ	5.5 to 6.1 Ω	—	
		ⒹⒺ	1.0 to 1.3 Ω	—	

PRE-STROKE CONTROL INJECTION PUMP SYSTEM

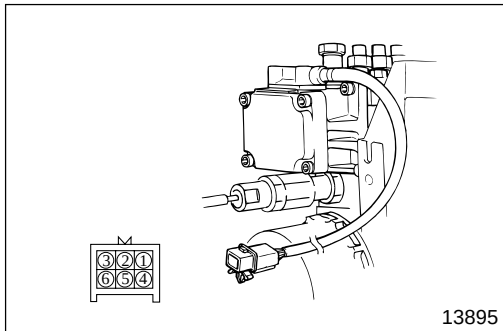
◆ Service procedure

1 Inspection of pre-stroke actuator

Inspect the following points and if any fault is found, have the unit inspected and repaired by a ZEXEL service station.

NOTE

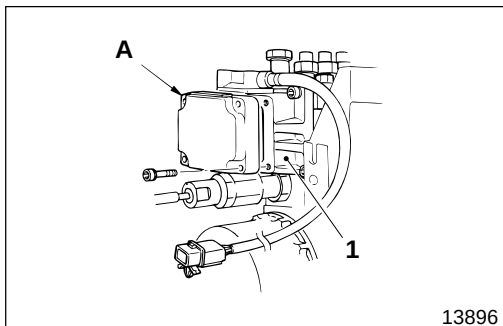
Inspection of pre-stroke actuator 1 must be carried out when the engine is cold.



13895

(1) Inspection at connector point

- Measure resistance between terminals ②-③, ①-③, ①-② and ④-⑤.



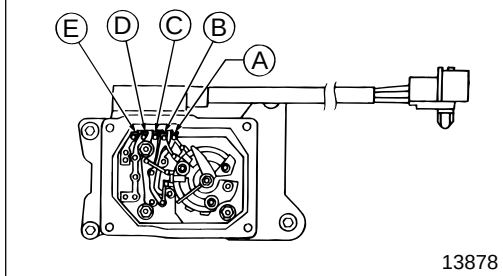
13896

(2) Inspection of pre-stroke actuator body

- Remove cover A from pre-stroke actuator 1.

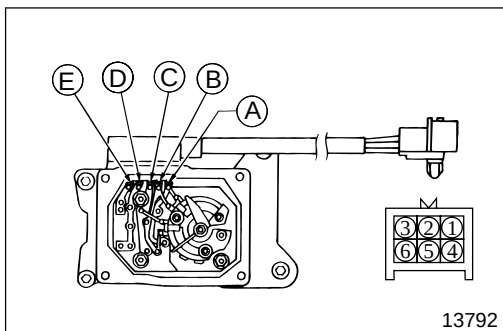
CAUTION ⚠

- Remove only cover A from pre-stroke actuator 1, never remove the actuator body itself. If the actuator is removed, it requires special tools to replace and adjust it.
- When removing cover A, do not exert excessive force on pre-stroke actuator 1 with your hands or by treading on it, etc.



13878

- Measure resistance between terminals ①-③, ②-③, ①-② and ④-⑤.

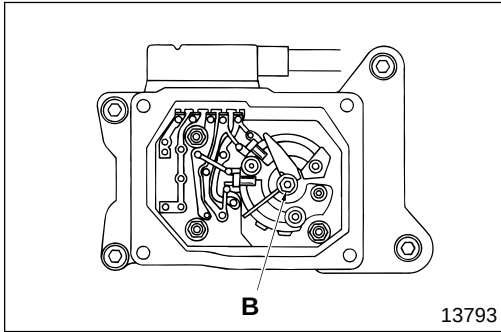


13792

(3) Inspection of continuity between pre-stroke actuator and connector

Make sure that continuity exists between terminals as listed in the table below.

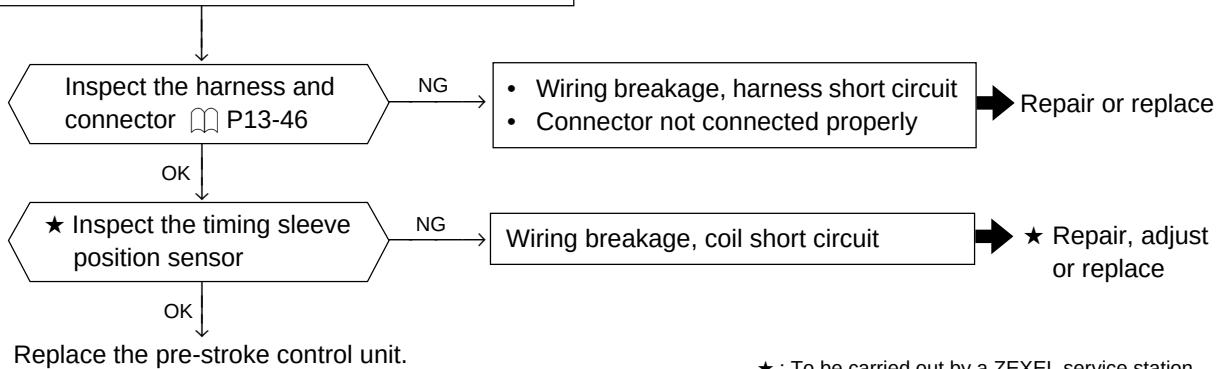
Connector terminal	Pre-stroke actuator body	Application
④	①	Pre-stroke actuator driving power source ⊖
⑤	②	Pre-stroke actuator driving power source ⊕
⑥	GND	Shield
①	③	Pre-stroke position sensor (GND)
②	④	Pre-stroke position sensor (MDL)
③	⑤	Pre-stroke position sensor (OSC)



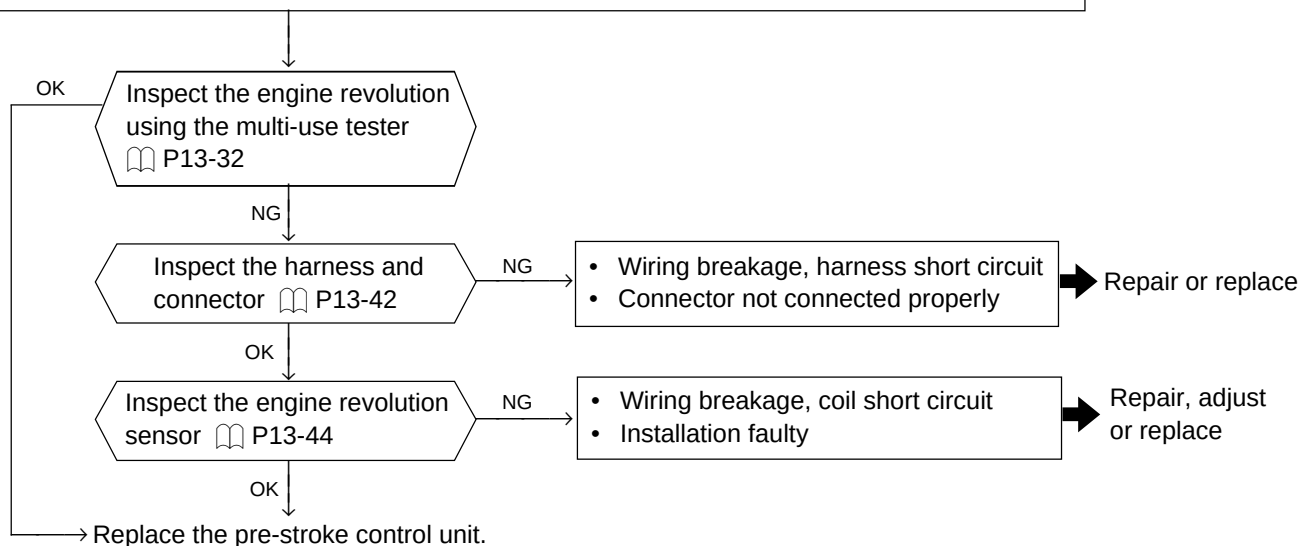
(4) Inspection of copper plate mounting nut

Check that copper plate mounting nut **B** was not loosened when the cover of pre-stroke actuator **1** was removed.
If nut **B** is loose, tighten it.

Diagnosis code 13 Pre-stroke position sensor faulty



Diagnosis code 15 Engine revolution sensor faulty (Wiring breakage error : No output signal transmitted by the sensor)

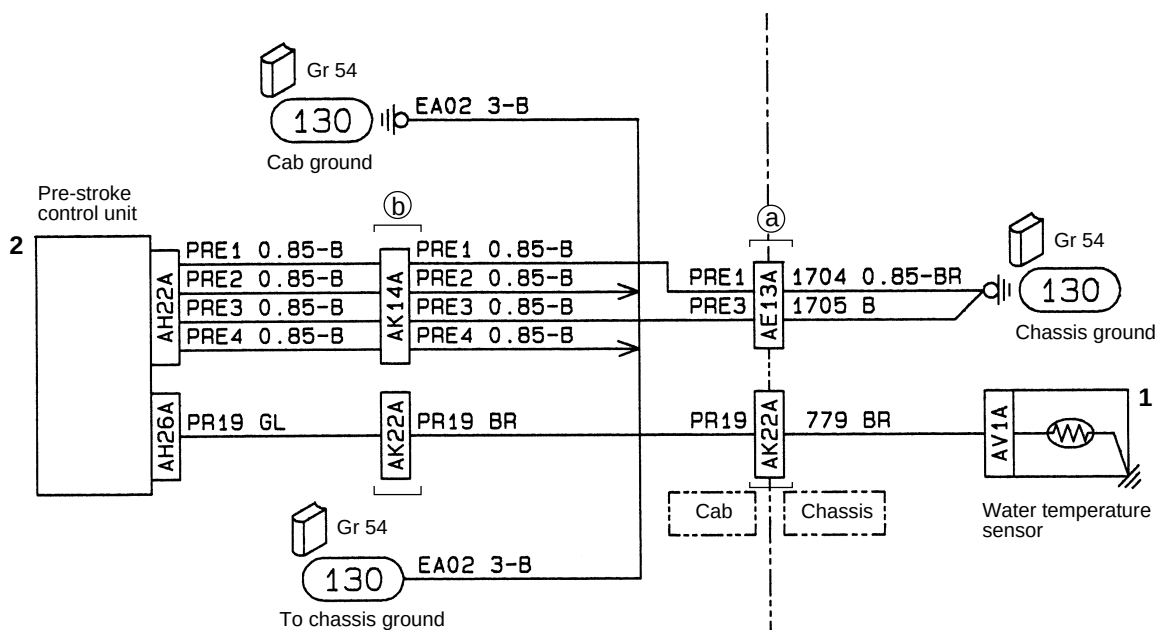



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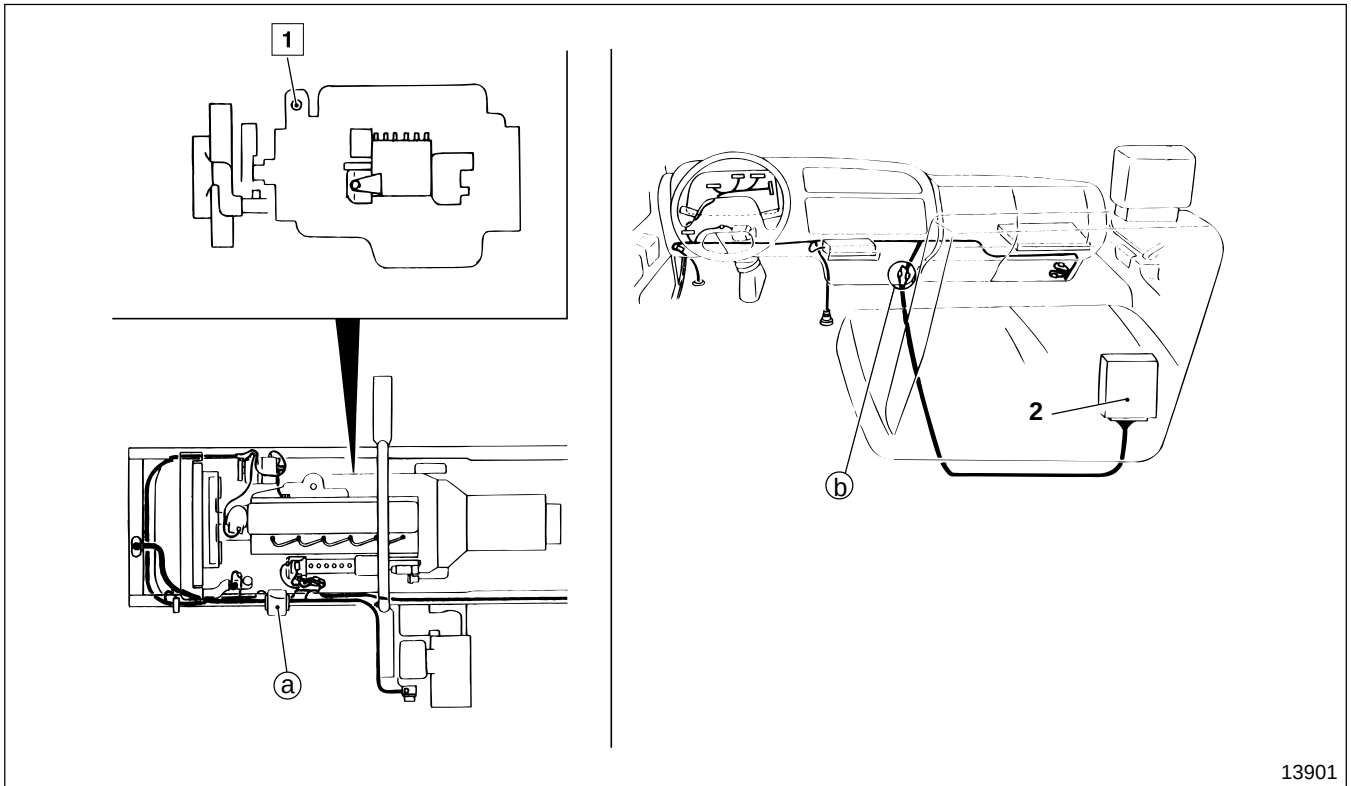
graph TD
    Start([Start]) --> Step1{{Inspect the engine coolant temperature using the multi-use tester P13-32}}
    Step1 -- OK --> End1([End])
    Step1 -- NG --> Step2{{Inspect the harness and connector}}
    Step2 -- NG --> Box1[Wiring breakage, harness short circuit  
Connector not connected properly]
    Box1 --> End2([Repair or replace])
    Step2 -- OK --> Step3{{Inspect the water temperature sensor P13-51}}
    Step3 -- NG --> Box2[Wiring breakage, coil short circuit  
Installation faulty]
    Box2 --> End3([Repair, adjust or replace])
    Step3 -- OK --> End1
    
```

Flowchart for P1351: Coolant Temperature Sensor Circuit No Signal:

- Inspect the engine coolant temperature using the multi-use tester P13-32.
 - If OK, proceed to Replace the pre-stroke control unit.
 - If NG, proceed to Inspect the harness and connector.
- Inspect the harness and connector.
 - If NG, check for:
 - Wiring breakage, harness short circuit
 - Connector not connected properly
 Then, Repair or replace.
 - If OK, proceed to Inspect the water temperature sensor P13-51.
- Inspect the water temperature sensor P13-51.
 - If NG, check for:
 - Wiring breakage, coil short circuit
 - Installation faulty
 Then, Repair, adjust or replace.
 - If OK, proceed to Replace the pre-stroke control unit.



13900



13901

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

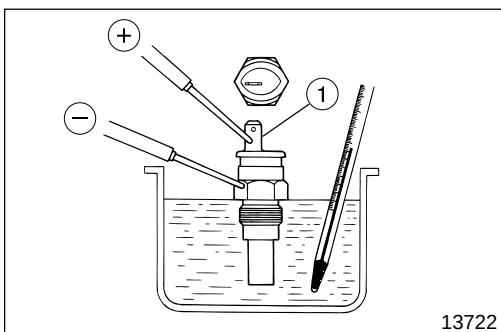
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
1	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

1 Inspection of water temperature sensor

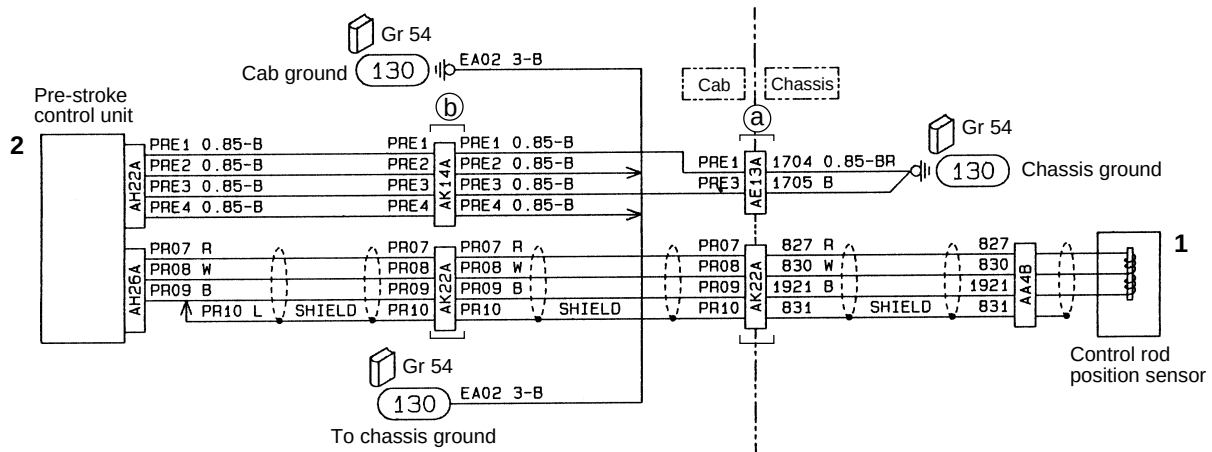
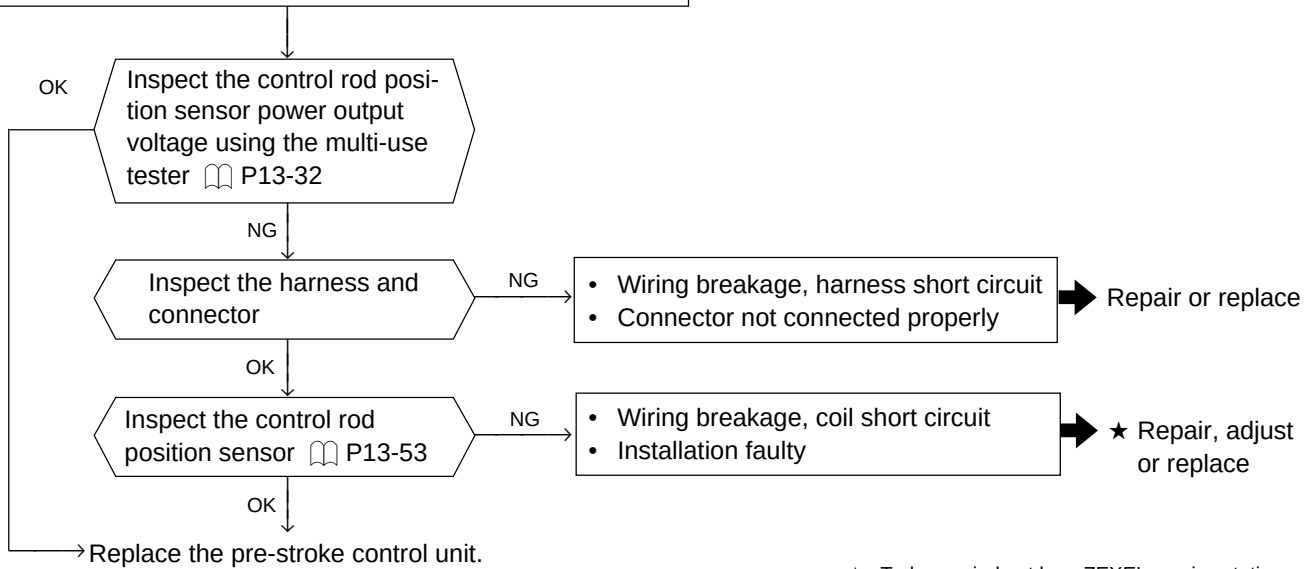
- Place water temperature sensor 1 in engine oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminal ① and the body.
- If the measured value deviates from the standard value, replace water temperature sensor 1. Gr 14



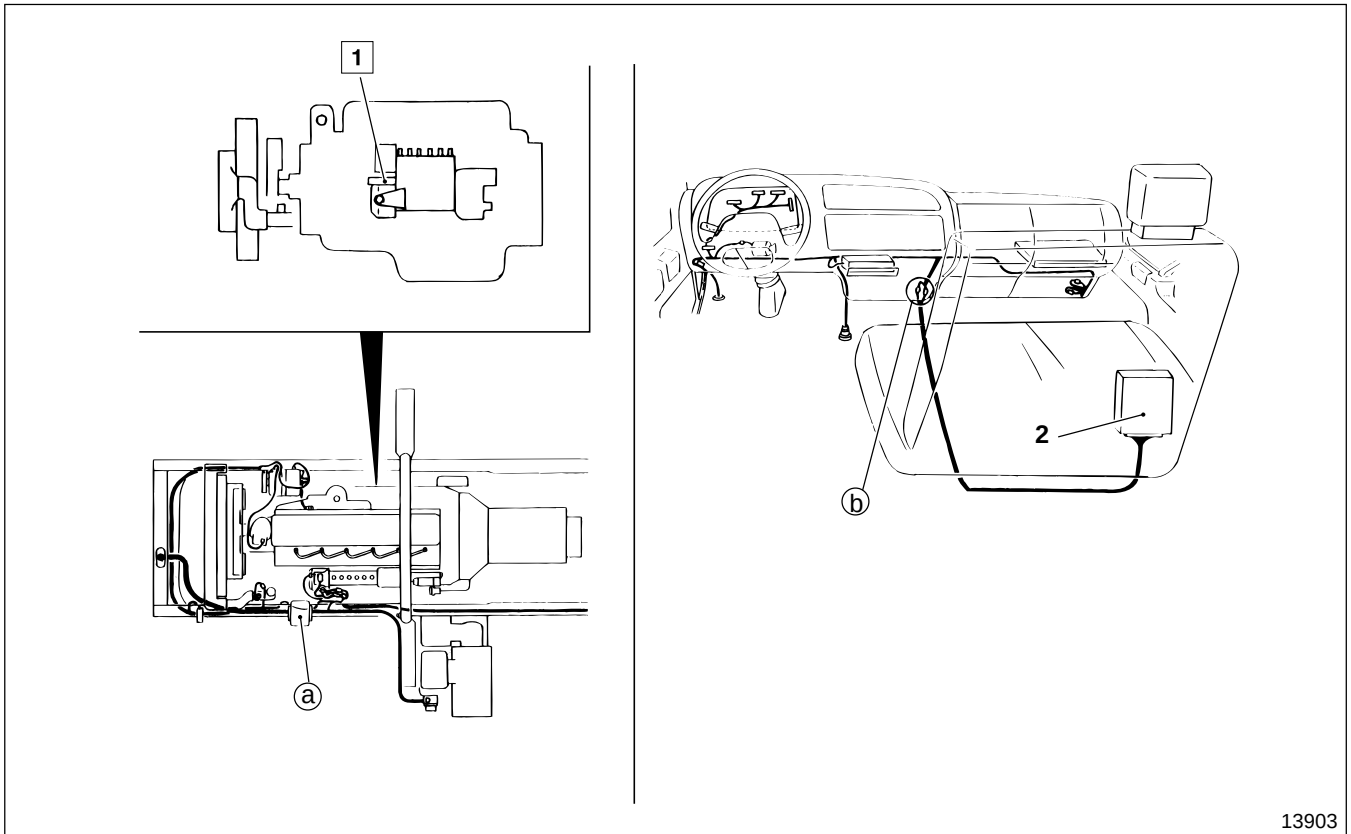
13722

PRE-STROKE CONTROL TYPE INJECTION PUMP SYSTEM

Diagnosis code 22 Control rod position sensor faulty



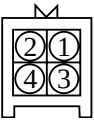
13902



13903

- 1 Control rod position sensor
2 Pre-stroke control unit

Service standards

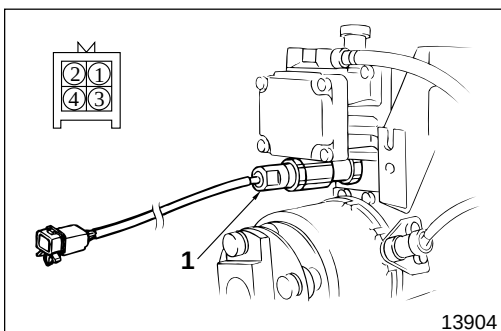
Location	Maintenance item		Standard value	Limit	Remedy
1	Resistance value of control rod position sensor 	①-④	92.5 to 101.5 Ω	—	Replace (To be carried out by a ZEXEL service station)
		①-③	92.5 to 101.5 Ω	—	
		③-④	185 to 203 Ω	—	

13725

◆ Service procedure

1 Inspection of control rod position sensor

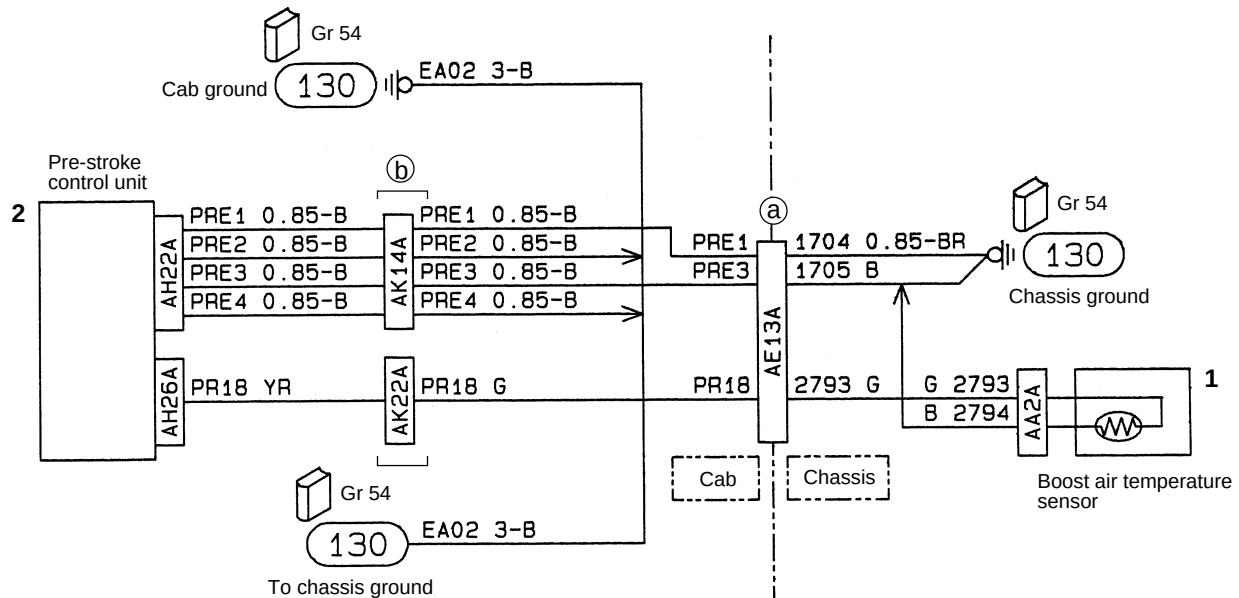
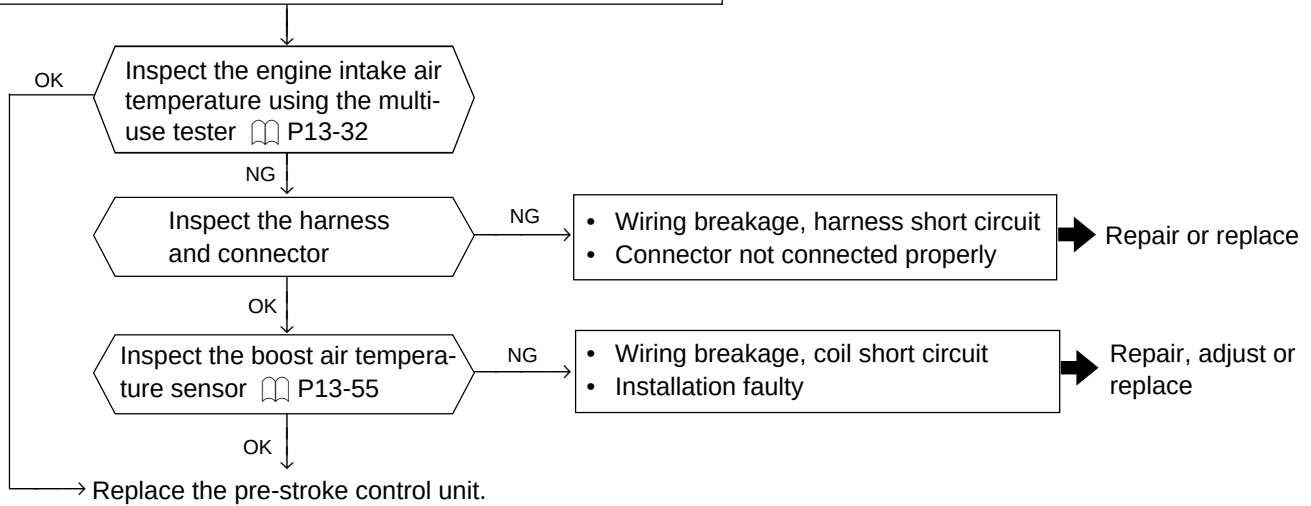
- Measure resistance between terminals ①-④, ①-③ and ③-④.
- If the measured value deviates from the standard value, replace control rod position sensor **1**.
- Replacement work is to be carried out by a ZEXEL service station.



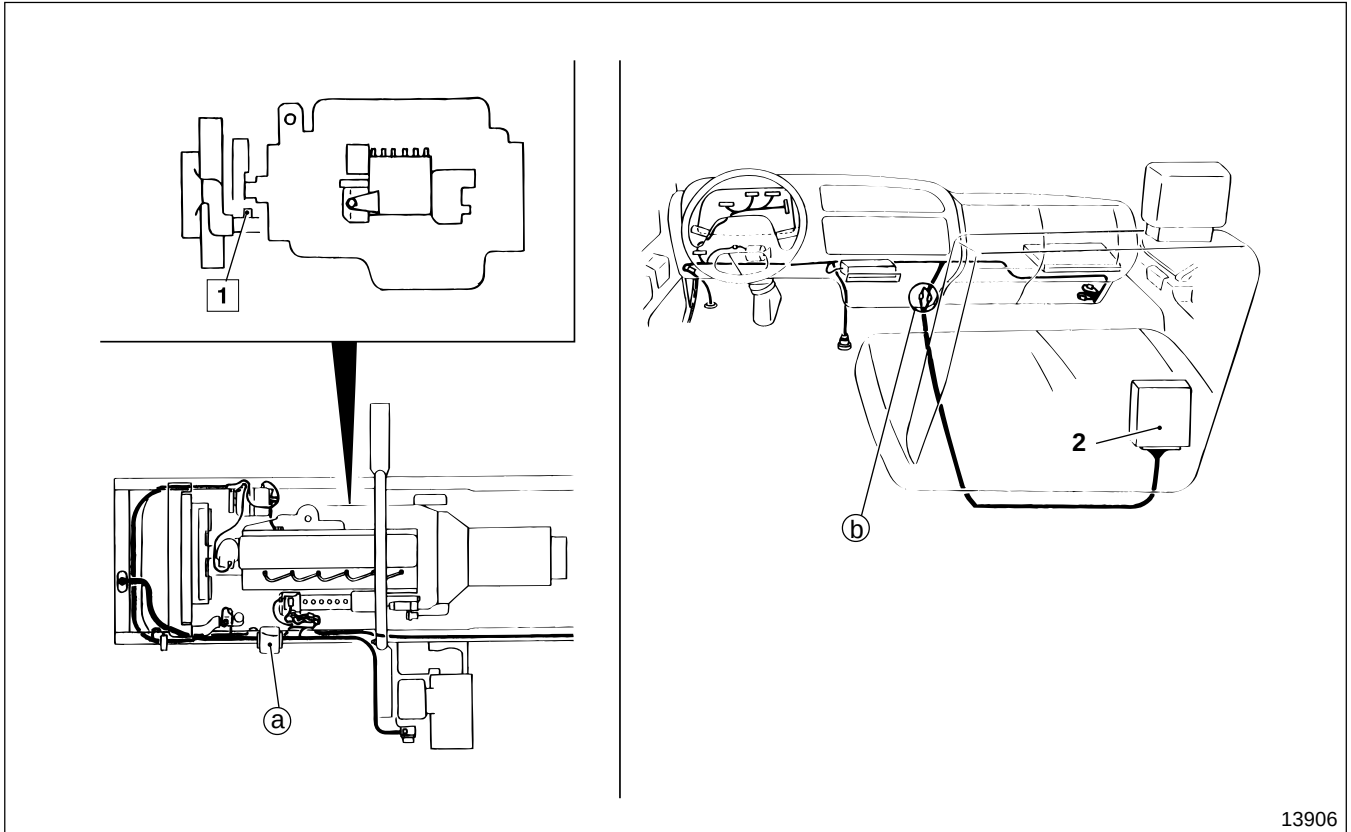
13904

PRE-STROKE CONTROL INJECTION PUMP SYSTEM

Diagnosis code 41 Boost air temperature sensor faulty



13905



13906

- 1 Boost air temperature sensor
2 Pre-stroke control unit

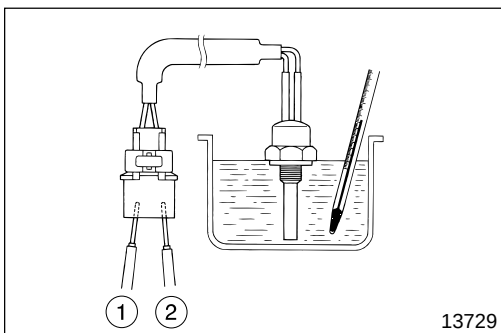
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
1	Resistance value of boost air temperature sensor	0°C {32°F}	5880±588 Ω	—	Replace
		20°C {68°F}	2455±245 Ω	—	Replace
		80°C {176°F}	322±32 Ω	—	Replace

◆ Service procedure

1 Inspection of boost air temperature sensor

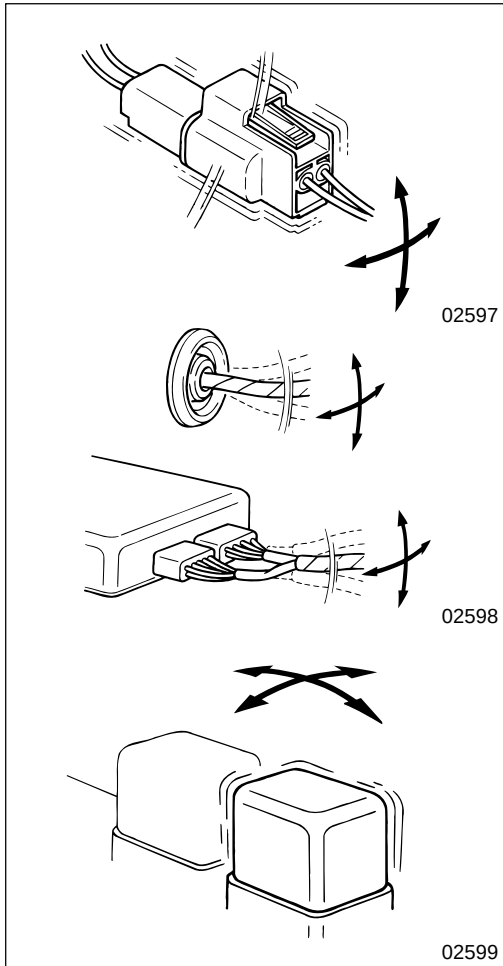
- Place boost air temperature sensor 1 in rape seed oil in a container.
- Raise the oil temperature to the specified values and stir the oil.
- Measure the resistance between terminals ① and ②.
- If the measured value deviates from the standard value, replace boost air temperature sensor 1. Gr 15



13729

PRE-STROKE CONTROL INJECTION PUMP SYSTEM

Inspection of Temporary Faults



Temporary faults often occur under certain conditions. So identifying those conditions helps to find possible causes. To find the conditions under which temporary faults occurred, you need to reproduce the faults after interviewing customers in detail about actual driving conditions, weather, frequency of occurrence and fault phenomena.

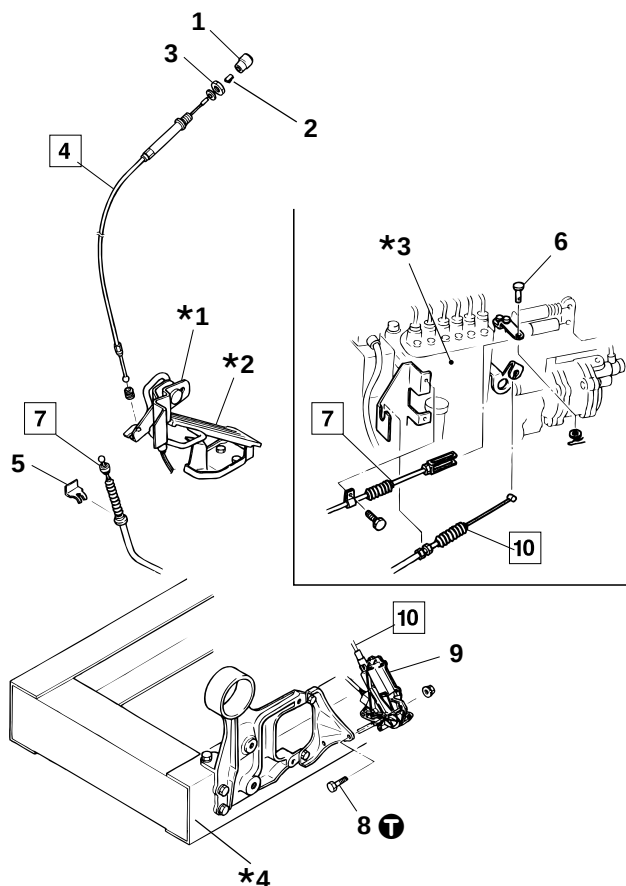
Then determine if the faults were caused by vibration, temperature or other possible elements depending on the actual conditions identified. If vibration is suspected as a possible cause, inspect individual connectors as follows to check if the fault will occur:

- Shake the connector gently in all four directions of the arrows as illustrated.
- Shake the wiring harness gently in all four directions of the arrows as illustrated.
- Wiggle each sensor or piece of equipment by hand.
- Gently shake the wiring harnesses near movable parts such as suspensions.

The inspection subjects include possible causes related to the diagnosis code outputs and faults, as well as the connectors and other parts in the inspection procedure.

MEMO

ENGINE CONTROL



13818

● Disassembly sequence

- 1 Idling control knob
- 2 Clip
- 3 Nut
- 4 Idling control cable
- 5 Cable clip
- 6 Clevis pin
- 7 Accelerator control cable
- 8 Bolt

- 9 Fuel-cut motor Gr 54
- 10 Engine stop cable

- *1 : Accelerator arm assembly P13-62
 *2 : Accelerator pedal assembly P13-61
 *3 : Injection pump assembly P13-68
 *4 : Frame Gr 41

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

Be sure when laying and routing cables, not to let them contact metal edges.

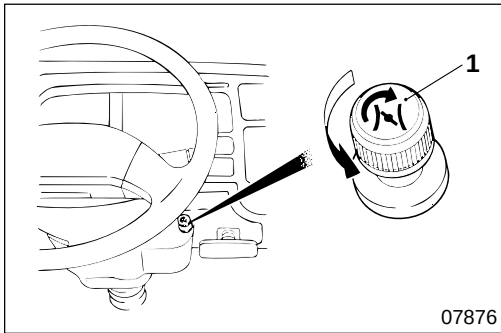
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

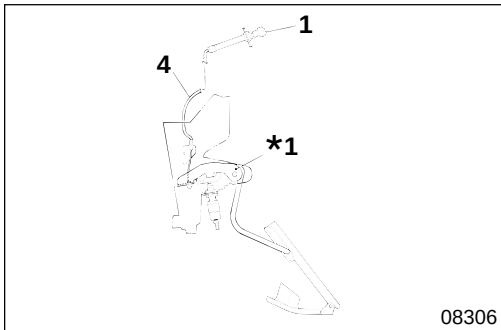
Location	Parts to be tightened	Tightening torque	Remarks
8	Bolt (Fuel-cut motor mounting)	4.9 to 5.9 {3.6 to 4.3, 0.5 to 0.6}	—

◆ Service procedure**4 Installation of idling control cable**

- Rotate idling control knob **1** counterclockwise until the inner cable protrudes at its maximum.

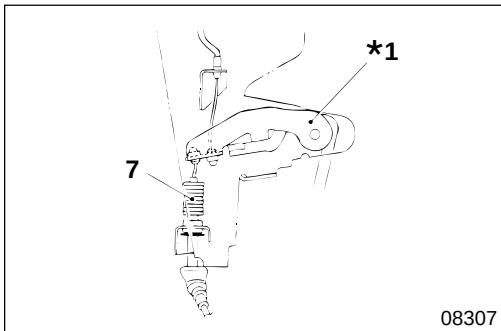


- While maintaining this state, install accelerator arm assembly ***1**.

**7 Accelerator control cable**

[Installation]

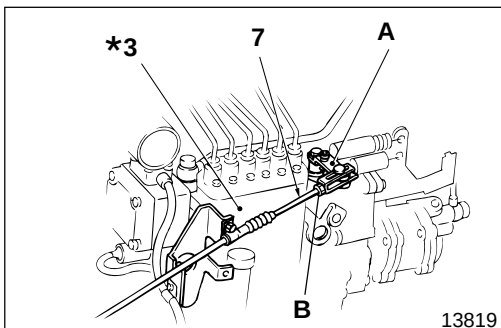
- Mount accelerator control cable **7** to accelerator arm assembly ***1**.



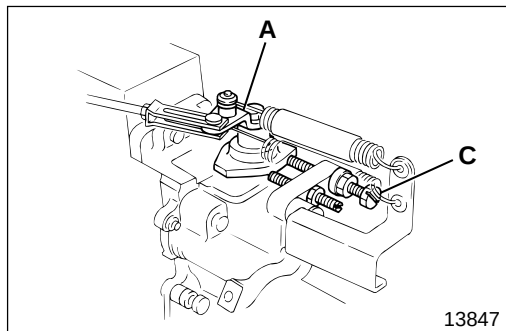
- Make sure that the accelerator pedal does not move by turning idling control knob **1** clockwise as far as it will go.
- Mount the engine end of accelerator control cable **7** to control lever **A** of injection pump assembly ***3**.
- Tighten the accelerator control cable **7** using adjustor nut **B** so that the accelerator pedal does not move.

NOTE

When mounting accelerator control cable **7**, do not move control lever **A**.

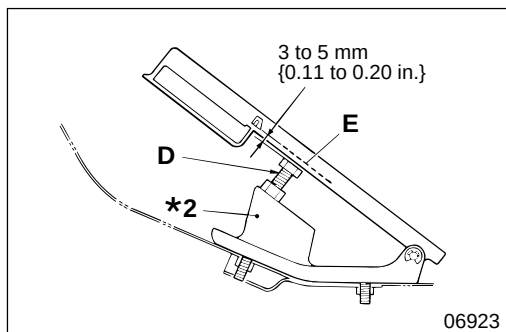


ENGINE CONTROL

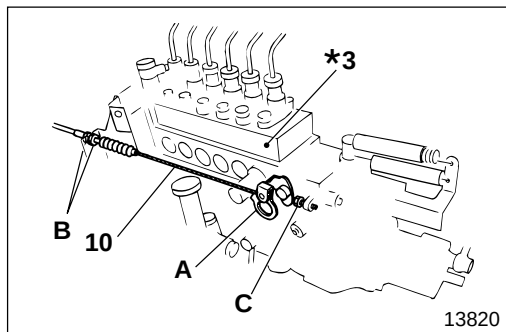


[Adjustment]

- Turn the starter switch ON, and press down on the accelerator pedal until control lever **A** hits stopper bolt **C**.



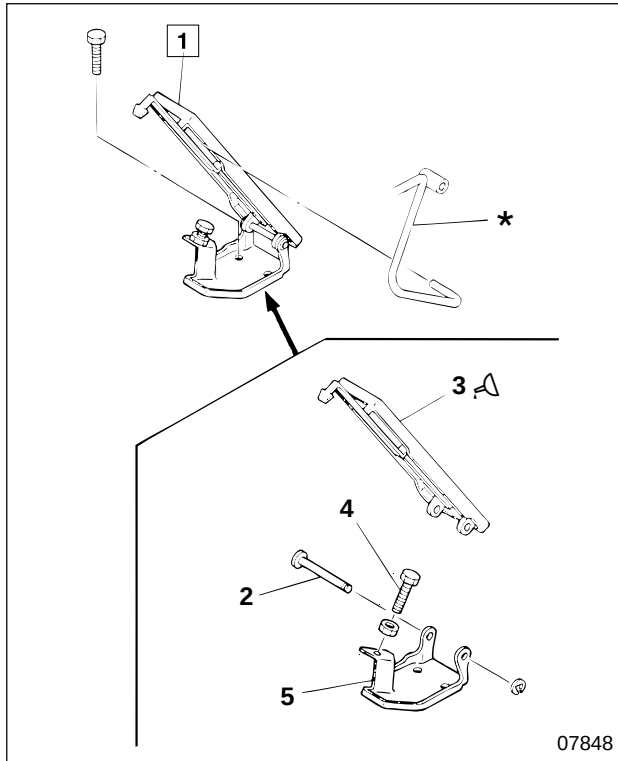
- Adjust the height of stopper bolt **D** of accelerator pedal assembly ***2** in such a manner that the clearance between stopper bolt contact surface **E** and the stopper bolt conforms to the specified value.



10 Installation of engine stop cable

- Mount engine stop cable **10** to stop lever **A** of injection pump assembly ***3**.
- Turn the starter switch to ACC or LOCK. Fasten using mounting nut **B** while keeping stop lever **A** pressed against stopper bolt **C**.
- After installation, start the engine using the starter switch, and make sure that the engine stops when the switch is turned to ACC.

Accelerator Pedal Assembly



● Disassembly sequence

- 1 Accelerator pedal assembly
- 2 Clevis pin
- 3 Accelerator pedal
- 4 Stopper bolt
- 5 Accelerator pedal bracket

* : Accelerator arm assembly P13-62

● Assembly sequence

Follow the disassembly sequence in reverse.

Lubricant

Location	Points of application	Kinds	Quantity
3	Slide-contacting surfaces of accelerator pedal and bracket	Chassis grease [NLGI No.1 (Ca soap)]	As required

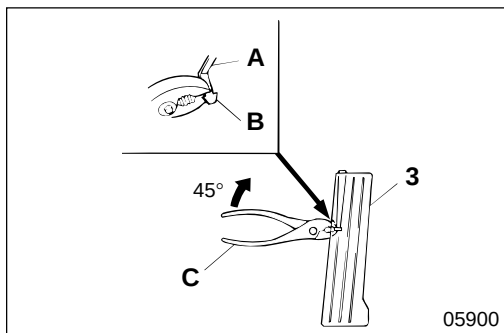
◆ Service procedure

1 Removal of accelerator pedal assembly

Pinch hook **B** of stopper **A** of accelerator pedal **3** using pliers **C** and rotating approximately 45° pull out the stopper towards the front of the vehicle.

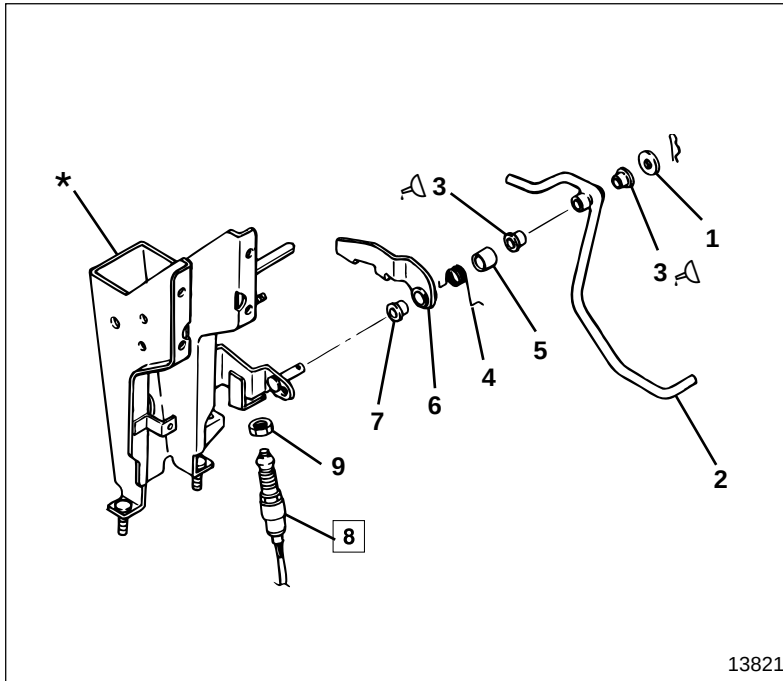
CAUTION

Take care not to damage stopper **A** itself during removal, do not pull it out too forcibly.



ENGINE CONTROL

Accelerator Arm Assembly



● Disassembly sequence

- 1 Washer
- 2 Accelerator arm
- 3 Bushing
- 4 Spring
- 5 Collar
- 6 Accelerator lever
- 7 Bushing
- 8 Accelerator switch  Gr 35, 54
- 9 Nut

* : Support assembly  Gr 35

● Assembly sequence

Follow the disassembly sequence in reverse.

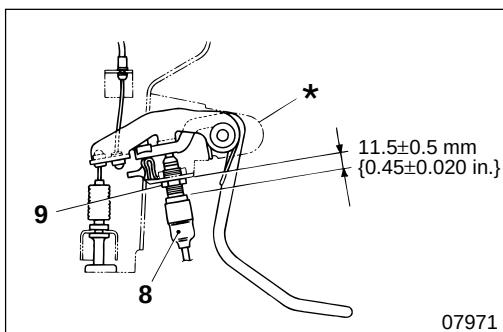
Lubricant

Location	Points of application	Kinds	Quantity
3	Slide-contacting surfaces of bushing and support assembly	Chassis grease [NLGI No.1 (Ca soap)]	As required

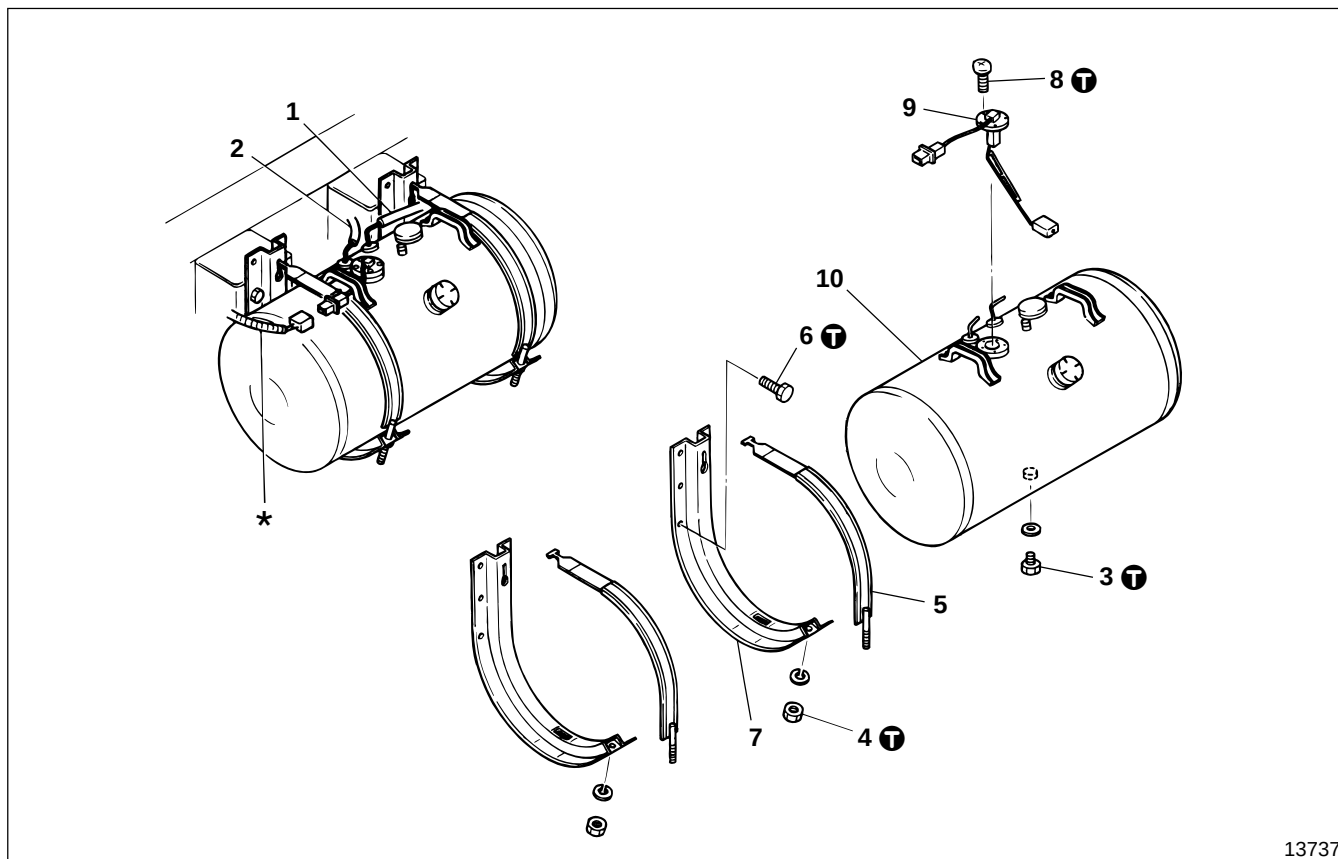
◆ Service procedure

8 Installation of accelerator switch

- Screw in accelerator switch **8** and fasten with nut **9** in such a way that the clearance between the accelerator switch and support assembly ***** is set to the standard value.
- Inspect and adjust the exhaust brake system.  Gr 35



FUEL TANK

13


13737

● Work before removal

WARNING

- Keep naked lights away because of the risk of explosion.
- Wipe up any spilled fuel because it can cause a fire.

NOTE

Drain fuel before working on the job.

● Removal sequence

- | | | |
|------------------|---------------------|---------------------|
| 1 Suction hose | 6 Bolt | * : Chassis harness |
| 2 Return hose | 7 Fuel tank bracket | |
| 3 Drain plug | 8 Screw | |
| 4 Nut | 9 Fuel gauge unit | |
| 5 Fuel tank band | 10 Fuel tank | |

● Installation sequence

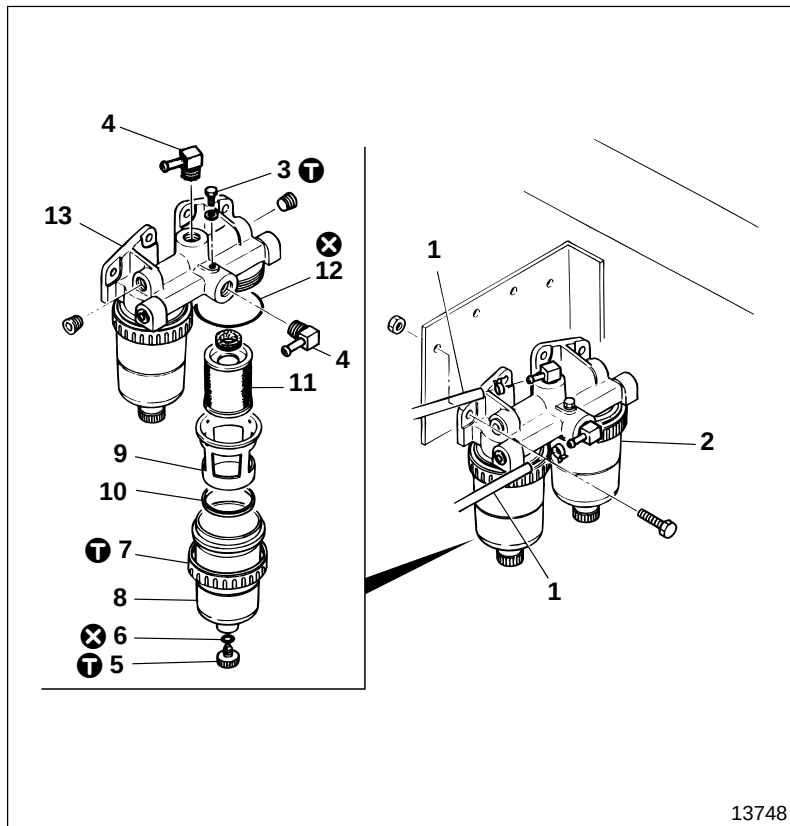
Follow the removal sequence in reverse.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Drain plug	59 to 98 {43 to 72, 6 to 10}	—
4	Nut (Fuel tank band mounting)	5.9 to 9.8 {4.3 to 7.2, 0.6 to 1.0}	—
6	Bolt (Fuel tank bracket mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
8	Screw (Fuel gauge unit mounting)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.15}	—

WATER SEPARATOR



● Disassembly sequence

- 1 Fuel feed hose
- 2 Water separator assembly
- 3 Air vent plug
- 4 Connector
- 5 Drain plug
- 6 O-ring
- 7 Ring nut
- 8 Case
- 9 Baffle plate and screen assembly
- 10 Water level ring
- 11 Clean screen
- 12 O-ring
- 13 Head

⊗ : Non-reusable parts

WARNING ⚠

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any spilled gas oil because it can cause a fire.

● Assembly sequence

Follow the disassembly sequence in reverse.

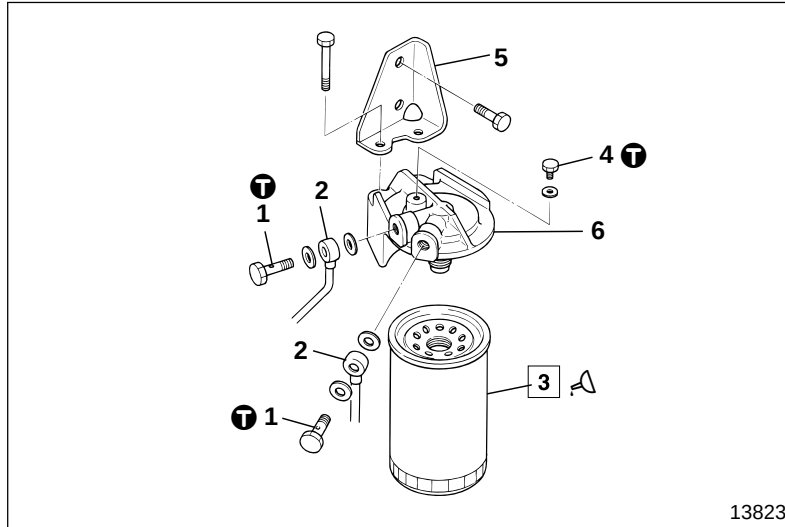
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Air vent plug	7.8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—
5	Drain plug	2.9 to 3.9 {2.2 to 3.9, 0.3 to 0.4}	—
7	Ring nut	5.9 to 7.8 {4.3 to 5.8, 0.6 to 0.8}	—

MEMO

FUEL FILTER



● Disassembly sequence

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

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

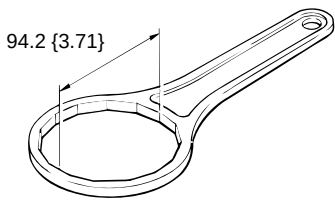
Location	Parts to be tightened	Tightening torque	Remarks
1	Eye bolt	25 to 34 {18 to 25, 2.5 to 3.5}	—
4	Air vent plug	7.8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—

L Lubricant

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

C Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3	Filter wrench 	MH061572	Removal of fuel filter

01882

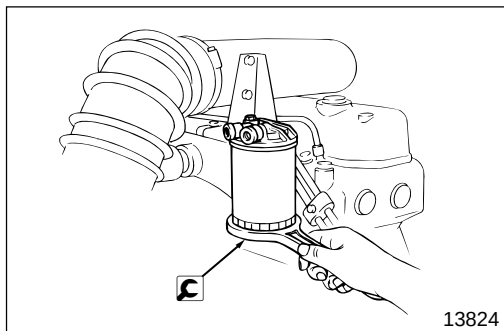
◆ Service procedure

3 Fuel filter

WARNING ⚠

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any spilled gas oil because it can cause a fire.

[Removal]

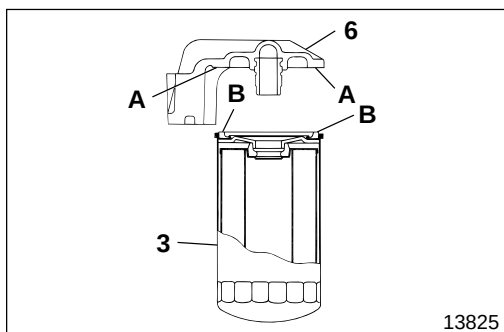


[Installation]

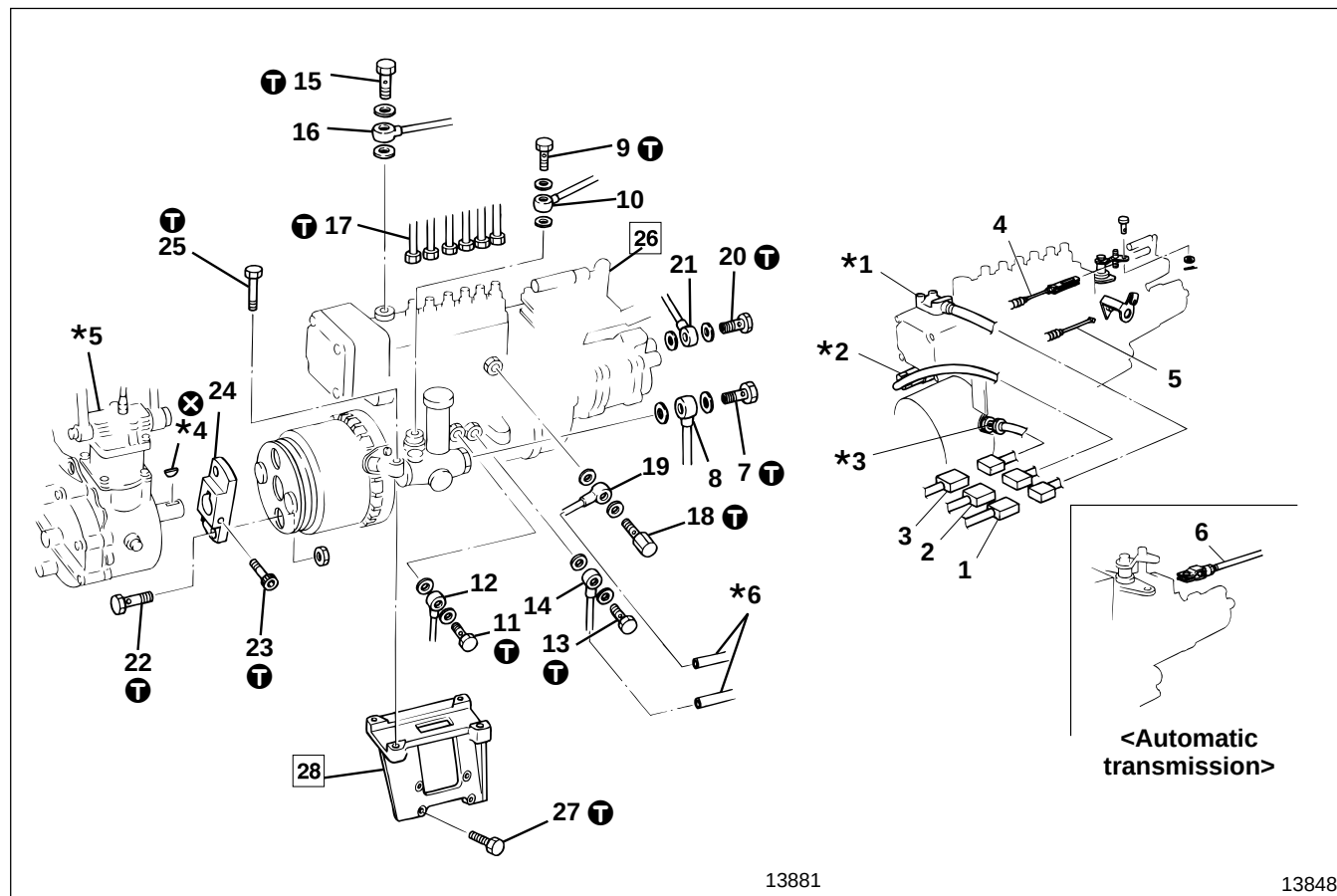
WARNING ⚠

You must use a genuine replacement part filter because using unsuitable fuel filter 3 can cause fuel leakage and a fire.

- Install by tightening by three-quarters to one full turn after contact surface A of fuel filter head 6 contacts gasket B of fuel filter 3. Be sure to tighten by hand.
- After installation, run the engine to check for fuel leakage.



INJECTION PUMP



● Removal sequence

- 1 Harness (Pre-stroke actuator)
- 2 Harness (Control rod position sensor)
- 3 Harness (Engine revolution sensor)
- 4 Accelerator control cable P13-58
- 5 Engine stop cable P13-58
- 6 Modulator control rod < Automatic transmission >
 Gr 23
- 7 Eye bolt
- 8 Fuel suction pipe
- 9 Eye bolt
- 10 Fuel feed pipe
- 11 Eye bolt
- 12 Oil feed pipe
- 13 Eye bolt
- 14 Oil return pipe
- 15 Eye bolt
- 16 Fuel feed pipe
- 17 Injection pipe
- 18 Overflow valve
- 19 Fuel return pipe

- 20 Eye bolt
- 21 Boost hose
- 22 Bolt
- 23 Cotter bolt
- 24 Driving coupling
- 25 Bolt
- 26 Injection pump assembly
- 27 Bolt
- 28 Injection pump bracket

- *1 : Pre-stroke actuator P13-10, 12
- *2 : Control rod position sensor P13-16
- *3 : Engine revolution sensor P13-16
- *4 : Key Gr 35A, B
- *5 : Air compressor Gr 35A, B
- *6 : Fuel hose

: Non-reusable parts

WARNING ⚠

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any spilled fuel because it can cause a fire.

CAUTION ⚠

- 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 pump assembly 26.
- Do not hold the control lever when lifting injection pump assembly 26. Also, do not remove the control lever because removal of the lever might cause poor performance of the pump.
- Do not remove injection pump bracket 28 unless it is faulty.
- Make sure you connect fuel hose *6 at a high position because fuel in the fuel tank would leak out if the end of the fuel hose were at a position lower than the tank.

● **Installation sequence**

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
28	Injection pump bracket (eccentricity of injection pump centering tool to air compressor crankshaft)	0.2 {0.0079} or less	—	Adjust

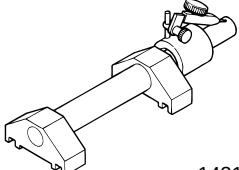
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
7, 9, 15	Eye bolt (Fuel suction pipe and fuel feed pipe mounting)		25 to 29 {18 to 22, 2.5 to 3}	—
11, 20	Eye bolt (Oil feed pipe and boost hose mounting)		12 to 15 {8.7 to 11, 1.2 to 1.5}	—
13	Eye bolt (Oil return pipe mounting)		20 to 29 {14 to 22, 2 to 3}	—
17	Injection pipe mounting		29 to 49 {22 to 36, 3 to 5}	—
18	Overflow valve mounting		20 to 29 {14 to 22, 2 to 3}	—
22	Bolt (Driving coupling mounting)		59 to 64 {43 to 47, 6 to 6.5}	—
23	Cotter bolt		83 to 93 {61 to 69, 8.5 to 9.5}	—
25	Bolt (Injection pump assembly mounting)	Primary tightening	4.9 {3.6, 0.5}	—
		Secondary tightening	25 {18, 25}	—
27	Bolt (Injection pump bracket mounting)		33 to 55 {25 to 41, 3.4 to 5.6}	—

Special tools

Unit : mm {in.}

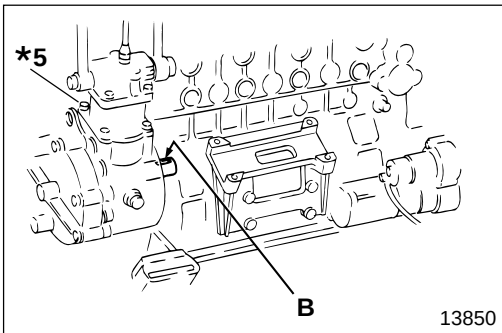
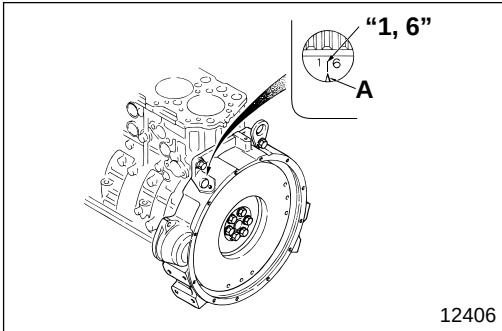
Location	Tool name and shape	Part No.	Application
28	Injection pump centering tool  14311	MH063336	Positioning of injection pump bracket

INJECTION PUMP

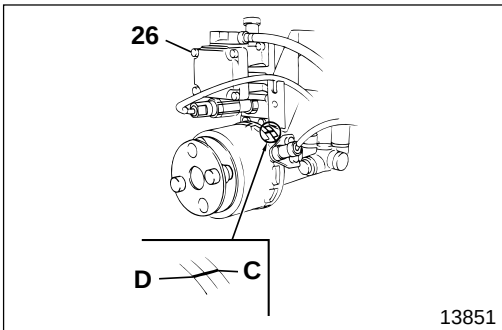
◆ Service procedure

26 Installation of injection pump assembly

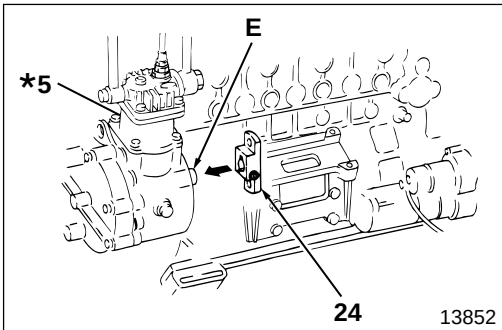
- Crank the engine to bring No. 1 cylinder piston to top dead center in the compression cycle, and align mark “1, 6” of the flywheel with pointer A on the flywheel housing.



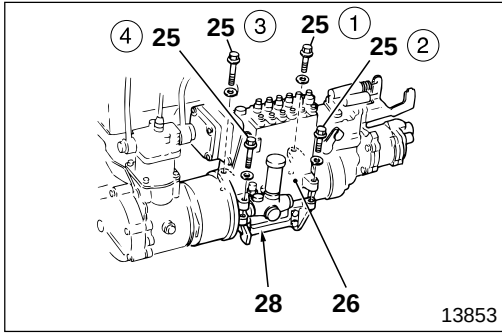
- In this state, make sure that keyway B in the crankshaft of air compressor *5 faces upward.
- If keyway B is not facing upward, turn the engine crankshaft by one turn.



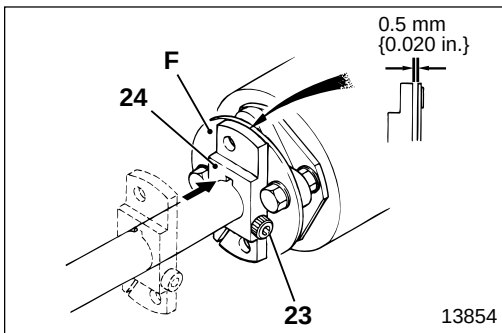
- Align pointer C on injection pump assembly 26 with notch D on the automatic timer.



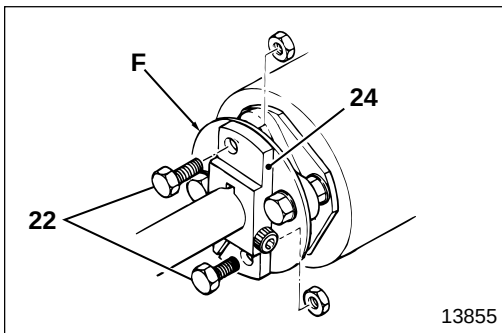
- Install driving coupling 24 to crankshaft E of air compressor *5 and place the driving coupling on the air compressor side.
- Install injection pump assembly 26 on the injection pump bracket.



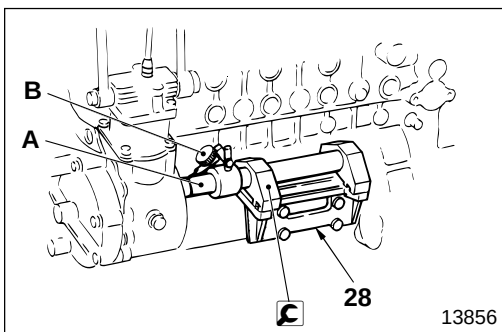
- Install injection pump assembly **26** on injection pump bracket **28**.
- Tighten bolts **25** in the order as illustrated at specified torque for primary tightening.
- Retighten bolts **25** in the order as illustrated at specified torque for secondary tightening.



- Move driving coupling **24** to adjust the clearance between the driving coupling and coupling plate **F** as illustrated, then tighten cotter bolt **23** at specified torque.



- Attach driving coupling **24** and coupling plate **F** using bolts **22** and tighten the bolts temporarily.
- In this state, adjust the fuel injection timing.
Adjustment of fuel injection timing : P13-28
After adjusting the fuel injection timing, tighten bolts **22** at specified torque.

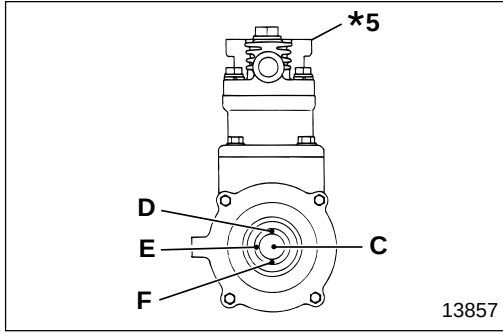


28 Injection pump bracket

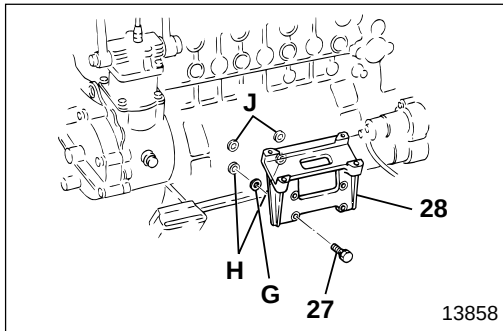
[Inspection]

- Attach dial gauge **B** to arbor **A** of injection pump centering tool and adjust to carry out zero point adjustment.

INJECTION PUMP



- Slide dial gauge **B** toward air compressor ***5** and measure the eccentricity of crankshaft **C** against arbor **A** at points **D**, **E** and **F**.
- If the measured value is higher than the standard value, adjust as follows.



[Adjustment]

- When the measured value at point **E** is higher than the standard value:
Insert shims **G** into four points equally.
- When the measured value at point **D** is higher than the standard value:
Insert shims **G** into lower side **H**.
- When the measured value at point **F** is higher than the standard value:
Insert shims **G** into upper side **J**.

CAUTION

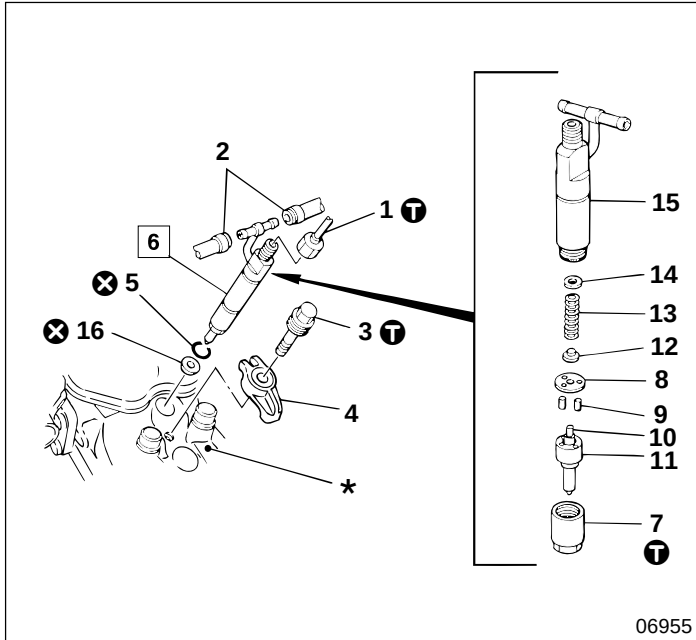
Insert shims **G** observing the following conditions:

- Number of shims per point is three or less.
- The same number of shims should be used for the front and the rear.
- The difference in number of shims used for bottom and top is none or one.

- Tighten bolt **27** at specified torque, then reinspect.

MEMO

INJECTION NOZZLE



● Inspection before disassembly

📖 P13-75

● 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}	—

Special tools

Location	Tool name and shape	Part No.	Application
—	Nozzle cleaning tool	★105789-0010	Cleaning of injection nozzle assembly

★ ZEXEL code number

Service procedure

Inspection before disassembly

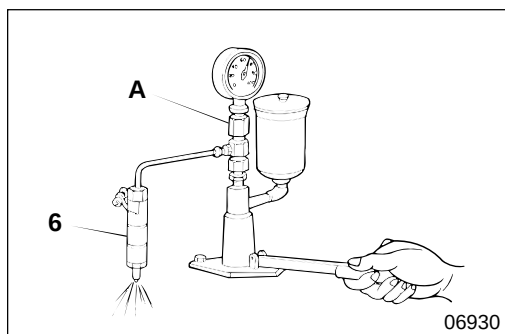
Attach injection nozzle assembly **6** to nozzle tester **A**, and conduct the following inspection.

WARNING

Never touch the spray from nozzle **11** or let your hands get too close to the spray point during the test.

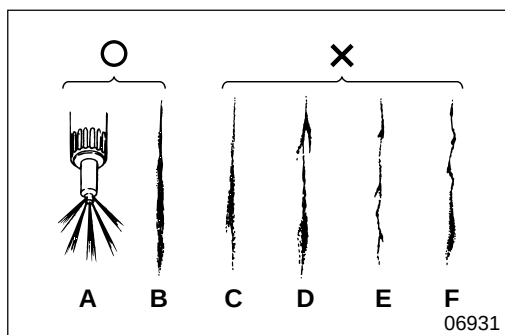
NOTE

Before inspection, bleed the air out in a couple of bursts by pressing nozzle tester **A** lever.



(1) Valve opening pressure

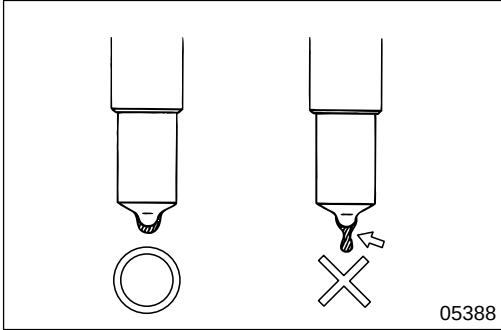
- Raise the pressure of nozzle tester **A** by operating the lever, and measure the pressure that the gauge registers when the pressure is released which will be observed by the sudden movement of the gauge indicator.
- If the measured value deviates from the standard value, disassemble the nozzle and clean, and adjust it using adjusting shims **14**.
- Variation of 0.05 mm {0.0020 in.} thickness in adjusting shims **14** causes a difference of 735 kPa {105 lbf/in², 7.5 kgf/cm²} of pressure, for example, to alter the pressure for 98 kPa {14 lbf/in², 1 kgf/cm²}, a thickness of 0.0067 mm {0.00026 in.} is required.
- If the performance cannot reach the standard value even after adjustment, replace injection nozzle assembly **6**.



(2) Spray condition

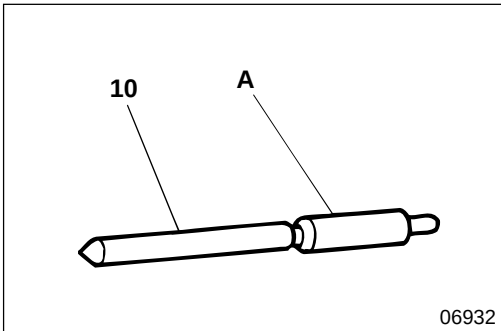
- Test injection spray condition by quick lever actions of nozzle tester **A**, 4 to 6 actions per second.
 - A** : Even spray from all five orifices (Good)
 - B** : Even and symmetrical spray (Good)
 - C** : Asymmetrical spray (Faulty)
 - D** : Spray direction deviates from the nozzle axis line (Faulty)
 - E** : Thin and insufficient spray (Faulty)
 - F** : Irregular spray (Faulty)
- If faulty spray cannot be corrected, disassemble injection nozzle assembly **6** and clean every part and repeat the test. If faulty spray still occurs after repeating test, replace the injection nozzle assembly.
- Make sure that there is no post-spray dripping after injection.

INJECTION NOZZLE



(3) Fuel air tightness and leakage at related contact points

- Maintain interior pressure of nozzle at 1960 kPa {285 lbf/in², 20 kgf/cm²} lower than the valve opening pressure, and check and see if any fuel seeps out of the nozzle tip within 10 seconds.
- If any fault is found, disassemble injection nozzle assembly **6** and clean every part and repeat the test. If any fault is still found, replace the injection nozzle assembly.

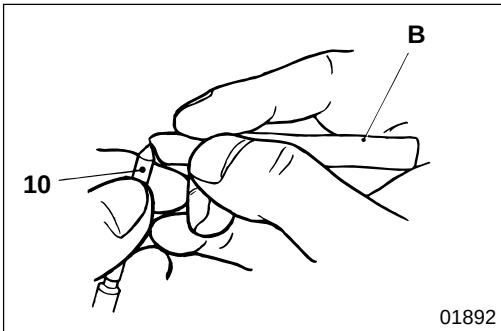


6 Injection nozzle assembly

[Disassembly]

CAUTION ⚠

- Be sure not to touch sliding part A of needle valve 10 with your hands.
- Never change the combination of removed needle valve 10 and nozzle 11 for each cylinder.



[Cleaning]

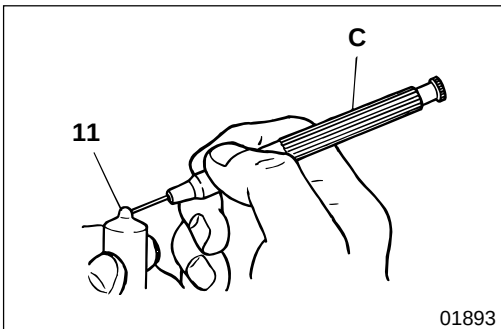
Clean needle valve **10** and nozzle **11** with gas oil (cleaning solvent).

Remove carbon deposits with  cleaning tool in the following manner:

- Clean needle valve **10** by removing carbon deposits from its tip using cleaning bar **B** of  cleaning tool.

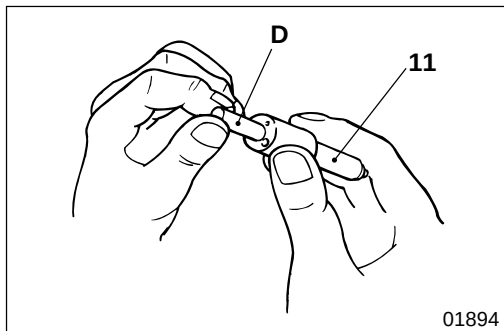
CAUTION ⚠

Never use a wire brush or hard steel for cleaning.

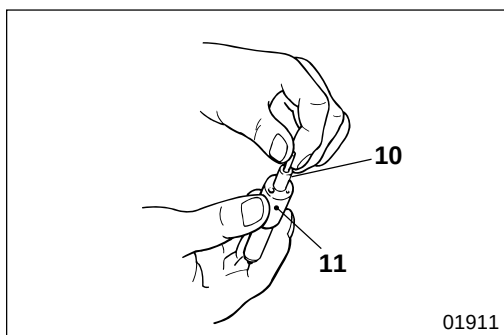


- To clean nozzle **11**, remove carbon deposits from the orifices of the nozzle using needle cleaner **C** of  cleaning tool, by inserting it into the orifices and turning it.

Needle cleaner diameter : $\varnothing 0.25$ mm {0.0098 in.} or less



- Clean the seat of nozzle **11** using cleaning needle **D** of  cleaning tool.
- Use FUSO carbon remover to remove hard-to-remove, burnt-on carbon deposits.



[Inspection]

- Immerse needle valve **10** and nozzle **11** in gas oil (cleaning solvent) and clean them thoroughly.
- Check and see if needle valve **10** drops by its own weight into the nozzle from the position where a third of its length is pulled out. (Repeat this several times rotating the needle valve.)
- If needle valve **10** does not drop smoothly, repeat cleaning and repeat the test. If any fault is still found, replace both the needle valve and nozzle **11** together as a set.



FH

Service Manual

Group 13

Fuel and Engine Control

'99 Minor Change

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

GROUP 13 FUEL AND ENGINE CONTROL

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SPECIFICATIONS

Injection Pump

Item	Specifications
Manufacturer	ZEXEL
Body model	MD-TICS (Pre-stroke control type)
Governor type	RED-III electronically controlled governor
Feed pump model	KD
Automatic timer model	SPG mechanical type

Injection Nozzle

Item	Specifications
Manufacturer	ZEXEL
Model and type	DLLA hole type 1-spring nozzle
Nozzle orifice quantity	5
Orifice diameter	mm {in.} ϕ 0.23 {0.0091}

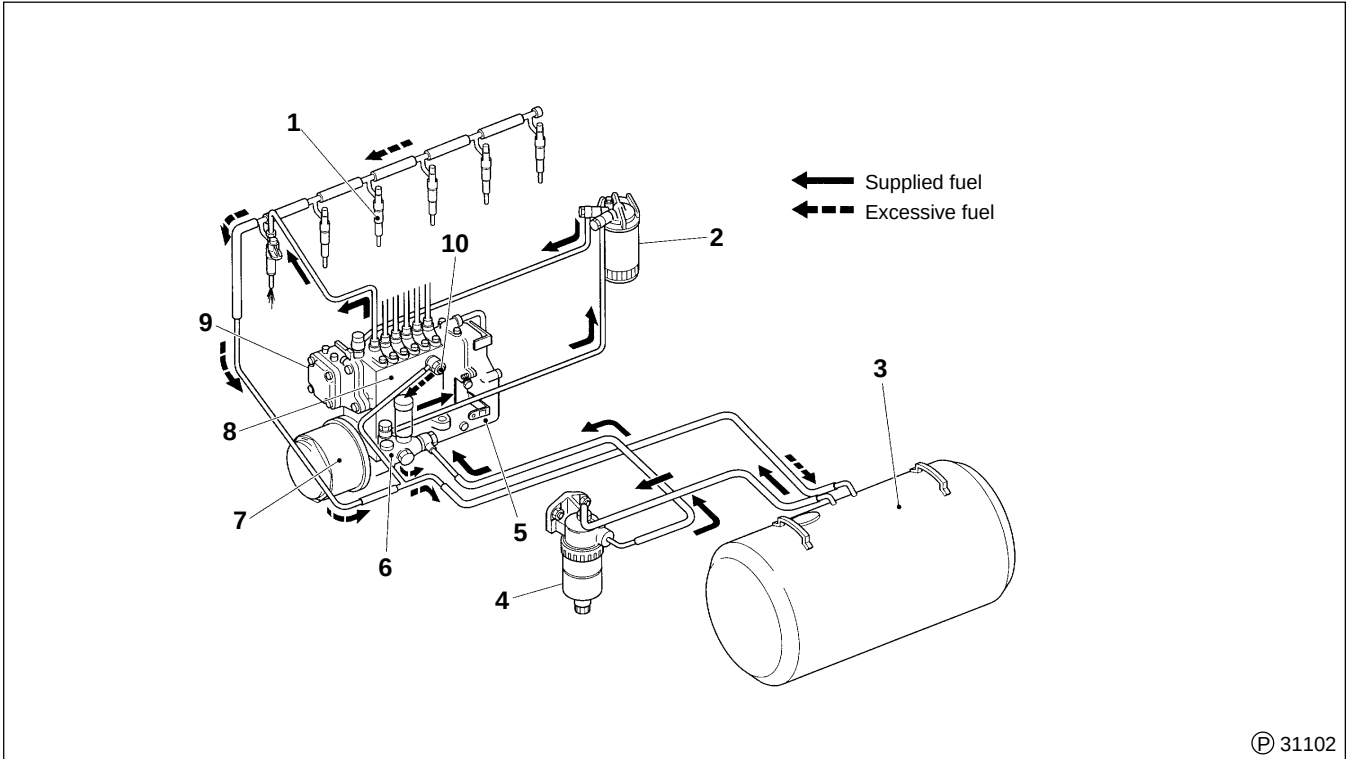
Fuel Filter Type

Item	Specifications
Filter type	Spin-on type

MEMO

STRUCTURE AND OPERATION

Fuel System (Flow of Fuel)



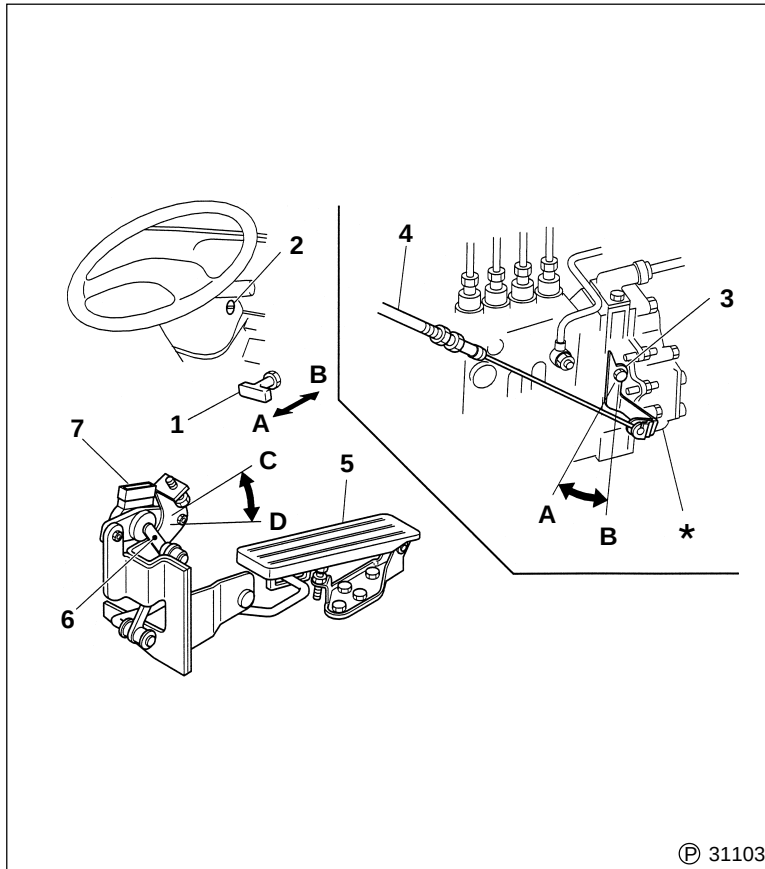
- | | |
|--------------------|-----------------------|
| 1 Injection nozzle | 6 Feed pump |
| 2 Fuel filter | 7 Automatic timer |
| 3 Fuel tank | 8 Injection pump |
| 4 Water separator | 9 Pre-stroke actuator |
| 5 Governor | 10 Overflow valve |

Fuel in fuel tank **3** is sucked up by feed pump **6** which is driven by the cam action of injection pump **8** and is filtered through fuel filter **2** which removes dirt and other foreign particles.

Filtered fuel is sent to the injection pump where the fuel pressure is boosted and injected through injection nozzle **1** into the combustion chamber.

When fuel pressure is higher than the specified value, overflow valve **10** opens to let the fuel return to the fuel tank.

Engine Control



- 1 Emergency engine stop handle
- 2 Starter switch
- 3 Engine stop lever
- 4 Engine stop cable
- 5 Accelerator pedal assembly
- 6 Lever
- 7 Accelerator pedal position sensor

* : Electronic governor

- A : Engine-stop position
- B : Engine start-up position
- C : Full-load position
- D : Idling position

© 31103

● Accelerator switch

The accelerator switch is integrated in the accelerator pedal position sensor 7. It detects the pressing of accelerator pedal assembly 5.

● Accelerator pedal position sensor

Accelerator pedal position sensor 7 detects the movement of accelerator pedal assembly 5, and sends an electric signal to the electronic governor control unit. Lever 6 of the accelerator pedal position sensor is constantly pulled by the return spring towards idle position D.

● Emergency engine stop button

In normal condition, turn starter switch 2 to the ACC position to electrically shut down the engine operation.

In the case the engine does not stop when the starter switch is turned to the ACC position due to malfunction of the electronic governor system or other cause, stop the engine by pulling emergency engine stop handle 1 to move stop lever 3 of electronic governor * to engine stop position A.

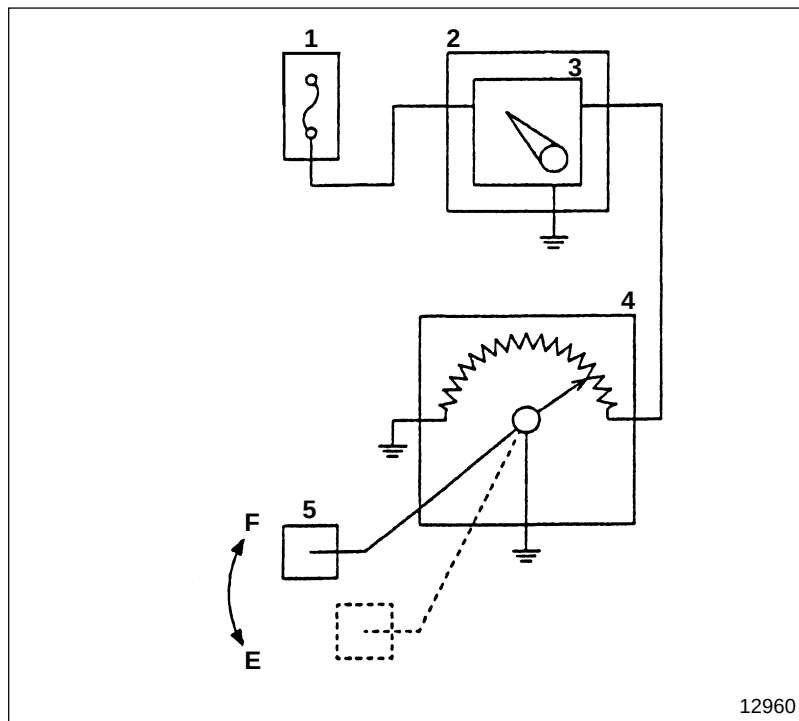
CAUTION ⚠

When the engine is stopped by pulling engine stop handle 1, set starter switch 2 to the ACC or LOCK position to reset the control unit computer.

Restarting the engine without resetting the computer results in unstable engine speed control.

STRUCTURE AND OPERATION

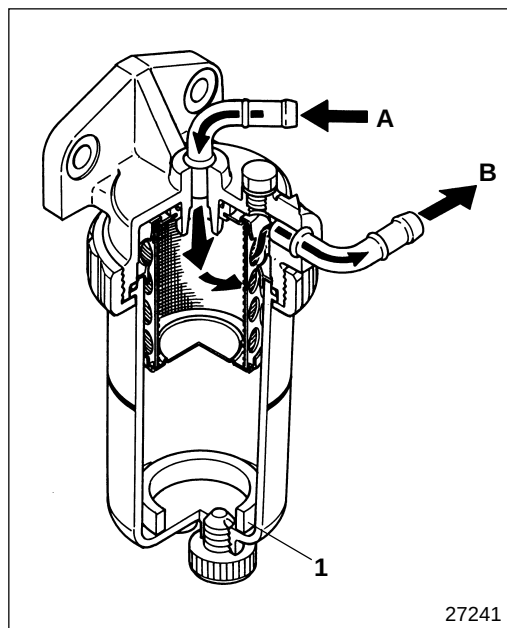
Fuel Gauge Electric Circuit



- 1 Fuse box
- 2 Meter cluster
- 3 Fuel gauge
- 4 Fuel gauge sending unit
- 5 Float

The fuel gauge circuit indicates the amount of fuel remaining in the fuel tank by means of a gauge.

Water Separator

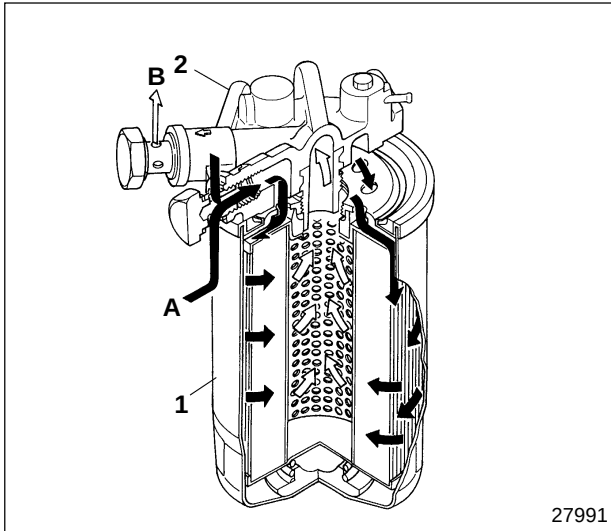


- 1 Water level ring

A : From fuel tank
B : To feed pump

The water separator is installed between the fuel tank and the feed pump. Any water present in the fuel is separated by the baffle plate and the screen assembly.

Fuel Filter



- 1 Fuel filter
- 2 Fuel filter head

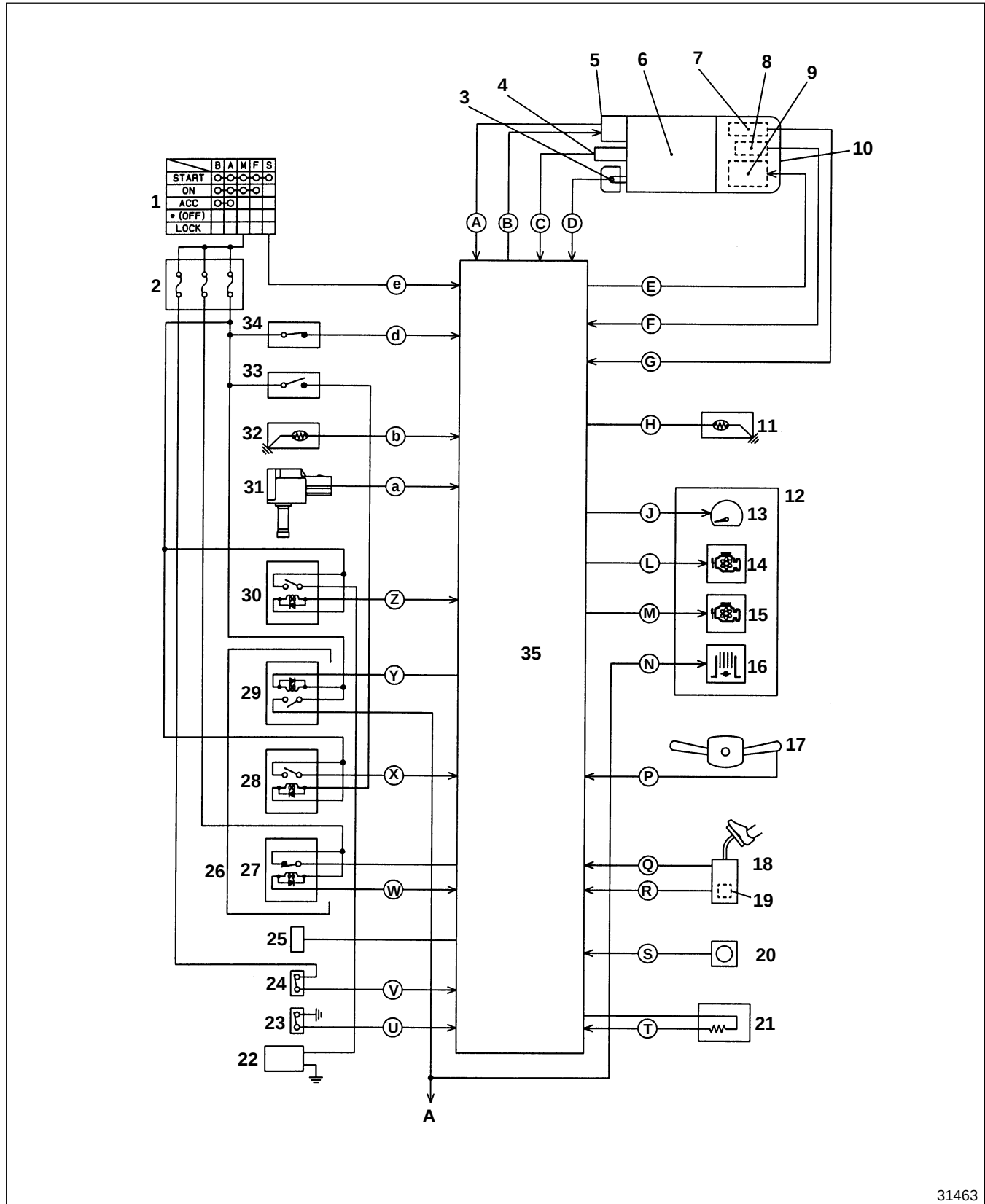
A : From feed pump

B : To injection pump

Pressurized fuel is delivered from the feed pump of the injection pump to the fuel filter which separates water from the fuel. Dirt and other foreign particles are removed from the fuel by fuel filter 1.

STRUCTURE AND OPERATION

Configuration of Electronic Governor and Pre-stroke Control Injection Pump System



A : To exhaust brake 3-way magnetic valve  Gr 54

Part		Main function/operation	Data signal
1	Starter switch	Sensing of start signal	Ⓔ : Start signal
2	Fuse box	—	—
3	Engine speed sensor	Sensing of engine speed	Ⓓ : Engine speed signal
4	Sub control rack position sensor	Sensing of control rack position	Ⓒ : Control rack position signal (backup)
5	Pre-stroke actuator • Pre-stroke position sensor • Drive unit	— —	Ⓐ : Pre-stroke position signal Ⓑ : Actuator drive signal
6	Pre-stroke control type injection pump	Alteration of pre-stroke (advancement of fuel injection timing)	—
7	Control rack position sensor	Sensing of control rack position	Ⓖ : Control rack position signal
8	Backup engine speed sensor	Sensing of engine speed	Ⓕ : Engine speed signal (backup)
9	Linear DC motor	Activation of rack	Ⓔ : Linear DC motor drive signal
10	Electronic governor	—	—
11	Boost temperature sensor	Detection of engine intake air temperature	Ⓗ : Boost temperature signal
12	Meter cluster	—	—
13	Tachometer	—	Ⓙ : Tachometer drive signal
14	Warning lamp (Orange)	Indication of system faults and diagnosis codes	Ⓛ : Lamp illumination signal
15	Warning lamp (Red)		Ⓜ : Lamp illumination signal
16	Indicator lamp	—	Ⓝ : Lamp illumination signal
17	Auxiliary brake switch	ON/OFF switching of Exhaust brake	Ⓟ : Exhaust brake ON signal
18	Accelerator pedal position sensor	Sensing of accelerator pedal depression amount	Ⓠ : Accelerator pedal position signal
19	Accelerator pedal switch	Turns OFF when accelerator pedal is depressed	Ⓡ : Accelerator pedal depression signal
20	Idling speed adjustment potentiometer	Shortening of warmup time	Ⓢ : Warmup time shortening signal
21	Fuel injection rate adjustment resistor	Correction of fuel injection rate	Ⓣ : Injection volume correction signal
22	Modulator	—	—
23	Diagnosis switch	Generation of diagnosis codes	Ⓤ : Diagnosis code signal
24	Memory clear switch	Eraser of diagnosis codes	Ⓥ : Diagnosis code eraser signal
25	MUT-II connector (16 pin)	Connection of MUT-II	—
26	Relay box	—	—
27	Pre-stroke cut relay	Closes contacts upon plunger pre-stroke operation	Ⓦ : Pre-stroke operation signal
28	Transmission neutral relay	Contact closed when transmission is in neutral	Ⓧ : Transmission neutral signal
29	Exhaust brake relay	Closes contacts upon exhaust brake operation	Ⓨ : Exhaust brake operation signal
30	Accelerator relay	Contact closed when modulator is activated	Ⓩ : Modulator operation signal
31	Boost pressure sensor	Sensing of boost pressure	ⓐ : Boost pressure signal
32	Coolant temperature sensor	Sensing of engine coolant temperature	ⓑ : Coolant temperature signal
33	Transmission neutral switch	Turns OFF when transmission neutral is selected	—
34	Clutch pedal switch	Turns OFF when clutch pedal is depressed	ⓓ : Clutch pedal depression signal
35	Electronic governor control unit	Control of overall system	—

STRUCTURE AND OPERATION

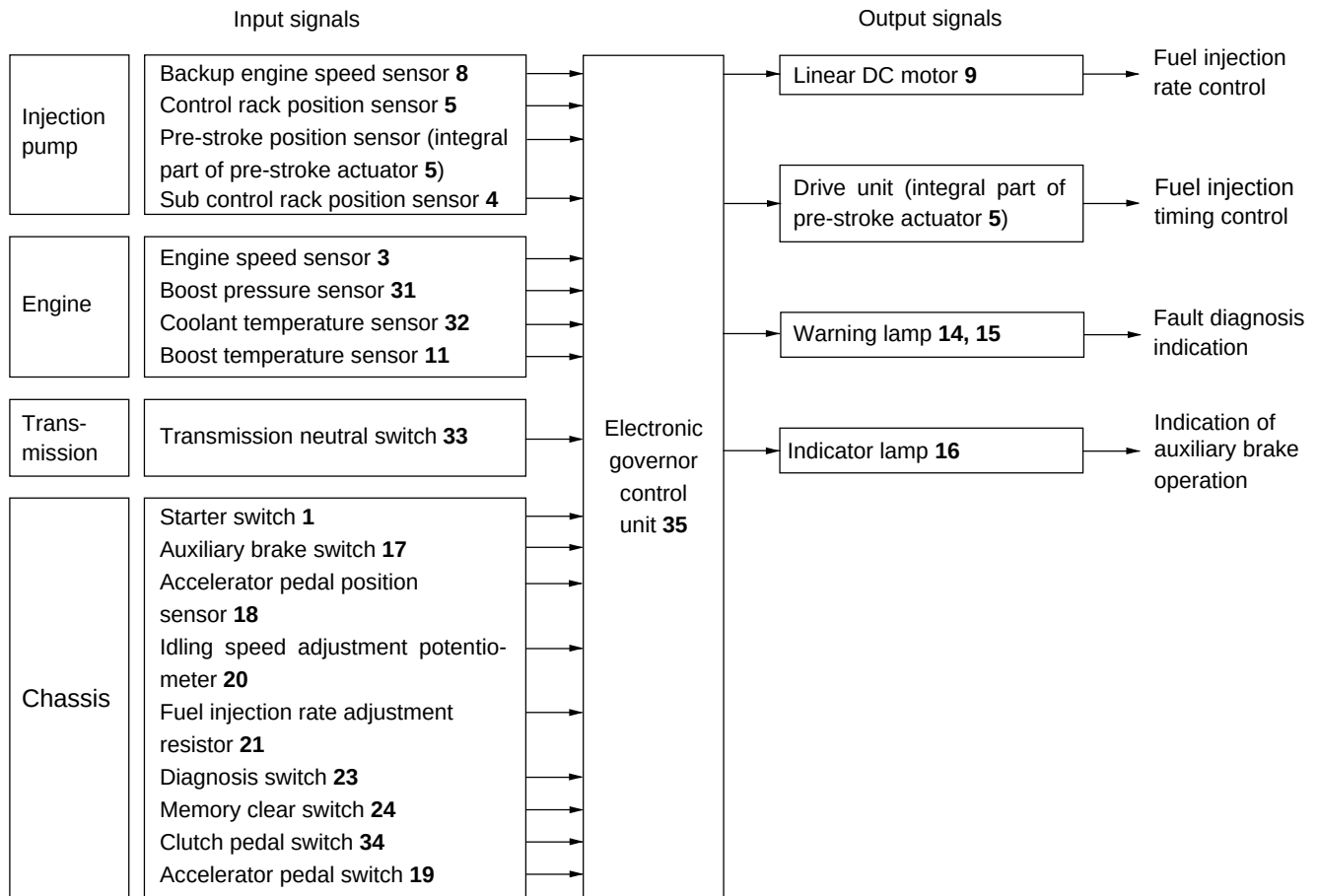
- The electronic governor and pre-stroke control injection pump system combines an electronic governor **10** with an injection pump **6** that has an electronically controlled pre-stroke adjustment feature.
- The injection pump's plunger lift speed varies in accordance with the engine speed, causing concomitant variations in the injection pipe pressure.
- Variations in the injection pipe pressure make it difficult to achieve an optimum spray from the injection nozzles and the optimum air/fuel mixture.
- To compensate for changes in the injection pipe pressure, the injection pump plunger pre-stroke is increased at low and mid- range speeds, thus ensuring that fuel injection takes place late in the cam lift, when plunger movement is relatively fast.
- At high speeds, the plunger pre-stroke is decreased, thus ensuring that fuel injection takes place in early in the cam lift, when plunger movement is relatively slow. Excessive increases in injection pipe pressure are thus prevented.
- By adjusting the plunger pre-stroke in this manner, the pre-stroke control injection pump **6** ensures that the spray and air/ fuel mixture are always optimally suited to combustion.
- The overall benefits are higher engine torque and cleaner exhaust emissions than are possible with a conventional injection pump.
- Control operations are performed by the electronic governor control unit **35**, which receives data from sensors on the engine and other vehicle components, processes them, and issues appropriate drive signals to the pre-stroke actuator **5** (located at the rear of the injection pump) and to the linear DC motor **9** (located inside the electronic governor).

The system's control functions (including auxiliary functions) are shown in the following table.

Item	Operation	Data source	
		Sensor(s)	Data signal(s)
Fuel injection rate control	The fuel injection rate is optimized to match engine operating conditions. P13-12	3, 7, 18, 19, 21, 31	(D, G, Q, R, T, a)
Pre-stroke control	The timing sleeve position is altered, thereby changing the pre-stroke and advancing the fuel injection timing. P13-13	3, 5, 7, 18, 32	(D, A, B, G, Q, b)
* Control rack preliminary operation	In cold weather and other conditions that are unfavorable for engine startup, the control rod is caused to move slightly in the fuel increase direction, thus enhancing startability. This operation takes place when the starter switch is turned ON.	1, 18, 19, 32	(e, Q, R, b)
* Warmup time shortening function	In cold weather, the engine's idling speed is increased to shorten the time required for warmup. P13-14	18, 19, 20	(Q, R, S)
* Overrun prevention function	In the event of an abnormal increase in engine speed, the control rack is pulled in the fuel decrease direction to prevent the engine from overrunning.	3	(D)
* Emergency vehicle operation function (used in event of control rack position sensor fault)	In the event of a fault in the control rack position sensor 7 , the control rack position is sensed by the sub control rack position sensor 4 . If both rack position sensors develop faults, thus preventing detection of the rack position and optimization of the fuel injection rate, the fuel injection rate is controlled in accordance with engine speed signals only. P13-16	3, 4, 7	(D, C, G)
* Auxiliary brake control function	The auxiliary braking devices (exhaust brake) are controlled by the electronic governor control unit 35 . (In a conventional system, the auxiliary braking devices are controlled by switches, relays, and dedicated controllers.) P13-17	3, 16, 18, 19, 28, 33, 34	(D, N, Q, R, X, d)
* Fault diagnosis function	The status of each system sensor is monitored continuously during engine operation. In the event of a fault, a warning lamp is illuminated to alert the driver and data related to the fault are stored in memory. P13-36	ALL	ALL
* Fail-safe function	In the event of a fault, a backup mode is selected and remedial action is taken in accordance with the type of fault. P13-40	ALL	ALL
* Reverse engine operation prevention function	In the event of reverse engine operation, the control rack is pulled in the fuel decrease direction to stop the engine	3	(D)

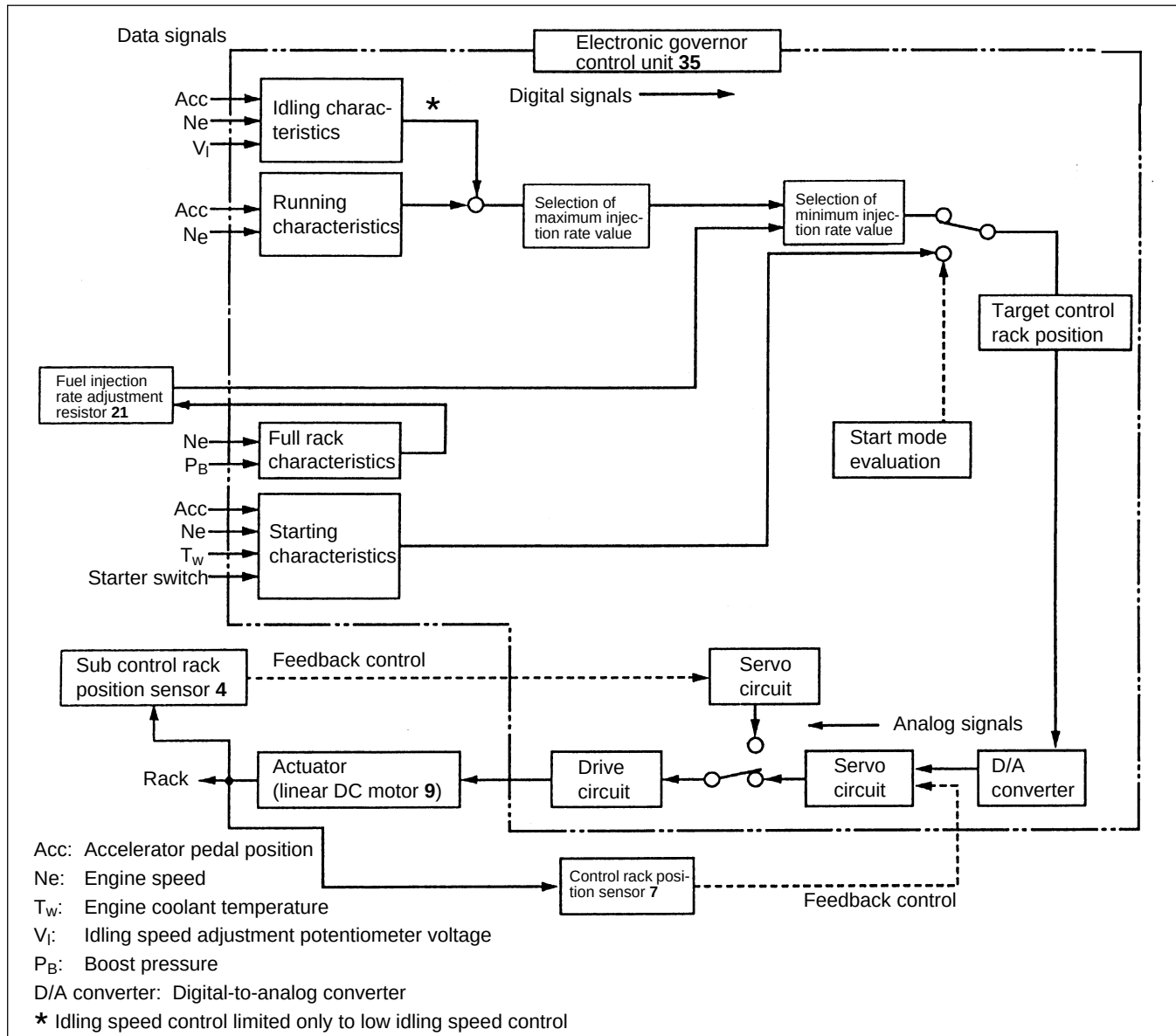
* : Auxiliary function

System Block Diagram



STRUCTURE AND OPERATION

Fuel Injection Rate Control



Operation of electronic governor control unit 35

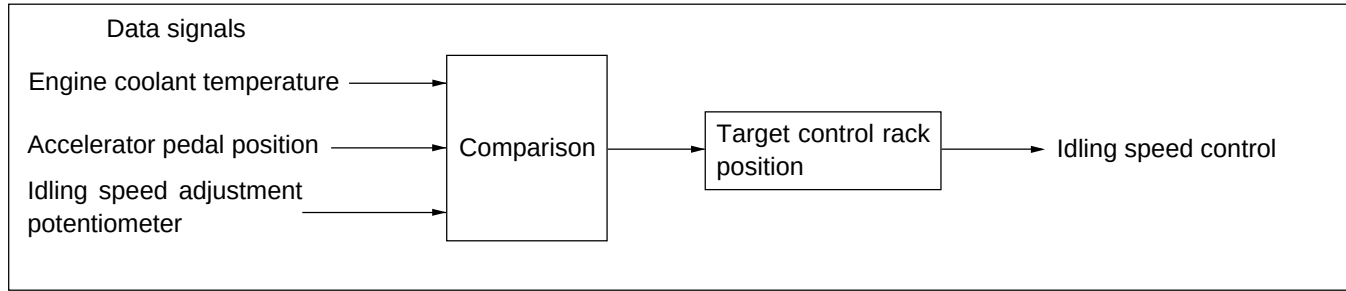
- During engine operation, control is effected in accordance with the idling characteristics and running characteristics. The maximum fuel injection rate value is selected in accordance with the output signals.
- After this selection, the control unit calculates and determines the minimum injection rate to prevent the injection rate selected in accordance with the full rack characteristics from exceeding the maximum injection rate. The target control rack position is thus determined. (During engine startup, control is effected in accordance with the starting characteristics with the target rack position determined directly in accordance with the data signals.)
- The determined control rack position signal is converted into a continuous analog signal. By way of the servo circuit and drive circuit, the signal is applied to the linear DC motor 9, which moves the rack.

Operation of control rack position sensor 7

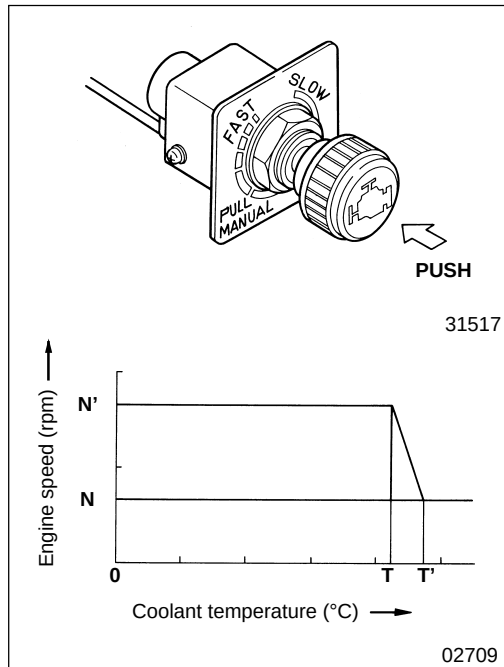
- The control rack position sensor 7 monitors the operation of the linear DC motor 9. In accordance with the position of the control rack, the sensor determines whether the linear DC motor is operating in accordance with the target, and it transmits feedback signals to the electronic governor control unit 35.
- In accordance with the feedback signals, the electronic governor control unit 35 calculates the actual control rack position. If the actual position differs from the target, the control unit issues a correction command.
- Through repetition of this process, the system ensures that the control rack position complies with the target at all times.

STRUCTURE AND OPERATION

● Warmup time shortening function

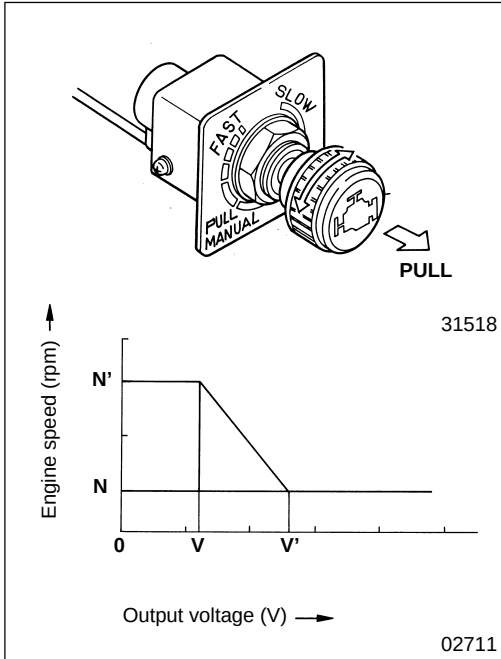


The warmup time shortening function increases the engine's idling speed in accordance with the coolant temperature, thereby shortening the time required for the engine to warm up. Control is effected automatically or manually in accordance with the position of the idling speed adjustment potentiometer **20**. Automatic control is selected by pushing the potentiometer, and manual control is selected by pulling it.



Automatic control (Potentiometer pushed)

- Automatic control is selected when the idling speed adjustment potentiometer **20** is pushed.
- When the coolant temperature is low, the engine's idling speed is automatically increased to shorten the time required for warmup.
- If the coolant temperature increases from T to T' (see the graph), the engine speed is decreased from N' to N , thus returning to its standard idling level.



Manual control (Potentiometer pulled)

- When the idling speed adjustment potentiometer **20** is pulled, the automatic mechanism is deselected. The driver can then adjust the idling speed as desired by rotating the potentiometer. (Rotation of the potentiometer causes the potentiometer's output voltage to change accordingly.)
- With the output voltage between **0** and **V**, the engine speed stays at the **N** to **N'** level.
- If the output voltage is increased from **V** to **V'** (see the graph), the engine speed decreases from **N'** until it reaches its standard idling level **N**.

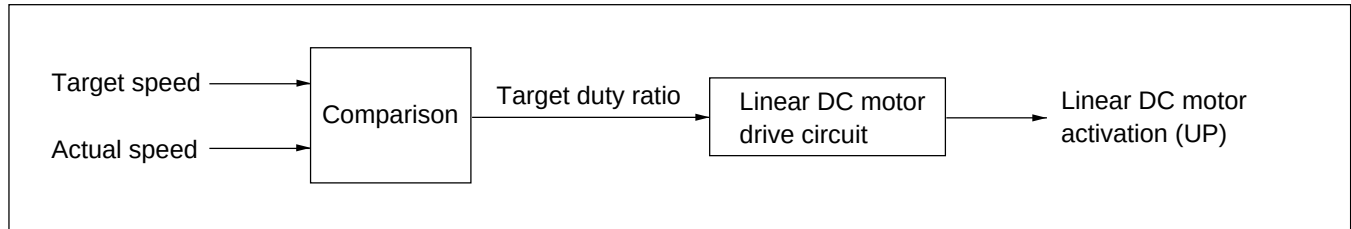
STRUCTURE AND OPERATION

● Emergency vehicle operation function (Used of event in control rack position sensor fault)

Fault in Control rack position sensor 7

In the event of a fault in the control rack position sensor 7, detection of the control rack position is performed using the sub control rack position sensor 4. This enables more-or-less normal vehicle operation.

Fault in control rack position sensor 7 and sub control rack position sensor 4



In the event of faults in both the control rack position sensor 7 and sub control rack position sensor 4, the position of the rack, which is controlled by the linear DC motor 9, cannot be sensed directly. The fuel injection rate cannot be controlled normally with the engine in this condition. As an emergency measure, therefore, control operations are performed in accordance with engine speed data signals only. For this function, target engine speeds for given degrees of accelerator pedal depression are pre-programmed into the electronic governor control unit 35. Control is effected as follows:

- The target engine speed is compared with the actual engine speed (this is indicated by the engine speed sensor 3).
- The target duty ratio is determined in accordance with the result of the comparison. In accordance with the target duty ratio, a drive signal is transmitted to the UP-side (speed increasing side) circuit to effect control over the engine speed. If the target engine speed exceeds the actual engine speed or vice versa, the UP-side circuit's ON time period is altered such that the target engine speed is maintained.

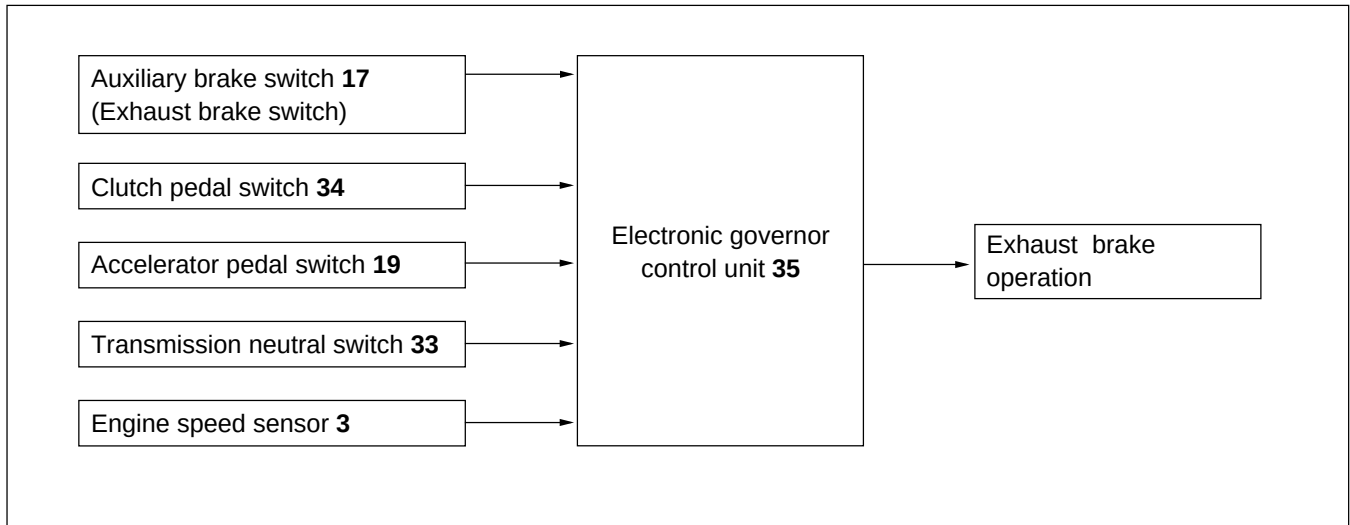
The target duty ratio is the ratio of the time periods during which the linear DC motor's UP-side and DOWN-side (speed decreasing side) circuits are energized. It is calculated as follows:

$$\text{Duty ratio} = \frac{\text{UP-side circuit ON time period}}{\text{UP-side circuit ON time period} + \text{DOWN-side circuit ON time period}} \times 100\%$$

CAUTION ⚠

When this function is activated, the warning lamp 14, 15 flashes to indicate that the engine must be inspected immediately. 📖 P13-36

● Auxiliary brake control function

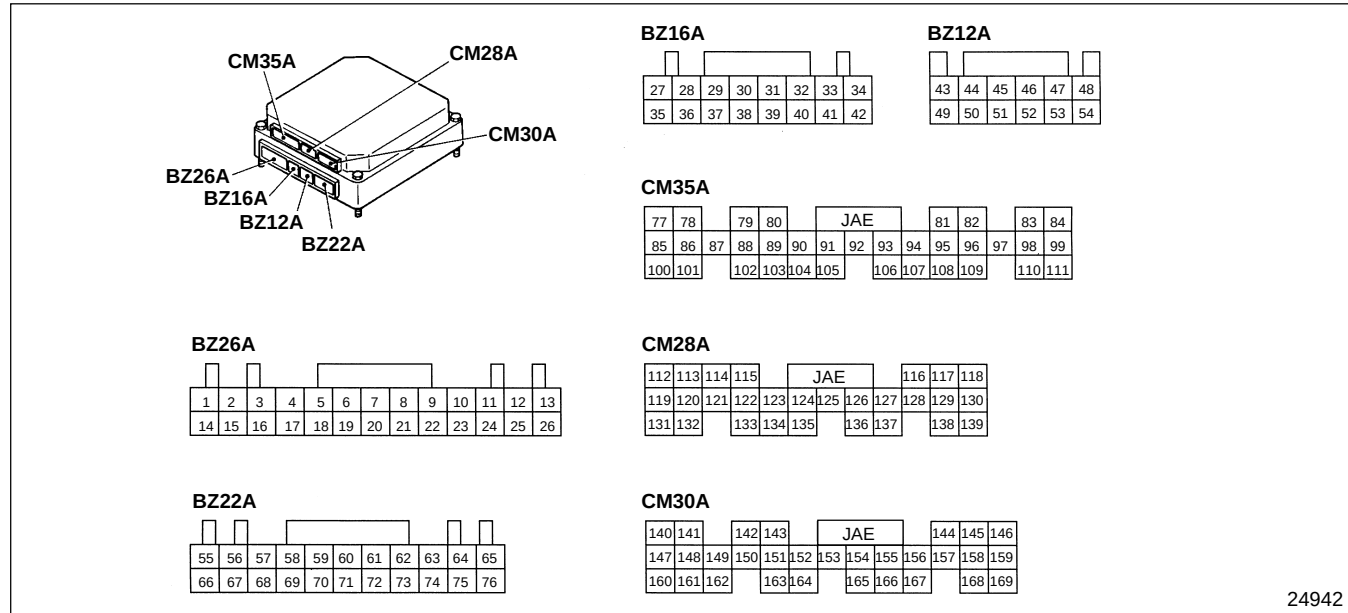


The auxiliary brake control function acts upon the auxiliary braking devices, i.e., the exhaust brake, when the following conditions are satisfied:

- Clutch pedal switch **34**: OFF (clutch pedal released)
- Accelerator pedal switch **19**: ON (accelerator pedal released)
- Transmission neutral switch **33**: ON (transmission not in neutral)

STRUCTURE AND OPERATION

Electronic Governor Control Unit



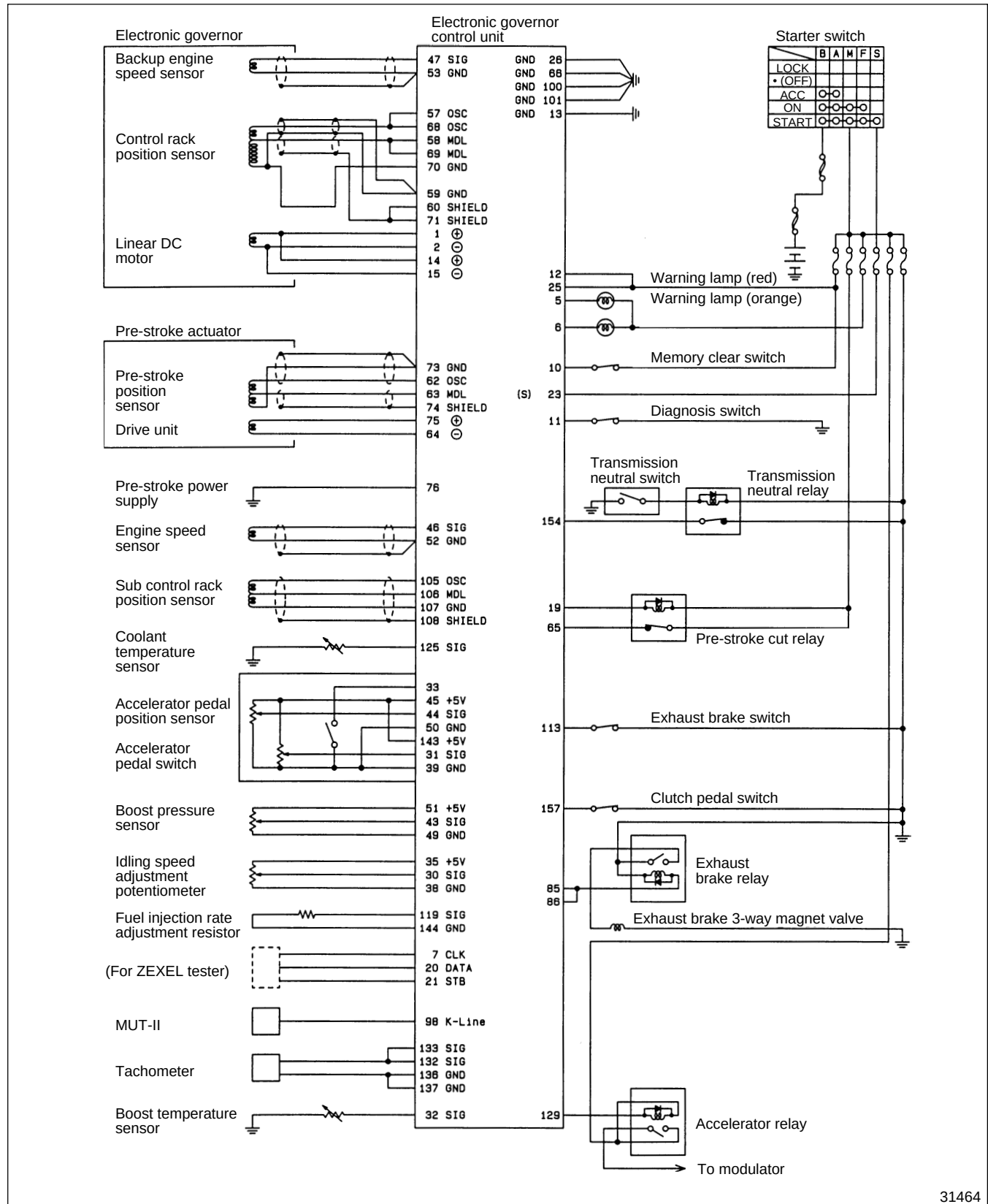
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Con- nector	Termi- nal	Connected to		Con- nector	Termi- nal	Connected to		Con- nector	Termi- nal	Connected to	
BZ 26A	1	Linear DC motor	⊕	BZ 26A	19	Pre-stroke cut relay		BZ 16A	37	—	
	2		⊖		20	DDS-3	(DATA)		38	Idling speed adjustment potentiometer (GND)	
	3	—			21		(STB)		39	Accelerator pedal position sensor II (GND)	
	4				22	—			40	—	
	5	Warning lamp	(Red)		23	Start signal			41		
	6		(Orange)		24	—			42		
	7	DDS-3 (CLK)			25	Control unit power supply (starter switch terminal M)		43	Boost pressure sensor (SIG)		
	8	—		26	Control unit GND		44	Accelerator pedal position	(SIG)		
	9			27	—		45	sensor I	(+5V)		
	10	Memory clear switch		28			46	Engine speed sensor (SIG)			
	11	Diagnosis switch		29			47	Backup engine speed sensor (SIG)			
	12	Control unit power supply (starter switch terminal M)		30	Idling speed adjustment potentiometer (SIG)		48	—			
	13	Control unit GND (analog GND)		31	Accelerator pedal position sensor II (SIG)		49	Boost pressure sensor (GND)			
	14	Linear DC motor	⊕	32	Boost temperature sensor (SIG)		50	Accelerator pedal position sensor I (GND)			
	15		⊖	33	Accelerator pedal switch		51	Boost pressure sensor (+5V)			
	16	—		34	—		52	Engine speed sensor (GND)			
	17			35	Idling speed adjustment potentiometer (+5V)		53	Backup engine speed sensor (GND)			
	18			36	—		54	—			

Con- nector	Termi- nal	Connected to		Con- nector	Termi- nal	Connected to		Con- nector	Termi- nal	Connected to	
BZ 22A	55	—		CM 35A	94	—		CM 28A	132	Tachometer output	(SIG)
	56				95				133		(SIG)
	57	Control rack position sensor	(OSC)		134				—		
	58		(MDL)		135						
	59		(GND)		136	Tachometer output	(GND)				
	60		(SHIELD)		137		(GND)				
	61	—			138	—					
	62	Pre-stroke position sensor	(OSC)		139						
	63		(MDL)								
	64	Pre-stroke actuator ⊖			140						
	65	Pre-stroke cut relay (+24V)			141						
	66	Control unit GND			142						
	67	—			143	Accelerator pedal position sensor II (+5V)					
	68				Control rack position sensor	(OSC)	144	Fuel injection rate adjust- ment resistor (GND)			
	69	(MDL)	145			—					
	70	(GND)	146								
	71	(SHIELD)	147								
	72	—			148						
	73	Pre-stroke position sensor	(GND)		149						
	74		(SHIELD)		150						
	75	Pre-stroke actuator ⊕			151						
	76	Pre-stroke power supply (GND)			152						
CM 35A	77	—		CM 28A	112	Exhaust brake switch	CM 30A	153	Transmission neutral relay		
	78				113			154			
	79				114			155			
	80				115			156			
	81				116			Fuel injection rate adjust- ment resistor (SIG)	157	Clutch pedal switch	
	82				117				158	—	
	83				118				159		
	84				119				160		
	85	120	161								
	86	Exhaust brake relay	121		162						
	87		122		163						
	88		123		164						
	89		124		165						
	90	—	125		Coolant temperature sensor (SIG)	166					
	91		126		—	167	Idle up prohibit switch				
	92		127			168					
	93		128			169					
	129	Accelerator relay									
	130	—									
	131										

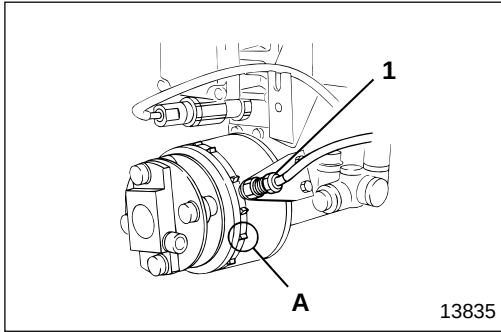
STRUCTURE AND OPERATION

Electronic governor control unit



31464

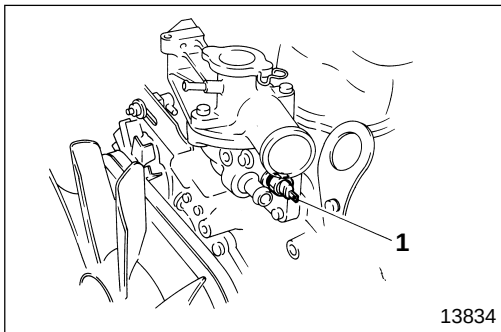
Engine speed sensor



- The engine speed sensor **1** is a pickup type. It converts the rotation speed of a injection pump into electric signals.
- Signals generated by the engine speed sensor are fed to the electronic governor control unit which uses them as correction values in its calculation of the target pre-stroke position.

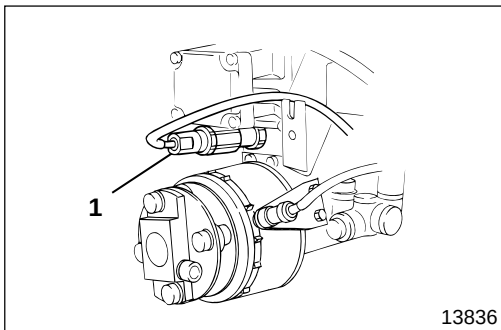
A : Timer housing protrusion

Coolant temperature sensor



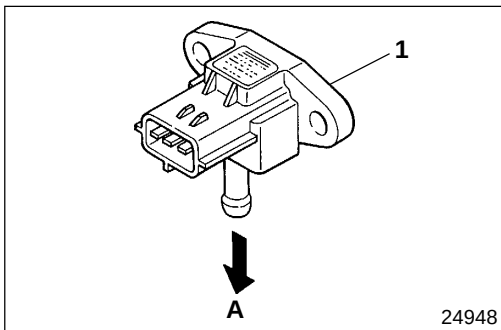
- The coolant temperature sensor **1** is a thermistor type. It converts the engine coolant temperature into electric signals.
- Signals generated by the coolant temperature sensor are fed to the electronic governor control unit which uses them as correction values in its calculation of the target rack position.

Sub control rack position sensor



- The sub control rack position sensor **1** provides backup detection of the control rack position in the event of a fault in the control rack position sensor.
- The sub control rack position sensor **1** converts the degree of control rack movement into electric signals.
- Signals generated by the sub control rack position sensor are fed to the electronic governor control unit which uses them as correction values in its calculation of the target rack position.

Boost pressure sensor

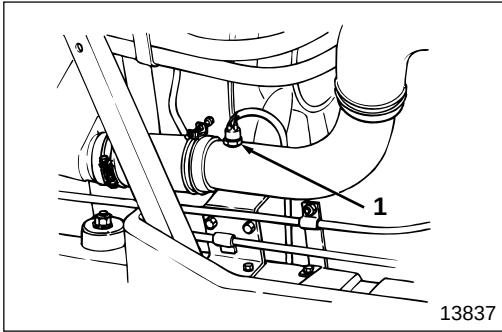


The boost pressure sensor **1** feeds boost pressure information to the electronic governor control unit. During turbocharged engine operation, it enables the full rack signal (maximum fuel injection rate value) characteristics to be selected by the control unit in accordance with the engine speed.

A : To intake manifold

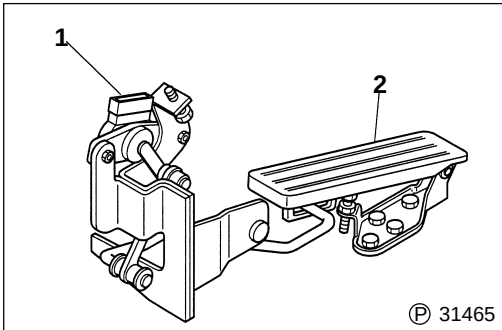
STRUCTURE AND OPERATION

Boost Air temperature sensor



- Boost air temperature sensor **1** is a thermistor type that converts the intake air temperature, immediately after its passage through the intercooler, into an electric signal.
- This electric signal is transmitted to the pre-stroke control unit as the boost air temperature signal, which is used as the correction value by the electronic governor control unit to determine the desired pre-stroke position value.

Accelerator pedal position sensor and accelerator pedal switch



- The accelerator pedal position sensor **1** provides the electronic governor control unit with information on the degree to which the accelerator pedal **2** is depressed.
 - The accelerator pedal switch detects whether the accelerator pedal is currently depressed or released.
- Accelerator switch is integrated in accelerator pedal position sensor **1**.

Pre-stroke position sensor

 P13-13

Idling speed adjustment potentiometer

 P13-14

Linear DC motor

 P13-28

Control rack position sensor

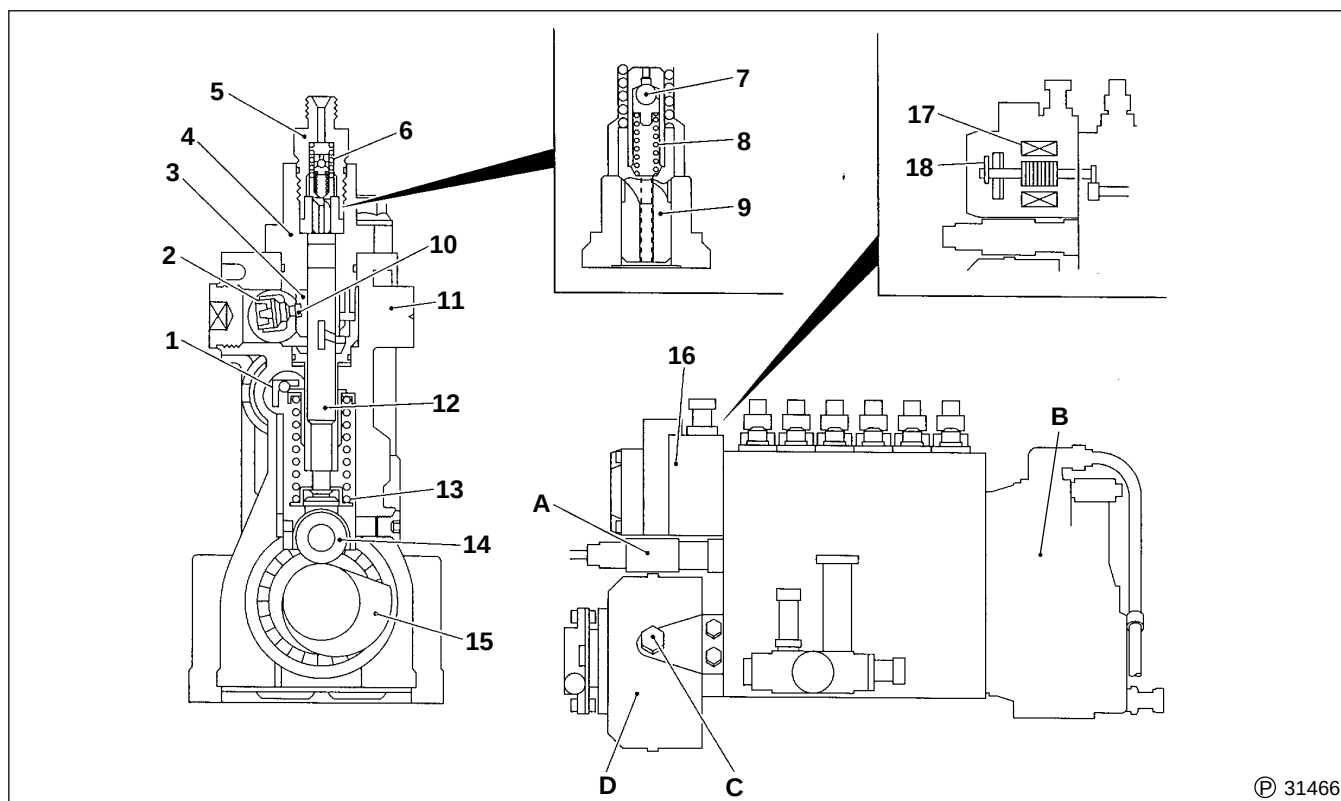
 P13-28

Backup engine speed sensor

 P13-29

STRUCTURE AND OPERATION

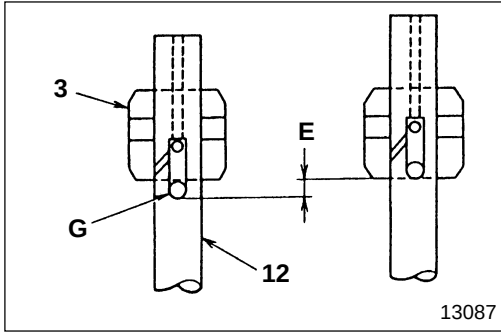
Pre-stroke Control Injection Pump Unit



© 31466

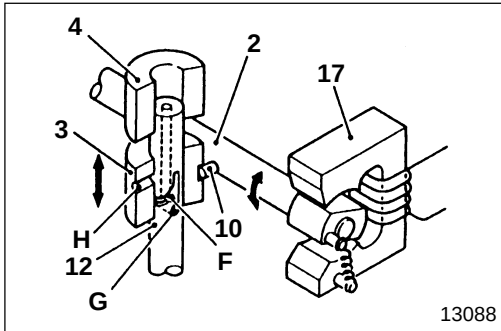
- | | |
|-------------------------|-------------------------------------|
| 1 Control rod | 13 Plunger spring |
| 2 Timing rod | 14 Tappet |
| 3 Timing sleeve | 15 Camshaft |
| 4 Plunger barrel | 16 Pre-stroke actuator |
| 5 Delivery valve holder | 17 Drive unit |
| 6 Delivery valve spring | 18 Pre-stroke position sensor |
| 7 Ball | |
| 8 Spring | A : Sub-control rod position sensor |
| 9 Delivery valve | B : Electronic governor |
| 10 Pin | C : Engine speed sensor |
| 11 Pump housing | D : Mechanical timer |
| 12 Plunger | |

- The injection pump is provided with a mechanism that enables variation of the plunger pre-stroke.
- Variation of the plunger pre-stroke enables the creation of air/fuel mixture and spray conditions that are optimally suited to combustion. The overall benefits are higher engine torque and cleaner exhaust emissions than are possible with a conventional injection pump.



Pre-stroke

The term "pre-stroke" refers to the stroke dimension **E** of a plunger **12** from the plunger's bottom dead center position to the point at which its fuel inlet hole **G** is closed by the timing sleeve **3** and fuel feed begins. This stroke dimension is constant in a conventional injection pump.



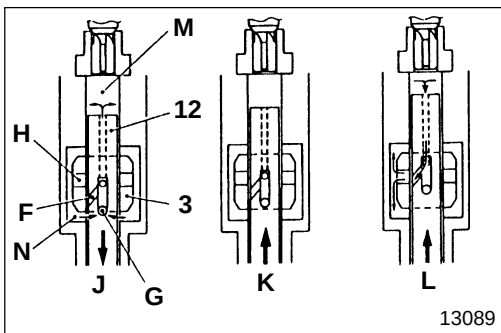
Variable pre-stroke mechanism

F : Lead

G : Inlet hole

H : Outlet hole

- In contrast to the fixed plunger barrel arrangement of a conventional injection pump, each plunger barrel **4** in the pre-stroke control type injection pump incorporates a vertically moveable timing sleeve **3**.
- Movement of the timing sleeve is effected by the timing rod **2**, pin **10**, and drive unit **17**.
- When the drive unit **17** rotates the timing rod **2**, the pin **10** moves the timing sleeve **3** up or down accordingly.
- Since the timing sleeve **3** incorporates a fuel outlet hole **H**, the pre-stroke changes in accordance with the movement of the timing sleeve.



Fuel feed action

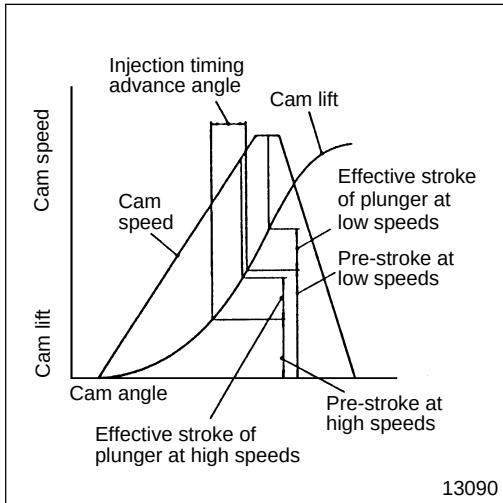
J : Fuel intake

K : Start of pressurization

L : End of pressure feed

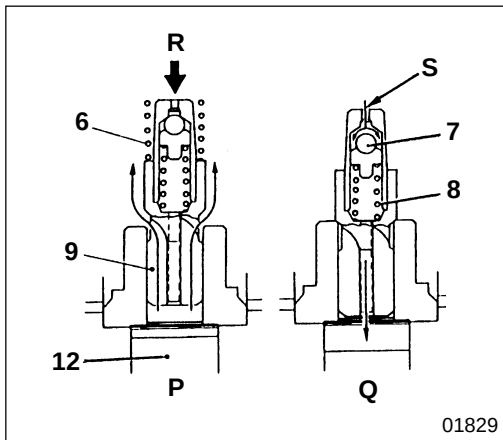
- As the plunger **12** moves downward from its top dead center position and its inlet hole **G** opens, fuel flows into the pressure chamber **M** owing to the vacuum pressure created by the plunger's downward movement and the fuel pressure produced by the feed pump.
- When the plunger **12** moves upward but its lift dimension is still small, the fuel in the pressure chamber **M** escapes into the sump **N** through the inlet hole **G** in the plunger. Thus, the pressure in the pressure chamber does not increase.
- As the plunger **12** moves further upward and the inlet hole **G** is closed by the timing sleeve **3**, the fuel starts to be pressurized. The pressure increases as the plunger moves upward, and the injection pump starts to feed the pressurized fuel to each injector.
- When the lead **F** in the plunger **12** becomes aligned with the outlet hole **H** in the timing sleeve **3**, the fuel in the pressure chamber **M** returns to the sump **N**, thus completing the pressure feed cycle.
- Adjustment of the injected fuel volume is achieved by rotation of the plunger **12**, which alters the position of the outlet hole **H** in the timing sleeve **3** relative to the lead **F** in the plunger.

STRUCTURE AND OPERATION



Fuel injection timing and fuel injection characteristics

- Changes in the position of the timing sleeve **3** cause concomitant changes in the pre-stroke, which in turn alter the fuel injection timing.
- A decrease in the pre-stroke causes the fuel inlet hole **G** in the plunger **12** to close earlier such that the fuel injection timing is advanced.
- This arrangement provides highly responsive control over the injection timing and thus enhances the engine's cold startability.



Delivery valve

P : Start of pressure feed

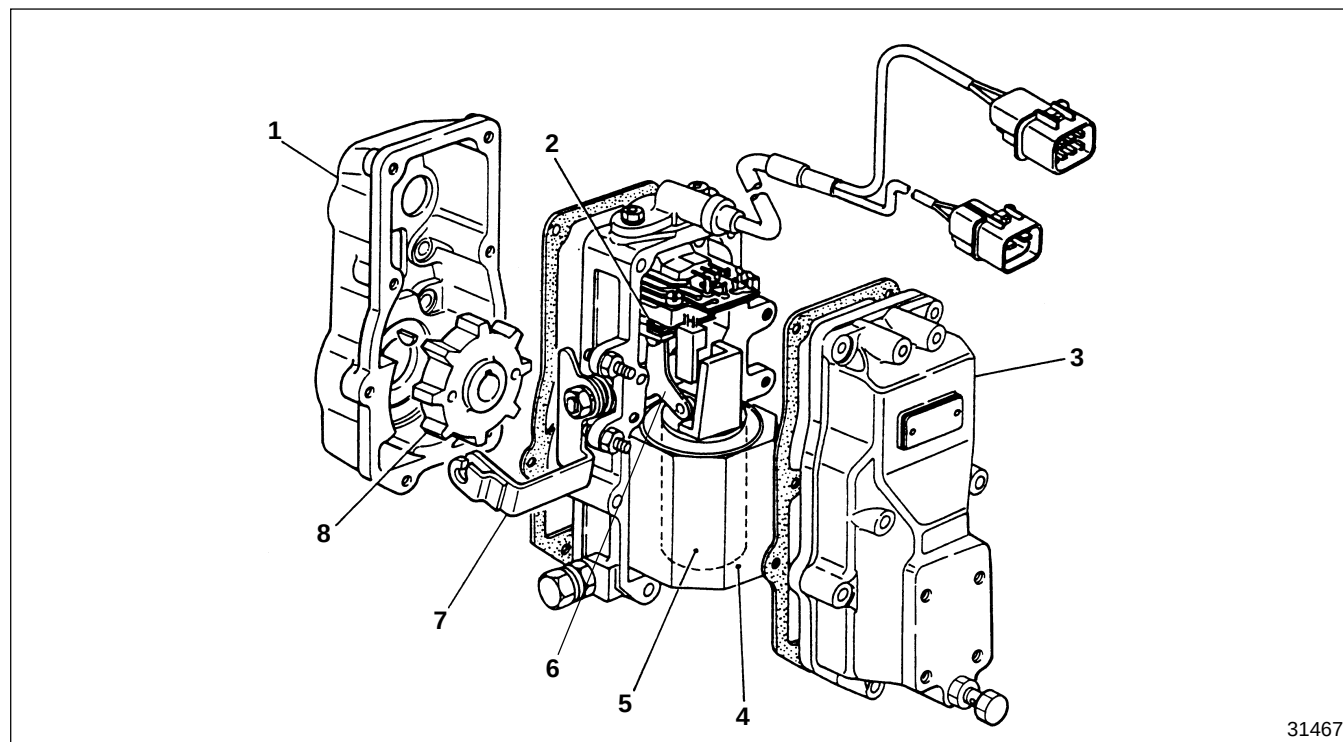
Q : End of pressure feed

- The delivery valve **9** keeps constant the residual pressure **R** in the injection pipe at all engine speeds. This operation prevents the generation of bubbles in the fuel (this is known as "cavitation") and thus enables fuel injection at a high pressure.
- When the plunger **12** moves upward and the pressure of the fuel pushed by the plunger overcomes the residual pressure **R** in the injection pipe and the preset force of the delivery valve spring **2**, the delivery valve is pushed upward and delivery of the pressurized fuel begins.
- As soon as fuel delivery is complete, the fuel in the injection pipe rapidly returns to the plunger side and the delivery valve closes.
- Surplus fuel slowly returns through the orifice **S**, thus reducing the pressure in the injection pipe.
- When the preset force of the spring **8** in the delivery valve **9** is exactly offset by the pressure in the injection pipe, the ball **7** closes the orifice **S**, thus ensuring that the residual pressure **R** in the injection pipe remains constant.

MEMO

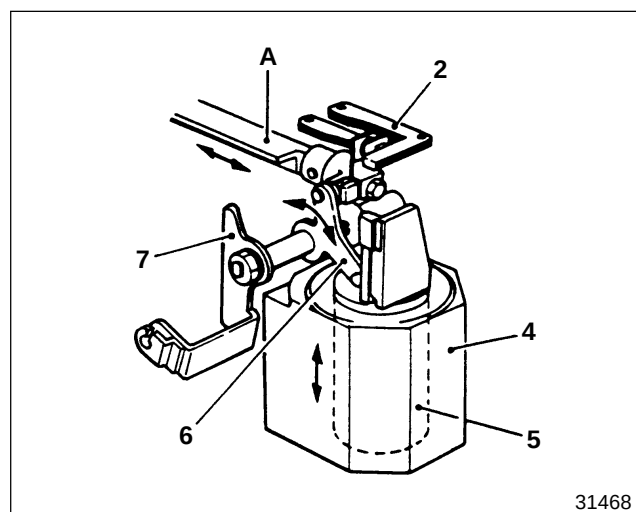
STRUCTURE AND OPERATION

Electronic Governor



31467

- | | |
|--------------------------------|-------------------------------|
| 1 Housing | 5 Linear DC motor |
| 2 Control rack position sensor | 6 Link |
| 3 Cover | 7 Emergency engine stop lever |
| 4 Coil assembly | 8 Sensing gear |



31468

● Linear DC motor

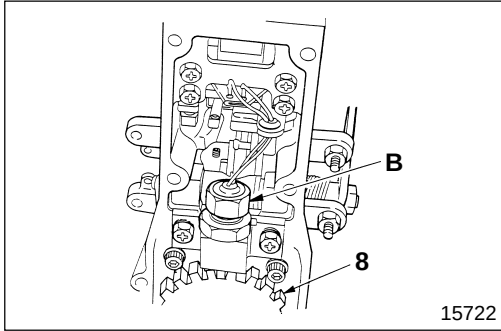
The linear DC motor **5** moves the coil assembly **4** vertically in accordance with signals from the electronic governor control unit. Via the link **6**, this movement is transmitted to the control rack **A**, which moves longitudinally to increase and decrease the fuel quantity.

● Control rack position sensor

The control rack position sensor **2** senses whether the control rack **A** is moved to the correct position by the linear DC motor **5**. In the event of a discrepancy between the actual control rack position and the target control rack position (this is determined by the electronic governor control unit), the control unit instructs the linear DC motor to perform a corrective movement.

● Emergency engine stop lever

The emergency engine stop lever **7** is connected to the link **6**. Via a cable, it enables the link to be moved from the driver's seat. In the event of a system fault that prevents the engine from being stopped normally, operation of the emergency engine stop lever forces the control rack **A** to move to the position at which fuel injection is terminated. This operation takes place irrespective of the position of the linear DC motor **5**.

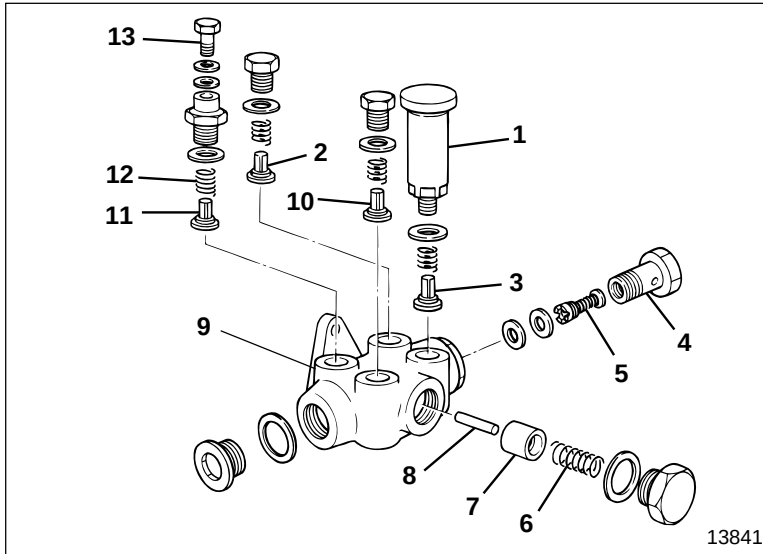


● Backup engine speed sensor

The backup engine speed sensor **B** is fitted inside the governor. It converts the rotation speed of the sensing gear **8** into electric signals and feeds the signals to the electronic governor control unit to provide an indication of the engine speed.

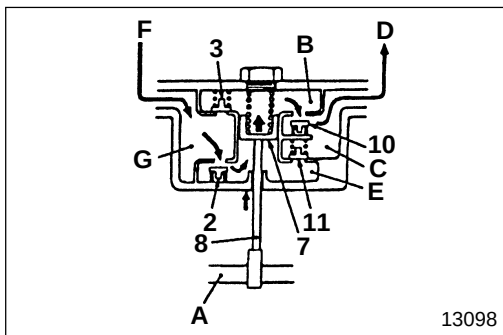
STRUCTURE AND OPERATION

Feed Pump

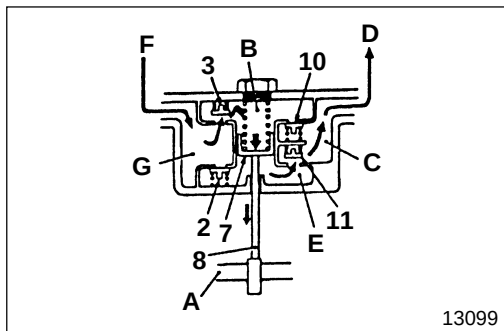


- 1 Priming pump
- 2 Check valve
- 3 Check valve
- 4 Eye bolt on fuel inlet side
- 5 Gauze filter
- 6 Piston spring
- 7 Piston
- 8 Push rod
- 9 Feed pump housing
- 10 Check valve
- 11 Check valve
- 12 Check valve spring
- 13 Eye bolt on fuel outlet side

- The feed pump is a double-action type pump which, with four check valves operating, sucks and discharges fuel during both strokes of pistons 7.
- Push rod 8 makes contact with the injection pump camshaft directly, moving piston 7.
- Priming pump 1 can be manually operated, when the injection pump is not operating, to suck up fuel and thus can be used for air bleeding.
- Gauze filter 5 eliminates large foreign particles from the fuel sucked up from the fuel tank to prevent clogging of the feed pump. This gauze filter must be cleaned with diesel fuel periodically.



The rotation of injection pump camshaft **A**, pushes up push rod 8 and piston 7, and the pressure in inner chamber **B** increases. This closes check valve 3, and check valve 10 opens to let the fuel in inner chamber **B** flow through outer chamber **C** to fuel filter **D**. When the pressure in inner chamber **E** decreases, check valve 11 closes, and check valve 2 opens to let fuel flow from fuel tank **F** through outer chamber **G** to inner chamber **E**.

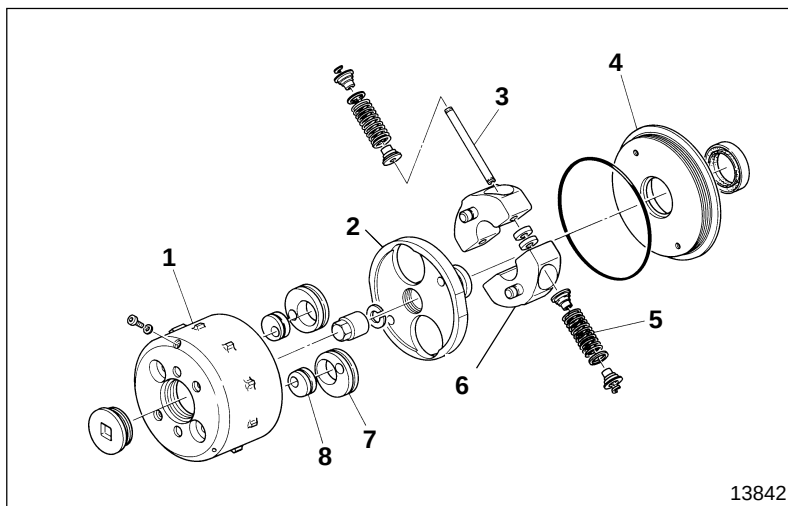


13099

When injection pump camshaft **A** rotates further, it pushes down push rod **8** and piston **7**, and the pressure in inner chamber **E** increases. This closes check valve **2**, and check valve **11** opens to let the fuel in inner chamber **E** flow through outer chamber **C** to fuel filter **D**.

When the pressure in inner chamber **B** decreases, check valve **10** closes, and check valve **3** opens to let fuel from fuel tank **F** flow through outer chamber **G** to inner chamber **B**.

Automatic Timer



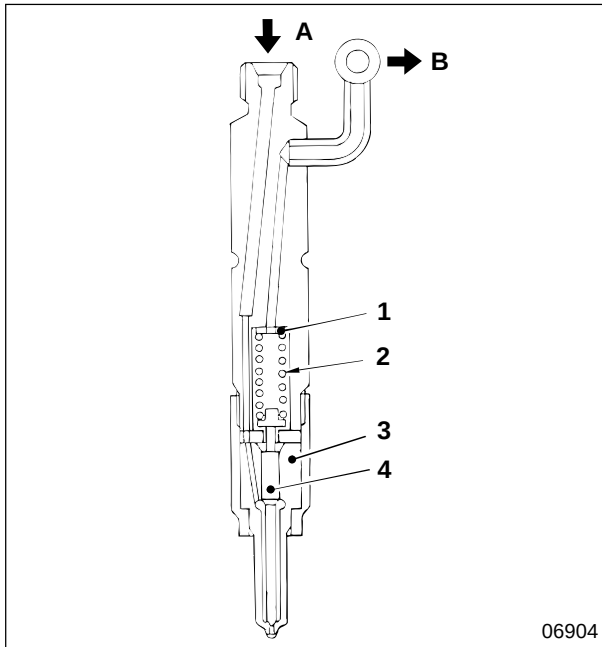
13842

- 1 Timer housing
- 2 Timer holder
- 3 Pilot pin
- 4 Cover
- 5 Timer spring
- 6 Flyweight
- 7 Eccentric cam (Large)
- 8 Eccentric cam (Small)

- The mechanical type automatic timer changes fuel injection timing automatically when the engine revolution reaches the specified rate.
- The automatic timer controls the retard of fuel injection timing. The pre-stroke control unit controls the advance of fuel injection timing.

STRUCTURE AND OPERATION

Injection Nozzle



- 1 Washer
- 2 Spring
- 3 Nozzle tip
- 4 Needle valve

A : From injection pump

B : To fuel tank

- As the pressure of the fuel delivered from the injection pump overcomes the repercussive force of spring 2, needle valve 4 is pushed up to allow the fuel to spray out the opening at the tip of the nozzle.
- Injection pressure can be adjusted by increasing or decreasing the number of washers 1.

MEMO

TROUBLESHOOTING

Symptoms		Engine will not start	Engine difficult to start	Engine knocks	Unstable engine output	Insufficient engine output	Engine maximum speed too high	Unstable engine idling	Engine stops soon after starting	Engine does not reach maximum speed	Engine will not stop	Accelerator pedal too stiff	Defective fuel supply	Warning lamp illuminates	Remarks
Possible causes															
Defective pre-stroke injection pump system															
Injection pump proper	Defective injection pump proper	○	○	○	○	○	○	○	○	○	○				*
	Defective mounting (poorly adjusted injection timing)		○		○	○		○							
	Defective overflow valve operation	○	○			○		○					○		
Defective pre-stroke actuator				○	○	○		○							
Fuel feed pump	Gauze filter clogged	○	○			○		○	○				○		
	Check valve not operating	○											○		
	Sticky piston	○											○		
	Sticky push rod	○											○		
	Defective check valve operation	○	○		○			○					○		
	Piston worn		○		○			○					○		
Defective governor				○	○	○	○	○	○	○	○				*
Injection nozzles	Sticky needle valve	○													
	Valve opening pressure too low	○								○					
	Blocked injection orifice	○		○		○		○		○					
	Poor airtightness in nozzle	○		○		○		○		○					
	Valve opening pressure too high			○											
	Broken spring				○	○									
	Defective sliding action in needle valve				○										
	Defective valve opening pressure				○										
	Weakness/deterioration in spring							○							
Fuel filter	Clogged filter	○			○			○	○						
Fuel tank empty		○													
Fuel pipes blocked and/or fuel leaking from connections		○													
Air or water in fuel system		○			○			○	○						
Low-quality fuel in use			○	○		○		○							

★ : Must be serviced by ZEXEL service station.

Symptoms		Engine will not start	Engine difficult to start	Engine knocks	Unstable engine output	Insufficient engine output	Engine maximum speed too high	Unstable engine idling	Engine stops soon after starting	Engine does not reach maximum speed	Engine will not stop	Accelerator pedal too stiff	Defective fuel supply	Warning lamp illuminates	Remarks
Possible causes															
Engine control	Incorrect accelerator pedal stopper bolt adjustment					○				○					
	Rusted accelerator pedal arm										○				
	Defective accelerator pedal position sensor													○	
Cracked fuel pipe													○		
Leaky fuel tank													○		
Incorrect oil viscosity			○												Gr 12
Incorrect valve clearance			○					○							Gr 11
Defective cylinder head gasket			○					○							Gr 11
Wear and/or carbon deposits on valve and valve seat			○					○							Gr 11
Weakness/deterioration in valve spring			○					○							Gr 11
Worn/damaged piston ring(s)			○					○							Gr 11
Worn/damaged piston ring groove(s)			○					○							Gr 11
Worn piston and cylinder liner			○												Gr 11
Cooling system malfunctioning			○					○							Gr 14
Defective starter switch			○												Gr 54

TROUBLESHOOTING

Fault Diagnosis Function

- While the starter switch is in the ON position, the fault diagnosis function continuously monitors relevant sensors for faults.
In the event that a fault is detected, the function illuminates a  warning lamp (red or orange) in the meter cluster to alert the driver, memorizes the location of the fault, and switches to a backup mode.
- The memorized fault location can be read as a diagnosis code using an MUT-II or the diagnosis switch.

Warning lamp illumination

	 (Orange)	 (Red)
1. Safety-critical error (vehicle must not be driven)	OFF	ON
2. Non-safety-critical error (vehicle can be driven despite poor control feeling)	ON	OFF

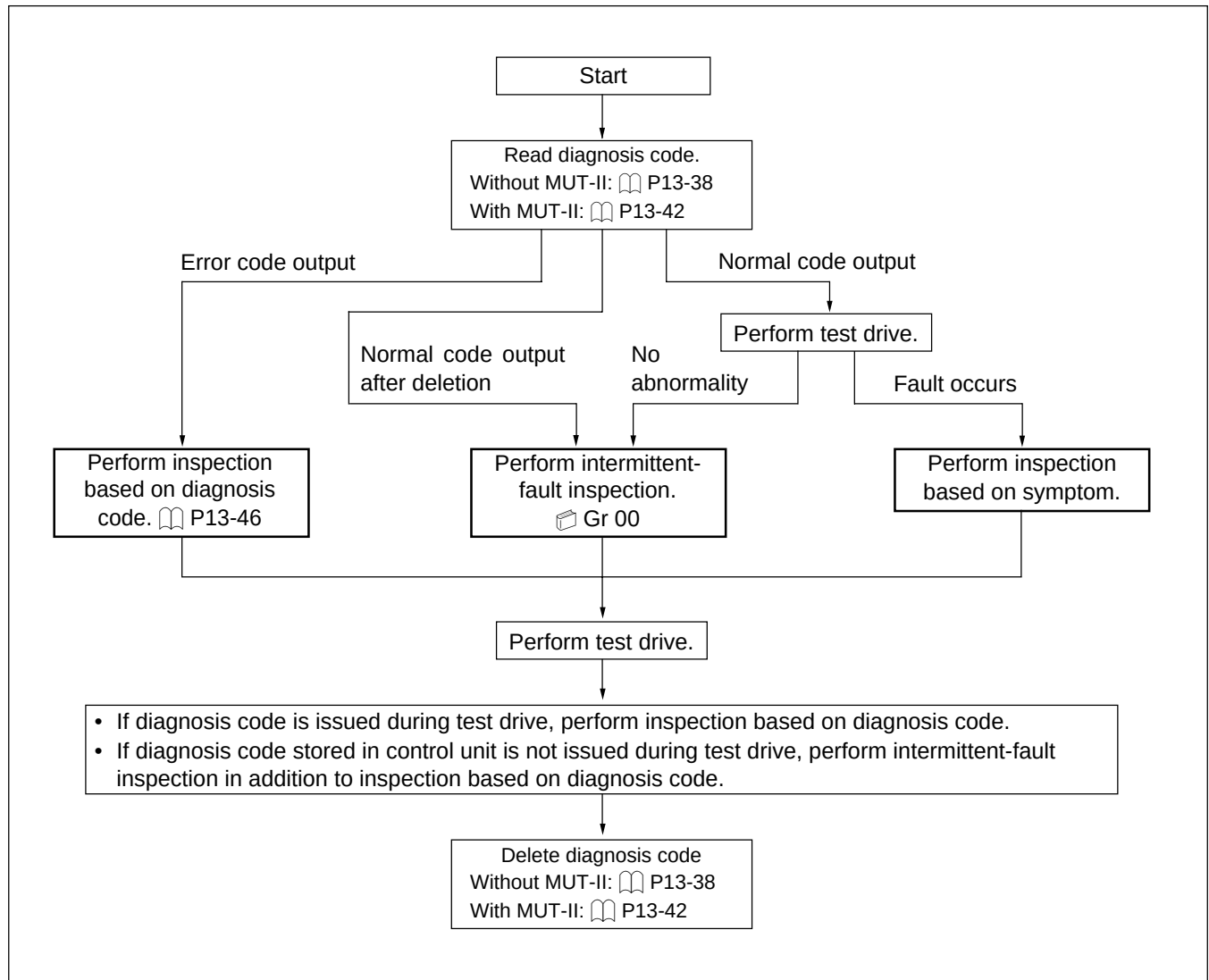
CAUTION

- The fault diagnosis function requires a battery voltage of 12 V or higher.
 - In the event of fault detection, check the harnesses and connectors for looseness. Before undoing any connector, turn the starter switch to the LOCK position and wait for 20 seconds.
 - After rectifying a fault, delete the fault code using the MUT-II or memory clear switch.
 - As a general rule, inspections should be performed with the starter switch in the LOCK position. If any inspection requires that the starter switch be in the ON position, be careful to avoid short circuits between connector terminals and with the vehicle body.
 - All component resistances shown in this manual assume a temperature range of 10 to 35°C {50 to 95°F}. In practice, component values may not comply with standard values owing to temperature effects and/or to inaccuracy in the test instrument.
 - After the rectification of a fault, the system's ability to return to normal operation automatically depends upon the diagnosis code, i.e., the fault location. When the system returns to normal operation, the warning lamp goes out.
 - When the system returns to normal operation after the rectification of a fault, the diagnosis code remains stored in electronic governor control unit.
-

Inspection Procedure

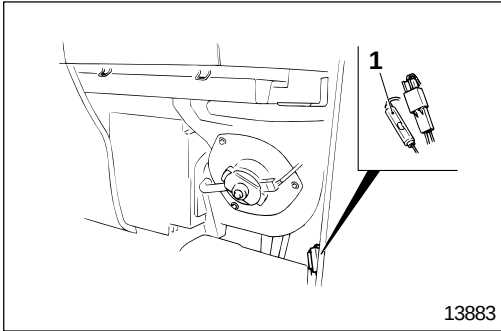
Inspection of the electronic governor and pre-stroke control injection pump system can be performed most effectively using an MUT-II. Types of system inspection can, in accordance with fault systems and diagnosis codes, be broadly classified as follows:

- Inspections based on diagnosis codes stored in the control unit
- Inspections based on symptoms
- Inspections of intermittent faults



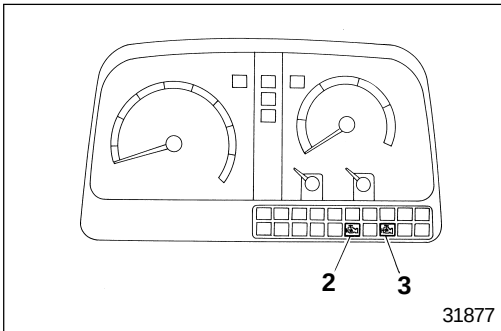
READING AND ERASING DIAGNOSIS CODES

Without MUT-II

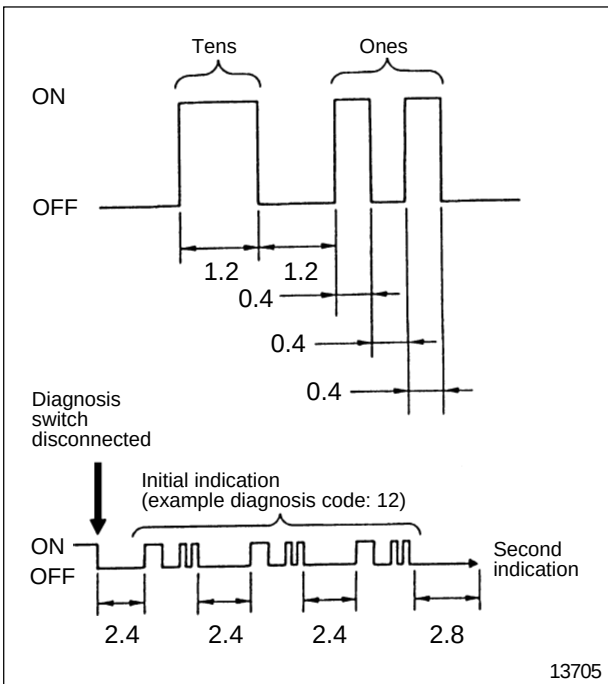


Current diagnosis code

- Turn ON the starter switch.
- Disconnect the diagnosis switch 1.

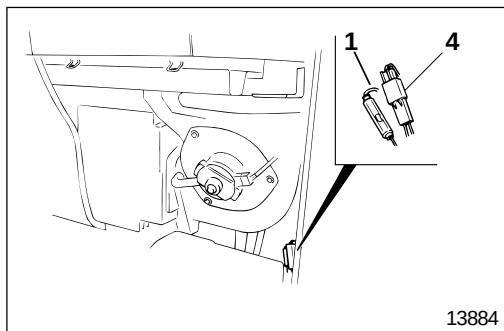


- The diagnosis code is indicated by flashing of the  warning lamp 2 (red) or  warning lamp 3 (orange).



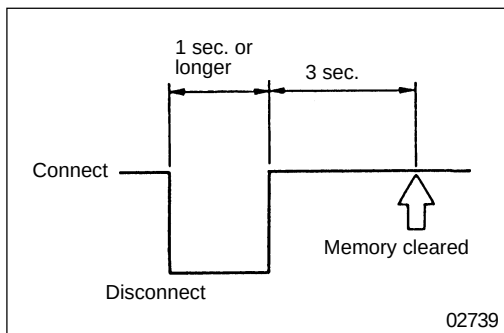
Diagnosis code indication

- Diagnosis codes are indicated by the numbers and durations of the  warning lamp flashes.
 - Flashes for units of ten and units of one have different lengths, as follows:
 - Units of ten: 1.2 seconds
 - Units of one: 0.4 second
 - For each diagnosis code, units of ten are given first, followed by units of one. For a code that has no units of ten, only units of one are given.
- Each diagnosis code is indicated three times. If there are no new codes, the sequence is then repeated from the beginning with each code indicated three times.
- When the diagnosis switch 1 is connected, the control unit immediately stops the indication of codes.



Past diagnosis codes

With the diagnosis switch **1** disconnected, disconnect the memory clear switch **4** after reading the current diagnosis code(s). The  warning lamp will begin to flash again, this time to indicate any past diagnosis code(s). Verify the fault location in accordance with the code(s).



Diagnosis code eraser

To erase all stored diagnosis codes from the control unit, disconnect and reconnect the memory clear switch **4**.

CAUTION

- Stored codes are cleared only by disconnection and reconnection of the memory clear switch **4**.
- To prevent the memory contents from being cleared after the indication of stored codes, turn OFF the starter switch with the memory clear switch **3** disconnected then connect the memory clear switch.

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

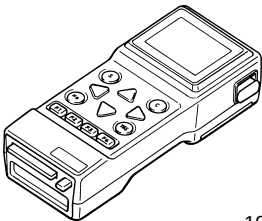
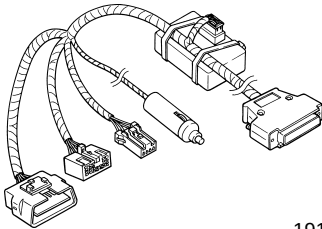
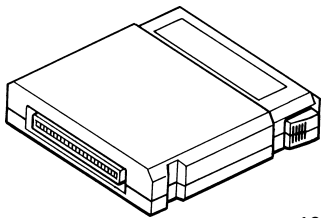
*2 : Driveable if the starter switch is turned OFF once and then restarted again.

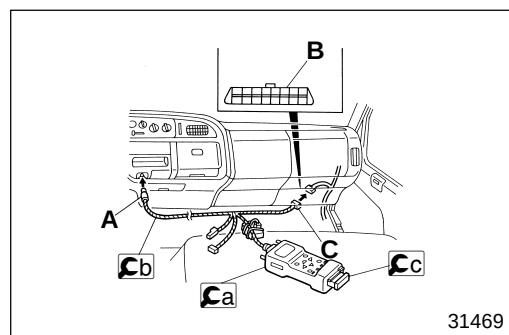
M E M O

READING AND ERASING DIAGNOSIS CODES

With MUT-II

Special tools

Location	Tool name and shape	Part No.	Application
—	MUT-II PLUS  19492	MB991496-A	Inspection of electronic governor and pre-stroke control injection pump system
—	MUT Communication Harness  19141	MK327601	
—	ROM Pack (MRT-E4)  19493	MK327927	

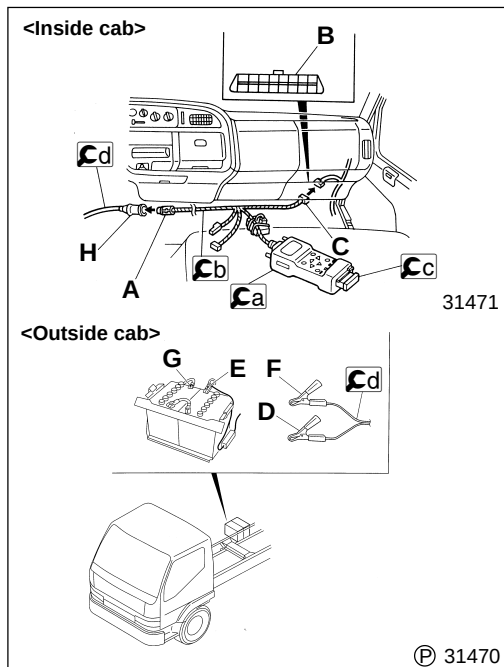


Connecting the MUT-II

- Turn the starter switch to the LOCK position.
- Connect the  MUT Communication Harness to the  MUT-II, and insert the  ROM Pack.
- Plug connector **A** into the cigarette lighter socket.
- Fit connector **C** onto MUT connector **B** (16 pin) in the relay box.

NOTE

Instructions for operation of the MUT-II are given in the separate MUT-II Reference Manual.



- To verify the service data "START SIG", connect the MUT-II as follows:
- Turn the starter switch to the LOCK position.
- Connect the **Ca** MUT Communication Harness to the **Ca** MUT-II, and insert the **Cc** ROM Pack.
- Attach the (+) clamp **D** (red) of the **Cd** Battery Clamp Harness to the battery's (+) terminal **E**. Attach the (-) clamp **F** (black) of the **Cd** Battery Clamp Harness to the battery's (-) terminal **G**.
- Fit the connector **A** into the socket **H** of the **Cd** Battery Clamp Harness.
- Fit connector **C** onto MUT connector **B** (16 pin) in the relay box.

CAUTION

Connect the (+) clamp **D** (red) of the **Cb** Battery Clamp Harness before connecting the (-) clamp **F** (black).

Current diagnosis codes

- Turn the starter switch to the ON position.
- Determine the fault location(s) in accordance with the MUT-II diagnosis code(s).

Past diagnosis codes

- Turn the starter switch to the ON position.
- Determine the fault location(s) in accordance with the past MUT-II diagnosis code(s).

Diagnosis code erasure

- Turn the starter switch to the ON position.
- Using the MUT-II, erase all diagnosis codes stored in the control unit.

Diagnosis codes

Diagnosis codes are indicated as shown in the following table. For details of these codes, refer to the "Without MUT-II" section. P13-40

Display item			
Diagnosis code	Fault	Diagnosis code	Fault
03	PS OFFSET	22	RACK SNSR
06	SUB RACK SNSR	24	ACCEL. SNSR-1
11	GOV. SERVO	31	IDLE VOLUME
12	PS SERVO	32	BST PRES SNSR
13	PS SNSR	33	RAM
14	SUB NE SNSR	41	BST TEMP SNSR
15	NE SNSR	45	ENG. REVERSE
16	ACCEL. SNSR-2	65	ACCEL SW
21	WTR TEMP SNSR		

SERVICE PROCEDURES USING MUT-II

Service operations can be performed most effectively using the following MUT-II functions:

● Reading of diagnosis codes

Using the diagnosis code function, it is possible to read diagnosis codes stored in the control unit.

● Erasure of diagnosis codes

By selecting the diagnosis code erasure function from the special function menu, it is possible to erase diagnosis codes stored in the control unit.

● Indication of service data

When required for service operations, data in the control unit's random-access memory can be displayed as numeric values or graphs.

Service data

MUT-II display			Inspection procedure	
No.	Data signal	Type of data	Inspection condition	Evaluation criterion
11	ENGINE SPEED	■■■. rpm	Gradual acceleration (during engine operation)	Synchronization with tachometer
12	TARGET RACK	■.■ mm	Starter switch ON	3 mm
13	REAL RACK	■.■ mm	Starter switch ON	3 mm
14	ACCEL. VOLT	■.■■ V	Accelerator pedal gradually depressed from throttle-fully-open to throttle-fully-closed position	1 to 3 V
15	WATER TEMP	■■.■ °F	Engine cold Engine warming up Engine stopped after warmup	Same as ambient temperature Gradual increase Gradual decrease
16	BOOST PRESS	■■■. mmHg	Engine running at high idling speed	270 mmHg or higher
17	PS ANG. DIFF.	■.■ deg	400 < Ne ≤ 2,000 Ne: Engine speed	−5.5° or greater 5.5° or smaller
18	SUPPLY VOLT	■.■ V	Starter switch ON	16 Volts
19	ACCEL. STROKE	■■.■ %	Throttle completely closed Pedal gradually depressed Throttle completely open	0 % Gradual increase 100 %
20	BOOST TEMP	■■.■ °F	Engine cold Engine warming up Engine stopped after warmup	Same as ambient temperature Gradual increase Gradual decrease
21	START SIG	ON/OFF	Engine cranked using starter switch	ON
33	ACCEL. SW	ON/OFF	Accelerator pedal depressed	OFF
34	DIAGNOSIS SW	ON/OFF	Diagnosis switch turned ON/OFF	ON/OFF
35	DIAG. RESET SW	ON/OFF	Memory clear switch turned ON/OFF	ON/OFF
37	CLUTCH SW	ON/OFF	Clutch pedal depressed	ON
38	NEUTRAL SW	ON/OFF	Transmission in neutral	OFF
42	EXH. BRAKE SW	ON/OFF	Switch ON	ON
51	A/C SW	ON/OFF	Air conditioner switch turned ON or OFF	ON/OFF
61	EXH. BRAKE SIG	ON/OFF	Exhaust brake operating	ON
75	IDLE UP CNCL	ON/OFF	Idle up prohibited (other than N range)	ON

MEMO

INSPECTION BASED ON DIAGNOSIS CODE

Diagnosis code	Diagnosis code display condition (s)	Cause	Remedy
03	Indicated that pre-stroke learning function has not been executed.	Faulty timing rod, timing sleeve or other parts in the injection pump assembly.	Repair or replace the injection pump assembly. *
		Faulty adjustment or pre-stroke position sensor	Repair or replace the injection pump. *
		Faulty electronic governor control unit	Replace the electronic governor control unit
06	Displayed if the output voltage of the control rack position sensor is less than 0.06 V or more than 3.5 V.	Open or short in harness wire or poor connector contact between the sub-control rack position sensor and the electronic governor control unit	Inspect the harness and the connector 📖 P13-88
		Open, short, or poor connector contact in the sub-control rack position sensor	Inspect the sub-control rack position sensor 📖 P13-83
		Faulty electronic governor control unit	Replace the electronic governor control unit
11	Displayed if the difference between the target control rack position and the actual control rack position is $\pm 1\text{mm}$ {0.039 in.}.	Open or short in harness wire or poor connector contact between the linear DC motor and the electronic governor control unit	Inspect the harness and the connector 📖 P13-88
		Open or shorted wire in the linear DC motor connector	Inspect the linear DC motor 📖 P13-82
		Poor adjustment of the emergency engine stop cable (The lever is pulled in the stop direction)	Inspect the emergency engine stop button 📖 P13-84
		Faulty injection pump assembly rack movement or poor governor actuator link	Repair or replace the injection pump assembly. *
		Faulty electronic governor control unit	Replace the electronic governor control unit
12	Displayed if the difference between the target timing rod angle and the actual timing rod angle is $\pm 2^\circ$.	Open or short in harness wire or poor connector contact between the pre-stroke actuator, pre-stroke cut relay, and electronic governor control unit	Inspect the harness and the connector 📖 P13-88
		Open or shorted wire in the pre-stroke cut relay	Inspect the pre-stroke cut relay 📖 P13-79
		Faulty pre-stroke actuator	Repair or replace the injection pump assembly. *
		Faulty timing rod, timing sleeve, etc. in the injection pump assembly	Repair or replace the injection pump assembly. *
		Faulty electronic governor control unit	Replace the electronic governor control unit

* : Contact your MFTA representative for current injection pump repair and replacement procedures.

Diagnosis code	Diagnosis code display condition (s)	Cause	Remedy
13	Displayed if the output voltage of the pre-stroke position sensor is less than 0.9 V or more than 3.4 V.	Open or short in harness wire or poor connector contact between the pre-stroke position sensor and the electronic governor control unit	Inspect the harness and the connector  P13-88
		Open or shorted pre-stroke position sensor coil	Inspect the pre-stroke actuator  P13-83
		Faulty electronic governor control unit	Replace the electronic governor control unit
14	Displayed if the pulse count of the back-up engine speed sensor is less than that of the main engine speed sensor.	Open or short in harness wire or poor connector contact between the back-up engine speed sensor and the electronic governor control unit	Inspect the harness and the connector  P13-88
		Faulty back-up engine speed sensor	Repair or replace the injection pump assembly. *
		Faulty electronic governor control unit	Replace the electronic governor control unit
15	Displayed if the pulse count of the main engine speed sensor is less than that of the back-up engine speed sensor.	Open or short in harness wire or poor connector contact between the speed sensor and the electronic governor control unit	Inspect the harness and the connector  P13-88
		Open or shorted wire or improperly assembled coil in the engine speed sensor main unit	Inspect the engine speed sensor main unit  P13-84
		Faulty electronic governor control unit	Replace the electronic governor control unit
16	Displayed if the output voltage of the accelerator pedal position sensor is less than 0.5 V or more than 4.5 V.	Open or short in harness wire or poor connector contact between the accelerator pedal position sensor II and the electronic governor control unit	- Inspect the accelerator position sensor using MUT-II  P13-44 - Inspect the harness and the connector  P13-88
		Internal malfunction or faulty adjustment of the lever portion of the accelerator pedal position sensor II	- Inspect the accelerator pedal position sensor  P13-54 - Inspect the accelerator pedal position sensor using MUT-II  P13-44
		Faulty electronic governor control unit	Replace the electronic governor control unit
21	—	Open or short in harness wire or poor connector contact between the coolant temperature sensor and the electronic governor control unit	Inspect the harness and the connector  P13-88
		Faulty coolant temperature sensor	- Inspect the coolant temperature sensor  P13-80 - Inspect the coolant temperature sensor using MUT-II  P13-44
		Faulty electronic governor control unit	Replace the electronic governor control unit

* : Contact your MFTA representative for current injection pump repair and replacement procedures.

INSPECTION BASED ON DIAGNOSIS CODE

Diagnosis code	Diagnosis code display condition (s)	Cause	Remedy
22	Displayed if the output voltage of the control rack position sensor I is less than 0.5 V or more than 4.5 V.	Open or short in harness wire or poor connector contact between the control rack position sensor and the electronic governor control unit	Inspect the harness and the connector 📖 P13-88
		Open or shorted wire in the coil or poor control rack position sensor contact	- Inspect the control rack position sensor 📖 P13-81 - Inspect the control rack position sensor using MUT-II 📖 P13-44
		Faulty movement of the injection pump assembly control hook or poor governor actuator link.	Repair or replace the injection pump assembly. *
		Faulty electronic governor control unit	Replace the electronic governor control unit
24	Displayed if the output voltage of the accelerator pedal position sensor I is less than 0.5 V or more than 4.5 V.	Open or short in harness wire or poor connector contact between the accelerator pedal position sensor and the electronic governor control unit	- Inspect the accelerator position sensor using MUT-II 📖 P13-44 - Inspect the harness and the connector 📖 P13-88
		Internal malfunction or poor adjustment of the accelerator pedal position sensor I lever	- Inspect the accelerator position sensor I 📖 P13-54 - Inspect the accelerator pedal position sensor using MUT-II 📖 P13-44
		Faulty electronic governor control unit	Replace the electronic governor control unit
31	Displayed if the output voltage of the idling adjustment volume is less than 0.6 V or more than 4.6 V.	Stuck idling speed adjustment potentiometer knob (between PUSH and PULL)	Reset the knob to PUSH or PULL
		Open or short in harness wire or poor connector contact between the idling speed adjustment potentiometer and the electronic governor control unit	Inspect the harness and the connector 📖 P13-88
		Open wire in the switch portion of the idling speed adjustment potentiometer or faulty internal movement	Inspect the idling speed adjustment potentiometer 📖 P13-79
		Faulty electronic governor control unit	Replace the electronic governor control unit
32	Displayed if the output voltage of the boost pressure sensor is less than 0.5 V or more than 4.8 V.	Open or short in harness wire or poor connector contact between the boost pressure sensor and the electronic governor control unit	Inspect the harness and the connector 📖 P13-88
		Internal malfunction of boost pressure sensor	- Inspect the boost pressure sensor using MUT-II 📖 P13-44 - Inspect the boost pressure sensor 📖 P13-80
		Clogged boost hose or faulty assembly	Inspect the boost hose
		Faulty electronic governor control unit	Replace the electronic governor control unit

* : Contact your MFTA representative for current injection pump repair and replacement procedures.

Diagnosis code	Diagnosis code display condition (s)	Cause	Remedy
33	Displayed if the electronic governor control unit is faulty.	Faulty electronic governor control main unit	In order to reset the electronic governor control unit, temporarily turn the starter switch OFF and erase the diagnostic codes by pressing the memory clear switch  P13-39 Replace the electronic governor control unit if the diagnostic codes persist after performing the above procedure
41	Displayed if the output voltage of the boost temperature sensor is more than 4.9 V.	Open or short in harness wire and poor connector contact between the boost temperature sensor and the electronic governor control unit	Inspect the harness and the connector  P13-88
		Open or shorted wire or poor assembly of the boost temperature sensor coil	- Inspect the boost temperature sensor  P13-80 - Inspect the boost temperature sensor using MUT-II  P13-44
		Faulty electronic governor control unit	Replace the electronic governor control unit
45	—	Faulty phase of engine speed sensor and backup engine speed sensor	- Inspect the engine speed sensor  P13-84 - Repair or replace the injection pump assembly. *
65	Faulty accelerator switch	Open or short in harness wire or poor connector contact between the accelerator switch and the electronic governor control unit	Inspect the harness and the connector  P13-88
		Open or shorted wire in the accelerator switch	Inspect the accelerator switch (Accelerator switch is built in the accelerator pedal position switch.)  P13-54
		Faulty electronic governor control unit	Replace the electronic governor control unit

* : Contact your MFTA representative for current injection pump repair and replacement procedures.

ON-VEHICLE INSPECTION AND ADJUSTMENT

Checking and Adjusting Injection Timing

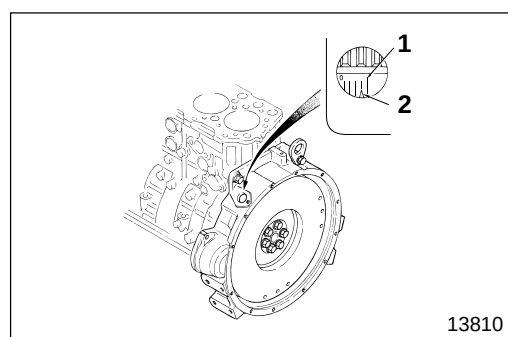
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Fuel injection timing (BTDC)	$3^{\circ} \pm 0.5^{\circ}$	—	Adjust

Tightening torque

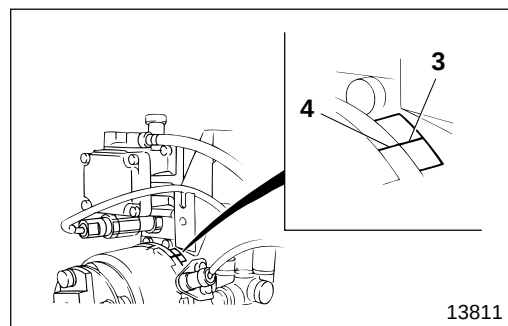
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Adjusting bolt	59 to 64 {43 to 47, 6 to 6.5}	—

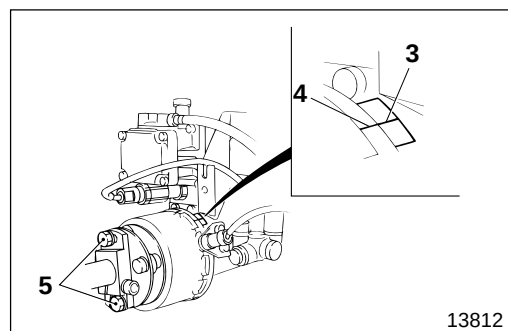


[Inspection]

- Turn the crankshaft more than 180° in the direction of engine rotation. Check if notch **1** on the flywheel and pointer **2** on the flywheel housing show the standard fuel injection timing.



- When pointer **3** on the injection pump and notch **4** on the automatic timer align, the fuel injection timing is standard.
- If the fuel injection timing is not standard, adjust as follows.



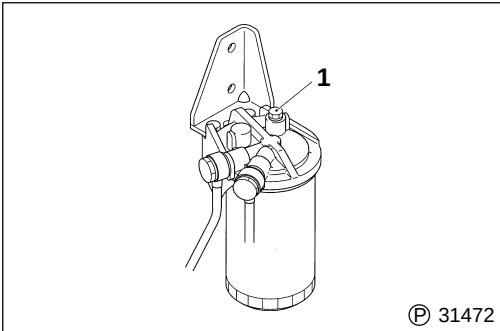
[Adjustment]

- Loosen adjusting bolts **5** and turn the automatic timer to align pointer **3** and notch **4**.
- Tighten adjusting bolts **5** at specified torque.
- Reinspect the fuel injection timing.

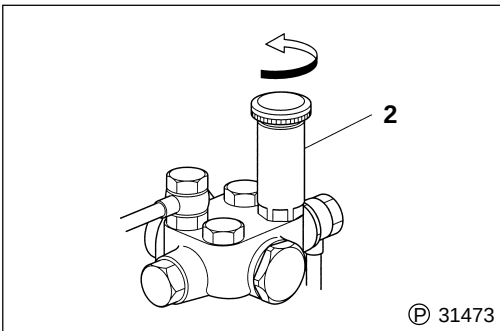
CAUTION

Do not loosen any bolts other than adjusting bolts **5**.

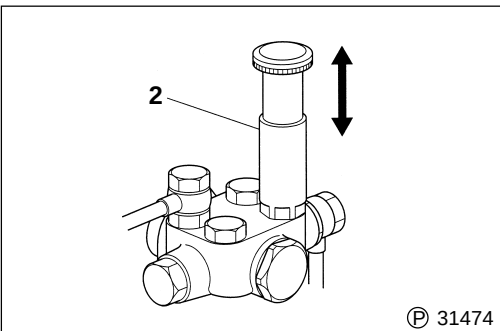
Bleeding Air from Fuel System



- Loosen the fuel filter air plug 1.



- Turn the priming pump knob 2 counterclockwise until it pops up.
- Move the priming pump knob 2 up and down to feed fuel through the fuel filter.
- When fuel emerging from the fuel filter air plug 1 no longer contains air bubbles, tighten the air plug securely.

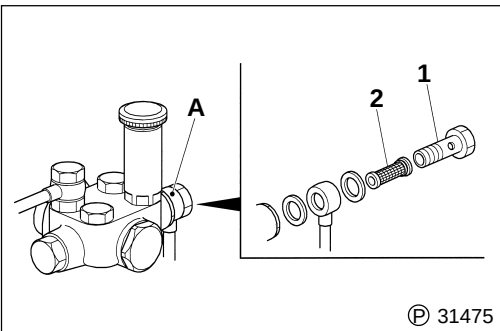


- Move the priming pump knob 2 up and down five or six more times. Then, press the knob down and screw it clockwise to lock it in position.
- Wipe up all spilled fuel, then start the engine.
- Check that no fuel leakage occurs.

WARNING

- Be sure to wipe up all spilled fuel. Unless it is wiped up, it could catch fire.
- Fuel is highly flammable. Keep it away from flames and sources of heat.

Cleaning Gauze Filter



- Remove the eyebolt 1 from the suction port side A of the fuel feed pump.
- Remove the gauze filter 2 from the eyebolt 1.
- Clean the gauze filter 2 in diesel fuel.
- Refit the gauze filter 2 and eyebolt 1 in the opposite order to that in which they were removed.
- Bleed all air out of the fuel system. P13-51
- Start the engine and check that no fuel leakage occurs.

WARNING

- To minimize the risk of fire, wipe up any spilled fuel.
- Fuel is highly flammable. Keep it away from flames and sources of heat.
- After refitting the gauze filter, check that no fuel leakage occurs.

ON-VEHICLE INSPECTION AND ADJUSTMENT

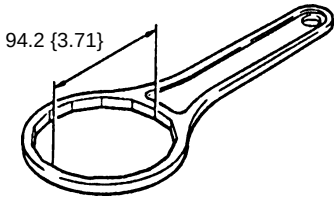
Replacing Fuel Filter

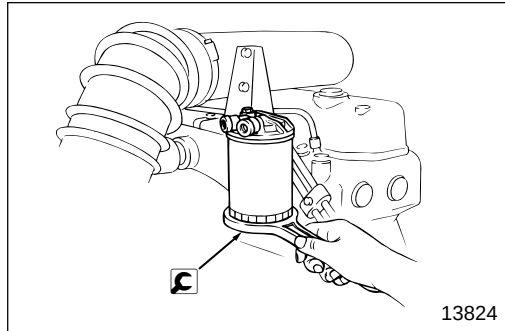
Lubricant

Location	Points of application	Specified lubricant	Quantity
1	Gasket between fuel filter and fuel filter head	Engine oil	As required

Special tool

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Filter wrench  01882	MH061572	Fuel filter removal



[Removal]

 : Filter Wrench

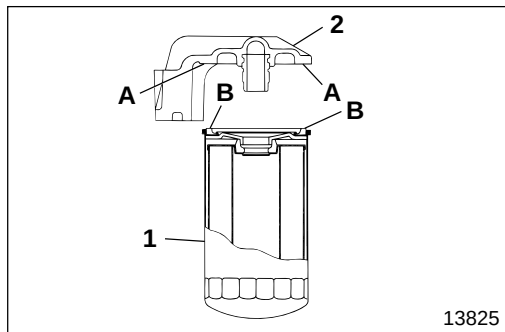
WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- To minimize the risk of fire, wipe up any spilled fuel.

[Installation]

WARNING

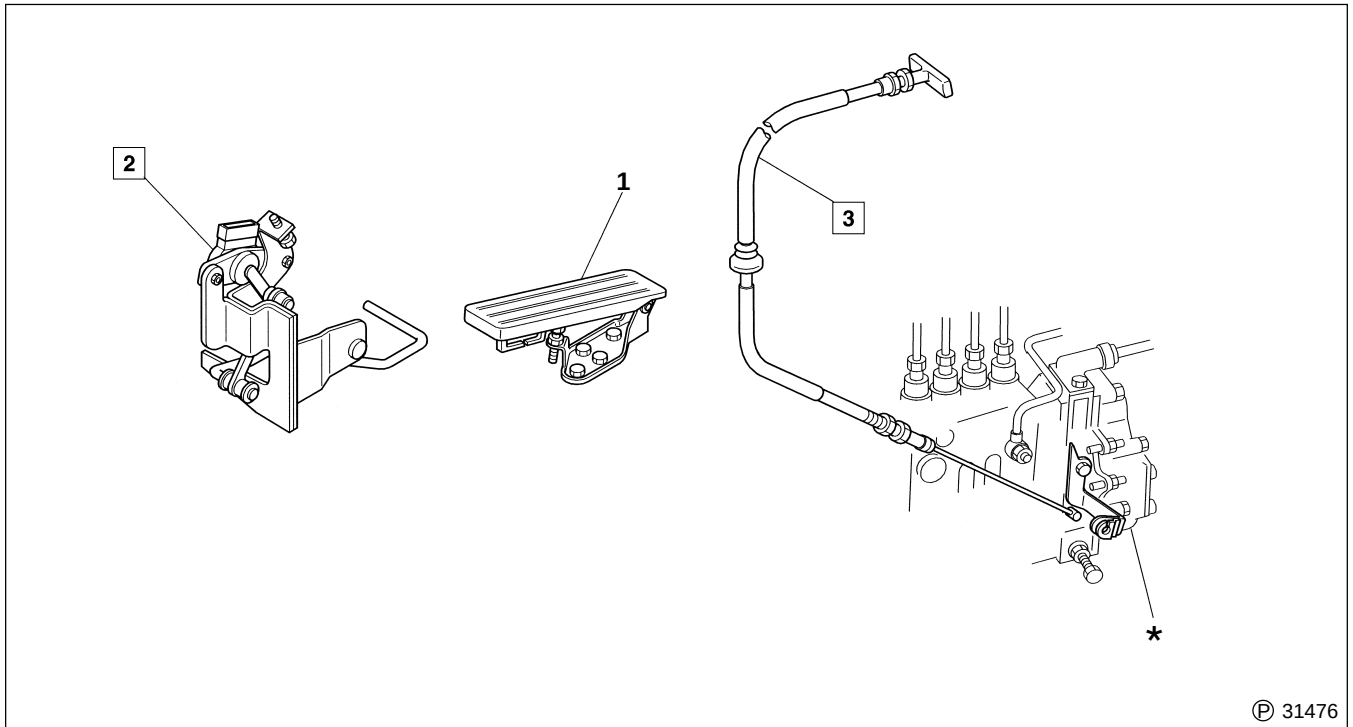
Use of an unsuitable fuel filter **1** can lead to fuel leaks and fires. Be sure to use a genuine filter.



- To fit the fuel filter **1**, turn it until the gasket **B** touches surface **A** of the fuel filter head **2**. Then, tighten the filter by 1 to $1\frac{1}{8}$ turn. Be sure to turn the filter by hand.
- Bleed all air out of the fuel system.  P13-51

WARNING

After fitting the fuel filter **1**, start the engine and check that no fuel leakage occurs. Any leaking fuel could cause a fire.



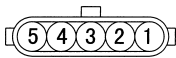
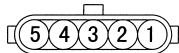
● Removal sequence

- 1 Accelerator pedal assembly
 - 2 Accelerator pedal position sensor assembly
 - 3 Emergency engine stop cable
- * : Injection pump assembly

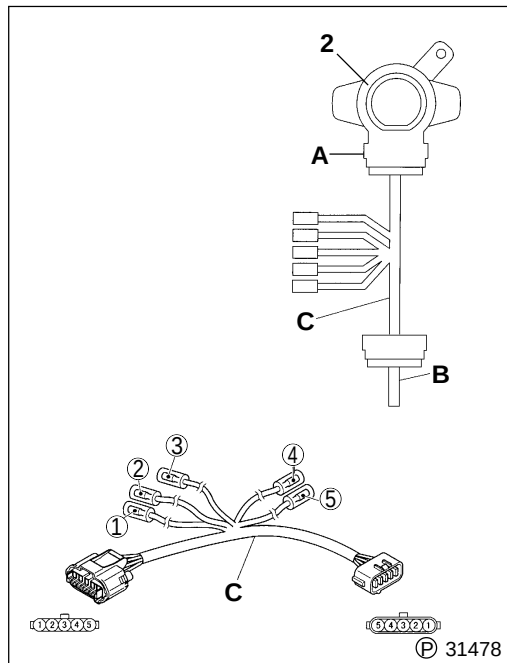
● Installation sequence

Follow the removal sequence in reverse.

Service standards

Location	Maintenance item		Standard value	Limit	Remedy	
4	Output voltage of accelerator pedal position sensor  Ⓔ 31477	Sensor II: ① – ④	Idle position	$0.85 \pm 0.1 \text{ V}$	—	Adjust or replace
		Sensor I: ④ – ⑤	Full-load position	$4.15 \pm 0.1 \text{ V}$	—	Adjust or replace
	Output voltage of accelerator switch  Ⓔ 31477	Electrical conduction between terminals ② and ③ of accelerator switch	$1.00 \pm 0.24 \text{ V}$	—	Adjust or replace	

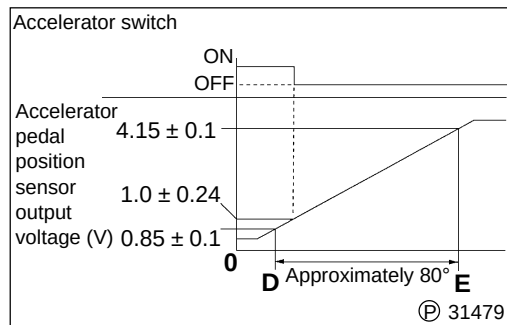
ENGINE CONTROL



2 Inspection of accelerator pedal position sensor assembly

- Disconnect connector **A** of accelerator pedal position sensor **2** from harness **B** on the cab side. Prepare inspection harness **C**, and connect it between the above two connectors. (Not required with MUT-II PLUS)
- Set the starter switch to the **ON** position.
- Measure the output voltages of accelerator pedal position sensor **4** and the accelerator switch according to the table below. Adjust, if necessary.

Item	Connector terminal					
	Accelerator position sensor inspection harness					
	Sensor II		Sensor I		Accelerator switch	
	①	④	④	⑤	②	③
Output voltage *a (Idle position)	⊖	⊕	⊖	⊕		
Output voltage *b (Full-load position)	⊖	⊕	⊖	⊕		
Output voltage *c (Accelerator switch activating point)					⊖	⊕



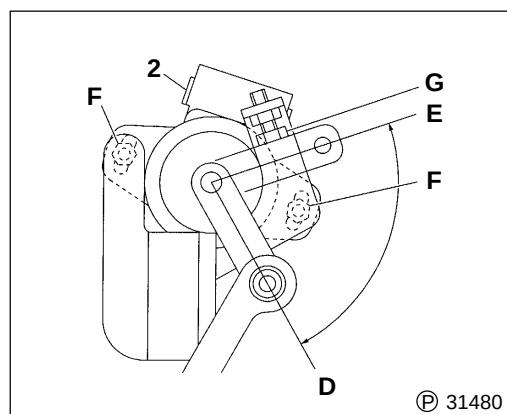
***a** : Measure voltage with accelerator pedal at idle position.

***b** : Measure voltage with the accelerator pedal at full-load position.

***c** : Press accelerator pedal gradually from idle position. Measure voltage when electrical conduction stops between connector terminals ② and ③ of accelerator pedal position sensor **2**.

D : Idle position

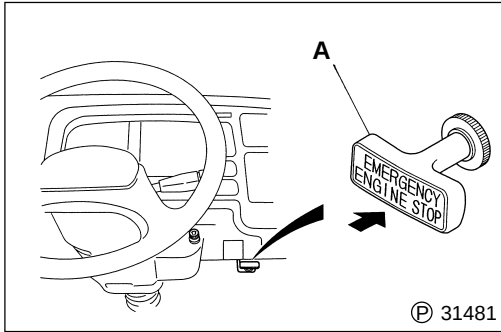
E : Full-load position



- If measured value ***a** and ***b** deviate from the standard values, adjust the following adjusting bolts.

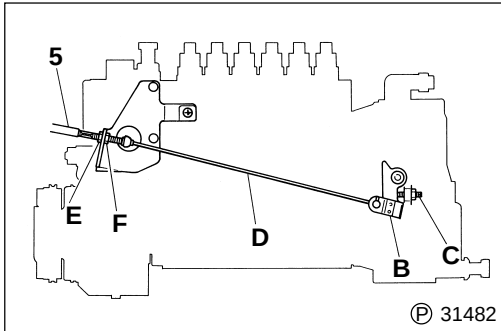
Adjustment item	Adjusting bolt
*a Idle position output voltage	Screw F
*b Full-load position output voltage	Full-load stopper bolt G

- If the measured output voltage at accelerator switch activating point ***c** deviates from the standard value, replace accelerator pedal position sensor **2**.



5 Installation of emergency engine stop cable

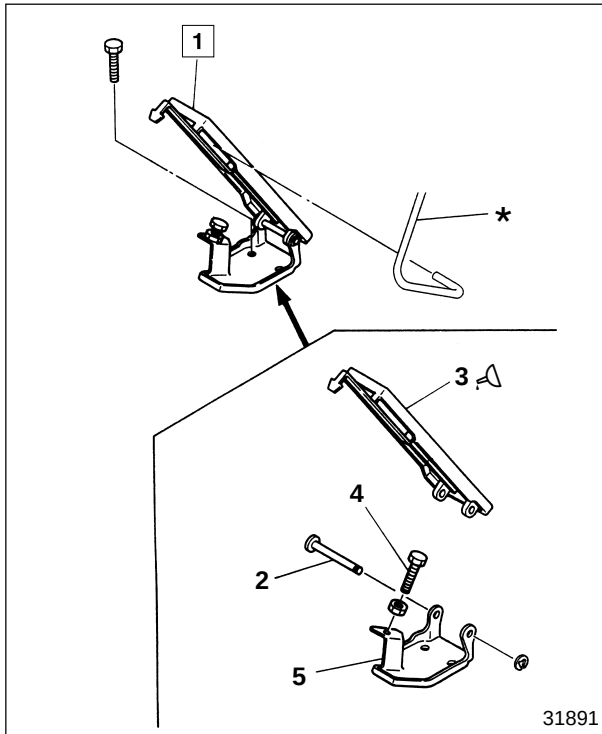
- Mount stop button **A** on emergency engine stop cable **5** and press the button firmly in position.



- With stop lever **B** of the governor contacting stopper bolt **C**, adjust nut **E** so that inner cable **D** of emergency stop cable **5** is taut. Then, tighten nut **F** to secure it in place.
- After installation, start the engine. Pull the stop button to make sure that the engine stops operating.

ENGINE CONTROL

Accelerator Pedal Assembly



● Disassembly sequence

- 1 Accelerator pedal assembly
- 2 Clevis pin
- 3 Accelerator pedal
- 4 Stopper bolt
- 5 Accelerator pedal bracket

* : Accelerator pedal position sensor assembly P13-53

● Assembly sequence

Follow the disassembly sequence in reverse.

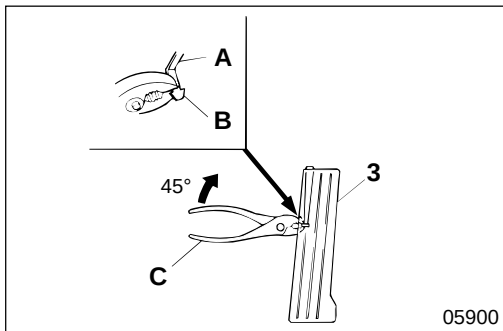
Lubricant

Location	Points of application	Specified lubricant	Quantity
3	Slide-contacting surfaces of accelerator pedal and bracket	Chassis grease [NLGI No.1 (Ca soap)]	As required

◆ Service procedure

1 Removal of accelerator pedal assembly

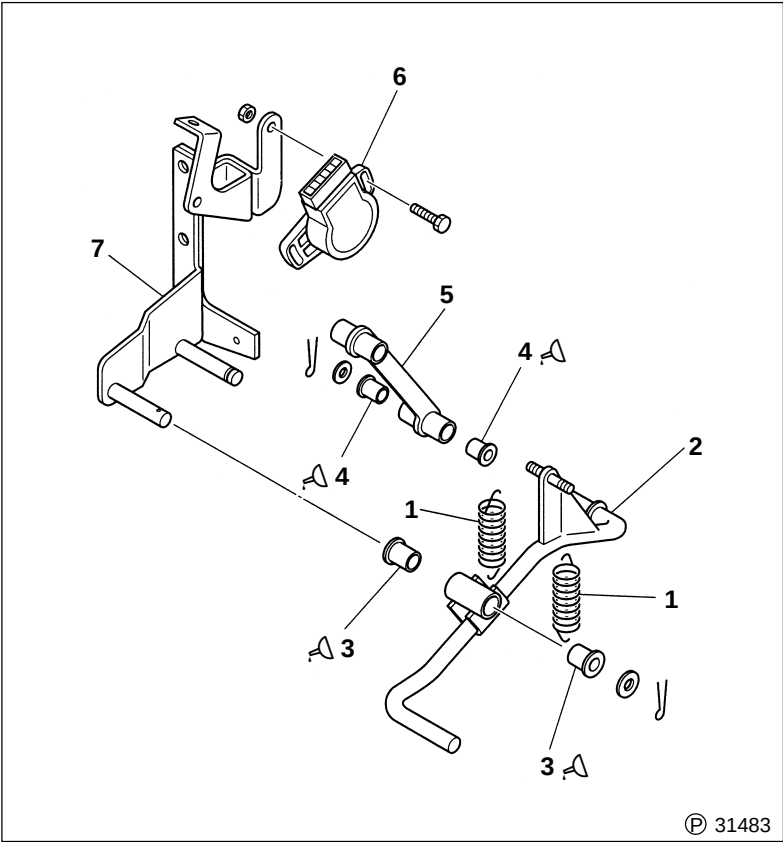
Pinch hook **B** of stopper **A** of accelerator pedal **3** using pliers **C** and rotating approximately 45° pull out the stopper towards the front of the vehicle.



CAUTION

Take care not to damage stopper A itself during removal, do not pull it out too forcibly.

Accelerator Pedal Position Sensor Assembly



● Removal sequence

- 1 Return spring
- 2 Accelerator control arm
- 3 Bushing
- 4 Bushing
- 5 Accelerator control extension
- 6 Accelerator pedal position sensor
- 7 Bracket

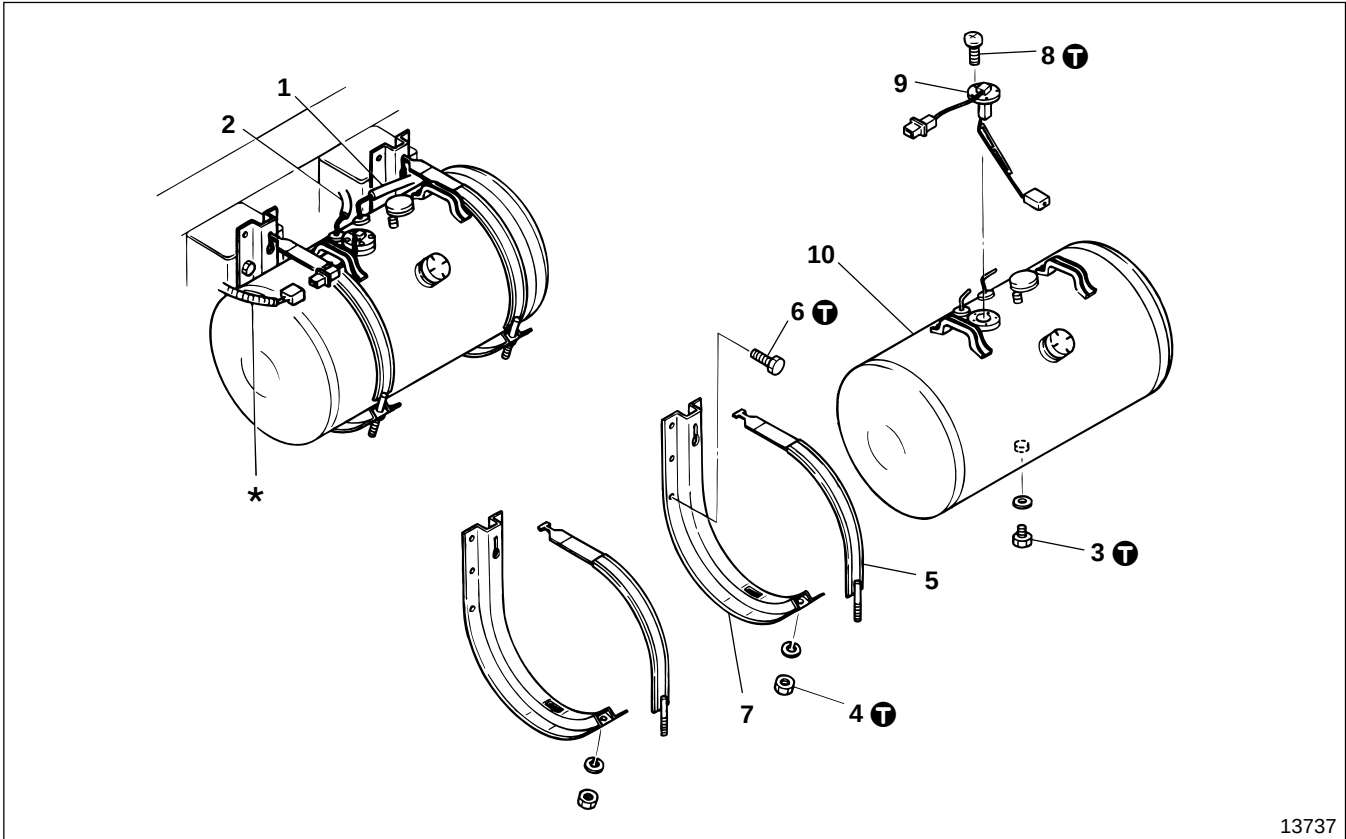
● Installation sequence

Follow the removal sequence in reverse.

 Lubricant

Location	Points of application	Specified lubricant	Quantity
3, 4	Slide-contacting surfaces of bushing and support assembly	Chassis grease [NLGI No.1 (Ca soap)]	As required

FUEL TANK



● Work before removal

WARNING ⚠

- Keep drop lights away because of the risk of explosion.
- Wipe up any spilled fuel because it can cause a fire.

NOTE

Drain fuel before working on the job.

● Removal sequence

- | | |
|------------------|----------------------------------|
| 1 Suction hose | 7 Fuel tank bracket |
| 2 Return hose | 8 Screw |
| 3 Drain plug | 9 Fuel gauge sending unit Gr 54 |
| 4 Nut | 10 Fuel tank |
| 5 Fuel tank band | |
| 6 Bolt | |

* : Chassis harness Gr 54

● Installation sequence

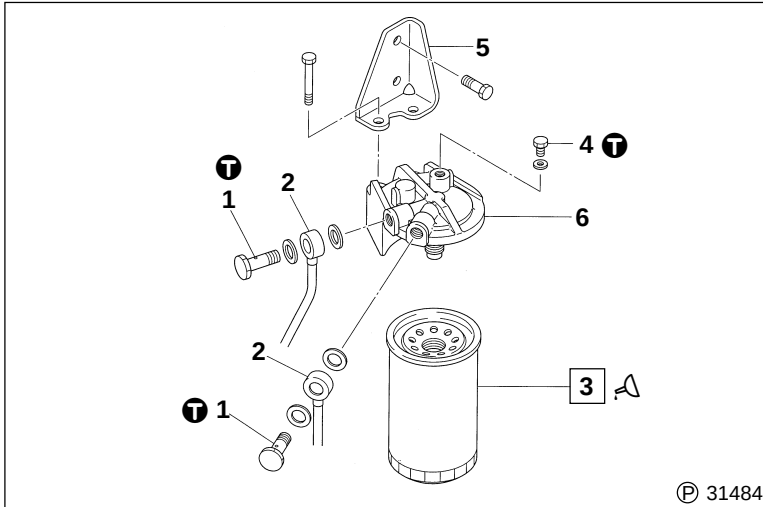
Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Drain plug	59 to 98 {43 to 72, 6 to 10}	—
4	Nut (Fuel tank band mounting)	5.9 to 9.8 {4.3 to 7.2, 0.6 to 1.0}	—
6	Bolt (Fuel tank bracket mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
8	Screw (Fuel gauge sending unit mounting)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.15}	—

FUEL FILTER

13


● Disassembly sequence

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

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

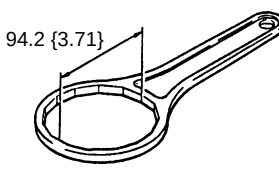
Location	Parts to be tightened	Tightening torque	Remarks
1	Eye bolt	25 to 34 {18 to 25, 2.5 to 3.5}	—
4	Air vent plug	7.8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—

L Lubricant

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

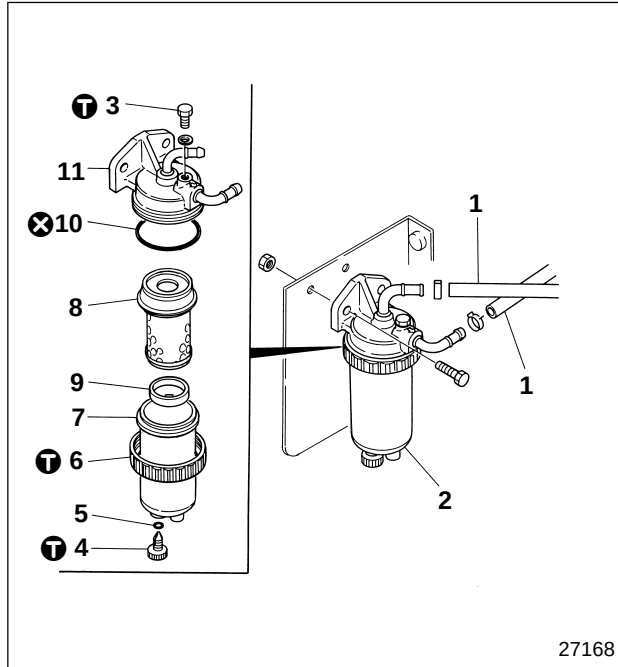
C Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3	Filter wrench 	MH061572	Removal of fuel filter

01882

WATER SEPARATOR



● Disassembly sequence

- 1 Fuel hose
- 2 Water separator assembly
- 3 Air vent plug
- 4 Drain plug
- 5 O-ring
- 6 Ring nut
- 7 Case
- 8 Screen assembly
- 9 Water level ring
- 10 O-ring
- 11 Head

⊗ : Non-reusable part

● Assembly sequence

Follow the disassembly sequence in reverse.

● Operations after assembly

Bleed all air out of the fuel system. P13-51

WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- After assembling the water separator, start the engine and check that no fuel leakage occurs. Any leaking fuel could cause a fire.

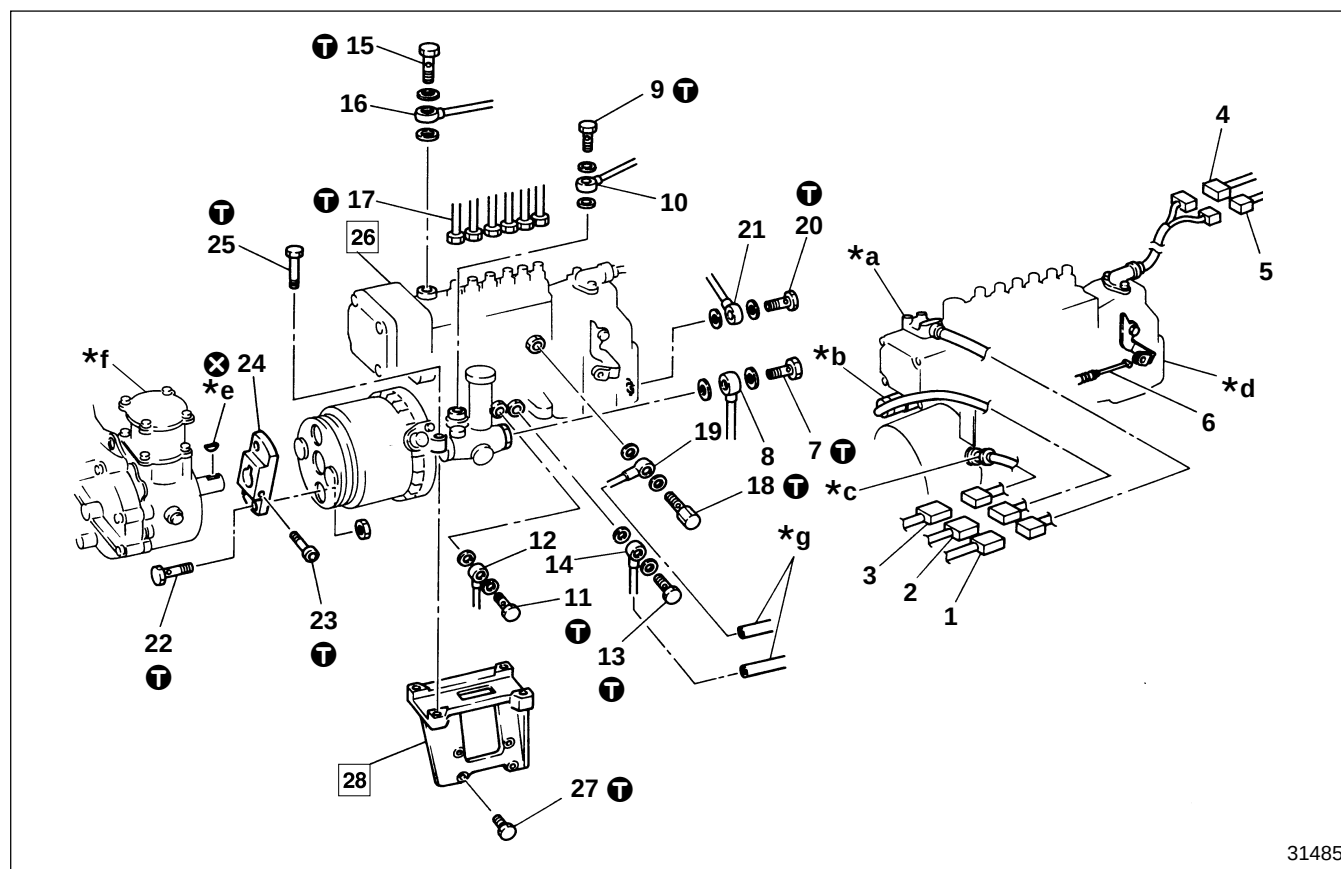
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Air vent plug	8 to 12 {5.8 to 8.7, 0.8 to 1.2}	—
4	Drain plug	3 to 4 {2.2 to 2.9, 0.3 to 0.4}	—
6	Ring nut	23 to 27 {17 to 20, 2.3 to 2.8}	—

M E M O

INJECTION PUMP



31485

● Removal sequence

- | | |
|---------------------------------------|--|
| 1 Harness (6 pin) | 20 Eye bolt |
| 2 Harness (4 pin) | 21 Oil return pipe |
| 3 Harness (3 pin) | 22 Bolt |
| 4 Harness (10 pin) | 23 Cotter bolt |
| 5 Harness (3 pin) | 24 Driving coupling |
| 6 Emergency engine stop cable P13-53 | 25 Bolt |
| 7 Eye bolt | 26 Injection pump assembly |
| 8 Fuel suction pipe | 27 Bolt |
| 9 Eye bolt | 28 Injection pump bracket |
| 10 Fuel feed pipe | |
| 11 Eye bolt | *a : Pre-stroke actuator P13-13, 24 |
| 12 Oil feed pipe | *b : Sub control rod position sensor P13-21 |
| 13 Eye bolt | *c : Engine speed sensor P13-21 |
| 14 Oil return pipe | *d : Electronic governor P13-28 |
| 15 Eye bolt | *e : Key |
| 16 Fuel feed pipe | *f : Injection pump drive case P13-68 |
| 17 Injection pipe | *g : Fuel hose |
| 18 Overflow valve | ⊗ : Non-reusable parts |
| 19 Fuel return pipe | |

WARNING ⚠

- Fuel ignites easily. Do not get it near flame or heat.
- Wipe up any spilled fuel because it can cause a fire.

CAUTION ⚠

- 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 pump assembly 26.
- Do not hold the control lever when lifting injection pump assembly 26. Also, do not remove the control lever because removal of the lever might cause poor performance of the pump.
- Do not remove injection pump bracket 28 unless it is faulty.
- Make sure you connect fuel hose *g at a high position because fuel in the fuel tank would leak out if the end of the fuel hose were at a position lower than the tank.

● **Installation sequence**

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
28	Injection pump bracket (eccentricity of injection pump centering tool to air compressor crankshaft)	0.2 {0.0079} or less	—	Adjust

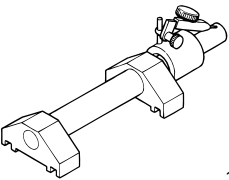
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
7, 9, 15	Eye bolt (Fuel suction pipe and fuel feed pipe mounting)		25 to 29 {18 to 22, 2.5 to 3}	—
11, 20	Eye bolt (Oil feed pipe and Oil return pipe mounting)		12 to 15 {8.7 to 11, 1.2 to 1.5}	—
13	Eye bolt (Oil return pipe mounting)		20 to 29 {14 to 22, 2 to 3}	—
17	Injection pipe mounting		29 to 49 {22 to 36, 3 to 5}	—
18	Overflow valve mounting		20 to 29 {14 to 22, 2 to 3}	—
22	Bolt (Driving coupling mounting)		59 to 64 {43 to 47, 6 to 6.5}	—
23	Cotter bolt		83 to 93 {61 to 69, 8.5 to 9.5}	—
25	Bolt (Injection pump assembly mounting)	Primary tightening	4.9 {3.6, 0.5}	—
		Secondary tightening	25 {18, 25}	—
27	Bolt (Injection pump bracket mounting)		33 to 55 {25 to 41, 3.4 to 5.6}	—

Special tools

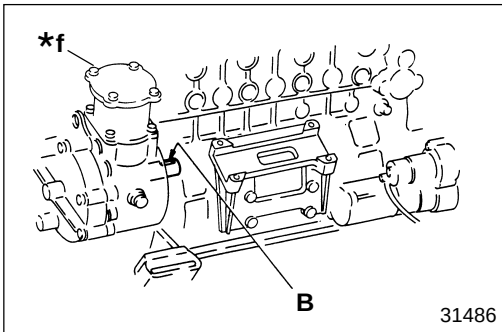
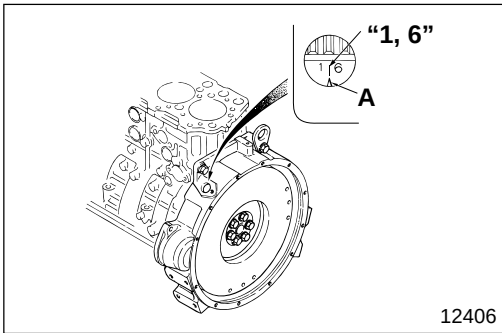
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
28	Injection pump centering tool  14311	MH063336	Positioning of injection pump bracket

INJECTION PUMP

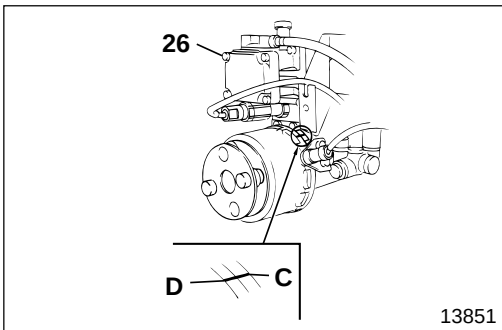
◆ Service procedure

26 Installation of injection pump assembly

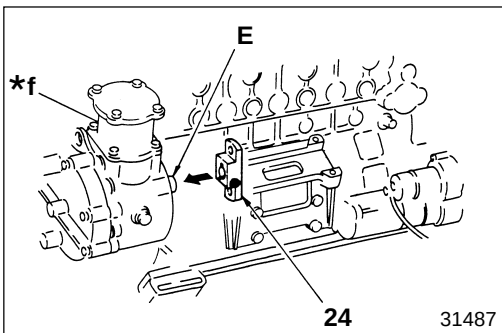


- Turn the engine to bring No.1 cylinder piston to top dead center in the compression cycle, and align mark "1, 6" of the flywheel with pointer A on the flywheel housing.

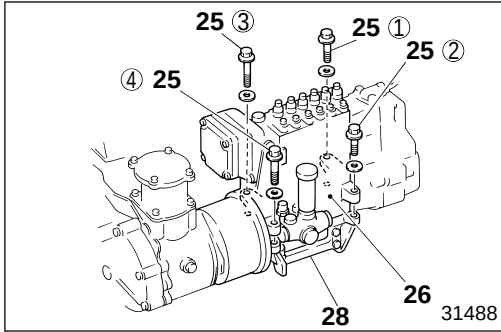
- In this state, make sure that keyway B in the crankshaft of injection pump drive case *f faces upward.
- If keyway B is not facing upward, turn the engine crankshaft by one turn.



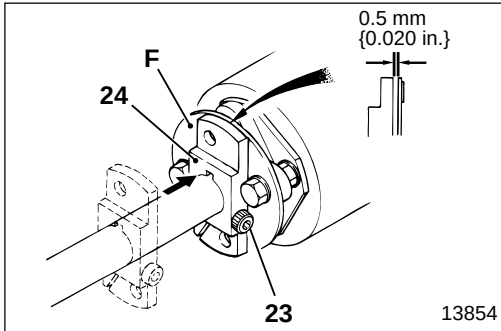
- Align pointer C on injection pump assembly 26 with notch D on the automatic timer.



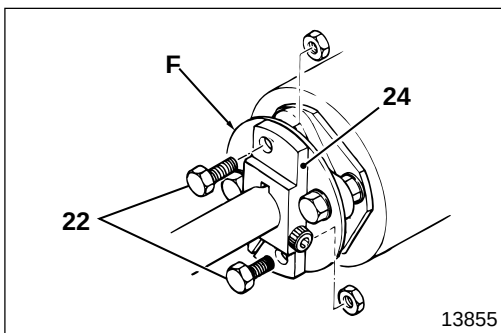
- Install driving coupling 24 to crankshaft E of injection pump drive case *f and place the driving coupling on the air compressor side.
- Install injection pump assembly 26 on the injection pump bracket.



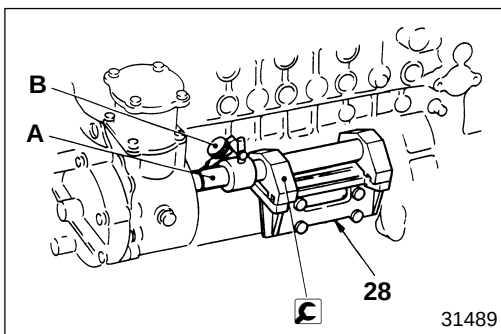
- Install injection pump assembly **26** on injection pump bracket **28**.
- Tighten bolts **25** in the order as illustrated at specified torque for primary tightening.
- Retighten bolts **25** in the order as illustrated at specified torque for secondary tightening.



- Move driving coupling **24** to adjust the clearance between the driving coupling and coupling plate **F** as illustrated, then tighten cotter bolt **23** at specified torque.



- Attach driving coupling **24** and coupling plate **F** using bolts **22** and tighten the bolts temporarily.
- In this state, adjust the fuel injection timing.
Adjustment of fuel injection timing : [P13-50](#)
After adjusting the fuel injection timing, tighten bolts **22** at specified torque.

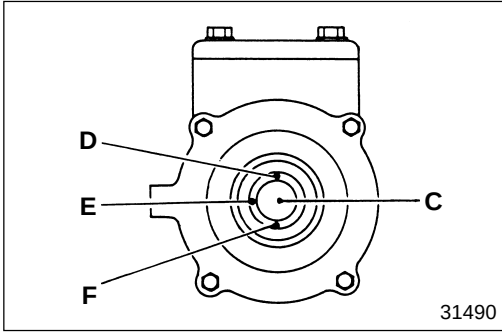


28 Injection pump bracket

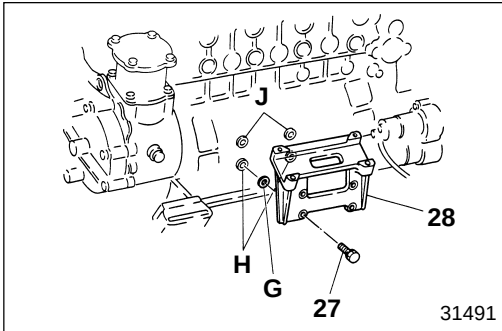
[Inspection]

- Attach dial gauge **B** to arbor **A** of  injection pump centering tool and adjust to gauge to zero setting.

INJECTION PUMP



- Slide dial gauge **B** toward injection pump drive case ***f** and measure the eccentricity of crankshaft **C** against arbor **A** at points **D**, **E** and **F**.
- If the measured value is higher than the standard value, adjust as follows.



[Adjustment]

- When the measured value at point **E** is higher than the standard value:
Insert shims **G** into four points equally.
- When the measured value at point **D** is higher than the standard value:
Insert shims **G** into lower side **H**.
- When the measured value at point **F** is higher than the standard value:
Insert shims **G** into upper side **J**.

CAUTION

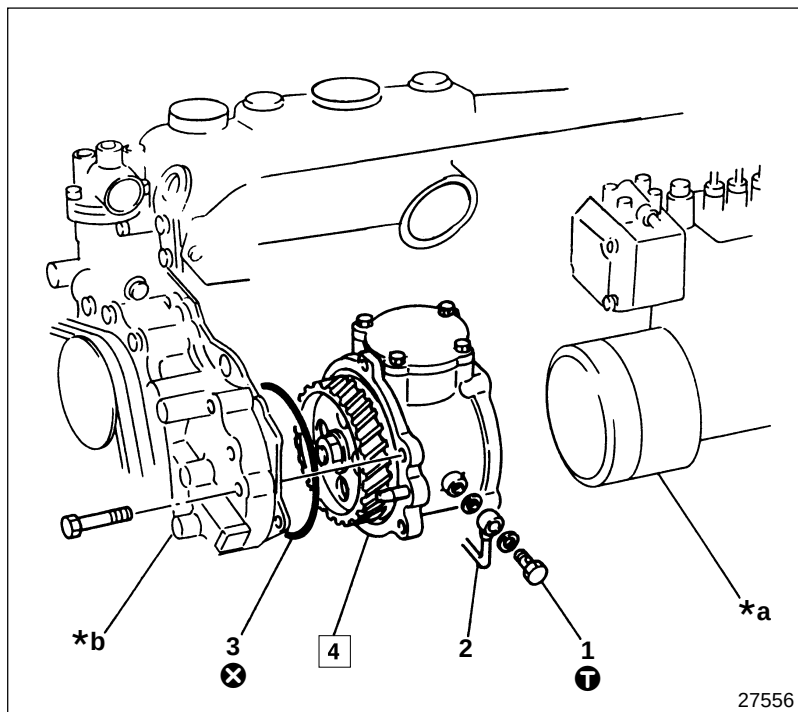
Insert shims **G** observing the following conditions:

- Number of shims per point is three or less.
- The same number of shims should be used for the front and the rear.
- The difference in number of shims used for bottom and top is none or one.

- Tighten bolt **27** at specified torque, then reinspect.

M E M O

INJECTION PUMP DRIVE CASE



● Removal sequence

- 1 Eye bolt
- 2 Oil pipe
- 3 O-ring
- 4 Injection pump drive case assembly P13-70

*a : Injection pump assembly P13-62

*b : Timing gear case Gr 11

⊗ : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

Ⓙ Tightening torque

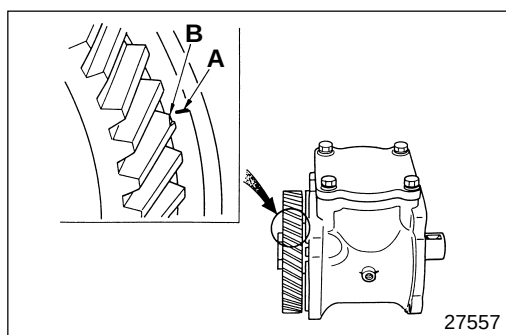
Unit : N·m {lb.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Eye bolt	21 {15, 2.1}	—

◆ Service procedure

4 Installation of injection pump drive case assembly

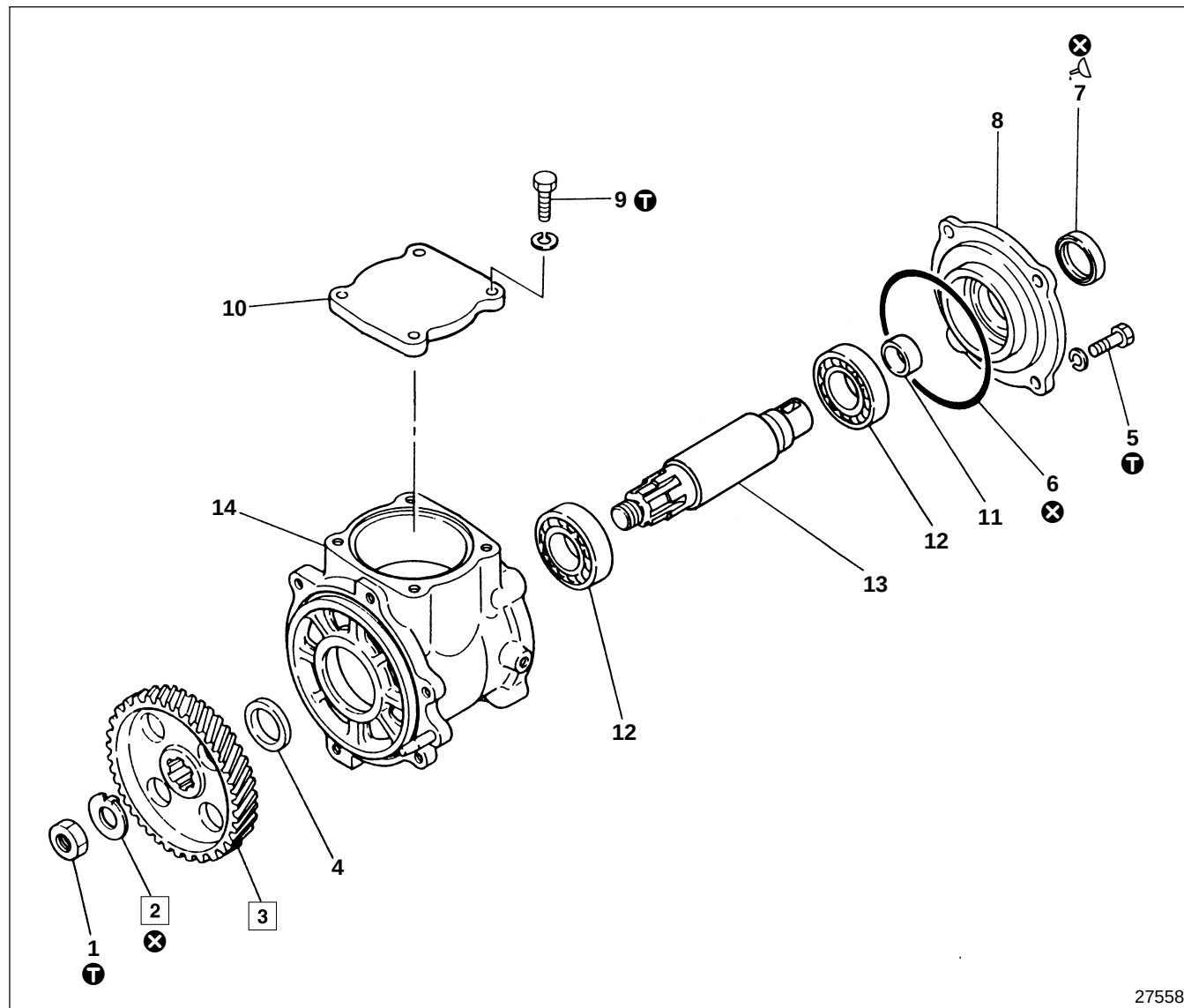
- Position No.1 cylinder of the engine at top dead center in the compression cycle. Gr 11
- Align marking line **A** with notch **B**, then install injection pump drive case assembly **4** on timing gear case ***b**.



MEMO

INJECTION PUMP DRIVE CASE

Injection Pump Drive Case Assembly



● Disassembly sequence

- | | | |
|---------------|------------------|------------------------|
| 1 Nut | 7 Oil seal | 13 Shaft |
| 2 Lock washer | 8 Bearing holder | 14 Crankcase |
| 3 Drive gear | 9 Bolt | ⊗ : Non-reusable parts |
| 4 Collar | 10 Cover | |
| 5 Bolt | 11 Sleeve | |
| 6 O-ring | 12 Bearing | |

● Assembly sequence

Follow the disassembly sequence in reverse.

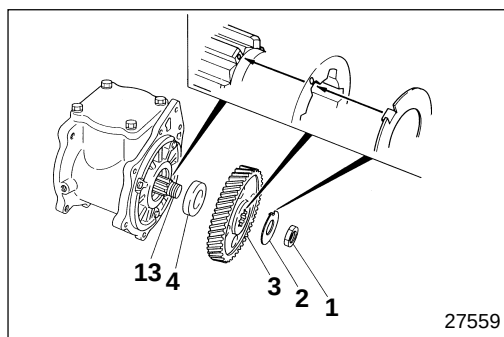
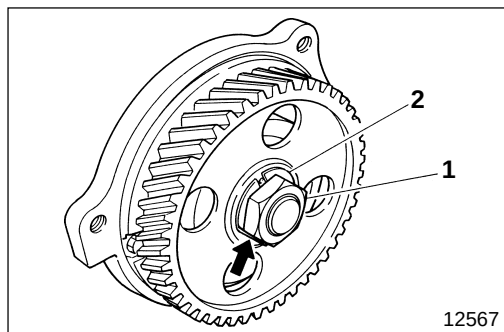
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

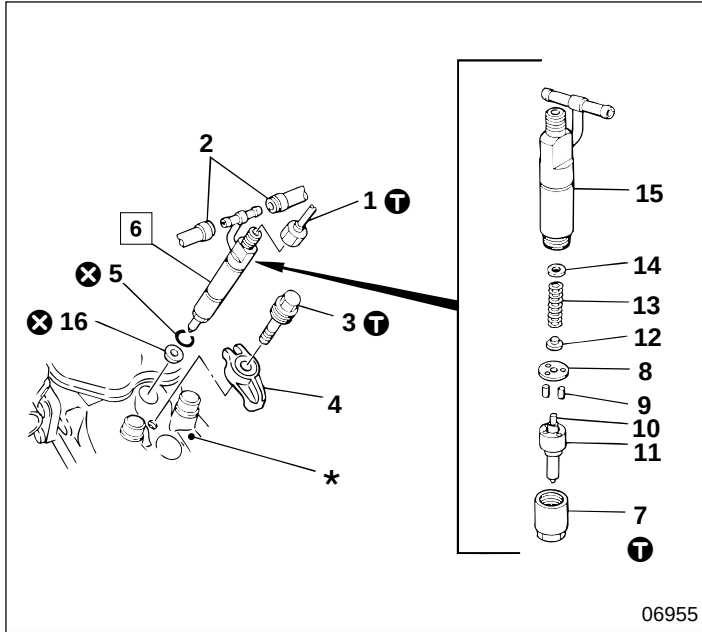
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Drive gear mounting)	166.7 to 210.8 {120 to 155, 17.0 to 21.5}	—
5	Bolt (Bearing holder mounting)	13.7 to 17.7 {10 to 13, 1.4 to 1.8}	—
9	Bolt (Cylinder head assembly mounting)	24.5 to 29.4 {18 to 22, 2.5 to 3.0}	—

L Lubricant

Location	Points of application	Specified lubricant	Quantity
7	Oil seal lip	Engine oil	As required

◆ Service procedure**2 3 Installation of lock washer and drive gear**After installation, bend lock washer **2** to nut **1** side.

INJECTION NOZZLE



● Inspection before disassembly

📖 P13-73

● 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 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}	—

Special tools

Location	Tool name and shape	Part No.	Application
—	Nozzle cleaning tool	★105789-0010	Cleaning of injection nozzle assembly

★ ZEXEL code number

Service procedure

Inspection before disassembly

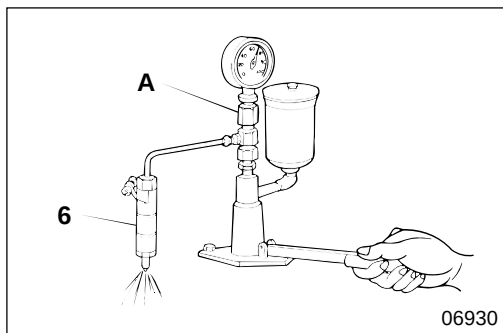
Attach injection nozzle assembly **6** to nozzle tester **A**, and conduct the following inspection.

WARNING

Never touch the spray from nozzle **11** or let your hands get too close to the spray point during the test.

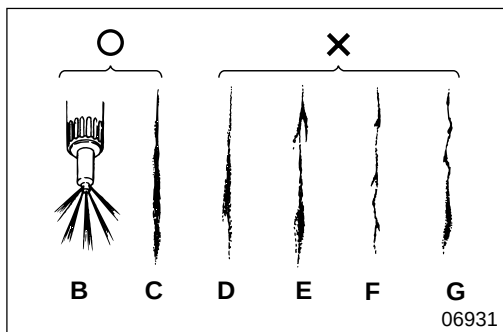
NOTE

Before inspection, bleed the air out in a couple of bursts by pressing nozzle tester **A** lever.



(1) Valve opening pressure

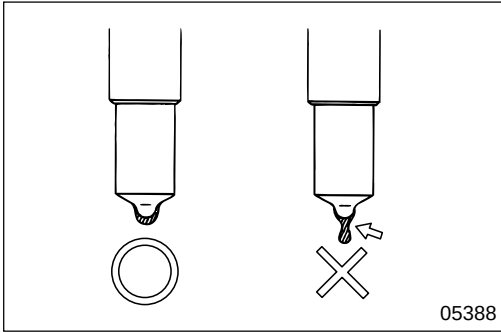
- Raise the pressure of nozzle tester **A** by operating the lever, and measure the pressure that the gauge registers when the pressure is released which will be observed by the sudden movement of the gauge indicator.
- If the measured value deviates from the standard value, disassemble the nozzle and clean, and adjust it using adjusting shims **14**.
- Variation of 0.05 mm {0.0020 in.} thickness in adjusting shims **14** causes a difference of 735 kPa {105 lbf/in², 7.5 kgf/cm²} of pressure, for example, to alter the pressure for 98 kPa {14 lbf/in², 1 kgf/cm²}, a thickness of 0.0067 mm {0.00026 in.} is required.
- If the performance cannot reach the standard value even after adjustment, replace injection nozzle assembly **6**.



(2) Spray condition

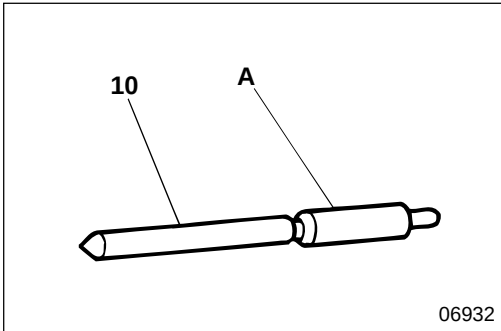
- Test injection spray condition by quick lever actions of nozzle tester **A**, 4 to 6 actions per second.
 - B** : Even spray from all five orifices (Good)
 - C** : Even and symmetrical spray (Good)
 - D** : Asymmetrical spray (Faulty)
 - E** : Spray direction deviates from the nozzle axis line (Faulty)
 - F** : Thin and insufficient spray (Faulty)
 - G** : Irregular spray (Faulty)
- If faulty spray cannot be corrected, disassemble injection nozzle assembly **6** and clean every part and repeat the test. If faulty spray still occurs after repeating test, replace the injection nozzle assembly.
- Make sure that there is no post-spray dripping after injection.

INJECTION NOZZLE



(3) Fuel air tightness and leakage at related contact points

- Maintain interior pressure of nozzle at 1960 kPa {285 lbf/in², 20 kgf/cm²} lower than the valve opening pressure, and check and see if any fuel seeps out of the nozzle tip within 10 seconds.
- If any fault is found, disassemble injection nozzle assembly **6** and clean every part and repeat the test. If any fault is still found, replace the injection nozzle assembly.

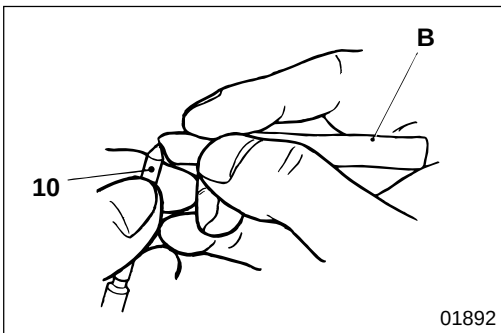


6 Injection nozzle assembly

[Disassembly]

CAUTION ⚠

- Be sure not to touch sliding part A of needle valve 10 with your hands.
- Never change the combination of removed needle valve 10 and nozzle 11 for each cylinder.



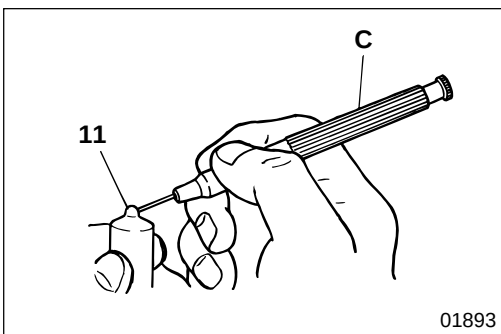
[Cleaning]

Clean needle valve **10** and nozzle **11** with diesel fuel (cleaning solvent). Remove carbon deposits with  cleaning tool in the following manner:

- Clean needle valve **10** by removing carbon deposits from its tip using cleaning bar **B** of  cleaning tool.

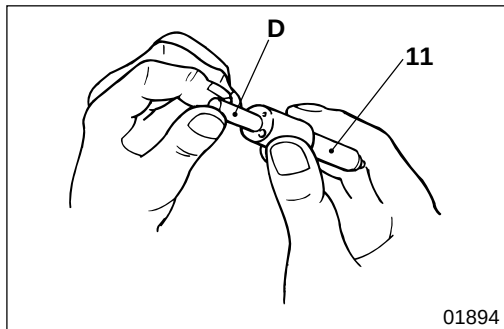
CAUTION ⚠

Never use a wire brush or hard steel for cleaning.

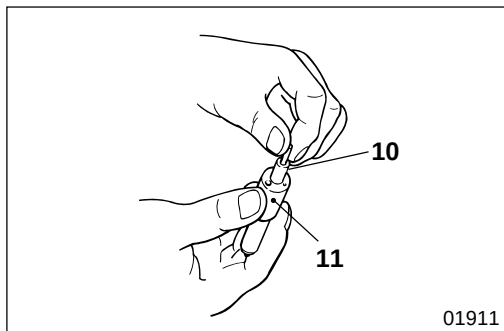


- To clean nozzle **11**, remove carbon deposits from the orifices of the nozzle using needle cleaner **C** of  cleaning tool, by inserting it into the orifices and turning it.

Needle cleaner diameter : $\varnothing$ 0.25 mm {0.0098 in.} or less



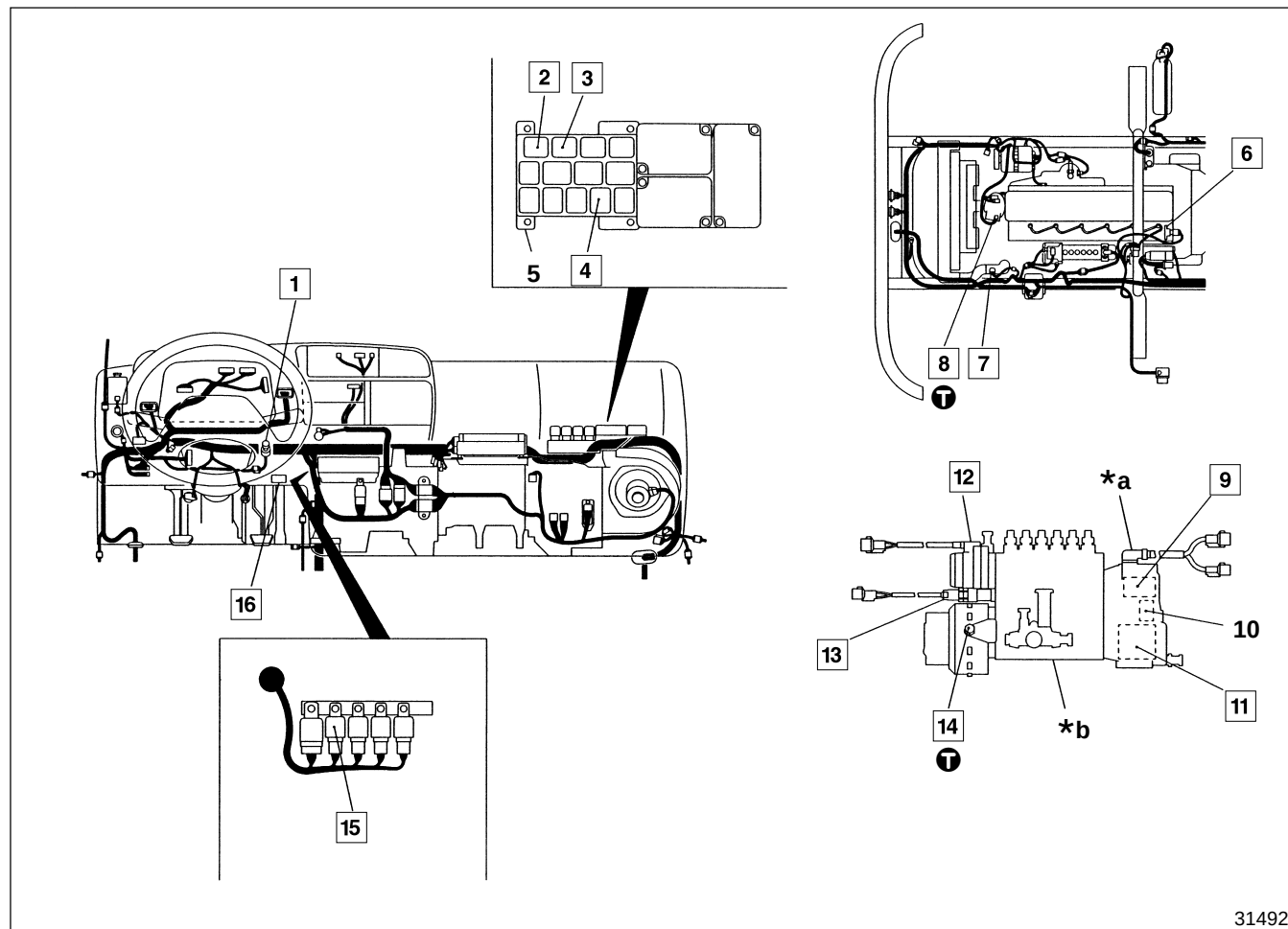
- Clean the seat of nozzle **11** using cleaning needle **D** of  cleaning tool.
- Use FUSO carbon remover to remove hard-to-remove, burnt-on carbon deposits.



[Inspection]

- Immerse needle valve **10** and nozzle **11** in diesel fuel (cleaning solvent) and clean them thoroughly.
- Check and see if needle valve **10** drops by its own weight into the nozzle from the position where a third of its length is pulled out. (Repeat this several times rotating the needle valve.)
- If needle valve **10** does not drop smoothly, repeat cleaning and repeat the test. If any fault is still found, replace both the needle valve and nozzle **11** together as a set.

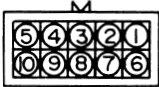
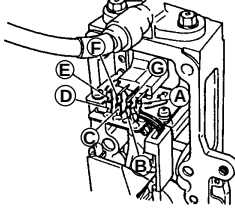
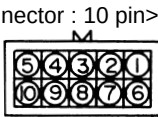
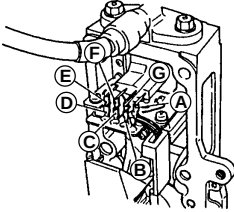
INSPECTION OF OTHER DEVICES



31492

- | | |
|---|-------------------------------------|
| 1 Idling speed adjustment potentiometer | 12 Pre-stroke actuator |
| 2 Pre-stroke cut relay | 13 Sub control rack position sensor |
| 3 Transmission neutral relay | 14 Engine speed sensor |
| 4 Exhaust brake relay | 15 Accelerator relay < A/T > |
| 5 Relay box | 16 Emergency engine stop button |
| 6 Boost pressure sensor | |
| 7 Boost temperature sensor | |
| 8 Engine coolant temperature sensor | |
| 9 Control rack position sensor | |
| 10 Backup engine speed sensor | |
| 11 Linear DC motor | |
- *a : Electronic governor
 *b : Injection pump assembly
 M/T : Manual transmission
 A/T : Automatic transmission

Service standards

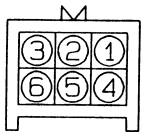
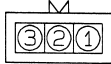
Location	Maintenance item			Standard value	Limit	Remedy
1	Output voltage of idling speed adjustment potentiometer  16184	②-③	Knob pulled	1 to 3 V	—	Replace
			Knob pushed	3.6 to 4.3 V	—	
7	Resistance value of boost temperature sensor		0°C {32°F}	5880 ± 588 Ω	—	Replace
			20°C {68°F}	2455 ± 245 Ω	—	
			80°C {176°F}	322 ± 32 Ω	—	
8	Engine coolant temperature sensor	Between terminal and body	20°C {68°F}	(3.25 kΩ)	—	Replace
			40°C {104°F}	(1.5 kΩ)	—	
			60°C {140°F}	(620 ± 62 kΩ)	—	
9	Resistances of control rack position sensor	<Connector : 3 pin>  16165	③-④ <3 pin>	31.5 to 36.5 Ω	—	Repair or replace the injection pump assembly. ★
			③-⑨ <10 pin>	18.0 to 21.0 Ω	—	
		<Connector : 10 pin>  16160	④-⑨	13.5 to 15.5 Ω	—	
			<Governor actuator>  24816	⑥-⑦	31.5 to 36.5 Ω	
		⑥-⑨		18.0 to 21.0 Ω	—	
		⑦-⑨		13.5 to 15.5 Ω	—	
11	Resistances of linear DC motor	<Connector : 3 pin>  16165	①-②	9.0 to 9.8 Ω	—	Repair or replace the injection pump assembly. ★
		<Connector : 10 pin>  16160	①-②		—	Repair or replace the injection pump assembly. ★
		<Governor actuator>  24816	①-②		—	Repair or replace the injection pump assembly. ★

The values in () are reference values.

* : Contact your MFTA representative for current injection pump repair and replacement procedures.

INSPECTION OF OTHER DEVICES

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
12	Resistances of pre-stroke actuator (measured at connector)	 13714	②-③	5.5 to 6.1 Ω	Repair or replace the injection pump assembly. *
			①-③	11.0 to 12.2 Ω	
			①-②	5.5 to 6.1 Ω	
			④-⑤	2.45 to 2.95 Ω	
13	Resistances of sub control rack position sensor	 13725	①-④	92.5 to 101.5 Ω	Repair or replace the injection pump assembly. *
			①-③	92.5 to 101.5 Ω	
			③-④	185 to 203 Ω	
14	Resistances of engine speed sensor (at 25°C {77°F})	 14013	①-②	2.1 to 2.5 k Ω	Replace
	Gap between the engine speed sensor and timer housing protrusion			0.8 to 1 {0.031 to 0.039}	Adjust

* : Contact your MFTA representative for current injection pump repair and replacement procedures.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

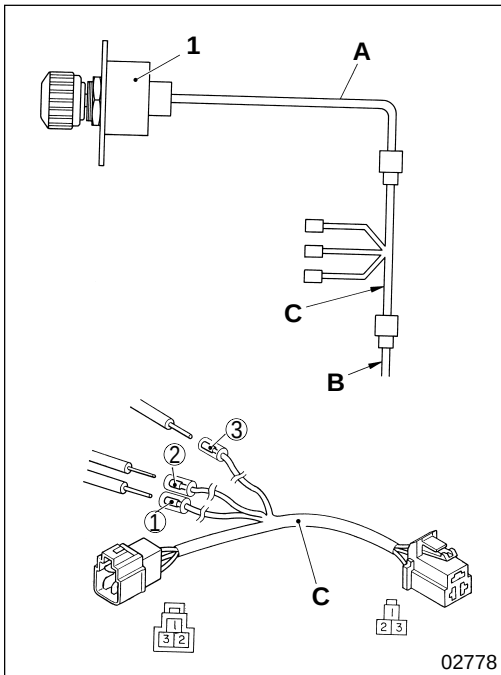
Location	Parts to be tightened	Tightening torque	Remarks
8	Coolant temperature sensor	34 ± 6.9 {25 ± 5, 3.5 ± 0.7}	—
14	Engine speed sensor lock nut	24 to 35 {17 to 26, 2.4 to 3.6}	—

◆ Service procedure

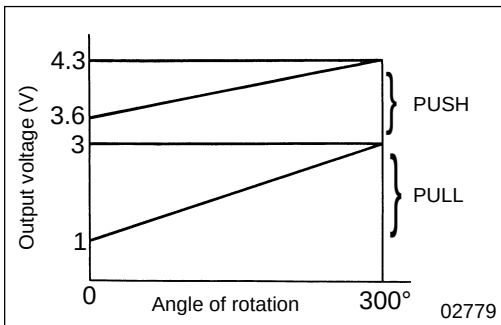
1 Inspection of idling speed adjustment potentiometer

- Disconnect the harness **A** of the idling speed adjustment potentiometer **1** from the cab-side harness **B**. Then, connect an inspection harness **C** between harnesses **A** and **B**. (The inspection harness must be made specially for this procedure.)
- Turn the starter switch to the ON position.
- Check the output voltages of the idling speed adjustment potentiometer **1** in accordance with the following table.

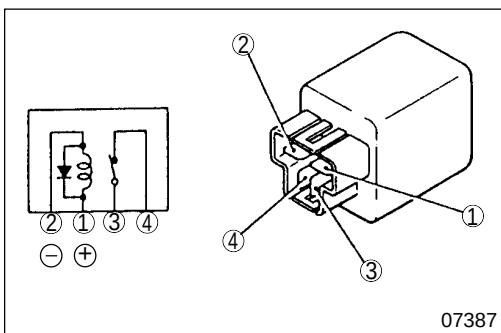
Item	Connector terminal		
	Accelerator pedal position sensor inspection harness		
	①: Power supply (+)	②: GND (-)	③: Output (+)
Output voltage with knob pulled		⊖	⊕
Output voltage with knob pushed			



Output characteristics



- If the output voltages are out of specification, replace the idling speed adjustment potentiometer **1**.



2 3 Inspection of pre-stroke cut relay and transmission neutral relay (normally-closed type with 4 pin connector)

- Perform continuity checks in accordance with the following table.

	①	②	③	④
Not energized	○	○	○	○
Energized	⊕	⊖	(- - - - -)	(- - - - -)

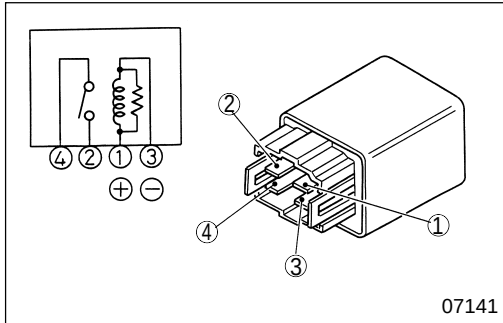
○ — ○ : Continuity exists between terminals.

⊕ — ⊖ : Terminals across which 12 V DC is applied

(- - - - -) : Continuity no longer exists between terminals

- Replace the relay if any abnormality is evident.

INSPECTION OF OTHER DEVICES



4 15 Inspection of exhaust brake relay and accelerator relay

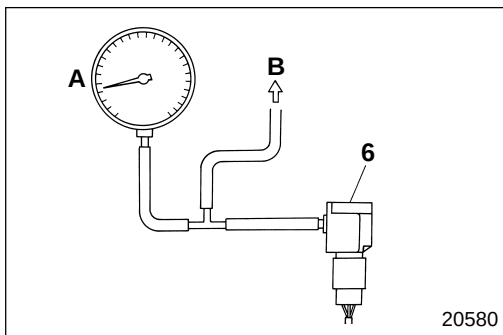
- Check the electrical conduction and operation according to the table below.

	①	②	③	④
Electric current not supplied	○	○	○	○
Electric current supplied	⊕	○	○	○

○—○ Electric conduction between terminals.

⊕—○ Terminals applied with 12 VDC.

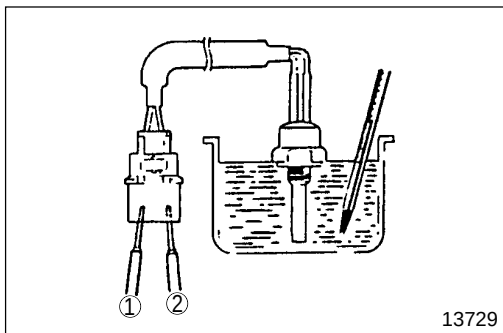
- If an abnormality is found, replace the relay.



6 Inspection of boost pressure sensor

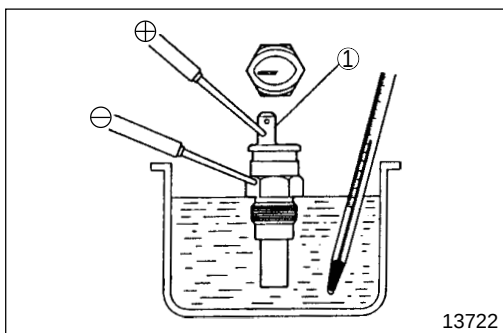
- Install pressure gauge **A** for boost pressure measurement as shown in the diagram.
- Connect the MUT-II P13-42
- Set the MUT-II for boost pressure measurement
- Start the engine. Compare the value displayed on the MUT-II and the value indicated by pressure gauge **A**. If the values are different, replace boost pressure sensor **6**.

B : To the inlet manifold



7 Inspection of boost temperature sensor

- Place boost temperature sensor **7** in glycerin in a container.
- Raise the glycerin temperature to the specified values and stir the glycerin.
- Measure the resistance between terminals ① and ②.
- If the measured value deviates from the standard value, replace boost temperature sensor **7**. Gr 15



8 Inspection of engine coolant temperature sensor

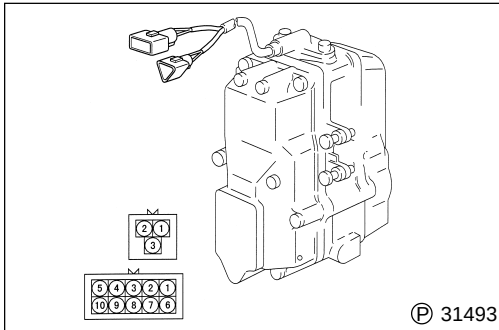
- Put the engine coolant temperature sensor **8** in a container of engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil to ensure that it heats up evenly.
- At each of the specified temperatures, measure the resistance between the terminal ① and body of the engine coolant temperature sensor **8**.
- If the measurements are out of specification, replace the engine coolant temperature sensor **8**.

9 Inspection of control rack position sensor

Perform the following inspections. If any abnormality is evident, have inspection and repair performed by the nearest MFTA Dealer.

● Measurements on connectors

Measure the resistances between the following terminals: 3 pin connector's ③ and 10 pin connector's ④; 10 pin connector's ③ and ⑨; ④ and ⑨.



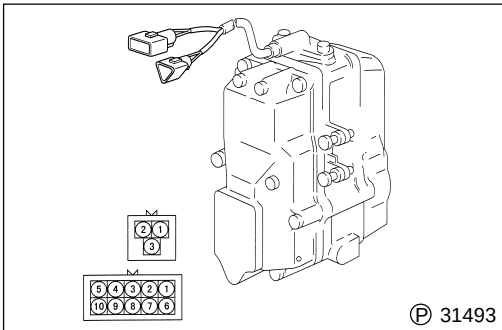
INSPECTION OF OTHER DEVICES

11 Inspection of linear DC motor

Perform the following inspections. If any abnormality is evident, have inspection and repair performed by the nearest MFTA Dealer.

(1) Measurements on connectors

Measure the resistance between terminals ① and ② on each connector.

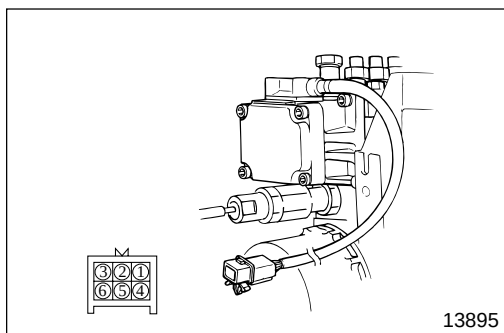


12 Inspection of pre-stroke actuator

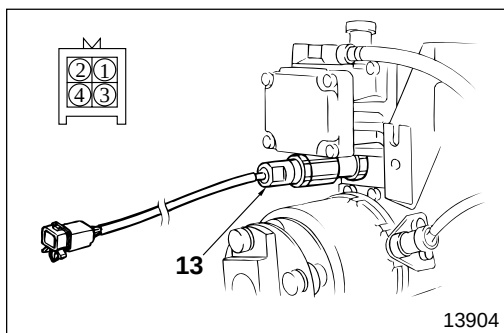
Perform the following inspections. If any abnormality is evident, have inspection and repair performed by the nearest MFTA Dealer.

CAUTION ⚠

The pre-stroke actuator 12 must be inspected when the engine is cold.

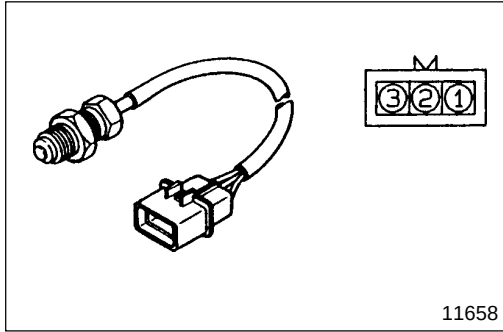
**(1) Measurements on connectors**

Measure the resistance between terminals ② and ③; ① and ③; ① and ②; ④ and ⑤.

**13 Inspection of sub control rack position sensor**

- Measure the resistances between the following terminals: ① and ④; ① and ③; ③ and ④.
- If any resistance is out of specification, replace the sub control rack position sensor 13.
- Have replacement performed by the nearest MFTA Dealer.

INSPECTION OF OTHER DEVICES



14 Engine speed sensor

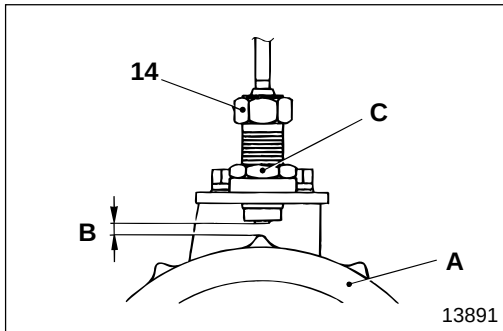
[Inspection]

(1) Main Unit

- Measure the resistance between terminals ① and ②.
- If the measured value deviates from the standard value, replace engine speed sensor 14.

CAUTION ⚠

Be sure to check the tightening torque of engine speed sensor 14. If the tightening torque is insufficient, the sensor may not output a signal.



(2) Clearance between protrusions

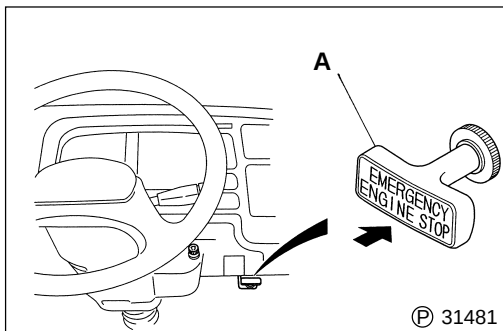
If the clearance between engine speed sensor 14 and timer housing protrusion A deviates from the standard value, adjust by following the procedure below.

[Adjustment]

- Loosen lock nut C, and rotate engine speed sensor 14 to adjust the clearance.
- After adjustment, tighten lock nut C to the specified torque.

CAUTION ⚠

If clearance B between engine speed sensor 14 and timer housing protrusion A is too large, the sensor may not output a signal. If the clearance is too small, the sensor may contact the protrusions.

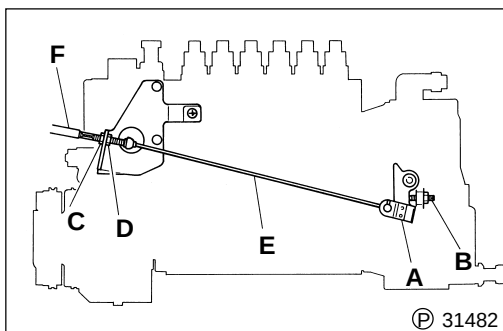


16 Inspection of emergency engine stop button

- Push emergency engine stop button 16 all the way.
- In this step, make sure that stop lever A of the governor is in contact with stopper bolt B.
- If the stop lever does not contact the stopper bolt, turn nut C until they contact, and tighten nut D to secure it in place.
- Inner wire E of stop cable F should be taut. If not, make adjustment.

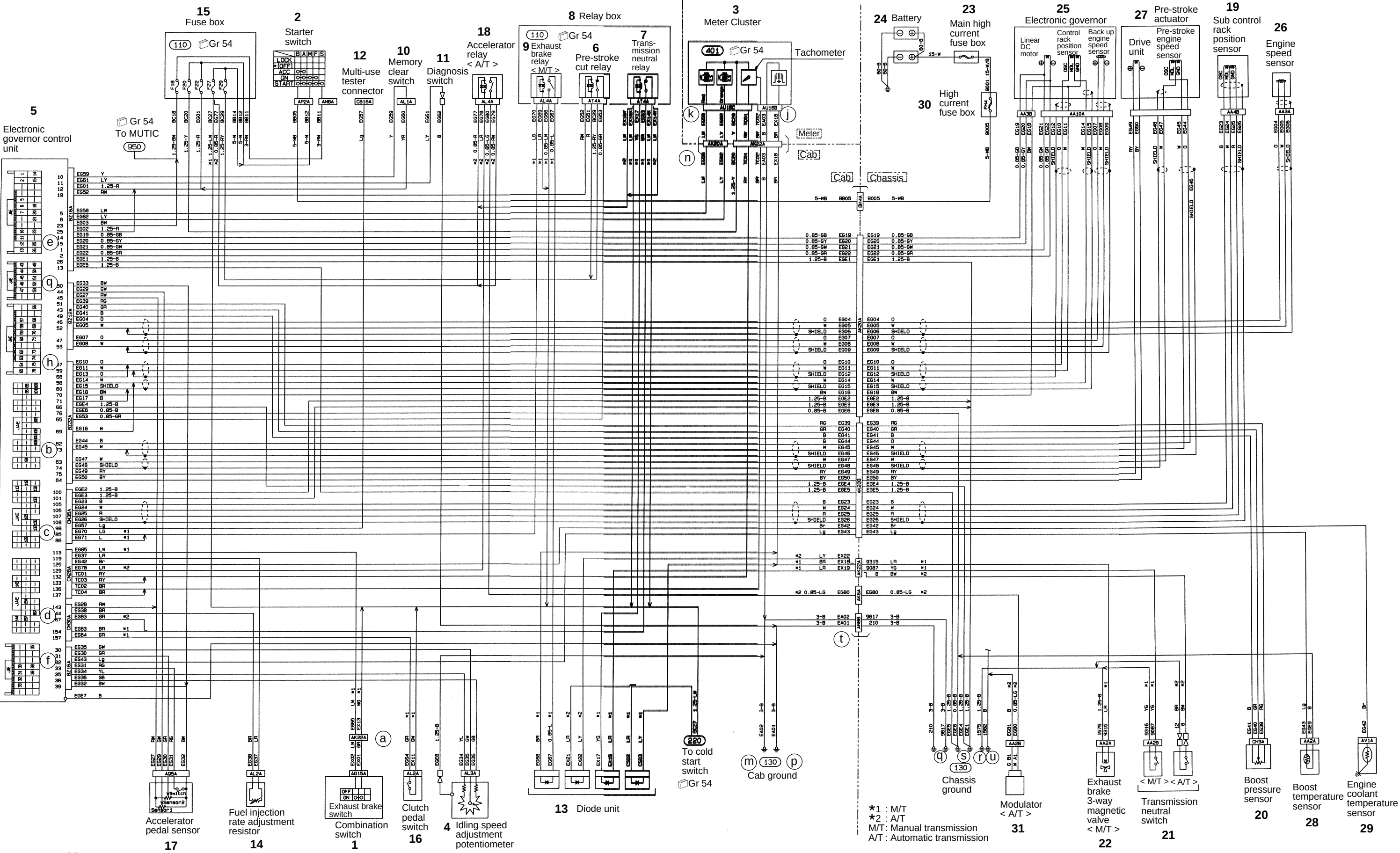
CAUTION ⚠

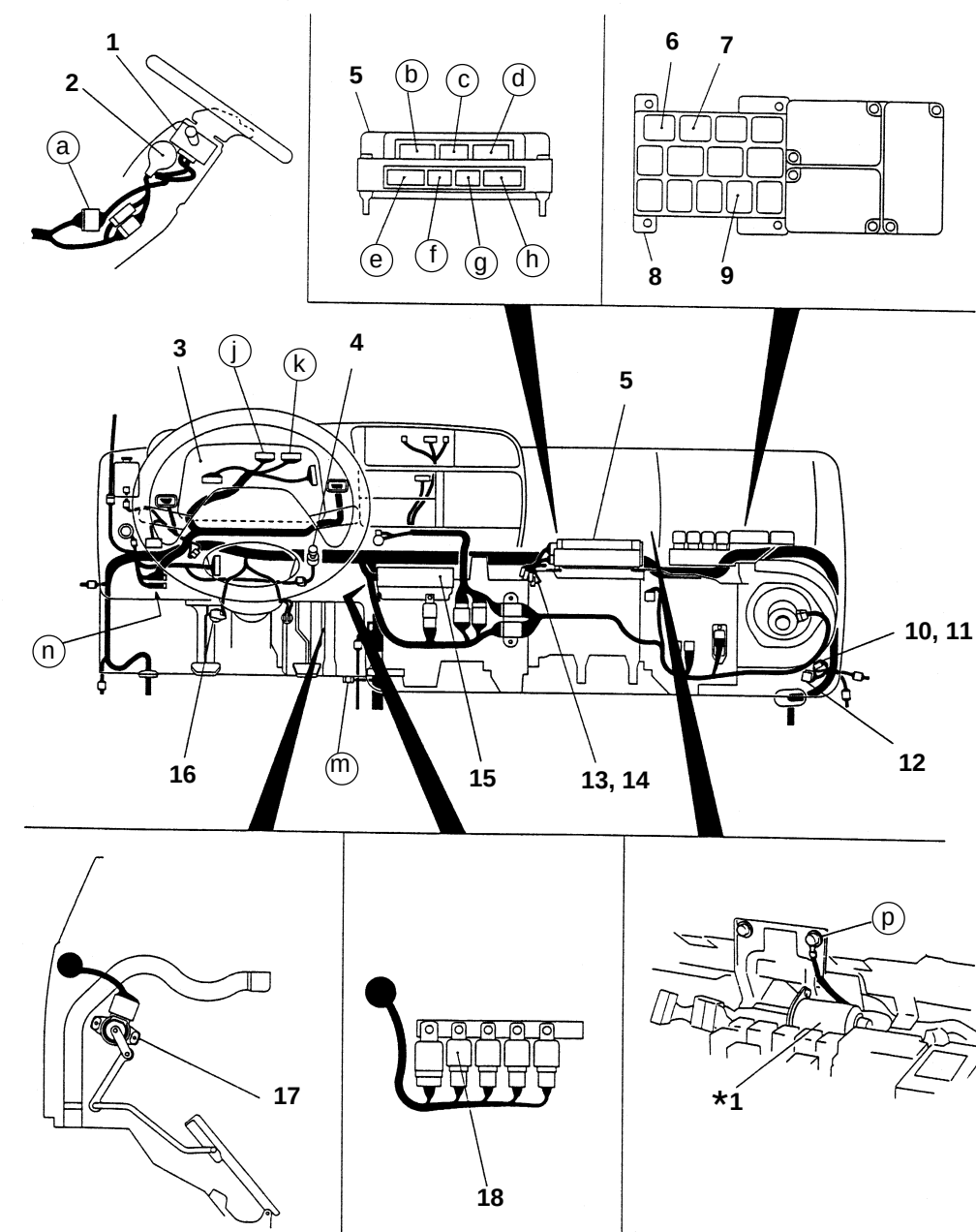
Be careful not to make the tension of inner wire E too high, since excess tension prevents stop lever A from fully contacting stopper bolt B.



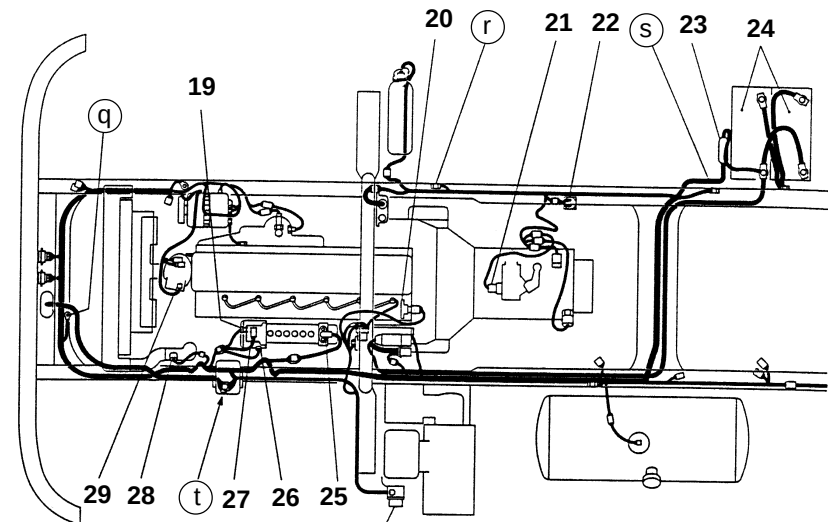
MEMO

ELECTRIC CIRCUIT AND PART INSTALLATION LOCATIONS

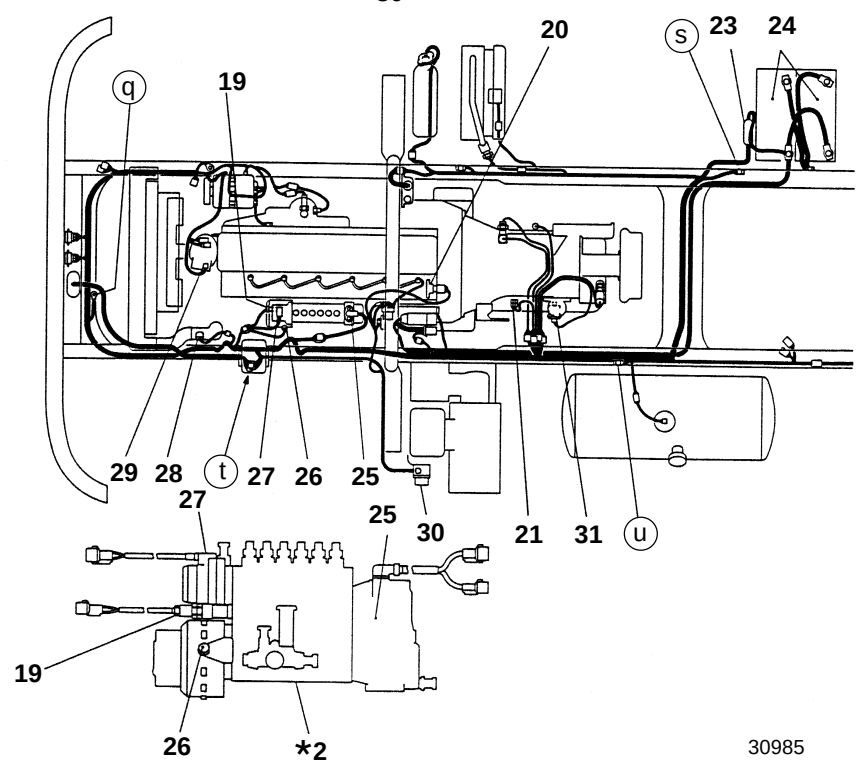




< Manual transmission >



< Automatic transmission >



- 1 Combination switch
- 2 Starter switch
- 3 Meter cluster
- 4 Idling speed adjustment potentiometer
- 5 Electronic governor control unit
- 6 Pre-stroke cut relay
- 7 Transmission neutral relay
- 8 Relay box
- 9 Exhaust brake relay
- 10 Memory clear switch
- 11 Diagnosis switch
- 12 Multi-use tester connector
- 13 Diode unit
- 14 Fuel injection rate adjustment resistor
- 15 Fuse
- 16 Clutch pedal switch
- 17 Accelerator pedal sensor
- 18 Accelerator relay < A/T >
- 19 Sub control rack position sensor
- 20 Boost pressure sensor
- 21 Transmission neutral switch
- 22 Exhaust brake 3-way magnetic valve < M/T >
- 23 Main high current fuse box
- 24 Battery
- 25 Electronic governor
- 26 Engine speed sensor
- 27 Pre-stroke actuator
- 28 Boost temperature sensor
- 29 Engine water temperature sensor
- 30 High current fuse box
- 31 Modulator

- *1 : Wiper motor
- *2 : Injection pump assembly
- M/T : Manual transmission
- A/T : Automatic transmission

30985



FH

Service Manual

Group 14

Cooling

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

GROUP 14 COOLING

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
TROUBLESHOOTING	6
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Replacing Coolant and Cleaning Cooling System	8
• Air Bleeding of Cooling System	10
• Gas Leakage Test	10
RADIATOR AND FAN SHROUD	12
SURGE TANK	16
COOLING FAN AND V-BELT	18
WATER PUMP	21
THERMOSTAT	22

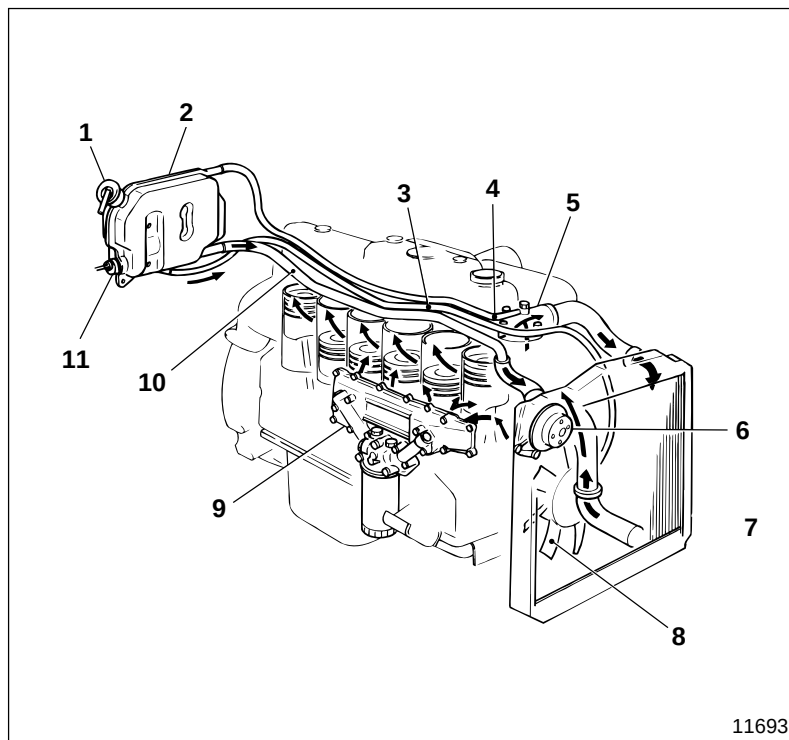
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item	Specifications
Kind of cooling system	Forced water circulation system
Water pump type	Belt-driven involute type
Thermostat type	Wax-pellet, bottom bypass type (with jiggling valve)
Automatic cooling fan coupling type	Continuous control type
Radiator type	Tube and corrugated fin type
Coolant capacity	L {qts}
	21 {22}

STRUCTURE AND OPERATION

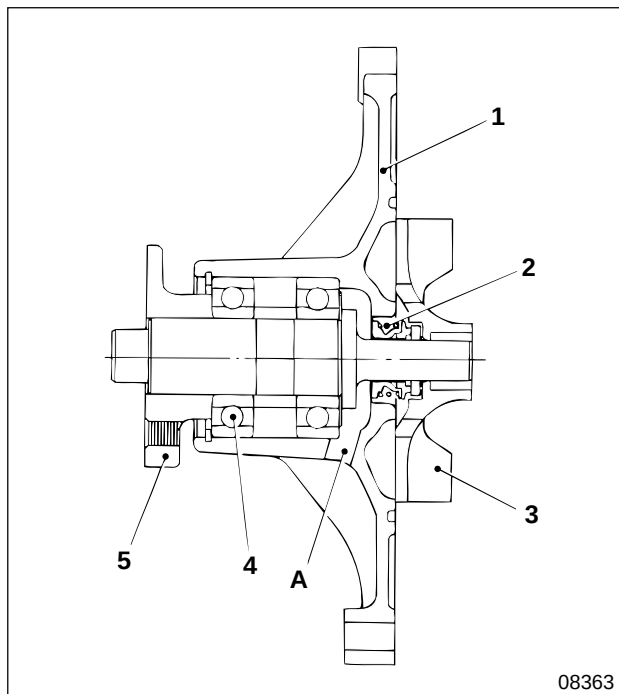
Cooling System (Flow of Coolant)



- 1 Pressure cap
- 2 Surge tank
- 3 Suction pipe
- 4 Air pipe
- 5 Thermostat
- 6 Water pump
- 7 Radiator
- 8 Cooling fan
- 9 Oil cooler
- 10 Water inlet pipe
- 11 Water level sensor

Surge tank **2** is installed at a higher position than radiator **7** and automatically adds coolant when the coolant level in the radiator drops.

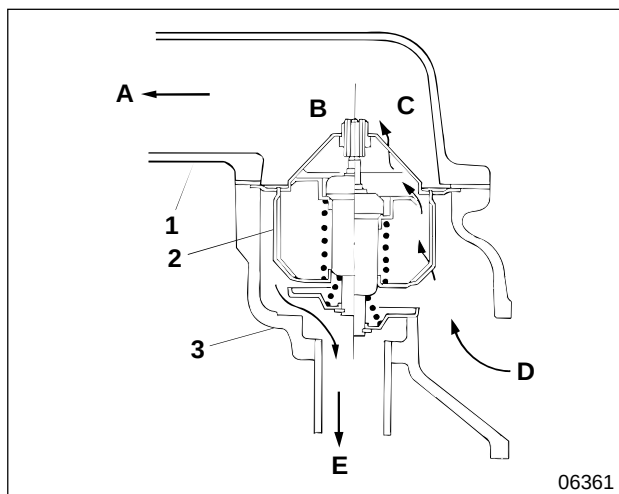
Water Pump



- 1 Case
- 2 Unit seal
- 3 Impeller
- 4 Ball bearing
- 5 Flange

A : Drain hole

Thermostat



- 1 Thermostat cover
- 2 Thermostat
- 3 Thermostat case

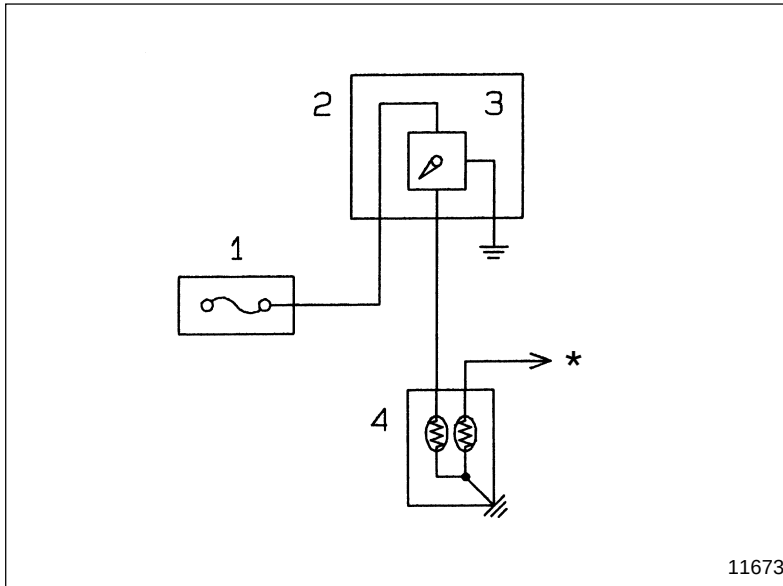
A : To radiator
 B : When low coolant temperature
 C : When high coolant temperature
 D : From cylinder head
 E : To water pump

Thermostat 2 is a bottom bypass type that uses wax pellets as its regulating element. As the wax changes its form from solid to liquid according to changes in temperature, the volume of the wax changes. Therefore, the position of the valve, changed by the coolant temperature, regulates the flow of the coolant to the radiator and water pump (bypass side) and controls the coolant temperature.

STRUCTURE AND OPERATION

Cooling System Electric Circuit

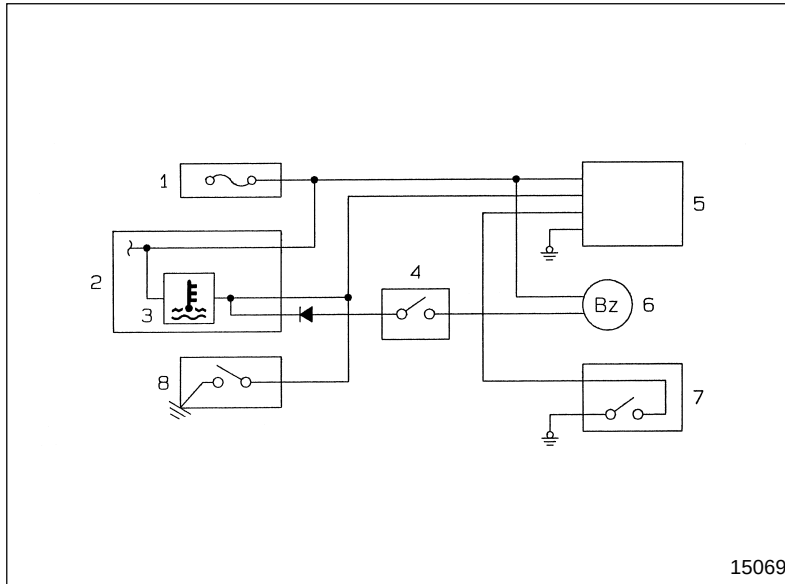
● Water temperature gauge circuit



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

* : To cold start switch

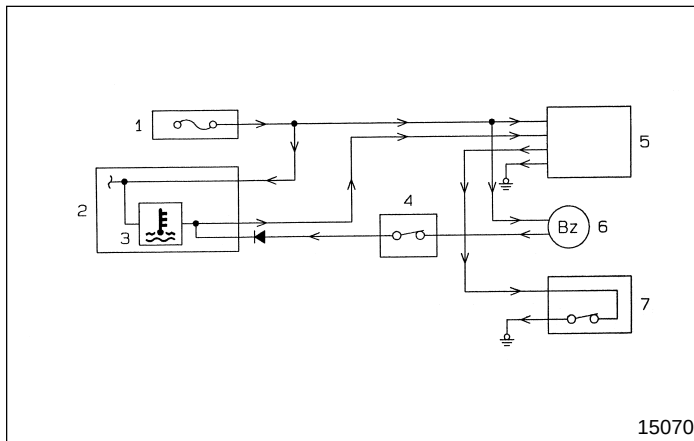
● Water level sensor and overheating circuit



- 1 Fuse box
- 2 Meter cluster
- 3 Water level warning lamp
- 4 Parking brake switch
- 5 Water level control unit
- 6 Buzzer
(Buzzer does not work when the parking brake is engaged.)
- 7 Water level sensor
- 8 Overheating switch

15069

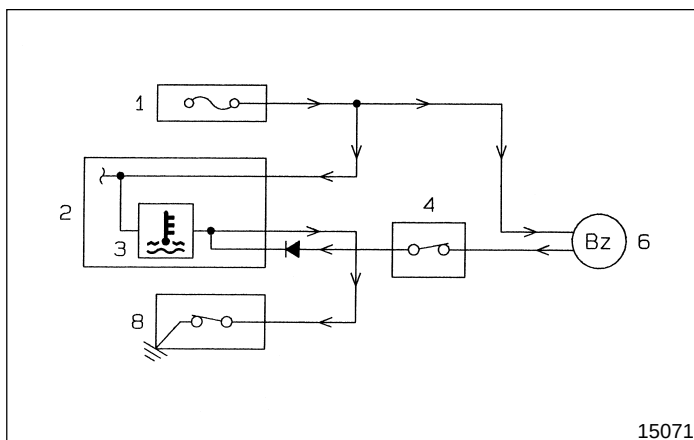
When this circuit detects insufficient coolant or extremely high coolant temperature, it lights water level warning lamp **3** and sounds buzzer **6** to warn the driver of the abnormal conditions.



15070

When water level sensor is activated

- 1→5→7→Ground
- Water level control unit **5** detects insufficient coolant.
- 1→3→5→Ground
- When the sensor is activated, water level warning lamp **3** lights up and buzzer **6** sounds.



15071

When overheating switch is activated

- 1→3→8→Ground
- When the switch is activated, water level warning lamp **3** lights up and buzzer **6** sounds.

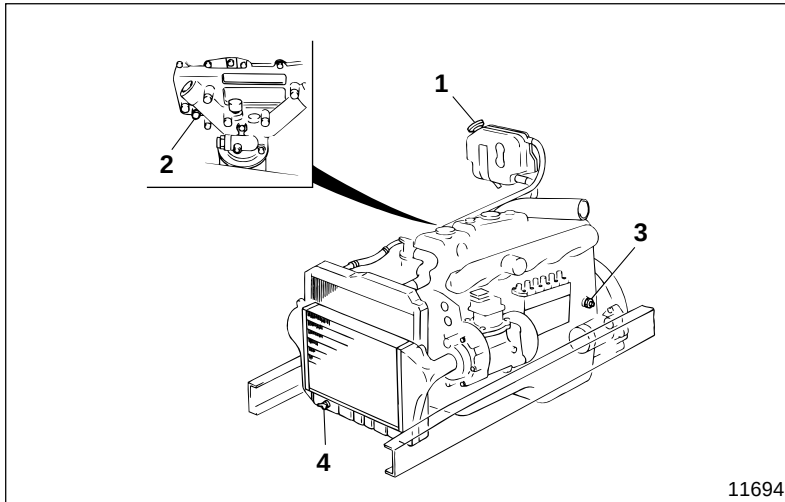
TROUBLESHOOTING

Symptoms		Overheating (Low cooling effect)	Overcooling	Noise occurs	Coolant loss excessive	Remarks
Possible causes						
V-belt	Loose or damaged	☐		☐		
	Tension excessive			☐		
	Oily	☐				
Water pump	Water pump installation faulty	☐		☐	☐	
	Unit bearing faulty	☐		☐		
	Impeller faulty	☐		☐		
	Unit seal faulty	☐			☐	
	Unit bearing-to-flange and to-impeller fitting loose	☐		☐		
Thermostat	Case installation faulty	☐			☐	
	Valve opening temperature too high, valve remains closed	☐				
	Valve opening temperature too low, valve remains open		☐			
	Gasket faulty	☐			☐	
	Water level sensor leaking water	☐			☐	
Radiator	Space between core and fin clogged	☐				
	Core cracked or soldered part separated	☐			☐	
Surge tank	Pressure cap airtightness poor	☐				
	Water level sensor leaking water	☐			☐	
Cooling fan	Fan shroud installation faulty	☐		☐		
Automatic cooling fan coupling	Bearing faulty	☐		☐		
	Bimetal damaged	☐				
	Bimetal contaminated with foreign particles	☐	☐			
	Silicon oil leaking	☐		☐		
Oil cooler	Oil cooler mounted incorrectly	☐			☐	📖 Gr 12
	Gasket faulty	☐			☐	📖 Gr 12
Cylinder head	Cylinder head mounted incorrectly	☐			☐	📖 Gr 11
	Gasket faulty	☐			☐	📖 Gr 11
Coolant quantity insufficient		☐				
Coolant passage furred and clogged		☐				
Water hose installation faulty		☐			☐	
Exterior temperature extremely cold			☐			

MEMO

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Replacing Coolant and Cleaning Cooling System



- 1 Pressure cap
- 2 Oil cooler drain plug
- 3 Crankcase drain plug
- 4 Radiator drain plug

11694

Tightening torque

Unit : N·m {lb·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Oil cooler drain plug	34 to 39 {25 to 29, 3.5 to 4.0}	—
3	Crankcase drain plug	98 {12, 10}	—

Using the radiator for a long period of time without cleaning it will cause overheating because rust and scale deposits will accumulate inside the cooling system. Periodical cleaning is recommended.

Draining coolant

First loosen pressure cap 1, to lower the pressure in the cooling system, before draining coolant.

WARNING

- You must make sure that the engine coolant is cold before draining it so as not to scald yourself.
- It is dangerous to open pressure cap 1, when the coolant temperature is high, without taking due care because the hot water would spray out. Be sure to cover the pressure cap with a cloth and loosen slowly to bleed the pressure before opening fully.

Cleaning procedure

- Keep the coolant temperature at approximately 90°C {194°F} so that the thermostat valve remains open and the coolant continues to circulate in the radiator.
- For the sake of convenience you can raise the coolant temperature quickly by covering the front of the radiator with corrugated cardboard or something similar.
- Set the temperature adjusting lever of the heater controller at maximum so that the coolant can circulate freely in the heater piping area.
- In cases where a great amount of rust has accumulated it often happens that as a result of cleaning the radiator starts leaking. Conduct a thorough check for leakage after cleaning.
- Soft water to be used should have the following properties.

CAUTION

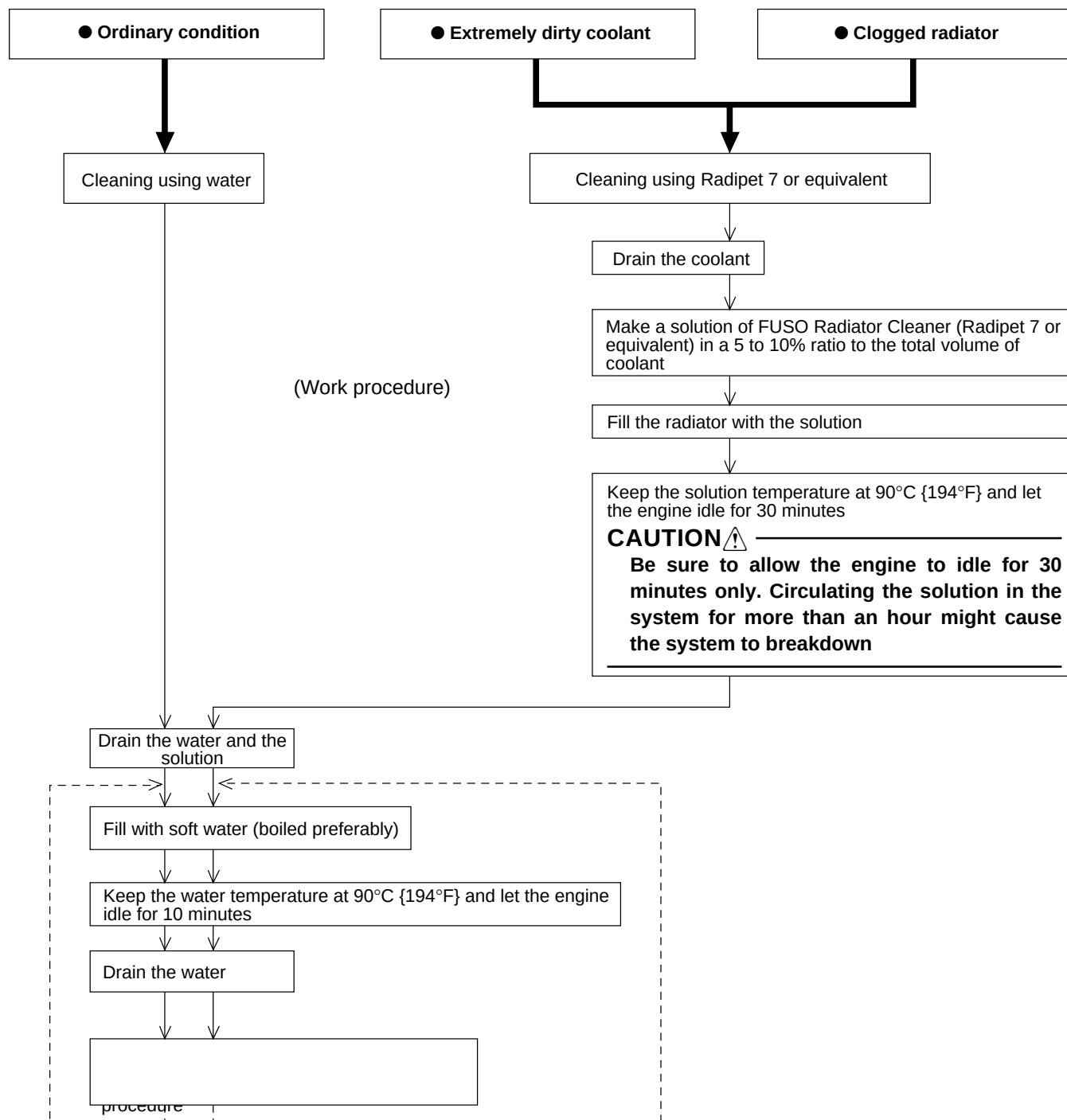
Do not use hard water as it causes scale and rust.

Required properties of soft water

Total hardness	300 ppm or less
Sulfate SO ₄ ⁻	100 ppm or less
Chloride Cl ⁻	100 ppm or less

Total dissolved solids	500 ppm or less
pH	6 to 8

Method of cleaning the cooling system depends on its condition.



DANGER ⚠

If FUSO DIESEL LONG LIFE COOLANT solution gets in your eyes accidentally, you must immediately rinse your eyes with copious amounts of water, and be sure to consult a doctor.

WARNING ⚠

FUSO DIESEL LONG LIFE COOLANT is inflammable. Do not put it near naked lights.

NOTE

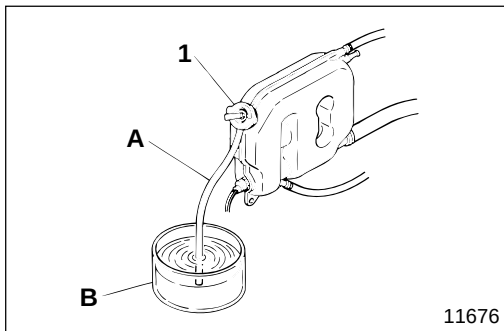
- After cleaning with solution, fill with coolant as quickly as possible.
- To prevent freezing of the coolant and corrosion of the cooling system, use specified coolant solution of FUSO DIESEL LONG LIFE COOLANT. (See the Owner's Handbook for use of these materials.)

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Air Bleeding of Cooling System

- Remove the pressure cap and keep the coolant temperature at 90°C {194°F} while letting the engine idle and bleed the air out completely. Keep the temperature adjusting lever of the heater controller at maximum so that the coolant can circulate freely in the heater piping area.
- After completing adequate air bleeding of the cooling system, refill coolant sufficiently enough for the surge tank.

Gas Leakage Test

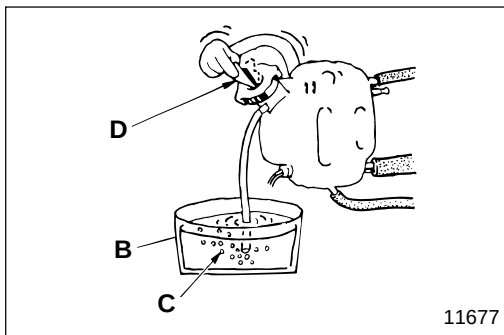


Air or exhaust gas in the coolant increases corrosion and rusting in the system. Therefore, carry out the following test:

- Remove surge tank pressure cap **1** and check if the coolant level comes up to the lip of the tank.
- Put the end of overflow pipe **A** into water tank **B**.

WARNING ⚠

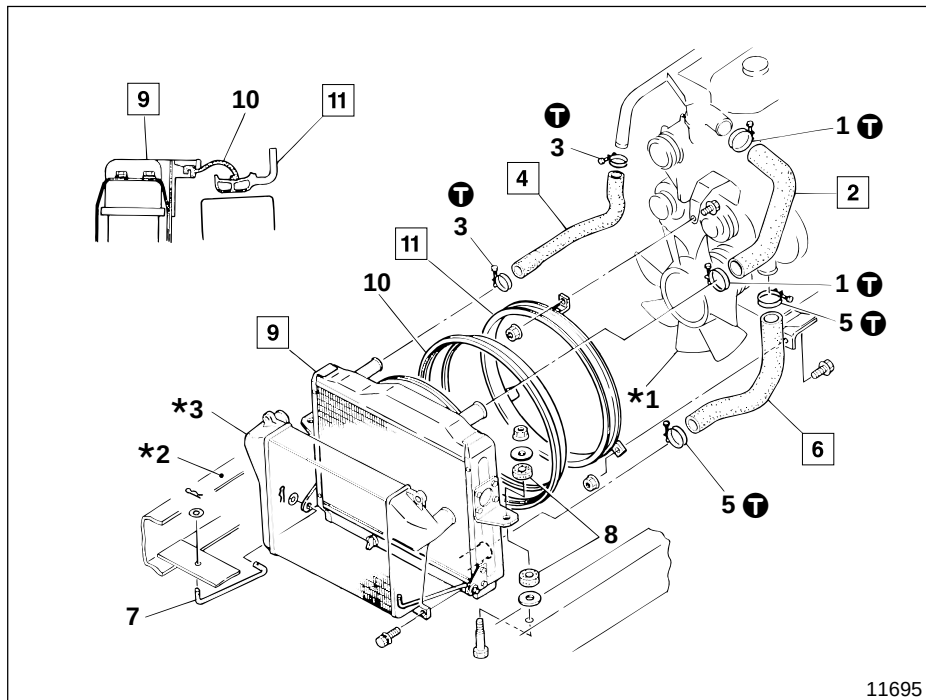
Be sure that the coolant temperature is low enough so that hot coolant does not spout out when you loosen pressure cap **1.**



- Run the engine to bring the coolant temperature to approximately 90°C {194°F}.
- Lift lever **D** of pressure cap **1**.
- If air bubbles **C** continuously rise in water tank **B**, it is an indication that air or exhaust gas has gotten into the coolant.
- If it is air, it is possible that the cylinder head bolts, the water pump mounting bolts or the hose connections are loose, or that the hose is damaged.
- If it is exhaust gas, it is possible that the cylinder head gaskets are damaged, or that the cylinder head is cracked.

MEMO

RADIATOR AND FAN SHROUD



● Removal sequence

- 1 Hose clamp
- 2 Outlet hose
- 3 Hose clamp
- 4 Supply hose
- 5 Hose clamp
- 6 Inlet hose
- 7 Support rod
- 8 Rubber sheet
- 9 Radiator assembly
- 10 Shroud seal
- 11 Fan shroud

P14-14

- *1 : Cooling fan
 *2 : Frame
 *3 : Intercooler Gr 15

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
11, *1	Clearance between fan shroud and cooling fan tip	4.5 to 8.3 {0.18 to 0.33}	—	Adjust

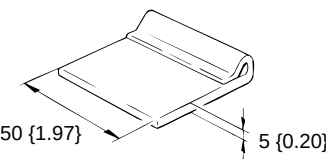
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 3, 5	Hose clamp	3.9 {2.9, 0.4}	—

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
11	Tip clearance spacer 	MC019470	Adjustment of clearance between fan shroud and cooling fan

00189

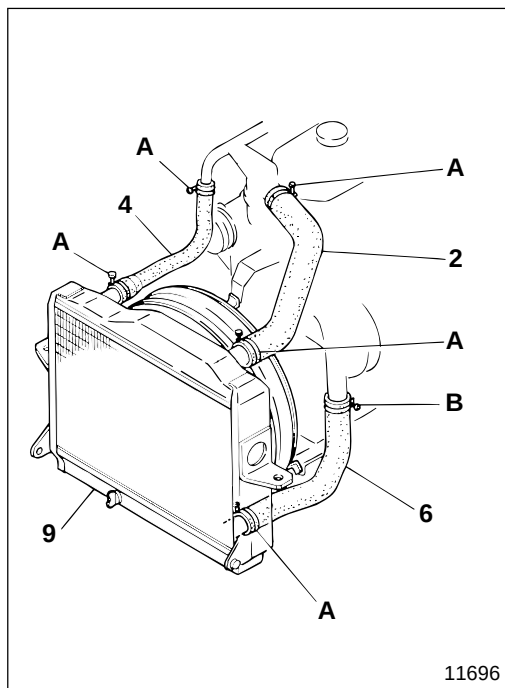
◆ Service procedure

2 4 6 Installation of hose

The depth of hose installation is as follows.

A : 35 mm {1.38 in.}

B : 40 mm {1.58 in.}

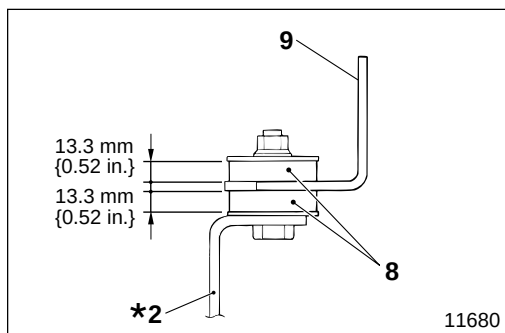


11696

9 Installation of radiator assembly

Tighten nuts until the thickness of rubber sheet 8 conforms to the specified value.

*2 : Frame

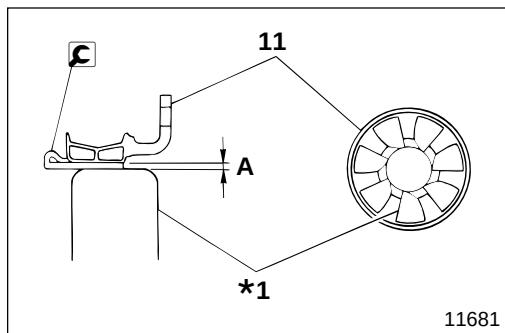


11680

11 Installation of fan shroud

Adjust using C tip clearance spacer so that clearance A conforms to the standard value all around the periphery.

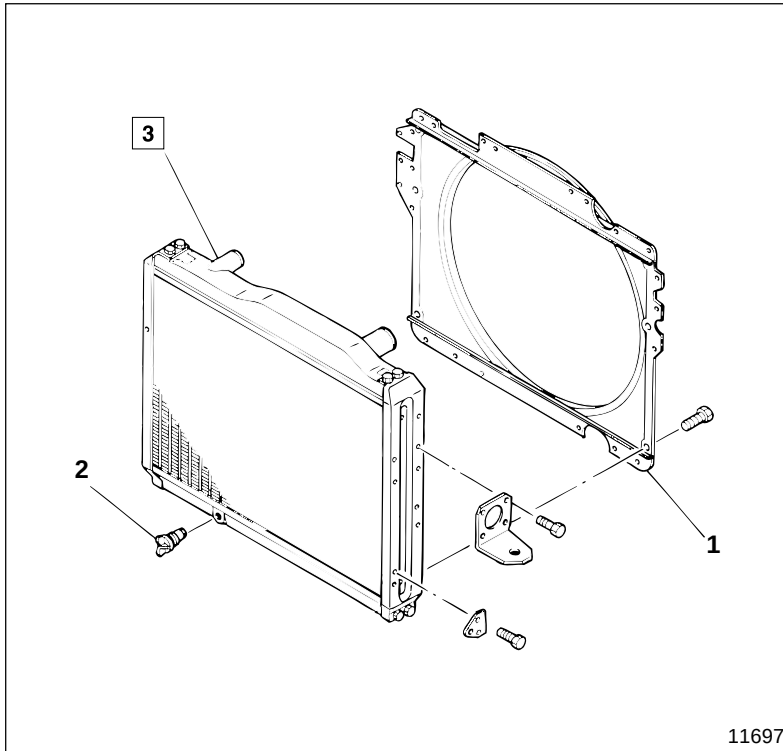
*1 : Cooling fan



11681

RADIATOR AND FAN SHROUD

Radiator Assembly



● Disassembly sequence

- 1 Radiator shroud
- 2 Drain cock
- 3 Radiator

● Assembly sequence

Follow the disassembly sequence in reverse.

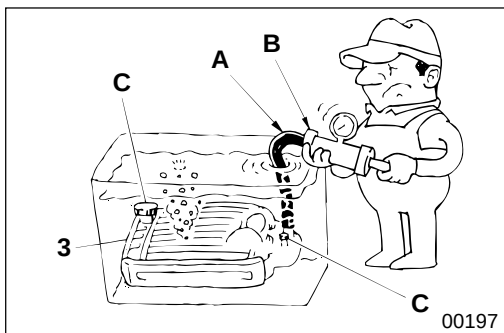
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
3	Radiator air leakage (Air pressure of 150 kPa {21 lbf/in ² , 1.5 kg/cm ² })	0 cm ³ {0 cu. in.}	—	Correct or replace

◆ Service procedure

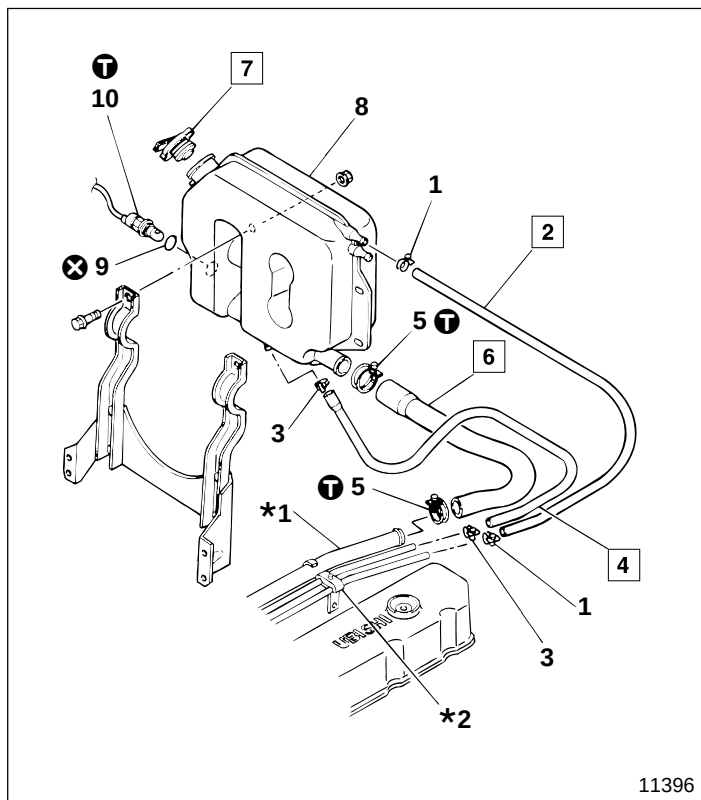
3 Inspection of radiator

- Install radiator cap tester **B** by connecting hose **A** to the upper tank, and insert plug **C**.
- Plug lower tank opening with plug **C**, and immerse the radiator in a water tank.
- Apply specified air pressure of 150 kPa {21 lbf/in², 1.5 kg/cm²} using cap tester **B**, and check if there is any air leakage.
- If you find air leakage, correct or replace radiator **3**.



MEMO

SURGE TANK



● Disassembly sequence

- 1 Clamp
- 2 Air hose
- 3 Clamp
- 4 Water hose
- 5 Clamp
- 6 Supply hose
- 7 Pressure cap
- 8 Surge tank
- 9 O-ring
- 10 Water level sensor  Gr 54

- *1 : Water inlet pipe
 *2 : Air and water suction pipe
 X : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
7	Pressure cap valve opening pressure	69±15 kPa {10±2.1 lbf/in ² , 0.7±0.15 kgf/cm ² }	—	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

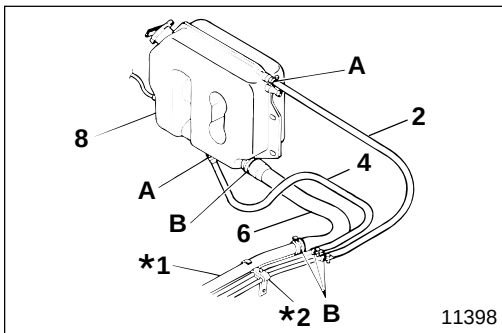
Location	Parts to be tightened	Tightening torque	Remarks
5	Clamp	3.9 {2.9, 0.4}	—
10	Water level sensor	2.9 to 3.9 {2.2 to 2.9, 0.3 to 0.4}	—

◆ Service procedure

2 4 6 Installation of hose

The depth of hose installation is as follows.

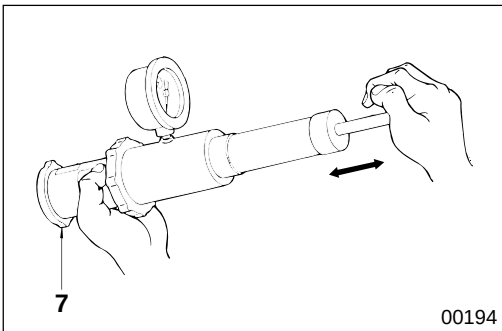
- A : 15 mm {0.59 in.}
B : 30 mm {1.18 in.}



7 Inspection of pressure cap

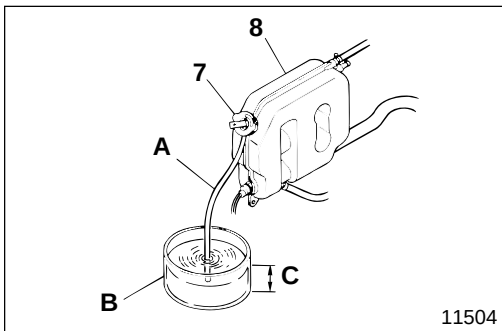
(1) Pressure valve opening pressure

If the measured value deviates from the standard value, replace pressure cap 7.



(2) Inspection of vent valve

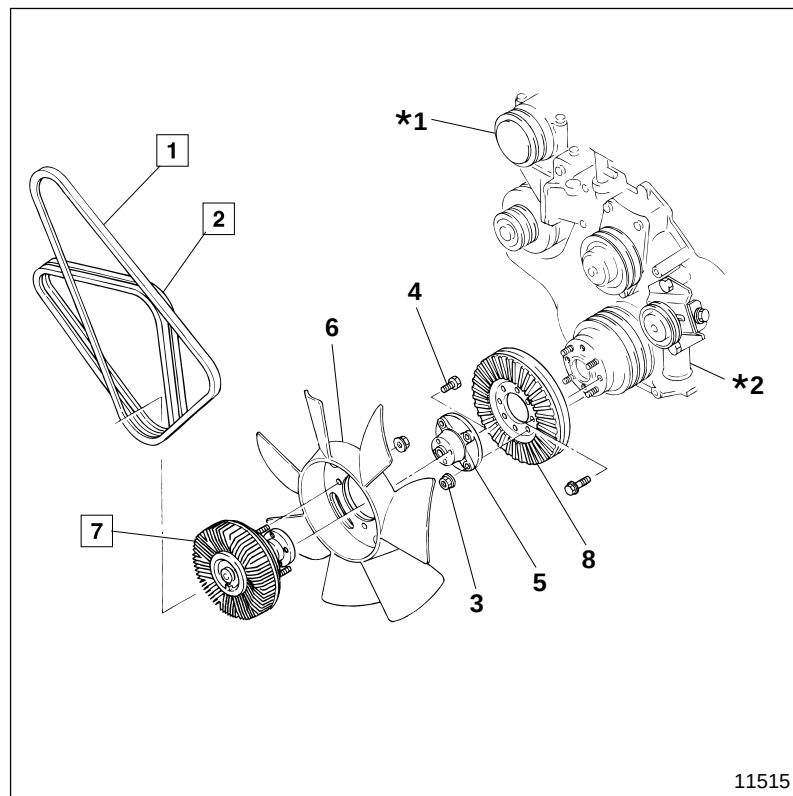
- Check that the coolant level comes up to the lip of surge tank 8. If the level is low, add coolant.
- Tighten pressure cap 7.
- Put the end of overflow hose A into water tank B.
- Check coolant level C of water tank B.
- Run the engine at a high revolution to increase the coolant temperature.
- Stop the engine when some of the coolant in surge tank 8 has overflowed into water tank B.
- Leave things for a while.
- Check the time it takes for the coolant temperature to return to the ambient temperature, and check whether coolant level C in the tank is the same as before running the engine.
- If the coolant level has not returned to that before running engine, replace pressure cap 7.



NOTE

Do not remove pressure cap 7 before the coolant temperature decreases to the ambient temperature. If you do the coolant will not return to reservoir tank A because negative pressure in the radiator is lost.

COOLING FAN AND V-BELT



● Removal sequence

- 1 V-belt (Air-conditioner)
- 2 V-belt (Fan)
- 3 Nut
- 4 Bolt
- 5 Fan spacer
- 6 Cooling fan
- 7 Automatic cooling fan coupling
- 8 Torsional damper

*1 : Cooler compressor

*2 : Tension pulley

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- Be sure to replace automatic cooling fan coupling 7 as an assembly if it is faulty because it is a unit construction.
- Be sure to replace V-belts 2 as a set to maintain even tension between them.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	V-belt tension (Air-conditioner)	16 to 20 {0.63 to 0.79}	—	Adjust
2	V-belt tension (Fan)	12 to 16 {0.47 to 0.63}	—	Adjust

🔧 Special tools

Location	Tool name and shape	Part No.	Application
1, 2	Belt tension gauge 	MH062345	Measurement of tension of V-belt

03612

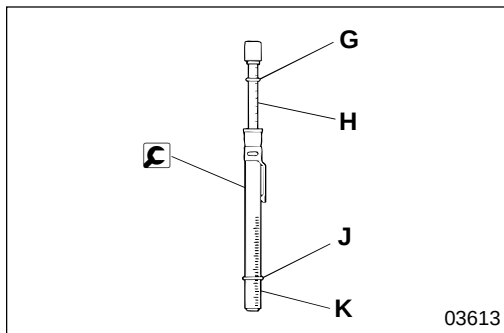
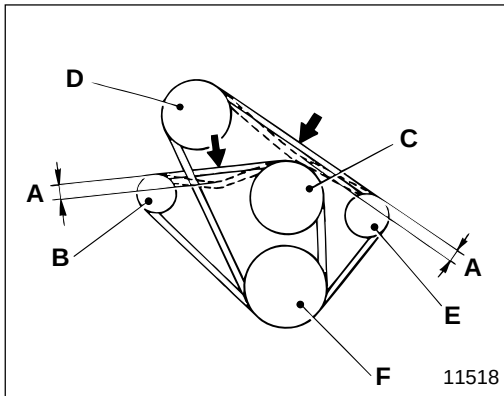
◆ Service procedure

1 2 V-belt

[Inspection]

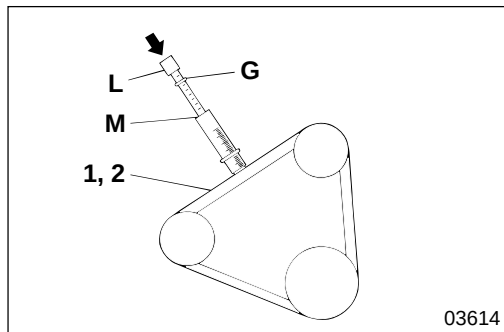
Measure the extent of flex **A** when the center of V-belts **1, 2** as illustrated is depressed with a force of approximately 98 N {72 lbf, 10 kgf}.

- B** : Alternator pulley
- C** : Water pump pulley
- D** : Cooler compressor pulley (Air-conditioner)
- E** : Tension pulley
- F** : Crankshaft pulley

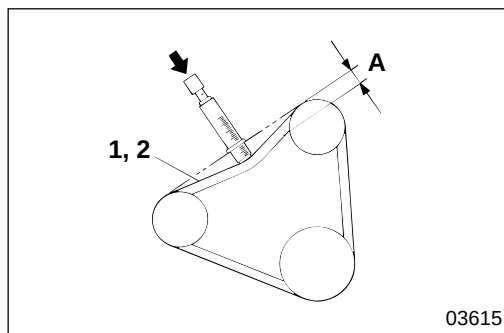


● Use of special tool belt tension gauge

- Set upper O-ring **G** of belt tension gauge to 98 N {72 lbf, 10 kgf} (push load) on graduation **H**.
- Set lower O-ring **J** of belt tension gauge to graduation **K** (maximum flex of belt).

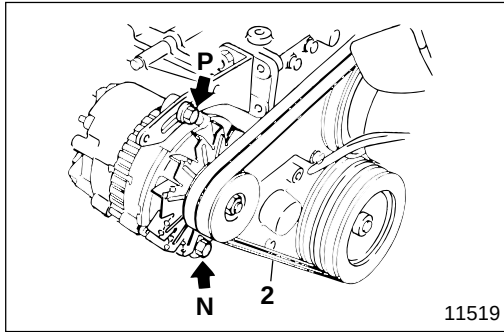


- Place belt tension gauge at the center of V-belts **1, 2** perpendicularly as illustrated and push top **L** all the way down until upper O-ring **G** hits upper edge **M**.



- Measure the extent of flex **A** of V-belts **1, 2** at this point, and if the measured value deviates from the standard value, adjust as follows.

COOLING FAN AND V-BELT



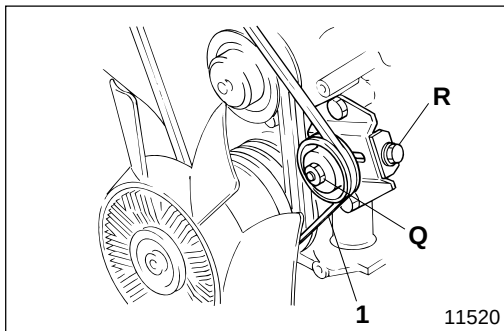
[Adjustment]

(1) Adjustment of V-belt tension for fan

- Loosen alternator mounting bolts **N** (two places), and adjust the tension of V-belts **2** using adjusting bolt **P**.
- After adjustment, tighten the bolts and nuts securely.

CAUTION

- Bear in mind that excessive tension of V-belts **2** might damage the belts and bearings that engage with the V-belts.
- Be sure to replace V-belts **2** as a set to maintain even tension between them.
- Be careful not to let oil stick to V-belts **2**, if oil gets onto the belts, it causes slipping, resulting in overheating and insufficient battery charging.

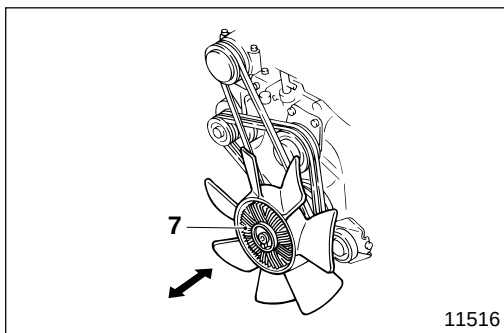


(2) Adjustment V-belt tension for air-conditioner

- Loosen tension pulley mounting nut **Q**, and adjust the tension of V-belt **1** using adjusting bolt **R**.
- After adjustment, tighten the bolt **R** and nut **Q** securely.

CAUTION

- Bear in mind that excessive tension of V-belt **1** might damage the belt and bearings that engage with the V-belt.
- Be careful not to let oil stick to V-belt **1**, if oil gets onto the belt, it causes slipping, resulting in poor performance of the air conditioner.

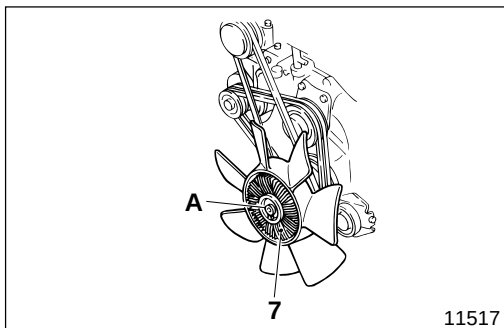


7 Automatic cooling fan coupling

[Inspection]

Carry out the following inspection of automatic cooling fan coupling **7** and if any fault is found, replace the unit.

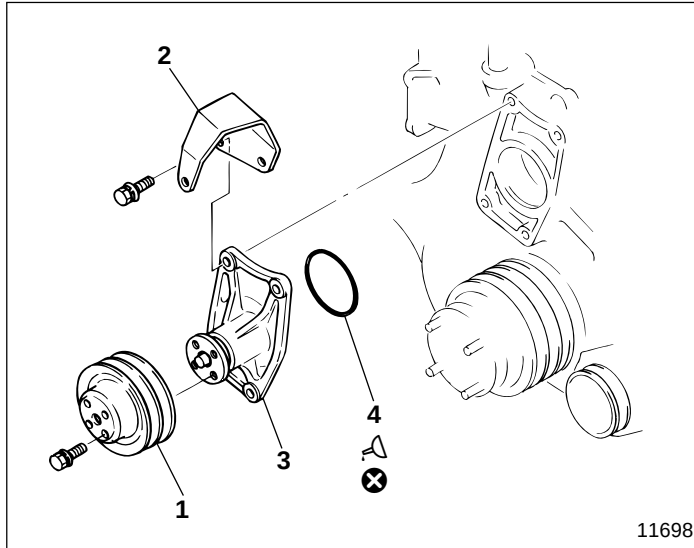
- Check for any leakage of lubricating oil sealed in the coupling body.
- Rotate automatic cooling fan coupling **7** by hand, and check for any irregularity in rotation related to the coupling bearing or any abnormal noise.
- Check for any excessive play of automatic cooling fan coupling **7** in the axial direction when the engine is cool.



[Cleaning]

- If there are any foreign particles sticking to bimetal **A**, remove them by brushing lightly.

WATER PUMP

14


● Removal sequence

- 1 Water pump pulley
- 2 Upper shroud stay
- 3 Water pump
- 4 O-ring

⊗ : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

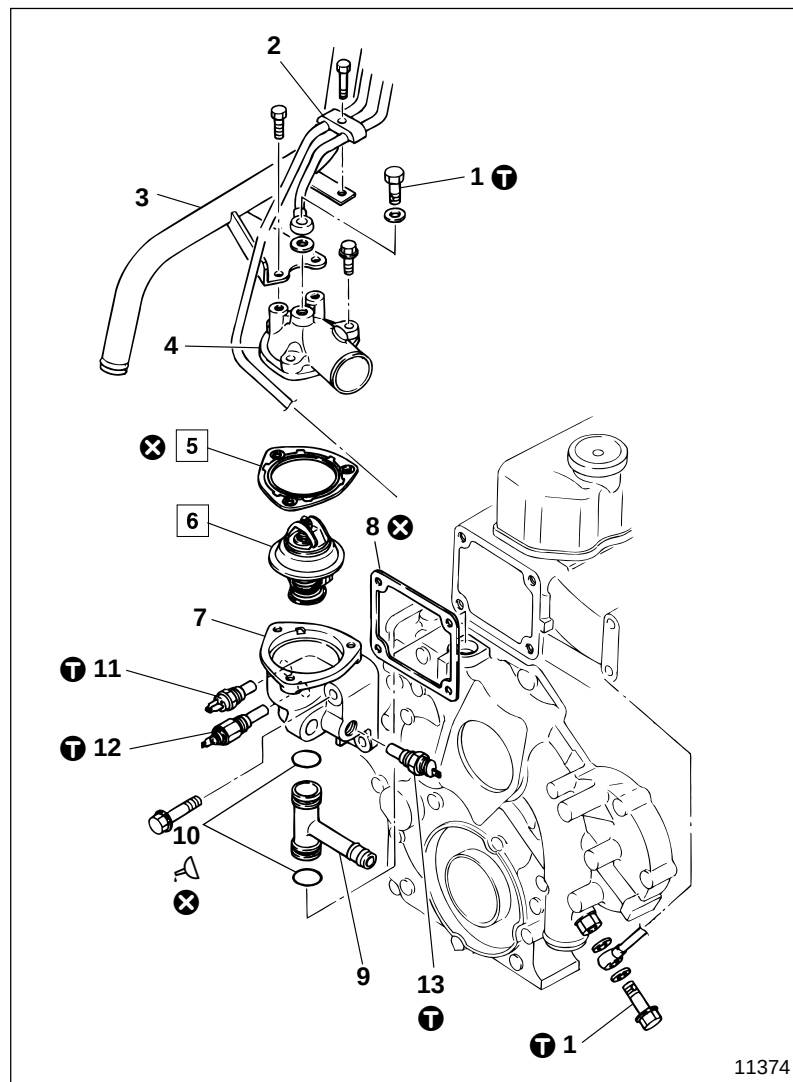
CAUTION ⚠

- Be sure to replace water pump 3 as an assembly if it is faulty because it is a unit construction.
- Never apply engine oil to the O-ring because it will cause the O-ring to swell.

🔊 Lubricant

Location	Points of application	Kinds	Quantity
4	Periphery of O-ring	Soapy water	As required

THERMOSTAT



● Disassembly sequence

- 1 Eye bolt
- 2 Air and water suction pipe
- 3 Water inlet pipe
- 4 Thermostat cover
- 5 Thermostat cover gasket
- 6 Thermostat
- 7 Thermostat case
- 8 Thermostat case gasket
- 9 Bypass pipe
- 10 O-ring
- 11 Water temperature sensor
(Water temperature gauge and multi-purpose timing control unit)
- 12 Overheating switch
- 13 Water temperature sensor
(Pre-stroke control type injection pump)

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

Never apply engine oil to O-ring 10 because it will cause the O-ring to swell.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
6	Thermostat	Valve opening temperature	82±2°C {180±3.6°F}	—	Replace
		Extent of valve lift (95°C {203°F})	10 {0.39} or more	—	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Eye bolt	25 {19, 2.6}	—
11	Water temperature sensor	34±6.9 {25±5.1, 3.5±0.7}	—
12	Overheating switch	27 to 41 {20 to 30, 2.8 to 4.2}	—
13	Water temperature sensor	34±6.9 {25±5.1, 3.5±0.7}	—

Lubricant

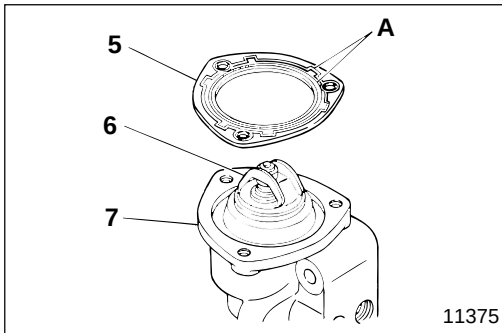
Location	Points of application	Kinds	Quantity
10	O-ring	Soapy water	As required

◆ Service procedure

5 Mounting of thermostat cover gasket

Mount thermostat cover gasket **5** on thermostat case **7** in the direction as illustrated.

A : Sealant application surface



6 Thermostat

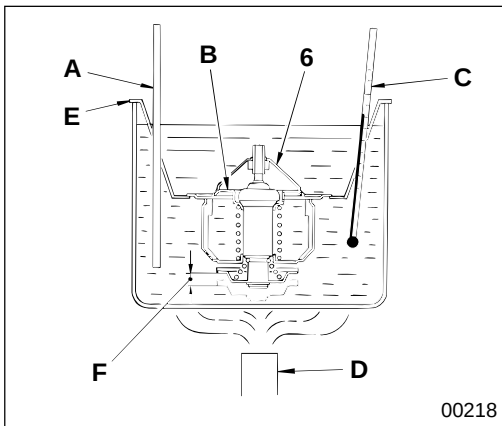
[Inspection]

Stir the water using stick **A** to maintain an even water temperature in the container, then carry out the following tests. If the measured value deviates from the standard value, replace thermostat **6**.

(1) Valve opening temperature

- Hold thermostat **6** with wire **E** so as not to get the thermostat too close to heat **D**.
- Heat the water gradually to raise the temperature to the valve opening temperature.
- Maintain this temperature for five minutes and make sure that valve **B** has opened.
- Make sure that valve **B** has closed when the water temperature has dropped to 65°C {149°F}.

C : Water temperature gauge



(2) Extent of valve lift

Measure valve lift **F**, while maintaining the water temperature a little higher than the valve opening temperature, with valve **B** fully open for five minutes.



FH

Service Manual

Group 15

Intake and Exhaust

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

GROUP 15 INTAKE AND EXHAUST

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
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TURBOCHARGER	12
INTERCOOLER	17
INTAKE MANIFOLD	18
EXHAUST MANIFOLD	19
EXHAUST PIPE AND MUFFLER	20

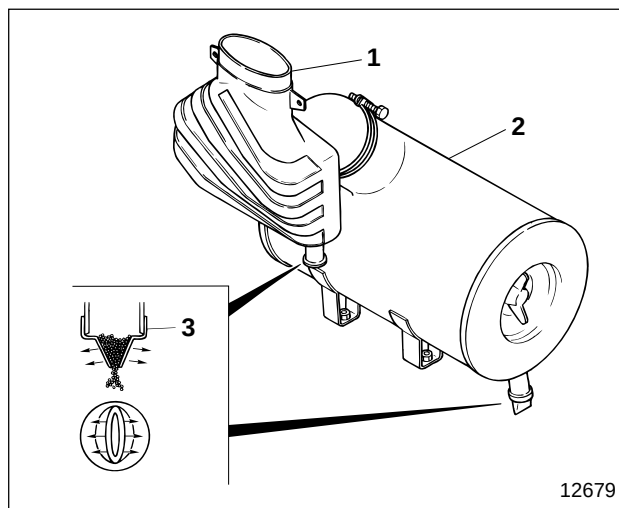
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Items		Specifications
Air cleaner element		Cyclone paper filter type
Turbocharger	Model	TD06
	Manufacturer	MITSUBISHI HEAVY INDUSTRIES
Intercooler type		Air-cooled, tube and corrugated fin type

STRUCTURE AND OPERATION

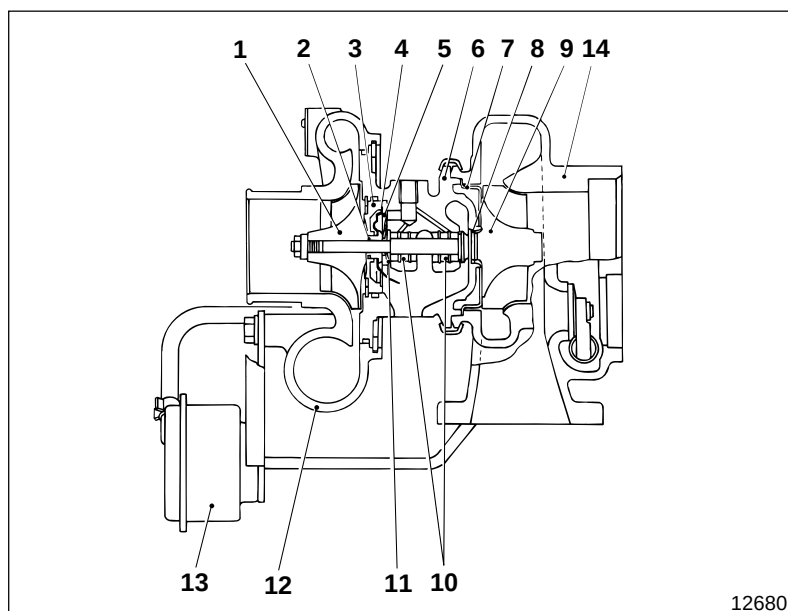
Air Cleaner



- 1 Air lower duct
- 2 Air cleaner assembly
- 3 Evacuator valve

- Air cleaner assembly **2** uses a single element.
- Evacuator valves **3** are fitted with air lower duct **1** and air cleaner assembly **2**.
- Evacuator valves **3** automatically vent dust and dirt by the repercussive force of the rubber of the valve that overcomes the inner negative pressure when the engine revolution falls below the specified revolution.

Turbocharger

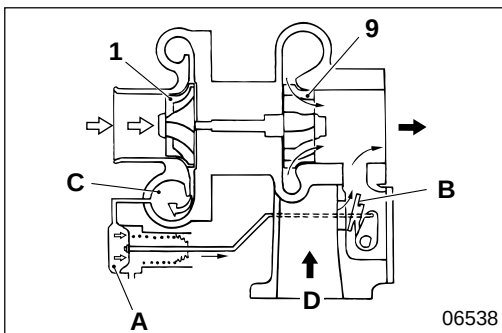
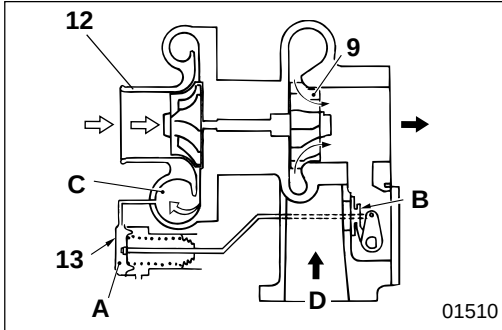


- 1 Compressor wheel
- 2 Thrust sleeve
- 3 Insert
- 4 Oil deflector
- 5 Thrust bearing
- 6 Bearing housing
- 7 Turbine backplate
- 8 Piston ring
- 9 Shaft and turbine wheel
- 10 Bearing
- 11 Thrust bearing
- 12 Compressor cover
- 13 Actuator
- 14 Turbine housing assembly

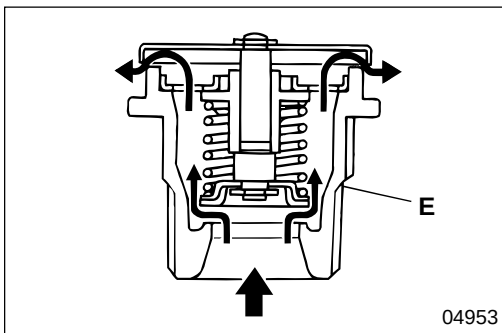
1 to 11 : Cartridge assembly

Waste gate mechanism

- The waste gate mechanism relieves the boost pressure of excess exhaust gas using actuator **13**. This controls the boost pressure appropriately and prevents the turbocharger from overrunning, and prevents excessive pressure in the intake manifold.
- The boost pressure is fed into chamber **A** of actuator **13** from compressor cover **12** via a rubber hose. When boost pressure **C**, acting on the chamber, is lower than the preset value, the actuator does not operate and waste gate valve **B** remains closed, therefore exhaust gas **D** is blown against shaft and turbine wheel **9**.

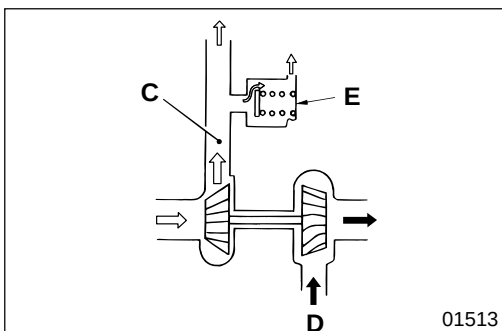


- As the boost pressure acting on chamber **A** increases to become higher than the preset value, waste gate valve **B** is opened and the exhaust gas blown against shaft and turbine wheel **9** decreases. Therefore the rotation of compressor wheel **1** decreases, causing the boost pressure to decrease.



Operation of over-boost valve

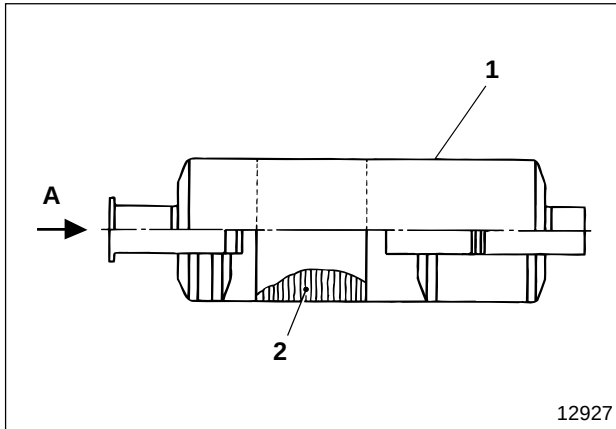
- Over-boost valve **E** operates when the boost pressure increases abnormally because of faulty operation of the waste gate mechanism.



- If boost pressure **C** of over-boost valve **E** increases to become higher than the preset value, the excessive boost pressure is discharged into the atmosphere, protecting the engine from excessive boost pressure. When the valve is operating, a pipe-blowing sound is generated.

STRUCTURE AND OPERATION

Muffler



- 1 Muffler
- 2 Catalytic converter

A : Exhaust gas intake

Converter **2** is built into muffler **1** to decrease the amount of particulate matter (PM) in the exhaust gas.

TROUBLESHOOTING

15

Possible causes		Symptoms						Remarks
		Engine hard to start	Exhaust gas dark	Exhaust gas whitish	Engine output insufficient	Oil consumption excessive	Noise and vibration in intake/exhaust systems	
Air cleaner	Air cleaner element clogged	○	○		○			
Turbocharger	Cartridge assembly	Bearing faulty		○	○		○	
		Carbon deposits on shaft and turbine wheel		○	○			
		Shaft and turbine wheel interfering with turbine backplate		○	○			
		Shaft and turbine wheel interfering with turbine housing		○	○			
		Shaft and turbine wheel bent		○	○		○	
		Shaft and turbine wheel broken		○	○		○	
		Compressor wheel interfering with compressor housing		○	○			
		Thrust sleeve and thrust bearing seized		○	○		○	
		Compressor wheel broken		○	○		○	
		Engine oil leaking because piston ring and inserter worn		○	○	○		
		Piston rings installation faulty				○		
		Parts not sliding smoothly because oil lubrication pipe and eye bolt clogged		○	○			
		Oil seals damaged because oil return pipe clogged			○	○		
	Compressor housing installation faulty		○		○	○	○	
	Turbine housing installation faulty				○		○	
Intercooler	Foreign particles on intercooler front core				○			
Actuator	Butterfly valve does not open		○	○	○			
	Butterfly valve opening and closing adjusted incorrectly		○	○	○			
Front pipe, muffler and tail pipe deformed							○	
Front pipe, muffler and tail pipe installation faulty							○	
Valve clearance faulty			○					 Gr 11
Head gasket faulty			○					 Gr 11
Valve and valve seat worn and carbon deposits			○					 Gr 11
Valve spring fatigued			○					 Gr 11
Piston ring worn and damaged			○					 Gr 11
Piston ring groove worn and damaged			○					 Gr 11
Cooling system malfunctioning			○					 Gr 14
Engine oil excessive			○					 Gr 12
Main moving parts seized			○					 Gr 11
Fuel injection quantity uneven or excessive			○					 Gr 13

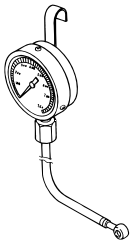
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

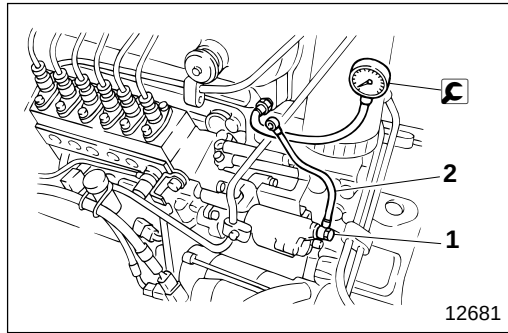
Measurement of Turbo Boost Pressure

Service standards

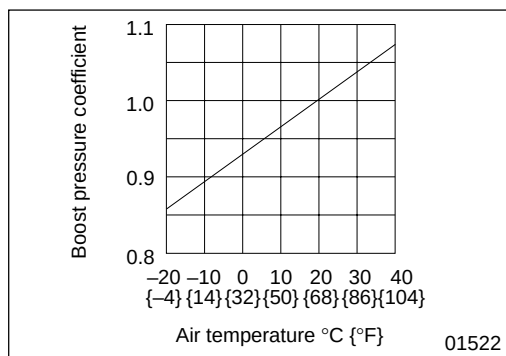
Location	Maintenance item	Standard value	Limit	Remedy
—	Boost pressure (Air temperature 20°C {68°F}, Atmospheric pressure 100 kPa {29.9 in. Hg, 760 mmHg})	—	32 kPa {9.45 in. Hg, 240 mmHg}/ 3700 rpm	Inspect and adjust

Special tools

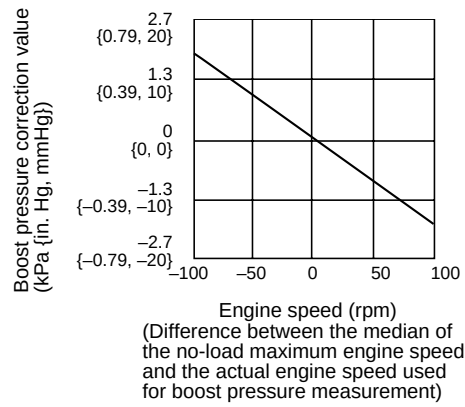
Location	Tool name and shape	Part No.	Application
—	 Boost pressure gauge	MH061366	Measurement of turbo boost pressure



- Before measuring the turbo boost pressure, clean or replace the air cleaner element.
- Slacken off eye bolt **1** of boost compensator and remove boost compensator pipe **2**, then attach  boost pressure gauge.
- After warming up the engine, measure the boost pressure at the no-load maximum engine speed. Also, measure the engine speed and the air temperature.



- Correct the boost pressure at standard conditions. (Since the boost pressure varies depending on the air temperature and engine speed.)
[Correction for air temperature]
Identify boost pressure coefficient depending on the air temperature from the graph.



12682

[Correction for engine speed]

Subtract the engine speed actually used for measuring the boost pressure from the median of the no-load maximum engine speed. Identify the boost pressure correction value (**Pa**) according to the graph.

Median value : 3700 rpm

[Calculation of corrected boost pressure]

Given the measured boost pressure to be **P**, corrected boost pressure **Pb** can be calculated from the following equation:

$$Pb = ktP + Pa$$

Pb : Corrected boost pressure

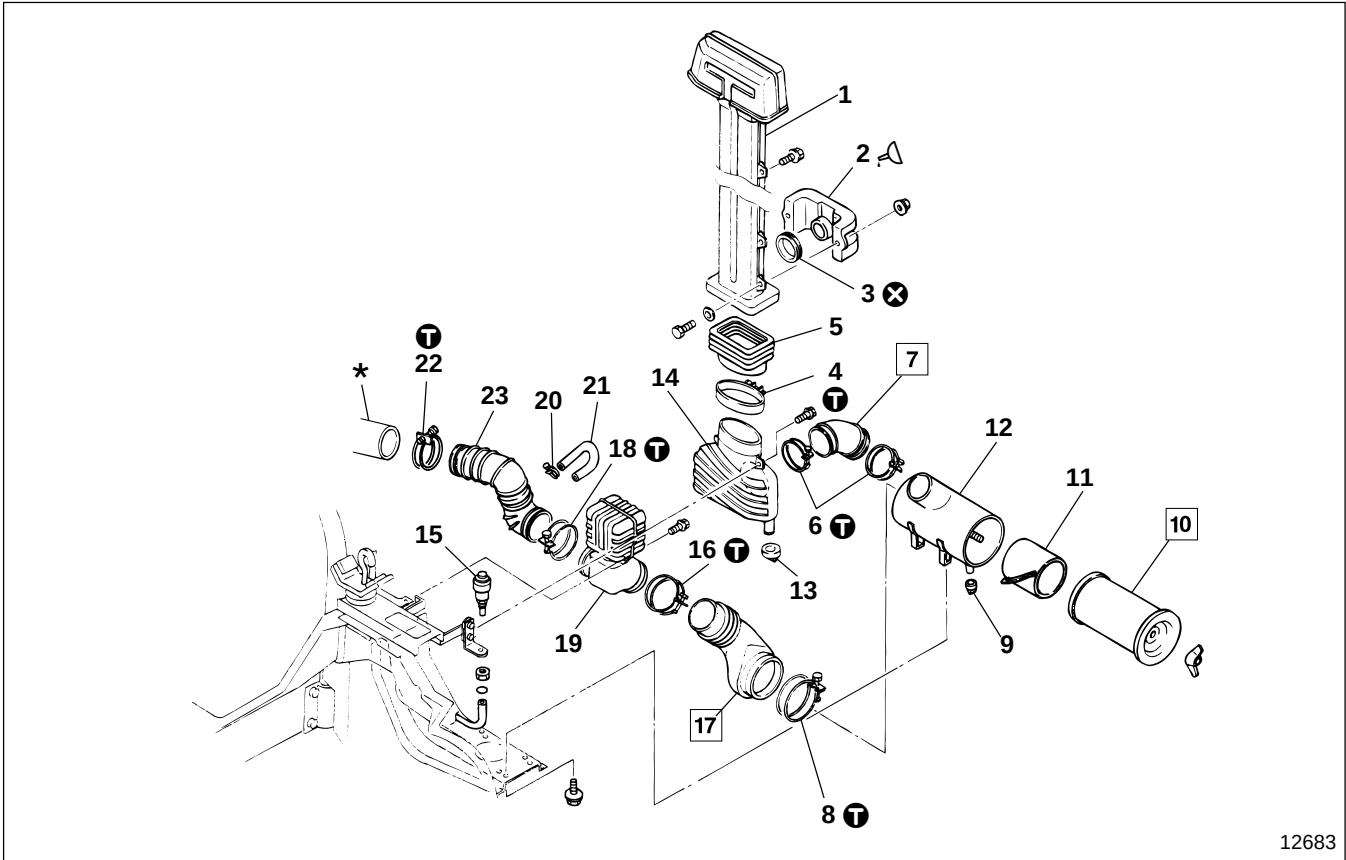
P : Measured boost pressure

kt : Boost pressure correcting coefficient depending on air temperature

Pa : Boost pressure correction value

If **Pb** is lower than the limit, the turbocharger must be inspected and adjusted.

AIR DUCT AND AIR CLEANER



12683

● Disassembly sequence

- | | | |
|-------------------|--------------------|---------------------|
| 1 Air upper duct | 10 Element | 19 Air duct |
| 2 Resonator | 11 Adapter vane | 20 Clamp |
| 3 Grommet | 12 Body | 21 Air suction hose |
| 4 Clamp | 13 Evacuator valve | 22 Clamp |
| 5 Rubber boot | 14 Air lower duct | 23 Air intake hose |
| 6 Clamp | 15 Dust indicator | |
| 7 Air intake hose | 16 Clamp | |
| 8 Clamp | 17 Air duct | |
| 9 Evacuator valve | 18 Clamp | |

* : Air inlet pipe P15-9

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Do not remove adapter vane 11 unless it is faulty.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4, 6, 8, 16	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	—
18, 22	Clamp	2.9 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	—

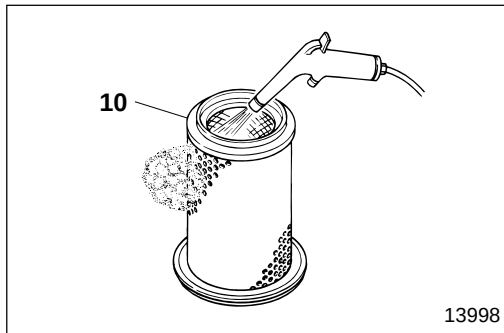
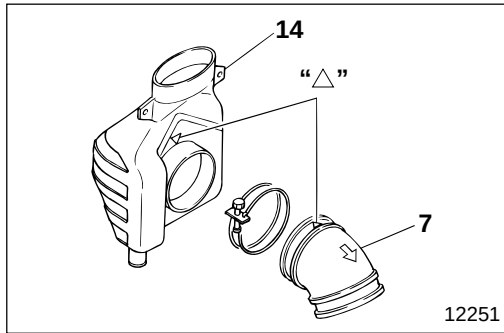
Sealant

Location	Points of application	Kinds	Quantity
2	Grommet installation area of resonator	THREEBOND 1207C	As required

◆ Service procedure

7 Installation of air intake hose

△ : Alignment mark



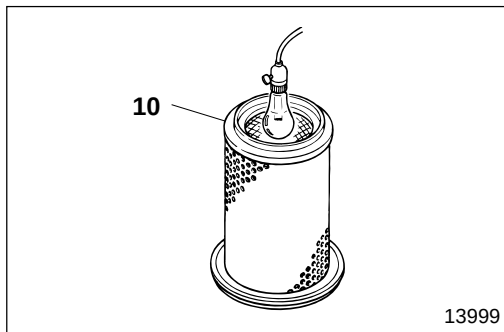
10 Element

[Cleaning]

- Blow compressed air of 685 kPa {100 lbf/in², 7 kgf/cm²} or less through element **10** from the inside.
- When using compressed air, move the blower's nozzle up and down along the pleats of element **10** evenly.

CAUTION ⚠

- Do not tap or hit element **10** to remove dust.
- Do not blow compressed air through element **10** from the outside.

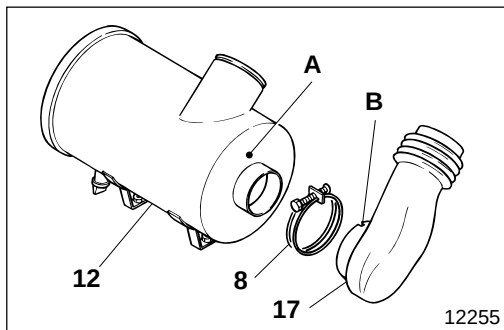


[Inspection]

- Illuminate the inside of element **10**.
- If parts of the filter paper are torn or thin, or if the packing of the upper surface of element **10** is damaged, replace the element.

NOTE

If the dust on air cleaner element **10** is wet due to oil smoke or soot, replace the air cleaner regardless of the scheduled replacement interval.

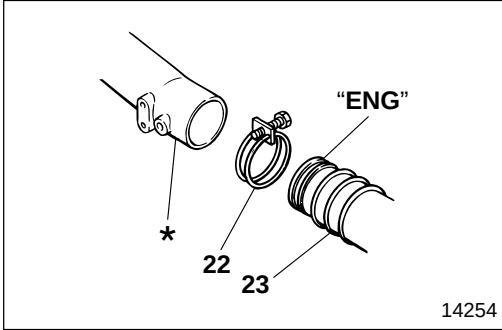


16 Installation of air duct

Install air duct **17** in the direction as illustrated.

- A : White paint
- B : Indent

AIR DUCT AND AIR CLEANER

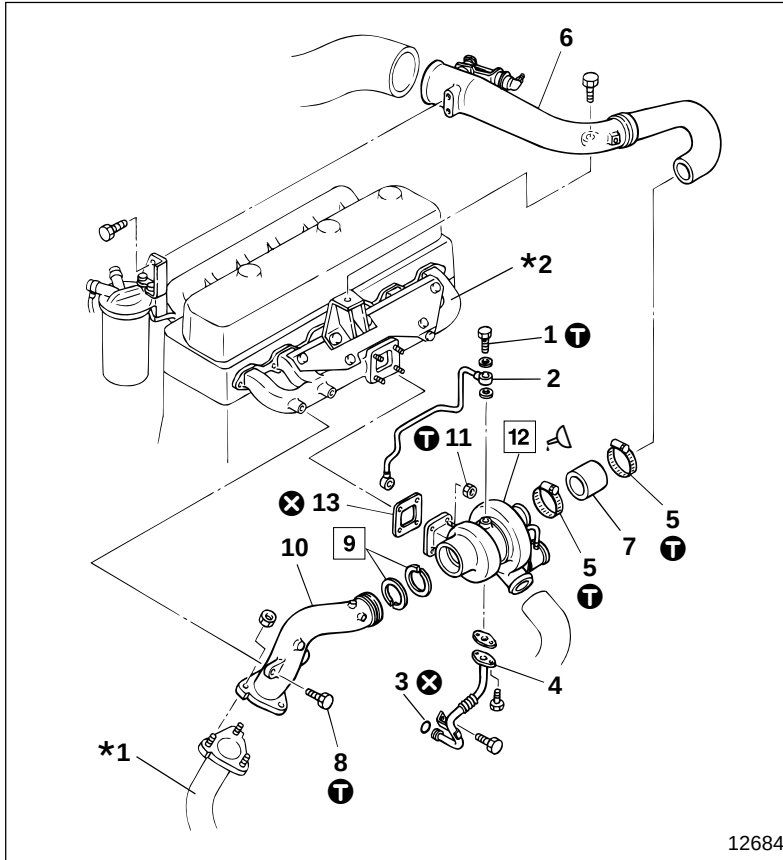


23 Installation of air intake hose

ENG : Alignment mark

MEMO

TURBOCHARGER



● Removal sequence

- 1 Eye bolt
- 2 Oil pipe
- 3 O-ring
- 4 Oil return pipe
- 5 Clamp
- 6 Air inlet pipe assembly Gr 35A, B
- 7 Rubber hose
- 8 Bolt
- 9 Seal ring
- 10 Exhaust pipe
- 11 Nut
- 12 Turbocharger assembly P15-14
- 13 Gasket

*1 : Front pipe P15-20

*2 : Exhaust manifold P15-19

⊗ : Non-reusable parts

● 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	Eye bolt	21 {15, 2.1}	—
5	Clamp	4.9 {3.6, 0.5}	—
8	Bolt (Exhaust pipe mounting)	53 {39, 5.4}	—
11	Nut (Turbocharger assembly mounting)	41 {30, 4.2}	—

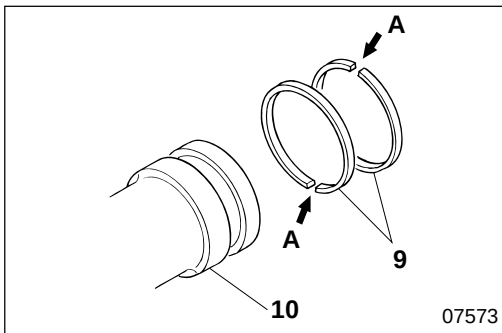
Lubricant

Location	Points of application	Kinds	Quantity
12	Supply when installing turbocharger assembly	Engine oil	As required

◆ Service procedure

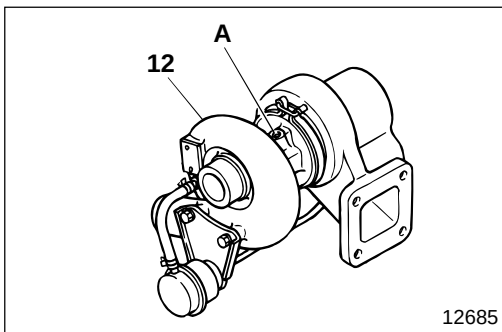
9 Installation of seal ring

Offset splits **A** of seal rings **9** at 180°.



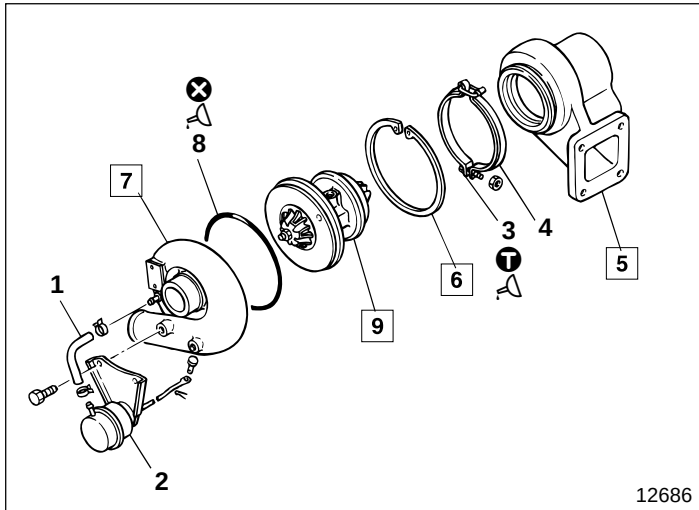
12 Installation of turbocharger assembly

When installing turbocharger assembly **12**, supply engine oil via oil port **A** as required to ensure that parts move smoothly.



TURBOCHARGER

Turbocharger Assembly



● Work before disassembly

📖 P15-15

● Disassembly sequence

- 1 Hose
- 2 Actuator
- 3 Bolt
- 4 Coupling
- 5 Turbine housing
- 6 Snap ring
- 7 Compressor cover
- 8 O-ring
- 9 Cartridge assembly

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection after assembly

📖 P15-15

NOTE

Since cartridge assembly 9 is a unit construction, if the turbine wheel or the compressor wheel is damaged, or the cartridge assembly does not revolve smoothly, or any other fault is found, replace the assembly as a unit.

Service standards

Unit : mm {in.}

Location	Maintenance item			Standard value	Limit	Remedy
9	Cartridge assembly	Play in the shaft direction		0.05 to 0.09 {0.0020 to 0.0035}	0.1 {0.0039}	Replace
		Play at right angles to the shaft	Turbine wheel side	0.40 to 0.53 {0.016 to 0.021}	0.58 {0.023}	Replace
			Compressor wheel side	0.55 to 0.66 {0.022 to 0.026}	0.72 {0.028}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Bolt (Coupling mounting)	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	—

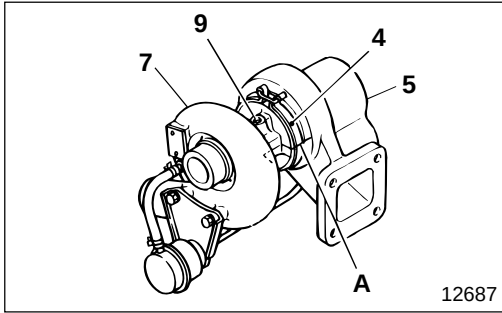
Lubricant

Location	Points of application	Kinds	Quantity
3	Thread area of bolt	Molybdenum disulfide grease	As required
8	Periphery of O-ring	Engine oil	As required

◆ Service procedure

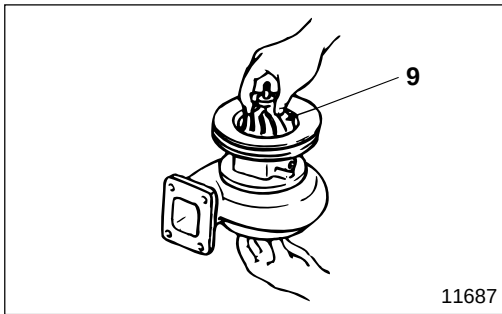
● Work before disassembly

Put alignment marks **A** on coupling **4**, turbine housing **5**, compressor cover **7** and cartridge assembly **9**.



● Inspection after assembly

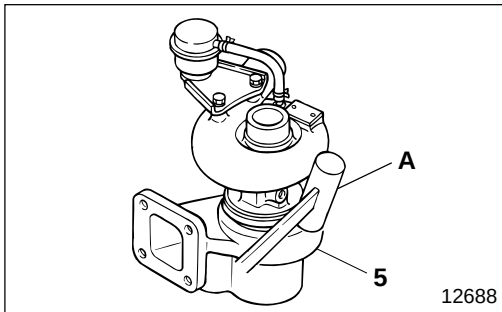
Turn the turbine wheel and the compressor wheel of cartridge assembly **9** to make sure that they turn smoothly.



5 Removal of turbine housing

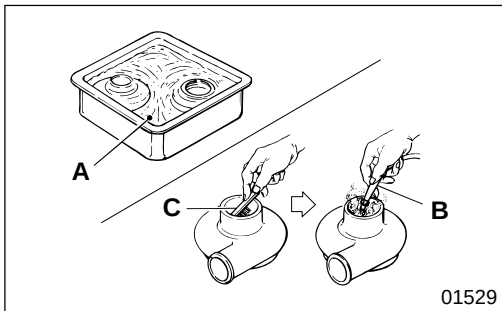
CAUTION ⚠

- When removing turbine housing **5**, tap all around the circumference lightly using rubber-headed hammer **A** so as not to damage the turbine housing.
- Do not hit the turbine wheel near turbine housing **5**, since the blade of the turbine wheel can be easily bent.



5 7 Cleaning of turbine housing and compressor cover

- Visually inspect related parts before cleaning to check if there are any burns or scratches as these would not be seen after cleaning. If any fault is found, replace the faulty parts.
- Remove any foreign particles before cleaning by scraping them off using plastic scraper or bristle-headed brush **C**. Immerse the disassembled parts in nonflammable solvent **A** (DAIDO KAGAKU KOGYO DAICLEANER T-30), then take them out and blow compressed air **B** on them.

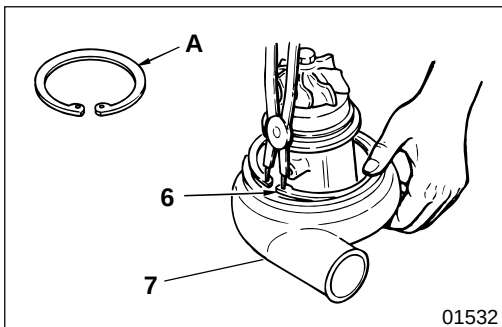


6 Installation of snap ring

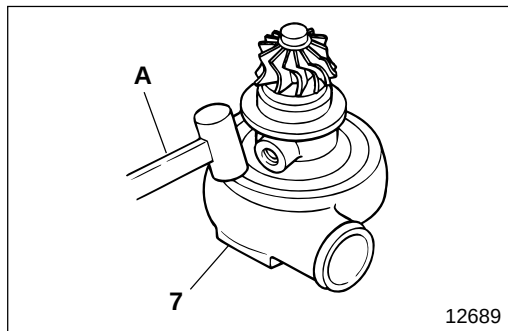
Install snap ring **6** into compressor cover **7** with taper surface **A** upward.

WARNING ⚠

Use your hand to hold snap ring **6** in place to prevent it from springing out.



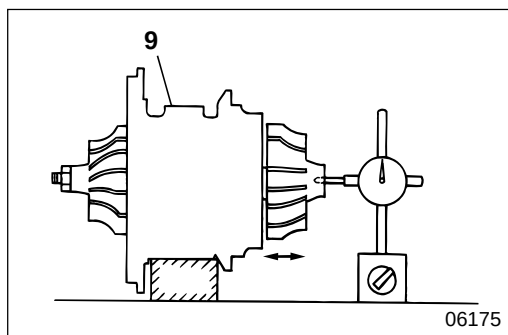
TURBOCHARGER



7 Removal of compressor cover

CAUTION ⚠

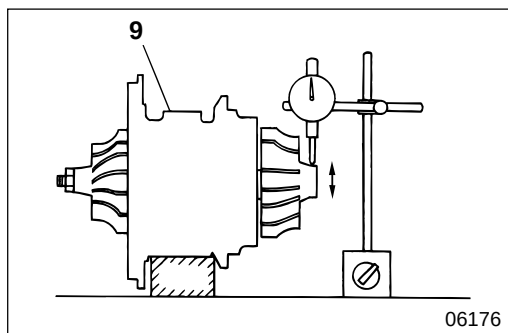
- When removing compressor cover 7, tap all around the circumference lightly so as not to damage the compressor cover.
- Avoid hitting the compressor wheel near compressor cover 7, since the blade of the compressor wheel can be easily bent.



9 Inspection of cartridge assembly

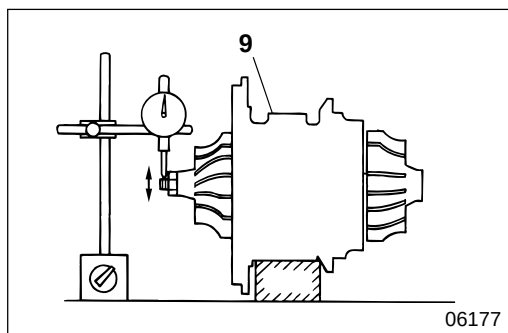
(1) Play in the shaft direction of the shaft and turbine wheel assembly

If the measured value deviates from the standard value, replace cartridge assembly 9.



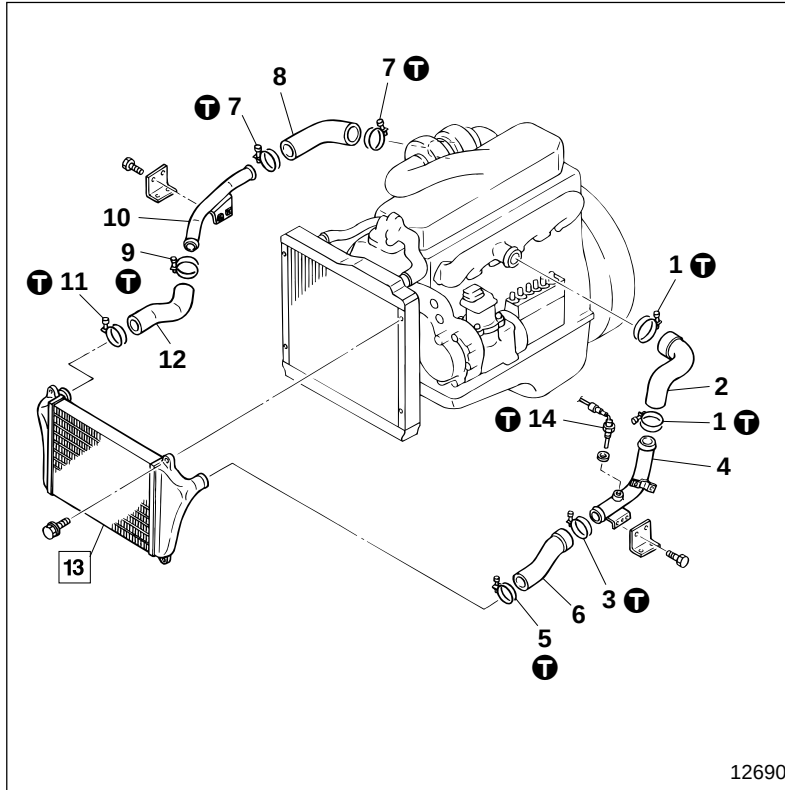
(2) Play at right angles to the shaft of the shaft and turbine wheel assembly

- Play on turbine wheel side
If the measured value is higher than the limit, replace cartridge assembly 9.



- Play on compressor wheel side
If measured value is higher than the limit, replace cartridge assembly 9.

INTERCOOLER

15


● Disassembly sequence

- 1 Clamp
- 2 Air inlet hose
- 3 Clamp
- 4 Air inlet pipe
- 5 Clamp
- 6 Air inlet hose
- 7 Clamp
- 8 Air inlet hose
- 9 Clamp
- 10 Air inlet pipe
- 11 Clamp
- 12 Air inlet hose
- 13 Intercooler
- 14 Boost air temperature sensor  Gr 13

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
13	Air leakage from intercooler (Air pressure : 150 kPa {21 lbf/in ² , 1.5 kg/cm ² })	0 cm ³ {0 cu. in.}	—	Replace

T Tightening torque

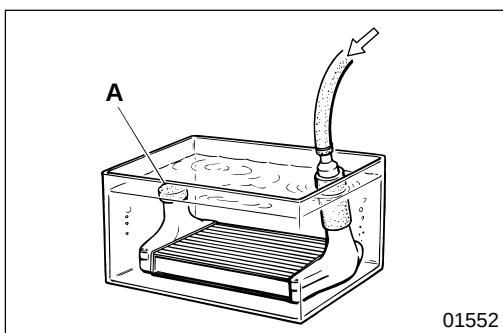
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 3, 5, 7, 9, 11	Clamp	2.9 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	—
14	Boost air temperature sensor	14.7±2 {11±1.4, 1.5±0.2}	—

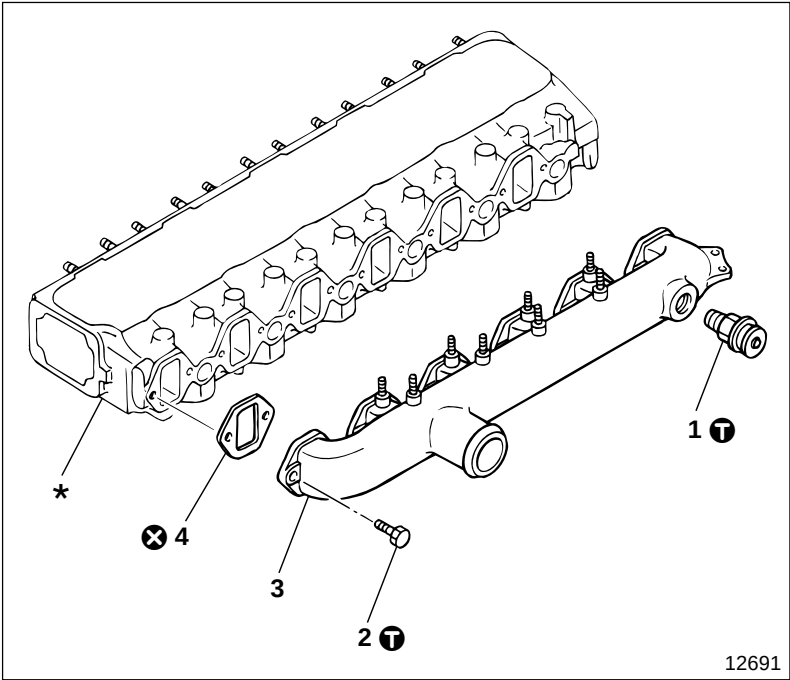
◆ Service procedure

13 Inspection of intercooler

- Fit plug **A** on one of the air inlets of intercooler **13** and connect a hose to the other, then lower the intercooler into the water tank. Apply air at the specified pressure (150 kPa {21 lbf/in², 1.5 kgf/cm²}) from the hose side and check for air leaks.
- If air leaks, replace intercooler **13**.



INTAKE MANIFOLD



● Disassembly sequence

- 1 Over-boost valve
- 2 Bolt
- 3 Intake manifold
- 4 Gasket

* : Cylinder head Gr 11

⊗ : Non-reusable parts

● Assembly sequence

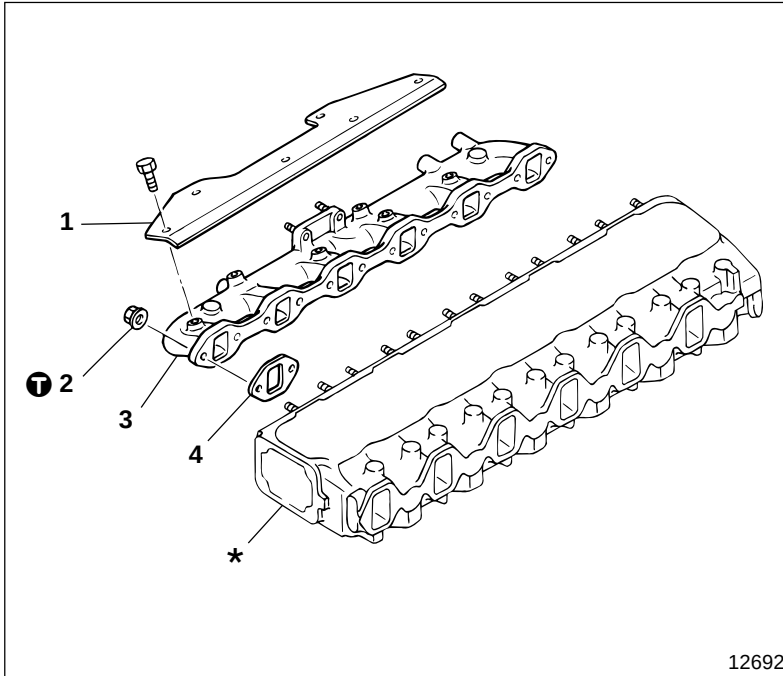
Follow the disassembly sequence in reverse.

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Over-boost valve	49 {36, 5}	—
2	Bolt (Intake manifold mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—

EXHAUST MANIFOLD

15


● Disassembly sequence

- 1 Insulator
- 2 Nut
- 3 Exhaust manifold
- 4 Gasket

* : Cylinder head  Gr 11

⊗ : Non-reusable parts

● Assembly sequence

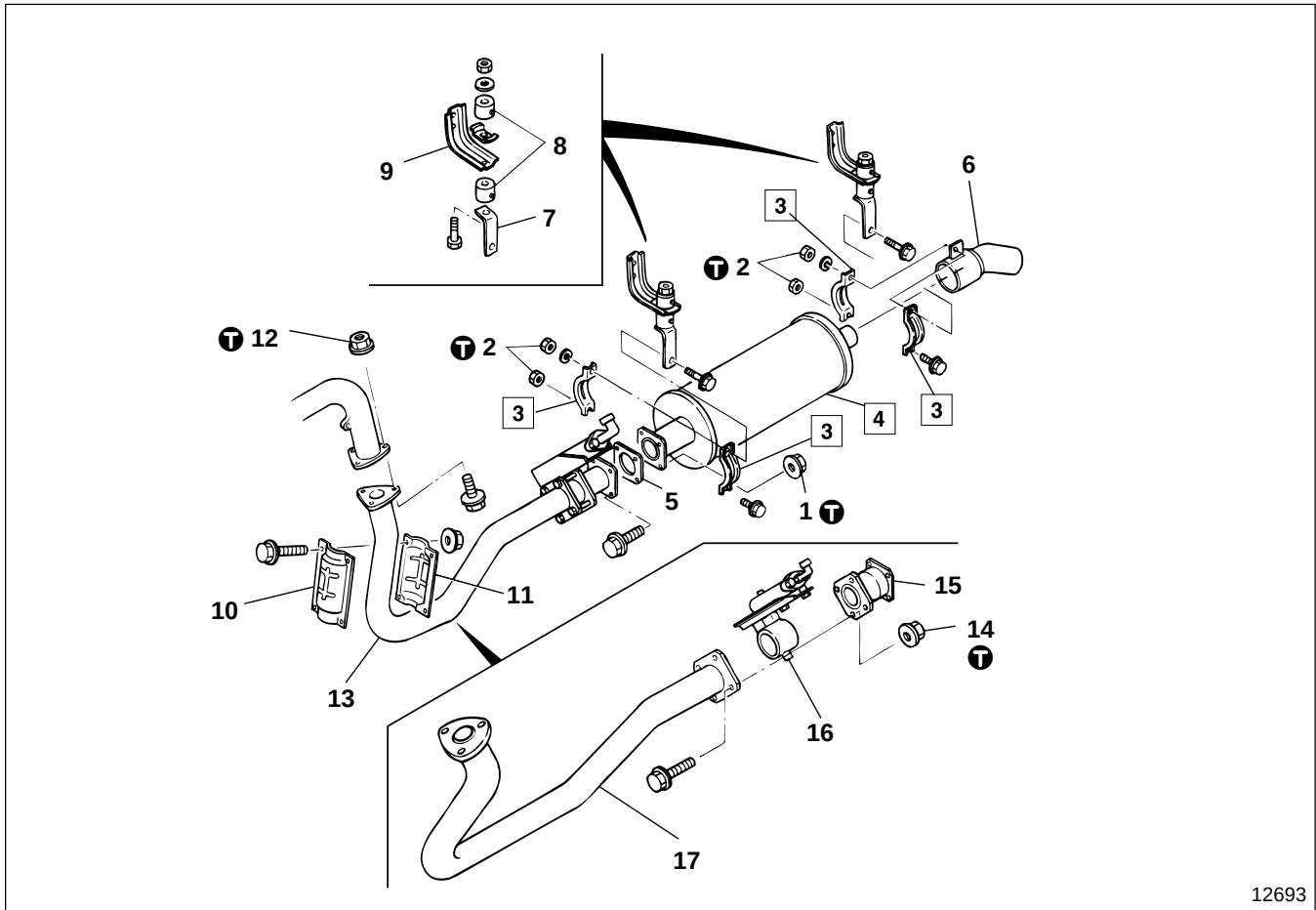
Follow the disassembly sequence in reverse.

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Exhaust manifold mounting)	58 {43, 5.9}	—

EXHAUST PIPE AND MUFFLER



12693

● Disassembly sequence

- | | | |
|-------------|---------------------------|---|
| 1 Nut | 7 Pipe clamp stay | 13 Front pipe assembly |
| 2 Nut | 8 Rubber cushion | 14 Nut |
| 3 Clamp | 9 Exhaust pipe hanger | 15 Center pipe |
| 4 Muffler | 10 Exhaust pipe insulator | 16 Exhaust brake unit  Gr 35A, B |
| 5 Gasket | 11 Exhaust pipe cover | 17 Front pipe |
| 6 Tail pipe | 12 Nut | |

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

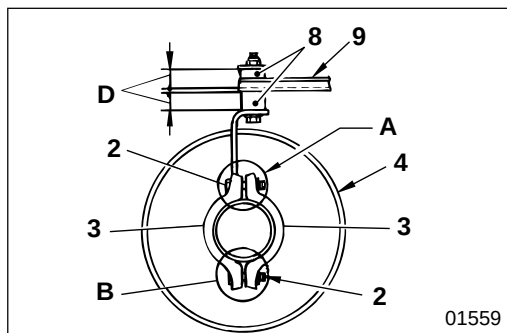
- Never hit or kick muffler 4, or the catalyzer in the muffler will be damaged.
- A small amount of water sometimes collects inside muffler 4. Never touch this water, if you do by mistake, wash it off immediately with clean water.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

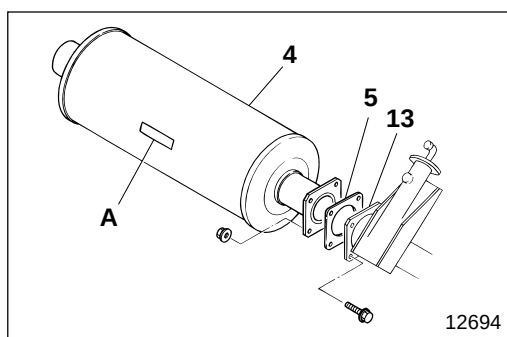
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Muffler mounting)	43 {32, 4.4}	—
2	Nut (Clamp tightening)	20 {14, 2}	—
12	Nut (Front pipe assembly mounting)	58 {43, 5.9}	—
14	Nut (Exhaust brake unit mounting)	58 {43, 5.9}	—

◆ Service procedure



3 8 Installation of clamp and rubber cushion

- Tighten bolt 2 temporarily to let clamp 3 move slightly.
- Tighten bolt 2 until it makes contact with area A of clamp 3.
- After tightening area A, tighten area B using bolt 2.
- Tighten until dimension D of rubber cushion 8 is as follows:
 D : Before tightening 25 mm {0.98 in.}
 After tightening 23 mm {0.91 in.}



4 Installation of muffler

Install muffler 4 on front pipe assembly 13 in the direction as illustrated.

A : Part No. marked position



FH

Service Manual

Group 21

Clutch

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

GROUP 21 CLUTCH

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
TROUBLESHOOTING	5
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Clutch Fluid (Brake Fluid) Replacement and Air Bleeding	6
• Clutch Pedal Free Play	8
CLUTCH PEDAL	10
CLUTCH MASTER CYLINDER	14
CLUTCH POWER CYLINDER	16
WORK BEFORE REMOVAL AND INSTALLATION	
OF CLUTCH BODY	18
CLUTCH BODY	20
CLUTCH CONTROL	30

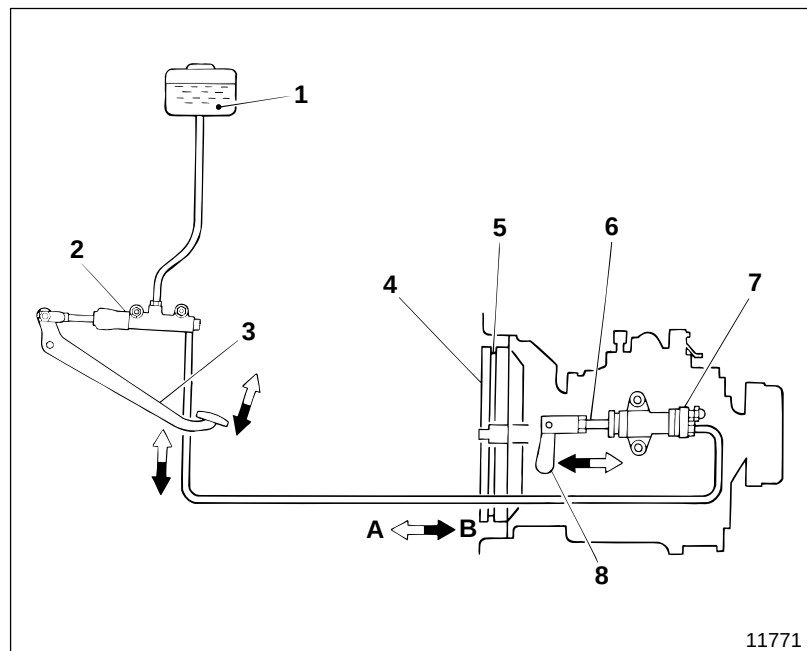
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item		Specifications
Clutch	Model	C5M33
Drive type		Strap drive
Clutch disc	Type	Dry, single plate type
Pressure plate	Type	Coil spring type
Control system		Hydraulic pressure type
Clutch master cylinder	Manufacturer	NABCO
Clutch power cylinder	Manufacturer	NABCO

STRUCTURE AND OPERATION

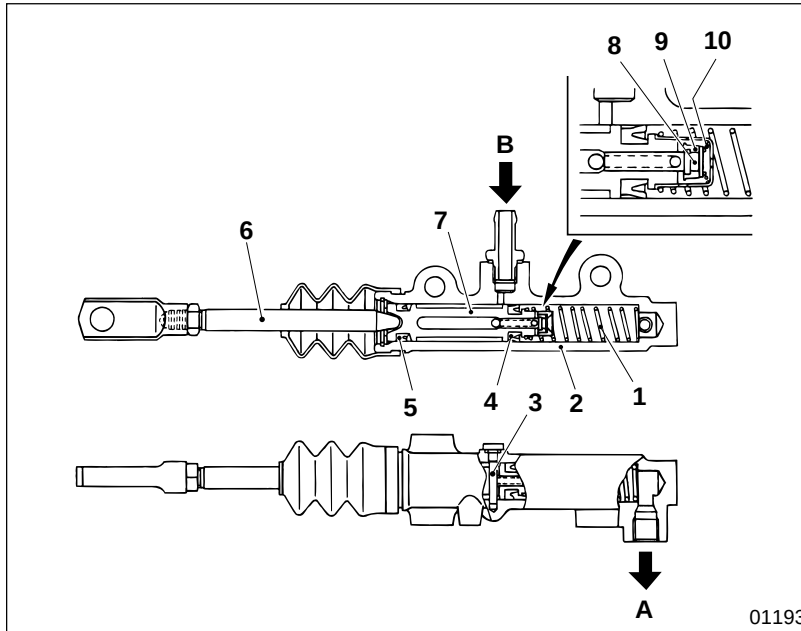
Clutch Control



- 1 Fluid tank
- 2 Clutch master cylinder
- 3 Clutch pedal
- 4 Flywheel
- 5 Clutch disc
- 6 Push rod
- 7 Clutch power cylinder
- 8 Release fork shaft

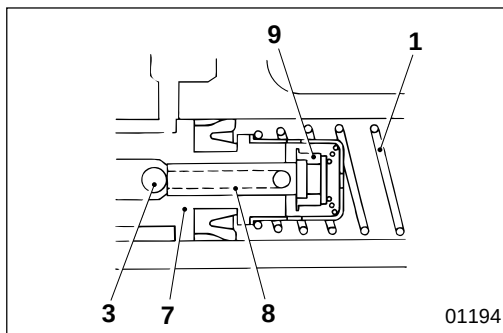
A : Engine power transmitted
B : Engine power cut off

Clutch Master Cylinder



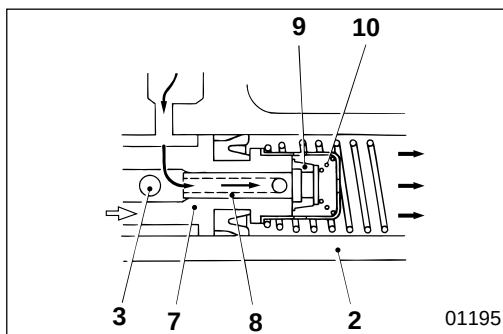
- 1 Return spring
- 2 Cylinder
- 3 Supply valve stopper
- 4 Primary cup
- 5 Secondary cup
- 6 Push rod
- 7 Piston
- 8 Supply valve rod
- 9 Supply valve
- 10 Supply valve spring

A : To clutch power cylinder
B : From fluid tank



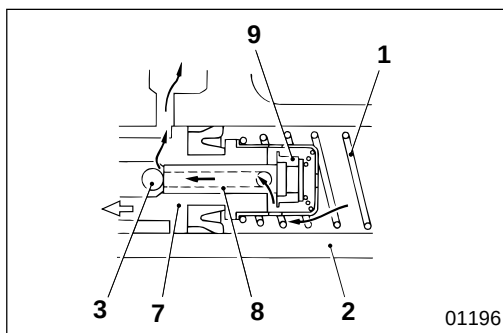
Before clutch pedal is depressed

- As piston 7 is pressed towards the push rod side by return spring 1, supply valve rod 8 rests against supply valve stopper 3, and supply valve 9 remains open.
- Thus, the passage between the fluid tank and the clutch is open.



When clutch pedal is depressed

- As push rod 6 pushes piston 7, supply valve rod 8 moves away from supply valve stopper 3, and supply valve 9 is closed by the repercussive force of supply valve spring 10.
- As piston 7 is pressed further, the hydraulic pressure generated within cylinder 2 actuates the clutch power cylinder.
- This results in fluid being supplied in direct proportion to the movement of piston 7.

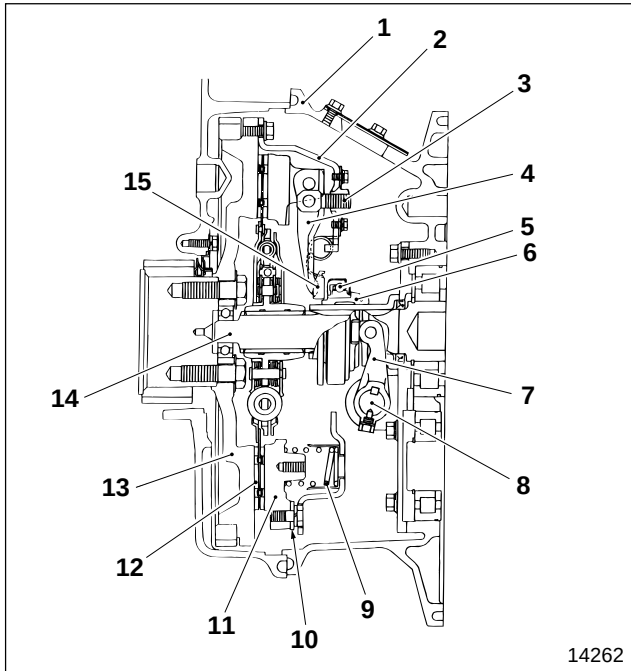


When clutch pedal is released

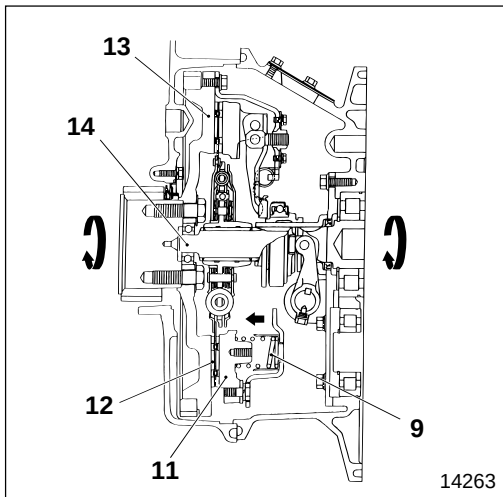
- As piston 7 is pushed back by the hydraulic pressure from cylinder 2 and the repercussive force of return spring 1, supply valve rod 8 hits valve stopper 3 and supply valve 9 opens.
- Thus, the fluid in the clutch power cylinder side returns to the fluid tank and the hydraulic pressure drops to zero.

STRUCTURE AND OPERATION

Clutch

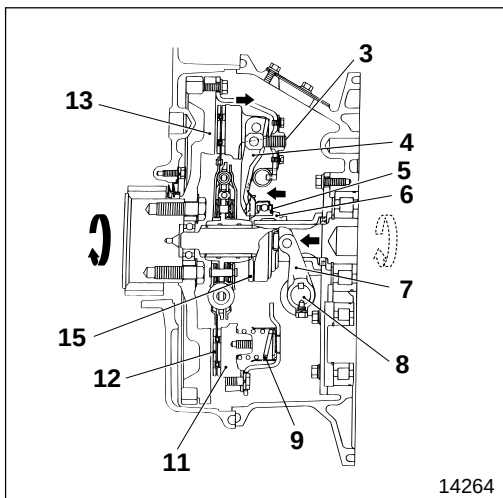


- 1 Clutch housing
- 2 Clutch cover
- 3 Support lever
- 4 Release lever
- 5 Release bearing
- 6 Clutch shifter
- 7 Release fork
- 8 Release fork shaft
- 9 Pressure spring
- 10 Strap plate
- 11 Pressure plate
- 12 Clutch disc
- 13 Flywheel
- 14 Drive pinion
- 15 Release lever plate



When clutch pedal is released

- Pressure plate **11**, activated by pressure spring **9**, presses clutch disc **12** firmly against flywheel **13**.
- Clutch disc **12** forced against flywheel **13** runs together with the flywheel and transmits power from the engine to transmission drive pinion **14**.



When clutch pedal is depressed

- Hydraulic pressure generated within the clutch master cylinder activates the clutch power cylinder. Thus, release fork shaft **8** actuates release fork **7**, pushing forward release bearing **5** and clutch shifter **6**, which in turn push release lever plate **15** and release lever **4**.
- Release lever **4**, using support lever **3** as a fulcrum, compresses pressure spring **9** and retracts pressure plate **11**, creating a clearance between clutch disc **12** and flywheel **13**, cutting off the transmission of engine power.

TROUBLESHOOTING

21

Symptoms		Clutch disengaged but drags	Clutch slips	Clutch does not engage smoothly	Clutch makes noise on disengagement	Clutch makes noise on engagement	Judder when vehicle starting	Remarks
Pressure plate and lever assembly	Release bearing faulty	○			○			
	Release lever heights uneven	○	○	○			○	
	Pressure plate warped or faulty	○	○	○			○	
	Pressure spring fatigued		○	○		○		
	Strap bolts loose						○	
	Strap plate bent				○			
Clutch disc	Disc deformed	○		○			○	
	Disc rivets loose			○			○	
	Disc torsion spring fatigued or fractured		○	○	○	○	○	
	Spline worn	○			○	○	○	
	Spline rusted	○		○				
	Facing worn		○					
	Facing surface hardened		○	○			○	
	Facing oily or greasy		○	○			○	
Clutch pedal	Pedal free play inadequate		○					
	Pedal free play excessive	○						
	Pedal stroke inadequate	○						
	Return spring fatigued		○					
	Pedal friction surfaces faulty			○			○	
Clutch master cylinder	Piston and piston cup sliding movement faulty	○	○	○				
	Spring fatigued	○	○	○				
	Brake fluid port clogged	○	○	○				
Clutch power cylinder	Return spring fatigued	○	○	○				
	Piston and piston cup sliding movement faulty	○	○	○				
	Brake fluid port clogged	○	○	○				
Clutch control	Release bearing faulty						○	
	Clutch shifter sliding movement faulty						○	
	Clutch shifter lubricated incorrectly						○	
	Clutch release fork deformed						○	
Transmission drive pinion spline area worn		○				○		 Gr 22
Engine idling speed too slow						○		 Gr 13
Engine mounting fatigued							○	 Gr 10
Flywheel warped, deformed or stepped wear		○	○	○			○	 Gr 11
Flywheel pilot bearing faulty		○			○			
Air mixed in clutch hydraulic system		○						
Clutch hydraulic system leaking		○						

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Clutch Fluid (Brake Fluid) Replacement and Air Bleeding

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

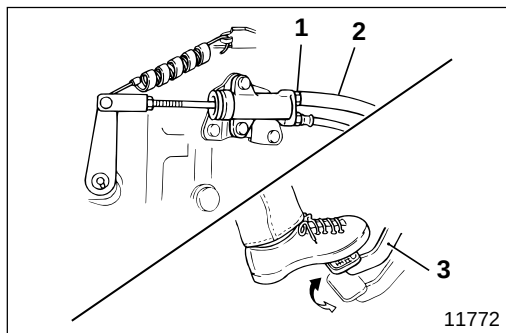
Location	Parts to be tightened	Tightening torque	Remarks
1	Air bleeder	25 to 34 {18 to 25, 2.5 to 3.5}	—

Fluid

Location	Points of application	Kinds	Quantity
4	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

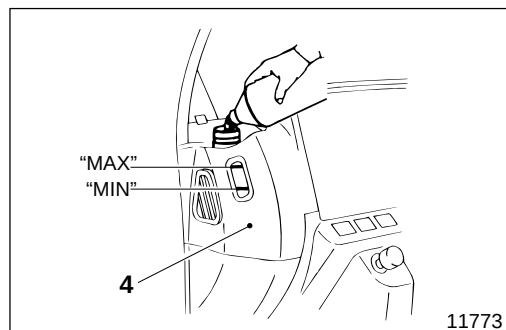
CAUTION

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.
- You must use new brake fluid (SAE J1703f or FMVSS No. 116 DOT3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system to swell, resulting in faulty clutch operation.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will cause faulty clutch operation.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oils.

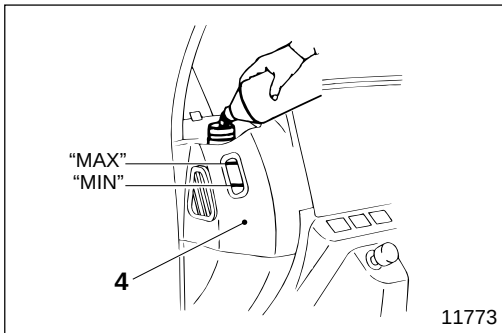
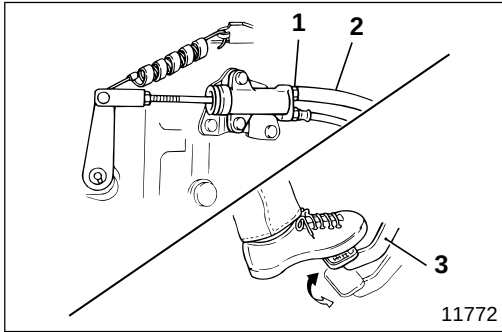


(1) Replacement of brake fluid

- Attach vinyl pipe 2 to air bleeder 1 of the clutch power cylinder.
- Loosen air bleeder 1 and depress clutch pedal 3 several times to drain brake fluid completely.



- Supply new brake fluid to the "MAX" level of fluid tank 4. Depress clutch pedal 3 repeatedly until the old brake fluid discharged from vinyl pipe 2 is replaced by the new brake fluid.



(2) Air bleeding of clutch system

NOTE

Carry out this operation maintaining the brake fluid level in fluid tank 4 between "MAX" and "MIN".

- Attach vinyl pipe 2 to air bleeder 1 of the clutch power cylinder as in the replacement procedure.
- Fill fluid tank 4 with brake fluid, and loosen air bleeder 1 of the clutch power cylinder, then depress clutch pedal 3 continuously.
- Keep depressing clutch pedal 3, and tighten air bleeder 1 when air is bled completely.
- Depress clutch pedal 3 several times again, then keep it depressed at its fullest extent.
- With the clutch pedal depressed, loosen air bleeder 1 to drain brake fluid containing air. Release the pedal after tightening the air bleeder.
- Repeat this operation until air is no longer present in the fluid being drained.
- When this operation is completed, tighten air bleeder 1 at specified torque.
- Check that brake fluid is at the "MAX" level of fluid tank 4, and supply new brake fluid if necessary.
- Check for brake fluid leakage from each of the parts with clutch pedal 3 depressed.

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

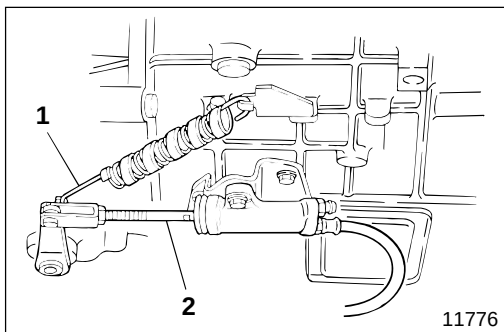
Clutch Pedal Free Play

Service standards

Unit : mm {in.}

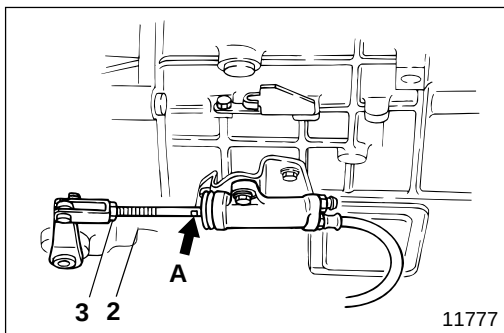
Location	Maintenance item	Standard value	Limit	Remedy
2	Push rod stroke	3.6 {0.14}	—	Adjust or replace
4	Clutch pedal free play	32 to 44 {1.26 to 1.73}	—	Adjust or replace

Inspect and adjust the free play of the clutch pedal, by noting the stroke of the clutch power cylinder push rod, after the clutch pedal has been correctly adjusted.



[Inspection]

- Bleed air from the clutch system. [P21-7](#)
- Adjust the clutch pedal. [P21-11](#)
- Disconnect return spring **1** and check the free play of push rod **2** by hand. If the measured value deviates from the standard value, adjust as follows:

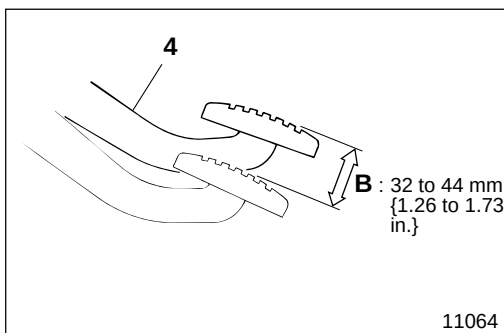


[Adjustment]

- Loosen nut **3** and turn head **A** of push rod **2** to extend the push rod until it stops.
- Then, slacken off head **A** of push rod **2** by the following value and retighten nut **3**.

Amount of slackening off : Approximately three turns

- If push rod **2** does not return by the above amount, replace the clutch disc because it is worn beyond the limit.



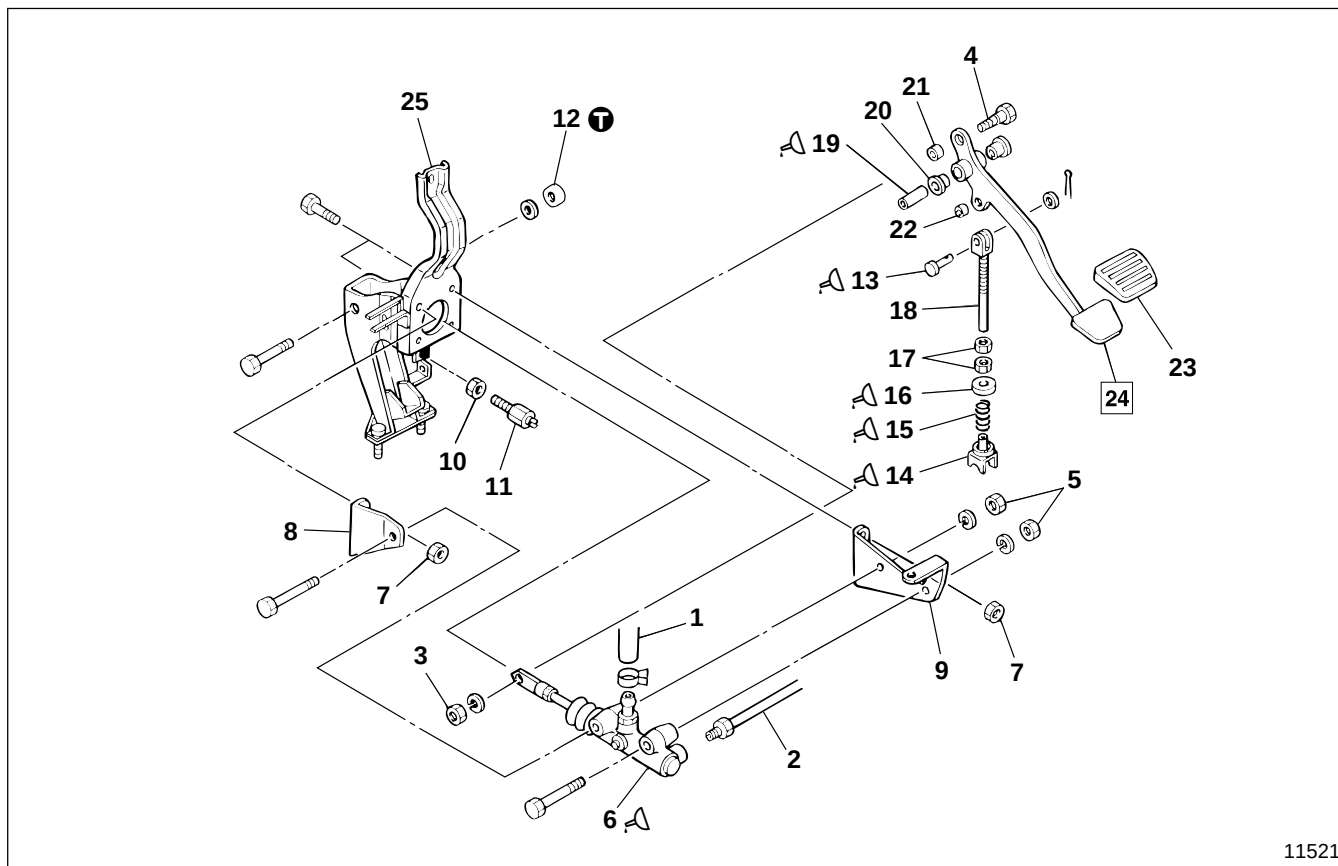
[Confirmation]

Push clutch pedal **4** with your hand until you feel a resistance and measure free play **B**.

If the measured value deviates from the standard value, readjust or replace the clutch disc.

MEMO

CLUTCH PEDAL



11521

● Disassembly sequence

- | | | |
|--------------------------------------|--------------------------------------|-------------------------|
| 1 Fluid hose | 9 Clutch master cylinder bracket, RH | 17 Nut |
| 2 Fluid pipe | 10 Nut | 18 Spring assist rod |
| 3 Nut | 11 Clutch switch
Gr 54 | 19 Collar |
| 4 Offset bolt | 12 Nut | 20 Bushing |
| 5 Nut | 13 Clevis pin | 21 Bushing |
| 6 Clutch master cylinder
P21-14 | 14 Spring holder | 22 Bushing |
| 7 Nut | 15 Return spring | 23 Pedal pad |
| 8 Clutch master cylinder bracket, LH | 16 Plate | 24 Clutch pedal |
| | | 25 Clutch pedal support |

● Assembly sequence

Follow the disassembly sequence in reverse.

● Adjustment after assembly

P21-11

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
4, 21	Clearance between offset bolt and bushing	[18] 0.06 to 0.36 {[0.71] 0.0024 to 0.014}	—	Replace
15	Installed load of return spring (Installed length 37 {1.46})	185 N {41 lbf, 18.7 kgf}	160 N {36 lbf, 16.5 kgf}	Replace
19, 20	Clearance between collar and bushing	[14] 0.02 to 0.26 {[0.55] 0.00079 to 0.010}	0.3 {0.012}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
12	Nut (Clutch pedal mounting)	16.7 to 25.5 {12 to 19, 1.7 to 2.6}	—

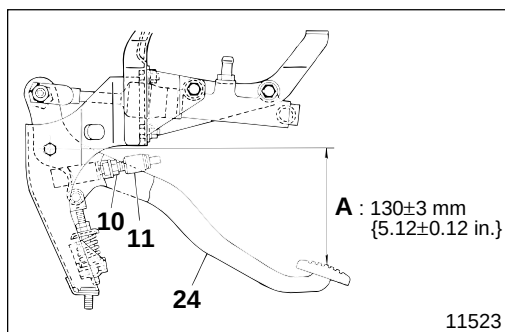
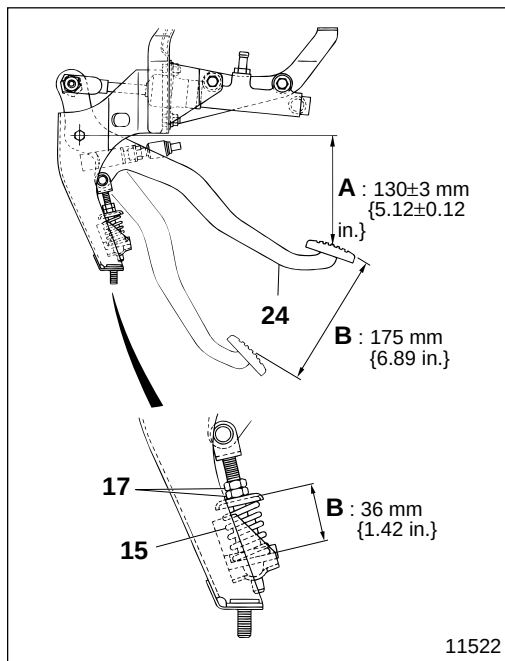
Lubricant

Location	Points of application	Kinds	Quantity
6	Offset bolt mounting area	Chassis grease [NLGI No.1 (Ca soap)]	As required
13	Clevis pin	Chassis grease [NLGI No.1 (Ca soap)]	As required
14 to 16	Friction surfaces of spring holder, return spring and plate	Chassis grease [NLGI No.1 (Ca soap)]	As required
19	External surface of collar	Chassis grease [NLGI No.1 (Ca soap)]	As required

Service procedure

Adjustment after assembly

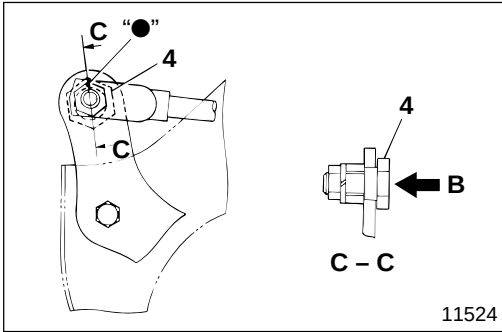
Adjust return spring **15** to the installed dimension **C** using lock nut **17**, maintaining the installed dimensions **A**, **B** for clutch pedal **24**.



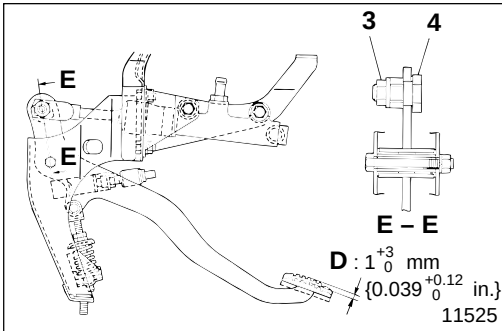
24 Adjustment of clutch pedal

- Turn clutch switch **11** to obtain the illustrated dimension **A**, and tighten nut **10**.

CLUTCH PEDAL



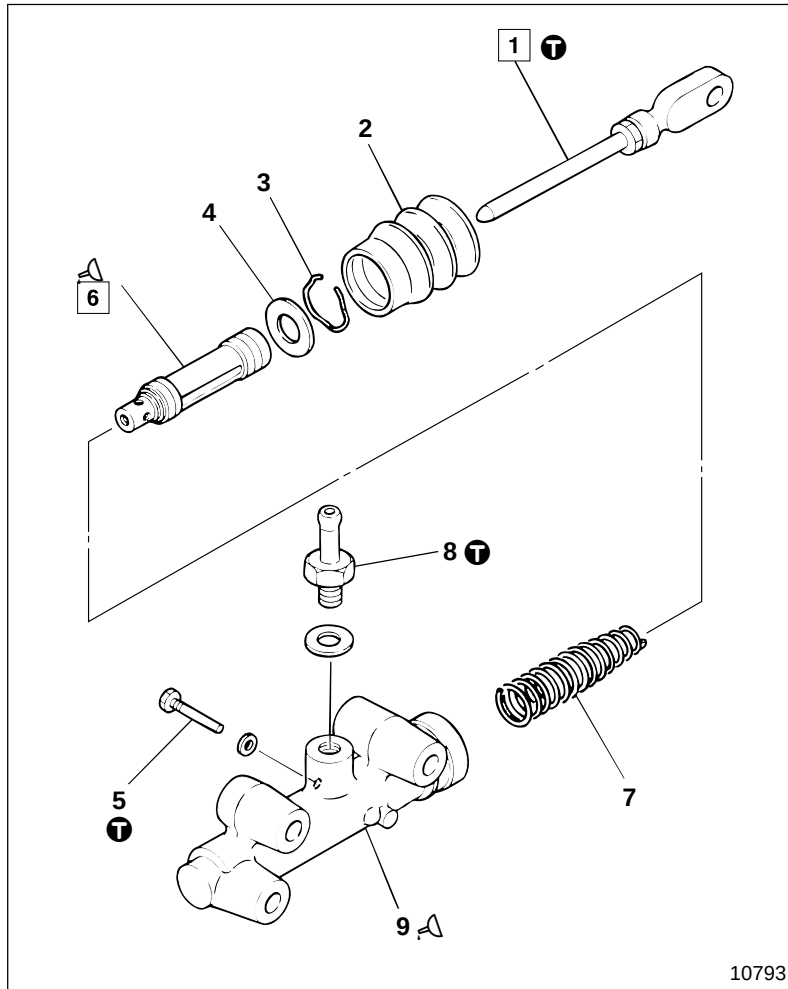
- At this time, temporarily tighten offset bolt **4** at the illustrated position.
B : "●" Marked side



- Then, turn offset bolt **4** to adjust free play **D** of the clutch pedal top to conform to the dimension as illustrated, and tighten using nut **3**.

MEMO

CLUTCH MASTER CYLINDER



● Disassembly sequence

- 1 Push rod
- 2 Boot
- 3 Piston stop ring
- 4 Piston stop plate
- 5 Supply valve stopper
- 6 Piston assembly
- 7 Return spring
- 8 Nipple
- 9 Cylinder

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Piston and boot kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
6, 9	Clearance between piston assembly and cylinder	[19.05] 0.020 to 0.105 {[0.750] 0.00079 to 0.0041}	0.2 {0.0079}	Replace
7	Free length of return spring	97 {3.82}	92 {3.62}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Push rod (Lock nut tightening)	9.8 to 14.7 {7.2 to 11, 1.0 to 1.5}	—
5	Supply valve stopper	1.47 to 2.94 {1.1 to 2.2, 0.15 to 0.3}	—
8	Nipple	24.5 to 34.3 {18 to 25, 2.5 to 3.5}	—

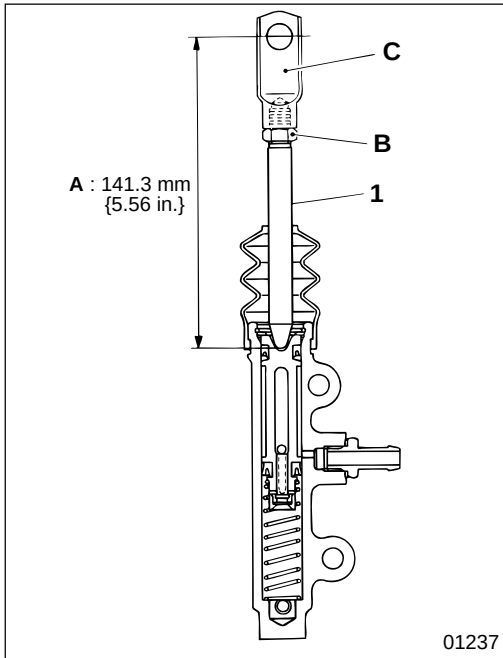
L Lubricant

Location	Points of application	Kinds	Quantity
6, 9	Friction surfaces of piston assembly and cylinder body	Rubber grease	As required

◆ Service procedure

1 Adjustment of push rod length

If dimension **A**, as illustrated, deviates from the standard value, loosen lock nut **B** of push rod **1**, and adjust the length by turning head **C**. After adjustment, tighten the lock nut at specified torque.



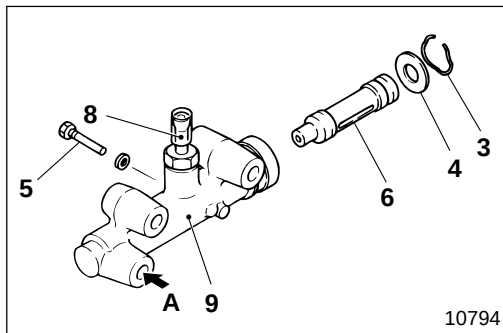
6 Piston assembly

[Removal]

- Remove piston stop ring **3**, piston stop plate **4** and supply valve stopper **5**.
- Block nipple **8** of cylinder **9**, and apply compressed air from **A** as illustrated to remove piston assembly **6**.

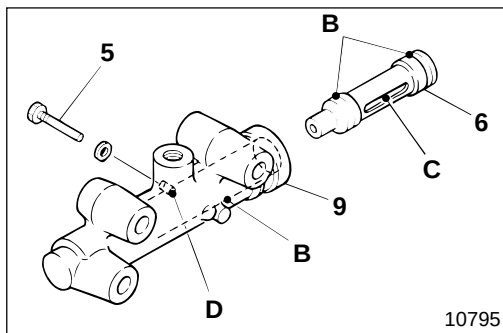
WARNING ⚠

You must apply compressed air gradually when you remove piston assembly **6**. If you applied compressed air strongly at one time, the piston assembly would be violently ejected.

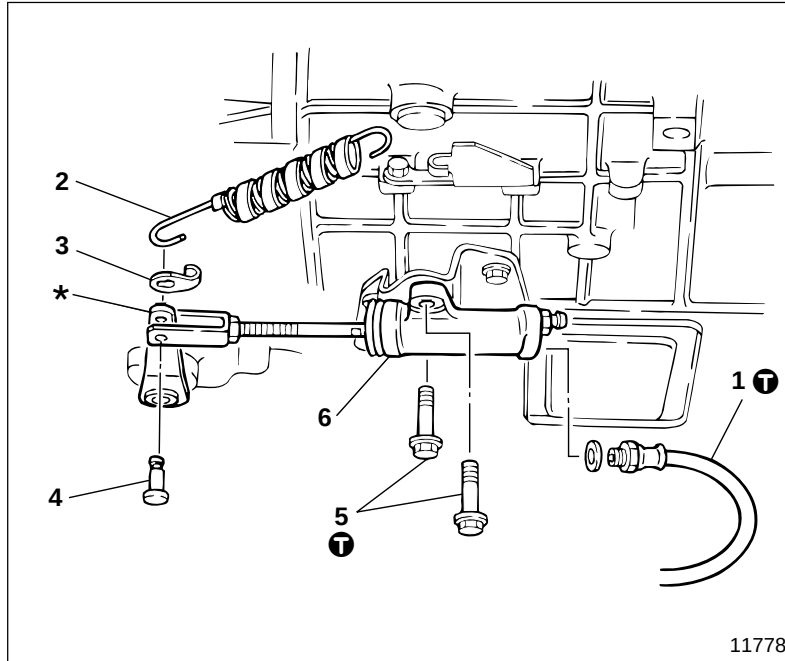


[Installation]

- Before installing the assembly, apply rubber grease to friction surface **B** of piston assembly **6** and cylinder **9**.
- To install the piston, align groove **C** of piston assembly **6** with hole **D** of cylinder **9**, then insert valve stopper **5** to hold the piston in place.



CLUTCH POWER CYLINDER



● Removal sequence

- 1 Fluid hose
 - 2 Return spring
 - 3 Return spring claw
 - 4 Clevis pin
 - 5 Bolt
 - 6 Clutch power cylinder assembly
- 📖 P21-17

* : Clutch release fork shaft

CAUTION ⚠

Make sure you plug the hose opening after disconnection to prevent fluid from running out.

● Installation sequence

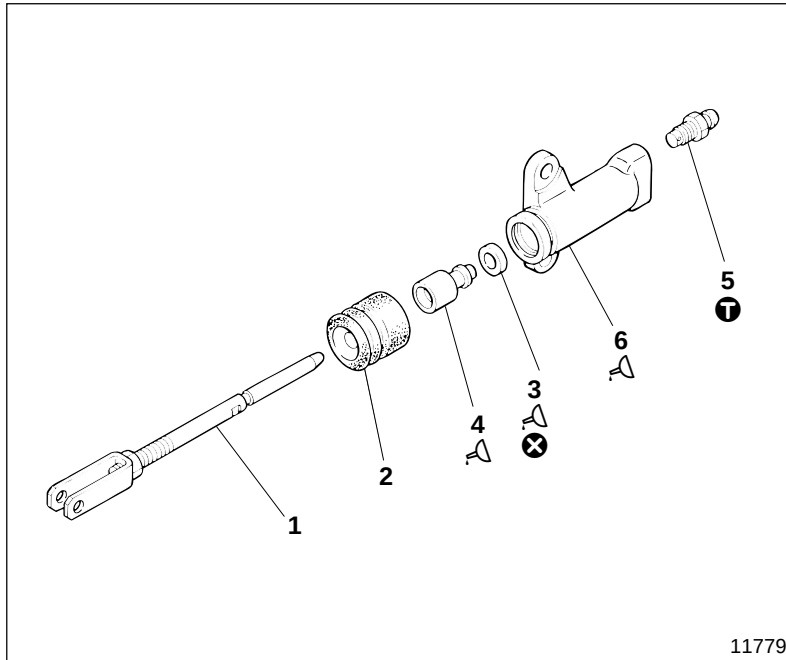
Follow the removal sequence in reverse.

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Tightness of fluid hose connection	21 to 31 {15 to 23, 2.1 to 3.2}	—
5	Bolt (Clutch power cylinder assembly mounting)	47 {35, 4.8}	—

Clutch Power Cylinder Assembly



● Disassembly sequence

- 1 Push rod
- 2 Boot
- 3 Piston cup
- 4 Piston
- 5 Air bleeder
- 6 Cylinder

⊗ : Non-reusable parts

● Assembly sequence

4→3
6→5 → 2→1

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
4, 6	Clearance between cylinder and piston	[20.64] 0.04 to 0.125 {[0.81] 0.0016 to 0.0049}	0.24 {0.0094}	Replace

Ⓣ Tightening torque

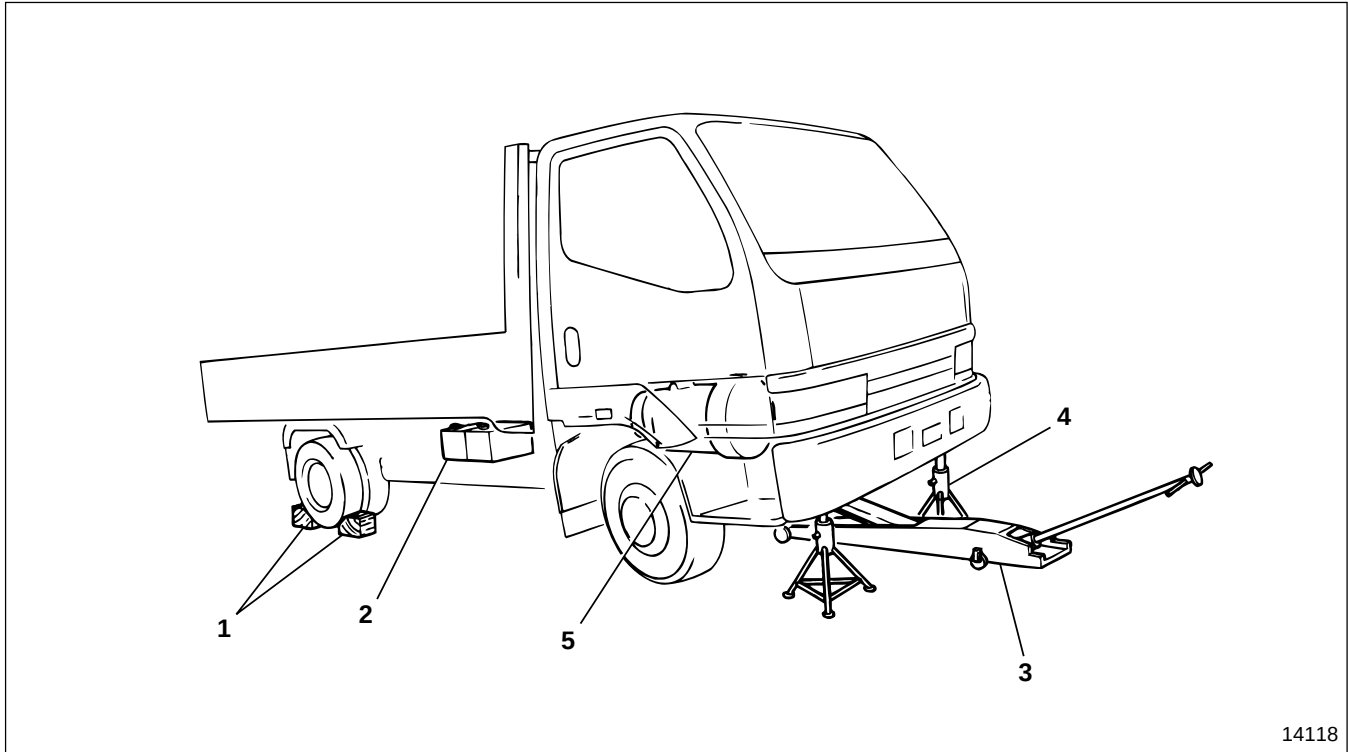
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Air bleeder	25 to 34 {18 to 25, 2.5 to 3.5}	—

🛢 Lubricant

Location	Points of application	Kinds	Quantity
3	Piston cup circumference	Rubber grease	As required
4	Friction surface of piston	Rubber grease	As required
6	Cylinder bore	Rubber grease	As required

WORK BEFORE REMOVAL AND INSTALLATION OF CLUTCH BODY



● Work sequence before removal

- 1 Place wheel chocks.
- 2 Disconnect the negative battery cable.  Gr 54
- 3 Jack up the front axle using a garage jack.
- 4 Support the front frame on rigid racks.
- 5 Remove the transmission.  Gr 22

WARNING

- Since the parking brake will be removed, naturally it cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Keep the transmission in neutral throughout the operation.

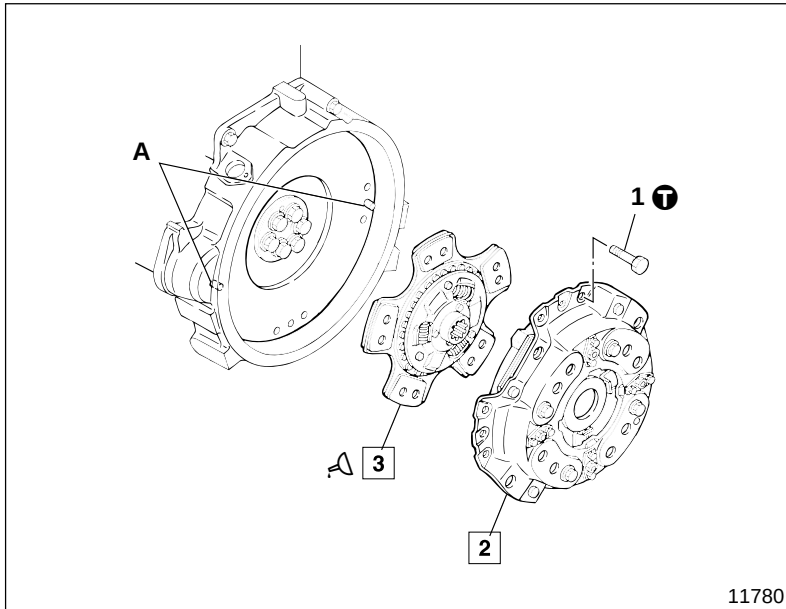
● Work sequence after installation

Follow the work sequence before removal in reverse.

MEMO

CLUTCH BODY

Clutch Disc



● Removal sequence

- 1 Bolt
- 2 Pressure plate and lever assembly
P21-24
- 3 Clutch disc

A : Positioning pins (two points)

WARNING ⚠

Be careful when you handle pressure plate and lever assembly 2 because it is rather heavy.

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

Be careful not to get oily substances on clutch disc 3 surfaces because this will cause the clutch to slip.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
3	Clutch disc	Lateral runout	1.2 {0.047} or less	—	Replace
		Vertical runout	1.2 {0.047} or less	1.8 {0.071}	Replace
		Play in revolving direction at spline	0.06 to 0.21 {0.0024 to 0.0083}	0.5 {0.02}	Replace
		Depth from facing surface to cup	0.79 to 1.43 {0.031 to 0.056}	0.2 {0.0079}	Replace

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

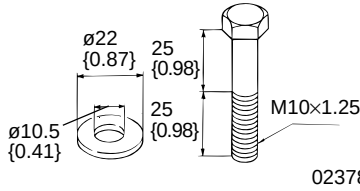
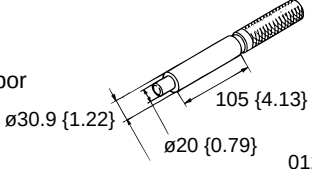
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Pressure plate and lever assembly mounting)	32 to 49 {24 to 36, 3.3 to 5.0}	—

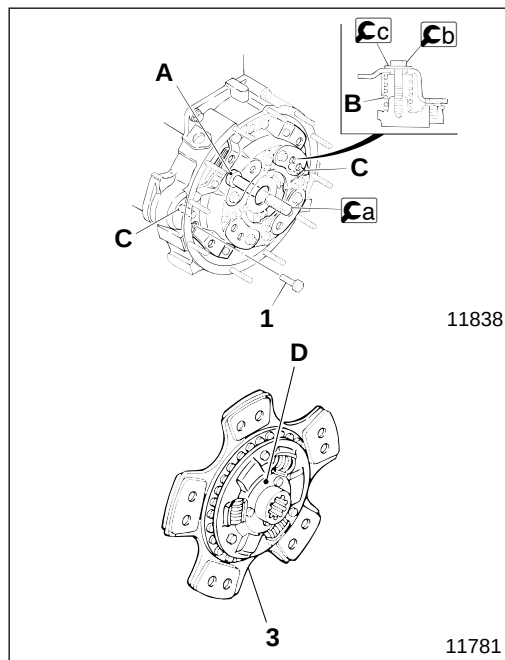
🔧 Lubricant

Location	Points of application	Kinds	Quantity
3	Spline of clutch disc	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	3.2 to 4.2 g {0.11 to 0.15 oz}

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Stopper bolt Washer 	ME521425 < Stopper bolt > ME521426 < Washer >	Removal and installation of pressure plate and lever assembly
3	Clutch alignment arbor 	MH061986	Holding of clutch disc



Service procedure

2 Removal and installation of pressure plate and lever assembly

- Insert  clutch alignment arbor into flywheel pilot bearing **A** to hold clutch disc **3**.
- Compress pressure springs **B** using  stopper bolt and  washer, then remove bolt **1**.
- For installation, follow the removal sequence in reverse.
- Install clutch disc **3** so that part No. **D** is visible.
- Tighten bolts **1** gradually, in diagonal order, to specified torque.

CAUTION

- Make sure you use  stopper bolts and  washers (four points) when you remove bolt **1**. If you do not, pressure springs **B** might force up pressure plate and lever assembly **2**, damaging the strap plate, and separate and fall off knock pin **C**.
- Remember to remove  stopper bolts and  washers after installation (four points). If the stopper bolts and washers are left on, the clutch will not engage.

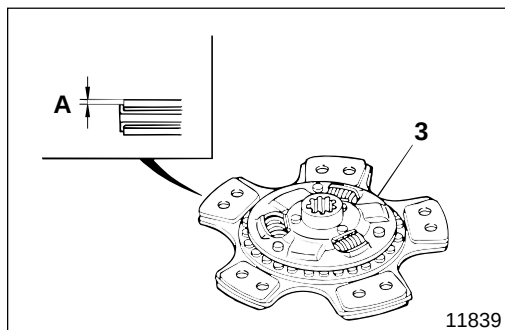
NOTE

Clean flywheel contact surface of clutch disc **3** before installing pressure plate and lever assembly **12**.

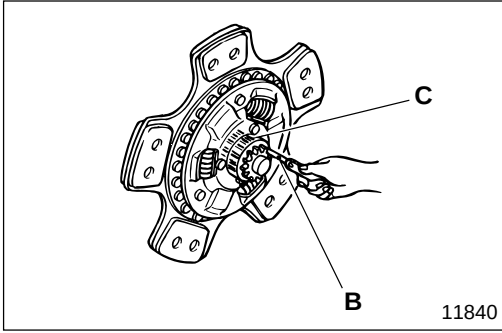
3 Clutch disc

(1) Height of facing

Measure illustrated dimension **A** of clutch disc **3**. If the measured value is lower than the limit, replace the clutch disc.

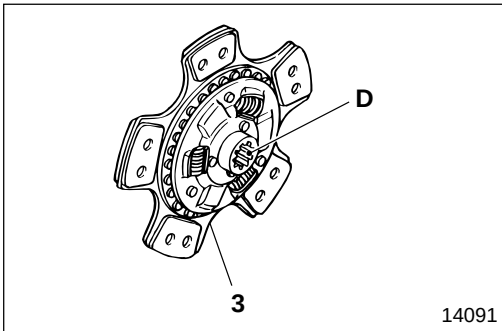


CLUTCH BODY



(2) Play in direction of revolution

- First, reshape feeler gauge **B** for insertion into drive pinion spline **C**, and measure play at the spline.
- If the measured value is higher than the limit, replace clutch disc **3** or the drive pinion.
- Carry out the same measurement on new clutch disc **3**. If the measured value is higher than the limit, replace the drive pinion.



(3) Applying grease

Apply grease evenly to spline **D** and the entire tooth surface of clutch disc **3**. Apply grease to the grease groove of spline up to its large diameter.

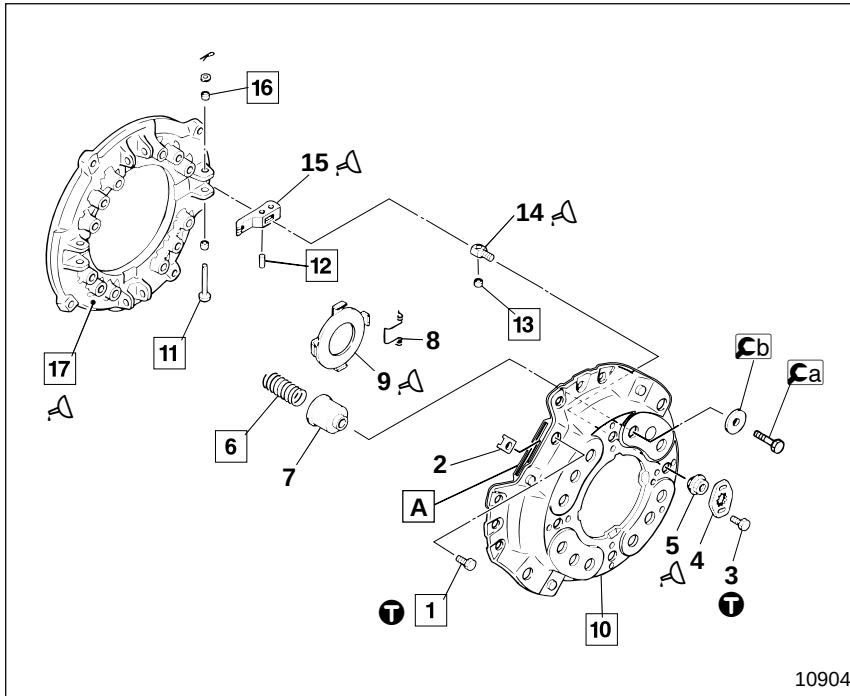
CAUTION

Be careful not to apply too much grease because excessive grease causes grease leakage from the spline **D** and makes the clutch slippery.

MEMO

CLUTCH BODY

Pressure Plate and Lever Assembly



● Work before disassembly

📖 P21-26

● Disassembly sequence

- 1 Strap bolt
- 2 Washer
- 3 Bolt
- 4 Lock plate
- 5 Support nut
- 6 Pressure spring
- 7 Pressure spring cap
- 8 Return spring
- 9 Release lever plate
- 10 Clutch cover
- 11 Release lever pin
- 12 Support lever pin
- 13 Bushing
- 14 Support lever
- 15 Release lever
- 16 Bushing
- 17 Pressure plate

A : Strap plate

Ca : Stopper bolt

Cb : Washer

NOTE

Do not remove bushings 13, 16 unless they are faulty.

● Assembly Sequence

Follow the disassembly sequence in reverse.

Repair kit : Clutch release lever kit

● Inspection and adjustment after assembly

📖 P21-26

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
1, A	Clearance between strap bolt and strap plate		0.01 to 0.16 {0.00039 to 0.0063}	0.3 {0.012}	Replace
6	Pressure spring	Installed load (Installed length 49.1 {1.93})	885 N {200 lbf, 90.2 kgf}	750 N {170 lbf, 76.7 kgf}	Replace
		Tilt	2.9 {0.11} or less	5.0 {0.20}	Replace
9	Height of release lever plate		53.8±0.7 {2.12±0.028}	Difference between any two: 0.5 {0.020} or less	Adjust
11, 16	Clearance between release lever pin and bushing		[10] 0.02 to 0.11 {[0.39] 0.00079 to 0.0043}	0.4 {0.016}	Replace
12, 13	Clearance between support lever pin and bushing		[10] 0.02 to 0.12 {[0.39] 0.00079 to 0.0047}	0.4 {0.016}	Replace
17	Pressure plate	Thickness	23.6±0.1 {0.93±0.0039}	21 {0.83}	Replace
		Flatness	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Inner diameter of strap bolt fitting hole	10.2 to 10.25 {0.402 to 0.404}	10.5 {0.41}	Replace

Tightening torque

Unit : N·m {lb.ft, kgf·m}

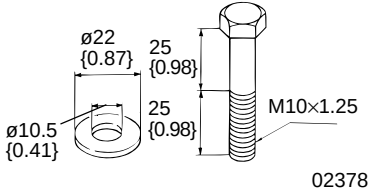
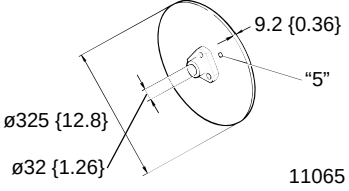
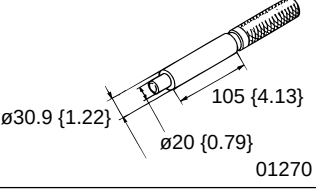
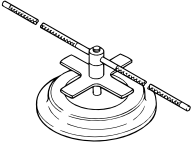
Location	Parts to be tightened	Tightening torque	Remarks
1	Strap bolt (Strap plate mounting)	39 to 59 {29 to 43, 4 to 6}	—
3	Bolt (Lock plate mounting)	5.9 to 7.8 {4.3 to 5.8, 0.6 to 0.8}	—

Lubricant

Location	Points of application	Kinds	Quantity
5	Thread area and spherical surfaces of support nut	Anti-seizure compound	As required
9, 15	Friction surfaces of release lever plate and release lever	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
14, 15	Friction surfaces of support lever and release lever	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
15, 17	Friction surfaces of release lever and pressure plate	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
—	Stopper bolt Washer 	ME521425 < Stopper bolt > ME521426 < Washer >	Disassembly and assembly of pressure plate and lever assembly
9	Clutch master plate 	MH062291	Adjust release lever heights
	Clutch alignment arbor 	MH061986	Holding of clutch disc
10	Clutch installer 	MH061051	Removal and installation of clutch cover

CLUTCH BODY

◆ Service procedure

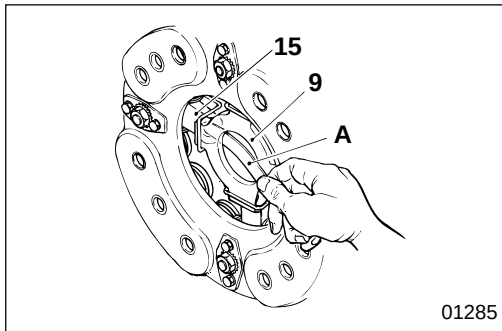
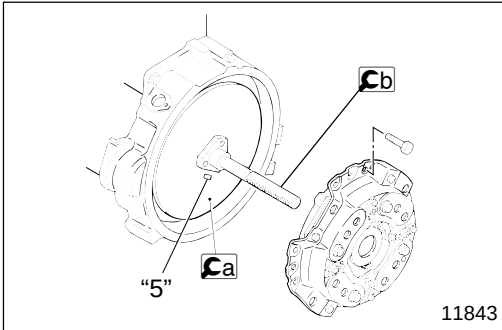
● Work before disassembly

Put alignment marks on all parts before disassembly.

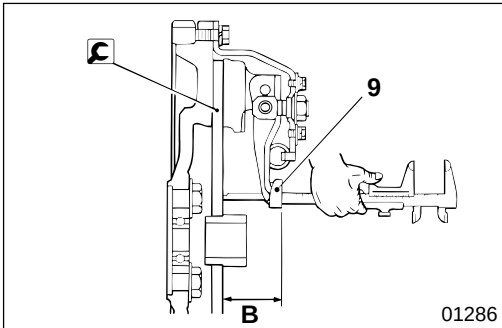
● Inspection and adjustment after assembly

(1) Measurement of release lever height

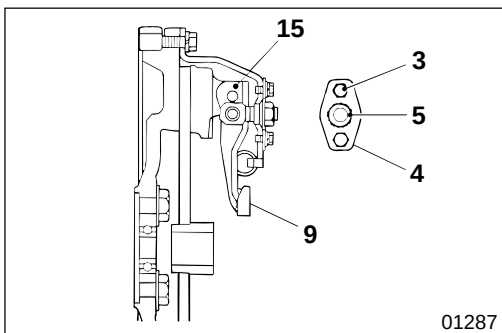
- Install the pressure plate and lever assembly using **C_a** clutch master plate and **C_b** clutch alignment arbor in place of the clutch disc.
- Install **C_a** clutch master plate so that identification mark "5" is visible.



- Make certain that the clearance between release lever **15** and release lever plate **9** is such that a 0.05 mm {0.0020 in.} feeler gauge **A** cannot be inserted between them.
If there is excessive clearance, press in strongly using your fingers, and return slowly to lessen the clearance.

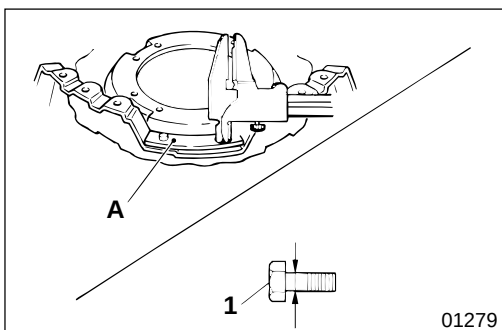


- Measure dimension **B**, **C** clutch master plate to upper surface of release lever plate **9** (at four points).
If the measured value does not conform to the standard value, adjust as explained below. Note that even if the measured value is within the standard value, adjustment is necessary if the difference between any two points is higher than 0.5 mm {0.020 in.}.



(2) Adjustment of release lever height

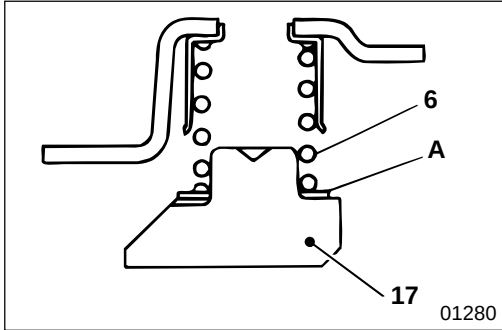
Remove bolt **3** and lock plate **4**, then turn support nut **5** to adjust.
After adjustment, install lock plate **4**, then lock support nut **5**, and check the height of release lever plate **9**.



1 A Clearance between strap bolt and strap plate

If the measured value is higher than the limit, replace the faulty parts.

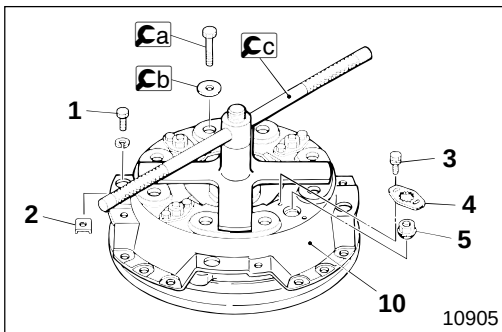
A : Strap plate



6 Installation of pressure spring

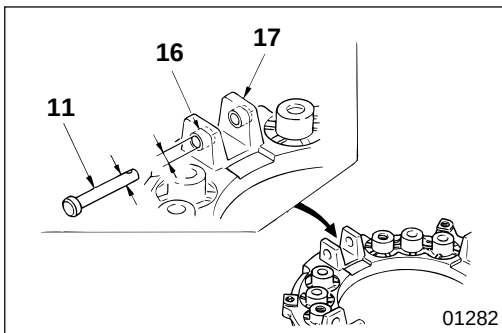
When pressure plate 17 has been corrected by grinding, place adjusting washer A equivalent to the correction depth between the plate and pressure spring 6.

Amount of correction made	Thickness of washers and quantity
Less than 1 mm {0.039 in.}	Not required
1 to 2 mm {0.039 to 0.079 in.}	1×1.2 mm {0.047 in.}
2 to 3 mm {0.079 to 0.12 in.}	2×1.2 mm {0.047 in.}, or 1×2.3 mm {0.091 in.}



10 Removal and installation of clutch cover

- Compress pressure spring 6 using clutch installer, and remove stopper bolt, washer, strap bolt 1, washer 2, bolt 3, lock plate 4 and support nut 5.
- Gradually loosen clutch installer until pressure spring 6 is fully extended, then remove clutch cover 10.
- For installation, follow the removal procedure in reverse.

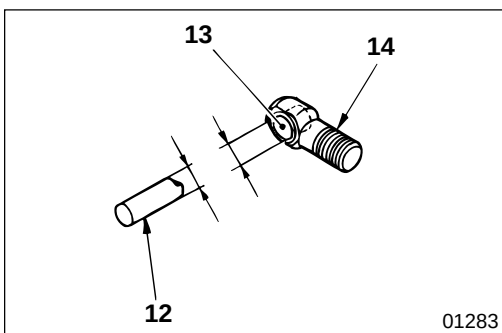


11 16 Clearance between release lever pin and bushing

If the measured value is higher than the limit, replace the faulty parts.

NOTE

Measure the bore of bushing 16 as press-fitted in pressure plate 17.

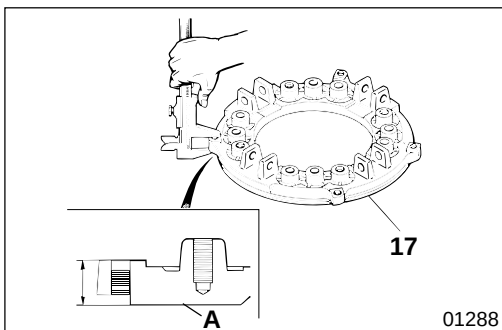


12 13 Clearance between support lever pin and bushing

If the measured value is higher than the limit, replace the faulty parts.

NOTE

Measure the bore of bushing 13 as press-fitted in support lever 14.



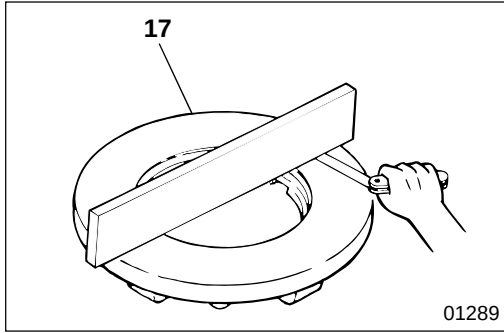
17 Pressure plate

(1) Thickness

Measure friction surface A of pressure plate 17 (measuring position must be within the maximum and minimum diameters), and if the measured value is lower than the limit, replace the pressure plate.

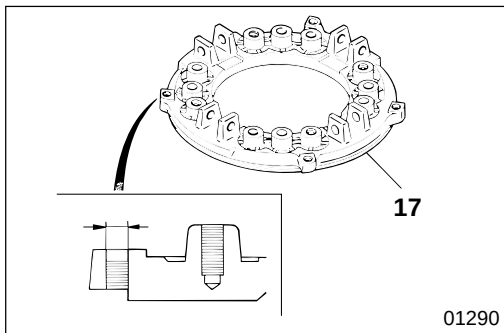
Maximum diameter	320 mm {12.6 in.}
Minimum diameter	220 mm {8.66 in.}

CLUTCH BODY



(2) Flatness

If the measured value is higher than the limit, replace pressure plate 17.

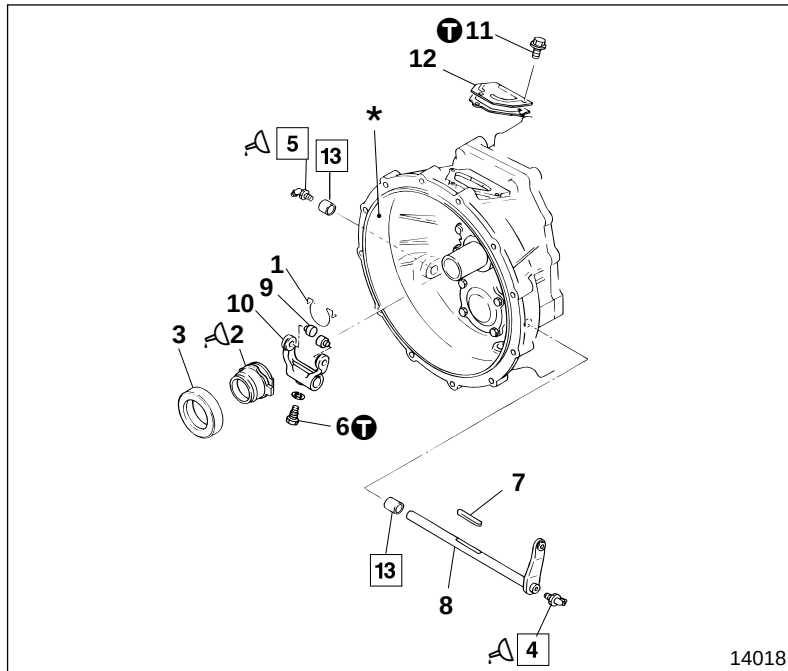


(3) Strap bolt fitting hole inner diameter

If the measured value is higher than the limit, replace pressure plate 17.

MEMO

CLUTCH CONTROL



● Disassembly sequence

- 1 Return spring
- 2 Clutch shifter
- 3 Release bearing
- 4 Grease nipple
- 5 Grease nipple
- 6 Set screw
- 7 Key
- 8 Release fork shaft
- 9 Cam follower
- 10 Release fork
- 11 Bolt
- 12 Cover
- 13 Needle roller bearing

* : Clutch housing

Gr 22

NOTE

Do not remove release bearing 3 or needle roller bearing 13 unless they are faulty.

● 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
6	Set screw	21 {15, 2.1}	—
11	Bolt (Clutch housing cover mounting)	9.8 to 15 {7.2 to 11, 1.0 to 1.5}	—

L Lubricant

Location	Points of application	Kinds	Quantity
2	Pack the clutch shifter	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
4, 5	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

C Special tools

Unit : mm {in.}

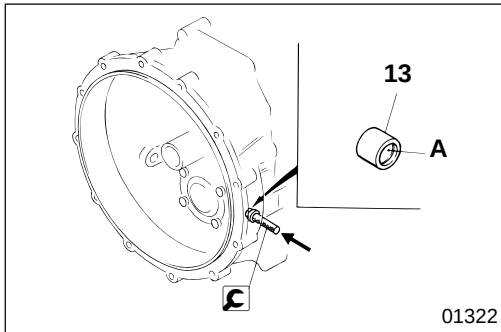
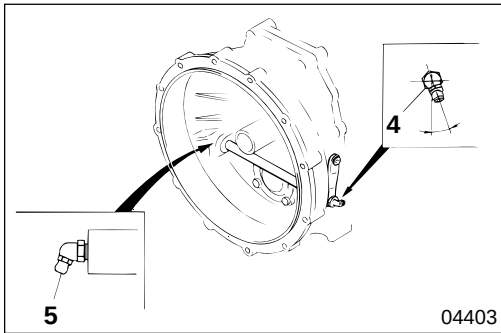
Location	Tool name and shape	Part No.	Application
13	Needle roller bearing installer 	03726-83000	Installation of needle roller bearing

◆ Service procedure

4 5 Installation of grease nipple

NOTE

Install grease nipple 4, 5 so that it faces the direction as illustrated.



13 Installation of needle roller bearing

Install needle roller bearing 13 with yellow sticker A facing outside.

CAUTION ⚠

Do not damage the bearing by hitting it directly with a hammer during installation.



FH

Service Manual

Group 22

Manual Transmission

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

GROUP 22 MANUAL TRANSMISSION

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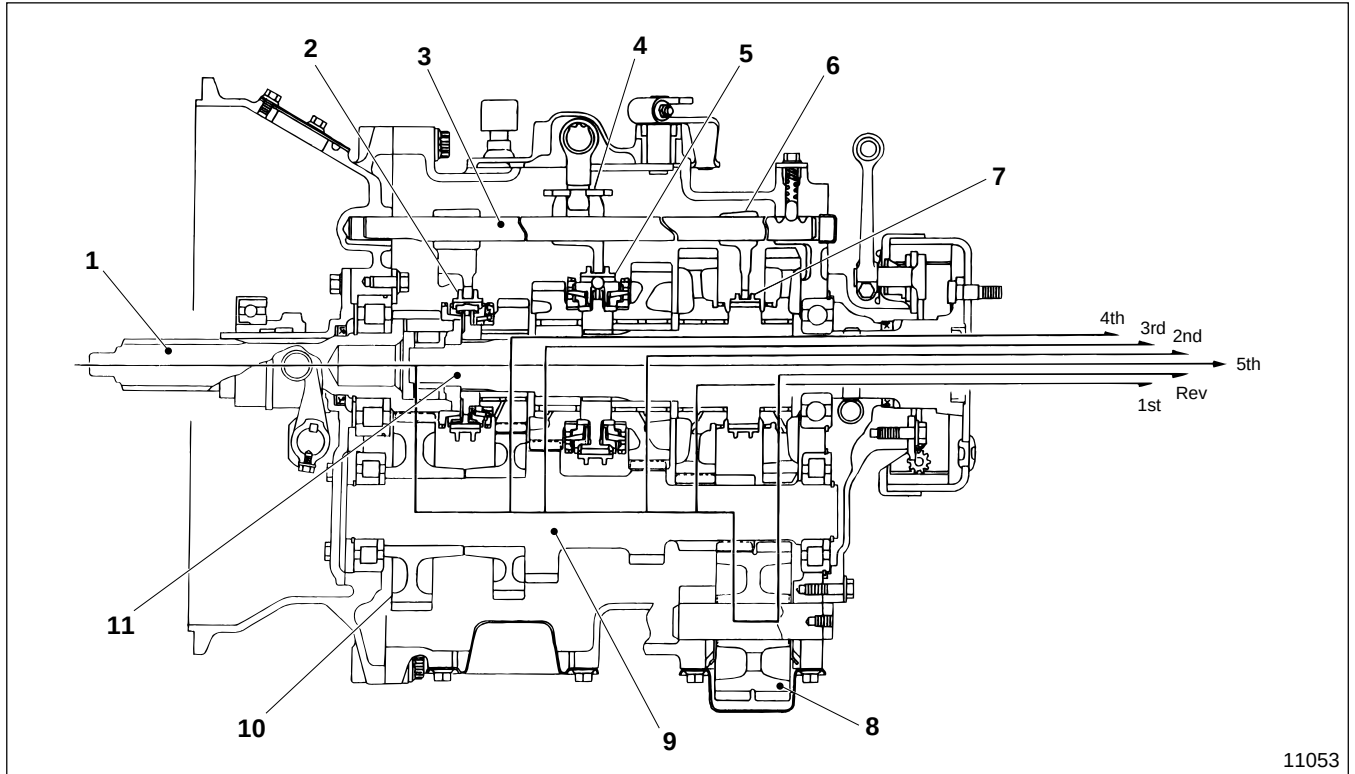
SPECIFICATIONS

Item		Specifications
Mode of control		Floor shift remote control
Transmission model		M050S5
Gear ratio	1st	6.875
	2nd	4.189
	3rd	2.311
	4th	1.409
	5th	1.000
	6th	—
	Reverse	6.875
Oil capacity	L {qts}	5.7 {6.0}
Mass	kg {lb}	120 {265}

STRUCTURE AND OPERATION

22

Transmission



- | | |
|-------------------------------------|--|
| 1 Drive pinion | 7 1st and reverse constant mesh assembly |
| 2 4th and 5th synchronizer assembly | 8 Reverse idler gear |
| 3 Shift rail | 9 Countershaft |
| 4 Interlock mechanism | 10 Non-backlash mechanism |
| 5 2nd and 3rd synchronizer assembly | 11 Mainshaft |
| 6 Shift fork | |

The transmission changes revolution and torque generated by the engine into those that match the vehicle's power requirement (driving force). Revolution and torque are increased or decreased by making a selection from several sets of engaged gears. The transmission uses an interlock mechanism to avoid double engagement and the non-backlash mechanism reduces the idling noise of the transmission when the engine is idling.

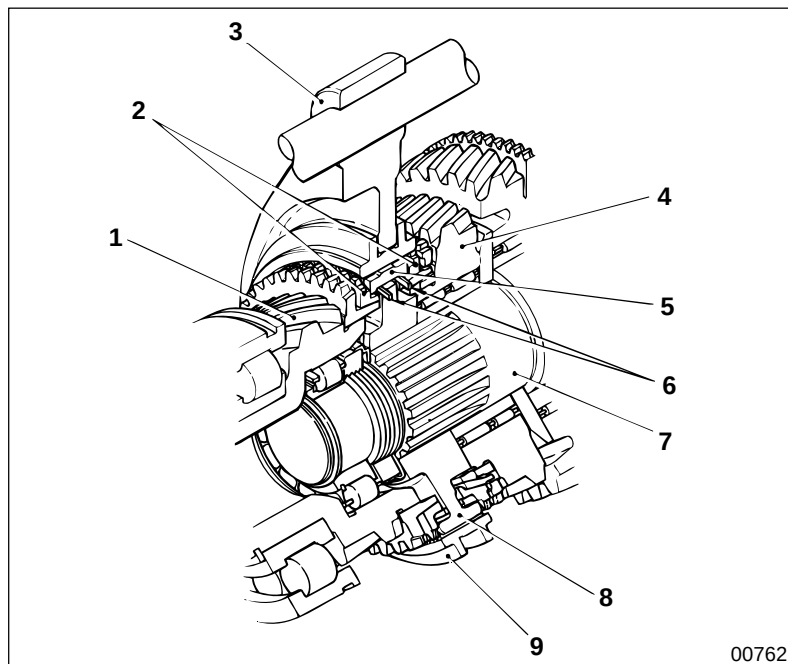
STRUCTURE AND OPERATION

Synchromesh Mechanism

This vehicle has two synchromesh mechanisms, a single cone type, and a double cone type, and uses the key system. The single or double cone type is used depending on the gear positions as shown below:

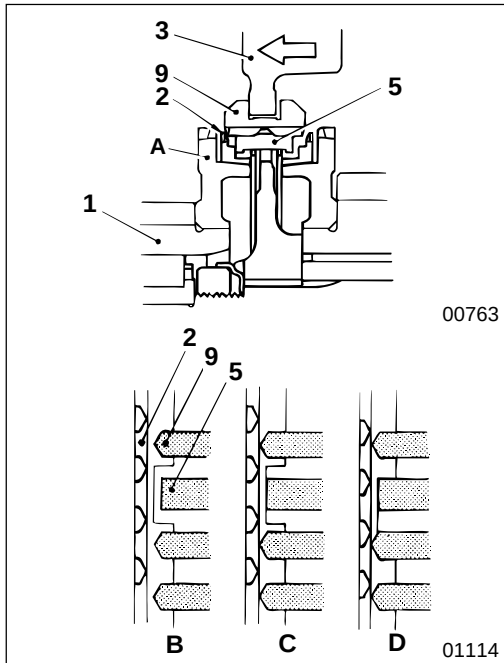
Synchromesh type	Parts used
Single cone type	5th
Double cone type	2nd and 3rd, 4th

Single Cone Type

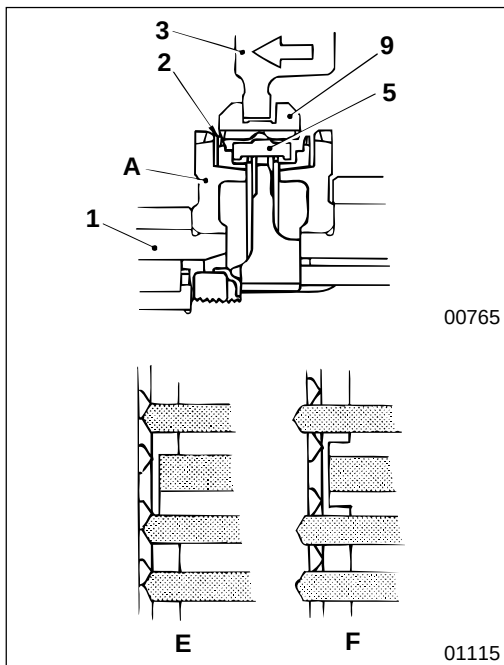


- 1 Drive pinion (Single cone type)
- 2 Synchronizer ring
- 3 4th and 5th shift fork
- 4 4th gear (Double cone type)
- 5 Shifting key
- 6 Shifting key spring
- 7 Mainshaft
- 8 Synchronizer hub
- 9 Synchronizer sleeve

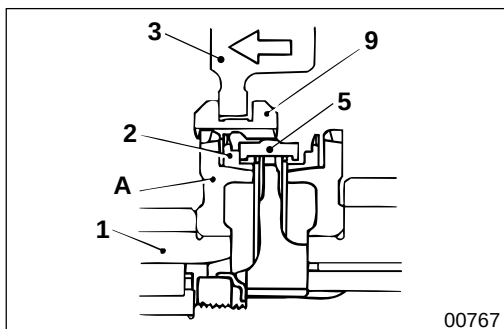
- The following descriptions are for 4th and 5th gear
The inside of synchronizer hub 8 engages the spline of mainshaft 7 and rotates with it. The outside of the synchronizer hub has a spline that engages synchronizer sleeve 9 and three keyways.
- Shifting keys 5 are inserted into these keyways. When the gear shift is in neutral, a protrusion in the center of each shifting key engages a groove inside the synchronizer sleeve and the shifting keys are pressed against the inside of the synchronizer sleeve by shifting key springs 6.
- Synchronizer rings 2 are inserted into drive pinions 1 in the front and rear of synchronizer hub 8, and the taper cone of 4th gear 4.
- The internal tapers of synchronizer rings 2 have fine threads, and the outer splines engage synchronizer sleeve 9. On the hub side of the synchronizer rings are three keyways in which the ends of shifting keys 5 are inserted. These keyways are wider than the width of the shifting keys.
- Synchronizer rings 2 rotate relative to synchronizer sleeve 9 by the amount of play of the keyways.



- When the gear shift is in neutral (Figure B), moving shift fork 3 in the direction of the arrow as illustrated, moves synchronizer sleeve 9 slightly to the left. At the same time, shifting key 5, the central protrusion of which engages the synchronizer sleeve, moves to the left and presses synchronizer rings 2 against taper cone A of drive pinion 1. (Figure C)
- When the taper surfaces of synchronizer rings 2 make contact with the taper cone of the drive pinion, the taper surfaces of the synchronizer rings act as cone clutches. This frictional torque rotates the synchronizer rings in the rotating direction of the drive pinion by the amount of play between shifting key 5 and the synchronizer rings. The spline chamfers of the synchronizer rings and the spline chamfer of synchronizer sleeve 9 are offset from each other. (Figure D)
- The disengagement direction of synchronizer rings 2 is defined by the speed of rotation of the synchronizer—sleeve 9, and the synchronized—drive pinion 1. When increasing the vehicle speed by shifting up, disengagement is made in the opposite direction to rotation, and when decreasing the vehicle speed by shifting down, disengagement is made in the rotating direction.



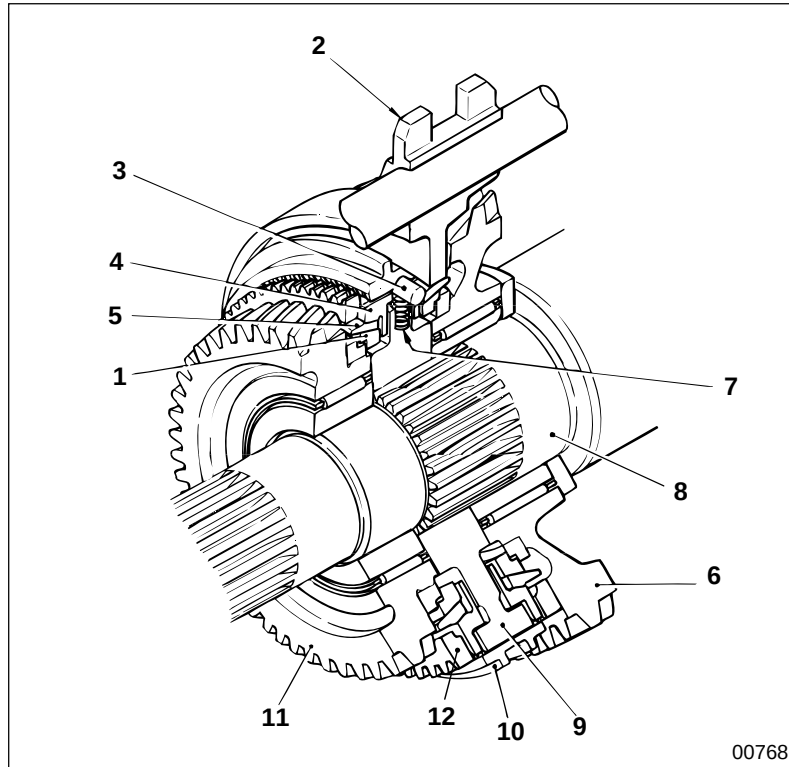
- When synchronizer sleeve 9 moves further to the left, synchronizer rings 2 prevent shifting key 5 from moving, and the synchronizer sleeve disengages from the protrusion of the shifting key.
 - Since synchronizer rings 2 remain disengaged, the spline chamfer of synchronizer sleeve 9 presses the spline chamfers of the synchronizer rings, which in turn press the synchronizer rings against taper cone A of drive pinion 1.
 - As the frictional torque increases on the taper surfaces, the relative speed of the synchronizer and the synchronized gradually decreases.
- E : In synchronization
F : After synchronization



- When synchronizer sleeve 9 and drive pinion 1 rotate at the same speed, synchronizer rings 2 no longer prevent the synchronizer sleeve from moving, and the synchronizer sleeve moves further to the left and smoothly engages the spline of taper cone A of drive pinion 1, transmitting the driving force.

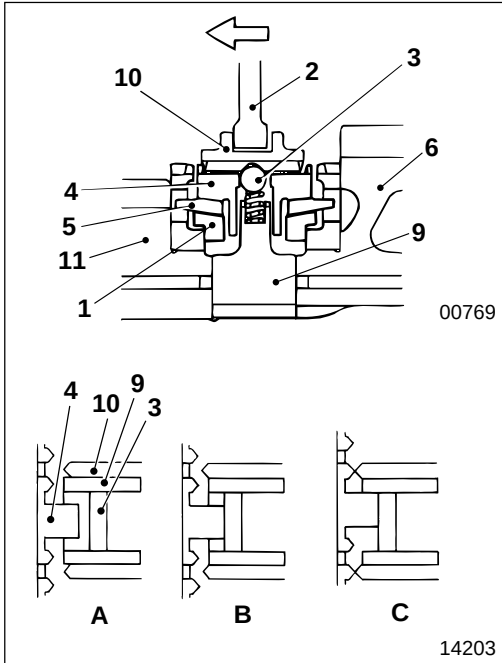
STRUCTURE AND OPERATION

Double Cone Type

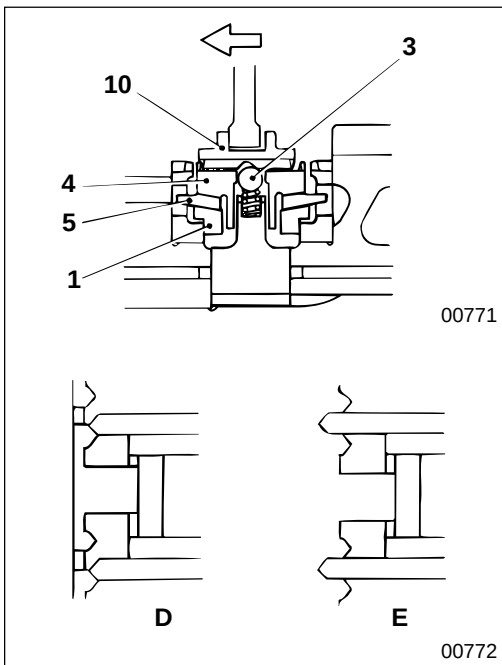


- 1 Synchronizer inner ring
- 2 2nd and 3rd shift fork
- 3 Shifting key
- 4 Synchronizer outer ring
- 5 Synchronizer center cone
- 6 2nd gear
- 7 Shifting key spring
- 8 Mainshaft
- 9 Synchronizer hub
- 10 Synchronizer sleeve
- 11 3rd gear
- 12 Dog clutch

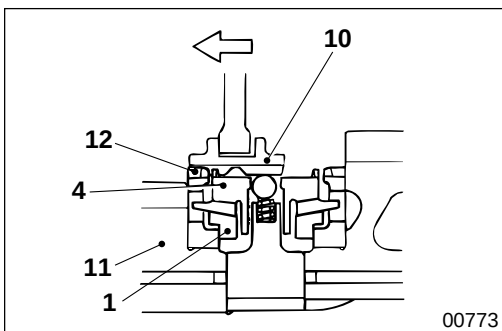
- The following descriptions are for 2nd and 3rd gear
The synchromesh structure and operation of the double cone type are basically the same as for the single cone type.
- Synchronizer center cone **5** is a taper cone independent of 2nd gear **6** and 3rd gear **11**, (both the inside and outside surfaces are tapered). The synchronizer center cone is between synchronizer inner ring **1** and synchronizer outer ring **4** to increase the synchronization capacity.
- Six protrusions on the outside of center cone **5** fit into corresponding gear holes, in the same manner as the taper cone of the single cone type. The center cone and the gear are installed as if integrated.
Shifting key **3** is a cylinder installed so that the lengthwise direction of the cylinder is at right angles to the diameter direction of synchronizer hub **9**. Shifting key spring **7** is a coil spring inserted in a hole in the synchronizer hub, this spring presses the shifting key against the inside of synchronizer sleeve **10**.
- The 4th gear uses the double cone type; however, the structure of shifting key **3** and shifting key spring **7** is the same as for the single cone type.



- When the gear shift is in neutral (Figure A), moving shift fork 2 in the direction of the arrow as illustrated, moves synchronizer sleeve 10 slightly to the left. At the same time, shifting key 3, the central protrusion of which engages the synchronizer sleeve, moves to the left and presses synchronizer outer ring 4 against synchronizer center cone 5. (Figure B)
- When the taper surface of synchronizer outer ring 4 makes contact with the taper cone of synchronizer center cone 5, the taper surface of the synchronizer outer ring acts as a cone clutch. This frictional torque rotates the synchronizer outer ring in the rotating direction of 3rd gear 11 by the amount of play between the synchronizer outer ring and synchronizer hub 9. The spline chamfer of the synchronizer outer ring and the spline chamfer of synchronizer sleeve 10 are offset from each other. (Figure C)
- The disengagement direction of synchronizer outer ring 4 is defined by the speed of rotation of the synchronizer—the sleeve, and the synchronized—3rd gear 11. When increasing the vehicle speed by shifting up, disengagement is made in the opposite direction to rotation, and when decreasing the vehicle speed by shifting down, disengagement is made in the rotating direction.



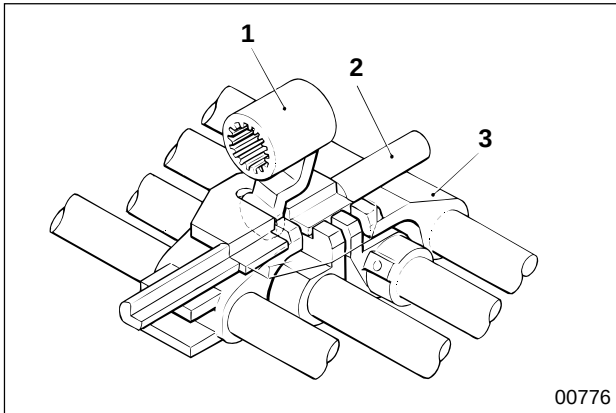
- When synchronizer sleeve 10 moves further to the left, synchronizer outer ring 4 prevents shifting key 3 from moving, and the synchronizer sleeve disengages from the protrusion of the shifting key.
 - Since synchronizer outer ring 4 remains disengaged, the spline chamfer of synchronizer sleeve 10 presses the spline chamfer of the synchronizer outer ring, which in turn presses the synchronizer outer ring against the taper cone of synchronizer center cone 5, and the frictional torque acts on the taper surface.
 - As the frictional torque increases on the taper surface of synchronizer inner ring 1, the relative speed of the synchronizer and the synchronized gradually decreases. The frictional torque acts on both sides of the synchronizer center cone. The double cone type has greater capacity for synchronization than the single cone type.
- E : In synchronization
F : After synchronization



- When synchronizer sleeve 10 and 3rd gear 11 rotate at the same speed, synchronizer outer ring 4 no longer prevents the synchronizer sleeve from moving and the synchronizer sleeve moves further to the left and smoothly engages the spline of dog clutch 12 of the 3rd gear, transmitting the driving force.

STRUCTURE AND OPERATION

Interlock Mechanism

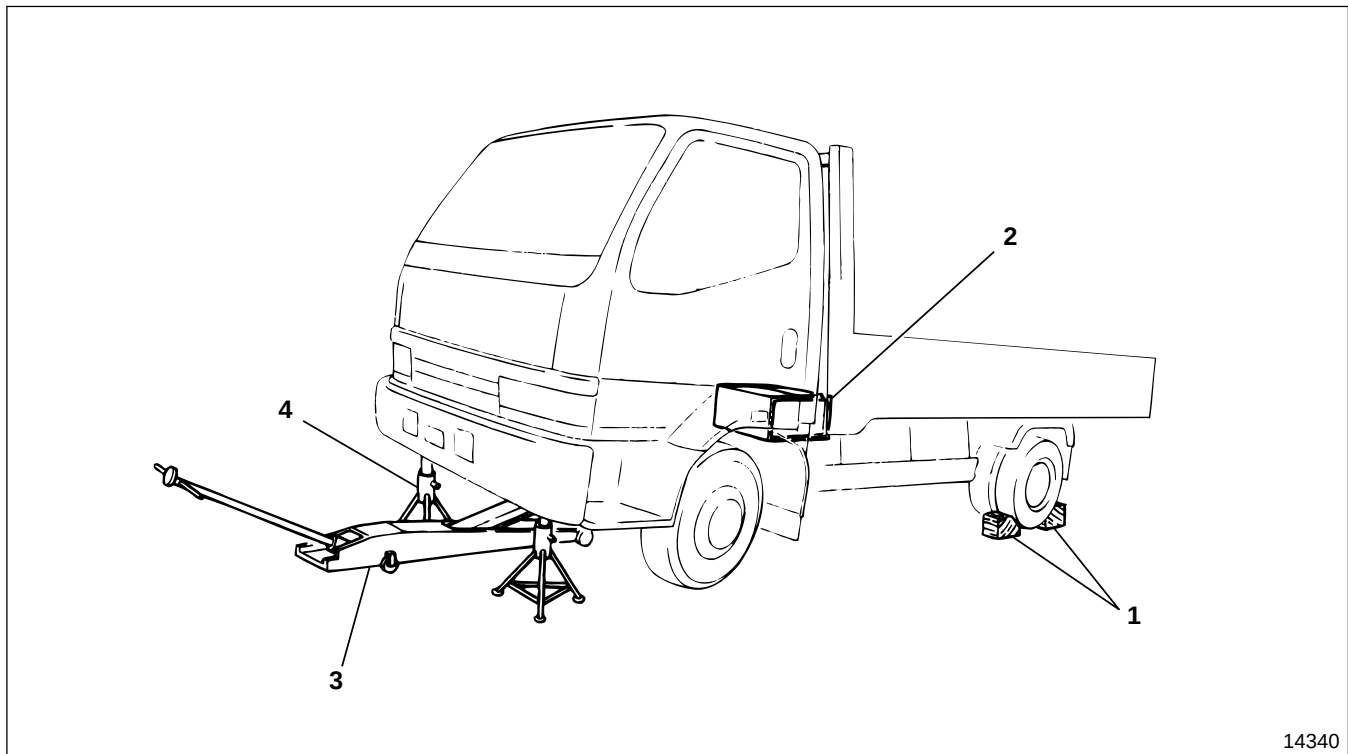


In the interlock mechanism, the rail beneath interlock plate **2** locks jaws **3**, (apart from the jaws shifted by gear shift slide lever **1**), preventing double engagement of gears.

MEMO

TROUBLESHOOTING

Possible causes		Symptoms				
		Gears slip out of engagement	Gears hard to engage	Noise when engine is idling	Noise while cruising	Noise when changing gear
Transmission body faulty	Mainshaft rear lock nut loose	☐	☐			
	Mainshaft thrust washer worn	☐	☐			
	Mainshaft bearing worn or damaged	☐	☐			
	Synchronizer ring and synchronizer sleeve spline worn	☐				
	Synchronizer ring and gears taper cone area worn		☐			
	Mainshaft pilot bearing worn or damaged			☐	☐	
	Drive pinion bearing worn or damaged			☐		
	Countershaft bearing worn or damaged			☐		
	Needle bearings of gears worn or damaged			☐	☐	
	Mainshaft and countershaft bearings worn or damaged				☐	
	Mainshaft and countershaft gears backlash excessive				☐	
	Spline of gears worn					☐
	Gears damaged				☐	
	Gear oil insufficient				☐	
Control mechanisms faulty	Control cable joint play	☐	☐			
	Set board assembly bushings worn	☐				
	Shift rail steel ball and groove worn	☐				
	Shift rail poppet spring fatigued or damaged	☐				
	Shift rail sliding movement faulty		☐			
	Shift fork jaws worn		☐			
	Shift fork bent		☐			
Synchronizer faulty	Contacting surfaces of synchronizer ring and gear taper cone worn					☐
	Shifting key worn					☐
	Shifting key spring deteriorated or damaged					☐
	Synchronizer sleeve worn or damaged				☐	☐



● **Work sequence before removal**

- 1 Place wheel chocks.
- 2 Disconnect negative battery cable. Gr 54
- 3 Jack up the front axle on a garage jack.
- 4 Support the front frame on rigid racks.

WARNING

- Since the parking brake will be removed, naturally it cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

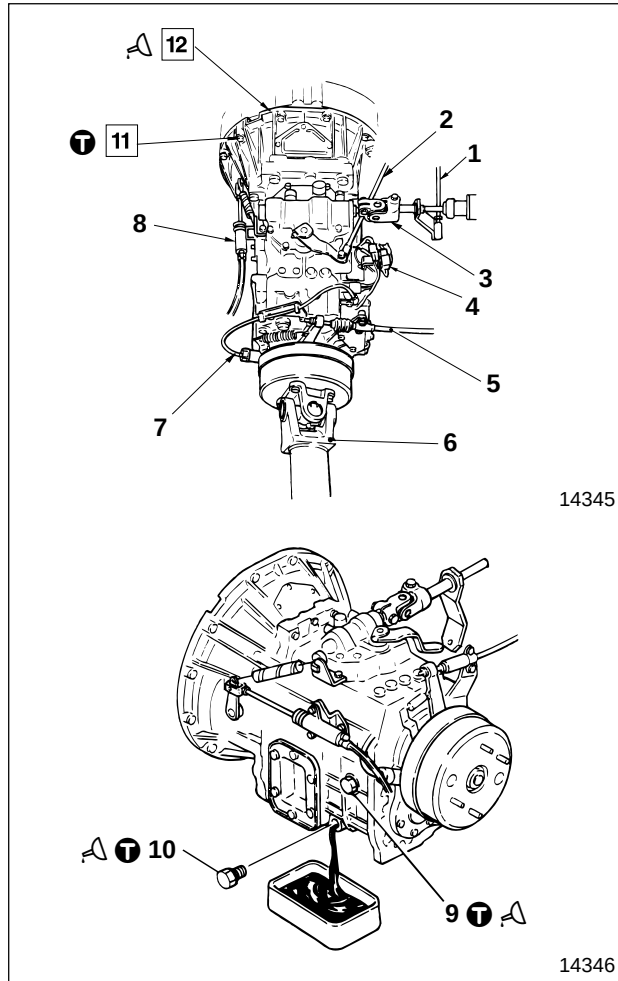
Keep the transmission in neutral throughout the operation.

● **Work sequence after installation**

Follow the work sequence before removal in reverse.

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY

Removal and Installation



● Disassembly sequence

- 1 Shift cable P22-54
- 2 Selector cable P22-54
- 3 Cross shaft P22-58
- 4 Harness connector
- 5 Parking brake cable Gr 36
- 6 Propeller shaft Gr 25
- 7 Speed sensor Gr 54
- 8 Clutch power cylinder Gr 21
- 9 Inspection plug
- 10 Drain plug
- 11 Bolt
- 12 Transmission assembly

● 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
9	Inspection plug	69±15 {51±11, 7±1.5}	—
10	Drain plug	69±15 {51±11, 7±1.5}	—
11	Bolt (Transmission mounting)	40 {30, 4.1}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
9	Thread area of inspection plug	THREEBOND 1105D	As required
10	Thread area of drain plug	THREEBOND 1105D	As required
12	Spline of drive pinion	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

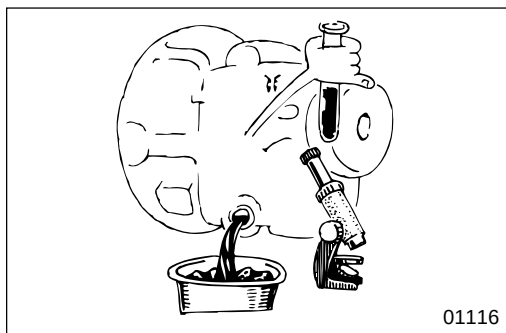
● Oil change

[Draining]

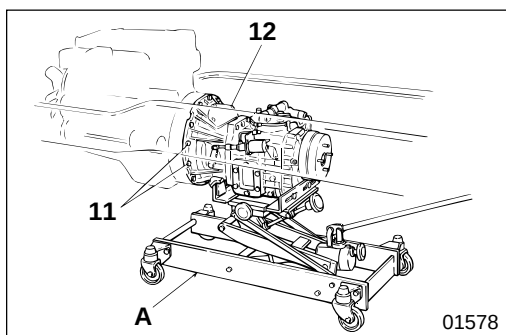
- When draining oil, check the quantity and quality of oil, especially for small pieces of metal and metal dust.
- Clean drain plug **10** before reinstalling it because it is magnetic.

[Filling]

- Check that drain plug **10** are tightened at specified torque.
- Pour in gear oil until the oil overflows from the inspection hole. (For oil quantity, see specifications.)



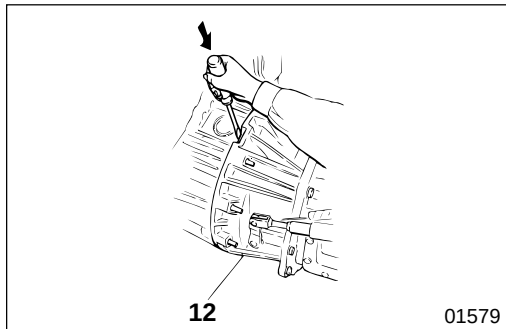
01116



01578

11 Removal of transmission mounting bolt

- Support transmission assembly **12** on transmission jack **A**.
- Tighten transmission mounting bolt **11**.



01579

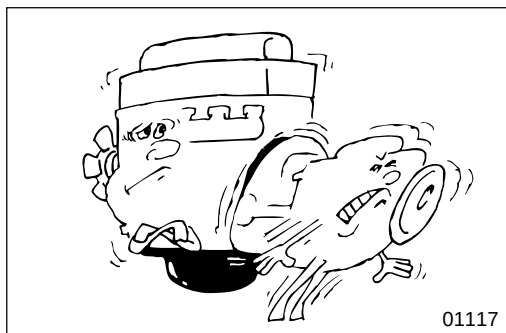
12 Transmission assembly

[Removal]

- Insert a screwdriver into the three removal grooves and pry transmission assembly **12** from the engine.

CAUTION ⚠

Make sure that you remove hoses and cables before starting service operations.



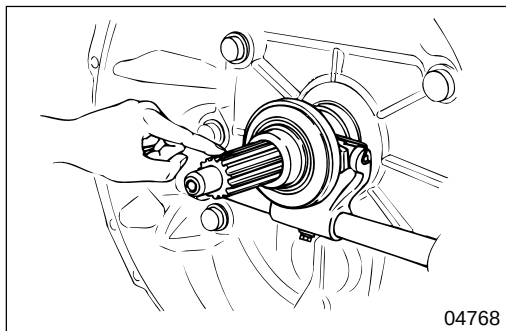
01117

- Move transmission assembly **12** backward until the spline of the drive pinion is detached from the clutch.

CAUTION ⚠

Make sure that you pull transmission assembly **12** out in a straight line. If you seesaw the transmission assembly violently, you will damage the spline that connects the drive pinion and the clutch.

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY

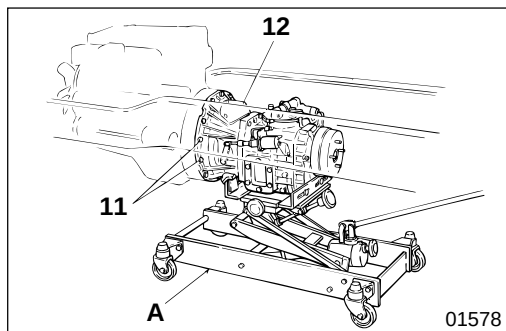


[Installation]

- Check the spline of the drive pinion for rust.
- If rust is found, remove it using a wire brush.
- Rub grease onto the clutch disc sliding surfaces of the drive pinion using your hand.

CAUTION

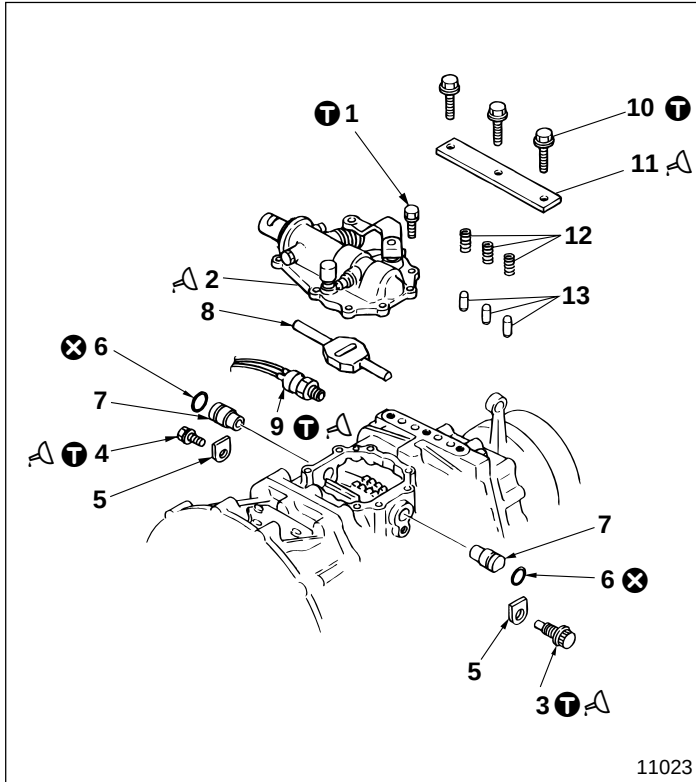
Make sure that you apply only the necessary amount of grease because too much grease would drip and cause clutch slip.



- Support transmission assembly **12** on transmission jack **A**, and insert the transmission assembly into the pilot bearing of the flywheel paying attention to the drive pinion spline.
- Tighten transmission mounting bolt **11** at specified torque.

MEMO

GEAR SHIFTER UPPER AND INTERLOCK PLATE



Disassembly sequence

- 1 Bolt
- 2 Gear shifter upper assembly P 22-17
- 3 Jaw set bolt
- 4 Bolt
- 5 Lock plate
- 6 O-ring
- 7 Bushing
- 8 Interlock plate
- 9 Backup lamp switch Gr 54
- 10 Bolt
- 11 Poppet spring plate
- 12 Poppet spring
- 13 Interlock pin

* : Transmission body

X : Non-reusable parts

Assembly sequence

- 7→6
 8→5→4→3→9→2→1→13→12→11→10

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
7, 8	Clearance between interlock plate axis and bushing	[12] 0.14 to 0.19 {[0.47] 0.0055 to 0.0075}	0.4 {0.016}	Replace
12	Poppet spring load (Installed length 29 {1.14})	78 N {18 lbf, 8 kgf}	67 N {15 lbf, 68 kgf}	Replace

Tightening torque

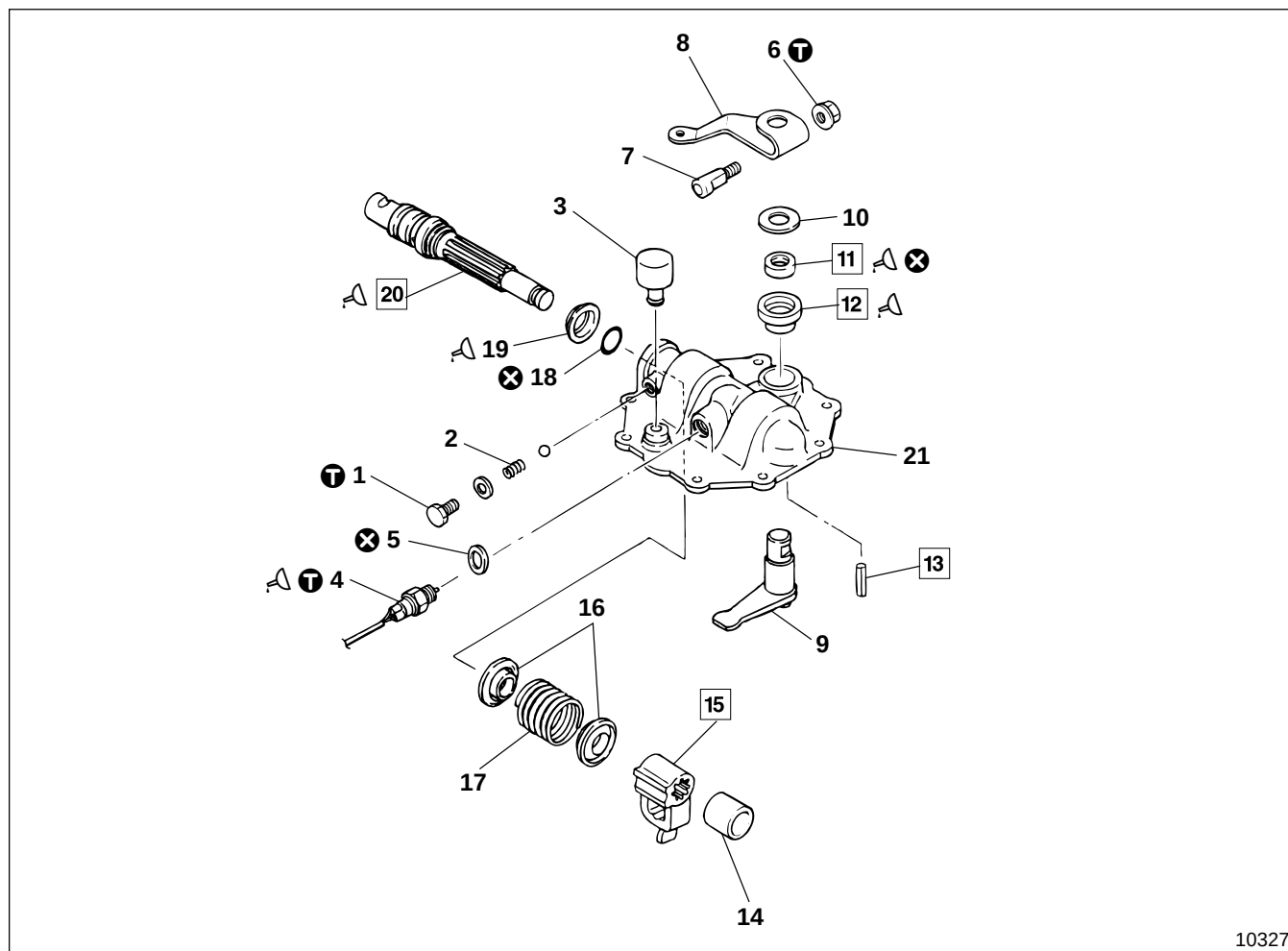
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Gear shifter upper mounting)	23 {17, 2.3}	—
3	Jaw set bolt	135 {98, 13.6}	—
4	Bolt (Lock plate mounting)	40 {30, 4.1}	—
9	Backup lamp switch	49 {36, 5.0}	—
10	Bolt (Poppet spring plate mounting)	49 {36, 5.0}	—

Sealant

Location	Points of application	Kinds	Quantity
2	Contact surface with transmission case	THREEBOND 1215	As required
3	Thread area of jaw set bolt	THREEBOND 1104J	As required
4	Thread area of bolt	THREEBOND 1104J	As required
9	Thread area of backup lamp switch	THREEBOND 1105D	As required
11	Contact surface with transmission case	THREEBOND 1215	As required

Gear Shifter Upper Assembly



10327

● Disassembly sequence

- | | | |
|--|-----------------------------|------------------------|
| 1 Plug | 9 Gear selector lever A | 17 Return spring A |
| 2 Torsion shaft spring | 10 Washer | 18 O-ring |
| 3 Air breather | 11 Oil seal | 19 Dust seal |
| 4 Neutral switch  Gr 54 | 12 Bushing | 20 Gear shift lever |
| 5 Gasket | 13 Spring pin | 21 Selector lever case |
| 6 Nut | 14 Gear selector stopper | |
| 7 Lock pin | 15 Gear shift slide lever | ⊗ : Non-reusable parts |
| 8 Gear selector lever B | 16 Return spring A retainer | |

NOTE

Do not remove bushing 12 except for replacement.

● Assembly sequence

21→12→11
 20→19→18
 →16→17→16→15→14→13→9→10→8→7→6
 5→4
 →3→2→1

CAUTION

Be sure when assembling gear selector lever A 9, that you turn the lever so you do not damage the lip area of oil seal 11.

GEAR SHIFTER UPPER AND INTERLOCK PLATE

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Torsion shaft spring load (Installed length 16.2 {0.64})	50 N {11 lbf, 5.1 kgf}	42 N {9.48 lbf, 4.3 kgf}	Replace
9	Play in axial direction of gear selector lever A	0.3 to 0.6 {0.012 to 0.024}	—	Replace
17	Return spring A load (Installed length 27.6 {1.09})	94 N {21 lbf, 9.6 kgf}	80 N {18 lbf, 8.2 kgf}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

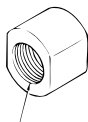
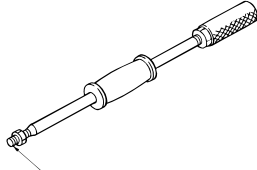
Location	Parts to be tightened	Tightening torque	Remarks
1	Plug	23 {17, 2.3}	—
4	Neutral switch	34 to 39 {25 to 29, 3.5 to 4.0}	—
6	Nut (Lock pin mounting)	17 {12, 1.7}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
4	Thread area of neutral switch	THREEBOND 1104J	As required
11	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
12	Inner surface of gear selector lever A axis bushing and its friction surface	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
	Contact surfaces between bushing outer surface and case	THREEBOND 1215	As required
19	Pack dust seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
20	Gear shift lever O-ring groove	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

Special tools

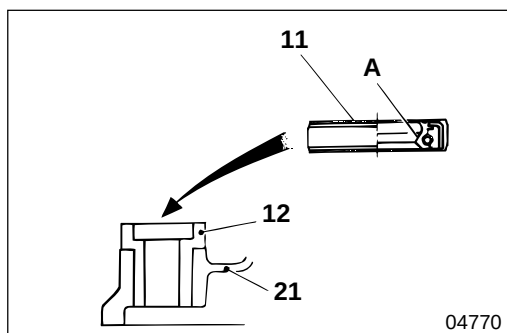
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
13	 Spring pin puller M12×1.25 02399	MH062445	Removal of spring pin
	 Reverse shaft puller M12×1.25 02118	03726-82000	

◆ Service procedure

11 Installation of oil seal

- Apply grease to lip area **A** of oil seal **11**.
- Press-fit oil seal **11** into bushing **12** in the direction as illustrated.



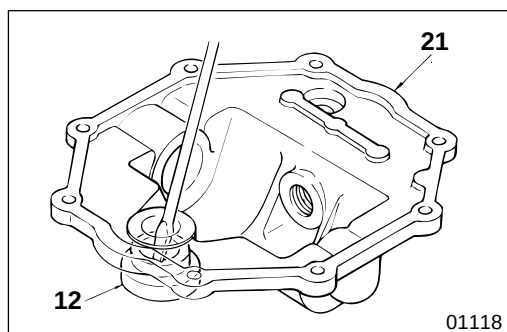
12 Bushing

[Removal]

Remove bushing **12** from selector lever case **21** using a screwdriver.

CAUTION ⚠

Be careful not to damage selector lever case **21**.

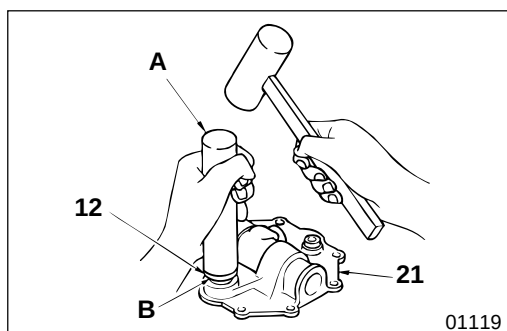


[Installation]

- Clean the inner surface of selector lever case **21**.
- Press-fit bushing **12** into selector lever case **21** using bar **A** (approximately $\varnothing 40$ mm {1.57 in.}).
- When press-fitting bushing **12**, take care not to damage selector lever case **23**.
- After press-fitting, apply sealant to press-fitted side **B** of bushing **12**.

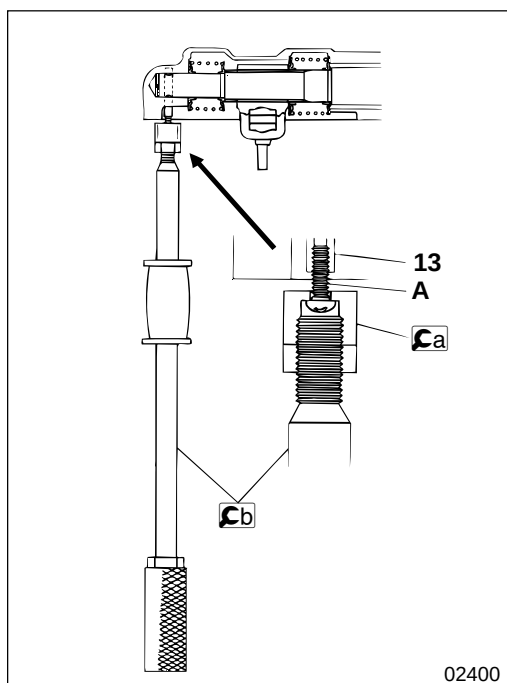
CAUTION ⚠

Prevent sealant from sticking to the inner surface of bushing **12**.

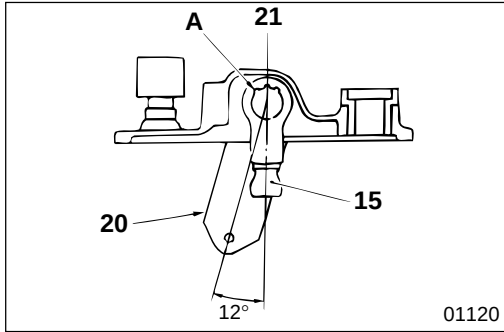


13 Removal of spring pin

- Tap spring pin **13** using an M4 tap.
- Into **Ca** spring pin puller with an M4 thread **A** of appropriate length into spring pin **13**.
- Position **Cb** reverse shaft puller on **Ca** spring pin puller.
- Remove spring pin **13** from selector lever case **21** using **Ca** spring pin puller and **Cb** reverse shaft puller.



GEAR SHIFTER UPPER AND INTERLOCK PLATE



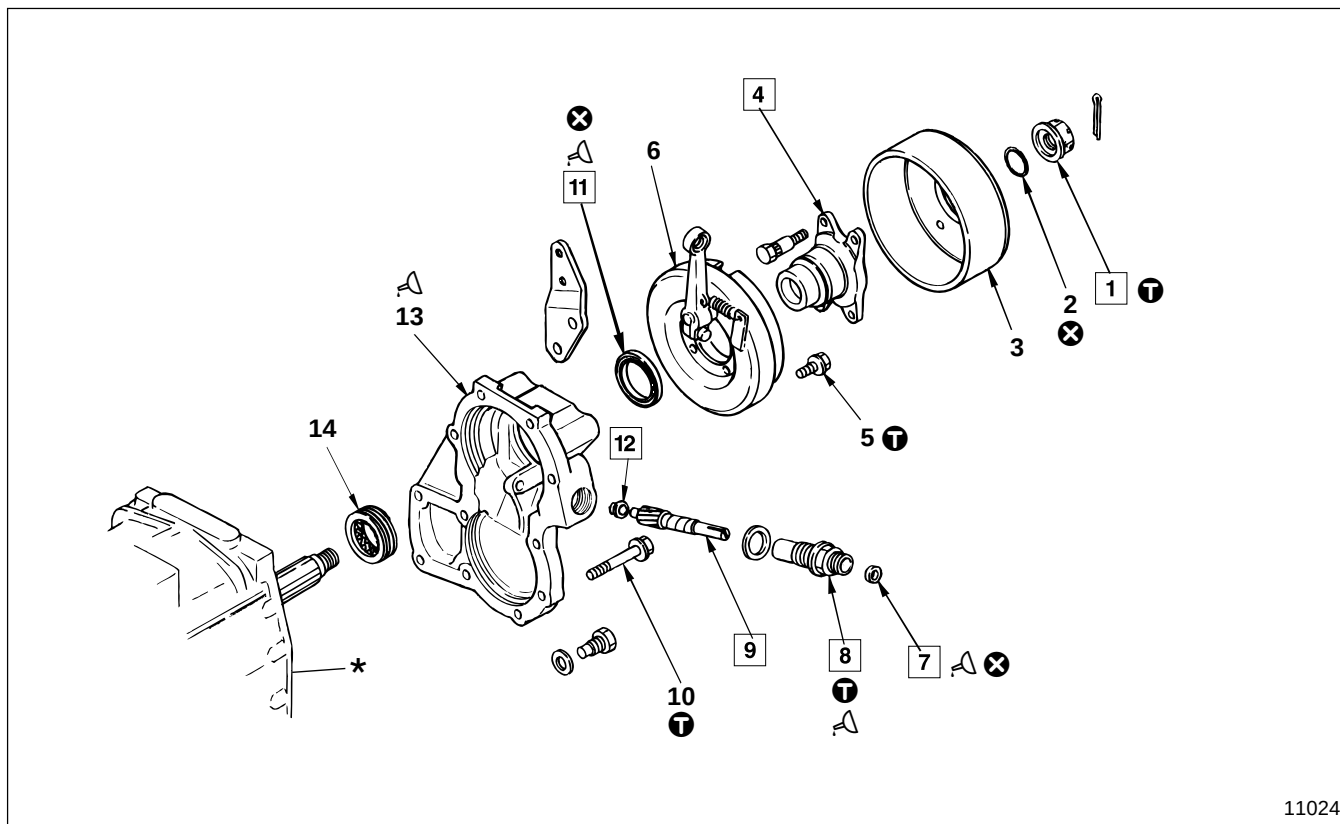
15 **20**

Installation of gear shift slide lever and gear shift lever

When you install gear shift slide lever **15** in gear shift lever **20**, position spline **A** so that the angle between the slide lever and the shift lever is as illustrated.

MEMO

REAR COVER AND PARKING BRAKE ASSEMBLY

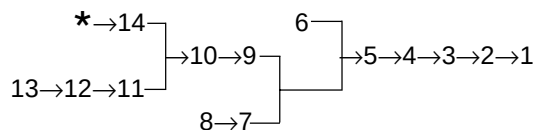


11024

● Disassembly sequence

- | | |
|---|-------------------------------|
| 1 Lock nut | 10 Bolt |
| 2 O-ring | 11 Oil seal |
| 3 Parking brake drum | 12 Speedometer gear bushing A |
| 4 Companion flange | 13 Rear cover |
| 5 Bolt | 14 Speedometer worm |
| 6 Support plate and shoe assembly  Gr 36 | |
| 7 Oil seal | |
| 8 Speedometer gear bushing | |
| 9 Speedometer gear | |
- * : Transmission body
 X : Non-reusable parts

● Assembly sequence



NOTE

Inspect backlash of speedometer gear 9 before disassembly.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
8, 9	Clearance between speedometer gear bushing and speedometer gear	[12] 0.020 to 0.070 {[0.47] 0.00079 to 0.0028}	0.15 {0.0059}	Replace
9, 14	Play between speedometer gear and speedometer worm	0.13 to 0.29 {0.0051 to 0.011}	0.36 {0.014}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

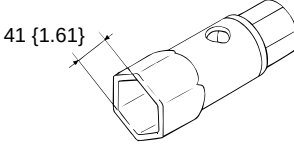
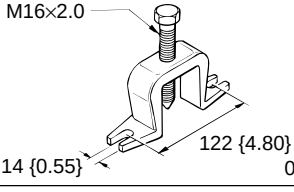
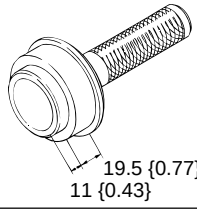
Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut	245 to 345 {180 to 255, 25 to 35}	—
5	Bolt (Support plate and shoe assembly mounting)	40 {30, 4.1}	—
8	Speedometer gear bushing	145 {110, 15}	—
10	Bolt (Rear cover mounting)	40 {30, 4.1}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
7, 11	Interior and lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
8	Friction surface with speedometer gear bushing	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
13	Mating surfaces of rear cover and transmission case	THREEBOND 1215	As required

Special tools

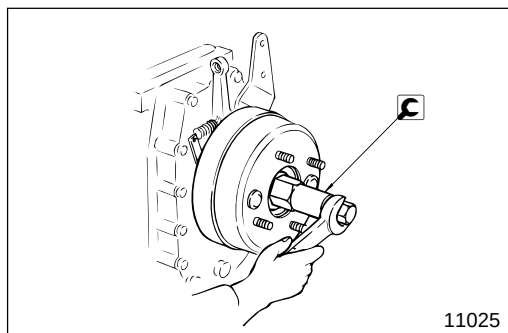
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Socket wrench  00069	MH061532	Removal and installation of mainshaft rear lock nut
4	Flange puller  03159	MC881524	Removal of flange at rear of mainshaft
11	Oil seal installer  02031	ME624242	Installation of oil seal in rear cover

REAR COVER AND PARKING BRAKE ASSEMBLY

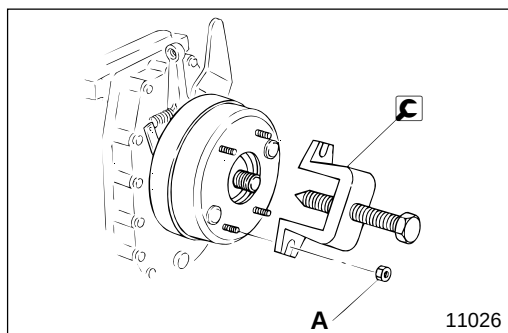
◆ Service procedure

1 Removal and installation of lock nut



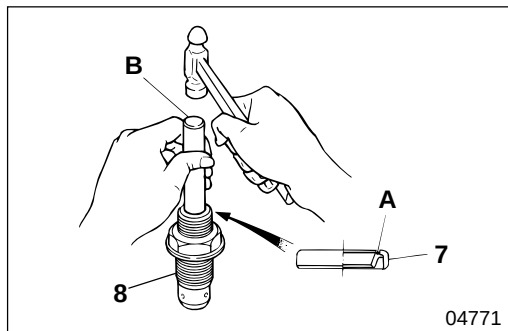
4 Removal of companion flange

A : Propeller shaft mounting nut



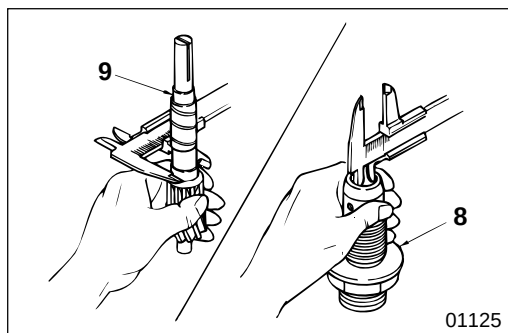
7 Press-fitting of oil seal

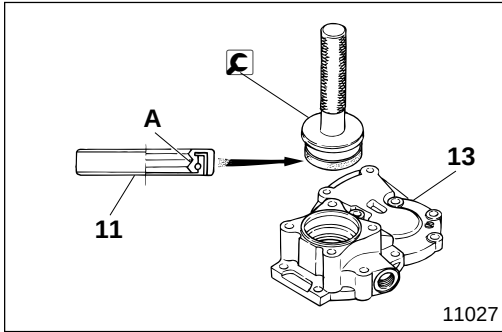
- Apply grease to inside of oil seal 7 packing A.
- Press-fit oil seal 7 into speedometer gear bushing 8 in the direction as illustrated using bar B (approximately $\varnothing 15$ mm {0.59 in.}).



8 9 Clearance between speedometer gear bushing and speedometer gear

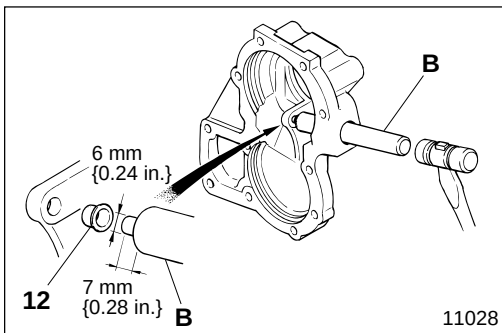
If the clearance is higher than the limit, replace the faulty parts.





11 Installation of oil seal

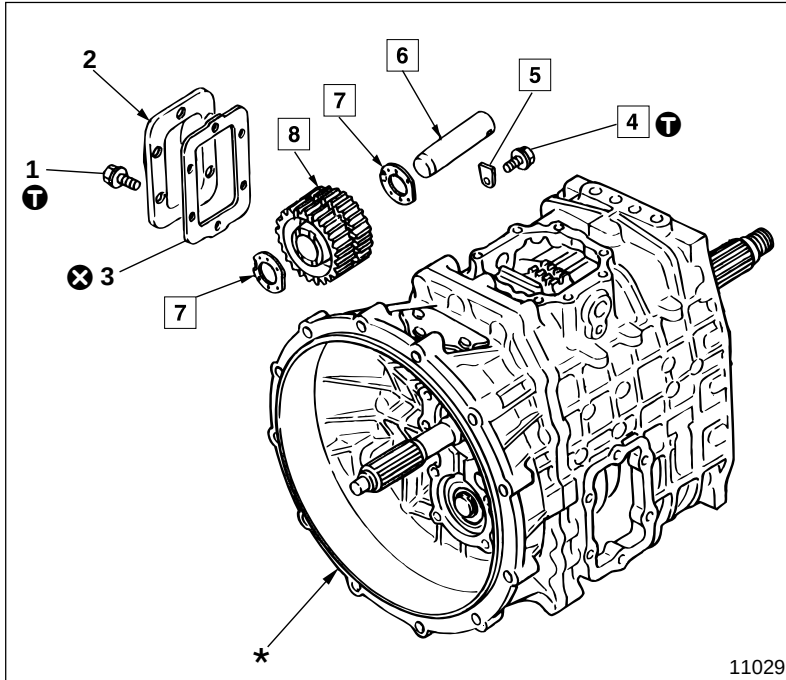
- Apply grease to lip area **A** of oil seal **11**.
- Press-fit oil seal **11** into rear cover **13** in the direction as illustrated using **12** oil seal installer.



12 Installation of speedometer gear bushing A

Install speedometer gear bushing **A 12** into rear cover **13** using bar **B**, turned to the dimensions as illustrated.

REVERSE IDLER GEAR



● Inspection before disassembly

📖 P22-27

● Disassembly sequence

- 1 Bolt
- 2 Reverse idler gear cover
- 3 Gasket
- 4 Bolt
- 5 Reverse shaft lock piece
- 6 Reverse idler shaft
- 7 Reverse shaft gear side washer
- 8 Reverse idler gear

★ : Transmission body

✕ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
6, 8	Diameter direction after assembling reverse idler gear	—	0.12 {0.0047}	Replace
8	End play of reverse idler gear	0.2 to 0.9 {0.0079 to 0.035}	1.2 {0.047}	Replace

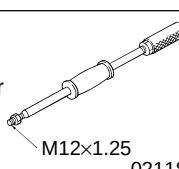
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Reverse idler gear cover mounting)	19 {14, 1.9}	—
4	Bolt (Reverse shaft lock piece mounting)	40 {30, 4.1}	—

🔧 Special tools

Unit : mm {in.}

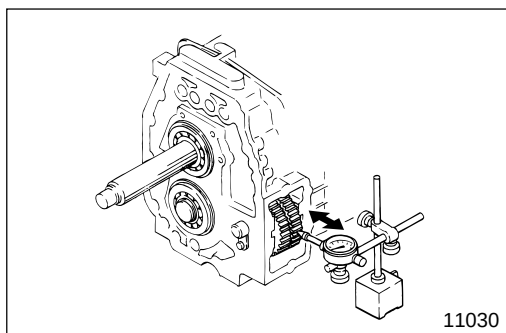
Location	Tool name and shape	Part No.	Application
6	Drive pinion and reverse shaft puller 	03726-82000	Removal of reverse idler shaft

◆ Service procedure

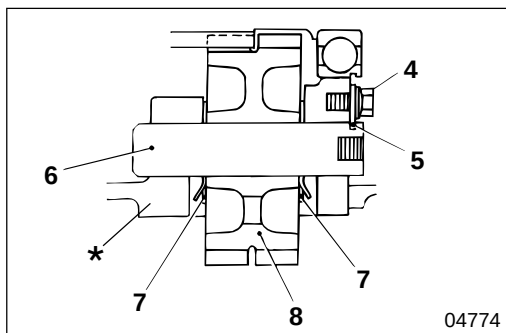
● Inspection before disassembly

Play of reverse idler gear in the diameter direction

- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



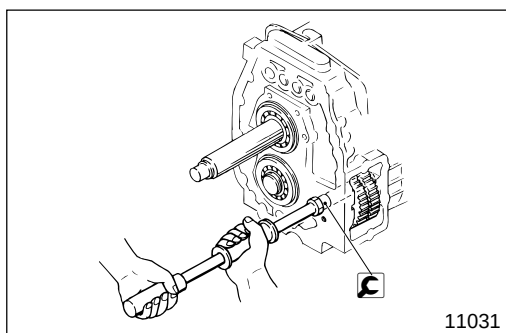
11030



04774

4 to 8 Assembly of reverse idler gear

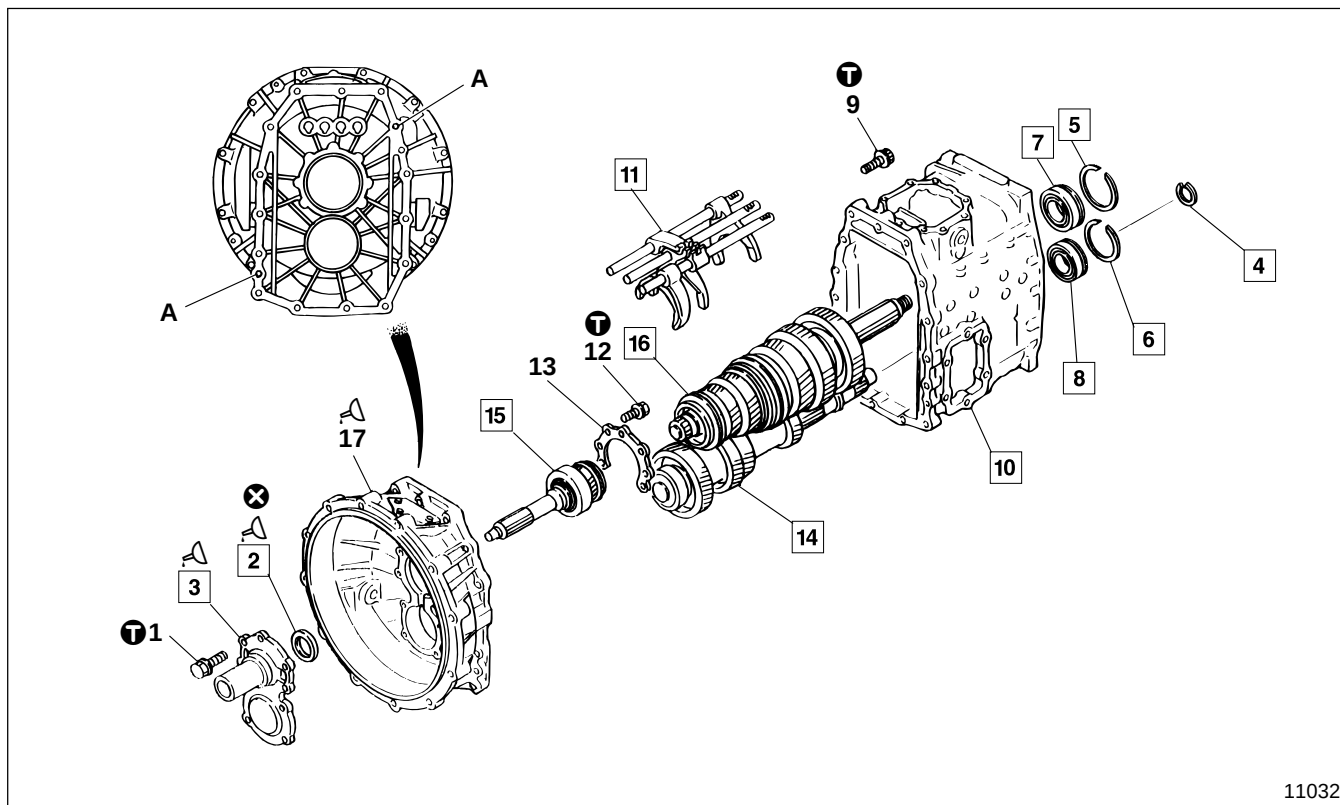
- Install reverse shaft gear side washer 7 and reverse idler gear 8 in transmission body *.
- Install reverse idler shaft 6 in transmission body * using a plastic-headed mallet.
- Install reverse shaft lock piece 5 in transmission body * with mounting bolt 4.



11031

6 Removal of reverse idler shaft

TRANSMISSION BODY



● Disassembly sequence

- | | |
|-----------------------------|--------------------------------------|
| 1 Bolt | 11 Shift rail and shift fork P22-38 |
| 2 Oil seal | 12 Bolt |
| 3 Front bearing retainer | 13 Drive pinion bearing retainer |
| 4 Snap ring | 14 Countershaft assembly P22-50 |
| 5 Snap ring | 15 Drive pinion assembly P22-40 |
| 6 Snap ring | 16 Mainshaft assembly P22-42 |
| 7 Mainshaft rear bearing | 17 Clutch housing assembly |
| 8 Countershaft rear bearing | |
| 9 Bolt | A : Positioning pin (two points) |
| 10 Transmission case | ⊗ : Non-reusable parts |

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

- After removing parts 1 to 3, disassemble the transmission assembly with the body laid vertically on its clutch housing side.
- Remove parts 11, and 14 to 16 as a group. However, shift rail and shift fork 11 can be disassembled on its own if you are not going to disassemble parts 14 to 16. P22-38

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

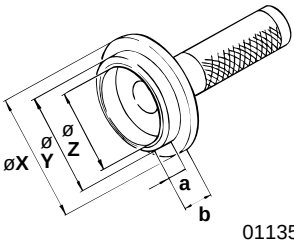
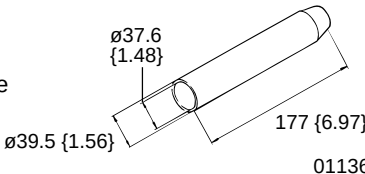
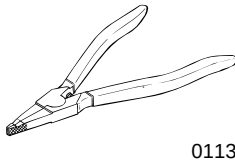
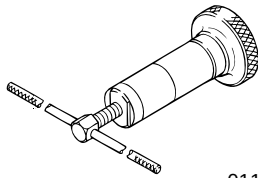
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Front bearing retainer mounting)	40 {30, 4.1}	—
9	Bolt (Transmission case mounting)	120 {90, 12.4}	—
12	Bolt (Drive pinion retainer mounting)	40 {30, 4.1}	—

L Lubricant and sealant

Location	Points of application	Kinds	Quantity
2	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
3	Contact surface between front bearing retainer and clutch housing assembly	THREEBOND 1215	As required
17	Contact surface between clutch housing assembly and transmission case	THREEBOND 1215	As required

S Special tools

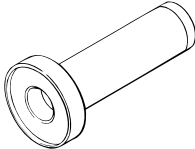
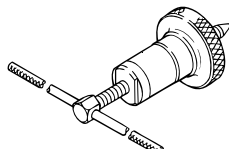
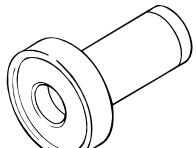
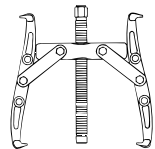
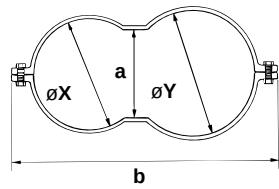
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Oil seal installer	ME624241	Installation of front bearing retainer oil seal
	X 62 {2.44}		
	Y 40 {1.57}		
	Z 30 {1.18}		
	a 10 {0.39}		
	b 10 {0.39}		
		01135	
3	Oil seal front guide	MH061990	Installation of front bearing retainer
			
4, 5, 6	Snap ring expander	MH061268	Removal of snap rings from mainshaft rear bearing and countershaft front and rear bearings
		01137	
7	Mainshaft bearing puller	*MH061732	Removal of mainshaft rear bearing
			

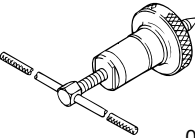
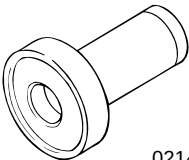
* components of puller and installer kit  P22-59

TRANSMISSION BODY

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application								
7	Mainshaft bearing installer  02115	*MH624234	Installation of mainshaft rear bearing								
8	Countershaft bearing puller  01139	*ME061731	Removal of countershaft rear bearing								
	Countershaft bearing installer  02141	*ME624233	Installation of countershaft bearing								
10	Eye bolt  M10×1.5 01140	MH062340	Lifting of transmission case								
	Gear puller  01148	MH062308	Removal of transmission case								
14 to 16	Steel lifting band <table border="1"><tr><td>X</td><td>87 {3.43}</td></tr><tr><td>Y</td><td>175 {6.89}</td></tr><tr><td>a</td><td>80 {3.15}</td></tr><tr><td>b</td><td>336 {13}</td></tr></table>  01141	X	87 {3.43}	Y	175 {6.89}	a	80 {3.15}	b	336 {13}	MH062343	Removal and installation of mainshaft assembly, countershaft assembly and drive pinion assembly
	X	87 {3.43}									
Y	175 {6.89}										
a	80 {3.15}										
b	336 {13}										
Eye nut  M27×1.5 01142	MH062341										

* components of puller and installer kit  P22-59

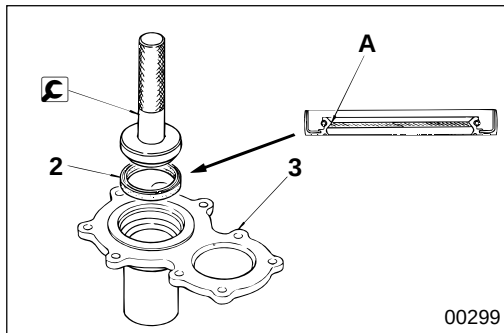
Location	Tool name and shape	Part No.	Application
14	Countershaft bearing puller  01139	*MH062426	Removal of countershaft front bearing
	Countershaft bearing installer  02141	*ME624233	Installation of countershaft front bearing

* components of puller and installer kit  P22-59

◆ Service procedure

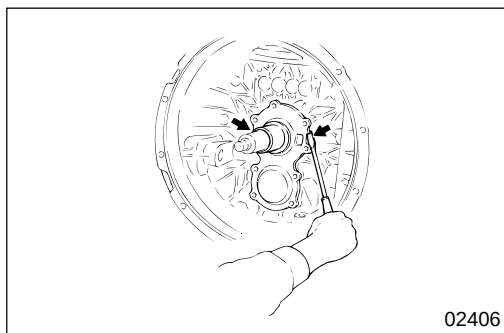
2 Installation of oil seal

- Apply grease to lip area A of oil seal 2.
- Press-fit oil seal 2 into front bearing retainer 3 in the direction as illustrated using  oil seal installer.



3 Front bearing retainer

[Removal]

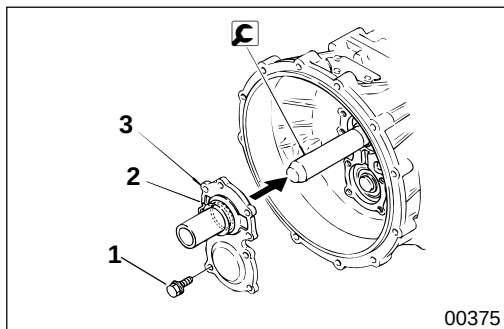


[Installation]

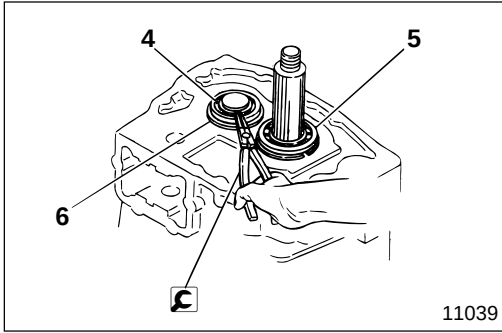
Press-fit front bearing retainer 3 into clutch housing assembly 19 using  oil seal front guide.

CAUTION

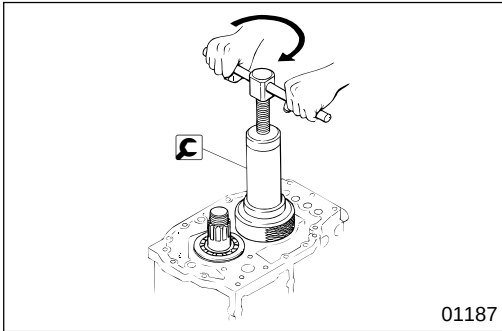
Be careful when installing front bearing retainer 3, that you do not damage oil seal 2 installed on the front bearing retainer.



TRANSMISSION BODY

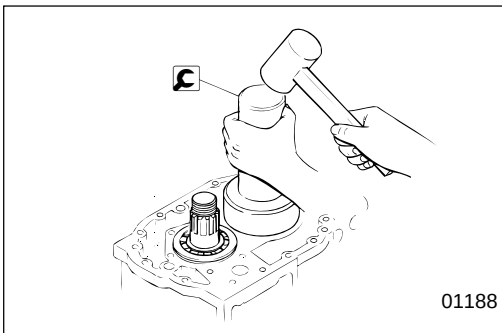


4 to 6 Removal and installation of snap ring

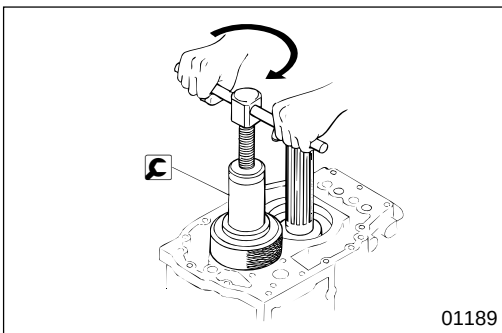


7 Mainshaft rear bearing

[Removal]

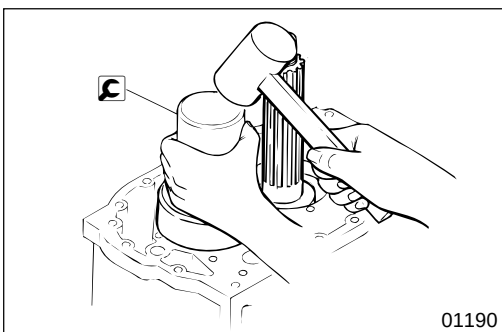


[Installation]

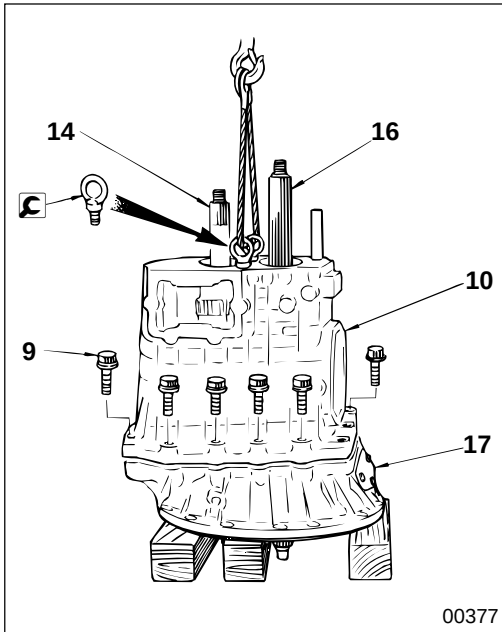


8 Countershaft rear bearing

[Removal]



[Installation]



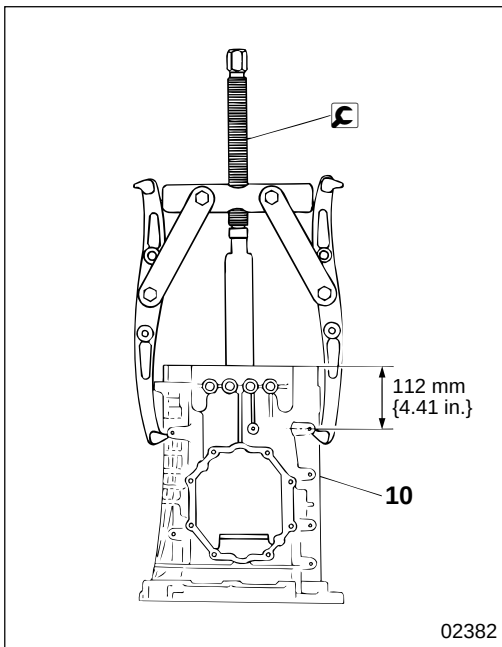
10 Removal and installation of transmission case

[Removal]

● Remove transmission case 10.

Method 1

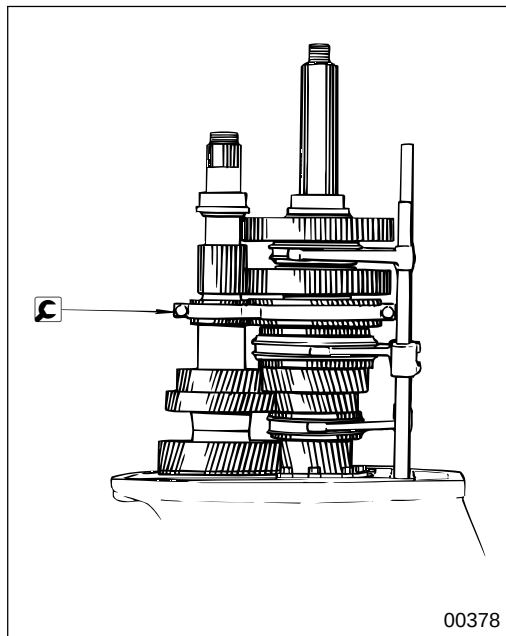
- When lifting up with a crane, install  eye bolts on transmission case 10 and pass a steel sling through them.
- After removing bolts 9, lift transmission case 10 up with a crane and keep hitting the rear ends of clutch housing assembly 17, mainshaft assembly 16 and countershaft assembly 14. Use a plastic-headed or copper-headed mallet to remove the transmission case.



Method 2

- A  gear puller can be used instead of a crane.

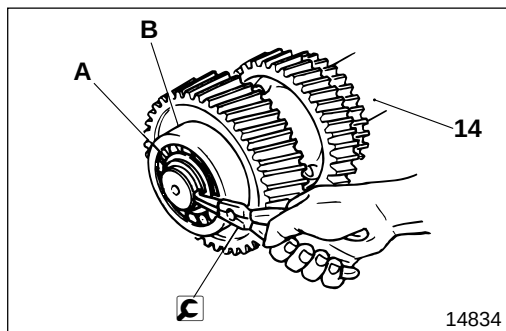
TRANSMISSION BODY



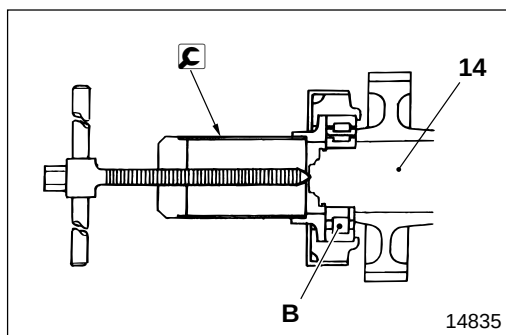
- After removing transmission case **10**, fit the 2nd gear using  steel lifting band to ensure safety.

CAUTION

Be sure to tighten  steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.



- Remove snap ring **A** from countershaft assembly **14**.
B : Countershaft front bearing



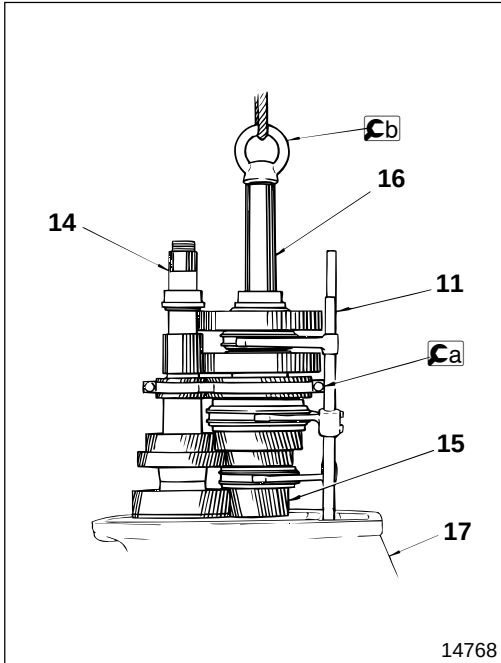
- Remove countershaft bearing **B** from countershaft assembly **14**.

[Installation]

Follow the removal sequence in reverse.

CAUTION

Be careful not to damage mainshaft assembly **16**, or rear bearings **7, 9** of countershaft assembly **14** during installation.



11 14 to 16 Shift rail and shift fork, countershaft assembly, drive pinion assembly, and mainshaft assembly

[Removal]

Remove or install shift rail and shift fork **11**, countershaft assembly **14**, drive pinion assembly **15**, and mainshaft assembly **16** as a group.

- Before lifting, after removing the case, install **Cb** eye nut at the end of mainshaft **18**, fitted with **Ca** steel lifting band.
- Fix shift rail and shift fork **11** to mainshaft assembly **16** with a rubber band.
- Fix a piece of wood to clutch housing assembly **17**, and use a crane to lift the clutch housing together with drive pinion assembly **15** up, at the same time hitting them with a plastic-headed mallet to remove them.

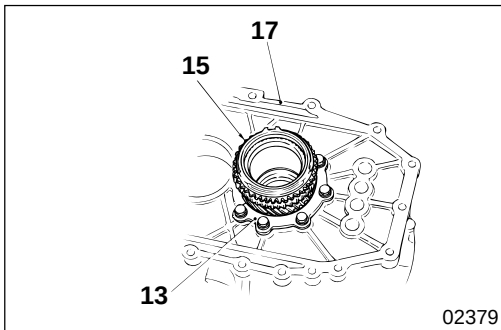
CAUTION ⚠

- Be sure to tighten **Ca** steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.
- Make sure, when lifting mainshaft assembly **16** or other parts, that you support drive pinion assembly **15** with your hand in order to prevent it from falling when the mainshaft assembly and countershaft assembly **14** come apart.

[Installation]

Method 1

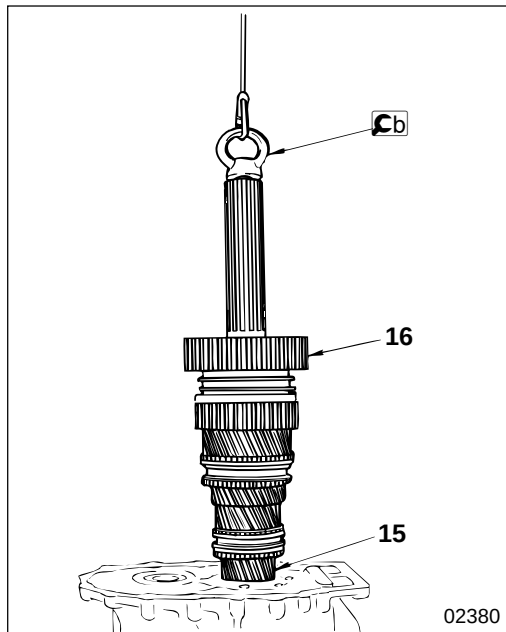
- Follow the removal sequence in reverse.



Method 2

- After installing drive pinion assembly **15** in clutch housing assembly **17**, install drive pinion bearing retainer **13**.

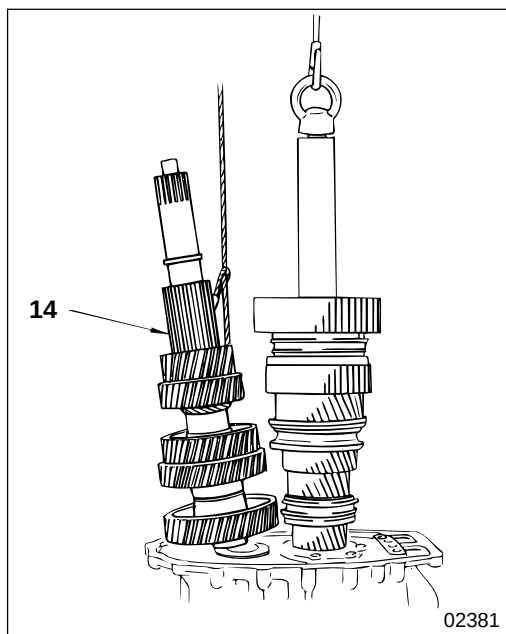
TRANSMISSION BODY



- Install **16b** eye nut at the end of mainshaft assembly **16**.
- Lift mainshaft assembly **16** up using a crane and install the mainshaft assembly on drive pinion assembly **15**.

CAUTION

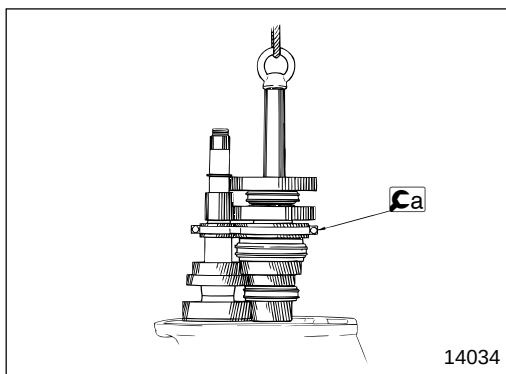
To prevent mainshaft assembly **16** from falling, support it using a crane.



- Install countershaft assembly **14** in clutch housing assembly **17**.

CAUTION

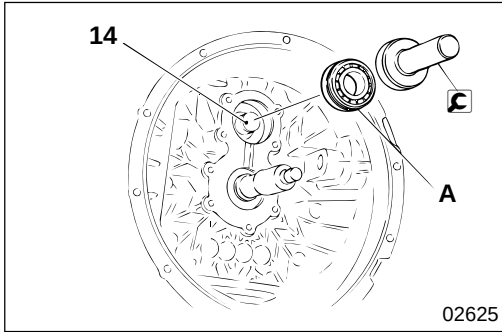
If you use this method of installation, first remove the countershaft front bearing.  P22-52



- Fit the 2nd gear unit using **14a** steel lifting band to ensure safety.

CAUTION

Be sure to tighten **14a** steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.



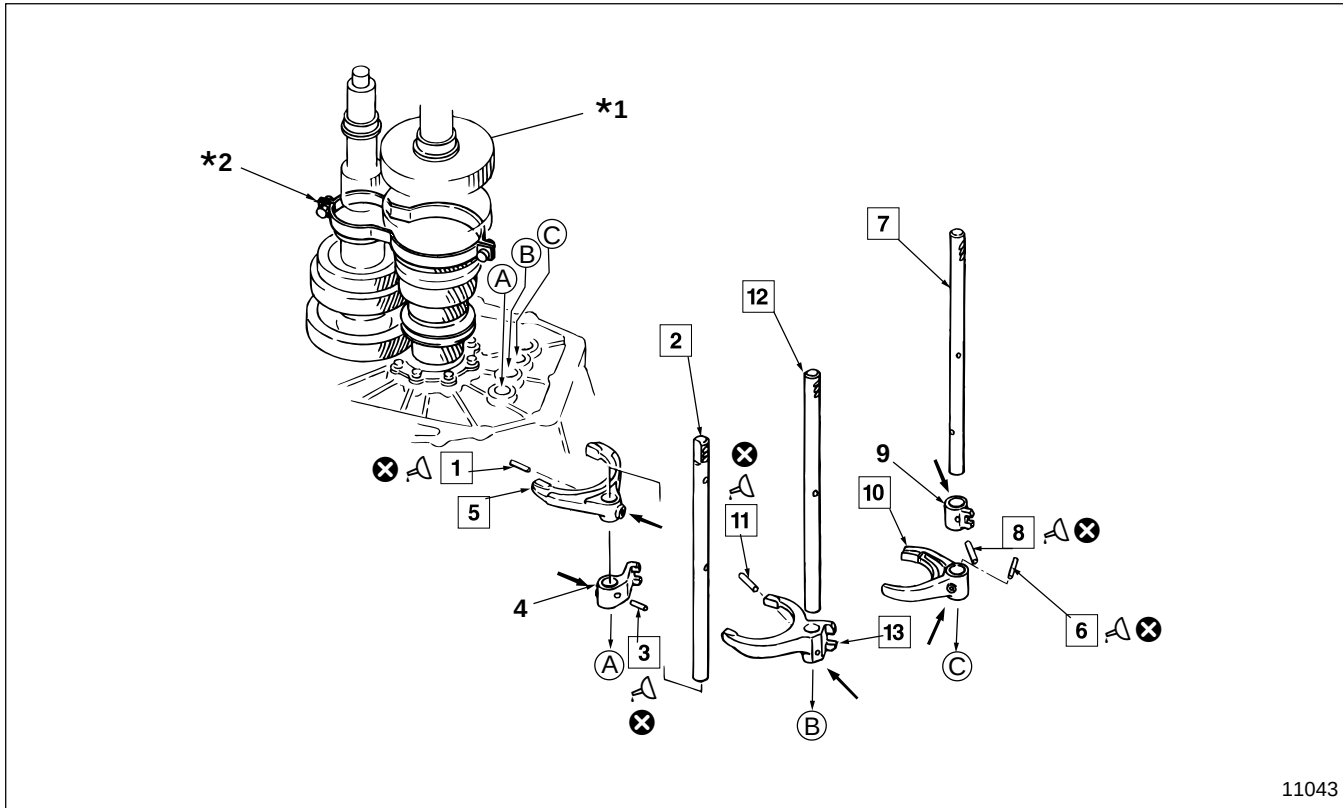
- Install shift rail and shift fork **11** and transmission case **10** in clutch housing assembly **17**.
- Place clutch housing assembly **17** horizontally so that countershaft assembly **14** is uppermost.
- Install the countershaft front bearing **A** into clutch housing assembly **17** using  countershaft bearing installer.

CAUTION

Be sure to install the snap ring of the countershaft front bearing.

TRANSMISSION BODY

Shift Rail and Shift Fork



11043

Arrow mark : Removal and installation direction for spring pin

● Disassembly sequence

(When the mainshaft assembly is not removed or installed and only the shift rail and shift fork is disassembled)

- | | | |
|----------------------------------|------------------------------|---------------------------|
| 1 Spring pin | 7 4th and 5th shift rail | 13 2nd and 3rd shift fork |
| 2 1st and reverse shift rail | 8 Spring pin | |
| 3 Spring pin | 9 4th and 5th shift rail jaw | *1 : Mainshaft assembly |
| 4 1st and reverse shift rail jaw | 10 4th and 5th shift fork | *2 : steel lifting band |
| 5 1st and reverse shift fork | 11 Spring pin | ⊗ : Non-reusable parts |
| 6 Spring pin | 12 2nd and 3rd shift rail | |

● Assembly sequence

Follow the disassembly sequence in reverse. Remove steel lifting band after installing the shift rail and shift fork.

Service standards

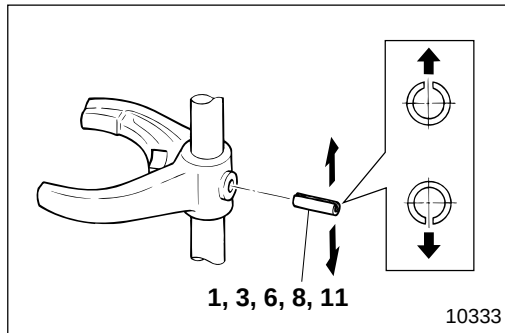
Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2, 7, 12	Bend of shift rail	0.039 {0.0015} or less	0.08 {0.0031}	Correct or replace
5, 10, 13	Tilt of shift fork claw	0.1 {0.0039} or less	0.2 {0.0079}	Replace
5, *1	Clearance between 1st and reverse shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace
10, *1	Clearance between 4th and 5th shift fork and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace
13, *1	Clearance between 2nd and 3rd shift fork and synchronizer sleeve	0.2 to 0.4 {0.0079 to 0.016}	1.0 {0.039}	Replace

Sealant

Location	Points of application	Kinds	Quantity
1, 3, 6, 8, 11	Spring pin	LOCTITE 601	As required

◆ Service procedure

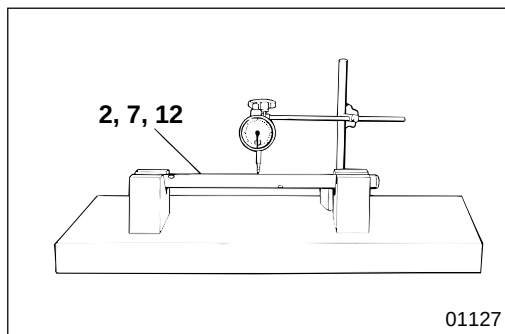


1 3 6 8 11 Installation of spring pin

Install spring pins 1, 3, 6, 8, 11 in the direction as illustrated.

CAUTION ⚠

- Make sure you do not drive in spring pins 1, 3, 6, 8, fully, leave 0 to 0.5 mm {0 to 0.020 in.} outside to prevent them from slipping out.
- Do not remove spring pin 6 for 4th and 5th shift fork 10 (made of aluminum), except when replacing shift fork 10 or shift rail 7.
- Note that the length of spring pin 6 differs from that of spring pins 1, 3, 8, 11.
- Be careful when driving in spring pins 1, 3, 6, 8, 11, that you do not subject shift rails 2, 7, 12 to excessive strain, because this would cause faults such as bent shift rails.

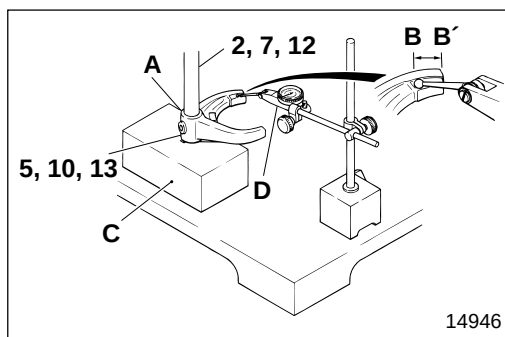


2 7 12 Bend of shift rail

If the measured value is higher than the limit, correct or replace shift rail 2, 7, or 12.

NOTE

Read dial gauge after turning shift rails 2, 7, 12 one full revolution. The bend is one half of the indicated value.

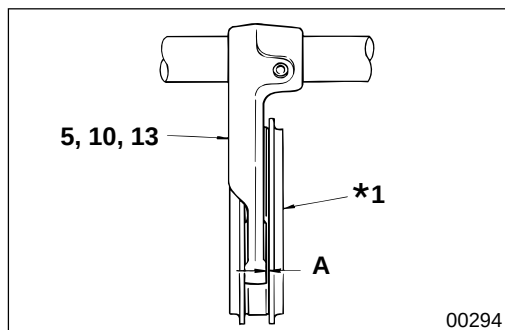


5 10 13 Tilt of shift fork claws

- Measure the tilt (difference between B and B') of claw B-B' against hole A of shift rails 2, 7, 12 of shift forks 5, 10, 13 with the shift rails upright.
- If the measured value is higher than the limit, replace shift forks 5, 10, or 13.

C : V-block

D : Dial gauge

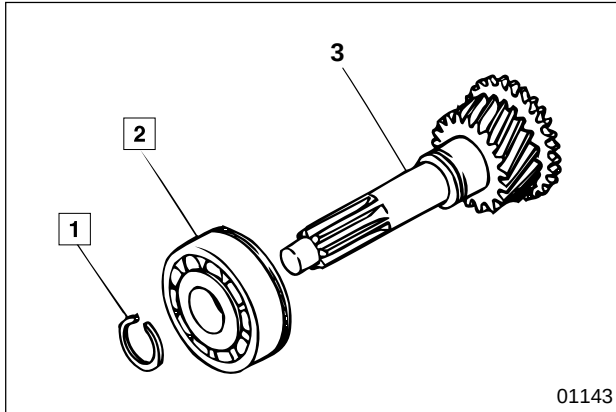


5 10 13 *1 Clearance between gear shift fork and synchronizer sleeve of mainshaft

If clearance A is higher than the limit, replace the faulty parts.

*1 : Synchronizer ring of mainshaft assembly

DRIVE PINION ASSEMBLY



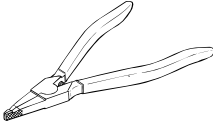
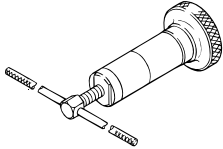
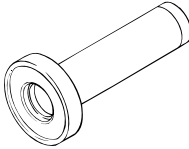
● Disassembly sequence

- 1 Snap ring
- 2 Drive pinion bearing
- 3 Drive pinion

● Assembly sequence

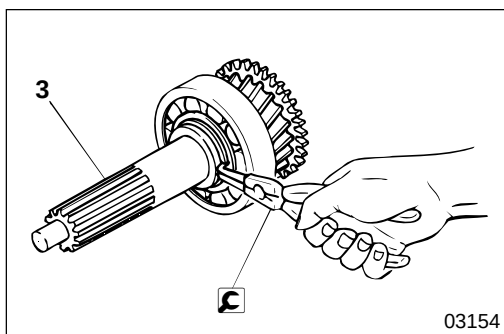
Follow the disassembly sequence in reverse.

🔧 Special tools

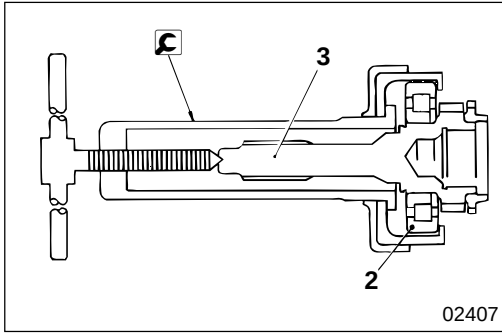
Location	Tool name and shape	Part No.	Application
1	Snap ring expander  01137	MH061268	Removal and installation of snap ring of drive pinion bearing
2	Drive pinion bearing puller  01138	*MH062440	Removal of drive pinion bearing
	Drive pinion bearing installer  02142	*ME624235	Installation of drive pinion bearing

* components of puller and installer kit 📖 P22-59

◆ Service procedure

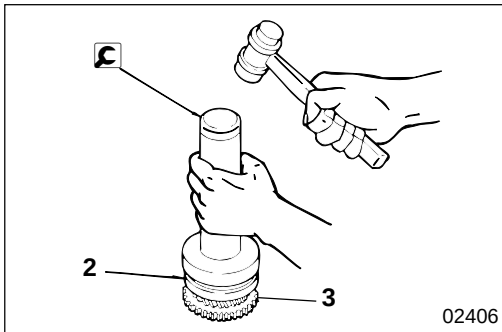


1 Removal and installation of snap ring



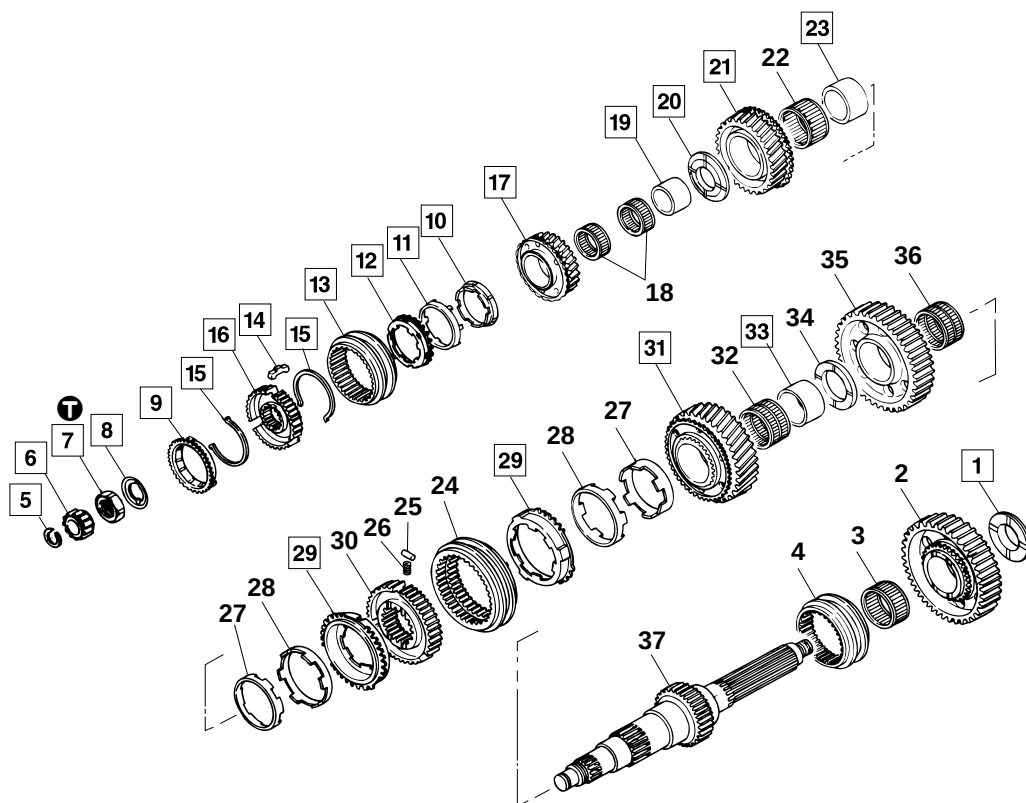
2 Drive pinion bearing

[Removal]



[Installation]

MAINSHAFT ASSEMBLY



11044

● Work before disassembly

📖 P22-45

● Disassembly sequence

- | | |
|------------------------------|-----------------------------------|
| 1 Reverse gear thrust washer | 20 3rd and 4th gear thrust washer |
| 2 Reverse gear | 21 3rd gear assembly |
| 3 Needle bearing | 22 Needle bearing |
| 4 Sleeve | 23 3rd gear bearing sleeve |
| 5 Snap ring | 24 Synchronizer sleeve |
| 6 Pilot bearing | 25 Shifting key |
| 7 Lock nut | 26 Synchronizer spring |
| 8 Lock washer | 27 Synchronizer inner ring |
| 9 Synchronizer ring | 28 Synchronizer center cone |
| 10 Synchronizer inner ring | 29 Synchronizer outer ring |
| 11 Synchronizer center cone | 30 Synchronizer hub |
| 12 Synchronizer outer ring | 31 2nd gear assembly |
| 13 Synchronizer sleeve | 32 Needle bearing |
| 14 Shifting key | 33 2nd gear bearing sleeve |
| 15 Shifting key spring | 34 1st and 2nd gear thrust washer |
| 16 Synchronizer hub | 35 1st gear |
| 17 4th gear assembly | 36 Needle bearing |
| 18 Needle bearing | 37 Mainshaft |
| 19 4th gear bearing sleeve | |

● Assembly sequence

37→36→35→34→33→32→31
30→29→28→27→24→26→25
16→15→13→14→15→12→11→10→9
23→22→21→20→19→18→17
8→7→6→5→4→3→2→1

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
2	End play of reverse gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
2, 3, 37	Play in the diameter direction after assembling reverse gear	—	0.12 {0.0047}	Replace
4, 37	Play in the rotating direction of sleeve and spline of mainshaft	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
6, 37	Play in the diameter direction after assembling pilot bearing	—	0.12 {0.0047}	Replace
9	Clearance between synchronizer ring and cone of drive pinion assembly	1.48 to 1.77 {0.058 to 0.070}	0.2 {0.0079}	Replace
9, 14	Clearance between synchronizer ring keyway and shifting key	4.75 to 4.95 {0.187 to 0.195}	5.8 {0.23}	Replace
12, 14	Clearance between synchronizer outer ring keyway and shifting key	4.75 to 4.95 {0.187 to 0.195}	5.8 {0.23}	Replace
12, 17	Clearance between synchronizer outer ring and cone area of 4th gear	1.5 to 2.0 {0.059 to 0.079}	0.2 {0.0079}	Replace
13, 16	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
14, 16	Clearance between shifting key and synchronizer hub keyway	0.05 to 0.2 {0.0020 to 0.0079}	0.5 {0.020}	Replace
17	End play of 4th gear	0.25 to 0.4 {0.0098 to 0.016}	0.5 {0.020}	Replace gear or thrust washer
17, 18, 19, 37	Play in the diameter direction after assembling 4th gear	—	0.12 {0.0047}	Replace
19	Outer diameter of 4th gear bearing sleeve	$[54]_{-0.043}^{-0.030} \{ [2.12]_{-0.0017}^{-0.0012} \}$	-0.1 {-0.0039}	Replace
21	End play of 3rd gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
21, 29	Clearance between cone area of 3rd gear and synchronizer outer ring	1.21 to 1.79 {0.048 to 0.070}	0.2 {0.0079}	Replace
21, 22, 23, 37	Play in the diameter direction after assembling 3rd gear	—	0.12 {0.0047}	Replace
23	Outer diameter of 3rd gear bearing sleeve	$[68]_{-0.043}^{-0.030} \{ [2.68]_{-0.0017}^{-0.0012} \}$	-0.1 {-0.0039}	Replace
29, 31	Clearance between synchronizer outer ring and cone area of 2nd gear	1.21 to 1.79 {0.048 to 0.070}	0.5 {0.020}	Replace
31	End play of 2nd gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
31, 32, 33, 37	Play in the diameter direction after assembling 2nd gear	—	0.12 {0.0047}	Replace
33	Outer diameter of 2nd gear bearing sleeve	$[71]_{-0.043}^{-0.030} \{ [2.8]_{-0.0017}^{-0.0012} \}$	-0.1 {-0.0039}	Replace
35	End play of 1st gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
35, 36, 37	Play in the diameter direction after assembling 1st gear	—	0.12 {0.0047}	Replace

MAINSHAFT ASSEMBLY

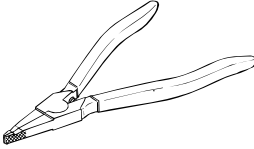
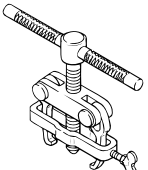
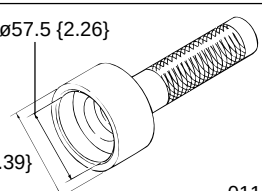
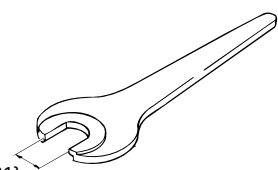
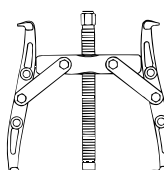
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
7	Lock nut	245 {180, 25}	—

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
5	Snap ring expander  01137	MH061268	Removal and installation of snap ring
6	Pilot bearing puller  01146	MH061043	Removal of pilot bearing
	Pilot bearing installer  01147	*ME624236	Installation of pilot bearing
7	Single spanner  01126	MH061555	Removal and installation of lock nut
19, 23, 33	Gear puller  01148	MH062308	Removal of mainshaft rear bearing inner race and bearing sleeves

* components of puller and installer kit  P22-59

◆ Service procedure

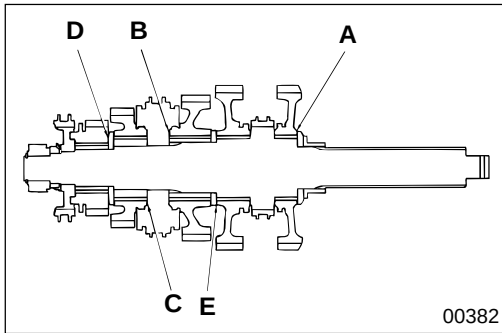
● Work before disassembly

[Inspection]

(1) End play of gears

- A : Reverse gear
- B : 2nd gear
- C : 3rd gear
- D : 4th gear
- E : 1st gear

If the measured value is higher than the limit, replace the faulty parts. Also inspect this item after assembly and make sure that the measured value is within the limit.

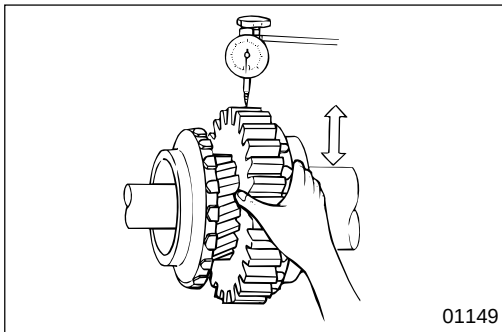


(2) Play of gears in diameter direction

If the measured value is higher than the limit, replace the faulty parts. Also inspect this item after assembly and make sure that the measured value is within the limit.

CAUTION ⚠

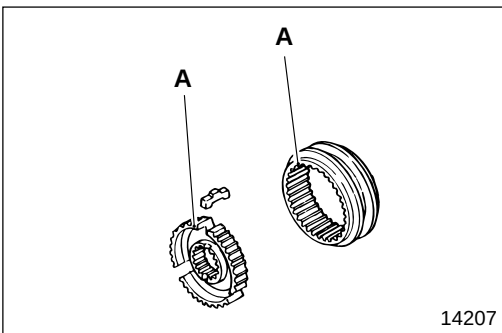
Be sure when you replace the two needle bearings of a gear, that both needle bearings are from the same color package.



[Alignment marks]

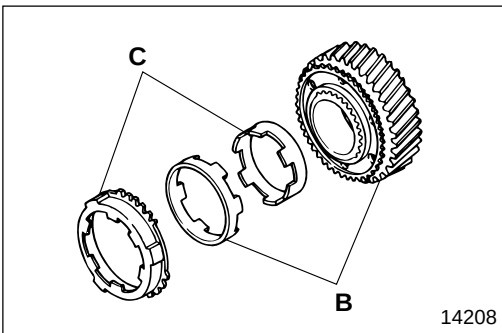
(1) Synchronizer sleeve and synchronizer hub

Before disassembling the synchronizer sleeve and the synchronizer hub, put alignment marks **A** on the places where the shifting keys are installed. When reusing parts, align the alignment marks to assemble.

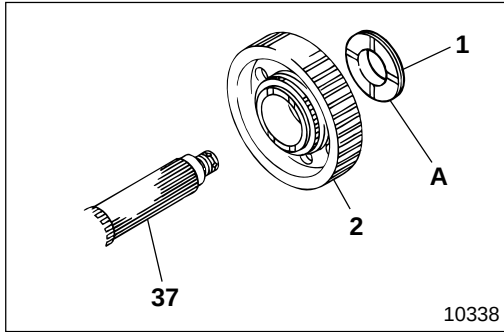


(2) Ring, cone and gear assembly of double cone synchronizer

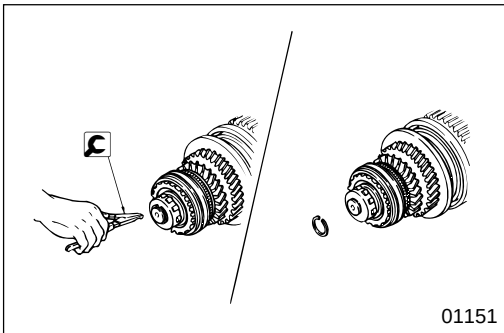
Before disassembling synchronizer center cone and gear assembly (**B**), and synchronizer center ring and synchronizer outer ring (**C**), put alignment marks on them. When reusing parts, align the alignment marks to assemble.



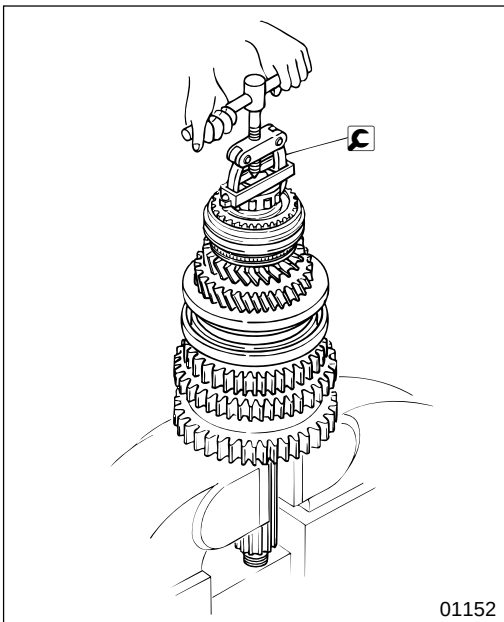
MAINSHAFT ASSEMBLY



- 1 Installation of reverse gear thrust washer**
A : Oil groove

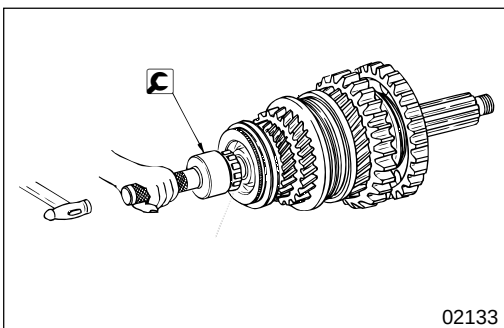


- 5 Removal and installation of snap ring**

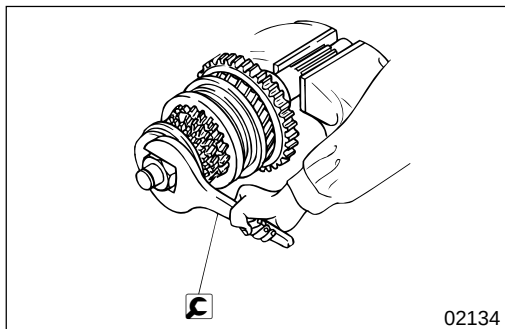


- 6 Pilot bearing**

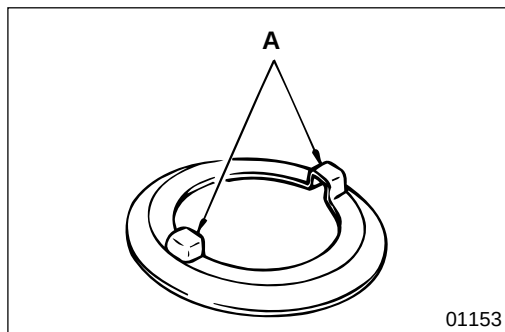
[Removal]



[Installation]

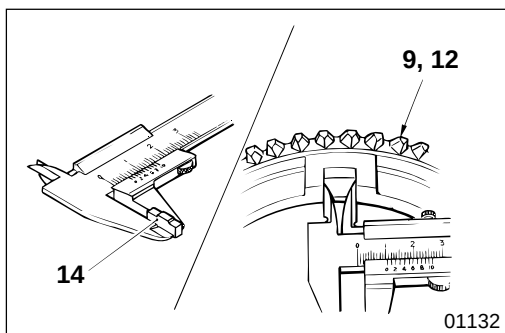


7 Removal and installation of lock nut



8 Installation of lock washer

Install so that protrusions **A** (two points as illustrated) fit into the grooves of synchronizer hub **16**.

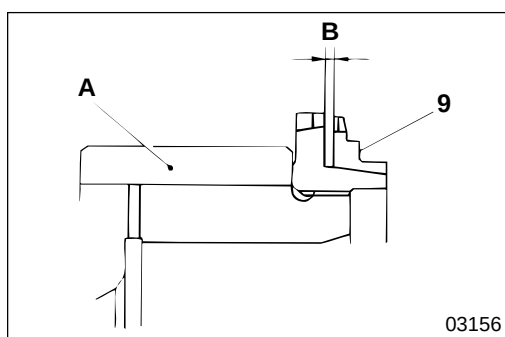


9 to 17 Synchromesh mechanism and 4th gear

[Inspection]

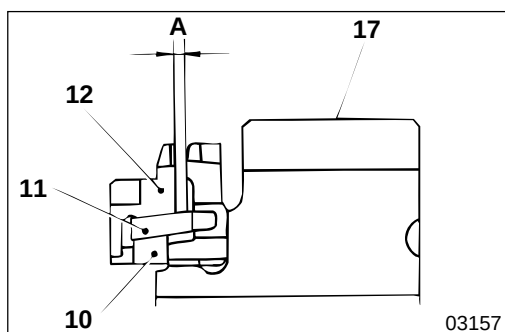
(1) Clearance between synchronizer ring 9 or outer ring 12 and shifting key 14

If the measured value is higher than the limit, replace the faulty parts.



(2) Clearance between synchronizer ring 9 and drive pinion

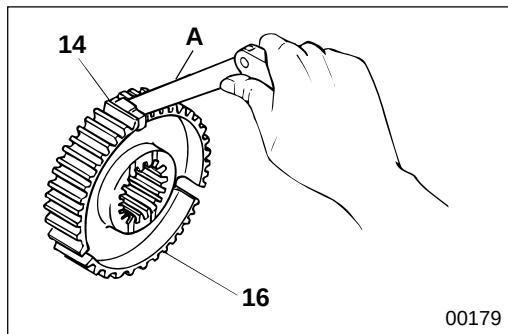
- Measure clearance **B** between synchronizer ring **9** and the gear cone of drive pinion **A**.
- When measuring this value, press synchronizer ring **9** evenly, and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.



(3) Clearance between synchronizer outer ring and 4th gear

- Measure clearance **A** between synchronizer outer ring **12** and the gear cone of 4th gear **17**.
- When measuring this value, press synchronizer inner ring **10**, center cone **11**, and the outer ring evenly and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.

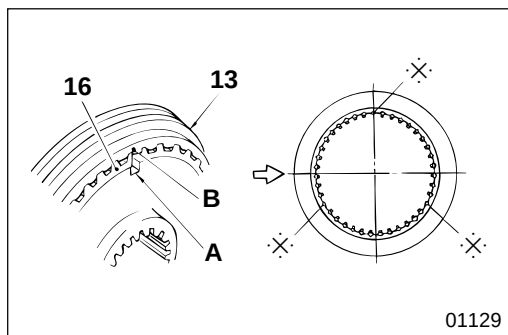
MAINSHAFT ASSEMBLY



(4) Clearance between shifting key 14 and synchronizer hub 16

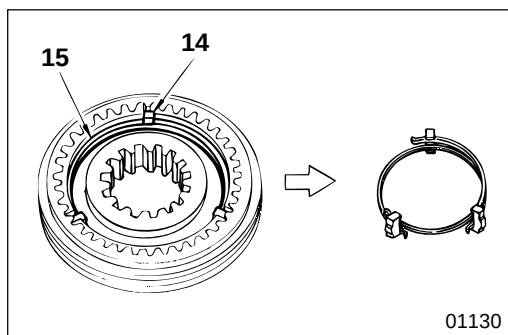
If the measured value is higher than the limit, replace the faulty parts.

A : Feeler gauge

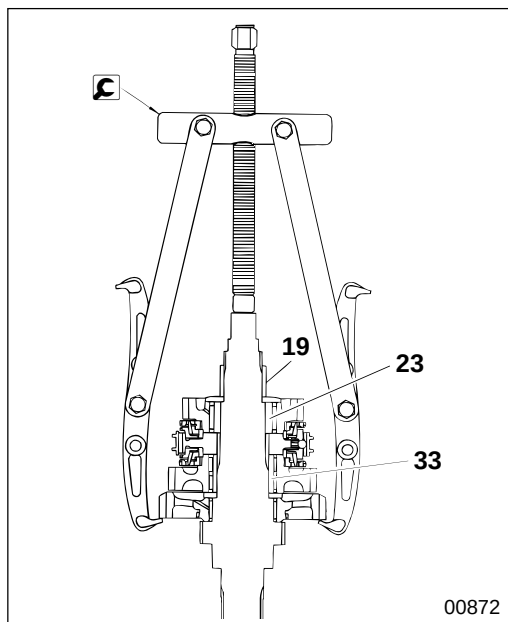


[Installation]

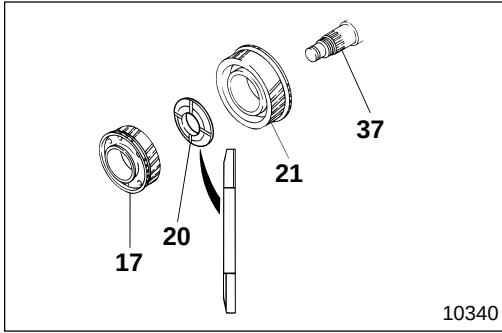
- Align the three keyways **A** of synchronizer hub **16** with the three stub teeth **B** (illustrated by **X** mark) of synchronizer sleeve **13** to install the synchronizer hub.
- To reassemble synchronizer hub **16** and synchronizer sleeve **13**, align the alignment marks made during disassembly.



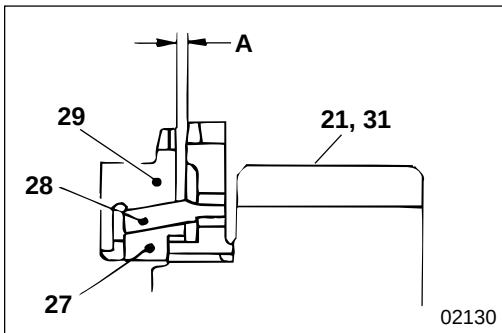
- Insert shifting key **14** into the keyway.
- Install shifting key spring **15** so that its opening is offset from the one of the shifting key.
- Make sure that the openings of shifting key springs do not align with each other.



19 23 33 Removal of 4th, 3rd, 2nd gear bearing sleeves



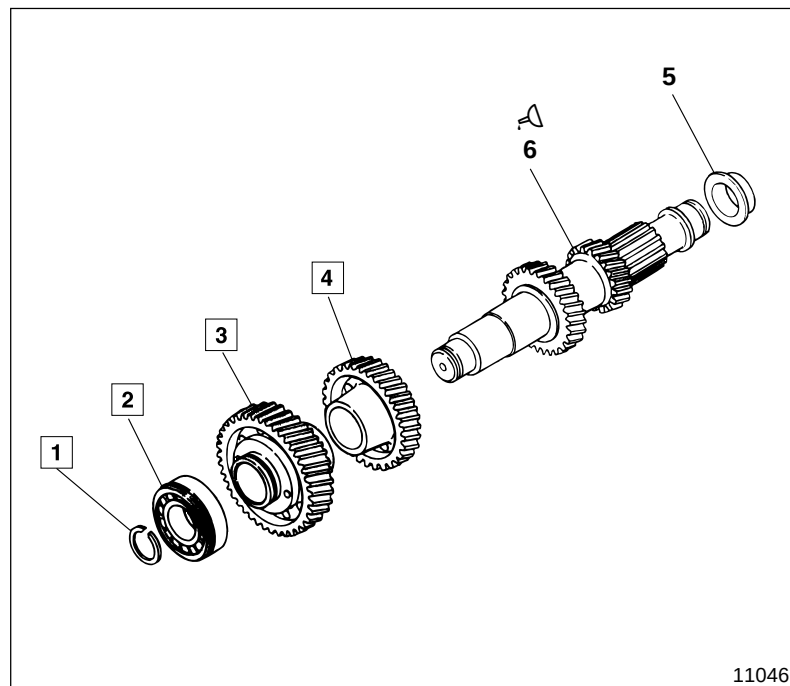
20 Installation of 3rd and 4th gear thrust washer



21 29 31 Clearance between synchronizer outer ring and 3rd gear assembly or 2nd gear assembly

- Measure clearance **A** between synchronizer outer ring **29** and the cone of 3rd gear assembly **21** or 2nd gear assembly **31**.
- When measuring this value, press synchronizer inner ring **27**, synchronizer outer ring **29** and synchronizer center ring **28** evenly and measure all around the circumference.
- If the measured value is higher than the limit, replace the faulty parts.

COUNTERSHAFT ASSEMBLY



● Disassembly sequence

- 1 Snap ring
- 2 Countershaft front bearing
- 3 Countershaft constant mesh gear
- 4 Countershaft 4th gear
- 5 Countershaft rear bearing inner race
- 6 Countershaft

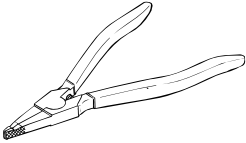
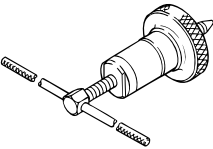
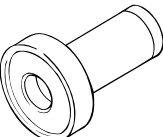
● Assembly sequence

Follow the disassembly sequence in reverse.

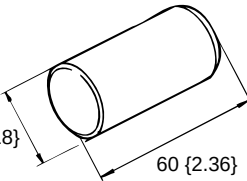
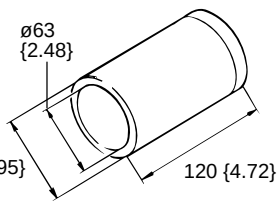
🔧 Sealant

Location	Points of application	Kinds	Quantity
6	Gear installation area of countershaft	THREEBOND 1375B	As required

🔧 Special tools

Location	Tool name and shape	Part No.	Application
1	Snap ring expander 	MH061268	Removal and installation of snap rings of countershaft bearing
2	Countershaft bearing puller 	*MH062426	Removal of countershaft front bearing
	Countershaft bearing installer 	*ME624233	Installation of countershaft front bearing

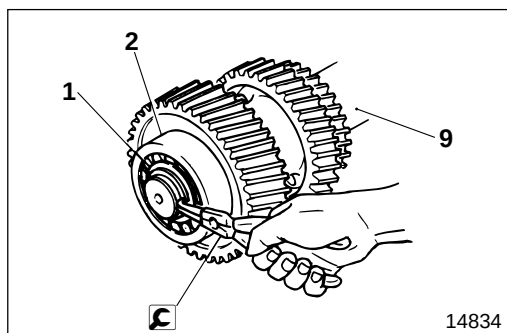
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3, 4	Countershaft gear puller  01155	ME624243	Removal of countershaft gear
	Countershaft gear installer  01156	MH061740	Press-fitting of countershaft gear

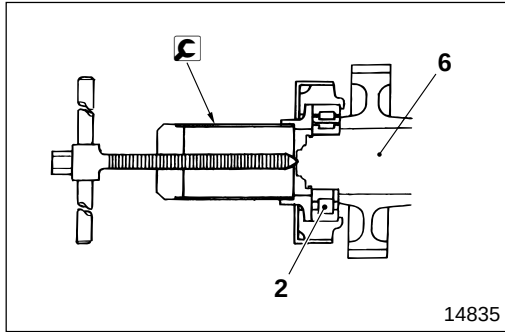
* components of puller and installer kit  P22-59

◆ Service procedure

1 Removal and installation of snap ring

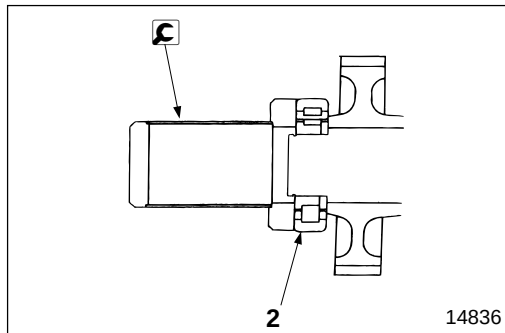


COUNTERSHAFT ASSEMBLY

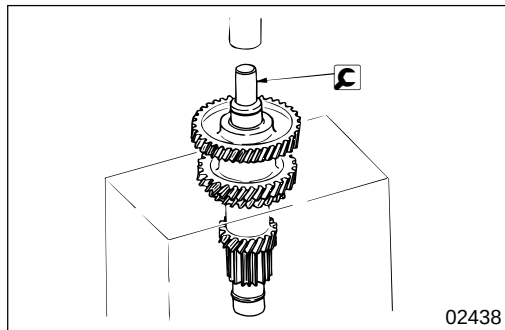


2 Countershaft front bearing

[Removal]



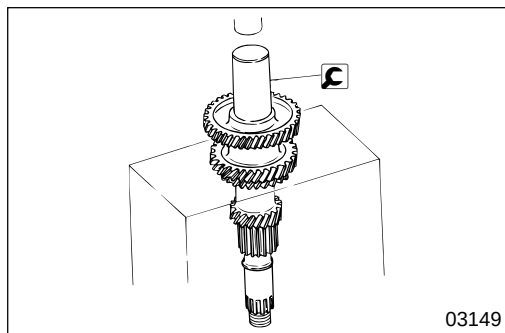
[Installation]



3 4 Countershaft constant mesh gear and countershaft 4th gear

[Removal]

Use a press.

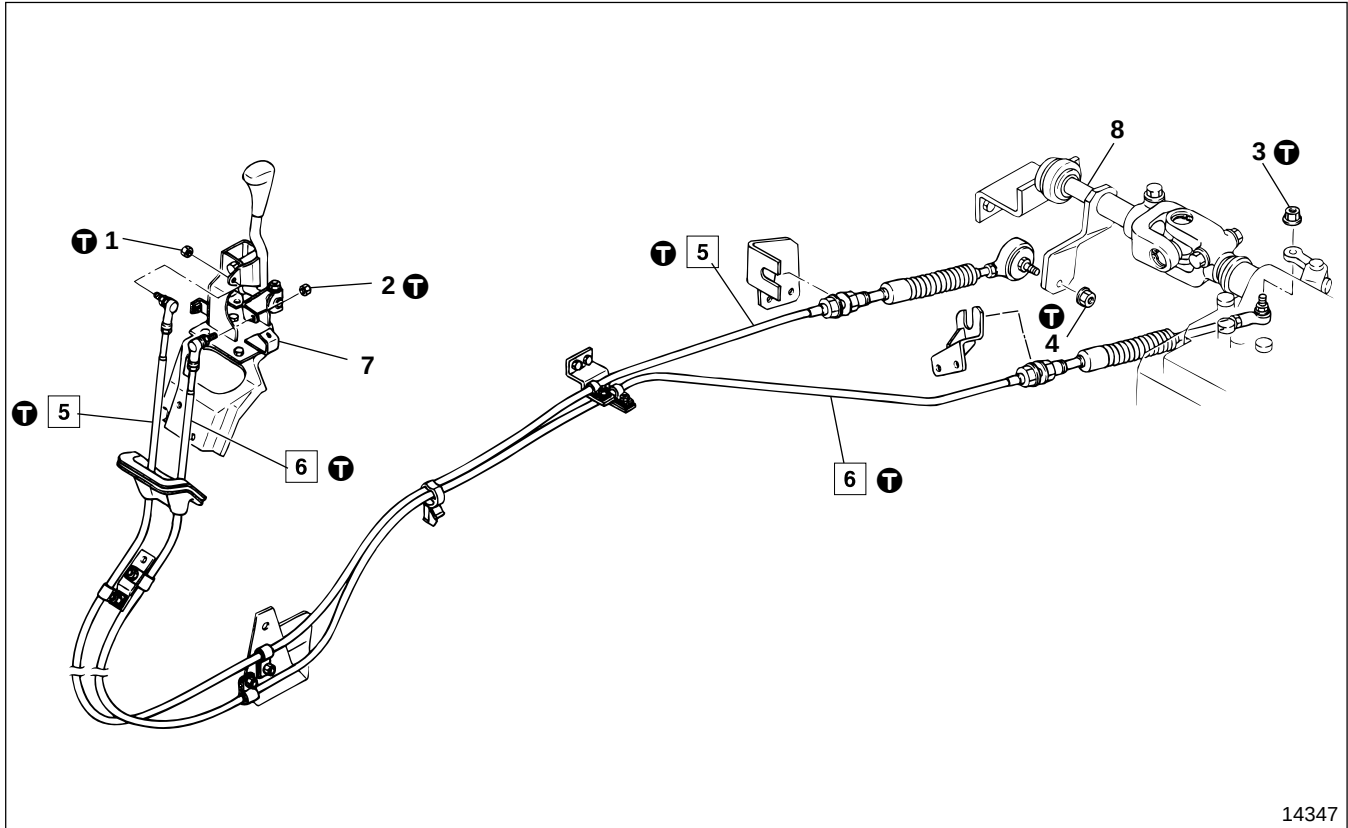


[Installation]

Use a press.

MEMO

TRANSMISSION CONTROL



● Disassembly sequence

- | | | |
|-------|------------------|---|
| 1 Nut | 4 Nut | 7 Transmission control lever assembly P22-57 |
| 2 Nut | 5 Shift cable | 8 Cross shaft P22-58 |
| 3 Nut | 6 Selector cable | |

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

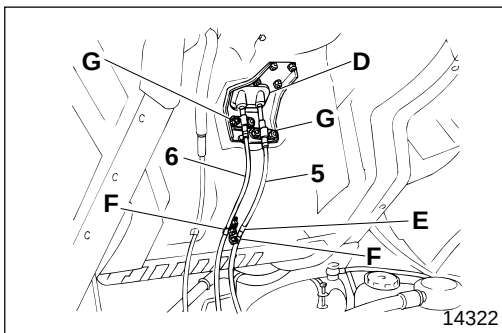
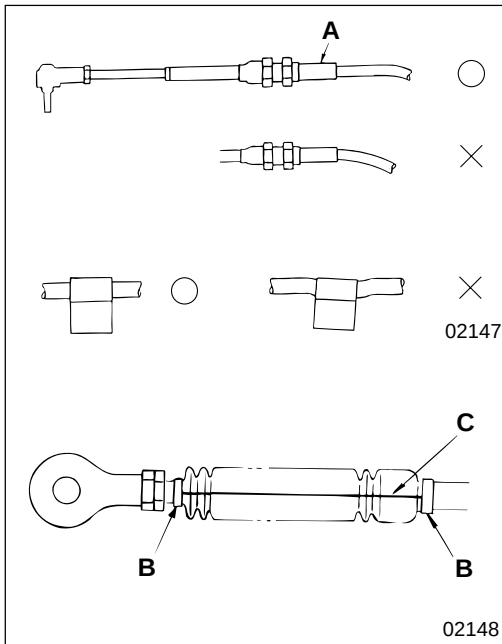
Location	Parts to be tightened	Tightening torque	Remarks
1 to 4	Nut (Ball joint or rubber damper mounting)	19 to 24 {14 to 17, 1.9 to 2.4}	—
5, 6	Cable lock nut tightening	59 to 83 {43 to 61, 6 to 8.5}	—

◆ Service procedure

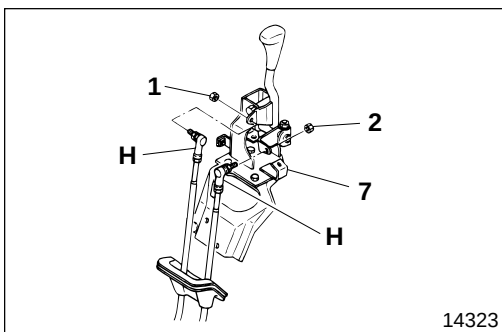
5 6 Installation of shift cable and selector cable

CAUTION ⚠

- Be sure to install casing cap A lengthwise.
- Make sure the radius of the bend is 200 mm {7.87 in.} or more.
- Make sure the cable operates smoothly.
- Be sure to install the clamps vertically against the cable.
- Make sure you do not twist clamps B at both ends of the boot.
- Make sure that white line C on the boot is aligned.
- Make sure the identification marks on the cable, the ball joint and the rubber damper point in the right direction when you install the cables. Installing the cables with the identification marks in the wrong direction can remarkably reduce the durability of the cables.



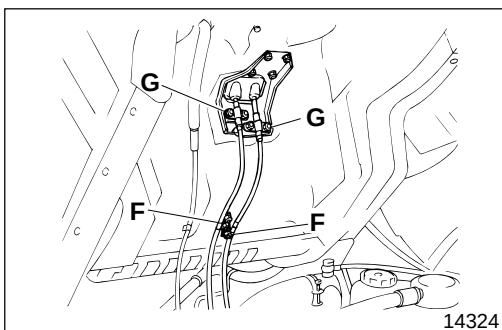
- Install shift cable 5 and selector cable 6 to the frame after having temporarily installed all the clamps.
- Insert shift cable 5 and selector cable 6 through grommet D of the cab floor into the inside of the cab, then install clip F and clip G temporarily by making identification mark E on the shift cable come to clip F position. (The selector cable has no identification mark.)



- Lower the cab.
- Install ball joint H of the cable to the shift lever and selector lever of transmission control lever assembly 7.

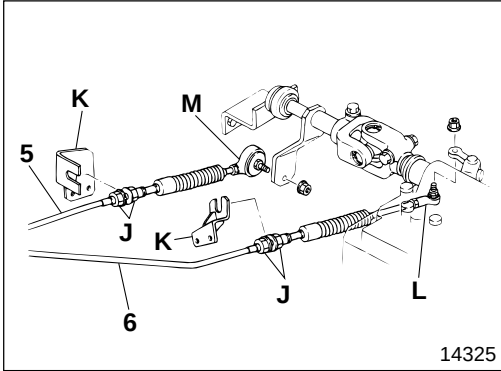
CAUTION ⚠

Make sure that ball joint H faces the correct direction.



- Tilt the cab up and tighten clip F and clip G permanently without applying force to the cables.

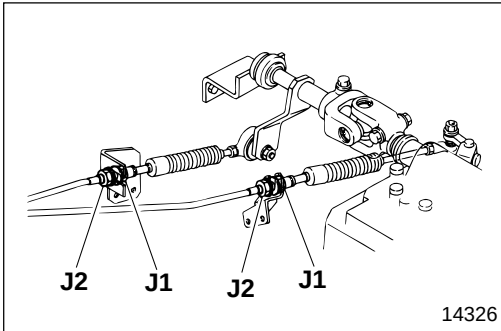
TRANSMISSION CONTROL



- Install lock nut **J** to bracket **K** temporarily and connect ball joint **L** or rubber damper **M** to the shift lever and selector lever.
- Tighten lock nut **J** permanently without applying force to the cables.

CAUTION ⚠

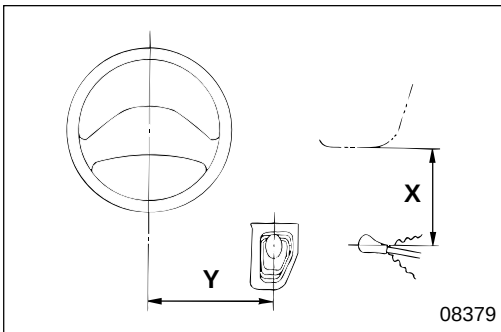
Make sure that ball joint **L** and rubber damper **M** face the correct direction.



CAUTION ⚠

Make sure not to move lock nut **J1** of the transmission side when tightening lock nut **J**. Tighten lock nut **J2**.

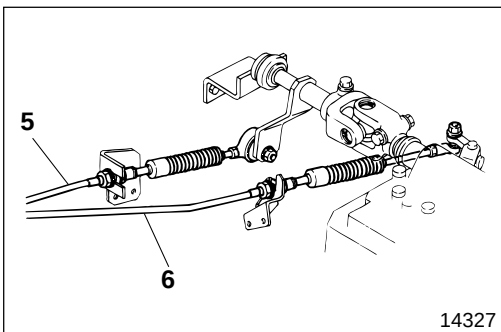
- Check when you operate the gear shift lever that it shifts and selects each position smoothly.



- If the gear shift lever leans to the front or rear, or to the left or right, excessively, adjust the length of the cable.
- When adjusting the gear shift lever, use the distance from the center of the steering wheel or from the instrument panel as the reference distance.

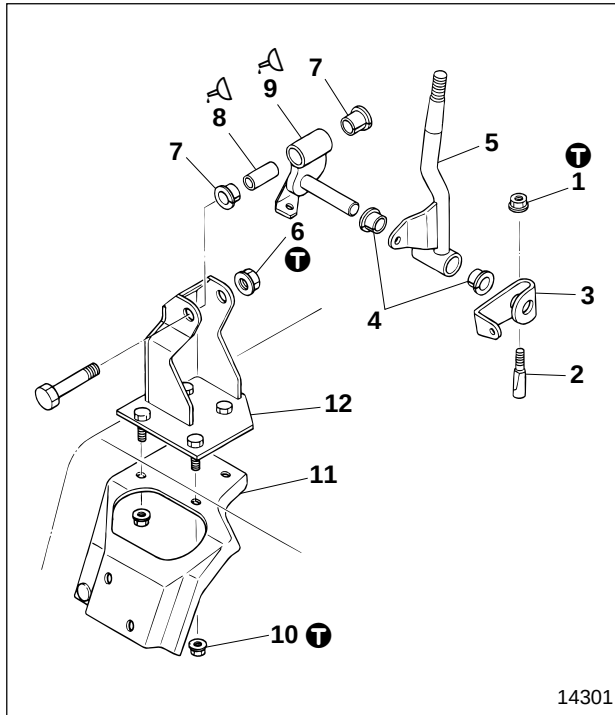
Unit : mm {in.}

Front and rear direction X (Distance from the instrument panel)	Left and right direction Y (Distance from the steering wheel center)
309 {12.17}	350 {13.78} (4th and 5th gear position)



	Shift cable 5	Selector cable 6
To front	Shorten	—
To rear	Lengthen	—
To right	—	Lengthen
To left	—	Shorten

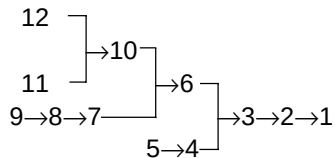
Transmission Control Lever Assembly



● Disassembly sequence

- 1 Nut
- 2 Lock pin
- 3 Select lever
- 4 Bushing
- 5 Lever
- 6 Nut
- 7 Bushing
- 8 Caller
- 9 Shaft assembly
- 10 Nut
- 11 Set board bracket
- 12 Set board

● Assembly sequence



T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

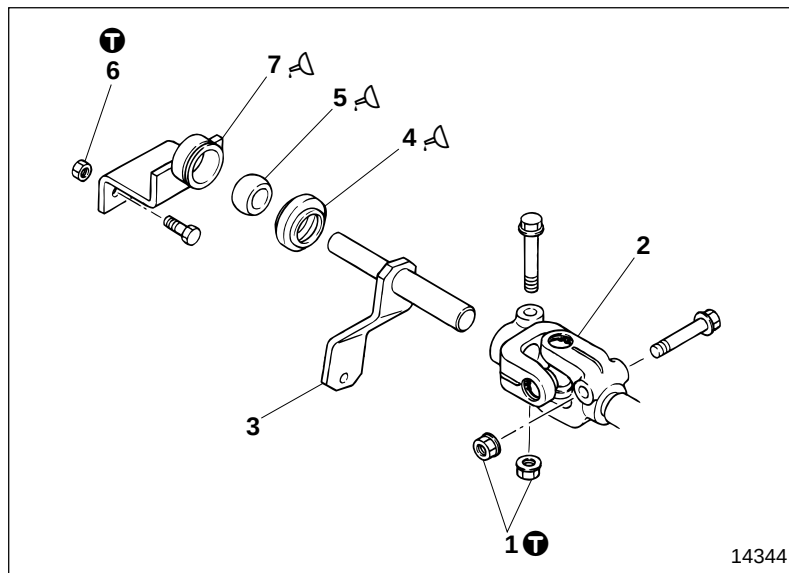
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Lock pin tightening)	10 to 15 {7.2 to 11, 1.0 to 1.5}	—
6	Nut (Shaft assembly mounting)	38 to 54 {27 to 40, 3.8 to 5.5}	—
10	Nut (Set board bracket and set board assembly mounting)	21 to 30 {15 to 22, 2.1 to 3.1}	—

L Lubricant

Location	Points of application	Kinds	Quantity
8	Friction surfaces of collar and bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required
9	Friction surfaces of shaft assembly and bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required

TRANSMISSION CONTROL

Cross shaft



● Disassembly sequence

- 1 Nut
- 2 Universal joint assembly
- 3 Cross shaft
- 4 Dust cover
- 5 Ball bushing
- 6 Nut
- 7 Cross shaft support

● Assembly sequence

- 7→6
2→3→4→5 →1

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Universal joint assembly mounting)	85 to 110 {61 to 80, 8.5 to 11.0}	—
6	Nut (Cross shaft support mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—

Lubricant

Location	Points of application	Kinds	Quantity
4	Pack into the interior of dust cover	Chassis grease [NLGI No.1 (Ca soap)]	As required
5	Friction parts inside and outside of ball bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required
7	Inner periphery of cross shaft support pipe	Chassis grease [NLGI No.1 (Ca soap)]	As required

PULLER AND INSTALLER KIT

22

Puller and installer kit No.	Bearing puller used for		Removal of countershaft rear bearing	Removal of mainshaft rear bearing	Removal of countershaft front bearing	Removal of drive pinion bearing
	Component	Part No.	MH061731	MH061732	MH062426	MH062440
MH062425	Handle	MH061162	○	○	○	○
	Bolt	ME624232	○	○	○	○
	Body	MH061734	○		○	
	Body	MH061735		○		○
	Protector	ME624229	○	○		
	Protector	MH062428			○	○
	Claw	ME624226	○			
	Claw	ME624227		○		
	Claw	MH062427			○	
	Claw	MH062430				○
	Installer	ME624233				
	Installer	ME624234				
	Installer	ME624235				
	Installer	ME624236				

The puller and installer kit consists of principal bearing pullers and installers selected from the special tools used for servicing of manual transmission vehicles in this group. For an installer use a component of this kit independently, and for a puller use the components of this kit in combination.



FH

Service Manual

Group 22
Manual Transmission
< M050S5, S6 >

'00 Minor Change

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

GROUP 22 MANUAL TRANSMISSION < M050S5, S6 >

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REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY	22 - 12
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SPECIFICATIONS

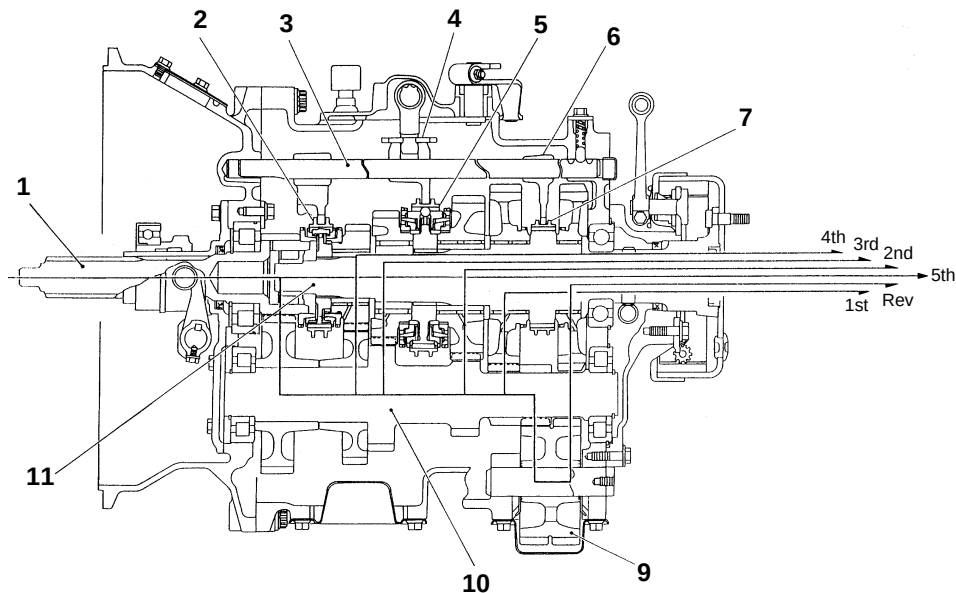
Item		Specifications	
Mode of control		Floor shift remote control	
Transmission model		M050S5	M050S6
Gear ratio	1st	6.875	6.523
	2nd	4.189	3.975
	3rd	2.311	2.193
	4th	1.409	1.336
	5th	1.000	1.000
	6th	—	0.803
	Reverse	6.875	6.523
Oil	Engine oil	Long period of high-speed driving : API CC SAE30 or SAE40 : API CC/SF SAE30 or SAE40	
	Quantity L {qts}	5.4 {5.7}	6.5 {6.9}
Mass	kg {lb}	122 {270}	137 {300}

STRUCTURE AND OPERATION

22

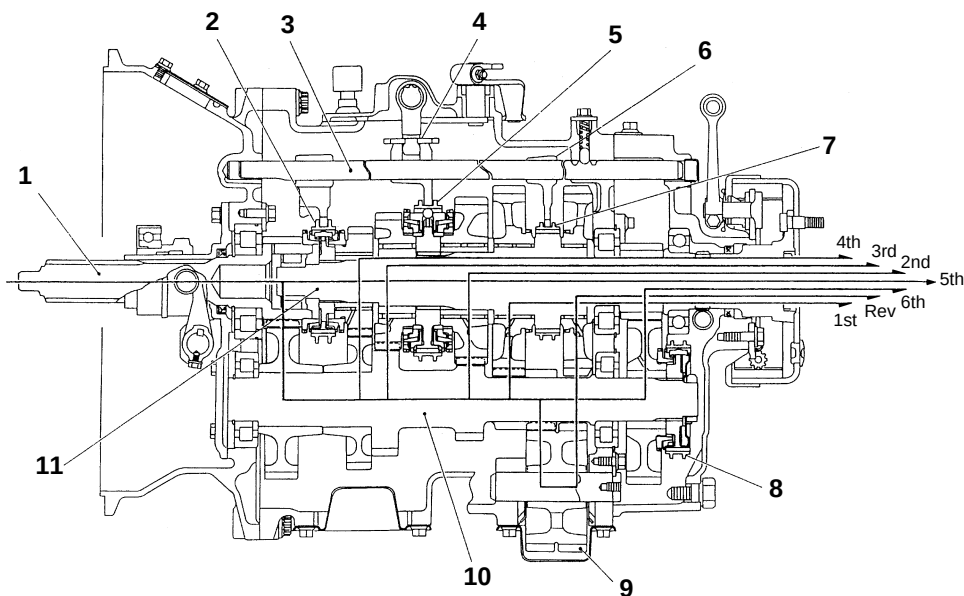
Transmission

< S5 >



37122

< S6 >



36021

- | | |
|-------------------------------------|--|
| 1 Drive pinion | 7 1st and reverse constant mesh assembly |
| 2 4th and 5th synchronizer assembly | 8 6th synchronizer assembly < S6 > |
| 3 Shift rail | 9 Reverse idler gear |
| 4 Interlock mechanism | 10 Countershaft |
| 5 2nd and 3rd synchronizer assembly | 11 Mainshaft |
| 6 Shift fork | |

The transmission changes revolution and torque generated by the engine into those that match the vehicle's power requirement (driving force). Revolution and torque are increased or decreased by making a selection from several sets of engaged gears. The transmission uses an interlock mechanism to avoid double engagement.

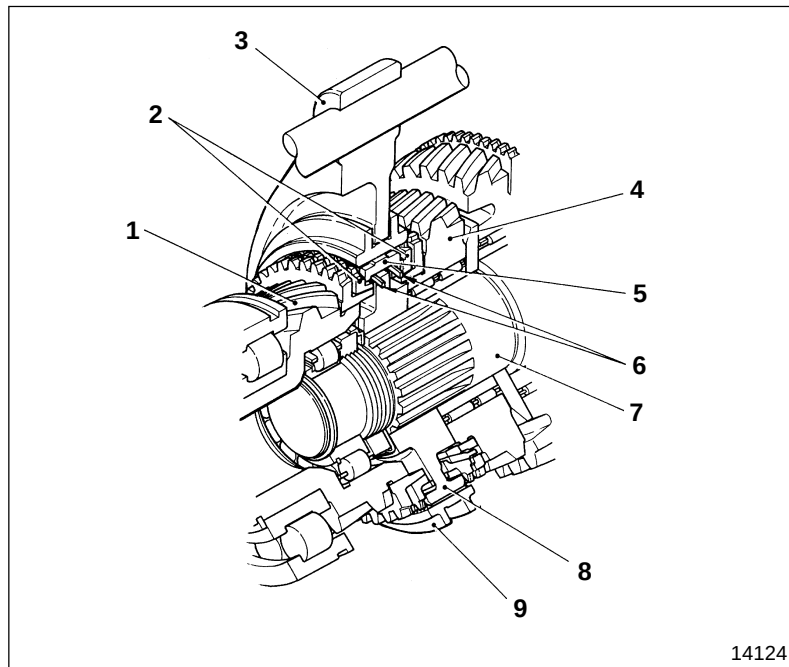
STRUCTURE AND OPERATION

Synchromesh Mechanism

This vehicle has two synchromesh mechanisms, a single cone type, and a double cone type, and uses the key system. The single or double cone type is used depending on the gear positions as shown below:

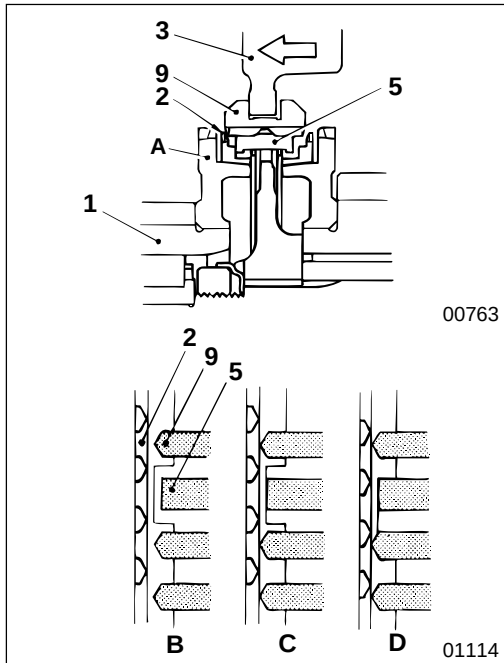
Synchromesh type	Parts used
Single cone type	4th, 5th, 6th
Double cone type	2nd and 3rd

Single Cone Type

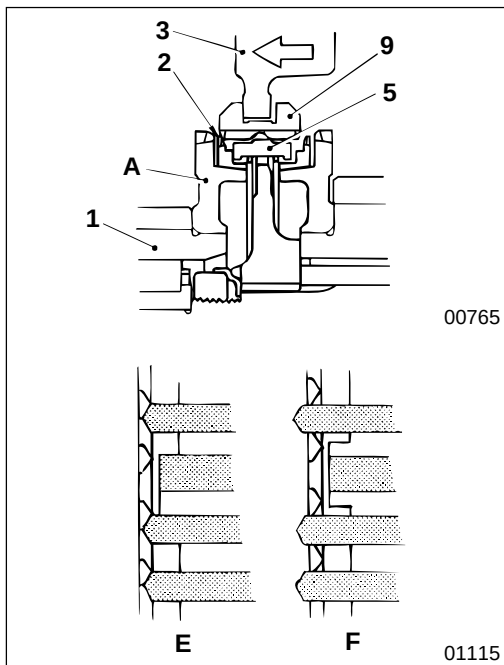


- 1 Drive pinion
- 2 Synchronizer ring
- 3 4th and 5th shift fork
- 4 4th gear
- 5 Shifting key
- 6 Shifting key spring
- 7 Mainshaft
- 8 Synchronizer hub
- 9 Synchronizer sleeve

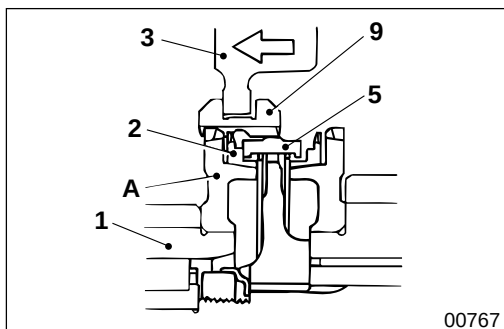
- The following descriptions are for 4th and 5th gear
The inside of synchronizer hub **8** engages the spline of mainshaft **7** and rotates with it. The outside of the synchronizer hub has a spline that engages synchronizer sleeve **9** and three keyways.
- Shifting keys **5** are inserted into these keyways. When the gear shift is in neutral, a protrusion in the center of each shifting key engages a groove inside the synchronizer sleeve and the shifting keys are pressed against the inside of the synchronizer sleeve by shifting key springs **6**.
- Synchronizer rings **2** are inserted into drive pinions **1** in the front and rear of synchronizer hub **8**, and the taper cone of 4th gear **4**.
- The internal tapers of synchronizer rings **2** have fine threads, and the outer splines engage synchronizer sleeve **9**. On the hub side of the synchronizer rings are three keyways in which the ends of shifting keys **5** are inserted. These keyways are wider than the width of the shifting keys.
- Synchronizer rings **2** rotate relative to synchronizer sleeve **9** by the amount of play of the keyways.



- When the gear shift is in neutral (Figure B), moving shift fork 3 in the direction of the arrow as illustrated, moves synchronizer sleeve 9 slightly to the left. At the same time, shifting key 5, the central protrusion of which engages the synchronizer sleeve, moves to the left and presses synchronizer rings 2 against taper cone A of drive pinion 1. (Figure C)
- When the taper surfaces of synchronizer rings 2 make contact with the taper cone of the drive pinion, the taper surfaces of the synchronizer rings act as cone clutches. This frictional torque rotates the synchronizer rings in the rotating direction of the drive pinion by the amount of play between shifting key 5 and the synchronizer rings. The spline chamfers of the synchronizer rings and the spline chamfer of synchronizer sleeve 9 are offset from each other. (Figure D)
- The disengagement direction of synchronizer rings 2 is defined by the speed of rotation of the synchronizer—sleeve 9, and the synchronized—drive pinion 1. When increasing the vehicle speed by shifting up, disengagement is made in the opposite direction to rotation, and when decreasing the vehicle speed by shifting down, disengagement is made in the rotating direction.



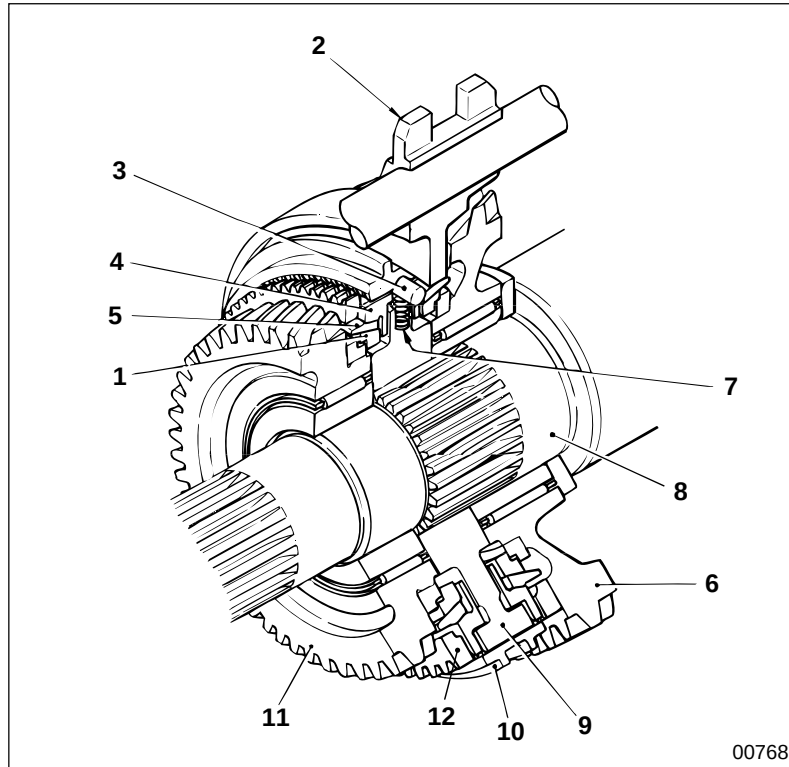
- When synchronizer sleeve 9 moves further to the left, synchronizer rings 2 prevent shifting key 5 from moving, and the synchronizer sleeve disengages from the protrusion of the shifting key.
 - Since synchronizer rings 2 remain disengaged, the spline chamfer of synchronizer sleeve 9 presses the spline chamfers of the synchronizer rings, which in turn press the synchronizer rings against taper cone A of drive pinion 1.
 - As the frictional torque increases on the taper surfaces, the relative speed of the synchronizer and the synchronized gradually decreases.
- E : In synchronization
F : After synchronization



- When synchronizer sleeve 9 and drive pinion 1 rotate at the same speed, synchronizer rings 2 no longer prevent the synchronizer sleeve from moving, and the synchronizer sleeve moves further to the left and smoothly engages the spline of taper cone A of drive pinion 1, transmitting the driving force.

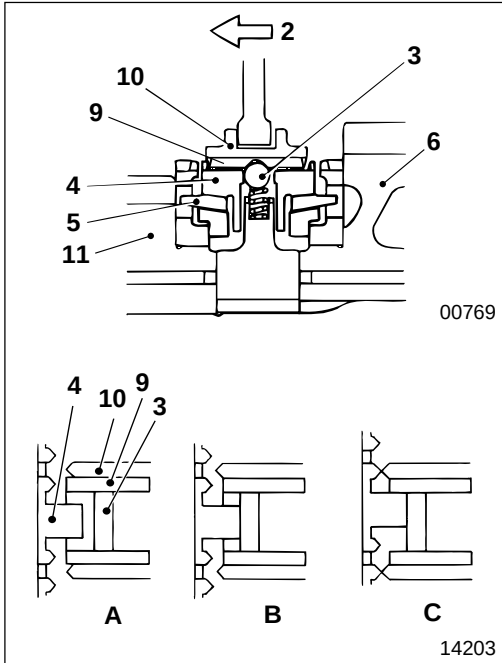
STRUCTURE AND OPERATION

Double Cone Type

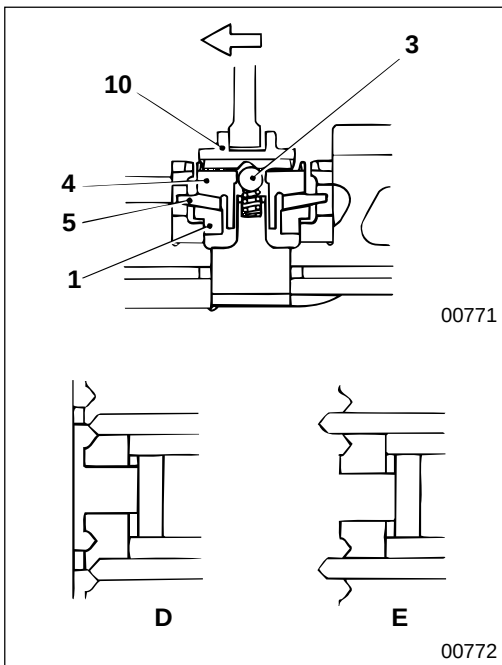


- 1 Synchronizer inner ring
- 2 2nd and 3rd shift fork
- 3 Shifting key
- 4 Synchronizer outer ring
- 5 Synchronizer center cone
- 6 2nd gear
- 7 Shifting key spring
- 8 Mainshaft
- 9 Synchronizer hub
- 10 Synchronizer sleeve
- 11 3rd gear
- 12 Dog clutch

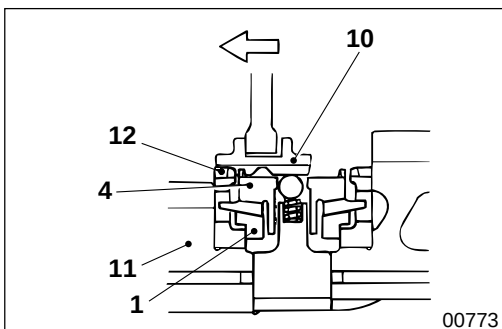
- The following descriptions are for 2nd and 3rd gear
The synchromesh structure and operation of the double cone type are basically the same as for the single cone type.
- Synchronizer center cone **5** is a taper cone independent of 2nd gear **6** and 3rd gear **11**, (both the inside and outside surfaces are tapered). The synchronizer center cone is between synchronizer inner ring **1** and synchronizer outer ring **4** to increase the synchronization capacity.
- Six protrusions on the outside of center cone **5** fit into corresponding gear holes, in the same manner as the taper cone of the single cone type. The center cone and the gear are installed as if integrated.
Shifting key **3** is a cylinder installed so that the lengthwise direction of the cylinder is at right angles to the diameter direction of synchronizer hub **9**. Shifting key spring **7** is a coil spring inserted in a hole in the synchronizer hub, this spring presses the shifting key against the inside of synchronizer sleeve **10**.



- When the gear shift is in neutral (Figure A), moving shift fork **2** in the direction of the arrow as illustrated, moves synchronizer sleeve **10** slightly to the left. At the same time, shifting key **3**, the central protrusion of which engages the synchronizer sleeve, moves to the left and presses synchronizer outer ring **4** against synchronizer center cone **5**. (Figure B)
- When the taper surface of synchronizer outer ring **4** makes contact with the taper cone of synchronizer center cone **5**, the taper surface of the synchronizer outer ring acts as a cone clutch. This frictional torque rotates the synchronizer outer ring in the rotating direction of 3rd gear **11** by the amount of play between the synchronizer outer ring and synchronizer hub **9**. The spline chamfer of the synchronizer outer ring and the spline chamfer of synchronizer sleeve **10** are offset from each other. (Figure C)
- The disengagement direction of synchronizer outer ring **4** is defined by the speed of rotation of the synchronizer—the sleeve, and the synchronized—3rd gear **11**. When increasing the vehicle speed by shifting up, disengagement is made in the opposite direction to rotation, and when decreasing the vehicle speed by shifting down, disengagement is made in the rotating direction.



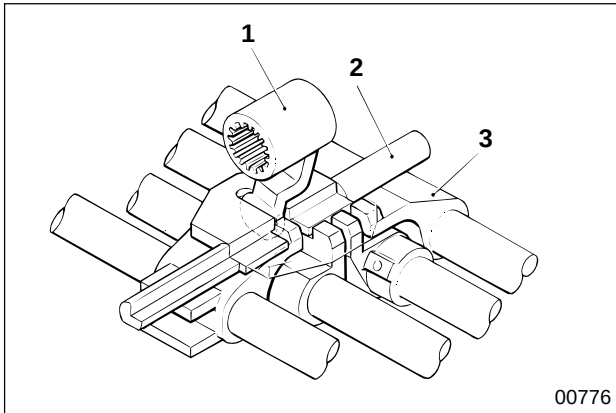
- When synchronizer sleeve **10** moves further to the left, synchronizer outer ring **4** prevents shifting key **3** from moving, and the synchronizer sleeve disengages from the protrusion of the shifting key.
- Since synchronizer outer ring **4** remains disengaged, the spline chamfer of synchronizer sleeve **10** presses the spline chamfer of the synchronizer outer ring, which in turn presses the synchronizer outer ring against the taper cone of synchronizer center cone **5**, and the frictional torque acts on the taper surface.
- As the frictional torque increases on the taper surface of synchronizer inner ring **1**, the relative speed of the synchronizer and the synchronized gradually decreases. The frictional torque acts on both sides of the synchronizer center cone. The double cone type has greater capacity for synchronization than the single cone type.
- D** : In synchronization
- E** : After synchronization



- When synchronizer sleeve **10** and 3rd gear **11** rotate at the same speed, synchronizer outer ring **4** no longer prevents the synchronizer sleeve from moving and the synchronizer sleeve moves further to the left and smoothly engages the spline of dog clutch **12** of the 3rd gear, transmitting the driving force.

STRUCTURE AND OPERATION

Interlock Mechanism



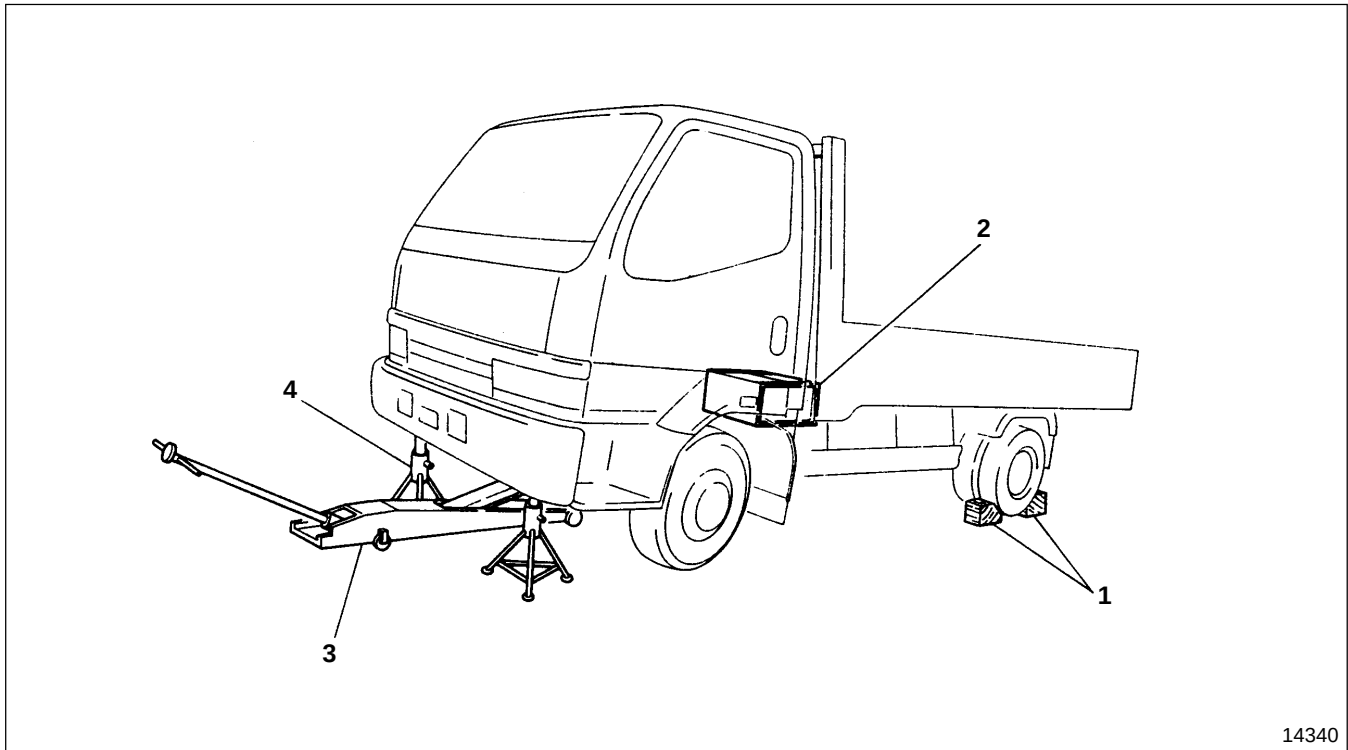
In the interlock mechanism, the rail beneath interlock plate **2** locks jaws **3**, (apart from the jaws shifted by gear shift slide lever **1**), preventing double engagement of gears.

TROUBLESHOOTING

22

Possible causes		Symptoms				
		Gears slip out of engagement	Gears hard to engage	Noise when engine is idling	Noise while cruising	Noise when changing gear
Transmission body faulty	Mainshaft rear lock nut loose	☐	☐			
	Mainshaft thrust washer worn	☐	☐			
	Mainshaft bearing worn or damaged	☐	☐			
	Synchronizer ring and synchronizer sleeve spline worn	☐				
	Synchronizer ring and gears taper cone area worn		☐			
	Mainshaft pilot bearing worn or damaged			☐	☐	
	Drive pinion bearing worn or damaged			☐		
	Countershaft bearing worn or damaged			☐		
	Needle bearings of gears worn or damaged			☐	☐	
	Mainshaft and countershaft bearings worn or damaged				☐	
	Mainshaft and countershaft gears backlash excessive				☐	
	Spline of gears worn					☐
	Gears damaged				☐	
	Gear oil insufficient				☐	
Control mechanisms faulty	Control cable joint play	☐	☐			
	Set board assembly bushings worn	☐				
	Shift rail steel ball and groove worn	☐				
	Shift rail poppet spring fatigued or damaged	☐				
	Shift rail sliding movement faulty		☐			
	Shift fork jaws worn		☐			
	Shift fork bent		☐			
Clutch faulty	Clutch disengagement faulty	 Gr 21		☐		☐
	Clutch pedal play faulty			☐		
Synchronizer faulty	Contacting surfaces of synchronizer ring and gear taper cone worn					☐
	Shifting key worn					☐
	Shifting key spring deteriorated or damaged					☐
	Synchronizer sleeve worn or damaged				☐	☐

WORK BEFORE REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY



● Work sequence before removal

- 1 Place wheel chocks.
- 2 Disconnect negative battery cable.  Gr 54
- 3 Jack up the front axle on a garage jack.
- 4 Support the front frame on jack stands.

WARNING

- Since the parking brake will be removed, naturally it cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on jack stands.
- Leave the garage jack and jack stands in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Keep the transmission in neutral throughout the operation.

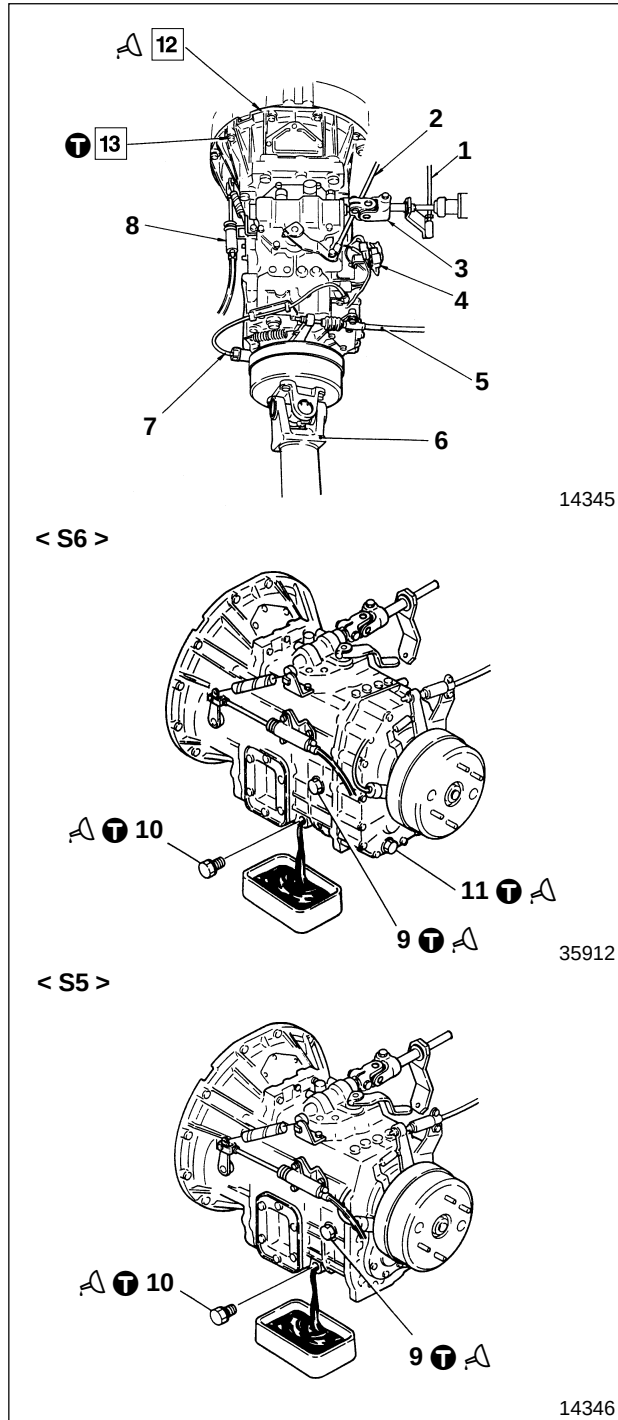
● Work sequence after installation

Follow the work sequence before removal in reverse.

M E M O

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY

Removal and Installation



● Disassembly sequence

- 1 Shift cable P22-60
- 2 Selector cable P22-60
- 3 Cross shaft P22-64
- 4 Harness connector
- 5 Parking brake cable Gr 36
- 6 Propeller shaft Gr 25
- 7 Speed sensor Gr 54
- 8 Clutch slave cylinder Gr 21
- 9 Inspection plug
- 10 Drain plug (on transmission case)
- 11 Drain plug (on extension housing)
- 12 Nut or bolt
- 13 Transmission assembly

● 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
8	Clutch slave cylinder hose connector	20 {14.8, 2}	—
9	Inspection plug	69±15 {51±11, 7±1.5}	—
10, 11	Drain plug	69±15 {51±11, 7±1.5}	—
12	Nut or bolt (Transmission mounting)	40 {30, 4.1}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
9	Thread area of inspection plug	THREEBOND 1105D	As required
10, 11	Thread area of drain plug	THREEBOND 1105D	As required
13	Spline of drive pinion	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

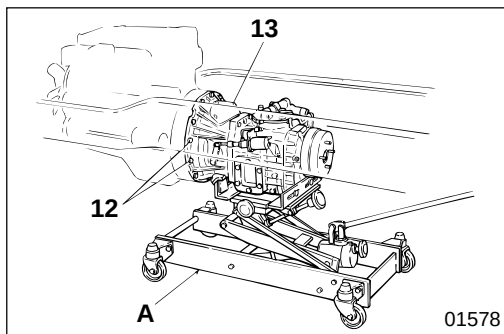
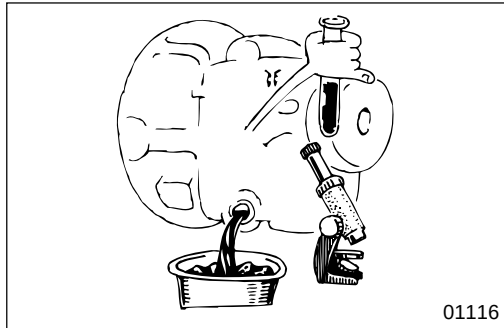
● Oil change

[Draining]

- When draining oil, check the quantity and quality of oil, especially for small pieces of metal and metal dust.
- Clean inspection plug **9** before reinstalling it because it is magnetic.

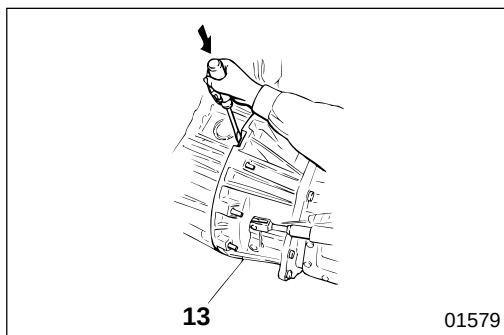
[Filling]

- Check that drain plugs **10, 11** are tightened at specified torque.
- Pour in gear oil until the oil overflows from the inspection hole. (For oil quantity, see specifications.) See illustrations on page 22-12.



12 Removal of transmission mounting nut or bolt

- Support transmission assembly **13** on transmission jack **A**.
- Loosen transmission mounting nuts or bolts **12**.



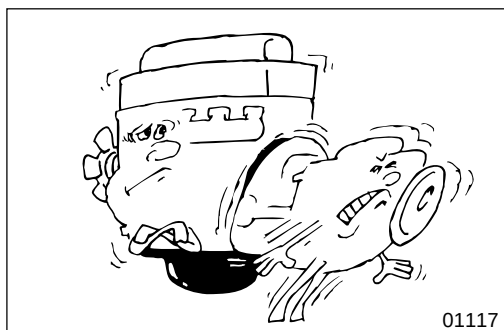
13 Transmission assembly

[Removal]

- Insert a screwdriver into the three removal grooves and pry transmission assembly **13** from the engine.

CAUTION ⚠

Make sure that you remove hoses and cables before starting service operations.

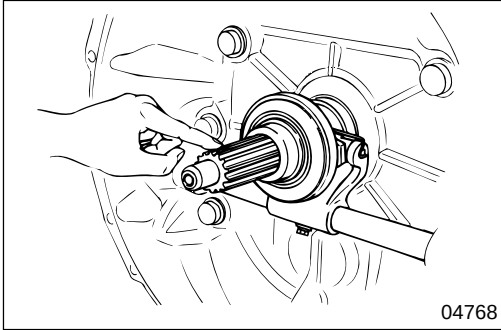


- Move transmission assembly **13** backward until the spline of the drive pinion is detached from the clutch.

CAUTION ⚠

Make sure that you pull transmission assembly **13** out in a straight line. If you seesaw the transmission assembly violently, you will damage the spline that connects the drive pinion and the clutch.

REMOVAL AND INSTALLATION OF TRANSMISSION ASSEMBLY

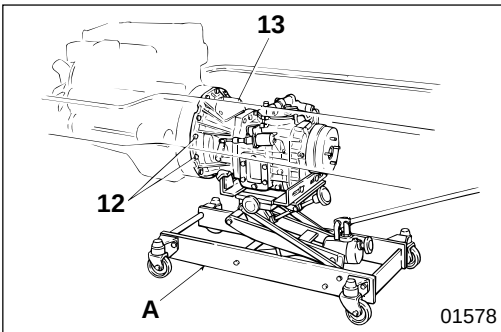


[Installation]

- Check the spline of the drive pinion for rust.
- If rust is found, remove it using a wire brush.
- Rub grease onto the clutch disc sliding surfaces of the drive pinion using your hand.

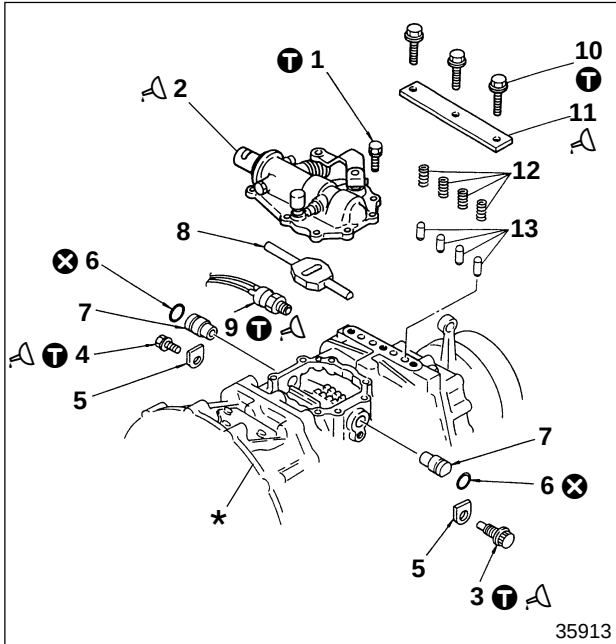
CAUTION ⚠

Make sure that you apply only the necessary amount of grease because too much grease would drip and cause clutch slip.



- Support transmission assembly **13** on transmission jack **A**, and insert the transmission assembly into the pilot bearing of the flywheel paying attention to the drive pinion spline.
- Tighten transmission mounting nuts or bolts **12** at specified torque.

GEAR SHIFTER UPPER AND INTERLOCK PLATE

22


● Disassembly sequence

- 1 Bolt
- 2 Gear shifter upper assembly P22-16
- 3 Jaw set bolt
- 4 Bolt
- 5 Lock plate
- 6 O-ring
- 7 Bushing
- 8 Detent plate
- 9 Backup lamp switch Gr 54
- 10 Bolt
- 11 Poppet spring plate
- 12 Poppet spring
- 13 Detent pin

* : Transmission body

✕ : Non-reusable parts

● Assembly sequence

6→7
8→5→4→3→9→2→1→13→12→11→10

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
7, 8	Clearance between interlock plate axis and bushing	[12 {0.47}] 0.14 to 0.19 {0.0055 to 0.0075}	0.4 {0.016}	Replace
12	Poppet spring load (Installed length 29 {1.14})	78 N {18 lbf, 8 kgf}	67 N {15 lbf, 68 kgf}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

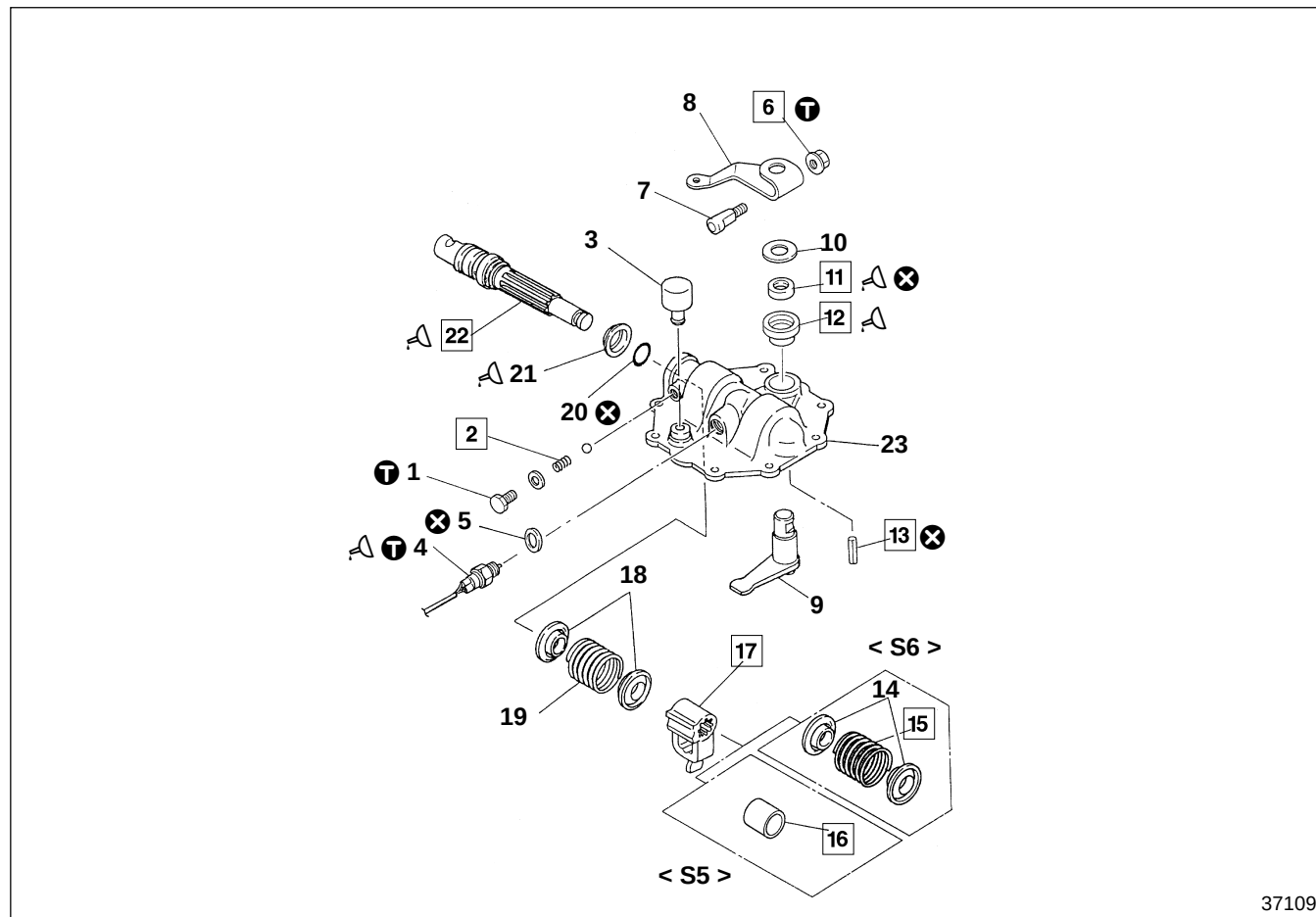
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Gear shifter upper mounting)	23 {17, 2.3}	—
3	Jaw set bolt	135 {98, 13.6}	—
4	Bolt (Lock plate mounting)	40 {30, 4.1}	—
9	Backup lamp switch	49 {36, 5.0}	—
10	Bolt (Poppet spring plate mounting)	49 {36, 5.0}	—

Sealant

Location	Points of application	Specified sealant	Quantity
2	Contact surface with transmission case	THREEBOND 1215	As required
3	Thread area of jaw set bolt	THREEBOND 1104J	As required
4	Thread area of bolt	THREEBOND 1104J	As required
9	Thread area of backup lamp switch	THREEBOND 1105D	As required
11	Contact surface with transmission case	THREEBOND 1215	As required

GEAR SHIFTER UPPER AND INTERLOCK PLATE

Gear Shifter Upper Assembly



Disassembly sequence

- | | | |
|--|------------------------------------|-----------------------------|
| 1 Plug | 10 Washer | 18 Return spring A retainer |
| 2 Torsion shaft spring | 11 Oil seal | 19 Return spring A |
| 3 Air breather | 12 Bushing | 20 O-ring |
| 4 Neutral switch  Gr 54 | 13 Spring pin | 21 Dust seal |
| 5 Gasket | 14 Return spring B retainer < S6 > | 22 Gear shift lever |
| 6 Nut | 15 Return spring B < S6 > | 23 Selector lever case |
| 7 Lock pin | 16 Gear selector stopper < S5 > | |
| 8 Gear selector lever B | 17 Gear shift slide lever | |
| 9 Gear selector lever A | | |

 : Non-reusable parts

NOTE

Do not remove bushing 12 except for replacement.

Assembly sequence

23→12→11→18→19→18→17→14→15→16→14→13→9→10→8→7→6→3→2→1
 21→22→20→5→4

CAUTION

Be sure when assembling gear selector lever A 9, that you turn the lever so you do not damage the lip area of oil seal 11.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Torsion shaft spring load (Installed length 16.2 {0.64})	50 N {11 lbf, 5.1 kgf}	42 N {9.48 lbf, 4.3 kgf}	Replace
9	Play in axial direction of gear selector lever A	0.3 to 0.6 {0.012 to 0.024}	—	Replace
15	Return spring B load (Installed length 23.6 {0.93})	92 N {21 lbf, 9.4 kgf}	78 N {18 lbf, 8.0 kgf}	Replace
19	Return spring A load (Installed length 27.6 {1.09})	94 N {21 lbf, 9.6 kgf}	80 N {18 lbf, 8.2 kgf}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

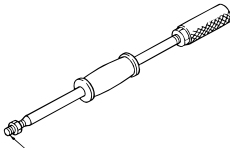
Location	Parts to be tightened	Tightening torque	Remarks
1	Plug	23 {17, 2.3}	—
4	Neutral switch	34 to 39 {25 to 29, 3.5 to 4.0}	—
6	Nut (Lock pin mounting)	17 {12, 1.7}	—

L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
4	Thread area of neutral switch	THREEBOND 1104J	As required
11	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
12	Inner surface of gear selector lever A axis bushing and its friction surface	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
	Contact surfaces between bushing outer surface and case	THREEBOND 1215	As required
21	Pack dust seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
22	Gear shift lever O-ring groove	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

S Special tools

Unit : mm {in.}

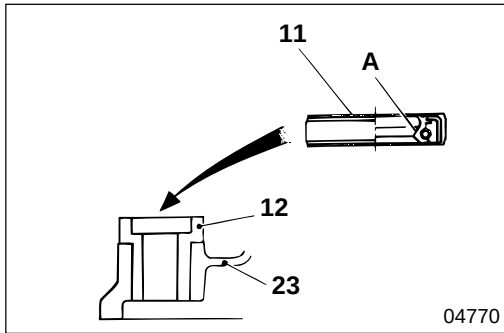
Location	Tool name and shape	Part No.	Application
13	Spring pin puller  M12×1.25 02399	MH062445	Removal of spring pin
	Reverse shaft puller  M12×1.25 02118	03726-82000	

GEAR SHIFTER UPPER AND INTERLOCK PLATE

◆ Service procedure

11 Installation of oil seal

- Apply grease to lip area **A** of oil seal **11**.
- Press-fit oil seal **11** into bushing **12** in the direction as illustrated.



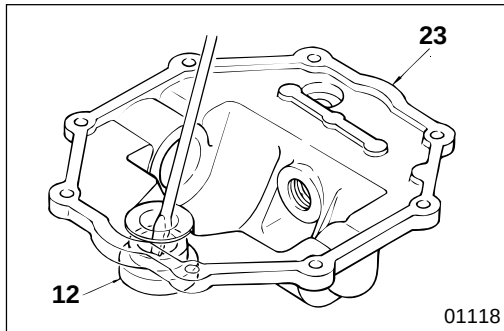
12 Bushing

[Removal]

Remove bushing **12** from selector lever case **23** using a screwdriver.

CAUTION ⚠

Be careful not to damage selector lever case **23**.

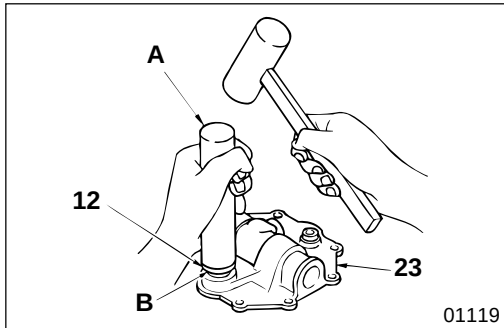


[Installation]

- Clean the inner surface of selector lever case **23**.
- Press-fit bushing **12** into selector lever case **23** using bar **A** (approximately $\varnothing 40$ mm {1.57 in.}).
- When press-fitting bushing **12**, take care not to damage selector lever case **23**.
- After press-fitting, apply sealant to press-fitted side **B** of bushing **12**.

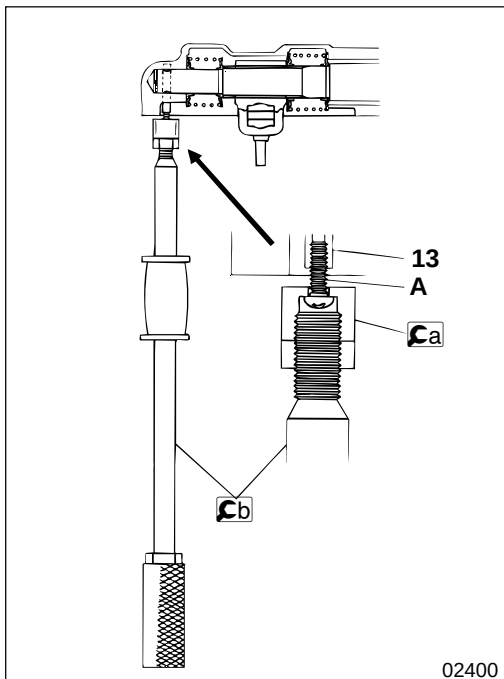
CAUTION ⚠

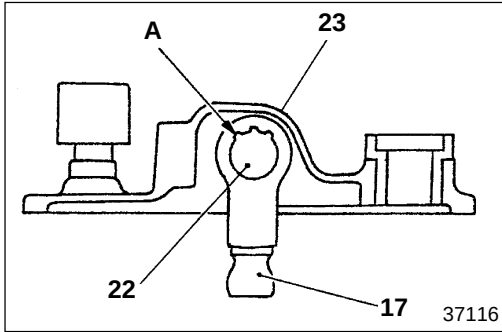
Prevent sealant from sticking to the inner surface of bushing **12**.



13 Removal of spring pin

- Tap spring pin **13** using an M4 tap.
- Insert **Ca** spring pin puller with an M4 thread **A** of appropriate length into spring pin **13**.
- Position **Cb** reverse shaft puller on **Ca** spring pin puller.
- Remove spring pin **13** from selector lever case **23** using **Ca** spring pin puller and **Cb** reverse shaft puller.

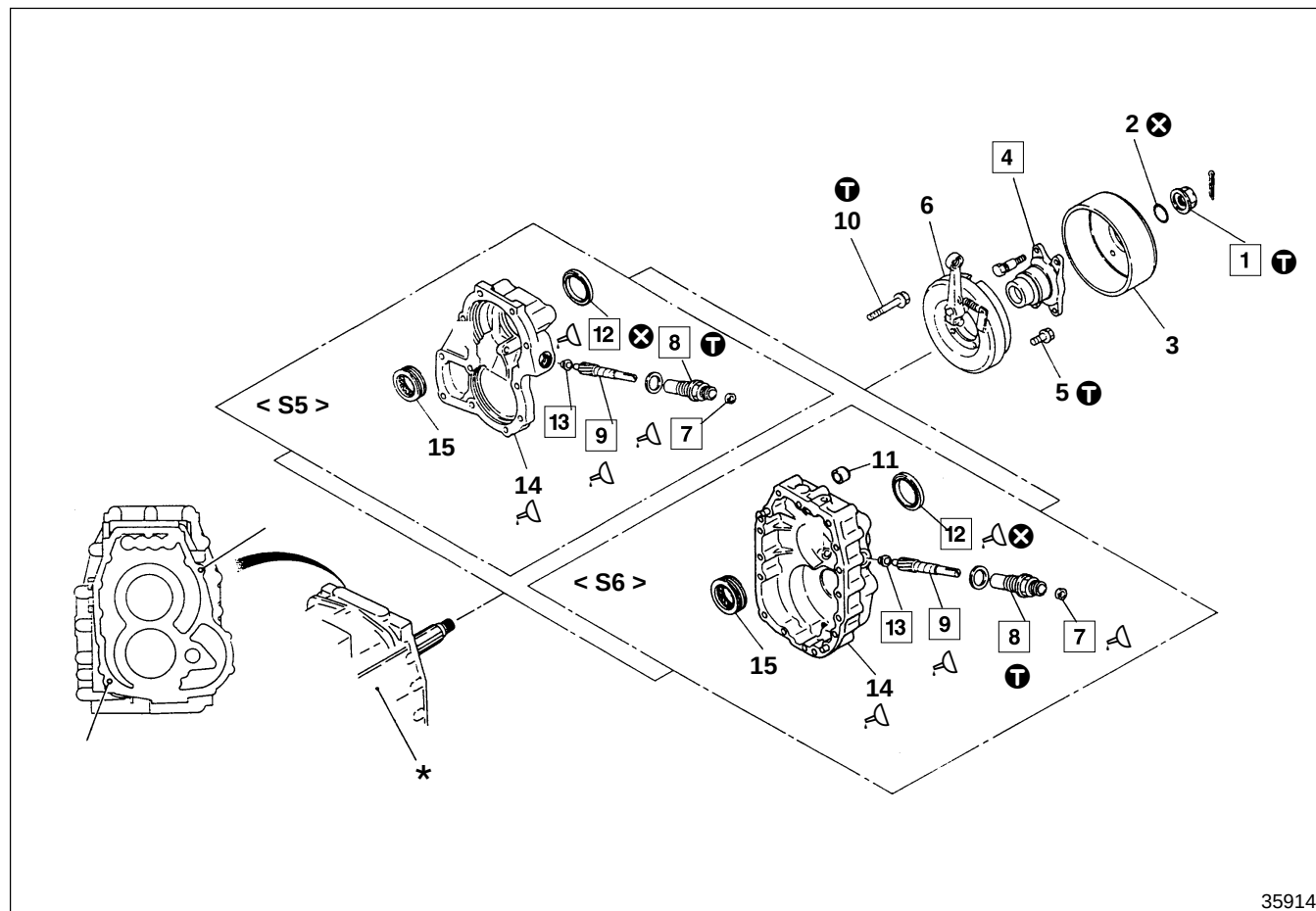




17 Installation of gear shift slide lever

When you install gear shift slide lever **17** in gear shift lever **22**, position spline **A** is as illustrated.

EXTENSION HOUSING, REAR COVER AND PARKING BRAKE ASSEMBLY

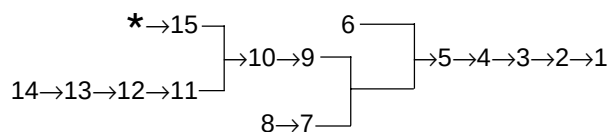


35914

● Disassembly sequence

- | | |
|---|-------------------------------|
| 1 Lock nut | 11 Dust plug < S6 > |
| 2 O-ring | 12 Oil seal |
| 3 Parking brake drum | 13 Speedometer gear bushing A |
| 4 Companion flange | 14 Rear cover < S5 > |
| 5 Bolt | Extension housing < S6 > |
| 6 Support plate and shoe assembly  | 15 Speedometer worm |
| 7 Oil seal | |
| 8 Speedometer gear bushing | |
| 9 Speedometer gear | |
| 10 Bolt | |
- * : Transmission body
 : Positioning pins
 ⊗ : Non-reusable parts

● Assembly sequence



NOTE

Inspect play of speedometer gear 9 before disassembly.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
8, 9	Clearance between speedometer gear bushing and speedometer gear	[12] 0.02 to 0.07 {[0.47] 0.00079 to 0.0028}	0.15 {0.0059}	Replace
9, 15	Play between speedometer gear and speedometer worm	0.13 to 0.29 {0.0051 to 0.011}	0.36 {0.014}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

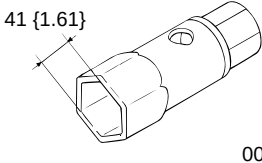
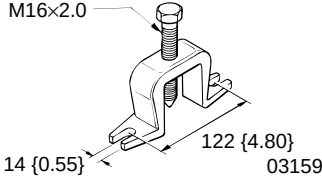
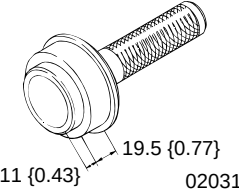
Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut	245 to 345 {180 to 255, 25 to 35}	—
5	Bolt (Support plate and shoe assembly mounting)	40 {30, 4.1}	—
8	Speedometer gear bushing	145 {110, 15}	—
10	Bolt (Extension housing or rear cover mounting)	40 {30, 4.1}	—

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
7, 12	Interior and lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
9	Friction surface with speedometer gear bushing	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
14	Contact surfaces between rear cover or extension housing and transmission case	THREEBOND 1215	As required

Special tools

Unit : mm {in.}

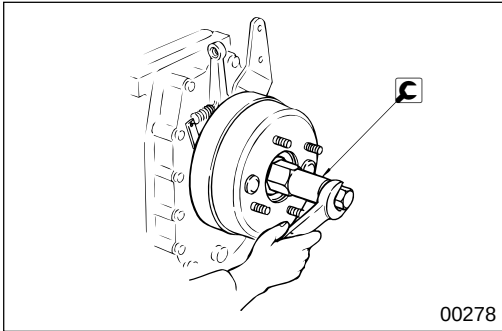
Location	Tool name and shape	Part No.	Application
1	Socket wrench 	MH061532 00069	Removal and installation of mainshaft rear lock nut
4	Flange puller 	MC881524	Removal of flange at rear of mainshaft
12	Oil seal installer 	ME624242 02031	Installation of oil seal in rear cover or extension housing

EXTENSION HOUSING, REAR COVER AND PARKING BRAKE ASSEMBLY

◆ Service procedure

1 Removal and installation of lock nut

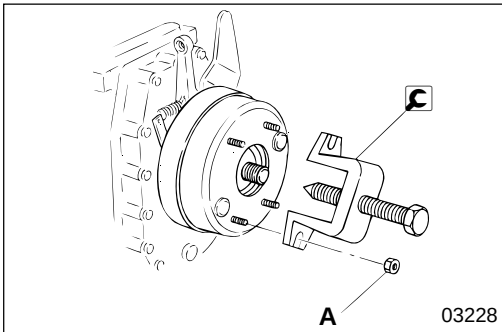
 : Socket wrench



4 Removal of companion flange

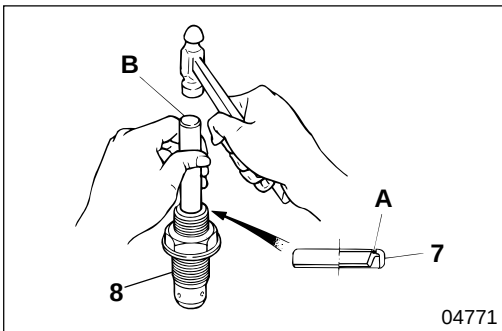
A : Propeller shaft mounting nut

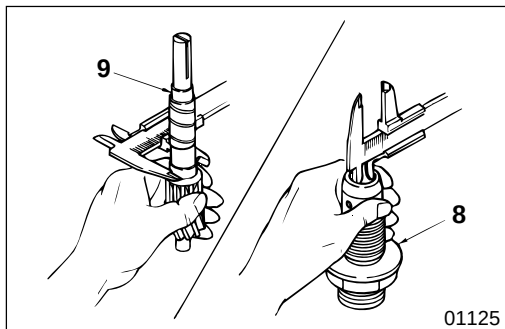
 : Flange puller



7 Press-fitting of oil seal

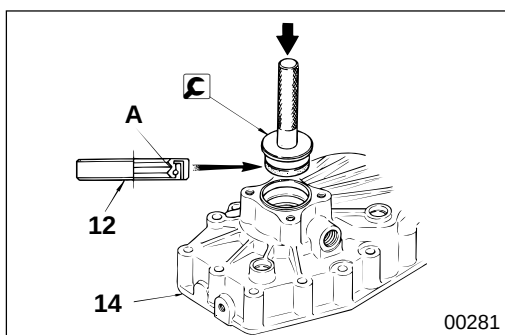
- Apply grease to inside of oil seal **7** packing **A**.
- Press-fit oil seal **7** into speedometer gear bushing **8** in the direction as illustrated using bar **B** (approximately $\varnothing 15$ mm {0.59 in.}).





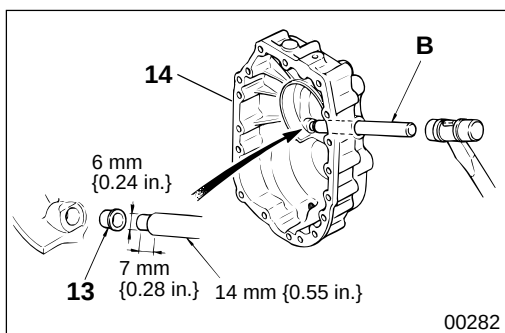
8 9 Clearance between speedometer gear bushing and speedometer gear

If the clearance is higher than the limit, replace the faulty parts.



12 Installation of oil seal

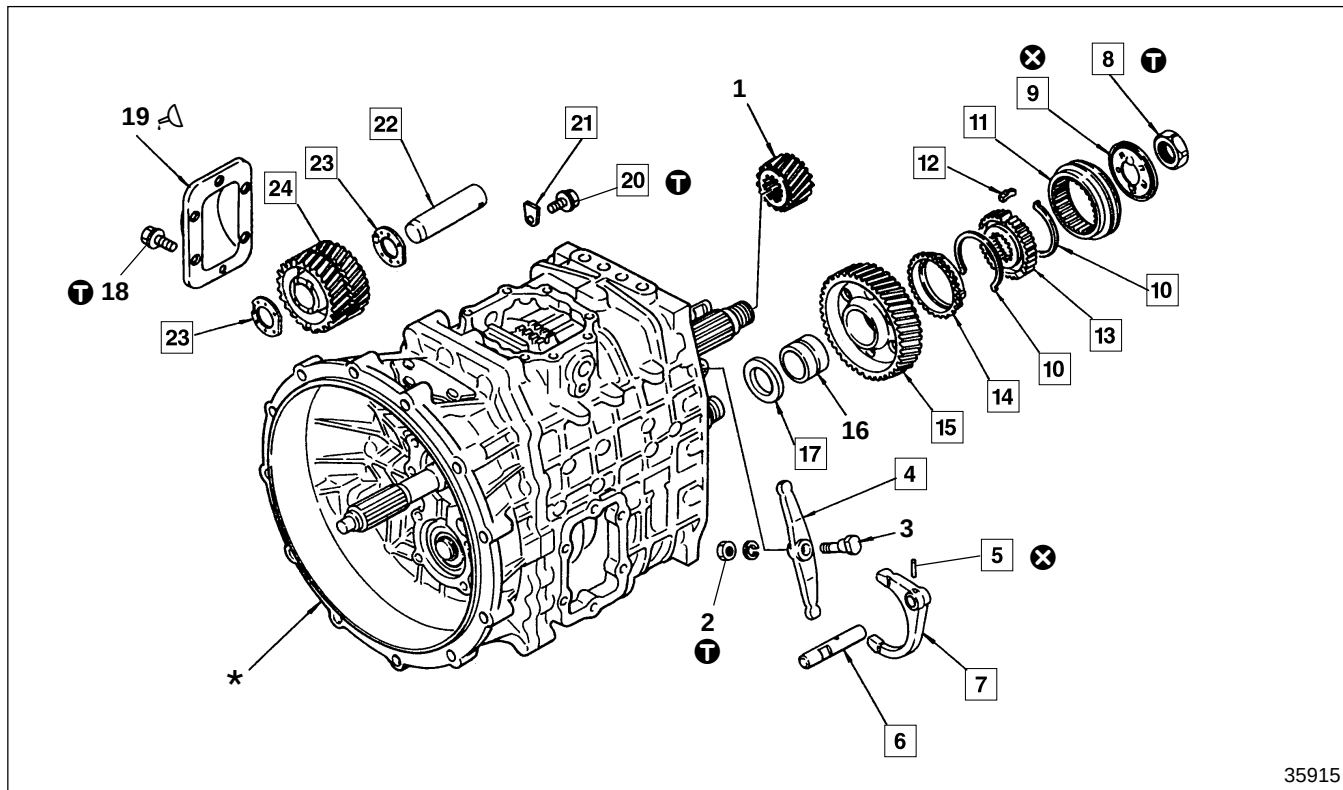
- Apply grease to lip area **A** of oil seal **12**.
- Press-fit oil seal **12** into extension housing or rear cover **14** in the direction as illustrated using **C** oil seal installer.



13 Installation of speedometer gear bushing A

Press-fit speedometer gear bushing **A** into extension housing or rear cover **14** using bar **B**, turned to the dimensions as illustrated.

6TH GEAR < S6 > AND REVERSE IDLER GEAR



35915

● Inspection before disassembly

☞ P22-26

● Disassembly sequence

- | | |
|------------------------------|-----------------------------------|
| 1 Mainshaft O/D gear | 15 Countershaft O/D gear assembly |
| 2 Nut | 16 O/D gear sleeve |
| 3 O/D shift shaft | 17 Thrust washer |
| 4 O/D shift lever | 18 Bolt |
| 5 Spring pin | 19 Reverse idler gear cover |
| 6 O/D shift rail C | 20 Bolt |
| 7 O/D gear shift fork | 21 Reverse shaft lock piece |
| 8 Countershaft rear lock nut | 22 Reverse idler shaft |
| 9 Shifting Key retainer | 23 Reverse shaft gear side washer |
| 10 Shifting key spring | 24 Reverse idler gear |
| 11 Synchronizer sleeve | |
| 12 Shifting key | |
| 13 Synchronizer hub | |
| 14 Synchronizer ring | |
- ★ : Transmission body
1 to 17 is applicable only to S6.
✕ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
3, 4	Clearance between O/D shaft and O/D shift lever	[16 {0.63}] 0.02 to 0.07 {0.00079 to 0.0028}	0.15 {0.0059}	Replace
4	Bend of O/D shift lever	0.05 {0.0020} or less	0.1 {0.0039}	Replace
6	Bend of O/D shift rail C	0.02 {0.00079} or less	0.04 {0.0016}	Replace
7	Tilt of O/D gear shift fork claw	0.1 {0.0039} or less	0.2 {0.0079}	Replace
7, 11	Clearance between gear shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace
11, 13	Play to rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
12, 13	Clearance between shifting key and synchronizer hub	0.05 to 0.20 {0.0020 to 0.0079}	0.5 {0.020}	Replace
12, 14	Clearance between shifting key and synchronizer ring	4.75 to 4.95 {0.187 to 0.195}	5.8 {0.228}	Replace
13, *	Fitness to revolving direction of synchronizer hub and countershaft	-0.006 to 0.088 {-0.00024 to 0.0035}	0.2 {0.0079}	Replace
14, 15	Clearance between synchronizer ring and countershaft O/D gear assembly	1.45 to 1.85 {0.057 to 0.073}	0.2 {0.0079}	Replace
15	End play of countershaft O/D gear	0.25 to 0.40 {0.0098 to 0.016}	0.5 {0.020}	Replace
15, 16	Diameter direction after assembling countershaft O/D gear	0.105 to 0.150 {0.0041 to 0.0059}	0.3 {0.012}	Replace
22, 24	Diameter direction after assembling reverse idler gear	—	0.12 {0.0047}	Replace
24	End play of reverse idler gear	0.2 to 0.9 {0.0079 to 0.0035}	1.2 {0.047}	Replace side washer

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

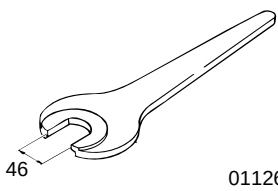
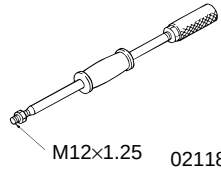
Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (O/D shift shaft and O/D shift lever mounting)	42 {31, 4.3}	—
8	Countershaft rear lock nut	345±49 {253±36, 35±5}	—
18	Bolt (Reverse idler gear cover mounting)	19 {14, 1.9}	—
20	Bolt (Reverse shaft lock piece mounting)	40 {30, 4.1}	—

Sealant

Location	Points of application	Specified sealant	Quantity
19	Reverse idler gear cover installation surface	THREEBOND 1215	As required

6TH GEAR < S6 > AND REVERSE IDLER GEAR

Special tools

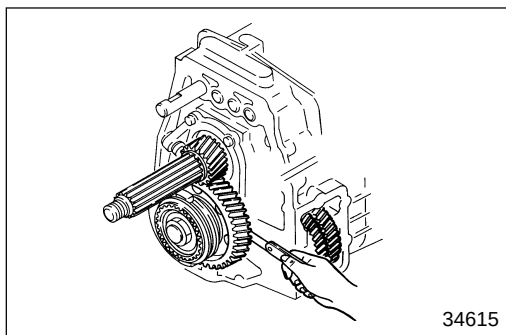
Location	Tool name and shape	Part No.	Application
8	Single spanner  46 01126	MH061555 < S6 >	Removal and installation of countershaft rear lock nut
22	Drive pinion and reverse shaft puller  M12x1.25 02118	03726-82000	Removal of reverse idler shaft

◆ Service procedure

● Inspection before disassembly

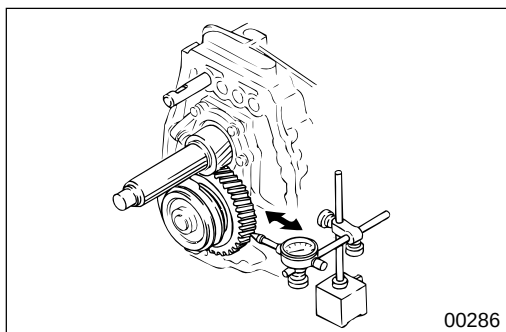
(1) End play of various gears < S6 >

- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



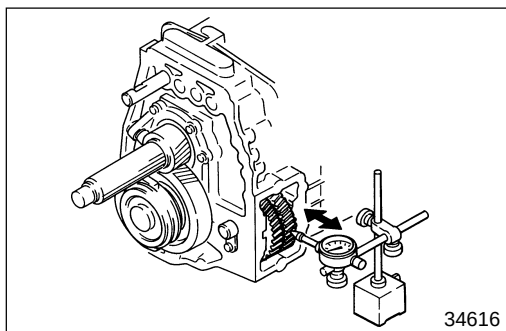
(2) Play of countershaft O/D gear in the diameter direction < S6 >

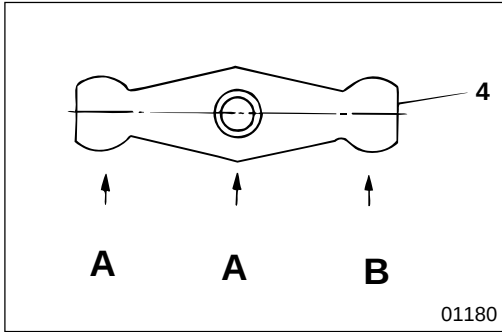
- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.



(3) Play of reverse idler gear in the diameter direction

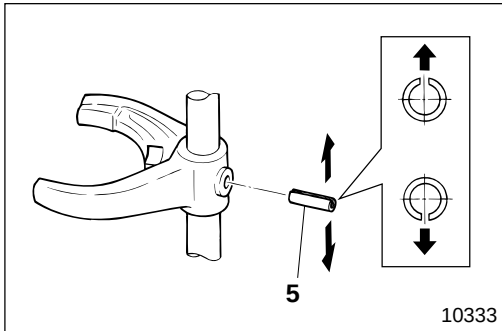
- If the measured value is higher than the limit, replace the faulty parts.
- Reinspect play after assembly to check that the measured value is within the limit.





4 Bend of O/D shift lever

If bend **B** exceeds the limit on the basis of illustrated **A - A**, replace O/D shift lever 4.

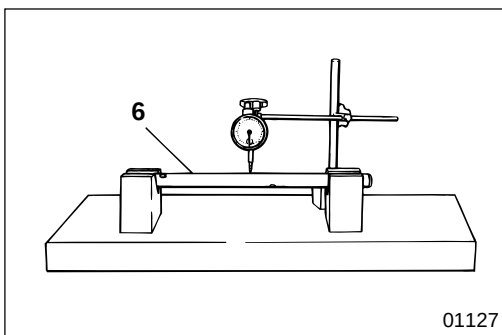


5 Installation of spring pin

Install spring pin 5 in O/D gear shift fork 7 in the direction as illustrated.

CAUTION

Make sure you do not drive in spring pin 5 fully, leave 0 to 0.5 mm {0 to 0.020 in.} outside to prevent them from slipping out.

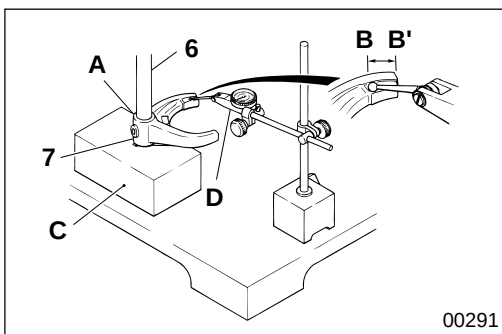


6 Bend of O/D shift rail C

If the measured value is higher than the limit, correct or replace O/D shift rail C6.

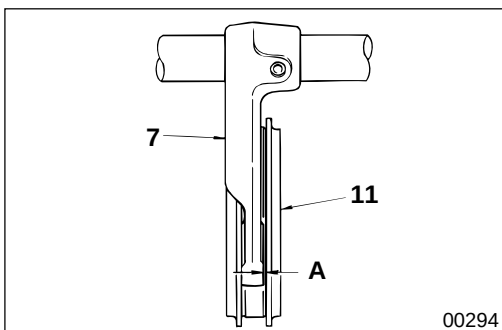
NOTE

Read the dial gauge after turning O/D shift rail C6 one full revolution. The bend is one half of the indicated value.



7 Tilt of O/D gear shift fork claw

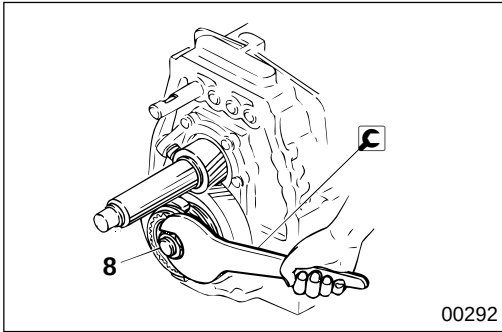
- Measure the tilt (difference between **B** and **B'**) of claw **B-B'** against hole **A** of O/D shift rail C6 of O/D gear shift fork 7 with the shift rail upright.
 - If the measured value is higher than the limit, replace gear shift fork 7.
- C:** V-block
D: Dial gauge



7 11 Clearance between O/D gear shift fork and synchronizer sleeve

- Measure clearance **A** between O/D gear shift fork 7 and synchronizer sleeve 11.
- If the measured value is higher than the limit, replace the faulty parts.

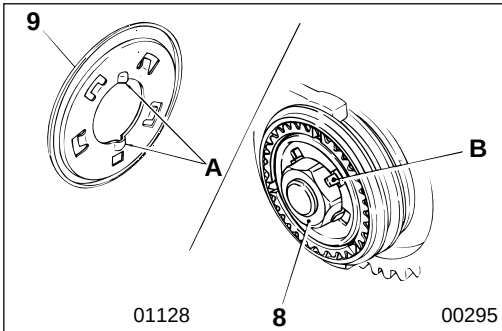
6TH GEAR < S6 > AND REVERSE IDLER GEAR



8 Removal and installation of countershaft rear lock nut

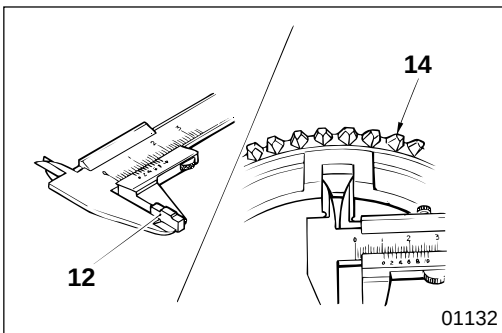
Have transmissions engaged in two gears to lock counter shaft for this work.

 : Single spanner



9 Installation of shifting key retainer

- Install so that shifting key retainer **9** protrusions **A** (at 2 places) rest in recessions provided on synchronizer hub.
- After tightening of lock nut, stake the areas with slits **B** at 4 places of shifting retainer, toward lock nut **8**.

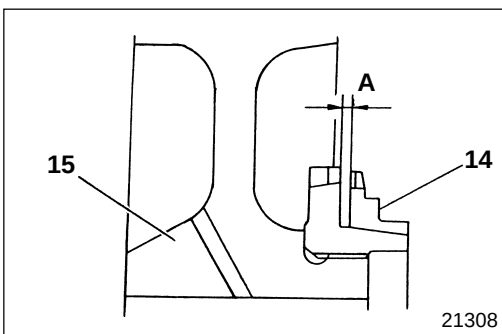


10 to 15 Synchromesh mechanism and countershaft O/D gear assembly

[Inspection]

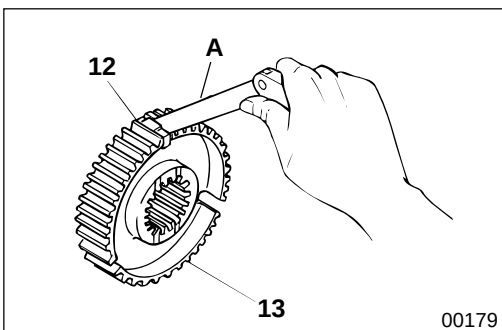
(1) Clearance between synchronizer ring 14 and shifting key 12.

If the measured value is higher than the limit, replace the faulty parts.



(2) Clearance between synchronizer ring 14 and countershaft O/D gear assembly 15

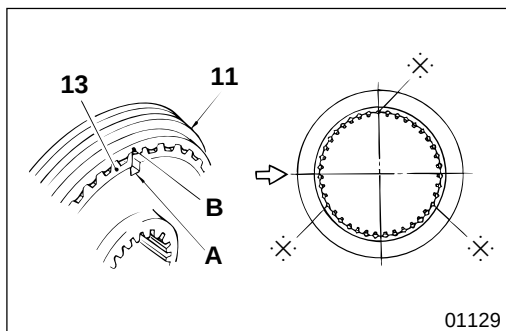
- Measure clearance **A** between synchronizer ring **14** and the gear cone of countershaft O/D gear assembly **15**.
- When measuring this value, press synchronizer ring **14** evenly, and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.



(3) Clearance between shifting key 12 and synchronizer hub 13

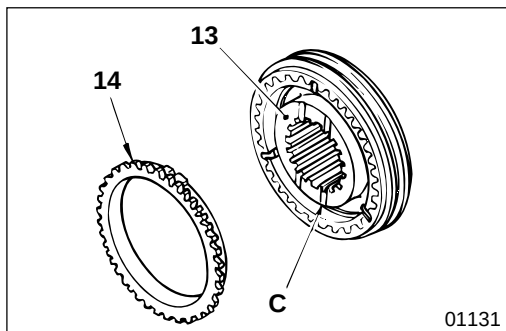
If the measured value is higher than the limit, replace the faulty parts.

A : Feeler gauge

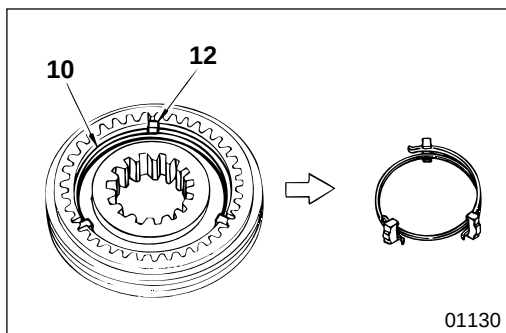


[Installation]

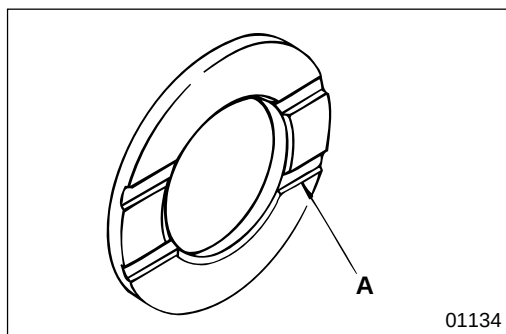
- Align the three keyways **A** of synchronizer hub **13** with the three stub teeth **B** (illustrated by $\times$ mark) of synchronizer sleeve **11** to install the synchronizer hub.
- To reassemble synchronizer hub **13** and synchronizer sleeve **11**, align the alignment marks made during disassembly.



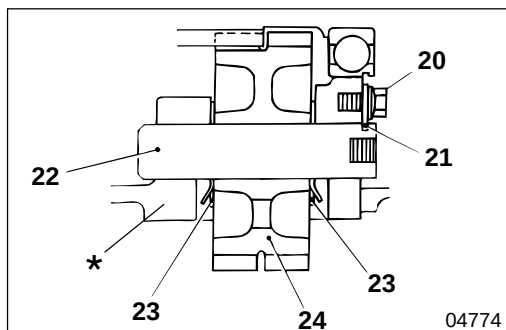
- Assemble synchronizer ring **14** on synchronizer hub **13** with the keyway aligned to the side where oil groove **C** is located.



- Insert shifting key **12** into the keyway.
- Install shifting key spring **10** so that its opening is offset from the one of the shifting key.
- Make sure that the openings of shifting key springs do not align with each other.

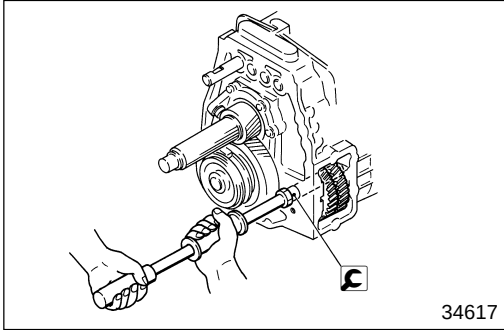
**17 Installation of thrust washer**

Install with the side having oil grooves **A** facing the side of gear.

**20 to 24 Assembly of reverse idler gear**

- Install reverse shaft gear side washer **23** and reverse idler gear **24** in transmission body *****.
- Install reverse idler shaft **22** in transmission body ***** using a plastic-headed mallet.
- Install reverse shaft lock piece **21** in transmission body ***** with mounting bolt **20**.

6TH GEAR < S6 > AND REVERSE IDLER GEAR

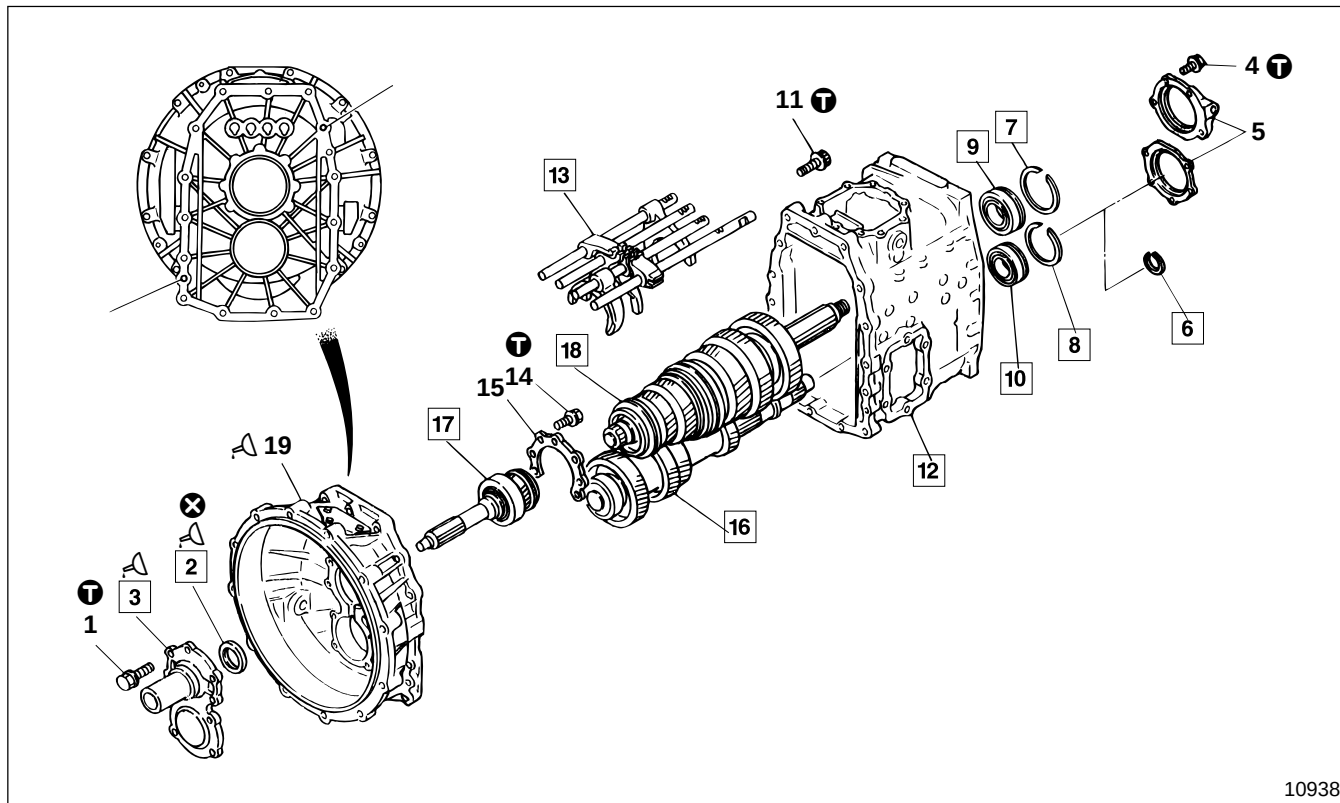


22 Removal of reverse idler shaft.

 : Drive pinion and reverse shaft puller

MEMO

TRANSMISSION BODY



10938

● Disassembly sequence

- | | |
|--------------------------------|--------------------------------------|
| 1 Bolt | 12 Transmission case |
| 2 Oil seal | 13 Shift rail and shift fork P22-42 |
| 3 Front bearing retainer | 14 Bolt |
| 4 Bolt < S6 > | 15 Drive pinion bearing retainer |
| 5 Rear bearing retainer < S6 > | 16 Countershaft assembly P22-56 |
| 6 Snap ring < S5 > | 17 Drive pinion assembly P22-46 |
| 7 Snap ring | 18 Mainshaft assembly P22-48 |
| 8 Snap ring | 19 Clutch housing assembly |
| 9 Mainshaft rear bearing | |
| 10 Countershaft rear bearing | |
| 11 Bolt | |
- : Positioning pins
 X : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

- After removing parts 1 to 3, disassemble the transmission assembly with the body laid vertically on its clutch housing side.
- Remove parts 13, and 16 to 18 as a group. However, shift rail and shift fork 13 can be disassembled on its own if you are not going to disassemble parts 16 to 18. P22-42

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

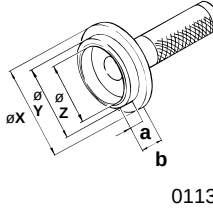
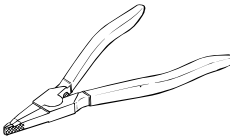
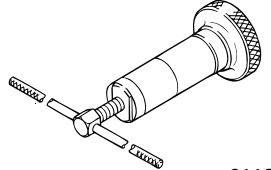
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Front bearing retainer mounting)	40 {30, 4.1}	—
4	Bolt (Rear bearing retainer mounting)	40 {30, 4.1}	—
11	Bolt (Transmission case mounting)	120 {90, 12.4}	—
14	Bolt (Drive pinion retainer mounting)	40 {30, 4.1}	—

L Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
2	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
3	Contact surface between front bearing retainer and clutch housing assembly	THREEBOND 1215	As required
19	Contact surface between clutch housing assembly and transmission case	THREEBOND 1215	As required

S Special tools

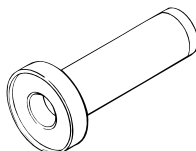
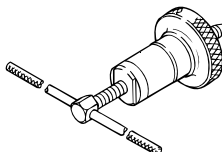
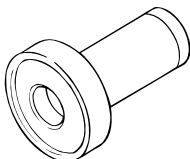
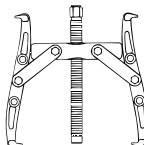
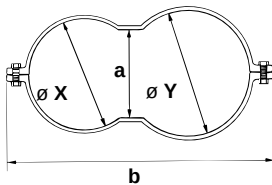
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application										
2	Oil seal installer <table><tr><td>X</td><td>62 {2.44}</td></tr><tr><td>Y</td><td>40 {1.57}</td></tr><tr><td>Z</td><td>30 {1.18}</td></tr><tr><td>a</td><td>10 {0.39}</td></tr><tr><td>b</td><td>10 {0.39}</td></tr></table> 	X	62 {2.44}	Y	40 {1.57}	Z	30 {1.18}	a	10 {0.39}	b	10 {0.39}	ME624241	Installation of front bearing retainer oil seal
	X	62 {2.44}											
Y	40 {1.57}												
Z	30 {1.18}												
a	10 {0.39}												
b	10 {0.39}												
6, 7, 8	Snap ring expander  01137	MH061268	Removal of snap rings from mainshaft rear bearing and countershaft front and rear bearings										
9	Mainshaft bearing puller  01138	*MH061732	Removal of mainshaft rear bearing										

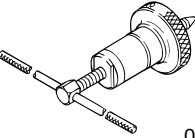
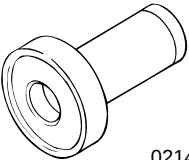
* components of puller and installer kit  P22-65

TRANSMISSION BODY

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application								
9	Mainshaft bearing installer  02115	*MH624234	Installation of mainshaft rear bearing								
10	Countershaft bearing puller  01139	*ME061731	Removal of countershaft rear bearing								
	Countershaft bearing installer  02141	*ME624233	Installation of countershaft bearing								
12	Eye bolt  M10×1.5 01140	MH062340	Lifting of transmission case								
	Gear puller  01148	MH062308	Removal of transmission case								
16 to 18	Steel lifting band <table border="1"><tr><td>X</td><td>87 {3.43}</td></tr><tr><td>Y</td><td>175 {6.89}</td></tr><tr><td>a</td><td>80 {3.15}</td></tr><tr><td>b</td><td>336 {13.2}</td></tr></table>  01141	X	87 {3.43}	Y	175 {6.89}	a	80 {3.15}	b	336 {13.2}	MH062343	Removal and installation of mainshaft assembly, countershaft assembly and drive pinion assembly
	X	87 {3.43}									
Y	175 {6.89}										
a	80 {3.15}										
b	336 {13.2}										
Eye nut  M27×1.5 01142	MH062341										

* components of puller and installer kit.  P22-65

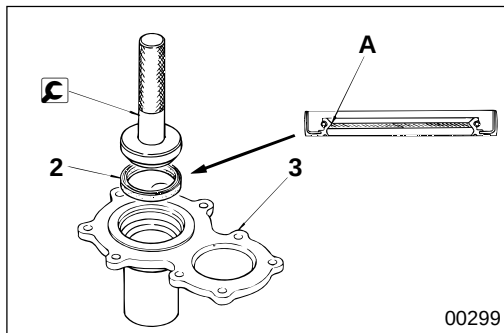
Location	Tool name and shape	Part No.	Application
16	Countershaft bearing puller  01139	*MH062426	Removal of countershaft front bearing
	Countershaft bearing installer  02141	*ME624233	Installation of countershaft front bearing

* components of puller and installer kit.  P22-65

◆ Service procedure

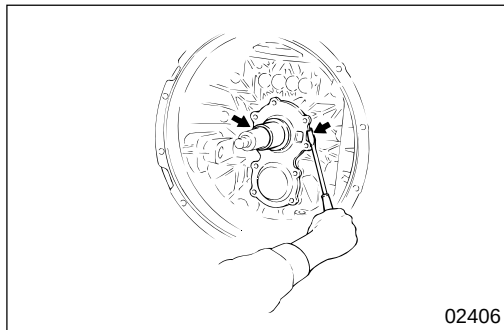
2 Installation of oil seal

- Apply grease to lip area **A** of oil seal **2**.
- Press-fit oil seal **2** into front bearing retainer **3** in the direction as illustrated using  oil seal installer.

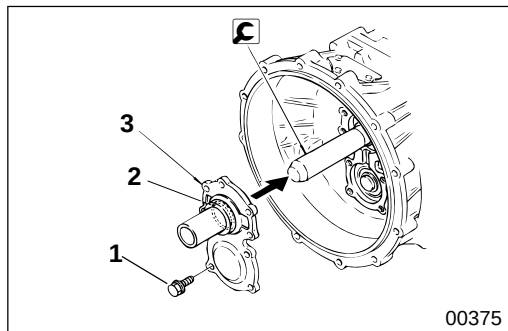


3 Front bearing retainer

[Removal]



TRANSMISSION BODY

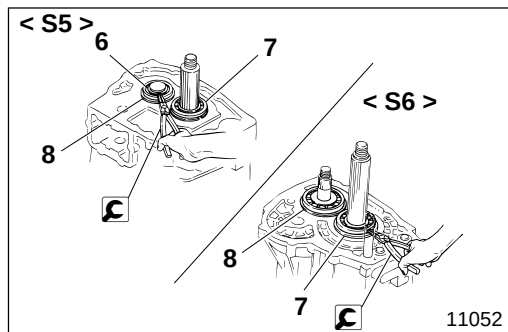


[Installation]

Press-fit front bearing retainer **3** into clutch housing assembly **19** using oil seal front guide.

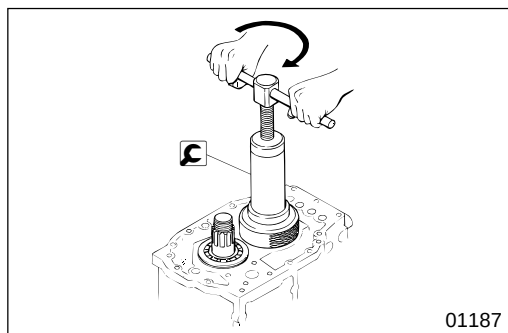
CAUTION

Be careful when installing front bearing retainer **3**, that you do not damage oil seal **2** installed on the front bearing retainer.



6 to 8 Removal and installation of snap ring

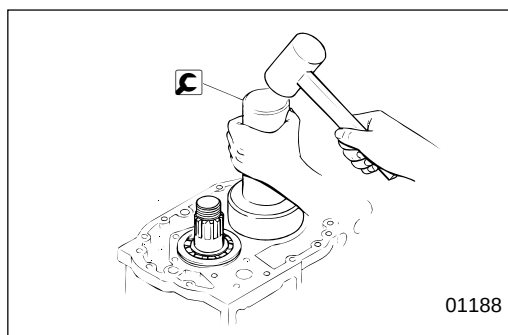
: Snap ring expander



9 Mainshaft rear bearing

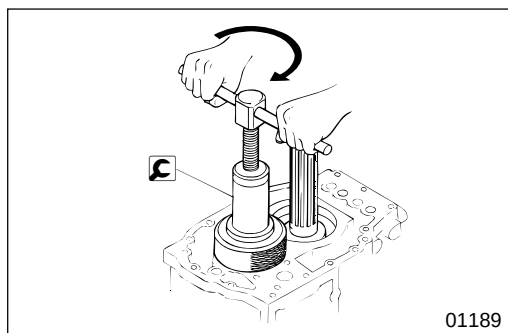
[Removal]

: Mainshaft bearing puller



[Installation]

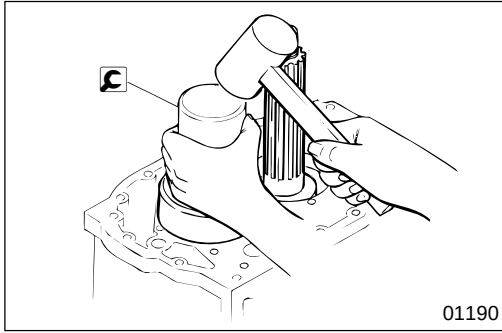
: Mainshaft bearing installer



10 Countershaft rear bearing

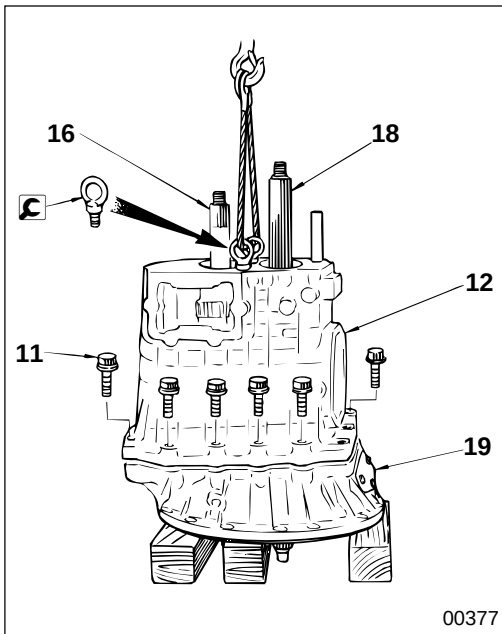
[Removal]

: Countershaft bearing puller



[Installation]

C : Countershaft bearing installer



12 Removal and installation of transmission case

[Removal]

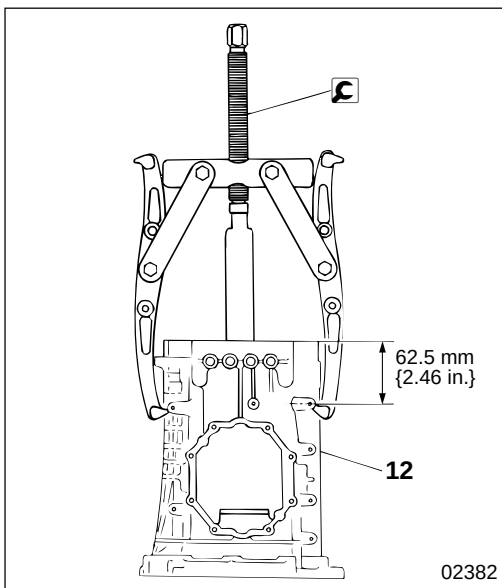
● Remove transmission case 12.

Method 1

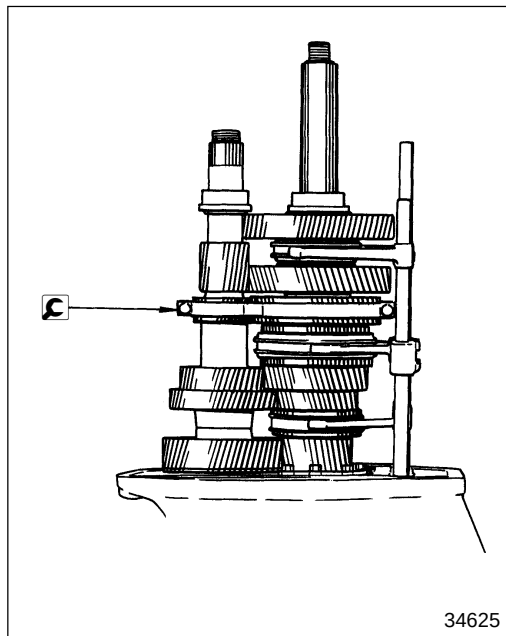
- When lifting up with a crane, install **C** eye bolts on transmission case 12 and pass a steel sling through them.
- After removing bolts 11, lift transmission case 12 up with a crane and keep hitting the rear ends of clutch housing assembly 19, mainshaft assembly 18 and countershaft assembly 16. Use a plastic-headed or copper-headed mallet to remove the transmission case.

Method 2

- A **C** gear puller can be used instead of a crane.
Puller installation position



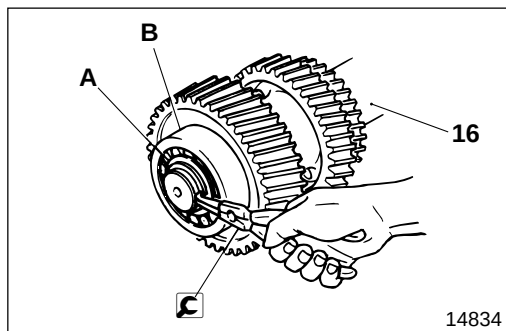
TRANSMISSION BODY



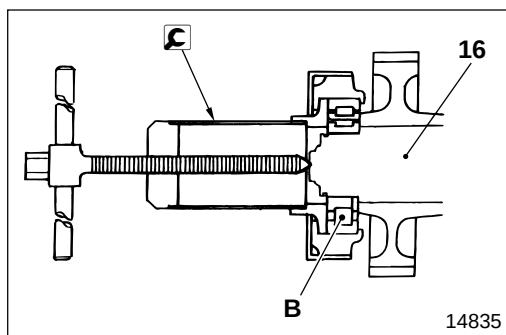
- After removing transmission case **12**, fit the 2nd gear unit using  steel lifting band to ensure safety.

CAUTION

Be sure to tighten  steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.



- Remove snap ring **A** from countershaft assembly **16**.
B : Countershaft front bearing
 : Snap ring expander



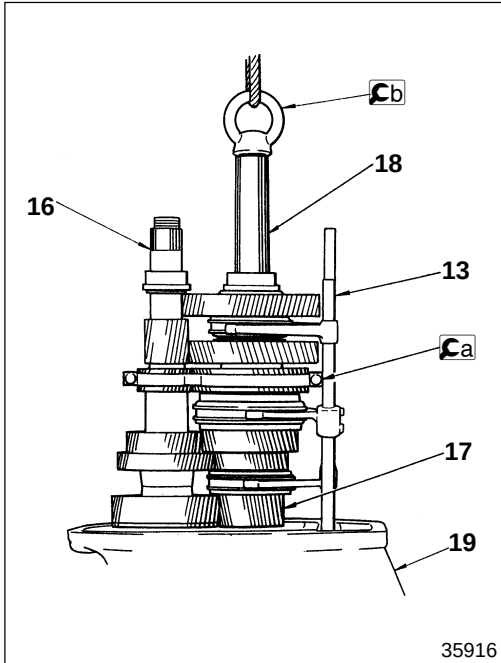
- Remove countershaft bearing **B** from countershaft assembly **16**.
 : Countershaft bearing puller

[Installation]

Follow the removal sequence in reverse.

CAUTION

Be careful not to damage mainshaft assembly **18**, or rear bearings **9**, **10** of countershaft assembly **16** during installation.



13 16 to 18 Shift rail and shift fork, countershaft assembly, drive pinion assembly, and mainshaft assembly

[Removal]

Remove or install shift rail and shift fork **13**, countershaft assembly **16**, drive pinion assembly **17**, and mainshaft assembly **18** as a group.

- Before lifting, after removing the case, install **Cb** eye nut at the end of mainshaft **18**, fitted with **Ca** steel lifting band.
- Fix shift rail and shift fork **13** to mainshaft assembly **18** with a rubber band.
- Fix a piece of wood to clutch housing assembly **19**, and use a crane to lift the clutch housing together with drive pinion assembly **17** up, at the same time hitting them with a plastic-headed mallet to remove them.

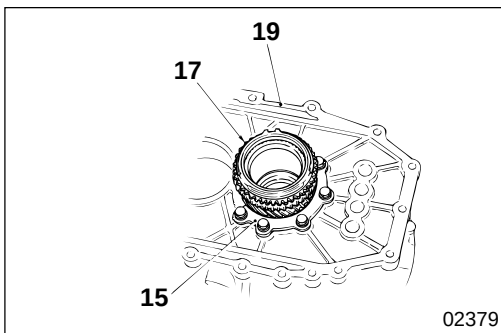
CAUTION ⚠

- Be sure to tighten **Ca** steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.
- Make sure, when lifting mainshaft assembly **18** or other parts, that you support drive pinion assembly **17** with your hand in order to prevent it from falling when the mainshaft assembly and countershaft assembly **16** come apart.

[Installation]

Method 1

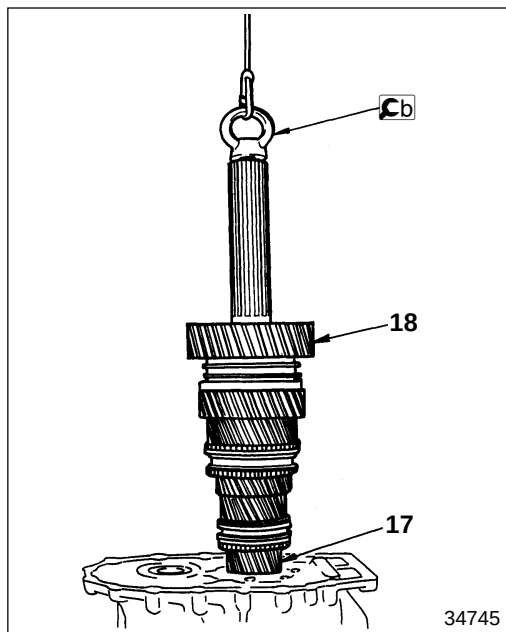
- Follow the removal sequence in reverse.



Method 2

- After installing drive pinion assembly **17** in clutch housing assembly **19**, install drive pinion bearing retainer **15**.

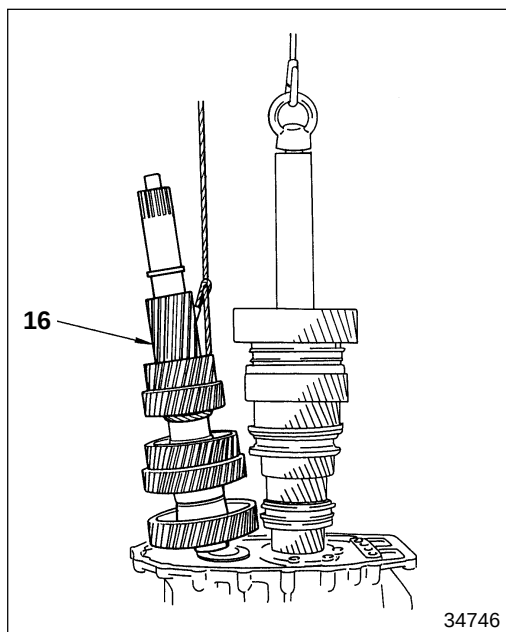
TRANSMISSION BODY



- Install **Cb** eye nut at the end of mainshaft assembly **18**.
- Lift mainshaft assembly **18** up using a crane and install the mainshaft assembly on drive pinion assembly **17**.

CAUTION

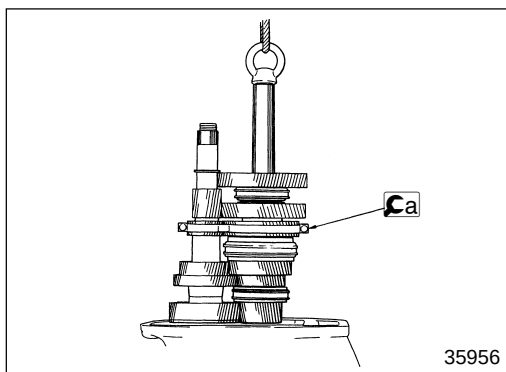
To prevent mainshaft assembly **18** from falling, support it using a crane.



- Install countershaft assembly **16** in clutch housing assembly **19**.

CAUTION

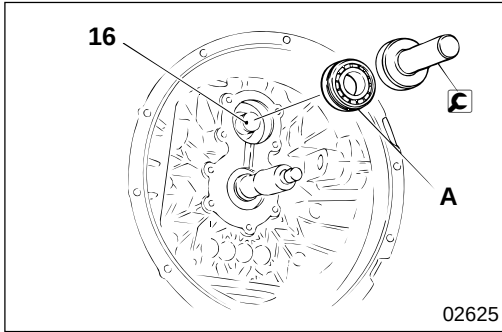
If you use this method of installation, first remove the countershaft front bearing.  P22-56



- Fit the 2nd gear unit using **Ca** steel lifting band to ensure safety.

CAUTION

Be sure to tighten **Ca** steel lifting band adequately enough to prevent it from coming undone, but not excessively, because excessive tightening would damage the gears, etc.



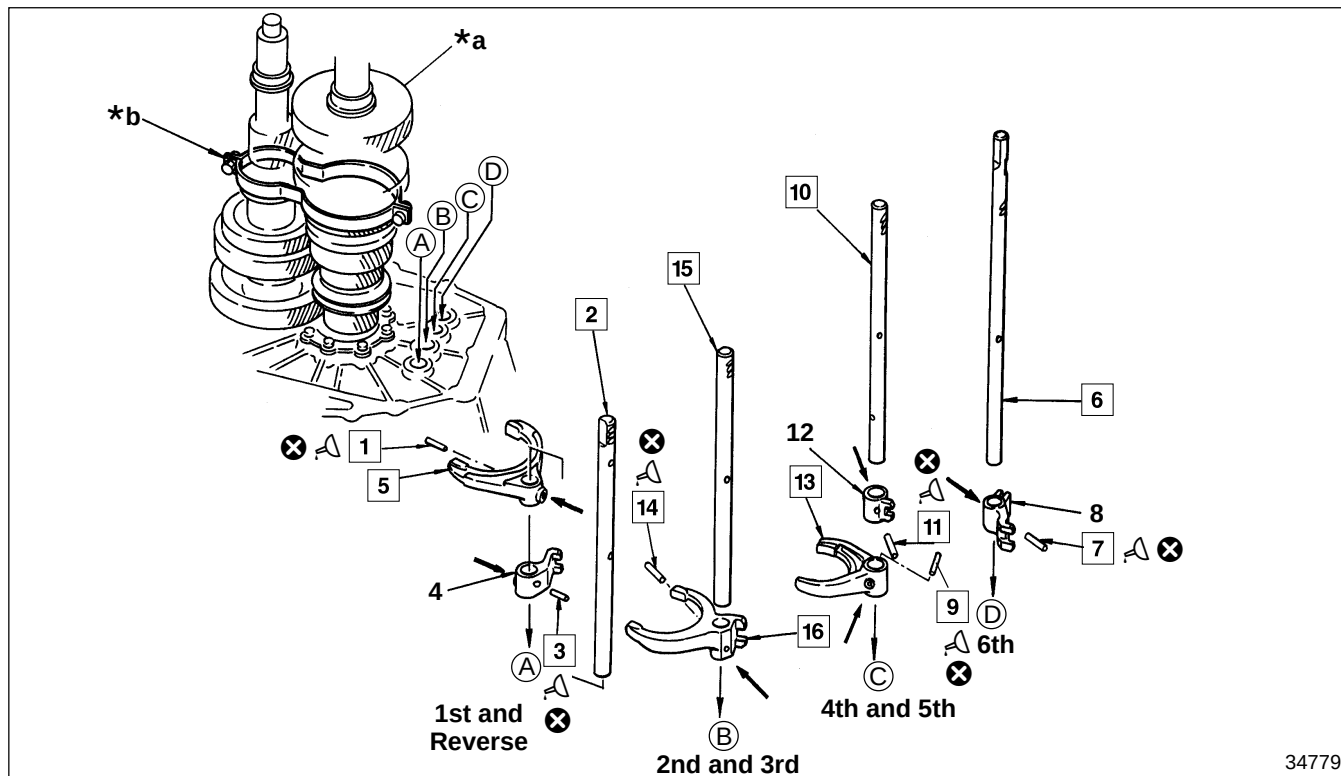
- Install shift rail and shift fork **13** and transmission case **12** in clutch housing assembly **19**.
- Place clutch housing assembly **19** horizontally so that countershaft assembly **16** is uppermost.
- Install the countershaft front bearing **A** into clutch housing assembly **19** using  countershaft bearing installer.

CAUTION

Be sure to install the snap ring of the countershaft front bearing.

TRANSMISSION BODY

Shift Rail and Shift Fork



34779

Arrow mark : Removal and installation direction for spring pin

● Disassembly sequence (When the mainshaft assembly is not removed or installed and only the shift rail and shift fork is disassembled)

- | | |
|----------------------------------|-------------------------------|
| 1 Spring pin | 11 Spring pin |
| 2 1st and reverse shift rail | 12 4th and 5th shift rail jaw |
| 3 Spring pin | 13 4th and 5th shift fork |
| 4 1st and reverse shift rail jaw | 14 Spring pin |
| 5 1st and reverse shift fork | 15 2nd and 3rd shift rail |
| 6 6th shift rail < S6 > | 16 2nd and 3rd shift fork |
| 7 Spring pin < S6 > | |
| 8 6th shift rail jaw < S6 > | |
| 9 Spring pin | |
| 10 4th and 5th shift rail | |

- *a : Mainshaft assembly
 *b : steel lifting band
 X : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse. Remove steel lifting band after installing the shift rail and shift fork.

Service standards

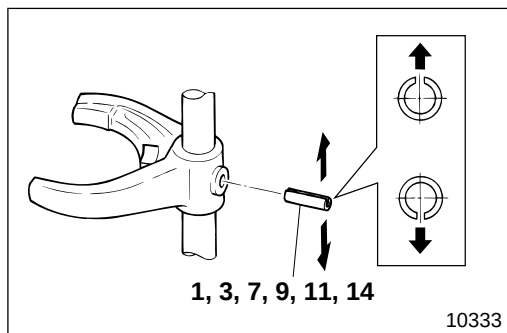
Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2, 10, 15	Bend of shift rail	0.039 {0.0015} or less	0.08 {0.0031}	Correct or replace
5, 13, 16	Tilt of shift fork claw	0.1 {0.0039} or less	0.2 {0.0079}	Replace
5, *a	Clearance between 1st and reverse shift fork and synchronizer sleeve	0.3 to 0.5 {0.012 to 0.020}	1.0 {0.039}	Replace
6	Bend of 6th shift rail	0.047 {0.0019} or less	0.09 {0.0035}	Correct or replace
13, *a	Clearance between 4th and 5th shift fork and synchronizer sleeve	0.3 to 0.6 {0.012 to 0.024}	1.0 {0.039}	Replace
16, *a	Clearance between 2nd and 3rd shift fork and synchronizer sleeve	0.2 to 0.4 {0.0079 to 0.016}	1.0 {0.039}	Replace

Sealant

Location	Points of application	Specified sealant	Quantity
1, 3, 7, 9, 11, 14	Spring pin	LOCTITE 601	As required

◆ Service procedure

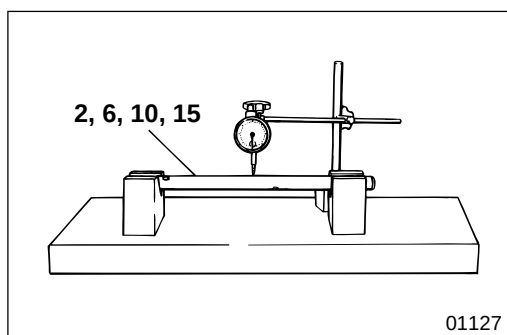


1 3 7 9 11 14 Installation of spring pin

Install spring pins 1, 3, 7, 9, 11, 14 in the direction as illustrated.

CAUTION ⚠

- Make sure you do not drive in spring pins 1, 3, 7, 9, 11, 14 fully, leave 0 to 0.5 mm {0 to 0.020 in.} outside to prevent them from slipping out.
- Do not remove spring pin 9 for 4th and 5th shift fork 13 (made of aluminum), except when replacing shift fork 13 or shift rail 10.
- Note that the length of spring pin 9 differs from that of spring pins 1, 3, 7, 11, 14.
- Be careful when driving in spring pins 1, 3, 7, 9, 11, 14 that you do not subject shift rails 2, 6, 10, 15 to excessive strain, because this would cause faults such as bent shift rails.



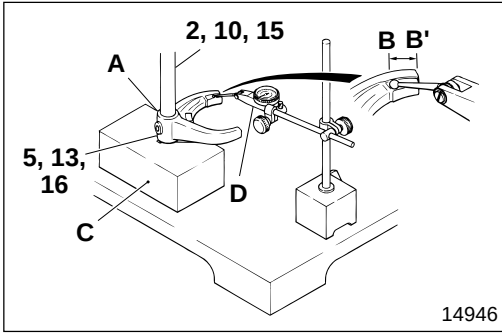
2 6 10 15 Bend of shift rail

If the measured value is higher than the limit, correct or replace shift rail 2, 6, 10 or 15.

NOTE

Read the dial gauge after turning shift rails 2, 6, 10, 15 one full revolution. The bend is one half of the indicated value.

TRANSMISSION BODY

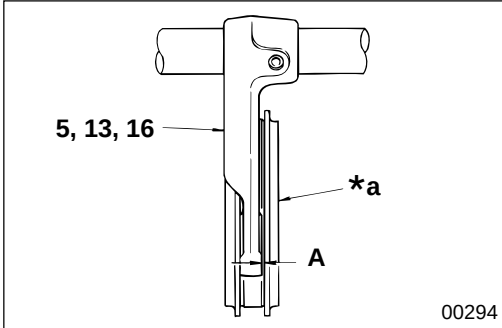


5 13 16 Tilt of shift fork claws

- Measure the tilt (difference between **B** and **B'**) of claw **B–B'** against hole **A** of shift rails **2, 10, 15** of shift forks **5, 13, 16** with the shift rails upright.
- If the measured value is higher than the limit, replace shift fork **5, 13**, or **16**.

C : V-block

D : Dial gauge



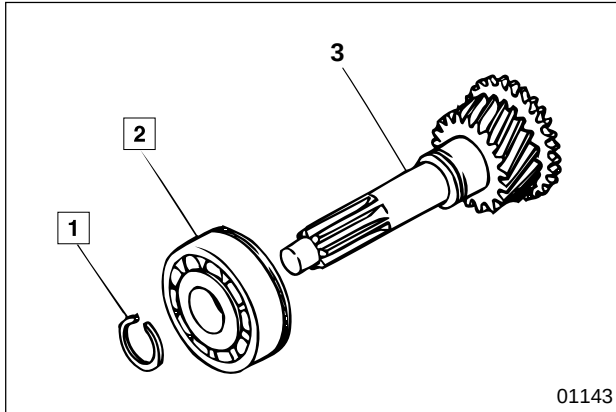
5 13 16 *a Clearance between gear shift fork and synchronizer sleeve of mainshaft

If clearance **A** is higher than the limit, replace the faulty parts.

***a** : Synchronizer ring of mainshaft assembly

MEMO

DRIVE PINION ASSEMBLY



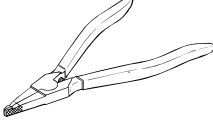
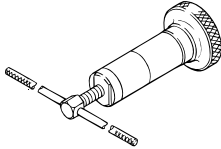
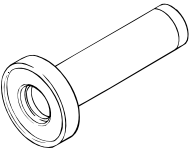
● Disassembly sequence

- 1 Snap ring
- 2 Drive pinion bearing
- 3 Drive pinion

● Assembly sequence

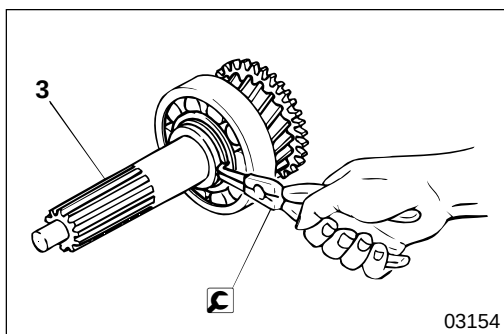
Follow the disassembly sequence in reverse.

🔧 Special tools

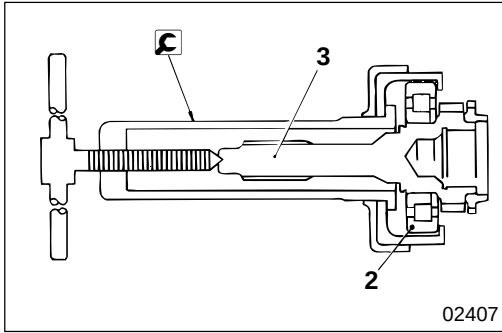
Location	Tool name and shape	Part No.	Application
1	Snap ring expander  01137	MH061268	Removal and installation of snap ring of drive pinion bearing
2	Drive pinion bearing puller  01138	*MH062440	Removal of drive pinion bearing
	Drive pinion bearing installer  02142	*ME624235	Installation of drive pinion bearing

* components of puller and installer kit 📖 P22-65

◆ Service procedure

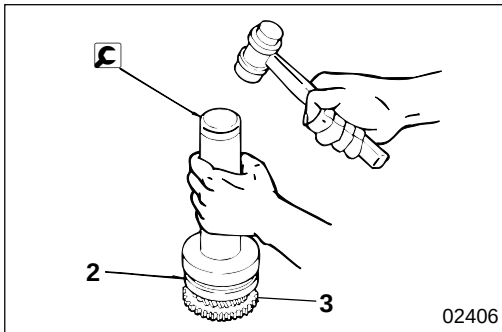


1 Removal and installation of snap ring



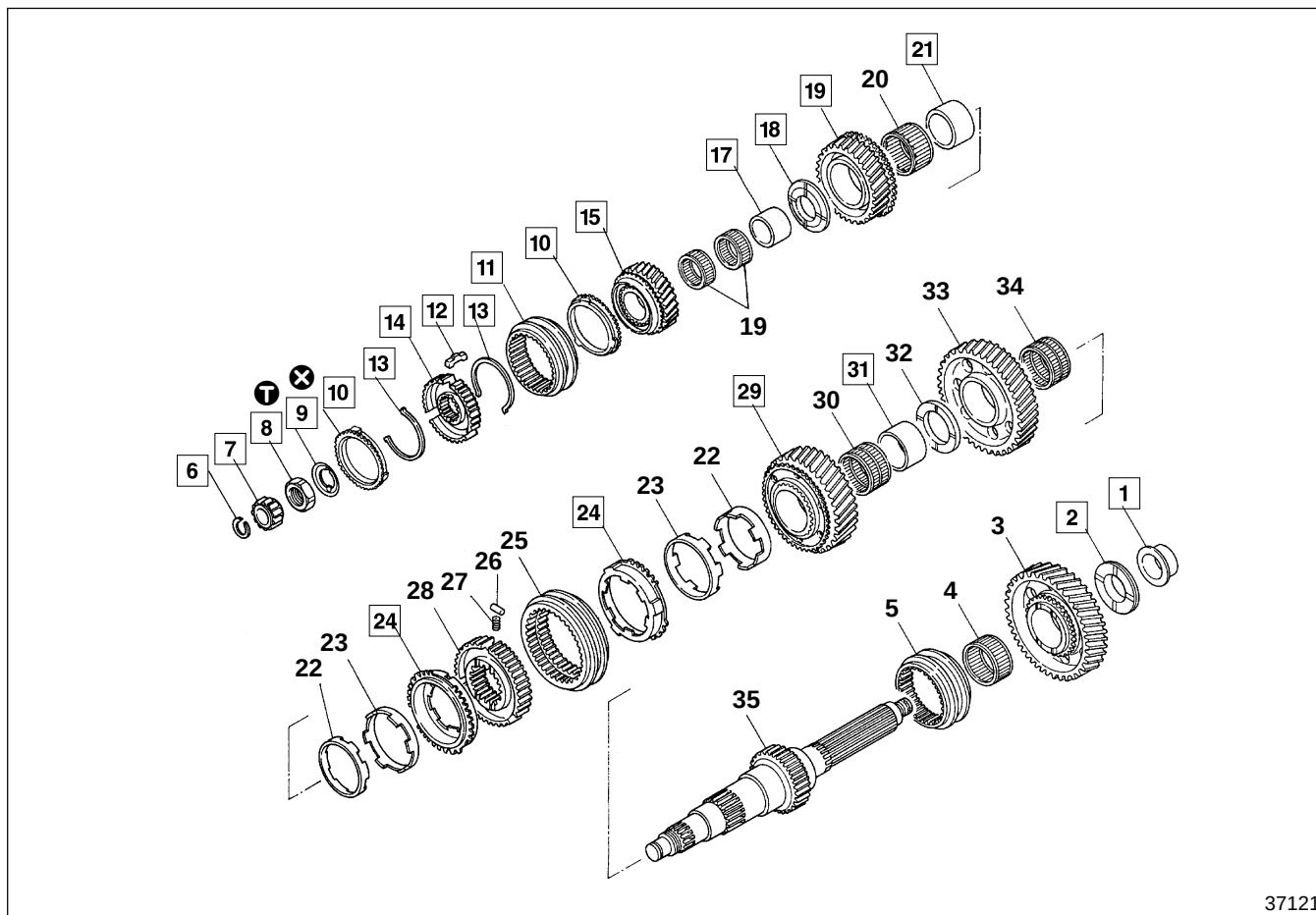
2 Drive pinion bearing

[Removal]



[Installation]

MAINSHAFT ASSEMBLY



37121

Work before disassembly

📖 P22-51

Disassembly sequence

- | | | |
|--|-----------------------------------|-----------------------------------|
| 1 Mainshaft rear bearing inner race < S6 > | 13 Shifting key spring | 26 Shifting key |
| 2 Reverse gear thrust washer | 14 Synchronizer hub | 27 Synchronizer spring |
| 3 Reverse gear | 15 4th gear assembly | 28 Synchronizer hub |
| 4 Needle bearing | 16 Needle bearing | 29 2nd gear assembly |
| 5 Sleeve | 17 4th gear bearing sleeve | 30 Needle bearing |
| 6 Snap ring | 18 3rd and 4th gear thrust washer | 31 2nd gear bearing sleeve |
| 7 Pilot bearing | 19 3rd gear assembly | 32 1st and 2nd gear thrust washer |
| 8 Lock nut | 20 Needle bearing | 33 1st gear |
| 9 Lock washer | 21 3rd gear bearing sleeve | 34 Needle bearing |
| 10 Synchronizer ring | 22 Synchronizer inner ring | 35 Mainshaft |
| 11 Synchronizer sleeve | 23 Synchronizer center cone | |
| 12 Shifting key | 24 Synchronizer outer ring | |
| | 25 Synchronizer sleeve | |

⊗ : Non-reusable part

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [J])	Limit	Remedy
3	End play of reverse gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
3, 4, 35	Play in the diameter direction after assembling reverse gear	—	0.12 {0.0047}	Replace
5, 35	Play in the rotating direction of sleeve and spline of mainshaft	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
7, 35	Play in the diameter direction after assembling pilot bearing	—	0.12 {0.0047}	Replace
10	Clearance between synchronizer ring and cone of drive pinion assembly	1.48 to 1.77 {0.058 to 0.070}	0.2 {0.0079}	Replace
10, 12	Clearance between synchronizer ring keyway and shifting key	4.75 to 4.95 {0.187 to 0.195}	5.8 {0.23}	Replace
10, 15	Clearance between synchronizer ring and cone of 4th gear	1.48 to 1.77 {0.058 to 0.070}	0.2 {0.0079}	Replace
11, 14	Play in the rotating direction of synchronizer sleeve and synchronizer hub	0.052 to 0.148 {0.0020 to 0.0058}	0.3 {0.012}	Replace
12, 14	Clearance between shifting key and synchronizer hub keyway	0.05 to 0.2 {0.0020 to 0.0079}	0.5 {0.020}	Replace
15	End play of 4th gear	0.25 to 0.4 {0.0098 to 0.016}	0.5 {0.020}	Replace gear or thrust washer
15, 16, 17, 35	Play in the diameter direction after assembling 4th gear	—	0.12 {0.0047}	Replace
17	Outer diameter of 4th gear bearing sleeve	$[54] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.12] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	—0.1 {—0.0039}	Replace
19	End play of 3rd gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
19, 24	Clearance between cone area of 3rd gear and synchronizer outer ring	1.21 to 1.79 {0.048 to 0.070}	0.2 {0.0079}	Replace
19, 20, 21, 35	Play in the diameter direction after assembling 3rd gear	—	0.12 {0.0047}	Replace
21	Outer diameter of 3rd gear bearing sleeve	$[68] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.68] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	—0.1 {—0.0039}	Replace
24, 29	Clearance between synchronizer outer ring and cone area of 2nd gear	1.21 to 1.79 {0.048 to 0.070}	0.5 {0.020}	Replace
29	End play of 2nd gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
29, 30, 31, 35	Play in the diameter direction after assembling 2nd gear	—	0.12 {0.0047}	Replace
31	Outer diameter of 2nd gear bearing sleeve	$[71] \begin{smallmatrix} -0.030 \\ -0.043 \end{smallmatrix} \{ [2.8] \begin{smallmatrix} -0.0012 \\ -0.0017 \end{smallmatrix} \}$	—0.1 {—0.0039}	Replace
33	End play of 1st gear	0.15 to 0.35 {0.0059 to 0.014}	0.5 {0.020}	Replace gear or thrust washer
33, 34, 35	Play in the diameter direction after assembling 1st gear	—	0.12 {0.0047}	Replace

MAINSHAFT ASSEMBLY

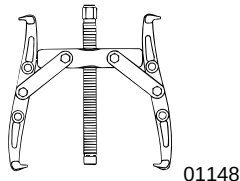
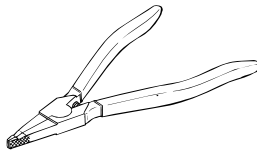
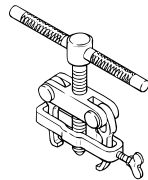
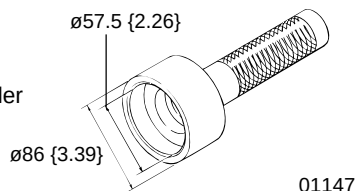
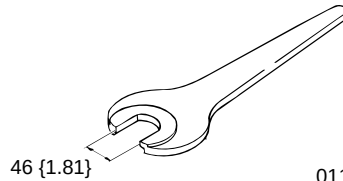
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Lock nut	245 {180, 25}	—

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1, 17, 21, 31	 01148	MH062308	Removal of bearing sleeve
6	 01137	MH061268	Removal and installation of snap ring
7	 01146	MH061043	Removal of pilot bearing
	 01147	*ME624236	Installation of pilot bearing
8	 01126	MH061555	Removal and installation of lock nut

* components of puller and installer kit  P22-65

◆ Service procedure

● Work before disassembly

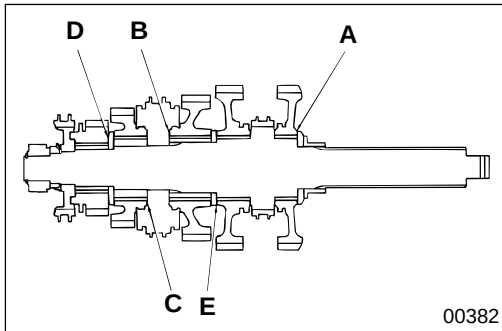
[Inspection]

(1) End play of gears

- A : Reverse gear
- B : 2nd gear
- C : 3rd gear
- D : 4th gear
- E : 1st gear

If the measured value is higher than the limit, replace the faulty parts.

Also inspect this item after assembly and make sure that the measured value is within the limit.

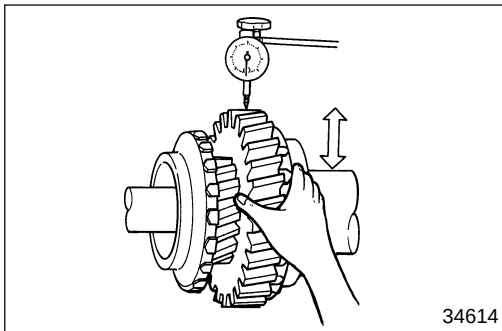


(2) Play of gears in diameter direction

If the measured value is higher than the limit, replace the faulty parts. Also inspect this item after assembly and make sure that the measured value is within the limit.

CAUTION ⚠

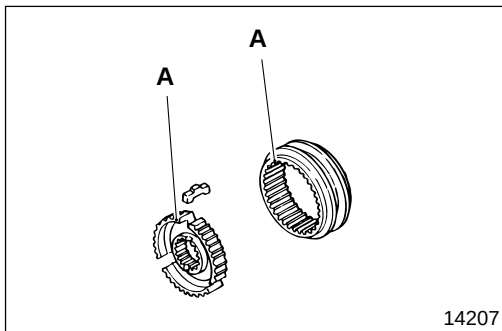
Be sure when you replace the two needle bearings of a gear, that both needle bearings are from the same color package.



[Alignment marks]

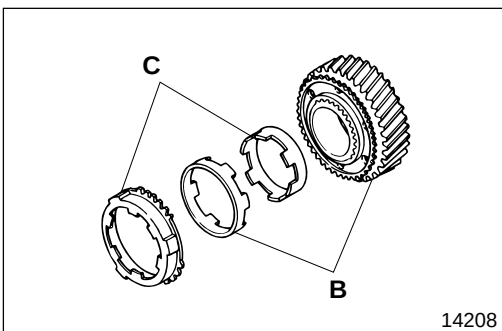
(1) Synchronizer sleeve and synchronizer hub

Before disassembling the synchronizer sleeve and the synchronizer hub, put alignment marks **A** on the places where the shifting keys are installed. When reusing parts, align the alignment marks to assemble.

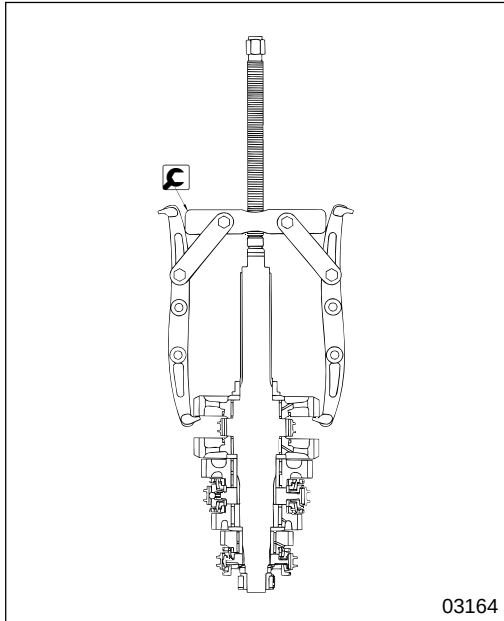


(2) Ring, cone and gear assembly of double cone synchronizer

Before disassembling synchronizer center cone and gear assembly (**B**), and synchronizer center ring and synchronizer outer ring (**C**), put alignment marks on them. When reusing parts, align the alignment marks to assemble.

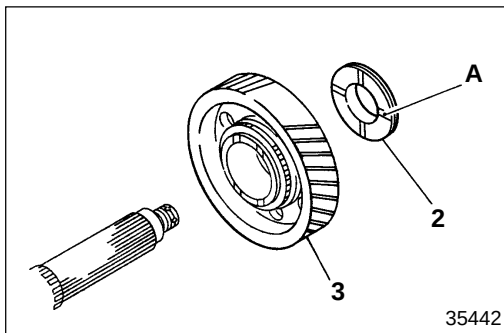


MAINSHAFT ASSEMBLY



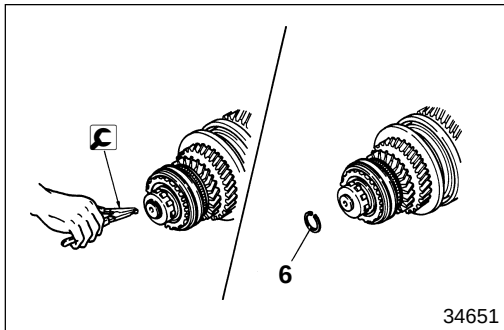
1 Removal of mainshaft rear bearing inner race < S6 >

 : Gear puller



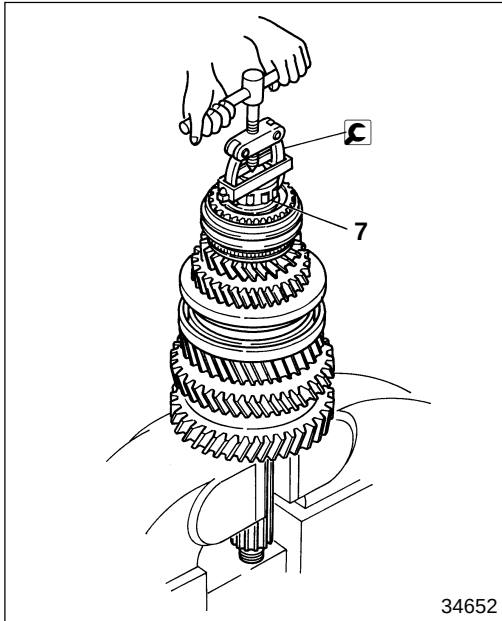
2 Installation of reverse gear thrust washer

A : Oil groove



6 Removal and installation of snap ring

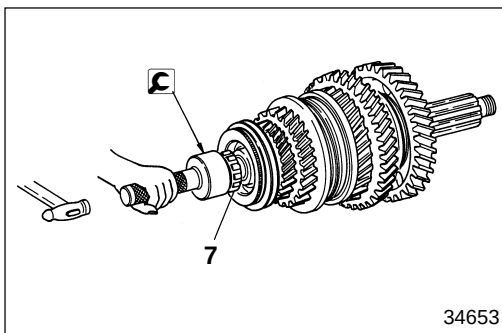
 : Snap ring expander



7 Pilot bearing

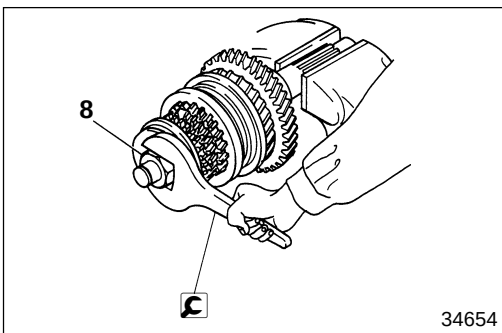
[Removal]

 : Pilot bearing puller



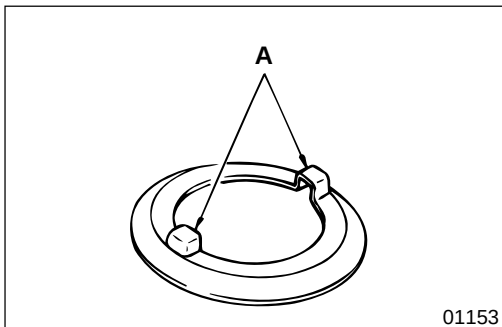
[Installation]

 : Pilot bearing installer



8 Removal and installation of lock nut

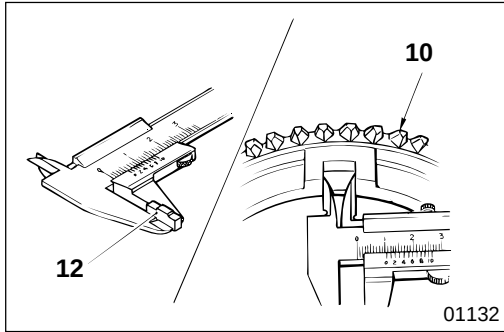
 : Single spanner



9 Installation of lock washer

Install so that protrusions **A** (two points as illustrated) fit into the grooves of synchronizer hub **14**.

MAINSHAFT ASSEMBLY

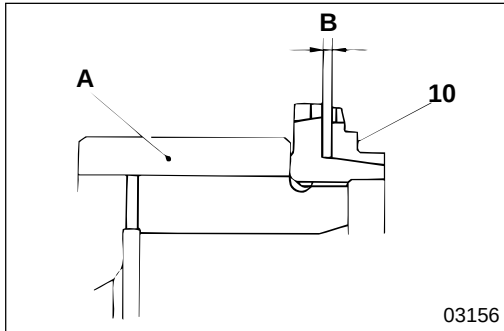


10 to 15 Synchronmesh mechanism and 4th gear

[Inspection]

(1) Clearance between synchronizer ring 10 and shifting key 12

If the measured value is higher than the limit, replace the faulty parts.

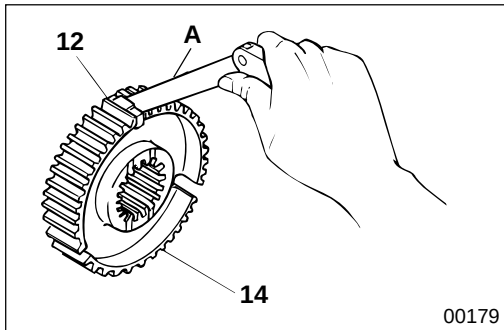


(2) Clearance between synchronizer ring 10 and drive pinion

- Measure clearance **B** between synchronizer ring **10** and the gear cone of drive pinion **A**.
- When measuring this value, press synchronizer ring **10** evenly, and measure all around the circumference.
- If the measured value is lower than the limit, replace the faulty parts.

(3) Clearance between synchronizer ring and 4th gear

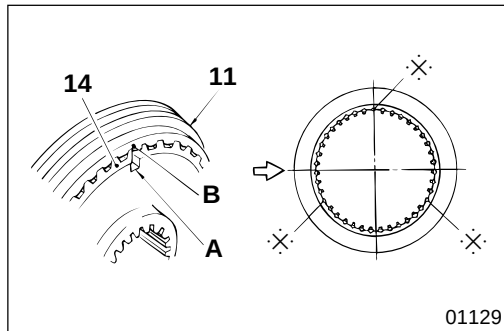
- According to the procedure described in (2), measure clearance between synchronizer ring **10** and the gear cone of 4th gear **15**.



(4) Clearance between shifting key 12 and synchronizer hub 14

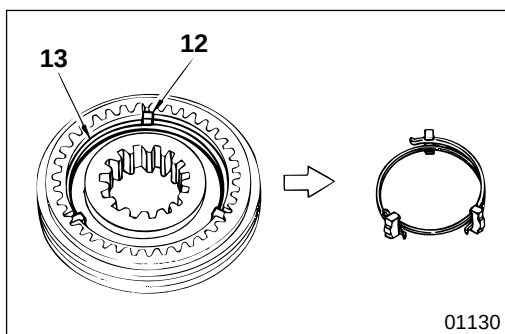
If the measured value is higher than the limit, replace the faulty parts.

A : Feeler gauge

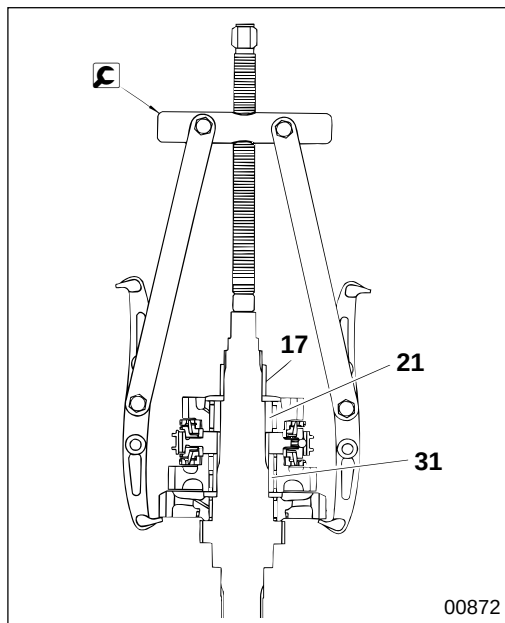


[Installation]

- Align the three keyways **A** of synchronizer hub **14** with the three stub teeth **B** (illustrated by ✕ mark) of synchronizer sleeve **11** to install the synchronizer hub.
- To reassemble synchronizer hub **14** and synchronizer sleeve **11**, align the alignment marks made during disassembly.

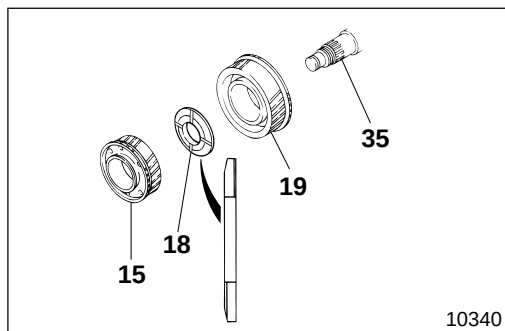


- Insert shifting key **12** into the keyway.
- Install shifting key spring **13** so that its opening is offset from the one of the shifting key.
- Make sure that the openings of shifting key springs do not align with each other.

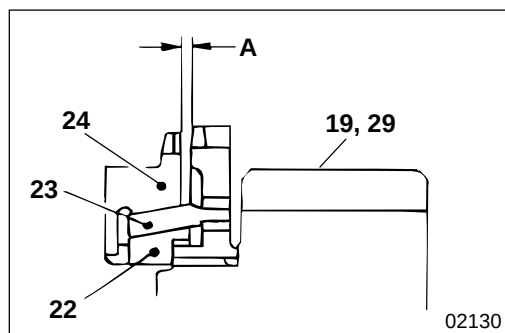


17 21 31 Removal of 4th, 3rd, 2nd gear bearing sleeves

 : Gear puller



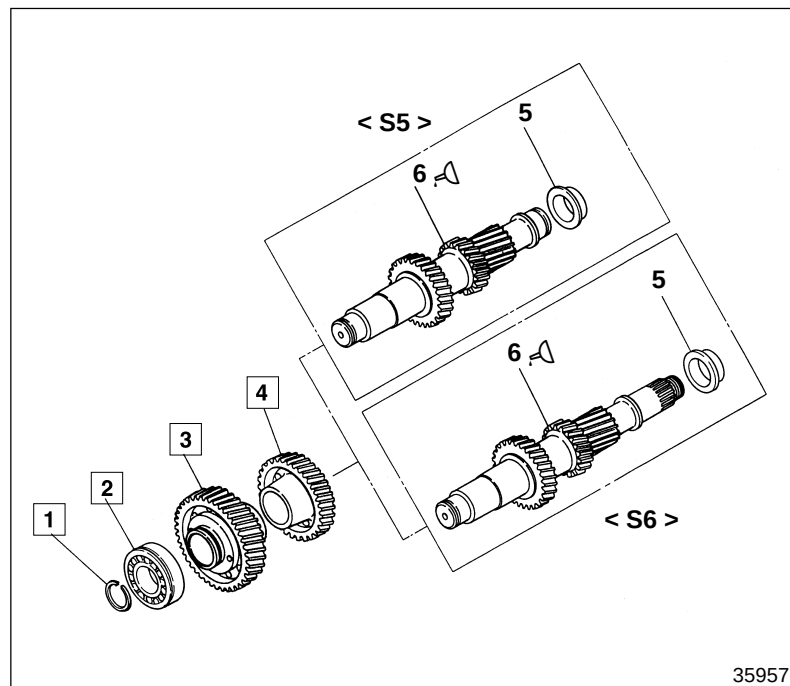
18 Installation of 3rd and 4th gear thrust washer



19 24 29 Clearance between synchronizer outer ring and 3rd gear assembly or 2nd gear assembly

- Measure clearance **A** between synchronizer outer ring **24** and the cone of 3rd gear assembly **19** or 2nd gear assembly **29**.
- When measuring this value, press synchronizer inner ring **22**, synchronizer outer ring **24** and synchronizer center ring **23** evenly and measure all around the circumference.
- If the measured value is higher than the limit, replace the faulty parts.

COUNTERSHAFT ASSEMBLY



● Disassembly sequence

- 1 Snap ring
- 2 Countershaft front bearing
- 3 Countershaft constant mesh gear
- 4 Countershaft 4th gear
- 5 Countershaft rear bearing inner race
- 6 Countershaft

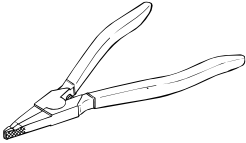
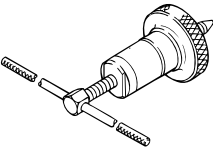
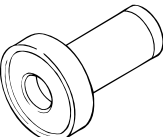
● Assembly sequence

Follow the disassembly sequence in reverse.

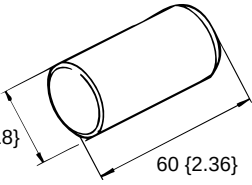
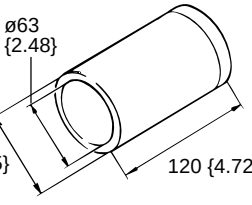
🔧 Sealant

Location	Points of application	Specified sealant	Quantity
6	Gear installation area of countershaft	THREEBOND 1375B	As required

🔧 Special tools

Location	Tool name and shape	Part No.	Application
1	Snap ring expander 	MH061268	Removal and installation of snap rings of countershaft bearing
2	Countershaft bearing puller 	*MH062426	Removal of countershaft front bearing
	Countershaft bearing installer 	*ME624233	Installation of countershaft front bearing

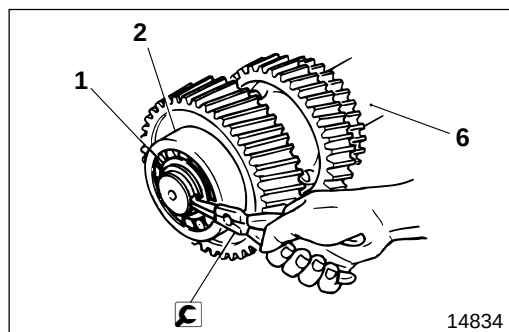
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
3, 4	Countershaft gear puller  01155	ME624243	Removal of countershaft gear
	Countershaft gear installer  01156	MH061740	Press-fitting of countershaft gear

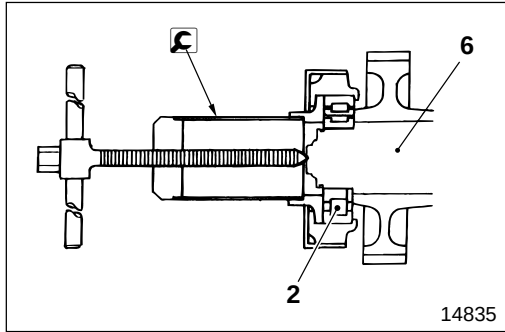
* components of puller and installer kit  P22-65

◆ Service procedure

1 Removal and installation of snap ring

 : Snap ring expander


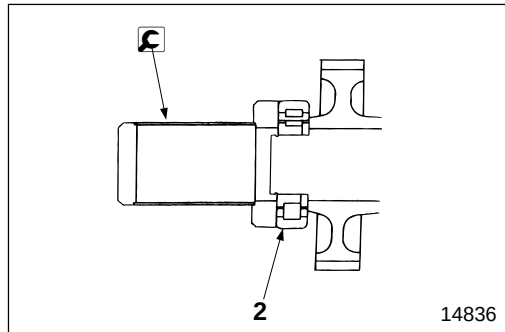
COUNTERSHAFT ASSEMBLY



2 Countershaft front bearing

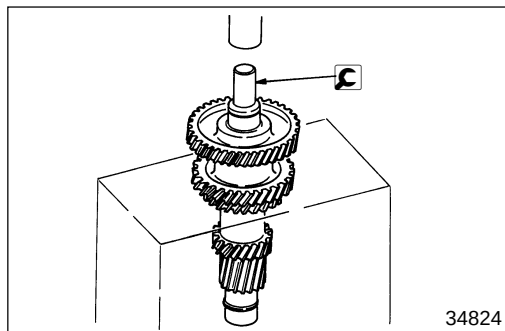
[Removal]

 : Countershaft bearing puller



[Installation]

 : Countershaft bearing installer

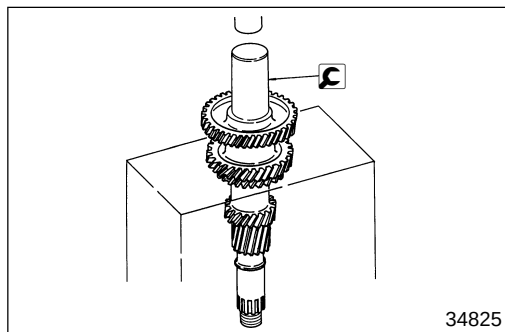


3 4 Countershaft constant mesh gear and countershaft 4th gear

[Removal]

Use a press.

 : Countershaft gear puller



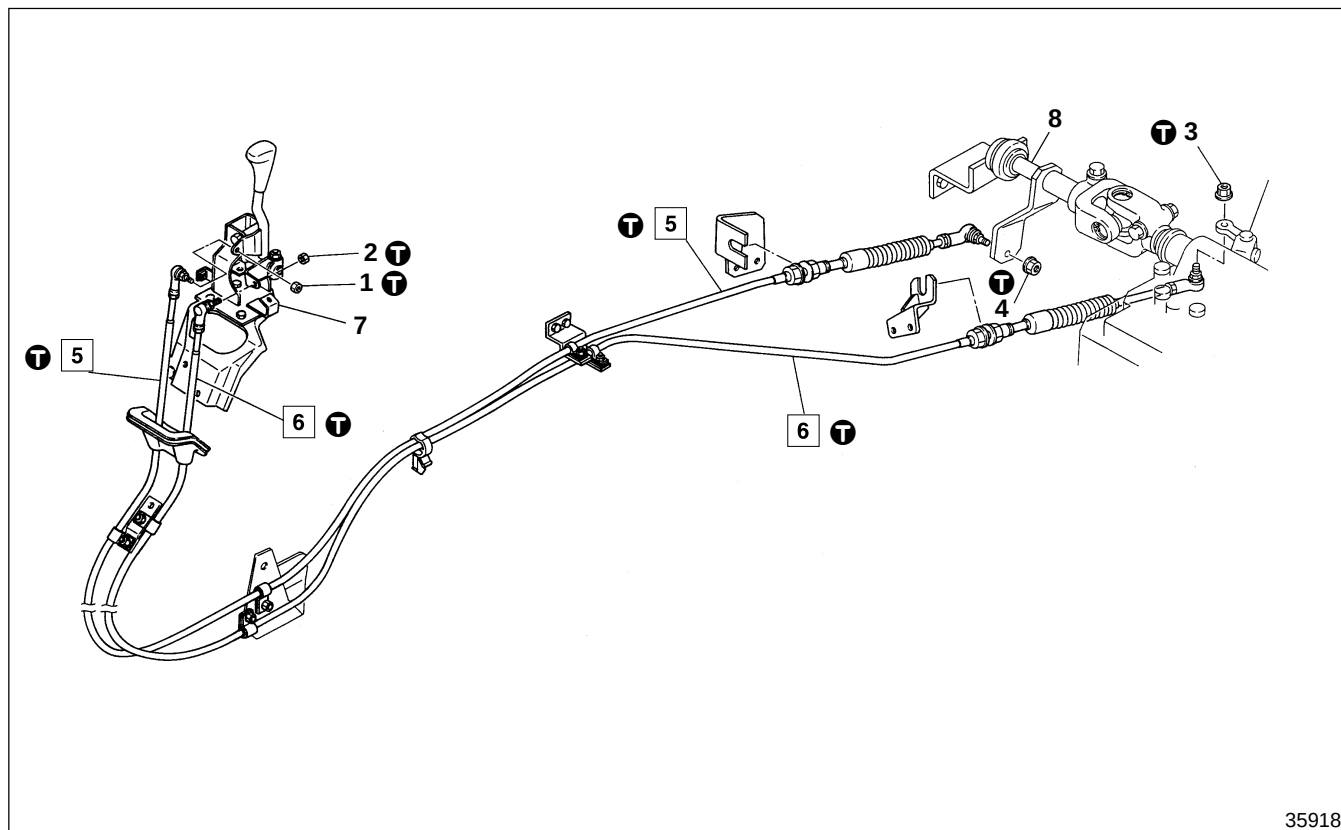
[Installation]

Use a press.

 : Countershaft gear installer

MEMO

TRANSMISSION CONTROL



35918

● Disassembly sequence

- | | | |
|-------|------------------|---|
| 1 Nut | 4 Nut | 7 Transmission control lever assembly P22-63 |
| 2 Nut | 5 Shift cable | 8 Cross shaft P22-64 |
| 3 Nut | 6 Selector cable | |

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

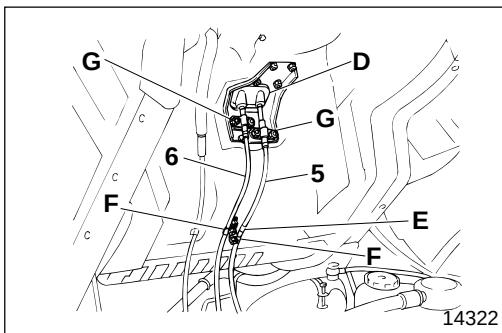
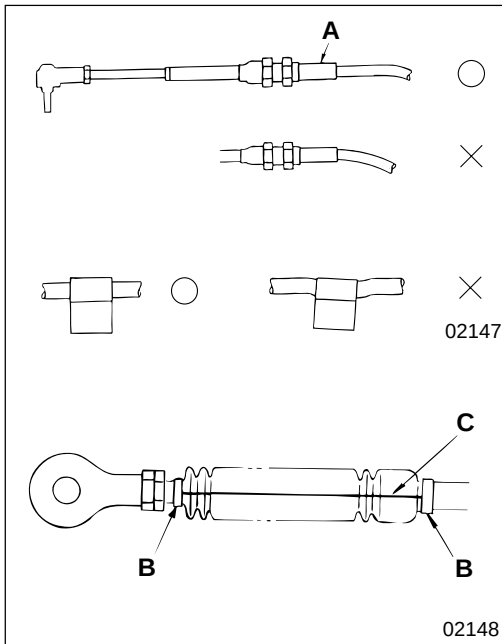
Location	Parts to be tightened	Tightening torque	Remarks
1 to 4	Nut (Ball joint or rubber damper mounting)	19 to 24 {14 to 17, 1.9 to 2.4}	—
5, 6	Cable lock nut tightening	59 to 83 {43 to 61, 6 to 8.5}	—

◆ Service procedure

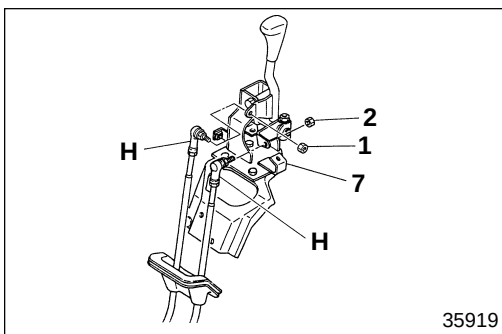
5 6 Installation of shift cable and selector cable

CAUTION ⚠

- Be sure to install casing cap A lengthwise.
- Make sure the radius of the bend is 200 mm {7.87 in.} or more.
- Make sure the cable operates smoothly.
- Be sure to install the clamps vertically against the cable.
- Make sure you do not twist clamps B at both ends of the boot.
- Make sure that white line C on the boot is aligned.
- Make sure the identification marks on the cable, the ball joint and the rubber damper point in the right direction when you install the cables. Installing the cables with the identification marks in the wrong direction can remarkably reduce the durability of the cables.



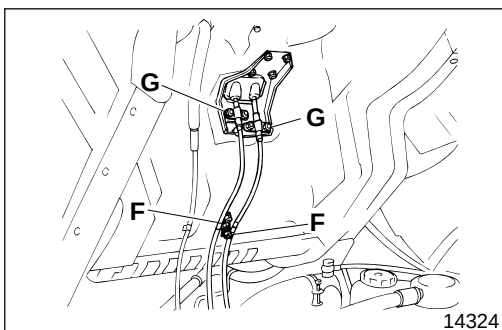
- Install shift cable 5 and selector cable 6 to the frame after having temporarily installed all the clamps.
- Insert shift cable 5 and selector cable 6 through grommet D of the cab floor into the inside of the cab, then install clip F and clip G temporarily by making identification mark E on the shift cable come to clip F position. (The selector cable has no identification mark.)



- Lower the cab.
- Install ball joint H of the cable to the shift lever and selector lever of transmission control lever assembly 7.

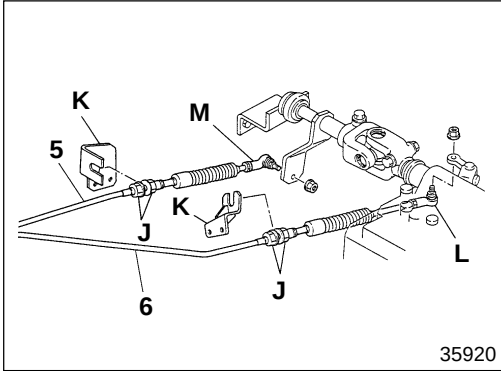
CAUTION ⚠

Make sure that ball joint H faces the correct direction.



- Tilt the cab up and tighten clip F and clip G permanently without applying force to the cables.

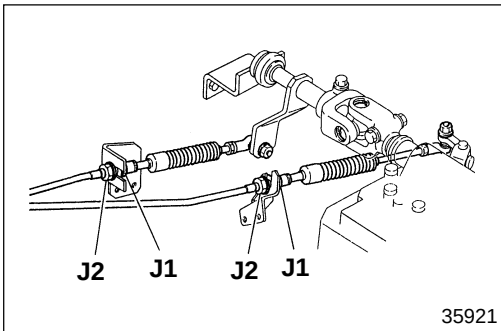
TRANSMISSION CONTROL



- Install lock nut **J** to bracket **K** temporarily and connect ball joint **L** or rubber damper **M** to the shift lever and selector lever.
- Tighten lock nut **J** permanently without applying force to the cables.

CAUTION ⚠

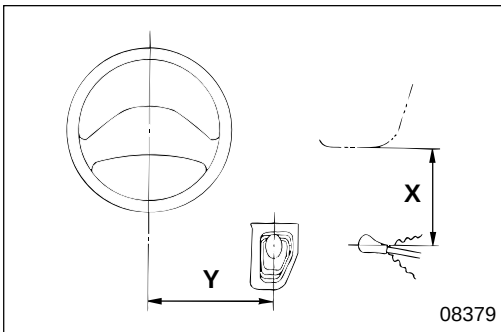
Make sure that ball joint **L** and rubber damper **M** face the correct direction.



CAUTION ⚠

Make sure not to move lock nut **J1** of the transmission side when tightening lock nut **J**. Tighten lock nut **J2**.

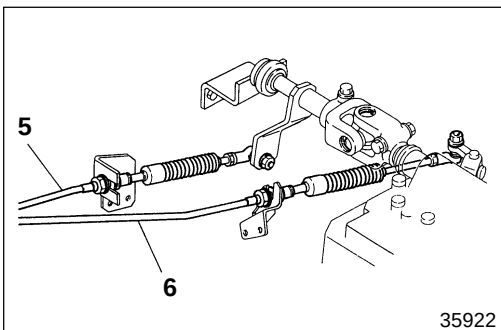
- Check when you operate the gear shift lever that it shifts and selects each position smoothly.



- If the gear shift lever leans to the front or rear, or to the left or right, excessively, adjust the length of the cable.
- When adjusting the gear shift lever, use the distance from the center of the steering wheel or from the instrument panel as the reference distance.

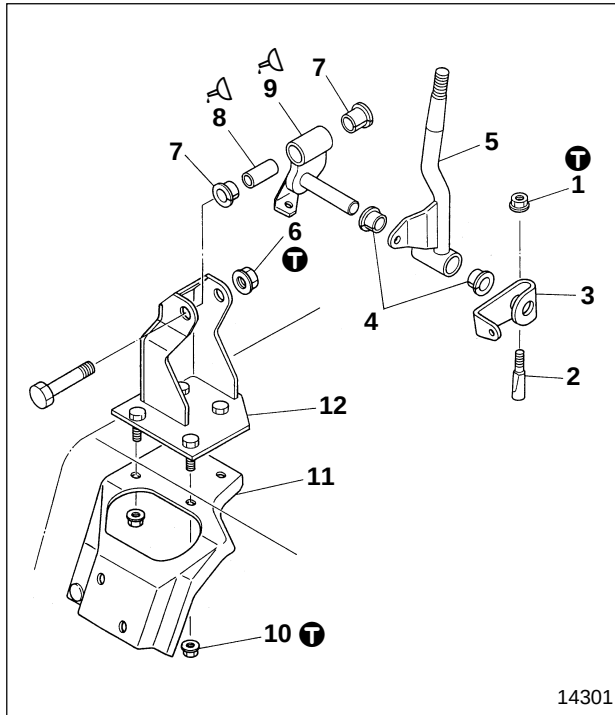
Unit : mm {in.}

Front and rear direction X (Distance from the instrument panel)	Left and right direction Y (Distance from the steering wheel center)
309 {12.17}	350 {13.78} (4th and 5th gear position)



	Shift cable 5	Selector cable 6
To front	Shorten	—
To rear	Lengthen	—
To right	—	Lengthen
To left	—	Shorten

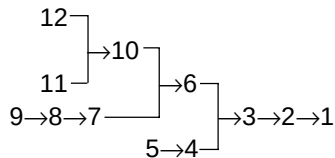
Transmission Control Lever Assembly



● Disassembly sequence

- 1 Nut
- 2 Lock pin
- 3 Select lever
- 4 Bushing
- 5 Lever
- 6 Nut
- 7 Bushing
- 8 Collar
- 9 Shaft assembly
- 10 Nut
- 11 Set board bracket
- 12 Set board

● Assembly sequence



T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

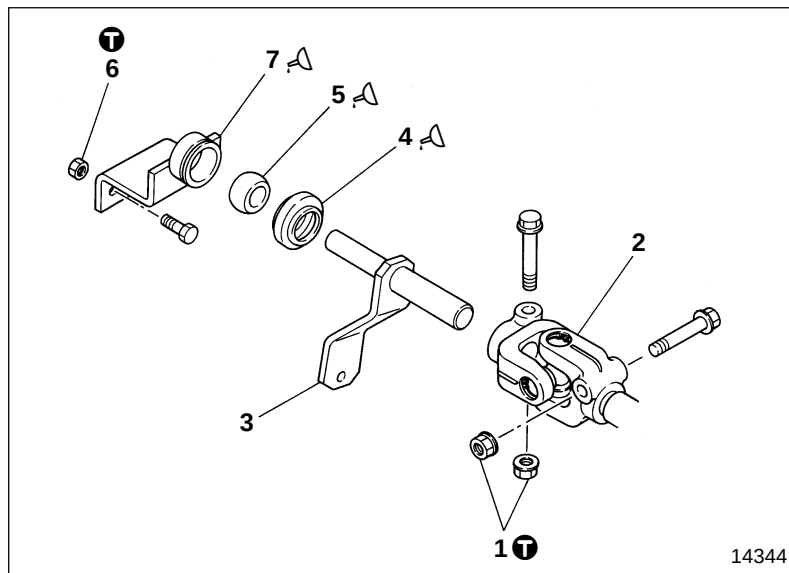
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Lock pin tightening)	10 to 15 {7.2 to 11, 1.0 to 1.5}	—
6	Nut (Shaft assembly mounting)	29 to 43 {22 to 32, 3.0 to 4.4}	—
10	Nut (Set board bracket and set board assembly mounting)	21 to 30 {15 to 22, 2.1 to 3.1}	—

L Lubricant

Location	Points of application	Specified lubricant	Quantity
8	Friction surfaces of collar and bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required
9	Friction surfaces of shaft assembly and bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required

TRANSMISSION CONTROL

Cross shaft



● Disassembly sequence

- 1 Nut
- 2 Universal joint assembly
- 3 Cross shaft
- 4 Dust cover
- 5 Ball bushing
- 6 Nut
- 7 Cross shaft support

● Assembly sequence

- 7→6→1
2→3→4→5

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Universal joint assembly mounting)	85 to 110 {61 to 80, 8.5 to 11.0}	—
6	Nut (Cross shaft support mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—

L Lubricant

Location	Points of application	Specified lubricant	Quantity
4	Pack into the interior of dust cover	Chassis grease [NLGI No.1 (Ca soap)]	As required
5	Friction parts inside and outside of ball bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required
7	Inner periphery of cross shaft support pipe	Chassis grease [NLGI No.1 (Ca soap)]	As required



FH

Service Manual

Group 23

Automatic Transmission

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

GROUP 23 AUTOMATIC TRANSMISSION

SPECIFICATIONS	2
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TROUBLESHOOTING	6
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REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION ASSEMBLY	12
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OIL PAN AND OIL FILTER	19
AUTOMATIC TRANSMISSION CONTROL	20
OIL COOLER	26
OIL FILTER	28

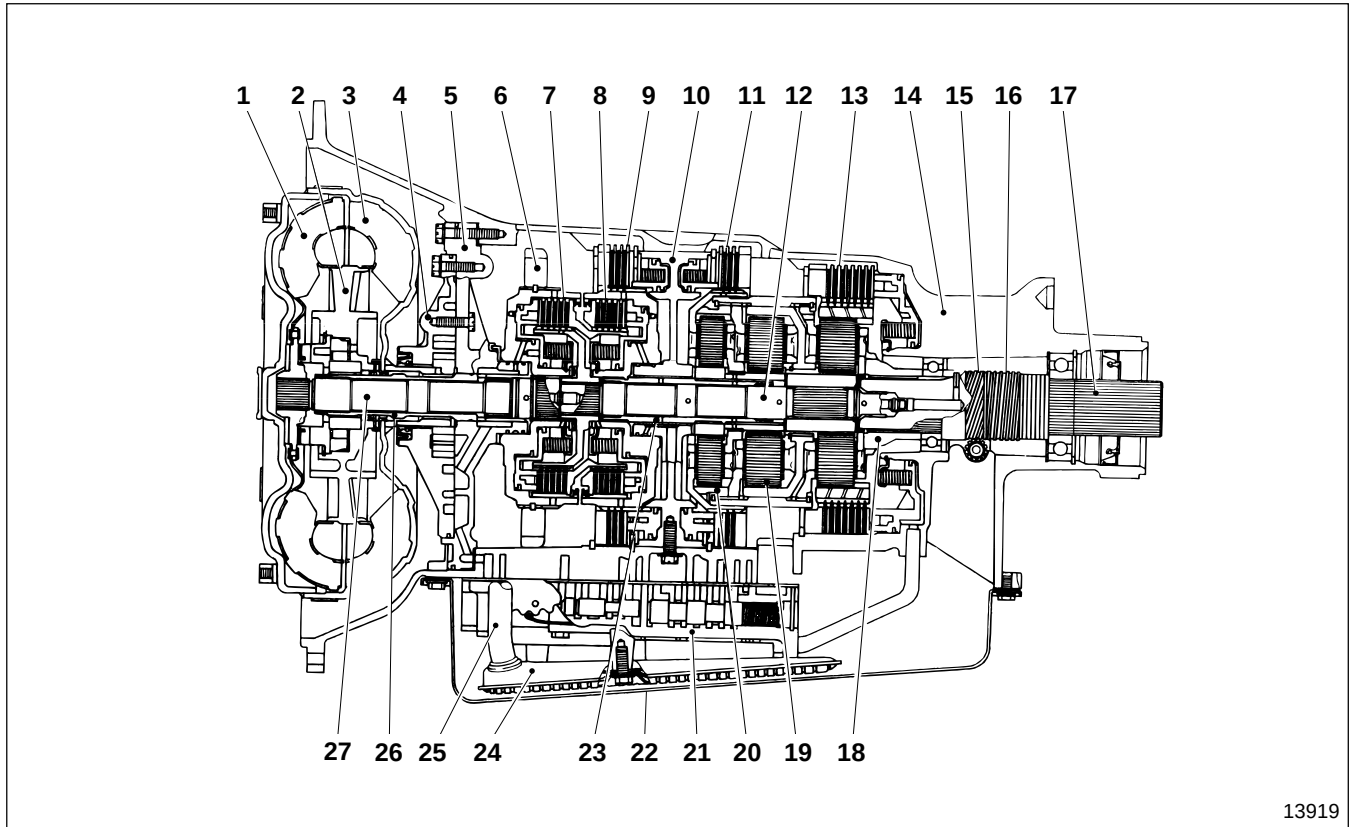
SPECIFICATIONS

Item			Specifications	
Type			M4A4 (Allison AT542)	
Torque converter	Type Stall torque ratio		3-element, 1-stage, 2-phase 1.72	
Transmission	Type		Planetary gear type 4 forward speeds, 1 reverse speed	
	Gear ratio	1st	3.454	
		2nd	2.253	
		3rd	1.407	
		4th	1.000	
		Reverse	5.024	
Range selector pattern			R— <u>N</u> —D—3—2—1 (Engine can be started in <u>N</u> position only)	
Recommended fluid	Fluid quantity (except oil cooler piping L {qts})		Automatic transmission fluid (DEXRON or DEXRON II type) 14 {15} When oil is replaced: 8.5 {9.0}	
Mass < Wet > kg {lb}			167 {368}	
Transmission control			Floor shift remote control, cable type	

STRUCTURE AND OPERATION

23

Automatic Transmission Assembly



13919

- | | | |
|-----------------------------|----------------------------------|------------------------------|
| 1 Turbine | 10 Center support | 19 Center planetary gear set |
| 2 Stator | 11 2nd clutch | 20 Front planetary gear set |
| 3 Impeller | 12 Mainshaft | 21 Control valve assembly |
| 4 Oil pump assembly | 13 1st and reverse clutch | 22 Oil pan |
| 5 Front support | 14 Transmission case | 23 Sun gear shaft |
| 6 Power take-off drive gear | 15 Governor drive gear | 24 Oil filter |
| 7 Forward clutch | 16 Speedometer sensor drive gear | 25 Intake pipe |
| 8 4th clutch | 17 Output shaft | 26 Stator shaft |
| 9 3rd clutch | 18 Rear planetary gear set | 27 Turbine shaft |

The automatic transmission consists of a torque converter and a fully automatic 4-speed gear system.

● Torque converter

The torque converter is driven by the engine crankshaft, and functions as the input device for the transmission. The torque converter also acts as the fluid coupling, absorbing shock during engine start up and gear shifting.

● Transmission (4 forward speeds, 1 reverse speed)

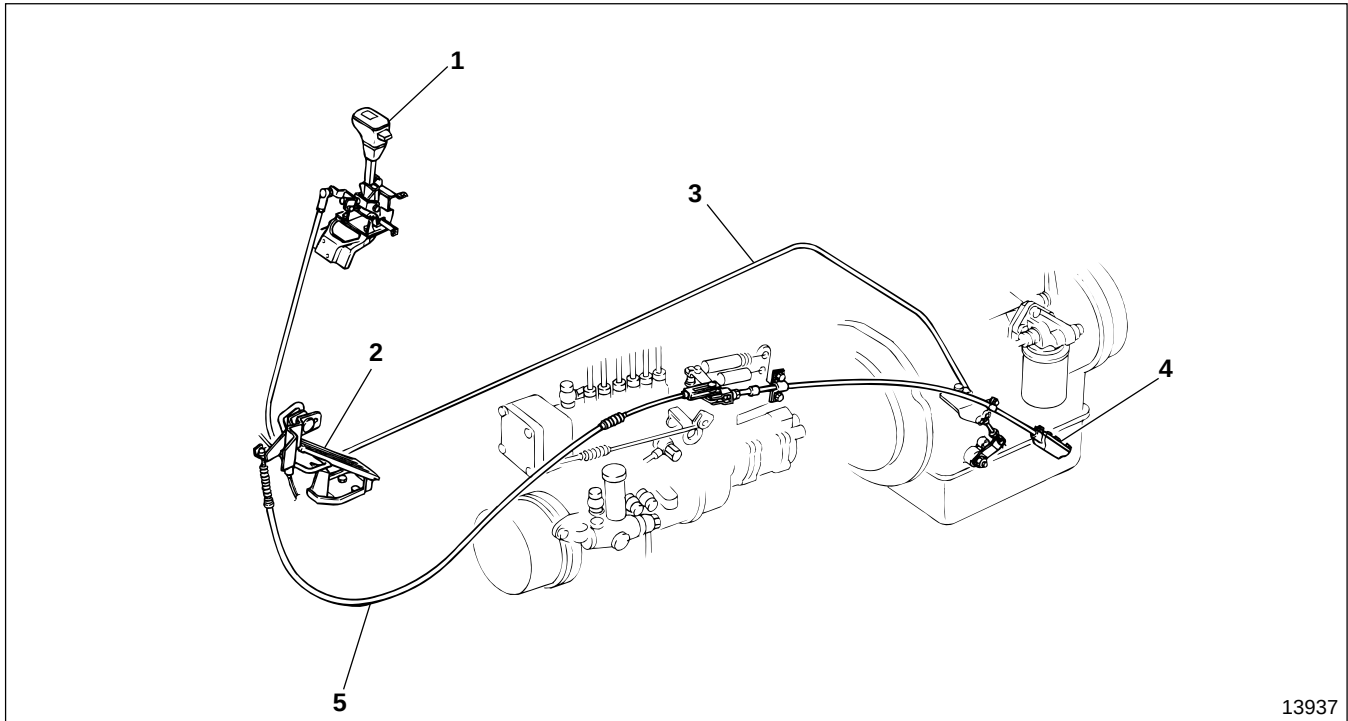
The transmission is accomplished by three sets of planetary gears **18**, **19**, **20** and five sets of oil pressure-operated, wet-type multiple disc clutches **7**, **8**, **9**, **11**, **13**. These oil-cooled clutch discs are self-adjusting to compensate for wear.

● Oil pressure control area

This oil pressure control area consists of oil pump **4**, control valve assembly **21** that controls the changeover between clutches **7**, **8**, **9**, **11**, and **13**, the modulator that monitors the amount the accelerator pedal is depressed, and the governor that monitors the vehicle speed. Gear shift is made automatically and depends on how much the accelerator pedal is depressed and how fast the vehicle is travelling.

STRUCTURE AND OPERATION

Automatic Transmission Control



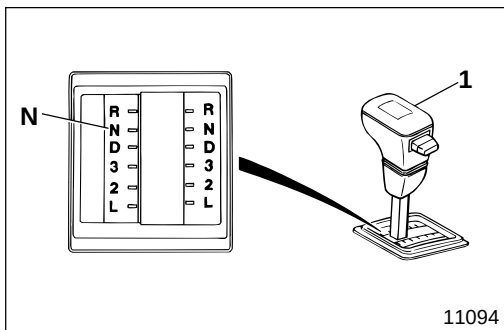
1 Range selector lever
2 Accelerator pedal

3 Selector cable
4 Modulator

5 Accelerator control cable

13937

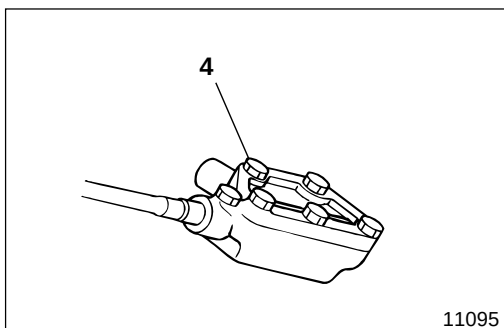
Selector Lever



Range selector lever 1 selects the most suitable range for the operating conditions, ensuring optimum service from the automatic transmission. Safety features are incorporated that make sure that the engine cannot be started when the range selector lever is in any position other than neutral (N).

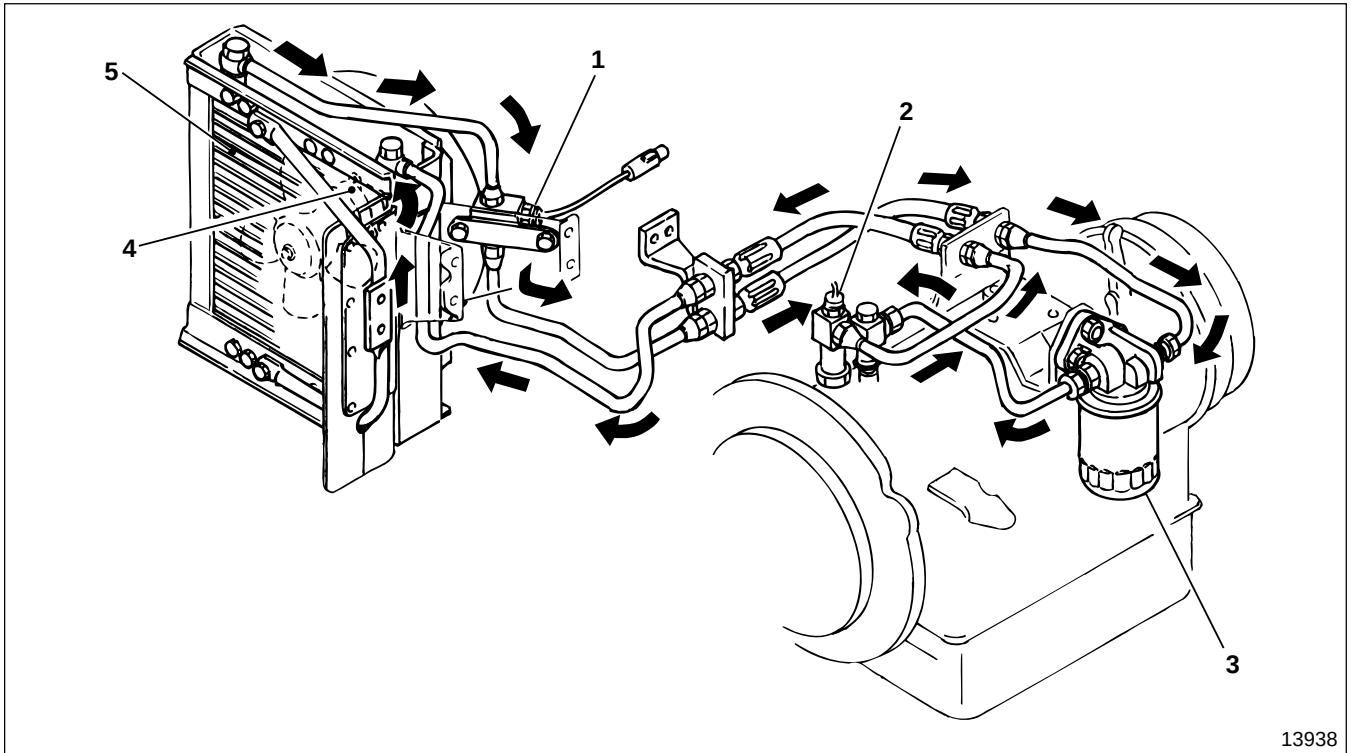
N : Neutral

Modulator

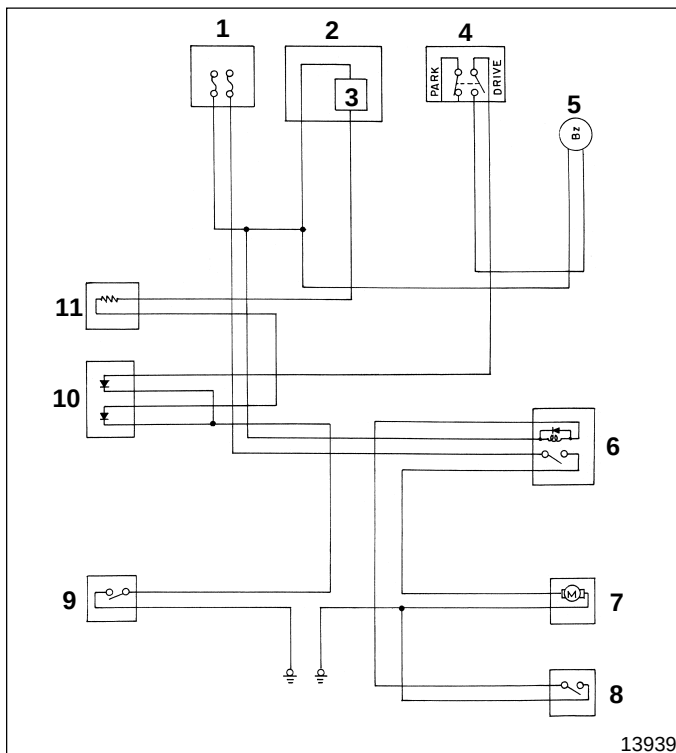


Modulator 4 converts the amount the accelerator pedal is depressed into hydraulic pressure.

Oil Cooler



Oil Temperature Warning System



TROUBLESHOOTING

Possible causes		Symptoms							
		Excessive shock when shifting from (N) to (D)	Engagement interval too long when shifting from (N) to (D)	Engine races when shifting up	Does not shift up	Kick down impossible or shifting down abnormal	Abnormal shifting	Slips out of gear while driving forward	Slips out of gear in (R) position
Engine faulty	Engine idling speed too fast	☐							
	Engine idling speed too slow		☐						
Incorrect adjustment of cables	Selector cable adjusted incorrectly		☐		☐		☐	☐	☐
	Modulator cable adjusted incorrectly	☐				☐			
Automatic transmission fluid unsuitable situation	Fluid level too low		☐	☐	☐		☐	☐	☐
	Oil filter clogged		☐	☐			☐	☐	☐
	Air mixed in fluid		☐	☐			☐	☐	
	Fluid level too high								
	Oil cooler pipe damaged or deteriorated								
	Oil cooler fan malfunctioning								
Internal malfunction of automatic transmission assembly	Fluid pressure too low		☐	☐	☐		☐	☐	☐
	Valve body abnormality or leakage	☐	☐	☐	☐	☐	☐	☐	☐
	Oil pump malfunctioning		☐				☐	☐	☐
	Output shaft bearing or bushing damaged								
	Governor abnormal				☐	☐	☐		
	Clutch damaged or malfunctioning		☐	☐	☐		☐	☐	☐
	Breather clogged								
	Fluid pressure too high	☐							
	Clutch plate clearance insufficient								
	Clutch dragging								
	Planetary gear damaged or stuck								

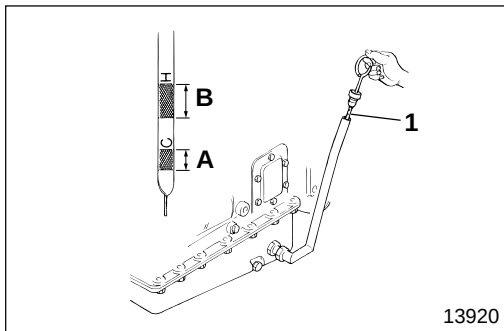
Symptoms		Possible causes										
		Slips out of gear while in any position	Vehicle does not move irrespective of selector position	Vehicle does not move while selector in forward position	Vehicle does not move while selector in Ⓜ position	Vehicle moves while selector is in Ⓝ position	Scraping or squeaking noise	Humming noise	Trouble in fluid supply. Automatic transmission fluid spouting from filler tube	Excessive shock when shifting	Shift up too slow	Automatic transmission overheating
Engine faulty	Engine idling speed too fast											○
	Engine idling speed too slow											
Incorrect adjustment of cables	Selector cable adjusted incorrectly				○	○						○
	Modulator cable adjusted incorrectly								○	○		
Automatic transmission fluid unsuitable situation	Fluid level too low	○	○	○				○				○
	Oil filter clogged	○	○						○			
	Air mixed in fluid	○						○	○			
	Fluid level too high								○			
	Oil cooler pipe damaged or deteriorated											○
	Oil cooler fan malfunctioning											○
Internal malfunction of automatic transmission assembly	Fluid pressure too low	○	○	○	○					○		○
	Valve body abnormality or leakage	○	○	○	○	○		○		○	○	
	Oil pump malfunctioning	○	○									○
	Output shaft bearing or bushing damaged						○					
	Governor abnormal										○	
	Clutch damaged or malfunctioning			○	○						○	
	Breather clogged								○			
	Fluid pressure too high									○		
	Clutch plate clearance insufficient											○
	Clutch dragging					○						
	Planetary gear damaged or stuck		○	○	○		○					

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Inspection of Automatic Transmission Fluid

(1) Inspection of characteristics

If the automatic transmission fluid smells burnt or if it contains metal particles or sludge as a result of internal friction and wear of metal or other material, the transmission assembly must be completely overhauled. Make sure you carefully examine the automatic transmission fluid on the dipstick. If you find the quality questionable, take a sample and examine it more closely.



(2) Inspection of automatic transmission fluid level

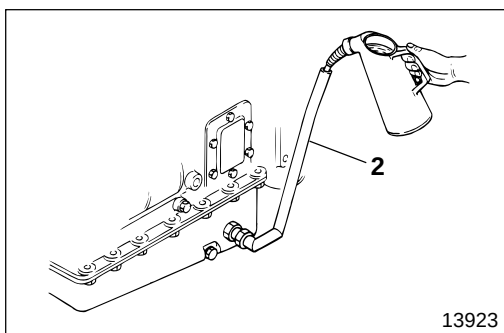
- Park the vehicle on level ground, make sure that the parking brake is fully activated and chock the wheels to keep them from rolling.
- Start the engine and let it idle. To fill the hydraulic circuit with automatic transmission fluid, shift the range selector lever from N → R → N → D → 2 → D → N. Repeat this process five times, finally shifting to N.
- While the engine is still idling, pull out dipstick **1** and wipe off the fluid sticking to it. Reinsert the dipstick, then pull it out again and check the fluid level.
- If the fluid level is inspected right after the engine is started and the fluid temperature is still low (approximately 15 to 49°C {60 to 120°F}), the level should be within area **A** marked COLD on the dipstick.
- If the fluid level is inspected after the vehicle has been driven and the fluid temperature is high (approximately 71 to 93°C {160 to 200°F}), the level should be within area **B** marked HOT on dipstick **1**.

WARNING

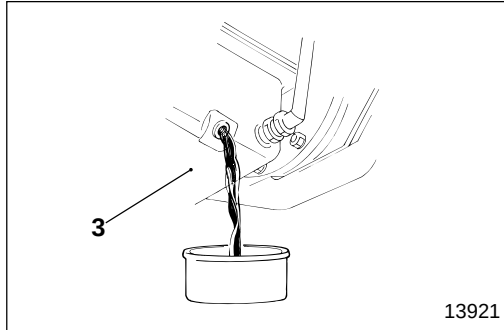
Take care during the inspection because the engine will be running. Take sufficient care to avoid burns or injuries resulting from contact with moving parts.

NOTE

- Make sure the vehicle is parked on level ground when you are checking the fluid level.
- Make sure the range selector lever is in the N position and the engine is idling when you are checking the fluid level. When the engine is stopped, the fluid level appears higher than it actually is.
- Be sure to wipe off the dust from the safety cap and the upper part of dipstick guide **2** before you pull out dipstick **1**.
- To ensure the fluid is correct, reinspect the fluid level after an actual drive.
- If the fluid level is low, add automatic transmission fluid (DEXRON or DEXRON II type) through dipstick guide **2** until the correct level on dipstick **1** is reached.



Replacement of Automatic Transmission Fluid



(1) Draining

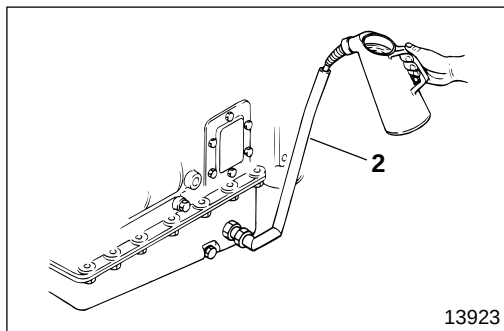
- Park the vehicle on level ground, chock the wheels and shift the range selector lever to the **N** position.
- Place a container under oil pan **3**, remove the drain plug and drain the fluid.
- Clean oil pan **3** and the drain plug. Replace the oil filter. P23-19
- Replace the outer oil filter. P23-28

WARNING

Take care because the fluid temperature immediately after the engine has stopped is very high. To avoid scalds, wait until a safe temperature has been reached before draining the fluid.

NOTE

- The fluid will drain faster if the engine is first run to raise the fluid temperature.
- The fluid cannot be drained from the hydraulic circuit, the torque converter or the oil cooler.
- Check the drained fluid for dirt, metal particles and metal fragments.



(2) Supply

- Install oil filter, oil pan **3** and drain plug. P 23-19
- Add 8.5 L {9.0 qts} of fluid via dipstick guide **2**.

CAUTION

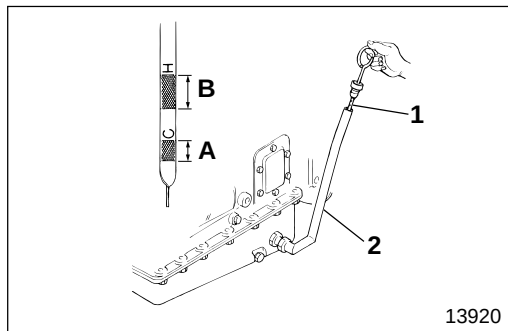
Make sure that dirt and foreign particles do not become mixed in with the fluid when it is added.

- Shift the range selector lever to the **N** position, start the engine and let it idle for about one minute.
- After shifting the lever through all positions once, shift it back to **N** position.

CAUTION

To prevent burning out the interior of the automatic transmission assembly, make sure that the engine is not allowed to race when you do the above.

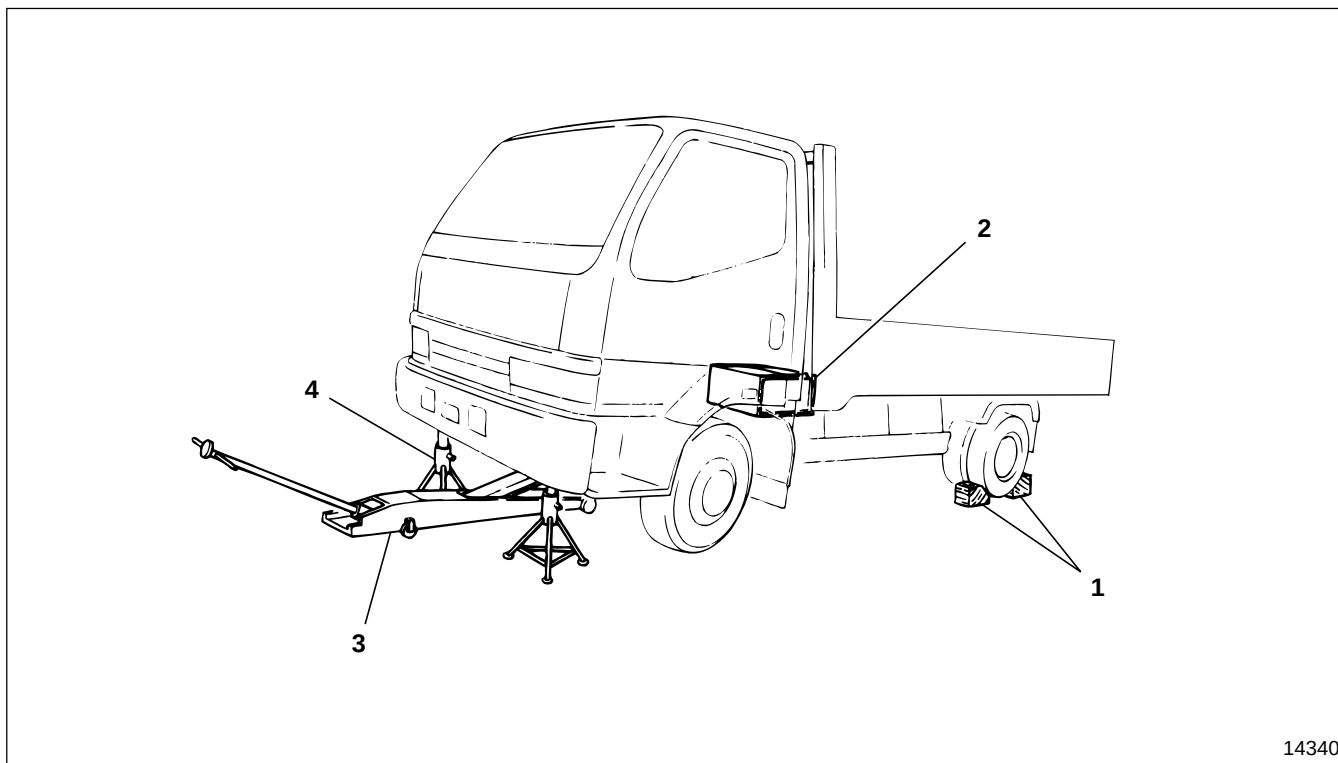
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE



- Check and adjust so that the fluid level is within the specified area on dipstick 1.

NOTE

- As the temperature of the fluid rises, so does the fluid level. If you add fluid while the temperature is still low (approximately 15 to 49°C {60 to 120°F}), make sure that the level stays within area A, marked COLD on dipstick 1.
- Let the engine idle and, while paying attention to the fluid level, pour in the fluid slowly.
- It is sometimes hard to check the fluid level, immediately after supplying fluid, because of the fluid adhering to the interior of dipstick guide 2. If this is the case, check the fluid level several times at intervals.
- Be careful not to supply too much fluid because you might mistake the fluid that overflows from the air breather for fluid leakage.



14340

● **Work sequence before removal**

- 1 Place wheel chocks.
- 2 Disconnect the negative battery cable  Gr 54
- 3 Jack up the front axle with a garage jack.
- 4 Support the front frame on rigid racks.

WARNING

- The parking brake will be removed so naturally it cannot be used. Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

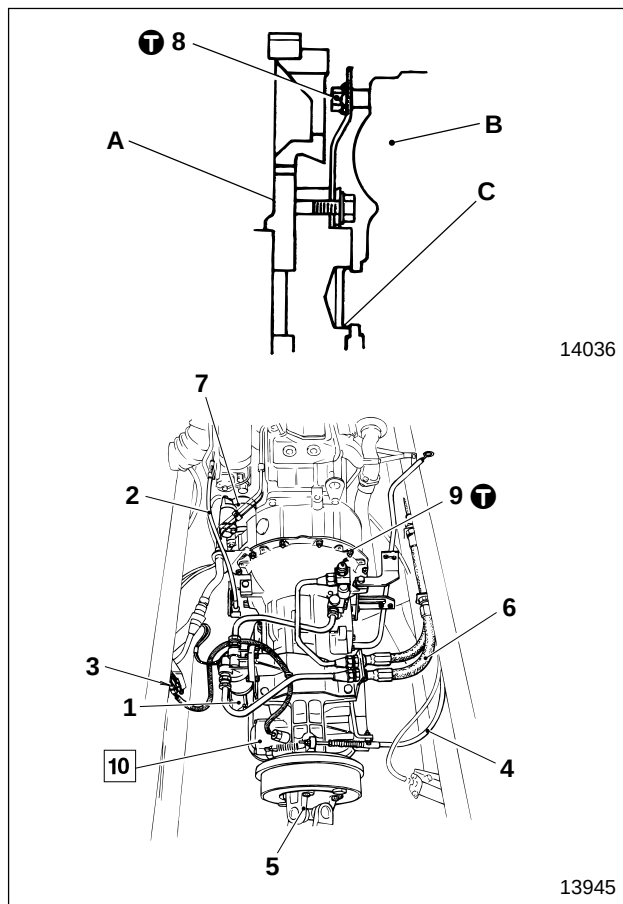
CAUTION

Be sure to keep the automatic transmission in neutral throughout the operation.

● **Work sequence after installation**

Follow the work sequence before removal in reverse.

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION ASSEMBLY



● Removal Sequence

- 1 Modulator
- 2 Selector cable
- 3 Harness connector
- 4 Parking brake cable Gr 36
- 5 Propeller shaft Gr 25
- 6 Oil cooler hose
- 7 Starter Gr 54
- 8 Bolt
- 9 Nut
- 10 Automatic transmission assembly

A : Flywheel

B : Torque converter

C : Torque converter pilot area

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

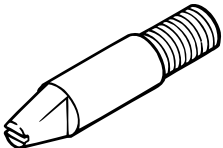
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Bolt (Torque converter and flywheel mounting)	51 to 61 {38 to 45, 5.20 to 6.22}	—
9	Nut (Automatic transmission assembly mounting)	39 to 58 {28 to 43, 3.9 to 6.0}	—

Lubricant

Location	Points of application	Kinds	Quantity
10	Torque converter pilot area (area C)	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required

Special tools

Location	Tool name and shape	Part No.	Application
10	Converter installer 	ME633437	Automatic transmission assembly installation guide

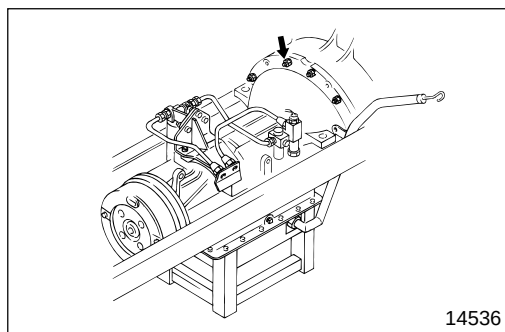
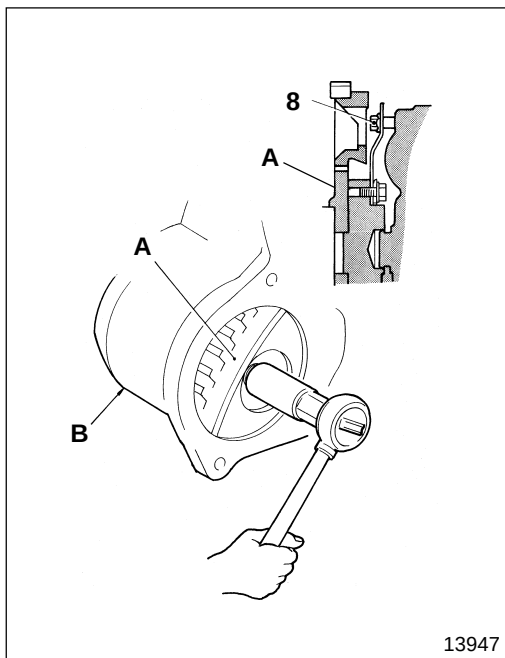
03726

◆ Service procedure

10 Automatic transmission assembly

[Removal]

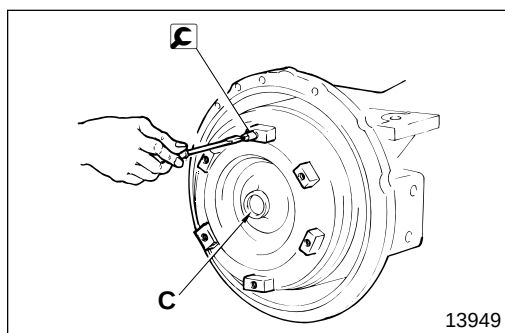
- Rotate flywheel **A** and remove bolts **8** in sequence.
- B** : Starter housing



- Use a square bar or a similar object to support the oil pan of automatic transmission assembly **10**, then remove it by pulling it out backward.

CAUTION ⚠

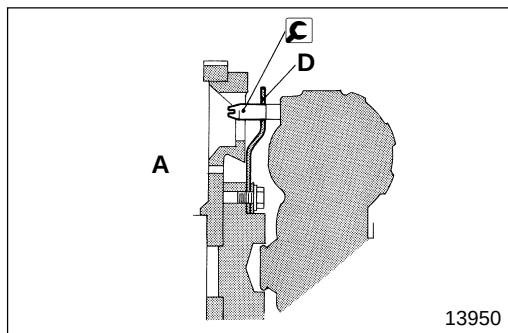
- Be careful not to apply force unevenly to any of the oil pan parts.
- Be careful not to let the torque converter fall from the transmission body because as a single unit the torque converter can come loose easily.



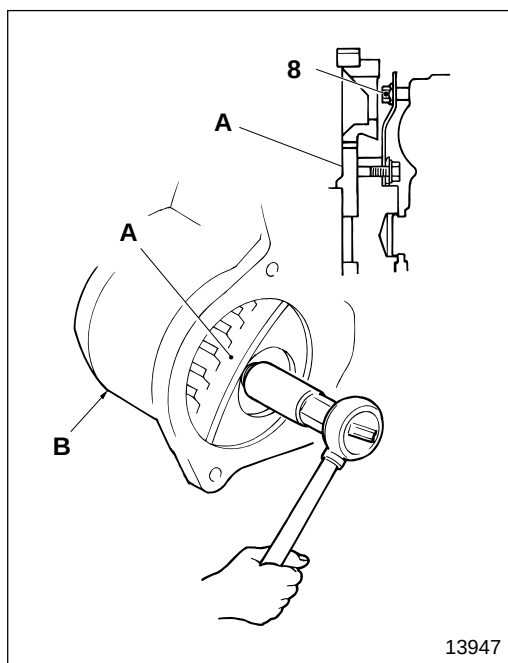
[Installation]

- Apply molybdenum disulfide grease to torque converter pilot area **C**.
- Mount  torque converter installer in the tapped hole on the torque converter periphery.

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION ASSEMBLY



- Install the automatic transmission assembly to the engine flywheel housing, by aligning  torque converter installer with the hole in flexplate **D** of flywheel **A**.



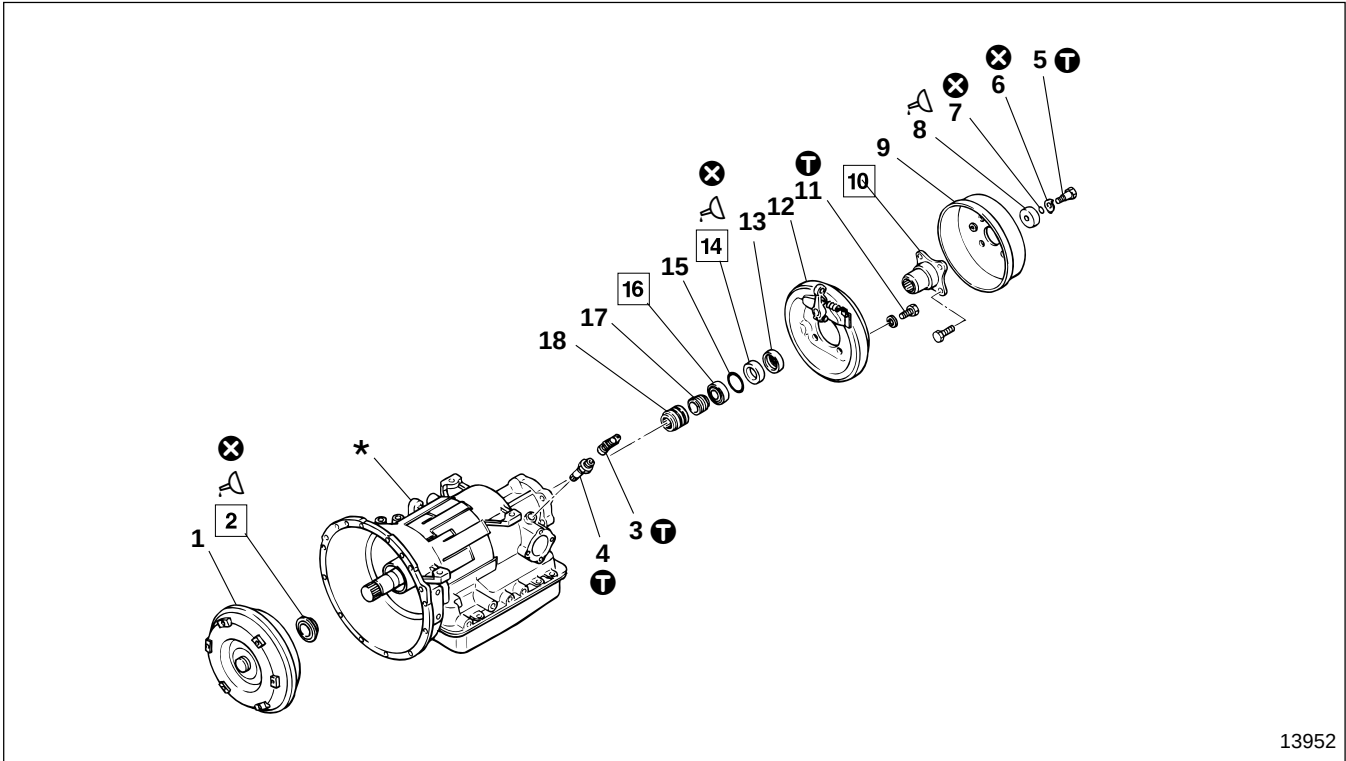
- Rotate flywheel **A** and tighten bolts **8**, in sequence, through the working hole of starter housing **B** (6 points).
- Remove the converter installer and replace it with bolt **8**.
- First tighten all six bolts **8** temporarily, then tighten at specified torque.

NOTE

Be careful not to drop bolts 8 into the gap between flywheel **A and the torque converter.**

MEMO

OIL SEAL AND SPEEDOMETER WORM



13952

Disassembly sequence

- | | | |
|----------------------------|------------------------------------|---------------------|
| 1 Torque converter | 8 Retainer washer | 15 Snap ring |
| 2 Oil seal | 9 Parking brake drum | 16 Bearing |
| 3 Speedometer gear adapter | 10 Companion flange | 17 Spacer |
| 4 Speedometer gear | 11 Bolt | 18 Speedometer worm |
| 5 Flange set bolt | 12 Support plate and shoe assembly | |
| 6 Lock washer | 13 Seal plate | |
| 7 O-ring | 14 Oil seal | |

* : Automatic transmission assembly

X : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
4, 18	Backlash between speedometer gear and speedometer worm	0.13 to 0.29 {0.0051 to 0.011}	0.36 {0.014}	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

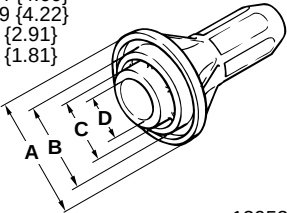
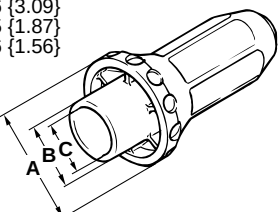
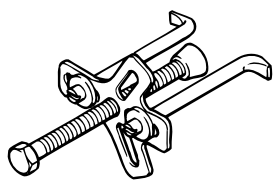
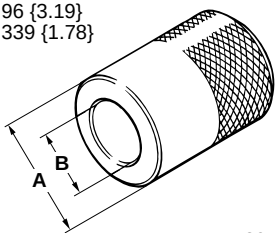
Location	Parts to be tightened	Tightening torque	Remarks
3	Speedometer gear adapter	55 to 82 {41 to 61, 5.6 to 8.4}	—
4	Speedometer gear	61 to 68 {45 to 50, 6.22 to 6.93}	—
5	Flange set bolt	140 to 160 {100 to 120, 14.1 to 16.72}	—
11	Bolt (Support plate and shoe assembly mounting)	110 to 130 {81 to 97, 11.22 to 13.46}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
2	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
	Oil seal periphery	THREEBOND 1215	As required
8	Retainer washer periphery	THREEBOND 1215	As required
14	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
	Oil seal periphery	THREEBOND 1215	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	$A=\varnothing 116.84 \{4.60\}$ $B=\varnothing 107.19 \{4.22\}$ $C=\varnothing 73.91 \{2.91\}$ $D=\varnothing 45.97 \{1.81\}$  13953	ME633191	Installation of front side oil seal
14	$A=\varnothing 78.6 \{3.09\}$ $B=\varnothing 47.5 \{1.87\}$ $C=\varnothing 39.6 \{1.56\}$  13954	ME633192	Installation of rear side oil seal
16	 13955	ME633221	Removal of bearing
	$A=\varnothing 80.96 \{3.19\}$ $B=\varnothing 45.339 \{1.78\}$  13956	ME633220	Installation of bearing

OIL SEAL AND SPEEDOMETER WORM

◆ Service procedure

1 Installation of torque converter

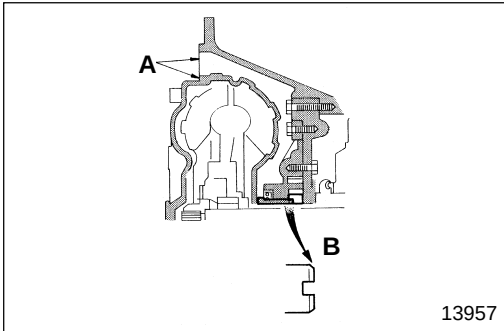
Align the hub groove of torque converter **1** with the claw of the oil pump, then insert until the welded part on the converter periphery and the housing flange almost coincide.

CAUTION ⚠

Be careful not to scratch the oil seal.

A : Guide to insertion position (Align faces)

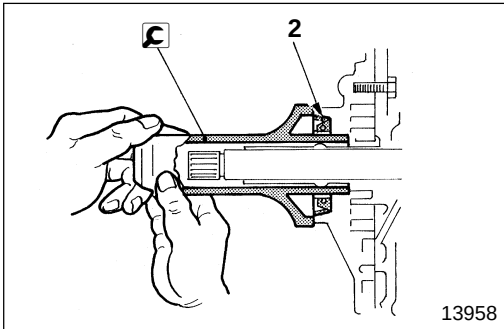
B : Align claw position



13957

2 Installation of oil seal

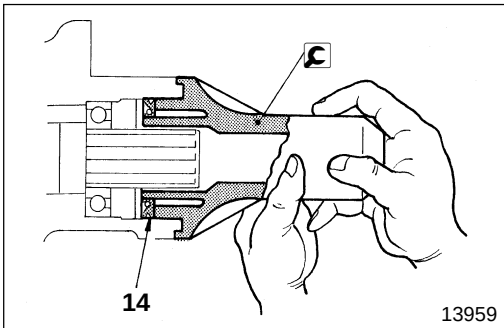
- Apply grease to the lip area, and apply sealant to the periphery of oil seal **2**.
- Use  pump seal installer and install oil seal **2**.



13958

14 Installation of oil seal

- Apply grease to the lip area, and apply sealant to the periphery of oil seal **14**.
- Use  rear oil seal installer and install oil seal **14**.

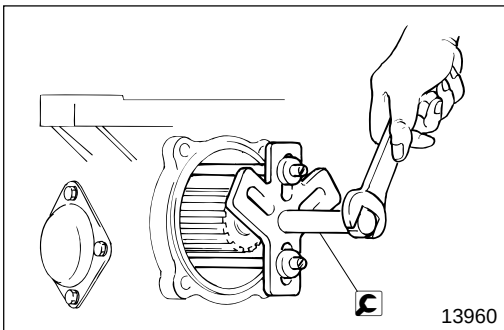


13959

16 Bearing

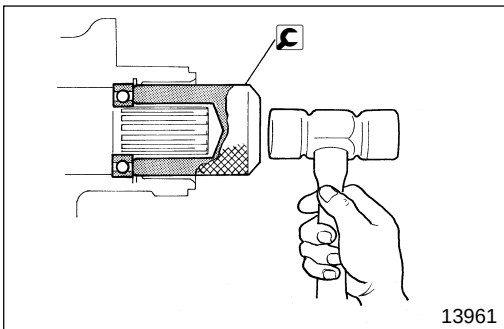
[Removal]

- Insert the claw on the tip of  bearing remover set rod between the bearing race of bearing **16**.
- Insert the bolt of  bearing remover set into the automatic transmission output shaft, then remove bearing **16** by tightening the bearing remover.



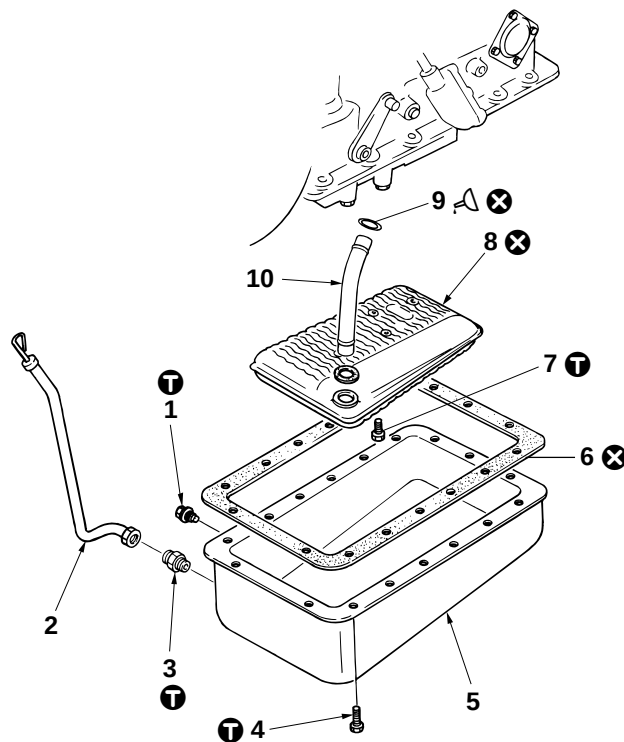
13960

[Installation]



13961

OIL PAN AND OIL FILTER

23


13962

● Removal sequence

- | | | |
|-------------------------------|--------------|------------------------|
| 1 Drain plug | 5 Oil pan | 9 Seal ring |
| 2 Dipstick and dipstick guide | 6 Gasket | 10 Intake pipe |
| 3 Dipstick guide connector | 7 Bolt | |
| 4 Bolt | 8 Oil filter | ⊗ : Non-reusable parts |

● Installation sequence

Follow the removal sequence in reverse.

Repair kit : Oil filter and gasket kit

Ⓙ Tightening torque

Unit : N·m {lb·ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Drain plug	20 to 27 {15 to 20, 2.05 to 2.75}	—
3	Dipstick guide connector	125 to 135 {91 to 100, 12.55 to 13.76}	—
4	Bolt (Oil pan mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—
7	Bolt (Oil filter mounting)	14 to 18 {10 to 13, 1.4 to 1.8}	—

🔧 Fluid

Location	Points of application	Kinds	Quantity
9	Seal ring	Automatic transmission fluid (DEXRON or DEXRON II type)	As required

Technical diagram of a bicycle rear suspension system. The diagram shows the shock absorber (1) connected to the shock absorber cable (6). The shock absorber cable is connected to the rear shock absorber assembly (2, 3, 4, 5, 7, 8). The shock absorber cable is secured with a cable end cap (6). The rear shock absorber assembly is mounted to the frame and swingarm. The diagram includes torque specifications (T) for various bolts and a note (*) indicating a specific component.

* : Range selector lever P23-22

$$\begin{array}{ccccccccc} * & \rightarrow & 6 & \rightarrow & 1 & \rightarrow & 5 & \rightarrow & 4 & \rightarrow & 3 \\ & & & & & & & & & & \downarrow \\ & & & & & & & & & & 2 \\ & & & & & & & & 8 & \rightarrow & 7 \\ & & & & & & & & & & \downarrow \end{array}$$

P23-21

Unit : N·m {lbf.ft, kgf·m}

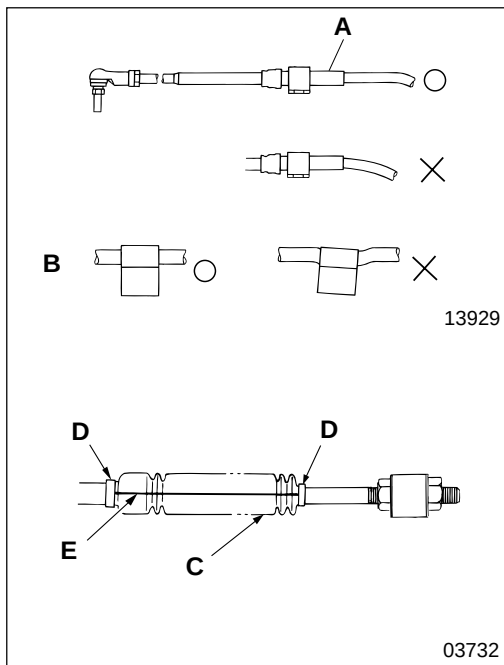
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Selector cable mounting)	18.6 to 23.5 {14 to 17, 1.9 to 2.4}	—
2	Nut (U-bolt mounting)	21 to 30 {16 to 22, 2.15 to 3.05}	—
3, 5	Nut (Selector cable mounting)	4 to 6 {3.0 to 4.4, 0.41 to 0.61}	—
7	Nut (Selector lever mounting)	23.5±3.4 {17±2.5, 2.4±0.35}	—

◆ Service procedure

6 Installation of selector cable

NOTE

- Make sure casing cap A is installed in a straight line.
- Cable bend radius must be 20 cm {7.87 in.} or more.
- Make sure the cable is straight.
- Install the clamp at right angles to the cable. (Figure B)
- Do not twist clamps D at the ends of boot C. Install so that white line E on the boot is a straight line. (Figure E)

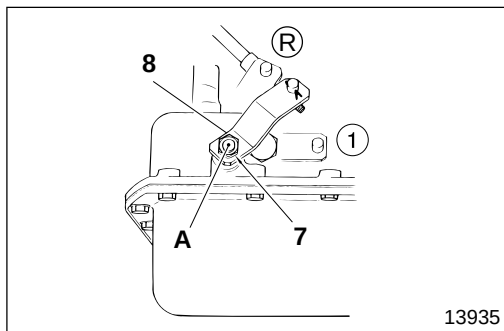


8 Installation of selector lever

If selector lever 8 has been removed, rotate selector shaft A and move it to an intermediate position between, but other than, ① and ②, then tighten nut 7.

CAUTION ⚠

Be careful not to overtighten nut 7, it might cause the internal lever to malfunction.

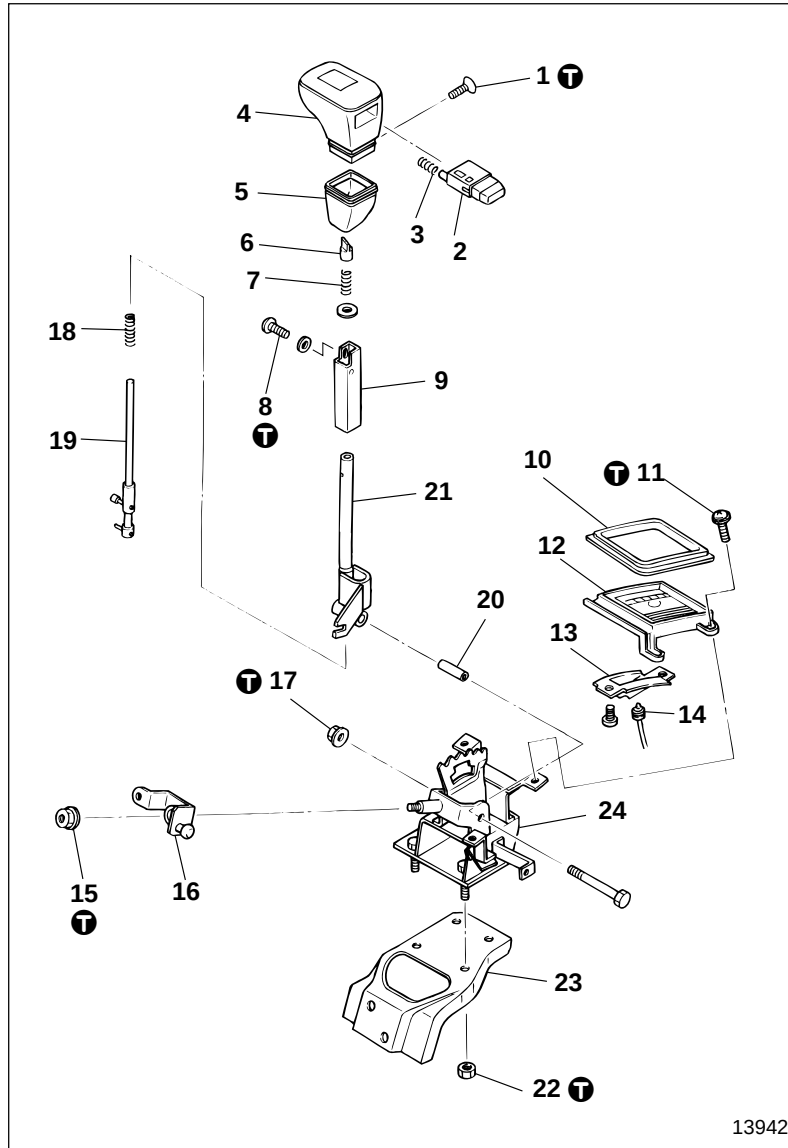


● Inspection after installation

- Make sure that when the range selector lever ★ on the driver's side is operated, the detent positions of selector lever 8 on the automatic transmission side agree with the corresponding positions of the range selector lever on the driver's side. Also make sure that the range selector lever on the driver's side and the selector lever on the automatic transmission side are both operating smoothly.
- Make sure the modulator cable moves smoothly.
- Make sure the starter switch can be operated only in the neutral position, and is disabled for all other positions.
- Make sure the backup lamps light when the selector is in the reverse (R) position.
(The lamps do not light when the engine is stopped.)

AUTOMATIC TRANSMISSION CONTROL

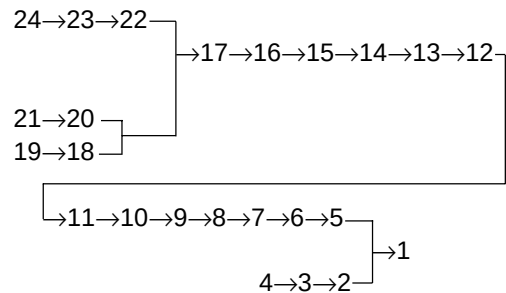
Range Selector Lever



● Disassembly sequence

- 1 Screw
- 2 Push button
- 3 Spring
- 4 Knob assembly
- 5 Cover
- 6 Sleeve
- 7 Spring
- 8 Screw
- 9 Pipe
- 10 Indicator rubber
- 11 Screw
- 12 Panel assembly
- 13 Holder
- 14 Indicator lamp
- 15 Nut
- 16 Range selector lever B
- 17 Nut
- 18 Spring
- 19 Rod assembly
- 20 Pipe
- 21 Range selector lever A
- 22 Nut
- 23 Set board bracket
- 24 Set board assembly

● Assembly Sequence



Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Screw (Knob assembly mounting)	2 {1.4, 0.2}	—
8	Screw (Pipe mounting)	2 {1.4, 0.2}	—
11	Screw (Panel assembly mounting)	2 {1.4, 0.2}	—
15	Nut (Range selector lever B mounting)	9.8 to 15 {7.2 to 11, 1.0 to 1.5}	—
17	Nut (Range selector lever A mounting)	9.8 to 15 {7.2 to 11, 1.0 to 1.5}	—
22	Nut (Setboard bracket mounting)	21 to 30 {16 to 22, 2.15 to 3.05}	—

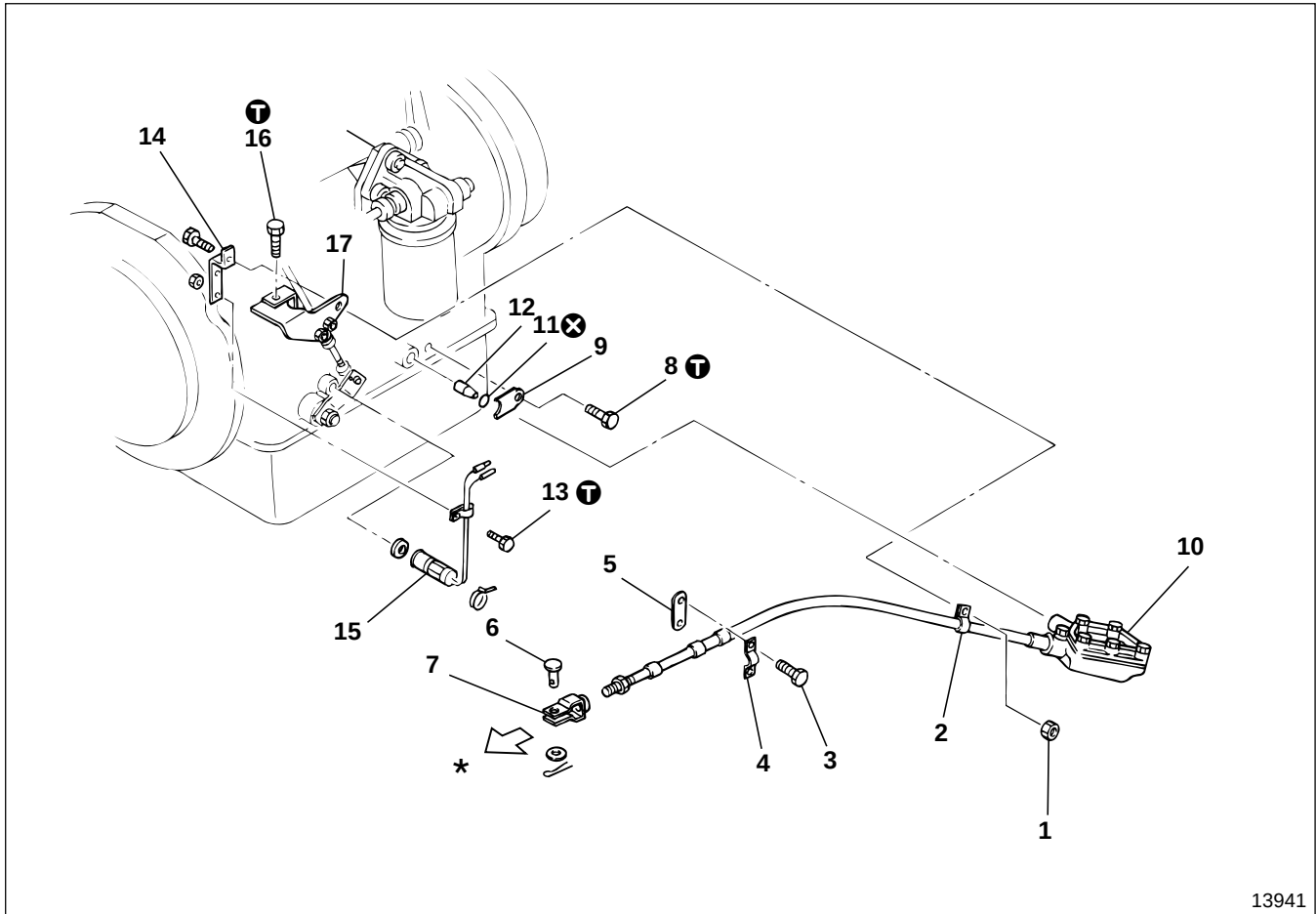
Lubricant

Location	Points of application	Kinds	Quantity
—	All sliding areas	Chassis grease [NLGI No.1 (Ca soap)]	As required

MEMO

AUTOMATIC TRANSMISSION CONTROL

Modulator Assembly and Neutral Start Switch



13941

● Removal sequence

- | | | |
|--------------|-----------------------|--------------------------------|
| 1 Nut | 8 Bolt | 14 Bracket |
| 2 Clip | 9 Retainer | 15 Neutral start switch Gr 54 |
| 3 Screw | 10 Modulator assembly | 16 Bolt |
| 4 Clamp | P23-25 | 17 Bracket |
| 5 Shim | 11 O-ring | |
| 6 Clevis pin | 12 Valve rod | *: To injection pump Gr 13 |
| 7 Clevis | 13 Bolt | ⊗ : Non-reusable parts |

● Installation sequence

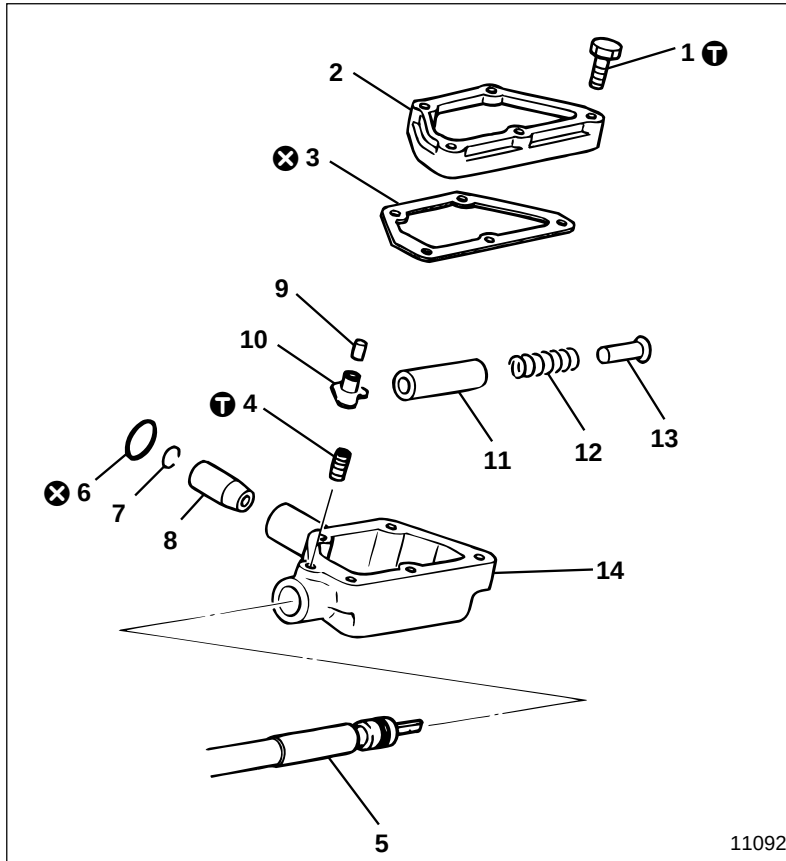
17→16→15→14→13→12→11
 10→9→8→7→6→5→4→3→2→1

Ⓙ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Bolt (Retainer mounting)	17±2.5 {13±1.8, 1.75±0.25}	—
13	Bolt (Clamp mounting)	3.9 to 5.9 {2.9 to 4.3, 0.4 to 0.6}	—
16	Bolt (Bracket mounting)	59 to 83 {43 to 61, 6.0 to 8.5}	—

Modulator Assembly



11092

● Disassembly sequence

- 1 Screw
- 2 Cover
- 3 Gasket
- 4 Set screw
- 5 Cable assembly
- 6 O-ring
- 7 Snap ring
- 8 Plunger
- 9 Dwell pin
- 10 Lever
- 11 Retainer
- 12 Spring
- 13 Thimble
- 14 Housing

⊗ : Non-reusable parts

● Assembly sequence

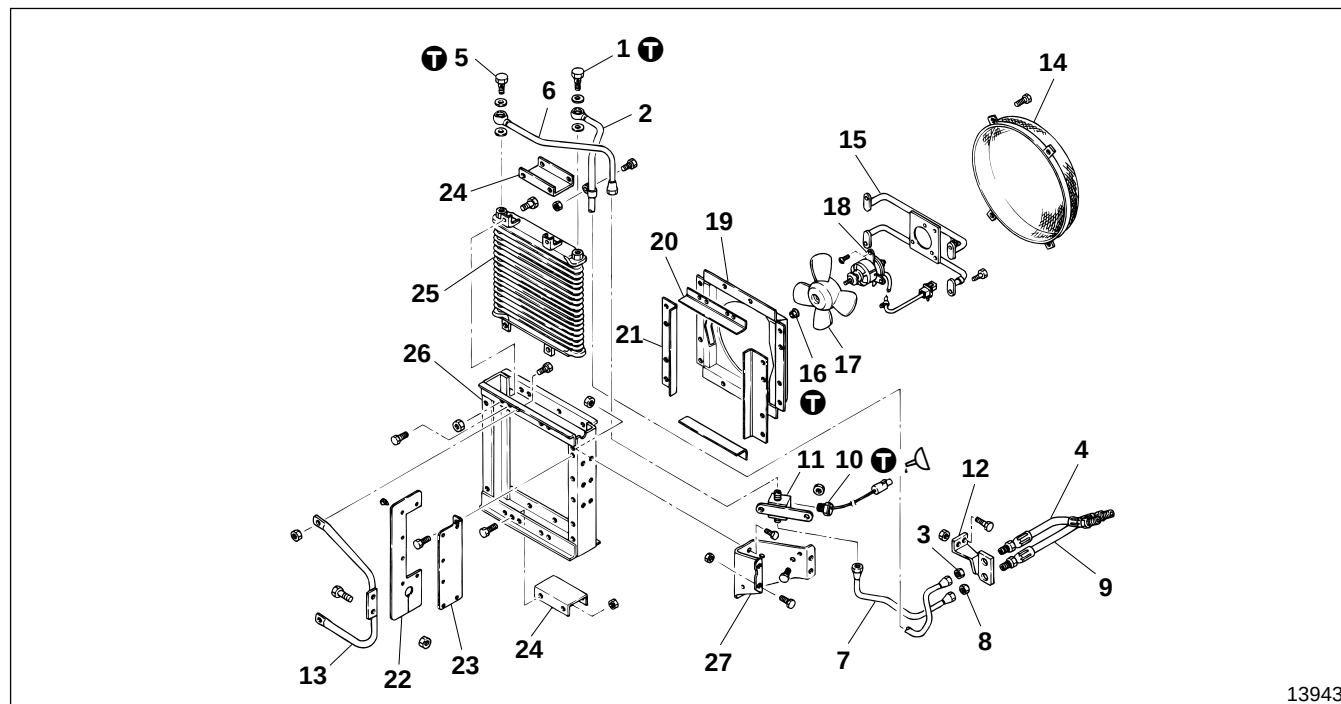
Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Screw (Cover mounting)	4.8±0.3 {3.5±0.2, 0.49±0.03}	—
4	Set screw (Cable assembly mounting)	2.5±0.3 {1.9±0.2, 0.26±0.03}	—

OIL COOLER



13943

● Removal sequence

- | | | |
|--|--------------------------|-------------------------|
| 1 Eye bolt | 11 Connector | 22 Baffle plate |
| 2 Oil pipe | 12 Hose bracket | 23 Baffle plate bracket |
| 3 Nut | 13 Oil cooler stay | 24 Stay |
| 4 Oil hose | 14 Fan cover | 25 Oil cooler |
| 5 Eye bolt | 15 Fan motor bracket | 26 Oil cooler bracket |
| 6 Oil pipe | 16 Nut | 27 Oil cooler support |
| 7 Oil pipe | 17 Fan assembly | |
| 8 Nut | 18 Motor assembly Gr 54 | |
| 9 Oil hose | 19 Fan shroud | |
| 10 Automatic transmission fluid thermostat switch Gr 54 | 20 Fan shroud A | |
| | 21 Fan shroud B | |

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

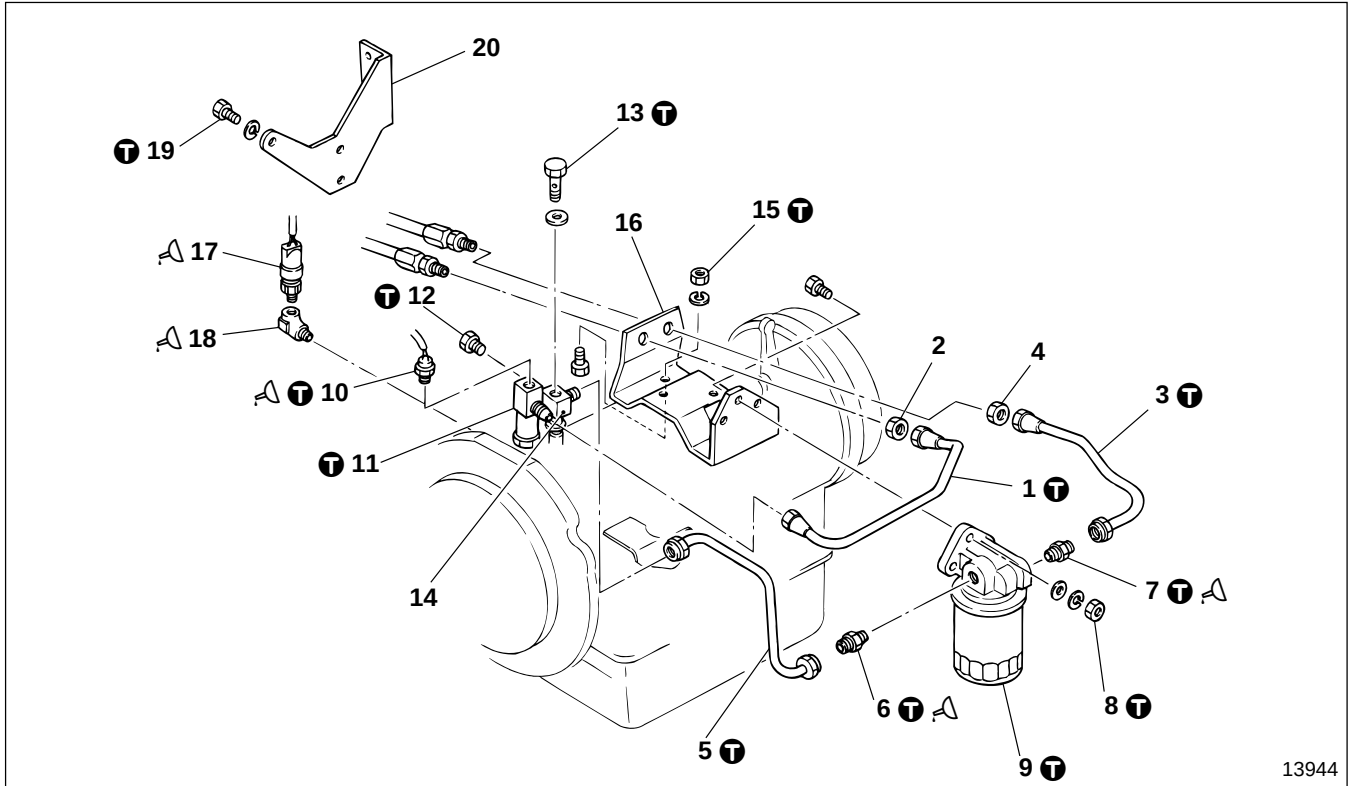
Location	Parts to be tightened	Tightening torque	Remarks
1, 5	Eye bolt	59 to 88 {43 to 65, 6 to 9}	—
10	Automatic transmission fluid thermostat switch	29 to 39 {22 to 29, 3 to 4}	—
16	Nut (Fan assembly mounting)	4.2 to 5.2 {3.1 to 3.8, 0.43 to 0.53}	—

Sealant

Location	Points of application	Kinds	Quantity
10	Automatic transmission fluid thermostat switch	THREEBOND 1110B	As required

MEMO

OIL FILTER



13944

● Removal sequence

- | | | |
|-------------|--|---|
| 1 Oil pipe | 8 Nut | 14 Union joint |
| 2 Nut | 9 Oil filter | 15 Nut |
| 3 Oil pipe | 10 Automatic transmission fluid temperature switch  Gr 54 | 16 Oil filter bracket |
| 4 Nut | 11 Connector | 17 Backup lamp switch  Gr 54 |
| 5 Oil pipe | 12 Plug | 18 Connector |
| 6 Connector | 13 Eye bolt | 19 Bolt |
| 7 Connector | | 20 Hand brake cable bracket |

● 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, 3, 5	Oil pipe	69 to 93 {51 to 69, 7.0 to 9.5}	—
6, 7	Connector	59 to 98 {43 to 72, 6 to 10}	—
8	Nut (Oil filter mounting)	21 {15, 2.13}	—
9	Oil filter (Cartridge mounting)	9.8 to 20 {7.2 to 14, 1 to 2}	—
10	Automatic transmission fluid temperature switch	29 to 39 {22 to 29, 3 to 4}	—
11	Connector	39 to 49 {29 to 36, 4 to 5}	—
12	Plug	34±7.8 {25±5.8, 3.5±0.8}	—
13	Eye bolt	74±15 {54±11, 7.5±1.5}	—
15	Nut (Oil filter bracket mounting)	115 to 155 {87 to 115, 12 to 16}	—
19	Bolt (Hand brake cable bracket mounting)	58 to 68 {43 to 50, 5.9 to 6.9}	—

 Sealant

Location	Points of application	Kinds	Quantity
6, 7, 17, 18	Connector and thread area of backup lamp switch	THREEBOND 1207B	As required
10	Thread area of automatic transmission fluid temperature switch	THREEBOND 1110B	As required



FH

Service Manual

Group 25

Propeller Shaft

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

GROUP 25 PROPELLER SHAFT

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
TROUBLESHOOTING	3
REMOVAL AND INSTALLATION OF PROPELLER SHAFT	4
REAR PROPELLER SHAFT	6
FRONT PROPELLER SHAFT	10
BALANCING PROPELLER SHAFT	14

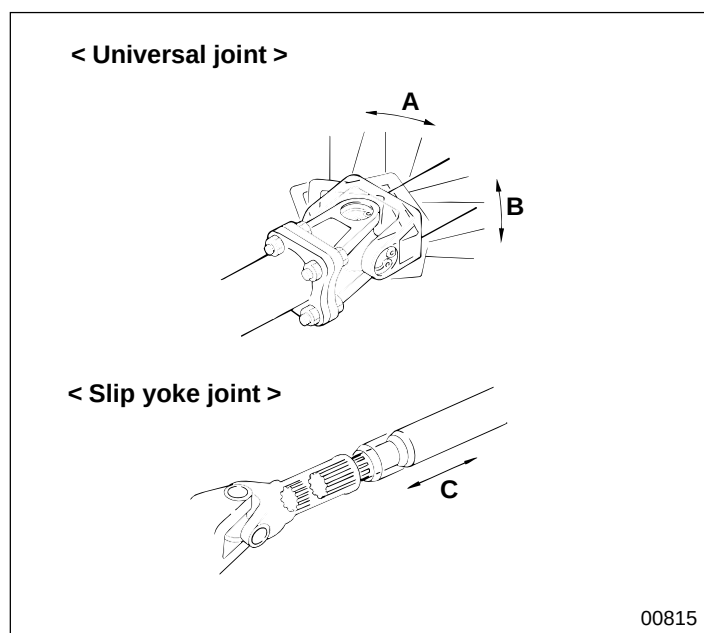
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item			Specifications
Propeller shaft	Model		P4
Pipe	Outer diameter×Wall thickness	mm {in.}	90×2.6 {3.54×0.10}
Universal joint	Spider outer diameter	mm {in.}	26.7 {1.05}
Needle bearing	Outer diameter	mm {in.}	3.0 {0.12}
	Length of needle roller	mm {in.}	21.8 {0.86}
	Quantity of needle rollers		31
Slip yoke joint	Spline diameter	mm {in.}	48 {1.89}
Center bearing	Model No.		6209
	Inner diameter×Outer diameter	mm {in.}	45×85 {1.77×3.35}

STRUCTURE AND OPERATION

Swing of Propeller Shaft



A : Lateral swing

B : Longitudinal swing

C : Fore-and-aft movement

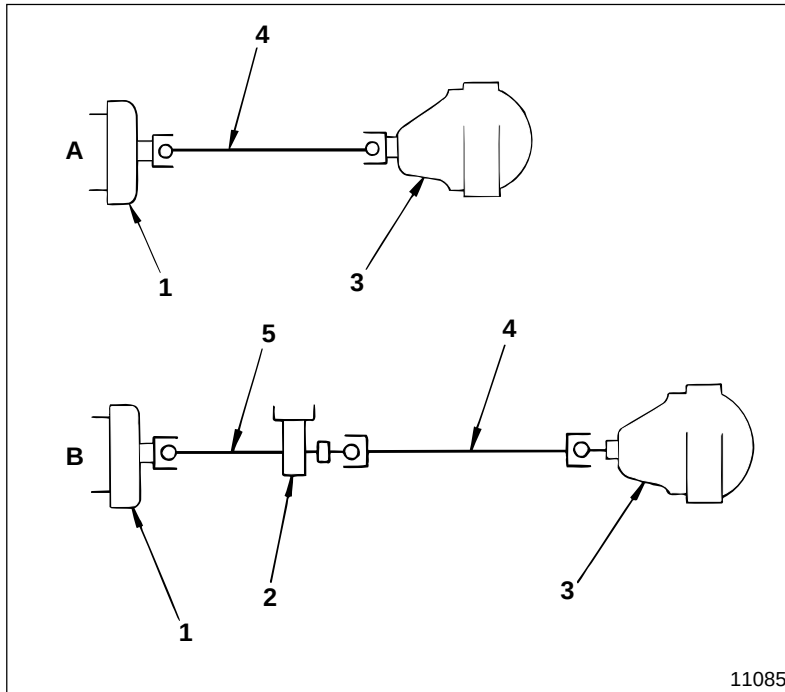
Relative positions of transmission and rear axle vary depending on the fluctuation of the road surface and load carried when operating the vehicle.

The universal joint and the slip yoke joint are provided to absorb these influences.

TROUBLESHOOTING

25

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

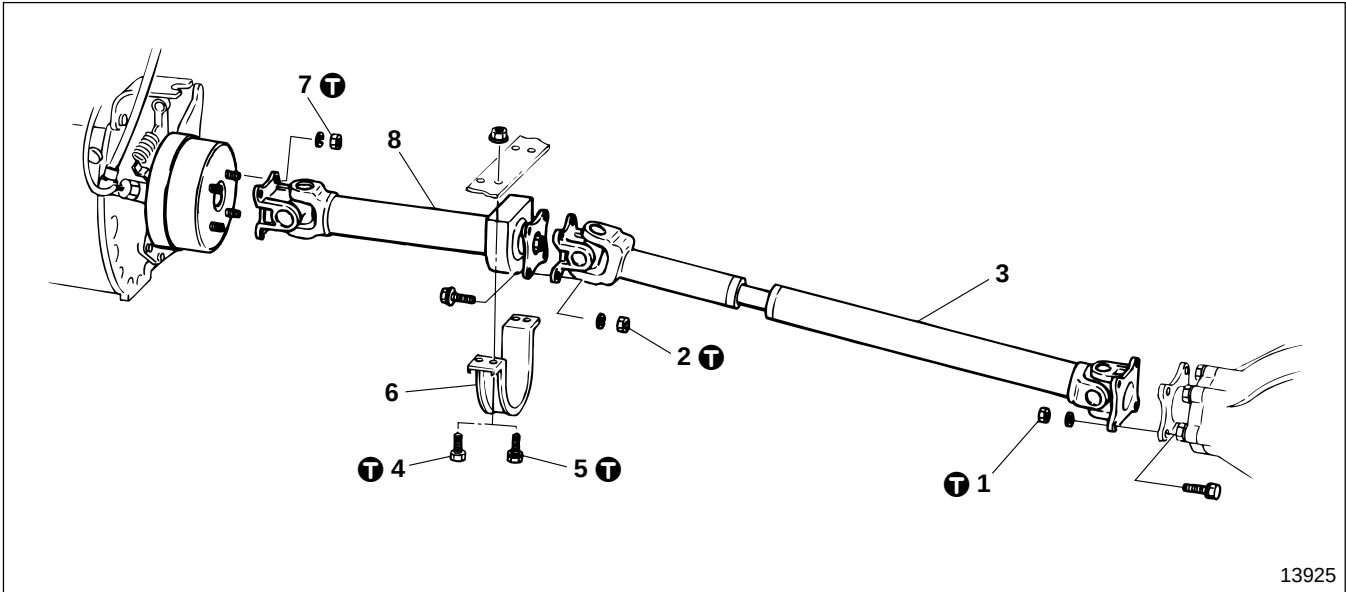
B : Twin-shaft connection

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						○		
	Bracket mounting bolt loose						○		
Propeller shaft	Mounting bolt loose			○			○		
	Bent			○					
	Dynamic balance adjusted incorrectly			○					
Transmission gear selection too high					○				

REMOVAL AND INSTALLATION OF PROPELLER SHAFT



13925

● Work before removal

📖 P25-4

● Removal sequence

- | | | |
|------------------------|--------------------------|-------------------------|
| 1 Nut | 4 Bolt | 8 Front propeller shaft |
| 2 Nut | 5 Bolt | 📖 P25-10 |
| 3 Rear propeller shaft | 6 Center bearing bracket | |
| 📖 P25-6 | 7 Nut | |

● Installation sequence

Follow the removal sequence in reverse.

⚙ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Propeller shaft mounting at rear axle side)	85 {61, 8.5}	—
2	Nut (Propeller shaft mounting at center bearing side)	85 {61, 8.5}	—
4	Bolt (Center bearing bracket mounting)	39 to 59 {28 to 43, 3.9 to 6.0}	—
5	Bolt (Center bearing bracket mounting)	36 to 52 {25 to 40, 3.5 to 5.5}	With spring washer
7	Nut (Propeller shaft mounting at propeller shaft side)	85 {61, 8.5}	—

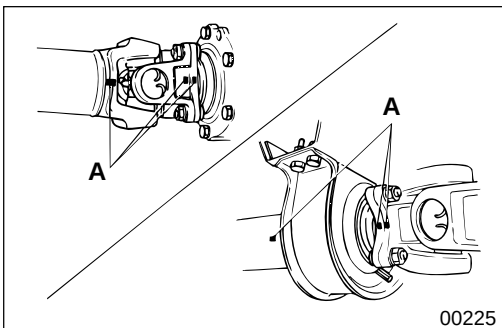
◆ Service procedure

● Work before removal

WARNING ⚠

- Since the propeller shaft will be removed, the parking brake cannot be used. Therefore, you must chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.

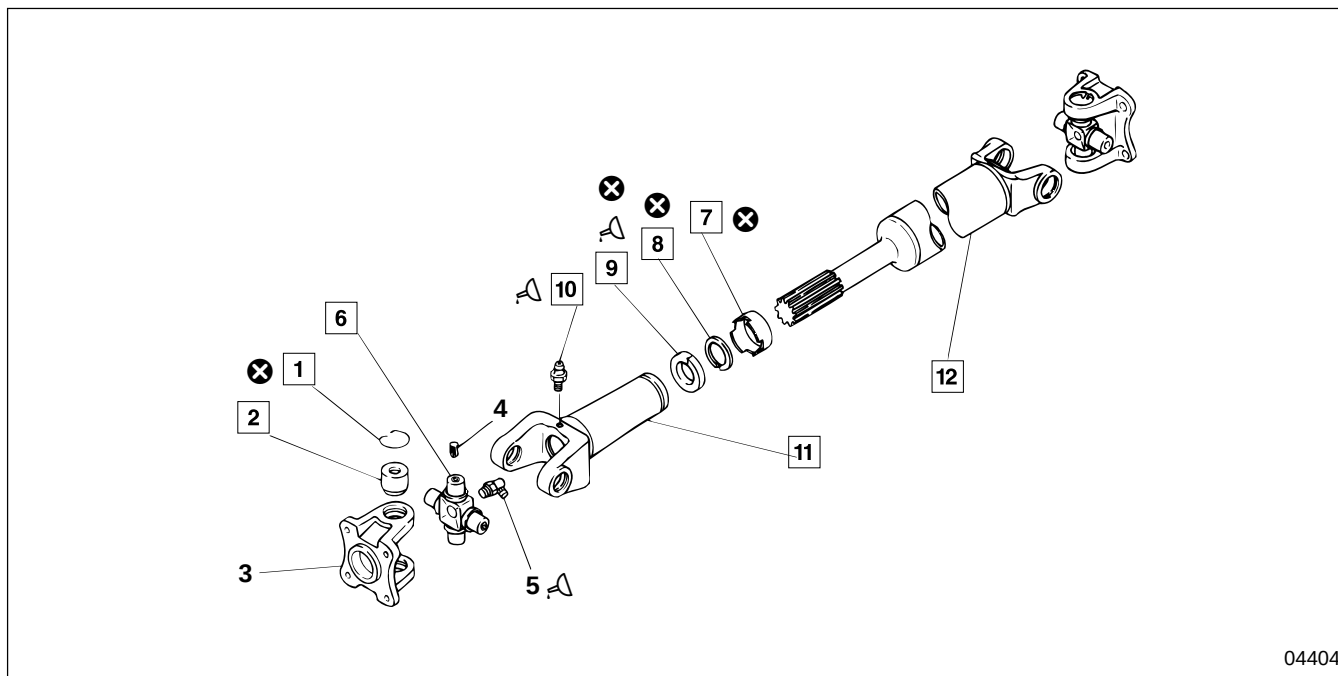
Remember to make alignment marks **A** before removal.



00225

MEMO

REAR PROPELLER SHAFT



● Inspection before disassembly

📖 P25-7

● Disassembly sequence

- | | | |
|------------------|------------------|-------------------------|
| 1 Snap ring | 6 Spider | 11 Slip yoke joint |
| 2 Needle bearing | 7 Dust cap | 12 Rear propeller shaft |
| 3 Flange yoke | 8 Retainer | |
| 4 Grease keeper | 9 Cork seal | |
| 5 Grease nipple | 10 Grease nipple | |

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Universal joint spider kit

Service standards

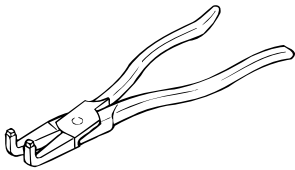
Unit : mm {in.}

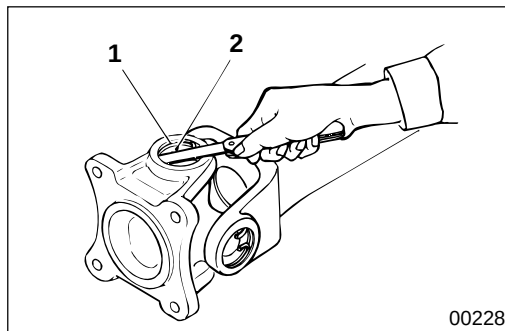
Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
1 to 6	Clearance in axial direction of spider	0 to 0.25 {0 to 0.0098}	—	Adjust
2, 6	Clearance between needle bearing and spider	[26.7] 0.02 to 0.07 {[1.05] 0.00079 to 0.0028}	0.2 {0.0079}	Replace
11, 12	Play to revolving direction between slip yoke joint and rear propeller shaft	0.07 to 0.18 {0.0028 to 0.0071}	0.3 {0.012}	Replace
12	Bend of rear propeller shaft (Center)	—	0.6 {0.024}	Correct or replace

Lubricant

Location	Points of application	Kinds	Quantity
5	Supply via grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	Pack until grease overflows from spider dust cover
9	Inner surface of cork seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
10	Supply via grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	Pack until grease overflows from dust plug hole

Special tools

Location	Tool name and shape	Part No.	Application
1	Snap ring repressor  00227	MH061001	Removal and installation of snap ring



◆ Service procedure

● Inspection before disassembly

Clearance in axial direction for spider

Press needle bearing **2** downward firmly, and measure the clearance between snap ring **1** and the needle bearing. If the measured value is higher than the standard value, adjust it by changing the thickness of the snap ring.

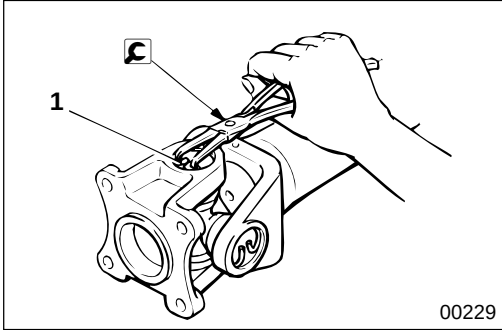
- Available snap ring thicknesses

Part name	Thickness	Identification color
Snap ring A	2.5 mm {0.098 in.}	Green
Snap ring B	2.6 mm {0.10 in.}	Red

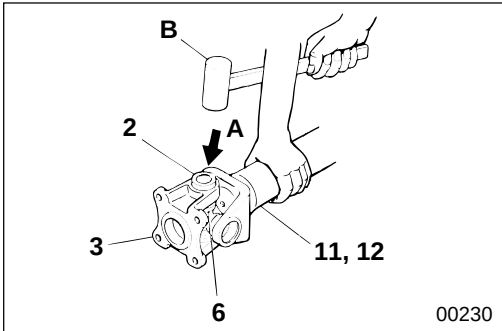
NOTE

For snap ring **1**, it is recommended that you use rings with the same thickness on both ends to ensure balanced revolution.

REAR PROPELLER SHAFT



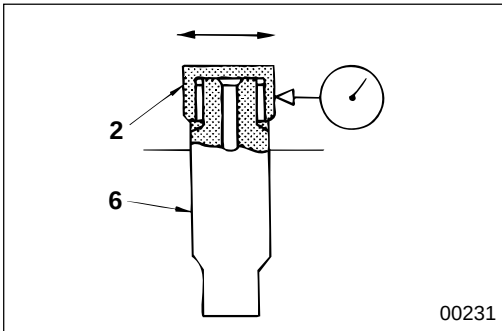
1 Removal and installation of snap ring



2 Removal of needle bearing

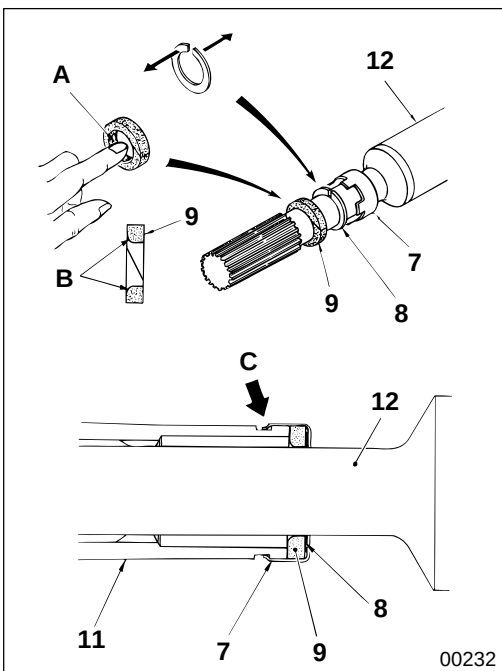
- Make alignment marks on needle bearing **2** and spider **6**.
- Make alignment marks across flange yoke **3**, slip yoke joint **11** and rear propeller shaft **12**.
- Hit the yoke lightly at shoulder area **A** so that needle bearing **2** bounces out due to reaction.

B : Mallet



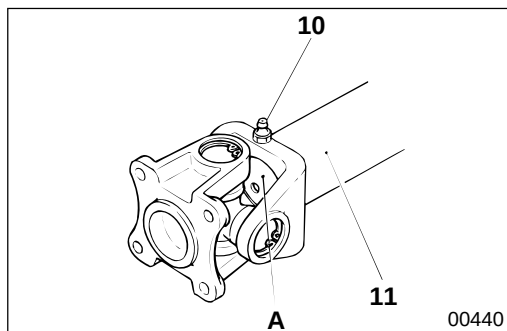
2 6 Clearance between needle bearing and spider

Measure the play towards the diameter direction between needle bearing **2** and spider **6**. If the measured value is higher than the limit, replace with universal joint spider kit.



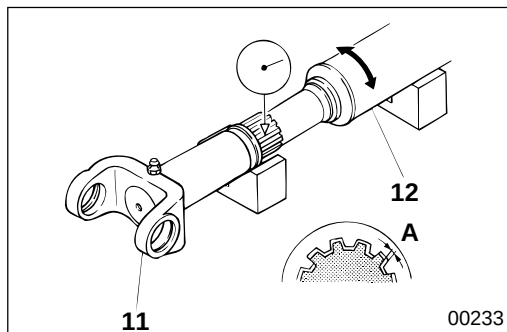
7 to 9 Assembly of dust cap, retainer and cork seal

- Insert dust cap **7** into rear propeller shaft **12** and expand retainer **8** carefully to mount it on the propeller shaft. Then, release the retainer and allow it to return to its original shape.
- Apply grease to inner surface **A** of cork seal **9**, face its chamfered side **B** towards the spline and mount in the same way as retainer **8**.
- Press cork seal **9**, compressing it by 1 to 2 mm {0.039 to 0.079 in.}, against slip yoke joint **11**, then caulk pawl area **C**.



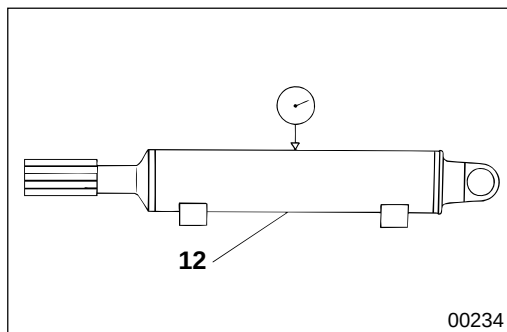
10 Supply of grease via grease nipple

Pack grease via grease nipple **10** until grease starts overflowing from the hole in dust plug **A** of slip yoke joint **11**.



11 12 Play between slip yoke joint and rear propeller shaft spline in rotating direction

Measure play **A** between slip yoke joint **11** and rear propeller shaft **12** at the spline area. If the measured value is higher than the limit, replace the faulty parts.



12 Bend of rear propeller shaft

Measure bend of rear propeller shaft **12** at its center. If the measured value is higher than the limit, correct or replace it.

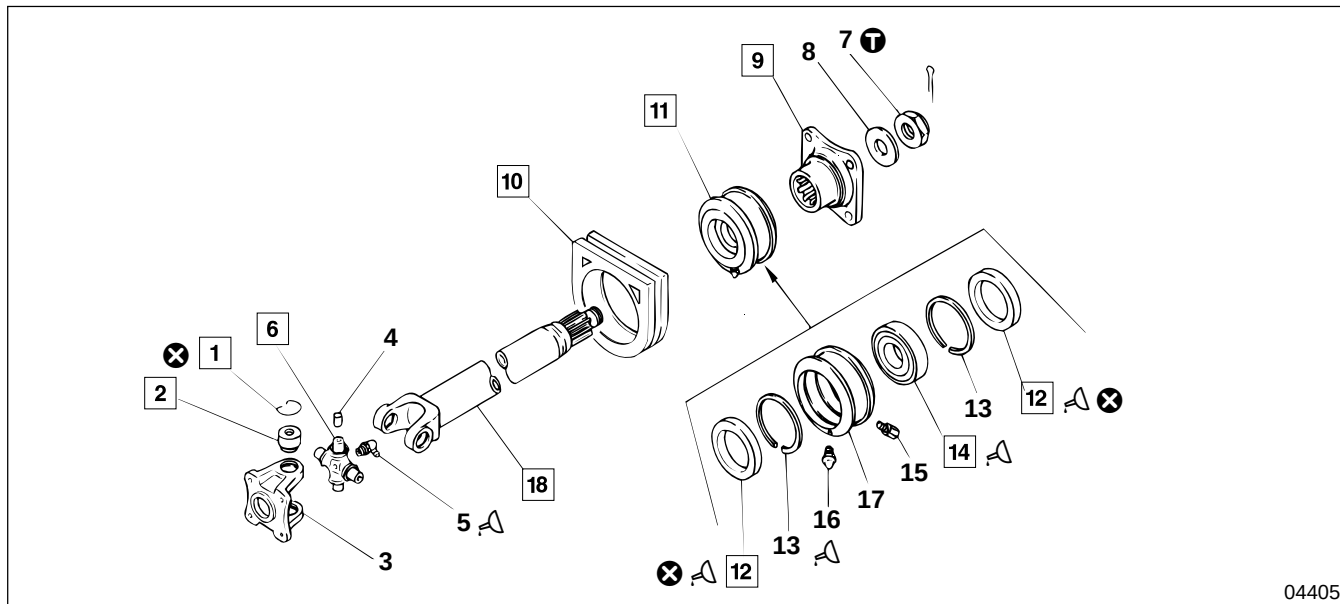
CAUTION ⚠

Be sure to check for cracks at the welded area after straightening has been done by means of a press.

NOTE

To measure the bend of rear propeller shaft **12**, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

FRONT PROPELLER SHAFT



● Inspection before disassembly

📖 P25-11

● Disassembly sequence

- | | | |
|------------------|--------------------|--------------------------|
| 1 Snap ring | 8 Washer | 15 Relief valve |
| 2 Needle bearing | 9 Companion flange | 16 Grease nipple |
| 3 Flange yoke | 10 Cushion rubber | 17 Center bearing case |
| 4 Grease keeper | 11 Center bearing | 18 Front propeller shaft |
| 5 Grease nipple | 12 Oil seal | |
| 6 Spider | 13 Snap ring | |
| 7 Nut | 14 Center bearing | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Universal joint spider kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
1 to 6	Clearance of spider is axial direction	0 to 0.25 {0 to 0.0098}	—	Adjust
2, 6	Clearance between needle bearing and spider	[26.7] 0.02 to 0.07 {[1.05] 0.00079 to 0.0028}	0.2 {0.0079}	Replace
18	Bend of front propeller shaft (Center)	—	0.6 {0.024}	Correct or replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

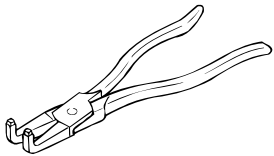
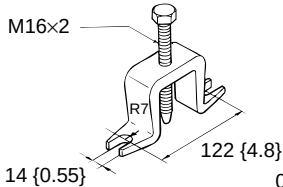
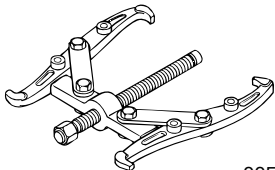
Location	Parts to be tightened	Tightening torque	Remarks
7	Nut (Companion flange mounting)	200 to 340 {145 to 255, 20 to 35}	—

Lubricant

Location	Points of application	Kinds	Quantity
5	Supply via grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	Pack until grease overflows from spider dust cover
12	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
14	Pack area of center bearing assembly that houses ball bearings	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
16	Supply via grease nipple	Wheel bearing grease [NLGI No. 2 (Li soap)]	Pack until grease overflows from relief valve

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Snap ring expander  00227	MH061001	Removal and installation of snap ring
9	Flange puller  00552	MC881524	Removal of companion flange
17	Gear puller  00553	MH061102	Removal of center bearing

◆ Service procedure

● Inspection before disassembly

Clearance in axial direction for spider

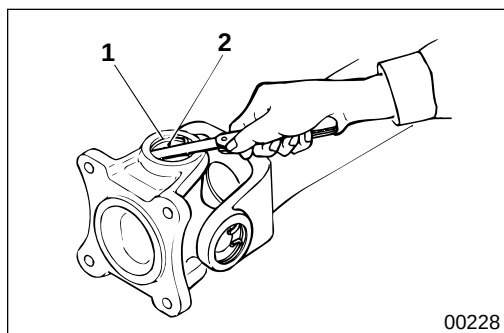
Press needle bearing **2** downward firmly, and measure the clearance between snap ring **1** and the needle bearing. If the measured value is higher than the standard value, adjust it by changing the thickness of the snap ring.

• Available snap ring thicknesses

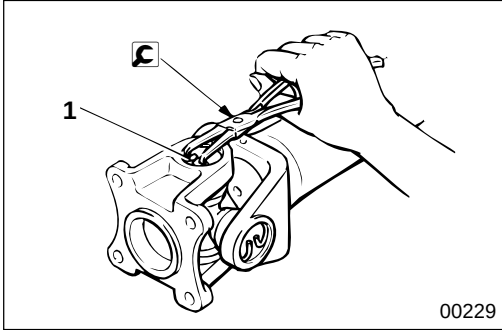
Part name	Thickness	Identification color
Snap ring A	2.5mm {0.098 in.}	Green
Snap ring B	2.6mm {0.10 in.}	Red

NOTE

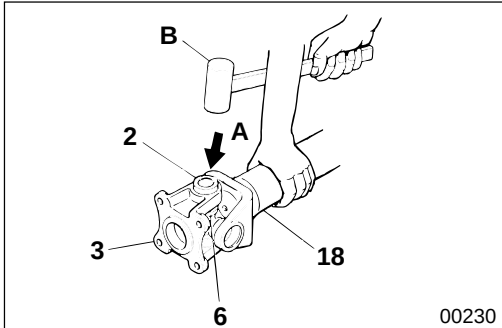
For snap ring **1**, it is recommended that you use rings with the same thickness on both ends to ensure balanced revolution.



FRONT PROPELLER SHAFT



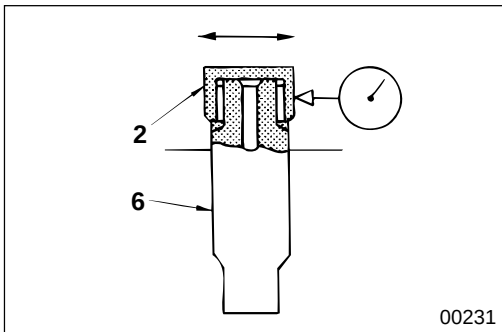
1 Removal and installation of snap ring



2 Removal of needle bearing

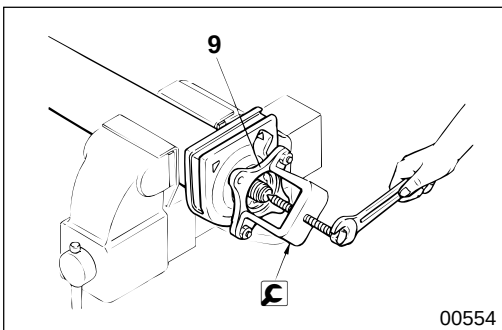
- Make alignment marks on needle bearing **2** and spider **6**.
- Make alignment marks across flange yoke **3** and front propeller shaft **18**.
- Hit the yoke lightly at shoulder area **A** so that needle bearing **2** bounces out due to reaction.

B : Mallet

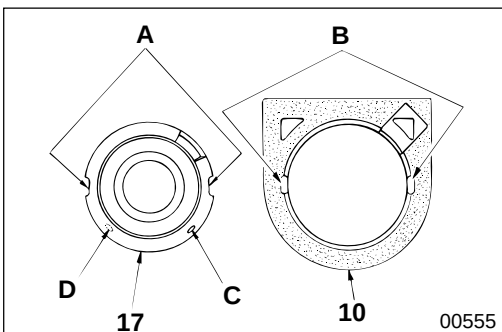


2 6 Clearance between needle bearing and spider

Measure the play towards the diameter direction between needle bearing **2** and spider **6**. If the measured value is higher than the limit, replace with universal joint spider kit.



9 Removal of companion flange

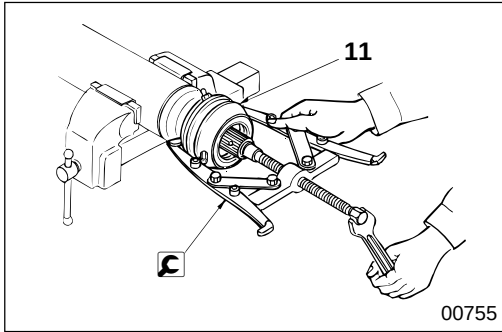


10 Installation of cushion rubber

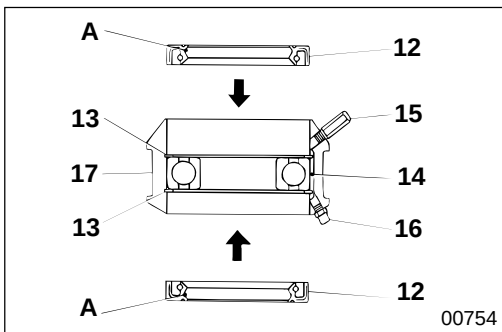
- Align part **A** of center bearing case **17** to part **B** of cushion rubber **10**, and fit them together. When it is hard to fit them together, apply some soapy water to facilitate the fitting work.
- Assemble center bearing case **17** so that grease nipple mounting hole **D** faces downward.

C : Relief valve mounting hole

D : Grease nipple mounting hole

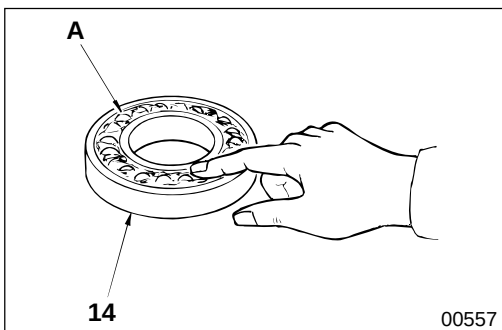


11 Removal of center bearing assembly



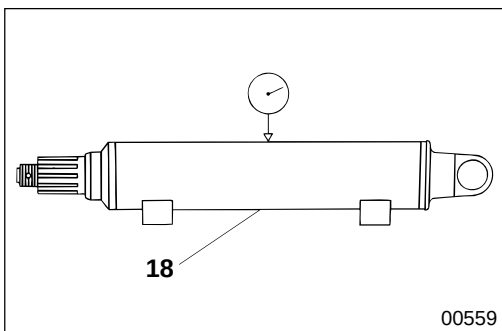
12 Installation of oil seal

- Apply grease to oil seal **12** lip area **A** and install to the direction as illustrated.
- Install oil seal **12** flush with center bearing case **17** end surface.



14 Packing grease in center bearing

Pack grease into the area that houses ball bearings **A** of center bearing **14**.



18 Bend of front propeller shaft

Measure bend of front propeller shaft **18** at its center. If the measured value is higher than the limit, connect or replace it.

CAUTION

Be sure to check for cracks at the welded area after straightening has been done by means of a press.

NOTE

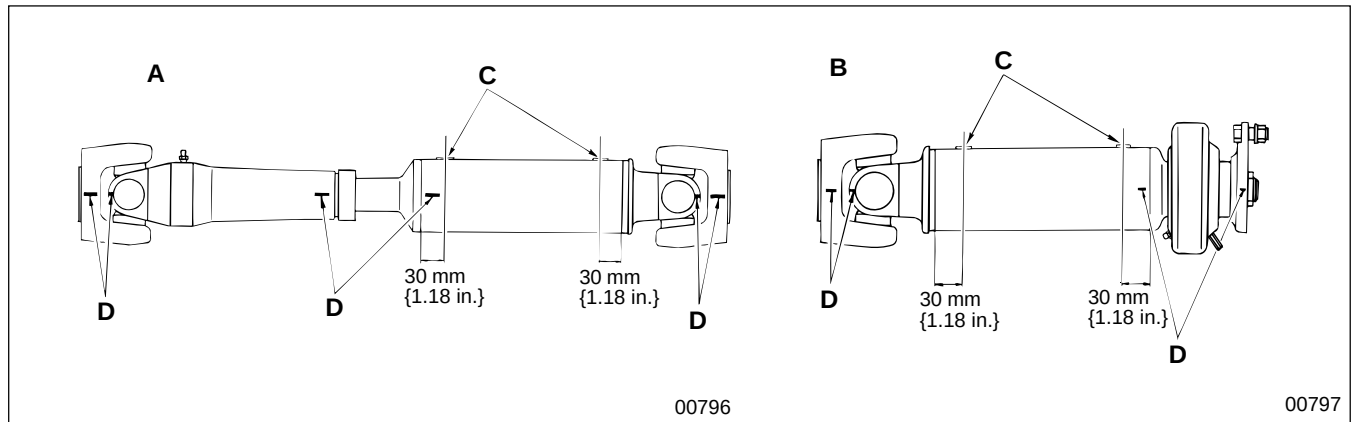
To measure the bend of front propeller shaft **18**, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

BALANCING PROPELLER SHAFT

Adjustment after Assembly

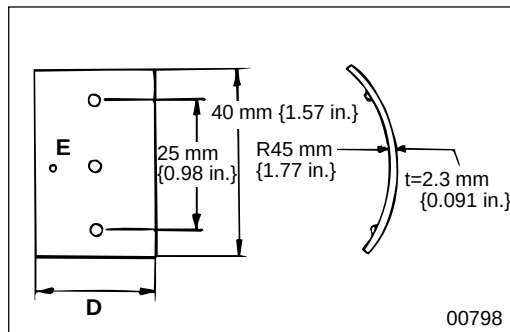
- (1) After correction of propeller shaft deflection, or replacement of flange yoke and universal joint, adjust the amount of balance of the completed propeller shaft assembly on a balancing machine, and adjust by adding balance piece(s) so that the amount comes within the permissible limit.
- (2) For correction of dynamic balance, use the polar coordination method.
- (3) Permissible amount of unbalance
0.49 N·cm {0.0036 lbf.ft, 50 gf·cm}/1600 rpm (Pipe outer periphery)
- (4) Method of correction by way of the polar coordination method

- Balance piece attachment point



A : Rear propeller shaft
B : Front propeller shaft

C : Balance piece attachment point
D : Alignment mark



- Balance pieces available

Part name	Mass {oz}	Dimension D mm {in.}
Balance piece G	10 {0.35}	14 {0.55}
Balance piece A	20 {0.71}	28 {1.1}
Balance piece B	40 {1.41}	55.7 {2.19}
Balance piece C	60 {2.36}	83.5 {3.29}
Balance piece H	30 {1.06}	42 {1.65}

E : Mass punch mark

NOTE

- Maximum balance piece allowed for one point is 120 g {4.23 oz}.
- Use a combination that keeps balance pieces to the minimum.



FH

Service Manual

Group 26

Front Axle

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

GROUP 26 FRONT AXLE

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Adjustment of Wheel Alignment	4
• Adjustment of Steering Angle	8
• Measurement of Side Slip	8
WORK BEFORE REMOVAL AND INSTALLATION OF FRONT AXLE .	9
WHEEL HUB AND BRAKE DRUM	10
FRONT AXLE, KNUCKLE AND KINGPIN	18

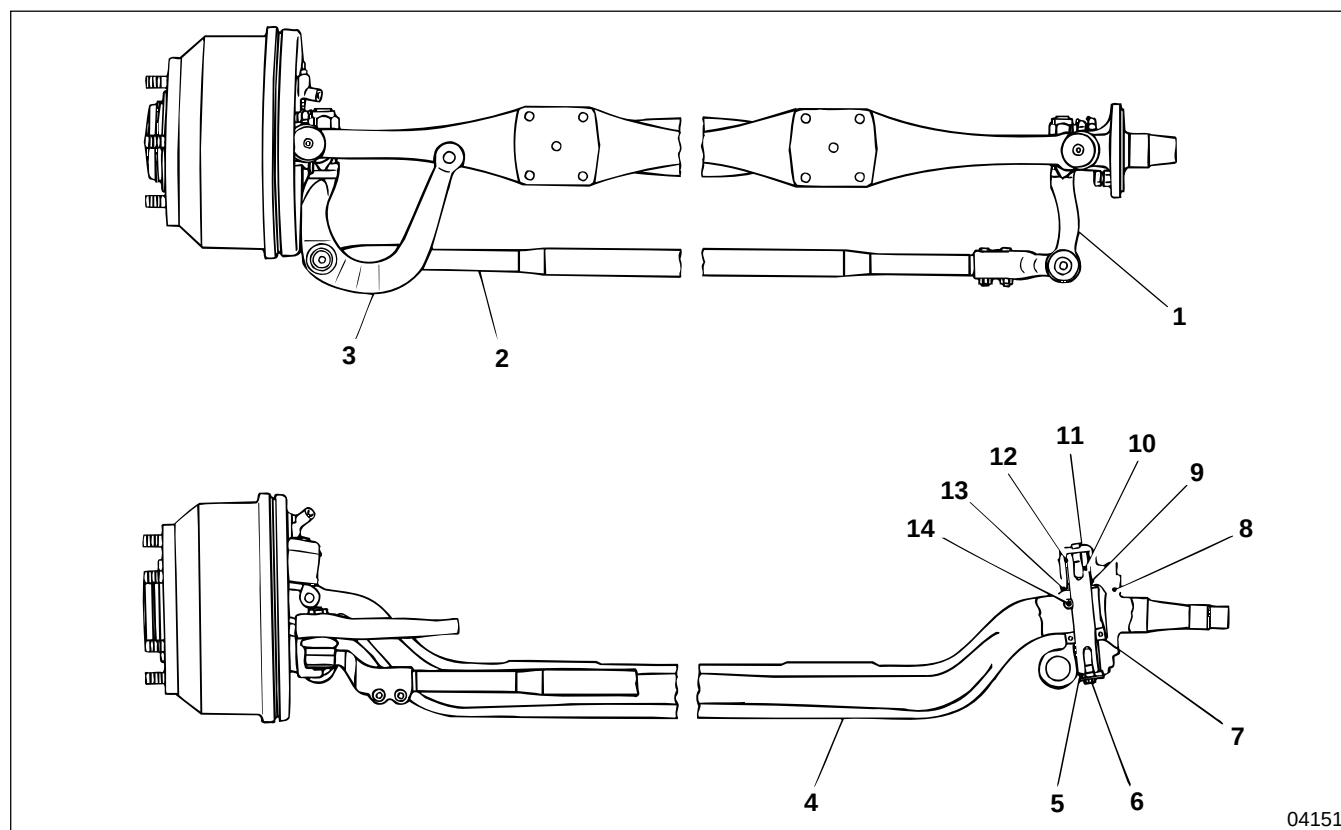
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item		Specifications
Front axle	Model	F040T
	Type	I section, reverse Elliot type
Kingpin	Outer diameter × Length mm {in.}	35×195 {1.38×7.68}
Tread	mm {in.}	1785 {70.3}
Mass	kg {lb}	Approximately 185 {405}

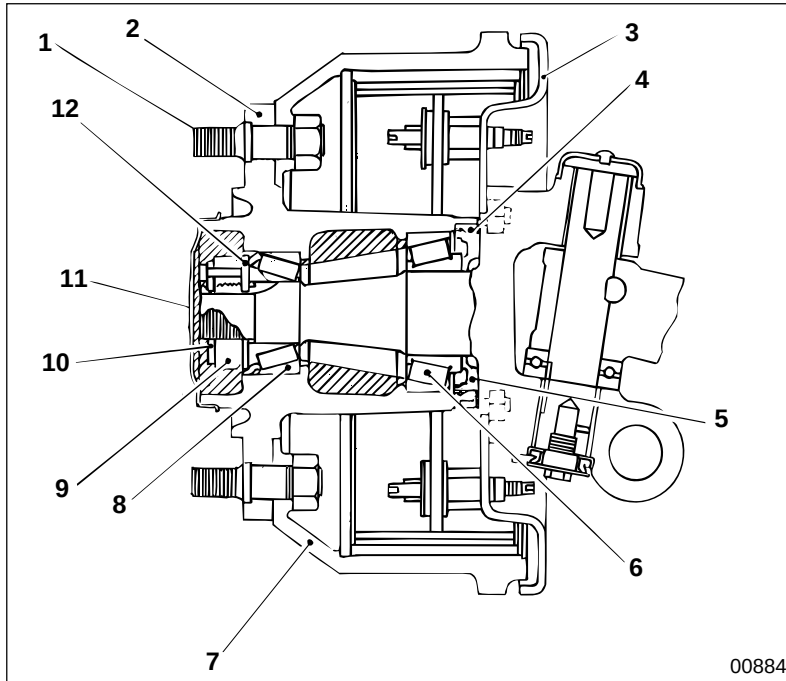
STRUCTURE AND OPERATION

Front Axle, Knuckle and Kingpin



- | | |
|-----------------------|------------------|
| 1 Tie rod arm | 8 Knuckle |
| 2 Tie rod assembly | 9 Oil seal |
| 3 Knuckle arm | 10 Kingpin |
| 4 Front axle | 11 Kingpin cap |
| 5 Dust seal | 12 Bushing |
| 6 Lower kingpin cover | 13 Thrust washer |
| 7 Bearing | 14 Set bolt |

Wheel Hub and Brake Drum



- 1 Hub bolt
- 2 Front wheel hub
- 3 Front brake assembly
- 4 Oil seal
- 5 Knuckle retainer
- 6 Inner bearing
- 7 Front brake drum
- 8 Outer bearing
- 9 Lock nut
- 10 Lock plate
- 11 Wheel hub cap
- 12 Lock washer

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

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±1 {0±0.039}	—	Adjust
		Camber	1°30'±1°00'	—	Adjust
		Caster	2°30' +1°30' -1°00'	—	Adjust
		Kingpin inclination angle	7°00'	7°00'±30'	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

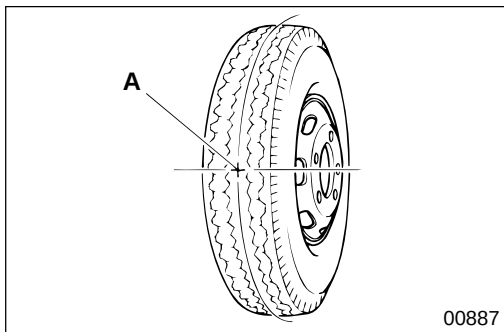
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Tie rod end clamp fastening)	78 {58, 8}	Wet

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:

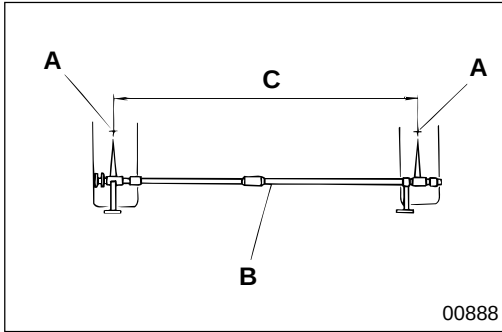
- Play in front wheel hub
- Play or looseness in kingpin
- Play or looseness in the joint between the tie rod and the knuckle arm
- Looseness of any fasteners
- Permanently set or damaged leaf springs
- Incorrect tire pressure
- Power steering booster backlash adjustment incorrect



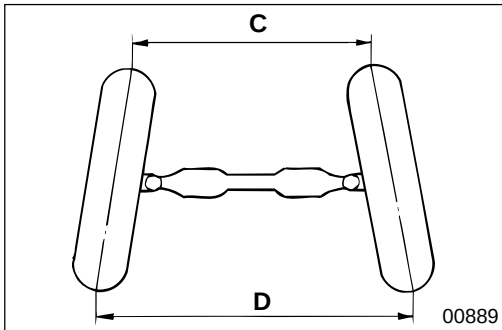
00887

(1) Measurement and adjustment of toe-in

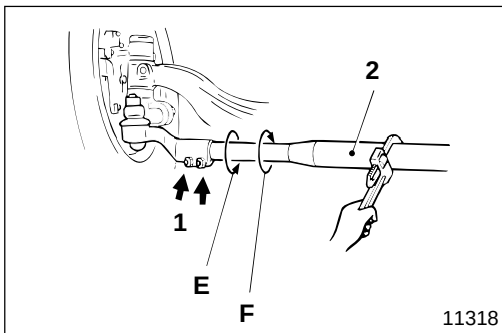
- Point the front wheels forward exactly in running order.
- Put mark **A** on the left and right front tires at the height of front wheel axis and in the middle of the tire width.



- Align the two points of toe-in gauge **B** to the respective marks **A** on the front tires. Measure the distance **C** between the marks at the front of the vehicle.



- Rotate the tires 180° and measure distance **D** between the marks at the rear of the vehicle with the tires on the ground.
- Check if the difference between distances **C** and **D** is within the standard value.

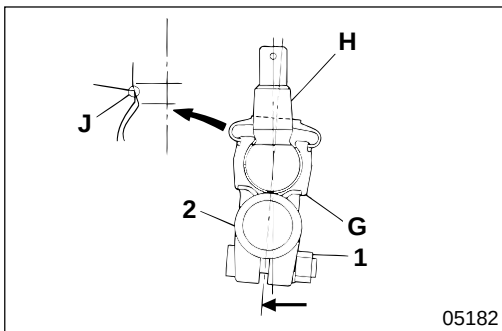


- If the measured value deviates from the standard value, with the tires pointed forward, loosen the left and right pairs of nuts **1**. (Total four nuts)
- Adjust the toe-in to the standard value by turning tie rod **2** with a pipe wrench.

E : To adjust toe-in outward.

F : To adjust toe-in inward.

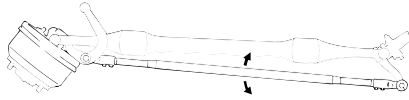
(★ : If tie rod **2** does not swing after the adjustment on P26-6, redo from this item.)



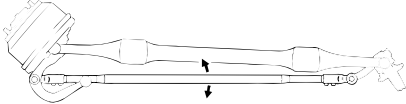
- When tightening nuts **1**, push down and hold tie rod **2** backward or forward in the longitudinal direction of the vehicle so that left and right tie rod ends **G** are in contact (**J** as illustrated) with ball studs **H** at the same time.
- Tighten nuts **1** without allowing tie rod ends **G** to move backward or forward in the longitudinal direction of the vehicle.
- If you have to do the above work on your own; after you tighten nuts on one side of tie rod end **G**, when you tighten the nuts on the other end of the tie rod, make sure you keep the tie rod pushed down in the same direction.

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Steering wheel turned to the left



Steering wheel turned to the right



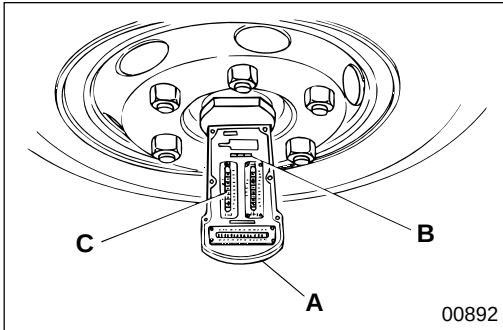
11319

- After adjustment, turn the steering wheel to the left (until the knuckle stopper bolt is contacted), then shake tie rod 2 backward and forward in the longitudinal direction of the vehicle and see if the tie rod moves. Do the same with the steering wheel turned to the right. (If the tie rod can be moved, it means that tie rod end G and ball stud H are in simultaneous contact.)

WARNING

You must be careful not to catch your hand when turning the steering wheel to the left or right, since the tie rod moves.

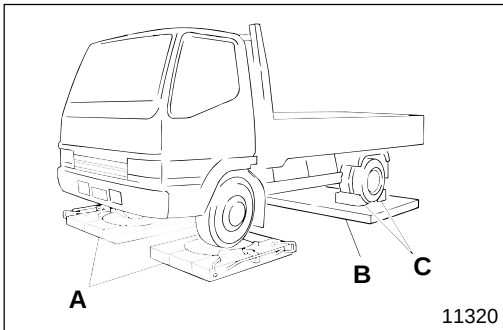
- If tie rod 2 does not swing, redo the procedure from the item marked ★.  P26-5



00892

(2) Measurement of camber

- Point the front wheels exactly forward.
 - Remove the hub caps.
 - Wipe off grease from the knuckle end, and attach camber/caster/kingpin gauge A to the knuckle.
 - While keeping the bubble in level B centered, measure the camber angle by reading the scale mark at the center of the bubble on camber scale C.
- Follow this procedure to measure the camber angles on the left and right sides.



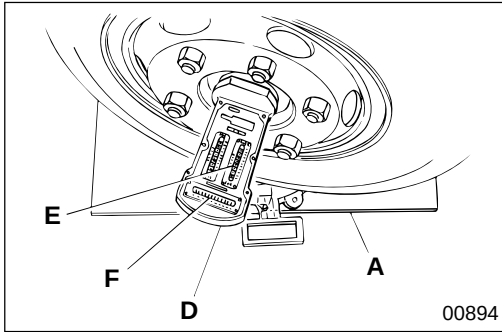
11320

(3) Measurement of caster and kingpin inclination angle

- Prepare a platform B having the same height as turning radius gauges A and place the platform under the rear wheels so that the vehicle is kept level.
- Keep the turning radius gauges A locked.
- Jack up the vehicle and set the left and right wheels so that the ground contact area of both front tires and the turntables of turning radius gauges A meet at their respective centers.

WARNING

- After jacking up the vehicle, chock the rear wheels securely with chocks C.
- Do not remove chocks C until the entire operation is completed.



- Unlock turning radius gauge **A**, and set the scale to 0°.
- As in measuring camber explained previously, attach camber/caster/kingpin gauge **D** tightly to the front wheel hub and keep the bubble centered.
- Apply the brake to the front wheels and turn the steering wheel slowly from the 0° point on the scale of turning radius gauge **A**, until direction changes 20° to the left for the left front wheel and 20° to the right for the right front wheel.

NOTE

It is not possible to obtain an exact reading of camber unless the brake is applied to the front wheels because the tires might rotate slightly.

- At the 20° point, align the bubbles in caster scale **E** and kingpin scale **F** to 0° by turning the adjuster.

NOTE

Kingpin scale F has scales for left and right; use the left scale when adjusting the left wheel, and the right scale when adjusting the right wheel.

- Turn the steering wheel slowly until the left front wheel changes its direction 20° to the right, or until the right front wheel changes its direction 20° to the left, past the 0° point of turning radius gauge **A** scale. At this point read the scale marks at the center of the bubbles on caster scale **E** and kingpin scale **F**. The scale marks indicate the caster and kingpin inclination angles.

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Adjustment of Steering Angle

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Steering angle	Inside (Outside: reference)	54° (38°52')	—	Adjust

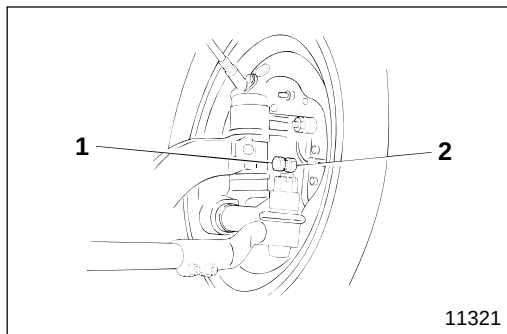
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Lock nut (Knuckle stopper bolt fastening)	71±12 {52±9, 7.25±1.25}	—

NOTE

Be sure that wheel alignment is adjusted perfectly before adjusting the steering angle.

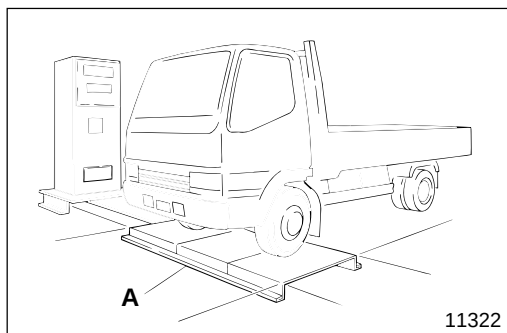


- To adjust the steering angle, set the turning radius gauges and platform in the same way as for caster and kingpin inclination angle measurement.
- Turn the steering wheel to the left or right completely, and from the position where the turning radius gauge is aligned to 0°, adjust knuckle stopper bolt **1**. Adjust so that the steering angle is within the standard inside steering angle value, to the left for the left front wheel, and to the right for the right front wheel. Then, tighten lock nut **2** at specified torque.

Measurement of Side Slip

NOTE

Be sure that wheel alignment is adjusted fully before measuring side slip.

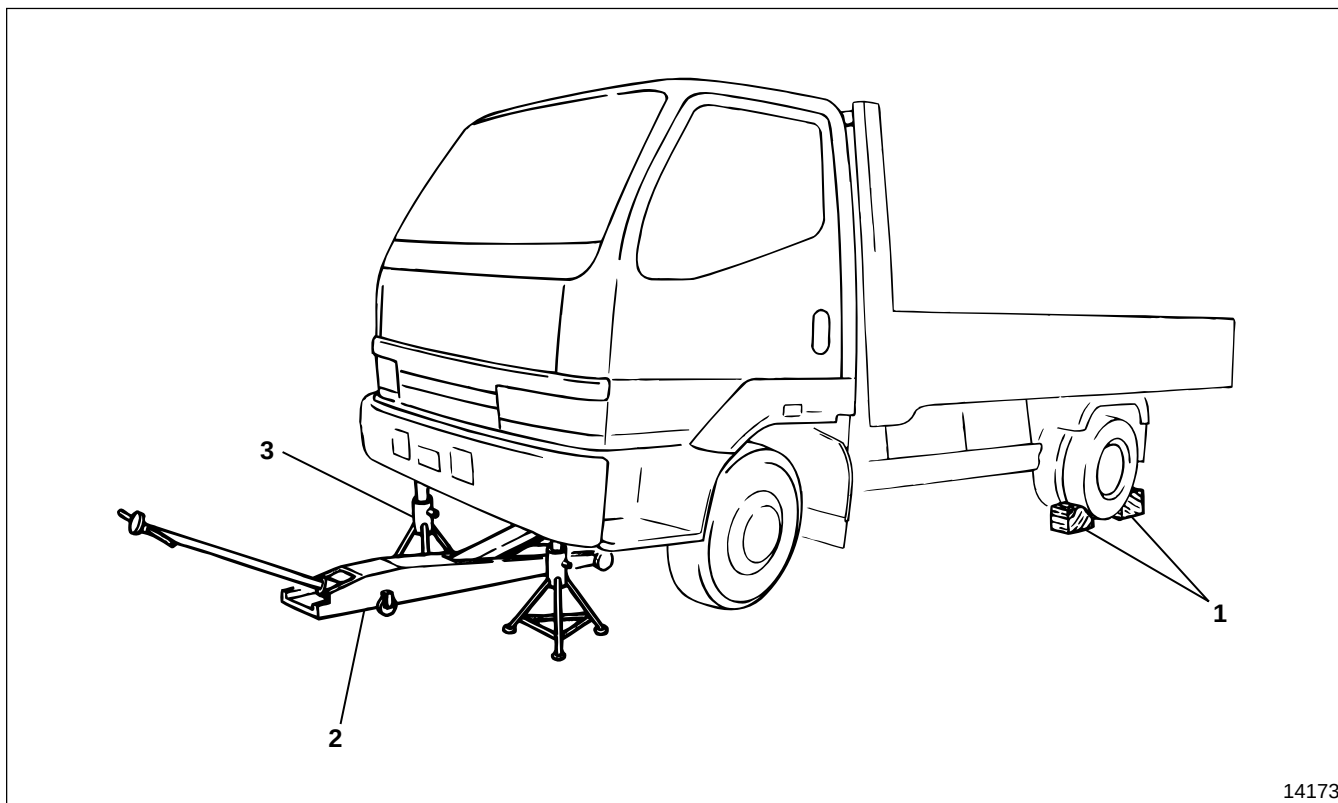


- Point the front wheels exactly forward.
- Maintain this position and slowly move vehicle forward, over side slip tester **A**, as slowly as possible.

NOTE

Make sure, when measuring side slip, that the wheels point exactly forward when the vehicle passes over side slip tester **A**. Do not allow the wheels to veer from side-to-side.

- The side slip is indicated by side slip tester **A** after the vehicle has passed through the tester. Readjust wheel alignment if slippage is 3 mm {0.12 in.} or more per meter {3.28 ft.}.



14173

● Work sequence before removal

- 1 Place wheel chocks.
- 2 Jack up the front axle with a garage jack.
- 3 Support the front frame on rigid racks.

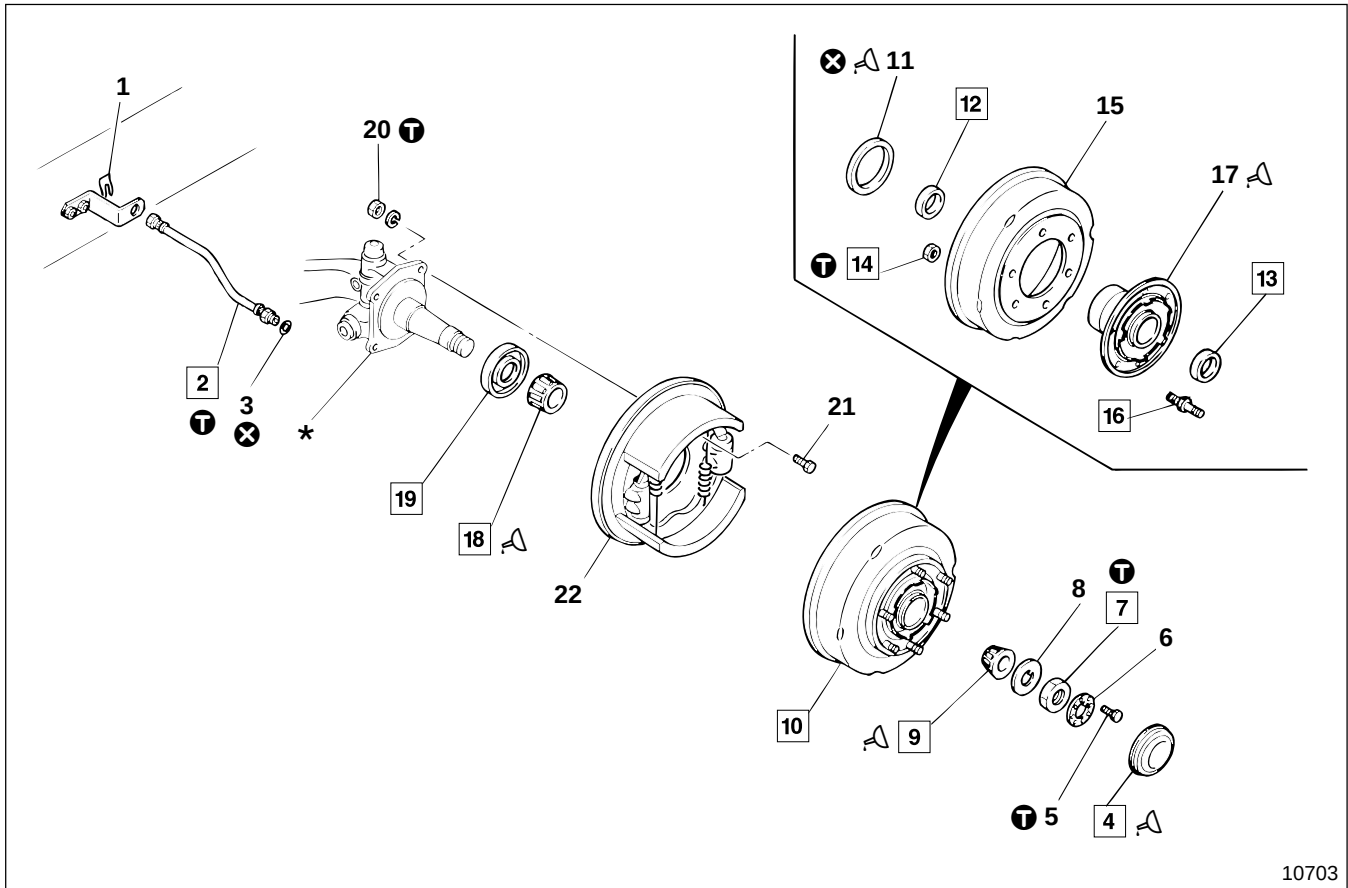
WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

● Work sequence after installation

Follow the work sequence before removal in reverse.

WHEEL HUB AND BRAKE DRUM



10703

Disassembly sequence

- | | | |
|----------------------------|--------------------------------------|-----------------------------|
| 1 Clip | 10 Wheel hub and brake drum assembly | 18 Inner bearing inner race |
| 2 Brake hose | 11 Oil seal | 19 Knuckle retainer |
| 3 Packing | 12 Inner bearing outer race | 20 Nut |
| 4 Wheel hub cap | 13 Outer bearing outer race | 21 Bolt |
| 5 Bolt | 14 Nut | 22 Brake assembly Gr 35 |
| 6 Lock plate | 15 Brake drum Gr 35 | |
| 7 Lock nut | 16 Hub bolt | |
| 8 Lock washer | 17 Wheel hub | |
| 9 Outer bearing inner race | | |
- * : Knuckle P26-18
X : Non-reusable parts

CAUTION

Be sure to protect brake hose 2 from dust by fitting blanking plugs after removal.

NOTE

Do not disassemble brake drum 15 and wheel hub 17 except for replacement.

Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

You must bleed air from the brake system after installing the brake hose, failure to do so would cause the brake to malfunction. Gr 35

CAUTION

Be careful not to damage oil seal 11 when installing wheel hub and brake drum assembly 10 onto knuckle *.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
9, 12, 13, 18	Starting torque of wheel hub bearing	1 to 4 N·m {0.72 to 2.89 lbf.ft, 0.1 to 0.4 kgf·m}	—	Tangential force at hub bolt 9 to 35 N {1.98 to 7.94 lbf, 0.9 to 3.6 kgf}

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

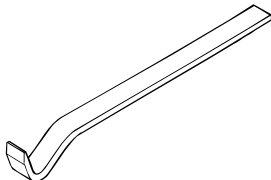
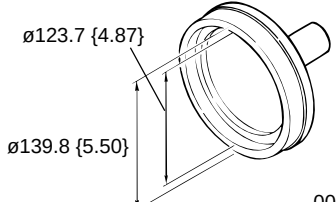
Location	Parts to be tightened	Tightening torque	Remarks
2	Brake hose tightening (Axle side)	21 to 30 {15 to 22, 2.1 to 3.1}	—
5	Bolt (Lock plate mounting)	7 to 11 {5.1 to 8.0, 0.7 to 1.1}	—
7	Lock nut	200 {145, 20}	Slackening off angle : 30°(one twelfth of a turn)
14	Nut (Wheel hub and brake drum mounting)	320 {235, 32.8}	—
20	Nut (Brake assembly mounting)	135 {100, 13.8}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
4	Pack wheel hub cap	Wheel bearing grease [NLGI No.2 (Li soap)]	120±10 g {4.23±0.35 oz}
	Contact surface between wheel hub cap and wheel hub	THREEBOND 1104	As required
9, 18	Pack the space between rollers of outer and inner bearing races	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
11	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
17	Pack interior of wheel hub	Wheel bearing grease [NLGI No.2 (Li soap)]	250±10 g {8.81±0.35 oz}

Special tools

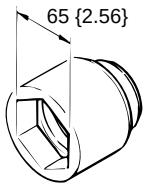
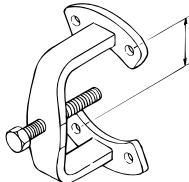
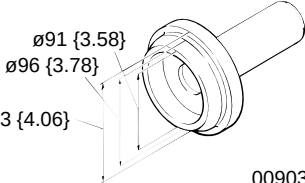
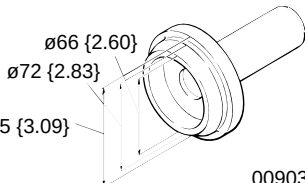
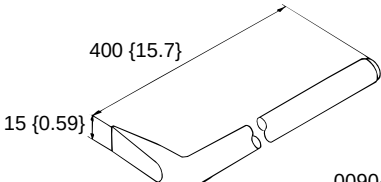
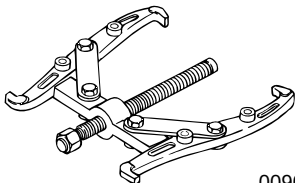
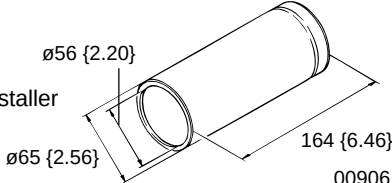
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
4	Hub cap wrench 	MH061948	Removal of wheel hub cap
	Hub cap installer 	MH062204	Press-fitting of wheel hub cap

WHEEL HUB AND BRAKE DRUM

Special tools

Unit : mm {in.}

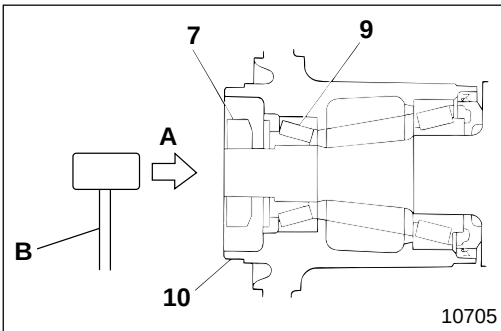
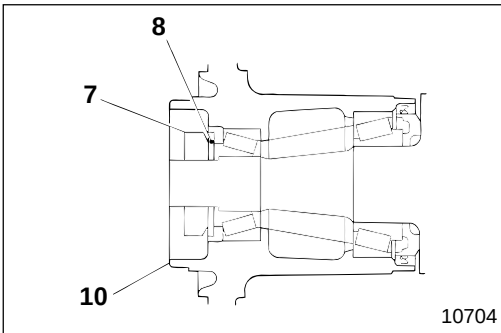
Location	Tool name and shape	Part No.	Application
7	Socket wrench  00900	MH061531	Removal and installation of lock nut
10	Wheel hub puller  00901	MH061966 or MH061017	Removal of wheel hub and brake drum assembly
12	Inner bearing installer  00903	MH061974	Press-fitting of inner bearing outer race
13	Outer bearing installer  00903	MC881484	Press-fitting of outer bearing outer race
18, 19	Lever  00904	MH061683	Pinching for knuckle retainer
	Gear puller  00905	MH061102	Removal of inner bearing inner race and knuckle retainer
	Inner bearing installer  00906	MH061475	Press-fitting of inner bearing inner race and knuckle retainer

◆ Service procedure

● Starting torque of wheel hub bearing

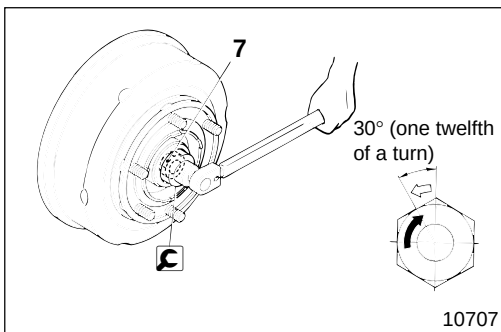
[Adjustment]

- Install lock washer **8** and lock nut **7** on wheel hub and brake drum assembly **10**, then tighten the lock nut at specified torque by 3 turns or more.
- Then, slacken off lock nut **7** completely until there is clearance with lock washer **8**.



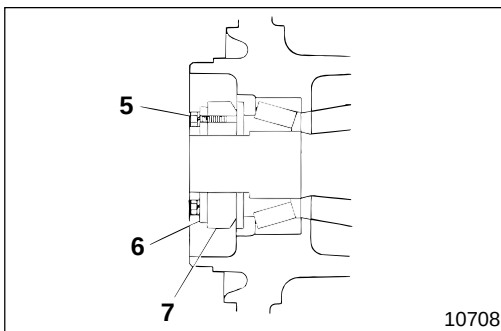
- Return outer bearing **9** toward lock nut **7** by hitting illustrated part **A** two or three times while turning wheel hub and brake drum assembly **10**.

B : Copper-headed hammer

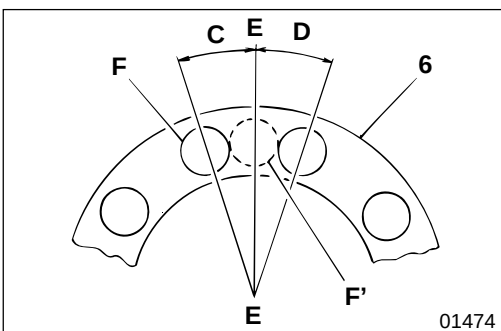


- ★ • After retightening lock nut **7** at specified torque, slacken it off by 30° (one twelfth of a turn).

(★: If any fault is found in the tangential force measurement in P26-14, redo the procedure from this step.)



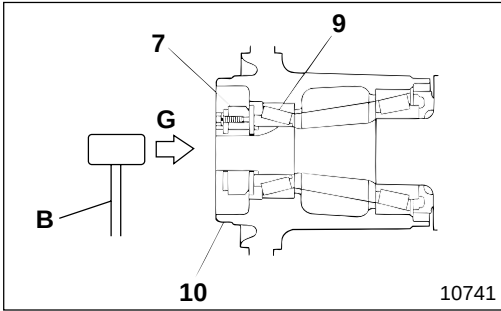
- Fit lock plate **6** into place, making sure that lock nut **7** and the mounting holes in the lock plate align, then tighten mounting bolts **5** at specified torque.



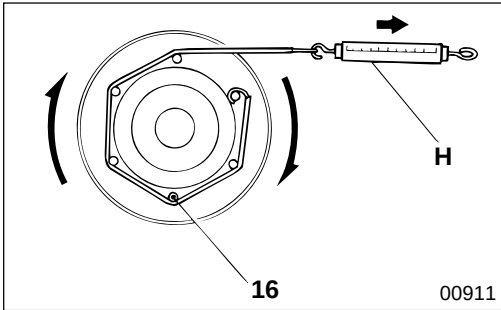
- If the mounting holes of lock plate **6** and lock nut **7** do not align, align them as follows:

Lock nut hole position	How to align lock plate hole
Range C	Slacken off lock nut
Range D	Turn over lock plate and slacken off lock nut
On line E-E	Turn over lock plate (Hole position changes F' to F)

WHEEL HUB AND BRAKE DRUM



- Return outer bearing **9** toward the lock nut **7** by hitting illustrated part **G** two or three times while turning wheel hub and brake drum assembly **10**.
B : Copper-headed hammer

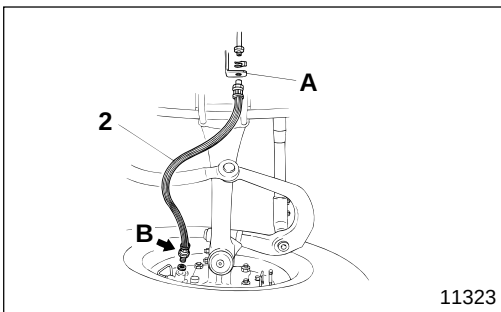


[Measurement]

- Fasten spring balance **H** to hub bolt **16** and measure the tangential force.
- If the measured tangential force is the standard value, the starting torque conforms to the standard value.
- Make sure that the starting torque is smaller than the tangential force.
- If the tangential force deviates from the specified value, adjust the starting torque again.
- If the measured value deviates from the standard value, redo the procedure from the item marked ★. P26-13
- If, after this, the result is still not satisfactory, replace outer bearings **9**, **13** and inner bearings **12**, **18**.

NOTE

- Measure the starting torque when oil seal **11** has been installed.
- Make sure that the brake lining and brake drum **15** do not drag before measurement.

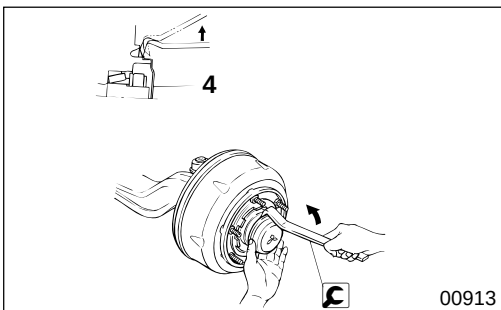


2 Removal and installation of brake hose

First remove brake hose **2** from bracket **A** (on the frame), then remove the brake hose from wheel brake **B**. For installation, follow this procedure in reverse.

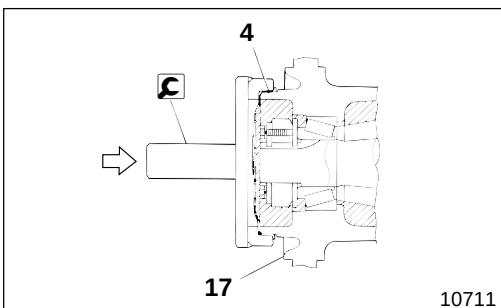
CAUTION

Make sure that brake hose **2** is not twisted when you install it.



4 Wheel hub cap

[Removal]

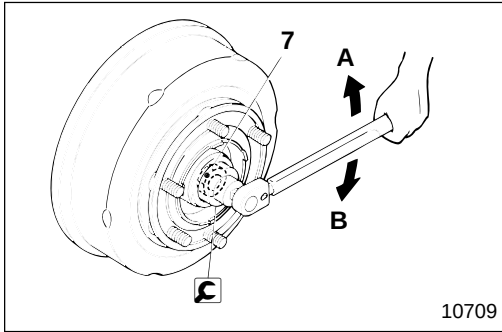


[Installation]

Pack grease into wheel hub cap **4** and apply sealant to the contact surface with wheel hub **17**, then install it.

CAUTION

Be careful during installation not to hit wheel hub cap **4** too hard with the mallet, or you will deform the contact surfaces, spoiling the water tightness.

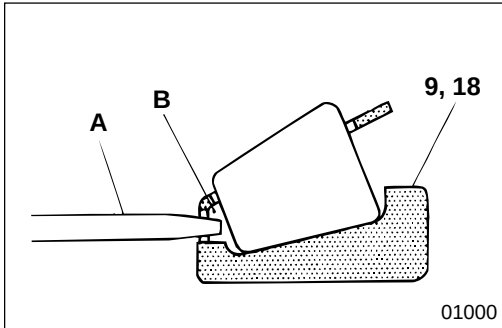


7 Removal and installation of lock nut

Refer to adjustment of starting torque of wheel hub bearing. P26-13

A : Removal

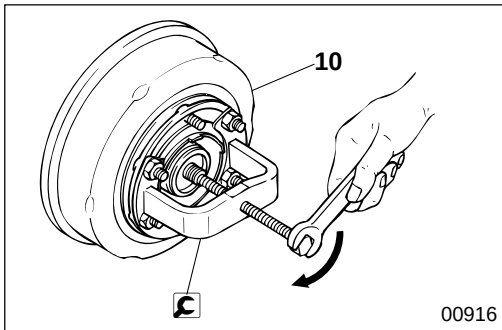
B : Installation



9 18 Packing grease into outer and inner bearing inner races

A : Grease pump nozzle

B : Between rollers

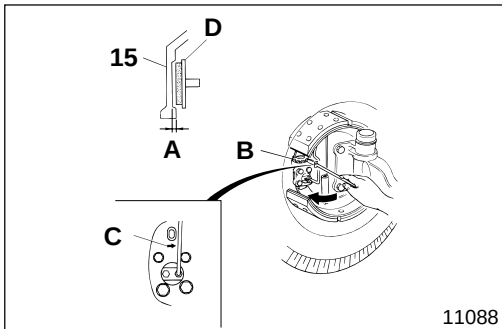


10 Wheel hub and brake drum assembly

[Removal]

CAUTION

Make sure you remove wheel hub and brake drum assembly 10 in a straight line to prevent damage to oil seal 11.



- If it is hard to remove wheel hub and brake drum assembly 10 because brake drum 15 has stepped wear A, remove the wheel hub and brake drum assembly as follows:

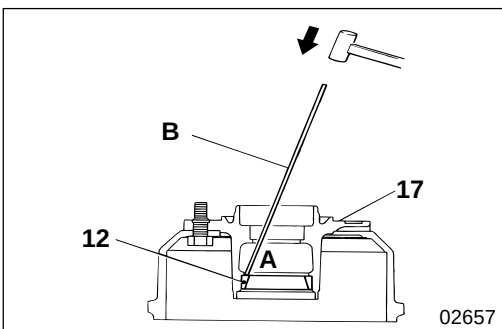
- Turn adjuster B in the opposite direction to arrow C on the backing plate, and expand the clearance between brake drum 15 and brake shoe D. Then remove the brake drum.

CAUTION

Be sure to correct brake drum 15 if it is faulty. Gr 35

[Installation]

After installing wheel hub and brake drum assembly 10, adjust the brake shoe clearance. Gr 35



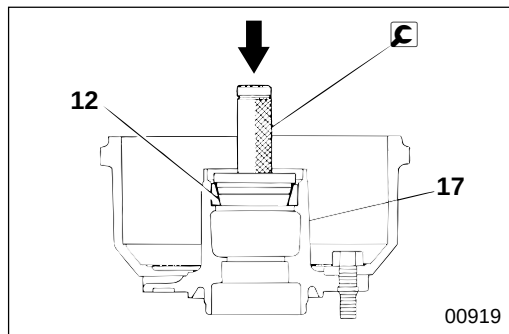
12 Inner bearing outer race

[Removal]

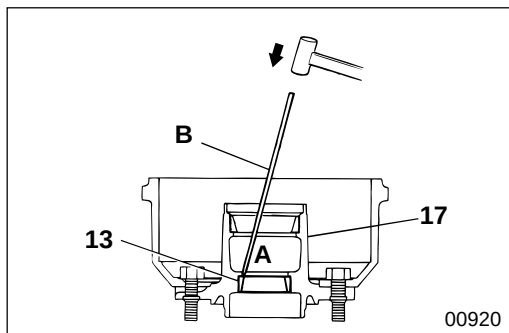
Drive out inner bearing outer race 12 from the two indented parts A in wheel hub 17.

B : Pin-punch

WHEEL HUB AND BRAKE DRUM



[Installation]

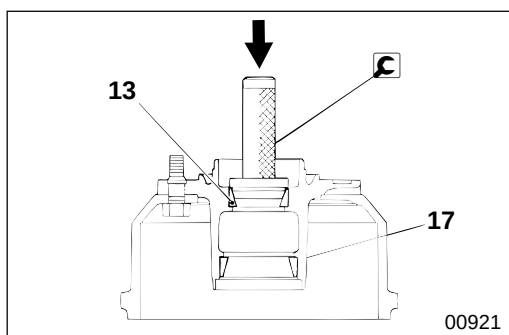


13 Outer bearing outer race

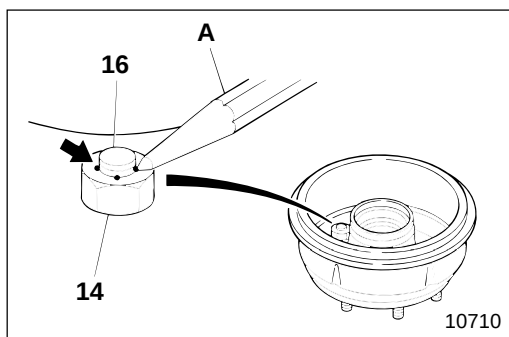
[Removal]

Drive out outer bearing outer race **13** from the two indented parts **A** in wheel hub **17**.

B : Pin-punch



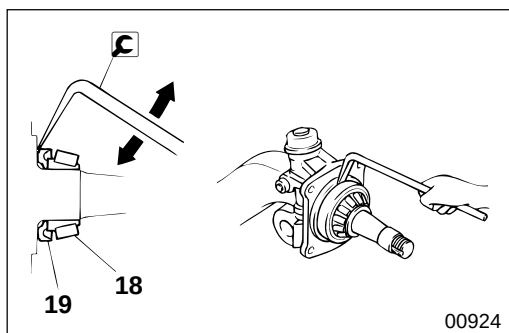
[Installation]



14 16 Installation of nut and hub bolt

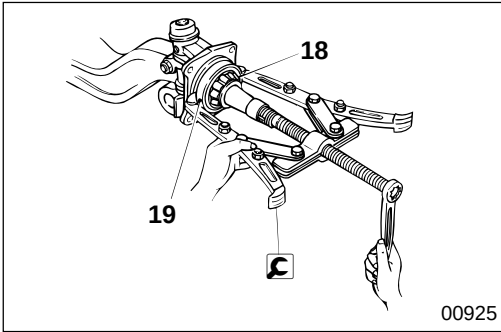
Tighten nut **14** at specified torque, then caulk hub bolt **16** evenly at four points.

A : Punch

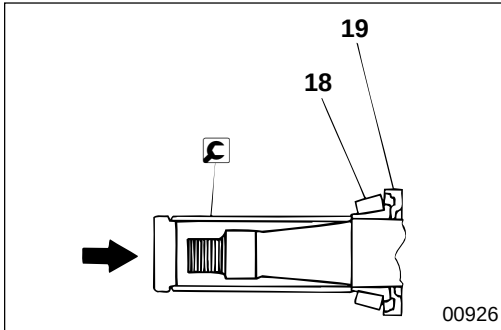


18 19 Inner bearing inner race and knuckle retainer

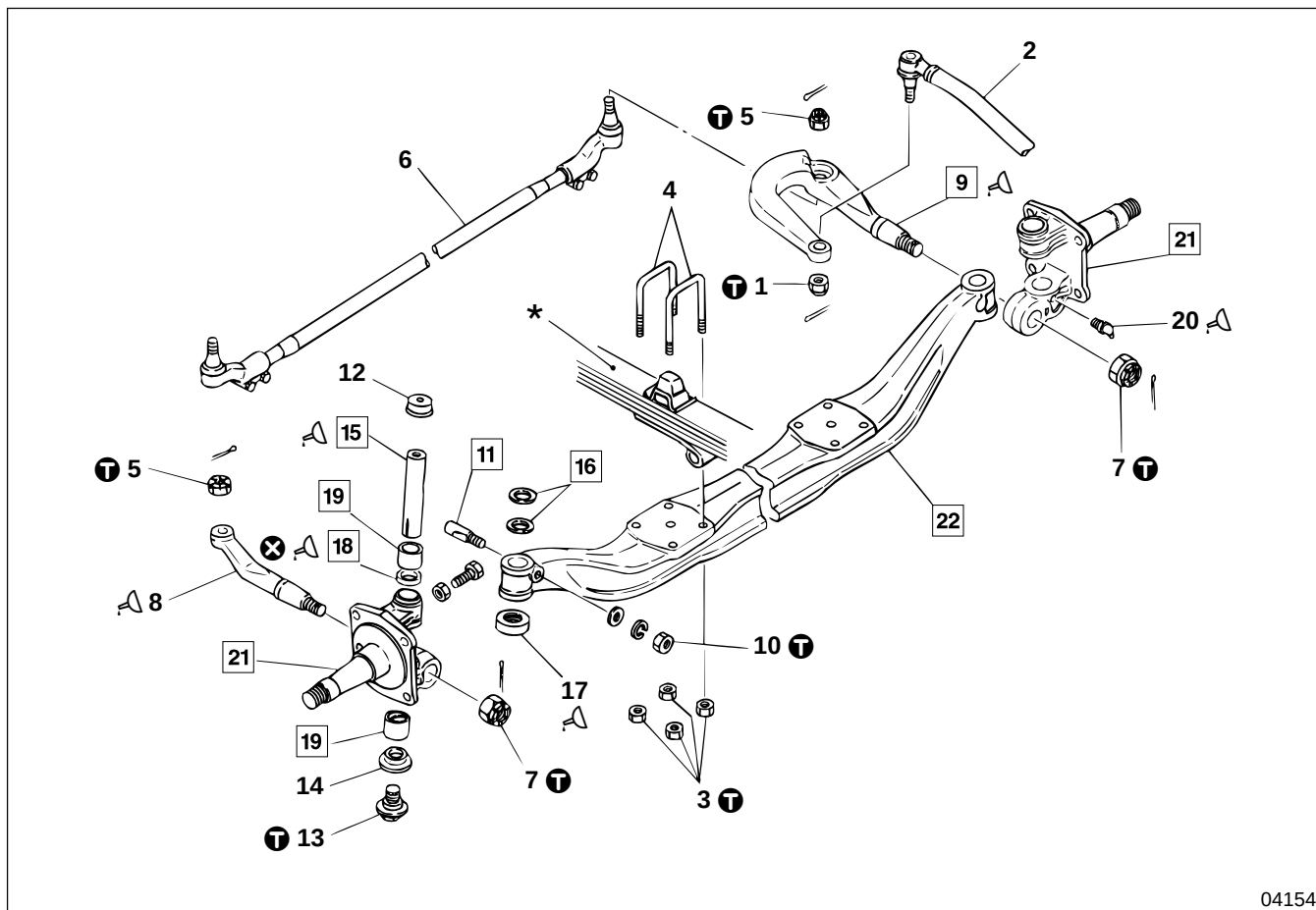
[Removal]



[Installation]



FRONT AXLE, KNUCKLE AND KINGPIN



● Disassembly sequence

- | | | |
|--|------------------------|---|
| 1 Nut | 10 Nut | 19 Bushing |
| 2 Drag link  | 11 Set bolt | 20 Grease nipple |
| 3 U-bolt nut  | 12 Kingpin cap | 21 Knuckle |
| 4 U-bolt | 13 Lower kingpin cover | 22 Front axle |
| 5 Nut | 14 Dust seal | |
| 6 Tie rod  | 15 Kingpin | * : Front leaf spring  |
| 7 Nut | 16 Thrust washer | ⊗ : Non-reusable parts |
| 8 Tie rod arm | 17 Bearing | |
| 9 Knuckle arm | 18 Oil seal | |

● Assembly sequence

21 → 20 → 19 → 18 → 15 → 11 → 10 → 14 → 13 → 12 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

22 → 17 → 16 →

Repair kit : Kingpin kit

● Work after assembly

 P26-20

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
15	Kingpin	Outer diameter	[35] $\begin{matrix} -0.002 \\ -0.015 \\ \{ [1.38] \begin{matrix} -0.000079 \\ -0.00059 \end{matrix} \end{matrix}$	34.9 {1.37}	Replace
		Inclination angle	7°	7°±30'	
19	Kingpin bushing	Inner diameter (after press-fitting into knuckle)	[35] $\begin{matrix} +0.045 \\ +0.018 \\ \{ [1.38] \begin{matrix} +0.0018 \\ +0.00071 \end{matrix} \end{matrix}$	—	Replace
		Clearance between kingpin and kingpin bushing	0.02 to 0.06 {0.00079 to 0.0024}	0.15 {0.0059}	Replace
21, 22	Vertical clearance between knuckle and front axle		0.1 {0.0039} or less	0.2 {0.0079}	Adjust using thrust washer
22	Front axle	Bend in longitudinal direction	2.5 {0.098} or less	7 {0.28}	Replace
		Bend in vertical direction	3 {0.12} or less	7 {0.28}	

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Drag link mounting)	190±47.5 {140±35, 19.4±4.85}	—
3	U-bolt nut (U-bolt mounting)	240±36 {175±27, 24.5±3.7}	Wet
5	Nut (Tie rod mounting)	190±48 {140±35, 19.4±4.85}	—
7	Nut (Tie rod arm and knuckle arm mounting)	686±98 {505±72, 70±10}	—
10	Nut (Set bolt tightening)	29 {22, 3}	—
13	Kingpin lower cover	39±10 {29±7, 4±1}	—

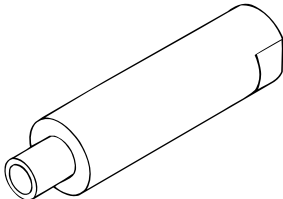
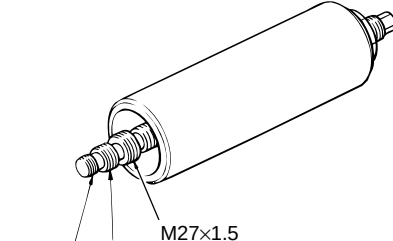
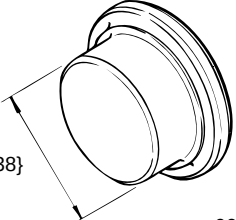
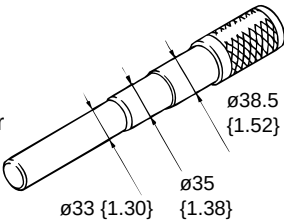
Lubricant

Location	Points of application	Kinds	Quantity
8, 9	Thread areas of knuckle arm and tie rod arm	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Periphery of kingpin and pack through hole	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
17	Pack in bearing	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
18	Lip area of oil seal	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
20	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

FRONT AXLE, KNUCKLE AND KINGPIN

Special tools

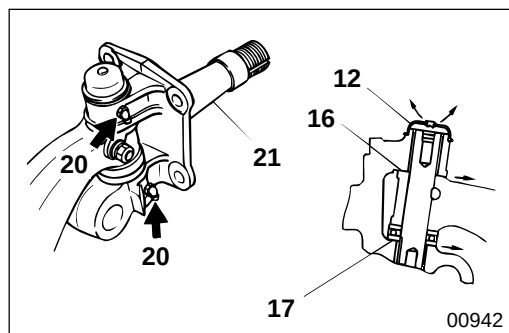
Unit : mm {in.}

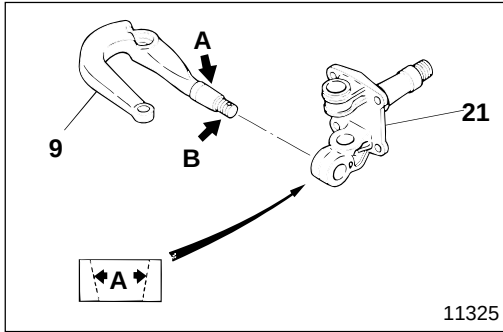
Location	Tool name and shape	Part No.	Application
11	Kingpin set bolt remover  00938	MH061688	Removal of kingpin set bolt
15	Kingpin puller  00939	MH061684	Removal of kingpin
18	Oil seal installer  00940	MH062201	Installation of oil seal
19	Kingpin bushing remover  00941	MH061037	Removal and installation of kingpin bushing

Service procedure

Work after assembly

Pack knuckle **21** with grease via grease nipple **20**. Pack until grease starts overflowing from the dust cap of upper cap **12**, thrust washer **16**, and the press side of bearing **17**.

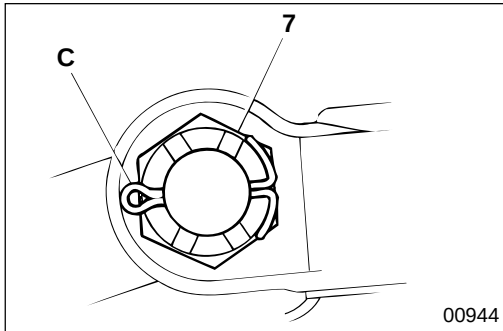




9 21 Installation of knuckle arm and knuckle

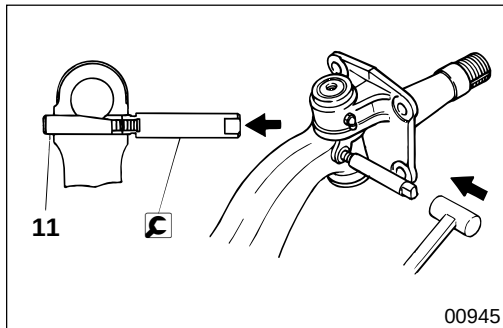
(1) Reassembly of existing knuckle arm 9 and/or knuckle 21

- Polish taper surfaces **A** of knuckle arm **9** and knuckle **21** with emery paper (120 grit or finer) uniformly, until abrasion traces left by the emery paper are only just visible. For new parts, polishing is not necessary.
- Clean taper surfaces **A** of knuckle arm **9** and knuckle **21**, and thread **B** of the knuckle arm. (Use a cleaning solvent for acetone color checking or other solvent.)
- Install knuckle arm **9** after applying grease to thread **B**. (Do not grease the taper surface of the knuckle arm and knuckle **21**.)
- Tighten new nut **7** at specified torque. Make sure you align the pin hole by turning in the tightening direction when you insert and fix split pin **C**.

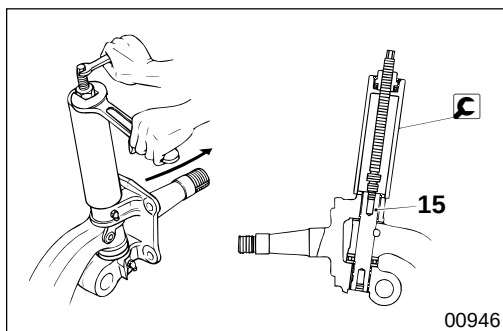


(2) Installation of new knuckle arm 9 and knuckle 21

- Clean taper surfaces **A** of knuckle arm **9**, knuckle **21**, and thread **B** of the knuckle arm, and install them without greasing.
- Tighten new nut **7** at specified torque. Make sure you align the pin hole by turning in the tightening direction when you insert and fix split pin **C**.

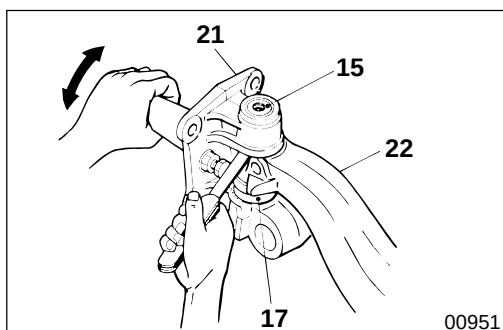


11 Removal of set bolt



15 Removal of kingpin

- Remove the kingpin cap; tighten  kingpin puller bolt into the thread of kingpin **15** to remove the kingpin.

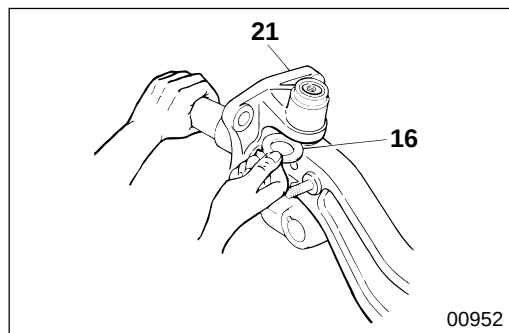


16 21 22 Thrust washer, knuckle and front axle

[Inspection]

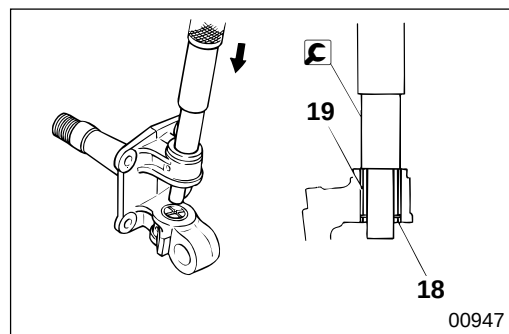
- Assemble kingpin **15** and bearing **17** temporarily, and turn knuckle **21** a few times to smooth its operation.
- Measure the clearance between the upper surface of front axle **22** and the lower part of knuckle **21**.
- If the measured value is higher than the limit, adjust the clearance with thrust washer **16**.

FRONT AXLE, KNUCKLE AND KINGPIN



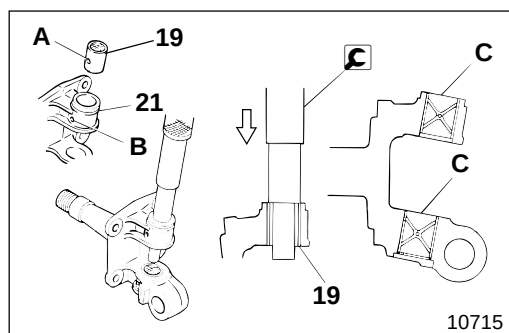
[Adjustment]

- Available adjusting thrust washer **16** thicknesses: 2.1 to 2.8 mm {0.083 to 0.11 in.} (8 thicknesses are available in 0.1 mm {0.0039 in.} increments.)
- Minimize the clearance by selecting appropriate thrust washer **16**.
- Check that knuckle **21** turns smoothly after assembly.



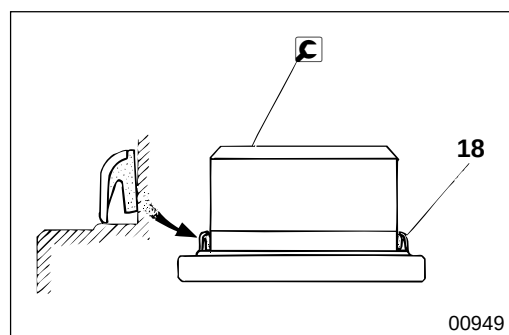
18 19 Oil seal and bushing

[Removal]

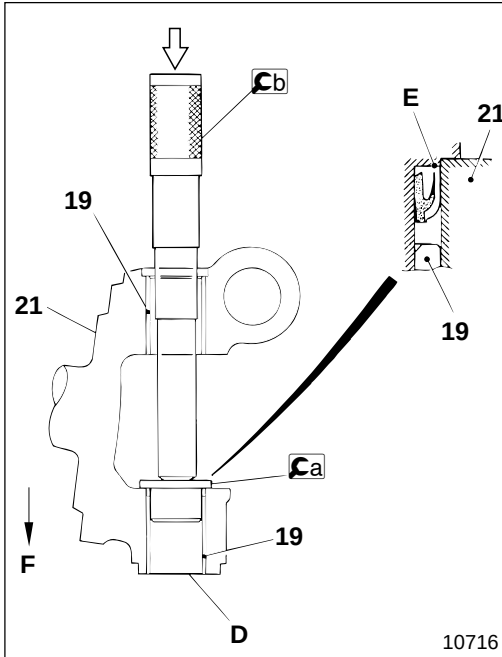


[Installation]

- Install bushing **19** so that the direction of oil hole **A** is aligned with oil hole **B** of knuckle **21** and the bushing end is set in the same plane with end **C**.

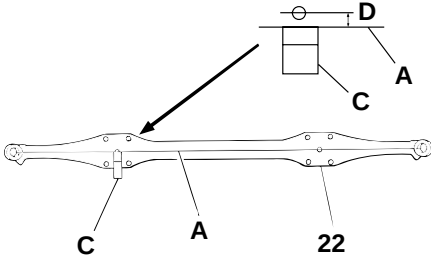


- Apply grease to the lip area of oil seal **18** and install it on  oil seal installer.

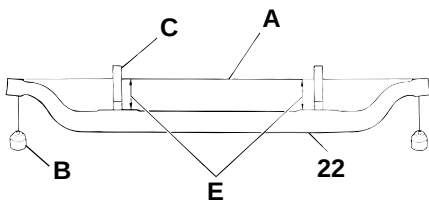


- Next, install **Ca** oil seal installer on knuckle **21** in the direction as illustrated.
 - Pass **Cb** kingpin bushing remover through kingpin hole until it makes contact with **Ca** oil seal installer.
 - Drive the head of **Cb** kingpin bushing remover using a mallet until **Ca** oil seal installer makes contact with knuckle **21**.
 - Check that end **D** of bushing **19** is aligned with knuckle **21**.
 - Make sure that oil seal end **E** does not protrude from knuckle **21**.
- F** : Top of vehicle

Longitudinal direction



Vertical direction



22 Inspection of front axle

(1) Measurement of bend in front axle 22 in longitudinal and vertical directions

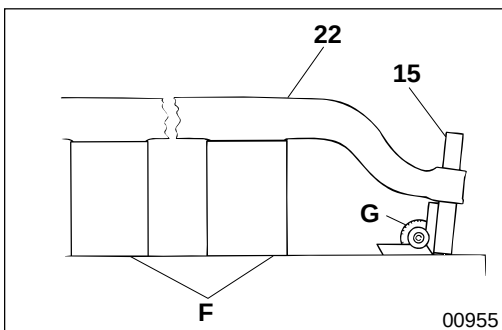
- Pass a piece of thread **A** through the kingpin hole of front axle **22** and hang weights **B** on both ends.
- Use square **C** to find the degree of bend in both the longitudinal direction **D** and the vertical direction **E**.
- If the measured value is higher than the limit, replace front axle **22**.

(2) Measurement of kingpin inclination angle

Mount kingpin **15** in front axle **22** as illustrated, and measure the kingpin inclination angle. If the measured value is higher the limit, replace the front axle.

F : Block gauge

G : Angle gauge





FH

Service Manual

Group 27

Rear Axle

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

GROUP 27 REAR AXLE

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
TROUBLESHOOTING	4
WORK BEFORE REMOVAL AND INSTALLATION OF REAR AXLE	6
WHEEL HUB AND BRAKE DRUM	8
AXLE HOUSING	18
REDUCTION AND DIFFERENTIAL	22

SPECIFICATIONS/STRUCTURE AND OPERATION

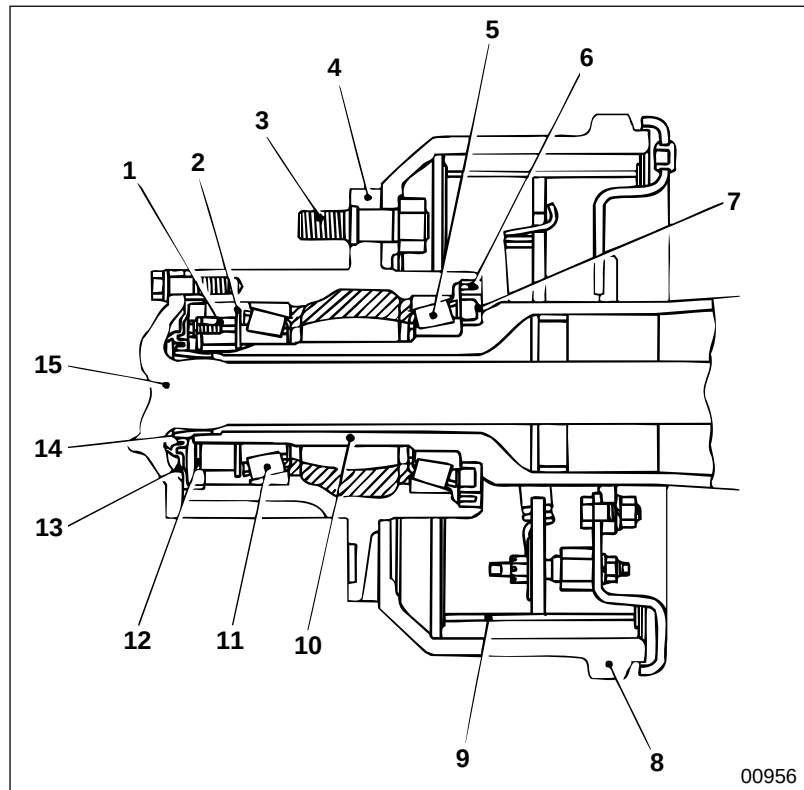
SPECIFICATIONS

Item		Specifications
Rear axle	Model	R040T
	Type	Banjo type, full floating
Reduction	Model	D040H
	Type	Single-reduction
	Tooth shape	Hypoid gear
	Speed reduction ratio	4.111
Differential	Tooth shape	Straight bevel gear
Gear oil	Grade	* Normal : Maximum air temperature during operation below 40°C {104°F} API GL-5 SAE 90 Hot areas : Maximum air temperature during operation above 40°C {104°F} API GL-5 SAE 140
	Quantity L {qts}	4.5 {4.8}
Mass	kg {lb}	Approximately 285 {630}

* : When used under heavily-loaded, severe conditions such as continuous driving on uphill grades, it is recommended that you use gear oil with a SAE viscosity grade of 140. However, the air temperature must be above 10°C {50°F}.

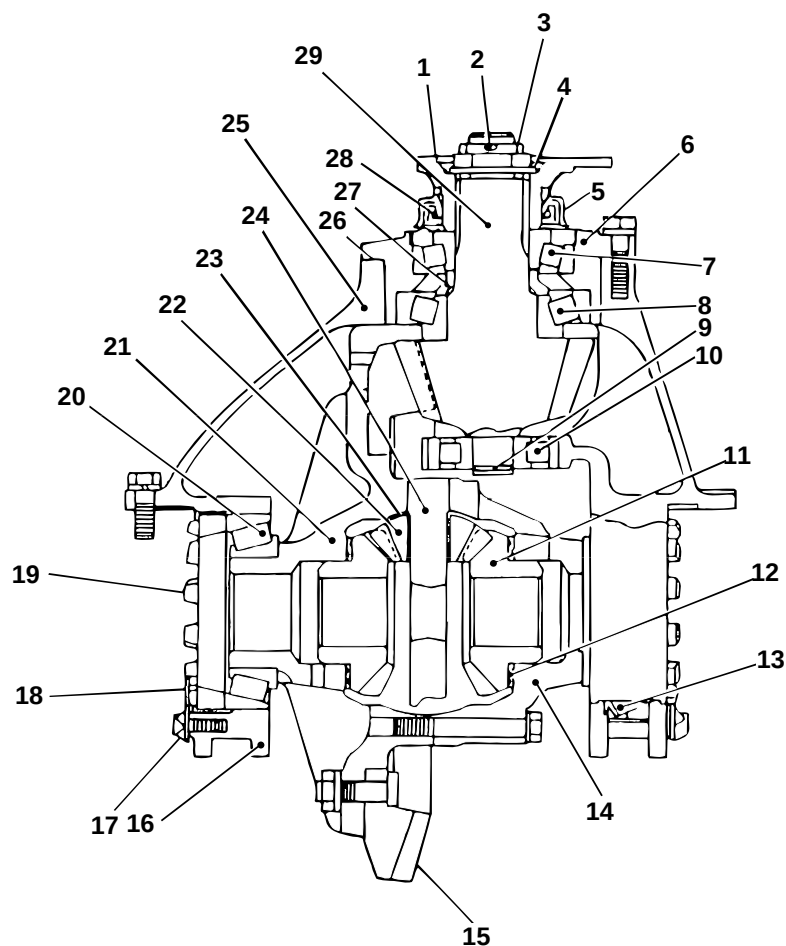
STRUCTURE AND OPERATION

Wheel Hub and Brake Drum



- 1 Lock nut
- 2 Lock washer
- 3 Hub bolt
- 4 Wheel hub
- 5 Inner bearing
- 6 Oil seal
- 7 Oil seal retainer
- 8 Brake drum
- 9 Brake assembly
- 10 Axle tube
- 11 Outer bearing
- 12 Lock plate
- 13 Oil seal
- 14 Oil seal retainer
- 15 Axle shaft

Reduction and Differential



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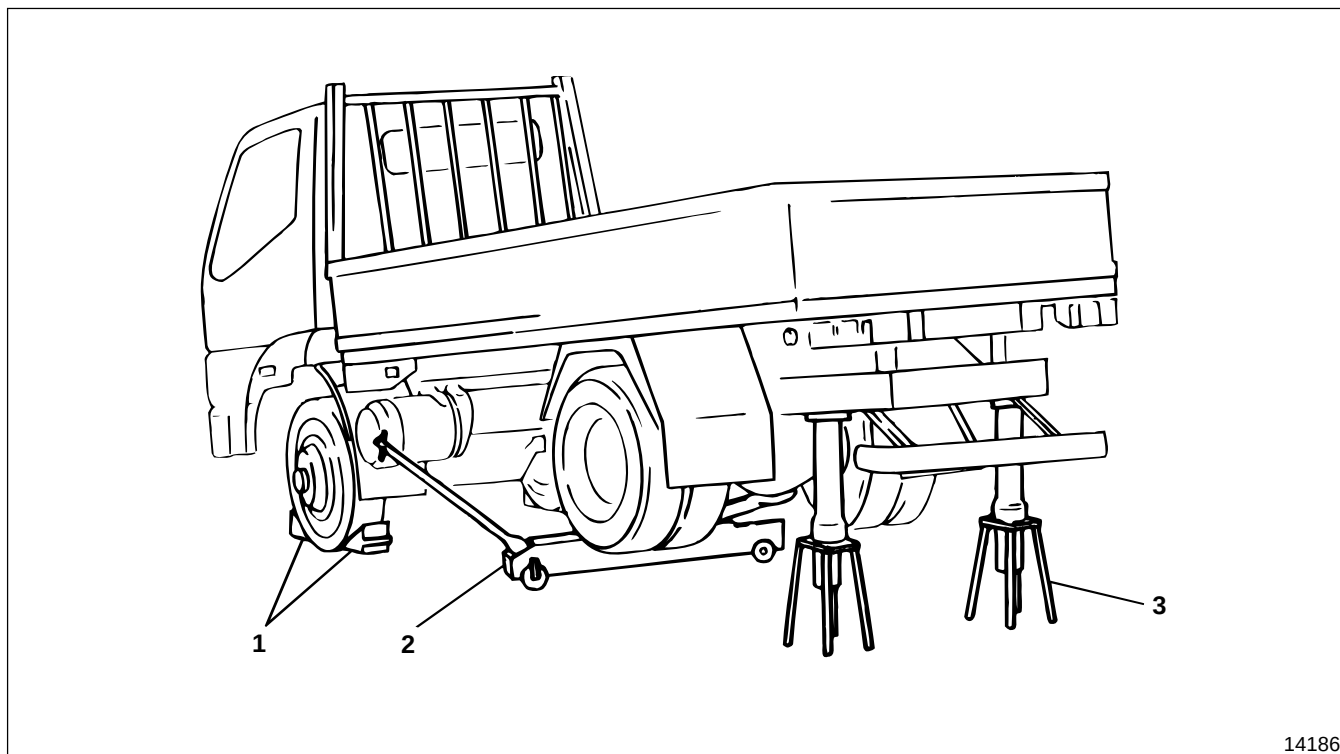
- | | |
|-----------------------------|-------------------------------|
| 1 Companion flange | 16 Bearing cap |
| 2 Split pin | 17 Lock sheet |
| 3 Lock nut | 18 Lock pawl |
| 4 Washer | 19 Adjusting screw |
| 5 Dust cover | 20 Side bearing |
| 6 Bearing retainer | 21 Differential case, LH |
| 7 Outer bearing | 22 Differential pinion |
| 8 Inner bearing | 23 Differential pinion washer |
| 9 Lock ring | 24 Pinion spider |
| 10 Pinion pilot bearing | 25 Differential carrier |
| 11 Differential gear | 26 Shim |
| 12 Differential gear washer | 27 Collar |
| 13 Lock plate | 28 Oil seal |
| 14 Differential case, RH | 29 Reduction pinion |
| 15 Reduction gear | |

TROUBLESHOOTING

Symptoms		Oil leaking from companion flange assembly	Oil leaking from differential carrier and axle housing	Oil leaking from axle shaft	Power transmission insufficient							
					Propeller shaft turns but vehicle does not move	Noise when starting and changing speed	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Seizure	Damage
Possible causes												
Wheel hub, axle housing	Axle shaft mounting bolt loose			○				○				
	Axle housing bent						○					
	Axle shaft bent						○					
	Axle shaft fractured				○							
	Axle shaft slips out of engagement				○							
	Oil seal faulty			○								
	Air breather clogged			○								
	Wheel hub bearing seized, worn or rotation faulty						○					
	Wheel hub bearing broken							○				
Reduction and differential	Gear oil excessive	○										
	Gear oil insufficient					○	○				○	
	Oil seal faulty	○										
	Sealant faulty		○									
	Side bearing seized, worn or rotation faulty						○		○			
	Side bearing broken							○				
	Side bearing preload adjusted incorrectly						○				○	
	Side bearing starting torque faulty					○	○		○			○
	Reduction and differential assembly mounting bolt and nut loose		○									
	Differential carrier cracked or damaged		○									
	Reduction gear and differential case tightening bolts loose					○		○				
	Reduction gear or reduction pinion broken				○	○	○	○	○			
	Reduction gear or reduction pinion worn						○		○			
	Reduction gear to reduction pinion backlash excessive					○						○
	Reduction gear to reduction pinion backlash insufficient						○				○	
	Reduction gear tooth contact adjusted incorrectly						○					

Symptoms		Oil leaking from companion flange assembly	Oil leaking from differential carrier and axle housing	Oil leaking from axle shaft	Power transmission insufficient							
					Propeller shaft turns but vehicle does not move	Noise when starting and changing speed	Continuous noise while cruising	Intermittent noise while cruising	Noise while cornering	Tires drag while cornering	Seizure	Damage
Possible causes												
Reduction and differential	Reduction pinion assembly starting torque excessive					○	○				○	
	Reduction pinion assembly starting torque insufficient					○	○					
	Reduction pinion lock nut loose					○	○					
	Reduction pinion assembly inner bearing or outer bearing seized				○		○					
	Reduction pinion assembly inner bearing or outer bearing worn						○					
	Reduction pinion assembly inner bearing or outer bearing broken							○				
	Reduction pinion pilot bearing worn						○					
	Reduction pinion pilot bearing seized							○				
	Differential pinion spider broken				○							
	Differential gear or differential pinion broken				○			○	○	○		
	Differential gear or differential pinion seized				○					○		
	Differential gear or differential pinion worn								○	○		
	Differential gear washer worn or damaged							○	○	○		
	Differential gear backlash excessive					○						○
	Differential gear backlash insufficient								○		○	
	Play between differential gear and axle shaft spline excessive					○						○

WORK BEFORE REMOVAL AND INSTALLATION OF REAR AXLE



● Work sequence before removal

- 1 Place wheel chocks.
- 2 Jack up the rear axle using a garage jack.
- 3 Support the rear frame on rigid racks.

WARNING

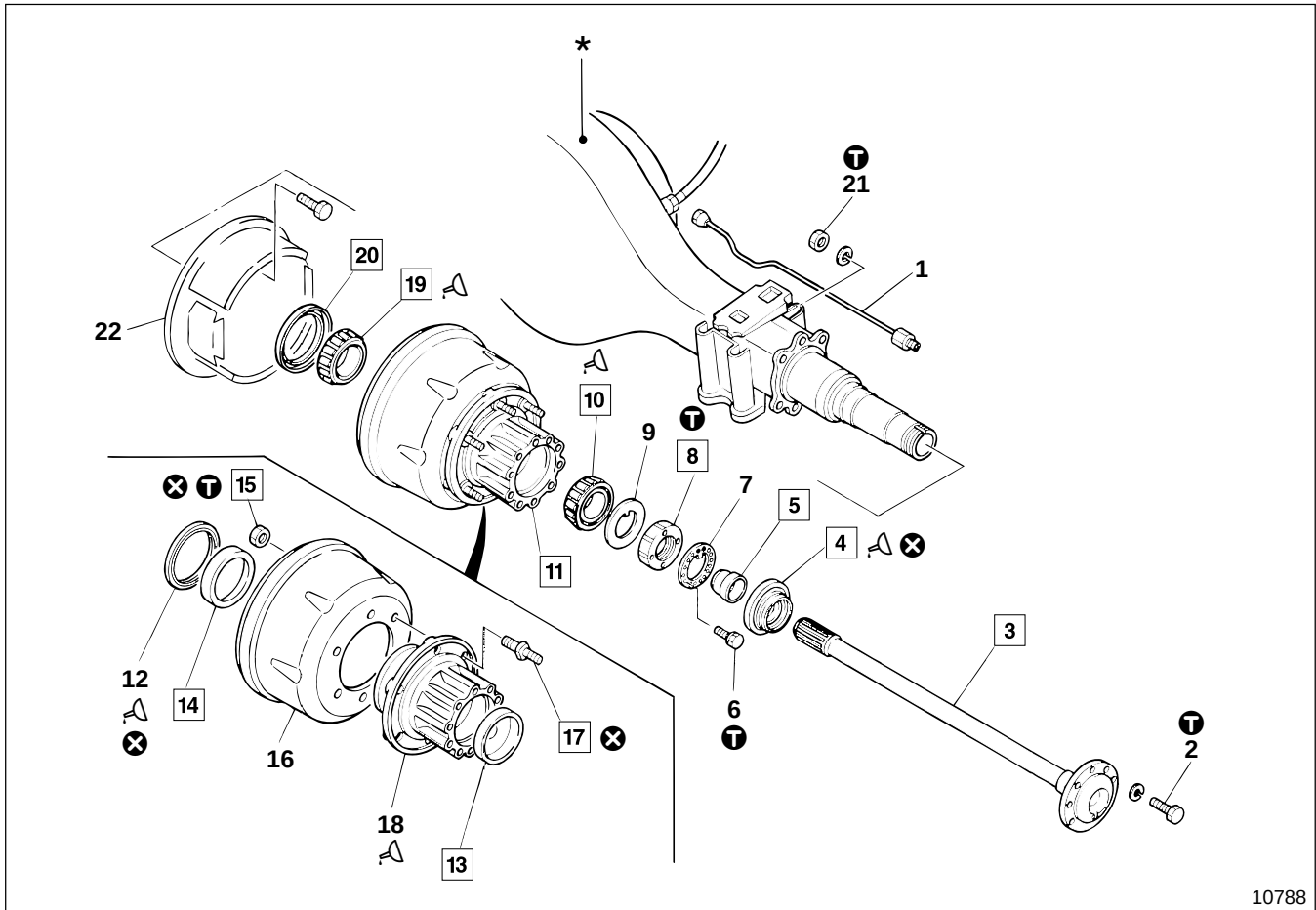
- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

● Work sequence after installation

Follow the work sequence before removal in reverse.

MEMO

WHEEL HUB AND BRAKE DRUM



10788

● Disassembly sequence

- | | | |
|---------------------|--------------------------------------|-----------------------------|
| 1 Brake pipe | 10 Outer bearing inner race | 18 Wheel hub |
| 2 Bolt | 11 Wheel hub and brake drum assembly | 19 Inner bearing inner race |
| 3 Axle shaft | 12 Oil seal | 20 Oil seal retainer |
| 4 Oil seal | 13 Outer bearing outer race | 21 Nut |
| 5 Oil seal retainer | 14 Inner bearing outer race | 22 Brake assembly Gr 35 |
| 6 Bolt | 15 Nut | |
| 7 Lock plate | 16 Brake drum | * : Axle housing P27-18 |
| 8 Lock nut | 17 Hub bolt | ⊗ : Non-reusable parts |
| 9 Lock washer | | |

CAUTION

Be sure to protect brake pipe 1 from dust by fitting blanking plugs after removal.

NOTE

Do not disassemble wheel hub 18 and brake drum 16 unless they are faulty.

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

You must bleed air from the brake system after assembly, failure to do so would cause the brake to malfunction. Gr 35

CAUTION

Be careful not to damage oil seal 12 when installing wheel hub and brake drum assembly 11 in axle housing *.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
3	Axle shaft	Bend of shaft center	1.0 {0.039} or less	2.0 {0.079}	Replace
		Wobble of flange face	0.04 {0.0016}	0.5 {0.020}	Replace
10, 13, 14, 19	Starting torque of wheel hub bearing		2.5 to 5.4 N·m {1.8 to 4.0 lbf.ft, 0.25 to 0.55 kgf·m}	—	Tangential force at hub bolt position: 22 to 48 N {4.9 to 11 lbf, 2.2 to 4.9 kgf}

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

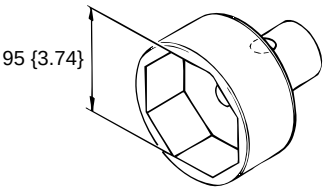
Location	Parts to be tightened	Tightening torque	Remarks
2	Bolt (Axle shaft mounting)	105 {80, 11}	—
6	Bolt (Lock plate mounting)	6.9 to 11 {5.1 to 8.0, 0.7 to 1.1}	—
8	Lock nut	195 {145, 20}	Screw slackening angle 22.5° (one sixteenth of a turn)
15	Nut (Wheel hub and brake drum mounting)	320 {235, 32.8}	—
21	Nut (Brake assembly mounting)	76 {56, 7.8}	—

Lubricant

Location	Points of application	Kinds	Quantity
4, 12	Lip area of oil seal	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
10, 19	Pack the space between rollers of outer bearing inner race and inner bearing inner race	Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
18	Pack interior of wheel hub	Wheel bearing grease [NLGI No. 2 (Li soap)]	280 g {9.88 oz}

Special tools

Unit : mm {in.}

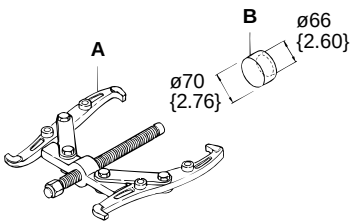
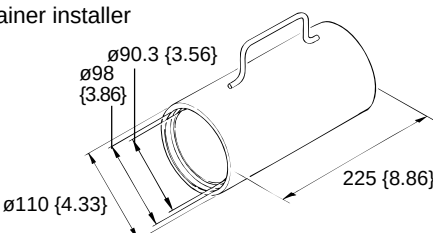
Location	Tool name and shape	Part No.	Application
8	Socket wrench  00969	MH061597	Removal and installation of lock nut

WHEEL HUB AND BRAKE DRUM

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
11	A : Wheel hub puller B : Adapter 00972	A : MH061966 B : MH061962 or C : MH061017	Removal of wheel hub and brake drum assembly
13	Wheel hub outer bearing installer 00974	MH061012	Press-fitting of outer bearing outer race
14	Wheel hub inner bearing installer 00974	MH061010	Press-fitting of inner bearing outer race
19	A : Gear puller B : Adapter 00975	A : MH061102 B : MH061962	Removal of inner bearing inner race
	Wheel bearing installer 00970	MH061009	Press-fitting of inner bearing inner race

Unit : mm {in.}

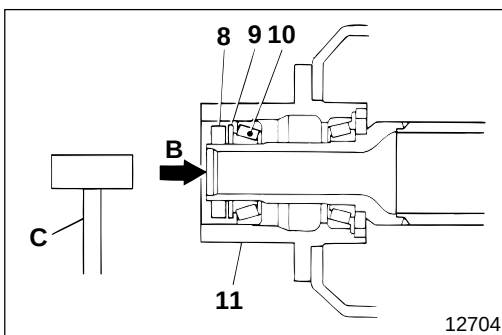
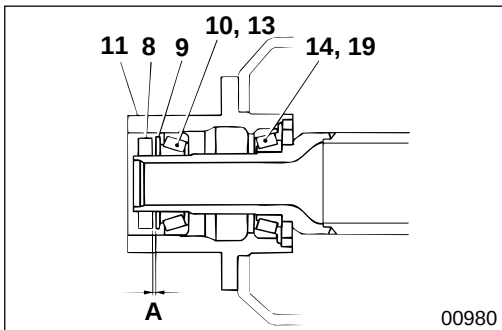
Location	Tool name and shape	Part No.	Application
20	 A : Gear puller B : Adapter 00975	A : MH061102 B : MH061962	Removal of oil seal retainer
	 Oil seal retainer installer 00977	MH061008	Press-fitting of oil seal retainer

◆ Service procedure

● Starting torque of wheel hub bearing

[Adjustment]

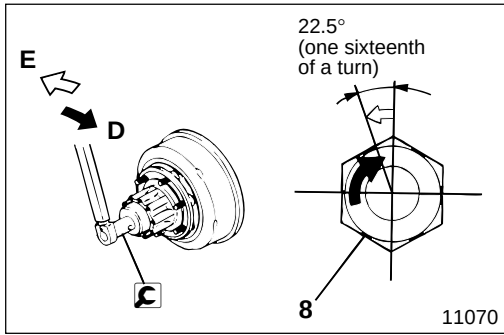
- Install lock washer **9** and lock nut **8**.
- Turn wheel hub and brake drum assembly **11** several times to smooth operation of outer bearings **10**, **13** and inner bearings **14**, **19**.
- Tighten lock nut **8** at specified torque.
- Slacken off lock nut **8** to obtain clearance **A** between the lock nut and lock washer **9**.



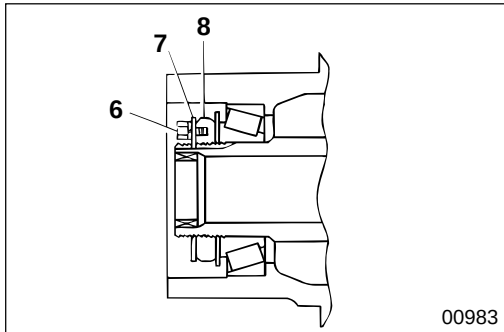
- To slide outer bearing inner race **10** towards lock nut **8**, hit end **B** of the axle tube two or three times with a mallet, while turning wheel hub and brake drum assembly **11**.

C : Copper-headed mallet

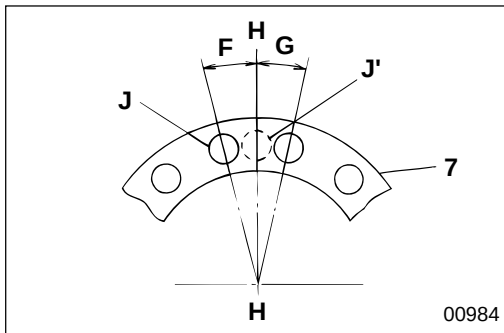
WHEEL HUB AND BRAKE DRUM



- ★ • Tighten lock nut **8** at specified torque.
D : Tightening direction
- Slacken off lock nut **8** by 22.5° (one sixteenth of a turn).
E : Slackening off direction
(★ : If any fault is found when measuring tangential force, redo from this item.)

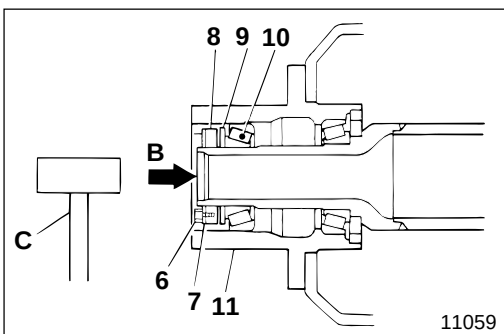


- Install lock plate **7**.
- Make sure that bolt **6** mounting holes of lock nut **8** and lock plate **7** align.
- Tighten bolt **6** at specified torque.

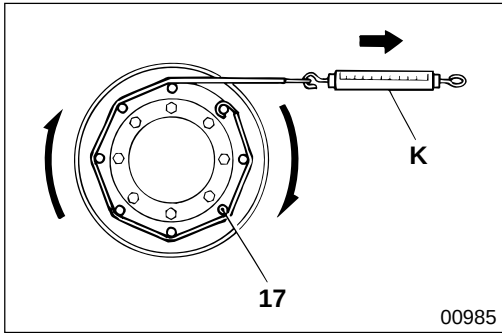


- If the mounting holes of lock plate **7** and lock nut **8** do not align, align as follows:

Hole position of lock nut	How to align hole of lock plate
Within range F	Loosen lock nut to align holes
Within range G	Turn over lock plate and loosen lock nut to align holes
On line H-H	Turn over lock plate to align holes (Hole position J' changes to J)



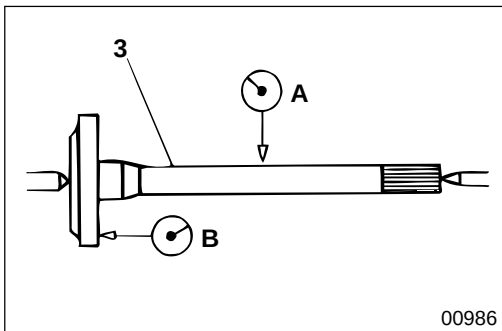
- To slide outer bearing inner race **10** towards lock nut **8**, hit end **B** of the axle tube two or three times with a mallet, while turning wheel hub and brake drum assembly **11**.
C : Copper-headed mallet

**[Measurement]**

- Install spring balance **K** on hub bolt **17**.
- Measure tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- Do not allow the tangential force to become higher than the upper limit of the specified value.
- If the measured tangential force deviates from the specified value, repeat from step ★.
- If the result is still not satisfactory, replace outer bearings **10**, **13** and inner bearings **14**, **19**.

NOTE

- Make sure that there is no drag in brake drum **16** and the brake lining before you measure the tangential force.
- Measure the starting torque when oil seal **12** has been installed.

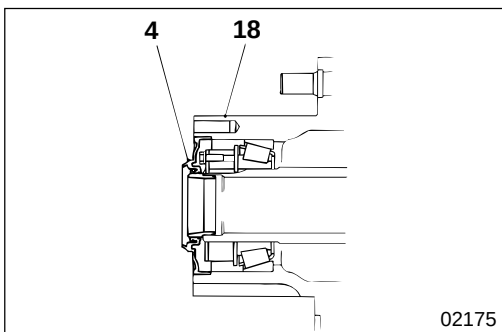
**3 Inspection of axle shaft**

A : Bend of shaft center

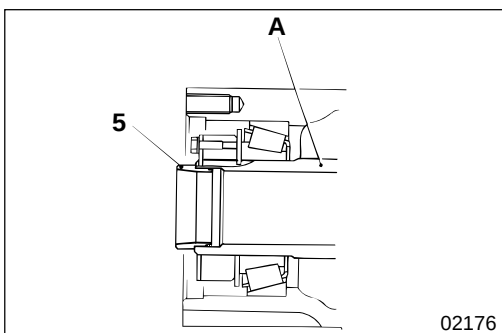
NOTE

To measure the bend of axle shaft **3**, turn it one full revolution and read the dial gauge indicator. The bend is one half of the indicated value.

B : Wobble of flange face

**4 Installation of oil seal**

Press-fit oil seal **4** until it is flush with the end of wheel hub **18**.

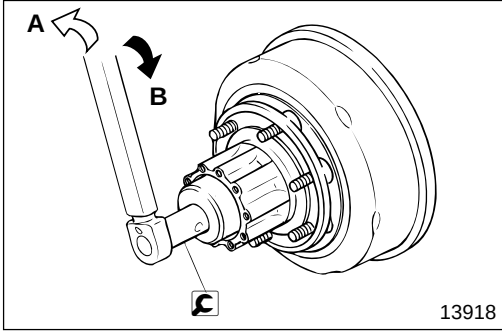
**5 Oil seal retainer****[Removal]**

It is not necessary to remove oil seal retainer **5** other than for replacement of oil seal **4**.

[Installation]

Press-fit oil seal retainer **5** until it is flush with the end of axle tube **A**.

WHEEL HUB AND BRAKE DRUM



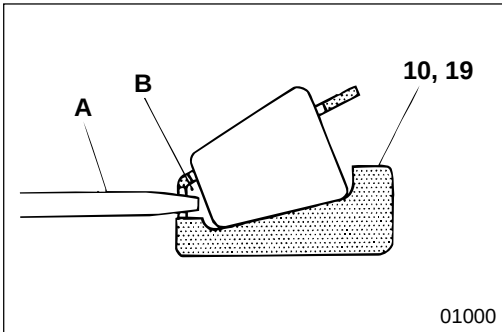
8 Removal and installation of lock nut

After installation, adjust the starting torque of the wheel hub bearing.

📖 P27-11

A : Removal

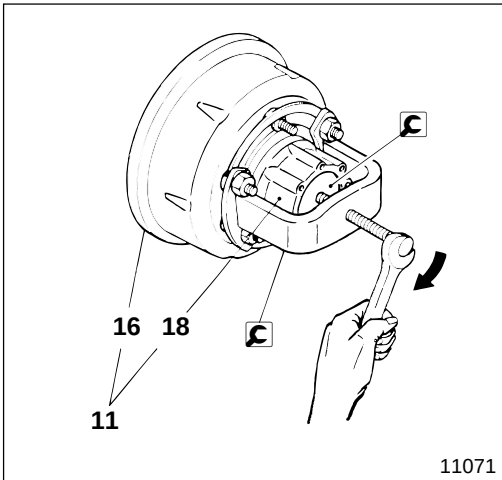
B : Installation



10 19 Packing grease in outer bearing inner race and inner bearing inner race

A : Grease pump nozzle

B : Space between rollers

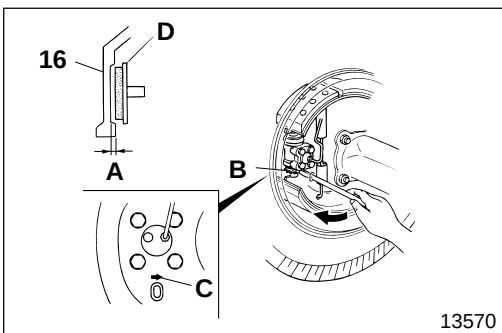


11 Wheel hub and brake drum assembly

[Removal]

CAUTION ⚠

Make sure you remove wheel hub and brake drum assembly 11 in a straight line to prevent damage to oil seal 12.



- If wheel hub and brake drum assembly 11 cannot be removed because of stepped wear A in brake drum 16, carry out the following:
- Turn adjuster B in the opposite direction to arrow C on the packing plate, and expand the clearance between brake drum 16 and brake shoe assembly D. Then remove wheel hub and brake drum assembly 11.

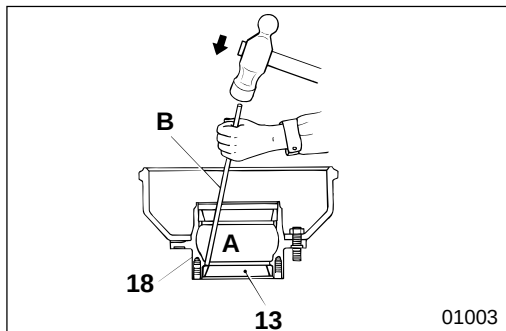
CAUTION ⚠

If brake drum 16 is faulty, correct it. 📦 Gr 35

[Installation]

After installing wheel hub and brake drum assembly 11, adjust the brake shoe clearance.

📦 Gr 35

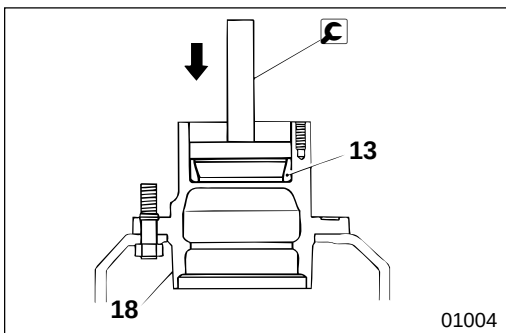


13 Outer bearing outer race

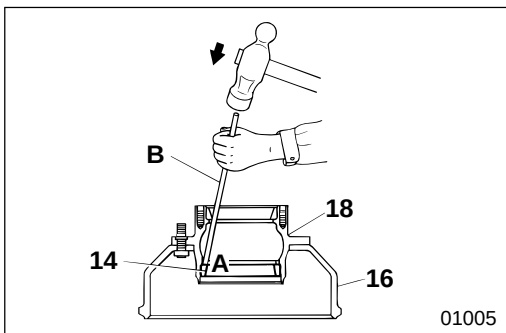
[Removal]

Drive out outer bearing outer race **13** evenly from four indented parts **A** in wheel hub **18**.

B : Pin-punch



[Installation]

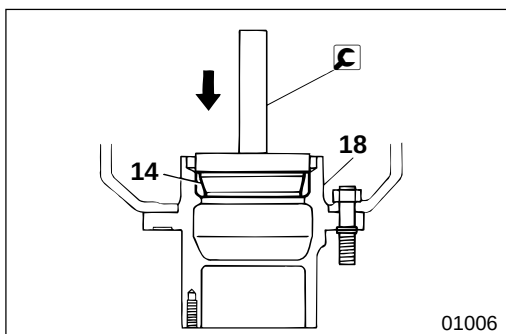


14 Inner bearing outer race

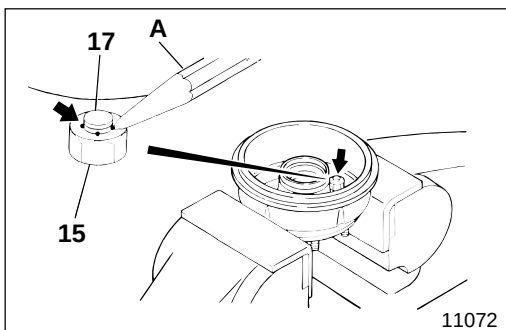
[Removal]

Drive out inner bearing outer race **14** evenly from four indented parts **A** in wheel hub **18**.

B : Pin-punch



[Installation]

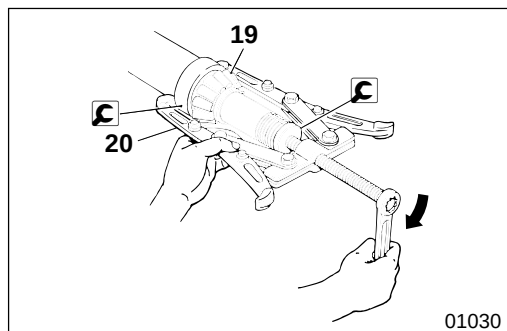


15 17 Installation of hub bolt and nut

- Install hub bolt **17**.
- Tighten nut **15** at specified torque.
- Caulk nut **15** evenly at four points to keep it from turning.

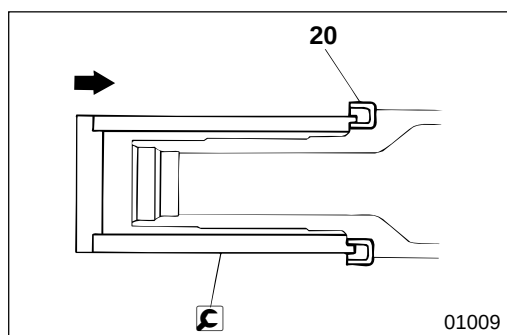
A : Pin-punch

WHEEL HUB AND BRAKE DRUM

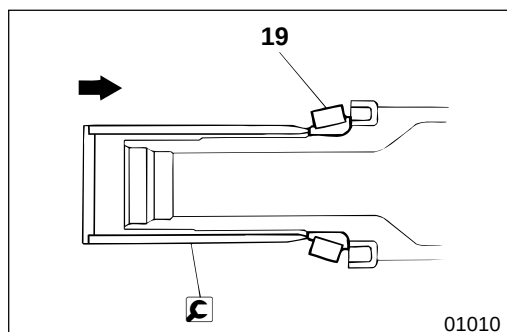


19 **20** Inner bearing inner race and oil seal retainer

[Removal]

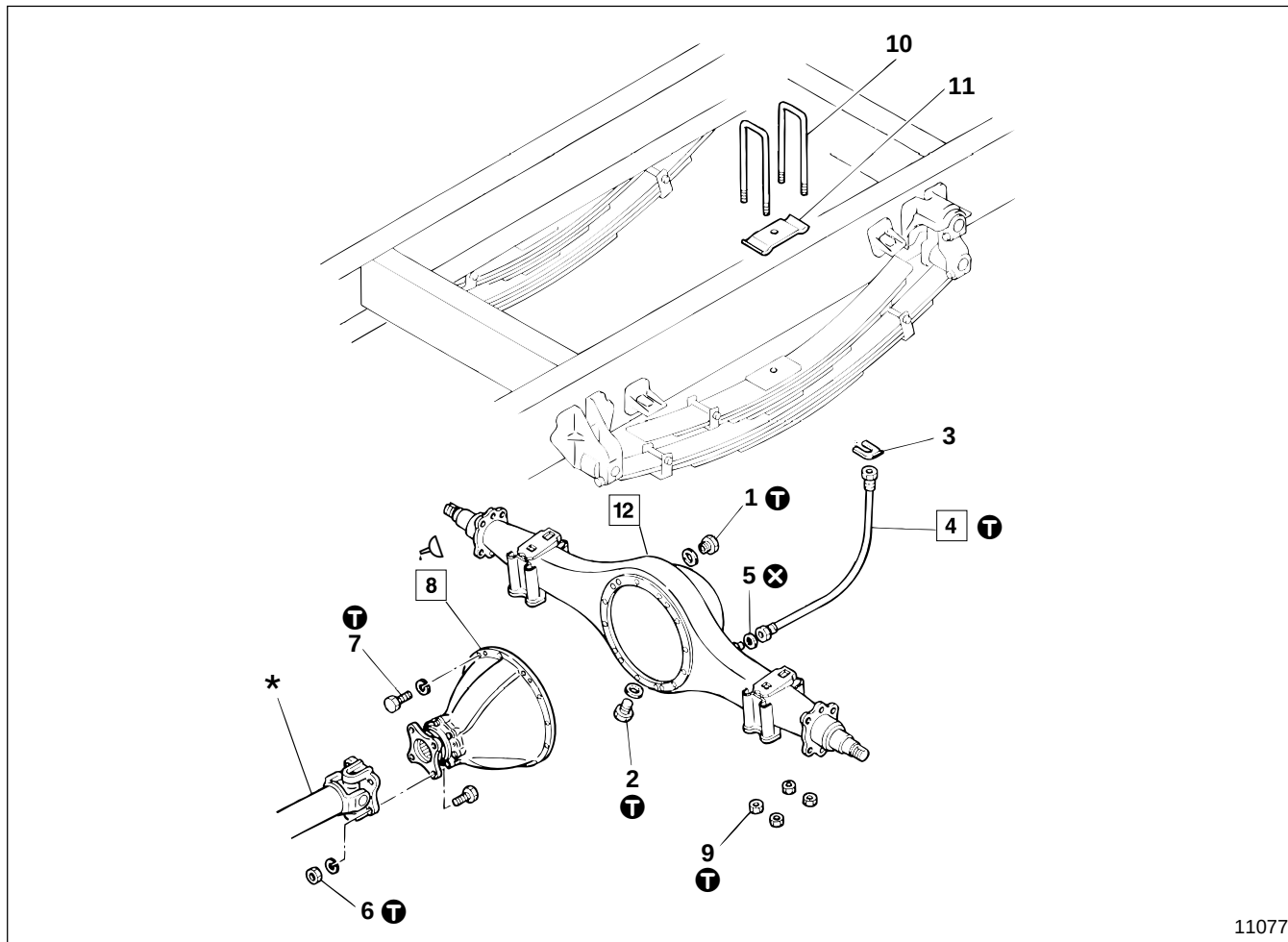


[Installation]



MEMO

AXLE HOUSING



11077

● Work before removal P27-19

● Removal sequence

- | | | |
|-------------------|---|----------------------------|
| 1 Inspection plug | 7 Bolt | 11 Spring upper pad |
| 2 Drain plug | 8 Reduction and differential assembly P27-22 | 12 Axle housing |
| 3 Clip | 9 U-bolt nut | |
| 4 Brake hose | 10 U-bolt | * : Propeller shaft Gr 25 |
| 5 Packing | | ⊗ : Non-reusable parts |
| 6 Nut | | |

CAUTION

Be sure to protect brake hose 4 from dust by fitting blanking plugs after removal.

NOTE

Do not remove axle housing 12 unless it is faulty.

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

Make sure that brake hose 4 is not twisted when you install it.

NOTE

Do not let sealant ooze from the mounting surfaces of reduction and differential assembly 8 and axle housing 12.

● Work after installation P27-19

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
12	Bend of axle housing (C-B)	0.2 {0.0079} or less	0.5 {0.020} or more	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

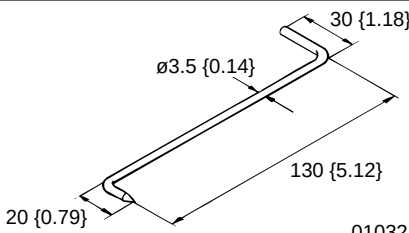
Location	Parts to be tightened	Tightening torque	Remarks
1	Inspection plug	98 to 115 {72 to 87, 10 to 12}	—
2	Drain plug	98 to 115 {72 to 87, 10 to 12}	—
4	Brake hose mounting (Axle housing side)	21 to 30 {15 to 22, 2.1 to 3.1}	—
6	Nut (Propeller shaft mounting)	85 {61, 8.5}	—
7	Bolt (Reduction and differential assembly mounting)	120 {90, 12.5}	—
9	U-bolt nut (U-bolt mounting)	414±62 {305±46, 42.2±6.3}	Wet

Sealant

Location	Points of application	Kinds	Quantity
8	Connecting surfaces of reduction and differential assembly and axle housing	THREEBOND 1215	As required

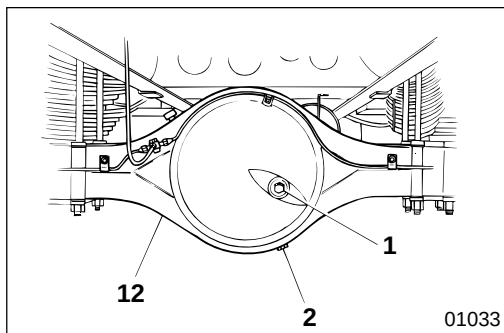
Special tools

Unit : mm {in.}

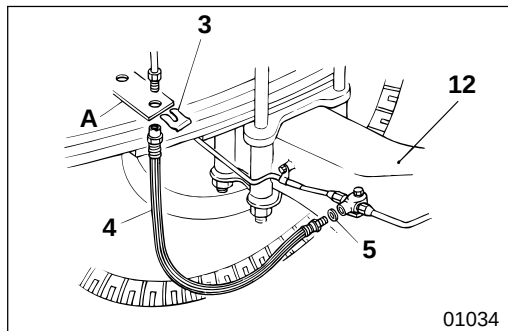
Location	Tool name and shape	Part No.	Application
12	Measuring bar 	MH061003	Measures bend of axle housing : Two required

Service procedure**Work before removal**Remove drain plug **2** and drain the gear oil.**WARNING**

The oil temperature is high immediately after the vehicle has stopped, so take care not to scald yourself.

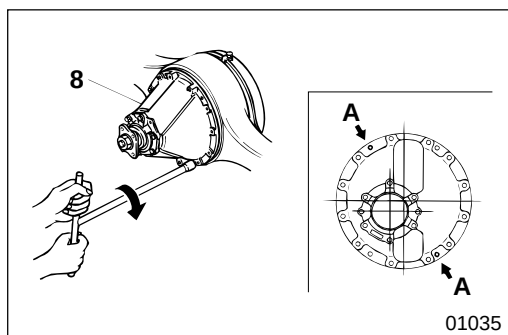
Work after installationFill with the specified amount of gear oil via inspection plug **1**.

AXLE HOUSING



4 Removal and installation of brake hose

- Remove brake hose 4 from frame A side first, then from axle housing 12 side.
- For installation, follow the removal sequence in reverse.

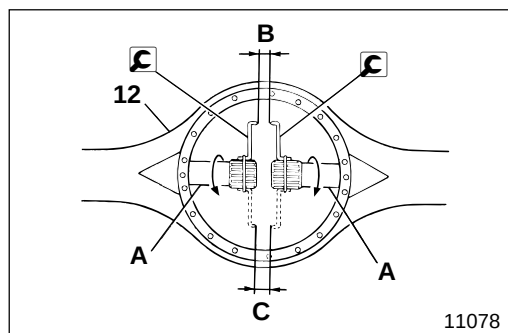


8 Removal of reduction and differential assembly

To remove reduction and differential assembly 8, screw two M12×1.25 mm bolts evenly into two screw holes A.

NOTE

Completely remove adhered sealant from the mounting surfaces of reduction and differential assembly 8 and axle housing 12.



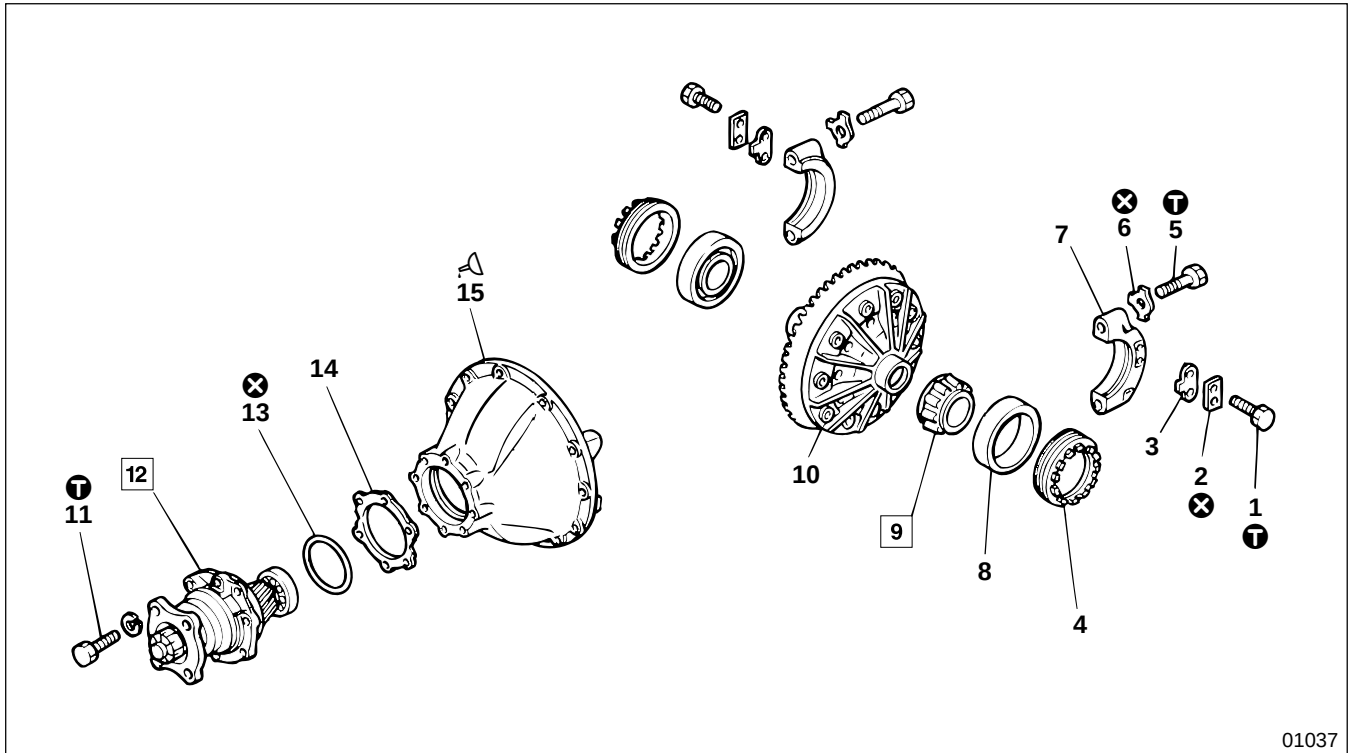
12 Bend of axle housing

- Leave axle shaft A installed in axle housing 12.
- Install C measuring bar on axle shaft A, and measure clearance B.
- Turn axle shaft A 180°, and measure clearance C.
- The difference between B and C is the amount of bend of axle housing 12.
- If the bend of axle housing 12 is higher than the limit, replace the axle housing.

MEMO

REDUCTION AND DIFFERENTIAL

Reduction and Differential Assembly



● Inspection before disassembly P27-24

● Work before disassembly P27-25

● Disassembly sequence

- | | |
|---------------------------|---|
| 1 Bolt | 10 Differential assembly  P27-30 |
| 2 Lock seat | 11 Bolt |
| 3 Lock pawl | 12 Pinion assembly  P27-34 |
| 4 Adjusting screw | 13 O-ring |
| 5 Bolt | 14 Shim |
| 6 Lock plate | 15 Differential carrier |
| 7 Bearing cap | |
| 8 Side bearing outer race | |
| 9 Side bearing inner race | |

⊗ : Non-reusable parts

CAUTION

- Make sure you replace bearing caps 7, differential carrier 15 and bolt 5 as a differential carrier set.
- Make sure you replace the reduction gear of differential assembly 10 and the reduction pinion of pinion assembly 12 as a reduction gear set.
- Make sure you keep left and right side bearings 8, 9 separate after removal, and be careful not to mix them up when installing them.

NOTE

Write down the thickness of shim 14 before disassembly to use it as reference when assembly.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection and adjustment after assembly P27-25

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
8, 9	Starting torque of side bearing	2.0 to 2.9 N·m {1.4 to 2.2 lbf.ft, 0.2 to 0.3 kgf·m}	—	• Adjust using adjusting screw • Tangential force at 170 {6.69} outer periphery point of differential case : 24 to 34 N {5.3 to 7.7 lbf, 2.4 to 3.5 kgf}
10	Wobble of reduction gear back face	0.15 {0.0059} or less	0.2 {0.0079}	• Adjust or replace as a gear set • Measure at the 145 {5.71} radial point from reduction gear center
10, 12	Backlash between reduction gear and reduction pinion	0.25 to 0.33 {0.0098 to 0.013}	0.6 {0.024}	Adjust or replace as a gear set

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Lock pawl mounting)	34 {25, 3.5}	—
5	Bolt (Bearing cap mounting)	235 {175, 24}	—
11	Bolt (Differential carrier and pinion assembly mounting)	78 {58, 8}	—

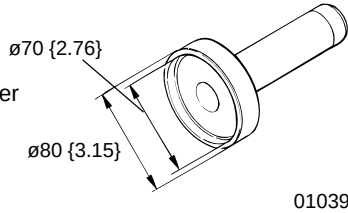
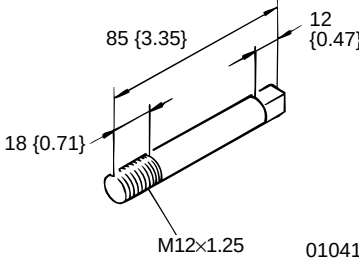
Sealant

Location	Points of application	Kinds	Quantity
15	Mounting surface of pinion pilot bearing	LOCTITE 601	As required

REDUCTION AND DIFFERENTIAL

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
9	Side bearing installer 	MH061748 01039	Press-fitting of side bearing inner race
12	Bearing retainer guide pin 	MH061745 01041	Installation of pinion assembly : Two required

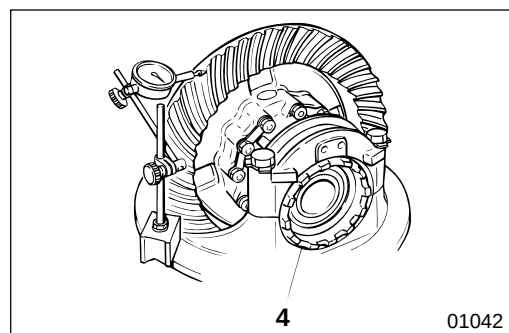
Service procedure

Inspection before disassembly

Inspect for faulty parts before disassembly.

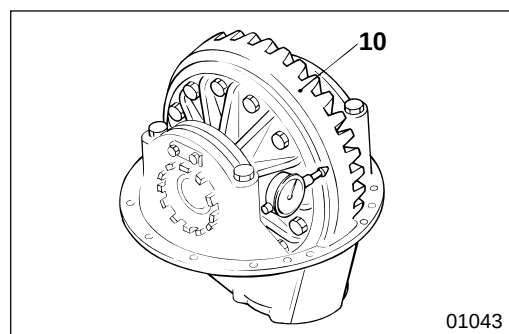
(1) Backlash of reduction gear and reduction pinion

If there is any fault, it is considered to be because of the amount adjusting screw **4** was tightened.



(2) Wobble of back face of reduction gear

Measure wobble at a point 145 mm {5.71 in.} (on the radius) from the center of the reduction gear, turning differential assembly **10** one full revolution.

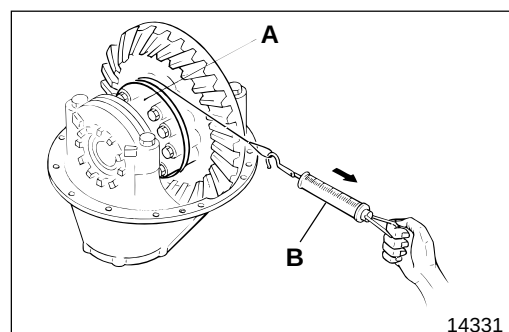


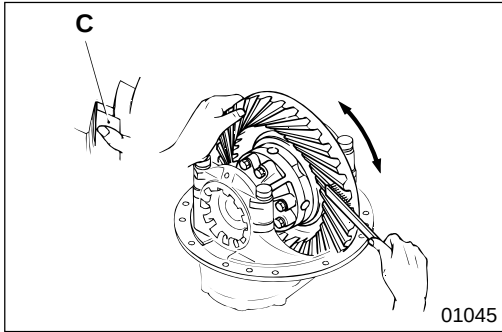
(3) Starting torque of side bearing

- Install spring balance **B** at 170 mm {6.69 in.} outer periphery point of differential case **A**.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.

NOTE

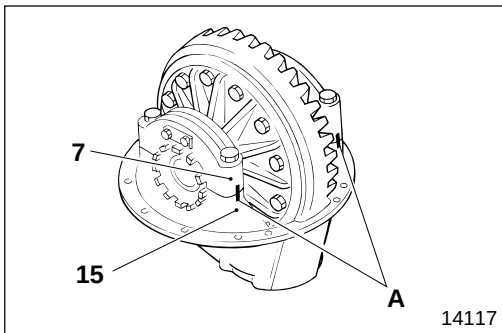
Measure the starting torque within reduction gear and reduction pinion backlash range.





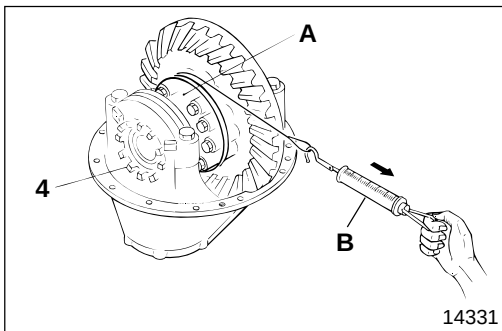
(4) Tooth contact of reduction gear

Apply red lead to three or four gear teeth, turn the gear a few times, and examine tooth contact with a piece of paper **C**.



● Work before disassembly

Put alignment marks **A** on bearing cap **7** and differential carrier **15** to identify left and right.



● Inspection and adjustment after assembly

(1) Starting torque of side bearing

[Inspection]

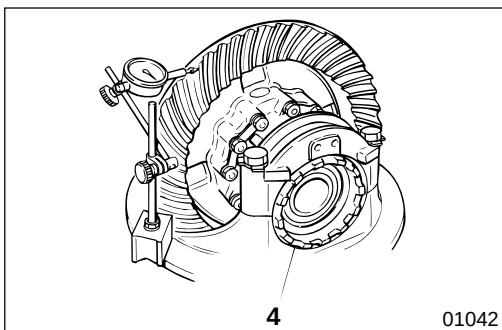
- Install spring balance **B** at 170 mm {6.69 in.} outer periphery point of differential case **A**.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the specified value, adjust.

[Adjustment]

If the measured value does not meet the specified value, adjust using left and right adjusting screws **4**.

CAUTION ⚠

- Tighten left and right adjusting screws **4** the same amount.
- Adjust the starting torque within the reduction gear and reduction pinion backlash range.



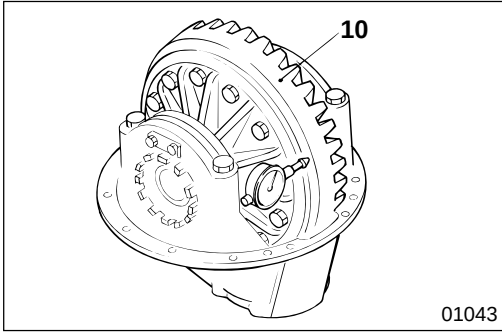
(2) Adjustment of backlash between reduction gear and reduction pinion

Adjust the starting torque of the side bearings using left and right adjusting screws **4**, taking care not to change the starting torque.

CAUTION ⚠

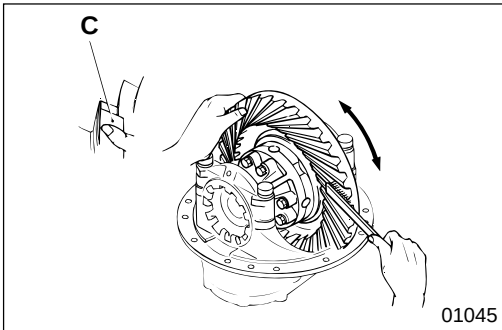
Make sure when you loosen one adjusting screw **4** that you tighten the other adjusting screw by the same amount, because the starting torque of the side bearing changes.

REDUCTION AND DIFFERENTIAL



(3) Inspection of wobble of back face of reduction gear

Measure wobble at a point 145 mm {5.71 in.} (on the radius), from the center of the reduction gear, turning differential assembly **10** one full revolution.



(4) Tooth contact of reduction gear

[Inspection]

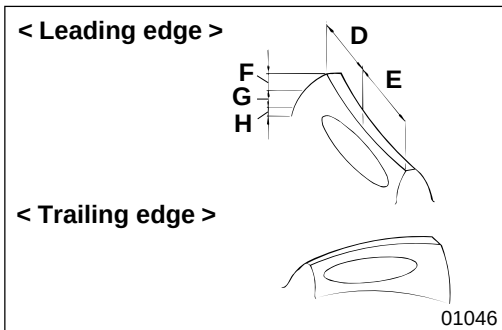
Apply red lead to three or four gear teeth, turn the gear a few times, and examine tooth contact with a piece of paper **C**.

[Adjustment]

If contact area is remarkably offset, adjust with reduction pinion mounting adjusting shims **14** to increase or decrease the backlash.

CAUTION ⚠

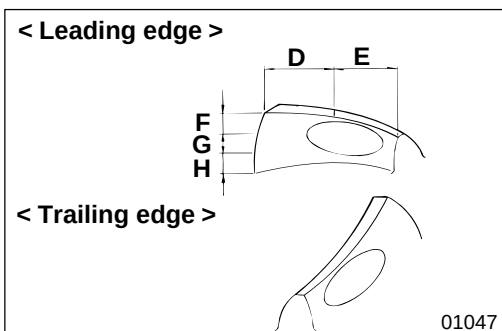
- Make sure you replace as a reduction gear set (reduction gear and reduction pinion), when you replace the gear because of excessive teeth wear.
- When good tooth contact adjustment has been obtained, but backlash does not meet the standard value, tooth contact has priority. It is not necessary to adjust backlash to the standard value if it is less than 0.15 mm {0.0059 in.} out.



● Normal tooth contact at no load

< Reduction gear >

D : Heel
E : Toe
F : Face
G : Flank
H : Clearance



< Reduction pinion >

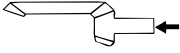
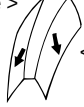
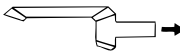
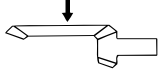
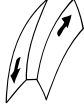
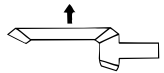
D : Heel
E : Toe
F : Face
G : Flank
H : Clearance

Maintenance item			Assembly standards
At no load	Tooth contact position	Lengthwise direction of tooth	From center toward toe
		Vertical direction	From center toward top of tooth for reduction gear and center of tooth for pinion
	Tooth contact shape	Length	About 50 to 70% of tooth width
		Width	About 50 to 70% of tooth depth
	Degree of tooth contact		Degree of tooth contact becomes weaker as it comes nearer to root or top

NOTE

When tooth contact area is nearer to toe at no load, it becomes middle area contact under load.

Adjustment of Tooth Contact

	Mode of adjustment	Moving direction
Adjustment by adding or reducing shims	Advances reduction pinion to reduction gear (Shims are reduced) 	< Leading edge >  < Trailing edge > Tooth contact moves toward root of tooth
	Retards reduction pinion from reduction gear (Shims are added) 	 Tooth contact moves toward top of tooth
Adjustment using adjusting screw	Advance reduction gear to reduction pinion axis (Less backlash) 	 Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to toe and slightly nearer to root of tooth Trailing edge: Nearer to heel and slightly nearer to top of tooth
	Retard reduction gear from reduction pinion axis (More backlash) 	 Tooth contact moves in lengthwise direction of tooth Leading edge: Nearer to heel and slightly nearer to top of tooth Trailing edge: Nearer to toe and slightly nearer to root of tooth

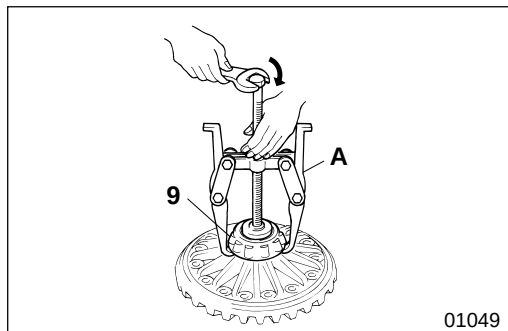
REDUCTION AND DIFFERENTIAL

◆ Service procedure

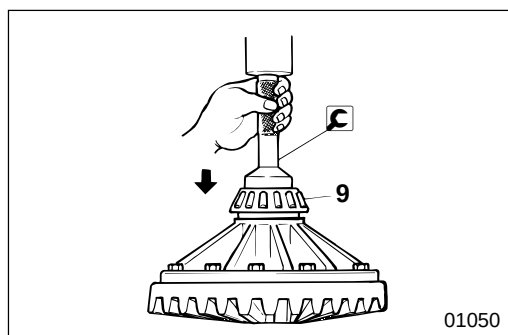
9 Side bearing inner race

[Removal]

A : Gear puller (General tool)



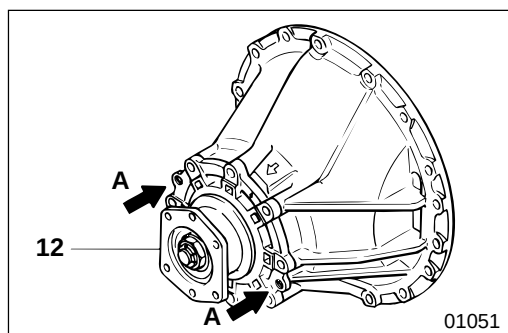
[Installation]



12 Pinion assembly

[Removal]

To remove pinion assembly **12**, screw two M12×1.25 mm bolts evenly into the two pinion assembly removal screw holes **A**.



[Adjustment]

- Carry out the following procedure so that **B**, **C** and **D** conform to the standard dimension.
- Calculate shim thickness **E** according to the following formula based upon the machining error data stamped on pinion assembly **12** and differential carrier **15**.

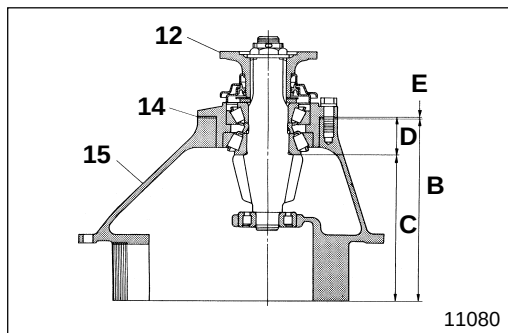
Formula for calculation:

$$E = 0.5 \{0.020\} - b + c + d$$

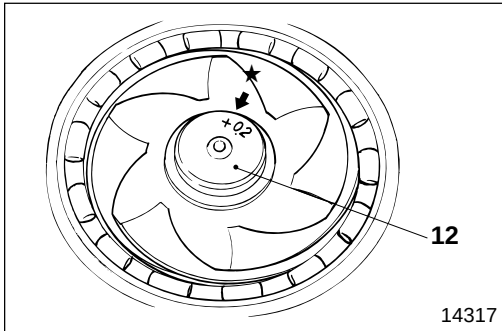
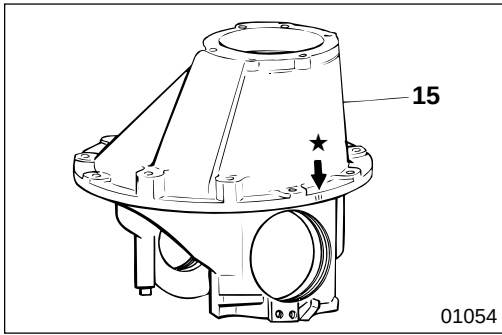
b : Deviation from basic dimension **B**

c : Deviation from basic dimension **C**

d : Deviation from basic dimension **D**



Unit : mm {in.}

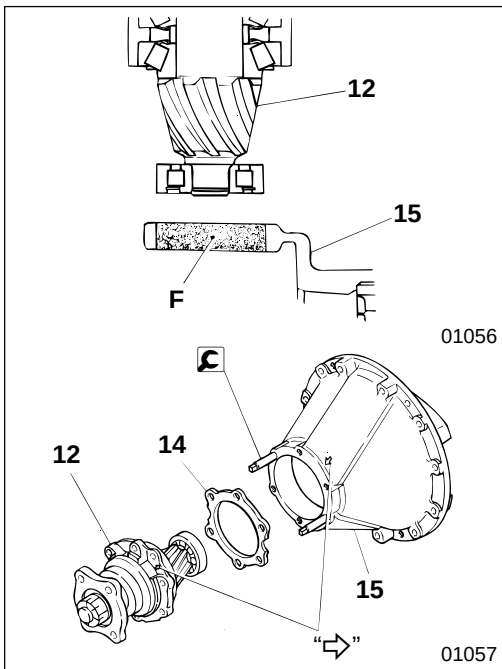


Location	Standard dimension	How to calculate deviation
Shim thickness	0.5 {0.020}	—
B	227 {8.94}	The basic dimension, multiplied by 100, is stamped on the periphery of differential carrier 15 flange
C	175 {6.89}	The basic dimension is stamped on the top of pinion assembly 12
D	52 {2.05}	Measure the deviation from D using a dial gauge. However, If it is difficult to measure the actual deviation, assume a value from 0 to 0.2 {0 to 0.0079}

★ : Stamped number position

NOTE**Thickness is stamped in millimeters.**

- Select shim **14** from shim thickness **E**.
Available thicknesses of shim **14** : 0.1 mm {0.0039 in.} and 0.2 mm {0.0079 in.}

**[Installation]**

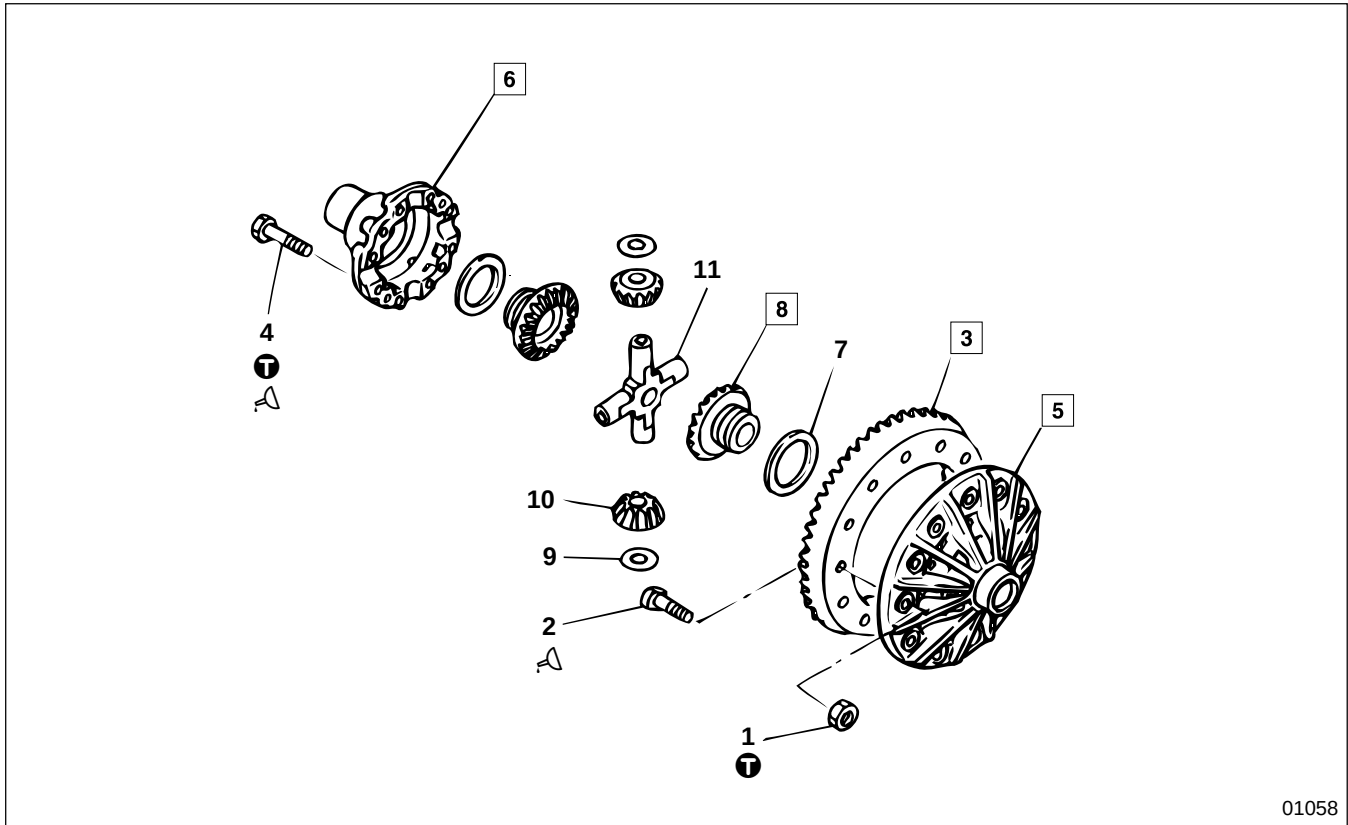
- Apply lock paint to pinion pilot bearing mounting surface **F** of differential carrier **15**.
- Install pinion assembly **12**.

CAUTION ⚠

- Be sure to let the lock paint harden undisturbed for 30 minutes to two hours after installation.
- Be sure to wait at least three hours before running the vehicle, and if possible wait 24 hours to let the lock paint harden.

REDUCTION AND DIFFERENTIAL

Differential Assembly



01058

● Disassembly sequence

- | | |
|-------------------------|------------------------------|
| 1 Nut | 7 Differential gear washer |
| 2 Bolt | 8 Differential gear |
| 3 Reduction gear | 9 Differential pinion washer |
| 4 Bolt | 10 Differential pinion |
| 5 Differential case, LH | 11 Pinion spider |
| 6 Differential case, RH | |

CAUTION

Make sure you replace differential case LH 5 and differential case RH 6 as a differential case set.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Adjustment after assembly P27-31

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
8	Play between differential gear and axle shaft spline	0.10 to 0.18 {0.0039 to 0.0071}	0.5 {0.020}	Replace
8, 10	Backlash between differential pinion and differential gear	0.19 to 0.25 {0.0075 to 0.0098}	0.5 {0.020}	Replace
10, 11	Clearance between differential pinion and pinion spider	[26] 0.17 to 0.27 {[1.02] 0.0067 to 0.011}	0.5 {0.020}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

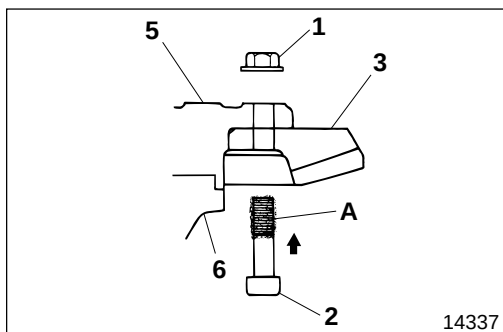
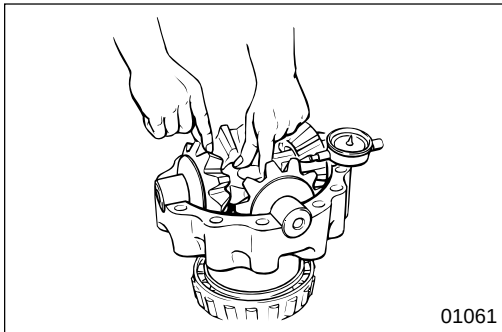
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Reduction gear and differential case LH mounting)	295 {215, 30}	—
4	Bolt (Differential case LH and differential case RH mounting)	180 {135, 18.5}	—

L Lubricant and sealant

Location	Points of application	Kinds	Quantity
2, 4	Entire bolt	Rust preventive	As required
	Thread area of bolt	LOCTITE 271	As required

◆ Service procedure**● Adjustment after assembly****Backlash between differential gear and differential pinion**

If the measured value deviates from the standard value, replace differential gear washer 7.

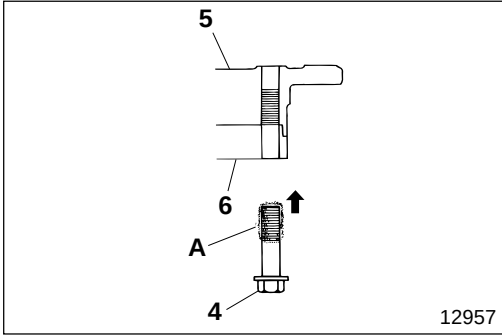
**3 5 Installation of differential case LH and reduction gear**

- Apply rust preventive to entire surface of bolt 2.
- Apply lock paint to thread area A of bolt 2.
- Tighten nut 1 at specified torque.

CAUTION ⚠

- Be sure to apply rust preventive to nut 1 because of the need to tighten it at specified torque.
- Be sure not to operate the vehicle for at least one hour after installation in order to let the lock paint harden.
- Be sure not to operate the vehicle at full torque for at least four hours after installation in order to let the lock paint harden.

REDUCTION AND DIFFERENTIAL

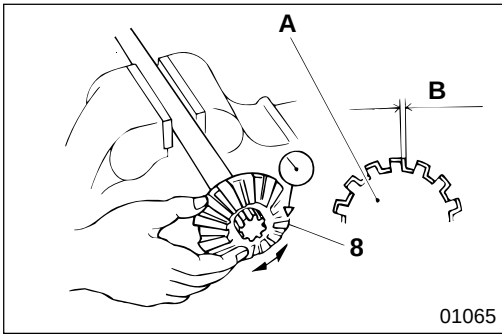


5 6 Installation of differential case LH and differential case RH

- Apply rust preventive to entire surface of bolt 4.
- Apply lock paint to thread area A of bolt 4.
- Tighten bolt 4 at specified torque.

CAUTION ⚠

- Be sure to apply rust preventive to bolt 4 because of the need to tighten it at specified torque.
- Be sure not to operate the vehicle for at least one hour after installation in order to let the lock paint harden.
- Be sure no to operate the vehicle at full torque for at least four hours after installation in order to let the lock paint harden.



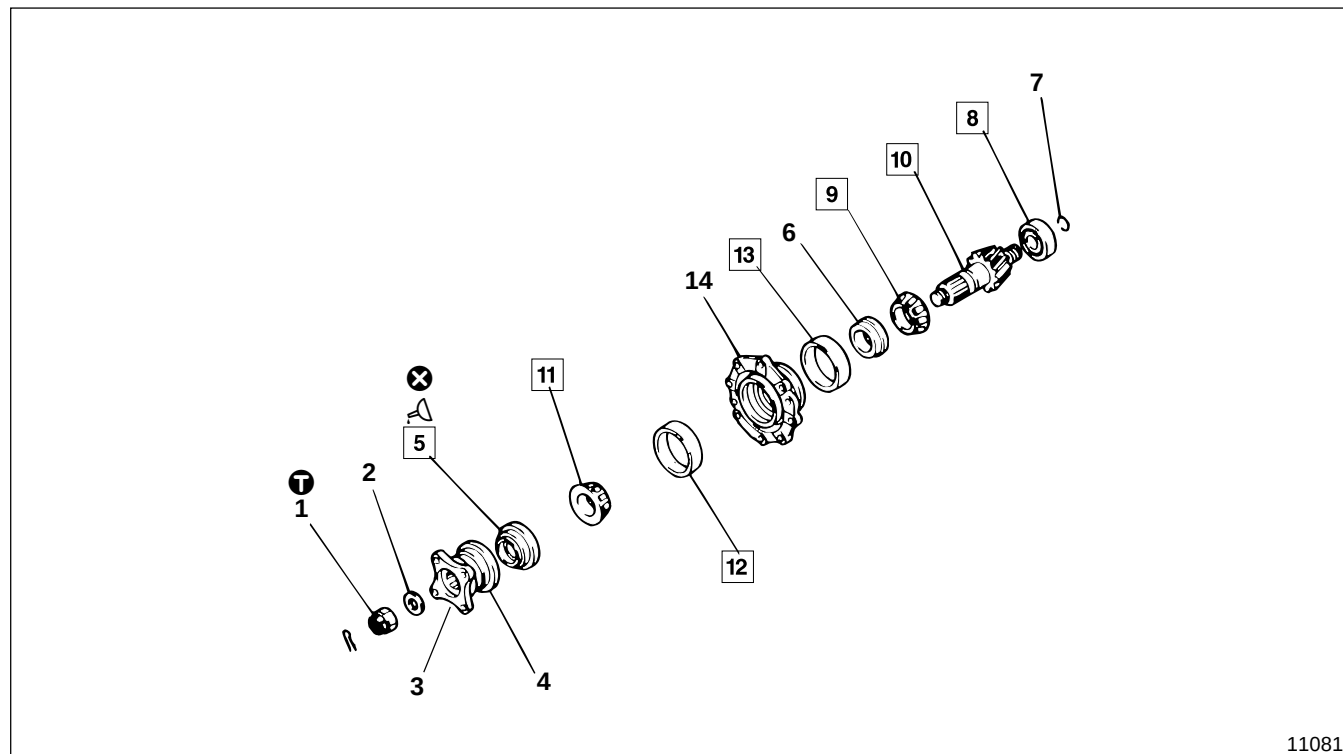
8 Play between differential gear and axle shaft at the spline

- A : Axle shaft
B : Play

MEMO

REDUCTION AND DIFFERENTIAL

Pinion Assembly



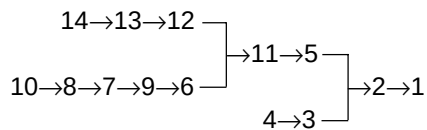
● Disassembly sequence

- | | |
|------------------------|-----------------------------|
| 1 Lock nut | 9 Inner bearing inner race |
| 2 Washer | 10 Reduction pinion |
| 3 Companion flange | 11 Outer bearing inner race |
| 4 Dust cover | 12 Outer bearing outer race |
| 5 Oil seal | 13 Inner bearing outer race |
| 6 Collar | 14 Bearing retainer |
| 7 Lock ring | |
| 8 Pinion pilot bearing | |
- ⊗ : Non-reusable parts

NOTE

Record the thicknesses and number of collars 6 before disassembling for reference when assembling.

● Assembly sequence



● Inspection and adjustment after assembly P27-37

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
9, 11, 12, 13	Starting torque of pinion bearing	When new bearings are used	2.0 to 2.9 N·m {1.4 to 2.2 lbf.ft, 0.20 to 0.30 kgf·m}	—	• Adjust using collar • Tangential force at 134 {5.28} outer periphery point of bearing retainer : 29.4 to 44.1 N {6.6 to 9.9 lbf, 3 to 4.5 kgf}
		When bearings are reused	1.6 to 2.4 N·m {1.2 to 1.7 lbf.ft, 0.16 to 0.24 kgf·m}	—	• Adjust using collar • Tangential force at 134 {5.28} outer periphery point of bearing retainer : 24 to 34 N {5.3 to 7.7 lbf, 2.4 to 3.5 kgf}

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut (Companion flange and reduction pinion mounting)	195 to 345 {145 to 255, 20 to 35}	—

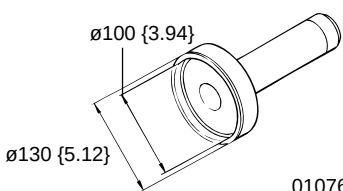
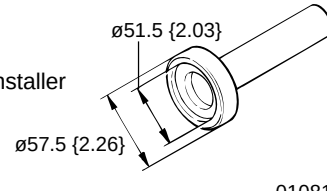
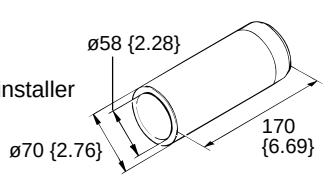
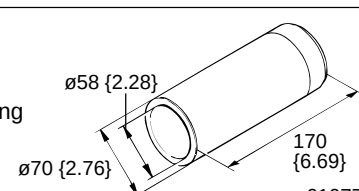
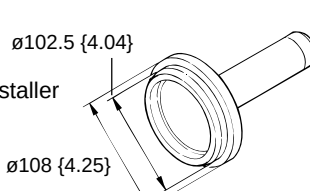
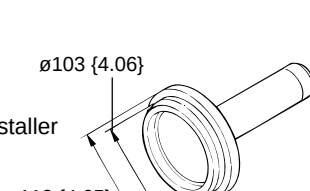
Lubricant

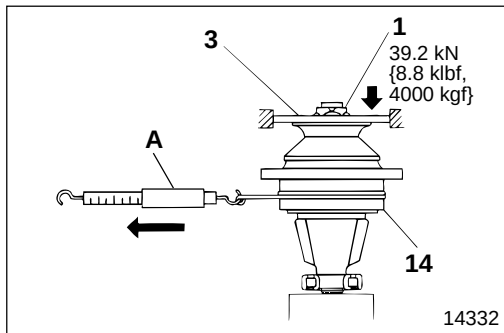
Location	Points of application	Kinds	Quantity
5	Lip area of oil seal	Chassis grease [NLGI No. 1 (Ca soap)]	As required

REDUCTION AND DIFFERENTIAL

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
5	Oil seal installer 	MH061752	Press-fitting of oil seal
8	Pinion pilot bearing installer 	03723-27001	Press-fitting of pinion pilot bearing
9	Pinion inner bearing installer 	MH061004	Press-fitting of inner bearing inner race
11	Pinion outer bearing installer 	MH061004	Press-fitting of outer bearing inner race
12	Pinion outer bearing installer 	MH061007	Press-fitting of outer bearing outer race
13	Pinion inner bearing installer 	MH061006	Press-fitting of inner bearing outer race



◆ Service procedure

● Inspection and adjustment after assembly

Starting torque of pinion bearing

[Inspection]

- Apply load of approximately 39.2 kN {8.8 klbf, 4000 kgf} to companion flange 3 or tighten lock nut 1 at specified torque.
- Install spring balance A at 134 mm {5.28 in.} outer periphery point of bearing retainer 14.
- Measure the tangential force.
- If the measured tangential force is within the specified value, the starting torque conforms to the standard value.
- If the measured value deviates from the specified value, adjust.

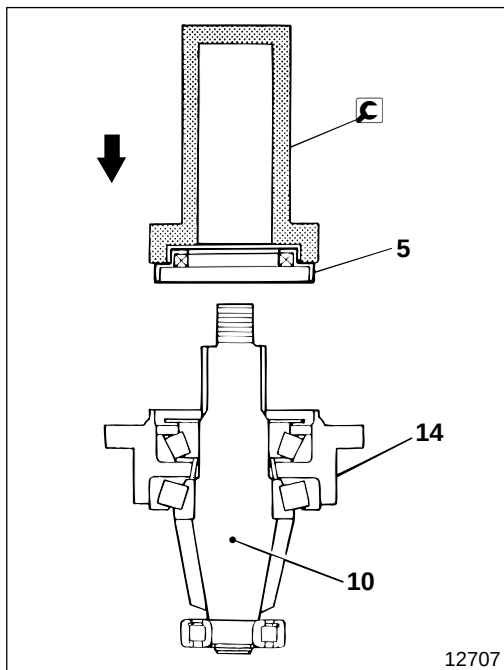
NOTE

- Tighten companion flange 3 before measuring.
- Measure with oil seal 5 removed.

[Adjustment]

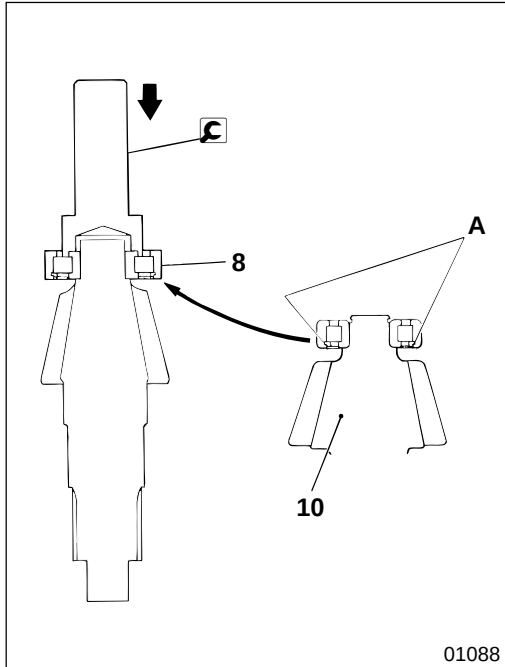
If the measured value does not conform to the specified value, adjust with collar 6 to obtain specified tangential force. Choose an appropriate collar by referring to the table below.

Thickness of collar : 15.875 to 16.475 mm {0.62 to 0.65 in.} (25 thicknesses in 0.025 mm {0.00098 in.} increments)



5 Installation of oil seal

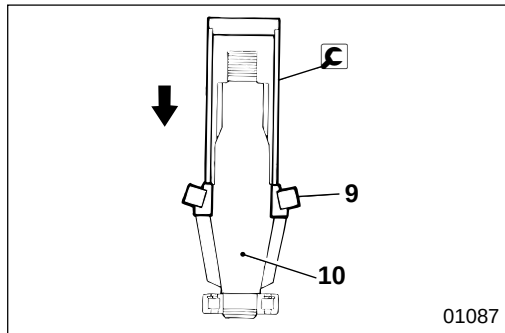
REDUCTION AND DIFFERENTIAL



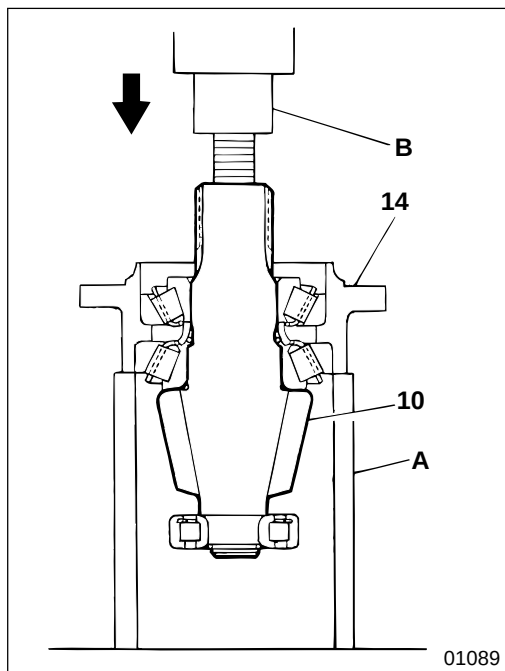
8 Installation of pinion pilot bearing

Press-fit pinion pilot bearing **8** in the direction as illustrated.

A : Lock ring



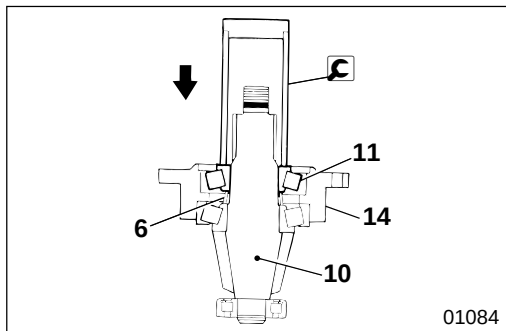
9 Installation of inner bearing inner race



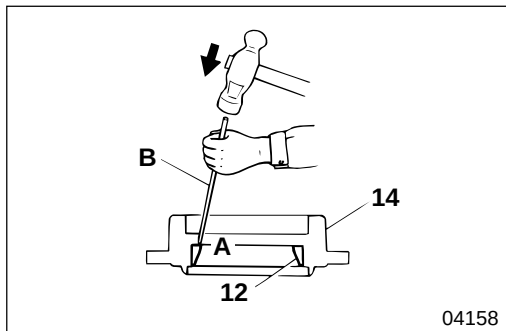
10 Removal of reduction pinion

A : Cylindrical guide

B : Press



11 Installation of outer bearing inner race

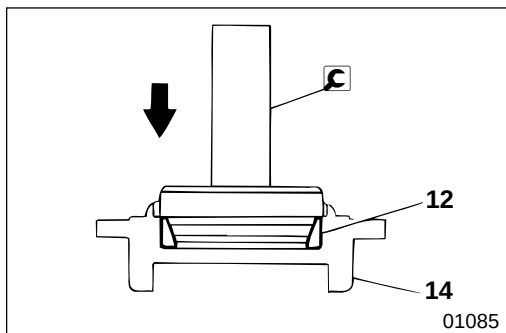


12 Outer bearing outer race

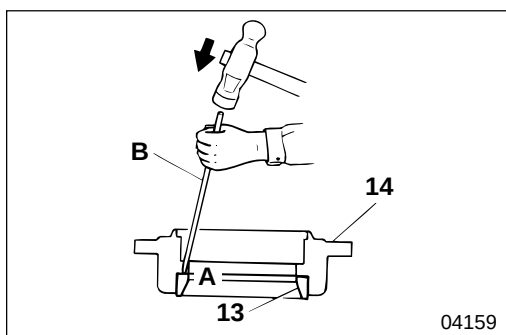
[Removal]

Drive out outer bearing outer race **12** evenly from three indented parts **A** in bearing retainer **14**.

B : Pin-punch



[Installation]

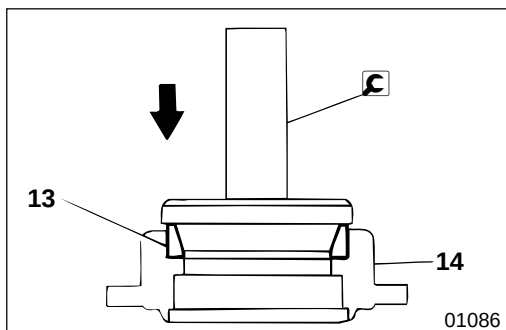


13 Inner bearing outer race

[Removal]

Drive out inner bearing outer race **13** evenly from three indented parts **A** in bearing retainer **14**.

B : Pin-punch



[Installation]



FH

Service Manual

Group 31

Wheel and Tire

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

GROUP 31 WHEEL AND TIRE

SPECIFICATIONS	2
TROUBLESHOOTING	2
WHEEL AND TIRE	3

SPECIFICATIONS/TROUBLESHOOTING

SPECIFICATIONS

Tire size	Air pressure kPa {psi, kgf/cm ² }		Application wheel
	Front	Rear	
215/75R17.5 124/123L	700 {100, 7.00}	700 {100, 7.00}	17.5×6.00-135-9t

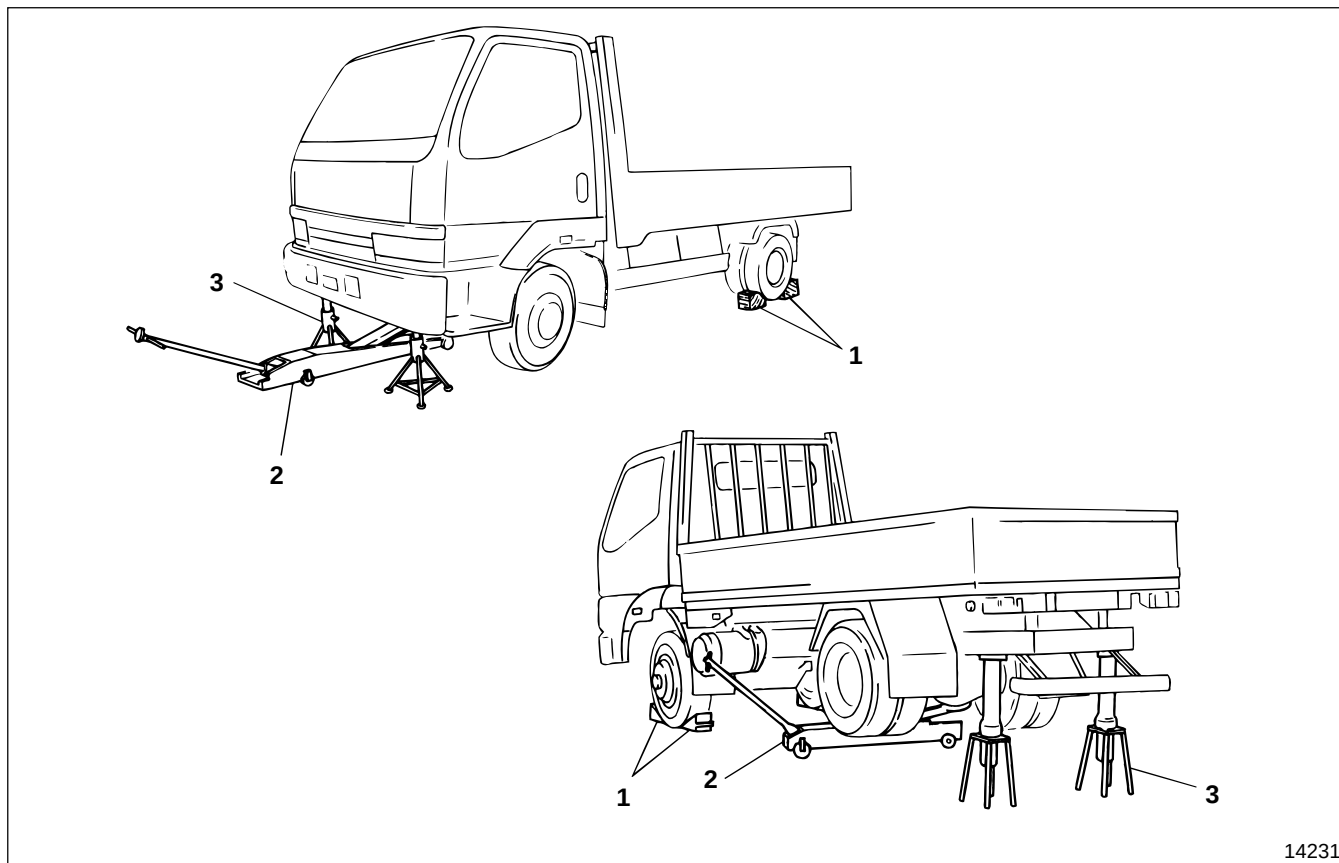
TROUBLESHOOTING

Symptoms		Tire tread worn										Remarks
		Both shoulders worn	Center worn	Outside worn	Inside worn	Feather-edged wear from outside to inside	Feather-edged wear from inside to outside	Wavy wear	Dished wear (one or more spots)	Pitted wear (dented) all around	Jagged wear	
Possible causes												
Overloading		☐										
Tire air pressure	Insufficient	☐						☐	☐	☐	☐	
	Excessive		☐									
Wheel alignment Gr 26	Toe-in	Excessive		☐		☐						
		Insufficient			☐							
	Camber	Excessive		☐								
		Insufficient			☐							
	Toe-out excessive				☐		☐					
	Overall misalignment		☐		☐	☐	☐	☐	☐	☐		
Knuckle arm bent				☐	☐	☐	☐					Gr 26
Left and right tie rod lengths different						☐						Gr 26
Wheel balance incorrect								☐	☐	☐	☐	
Wheel bearing loose								☐	☐	☐	☐	Gr 26, 27
Ball joint loose									☐			Gr 26
Tie rod end loose									☐			Gr 37
Brake drum eccentric									☐	☐		Gr 35
Axle bent								☐	☐			Gr 26, 27
Sudden starting, sudden braking or sharp turn									☐	☐		
Left and right front wheel turning radius incorrect											☐	Gr 26
Road surface influence				☐	☐							

WHEEL AND TIRE

31

Work for Removal and Installation of Wheel and Tire



● Work sequence

- 1 Place wheel chocks.
- 2 Jack up the front or rear axle using a garage jack placed under the center of the axle.
- 3 Support the frame on rigid racks.

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

● Work sequence after removal and installation

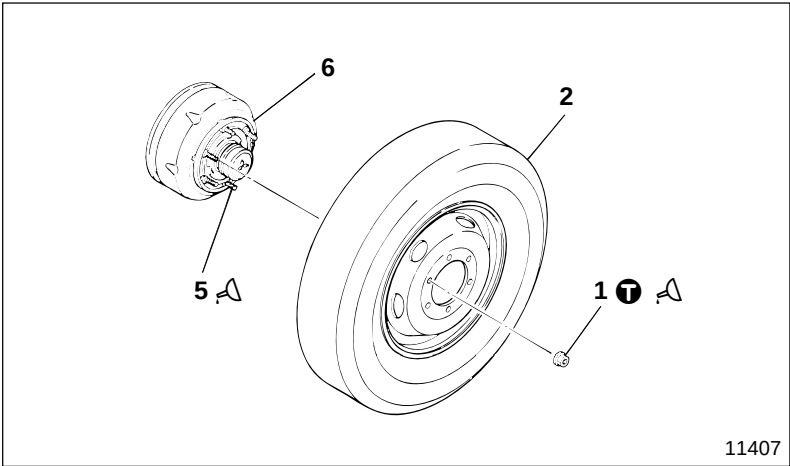
Follow the work sequence in reverse.

WHEEL AND TIRE

NOTE

Use right-hand threaded wheel nuts marked “R” for right side wheel and left-hand threaded wheel nuts marked “L” for left side wheel.

< Single tire >



● Removal sequence

- 1 Wheel nut
- 2 Tire assembly P31-6
- 5 Hub bolt
- 6 Hub

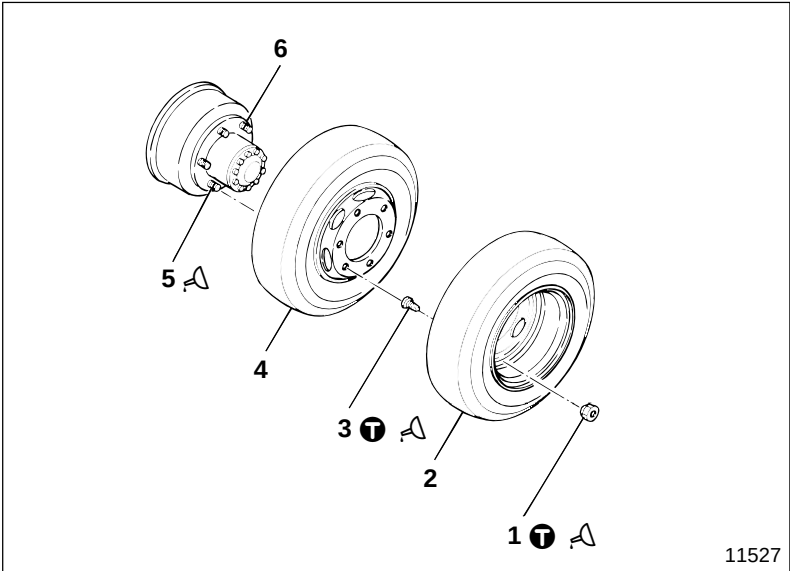
● Cleaning and applying grease before installation

P31-5

● Installation sequence

Follow the removal sequence in reverse.

< Double tire >



● Removal sequence

- 1 Wheel nut (outer)
- 2 Tire assembly P31-6
- 3 Wheel nut (inner)
- 4 Tire assembly P31-6
- 5 Hub bolt
- 6 Hub

● Cleaning and applying grease before installation

P31-5

● Installation sequence

Follow the removal sequence in reverse.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1, 3	Wheel nut	370 to 410 {275 to 305, 38 to 42}	Wet

Lubricant

Location	Points of application	Kinds	Quantity
1	Wheel nut spherical area	Chassis grease [NLGI No. 1 (Ca soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
3	Thread and spherical areas of wheel nut (inner)	Chassis grease [NLGI No. 1 (Ca soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required
5	Thread area of hub bolt	Chassis grease [NLGI No. 1 (Ca soap)] or Wheel bearing grease [NLGI No. 2 (Li soap)]	As required

◆ Service procedure

● Cleaning and applying grease before installation

[Cleaning]

To prevent wheel nuts **1** and **3** and hub bolt **5** from becoming loose and to prevent mounting parts (tire assemblies **2** and **4** and hub **6**) from being damaged, remove rust, dust, additional coatings of paint, and foreign particles from the following areas:

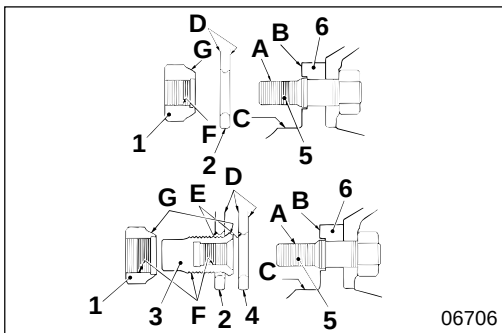
- A** : Hub bolt thread area
- B** : Wheel mounting surface of hub
- C** : Wheel alignment area of hub
- D** : Disc wheel mating surface
- E** : Disc wheel nut mounting surface
- F** : Wheel nut thread area
- G** : Wheel nut spherical area

[Applying grease]

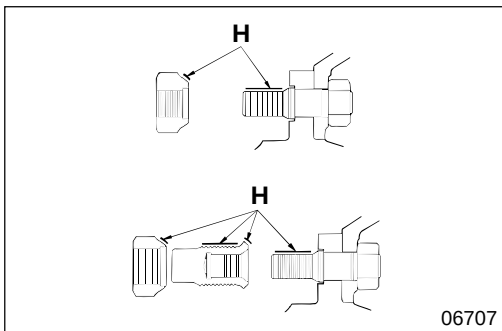
- H** : Grease application location

WARNING ⚠

Never use grease containing molybdenum disulfide, since it can cause loosening of fitted screws.



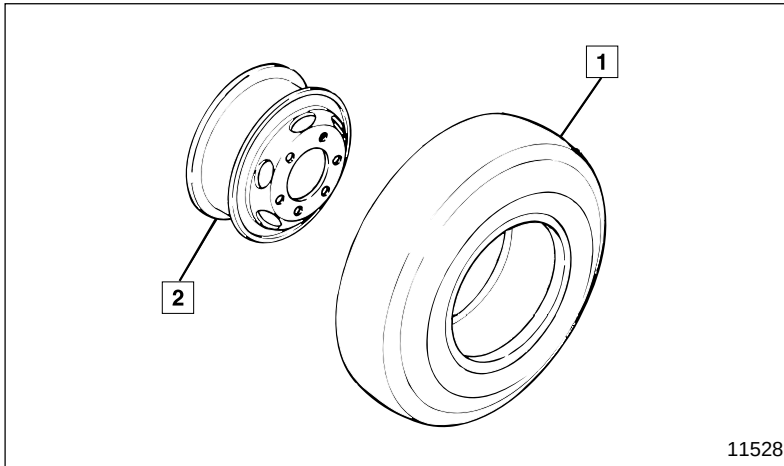
06706



06707

WHEEL AND TIRE

Tire Assembly



● Disassembly sequence

- 1 Tire
- 2 Disc wheel

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

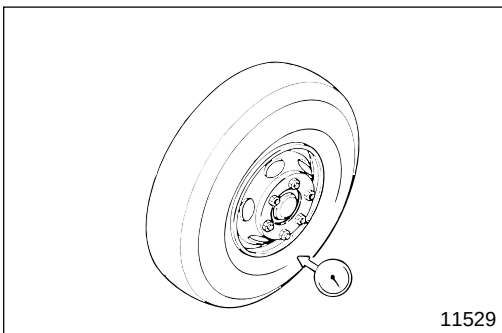
Location	Maintenance item		Standard value	Limit	Remedy
1	Horizontal deflection of tire (When assembled)		3.5 {0.14} or less	—	—
2	Disc wheel	Flatness	0.2 {0.0079} or less	—	—
		Horizontal deflection	1.5 {0.059} or less	—	—
		Vertical deflection	1.5 {0.059} or less	—	—

◆ Service procedure

1 Deflection of tire

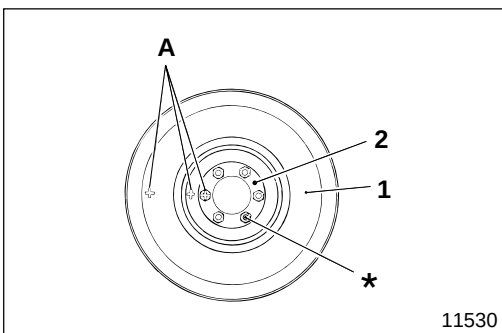
[Inspection]

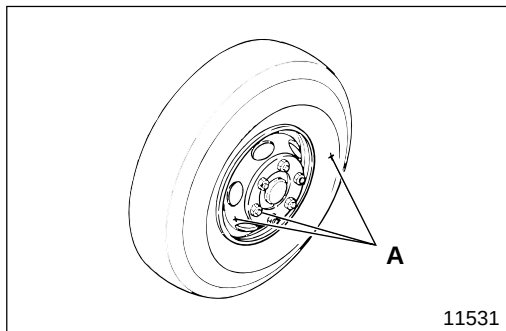
If the measured value is higher than the limit, make corrections as follows.



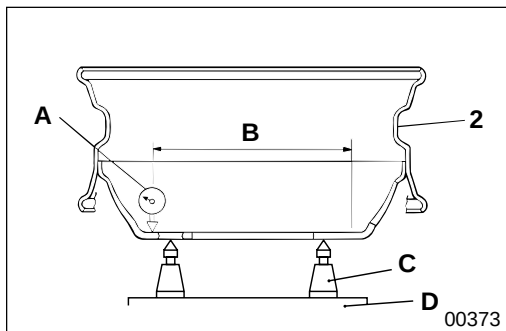
[Correction]

- Put chalk marks on tire 1, disc wheel 2, and hub bolt * (positions A as illustrated).
- Remove tire 1 from disc wheel 2.





- Measure deflection of disc wheel **2**. If the most deflective position is near the chalk mark, reinstall tire **1** rotating it half a turn from the chalk mark and tighten nuts.
- Remeasure deflection of tire **1**.
- If the measured value is still higher than the limit, replace tire **1** and disc wheel **2** together as an assembly.



2 Inspection of disc wheel

(1) Flatness

- Measure flatness at specified position **B** from the center of disc wheel **2**.
Measure flatness at six equidistant points (wheel with 6 studs) on the wheel.

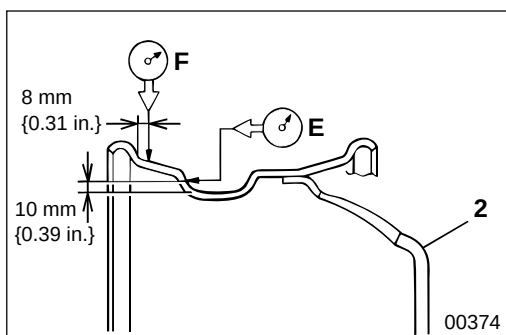
A : Dial gauge

B : $\varnothing 170$ to 270 mm {6.69 to 10.6 in.}

C : Portable screw jacks (x 4)

D : Surface plate

- Replace disc wheel **2** if the measured value is higher than the limit.



(2) Deflection

Replace disc wheel **2** if the measured value is higher than the limit.

E : Horizontal deflection measuring point

F : Vertical deflection measuring point



FH

Service Manual

Group 33

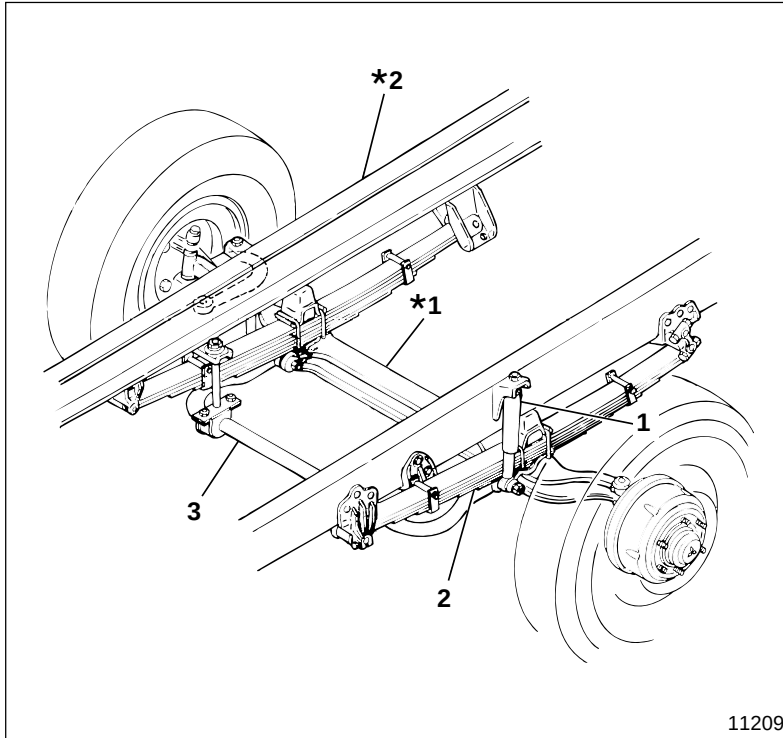
Front Suspension

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

GROUP 33 FRONT SUSPENSION

STRUCTURE AND OPERATION	2
TROUBLESHOOTING	3
WORK BEFOR REMOVAL AND INSTALLATION OF FRONT SUSPENSION	4
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY	6
LEAF SPRING ASSEMBLY	12
SHOCK ABSORBER	14
STABILIZER	15

STRUCTURE AND OPERATION



- 1 Shock absorber
- 2 Leaf spring assembly
- 3 Stabilizer

*1: Front axle
*2: Frame

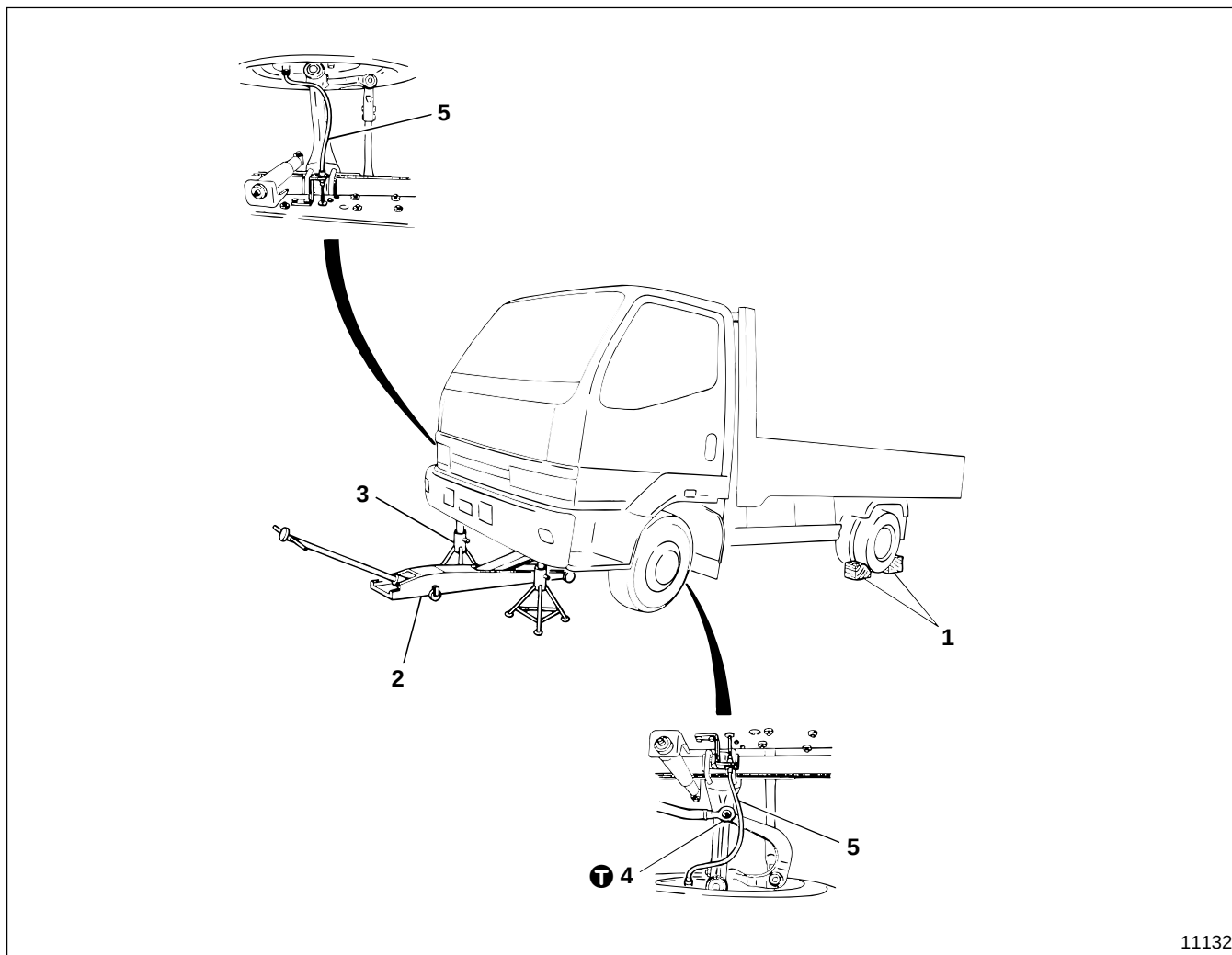
Leaf spring assembly **2**, shock absorber **1** and stabilizer **3** are installed between frame ***2** and front axle ***1** to support the vehicle body mass and absorb vibration and shock from the road surface to prevent them from being directly transmitted to the vehicle body thereby protecting the crew, the vehicle body, and the cargo. In addition, irregular vibration from the wheels is restrained, ensuring driving stability.

TROUBLESHOOTING

33

Possible causes		Symptoms						Remarks
		Ride soft with gentle swaying	Noise generated when vehicle is unloaded	Direct impact transmitted from uneven road surface	Noise generated when vehicle is loaded	Excessive rolling while cruising	Periodic jolts received from the road surface	
Leaf spring	Cracked or damaged			○				
	Fractured		○					
	Spring brackets broken				○			
	U-bolts loose				○			
	Spring bushing worn		○					
Shackle pin play in thrust direction			○					
Bump stopper damaged or broken					○			
Shock absorber	Oil leaking noticeable or damping force decreased	○						
	Rubber bushing worn		○					
	Installation loose		○					
Stabilizer	Stabilizer deformed or bushing worn					○		
Tire	Tires worn unevenly						○	Gr 31
	Tires and wheels unbalanced						○	
	Air pressure excessive			○				

WORK BEFORE REMOVAL AND INSTALLATION OF FRONT SUSPENSION



11132

● Removal sequence

- 1 Place wheel chocks.
- 2 Jack up the front axle with a garage jack.
- 3 Support the front frame on rigid racks.
- 4 Remove the nut (that connect the knuckle arm and the drag link).
- 5 Disconnect the brake hose (on the frame side).

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame with rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Be sure to protect the brake hose from dust by fitting blanking plugs.

● Installation sequence

Follow the removal sequence in reverse.

WARNING

You must bleed air from the brake system after connecting the brake hose, failure to do so would cause the brakes to malfunction.  Gr 35

CAUTION

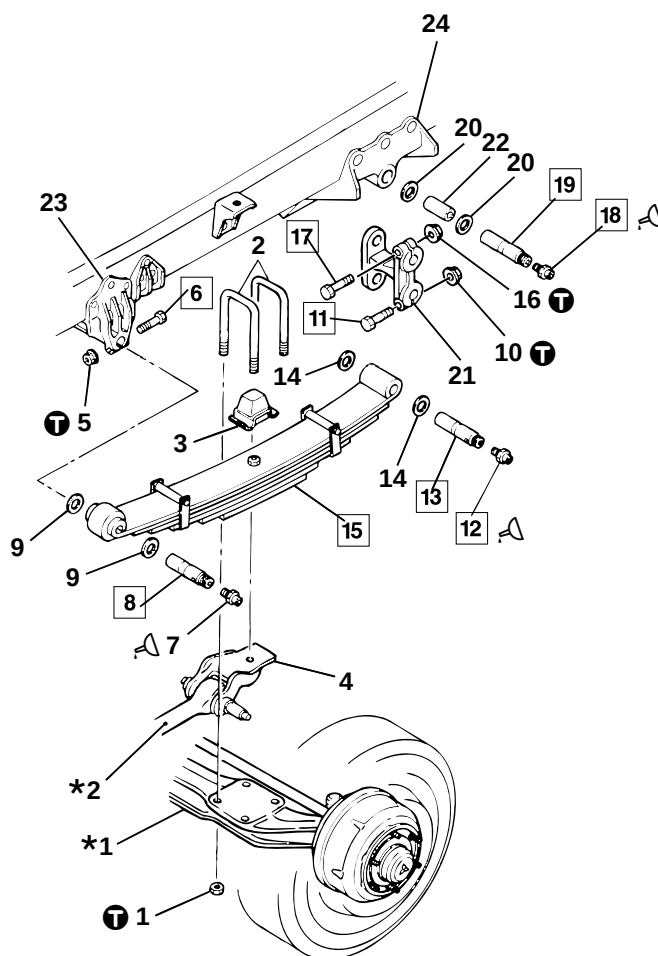
Be sure that the brake hose is not twisted when you connect it.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (Knuckle arm and drag link connecting)	190±47.5 {140±35, 19.4±4.85}	—

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



11133

● Removal sequence

- | | | |
|----------------------|-------------------------|-------------------------------|
| 1 U-bolt nut | 10 Nut | 19 Shackle pin |
| 2 U-bolt | 11 Bolt | 20 Side washer |
| 3 Bump stopper | 12 Grease nipple | 21 Shackle link |
| 4 Stabilizer bracket | 13 Shackle pin | 22 Bushing |
| ☞ P33-15 | 14 Side washer | 23 Front spring front bracket |
| 5 Nut | 15 Leaf spring assembly | 24 Front spring rear bracket |
| 6 Bolt | ☞ P33-12 | |
| 7 Grease nipple | 16 Nut | |
| 8 Shackle pin | 17 Bolt | |
| 9 Side washer | 18 Grease nipple | |

*1 : Front axle ☞ Gr 26
*2 : Stabilizer ☞ P33-15

NOTE

Do not remove front spring front bracket 23 and rear bracket 24 unless they are faulty. ☞ Gr 41

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
8, 3, 15	Clearance between shackle pin and leaf spring assembly bushing	[28] 0 to 0.12 {[1.10] 0 to 0.0047}	0.3 {0.012}	Replace
8, 23	Clearance between shackle pin and front spring front bracket	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.012}	Replace
13, 19, 21	Clearance between shackle pin and shackle link	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.012}	Replace
15, 21	Clearance between leaf spring assembly and shackle link	0.5 to 1.2 {0.020 to 0.047}	1.5 {0.059}	Replace side washer
15, 23	Clearance between leaf spring assembly and front spring front bracket	0.2 to 0.9 {0.0079 to 0.035}	—	Replace side washer
19, 22	Clearance between shackle pin and bushing	[28] 0.02 to 0.14 [1.10] 0.00079 to 0.0055}	—	Replace
21, 24	Clearance between shackle link and front spring rear bracket	0.5 to 1.2 {0.020 to 0.047}	—	Replace side washer

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

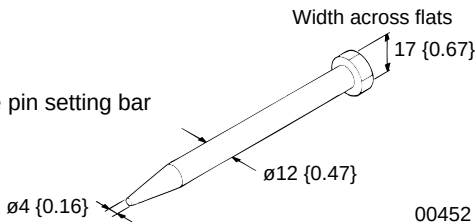
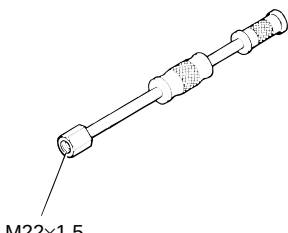
Location	Parts to be tightened	Tightening torque	Remarks
1	U-bolt nut (U-bolt mounting)	240±36 {175±27, 24.5±3.7}	Wet
5, 10, 16	Nut (Shackle pin mounting)	80 to 110 {58 to 80, 8.0 to 11}	—

Lubricant

Location	Points of application	Kinds	Quantity
7, 12, 18	Grease nipple	Chassis grease [NLGI NO.1 (Ca soap)]	As required

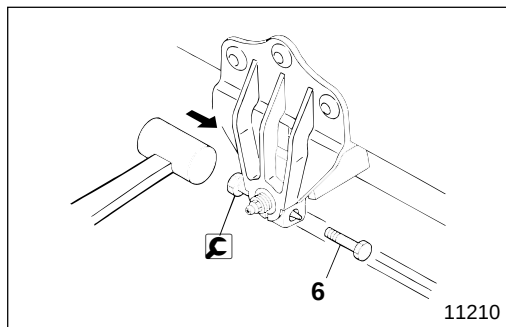
Special tools

Unit : mm {in.}

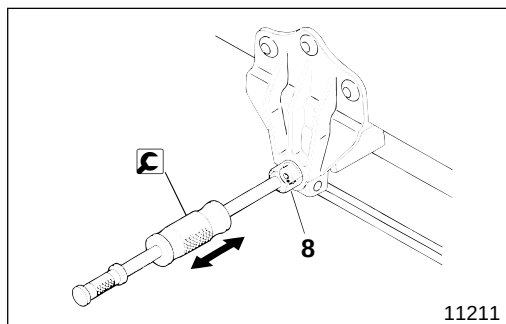
Location	Tool name and shape	Part No.	Application
6, 8, 11, 13, 17, 19	 Shackle pin setting bar 00452	MC023419	Removal of bolt (installation of shackle pin), alignment of shackle pin bolt slot
8, 3, 19	 Shackle pin remover 06350	MB999112	Removal of shackle pin

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY

◆ Service procedure

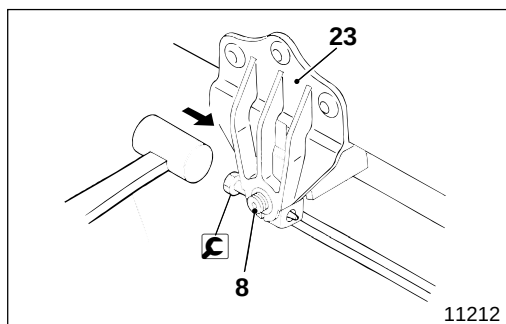


6 Removal of bolt



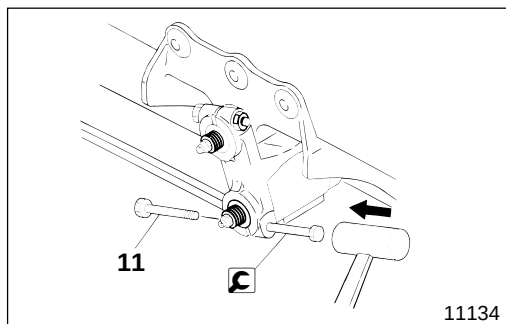
8 Shackle pin

[Removal]

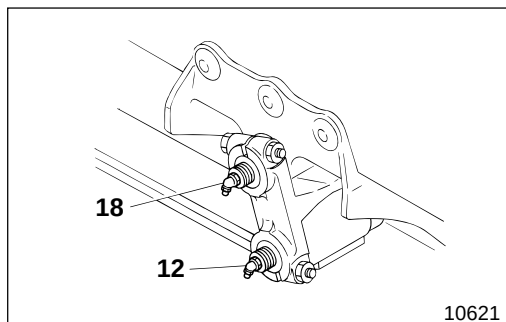


[Installation]

Align the bolt hole of front spring front bracket **23** and the bolt slot of shackle pin **8** using  shackle pin setting bar.

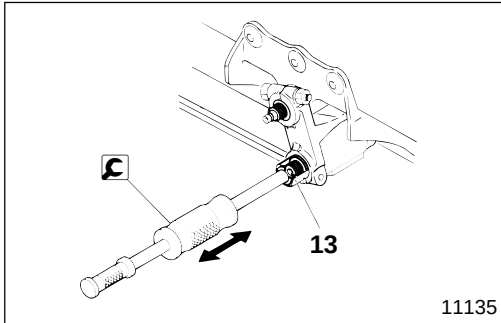


11 Removal of bolt

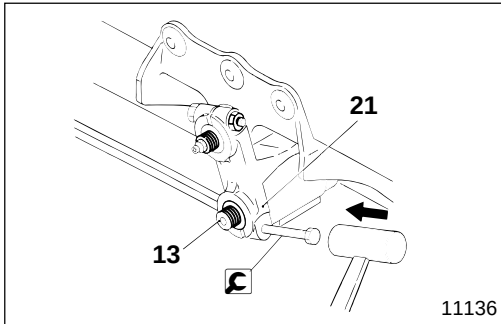


12 **18** Installation of grease nipple

- Install grease nipples **12**, **18** on the driver's side (rear left) so that they face the most convenient side for supplying grease.
- For the automatic transmission model, also install grease nipples **12**, **18** on the passenger's side (rear right) so that they face the most convenient side for supplying grease.

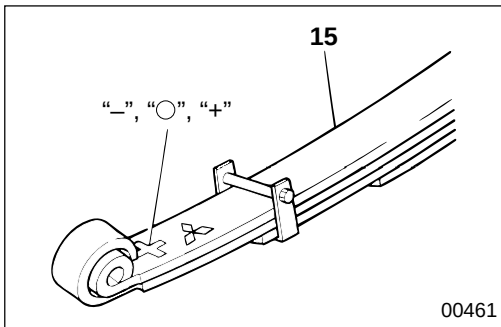
**13 Shackle pin**

[Removal]



[Installation]

Align the bolt hole of shackle link **21** and the bolt slot of shackle pin **13** using  shackle pin setting bar.

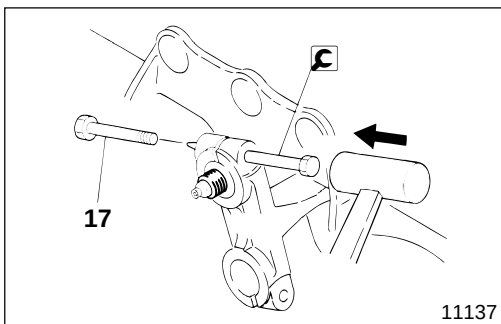
**15 Leaf spring assembly left/right height combinations**

When replacing leaf spring assembly **15**, select the members so that the left and right height marks "+", "O" and "-" are combined as shown below.

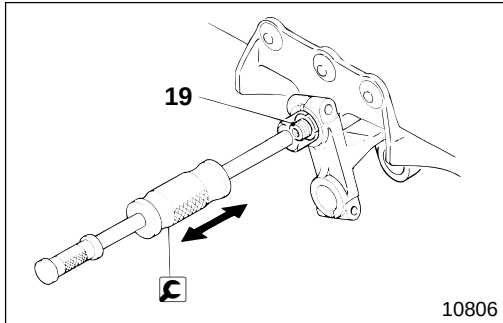
Item	Combination				
	1	2	3	4	5
Right leaf spring assembly, passenger's side	-	-	O	O	+
Left leaf spring assembly, driver's side	-	O	O	+	+

CAUTION

Passenger's side leaf spring assembly **15** differs from driver's side leaf spring assembly in camber (arch). Do not mix them up when mounting, or this would cause vehicle tilt.

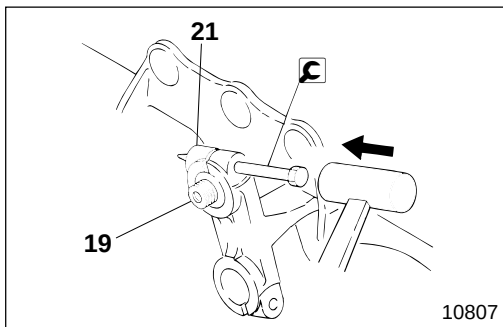
**17 Removal of bolt**

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



19 Shackle pin

[Removal]

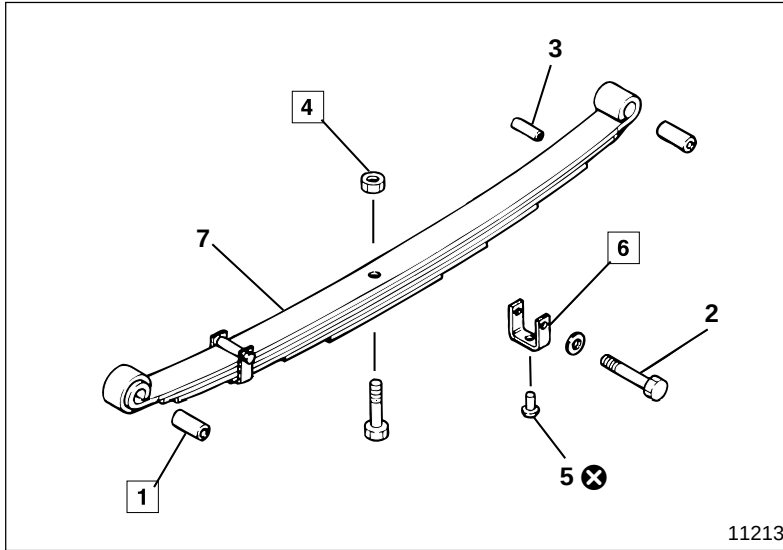


[Installation]

Align the bolt hole of shackle link **21** and the bolt slot of shackle pin **19** using  shackle pin setting bar.

MEMO

LEAF SPRING ASSEMBLY



Disassembly sequence

- 1 Spring bushing
- 2 Clip bolt
- 3 Pipe
- 4 Center nut
- 5 Rivet
- 6 Clip
- 7 Leaf spring

⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Special tools

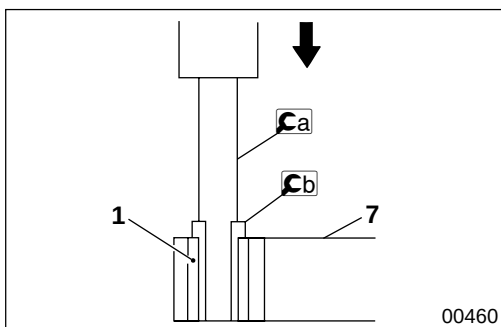
Unit : mm {in.}

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

Service procedure

1 Removal and installation of spring bushing

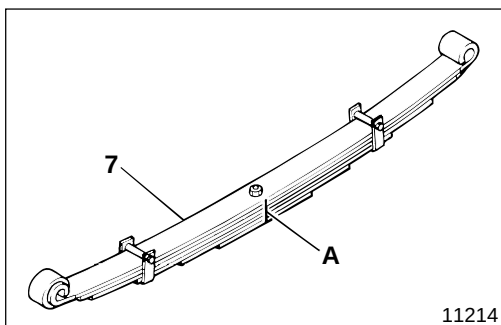
Remove spring bushing 1 from leaf spring 7 using bushing installer A and bushing installer B. For installation, follow the removal sequence in reverse.

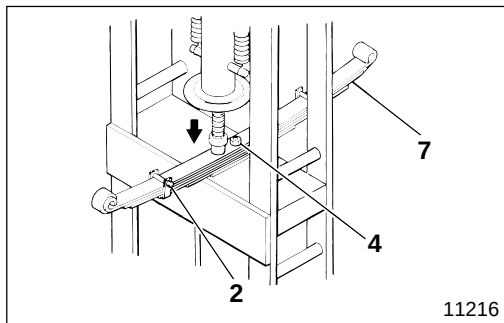


4 Center nut

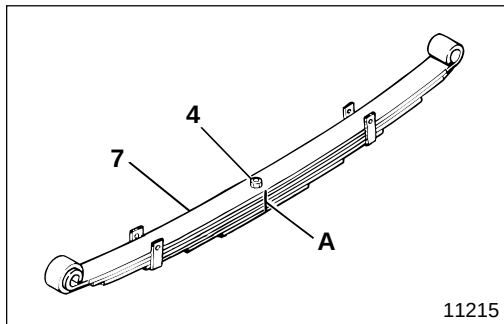
[Removal]

- Put alignment marks A on the side of leaf spring 7.



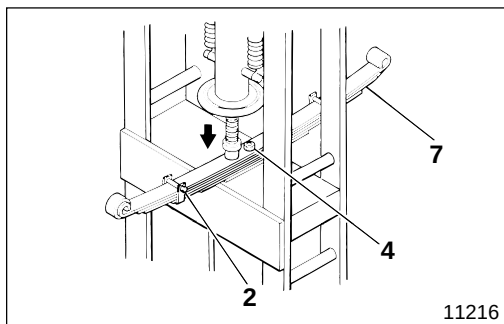


- Compress leaf springs 7 using a press, remove clip bolt 2 and center nut 4.

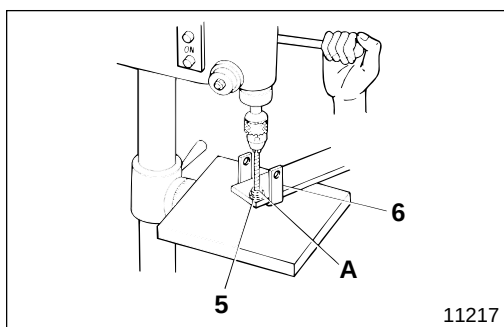


[Installation]

- Align alignment marks A on leaf spring 7 and assemble.
- Tighten center nut 4 temporarily.



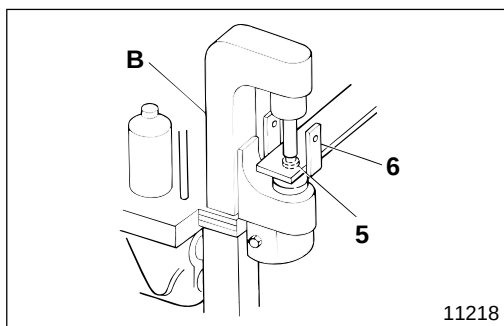
- Compress leaf spring 7 using a press, then install center nut 4. After installation, caulk at three points using a punch.
- Tighten center clip bolt 2.



6 Clip

[Removal]

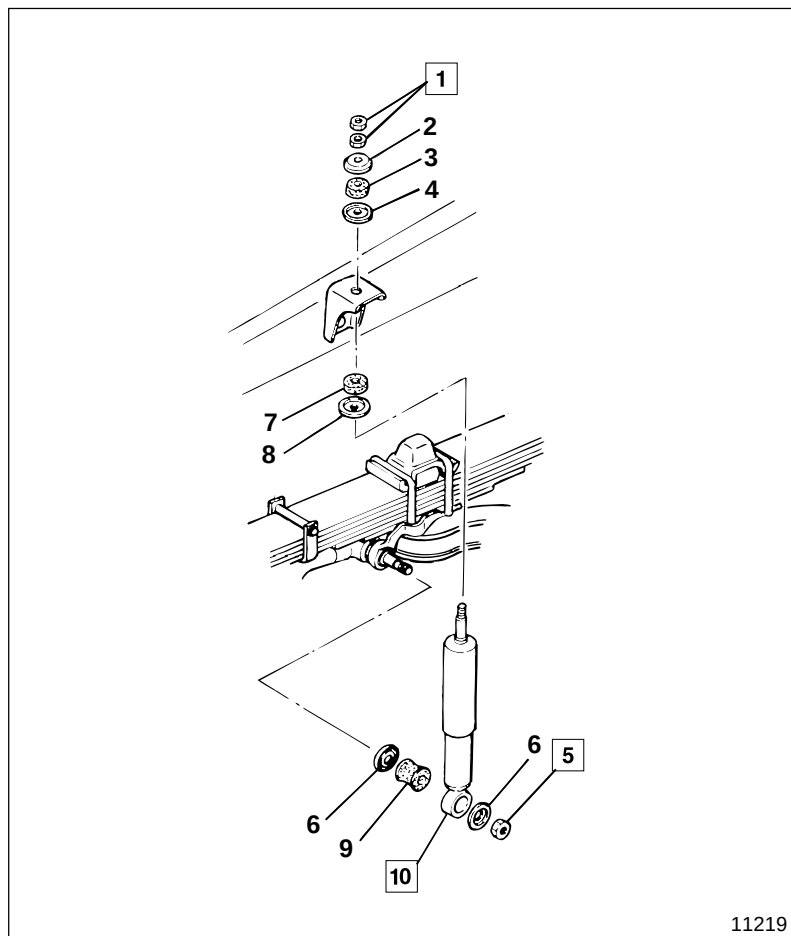
Drill out caulked end A of rivet 5 on a drill press, then remove clip 6.



[Installation]

Using riveting machine B, install clip 6 by caulking rivet 5.

SHOCK ABSORBER



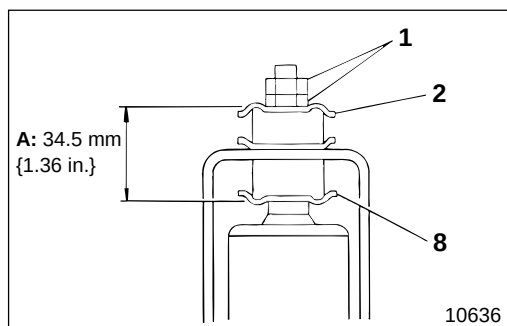
● Removal sequence

- 1 Nut
- 2 Washer
- 3 Rubber bushing
- 4 Centering washer
- 5 Nut
- 6 Washer
- 7 Rubber bushing
- 8 Washer
- 9 Rubber bushing
- 10 Shock absorber

● Installation sequence

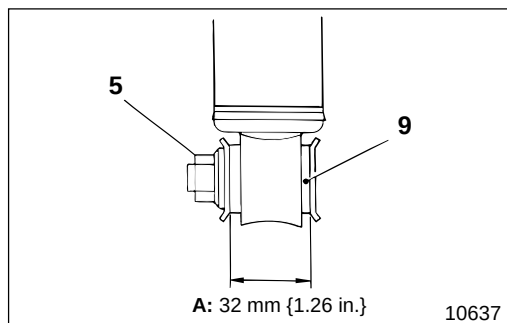
Follow the removal sequence in reverse.

◆ Service procedure



1 Nut

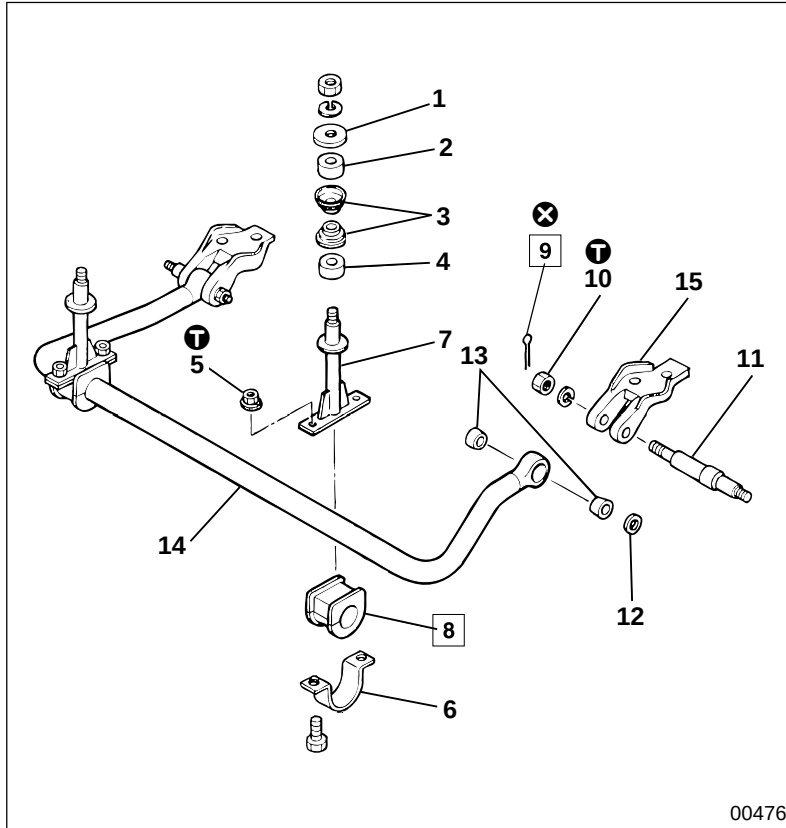
Install nut 1 so that the distance between washers 2, 8 is A.



5 Nut

Install nut 5 so that dimension of rubber bushing 9 is A.

STABILIZER

33


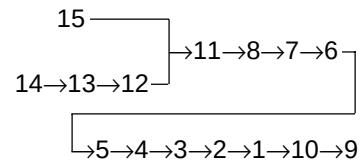
00476

● Removal sequence

- 1 Sheet
- 2 Bushing
- 3 Holder
- 4 Bushing
- 5 Nut
- 6 Cap
- 7 Stabilizer rod
- 8 Stabilizer bushing
- 9 Split pin
- 10 Nut
- 11 Stabilizer pin
- 12 Side washer
- 13 Bushing
- 14 Stabilizer bar
- 15 Stabilizer bracket

⊗ : Non-reusable parts

● Installation sequence



CAUTION

Be careful not to force in bushings 2, 4 and stabilizer rod 7 when installing them.

T Tightening torque

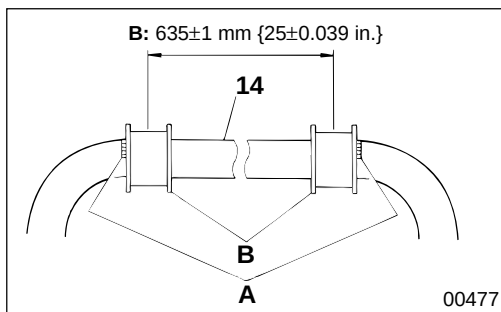
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Nut (Cap installation)	80 to 110 {58 to 80, 8.0 to 11}	—
10	Nut (Stabilizer pin installation)	100 to 160 {72 to 115, 10 to 16}	—

◆ Service procedure

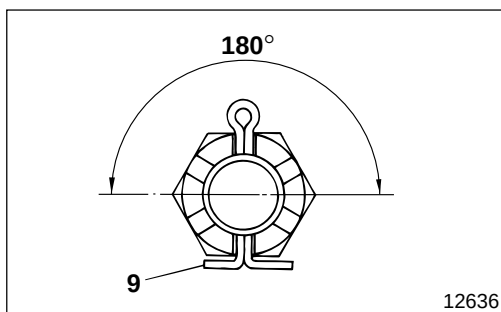
8 Stabilizer bushing

Install stabilizer bushing 8 with their end faces aligned with marks A on stabilizer bar 14 so that the distance between ends is B.



9 Installation of split pin

Insert split pin 9 so that its head is placed within the illustrated range, then bend the split pin securely.





FH

Service Manual

Group 34

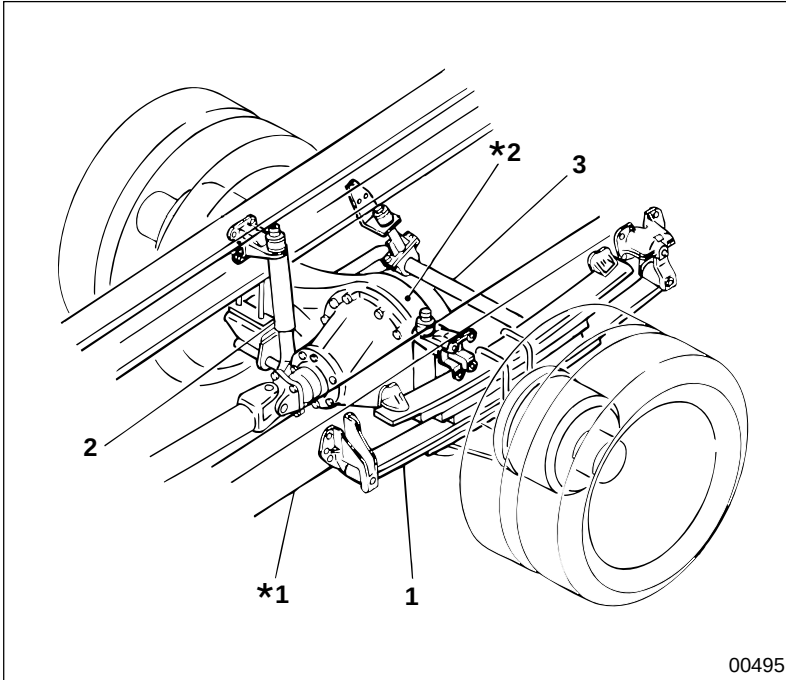
Rear Suspension

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

GROUP 34 REAR SUSPENSION

STRUCTURE AND OPERATION	2
TROUBLESHOOTING	3
WORK BEFORE REMOVAL AND INSTALLATION OF REAR SUSPENSION	4
REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY	6
LEAF SPRING ASSEMBLY	10
SHOCK ABSORBER	12
STABILIZER	13

STRUCTURE AND OPERATION



- 1 Leaf spring assembly
- 2 Shock absorber
- 3 Stabilizer

*1 : Frame

*2 : Rear axle

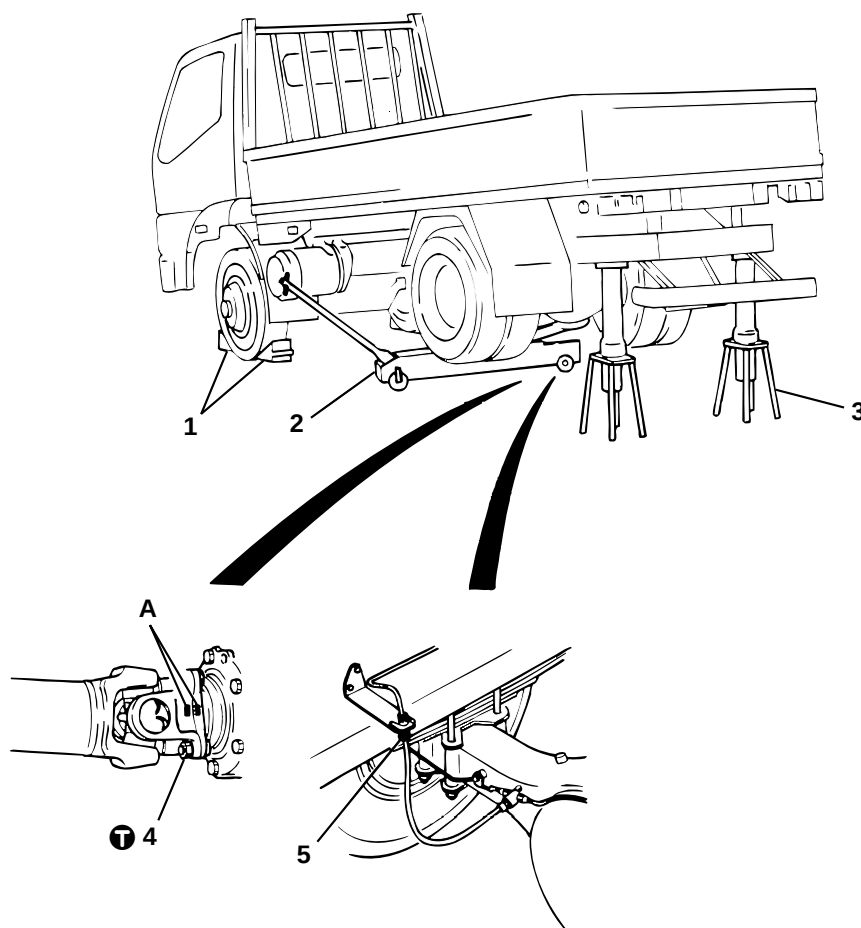
Leaf spring assembly 1 and shock absorber 2 are installed between frame *1 and rear axle *2 to support the vehicle body mass and absorb vibration and shock from the road surface to prevent them from being directly transmitted to the vehicle body thereby protecting the crew, the vehicle body, and the cargo. In addition, irregular vibration from the wheels is restrained, ensuring driving stability. Stabilizer 3 is installed to prevent rolling.

TROUBLESHOOTING

34

Possible causes		Symptoms						Remarks
		Ride spongy	Noise generated when vehicle is unloaded	Impact transmitted from uneven road surface	Noise generated when vehicle is loaded	Excessive rolling while cruising	Periodic jolts caused by the road surface	
Leaf spring	Cracked or damaged			○				
	Damaged		○					
	Spring bracket broken				○			
	U-bolts loose				○			
	Spring bushing worn		○					
Shackle pins thrust play excessive			○					
Helper stopper damaged or broken					○			
Shock absorber	Oil leaking noticeable or damping force decreased	○						
	Rubber bushing worn		○					
	Bolt loose		○					
Stabilizer	Stabilizer deformed, bushing worn					○		
Tire	Tires worn unevenly						○	Gr 31
	Tires and wheels unbalanced						○	
	Air pressure excessive			○				

WORK BEFORE REMOVAL AND INSTALLATION OF REAR SUSPENSION



11203

● Removal sequence

- 1 Place wheel chocks.
- 2 Jack up the rear axle with a garage jack.
- 3 Support the rear frame on a rigid rack.
- 4 Put alignment marks **A** on the rear axle companion flange and the propeller shaft flange yoke, then remove the nuts (on the joint between the rear axle and the propeller shaft).
- 5 Remove the brake hose joint (on the frame).

WARNING

- Chock the wheels securely so the vehicle does not move.
- Do not remove the chocks until the entire operation is completed.
- Supporting a vehicle on a garage jack only is extremely dangerous, so always support the frame on rigid racks.
- Leave the garage jack and rigid racks in place until the entire operation is completed. Never remove them during the operation.

CAUTION

Be sure to protect the brake hose from dust by fitting blanking plugs.

● Installation sequence

Follow the removal sequence in reverse.

WARNING

You must bleed air from the brake system after installing the brake hose, failure to do so would cause the brake to malfunction.  Gr 35

CAUTION

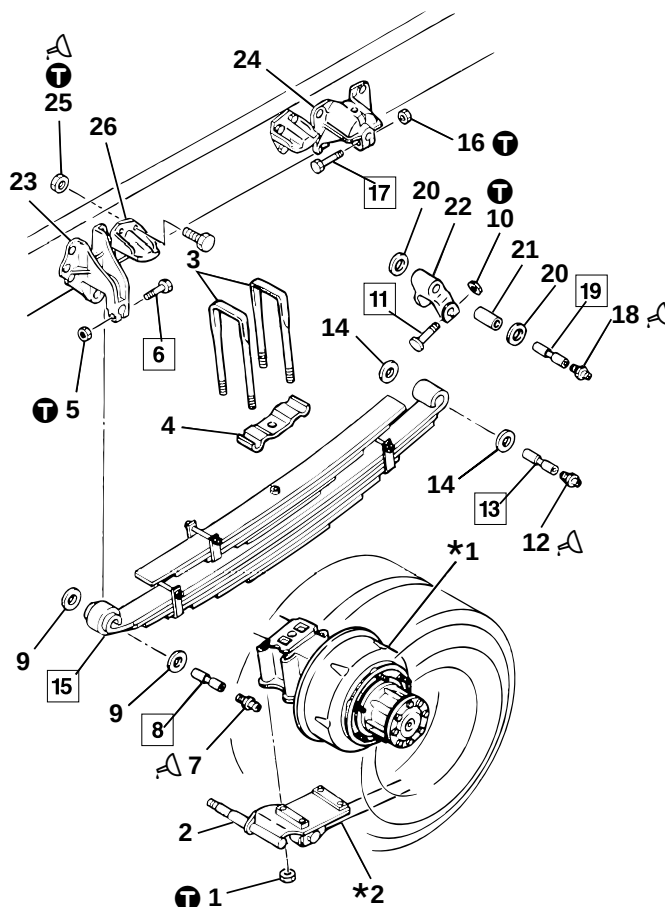
Be sure that the brake hose is not twisted when you install it.

T **Tightening torque**

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (Rear axle and propeller shaft connecting)	85 {61, 8.5}	—

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY



11207

● Removal sequence

- | | | |
|---|---------------------------------|------------------------------|
| 1 U-bolt nut | 12 Grease nipple | 21 Bushing |
| 2 Shock absorber and stabilizer bracket P34-13 | 13 Shackle pin | 22 Shackle link |
| 3 U-bolt | 14 Side washer | 23 Rear spring front bracket |
| 4 Spring pad | 15 Leaf spring assembly P34-10 | 24 Rear spring rear bracket |
| 5 Nut | 16 Nut | 25 Nut |
| 6 Bolt | 17 Bolt | 26 Helper stopper |
| 7 Grease nipple | 18 Grease nipple | |
| 8 Shackle pin | 19 Shackle pin | |
| 9 Side washer | 20 Side washer | |
| 10 Nut | | |
| 11 Bolt | | |

*1 : Rear axle Gr 27
 *2 : Stabilizer P34-13

NOTE

Do not remove rear spring front bracket 23 or rear spring rear bracket 24 unless they are faulty. Gr 41

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
8, 13, 15	Clearance between shackle pin and bushing of leaf spring assembly	[28] 0 to 0.12 {[1.10] 0 to 0.0047}	0.3 {0.019}	Replace
19, 21	Clearance between shackle pin and bushing	[28] 0.02 to 0.14 {[1.10] 0.00079 to 0.0055}	0.3 {0.019}	Replace
8, 23	Clearance between shackle pin and rear spring front bracket	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.019}	Replace
15, 22	Clearance between leaf spring assembly and shackle link	0.2 to 0.9 {0.0079 to 0.035}	—	Replace side washer
13, 22	Clearance between shackle pin and shackle link	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	0.3 {0.019}	Replace
15, 23	Clearance between leaf spring assembly and rear spring front bracket	0.2 to 0.9 {0.0079 to 0.035}	—	Replace side washer
19, 24	Clearance between shackle pin and rear spring rear bracket	[28] 0 to 0.04 {[1.10] 0 to 0.0016}	1.0 {0.039}	Replace
22, 24	Clearance between shackle link and rear spring rear bracket side washer	0.2 to 0.6 {0.0079 to 0.024}	—	Replace side washer

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

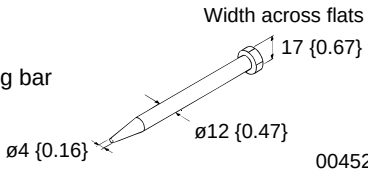
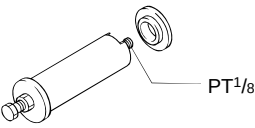
Location	Parts to be tightened	Tightening torque	Remarks
1	U-bolt nut (U-bolt mounting)	414±62 {305±46, 42.2±6.3}	Wet
5, 10, 16	Nut (Shackle pin mounting)	80 to 110 {58 to 80, 8 to 11}	—
25	Nut (Helper stopper mounting)	103 to 132 {76 to 98, 10.5 to 13.5}	Wet

Lubricant

Location	Points of application	Kinds	Quantity
7, 12, 18	Supply via grease nipple	Chassis grease [NLGI No.1 (Ca soap)]	As required
25	Thread and contact surface of nut	Engine oil	As required

Special tools

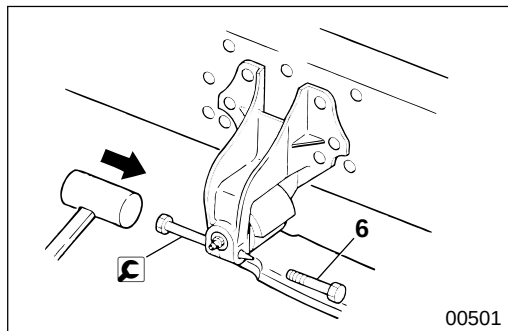
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
6, 8, 11, 13, 17, 19	Shackle pin setting bar 	MC023419 00452	Removal of bolt (shackle pin installation), alignment of the shackle pin bolt groove
8, 13, 19	Shackle pin puller 	MH061452 00453	Removal of shackle pin

REMOVAL AND INSTALLATION OF LEAF SPRING ASSEMBLY

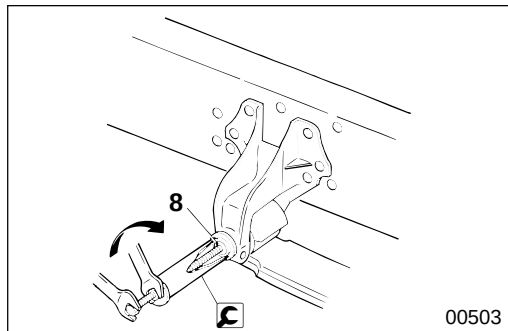
◆ Service procedure

6 Removal of bolt



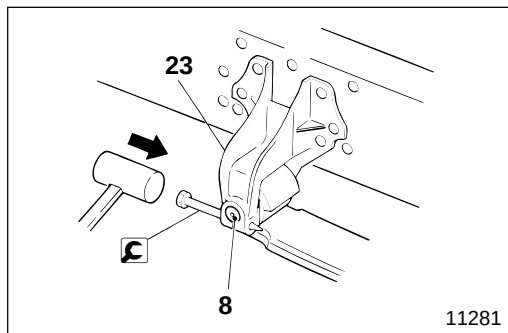
8 Shackle pin

[Removal]

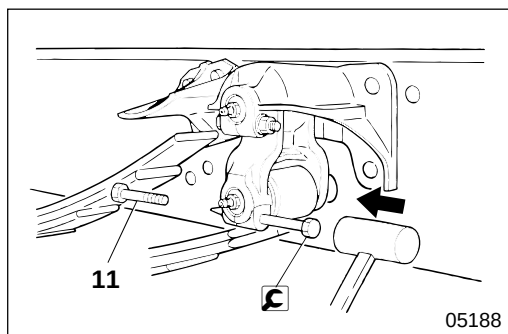


[Installation]

Align the bolt hole of rear spring front bracket **23** with the bolt groove of shackle pin **8** using  shackle pin setting bar.

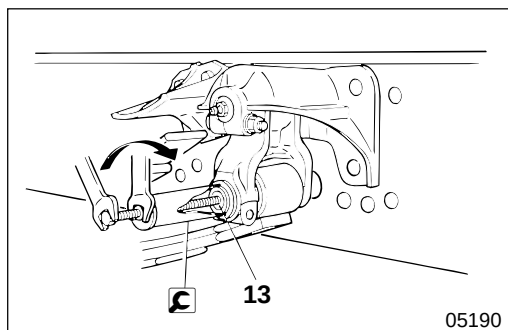


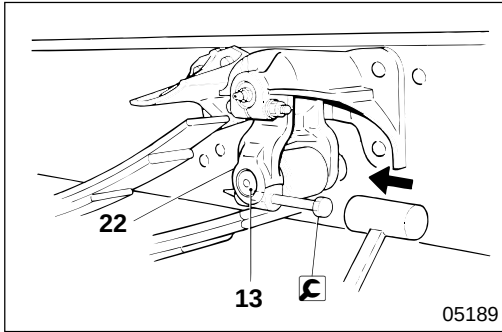
11 Removal of bolt



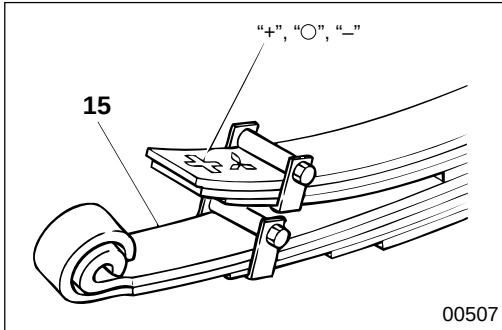
13 Shackle pin

[Removal]



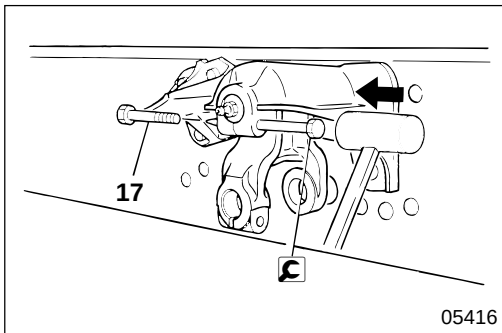
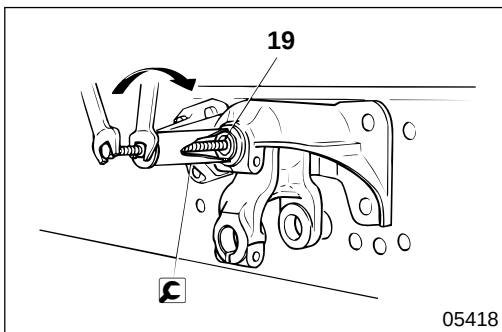
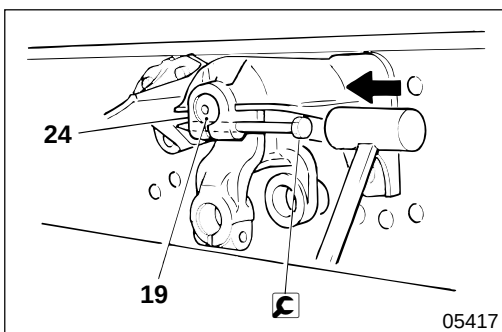
**[Installation]**

Align the bolt hole of shackle link **22** with the bolt groove of shackle pin **13** using shackle pin setting bar.

**15 Leaf spring assembly left/right height combinations**

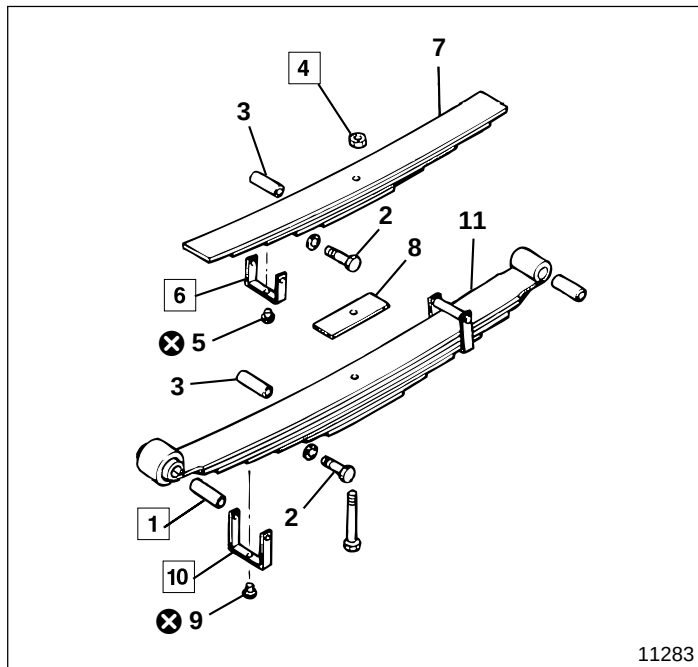
When replacing leaf spring assembly **15**, select the members so that the left and right height marks “+”, “O” and “-” are combined as shown below.

Item	Combination		
	1	2	3
Leaf spring assembly, left side	+	O	-
Leaf spring assembly, right side	+	O	-

**17 Removal of bolt****19 Shackle pin****[Removal]****[Installation]**

Align the bolt hole of rear spring rear bracket **24** and the bolt groove of shackle pin **19** using shackle pin setting bar.

LEAF SPRING ASSEMBLY



Disassembly sequence

- | | |
|------------------|------------------------|
| 1 Spring bushing | 8 Seat |
| 2 Clip bolt | 9 Rivet |
| 3 Pipe | 10 Clip |
| 4 Center nut | 11 Main spring |
| 5 Rivet | |
| 6 Clip | ⊗ : Non-reusable parts |
| 7 Helper spring | |

Assembly sequence

Follow the disassembly sequence in reverse.

Special tools

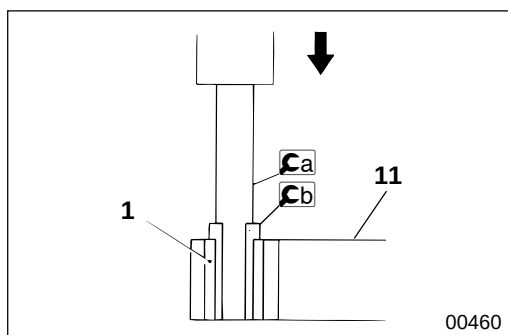
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Bushing installer set A : Bushing installer A B : Bushing installer B 00454	MB999066 A : MB999067 B : MB999068	Removal and installation of bushing

Service procedure

1 Removal and installation of spring bushing

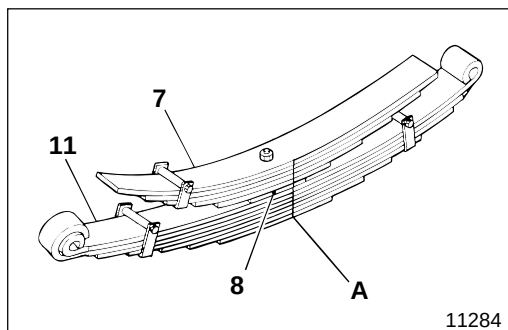
Remove spring bushing **1** from main springs **11** using bushing installer **A** and bushing installer **B**. For installation, follow the removal sequence in reverse.

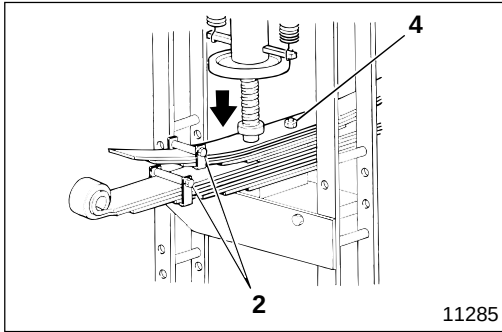


4 Center nut

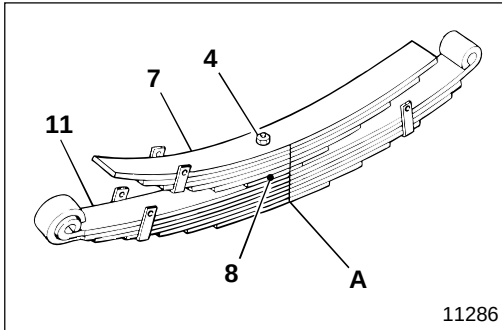
[Removal]

- Put alignment marks **A** on the sides of helper springs **7**, seat **8**, and main springs **11**.



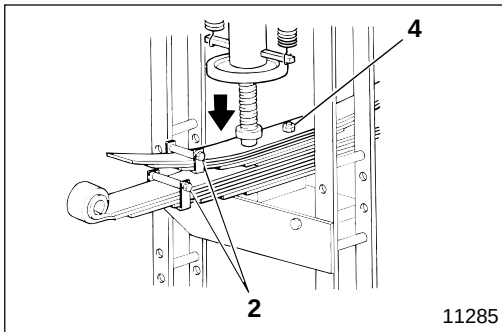


- Compress the leaf springs using a press to remove clip bolt 2 and center nut 4.

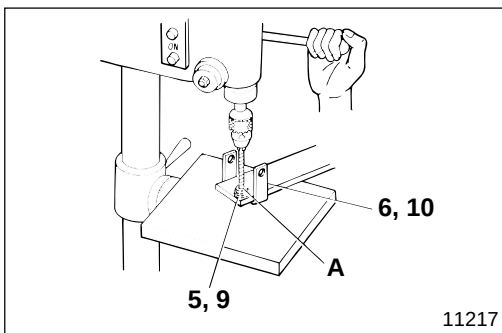


[Installation]

- Align alignment marks **A** on helper springs 7, seat 8, and main springs 11 to assemble them.
- Tighten center nut 4 temporarily.



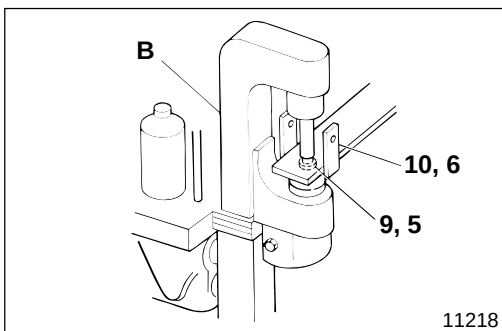
- Compress leaf springs using a press to install center nut 4, then caulk it using a three-point punch.
- Install clip bolt 2.



6 10 Clip

[Removal]

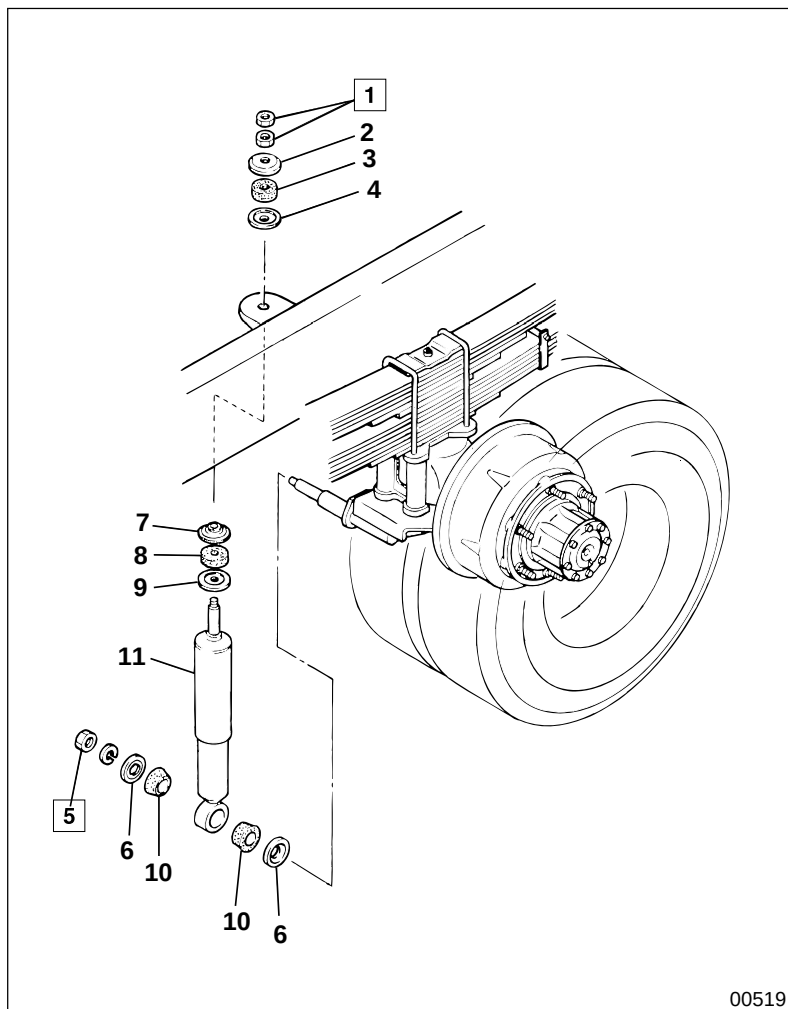
Drill out caulked ends **A** of rivets 5, 9 on a drill press to remove clips 6, 10.



[Installation]

Caulk rivets 9, 5 using riveting machine **B** to install clips 10, 6.

SHOCK ABSORBER



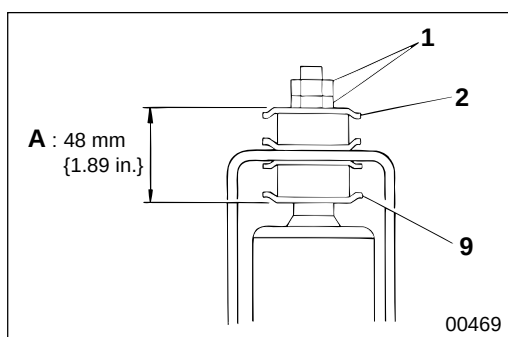
● Removal sequence

- 1 Nut
- 2 Washer
- 3 Rubber bushing
- 4 Centering washer
- 5 Nut
- 6 Washer
- 7 Centering washer
- 8 Rubber bushing
- 9 Washer
- 10 Rubber bushing
- 11 Shock absorber

● Installation sequence

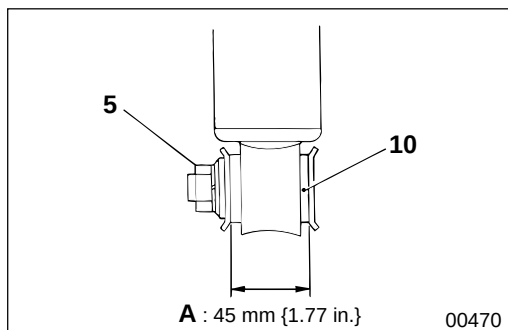
Follow the removal sequence in reverse.

◆ Service procedure



1 Nut

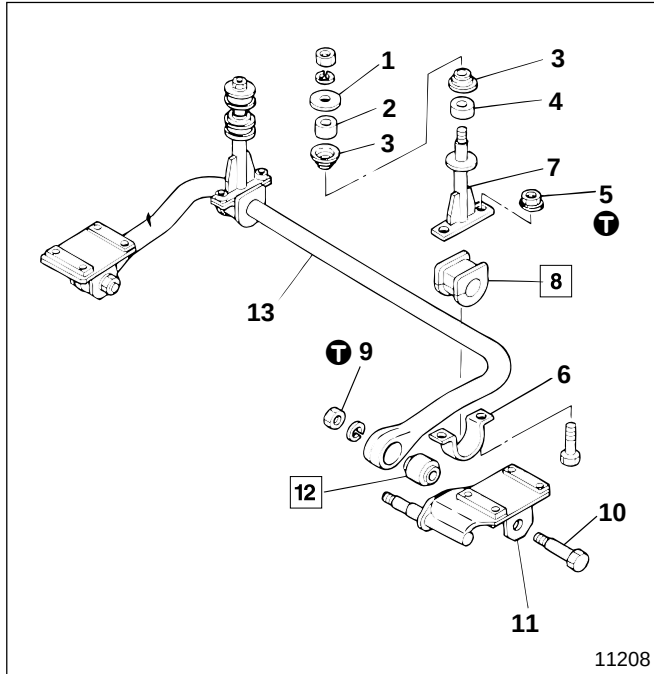
Install nut 1 so that the distance between washers 2, 9 is A.



5 Nut

Install nut 5 so that dimension of rubber bushing 10 is A.

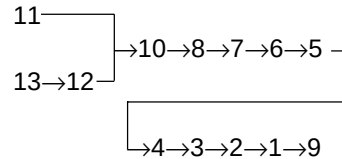
STABILIZER

34


● Removal sequence

- | | |
|----------------------|--|
| 1 Seat | 9 Nut |
| 2 Bushing | 10 Stabilizer pin |
| 3 Holder | 11 Shock absorber and stabilizer bracket |
| 4 Bushing | 12 Bushing |
| 5 Nut | 13 Stabilizer bar |
| 6 Cap | |
| 7 Stabilizer rod | |
| 8 Stabilizer bushing | |

● Installation sequence



CAUTION ⚠

Be sure not to force in bushings 2, 4 and stabilizer rod 7 when installing them.

T Tightening torque

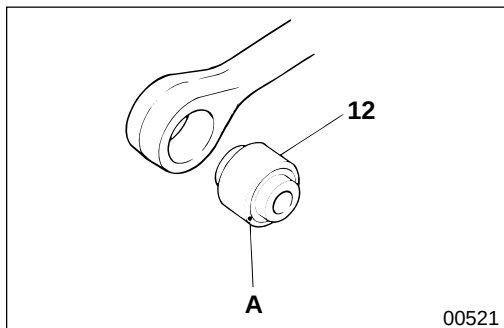
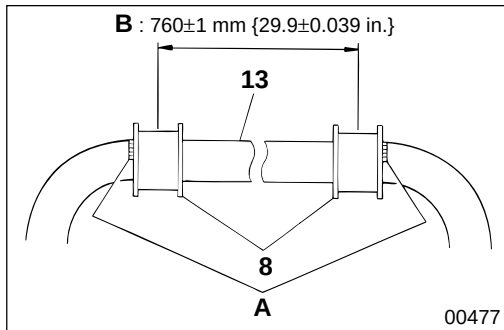
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
5	Nut (Cap mounting)	80 to 110 {58 to 80, 8 to 11}	—
9	Nut (Stabilizer bracket mounting)	410 to 550 {295 to 405, 41 to 56}	—

◆ Service procedure

8 Stabilizer bushing

Align the ends of stabilizer bushings 8 with markings A of stabilizer bar 12 so that the distance between each bushing center is B.



12 Removal and installation of bushing

Compress outer cylinder A to remove bushing 12. For installation, follow the removal sequence in reverse.

CAUTION ⚠

Make sure you apply force to the outer cylinder when compressing outer cylinder A to avoid damaging bushing 12.



FH

Service Manual

Group 35

Brake

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

GROUP 35 BRAKE

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SPECIFICATIONS

< Equipment for Service Brake >

Item		Specifications
Brake booster (Airmaster)	Power cylinder inner diameter×Stroke mm {in.}	ø114.3×79 {4.50×3.11}
	Hydraulic cylinder inner diameter×Stroke mm {in.}	ø23.8×76 {0.94×2.99}
	Operating starting pressure kPa {lbf/in ² , kgf/cm ² }	18±9.8 {2.6±1.4, 0.18±0.1}
	Residual pressure kPa {lbf/in ² , kgf/cm ² }	78 to 125 {11 to 18, 0.8 to 1.3}
	Manufacturer	JIDOSHA KIKI
Air compressor	Type	Air-cooled, single cylinder
	Cylinder diameter×Stroke mm {in.}	ø70×40 {2.76×1.57}
	Cylinder capacity cm ³ {cu.in.}	154 {9.40}
	Manufacturer	SANWA SEIKI
Air dryer	Type	DR-41
	Heater capacity V-W	12-50
	Thermostat operating temperature °C {°F}	ON 4±4 {39±7.2}
		OFF 20 {68} or less
	Purge chamber capacity L {qts}	0.9 {0.95}
	Required time for recycling desiccant Sec	30
	Manufacturer	NABCO
Air tank	Capacity L {qts}	8+9+8 {8.45+9.50+8.45}

< Wheel Brake >

Item		Specifications
Brake type	Front	Drum brake (2-leading type)
	Rear	Drum brake (Dual 2-leading type)
Brake drum inner diameter	mm {in.}	ø320 {12.6}
Wheel cylinder inner diameter	Front mm {in.}	ø34.93 {1.38}
	Rear mm {in.}	ø36.51 {1.44}
Brake lining Width×Thickness	Front mm {in.}	120×12 {4.72×0.47}
	Rear mm {in.}	140×12 {5.51×0.47}

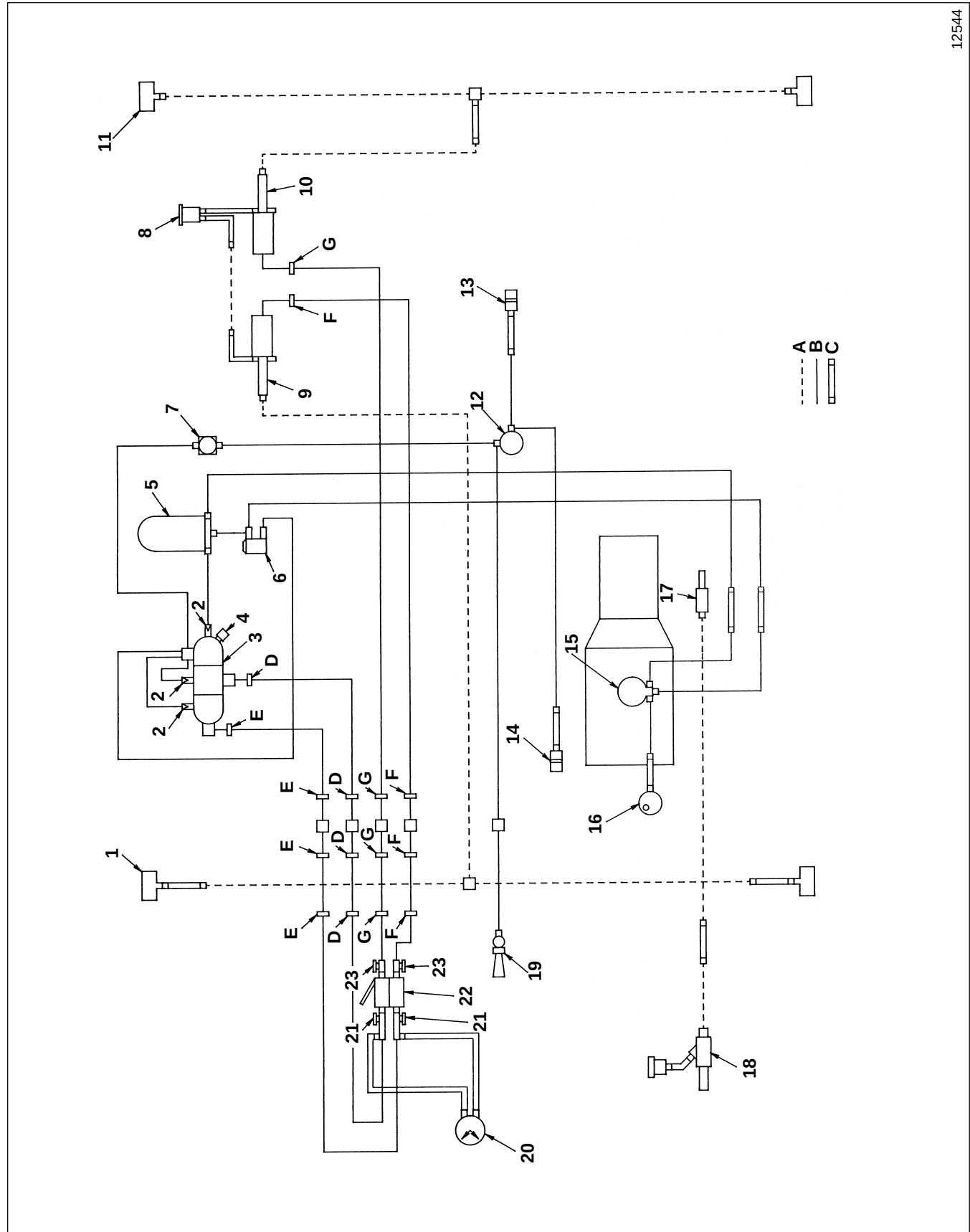
< Exhaust Brake >

Item	Specifications
Control type	Combined electric and air
Valve type	Butterfly valve

MEMO

STRUCTURE AND OPERATION

Brake System



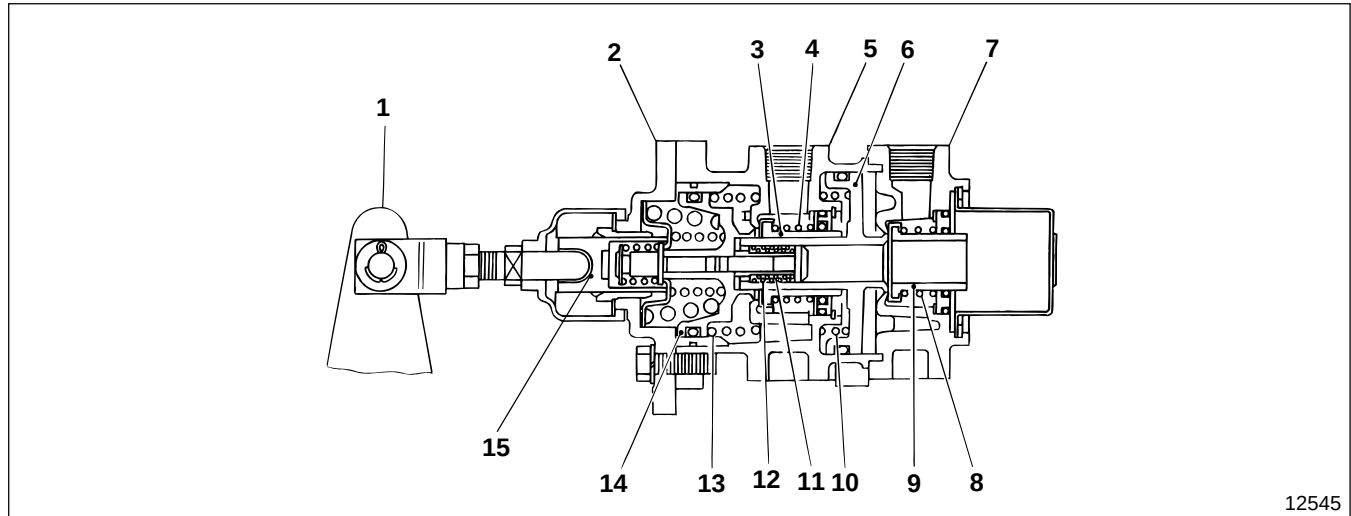
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- | | |
|---|---------------------------------------|
| 1 Front wheel cylinder | 17 Power cylinder |
| 2 Check valve | 18 Master cylinder |
| 3 Air tank | 19 Air horn |
| 4 Safety valve | 20 Air pressure gauge |
| 5 Air dryer | 21 Low air pressure switch |
| 6 Air pressure governor | 22 Dual brake valve |
| 7 Supply valve | 23 Stop lamp switch |
| 8 Fluid tank | |
| 9 Airmaster (Front) | A : Fluid line |
| 10 Airmaster (Rear) | B : Air line |
| 11 Rear wheel cylinder | C : Hose |
| 12 3-way magnetic valve | D : Red identification tape |
| 13 Exhaust brake unit | E : Blue identification tape |
| 14 Intake silencer < Manual transmission > | F : White identification tape |
| 15 Air compressor | G : Yellow identification tape |
| 16 Air cleaner | |

- The brake system is an air over hydraulic, all-wheel braking type consisting of separate front and rear systems.
- The servo system is fitted with airmasters **9, 10**.
- An exhaust brake system, of the exhaust pipe opening and closing valve type, is fitted as a sub-brake system.

STRUCTURE AND OPERATION

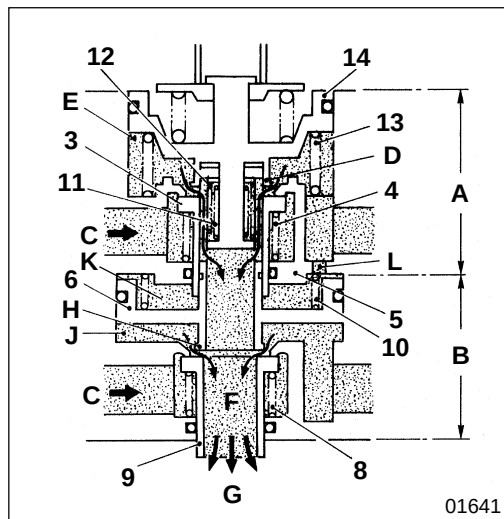
Dual Brake Valve



- | | |
|--------------------------------|--------------------------|
| 1 Brake pedal | 9 Secondary inlet valve |
| 2 Plate assembly | 10 Relay piston spring |
| 3 Primary inlet valve | 11 Sleeve inner spring |
| 4 Primary inlet valve spring | 12 Sleeve outer spring |
| 5 Body | 13 Primary piston spring |
| 6 Relay piston | 14 Primary piston |
| 7 Cover | 15 Plunger |
| 8 Secondary inlet valve spring | |

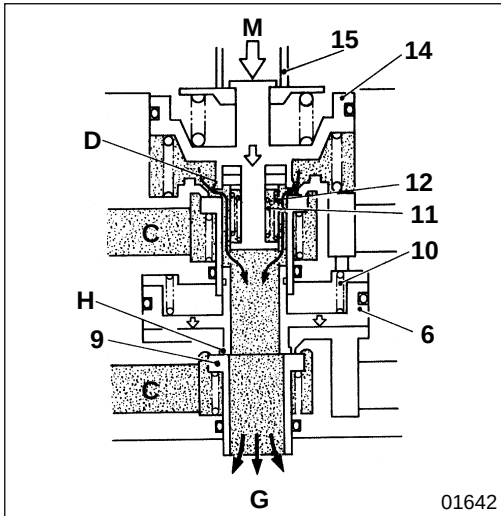
The dual brake valve controls the braking force of the vehicle by feeding pressurized air to the airmaster in accordance with the brake pedal depression angle of brake pedal 1.

● When depressing brake pedal (braking pressure is generated)



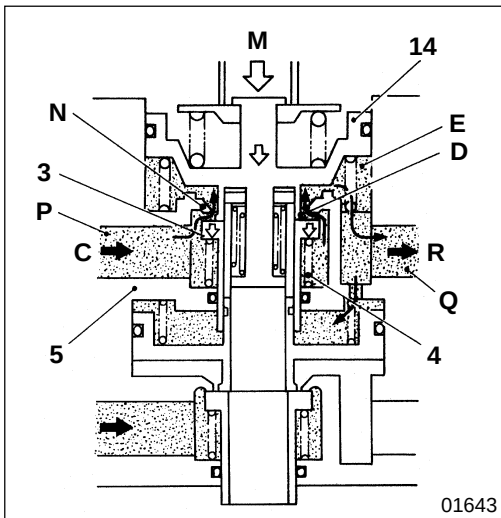
- The percussive forces of primary inlet valve spring 4 and secondary inlet valve spring 8 seat primary inlet valve 3 at primary side A, and secondary inlet valve 9 at secondary side B, on their respective seats. This shuts off air C from the air tank to maintain airtightness.
 - The percussive force of primary piston spring 13 raises primary piston 14 to its upper position. Exhaust valve seat D opens and chamber E is open to atmosphere G via chamber F.
 - Since the percussive forces of sleeve inner spring 11 and sleeve outer spring 12 is stronger than the percussive force of relay piston spring 10, relay piston 6 is raised to its upper position and exhaust valve seat H is opened. This opens chamber J to atmosphere G via chamber F.
- Chamber E at the primary side and chamber K at the upper part of relay piston 6 at the secondary side are connected via passage port L of body 5.

● When depressing brake pedal (before braking pressure is generated)



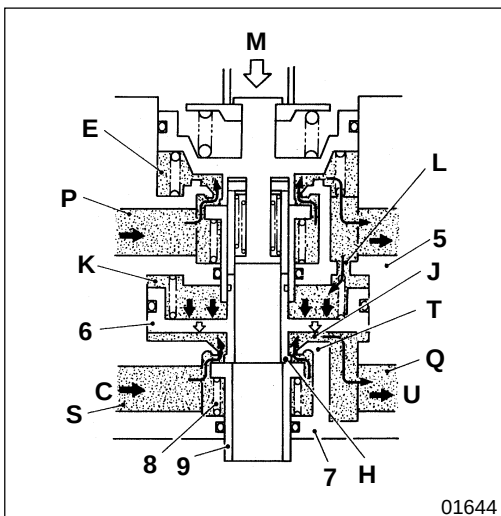
- Depressing the brake pedal (illustrated as pedal action **M**), forces down primary piston **14** via plunger **15**.
- Forcing down primary piston **14** changes the balance between the percussive forces of inner spring **11** and outer spring **12**, and the percussive force of relay piston spring **10**, forcing down relay piston **6**. This seats the relay piston on secondary inlet valve **9** and closes exhaust valve seat **H**.
- This closes the secondary side exhaust passage; however, primary side exhaust valve seat **D** remains open. No braking pressure is generated at either primary or secondary sides.

● When depressing brake pedal (braking pressure is generated)



Primary side

- As the brake pedal is depressed further (illustrated as brake pedal action **M**), primary piston **14** is forced down until it is seated on primary inlet valve **3**, closing exhaust valve seat **D**.
- Primary inlet valve **3** is forced down, compressing primary valve spring **4**, and supply valve seat **N** of body **5** separates from the primary inlet valve. The air in chamber **P** flows into chamber **E** and is fed to rear brake system **R** via discharge port **Q** as braking pressure.



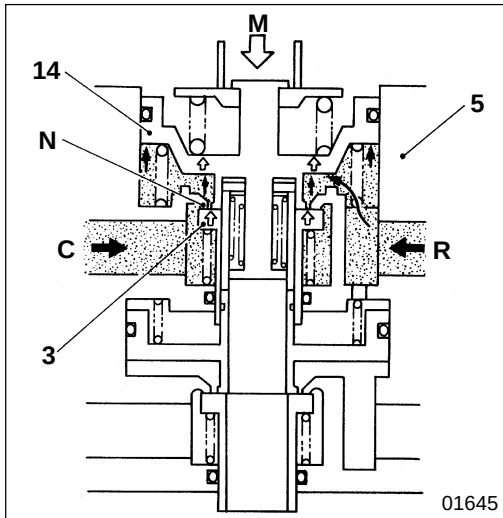
Secondary side

- The air at the primary side flows into chamber **K** via passage port **L** of body **5**.
- The air fed into chamber **K** acts on the upper part of relay piston **6** to force down the relay piston and compress secondary valve spring **8**, forcing down secondary inlet valve **9**.
- This separates supply valve seat **T** and secondary inlet valve **9** of cover **7**.
- The air in supply port chamber **S** flows into chamber **J** and is fed to front brake system **U** via discharge port **Q** as braking pressure.

STRUCTURE AND OPERATION

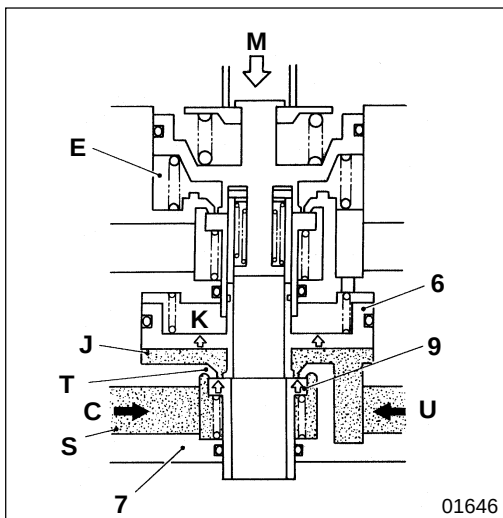
● Stabilization of braking pressure

When the brake pedal remains depressed at the specified depression angle, the braking air pressure stabilizes at the pressure corresponding to the brake pedal depression angle.



Primary side

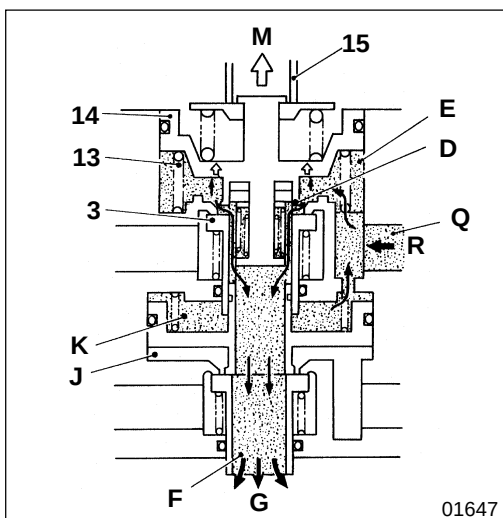
- The braking air pressure fed under the bottom of primary piston 14 raises the primary piston and primary inlet valve 3 together in tandem.
- Primary inlet valve 3 makes contact with supply valve seat N of body 5, then the supply of air C from the air tank ceases and the increases in the braking air pressure stops. This stabilizes braking pressure R for the rear brake system.



Secondary side

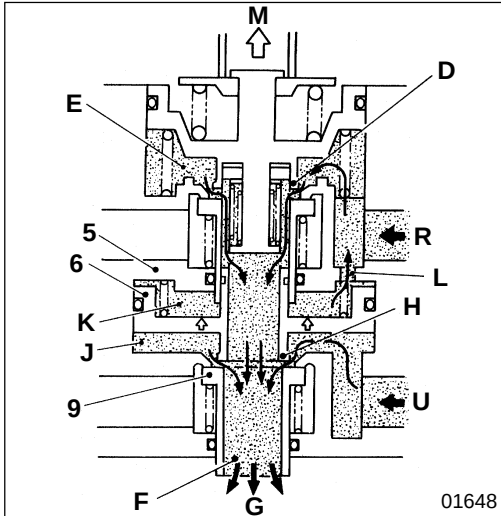
- As the braking pressure (pressure in chamber J) for the front brake system balances the pressures in chambers E and K, the force raising relay piston 6 disappears, and the relay piston rises in tandem with secondary inlet valve 9.
- Secondary inlet valve 9 makes contact with supply valve seat T of cover 7, then the supply of air from supply port chamber S to chamber J ceases. This stabilizes brake pressure U for the front system.

● Release of brake pressure



Primary side

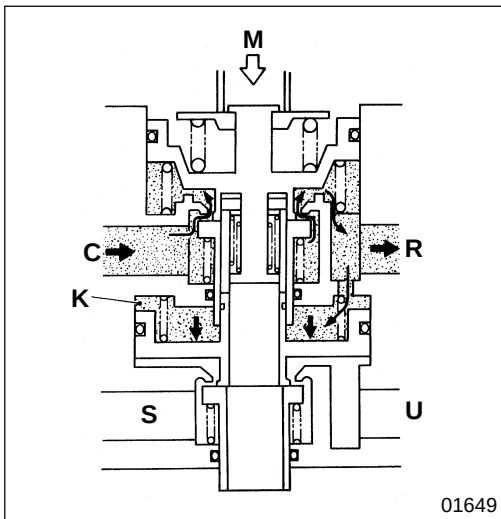
When the brake pedal is released (illustrated as brake pedal action M), primary piston spring 13 and air pressure R at discharge port Q (pressure in chamber E) raise plunger 15 and primary piston 14. Then, exhaust valve seat D at the lower end of the primary piston separates from primary inlet valve 3. The air pressure of the rear brake system flows through chamber E to be discharged from exhaust passage chamber F into atmosphere G.



Secondary side

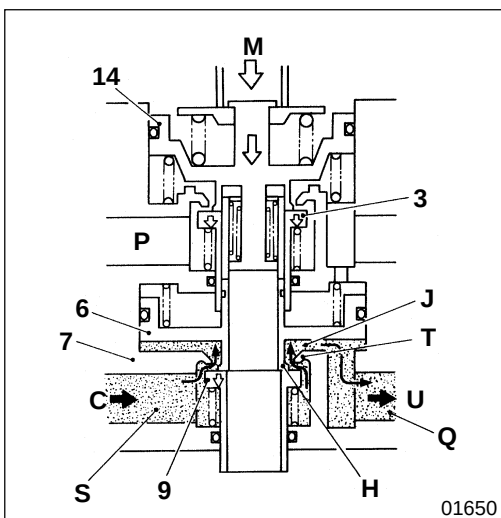
- As the air pressure in the rear brake system drops, the air pressure in chamber K is discharged via passage port L of body 5, and chambers E, F into atmosphere G.
- This changes the air pressure balance between chambers K and J. The air pressure in chamber J raises relay piston 6, and exhaust valve seat H at the lower end of the relay piston separates from secondary inlet valve 9. Air pressure U in the front brake system is discharged from exhaust passage chamber F into atmosphere G.

● When abnormality occurs



Operation when the air pipe of the front brake system fails

- The primary side operates the same as normal, generating braking pressure in rear brake system R.
- At the secondary side, even if the primary side generates air pressure in chamber K, braking pressure is not generated in front brake system U, since no air pressure is generated in supply port S.

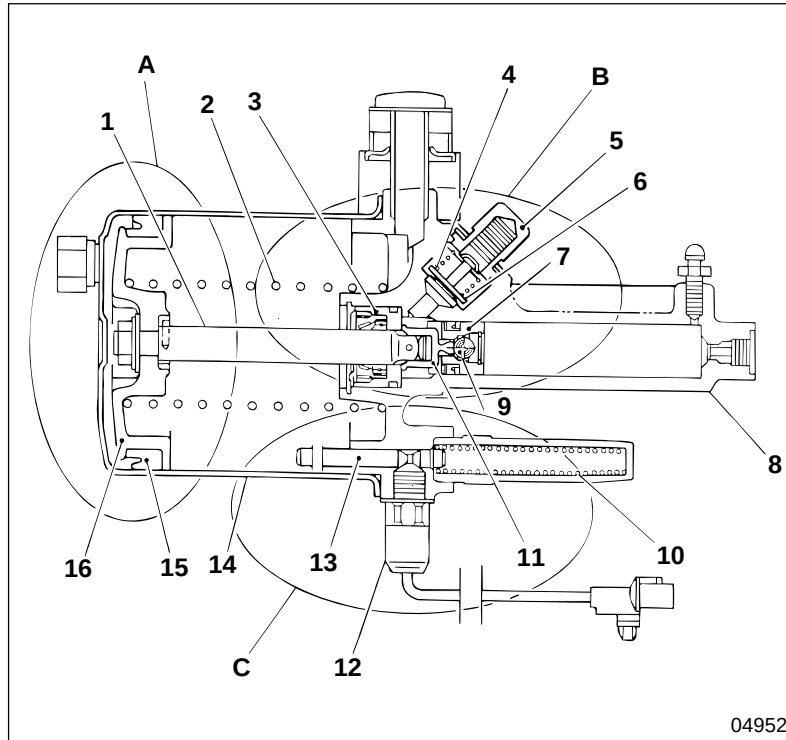


Operation when the air pipe of the rear brake system fails

- In the rear brake system, air pressure is not generated up to supply port P. Therefore, even if the brake pedal is depressed (causing primary piston 14 to force down primary inlet valve 3), braking pressure is not generated.
- If the brake pedal is depressed further (illustrated as brake pedal action M), primary piston 14 makes contact with relay piston 6 and they force down secondary inlet valve 9.
- This action separates supply valve seat T of cover 7 from secondary inlet valve 9. The air pressure flows into chamber J from chamber S and is fed to front brake system U via discharge port Q as braking pressure.

STRUCTURE AND OPERATION

Brake Booster (Airmaster)



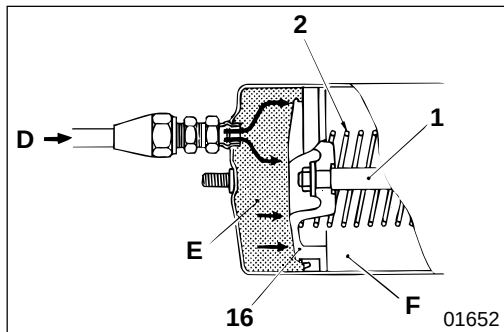
- 1 Push rod
- 2 Return spring
- 3 Retainer assembly
- 4 Spring
- 5 Connector
- 6 Residual valve
- 7 Hydraulic piston
- 8 Body assembly
- 9 Steel ball
- 10 Return spring
- 11 Yoke
- 12 Stroke switch
- 13 Rod
- 14 Cylinder shell
- 15 Cup packing
- 16 Piston plate

A : Power cylinder area

B : Hydraulic piston area

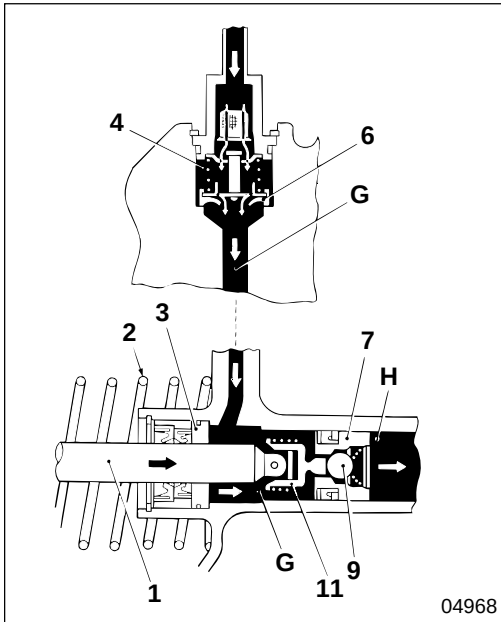
C : Power piston stroke detection switch area

● Power cylinder area



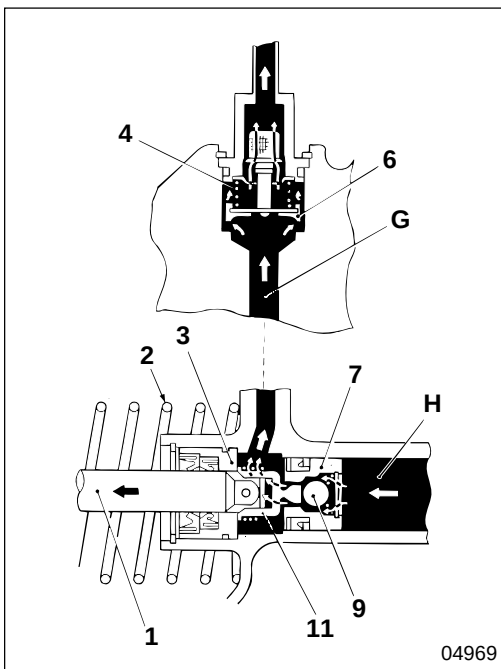
- Operation of the dual brake valve feeds compressed air **D** into chamber **E**, activating piston plate **16**. This opens chamber **F** to the atmosphere, generating a pressure difference between chambers **E** and **F**. When this force becomes greater than the repercussive force of return spring **2**, the piston plate moves to the right.
- Piston plate **16** is fitted with push rod **1** that transmits the force of the compressed air received at the piston plate to hydraulic piston area **B**.

● Hydraulic piston area



When functioning

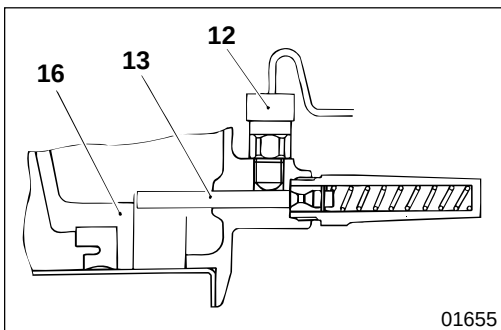
- The movement of the piston plate compresses return spring 2, which moves push rod 1, then hydraulic piston 7 to the right. This movement separates yoke 11 from retainer assembly 3, and seats steel ball 9 at the end of the hydraulic piston. This closes the passage between brake fluid tank chamber G and wheel cylinder chamber H. The hydraulic piston moves to the right and pressurizes the brake fluid in chamber H, transmitting power to the wheel cylinder.
- In residual valve 6, negative pressure from chamber G increases as the volume expands in line with the movement of the hydraulic piston. This opens the residual valve, allowing it to suck brake fluid from the fluid tank.



When released

- Releasing the brake pedal frees the compressed air at the rear side of the piston plate into the atmosphere. Hydraulic piston 7 is returned to its original position by the combined repercussive forces of return spring 2 of push rod 1, and the brake fluid pressure of chamber H yoke 11 hits retainer assembly 3, connecting chamber G and chamber H.
- Brake fluid flows through chamber G to compress spring 4 of residual valve 6. The brake fluid passes around the residual valve and returns to the fluid tank.
- Residual valve 6 closes when the repercussive forces of spring 4 and the brake fluid pressure balance.

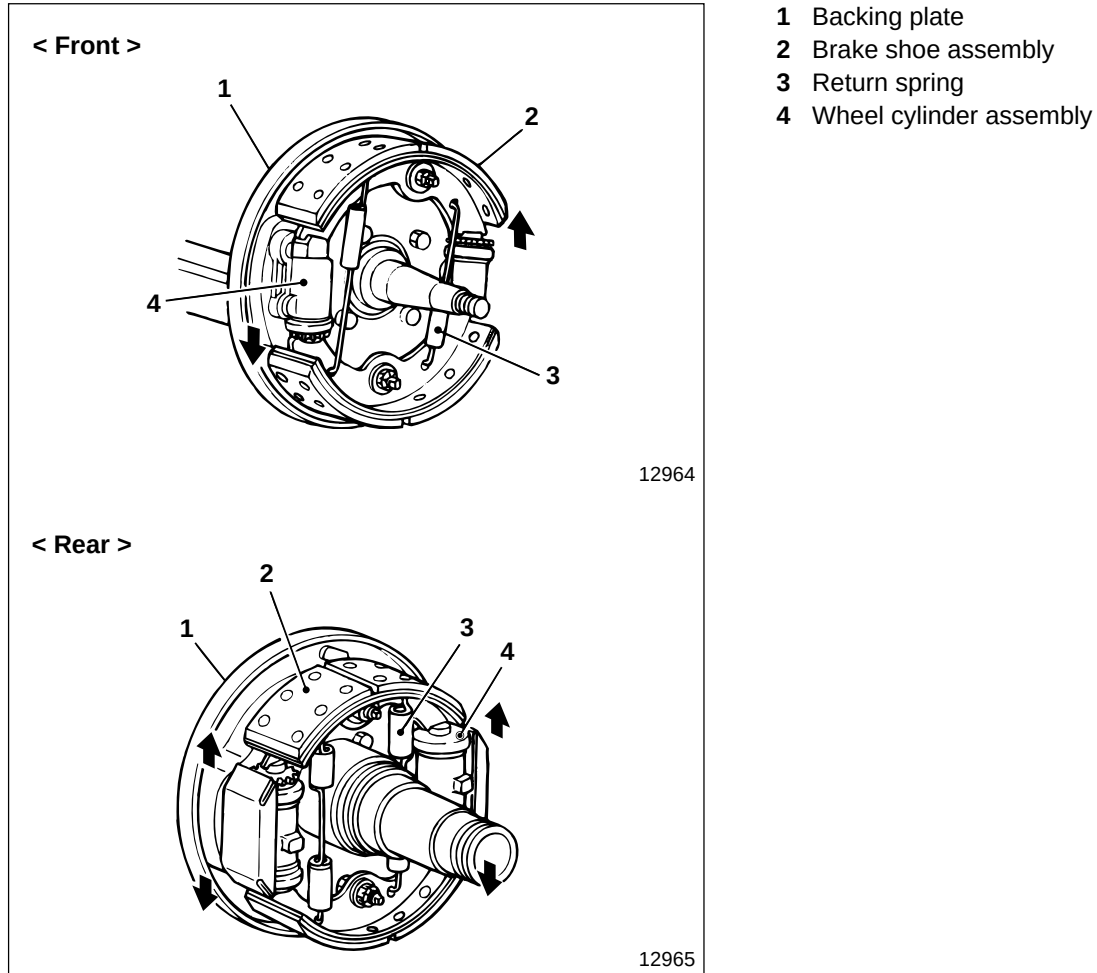
● Power piston stroke detecting switch area



- When brake fluid has been lost due to damage to the brake pipe, the stroke of the power piston increases, and piston plate 16 hits the end of rod 13, and the rod is moved to the right.
- Because of this, stroke switch 12 leaves the recessed area of the rod 13, and turns the stroke switch ON. This turns on a warning lamp within the meter cluster to alert the driver.

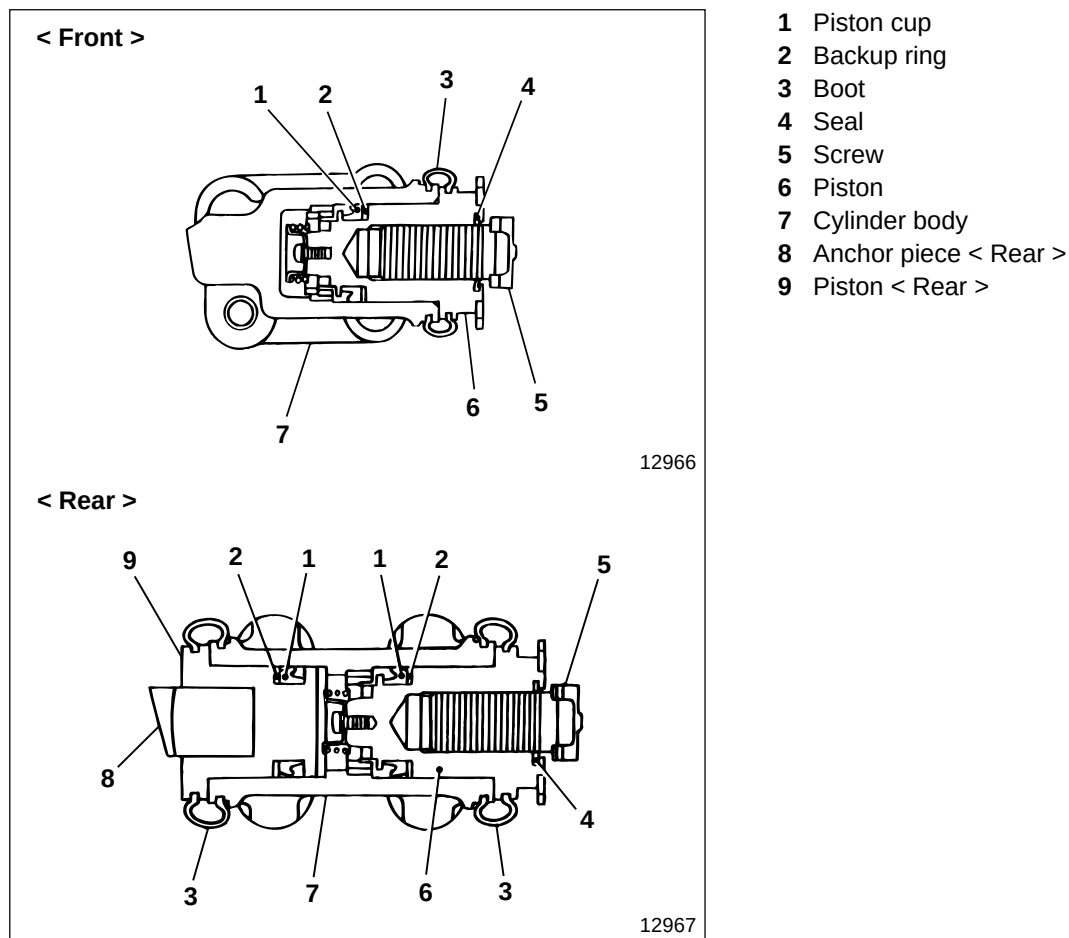
STRUCTURE AND OPERATION

Wheel Brake



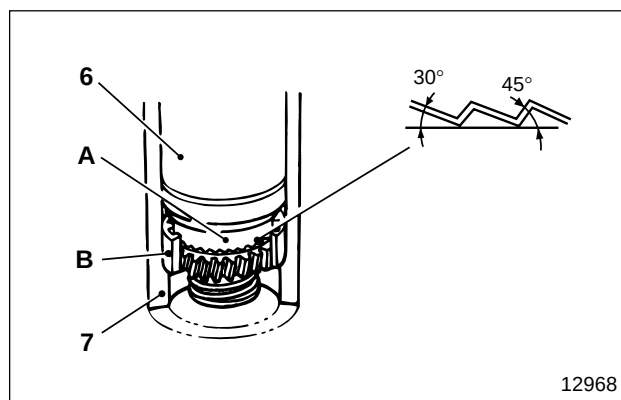
- The front wheel brake is an internal expanding 2-leading brake type.
- The rear wheel brake is an internal expanding dual 2-leading brake type.
- Front and rear wheel cylinder assemblies 4 have shoe clearance automatic adjusting mechanisms to adjust shoe clearance within a specific range.

● Wheel cylinder assembly



Even if the brake lining has worn to the extent that the brake shoe clearance is higher than the specified value, the brake shoe clearance automatic adjusting mechanism automatically adjusts the brake shoe clearance to maintain the appropriate brake shoe clearance when the vehicle is braked when moving forwards.

● Operation of automatic shoe clearance adjusting mechanism (one-way clutch)



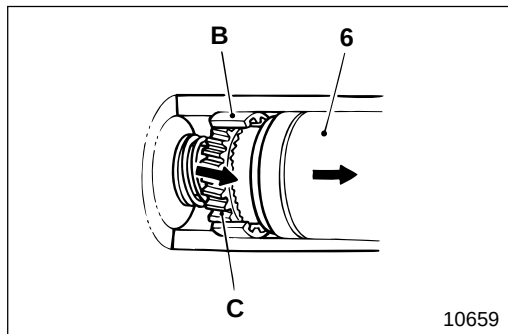
30° : When piston **6** appears, the double helical gear slides out easily.

45° : When turning piston **6**, the double helical gear receives and maintains the rotational force.

A : Clutch

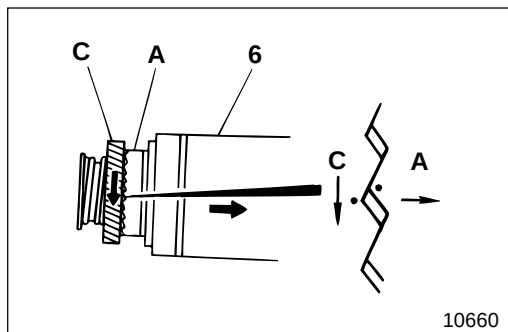
B : Guide

STRUCTURE AND OPERATION

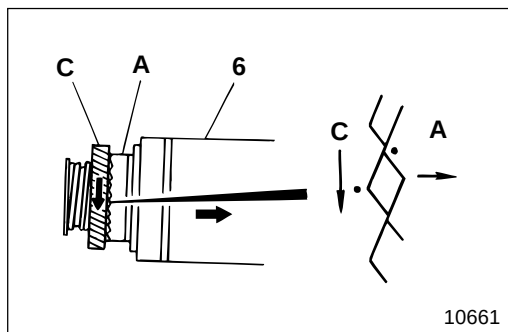


● When braking starts

- When hydraulic braking pressure acts on the wheel cylinder, it pushes piston **6** forward.
- Idler **C** of extended piston **6** is engaged with the diagonal gears cut in guide **B** of the cylinder body, so the idler advances while turning, in accordance with the travel of the piston.



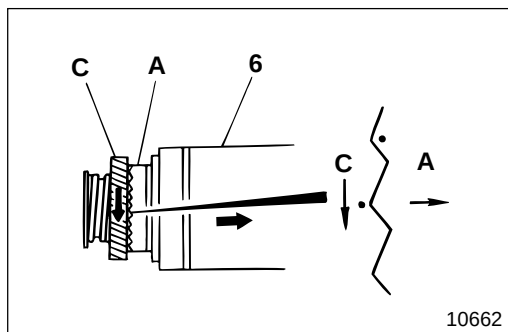
- The rotation of idler **C** slides out the double helical gear of clutch **A**.



● When depressing brake pedal

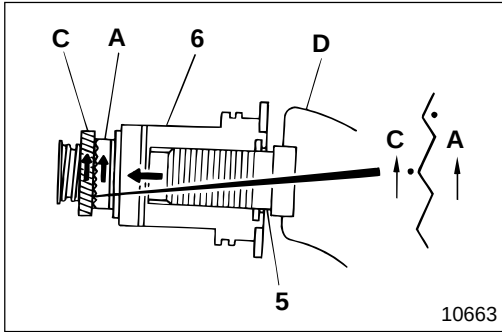
When the brake shoe clearance conforms to the specified value

- The amount of travel of idler **C** is proportional to the amount of travel of piston **6**. The amount of travel is not enough to make the double helical gear of clutch **A** climb over the opposite double helical gear when the brake shoe clearance is within the specified value.



When the brake shoe clearance is higher than the specified value

- When the brake shoe clearance is higher than the specified value, the amount of travel of idler **C** increases enough to make the double helical gear of clutch **A** climb over the opposite double helical gear.

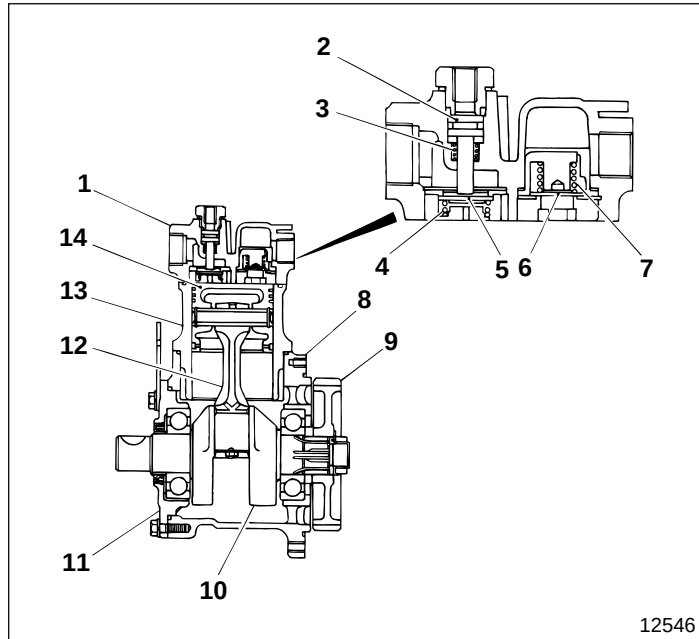


● **When releasing brake pedal**

- As the brake fluid pressure decreases and piston **6** returns, idler **C** also returns, turning in the opposite direction along guide **B** of the cylinder body.
- When the brake shoe clearance is within the specified value, piston **6** returns to its original position without turning, because the double helical gear of clutch **A** has not climbed over the opposite double helical gear.
- When the brake shoe clearance is higher than the specified value, piston **6** returns while turning by one gear tooth, since the double helical gear of clutch **A** has climbed over the opposite gear. This lowers the brake shoe clearance to the specified value, because screw **5** of the piston is fixed by brake shoe **D** and does not turn.

STRUCTURE AND OPERATION

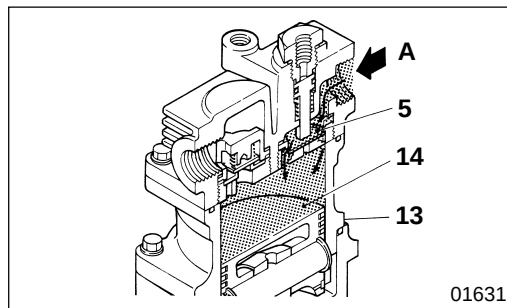
Air Compressor



- 1 Cylinder head
- 2 Unloader valve
- 3 Unloader valve spring
- 4 Suction valve spring
- 5 Suction valve
- 6 Delivery valve
- 7 Delivery valve spring
- 8 Crankcase
- 9 Drive gear
- 10 Crankshaft
- 11 Bearing holder
- 12 Connecting rod
- 13 Cylinder liner
- 14 Piston

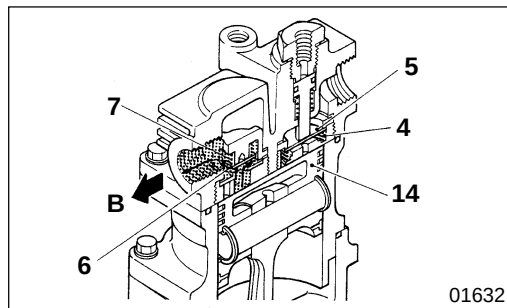
The air compressor is driven by the engagement of drive gear **9** with the engine timing gear.

● During suction



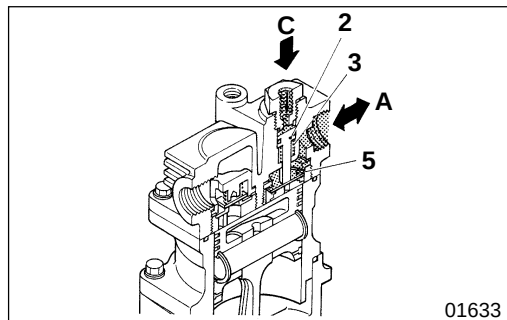
- When drive gear **16** is driven, crankshaft **10** engaged with the drive gear turns to force down piston **14**.
- The negative pressure generated at this time opens suction valve **5**, sucking air **A** into cylinder liner **13**.

● During pressurized delivery



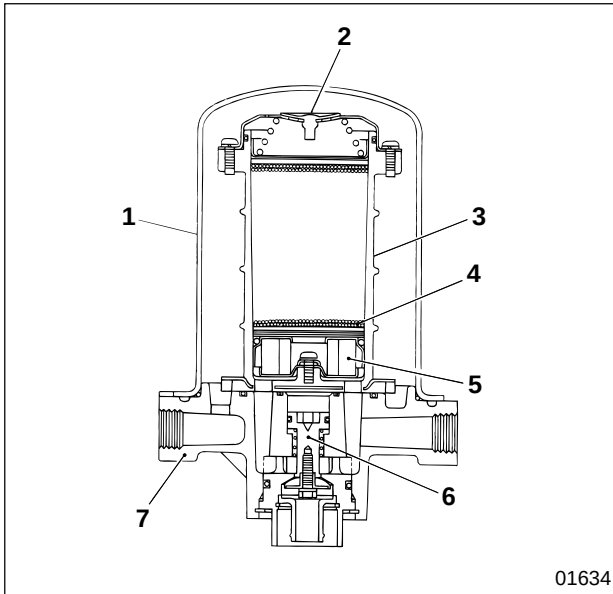
- As piston **14** rises and enters into the compression stroke, suction valve spring **4** closes suction valve **5**.
- The pressure of the compressed air overcomes the repercussive force of delivery valve spring **7** and opens delivery valve **6** to compress and deliver air **B** to the air tank.

● When unloader valve operates



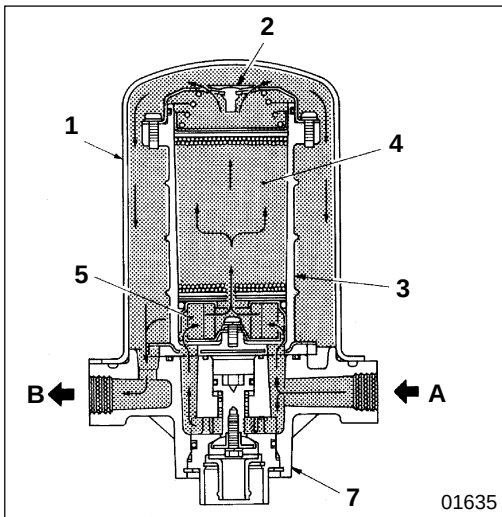
- When the air pressure in the air tank becomes higher than the specified value, the air pressure governor feeds compressed air **C** to unloader valve **2**. This forces down the unloader valve and holds suction valve **5** open at the same time. Therefore, air **A** is not compressed and the air compressor idles.
- When the air pressure in the air tank drops below the specified value, the air pressure governor discharges compressed air from the upper part of unloader valve **2**. So, unloader spring **3** returns the unloader valve to its original position.

Air Dryer



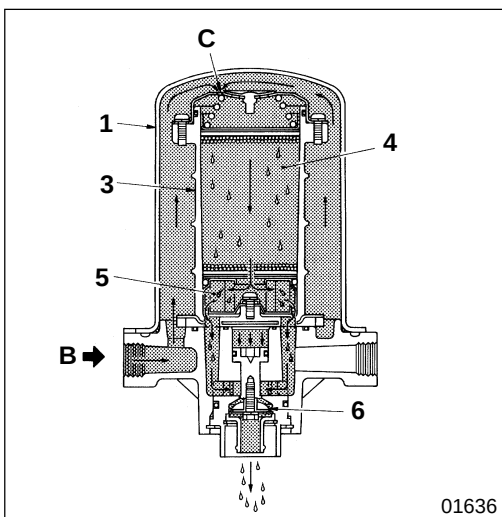
- 1 Purge chamber
- 2 Check valve
- 3 Case
- 4 Desiccant
- 5 Oil filter
- 6 Valve
- 7 Body

The air dryer removes moisture and oil in the air compressed by the air compressor and protects the brake assembly.



Dehumidification

- The pressurized air from the air compressor enters delivery side **A** of the air dryer. Once in body **7**, moisture and oil are separated from the air and collected in the bottom. Then, the air passes through oil filter **5**, where small oil droplets and dust are removed. Next, the air is delivered into case **3**, where moisture is removed by desiccant **4**.
- As the air travels from the bottom to the top of case **3**, it comes into contact with more dried desiccant. This removes residual moisture from the air, drying the air as it reaches the top of the case. The air passes through check valve **2** and purge chamber **1**, and is delivered to the air tank through exhaust side **B**.

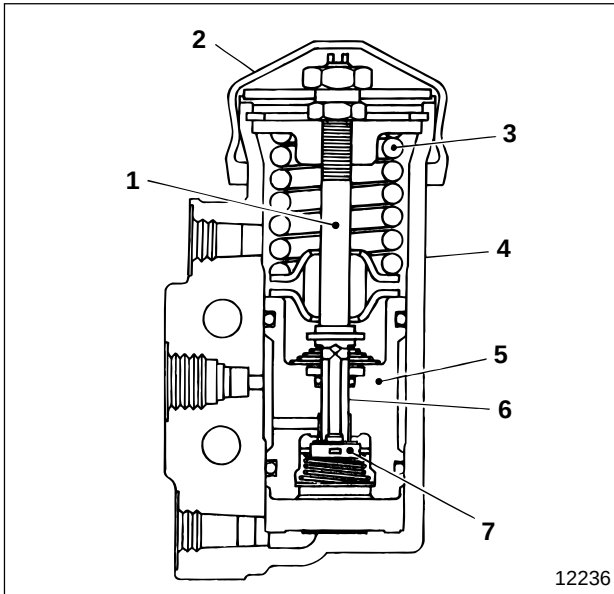


Regeneration of desiccant

- When the supply of air from the air compressor stops, pressure **D** from the air pressure governor opens valve **6** of the control port of the air dryer. The pressure in case **3** cleans oil filter **5**, releasing the condensed water and oil into the atmosphere.
- After being quickly decompressed, the dry air in purge chamber **1** passes through hole **C**, where the air expands under the reduced pressure, becoming super dry air. This air flows back through case **3** and collects the moisture in desiccant **4**, releasing this moisture into the atmosphere, thereby recycling the desiccant.

STRUCTURE AND OPERATION

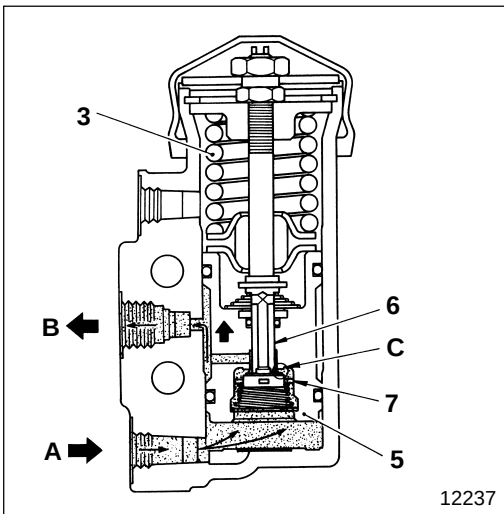
Air Pressure Governor



- 1 Adjusting screw
- 2 Cover
- 3 Spring
- 4 Body
- 5 Piston
- 6 Exhaust stem
- 7 Valve

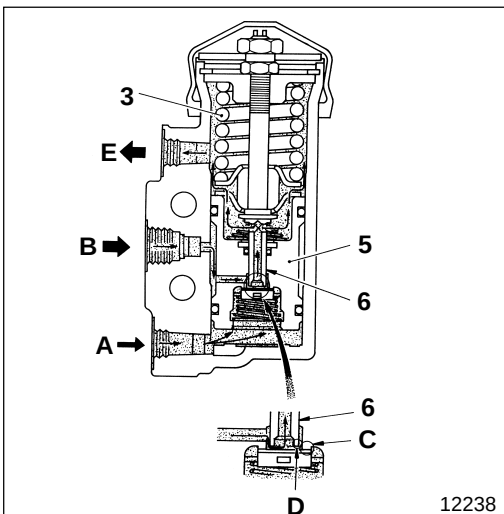
The air pressure governor keeps the air pressure in the air tank at the specified pressure, by operating the air compressor with or without load in accordance with the air pressure in the air tank.

● High specified-pressure



- Pressurized air **A** from the air tank acts constantly on piston **5**. As the pressure in the air tank rises to overcome the repercussive force of spring **3**, the piston rises and valve **7** closes.
- As air pressure **A** from the air tank rises further to become higher than the high specified-pressure, piston **5** rises further. Therefore, exhaust stem **6** opens inlet valve **C** and the air pressure in the air tank flows from unloader port **B** to the unloader valve of the air compressor via the inlet valve. Then the air compressor enters unloaded operation. Pressure also reaches the air dryer to recycle the desiccant.

● Low specified-pressure

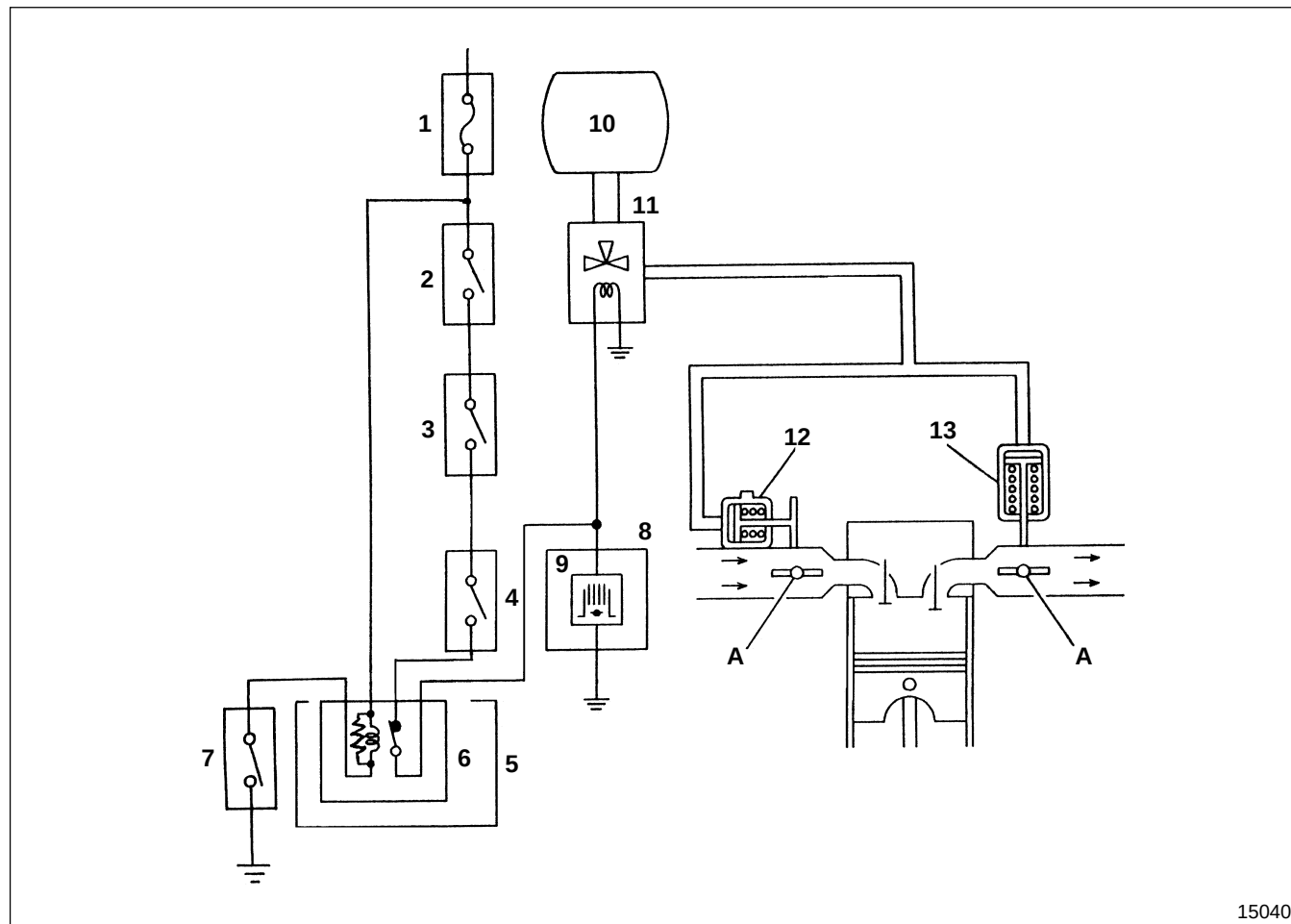


When pressurized air **A** from the air tank gradually drops below the specified-pressure, spring **3** forces down piston **5**. This closes inlet valve **C** and opens exhaust valve seat **D** so pressurized air **B**, up to the unloader valve of the air compressor, is discharged through the opening of cover **2** via exhaust stem **6** as exhausted air **E**, operating the air compressor at load. The pressurized air up to the air dryer is also discharged into the atmosphere.

MEMO

STRUCTURE AND OPERATION

Exhaust Brake System

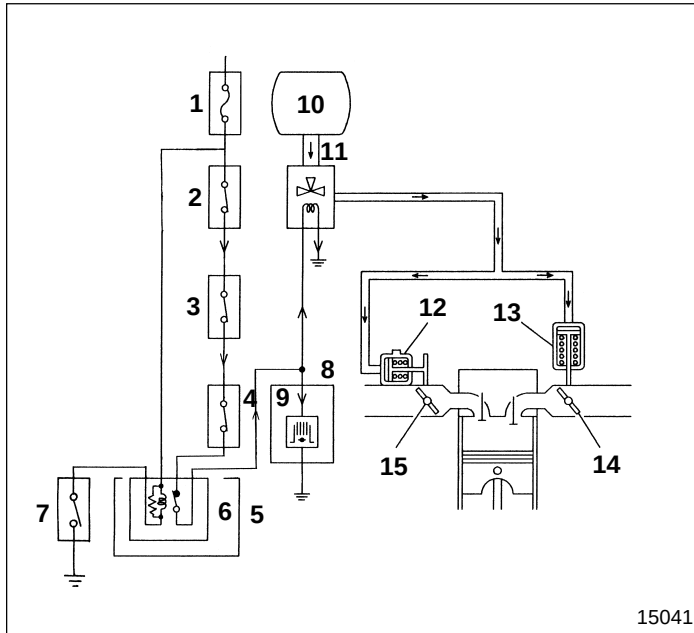


15040

- | | |
|-------------------------------|--------------------------------|
| 1 Fuse box | 9 Exhaust brake indicator lamp |
| 2 Clutch switch | 10 Air tank |
| 3 Accelerator switch | 11 3-way magnetic valve |
| 4 Exhaust brake switch | 12 Intake silencer actuator |
| 5 Relay box | 13 Exhaust brake unit |
| 6 Exhaust brake cut relay | |
| 7 Transmission neutral switch | A : Butterfly valve |
| 8 Meter cluster | |

- Excitation of 3-way magnetic valve **11** causes the air pressure in air tank **10** to act on intake silencer actuator **12** and exhaust brake unit **13** to close butterfly valve **A**, activating the exhaust brake.
- If the exhaust brake is activated while the vehicle is stationary, the coolant temperature can rise excessively, overheating the engine. To avoid this, when the transmission is in neutral, transmission neutral switch **7** turns ON, cutting the exhaust brake system.

● When exhaust brake system is activated

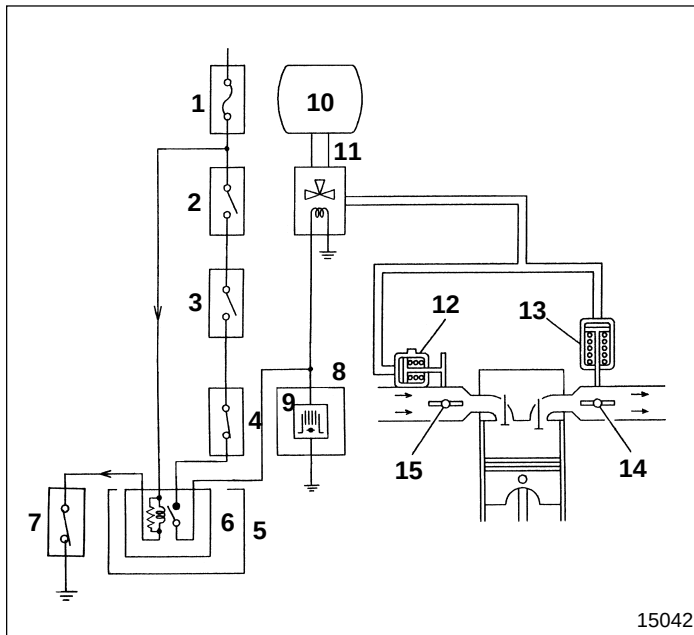


When exhaust brake switch 4 is turned on, the current flows as illustrated to activate the exhaust brake.

Fuse 1→Clutch switch 2→Accelerator switch 3→Exhaust brake switch 4→Exhaust brake cut relay 6→3-way magnetic valve 11→Ground

→Exhaust brake indicator lamp 9 (ON)→Ground

● When the exhaust brake system is released



When the accelerator pedal or clutch pedal is depressed while the exhaust brake is working, all switches 3, 2 turn off, shutting off the current, releasing the exhaust brake.

● When clutch pedal is depressed

Fuse 1→Clutch switch 2 (OFF)→Since no current flows, the circuit turns off and the exhaust brake is released.

● When accelerator pedal is depressed

Fuse 1→Clutch switch 2→Accelerator switch 3 (OFF)→Since there is no grounding, current does not flow, so the exhaust brake is released.

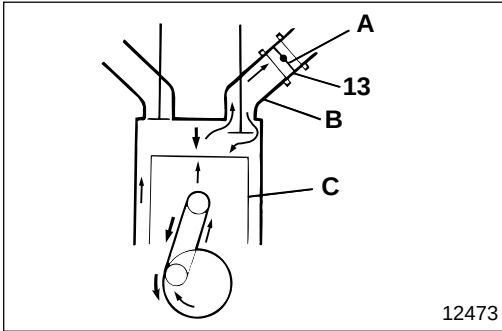
STRUCTURE AND OPERATION

● Releasing exhaust brake system by placing transmission in neutral

Fuse **1**→Exhaust brake cut relay **6** excitation→Transmission neutral switch **7**→Ground

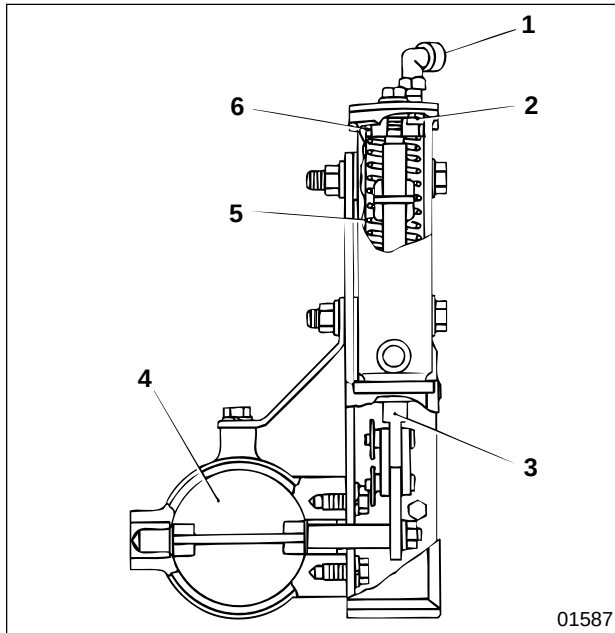
Fuse **1**→Clutch switch **2**→Accelerator switch **3**→Exhaust brake switch **4**→Exhaust brake cut relay **6** (OFF)→Beyond this, current does not flow so the exhaust brake is released.

● Working principle of exhaust brake



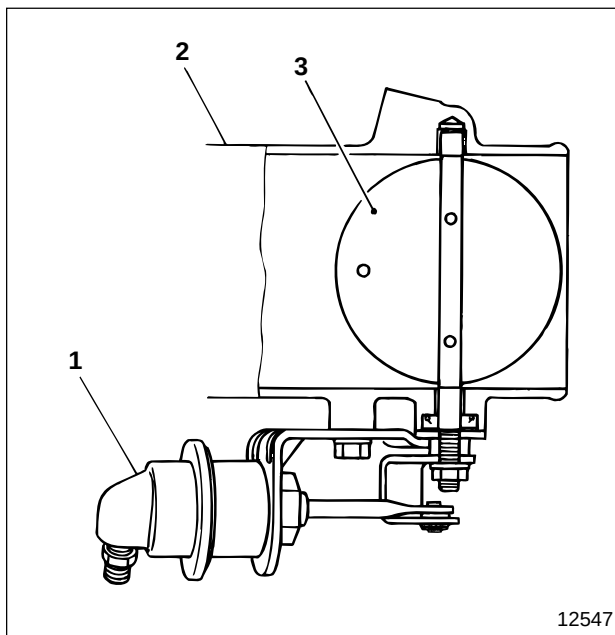
When butterfly valve **A** of exhaust brake unit **13**, in exhaust pipe **B**, is closed, the pressure in the exhaust pipe rises. The pressure rises further in the exhaust stroke, generating a force that pushes back piston **C**, the exhaust braking force.

● Exhaust brake unit



- 1 Connector
- 2 Packing
- 3 Shaft assembly
- 4 Butterfly valve
- 5 Spring
- 6 Plate

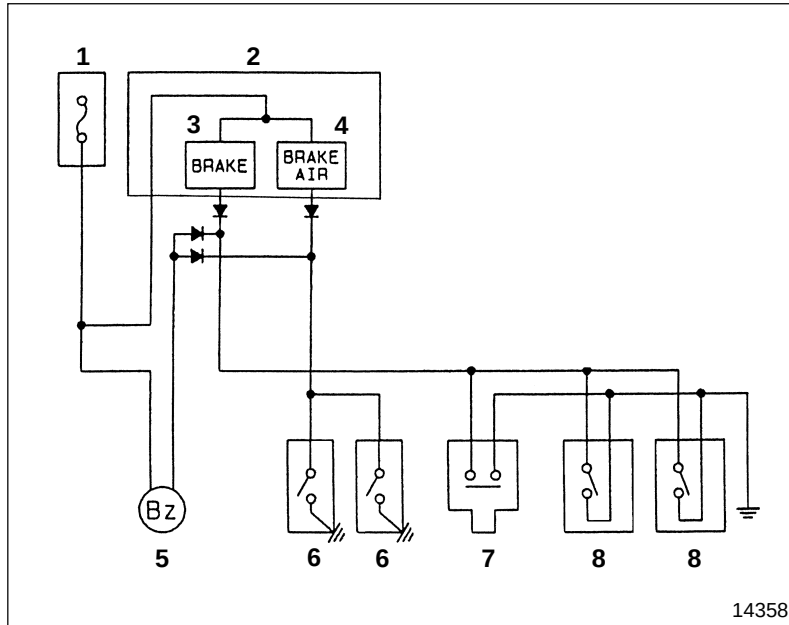
● Intake silencer



- 1 Actuator assembly
- 2 Intake pipe
- 3 Butterfly valve

STRUCTURE AND OPERATION

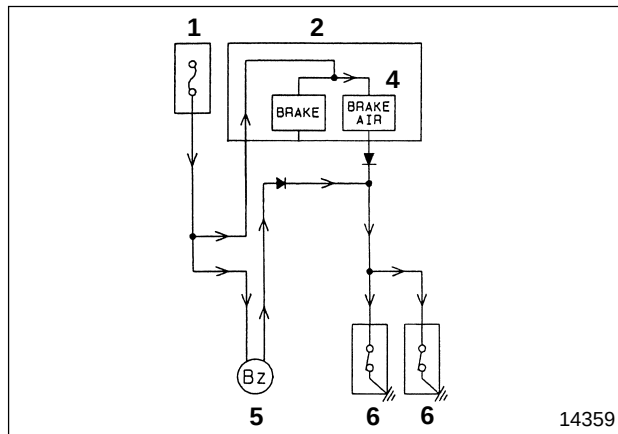
Brake Warning System



- 1 Fuse and relay box
- 2 Meter cluster
- 3 Brake fluid warning lamp
- 4 Air warning lamp
- 5 Warning buzzer
- 6 Low air pressure switch
- 7 Brake fluid level switch (installed on fluid tank)
- 8 Stroke switch (installed on airmaster)

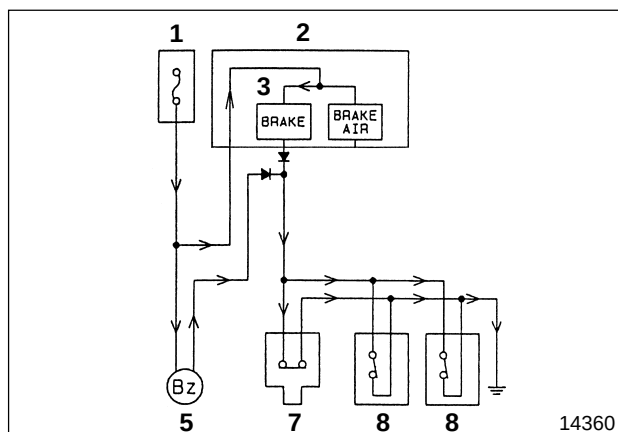
The brake warning system consists of two circuits: the air pressure warning circuit and the brake fluid warning circuit. The first detects decrease of air pressure in the air tank, the second detects decrease in brake fluid in the fluid tank and brake fluid leakage in the brake fluid system. Both circuits light warning lamps and at the same time sound a buzzer to alert the driver.

● Air pressure warning circuit



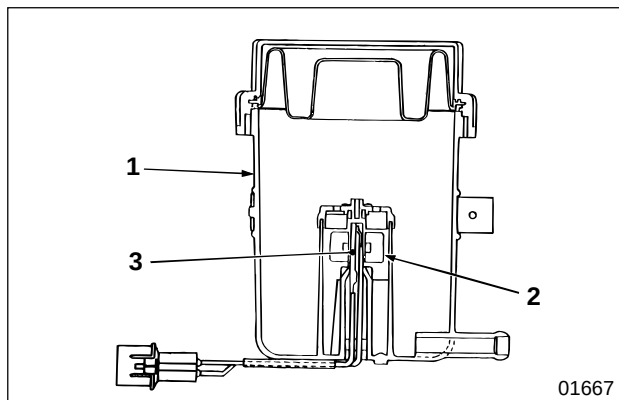
When the air pressure in the air tank drops below the specified value, low air pressure switch 6 turns on to light air warning lamp 4 and sound warning buzzer 5.

● Brake fluid warning circuit



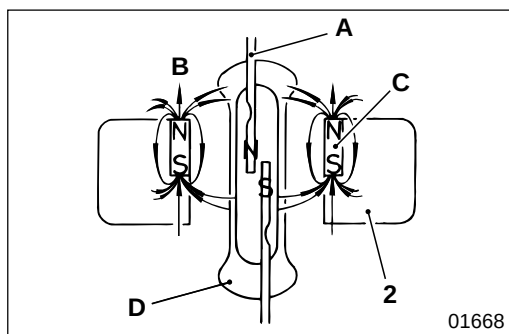
- When the brake fluid in the fluid tank drops below the specified level, brake fluid level switch 7 in the fluid tank turns on, brake fluid warning lamp 3 lights and warning buzzer 5 sounds. At this time, current flows as follows:
- If brake fluid leaks from the brake fluid system, stroke switch 8 of the airmaster turns on, brake fluid warning lamp 3 lights and warning buzzer 5 sounds.

● Brake fluid level switch



- 1 Fluid tank
- 2 Float
- 3 Brake fluid level switch

- Brake fluid level switch **3**, installed on fluid tank **1**, monitors the brake fluid level in the fluid tank. If the brake fluid level drops below the specified level, float **2** moves and lights up the warning lamp within the meter cluster to alert the driver.



- If the brake fluid level in fluid tank **1** drops and float **2** drops lower than level **L**, magnetic force **B** that passes through the contact point (ferromagnetic body **A**), increases generating north and south poles at the ends of the contact points. Therefore, the contact points pull each other and overcome the repercussive force of the springs of the contact points, forming an electric circuit.

- C** : Permanent magnet
- D** : Glass

TROUBLESHOOTING

● Wheel Brake

Symptoms		Wheel brake does not work effectively				Brake drum over-heating				
		Air leakage when brake pedal depressed	Air leakage when brake pedal released	No air leakage but brake works ineffectively	Air pressure low	Brake shoe self-return poor after releasing brake pedal (Wheel drags)	Noise when brake pedal depressed	One-sided braking	Wheel brake works suddenly	Brake warning lamp lights
Possible causes										
Wheel brake	Wheel cylinder malfunctioning			○				○		○
	Brake lining surface contaminated with oil			○						
	Brake lining surface hardened			○			○			
	Brake fluid leaking because wheel cylinder cup worn			○						
	Brake lining worn									○
	Brake lining worn exposing rivet head						○			
	Brake drum interior worn unevenly						○			
	Brake shoe and brake lining close contact faulty						○			
	Brake drum installation loose						○	○		
	Brake lining materials unequal							○		
	Brake lining contact faulty							○		
	Brake drum runout							○		
	Backing plate warped							○		
	Brake shoe clearance insufficient					○		○	○	
	Brake shoe return spring deteriorated or fractured					○		○		
	Wheel cylinder piston return faulty					○		○		
	Brake fluid return faulty because brake pipe or joints clogged					○				

Symptoms		Wheel brake does not work effectively				Brake drum over-heating				
		Air leakage when brake pedal depressed	Air leakage when brake pedal released	No air leakage but brake works ineffectively	Air pressure low	Brake shoe self-return poor after releasing brake pedal (Wheel drags)				
Possible causes							Noise when brake pedal depressed	One-sided braking	Wheel brake works suddenly	Brake warning lamp lights
Dual brake valve	O-ring damaged	○								
	Primary and secondary valve airtightness faulty	○	○							
	Primary and secondary valve return faulty or exhaust port clogged with foreign particles					○				
Airmaster	Power cylinder lubrication faulty or rubber packing damaged			○						
	Hydraulic piston valve seal close contact faulty			○						
	Hydraulic piston cup packing damaged, wrong combination, or foreign particles adhering to it			○				○		
	Exhaust port clogged with foreign particles					○				
	Push rod bent					○				
	Power cylinder rubber packing lubricated incorrectly					○				
Brake air system	Connector loose	○	○							
	Air leakage				○					
	Air pressure governor adjusted incorrectly				○					
	Air compressor malfunctioning				○					
Brake fluid system	Brake fluid leaking or insufficient			○						○
	Air mixed in brake fluid system			○						○
Tire	Left and right air pressure different  Gr 31							○		
Suspension	Leaf spring U-bolt loose  Gr 33, 34							○		

TROUBLESHOOTING

Possible causes		Symptoms						Remarks
		Drainage from air tank drain cock	Drainage not drawn off from exhaust port	Air dryer interior frozen	Air leakage from exhaust port	Air pressure in air reservoir drops extraordinarily	Engine oil coming out exhaust port	
Air Dryer	Desiccant deteriorated	☐						
	Heater not working and air dryer frozen		☐					
	Valve malfunctioning because of foreign particles adhering to it		☐					
	No warming because heater wiring broken			☐				
	Heater malfunctioning because thermostat faulty			☐				
	Temperature extremely low because of snow and ice sticking to air dryer body			☐				
	Heater malfunctioning because wiring to thermostat disconnected			☐				
	Valve seat close contact faulty because of clogging by foreign particles				☐			
	Dry air returning from air tank because air tank check valve malfunctioning during air compressor unloading cycle					☐		
	Air compressor oiling-up						☐	

● Exhaust Brake

Possible causes		Symptoms				Remarks
		Exhaust brake does not work	Exhaust brake cannot be released	Intake silencer does not work	Intake silencer cannot be released	
Exhaust brake unit	Valve assembly malfunctioning	☐	☐			
	Valve assembly shaft stuck	☐	☐			
	Control cylinder malfunctioning	☐				
	Butterfly valve adjusted incorrectly	☐				
Intake silencer	Malfunctioning			☐	☐	
3-way magnetic valve	Malfunctioning	☐	☐	☐		 Gr 54
Brake air system	Air pressure abnormal	☐		☐		
	Air pipes crushed	☐		☐		
Electric system	Malfunctioning	☐	☐	☐	☐	 Gr 54

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

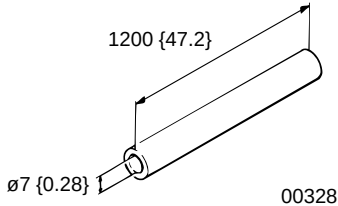
Replacement of Brake Fluid

Fluid

Location	Points of application	Kinds	Quantity
—	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Vinyl hose 	MH033102	Air bleeding

WARNING

- You must use new brake fluid (SAE J1703f or FMVSS No. 116 DOT3).
- Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the brake system, because this will cause the rubber parts of the brake system to swell, resulting in brake dragging or ineffective braking.
- Do not allow foreign particles or water to get mixed in with the brake fluid when you add it.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oil.

CAUTION

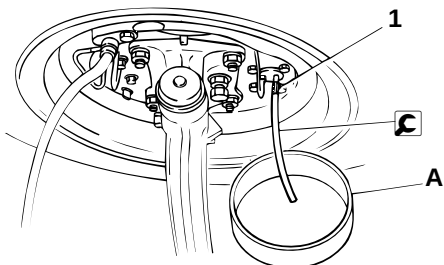
- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

NOTE

Supply and maintain brake fluid to the “H” level of the fluid tank.

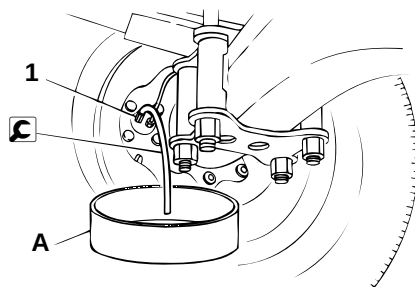
- Start engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to air bleeder **1** and place the other end in container **A**.

< Front >



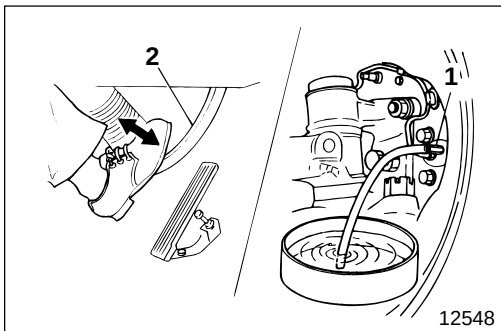
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< Rear >



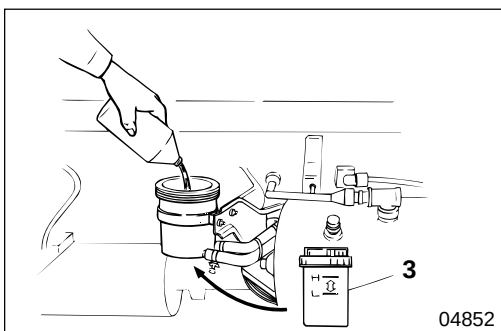
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- Loosen air bleeder **1** and depress brake pedal **2** to drain brake fluid completely.



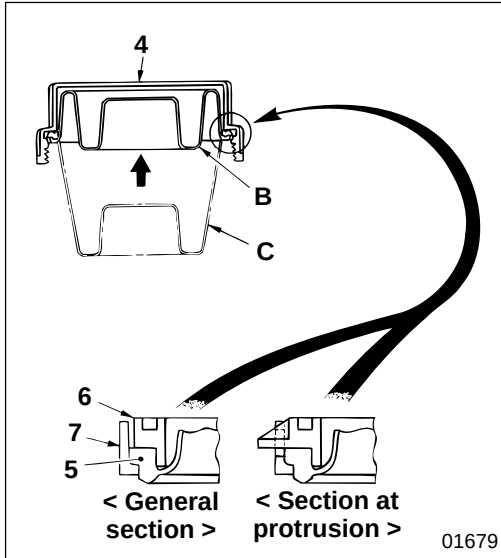
12548

- Maintain a supply of new brake fluid up to the "H" level of fluid tank **3**, depress the brake pedal repeatedly until the old brake fluid of the brake system is replaced with new fluid.



04852

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE



- If diaphragm **5** is not in its normal posture when the brake fluid is supplied, correct it to its normal posture, and install cap **4**. If brake fluid leaks from the cap area after you have supplied brake fluid, check whether the diaphragm is assembled as illustrated.

6 : Slide ring

7 : Ring cover

B : Correct condition of diaphragm when brake fluid is being supplied

C : Condition when diaphragm is extended when brake fluid has decreased

- Air bleeding of brake system. P35-32

Air Bleeding of Brake System

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
—	Air bleeder (Airmaster)	6.9 to 12.7 {5.1 to 9.4, 0.7 to 1.3}	—
—	Air bleeder (Wheel brake)	7.8 to 12 {5.8 to 8.5, 0.8 to 1.2}	—

Fluid

Location	Points of application	Kinds	Quantity
—	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Vinyl hose 00328	MH033102	Air bleeding

WARNING ⚠

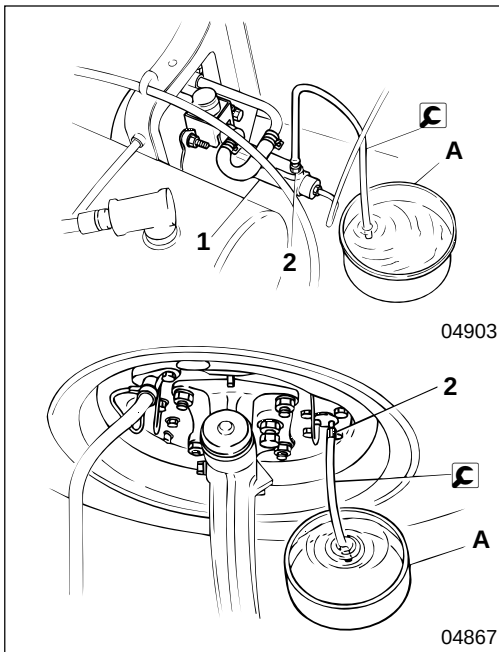
- You must use new brake fluid (SAE J1703f or FMVSS No. 116 DOT3).
- Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the brake system, because this will cause the rubber parts of the brake system to swell, resulting in brake dragging or ineffective braking.
- Do not allow foreign particles or water to get mixed in with the brake fluid when you add it.
- If you use a mug for adding brake fluid, keep it solely for that purpose to prevent contamination from different quality fluids or mineral oil.

CAUTION ⚠

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

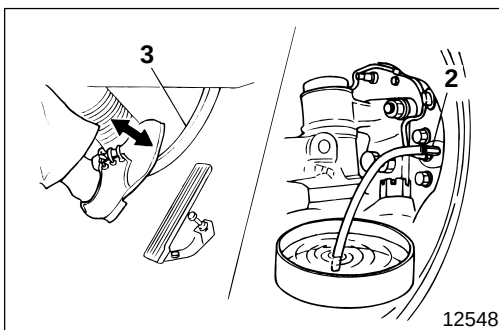
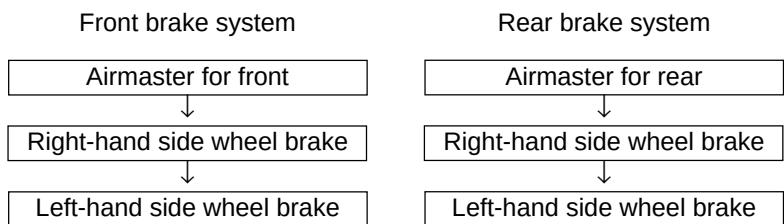
NOTE

- Supply and maintain brake fluid to the “H” level of the fluid tank.
- Make sure you maintain brake fluid at the “H” level of the fluid tank since the brake fluid level drops during air bleeding.



- Start engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to front or rear airmaster 1. Then, attach one end of another vinyl hose to air bleeder 2 of the wheel brake. Finally, place both free ends in container A filled with brake fluid.

- Carry out air bleeding in the following sequence:



- Depress brake pedal 3 slowly a few times, and with the brake pedal depressed, loosen air bleeder 2 to drain brake fluid containing air.

INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

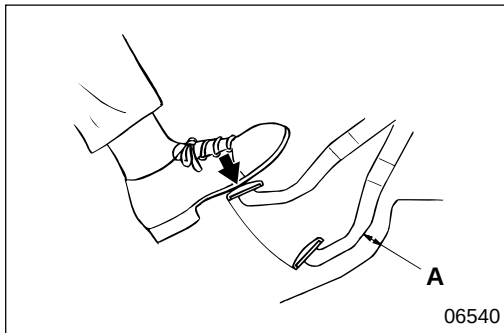
- Tighten air bleeder **2**, and release brake pedal **3**.
- Repeat this service procedure until air is no longer present in the fluid being drained.
- Tighten air bleeder **2** at specified torque as soon as brake fluid flowing out is free of air bubbles.
- Adjust brake shoe clearance when you have finished air bleeding.
📖 P35-32
- Check that brake fluid comes up to level “**H**” of fluid tank. If it does not, refill with new brake fluid.
- Depress brake pedal **3** a few times and check for any leakage of brake fluid, then test the brakes.
- When you test the brakes, if the brake warning lamp within the meter cluster lights, it means that air has not been bled completely. Redo air bleeding.

Inspection and Adjustment of Clearance between Brake Pedal and Floor Panel

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Clearance between brake pedal and floor panel (with pedal depressed at 490 N {110 lbf, 50 kgf})	45 {1.8} or more	—	Adjust



[Inspection]

Depress the brake pedal using 490 N {110 lbf, 50 kgf} when the engine is idling to check if clearance **A** between the brake pedal and the floor panel conforms to the standard value. If the measured value deviates from the standard value, adjust the height of the brake pedal.

[Adjustment]

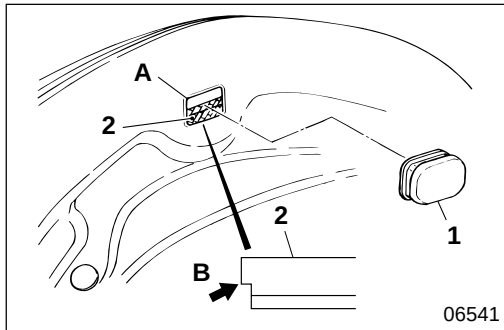
📖 P35-38

Thickness Inspection and Replacement of Brake Lining

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Thickness of brake lining	—	5.5 {0.22} (Side shoulder means wear limit)	Replace



[Inspection]

NOTE

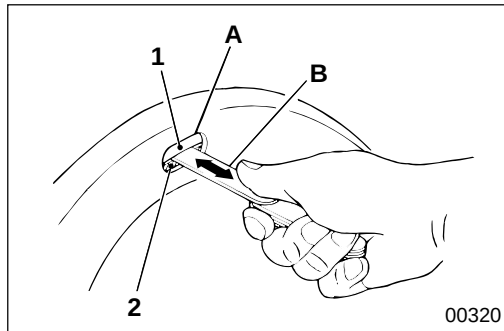
Be sure to inspect at two points for each wheel per side.

- Remove check hole plug **1** from the backing plate.
- Inspect through check hole **A** whether brake lining **2** is worn to the point of side shoulder **B** of the brake lining (the limit).
- If the measured value is lower than the limit, replace brake lining **2** on the same axle as a unit.
- After inspection, be sure to reinstall check hole plug **1**.

[Replacement]

P35-56, 64

Inspection of Brake Shoe Clearance



NOTE

When the vehicle is jacked up and the wheel is being turned, make sure that there is no dragging.

- Remove the check hole plug from the backing plate.
 - **A** : Check hole
 - Try to insert a 1 mm {0.039 in.} feeler gauge **B** between brake drum **1** and brake lining **2**. Check that the clearance is too small to let the feeler gauge enter.
- If feeler gauge **A** enters the clearance, disassemble the wheel cylinder and inspect.

P35-62, 70

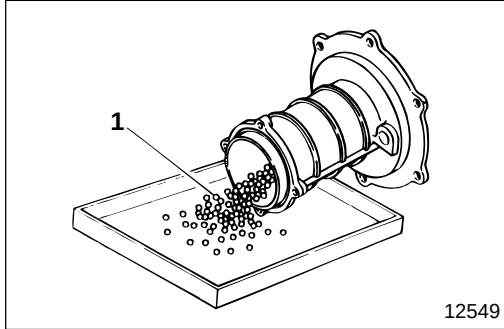
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Inspection and Maintenance of Air Dryer

Carry out inspection and maintenance according to the following interval or vehicle mileage.

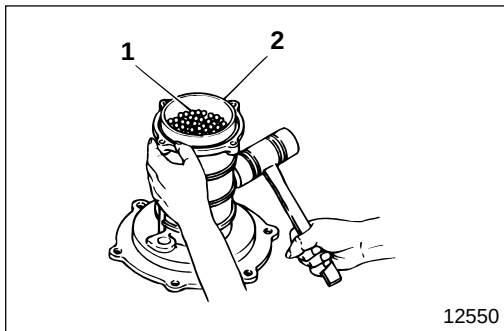
(1) Every three months or 10000 km {6000 miles}

- To check that the air dryer operates correctly, open the drain cock of the air tank and see if any drainage comes out.
- If a little drainage comes out, check if desiccant **1** is discolored. If more than one fifth of the desiccant has changed color from white to brown, renew desiccant.



NOTE

In an operational environment where the decrease of the ambient temperature in the air tank is higher than 16°C {29°F}, a little moisture might collect.



- Pour desiccant **1** into container **2**, tap around the container lightly to settle the desiccant.

- Carefully inspect the drainage from the exhaust port of the air dryer body. Inspect the air compressor and take appropriate action for abnormal oil consumption.

📖 P35-72

(2) Every year or every 60000 km {36000 miles}

Disassemble the air dryer body. Replace the oil filter, filter and all the rubber parts together with a repair kit.

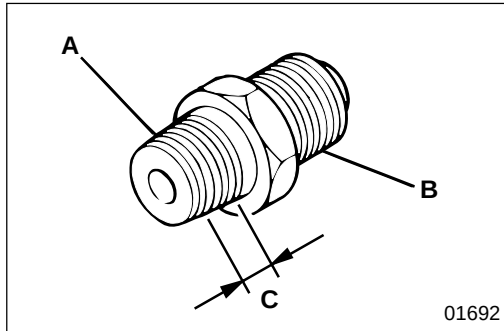
📖 P35-80

HANDLING OF CONNECTORS

35

Sealant

Location	Points of application	Kinds	Quantity
—	Taper thread of connector	THREEBOND 1110B	As required



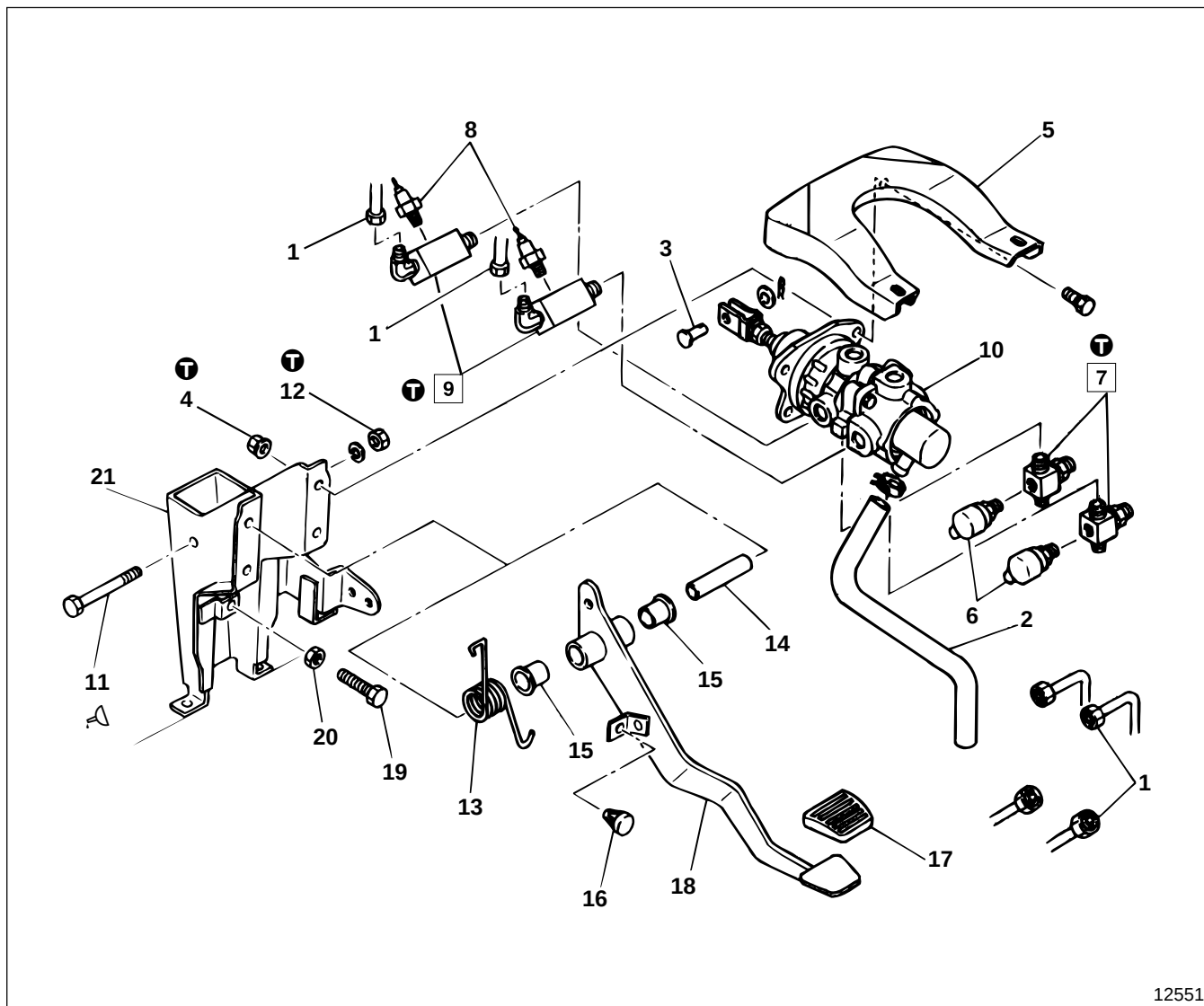
- If the connectors for the brake air system are to be reused after removal, thoroughly remove residual sealant, oil, moisture, etc.
- Apply sealant to the threads of the connector taper except for one or two turns from the end, then tighten.
- When positioning, adjust in the tightening direction.

A : Taper thread

B : Parallel thread (Do not apply sealant here)

C : Apply sealant here

BRAKE PEDAL



12551

● Removal sequence

- | | | |
|--|---|-----------------------|
| 1 Nylon tube | 8 Low air pressure switch  Gr 54 | 15 Bushing |
| 2 Vinyl tube | 9 Connector | 16 Stopper |
| 3 Clevis pin | 10 Dual brake valve  P35-42 | 17 Pedal pad |
| 4 Nut | 11 Bolt | 18 Brake pedal |
| 5 Valve support bracket | 12 Nut | 19 Pedal stopper bolt |
| 6 Stop lamp switch  Gr 54 | 13 Return spring | 20 Lock nut |
| 7 Connector | 14 Collar | 21 Support assembly |

● Installation sequence

Follow the removal sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
14, 15	Clearance between collar and bushing	[16] 0.02 to 0.26 {[0.63] 0.00079 to 0.010}	0.05 {0.0020}	Replace
18	Installation height of brake pedal	305 {12.0}	—	Adjust
	Stroke of brake pedal	54 {2.13}	—	Adjust

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (Dual brake valve mounting)	19 to 28 {14 to 21, 1.9 to 2.9}	—
7	Connector	29.4 to 39.2 {22 to 29, 3.0 to 4.0}	—
9	Connector	29.4 to 117.6 {22 to 87, 3.0 to 12}	—
12	Nut (Brake pedal mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—

L Lubricant

Location	Points of application	Kinds	Quantity
11	Friction surfaces of bolt and bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required

◆ Service procedure**● Adjustment after assembly****(1) Adjustment of brake pedal installation height**

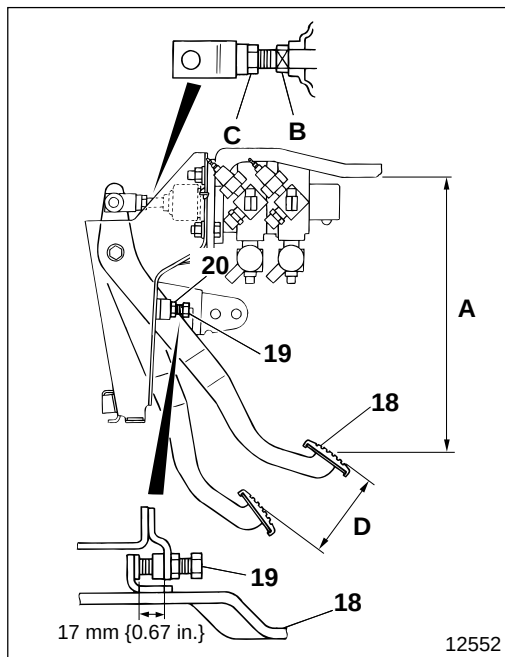
- Adjust the installation distance of pedal stopper bolt **19** to 17 mm {0.67 in.}.
- Turn operating rod **B** to adjust brake pedal installation height **A** to the standard value. After adjustment, fix using lock nut **C**.

(2) Inspection of brake pedal stroke

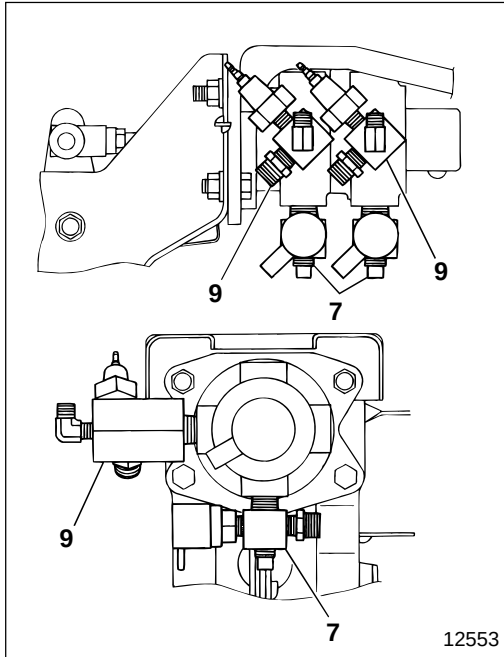
- Make sure that brake pedal stroke **D** is the standard value when brake pedal **18** is depressed fully.
- If any fault is found, adjust the brake pedal installation height.

WARNING ⚠

Make sure that brake pedal **18** is stopped by operating rod **B**, because if the brake pedal makes contact with the floor panel when depressed fully, braking force is reduced.



BRAKE PEDAL

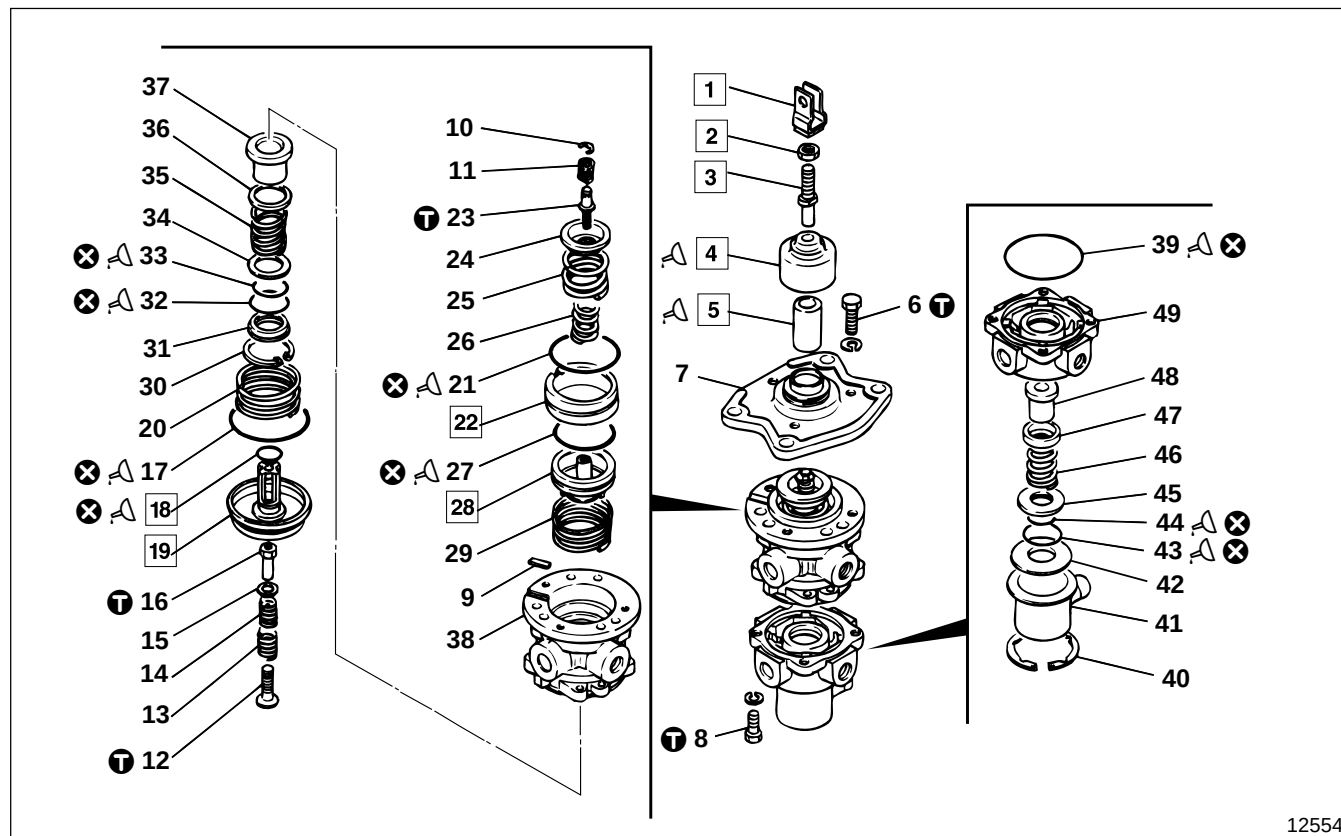


7 9 Installation of connector

For connectors **7**, **9**, determine the direction within one turn of exceeding 29 N·m {22 lbf.ft, 3 kgf·m}.

MEMO

DUAL BRAKE VALVE



12554

● Work before disassembly

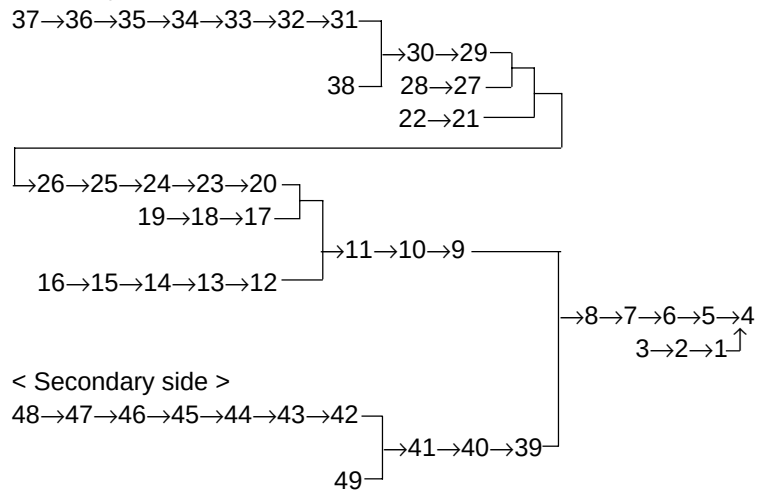
📖 P35-45

● Disassembly sequence

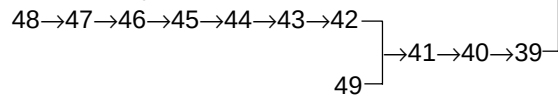
- | | | |
|-------------------|------------------------|-------------------|
| 1 Clevis | 18 O-ring | 35 Valve spring |
| 2 Nut | 19 Relay piston | 36 Washer |
| 3 Push rod | 20 Relay piston spring | 37 Inlet valve |
| 4 Boot | 21 O-ring | 38 Body |
| 5 Plunger | 22 Bushing | 39 O-ring |
| 6 Bolt | 23 Self-locking bolt | 40 Retaining ring |
| 7 Plate | 24 Spring seat | 41 Valve seat |
| 8 Bolt | 25 Outer spring | 42 Washer |
| 9 Plug | 26 Inner spring | 43 O-ring |
| 10 Retaining ring | 27 O-ring | 44 O-ring |
| 11 Spring | 28 Primary piston | 45 Valve retainer |
| 12 Screw | 29 Spring | 46 Valve spring |
| 13 Outer spring | 30 Retaining ring | 47 Valve retainer |
| 14 Inner spring | 31 Valve retainer | 48 Inlet valve |
| 15 Washer | 32 O-ring | 49 Cover |
| 16 Sleeve | 33 O-ring | |
| 17 O-ring | 34 Washer | |
- ⊗ : Non-reusable parts

● Assembly sequence

< Primary side >



< Secondary side >



Repair kit : Dual brake valve kit

● Inspection of function after assembly

📖 P35-45

DUAL BRAKE VALVE

Service standards

Unit : mm {in.}

Location	Maintenance item				Standard value		Limit	Remedy
5	Outer diameter of plunger				19.9 {0.783}		19.8 {0.780}	Replace
7	Inner diameter of bushing				20 {0.787}		20.08 {0.791}	Replace plate
11	Spring load (Installed length 12.6 {0.496})				—		215 N {49 lbf, 22 kgf}	Replace
20	Relay piston spring load (Installed length 12.8 {0.504})				—		47 N {11 lbf, 48 kgf}	Replace
25	Outer spring load (Installed length 26.5 {1.04})				—		214 N {48 lbf, 21.8 kgf}	Replace
26	Inner spring load (Installed length 19.1 {0.75})				—		60 N {13 lbf, 6.1 kgf}	Replace
29	Spring load (Installed length 17 {0.67})				—		97 N {22 lbf, 9.9 kgf}	Replace
35	Valve spring load (Installed length 14.3 {0.56})				—		37 N {8.4 lbf, 38 kgf}	Replace
46	Valve spring load (Installed length 12.8 {0.51})				—		47 N {11 lbf, 4.8 kgf}	Replace
—	Play	Input air pressure 685 kPa {100 lbf/in ² , 7 kgf/cm ² }	Push rod stroke	1.5 {0.059}	Output air pressure	—	—	—
	$1.5^{+0.6}_{-0.4}$ {0.059 ^{+0.024} _{-0.016} }			29 kPa {43 lbf/in ² , 0.3 kgf/cm ² } or less		—		
	6 {0.24}			310 kPa {45 lbf/in ² , 3.18 kgf/cm ² }		—		
	7 {0.28}			685 kPa {100 lbf/in ² , 7 kgf/cm ² }		—		

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
6	Bolt (Plate mounting)	12 to 19 {8.7 to 14, 1.2 to 1.9}	—
8	Bolt (Primary and secondary side assembling)	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
12	Screw	4.9 to 7.8 {3.6 to 5.8, 0.5 to 0.8}	—
16	Sleeve	1.0 to 2.9 {0.7 to 2.2, 0.1 to 0.3}	—
23	Self-locking bolt	12 to 19 {8.7 to 14, 1.2 to 1.9}	—

Lubricant

Location	Points of application	Kinds	Quantity
4, 5	Pack between boot and plunger	Multipurpose grease [NLGI No.2 (Li soap)]	1 cm ³ {0.061 cu. in.}
5	Friction surfaces of plunger and other parts	Multipurpose grease [NLGI No.2 (Li soap)]	As required
—	O-ring and its friction surface, metal friction surface, and O-ring groove	Multipurpose grease [NLGI No.2 (Li soap)]	As required

Special tools

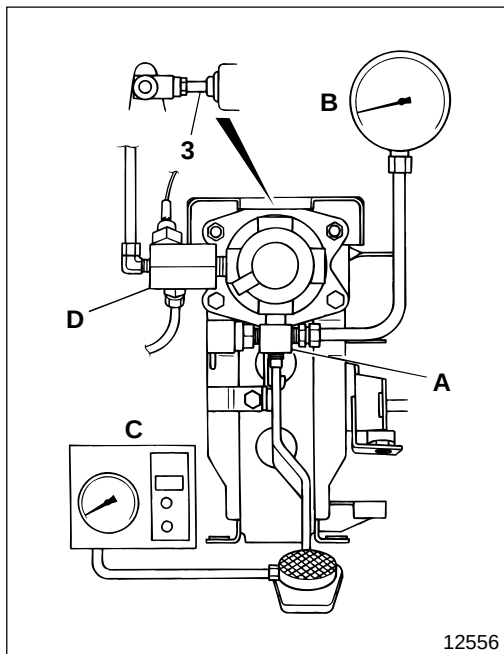
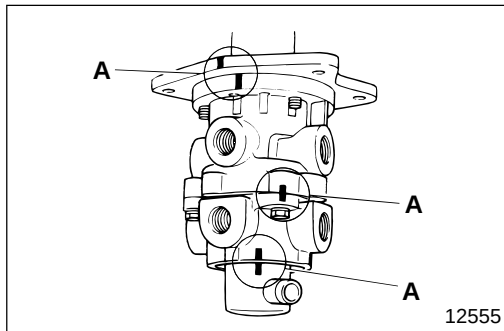
Location	Tool name and shape	Part No.	Application
21	Insert tool	*910-24461	Installation of O-ring
32	Retainer	*910-24590	Holding of primary piston

* : JIDOSHA KIKI Part No.

◆ Service procedure

● Work before disassembly

A : Alignment mark



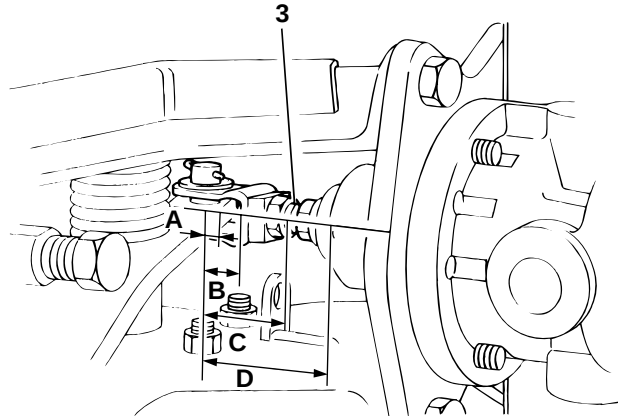
● Inspection of function after assembly

Check if the output air pressure, corresponding to the stroke of push rod **3**, conforms to the standard value. This inspection of function is carried out by installing a gauge on the brake pedal.  P35-38

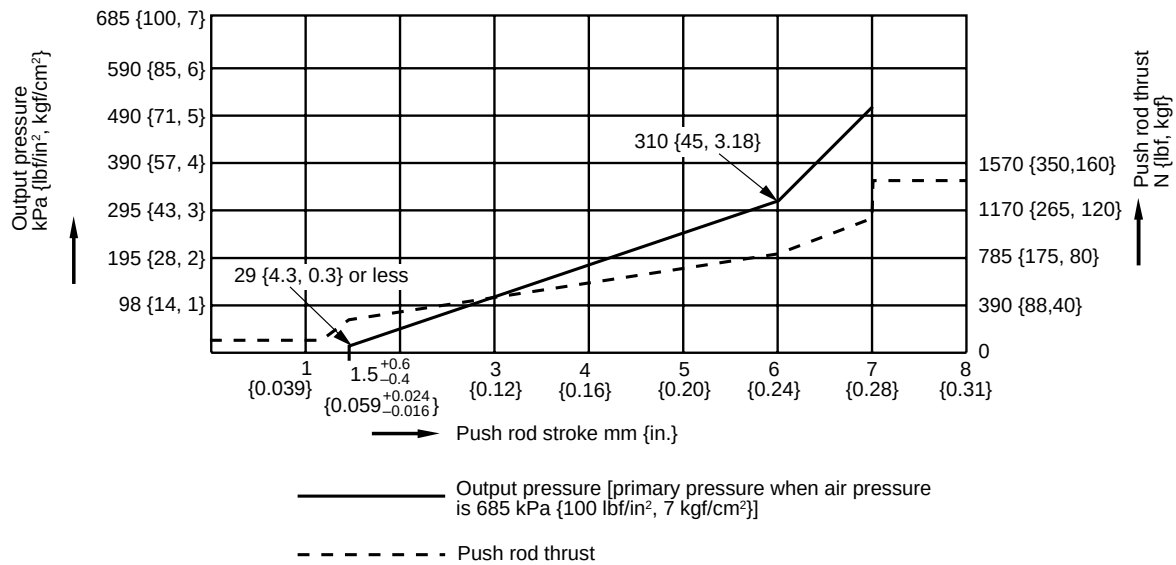
- Install pressure gauge **B** capable of measuring 980 kPa {140 lbf/in², 10 kgf/cm²} or more on primary output side port **A**.
- Install depression gauge **C** on the brake pedal.
- Apply air pressure of 685 kPa {100 lbf/in², 7 kgf/cm²} to primary input side port **D** and inspect the parts for air leakage.
- If an air leakage is found, take the following countermeasures:
 - Tighten connectors further.
 - Disassemble the dual brake valve and inspect the O-ring assemblies of all parts.
- Then, adjust the installation height of the brake pedal.
- After adjustment, read pressure gauge **B** and make sure that the primary output pressure, corresponding to the stroke of push rod **3**, conforms to the standard value as shown in the input/output characteristic curve diagram overleaf.
- If the primary output air pressure is lower than the standard value, replace the following springs:
 - Spring **11**
 - Outer spring **25**
 - Inner spring **26**

DUAL BRAKE VALVE

Input/Output Characteristic Curve Diagram

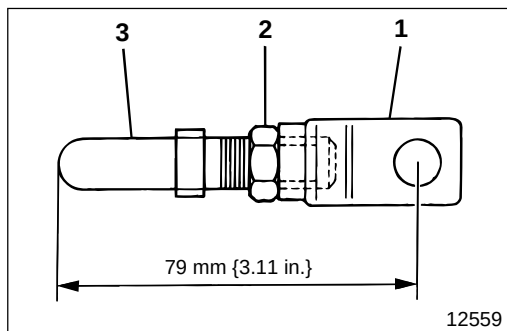


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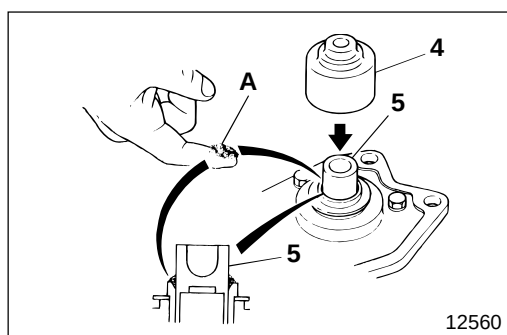


12558

- A : Play 1.5 mm {0.059 in.}
- B : Pressure stroke 1.5 ^{+0.6}/_{-0.4} mm {0.059 ^{+0.024}/_{-0.016} in.}
- C : Pressure stroke 6 mm {0.24 in.}
- D : Pressure stroke 7 mm {0.28 in.}

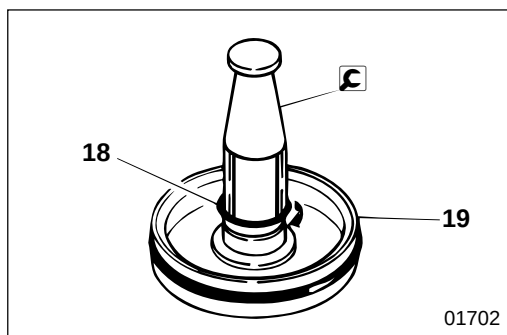


1 to 3 Installation of clevis, nut and push rod

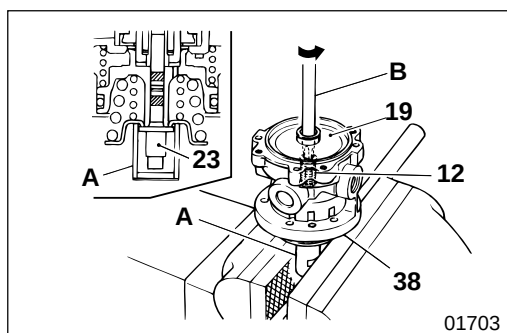


4 5 Packing grease between boot and plunger

A : Grease



18 Installation of O-ring



19 Removal of relay piston

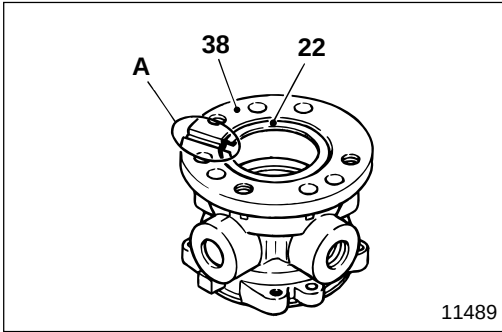
- Grip a (14 mm {0.55 in.}) socket wrench **A** in a vise.
- Insert the head of self-locking bolt **23** into socket wrench **A** to tighten body **38**.

WARNING ⚠

You must be careful when you loosen screw **12**, because the spring in body **38** can forcibly eject relay piston **19**. To avoid this hazard, press down on the relay piston with your hand when you carry out the above work.

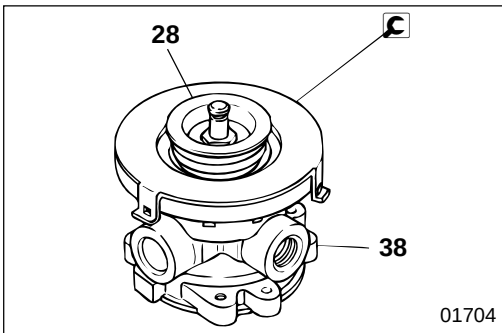
- Loosen screw **12** gradually to remove relay piston **19**.
- B** : Phillips screwdriver

DUAL BRAKE VALVE



22 Installation of bushing

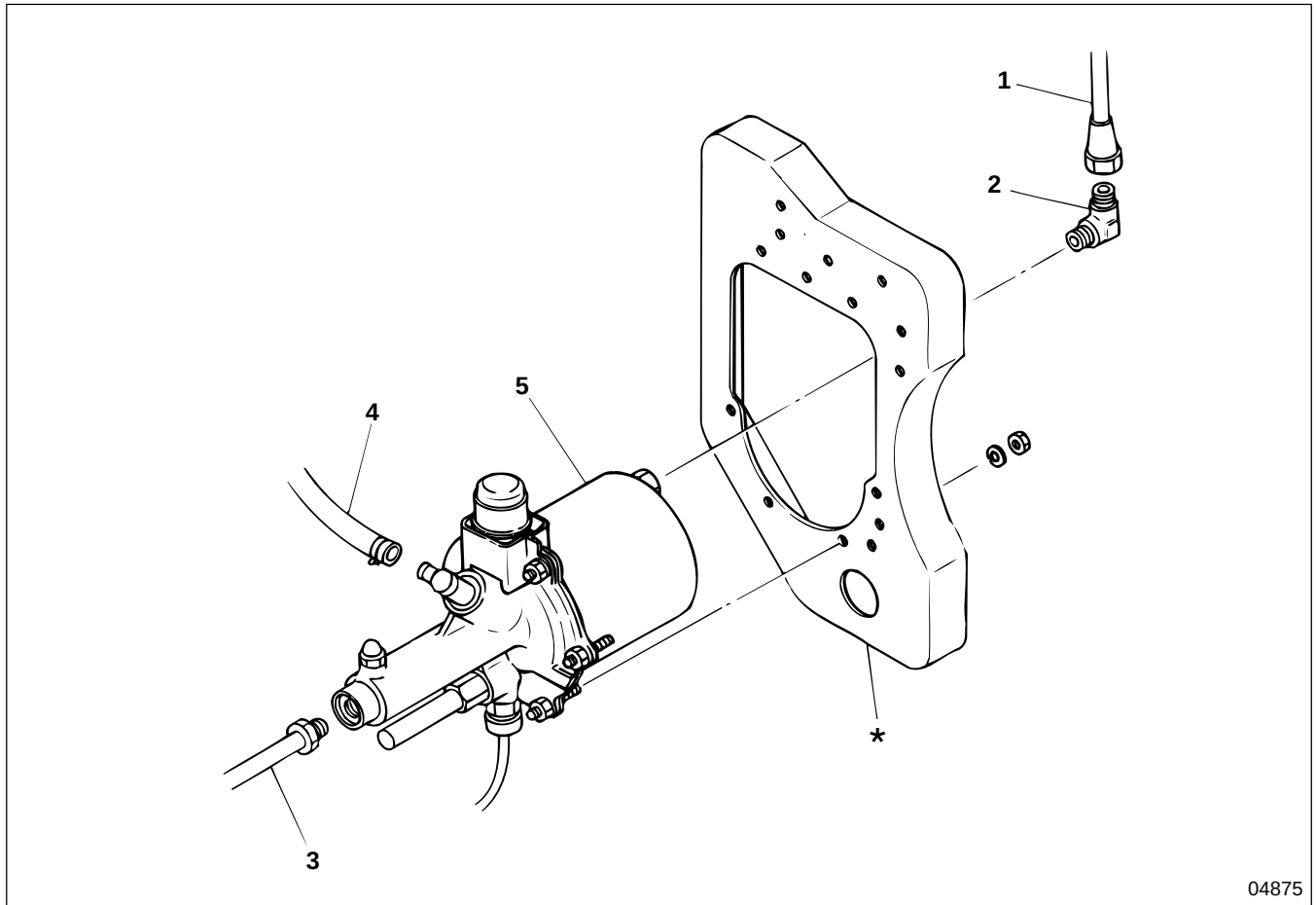
A : Indent



28 Removal and installation of primary piston

BRAKE BOOSTER (AIRMASTER)

35



● Disassembly sequence

- 1 Air pipe
- 2 Connector
- 3 Brake pipe
- 4 Brake hose

5 Airmaster P35-50

* : Airmaster and air tank bracket

● Assembly sequence

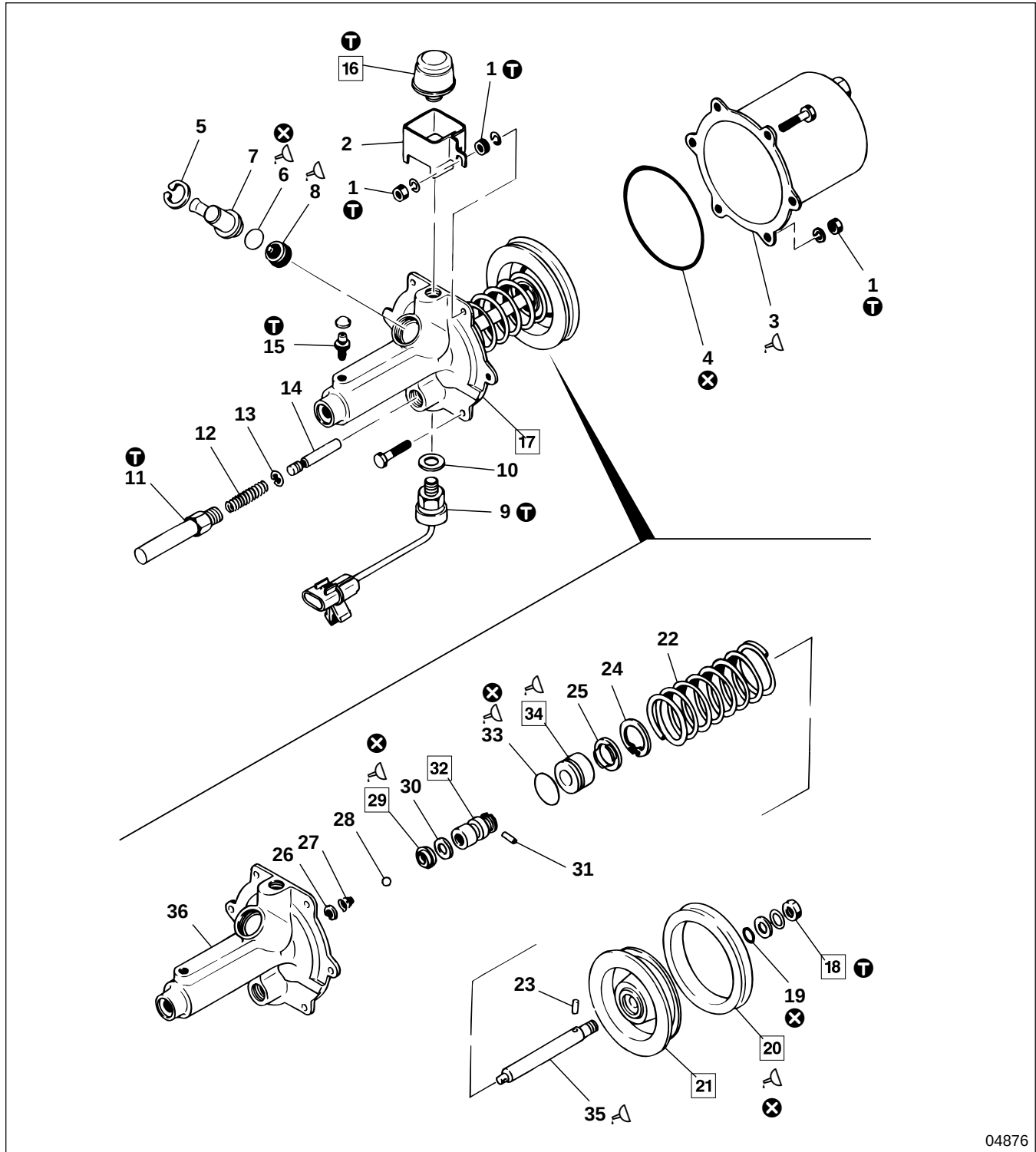
Follow the disassembly sequence in reverse.

NOTE

Check for air and liquid leakage after installation. Also, carry out air bleeding of brake system. P35-32

BRAKE BOOSTER (AIRMMASTER)

Airmaster Assembly



04876

● Disassembly sequence

- | | |
|---|----------------------|
| 1 Nut | 20 Cup packing |
| 2 Bracket | 21 Piston plate |
| 3 Cylinder shell | 22 Return spring |
| 4 O-ring | 23 Straight pin |
| 5 Retaining ring | 24 Retaining ring |
| 6 O-ring | 25 Washer |
| 7 Connector | 26 Retaining ring |
| 8 Residual valve | 27 Spring |
| 9 Stroke switch  Gr 54 | 28 Steel ball |
| 10 Shim | 29 Cup packing |
| 11 Retainer | 30 Backup ring |
| 12 Return spring | 31 Straight pin |
| 13 Retaining ring | 32 Hydraulic piston |
| 14 Rod | 33 O-ring |
| 15 Air bleeder | 34 Retainer assembly |
| 16 Exhaust cover | 35 Push rod |
| 17 Body assembly | 36 Body |
| 18 Nut | |
| 19 O-ring | |

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Airmaster kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3, 21	Clearance between cylinder shell and piston plate	[114.3] 0.5 to 1.4 {[4.50] 0.20 to 0.055}	1.8 {0.071}	Replace piston plate
22	Return spring load (Installed length 120 {4.72})	78±7.8 N {18±1.8 lbf, 8±0.8 kgf}	69 N {15 lbf, 7 kgf}	Replace
32, 36	Clearance between body and hydraulic piston	[23.8] 0.04 to 0.11 {[0.94] 0.0016 to 0.0043}	0.15 {0.0059}	Replace hydraulic piston
35	Bend of push rod	0.05 {0.0020} or less	0.15 {0.0059}	Replace

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Body and cylinder shell mounting)	11 to 15 {8.0 to 12, 1.1 to 1.6}	—
9	Stroke switch	24.6 to 34.3 {18 to 25, 2.5 to 3.5}	—
11	Retainer	7.9 to 19 {5.8 to 14, 0.8 to 2}	—
15	Air bleeder	6.9 to 12.7 {5.1 to 9.4, 0.7 to 1.3}	—
16	Exhaust cover	7.9 to 19 {5.8 to 14, 0.8 to 2}	—
18	Nut (Piston plate and push rod mounting)	20 to 29 {14 to 22, 2 to 3}	—

BRAKE BOOSTER (AIRMMASTER)

Lubricant and fluid

Location	Points of application	Kinds	Quantity
3	Cylinder shell bore	Multipurpose grease [NLGI No.2 (Li soap)]	10 g {0.35 oz}
6	O-ring	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required
8	Residual valve	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required
20	Surface of cup packing and friction surface of push rod	Multipurpose grease [NLGI No.2 (Li soap)]	5 g {0.18 oz}
29	Interior surface of cup packing	Multipurpose grease [NLGI No.2 (Li soap)]	As required
33	O-ring	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required
34	Fill oil seal groove of inside of retainer	Silicon grease	As required
35	Push rod friction surface against retainer	Silicon grease	As required

Special tools

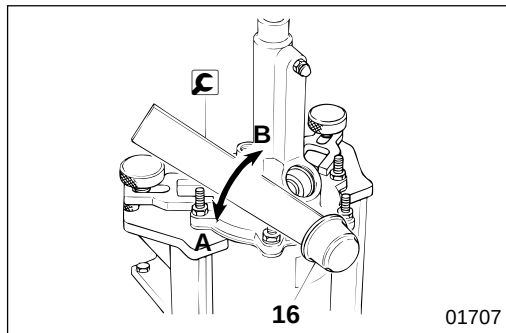
Location	Tool name and shape	Part No.	Application
16	L-spanner	*910-23370	Removal and installation of exhaust cover
17	Stand	*910-00450	Working bench
21	Holder	*910-24831	Removal and installation of piston plate
29	Cup insert guide	*910-23289	Installation of cup packing

* : JIDOSHA KIKI Part No.

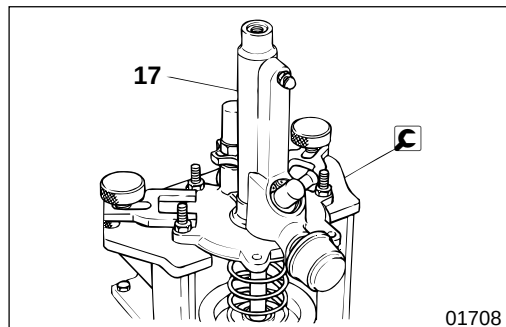
◆ Service procedure

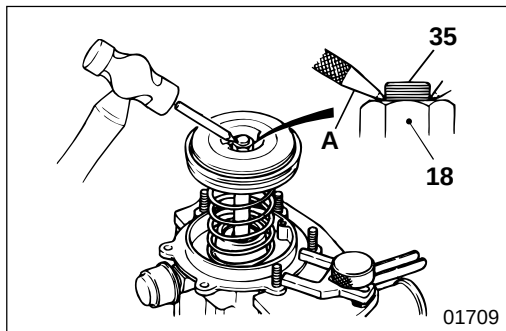
16 Removal and installation of exhaust cover

- A** : Removal
B : Installation



17 Installation of body assembly

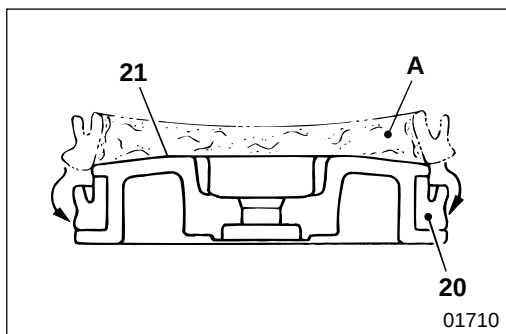




18 Installation of nut

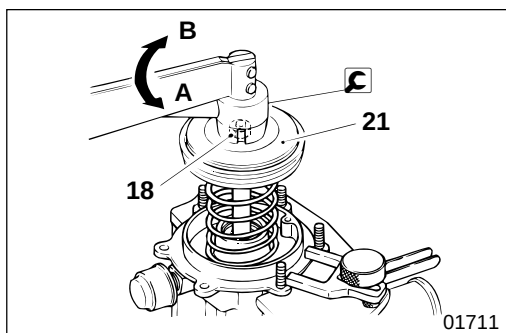
After tightening nut **18** at specified torque, caulk the nut and push rod **35** thread area.

A : Center punch



20 Installation of cup packing

A : Grease



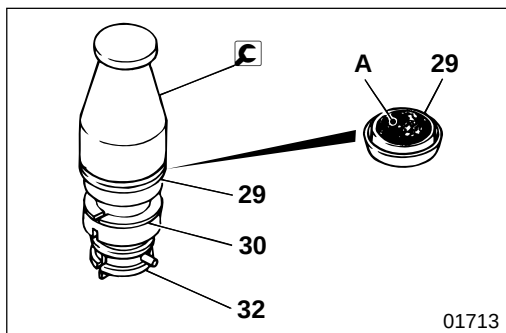
21 Removal and installation of piston plate

A : Removal

B : Installation

NOTE

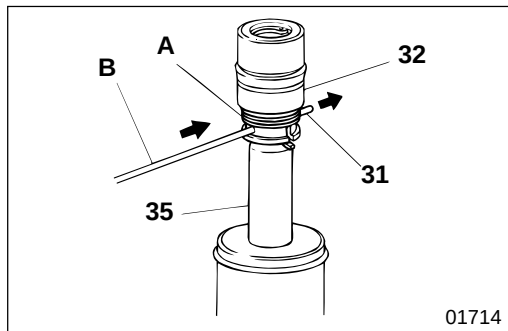
After installation, tighten nut **18** at specified torque.



29 Installation of cup packing

A : Grease

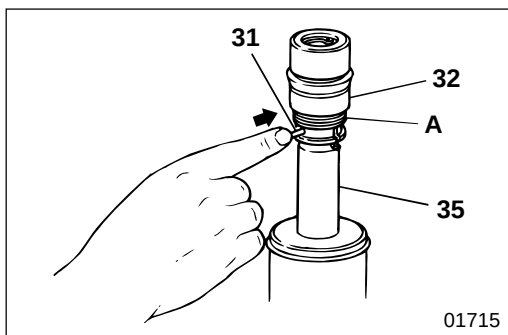
BRAKE BOOSTER (AIRMMASTER)



32 Hydraulic piston

[Removal]

- A : Spring
B : Needle



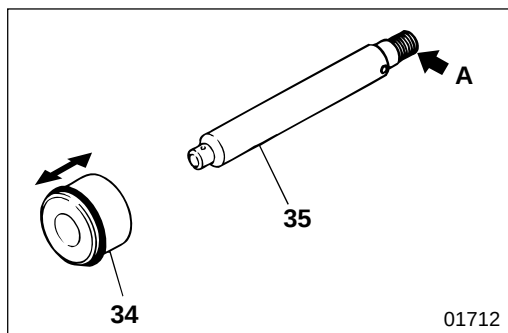
[Installation]

Align holes of hydraulic piston **32** and push rod **35**, and insert straight pin **31**.

- A : Spring

NOTE

After inserting straight pin **31**, make sure that the hydraulic piston spring is hanging over the straight pin and working as a stopper.



34 Removal and installation of retainer

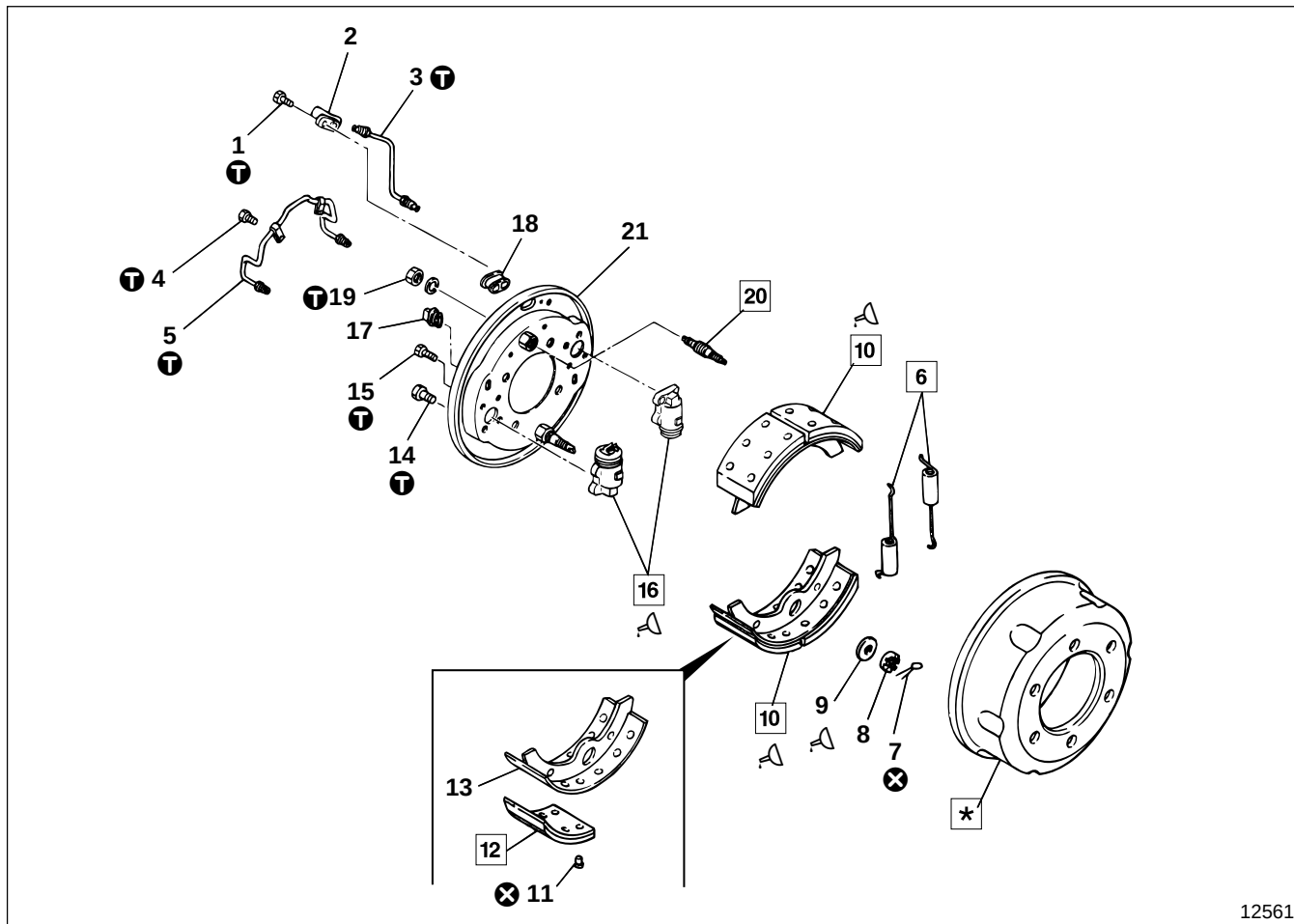
CAUTION ⚠

Do not remove or install retainer **34** from the side of thread area **A**, or the inside of the retainer might be damaged.

MEMO

FRONT WHEEL BRAKE

Front Wheel Brake Assembly



12561

● Disassembly sequence

- | | | |
|------------------|----------------------------|------------------------|
| 1 Bolt | 9 Washer | 17 Adjusting hole plug |
| 2 Joint assembly | 10 Brake shoe assembly | 18 Check hole plug |
| 3 Pipe assembly | 11 Rivet | 19 Nut |
| 4 Bolt | 12 Brake lining | 20 Holder pin |
| 5 Pipe assembly | 13 Brake shoe | 21 Backing plate |
| 6 Return spring | 14 Bolt | |
| 7 Split pin | 15 Bolt | |
| 8 Holder pin nut | 16 Wheel cylinder assembly | |
- ⊗ : Non-reusable parts
 * : Brake drum Gr 26

WARNING ⚠

Do not leave grease or oil on the surface of brake lining 12 or inner surface of brake drum * because this reduces braking performance.

CAUTION ⚠

Do not turn or remove holder pin 20 unless it is necessary, or the squareness of brake shoe assembly 10 can be influenced causing brake drag.

● Assembly sequence

Follow the disassembly sequence in reverse.
 Repair kit : Brake lining kit

● Initial adjustment of brake shoe clearance after installation

☞ P35-57

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
6	Return spring load (Installed length 192 {7.56})		325 N {73 lbf, 33 kgf}		Clearance between coils or coil and cover	Replace
12	Brake lining thickness		12.0 {0.47}		5.0 {0.20} (Side shoulder means wear limit)	Replace brake lining
*	Brake drum	Inner diameter	320 {12.5}	*321 {12.64}	322 {12.68}	Replace
		Cylindrical accuracy	0.05 {0.0020}		0.2 {0.0079}	Correct or replace

* : Indicates correction limit.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Joint assembly mounting)	9.8±1.0 {7.2±1.4, 1.0±0.2}	—
3, 5	Flair nut (Pipe assembly mounting)	14±2.0 {10±1.4, 1.4±0.2}	—
4	Bolt (Pipe clamp mounting)	4.9±1.0 {3.6±0.7, 0.5±0.1}	—
14	Bolt (Wheel cylinder assembly mounting)	78±16 {58±12, 8.0±1.6}	—
15	Bolt (Wheel cylinder assembly mounting)	44±8.8 {33±6.5, 4.5±0.9}	—
19	Nut (Holder pin mounting)	29±5.9 {22±4.3, 3.0±0.6}	—

Lubricant

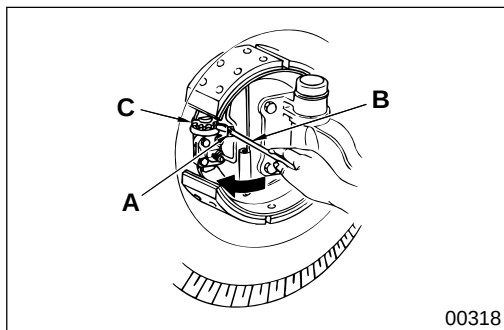
Location	Points of application	Kinds	Quantity
9, 10, 16	Contact areas between washer and brake shoe assembly; and between brake shoe assembly and wheel cylinder assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure**● Initial adjustment of brake shoe clearance after installation**

- Jack up the front wheels, and make sure that there is no play in the hub bearings.
- Insert screwdriver **B** into adjusting hole **A** and turn adjuster **C** in the direction of the arrow marked on backing plate **21** until the wheel drags slightly when turned by hand.

NOTE

- Be sure to adjust the clearance at two points for each wheel per side.
- The arrow mark on backing plate **21** is near adjusting hole **A**.



FRONT WHEEL BRAKE

- After depressing the brake pedal several times, release it and make sure that the wheel drags lightly when turned by hand. If the wheel turns without stress, repeat the above steps. Slacken off adjuster **B**, in the reverse direction to the arrow mark, by eight or nine notches.

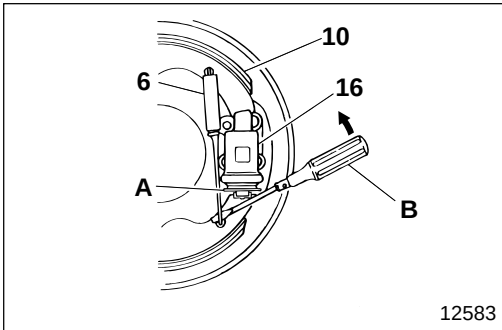
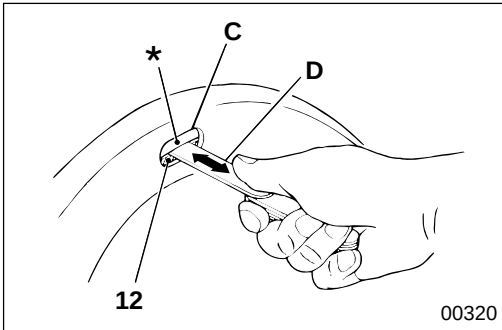
NOTE

Be sure to adjust the clearance at two points for each wheel per side.

- Make sure that the wheel does not drag when turned by hand. If the wheel drags, repeat the above steps.
- Insert feeler gauge **D** between brake drum ***** and brake lining **12** through check hole **C**, and make sure that a little resistance is felt when the feeler gauge is pulled out or pushed in.

NOTE

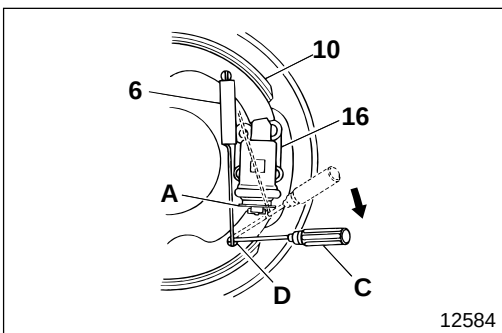
Be sure to adjust the clearance at two points for each wheel per side.



6 Return Spring

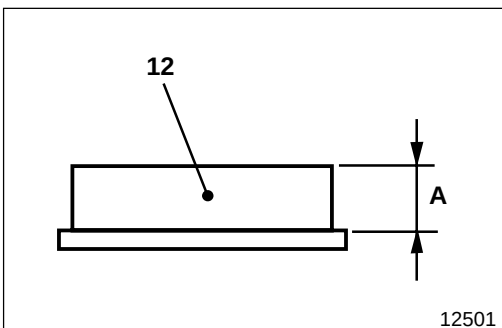
[Removal]

To remove return spring **6**, place screwdriver **B** on the hook of the return spring, then pry and remove the return spring making use of wheel cylinder assembly **16** adjuster **A** as a fulcrum.



[Installation]

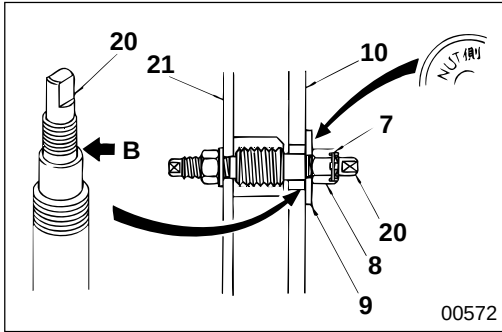
- Install the shorter hook end of return spring **6** in brake shoe assembly **10** at the side opposite to adjuster **A** of wheel cylinder assembly **16**.
- Insert a small Phillips screwdriver **C** into the hook of return spring **6**, insert the tip of the screwdriver into return spring installation hole **D** of the brake shoe assembly to pry on the return spring.



10 Brake shoe assembly

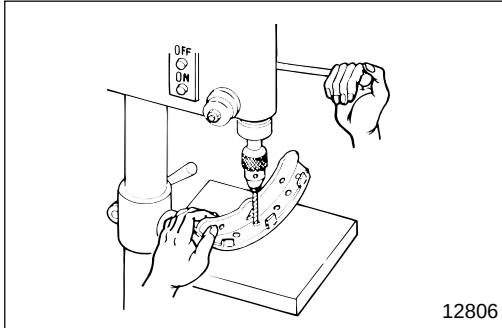
[Inspection]

If thickness **A** of brake lining **12** is lower than the limit replace the brake lining on the same axle as a unit.

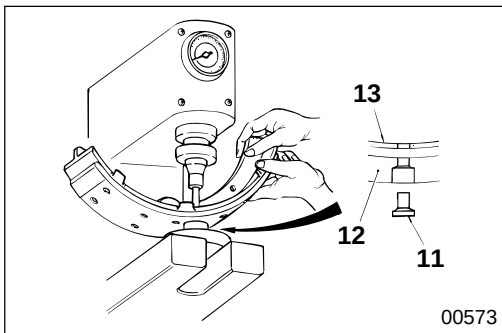


[Installation]

- Install brake shoe assembly **10**.
- Insert washer **9** with the side stamped "NUT 側" facing outside, screw down holder pin nut **8** until washer hits stepped area **B** of holder pin **20** gently, then slacken off the nut within the 0 to 60° limit until the nut is aligned with the first split pin hole.
- Insert split pin **7**, and bend it securely.

**12 Brake lining**

[Removal]



[Installation]

- Clean the mounting surfaces of brake lining **12** and brake shoe **13** with cleaning fluid and dry them.
- Insert rivets **11** from brake lining **12** side, and caulk the rivets at the specified load so that there is no clearance between brake shoe **13** and the brake lining.

Caulking load for rivets : 17 to 19 kN {3750 to 4190 lbf, 1700 to 1900 kgf}

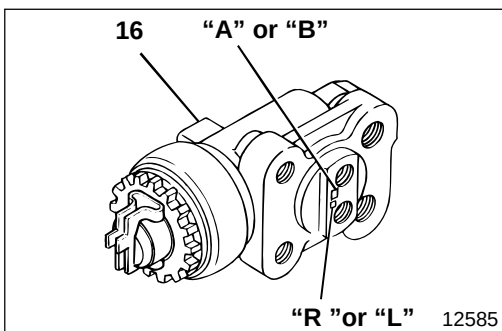
- Make sure that you inspect contact with the inner surface of brake drum * after you replace brake linings **12**. If contact is incorrect, correct with the brake assembled.

WARNING ⚠

Do not leave lubricant on the surface of brake lining **12** because this reduces braking performance.

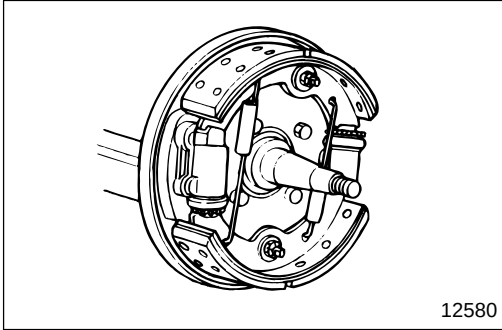
CAUTION ⚠

Make sure that the type of brake linings **12** you fit are suitable for the intended use of the vehicle. Make sure that you fit identical size and color coated linings on the left and right sides of one shaft.

**16 Installation of wheel cylinder assembly**

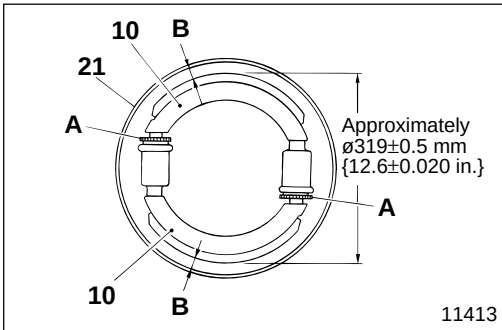
Identification mark	Installation position
RA	Front of front axle right wheel
RB	Rear of front axle right wheel
LA	Front of front axle left wheel
LB	Rear of front axle left wheel

FRONT WHEEL BRAKE

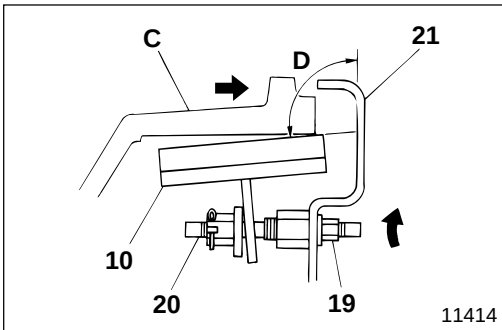


20 Adjustment of holder pin

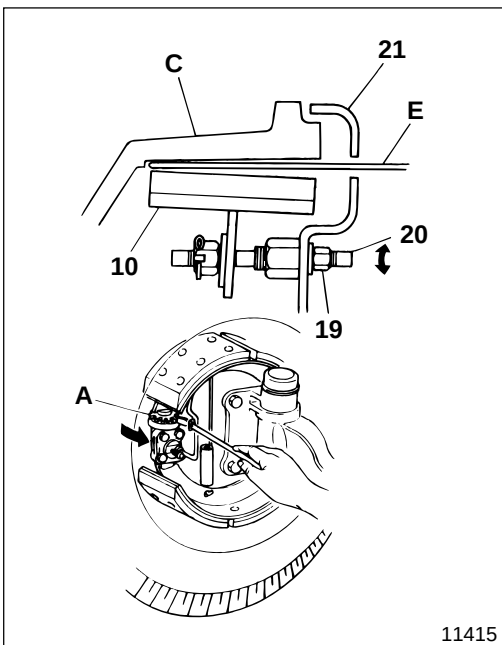
- Install the front wheel brake assembly on the front axle. Gr 26



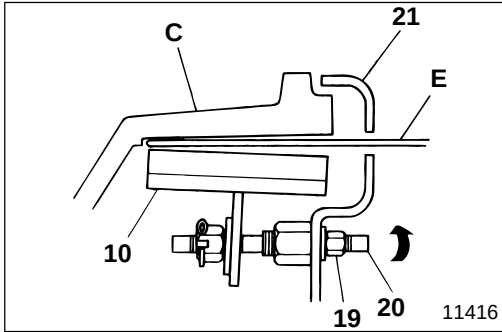
- Turn adjuster **A** to adjust the outer diameter to approximately $\varnothing 319 \pm 0.5 \text{ mm}$ {12.6±0.020 in.}.
- Then, move brake shoe assembly **10** to adjust clearance **B** evenly.



- Install hub and drum assembly **C** on the front wheel brake assembly. Gr 26
At this time, the hub and drum assembly cannot be inserted in the specified position if squareness **D** is 90° or more, so loosen nut **19** and turn holder pin **20** to adjust the squareness to as close to 90° as possible.
- Bleed the brake system. P35-32



- ★ Turn adjuster **A** to widen brake shoe assembly **10** until 0.2 mm {0.0079 in.} feeler gauge **E** cannot be pulled out easily.
- ★ Loosen nut **19** and turn holder pin **20** to the right or left so that feeler gauge **E** can be pushed in or pulled out easily.
- Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.
- Depress the brake pedal a few times lightly to equalize clearance **B** (adjusted in the previous section).
- Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.



- If feeler gauge **E** cannot be pushed in or pulled out easily it is because it is making contact over the full width of brake shoe assembly **10**.
- Turn holder pin **20** so that when you pull out feeler gauge **E**, in the above condition, and reinsert the feeler gauge, pushing in or pulling out the feeler gauge at the rear is difficult.
- After adjustment, tighten nut **19** at specified torque.

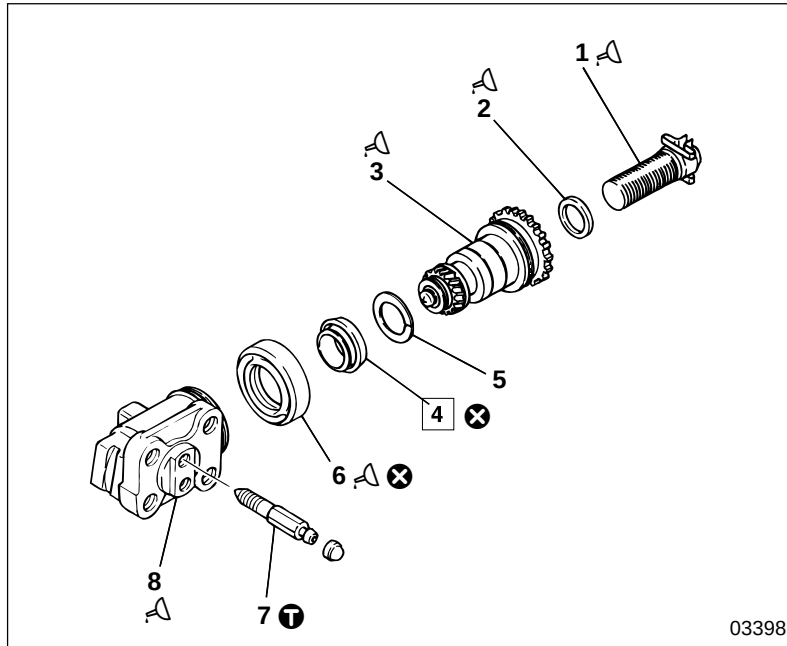


Correction of brake drum

If the cylindrical accuracy of brake drum ***** is higher than the limit, or there are seams, correct by machining to the correction limit. Machining of the brake drum should be done with the wheel hub attached as an integral part.

FRONT WHEEL BRAKE

Wheel Cylinder Assembly



● Disassembly sequence

- 1 Screw
- 2 Seal
- 3 Piston
- 4 Piston cup
- 5 Backup ring
- 6 Boot
- 7 Air bleeder (only at the rear)
- 8 Body

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3, 8	Clearance between piston and body	[34.93] 0.03 to 0.09 {[1.38] 0.0012 to 0.0035}	0.2 {0.0079}	Replace piston

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

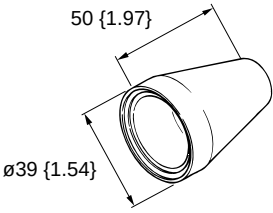
Location	Parts to be tightened	Tightening torque	Remarks
7	Air bleeder	9.8±2.0 {7.2±1.4, 1.0±0.2}	—

L Lubricant

Location	Points of application	Kinds	Quantity
1, 2, 3, 6, 8	Thread area of screw, outer periphery of seal, outer periphery of piston, mounting groove and thread area of boot, and inner surface of body	Rubber grease	As required

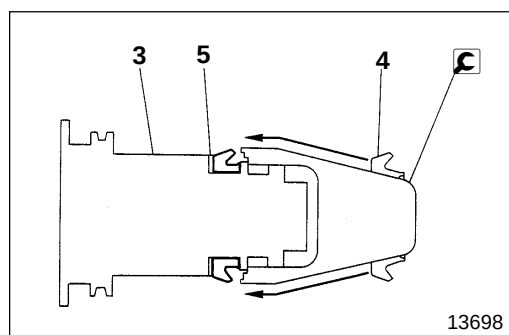
 Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
4	Piston cup guide  13697	MC895722	Installation of piston cup

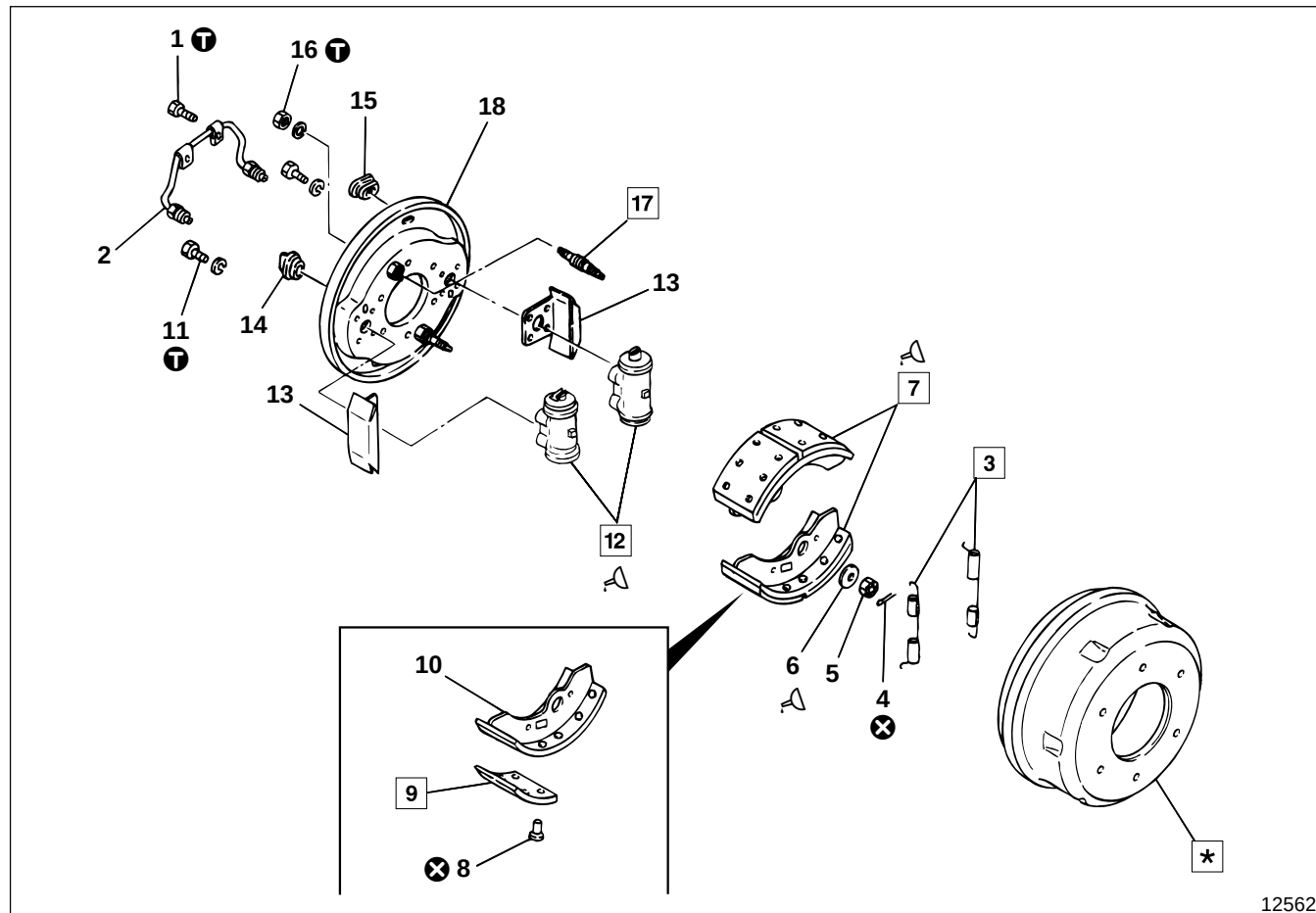
◆ **Service procedure**

4 Installation of piston cup



REAR WHEEL BRAKE

Rear Wheel Brake Assembly



12562

● Disassembly sequence

- | | | |
|-----------------------|----------------------------|------------------------|
| 1 Bolt | 8 Rivet | 14 Adjusting hole plug |
| 2 Pipe assembly | 9 Brake lining | 15 Check hole plug |
| 3 Return spring | 10 Brake shoe | 16 Nut |
| 4 Split pin | 11 Bolt | 17 Holder pin |
| 5 Holder pin nut | 12 Wheel cylinder assembly | 18 Backing plate |
| 6 Washer | ⓘ P35-70 | |
| 7 Brake shoe assembly | 13 Wheel cylinder cover | ⊗ : Non-reusable parts |
| | | * : Brake drum ⓘ Gr 27 |

WARNING ⚠

Do not leave grease or oil on the surface of brake lining 9 or inner surface of brake drum * because this reduces braking performance.

CAUTION ⚠

Do not turn or remove holder pin 17 unless it is necessary, or the squareness of brake shoe assembly can be influenced causing brake drag.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Brake lining kit

● Initial adjustment of brake shoe clearance after installation

ⓘ P35-65

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
3	Return spring load (Installed length 217 {8.54})		390 N {88 lbf, 40 kgf}		Clearance between coils or coil and cover	Replace
9	Brake lining thickness		12.0 {0.47}		5.0 {0.20} (Side shoulder means wear limit)	Replace lining
*	Brake drum	Inner diameter	320 {12.5}	*321 {12.64}	322 {12.68}	Replace
		Cylindrical accuracy	0.05 {0.0020}		0.2 {0.0079}	Correct or replace

* : Indicates correction limit.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Pipe clamp mounting)	4.9±1.0 {3.6±0.7, 0.5±0.1}	—
2	Flair nut (Pipe assembly mounting)	14±2.0 {10±1.4, 1.4±0.2}	—
11	Bolt (Wheel cylinder assembly mounting)	78±16 {58±12, 8.0±1.6}	—
16	Nut (Holder pin mounting)	29±5.9 {22±4.3, 3.0±0.6}	—

L Lubricant

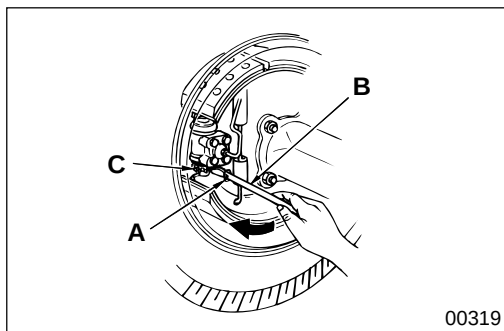
Location	Points of application	Kinds	Quantity
6, 7, 12	Contact areas between washer and brake shoe assembly; and between brake shoe assembly and wheel cylinder assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure**● Initial adjustment of brake shoe clearance after installation**

- Jack up the front wheels, and make sure that there is no play in the hub bearings.
- Insert screwdriver **B** into adjusting hole **A** and turn adjuster **C** in the direction of the arrow marked on the back plate until the wheel drags slightly when turned by hand.

NOTE

- Be sure to adjust the clearance at two points for each wheel per side.
- The arrow mark on backing plate 18 is near adjusting hole A.



REAR WHEEL BRAKE

- After depressing the brake pedal several times, release it and make sure that the wheel drags lightly when turned by hand. If the wheel turns without stress, repeat the above steps. Slacken off adjuster **B**, in the reverse direction to the arrow mark, by eight or nine notches.

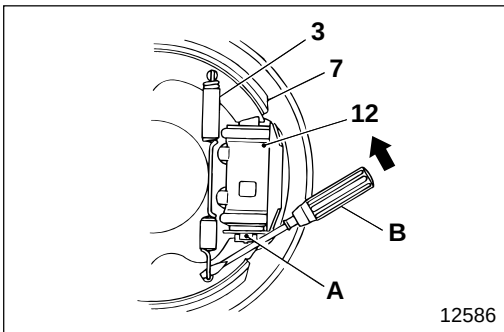
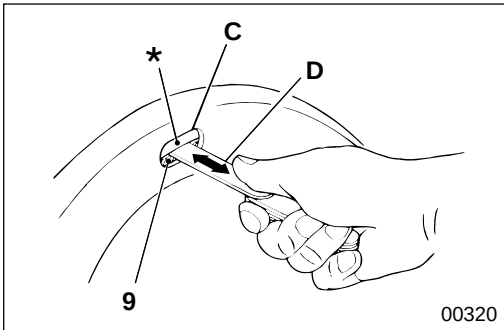
NOTE

Be sure to adjust the clearance at two points for each wheel per side.

- Make sure that the wheel does not drag when turned by hand. If the wheel drags, repeat the above steps.
- Insert feeler gauge **D** between brake drum ***** and lining **9** through check hole **C**, and make sure that a little resistance is felt when the feeler gauge is pulled out or pushed in.

NOTE

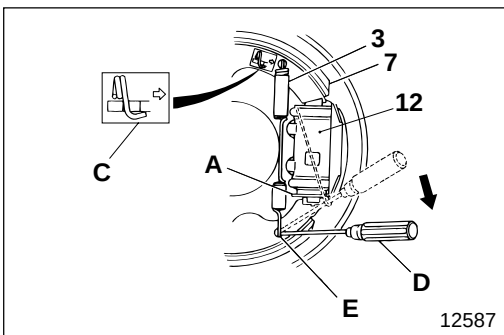
Be sure to adjust the clearance at two points for each wheel per side.



3 Return Spring

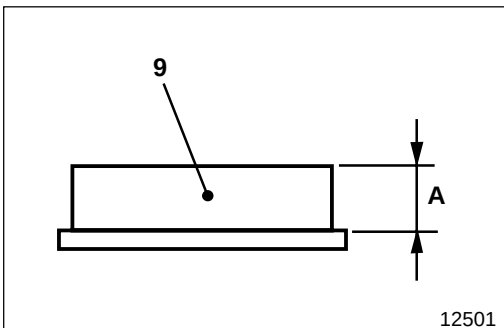
[Removal]

To remove return spring **3**, place screwdriver **B** on the hook of the return spring, then pry and remove the return spring making use of wheel cylinder assembly **12** adjuster **A** as a fulcrum.



[Installation]

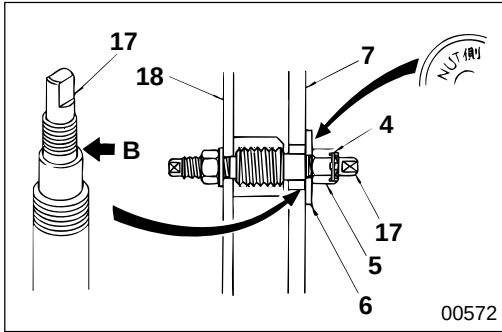
- Refer to the illustration on the caution plate fitted to brake shoe assembly **7** or marking **C**, and connect shorter hook end of return spring **3** to the brake shoe assembly at the side opposite the adjuster of wheel cylinder assembly **12**.
- Insert a small Phillips screwdriver **D** into the hook of return spring **3**, insert the tip of the screwdriver into return spring installation hole **E** of brake shoe assembly **7** to pry on the return spring.



7 Brake shoe assembly

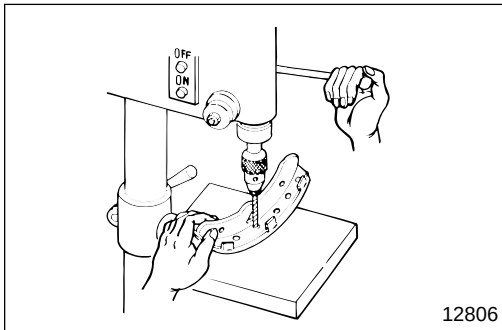
[Inspection]

If thickness **A** of brake lining **9** is lower than the limit replace the brake lining on the same axle as a unit.

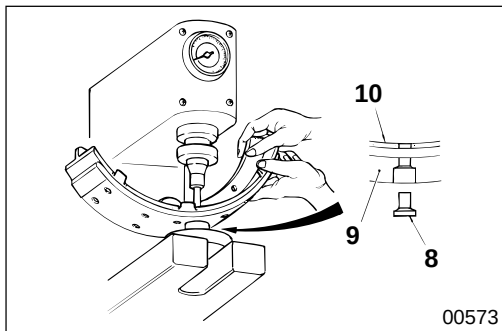


[Installation]

- Install brake shoe assembly 7.
- Insert washer 6 with the side stamped "NUT 側" facing outside, screw down holder pin nut 5 until washer hits stepped area B of holder pin 17 gently, then slacken off the nut within the 0 to 60° limit until the nut is aligned with the first split pin hole.
- Insert split pin 4, and bend it securely.

**9 Brake lining**

[Removal]



[Installation]

- Clean the mounting surfaces of brake lining 9 and brake shoe 10 with cleaning fluid and dry them.
- Insert rivets 8 from brake lining 9 side, and caulk the rivets at the specified load so that there is no clearance between brake shoe 10 and the brake lining.

Caulking load for rivets : 17 to 19 kN {3750 to 4190 lbf, 1700 to 1900 kgf}

- Make sure that you inspect contact with the inner surface of brake drum ★ after you replace brake linings 9. If contact is incorrect, correct with the brake assembled.

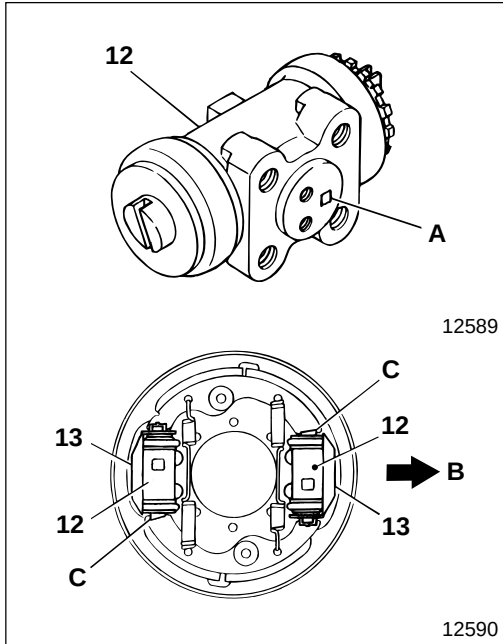
WARNING ⚠

Do not leave lubricant on the surface of brake lining 9 because this reduces braking performance.

CAUTION ⚠

Make sure that the type of brake linings 9 you fit are suitable for the intended use of the vehicle. Make sure that you fit identical size and color coated linings on the left and right sides of one shaft.

REAR WHEEL BRAKE



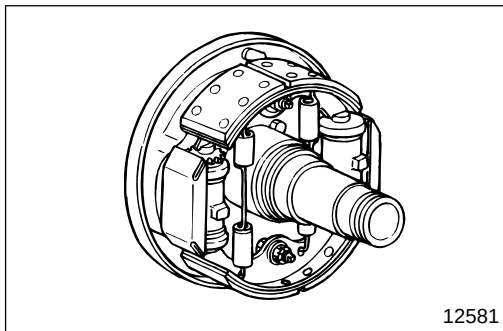
12 Installation of wheel cylinder assembly

A : Identification mark

Identification mark	Installation position
R	Right wheel forward
L	Left wheel forward
No mark	Left and right wheel rearward

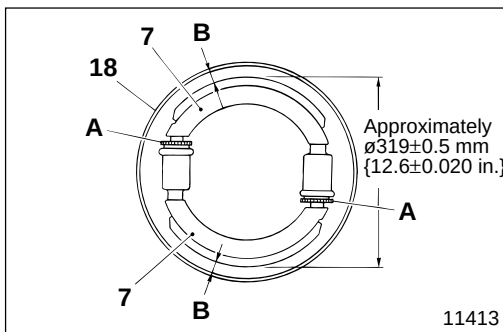
- Install anchor piece **C** so its recession is at the deeper side of the brake shoe at the outside.

B : Front of the vehicle

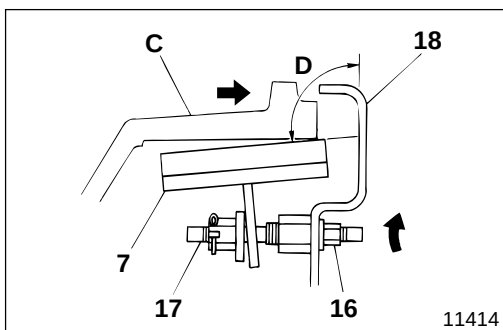


17 Adjustment of holder pin

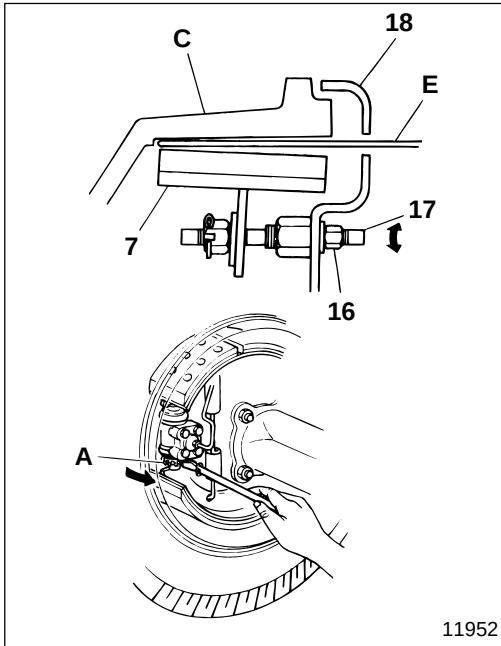
- Install the rear wheel brake assembly on the rear axle. Gr 27



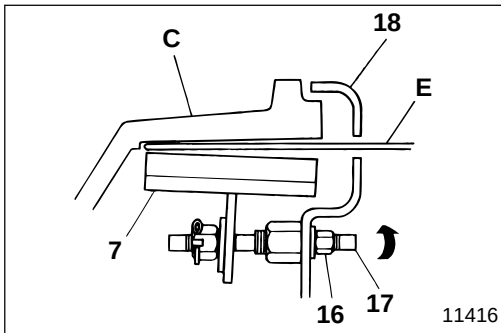
- Turn adjuster **A** to adjust the outer diameter to approximately $\varnothing 319 \pm 0.5 \text{ mm}$ {12.6±0.020 in.}.
- Then, move brake shoe assembly **7** to adjust clearance **B** evenly.



- Install hub and drum assembly **C** on the rear wheel brake assembly. Gr 27
At this time, the hub and drum assembly cannot be inserted in the specified position if squareness **D** is 90° or more, so loosen nut **16** and turn holder pin **17** to adjust the squareness to as close to 90° as possible.
- Bleed the brake system. P35-32



- ★ • Turn adjuster **A** to widen brake shoe assembly **7** until 0.2 mm {0.0079 in.} feeler gauge **E** cannot be pulled out easily.
- ★ • Loosen nut **16** and turn holder pin **17** to the right or left so that feeler gauge **E** can be pushed in or pulled out easily.
 - Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.
 - Depress the brake pedal a few times lightly to equalize clearance **B** (adjusted in the previous section).
 - Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.



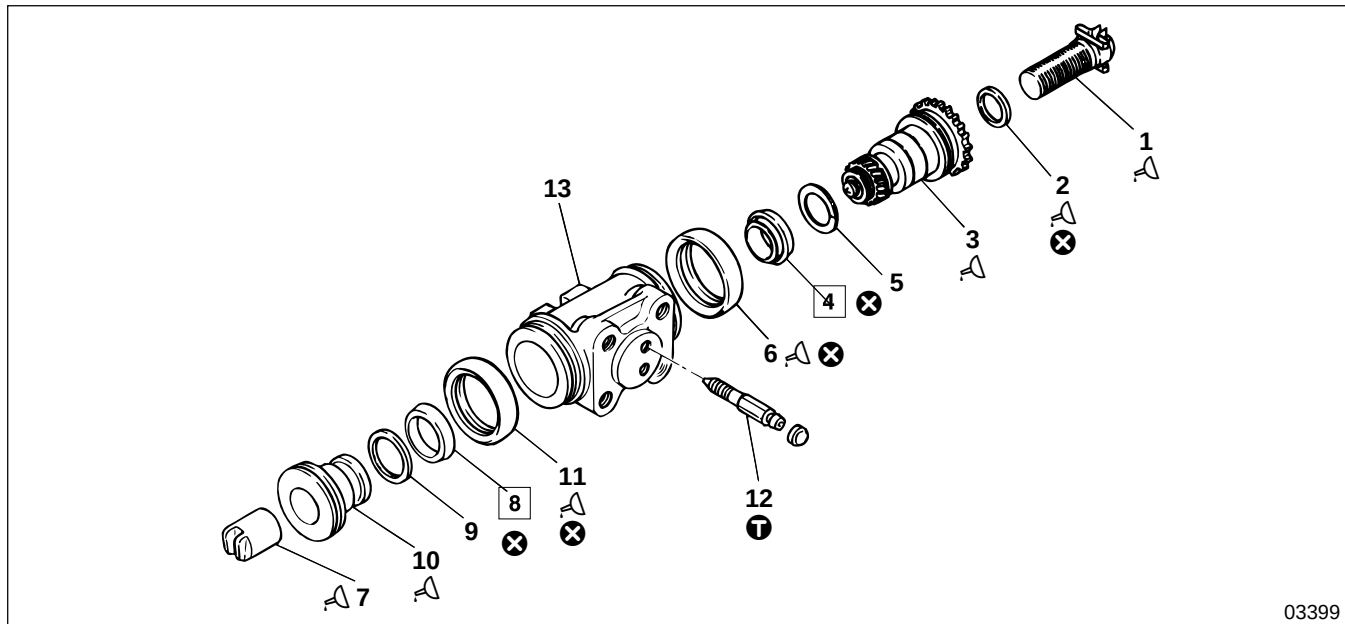
- If feeler gauge **E** cannot be pushed in or pulled out easily it is because it is making contact over the full width of brake shoe assembly **7**.
- Turn holder pin **17** so that when you pull out feeler gauge **E**, in the above condition, and reinsert the feeler gauge, pushing in or pulling out the feeler gauge at the rear is difficult.
- After adjustment, tighten nut **16** at specified torque.

★ Correction of brake drum

If the cylindrical accuracy of brake drum ★ is higher than the limit, or there are seams, correct by machining to the correction limit. Machining of the brake drum should be done with the wheel hub attached as an integral part.

REAR WHEEL BRAKE

Wheel Cylinder Assembly



03399

Disassembly sequence

- | | | |
|---------------|----------------|----------------------------------|
| 1 Screw | 7 Anchor piece | 12 Air bleeder |
| 2 Seal | 8 Piston cup | (Only identification marks L, R) |
| 3 Piston | 9 Backup ring | 13 Body |
| 4 Piston cup | 10 Piston | |
| 5 Backup ring | 11 Boot | |
| 6 Boot | | |
- ⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3, 10, 13	Clearance between piston and body	[36.51] 0.03 to 0.09 {[1.44] 0.0012 to 0.0035}	0.2 {0.0079}	Replace piston

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

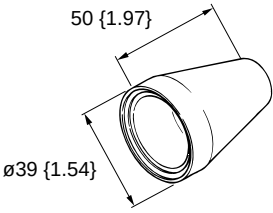
Location	Parts to be tightened	Tightening torque	Remarks
12	Air bleeder	9.8±2.0 {7.2±1.4, 1.0±0.2}	—

Lubricant

Location	Points of application	Kinds	Quantity
1, 2, 3, 6, 10, 11	Thread area of screw, outer periphery of seal, outer periphery of piston, mounting groove and thread area of boot, and inner surface of body	Rubber grease	As required
7	Bottom surface of anchor piece	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

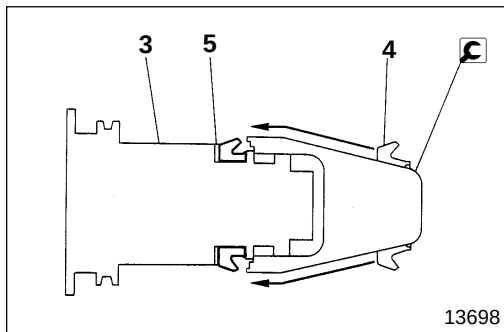
Special tools

Unit : mm {in.}

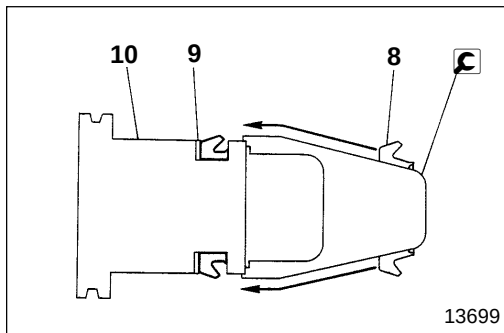
Location	Tool name and shape	Part No.	Application
4, 8	Piston cup guide  13697	MC895722	Installation of piston cup

Service procedure

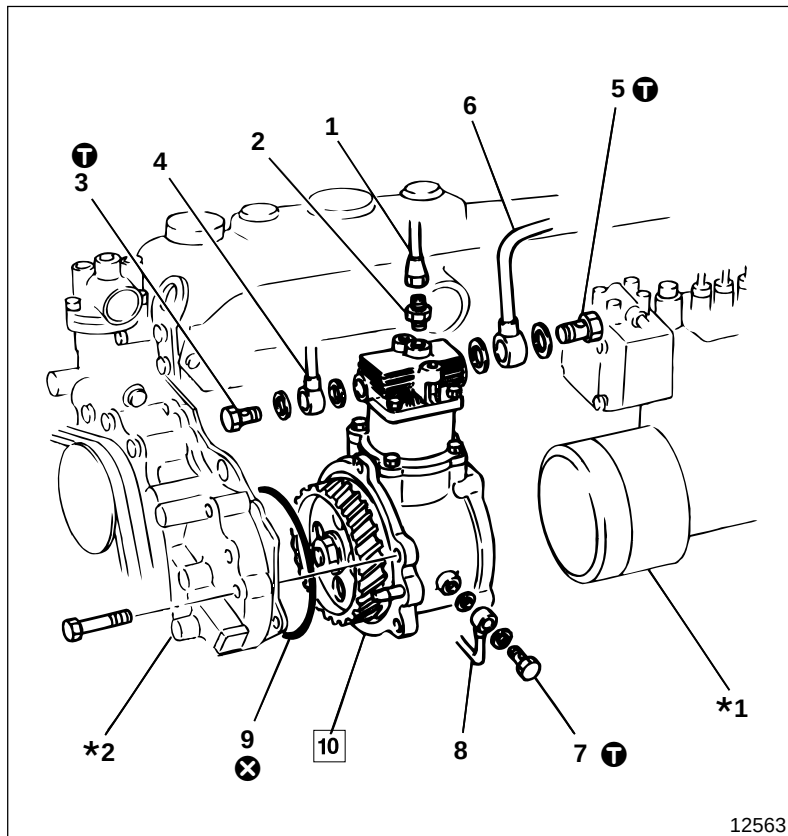
4 Installation of piston cup



8 Installation of piston cup



AIR COMPRESSOR



● Removal sequence

- 1 Unloader pipe
- 2 Connector
- 3 Eye bolt
- 4 Air outlet pipe
- 5 Eye bolt
- 6 Air inlet pipe
- 7 Eye bolt
- 8 Oil pipe
- 9 O-ring
- 10 Air compressor assembly (P35-74)

*1 : Injection pump assembly (Gr 13)

*2 : Timing gear case

⊗ : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

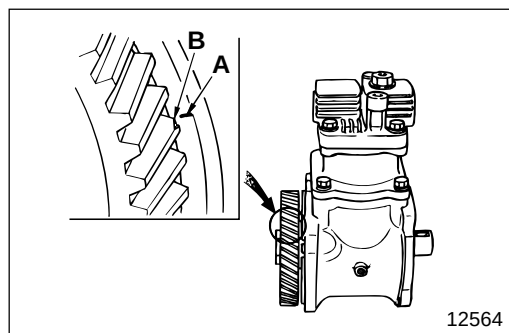
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Eye bolt	98 {72, 10}	—
5	Eye bolt	98 {72, 10}	—
7	Eye bolt	21 {15, 2.1}	—

◆ Service procedure

10 Installation of air compressor assembly

- Position No.1 cylinder of the engine at top dead center in the compression cycle. (Gr 11)
- Align marking line **A** with notch **B**, then install air compressor assembly **10** on timing gear case ***2**.



MEMO

This diagram illustrates the exploded view of a mechanical assembly, likely a pump or motor component. The parts are numbered 1 through 47, and their assembly sequence is indicated by symbols: a circle with a cross (X) for insertion, a circle with a dot (T) for tightening, and a circle with a triangle (Δ) for alignment. The assembly is shown in a disassembled state, with components arranged in a logical sequence from top to bottom. Key components include a central housing (30), a base (47), a gear (4), and various internal parts like bearings (11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26), seals (31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46), and fasteners (5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47). The diagram is a technical drawing with clear lines and labels, typical of a service manual.

● Disassembly sequence

1 Nut	18 Suction valve	35 Retaining ring
2 Lock washer	19 Suction valve seat	36 Piston pin
3 Drive gear	20 Packing	37 Piston
4 Collar	21 Delivery valve seat	38 Nut
5 Bolt	22 Packing	39 Lock washer
6 O-ring	23 Delivery valve	40 Connecting rod
7 Oil seal	24 Delivery valve spring	41 Bearing
8 Bearing holder	25 Delivery valve holder	42 Bolt
9 Bolt	26 Packing	43 Connecting rod cap
10 Cylinder head assembly	27 Cylinder head	44 Sleeve
11 Connector	28 Bolt	45 Bearing
12 Packing	29 O-ring	46 Crankshaft
13 O-ring	30 Cylinder liner	47 Crankcase
14 Unloader valve	31 1st compression ring	
15 Unloader valve spring	32 2nd compression ring	⊗ : Non-reusable parts
16 Suction valve holder	33 3rd compression ring	
17 Suction valve spring	34 Oil ring	

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Piston ring kit

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
17	Suction valve spring load (Installed length 7 {0.28})		1.3 N {0.3 lbf, 0.13 kgf}	0.98 N {0.2 lbf, 0.1 kgf}	Replace
24	Delivery valve spring load (Installed length 11.5 {0.45})		2.9 N {0.7 lbf, 0.3 kgf}	1.5 N {0.3 lbf, 0.15 kgf}	Replace
30, 37	Clearance between piston and cylinder liner	Top	[70] {0.22 to 0.28 {[2.76] 0.0087 to 0.011}}	0.32 {0.013}	Replace cylinder liner
		Skirt	[70] {0.13 to 0.18 {[2.76] 0.0051 to 0.0071}}	0.22 {0.0087}	
31 to 34	Clearance of piston ring gap (Measure at interior of cylinder liner)	Compression ring	—	0.8 {0.031}	Replace piston ring kit
		Oil ring	—	0.8 {0.031}	
31 to 34, 37	Clearance between piston ring and piston ring groove	Compression ring	—	0.07 {0.0028}	Replace piston ring kit
		Oil ring	—	0.07 {0.0028}	
36, 37	Clearance between piston pin and piston		[6] {[0.63]}	0.08 {0.0031}	Replace piston pin
36, 40	Clearance between piston pin and connecting rod small end		[6] {[0.63]}	0.07 {0.0028}	Replace connecting rod
40, 43, 46	End play of connecting rod		—	0.5 {0.020}	Replace
41, 46	Clearance between crankshaft and connecting rod bearing		[34] {[1.34]}	0.1 {0.0039}	Replace
46, 47	End play of crankshaft		—	1.0 {0.0039}	Replace

AIR COMPRESSOR

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

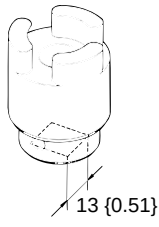
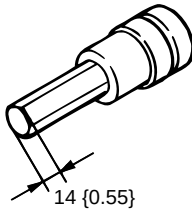
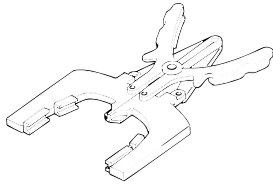
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Drive gear mounting)	166.7 to 210.8 {120 to 155, 17.0 to 21.5}	—
5	Bolt (Bearing holder mounting)	13.7 to 17.7 {10 to 13, 1.4 to 1.8}	—
9	Bolt (Cylinder head assembly mounting)	24.5 to 29.4 {18 to 22, 2.5 to 3.0}	—
11	Connector	29.4 to 34.3 {22 to 25, 3.0 to 3.5}	—
16	Suction valve holder	117.7 to 127.5 {87 to 94, 12 to 13}	—
21	Delivery valve seat	117.7 to 127.5 {87 to 94, 12 to 13}	—
28	Bolt (Cylinder liner mounting)	24.5 to 29.4 {18 to 22, 2.5 to 3.0}	—
38	Nut (Connecting rod mounting)	22.6 to 25.5 {17 to 19, 2.3 to 2.6}	—

Lubricant and sealant

Location	Points of application	Kinds	Quantity
7	Oil seal lip	Engine oil	As required
13	O-ring	Silicon grease	As required
16	Thread area of suction valve holder	THREEBOND 1360	As required
21	Thread area of delivery valve seat	THREEBOND 1360	As required

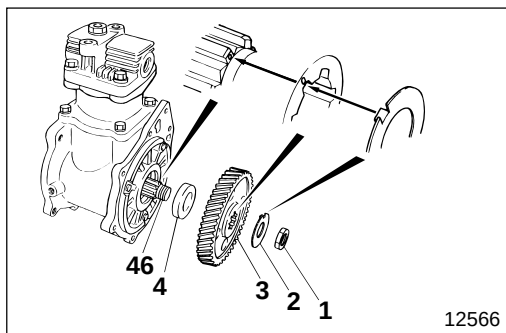
Special tools

Unit : mm {in.}

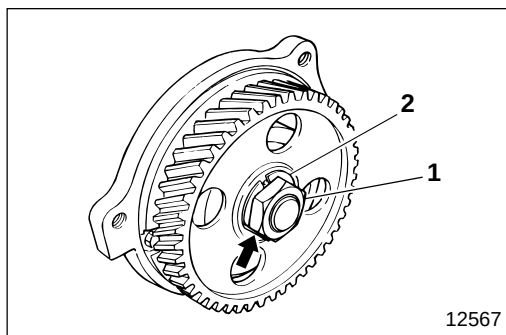
Location	Tool name and shape	Part No.	Application
16	Suction valve tool  01730	MH061984	Removal and installation of suction valve holder
21	Delivery valve tool  01731	MH061595	Removal and installation of delivery valve seat
31 to 34	Piston ring tool  01732	MH060014	Removal and installation of piston ring (Compression ring and oil ring)

◆ Service procedure

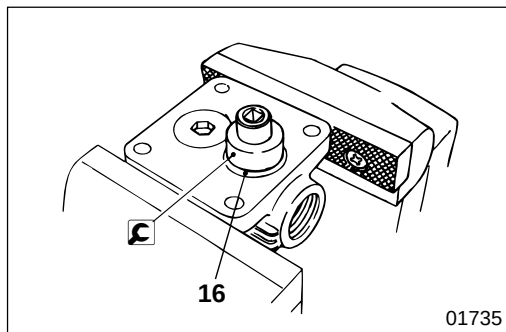
2 3 Installation of lock washer and drive gear



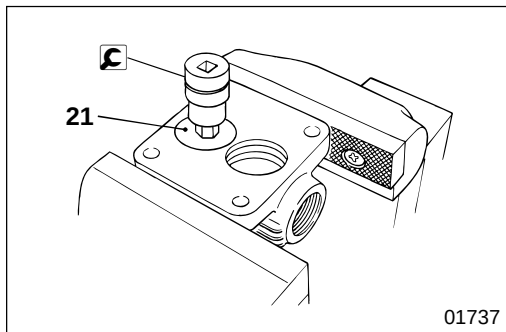
After installation, bend lock washer **2** to nut **1** side.



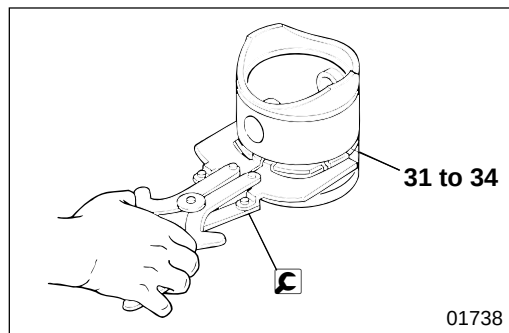
16 Removal and installation of suction valve holder



21 Removal and installation of delivery valve seat

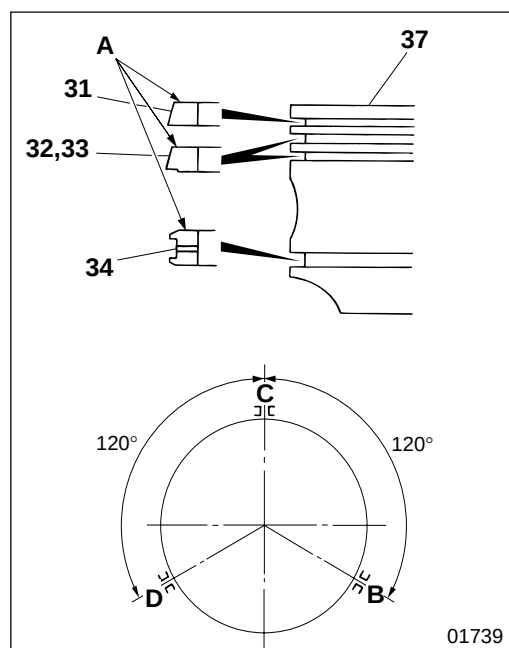


AIR COMPRESSOR



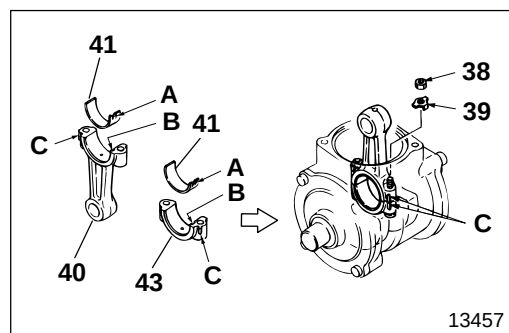
31 to 34 Piston ring (Compression ring and oil ring)

[Removal and installation]



[Installation position]

- A : Stamped area
- B : 1st compression ring split 31
- C : 2nd compression ring split 32
- D : 3rd compression ring split 33

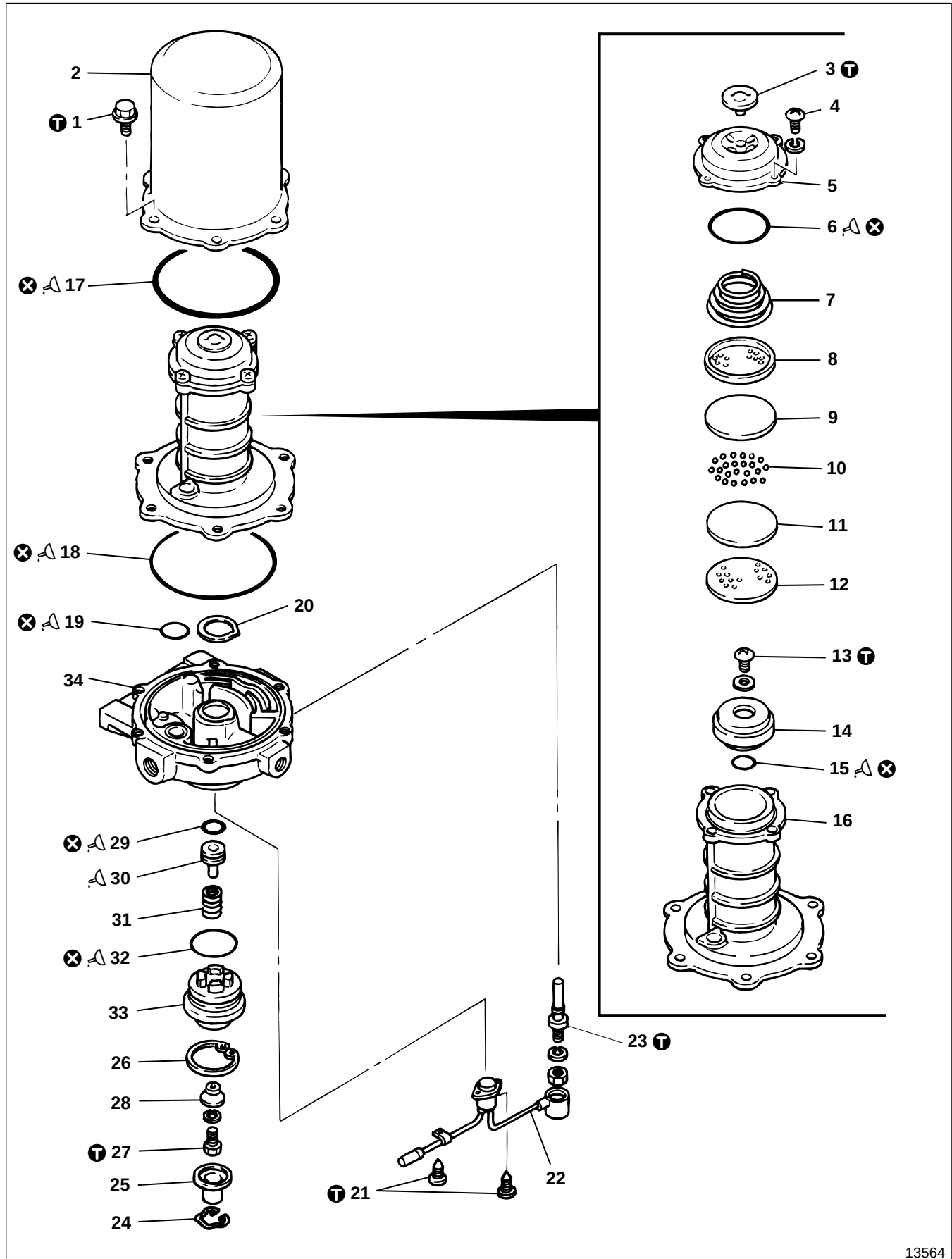


40 41 43 Installation of connecting rod, bearing and connecting rod cap

- A : Lug
- B : Notch
- C : Alignment marks

MEMO

AIR DRYER



● Disassembly sequence

1 Bolt	13 Screw	25 Exhaust cover
2 Purge chamber	14 Oil filter	26 Retaining ring
3 Screw	15 O-ring	27 Bolt
4 Check valve	16 Case	28 Valve assembly
5 Case cover	17 O-ring	29 O-ring
6 O-ring	18 O-ring	30 Piston
7 Set spring	19 O-ring	31 Valve spring
8 Filter plate	20 Gasket	32 O-ring
9 Filter	21 Screw	33 Valve body
10 Desiccant	22 Thermostat assembly  Gr 54	34 Body
11 Filter	23 Heater  Gr 54	
12 Filter plate	24 Stopper ring	⊗ : Non-reusable parts

CAUTION

Clean disassembled parts thoroughly, except for rubber parts and desiccant 10, with clean wash oil, wipe off foreign particles and dry.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Air dryer kit

CAUTION

Make sure you install filters 9, 11, with their soft layer sides toward desiccant 10.

● Inspection after installation

 P35-82

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Purge chamber and body mounting)	8.8 to 14 {6.5 to 10, 0.9 to 1.4}	—
3	Screw (Case cover and case mounting)	0.8 to 1.0 {0.6 to 0.7, 0.08 to 0.1}	—
13	Screw (Oil filter mounting)	0.8 to 1.0 {0.6 to 0.7, 0.08 to 0.1}	—
21	Screw (Thermostat assembly mounting)	0.8 to 1.0 {0.6 to 0.7, 0.08 to 0.1}	—
23	Heater	20 to 29 {14 to 22, 2 to 3}	—
27	Bolt (Valve assembly mounting)	3.9 to 6.9 {2.9 to 5.1, 0.4 to 0.7}	—

Lubricant

Location	Points of application	Kinds	Quantity
6, 15, 17 to 19, 29, 30, 32	Friction surfaces of O-ring and piston	Multipurpose grease [NLGI No. 2 (Li soap)]	As required

AIR DRYER

◆ Service procedure

● Inspection after installation

- Start the engine.
- Make sure that air is exhausted from the port of exhaust cover **25** when the air pressure reaches the specified level and the air compressor is switched to idling.

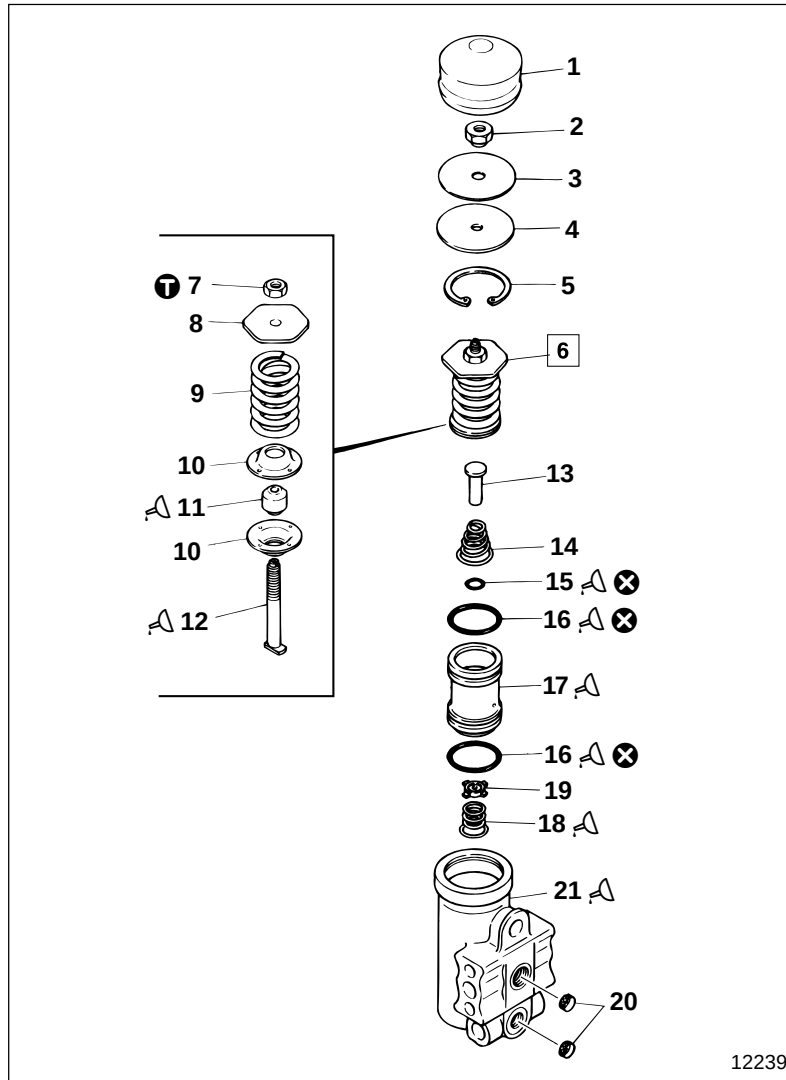
NOTE

If high air pressure is exhausted first and approximately three seconds later, you cannot hear an exhausting sound, do not worry, it is normal.

- Make sure that there is no air leakage from any piping connection.

MEMO

AIR PRESSURE GOVERNOR



Disassembly sequence

- 1 Cover
- 2 Nut
- 3 Plate
- 4 Seat
- 5 Retaining ring
- 6 Adjusting screw assembly
- 7 Lock nut
- 8 Upper spring seat
- 9 Spring
- 10 Lower spring seat
- 11 Spring guide
- 12 Adjusting screw
- 13 Exhaust stem
- 14 Exhaust stem spring
- 15 O-ring
- 16 O-ring
- 17 Piston
- 18 Valve spring
- 19 Valve
- 20 Filter
- 21 Body

⊗ : Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Air pressure governor kit

Inspection of function after assembly

📖 P35-85

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Specified pressure	High specified pressure	805^{+29}_{-20} kPa { $115^{+4.3}_{-2.8}$ lbf/in ² , $8.2^{+0.3}_{-0.2}$ kgf/cm ² }	—	Adjust
		Low specified pressure	685 ± 20 kPa { 100 ± 2.8 lbf/in ² , 7.0 ± 0.2 kgf/cm ² }		

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
7	Lock nut	3.9 to 6.9 {2.9 to 5.1, 0.4 to 0.7}	—

Lubricant

Location	Points of application	Kinds	Quantity
11	Surface of spring guide	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
12	Surface of adjusting screw, except for thread area	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
15, 16	Entire O-ring	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
17	Outer periphery of piston and O-ring groove	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
21	Interior of body	Multipurpose grease [NLGI No. 2 (Li soap)]	As required

◆ Service procedure

● Inspection of function after assembly

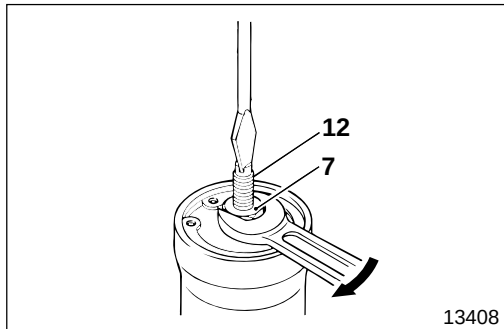
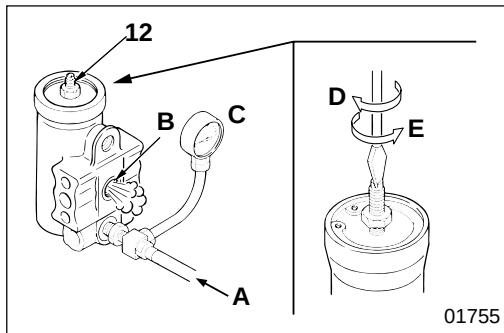
- Increase air pressure **A** gradually and read the value on air pressure gauge **C** when air is discharged from **B**. Adjust by turning adjusting screw **12** so that the reading conforms to the standard value (high specified-pressure).

D : Turning clockwise decreases the pressure

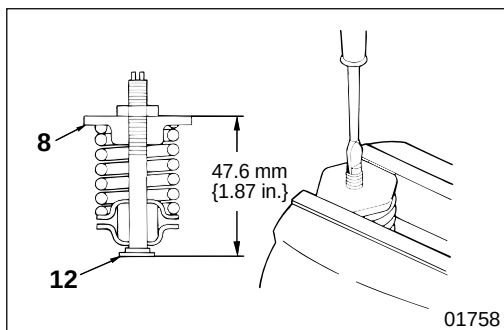
E : Turning counterclockwise increases the pressure

- Lower air pressure **A** to 685 kPa {100 lbf/in², 7 kgf/cm²} or less, then raise the air pressure gradually. Read air pressure gauge **C** when it stops and check that the value conforms to the standard value (high specified-pressure). If the value deviates from the standard value, readjust.

- Lower air pressure **A** gradually. When the discharge of air from **B** ceases, read air pressure gauge **C** to check that the valve conforms to the standard value (high specified-pressure). If the value deviates from the standard value, replace the air pressure governor assembly.



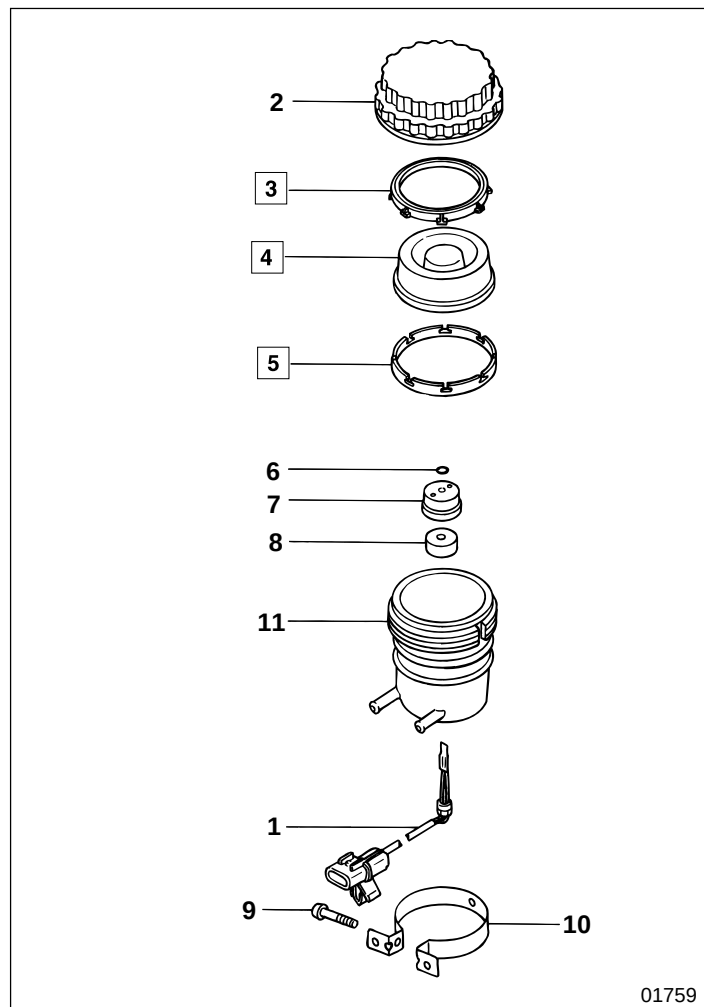
- After adjusting, tighten lock nut **7** to prevent adjusting screw **12** being turned accidentally.



6 Preliminary adjustment of adjusting screw assembly

It is recommended that you adjust the distance from the upper level of upper spring seat **8** to the lower level of adjusting screw **12** to 47.6 mm {1.87 in.} by turning the adjusting screw, because this makes adjustment to the specified value easier.

FLUID TANK



● Disassembly sequence

- 1 Brake fluid level switch  Gr 54
- 2 Cap
- 3 Slide ring
- 4 Diaphragm
- 5 Ring cover
- 6 Stopper ring
- 7 Float stopper
- 8 Float
- 9 Screw
- 10 Fluid tank bracket
- 11 Tank

● Assembly sequence

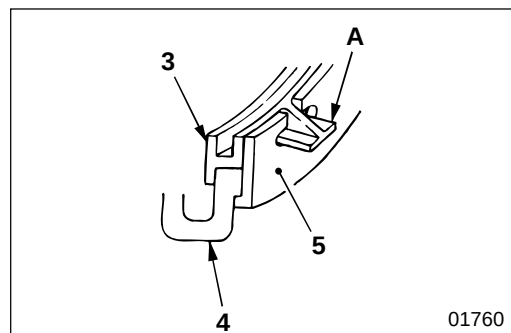
Follow the disassembly sequence in reverse.

01759

◆ Service procedure

3 to 5 Installation of slide ring, diaphragm and ring cover

Be sure to install claw **A** of slide ring **3** to ring cover **5** securely. Install diaphragm **4** in the direction as illustrated.

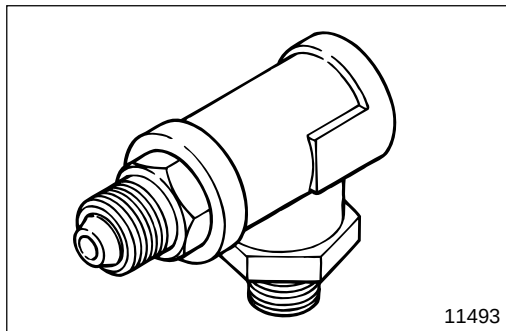


01760

CHECK VALVE/SAFETY VALVE

35

CHECK VALVE



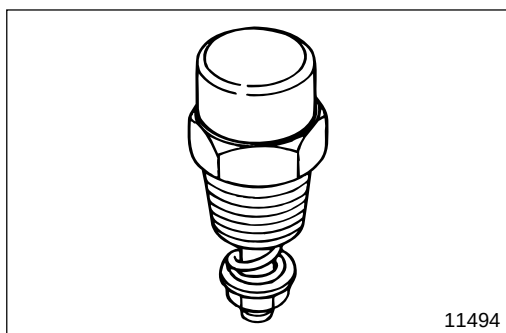
CAUTION

Do not disassemble this check valve because it is a unit construction.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Pressure difference between inlet and outlet	29 kPa {4.3 lbf/in ² , 0.3 kgf/cm ² } or less	—	Replace

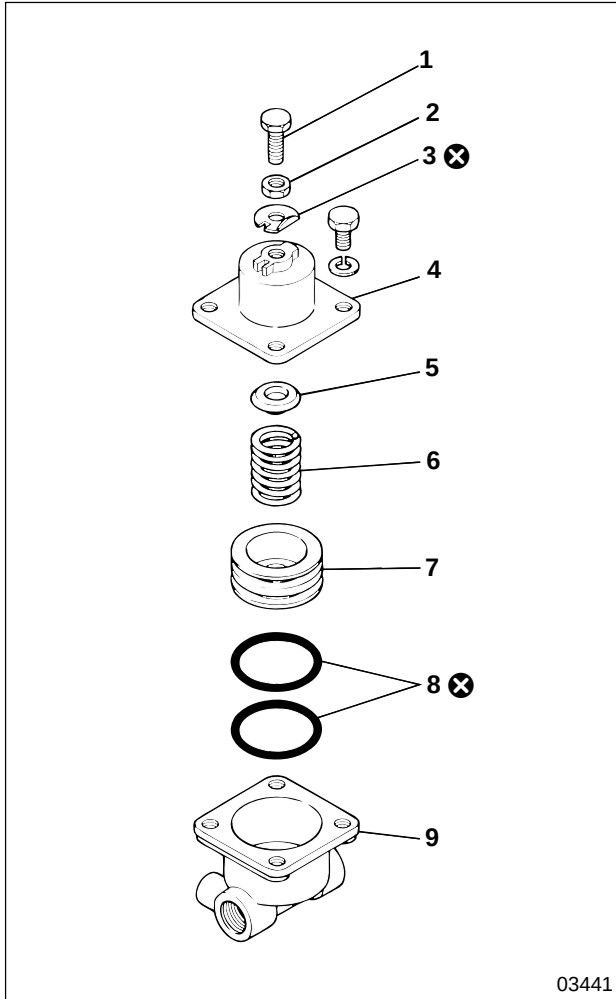
SAFETY VALVE



Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Release pressure of safety valve	950±20 kPa {135±2.8 lbf/in ² , 9.7±0.2 kgf/cm ² }	—	Replace

SUPPLY VALVE



03441

● Disassembly sequence

- 1 Adjusting bolt
- 2 Lock nut
- 3 Claw washer
- 4 Cap
- 5 Spring retainer
- 6 Spring
- 7 Piston
- 8 O-ring
- 9 Valve body

⊗ : Non-reusable parts

CAUTION ⚠

Make sure that adjusting bolt 1 is not turned except for adjustment.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection after assembly

📖 P35-88

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Specified pressure	Valve opening pressure	345±29 kPa {50±4.3 lbf/in ² , 3.5±0.3 kgf/cm ² }	—	Adjust or replace
		Valve closing pressure	315±20 kPa {46±2.8 lbf/in ² , 3.2±0.2 kgf/cm ² }	—	

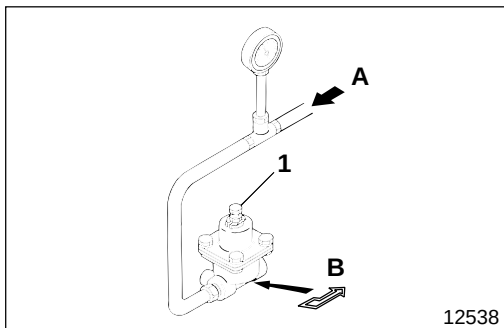
◆ Service procedure

● Inspection after assembly

Adjust by turning adjusting bolt 1 after loosening lock nut 2. After adjusting, tighten the lock nut without turning the adjusting bolt, and bend claw washer 3 to secure the lock nut.

- Adjust adjusting bolt 1 so that air is discharged from the outlet port (arrow mark **B** in the illustration), when valve opening pressure is applied to the inlet port (arrow mark **A** in the illustration).
- After adjusting valve opening pressure, adjust adjusting bolt 1 so that air is not discharged from the outlet port (arrow mark **B** in the illustration) when valve closing pressure is applied to the inlet port (arrow mark **A** in the illustration).

B : Arrow showing the air flow direction

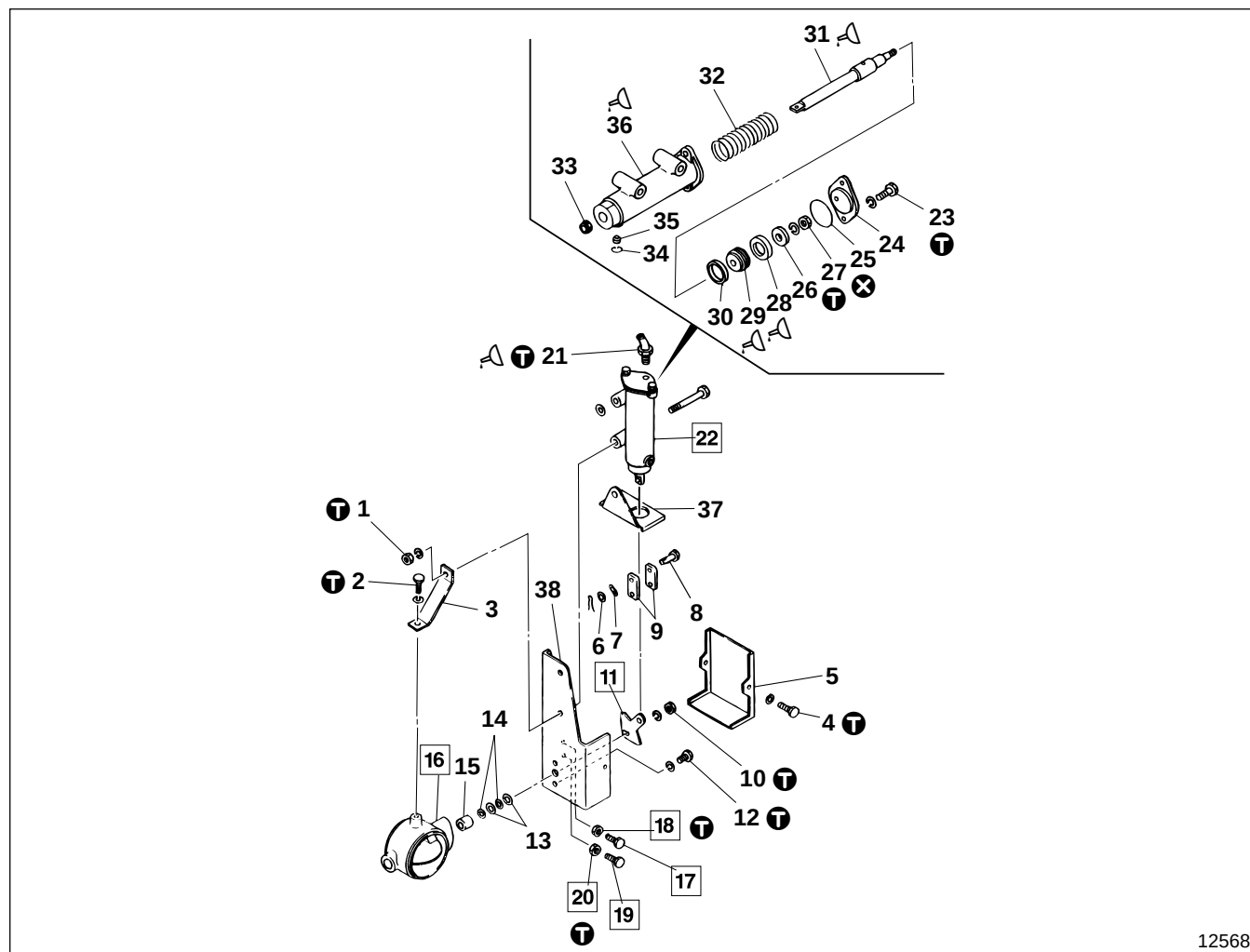


12538

MEMO

EXHAUST BRAKE SYSTEM

Exhaust Brake Unit



12568

● Disassembly sequence

- | | | |
|----------------------|---------------------|-------------------|
| 1 Nut | 15 Bushing | 29 Plate |
| 2 Bolt | 16 Valve assembly | 30 Wear ring |
| 3 Arm | 17 Adjusting bolt | 31 Shaft assembly |
| 4 Screw | 18 Lock nut | 32 Spring |
| 5 Cover | 19 Adjusting bolt | 33 Dust seal |
| 6 Plain washer | 20 Lock nut | 34 Retaining ring |
| 7 Wave washer | 21 Connector | 35 Filter |
| 8 Pin | 22 Control cylinder | 36 Cylinder |
| 9 Link | 23 Bolt | 37 Cover |
| 10 Nut | 24 Cover | 38 Plate |
| 11 Lever | 25 O-ring | |
| 12 Bolt | 26 Retainer | |
| 13 Seal ring (Large) | 27 Nut | |
| 14 Seal ring (Small) | 28 Packing | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
16	Clearance between butterfly valve and body; when butterfly valve of valve assembly is working (when air pressure 685 ± 49 kPa { 100 ± 7.1 lbf/in ² , 7 ± 0.5 kgf/cm ² } is applied to control cylinder)	0.4 to 0.6 {0.016 to 0.024}	—	Adjust
22	Airtightness of control cylinder (air leakage from various parts when subjected to air pressure of 980 kPa {140 lbf/in ² , 10 kgf/cm ² })	No leakage	—	Replace
32	Spring load (Installed length 109 {4.29})	72 N {16 lbf, 7.3 kgf}	61 N {14 lbf, 6.2 kgf}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Arm, plate, and control cylinder mounting)	21 to 25 {15 to 19, 2.1 to 2.6}	—
2	Bolt (Arm and valve assembly mounting)	9.8 to 16 {7.2 to 12, 1.0 to 1.6}	—
4	Screw (Cover and plate mounting)	4.9 to 6.9 {3.6 to 5.1, 0.5 to 0.7}	—
10	Nut (Valve assembly and spindle mounting)	9.8 to 16 {7.2 to 12, 1.0 to 1.6}	—
12	Bolt (Valve assembly body mounting)	9.8 to 16 {7.2 to 12, 1.0 to 1.6}	—
18, 20	Lock nut	4.9 to 6.9 {3.6 to 5.1, 0.5 to 0.7}	—
21	Connector	4.9 {3.6, 0.5} or more	—
23	Bolt (Cover mounting)	9.8 to 16 {7.2 to 12, 1.0 to 1.6}	—
27	Nut (Plate mounting)	9.8 to 16 {7.2 to 12, 1.0 to 1.6}	—

L Lubricant and sealant

Location	Points of application	Kinds	Quantity
21	Thread area of connector	THREEBOND No.1211	As required
28	Packing surface	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
29, 31	Mating surfaces of plate and shaft assembly	SANNOW KOGYO CO., HERMETIC GA	As required
31	ø12 mm {0.47 in.} area of shaft assembly	Multipurpose grease [NLGI No. 2 (Li soap)]	As required
36	Inside of cylinder	Multipurpose grease [NLGI No. 2 (Li soap)]	2 cm ³ {0.12 cu. in.}

EXHAUST BRAKE SYSTEM

Inspection and Adjustment of Exhaust Brake System

[Inspection]

Turn the exhaust brake switch ON, depress the accelerator pedal gradually, and make sure that when the engine revolution reaches 800 to 950 rpm the exhaust brake operation indicator lamp within the meter cluster goes out. If any fault is found, adjust accelerator switch **1**.

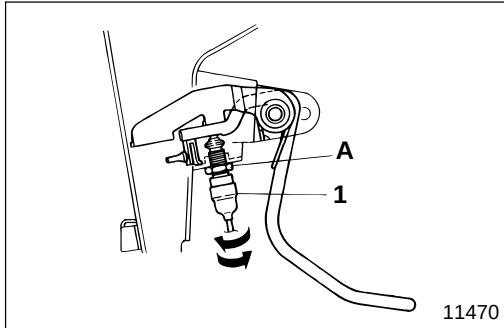
◆ Service procedure

1 Adjustment of accelerator switch

- Turn the exhaust brake switch ON while the engine is idling, depress the accelerator pedal gradually, and check the engine revolution when the exhaust brake operation indicator lamp within the meter cluster goes out.
- Turn accelerator switch **1** to adjust the engine revolution, referring to the following table:

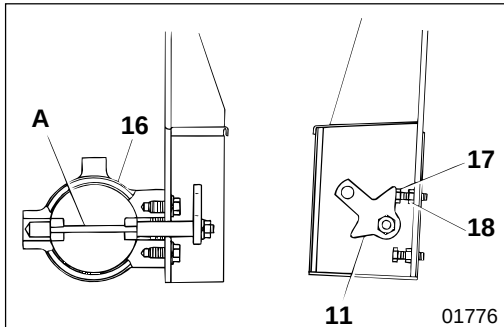
Confirmed engine revolution	Adjusting direction of accelerator switch 1
800 rpm or less	
950 rpm or more	

- After adjustment, tighten nut **A** to fix accelerator switch **1**.



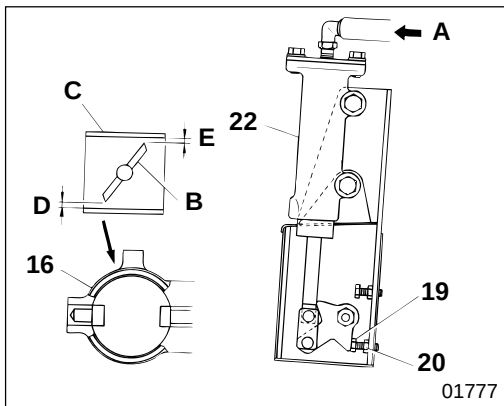
11 **16** to **18** Adjustment of fully opened position of butterfly valve of valve assembly

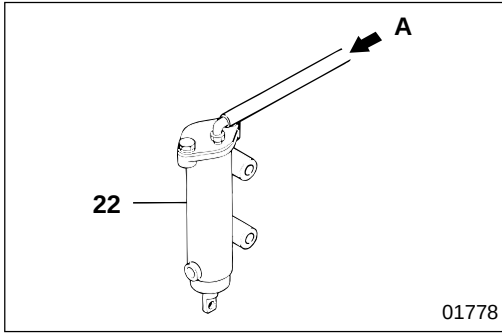
Turn adjusting bolt **17** so that its head is level with lever **11** (at this time, butterfly valve **A** of valve assembly **16** is fully open). Then, tighten lock nut **18** at specified torque.



16 **19** **20** **22** Adjustment of fully closed position of butterfly valve of valve assembly

- Supply air pressure **A** of 685 ± 49 kPa $\{100 \pm 7.1 \text{ lbf/in}^2, 7 \pm 0.5 \text{ kgf/cm}^2\}$ to control cylinder **22**, and turn adjusting bolt **19** (bolt for adjustment of fully closed position) so that the mean value of clearances **D** and **E** between butterfly valve **B** and body **C** conforms to the standard value.
- Calculate the mean value of clearances **D** and **E** by $(D+E)/2$.
- Tighten lock nut **20** at specified torque.



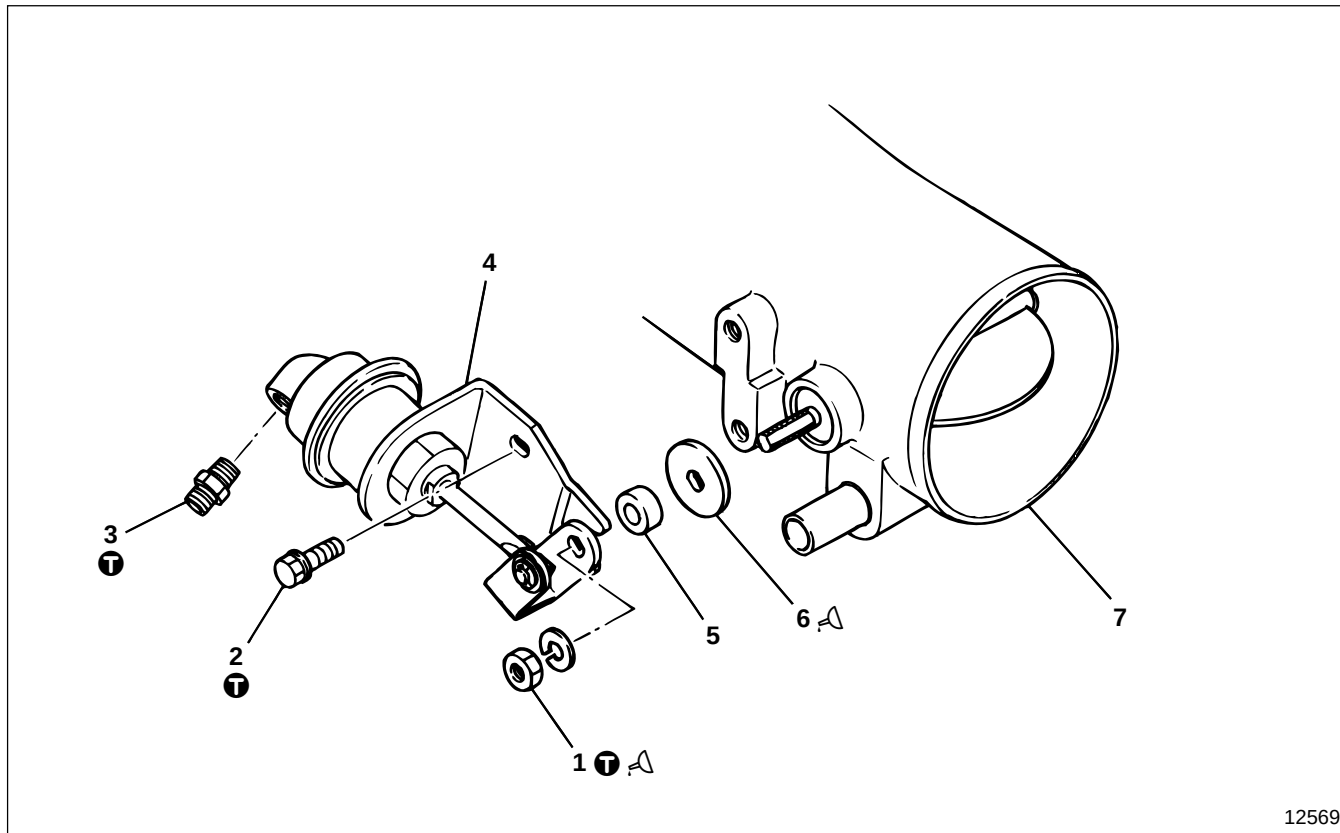


22 Inspection of airtightness of control cylinder

Check that there is no air leakage when pressure **A** of 980 kPa {140 lbf/in², 10 kgf/cm²} is applied to control cylinder **22**. Replace any control cylinder that leaks.

EXHAUST BRAKE SYSTEM

Intake Silencer



12569

● Disassembly sequence

- | | | |
|-------------|---------------------|------------------|
| 1 Nut | 4 Actuator assembly | 6 Thrust washer |
| 2 Bolt | 5 Spacer | 7 Air inlet pipe |
| 3 Connector | | |

● Assembly sequence

Follow the disassembly sequence in reverse.

● Adjustment after assembly

📖 P35-95

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Clearance between top of butterfly valve and center of air inlet pipe		1.5 {0.059}	—	Adjust
	Clearance of butterfly valve (when fully closed) and air inlet pipe	Upper and lower clearances	1 {0.039} or more	—	Adjust
		Mean value of upper and lower clearances	3.5 to 4.0 {0.14 to 0.16}	—	Adjust

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

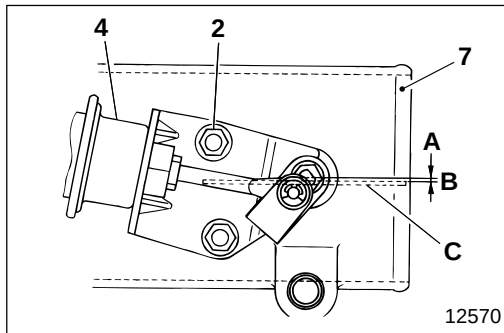
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Valve shaft mounting)	8 {5.9, 0.8}	—
2	Bolt (Actuator assembly mounting)	15 {11, 1.5}	—
3	Connector	10 {7.2, 1.0}	—

L Lubricant and sealant

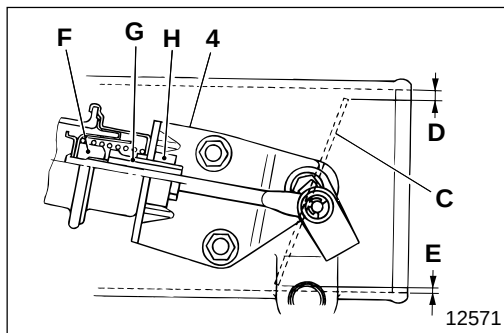
Location	Points of application	Kinds	Quantity
1	Thread area of nut	LOCTITE 271	As required
6	Both surfaces of thrust washer	Molybdenum disulfide grease	As required

◆ Service procedure**● Adjustment after assembly****(1) Butterfly valve full-open adjustment**

- Loosen bolt **2** so that actuator assembly **4** can move slightly.
 - Move actuator assembly **4** to adjust clearance **A** to the standard value.
 - After adjustment, tighten bolt **2** at specified torque.
- B** : Center of air inlet pipe **7**
C : Butterfly valve

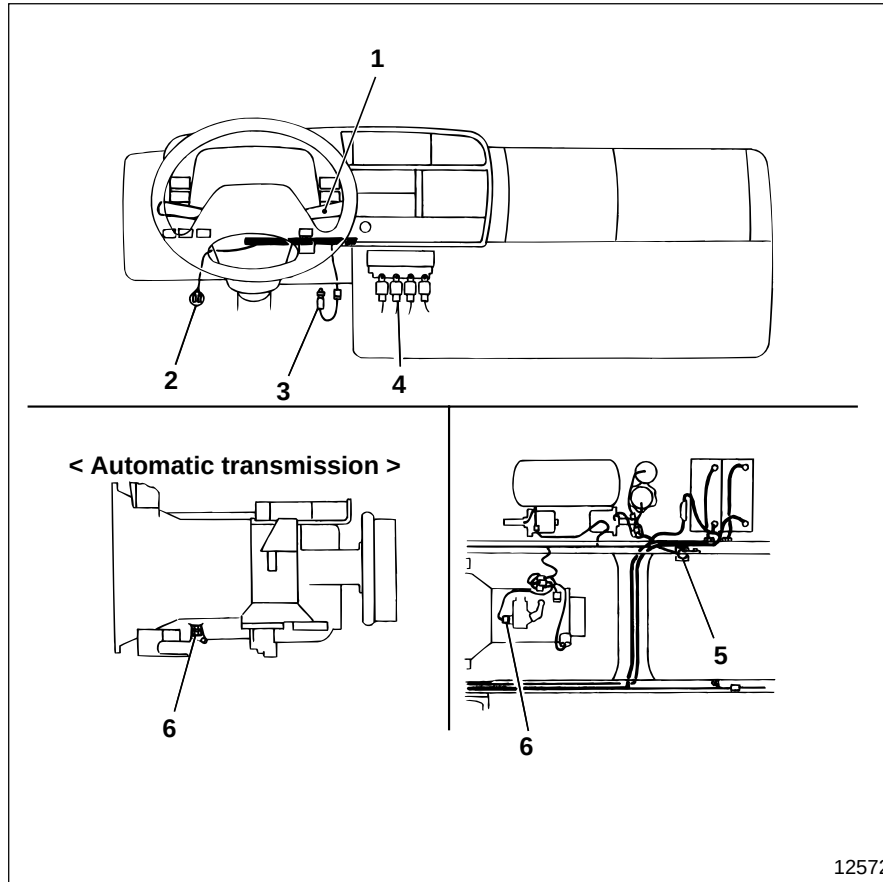
**(2) Butterfly valve full-close adjustment**

- Move butterfly valve **C** so that stopper **F** makes contact with adjusting screw **G**.
- Turn adjusting screw **G** to adjust clearances **D** (upper) and **E** (lower) to their respective standard values, and check that the mean value of upper and lower clearances **D**, **E** conforms to the standard value.
- Calculate the mean value of the upper and lower clearances by $(D+E)/2$.
- After adjustment, fix adjusting screw **G** using lock nut **H**.



EXHAUST BRAKE SYSTEM

Exhaust Brake System Electric Equipment





FH

Service Manual

Group 35

Brake

'98 Minor Change

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

GROUP 35 BRAKE

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EXHAUST BRAKE SYSTEM	35- 60

SPECIFICATIONS

< Equipment for Service Brake >

Item			Specifications
Brake booster (Hydraulic booster)	Booster		Hydraulic type
	Manufacturer		NABCO
Brake master cylinder	Cylinder	Inner diameter mm {in.}	ø41.28 {1.63}
	Piston stroke	Front mm {in.}	15.5 {0.61}
		Rear mm {in.}	19.0 {0.75}
	Manufacturer		NABCO
Vacuum pump	Type		Vane type
	Delivery	cm ³ {cu.in.}	120 {7.32}
	Manufacturer		MITSUBISHI ELECTRIC

< Wheel Brake >

Item			Specifications
Brake type	Front		Drum brake (2-leading type)
	Rear		Drum brake (Dual 2-leading type)
Brake drum inner diameter		mm {in.}	ø320 {12.6}
Wheel cylinder inner diameter	Front	mm {in.}	ø34.93 {1.38}
	Rear	mm {in.}	ø36.51 {1.44}
Brake lining	Front	mm {in.}	120×12 {4.72×0.47}
Width×Thickness	Rear	mm {in.}	140×12 {5.51×0.47}

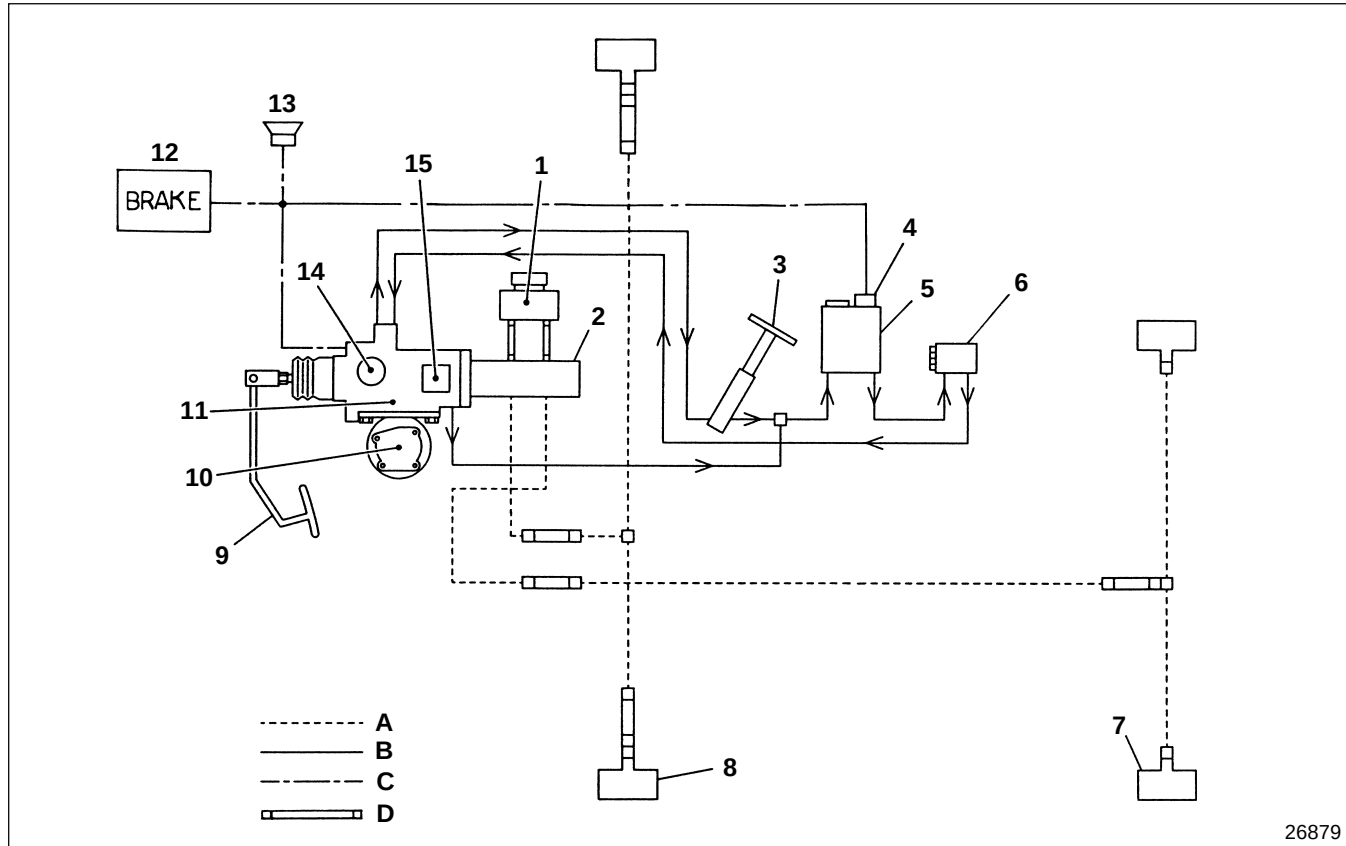
< Exhaust Brake >

Item	Specifications
Control type	Combined electric and vacuum
Valve type	Butterfly valve

MEMO

STRUCTURE AND OPERATION

Hydraulic booster brake system



- | | | |
|-------------------------------------|--------------------------------------|-------------------------------|
| 1 Brake fluid tank | 8 Front wheel cylinder | 14 Flow switch |
| 2 Brake master cylinder | 9 Brake pedal | 15 Motor relay |
| 3 Power steering booster | 10 Emergency pump motor | A : Brake fluid line |
| 4 Power steering fluid level sensor | 11 Brake booster (Hydraulic booster) | B : Power steering fluid line |
| 5 Power steering oil tank | 12 Brake warning lamp | C : Electric line |
| 6 Power steering oil pump | 13 Warning buzzer | D : Hose |
| 7 Rear wheel cylinder | | |

- The brake system is a hydraulic booster brake type, all-wheel braking type consisting of separate front and rear systems.
- The servo system is fitted with brake booster (hydraulic booster) **11**.
- The hydraulic booster brake type uses the fluid pressure from power steering oil pump **6** to boost brake pedal **9** operating force.
- If fluid pressure stops being generated because of engine stoppage, power steering oil pump **6** failure, or fluid leakage from the power steering piping, it is detected by flow switch **14**. To ensure proper fluid pressure in an emergency, the emergency pump motor **10** rotates by the action of operating currents from motor relay **15**.

- Emergency pump **10** operates only when brake pedal **9** is depressed.
Operation conditions details are as follows.

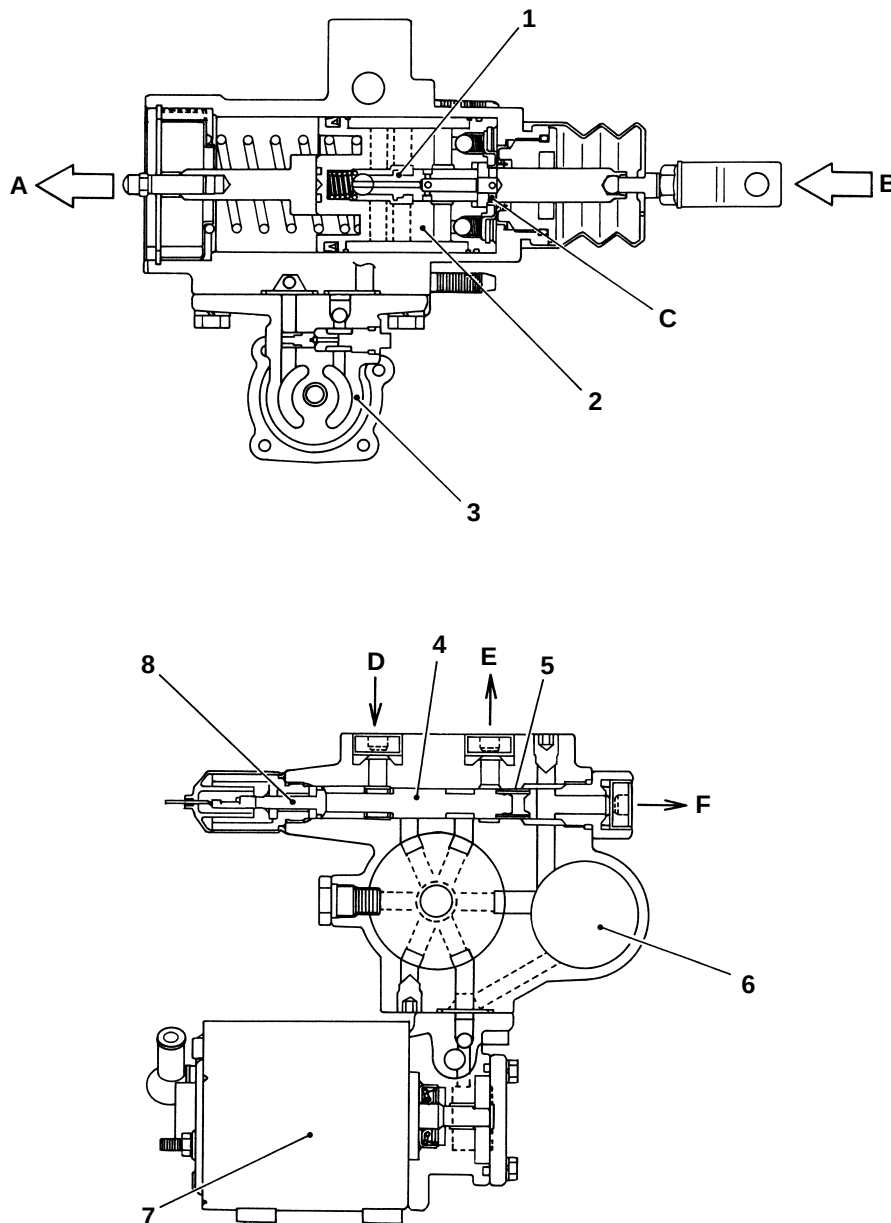
Starter switch	Engine	Parking brake switch	Alarms		Power steering fluid pressure	*1 Emergency pump motor ○ ... Running × ... Stopped	Vehicle condition
			Brake warning lamp ○ ... Lit × ... Not lit	Warning buzzer ○ ... Sounding × ... Silent			
ON	Running	ON (Pulled)	×	×	Present	×	When normal
			○	○	Absent	○	*2 Power steering piping fluid leakage
		OFF (Returned)	×	×	Present	×	When normal
			○	○	Absent	○	*2 Power steering piping fluid leakage
		ON (Pulled)	○	○	Absent	○	When engine is started
		OFF (Returned)	○	○		○	When engine stalls during take-off on a slope
OFF	Stopped	ON (Pulled)	×	×		○	When vehicle starts moving right after being parked (when parking brake force is insufficient)
		OFF (Returned)	×	×		○	When engine is cut off right before the vehicle comes to a stop
ON	—	—	○	○	—	—	When fluid level in power steering oil tank is below "MIN"
OFF	—	—	×	×	—	—	or above "MAX"

*1 : The emergency pump motor operates when the brake pedal is depressed.

*2 : Fluid pressure is obtained by the action of the brake booster (hydraulic booster) fail-safe system which cuts off the flow of fluid to the power steering piping.  P35-6

STRUCTURE AND OPERATION

Brake Booster (Hydraulic Booster)



26929

- 1 Spool valve
- 2 Hydraulic piston
- 3 Emergency pump
- 4 Piston
- 5 Spring
- 6 Reservoir
(Brake booster built-in)
- 7 Emergency pump motor

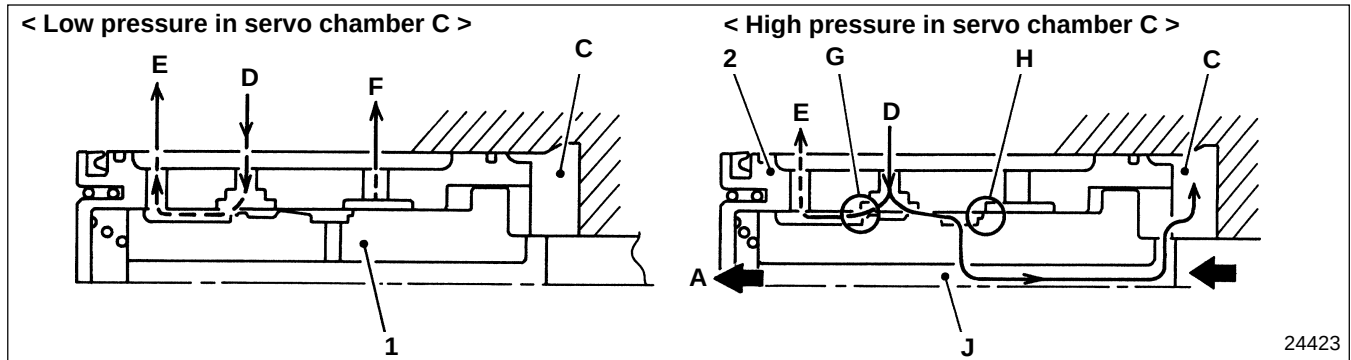
- 8 Flow switch

- A : Brake master cylinder
- B : Brake pedal
- C : Servo chamber
- D : Power steering oil pump
- E : Power steering booster
- F : Drain

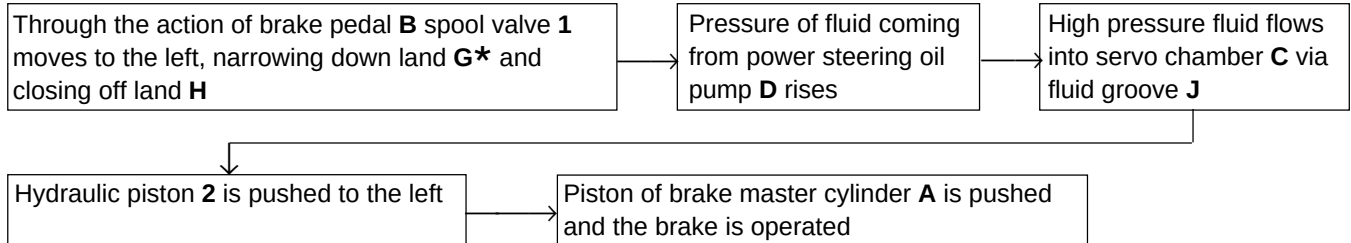
- Spool valve **1** is an adjusting valve linked to brake pedal **B** that generates fluid pressure in accordance with the pedal operating force.
- Hydraulic piston **2** is linked to brake master cylinder **A**, by storing the fluid supplied via spool valve **1** in servo chamber **C** its force is boosted.

- In case there is fluid leaking from the power steering piping and fluid pressure is lost, piston 4 is depressed by the action of spring 5 and moves to the left, shutting off the flow of fluid to power steering oil pump D and power steering booster E. As a result fluid hydraulic circuit is created only inside the brake booster.
- When piston 4 moves to the left, flow switch 8 is turned ON and emergency pump motor 7 starts operating. By the action of emergency pump 3, fluid pressure is generated within the fluid hydraulic circuit inside the brake booster.

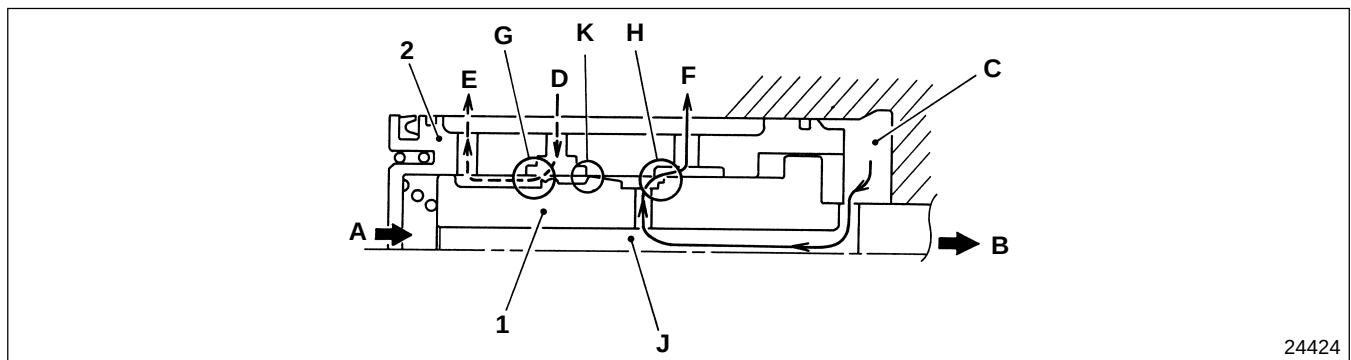
● Spool valve



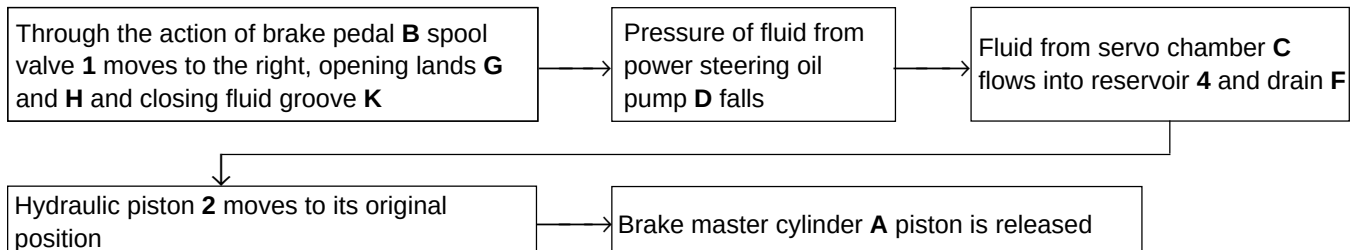
At operation



* : When the brake is operating, land G is not completely shut, therefore the power steering booster is not affected.

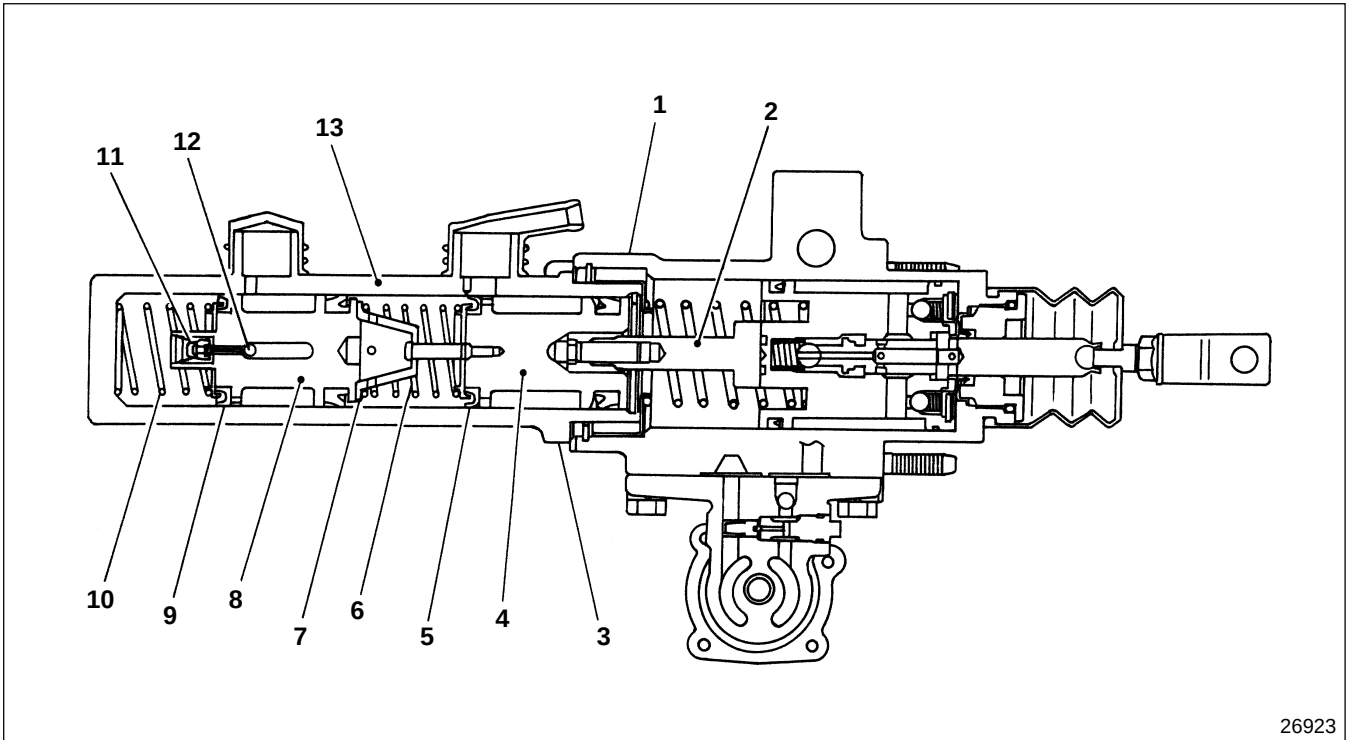


When released



STRUCTURE AND OPERATION

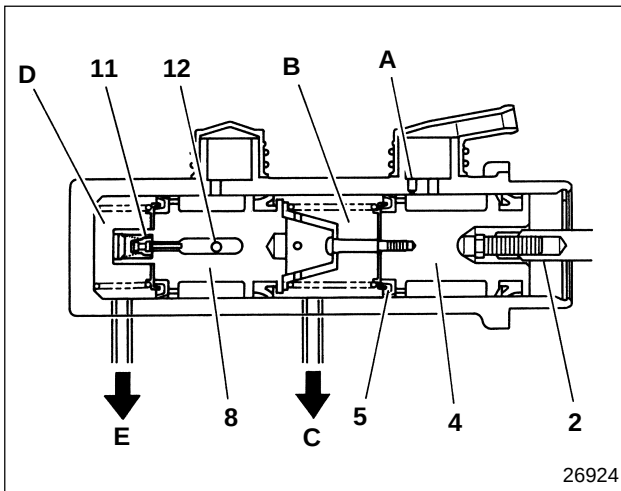
Brake Master Cylinder



26923

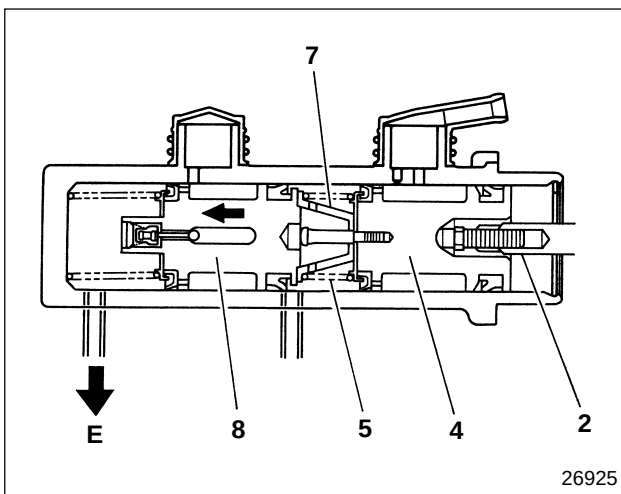
- | | |
|-------------------------------------|-----------------------------------|
| 1 Brake booster (Hydraulic booster) | 8 Secondary piston |
| 2 Hydraulic piston | 9 Packing cup |
| 3 Brake master cylinder | 10 Secondary piston return spring |
| 4 Primary piston | 11 Supply valve |
| 5 Packing cup | 12 Supply valve stopper |
| 6 Primary piston return spring | 13 Cylinder |
| 7 Retainer | |

- Brake master cylinder **3** consists of separate and independent front and rear hydraulic systems. Therefore, if by chance there should be leakage in either the front or the rear hydraulic systems, the safety mechanism ensures that the other unaffected system can operate the brakes.



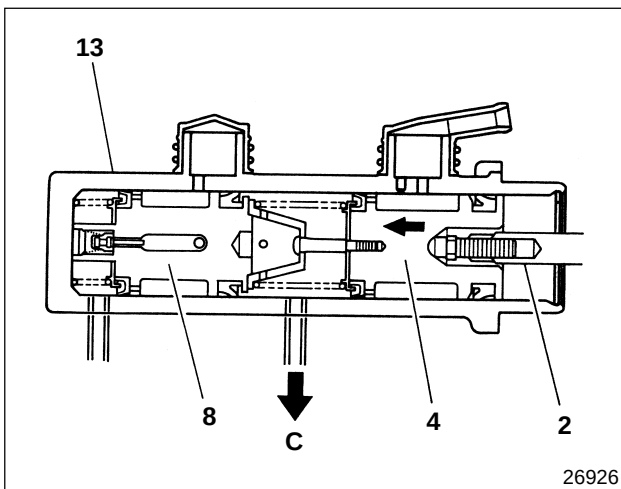
● When brake pedal is depressed

- Depressing the brake pedal makes brake booster (hydraulic booster) hydraulic piston 2 push in primary piston 4 and secondary piston 8, packing cup 5 passes return port A, generates hydraulic pressure in chamber B, and feeds fluid to front brake system C.
- Supply valve 11 separates from supply valve stopper 12, generates hydraulic pressure in chamber D, and feeds fluid to rear brake system E.



● When there is fluid leakage in the front brake system

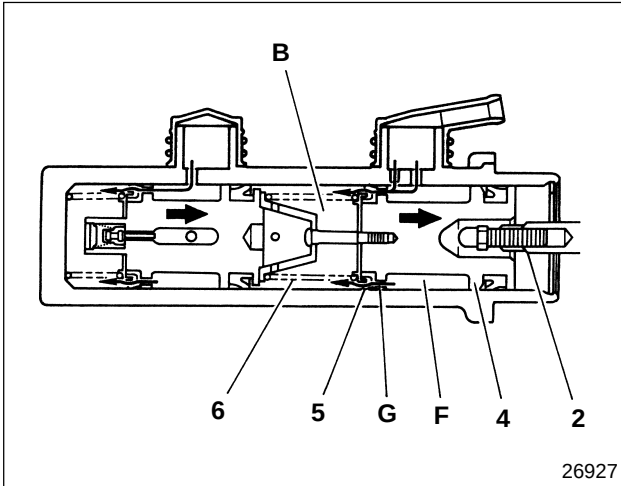
- Depressing the brake pedal makes hydraulic piston 2 push in primary piston 4. However, if the brake fluid in the front brake system leaks, hydraulic pressure is not generated in the front brake system.
- Depressing the brake pedal further makes primary piston 4 compress primary piston return spring 6 causing retainer 7 to push in secondary piston 8, thus generating hydraulic pressure only in the rear brake system E.



● When there is fluid leakage in the rear brake system

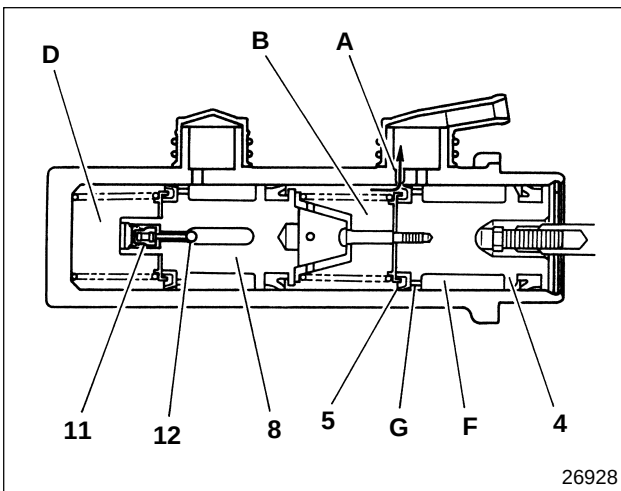
- Depressing the brake pedal makes hydraulic piston 2 push in primary piston 4 and secondary piston 8. However, if the brake fluid in the rear brake system leaks, hydraulic pressure is not generated in the rear brake system.
- Depressing the brake pedal further makes the end of secondary piston 8 hit against cylinder 13, pushing primary piston 4 and generating hydraulic pressure only in the front brake system C.

STRUCTURE AND OPERATION



● When the brake pedal is released

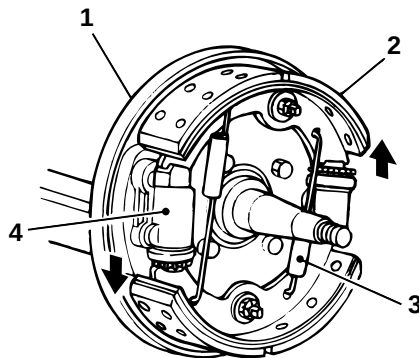
- When hydraulic piston 2 returns to its original position, as a result of the repercussive force of primary piston return spring 6, primary piston 4 begins to return immediately. However, because of a lack of a pressure difference between chambers B and F brake fluid delivered from the brake master cylinder cannot return quickly.
- When primary piston 4 begins to return, hydraulic pressure in chamber B becomes lower than that in chamber F, the pressure difference causes packing cup 5 to deform opening up passage G. This causes brake fluid from chamber F to flow into chamber B.



- When primary piston 4 moves further and returns to its original position, the pressure in chambers B and F become the same, and packing cup 5 closes passage G. The hydraulic fluid in the brake pipe returns from chamber B to the reservoir tank via return port A.
- The same action also takes place in the secondary side. However, when secondary piston 8 is pushed back, supply valve 11 hits against supply valve stopper 12 and the supply valve opens.
- Therefore the hydraulic fluid in the brake pipe returns from chamber D to the reservoir tank via supply valve 11.

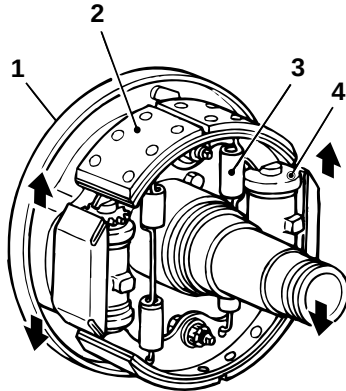
Wheel Brake

< Front >



- 1 Backing plate
- 2 Brake shoe assembly
- 3 Return spring
- 4 Wheel cylinder assembly

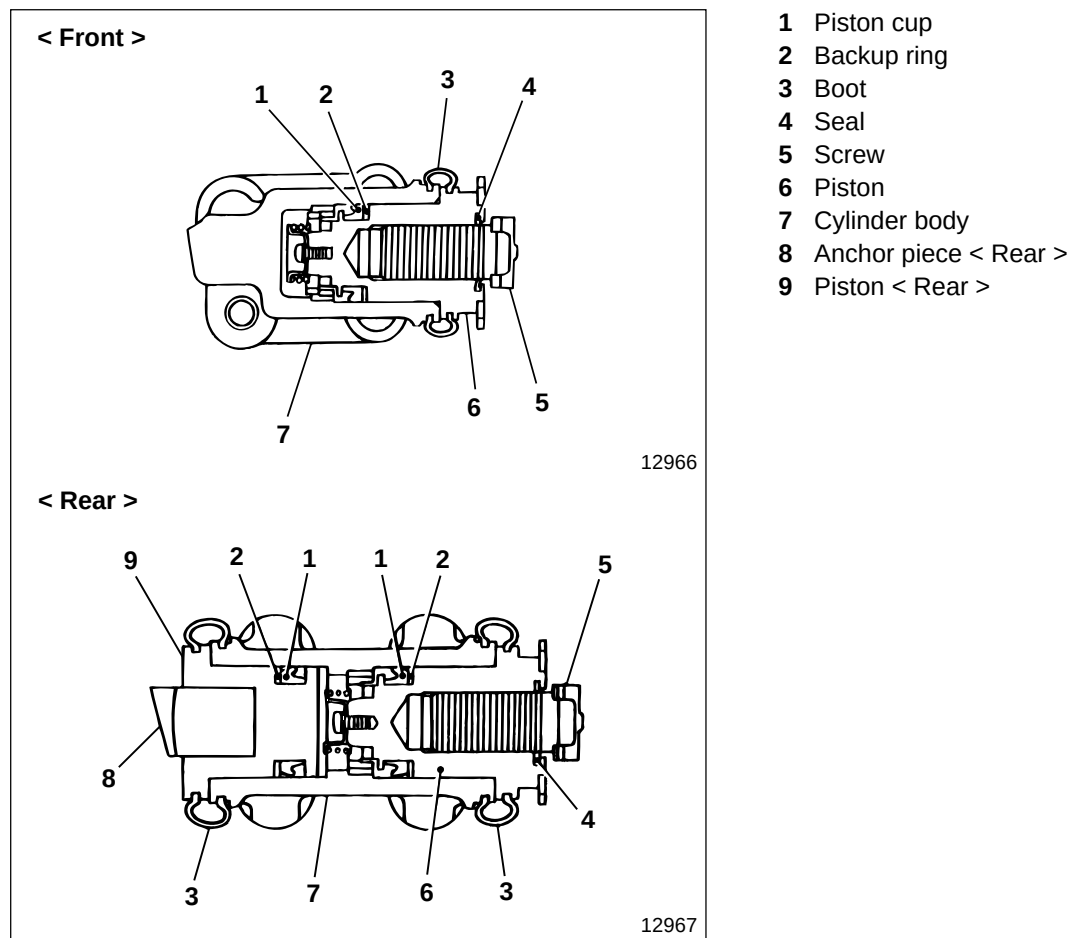
< Rear >



- The front wheel brake is an internal expanding 2-leading brake type.
- The rear wheel brake is an internal expanding dual 2-leading brake type.
- Front and rear wheel cylinder assemblies 4 have shoe clearance automatic adjusting mechanisms to adjust shoe clearance within a specific range.

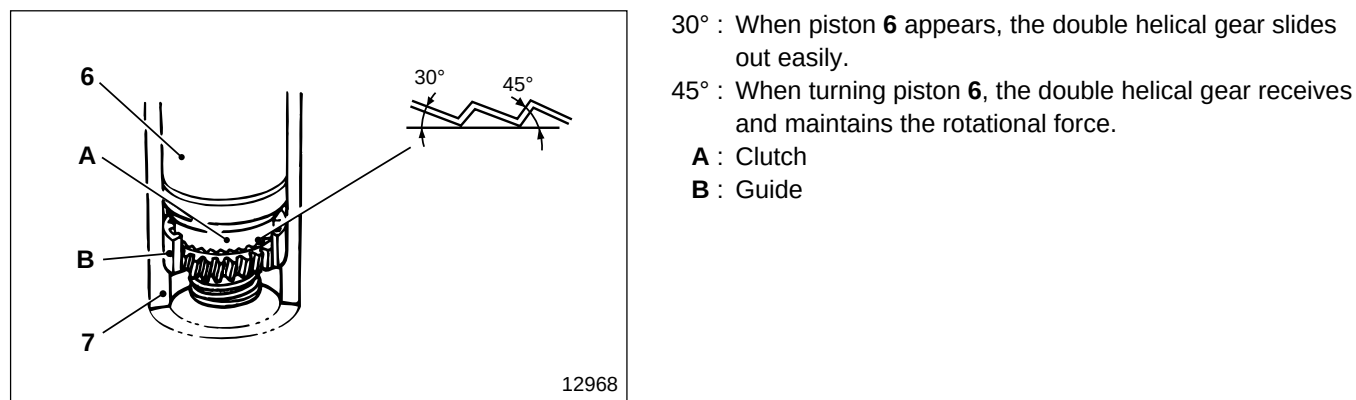
STRUCTURE AND OPERATION

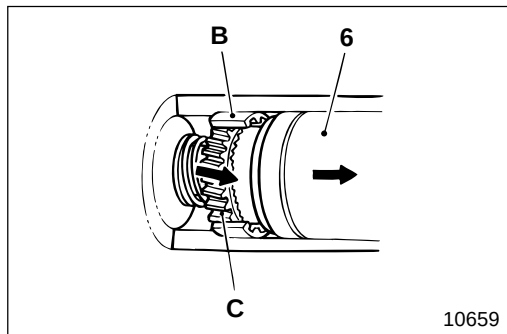
● Wheel cylinder assembly



Even if the brake lining has worn to the extent that the brake shoe clearance is higher than the specified value, the brake shoe clearance automatic adjusting mechanism automatically adjusts the brake shoe clearance to maintain the appropriate brake shoe clearance when the vehicle is braked when moving forward.

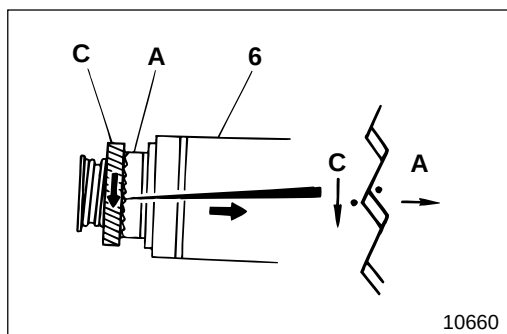
● Operation of automatic shoe clearance adjusting mechanism (one-way clutch)



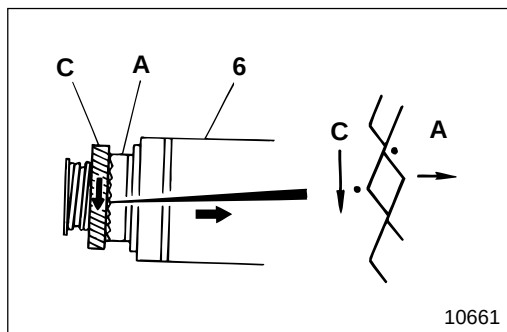


● When braking starts

- When hydraulic braking pressure acts on the wheel cylinder, it pushes piston 6 forward.
- Idler C of extended piston 6 is engaged with the diagonal gears cut in guide B of the cylinder body, so the idler advances while turning, in accordance with the travel of the piston.



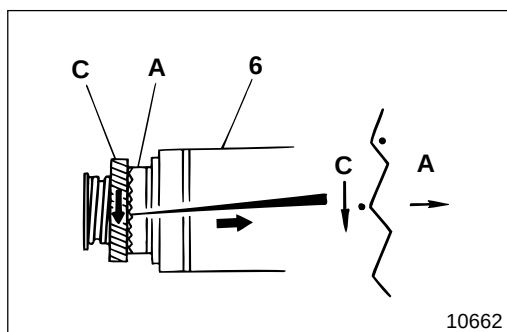
- The rotation of idler C slides out the double helical gear of clutch A.



● When depressing brake pedal

When the brake shoe clearance conforms to the specified value

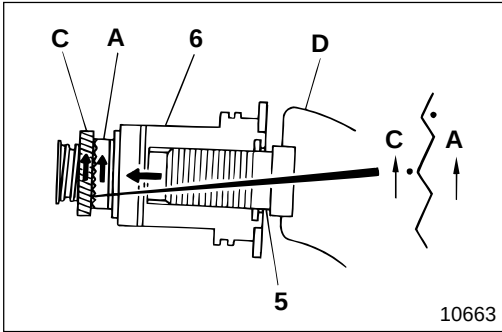
- The amount of travel of idler C is proportional to the amount of travel of piston 6. The amount of travel is not enough to make the double helical gear of clutch A climb over the opposite double helical gear when the brake shoe clearance is within the specified value.



When the brake shoe clearance is higher than the specified value

- When the brake shoe clearance is higher than the specified value, the amount of travel of idler C increases enough to make the double helical gear of clutch A climb over the opposite double helical gear.

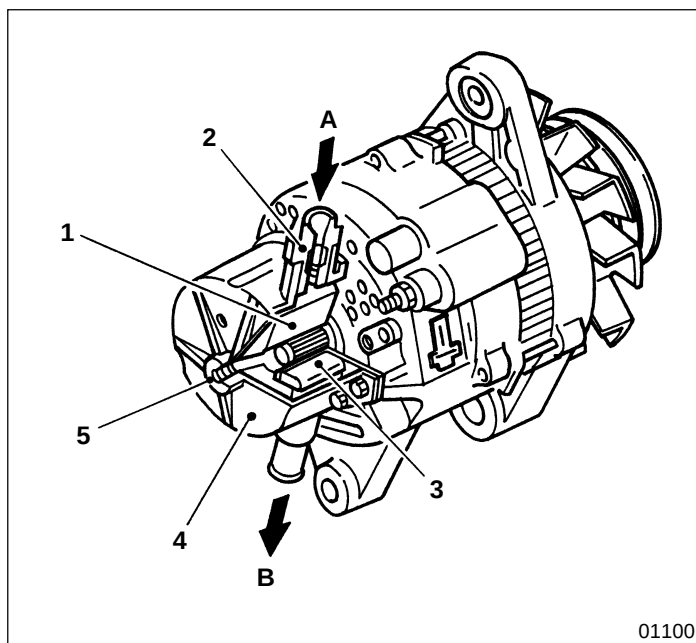
STRUCTURE AND OPERATION



● When releasing brake pedal

- As the brake fluid pressure decreases and piston **6** returns, idler **C** also returns, turning in the opposite direction along guide **B** of the cylinder body.
- When the brake shoe clearance is within the specified value, piston **6** returns to its original position without turning, because the double helical gear of clutch **A** has not climbed over the opposite double helical gear.
- When the brake shoe clearance is higher than the specified value, piston **6** returns while turning by one gear tooth, since the double helical gear of clutch **A** has climbed over the opposite gear. This lowers the brake shoe clearance to the specified value, because screw **5** of the piston is fixed by brake shoe **D** and does not turn.

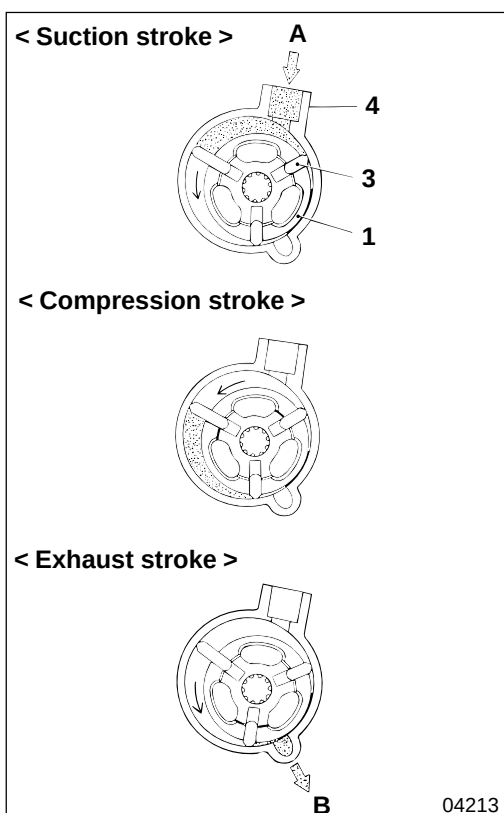
Vacuum Pump



- 1 Rotor
- 2 Check valve
- 3 Vane
- 4 Housing
- 5 Oil filler hole

A : Inlet
B : Outlet

- The vacuum pump is installed on the rear part of alternator and is rotated by the V-belt.
- Check valve 2 is fitted to prevent the atmospheric pressure and the lubricating oil from flowing in reverse from the vacuum pump when the engine is stopped.

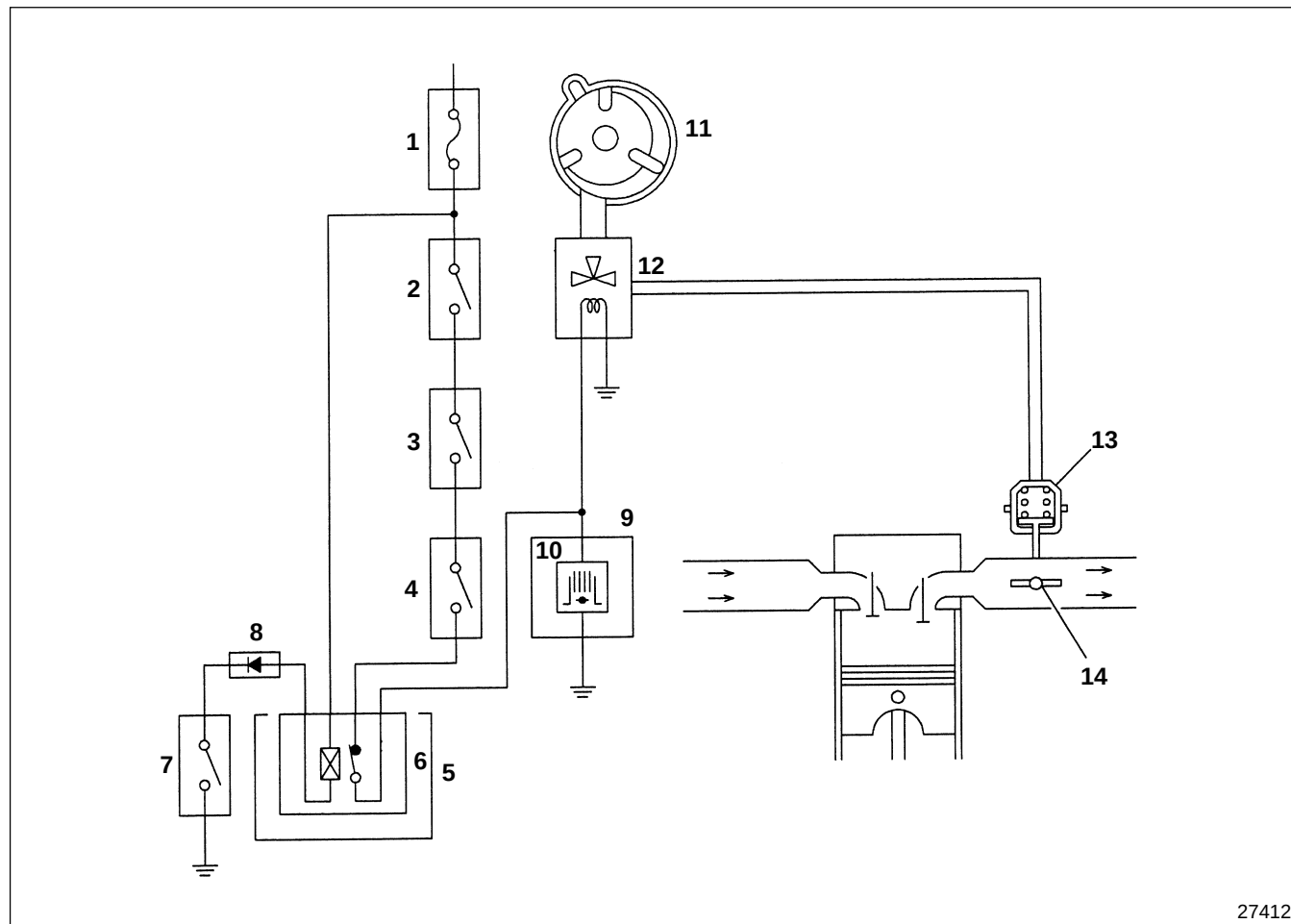


● Operation

- Inside cylindrical housing 4, rotor 1 equipped with three vanes (movable blades) 3 rotates, pressing the vanes against the inside surface of the housing by centrifugal force.
- Since rotor 1 is eccentric with respect to housing 4, as the rotor rotates, the atmospheric pressure of the exhaust brake unit is drawn in from inlet A and discharges from outlet B by the gradual compression of the air. This repetition of the suction, compression and exhaust strokes generates a vacuum, realizing a near-vacuum in the exhaust brake unit.
- The engine oil that lubricates and cools the inside of housing 4 is returned, along with air pressure, through outlet B to the oil pan.

STRUCTURE AND OPERATION

Exhaust Brake System

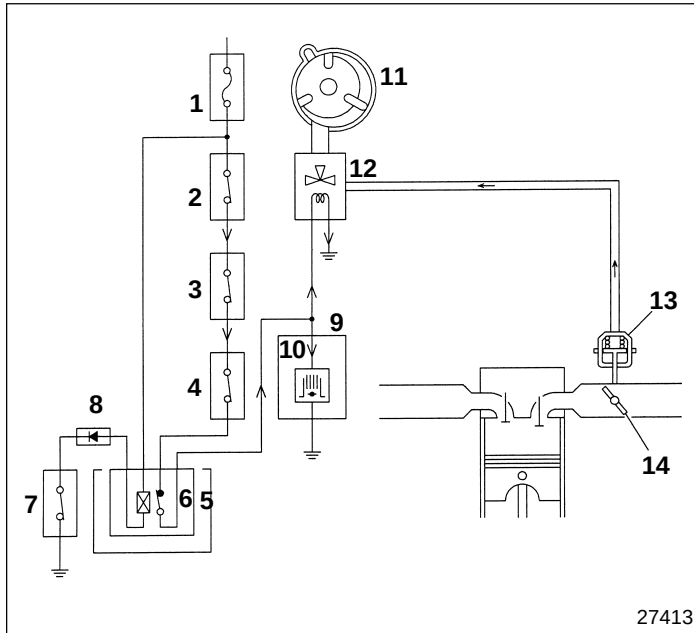


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- | | |
|-------------------------------|---------------------------------|
| 1 Fuse box | 8 Diode |
| 2 Clutch switch | 9 Meter cluster |
| 3 Accelerator switch | 10 Exhaust brake indicator lamp |
| 4 Exhaust brake switch | 11 Vacuum pump |
| 5 Relay box | 12 3-way magnetic valve |
| 6 Exhaust brake cut relay | 13 Exhaust brake unit |
| 7 Transmission neutral switch | 14 Butterfly valve |

- Excitation of the coil of 3-way magnetic valve **12** closes the atmospheric valve and opens the vacuum valve. This makes the vacuum pump **11** act on exhaust brake unit **13** which closes butterfly valve **14**, activating the exhaust brake.
- If the exhaust brake is activated while the vehicle is stationary, the coolant temperature can rise excessively, overheating the engine. To avoid this, when the transmission is in neutral, transmission neutral switch **7** turns ON, cutting the exhaust brake system.

● When exhaust brake system is activated

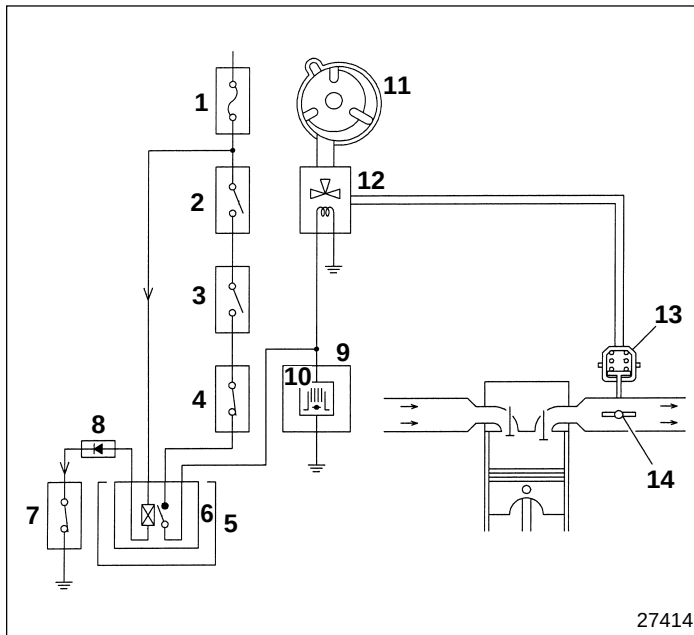


When exhaust brake switch 4 is turned on, the current flows as illustrated to activate the exhaust brake.

Fuse 1→Clutch switch 2→Accelerator switch 3→Exhaust brake switch 4→Exhaust brake cut relay 6→3-way magnetic valve 12→Ground

→Exhaust brake indicator lamp 10 (ON)→Ground

● When the exhaust brake system is released



When the accelerator pedal or clutch pedal is depressed while the exhaust brake is working, all switches 3, 2 turn off, shutting off the current, releasing the exhaust brake.

● When clutch pedal is depressed

Fuse 1→Clutch switch 2 (OFF)→Since no current flows, the circuit turns off and the exhaust brake is released.

● When accelerator pedal is depressed

Fuse 1→Clutch switch 2→Accelerator switch 3 (OFF)→Since there is no grounding, current does not flow, so the exhaust brake is released.

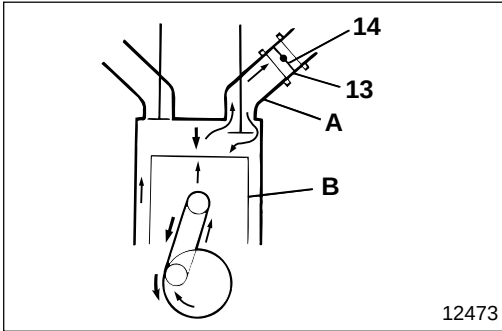
STRUCTURE AND OPERATION

● Releasing exhaust brake system by placing transmission in neutral

Fuse 1→Exhaust brake cut relay 6 excitation→Transmission neutral switch 7→Ground

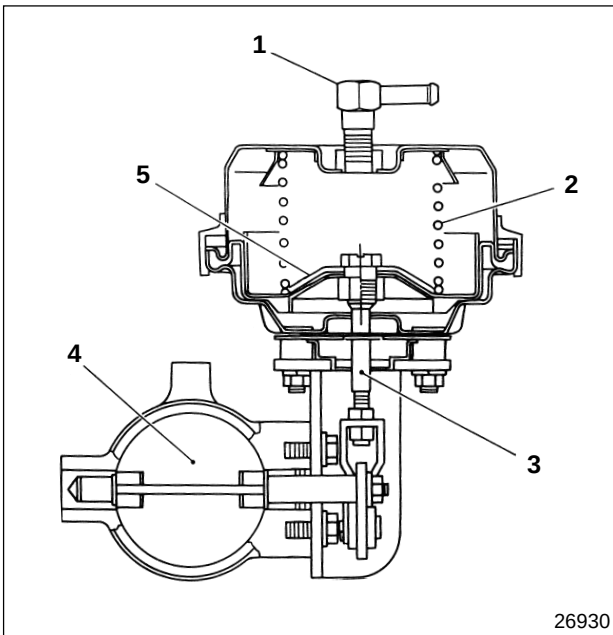
Fuse 1→Clutch switch 2→Accelerator switch 3→Exhaust brake switch 4→Exhaust brake cut relay 6 (OFF)→Beyond this, current does not flow so the exhaust brake is released.

● Working principle of exhaust brake



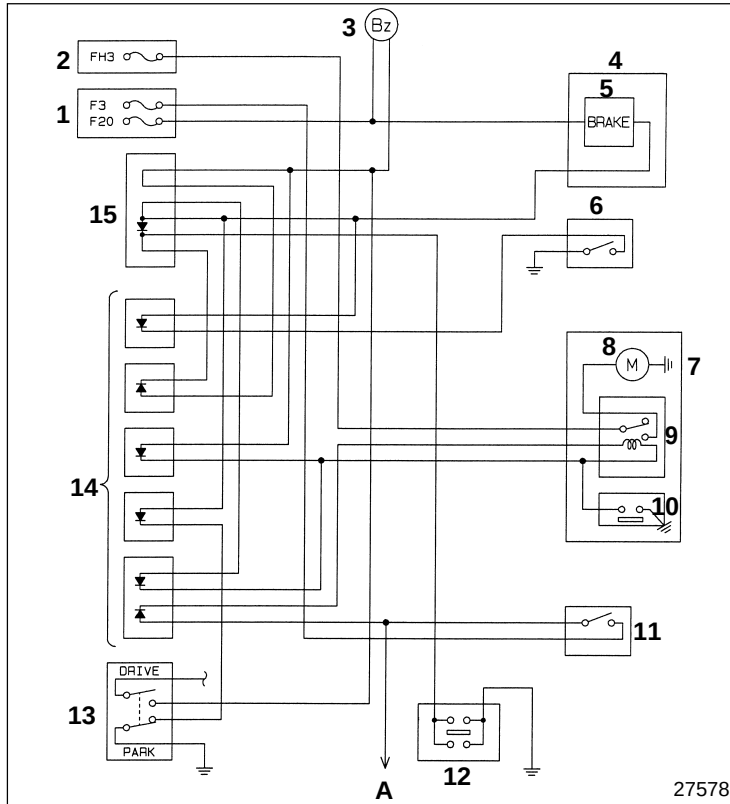
When butterfly valve 14 of exhaust brake unit 13, in exhaust pipe A, is closed, the pressure in the exhaust pipe rises. The pressure rises further in the exhaust stroke, generating a force that pushes back piston B, the exhaust braking force.

● Exhaust brake unit



- 1 Connector
- 2 Spring
- 3 Push rod
- 4 Butterfly valve
- 5 Diaphragm

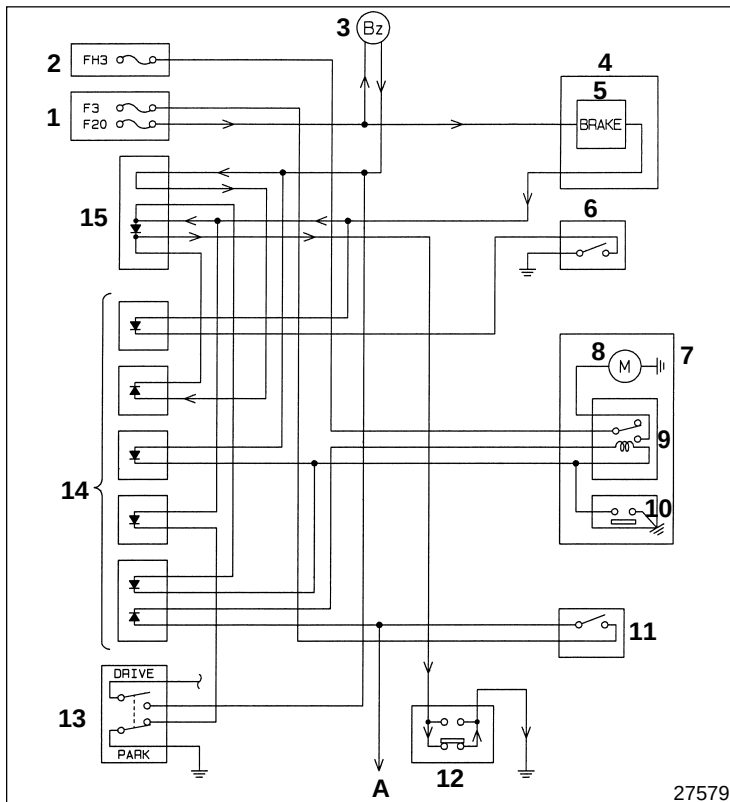
Brake Warning and Brake booster (Hydraulic Booster) Fail-Safe System



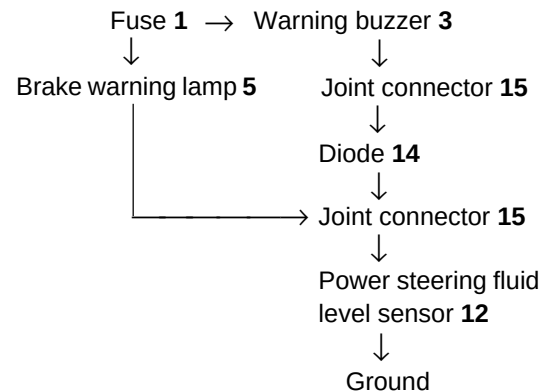
- 1 Fuse box
- 2 High current fuse box
- 3 Warning buzzer
- 4 Meter cluster
- 5 Brake warning lamp
- 6 Brake fluid level switch
- 7 Brake booster (Hydraulic booster)
- 8 Emergency pump motor
- 9 Motor relay
- 10 Flow switch
- 11 Stop lamp switch
- 12 Power steering fluid level sensor
- Gr 37
- 13 Parking brake switch
- 14 Diode
- 15 Joint connector

A: To stop lamp

● Power steering fluid level warning circuit



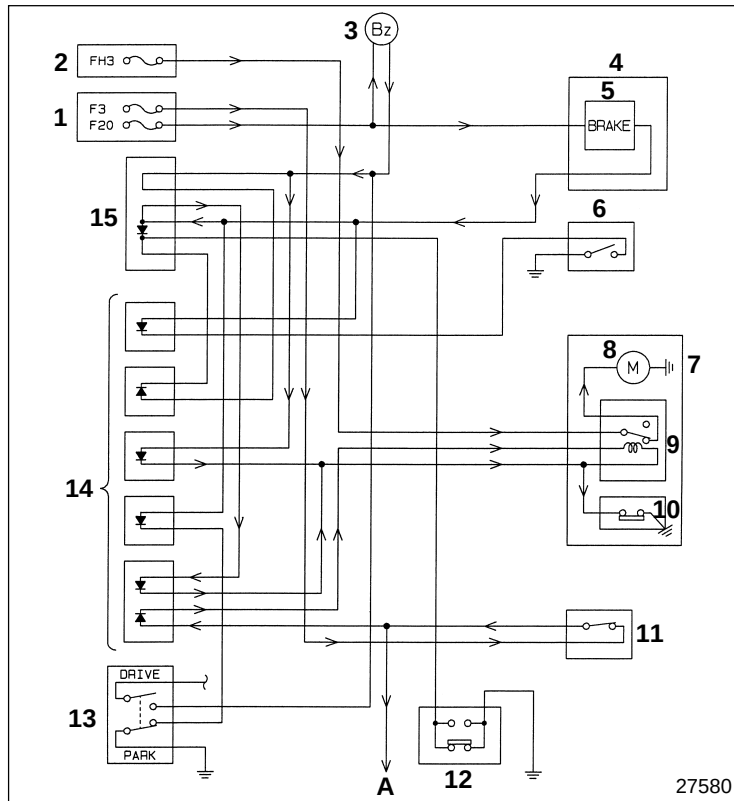
- Since the fluid pressure of the power steering fluid is also used for brake booster (hydraulic booster) 7, the power steering fluid level warning circuit is connected to warning buzzer 3 and brake warning lamp 5.
- When the power steering fluid level drops below the "MIN" level or rises above the "MAX" level of the power steering oil tank, power steering fluid level sensor 12 is turned ON, and the flow of current at such time is as follows.



As a result warning buzzer 3 sounds and warning lamp 5 lights to warn the driver.

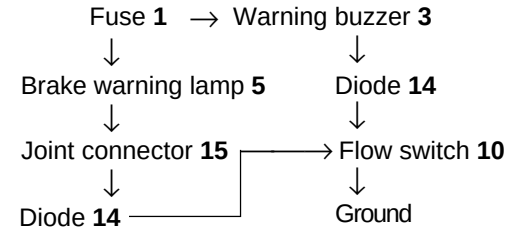
STRUCTURE AND OPERATION

● Brake booster (hydraulic booster) fail-safe system



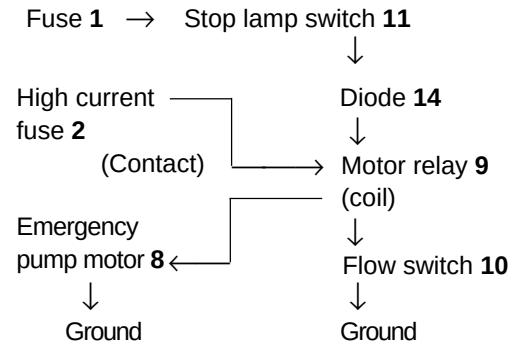
- If there is a fluid leakage in the power steering system piping and hydraulic pressure is lost, the brake booster (hydraulic booster) fail-safe system will act in the following manner.

Flow switch **10** is turned ON and the flow of current is as follows.



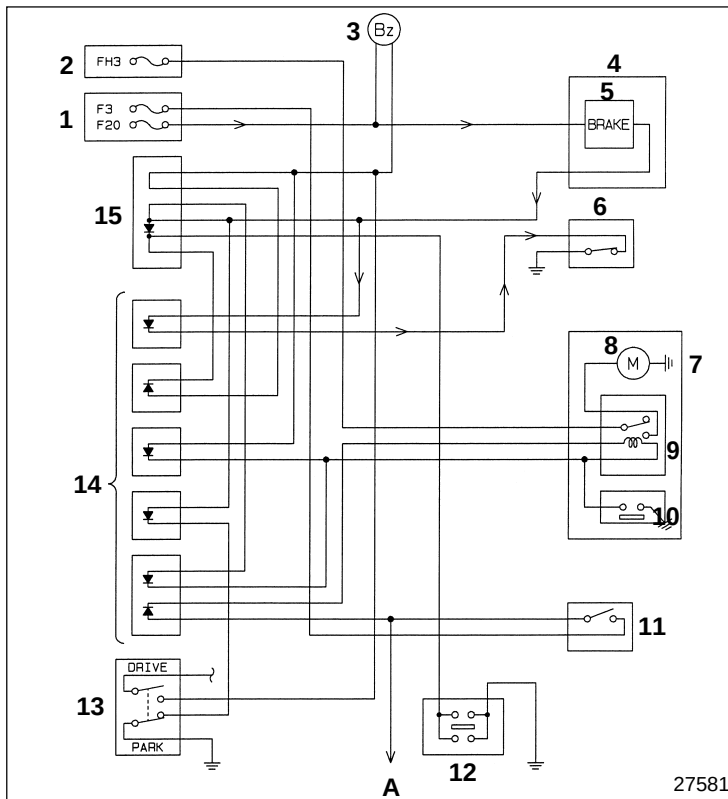
As a result warning buzzer **3** sounds and brake warning lamp **5** lights.

Depressing the brake pedal when flow switch **10** is ON, will cause the current to flow as follows.



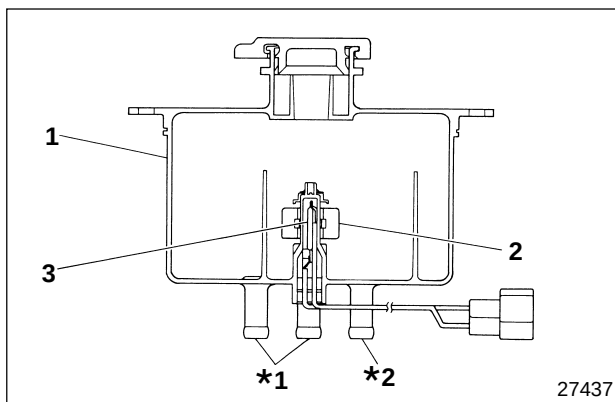
As a result emergency pump motor **8** starts operating, maintaining the hydraulic pressure during an emergency.

● Brake fluid warning circuit



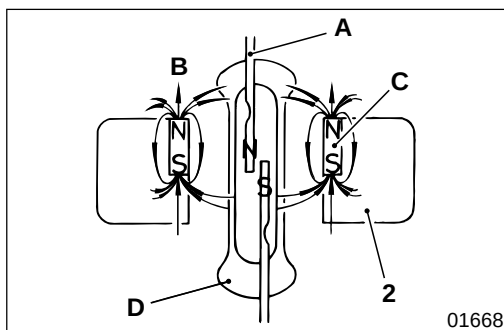
- When the brake fluid in the fluid tank drops below the specified level, brake fluid level switch 6 in the fluid tank turns on, brake warning lamp 5 lights.

● Brake fluid level switch



- 1 Fluid tank
- 2 Float
- 3 Brake fluid level switch
- *1 : For brakes
- *2 : For clutch

- Brake fluid level switch 3, installed on fluid tank 1, monitors the brake fluid level in the fluid tank. If the brake fluid level drops below the specified level, float 2 moves and lights up the warning lamp within the meter cluster to alert the driver.



- If the brake fluid level in fluid tank 1 drops and float 2 drops lower than level L, magnetic force B that passes through the contact point (ferromagnetic body A), increases generating north and south poles at the ends of the contact points. Therefore, the contact points pull each other and overcome the repercussive force of the springs of the contact points, forming an electric circuit.
- C : Permanent magnet
- D : Glass

TROUBLESHOOTING

● Wheel Brake

Symptoms		Possible causes	One-sided braking	One-sided braking				Braking force insufficient	Brake pedal stroke reduced	Noise and judder when brakes are applied	Noise and judder when brakes are applied	
				Braking shoe return slow after releasing brake pedal	Braking force difference between left and right	Braking force unstable	Lock points difference				Noise generated when wheels are rotating, with vehicle jacked up	Continuous noise generated while braking (at low speed)
Tires	Air pressures uneven, etc.  Gr 31	☐										
	Left and right tire sizes different  Gr 31	☐										
Axle	Wheel hub bearing adjusted incorrectly  Gr 26, 27	☐										☐
	Left and right wheelbase difference excessive  Gr 26, 27	☐										
	Wheel alignment incorrect  Gr 26	☐										
	Kingpin bushing worn  Gr 26											
Wheel brakes	Backing plate ledge surface rough		☐		☐							
	Backing plate ledge surface not smooth											
	Backing plate deformed, mounted incorrectly				☐							
	Oil or water on brake lining surfaces			☐			☐					
	Brake lining changed in quality or wrong material used		☐									
	Brake lining unevenly worn or surface roughened			☐								
	Brake lining fading (surface change in material)						☐					
	Brake lining worn out completely											☐
	Abrasive on brake lining											
	Brake lining worn											
	Brake lining contact incorrect			☐		☐	☐					
	Brake lining ground radius irregular					☐						
	Wheel cylinder malfunctioning		☐	☐				☐		☐		
	Wheel cylinder piston cup faulty											
	Shoe return spring fatigued or broken		☐							☐		
	Brake drum worn unevenly			☐								
	Brake drum warped				☐							
	Brake drum worn					☐						
	Brake drum surface roughened						☐					
	Brake drum roughness excessive								☐			
	Brake drum glassy											

Symptoms		One-sided braking	One-sided braking				Braking force insufficient	Brake pedal stroke reduced	Noise and judder when brakes are applied	Noise and judder when brakes are applied	
			Braking shoe return slow after releasing brake pedal	Braking force difference between left and right	Braking force unstable	Lock points difference				Noise generated when wheels are rotating, with vehicle jacked up	Continuous noise generated while braking (at low speed)
Possible causes		One-sided braking	Braking shoe return slow after releasing brake pedal	Braking force difference between left and right	Braking force unstable	Lock points difference	Braking force insufficient	Brake pedal stroke reduced	Noise and judder when brakes are applied	Noise generated when wheels are rotating, with vehicle jacked up	Continuous noise generated while braking (at low speed)
Wheel brakes	Brake drum cracked								○		
	Brake drum clogged by foreign particles										
	Brake drum deformed or eccentric									○	
	Brake shoe deformed or damaged							○			
	Brake shoe twisted or tilted										
	Moving parts greased insufficiently								○		
Brake pedal	Brake pedal stroke faulty (52 mm {2.05 in.} or more at 490 N {110 lbf, 50 kgf} foot pressure)						○				
	Brake pedal adjusted incorrectly, looseness excessive							○			
	Brake booster (Hydraulic booster) operating rod pushing up										
Brake fluid system	Brake fluid insufficient							○			
	Brake fluid leaking							○			
	Air lock in system							○			
	Vapor lock							○			
	Brake fluid return insufficient because brake pipe tightened excessively										
Power steering fluid system	Degree of power steering fluid line pressure reduced							○			
Brake booster (Hydraulic booster)	Brake booster (Hydraulic booster) defective						○	○			
Brake master cylinder	Piston cup faulty							○			
	Return port clogged										

TROUBLESHOOTING

Symptoms		Brake drums overheating		Brakes squeaking	Squeaking in new vehicle or after brake lining replacement	Action too severe	Brake juddering	Brake pedal return faulty	Brake drags	Remarks
		All wheels overheating	One wheel overheating							
Possible causes										
Tires	Air pressures uneven, etc.									 Gr 31
	Left and right tire sizes different									 Gr 31
Axle	Wheel hub bearing adjusted incorrectly		○	○			○			 Gr26, 27
	Left and right wheelbase difference excessive									 Gr26, 27
	Wheel alignment incorrect									 Gr26
	Kingpin bushing worn						○			 Gr26
Wheel brakes	Backing plate ledge surface rough								○	
	Backing plate ledge surface not smooth		○							
	Backing plate deformed, mounted incorrectly					○				
	Oil or water on brake lining surfaces									
	Brake lining changed in quality or wrong material used									
	Brake lining unevenly worn or surface roughened									
	Brake lining fading (surface change in material)					○				
	Brake lining worn out completely									
	Abrasive on brake lining			○						
	Brake lining worn			○						
	Brake lining contact incorrect				○					
	Brake lining ground radius irregular									
	Wheel cylinder malfunctioning		○						○	
	Wheel cylinder piston cup faulty		○						○	
	Shoe return spring fatigued or broken		○						○	
	Brake drum worn unevenly									
	Brake drum warped									
	Brake drum worn									
	Brake drum surface roughened									
	Brake drum roughness excessive									
	Brake drum glassy					○				

Symptoms		Brake drums overheating			Brakes squeaking						Remarks
		All wheels overheating	One wheel overheating		Squeaking in new vehicle or after brake lining replacement	Action too severe	Brake juddering	Brake pedal return faulty	Brake drags		
Possible causes											
Wheel brakes	Brake drum cracked										
	Brake drum clogged by foreign particle										
	Brake drum deformed or eccentric						○				
	Brake shoe deformed or damaged					○					
	Brake shoe twisted or tilted		○								
	Moving parts greased insufficiently										
Brake pedal	Brake pedal stroke faulty (52 mm {2.05 in.} or more at 490 N {110 lbf, 50 kgf} foot pressure)										
	Brake pedal adjusted, looseness excessive										
	Brake pedal return faulty	○									
	Brake pedal free play inadequate								○		
	Linkage rusted or deformed							○			
	Return spring fatigued or broken							○			
	Brake booster (Hydraulic booster) operating rod pushing up							○			
Brake fluid system	Brake fluid insufficient										
	Brake fluid leaking										
	Air lock in system										
	Vapor lock										
	Brake fluid return insufficient because brake pipe tightened excessively		○								
Power steering fluid system	Degree of power steering fluid line pressure reduced										
Brake booster (Hydraulic booster)	Brake booster (Hydraulic booster) defective	○							○		
Brake master cylinder	Piston cup faulty	○							○		
	Return port clogged	○							○		

TROUBLESHOOTING

● Exhaust Brake

Symptoms		Exhaust brake does not work	Exhaust brake does not release	Remarks
Possible causes				
Vacuum system	Degree of vacuum insufficient	☐		
	Pipe crushed	☐		
3-way magnetic valve	Does not work	☐	☐	 Gr 54
Exhaust brake unit	Valve assembly does not work	☐	☐	
	Valve assembly shaft stuck	☐	☐	
	Vacuum chamber does not work	☐		
Electric system	Electric system faulty	☐	☐	 Gr 54

MEMO

ON-VEHICLE INSPECTION AND ADJUSTMENT

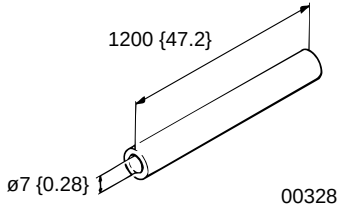
Replacement of Brake Fluid

Fluid

Location	Points of application	Specified fluid	Quantity
3	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Vinyl hose 	MH033102	Air bleeding

WARNING

- The clutch fluid system and the brake fluid system use the fluid tank in common.
- You must use new brake fluid (SAE J17031 or FMVSS No. 116 DOT 3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system and brake system to swell, resulting in faulty clutch operation, as well as ineffective braking and brake dragging.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will result in ineffective clutch and brake operations.
- If you use a mug for adding brake fluid, keep it solely for that purpose.

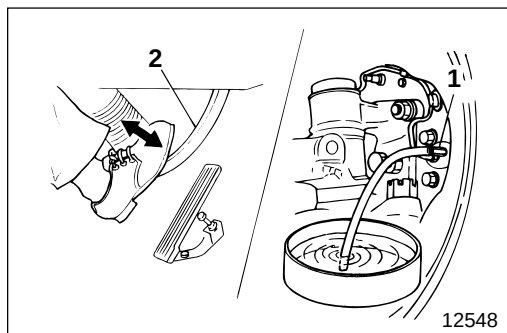
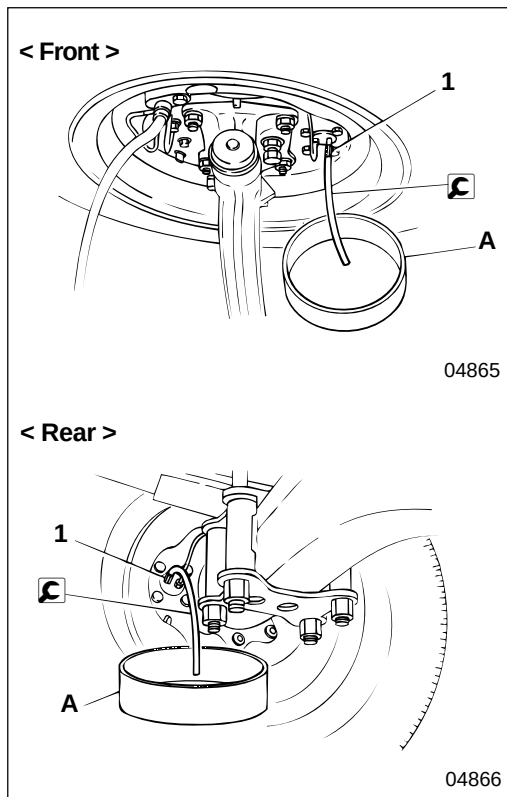
CAUTION

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

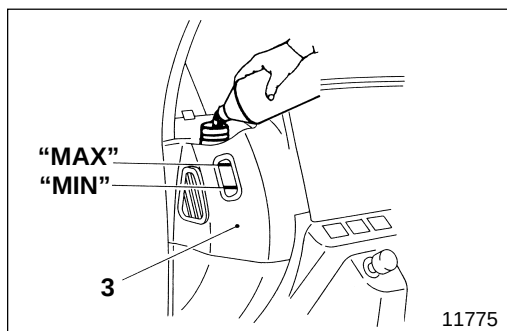
NOTE

Supply and maintain the brake fluid level to the “MAX” level of the fluid tank.

- Start engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to air bleeder **1** and place the other end in container **A**.



- Loosen air bleeder **1** and depress brake pedal **2** to drain brake fluid completely.



- Maintain a supply of new brake fluid up to the “**MAX**” level of fluid tank **3**, depress the brake pedal repeatedly until the old brake fluid of the brake system is replaced with new fluid.
- Bleed air from the brake system.
 P35-30

ON-VEHICLE INSPECTION AND ADJUSTMENT

Air Bleeding of Brake System

Tightening torque

Unit : N·m {lb.ft, kgf·m}

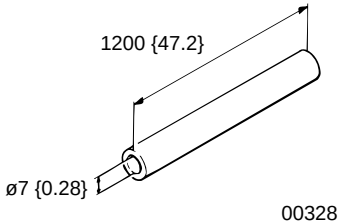
Location	Parts to be tightened	Tightening torque	Remarks
1	Air bleeder	7.8 to 12 {5.8 to 8.5, 0.8 to 1.2}	—

Fluid

Location	Points of application	Specified fluid	Quantity
—	Fluid tank	Brake fluid (SAE J1703f or FMVSS No.116 DOT3)	As required

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Vinyl hose 	MH033102	Air bleeding

WARNING

- The clutch fluid system and the brake fluid system use the fluid tank in common.
- You must use new brake fluid (SAE J1703f or FMVSS No. 116 DOT 3). Do not add different quality fluid or mineral oil (gas oil, engine oil, gear oil, automatic transmission fluid, etc.) to the clutch system, because this will cause the rubber parts of the clutch system and brake system to swell, resulting in faulty clutch operation, as well as ineffective braking and brake dragging.
- Do not allow foreign particles or water to become mixed into the brake fluid when refilling, because this will result in ineffective clutch and brake operations.
- If you use a mug for adding brake fluid, keep it solely for that purpose.

CAUTION ⚠

- Be careful not to splash brake fluid on related parts as this could damage the paintwork.
- Be sure to wipe off brake fluid immediately if you splash it on the paintwork.

NOTE

- Supply and maintain brake fluid to the “MAX” level of the fluid tank.
- Make sure you maintain brake fluid at the “MAX” level of the fluid tank since the brake fluid level drops during air bleeding.
- Start engine and let it idle until brake fluid replacement is completed.
- Attach one end of  vinyl hose to air bleeder **1** of the wheel brake. Place free end in container **A** filled with brake fluid.
- Carry out air bleeding in the following sequence:

Front brake system

Right-hand side wheel brake



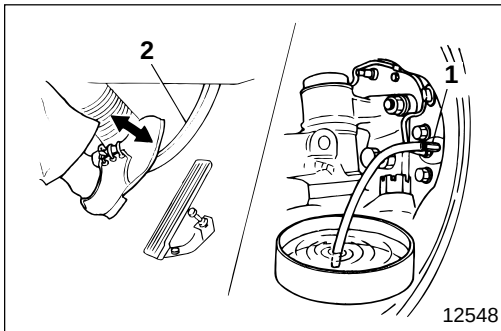
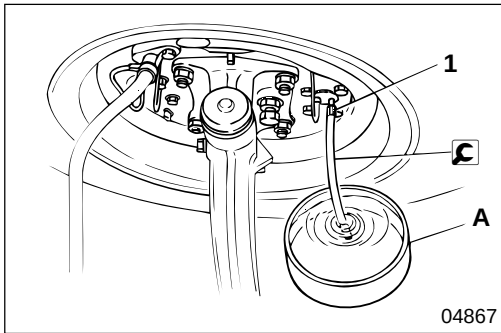
Left-hand side wheel brake

Rear brake system

Right-hand side wheel brake



Left-hand side wheel brake



- Depress brake pedal **2** slowly a few times, and with the brake pedal depressed, loosen air bleeder **1** to drain brake fluid containing air.
- Tighten air bleeder **1**, and release brake pedal **2**.
- Repeat this service procedure until air is no longer present in the fluid being drained.
- Tighten air bleeder **1** at specified torque as soon as brake fluid flowing out is free of air bubbles.
- Adjust brake shoe clearance when you have finished air bleeding.  P35-30
- Check that brake fluid comes up to level “MAX” of fluid tank. If it does not, refill with new brake fluid.
- Depress brake pedal **2** a few times and check for any leakage of brake fluid, then test the brakes.

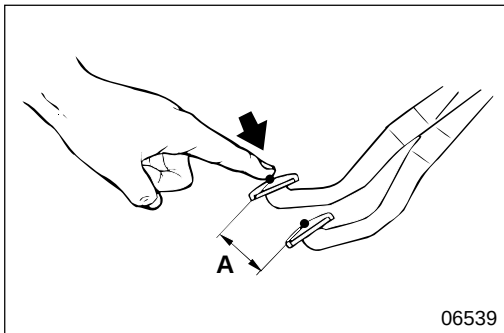
ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection and Adjustment of Brake Pedal Free Play

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Free play of brake pedal	10 to 15 {0.39 to 0.59}	—	Adjust



[Inspection]

Check if brake pedal free play **A** confirms to the standard value. If the measured value deviates from the standard value, adjust the position of the brake pedal.

[Adjustment]

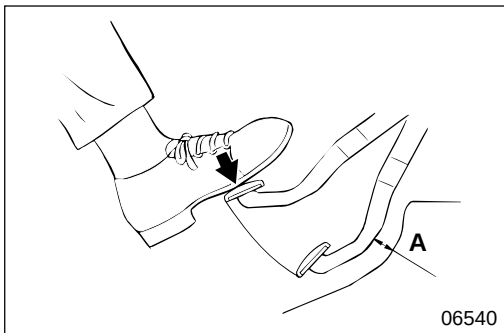
📖 P35-39

Inspection and Adjustment of Clearance between Brake Pedal and Floor Panel

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Clearance between brake pedal and floor panel (with pedal depressed at 490 N {110 lbf, 50 kgf})	52 {2.05} or more	—	Adjust



[Inspection]

Depress the brake pedal using 490 N {110 lbf, 50 kgf} when the engine is idling to check if clearance **A** between the brake pedal and the floor panel conforms to the standard value. If the measured value deviates from the standard value, adjust the position of the brake pedal.

[Adjustment]

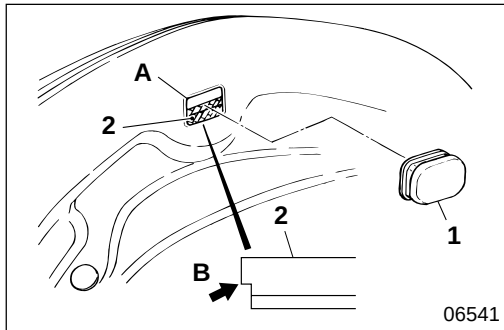
📖 P35-39

Thickness Inspection and Replacement of Brake Lining

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Thickness of brake lining	—	5.5 {0.22} (Side shoulder means wear limit)	Replace



[Inspection]

NOTE

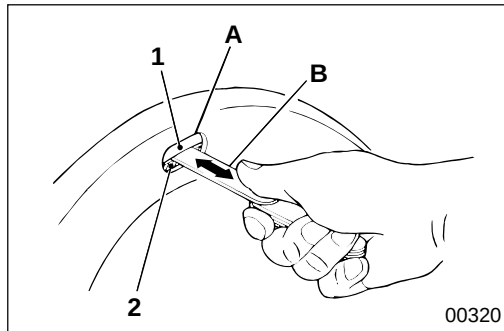
Be sure to inspect at two points for each wheel per side.

- Remove check hole plug 1 from the backing plate.
- Inspect through check hole A whether brake lining 2 is worn to the point of side shoulder B of the brake lining (the limit).
- If the measured value is lower than the limit, replace brake lining 2 on the same axle as a unit.
- After inspection, be sure to reinstall check hole plug 1.

[Replacement]

📖 P35-42, 50

Inspection of Brake Shoe Clearance



NOTE

When the vehicle is jacked up and the wheel is being turned, make sure that there is no dragging.

- Remove the check hole plug from the backing plate.
 - A : Check hole
 - Try to insert a 1 mm {0.039 in.} feeler gauge B between brake drum 1 and brake lining 2. Check that the clearance is too small to let the feeler gauge enter.
- If feeler gauge A enters the clearance, disassemble the wheel cylinder and inspect.

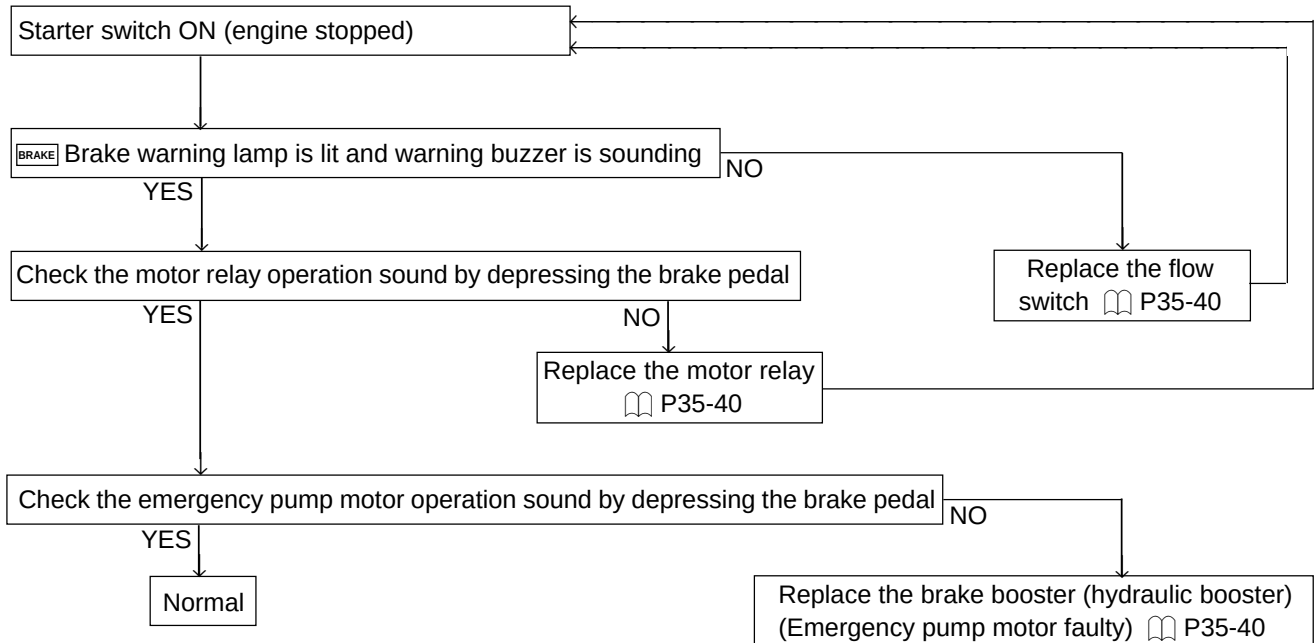
📖 P35-48, 56

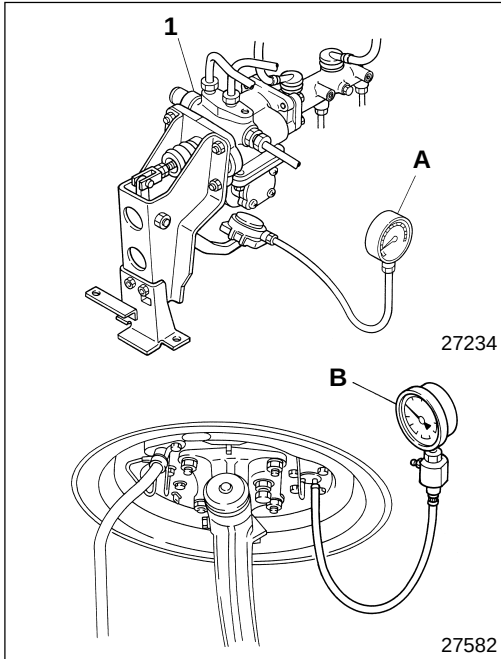
ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection of Brake Booster (Hydraulic Booster)

(1) Inspection of electric equipment

Perform inspection in accordance with the flow-chart below. Make sure the power steering fluid level sensor is working properly and power steering oil tank fluid level is normal. Make sure the parking brake is working properly and the wheels are chocked during inspection.





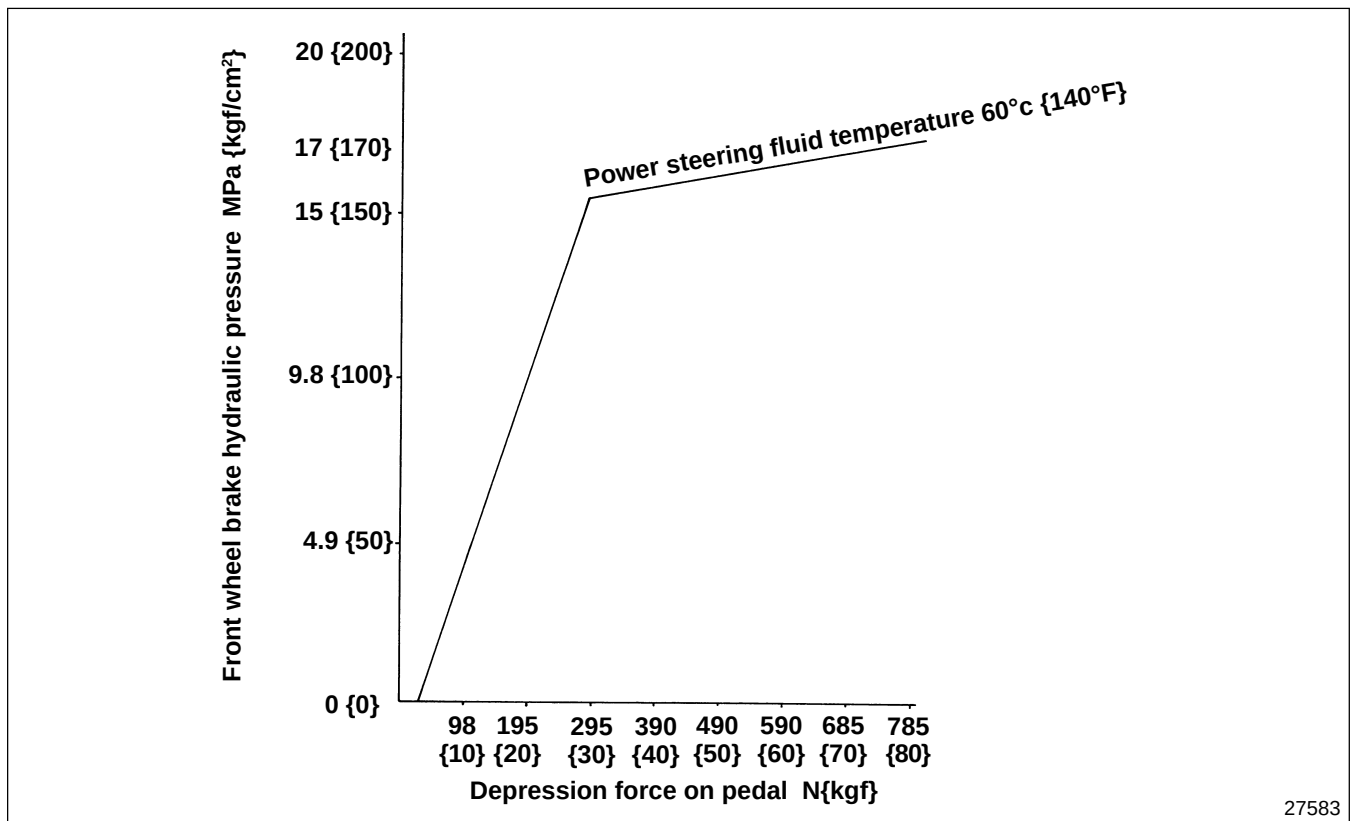
(2) Performance inspection

- Mount foot pressure meter **A** on the brake pedal, remove the front wheel brake air bleeder and after installing oil pressure gauge **B**, bleed the air from the pressure gauge.
- Carry out a performance evaluation test on the power steering system and make sure hydraulic pressure in the power steering fluid system is at a normal level. Gr 37
- If the above proves normal, check to make sure the hydraulic pressure of the front wheel brakes in response to foot pressure on the brake pedal is in conformity with the performance characteristics chart.

If faulty, replace brake booster (hydraulic booster) **1**.

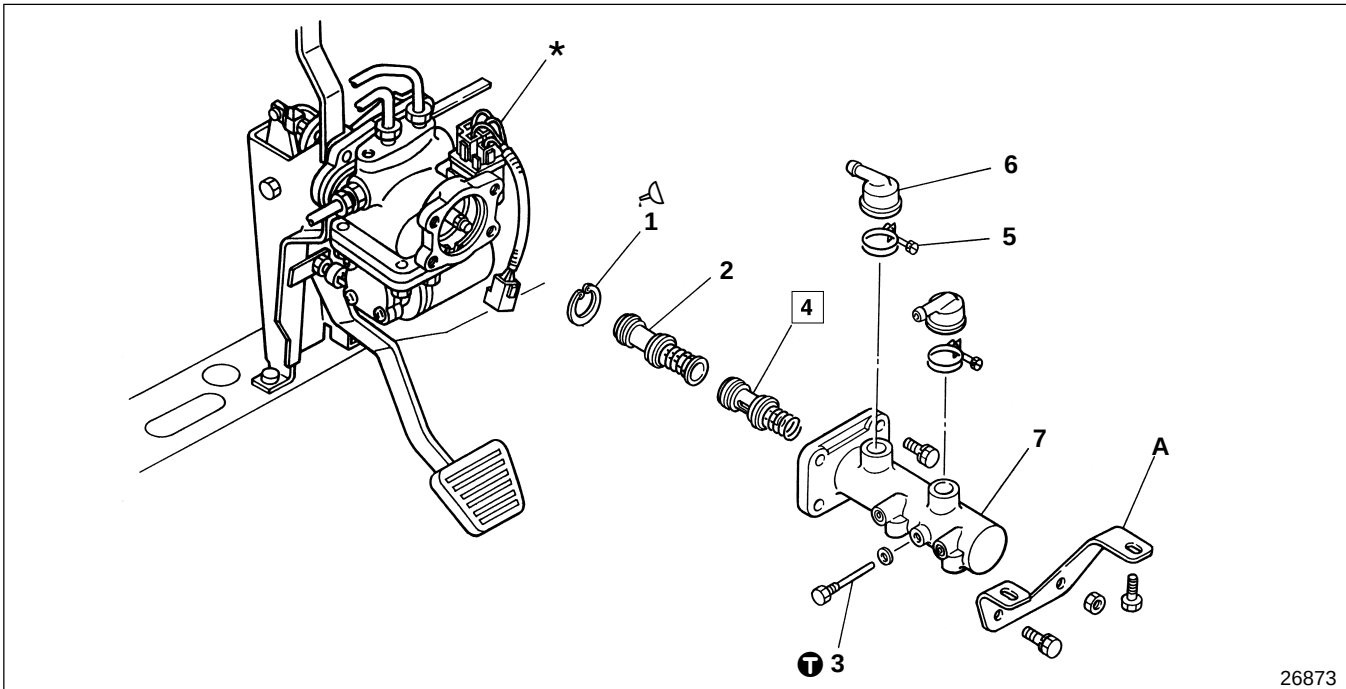
Gr 35-38

Performance characteristics chart



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BRAKE MASTER CYLINDER



26873

● Disassembly sequence

- 1 Retaining ring
- 2 Primary piston assembly
- 3 Set bolt
- 4 Secondary piston assembly

- 5 Clamp
- 6 Connector
- 7 Cylinder body

A : Brake booster support
 * : Brake pedal and brake booster (hydraulic booster) P35-38

WARNING

Be sure not to damage the inner surface of cylinder body 7, since it will cause air to get mixed in or will result in brake fluid leakage during the removal and installation of primary piston assembly 2 and secondary piston assembly 4.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
2	Primary piston assembly spring load (Installed length 35.1{1.38})	100 to 115 N {22 to 26 lbf, 10.2 to 11.7 kgf}	93 N {21 lbf, 9.5 kgf}	Replace
2, 4, 7	Clearance between primary and secondary piston assemblies and cylinder body	[41.28] 0.02 to 0.10 {[1.63] 0.00079 to 0.0039}	0.2 {0.0079}	Replace
4	Secondary piston assembly spring load (Installed length 34.1{1.34})	71 to 86 N {16 to 19 lbf, 7.2 to 8.8 kgf}	67 N {15 lbf, 6.8 kgf}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Set bolt	6.86 to 8.82 {5.1 to 6.5, 0.7 to 0.9}	—

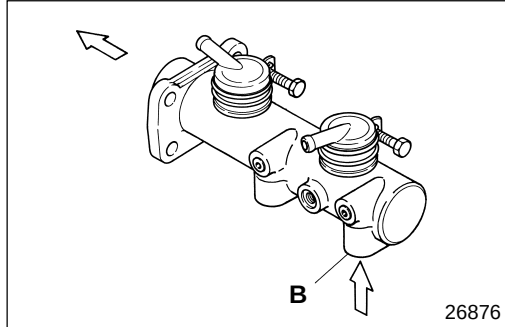
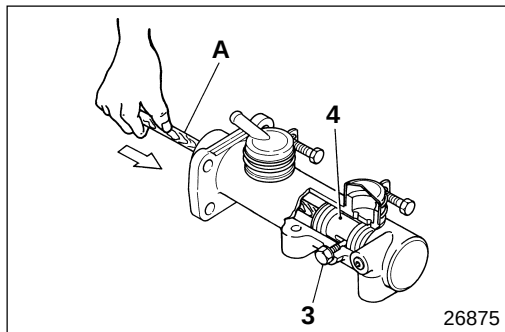
L Lubricant

Location	Points of application	Specified lubricant	Quantity
1	Periphery of retaining ring	Rubber grease	As required

◆ Service procedure**4 Secondary piston assembly**

[Removal]

- Using rod **A**, push in secondary piston assembly **4**, then loosen set bolt **3**.



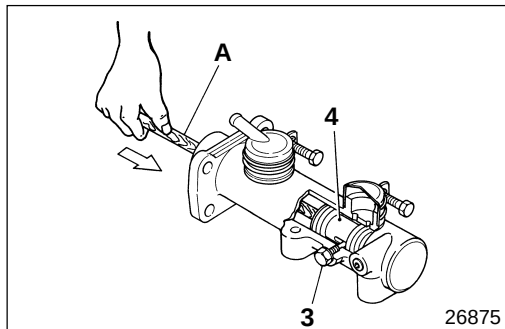
- Feed compressed air via discharge port **B** that leads to the rear wheel brake to extract secondary piston assembly **4**.

WARNING ⚠

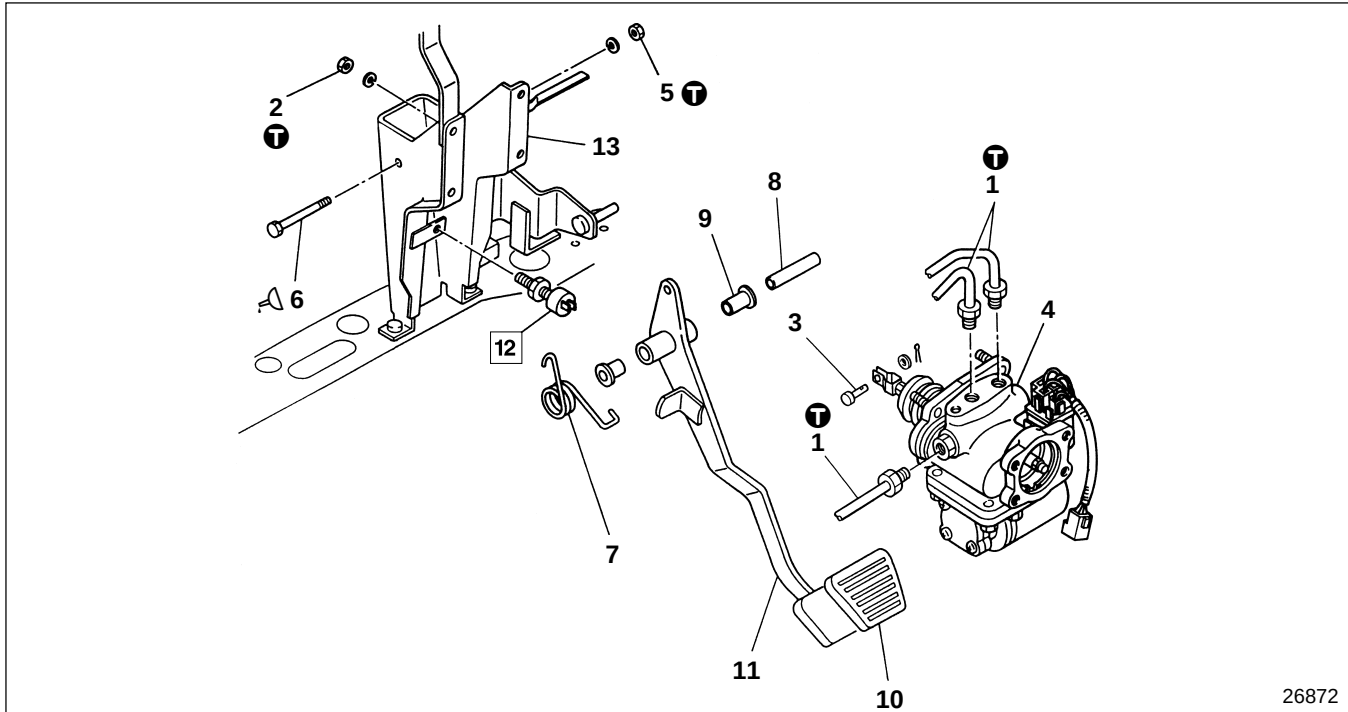
You must apply compressed air gradually when you remove secondary piston assembly **4**. If you applied compressed air strongly at one time, the secondary piston assembly would be violently ejected.

[Installation]

Using rod **A**, push in secondary piston assembly **4**, then tighten set bolt **3** at specified torque.



BRAKE PEDAL AND BRAKE BOOSTER (HYDRAULIC BOOSTER)



● Disassembly sequence

- | | | |
|-------------------------------------|----------------|---------------------|
| 1 Pipe Gr 37 | 6 Bolt | 12 Stop lamp switch |
| 2 Nut | 7 Spring | Gr 54 |
| 3 Clevis pin | 8 Collar | 13 Support assembly |
| 4 Brake booster (Hydraulic booster) | 9 Bushing | |
| P35-40 | 10 Pedal pad | |
| 5 Nut | 11 Brake pedal | |

WARNING

Power steering fluid is a mineral fluid. Make sure it does not get mixed with brake fluid (vegetable fluid) during disassembly, because it causes the rubber parts of the brake equipment to expand resulting in brake dragging or malfunction.

NOTE

Do not disassemble brake booster (hydraulic booster) 4 because it is a non-disassemble type.

● Assembly sequence

Follow the disassembly sequence in reverse.

● Adjustment after assembly P35-39

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy
8, 9	Clearance between collar and bushing		[16] 0.02 to 0.26 {0.00079 to 0.010}	0.5 {0.020}	Replace
11	Brake pedal	Height from pedal pad center to instrument panel underside	264 {10.4}	—	Adjust
		Full stroke	163 {6.42}	—	Adjust
11, 12	Clearance between brake pedal stopper and tip of stop lamp switch thread area		0 to 0.1 {0 to 0.0039}	—	Adjust

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Pipe (Brake booster connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
2	Nut (Brake booster mounting)	8.8 to 14 {6.5 to 10, 0.9 to 1.4}	—
5	Nut (Brake pedal mounting)	34.3 to 53.9 {25 to 40, 3.5 to 5.5}	—

Lubricant

Location	Points of application	Specified lubricant	Quantity
6	Friction surface of bolt bushing	Chassis grease [NLGI No.1 (Ca soap)]	As required

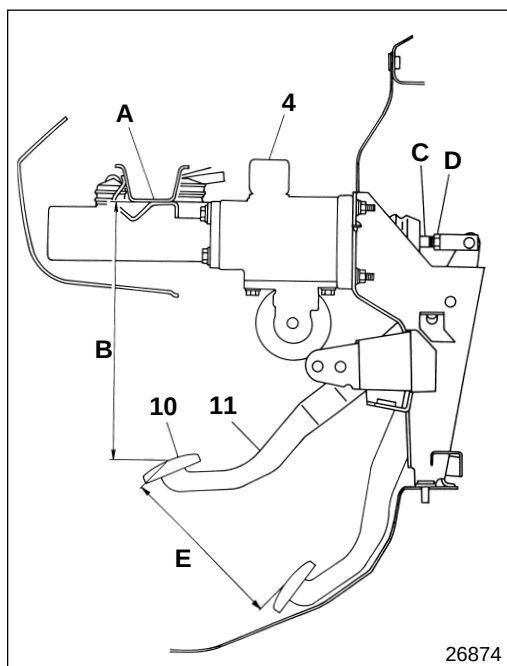
Service procedure**Adjustment after assembly**

- Adjustment of brake pedal installation height
By turning operating rod **C** of brake booster (hydraulic booster) **4**, adjust height **B** from the center of pedal pad **10** to the underside of instrument panel **A** to the standard value, then secure in place using nut **D**.

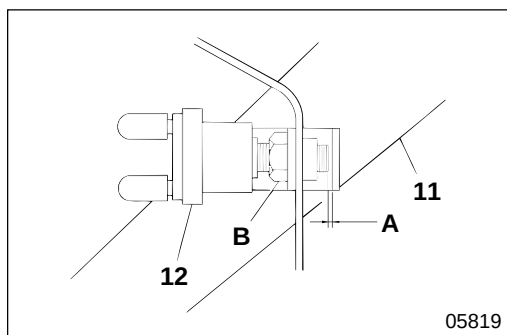
WARNING ⚠

Make sure, when brake pedal **11** is depressed fully, that operating rod **C** of brake booster (hydraulic booster) **4** functions as the stopper and the pedal does not come to a stop by hitting against the floor panel, since this will reduce brake effectiveness.

- Inspection of brake pedal full stroke
Make sure that full stroke **E** when brake pedal **11** is depressed fully conforms to the standard value.
If there is any fault, adjust the installation height of the brake pedal.
- Inspection of play towards brake pedal 📖 Gr 35-32



26874



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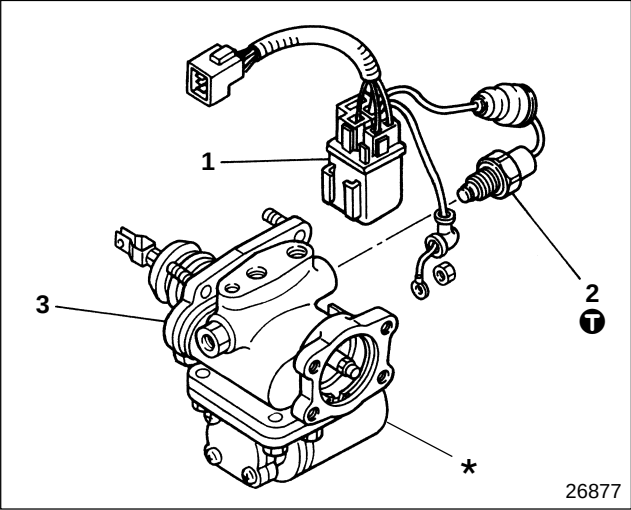
12 Adjustment of stop lamp switch

Turn stop lamp switch **12** to adjust clearance **A** between the top of the thread area of the stop lamp switch and the stopper of brake pedal **11** to the standard value, and fasten with lock nut **B**.

WARNING ⚠

Make sure, when brake pedal **11** is released, that stop lamp switch **12** does not stop the pedal, since this will cause the brake to drag.

BRAKE BOOSTER (HYDRAULIC BOOSTER)



● Disassembly sequence

- 1 Motor relay
- 2 Flow switch
- 3 Brake booster (Hydraulic booster)

*: Emergency pump motor

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

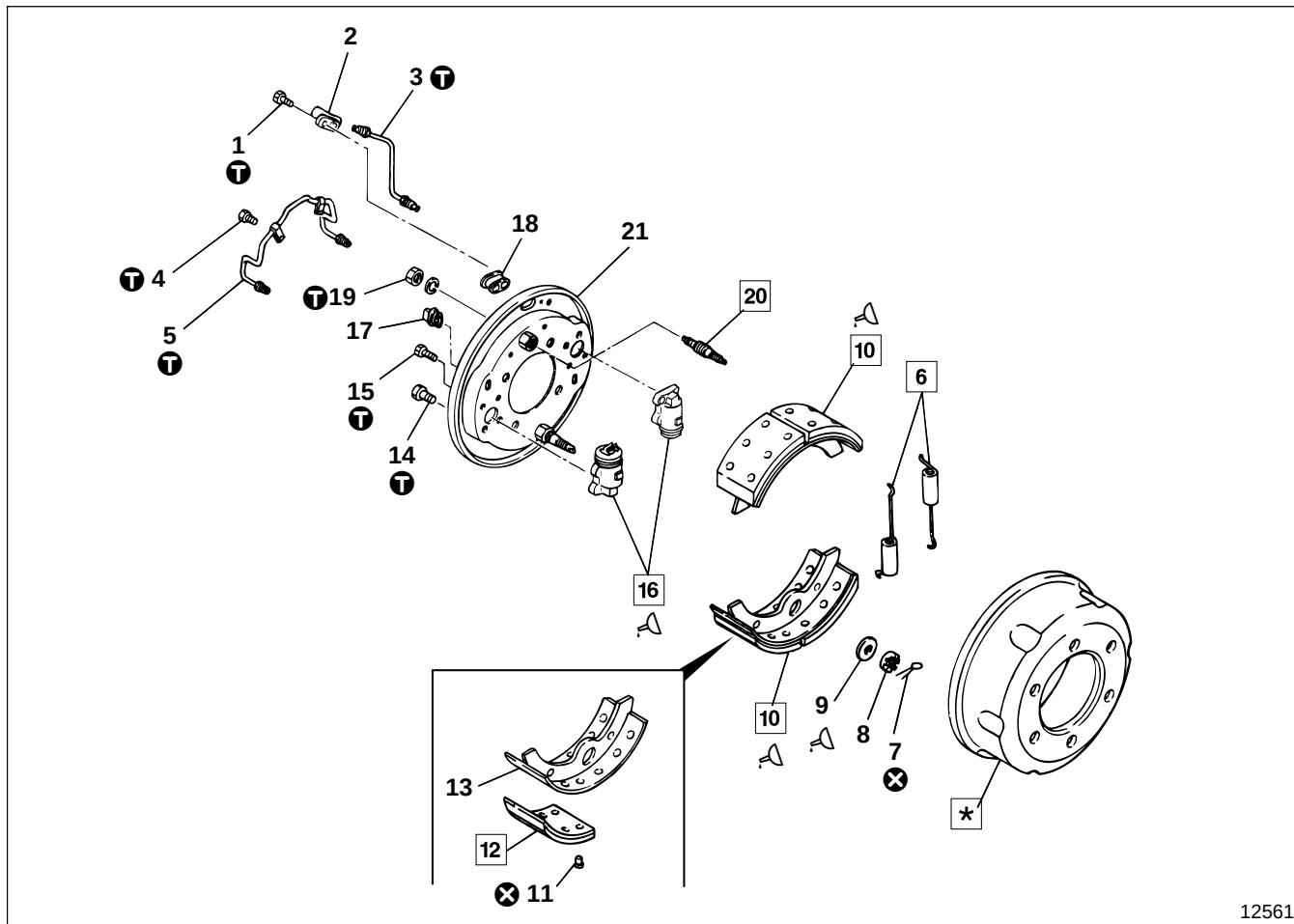
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Flow switch	24.5 to 34.3 {18 to 25, 2.5 to 3.5}	—

MEMO

FRONT WHEEL BRAKE

Front Wheel Brake Assembly



12561

● Disassembly sequence

- | | | |
|------------------|----------------------------|------------------------|
| 1 Bolt | 9 Washer | 17 Adjusting hole plug |
| 2 Joint assembly | 10 Brake shoe assembly | 18 Check hole plug |
| 3 Pipe assembly | 11 Rivet | 19 Nut |
| 4 Bolt | 12 Brake lining | 20 Holder pin |
| 5 Pipe assembly | 13 Brake shoe | 21 Backing plate |
| 6 Return spring | 14 Bolt | |
| 7 Split pin | 15 Bolt | |
| 8 Holder pin nut | 16 Wheel cylinder assembly | |
- ⊗ : Non-reusable parts
- * : Brake drum Gr 26

WARNING ⚠

Do not leave grease or oil on the surface of brake lining 12 or inner surface of brake drum * because this reduces braking performance.

CAUTION ⚠

Do not turn or remove holder pin 20 unless it is necessary, or the squareness of brake shoe assembly 10 can be influenced causing brake drag.

● Assembly sequence

Follow the disassembly sequence in reverse.
Repair kit : Brake lining kit

● Initial adjustment of brake shoe clearance after installation

📖 P35-43

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
6	Return spring load (Installed length 192 {7.56})		325 N {73 lbf, 33 kgf}		Clearance between coils or coil and cover	Replace
12	Brake lining thickness		12.0 {0.47}		5.0 {0.20} (Side shoulder means wear limit)	Replace brake lining
*	Brake drum	Inner diameter	320 {12.5}	*321 {12.64}	322 {12.68}	Replace
		Cylindrical accuracy	0.05 {0.0020}		0.2 {0.0079}	Correct or replace

* : Indicates correction limit.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Joint assembly mounting)	9.8±1.0 {7.2±1.4, 1.0±0.2}	—
3, 5	Flair nut (Pipe assembly mounting)	14±2.0 {10±1.4, 1.4±0.2}	—
4	Bolt (Pipe clamp mounting)	4.9±1.0 {3.6±0.7, 0.5±0.1}	—
14	Bolt (Wheel cylinder assembly mounting)	78±16 {58±12, 8.0±1.6}	—
15	Bolt (Wheel cylinder assembly mounting)	44±8.8 {33±6.5, 4.5±0.9}	—
19	Nut (Holder pin mounting)	29±5.9 {22±4.3, 3.0±0.6}	—

Lubricant

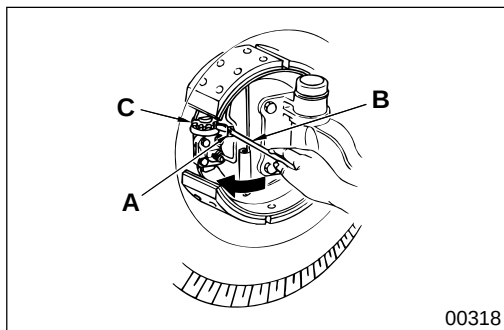
Location	Points of application	Specified lubricant	Quantity
9, 10, 16	Contact areas between washer and brake shoe assembly; and between brake shoe assembly and wheel cylinder assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure**● Initial adjustment of brake shoe clearance after installation**

- Jack up the front wheels, and make sure that there is no play in the hub bearings.
- Insert screwdriver **B** into adjusting hole **A** and turn adjuster **C** in the direction of the arrow marked on backing plate **21** until the wheel drags slightly when turned by hand.

NOTE

- Be sure to adjust the clearance at two points for each wheel per side.
- The arrow mark on backing plate **21** is near adjusting hole **A**.



FRONT WHEEL BRAKE

- After depressing the brake pedal several times, release it and make sure that the wheel drags lightly when turned by hand. If the wheel turns without stress, repeat the above steps. Slacken off adjuster **B**, in the reverse direction to the arrow mark, by eight or nine notches.

NOTE

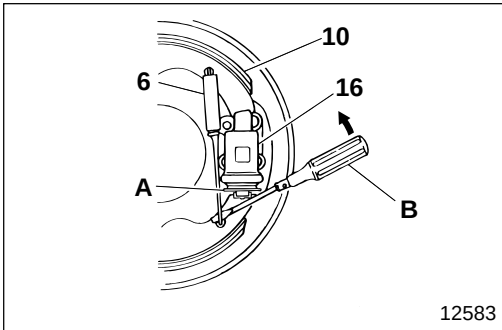
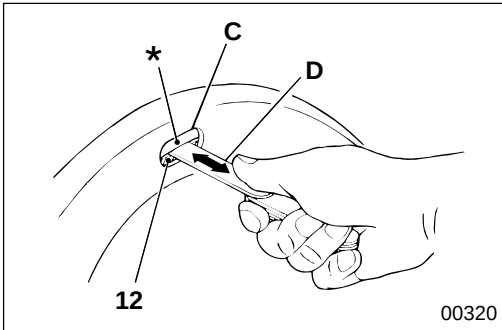
Be sure to adjust the clearance at two points for each wheel per side.

- Make sure that the wheel does not drag when turned by hand. If the wheel drags, repeat the above steps.

- Insert feeler gauge **D** between brake drum ***** and brake lining **12** through check hole **C**, and make sure that a little resistance is felt when the feeler gauge is pulled out or pushed in.

NOTE

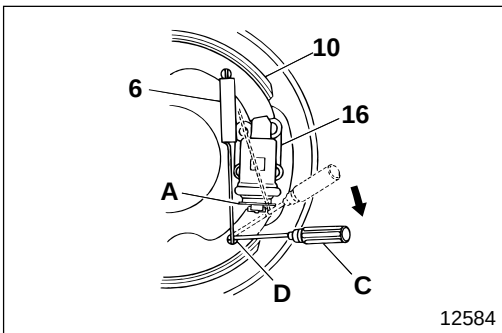
Be sure to adjust the clearance at two points for each wheel per side.



6 Return Spring

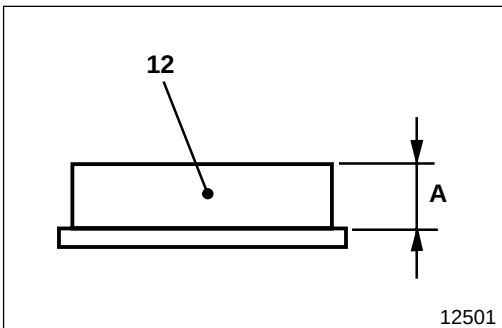
[Removal]

To remove return spring **6**, place screwdriver **B** on the hook of the return spring, then pry and remove the return spring making use of wheel cylinder assembly **16** adjuster **A** as a fulcrum.



[Installation]

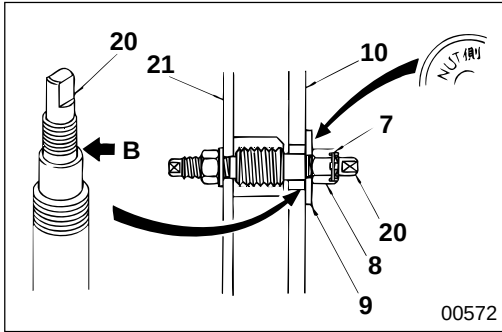
- Install the shorter hook end of return spring **6** in brake shoe assembly **10** at the side opposite to adjuster **A** of wheel cylinder assembly **16**.
- Insert a small Phillips screwdriver **C** into the hook of return spring **6**, insert the tip of the screwdriver into return spring installation hole **D** of the brake shoe assembly to pry on the return spring.



10 Brake shoe assembly

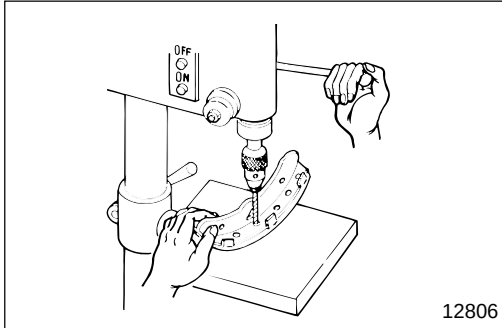
[Inspection]

If thickness **A** of brake lining **12** is lower than the limit replace the brake lining on the same axle as a unit.

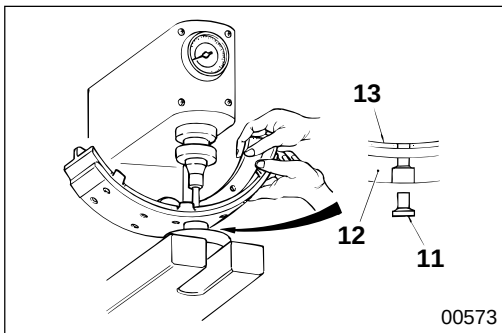


[Installation]

- Install brake shoe assembly **10**.
- Insert washer **9** with the side stamped "NUT 側" facing outside, screw down holder pin nut **8** until washer hits stepped area **B** of holder pin **20** gently, then slacken off the nut within the 0 to 60° limit until the nut is aligned with the first split pin hole.
- Insert split pin **7**, and bend it securely.

**12 Brake lining**

[Removal]



[Installation]

- Clean the mounting surfaces of brake lining **12** and brake shoe **13** with cleaning fluid and dry them.
- Insert rivets **11** from brake lining **12** side, and caulk the rivets at the specified load so that there is no clearance between brake shoe **13** and the brake lining.

Caulking load for rivets : 17 to 19 kN {3750 to 4190 lbf, 1700 to 1900 kgf}

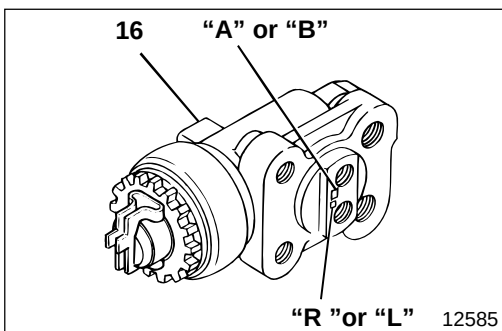
- Make sure that you inspect contact with the inner surface of brake drum * after you replace brake linings **12**. If contact is incorrect, correct with the brake assembled.

WARNING ⚠

Do not leave lubricant on the surface of brake lining **12** because this reduces braking performance.

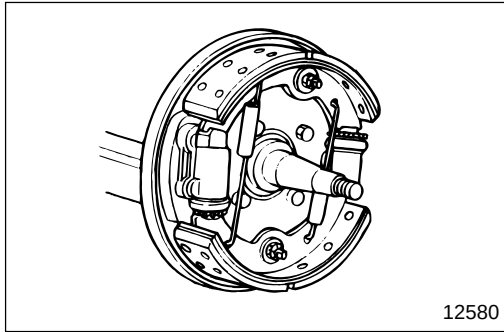
CAUTION ⚠

Make sure that the type of brake linings **12** you fit are suitable for the intended use of the vehicle. Make sure that you fit identical size and color coated linings on the left and right sides of one shaft.

**16 Installation of wheel cylinder assembly**

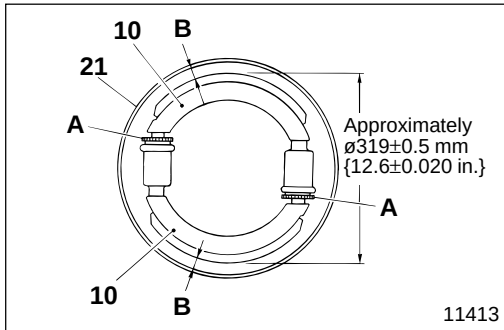
Identification mark	Installation position
RA	Front of front axle right wheel
RB	Rear of front axle right wheel
LA	Front of front axle left wheel
LB	Rear of front axle left wheel

FRONT WHEEL BRAKE

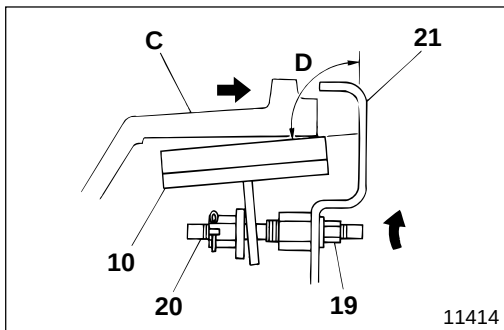


20 Adjustment of holder pin

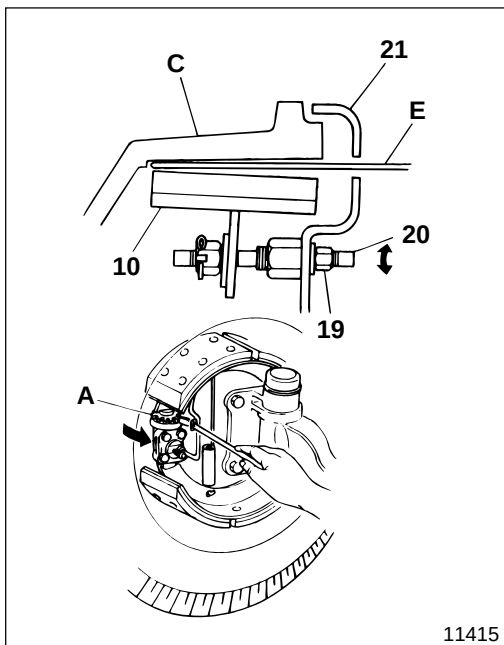
- Install the front wheel brake assembly on the front axle. Gr 26



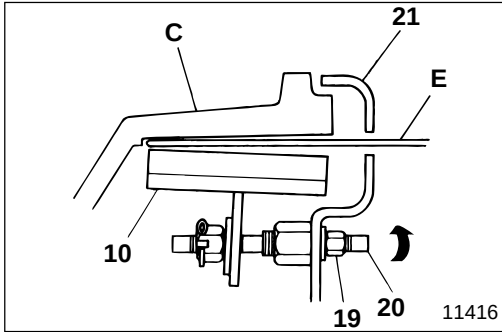
- Turn adjuster **A** to adjust the outer diameter to approximately $\varnothing 319 \pm 0.5 \text{ mm}$ {12.6 $\pm$ 0.020 in.}.
- Then, move brake shoe assembly **10** to adjust clearance **B** evenly.



- Install hub and drum assembly **C** on the front wheel brake assembly. Gr 26
At this time, the hub and drum assembly cannot be inserted in the specified position if squareness **D** is 90° or more, so loosen nut **19** and turn holder pin **20** to adjust the squareness to as close to 90° as possible.
- Bleed the brake system. P35-30



- ★ Turn adjuster **A** to widen brake shoe assembly **10** until 0.2 mm {0.0079 in.} feeler gauge **E** cannot be pulled out easily.
- ★ Loosen nut **19** and turn holder pin **20** to the right or left so that feeler gauge **E** can be pushed in or pulled out easily.
- Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.
- Depress the brake pedal a few times lightly to equalize clearance **B** (adjusted in the previous section).
- Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.



- If feeler gauge **E** cannot be pushed in or pulled out easily it is because it is making contact over the full width of brake shoe assembly **10**.
- Turn holder pin **20** so that when you pull out feeler gauge **E**, in the above condition, and reinsert the feeler gauge, pushing in or pulling out the feeler gauge at the rear is difficult.
- After adjustment, tighten nut **19** at specified torque.

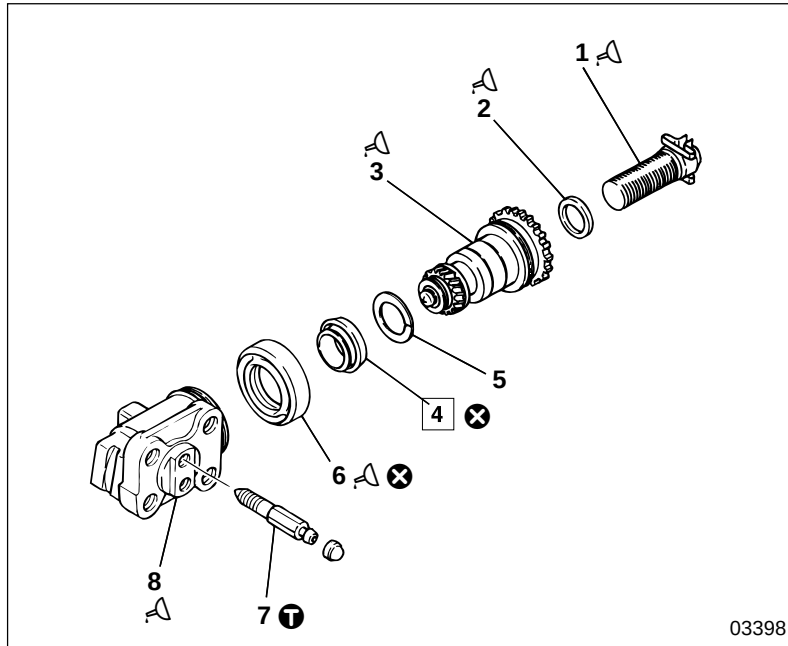


Correction of brake drum

If the cylindrical accuracy of brake drum ***** is higher than the limit, or there are seams, correct by machining to the correction limit. Machining of the brake drum should be done with the wheel hub attached as an integral part.

FRONT WHEEL BRAKE

Wheel Cylinder Assembly



● Disassembly sequence

- 1 Screw
- 2 Seal
- 3 Piston
- 4 Piston cup
- 5 Backup ring
- 6 Boot
- 7 Air bleeder (only at the rear)
- 8 Body

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3, 8	Clearance between piston and body	[34.93] 0.03 to 0.09 {[1.38] 0.0012 to 0.0035}	0.2 {0.0079}	Replace piston

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

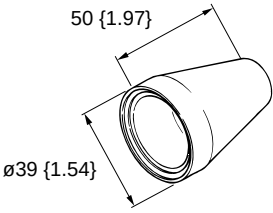
Location	Parts to be tightened	Tightening torque	Remarks
7	Air bleeder	9.8±2.0 {7.2±1.4, 1.0±0.2}	—

L Lubricant

Location	Points of application	Specified lubricant	Quantity
1, 2, 3, 6, 8	Thread area of screw, outer periphery of seal, outer periphery of piston, mounting groove and thread area of boot, and inner surface of body	Rubber grease	As required

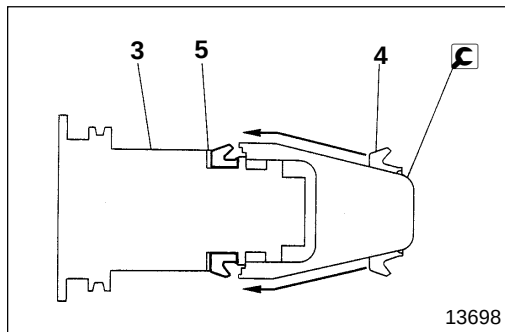
 Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
4	Piston cup guide  13697	MC895722	Installation of piston cup

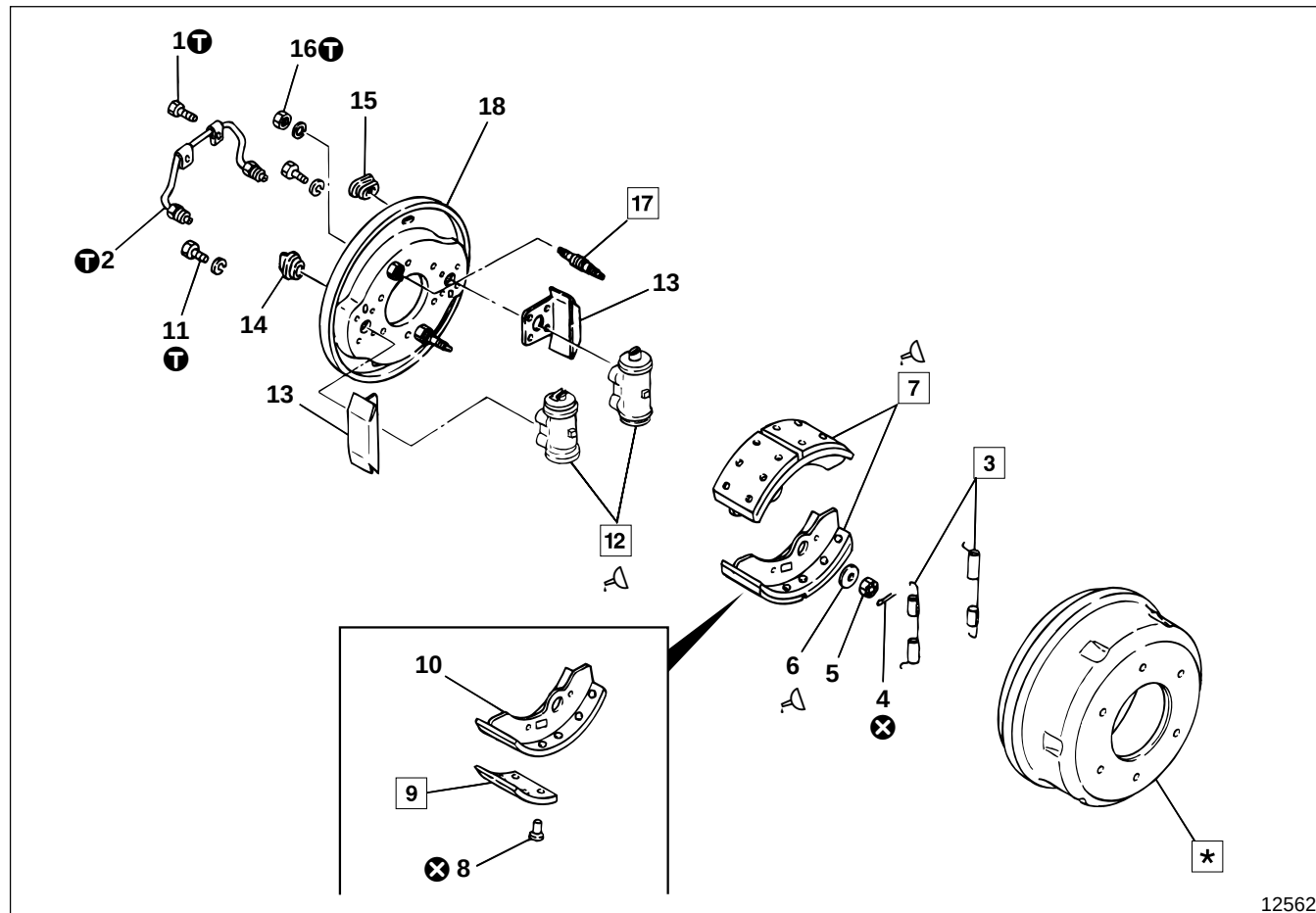
◆ **Service procedure**

4 Installation of piston cup



REAR WHEEL BRAKE

Rear Wheel Brake Assembly



12562

● Disassembly sequence

- | | | |
|-----------------------|----------------------------|------------------------|
| 1 Bolt | 8 Rivet | 14 Adjusting hole plug |
| 2 Pipe assembly | 9 Brake lining | 15 Check hole plug |
| 3 Return spring | 10 Brake shoe | 16 Nut |
| 4 Split pin | 11 Bolt | 17 Holder pin |
| 5 Holder pin nut | 12 Wheel cylinder assembly | 18 Backing plate |
| 6 Washer | ⓘ P35-56 | |
| 7 Brake shoe assembly | 13 Wheel cylinder cover | ⊗ : Non-reusable parts |
| | | * : Brake drum Gr 27 |

WARNING ⚠

Do not leave grease or oil on the surface of brake lining 9 or inner surface of brake drum * because this reduces braking performance.

CAUTION ⚠

Do not turn or remove holder pin 17 unless it is necessary, or the squareness of brake shoe assembly can be influenced causing brake drag.

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Brake lining kit

● Initial adjustment of brake shoe clearance after installation

ⓘ P35-51

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value		Limit	Remedy
3	Return spring load (Installed length 217 {8.54})		390 N {88 lbf, 40 kgf}		Clearance between coils or coil and cover	Replace
9	Brake lining thickness		12.0 {0.47}		5.0 {0.20} (Side shoulder means wear limit)	Replace lining
*	Brake drum	Inner diameter	320 {12.5}	*321 {12.64}	322 {12.68}	Replace
		Cylindrical accuracy	0.05 {0.0020}		0.2 {0.0079}	Correct or replace

* : Indicates correction limit.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Pipe clamp mounting)	4.9±1.0 {3.6±0.7, 0.5±0.1}	—
2	Flair nut (Pipe assembly mounting)	14±2.0 {10±1.4, 1.4±0.2}	—
11	Bolt (Wheel cylinder assembly mounting)	78±16 {58±12, 8.0±1.6}	—
16	Nut (Holder pin mounting)	29±5.9 {22±4.3, 3.0±0.6}	—

L Lubricant

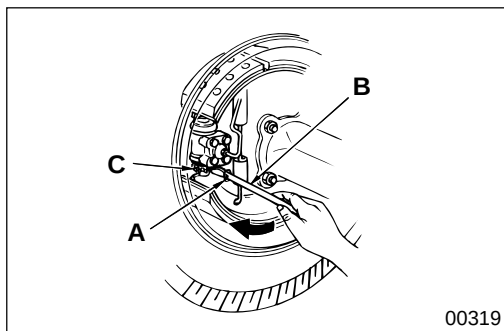
Location	Points of application	Specified lubricant	Quantity
6, 7, 12	Contact areas between washer and brake shoe assembly; and between brake shoe assembly and wheel cylinder assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure**● Initial adjustment of brake shoe clearance after installation**

- Jack up the front wheels, and make sure that there is no play in the hub bearings.
- Insert screwdriver **B** into adjusting hole **A** and turn adjuster **C** in the direction of the arrow marked on the back plate until the wheel drags slightly when turned by hand.

NOTE

- Be sure to adjust the clearance at two points for each wheel per side.
- The arrow mark on backing plate 18 is near adjusting hole A.



REAR WHEEL BRAKE

- After depressing the brake pedal several times, release it and make sure that the wheel drags lightly when turned by hand. If the wheel turns without stress, repeat the above steps. Slacken off adjuster **B**, in the reverse direction to the arrow mark, by eight or nine notches.

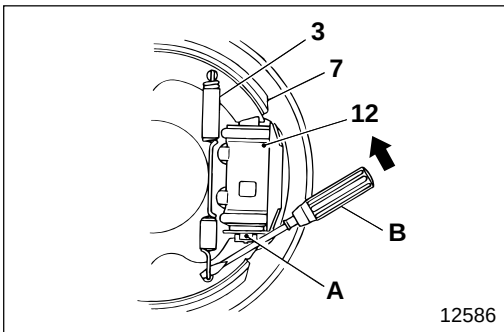
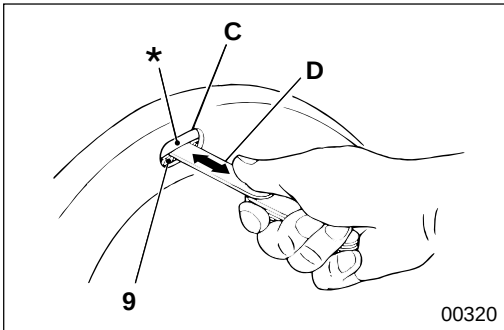
NOTE

Be sure to adjust the clearance at two points for each wheel per side.

- Make sure that the wheel does not drag when turned by hand. If the wheel drags, repeat the above steps.
- Insert feeler gauge **D** between brake drum ***** and lining **9** through check hole **C**, and make sure that a little resistance is felt when the feeler gauge is pulled out or pushed in.

NOTE

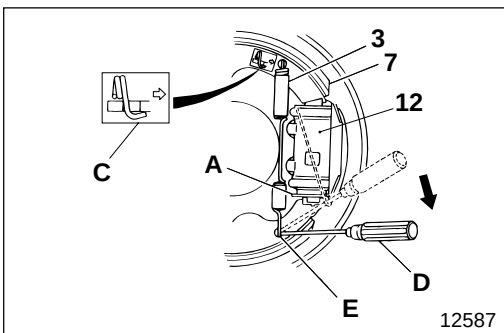
Be sure to adjust the clearance at two points for each wheel per side.



3 Return Spring

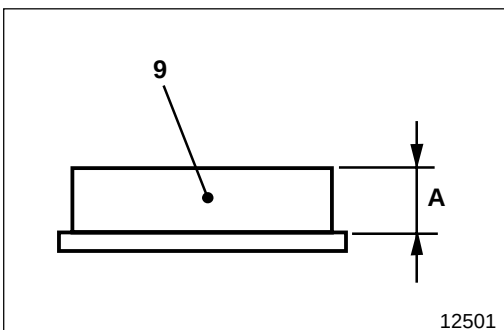
[Removal]

To remove return spring **3**, place screwdriver **B** on the hook of the return spring, then pry and remove the return spring making use of wheel cylinder assembly **12** adjuster **A** as a fulcrum.



[Installation]

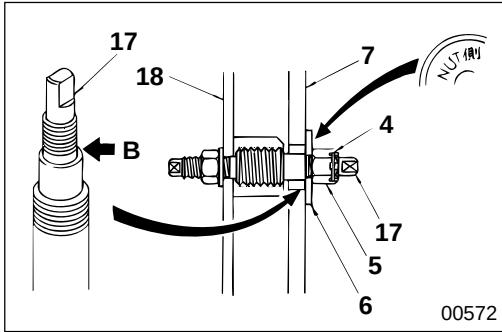
- Refer to the illustration on the caution plate fitted to brake shoe assembly **7** or marking **C**, and connect shorter hook end of return spring **3** to the brake shoe assembly at the side opposite the adjuster of wheel cylinder assembly **12**.
- Insert a small Phillips screwdriver **D** into the hook of return spring **3**, insert the tip of the screwdriver into return spring installation hole **E** of brake shoe assembly **7** to pry on the return spring.



7 Brake shoe assembly

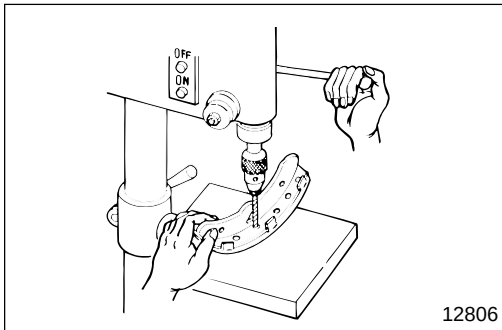
[Inspection]

If thickness **A** of brake lining **9** is lower than the limit replace the brake lining on the same axle as a unit.

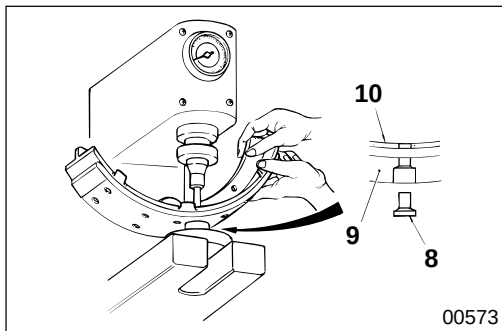


[Installation]

- Install brake shoe assembly 7.
- Insert washer 6 with the side stamped "NUT 側" facing outside, screw down holder pin nut 5 until washer hits stepped area B of holder pin 17 gently, then slacken off the nut within the 0 to 60° limit until the nut is aligned with the first split pin hole.
- Insert split pin 4, and bend it securely.

**9 Brake lining**

[Removal]



[Installation]

- Clean the mounting surfaces of brake lining 9 and brake shoe 10 with cleaning fluid and dry them.
- Insert rivets 8 from brake lining 9 side, and caulk the rivets at the specified load so that there is no clearance between brake shoe 10 and the brake lining.

Caulking load for rivets : 17 to 19 kN {3750 to 4190 lbf, 1700 to 1900 kgf}

- Make sure that you inspect contact with the inner surface of brake drum ★ after you replace brake linings 9. If contact is incorrect, correct with the brake assembled.

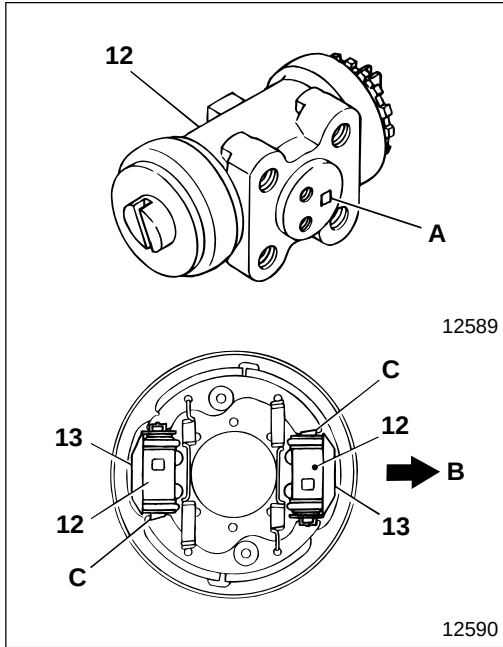
WARNING ⚠

Do not leave lubricant on the surface of brake lining 9 because this reduces braking performance.

CAUTION ⚠

Make sure that the type of brake linings 9 you fit are suitable for the intended use of the vehicle. Make sure that you fit identical size and color coated linings on the left and right sides of one shaft.

REAR WHEEL BRAKE



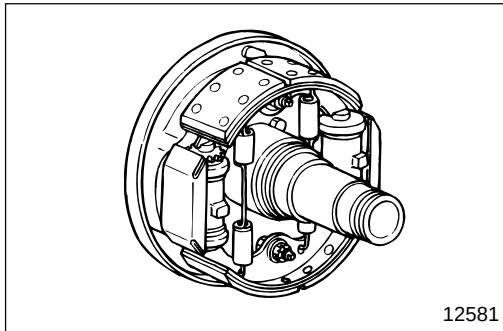
12 Installation of wheel cylinder assembly

A : Identification mark

Identification mark	Installation position
R	Right wheel forward
L	Left wheel forward
No mark	Left and right wheel rearward

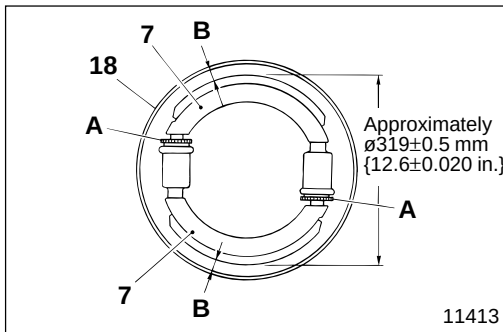
- Install anchor piece **C** so its recession is at the deeper side of the brake shoe at the outside.

B : Front of the vehicle

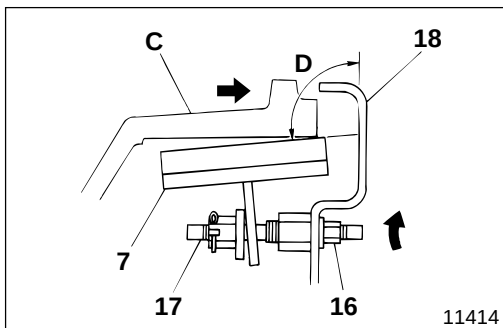


17 Adjustment of holder pin

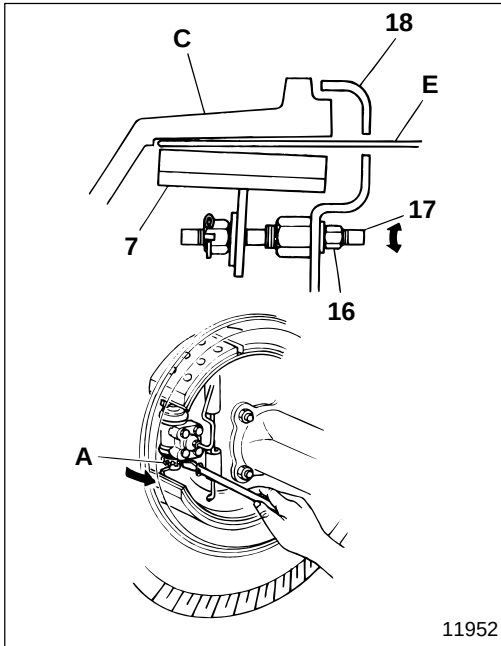
- Install the rear wheel brake assembly on the rear axle. Gr 27



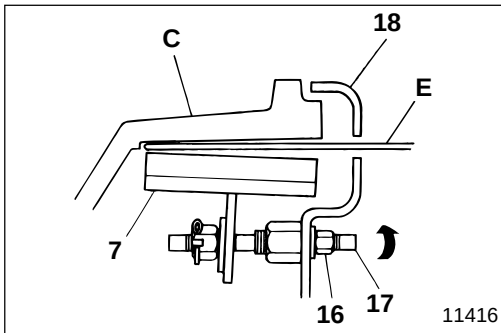
- Turn adjuster **A** to adjust the outer diameter to approximately $\varnothing 319 \pm 0.5 \text{ mm}$ {12.6±0.020 in.}.
- Then, move brake shoe assembly **7** to adjust clearance **B** evenly.



- Install hub and drum assembly **C** on the rear wheel brake assembly. Gr 27
At this time, the hub and drum assembly cannot be inserted in the specified position if squareness **D** is 90° or more, so loosen nut **16** and turn holder pin **17** to adjust the squareness to as close to 90° as possible.
- Bleed the brake system. P35-30



- ★ • Turn adjuster **A** to widen brake shoe assembly **7** until 0.2 mm {0.0079 in.} feeler gauge **E** cannot be pulled out easily.
- ★ • Loosen nut **16** and turn holder pin **17** to the right or left so that feeler gauge **E** can be pushed in or pulled out easily.
 - Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.
 - Depress the brake pedal a few times lightly to equalize clearance **B** (adjusted in the previous section).
 - Repeat the above steps (marked ★) until feeler gauge **E** cannot be pushed in or pulled out easily.



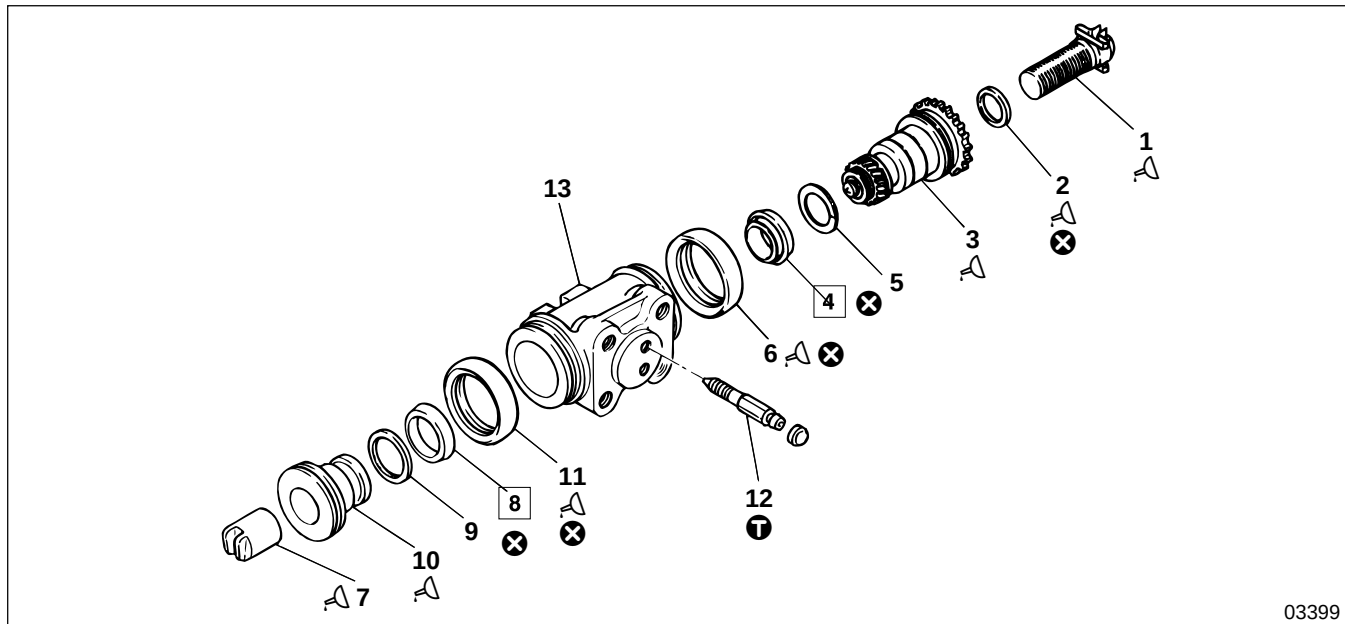
- If feeler gauge **E** cannot be pushed in or pulled out easily it is because it is making contact over the full width of brake shoe assembly **7**.
- Turn holder pin **17** so that when you pull out feeler gauge **E**, in the above condition, and reinsert the feeler gauge, pushing in or pulling out the feeler gauge at the rear is difficult.
- After adjustment, tighten nut **16** at specified torque.

★ Correction of brake drum

If the cylindrical accuracy of brake drum ★ is higher than the limit, or there are seams, correct by machining to the correction limit. Machining of the brake drum should be done with the wheel hub attached as an integral part.

REAR WHEEL BRAKE

Wheel Cylinder Assembly



03399

Disassembly sequence

- | | | |
|---------------|----------------|----------------------------------|
| 1 Screw | 7 Anchor piece | 12 Air bleeder |
| 2 Seal | 8 Piston cup | (Only identification marks L, R) |
| 3 Piston | 9 Backup ring | 13 Body |
| 4 Piston cup | 10 Piston | |
| 5 Backup ring | 11 Boot | |
| 6 Boot | | ⊗ : Non-reusable parts |

Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Wheel cylinder kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
3, 10, 13	Clearance between piston and body	[36.51] 0.03 to 0.09 {[1.44] 0.0012 to 0.0035}	0.2 {0.0079}	Replace piston

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

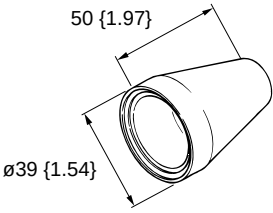
Location	Parts to be tightened	Tightening torque	Remarks
12	Air bleeder	9.8±2.0 {7.2±1.4, 1.0±0.2}	—

Lubricant

Location	Points of application	Specified lubricant	Quantity
1, 2, 3, 6, 10, 11	Thread area of screw, outer periphery of seal, outer periphery of piston, mounting groove and thread area of boot, and inner surface of body	Rubber grease	As required
7	Bottom surface of anchor piece	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

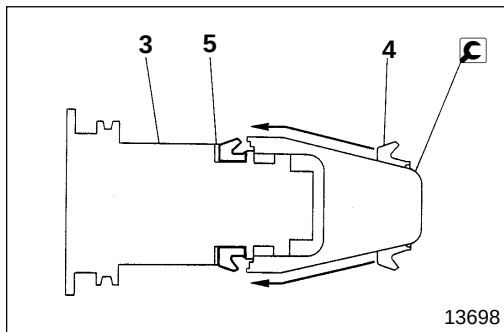
Special tools

Unit : mm {in.}

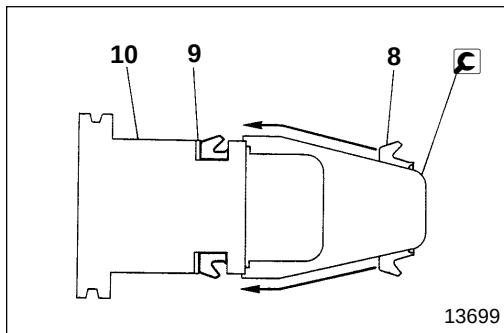
Location	Tool name and shape	Part No.	Application
4, 8	Piston cup guide  13697	MC895722	Installation of piston cup

Service procedure

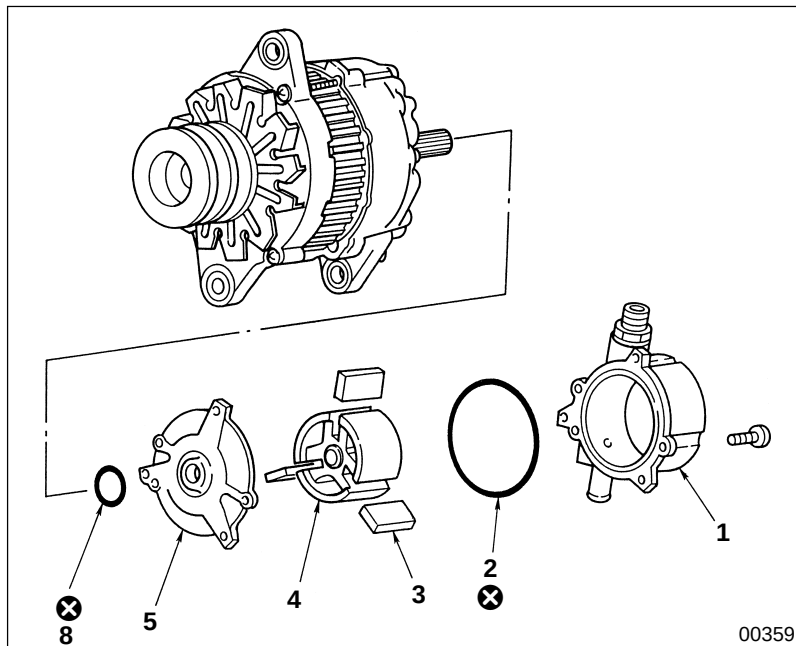
4 Installation of piston cup



8 Installation of piston cup



VACUUM PUMP



● Disassembly sequence

- 1 Vacuum housing
- 2 O-ring
- 3 Vane
- 4 Rotor
- 5 Plate
- 6 O-ring

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

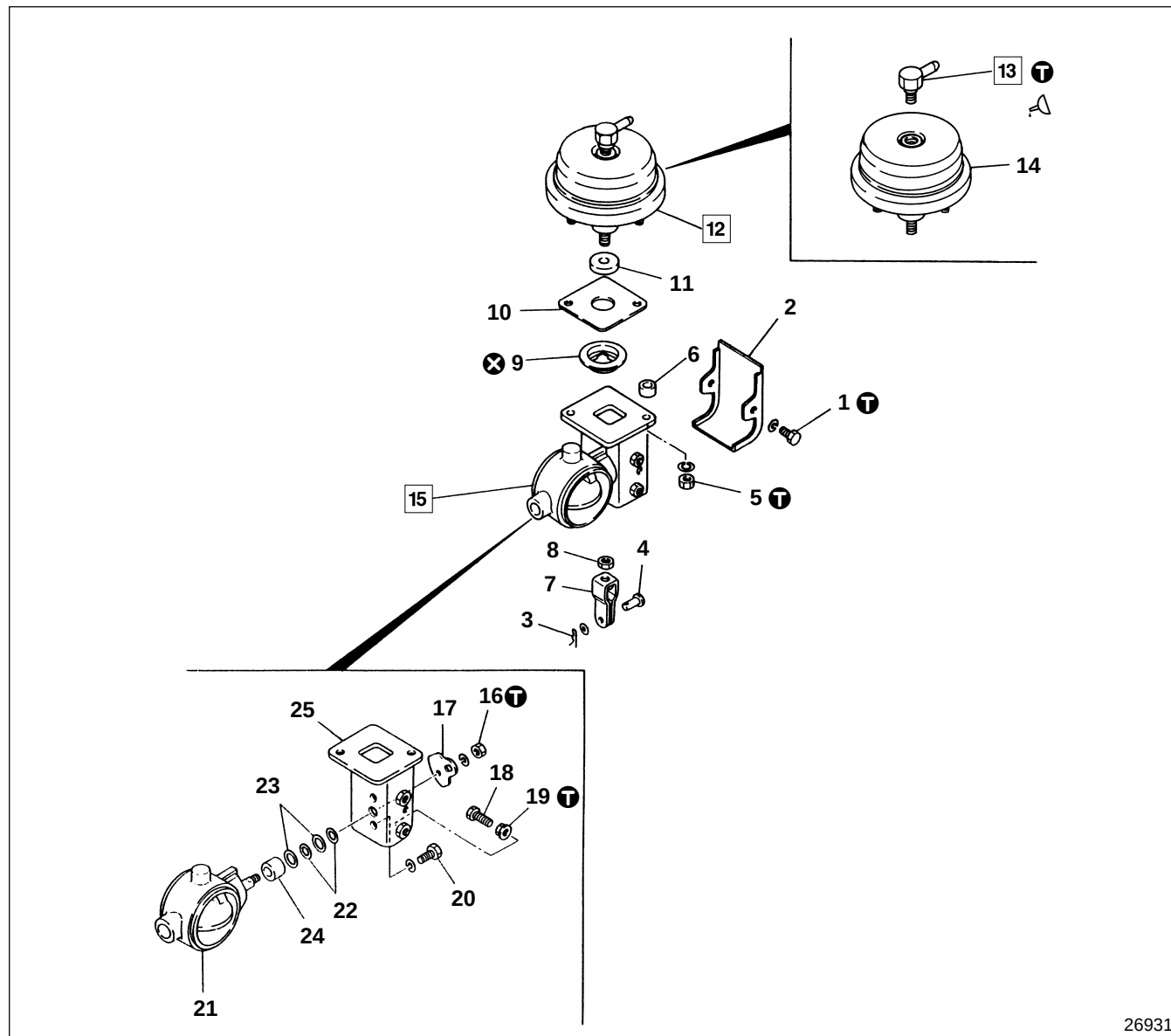
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Ultimate vacuum (When alternator number of revolutions is 1500 rpm)	93.3 kPa {27.6 in.Hg, 700 mmHg} or more	—	—

MEMO

EXHAUST BRAKE SYSTEM

Exhaust Brake Unit



- **Disassembly sequence**

- | | | |
|-------------------------|---|--|
| 1 Bolt | 10 Retainer | 19 Lock nut |
| 2 Cover | 11 Bearing | 20 Bolt |
| 3 Pin | 12 Vacuum chamber assembly | 21 Valve assembly |
| 4 Clevis pin | 13 Connector | 22 Seal ring (Small) |
| 5 Nut | 14 Vacuum chamber  P35-64 | 23 Seal ring (Large) |
| 6 Collar | 15 Valve and bracket assembly | 24 Bushing |
| 7 Clevis | 16 Nut | 25 Bracket assembly |
| 8 Lock nut | 17 Lever | |
| 9 Dust protector | 18 Adjusting bolt |  : Non-reusable parts |

⊗ : Non-reusable parts

● Assembly sequence

12 : 14→13

15 : 21→24→23→22 —
 25 — →20→19→18→17→16

15→9 —
 12→11→10→6 — →5→8→7→4→3→2→1

● Adjustment after assembly

📖 P35-62

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
12	Airtightness in vacuum chamber (Airtightness 15 seconds after applying negative pressure 67 kPa {19.7 in.Hg, 500 mmHg})	63 kPa {18.7 in.Hg, 475 mmHg} or more	—	Replace
—	Clearance between valve assembly butterfly valve and body when butterfly valve is fully closed (Degree of negative pressure in power chamber 87 to 93 kPa {25.6 to 27.6 in.Hg, 650 to 700 mmHg})	0.4 to 0.6 {0.016 to 0.023}	—	Adjust

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Cover mounting)	4.9 to 6.9 {3.6 to 5.0, 0.5 to 0.7}	—
5, 16	Nut (Vacuum chamber and lever mounting)	9.8 to 16 {7.3 to 11.5, 1.0 to 1.6}	—
13	Connector	9.8 {7.3, 1} or more	—
19	Lock nut (Adjusting bolt mounting)	4.9 to 6.9 {3.6 to 5.0, 0.5 to 0.7}	—

🔧 Sealant

Location	Points of application	Specified sealant	Quantity
13	Thread area of connector	THREEBOND 1211	As required

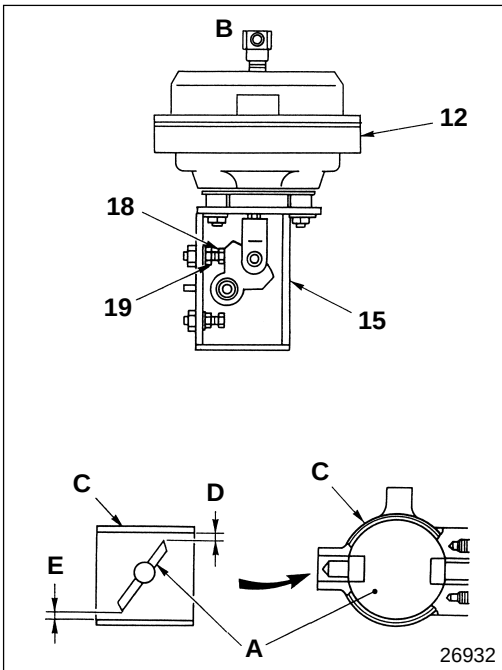
EXHAUST BRAKE SYSTEM

◆ Service procedure

● Adjustment after assembly

Adjustment of valve when fully-closed

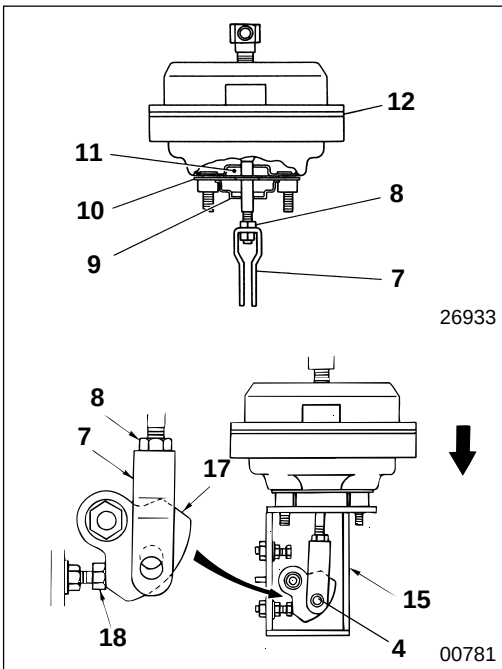
- While applying negative pressure **B** of 87 to 93 kPa {25.6 to 27.5 in.Hg, 650 to 700 mmHg} to vacuum chamber assembly **12**, adjust by turning adjusting bolt **18** so that clearance **D** and **E** between the butterfly valve and body **C** conforms to the standard value.
- After adjustment, tighten lock nut **19** at specified torque.
- Average value of clearance **D**, **E** = $(D + E)/2$.
- Fully-opened adjustment of butterfly valve **A** is done while valve and bracket assembly **15** is installed.

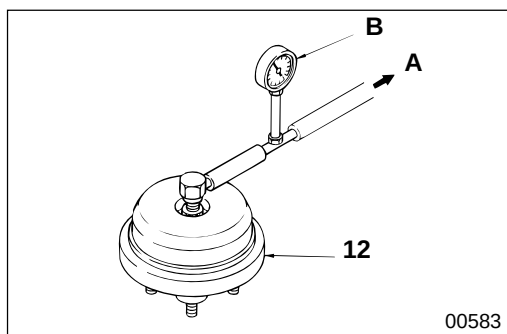


12 Vacuum chamber assembly

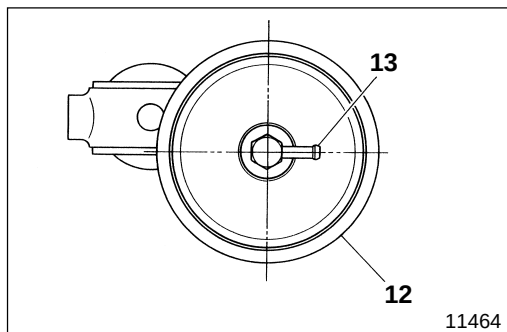
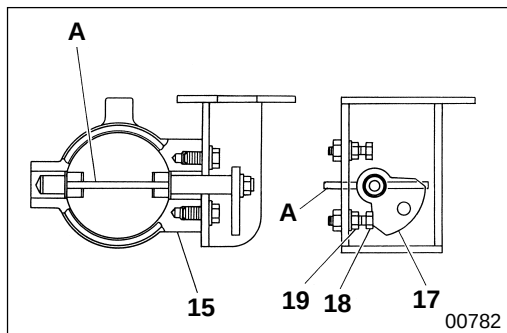
[Installation]

- Adjust valve and bracket assembly **15**. P35-63
- Adjust the hole of clevis **7** to position as illustrated.
- Fix clevis **7** using lock nut **8**.
- Push up and align clevis **7** with the hole of lever **17** and install using clevis pin **4**.



**[Inspection]**

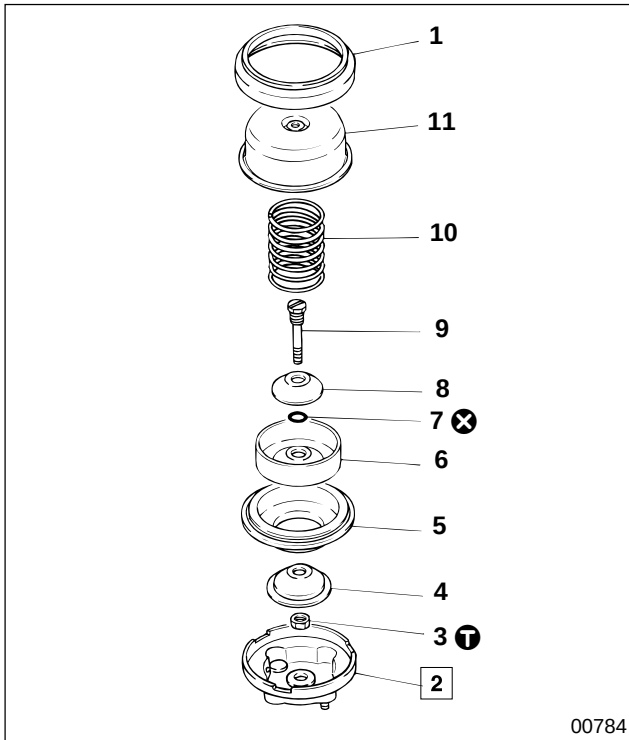
Apply negative pressure **A** of 67 kPa {19.6 in.Hg, 500 mmHg} or more to vacuum chamber assembly **12**. Check to ensure that the value of negative pressure gauge **B** 15 seconds after indicating 67 kPa {19.6 in.Hg, 500 mmHg} conforms to the standard value.

**13 Installation of connector****15 Adjustment of valve and bracket assembly butterfly valve when fully-opened**

- Adjust by turning adjusting bolt **18** so that lever **17** and the head of the adjusting bolt meet horizontally (butterfly valve **A** is fully opened at such time).
- After adjustment, tighten lock nut **19** at specified torque.

EXHAUST BRAKE SYSTEM

Vacuum Chamber



● Disassembly sequence

- 1 Dust cover
- 2 Rear shell
- 3 Nut
- 4 Diaphragm retainer
- 5 Diaphragm
- 6 Diaphragm plate
- 7 O-ring
- 8 Piston washer
- 9 Push rod
- 10 Spring
- 11 Front shell

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

● Inspection after assembly

📖 P35-65

Ⓣ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Nut (Push rod mounting)	44 to 59 {32.6 to 43.3, 4.5 to 6}	—

🔧 Special tools

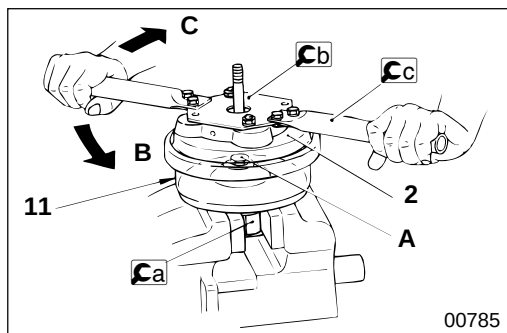
Location	Tool name and shape	Part No.	Application
2	Plate	*910-22060	Removal and installation of rear shell
	Lever	*910-22100	
11	Socket	*910-22110	Fixing of front shell

* : JIDOSHA KIKI part No.

◆ Service procedure

● Inspection after assembly

- Inspect the airtightness of the vacuum chamber assembly.
 P35-63
- If the measured value is higher than the limit, replace the vacuum chamber assembly.



2 Rear shell

[Removal]

- Fix  socket in a vice.
- Fix nut **A** of front shell **11** using  socket.
- Assemble  plate and  lever and install on rear shell **2**. Turn  lever in direction **B**.

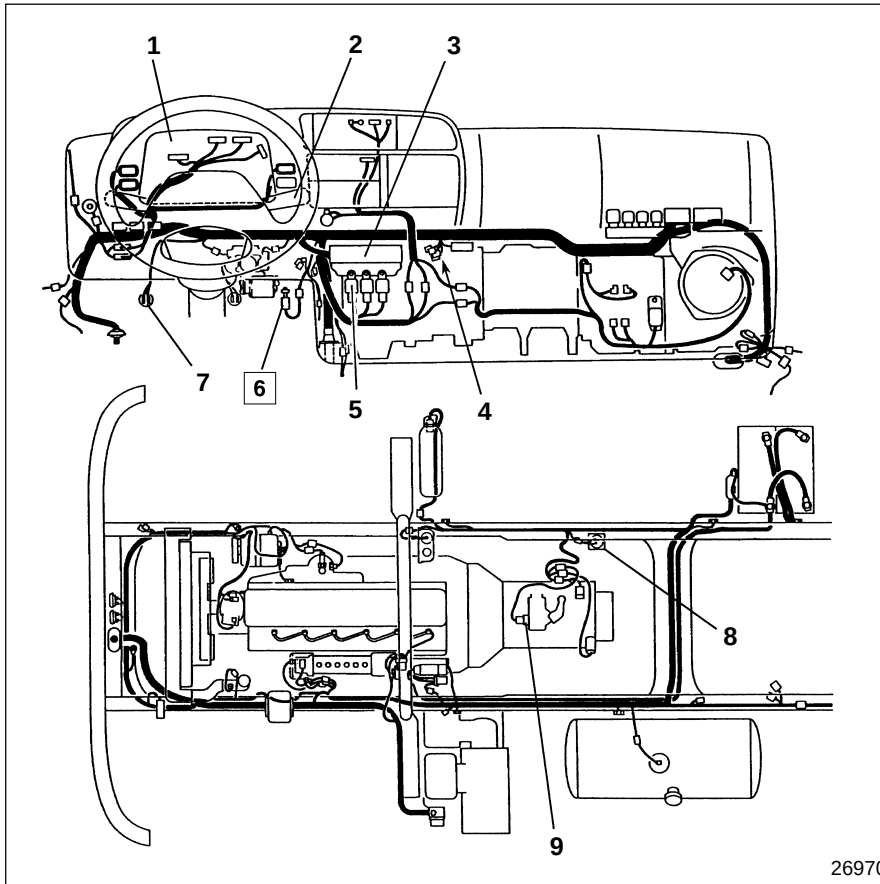
[Installation]

Set up as described above and turn  lever in direction **C**.

- After making sure the flange area of diaphragm **5** is fully inserted inside front shell **11**, turn rear shell **2**.

EXHAUST BRAKE SYSTEM

Exhaust Brake System Electric Equipment



- 1 Meter cluster
Gr 54
- 2 Exhaust brake switch
Gr 37, Gr 54
- 3 Fuse box
Gr 54
- 4 Diode
- 5 Exhaust brake cut relay
Gr 54
- 6 Accelerator switch
Gr 13, Gr 54
- 7 Clutch switch
Gr 21, Gr 54
- 8 3-way magnetic valve
Gr 54
- 9 Transmission neutral switch
Gr 22, Gr 54

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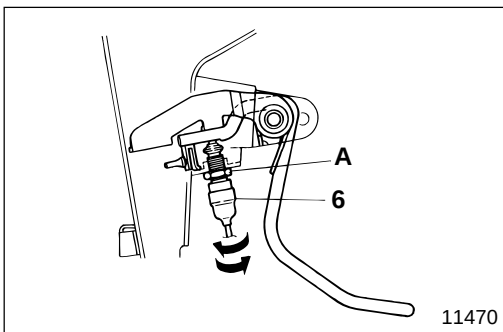
◆ Service procedure

6 Adjustment of accelerator switch

- While the engine is idling, turn exhaust brake switch 2 ON, depress the accelerator gradually, and check the engine revolution when the exhaust indicator lamp within the meter cluster goes off.
- Adjust on the basis of the following chart using accelerator switch 6.

Engine revolution	Adjusting direction of accelerator switch 6
800 rpm or less	↶
950 rpm or more	↷

- After adjustment, tighten nut A to fix accelerator switch 6.



11470



FH

Service Manual

Group 35A

Anti-Lock Brake System

(ABS)

'00 Minor Change

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

GROUP 35A ANTI-LOCK BRAKE SYSTEM (ABS)

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SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item	Specifications
Brake system	Hydraulic booster
Anti-lock brake system (number of sensors/number of channels)	ABS (4S/4K)
Manufacturer	NIPPON ABS

STRUCTURE AND OPERATION

Anti-lock Brake System (ABS)

The anti-lock brake system (ABS) prevents tire slippage due to wheel lockup caused by sudden braking and braking on slippery road surfaces. The ABS provides a driver with vehicle controllability and directional stability in braking.

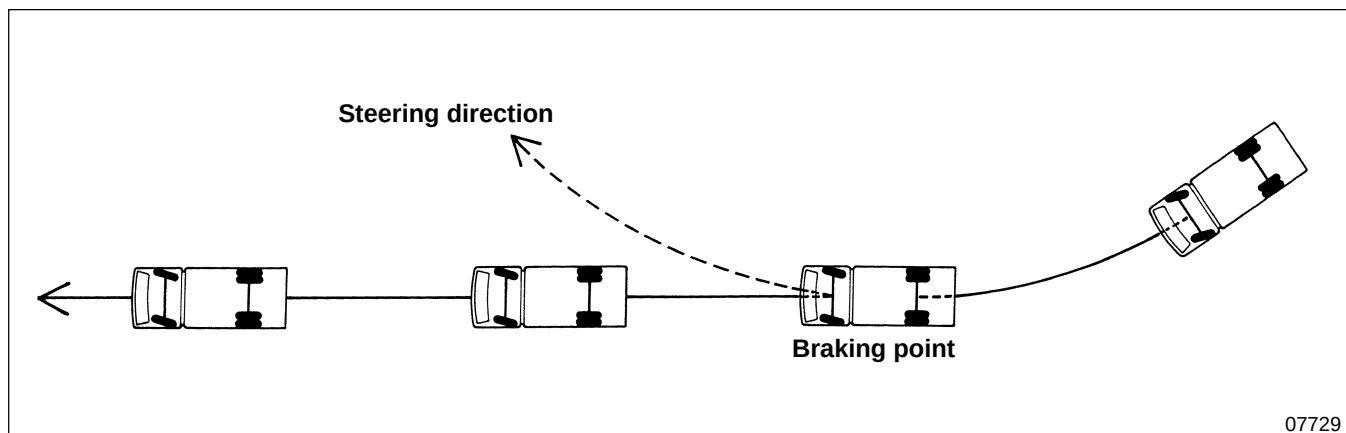
● Wheel lockup

Rotating tires of a moving vehicle have a tendency to continue traveling in the direction of tire rotation. Because of this characteristic, a driver can control the vehicle's traveling direction by moving the front wheels to a desired direction using the steering wheel.

In a vehicle not equipped with an anti-lock brake system, when a driver depresses the brake pedal with full force, the wheels can lock up under certain conditions. Tires in a wheel lockup condition lose the tendency to maintain directional characteristic, and the vehicle starts sliding in a direction of an externally applied force regardless of the tire direction. In other words, when wheel lockup occurs, the vehicle loses its directional stability, disallowing the driver to control the vehicle's movement.

The following shows how a vehicle without ABS loses its directional stability when different tires lock up on slippery road surfaces.

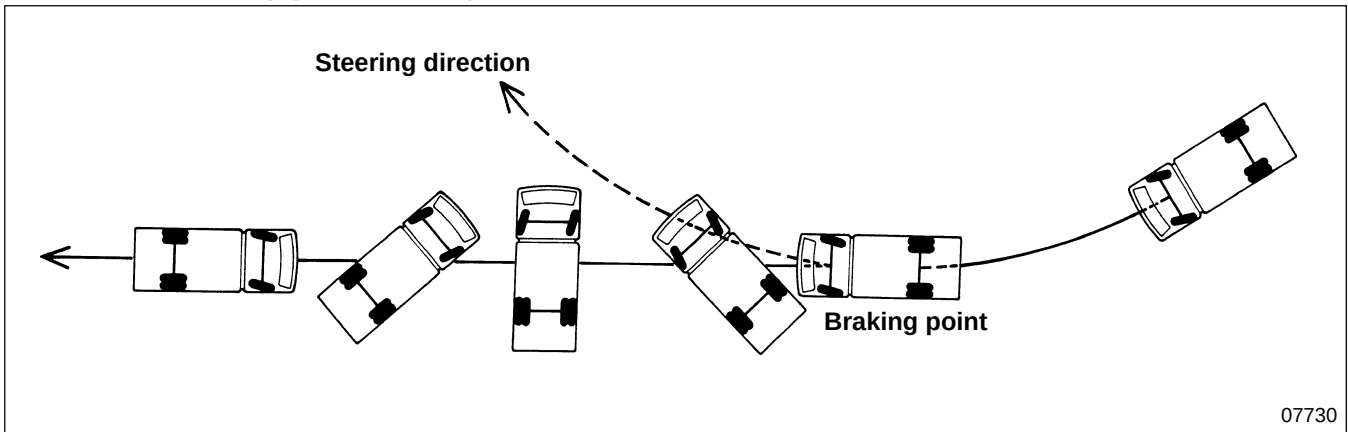
● Front wheel lockup (both front tires)



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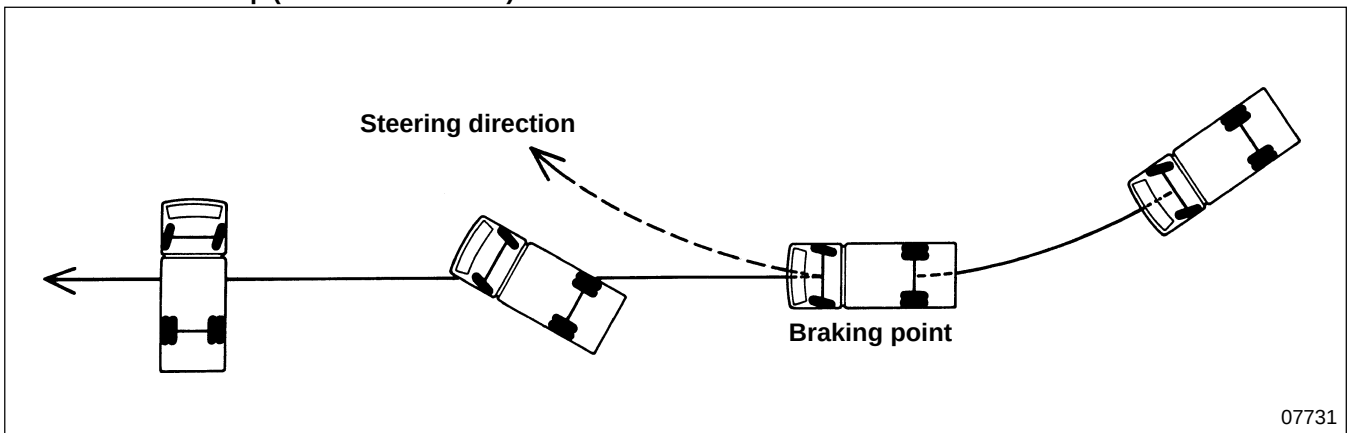
The front tires lose directional stability, but the rear tires try to travel in the direction of rotation since they are not locked up. Because of the front wheel lockup, a steering wheel operation does not change the vehicle's moving direction.

● **Rear wheel lockup (both rear tires)**



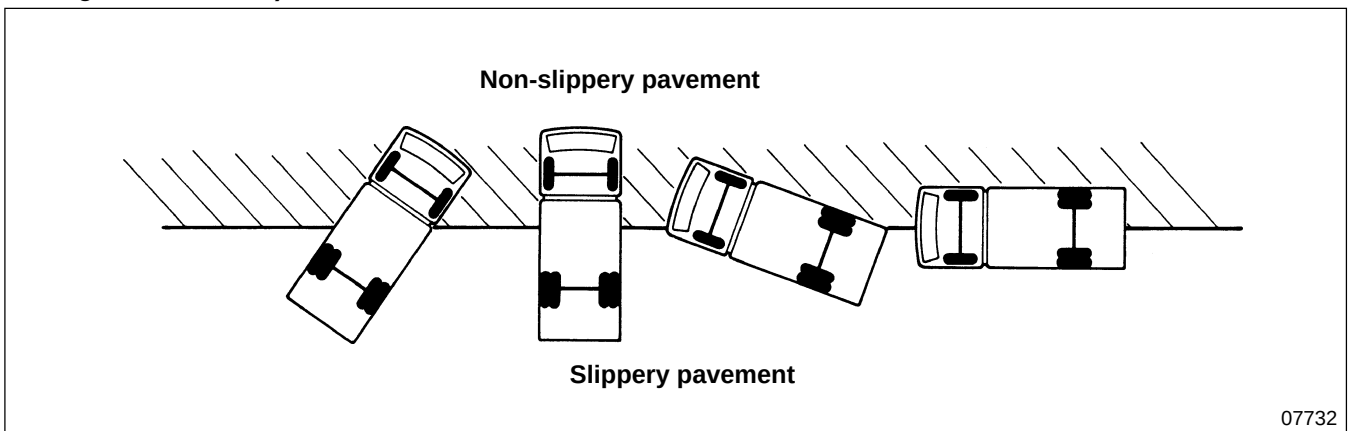
When the steering wheel is operated with the rear wheels in a lockup condition, the front tires try to change the vehicle's direction of travel, but the rear tires slide sideways, causing the vehicle to spin. If wheel lockup occurs in a vehicle traveling in a straight direction, the force of inertia continues to push the vehicle straight ahead from the back of the vehicle due to the lack of stopping force in the rear tires, and the vehicle can spin.

● **All wheel lock up (front and rear tires)**



When wheel lockup occurs in both front and rear tires, all four tires lose directional stability. Therefore, the vehicle slips in the direction of inertia regardless of the steering direction.

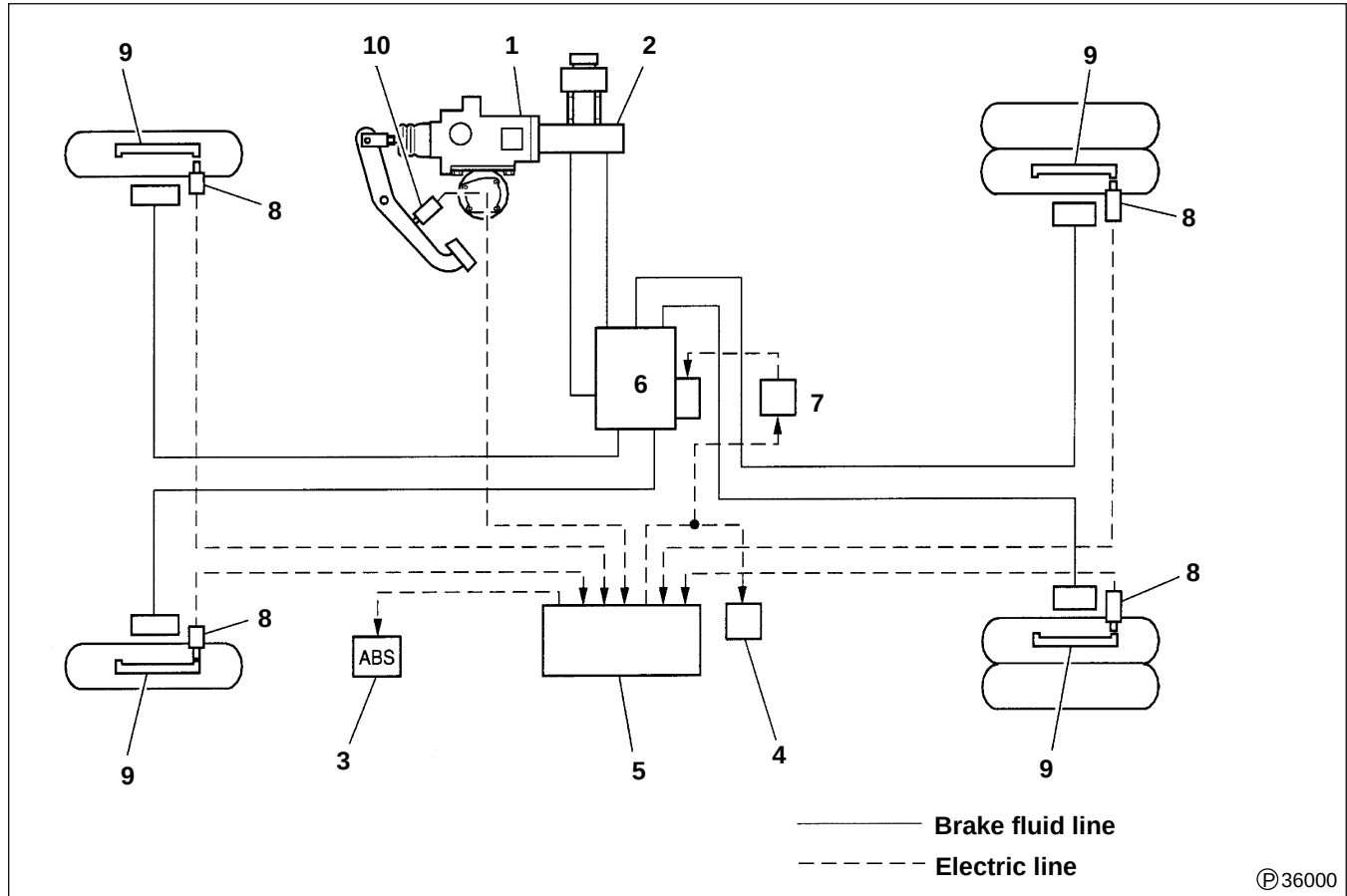
● **Wheel lockup on surfaces with split μ factors (road surface with different friction coefficients for right and left tires)**



The tires on a surface with a lower friction coefficient lock up first. The tires in a lockup condition start sliding, thus failing to provide effective stopping force. Due to this imbalance in the stopping power between the right and left tires, one side of the vehicle slows down while the other side continues traveling, thus resulting in the loss of directional stability. When this happens during sudden braking, the vehicle spins.

STRUCTURE AND OPERATION

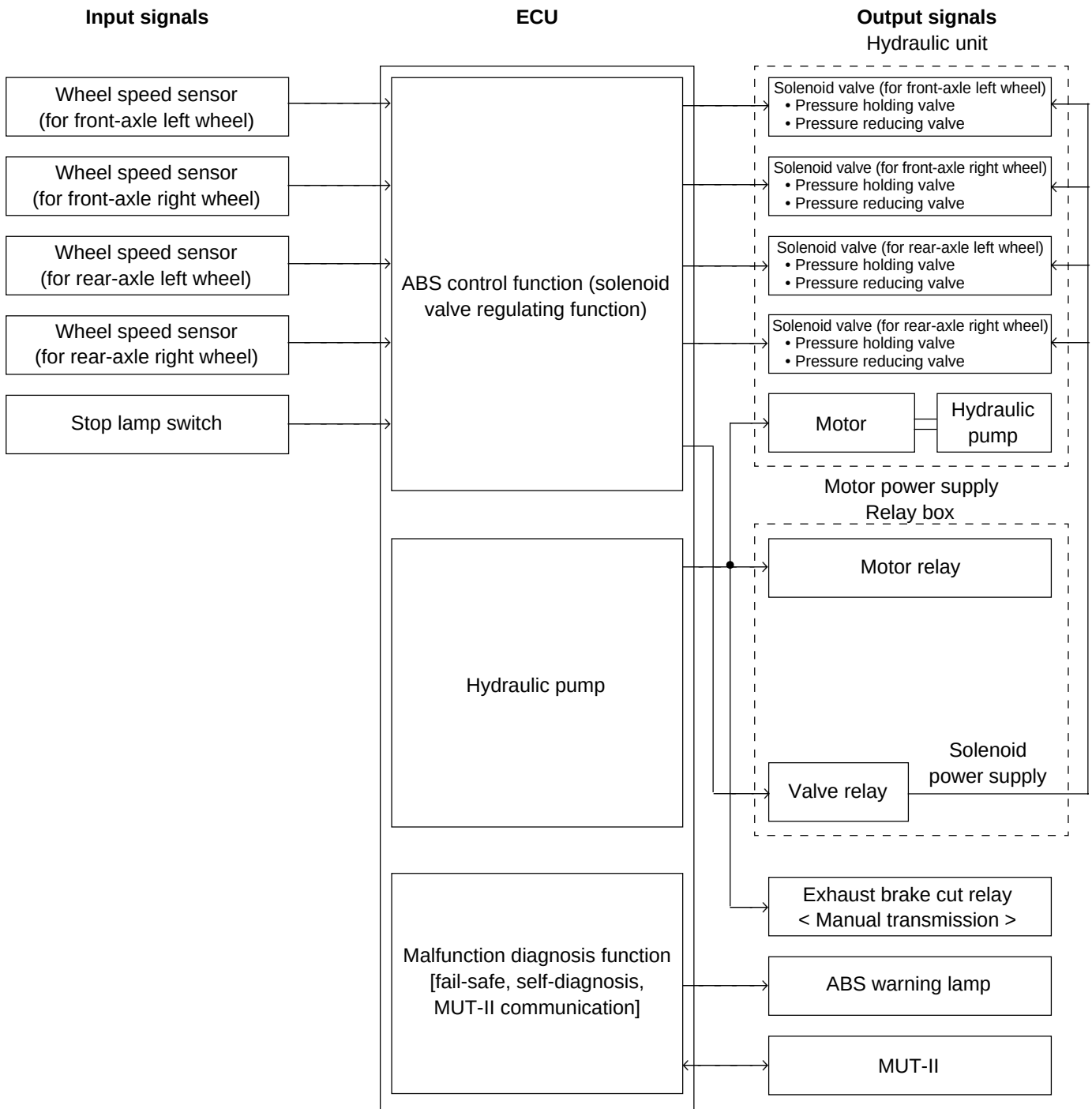
Structure of ABS



- | | |
|--|----------------------|
| 1 Hydraulic booster | 6 Hydraulic unit |
| 2 Brake master cylinder | 7 Relay box |
| 3 ABS warning lamp | 8 Wheel speed sensor |
| 4 Exhaust brake cut relay
< Manual transmission > | 9 Rotor |
| 5 ECU | 10 Stop lamp switch |

The ABS uses wheel speed sensors **8** and ECU **5** to monitor the rotating speed of each wheel. When the wheel speed exceeds the preset deceleration speed or slip rate, the ECU detects it as a tendency leading to wheel lockup, and sends control signals to hydraulic unit **6** and relay box **7**. The signals activate the solenoid valves to reduce the brake fluid pressure in the wheel brakes and ease the braking force to prevent wheel lockup. Then, when the wheel speed increases, wheel speed sensors **8** send signals to the solenoid valves in hydraulic unit **6** by way of ECU **5** to increase the brake fluid pressure in the wheel brakes to augment the braking force. This control cycle is repeated to prevent wheel lockup on slippery pavements and ensure the vehicle's directional stability during braking. The 4-sensor 4-channel anti-lock brake system uses four wheel speed sensors **8**, which are located at the front and rear wheels, to control each of the four wheels.

● ABS function



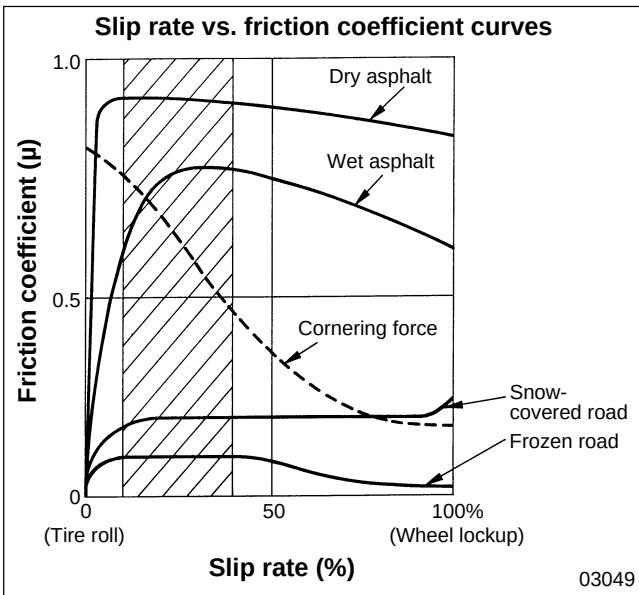
STRUCTURE AND OPERATION

● ABS control function

To provide optimum stopping power, the ABS controls the braking force based on the slip rate determined by the relationship between the wheel speed and the vehicle speed. When the brake is applied, the resulting force slows down the wheel rotation, thus reducing the vehicle speed. However, inertia acts on the vehicle and tries to maintain the vehicle's forward movement despite the stopping force applied by the tires. When there is a difference between the wheel speed and vehicle speed, slipping occurs. The degree of slippage is expressed by a slip rate.

$$\text{Slip rate (\%)} = \frac{\text{Vehicle speed} - \text{Wheel speed}}{\text{Vehicle speed}} \times 100$$

When the slip rate is 0%, there is no slippage between the tires and pavement. The slip rate of 100% refers to a wheel lockup condition.



The graph shows the time-based changes in the friction coefficient of a rolling tire during the process of wheel lockup. When the brake is applied gradually while the tires are rotating on pavement, the tires begin to slip while in rotation.

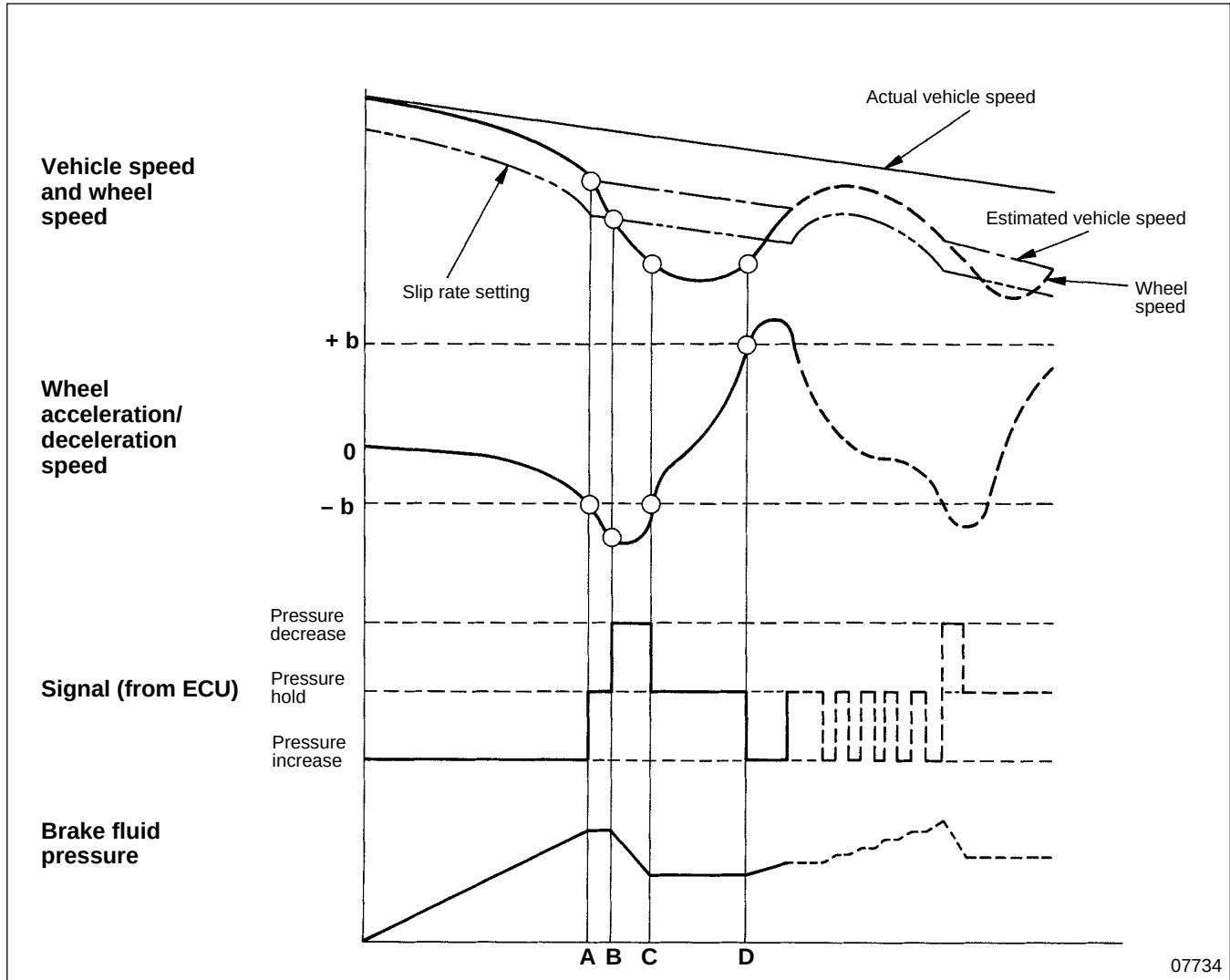
When the brake is applied harder, the tires stop rotating and start to slide on the pavement. This condition is called wheel lockup.

The friction coefficient is highest when the slip rate is within the shaded area on the graph.

In other words, tires provide maximum friction when the braking force is appropriately controlled to maintain the slip rate in the range indicated by the shaded area on the graph, rather than when the brake is applied at full force. In a vehicle equipped with ABS, the ECU and hydraulic unit adjust the braking force and maintain it within the shaded area on the graph where the friction coefficient is high, thus preventing tire slippage and ensuring braking stability.

ABS Operation

● ABS control characteristic curve



07734

The above ABS control characteristic graph shows the time-based changes in vehicle speed, wheel acceleration/deceleration speed and brake fluid pressure level during braking.

- When the wheel deceleration speed exceeds the speed setting $-b$ at point A, the ECU sends a signal to maintain the brake fluid pressure at the same level. At the same time, the ECU estimates the vehicle speed according to a programmed calculation method.
- When the vehicle speed decreases further and the slip rate exceeds the setting at point B, the ECU detects it as a tendency leading to wheel lockup, and sends a signal to reduce the brake fluid pressure.
- When the wheel speed increases because of the reduced brake fluid pressure and the wheel speed exceeds the setting $-b$ at point C, the ECU sends a signal to maintain the brake fluid pressure at the same level.
- When the wheel speed increases further and the wheel speed exceeds the setting $+b$ at point D, the ECU determines that there is no risk of wheel lockup and sends a signal to increase the brake fluid pressure.

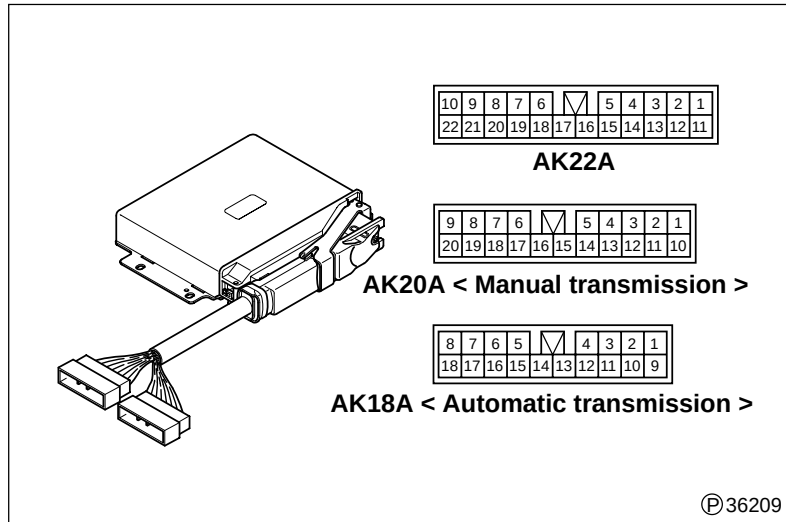
By repeating the above control cycle, the ABS prevents wheel lockup and provides maximum friction between the tires and pavement to ensure high stability during braking.

● ABS and exhaust brake system

On slippery road surfaces, activation of the exhaust brake system can result in wheel lockup. If the exhaust brake activates during an ABS braking operation, proper braking function cannot be provided by the ABS.

To prevent this, the exhaust brake system is deactivated during ABS operation even when the exhaust brake switch is turned ON. When the ABS stops providing its function, the exhaust brake system becomes operable if the exhaust brake switch is ON.

STRUCTURE AND OPERATION



● ECU

This component calculates the wheel speed and estimates the vehicle speed based on signals sent from the wheel speed sensors. Based on the calculation results, it determines the degree of wheel lockup tendency, and sends brake fluid pressure control signals to the solenoid valves of the hydraulic unit to regulate brake fluid pressure accordingly.

The ECU is equipped with a self-diagnosis function. Should an abnormality occur, the ECU turns on the warning lamp on the instrument panel to indicate the system malfunction and deactivates the ABS control to set the brake system in normal condition (without anti-lock brake system control).

	AK22A	AK20A < Manual transmission >	AK18A < Automatic transmission >
Terminal No.	Connection destination		
1	Ground	—	—
2	Ground	—	—
3	—	—	Meter cluster (ABS warning lamp)
4	Hydraulic unit (motor drive)	Meter cluster (ABS warning lamp)	Starter switch terminal M (ECU power supply)
5	Hydraulic unit (motor drive monitor)	Starter switch terminal M (ECU power supply)	Wheel speed sensor (rear-axle right-wheel input)
6	—	Wheel speed sensor (rear-axle right-wheel input)	Wheel speed sensor (rear-axle left-wheel input)
7	Hydraulic unit (rear-axle right-wheel brake fluid pressure decrease)	Wheel speed sensor (rear-axle left-wheel input)	Wheel speed sensor (front-axle right-wheel input)
8	Hydraulic unit (rear-axle left-wheel brake fluid pressure decrease)	Wheel speed sensor (front-axle right-wheel input)	Wheel speed sensor (front-axle left-wheel input)
9	Hydraulic unit (front-axle right-wheel brake fluid pressure decrease)	Wheel speed sensor (front-axle left-wheel input)	—
10	Hydraulic unit (front-axle left-wheel brake fluid pressure decrease)	—	MUT-II connector
11	Ground	—	MUT-II connector
12	Ground	MUT-II connector	Stop lamp switch
13	—	MUT-II connector	—
14	Relay box (valve relay drive)	Stop lamp switch	—
15	Relay box (valve relay and motor relay power supply)	—	Wheel speed sensor (rear-axle right-wheel grounding)
16	Exhaust brake cut relay < Manual transmission >	—	Wheel speed sensor (rear-axle left-wheel grounding)
17	Exhaust brake cut relay < Manual transmission >	Wheel speed sensor (rear-axle right-wheel grounding)	Wheel speed sensor (front-axle right-wheel grounding)
18	—	Wheel speed sensor (rear-axle left-wheel grounding)	Wheel speed sensor (front-axle left-wheel grounding)
19	Hydraulic unit (rear-axle right-wheel brake pressure hold)	Wheel speed sensor (front-axle right-wheel grounding)	
20	Hydraulic unit (rear-axle left-wheel brake pressure hold)	Wheel speed sensor (front-axle left-wheel grounding)	
21	Hydraulic unit (front-axle right-wheel brake pressure hold)		
22	Hydraulic unit (front-axle left-wheel brake pressure hold)		

Periodic Inspection Procedures

(1) Periodic inspection of Anti-lock brake system

- Inspect the vehicle's Anti-lock brake system following the procedure below.
- If an abnormality is found in this inspection, further inspect the Anti-lock brake system using  MUT-II (multi-use tester) by referring to TROUBLESHOOTING section.

 P35A-15

- Inspection procedure

① With the vehicle stationary, press the brake pedal and inspect the hydraulic unit for fluid leaks.

If fluid leaks from the hydraulic unit, replace the unit. If fluid leaks from the fluid pipe or connector, tighten the joint.

② Inspection using brake tester

Check the braking force at each wheel with a brake tester by following the inspection procedure for ordinary vehicles.

If an abnormality is found, inspect the wheel brake units, service brake system and hydraulic unit.

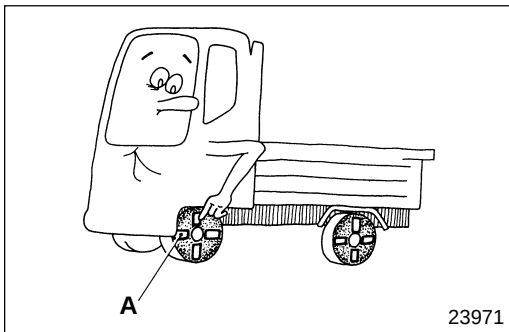
③ Drive the vehicle and check the operation of the Anti-lock brake system.

- Conduct a test drive at an open area to ensure safety.
- Conduct a test drive without cargo.

Attach white tape **A** on the sides of tires, so that it is easy to observe the rotation of the front and rear wheels.

- Turn the starter switch from the OFF position to the ON position, and make sure that the **ABS** warning lamp lights. Then, check that the **ABS** warning lamp turns off approximately two seconds after the starter switch is turned on.

- Drive the vehicle at a speed of 20 to 30 km/h {12 to 19 mph}, and apply a sudden brake. Make sure that wheel lockup does not occur in any of the tires.



ON-VEHICLE INSPECTION AND ADJUSTMENT

Adjustment of Wheel Speed Sensor Clearance

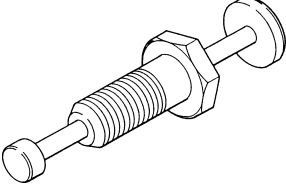
Tightening torque

Unit : N·m {lbf.ft, kgf·m}

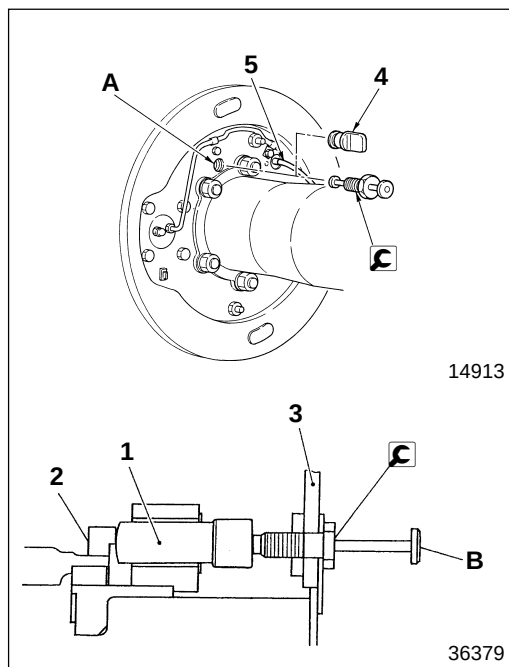
Location	Parts to be tightened	Tightening torque	Remarks
7	Bolt (Anchor bracket mounting)	135 {100, 13.8}	—

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Adjuster 	MH062080	Adjustment of wheel speed sensor clearance

14912



Tighten  adjuster to extend wheel speed sensor **1**, and adjust clearance between the sensor and rotor **2**.

- Remove plug **4** located on the back side of back plate **3**.
 - Mount  adjuster in adjustment hole **A**, and tighten the adjuster.
 - Wheel speed sensor **1** contacts the rotor before  adjuster is completely tightened. Therefore, do not press shaft **B**, and tighten the adjuster until resistance is felt.
 - Be sure to reinstall plug **4** after adjustment.
- 5:** Wheel speed sensor harness

Inspection of Wheel Speed Sensor Signal Waveform Using Oscilloscope

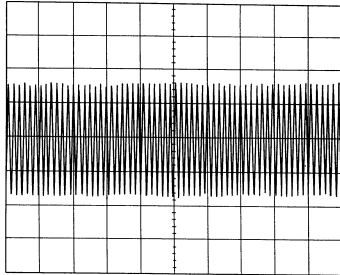
Inspect the rotor for dents using an oscilloscope, since the tester cannot be used for dent detection.

NOTE

Use an oscilloscope with a waveform recording function.

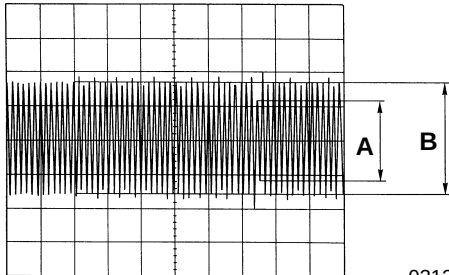
- Lift the wheel to be tested off the ground, and disconnect the connector at the wheel speed sensor.
- Connect the terminal of the oscilloscope to the terminal of the disconnected connector. Rotate the wheel at a constant speed. Check the waveform shown on the oscilloscope to check for dents on the rotor.
- Rotor dents are often made by the rotor press-fit on the hub end contacting the axle during installation of the hub and brake drum assembly on the axle. When installing the hub & brake drum assembly, pay close attention to prevent the rotor from contacting other parts.

Normal waveform (no dent on rotor)



03122

Abnormal waveform (with dents on rotor)



03123

A: Vmin (Minimum peak)

B: Vmean (Average of maximum peaks)

$$\frac{V_{\text{mean}} - V_{\text{min}}}{V_{\text{mean}}} = 0.2 \text{ (20\% or lower)}$$

If more than 20%, replace the rotor.

ON-VEHICLE INSPECTION AND ADJUSTMENT

Hydraulic Unit Operation Check

Operation check using MUT-II

- Lift the vehicle using a jack and support it with jack stands, or position the tires on brake tester rollers.

WARNING

- **The brake tester rollers and tires must be dry during inspection.**
 - **To test the front brakes, apply the parking brake. To test the rear brakes, place wheel chokes at the front tires to secure them in position.**
-

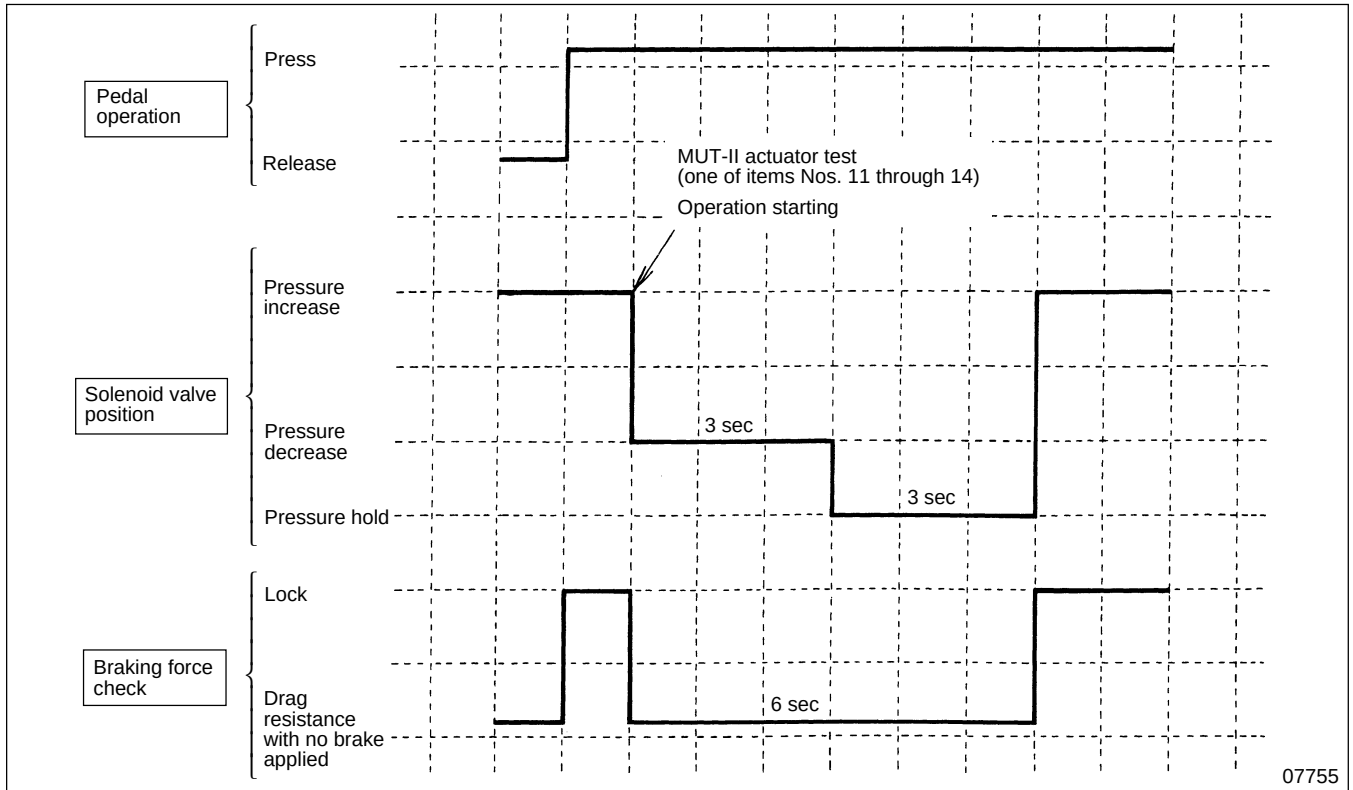
- Disengage the parking brake, and feel the drag resistance of the brake on each wheel.

When using a brake tester, record the indicated drag resistance of the brake.

- Set the starter switch to the OFF position, then connect the MUT-II.
- Set the testing equipment and system on the MUT-II.
- After making sure that the transmission is in the neutral position, start the engine.

NOTE

- **When the engine is turned on, the ABS switches to the MUT-II mode and the ABS warning lamp flashes.**
- **When the ABS function is deactivated due to the ECU's fail-safe function, the actuator test cannot be performed with the MUT-II.**



- If an abnormality is found during the inspection, take appropriate measures described in the following operating condition evaluation chart.

Operating condition evaluation chart

Item No.	MUT-II indication	Operation	Judgment		Cause	Remedy
			Normal	Malfunction		
11	FR ABS MV ON	(1) Depress the brake pedal to lock wheels. (2) On the MUT-II, select the wheel to be tested and forcibly drive the actuator. (3) Rotate the selected wheel using the brake tester or by hand, and check the change in braking power.	Braking force eases for 6 seconds from locked condition.	Wheel does not lock when brake pedal is depressed.	Clogging in brake line other than HU	Inspect and clean brake lines.
12	FL ABS MV ON			Braking force does not ease.	Clogging in hydraulic line inside HU	Replace HU assembly.
13	RR ABS MV ON				Erroneous HU brake tube connection	Correct tube connection.
14	RL ABS MV ON				Faulty HU solenoid valve	Replace HU assembly.

HU: Hydraulic unit

- After inspection, set the starter switch to OFF before disconnecting the MUT-II.

TROUBLESHOOTING

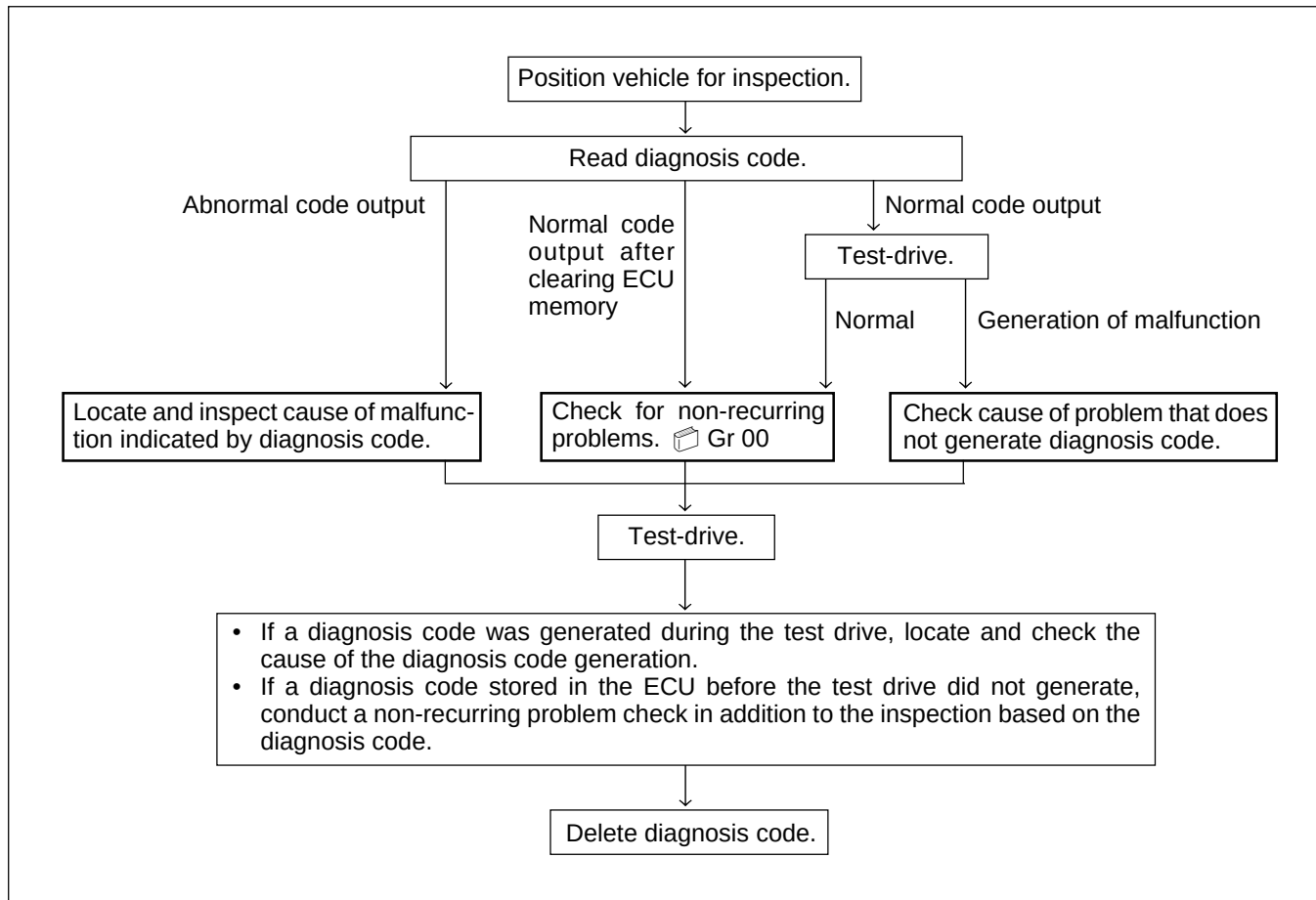
Troubleshooting Procedures

Inspection flow chart

The MUT-II allows efficient inspection of the ABS.

The types of system inspections can be roughly divided according to the malfunction condition and diagnosis code, as shown below.

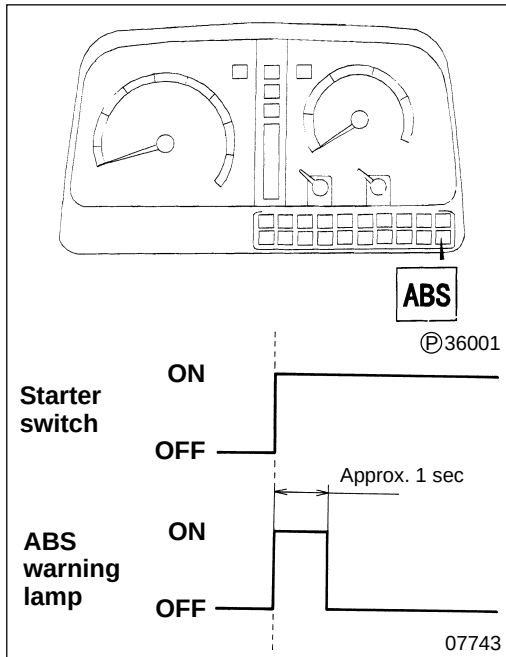
- Inspection based on individual malfunction diagnosis codes stored in the ECU
- Inspection based on symptoms not indicated by diagnosis codes
- Correcting non-recurring problems



Cautions in malfunction diagnosis

- The ABS uses electronic control to regulate the braking system. The following phenomena may occur during normal ABS operation, but they do not denote a malfunction.

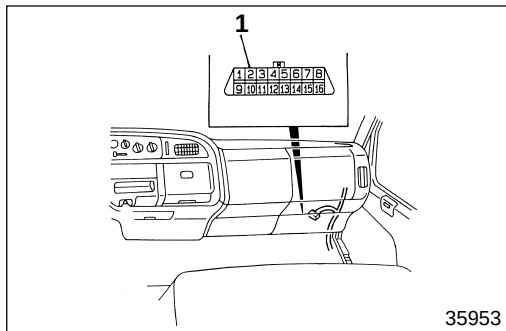
Phenomenon	Description
System checking sound	When the engine starts, a slight clunking sound may be generated in the left side of the frame near the cargo bed. This sound is produced by the system conducting an operation check, and does not denote a malfunction.
ABS operating sound	• Motor noise from the hydraulic unit (humming sound) • Noise generated as the brake pedal feel changes (grinding sound) • Noise from the chassis produced by repeated ON and OFF operations of the ABS (wheels: short squeak, suspension: slight thud)
ABS operation effect (longer stopping distance)	On snow-covered surfaces and gravel roads, a vehicle equipped with ABS may require a longer distance to come to a complete stop. Therefore, when driving on such road surfaces, reduce the speed sufficiently and drive carefully to minimize the use of brakes.



● Inspection of ABS warning lamp

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

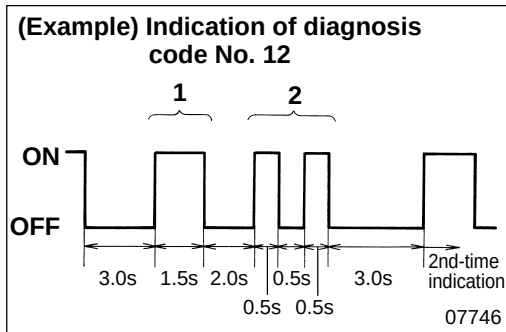
- Set the starter switch to the ON position, and check that the ABS warning lamp lights for about 1 second and turns off.
- If the lamp does not light as described above, check diagnosis codes stored in the ECU.



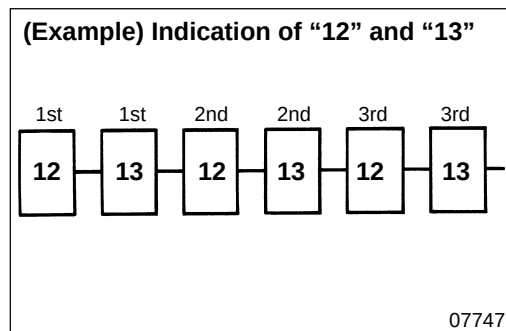
Diagnosis code indication

● Without MUT-II

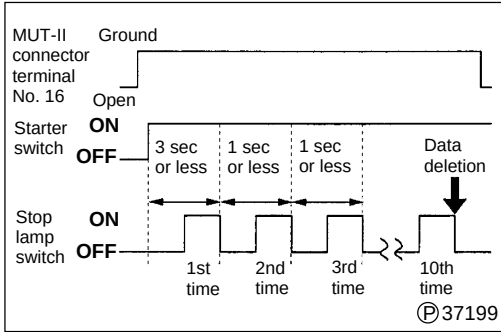
- With the vehicle stationary, ground terminal No. 16 of MUT-II connector 1, then turn the starter switch to the ON position. The ABS warning lamp will flash to indicate a diagnosis code.
- The ABS warning lamp starts flashing 3.0 seconds after the starter switch is turned ON. The flashing pattern of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



TROUBLESHOOTING



● Deletion of diagnosis codes

Connect terminal No. 16 of the MUT-II connector to the chassis for grounding. Turn on the starter switch, and depress the brake pedal within 3 seconds and turn On and Off the stop lamp switch ten times in intervals of 1 second or less. This erases diagnosis codes from the memory.

● Completion of diagnosis code check

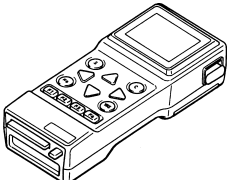
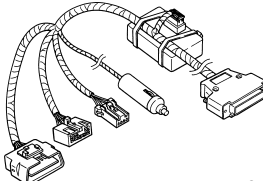
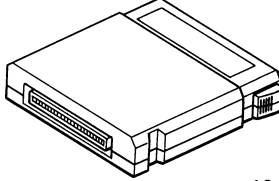
The diagnosis code check completes when diagnosis codes are erased from the ECU of terminal No. 16 of the MUT-II connector is disconnected.

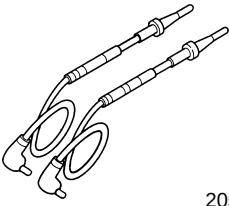
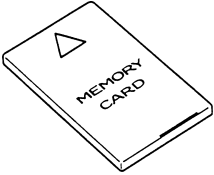
NOTE

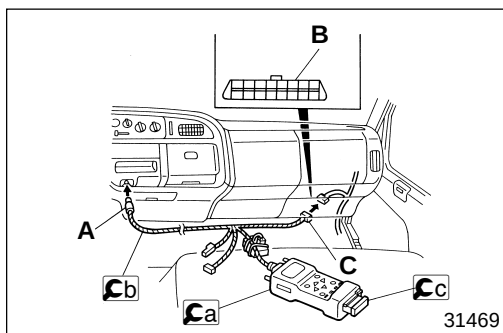
The diagnosis code check also ends when the vehicle moves from a stationary condition during the diagnosis code check.

With MUT-II

🔧 Special tools

Tool name and shape	Part No.	Application
MUT-II  19492	MB991496	Inspection of Anti-lock brake system
MUT-II harness (for data communication)  19141	MK327601	
ROM pack (MRT-E6)  19493	MK344606	

Tool name and shape	Part No.	Application
MUT-II harness (for circuit tester)  20536	MB991499	Inspection of Anti-lock brake system
Memory card (for MUT-II)  20538	MB991500	



Connecting the MUT-II

- Turn the starter switch to the LOCK position.
- Connect the  MUT Communication Harness to the  MUT-II, and insert the  ROM Pack.
- Plug connector **A** into the cigarette lighter socket.
- Fit connector **C** onto MUT connector **B** (16 pin) in the relay box.

NOTE

Instructions for operation of the MUT-II are given in the separate MUT-II Reference Manual.

Current diagnosis codes

- Turn the starter switch to the ON position.
- Determine the fault location(s) in accordance with the MUT-II diagnosis code(s).

Past diagnosis codes

- Turn the starter switch to the ON position.
- Determine the fault location(s) in accordance with the past MUT-II diagnosis code(s).

Diagnosis code erasure

- Turn the starter switch to the ON position.
- Using the MUT-II, erase all diagnosis codes stored in the control unit.

TROUBLESHOOTING

Diagnosis Code Chart

Diagnosis codes can be read by using the MUT-II or ABS warning lamp.

Diagnosis code	Malfunction location		
	MUT-II display	Description of malfunction	
11	FR-SNSR OPEN	Wheel speed sensor	Broken wire to front-axle right-wheel speed sensor
12	FL-SNSR OPEN		Broken wire to front-axle left-wheel speed sensor
13	RR-SNSR OPEN		Broken wire to rear-axle right-wheel speed sensor
14	RL-SNSR OPEN		Broken wire to rear-axle left-wheel speed sensor
*a 15	ROTA OR SNSR		Broken wire
16	ECU VOLTAGE	Drop in power supply voltage	
21	FR-SNSR SHORT	Wheel speed sensor	No broken wire to front-axle right-wheel speed sensor
22	FL-SNSR SHORT		No broken wire to front-axle left-wheel speed sensor
23	RR-SNSR SHORT		No broken wire to rear-axle right-wheel speed sensor
24	RL-SNSR SHORT		No broken wire to rear-axle left-wheel speed sensor
*b 35	EXB RLY	Exhaust brake cut relay	
38	STOP LAMP SW	Stop lamp switch	
41	FR-EV VALVE	Hydraulic unit	Front-axle right-wheel solenoid valve (pressure decrease)
42	FL-EV VALVE		Front-axle left-wheel solenoid valve (pressure decrease)
43	RR-EV VALVE		Rear-axle right-wheel solenoid valve (pressure decrease)
44	RL-EV VALVE		Rear-axle left-wheel solenoid valve (pressure decrease)
45	FR-AV VALVE		Front-axle right-wheel solenoid valve (pressure hold)
46	FL-AV VALVE		Front-axle left-wheel solenoid valve (pressure hold)
47	RR-AV VALVE		Rear-axle right-wheel solenoid valve (pressure hold)
48	RL-AV VALVE		Rear-axle left-wheel solenoid valve (pressure hold)
51	VALVE RLY	Relay box	Valve relay
53	MOTOR RLY		Motor relay or motor
			Motor monitor line
63	ECU ERR	ABS ECU	

Actuator Drive Chart

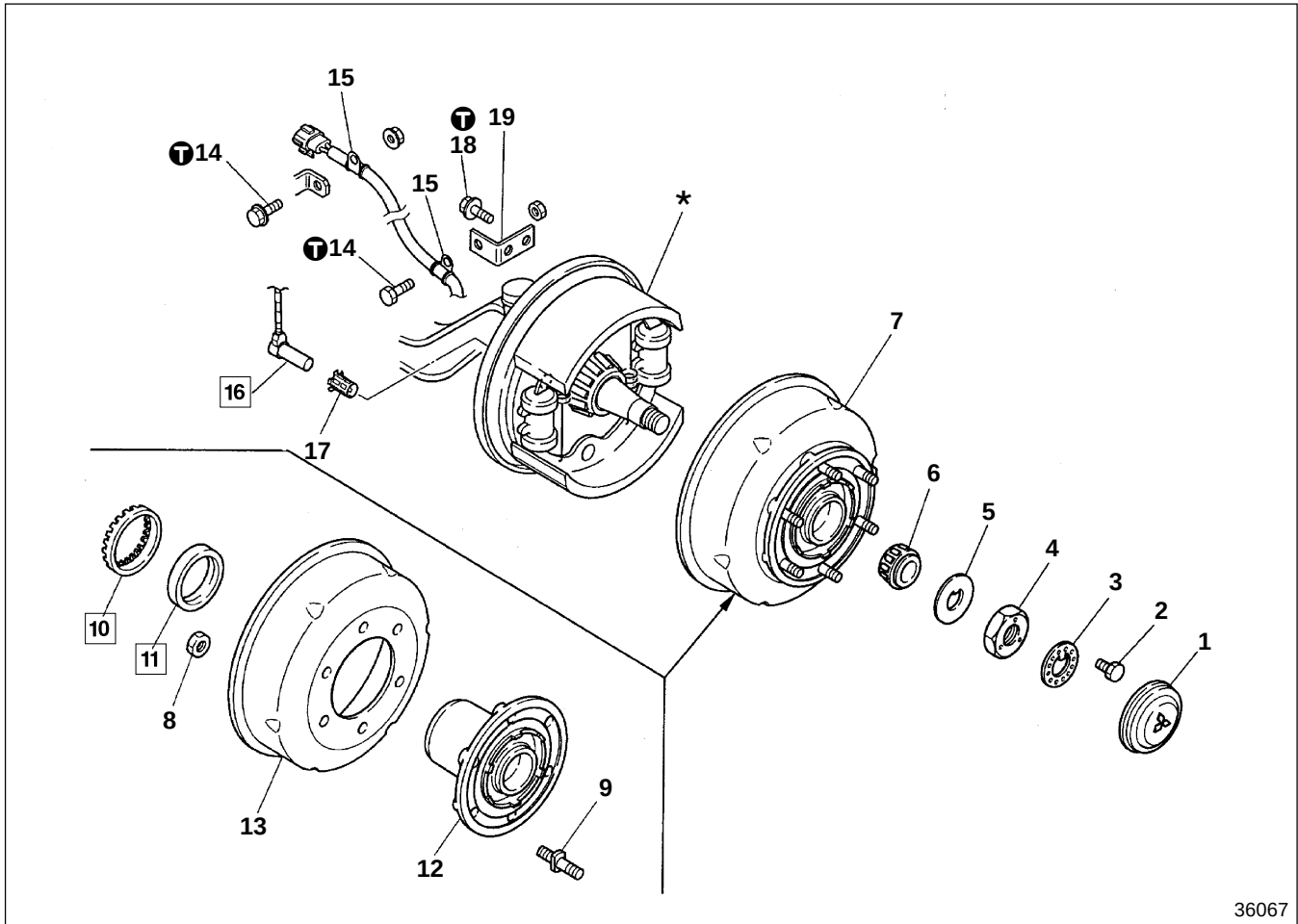
MUT-II display	
Item No.	Item name
11	FR ABS MV ON
12	FL ABS MV ON
13	RR ABS MV ON
14	RL ABS MV ON

Service Data

MUT-II display			Inspection condition	Criterion
11	FR SPEED	■ ■ ■ . ■ MPH	Constant-speed driving	Same as speedometer indication
12	FL SPEED	■ ■ ■ . ■ MPH		
13	RR SPEED	■ ■ ■ . ■ MPH		
14	RL SPEED	■ ■ ■ . ■ MPH		
15	ECU VOLTAGE	■ ■ . ■ V	Starter switch ON	Same as battery voltage
30	STOP LAMP SW	ON/OFF	Brake pedal depressed	ON
			Brake pedal released	OFF

WHEEL SPEED SENSOR AND ROTOR < FRONT AXLE >

The following describes the service procedures for wheel speed sensors and rotors only.
Regarding the procedures for servicing other components, refer to  Gr 26.



36067

● Disassembly sequence

- | | | |
|-------------------------------|---------------|-------------------------|
| 1 Wheel hub cap | 8 Nut | 15 Clip |
| 2 Bolt | 9 Hub bolt | 16 Wheel speed sensor |
| 3 Lock plate | 10 Rotor | 17 Spring spacer |
| 4 Lock nut | 11 Oil seal | 18 Bolt |
| 5 Lock washer | 12 Wheel hub | 19 Bracket |
| 6 Outer bearing | 13 Brake drum | |
| 7 Hub and brake drum assembly | 14 Bolt | *: Front brake assembly |

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- When removing or installing hub and brake drum assembly 7, handle rotor 10 with care to prevent damage. Also, do not damage oil seal 11 during assembly.
- Keep oil and grease off lining surface of front brake assembly * and the inner surface of brake drum 13.

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
10	Wobbling of rotor		0.1 {0.0039}	—	Replace
16	Wheel speed sensor	Resistance between terminals	950 to 1450Ω	—	Replace
		Insulation resistance	1MΩ or higher	—	Replace

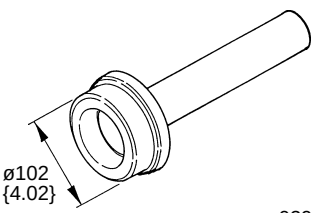
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
14	Bolt (Clip mounting)	19 to 27 {14 to 20, 1.9 to 2.8}	—
18	Bolt (Bracket mounting)	9.8 to 14.0 {7 to 10, 1.0 to 1.4}	—

C Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
11	ABS oil seal installer  02968	MH062305	Press-fitting of oil seal

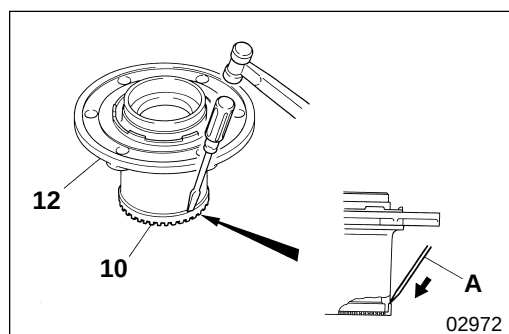
◆ Service procedure**10 Rotor**

[Removal]

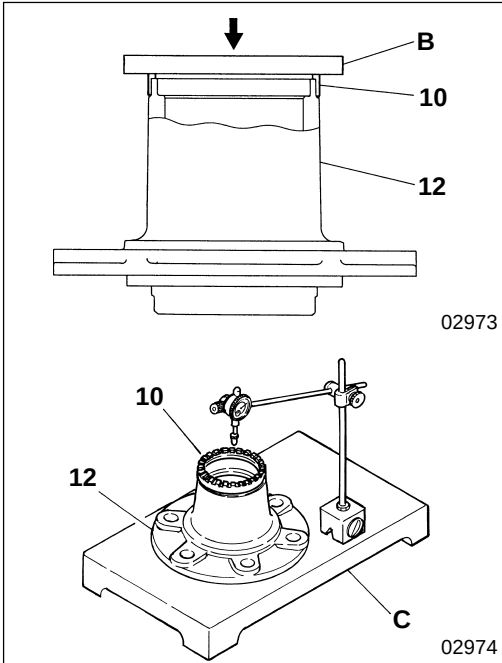
Strike the outer edge of rotor **10** evenly with flat-tip screwdriver **A** to remove the rotor from the wheel hub.

CAUTION ⚠

Be careful not to damage wheel hub **12**.



WHEEL SPEED SENSOR AND ROTOR < FRONT AXLE >



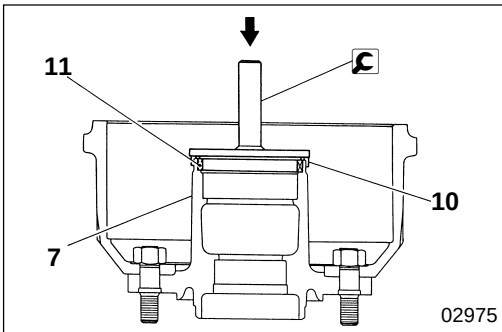
[Installation]

Heat rotor **10** to approximately 150°C {302°F}. Press the rotor evenly with iron plate **B** to press-fit the rotor to wheel hub **12**. Make sure there is no space between the rotor and wheel hub.

[Inspection]

- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

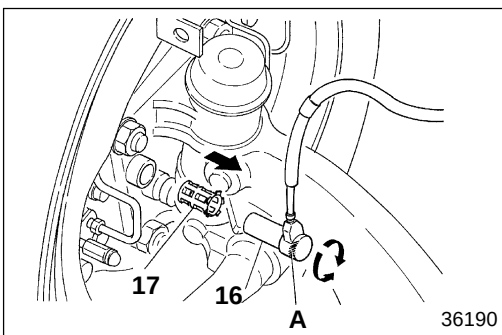
C : Base



11 Installation of oil seal

CAUTION

When hub and brake drum assembly **7** is removed for a service operation and if rotor **10** is still mounted on the wheel hub, use 0 ABS oil seal installer to press-fit oil seal **11**.



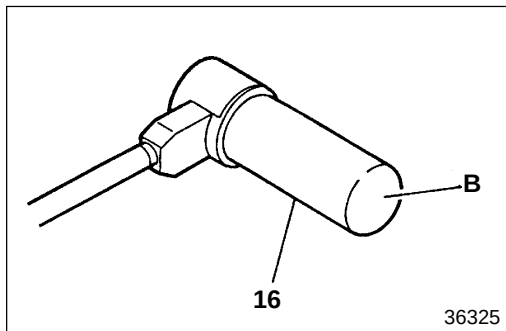
16 Wheel speed sensor

[Removal]

Hold shaded section **A** of wheel speed sensor **16** with pliers, and remove the sensor by twisting it slightly in left and right directions.

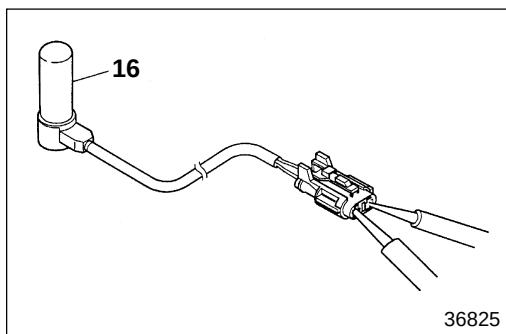
CAUTION

- When holding wheel speed sensor **16** with pliers, do not grip any section other than shaded area **A** in the diagram.
- When removing wheel speed sensor **16**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- If wheel speed sensor **16** dismounts easily, replace spring spacer **17**.

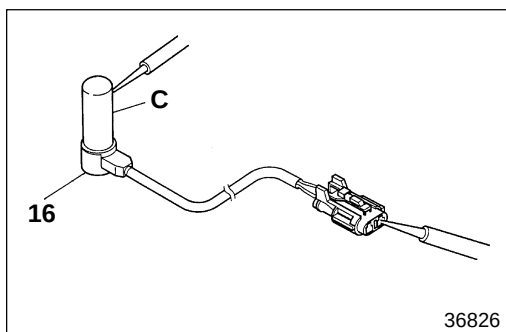


[Inspection]

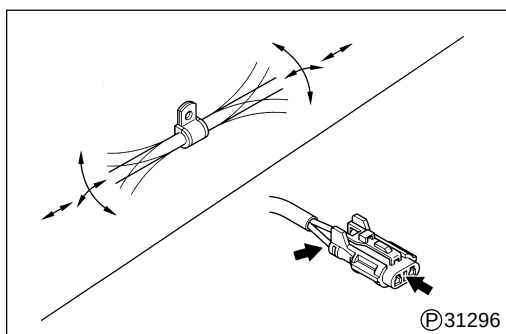
- Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **16**, it attracts metals. Do not allow the pole piece to collect metallic objects.



- Measure the resistance between the terminals of wheel speed sensor **16**.
If the measured value deviates from the standard value, replace the wheel speed sensor.

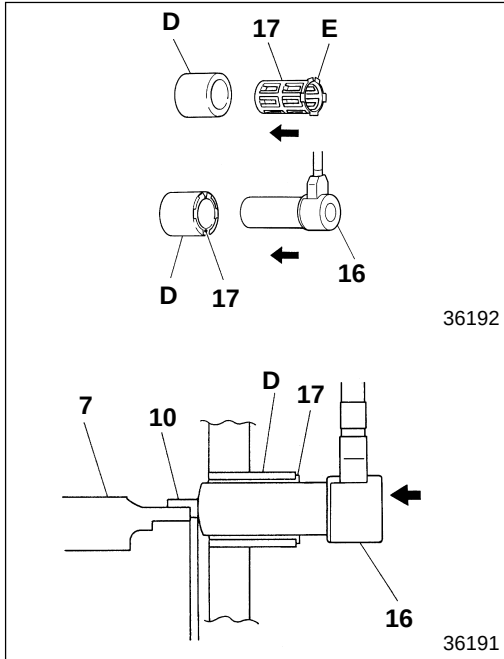


- Measure the insulation resistance between body **C** of wheel speed sensor **16** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.
If a defect is found, replace wheel speed sensor **16**.

WHEEL SPEED SENSOR AND ROTOR < FRONT AXLE >

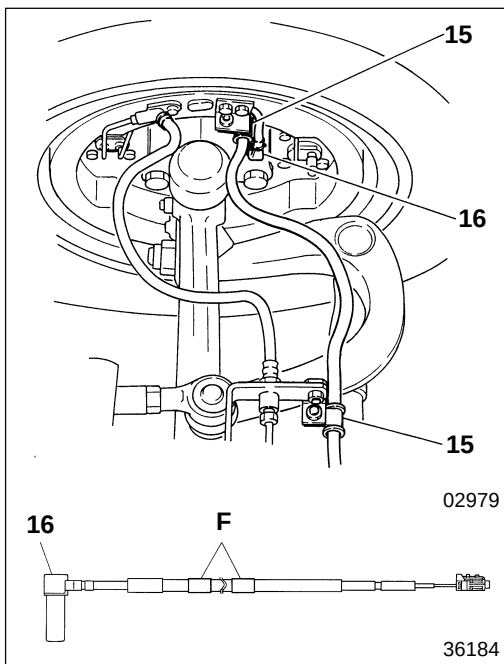


[Installation]

- Insert spring spacer **17** into holder section **D** of the knuckle, and press until stopper section **E** contacts the holder.
- Insert wheel speed sensor **16**, and press until it contacts rotor **10**.
- Rotate hub and brake drum assembly **7** slowly for two or three turns (2 seconds per turn) to make sure it rotates smoothly.

CAUTION ⚠

When installing wheel speed sensor **16**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.



- Secure white tape section **F** of the harness of wheel speed sensor **16** in place using clip **15** on the wheel brake side and clip **15** on the frame side.

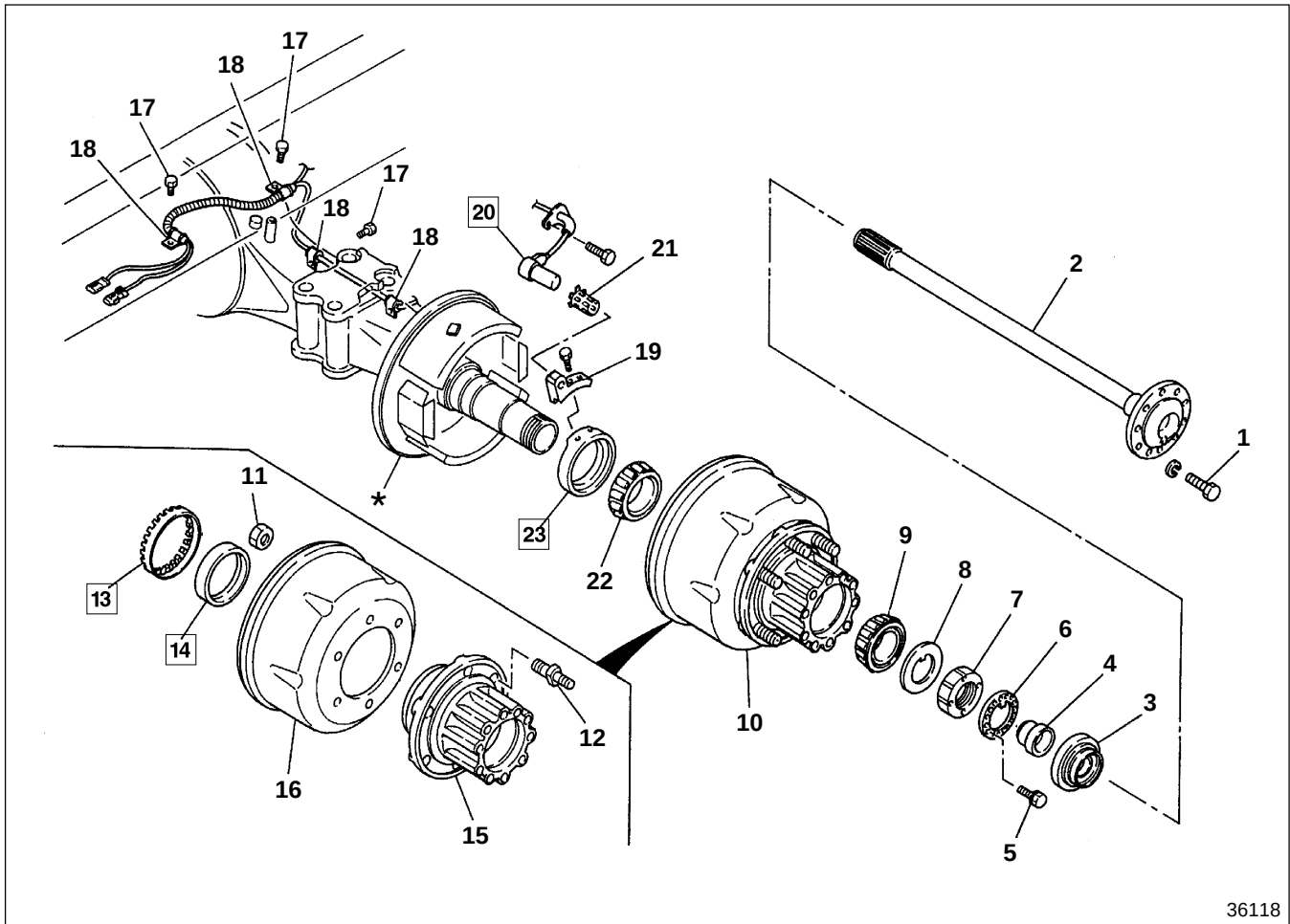
CAUTION ⚠

Be sure to clamp the harness of wheel speed sensor **16** at two white tape sections **F**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.

M E M O

WHEEL SPEED SENSOR AND ROTOR < REAR AXLE >

The following describes the service procedures for wheel speed sensors and rotors only.
Regarding the procedures for servicing other components, refer to  Gr 27.



36118

● Disassembly sequence

- | | | |
|---------------------|--------------------------------|------------------------|
| 1 Bolt | 10 Hub and brake drum assembly | 19 Sensor holder |
| 2 Rear axle shaft | 11 Nut | 20 Wheel speed sensor |
| 3 Oil seal | 12 Hub bolt | 21 Spring spacer |
| 4 Oil seal retainer | 13 Rotor | 22 Inner bearing |
| 5 Bolt | 14 Oil seal | 23 Oil seal retainer |
| 6 Lock plate | 15 Wheel hub | |
| 7 Lock nut | 16 Brake drum | *: Rear brake assembly |
| 8 Lock washer | 17 Bolt | |
| 9 Outer bearing | 18 Clip | |

● Assembly sequence

Follow the disassembly sequence in reverse.

- Do not remove oil seal retainer 4 unless it is damaged (scratches, bending, tilting).

CAUTION

- When removing or installing hub and brake drum assembly 10, handle rotor 13 with care to prevent damage. Also, do not damage oil seal 14 during assembly.
- Keep oil and grease off lining surface of rear brake assembly * and the inner surface of brake drum 16.

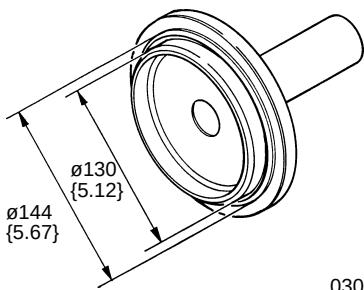
Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
13	Wobbling of rotor		0.1 {0.0039}	—	Replace
20	Wheel speed sensor	Resistance between terminals	950 to 1450Ω	—	Replace
		Insulation resistance	1MΩ or higher	—	Replace

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
14	Anti-lock brake system oil seal installer 	MH062664	Press-fitting of oil seal

◆ Service procedure

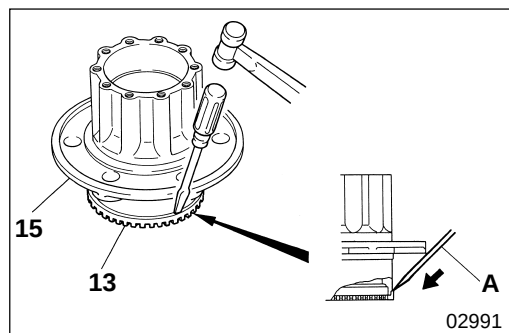
13 Rotor

[Removal]

Strike the outer edge of rotor **13** evenly with flat-tip screwdriver **A** to remove the rotor from the wheel hub.

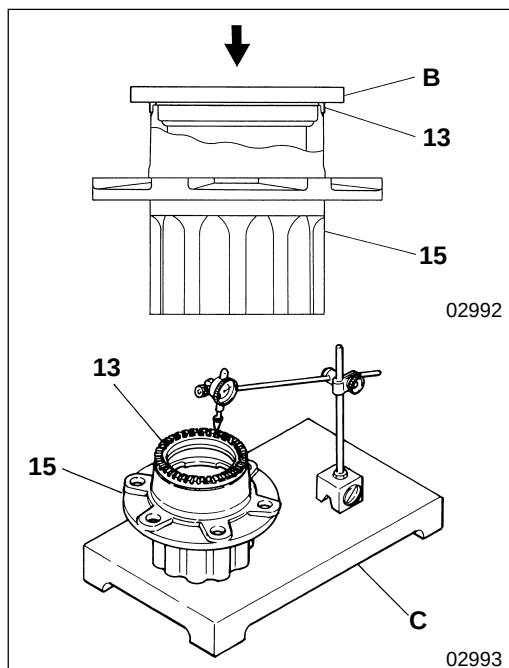
CAUTION ⚠

Be careful not to damage wheel hub **15**.



[Installation]

Heat rotor **13** to approximately 150°C {302°F}. Press the rotor evenly with iron plate **B** to press-fit the rotor to wheel hub **15**. Make sure there is no space between the rotor and wheel hub.

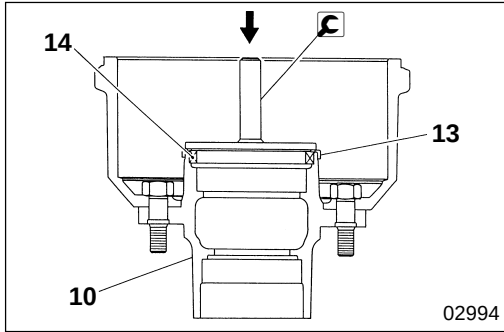


[Inspection]

- If the amount of wobbling exceeds the standard value, repeat the assembly procedure from the beginning.
- If the amount of wobbling exceeds the standard value after reassembly, replace defective parts.

C : Base

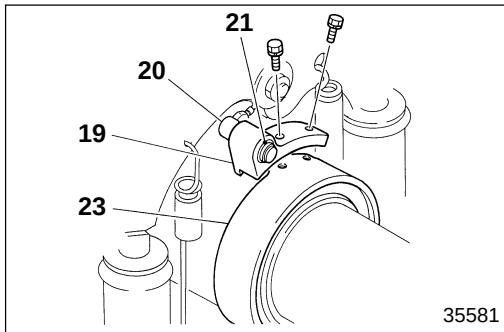
WHEEL SPEED SENSOR AND ROTOR < REAR AXLE >



14 Installation of oil seal

NOTE

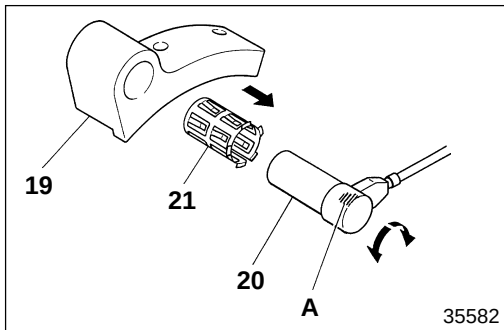
When hub and brake drum assembly 10 is removed for a service operation and if rotor 13 is still mounted on the wheel hub, use  Anti-lock brake system oil seal installer to press-fit oil seal 14.



20 Wheel speed sensor

[Removal]

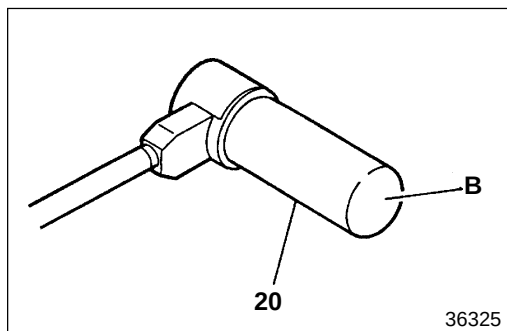
- With wheel speed sensor 20 and spring spacer 21 installed in sensor holder 19, remove the sensor holder from oil seal retainer 23.



- Hold shaded section **A** of wheel speed sensor 20 with pliers, and remove the sensor by twisting it slightly in left and right directions.

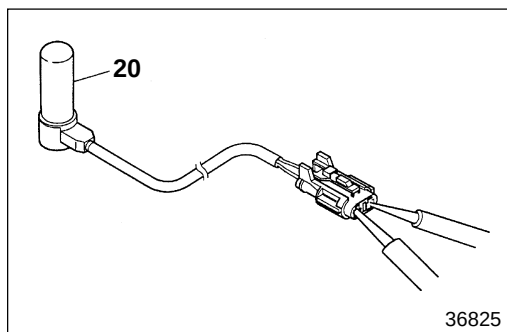
CAUTION

- When holding wheel speed sensor 20 with pliers, do not grip any section other than shaded area **A** in the diagram.
- When removing wheel speed sensor 20, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- If wheel speed sensor 20 dismounts easily, replace spring spacer 21.

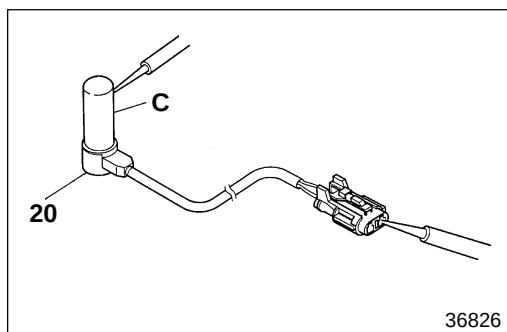


[Inspection]

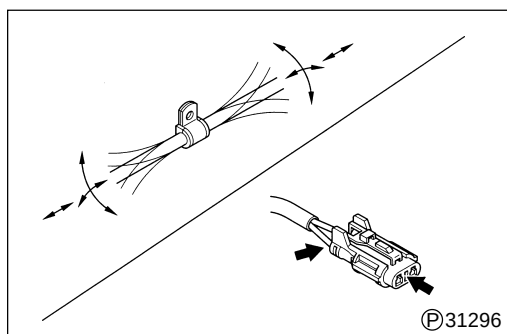
- Since pole piece section **B** is magnetized by the magnet inside wheel speed sensor **20**, it attracts metals. Do not allow the pole piece to collect metallic objects.



- Measure the resistance between the terminals of wheel speed sensor **20**.
If the measured value deviates from the standard value, replace the wheel speed sensor.

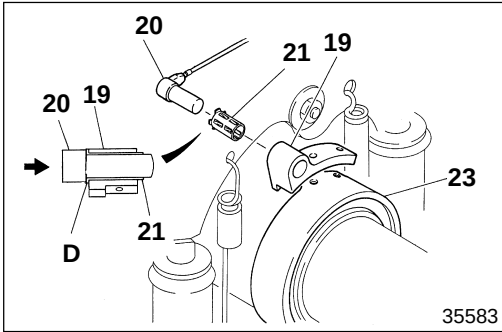


- Measure the insulation resistance between body **C** of wheel speed sensor **20** and each terminal.
If the measured values deviate from the standard value, replace the wheel speed sensor.



- To check for broken wires, remove the harness clamp section from the vehicle. Bend and extend the harness to check if there is any broken wire in the harness. Also, inspect the connector for proper contact.
If a defect is found, replace wheel speed sensor **20**.

WHEEL SPEED SENSOR AND ROTOR < REAR AXLE >



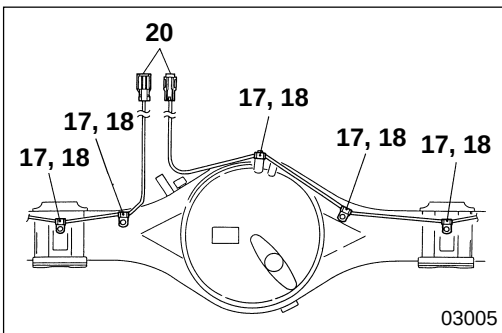
[Installation]

- Insert wheel speed sensor **20** from the back plate, and press until spring spacer **21** and stopper section **D** of the wheel speed sensor contacts sensor holder **19**.
- With wheel speed sensor **20** and spring spacer **21** installed in sensor holder **19**, mount the sensor holder on oil seal retainer **23**.

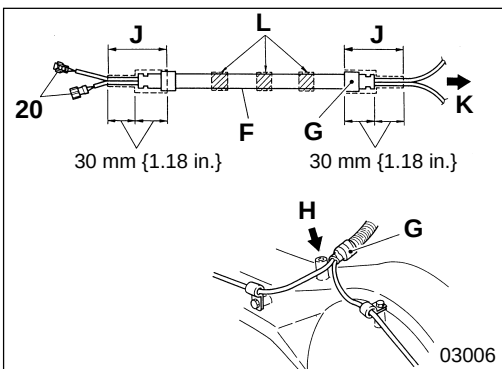
CAUTION ⚠

- When installing wheel speed sensor **20**, do not apply force on the sensor, such as by hitting with a hammer, prying with a screwdriver or pulling the harness, since these actions can result in wire breakage.
- Note that wheel speed sensor **20** is different for left and right wheels.

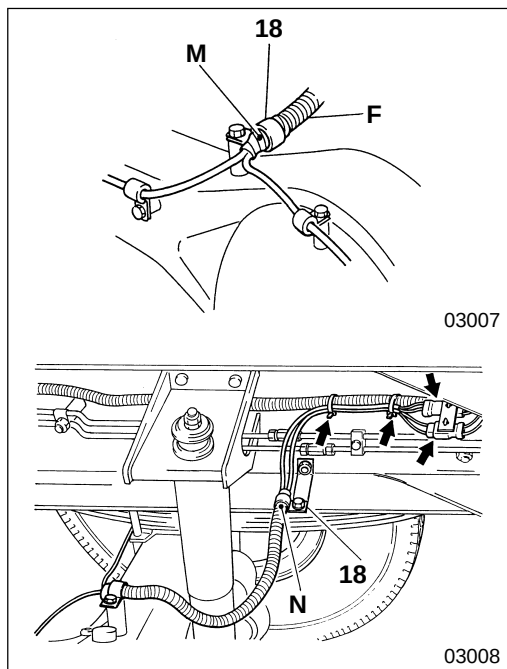
Location	Harness connector color	Harness connector shape
Left wheel	Gray	Male
Right wheel	Black	Female



- Rear axle housing section
Starting from the wheel brake side, secure the harness of wheel speed sensor **20** in place with clip **18** and bolt **17**. Make sure the harness does not interfere with other parts and there is no twist or slack in the harness.



- Binding of harness
 - Gather the harnesses of left and right wheel speed sensors **20**, and bind with corrugated tube **F**.
 - Adjust the position of the corrugated tube **F** so that white tape section **G** is located at clip position **H** on the rear axle housing. Then, turn the corrugated tube so that the slit faces down. Wrap black tape (electric harness tape) on both ends **J** of the corrugated tube. The tape should be placed over the tube end and harness.
- **K**: Rear axle housing side
- Wrap tape on the harnesses of wheel speed sensors **20** at sections **L** (three locations at equal intervals).



- Clamping of harness
 - Secure section **M** of corrugated tube **F** to the rear axle housing using clip **18**, and attach section **N** of the corrugated tube to the frame using clip **18**.
 - Connect the wheel speed sensor connector to the harness connector on the chassis side, and secure the connectors in place using the bracket.

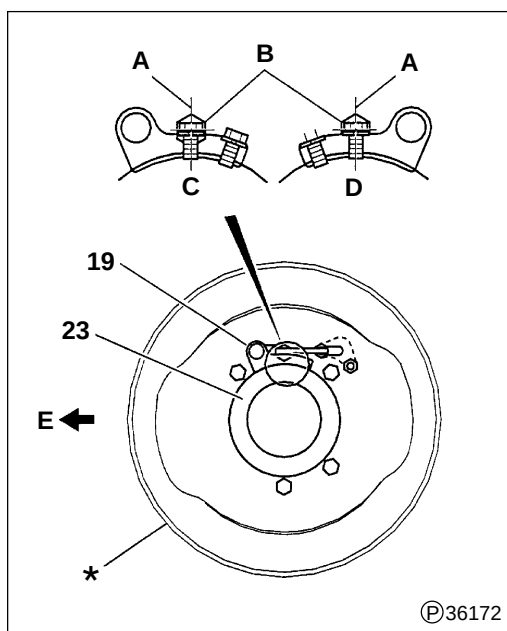
23 Installation of oil seal retainer

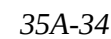
When installing oil seal retainer **23**, align mounting bolt center **A** of sensor holder **19** with the center line of mounting bolt **B** of rear brake assembly *****.

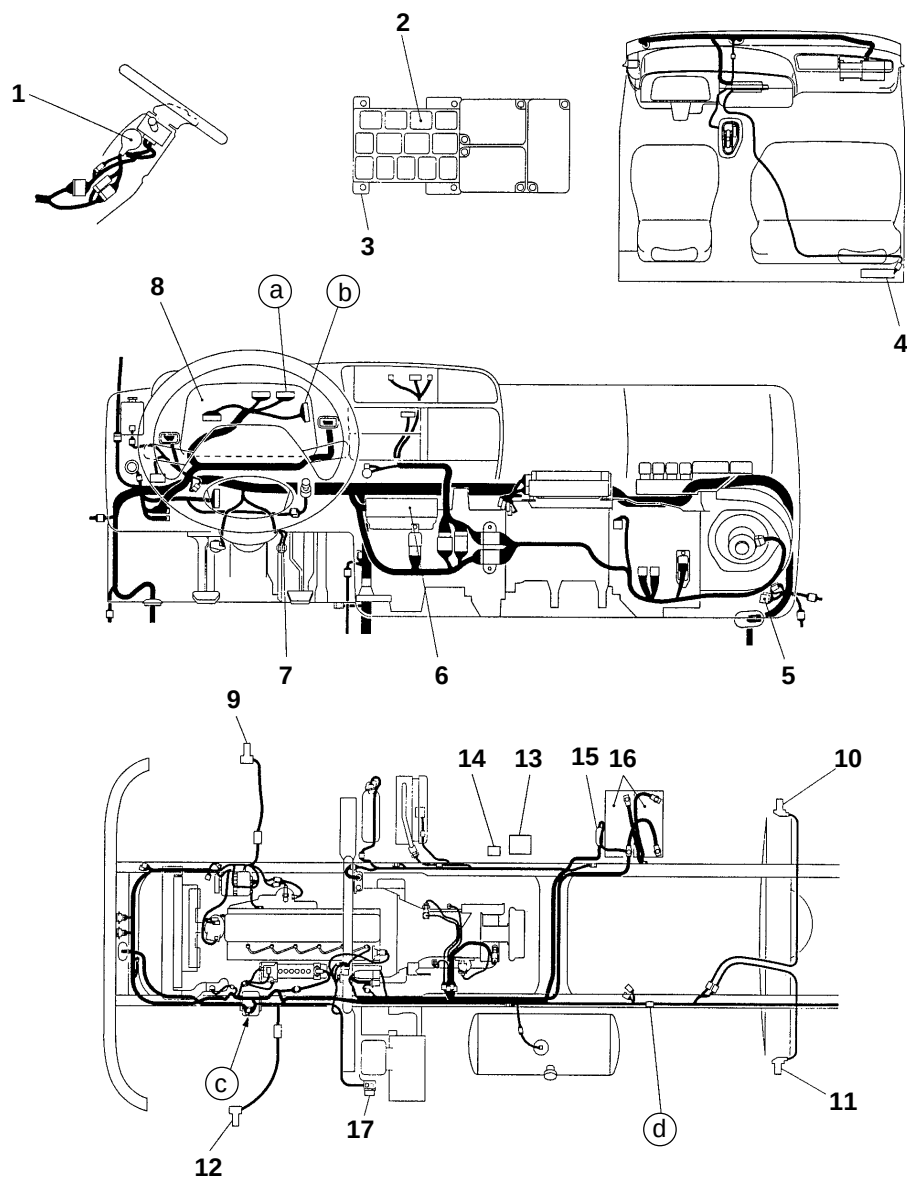
- C** : For left wheel
- D** : For right wheel
- E** : Front of vehicle

NOTE

The brake assembly diagram shows a left wheel.







36002

- | | | |
|---------------------------|---|---------------------------|
| 1 Starter switch | 7 Stop lamp switch | 13 Hydraulic unit |
| 2 Exhaust brake cut relay | 8 Meter cluster | 14 Relay box |
| 3 Relay box | 9 Wheel speed sensor (for front-axle right wheel) | 15 Main high-current fuse |
| 4 ECU | 10 Wheel speed sensor (for front-axle left wheel) | 16 Battery |
| 5 MUT-II connector | 11 Wheel speed sensor (for rear-axle left wheel) | 17 High-current fuse box |
| 6 Fuse box | 12 Wheel speed sensor (for rear-axle right wheel) | |



FH

Service Manual

Group 36

Parking Brake

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

GROUP 36 PARKING BRAKE

SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
TROUBLESHOOTING	4
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Adjustment of Parking Brake Shoe Clearance and Lever Stroke	5
PARKING BRAKE CONTROL	6
PARKING BRAKE ASSEMBLY	8
SUPPORT PLATE AND SHOE ASSEMBLY	
< ø203.2 mm {8 in.} Drum >	12
< ø254 mm {10 in.} Drum >	14

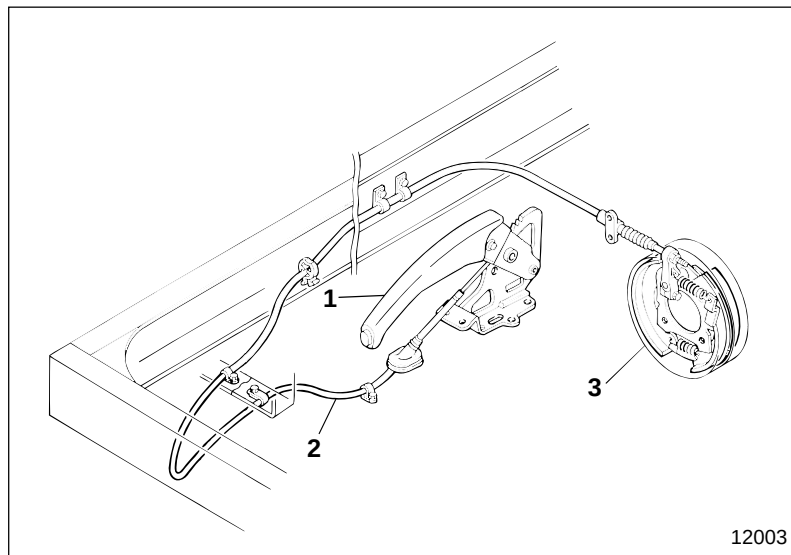
SPECIFICATIONS/STRUCTURE AND OPERATION

SPECIFICATIONS

Item		Vehicle model	FH211-A	FH211-B
			Manual transmission	Automatic transmission
Brake	Type		Propeller shaft internal expanding type brake	
	Operation type		Mechanical cable type	
Parking brake assembly	Type		Dual-servo type	
	Inner diameter of drum mm {in.}		ø203.2 {8}	ø254 {10}
	Lining width×Thickness mm {in.}		50×4.0 {1.97×0.16}	60×5.8 {2.36×0.23}

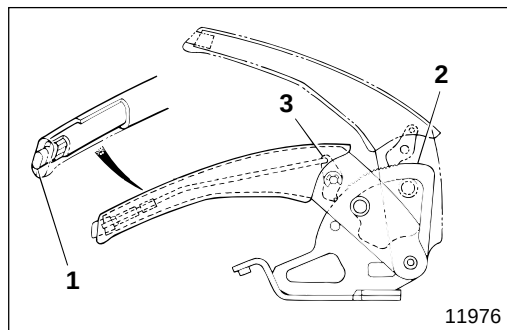
STRUCTURE AND OPERATION

Parking Brake Control



- 1 Parking brake lever
- 2 Parking brake cable
- 3 Parking brake assembly

Parking Brake Lever

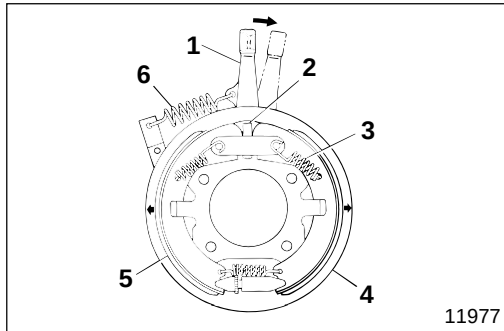


- 1 Release rod knob
- 2 Lever bracket
- 3 Locking latch

The parking brake has a built-in locking mechanism that prevents inadvertent release of the brake.

To release locking, push release rod knob 1 which will disengage from the serration of lever bracket 2 and the tooth of locking latch 3 freeing the parking brake lever and allowing it to return.

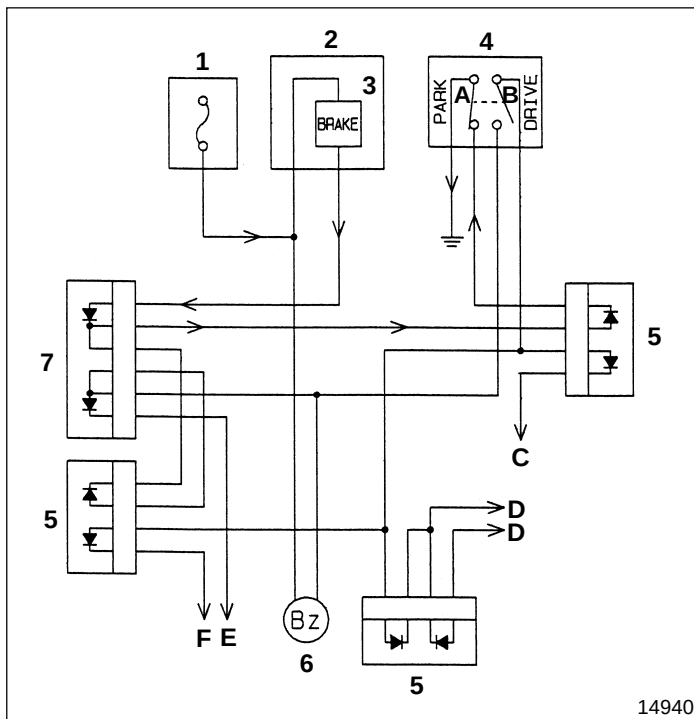
Parking Brake Assembly



- 1 Camshaft lever
- 2 Camshaft
- 3 Shoe return spring
- 4 Dust cover or support plate and cover assembly
- 5 Shoe and lining assembly
- 6 Camshaft lever return spring

Pulling the parking brake lever pulls the parking brake cable, which in turn pulls camshaft lever 1. At the same time, camshaft 2 rotates in conjunction with the camshaft lever, and expands shoe and lining assembly 5 making it press against the brake drum. This frictional force locks the propeller shaft that is connected to the drum. When the brake lever is released, the repercussive force of shoe return spring 3 releases the brake.

Parking Brake Electrical System



- 1 Fuse box
 - 2 Meter cluster
 - 3 Parking brake indicator lamp
 - 4 Parking brake switch
 - 5 Diode unit
 - 6 Buzzer
 - 7 Joint connector
- C : Cooling system
 D : Automatic transmission system
 E : Brake system
 D : Engine oil pressure system

- The parking brake electrical system is provided for indicating, its detecting and indicating function is activated by pulling the parking brake lever.
- When the parking brake lever is pulled, contact point A of parking brake switch 4 closes (ON), and parking brake indicator lamp 3 is lit, indicating that the parking brake is operating.
 The current flows as below:
 Fuse 1 → Parking brake indicator lamp 3 → Joint connector 7 → Diode unit 5 → Parking brake switch 4 → Ground
- Buzzer 6 sounds and gives a warning when any fault is detected in the cooling system, automatic transmission system, brake system or engine oil pressure system. Pulling the parking brake lever opens (OFF) contact point B of parking brake switch 4 to stop the buzzer from sounding.

TROUBLESHOOTING

Symptoms		Parking brake does not work	Parking brake does not release smoothly (dragging)	Remarks
Parking brake cable	Inner cable stretched or damaged	☐	☐	
	Inner cable rusted	☐	☐	
Parking brake lever	Ratchet bar and ratchet pawl engaging incorrectly	☐	☐	
	Pulling stroke insufficient	☐	☐	
	Pulling stroke excessive	☐	☐	
Parking brake assembly	Shoe clearance insufficient	☐	☐	
	Shoe clearance excessive	☐	☐	
	Parking brake drum inner surface deformed or warped	☐	☐	
	Lining worn unevenly	☐	☐	
	Brake drum inner surface greasy or oily	☐	☐	
	Lining surface greasy or oily	☐	☐	
	Camshaft lever return spring fatigued or fractured	☐	☐	
	Shoe return spring fatigued or fractured	☐	☐	

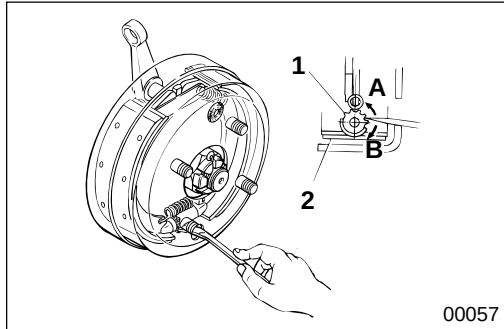
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE 36

Adjustment of Parking Brake Shoe Clearance and Lever Stroke

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Brake shoe clearance	0.1 to 0.25 {0.0039 to 0.0098}	—	Adjust
3	Brake lever pulling stroke (at operating force of 490 N {110 lbf, 50 kgf})	7 to 10 notches	—	Adjust

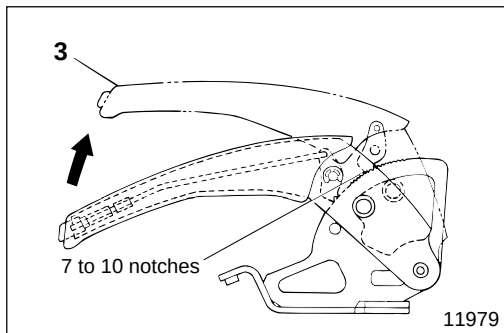


(1) Shoe clearance

When the camshaft lever is released, turn adjusting screw **1** in the expansion direction, using a screwdriver inserted through the shoe adjusting hole of the brake drum, and return 8 notches from the position where shoe **2** is in close contact with the drum. Then, the shoe clearance will be the standard value.

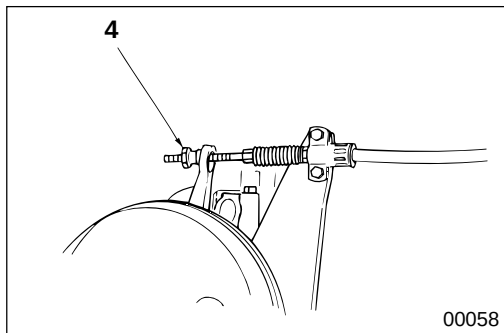
A : Expansion

B : Contraction

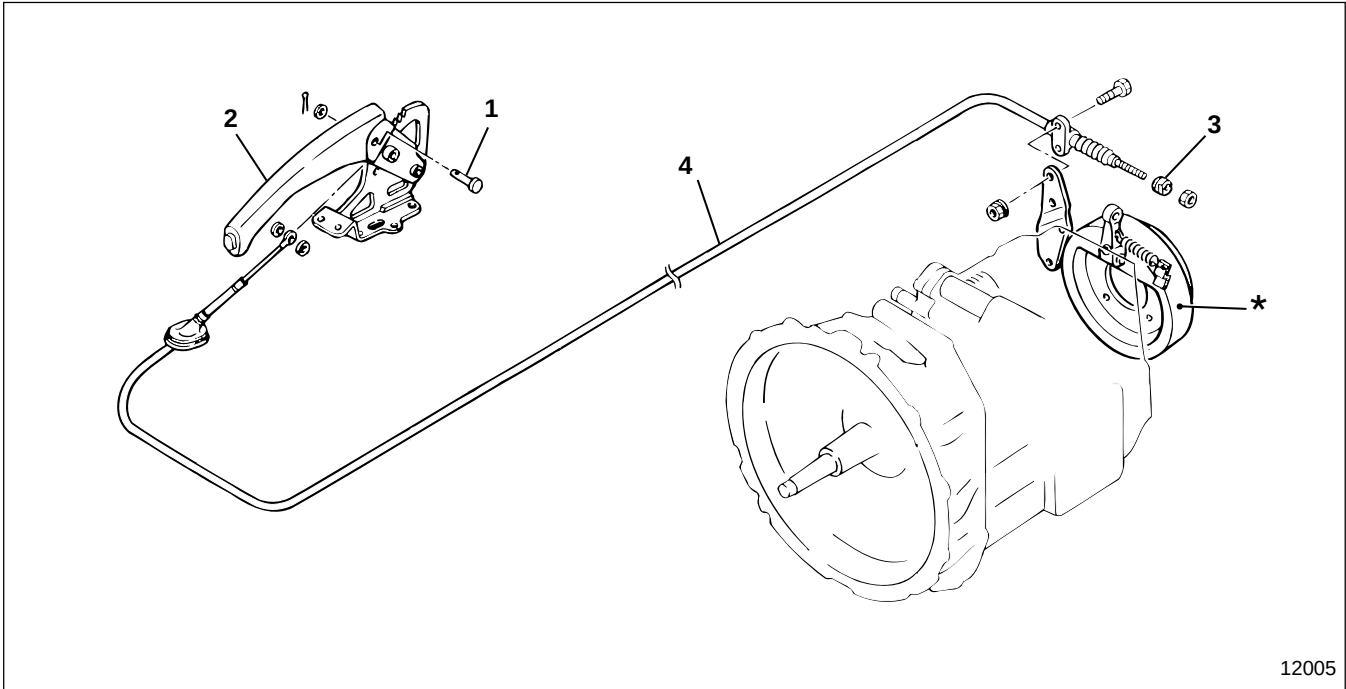


(2) Lever pulling stroke

Adjust camshaft lever lock nut **4** so that the number of notches (clicks heard) is the standard value when parking brake lever **3** is pulled from the released position by an operating force of 490 N {110 lbf, 50 kgf}. Operate the parking brake lever two or three times after adjusting to verify the pulling stroke, to make sure that the parking brake is operating properly and that the parking brake drum does not drag when the parking brake is released.



PARKING BRAKE CONTROL



12005

● Removal sequence

- 1 Clevis pin
- 2 Parking brake lever assembly  P36-7
- 3 Ball bushing
- 4 Parking brake cable

* : Parking brake assembly  P36-8

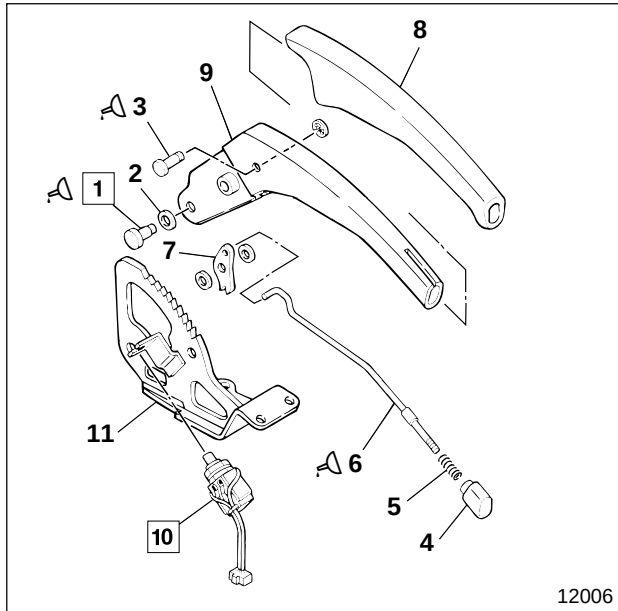
WARNING

- You must place wheel chocks securely in place to prevent the vehicle from moving.
- Do not remove the chocks until the entire operation is completed.

● Installation sequence

Follow the removal sequence in reverse.

Parking Brake Lever Assembly



● Disassembly sequence

- 1 Pin
- 2 Spacer
- 3 Pin
- 4 Release rod knob
- 5 Return spring
- 6 Release rod
- 7 Locking latch
- 8 Grip
- 9 Parking brake lever
- 10 Parking brake switch Gr 54
- 11 Lever bracket

● Assembly sequence

Follow the disassembly sequence in reverse.

🔧 Lubricant and sealant

Location	Points of application	Kinds	Quantity
1, 3	Rotating area and friction surface of pins	Chassis grease [NLGI No.1 (Ca soap)]	As required
6	Thread area of release rod	Cemedine 1500	As required

◆ Service procedure

1 Installation of pin

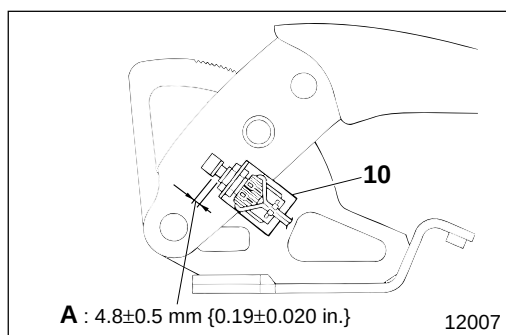
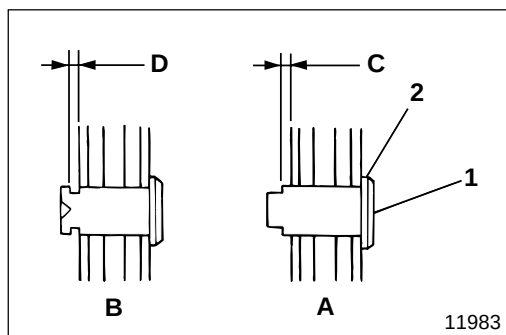
A : Before caulking

B : After caulking

When clearance **C** (before caulking) is less than 0.6 mm {0.024 in.}, do not use spacer **2**.

Also, use the spacer to adjust if clearance is 0.6 to 0.96 mm {0.024 to 0.038 in.}.

	Without spacer	With spacer
Dimension D	0.06 to 0.6 mm {0.0024 to 0.024 in.}	0 to 0.36 mm {0 to 0.014 in.}

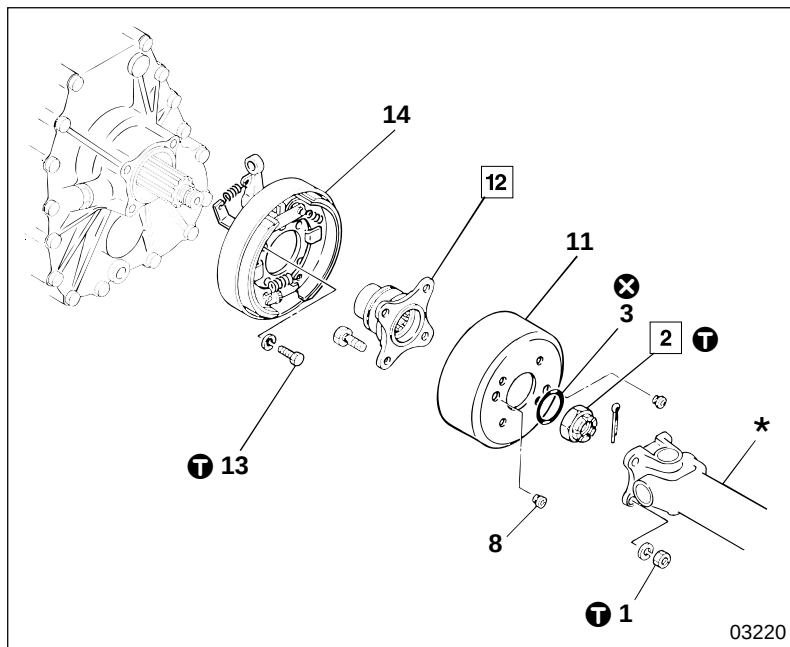


10 Installation of parking brake switch

Install parking brake switch **10** so that the stroke equals **A**.

PARKING BRAKE ASSEMBLY

< Manual Transmission >



● Inspection before disassembly

📖 P36-10

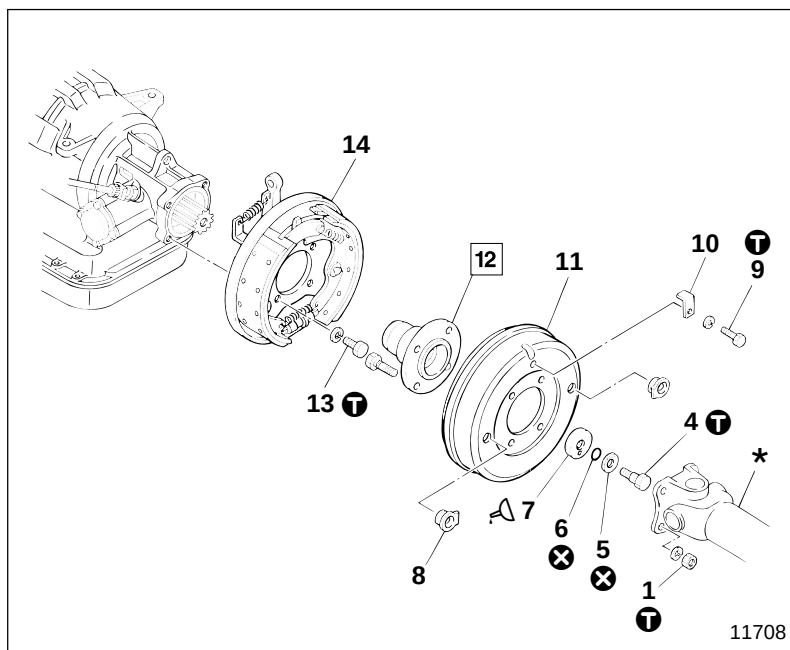
● Disassembly sequence

- 1 Nut
 - 2 Lock nut
 - 3 O-ring
 - 4 Flange set bolt
 - 5 Lock washer
 - 6 O-ring
 - 7 Retainer washer
 - 8 Dust plug
 - 9 Bolt
 - 10 Drum plate
 - 11 Parking brake drum
 - 12 Companion flange
 - 13 Bolt
 - 14 Support plate and shoe assembly
- 📖 P36-12 or P36-14

* : Propeller shaft 📦 Gr 25

⊗ : Non-reusable parts

< Automatic Transmission >



WARNING ⚠

- You must place wheel chocks securely in place to prevent the vehicle from moving.
- Do not remove the chocks until the entire operation is completed.

● Assembly sequence

Follow the disassembly sequence in reverse.

< Manual Transmission >

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
11	Parking brake drum	Deflection at mating area	0.15 {0.0059} or less	0.5 {0.020}	Replace
		Inner diameter	$\varnothing 203.2^{+0.3}_0$ { $8^{+0.012}_0$ }	$\varnothing 205$ {8.07}	
		Squareness	0.05 {0.0020} or less	—	
		Concentricity	$\varnothing 0.2$ {0.0079} or less	—	
		Cylindrical accuracy	0.05 {0.0020} or less	—	
		Static rotation imbalance	0.88 N·cm {0.0065 lbf.ft, 90 gf·cm}	—	

< Automatic Transmission >

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
11	Parking brake drum	Deflection at mating area	0.15 {0.0059} or less	0.5 {0.020}	Replace
		Inner diameter	$\varnothing 254.0^{+0.5}_0$ { $10^{+0.020}_0$ }	$\varnothing 255.5$ {10.1}	
		Squareness	0.05 {0.0020} or less	—	
		Concentricity	$\varnothing 0.1$ {0.0039} or less	—	
		Cylindrical accuracy	0.05 {0.0020} or less	—	
		Static rotation imbalance	0.88 N·cm {0.0065 lbf.ft, 90 gf·cm}	—	

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened		Tightening torque	Remarks
1	Nut (Propeller shaft mounting)		85 {61, 8.5}	—
2	Lock nut (Companion flange mounting)		245 to 345 {180 to 235, 25 to 35}	—
4	Flange set bolt (Companion flange mounting)		140 to 160 {100 to 120, 14.10 to 16.72}	—
9	Bolt (Drum plate mounting)		20 {14, 2}	—
13	Bolt (Support plate and shoe assembly mounting)	Manual transmission	40 {30, 4.1}	—
		Automatic transmission	110 to 130 {81 to 97, 11.22 to 13.46}	

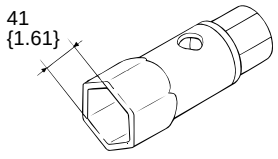
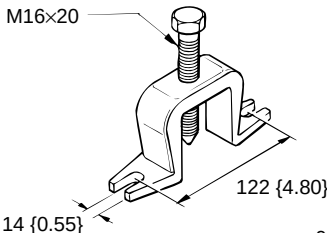
 Sealant

Location	Points of application	Kinds	Quantity
7	Outer periphery of retainer washer	THREEBOND 1215	As required

PARKING BRAKE ASSEMBLY

Special tools

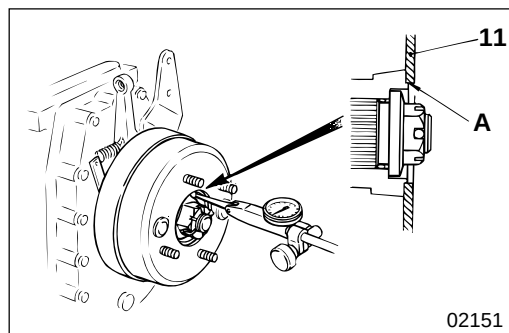
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
2	Socket wrench  00069	MH061532	Removal and installation of main shaft rear lock nut < Manual transmission >
12	Flange puller  03159	MC881524	Removal of main shaft rear companion flange

Service procedure

● Inspection before disassembly

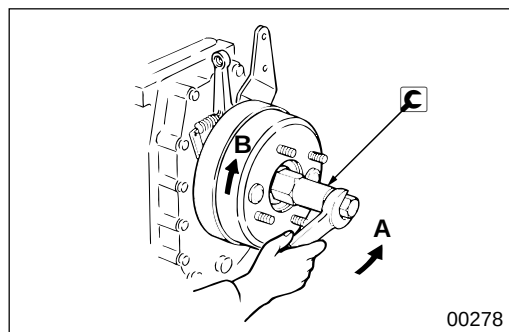
Measure parking brake drum **11** at mating area **A**, and replace the brake drum if the measured value is higher than the limit.

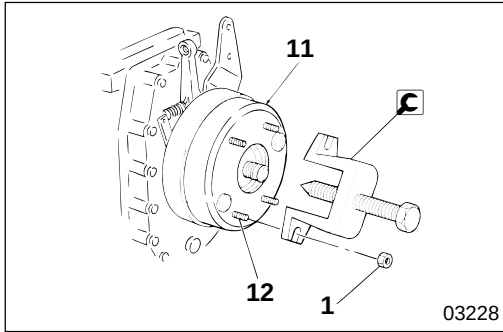


2 Removal and installation of lock nut < Manual transmission >

>

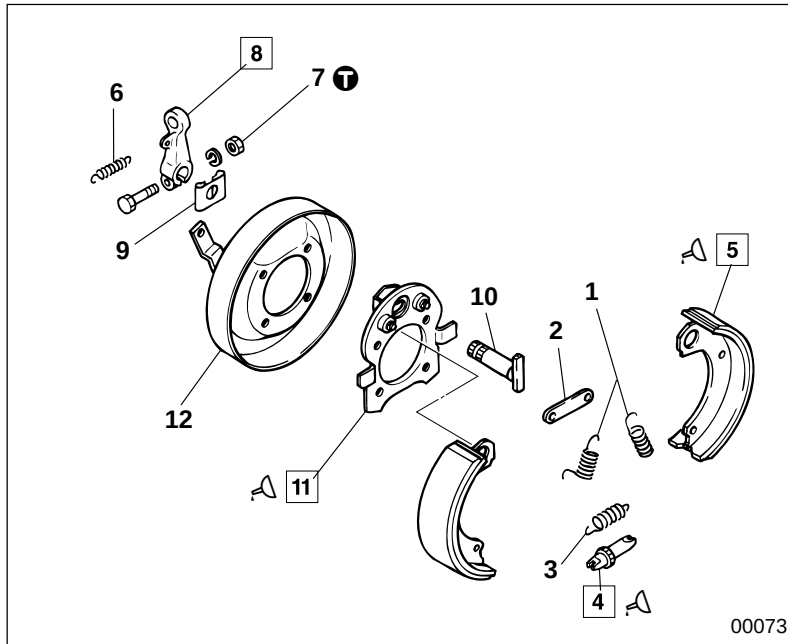
A : Removal





B : Installation

SUPPORT PLATE AND SHOE ASSEMBLY < ø203.2 mm {8 in.} Drum >



● Disassembly sequence

- 1 Shoe return spring
- 2 Anchor pin brace
- 3 Adjusting wheel return spring
- 4 Adjusting screw
- 5 Shoe and lining assembly
- 6 Camshaft lever return spring
- 7 Nut
- 8 Camshaft lever
- 9 Spring spacer
- 10 Camshaft
- 11 Support plate
- 12 Dust cover

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

Do not leave grease or oil on the surface of shoe and lining assembly 5 because this reduces braking performance.

NOTE

If shoe and lining assembly 5 has been replaced with a new part, check correctness of contact with the parking brake drum.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Installed load of shoe return spring (Installed length 57.5 {2.26})	145±15 N {33±3.3 lbf, 15±1.5 kgf}	115 N {26 lbf, 12 kgf}	Replace
3	Installed load of adjusting wheel return spring (Installed length 59 {2.32})	78±7.8 N {18±1.8 lbf, 8±0.8 kgf}	63 N {14 lbf, 6.4 kgf}	Replace
5	Lining thickness of shoe and lining assembly	4.0 {0.16}	1.4 {0.055}	Replace
6	Installed load of camshaft lever return spring (Installed length 85 {3.35})	62±5.9 N {14±1.3 lbf, 6.3±0.6 kgf}	49 N {11 lbf, 5 kgf}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
7	Nut (Camshaft lever mounting)	6.9 to 13 {5.1 to 9.4, 0.7 to 1.3}	—

Lubricant

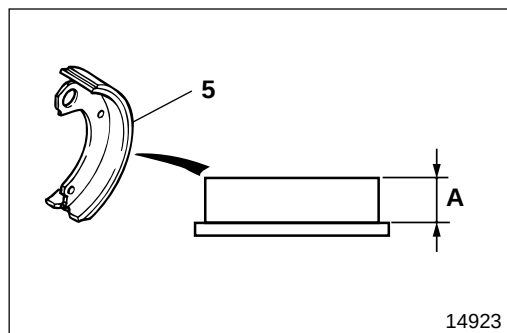
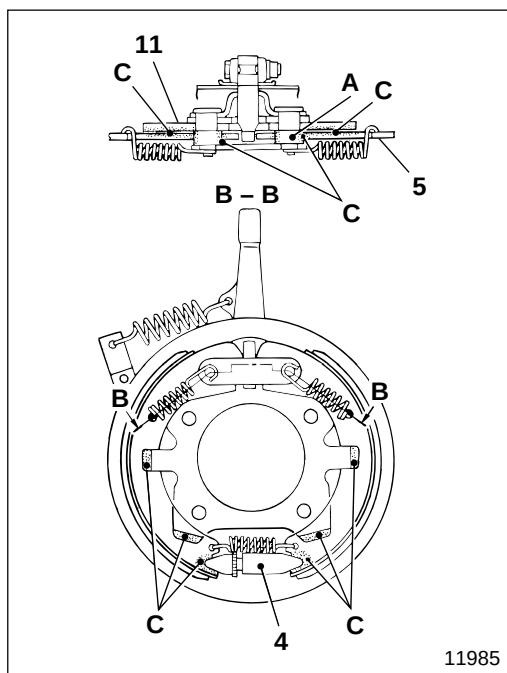
Location	Points of application	Kinds	Quantity
4, 5	Contact surfaces of both ends of adjusting screw with shoe and lining assembly	Brake grease (AKB100)	As required
5, 11	Contact surface of support plate and shoe and lining assembly	Brake grease (AKB100)	As required
	Contact surface of anchor pin area and support plate and shoe and lining assembly	Brake grease (AKB100)	As required

◆ Service procedure

- 4 5 11** Applying grease to adjusting screw, shoe and lining assembly, and support plate

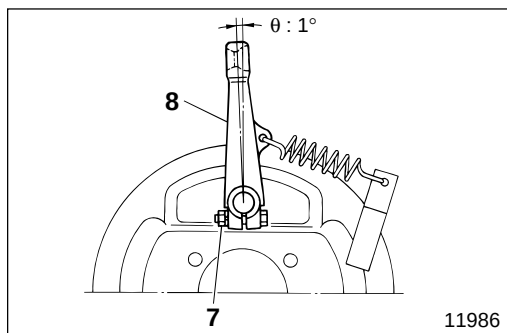
Apply grease to area **C**.

A : Anchor pin area



- 5** Inspection of shoe and lining assembly

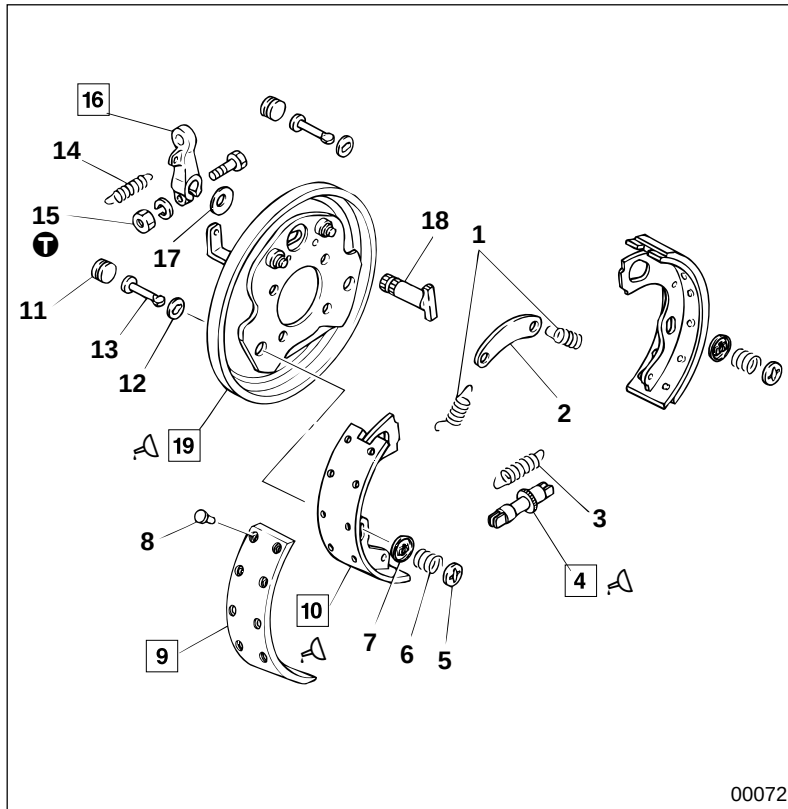
Measure thickness **A** of the lining. If the measured value is lower than the limit, replace shoe and lining assembly **5**.



- 8** Installation of camshaft lever

Install camshaft lever **8**, aligning the lever at the specified angle θ , then tighten nut **7** at specified torque.

SUPPORT PLATE AND SHOE ASSEMBLY < ø254 mm {10 in.} Drum >



● Disassembly sequence

- 1 Shoe return spring
- 2 Anchor pin brace
- 3 Adjusting wheel return spring
- 4 Adjusting screw
- 5 Shoe hold-down cup
- 6 Shoe hold-down spring
- 7 Shoe hold-down cup
- 8 Rivet
- 9 Lining
- 10 Brake shoe
- 11 Cover
- 12 Shoe hold-down washer
- 13 Shoe hold-down pin
- 14 Camshaft lever return spring
- 15 Nut
- 16 Camshaft lever
- 17 Spring spacer
- 18 Camshaft
- 19 Support plate and cover assembly

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

Do not leave grease or oil on the surface of lining 9 because this reduces braking performance.

NOTE

If lining 9 has been replaced with a new part, check correctness of contact with the parking brake drum.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
1	Installed load of shoe return spring (Installed length 75 {2.95})	180±18 N {41±4.0 lbf, 18.5±1.8 kgf}	145 N {33 lbf, 15 kgf}	Replace
3	Installed load of wheel return spring (Installed length 85 {3.35})	105±11 N {24±2.4 lbf, 11±1.1 kgf}	86 N {19 lbf, 8.8 kgf}	Replace
6	Installed load of shoe hold-down spring (Installed length 14 {0.55})	145±15 N {33±3.3 lbf, 15±1.5 kgf}	115 N {26 lbf, 12 kgf}	Replace
9	Lining thickness	5.8 {0.23}	3.5 {0.14}	Replace
14	Installed load of camshaft lever return spring (Installed length 85 {3.35})	62±5.9 N {14±1.3 lbf, 6.3±0.6 kgf}	49 N {11 lbf, 5 kgf}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
15	Nut (Camshaft lever mounting)	13.72 to 22.56 {10 to 17, 1.4 to 2.3}	—

Lubricant

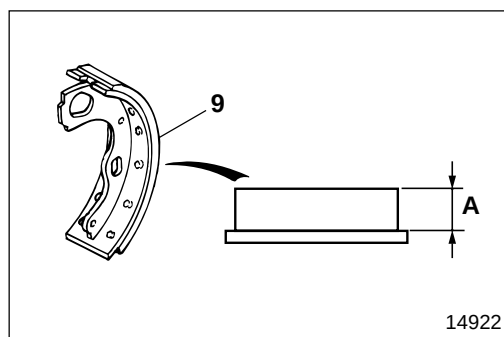
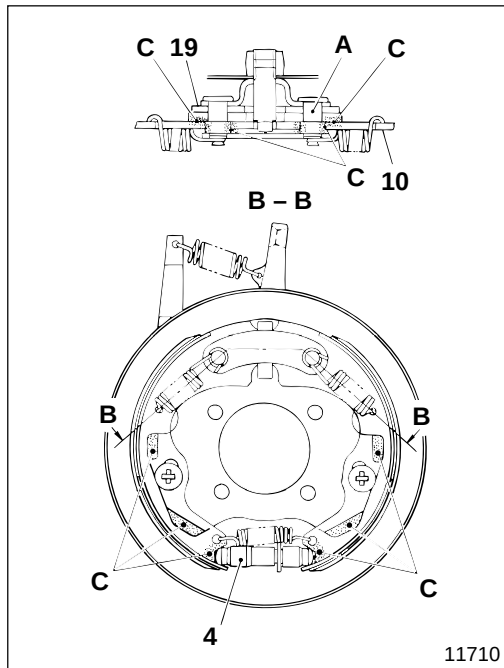
Location	Points of application	Kinds	Quantity
4, 10	Contact surfaces of both ends of adjusting screw with shoe and lining assembly	Brake grease (AKB100)	As required
10, 19	Contact surface of support plate and shoe and lining assembly	Brake grease (AKB100)	As required
	Contact surface of anchor pin area and support plate and shoe and lining assembly	Brake grease (AKB100)	As required

◆ Service procedure

4 10 19 Applying grease to adjusting screw, shoe and lining assembly, and support plate

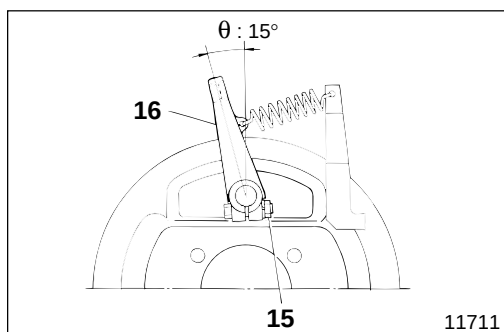
Apply grease to area **C**.

A : Anchor pin area



9 Inspection of lining

Measure thickness **A** of lining **9**. If the measured value is lower than the limit, replace the lining.



16 Installation of camshaft lever

Install camshaft lever **16**, aligning the lever at the specified angle θ , then tighten nut **15** at specified torque.



FH

Service Manual

Group 37

Steering

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

GROUP 37 STEERING

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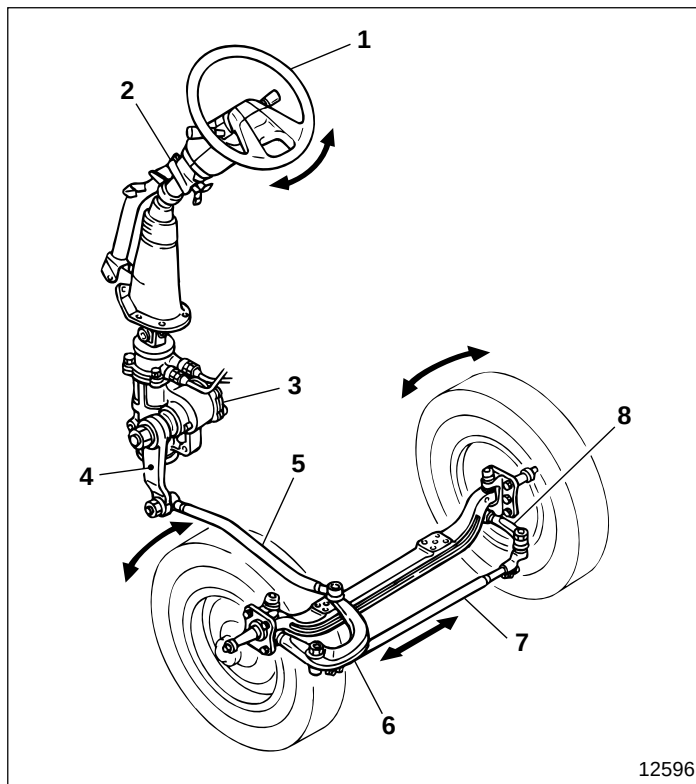
SPECIFICATIONS

Item		Specification
Steering wheel	Type	2-spoke type
	Outer diameter mm {in.}	450 {17.7}
Steering shaft	Type	Universal joint type (High tilt and telescopic type)
Power steering booster	Manufacturer	JIDOSHA KIKI
	Type	Ball nut type
	Form	Integral type
	Model No.	443-00015
	Gear ratio	17.1 to 20
	Cylinder diameter mm {in.}	85 {3.35}
	Mass (without pitman arm and fluid) kg {lb}	21 {46}
Power steering oil pump	Manufacturer	JIDOSHA KIKI
	Type	Vane type
	Model No.	470-03325
	Discharge amount cm ³ {cu. in.}/rotation	11.2 {0.68}
	Regulated flow amount L {qts}/min	12 {13}
	Regulated pressure (relief valve) MPa {lbf/in ² , kgf/cm ² }	12.3 {1780, 125}
	Permissible revolutions rpm	600 to 4800
	Mass (without drive gear and fluid) kg {lb}	2.7 {6.0}

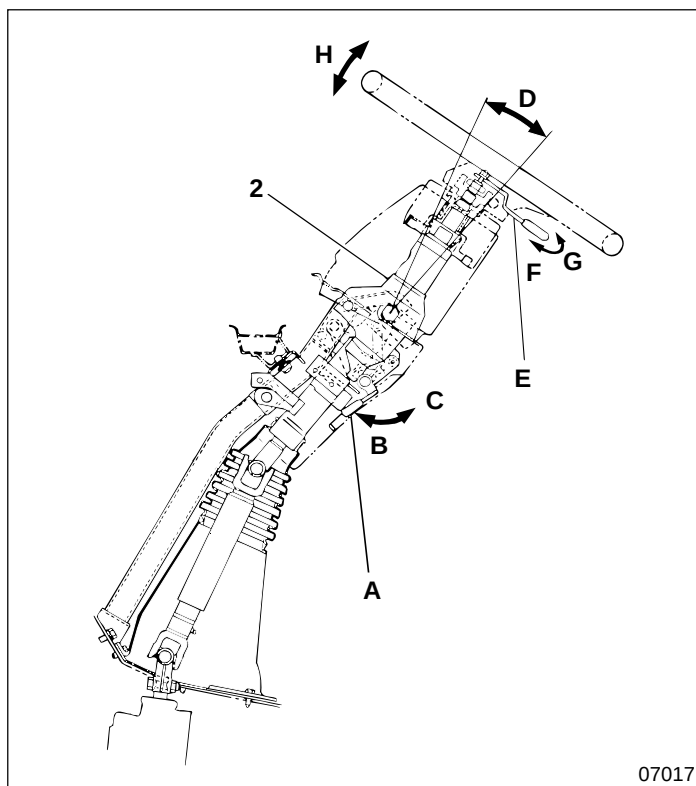
STRUCTURE AND OPERATION

37

Steering System



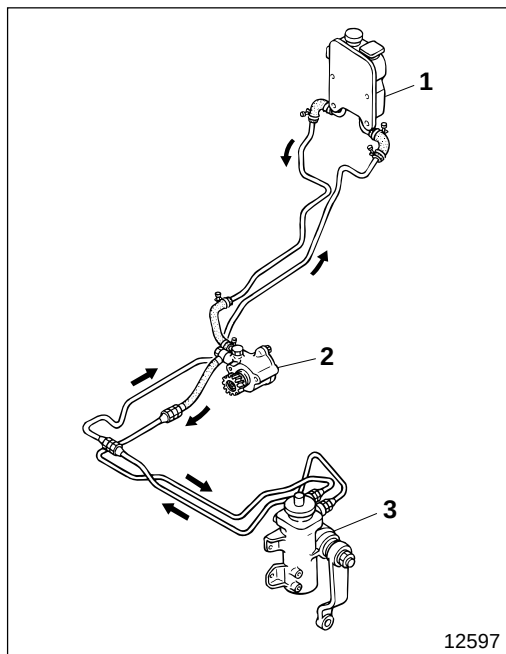
- 1 Steering wheel
- 2 Steering column subassembly
- 3 Power steering booster
- 4 Pitman arm
- 5 Drag link
- 6 Knuckle arm
- 7 Tie rod
- 8 Tie rod arm



Shifting lock lever **A** from lock position **B** to release position **C** produces high tilt **D**, and turning telescopic lever **E** (counterclockwise) from lock position **F** to release position **G** allows telescopic movement **H**. In this way, the structure of steering column subassembly **2** can be adjusted for optimum driving position.

STRUCTURE AND OPERATION

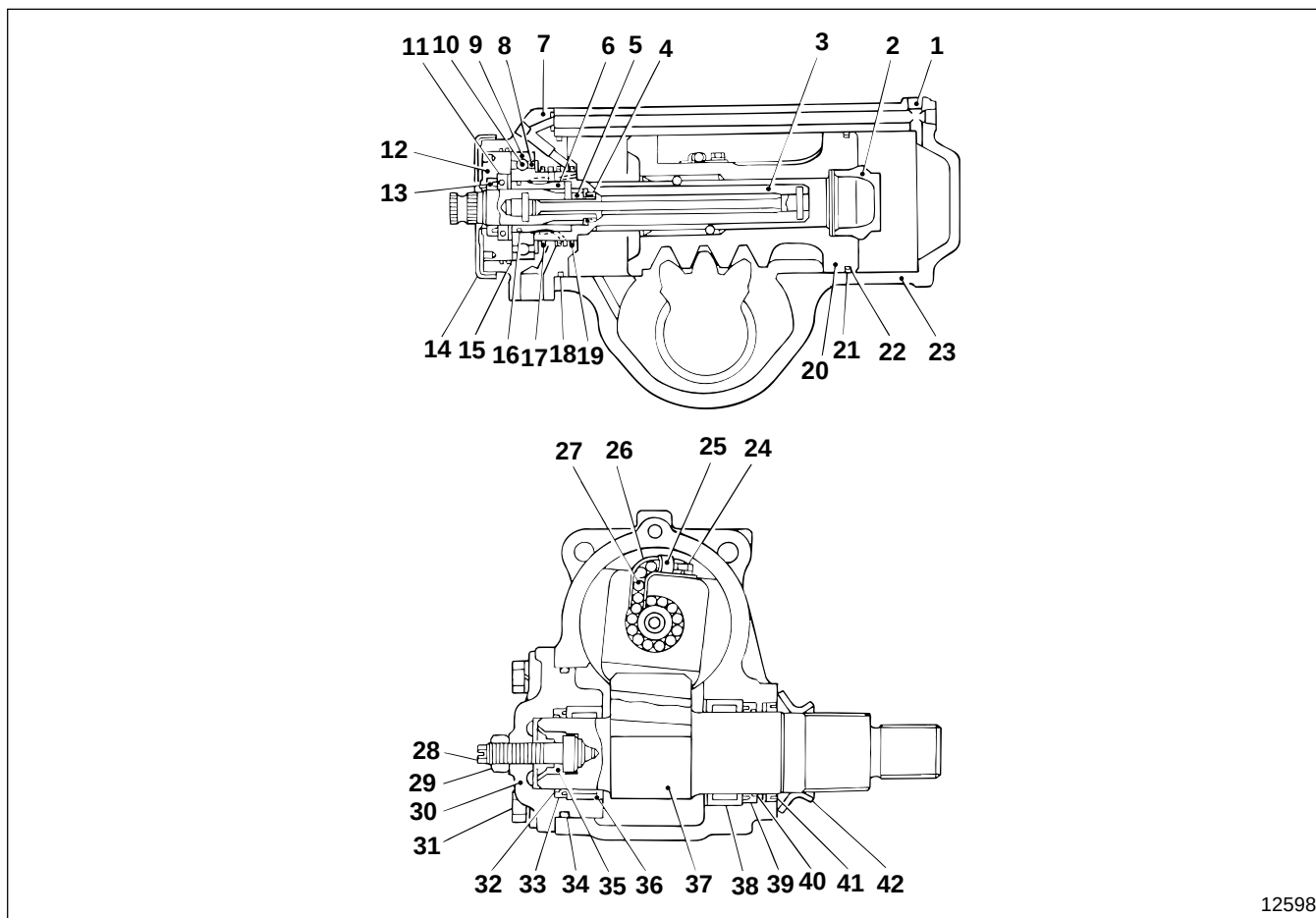
Power Steering System



- 1 Power steering oil tank
- 2 Power steering oil pump
- 3 Power steering booster

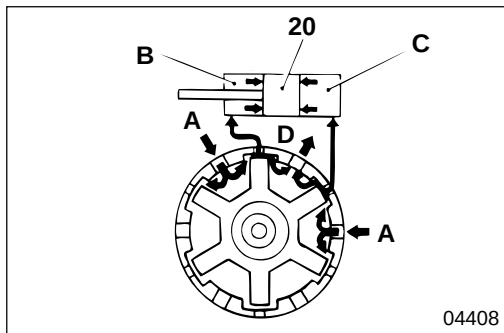
← : Fluid flow

Power Steering Booster



- | | | |
|-------------------|--------------------|-------------------|
| 1 Taper plug | 15 O-ring | 29 Nut |
| 2 Plug | 16 Seal ring | 30 Side cover |
| 3 Worm shaft | 17 O-ring | 31 Bolt |
| 4 Needle bearing | 18 O-ring | 32 Backup ring |
| 5 Stub shaft | 19 Seal ring | 33 Y-packing |
| 6 Rotor | 20 Piston | 34 O-ring |
| 7 Valve housing | 21 Seal ring | 35 Retainer |
| 8 Bearing cage | 22 O-ring | 36 Needle bearing |
| 9 Side race | 23 Body | 37 Sector shaft |
| 10 Steel ball | 24 Screw | 38 Needle bearing |
| 11 Ball bearing | 25 Ball tube clip | 39 Y-packing |
| 12 Adjusting plug | 26 Ball tube | 40 Backup ring |
| 13 Oil seal | 27 Steel ball | 41 Oil seal |
| 14 Dust cover | 28 Adjusting screw | 42 Dust cover |

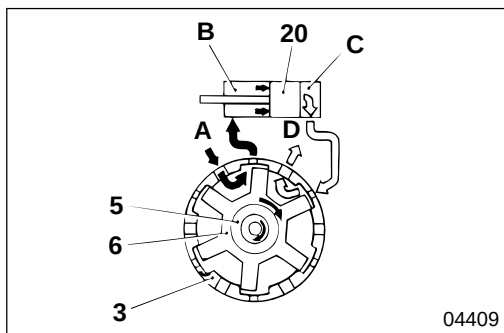
The rotary valve is the central part of the power steering booster. The torsion bar allows the steering reaction force and valve return to operate lightly and smoothly at low speed, and ensures stable steering feel even at high speed.



● Straight-ahead operation

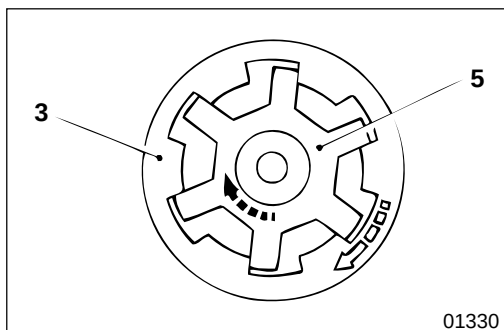
Piston 20 is in the neutral position as chambers B and C of the piston are under equal pressure.

- A : From oil pump
D : To oil tank



● Steering operation

Turning the steering wheel rotates stub shaft 5, causing rotor 6 to close the fluid feed passage to cylinder chamber C. This produces a pressure difference between cylinder chambers B, C, which causes piston 20 to move, and facilitates rotation of worm shaft 3.

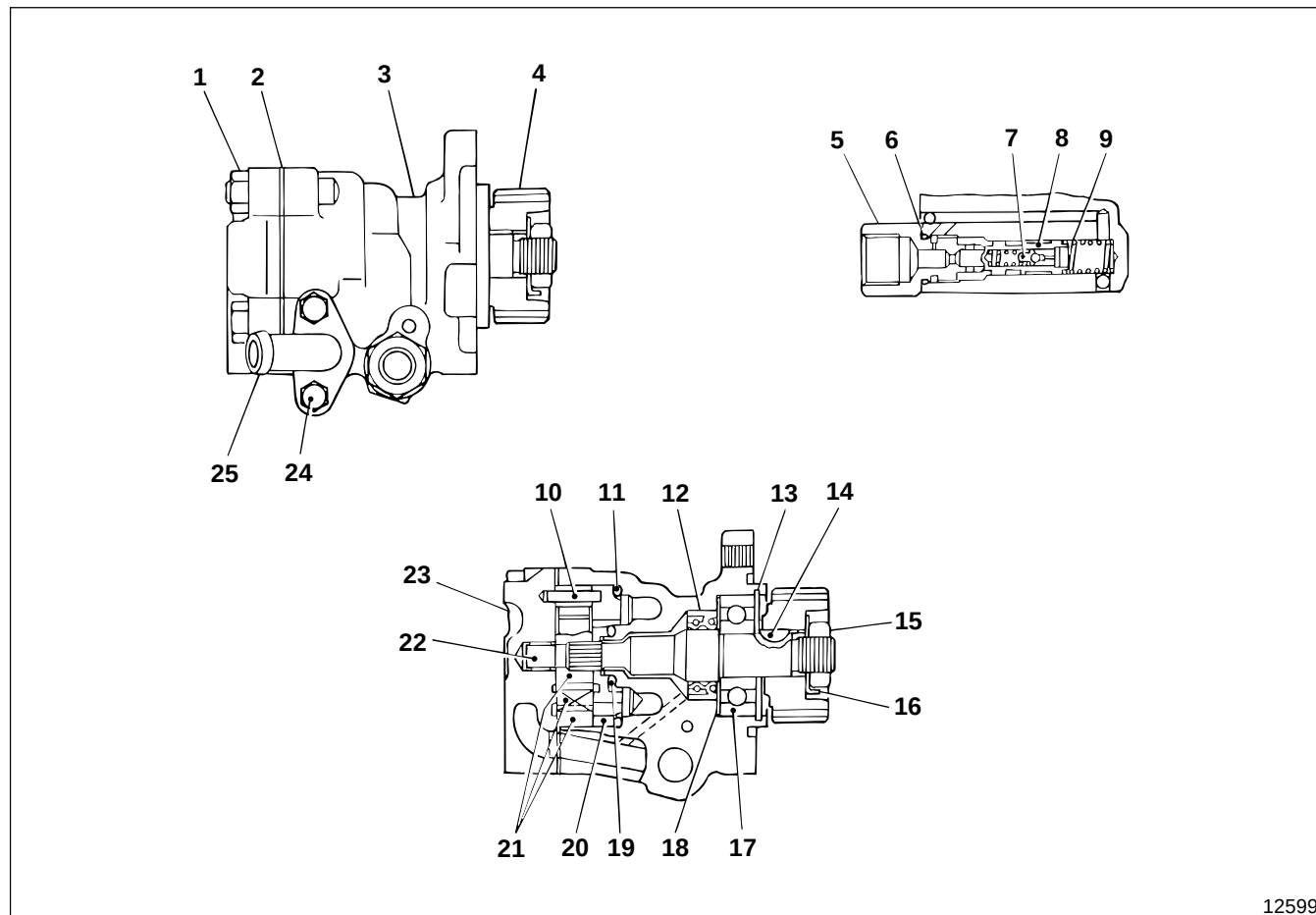


If the hydraulic circuit fails

The safety mechanism allows the vehicle to be steered manually, when the rotating force of stub shaft 5 alone directly turns worm shaft 3, transmitting the steering force.

STRUCTURE AND OPERATION

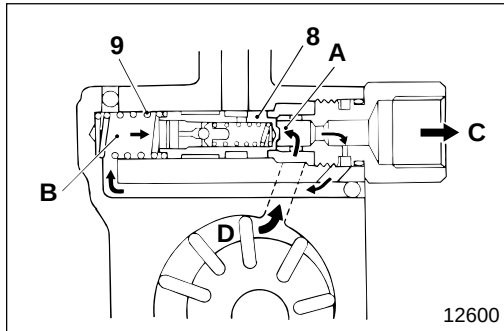
Power Steering Oil Pump



12599

- | | | |
|-------------------------------|-------------------|-----------------------|
| 1 Bolt | 10 Straight pin | 19 O-ring |
| 2 Gasket | 11 O-ring | 20 Pressure plate |
| 3 Front body | 12 Oil seal | 21 Cartridge assembly |
| 4 Gear | 13 Retaining ring | 22 Shaft |
| 5 Connector | 14 Key | 23 Rear body |
| 6 O-ring | 15 Nut | 24 Bolt |
| 7 Relief valve | 16 Lock washer | 25 Suction pipe |
| 8 Flow control valve assembly | 17 Ball bearing | |
| 9 Flow control spring | 18 Retaining ring | |

Flow Control Valve Assembly



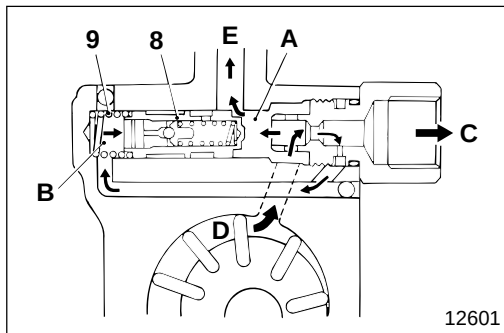
● Operation of flow control valve

(1) When not operating (When oil pump rotating at low speed)

The fluid pressure from chamber A does not move flow control valve assembly 8 because the fluid pressure is lower than the combined force of the fluid pressure from chamber B and the repercussive force of flow control spring 9.

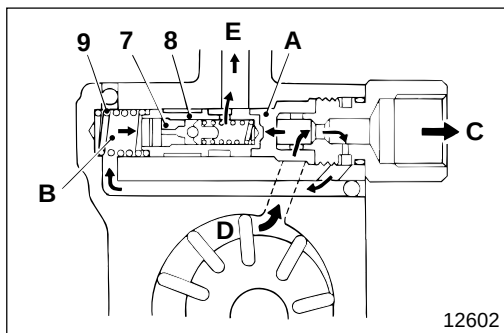
C : To power steering booster

D : Pressure chamber



(2) When operating (When oil pump rotating at middle or high speed)

The fluid pressure from chamber A moves flow control valve assembly 8 because the fluid pressure is higher than the combined force of the fluid pressure from chamber B and the repercussive force of flow control spring 9. Then, port E opens to release the fluid, maintaining the level of flow in chamber A.



● Operation of relief valve

The combined force of the fluid pressure from chamber B and the repercussive force of flow control spring 9 moves flow control valve assembly 8 because the fluid pressure is higher than the fluid pressure from chamber A. The hydraulic pressure in chamber B rises further to open relief valve 7 and port E, stabilizing the fluid pressure in chamber B.

TROUBLESHOOTING

Symptoms		Possible causes												Remarks
		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure abnormal	Oil pump gurgles	Oil pump squeaks	Oil pump growls	
Power steering mechanism faulty	Bearing damaged or worn	☐			☐	☐								
	Ball or groove of ball screw worn	☐	☐		☐									
	Air bled insufficiently	☐												
	Fluid viscosity unsuitable	☐												
	Power steering booster system faulty	☐												
	Flow control valve malfunctioning	☐												
	Ball screw unit rack and gear worn		☐											
	Sector shaft bearing worn		☐		☐									
	Power steering booster mounting bolt loose		☐											
	Ball screw unit and sector shaft play incorrect				☐									
	Valve control edge damaged or control seal ring broken				☐									
	Power steering system fluid unsuitable				☐									
	Rack engagement starting torque adjusted incorrectly	☐				☐								
	Fluid circuit clogged	☐				☐								
	Sector shaft gear worn		☐											
	Torsion shaft serration damaged or worn		☐											
	Power steering booster body faulty			☐	☐									
	O-ring, oil seal faulty							☐						
	Sealant applied incorrectly							☐						
Steering column and linkage mechanism faulty	Universal joint worn abnormally, damaged, lubricated incorrectly	☐	☐											
	Linkage deformed	☐												
	Drag link ball stud play		☐		☐									
	Tie rod end ball stud play		☐		☐									
	Tie rod bent						☐							
	Pitman arm mounting position incorrect						☐							
	Steering wheel turning center offset			☐										

Symptoms		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure abnormal	Oil pump gurgles	Oil pump squeaks	Oil pump growls	Remarks
Possible causes														
Front axle, etc. faulty	Kingpin lubricated incorrectly	☐				☐								Gr 26
	Front wheel alignment (toe-in, camber, caster) incorrect	☐		☐	☐	☐								
	Thrust bearing damaged	☐												
	Wheel hub bearing worn or damaged		☐	☐	☐									
	Kingpin or bushing worn or damaged		☐	☐	☐									
	Front axle deformed			☐										
	Knuckle arm, tie rod arm, or knuckle tightened incorrectly				☐									Gr 33
	U-bolt of front spring, nut, loose				☐									
	Front axle parts overtightened					☐								Gr 26
	Turning angle adjusted incorrectly						☐	☐						
	Mounting parts, connection point loose		☐					☐						
	Knuckle stopper bolt adjusted incorrectly							☐						
Oil pump faulty	Oil pump body faulty								☐					
	O-ring or oil seal faulty								☐					
	Bolt tightened incorrectly								☐					
	Maximum generated fluid pressure insufficient									☐				
	Fluid line crushed or clogged									☐				
	Air lock in oil pump										☐			
	Oil pump interior seized									☐	☐	☐		
	Mounting bolt or nut loose												☐	
	Pump body faulty												☐	
	Valve malfunctioning									☐				

TROUBLESHOOTING

Symptoms		Possible causes										Remarks
Oil tank faulty	Steering wheel operation heavy											
	Steering wheel play excessive and unstable											
	Steering wheel pulls to one side											
Other malfunctions	Steering wheel vibration											
	Steering wheel self-return poor											
	Steering wheel does not turn											
	Steering angle insufficient or difference between right and left											
	Fluid leaking											
	Oil pump fluid pressure abnormal											
	Oil pump gurgles											
	Oil pump squeaks											
	Oil pump growls											
Oil tank faulty	Oil tank leaking due to overflowing											
	Oil tank leaking due to air lock											
	Fluid level insufficient											
Other malfunctions	Load too far forward of load-carrying platform											
	Load too far rearward of load-carrying platform											
	Load too far to one side of load-carrying platform											
	Wheelbase difference between left and right excessive											
	Propeller shaft runout excessive											Gr 25
	Front axle bent											Gr 26
	Rear axle housing bent											
	Final drive gear and final drive pinion damaged or engaged incorrectly											Gr 27
	Tire pressure insufficient											
	Tire pressure excessive											
	Tire wear difference between left and right excessive											Gr 31
	Tire outer diameter difference between left and right											
	Front tire radial and lateral runout, static balance and dynamic balance incorrect											
	One-sided braking											Gr 35

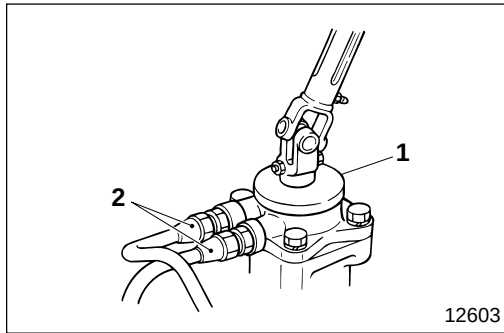
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE 37

Change of Power Steering Fluid

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Oil pipe	66.69±12.75 {49±9.4, 6.8±1.3}	—



[Draining]

- Jack up the front wheels.
- Loosen oil pipe 2 connected to power steering booster 1.
- Turn the steering wheel fully left and right repeatedly, and drain the fluid from power steering booster 1.
- After draining the fluid, tighten oil pipe 2 at specified torque.

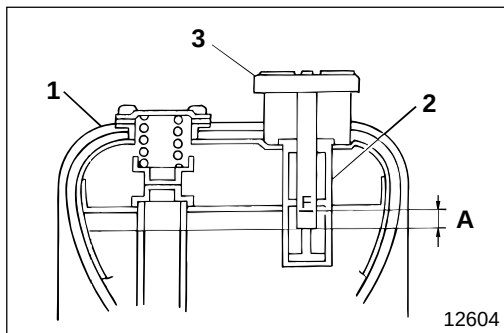
[Filling]

 P37-11

Bleeding of Power Steering System

Fluid

Location	Points of application	Kinds	Quantity
1	Power steering oil tank	Automatic transmission fluid (DEXRON or DEXRON II type)	Filler cap dipstick on filler cap between end and F



- Pour fluid into power steering oil tank 1 up to the inner port of strainer 2.
- With the engine stopped, jack up the front wheels and turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range A.

NOTE

Check the fluid level without screwing on filler cap 3.

- Start the engine and letting it idle, turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range A. Repeat these steps until the fluid level does not drop.
- If there is an abnormal noise, air is still in the system. Turn the steering wheel several times to raise the fluid temperature to approximately 60 to 80°C {140 to 176°F}, then stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times. If there is no noise, bleeding is completed.
- When bleeding is finished, check the fluid level of power steering oil tank 1, and pipe and hose connections for fluid leaks.

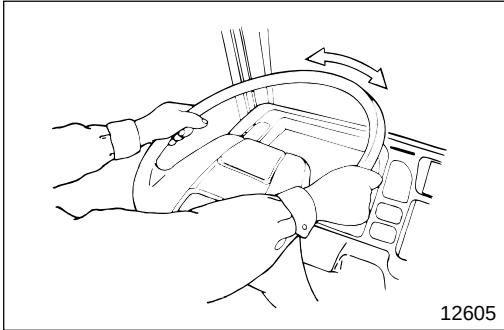
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Steering Wheel Play

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Steering wheel play (Measure at the outer circumference of steering wheel)	10 to 40 {0.39 to 1.57}	—	Adjust

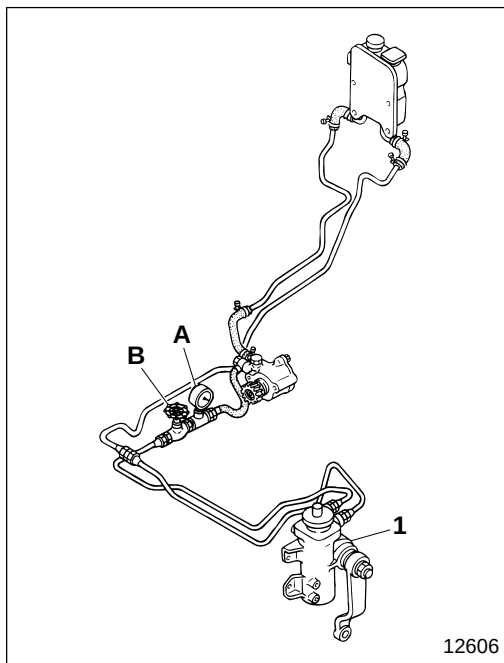


Point the wheels directly forward and gently turn the steering wheel left and right and measure the outer circumference play. If the play deviates from the standard value, adjust tightening points and power steering booster backlash.  P37-27

Performance Verification Test of Power Steering System

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Steering system fluid pressure (With hands off steering wheel)	490 kPa {71 lbf/in ² , 5 kgf/cm ² }	—	Repair
—	Relief set pressure (Measure with engine speed at 1000 to 1500 rpm and the stop valve closed)	12.3 MPa {1780 lbf/in ² , 125 kgf/cm ² }	Maximum +785 kPa {115 lbf/in ² , 8 kgf/cm ² } Minimum -1180 kPa {170 lbf/in ² , 12 kgf/cm ² }	Replace



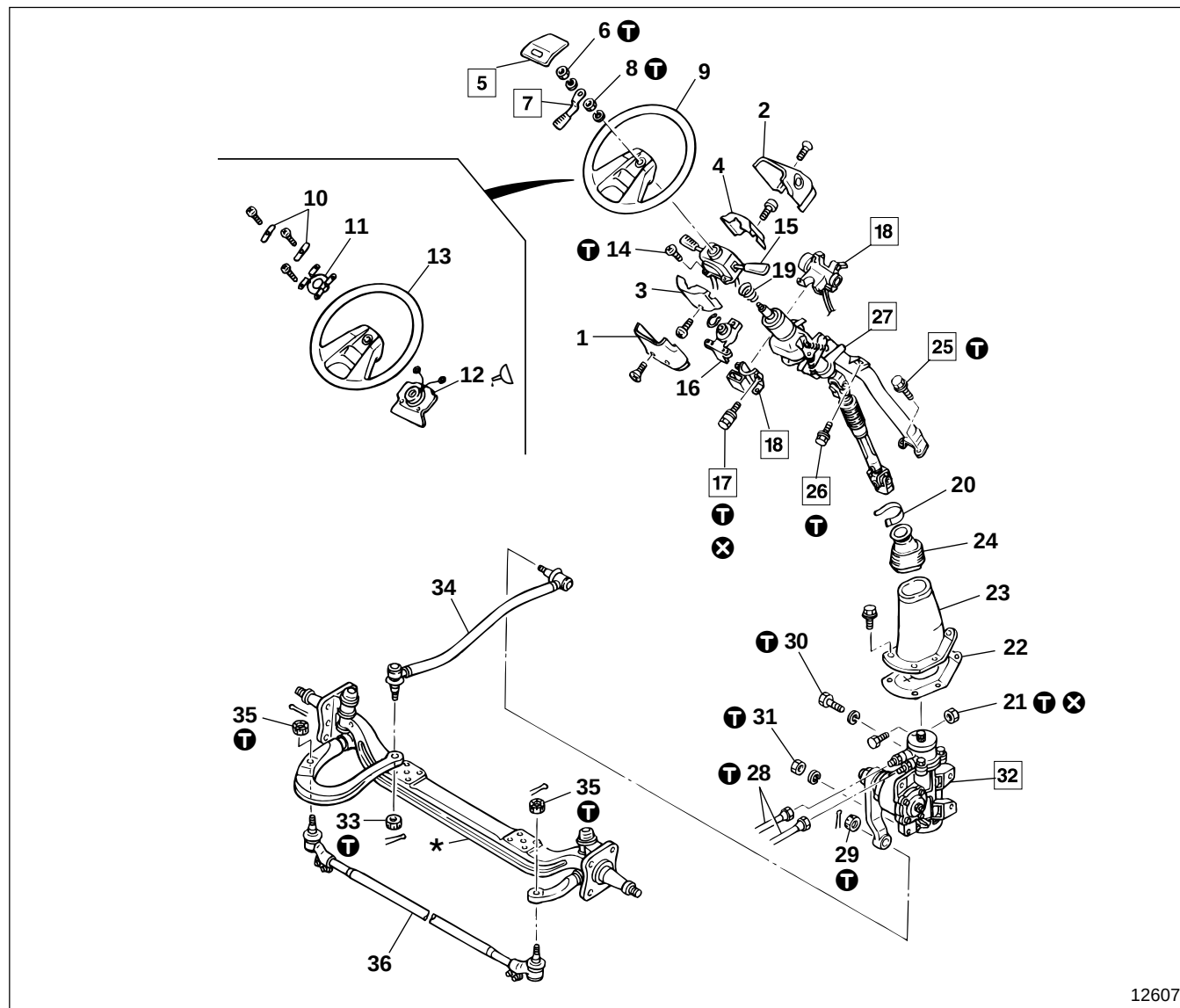
Verify that power steering booster **1** and the power steering oil pump are operating properly by testing the following items.

NOTE

If the fluid pressure is higher than 490 kPa {71 lbf/in², 5 kgf/cm²} with engine idling and the steering wheel free, inspect power steering booster **1** and the fluid circuit for clogging.

Test item	Test procedure	Assembly standards
Verification of smooth operation	Jack up the front wheels and turn steering wheel fully left and right	Smooth operation throughout test
Measurement conditions	- Install oil pressure gauge A capable of measuring above 14.7 MPa {2130 lbf/in², 150 kgf/cm²} and stop valve B, then bleed air - With engine idling, turn steering wheel left and right several times to raise fluid temperature to 50 to 60°C {122 to 140°F} - With the engine idling, open stop valve B	
Measurement of fluid pressure	Measure fluid pressure with hands off steering wheel	490 kPa {71 lbf/in ² , 5 kgf/cm ² }
Measurement of relief pressure	- Gradually increase engine speed and maintain it at 1000 to 1500 rpm, and close stop valve B to measure maximum fluid pressure - Do not keep stop valve B closed for more than fifteen seconds	Relief set pressure 12.3 MPa {1780 lbf/in ² , 125 kgf/cm ² }

STEERING SYSTEM



12607

● Removal sequence

- | | | |
|----------------------------|--|-----------------------------------|
| 1 Column cover outer lower | 15 Combination switch Gr 54 | 28 Oil pipe P37-39 |
| 2 Column cover outer upper | 16 Bracket | 29 Nut |
| 3 Column cover inner lower | 17 Head cutting bolt | 30 Bolt |
| 4 Column cover inner upper | 18 Starter switch Gr 54 | 31 Nut |
| 5 Horn pad | 19 Spring | 32 Power steering booster P37-22 |
| 6 Nut | 20 Band | 33 Nut |
| 7 Telescopic lever | 21 Nut | 34 Drag link P37-40 |
| 8 Nut | 22 Dust cover | 35 Nut |
| 9 Steering wheel assembly | 23 Dust cover | 36 Tie rod assembly P37-42 |
| 10 Horn spring | 24 Dust cover | |
| 11 Contact plate | 25 Bolt | |
| 12 Cover assembly | 26 Bolt | |
| 13 Steering wheel | 27 Steering column subassembly P37-18 | |
| 14 Screw | | |
| | | * : Front axle assembly Gr 26 |
| | | ⊗ : Non-reusable parts |

CAUTION

Be sure to clean the port area of oil pipe 28 when disconnecting the oil pipe, so as to keep it free from dust and foreign particles.

● 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
6	Nut (Telescopic lever mounting)	8.8 to 9.8 {6.5 to 7.2, 0.9 to 1.0}	—
8	Nut (Steering wheel assembly mounting)	39 to 49 {29 to 36, 4 to 5}	—
14	Screw (Combination switch mounting)	2.5±0.5 {1.8±0.36, 0.25±0.05}	—
17	Head cutting bolt (Starter switch mounting)	14.2±1.5 {10±1.1, 1.45±0.15}	—
21	Nut (Steering column subassembly and power steering booster mounting)	51.45±2.45 {38±1.8, 5.25±0.25}	—
25	Bolt (Steering column at floor side mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
26	Bolt (Steering column subassembly to instrument panel side mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
28	Oil pipe	66.69±12.75{49±9.4, 6.8±1.3}	—
29	Nut (Drag link and power steering booster mounting)	190±47.5 {140±35, 19.4±4.85}	—
30	Bolt (Power steering booster mounting)	175.4±26.5 {130±20, 17.9±2.7}	—
31	Nut (Power steering booster mounting)	175.4±26.5 {130±20, 17.9±2.7}	—
33	Nut (Drag link and front axle assembly mounting)	190±47.5 {140±35, 19.4±4.85}	—
35	Nut (Tie rod assembly and front axle assembly mounting)	190±47.5 {140±35, 19.4±4.85}	—

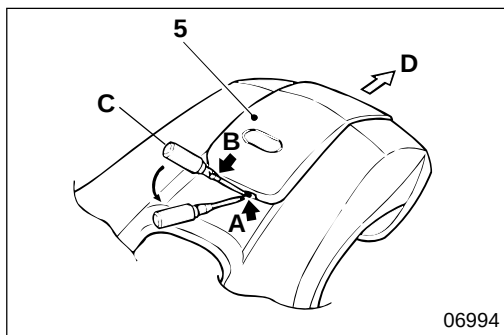
L Lubricant

Location	Points of application	Kinds	Quantity
12	Contact area between combination switch of cover assembly and horn contact	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

◆ Service procedure

5 Removal of horn pad

Insert flat-blade screwdriver **C** in grooves **A**, **B** of horn pad **5** and press down on the screwdriver until the horn pad is removed with a “click”. To remove the horn pad, raise and press it in direction **D** as illustrated.

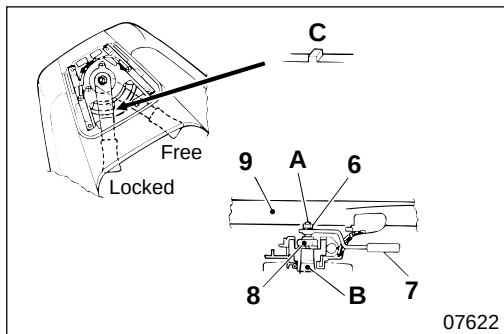


7 Installation of telescopic lever

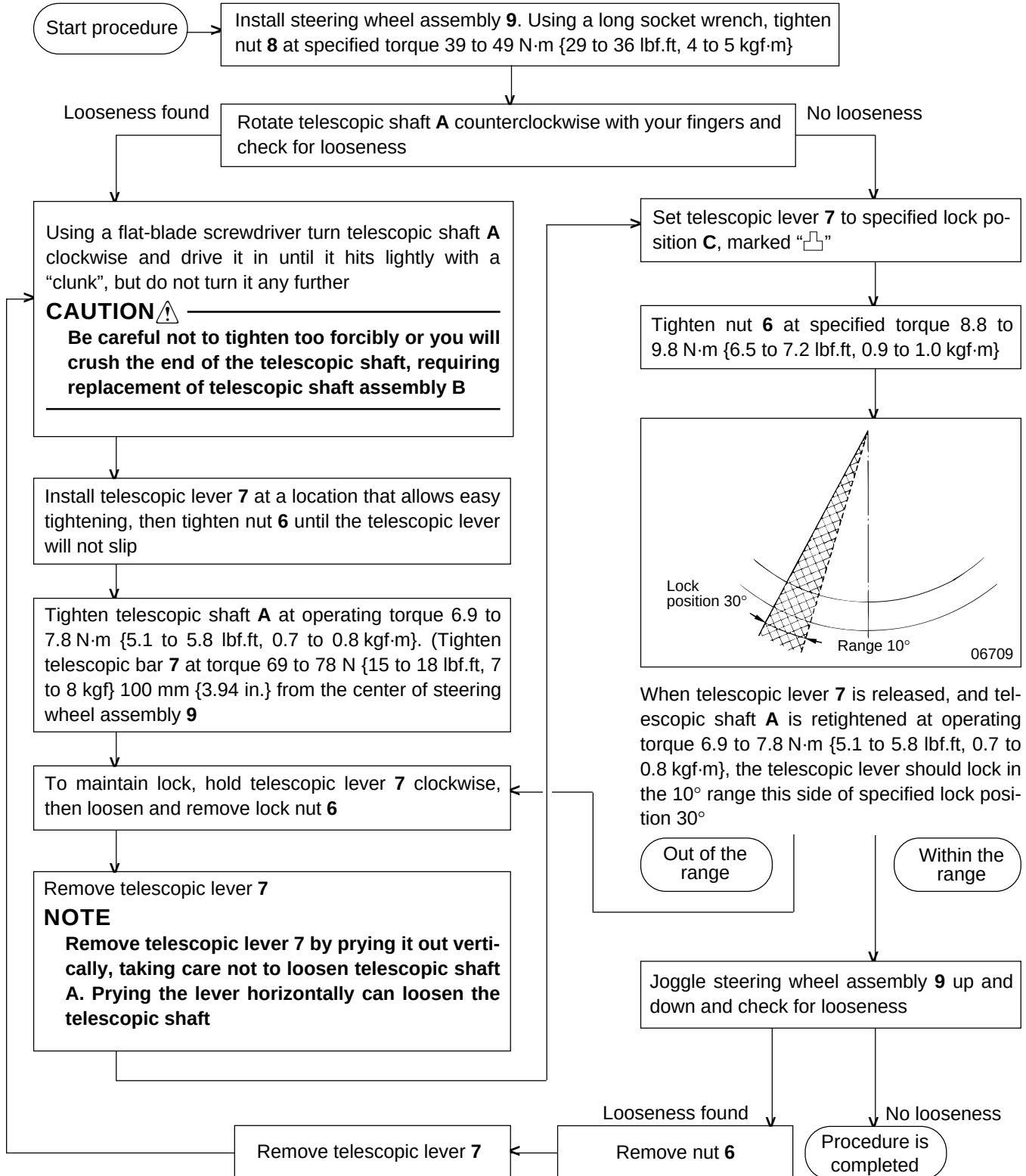
Locate telescopic lever **7** at the specified position, and adjust until the specified torque is applied to telescopic shaft **A**.

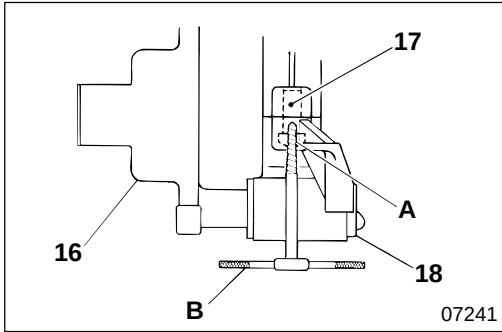
CAUTION

Do not crush the screw tip of telescopic shaft **A**.



STEERING SYSTEM

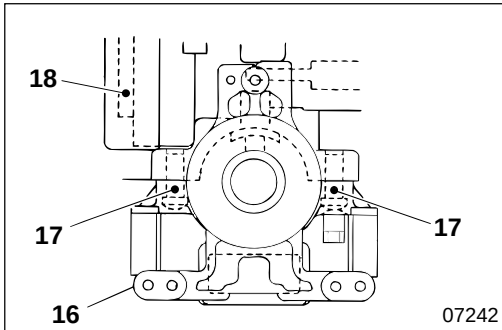




17 18 Head cutting bolt, starter switch

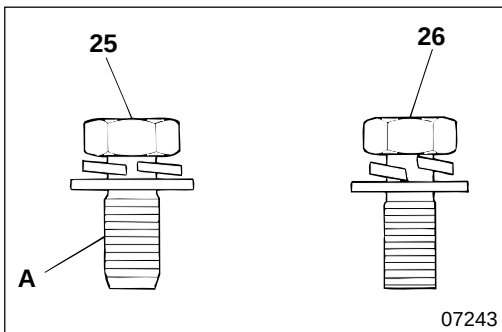
[Removal]

- After removing bracket **16**, 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 in surface **A** of head cutting bolt **17** for mounting starter switch **18**.
- Screw in screw extractor **B** counterclockwise, then remove head cutting bolt **17**.



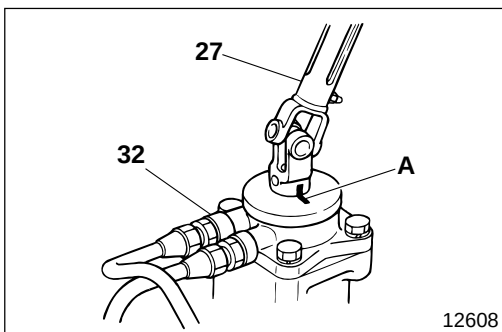
[Installation]

- With new head cutting bolt **17**, tighten starter switch **18** at specified torque to cut the head off the bolt.
- After installing bracket **16**, verify operation of the steering lock function of starter switch **18**.



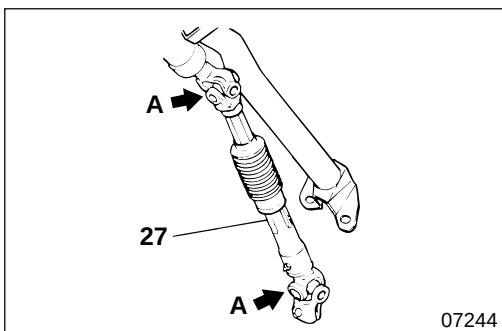
25 26 Installation of bolt

- Bolts **25** and **26**, differ in shape. Do not mix them up when installing.
- Thread area **A** of bolt **25** is elliptical to facilitate grounding of the horn circuit.



27 32 Removal and installation of steering column subassembly, and power steering booster

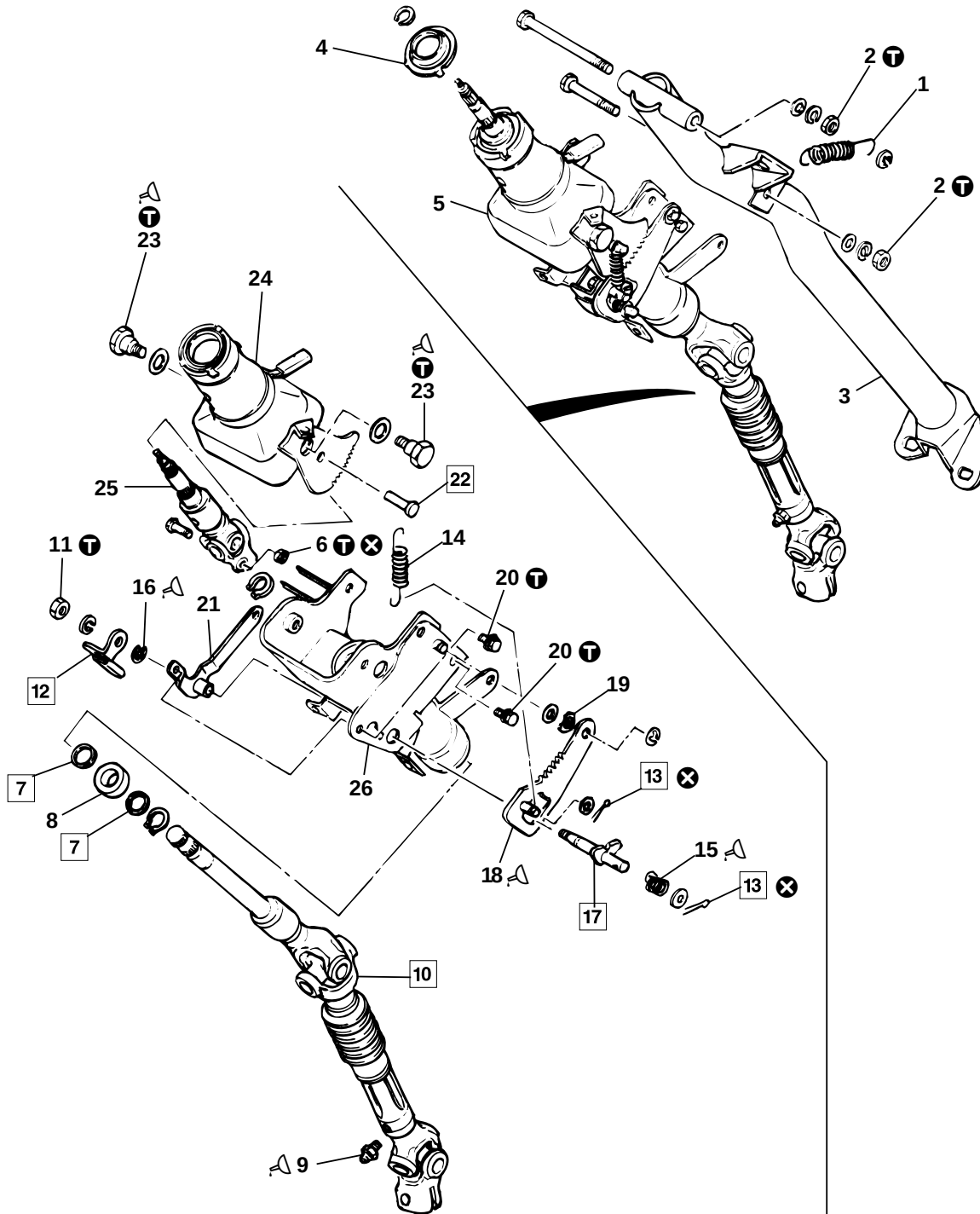
Before removing steering column subassembly **27** or power steering booster **32**, be sure to make alignment mark **A**.



27 Steering column subassembly

When the spline of steering column subassembly **27** has been disconnected, align marks **A** on the yokes to face the same direction.

STEERING COLUMN SUBASSEMBLY



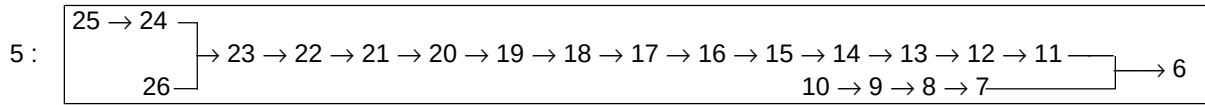
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● Disassembly sequence

- | | | |
|----------------------------|------------------|------------------------------|
| 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



ⓘ 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}	—

🔧 Lubricant and sealant

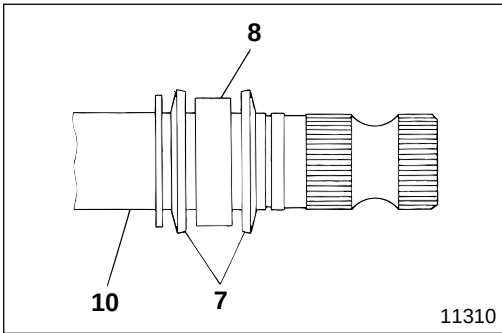
Location	Points of application	Kinds	Quantity
9	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Friction surfaces of return spring and washer	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
16	Friction surfaces of lever support and snap ring	Wheel bearing grease [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 surfaces of column support upper and bolt	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

STEERING COLUMN SUBASSEMBLY

◆ Service procedure

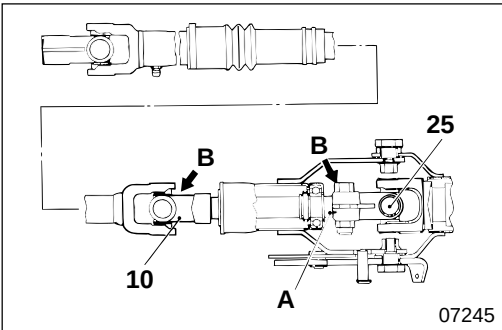
7 Installation of stopper

Install stoppers **7** on steering shaft assembly **10** in the direction as illustrated so that they straddle bearing spacer **8**.



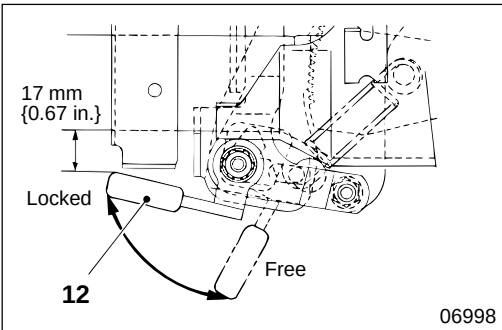
10 Steering shaft assembly

- Before removing steering shaft assembly **10**, be sure to make alignment mark **A**.
- Install the steering shaft with direction **B** of the telescopic shaft assembly **25** yoke and steering shaft assembly **10** yoke aligned or at phase angle of 90°.



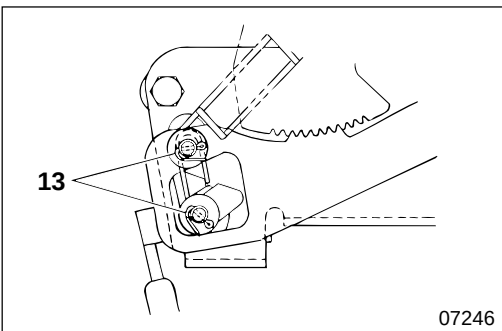
12 Installation of lock lever

- Install lock lever **12** so it is within the working angle when locked.
- After installing lock lever **12**, make sure that the lever operates smoothly (operating force less than 49 N {11 lbf, 5 kgf}). With the lever free, make sure that high tilt operates smoothly.



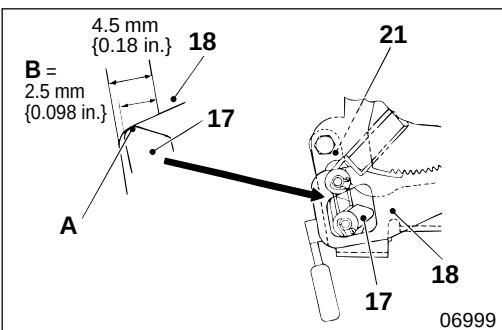
13 Installation of split pin

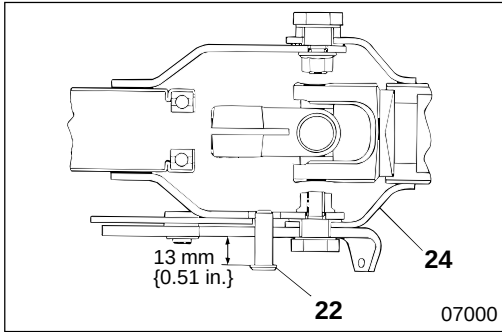
Bend split pin **13** to face outwards as illustrated.



17 Installation of cam

Adjust lever support **21** so that the top surface **A** of cam **17** is within dimension **B** of lock plate **18** to install the cam.

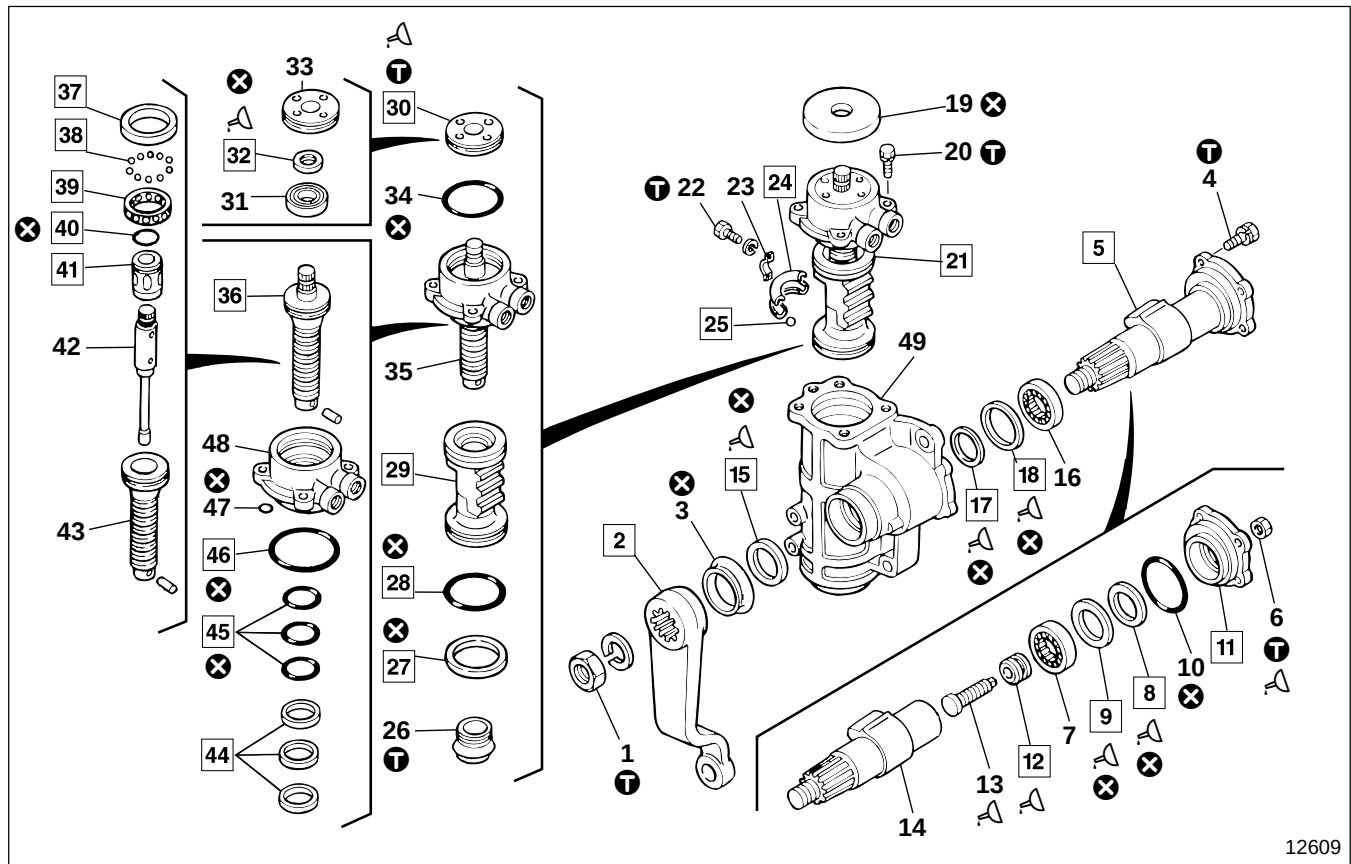




22 Installation of clevis pin

Drive clevis pin **22** into column support upper **24** so that the drive dimension is obtained.

POWER STEERING BOOSTER



12609

● Work before disassembly

📖 P37-26

● Disassembly sequence

- | | | |
|---|----------------------------|---|
| 1 Lock nut | 18 Y-packing | 35 Worm shaft assembly and valve housing assembly |
| 2 Pitman arm | 19 Dust cover | 36 Worm shaft assembly |
| 3 Dust cover | 20 Bolt | 37 Side race |
| 4 Bolt | 21 Ball screw assembly | 38 Steel ball |
| 5 Sector shaft assembly and side cover assembly | 22 Screw | 39 Bearing cage |
| 6 Nut | 23 Ball tube clip | 40 Seal ring |
| 7 Needle bearing | 24 Ball tube | 41 Rotor |
| 8 Backup ring | 25 Steel ball | 42 Stub shaft |
| 9 Y-packing | 26 Plug | 43 Worm shaft |
| 10 O-ring | 27 Seal ring | 44 Seal ring |
| 11 Side cover | 28 O-ring | 45 O-ring |
| 12 Retainer | 29 Piston | 46 O-ring |
| 13 Adjusting screw | 30 Adjusting plug assembly | 47 O-ring |
| 14 Sector shaft | 31 Ball bearing | 48 Valve housing |
| 15 Oil seal | 32 Oil seal | 49 Body (Cylinder) |
| 16 Needle bearing | 33 Adjusting plug | |
| 17 Backup ring | 34 O-ring | |

⊗ : Non-resusable parts

NOTE

- Do not remove needle bearing 7 or 16 unless they are faulty.
- Do not remove retainer 12 or adjusting screw 13 unless they are faulty.
- Have a tray or box ready to catch steel balls 25, 38.

● Assembly sequence

49 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 5 → 4 → 3 → 2 → 1

36 : 43 → 42 → 41 → 40 → 39 → 38 → 37

35 : 48 → 47 → 46 → 45 → 44 → 36

30 : 33 → 32 → 31

21 : 35 → 34 → 30 → 29 → 28 → 27 → 26 → 25 → 24 → 23 → 22

5 : 14 → 13 → 12 ———→ 6
11 → 10 → 9 → 8 → 7 ———→ 6

● Adjustment after assembly

📖 P37-27

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy	
5, 21	Backlash between sector shaft and ball screw (Measure at the end of pitman arm)		0.2 {0.0079}	0.5 {0.020}	ℓ=250 {9.84}	Adjust (Measure with applied load of ±15 N {3.3 lbf, 1.5 kgf})
12	Retainer		Tighten the retainer then slacken off by 180°, retighten at 39 N·m {29 lbf.ft, 4 kgf·m}, then slacken off by 20°. Make sure that the adjusting screw turns smoothly, then caulk it	—	—	
13, 14	Axial play of adjusting screw and sector shaft		0.01 to 0.10 {0.00039 to 0.0039}	0.2 {0.0079}	Replace	
14	Outer diameter of sector shaft	Adjusting screw side	ø39.975 {1.574}	ø39.875 {1.570}	Replace	
		Pitman arm side	ø44.975 {1.771}	ø44.875 {1.767}	Replace	
29, 43	Play of piston and worm shaft in axial direction		—	0.5 {0.02} or more	Replace	
29, 49	Clearance between outer diameter of piston and inner diameter of body (Cylinder)		[85 {3.3}] 0.11 {0.0043}	0.16 {0.0063}	Replace	
41, 43	Clearance between outer diameter of rotor and worm shaft		[35.5 {1.4}] 0.02 {0.00079}	0.03 {0.0012}	Replace	

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut (Pitman arm mounting)	270±25 {200±18, 27.5±2.5}	—
4	Bolt (Side cover mounting)	53.9 to 63.7 {40 to 47, 5.5 to 6.5}	—
6	Nut (Adjusting screw tightening)	63.7 to 73.5 {47 to 54, 6.5 to 7.5}	—
20	Bolt (Valve housing tightening)	98.1 to 107.9 {72 to 80, 10 to 11}	—
22	Screw (Ball tube clip mounting)	4.41 to 5.39 {3.3 to 4.0, 0.45 to 0.55}	—
26	Plug	246 to 274 {180 to 200, 25 to 28}	—
30	Adjusting plug assembly	177 to 196 {130 to 145, 18 to 20}	—

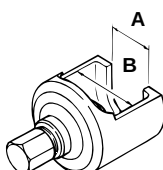
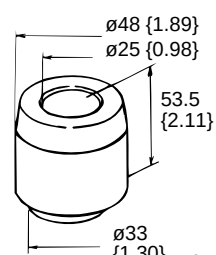
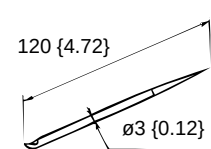
POWER STEERING BOOSTER

Lubricant and sealant

Location	Points of application	Kinds	Quantity
6	Contact surfaces of nut and side cover	Hermetic seal 101Y or THREEBOND 1102	As required
8, 17	Backup ring inner periphery	Multipurpose grease [NLGI No.2 (Li soap)]	As required
9, 18	Pack interior of Y-packing	Multipurpose grease [NLGI No.2 (Li soap)]	As required
12	Pack interior of retainer	Multipurpose grease [NLGI No.2 (Li soap)]	As required
13	Contact surfaces of adjusting screw and sector shaft	Multipurpose grease [NLGI No.2 (Li soap)]	As required
	Thread area of adjusting screw	Hermetic seal 101Y or THREEBOND 1102	As required
15, 32	Pack interior of oil seal	Multipurpose grease [NLGI No.2 (Li soap)]	As required
30	Adjusting plug assembly outer periphery	Hermetic seal 101Y or THREEBOND 1102	As required

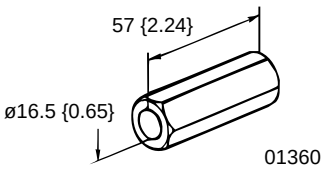
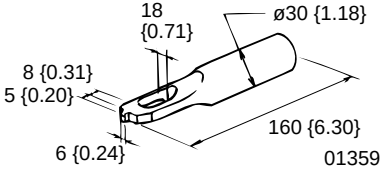
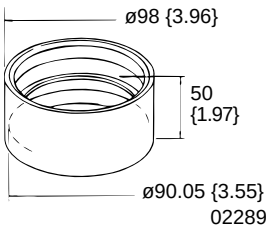
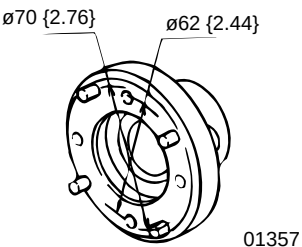
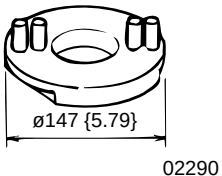
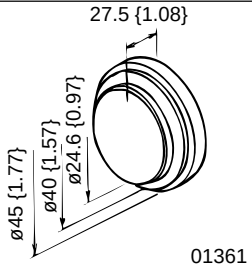
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application												
2	Pitman arm puller <table><tr><th>Part No.</th><th>A</th><th>B</th></tr><tr><td>MH061687</td><td>59 {2.32}</td><td>ø92 {3.62}</td></tr><tr><td>*910-00183</td><td></td><td></td></tr><tr><td>*910-00184</td><td>59 {2.32}</td><td>ø100 {3.94}</td></tr></table> 01355	Part No.	A	B	MH061687	59 {2.32}	ø92 {3.62}	*910-00183			*910-00184	59 {2.32}	ø100 {3.94}	MH061687 *910-00183 *910-00184	Removal of pitman arm
Part No.	A	B													
MH061687	59 {2.32}	ø92 {3.62}													
*910-00183															
*910-00184	59 {2.32}	ø100 {3.94}													
8,15, 17	Inserting tool assembly  01356	MC811971 *910-11001	Forming of backup ring and press-fitting of oil seal												
8,17	Inserting tool  01358	MC811974 *910-21715	Forming of backup ring												
10, 27, 28, 34, 40, 44, 45, 46, 47	Needle  02288	MC811948 *910-21200	Removal of O-ring and seal ring												

* JIDOSHA KIKI part No.

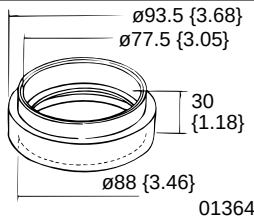
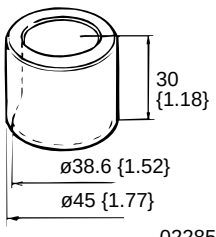
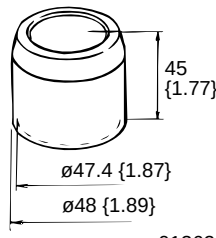
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
12	Bar 	MC811955 *910-22811	Turning of retainer
	Squeeze tool 	MC811950 *910-21801	Caulking of retainer
27	Inserting tool 	MC813516 *910-21718	Forming of piston seal ring
30	Wrench assembly 	MC811970 *910-10743	Removal and installation of adjusting plug assembly
	Attachment (A : Adapter) (B : Bolt) 	MC811969 *910-10671 (A : *910-23581) (B : *910-23194)	Holding down of valve housing
32	Press-fitting tool 	MC811972 *910-20404	Press-fitting of oil seal

* JIDOSHA KIKI part No.

POWER STEERING BOOSTER

Unit : mm {in.}

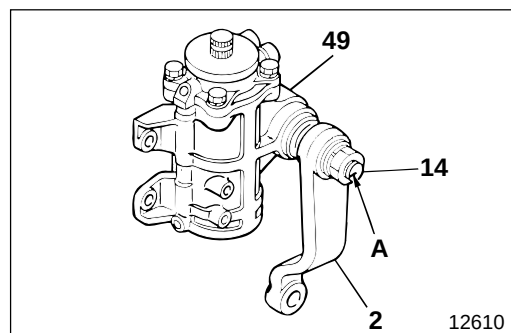
Location	Tool name and shape	Part No.	Application
37 to 39	Tool assembly  01363	MC811968 *910-10611	Assembly of thrust bearing
	Guide assembly  01364	MC090148 *910-23033	
40	Inserting tool  02285	*910-22777	Forming of rotor seal ring
44	Inserting tool  01362	MC811975 *910-22722	Forming of valve housing seal ring

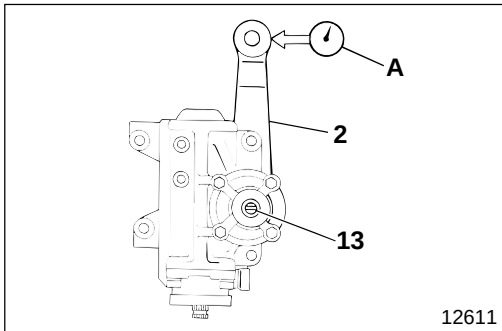
* JIDOSHA KIKI part No.

◆ Service procedure

● Work before disassembly

Move pitman arm 2, and align slit A of the V-groove of sector shaft 14 to the center of body 49 so that the gears are in neutral position.



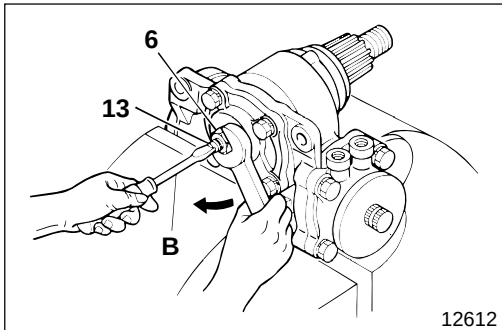


● Adjustment after assembly

Adjustment of backlash

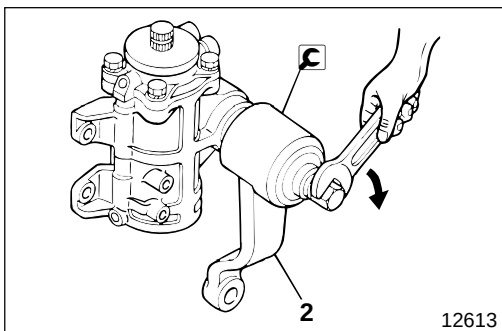
- (Carry out this work with the gears in neutral position.)
Measure play at the end of pitman arm 2 with dial gauge A, and adjust adjusting screw 13 so that the reading meets the standard value.

Measuring load : ± 15 N {3.3 lbf, 1.5 kgf}



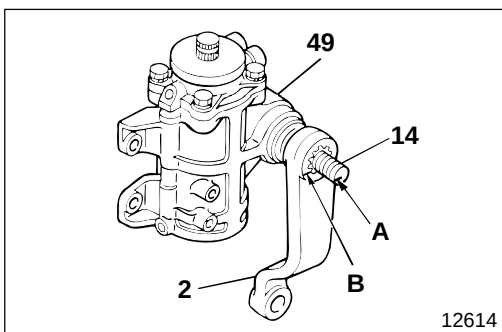
Tightening nut

- After adjusting backlash, apply sealer to thread area of adjusting screw 13. Hold it in place with screwdriver B and tighten nut 6 at specified torque.



2 Pitman arm

[Removal]

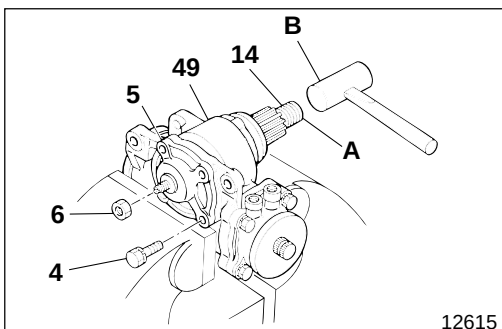


[Installation]

Align slit A of the V-groove of sector shaft 14 to the center of body 49, and align slit B of the V-groove of pitman arm 2 on the same line.

NOTE

Have pitman arm 2 make a full stroke of the piston to make sure that the piston moves smoothly.



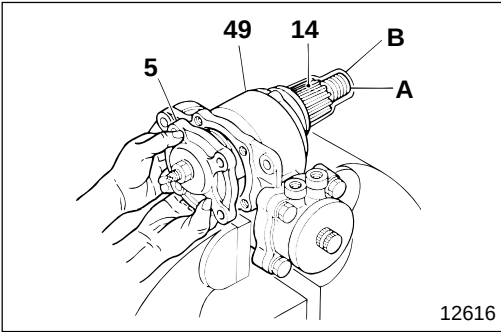
5 Sector shaft assembly and side cover assembly

[Removal]

- Make sure that the piston is in the neutral position (slit A of the V-groove at one end of sector shaft 14 is aligned with the center of body 49).
- Tap the end of sector shaft 14 and pull out sector shaft assembly 5 and side cover assembly 4.

B : Plastic-headed mallet

POWER STEERING BOOSTER

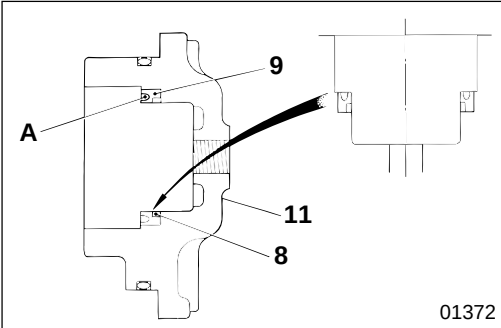


[Installation]

Position sector shaft **14** of sector shaft assembly and side cover assembly **5** so that slit **A** of its V-groove is aligned with the center of body **49**, and the piston gear and sector shaft gear engage at their centers.

CAUTION ⚠

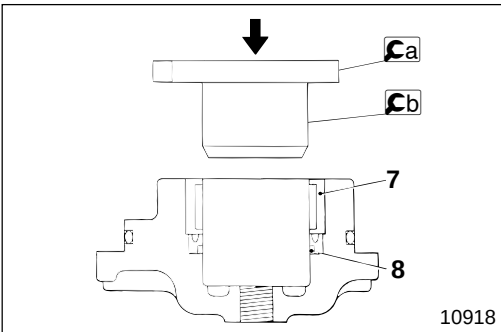
Before installation, apply tape **B** to the Y-packing to prevent it being damaged by the threads of sector shaft **14**.



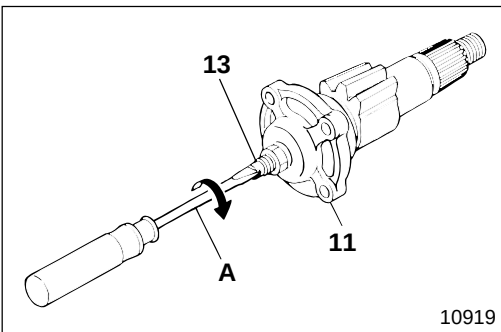
8 9 Backup ring, Y-packing

[Installation]

- Install Y-packing **9** into side cover **11** in the direction as illustrated.
- After installing backup ring **8**, pack groove **A** of Y-packing **9** with grease.



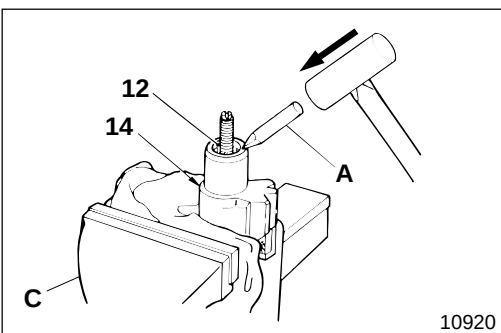
- After installing needle bearing **7** into backup ring **8**, form the bent up part of the backup ring using **Ca** insert tool assembly and **Cb** insert tool.



11 Removal of side cover

Screw in adjusting screw **13** and remove side cover **11**.

A : Screwdriver



12 Retainer

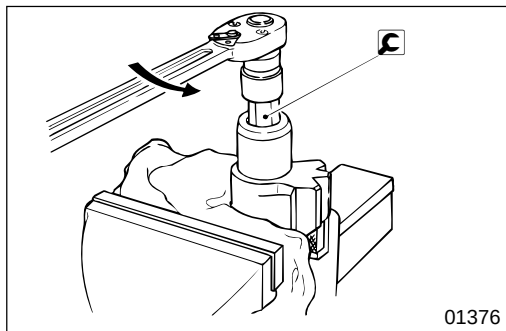
Disassemble sector shaft **14**, as follows, only if it is faulty :

[Removal]

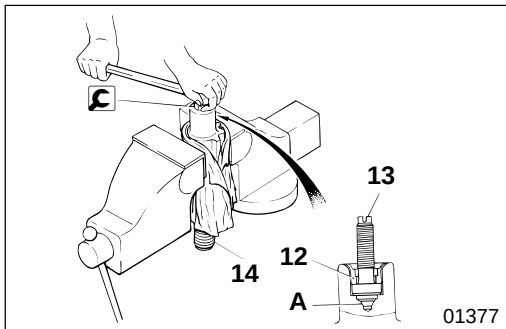
- Pry up (2 points) of retainer **12**.
- A :** Chisel

CAUTION ⚠

Make sure you use a cloth when you grip sector shaft **14** in vise **C** to prevent damage.

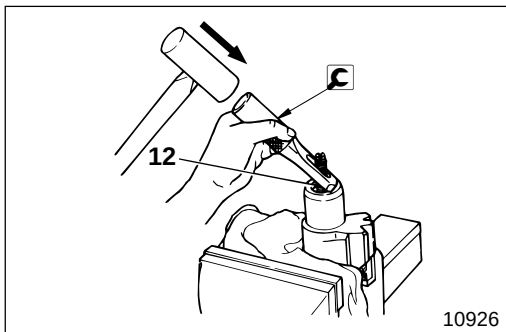


- Remove retainer **12** using bar.

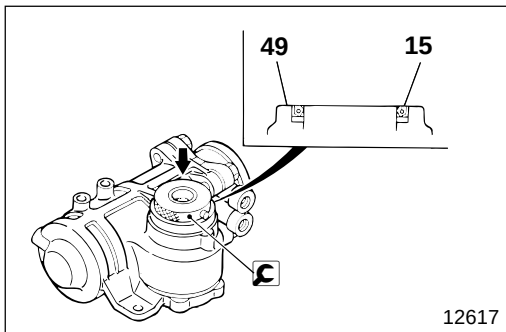


[Installation]

- Pack adjusting screw **13** mounting hole **A** of sector shaft **14** with grease.
- Install adjusting screw **13** into sector shaft **14**.
- Install retainer **12** into sector shaft **14** using bar.
- After installation, slacken off by 180°, retighten at 39 N·m {29 lbf.ft, 4 kgf·m}, then slacken off by 20°.
- Make sure that adjusting screw **13** turns smoothly.

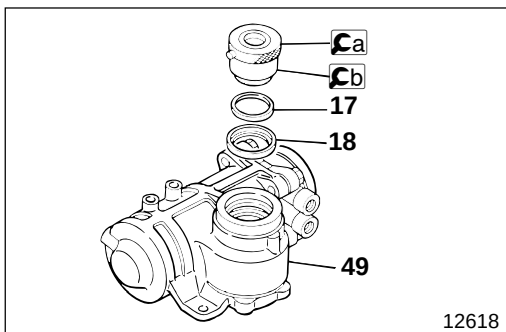


- After installing retainer **12**, caulk the retainer (2 points) using squeeze tool.



15 Installation of oil seal

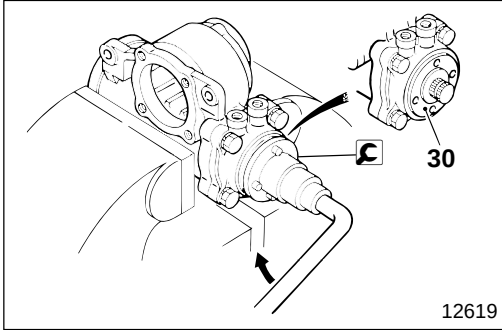
Install oil seal **15** into body **49** in the direction as illustrated.



17 18 Installation of backup ring and Y-packing

- Install Y-packing **18** and backup ring **17** to body **49**.
- Pack the groove of Y-packing **18** with grease.
- Form the shape of backup ring **17** using insert tool assembly and insert tool.

POWER STEERING BOOSTER



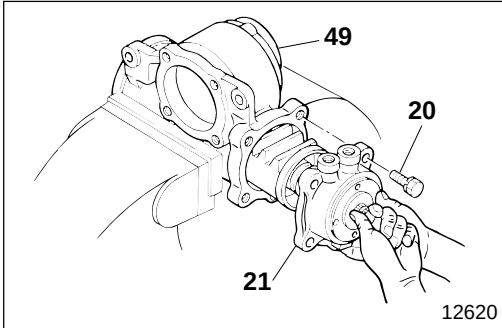
21 Ball screw assembly

[Removal]

- Loosen adjusting plug assembly 30 by approximately 180° using wrench assembly.

CAUTION ⚠

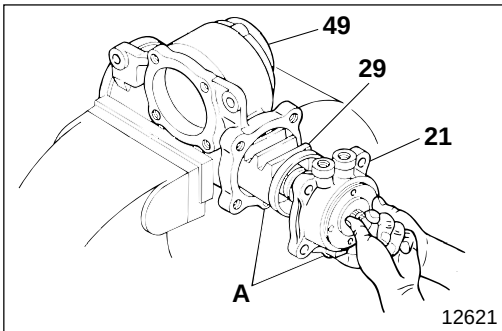
Make sure you only loosen adjusting plug assembly 30, do not undo it completely because the bearing inside the valve housing might spring out.



- Loosen bolt 20 and remove ball screw assembly 21 from body 49.

CAUTION ⚠

- Make sure that the balls of the ball screw do not spring out.
- Be careful not to damage the piston or the interior of body 49.



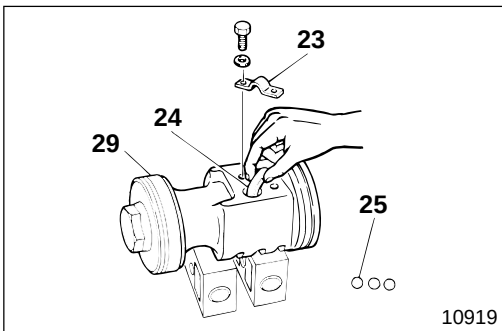
[Installation]

- Install ball screw assembly 21 into body 49, holding piston 29 so it will not turn.

CAUTION ⚠

Be careful not to damage the piston seal ring or the interior of body 49.

- Align oil passage ports A of ball screw assembly 21 and body 49, then tighten.

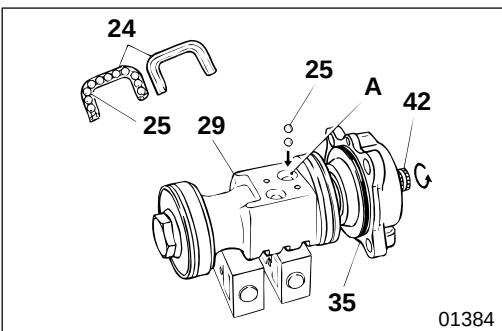


24 25 Ball tube and steel ball

First remove steel balls 25 from piston 29 and place them in the receiving tray, remove ball clip 23, grip ball tube 24 with your fingers and pull it out gently.

CAUTION ⚠

Be careful not to loose any steel balls 25 (×30).

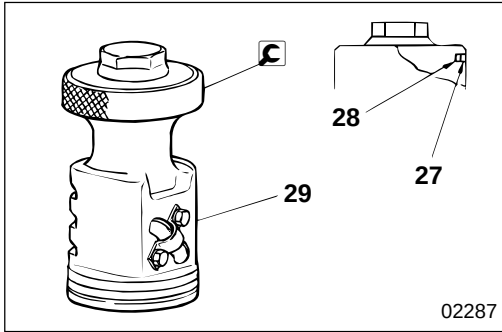


[Installation]

- Pack the interior of ball tube 24 with grease, lay 10 or 11 steel balls 25 in place, then mount the other side of the ball tube.
- Place piston 29 on a level surface, align assembled worm shaft assembly and valve housing assembly 35 and the piston ball race, then drop the steel balls through ball tube hole A while turning stub shaft 42.

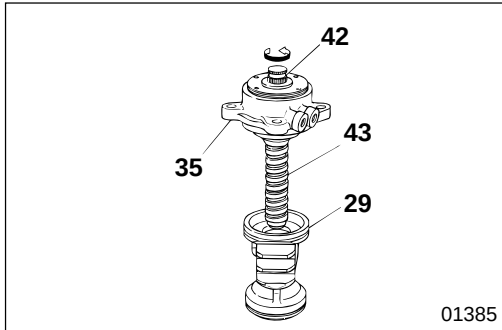
CAUTION ⚠

Make sure that you do not pull out worm shaft assembly and valve housing assembly 35 too far, or steel balls 25 will drop out of the ball race.



27 28 Installation of O-ring and seal-ring

Install O-ring 28 and seal ring 27 in the outside grooves of piston 29, then form the shape of the seal ring with  inserting tool.



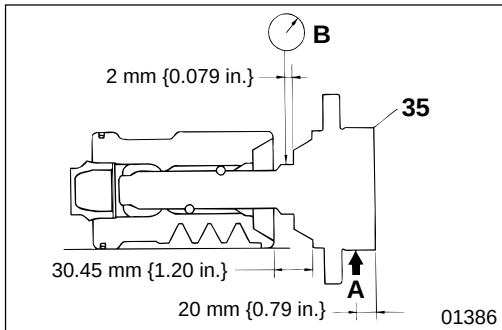
29 Piston

[Removal]

Holding worm shaft assembly and valve housing assembly 35 so that piston 29 is at the bottom, turn stub shaft 42 and remove the piston.

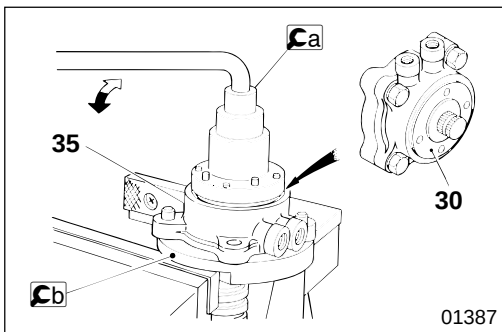
CAUTION

Be careful not to tilt piston 29 when you do this, otherwise steel balls 25 in the races of the piston and worm shaft 43, will drop into the piston.



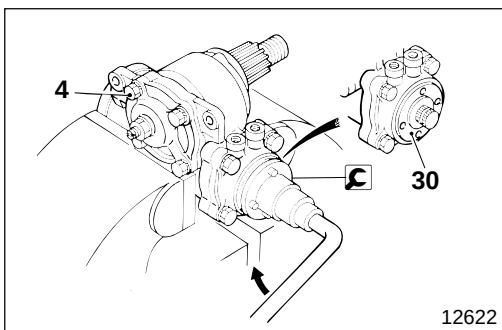
[Inspection]

Measure side play (play in axial direction) B of worm shaft assembly and valve housing assembly 35 when 49 N {11 lbf, 5 kgf} is applied to A as illustrated.



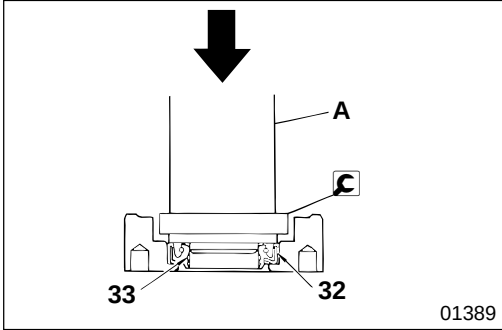
30 Installation of adjusting plug assembly

- After tightening adjusting plug assembly 30 of worm shaft assembly and valve housing assembly 35 at specified torque, slacken off by approximately 180°.



- Tighten bolt 4 at specified torque, then retighten adjusting plug assembly 30 at specified torque using .

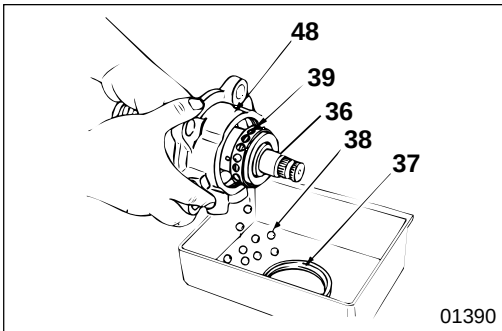
POWER STEERING BOOSTER



32 Installation of oil seal

Install oil seal **32** into adjusting plug **33** in the direction as illustrated.

A : Hand press



36 Worm shaft assembly

[Removal]

Push out worm shaft assembly **36** from valve housing **48** by pushing out the side of the worm shaft assembly where the piston is assembled.

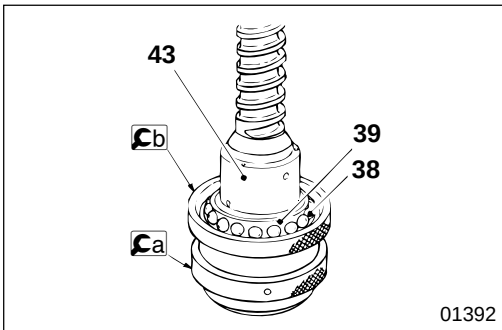
NOTE

Have a tray or box ready to catch side race **37**, steel balls **38**, and bearing cage **39** as these items separate on removal.

[Installation]

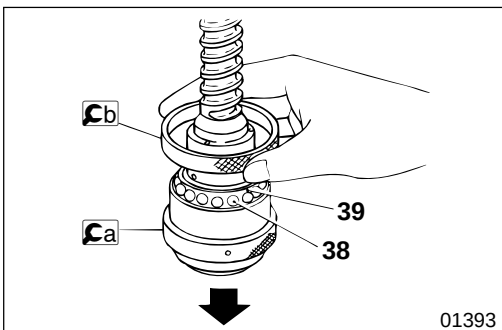
CAUTION ⚠

Be careful that worm shaft assembly **36** ball race does not damage seal ring **44**.

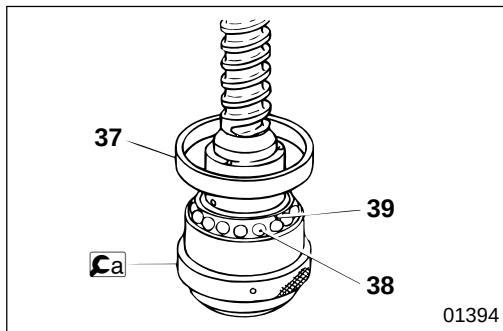


37 to 39 Installation of side race, steel ball, and bearing cage

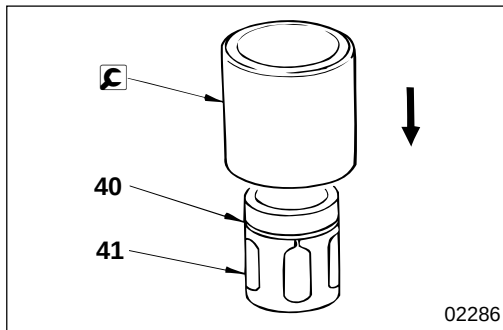
- Install **Cb** guide assembly on **Ca** tool assembly, and insert worm shaft **43** in the direction as illustrated.
- Assemble bearing cage **39** and steel balls **38** on worm shaft **43**.



- Hold down **Cb** with your hand and slide **Ca** downward, so that you can position steel balls **38** as specified.

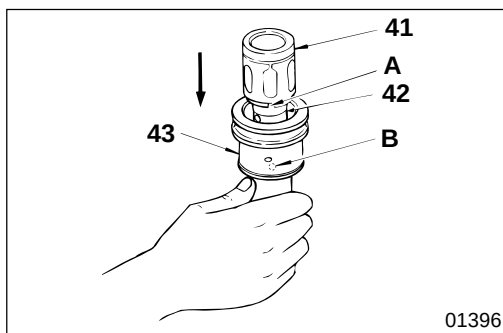


- Install side race **37** on top of steel balls **38** and bearing cage **39**.



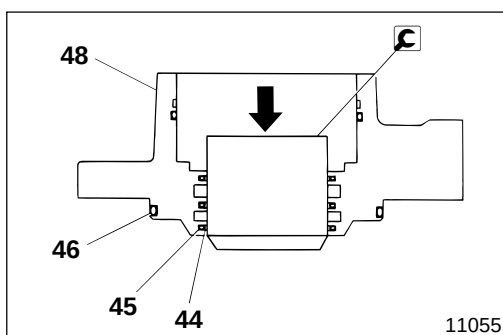
40 Installation of seal ring

- Install seal ring **40** onto rotor **41**.
- Form seal ring **40** using  insert tool.



41 Installation of rotor

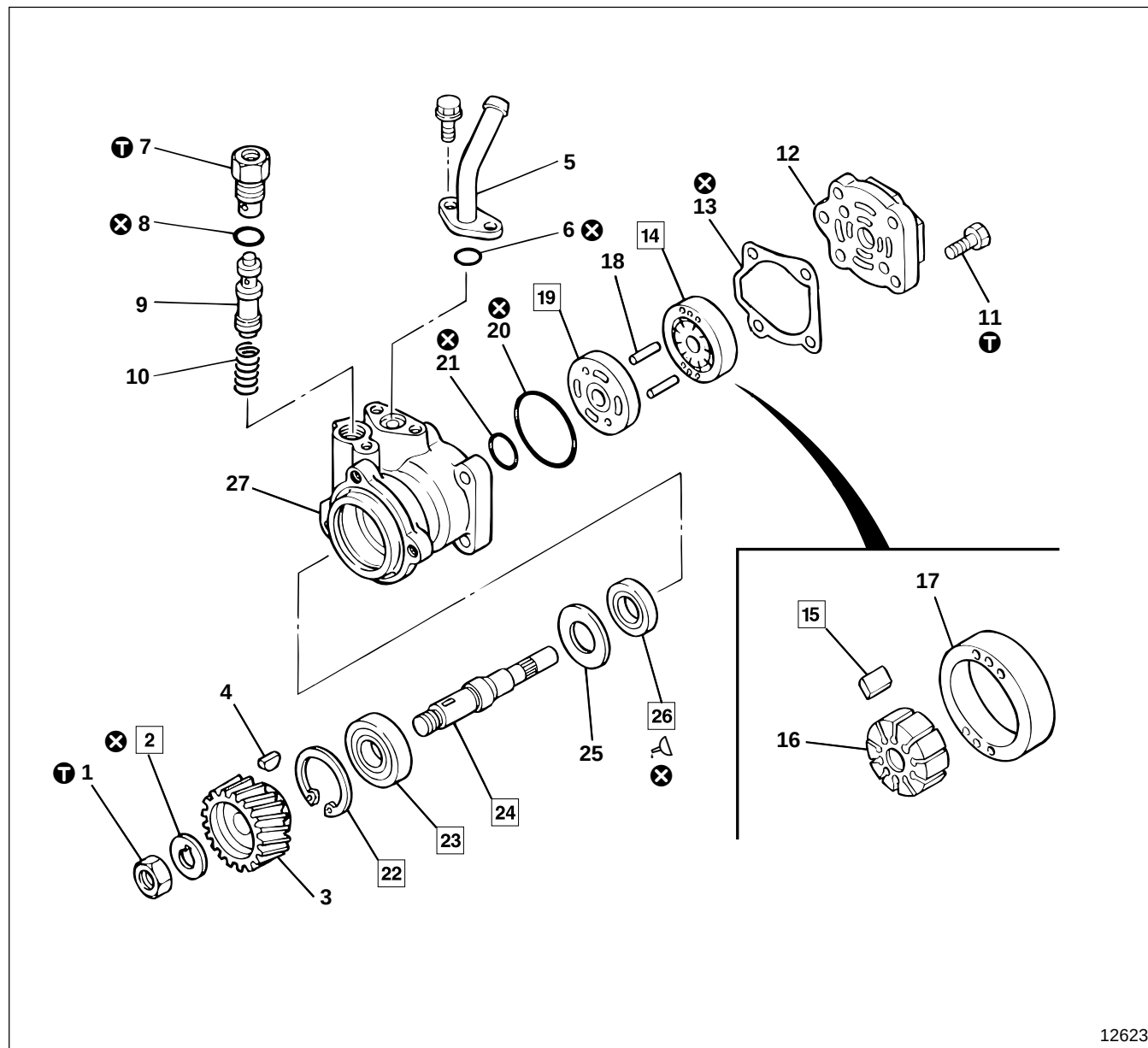
Install rotor **41** between stub shaft **42** and worm shaft **43** so that indent **A** of the rotor fits positioning pin **B** of the worm shaft.



44 to 46 Installation of seal ring and O-ring

- Install seal ring **44** and O-ring **45**, **46** into valve housing **48**.
- Form seal ring **44** using  insert tool.

POWER STEERING OIL PUMP



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● Disassembly sequence

- | | | |
|-------------------------------|-----------------------|-------------------|
| 1 Nut | 11 Bolt | 21 O-ring |
| 2 Lock washer | 12 Rear body | 22 Retaining ring |
| 3 Gear | 13 Gasket | 23 Ball bearing |
| 4 Key | 14 Cartridge assembly | 24 Shaft |
| 5 Suction pipe | 15 Vane | 25 Retaining ring |
| 6 O-ring | 16 Rotor | 26 Oil seal |
| 7 Connector | 17 Cam ring | 27 Front body |
| 8 O-ring | 18 Straight pin | |
| 9 Flow control valve assembly | 19 Pressure plate | |
| 10 Flow control spring | 20 O-ring | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.
Repair kit : Seal kit, Cartridge assembly kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
9, 27	Clearance between flow control valve assembly and front body	—	0.03 {0.0012}	*1
12, 19	Stepped wear on rear body and pressure plate where it is subject to friction against rotor and vane	—	0.01 {0.00039}	*2

***1** No seizure, wear, or scoring sufficient to catch a finger nail. Replace flow control valve assembly or front body.

***2** No seizure, wear, or scoring sufficient to catch a finger nail. Replace rear body or pressure plate.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Gear mounting)	68.8 to 88.2 {51 to 65, 7 to 9}	—
7	Connector	49 to 58.8 {36 to 43, 5 to 6}	—
11	Bolt (Rear body mounting)	49 to 58.8 {36 to 43, 5 to 6}	—

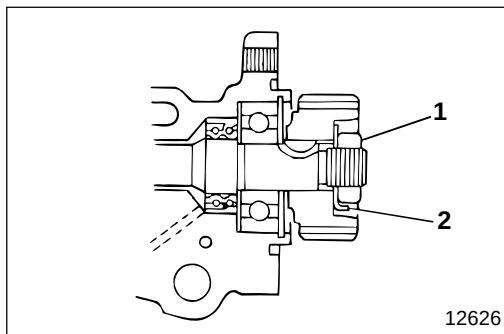
Special tools

Location	Tool name and shape	Part No.	Application
22	Pliers	*910-22570	Removal and installation of retaining ring
23	Press-fitting tool	*910-23061	Removal and installation of ball bearing, and installation of shaft
26	Stick	*910-21632	Driving out of oil seal
	Press-fitting tool	*910-23062	Press-fitting of oil seal

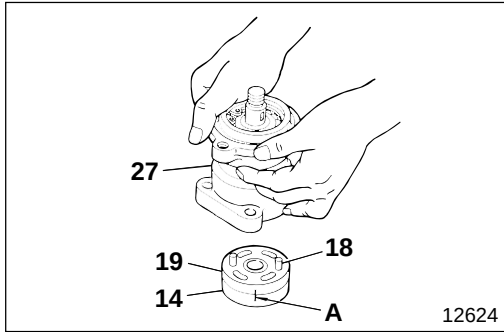
* JIDOSHA KIKI part No.

Service procedure**2 Installation of lock washer**

After installing nut **1**, bend up one lug on the circumference of lock washer **2**.



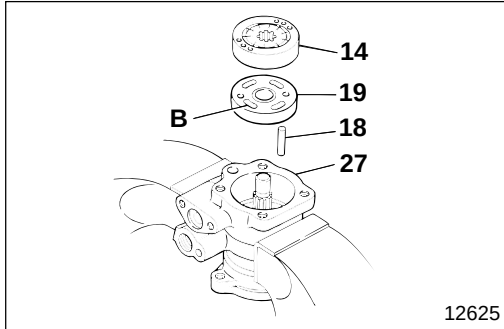
POWER STEERING OIL PUMP



14 Removal and installation of cartridge assembly

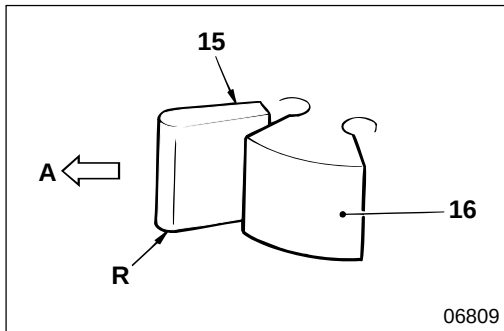
[Removal]

- Remove cartridge assembly **14**, pressure plate **19** and straight pin **18** together from front body **27**.
- Put alignment marks **A** around the outer circumferences of cartridge assembly **14** and pressure plate **19**.



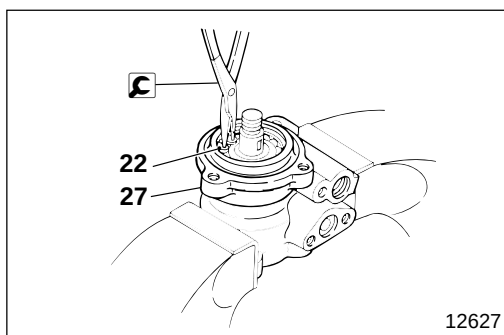
[Installation]

- Install straight pin **18** into front body **27**.
- Install pressure plate **19** onto front body **27**, so that groove **B** of the pressure plate faces the direction as illustrated.
- Align cartridge assembly **14** with straight pin **18**, then install the cartridge assembly.



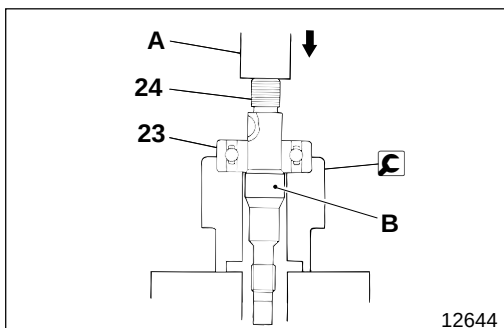
15 Installation of vane

With point **R** of vane **15** facing outside **A**, install it into rotor **16** and make sure that the vane moves smoothly. If it is faulty, replace the cartridge assembly.



22 Removal of retaining ring

Remove retaining ring **22** using pliers.



23 Removal and installation of ball bearing

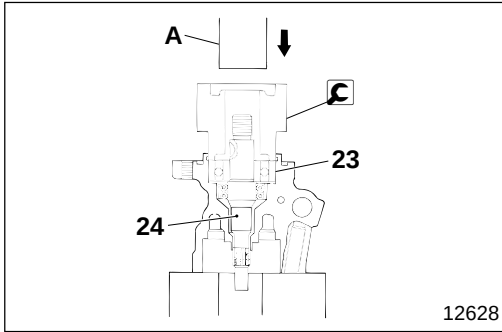
Remove ball bearing **23** from shaft **24** using press-fitting tool.

A : Hand press

For installation, follow the removal sequence in reverse.

CAUTION

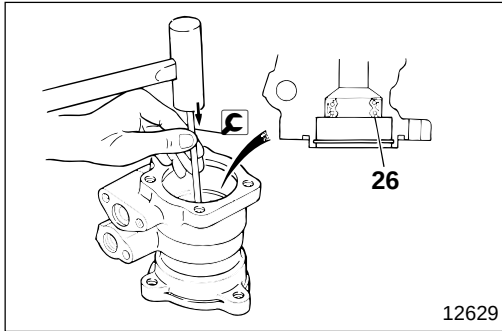
Be careful not to damage oil seal contact surface **B**.



23 24 Installation of ball bearing and shaft

Install ball bearing **23** and shaft **24** using  press-fitting tool.

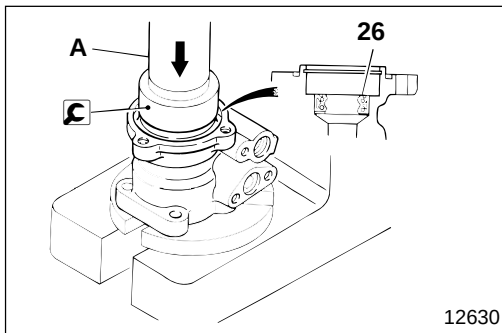
A : Hand press



26 Oil seal

[Removal]

Remove oil seal **26** using  stick.

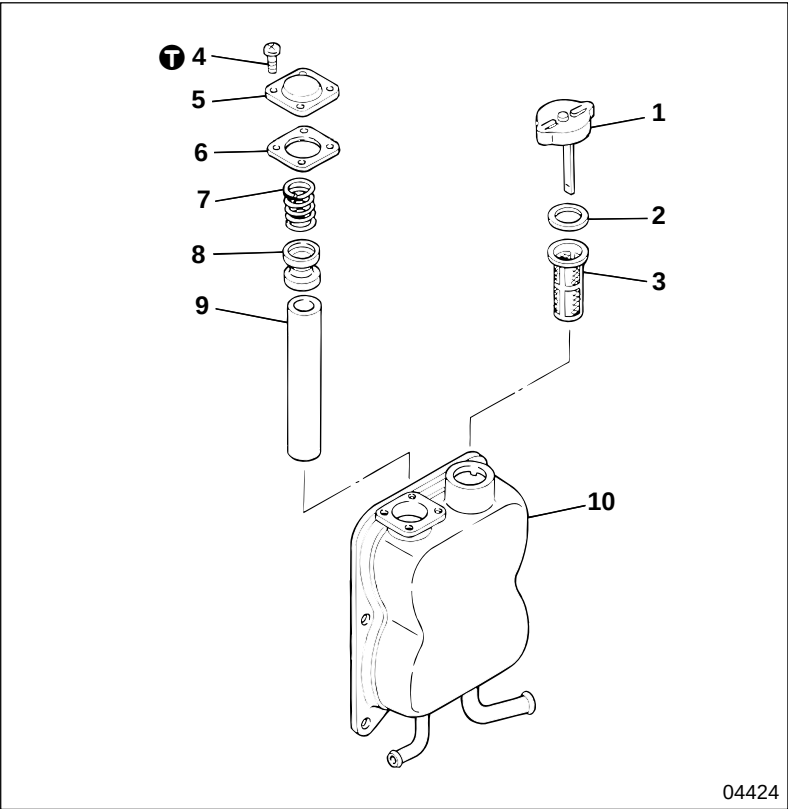


[Installation]

Install oil seal **26** in the direction as illustrated using  press-fitting tool.

A : Hand press

POWER STEERING OIL TANK



● Disassembly sequence

- 1 Filler cap
- 2 Packing
- 3 Strainer
- 4 Screw
- 5 Plate
- 6 Packing
- 7 Spring
- 8 Retainer
- 9 Return filter
- 10 Tank body assembly

● Assembly sequence

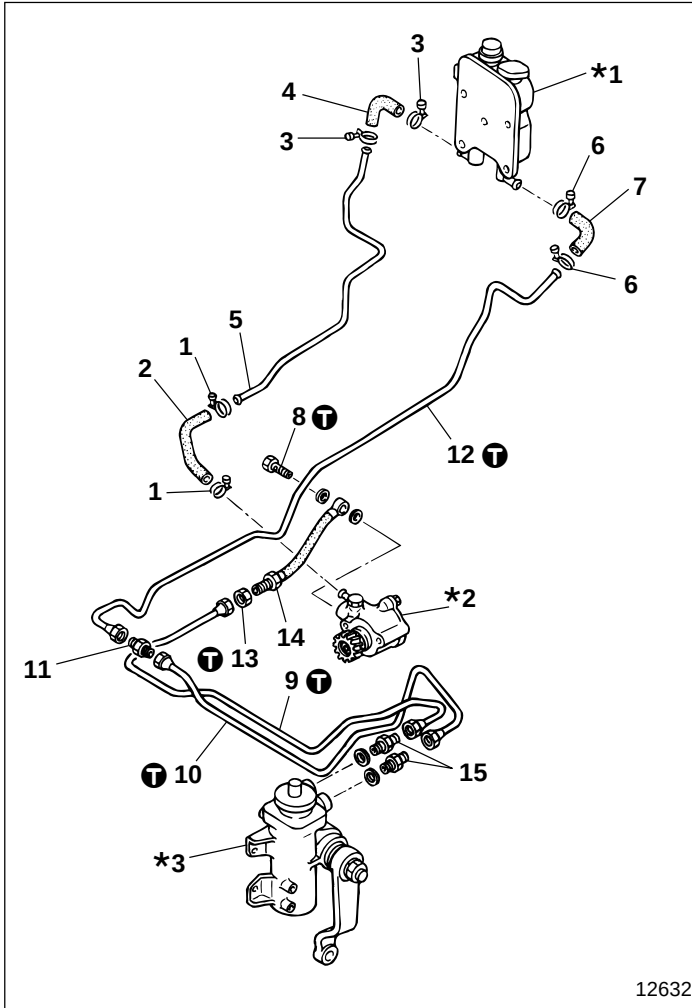
Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lb.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Screw (Plate mounting)	0.49 to 0.98 {0.36 to 0.72, 0.05 to 0.1}	—

POWER STEERING FLUID LINE

37


12632

● Removal sequence

- | | |
|--------------|--------------|
| 1 Clamp | 12 Oil pipe |
| 2 Oil hose | 13 Nut |
| 3 Clamp | 14 Oil hose |
| 4 Oil hose | 15 Connector |
| 5 Oil pipe | |
| 6 Clamp | |
| 7 Oil hose | |
| 8 Bolt | |
| 9 Oil pipe | |
| 10 Oil pipe | |
| 11 Connector | |

- *1 : Power steering oil tank
 *2 : Power steering oil pump
 *3 : Power steering booster

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

Be sure to bleed air after removing the fluid line, failure to do so would cause the power steering to malfunction.

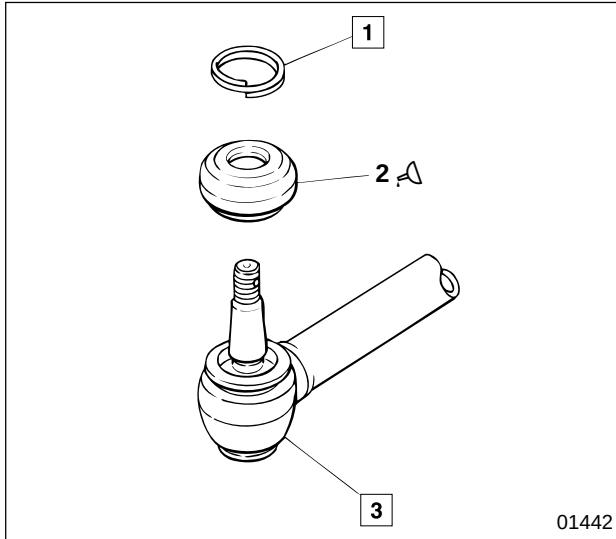
📖 P37-11

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8	Bolt (Oil hose mounting)	125 {94, 13}	—
9	Oil pipe (Oil hose and connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
10	Oil pipe (Connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
12	Oil pipe (Connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
13	Nut	66.69±12.75 {49±9.4, 6.8±1.3}	—

DRAG LINK



Disassembly sequence

- 1 Clip
- 2 Dust cover
- 3 Drag link

NOTE

- Do not remove clip 1 or dust cover 2 unless they are faulty.
- Do not disassemble drag link 3 because it is a unit construction.

Assembly sequence

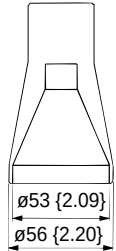
Follow the disassembly sequence in reverse.

Lubricant

Location	Points of application	Kinds	Quantity
2	Lip area of dust cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
	Pack interior of dust cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	11 g {0.39 oz}

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Clip guide 	MH061831	Installation of clip

Service procedure

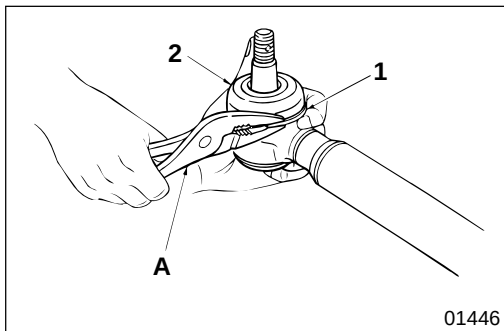
1 Clip

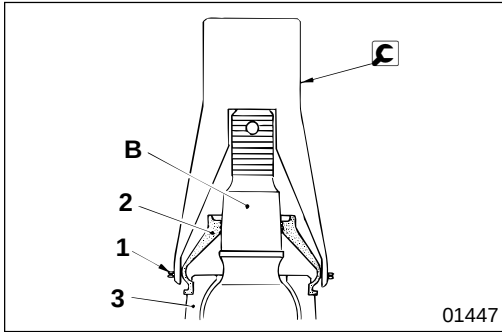
[Removal]

A : Long nose pliers

CAUTION

- Be careful not to damage clip 1 or dust cover 2 when you remove the clip.
- If clip 1 is deformed, do not reuse it.



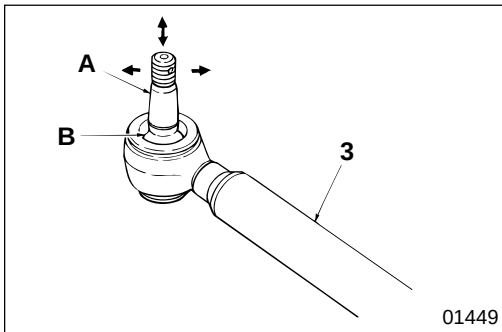


[Installation]

- Position the assembly so ball stud **B** is vertical.
- Place  clip guide on drag link **3**.
- Install clip **1** into the groove of dust cover **2**.

CAUTION

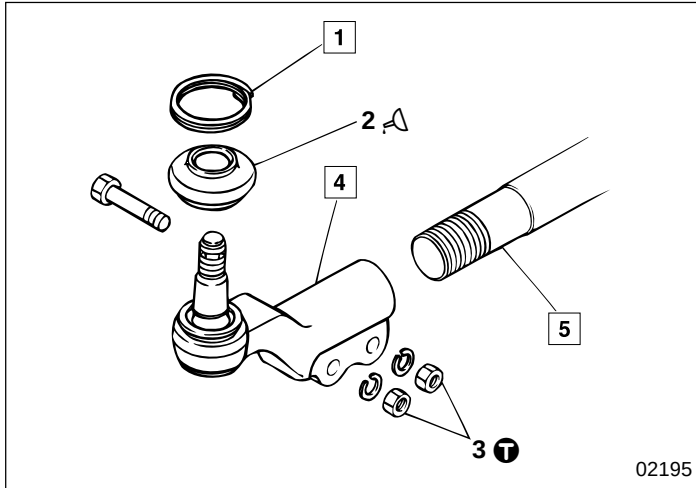
- Be careful that  clip guide end does not dig into dust cover **2**.
- Be especially careful that clip **1** end does not damage dust cover **2**.



3 Inspection of drag link

Move ball stud area **A** of drag link **3** vertically and horizontally to make sure that there is no play. Also, check that ball section **B** moves evenly. If any fault is found, replace the tie rod assembly.

TIE ROD ASSEMBLY



● Disassembly sequence

- 1 Clip
- 2 Dust cover
- 3 Nut
- 4 Tie rod end assembly
- 5 Tie rod

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Do not attempt to disassemble tie rod end assembly 4 because it is a unit construction.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
5	Bend of tie rod	1 {0.039} or less	1 {0.039}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

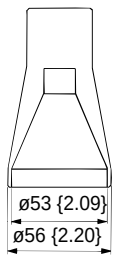
Location	Parts to be tightened	Tightening torque	Remarks
3	Nut (Tie rod end assembly fastening)	78 {58, 8}	Wet

L Lubricant

Location	Points of application	Kinds	Quantity
2	Lip area of dust seal	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
	Pack into dust cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	11 g {0.39 oz}

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Clip guide 	MH061831	Installation of clip

01443

◆ Service procedure

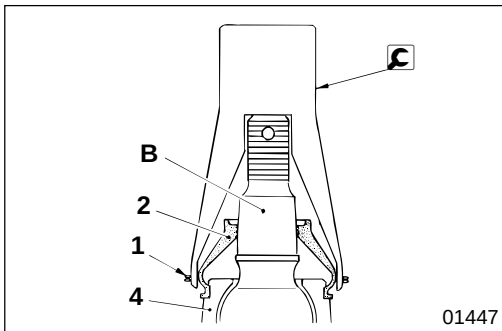
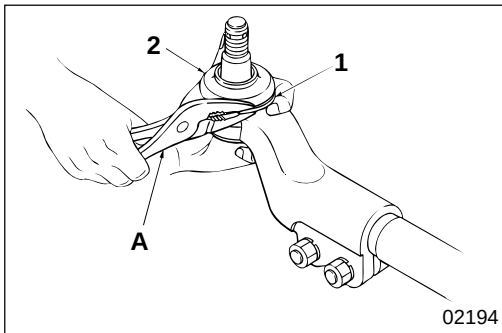
1 Clip

[Removal]

A : Long nose pliers

CAUTION ⚠

- Be careful not to damage clip 1 or dust cover 2 when you remove the clip.
- If clip 1 is deformed, do not reuse it.

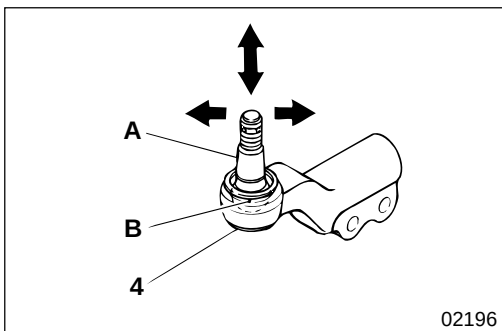


[Installation]

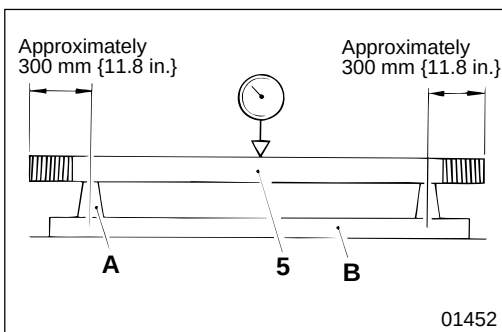
- Position so ball stud B is vertical.
- Place C clip guide on tie rod end assembly 4.
- Install clip 1 into the groove of dust cover 2.

CAUTION ⚠

- Be careful that C clip guide end does not dig into dust cover 2.
- Be especially careful that clip 1 end does not damage dust cover 2.



Move ball stud area A of tie rod end assembly 4 vertically and horizontally to make sure that there is no play. Also, check that ball section B moves evenly. If any fault is found, replace the tie rod end assembly.



5 Bend of tie rod

Measure the bend of tie rod 5 at the center point. If the measured value exceeds the limit, correct or replace the tie rod.

NOTE

To measure the deflection of tie rod 5, turn it one full rotation and read the dial gauge indicator. The deflection is one half of the indicated value.

A : V-block

B : Surface plate



FH

Service Manual

Group 37

Steering

'98 Minor Change

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

GROUP 37 STEERING

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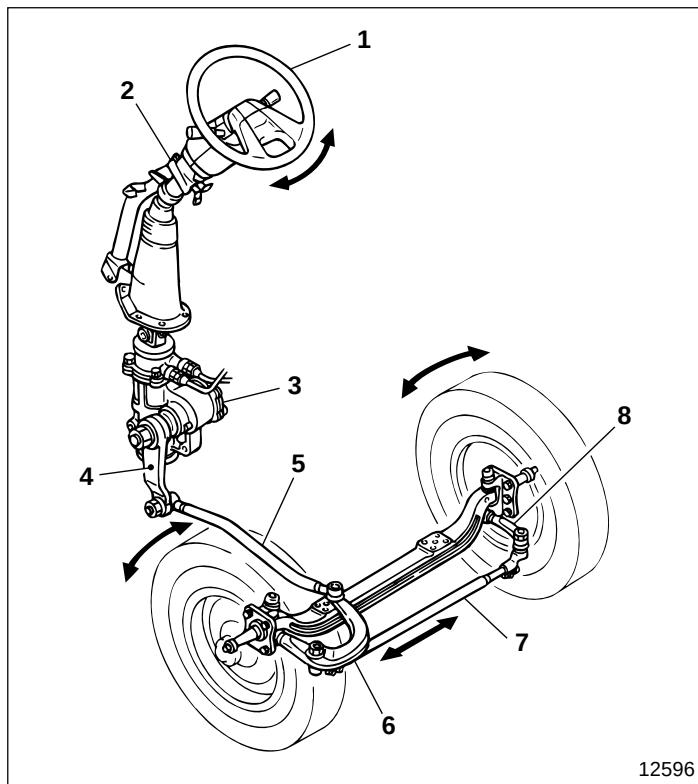
SPECIFICATIONS

Item		Specification
Steering wheel	Type	2-spoke type
	Outer diameter mm {in.}	450 {17.7}
Steering shaft	Type	Universal joint type (High tilt and telescopic type)
Power steering booster	Manufacturer	JIDOSHA KIKI
	Type	Ball nut type
	Form	Integral type
	Gear ratio	17.1 to 20
	Cylinder diameter mm {in.}	85 {3.35}
	Mass (without pitman arm and fluid) kg {lb}	21 {46}
Power steering oil pump	Manufacturer	JIDOSHA KIKI
	Type	Vane type
	Discharge amount cm ³ {cu. in.}/rotation	11.2 {0.68}
	Regulated flow amount L {qts}/min	12 {13}
	Regulated pressure (relief valve) MPa {lbf/in ² , kgf/cm ² }	12.3 {1780, 125}
	Permissible revolutions rpm	600 to 4800
	Mass (without drive gear and fluid) kg {lb}	2.7 {6.0}

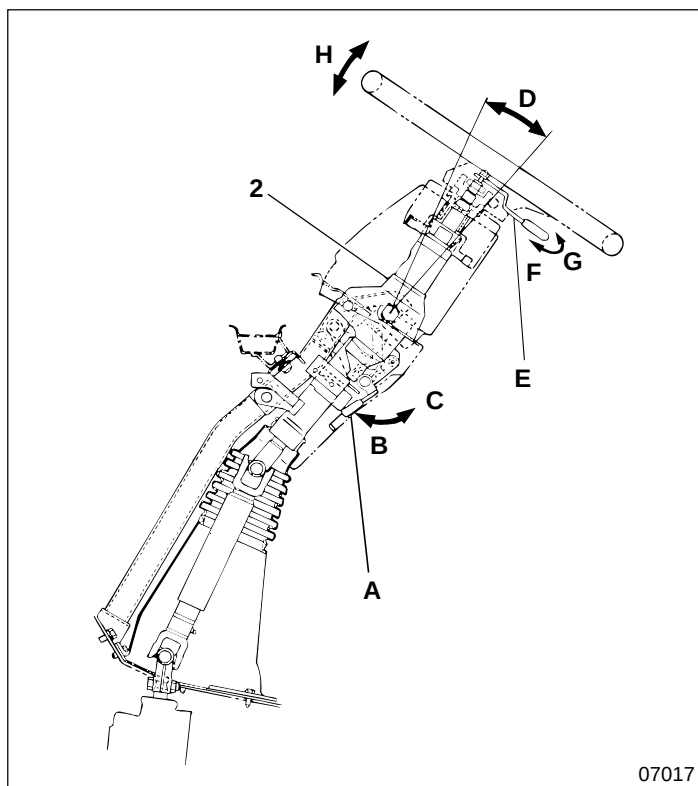
STRUCTURE AND OPERATION

37

Steering System



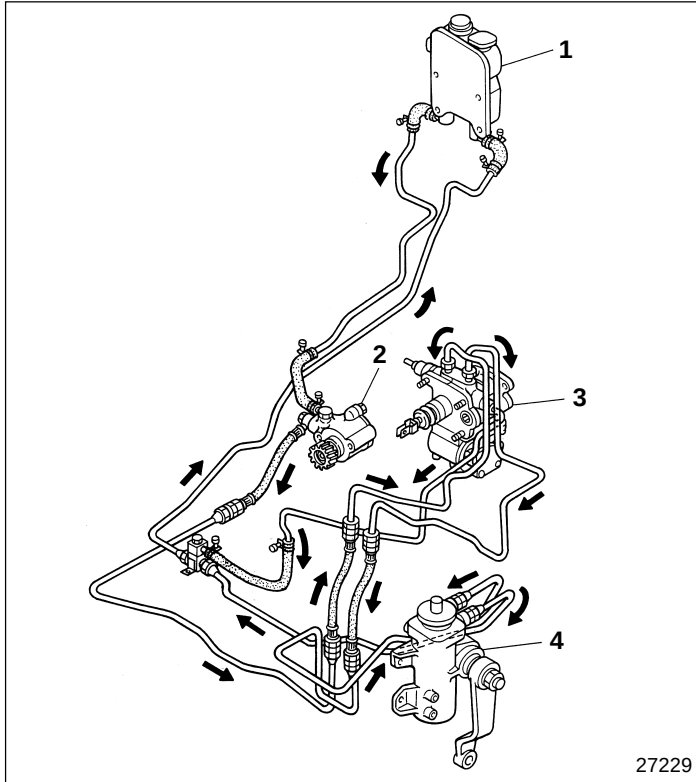
- 1 Steering wheel
- 2 Steering column subassembly
- 3 Power steering booster
- 4 Pitman arm
- 5 Drag link
- 6 Knuckle arm
- 7 Tie rod
- 8 Tie rod arm



Shifting lock lever **A** from lock position **B** to release position **C** produces high tilt **D**, and turning telescopic lever **E** (counterclockwise) from lock position **F** to release position **G** allows telescopic movement **H**. In this way, the structure of steering column subassembly **2** can be adjusted for optimum driving position.

STRUCTURE AND OPERATION

Power Steering System



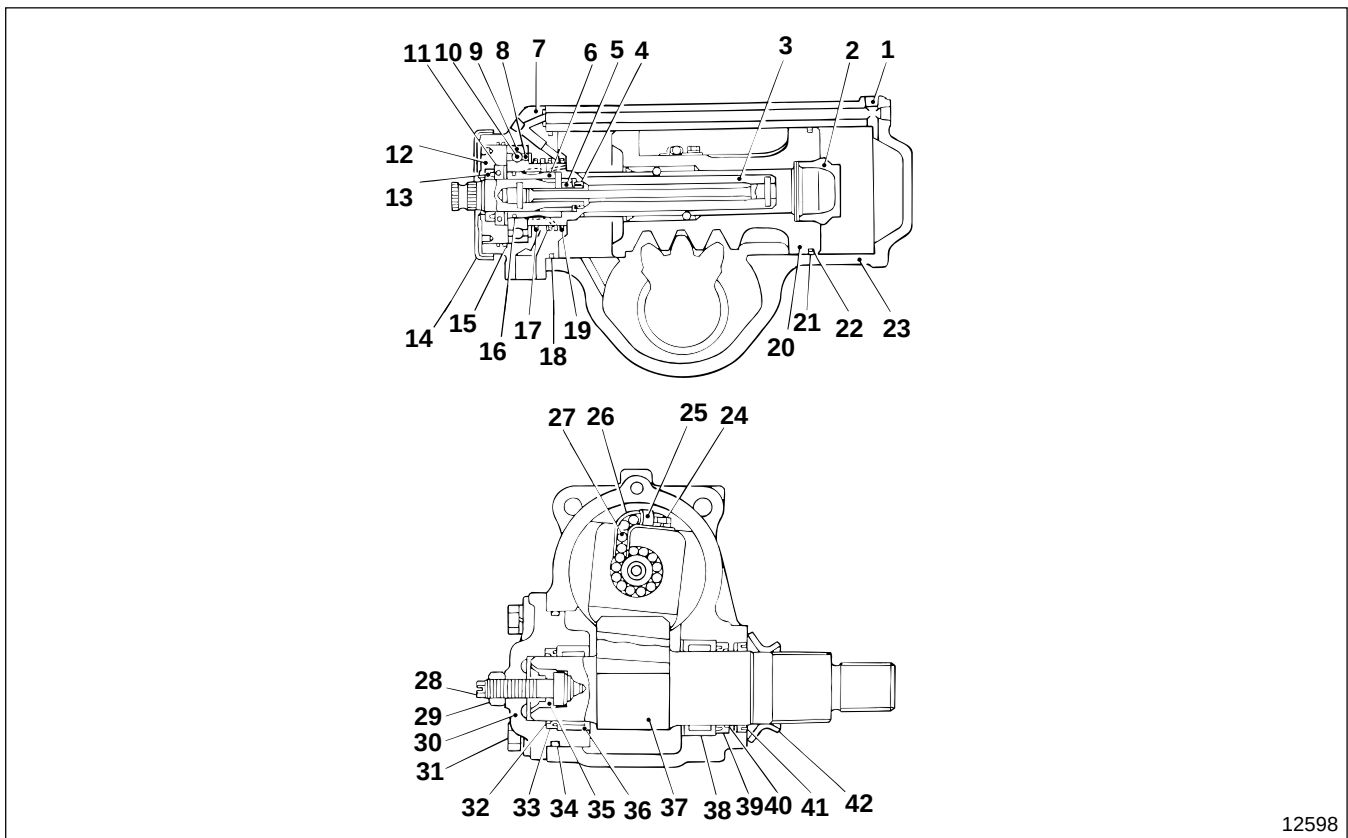
- 1 Power steering oil tank
- 2 Power steering oil pump
- 3 Brake booster (Hydraulic booster)
- 4 Power steering booster

← : Fluid flow

- In vehicles equipped with hydraulic booster brake, power steering oil pump 2 hydraulic pressure is also used for brake booster (hydraulic booster) 3 by the power steering system. Although the power steering pump is shared by both the power steering system and the brake system, the spool valve inside brake booster (hydraulic booster) ensures that power steering booster 4 and brake booster (hydraulic booster) operate without interfering with each other.

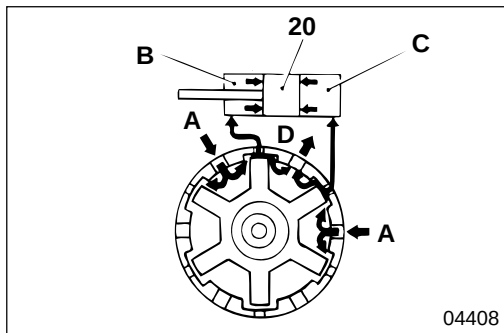
(For information on brake booster operation, refer to Gr 35.)

Power Steering Booster



- | | | |
|-------------------|--------------------|-------------------|
| 1 Taper plug | 15 O-ring | 29 Nut |
| 2 Plug | 16 Seal ring | 30 Side cover |
| 3 Worm shaft | 17 O-ring | 31 Bolt |
| 4 Needle bearing | 18 O-ring | 32 Backup ring |
| 5 Stub shaft | 19 Seal ring | 33 Y-packing |
| 6 Rotor | 20 Piston | 34 O-ring |
| 7 Valve housing | 21 Seal ring | 35 Retainer |
| 8 Bearing cage | 22 O-ring | 36 Needle bearing |
| 9 Side race | 23 Body | 37 Sector shaft |
| 10 Steel ball | 24 Screw | 38 Needle bearing |
| 11 Ball bearing | 25 Ball tube clip | 39 Y-packing |
| 12 Adjusting plug | 26 Ball tube | 40 Backup ring |
| 13 Oil seal | 27 Steel ball | 41 Oil seal |
| 14 Dust cover | 28 Adjusting screw | 42 Dust cover |

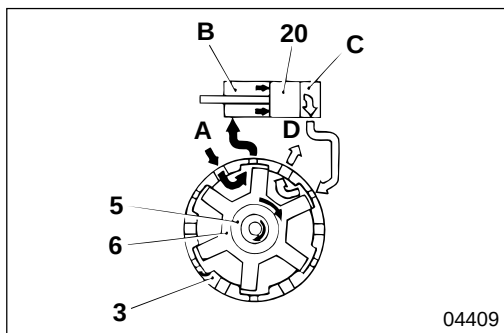
The rotary valve is the central part of the power steering booster. The torsion bar allows the steering reaction force and valve return to operate lightly and smoothly at low speed, and ensures stable steering feel even at high speed.



● Straight-ahead operation

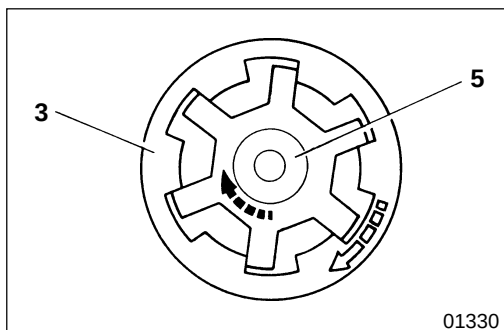
Piston 20 is in the neutral position as chambers B and C of the piston are under equal pressure.

- A : From oil pump
D : To oil tank



● Steering operation

Turning the steering wheel rotates stub shaft 5, causing rotor 6 to close the fluid feed passage to cylinder chamber C. This produces a pressure difference between cylinder chambers B, C, which causes piston 20 to move, and facilitates rotation of worm shaft 3.

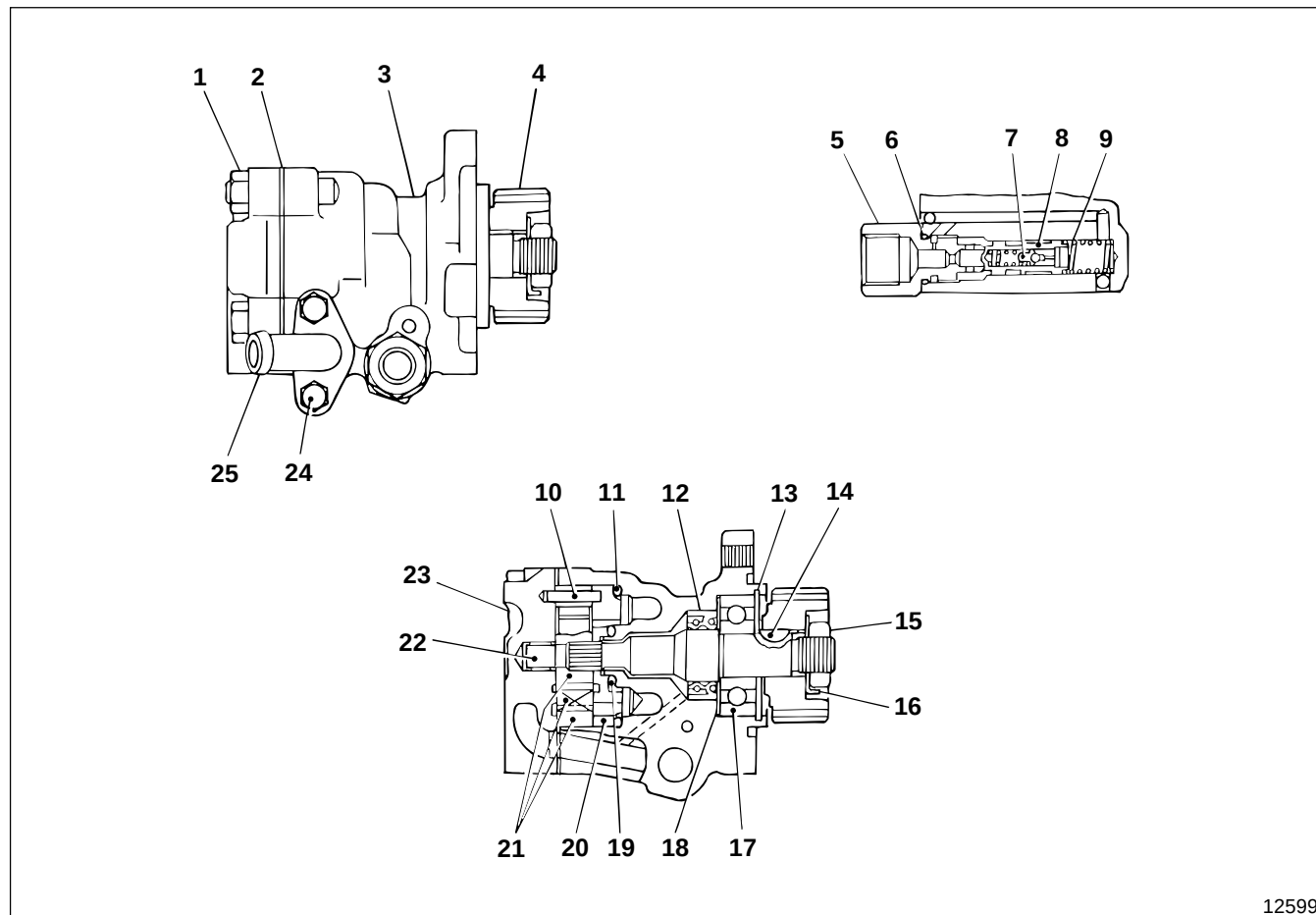


If the hydraulic circuit fails

The safety mechanism allows the vehicle to be steered manually, when the rotating force of stub shaft 5 alone directly turns worm shaft 3, transmitting the steering force.

STRUCTURE AND OPERATION

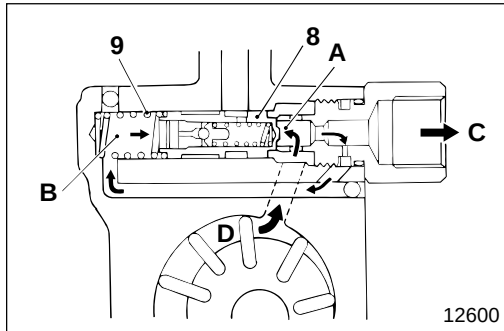
Power Steering Oil Pump



12599

- | | | |
|-------------------------------|-------------------|-----------------------|
| 1 Bolt | 10 Straight pin | 19 O-ring |
| 2 Gasket | 11 O-ring | 20 Pressure plate |
| 3 Front body | 12 Oil seal | 21 Cartridge assembly |
| 4 Gear | 13 Retaining ring | 22 Shaft |
| 5 Connector | 14 Key | 23 Rear body |
| 6 O-ring | 15 Nut | 24 Bolt |
| 7 Relief valve | 16 Lock washer | 25 Suction pipe |
| 8 Flow control valve assembly | 17 Ball bearing | |
| 9 Flow control spring | 18 Retaining ring | |

Flow Control Valve Assembly



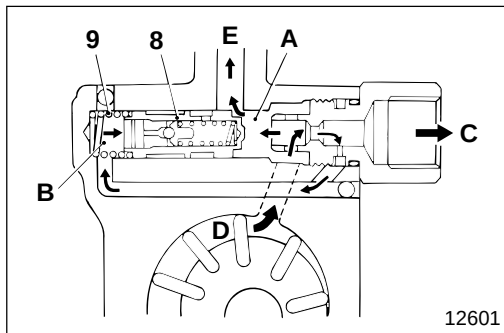
● Operation of flow control valve

(1) When not operating (When oil pump rotating at low speed)

The fluid pressure from chamber A does not move flow control valve assembly 8 because the fluid pressure is lower than the combined force of the fluid pressure from chamber B and the repercussive force of flow control spring 9.

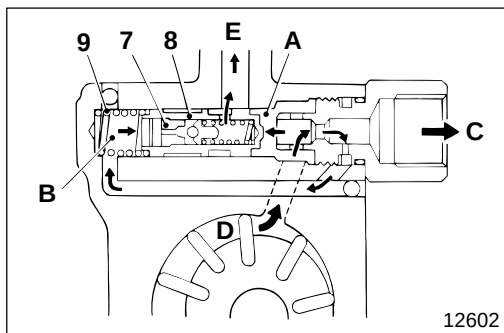
C : To power steering booster

D : Pressure chamber



(2) When operating (When oil pump rotating at middle or high speed)

The fluid pressure from chamber A moves flow control valve assembly 8 because the fluid pressure is higher than the combined force of the fluid pressure from chamber B and the repercussive force of flow control spring 9. Then, port E opens to release the fluid, maintaining the level of flow in chamber A.

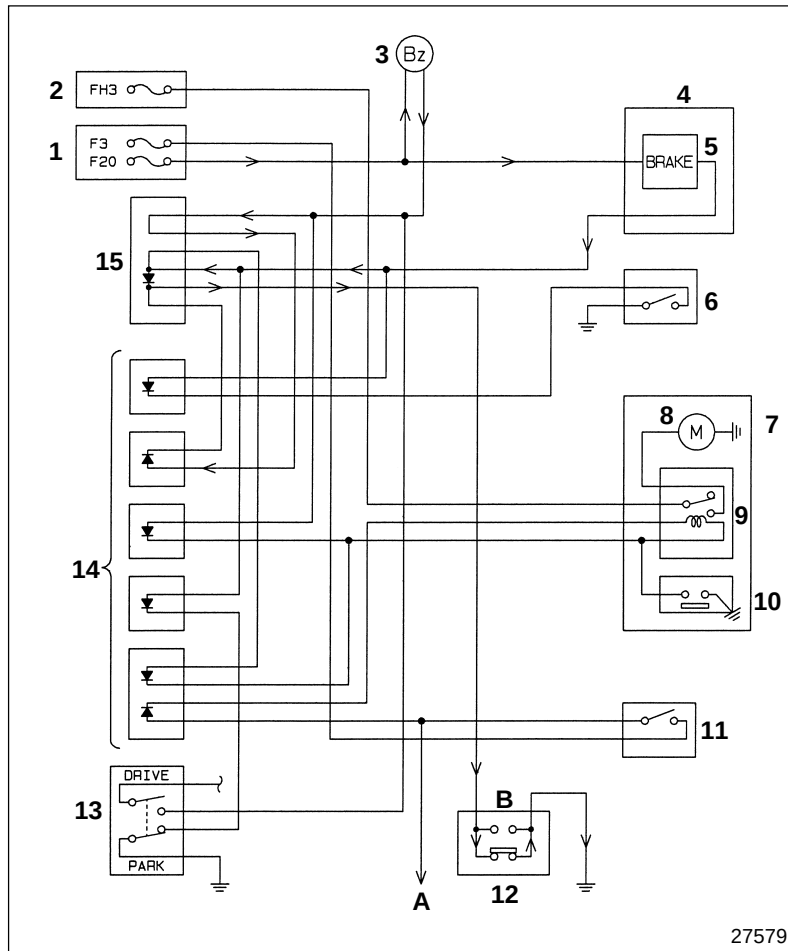


● Operation of relief valve

The combined force of the fluid pressure from chamber B and the repercussive force of flow control spring 9 moves flow control valve assembly 8 because the fluid pressure is higher than the fluid pressure from chamber A. The hydraulic pressure in chamber B rises further to open relief valve 7 and port E, stabilizing the fluid pressure in chamber B.

STRUCTURE AND OPERATION

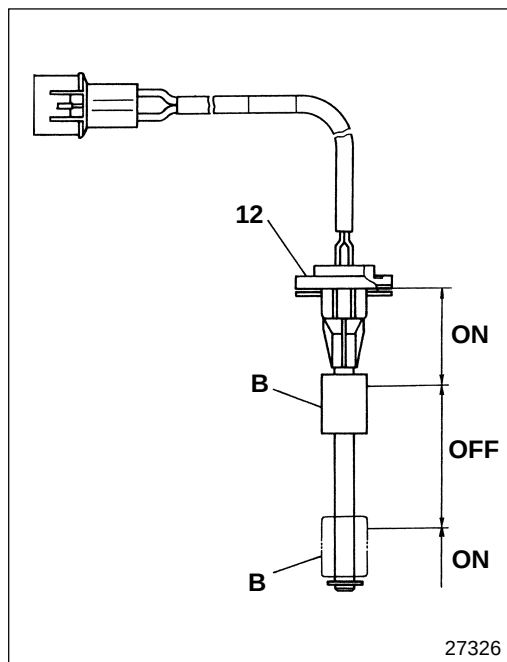
Power Steering Fluid Level Warning Circuit



- 1 Fuse box
- 2 High-current fuse box
- 3 Warning buzzer
- 4 Meter cluster
- 5 Brake warning lamp
- 6 Brake fluid level switch
- 7 Brake booster (Hydraulic booster)
- 8 Emergency pump motor
- 9 Motor relay
- 10 Flow switch
- 11 Stop lamp switch
- 12 Power steering fluid level sensor
- 13 Parking brake switch
- 14 Diode
- 15 Joint connector

A : To stop lamp

B : Float



- Power steering oil pump hydraulic pressure is also used for brake booster (hydraulic booster) 7 which reinforces brake. So the power steering fluid level warning circuit is connected to warning buzzer 3 and brake warning lamp 5.
- When the power steering fluid level drops below the “MIN” level or rises above the “MAX” level of the power steering oil tank, the magnet inside float B in power steering fluid level sensor 12 turns the power steering fluid level sensor ON. Warning buzzer 3 sounds and brake warning lamp 5 lights to warn the driver.

TROUBLESHOOTING

37

Symptoms		Possible causes													Remarks
		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure faulty	Oil pump gurgles	Oil pump squeaks	Oil pump growls		
Power steering mechanism faulty	Bearing damaged or worn	☐			☐	☐									
	Ball or groove of ball screw worn	☐	☐		☐										
	Air bled insufficiently	☐													
	Fluid viscosity unsuitable	☐													
	Power steering booster system faulty	☐													
	Flow control valve malfunctioning	☐													
	Ball screw unit rack and gear worn		☐												
	Sector shaft bearing worn		☐		☐										
	Power steering booster mounting bolt loose		☐												
	Ball screw unit and sector shaft play incorrect				☐										
	Valve control edge damaged or control seal ring broken				☐										
	Power steering system fluid unsuitable				☐										
	Rack engagement starting torque adjusted incorrectly	☐				☐									
	Fluid circuit clogged	☐				☐									
	Sector shaft gear worn		☐												
	Torsion shaft serration damaged or worn		☐												
	Power steering booster body faulty			☐	☐										
	O-ring, oil seal faulty								☐						
	Sealant applied incorrectly								☐						
Steering column and linkage mechanism faulty	Universal joint worn abnormally, damaged, lubricated incorrectly	☐	☐												
	Linkage deformed	☐													
	Drag link ball stud play		☐		☐										
	Tie rod end ball stud play		☐		☐										
	Tie rod bent						☐								
	Pitman arm mounting position incorrect							☐							
	Steering wheel turning center offset			☐											

TROUBLESHOOTING

Symptoms		Possible causes												Remarks
		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure faulty	Oil pump gurgles	Oil pump squeaks	Oil pump growls	
	Kingpin lubricated incorrectly	☐				☐								📦 Gr 26
	Front wheel alignment (toe-in, camber, caster) incorrect	☐		☐	☐	☐								
	Thrust bearing damaged	☐												
	Wheel hub bearing worn or damaged		☐	☐	☐									
	Kingpin or bushing worn or damaged		☐	☐	☐									
	Front axle deformed			☐										
	Knuckle arm, tie rod arm, or knuckle tightened incorrectly				☐									📦 Gr 33
	U-bolt of front spring, nut, loose				☐									
	Front axle parts overtightened					☐								📦 Gr 26
	Turning angle adjusted incorrectly						☐	☐						
	Mounting parts, connection point loose		☐											
	Knuckle stopper bolt adjusted incorrectly							☐						
Oil pump faulty	Oil pump body faulty								☐					
	O-ring or oil seal faulty								☐					
	Bolt tightened incorrectly								☐					
	Maximum generated fluid pressure insufficient									☐				
	Fluid line crushed or clogged									☐				
	Air lock in oil pump										☐			
	Oil pump interior seized									☐	☐	☐		
	Mounting bolt or nut loose												☐	
	Pump body faulty												☐	
	Valve malfunctioning									☐				

Symptoms		Steering wheel operation heavy	Steering wheel play excessive and unstable	Steering wheel pulls to one side	Steering wheel vibration	Steering wheel self-return poor	Steering wheel does not turn	Steering angle insufficient or difference between right and left	Fluid leaking	Oil pump fluid pressure faulty	Oil pump gurgles	Oil pump squeaks	Oil pump growls	Remarks
Possible causes														
	Oil tank leaking due to overflowing								○					
	Oil tank leaking due to air lock								○					
	Fluid level insufficient	○												
	Load too far forward of load-carrying platform	○												
	Load too far rearward of load-carrying platform		○											
	Load too far to one side of load-carrying platform			○										
	Wheelbase difference between left and right excessive			○										
	Propeller shaft runout excessive				○									Gr 25
	Front axle bent				○									Gr 26
	Rear axle housing bent			○										Gr 27
	Final drive gear and final drive pinion damaged or engaged incorrectly				○									
	Tire pressure insufficient	○												Gr 31
	Tire pressure excessive		○											
	Tire wear difference between left and right excessive			○										
	Tire outer diameter difference between left and right			○										
	Front tire radial and lateral runout, static balance and dynamic balance incorrect				○									
	One-sided braking			○										Gr 35

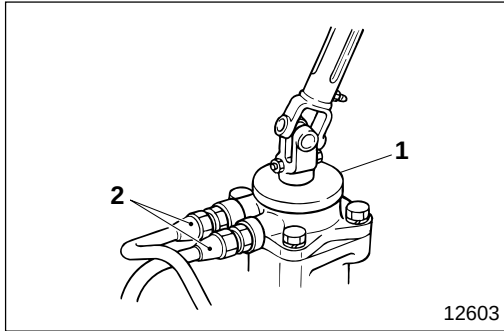
ON-VEHICLE INSPECTION AND ADJUSTMENT

Change of Power Steering Fluid

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Oil pipe	66.69±12.75 {49±9.4, 6.8±1.3}	—



[Draining]

- Jack up the front wheels.
- Loosen oil pipe 2 connected to power steering booster 1.
- Turn the steering wheel fully left and right repeatedly, and drain the fluid from power steering booster 1.
- After draining the fluid, tighten oil pipe 2 at specified torque.

[Filling]

P37-12

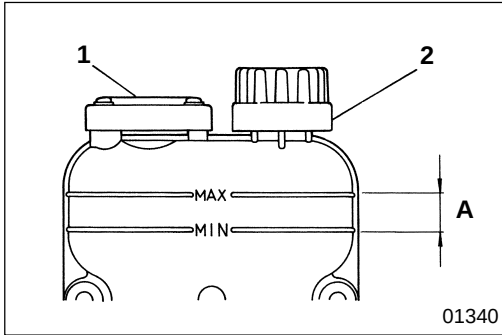
Bleeding of Power Steering System

Fluid

Location	Points of application	Specified fluid	Quantity
1	Power steering oil tank	Automatic transmission fluid (DEXRON or DEXRON II type)	Between the "MAX" and "MIN" levels in the power steering oil tank

WARNING

Because the brake booster (hydraulic booster) uses power steering fluid, do not let other fluids such as brake fluid, etc. get mixed with the power steering fluid inside the power steering oil tank.



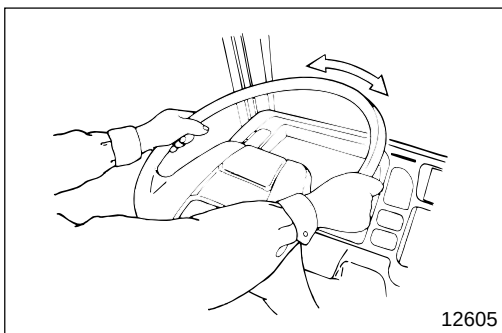
- Supply fluid into power steering oil tank **1** up to filler cap **2**.
- With the engine stopped, jack up the front wheels and turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**.
- Start the engine and letting it idle, turn the steering wheel fully left and right repeatedly. When the fluid level has dropped, add fluid to maintain the fluid level within range **A**. Repeat these steps until the fluid level does not drop.
- Depress the brake pedal fully several times repeatedly, until as in the case of the steering wheel, the fluid level does not drop anymore. (The steering wheel at such time does not need to be operated)
- If there is an abnormal noise, air is still in the system. Turn the steering wheel several times, next depress the brake pedal several times to raise the fluid temperature to approximately 60 to 80°C {140 to 176°F}, then stop the engine and wait for approximately five minutes.
- Lower the front wheels and turn the steering wheel several times to make sure there is no abnormal noise.
- With the engine stopped, depress the brake pedal several times, activate the brake booster (hydraulic booster) emergency pump and bleed air.
- When there is no abnormal noise after the above procedure has been performed, bleeding is completed. Check oil tank **1** fluid level, and pipe and hose connections for fluid leakage.
- After bleeding is completed, inspect brake booster (hydraulic booster) performance (input and output characteristics). Gr 35

Steering Wheel Play

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Steering wheel play (Measure at the outer circumference of steering wheel)	10 to 40 {0.39 to 1.57}	—	Adjust



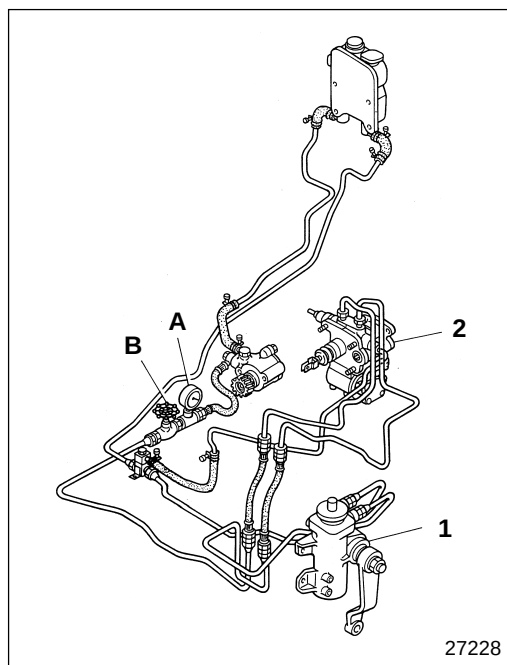
Point the wheels directly forward and gently turn the steering wheel left and right and measure the outer circumference play. If the play deviates from the standard value, adjust tightening points and power steering booster backlash. P37-31

ON-VEHICLE INSPECTION AND ADJUSTMENT

Performance Verification Test of Power Steering System

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Steering system fluid pressure (With hands off steering wheel)	490 kPa {71 lbf/in ² , 5 kgf/cm ² }	—	Repair
—	Relief set pressure (Measure with engine speed at 1000 to 1500 rpm and the stop valve closed)	12.3 MPa {1780 lbf/in ² , 125 kgf/cm ² }	Maximum +785 kPa {115 lbf/in ² , 8 kgf/cm ² } Minimum -1180 kPa {170 lbf/in ² , 12 kgf/cm ² }	Replace



Verify that power steering booster **1** and the power steering oil pump are operating properly by testing the following items.

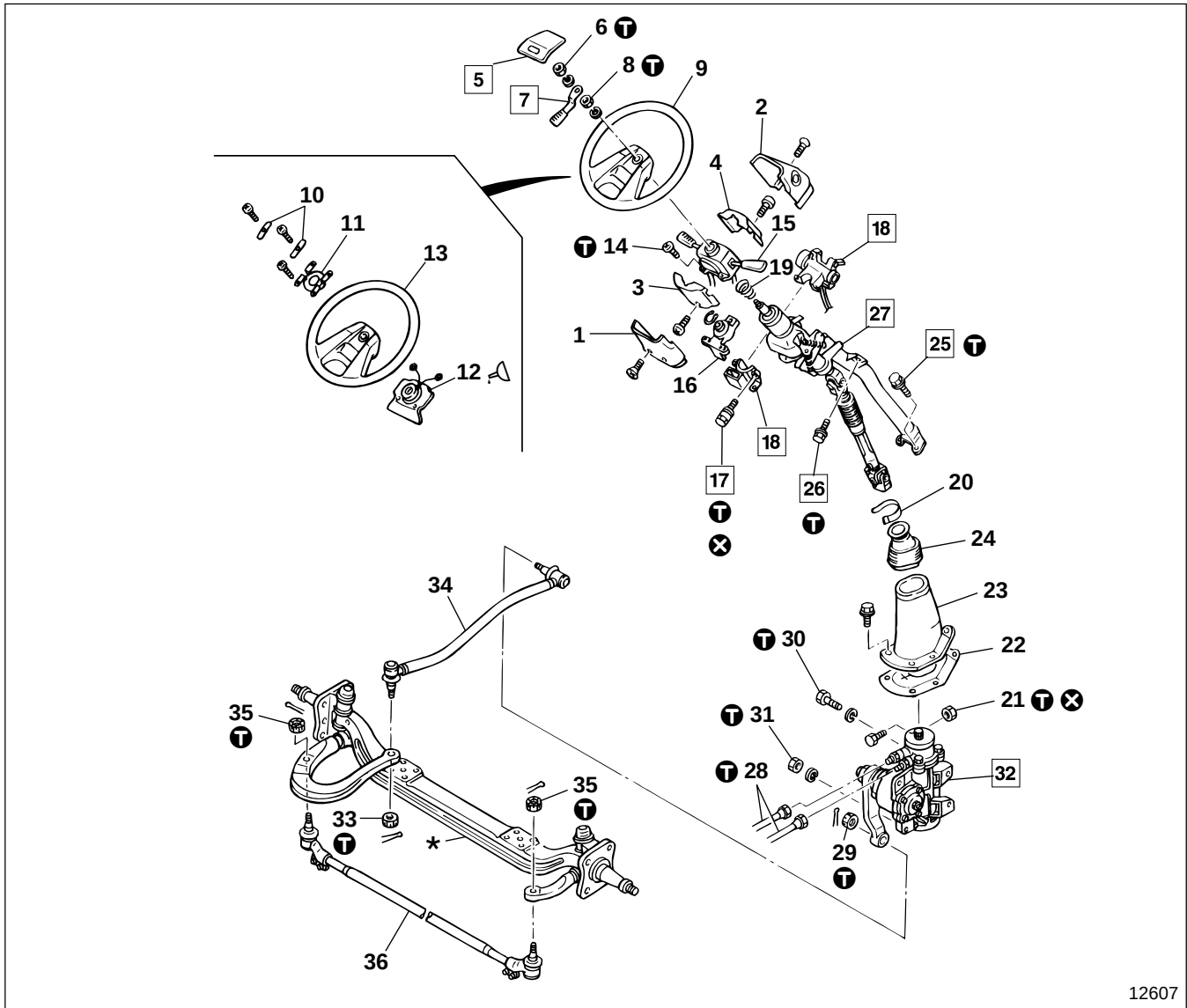
NOTE

If the fluid pressure is higher than 490 kPa {71 lbf/in², 5 kgf/cm²} with engine idling and the steering wheel free, inspect power steering booster **1**, brake booster (hydraulic booster) **2** and the fluid circuit for clogging.

Test item	Test procedure	Assembly standards
Verification of smooth operation	Jack up the front wheels and turn steering wheel fully left and right	Smooth operation through-out test
Measurement conditions	- Install oil pressure gauge A capable of measuring above 14.7 MPa {2130 lbf/in², 150 kgf/cm²} and stop valve B, then bleed air - With engine idling, turn steering wheel left and right several times to raise fluid temperature to 50 to 60°C {122 to 140°F} - With the engine idling, open stop valve B	
Measurement of fluid pressure	Measure fluid pressure with hands off steering wheel	490 kPa {71 lbf/in ² , 5 kgf/cm ² }
Measurement of relief pressure	- Gradually increase engine speed and maintain it at 1000 to 1500 rpm, and close stop valve B to measure maximum fluid pressure - Do not keep stop valve B closed for more than fifteen seconds	Relief set pressure 12.3 MPa {1780 lbf/in ² , 125 kgf/cm ² }

MEMO

STEERING SYSTEM



12607

● Removal sequence

- | | | |
|----------------------------|--|-----------------------------------|
| 1 Column cover outer lower | 15 Combination switch Gr 54 | 28 Oil pipe P37-44 |
| 2 Column cover outer upper | 16 Bracket | 29 Nut |
| 3 Column cover inner lower | 17 Head cutting bolt | 30 Bolt |
| 4 Column cover inner upper | 18 Starter switch Gr 54 | 31 Nut |
| 5 Horn pad | 19 Spring | 32 Power steering booster P37-26 |
| 6 Nut | 20 Band | 33 Nut |
| 7 Telescopic lever | 21 Nut | 34 Drag link P37-46 |
| 8 Nut | 22 Dust cover | 35 Nut |
| 9 Steering wheel assembly | 23 Dust cover | 36 Tie rod assembly P37-48 |
| 10 Horn spring | 24 Dust cover | |
| 11 Contact plate | 25 Bolt | |
| 12 Cover assembly | 26 Bolt | |
| 13 Steering wheel | 27 Steering column subassembly P37-22 | |
| 14 Screw | | |
| | | * : Front axle assembly Gr 26 |
| | | ⊗ : Non-reusable parts |

CAUTION

Be sure to clean the port area of oil pipe 28 when disconnecting the oil pipe, so as to keep it free from dust and foreign particles.

● Installation sequence

Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

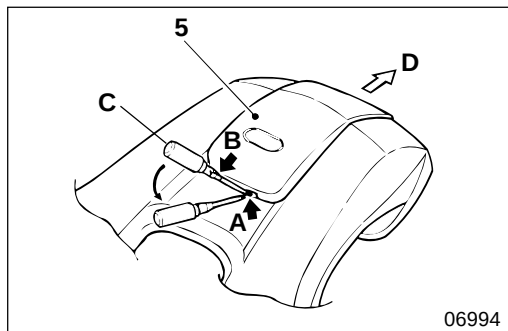
Location	Parts to be tightened	Tightening torque	Remarks
6	Nut (Telescopic lever mounting)	8.8 to 9.8 {6.5 to 7.2, 0.9 to 1.0}	—
8	Nut (Steering wheel assembly mounting)	39 to 49 {29 to 36, 4 to 5}	—
14	Screw (Combination switch mounting)	2.5±0.5 {1.8±0.36, 0.25±0.05}	—
17	Head cutting bolt (Starter switch mounting)	14.2±1.5 {10±1.1, 1.45±0.15}	—
21	Nut (Steering column subassembly and power steering booster mounting)	51.45±2.45 {38±1.8, 5.25±0.25}	—
25	Bolt (Steering column at floor side mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
26	Bolt (Steering column subassembly to instrument panel side mounting)	17 to 26 {12 to 19, 1.7 to 2.6}	—
28	Oil pipe	66.69±12.75 {49±9.4, 6.8±1.3}	—
29	Nut (Drag link and power steering booster mounting)	190±47.5 {140±35, 19.4±4.85}	—
30	Bolt (Power steering booster mounting)	175.4±26.5 {130±20, 17.9±2.7}	—
31	Nut (Power steering booster mounting)	175.4±26.5 {130±20, 17.9±2.7}	—
33	Nut (Drag link and front axle assembly mounting)	190±47.5 {140±35, 19.4±4.85}	—
35	Nut (Tie rod assembly and front axle assembly mounting)	190±47.5 {140±35, 19.4±4.85}	—

L Lubricant

Location	Points of application	Specified lubricant	Quantity
12	Contact area between combination switch of cover assembly and horn contact	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

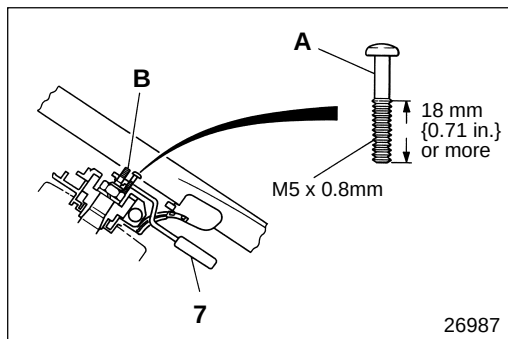
STEERING SYSTEM

◆ Service procedure



5 Removal of horn pad

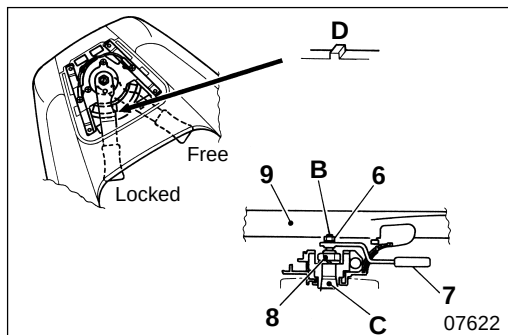
Insert flat-blade screwdriver **C** in grooves **A**, **B** of horn pad **5** and press down on the screwdriver until the horn pad is removed with a “click”. To remove the horn pad, raise and press it in direction **D** as illustrated.



7 Telescopic lever

[Removal]

Drive in screw **A** (M5 x 0.8 mm) into tapped hole of telescopic lever **7** and remove the telescopic lever from telescopic shaft **B**.

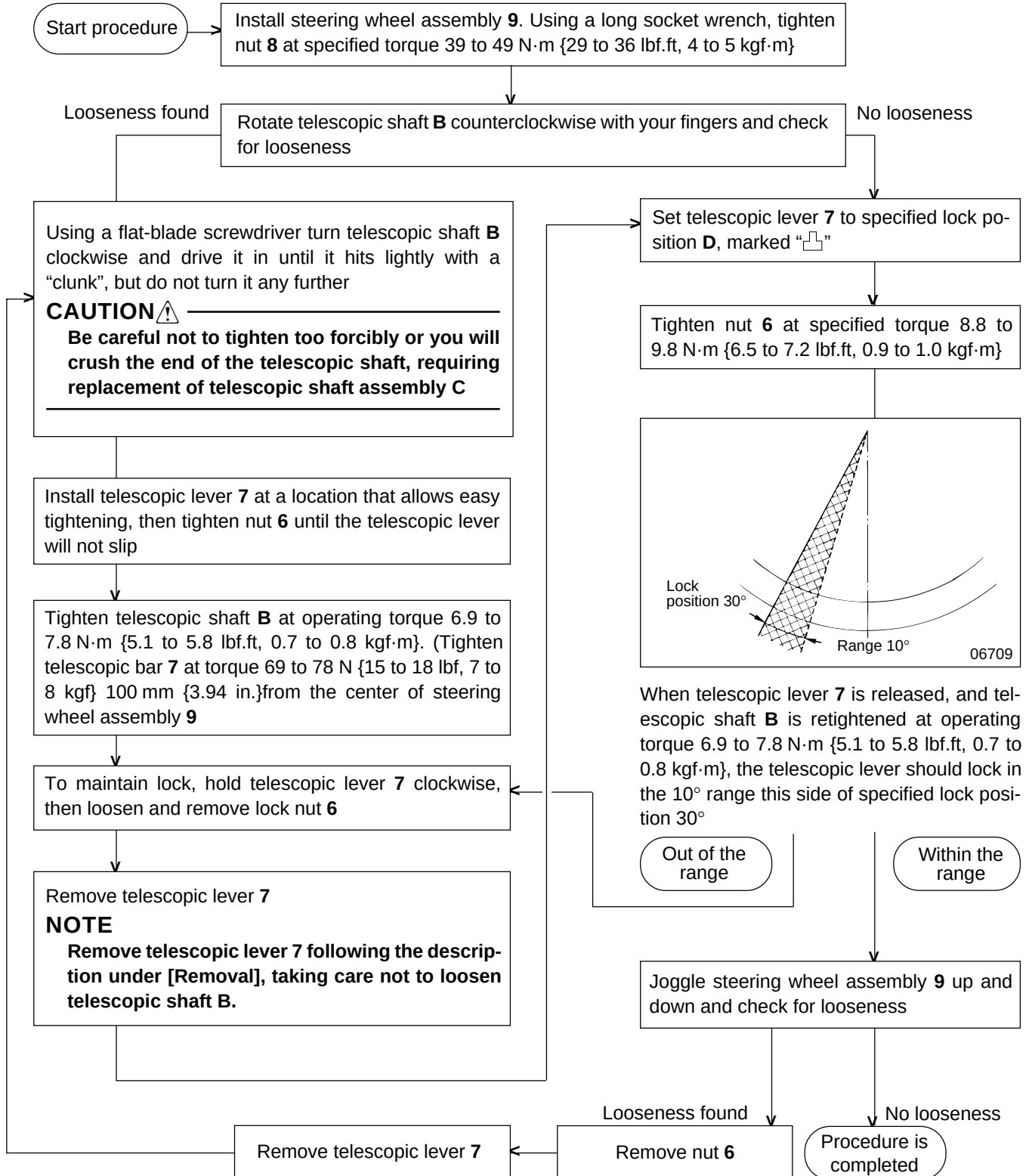


[Installation]

Locate telescopic lever **7** at the specified position (locked), and adjust until the specified torque is applied to telescopic shaft **B**.

CAUTION ⚠

Do not crush the screw tip of telescopic shaft **B**.

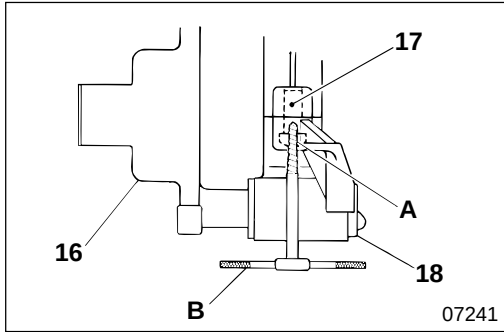
**CAUTION** ⚠️

Be sure not to operate telescopic shaft **B** while steering wheel assembly **9** is removed.

NOTE

Be sure to assemble telescopic lever **7** only after steering wheel assembly **9** has been installed.

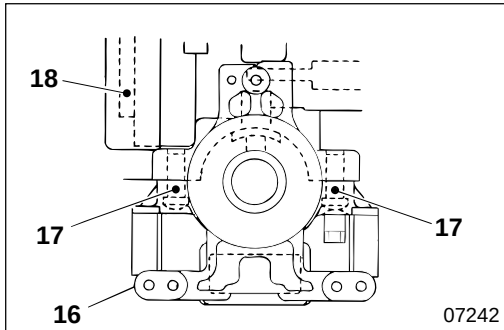
STEERING SYSTEM



17 18 Head cutting bolt, starter switch

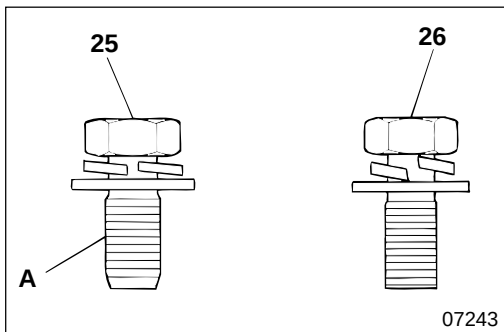
[Removal]

- After removing bracket **16**, 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 in surface **A** of head cutting bolt **17** for mounting starter switch **18**.
- Screw in screw extractor **B** counterclockwise, then remove head cutting bolt **17**.



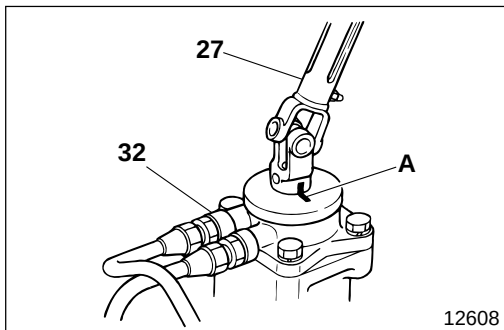
[Installation]

- With new head cutting bolt **17**, tighten starter switch **18** at specified torque to cut the head off the bolt.
- After installing bracket **16**, verify operation of the steering lock function of starter switch **18**.



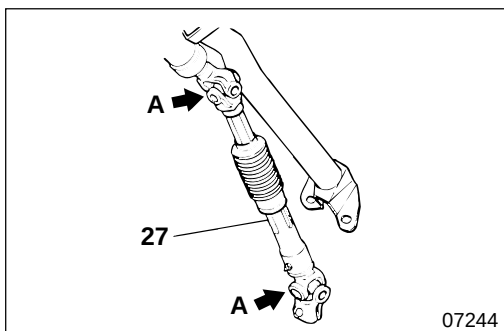
25 26 Installation of bolt

- Bolts **25** and **26**, differ in shape. Do not mix them up when installing.
- Thread area **A** of bolt **25** is elliptical to facilitate grounding of the horn circuit.



27 32 Removal and installation of steering column subassembly, and power steering booster

Before removing steering column subassembly **27** or power steering booster **32**, be sure to make alignment mark **A**.

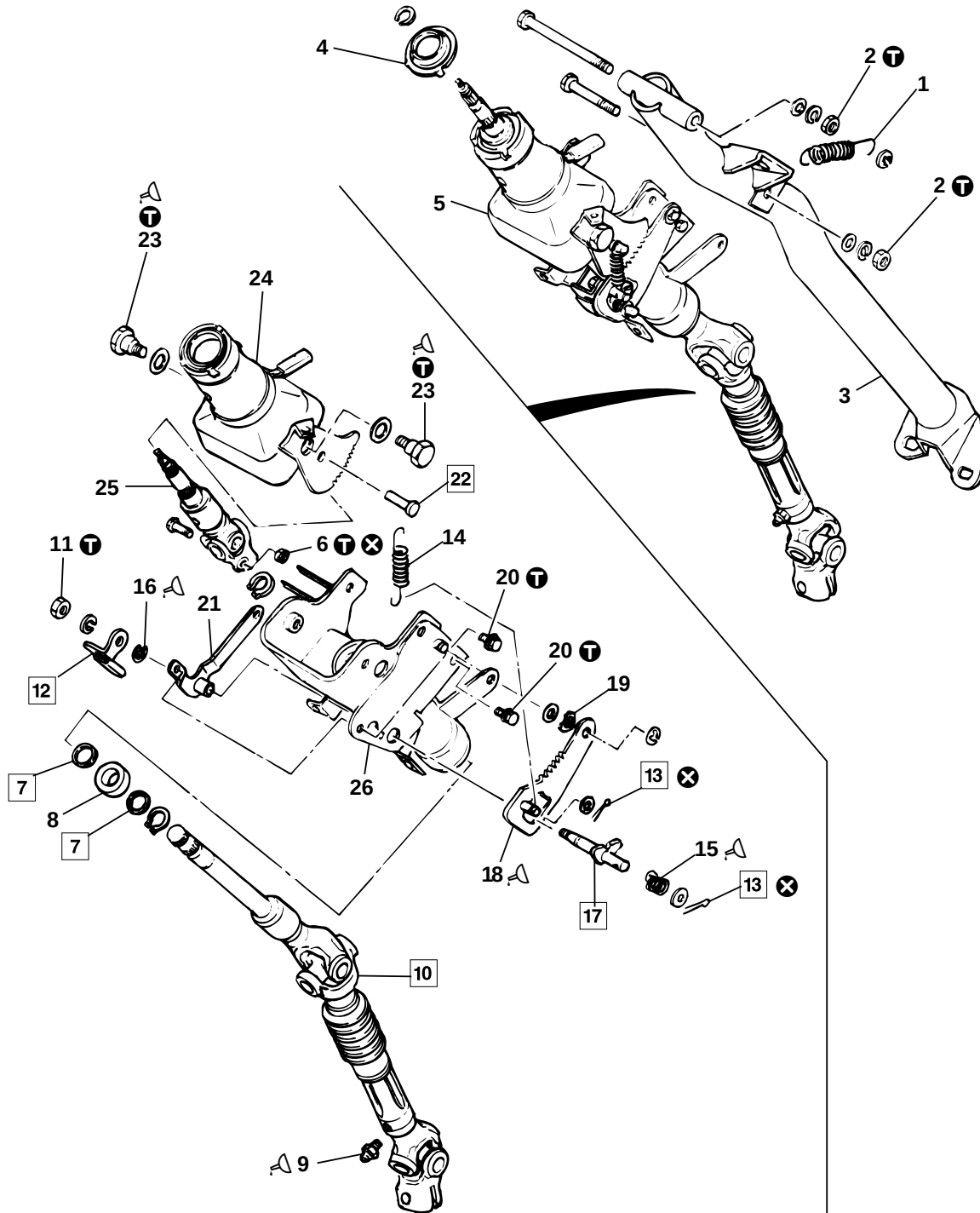


27 Steering column subassembly

When the spline of steering column subassembly **27** has been disconnected, align marks **A** on the yokes to face the same direction.

MEMO

STEERING COLUMN SUBASSEMBLY



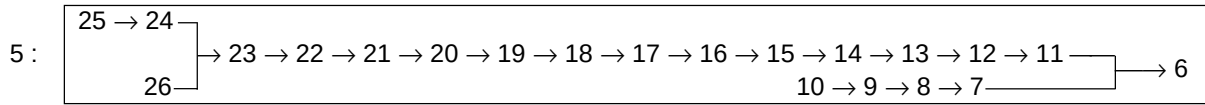
10840

● 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



ⓘ 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}	—

🔧 Lubricant and/or sealant

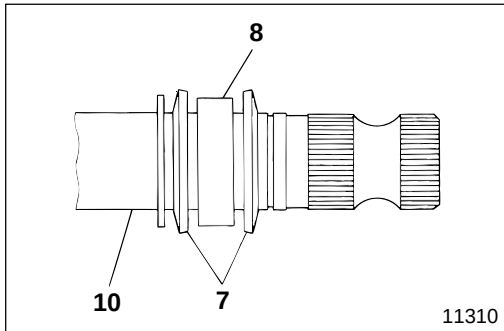
Location	Points of application	Specified lubricant and/or sealant	Quantity
9	Supply via grease nipple	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
15	Friction surfaces of return spring and washer	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
16	Friction surfaces of lever support and 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 surfaces of column support upper and bolt	Wheel bearing grease [NLGI No.2 (Li soap)]	As required

STEERING COLUMN SUBASSEMBLY

◆ Service procedure

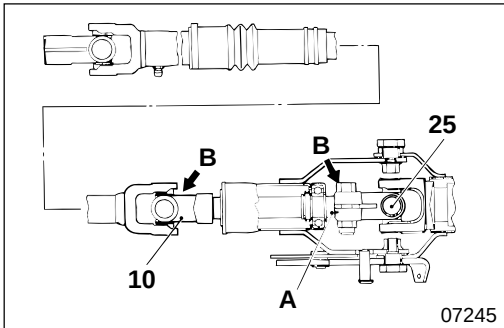
7 Installation of stopper

Install stoppers **7** on steering shaft assembly **10** in the direction as illustrated so that they straddle bearing spacer **8**.



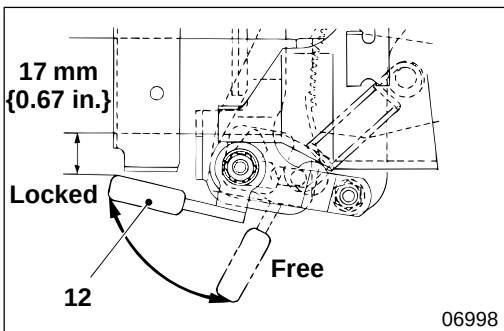
10 Steering shaft assembly

- Before removing steering shaft assembly **10**, be sure to make alignment mark **A**.
- Install the steering shaft with direction **B** of the telescopic shaft assembly **25** yoke and steering shaft assembly **10** yoke aligned or at phase angle of 90°.



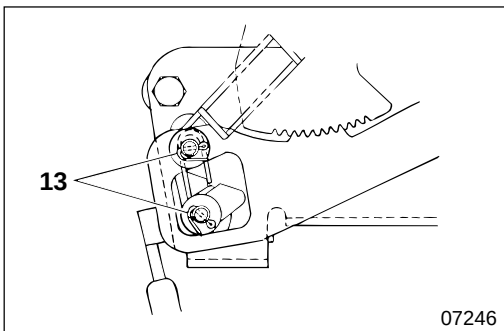
12 Installation of lock lever

- Install lock lever **12** so it is within the working angle when locked.
- After installing lock lever **12**, make sure that the lever operates smoothly (operating force less than 49 N {11 lbf, 5 kgf}). With the lever free, make sure that high tilt operates smoothly.



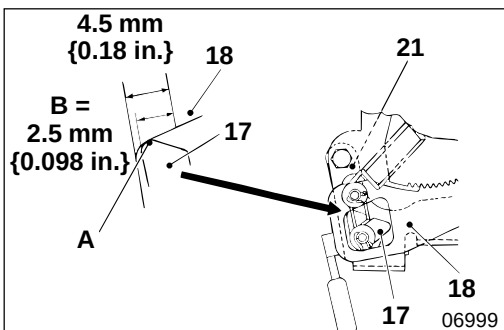
13 Installation of split pin

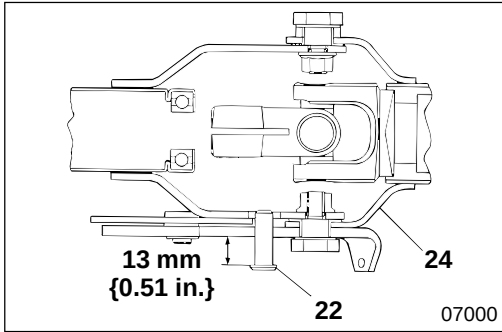
Bend split pin **13** to face outwards as illustrated.



17 Installation of cam

Adjust lever support **21** so that the top surface **A** of cam **17** is within dimension **B** of lock plate **18** to install the cam.

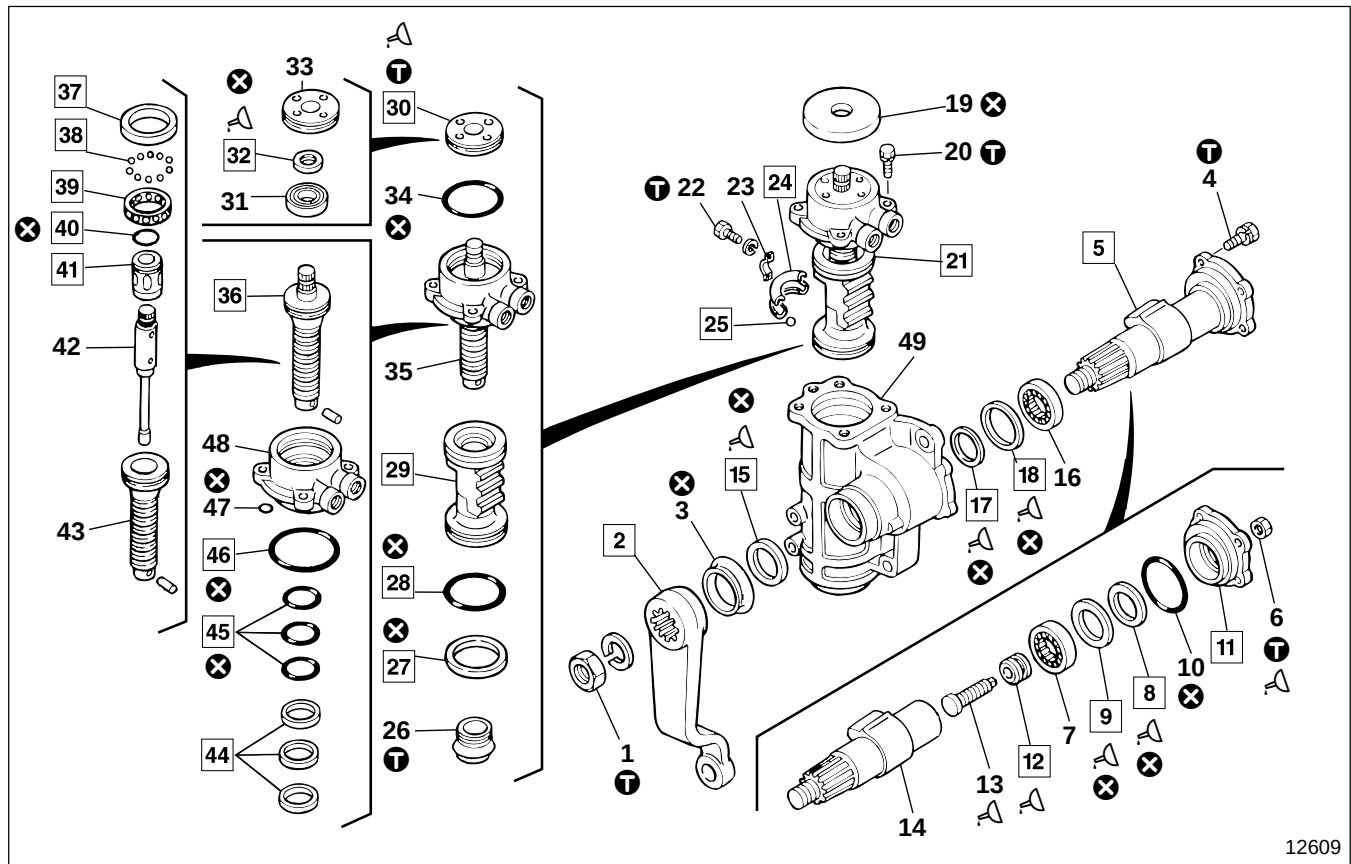




22 Installation of clevis pin

Drive clevis pin **22** into column support upper **24** so that the drive dimension is obtained.

POWER STEERING BOOSTER



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● Work before disassembly

📖 P37-30

● Disassembly sequence

- | | | |
|---|----------------------------|---|
| 1 Lock nut | 18 Y-packing | 35 Worm shaft assembly and valve housing assembly |
| 2 Pitman arm | 19 Dust cover | 36 Worm shaft assembly |
| 3 Dust cover | 20 Bolt | 37 Side race |
| 4 Bolt | 21 Ball screw assembly | 38 Steel ball |
| 5 Sector shaft assembly and side cover assembly | 22 Screw | 39 Bearing cage |
| 6 Nut | 23 Ball tube clip | 40 Seal ring |
| 7 Needle bearing | 24 Ball tube | 41 Rotor |
| 8 Backup ring | 25 Steel ball | 42 Stub shaft |
| 9 Y-packing | 26 Plug | 43 Worm shaft |
| 10 O-ring | 27 Seal ring | 44 Seal ring |
| 11 Side cover | 28 O-ring | 45 O-ring |
| 12 Retainer | 29 Piston | 46 O-ring |
| 13 Adjusting screw | 30 Adjusting plug assembly | 47 O-ring |
| 14 Sector shaft | 31 Ball bearing | 48 Valve housing |
| 15 Oil seal | 32 Oil seal | 49 Body (Cylinder) |
| 16 Needle bearing | 33 Adjusting plug | |
| 17 Backup ring | 34 O-ring | |

⊗ : Non-resusable parts

NOTE

- Do not remove needle bearing 7 or 16 unless they are faulty.
- Do not remove retainer 12 or adjusting screw 13 unless they are faulty.
- Have a tray or box ready to catch steel balls 25, 38.

● Assembly sequence

49 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 5 → 4 → 3 → 2 → 1

36 : 43 → 42 → 41 → 40 → 39 → 38 → 37

35 : 48 → 47 → 46 → 45 → 44 → 36

30 : 33 → 32 → 31

21 : 35 → 34 → 30 → 29 → 28 → 27 → 26 → 25 → 24 → 23 → 22

5 : 14 → 13 → 12 ———→ 6
11 → 10 → 9 → 8 → 7 ———→ 6

● Adjustment after assembly

📖 P37-31

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value (Basic diameter in [])	Limit	Remedy	
5, 21	Backlash between sector shaft and ball screw (Measure at the end of pitman arm)		0.2 {0.0079}	0.5 {0.020}	ℓ=250 {9.84}	Adjust (Measure with applied load of ±15 N {3.3 lbf, 1.5 kgf})
12	Retainer		Tighten the retainer then slacken off by 180°, retighten at 39 N·m {29 lbf.ft, 4 kgf·m}, then slacken off by 20°. Make sure that the adjusting screw turns smoothly, then caulk it	—	—	
13, 14	Axial play of adjusting screw and sector shaft		0.01 to 0.10 {0.00039 to 0.0039}	0.2 {0.0079}	Replace	
14	Outer diameter of sector shaft	Adjusting screw side	ø39.975 {1.574}	ø39.875 {1.570}	Replace	
		Pitman arm side	ø44.975 {1.771}	ø44.875 {1.767}	Replace	
29, 43	Play of piston and worm shaft in axial direction		—	0.5 {0.02} or more	Replace	
29, 49	Clearance between outer diameter of piston and inner diameter of body (Cylinder)		[85 {3.3}] 0.11 {0.0043}	0.16 {0.0063}	Replace	
41, 43	Clearance between outer diameter of rotor and worm shaft		[35.5 {1.4}] 0.02 {0.00079}	0.03 {0.0012}	Replace	

ⓘ Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut (Pitman arm mounting)	270±25 {200±18, 27.5±2.5}	—
4	Bolt (Side cover mounting)	53.9 to 63.7 {40 to 47, 5.5 to 6.5}	—
6	Nut (Adjusting screw tightening)	63.7 to 73.5 {47 to 54, 6.5 to 7.5}	—
20	Bolt (Valve housing tightening)	98.1 to 107.9 {72 to 80, 10 to 11}	—
22	Screw (Ball tube clip mounting)	4.41 to 5.39 {3.3 to 4.0, 0.45 to 0.55}	—
26	Plug	246 to 274 {180 to 200, 25 to 28}	—
30	Adjusting plug assembly	177 to 196 {130 to 145, 18 to 20}	—

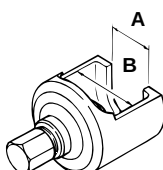
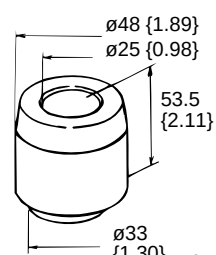
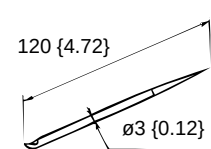
POWER STEERING BOOSTER

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
6	Contact surfaces of nut and side cover	Hermetic seal 101Y or THREEBOND 1102	As required
8, 17	Backup ring inner periphery	Multipurpose grease [NLGI No.2 (Li soap)]	As required
9, 18	Pack interior of Y-packing	Multipurpose grease [NLGI No.2 (Li soap)]	As required
12	Pack interior of retainer	Multipurpose grease [NLGI No.2 (Li soap)]	As required
13	Contact surfaces of adjusting screw and sector shaft	Multipurpose grease [NLGI No.2 (Li soap)]	As required
	Thread area of adjusting screw	Hermetic seal 101Y or THREEBOND 1102	As required
15, 32	Pack interior of oil seal	Multipurpose grease [NLGI No.2 (Li soap)]	As required
30	Adjusting plug assembly outer periphery	Hermetic seal 101Y or THREEBOND 1102	As required

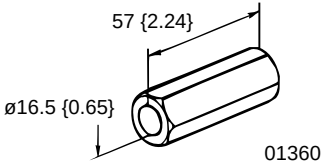
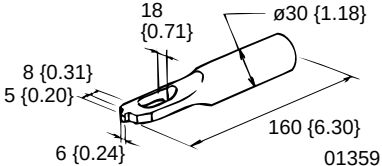
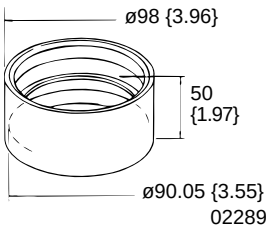
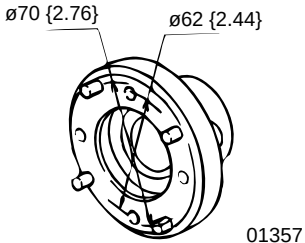
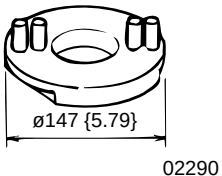
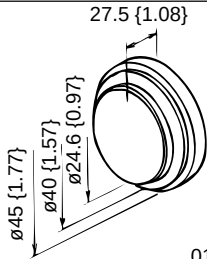
Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application												
2	Pitman arm puller <table><tr><th>Part No.</th><th>A</th><th>B</th></tr><tr><td>MH061687</td><td>59 {2.32}</td><td>ø92 {3.62}</td></tr><tr><td>*910-00183</td><td></td><td></td></tr><tr><td>*910-00184</td><td>59 {2.32}</td><td>ø100 {3.94}</td></tr></table> 01355	Part No.	A	B	MH061687	59 {2.32}	ø92 {3.62}	*910-00183			*910-00184	59 {2.32}	ø100 {3.94}	MH061687 *910-00183 *910-00184	Removal of pitman arm
Part No.	A	B													
MH061687	59 {2.32}	ø92 {3.62}													
*910-00183															
*910-00184	59 {2.32}	ø100 {3.94}													
8,15, 17	Inserting tool assembly  01356	MC811971 *910-11001	Forming of backup ring and press-fitting of oil seal												
8,17	Inserting tool  01358	MC811974 *910-21715	Forming of backup ring												
10, 27, 28, 34, 40, 44, 45, 46, 47	Needle  02288	MC811948 *910-21200	Removal of O-ring and seal ring												

* JIDOSHA KIKI part No.

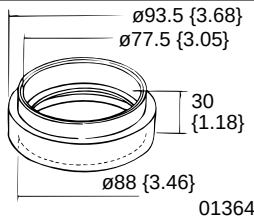
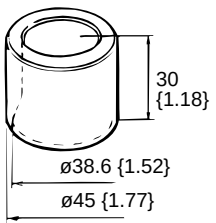
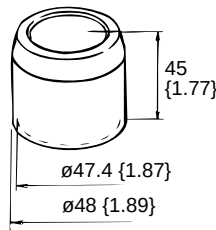
Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
12	Bar 	MC811955 *910-22811	Turning of retainer
	Squeeze tool 	MC811950 *910-21801	Caulking of retainer
27	Inserting tool 	MC813516 *910-21718	Forming of piston seal ring
30	Wrench assembly 	MC811970 *910-10743	Removal and installation of adjusting plug assembly
	Attachment (A : Adapter) (B : Bolt) 	MC811969 *910-10671 (A : *910-23581) (B : *910-23194)	Holding down of valve housing
32	Press-fitting tool 	MC811972 *910-20404	Press-fitting of oil seal

* JIDOSHA KIKI part No.

POWER STEERING BOOSTER

Unit : mm {in.}

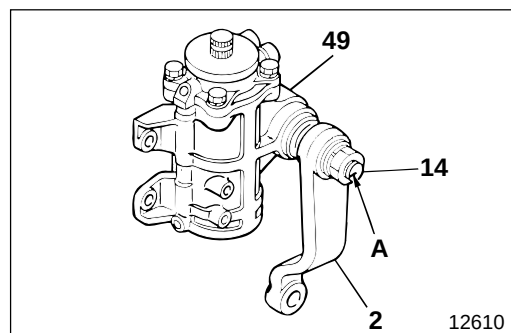
Location	Tool name and shape	Part No.	Application
37 to 39	Tool assembly  01363	MC811968 *910-10611	Assembly of thrust bearing
	Guide assembly  01364	MC090148 *910-23033	
40	Inserting tool  02285	*910-22777	Forming of rotor seal ring
44	Inserting tool  01362	MC811975 *910-22722	Forming of valve housing seal ring

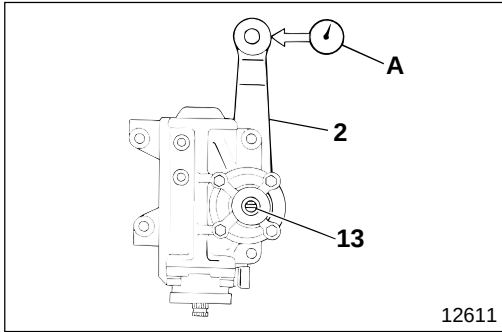
* JIDOSHA KIKI part No.

◆ Service procedure

● Work before disassembly

Move pitman arm 2, and align slit A of the V-groove of sector shaft 14 to the center of body 49 so that the gears are in neutral position.



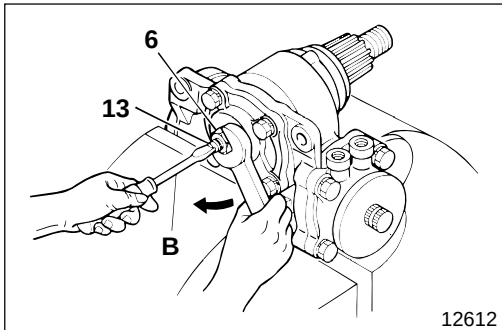


● Adjustment after assembly

Adjustment of backlash

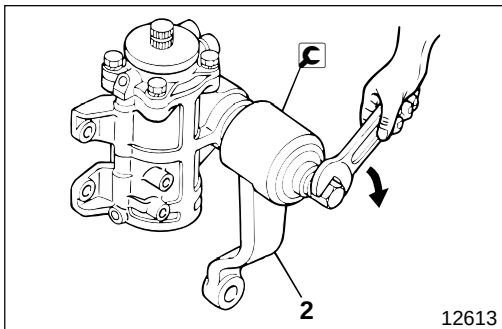
- (Carry out this work with the gears in neutral position.)
Measure play at the end of pitman arm 2 with dial gauge A, and adjust adjusting screw 13 so that the reading meets the standard value.

Measuring load : ± 15 N {3.3 lbf, 1.5 kgf}



Tightening nut

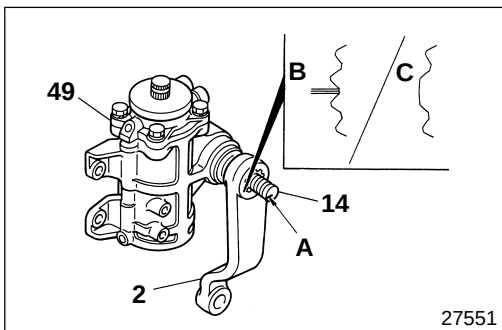
- After adjusting backlash, apply sealer to thread area of adjusting screw 13. Hold it in place with screwdriver B and tighten nut 6 at specified torque.



2 Pitman arm

[Removal]

- ☞ : Pitman arm puller

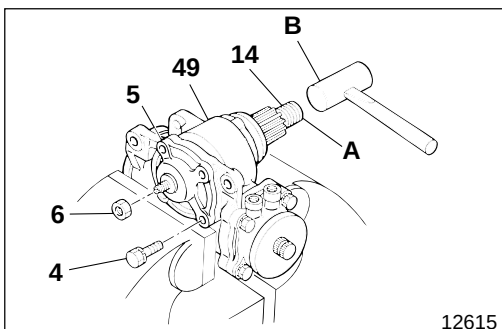


[Installation]

Align slit A of the V-groove of sector shaft 14 to the center of body 49, and align slit B of the V-groove of pitman arm 2 or serration missing part C on the same line.

NOTE

Have pitman arm 2 make a full stroke of the piston to make sure that the piston moves smoothly.



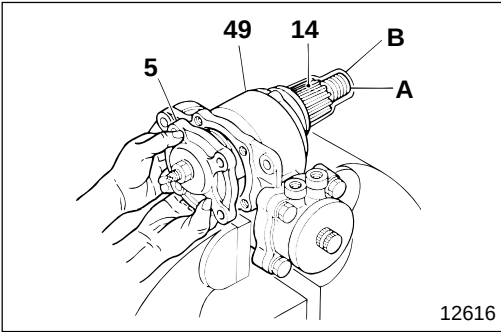
5 Sector shaft assembly and side cover assembly

[Removal]

- Make sure that the piston is in the neutral position (slit A of the V-groove at one end of sector shaft 14 is aligned with the center of body 49).
- Tap the end of sector shaft 14 and pull out sector shaft assembly and side cover assembly 5.

B : Plastic-headed mallet

POWER STEERING BOOSTER

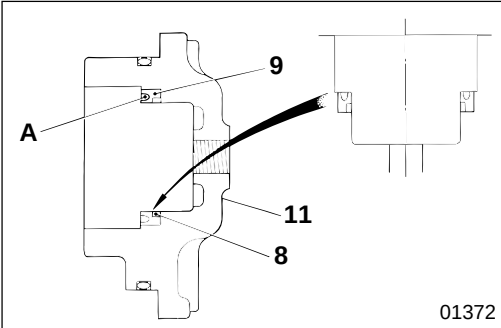


[Installation]

Position sector shaft **14** of sector shaft assembly and side cover assembly **5** so that slit **A** of its V-groove is aligned with the center of body **49**, and the piston gear and sector shaft gear engage at their centers.

CAUTION ⚠

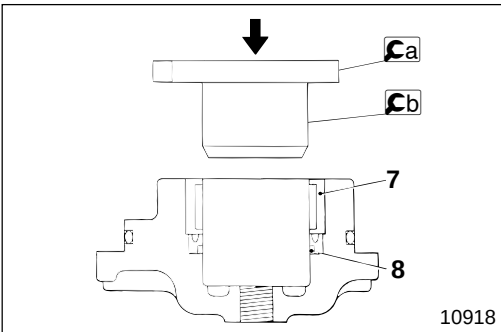
Before installation, apply tape **B** to the Y-packing to prevent it being damaged by the threads of sector shaft **14**.



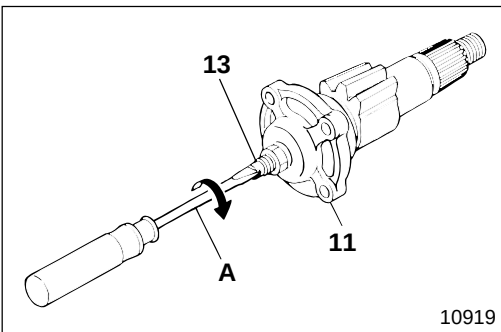
8 9 Backup ring, Y-packing

[Installation]

- Install Y-packing **9** into side cover **11** in the direction as illustrated.
- After installing backup ring **8**, pack groove **A** of Y-packing **9** with grease.



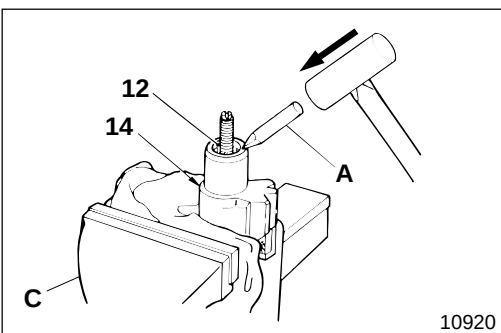
- After installing needle bearing **7** into backup ring **8**, form the bent up part of the backup ring using **Ca** insert tool assembly and **Cb** insert tool.



11 Removal of side cover

Screw in adjusting screw **13** and remove side cover **11**.

A : Screwdriver



12 Retainer

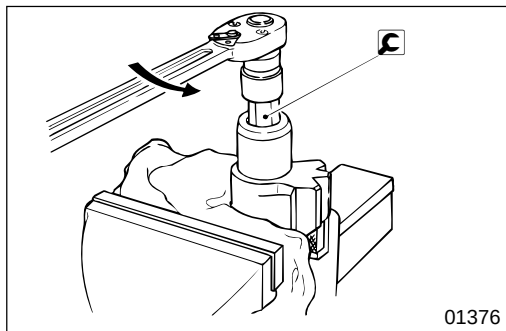
Disassemble sector shaft **14**, as follows, only if it is faulty :

[Removal]

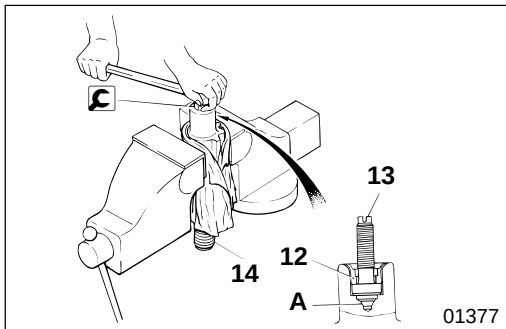
- Pry up (2 points) of retainer **12**.
- A** : Chisel

CAUTION ⚠

Make sure you use a cloth when you grip sector shaft **14** in vise **C** to prevent damage.

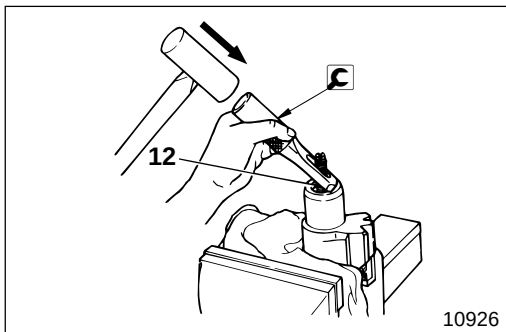


- Remove retainer **12** using bar.

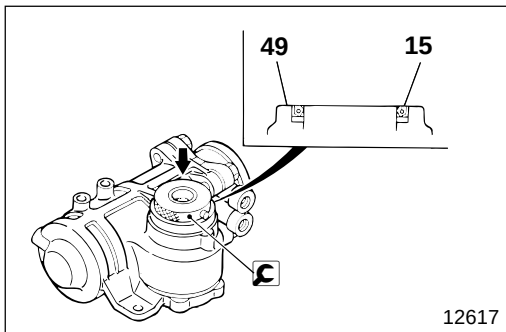


[Installation]

- Pack adjusting screw **13** mounting hole **A** of sector shaft **14** with grease.
- Install adjusting screw **13** into sector shaft **14**.
- Install retainer **12** into sector shaft **14** using bar.
- After installation, slacken off by 180°, retighten at 39 N·m {29 lbf.ft, 4 kgf·m}, then slacken off by 20°.
- Make sure that adjusting screw **13** turns smoothly.

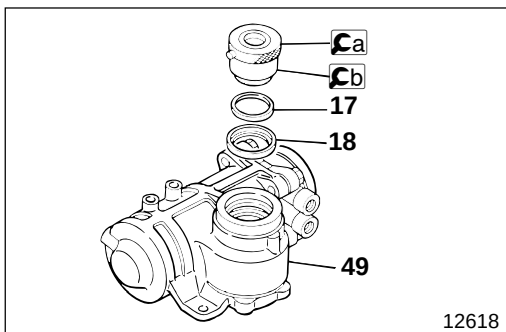


- After installing retainer **12**, caulk the retainer (2 points) using squeeze tool.



15 Installation of oil seal

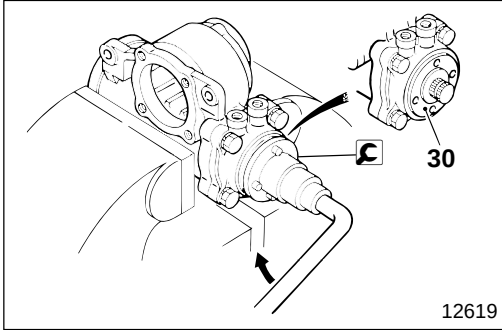
Install oil seal **15** into body **49** in the direction as illustrated.



17 18 Installation of backup ring and Y-packing

- Install Y-packing **18** and backup ring **17** to body **49**.
- Pack the groove of Y-packing **18** with grease.
- Form the shape of backup ring **17** using insert tool assembly and insert tool.

POWER STEERING BOOSTER



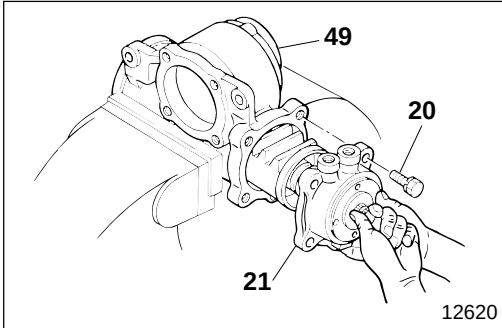
21 Ball screw assembly

[Removal]

- Loosen adjusting plug assembly 30 by approximately 180° using wrench assembly.

CAUTION ⚠

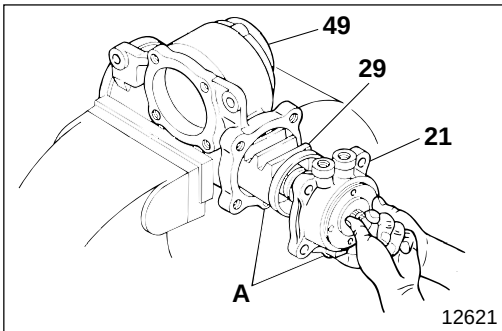
Make sure you only loosen adjusting plug assembly 30, do not undo it completely because the bearing inside the valve housing might spring out.



- Loosen bolt 20 and remove ball screw assembly 21 from body 49.

CAUTION ⚠

- Make sure that the balls of the ball screw do not spring out.
- Be careful not to damage the piston or the interior of body 49.



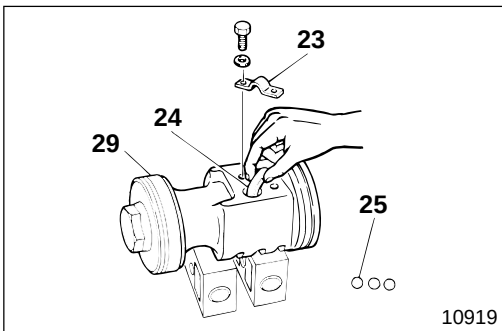
[Installation]

- Install ball screw assembly 21 into body 49, holding piston 29 so it will not turn.

CAUTION ⚠

Be careful not to damage the piston seal ring or the interior of body 49.

- Align oil passage ports A of ball screw assembly 21 and body 49, then tighten.

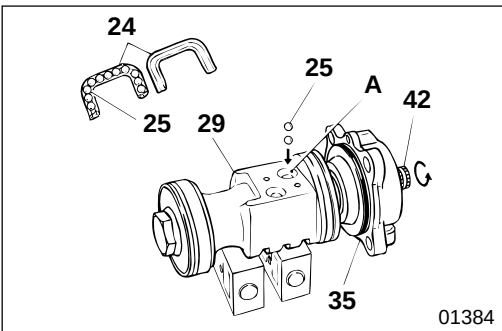


24 25 Ball tube and steel ball

First remove steel balls 25 from piston 29 and place them in the receiving tray, remove ball clip 23, grip ball tube 24 with your fingers and pull it out gently.

CAUTION ⚠

Be careful not to loose any steel balls 25 (×30).

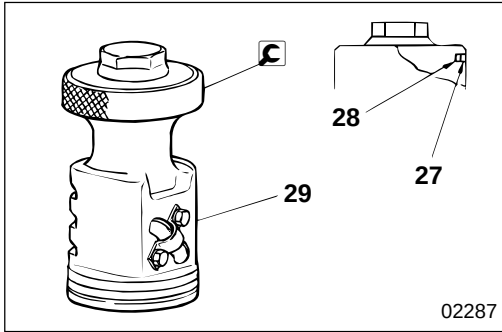


[Installation]

- Pack the interior of ball tube 24 with grease, lay 10 or 11 steel balls 25 in place, then mount the other side of the ball tube.
- Place piston 29 on a level surface, align assembled worm shaft assembly and valve housing assembly 35 and the piston ball race, then drop the steel balls through ball tube hole A while turning stub shaft 42.

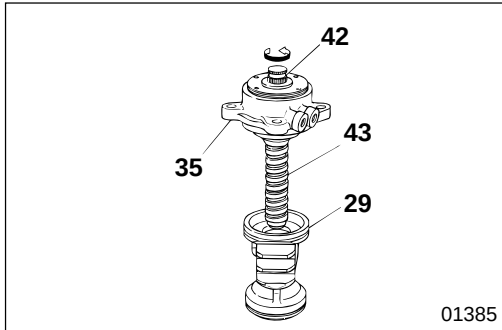
CAUTION ⚠

Make sure that you do not pull out worm shaft assembly and valve housing assembly 35 too far, or steel balls 25 will drop out of the ball race.



27 28 Installation of O-ring and seal-ring

Install O-ring 28 and seal ring 27 in the outside grooves of piston 29, then form the shape of the seal ring with  inserting tool.



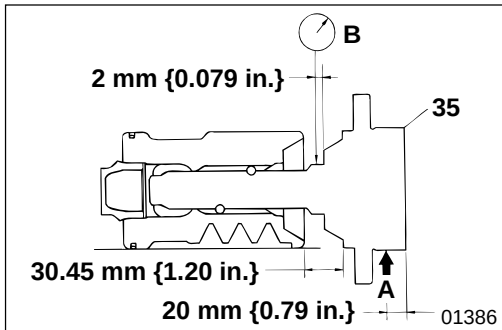
29 Piston

[Removal]

Holding worm shaft assembly and valve housing assembly 35 so that piston 29 is at the bottom, turn stub shaft 42 and remove the piston.

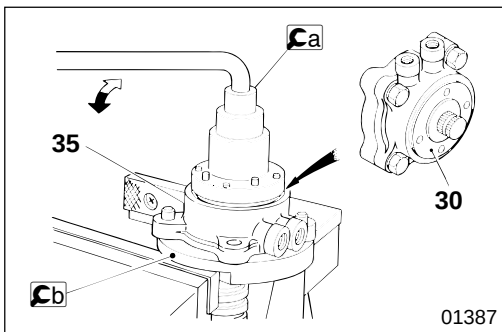
CAUTION

Be careful not to tilt piston 29 when you do this, otherwise steel balls 25 in the races of the piston and worm shaft 43, will drop into the piston.



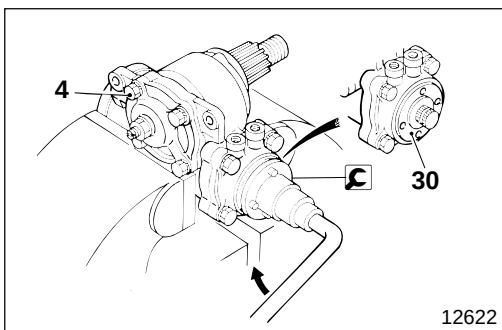
[Inspection]

Measure side play (play in axial direction) B of worm shaft assembly and valve housing assembly 35 when 49 N {11 lbf, 5 kgf} is applied to A as illustrated.



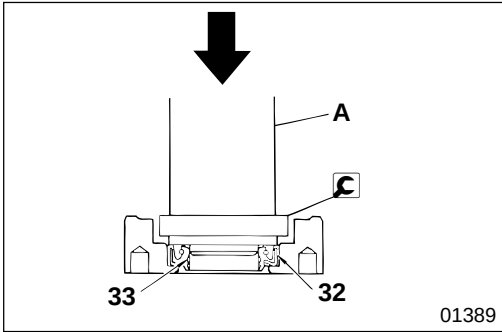
30 Installation of adjusting plug assembly

- After tightening adjusting plug assembly 30 of worm shaft assembly and valve housing assembly 35 at specified torque, slacken off by approximately 180°.



- Tighten bolt 4 at specified torque, then retighten adjusting plug assembly 30 at specified torque using .

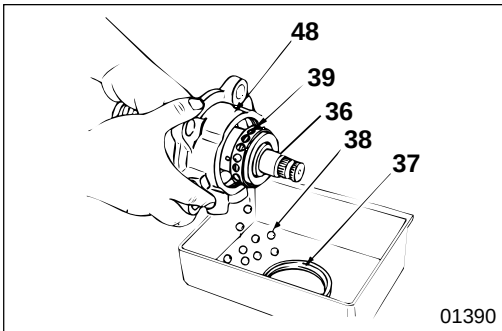
POWER STEERING BOOSTER



32 Installation of oil seal

Install oil seal **32** into adjusting plug **33** in the direction as illustrated.

A : Hand press



36 Worm shaft assembly

[Removal]

Push out worm shaft assembly **36** from valve housing **48** by pushing out the side of the worm shaft assembly where the piston is assembled.

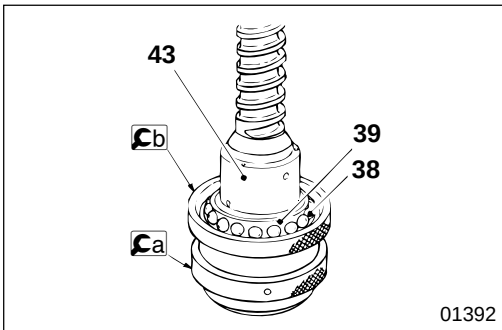
NOTE

Have a tray or box ready to catch side race **37**, steel balls **38**, and bearing cage **39** as these items separate on removal.

[Installation]

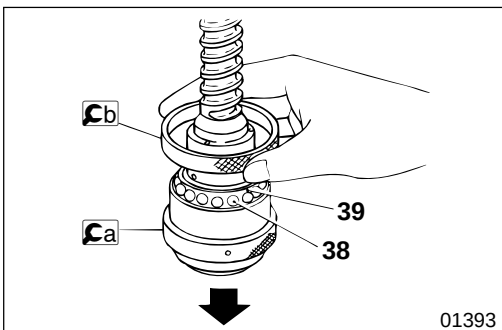
CAUTION ⚠

Be careful that worm shaft assembly **36** ball race does not damage seal ring **44**.

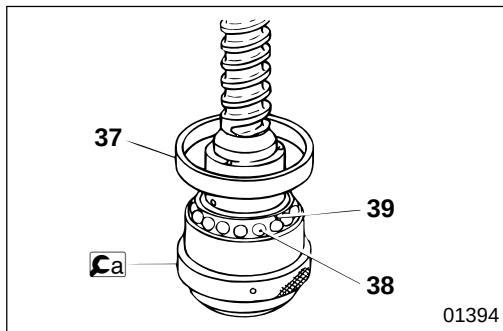


37 to 39 Installation of side race, steel ball, and bearing cage

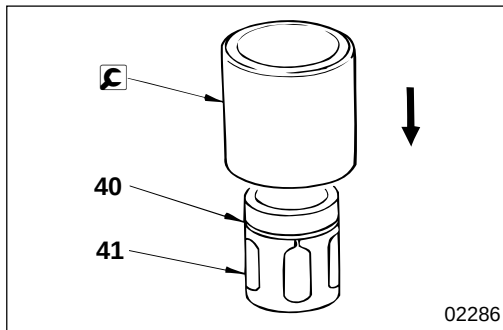
- Install **Cb** guide assembly on **Ca** tool assembly, and insert worm shaft **43** in the direction as illustrated.
- Assemble bearing cage **39** and steel balls **38** on worm shaft **43**.



- Hold down **Cb** with your hand and slide **Ca** downward, so that you can position steel balls **38** as specified.

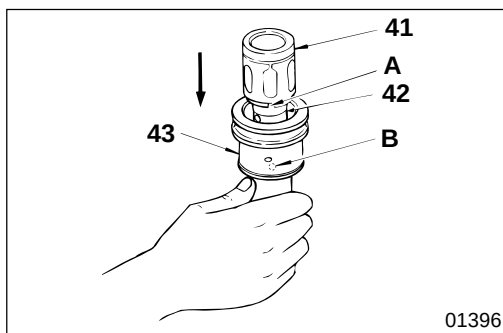


- Install side race **37** on top of steel balls **38** and bearing cage **39**.



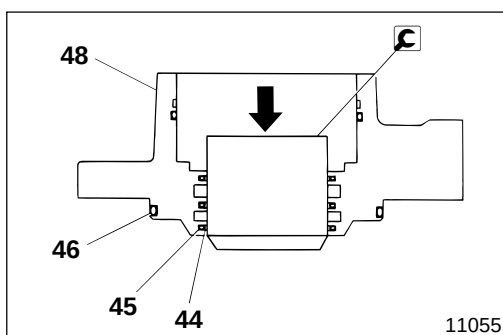
40 Installation of seal ring

- Install seal ring **40** onto rotor **41**.
- Form seal ring **40** using  insert tool.



41 Installation of rotor

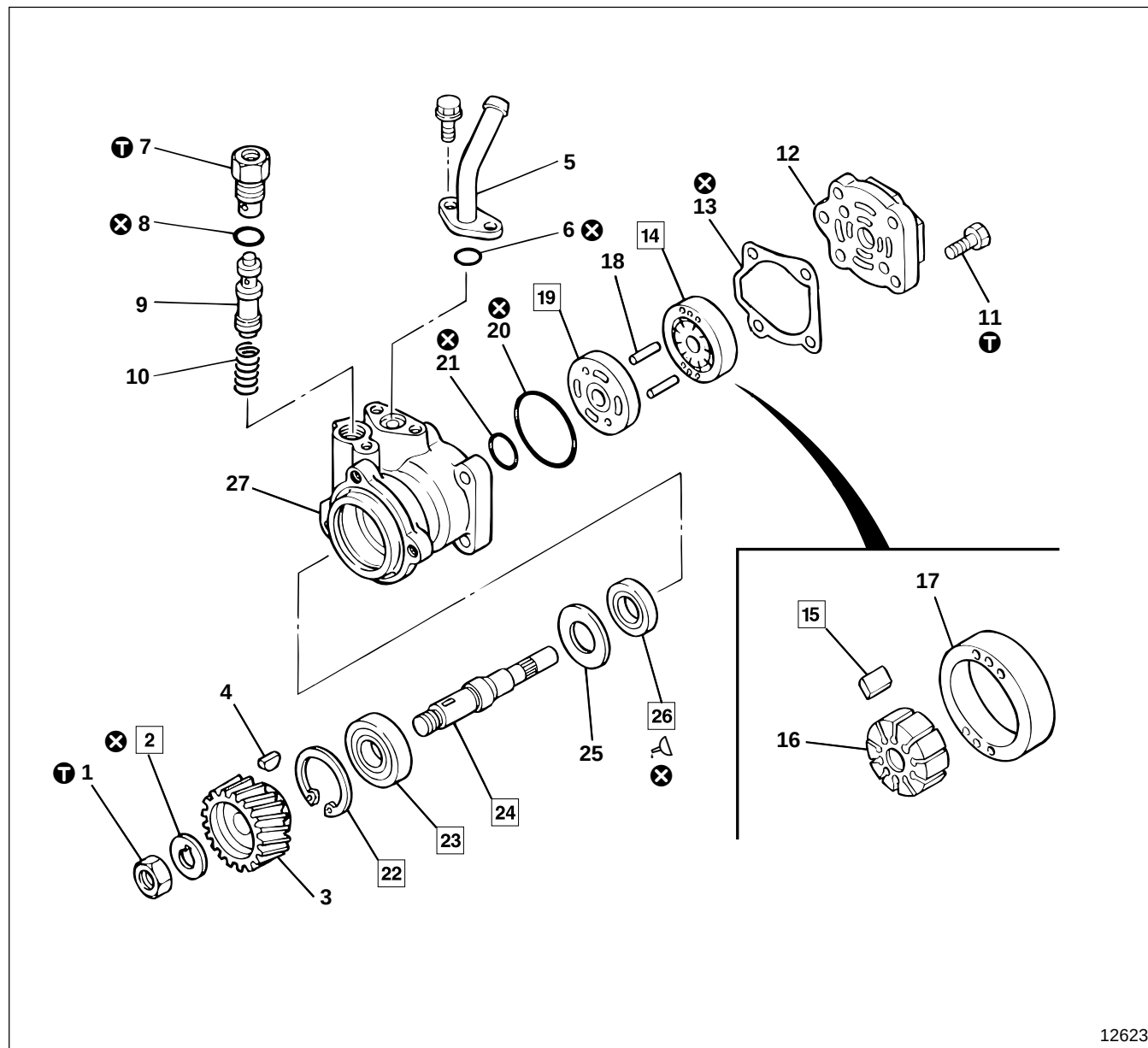
Install rotor **41** between stub shaft **42** and worm shaft **43** so that indent **A** of the rotor fits positioning pin **B** of the worm shaft.



44 to 46 Installation of seal ring and O-ring

- Install seal ring **44** and O-ring **45**, **46** into valve housing **48**.
- Form seal ring **44** using  insert tool.

POWER STEERING OIL PUMP



12623

● Disassembly sequence

- | | | |
|-------------------------------|-----------------------|-------------------|
| 1 Nut | 11 Bolt | 21 O-ring |
| 2 Lock washer | 12 Rear body | 22 Retaining ring |
| 3 Gear | 13 Gasket | 23 Ball bearing |
| 4 Key | 14 Cartridge assembly | 24 Shaft |
| 5 Suction pipe | 15 Vane | 25 Retaining ring |
| 6 O-ring | 16 Rotor | 26 Oil seal |
| 7 Connector | 17 Cam ring | 27 Front body |
| 8 O-ring | 18 Straight pin | |
| 9 Flow control valve assembly | 19 Pressure plate | |
| 10 Flow control spring | 20 O-ring | |
- ⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Repair kit : Seal kit, Cartridge assembly kit

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
9, 27	Clearance between flow control valve assembly and front body	—	0.03 {0.0012}	*1
12, 19	Stepped wear on rear body and pressure plate where it is subject to friction against rotor and vane	—	0.01 {0.00039}	*2

***1** No seizure, wear, or scoring sufficient to catch a finger nail. Replace flow control valve assembly or front body.

***2** No seizure, wear, or scoring sufficient to catch a finger nail. Replace rear body or pressure plate.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Gear mounting)	68.8 to 88.2 {51 to 65, 7 to 9}	—
7	Connector	49 to 58.8 {36 to 43, 5 to 6}	—
11	Bolt (Rear body mounting)	49 to 58.8 {36 to 43, 5 to 6}	—

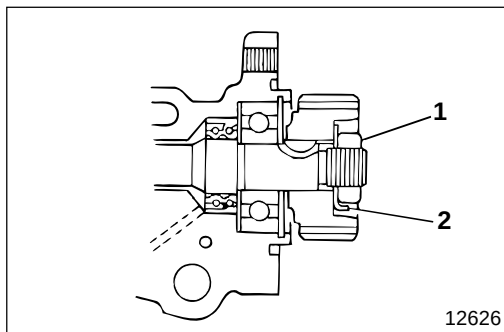
Special tools

Location	Tool name and shape	Part No.	Application
22	Pliers	*910-22570	Removal and installation of retaining ring
23	Press-fitting tool	*910-23061	Removal and installation of ball bearing, and installation of shaft
26	Stick	*910-21632	Driving out of oil seal
	Press-fitting tool	*910-23062	Press-fitting of oil seal

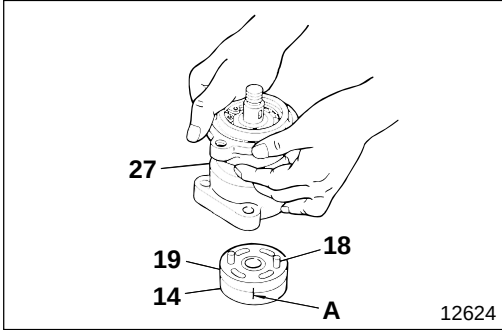
* JIDOSHA KIKI part No.

Service procedure**2 Installation of lock washer**

After installing nut **1**, bend up one lug on the circumference of lock washer **2**.



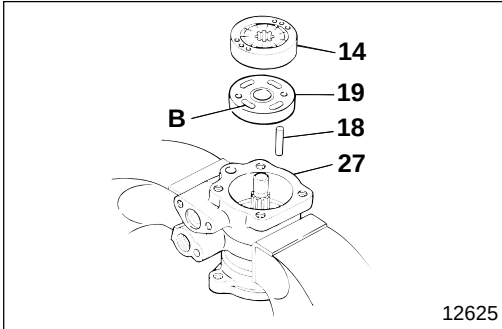
POWER STEERING OIL PUMP



14 Removal and installation of cartridge assembly

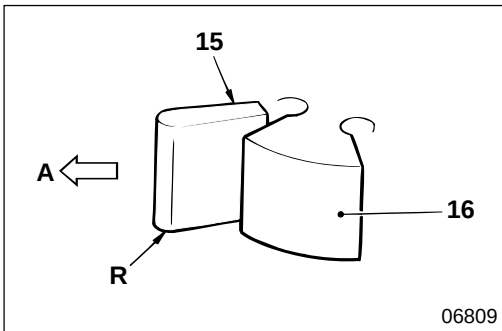
[Removal]

- Remove cartridge assembly **14**, pressure plate **19** and straight pin **18** together from front body **27**.
- Put alignment marks **A** around the outer circumferences of cartridge assembly **14** and pressure plate **19**.



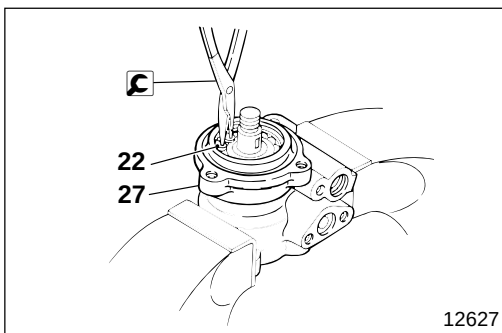
[Installation]

- Install straight pin **18** into front body **27**.
- Install pressure plate **19** onto front body **27**, so that groove **B** of the pressure plate faces the direction as illustrated.
- Align cartridge assembly **14** with straight pin **18**, then install the cartridge assembly.



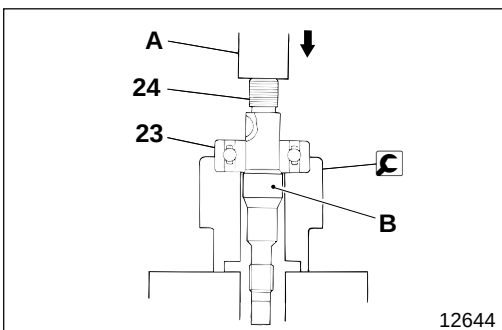
15 Installation of vane

With point **R** of vane **15** facing outside **A**, install it into rotor **16** and make sure that the vane moves smoothly. If it is faulty, replace the cartridge assembly.



22 Removal of retaining ring

Remove retaining ring **22** using pliers.



23 Removal and installation of ball bearing

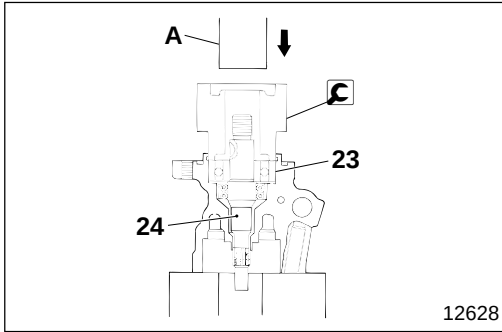
Remove ball bearing **23** from shaft **24** using press-fitting tool.

A : Hand press

For installation, follow the removal sequence in reverse.

CAUTION

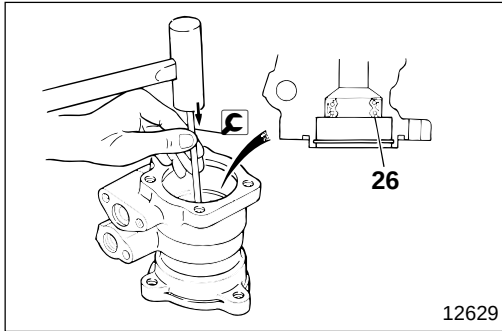
Be careful not to damage oil seal contact surface **B**.



23 24 Installation of ball bearing and shaft

Install ball bearing **23** and shaft **24** using  press-fitting tool.

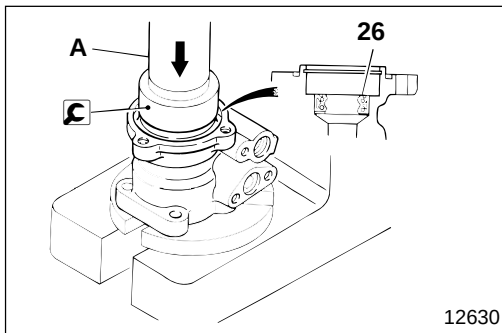
A : Hand press



26 Oil seal

[Removal]

Remove oil seal **26** using  stick.

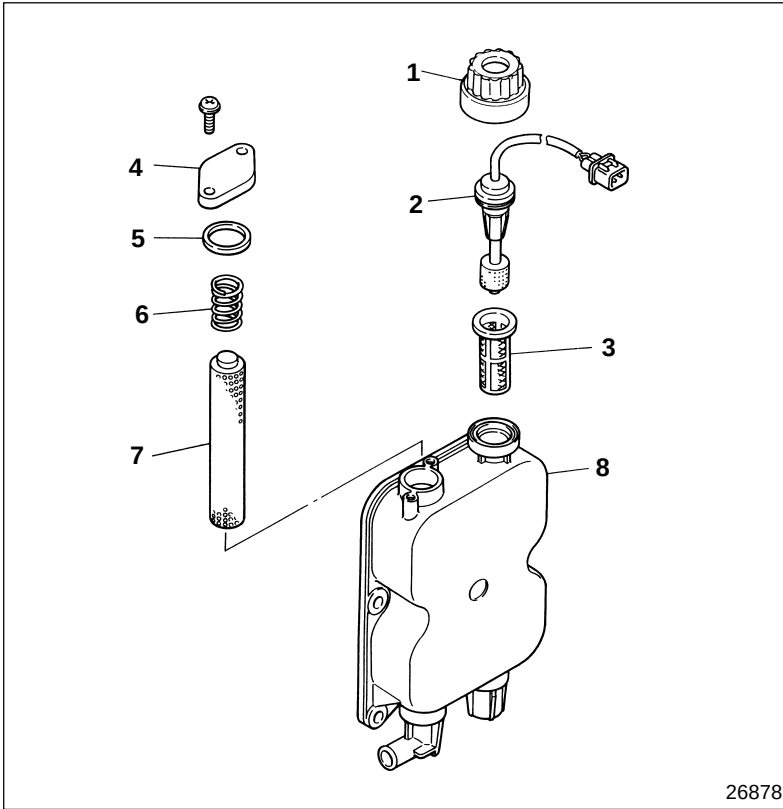


[Installation]

Install oil seal **26** in the direction as illustrated using  press-fitting tool.

A : Hand press

POWER STEERING OIL TANK



● Disassembly sequence

- 1 Cap (with packing)
- 2 Power steering fluid level sensor (with packing)  Gr 54
- 3 Strainer
- 4 Filter cap
- 5 Packing
- 6 Spring
- 7 Return filter
- 8 Tank body assembly

● Assembly sequence

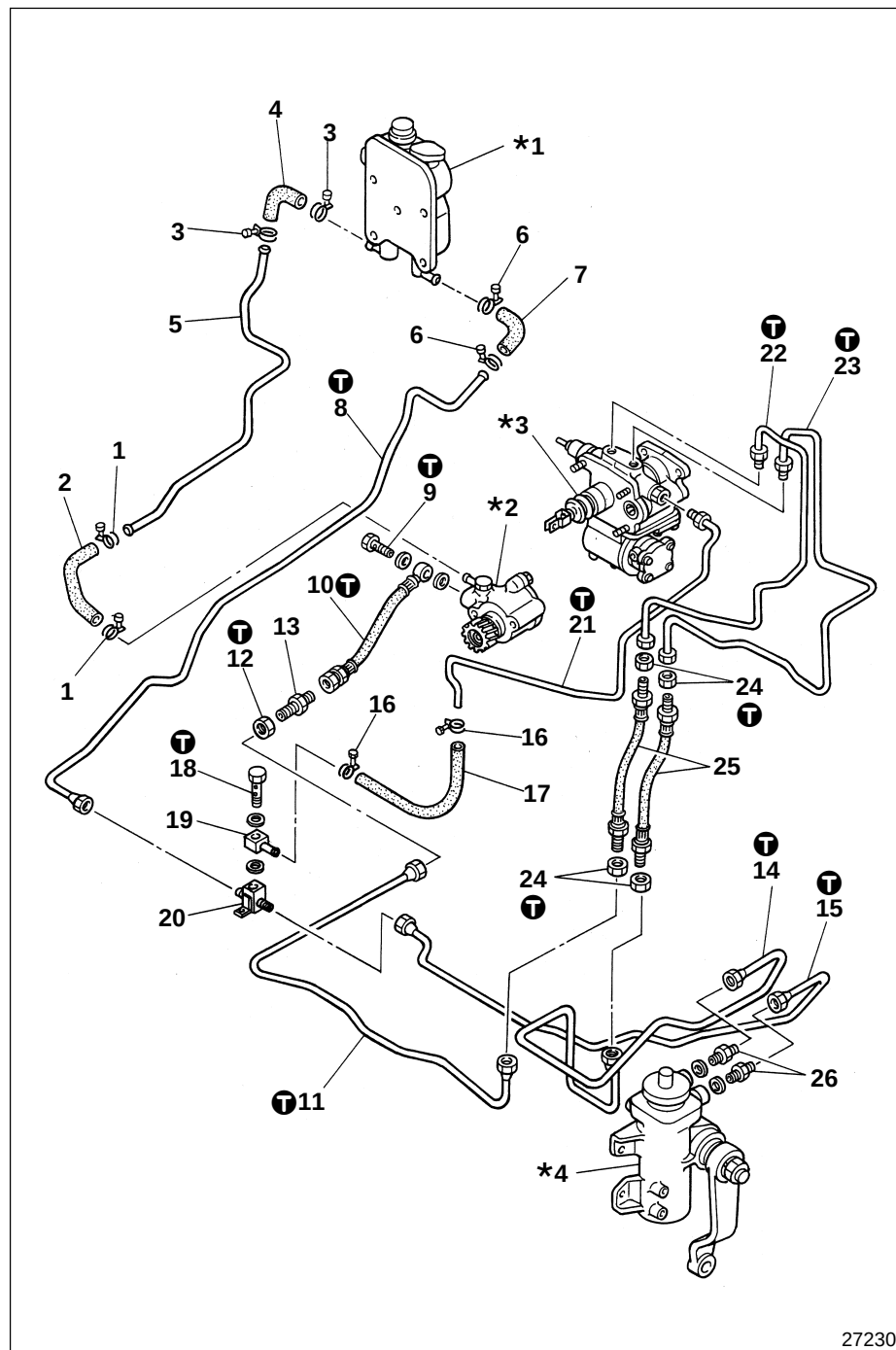
Follow the disassembly sequence in reverse.

CAUTION

Because the oil tank is made of resin make sure you do not hit the tank or let it suffer any other kind of shock.

MEMO

POWER STEERING FLUID LINE



● Removal sequence

- 1 Clamp
- 2 Oil hose
- 3 Clamp
- 4 Oil hose
- 5 Oil pipe
- 6 Clamp
- 7 Oil hose
- 8 Oil pipe
- 9 Bolt
- 10 Oil hose
- 11 Oil pipe
- 12 Nut
- 13 Connector
- 14 Oil pipe
- 15 Oil pipe
- 16 Clamp
- 17 Oil hose
- 18 Bolt
- 19 Connector
- 20 Connector
- 21 Oil pipe
- 22 Oil pipe
- 23 Oil pipe
- 24 Nut
- 25 Oil hose
- 26 Connector

- *1 : Power steering oil tank
 *2 : Power steering oil pump
 *3 : Brake booster
 (Hydraulic booster)
 Gr 35
 *4 : Power steering booster

● Installation sequence

Follow the removal sequence in reverse.

WARNING ⚠

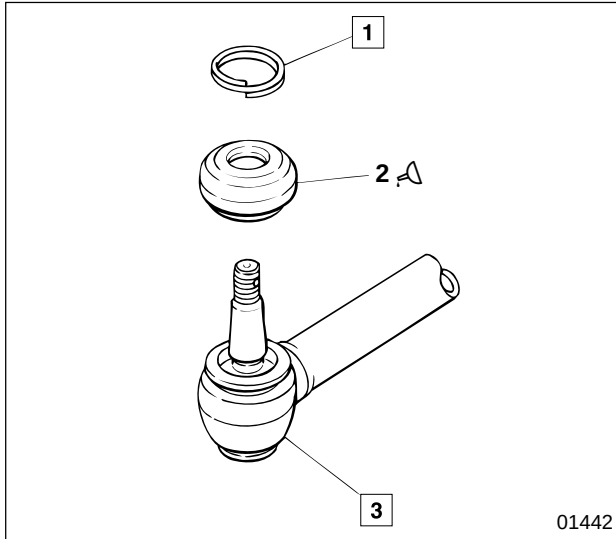
Be sure to bleed air after removing the fluid line, failure to do so would cause the brake and power steering to malfunction. P37-12

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
8,15	Oil pipe (Connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
9	Bolt (Oil hose mounting)	125 {94, 13}	—
10	Oil hose (Connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
11	Oil pipe (Oil hose and connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
12, 24	Nut	66.69±12.75 {49±9.4, 6.8±1.3}	—
14	Oil pipe (Oil hose and connector connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
18	Bolt (Connector mounting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
21	Oil pipe (Brake booster connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—
22, 23	Oil pipe (Oil hose and brake booster connecting)	66.69±12.75 {49±9.4, 6.8±1.3}	—

DRAG LINK



● Disassembly sequence

- 1 Clip
- 2 Dust cover
- 3 Drag link

NOTE

- Do not remove clip 1 or dust cover 2 unless they are faulty.
- Do not disassemble drag link 3 because it is a unit construction.

● Assembly sequence

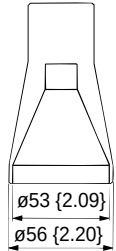
Follow the disassembly sequence in reverse.

Lubricant

Location	Points of application	Specified Lubricant	Quantity
2	Lip area of dust cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
	Pack interior of dust cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	11 g {0.39 oz}

Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Clip guide 	MH061831	Installation of clip

◆ Service procedure

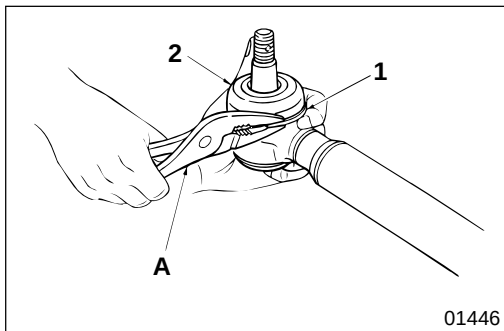
1 Clip

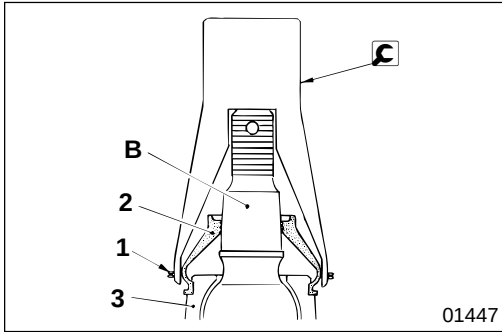
[Removal]

A : Long nose pliers

CAUTION ⚠

- Be careful not to damage clip 1 or dust cover 2 when you remove the clip.
- If clip 1 is deformed, do not reuse it.



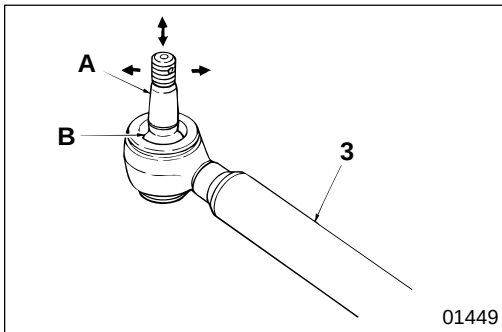


[Installation]

- Position the assembly so ball stud **B** is vertical.
- Place  clip guide on drag link **3**.
- Install clip **1** into the groove of dust cover **2**.

CAUTION

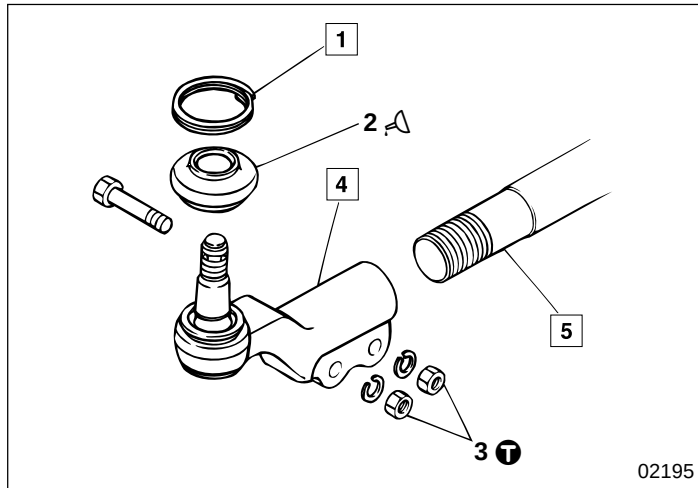
- Be careful that  clip guide end does not dig into dust cover **2**.
- Be especially careful that clip **1** end does not damage dust cover **2**.



3 Inspection of drag link

Move ball stud area **A** of drag link **3** vertically and horizontally to make sure that there is no play. Also, check that ball section **B** moves evenly. If any fault is found, replace the tie rod assembly.

TIE ROD ASSEMBLY



● Disassembly sequence

- 1 Clip
- 2 Dust cover
- 3 Nut
- 4 Tie rod end assembly
- 5 Tie rod

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Do not attempt to disassemble tie rod end assembly 4 because it is a unit construction.

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
5	Bend of tie rod	1 {0.039} or less	1 {0.039}	Replace

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

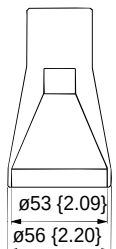
Location	Parts to be tightened	Tightening torque	Remarks
3	Nut (Tie rod end assembly fastening)	78 {58, 8}	Wet

L Lubricant

Location	Points of application	Specified lubricant	Quantity
2	Lip area of dust seal	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	As required
	Pack into dust cover	Molybdenum disulfide grease [NLGI No.2 (Li soap)]	11 g {0.39 oz}

C Special tools

Unit : mm {in.}

Location	Tool name and shape	Part No.	Application
1	Clip guide  01443	MH061831	Installation of clip

◆ Service procedure

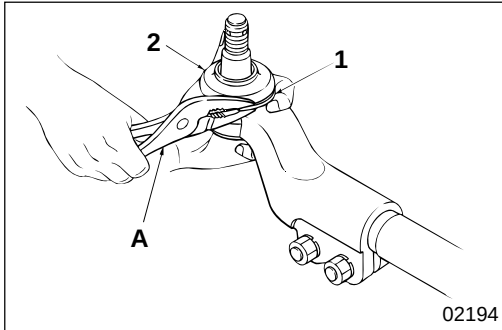
1 Clip

[Removal]

A : Long nose pliers

CAUTION ⚠

- Be careful not to damage clip 1 or dust cover 2 when you remove the clip.
- If clip 1 is deformed, do not reuse it.

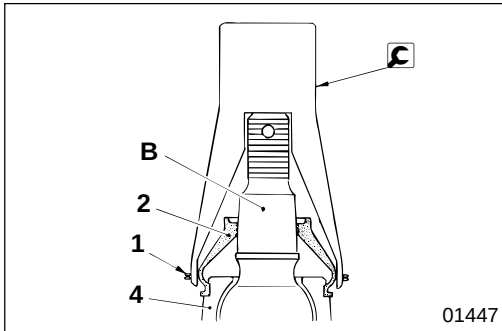


[Installation]

- Position so ball stud B is vertical.
- Place clip guide on tie rod end assembly 4.
- Install clip 1 into the groove of dust cover 2.

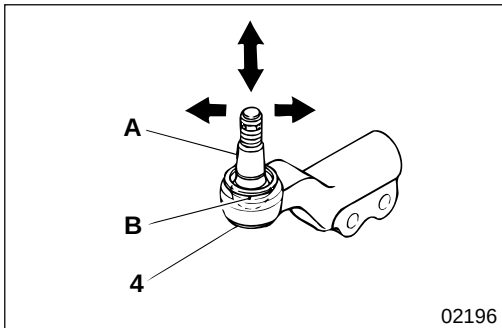
CAUTION ⚠

- Be careful that clip guide end does not dig into dust cover 2.
- Be especially careful that clip 1 end does not damage dust cover 2.



4 Inspection of tie rod end assembly

Move ball stud area A of tie rod end assembly 4 vertically and horizontally to make sure that there is no play. Also, check that ball section B moves evenly. If any fault is found, replace the tie rod end assembly.



5 Bend of tie rod

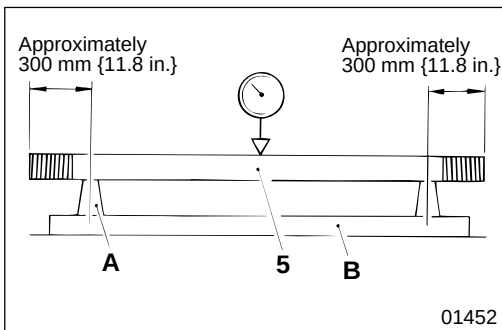
Measure the bend of tie rod 5 at the center point. If the measured value exceeds the limit, correct or replace the tie rod.

NOTE

To measure the deflection of tie rod 5, turn it one full rotation and read the dial gauge indicator. The deflection is one half of the indicated value.

A : V-block

B : Surface plate





FH

Service Manual

Group 41

Frame

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

GROUP 41 FRAME

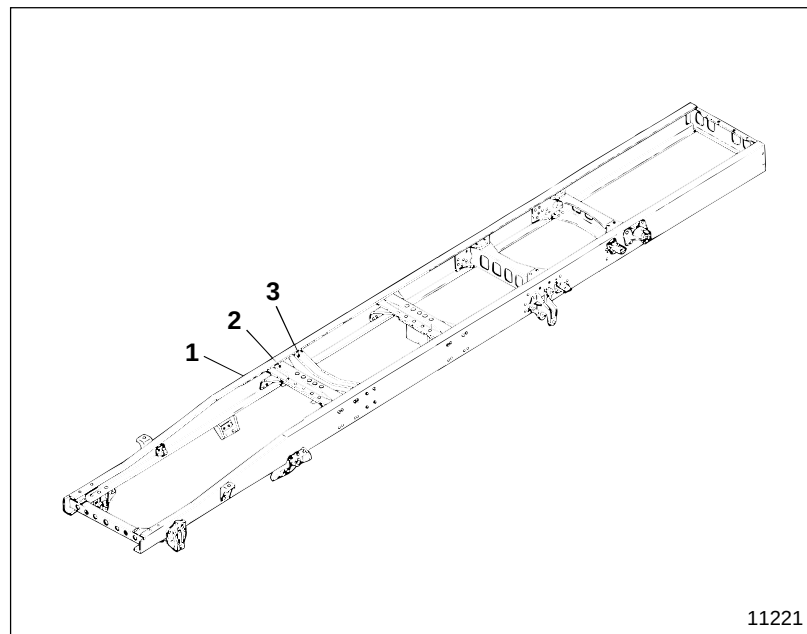
SPECIFICATIONS	2
STRUCTURE AND OPERATION	2
INSPECTION AND REPAIR OF FRAMES	2

SPECIFICATIONS/STRUCTURE AND OPERATION/INSPECTION AND REPAIR OF FRAMES

SPECIFICATIONS

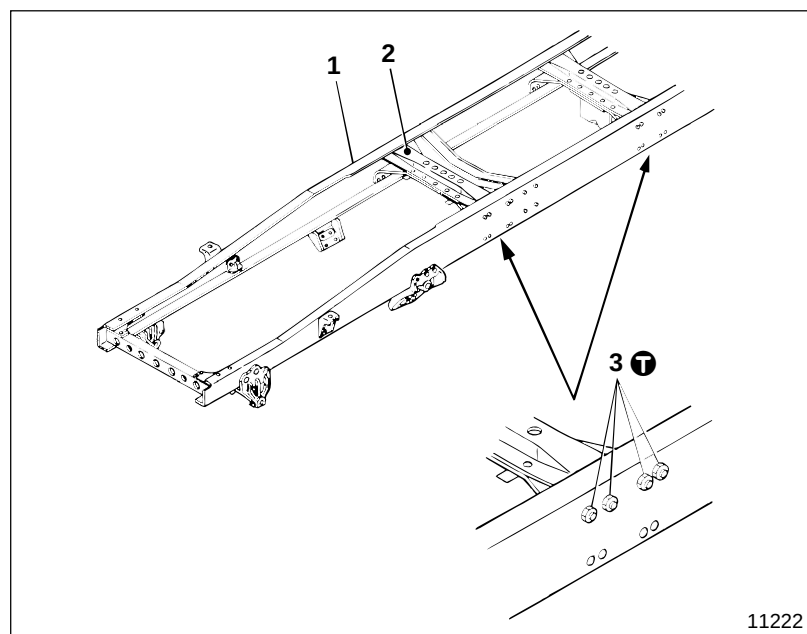
Item	Specifications
Frame type	Ladder type
Cross section configuration of side rail	☐ shape channel section

STRUCTURE AND OPERATION



- 1 Side rail
- 2 Cross member
- 3 Center bearing bracket

INSPECTION AND REPAIR OF FRAMES



- 1 Side rail
- 2 Cross member
- 3 Nut

T Tightening torque

Unit : N·m {lb.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
3	Nut (Cross member to side rail side wall mounting)	85 to 110 {61 to 80, 8.5 to 11}	—

◆ Service procedure**● Cleaning of frame**

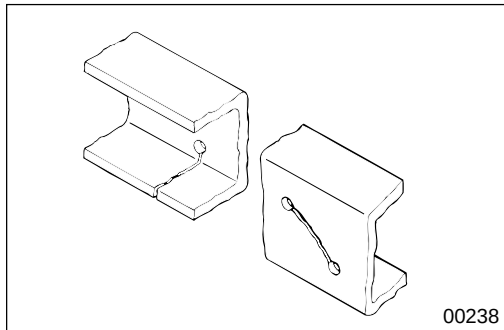
Carefully remove mud, grease, rust, etc. that is stuck to the outer and inner surfaces of the frame.

● Inspection for frame deformation

If any fault such as deformation is found, repair the frame.

● Inspection for cracks in frame

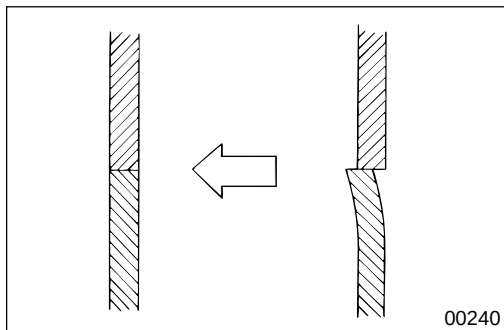
- Remove paint from any areas that are seemingly faulty and carefully inspect.
 - If visual inspection is difficult, inspect using color contrast penetrant examination or other methods.
- If a crack is found, repair as follows.

**● Repair of crack in frame**

- With the vehicle unloaded, level the frame.
- Drill a hole, about twice the thickness of the frame, 10 mm {0.39 in.} from the end of the crack.

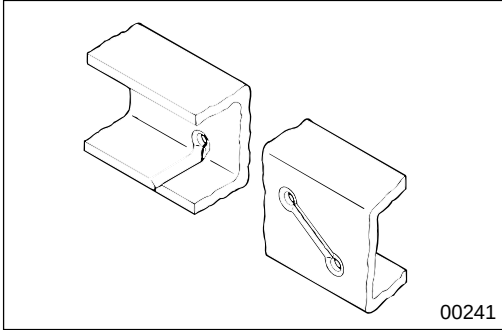
NOTE

If a crack is found inside the frame, drill holes at both ends of the crack.



- If the edges of the crack are not flush, make them flush with each other.

INSPECTION AND REPAIR OF FRAMES



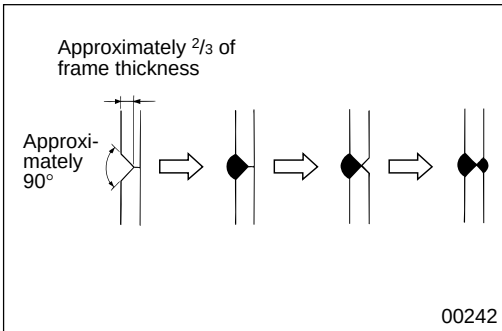
- Using a grinder, etc., grind a 90° V-section channel, two-thirds of the frame thickness, then weld.

WARNING ⚠

You must cover any inflammable materials, such as pipelines, wiring harnesses, rubber parts, and the fuel tank, that are near the welding site.

CAUTION ⚠

- Do not use gas welding because the high temperature produced alters the material properties and weakens the welded area. Be sure, therefore, to use electric welding.
- Be sure to remove the negative terminal of the battery, then ground the welder near the area to be welded to prevent reversed flow of current from the welder which might burn out electrical components.
- Be sure to protect mountings such as main sills that can be damaged by heat, by using heat insulators, etc.



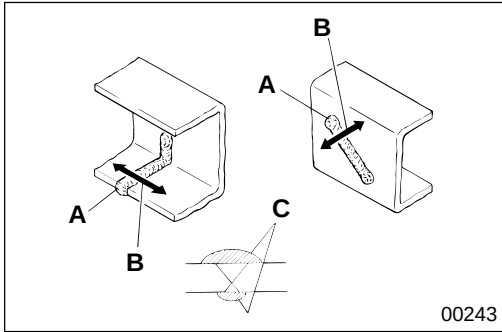
NOTE

- Use low-hydrogen type coated CO₂ and arc welding electrodes for welding to prevent harmful defects such as undercutting, blow holes, etc.
- Preheat the area to be welded to approximately 50 to 350°C {122 to 662°F} before welding when the workshop temperature is below 0°C {32°F}.

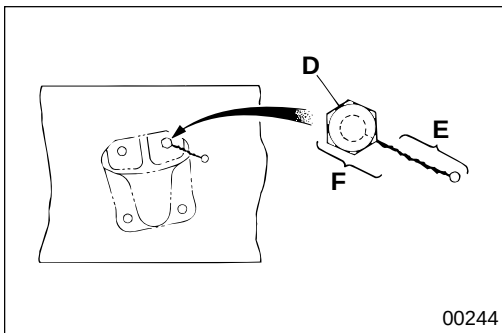
- Next, grind a V-section channel, as described above, on the opposite side of the weld and weld. At the same time, fill the holes at both ends of the crack by welding.

NOTE

In cold districts, heat the welded area to approximately 200°C {392°F} after welding.

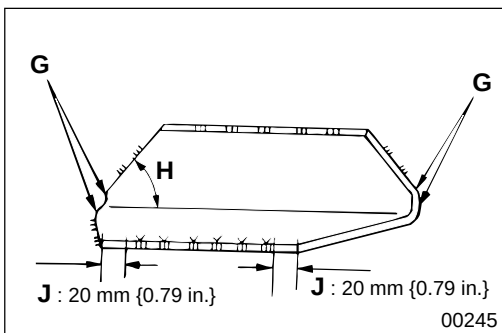


- After welding, grind bead **A** at right angles **B** to remove shaded area **C** as illustrated and grind the area flat.
- Finish the surface so that the frame thickness is identical to the original thickness.



[Repairing cracks caused by rivets or bolt holes]

- To make the edges of the holes flush at the cracked area, temporarily tighten bolt **D** in the hole.
- Weld cracked point **E** at least 20 mm {0.79 in.} from the center of the bolt.
For welding method refer to the above-mentioned procedures for repairing cracks. P41-3
- After removing the bolt and making the edges flush, weld remaining area **F** and fill the hole.
- After drilling a hole in the filled area, install a rivet or bolt.

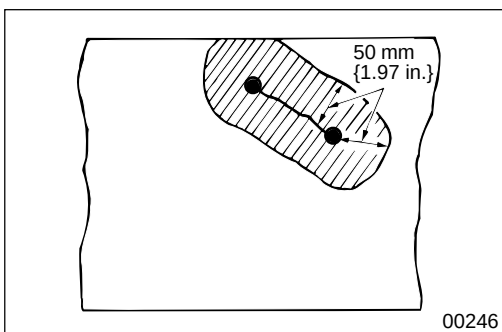


[Repairing using reinforcement plate]

- To prevent concentrated stress being produced at ends **G** of the reinforcement plate, weld the plate with angle **H** at both ends opened 30° or less.
Do not weld area **J**.
- The reinforcement plate must have enough strength for the cracked area.

NOTE

- **Thickness of reinforcement plate : same as frame thickness**
- **Reinforcement plate material : HTP540 (high tensile strength steel) or equivalent strength.**

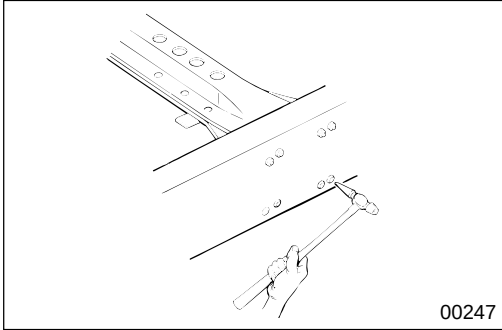


- After welding, heat the shaded area to 600 to 700°C {1112 to 1292°F}.

CAUTION ⚠

Be sure to protect mountings such as main sills that can be damaged by heat, by using heat insulators, etc.

INSPECTION AND REPAIR OF FRAMES

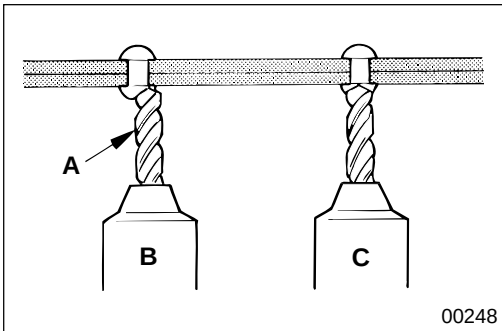


● Inspection for loose rivets

- Gently tap the rivet head using an inspection hammer and judge the condition by checking the vibration using the tip of your finger, or by listening to the sound.
- Rust between rivet and frame indicates that the rivet is loose.

CAUTION

Be sure to replace loose rivets because they can break or cause cracking of the frame in the area around the rivet hole, causing accidents.



● Repair of rivet

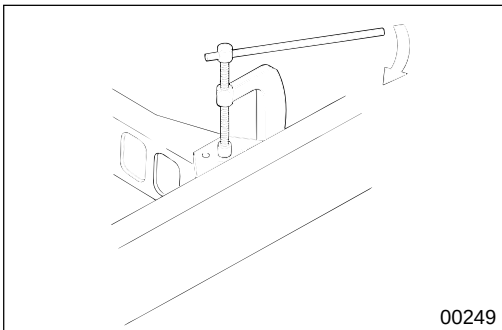
- When removing rivets, use a center punch to make an indent in the center of the rivet head; then, drill out using drill A or grind.

B : Incorrect

C : Correct

CAUTION

Make sure that you do not damage the rivet hole.



- When rivetting, first clamp both plates tightly near the rivet hole using a clamp to eliminate gaps between plates.

- Using a rivetting machine, insert the rivet (cold rivet).
- If rivetting is impossible, ream the rivet hole, drive in a reamer bolt, fully tightening the nut, then weld it in place.
A flange bolt and flange nut should be used for the reamer bolt and nut.

● Inspection for loose bolts and nuts

- Inspect the mounting bolts of the cross member and the helper stopper for looseness. Loosened bolts should be tightened at specified torque.  P41-2,  Gr 34

NOTE

Tighten the nut side when working on the helper stopper mounting bolts.



FH

Service Manual

Group 42

Cab

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

GROUP 42 CAB

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CAB EXTERIOR FITTING	40
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CAB INTERIOR FITTING	49
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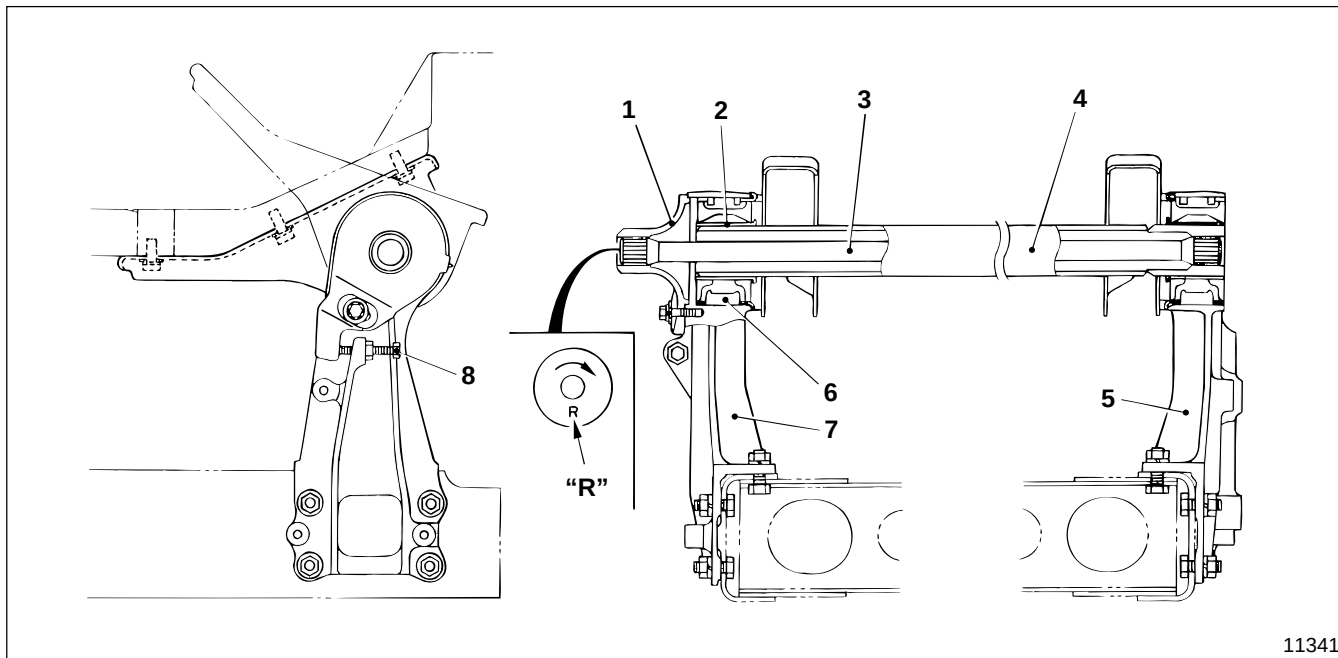
SPECIFICATIONS

Item		Specifications
Cab assembly	Type	Cab over type (Forward control type)
	Mass kg {lb}	Approximately 390 {860}
Cab tilt	Type	Torsion bar type
	Tilt angle	45°
Cab mounting Type		Fixed type
Windshield		Laminated glass
Glass other than windshield		Tempered glass
Door glass opening and closing mechanism		Manual control type (Cable driven)

STRUCTURE AND OPERATION

42

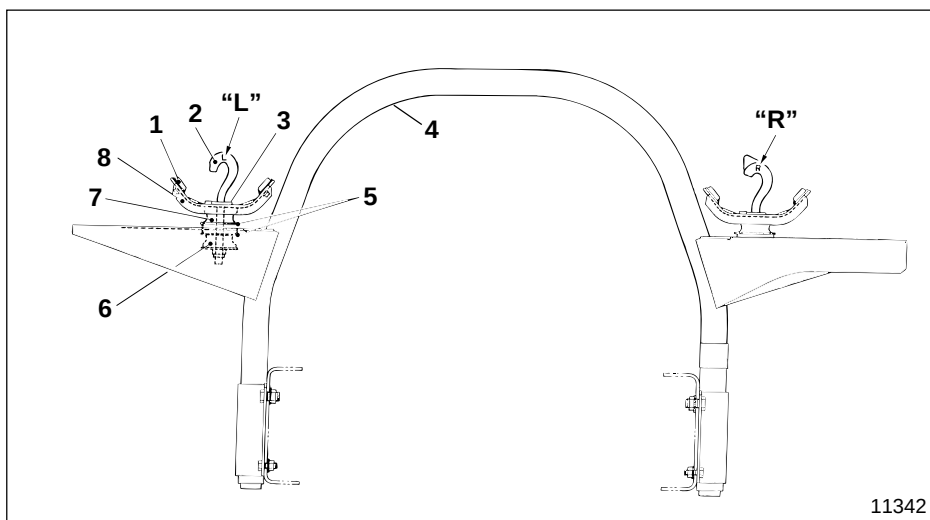
Front Cab Mounting



- | | |
|-------------------------------------|----------------------------------|
| 1 Anchor lever | 6 Front rubber assembly |
| 2 Bushing | 7 Front cab mounting bracket, RH |
| 3 Torsion bar | 8 Adjusting bolt |
| 4 Front floor cross member assembly | |
| 5 Front cab mounting bracket, LH | |

Since torsion bar **3** has torsional direction, it is marked “R” on its right end to indicate the torsional direction, preventing mistaken installation.

Rear Cab Mounting

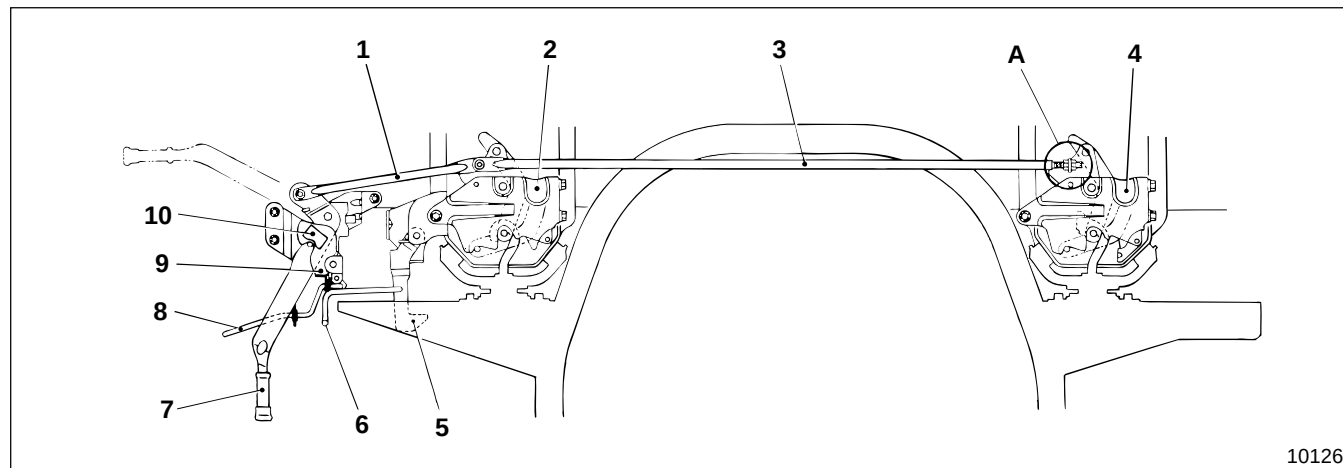


- | |
|----------------------|
| 1 Side rubber |
| 2 Anchor hook |
| 3 Spacer |
| 4 Rear mounting post |
| 5 Metal fixture |
| 6 Lower rubber |
| 7 Upper rubber |
| 8 Cab hold bracket |

- Anchor hooks **2** are marked “L” and “R” to identify left and right.
- Between anchor hook **2** and cab hold bracket **8** is spacer **3**. By increasing or decreasing the number of spacers, the cab tilt operating force can be adjusted.

STRUCTURE AND OPERATION

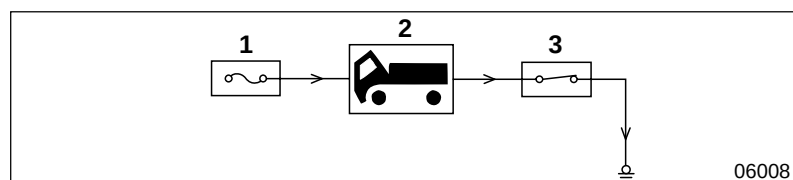
Cab Tilt Link



- | | | |
|---------------------|--------------------|--------------------------------|
| 1 Lock handle rod | 5 L-lever | 9 Lock latch |
| 2 Link assembly, LH | 6 L-lever rod | 10 Cab tilt lock switch |
| 3 Center rod | 7 Lock handle | A : Center rod adjusting point |
| 4 Link assembly, RH | 8 Lock latch lever | |

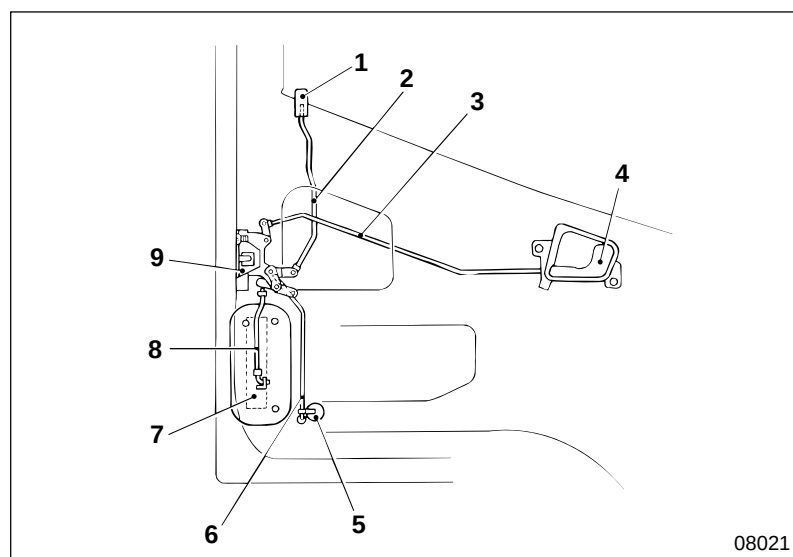
- The length of center rod **3** can be adjusted at mounting part **A** (center rod adjusting point) of link assembly RH **4**.
- Cab tilt lock switch **10**, mounted on lock latch **9**, detects whether lock handle **7** is locked securely.

Cab Tilt Warning Electric Circuit



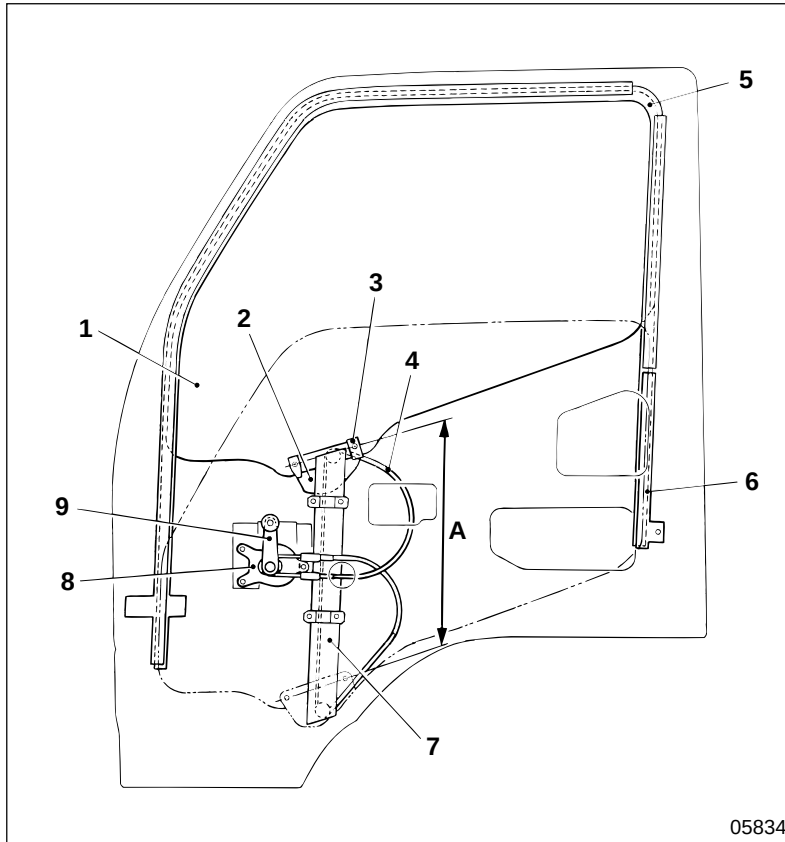
- | |
|-------------------------|
| 1 Fuse box |
| 2 Cab tilt warning lamp |
| 3 Cab tilt lock switch |

Door Locking System



- | |
|--------------------------|
| 1 Door lock knob |
| 2 Door lock rod |
| 3 Door opening rod |
| 4 Inside handle |
| 5 Door lock cylinder |
| 6 Door lock cylinder rod |
| 7 Outside handle |
| 8 Door opening rod |
| 9 Door lock latch |

Door Glass Opening System



- 1 Door glass
- 2 Carrier plate
- 3 Glass holder
- 4 Cable
- 5 Run channel
- 6 Lower sash
- 7 Rail
- 8 Regulator
- 9 Regulator handle

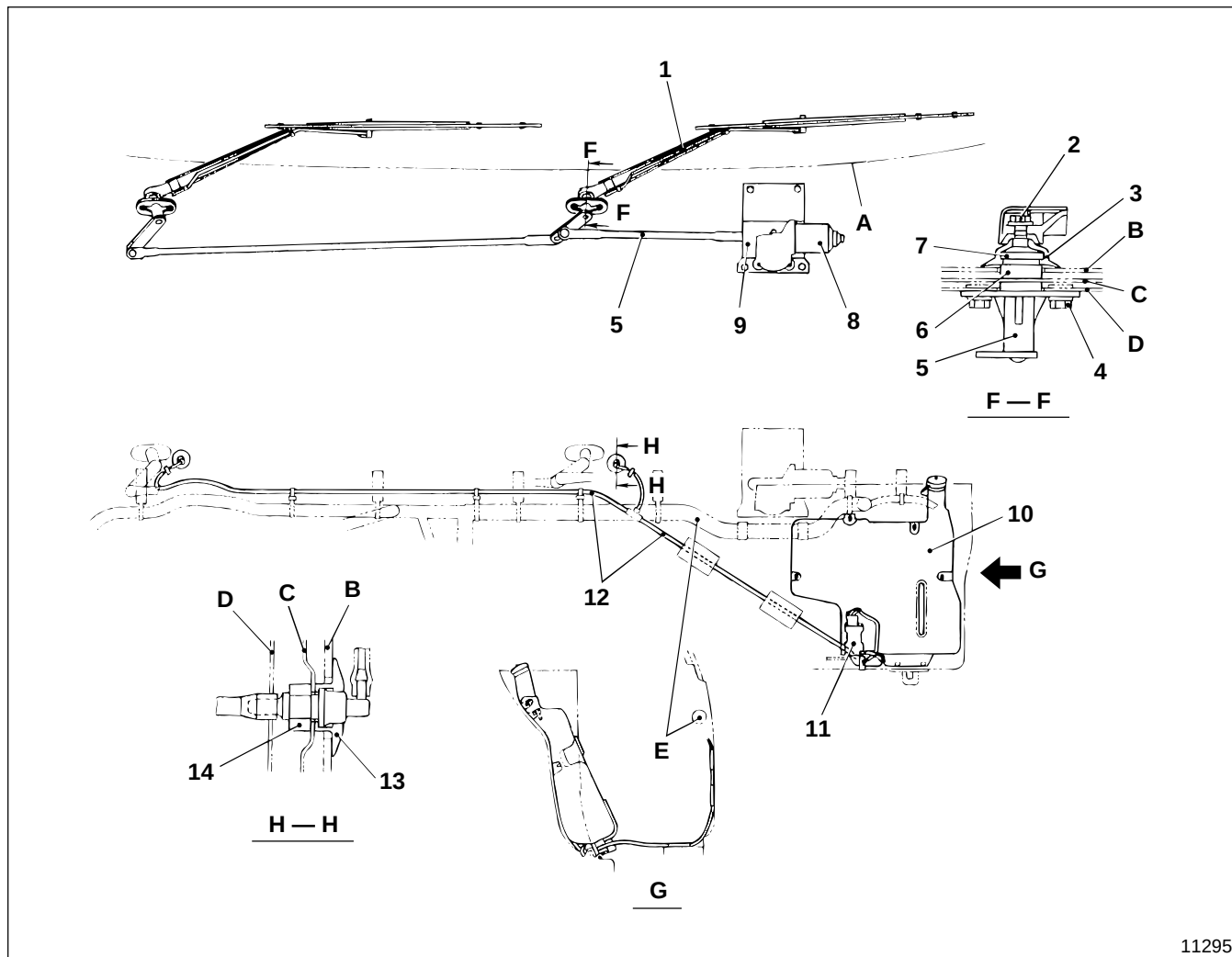
A : Carrier plate moving range

- Both ends of cable 4 are secured to carrier plate 2, and regulator 8 is installed in the middle of the cable.
- Regulator 8 winds cable 4, and moves carrier plate 2 vertically to open and close door glass 1.
- Carrier plate 2 and door glass 1 are secured by glass holder 3.
- Regulator handle 9 turns regulator 8.
- To allow removal and installation of door glass 1, lower sash 6 is removable.

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STRUCTURE AND OPERATION

Wiper and Washer



11295

- 1 Wiper arm and blade assembly
- 2 Nut
- 3 Pivot cap
- 4 Nut
- 5 Wiper link assembly
- 6 Packing washer
- 7 Nut
- 8 Wiper motor
- 9 Wiper motor bracket
- 10 Washer tank

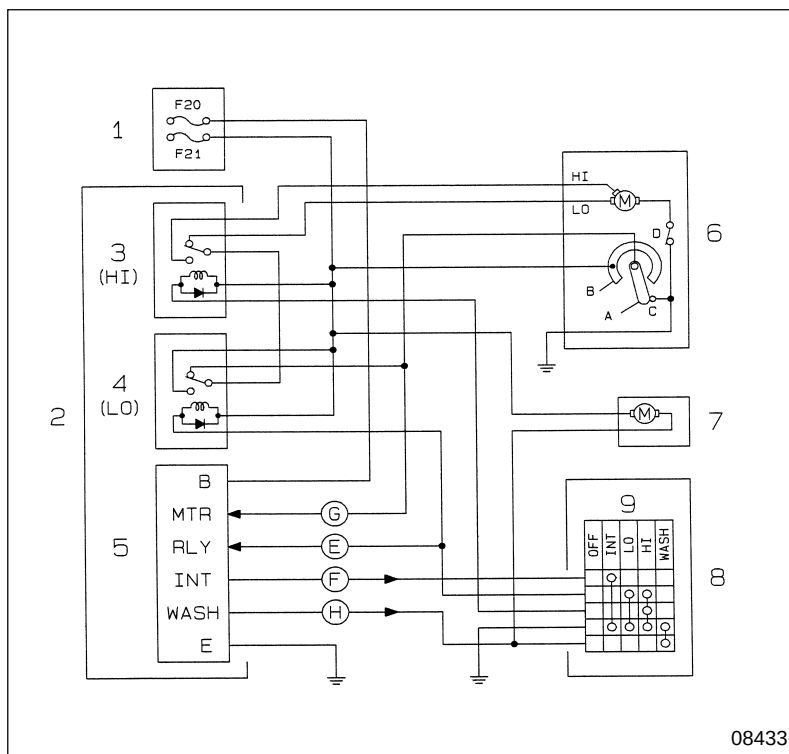
- 11 Washer motor
- 12 Washer hose
- 13 Hose joint
- 14 Nut

- A : Weatherstrip ends
- B : Front garnish
- C : Front panel
- D : Front rail
- E : Cab harness

inside the cab.

The viewpoint of this illustration is from

Wiper and Washer Electric Circuit

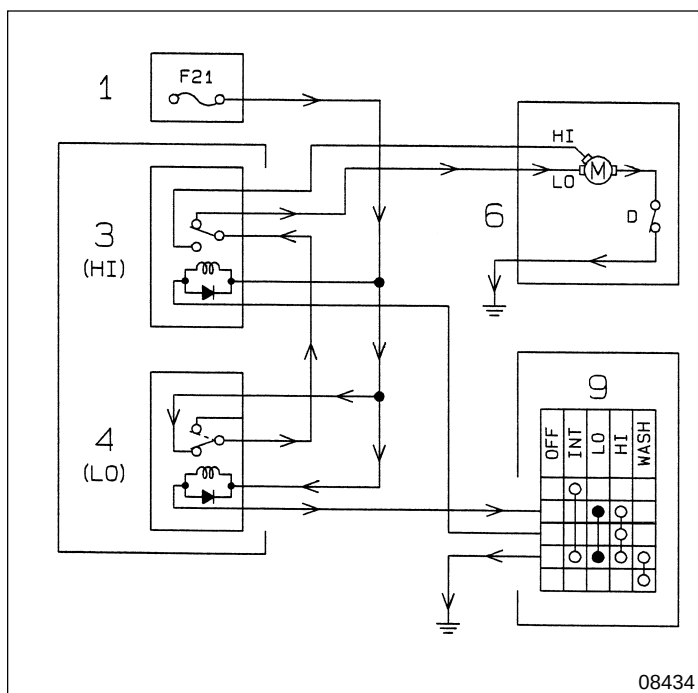


- 1 Fuse box
- 2 Relay box
- 3 Wiper relay (HIGH)
- 4 Wiper relay (LOW)
- 5 Multipurpose timing control unit
- 6 Wiper motor
- 7 Washer motor
- 8 Combination switch
- 9 Wiper and washer switch

Wiper motor 6 section

- A : Cam
B : Plate
C : Contact point
D : Circuit breaker

- Ⓔ : Wiper motor driving signal
(when wiper operating intermittently)
Ⓕ : Intermittent switch signal
(when wiper operating intermittently)
Ⓖ : Cam signal (when wiper stops)
Ⓗ : Washer switch signal



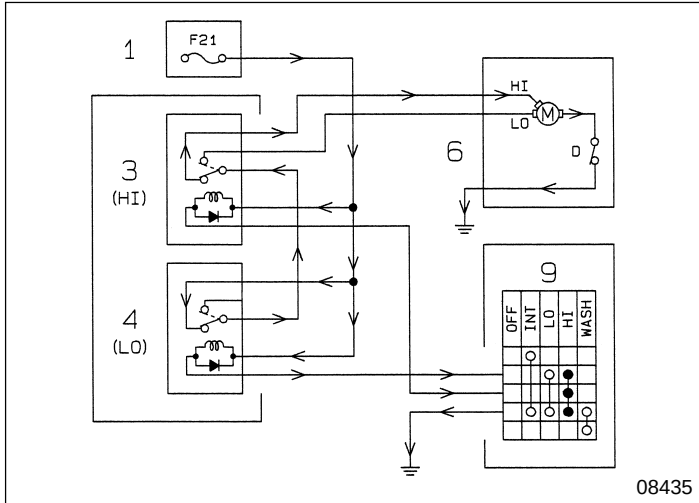
When wiper operating at LOW speed

Position of wiper and washer switch 9 : LO

- 1 (F21) → 4 (coil) → 9 (LO) → Ground
- 1 (F21) → 4 (contact point) → 3 (contact point) → 6 (LO) → 6 (D) → Ground

Wiper motor 6 rotates at low speed.

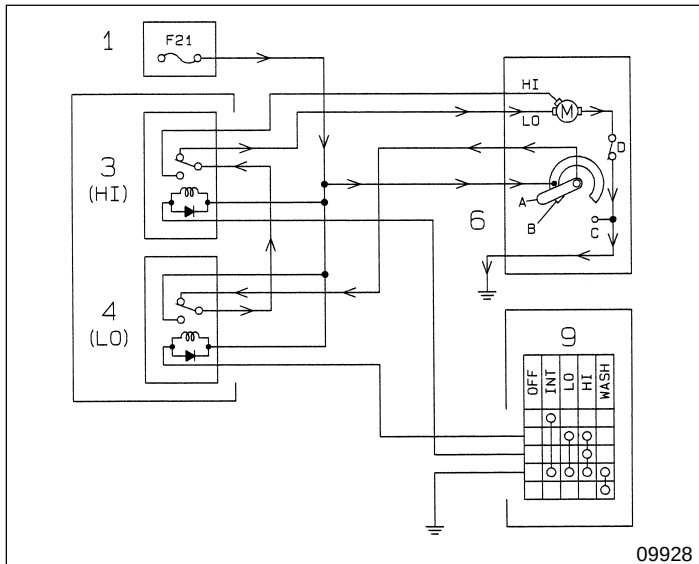
STRUCTURE AND OPERATION



When wiper operating at HIGH speed

Position of wiper and washer switch 9 : HI

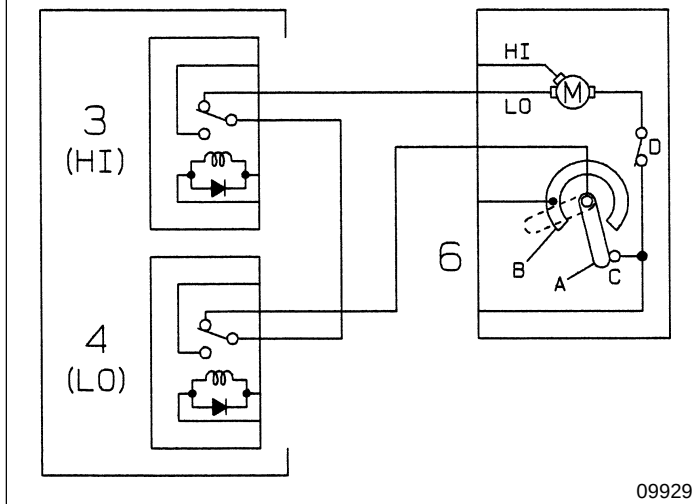
- 1 (F21) → 3 (coil) → 9 (HI) → Ground
 - 1 (F21) → 4 (contact point) → 3 (contact point) → 6 (HI) → 6 (D) → Ground
- Wiper motor 6 rotates at high speed.



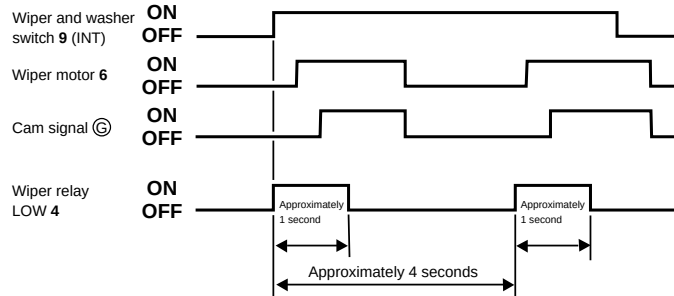
When wiper stops

Position of wiper and washer switch 9 : OFF

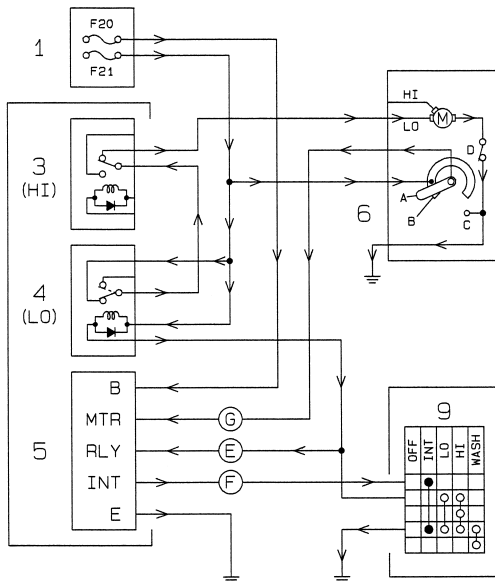
- 1 (F21) → 6 (B) → 6 (A) → 4 (contact point) → 3 (contact point) → 6 (LO) → 6 (D) → Ground
- Wiper motor 6 continues to rotate at low speed.



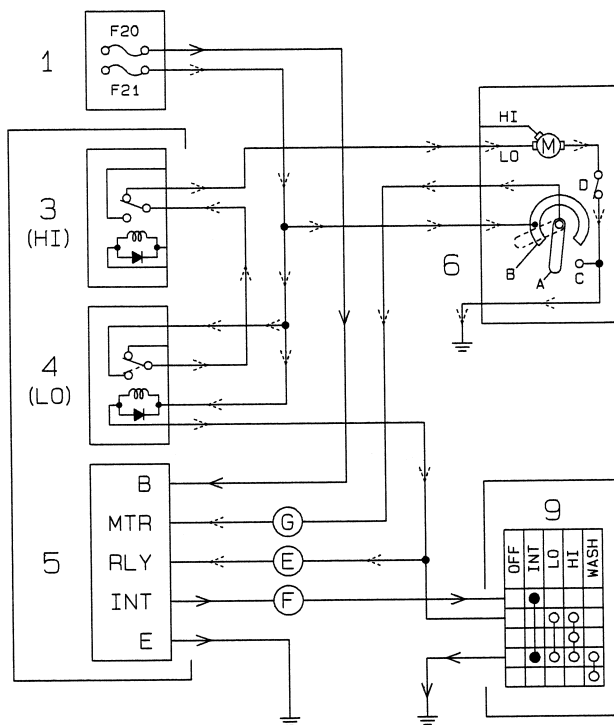
- When cam A is separated from plate B by rotation of wiper motor 6, the current to the motor is cut off.
 - Wiper motor 6 continues to rotate due to the inertia force of the motor and the wiper link.
 - When cam A of wiper motor 6 makes contact with contact point C, the following ungrounded circuit is formed.
- 6 (LO) → 6 (D) → 6 (C) → 3 (contact point) ← 4 (contact point) ← 6 (A) ←
- Wiper motor 6 stops by dynamic (electric) braking because of this circuit.



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When wiper operating intermittently

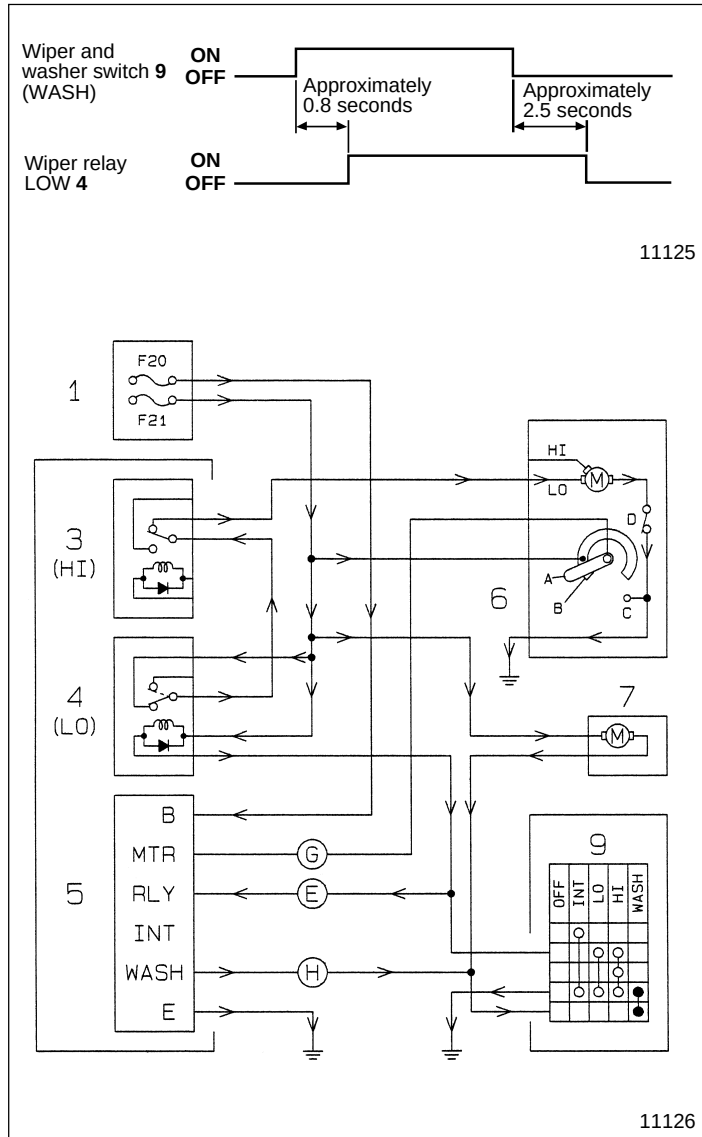
Operation mode with multipurpose timing control unit 5

Position of wiper and washer switch 9 : INT

- 1 (F20) → 5 (B) → Ground
- 5 (INT) —(F)→ 9 (INT) → Ground
- Multipurpose timing control unit 5 sends wiper motor driving signal ③ when it receives intermittent switch signal ③.
- 1 (F21) → 4 (coil) —(E)→ 5 (RLY)
- 1 (F21) → 4 (contact point) → 3 (contact point) → 6 (LO) → 6 (D) → Ground
- Wiper motor 6 rotates at low speed.
- Multipurpose timing control unit 5 sends wiper motor driving signal ③, then sends cam signal ③.
- 1 (F21) → 6 (B) → 6 (A) —(③)→ 5 (MTR)

- When cam A of wiper motor 6 is separated from plate B, cam signal ③ turns OFF.
- When cam signal ③ is turned OFF, multipurpose timing control unit 5 turns wiper motor driving signal ③ OFF for specified time.
- The illustrated part — of the circuit turns OFF.
- Wiper motor 6 stops. Gr 42-8
- After specified time has passed, multipurpose timing control unit 5 sends wiper motor driving signal ③ again.
- Wiper motor 6 rotates at low speed.

STRUCTURE AND OPERATION



When washer operating

Operation mode with multipurpose timing control unit 5

Position of wiper and washer switch 9 : WASH

- 1 (F20) → 5 (B) → Ground
- 1 (F21) → 7 → 9 → Ground
- 5 (WASH) → ①

When washer motor 7 operates to spray washer fluid, multipurpose timing control unit 5 transmits washer switch signal ①.

- 1 (F21) → 4 (coil) → ② → 5 (RLY)
- Washer switch signal ① makes multipurpose timing control unit 5 input wiper motor drive signal ②.
- 1 (F21) → 4 (contact point) → 3 (contact point)

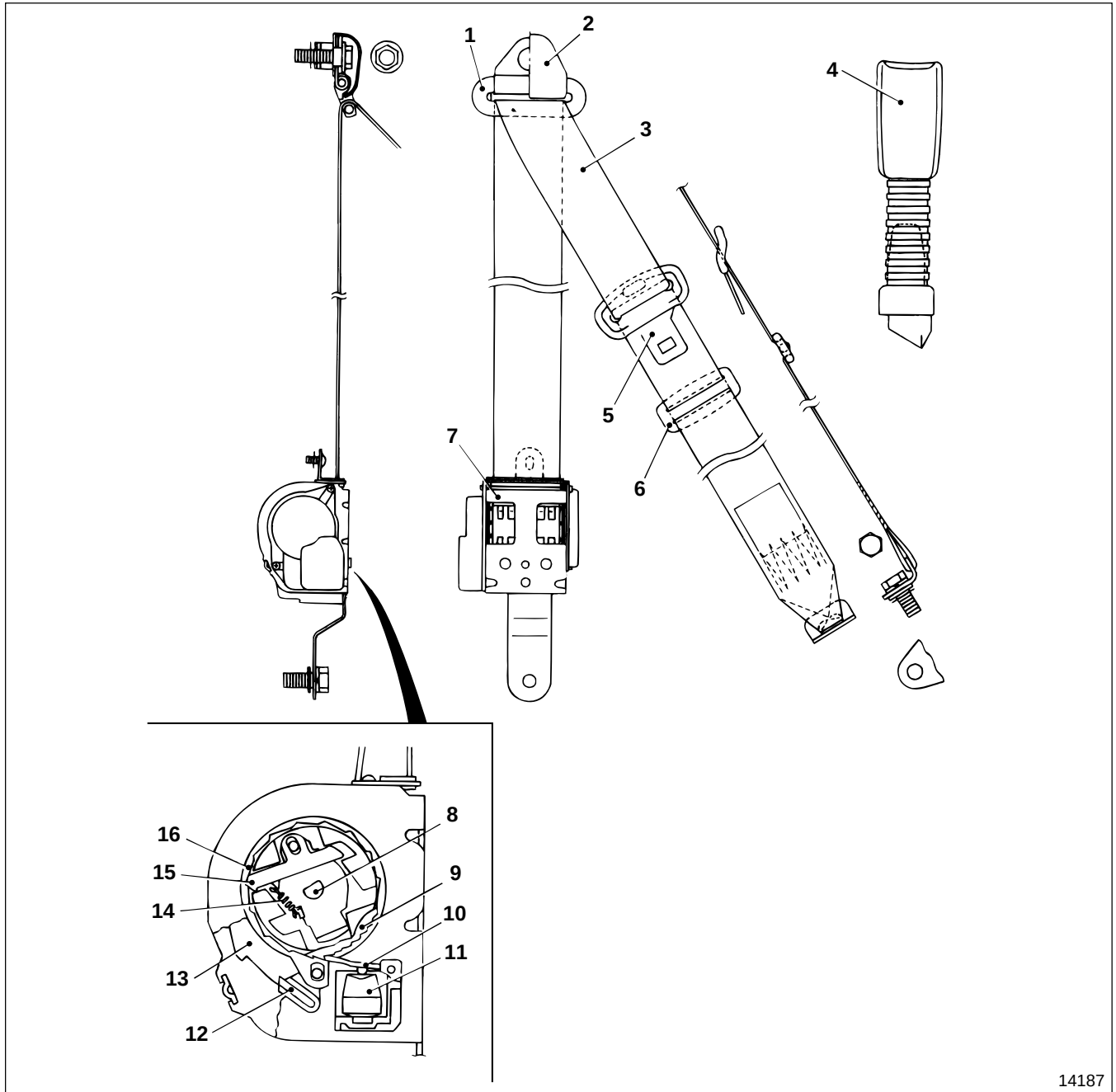
→ 6 (LO) → 6 (D) → Ground

Wiper motor 6 operates at LOW speed.

- When wiper and washer switch 9 is turned to OFF, washer motor 7 stops.
- Then, washer switch signal ① is turned off and multipurpose timing control unit 5 turns off wiper motor drive signal ② after specified time.
- Wiper motor 6 automatically stops.

📖 P42-8

Emergency Locking Retractor (ELR) Type Seat Belt



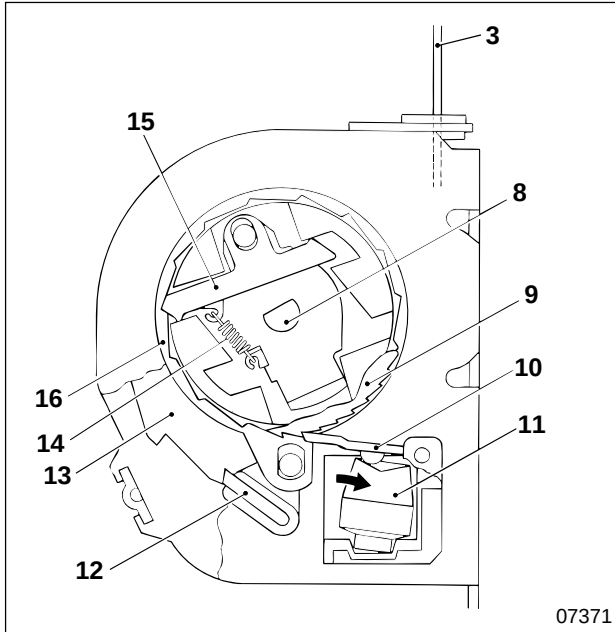
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- | | | |
|-------------------|--|------------------|
| 1 Sash guide | 7 Emergency locking retractor assembly | 12 Pawl |
| 2 Cover | 8 Spindle | 13 Ratchet gear |
| 3 Webbing | 9 Locking gear | 14 Sensor spring |
| 4 Buckle assembly | 10 Mechanism lever | 15 Lock arm |
| 5 Tongue plate | 11 Mechanism weight | 16 Clutch |
| 6 Tongue stopper | | |

CAUTION

Do not disassemble emergency locking retractor assembly 7, or malfunctions might occur.

STRUCTURE AND OPERATION



Webbing detecting lock

- When the vehicle is subjected to a sudden impact, such as a crash, webbing **3** retracts according to the movement of passengers, and spindle **8** rotates.
- As the rotation of spindle **8** is higher than the specified value, the repercussive force of sensor spring **14** can no longer retain lock arm **15**. Then, the arm is pulled out from the specified position and is locked by clutch **16**.
- If spindle **8** further rotates, clutch **16** lifts pawl **12** to lock with ratchet gear **13**, making spindle rotation impossible.

Body detecting lock

- When the body is tilted excessively, mechanism weight **11** is tilted, engaging mechanism lever **10** with locking gear **9**, locking it.
- If spindle **8** further rotates, clutch **16** operates as described above, and the spindle cannot rotate.

TROUBLESHOOTING

42

Cab as a Whole

Symptoms		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	Remarks
Possible causes								
Cab-related	Cab mounting loose or play	○						
	Front rubber, rear rubber deteriorated		○					
	Cab mounted incorrectly		○					
	Link assembly from anchor hook does not release			○				
	L-lever release faulty			○				
	Torsion bar damaged or fatigued			○				
	Torsion bar arm installation position incorrect			○				
	Link assembly not hooked to anchor hook				○			
	Link assembly contact with side cushion incorrect				○			
	Cab tilt lock switch adjusted incorrectly					○	○	
	Cab tilt lock switch faulty					○	○	
	Cab tilt warning lamp bulb burnt-out					○		
	Fuse, high-current fuse blown					○		
	Wiring broken or connection faulty					○		
Engine-related	Crossed axes angle of propeller shaft excessive due to increased tilt caused by deteriorated engine mounting		○					 Gr 10
	Engine installation faulty		○					
	Intake and exhaust system installation faulty		○					
Transmission-related	Transmission installation faulty		○					 Gr 22, 23
Propeller shaft-related	Propeller shaft run-out excessive		○					 Gr 25
	Universal joint worn excessively		○					
	Slip yoke joint spline play		○					
	Center bearing play excessive		○					
	Crossed axes angle of mounting dimension excessive due to deteriorated center bearing cushion rubber, etc.			○				
	Crossed axes angle of propeller shaft excessive due to increased tilt of drive axis caused by overloading		○					

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	☐						 Gr 26
Rear axle-related	Reduction gear engaged incorrectly		☐					 Gr 27
	Differential gear engaged incorrectly		☐					
Wheel and tire-related	Wheel and tire run-out excessive	☐						 Gr 31
	Wheel and tire unbalanced	☐						
	Size and kinds of tire unequal	☐						
	Wheel mounting surface warped	☐						
Front suspension-related	Leaf spring friction between leaves excessive	☐						 Gr 33
Brake-related	Brake drum unbalanced	☐						 Gr 35
	Brake drum eccentric	☐						
	Rotor of disc brake eccentric	☐						

Door Lock

Possible causes	Symptoms							Remarks
	Door does not shut completely	Door does not lock when door lock knob is pressed	Door does not lock when key is turned	Door does not open using outside door handle	Door does not open using inside door handle	Inside door handle self-return poor	Door and cab interference	
Door installation faulty	☐						☐	
Striker installation faulty	☐							
Door latch lock faulty	☐	☐	☐	☐	☐			
Door latch rod deformed		☐			☐			
Door latch rod removed		☐	☐		☐			
Door latch rod obstructed						☐		
Door lock cylinder deformed			☐					
Left side outside door handle faulty				☐				
Inside door handle installation faulty					☐			
Inside door handle spring fatigued						☐		

TROUBLESHOOTING

Wiper and Washer

Symptoms									Remarks	
	Wiper doe not work	Wiper does not stop	Wiper intermittent operation does not work	Wiper blade stop position incorrect	Wiper operation inadequate	Noise during wiper operation	Washer motor does not work	Washer fluid jetting insufficient		Washer fluid does not jet
Possible causes										
Wiper motor faulty	○	○		○		○				 Gr 54
Washer motor faulty							○	○	○	
Wiper and washer switch faulty	○	○	○				○			
Multipurpose timing control unit faulty			○							
Wiper relay faulty	○						○			
Fuse, high-current fuse blown	○						○			
Wiring broken or connection faulty	○		○				○		○	
Wiper motor crank arm set position faulty				○						
Wiper link and wiper arm connection faulty						○				
Wiper blade faulty					○	○				
Wiper arm faulty					○					
Washer hose twisted								○		
Washer hose connected incorrectly									○	
Washer nozzle clogged								○	○	
Washer fluid insufficient									○	

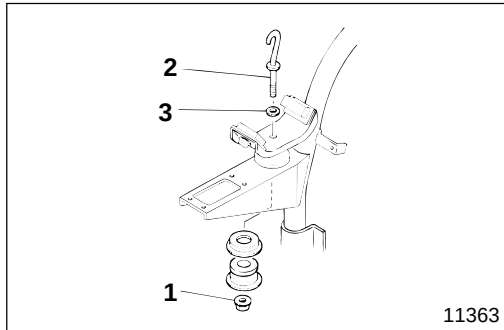
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE 42

Adjustment of Cab Tilt

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Lock nut (Anchor hook mounting)	83 to 98 {61 to 72, 8.5 to 10.0}	—
4	Bolt (Lock handle mounting)	29 to 39 {22 to 29, 3.0 to 4.0}	—



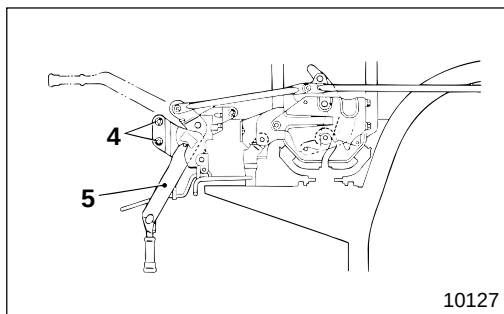
(1) Adjustment of lock handle operating force

Adjust the lock handle operating force by increasing or decreasing the number of spacers **3** as follows:

1 : Lock nut

2 : Anchor hook

	Number of spacers
Heavy operating force	Increased
Light operating force	Decreased



(2) Adjustment for unsmooth latch

If latch operation is not smooth, loosen bolt **4**, and adjust installation of lock handle **5**.

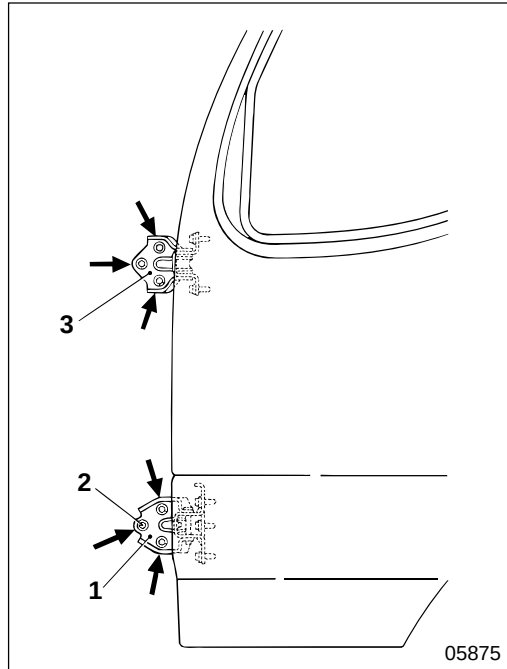
INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Adjustment of Door Fitting

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

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

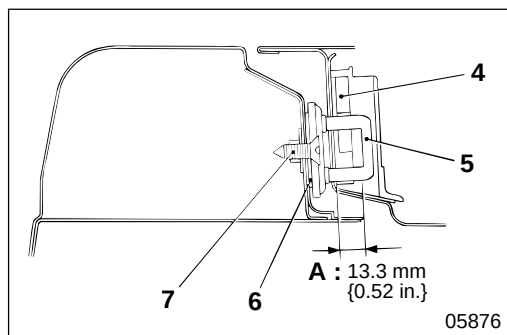


Adjust door fitting at hinge and striker.
(For door fitting dimensions: P42-19.)

(1) Adjustment of hinge

For adjustment, use front-side bolt 2 of lower hinge 1 as the reference point.

3 : Upper hinge

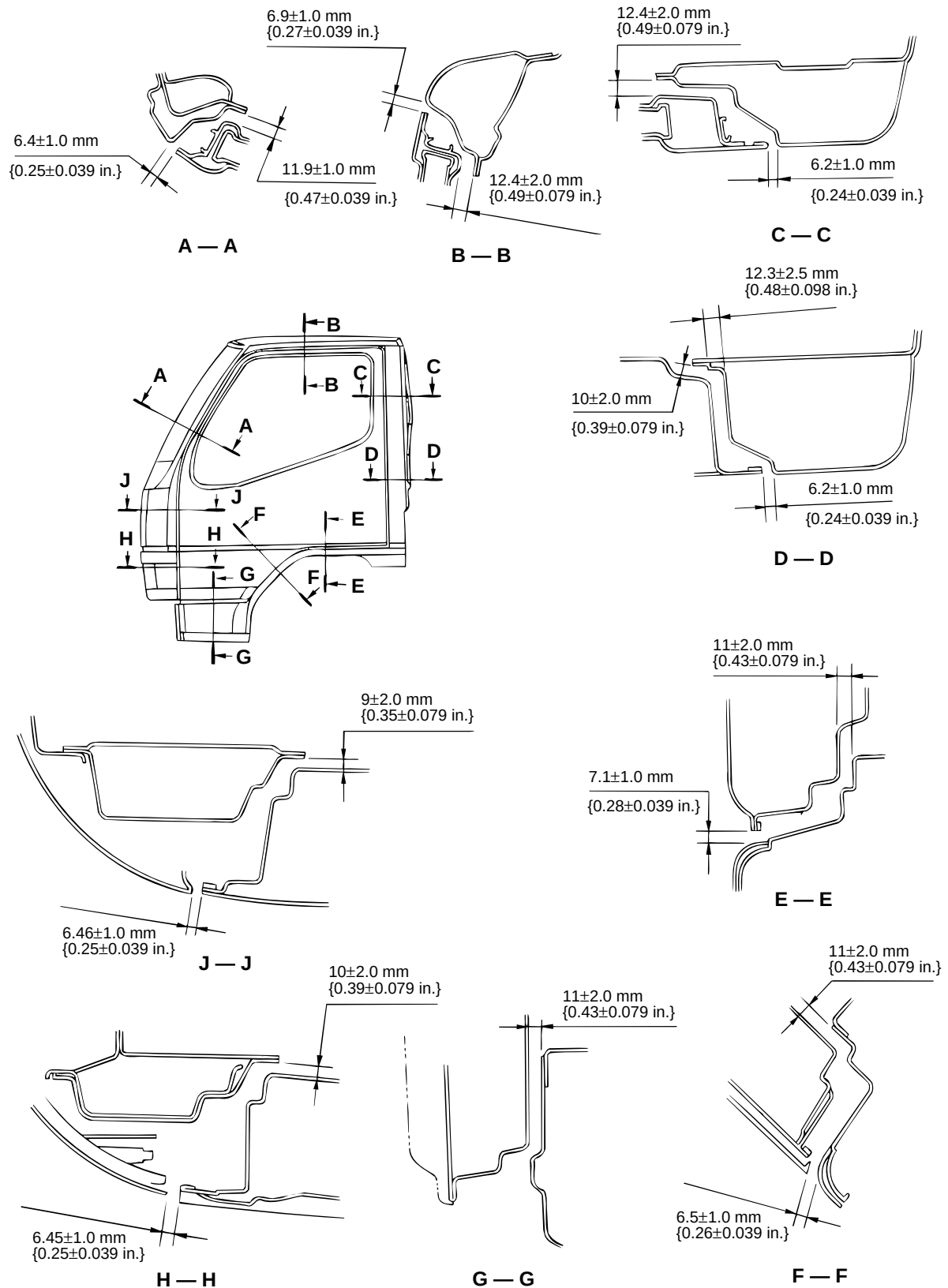


(2) Adjustment of striker

Engagement condition between door lock latch 4 and striker 5 should be adjusted with shim 6 within illustrated range A.

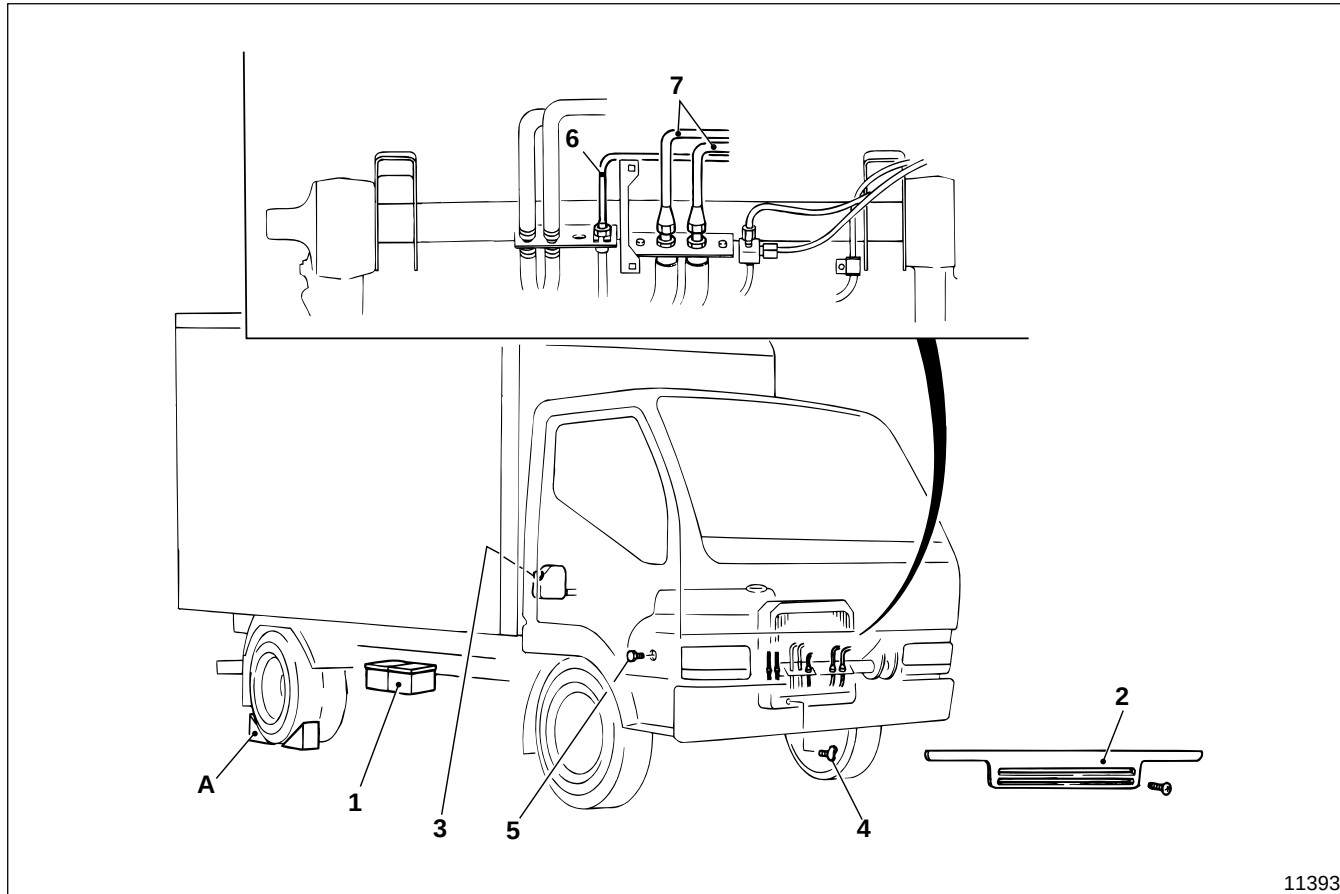
7 : Screw

Door Fitting Dimensions



REMOVAL AND INSTALLATION OF CAB

Preliminary Work



11393

● Disassembly sequence

- 1 Battery (negative terminal) Gr 54
- 2 Front grille P42-40
- 3 Pressure cap Gr 14
- 4 Radiator drain plug Gr 14
- 5 Crankcase drain plug Gr 14
- 6 Clutch fluid pipe
< Manual transmission > Gr 21
- 7 Brake fluid pipe Gr 35

Work items

- Draining, filling, and air bleeding of clutch fluid and brake fluid Gr 21, Gr 35
- Draining, filling, and air bleeding of coolant Gr 14

A : Wheel chock

WARNING

- Put chocks A securely because the vehicle cannot be maintained at a standstill just by using the parking brake during removal and installation of the cab.
- Do not remove chocks A until the entire operation is completed.

● Assembly sequence

Follow the disassembly sequence in reverse.

Work Inside Cab



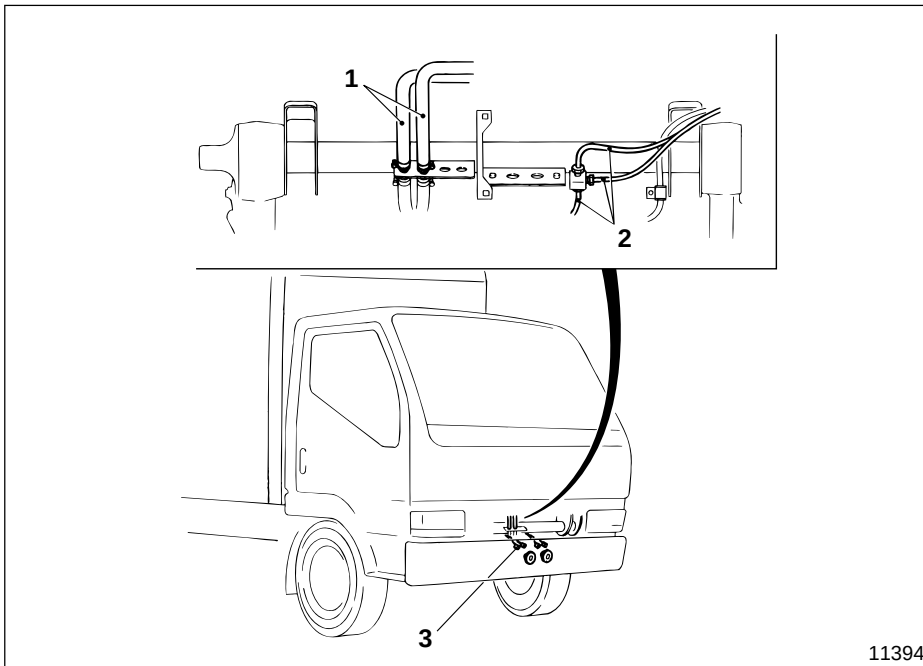
● Disassembly sequence

- 1 Parking brake cable  Gr 36

● Assembly sequence

Follow the disassembly sequence in reverse.

Work from Front of Cab



● Disassembly sequence

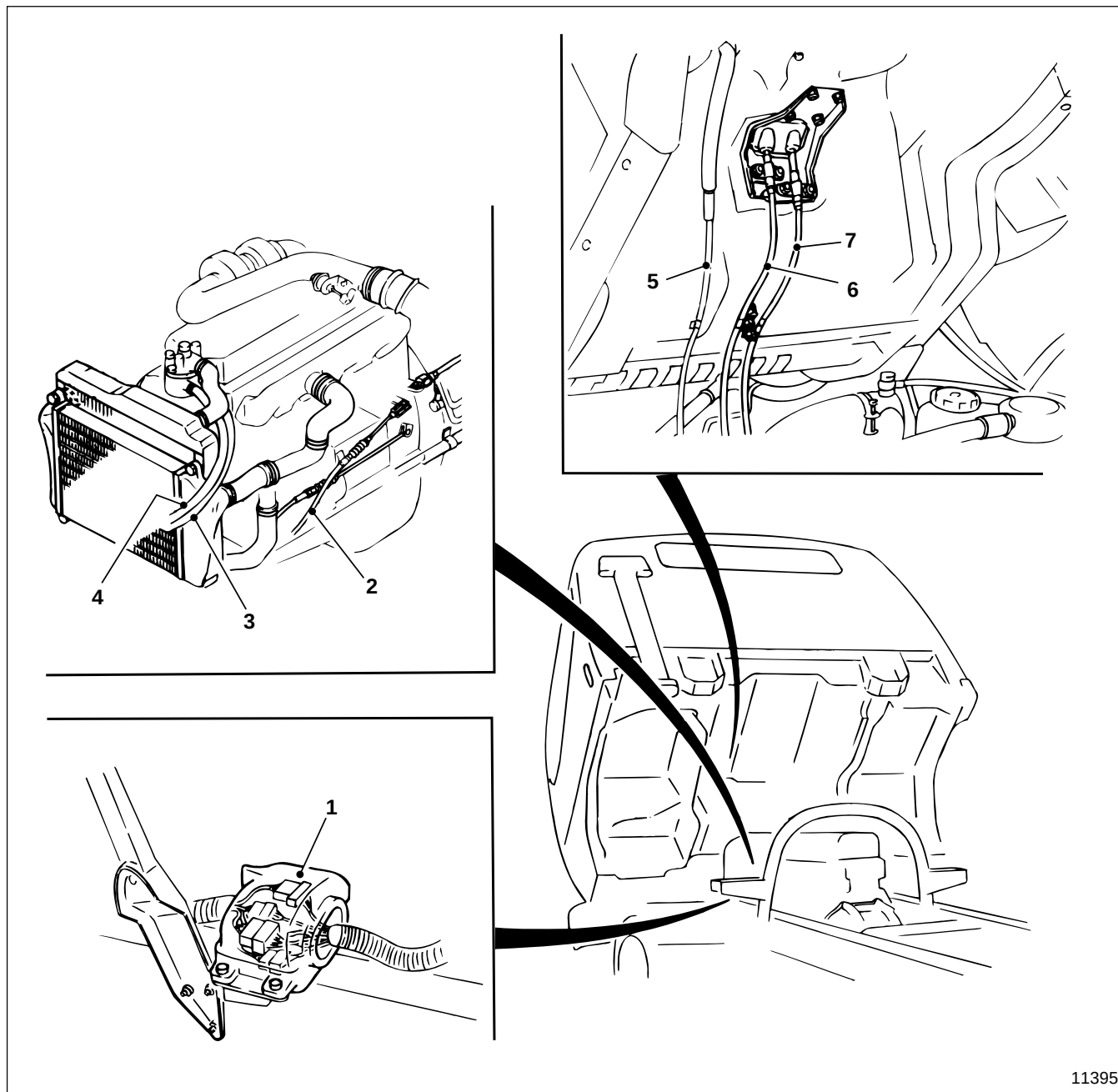
- 1 Heater hose  Gr 55B
- 2 Air hose  Gr 35
- 3 Horn harness

● Assembly sequence

Follow the disassembly sequence in reverse.

REMOVAL AND INSTALLATION OF CAB

Work with Cab Tilted Up



11395

● Disassembly sequence

- 1 Cab harness and chassis harness connection
- 2 Accelerator control cable  Gr 13
- 3 Heater hose (Engine in)
- 4 Heater hose (Engine out)
- 5 Range selector cable < Automatic transmission >  Gr 23
- 6 Shift cable < Manual transmission >  Gr 22
- 7 Selector cable < Manual transmission >  Gr 22

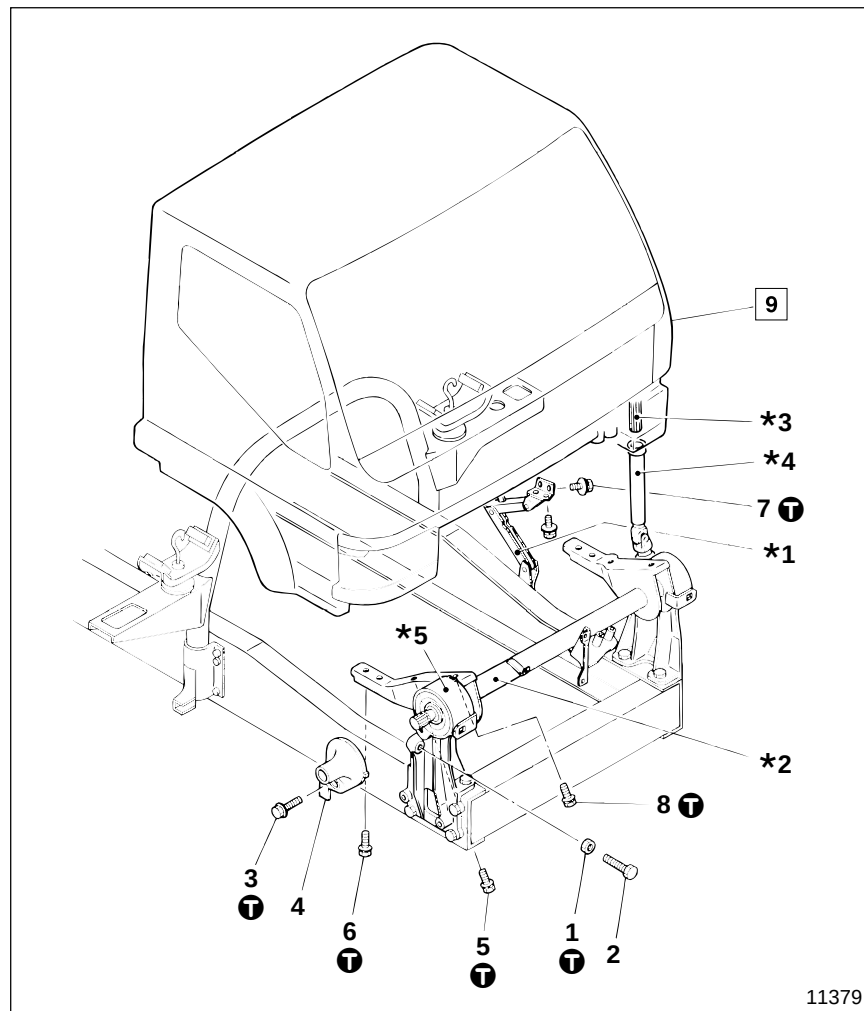
● Assembly sequence

Follow the disassembly sequence in reverse.

MEMO

REMOVAL AND INSTALLATION OF CAB

Removal and Installation of Tilt Cab Body



● Disassembly sequence

- 1 Nut
- 2 Bolt
- 3 Bolt
- 4 Anchor lever
- 5 Bolt
- 6 Bolt
- 7 Bolt
- 8 Bolt
- 9 Cab assembly

- *1 : Cab stay
 *2 : Front floor cross member
 *3 : Steering yoke
 *4 : Steering shaft
 *5 : Front cab mounting bracket

● Assembly sequence

Follow the disassembly sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

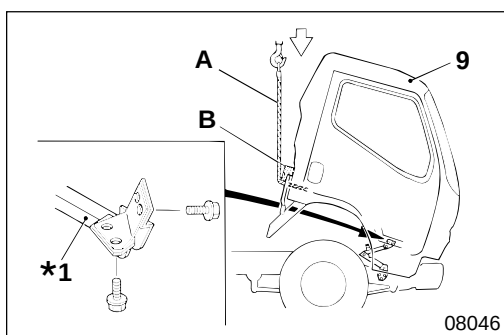
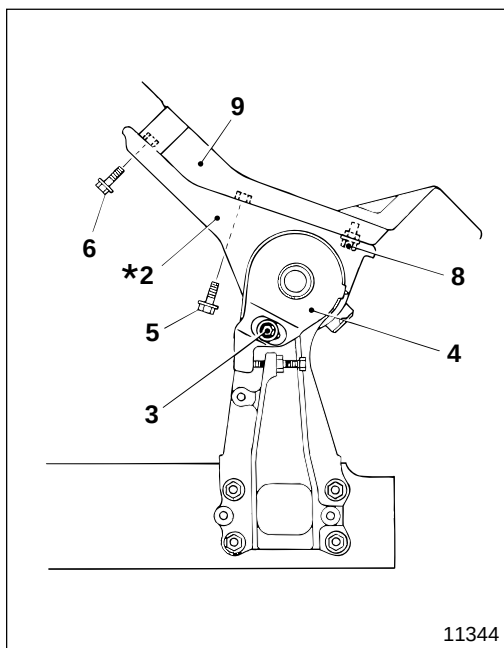
Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Anchor lever adjusting bolt locking)	59 to 83 {43 to 60, 6 to 8.5}	—
3	Bolt (Anchor lever mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
5, 6, 8	Bolt (Front floor cross member mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	—
7	Bolt (Cab stay mounting)	19 to 27 {14 to 21, 1.9 to 2.8}	—

◆ Service procedure

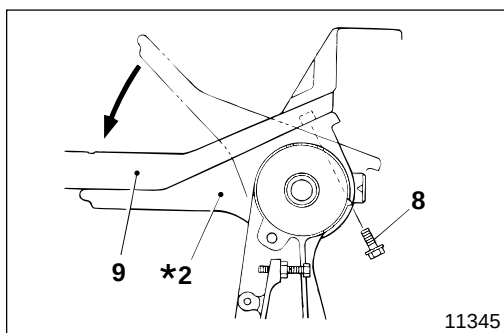
9 Cab assembly

[Removal]

- Tilt cab assembly **9** and lock cab stay ***1** securely.
- Remove bolt **3**, and remove anchor lever **4**.
- Of the three bolts that retain front floor cross member ***2**, remove bolts **5**, **6** at rear side, leaving bolt **8** at front side.

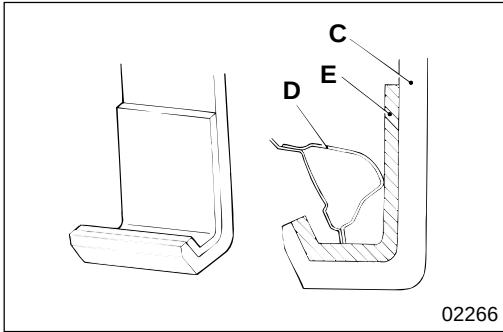


- To separate cab stay ***1** from cab assembly **9**, support the cab securely using crane **A** that is capable of lifting the cab.
B : Use a wood block for protecting the rear of the cab
- Using crane **A**, lower cab assembly **9** until cab stay ***1** can be removed, then remove it.



- Fully lower cab assembly **9** to remove remaining bolt **8** that retains front floor cross member ***2**.

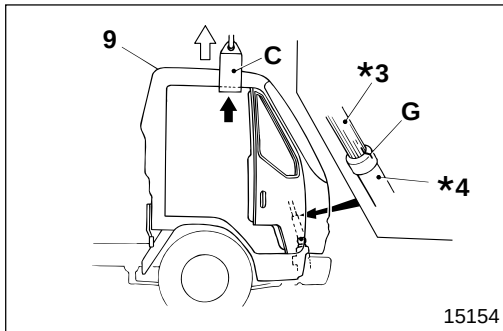
REMOVAL AND INSTALLATION OF CAB



- Set up hoist attachment **C** for the cab as illustrated.

CAUTION ⚠

- Make sure when you set up hoist attachment **C** that it is capable of lifting cab assembly **9** which weighs approximately 390 kg {860 lb}.
- Make sure you install rubber **E** on hoist attachment **C** to prevent cab roof **D** being deformed when the cab is lifted.



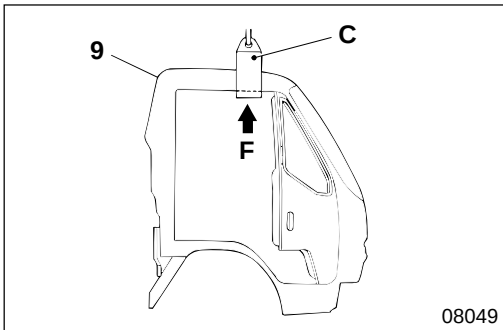
- Mount hoist attachment **C** at center-of-gravity point **F** of cab assembly **9**. Verify the position at which the cab can be lifted horizontally when the cab is lifted slightly.
- Slowly lift cab assembly **9** straight up, and finish lifting when steering yoke ***3** is pulled out from steering shaft ***4**. Make alignment mark **G** before the steering yoke is pulled out from the steering shaft.

WARNING ⚠

Never get under cab assembly **9** when it is being lifted.

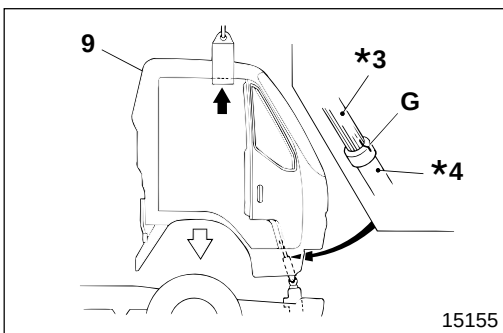
CAUTION ⚠

Make sure, when lifting cab assembly **9**, that the wiring harness, cable, hoses, etc. are completely disconnected when the cab is lifted slightly.

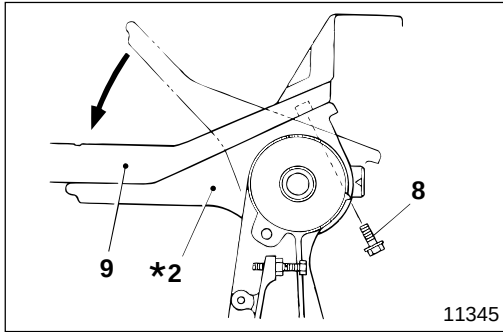


[Installation]

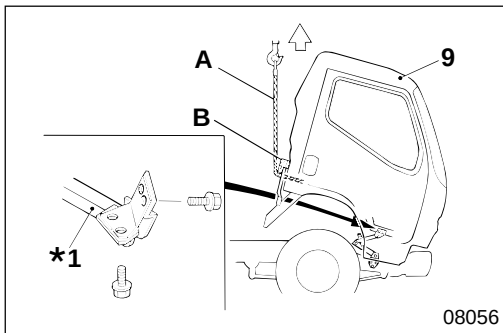
- Mount hoist attachment **C** at center-of-gravity point **F** of cab assembly **9**.



- Slowly lower cab assembly **9** horizontally to insert steering yoke ***3** into steering shaft ***4**, aligning alignment mark **G**.



- Slowly lower cab assembly 9 further, and remove hoist attachment C after it comes down fully.
- Tighten front bolt 8, one of the three bolts used for installing front floor cross member *2.

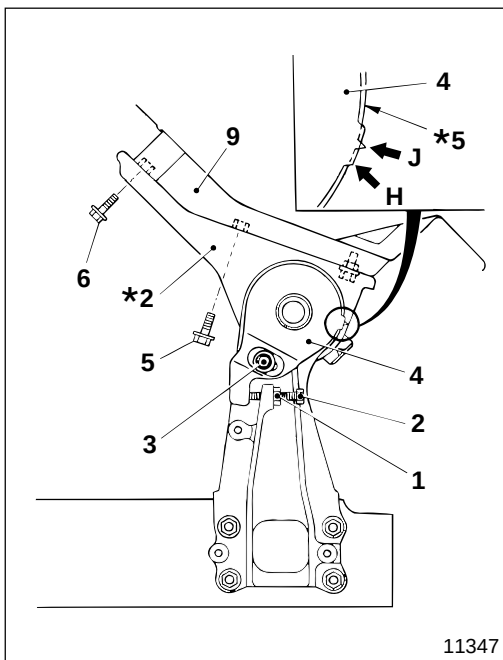


- Securely support cab on crane A to tilt cab assembly 9.
B : Use a wood block for protecting the rear of the cab
- Using crane A tilt cab assembly 9, and install cab stay *1.

WARNING ⚠

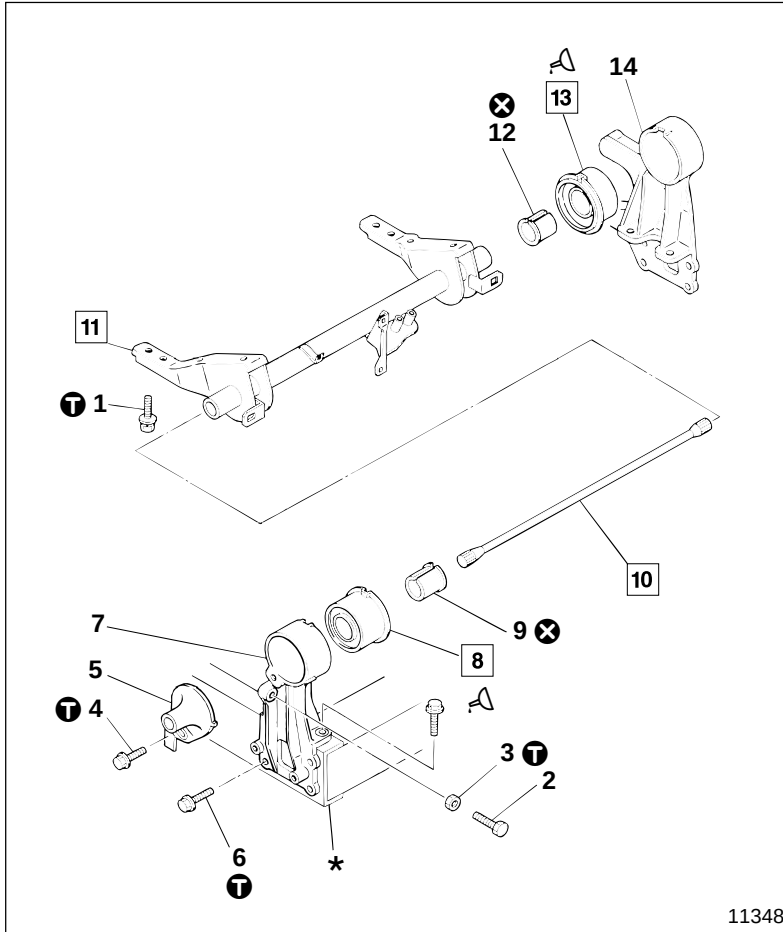
You must pay close attention to the tilt angle when tilting cab assembly 9 using crane A. It is very dangerous to tilt the cab excessively because it will topple over.

- After installing cab stay *1, tilt cab assembly 9 slowly until it is completely tilted, securely lock cab stay, then detach the cab from crane A.



- Tilt cab assembly 9, and securely lock cab stay *1.
- Tighten bolts 5, 6 to install front floor cross member *2.
- Position and install pointer J of front cab mounting bracket *5 in convex area H of anchor lever 4 and fix it with bolt 3.
- Position bolt 2 on anchor lever 4 and lock it with nut 1.
- After mounting cab assembly 9, check and adjust the operating force required for the lock handle. 📖 P42-17

FRONT CAB MOUNTING



● Disassembly sequence

- 1 Bolt
- 2 Bolt
- 3 Nut
- 4 Bolt
- 5 Anchor lever
- 6 Bolt
- 7 Front cab mounting bracket, RH
- 8 Front rubber assembly, RH
- 9 Bushing, RH
- 10 Torsion bar
- 11 Front floor cross member assembly
- 12 Bushing, LH
- 13 Front rubber assembly, LH
- 14 Front cab mounting bracket, LH

⊗ : Non-reusable parts
 * : Frame

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Since the following parts are assembled at the time the cab is mounted, see removal and installation of cab (P42-24) for assembly procedure.

- 1 : Bolt (Connection of front floor cross member assembly and cab assembly mounting)
 2 : Bolt (Adjustment of anchor lever)
 3 : Nut
 4 : Bolt (Installation of anchor lever)
 5 : Anchor lever

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Front floor cross member assembly and cab assembly mounting)	70 to 95 {51 to 70, 7.1 to 9.7}	—
3	Nut (Lock of anchor lever adjustment bolt)	59 to 83 {43 to 61, 6 to 8.5}	—
4	Bolt (Anchor lever mounting)	34 to 54 {25 to 40, 3.5 to 5.5}	—
6	Bolt (Front cab mounting bracket mounting)	70 to 85 {51 to 63, 7.1 to 8.7}	—

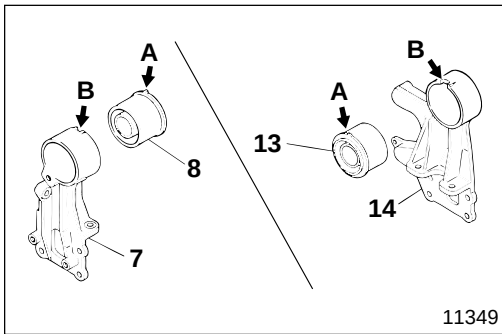
Lubricant

Location	Points of application	Kinds	Quantity
8, 13	Contact area between front rubber assemblies and front floor cross member assembly	Rubber grease	As required

◆ Service procedure

8 13 Installation of front rubber assembly

Install front rubber assembly RH **8** and LH **13** fitting protrusions **A** to the indents **B** of mounting bracket RH **7** and LH **14** respectively.

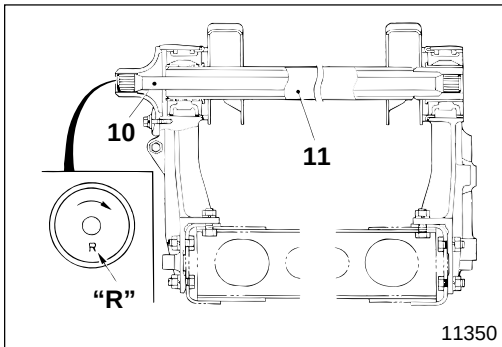


10 Installation of torsion bar

Install torsion bar **10** to front floor cross member assembly **11** in the direction as illustrated.

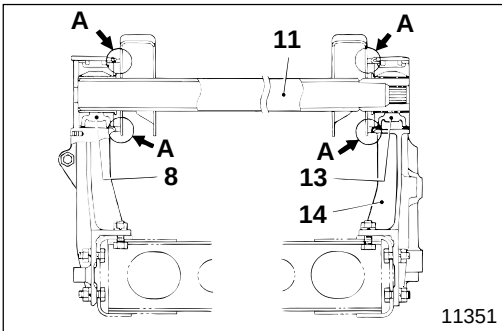
CAUTION

Be sure not to mistake the left side for the right side, when installing torsion bar **10**, because the torsion bar will be damaged if its torsion direction is reversed.

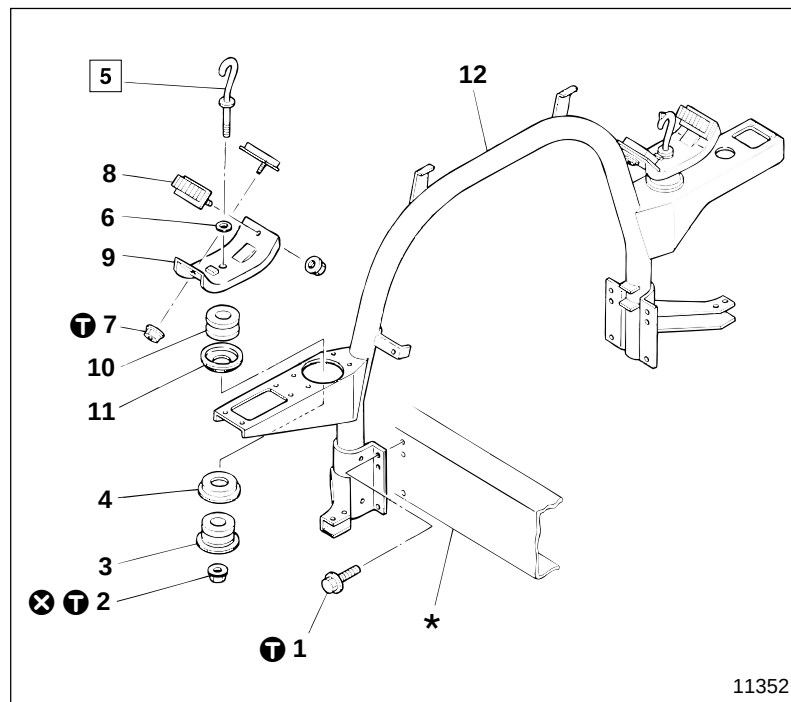


11 Installation of front floor cross member assembly

Install front floor cross member assembly **11**, adjusting front cab mounting bracket LH **14** so there is no gap between the front floor cross member assembly and front rubber assembly RH **8** and LH **13** at points **A**.



REAR CAB MOUNTING



● Disassembly sequence

- 1 Bolt
- 2 Nut
- 3 Lower rubber
- 4 Metal fixture
- 5 Anchor hook
- 6 Spacer
- 7 Nut
- 8 Side rubber
- 9 Cab hold bracket
- 10 Upper rubber
- 11 Metal fixture
- 12 Rear mounting post

⊗ : Non-reusable parts
 * : Frame

● Assembly sequence

Follow the disassembly sequence in reverse.

Ⓣ Tightening torque

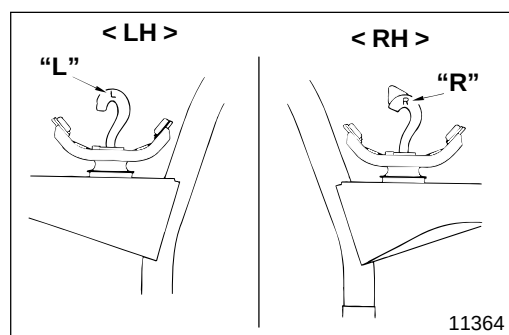
Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Rear mounting post mounting)	78 to 105 {58 to 80, 8 to 11}	—
2	Nut (Anchor hook mounting)	83 to 98 {61 to 72, 8.5 to 10.0}	—
7	Nut (Side rubber mounting)	16 to 20 {12 to 14, 1.6 to 2.0}	—

◆ Service procedure

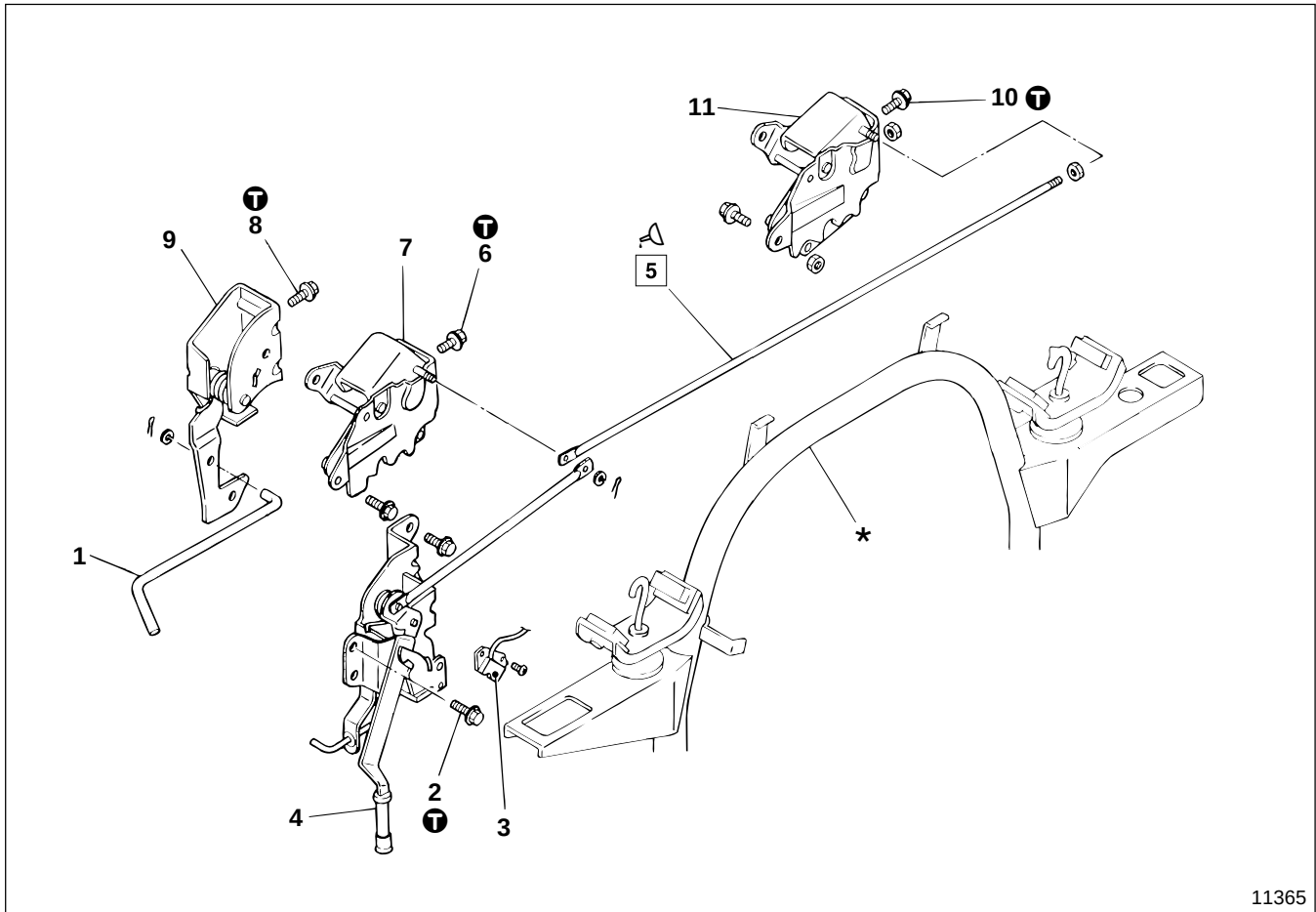
5 Installation of anchor hook

L : Left identification mark
 R : Right identification mark



MEMO

CAB TILT LINK



● Disassembly sequence

- | | |
|--|------------------------|
| 1 L-lever rod | 8 Bolt |
| 2 Bolt | 9 L-lever assembly |
| 3 Cab tilt lock switch  Gr 54 | 10 Bolt |
| 4 Lock handle assembly | 11 Link assembly, RH |
| 5 Center rod | |
| 6 Bolt | |
| 7 Link assembly, LH | * : Rear mounting post |

● 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
2	Bolt (Lock handle assembly mounting)	29 to 39 {22 to 29, 3 to 4}	—
6	Bolt (Link assembly, LH mounting)	29 to 39 {22 to 29, 3 to 4}	—
8	Bolt (L-lever assembly mounting)	29 to 39 {22 to 29, 3 to 4}	—
10	Bolt (Link assembly, RH mounting)	29 to 39 {22 to 29, 3 to 4}	—

Lubricant

Location	Points of application	Kinds	Quantity
5	Connecting area between center rod link assembly, LH and lock handle assembly	Wheel bearing grease [NLGI No2 (Li soap)]	As required

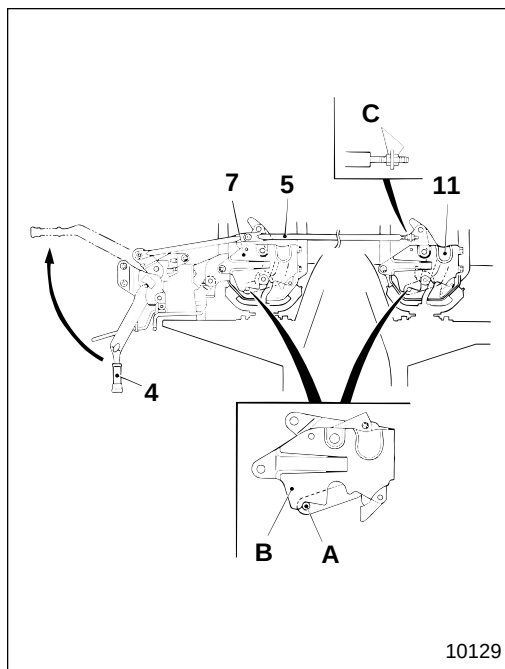
◆ Service procedure**● Inspection after assembly**

Make sure that operating force for lock handle assembly **4** is correct. If it is too heavy or too light, adjust. P42-17

5 Installation of center rod

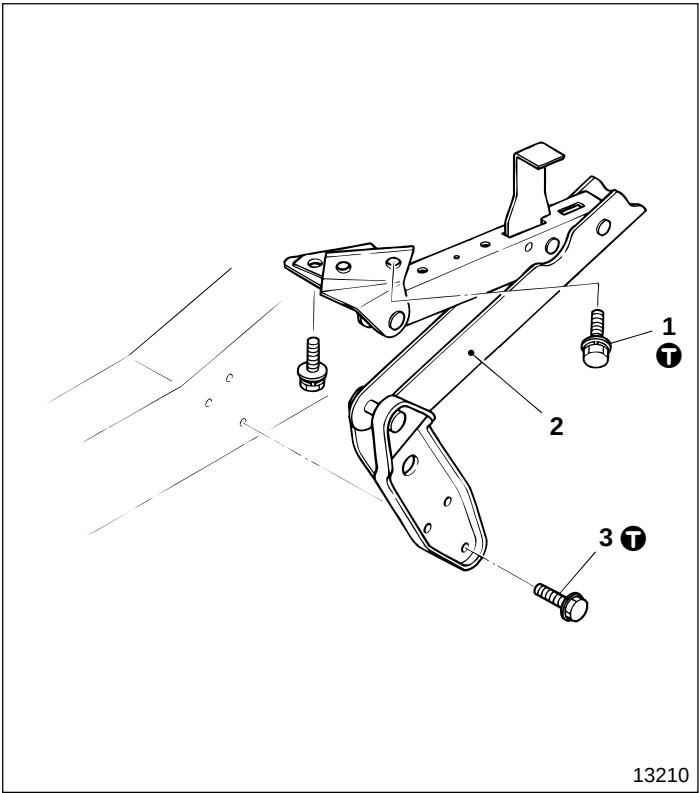
Adjust the length of center rod **5** using lock nut **C** to optimize locking and unlocking of rear cab mounting.

- Raise lock handle assembly **4** all the way, unlocking it.
- Turn and adjust lock nut **C** so that shafts **A** of link assembly LH **7** and RH **11** contact brackets **B**.



CAB TILT LINK

Cab Stay



● Removal sequence

- 1 Bolt
- 2 Cab stay assembly
- 3 Bolt

WARNING ⚠

You must use a hoist to support the cab when you remove the cab stay assembly.

● Installation sequence

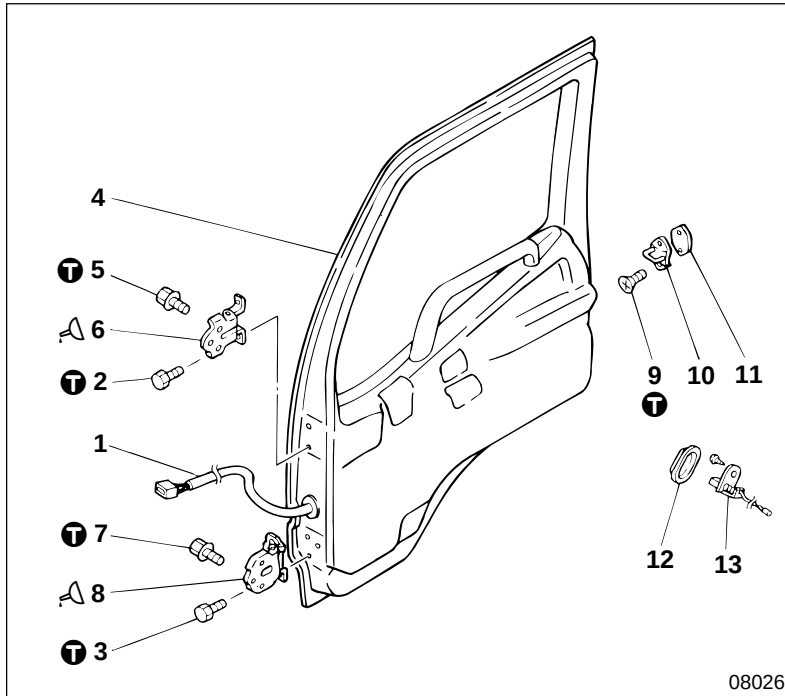
Follow the removal sequence in reverse.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (Cab stay mounting)	19 to 27 {14 to 20, 1.9 to 2.8}	—
3	Bolt (Cab stay mounting)	59 to 78 {43 to 65, 6 to 8}	—

Door Hinge and Striker



08026

● 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 fit: P42-18.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

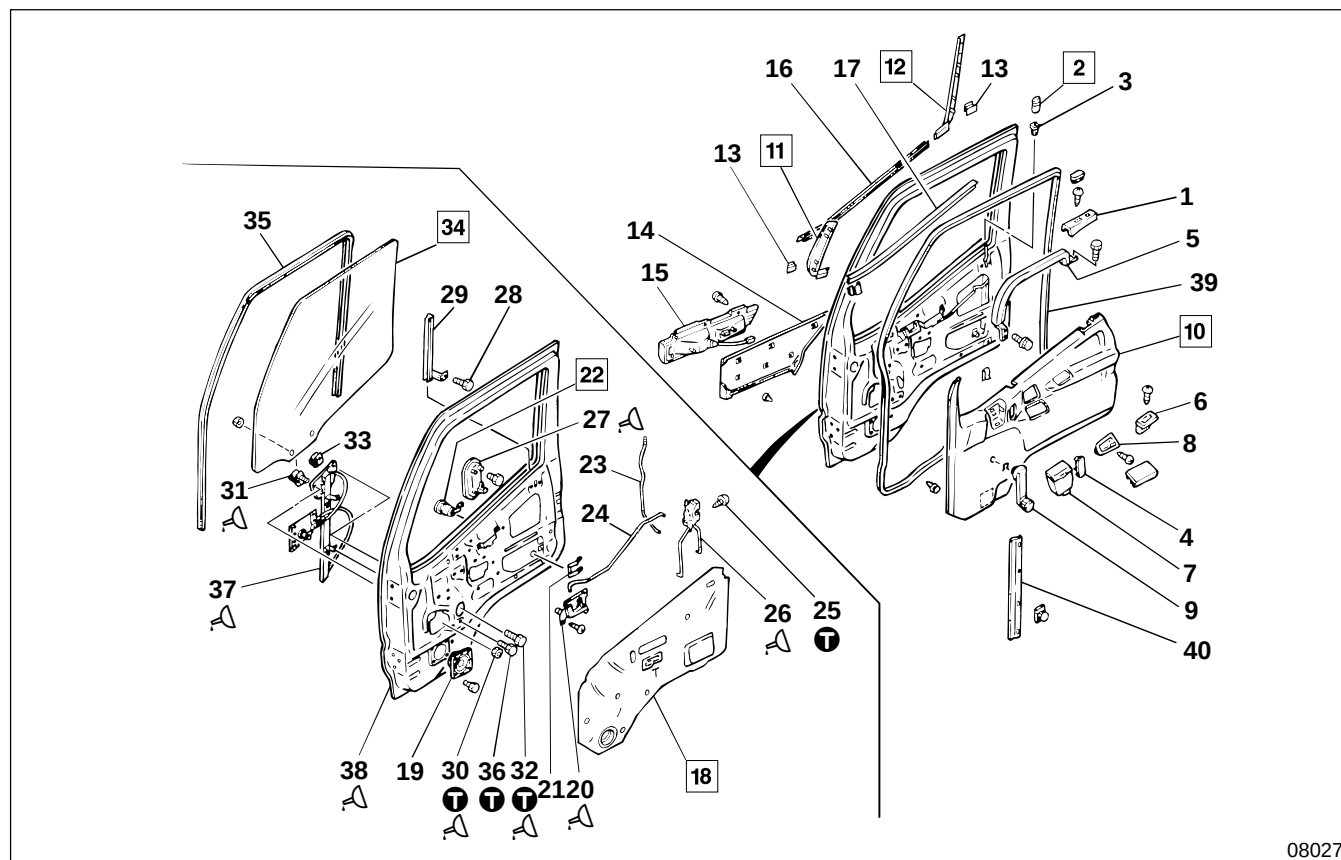
Location	Parts to be tightened	Tightening torque	Remarks
2, 3	Bolt (Door assembly mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
5	Bolt (Upper hinge mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
7	Bolt (Lower hinge mounting)	17 to 25 {12 to 19, 1.7 to 2.6}	—
9	Screw (Striker mounting)	8.8 to 14 {6.5 to 10,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

DOOR

Door Assembly



08027

● Disassembly sequence

- | | | |
|-----------------------|--------------------------|--------------------------------|
| 1 Cover | 15 Side combination lamp | 29 Lower sash |
| 2 Door lock knob | 16 Outer weatherstrip | 30 Nut |
| 3 Bushing | 17 Inner weatherstrip | 31 Glass holder |
| 4 Cover | 18 Waterproof cover | 32 Bolt |
| 5 Guard bar | 19 Speaker | 33 Glass holder |
| 6 Pull handle cover | 20 Inside handle | 34 Door glass |
| 7 Ashtray | 21 Clip | 35 Run channel |
| 8 Inside handle cover | 22 Door lock cylinder | 36 Bolt |
| 9 Regulator handle | 23 Door lock rod | 37 Regulator and rail assembly |
| 10 Door trim | 24 Door opening rod | 38 Door panel |
| 11 Front garnish | 25 Screw | 39 Weatherstrip |
| 12 Rear garnish | 26 Door lock assembly | 40 Weatherstrip |
| 13 Clip | 27 Outside handle | |
| 14 Outer garnish | 28 Bolt | |

● Assembly sequence

Follow the disassembly sequence in reverse.

NOTE

Service procedure describes details for right side door, the left side door has the same structure.

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
25	Screw (Door lock assembly mounting)	3.9 to 5.9 {2.9 to 4.3, 0.4 to 0.6}	—
30	Nut (Door glass mounting)	6.9 to 11 {5.1 to 8, 0.7 to 1.1}	—
32	Bolt (Door glass mounting)	6.9 to 11 {5.1 to 8, 0.7 to 1.1}	—
36	Bolt (Regulator and rail assembly mounting)	6.9 to 11 {5.1 to 8, 0.7 to 1.1}	—

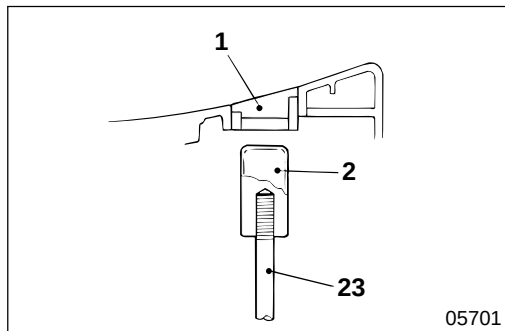
Lubricant and sealant

Location	Points of application	Kinds	Quantity
20	Turning part of inside handle	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
26	Friction part of door lock assembly	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
27	Friction part of outside handle	Wheel bearing grease [NLGI No.2 (Li soap)]	As required
30	Thread area of nut	LOCTITE DRYLOCK No.203	As required
31, 32	Thread area of bolt	LOCTITE DRYLOCK No.203	As required
37	Friction part of regulator and rail assembly	DYNAMIC GB	As required
38	Door panel and waterproof cover mounting surface	BUTYL TAPE	As required

Service procedure

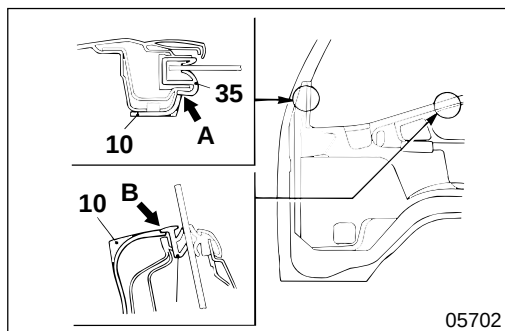
2 Installation of door lock knob

- Screw door lock knob **2** onto door lock rod **23** and turn to the right fully.
- Slacken off door lock knob **2** to the left by one or two turns.
- Install cover **1** to prevent door lock knob **2** from turning excessively.

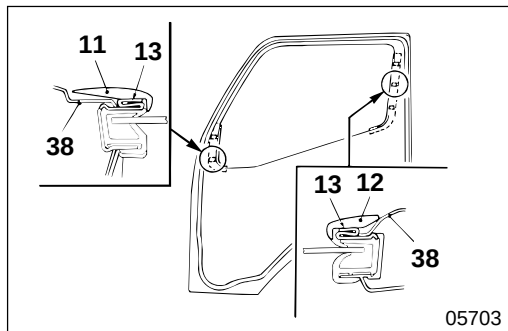


10 Installation of door trim

- At front pillar, tap door trim **10** against lip area **A** of run channel **35**.
- In belt line, insert door trim **10** into lip area **B** of inner weatherstrip **17** and install.

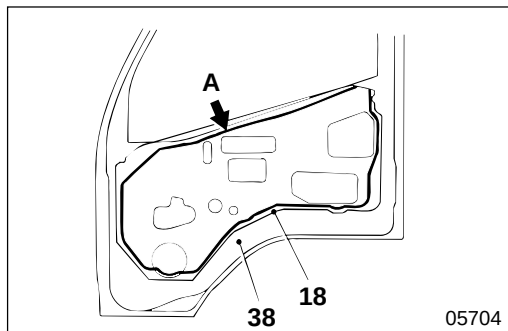


DOOR



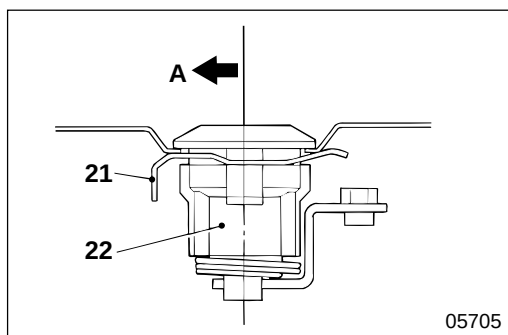
11 12 Installation of front garnish and rear garnish

- Install clips 13 on door panel 38.
- Install front garnish 11 and rear garnish 12 on clips 13.



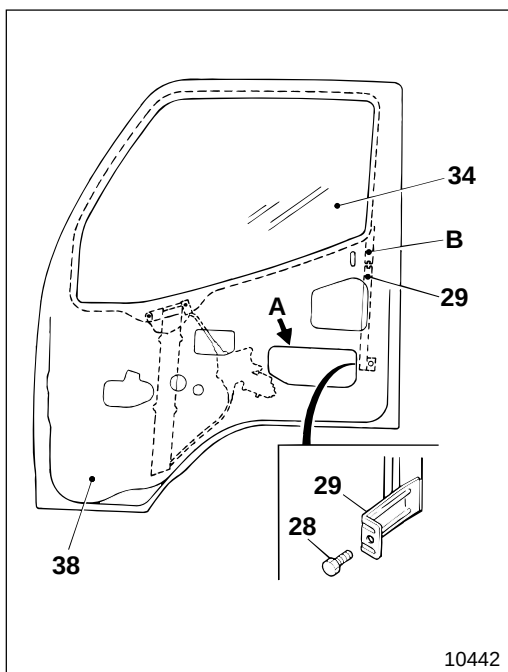
18 Installation of waterproof cover

- Apply butyl tape A to door panel 38 as illustrated.
- Stick waterproof cover 18 over butyl tape A.



22 Installation of door lock cylinder

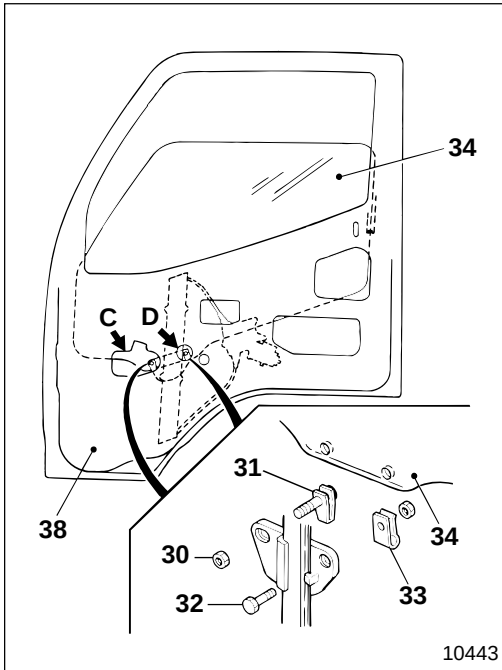
- 21 : Clip
A : Front of the vehicle



34 Removal and installation of door glass

Remove all parts supporting door glass 34 and remove the door glass from the door opening.

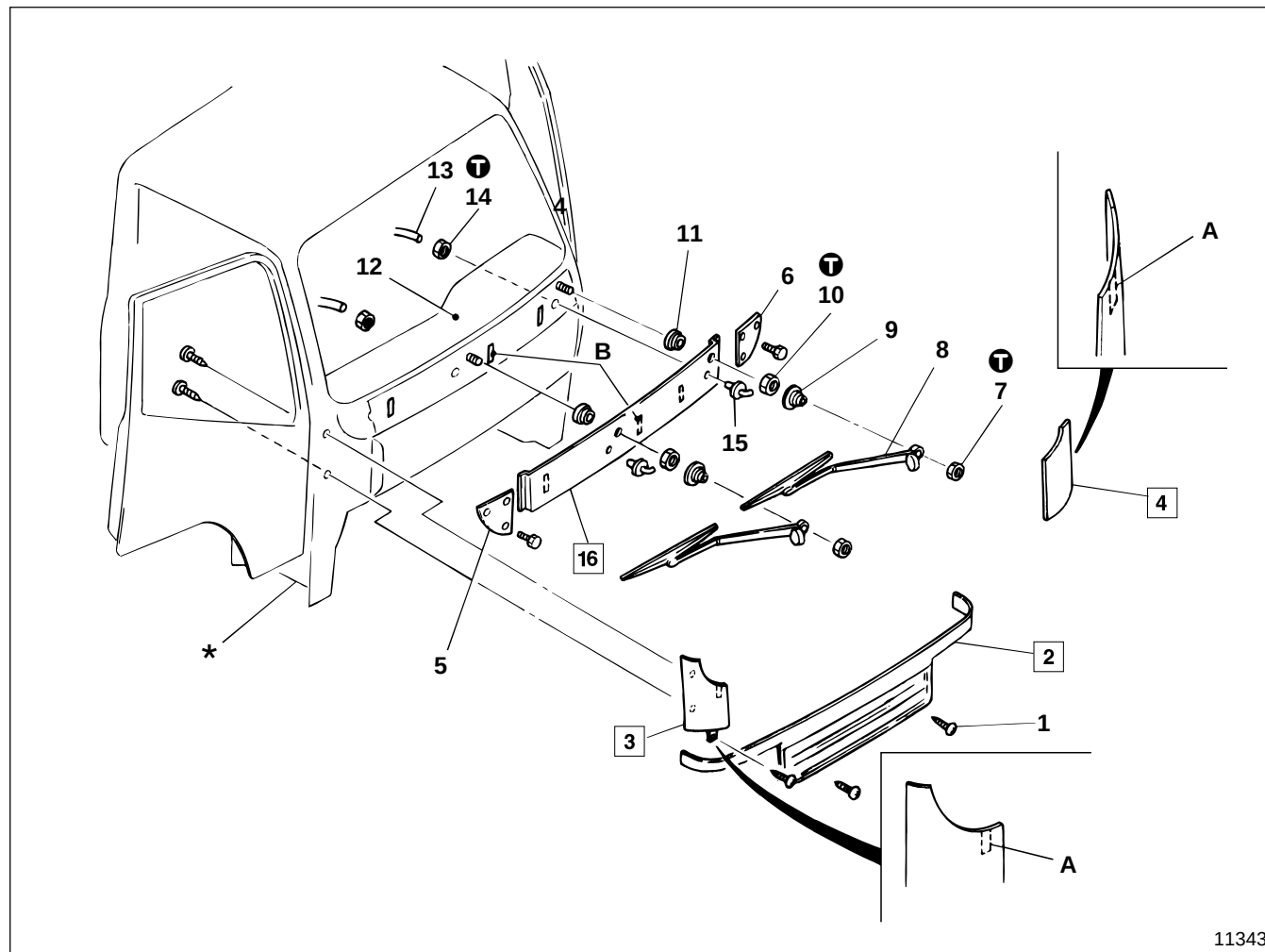
- Raise door glass 34 to the upper limit.
- Remove bolt 28 through hole A of door panel 38 to remove lower sash 29 which is inserted into upper sash B.



- Lower door glass **34** to the level where nut **30** and bolt **32** can be seen through holes **C** and **D** of door panel **38** respectively.
- Hold door glass **34** with your hands and remove glass holders **31**, **33**.
- Remove door glass **34** via the door opening.
- For installation, follow the removal sequence in reverse.

CAB EXTERIOR FITTING

Front Panel



11343

● Disassembly sequence

- | | | |
|------------------------|--------------------------------|-----------------------------|
| 1 Screw | 8 Wiper arm and blade assembly | 14 Nut |
| 2 Front grille | P42-46 | 15 Hose joint |
| 3 Front side panel, RH | 9 Pivot cap | 16 Front garnish |
| 4 Front side panel, LH | 10 Nut | |
| 5 Side garnish, RH | 11 Packing washer | ★ : Cab assembly |
| 6 Side garnish, LH | P42-46 | A : Pawl (Front side panel) |
| 7 Nut | 12 Instrument panel | B : Magic tape |
| | P42-53 | |
| | 13 Washer hose | |

● 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
7	Nut (Wiper arm and blade assembly mounting)	9.8 to 15 {7.2 to 11, 1.0 to 1.5}	—
10	Nut (Packing washer mounting)	14 to 20 {10 to 14, 1.4 to 2.0}	—
14	Nut (Hose joint connecting)	0.59 to 0.88 {0.43 to 0.65, 0.06 to 0.09}	—

◆ Service procedure

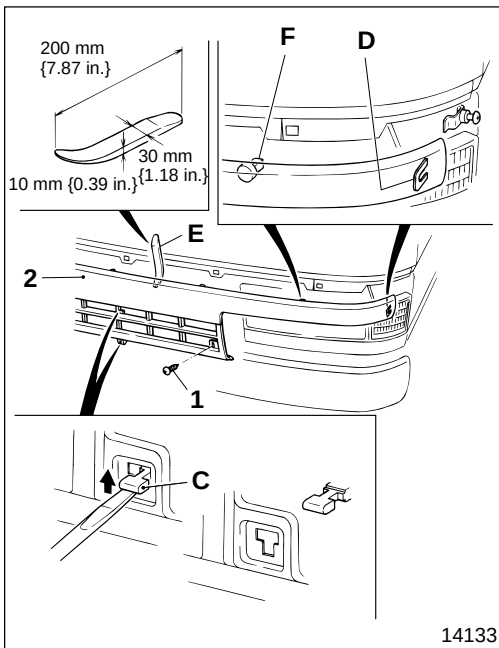
2 Removal and installation of front grille

- Remove screws **1** (two points) from front grilles **2**.
- Lift up the ends of clips **C** (two points), located in the center of front grilles **2**, using a screwdriver, and unlock them from the clips.
- Pull out front grilles **2** horizontally, in the vehicle forward running direction, to remove them.

CAUTION ⚠

- Be careful not to apply too much force to front grilles **2**, because this would damage them. Be especially careful to avoid applying force to clips **D** at both sides, support the clips using your hands. If it is hard to remove the front grilles, remove them using nylon jig **E** as illustrated.
- Be careful not to use force when you pull out clips **F** (five points) from the tops of front grilles **2**, because this would damage them.

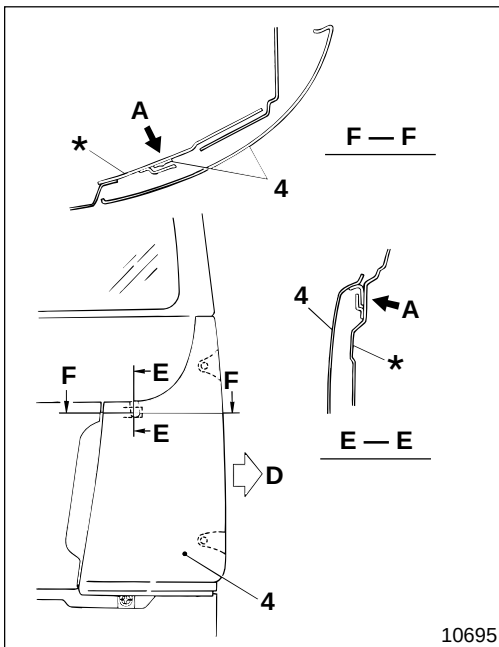
- For installation, follow the removal sequence in reverse.



14133

3 4 Installation and removal of front side panels RH, LH

- Move front side panels RH **3**, LH **4** to the outside of the vehicle to remove them from the cab assembly *****.
A : Pawl
(The illustration shows front side panel LH **4**.)
- For installation, follow the removal sequence in reverse.



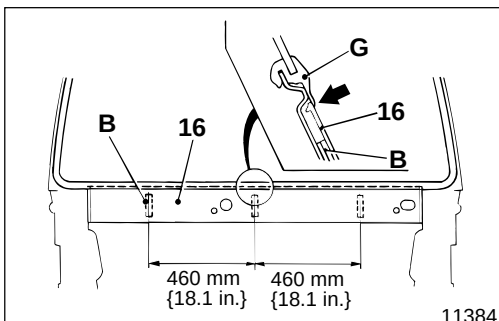
10695

16 Installation of front garnish

NOTE

When installing front garnish **16**, be careful not to catch weather-strip **G** of the windshield.

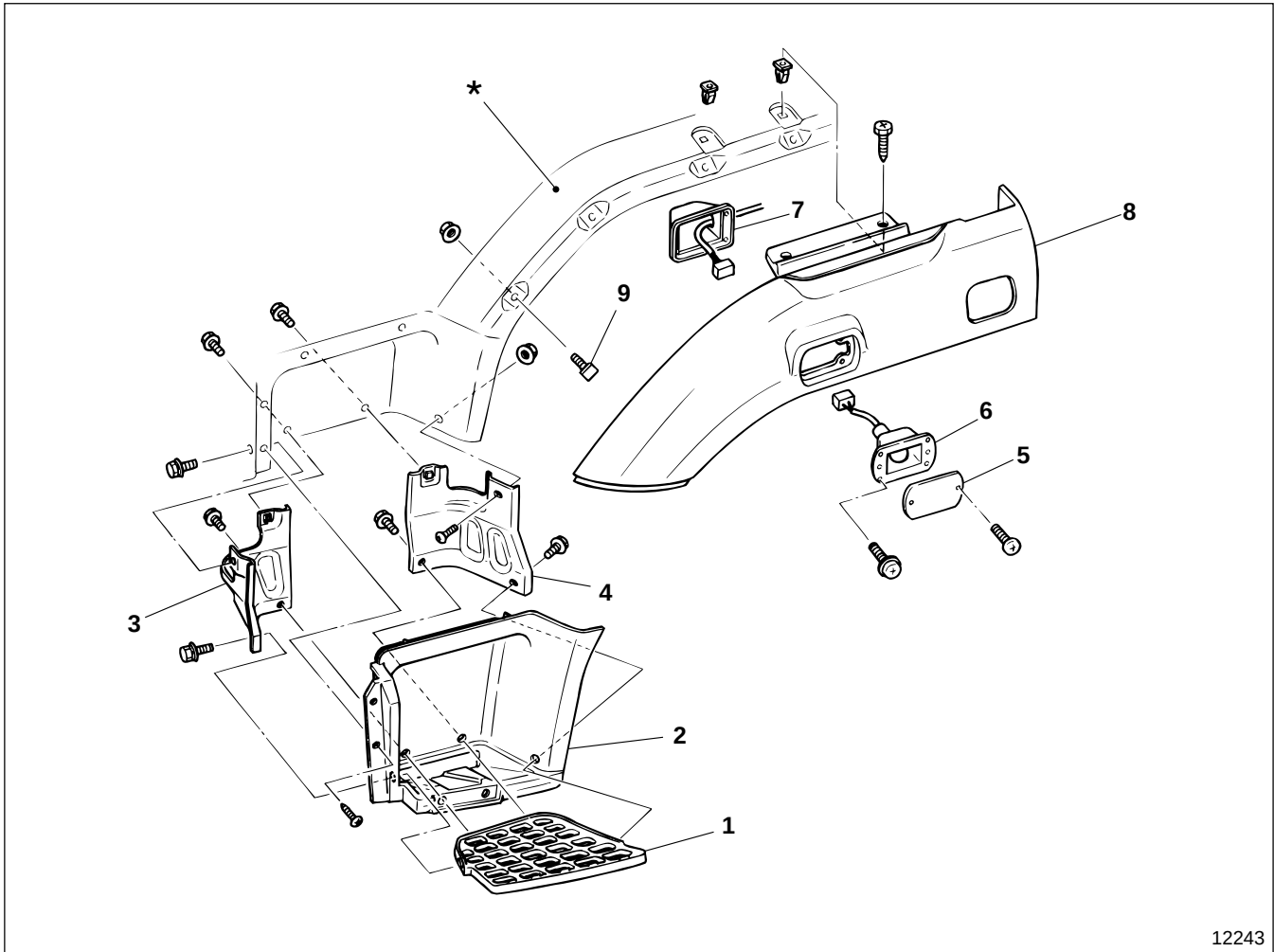
- B : Magic tape (3 points)



11384

CAB EXTERIOR FITTING

Step and Fender



● Removal sequence

- | | |
|-------------------------|-------------------------------|
| 1 Step | 7 Side turn signal lamp cover |
| 2 Step garnish | 8 Fender garnish |
| 3 Front step bracket | 9 Set bolt |
| 4 Rear step bracket | |
| 5 Lens | |
| 6 Side turn signal lamp | |

* : Cab assembly

● Installation sequence

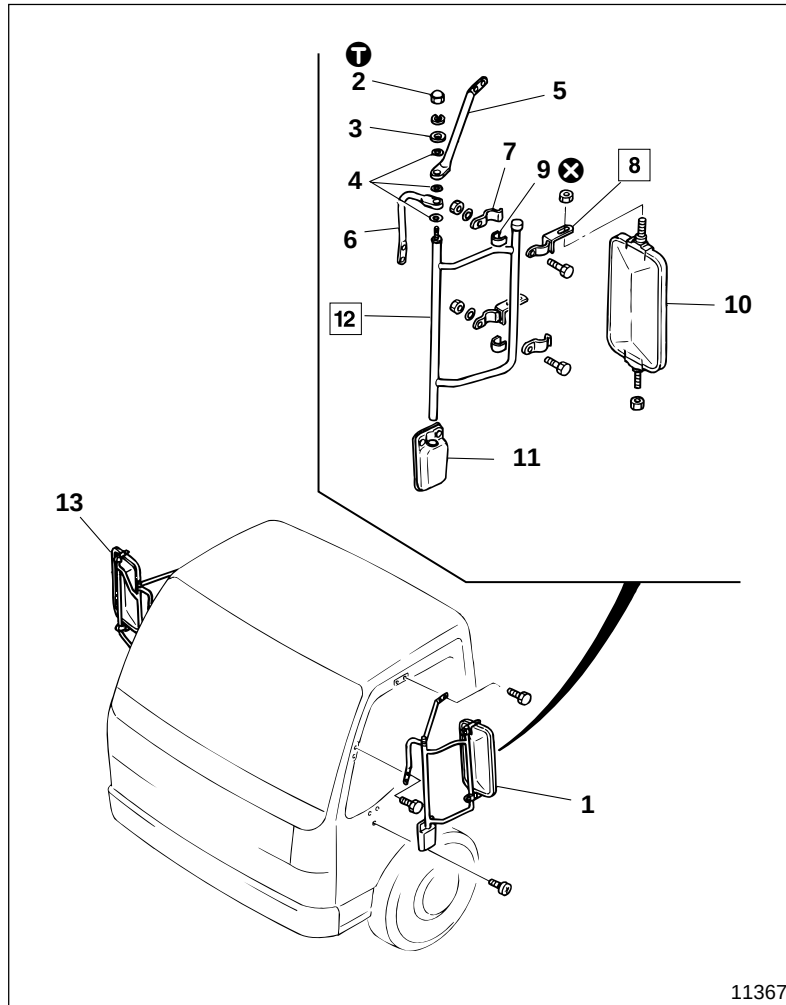
Follow the removal sequence in reverse.

NOTE

This illustration only shows the step and fender for the left side; the same service procedure described above is used for the right side.

MEMO

MIRROR



● Removal sequence

- 1 Outside mirror stay assembly, LH
- 2 Nut
- 3 Washer (Stainless)
- 4 Washer
- 5 Sub mirror stay
- 6 Sub mirror stay
- 7 Mirror holder B
- 8 Mirror holder
- 9 Packing
- 10 Outside mirror
- 11 Lower bracket
- 12 Main mirror stay
- 13 Outside mirror stay assembly, RH

⊗ : Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

NOTE

For outside mirror stay assembly RH 13, follow the same service procedure as for outside mirror stay assembly LH 1.

T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

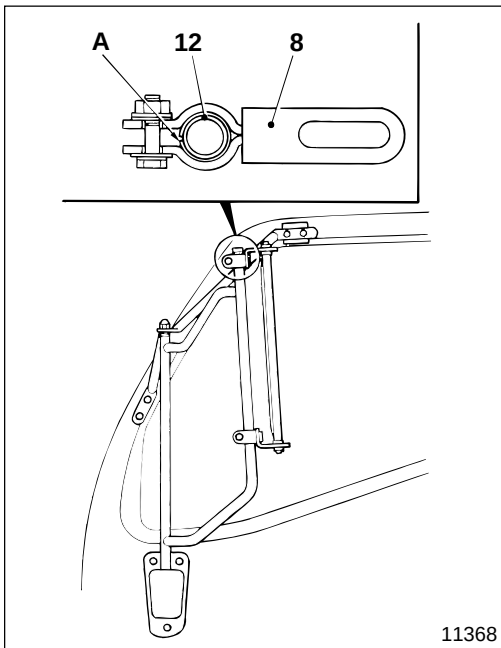
Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Sub mirror stay and main mirror stay mounting)	24.5 to 29.4 {18 to 22, 2.5 to 3.0}	—

◆ Service procedure

8 Installation of mirror holder

Install mirror holder **8** onto main mirror stay **12** in the direction as illustrated.

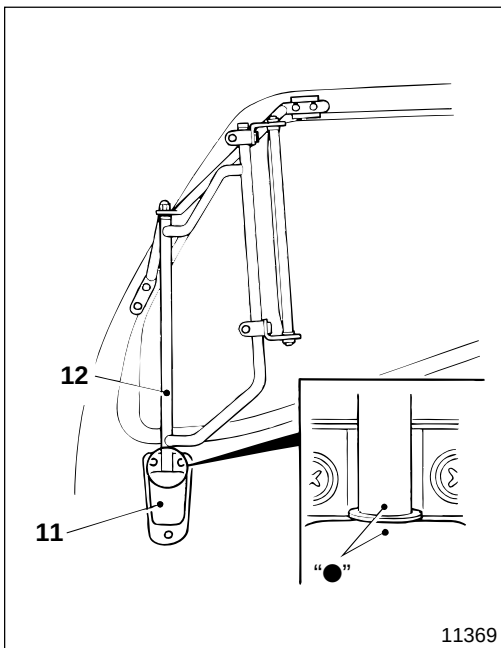
A : Indent of main mirror stay **12**.



11368

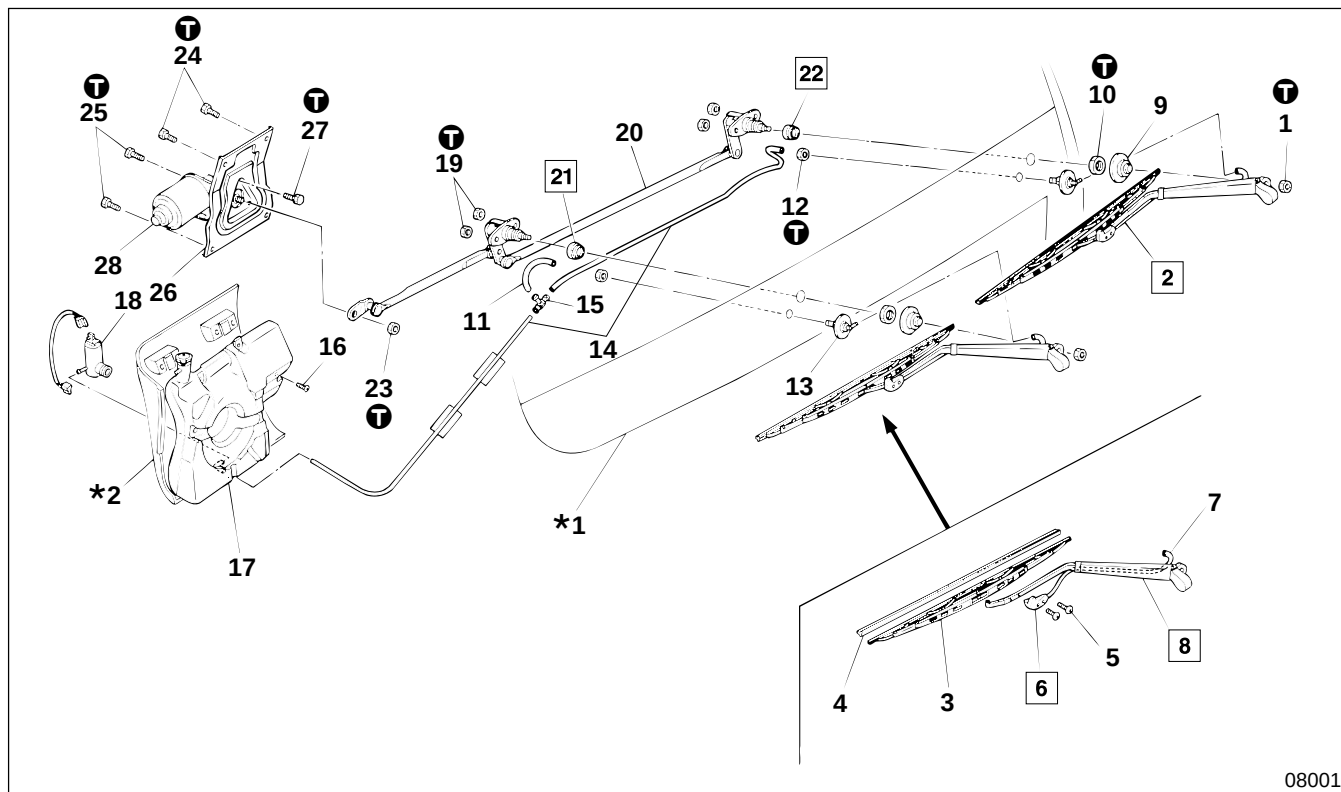
12 Installation of main mirror stay

Install main mirror stay **12** and lower bracket **11** so that alignment marks "●" are aligned.



11369

WIPER AND WASHER



08001

● Disassembly sequence

- 1 Nut
- 2 Wiper arm and blade assembly
- 3 Wiper blade
- 4 Blade rubber
- 5 Screw
- 6 Washer nozzle assembly
- 7 Hose
- 8 Wiper arm
- 9 Pivot cap
- 10 Nut
- 11 Washer hose
- 12 Nut
- 13 Hose joint
- 14 Washer hose
- 15 Joint
- 16 Screw

- 17 Washer tank
- 18 Washer motor  Gr 54
- 19 Nut
- 20 Wiper link assembly
- 21 Packing washer
- 22 Packing washer
- 23 Nut
- 24 Bolt (L : 16 mm {0.63 in.})
- 25 Bolt (L : 12 mm {0.47 in.})
- 26 Wiper motor bracket
- 27 Bolt
- 28 Wiper motor  Gr 54

*1 : Front garnish  P42-40

*2 : Assistant driver's side lower panel  P42-51

NOTE

Before disassembling parts 11 to 28, remove the instrument panel to allow access to them.  P42-49

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
2	Wiping force of wiper arm	5.7±0.49 N {1.28±0.11 lbf, 0.58±0.05 kgf}	—	Replace

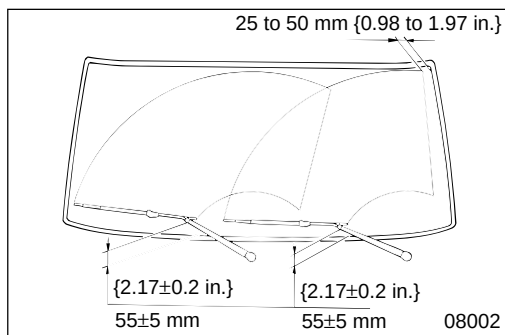
T Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Nut (Wiper arm and blade assembly mounting)	9.8 to 15 {7.2 to 11, 1 to 1.5}	—
10	Nut (Packing washer mounting)	14 to 20 {10 to 14, 1.4 to 2}	—
12	Nut (Hose joint mounting)	0.6 to 0.9 {0.4 to 0.7, 0.06 to 0.09}	—
19	Nut (Wiper link mounting)	9.8 to 15 {7.2 to 11, 1 to 1.5}	—
23	Nut (Wiper motor and wiper link mounting)	1.7 to 2.4 {1.2 to 1.7, 0.17 to 0.24}	—
24, 25	Bolt (Wiper motor bracket mounting)	9.8 to 15 {7.2 to 11, 1 to 1.5}	—
27	Bolt (Wiper motor mounting)	5.4 {4, 0.55}	—

◆ Service procedure**2 Installation of wiper arm and blade assembly**

Install wiper arm and blade assembly **2** so that dimensions from the edges of the weatherstrip are as illustrated.

**6 Inspection of washer nozzle assembly**

Make sure that washer fluid spreading target positions **H** are within dimensions **A** to **G**. (Illustration shows the view from inside cab.)

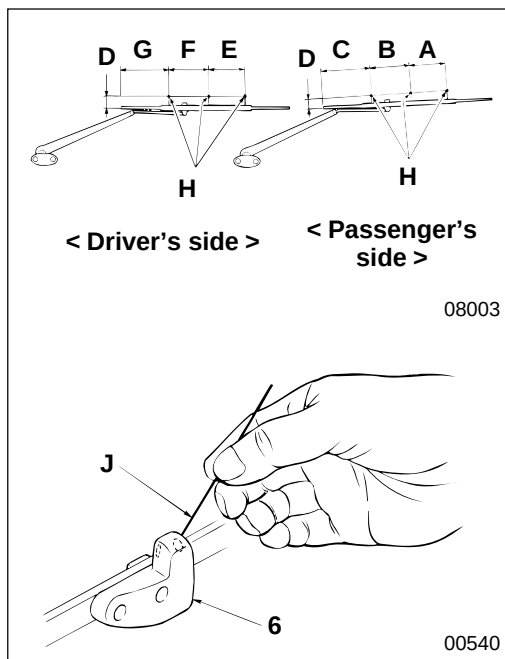
Unit : mm {in.}

		H
Passenger's side	A	110 {4.33}
	B	90 {3.54}
	C	170 {6.69}
	D	15 {0.59}
Driver's side	E	90 {3.54}
	F	90 {3.54}
	G	160 {6.30}

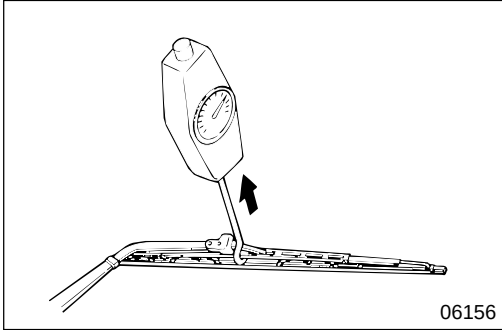
If washer fluid spreading target positions **H** deviate from these dimensions, adjust the jet hole angle of washer nozzle assembly **6** using wire **J**.

CAUTION ⚠

Be careful not to damage the jet hole of washer nozzle assembly **6** with wire **J** when adjusting the angle.

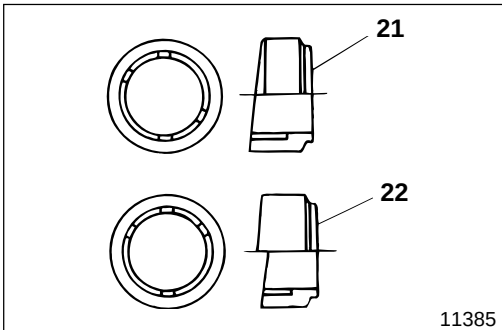


WIPER AND WASHER



8 Inspection of wiper arm

If the measured value deviates from the standard value, replace wiper arm **8**.



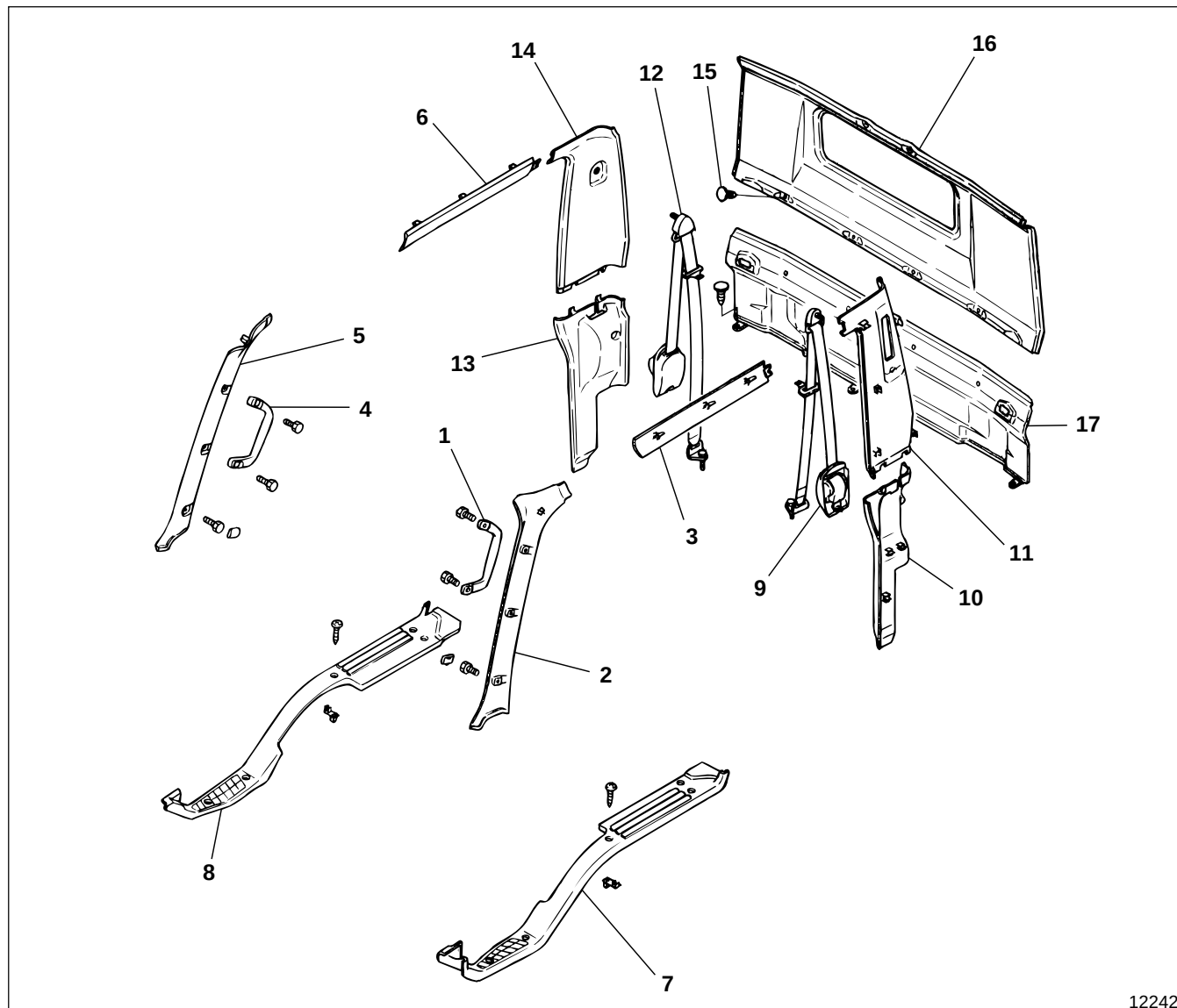
21 **22** Packing washer

Because the shape of packing washer **21** for the passenger's side and packing washer **22** for the driver's side are different, be careful not to mix them up during assembly.

CAB INTERIOR FITTING

42

Trim



12242

● Removal sequence

- | | | |
|-------------------------|-------------------------------|-------------------------------|
| 1 Front pillar grip, LH | 7 Scuff plate, LH | 13 Lower rear pillar trim, RH |
| 2 Front pillar trim, LH | 8 Scuff plate, RH | 14 Upper rear pillar trim, RH |
| 3 Roof side trim, LH | 9 Seat belt assembly, LH | 15 Rear trim clip |
| 4 Front pillar grip, RH | 10 Lower rear pillar trim, LH | 16 Upper rear trim |
| 5 Front pillar trim, RH | 11 Upper rear pillar trim, LH | 17 Lower rear trim |
| 6 Roof side trim, RH | 12 Seat belt assembly, RH | |

CAUTION

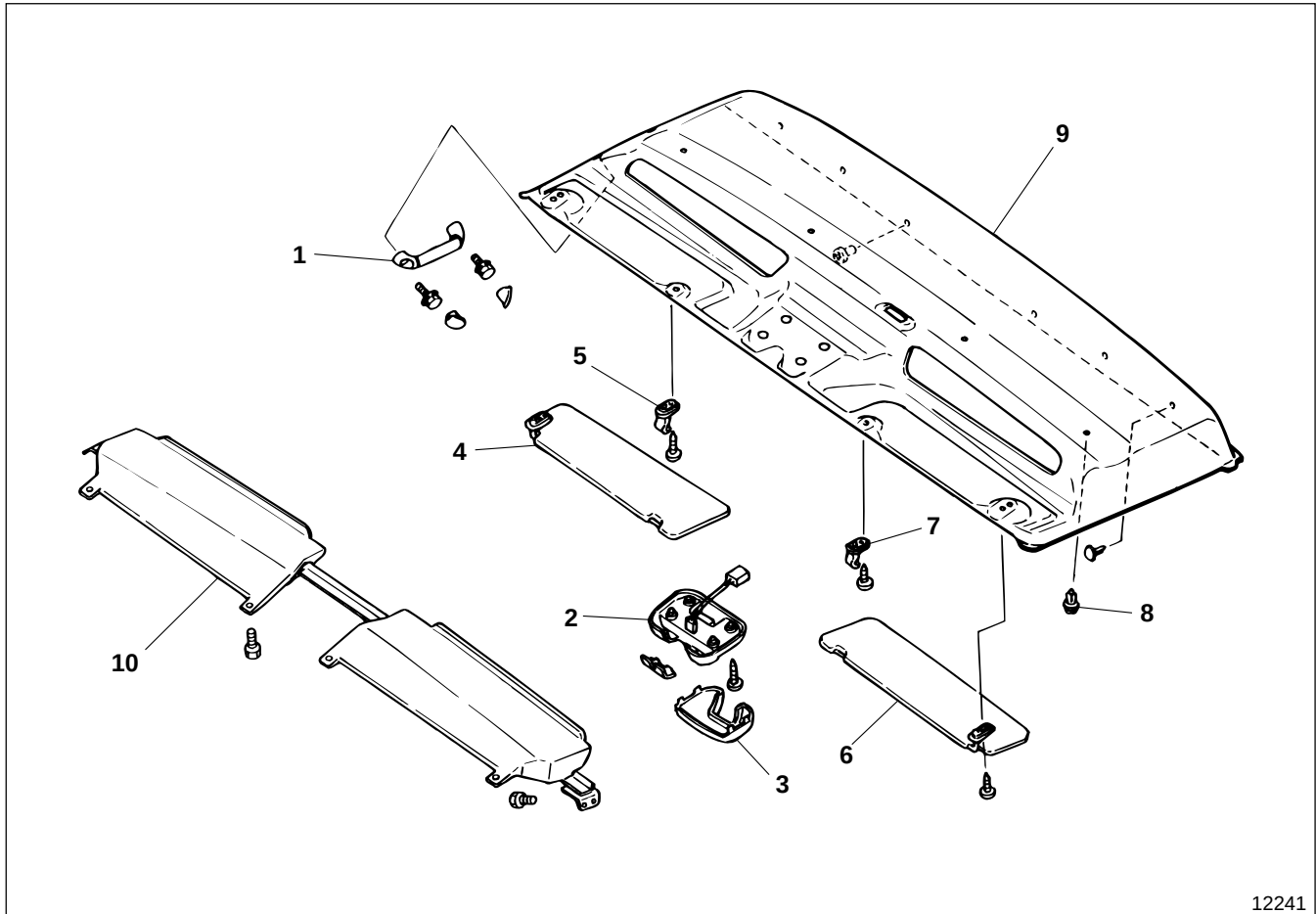
Do not disassemble seat belt assemblies 9, 12 because this might cause malfunction of the emergency locking retractor.

● Installation sequence

Follow the removal sequence in reverse.

CAB INTERIOR FITTING

Headlining



12241

● Removal sequence

- | | |
|---|-------------------|
| 1 Grip | 6 Sun visor, LH |
| 2 Lens | 7 Hook |
| 3 Cab lamp assembly  Gr 54 | 8 Headlining clip |
| 4 Sun visor, RH | 9 Headlining |
| 5 Hook | 10 Shelf assembly |

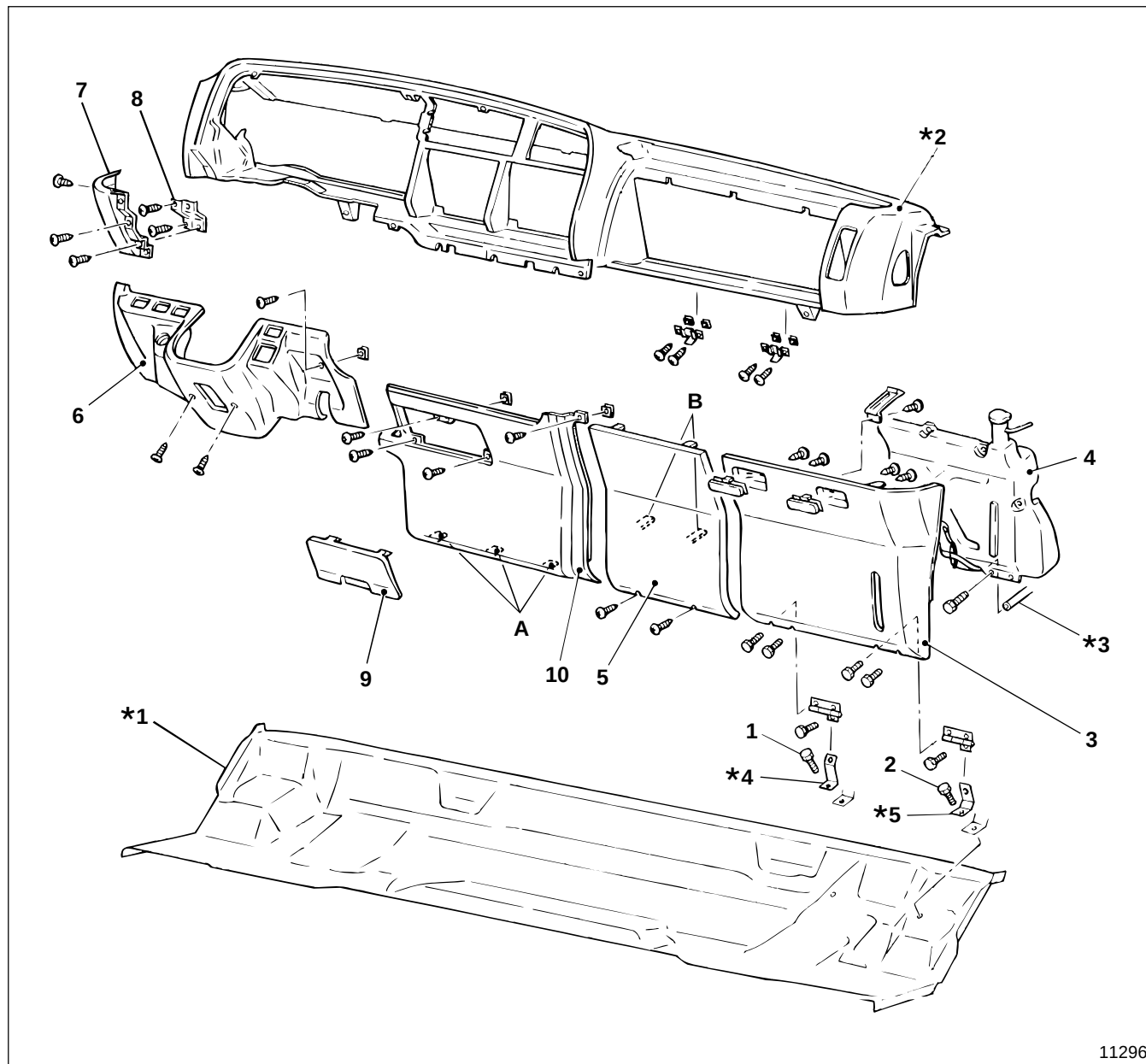
● Installation sequence

Follow the removal sequence in reverse.

INSTRUMENT PANEL

42

Lower Panel



● Disassembly sequence

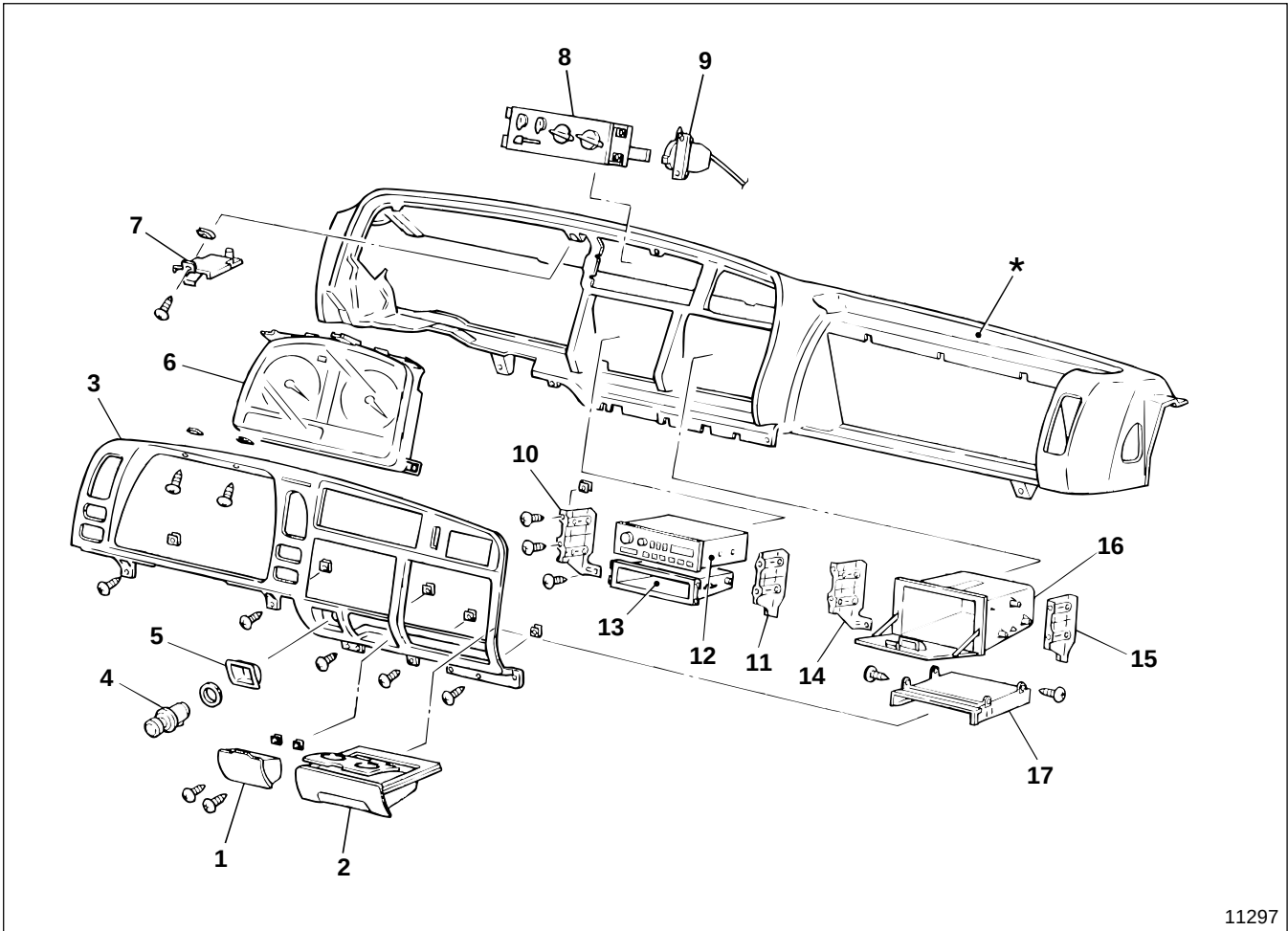
- | | | |
|--------------------------------|-----------------------|-------------------------------|
| 1 Bolt | 7 Side panel | *2 : Instrument panel P42-53 |
| 2 Bolt | 8 Side panel bracket | *3 : Water hose |
| 3 Passenger's side lower panel | 9 Fuse box lid | *4 : Cooling unit |
| 4 Window washer tank | 10 Center lower panel | *5 : Blower unit |
| 5 Center lower panel | | |
| 6 Driver's side lower panel | *1 : Front floor | A : Fixed on heater unit |
| | | B : Fixed on joint duct |

● Assembly sequence

Follow the disassembly sequence in reverse.

INSTRUMENT PANEL

Meter Bezel



11297

● Disassembly sequence

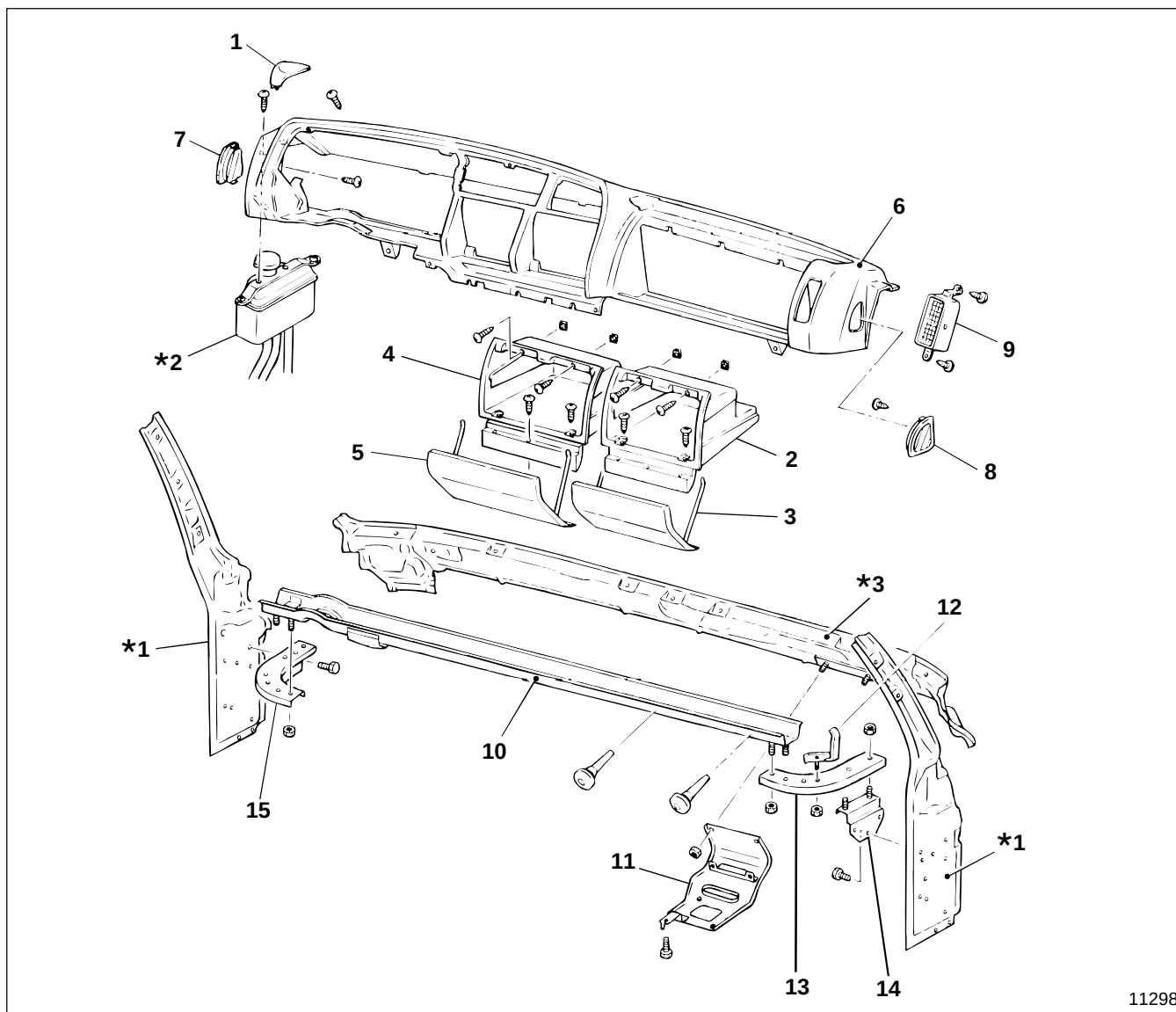
- | | |
|---|----------------------|
| 1 Ashtray | 10 Bracket, LH |
| 2 Cup holder | 11 Bracket, RH |
| 3 Meter bezel | 12 Radio < Option > |
| 4 Cigarette lighter  Gr 54 | 13 Box |
| 5 Protector | 14 Bracket, LH |
| 6 Meter cluster  Gr 54 | 15 Bracket, RH |
| 7 Card holder | 16 Glove compartment |
| 8 Heater control assembly  Gr 55B | 17 Cup holder base |
| 9 Cool air bypass control assembly  Gr 55B | |

* : Instrument panel  P42-53

● Assembly sequence

Follow the disassembly sequence in reverse.

Instrument Panel



11298

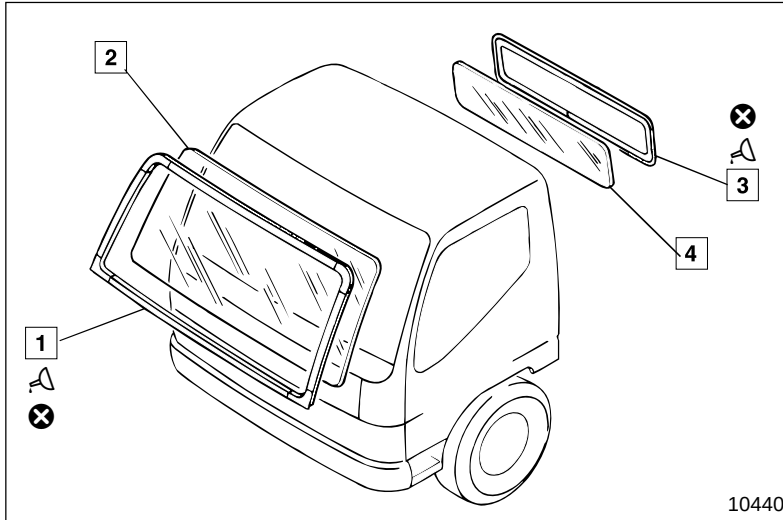
● Disassembly sequence

- | | | |
|-------------------------|-----------------------------|---|
| 1 Fluid tank lid | 8 Side demister grille | 15 Instrument panel bracket |
| 2 Glove compartment | 9 Air outlet grille | |
| 3 Glove compartment lid | 10 Instrument panel frame | *1 : Upper front inner pillar |
| 4 Glove compartment | 11 Relay bracket | *2 : Fluid tank  Gr 21 |
| 5 Glove compartment lid | 12 Instrument panel support | *3 : Front window rail |
| 6 Instrument panel | 13 Instrument panel bracket | |
| 7 Side demister grille | 14 Instrument panel bracket | |

● Assembly sequence

Follow the disassembly sequence in reverse.

WINDOW GLASS



● Disassembly sequence

- 1 Weatherstrip
- 2 Windshield
- 3 Weatherstrip
- 4 Rear window glass

⊗ : Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

🔧 Lubricant

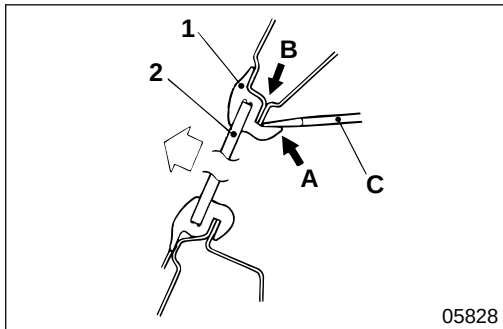
Location	Points of application	Kinds	Quantity
1, 3	Lip area of weatherstrip	Soapy water	As required

◆ Service procedure

1 2 Weatherstrip and windshield

[Removal]

- From the inside of the cab, separate lip **A** of weatherstrip **1** from flange lip **B** of the cab.
- C** : Screwdriver
- Push windshield **2** outward to remove it from the cab.

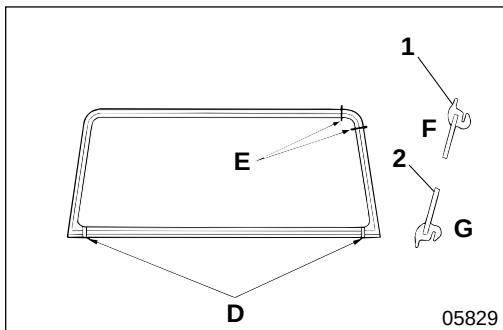


05828

[Installation]

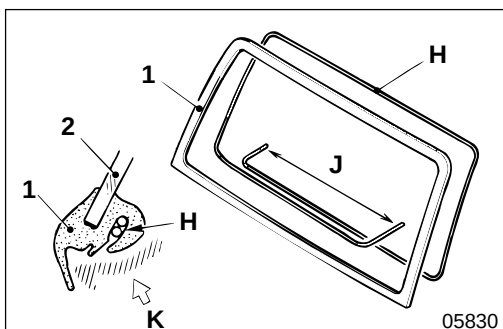
When installing the windshield, pull cord **H** attached to weatherstrip **1** and turn over lip **A**, following the procedure below:

- Position drain hole **D** and joint part **E** of weatherstrip **1** as illustrated and install them on windshield **2**.
- F** : Outside
- G** : Inside

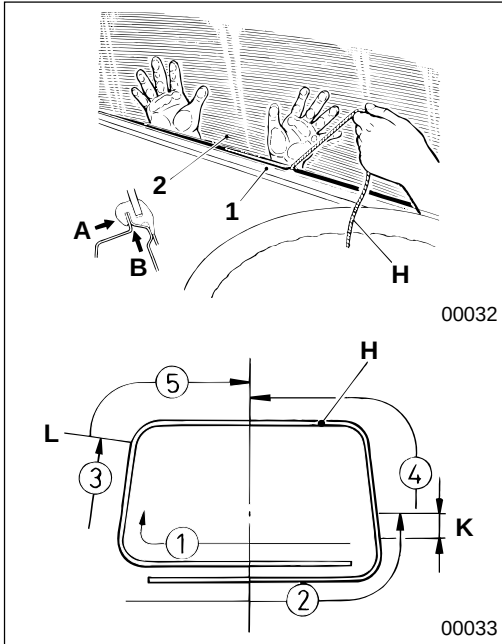


05829

- Lay cord **H** in the cab mounting groove of weatherstrip **1** as illustrated, and overlap the cord at the lower side of the glass by the specified length, see **J**.
- Apply soapy water **K** to weatherstrip **1**.
- Align windshield **2** with the cab.



05830



- Push windshield **2** inward from the outside of the cab firmly.
- Inside the cab, pull one end of cord **H** to install lip **A** of weatherstrip **1** into flange lip **B** of the cab.

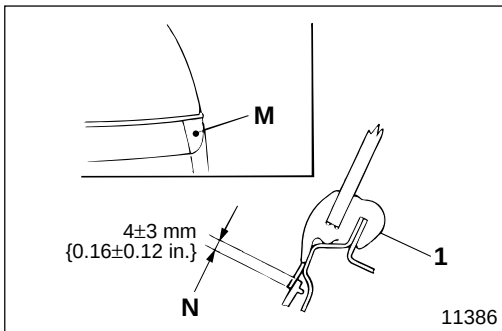
- Pull cord **H** in the numbered order as illustrated and at the same time have someone push windshield **2** into weatherstrip **1**, tapping the windshield with a rubber-headed mallet.

K : approximately 100 mm {3.94 in.} from the starting point of straight line

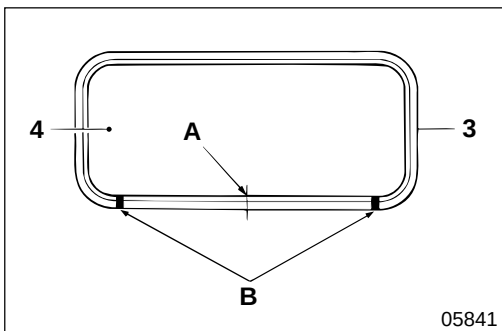
L : up to the end of straight line

CAUTION ⚠

Make sure that windshield **2 is installed correctly into the cab before hitting the windshield with the rubber-headed mallet, otherwise the windshield might be broken.**



- Provide an overlapped margin **N** on weatherstrip **1** and side garnish **M** to prevent water flowing backwards from the water drain hole.



3 4 Weatherstrip, rear window glass

- Install so that joint **A** of weatherstrip **3** is at the center of rear window **4**.
B : Water drain hole
- Except for the point mentioned above, follow the same service procedure as for installation of windshield. 📖 P42-54



FH

Service Manual

Group 54

Electrical

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

GROUP 54 ELECTRICAL

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8 ENGINE AND TRANSMISSION ELECTRICS

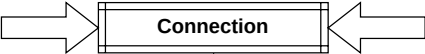
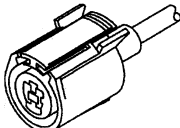
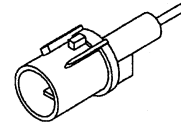
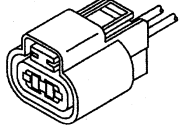
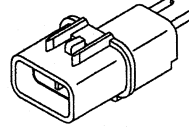
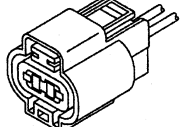
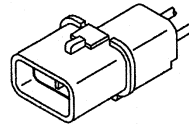
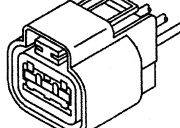
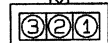
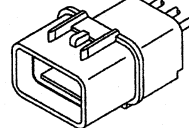
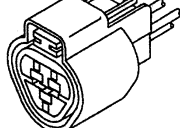
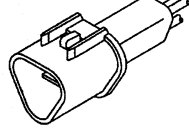
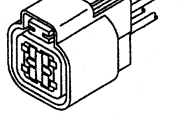
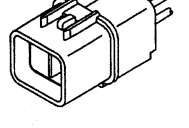
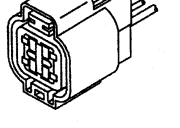
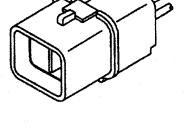
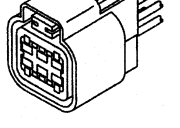
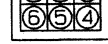
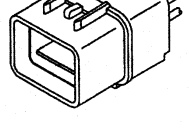
(801) ENGINE ELECTRICS	54-8-2
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(850) TRANSMISSION POWER TAKE-OFF CIRCUIT < Option >	54-8-10

9 OTHERS

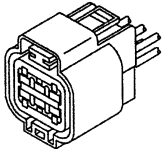
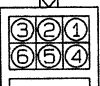
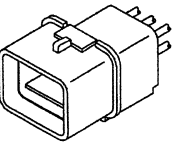
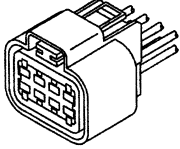
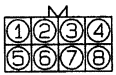
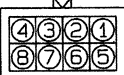
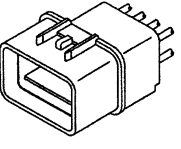
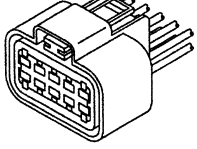
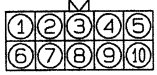
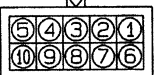
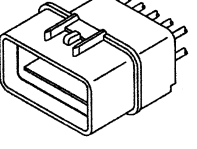
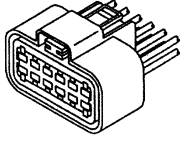
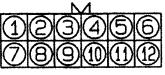
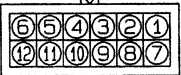
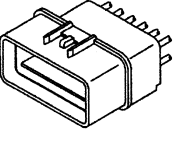
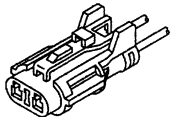
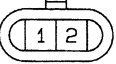
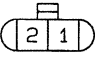
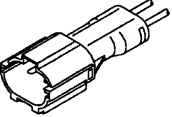
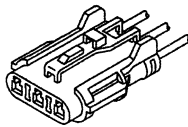
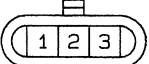
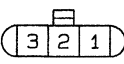
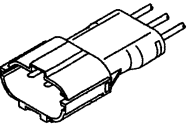
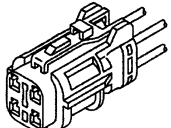
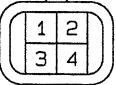
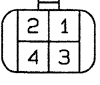
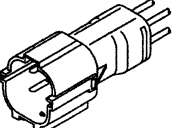
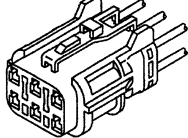
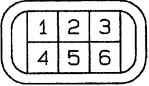
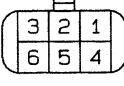
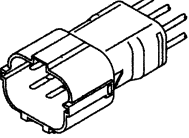
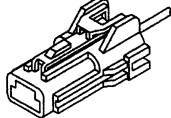
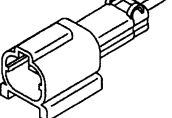
STRUCTURE AND OPERATION	54-9-2
(905) JOINT CONNECTOR	54-9-6
(910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT	54-9-8

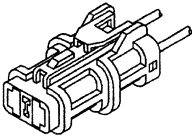
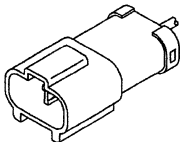
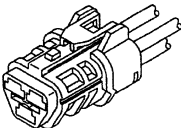
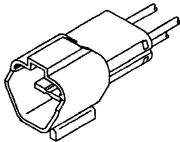
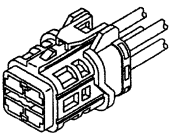
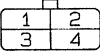
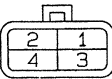
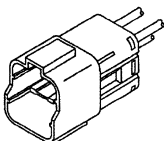
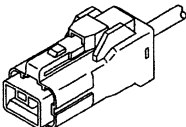
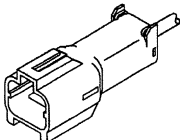
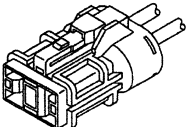
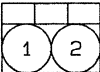
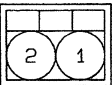
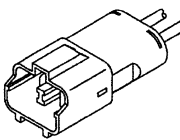
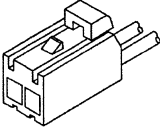
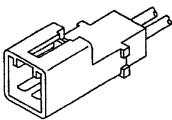
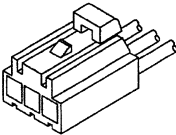
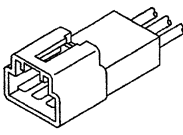
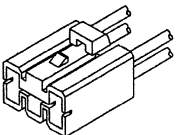
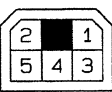
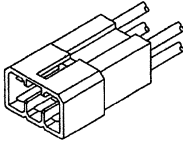
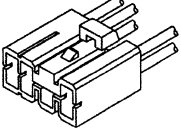
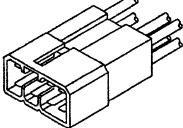
CONNECTOR CONFIGURATION CHART

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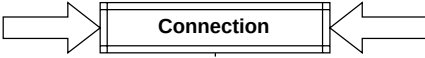
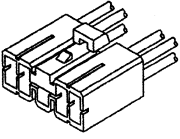
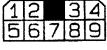
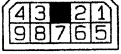
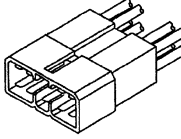
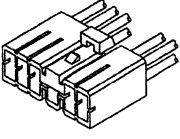
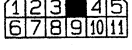
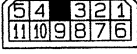
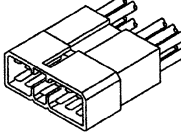
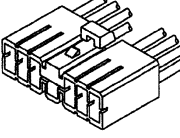
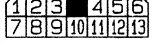
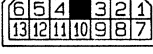
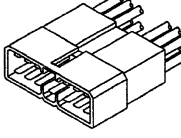
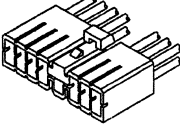
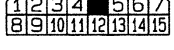
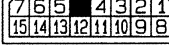
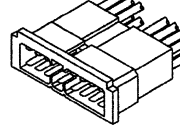
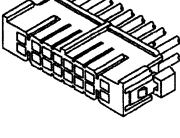
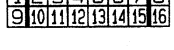
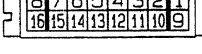
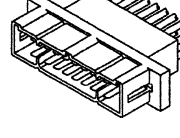
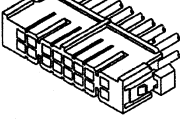
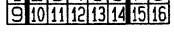
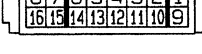
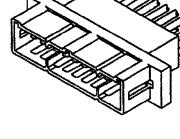
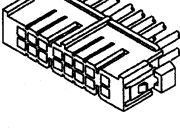
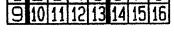
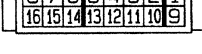
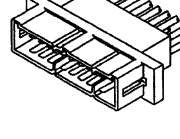
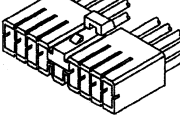
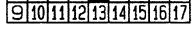
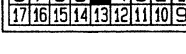
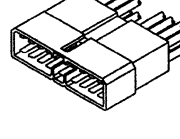
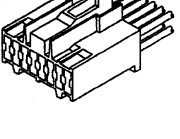
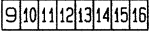
Model (Number shows number of pins)					
AA	AA 1 A				
	AA 2 A				
	AA 2 B				
	AA 3 A				
	AA 3 B				
	AA 4 A				
	AA 4 B				
	AA 6 A				

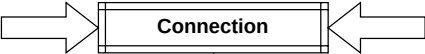
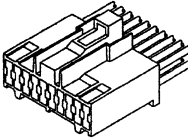
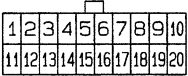
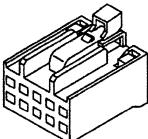
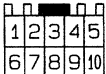
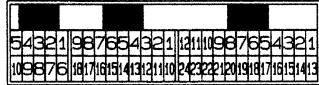
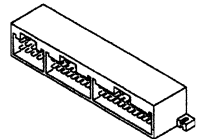
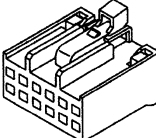
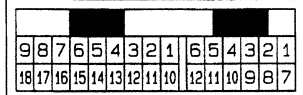
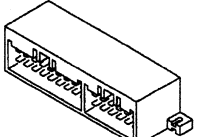
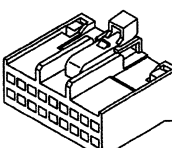
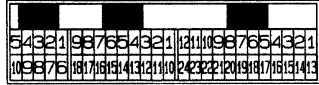
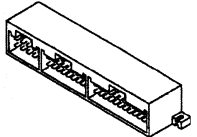
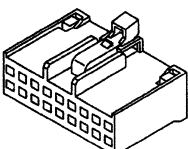
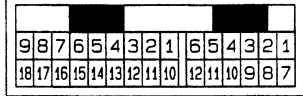
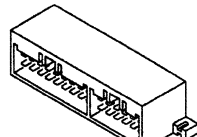
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		 Connection 			
AA	AA 6 B				
	AA 8 A				
	AA10A				
	AA12A				
AB	AB 2 A				
	AB 3 A				
	AB 4 A				
	AB 6 A				
AC	AC 1 A				

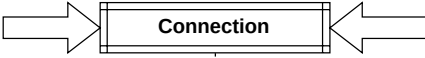
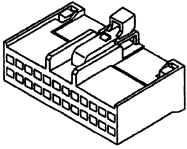
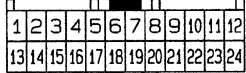
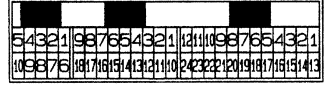
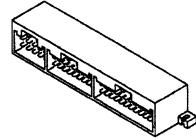
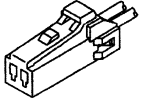
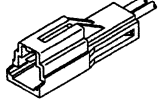
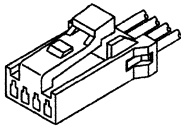
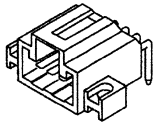
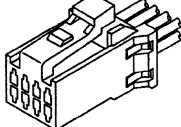
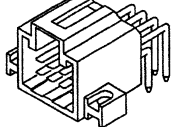
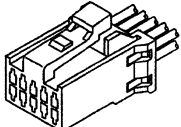
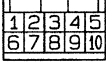
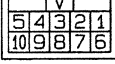
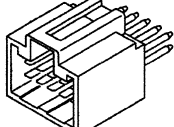
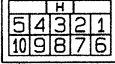
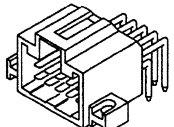
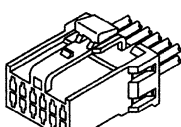
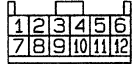
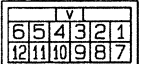
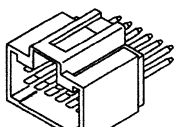
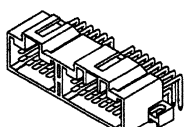
Model (Number shows number of pins)		Connection			
AC	AC 2 A				
	AC 3 A				
	AC 4 A				
AD	AD 1 A				
	AD 2 A				
AE	AE 2 A				
	AE 3 A				
	AE 5 A				
	AE 7 A				

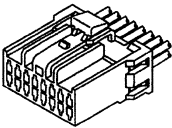
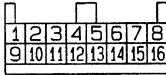
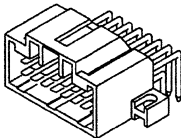
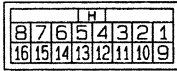
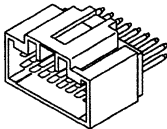
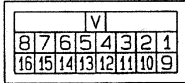
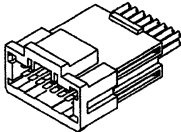
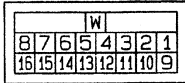
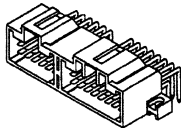
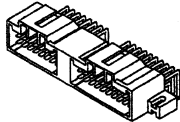
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)					
AE	AE 9 A				
	AE11A				
	AE13A				
	AE15A				
	AE16A (White, Gray, Black)				
	AE16B (Green)				
	AE16C (Blue)				
	AE17A				
AG	AG16A				

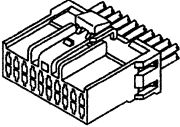
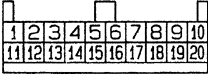
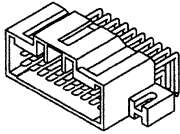
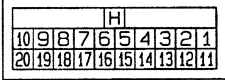
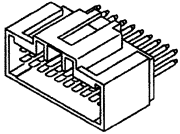
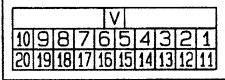
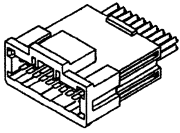
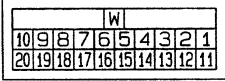
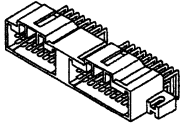
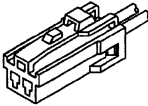
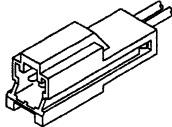
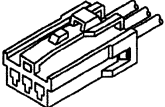
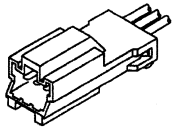
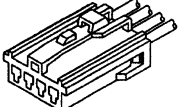
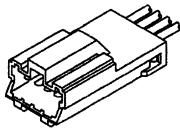
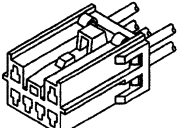
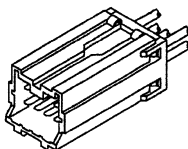
Model (Number shows number of pins)			
AG	AG20A	 	
AH	AH10A	 	 AH10A (AH18A) (AH24A) 
	AH12A	 	 (AH18A) AH12A 
	AH18A	 	 (AH10A) AH18A AH24A 
	AH18B	 	 AH18A (AH12A) 

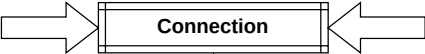
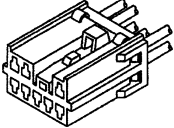
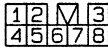
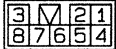
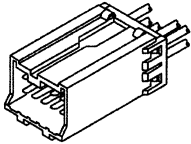
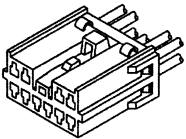
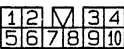
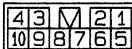
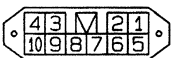
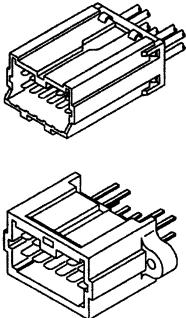
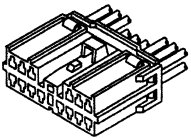
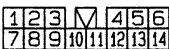
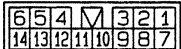
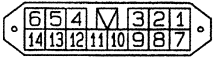
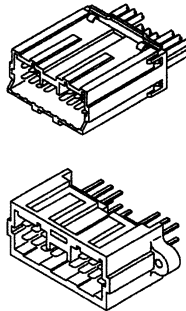
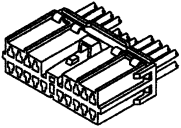
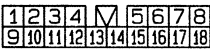
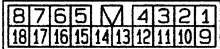
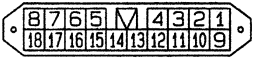
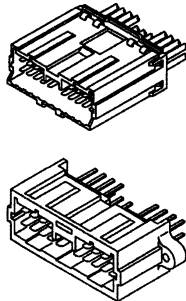
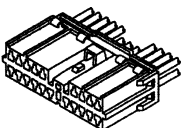
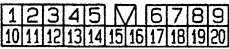
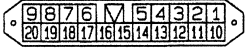
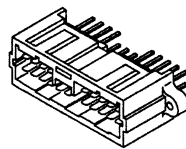
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AH	AH24A	 	 (AH10A) (AH18A) AH24A 
	AJ 2 A	 	 
AJ	AJ 4 A	 	 
	AJ 8 A	 	 
	AJ10A	 	   
	AJ12A	 	   AJ12 (AJ16) 

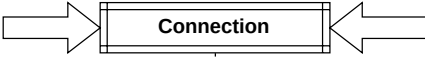
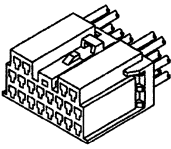
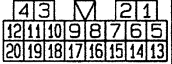
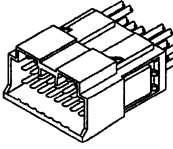
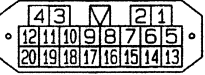
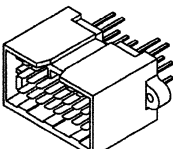
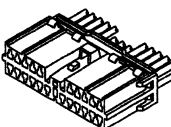
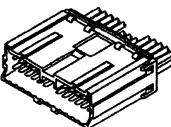
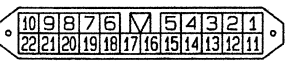
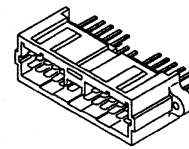
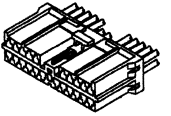
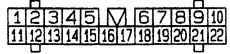
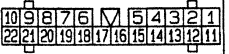
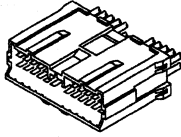
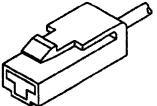
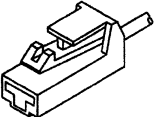
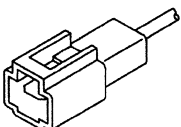
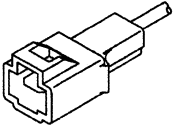
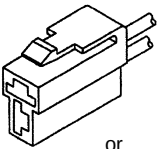
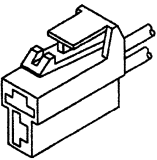
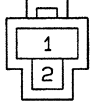
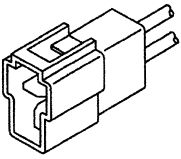
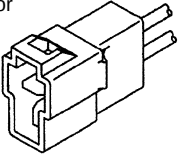
Model (Number shows number of pins)		Connection	
AJ	AJ16A		
			
			
			
			
			

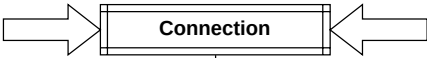
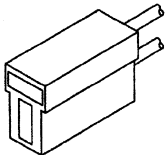
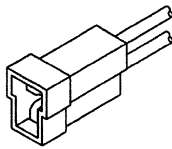
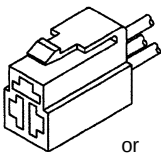
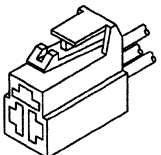
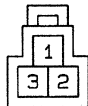
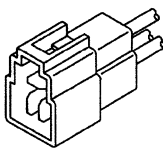
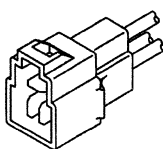
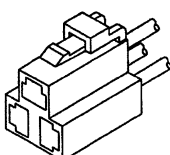
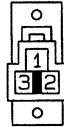
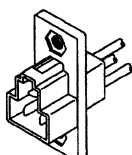
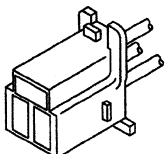
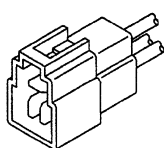
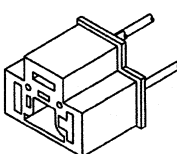
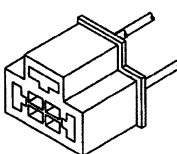
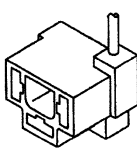
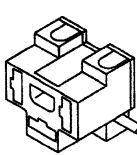
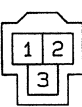
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		→ Connection ←	
AJ	AJ20A	 	 
			 
			 
			  (AJ16A) AJ20A
AK	AK 2 A	 	 
	AK 3 A	 	 
	AK 4 A	 	 
	AK 6 A	 	 

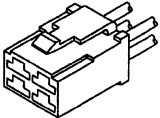
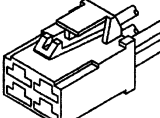
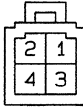
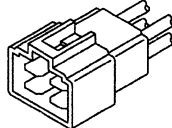
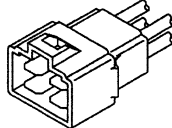
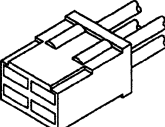
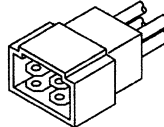
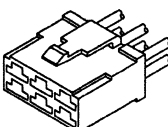
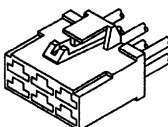
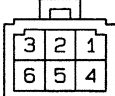
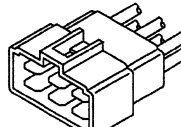
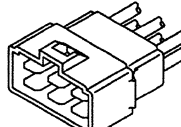
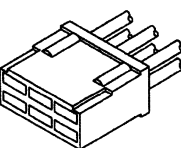
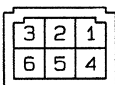
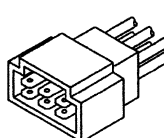
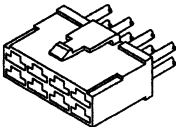
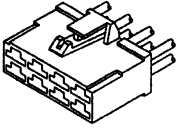
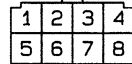
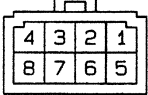
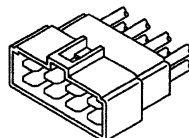
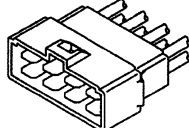
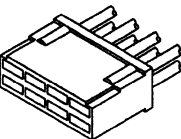
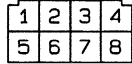
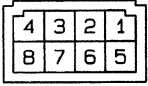
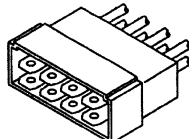
Model (Number shows number of pins)			
AK	AK 8 A	   	
	AK10A	    	
	AK14A	    	
	AK18A	    	
	AK20A	   	

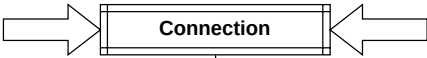
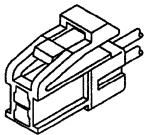
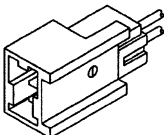
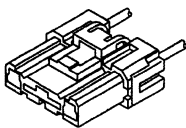
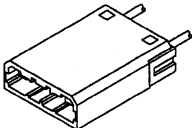
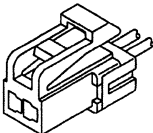
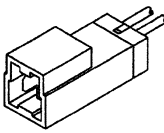
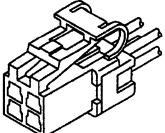
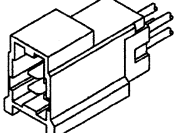
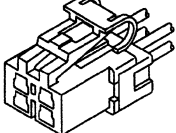
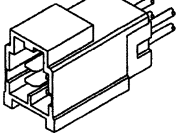
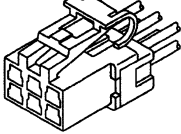
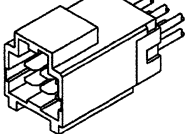
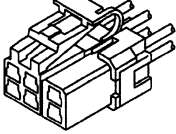
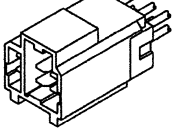
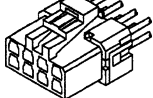
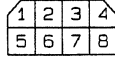
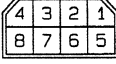
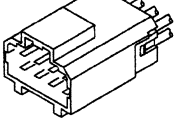
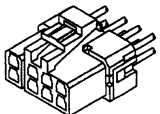
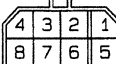
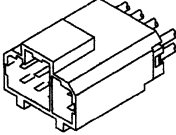
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AK	AK20B	   	 
	AK22A	   	 
	AK22B	   	
AL	AL 1 A	 or  	 or  or 
	AL 2 A	 or  	 or  or 

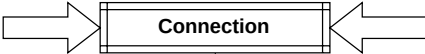
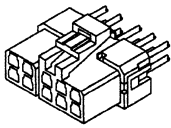
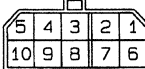
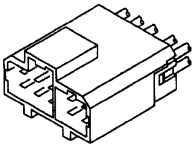
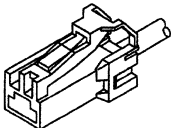
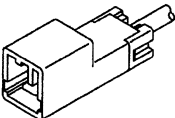
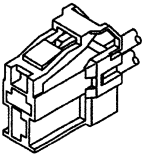
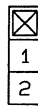
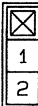
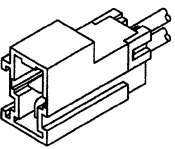
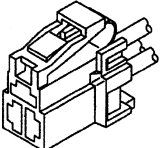
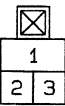
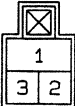
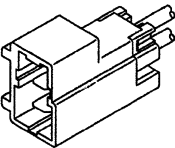
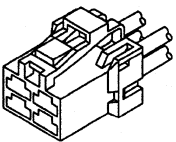
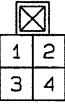
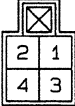
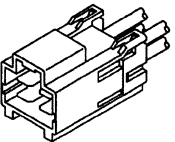
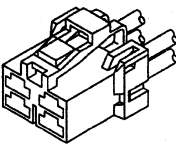
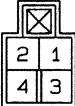
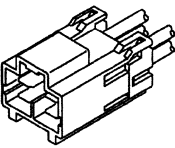
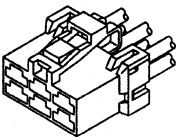
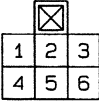
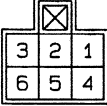
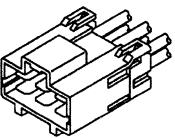
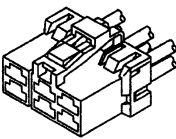
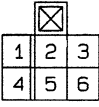
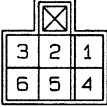
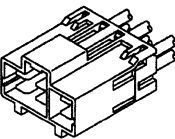
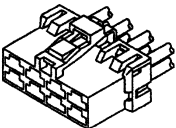
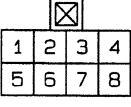
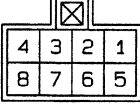
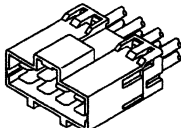
Model (Number shows number of pins)			
AL	AL 2 B	   	
	AL 3 A	 or     or 	
	AL 3 B	   	
	AL 3 C	   	
	AL 3 D	 or  	
	AL 3 E	 or  	

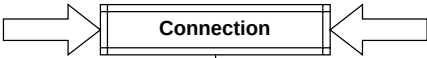
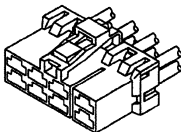
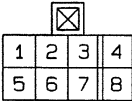
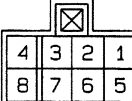
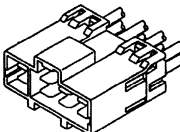
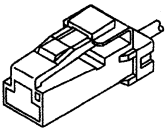
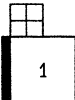
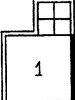
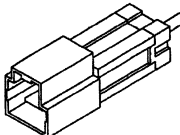
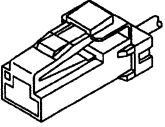
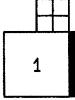
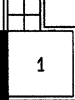
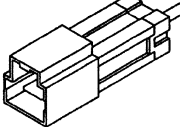
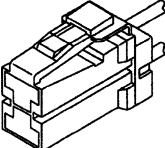
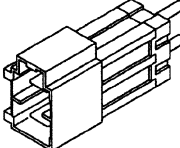
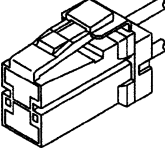
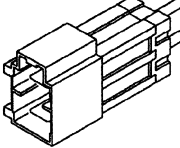
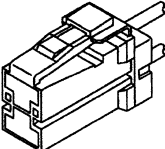
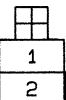
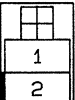
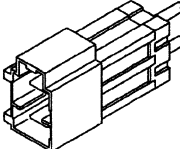
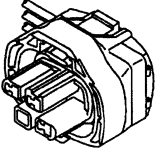
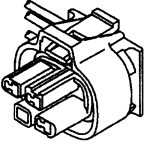
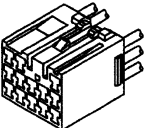
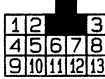
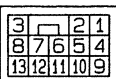
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)		 Connection 			
AL	AL 4 A	 or 			 or 
	AL 4 B				
	AL 6 A	 or 			 or 
	AL 6 B				
	AL 8 A	 or 			 or 
	AL 8 B				

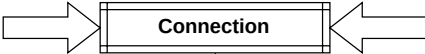
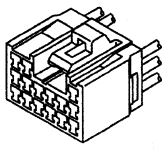
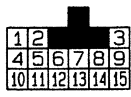
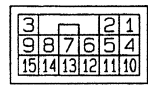
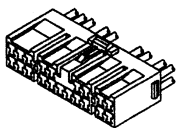
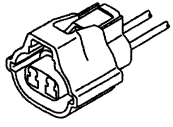
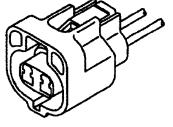
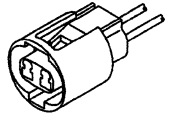
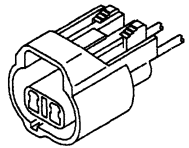
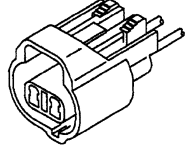
Model (Number shows number of pins)					
AM	AM 2 A				
	AM 2 B				
	AM 2 C				
	AM 4 A				
	AM 4 B				
	AM 6 A				
	AM 6 B				
	AM 8 A				
	AM 8 B				

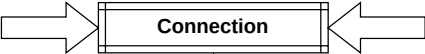
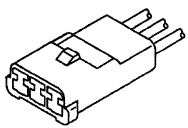
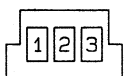
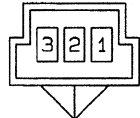
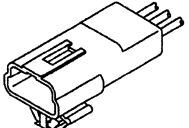
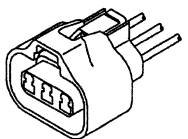
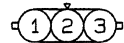
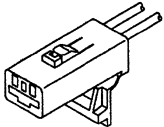
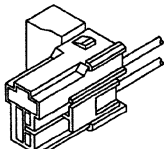
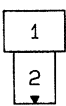
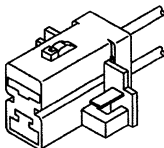
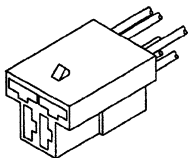
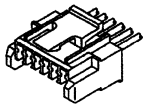
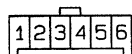
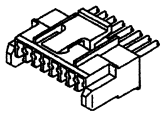
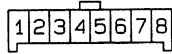
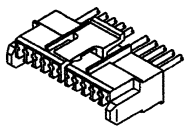
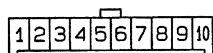
CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AM	AM10A	 	 
AN	AN 1 A	 	 
	AN 2 A	 	 
	AN 3 A	 	 
	AN 4 A	 	 
	AN 4 B	 	 
	AN 6 A	 	 
	AN 6 B	 	 
	AN 8 A	 	 

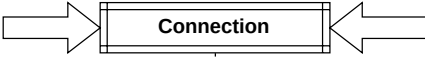
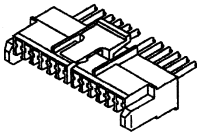
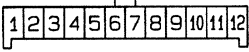
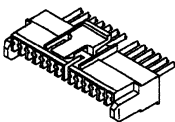
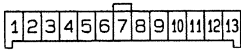
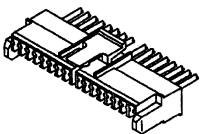
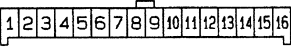
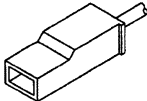
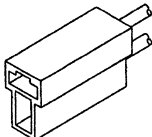
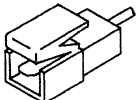
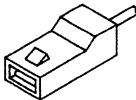
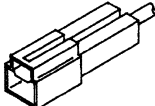
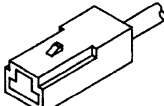
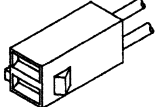
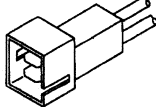
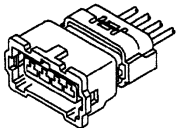
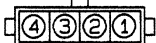
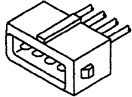
Model (Number shows number of pins)			
AN	AN 8 B	 	 
AP	AP 1 A	 	 
	AP 1 B	 	 
	AP 2 A	 	 
	AP 2 B	 	 
	AP 2 C	 	 
AQ	AQ 3 A	 	
	AQ 3 B	 	
	AQ13A	 	

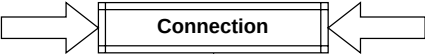
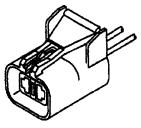
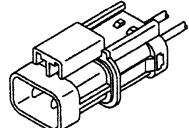
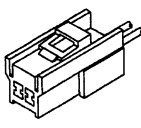
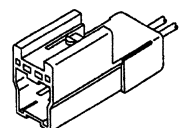
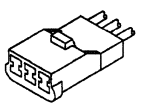
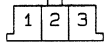
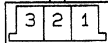
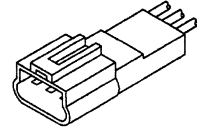
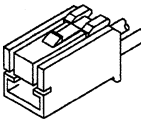
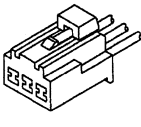
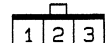
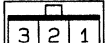
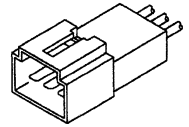
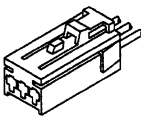
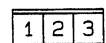
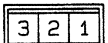
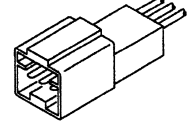
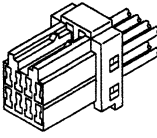
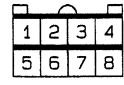
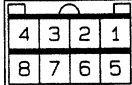
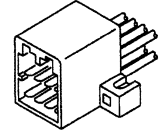
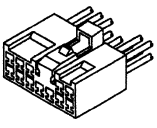
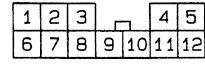
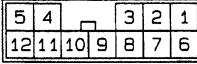
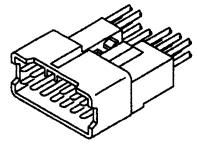
CONNECTOR CONFIGURATION CHART

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	AQ20A	 	
AR	AR 2 A	 	
	AR 2 B	 	
	AR 2 C	 	
	AR 2 D	 	
	AR 2 E	 	
	AR 2 F		

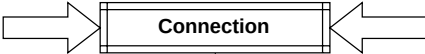
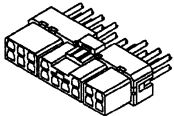
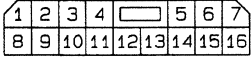
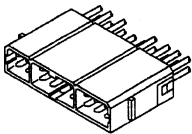
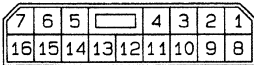
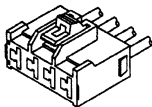
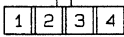
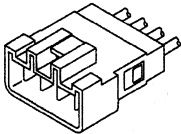
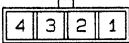
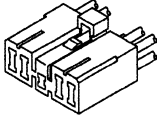
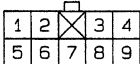
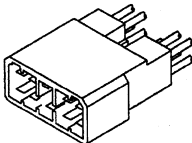
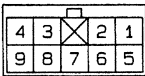
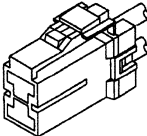
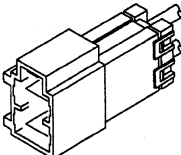
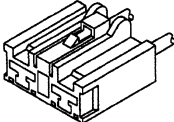
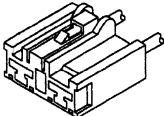
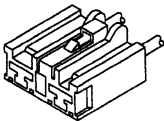
Model (Number shows number of pins)			
AR	AR 3 A	   	
		 	
AS	AS 1 A	 	
	AS 2 A	 	
	AS 2 B	 	
AT	AT 4 A	 	
AU	AU 6 A	 	
	AU 8 A	 	
	AU10A	 	

CONNECTOR CONFIGURATION CHART

Model (Number shows number of pins)			
AU	AU12A	 	
	AU13A	 	
	AU16A	 	
AV	AV 1 A	 	
	AV 2 A	 	
AW	AW 1 A	 	 
	AW 1 B	 	 
	AW 2 A	 	 
AX	AX 4 A	 	 

Model (Number shows number of pins)			
AY	AY 2 A	   	
AZ	AZ 2 A	   	
BA	BA 3 A	   	
BB	BB 2 A	   	
	BB 3 A	   	
BC	BC 3 A	   	
BD	BD 8 A	   	
BE	BE 6 A	   	
BF	BF12A	   	

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	 	

1 POWER, CHARGING AND GROUND

SPECIFICATIONS	54-1-2
STRUCTURE AND OPERATION	54-1-3
TROUBLESHOOTING	54-1-6
(100) INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
• Inspection of Alternator	54-1-8
• Inspection of Regulator	54-1-9
(101) BATTERY	54-1-10
(104) FUSE	54-1-14
(106) ALTERNATOR	54-1-16
(110) POWER CIRCUIT	54-1-22
(125) BATTERY CHARGING CIRCUIT	54-1-30
(130) GROUND	54-1-32

SPECIFICATIONS

Battery

Item	Specifications
Model	95E41R
Voltage×No. V	12×2 (Parallel connection)
Capacity (5-hour rating) Ah	80

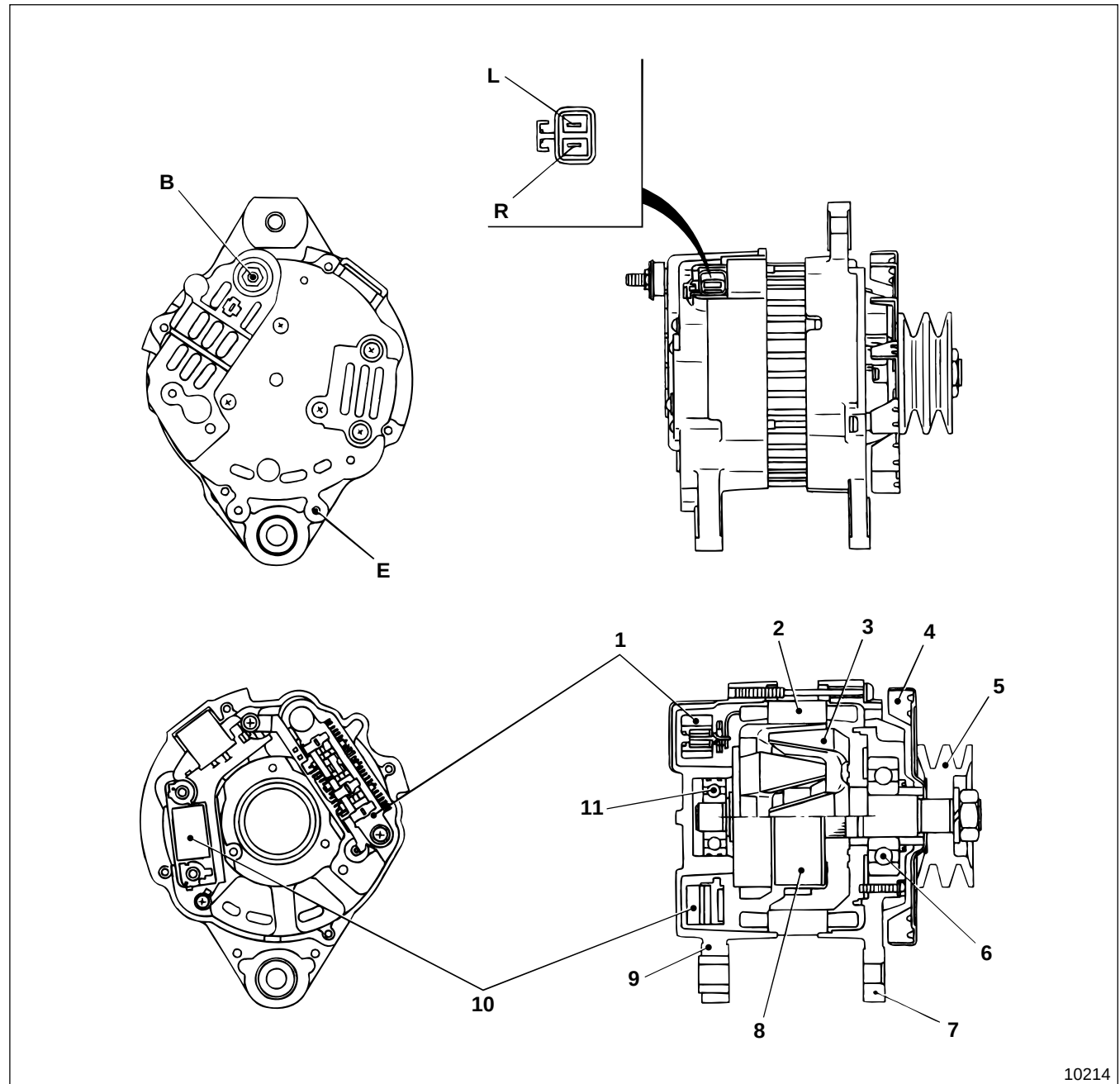
Alternator

Item	Specifications
Manufacturer	MITSUBISHI ELECTRIC
Type	Alternator with built-in regulator (without brush, external fan)
Model	A4TU0088
Output V-A	12-80

STRUCTURE AND OPERATION

54

Alternator



10214

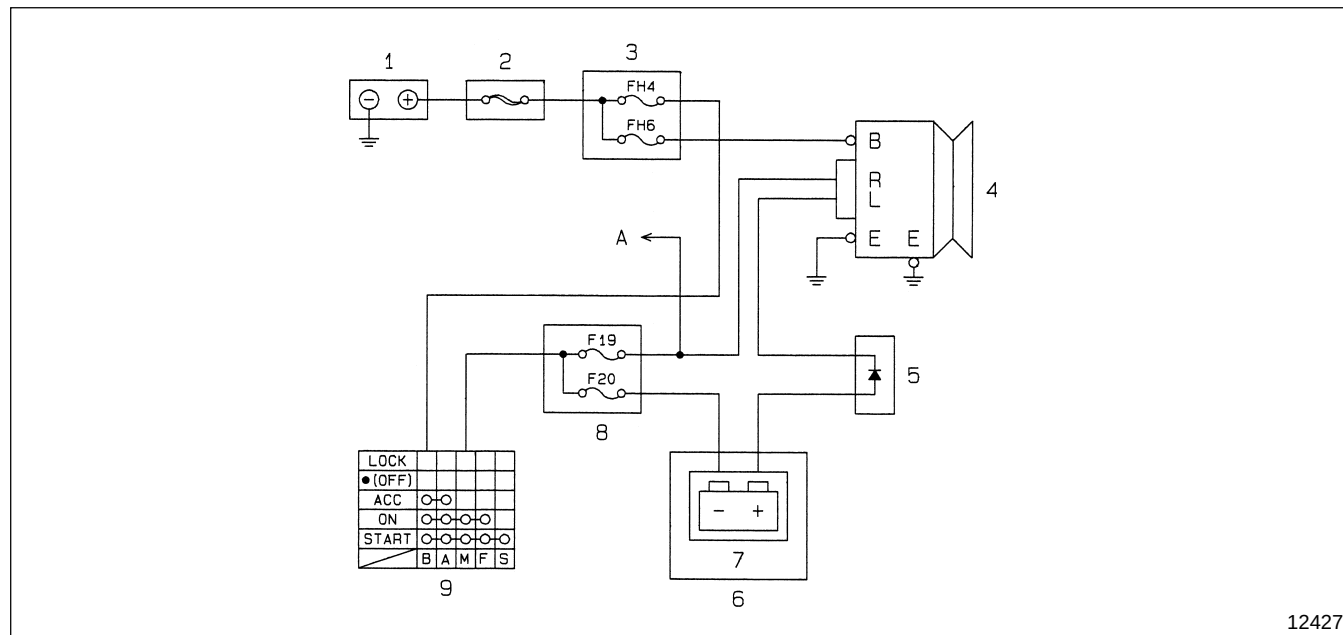
- 1 Rectifier
- 2 Stator assembly
- 3 Rotor assembly
- 4 Fan
- 5 Pulley
- 6 Front bearing

- 7 Front bracket
- 8 Field coil
- 9 Rear bracket
- 10 Regulator
- 11 Rear bearing

- B : Terminal B
- E : Terminal E
- L : Terminal L
- R : Terminal R

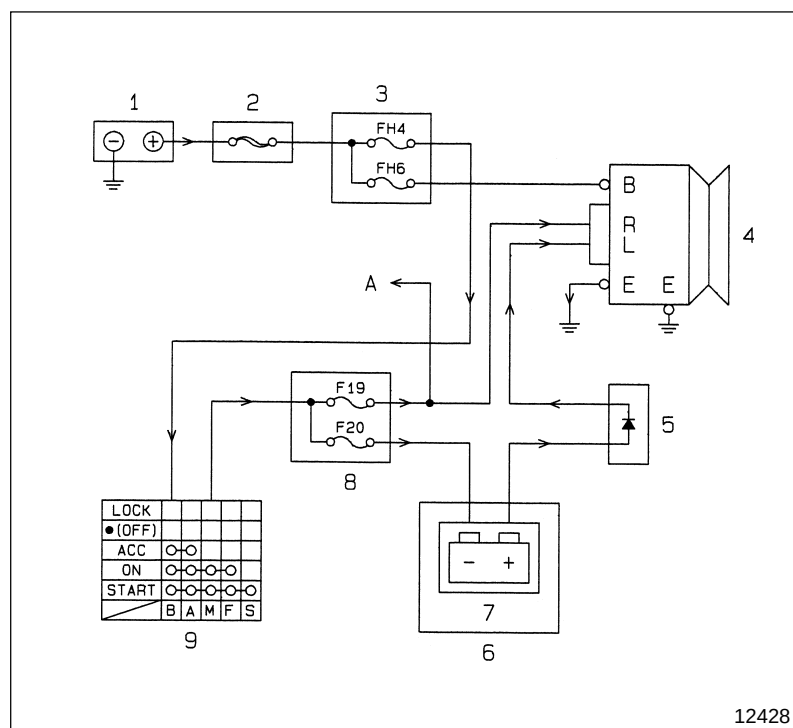
STRUCTURE AND OPERATION

Battery Charging Circuit



12427

- | | |
|--------------------------|------------------|
| 1 Battery | 9 Starter switch |
| 2 Main high-current fuse | |
| 3 High-current fuse box | |
| 4 Alternator | A : To each unit |
| 5 Diode | B : Terminal B |
| 6 Meter cluster | E : Terminal E |
| 7 Charge warning lamp | L : Terminal L |
| 8 Fuse box | R : Terminal R |

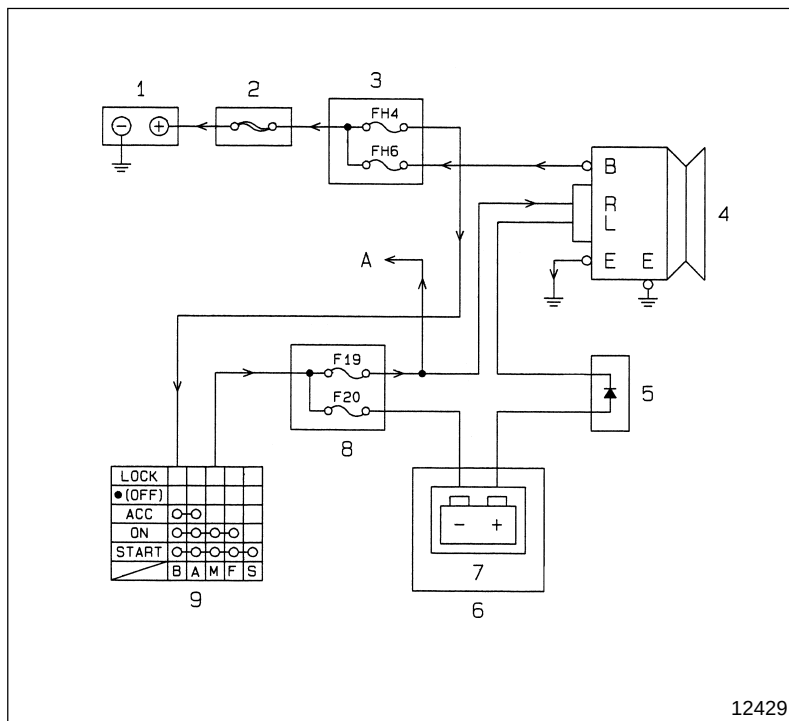


12428

At engine standstill (before starting)

Position of starter switch 9 : ON

- 1→2→3→9
 - 8 (F19)→4 (R→E)→Ground
 - 8 (F20)→7→5→4 (L→E)→Ground
- Charge warning lamp  7 lights up. To improve the low-speed power generation build-up performance of alternator 4, current is fed to terminal R immediately after the engine is started.



After engine start-up

Position of starter switch **9** : ON

- Alternator **4** starts to generate power.
- The voltage at terminal **B** of alternator **4** rises higher than the voltage of battery **1**.
- As alternator **4** starts to charge battery **1**, units **A** are supplied with power.
 4(B)→1→Ground
 →2→3→9→8(F19)→A
- Since there is no electric potential difference between the output voltage of terminal **L** of alternator **4** and the voltage of battery **1**, charge warning lamp **7** goes off.

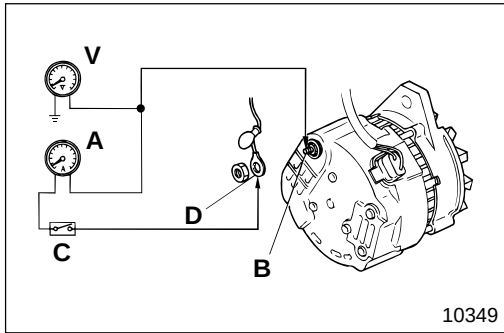
TROUBLESHOOTING

Symptoms		Battery electrolyte decreases too early	Battery overheating	Battery is normal but overdischarged	Charge warning lamp  does not light when turning starter switch ON, with engine stopped	Alternator is normal but battery overdischarged	Remarks
Possible causes							
Connector connection faulty, harness broken, grounding faulty				☐		☐	
Fuse blown					☐		
V-belts loose				☐		☐	 Gr 14
V-belts damaged				☐		☐	 Gr 14
Battery faulty		☐				☐	
Alternator	Stator coil broken			☐			
	Stator coil short-circuited with core			☐			
	Field coil broken			☐			
	Rectifier faulty			☐			
	Regulator faulty		☐	☐	☐		
	Wiring faulty			☐			
Meter cluster faulty					☐		

MEMO

100 INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Inspection of Alternator



Performance test

- Connect the meters to the alternator as illustrated.
- A** : Ammeter (100 amperes class)
- B** : Terminal B on alternator
- C** : Switch
- D** : Terminal
- V** : Voltmeter

WARNING

- **Terminal D is always loaded with voltage from the battery.**
- **You must handle terminal D carefully, it will short-circuit if it touches any part other than terminal B on the alternator.**

- Turn switch **C** ON to supply battery voltage to terminal **B** on the alternator.
- Start the engine.
- Turn the switches ON of all the lamps on the vehicle immediately.
- Measure the current when the engine speed reaches approximately 2260 rpm.
- The alternator is assumed to be normal if the measured value is higher than 70% of the specified output.

Specified output of alternator

Alternator model	Voltage	Output
A4TU0088	12 V	80 A

NOTE

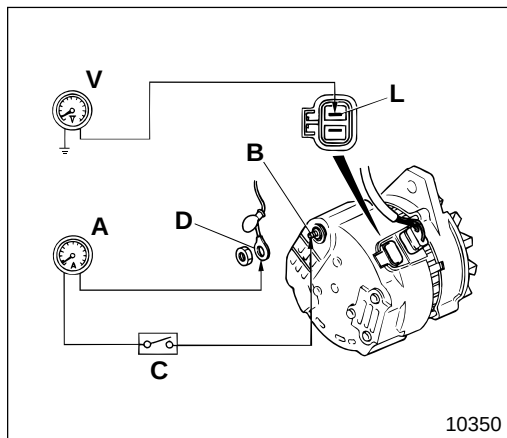
Since the above inspection is only a simplified check, it is necessary to conduct a stringent test bench for an official check.

P54-1-17

Inspection of Regulator

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Adjustment voltage of regulator	14.7±0.3 V	—	Replace



- Connect the meters to the alternator as illustrated.

A : Ammeter (100 amperes class)

B : Terminal B on alternator

C : Switch

D : Terminal

L : Terminal L on alternator

V : Voltmeter

WARNING

- **Terminal D is always loaded with voltage from the battery.**
- **You must handle terminal D carefully, it will short-circuit if it touches any part other than terminal B on the alternator.**

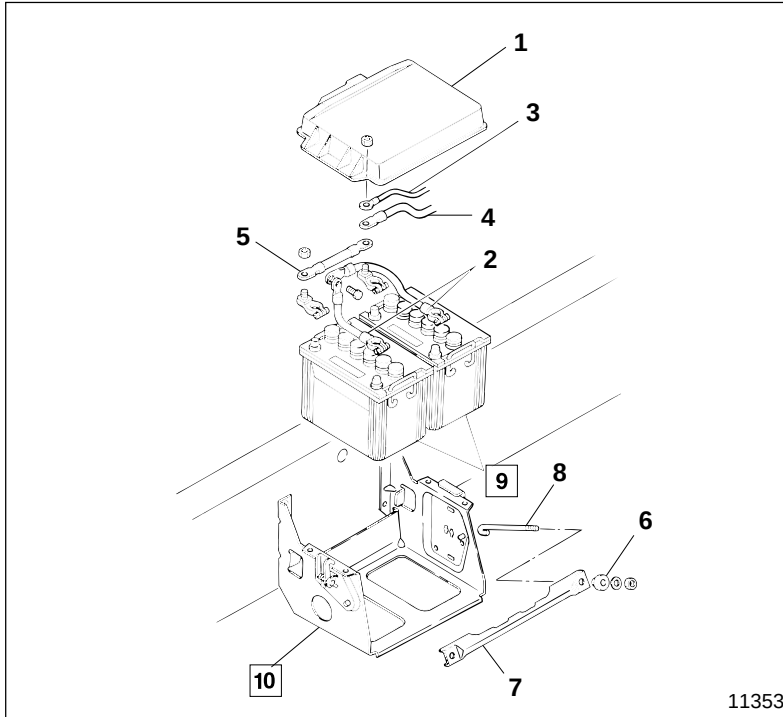
- Turn switch **C** ON and make sure that voltmeter **V** indicates 0 volt.
- If the needle of voltmeter **V** oscillates, something is wrong with the alternator or the wiring.
- Turn switch **C** OFF and start the engine.

CAUTION

Do not start the engine with switch C turned ON because the starter current will flow into ammeter A and damage it.

- If the charge current is five amperes or less and the engine speed is approximately 2260 rpm, measure the adjustment voltage.
- If the charge voltage is five amperes or more, do one of the following :
 - Run the engine for a while to charge the battery.
 - Replace the old battery with a fully-charged one.
 - Connect a $\frac{1}{4} \Omega$ (25 W) resistor in series with the battery to limit the charge current.
- If the measured value deviates from the standard value, change the regulators.

101 BATTERY



● Removal sequence

- 1 Battery cover
- 2 Battery cable $\ominus$
- 3 Harness (Main high-current fuse)
- 4 Starter cable
- 5 Battery cable $\oplus$
- 6 Rubber
- 7 Angle frame
- 8 Set bolt
- 9 Battery
- 10 Battery box

● Installation sequence

Follow the removal sequence in reverse.

DANGER ⚠

- Since flammable hydrogen gas is generated by battery 9, be sure to obey the following warnings :
 - Do not short-circuit the $\oplus$ and $\ominus$ terminals on the battery.
 - Keep sparks and lit cigarettes away from the battery.
 - Do not wear metal objects on your arms and lean over battery 9.
- Because the battery electrolyte is diluted sulfuric acid and is corrosive, when handling battery 9 wear safety glasses and rubber gloves to protect the eyes and hands.

WARNING ⚠

To prevent a short-circuit be sure that disconnected battery cables 2 and 5 do not accidentally touch the battery terminals.

CAUTION ⚠

- Make sure that you disconnect battery cable $\ominus$ 2 first when you disconnect battery cables 2 and 5.
- Make sure that all electrical switches of the vehicle are OFF before connecting battery cables 2 and 5.
- Make sure that you connect battery cable $\oplus$ 5 before you connect battery cable $\ominus$ 2.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
9	Specific gravity of battery electrolyte (20°C {68°F})	1.280	1.220	Charge or replace

◆ Service procedure

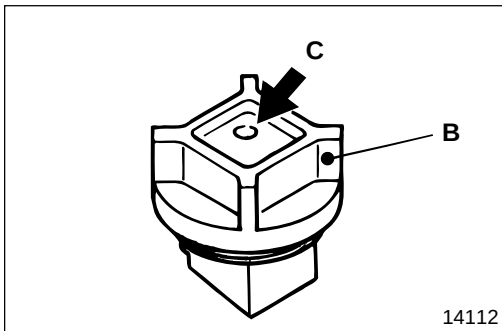
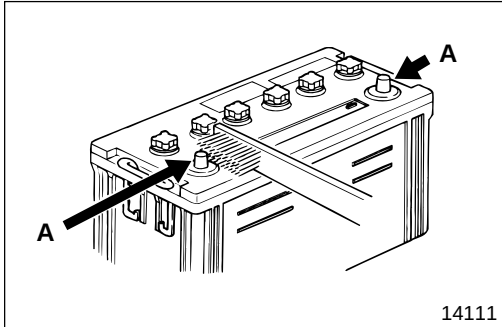
9 Inspection of battery

(1) Visual inspection

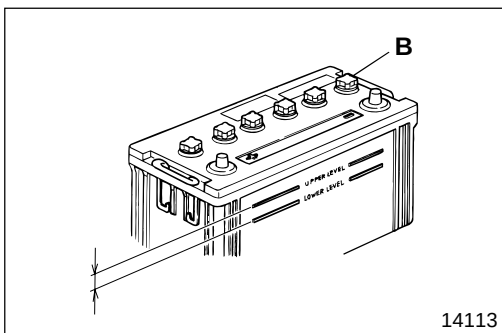
- If terminal **A** is corroded, scrub off the corrosion from it using a wire brush.
- If cracks or defects are found on battery **9**, replace it since the cracks or defects can cause liquid spills.

CAUTION

Make sure you grease the $\oplus$ side of terminal **A** because it is easily corroded.

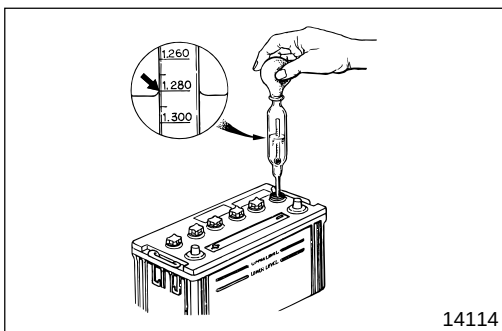


- If bleed hole **C** of vent plug **B** is clogged, clean the hole.



(2) Inspection of fluid level

- Make sure that the battery electrolyte level is between UPPER and LOWER.
- If the level is below LOWER, remove vent plug **B** and fill the battery with distilled water or battery replenisher to UPPER.



(3) Measurement of specific gravity

Measure the specific gravity of the battery electrolyte. If the measured value is lower than the limit, charge the battery.

NOTE

The specific gravity of the battery electrolyte depends on the liquid temperature. Use the following formula to convert the actual value to the value were the temperature 20°C {68°F}.

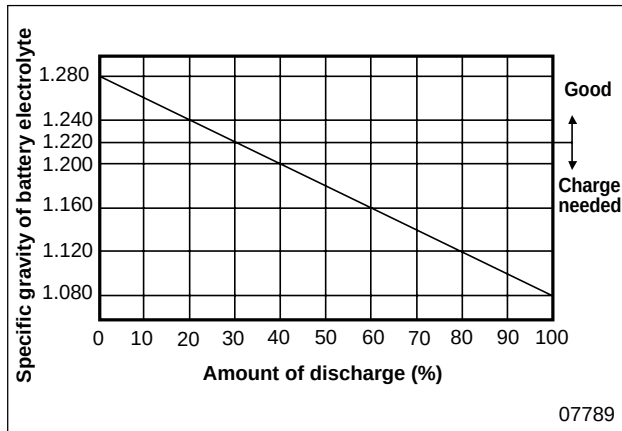
$$S_{20} \{68\} = S_t + 0.0007 (t - 20 \{68\})$$

$S_{20} \{68\}$: Specific gravity were the temperature 20°C {68°F}

S_t : Specific gravity actually measured with the temperature at t°C {t°F}

t : Temperature of battery electrolyte

101 BATTERY



(4) Charging

- Although, as a rule, charging of battery **9** should be done with the battery removed from the vehicle, if you have to charge the battery while it is on the vehicle, make sure that you stop the engine and disconnect battery cable **⊖ 2**.
- Remove vent plug **B** before charging the battery.
- 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	$\frac{\text{★Amount of discharge (Ah)}}{\text{Charge current (A)}} \times 1.2 (\text{to } 1.5)$	45 {113}
	10		
Quick charge	Value of 5-hour rating capacity	0.5	55 {131}
	1.5		

$$\text{★ Amount of discharge (Ah)} = \frac{\text{5-hour rating capacity (Ah)} \times \frac{\text{Amount of discharge (\%)}}{100}}{100}$$

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

DANGER ⚠

- Do not let the battery electrolyte level rise and overflow while charging the battery.
- Keep naked lights away from the battery while charging it or it might explode.
- Be careful not to generate sparks while charging the battery because its dangerous.
- After charging the battery, tighten vent plug **B**, wash away sulfuric acid from the battery using water, and dry the surface.

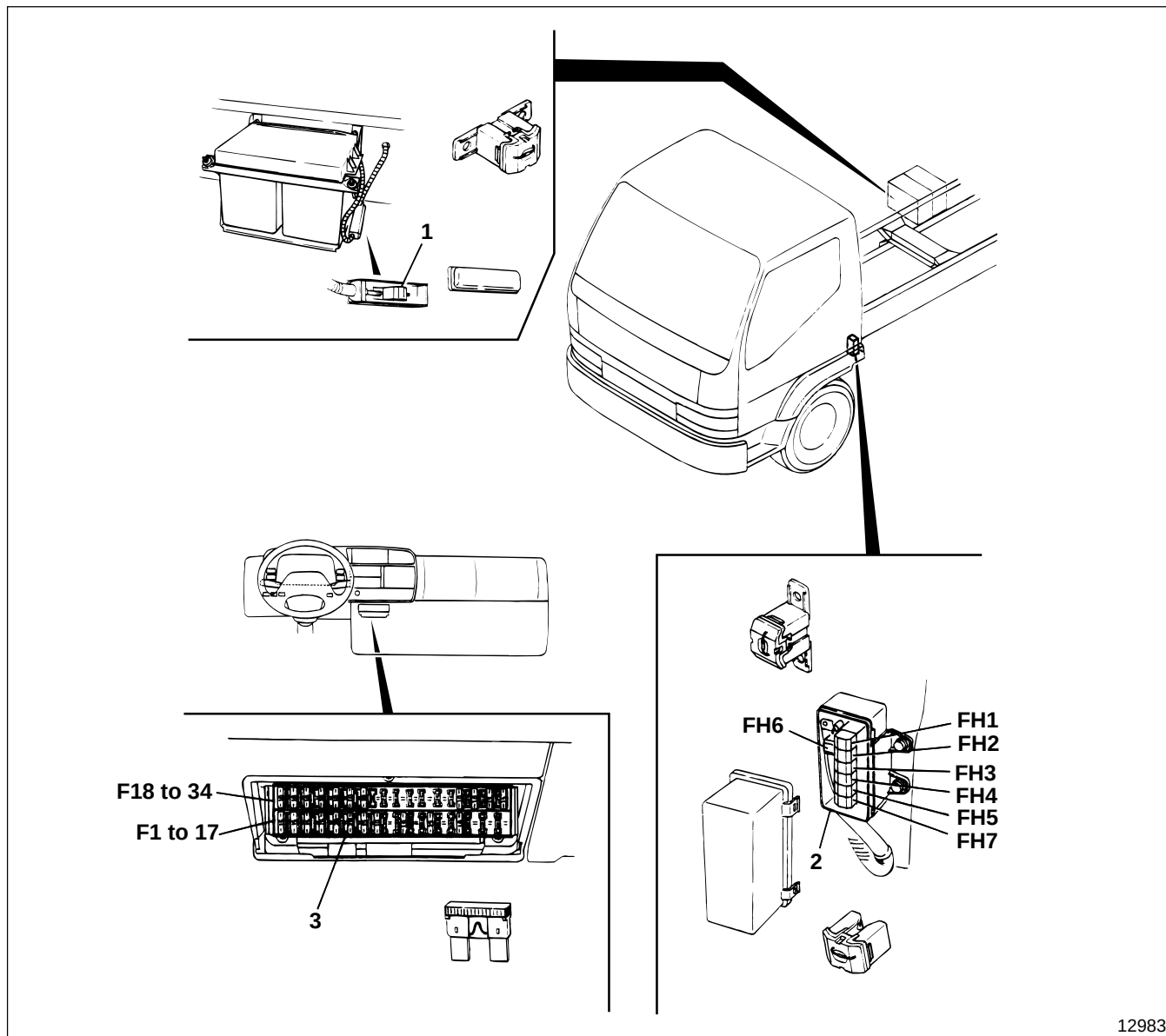
10 Inspection of battery box

- If battery box **10** is corroded, scrub off the corrosion from it using a wire brush and apply acid resistant coating.
- If battery box **10** is corroded excessively or if it is broken or cracked, replace it.

MEMO

104 FUSE

Installation Location



12983

- 1 Main high-current fuse
- 2 High-current fuse box
- 3 Fuse box

CAUTION

- If a fuse blows, make sure you identify and remedy the cause, then replace the fuse.
- Make sure that you replace the fuse with one having the same rating.
- Make sure that you remove the $\ominus$ terminal of the battery cable before removing main high-current fuse 1 and high-current fuses FH1 to 7.  (101)

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	120 A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50 A
FH2	Fuse box (F5 to F8)	50 A
FH3	Fuse box (F9 to F12)	40 A
FH4	Starter switch (Terminal B)	40 A
FH5	Glow relay	50 A
FH6	Alternator	120 A
FH7	Fuse box (F31 to F34)	40 A

Fuse box

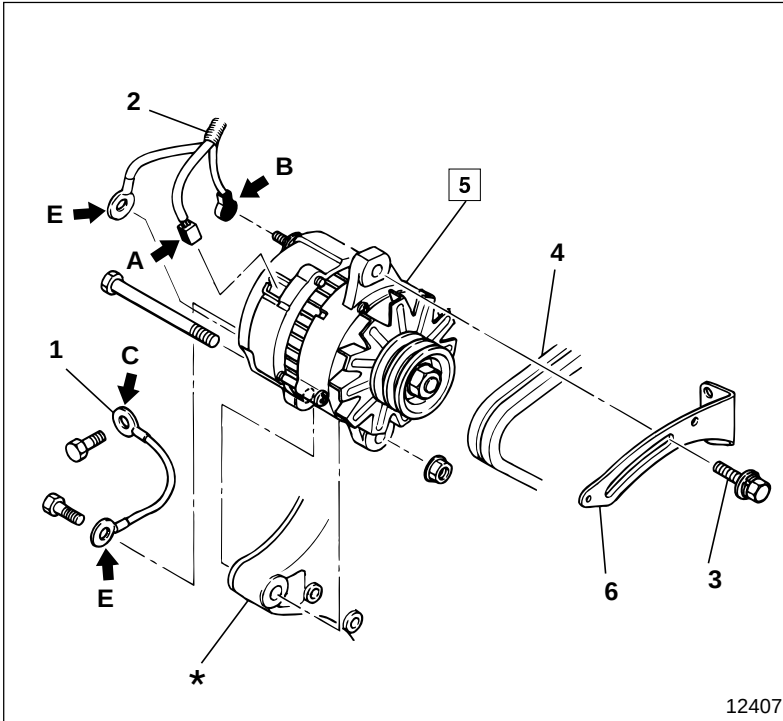
Fuse No.	Main load	Capacity
F1	Headlamp, LH	15 A
F2	Headlamp, RH	15 A
F3	Stop lamp, horn	15 A
F4	Turn signal lamp	15 A
F5	Fuel-cut motor	10 A
F6	Cab lamp	10 A
F7	Reserve power (BATT)	10 A
F8	—	—
F9	—	—
F10	—	—
F11	—	—
F12	—	—
F13	* Cigarette lighter	15 A
F14	Radio	10 A
F15	—	—
F16	—	—
F17	Fuel-cut relay	10 A

Fuse No.	Main load	Capacity
F18	Starter	10 A
F19	Backup lamp	10 A
F20	Meter cluster	10 A
F21	Wiper	10 A
F22	Air dryer	10 A
F23	—	—
F24	—	—
F25	—	—
F26	—	—
F27	Exhaust brake	10 A
F28	Transmission PTO	10 A
F29	Pre-stroke cut relay	15 A
F30	* Air-conditioner control	10 A
F31	* Air-conditioner compressor	10 A
F32	* Condenser fan	15 A
F33	Blower fan	25 A
F34	Tail lamp	15 A

* : Fuses are provided for these pieces of equipment only where they are installed.

PTO : Power take-off

106 ALTERNATOR



● Removal sequence

- 1 Ground cable
- 2 Chassis harness
- 3 Adjusting bolt
- 4 V-belts
- 5 Alternator P54-1-18
- 6 Adjusting plate

* : Timing gear case and front plate

Gr 11

A : To terminals L and R

B : To terminal B

C : Connected to crankcase

E : To terminal E

WARNING

- Terminal B is always loaded with voltage from the battery, supplied via chassis harness 2. Therefore when you remove the harness from terminal B, make sure that tools do not touch any adjacent parts because this would cause a short-circuit.
- Make sure that you disconnect terminal E of the battery before removing the harness and insulate the terminal with tape.

● Installation sequence

Follow the removal sequence in reverse.

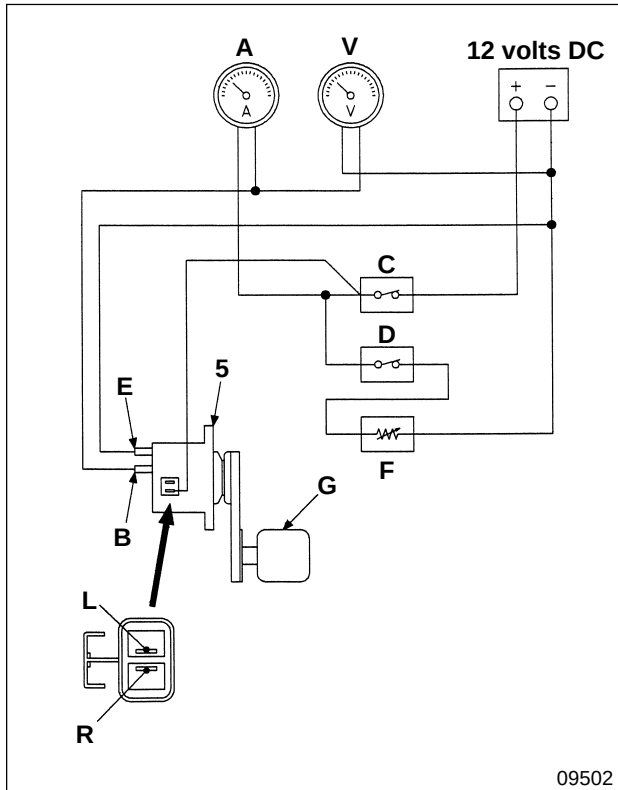
● Adjustment after installation

Adjustment of V-belt 4 tension Gr 14

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
5	Output current (* When engine is hot and 13.5 V is loaded)	At 1500 rpm	38 A or more	—	Inspect
		At 2500 rpm	65 A or more	—	
		At 5000 rpm	76 A or more	—	
	Adjustment voltage of regulator (At 5000 rpm, 5 A is loaded)		14.7±0.3 V	—	Replace

* : The value of the ambient temperature is measured after running the engine at maximum power (5000 rpm) for 30 minutes.



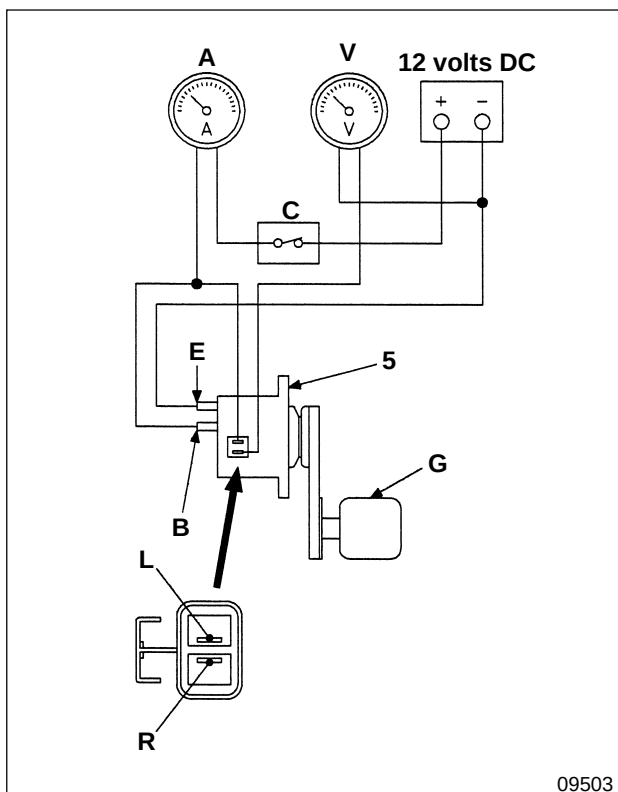
5 Inspection of alternator

(1) Inspection of alternator performance (bench test)

- Connect each unit to the alternators as illustrated.
 - A : Ammeter
 - B : Terminal B on alternator
 - C : Switch
 - D : Switch
 - E : Terminal E on alternator
 - F : Load resistance (variable resistance)
 - G : Alternator drive motor
 - L : Terminal L on alternator
 - R : Terminal R on alternator
 - V : Voltmeter
- Turn switches C, D OFF.
- Run alternator 5 at 5000 rpm.
- Adjust load resistance F to maintain the specified current.

Specified output of the alternator : 12 V-80 A

- After adjustment, run alternator 5 for 30 minutes.
- Maximize load resistance F (current hardly flows).
- Turn switches C, D ON.
- Increase the rotation of alternator 5 gradually and measure current at specified rpm.
- If the measured value deviates from the standard value, disassemble and inspect alternator 5. P54-1-18

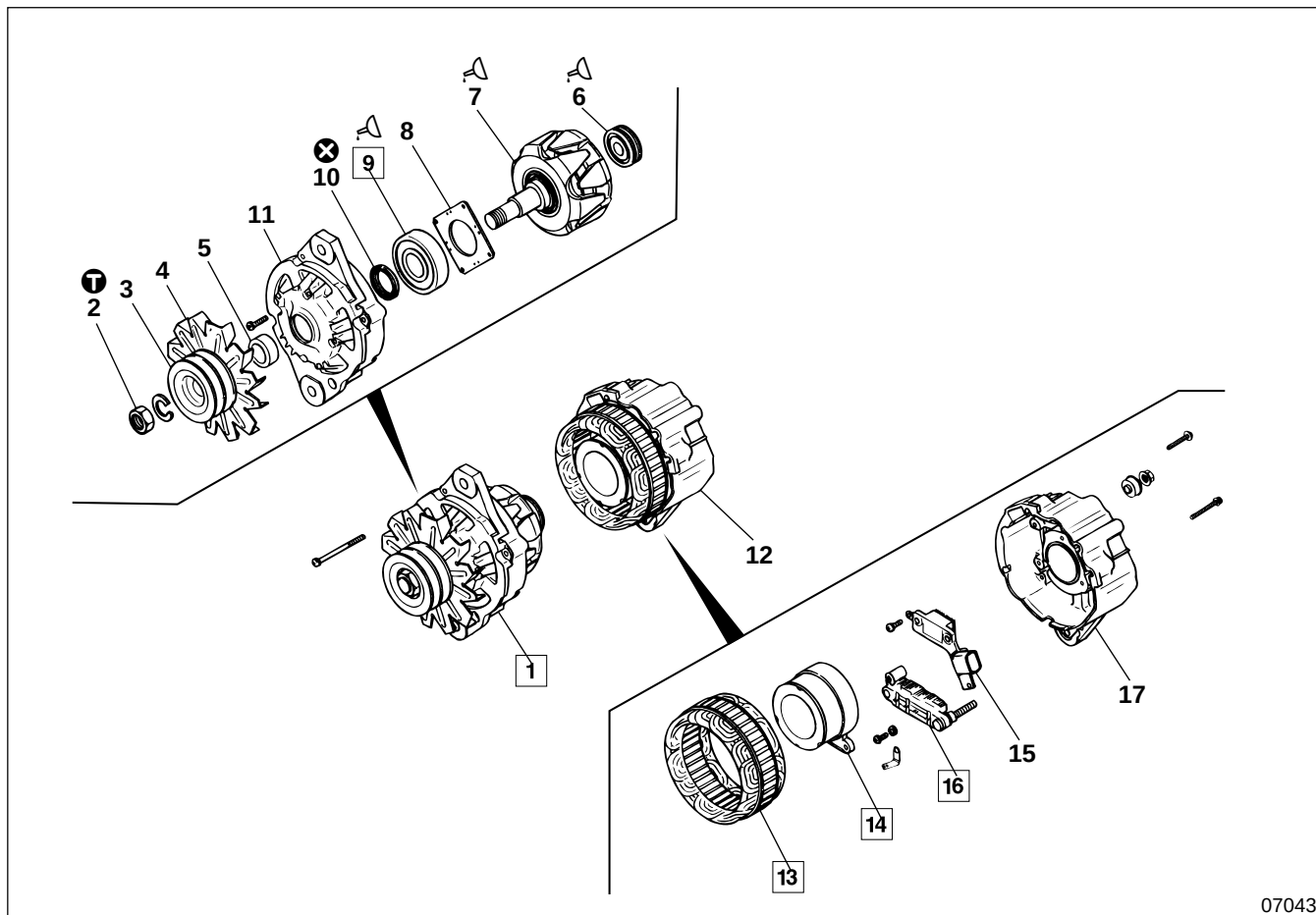


(2) Inspection of regulator (bench test)

- Connect each unit to the alternators as illustrated.
 - A : Ammeter
 - B : Terminal B on alternator
 - C : Switch
 - E : Terminal E on alternator
 - G : Alternator drive motor
 - L : Terminal L on alternator
 - R : Terminal R on alternator
 - V : Voltmeter
- Turn switch C ON.
- Run alternator 5.
- Make sure that the value of the current at 5000 rpm is five amperes or less.
- Measure voltage (adjustment voltage).
- If the measured value deviates from the standard value, replace the regulator (in alternator 5).

106 ALTERNATOR

Alternator



07043

● Disassembly sequence

- 1 Rotor and front bracket assembly
- 2 Nut
- 3 Pulley
- 4 Fan
- 5 Spacer
- 6 Rear bearing
- 7 Rotor assembly
- 8 Cover
- 9 Front bearing
- 10 Oil seal

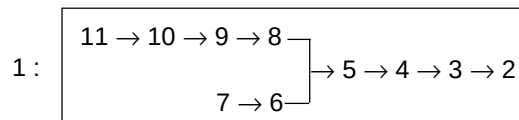
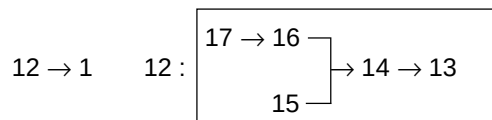
- 11 Front bracket
- 12 Stator and rear bracket assembly
- 13 Stator assembly
- 14 Field coil
- 15 Regulator
- 16 Rectifier
- 17 Rear bracket

⊗ : Non-reusable parts

NOTE

Do not remove parts 6, 9, 13 unless they are faulty.

● Assembly sequence



Service standards

Location	Maintenance item	Standard value	Limit	Remedy
14	Field coil resistance (20°C {68°F})	2.6 to 3.4 Ω	—	Replace

Tightening torque

Unit : N·m {lb.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (Pulley mounting)	132 to 162 {98 to 120, 13.5 to 16.5}	—

Lubricant

Location	Points of application	Kinds	Quantity
6	Rear bearing inner periphery	Engine oil	As required
7	Front bearing installation part of rotor assembly	Engine oil	As required
9	Front bearing outer periphery	Engine oil	As required

Service procedure

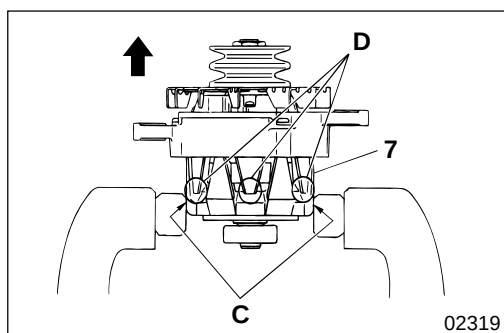
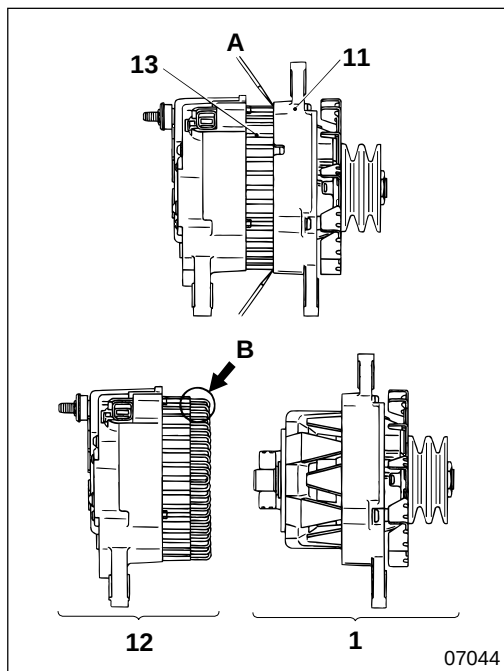
1 Rotor and front bracket assembly

[Removal]

- Insert screwdriver **A** between front bracket **11** and stator assembly **13**.
- Use screwdriver **A** to pry rotor and front bracket assembly **1** away from stator and rear bracket assembly **12**.

CAUTION

Be careful not to insert the screwdriver too deep or it will damage coil **B** of stator assembly **13** and might cause a short-circuit.

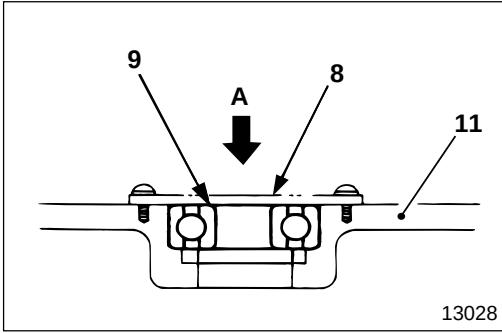


[Disassembly]

CAUTION

Make sure, when you hold rotor assembly **7** in a vise, to grip root **C** of the core claws. Gripping claws **D** can damage them.

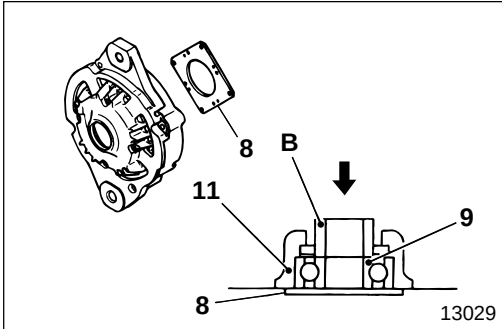
106 ALTERNATOR



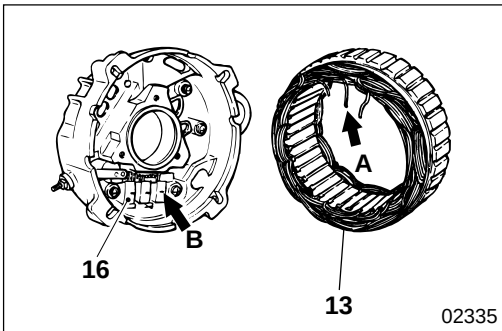
9 Installation of front bearing

- Press-fit front bearing **9** until it is flush with the installation part of cover **8**.

A : Press



- Install cover **8**.
- Press spacer **B** until it makes contact with front bearing **9** and cover **8**, using a press.



13 Stator assembly

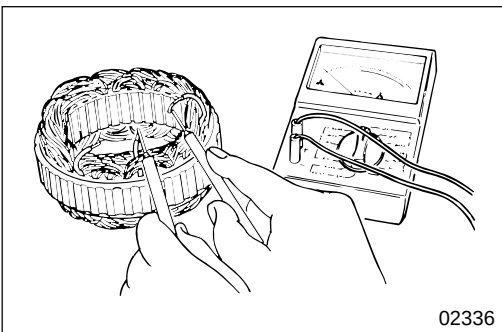
[Removal and installation]

- Disconnect lead **A** of stator assembly **13** from rectifier **16**. The lead is soldered to diode **B** of rectifier **16** at three points.

CAUTION ⚠

Make sure that you desolder within five seconds because the diode is heat sensitive.

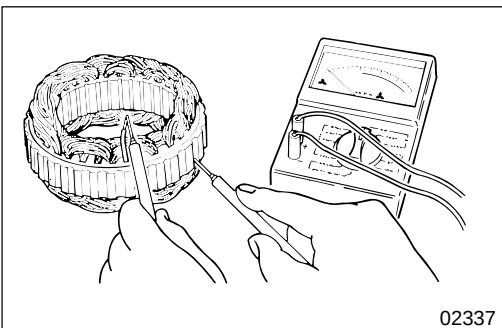
- To install, follow the removal sequence in reverse.



[Inspection]

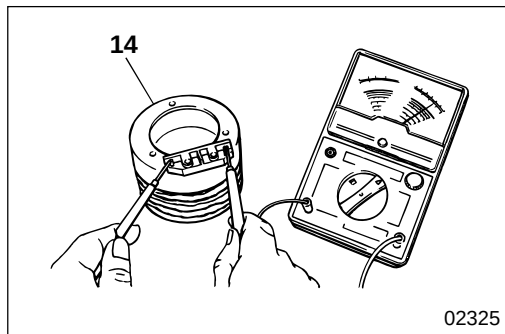
(1) Continuity of each lead wire

- Make sure that each lead wire has continuity.
- If there is no continuity, the lead wire is broken. Replace stator assembly **13**.



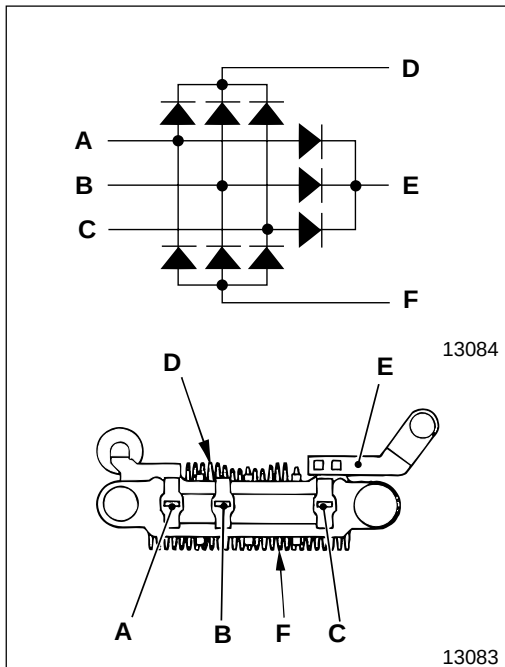
(2) Continuity between lead wires and the core

- Make sure that there is no continuity between lead wires and the core.
- If there is continuity, replace stator assembly **13**, since it might be short-circuited.



14 Inspection of field coil

- Measure the resistance between the terminals of field coil **14**.
- If the measured value deviates from the standard value, replace field coil **14**.



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.

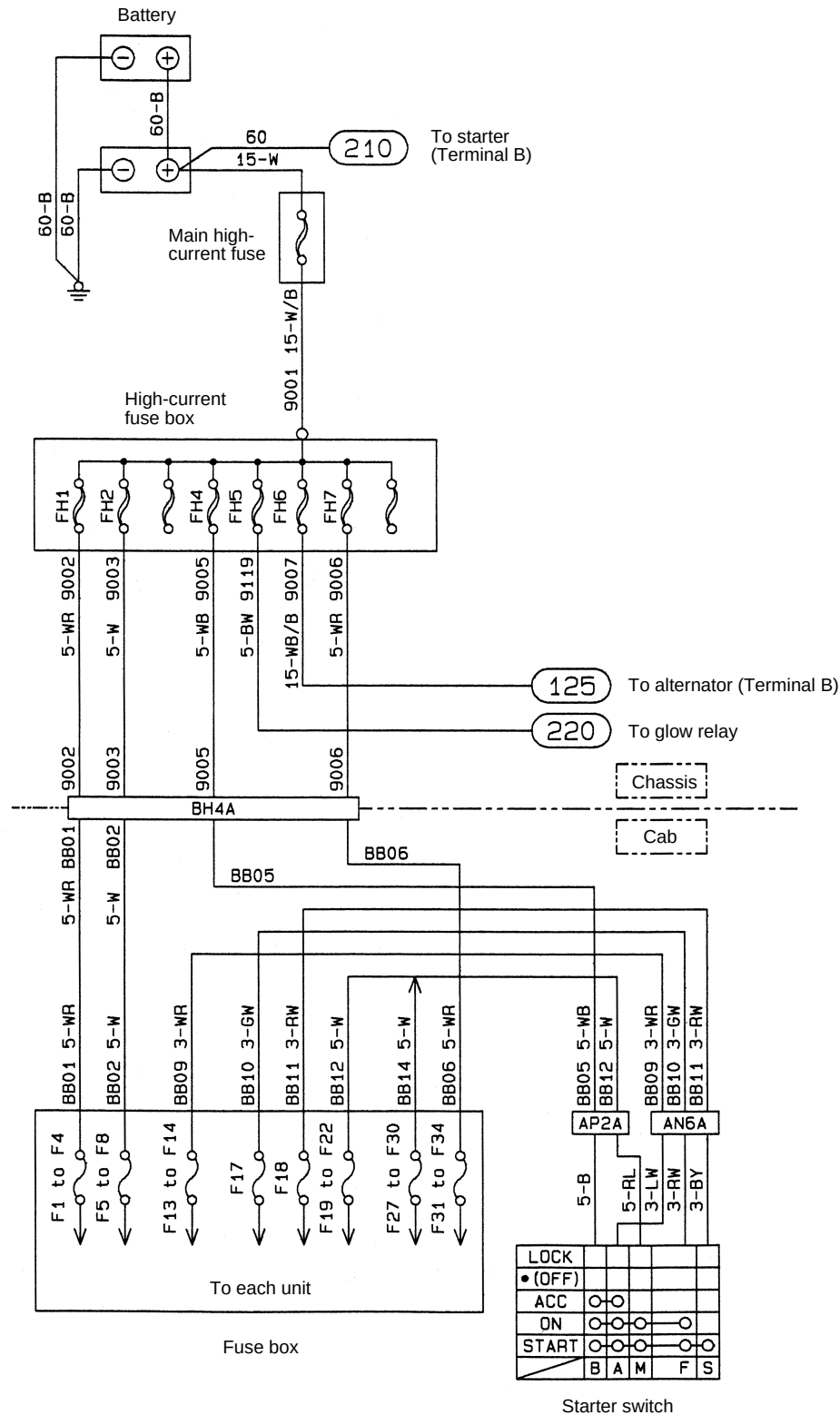
CAUTION

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.

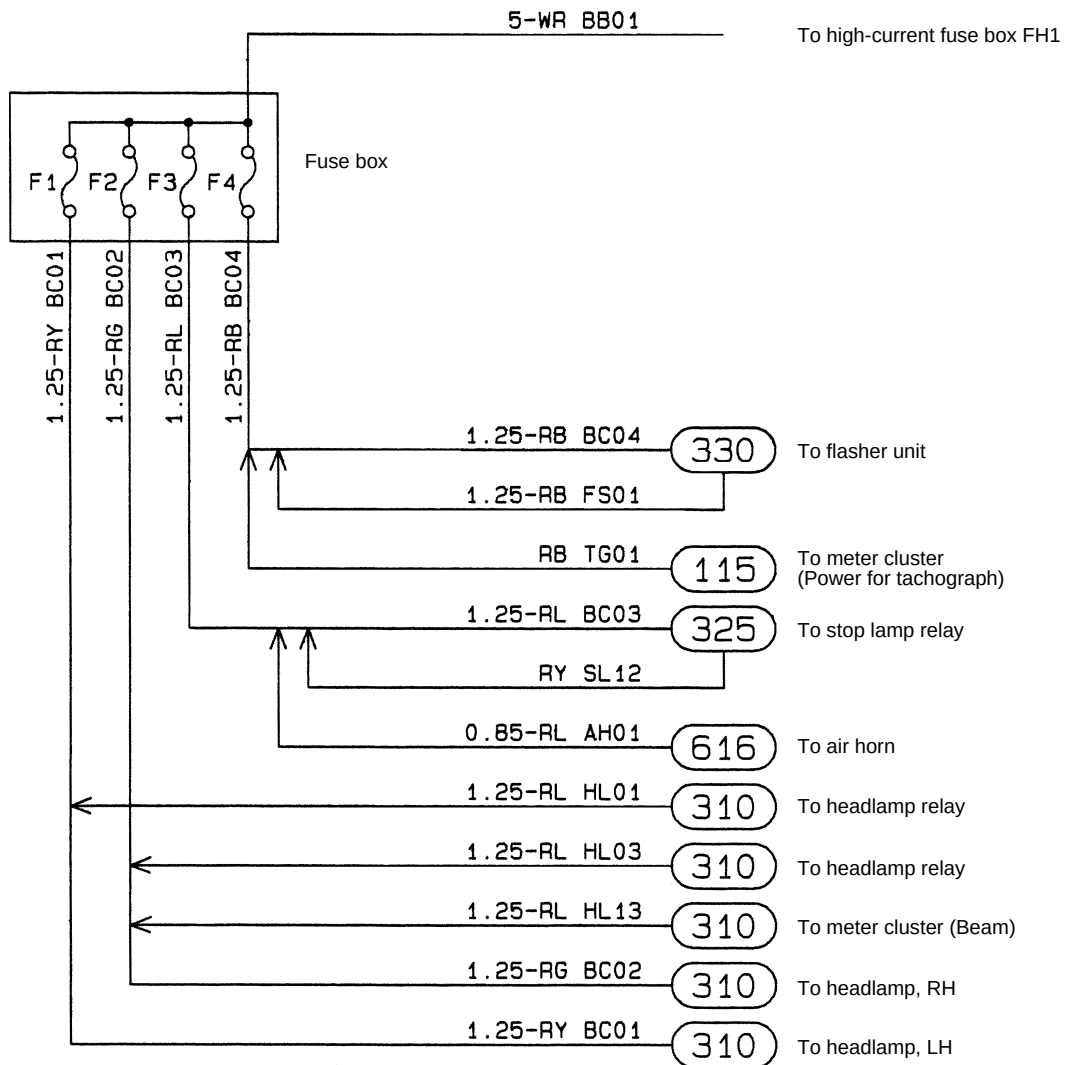
Also, this tendency increases as the range of the tester gets smaller. Therefore, use as big a range as possible.

110 POWER CIRCUIT

Power Supply (Battery to High-current Fuse Box and Fuse Box)

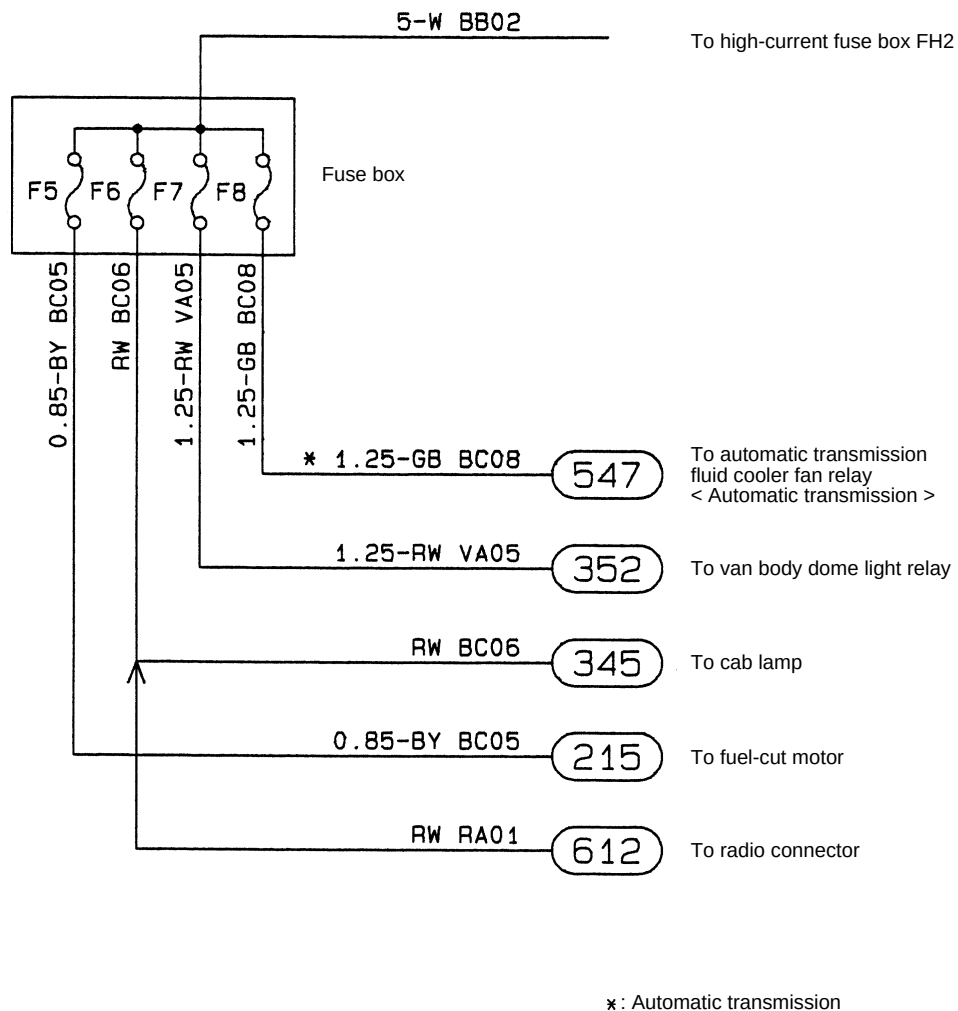


Fuses F1 to F4

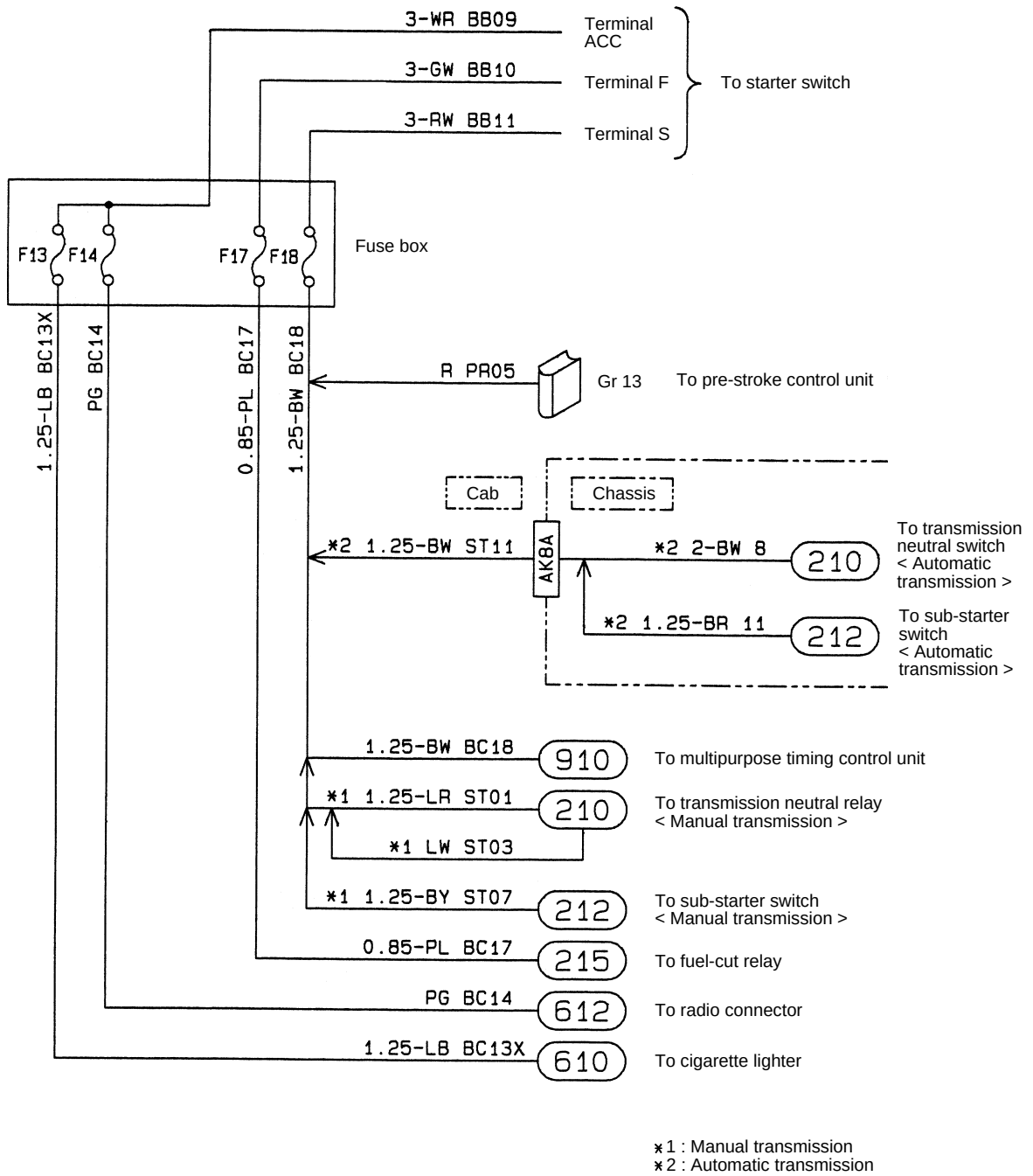


110 POWER CIRCUIT

Fuses F5 to F8

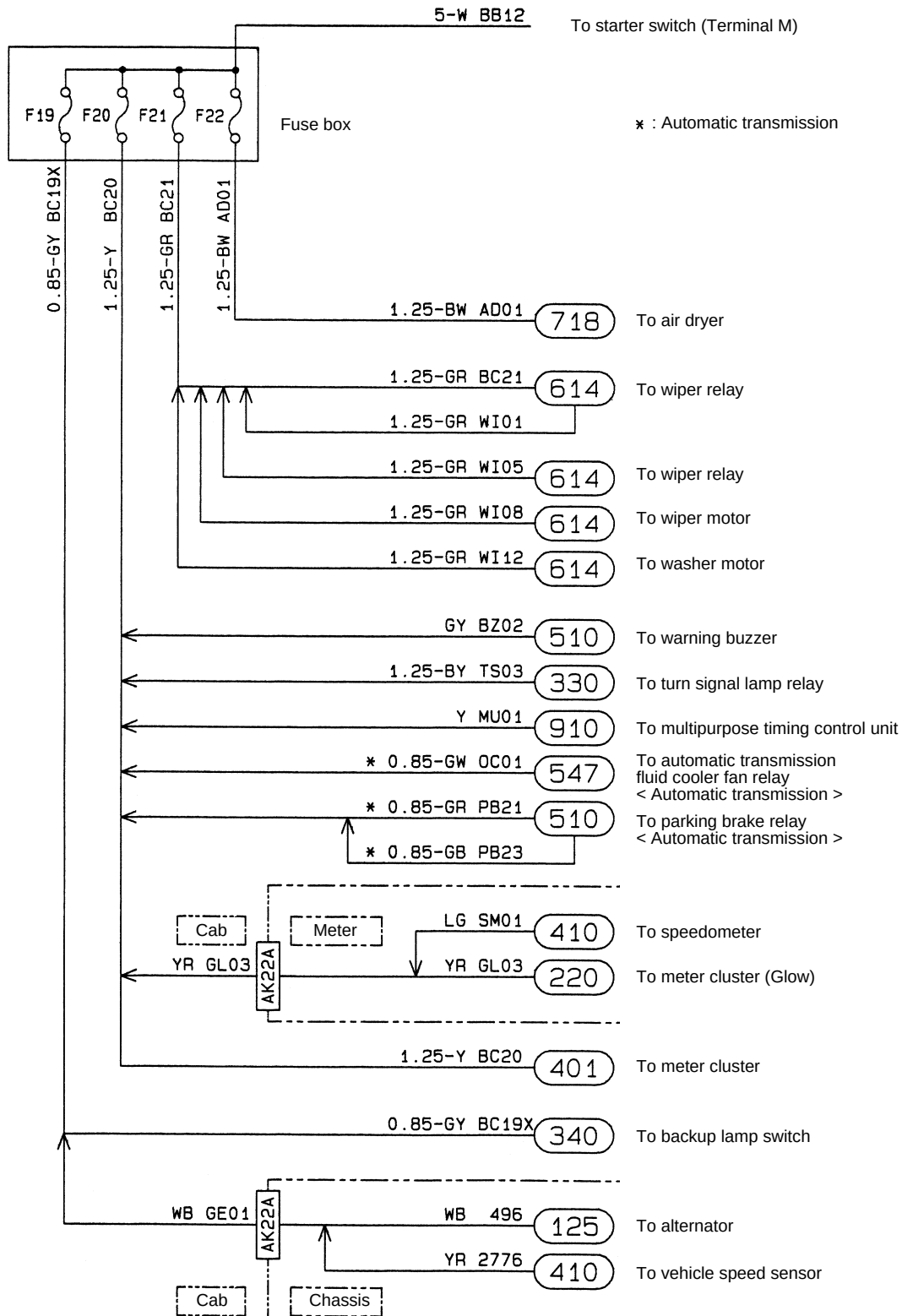


Fuses F13 to F18

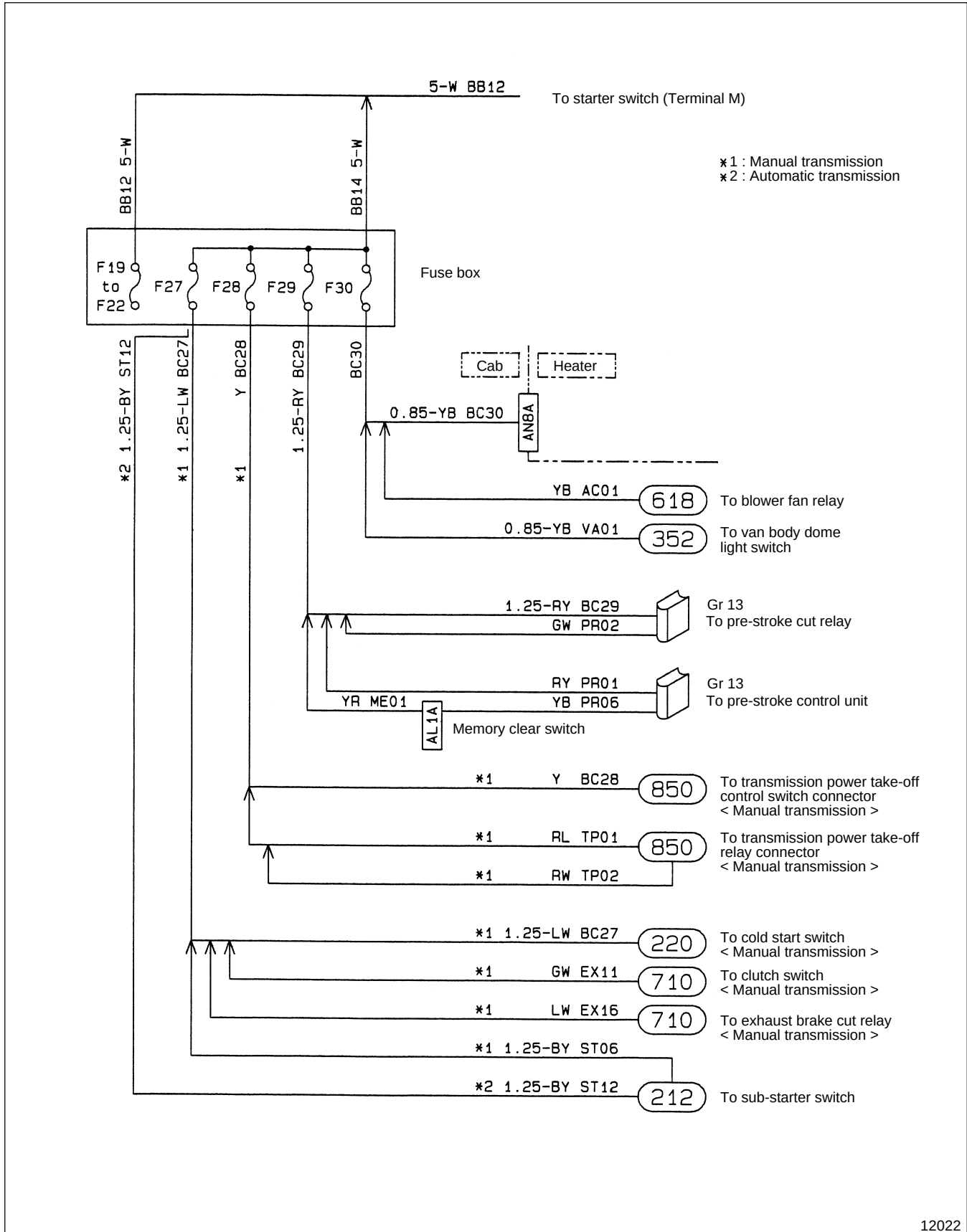


110 POWER CIRCUIT

Fuses F19 to F22

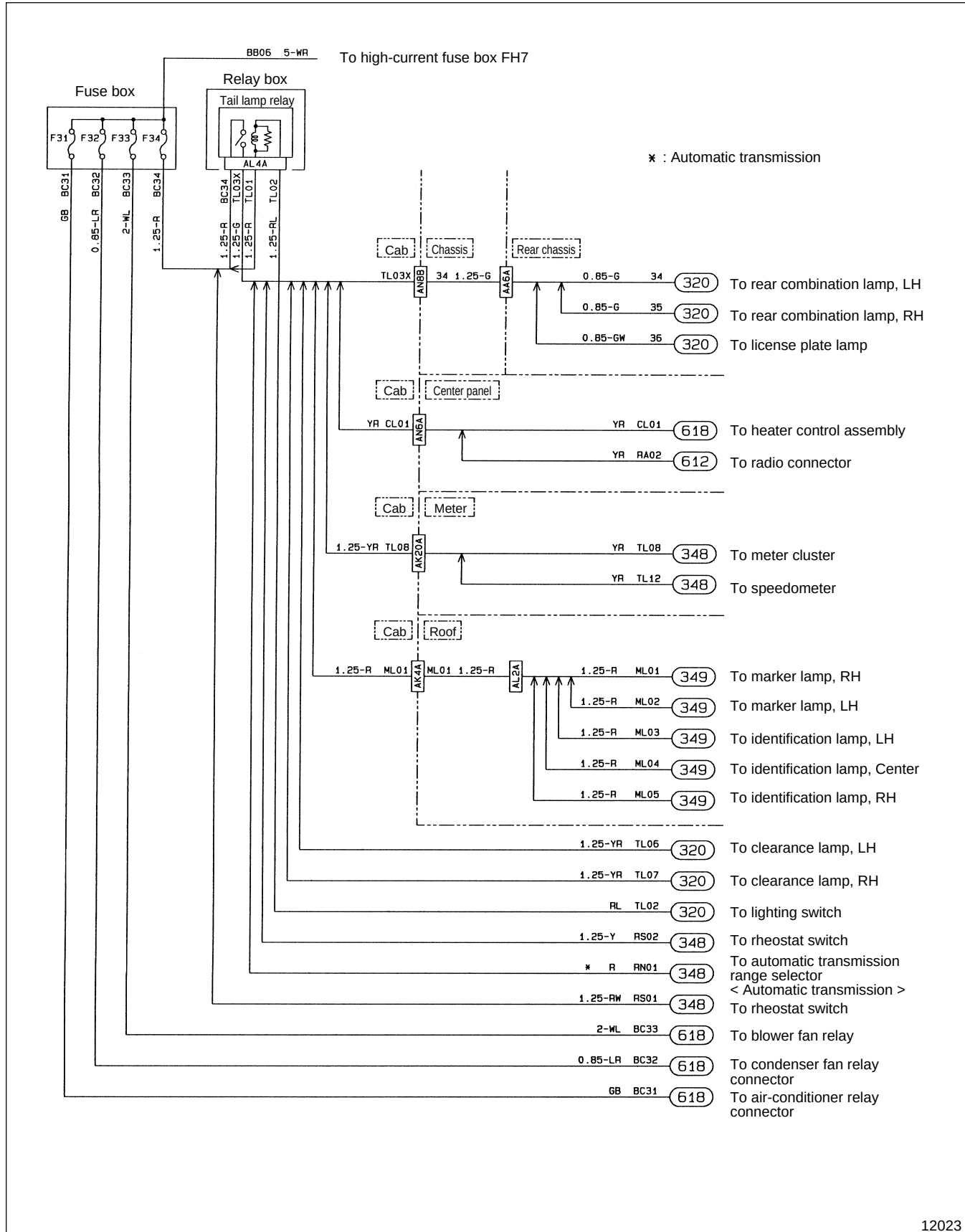


Fuses F27 to F30



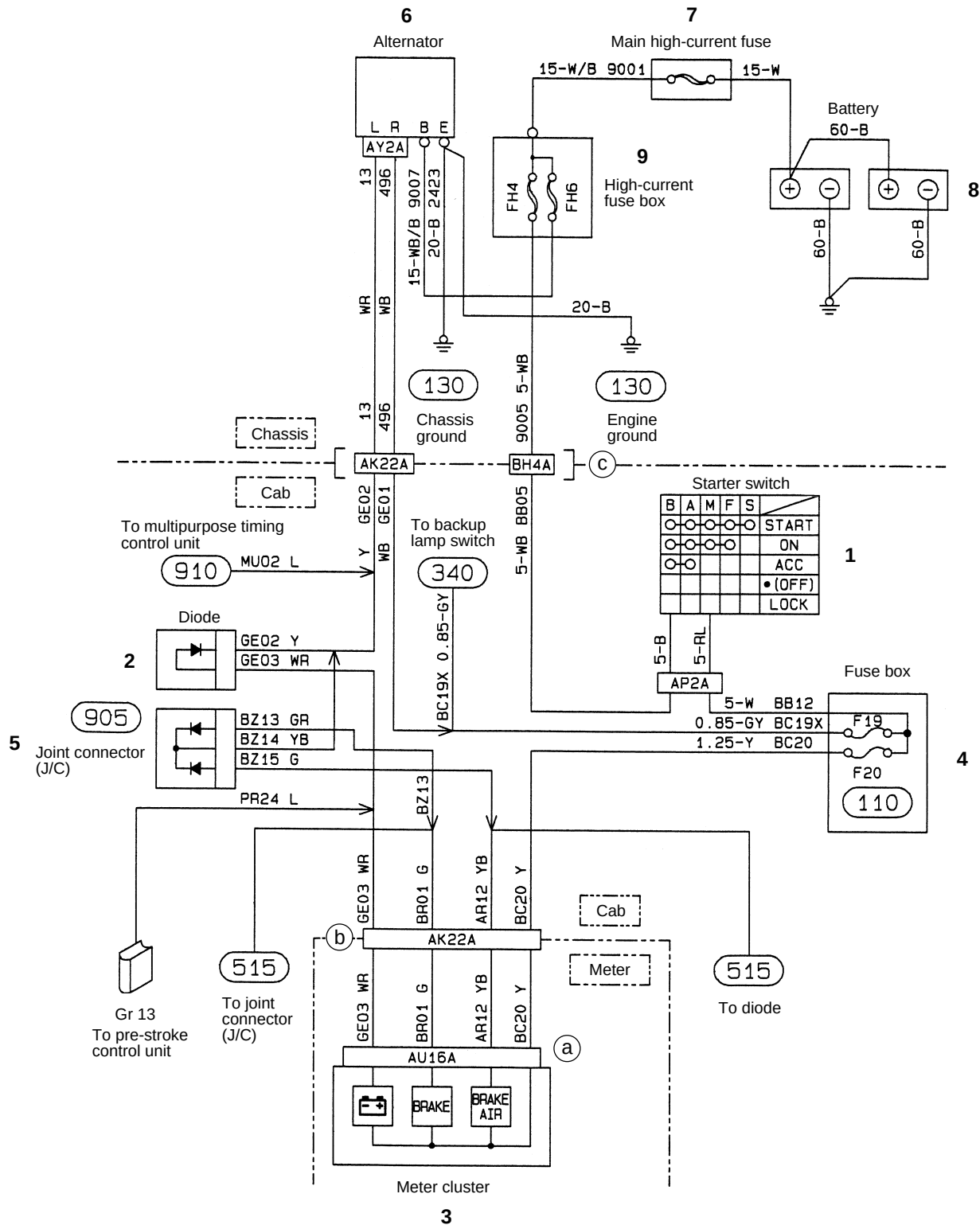
110 POWER CIRCUIT

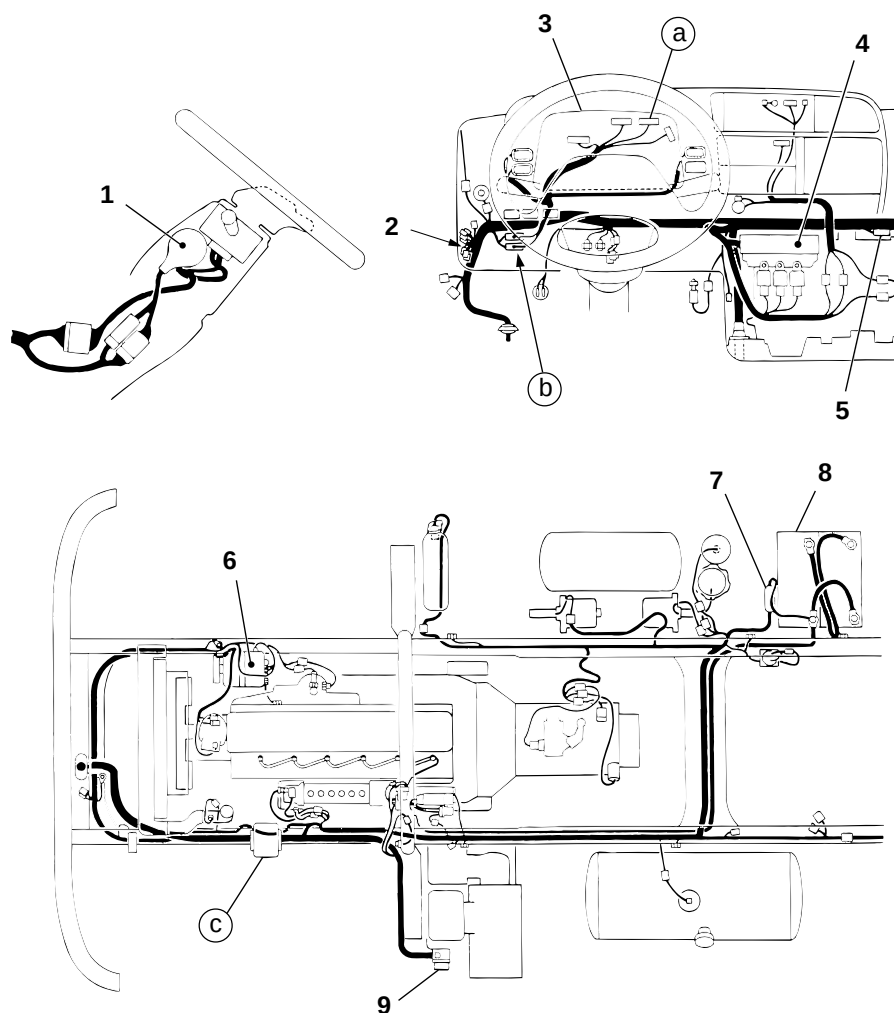
Fuses F31 to F34



MEMO

125 BATTERY CHARGING CIRCUIT





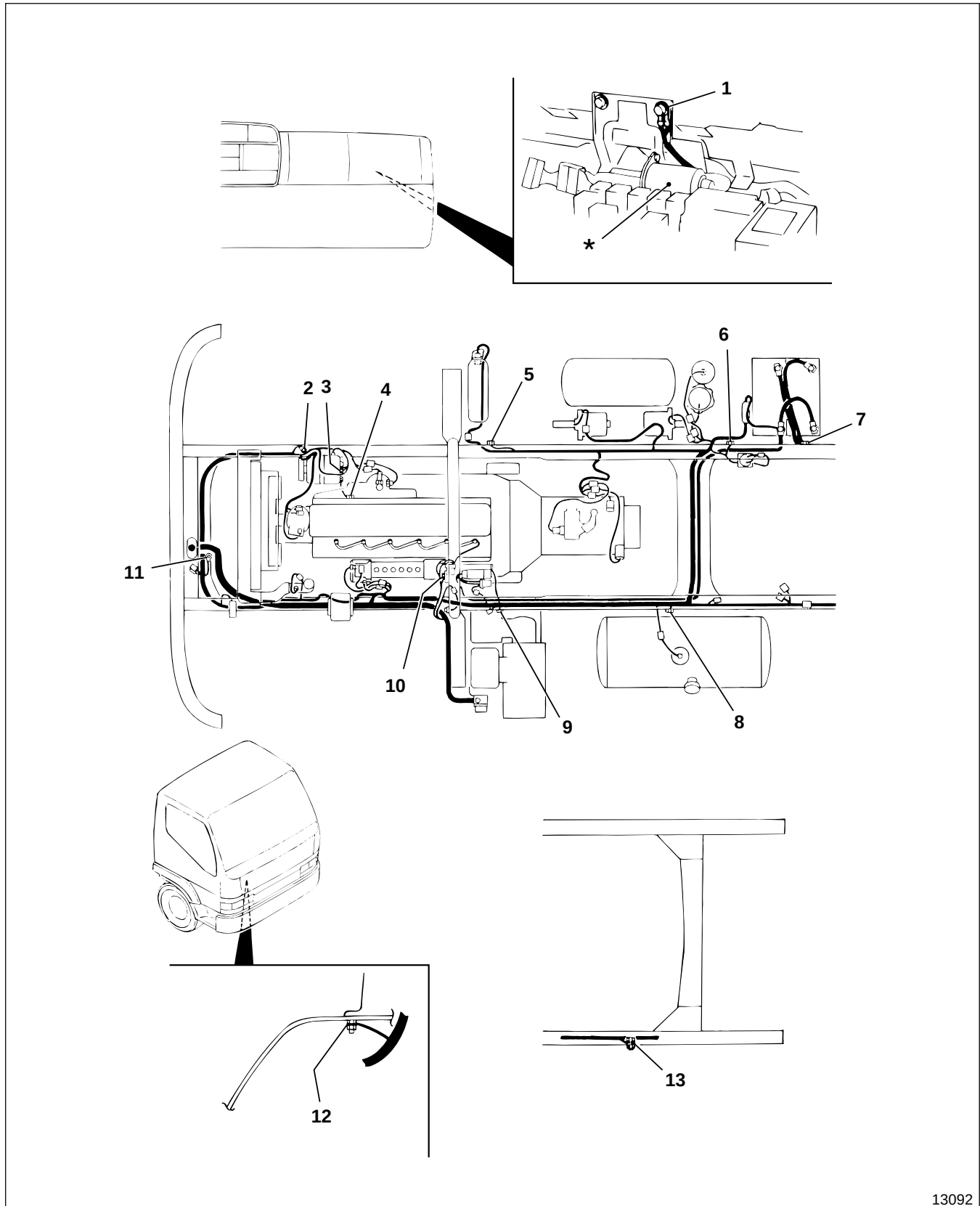
12703

- 1 Starter switch (210)
- 2 Diode
- 3 Meter cluster (401)
- 4 Fuse box (104)
- 5 Joint connector (J/C) (905)

- 6 Alternator (106)
- 7 Main high-current fuse (104)
- 8 Battery (101)
- 9 High-current fuse box (104)

130 GROUND

Ground Point



13092

* : Wiper motor

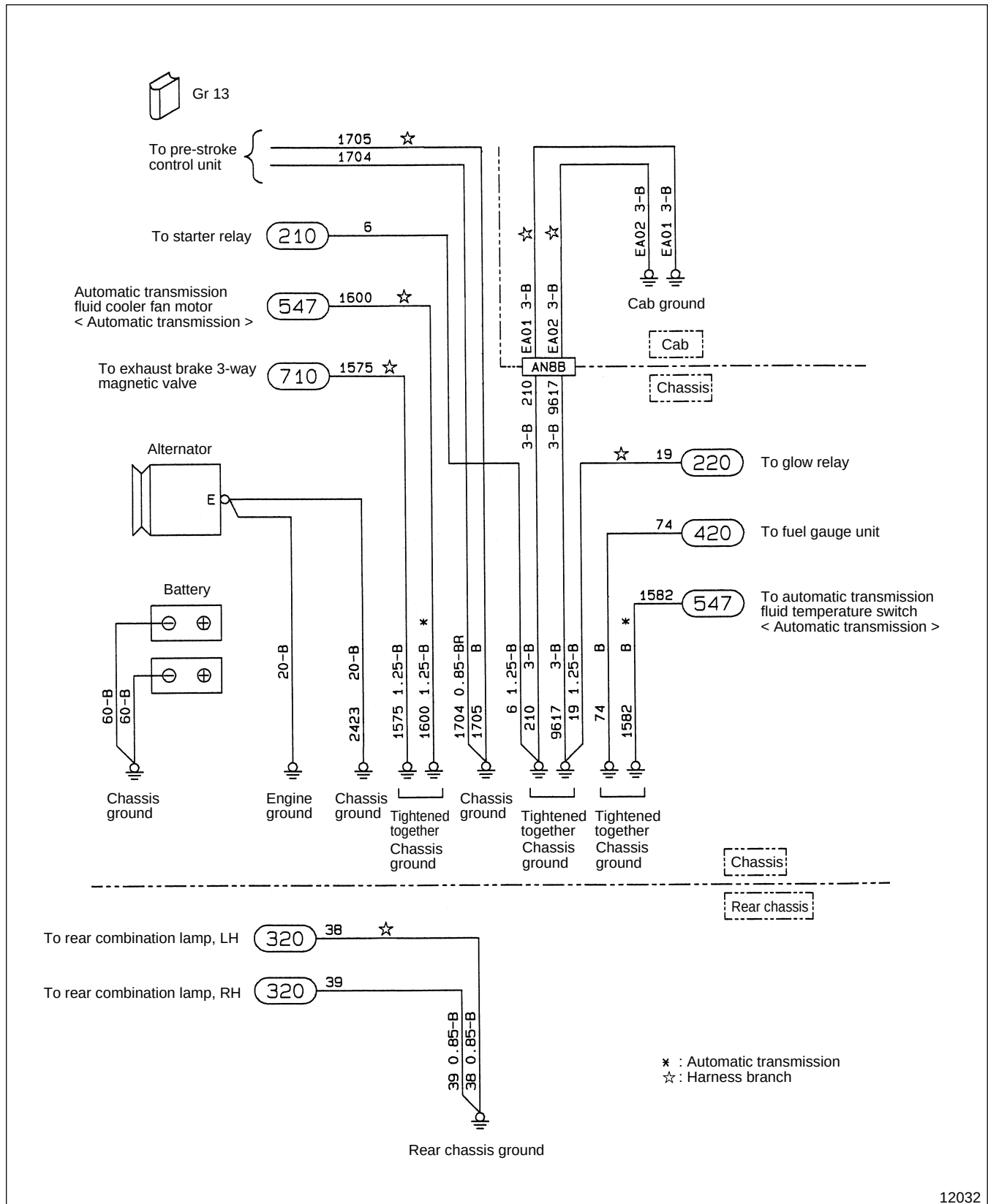
Location	Name	Circuit No.	Wire diameter-wire color	Remarks
1	Cab ground	EA01	3-B	
2	Chassis ground	2423	20-B	
3	Alternator ground	2423	20-B	
4	Alternator ground	—	5-B	
5	Chassis ground	1575	1.25-B	
		1600	1.25-B	A/T
6	Chassis ground	1704	0.85-BR	
		1705	B	
7	Battery ground	—	60-B	
8	Chassis ground	74	B	
		1582	B	A/T
9	Engine ground	—	—	
10	Chassis ground	19	1.25-B	
11	Chassis ground	6	1.25-B	
		19	1.25-B	
		210	3-B	
		9617	3-B	
12	Cab ground	EA02	3-B	
13	Rear chassis ground	38	0.85-B	
		39	0.85-B	

A/T : Automatic transmission

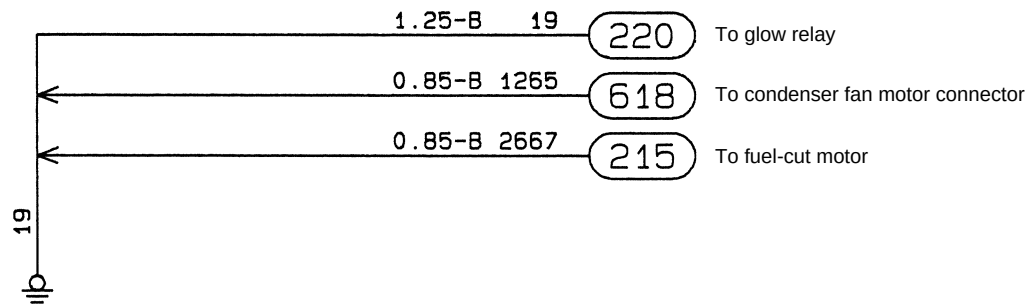
130 GROUND

Entire Ground

- This diagram indicates grounding points.
- See the following pages for branching of grounding (wiring for ☆). (in circuit No. order)

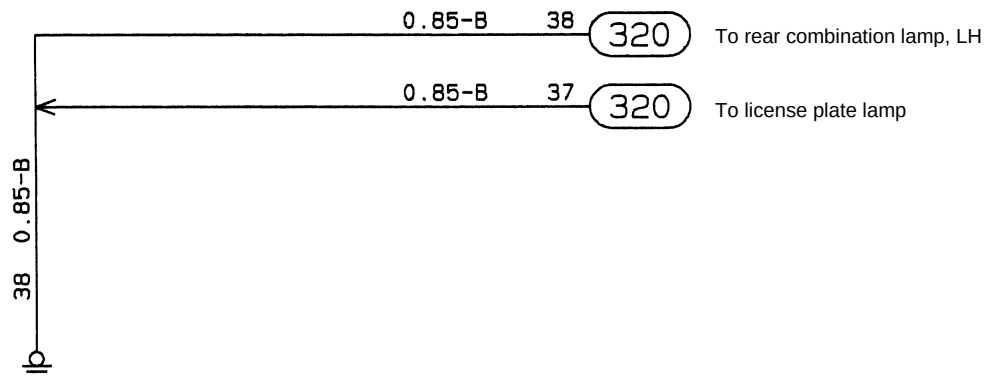


Circuit No.19 Chassis Ground



12027

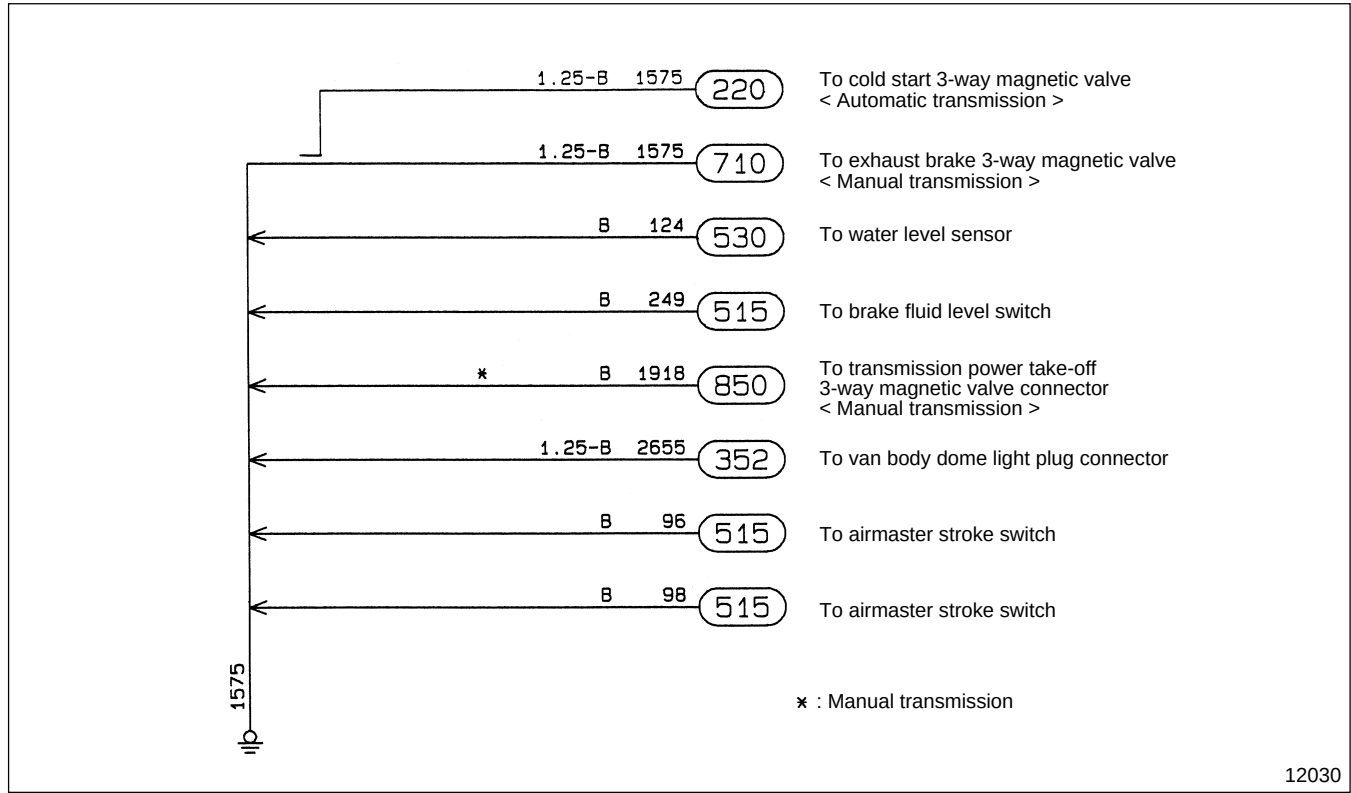
Circuit No.38 Rear Chassis Ground



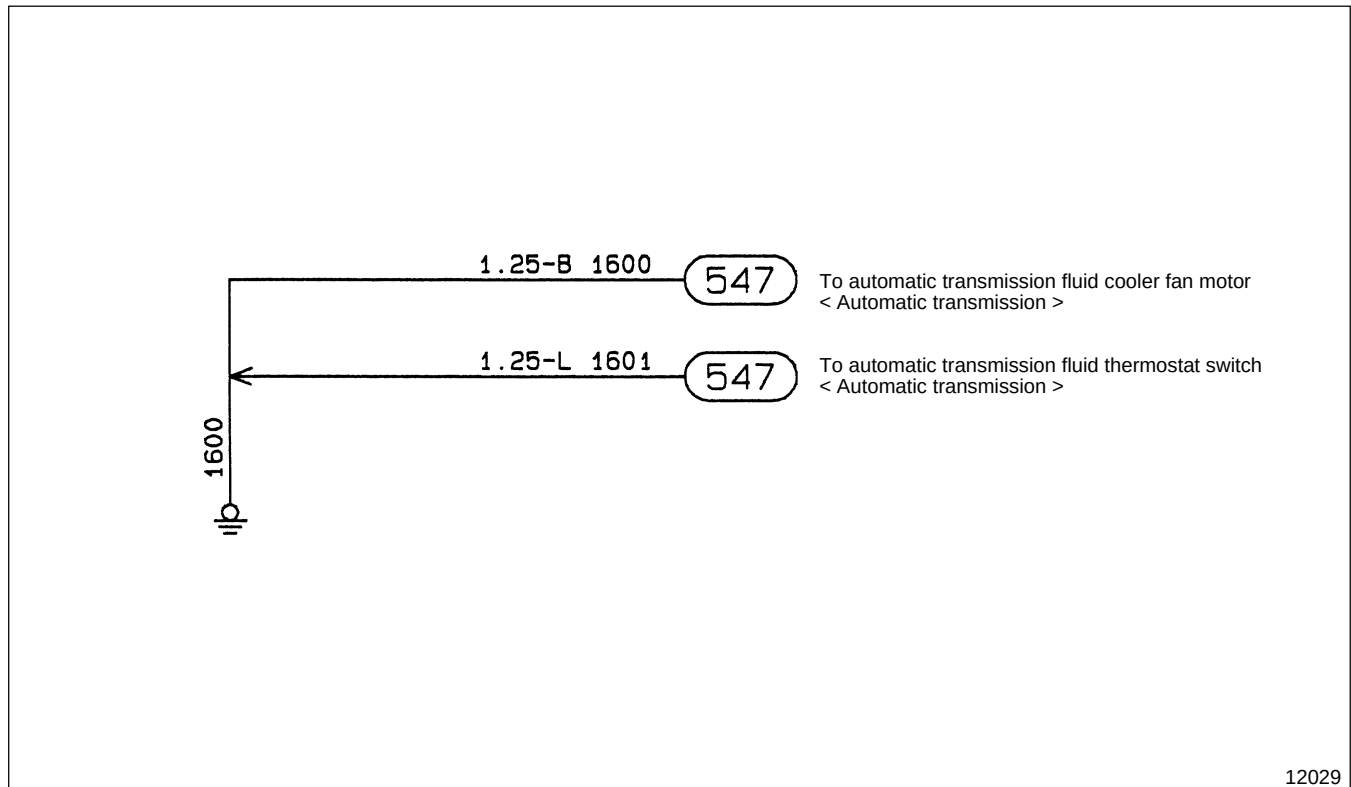
12031

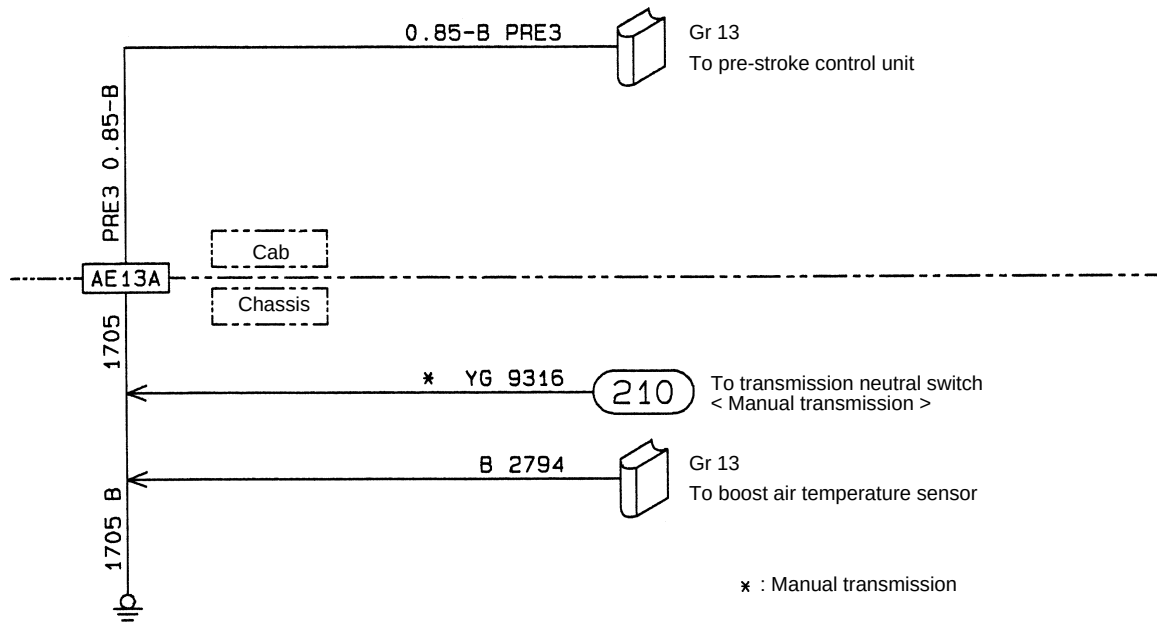
130 GROUND

Circuit No.1575 Chassis Ground



Circuit No.1600 Chassis Ground < Only for Automatic Transmission >

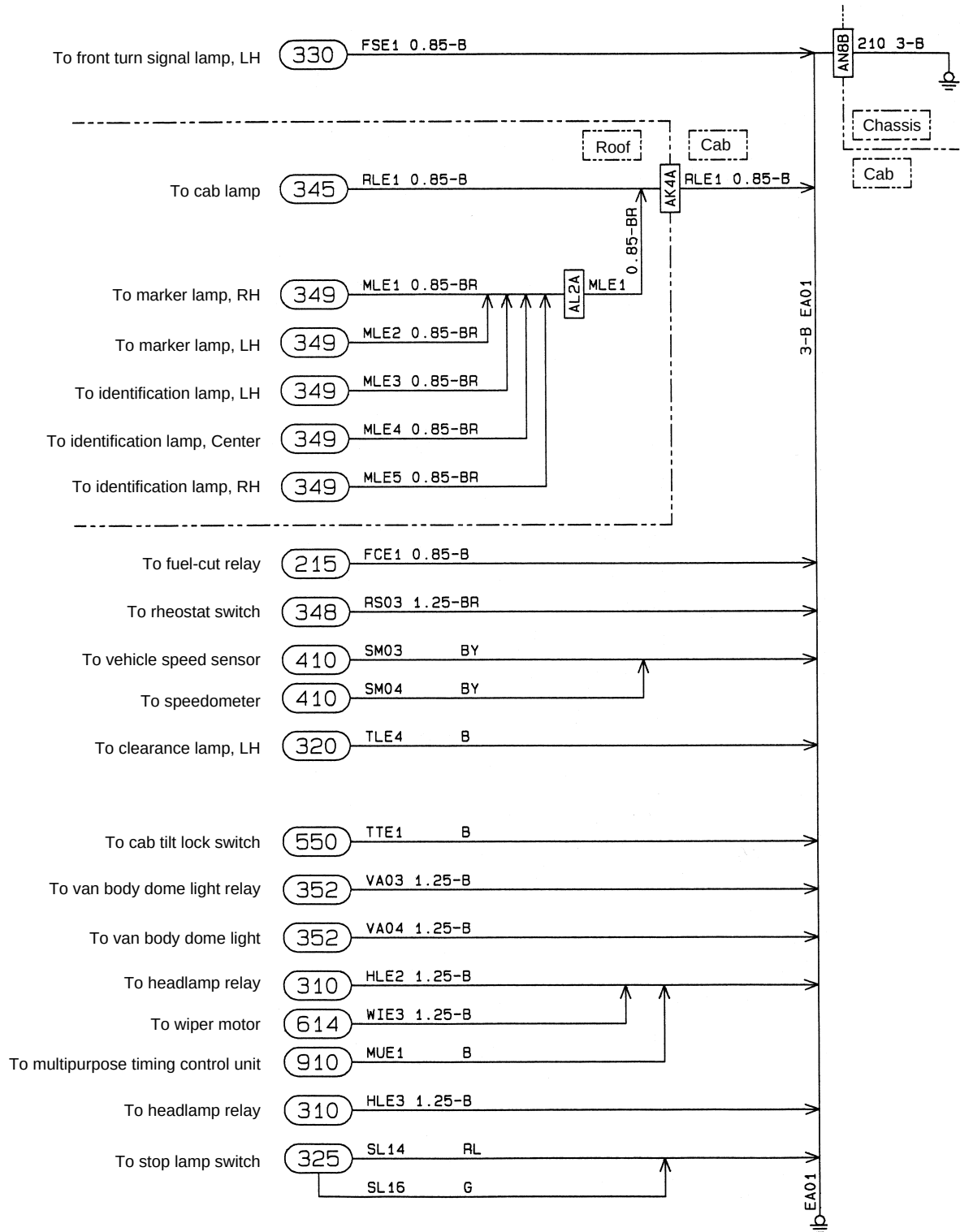


Circuit No.1705 Chassis Ground

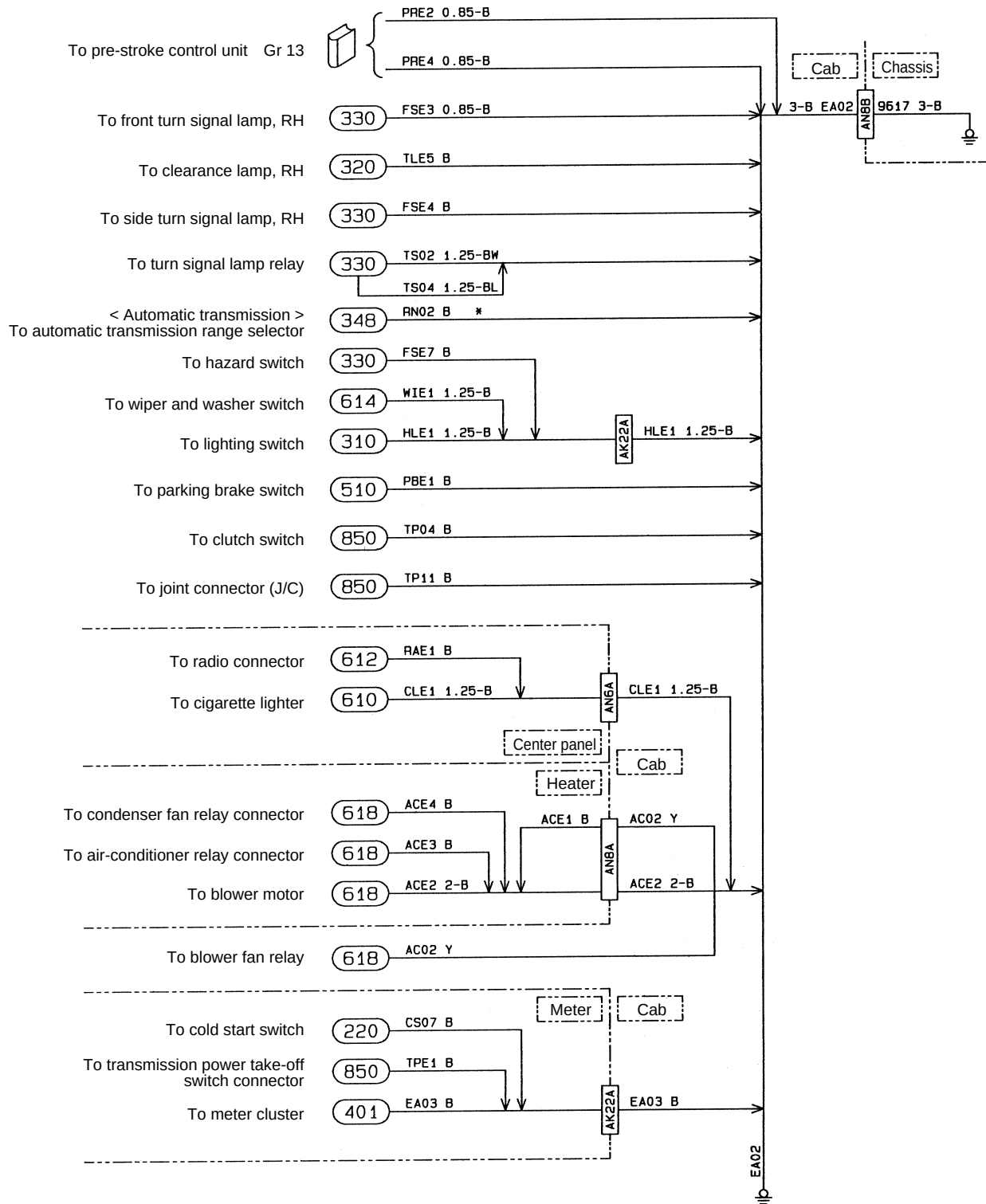
12028

130 GROUND

Circuit No.EA01 Cab Ground



Circuit No.EA02 Cab Ground



* : Automatic transmission

2 STARTING, PREHEATING AND STOPPING ENGINE

SPECIFICATIONS	54-2-2
STRUCTURE AND OPERATION	54-2-3
TROUBLESHOOTING	54-2-12
(200) INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
Inspection of Engine Preheating System	54-2-14
(201) STARTER	54-2-15
(210) ENGINE STARTING CIRCUIT	
< Manual Transmission >	54-2-28
< Automatic Transmission >	54-2-32
(212) SUB-STARTER CIRCUIT	
< Manual Transmission >	54-2-36
< Automatic Transmission >	54-2-38
(215) ENGINE STOPPING CIRCUIT	54-2-40
(220) ENGINE PREHEATING AND COLD START CIRCUIT	
< Manual Transmission >	54-2-44
< Automatic Transmission >	54-2-48

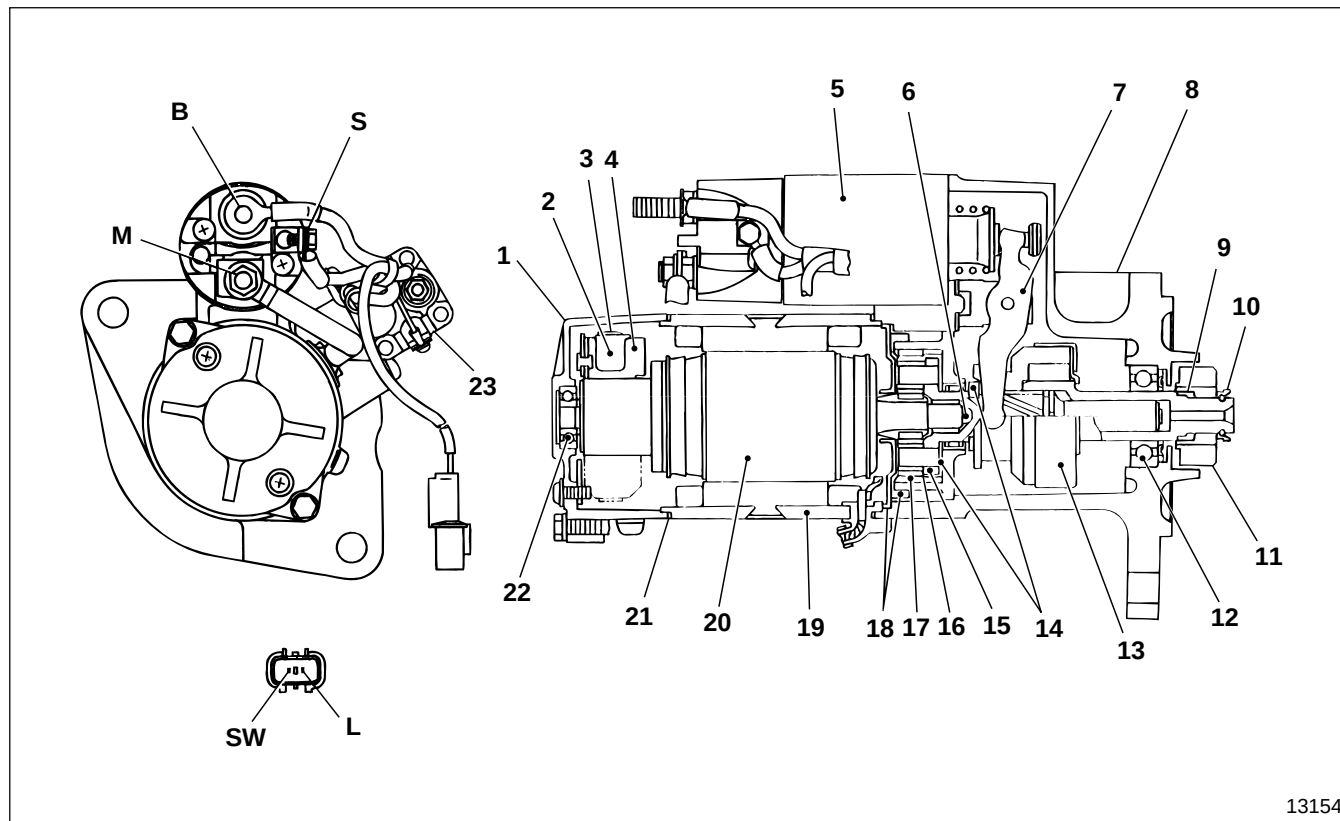
SPECIFICATIONS

Item		Specifications
Starter	Manufacturer	mitsubishi electric
	Reduction gear system	Planetary gear
	Model	M8T55171
	Power V-kW	12-3.5
	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	U1T06292
	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

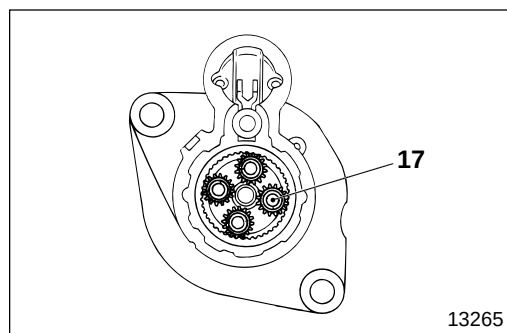
STRUCTURE AND OPERATION

54

Starter



- | | | |
|-------------------|-----------------------|-------------------|
| 1 Rear bracket | 11 Pinion | 21 Rubber packing |
| 2 Brush | 12 Front bearing | 22 Rear bearing |
| 3 Brush spring | 13 Overrunning clutch | 23 Starter relay |
| 4 Brush holder | 14 Washer | |
| 5 Magnetic switch | 15 Gear shaft | B : Terminal B |
| 6 Ball | 16 Internal gear | L : Terminal L |
| 7 Lever | 17 Planetary gear | M : Terminal M |
| 8 Front bracket | 18 Rubber packing | S : Terminal S |
| 9 Spring | 19 Yoke assembly | SW : Terminal SW |
| 10 Pinion stopper | 20 Armature | |

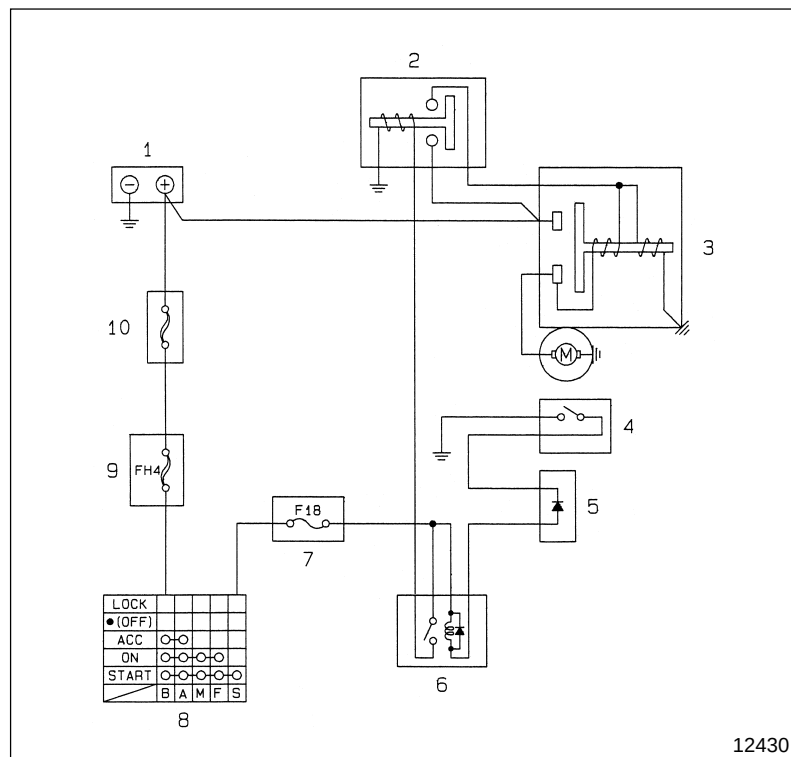


This starter uses planetary gear 17 for the reduction gear system.

STRUCTURE AND OPERATION

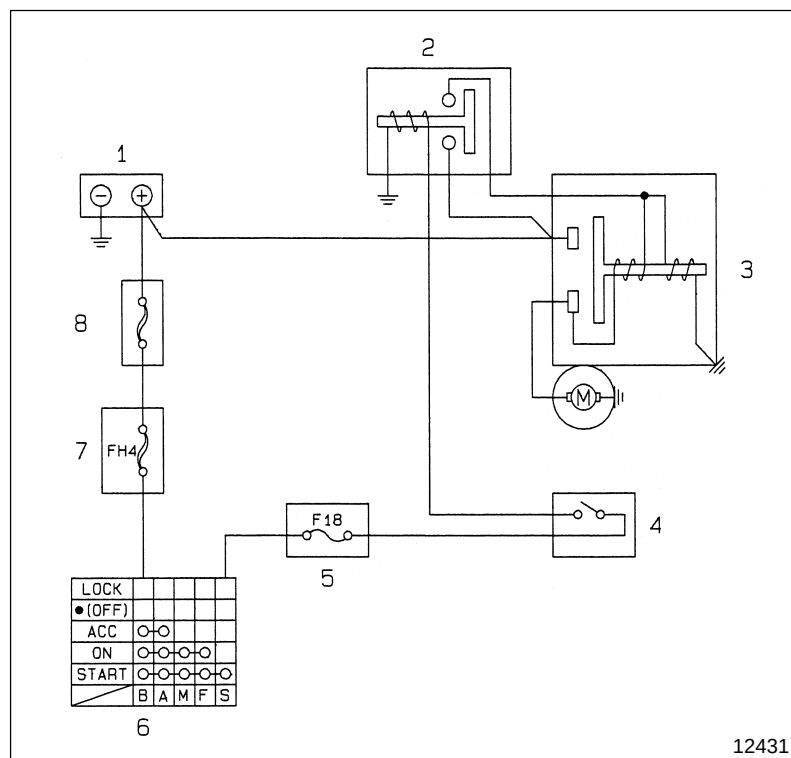
Engine Starting Circuit

< Manual Transmission >



- 1 Battery
- 2 Starter relay
- 3 Starter
- 4 Transmission neutral switch
- 5 Diode
- 6 Transmission neutral relay
- 7 Fuse box
- 8 Starter switch
- 9 High-current fuse box
- 10 Main high-current fuse

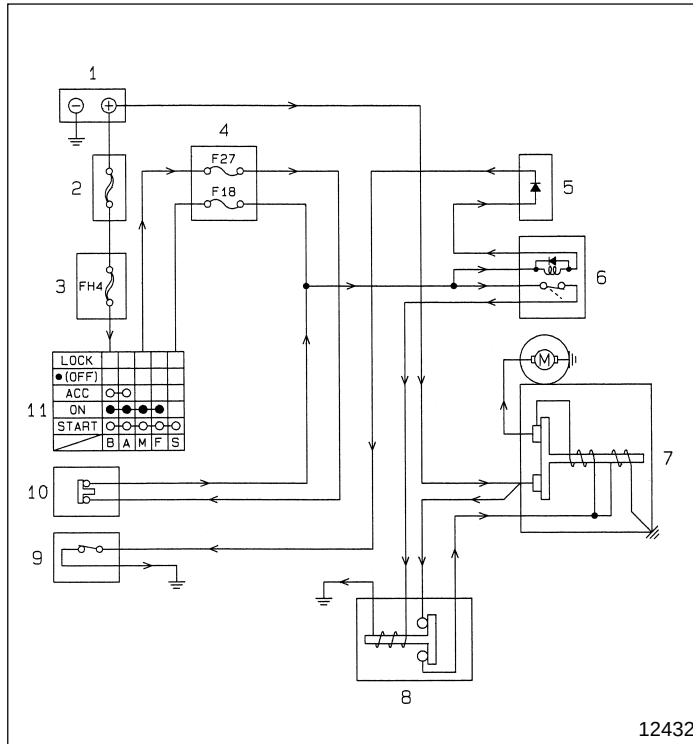
< Automatic Transmission >



- 1 Battery
- 2 Starter relay
- 3 Starter
- 4 Transmission neutral switch
- 5 Fuse box
- 6 Starter switch
- 7 High-current fuse box
- 8 Main high-current fuse

Sub-starter Circuit

< Manual Transmission >



- 1 Battery
- 2 Main high-current fuse
- 3 High-current fuse box
- 4 Fuse box
- 5 Diode
- 6 Transmission neutral relay
- 7 Starter
- 8 Starter relay
- 9 Transmission neutral switch
- 10 Sub-starter switch
- 11 Starter switch

Position of starter switch **11** : ON

Position of sub-starter switch **10** : ON

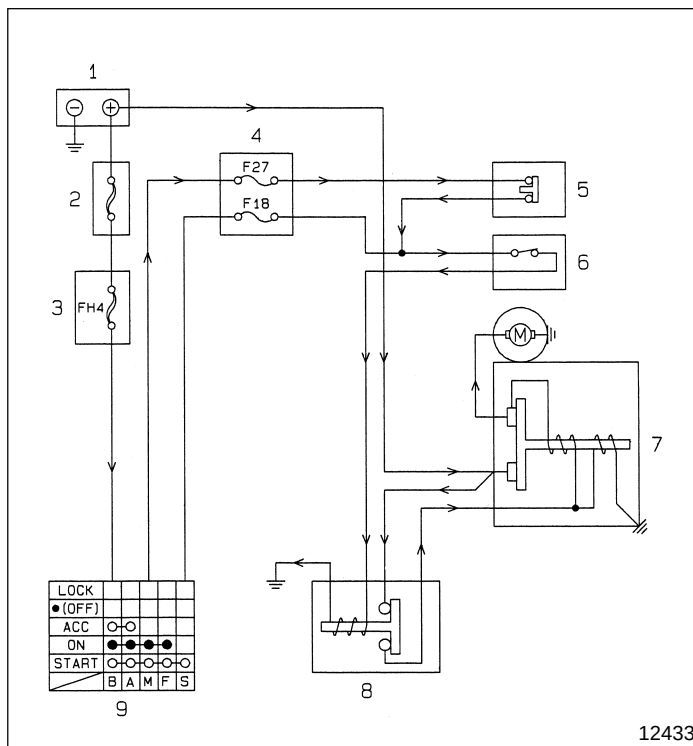
1→2→3→11→4 (F27)→10→6 (coil)→5→9→Ground

1→2→3→11→4 (F27)→10→6 (contact point)

→8 (coil)→Ground

Starter relay **8** operates to turn starter **7**.

< Automatic Transmission >



- 1 Battery
- 2 Main high-current fuse
- 3 High-current fuse box
- 4 Fuse box
- 5 Sub-starter switch
- 6 Transmission neutral switch
- 7 Starter
- 8 Starter relay
- 9 Starter switch

Position of starter switch **9** : ON

Position of sub-starter switch **5** : ON

1→2→3→9→4 (F27)→5→6→8 (coil)→Ground

Starter relay **8** operates to turn starter **7**.

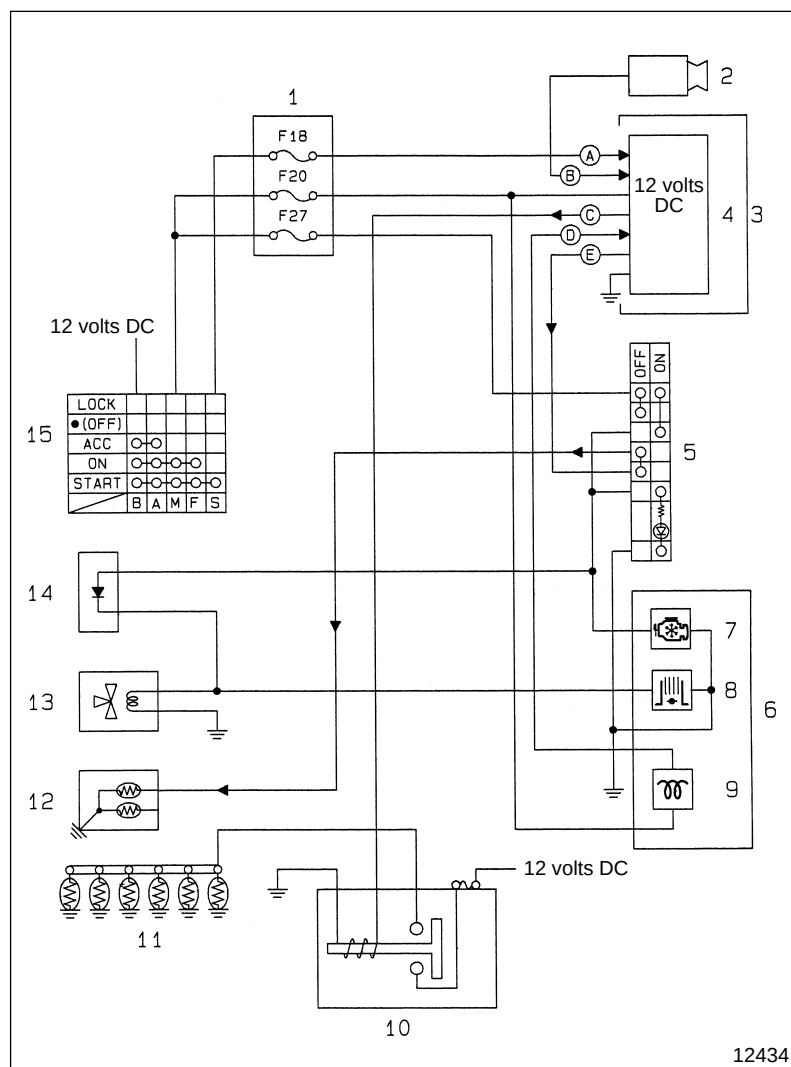
Engine Stopping Circuit

Gr 13

STRUCTURE AND OPERATION

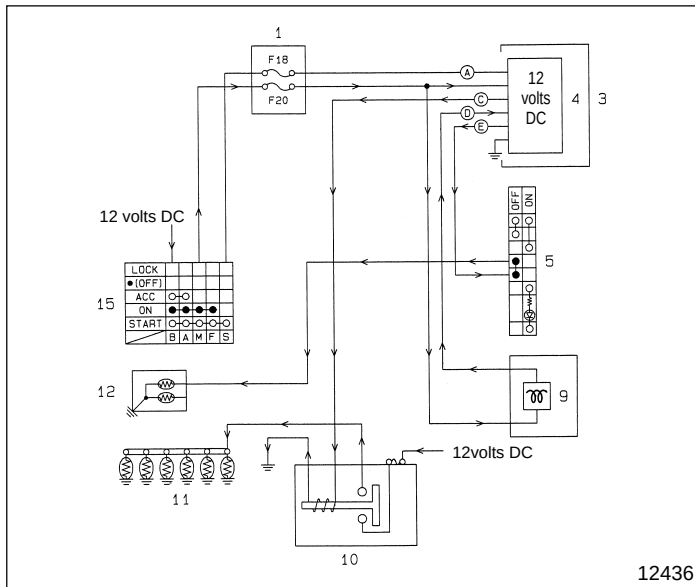
Engine Preheating and Cold Start Circuit

< Manual Transmission >



- 1 Fuse box
- 2 Alternator
- 3 Relay box
- 4 Multipurpose timing control unit
P54-9-2
- 5 Cold start switch
- 6 Meter cluster
- 7 Cold start indicator lamp
- 8 Exhaust brake indicator lamp
- 9 Engine preheating indicator lamp
- 10 Glow relay
- 11 Glow plug
- 12 Water temperature sensor
- 13 Exhaust brake 3-way magnetic valve
- 14 Diode
- 15 Starter switch

- Ⓐ Engine start signal
Ⓑ Alternator charge signal
Ⓒ Glow relay activation signal
Ⓓ lighting-up signal
Ⓔ Engine coolant temperature signal



● Engine preheating circuit

This circuit improves the engine starting performance when the engine coolant temperature is low. The preheating system is controlled by multipurpose timing control unit **4**. P54-9-2

Basic preheating operation

Operation mode P54-2-9

When engine coolant temperature is low (Approximately 60°C {140°F} or less)

Position of starter switch **15** : ON

15→1 (F20)→4→Ground
 E→5→12→Ground

Multipurpose timing control unit **4** detects the engine coolant temperature.

- When the engine coolant temperature is low, multipurpose timing control unit **4** outputs glow relay activation signal C.

4— C→10→Ground

- Glow relay **10** operates to feed power to glow plug **11** and lights up engine preheating indicator lamp **9**.

10 (contact point)→11→Ground

15→1 (F20)→9— D→4→Ground

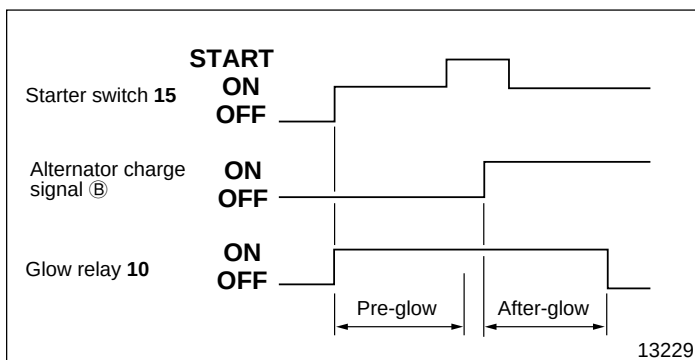
When engine coolant temperature is high (Approximately 60°C {140°F} or more)

- Position of starter switch **15** : ON

15→1 (F20)→4→Ground
 E→5→12→Ground

Multipurpose timing control unit **4** detects the engine coolant temperature.

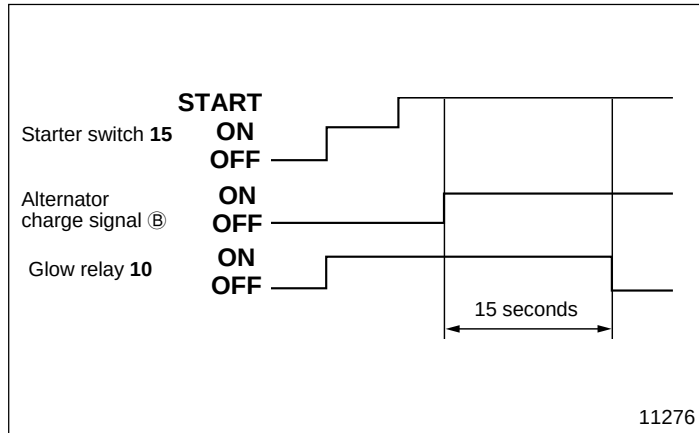
- When the engine coolant temperature is high, multipurpose timing control unit **4** does not output glow relay activation signal C, so no preheating is performed.



Pre-glow and after-glow

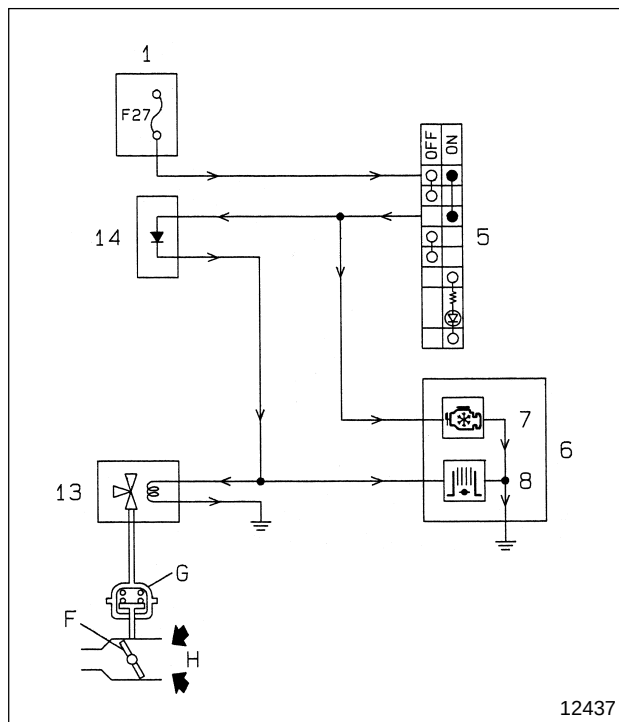
- There are two types of preheating: one is pre-glow, performed before starting the engine; the other is after-glow, performed after starting the engine. They are both controlled by start signal A and alternator charge signal B.

STRUCTURE AND OPERATION



Fail-safe

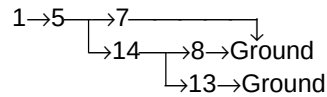
- If the contacts of the glow relay driving relay in multipurpose timing control unit 4 are welded, engine preheating indicator lamp 9 blinks to alert the driver of the fault.
- When all of the following conditions are satisfied, the fail-safe function turns off glow relay 10.
 - Coolant temperature is 60°C {140°F} or less.
 - Engine start signal A is ON.
 - Alternator charge signal B is ON for 15 seconds.



● Cold start circuit

This circuit helps the engine preheating performance when the ambient temperature is low.

Position of cold start switch 5 : ON



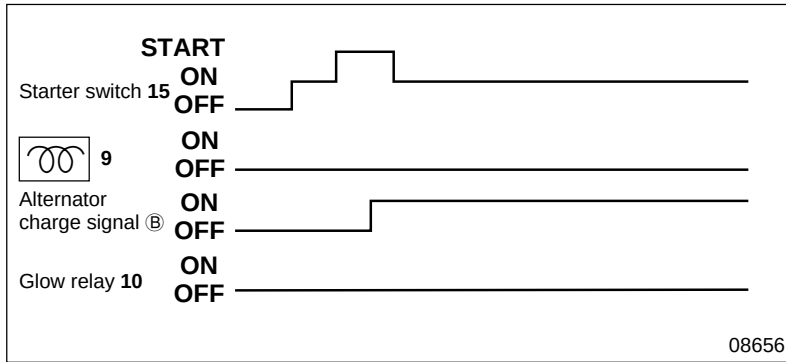
This circuit forces exhaust brake 3-way magnetic valve 13 to operate, closing exhaust brake butterfly valve F.

This decreases incoming cool air H from the engine exhaust system and reduces preheating time.

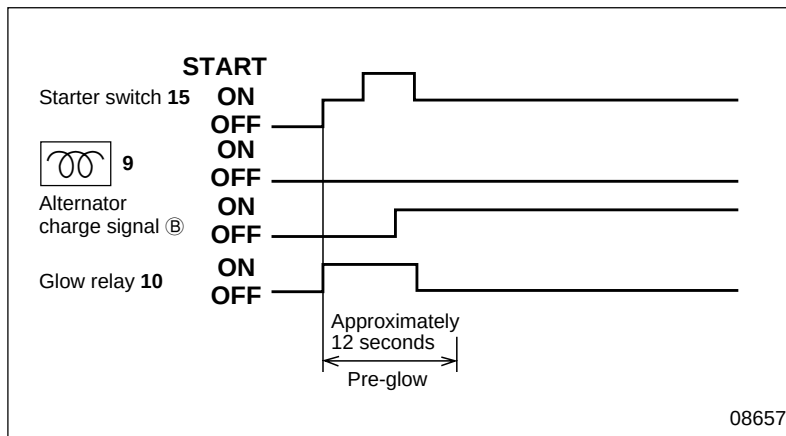
F : Exhaust brake butterfly valve

G : Exhaust brake unit

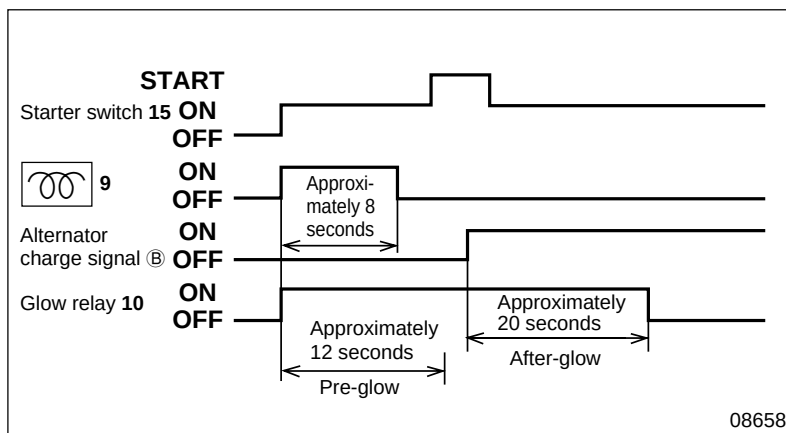
H : Cool air from engine exhaust system

**Operation mode**

- Where the engine coolant temperature is 60°C {140°F} or more.

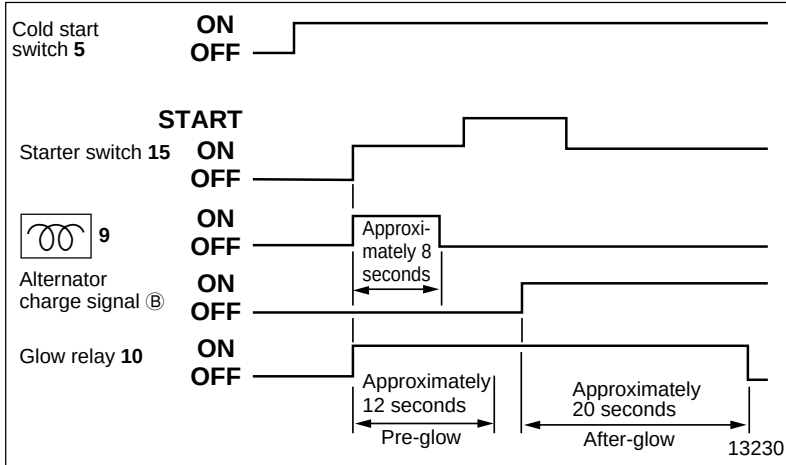


- Where the engine coolant temperature is 0 to 60°C {32 to 140°F}.



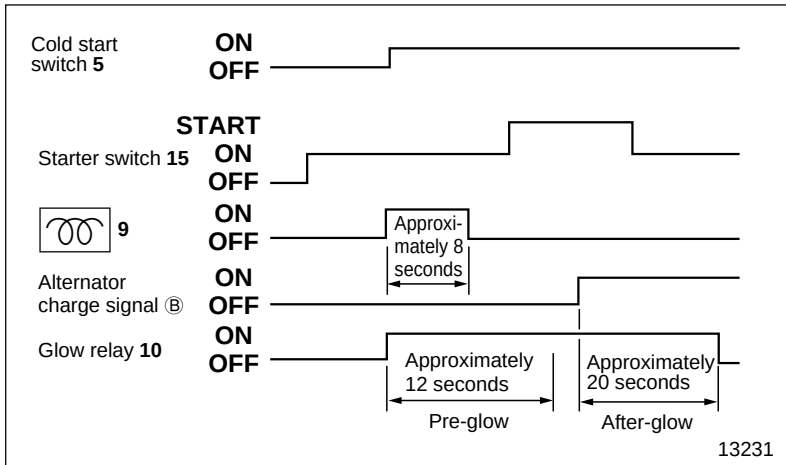
- Where the engine coolant temperature is 0°C {32°F} or less.

STRUCTURE AND OPERATION



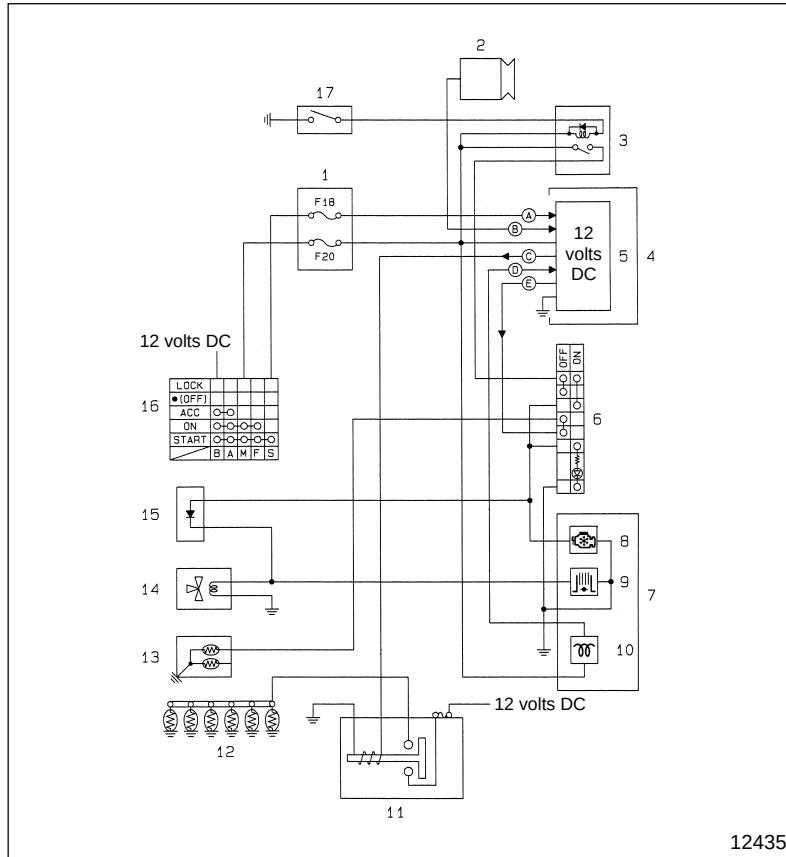
Operation mode when cold start switch is used

- When starter switch **15** is turned ON after cold start switch **5** is turned ON.



- When cold start switch **5** is turned ON after starter switch **15** is turned ON.
(Where the engine coolant temperature is 0°C {32°F} or more.)

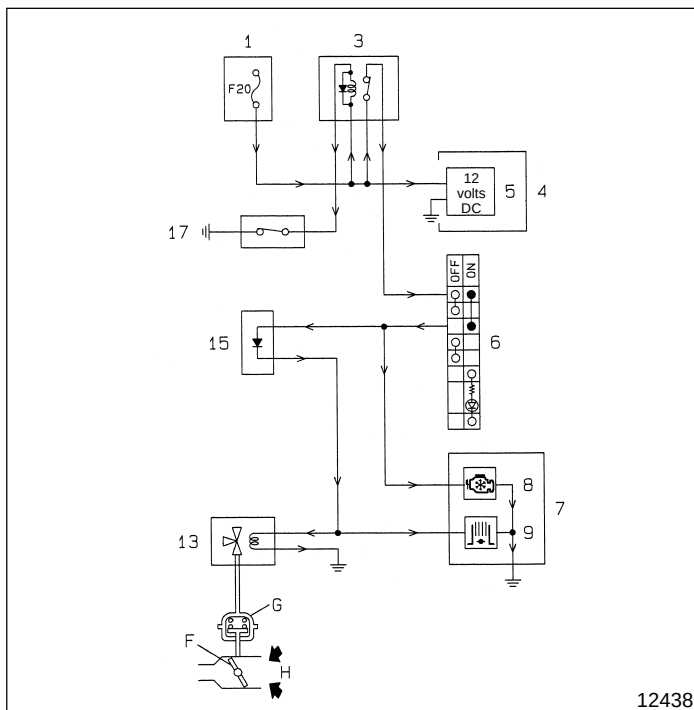
< Automatic Transmission >



- 1 Fuse box
 - 2 Alternator
 - 3 Parking brake relay
 - 4 Relay box
 - 5 Multipurpose timing control unit
P54-9-2
 - 6 Cold start switch
 - 7 Meter cluster
 - 8 Cold start indicator lamp
 - 9 Exhaust brake indicator lamp
 - 10 Engine preheating indicator lamp
 - 11 Glow relay
 - 12 Glow plug
 - 13 Water temperature sensor
 - 14 Exhaust brake 3-way magnetic valve
 - 15 Diode
 - 16 Starter switch
 - 17 Parking brake switch
- Ⓐ Engine start signal
Ⓑ Alternator charge signal
Ⓒ Glow relay activation signal
Ⓓ lighting-up signal
Ⓔ Engine coolant temperature signal

The engine preheating and cold start circuits of automatic transmission vehicles are the same as for manual transmission vehicles, except that parking brake relay **3** is installed in the cold start circuit part in automatic transmission vehicles.

54-2-6



● Cold start circuit

This circuit is formed only when the parking brake is working. The current flow is as follows.

The operating mode is the same as in manual transmission vehicles. P54-2-9

Position of starter switch **16** : ON

1→3 (coil)→17→Ground

1→3 (contact point)→6→8→Ground
15→14→Ground
9→Ground

- F** : Exhaust brake butterfly valve
G : Exhaust brake unit
H : Cold air from engine exhaust system

TROUBLESHOOTING

Symptoms		Starter works, but engine does not start				Engine does not stop	Engine cannot be preheated	Engine hard to start	Remarks
		Starter does not work	Pinion does not engage with ring gear	Pinion engages with ring gear, but does not rotate	Flywheel rotates, but engine does not start				
Possible causes									
Connector connection faulty, harness broken, grounding faulty		☐			☐	☐	☐	☐	
Fuse blown		☐							
Battery charge insufficient		☐		☐					
Starter	Magnetic switch contact point stuck or melted	☐							
	Magnetic switch coil broken	☐							
	Overrunning clutch malfunctioned		☐						
	Pinion worn or damaged		☐						
Starter relay faulty		☐							
Starter switch faulty		☐				☐			
Flywheel ring gear worn or damaged			☐						 Gr 11
Fuel-cut relay faulty					☐	☐			
Fuel-cut motor faulty					☐	☐			
Engine stop cable broken or damaged					☐	☐			 Gr 13
Engine stop cable adjusted incorrectly						☐			 Gr 13
Glow plug faulty							☐	☐	
Glow relay faulty							☐	☐	
Water temperature sensor faulty							☐	☐	
Multipurpose timing control unit faulty							☐	☐	
Connecting plate connection faulty							☐	☐	 Gr 11
Transmission neutral switch faulty < Manual transmission >		☐							
Transmission neutral relay faulty < Manual transmission >		☐							
Sub-starter switch faulty									
Cold start switch faulty									
Exhaust brake 3-way magnetic valve faulty									
Parking brake relay faulty < Automatic transmission >									

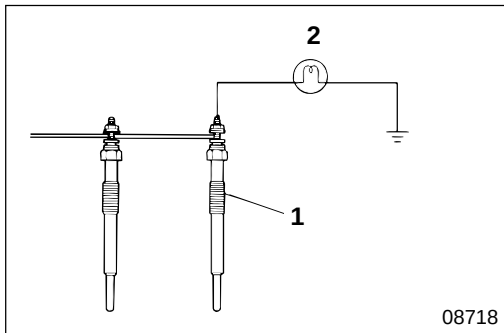
Symptoms		Engine does not start although sub-starter switch is turned ON	Cold start function does not work	Remarks
Possible causes				
Connector connection faulty, harness broken, grounding faulty		☐	☐	
Fuse blown		☐	☐	
Battery charge insufficient		☐	☐	
Starter	Magnetic switch contact point stuck or melted	☐		
	Magnetic switch coil broken	☐		
	Overrunning clutch malfunctioned			
	Pinion worn or damaged			
Starter relay faulty		☐		
Starter switch faulty		☐		
Flywheel ring gear worn or damaged				 Gr 11
Fuel-cut relay faulty				
Fuel-cut motor faulty				
Engine stop cable broken or damaged				 Gr 13
Engine stop cable adjusted incorrectly				 Gr 13
Glow plug faulty				
Glow relay faulty				
Water temperature sensor faulty			☐	
Multipurpose timing control unit faulty			☐	
Connecting plate connection faulty				 Gr 11
Transmission neutral switch faulty < Manual transmission >		☐		
Transmission neutral relay faulty < Manual transmission >		☐		
Sub-starter switch faulty		☐		
Cold start switch faulty			☐	
Exhaust brake 3-way magnetic valve faulty			☐	
Parking brake relay faulty < Automatic transmission >			☐	

200 INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

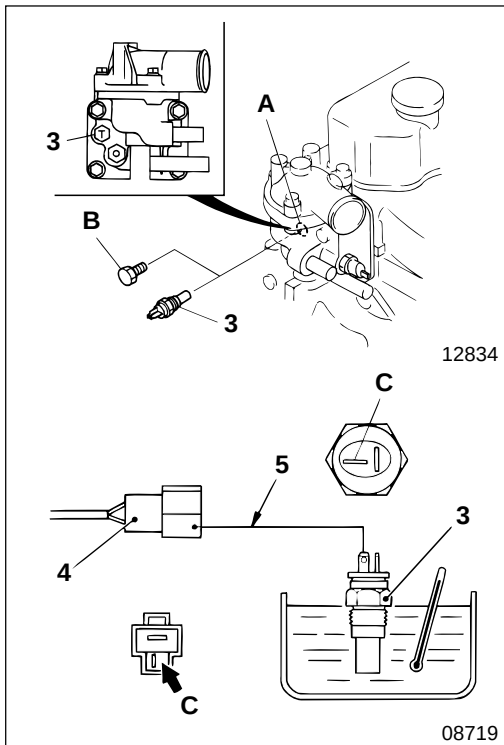
Inspection of Engine Preheating System

Service standards

Location	Maintenance item			Standard value	Limit	Remedy
—	Pre-glow time	Water temperature	60°C {140°F} or more	Does not pre-glow	—	Inspect
			0 to 60°C {32 to 140°F}	Approximately 12 seconds	—	
			0°C {32°F} or less	Approximately 12 seconds	—	
	After-glow time	Water temperature	60°C {140°F} or more	Does not after-glow	—	
			0 to 60°C {32 to 140°F}	Does not after-glow	—	
			0°C {32°F} or less	Approximately 20 seconds	—	
	Indicator lamp lighting time	Water temperature	60°C {140°F} or more	Does not light	—	
			0 to 60°C {32 to 140°F}	Does not light	—	
			0°C {32°F} or less	Approximately 8 seconds	—	



- Turn the starter switch OFF.
- Turn the cold start switch OFF.
- Connect inspection lamp 2 to glow plug 1.



- Remove water temperature sensor 3 from the engine and plug sensor mounting part A with plug B (M16×1.5 mm).
Removal and installation of water temperature sensor 3 Gr 14
- Connect extension harness 5 between water temperature sensor 3 and connector 4.

NOTE

Connect extension harness 5 to terminal C of the multipurpose timing control unit.

- Put water temperature sensor 3 into a container filled with water.
- Carry out the following inspection while changing the water temperature in the container. If any fault is found, inspect each unit.

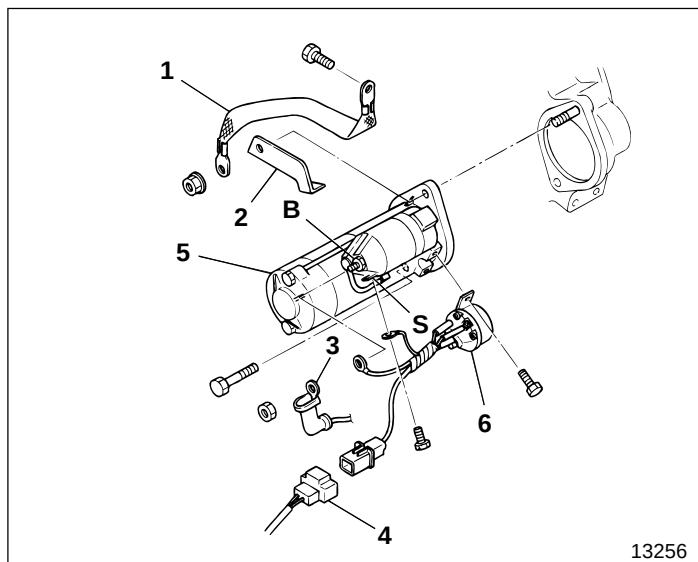
(1) Inspection of pre-glow time and indicator lamp lighting time

Turn the starter switch ON but do not start the engine. Make sure that the pre-glow time and the indicator lamp lighting time at each water temperature conform to the standard value.

- For pre-glow time inspection, measure the lighting time of inspection lamp 2.
- For indicator lamp lighting time inspection, measure the lighting time of lamp within the meter cluster directly.

(2) Inspection of after-glow time

Start the engine and measure the lighting time of inspection lamp 2 from the point lamp within the meter cluster goes off, and make sure that the after-glow time conforms to the standard value.



● Removal sequence

- 1 Ground strap (Engine ground)
- 2 Bracket
- 3 Starter cable (to battery connection)
- 4 Chassis harness
- 5 Starter 54-2-16
- 6 Starter relay

B : Terminal B

S : Terminal S

WARNING

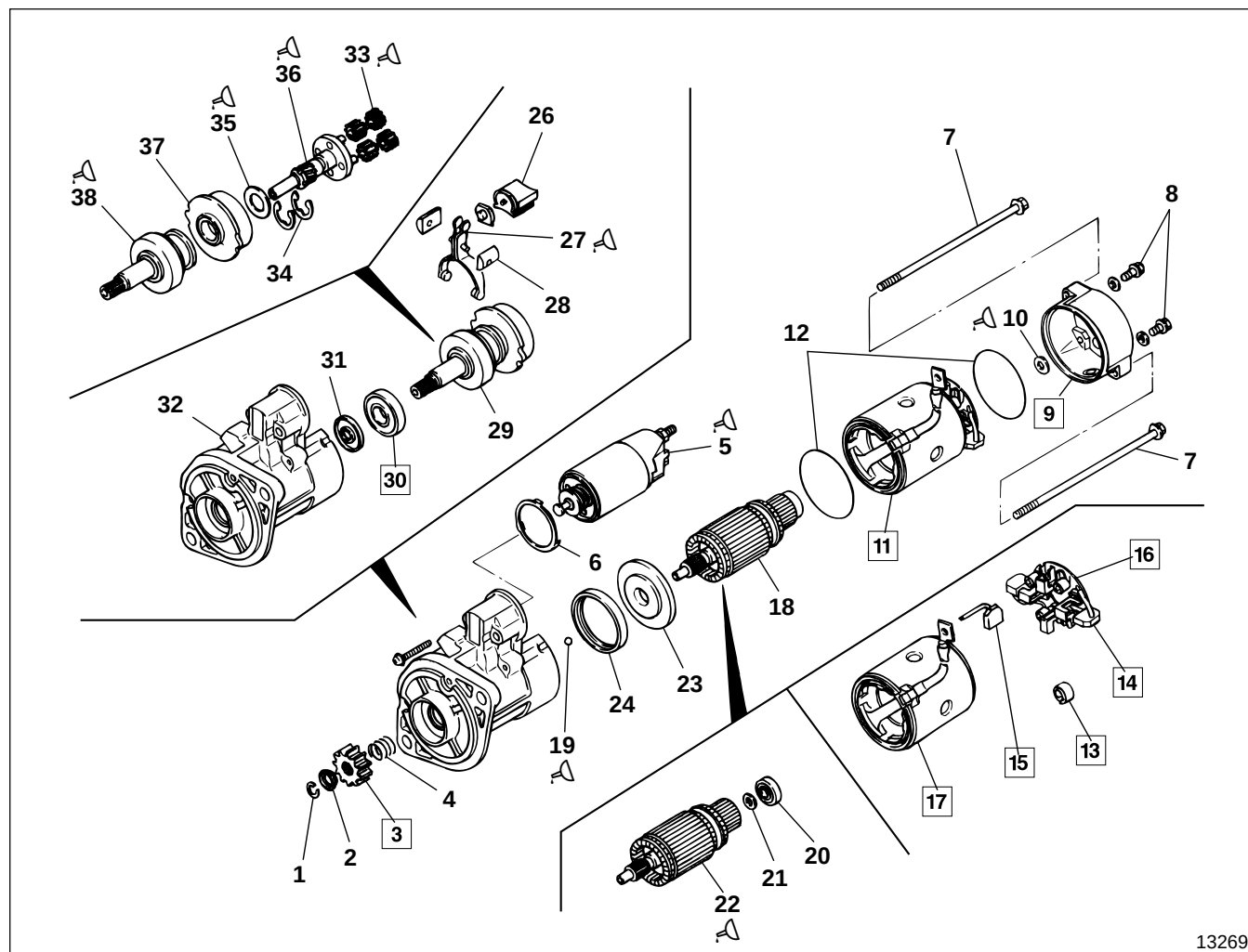
Never touch the starter with tools when you remove the harness from terminal B. This is because voltage is always supplied to it from starter cable 3, and you will short-circuit the starter. Before removing the harness from terminal B, remove the $\ominus$ battery terminal and tape it up to insulate it.

● Installation sequence

Follow the removal sequence in reverse.

201 STARTER

Starter



13269

● Disassembly sequence

- | | | |
|-----------------------------------|---------------------------|---|
| 1 Stopper ring | 14 Brush $\ominus$ | 28 Bushing |
| 2 Pinion stopper | 15 Brush $\oplus$ | 29 Gear shaft and overrunning clutch assembly |
| 3 Pinion | 16 Brush holder assembly | 30 Front bearing |
| 4 Spring | 17 Yoke assembly | 31 Dust seal |
| 5 Magnetic switch | 18 Armature assembly | 32 Front bracket |
| 6 Shim | 19 Ball | 33 Planetary gear |
| 7 Bolt | 20 Rear bearing | 34 Washer |
| 8 Screw | 21 Washer | 35 Washer |
| 9 Rear bracket | 22 Armature | 36 Gear shaft |
| 10 Conical washer | 23 Cover | 37 Internal gear |
| 11 Yoke and brush holder assembly | 24 Rubber packing | 38 Overrunning clutch |
| 12 Rubber packing | 25 Front bracket assembly | |
| 13 Brush spring | 26 Rubber packing | |
| | 27 Lever | |

CAUTION ⚠

- When removing yoke and brush holder assembly 11, make sure you first pull out brushes 14, 15 from brush holder assembly 16 to avoid damaging the commutator of armature 22.
- Do not remove bearings 20, 30 unless they are faulty.
- Make sure you do not drop armature assembly 18 when you remove yoke and brush holder assembly 11 from front bracket assembly 25.
- Be careful not to lose ball 19, since it might come out together with armature assembly 18 when you remove it.

NOTE

- You do not have to remove pinion 3 when you disassemble or inspect only the motor assembly, for example: when inspection of the brush assembly is required.
- Except for the above, make sure you remove pinion 3 before disassembling any parts.

● **Assembly sequence**

Follow the disassembly sequence in reverse.

NOTE

Whenever magnetic switch 5 has been replaced, be sure to adjust the pinion gap.

● **Inspection after assembly**

📖 P54-2-18

Service standards

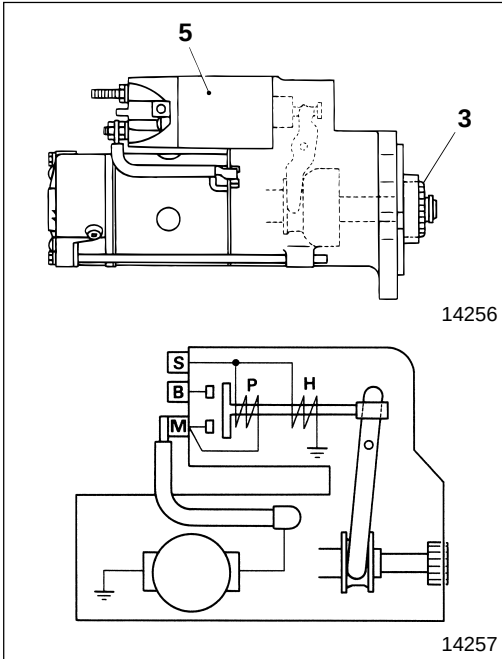
Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Pinion gap		0.5 to 2.0 {0.02 to 0.079}	—	Adjust
—	No-load characteristic (11 V when current flowing)	Current	180 A or less	—	Inspect
		Revolutions per minute	3800 rpm or more	—	
13	Pressure of brush spring		29 to 39 N {6.6 to 8.8 lbf, 3 to 4 kgf}	20 N {4.4 lbf, 2 kgf}	Replace
14, 15	Length of brush		18 {0.71}	11 {0.43}	Replace
18	Armature assembly	Outer diameter of commutator	32 {1.26}	31.4 {1.24}	Replace
		Deflection of commutator periphery	—	0.05 {0.002} or more	Replace
		Mica depth between segments	0.5 {0.02}	0.2 {0.0079} or less	Correct or replace

🔧 **Lubricant**

Location	Points of application	Kinds	Quantity
5	Contact surface between lever and magnetic switch	Multipurpose grease [NLGI No.2 Li soap]	As required
10	Conical washer	Multipurpose grease [NLGI No.2 Li soap]	As required
19	Ball	MOLYKOTE ® AG650	As required
22, 33	Teeth of armature gear and planetary gear	MOLYKOTE ® AG650	As required
22, 36	Friction surfaces of gear shaft and armature	MOLYKOTE ® AG650	As required
27	Friction surfaces of lever and overrunning clutch	Multipurpose grease [NLGI No.2 Li soap]	As required
35	Washer	MOLYKOTE ® AG650	As required
36, 38	Friction surfaces of gear shaft and overrunning clutch	Multipurpose grease [NLGI No.2 Li soap]	As required
38	Spline of overrunning clutch	Multipurpose grease [NLGI No.2 Li soap]	As required

201 STARTER



◆ Service procedure

● Inspection after assembly

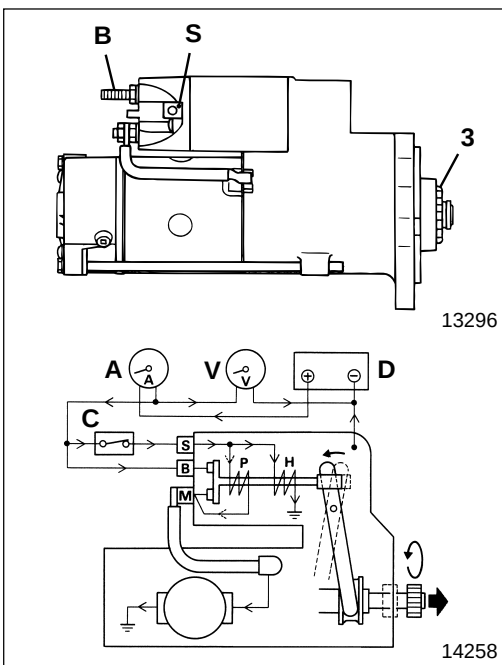
Inspections after assembling the starter should be carried out with current fed to the starter.

WARNING ⚠

- Do not touch pinion 3 because it jumps out and turns when current is fed to the starter.
- Take care not to burn your hand, magnetic switch 5 might be hot after inspection.

CAUTION ⚠

- The current feeding time to the starter should be within 10 seconds at pull-in coil P side and within 30 seconds at holding coil H side. If the current feeding time exceeds these limits the coil might burn due to overheating.
- When current is flowing into the starter, a current of over 100 amperes is fed. When inspecting, use thick cable, such as a booster cable, and make secure connections.



(1) Performance test

- Connect the starter as illustrated.

A : Ammeter	D : DC power supply (12 volts)
B : Terminal B of starter	S : Terminal S of starter
C : Switch	V : Voltmeter
- Set the voltage to 11 volts DC.

CAUTION ⚠

Up to 12 volts can be loaded.

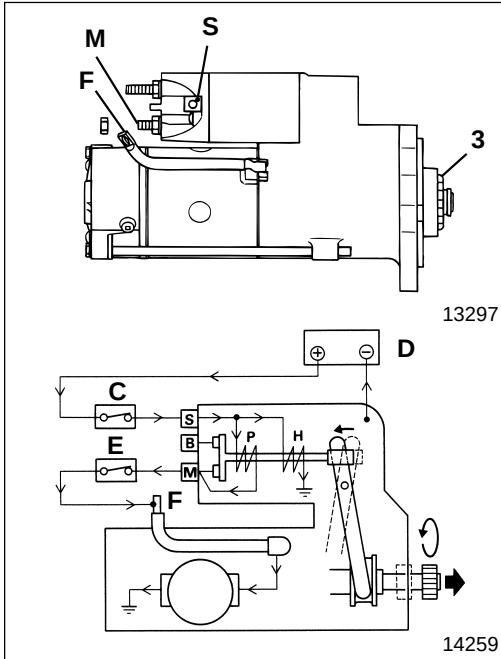
- The following work should be done with current fed to the starter. You must complete the full procedure of measuring the intensity of the current and the number of revolutions within 30 seconds.
- Turn switch C ON and feed current into the starter. In this state, pinion 3 jumps out and rotates.

CAUTION ⚠

When switch C is turned ON, current is fed both to pull-in coil P and holding coil H. When a large amount of current is fed into terminal M from DC power supply D, via terminal B of the starter, the current stops flowing into the pull-in coil but continues to flow into the holding coil.

To avoid burning the holding coil, be sure to carry out the performance test within 30 seconds.

- Measure the intensity of the current and the number of revolutions of the starter. Train a strobe light on pinion 3 to measure the revolutions.
- Turn switch C OFF to stop current to the starter.
- If the measured value deviates from the standard value, disassemble the starter again and inspect it.



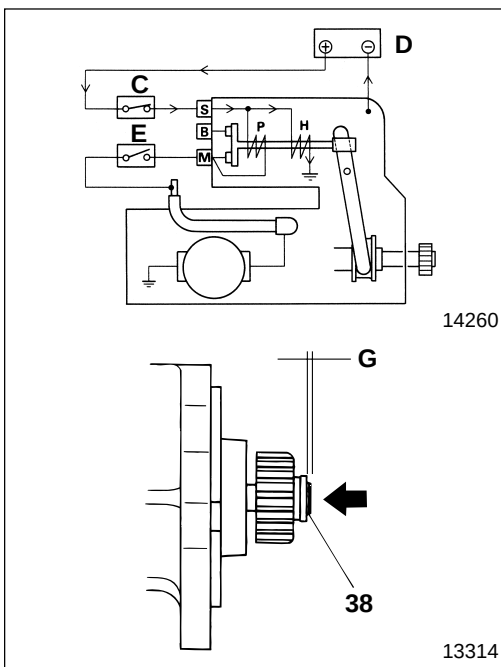
(2) Pinion gap

[Inspection]

- Connect the starter as illustrated.

C : Switch
D : 12 volts DC
E : Switch
F : Cable
M : Terminal M of starter
S : Terminal S of starter

- The following work should be done with current fed to the starter. You must complete the full procedure for measuring the pinion gap within 30 seconds.
 - Turn switches **C** and **E** ON and feed current to the starter. In this state, pinion **3** jumps out and rotates.



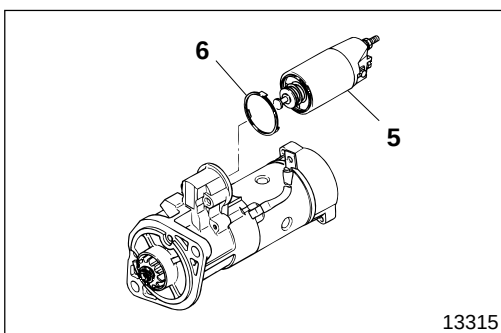
- Within five seconds of pinion **3** rotating, turn switch **E** OFF to stop rotation of the pinion.

CAUTION ⚠

When switches **C** and **E** are turned ON, current is fed both to pull-in coil **P** and holding coil **H**. The circuit is wired in such a way that the voltage is not applied to terminal **B** of the starter, so the current continues to flow into the pull-in coil while pinion **3** rotates.

To avoid burning the pull-in coil, be sure to turn switch **E** OFF within 5 seconds of the pinion rotating.

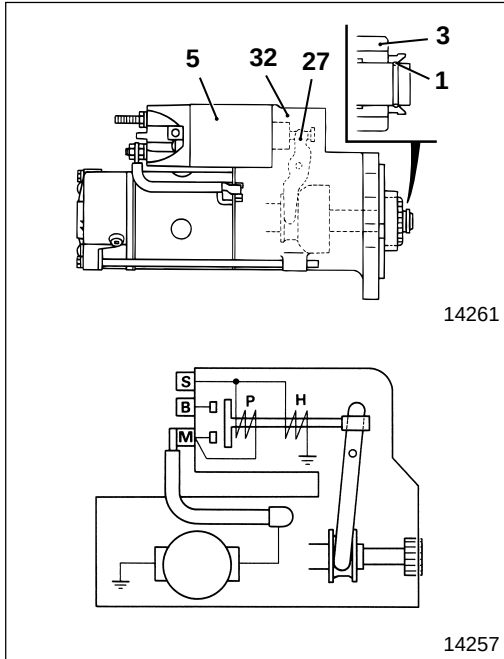
- Push the tip of overrunning clutch **38** lightly and measure pinion gap **G** in the axial direction.
- Turn switch **C** OFF to stop current to the starter.
- If the measured value deviates from the standard value, adjust the pinion gap as follows.



[Adjustment]

- Remove magnetic switch **5** from front bracket assembly **25**.
- Change the thickness of shims **6**. Adding shims decreases pinion gap **G**.
- Type of shim : 0.5, 0.25 mm {0.02, 0.0098 in.}

201 STARTER



3 Pinion

[Removal]

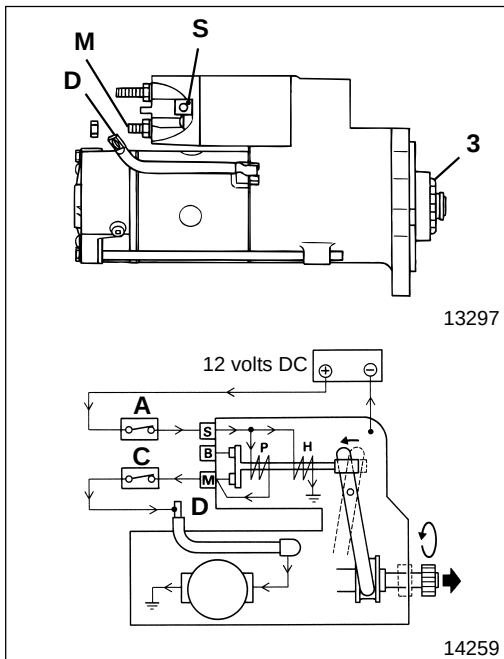
Feed current to the starter and protrude pinion 3 to remove the pinion.

WARNING ⚠

- Do not touch pinion 3 because it jumps out and turns when current is fed to the starter.
- Take care not to burn your hand, magnetic switch 5 might be hot after inspection.

CAUTION ⚠

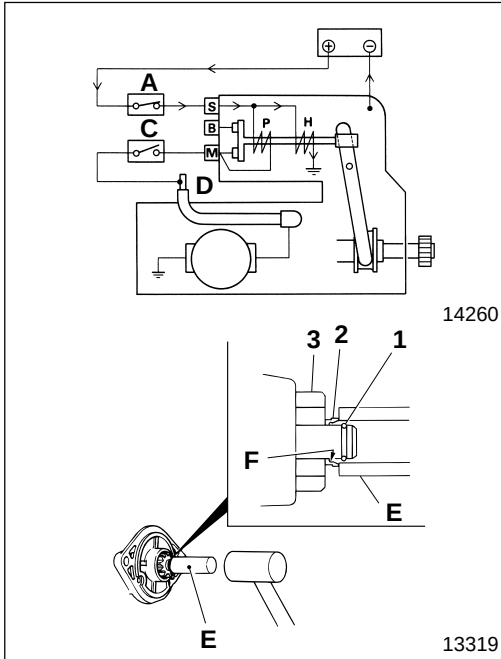
- The current feeding time to the starter should be within 10 seconds at pull-in coil P side and within 30 seconds at holding coil H side. If the current feeding time exceeds these limits, the coil might burn due to overheating.
- Before making pinion 3 jump out, be sure to feed current to the starter to obtain the correct state. If current is not fed to the starter and lever 27 is pulled to protrude the pinion, front bracket 32 or the lever might be damaged due to the shock produced on removal of stopper ring 1.
- The current, when fed to the starter, is over 100 amperes. When inspecting, use thick cable, such as a booster cable, and make secure connections.



- Connect the starter as illustrated.

A : Switch
C : Switch
D : Cable
M : Terminal M of starter
S : Terminal S of starter

- The following work should be done while current is flowing into the starter. You must complete the full procedure for removing pinion 3 within 30 seconds.
- Turn switches A and C ON and feed current to the starter. In this state, pinion 3 jumps out and rotates.



- Within 5 seconds of pinion 3 rotating, turn switch C OFF to stop rotation of the pinion.

CAUTION ⚠

When switches A and C are turned ON, current is fed both to pull-in coil P and holding coil H. The circuit is wired in such a way that the voltage is not applied to terminal B of the starter, so the current continues to flow into the pull-in coil while pinion 3 rotates.

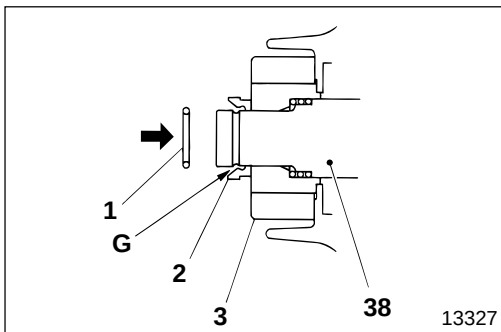
To avoid burning the pull-in coil, be sure to turn switch C OFF within five seconds after the pinion rotates.

- Apply pipe-shaped tool E onto pinion stopper 2.
- Hit tool E lightly using a mallet to remove stopper ring 1 from ring groove F of pinion stopper 2.
- Remove stopper ring 1 and pinion 3.
- Turn switch A OFF to stop current to the starter.

NOTE

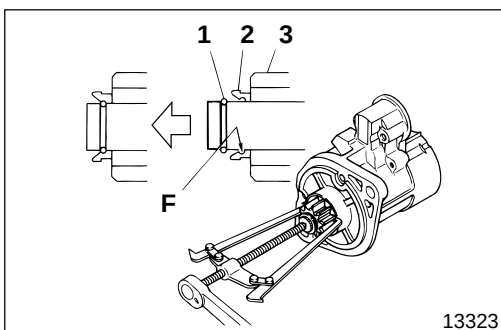
When the current to the starter is stopped, stopper ring 1 might fall back into ring groove F of pinion stopper 2 because pinion 3 is pushed inside.

If this occurs, feed current to the starter again and carry out the work.

**[Installation]**

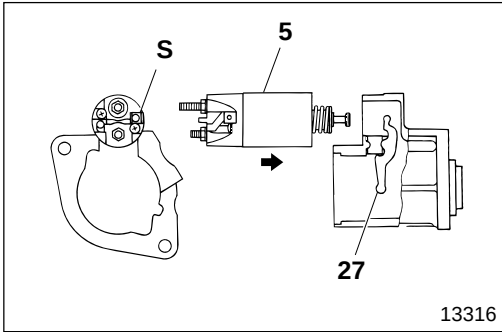
When installing pinion 3, it is not necessary to feed current to the starter.

- Install pinion stopper 2 and pinion 3 onto overrunning clutch 38 in the direction as illustrated.
- Fit stopper ring 1 into ring groove G of overrunning clutch 38.



- Pull pinion 3 firmly and set stopper ring 1 on groove F of pinion stopper 2.

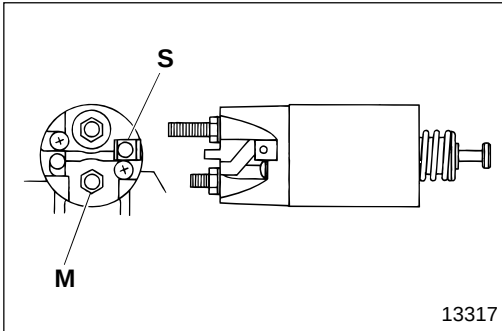
201 STARTER



5 Magnetic switch

[Installation]

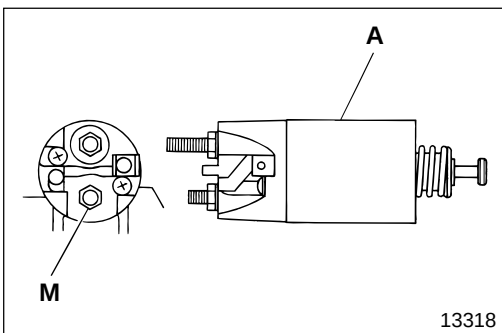
Install magnetic switch 5 to lever 27, with terminal S facing the direction as illustrated.



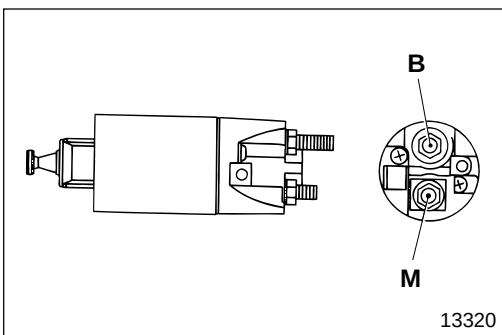
[Inspection]

(1) Testing for coil discontinuity

- Make sure that there is continuity between terminals S and M.
- If there is no continuity, replace magnetic switch 5.

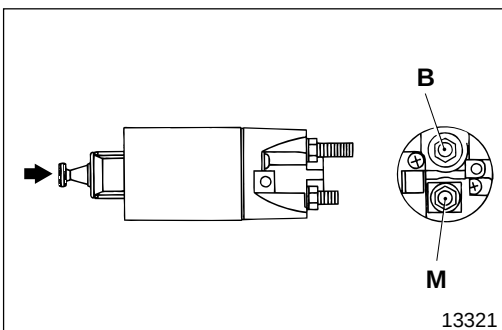


- Make sure that there is continuity between terminal M and body A of magnetic switch 5.
- If there is no continuity, replace magnetic switch 5.



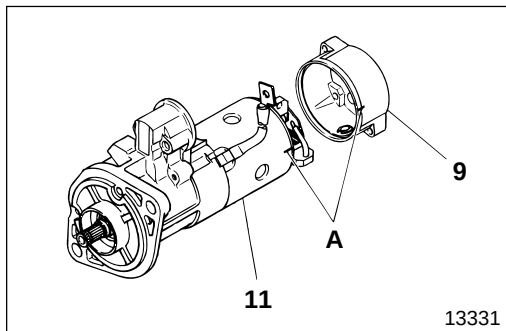
(2) Inspection of welded connections

- Make sure that there is no continuity between terminals B and M.
- If there is continuity, replace magnetic switch 5.



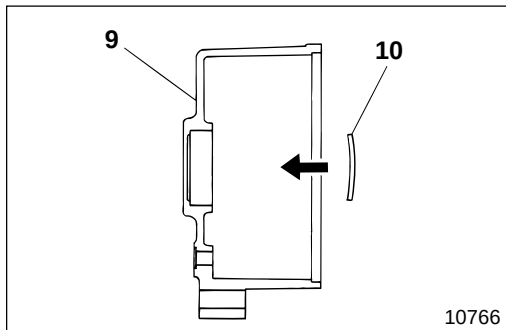
(3) Inspection of connections

- Push the tip of magnetic switch 5 to close the internal connection.
- Make sure that there is continuity between terminals B and M.
- If there is no continuity, replace magnetic switch 5.



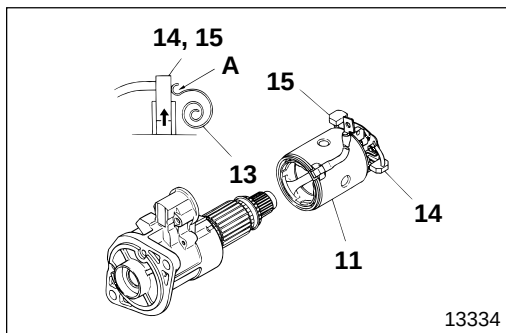
9 Installation of rear bracket

A : Alignment mark



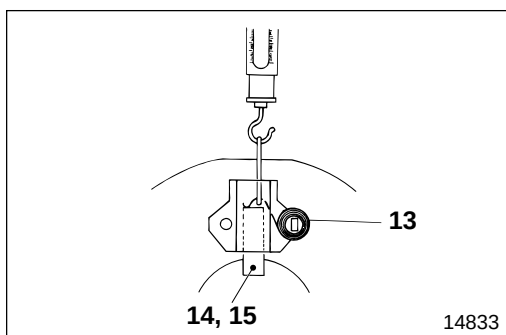
10 Installation of conical washer

Install conical washer **10** to rear bracket **9** in the direction as illustrated.



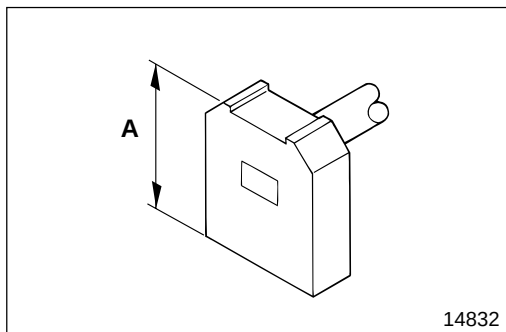
11 Removal and installation of yoke and brush holder assembly

- Pull point **A** of brush spring **13** to pull out brushes **14, 15**.
- After pulling out brushes **14, 15**, secure them with brush spring **13** as illustrated.
- Remove yoke and brush holder assembly **11**.
- For installation, reverse the removal procedure.



13 Inspection of brush spring

- Use new brushes **14, 15** and measure the load when brush spring **13** is detached from the brushes.
- If the measured value is higher than the limit, replace brush spring **13**.



14 15 Inspection of brush

(1) Length of brush

If the measured value is lower than the limit, replace brushes **14, 15**.

A : Length of brush

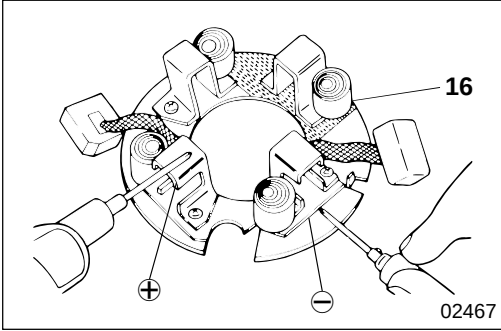
NOTE

To replace brush $\ominus$ **14**, replace entire brush holder assembly **16**.

(2) Contact surface with commutator

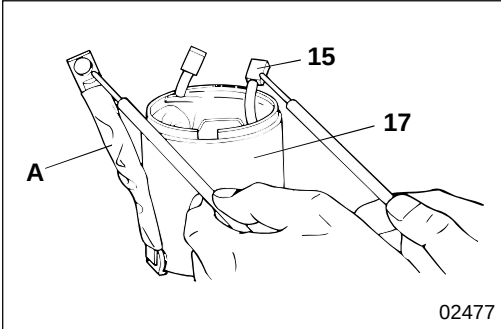
If the surface where the brushes contact the commutator is rough or is worn unevenly, polish the surface with emery paper (300 to 500 grit).

201 STARTER



16 Inspection of brush holder assembly

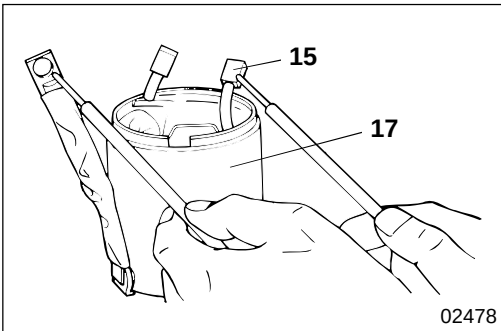
- Make sure that there is no continuity between the $\oplus$ side of the brush holder and the $\ominus$ side of the holder plate.
- If there is continuity, they are grounded. Replace brush holder assembly 16.



17 Inspection of yoke assembly

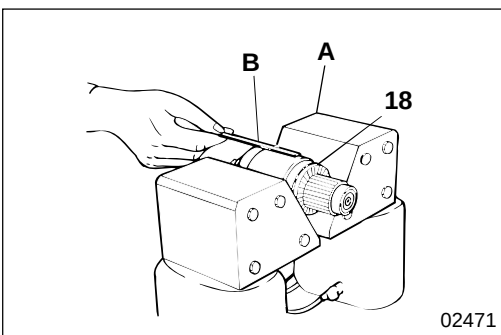
(1) Testing for coil disconnection

- Make sure that there is continuity between cable A and brush $\oplus$ 15.
- If there is no continuity, they are disconnected. Replace brush $\oplus$ 15 or yoke assembly 17.



(2) Testing for coil grounding

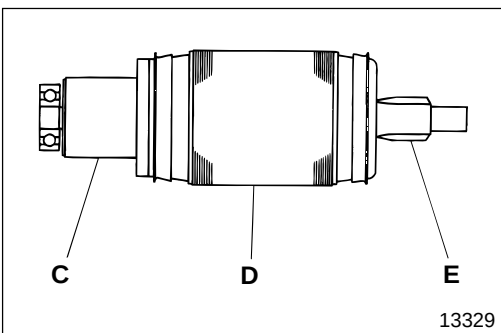
- Make sure that there is no continuity between yoke assembly 17 and brush $\oplus$ 15.
- If there is continuity, they are short-circuited. Inspect the insulated point. If it is hard to repair, replace brush $\oplus$ 15 or yoke assembly 17.



18 Inspection of armature assembly

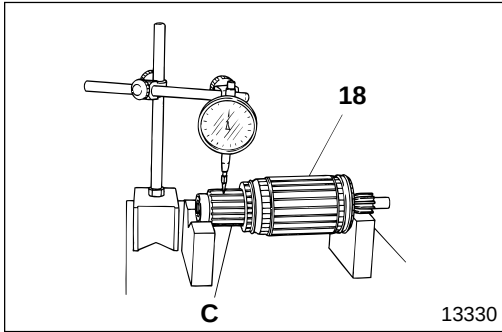
(1) Testing for coil short-circuit

- Place iron rod B parallel to armature assembly 18.
- A : Armature tester
- Rotate armature assembly 18 slowly.
- If iron rod B is pulled or shakes, it indicates that armature assembly 18 is short-circuited, so replace it.



(2) Testing for coil grounding

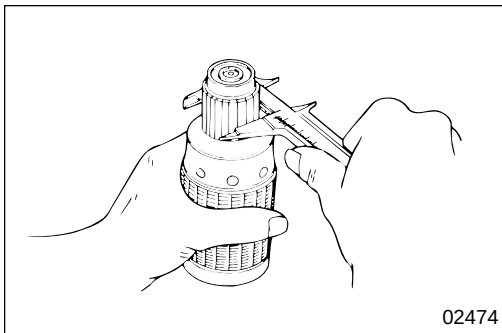
- Make sure that there is no continuity between commutator C and core D (or shaft E).
- If there is continuity between them, they are short-circuited. Replace armature assembly 18.

**(3) Deflection of commutator**

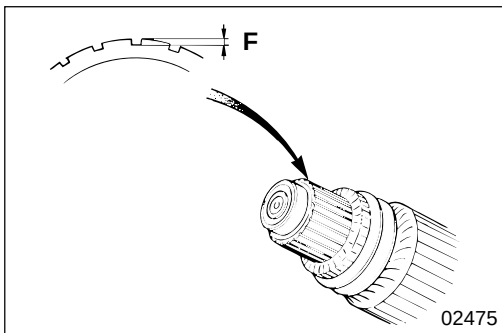
If the measured value is higher than the limit, adjust the outer diameter of commutator **C** within the limit.

(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**.

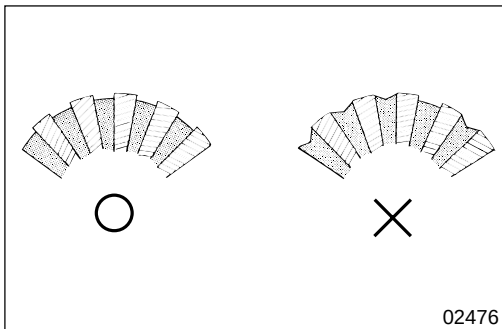
**(5) Outer diameter of commutator**

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

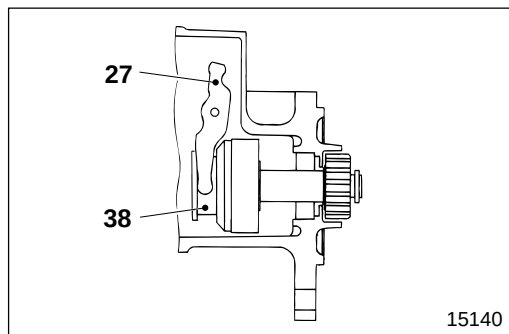


- If the mica is worn as illustrated, replace armature assembly **18**.

○ : Good

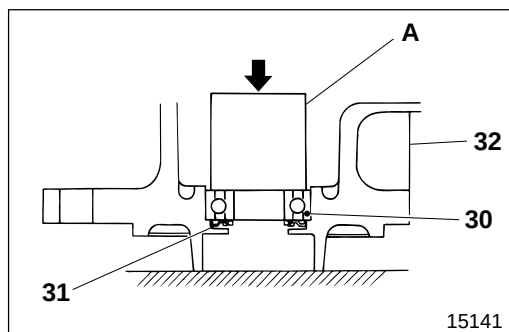
× : Faulty

201 STARTER



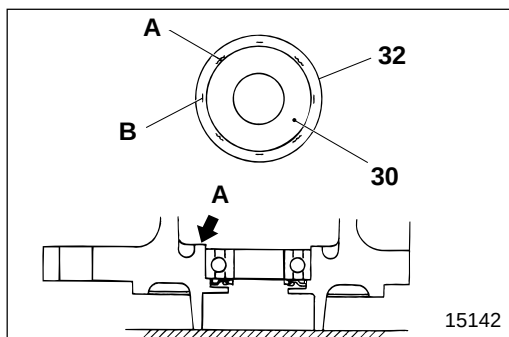
27 Installation of lever

Install lever 27 onto overrunning clutch 38 in the direction as illustrated.



30 Installation of front bearing

- Install dust seal 31 before press-fitting front bearing 30.
- Press-fit front bearing 30 into front bracket 32 using pipe-shaped tool A.

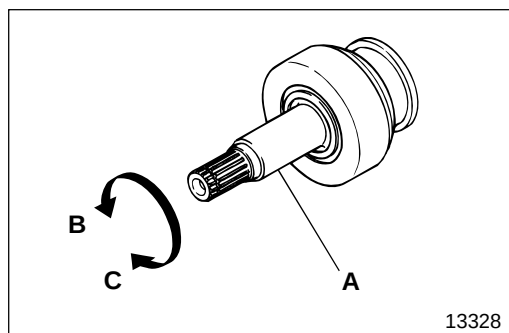


- Re-caulk front bracket 32.

NOTE

Do not re-caulk previously caulked points B.

A : Caulking points (4 points)



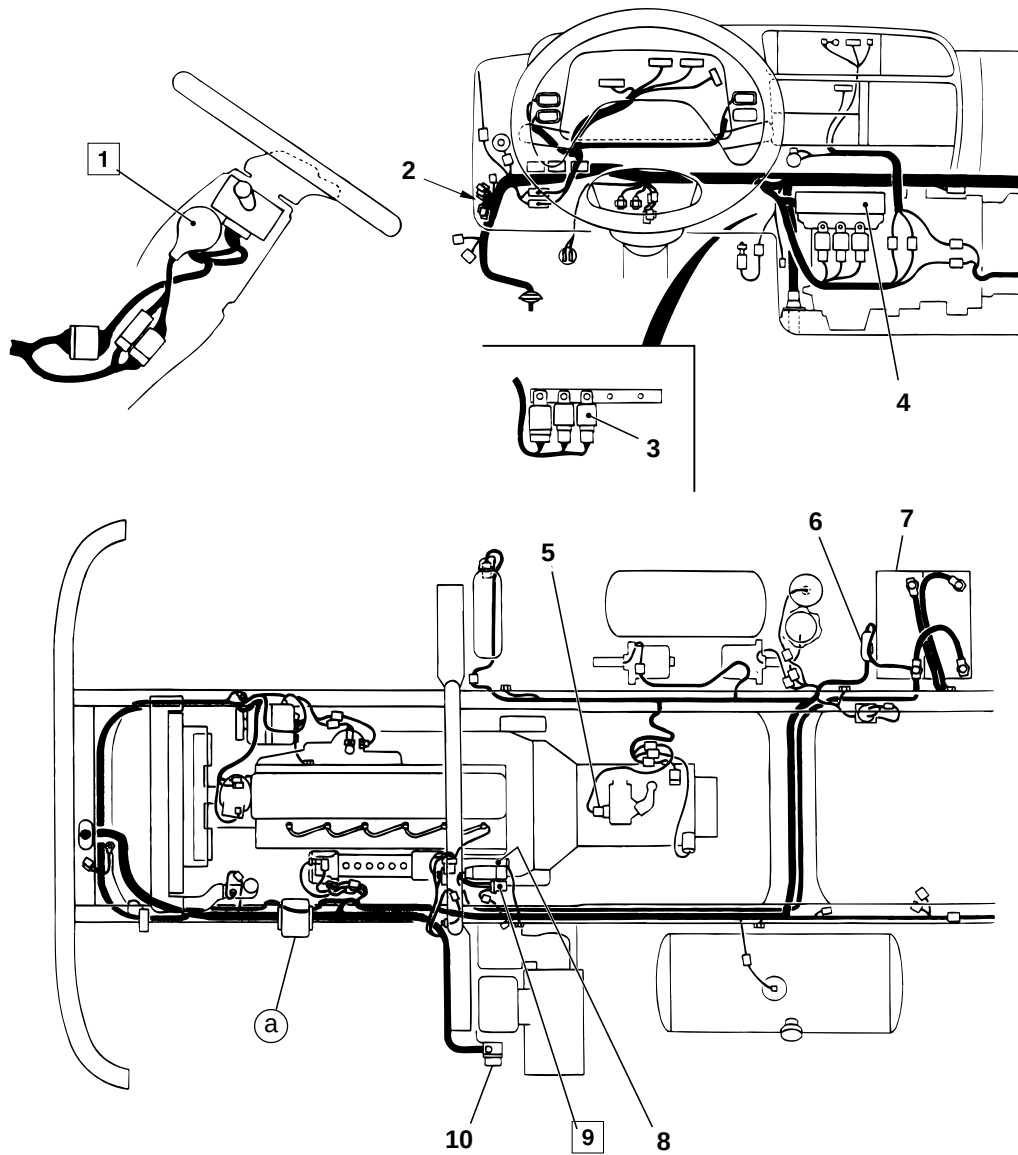
38 Installation of overrunning clutch

Carry out the following inspection. If any fault is found, replace overrunning clutch 38.

- Make sure that shaft A turns smoothly when turned in direction B.
- Make sure that shaft A locks when turned in direction C.

MEMO





12721

- | | |
|--------------------------------------|---------------------------------|
| 1 Starter switch | 6 Main high-current fuse (104) |
| 2 Diode | 7 Battery (101) |
| 3 Transmission neutral relay (604) | 8 Starter (201) |
| 4 Fuse box (104) | 9 Starter relay |
| 5 Transmission neutral switch (802) | 10 High-current fuse box (104) |

210 ENGINE STARTING CIRCUIT < Manual Transmission >

◆ Service procedure

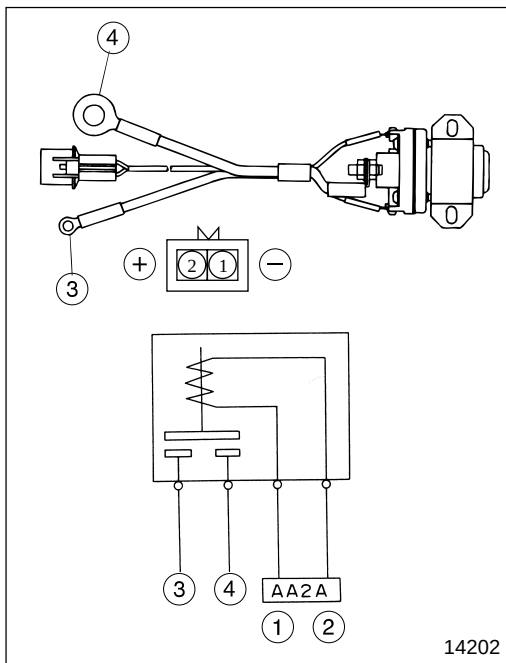
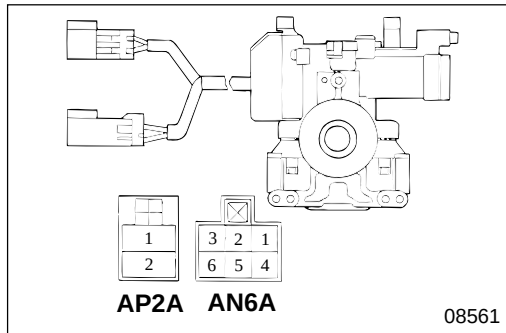
1 Inspection of the starter switch

- Follow the table below to inspect continuity :

	AP2A		AN6A		
	②	①	③	④	②
LOCK					
•(OFF)					
ACC	○		○		
ON	○	○	○	○	
START	○	○	○	○	○
	B	M	A	F	S

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

- If any fault is found, replace starter switch 1.  Gr 37



9 Inspection of starter relay

- Follow the table below to inspect continuity :

	④	③	②	①
No current			○	○
Current	○	○	+	-

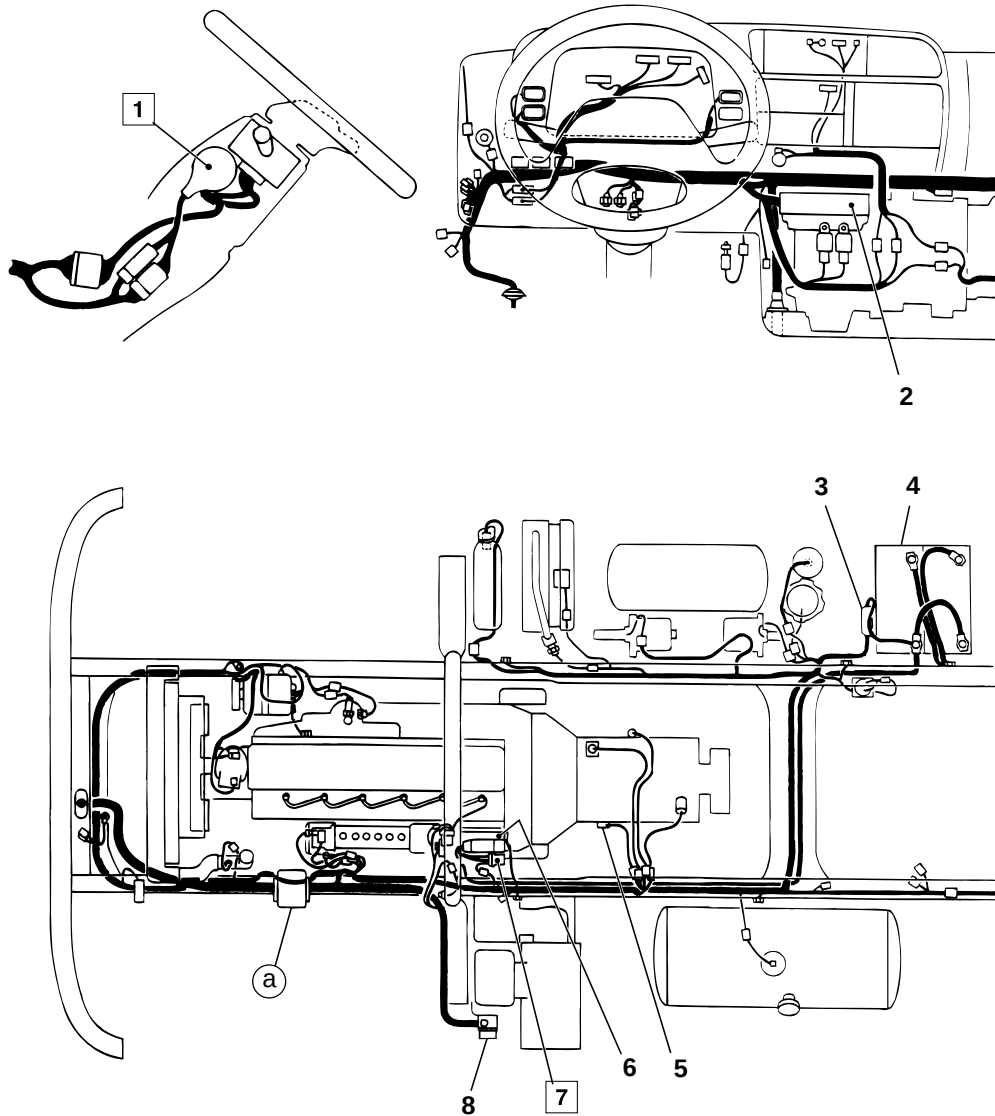
○—○ : There is continuity between terminals ○ and ○.

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

- If any fault is found, replace starter relay 9.  P54-2-15

MEMO





12722

- | | |
|---------------------------------|--------------------------------------|
| 1 Starter switch | 5 Transmission neutral switch (802) |
| 2 Fuse box (104) | 6 Starter (201) |
| 3 Main high-current fuse (104) | 7 Starter relay |
| 4 Battery (101) | 8 High-current fuse box (104) |

210 ENGINE STARTING CIRCUIT < Automatic Transmission >

◆ Service procedure

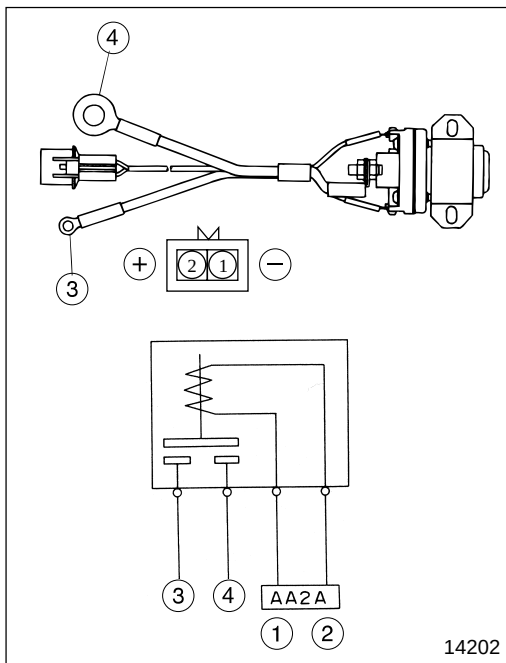
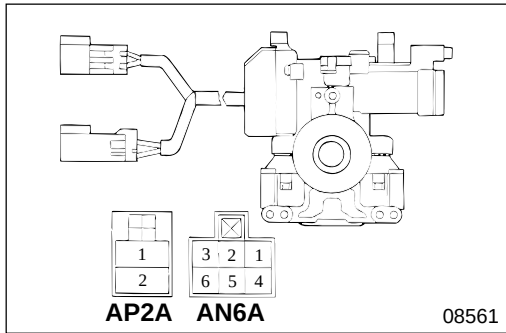
1 Inspection of the starter switch

- Follow the table below to inspect continuity :

	AP2A		AN6A		
	②	①	③	④	②
LOCK					
•(OFF)					
ACC	○		○		
ON	○	○	○	○	
START	○	○	○	○	○
	B	M	A	F	S

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

- If any fault is found, replace starter switch 1.  Gr 37



7 Inspection of starter relay

- Follow the table below to inspect continuity :

	④	③	②	①
No current			○	○
Current	○	○	+	-

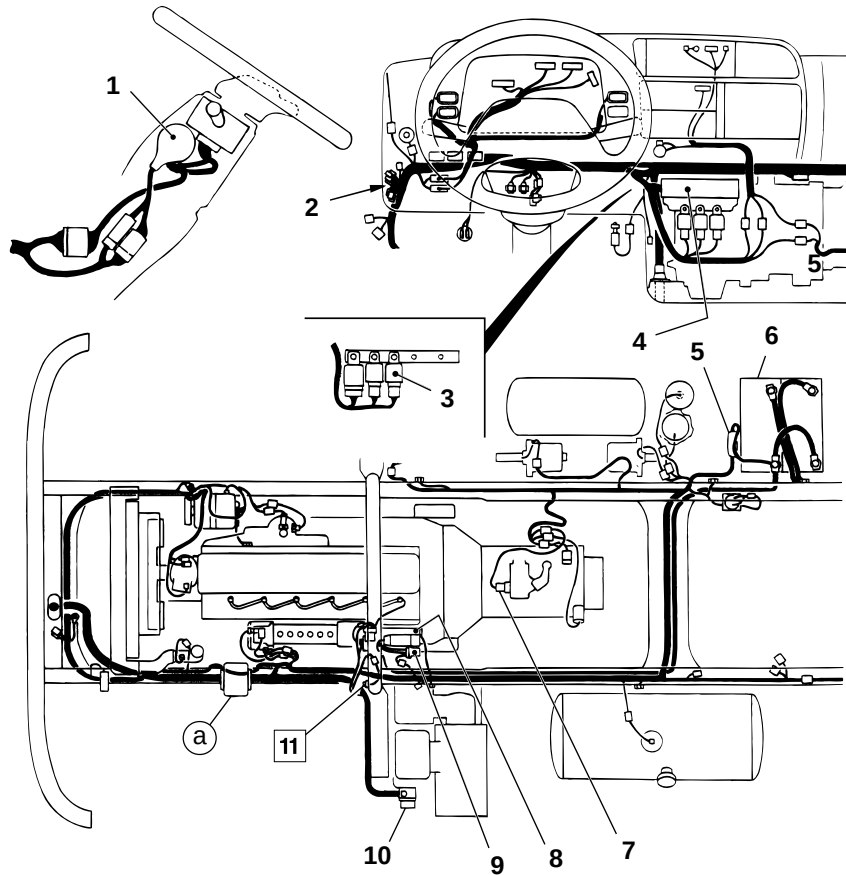
○—○ : There is continuity between terminals ○ and ○.

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

- If any fault is found, replace starter relay 7.  54-2-15

MEMO





12723

- | | |
|------------------------------------|-------------------------------------|
| 1 Starter switch (210) | 7 Transmission neutral switch (802) |
| 2 Diode | 8 Starter (201) |
| 3 Transmission neutral relay (604) | 9 Starter relay (210) |
| 4 Fuse box (104) | 10 High-current fuse box (104) |
| 5 Main high-current fuse (104) | 11 Sub-starter switch |
| 6 Battery (101) | |

◆ Service procedure

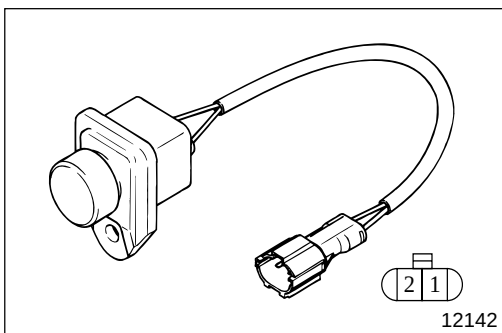
11 Inspection of sub-starter switch

- Follow the table below to inspect continuity :

	①	②
ON	○ — ○	○ — ○
OFF		

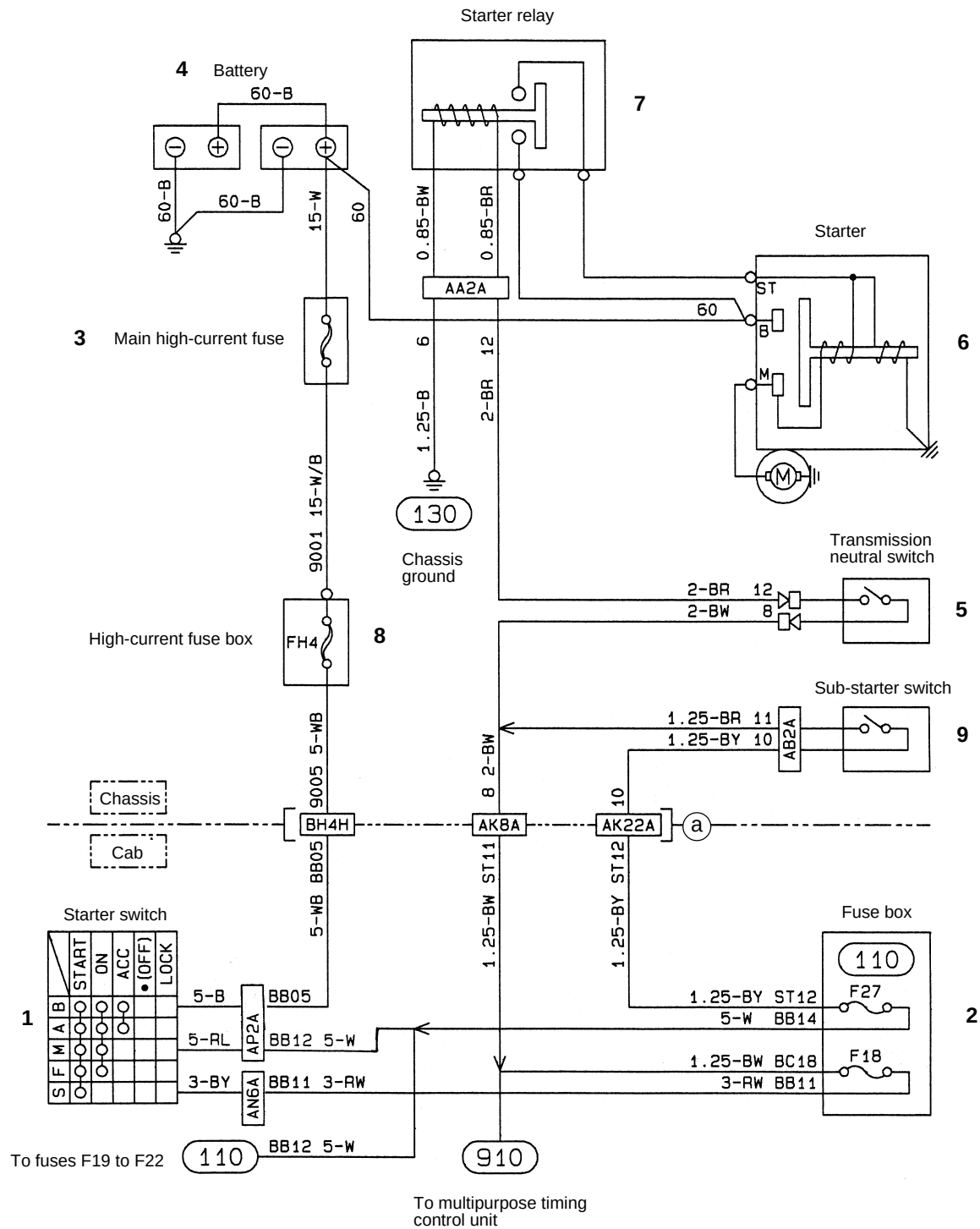
○ — ○ : There is continuity between terminals ○ and ○.

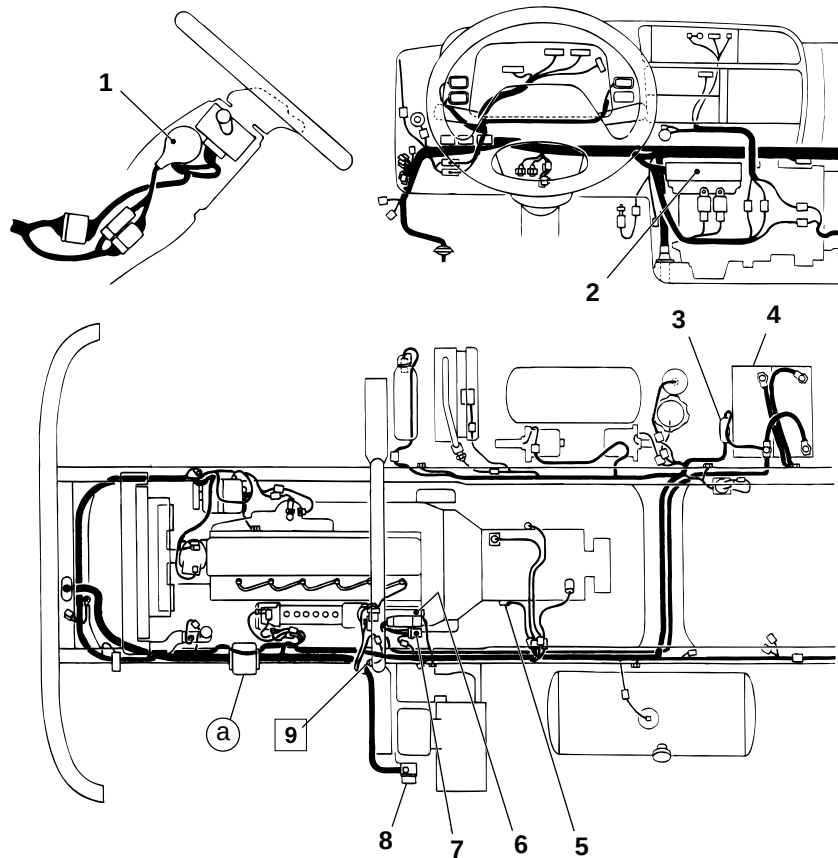
- If any fault is found, replace sub-starter switch **11**.



12142

212 SUB-STARTER CIRCUIT < Automatic Transmission >





12724

- | | | | |
|-------------------------------|---------|-------------------------|---------|
| 1 Starter switch | 📖 (210) | 6 Starter | 📖 (201) |
| 2 Fuse box | 📖 (104) | 7 Starter relay | 📖 (210) |
| 3 Main high-current fuse | 📖 (104) | 8 High-current fuse box | 📖 (104) |
| 4 Battery | 📖 (101) | 9 Sub-starter switch | |
| 5 Transmission neutral switch | 📖 (802) | | |

◆ Service procedure

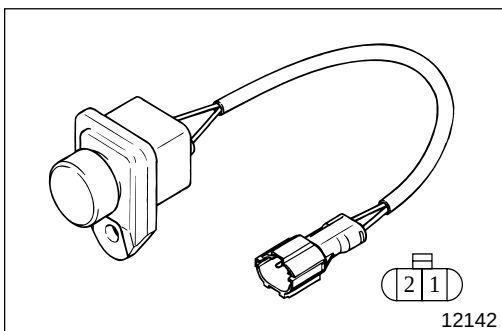
9 Inspection of sub-starter switch

- Follow the table below to inspect continuity :

	①	②
ON	○ — ○	
OFF		

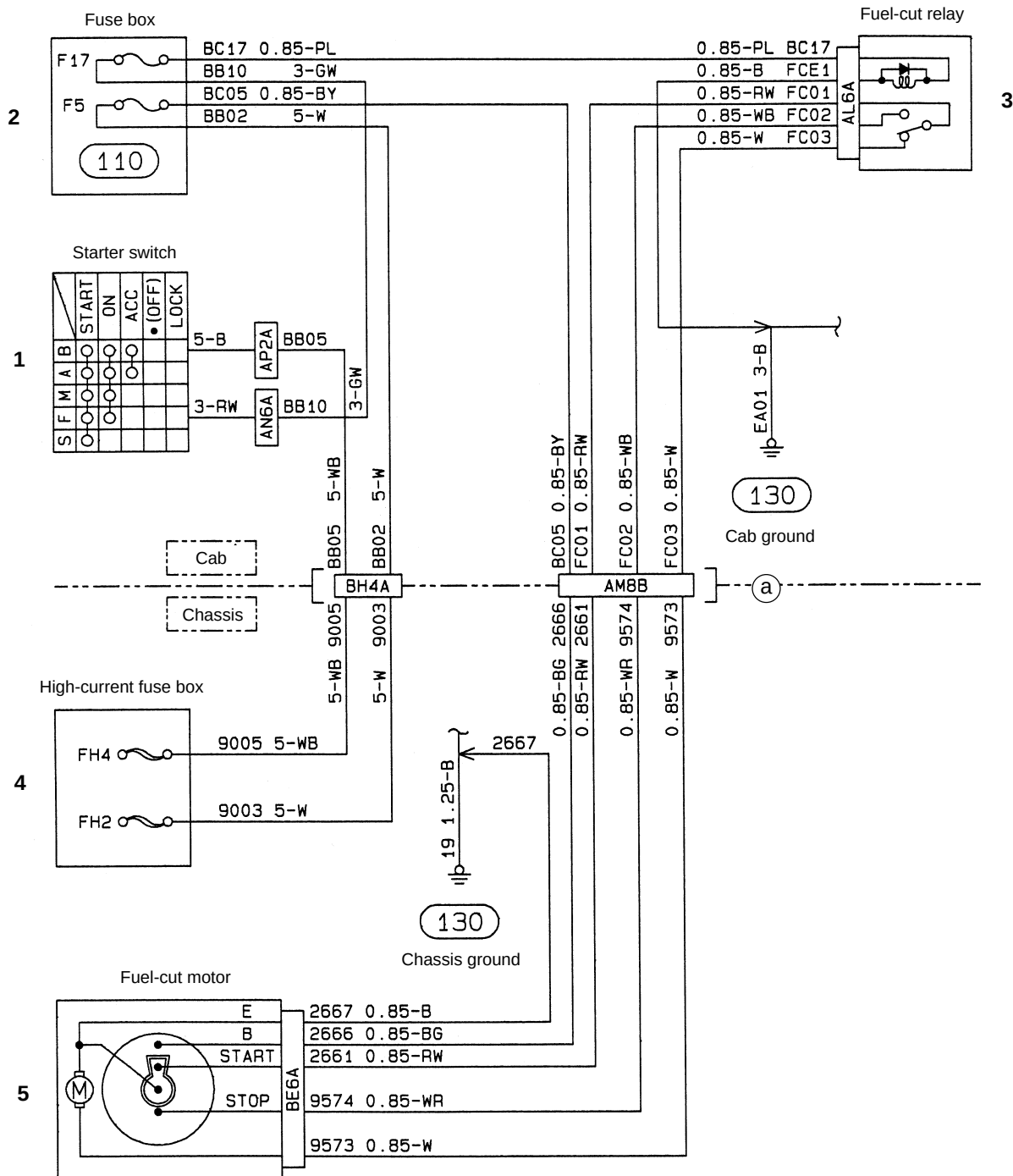
○ — ○ : There is continuity between terminals ○ and ○.

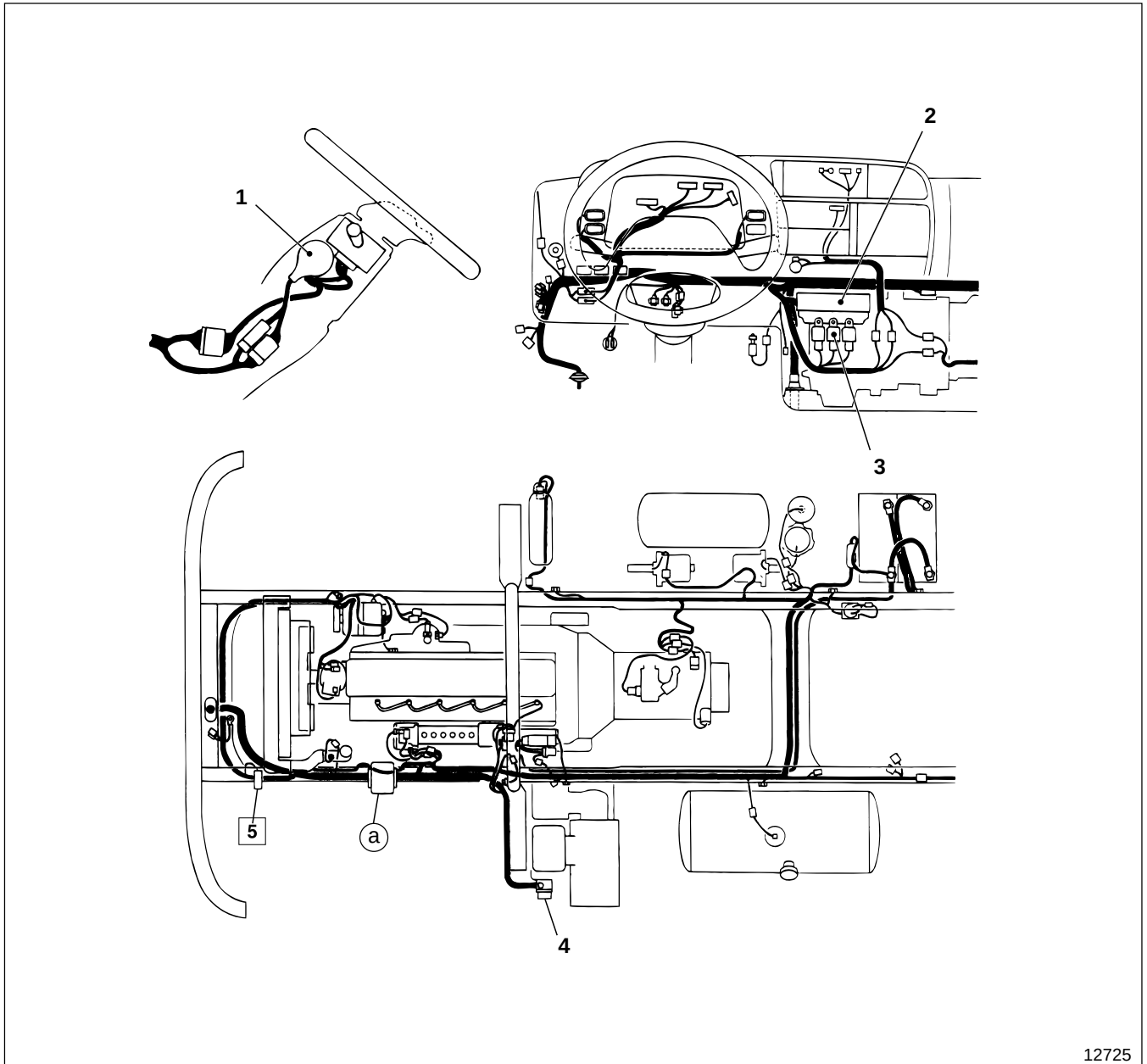
- If any fault is found, replace sub-starter switch 9.



12142

215 ENGINE STOPPING CIRCUIT





12725

- 1 Starter switch (210)
- 2 Fuse box (104)
- 3 Fuel-cut relay (604)

- 4 High-current fuse box (104)
- 5 Fuel-cut motor

215 ENGINE STOPPING CIRCUIT

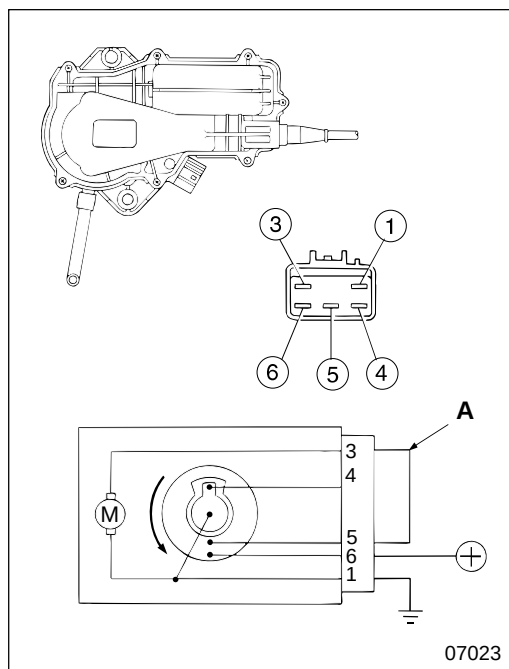
◆ Service procedure

5 Inspection of fuel-cut motor

Inspect the following. If any fault is found, replace fuel-cut motor 5.

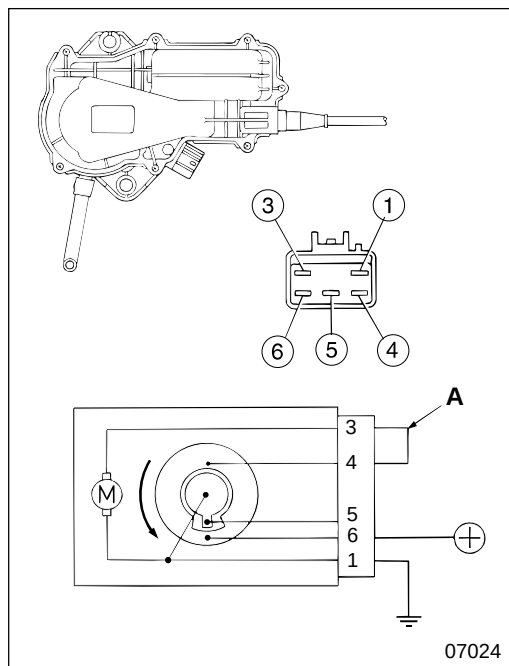
(1) When starter switch is OFF (Fuel-cut state)

- Connect inspection harness **A** between terminals ③ and ⑤.
- Apply 12 volts DC between terminals ① and ⑥ to ensure that fuel-cut motor 5 works correctly.



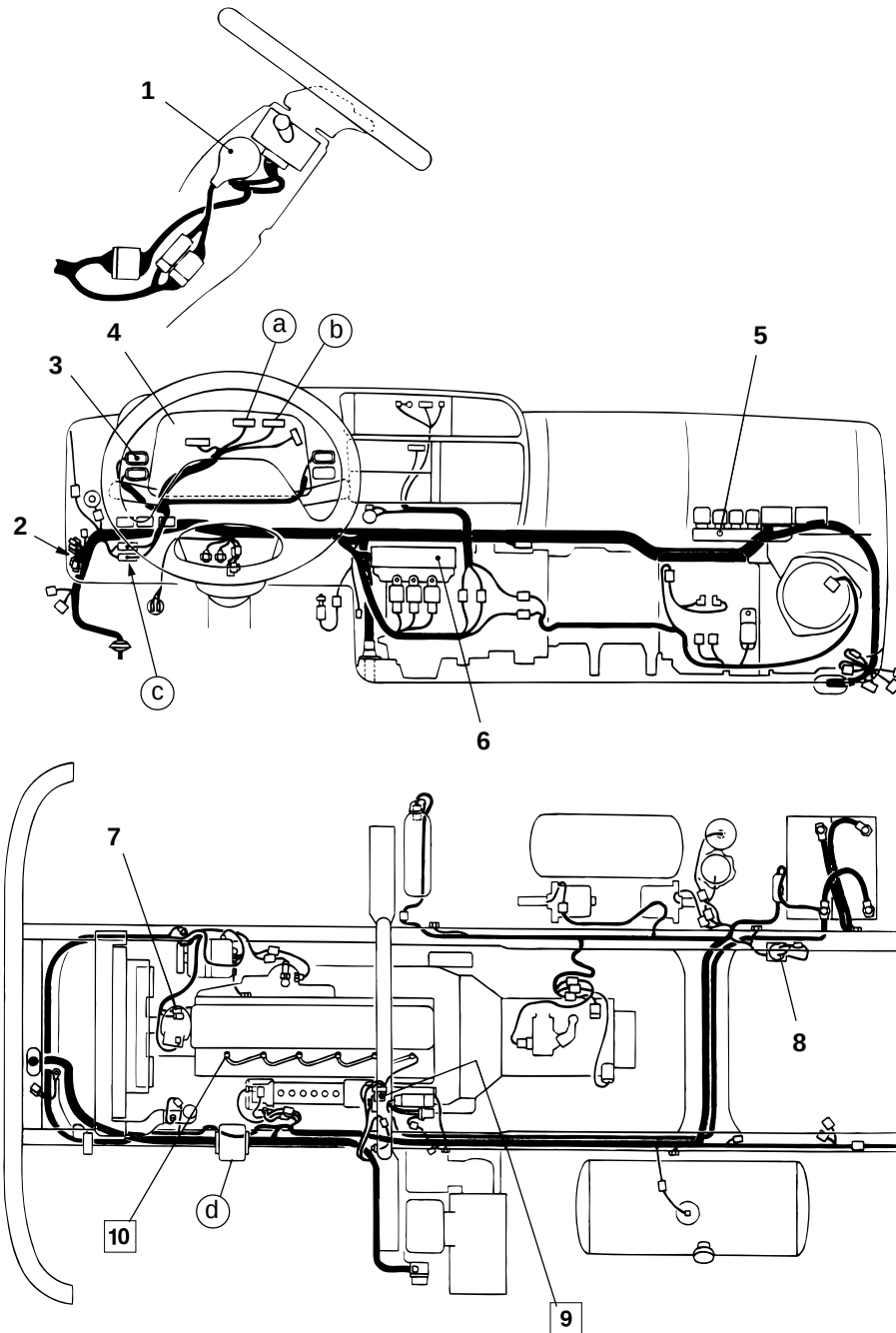
(2) When starter switch is ON (Fuel-cut reset state)

- Connect inspection harness **A** between terminals ③ and ④.
- Apply 12 volts DC between terminals ① and ⑥ to ensure that fuel-cut motor 5 works correctly.



MEMO





12726

- 1 Starter switch (210)
- 2 Diode
- 3 Cold start switch (601)
- 4 Meter cluster (401)
- 5 Relay box (604)

- 6 Fuse box (104)
- 7 Water temperature sensor (801)
- 8 Exhaust brake 3-way magnetic valve (701)
- 9 Glow relay
- 10 Glow plug

220 ENGINE PREHEATING AND COLD START CIRCUIT <Manual Transmission>**Service standards**

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

◆ Service procedure**9 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 :

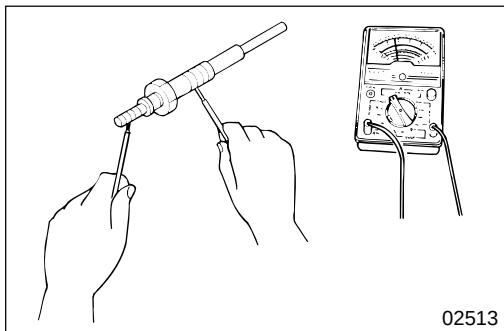
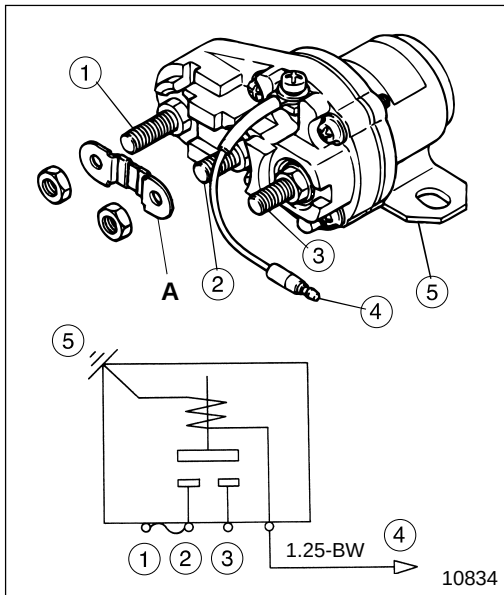
	①	②	③	④	⑤
No current	○—○				
Current	○—○	○—○	○—○	⊕—⊖	⊖—⊕

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

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

A : Fuse (127 amperes)

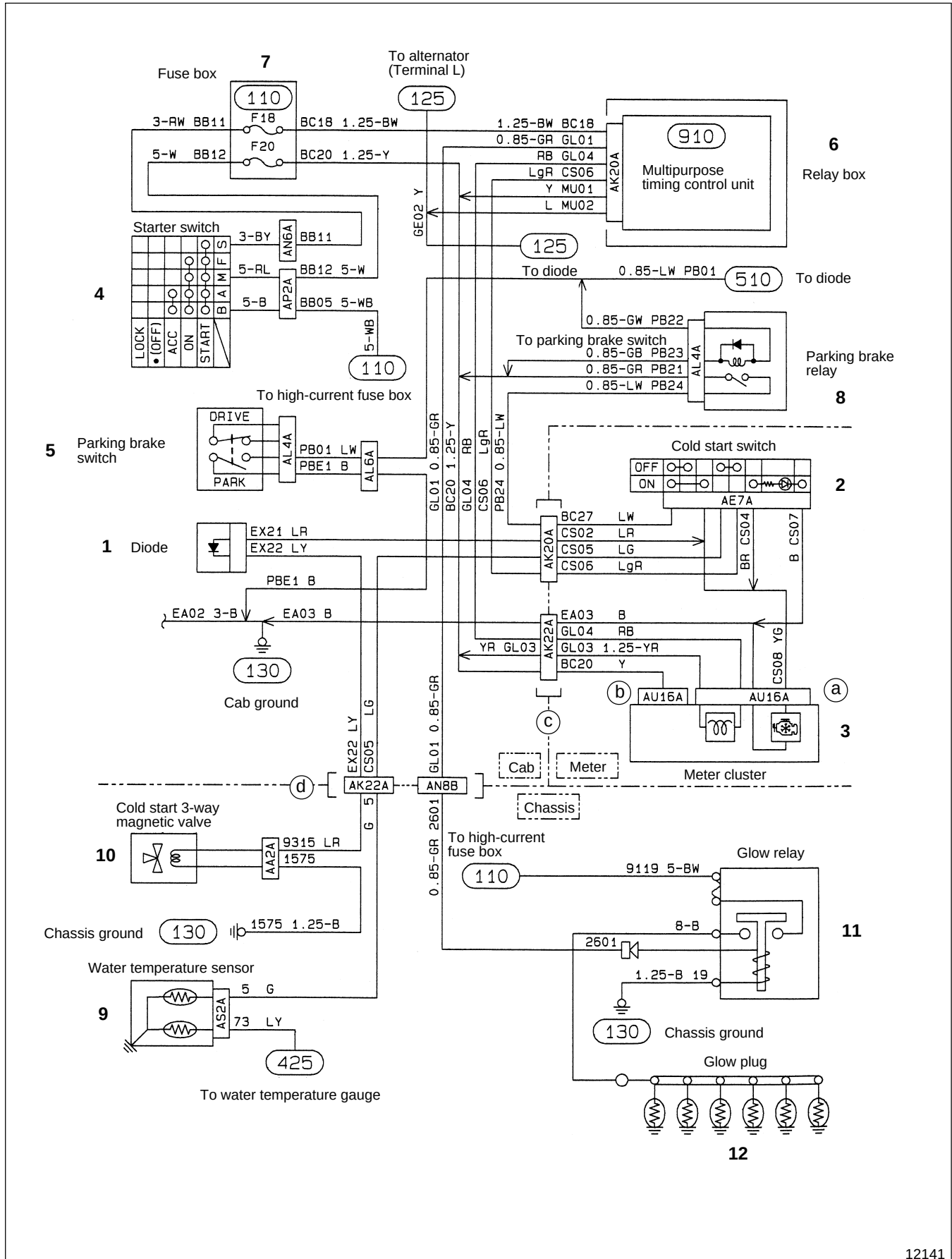
- If any fault is found, replace glow relay **9**.

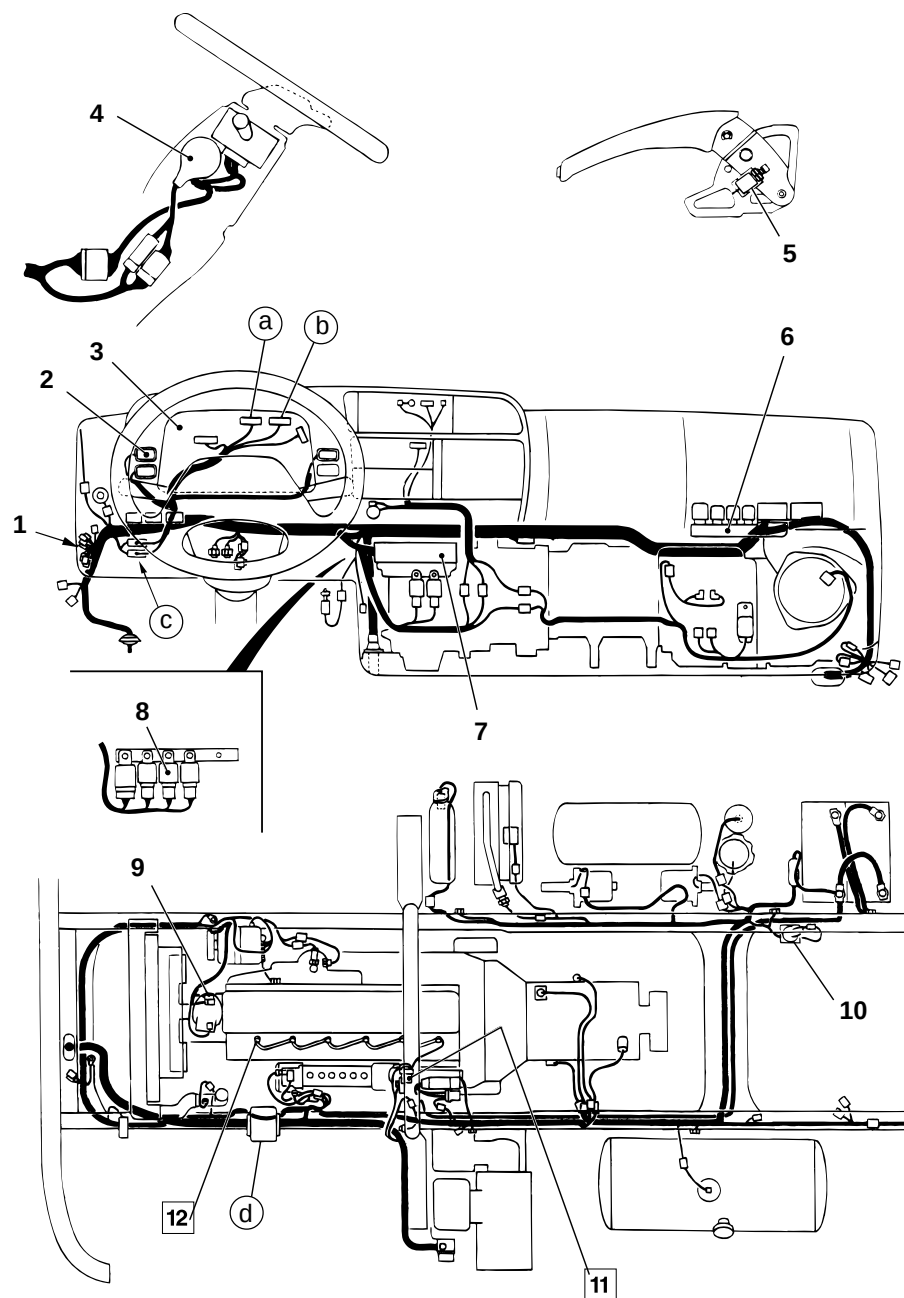
**10 Inspection of glow plug**

- Measure the resistance of glow plug **10** as illustrated.
- If the measured value deviates from the standard value, replace glow plug **10**.

MEMO

220 ENGINE PREHEATING AND COLD START CIRCUIT < Automatic Transmission >





12727

- | | |
|------------------------------|--|
| 1 Diode | 7 Fuse box (104) |
| 2 Cold start switch (601) | 8 Parking brake relay (604) |
| 3 Meter cluster (401) | 9 Water temperature sensor (801) |
| 4 Starter switch (210) | 10 Cold start 3-way magnetic valve (701) |
| 5 Parking brake switch (510) | 11 Glow relay |
| 6 Relay box (604) | 12 Glow plug |

220 ENGINE PREHEATING AND COLD START CIRCUIT < Automatic Transmission >**Service standards**

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

◆ Service procedure**11 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 :

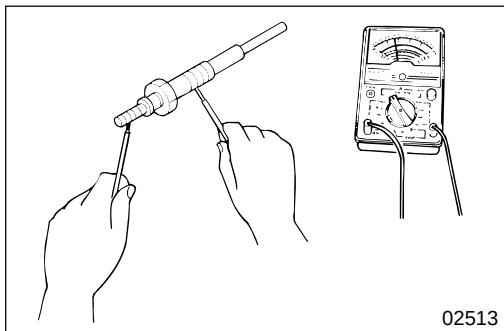
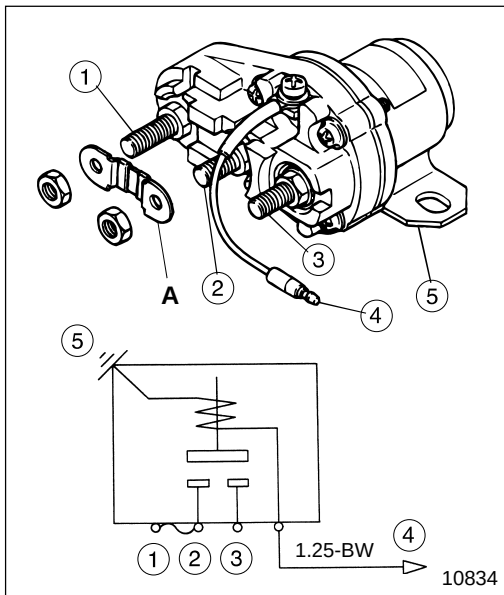
	①	②	③	④	⑤
No current	○	○			
Current	○	○	○	+	-

○ — ○ : 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 **11**.

**12 Inspection of glow plug**

- Measure the resistance of glow plug **12** as illustrated.
- If the measured value deviates from the standard value, replace glow plug **12**.

3 LIGHTING

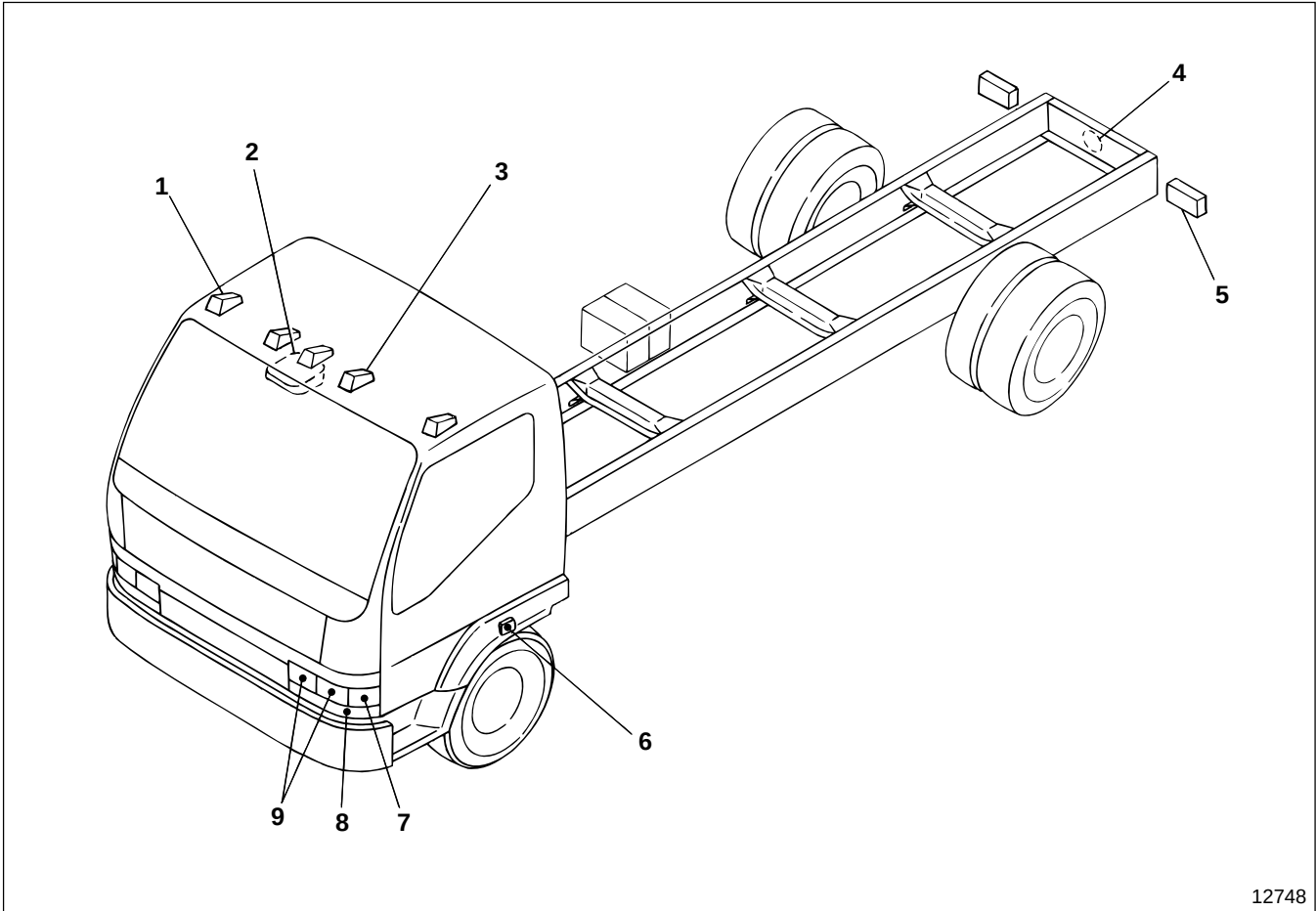
SPECIFICATIONS	54-3-2
STRUCTURE AND OPERATION	54-3-4
TROUBLESHOOTING	54-3-6
(300) INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE	
Headlamp Aiming	54-3-8
(310) HEADLAMP CIRCUIT	54-3-10
(320) TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE	
LAMP CIRCUITS	54-3-12
(325) STOP LAMP CIRCUIT	54-3-14
(330) TURN SIGNAL LAMP AND HAZARD	
LAMP CIRCUITS	54-3-18
(340) BACKUP LAMP CIRCUIT	54-3-20
(345) CAB LAMP CIRCUIT	54-3-24
(348) ILLUMINATION LAMP CIRCUIT	54-3-28
(349) MARKER LAMP AND IDENTIFICATION LAMP	
CIRCUITS	54-3-30
(352) VAN BODY DOME LIGHT CIRCUIT	54-3-32

SPECIFICATIONS

Item		Specifications
Voltage	V	12
Headlamp	Model	Sealed beam
	Type	Reflex type
	HIGH beam W	50
	HIGH/LOW beam W	60/40
Front turn signal lamp (also used as hazard lamp)	W	21
Clearance lamp	W	7.5
Side turn signal lamp (also used as hazard lamp)	W	10
Rear combination lamp	Stop/Tail W	27/8
	Turn (also used as hazard lamp) W	27
Backup	W	27
License plate lamp	W	7.5
Cab lamp	W	10
Identification lamp	W	7.5
Clearance and side marker lamp	W	7.5
Back buzzer	Rated voltage V	12
	Rated current mA	50 or less
	Sound pressure dB	85±10 (at 1 m {3.3 ft})
	Frequency Times/minute	85±15

MEMO

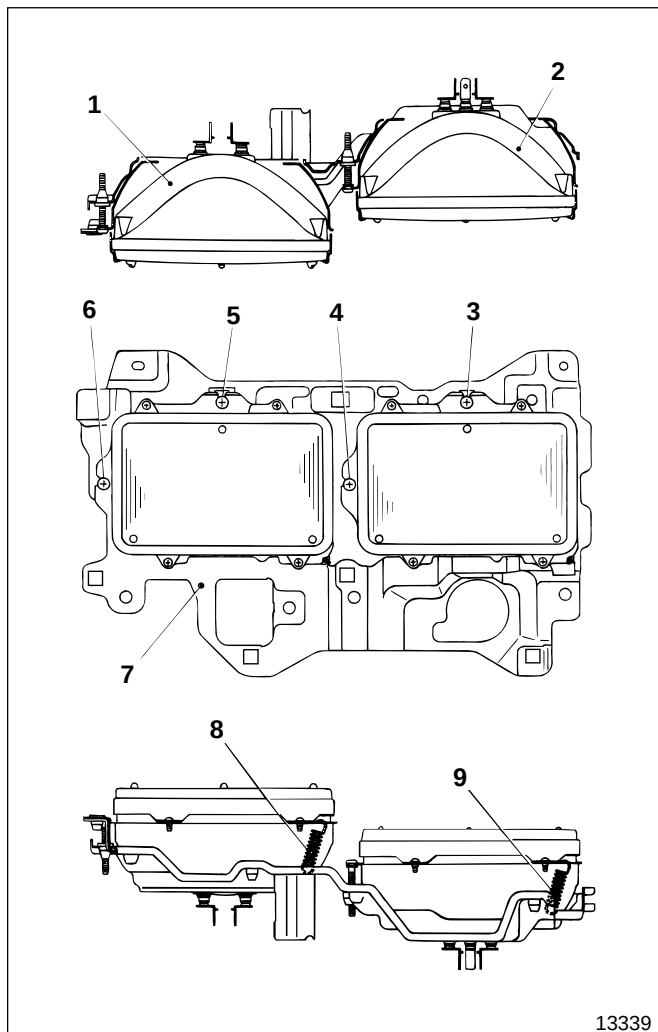
STRUCTURE AND OPERATION



12748

- | | |
|----------------------------------|--------------------------|
| 1 Clearance and side marker lamp | 6 Side turn signal lamp |
| 2 Cab lamp | 7 Clearance lamp |
| 3 Identification lamp | 8 Front turn signal lamp |
| 4 License plate lamp | 9 Headlamp |
| 5 Rear combination lamp | |

Headlamp



- 1 Sealed beam unit (HIGH beam)
- 2 Sealed beam unit (HIGH/LOW beam)
- 3 Screw (HIGH/LOW beam, vertical adjustment)
- 4 Screw (HIGH/LOW beam, horizontal adjustment)
- 5 Screw (HIGH beam, vertical adjustment)
- 6 Screw (HIGH beam, horizontal adjustment)
- 7 Housing
- 8 Extension spring
- 9 Extension spring

- The headlamp unit consists of sealed beam units **1, 2** separately installed in housing **7**. Sealed beam unit **1** is for HIGH beam, and sealed beam unit **2** is for HIGH/LOW beam.
- The headlamp aiming can be adjusted by changing the installation angle of sealed beam units **1, 2**.
- To adjust the installation angle of sealed beam unit **1**, turn screws **5, 6**. Extension spring **8** sets the angle of the sealed beam unit.
- To adjust the installation angle of sealed beam unit **2**, turn screws **3, 4**. Extension spring **9** sets the angle in the same way as for sealed beam unit **1**.

13339

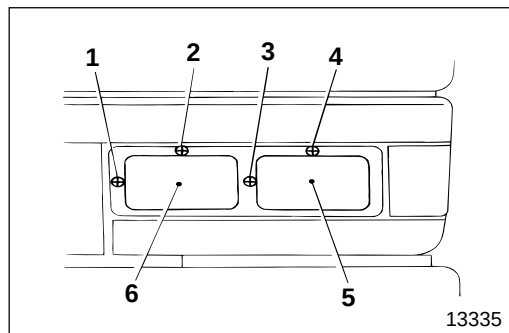
TROUBLESHOOTING

Symptoms		Headlamp				Tail lamp, clearance lamp, license plate lamp, clearance and side marker lamp, identification lamp	Stop lamp does not light
		Does not light	Dim	HIGH beam does not light	LOW beam does not light	Does not light	
Possible causes							
Connector connection faulty, harness broken, grounding faulty		☐				☐	☐
Fuse blown		☐				☐	☐
Battery charge insufficient			☐				
Alternator output insufficient			☐				
Bulb burnt-out		☐				☐	☐
Power (wattage) of bulb is lower than specified value							
Power (wattage) of bulb is higher than specified value							
Combination switch	Lighting switch faulty	☐				☐	
	Dimmer switch faulty			☐	☐		
	Turn signal switch faulty						
	Hazard switch faulty						
Relay box	Headlamp relay (HIGH/LOW) faulty	☐		☐	☐		
	Tail lamp relay faulty					☐	
	Flasher unit faulty						
	Stop lamp relay faulty						☐
Stop lamp switch faulty							☐
Meter cluster faulty							
Backup lamp switch faulty							
Back buzzer faulty							
Door switch faulty							
Cab lamp faulty							
Rheostat switch faulty							
Turn signal lamp relay faulty							
Tail lamp bulb burnt-out							
Van body dome light relay faulty							
Van body dome light switch faulty							

Symptoms Possible causes		Turn signal lamp (also used as hazard lamp)					Backup lamp does not light	Back buzzer does not sound	Cab lamp does not light	Meter and heater control illumination lamps do not light	Meter and heater control illumination lamps cannot be adjusted	Van body dome light does not light
		Does not light	Does not go off	Blinks too slowly	Blinks too quickly	Blink interval uneven						
Connector connection faulty, harness broken, grounding faulty		☐					☐	☐	☐	☐		☐
Fuse blown		☐					☐		☐	☐		☐
Battery charge insufficient			☐									
Alternator output insufficient			☐									
Bulb burnt-out		☐			☐		☐		☐	☐		☐
Power (wattage) of bulb is lower than specified value					☐							
Power (wattage) of bulb is higher than specified value				☐								
Combination switch	Lighting switch faulty											
	Dimmer switch faulty											
	Turn signal switch faulty	☐	☐									
	Hazard switch faulty	☐	☐									
Relay box	Headlamp relay (HIGH/LOW) faulty											
	Tail lamp relay faulty									☐		
	Flasher unit faulty	☐	☐	☐	☐	☐						
	Stop lamp relay faulty											
Stop lamp switch faulty												
Meter cluster faulty												
Backup lamp switch faulty							☐	☐				
Back buzzer faulty								☐				
Door switch faulty									☐			
Cab lamp faulty									☐			
Rheostat switch faulty										☐	☐	
Turn signal lamp relay faulty		☐										
Tail lamp bulb burnt-out								☐				
Van body dome light relay faulty												☐
Van body dome light switch faulty												☐

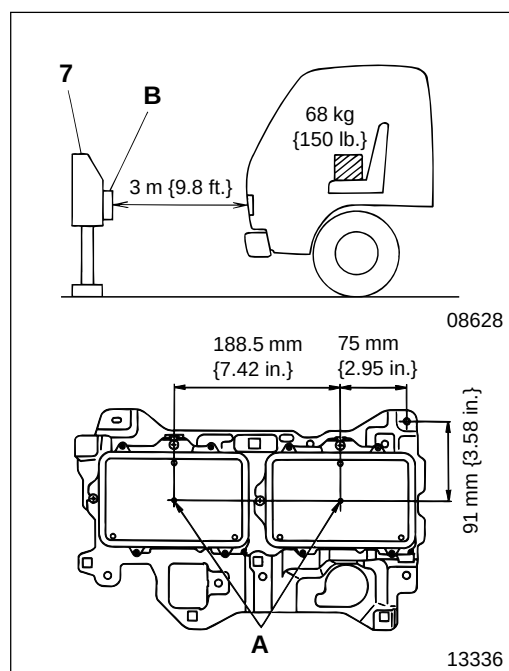
300 INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

Headlamp Aiming



- 1 Screw (HIGH beam, horizontal adjustment)
- 2 Screw (HIGH beam, vertical adjustment)
- 3 Screw (HIGH/LOW beam, horizontal adjustment)
- 4 Screw (HIGH/LOW beam, vertical adjustment)
- 5 HIGH/LOW beam
- 6 HIGH beam

To adjust the headlamp move the optical axis of HIGH beam **6** by turning screws **1, 2**; and move the optical axis of HIGH/LOW beam **5** by turning screws **3, 4**. You need to adjust the aiming of both the HIGH and the HIGH/LOW beams on both the left and right headlamps.



(1) Preparatory work before adjustment

- Park the vehicle on a level place.

WARNING

You must put wheel chocks securely in place.

- Unload the vehicle and make sure no one is in it.
- Inflate the tires to specified pressure. Gr 31
- Seat one person or an equivalent mass (68 kg {150 lb.}) in the vehicle.
- Start the engine and check that the battery is being charged.
- Place convergent headlamp tester **7** in line with HIGH beam **6** or HIGH/LOW beam **5** of either the left or right headlamp at a distance of 3 m {9.8 ft.}.
- Align the center of convergent lens **B** of convergent headlamp tester **7** with lamp center **A** of HIGH beam **6** or HIGH/LOW beam **5**. (The illustration shows a left headlamp.)
- When adjusting one headlamp, mask the other to avoid light leakage.

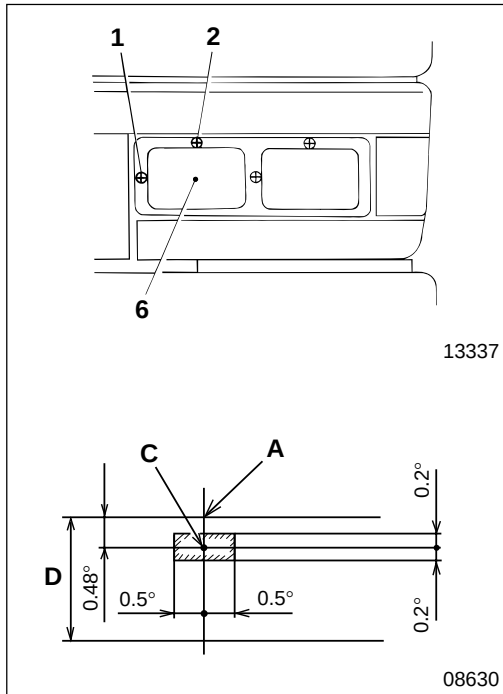
(2) Adjustment

WARNING

Do not mask a lit headlamp for more than 10 minutes or the heat generated might cause a fire.

CAUTION

When completing the adjustment using screws **1** to **4**, the action must be finished in the tightening direction.



● Adjustment of HIGH beam unit

- Turn on HIGH beam 6.
- Adjust as follows so that the optical axis (maximum illumination point) **C** of HIGH beam 6 is located as illustrated:

- Vertical adjustment: Turn screw 2 to adjust.
- Horizontal adjustment: Turn screw 1 to adjust.

The aiming of both left and right HIGH beams 6 should be adjusted to the position as illustrated.

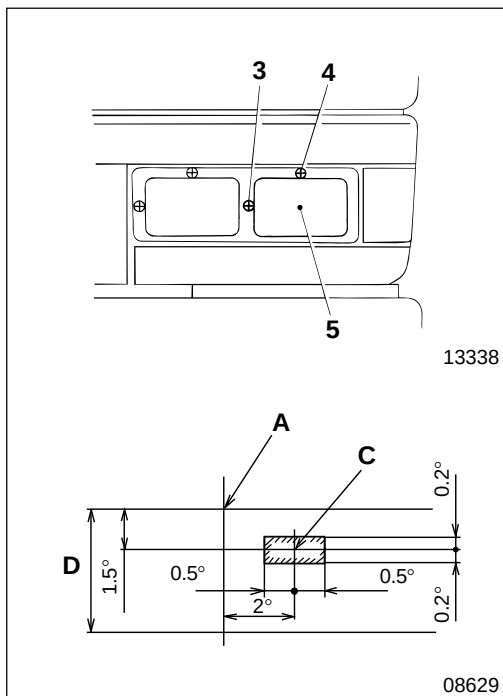
: Tolerance of adjustment

A : Center of headlamp

D : Height from the ground to headlamp center

	Adjusting direction for optical axis			
	Upward	Downward	Leftward	Rightward
Screw 1	—	—	(Counter-clockwise)	(Clockwise)
Screw 2	(Clockwise)	(Counter-clockwise)	—	—

Turning direction of the screws in the table is as viewed from the front.



● Adjustment of HIGH/LOW beam unit

- Turn on the LOW beam of HIGH/LOW beam 5.
- Adjust as follows so that the optical axis (maximum illumination point) **C** of HIGH/LOW beam is located as illustrated:

- Vertical adjustment: Turn screw 4 to adjust.
- Horizontal adjustment: Turn screw 3 to adjust.

The aiming of both left and right HIGH/LOW beams 5 should be adjusted to the position as illustrated.

: Tolerance of adjustment

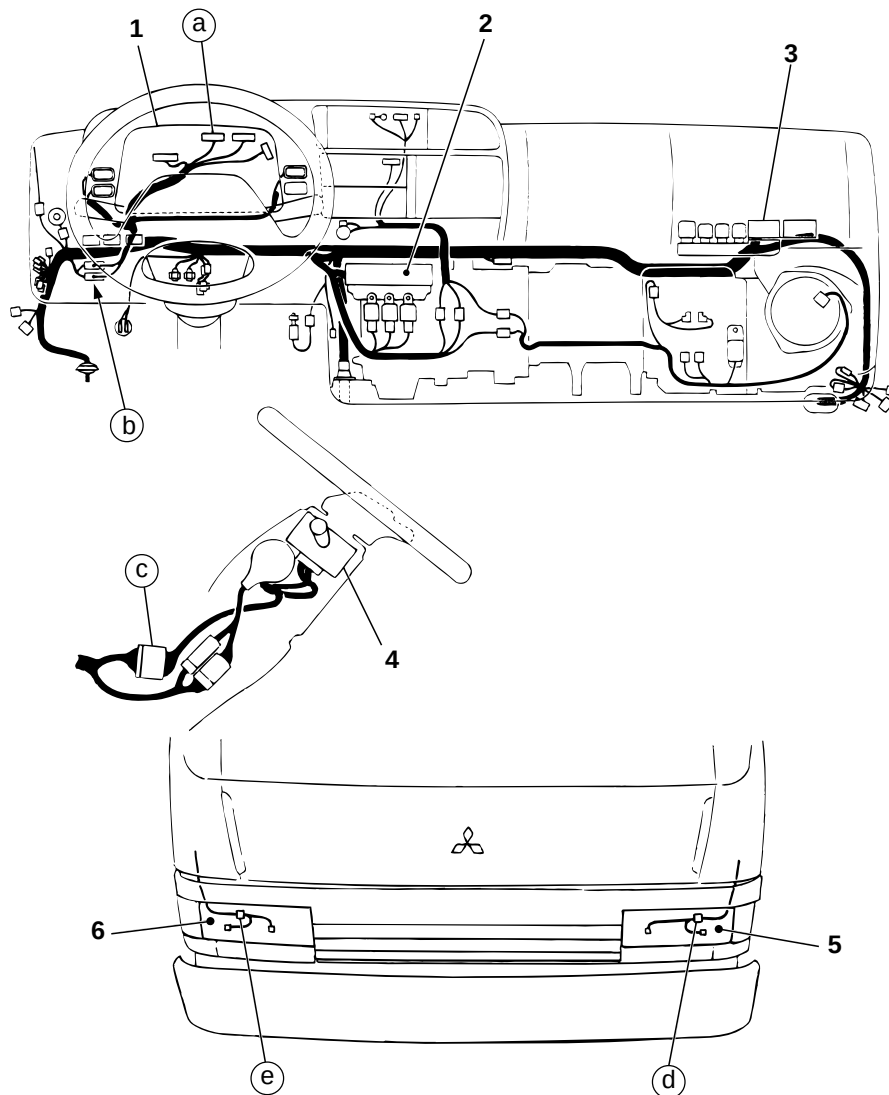
A : Center of lamp

D : Height from the ground to headlamp center

	Adjusting direction for optical axis			
	Upward	Downward	Leftward	Rightward
Screw 3	—	—	(Counter-clockwise)	(Clockwise)
Screw 4	(Clockwise)	(Counter-clockwise)	—	—

Turning direction of the screws in the table is as viewed from the front.

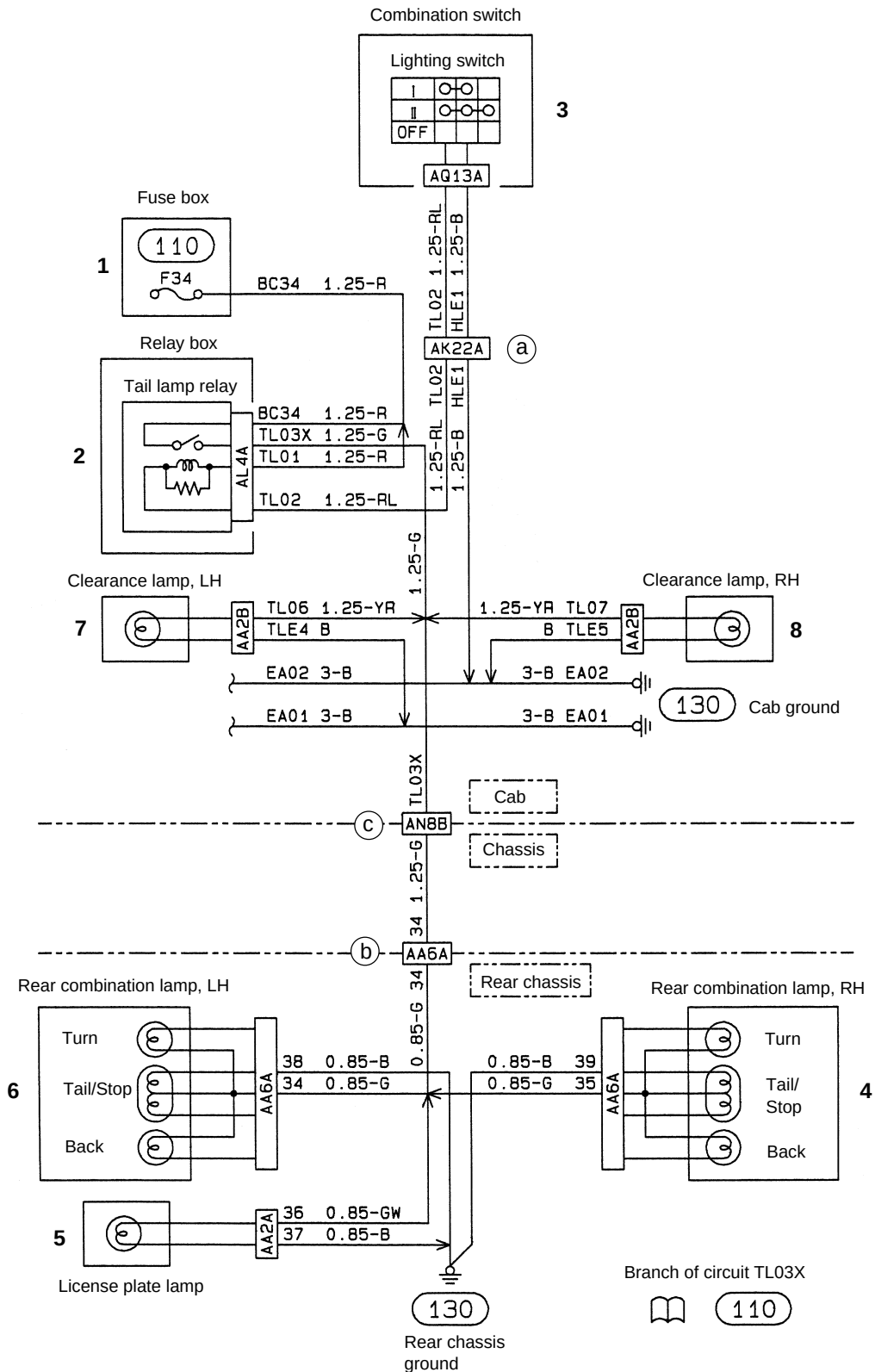




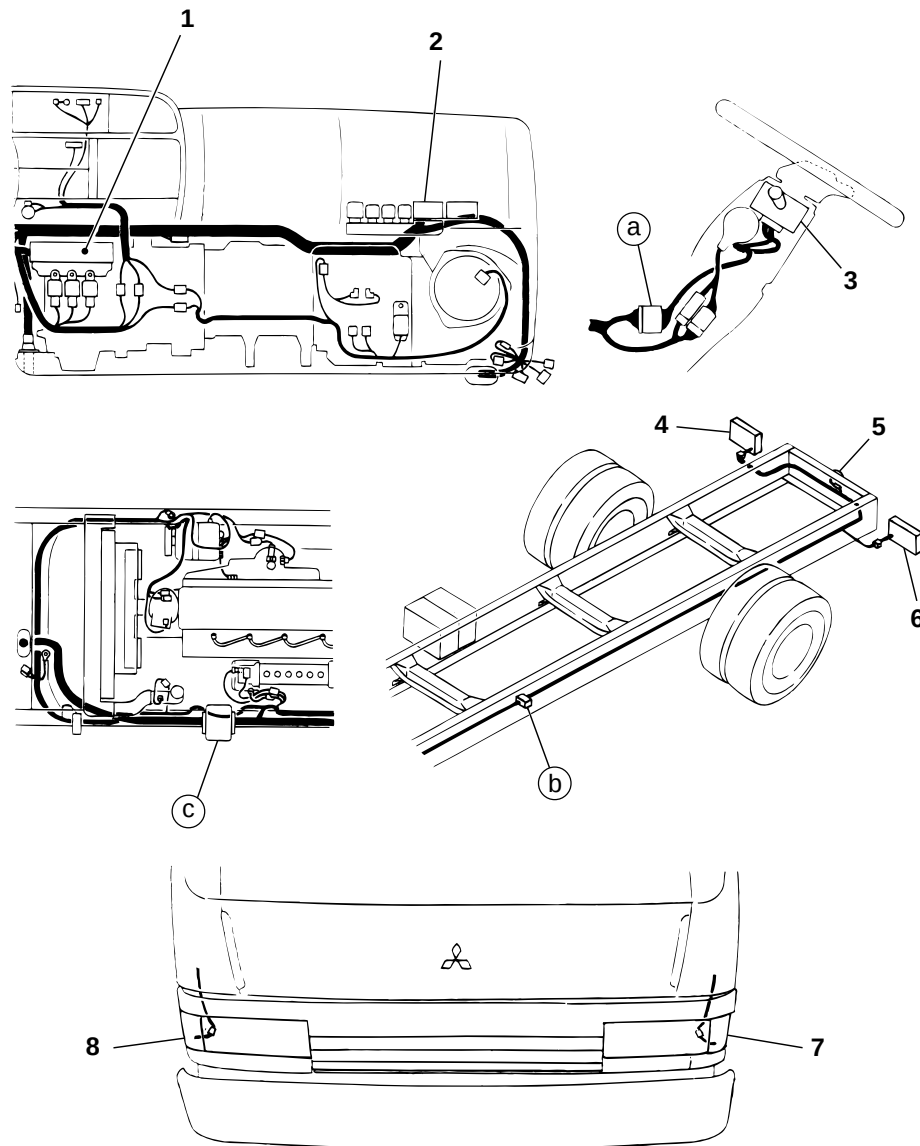
12749

- 1 Meter cluster (401)
- 2 Fuse box (104)
- 3 Relay box (604)
- 4 Combination switch (601)
- 5 Headlamp, RH (300)
- 6 Headlamp, LH (300)

320 TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS



12161

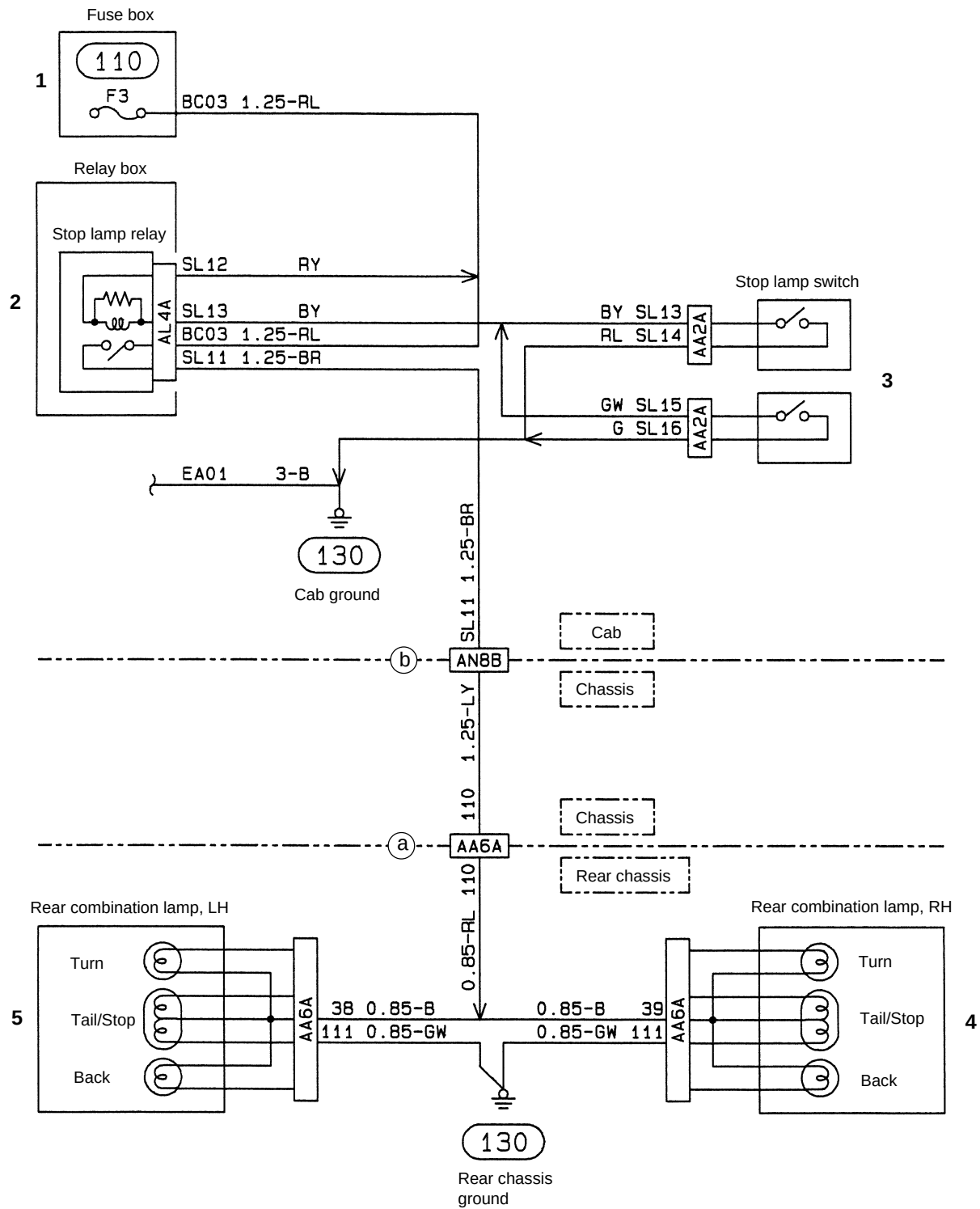


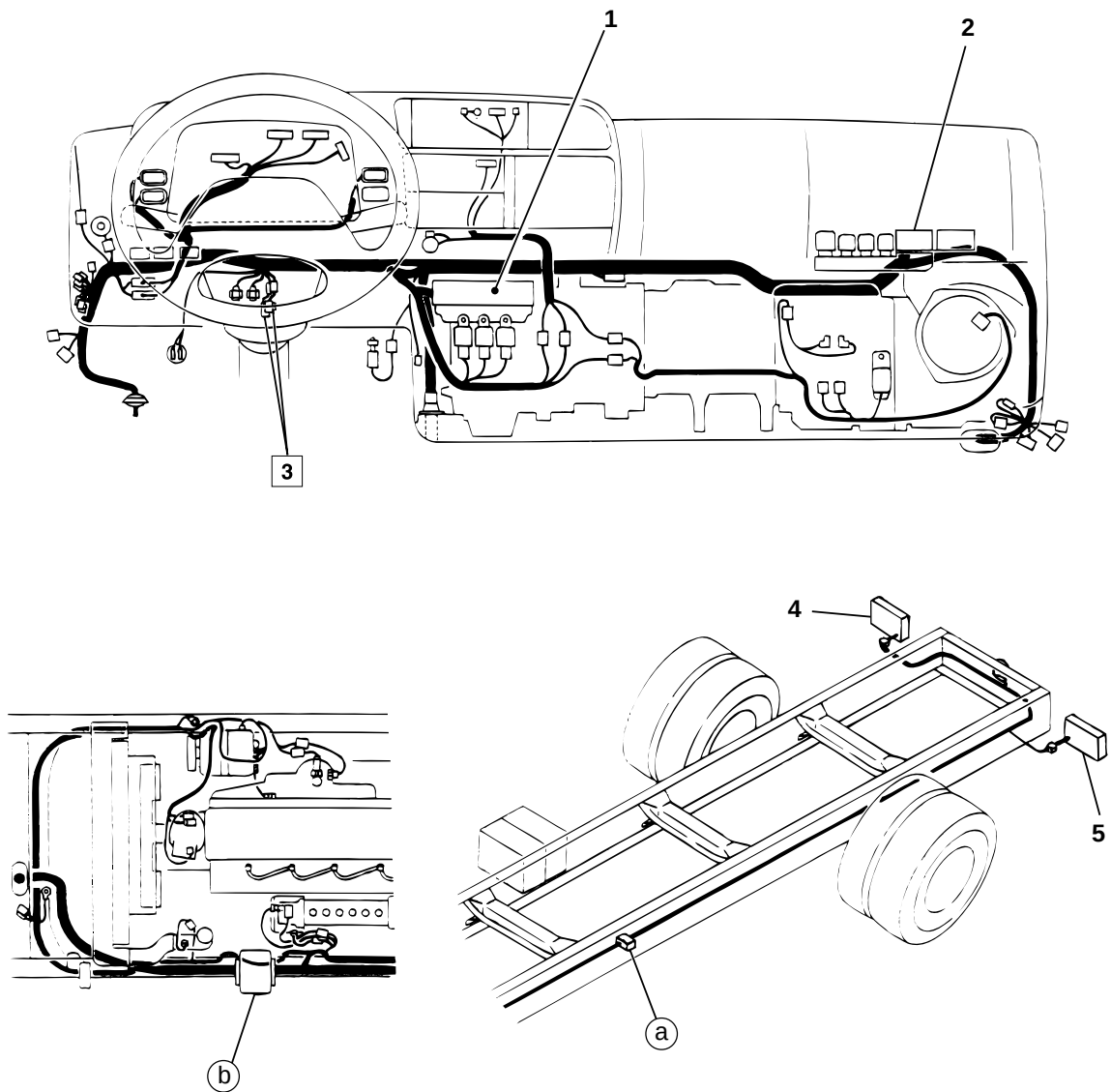
12750

- 1 Fuse box  (104)
- 2 Relay box  (604)
- 3 Combination switch  (601)
- 4 Rear combination lamp, RH

- 5 License plate lamp
- 6 Rear combination lamp, LH
- 7 Clearance lamp, LH
- 8 Clearance lamp, RH

325 STOP LAMP CIRCUIT





12751

- 1 Fuse box  (104)
- 2 Relay box  (604)
- 3 Stop lamp switch

- 4 Rear combination lamp, RH
- 5 Rear combination lamp, LH

325 STOP LAMP CIRCUIT

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
3	Operating pressure of stop lamp switch	29±9.8 kPa {4.3±1.4 lbf/in ² , 0.3±0.1 kgf/cm ² }	—	Replace

◆ Service procedure

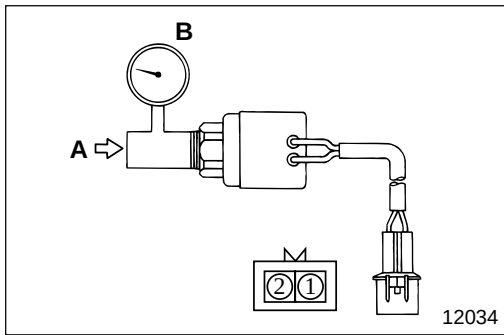
3 Inspection of stop lamp switch

Carry out the following inspection. If any fault is found, replace stop lamp switch 3.

- Make sure that there is no continuity between terminals ① and ② when air pressure **A** is not applied to stop lamp switch 3.
- Apply air pressure **A** to the stop lamp switch gradually starting from 0 kPa {0 lbf/in², 0 kgf/cm²}.

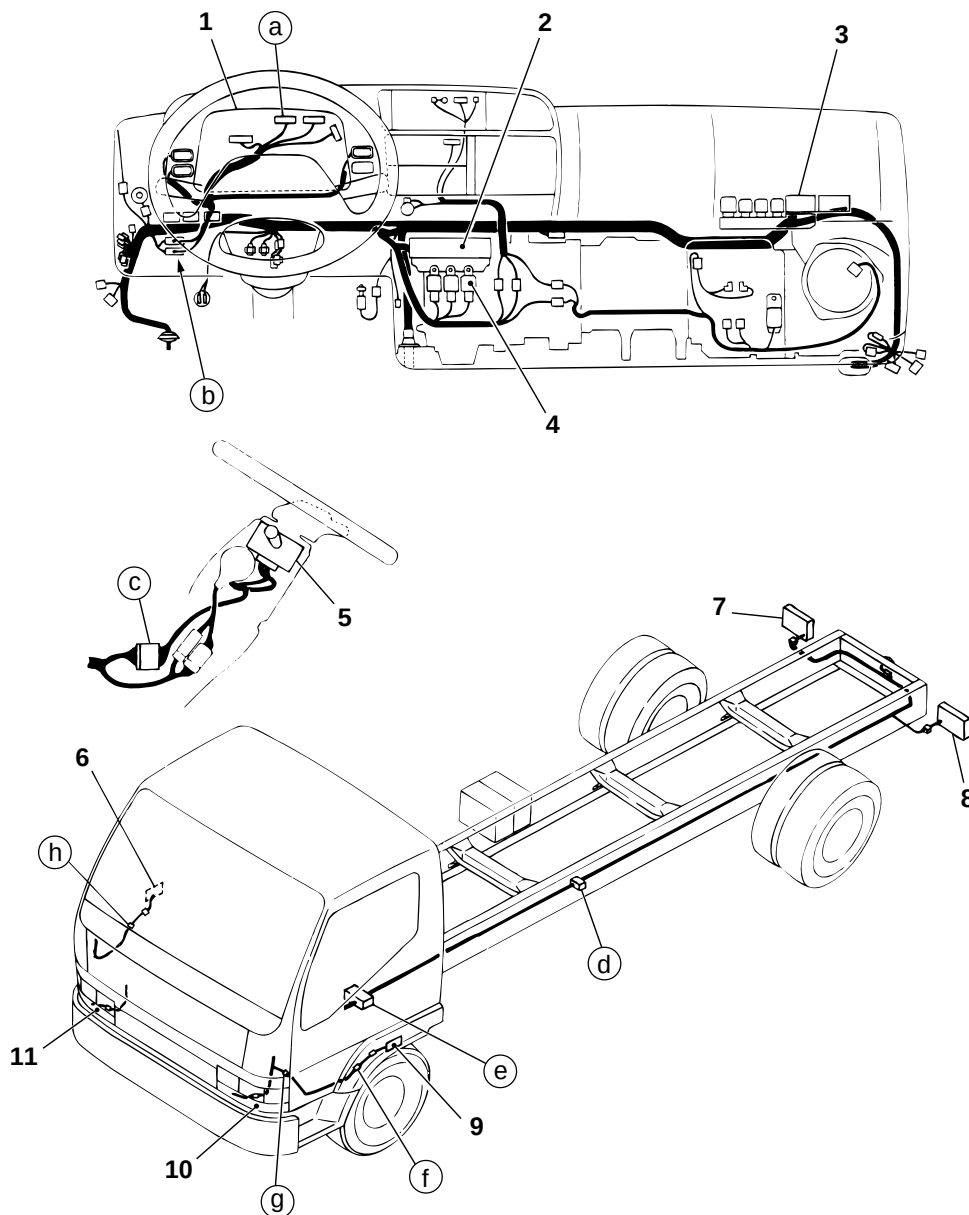
Measure air pressure **A** when continuity is present between terminals ① and ② to make sure that the value conforms to the standard value.

B : Air pressure gauge



MEMO

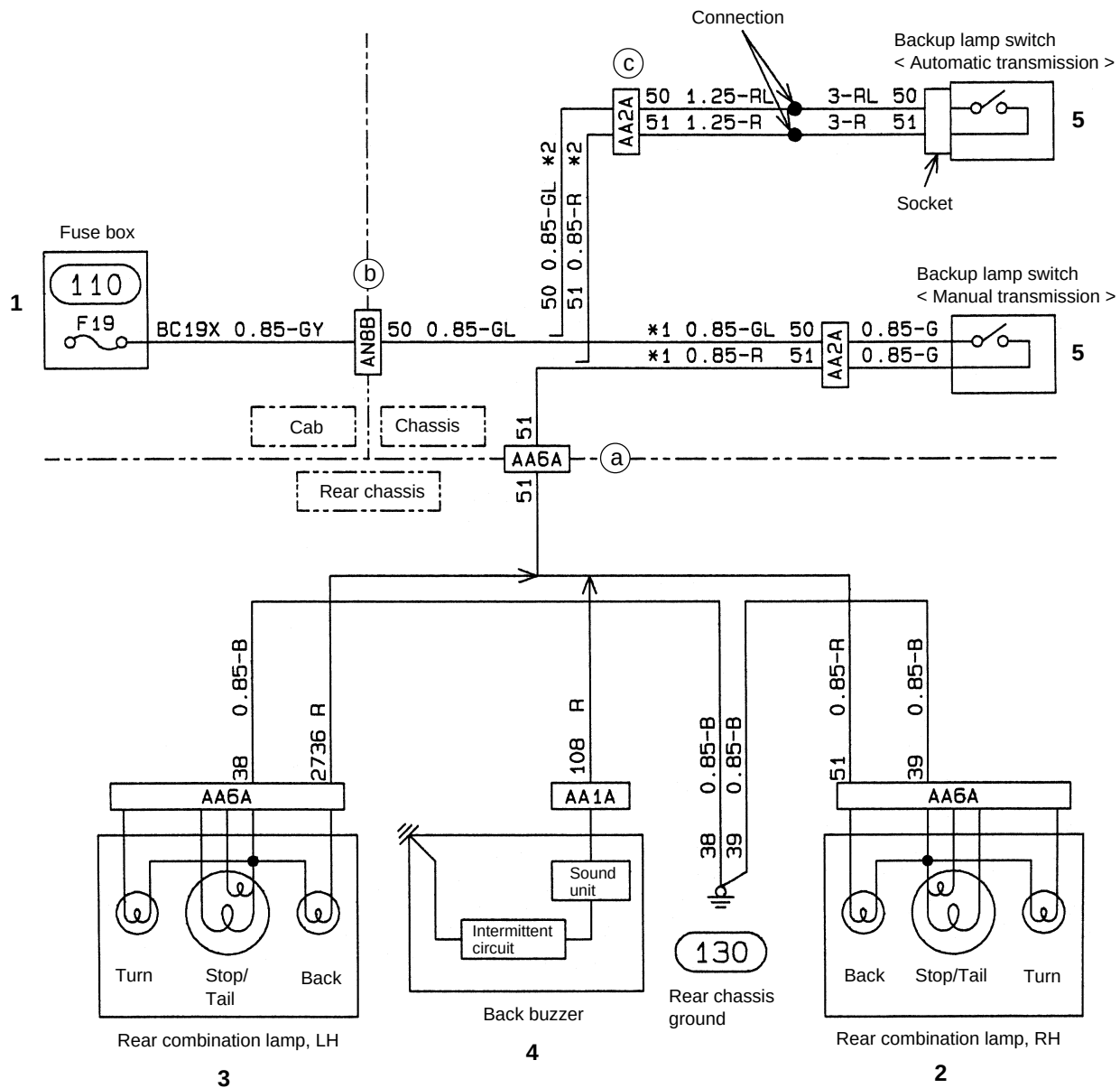




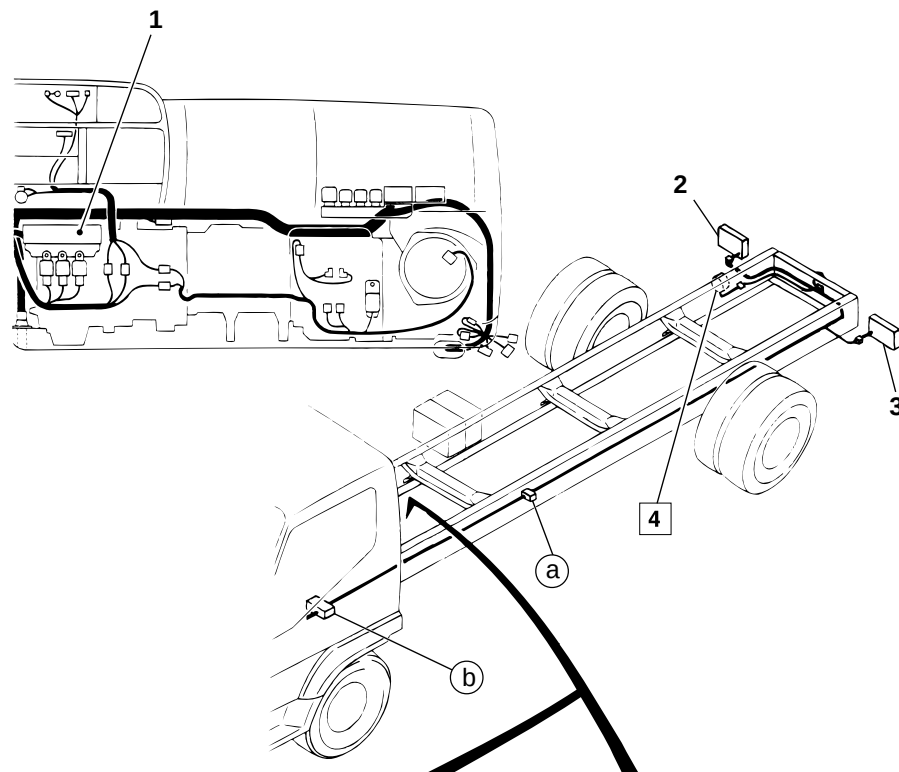
12752

- | | |
|--------------------------------|-------------------------------|
| 1 Meter cluster (401) | 7 Rear combination lamp, RH |
| 2 Fuse box (104) | 8 Rear combination lamp, LH |
| 3 Relay box (604) | 9 Side turn signal lamp, LH |
| 4 Turn signal lamp relay (604) | 10 Front turn signal lamp, LH |
| 5 Combination switch (601) | 11 Front turn signal lamp, RH |
| 6 Side turn signal lamp, RH | |

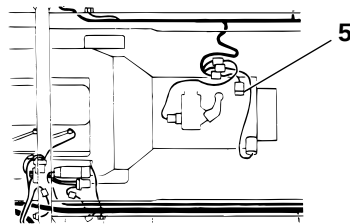
340 BACKUP LAMP CIRCUIT



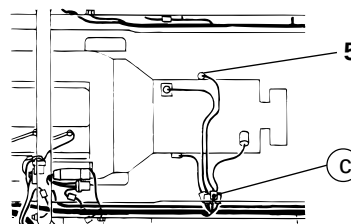
12164



< Manual transmission >



< Automatic transmission >



12753

- 1 Fuse box (104)
- 2 Rear combination lamp, RH
- 3 Rear combination lamp, LH
- 4 Back buzzer
- 5 Backup lamp switch (802)

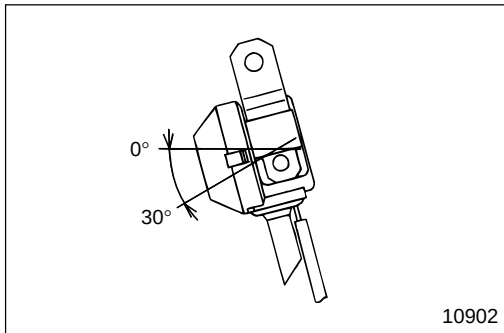
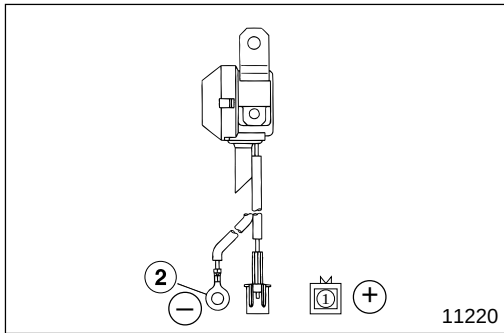
340 BACKUP LAMP CIRCUIT

◆ Service procedure

4 Back buzzer

[Inspection]

- Make sure that back buzzer 4 sounds intermittently when you apply 12 volts DC between terminals ① and ②.
- If any fault is found, replace back buzzer 4.



[Installation]

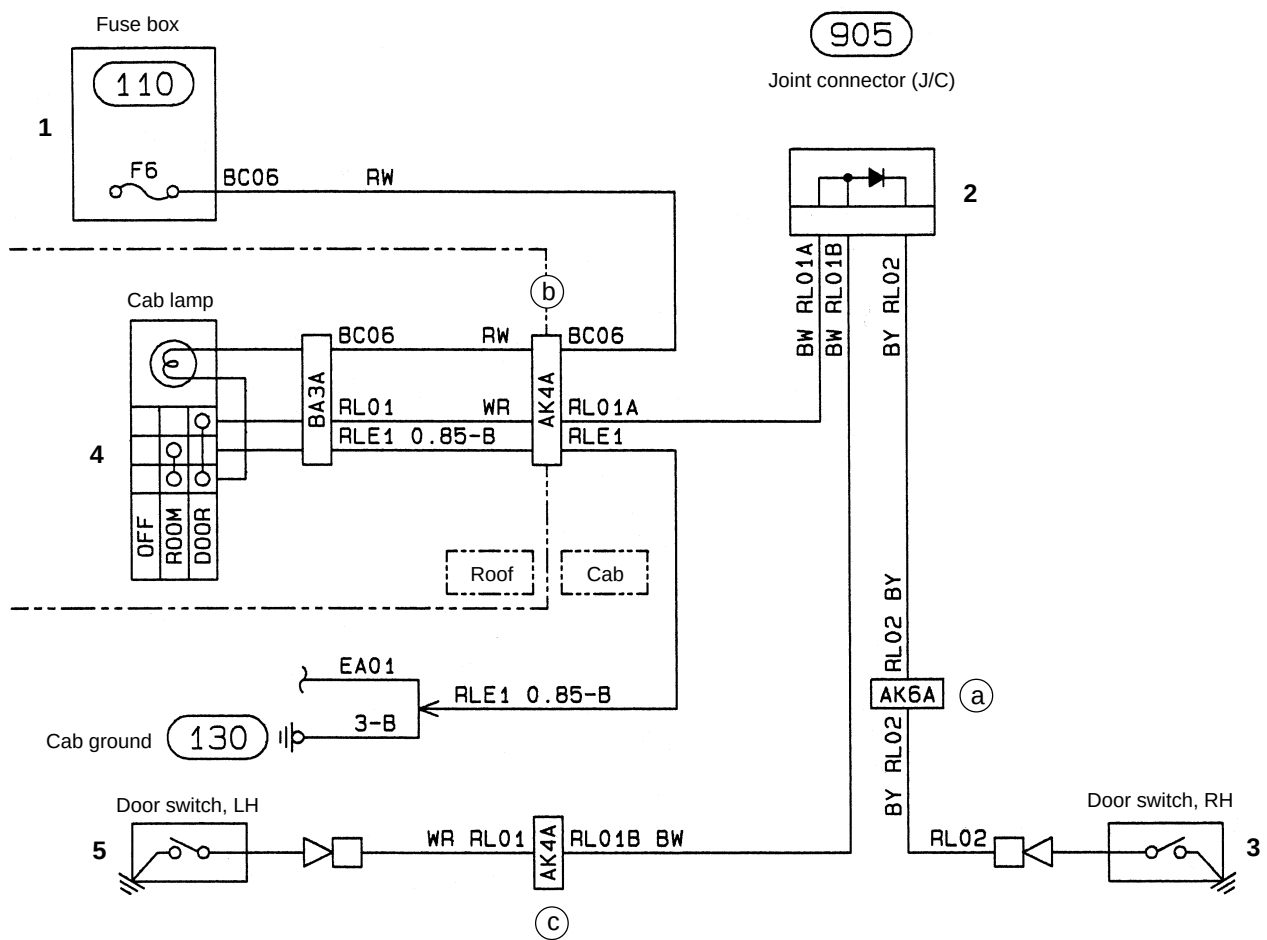
Install back buzzer 4 to the frame within the angle range as illustrated.

CAUTION ⚠

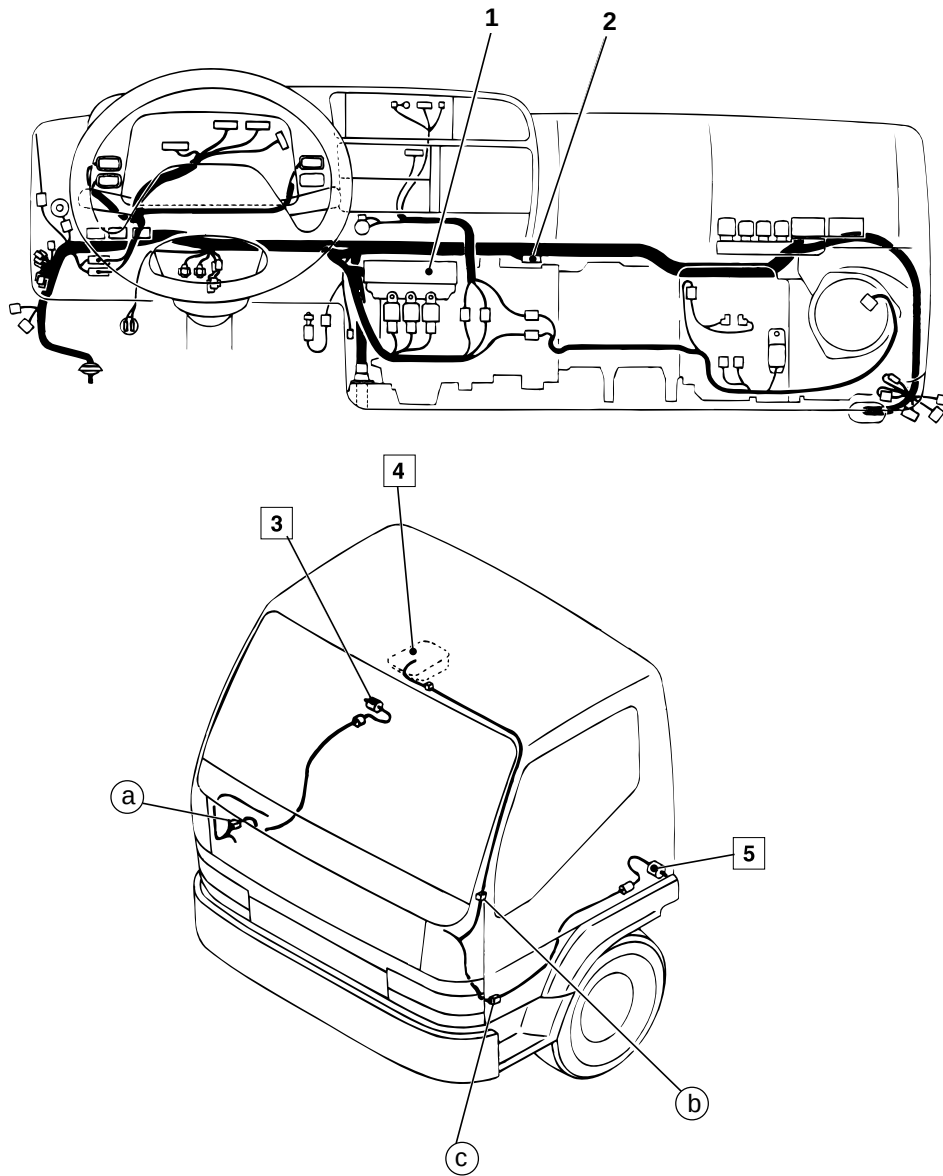
Be careful to install back buzzer 4 within the illustrated angle range or the back buzzer will not be drained normally.

MEMO

345 CAB LAMP CIRCUIT



12165

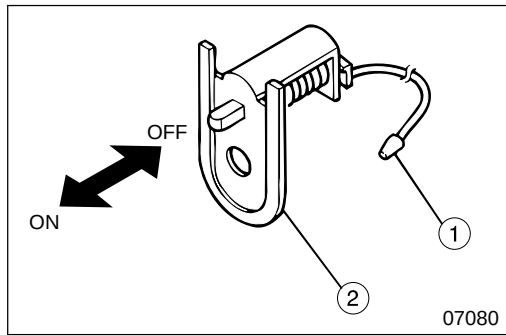


12754

- 1 Fuse box (104)
- 2 Joint connector (J/C) (905)
- 3 Door switch, RH

- 4 Cab lamp
- 5 Door switch, LH

345 CAB LAMP CIRCUIT



◆ Service procedure

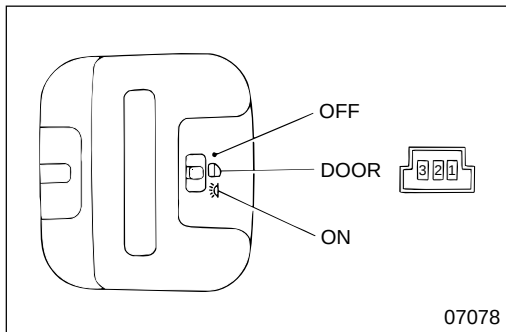
3 5 Inspection of door switches

- Follow the table below to inspect continuity:

	①	②
OFF		
ON	○ — ○	

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

- If any fault is found, replace door switches **3**, **5**. Gr 42



4 Inspection of cab lamp

- Follow the table below to inspect continuity:

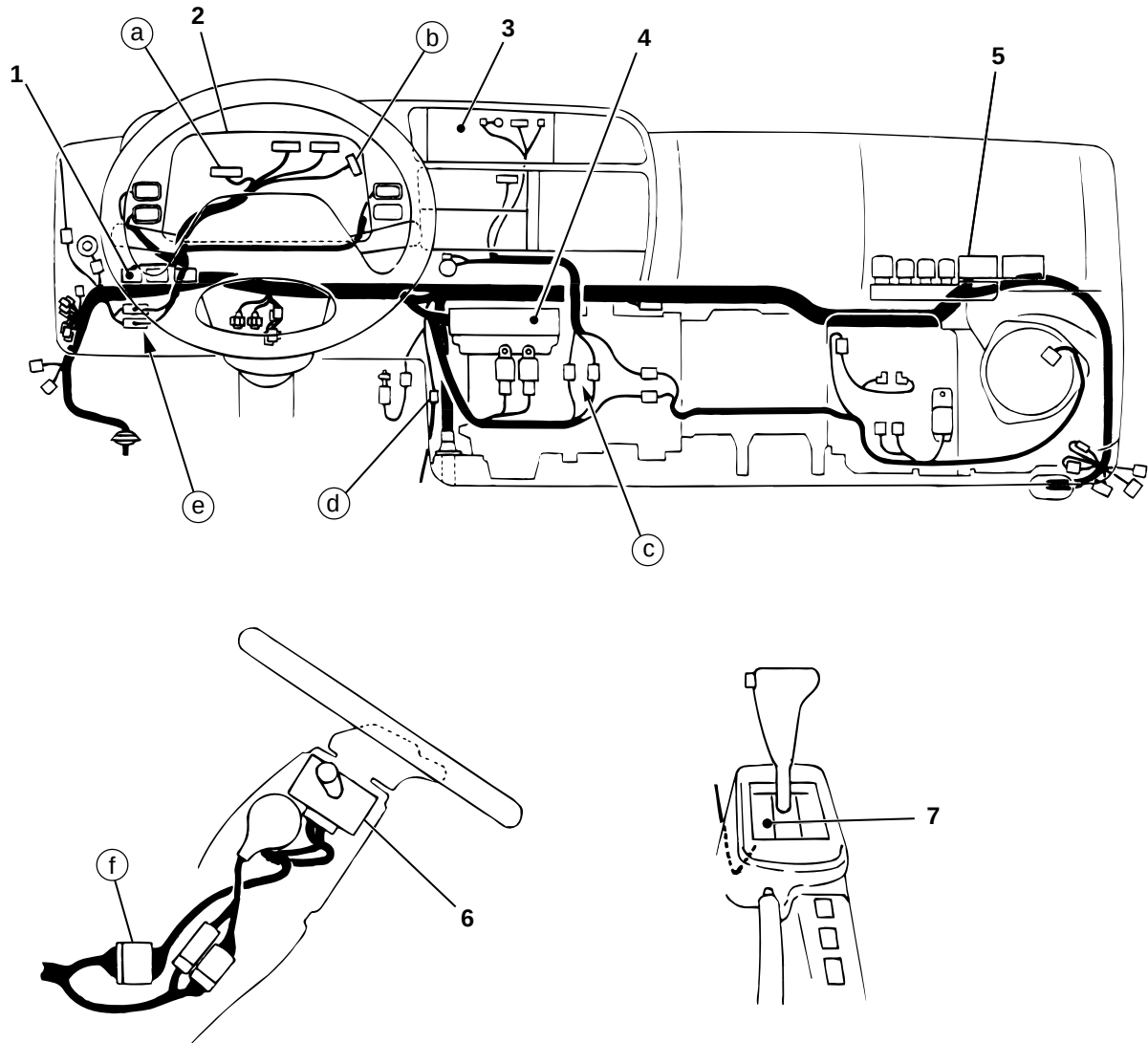
	①	②	③
OFF			
DOOR	○ — ○		
ON	○ — ○	○ — ○	

○ — ○ : There is continuity between terminals ○ and ○.
(When valve is installed.)

- If any fault is found, replace cab lamp **4**.

MEMO



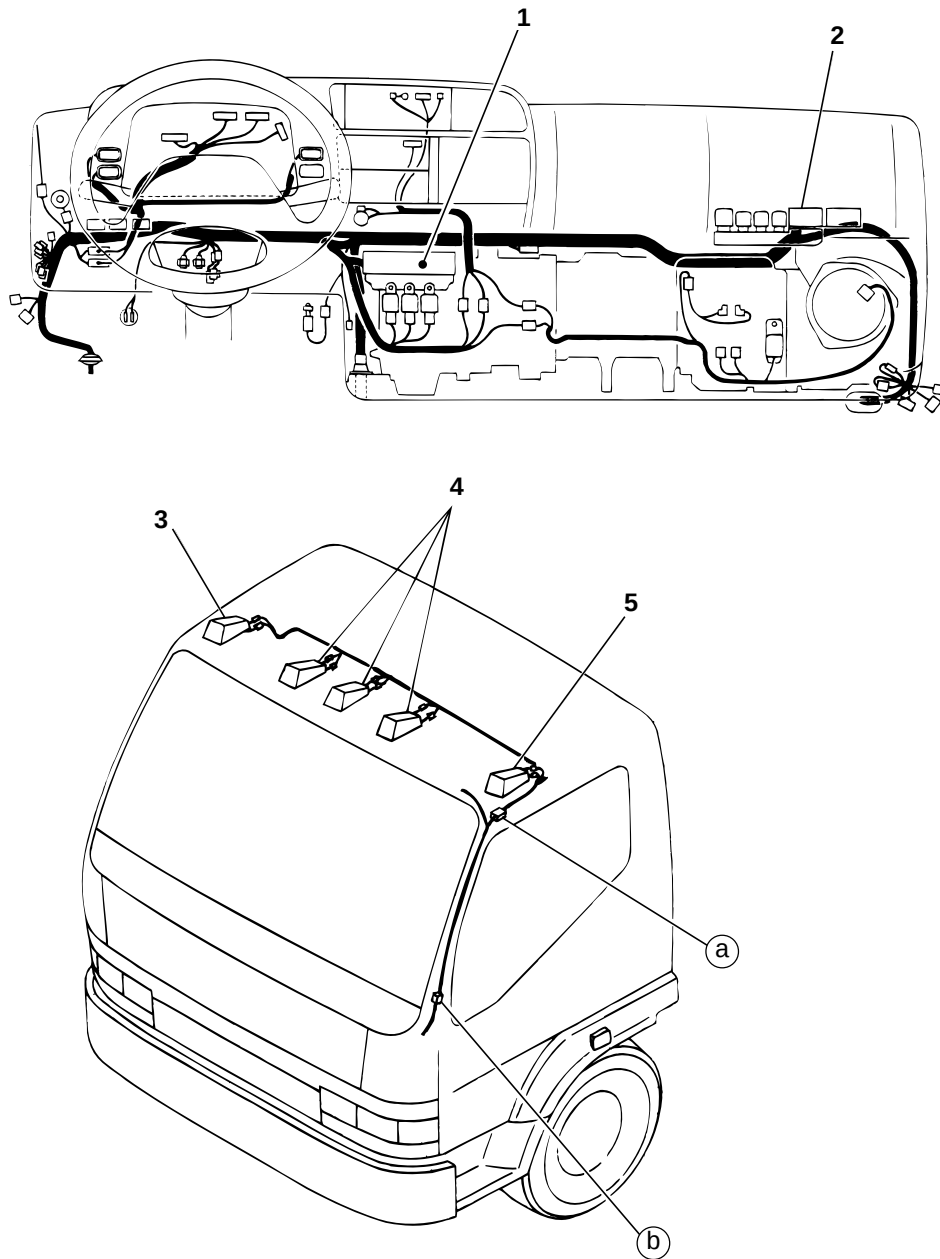


12755

- 1 Rheostat switch (601)
- 2 Meter cluster (401)
- 3 Heater control assembly (618)

- 4 Fuse box (104)
- 5 Relay box (604)
- 6 Combination switch (601)

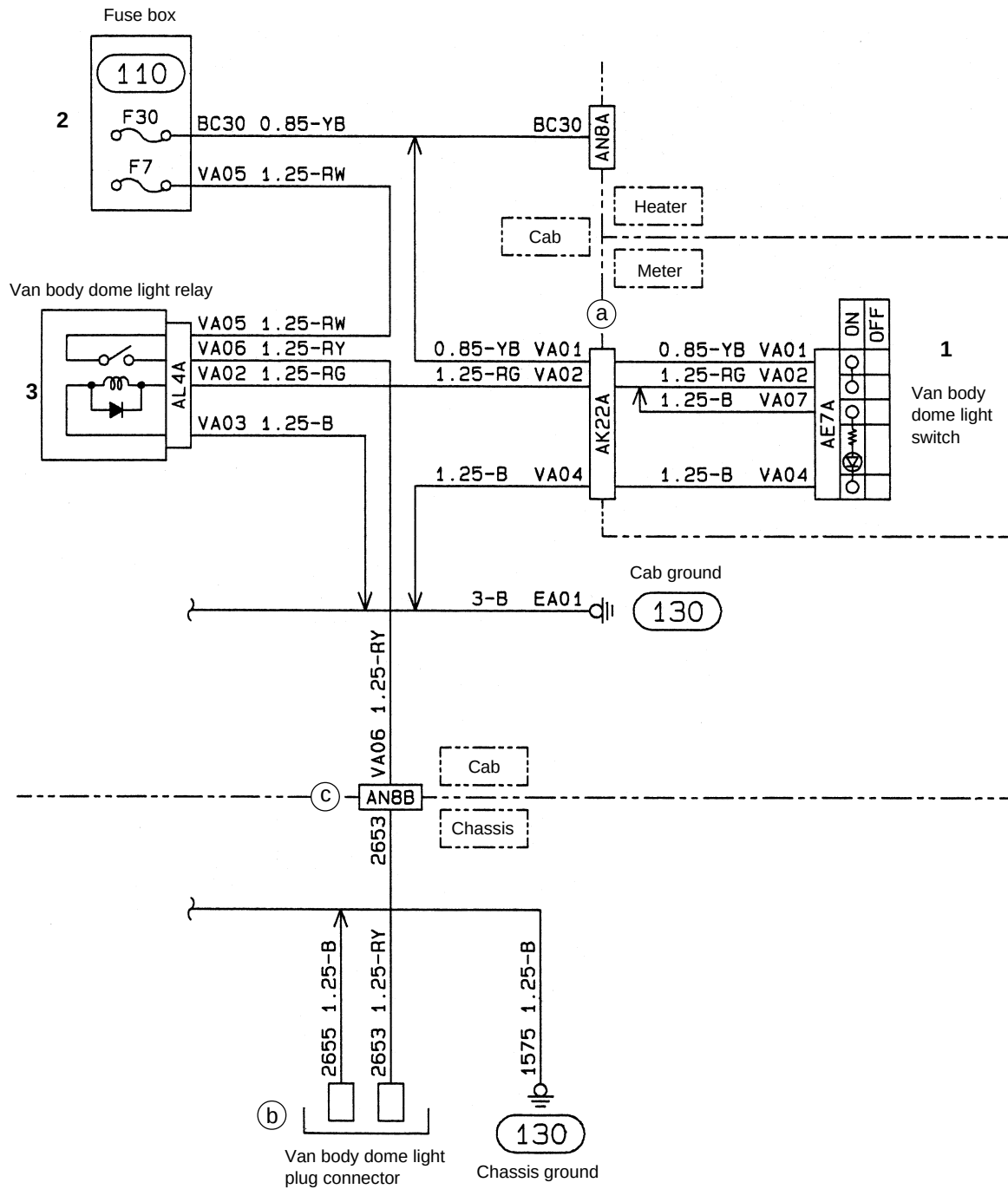


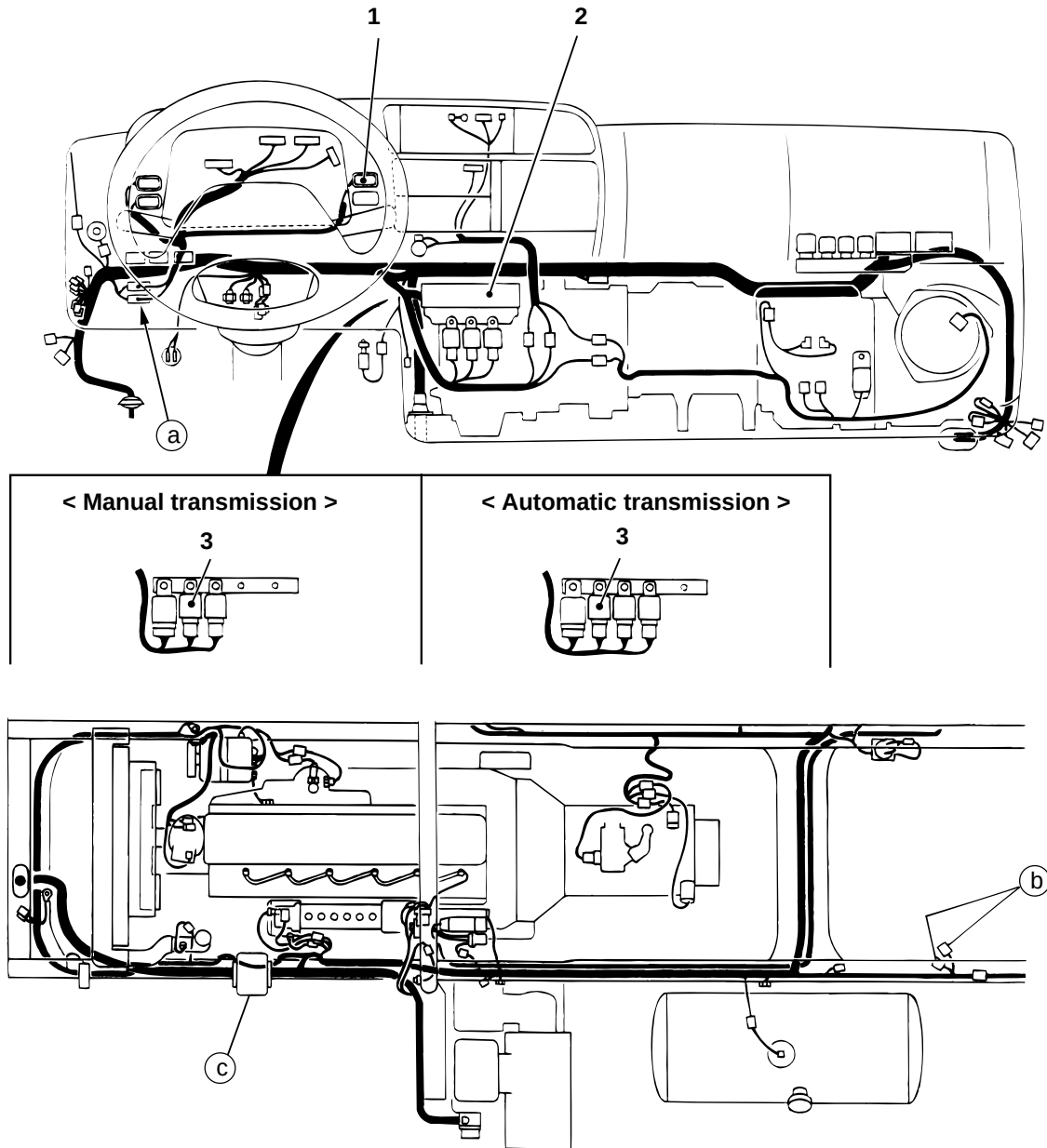


12756

- | | |
|---|--------------------------------------|
| 1 Fuse box  (104) | 4 Identification lamp |
| 2 Relay box  (604) | 5 Clearance and side marker lamp, LH |
| 3 Clearance and side marker lamp, RH | |

352 VAN BODY DOME LIGHT CIRCUIT





12757

- 1 Van body dome light switch 601
- 2 Fuse box 104
- 3 Van body dome light relay 604

4 METER

SPECIFICATIONS	54-4-2
TROUBLESHOOTING	54-4-3
(401) METER CLUSTER	54-4-4
(410) SPEEDOMETER AND TACHOMETER CIRCUITS	54-4-10
(420) FUEL GAUGE CIRCUIT	54-4-12
(425) WATER TEMPERATURE GAUGE CIRCUIT	54-4-16

SPECIFICATIONS

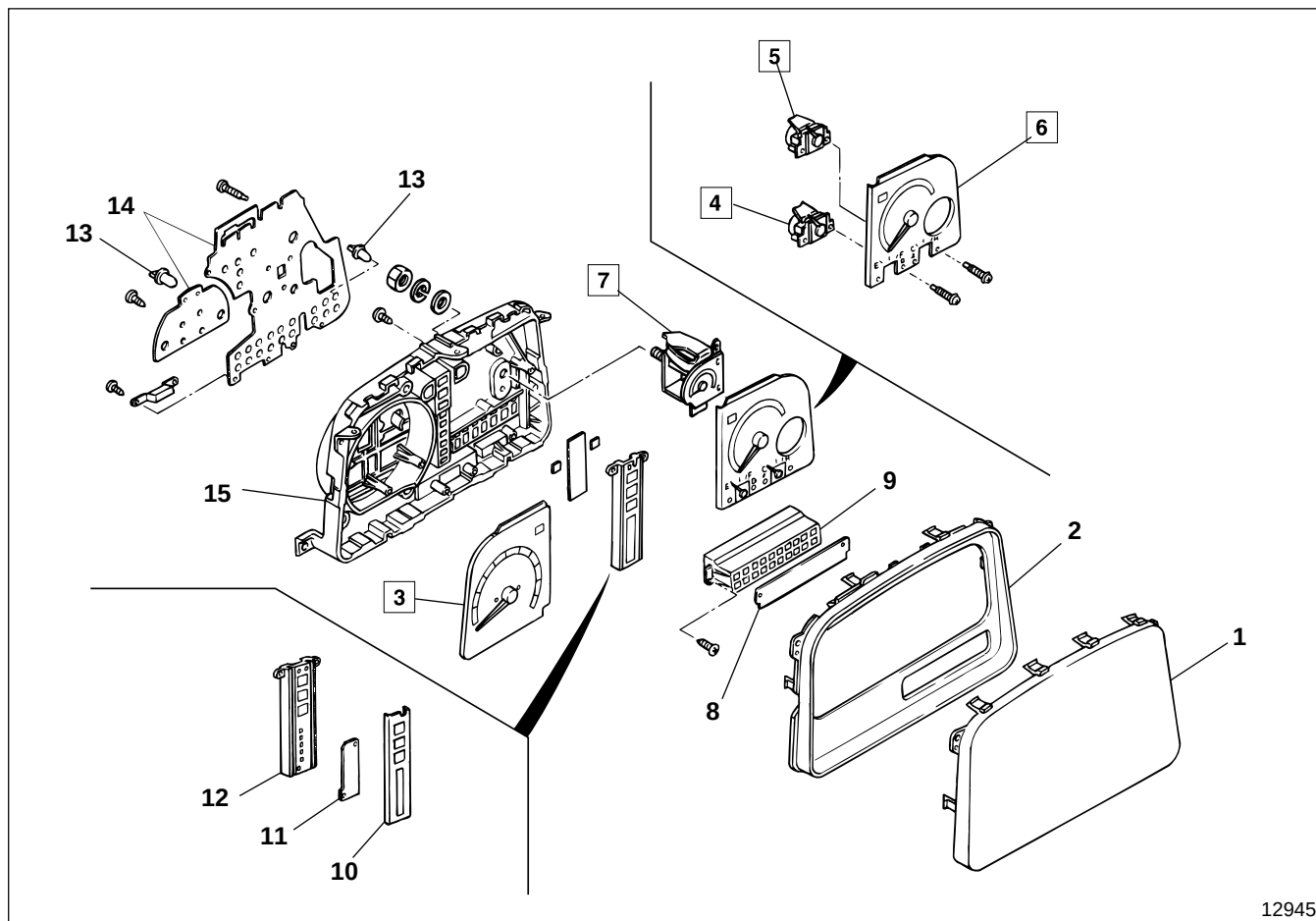
Item		Specifications
Meter cluster	Manufacturer	NIPPONDENSO
	Voltage V	12
	Lighting bulb W	3.4
	Indicator lamp bulb W	1.4
	Warning lamp bulb W	1.4

TROUBLESHOOTING

54

Symptoms		Needle does not move	Needle movement unstable	Indication error large	Meter generates noise	Remarks
Possible causes						
Connector connection faulty, harness broken, grounding faulty		☐	☐			
Fuse blown		☐				
Inner circuit of meter cluster faulty		☐	☐	☐		
Printed board of meter cluster faulty		☐				
Tachometer	Engine revolution sensor coil broken	☐				
	Engine revolution sensor installed incorrectly	☐	☐			 Gr 13
	Tachometer faulty	☐	☐	☐	☐	
Speedometer	Vehicle speed sensor faulty	☐				
	Vehicle speed sensor installation faulty		☐			
	Tires incorrect			☐		 Gr 31
	Tires worn and tire pressure incorrect			☐		 Gr 31
	Transmission L-joint incorrect (gear ratio different)			☐		 Gr 22
	Transmission speedometer gear incorrect (gear ratio different)			☐		 Gr 22
	Installation angle of transmission speedometer gear bush incorrect (not set at correct gear ratio point)			☐		 Gr 22
	Speedometer faulty	☐	☐	☐	☐	
Water temperature gauge	Water temperature sensor faulty	☐		☐		
	Water temperature gauge faulty	☐		☐		
	Thermostat does not close	☐				 Gr 14
Fuel gauge	Fuel gauge unit faulty	☐		☐		
	Fuel gauge faulty	☐		☐		

401 METER CLUSTER



12945

● Disassembly sequence

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

● Assembly sequence

Follow the disassembly sequence in reverse.

Removal and installation of meter cluster  Gr 42

Service standards

Location	Maintenance item			Standard value	Limit	Remedy
3	Indication area of speedometer assembly		At 10 mph	16.1±3.2 km/h {10±2 mph}	—	Replace
			At 20 mph	32.2 ^{+3.2} _{-2.4} km/h {20 ⁺² _{-1.5} mph}		
			At 40 mph	64.4 ⁺⁴ _{-1.6} km/h {40 ^{+2.5} ₋₁ mph}		
			At 50 mph	80.5 ^{+4.8} ₀ km/h {50 ⁺³ ₀ mph}		
			At 60 mph	96.6 ^{+4.8} ₀ km/h {60 ⁺³ ₀ mph}		
4	Resistance of fuel gauge	Needle position	FULL	4 Ω	—	Replace
			1/2	50 Ω		
			EMPTY	135 Ω		
5	Resistance of water temperature gauge	Needle position	65°C {149°F}	84.4 Ω	—	Replace
			100°C {212°F}	26.5 Ω		
6	Indication range of tachometer 20±2°C {68±3.6°F} 13±0.2 V		At 550 rpm	550±50 rpm	—	Replace
			At 1000 rpm	1000±70 rpm		
			At 1500 rpm	1500±110 rpm		
			At 2000 rpm	2000±110 rpm		
			At 2500 rpm	2500±110 rpm		
			At 3000 rpm	3000±110 rpm		
			At 4500 rpm	4500±125 rpm		
7	Indication range of air pressure gauge		At 275.8 kPa {40 lbf/in ² , 2.8 kgf/cm ² }	275.8±50 kPa {40±7 lbf/in ² , 2.8±0.5 kgf/cm ² }	—	Replace
			At 519.9 kPa {75.4 lbf/in ² , 5.3 kgf/cm ² }	519.9±50 kPa {75.4±7 lbf/in ² , 5.3±0.5 kgf/cm ² }		
			At 827.4 kPa {120 lbf/in ² , 8.4 kgf/cm ² }	827.4±50 kPa {120±7 lbf/in ² , 8.4±0.5 kgf/cm ² }		
			At 896.3 kPa {130 lbf/in ² , 9.1 kgf/cm ² }	896.3±50 kPa {130±7 lbf/in ² , 9.1±0.5 kgf/cm ² }		
			At 1103.2 kPa {160 lbf/in ² , 11.3 kgf/cm ² }	1103.2±50 kPa {160±7 lbf/in ² , 11.2±0.5 kgf/cm ² }		
	Tolerance of reading by two needles under the same pressure		At 519.9 kPa {75.4 lbf/in ² , 5.3 kgf/cm ² }	±50 kPa {±7 lbf/in ² , 0.5 kgf/cm ² }		
			At 896.3 kPa {130 lbf/in ² , 9.1 kgf/cm ² }	±50 kPa {±7 lbf/in ² , 0.5 kgf/cm ² }		

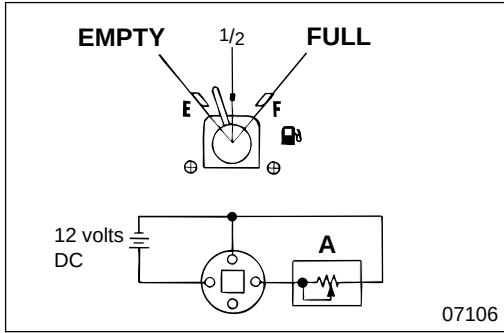
◆ Service procedure

3 Inspection of speedometer

- Measure the indication area of speedometer **3** at various speed ranges using a speedometer tester.
- If the measured value deviates from the standard value, carry out the following inspection. If the inspection does not indicate a fault, replace speedometer **3**.

(1) Inspection of vehicle speed sensor body (802)**(2)** Inspection of installed condition of vehicle speed sensor Gr 22 < Manual transmission > Gr 23 < Automatic transmission >

401 METER CLUSTER



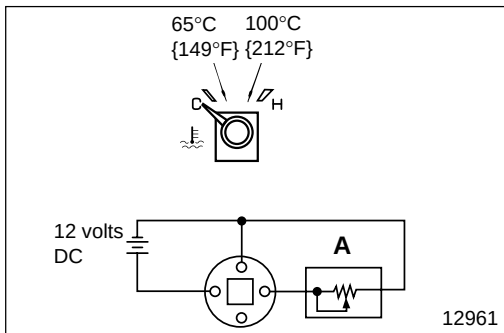
4 Inspection of fuel gauge

- Connect a variable resistor to fuel gauge 4 as illustrated.
A : Variable resistor
- Measurement order
FULL → 1/2 → EMPTY

NOTE

The movement of the gauge needle is subject to hysteresis (oscillation). Be sure to measure following the measurement order.

- Increase the value of variable resistor A gradually from 0 Ω.
- Measure the resistance respectively when the needle of fuel gauge 4 indicates FULL, 1/2 and EMPTY.
- If the measured value deviates from the standard value, replace fuel gauge 4.



5 Inspection of water temperature gauge

- Connect a variable resistor to water temperature gauge 5 as illustrated.
A : Variable resistor
- Measurement order
Low temperature → High temperature

NOTE

The movement of the gauge needle is subject to hysteresis (oscillation). Be sure to measure following the measurement order.

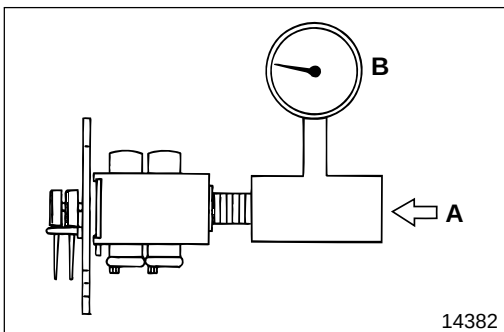
- Increase the value of variable resistor A gradually from 0 Ω.
- Measure the resistance respectively when the needle of water temperature gauge 5 indicates 65°C {149°F} and 100°C {212°F}.
- If the measured value deviates from the standard value, replace water temperature gauge 5.

6 Inspection of tachometer

- Measure the indication area of tachometer 6 at various revolution ranges using an engine revolution counter.
- If the measured value deviates from the standard value, carry out the following inspection. If the inspection does not indicate a fault, replace tachometer 6.

(1) Inspection of the engine revolution sensor body 801

(2) Inspection of the installed condition of the engine revolution sensor Gr 13



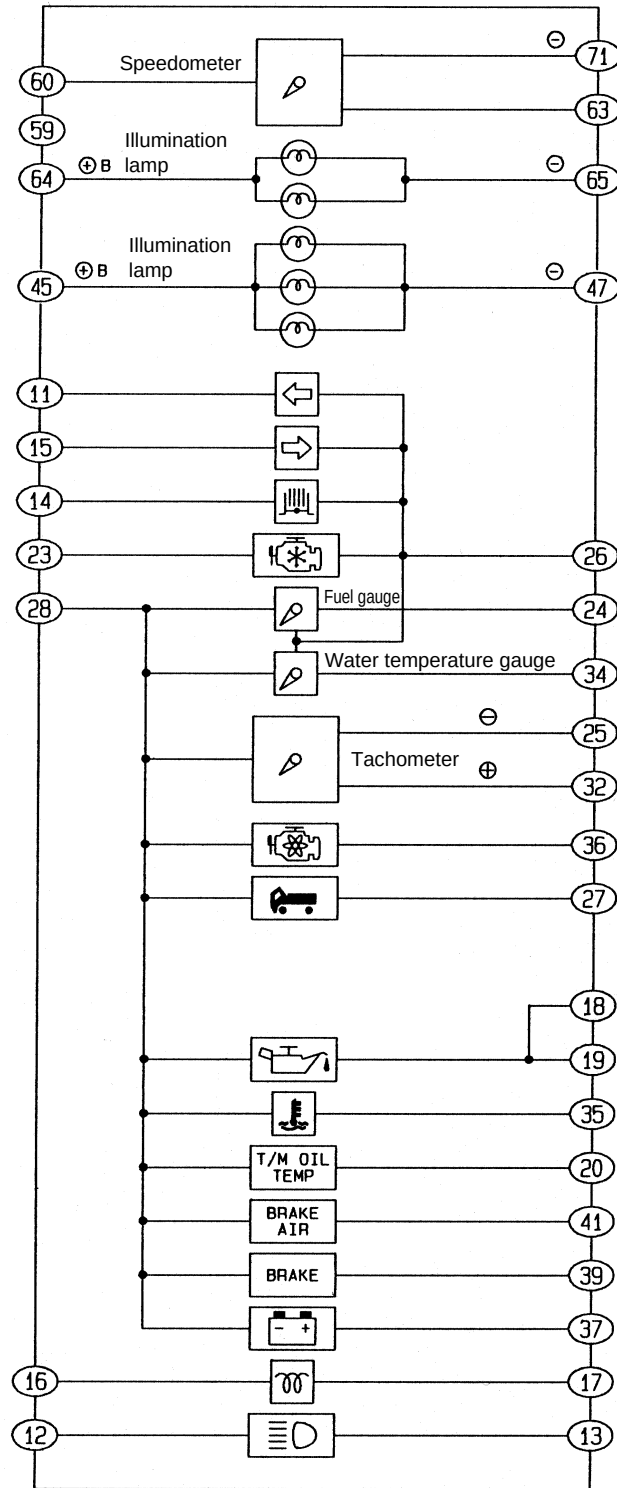
7 Inspection of air pressure gauge

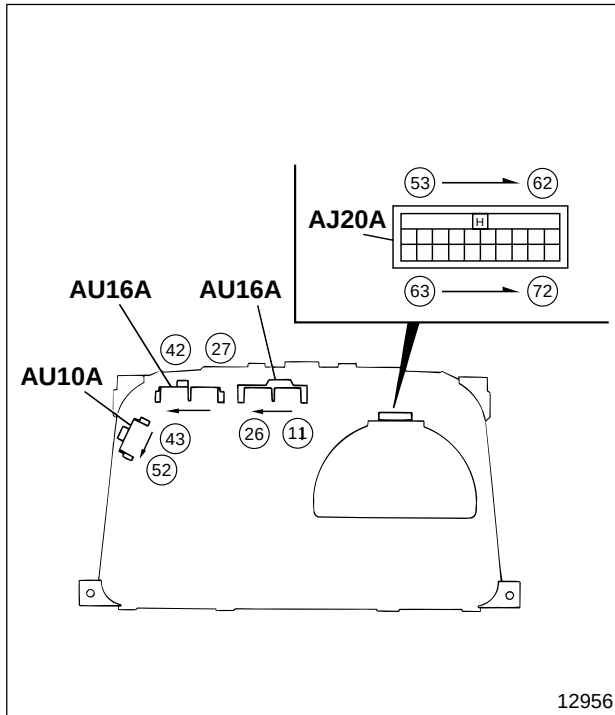
- Apply air pressure A to air pressure gauge 7.
B : Air pressure gauge
- Measure the indication area of air pressure gauge 7 at standard pressure.
- If the measured value deviates from the standard value, replace air pressure gauge 7.

MEMO

401 METER CLUSTER

Meter Cluster Internal Circuit





12956

Terminal No.	AU16A
11	Turn, LH (+)
12	Beam (+)
13	Beam (-)
14	Exhaust brake (+)
15	Turn, RH (+)
16	Glow (+)
17	Glow (-)
18	—
19	—
20	ATF temperature (-)
21	—
22	—
23	Cold start (+)
24	Fuel gauge unit (-)
25	Pre-stroke control (-)
26	Ground

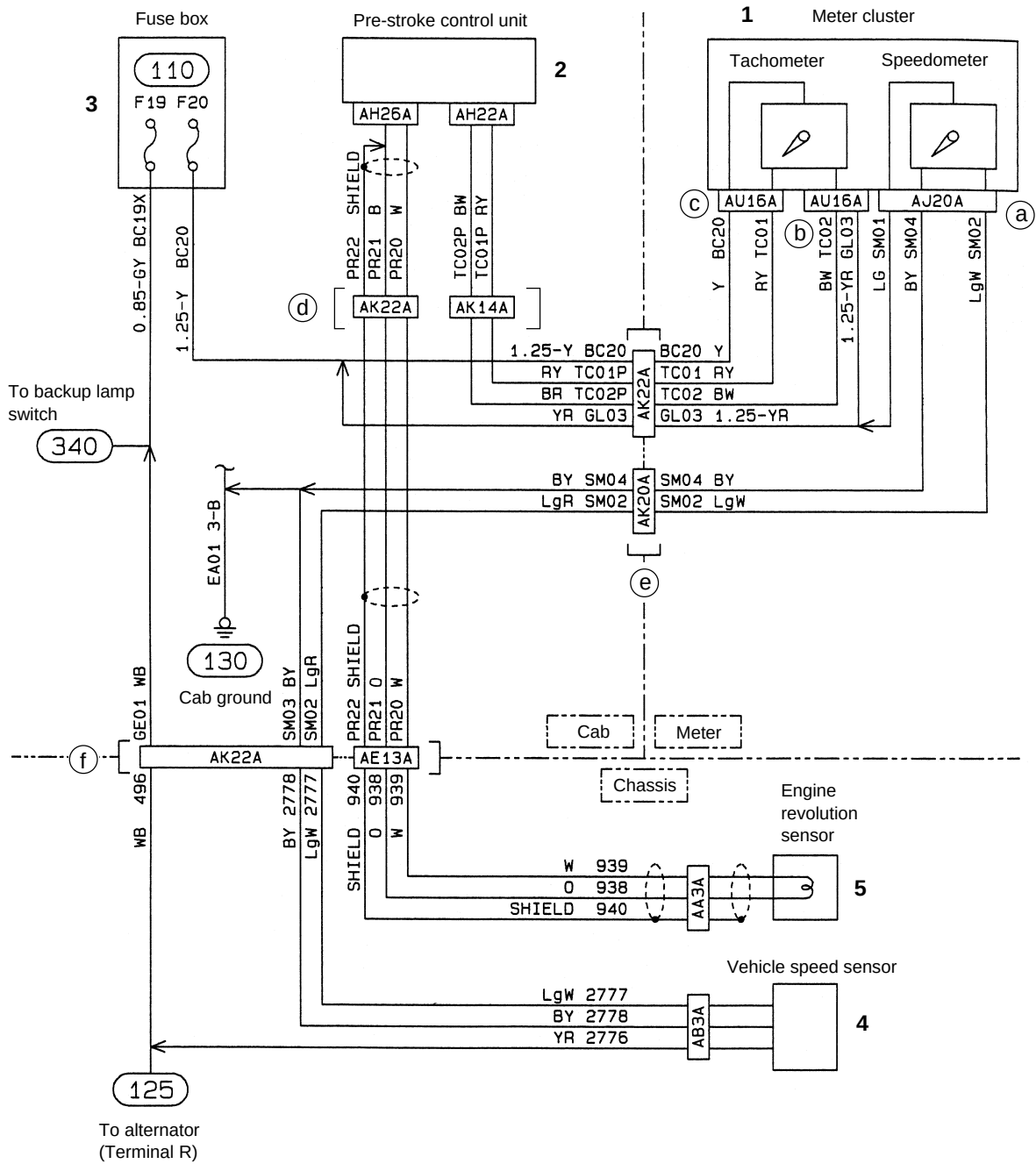
Terminal No.	AU16A
27	Cab tilt (-)
28	Starter switch terminal M
29	—
30	Door (-)
31	—
32	Pre-stroke control (-)
33	—
34	Water temperature (-)
35	Water level, overheating (-)
36	Pre-stroke control (-)
37	Alternator (-)
38	—
39	Parking brake (-)
40	—
41	Low-air pressure (-)
42	—

Terminal No.	AU10A
43	—
44	—
45	Illumination (+)
46	—
47	Illumination (-)
48	Engine oil pressure (-)
49	—
50	—
51	—
52	Engine oil bypass alarm (-)

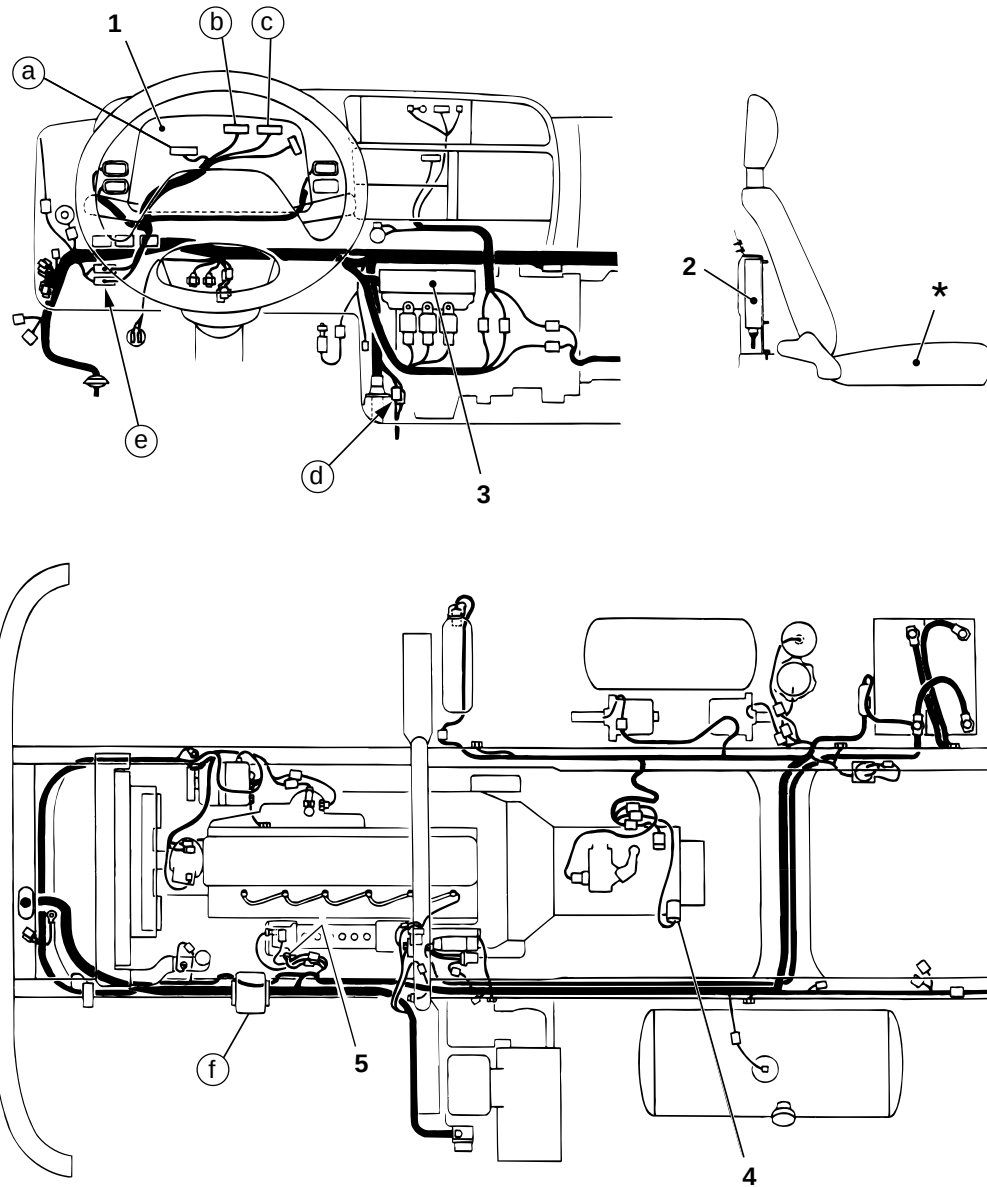
Terminal No.	AJ20A
53 to 59	—
60	Starter switch terminal M
61	—
62	—
63	Vehicle speed sensor (Signal)
64	Illumination (+)
65	Illumination (-)
66 to 70	—
71	Ground
72	—

ATF : Automatic transmission fluid

410 SPEEDOMETER AND TACHOMETER CIRCUITS



12212

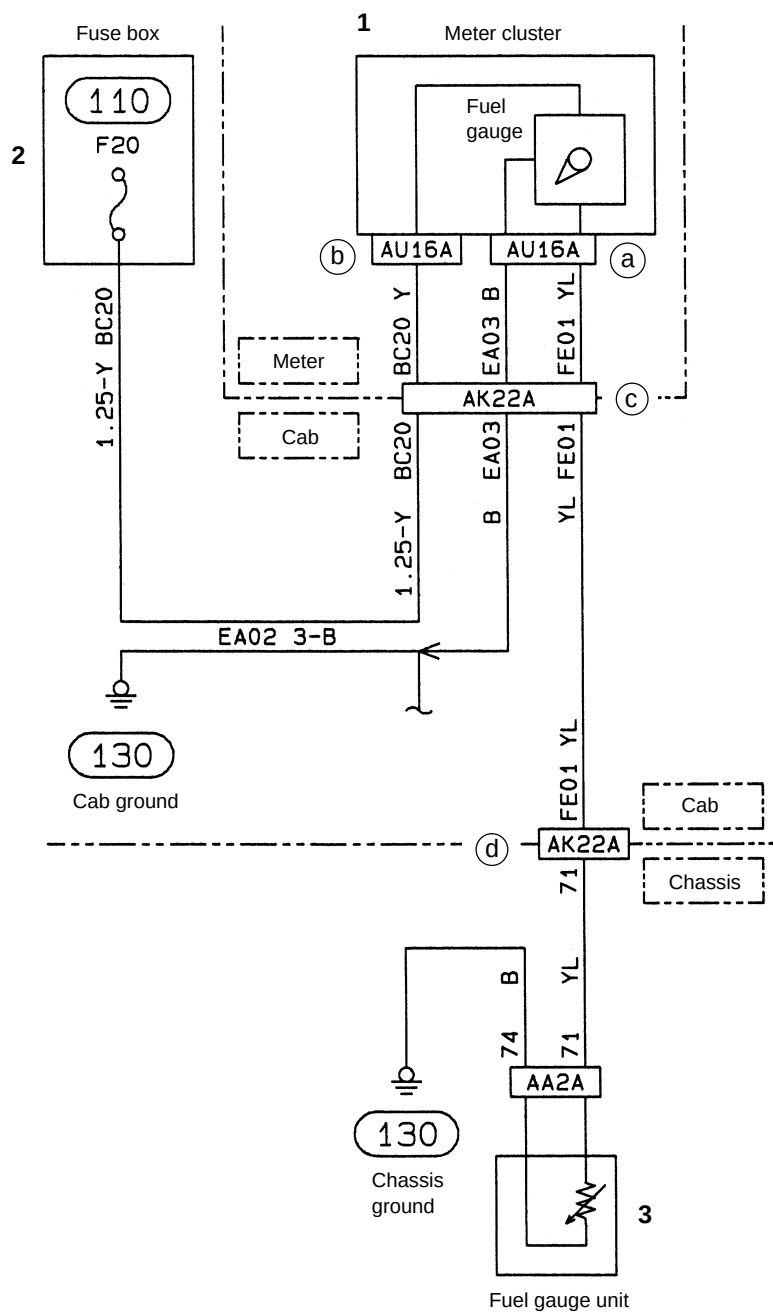


12699

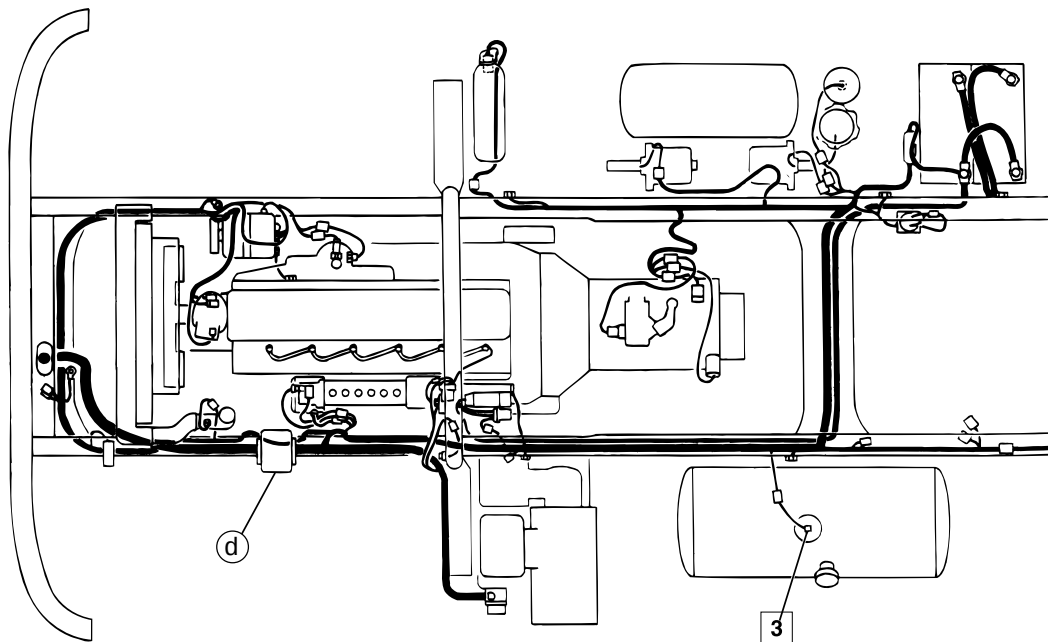
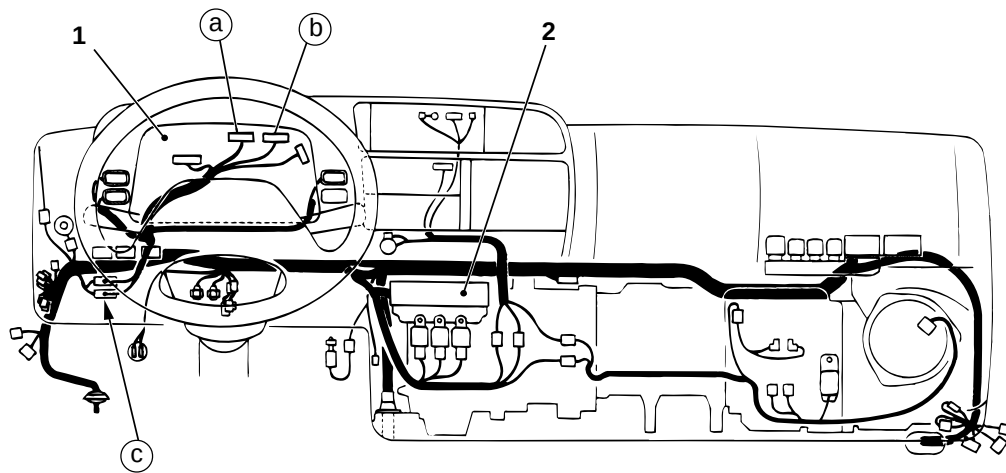
- 1 Meter cluster (401)
- 2 Pre-stroke control unit (604)
- 3 Fuse box (104)
- 4 Vehicle speed sensor (802)
- 5 Engine revolution sensor (801)

* : Passenger's seat

420 FUEL GAUGE CIRCUIT



12213



12700

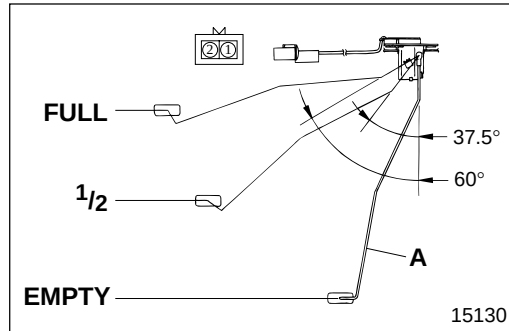
- 1 Meter cluster  (401)
- 2 Fuse box  (104)
- 3 Fuel gauge unit

420 FUEL GAUGE CIRCUIT

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
3	Resistance of fuel gauge unit	Float arm location	EMPTY	—	Replace
			$150 \pm 10 \ \Omega$		
			$50 \pm 3 \ \Omega$		
			FULL	$0 \begin{smallmatrix} +2 \\ 0 \end{smallmatrix} \ \Omega$	

(): Reference values



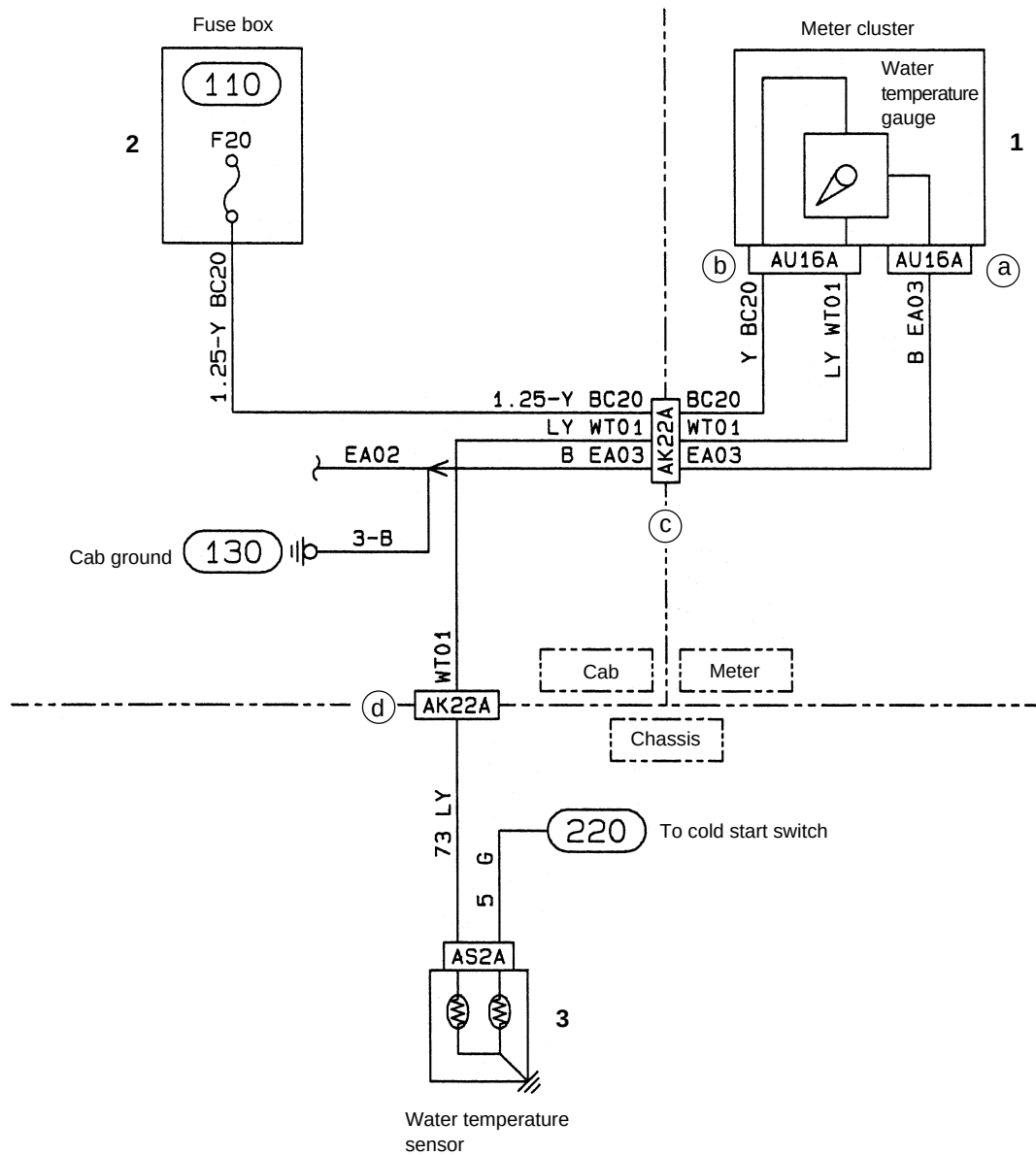
◆ Service procedure

3 Inspection of fuel gauge unit

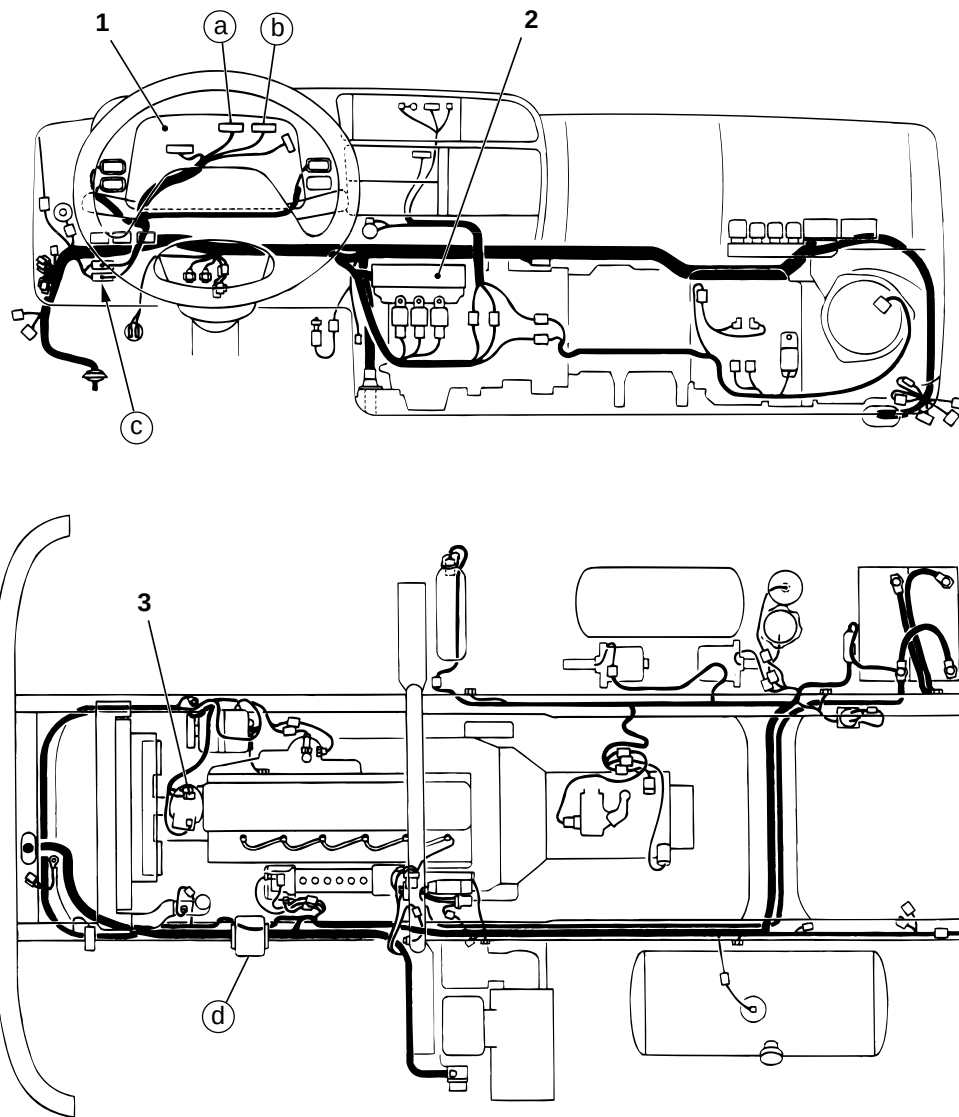
- Measure the resistance between terminals ① and ② when float arm **A** makes contact with both end stoppers (**E** and **F**) and midpoint positions of the movable range, respectively.
- If the measured value deviates from the standard value, replace fuel gauge unit **3**.

MEMO

425 WATER TEMPERATURE GAUGE CIRCUIT



12215



12701

- 1 Meter cluster  (401)
- 2 Fuse box  (104)
- 3 Water temperature sensor  (801)

5 INDICATOR AND WARNING

TROUBLESHOOTING..... 54-5-2

(500) INSPECTION AND ADJUSTMENT MOUNTED IN VEHICLE

• Inspection of Brake Fluid Level Switch 54-5-5

(510) PARKING BRAKE INDICATOR CIRCUIT  54-5-6

(515) BRAKE WARNING CIRCUIT   54-5-8

(530) WATER LEVEL WARNING CIRCUIT  54-5-12

(536) ENGINE OIL PRESSURE WARNING CIRCUIT  54-5-16

(537) OVERHEATING WARNING CIRCUIT  54-5-18

**(547) AUTOMATIC TRANSMISSION FLUID TEMPERATURE
WARNING CIRCUIT**  54-5-20

(550) CAB TILT WARNING CIRCUIT  54-5-24

For details on the following indicator and warning lamps, see the relevant sections.

  **(125)**

  **(220)**

  **(310)**

  **(330)**

  **(710)**

  Gr 13

TROUBLESHOOTING

Symptoms		Lamps do not light with starter switch turned ON (engine not started)	BRAKE					BRAKE AIR		Remarks
			Lamp does not light although parking brake lever is pulled	Lamp does not go out although parking brake lever is returned	Lamp does not light although brake fluid level is insufficient	Warning buzzer does not sound although brake fluid lever is insufficient	Lamp lights although brake fluid level is sufficient	Lamp does not light although air pressure level in air tank is low	Warning buzzer does not sound although air pressure level in air tank is low	
Possible causes										
Connector connection faulty, harness broken, grounding faulty		☐	☐		☐	☐		☐	☐	
Fuse blown		☐	☐		☐			☐		
Meter cluster	Internal circuit faulty	☐	☐	☐	☐		☐	☐	☐	
	Bulb burnt-out	☐	☐		☐			☐		
Warning buzzer faulty			☐	☐		☐			☐	
Parking brake switch faulty			☐	☐						
Parking brake relay faulty <Automatic transmission>			☐	☐						
Brake fluid level switch faulty					☐		☐			
Low air pressure switch faulty								☐		☐
Air master stroke switch faulty							☐			
Air master faulty							☐			 Gr 35
Cab tilt lock switch	Switch body faulty									
	Installation faulty									 Gr 42
Overheating switch faulty										
Water level sensor faulty										
Multipurpose timing control unit faulty										
Engine oil pressure switch faulty										
Engine oil bypass alarm switch faulty										
Automatic transmission fluid thermostat switch faulty										

Symptoms									Remarks
		Lamp does not light although engine coolant level is insufficient	Lamp lights although engine coolant level is sufficient	Lamp does not light although engine coolant over-heating	Lamp lights when not overheating	Warning buzzer does not stop sounding although parking brake lever is pulled	Lamp does not light although engine oil hydraulic pressure is low	Lamp lights although engine oil hydraulic pressure is sufficient	
Possible causes									
Connector connection faulty, harness broken, grounding faulty		☐		☐		☐	☐		
Fuse blown		☐		☐			☐		
Meter cluster	Internal circuit faulty	☐	☐	☐	☐		☐	☐	
	Bulb burnt-out	☐		☐			☐		
Warning buzzer faulty						☐			☐
Parking brake switch faulty									
Parking brake relay faulty < Automatic transmission >									
Brake fluid level switch faulty						☐			
Low air pressure switch faulty									
Air master stroke switch faulty									
Air master faulty									 Gr 35
Cab tilt lock switch	Switch body faulty								
	Installation faulty								 Gr 42
Overheating switch faulty				☐	☐				
Water level sensor faulty		☐	☐						
Multipurpose timing control unit faulty		☐	☐						
Engine oil pressure switch faulty							☐	☐	
Engine oil bypass alarm switch faulty							☐	☐	
Automatic transmission fluid thermostat switch faulty									

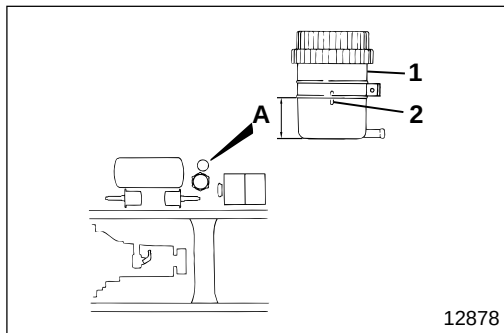
TROUBLESHOOTING

Symptoms		T/M OIL TEMP				Remarks
		Lamp does not light although automatic transmission fluid temperature is high	Lamp lights although automatic transmission fluid temperature is appropriate	Warning buzzer does not stop sounding although parking brake lever is pulled	Lamp lights although cab is locked to rear cab mounting	
Possible causes						
Connector connection faulty, harness broken, grounding faulty		☐		☐	☐	
Fuse blown		☐			☐	
Meter cluster	Internal circuit faulty	☐	☐		☐	
	Bulb burnt-out	☐			☐	
Warning buzzer faulty				☐		
Parking brake switch faulty						
Parking brake relay faulty < Automatic transmission >						
Brake fluid level switch faulty						
Low-air pressure switch faulty						
Air master stroke switch faulty						
Air master faulty						 Gr 35
Cab tilt lock switch	Switch body faulty				☐	☐
	Installation faulty				☐	 Gr 42
Overheating switch faulty						
Water level sensor faulty						
Multipurpose timing control unit faulty						
Engine oil pressure switch faulty						
Engine oil bypass alarm switch faulty						
Automatic transmission fluid thermostat switch faulty		☐	☐			

Inspection of Brake Fluid Level Switch**Service standards**

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Warning lamp lighting position for brake fluid level switch	$57^{+3.5}_{-0.5}$ { $2.24^{+0.14}_{-0.02}$ }	—	Replace



- Start engine.
- Drain the brake fluid gradually from fluid tank assembly **1**.

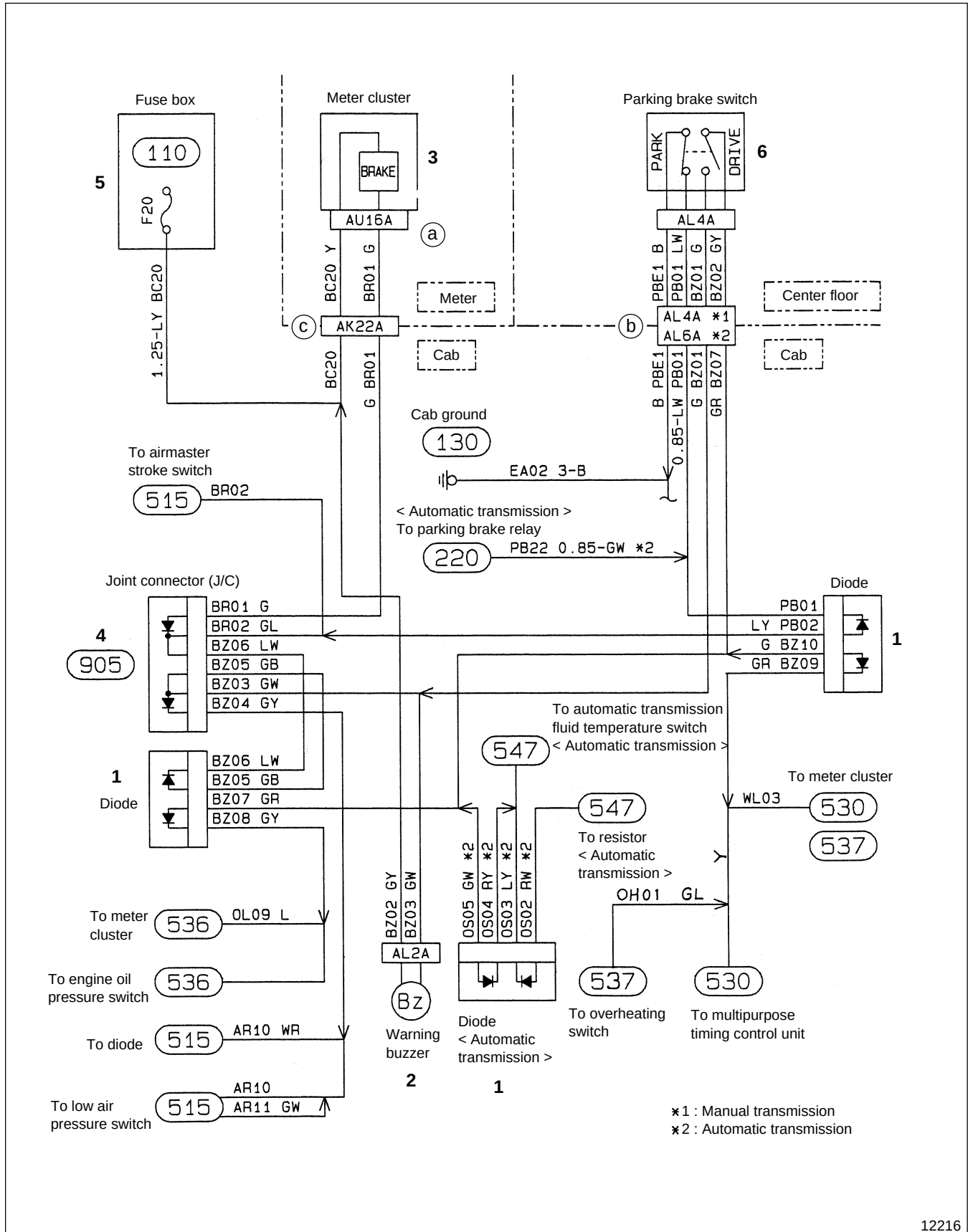
CAUTION ⚠

If brake fluid is spilt on any part of the vehicle, wipe it off immediately, since the solvent in the fluid can damage the paintwork.

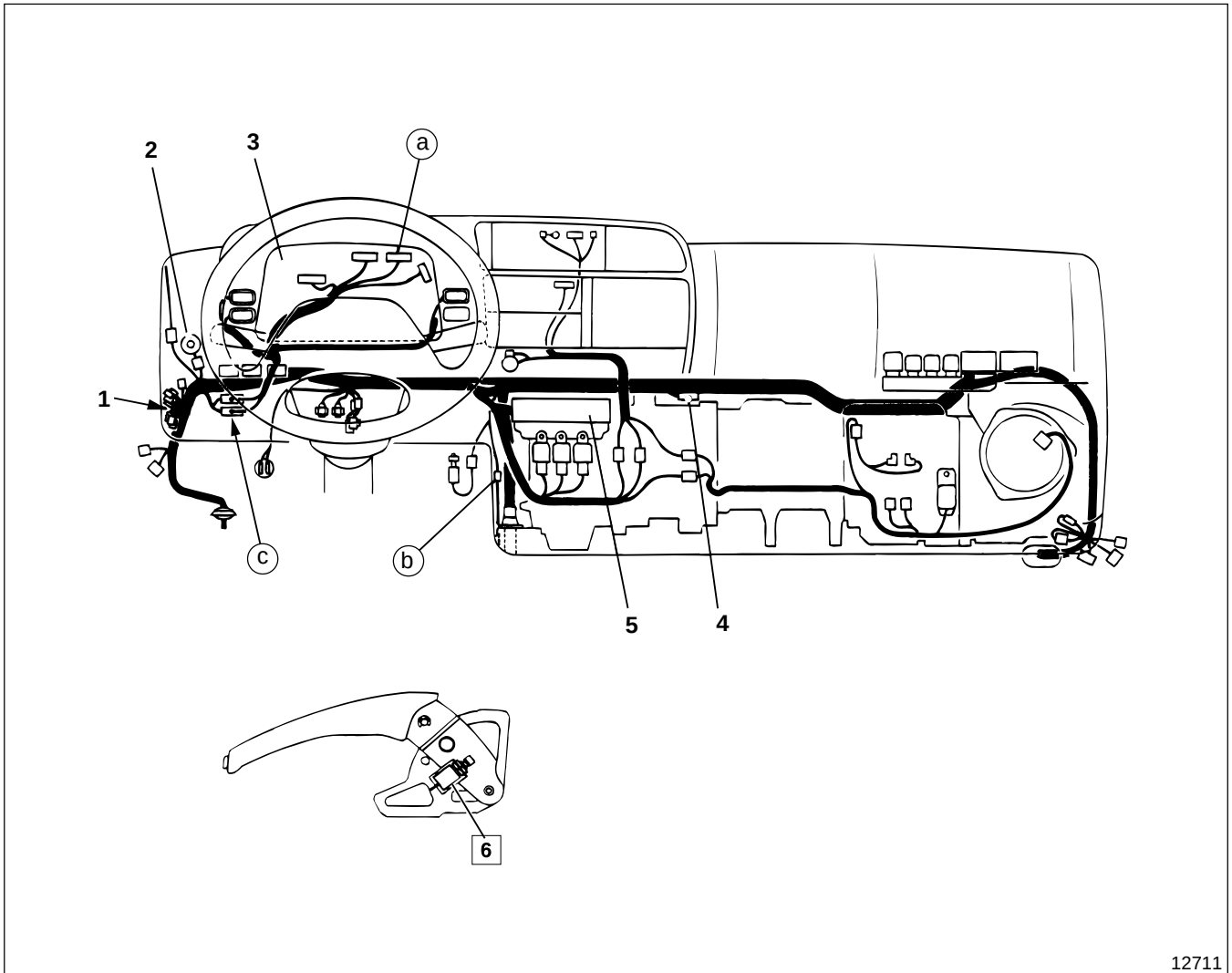
- Measure height **A** of brake fluid level switch **2** when BRAKE warning lamp within the meter cluster lights.
- If the measured value deviates from the standard value, remove and check fluid tank assembly **1**.

Removal and installation :  Gr 35Inspection :  **515**

510 PARKING BRAKE INDICATOR CIRCUIT



12216



12711

- 1 Diode
 2 Warning buzzer (606)
 3 Meter cluster (401)

- 4 Joint connector (J/C) (905)
 5 Fuse box (104)
 6 Parking brake switch

◆ Service procedures

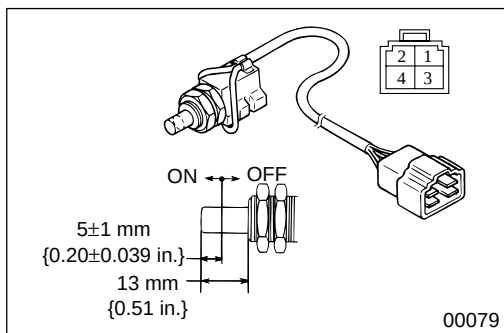
6 Inspection of parking brake switch

- Follow the table below to inspect continuity:

	①	②	③	④
ON (PARK)		○		○
OFF (DRIVE)	○		○	

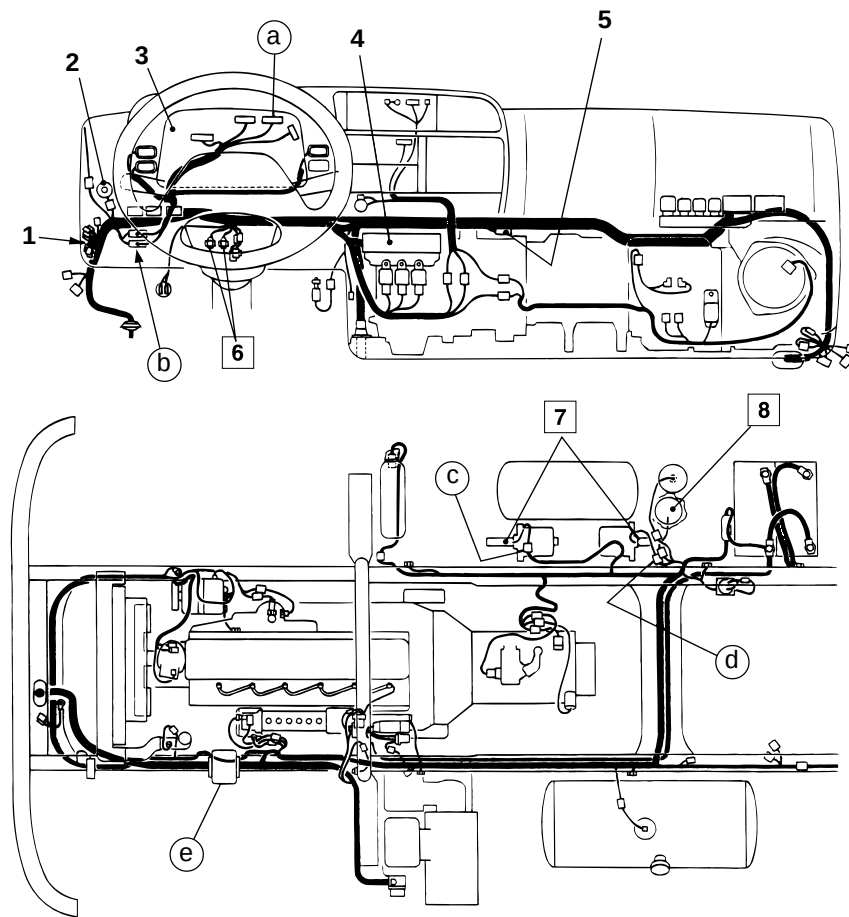
○ — ○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace parking brake switch 6. Gr 36



00079





12712

- | | |
|--------------------------------|----------------------------|
| 1 Diode | 6 Low air pressure switch |
| 2 Warning buzzer (606) | 7 Air master stroke switch |
| 3 Meter cluster (401) | 8 Brake fluid lever switch |
| 4 Fuse box (104) | |
| 5 Joint connector (J/C) (905) | |

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
6	Low air pressure switch operating pressure	When applying pressure	470 to 510 kPa {68 to 74 lbf/in ² , 4.8 to 5.2 kgf/cm ² }	—	Replace
		When releasing pressure	470 to 560 kPa {68 to 81 lbf/in ² , 4.8 to 5.7 kgf/cm ² }	—	
8	Continuity position of brake fluid level switch		57 ^{+3.5} _{-0.5} {2.24 ^{+0.14} _{-0.02} } (Equivalent to 345 cm ³ {21.1 cu.in., 345 cc})	—	Replace

515 BRAKE WARNING CIRCUIT

◆ Service procedure

6 Inspection of low air pressure switch

Carry out the following inspection. If any fault is found, replace low air pressure switch 6.

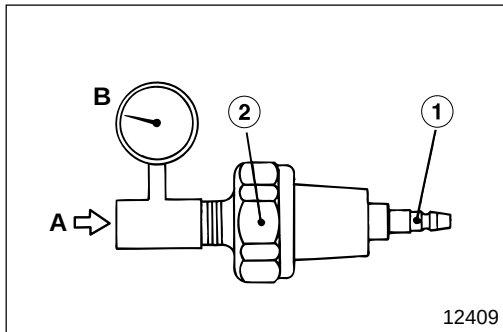
- Make sure that there is continuity between terminals ① and ② (Body) when air pressure **A** is not applied to low air pressure switch 6.
- Apply air pressure **A** to low air pressure switch 6 gradually starting from 0 kPa {0 lbf/in², 0 kgf/cm²}.

Measure the air pressure when continuity is lost between terminals ① and ② (Body) to make sure that the measured value conforms to the standard value.

B : Air pressure gauge

- When air pressure **A** of 785 kPa {115 lbf/in², 8 kgf/cm²} has been applied to low air pressure switch **A**, gradually release the air pressure.

Measure the air pressure when continuity is present between terminals ① and ② (Body) and make sure that the measured value conforms to the standard value.



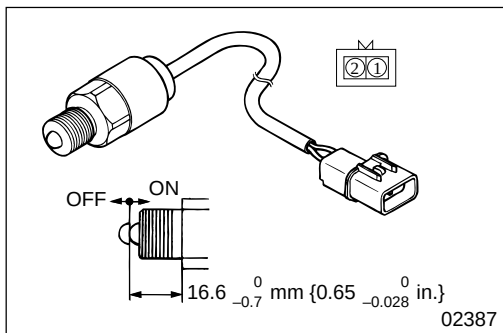
7 Follow the table below to inspect continuity:

	①	②
OFF		
ON	○	○

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

- If any fault is found, replace air master stroke switch 7.

Gr 35



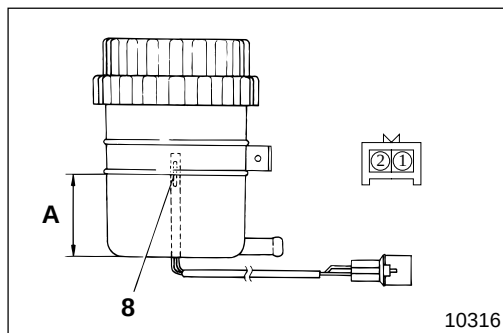
8 Inspection of brake fluid level switch

- Drain the brake fluid gradually from the brake fluid tank assembly.

CAUTION ⚠

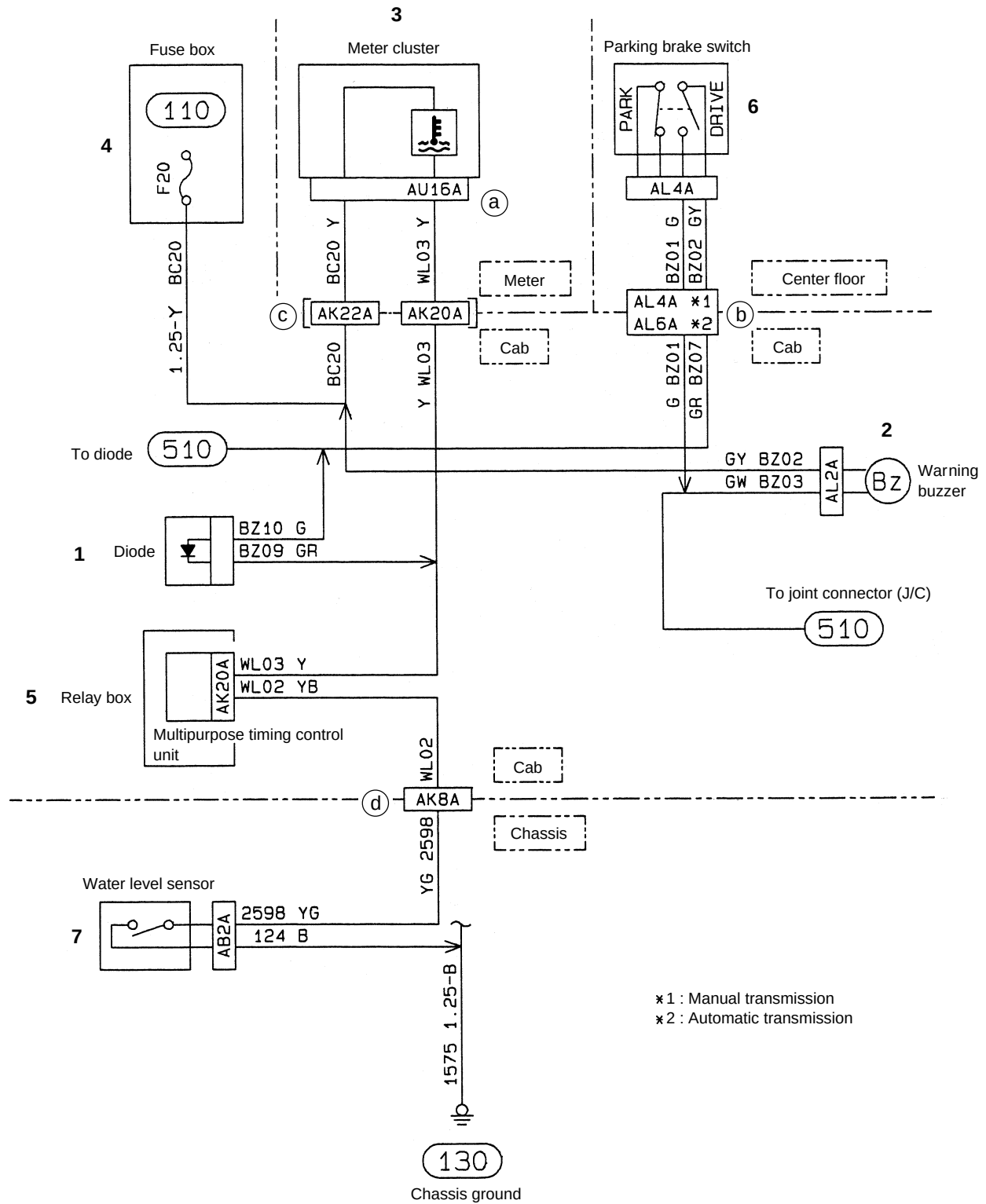
If brake fluid is spilt on any part of the vehicle, wipe it off immediately, since the solvent in the fluid can damage the paintwork.

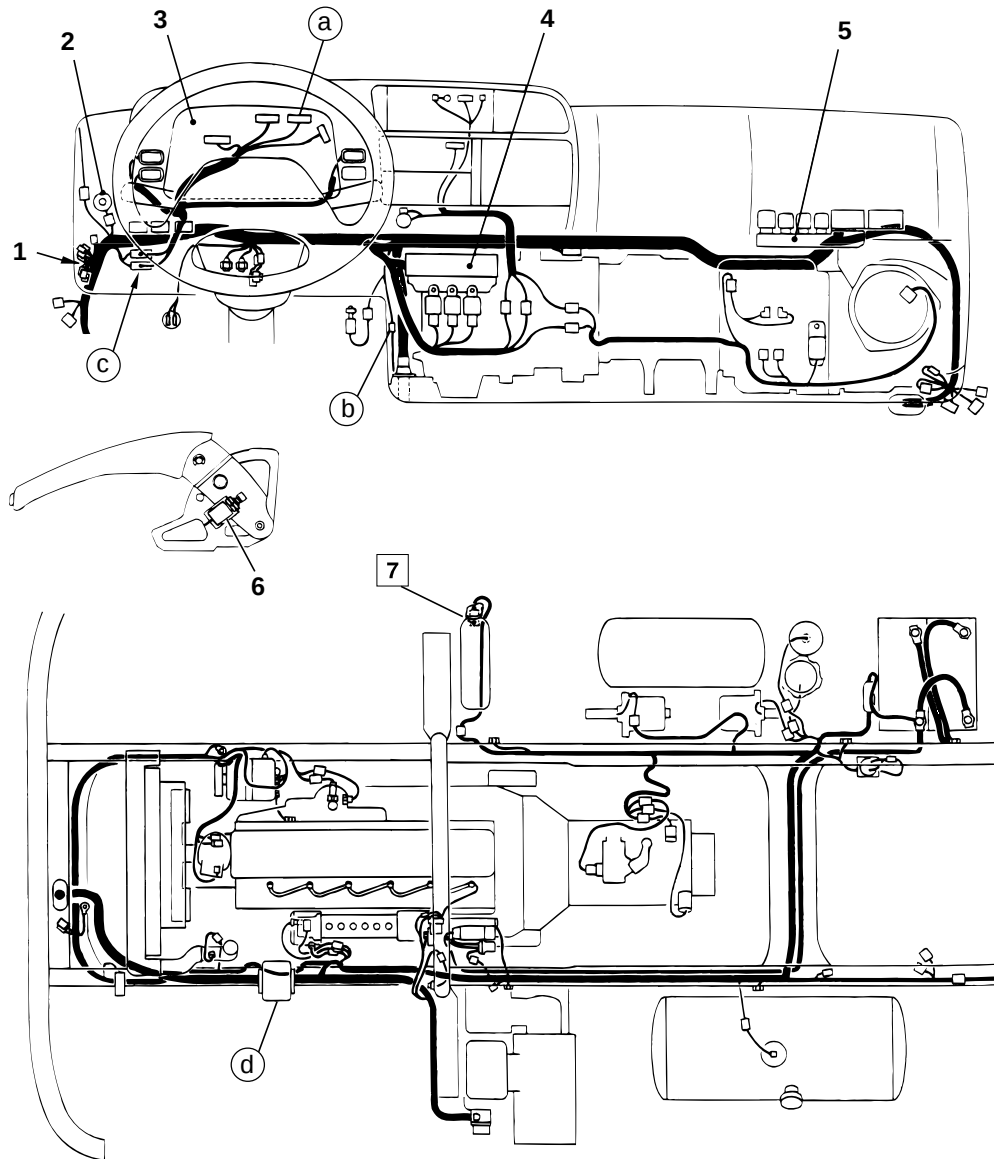
- Measure height **A** of brake fluid level switch 8 when continuity is present between terminals ① and ②.
- If the measured value deviates from the standard value, replace the fluid tank assembly. Gr 35



MEMO

530 WATER LEVEL WARNING CIRCUIT

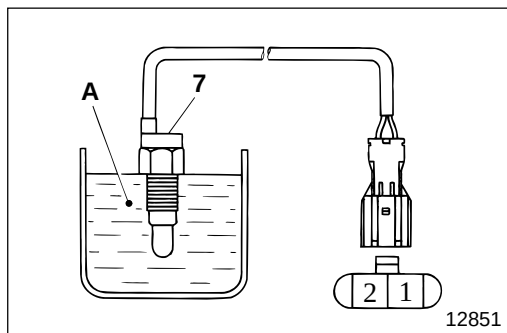




12713

- 1 Diode
- 2 Warning buzzer  (606)
- 3 Meter cluster  (401)
- 4 Fuse box  (104)
- 5 Relay box  (604)
- 6 Parking brake switch  (510)
- 7 Water level sensor

530 WATER LEVEL WARNING CIRCUIT



◆ Service procedure

7 Inspection of water level sensor

- Follow the table below to inspect continuity:

	①	②
When water level sensor is out of the water		
When water level sensor is in the water	○ — ○	○ — ○

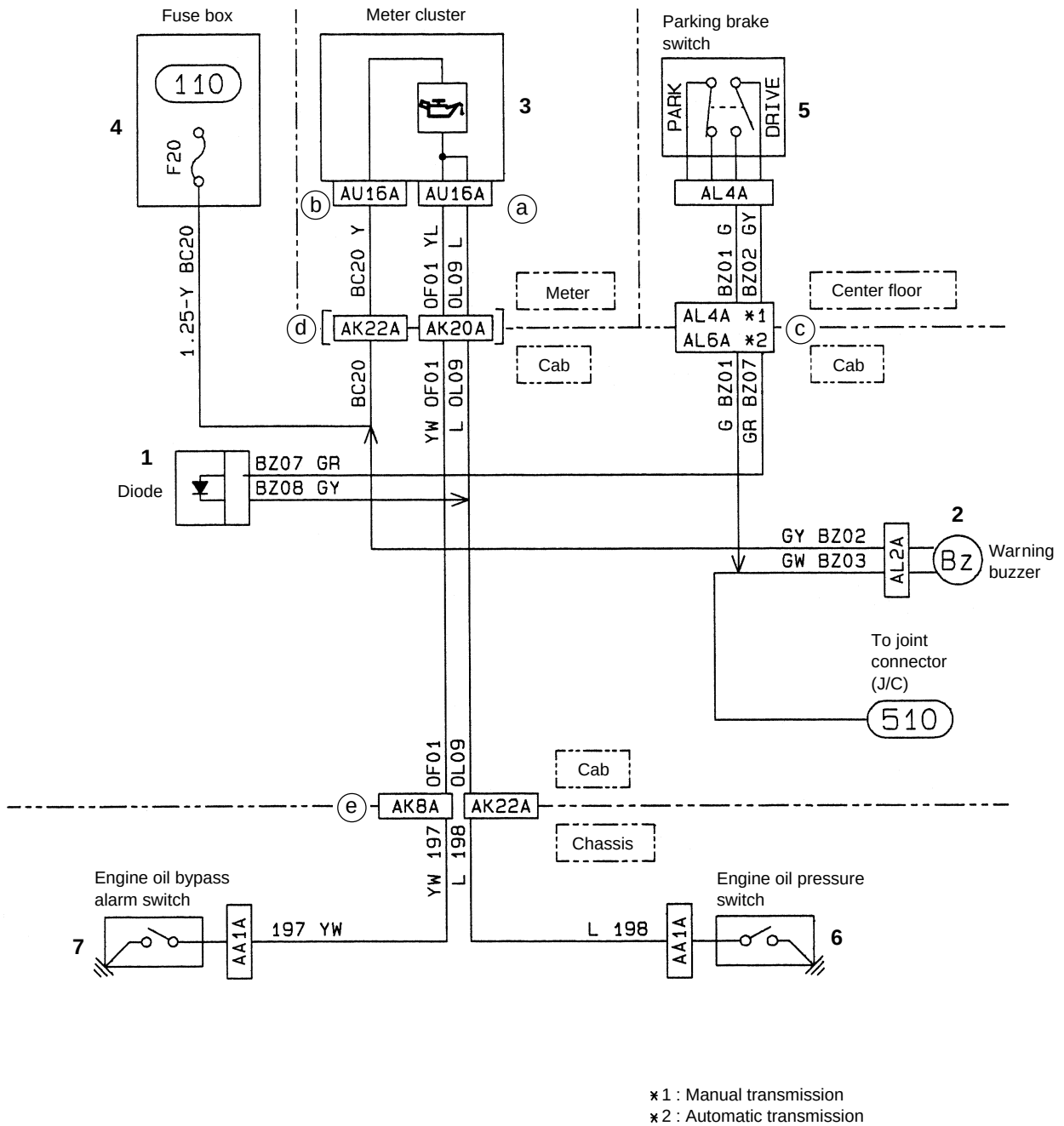
○ — ○: There is continuity between terminals ○ and ○.

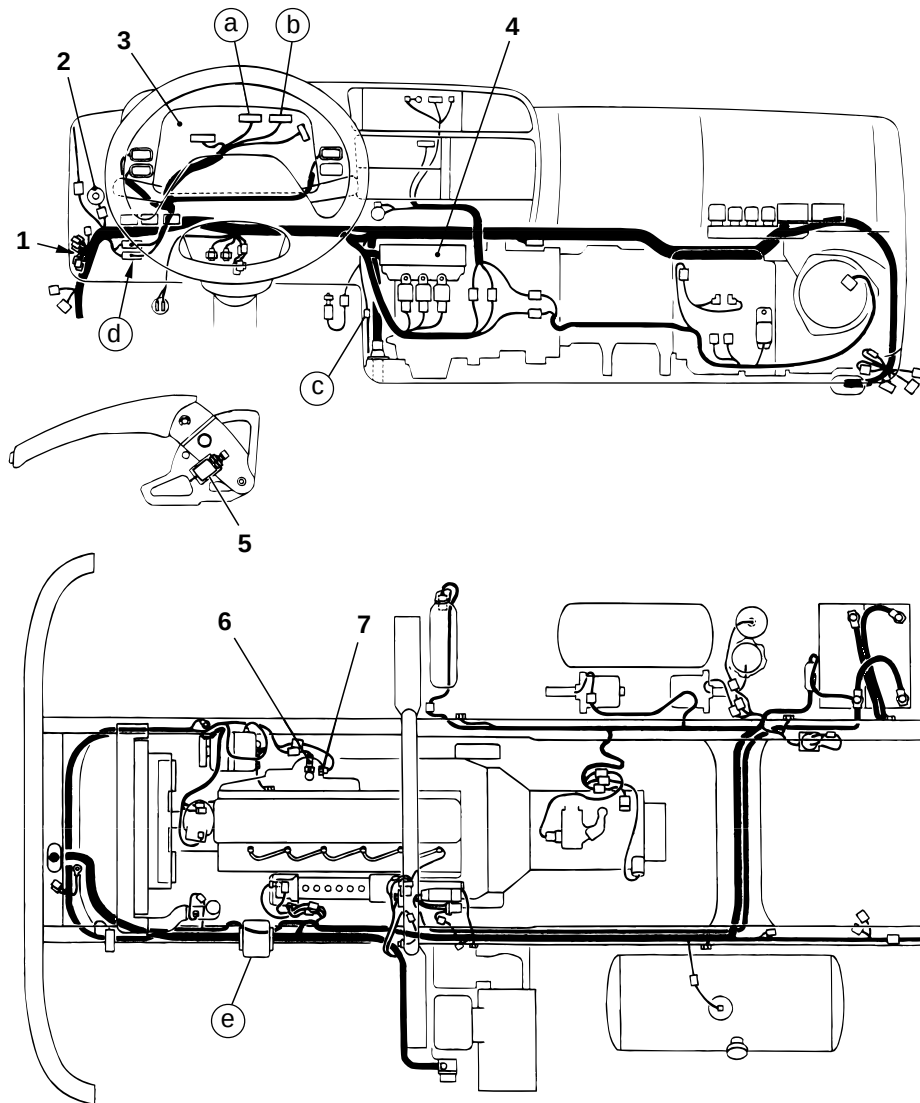
- If any fault is found, replace water level sensor 7. Gr 14

A : Engine coolant

MEMO

536 ENGINE OIL PRESSURE WARNING CIRCUIT

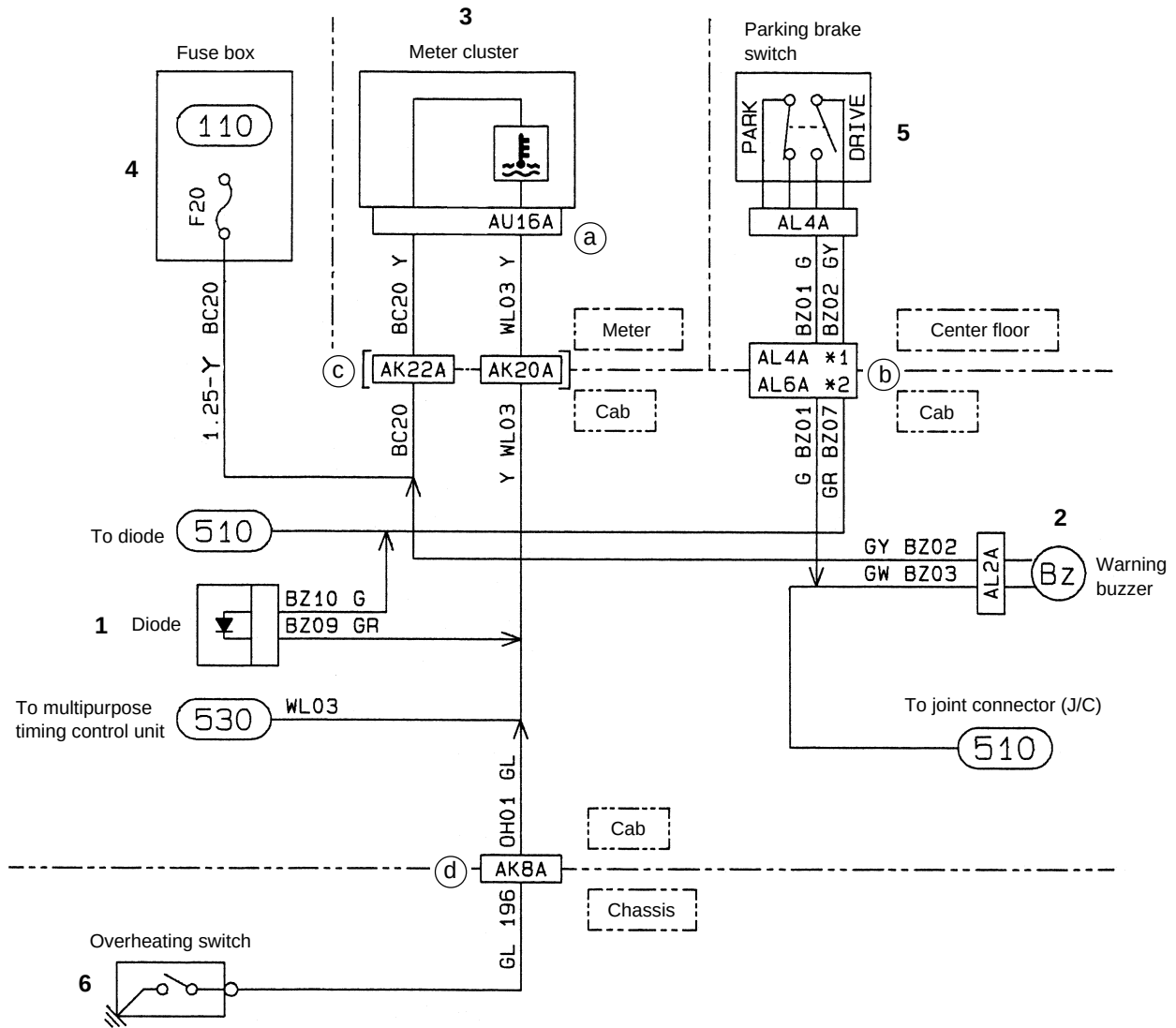


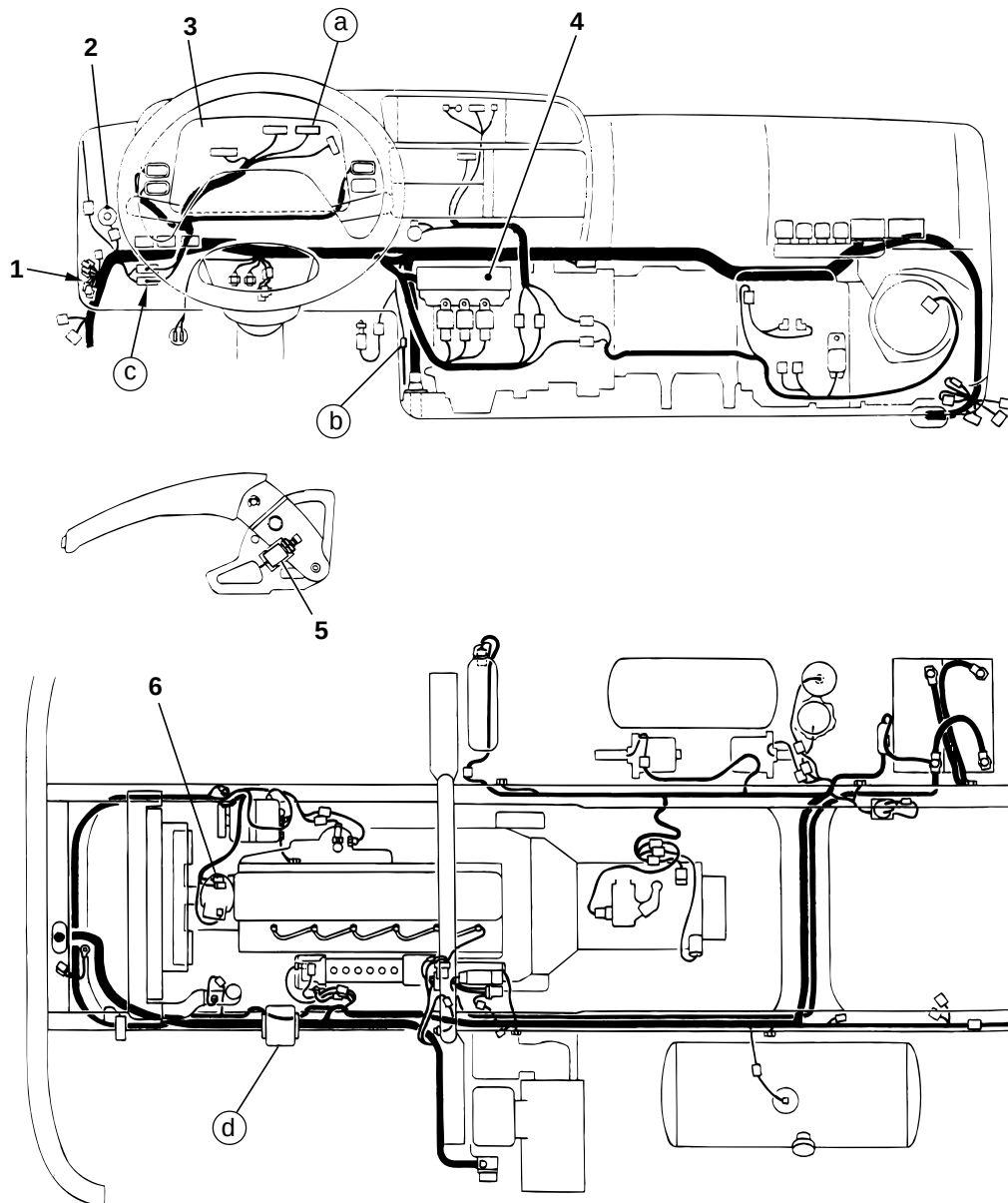


12714

- 1 Diode
- 2 Warning buzzer  (606)
- 3 Meter cluster  (401)
- 4 Fuse box  (104)
- 5 Parking brake switch  (510)
- 6 Engine oil pressure switch  (801)
- 7 Engine oil bypass alarm switch  (801)

537 OVERHEATING WARNING CIRCUIT

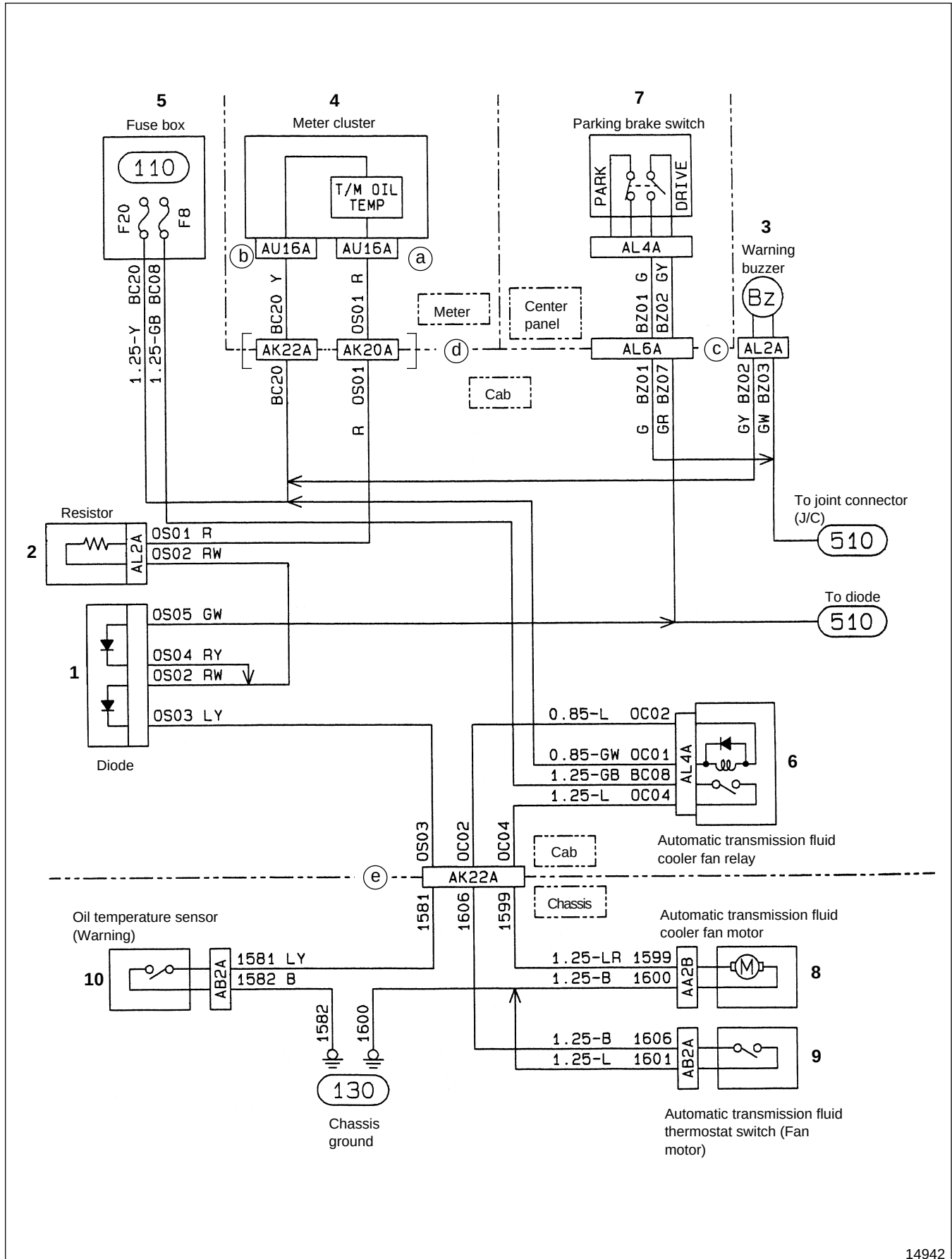


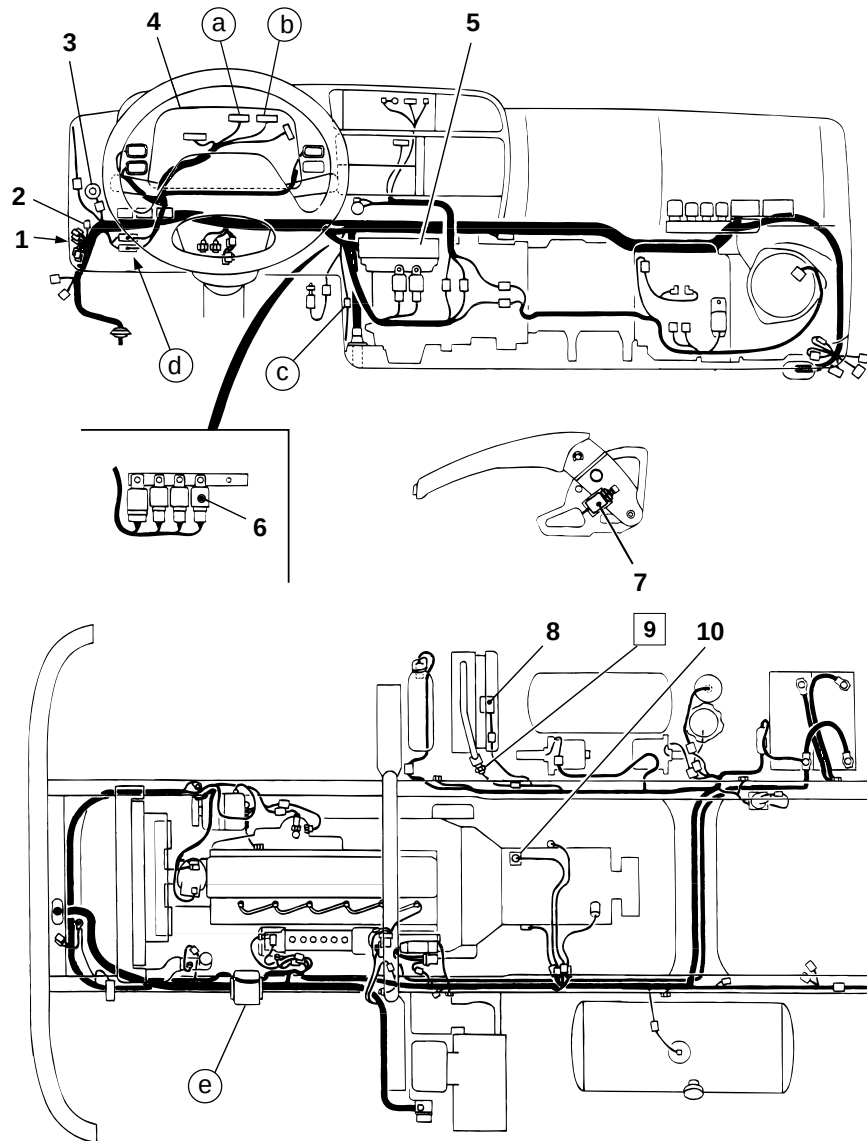


13082

- 1 Diode
- 2 Warning buzzer  (606)
- 3 Meter cluster  (401)
- 4 Fuse box  (104)
- 5 Parking brake switch  (510)
- 6 Overheating switch  (801)

547 AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT



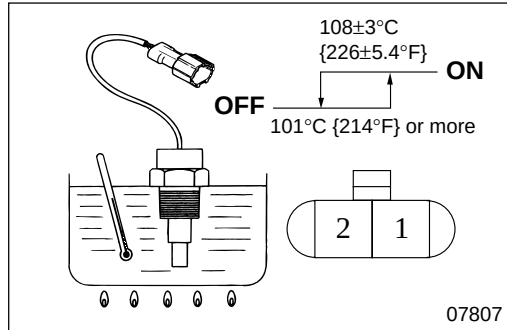


15022

- | | |
|-------------------------|---|
| 1 Diode | 6 Automatic transmission fluid cooler fan relay |
| 2 Resistor | 7 Parking brake switch (510) |
| 3 Warning buzzer (606) | 8 Automatic transmission fluid cooler fan motor |
| 4 Meter cluster (401) | 9 Automatic transmission fluid thermostat switch |
| 5 Fuse box (104) | 10 Automatic transmission fluid temperature switch (802) |

547 AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT**Service standards**

Location	Maintenance item		Standard value	Limit	Remedy
9	Operating temperature of automatic transmission fluid thermostat switch	When increases (OFF→ON)	108±3°C {226±5.4°F}	—	Replace
		When decreases (ON→OFF)	101°C {214°F} or more		

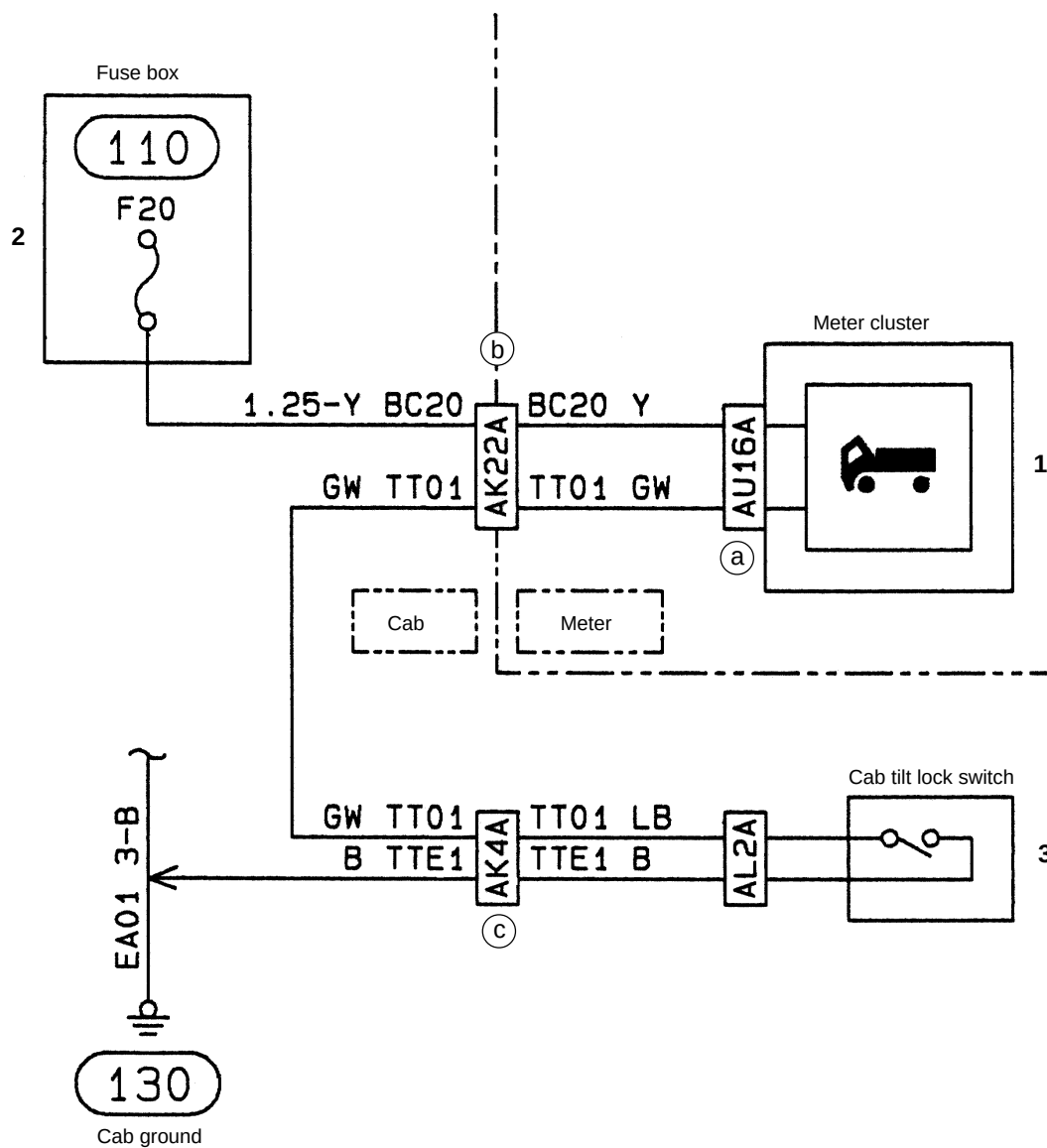
**◆ Service procedure****9 Inspection of automatic transmission fluid thermostat switch**

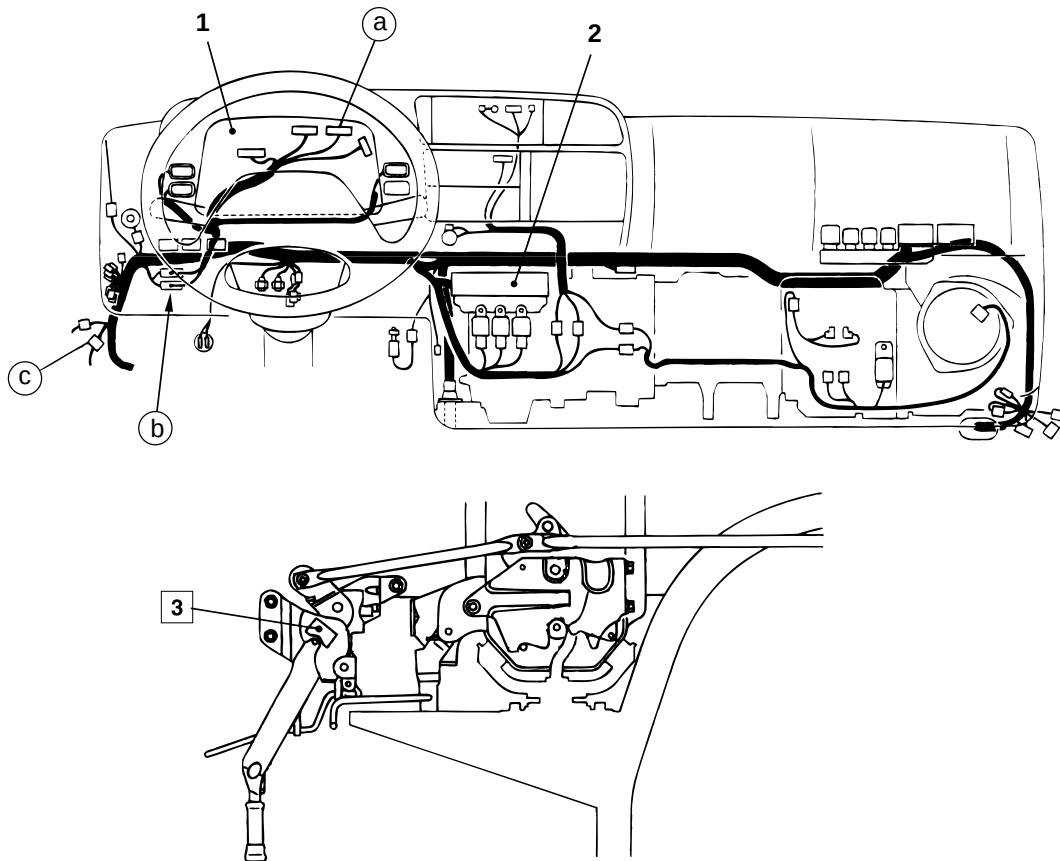
Carry out the following inspection. If any fault is found, replace automatic transmission fluid thermostat switch **9**. Gr 23

- Make sure that there is no continuity between terminals ① and ② at room temperature (20±5°C {68±9°F}).
- Place automatic transmission fluid thermostat switch **9** in a container filled with engine oil and raise the oil temperature while stirring the oil. Measure the temperature when there is continuity between terminals ① and ②, and make sure that the measured value conforms to the standard value.
- Lower the oil temperature and measure the temperature when continuity is lost between terminals ① and ②, and make sure that the measured value conforms to the standard value.

MEMO

550 CAB TILT WARNING CIRCUIT





12715

- 1 Meter cluster (401)
 2 Fuse box (104)
 3 Cab tilt lock switch

◆ Service procedure

3 Inspection of cab tilt lock switch

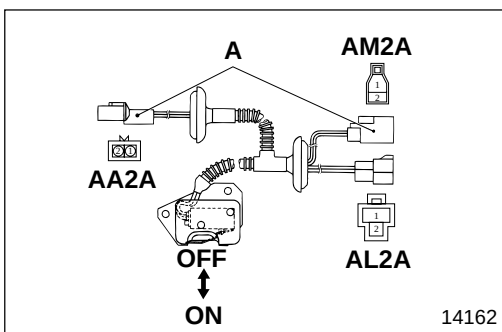
- Follow the table below to inspect continuity:
 AL2A

	①	②
ON	○ — ○	○ — ○
OFF		

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

A : Side turn signal lamp harness (AA2A, AM2A)

- If any fault is found, replace cab tilt lock switch 3. Gr 42



6 CAB SIDE ELECTRICS

SPECIFICATIONS	54-6-2
TROUBLESHOOTING	54-6-2
601 SWITCH	54-6-4
604 RELAY AND CONTROL UNIT	54-6-8
606 WARNING BUZZER	54-6-11
610 CIGARETTE LIGHTER CIRCUIT	54-6-12
612 AUDIO CIRCUIT	54-6-14
614 WIPER AND WASHER CIRCUIT	54-6-16
616 HORN CIRCUIT	54-6-20
618 HEATER CIRCUIT	54-6-22

SPECIFICATIONS/TROUBLESHOOTING

SPECIFICATIONS

Item			Specifications
Minimum operating voltage of relay			V
			8 or less
Speaker	Rated input	W	15
	Maximum input	W	30
	Impedance	Ω	4±0.6
Air horn	Rated voltage	V	12
	Rated current	A	3.2 or less
	Sound pressure	dB	115 $\pm$ 5 (at 2 m {6.6 ft})
Warning buzzer	Rated voltage	V	12
	Rated current	mA	150 or less
	Sound pressure	dB	75±10 (at 1 m {3.3 ft})

TROUBLESHOOTING

Symptoms	Cigarette lighter		Audio					Remarks
	Does not glow	Does not return	Specific frequency band does not work	Spurious noise generated	Sound quality poor	Sound from one side only	Left and right volume different	
Possible causes								
Connector connection faulty, harness broken, grounding faulty	☐			☐		☐		
Fuse blown	☐							
Cigarette lighter faulty	☐	☐						
Antenna and antenna cable connection faulty				☐				
Speaker faulty			☐	☐	☐	☐	☐	
Left and right speaker impedance different							☐	

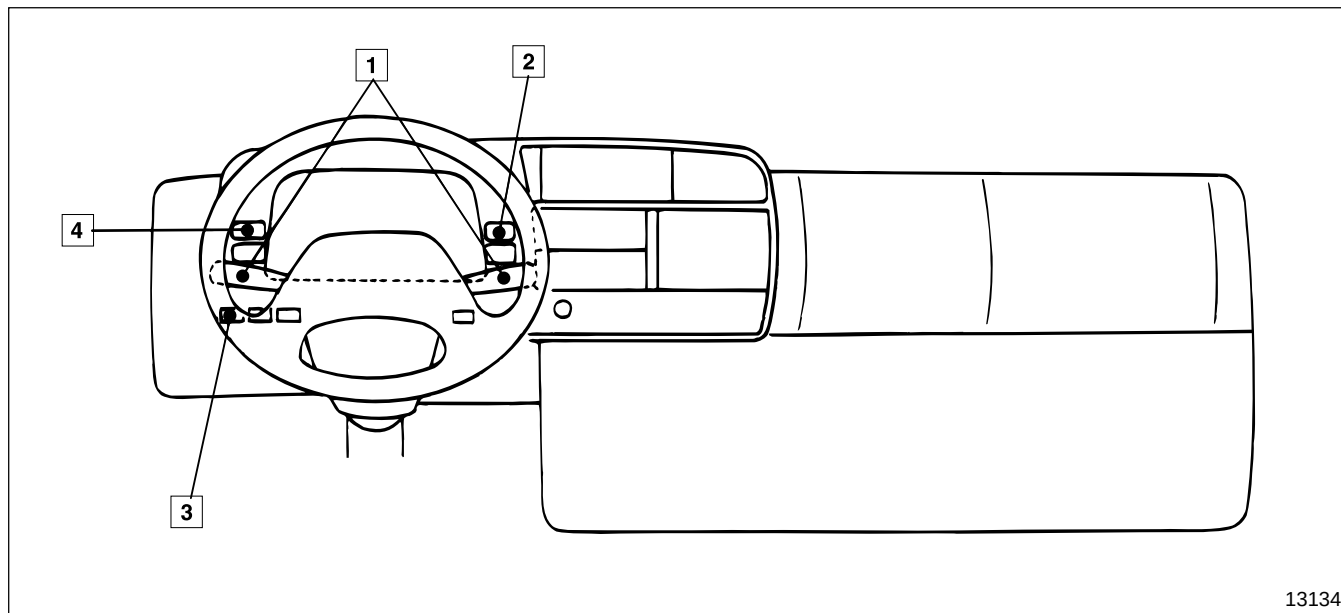
Accessory noise generation source

Accessory	Noise	Symptoms
Alternator	Whistling	High pitch sound when accelerator pedal suddenly depressed (Stops soon after engine stopped)
Water temperature gauge	Scratching	Occurs when engine running (Continues for a while after engine stops)
Engine oil pressure switch	Rattling	Depends on engine speed (Does not occur during idling)
Fuel gauge unit	Scratching	Occurs when engine suddenly revved, while running on rough roads, or starter switch turned ON
Flasher unit	Banging	When turn signal blinks
Horn	Hissing	Occurs when horn button pressed or released
Wiper motor	Whining	Depends on windshield wiper speed
Washer motor	Whining	When windshield washer operates

Symptoms	Horn				Remarks
	No Sound	Continuous sound	Small sound	Sound quality poor	
Possible causes					
Connector connection faulty, harness broken, grounding faulty	☐	☐	☐	☐	
Fuse blown	☐	☐	☐	☐	
Horn switch faulty	☐	☐	☐	☐	
Horn faulty	☐	☐	☐	☐	
Horn stay warped	☐	☐	☐	☐	
Battery voltage insufficient	☐	☐	☐	☐	
Air leaking from air system	☐	☐	☐	☐	

601 SWITCH

Installation Position

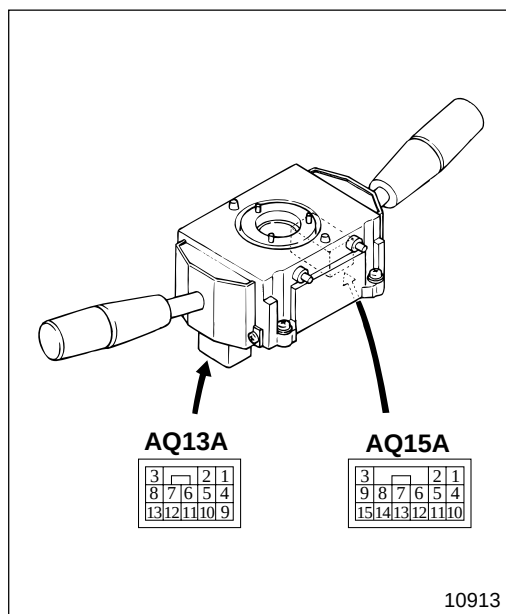


- 1 Combination switch
- 2 Van body dome light switch
- 3 Rheostat switch
- 4 Cold start switch

◆ Service procedure

1 Inspection of combination switch

- Operate combination switch **1**.
- Check for continuity between connector terminals, referring to the connector connection table.
There is continuity between terminals ○ and ○ in the table.
- If any fault is found, replace combination switch **1**.



AQ13A

3	2	1
8	7	6
13	12	11
10	9	

AQ15A

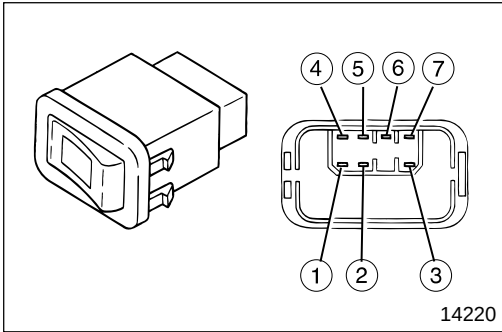
3	2	1
9	8	7
15	14	13
12	11	10

AQ13A Connector connection table

		①	②	③	⑦	⑧	⑨	⑩	⑪	Body ground	Internal connection
Lighting switch	OFF										
	I	○						○			
	II	○						○			○
Dimmer switch	Main						○				○
	↕						○		○		○
	Dimmer								○		○
	↕								○		○
	Passing	○					○				
Turn signal switch	LH			○	○						
	N (neutral)										
	RH			○		○					
Horn switch	OFF										
	ON		○							○	

AQ15A Connector Connection Table

		①	②	③	⑤	⑥	⑦	⑧	⑨	⑭	⑮
Wiper switch	OFF										
	INT (intermittent)			○							○
	LO (LOW)		○								○
	HI (HIGH)	○	○								○
	WASH (washer)									○	○
Exhaust brake switch	OFF										
	ON				○	○					
Hazard switch	OFF										
	ON						○	○	○		

601 SWITCH**2 Inspection of van body dome light switch**

- Follow the table below to inspect continuity:

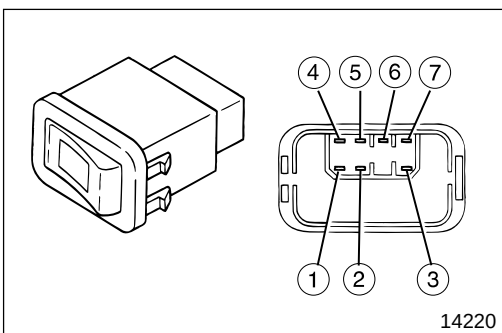
	①	⑤	⑦	LED (Operation indication light)	③
ON	○	○	○	—	○
OFF					

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

- If any fault is found, replace van body dome light switch 2.

3 Inspection of rheostat switch

- Rheostat switch 3 contains a control circuit, because of this it is difficult to inspect rheostat switch 3 independently, therefore you should inspect the rheostat switch indirectly, by inspecting the system harness and the related parts.
- If no fault is found in the related parts but the system is faulty, replace rheostat switch 3.

**4 Inspection of cold start switch**

- Follow the table below to inspect continuity:

	①	⑥	⑤	②	④	⑦	LED (Operation indication light)	③
ON	○	○	○	○	○	○	—	○
OFF	○	○		○	○			

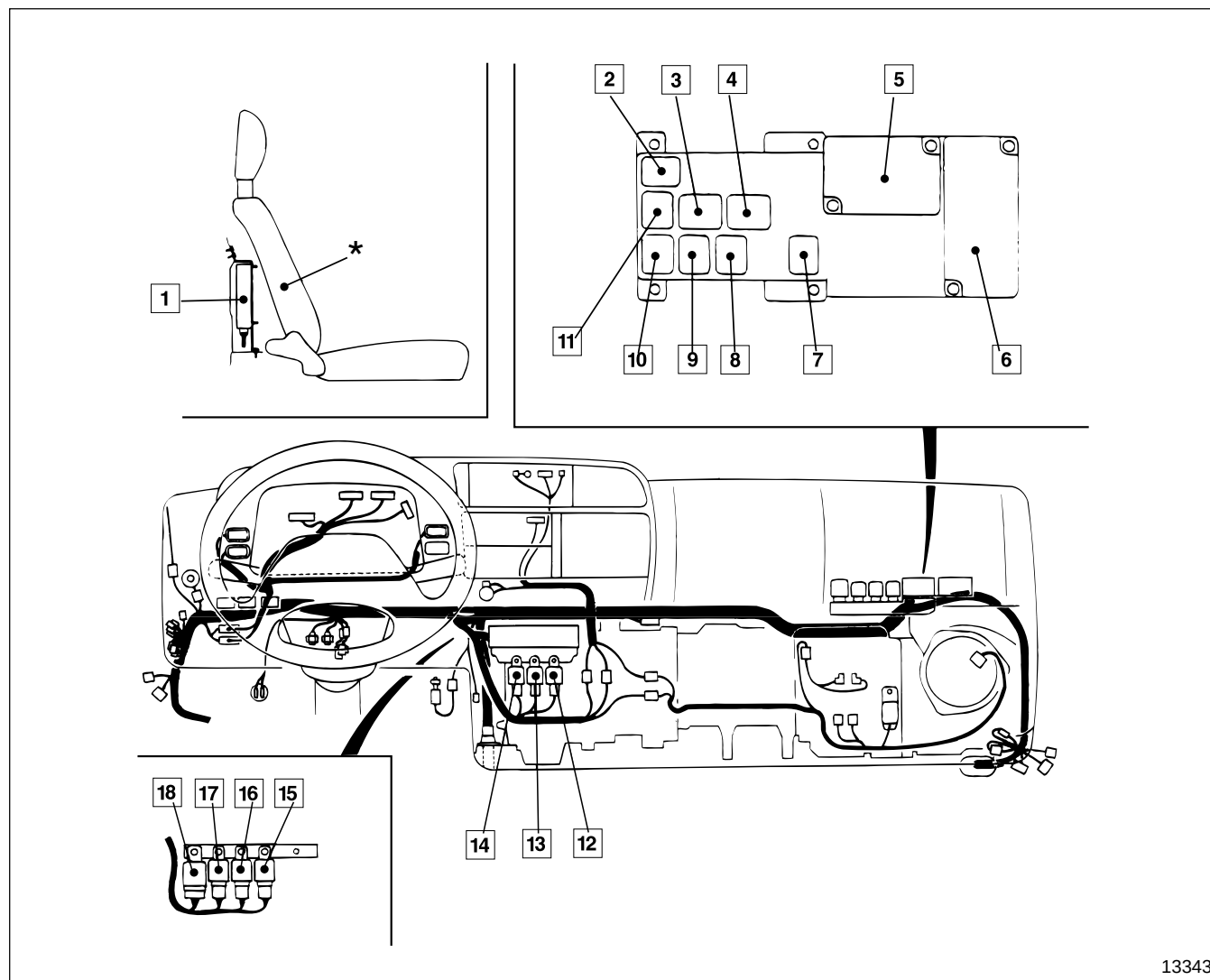
○—○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace cold start switch 4.

MEMO

604 RELAY AND CONTROL UNIT

Installation Position



13343

- | | |
|------------------------------------|--|
| 1 Pre-stroke control unit | 13 Fuel-cut relay |
| 2 Pre-stroke cut relay | 14 Exhaust brake cut relay (Time lag relay) |
| 3 Wiper relay (LOW) | < Manual transmission > |
| 4 Wiper relay (HIGH) | 15 Automatic transmission fluid cooler fan relay |
| 5 Flasher unit | < Automatic transmission > |
| 6 Multipurpose timing control unit | 16 Transmission neutral relay |
| 7 Stop lamp relay | < Manual transmission > |
| 8 Tail lamp relay | 17 Van body dome light relay |
| 9 Headlamp relay (HIGH) | 18 Transmission power take-off relay < Option > |
| 10 Headlamp relay (LOW) | |
| 11 Blower fan relay | |
| 12 Turn signal lamp relay | |
- * : Passenger's seat

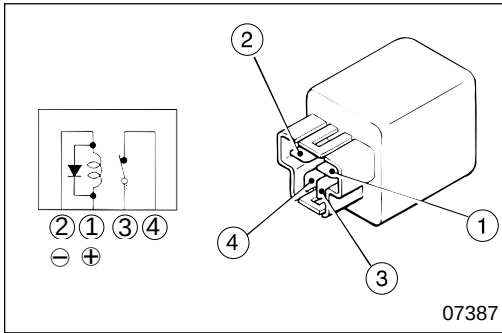
Service standards

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

◆ Service procedure

1 5 6 Inspection of control unit

Since it is difficult to check each unit separately, judge the soundness of each unit indirectly by checking switches, harnesses, and related parts in the system.



2 Inspection of relay (Close type 4-pin)

- Follow the table below to inspect continuity:

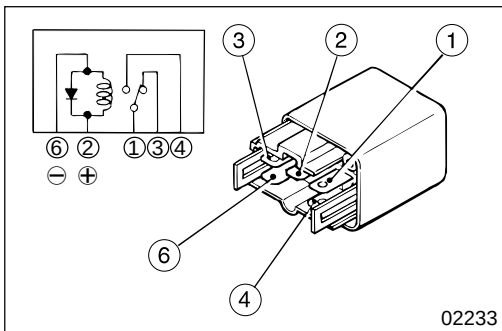
	①	②	③	④
No current	○—○		○—○	
Current	⊕—⊖		⊖—⊕	

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

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

⊖—⊕ : Indicates that continuity between the terminals is lost.

- If any fault is found, replace the relay.



3 4 13 18 Inspection of relay (Open type 5-pin)

- Follow the table below to inspect continuity:

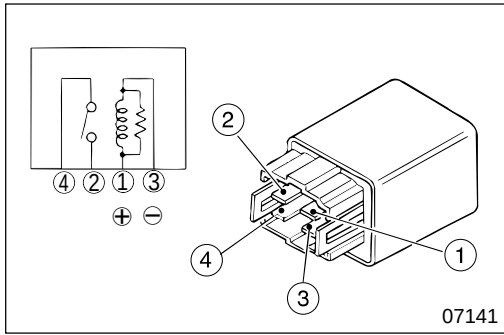
	①	②	③	④	⑥
No current	○—○		○—○		○—○
Current	○—○	⊕—⊖		○—○	⊖—⊕

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

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

- If any fault is found, replace the relay.

604 RELAY AND CONTROL UNIT



7 to 11 Inspection of relay (Open type 4-pin)

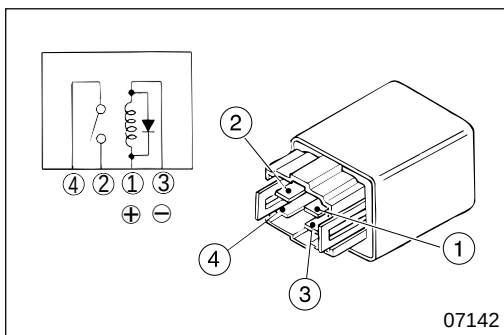
- Follow the table below to inspect continuity:

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

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

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

- If any fault is found, replace the relay.



12 15 to 17 Inspection of relay (Open type 4-pin)

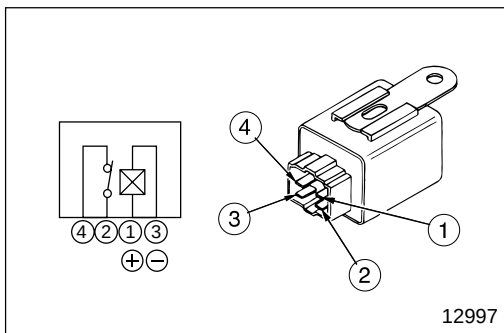
- Follow the table below to inspect continuity:

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

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

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

- If any fault is found, replace the relay.



14 Inspection of relay (Close type 4-pin time lag relay)

- Follow the table below to inspect continuity:

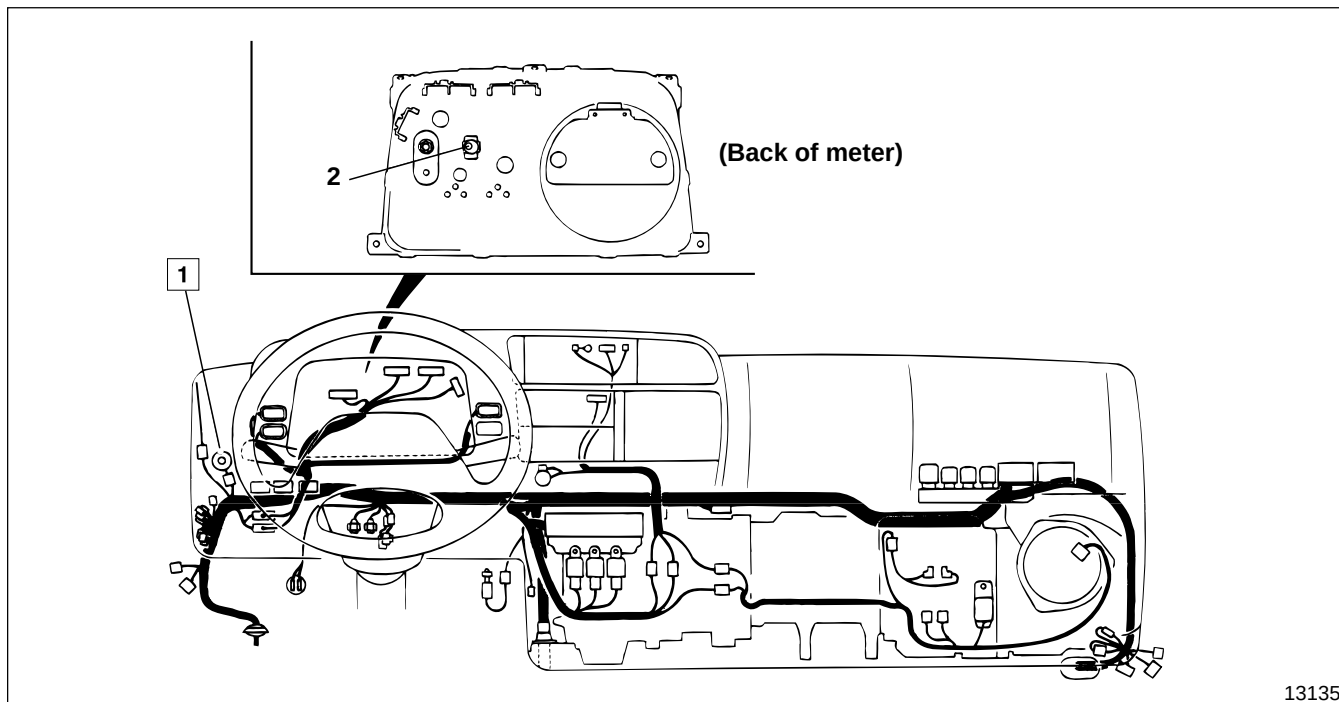
	①	②	③	④	Remarks
No current	○	—	○		—
Current	⊕	○	—	○	Measure time lag until continuity between the terminals is lost

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

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

○-----○ : Indicates that continuity between the terminals is lost.

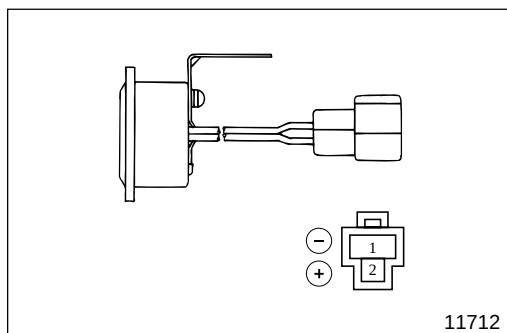
- If any fault is found, replace the relay.

Installation Position

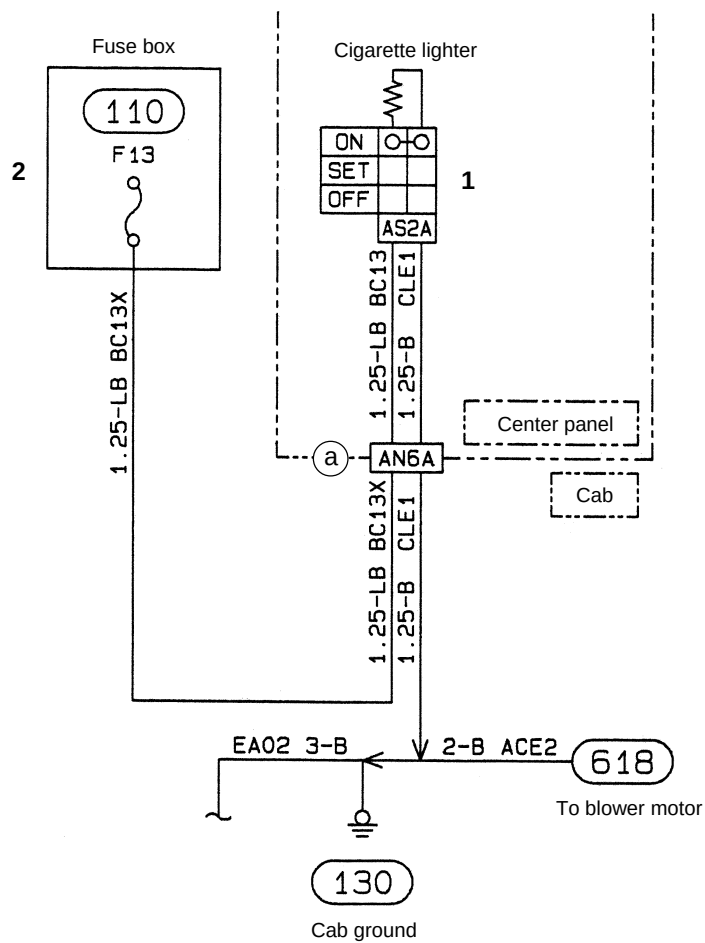
- 1 Warning buzzer
 2 Meter warning buzzer 401

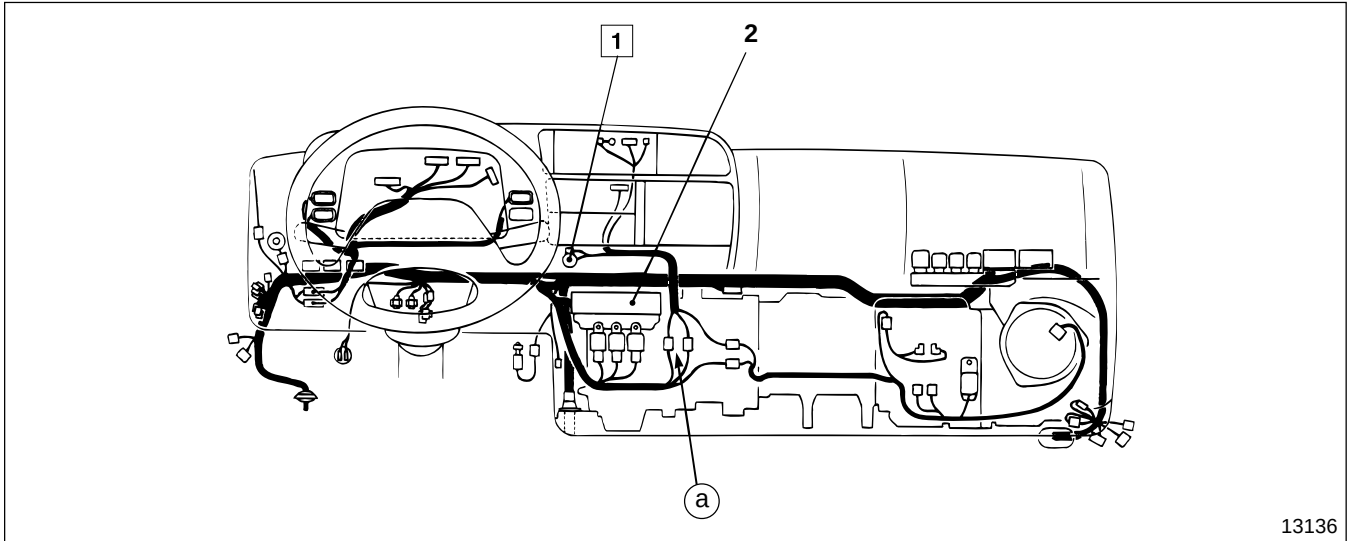
◆ Service procedure**1 Inspection of warning buzzer**

- Make sure that warning buzzer 1 sounds when you apply 12 volts DC between terminals ① and ②.
- If any fault is found, replace warning buzzer 1.



610 CIGARETTE LIGHTER CIRCUIT





13136

- 1 Cigarette lighter
 2 Relay box (604)
 3 Fuse box (104)

Service standards

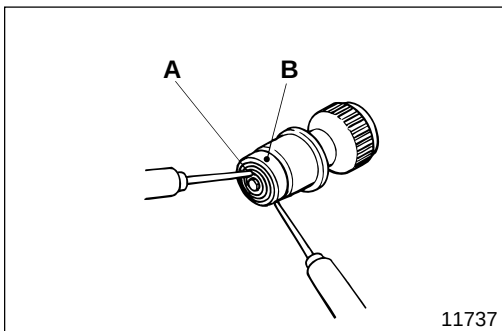
Location	Maintenance item	Standard value	Limit	Remedy
1	Cigarette lighter plug return time	15±5 seconds	—	Replace

◆ Service procedure

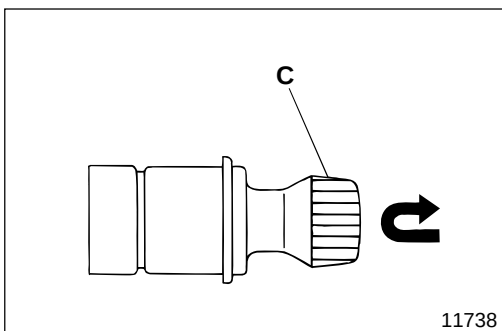
1 Inspection of cigarette lighter

Carry out the following inspection. If any fault is found, replace cigarette lighter 1 :

- Make sure that there is continuity between heater element **A** and body **B**.



11737

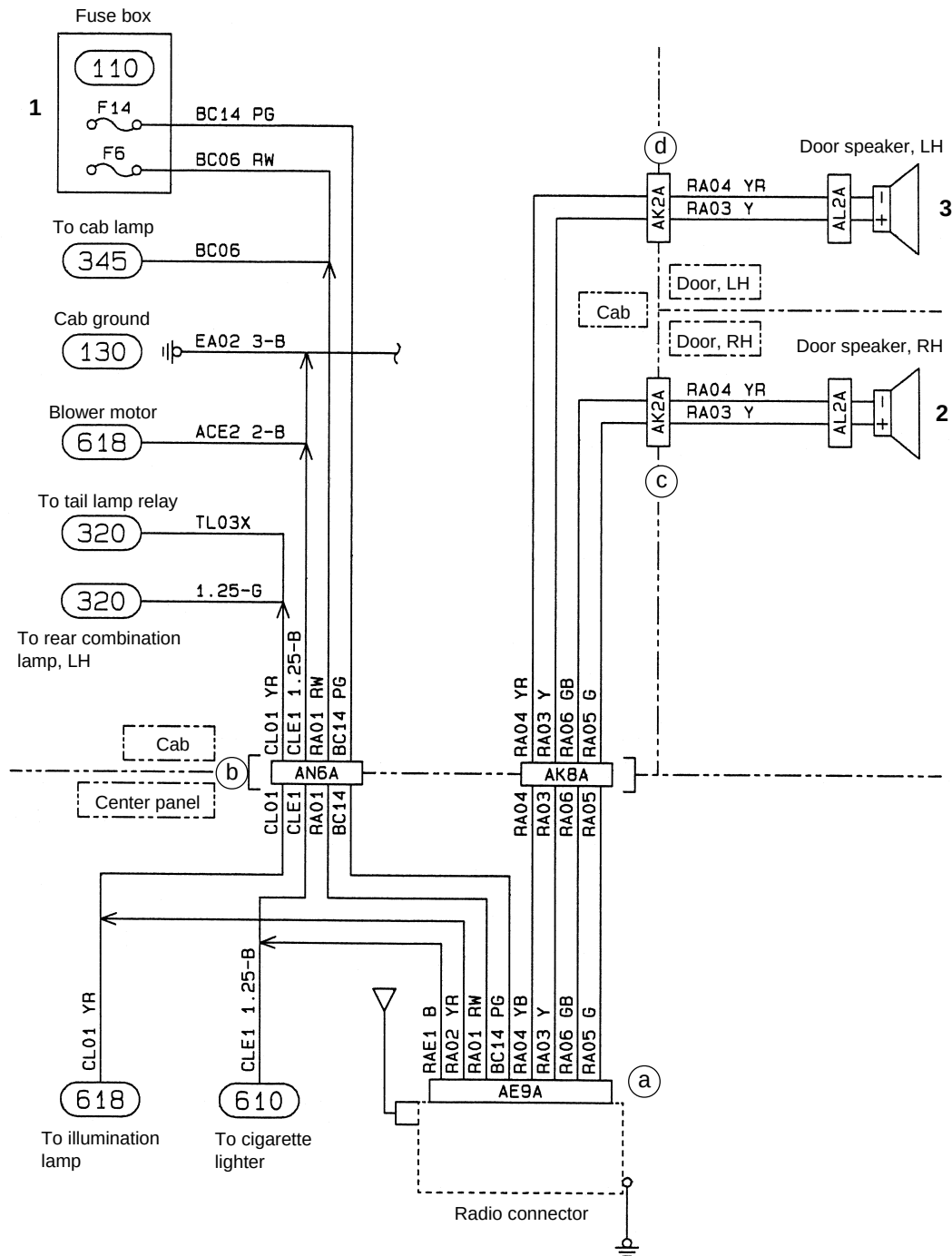


11738

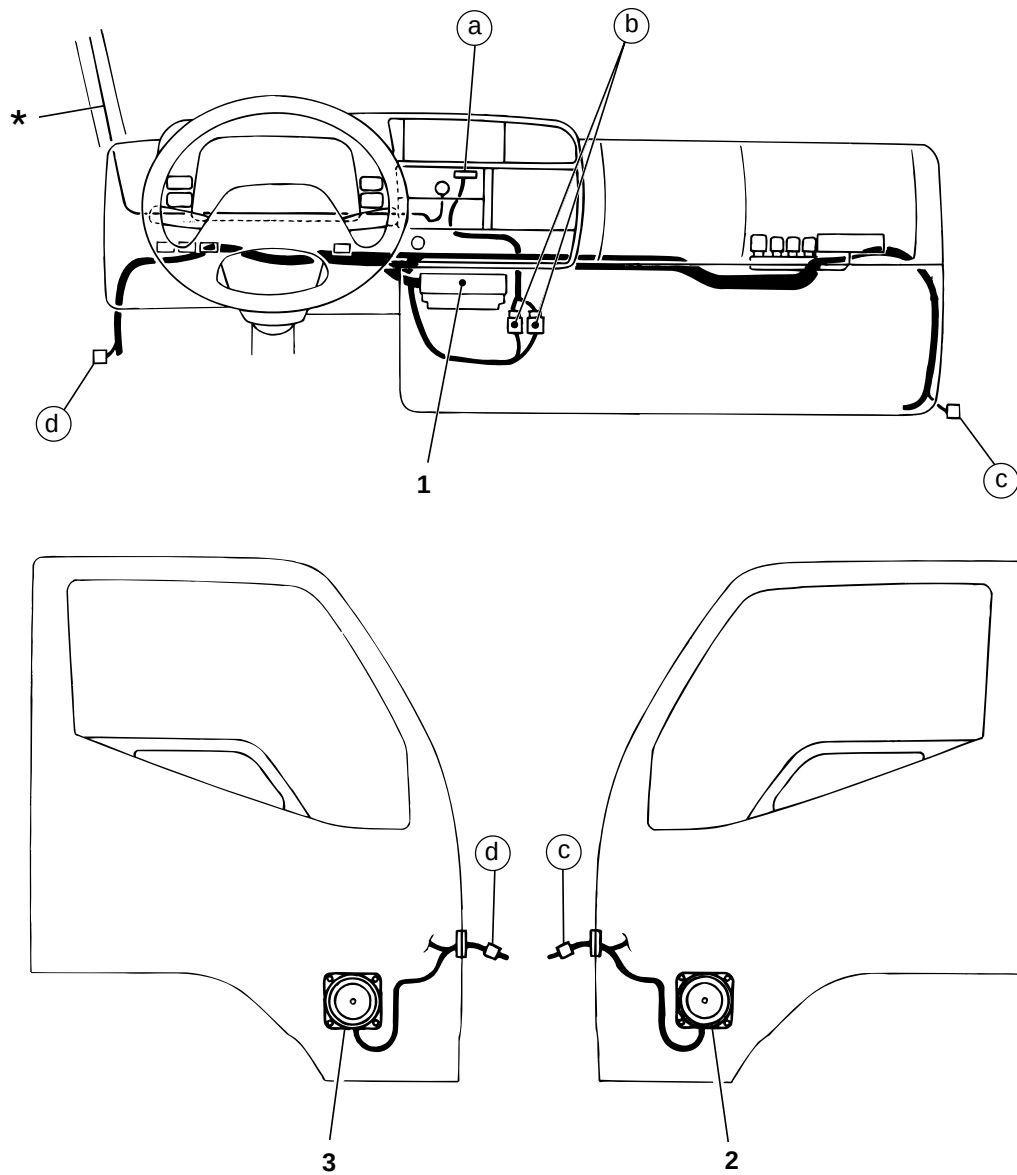
- Make sure that plug **C** returns to its original position quickly when it is pushed in.

- Turn the starter switch to ACC or ON.
- Push plug **C** into the socket of the vehicle.
- Measure the time required for pushed-in plug **C** to return to its original position.
- Make sure that heater element **A** is glowing.

612 AUDIO CIRCUIT



12222

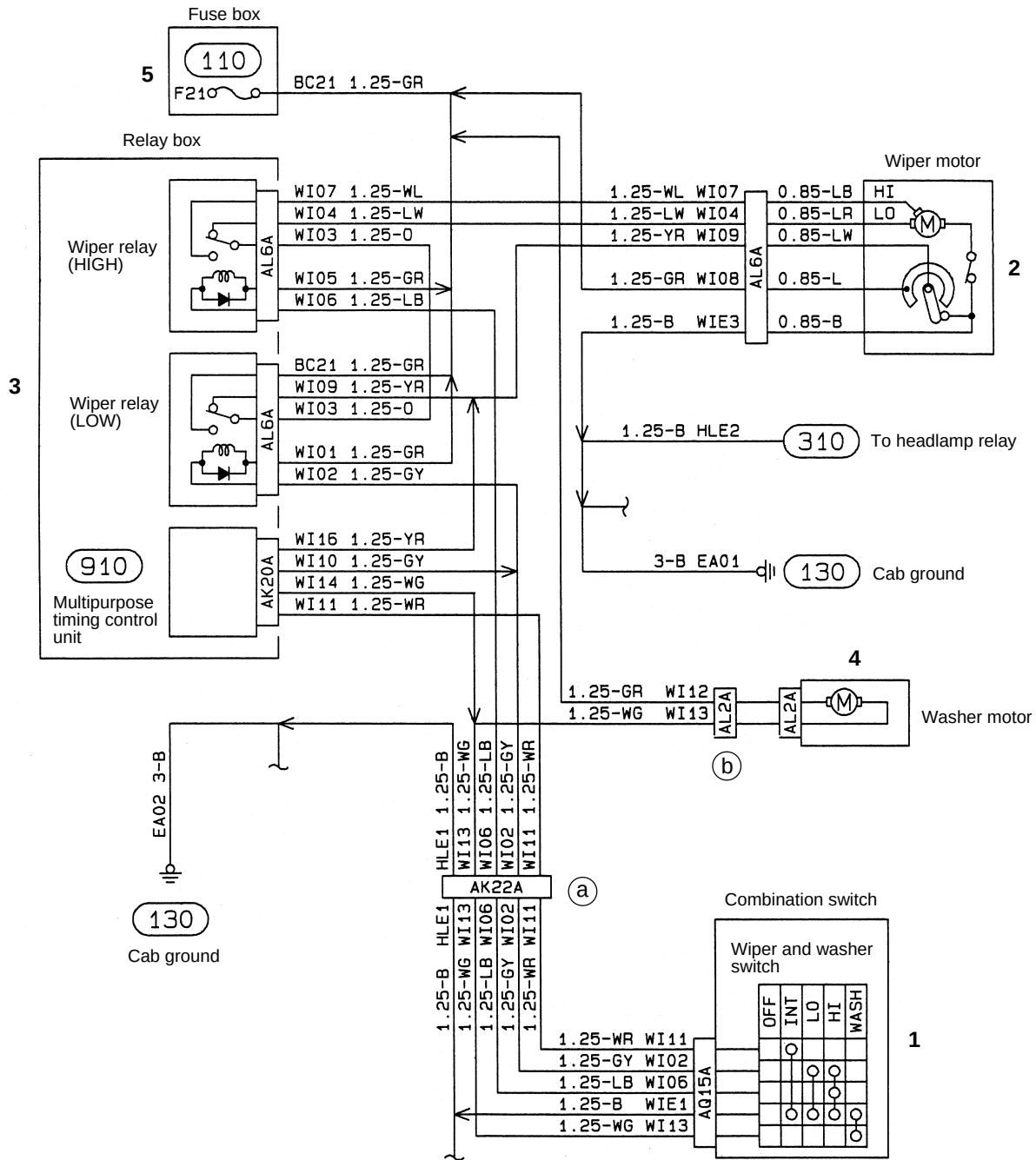


13463

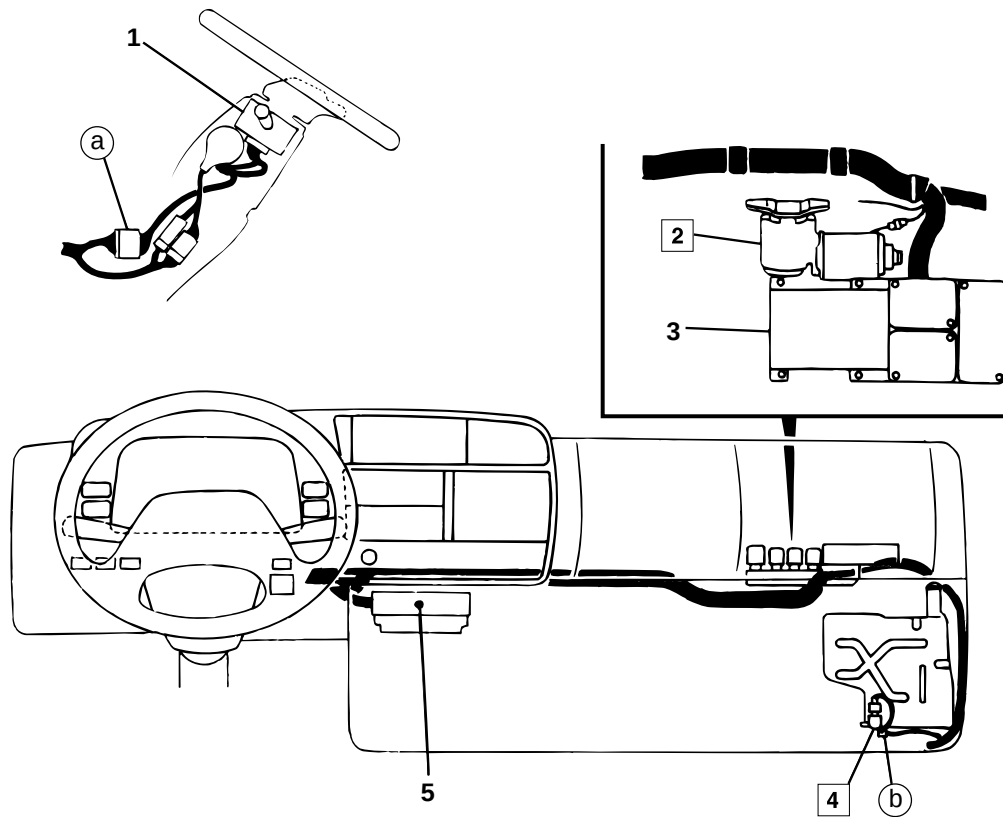
- 1 Fuse box  (104)
- 2 Door speaker, RH
- 3 Door speaker, LH

* : Antenna cable

614 WIPER AND WASHER CIRCUIT



12223



10878

- 1 Combination switch (601)
- 2 Wiper motor
- 3 Relay box (604)
- 4 Washer motor
- 5 Fuse box (104)

614 WIPER AND WASHER CIRCUIT

◆ Service Procedure

3 Inspection of wiper motor

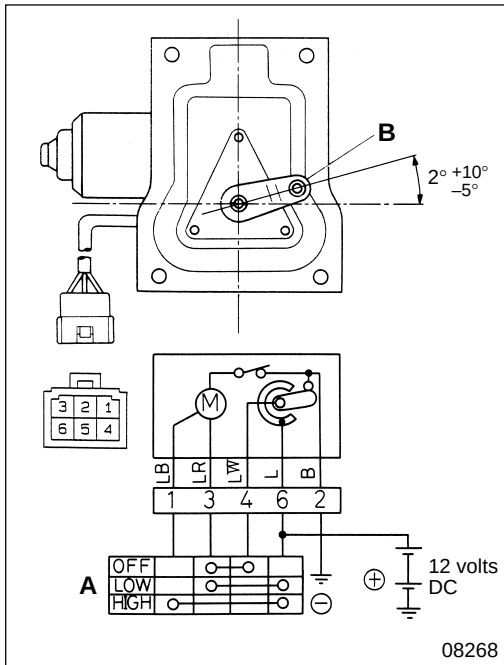
- Connect wiper motor **3** as illustrated.
- **A** : Switch
- Carry out the following inspection. If any fault is found, replace wiper motor **3**.  Gr 42

(1) Inspection of motor operation

- Make sure that wiper motor **3** turns at high speed when you turn switch **A** to HIGH.
- Make sure that wiper motor **3** turns at low speed when you turn switch **A** to LOW.

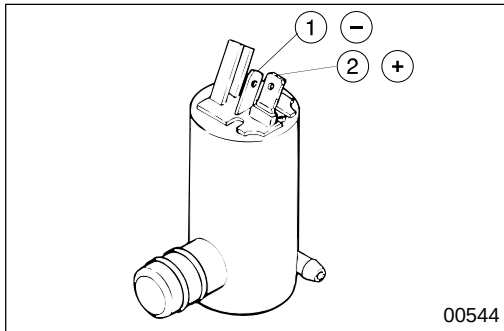
(2) Inspection of automatic stopping position

- Turn switch **A** to LOW to turn wiper motor **3** at low speed.
- When crank arm **B** is at any position other than the automatic stopping position (other than the illustrated angle), turn switch **A** to OFF.
- Make sure that crank arm **B** stops at the automatic stopping position (within the illustrated angle).



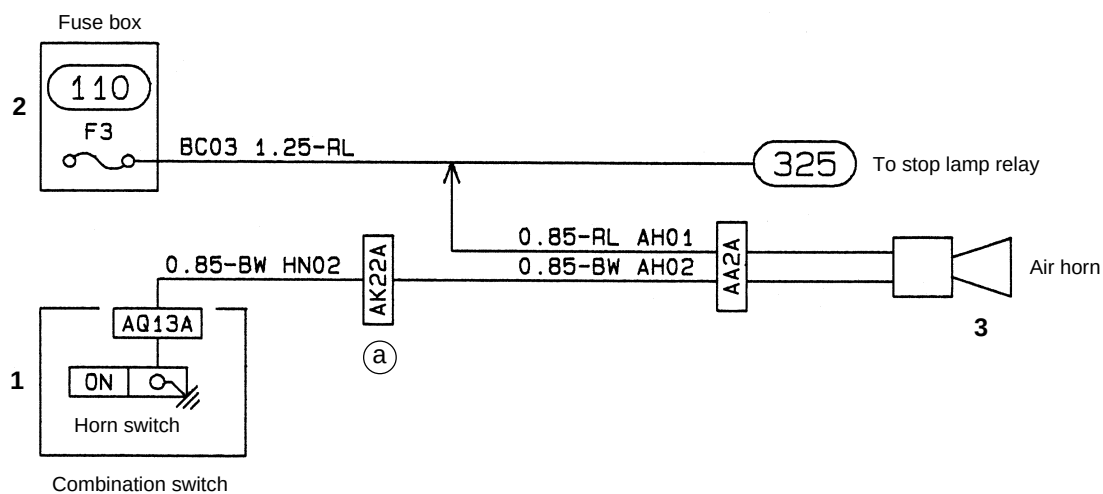
5 Inspection of washer motor

- Apply 12 volts DC between terminals ① and ② and make sure that washer motor **5** operates.
- If washer motor **5** does not operate, replace it.  Gr 42

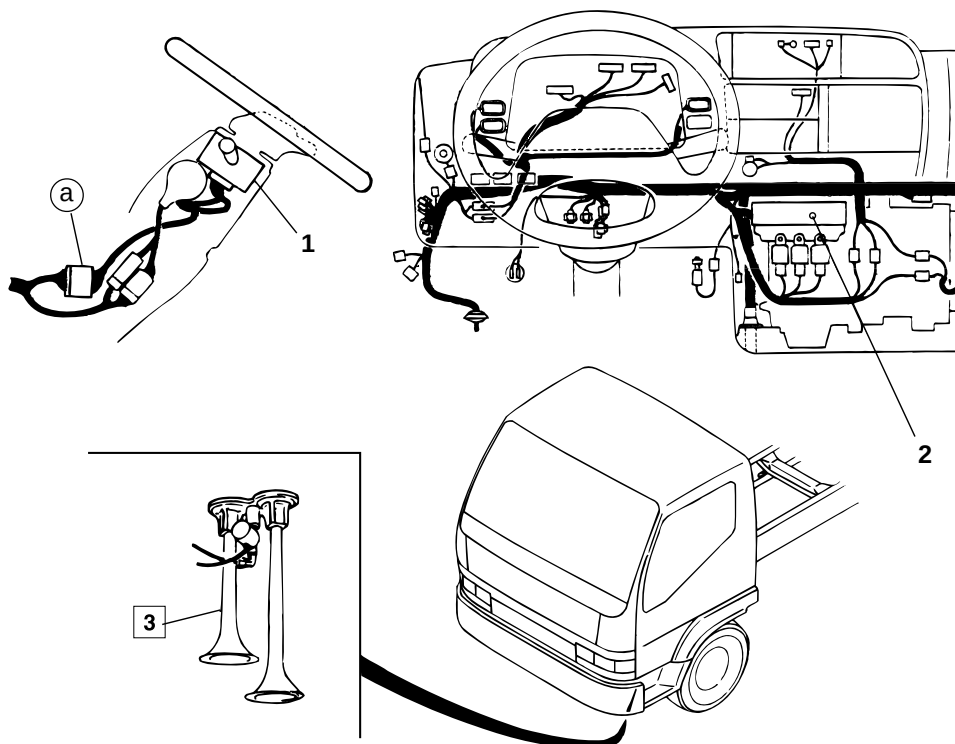


MEMO

616 HORN CIRCUIT



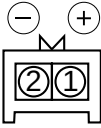
12224



13139

- 1 Combination switch (601)
- 2 Fuse box (104)
- 3 Air horn

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
3	Minimum operating voltage of air horn valve  14314	10 V or less	—	Replace
	Operating air pressure of horn	195 to 980 kPa {28 to 142 lbf/in ² , 2 to 10 kgf/cm ² }	—	Replace

◆ Service procedure

3 Inspection of air horn

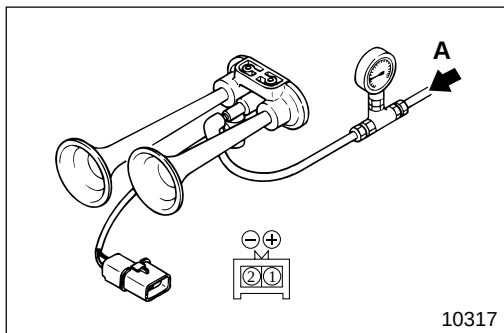
Carry out the following inspection. If any fault is found, replace air horn **3**.

(1) Minimum operating voltage of air horn valve

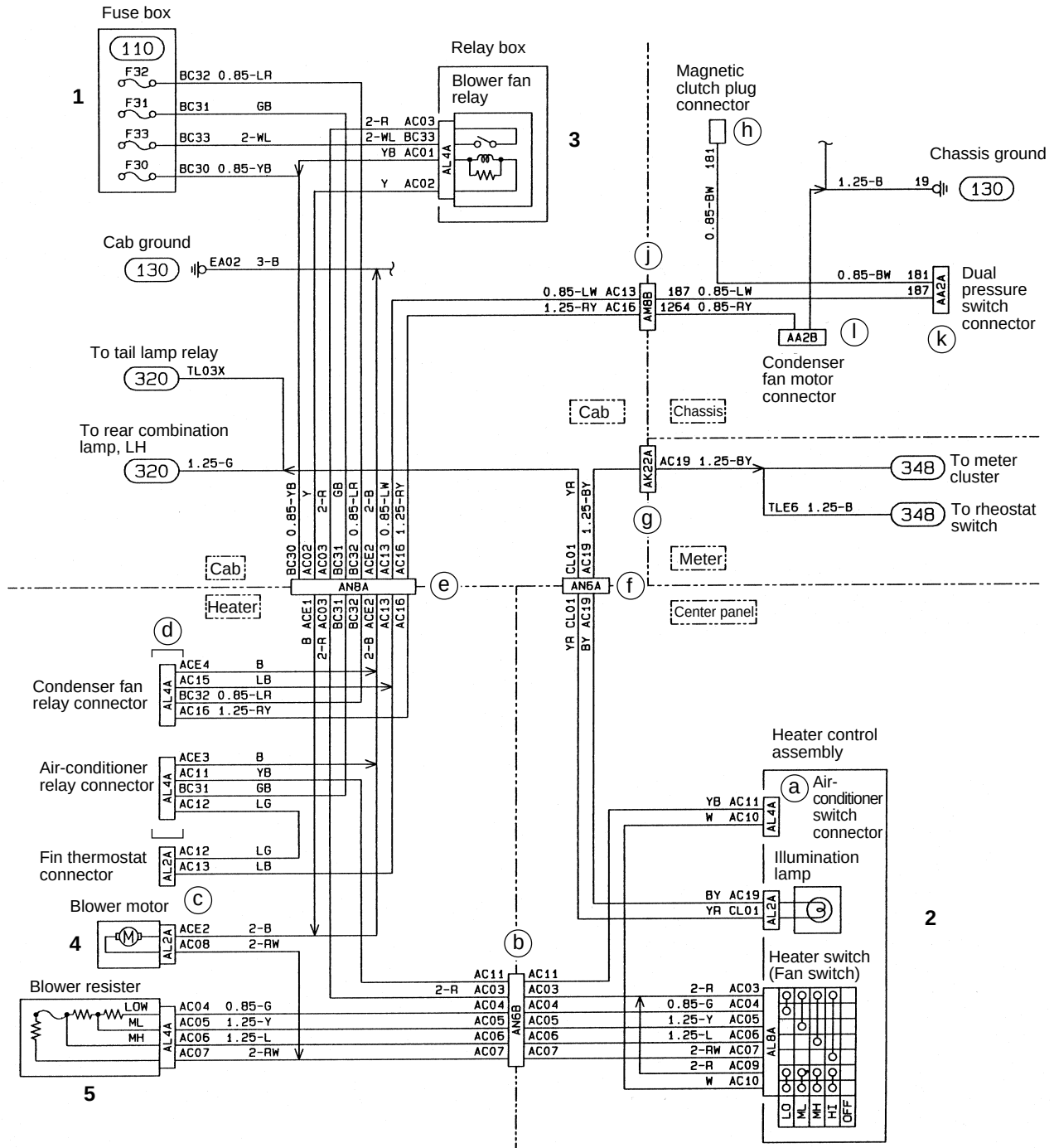
- Apply air pressure **A** of 785 kPa {115 lbf/in², 8 kgf/cm²} to air horn **3**.
- Apply voltage between terminals ① and ② starting from 0 volt DC gradually.
- Measure the voltage when air horn **3** sounds.

(2) Operating air pressure of horn

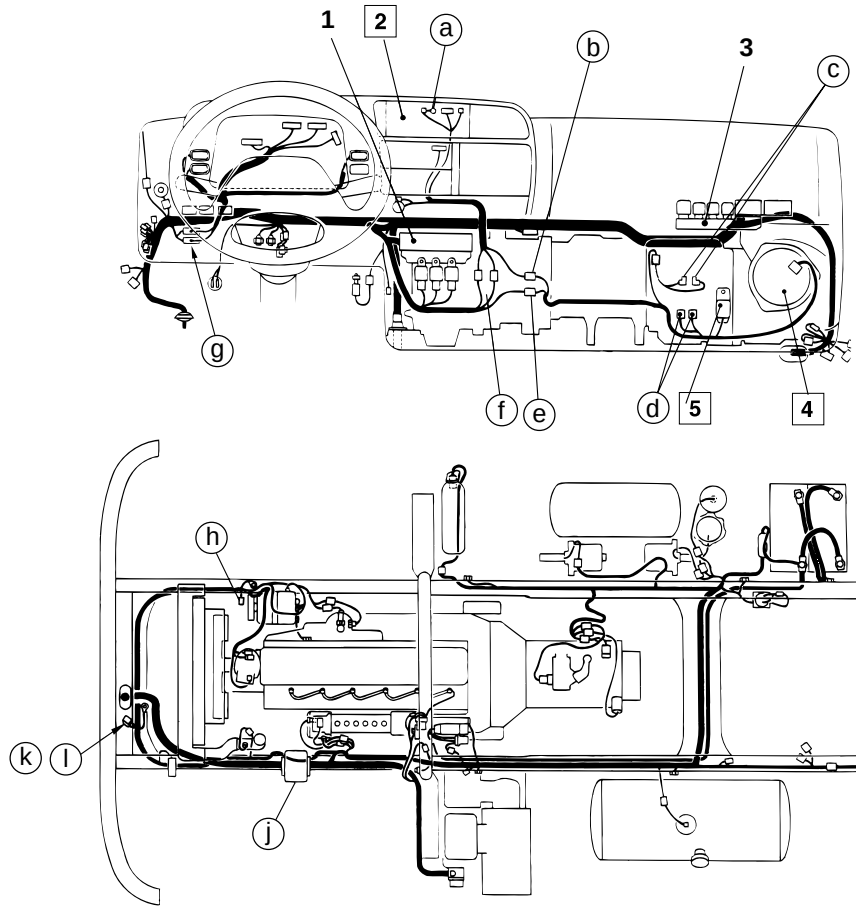
- Apply 12 volts DC between terminals ① and ②.
- Apply air pressure **A** to air horn **3** starting from 0 kPa {0 lbf/in², 0 kgf/cm²} gradually.
- Measure air pressure **A** when air horn **3** sounds.



618 HEATER CIRCUIT



12225



13140

1 Fuse box 104

2 Heater control assembly

3 Relay box 604

4 Blower motor

5 Blower resistor

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
5	Resistance of blower resistor 14315	① - ②	0.81 Ω	—	Replace
		① - ③	0.28 Ω		
		① - ④	1.94 Ω		

618 HEATER CIRCUIT

◆ Service procedure

2 Inspection of heater control assembly

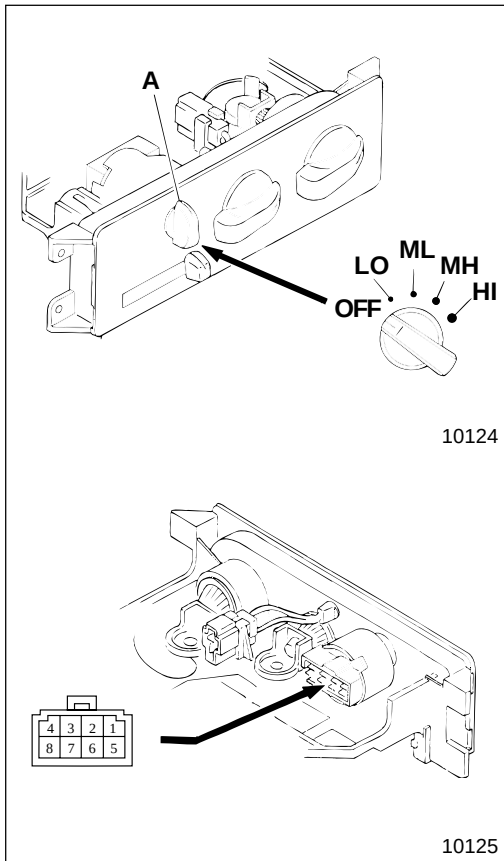
Inspection of blower switch A

- Follow the table below to inspect continuity:

	⑧	②	⑦	③	⑥	⑤	④
OFF							
LO (LOW)	○—○					○—○	
ML (MIDDLE LOW)	○—○		○—○			○—○	
MH (MIDDLE HIGH)	○—○			○—○		○—○	
HI (HIGH)	○—○				○—○	○—○	

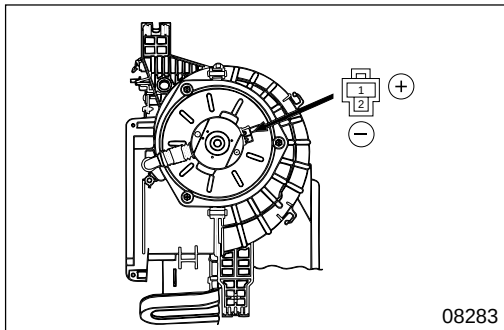
○—○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace blower switch A.



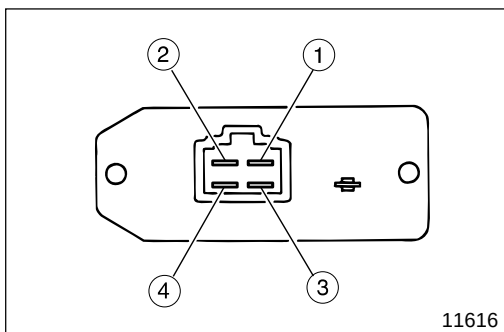
4 Inspection of blower motor

- Make sure that blower motor 4 operates when 12 volts DC is applied between terminals ① and ②.
- If any fault is found, replace blower motor 4.



5 Inspection of blower resistor

- Measure resistance between terminals ① and ② (MIDDLE LOW), ① and ③ (MIDDLE HIGH) and ① and ④ (LOW).
- If the measured value deviates from the standard value, replace blower resistor 5.

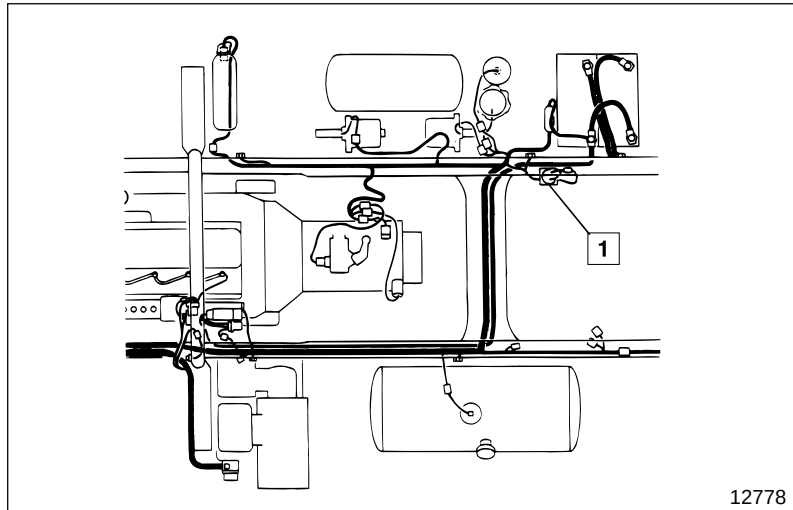


7 CHASSIS ELECTRICS

701	MAGNETIC VALVE.....	54-7-2
710	EXHAUST BRAKE CIRCUIT < Manual Transmission > ...	54-7-4
718	AIR DRYER CIRCUIT	54-7-8

701 MAGNETIC VALVE

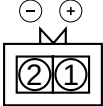
Installing Position



1 3-way magnetic valve

12778

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Minimum operating voltage of 3-way magnetic valve  14318	10 V or less	—	Replace

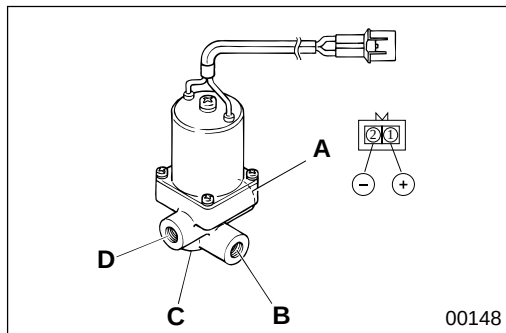
◆ Service procedure

1 Inspection of 3-way magnetic valve

Carry out the following inspection. If any fault is found, replace 3-way magnetic valves 1 :

Air circuit table (There is air continuity between terminals ○ and ○.)

	Input port B	Output port D	Unused A	Exhaust port C
ON	○	○		
OFF		○		○



00148

(1) Operation inspection

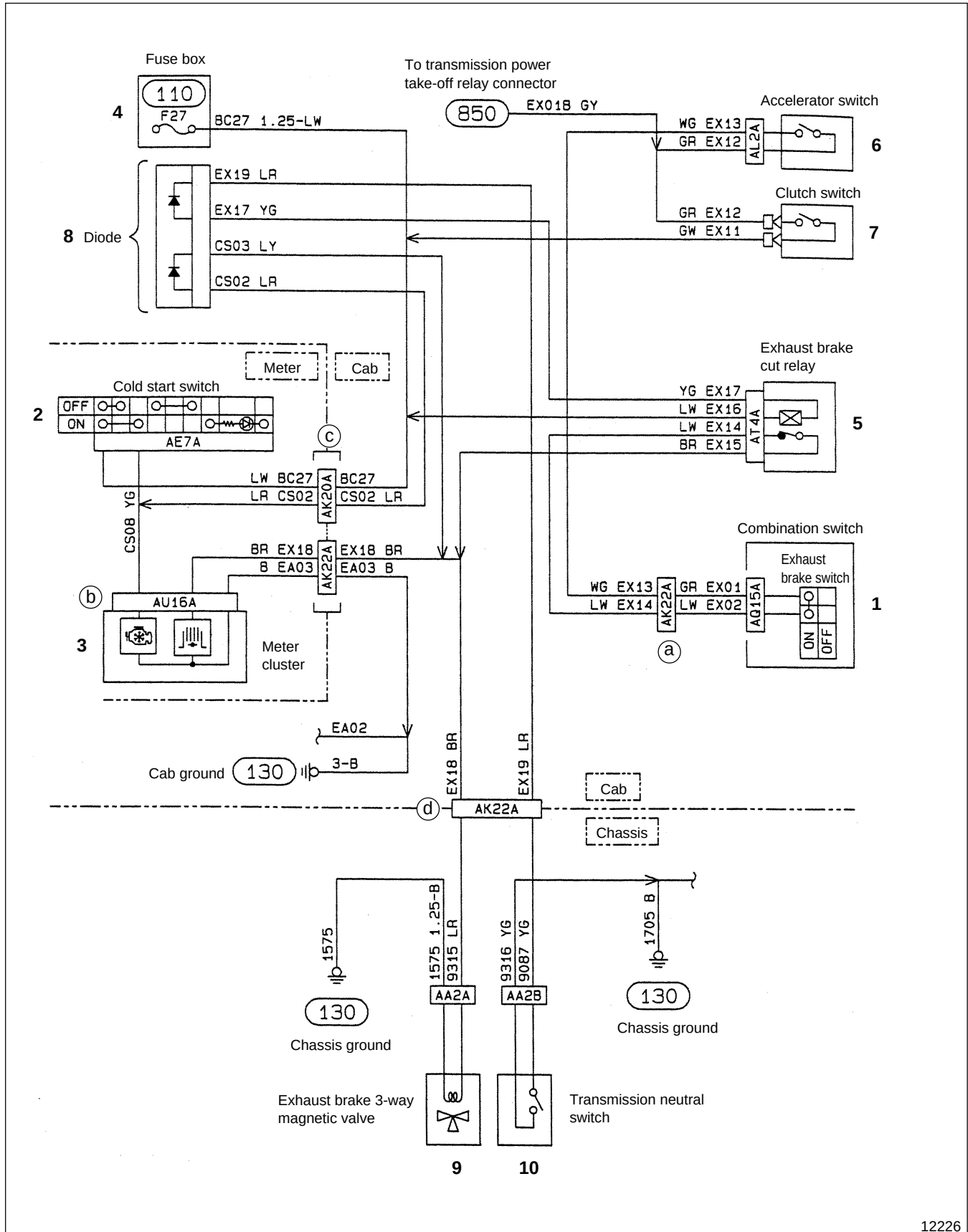
- Apply voltage between terminals ① and ②, increasing gradually from 0 volt.
- Measure voltage (minimum operating voltage) when magnetic valves 1 starts operating. (You can tell if the magnetic valves are ON or OFF by listening for an operating sound.)

(2) Airtightness inspection

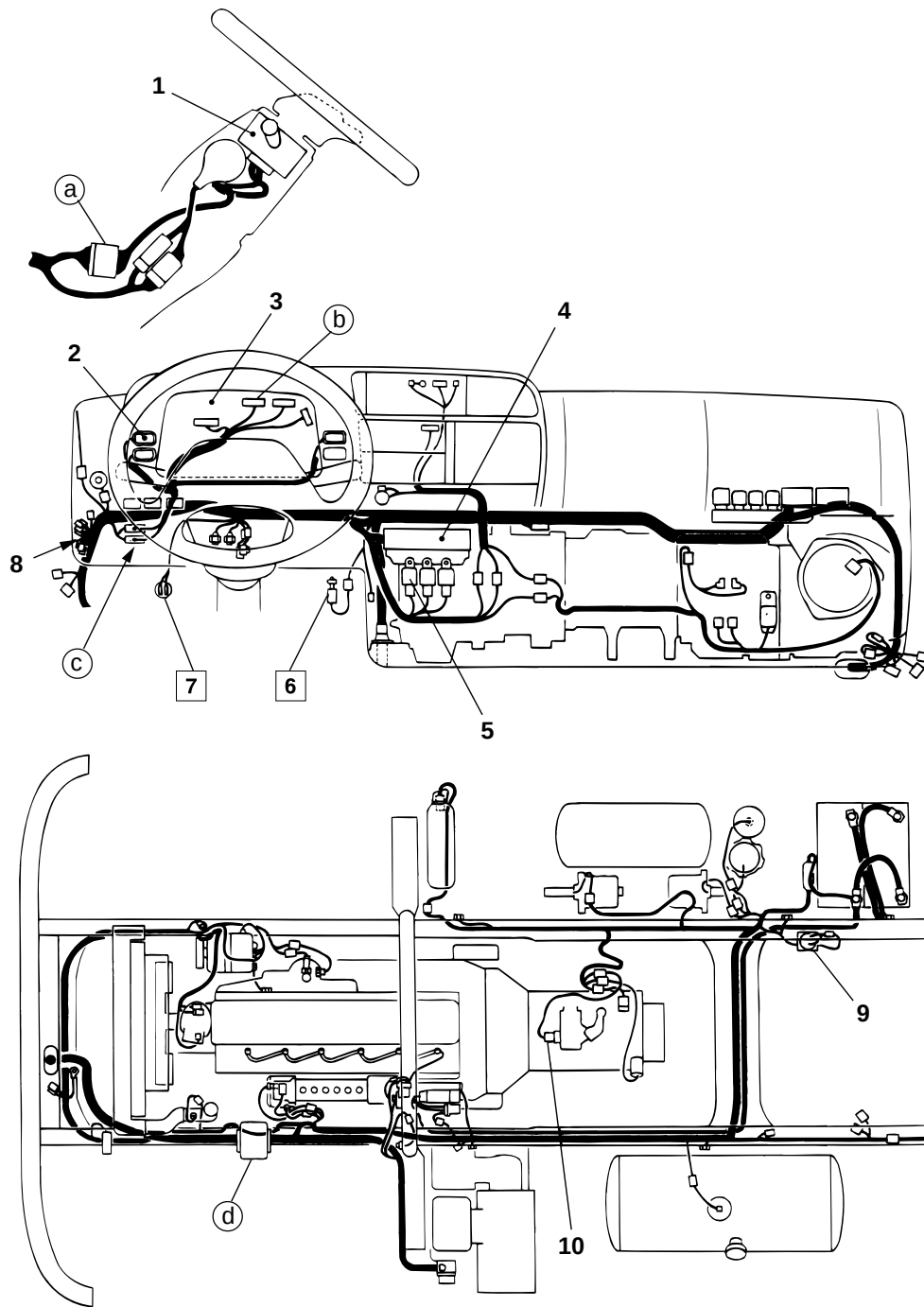
- When magnetic valve is ON :
 - Close output port D.
 - Apply 12 volts DC between terminals ① and ②.
 - Make sure that there is no air leaking from exhaust port C when air pressure (295 to 980 kPa {43 to 140 lbf/in², 3 to 10 kgf/cm²}) is applied to input valve B.
- When magnetic valve is OFF :
 - Make sure that there is no air leaking from exhaust port C or output port D when air pressure (295 to 980 kPa {43 to 140 lbf/in², 3 to 10 kgf/cm²}) is applied to input port B.

MEMO

710 EXHAUST BRAKE CIRCUIT < Manual Transmission >



12226



12779

- 1 Combination switch (601)
- 2 Cold start switch (601)
- 3 Meter cluster (401)
- 4 Fuse box (104)
- 5 Exhaust brake cut relay (604)

- 6 Accelerator switch
- 7 Clutch switch
- 8 Diode
- 9 Exhaust brake 3-way magnetic valve (701)
- 10 Transmission neutral switch (802)

710 EXHAUST BRAKE CIRCUIT < Manual Transmission >

◆ Service procedure

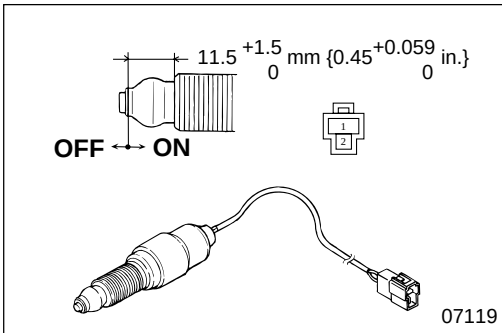
6 Inspection of accelerator switch

- Follow the table below to inspect continuity:

	①	②
OFF		
ON	○	○

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

- If any fault is found, replace accelerator switch 6.  Gr 13



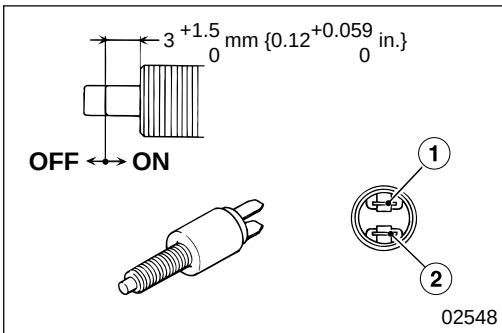
7 Inspection of clutch switch

- Follow the table below to inspect continuity:

	①	②
OFF		
ON	○	○

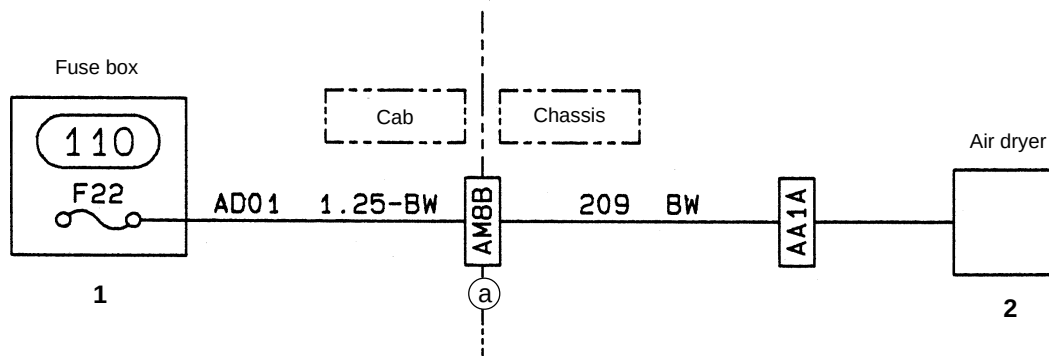
○—○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace clutch switch 7.  Gr 21

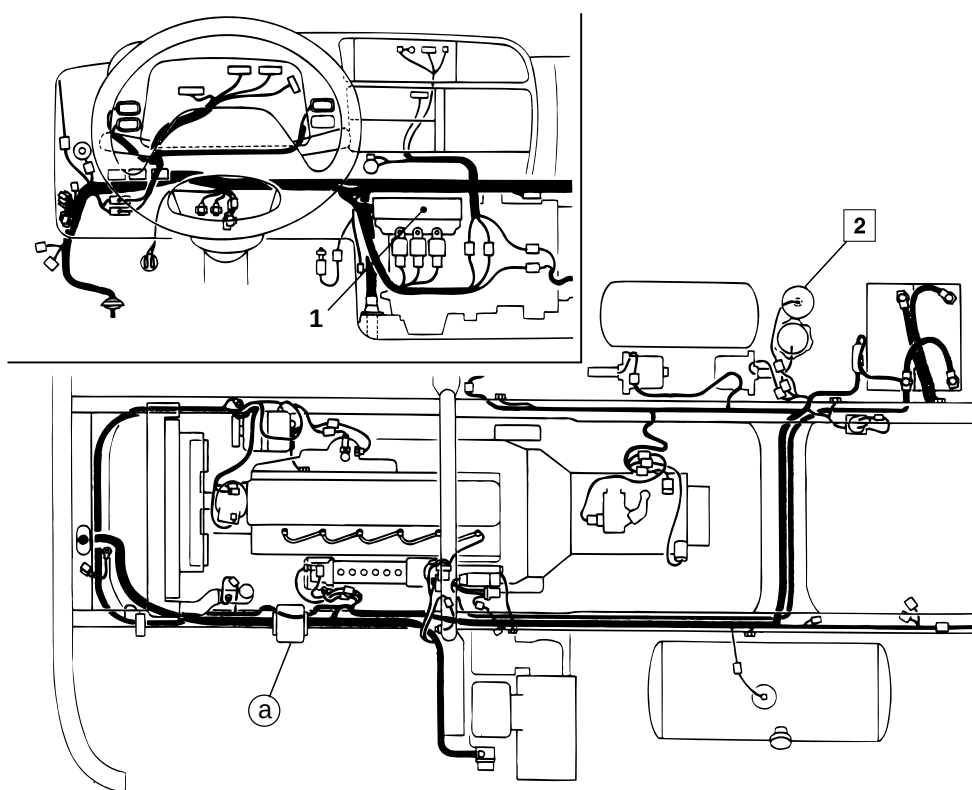


MEMO

718 AIR DRYER CIRCUIT



12227



12782

- 1 Fuse box (104)
2 Air dryer Gr 35

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
2	Operating temperature of complete thermostat	$4 \pm 4.0^{\circ}\text{C}$ $\{39 \pm 7.2^{\circ}\text{F}\}$	—	Replace

◆ Service procedure

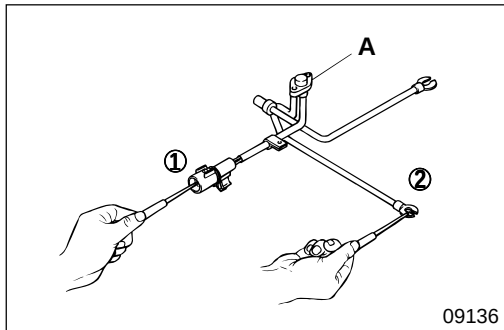
2 Air dryer

(1) Inspection of complete thermostat

Carry out the following inspection. If any fault is found, replace the complete thermostat.  Gr 35

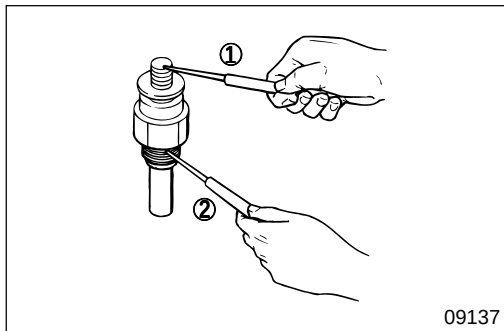
- Make sure that there is no continuity between terminals ① and ② at room temperature 20°C $\{68^{\circ}\text{F}\}$.
- Cool thermostat **A** in a refrigerator, etc.

Measure the temperature when there is continuity between terminals ① and ②, and make sure that the measured value conforms to the standard value.



(2) Inspection of heater

- Make sure that there is continuity between terminals ① and ②.
- If any fault is found, replace the heater.  Gr 35

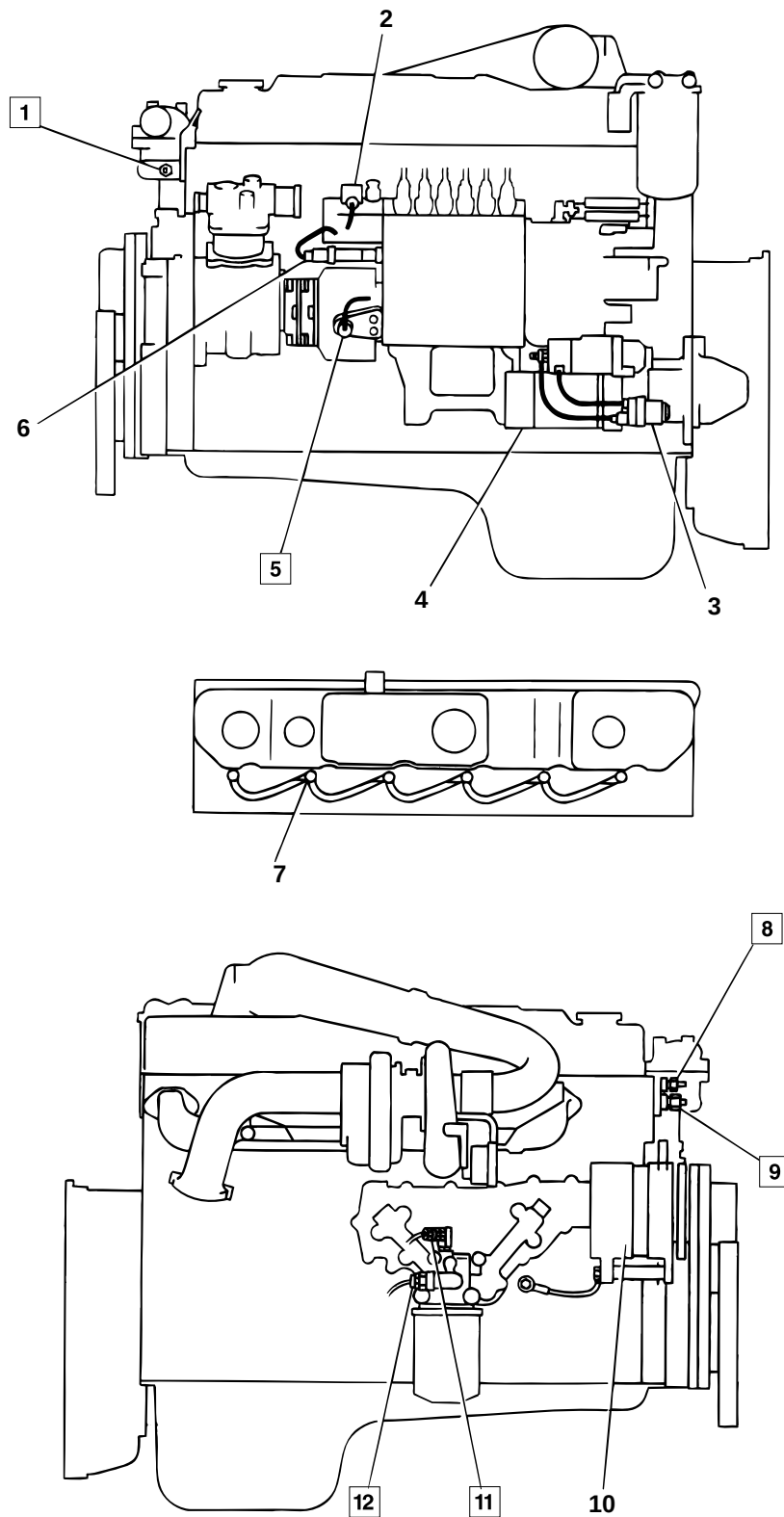


8 ENGINE AND TRANSMISSION ELECTRICS

801	ENGINE ELECTRICS	54-8-2
802	TRANSMISSION ELECTRICS	
	< Manual Transmission >	54-8-6
	< Automatic Transmission >	54-8-8
850	TRANSMISSION POWER TAKE-OFF CIRCUIT	
	< Option >	54-8-10

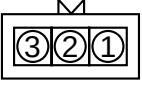
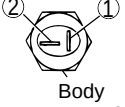
801 ENGINE ELECTRICS

Installation Position



- | | |
|--|--|
| 1 Water temperature sensor (Connects to pre-stroke control unit)  Gr 13 | 7 Glow plug  (220) |
| 2 Pre-stroke actuator  Gr 13 | 8 Water temperature sensor (Connects to water temperature gauge and multipurpose timing control unit) |
| 3 Starter relay  (210) | 9 Overheating switch |
| 4 Starter  (201) | 10 Alternator  (106) |
| 5 Engine revolution sensor | 11 Engine oil pressure switch |
| 6 Control rod position sensor  Gr 13 | 12 Engine oil bypass alarm switch |

Service standards

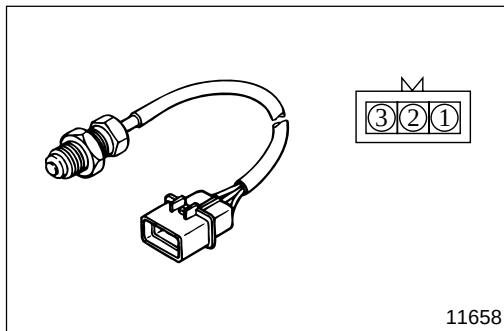
Location	Maintenance item		Standard value	Limit	Remedy
5	Resistance of engine revolution sensor (At room temperature 25°C {77°F})  14366		①-②	2.1 to 2.5 kΩ	— Replace
8	Resistance of water temperature sensor  Body 14321	① – (Body) (Water temperature gauge side)	50°C {122°F}	(153.9 Ω)	— Replace
			80°C {176°F}	51.9 ^{+4.9} _{-4.4} Ω	
			100°C {212°F}	27.4 ^{+1.9} _{-1.2} Ω	
		② – (Body) (Multipurpose timing control unit side)	20°C {68°F}	3.25±0.33 kΩ	
			60°C {140°F}	(620 Ω)	
			80°C {176°F}	(300 Ω)	
9	Operating temperature of overheating switch	When temperature increases (ON→OFF)	110±2°C {230±36°F}	—	Replace
		When temperature decreases (OFF→ON)	110±4°C {230±7.2°F}	—	
11	Operating pressure of engine oil pressure switch		49±9.8 kpa {7.1±1.4 lbf/in ² , 0.5±0.1 kgf/cm ² }	—	Replace
12	Operating pressure of engine oil bypass alarm switch		140±20 kPa {20±2.8 lbf/in ² , 1.4±0.2 kgf/cm ² }	—	Replace

The values in () are reference values.

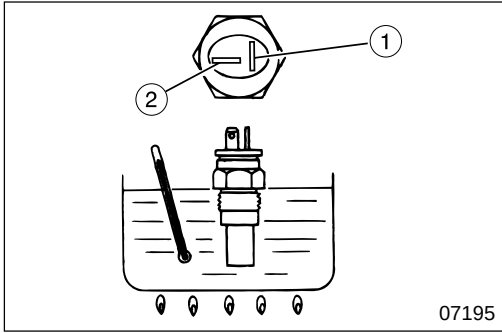
◆ Service procedures

5 Inspection of engine revolution sensor

- Measure the resistance between terminals ① and ②.
- If the measured value deviates from the standard value, replace engine revolution sensor 5.  Gr 13



801 ENGINE ELECTRICS



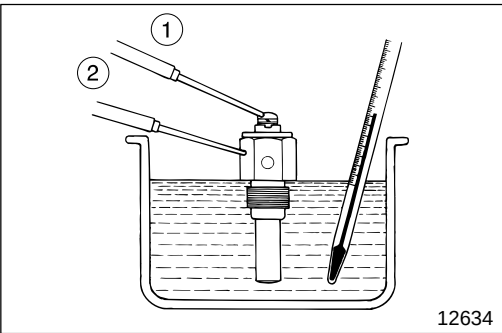
8 Inspection of water temperature sensor

- Place water temperature sensor 8 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, and terminal ② and the body.

Terminal ① : Water temperature gauge connection

Terminal ② : Multipurpose timing control unit connection

- If the measured value deviates from the standard value, replace water temperature sensor 8. Gr 14



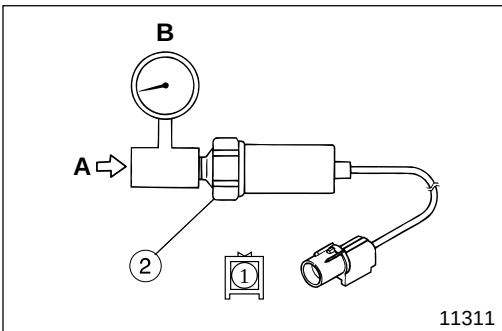
9 Inspection of overheating switch

Carry out the following inspection. If any fault is found, replace overheating switch 9. Gr 14

- Make sure that there is no continuity between terminals ① and ② (Body) at room temperature (20°C {68°F}).
- Place overheating switch 9 in a container filled with engine oil and raise the oil temperature while stirring the oil.

Measure the temperature when there is continuity between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.

- Lower the oil temperature and measure the temperature when continuity is lost between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.



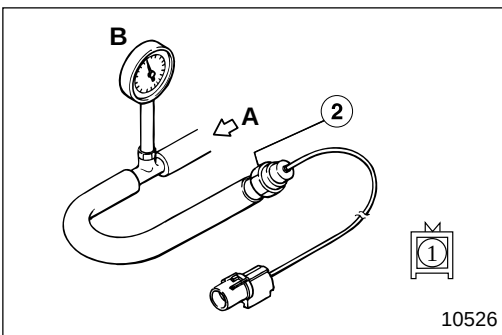
11 Inspection of engine oil pressure switch

Carry out the following inspection. If any fault is found, replace engine oil pressure switch 11. Gr 12

- Make sure that there is continuity between terminals ① and ② (Body) when air pressure A is not applied to engine oil pressure switch 11.
- Apply air pressure A to engine oil pressure switch 11 gradually starting from 0 kpa {0 lbf/in², 0 kgf/cm²}.

Measure the air pressure when continuity is lost between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.

B : Air pressure gauge



12 Inspection of engine oil bypass alarm switch

Carry out the following inspection. If any fault is found, replace engine oil bypass alarm switch 12. Gr 12

- Make sure that there is no continuity between terminals ① and ② (Body) when air pressure A is not applied to engine oil bypass alarm switch 12.
- Apply air pressure A to engine oil bypass alarm switch 12 gradually starting from 0 kpa {0 lbf/in², 0 kgf/cm²}.

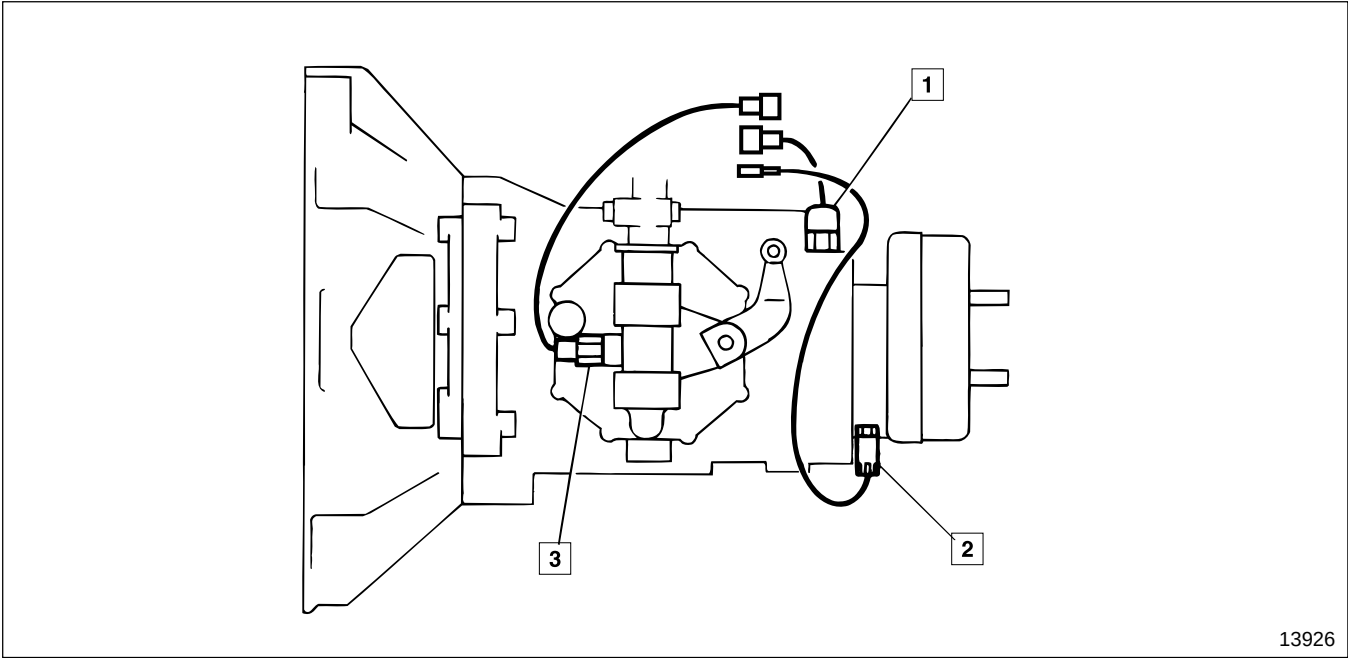
Measure the air pressure when continuity is present between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.

B : Air pressure gauge

MEMO

802 TRANSMISSION ELECTRICS < Manual Transmission >

Installation Position



- 1 Backup lamp switch
- 2 Vehicle speed sensor
- 3 Transmission neutral switch

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
2	Pulse output voltage of vehicle speed sensor (8 pulses)	①-②	Low pulse	1.5 V or less	Replace
			High pulse	12 V-(0.5 V or less)	

14367

Tester

③ ② ①

◆ Service procedure

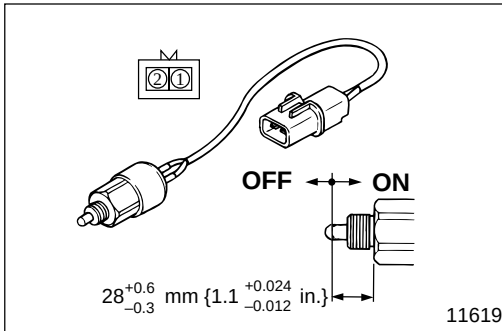
1 Inspection of Backup lamp switch

- Follow the table below to inspect continuity

	①	②
OFF		
ON	○	○

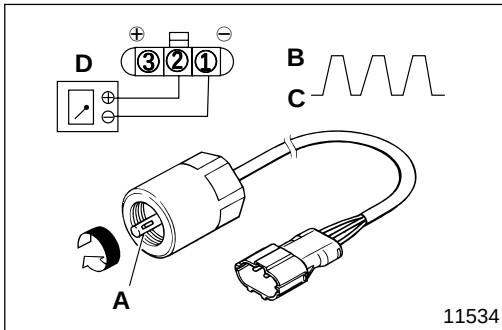
○—○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace backup lamp switch **1**. Gr 22



2 Inspection of vehicle speed sensor

- Apply 12 volts DC between terminals ① and ③, and rotate shaft **A** of vehicle speed sensor **2** slowly.
- At this state, measure the maximum voltage (High pulse voltage **B**) and the minimum voltage (Low pulse voltage **C**) generated between terminals ① and ②.
- D** : Tester
- If the measured value deviates from the standard value, replace vehicle speed sensor **2**. Gr 22



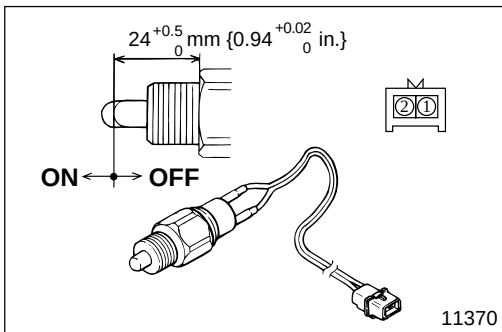
3 Inspection of transmission neutral switch

- Follow the table below to inspect continuity

	①	②
OFF		
ON	○	○

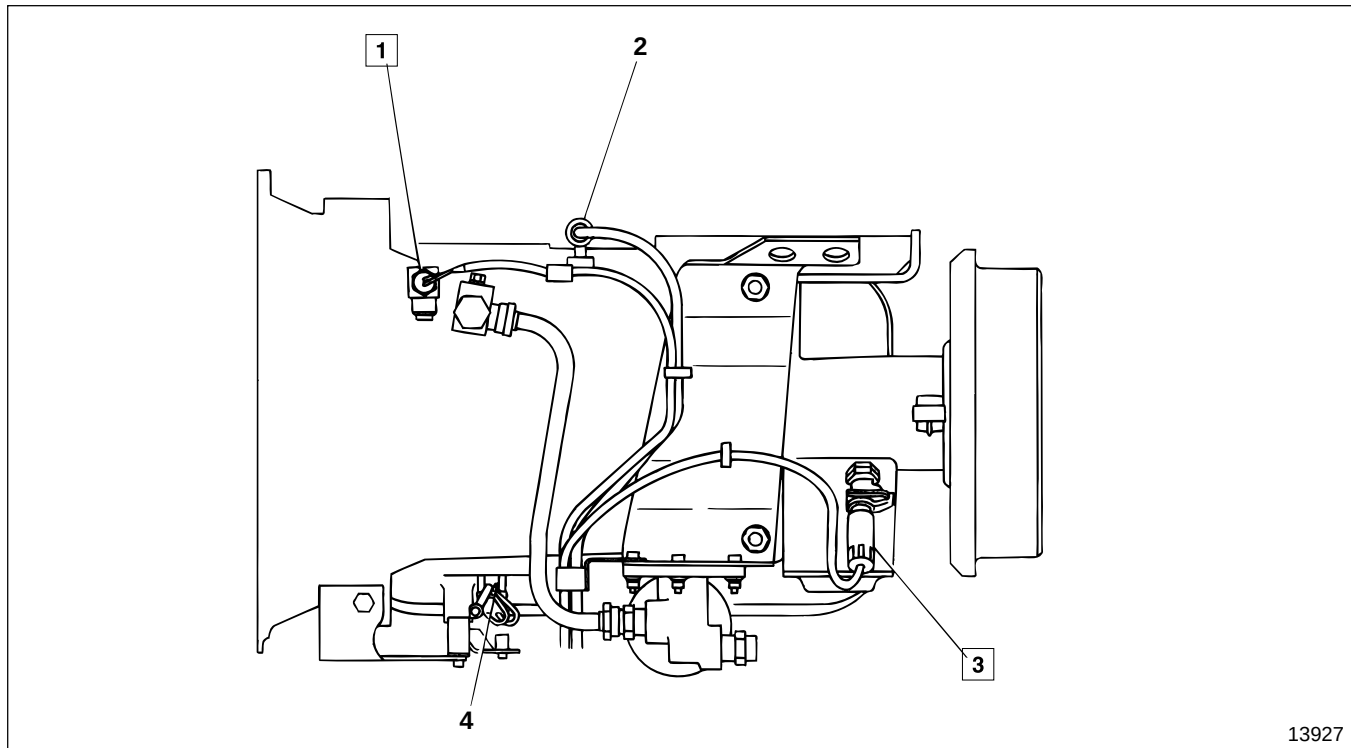
○—○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace transmission neutral switch **3**. Gr 22



802 TRANSMISSION ELECTRICS < Automatic Transmission >

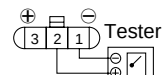
Installation Position



13927

- 1 Automatic transmission fluid temperature switch
- 2 Backup lamp switch  Gr 23
- 3 Vehicle speed sensor
- 4 Automatic transmission neutral switch  Gr 23

Service standards

Location	Maintenance item			Standard value	Limit	Remedy
1	Operating temperature of automatic transmission fluid temperature switch	When increases (OFF→ON)		140±3°C {284±5.4°F}	—	Replace
		When decreases (ON→OFF)		133°C {271°F} MIN		
3	Output voltage of vehicle speed sensor 	①-②	Low pulse	1.5 V or less	—	Replace
			High pulse	12 V-(0.5 V or less)	—	

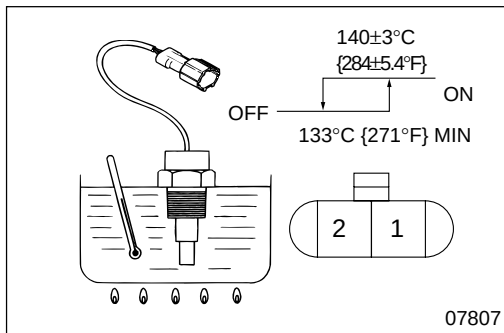
14367

◆ Service procedure

1 Inspection of automatic transmission fluid temperature switch

Carry out the following inspection. If any fault is found, replace automatic transmission fluid temperature switch **1**.  Gr 23

- Make sure that there is no continuity between terminals ① and ② at room temperature ($20\pm5^{\circ}\text{C}$ { $68\pm9^{\circ}\text{F}$ }).
- Place automatic transmission fluid temperature switch **1** in a container filled with engine oil and raise the oil temperature while stirring the oil. Measure the temperature when there is continuity between terminals ① and ②, and make sure that the measured value conforms to the standard value.
- Lower the oil temperature and measure the temperature when continuity is lost between terminals ① and ②, and make sure that the measured value conforms to the standard value.

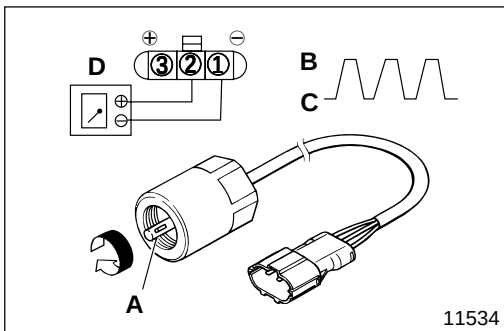


3 Inspection of vehicle speed sensor

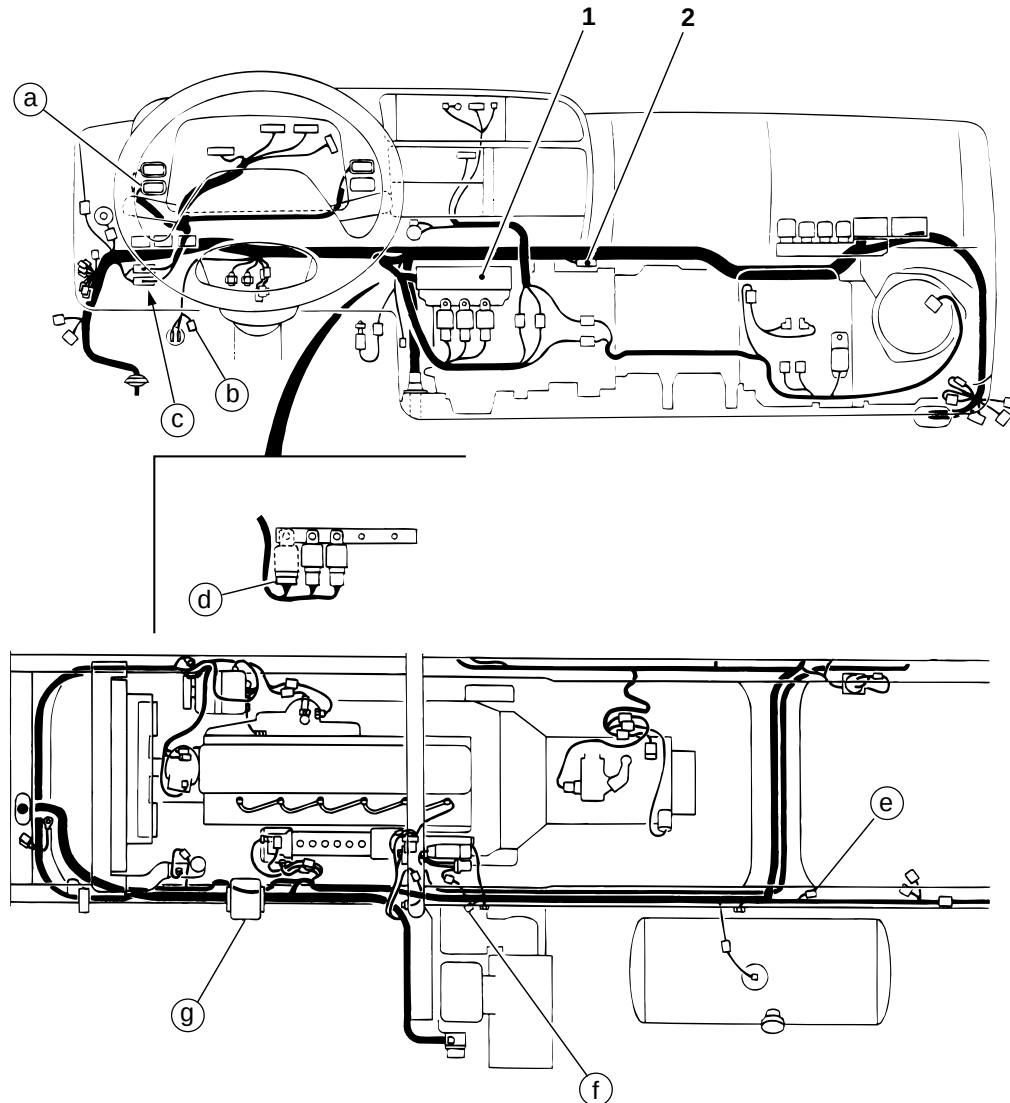
- Apply 12 volts DC between terminals ① and ③, and rotate shaft **A** of vehicle speed sensor **3** slowly.
- At this state, measure the maximum voltage (High pulse voltage **B**) and the minimum voltage (Low pulse voltage **C**) generated between terminals ① and ②.

D : Tester

- If the measured value deviates from the standard value, replace vehicle speed sensor **3**.  Gr 23







14223

- 1 Fuse box  (104)
- 2 Joint connector  (905)

9 OTHERS

STRUCTURE AND OPERATION 54-9-2

(905) JOINT CONNECTOR 54-9-6

(910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT 54-9-8

STRUCTURE AND OPERATION

Multipurpose Timing Control Unit

- The multipurpose timing control unit controls the following functions:

Intermittent wiper activation function

Gr 42

Wiper activation function (Even if the wiper switch is OFF, this function automatically activates the wiper when the window washer works)

Gr 42

Engine preheating function

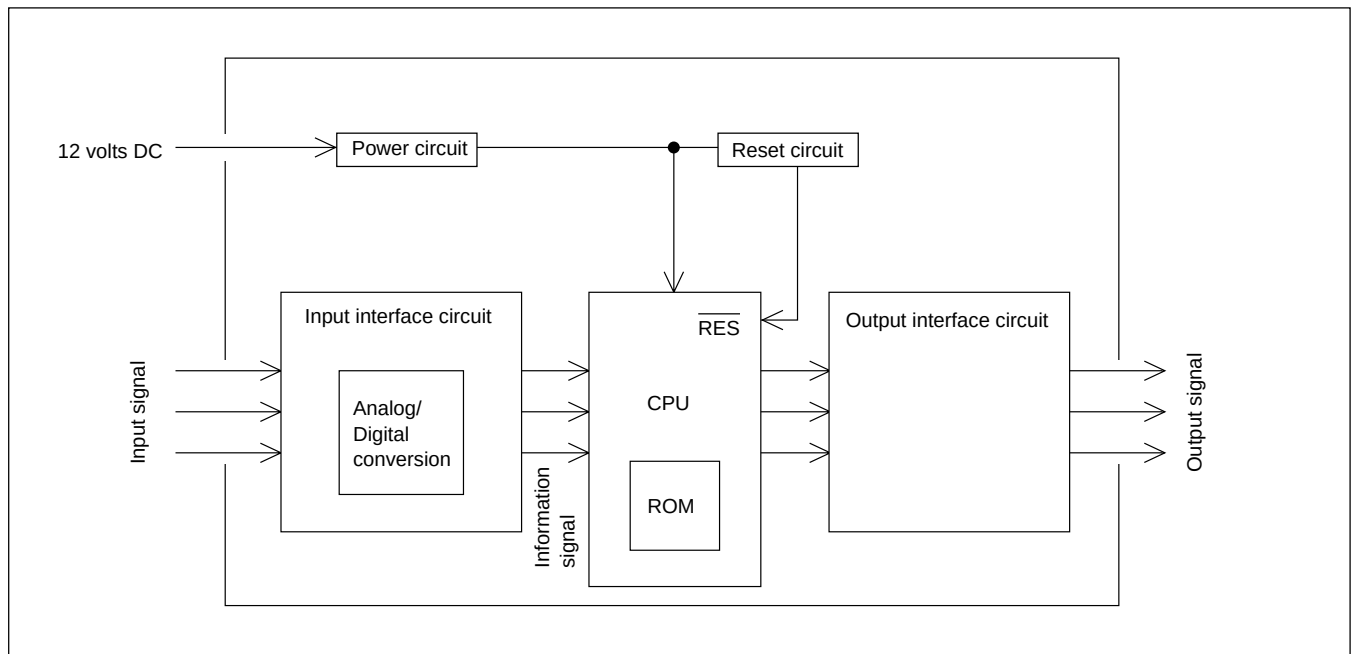
Gr 54-2-6

Water level warning function

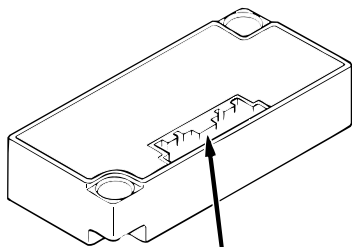
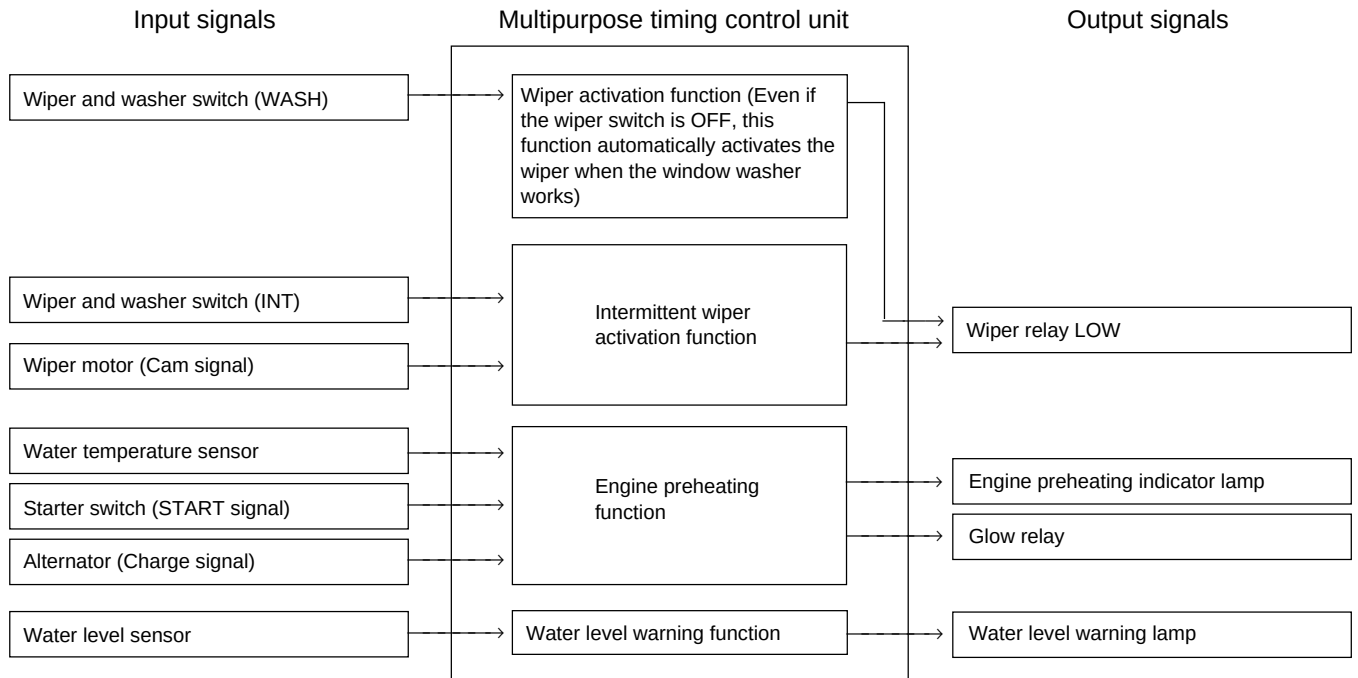
Gr 14

- Sensors and switches are fitted to these systems as information sources for the multipurpose timing control unit.
- Using the information provided, circuits in the multipurpose timing control unit control the functions mentioned above.

● Internal structure of multipurpose timing control unit



- The internal structure mainly consists of the input interface circuit, *1CPU, *2ROM, and the output interface circuit.
 - *1CPU : Central Processing Unit. Compares the input information with information stored in the memory to output commands.
 - *2ROM : Read Only Memory. Stores fixed data and programs that are not erased even after the power is turned off.
- Input signals are transmitted from information sources, such as sensors and switches, to the input interface circuit.
- The input interface circuit converts these input signals from analog signals to digital signals. This enables the CPU to calculate data and transmits them to the CPU as information signals.
- The CPU compares the information signals with the data in the ROM, calculates the signals, and sends them to the output interface circuit.
- The output interface circuit issues commands to systems, based on the above comparison and calculated results, as output signals.
- Sequential execution of the above processes allows optimum control over functions.

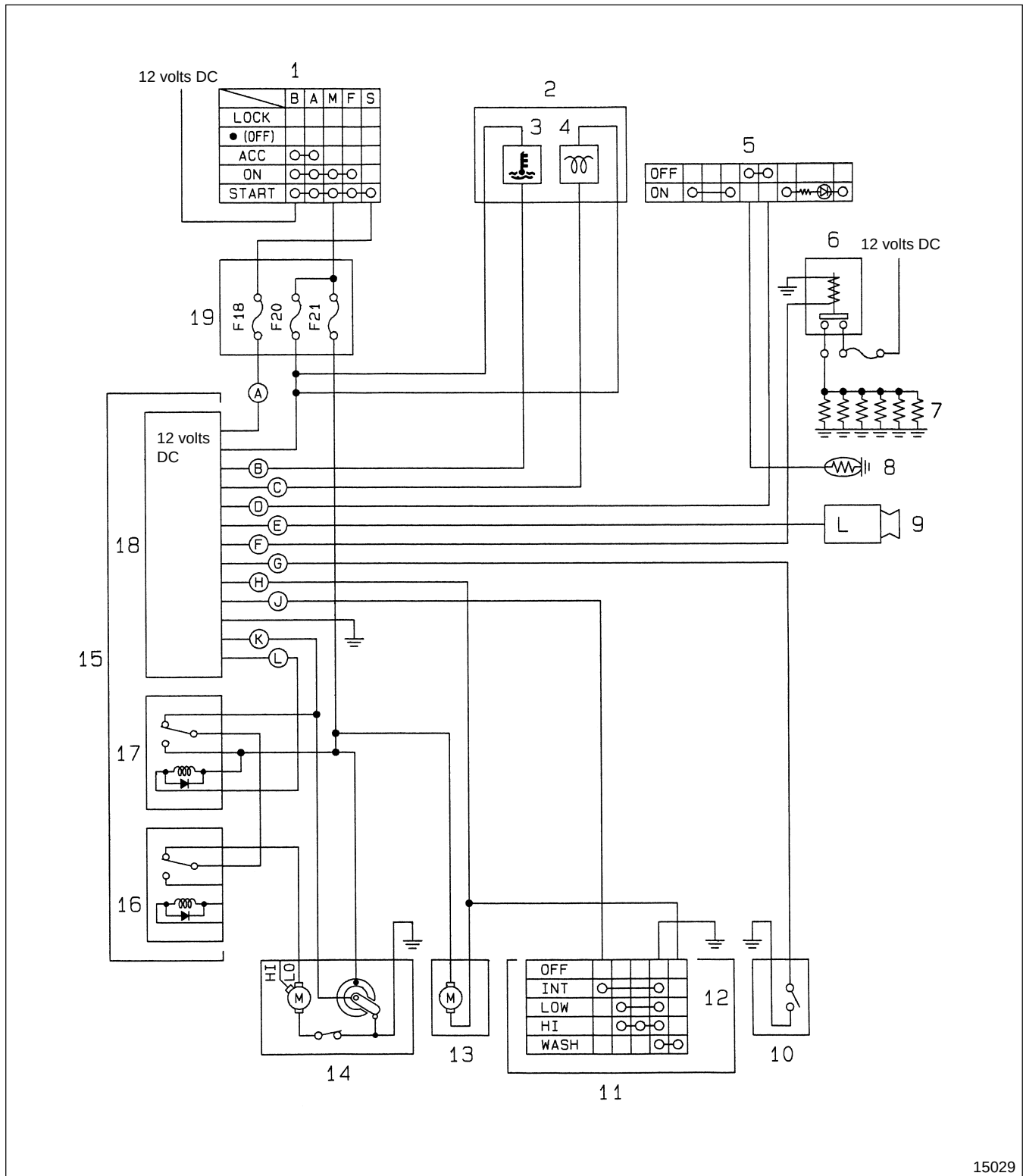


9	8	7	6	M	5	4	3	2	1	
20	19	18	17	16	15	14	13	12	11	10

07504

Terminal No.	Connecting destinations	Terminal No.	Connecting destinations
1	Glow relay	11	—
2	Wiper motor (Cam signal)	12	Water level warning lamp
3	Engine preheating indicator lamp	13	—
4	Wiper relay LOW	14	Cab ground
5	—	15	—
6	—	16	Alternator terminal L (Charge signal)
7	Washer switch	17	—
8	—	18	Starter switch (Start signal)
9	Water temperature sensor	19	Wiper switch (Intermittent)
10	Starter switch (ON power supply)	20	Water level sensor

STRUCTURE AND OPERATION

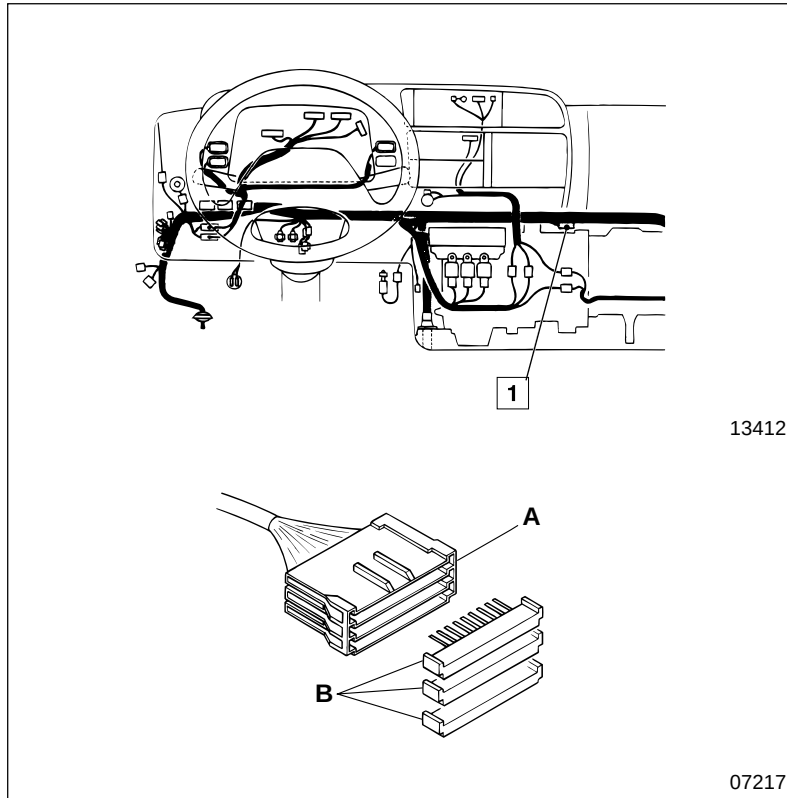


15029

54-9-5

905 JOINT CONNECTOR

Installation Position



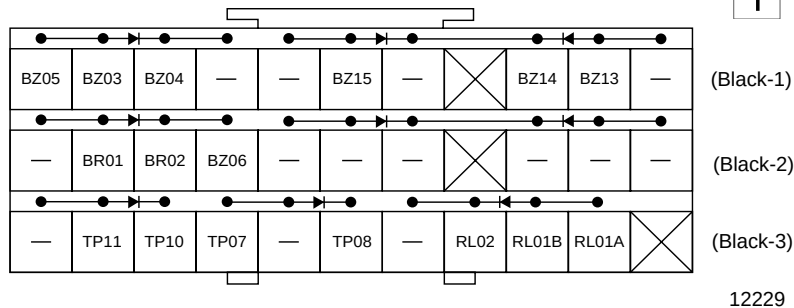
1 Joint connector

A : Housing

B : Joint

◆ Service procedure

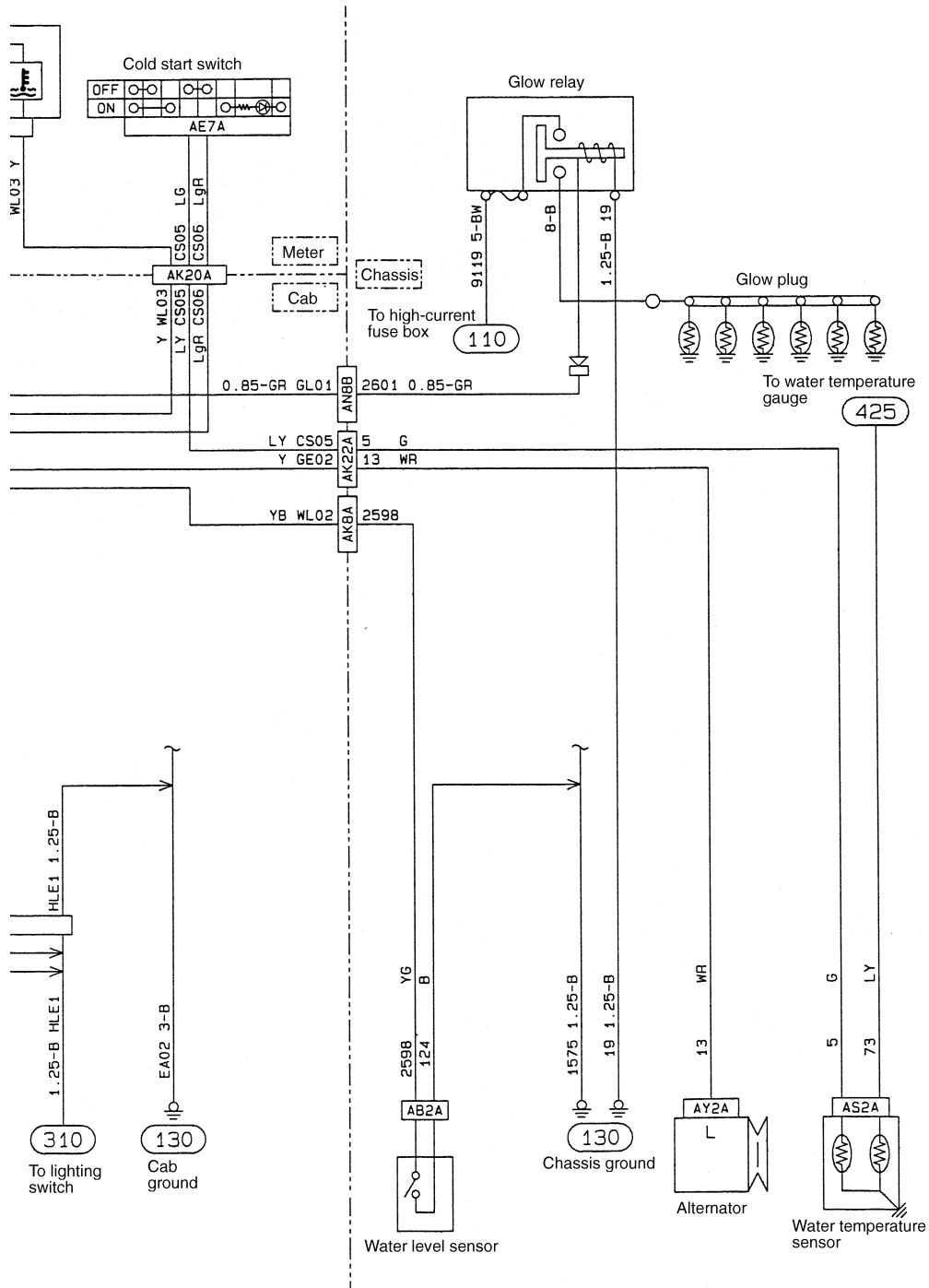
1 Joint connector



	Circuit No.	Wire color	Destinations	Index No.	Remarks
Black-1	BZ05	GB	Diode	(515)	
	BZ03	GW	Warning buzzer	(515)	
	BZ04	GY	AR10	(515)	
	BZ13	GR	AR12	(515)	
	BZ15	G	BR01	(515)	
	BZ14	YB	GE02	(215)	
Black-2	BR01	G	Meter cluster (Brake)	(515)	
	BR02	GL	Air master stroke switch	(515)	
	BZ06	LW	Diode	(515)	
Black-3	TP11	B	EA02	—	T/M PTO (Ground)
	TP10	G	TP09	—	T/M PTO
	TP07	RL	Transmission control switch	—	T/M PTO
	RL01A	BW	Cab lamp	(345)	
	TP08	RW	Transmission power take-off switch	—	T/M PTO
	RL02	BY	Door switch, RH	(345)	
	RL01B	BW	Door switch, LH	(345)	

T/M PTO : Transmission power take-off < Option >







FH

Service Manual

Group 54

Electrical

'98 Minor Change

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

GROUP 54 ELECTRICAL

1 POWER, CHARGE AND GROUND

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2 STARTING, PREHEATING AND STOPPING ENGINE

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4 METER

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(425) WATER TEMPERATURE GAUGE CIRCUIT	

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6 CAB SIDE ELECTRICAL

SPECIFICATIONS 54-6-2

TROUBLESHOOTING 54-6-3

- (601) SWITCH** 
- (604) RELAY AND CONTROL UNIT** 
- (606) WARNING BUZZER** 
- (610) CIGARETTE LIGHTER CIRCUIT** 
- (612) AUDIO CIRCUIT** 
- (614) WIPER AND WASHER CIRCUIT** 
- (616) HORN CIRCUIT** 54-6-4
- (618) HEATER CIRCUIT** 

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

★  : '97 Model Gr 54 (Pub. No. TWME9502-1)

7 CHASSIS ELECTRICAL

- (701) MAGNETIC VALVE**
 < Manual Transmission > 54-7-2
- (710) EXHAUST BRAKE CIRCUIT**
 < Manual Transmission > 54-7-4

8 ENGINE AND TRANSMISSION ELECTRICS

- (801) ENGINE ELECTRICS** 
- (802) TRANSMISSION ELECTRICS**
 < Manual Transmission > 
 < Automatic Transmission > 
- (850) TRANSMISSION POWER TAKE-OFF CIRCUIT**
 < Option > 

9 OTHERS

- STRUCTURE AND OPERATION ★ 
- (905) JOINT CONNECTOR** 54-9-2
- (910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT** ★ 

1 POWER, CHARGING AND GROUND

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 : '96 Model Gr 54 (Pub. No. TWME9502-54)

SPECIFICATIONS/STRUCTURE AND OPERATION

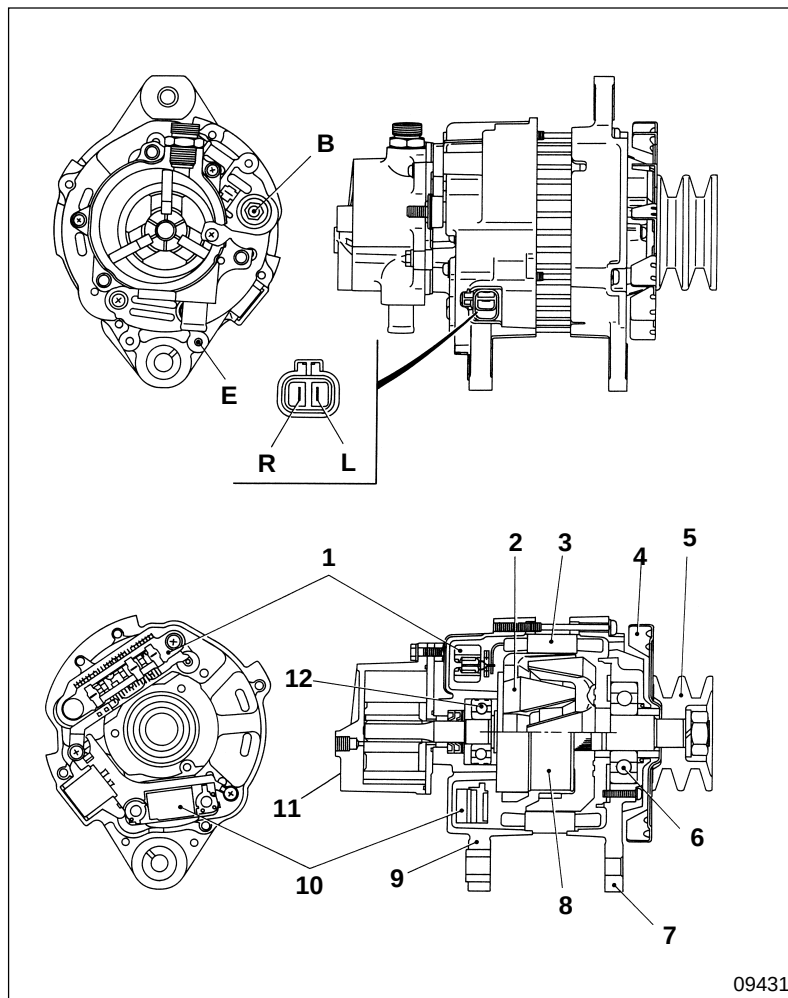
This chapter contains information on the alternator. Items not covered in this chapter are the same as those of '97 model.

SPECIFICATIONS

Item		Specifications
Alternator	Manufacturer	MITSUBISHI ELECTRIC
	Type	Alternator with built-in regulator (without brush external fan)
	Model	A4TU0388
	Output	12-80

STRUCTURE AND OPERATION

Alternator



- 1 Rectifier
- 2 Rotor assembly
- 3 Stator assembly
- 4 Fan
- 5 Pulley
- 6 Front bearing
- 7 Front bracket
- 8 Field coil
- 9 Rear bracket
- 10 Regulator
- 11 Vacuum pump
- 12 Rear bearing

B : Terminal B
E : Terminal E
L : Terminal L
R : Terminal R

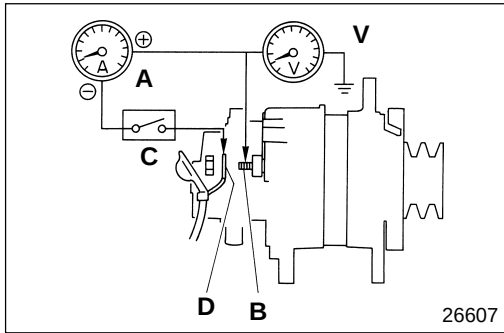
TROUBLESHOOTING

54

Possible causes		Symptoms					Remarks
		Battery electrolyte decreases too early	Battery overheating	Battery is normal but overdischarged	Charge warning lamp  does not light when turning starter switch ON, with engine stopped	Alternator is normal but battery overdischarged	
Connector connection faulty, harness broken, grounding faulty				☐		☐	
Fuse blown					☐		
V-belts loose				☐		☐	 Gr 14
V-belts damaged				☐		☐	 Gr 14
Battery faulty		☐				☐	
Alternator	Stator coil broken			☐			
	Stator coil short-circuited with core			☐			
	Field coil broken			☐			
	Rectifier faulty			☐			
	Regulator faulty		☐	☐	☐		
	Brush worn			☐			
	Brush spring fatigued			☐			
	Wiring faulty			☐			
Meter cluster faulty					☐		

100 ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection of Alternator



Performance test

- Connect the meters to the alternator as illustrated.
- A** : Ammeter (100 amperes class)
- B** : Terminal B on alternator
- C** : Switch
- D** : Terminal
- V** : Voltmeter

WARNING

- Terminal D is always loaded with voltage from the battery.**
- You must handle terminal D carefully, it will short-circuit if it touches any part other than terminal B on the alternator.**

- Turn switch **C** ON and make sure that voltmeter **V** indicates the voltage of the battery.
- Start the engine.
- Turn the switches ON of all the lamps on the vehicle immediately.
- Raise the engine speed immediately and measure the current when the speed reaches approximately 2260 rpm.
- The alternator is assumed to be normal if the measured value is higher than 70% of the specified output.

Specified output of alternator

Alternator model	Voltage	Output
A4TU0388	12 V	80 A

NOTE

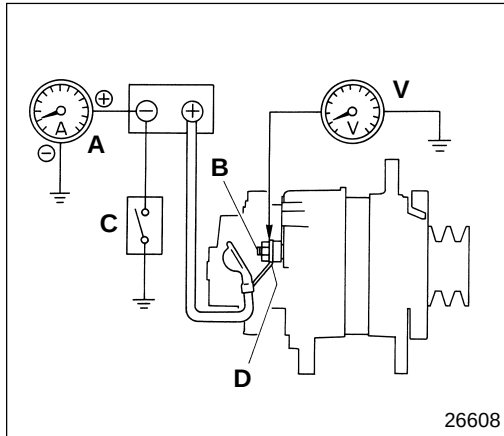
Since the above inspection is only a simplified check, it is necessary to conduct a stringent bench test for an official check.

P54-1-8

Inspection of Regulator

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Adjustment voltage of regulator	14.7±0.3 V	—	Replace



- Connect the meters to the alternator as illustrated.

A : Ammeter (100 amperes class)

B : Terminal B on alternator

C : Switch

D : Terminal

V : Voltmeter

WARNING

- **Terminal D is always loaded with voltage from the battery.**
- **You must handle terminal D carefully, it will short-circuit if it touches any part other than terminal B on the alternator.**

- Turn OFF the lamps, heater, etc., to ensure that there is no electrical loading during inspection.
- Turn switch **C** OFF and start the engine.

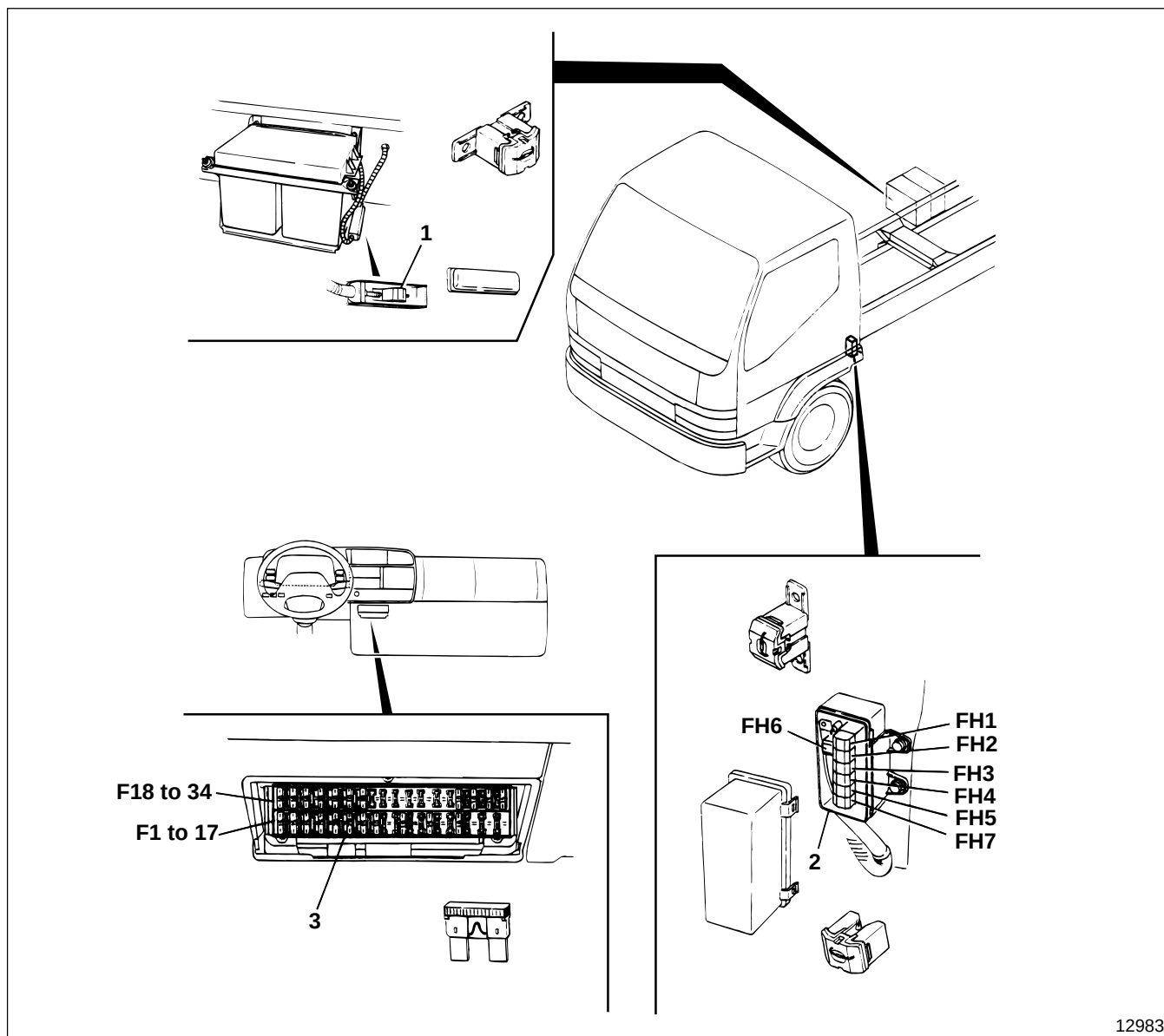
CAUTION

Do not start the engine with switch C turned ON because the starter current will flow into ammeter A and damage it.

- If the charge current is five amperes or less and the engine speed is approximately 2260 rpm, measure the adjustment voltage.
- If the charge voltage is five amperes or more, do one of the following :
 - Run the engine for a while to charge the battery.
 - Replace the old battery with a fully-charged one.
- If the measured value deviates from the standard value, reexamine on the test bench. P54-1-8

104 FUSE

Installation Location



12983

- 1 Main high-current fuse
- 2 High-current fuse box
- 3 Fuse box

CAUTION

- If a fuse blows, make sure you identify and remedy the cause, then replace the fuse.
- Make sure that you replace the fuse with one having the same rating.
- Make sure that you remove the $\ominus$ terminal of the battery cable before removing main high-current fuse 1 and high-current fuses FH1 to 7.  (101) ('96 Model Gr 54 (Pub. No. TWME9502-54))

Main high-current fuse

Fuse No.	Main load	Capacity
—	High-current fuse box	120 A

High-current fuse box

Fuse No.	Main load	Capacity
FH1	Fuse box (F1 to F4)	50 A
FH2	Fuse box (F5 to F8, F11)	40 A
FH3	Brake booster (Hydraulic booster)	50 A
FH4	Starter switch (Terminal B)	50 A
FH5	Glow relay	50 A
FH6	Alternator	120 A
FH7	Fuse box (F31 to F34)	40 A

Fuse box

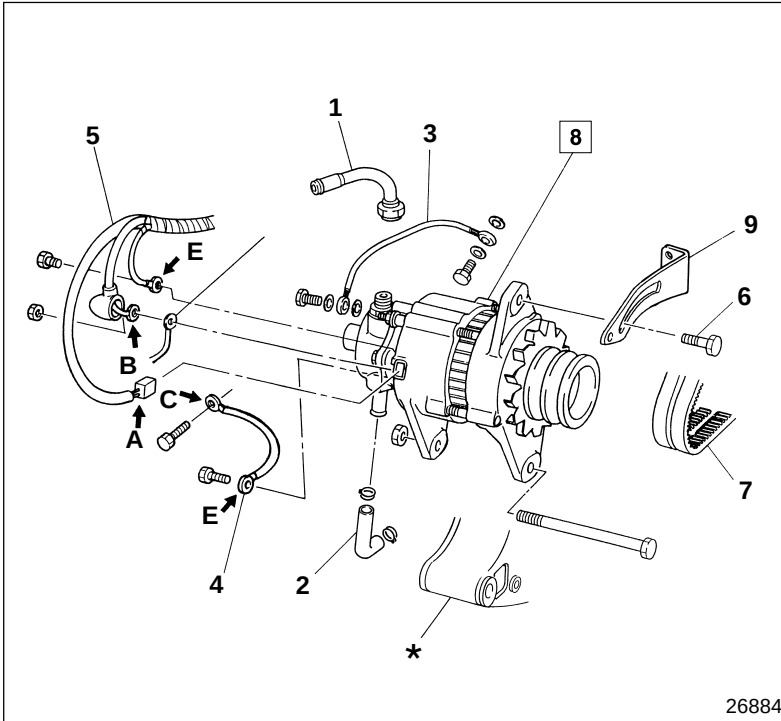
Fuse No.	Main load	Capacity
F1	Headlamp, LH	15 A
F2	Headlamp, RH	15 A
F3	Stop lamp, horn	15 A
F4	Turn signal lamp	15 A
F5	Fuel-cut motor	10 A
F6	Cab lamp	10 A
F7	Reserve power (BATT)	10 A
F8	A/T fluid cooler fan relay	10 A
F9	—	—
F10	—	—
F11	Reserve power (BATT)	10 A
F12	—	—
F13	* Cigarette lighter	15 A
F14	Radio	10 A
F15	Reserve power (ACC)	10 A
F16	—	—
F17	Fuel-cut relay	10 A

Fuse No.	Main load	Capacity
F18	Starter	10 A
F19	Backup lamp	10 A
F20	Meter cluster	10 A
F21	Wiper	10 A
F22	—	—
F23	—	—
F24	—	—
F25	—	—
F26	—	—
F27	Exhaust brake < M/T >	10 A
F28	Transmission PTO	10 A
F29	Pre-stroke cut relay	15 A
F30	* Air-conditioner control	10 A
F31	* Air-conditioner compressor	10 A
F32	* Condenser fan	15 A
F33	Blower fan	25 A
F34	Tail lamp	15 A

* : Fuses are provided for these pieces of equipment only where they are installed.

PTO : Power take-off
A/T : Automatic transmission
M/T : Manual transmission

106 ALTERNATOR



● Removal sequence

- 1 Vacuum pipe
- 2 Oil return hose
- 3 Oil inlet hose
- 4 Ground cable
- 5 Chassis harness
- 6 Adjusting bolt
- 7 V-belts
- 8 Alternator P54-1-10
- 9 Adjusting plate

* : Timing gear case and front plate

Gr 11

A : To terminals L and R

B : To terminal B

C : Connected to crankcase

E : To terminal E

WARNING

- Terminal B is always loaded with voltage from the battery, supplied via chassis harness 5. Therefore when you remove the harness from terminal B, make sure that tools do not touch any adjacent parts because this would cause a short-circuit.
- Make sure that you disconnect terminal of the battery before removing the harness and insulate the terminal with tape.

● Installation sequence

Follow the removal sequence in reverse.

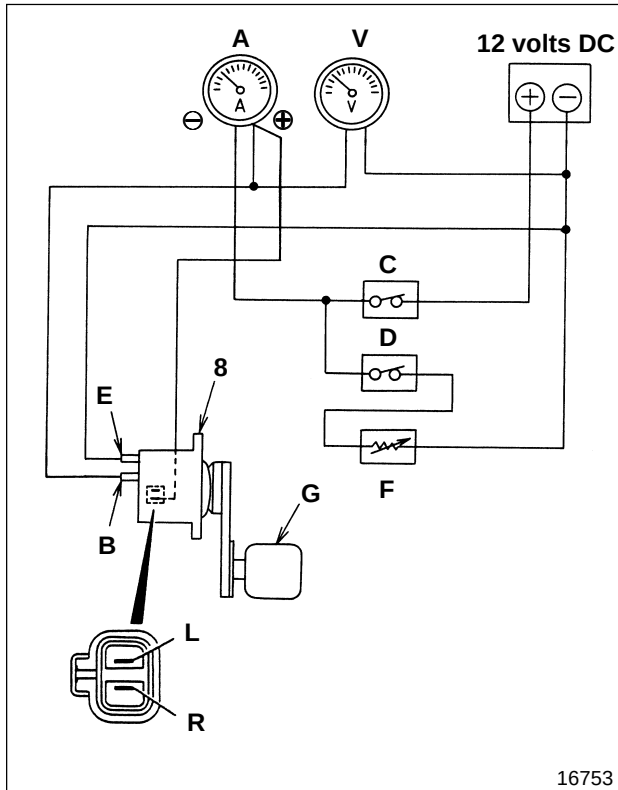
● Adjustment after installation

Adjustment of V-belt 7 tension Gr 14

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
8	Output current (* When engine is hot and 13.5 V is loaded)	At 1500 rpm	37 A or more	—	Inspect
		At 2500 rpm	64 A or more	—	
		At 5000 rpm	75 A or more	—	
	Adjustment voltage of regulator (At 5000 rpm, 5 A is loaded)		14.7±0.3 V	—	Replace

* : The value of the ambient temperature is measured after running the engine at maximum power (5000 rpm) for 30 minutes.



8 Inspection of alternator

(1) Inspection of alternator performance (bench test)

- Connect each unit to alternators **8** as illustrated.

CAUTION ⚠

Use sufficiently thick wires for the wiring and make sure all connecting parts are securely connected.

- A : Ammeter
- B : Terminal B on alternator
- C : Switch
- D : Switch
- E : Terminal E on alternator
- F : Load resistance (variable resistance)
- G : Alternator drive motor
- L : Terminal L on alternator
- R : Terminal R on alternator
- V : Voltmeter

- Maximize load resistance **F** (load current hardly flows).
- Warm-up alternator **8** by letting it run for 30 minutes at 5000 rpm.

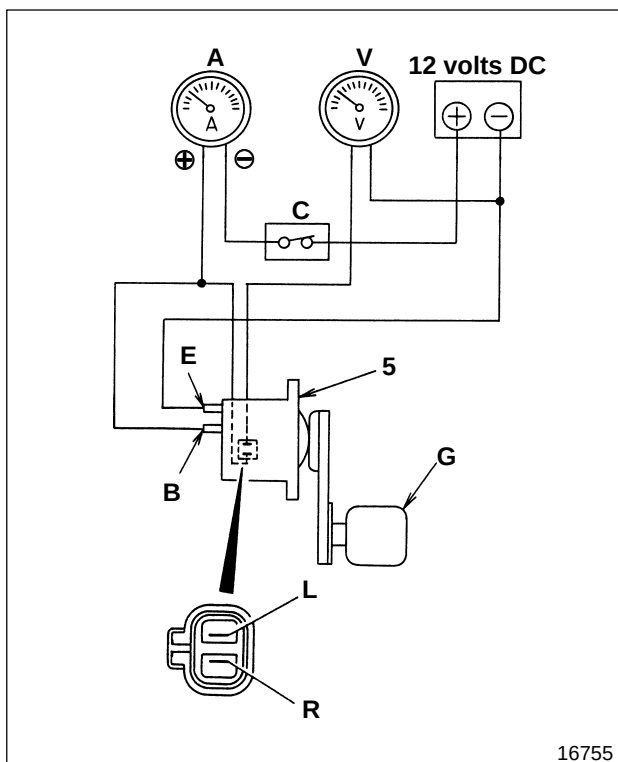
- Turn switches **C**, **D** ON.
- Adjust load resistance **F** to maintain the specified current.
Specified output of the alternator : 12 V-80 A
- Increase the rotation of alternator **8** gradually and measure current at specified rpm.
- If the measured value deviates from the standard value, disassemble and inspect alternator **8**. P54-1-10

(2) Inspection of regulator (bench test)

- Connect each unit to the alternators as illustrated.

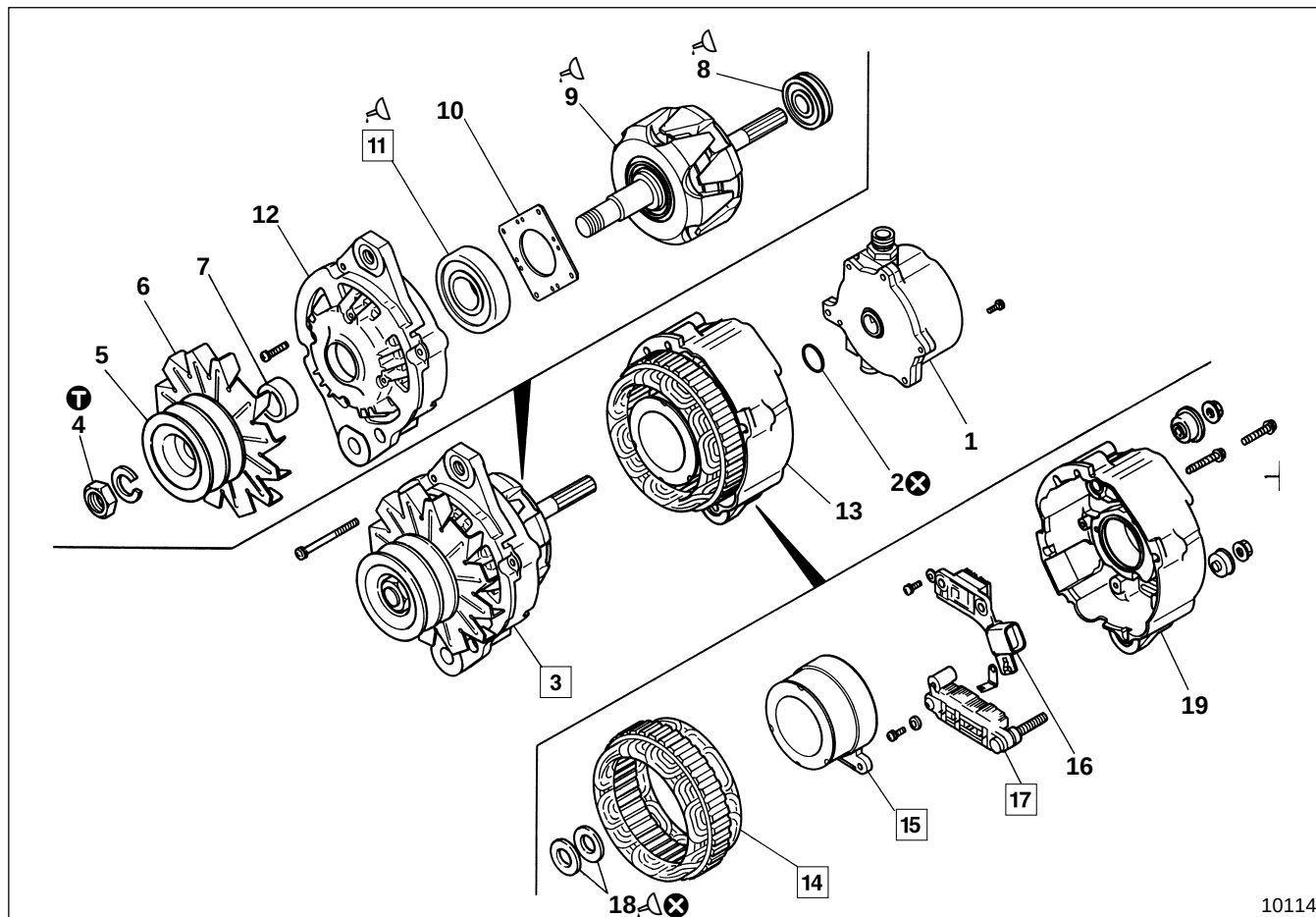
- A : Ammeter
- B : Terminal B on alternator
- C : Switch
- E : Terminal E on alternator
- G : Alternator drive motor
- L : Terminal L on alternator
- R : Terminal R on alternator
- V : Voltmeter

- Turn switch **C** ON.
- Run alternator **8** at low speed.
- Measure the voltage (adjustment voltage) when alternator **8** has reached a speed of 5000 rpm. Make sure at such time that the value of the current is five amperes or less.
- If the measured value deviates from the standard value, perform either of the following.
 - If the measured value is higher than the standard value : Replace the regulator
 - If the measured value is lower than the standard value : Before replacing the regulator check the alternator area.



106 ALTERNATOR

Alternator



10114

● Disassembly sequence

- | | |
|------------------------------------|-------------------------------------|
| 1 Vacuum pump | 12 Front bracket |
| 2 O-ring | 13 Stator and rear bracket assembly |
| 3 Rotor and front bracket assembly | 14 Stator assembly |
| 4 Nut | 15 Field coil |
| 5 Pulley | 16 Regulator |
| 6 Fan | 17 Rectifier |
| 7 Spacer | 18 Oil seal |
| 8 Rear bearing | 19 Rear bracket |
| 9 Rotor assembly | |
| 10 Cover | |
| 11 Front bearing | |
- ⊗ : Non-reusable parts

NOTE

Do not remove parts 8, 11, 14 unless they are faulty.

● Assembly sequence

13 → 3 → 2 → 1

13 :

19 → 18
16 → 17 → 15 → 14

3 :

12 → 11 → 10
9 → 8 → 7 → 6 → 5 → 4

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
15	Field coil resistance (20°C {68°F})	2.6 to 3.1 Ω	—	Replace

Tightening torque

Unit : N·m {lbf.ft, kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Nut (Pulley mounting)	132 to 162 {98 to 120, 13.5 to 16.5}	—

Lubricant

Location	Points of application	Specified lubricant	Quantity
8	Rear bearing inner periphery	Engine oil	As required
9	Front bearing installation part of rotor assembly	Engine oil	As required
11	Front bearing outer periphery	Engine oil	As required
18	Oil seal lip area	Idemitsu Autolex	As required

Service procedure

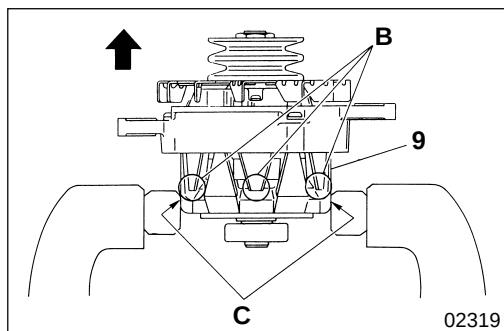
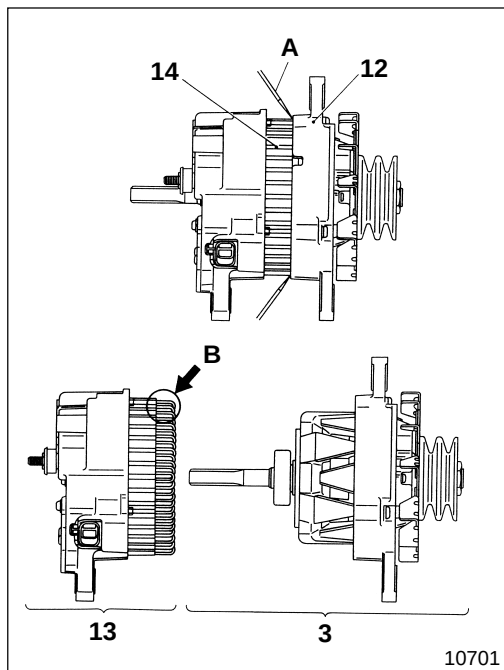
3 Rotor and front bracket assembly

[Removal]

- Insert screwdriver **A** between front bracket **12** and stator assembly **14**.
- Use screwdriver **A** to pry rotor and front bracket assembly **3** away from stator and rear bracket assembly **13**.

CAUTION

Be careful not to insert the screwdriver too deep or it will damage coil **B** of stator assembly **14** and might cause a short-circuit.

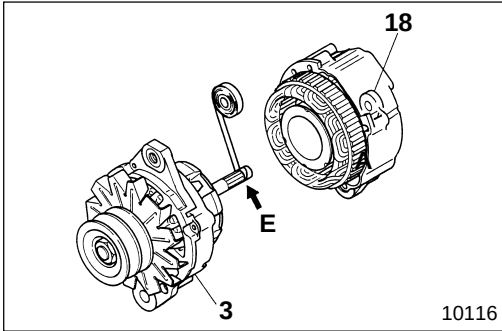


[Disassembly]

CAUTION

Make sure, when you hold rotor assembly **9** in a vise, to grip root **C** of the core claws. Gripping claws **D** can damage them.

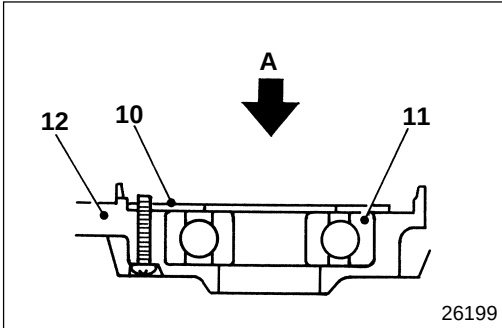
106 ALTERNATOR



[Installation]

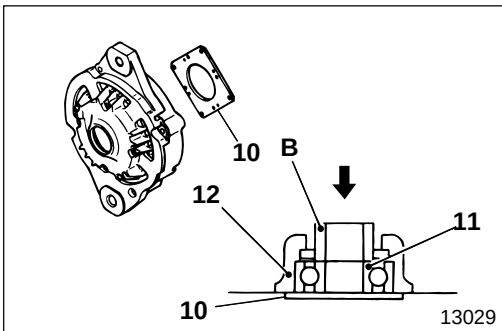
CAUTION ⚠

To prevent damaging oil seal 18 during assembly, cover spline area E of the shaft of rotor and front bracket assembly 3 with tape.

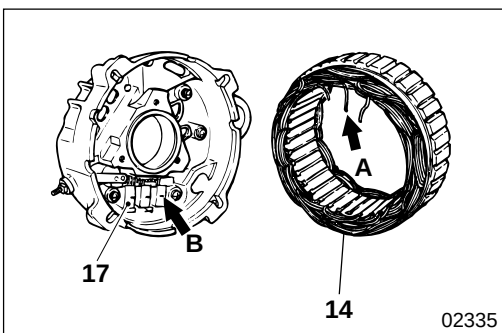


11 Installation of front bearing

- Press-fit front bearing 11 until it is flush with the installation part of cover 10.
- A : Press



- Install cover 10.
- Press spacer B until it makes contact with front bearing 11 and cover 10, using a press.



14 Stator assembly

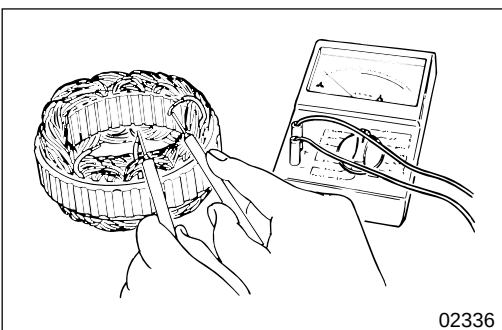
[Removal and installation]

- Disconnect lead A of stator assembly 14 from rectifier 17. The lead is soldered to diode B of rectifier 17 at three points.

CAUTION ⚠

Make sure that you desolder within five seconds because the diode is heat sensitive.

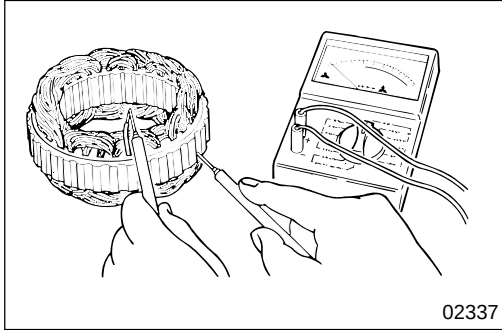
- To install, follow the removal sequence in reverse.



[Inspection]

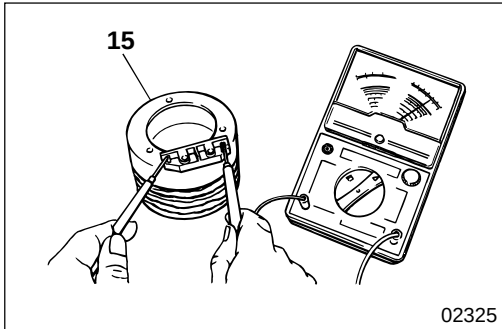
(1) Continuity of each lead wire

- Make sure that each lead wire has continuity.
- If there is no continuity, the lead wire is broken. Replace stator assembly 14.



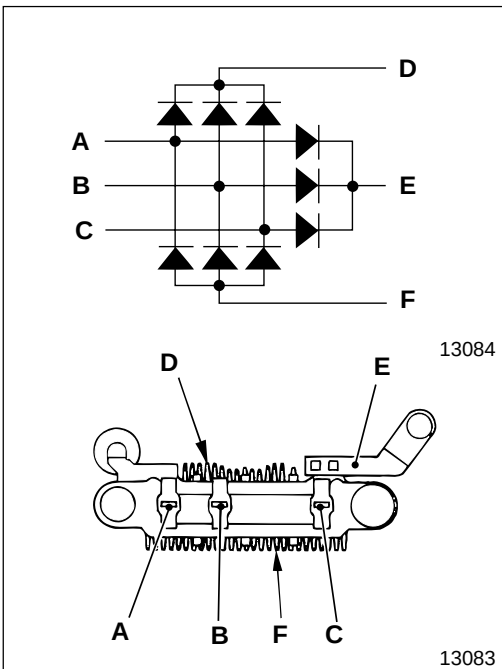
(2) Continuity between lead wires and the core

- Make sure that there is no continuity between lead wires and the core.
- If there is continuity, replace stator assembly **14**, since it might be short-circuited.



15 Inspection of field coil

- Measure the resistance between the terminals of field coil **15**.
- If the measured value deviates from the standard value, replace field coil **15**.



17 Inspection of rectifier

- Inspect whether the diode inside rectifier **17** 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.

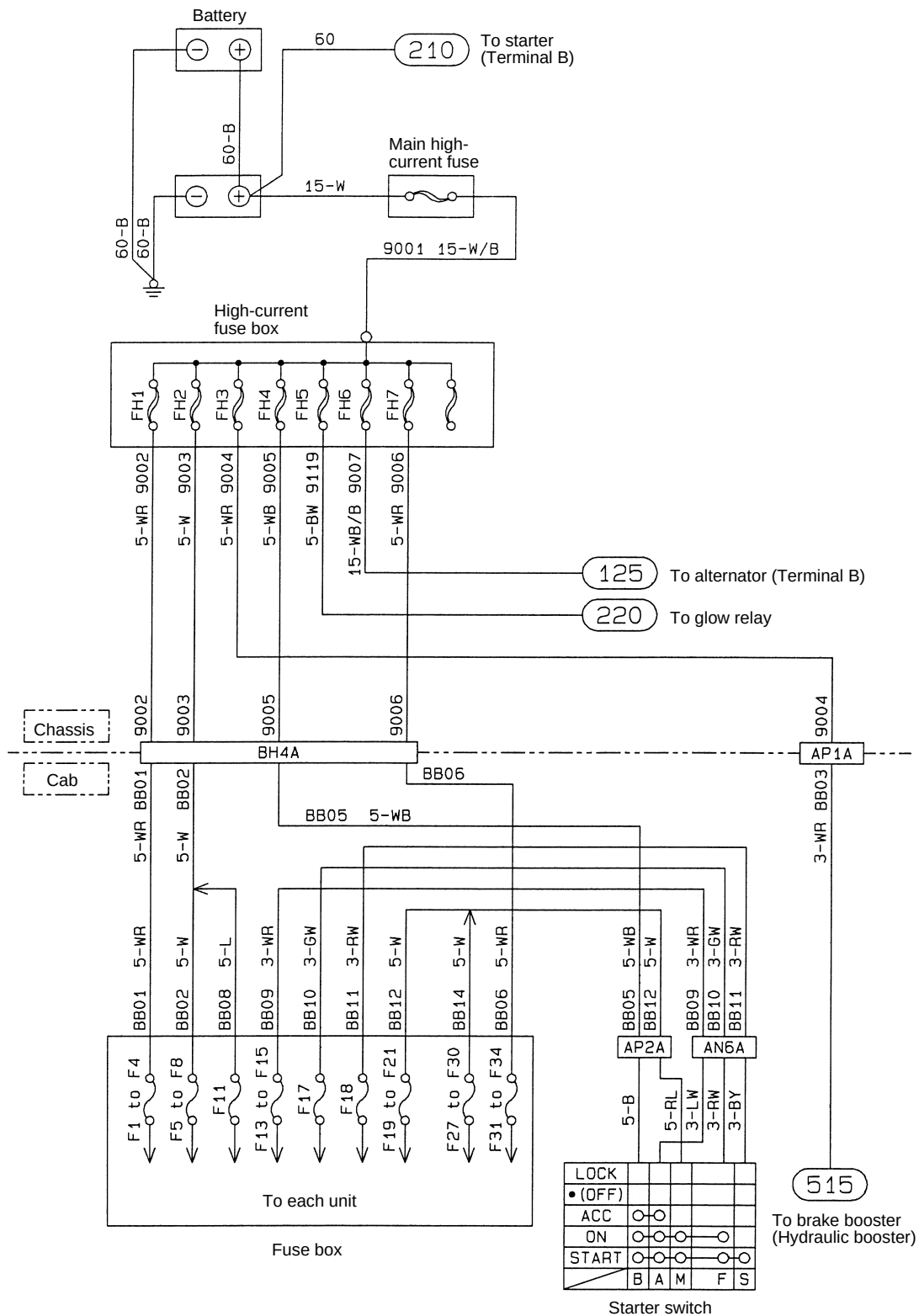
CAUTION

When inspecting using a tester, the current becomes weaker than the usual current flowing through rectifier **17**. Therefore, an incomplete resistance value might be indicated.

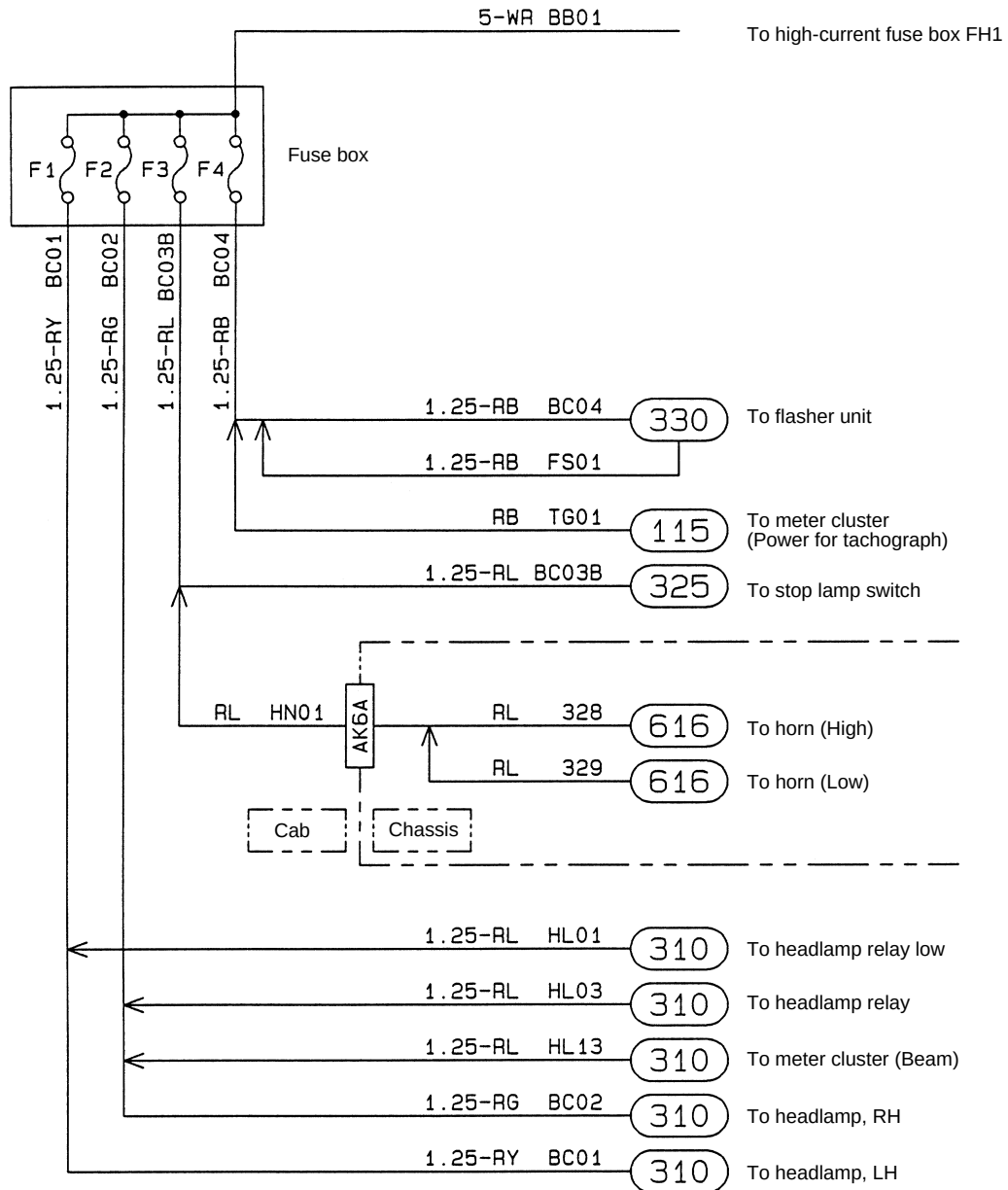
Also, this tendency increases as the range of the tester gets smaller. Therefore, use as large range as possible.

110 POWER CIRCUIT

Power Supply (Battery to High-current Fuse Box and Fuse Box)

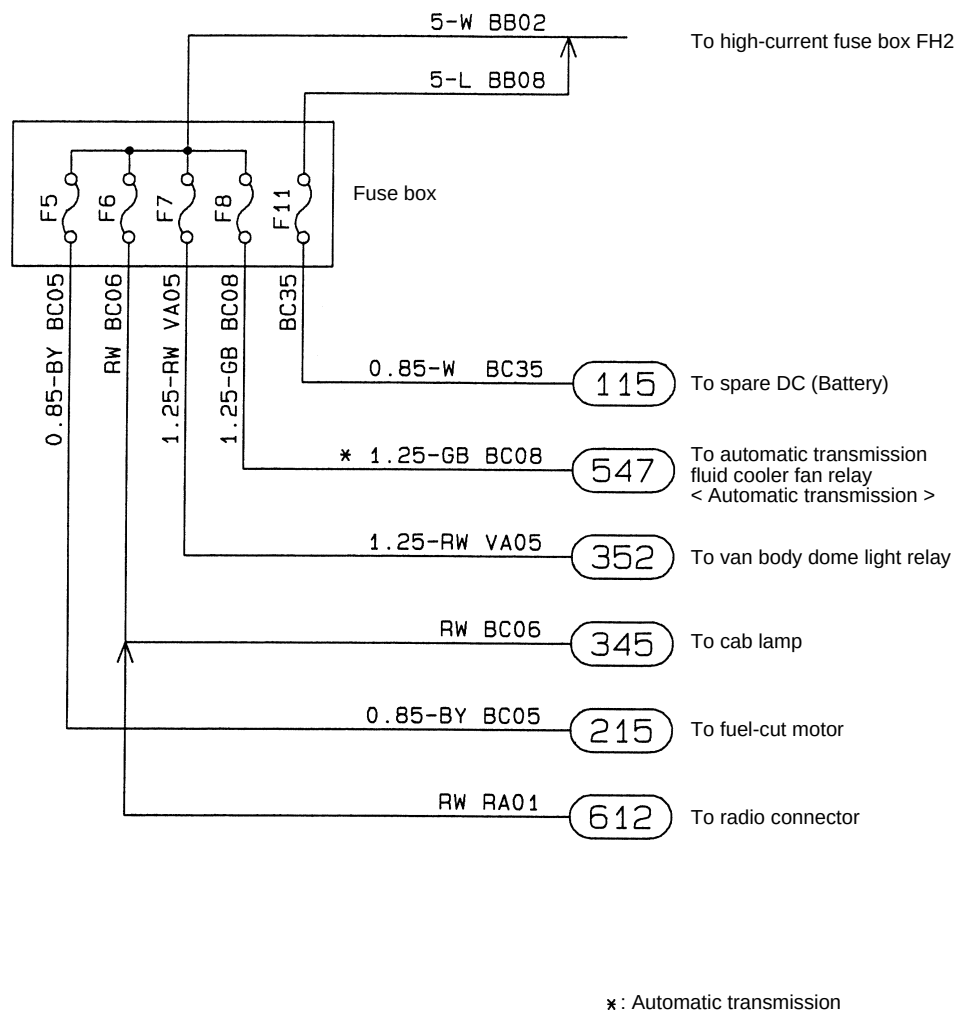


Fuses F1 to F4

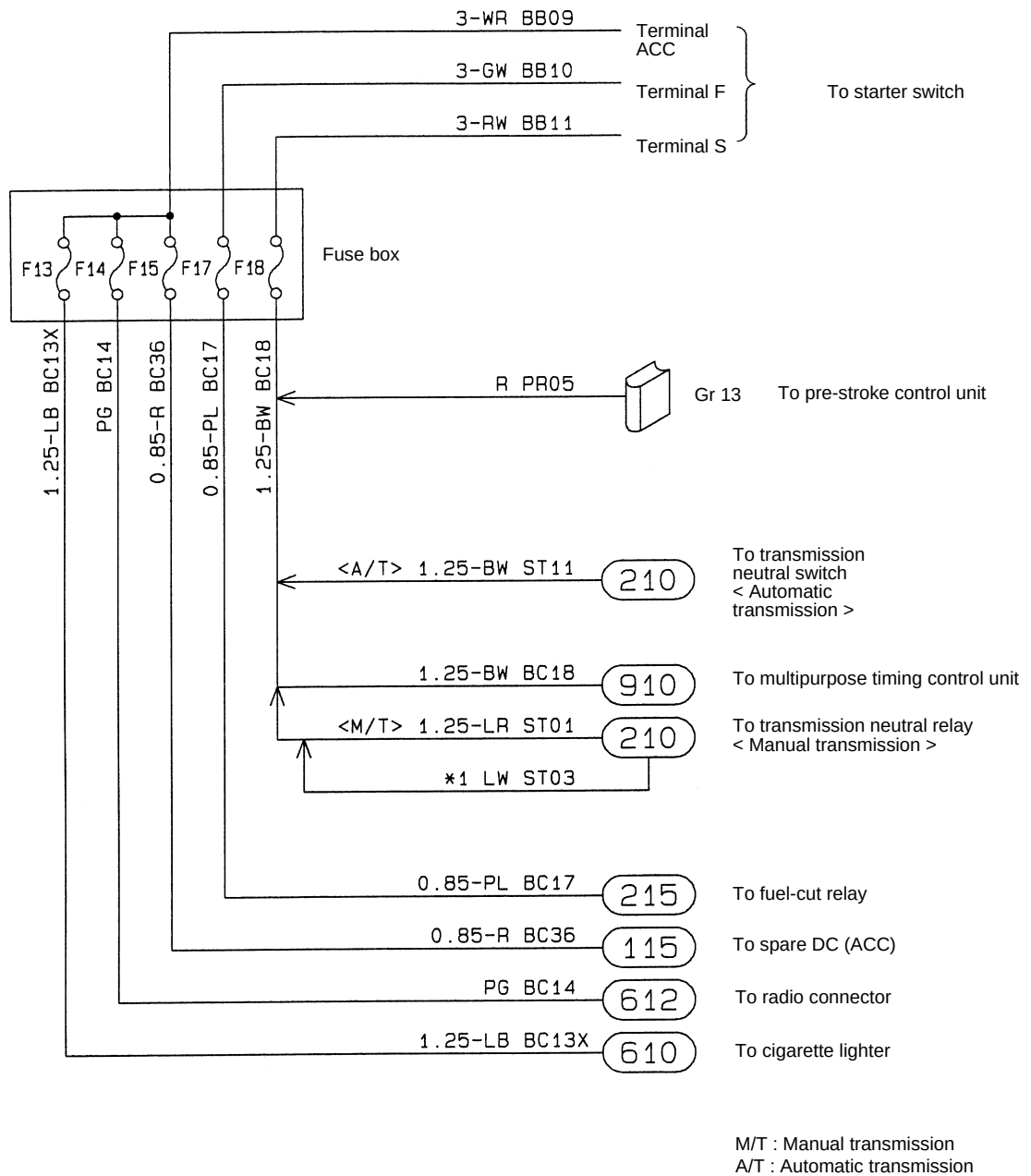


110 POWER CIRCUIT

Fuses F5 to F8, F11

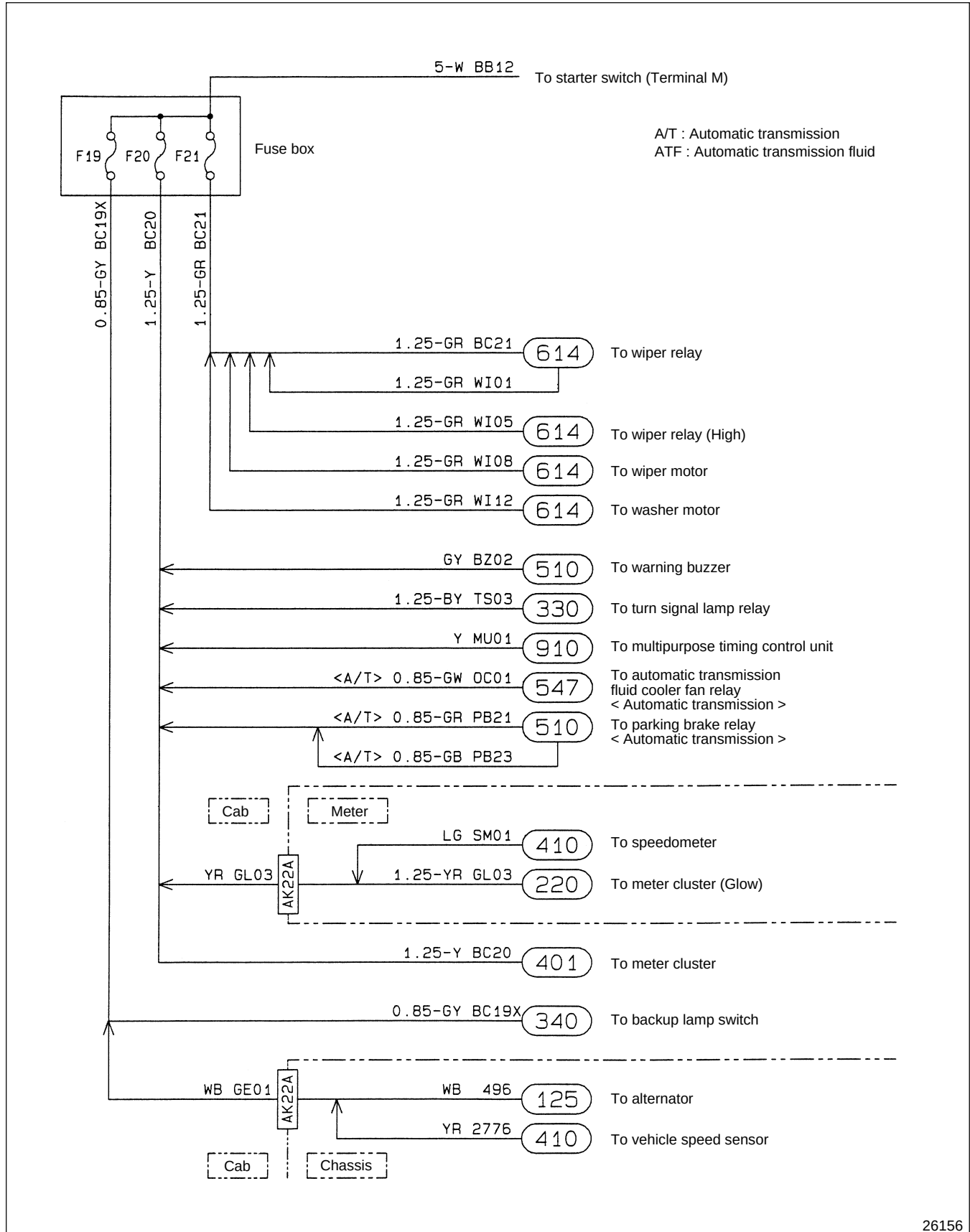


Fuses F13 to F18

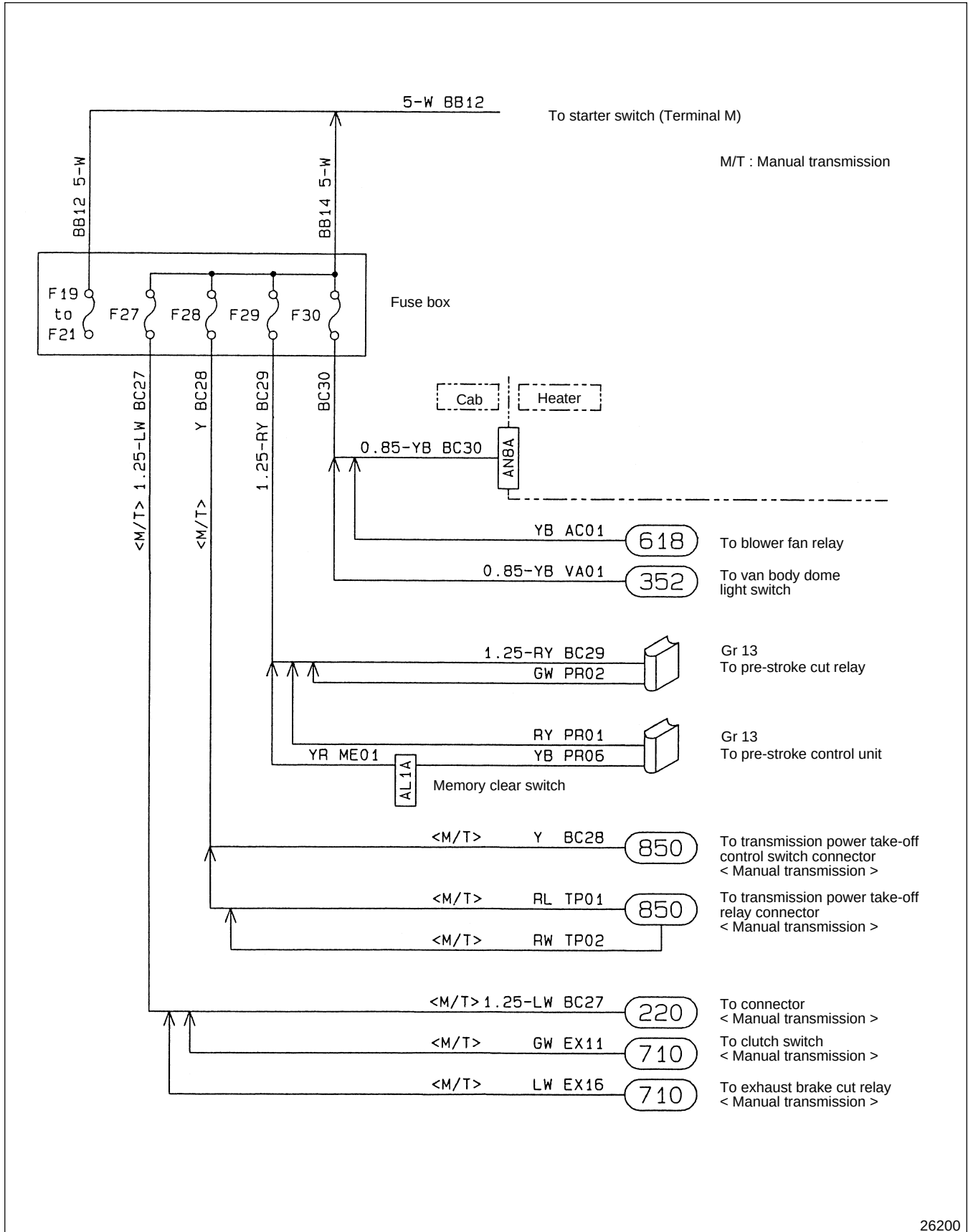


110 POWER CIRCUIT

Fuses F19 to F21

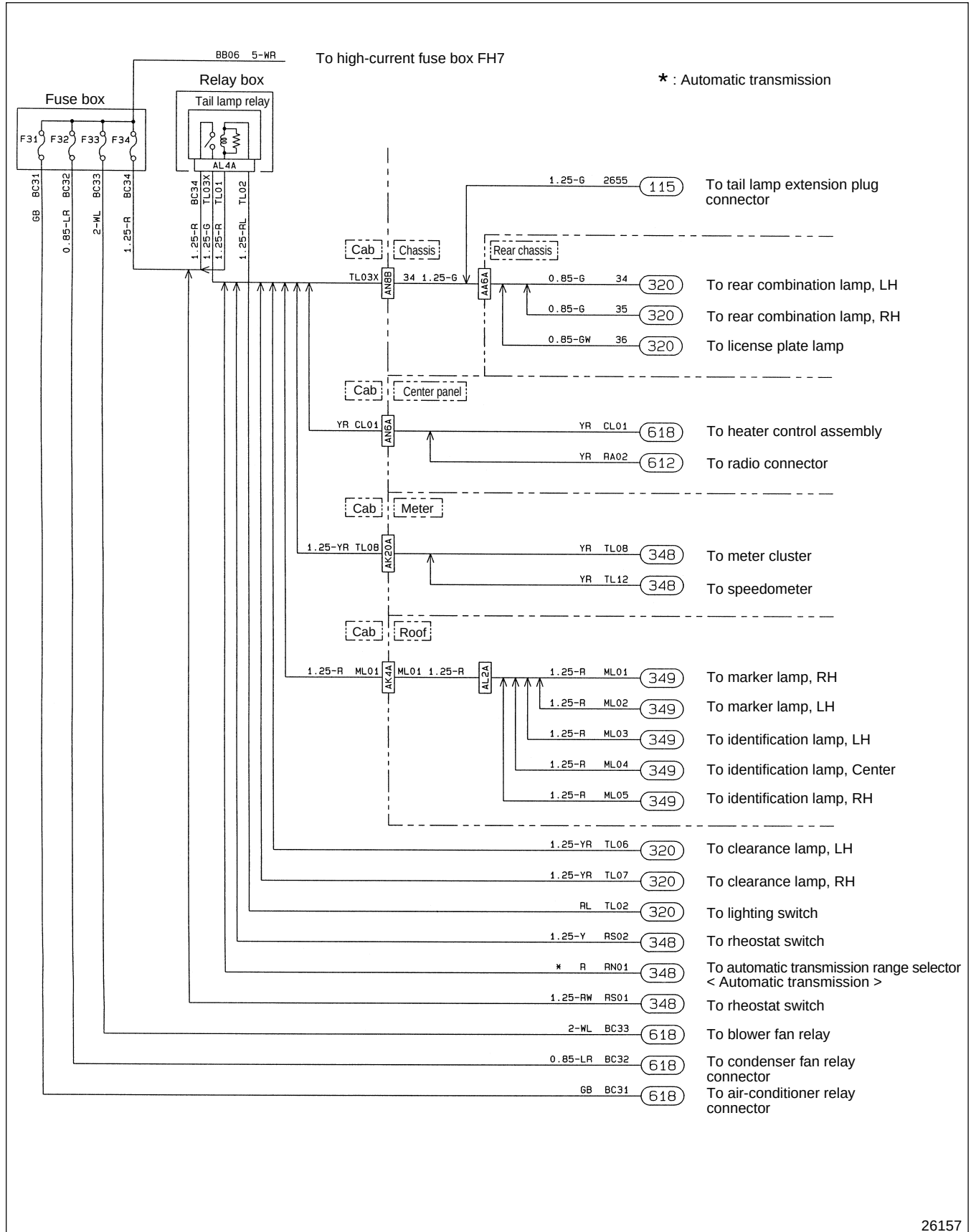


Fuses F27 to F30



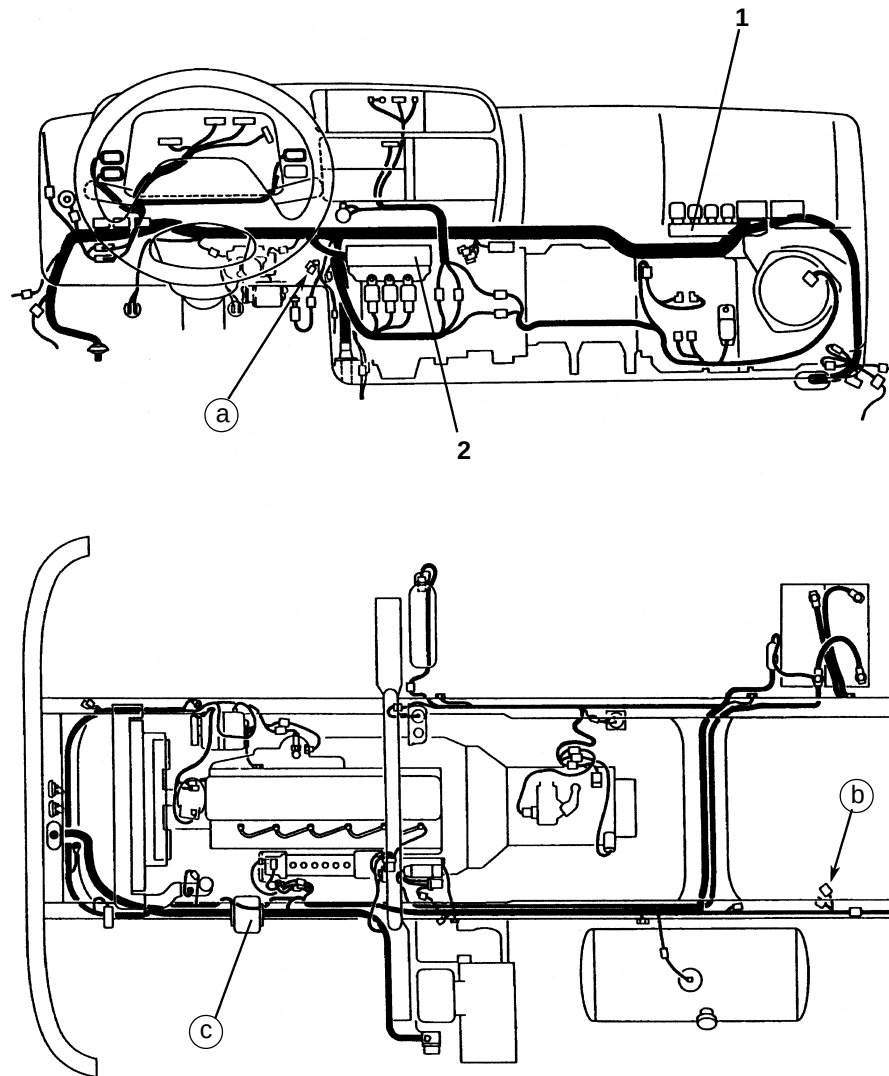
110 POWER CIRCUIT

Fuses F31 to F34



MEMO





26885

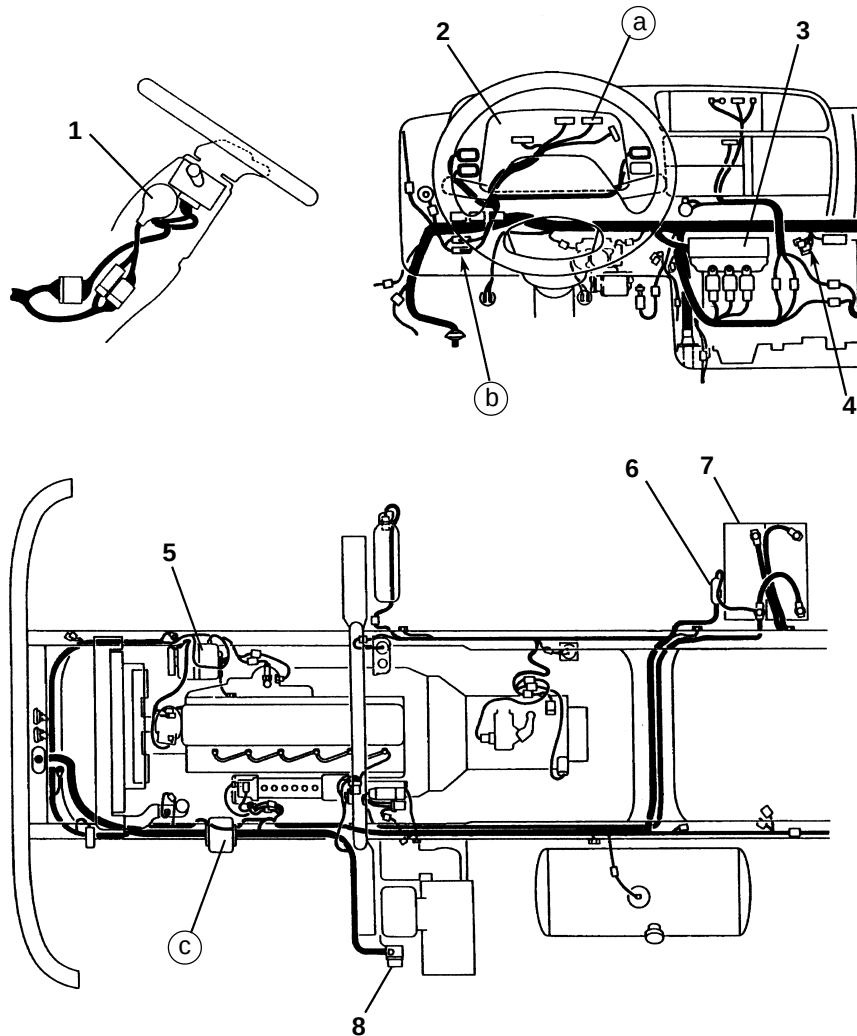
- 1 Relay box  (604)
 2 Fuse box  (104)

For information on the following equipment, refer to the manuals indicated.

- Transmission power take-off  (850)
- Van body dome light  (352)
- Air-conditioner  (618)

 : '96 model Gr 54 (TWME 9502-54)





26886

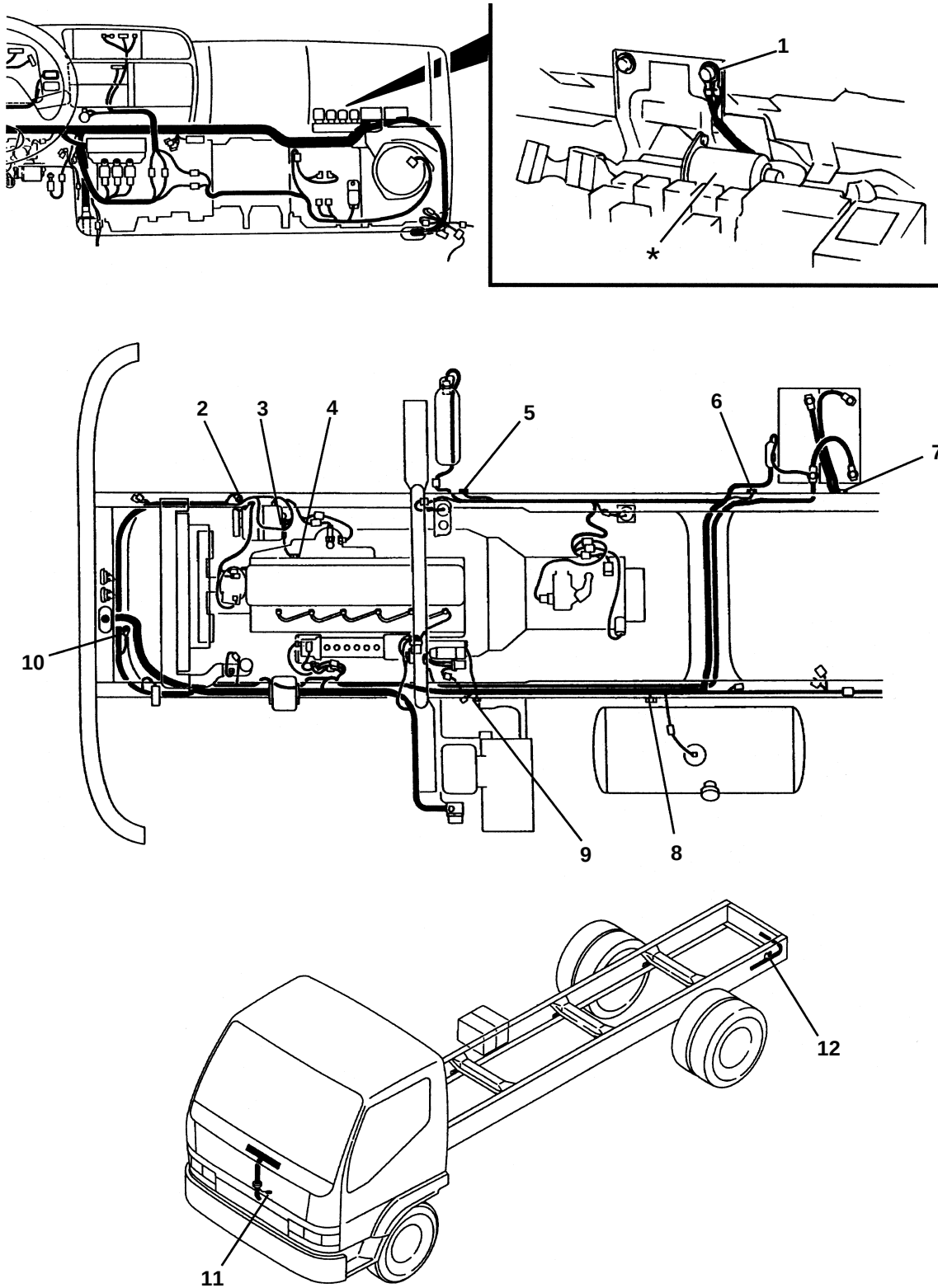
- 1 Starter switch (210)
- 2 Meter cluster (401)
- 3 Fuse box (104)
- 4 Diode

- 5 Alternator (106)
- 6 Main high-current fuse (104)
- 7 Battery (101)
- 8 High-current fuse box (104)

: '96 Model Gr 54 (Pub. No. TWME9502-54)

130 GROUND

Ground Point



26887

* : Wiper motor

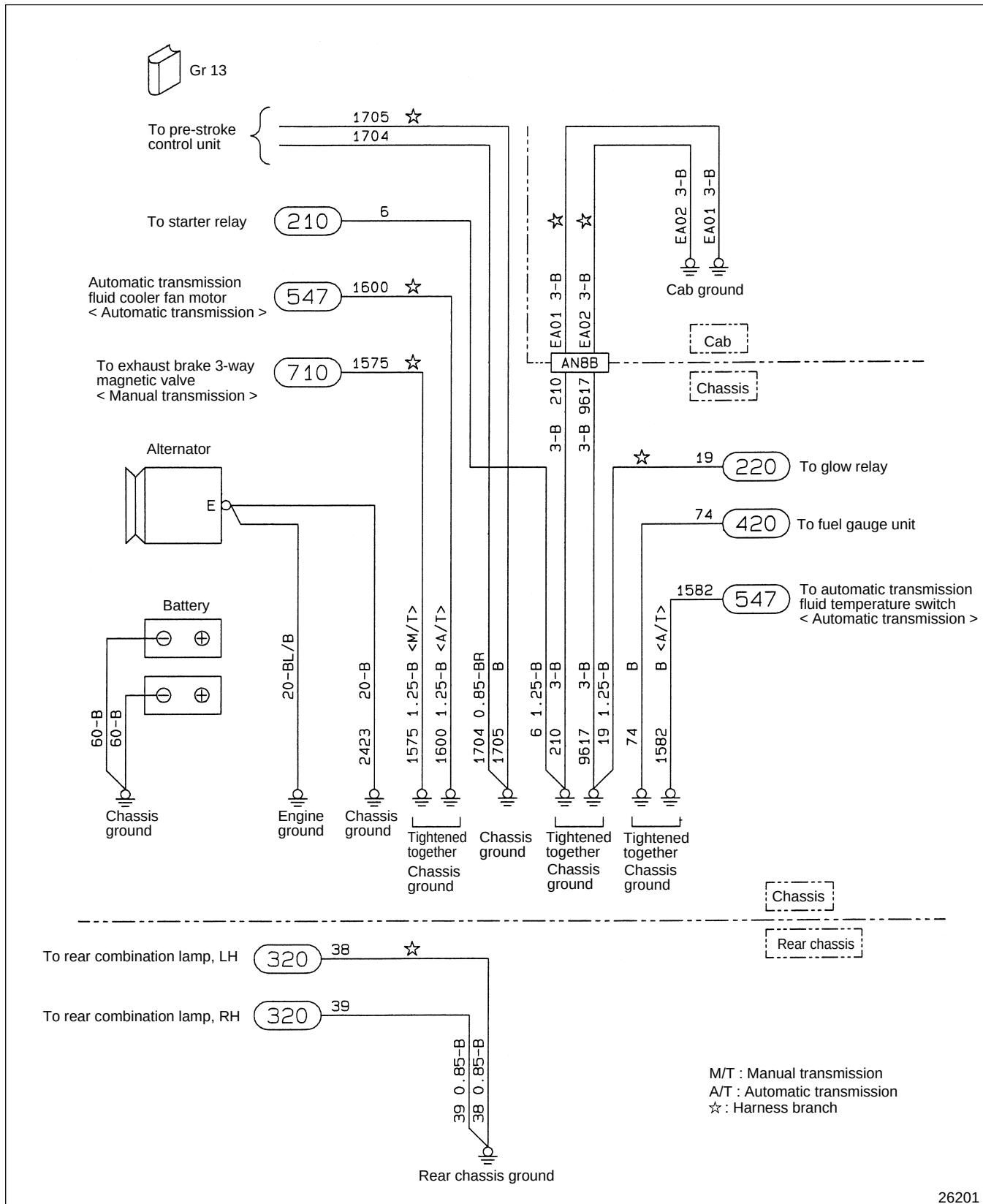
Location	Name	Circuit No.	Wire diameter-wire color	Remarks
1	Cab ground	EA01	3-B	
2	Chassis ground	2423	20-BL/B	
3	Alternator ground	2423	20-BL/B	
4	Alternator ground	—	5-B	
5	Chassis ground	1575	1.25-B	
		1600	1.25-B	A/T
6	Chassis ground	1704	0.85-BR	
		1705	B	
7	Battery ground	—	60-B	
8	Chassis ground	74	B	
		1582	B	A/T
9	Engine ground	—	—	
10	Chassis ground	6	1.25-B	
		19	1.25-B	
		210	3-B	
		9617	3-B	
11	Cab ground	EA02	3-B	
12	Rear chassis ground	38	0.85-B	
		39	0.85-B	

A/T : Automatic transmission

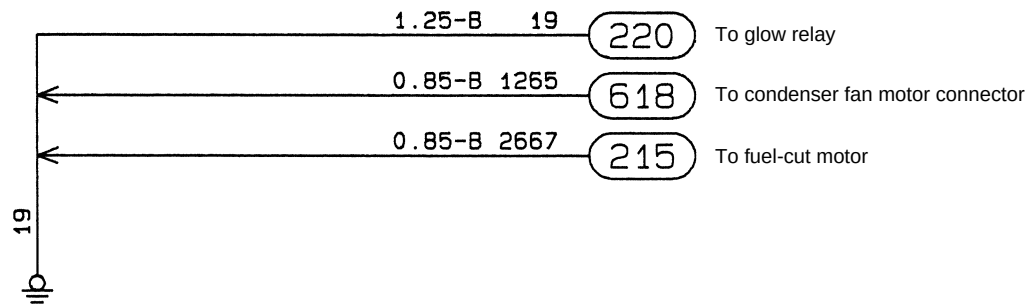
130 GROUND

Entire Ground

- This diagram indicates grounding points.
- See the following pages for branching of grounding (wiring for ☆). (in circuit No. order)

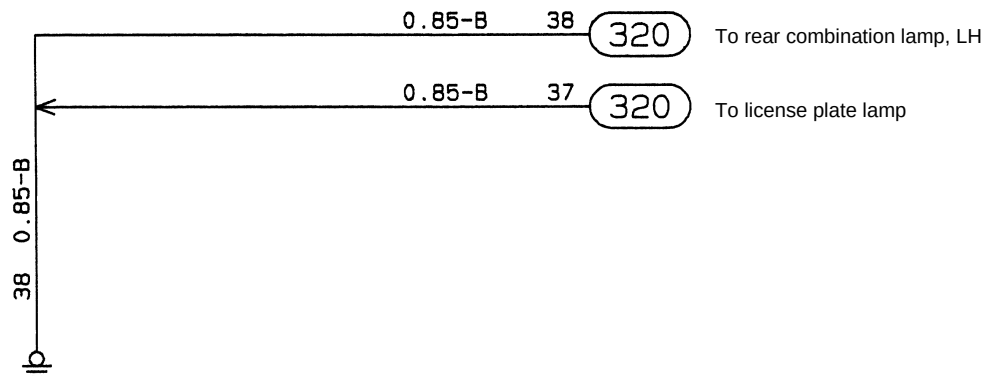


Circuit No.19 Chassis Ground



12027

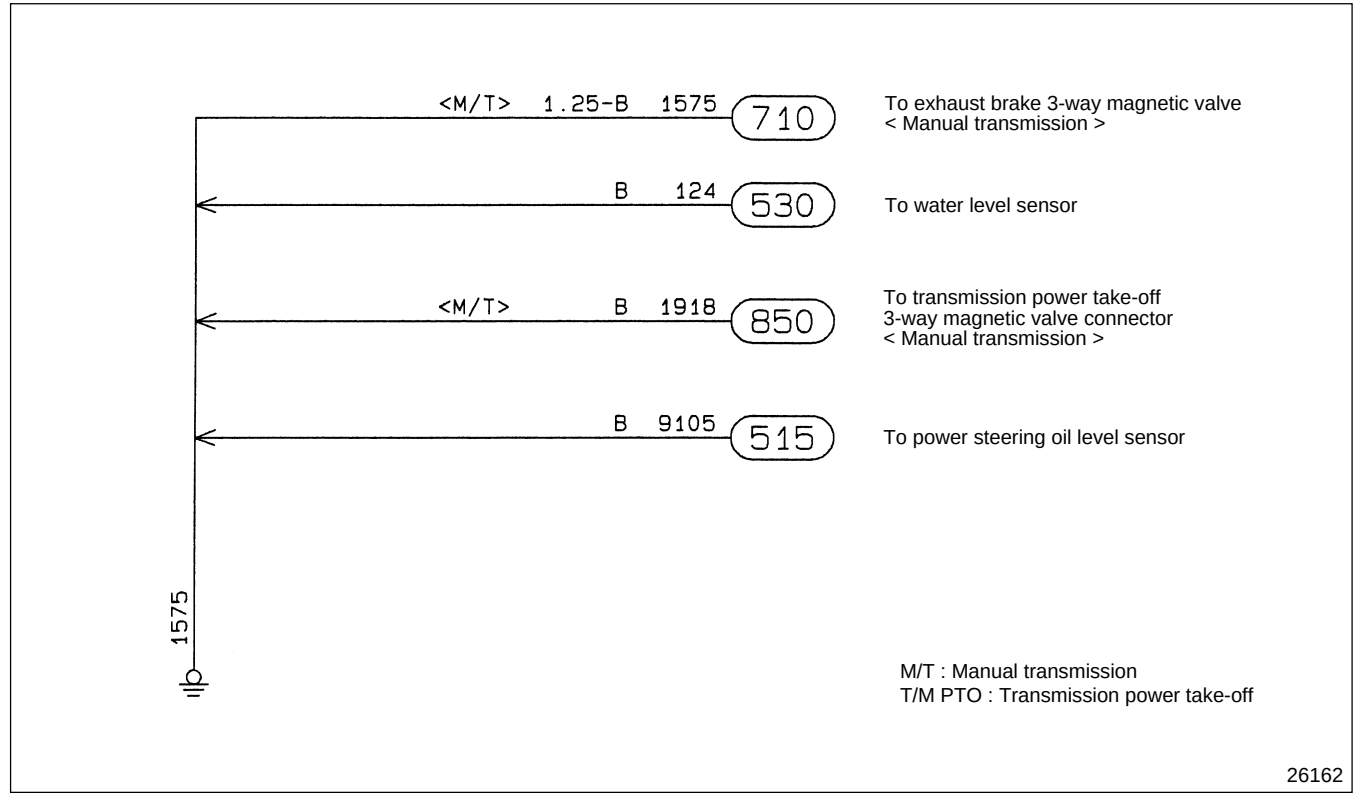
Circuit No.38 Rear Chassis Ground



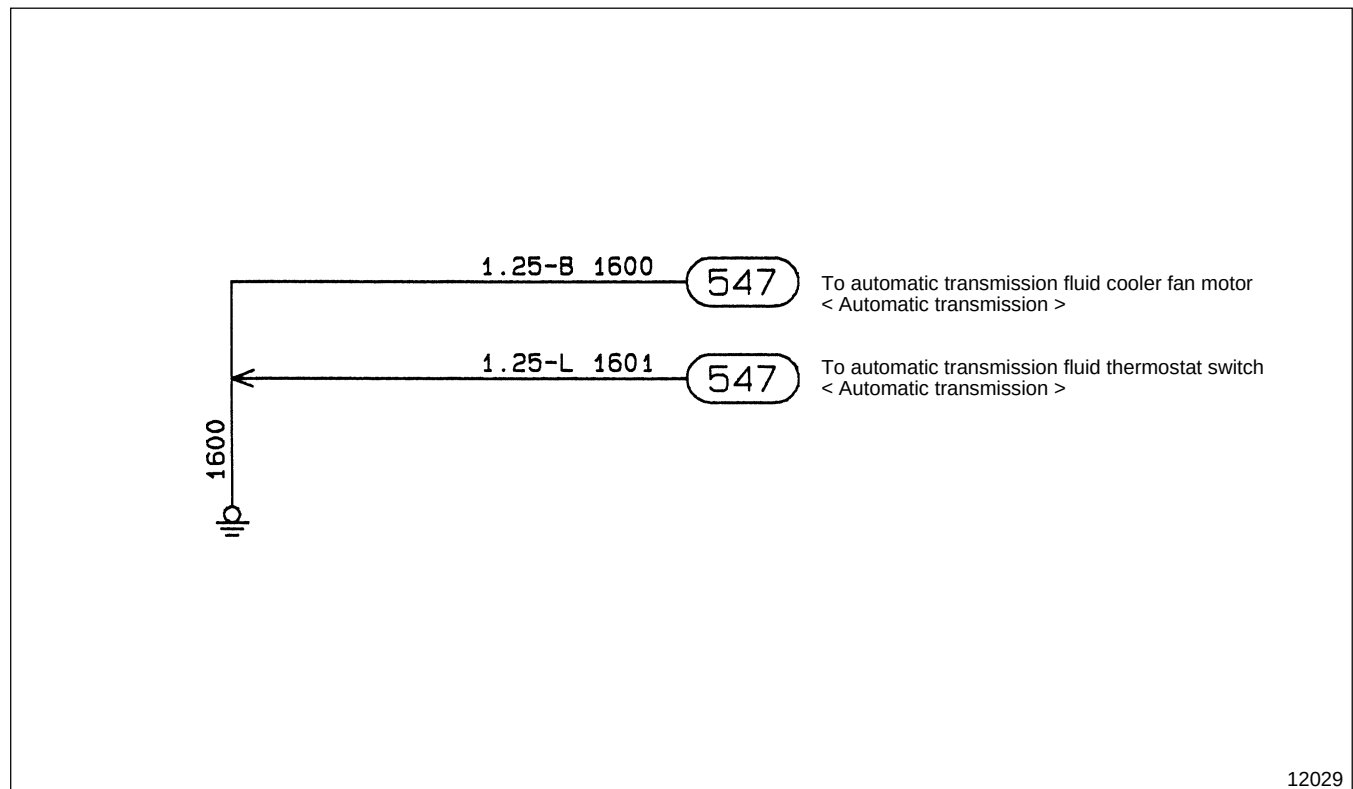
12031

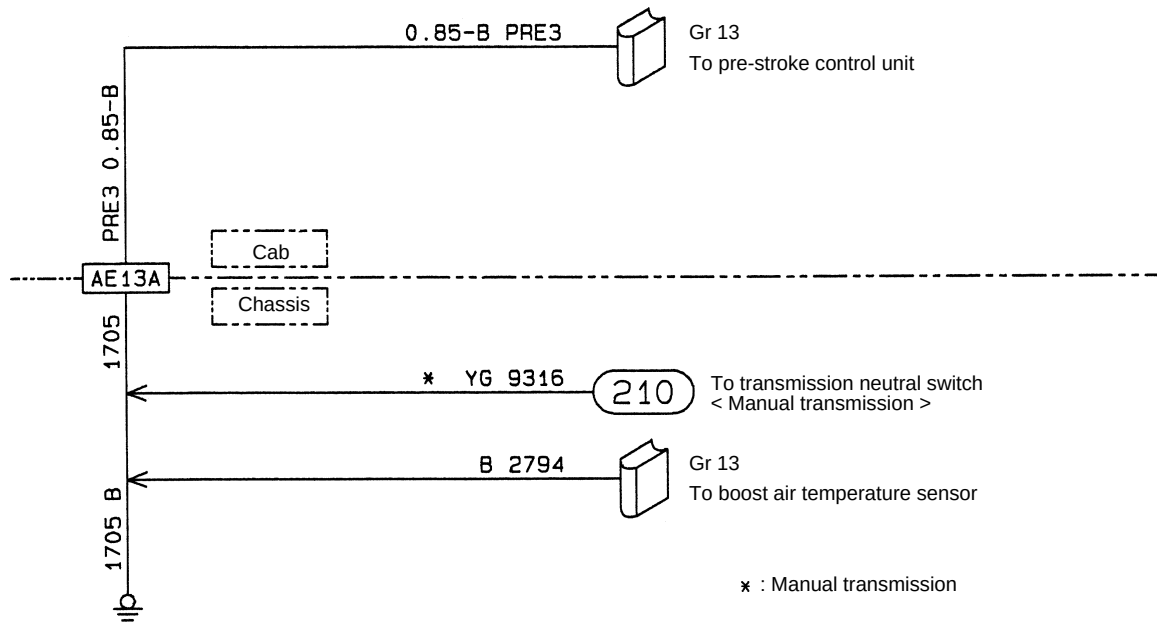
130 GROUND

Circuit No.1575 Chassis Ground



Circuit No.1600 Chassis Ground < Only for Automatic Transmission >

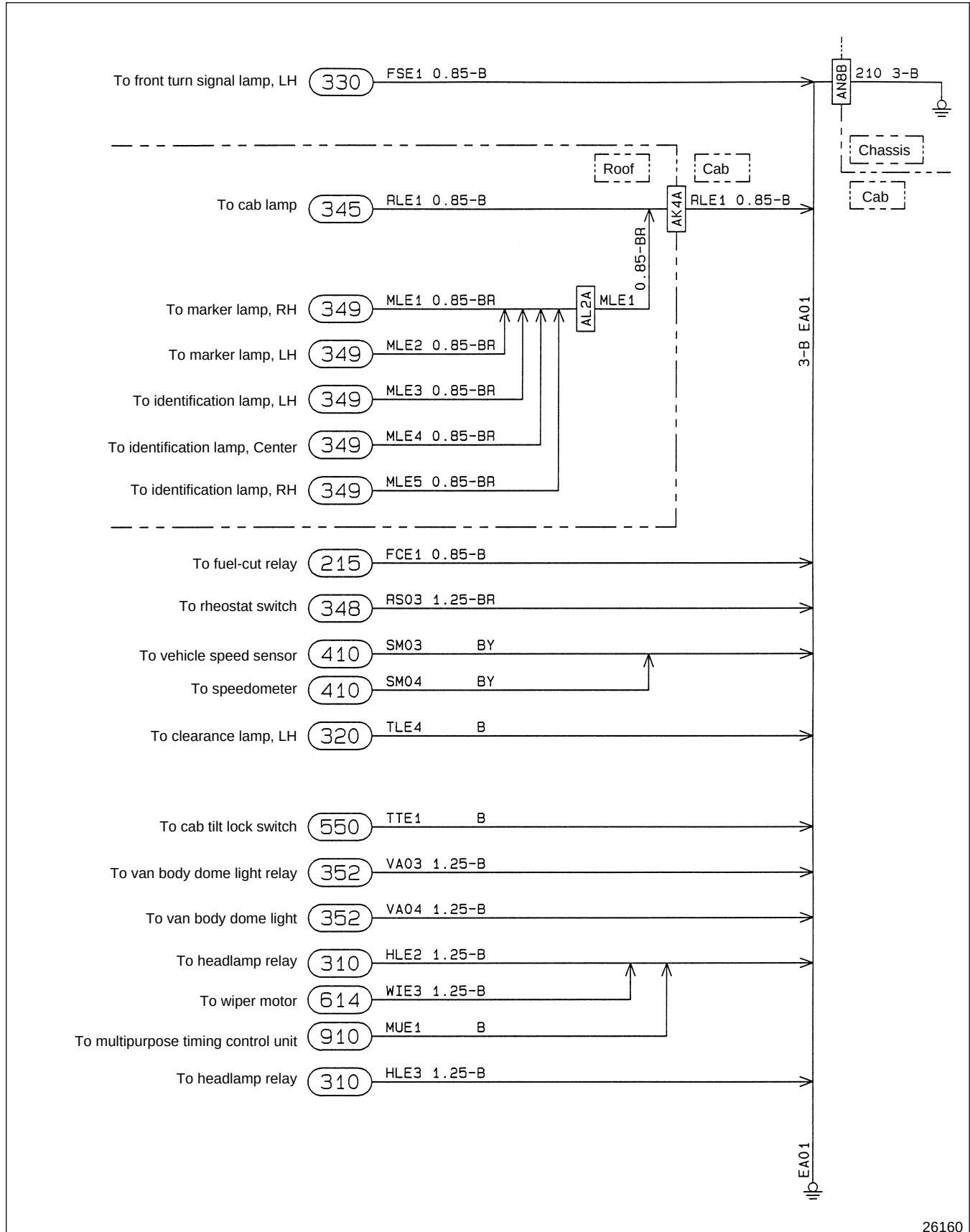


Circuit No.1705 Chassis Ground

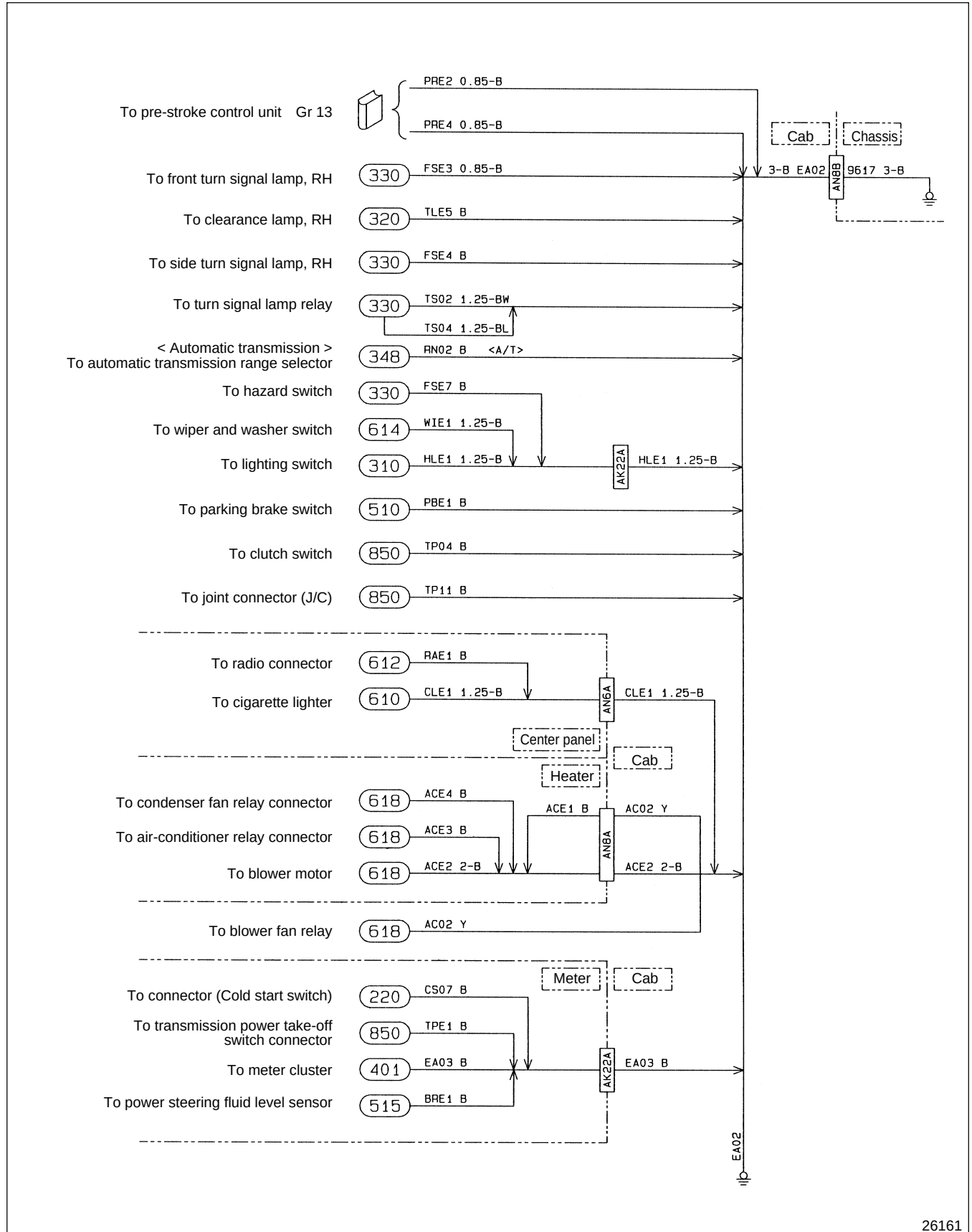
12028

130 GROUND

Circuit No.EA01 Cab Ground



Circuit No.EA02 Cab Ground

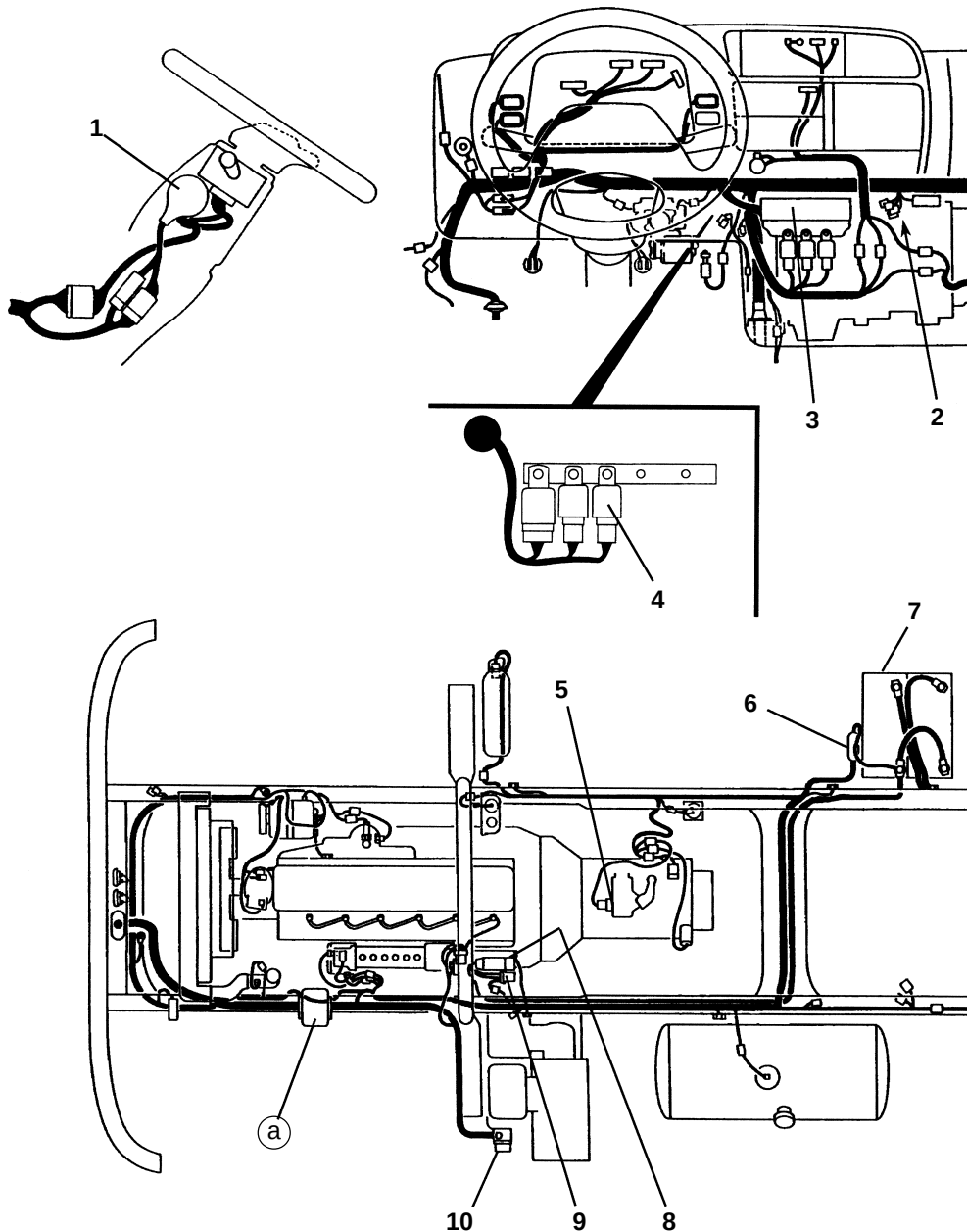


2 STARTING, PREHEATING AND STOPPING ENGINE

SPECIFICATIONS	
STRUCTURE AND OPERATION	
TROUBLESHOOTING	
(200) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Inspection of Engine Preheating System	
(201) STARTER	
(210) ENGINE STARTING CIRCUIT	
< Manual Transmission >	54-2-2
< Automatic Transmission >	
(215) ENGINE STOPPING CIRCUIT	
(220) ENGINE PREHEATING CIRCUIT	
< Manual Transmission >	54-2-4
< Automatic Transmission >	* 

 : '96 Model Gr 54 (Pub. No. TWME9502-54)
*****  : '97 Model Gr 54 (Pub. No. TWME9502-1)



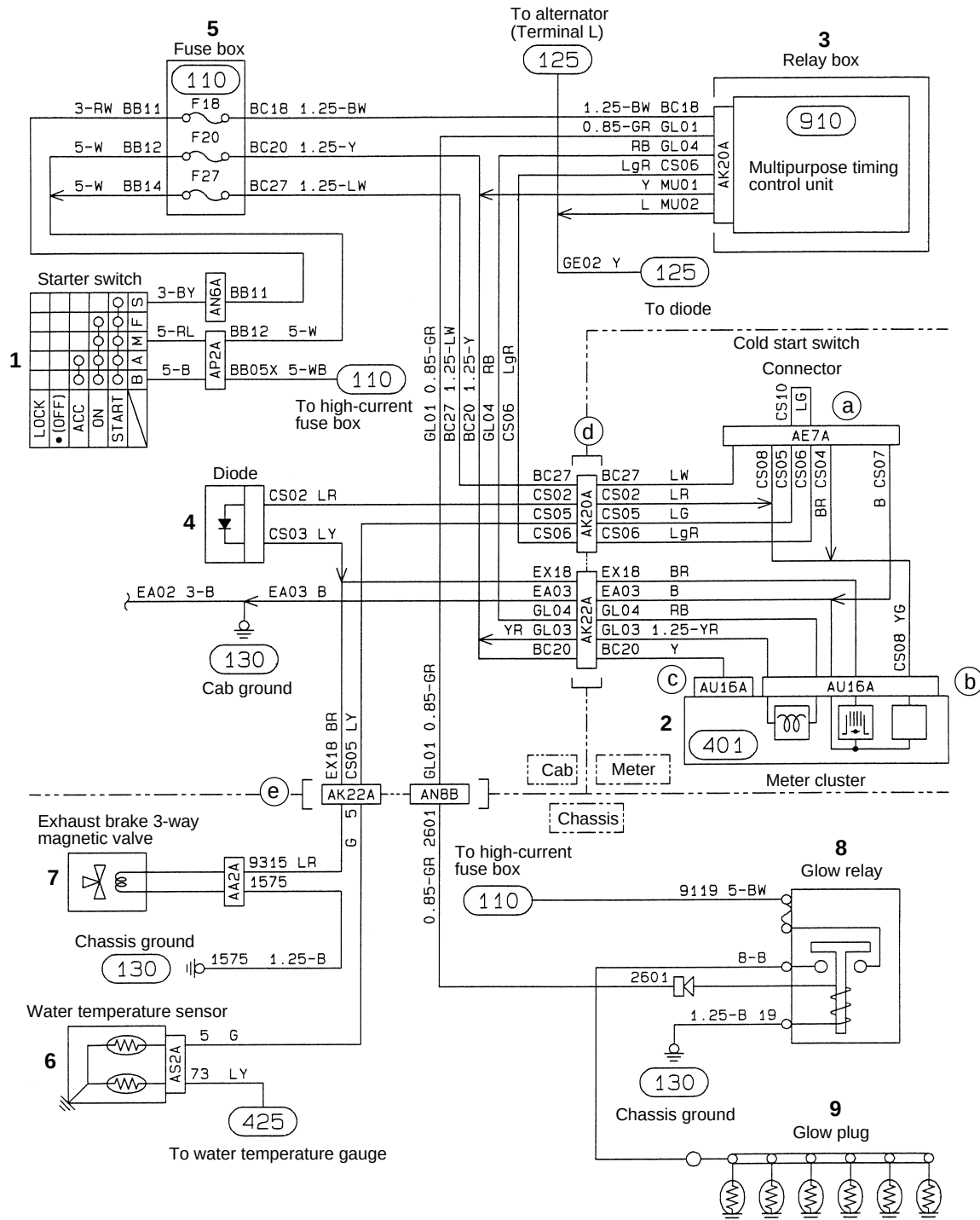


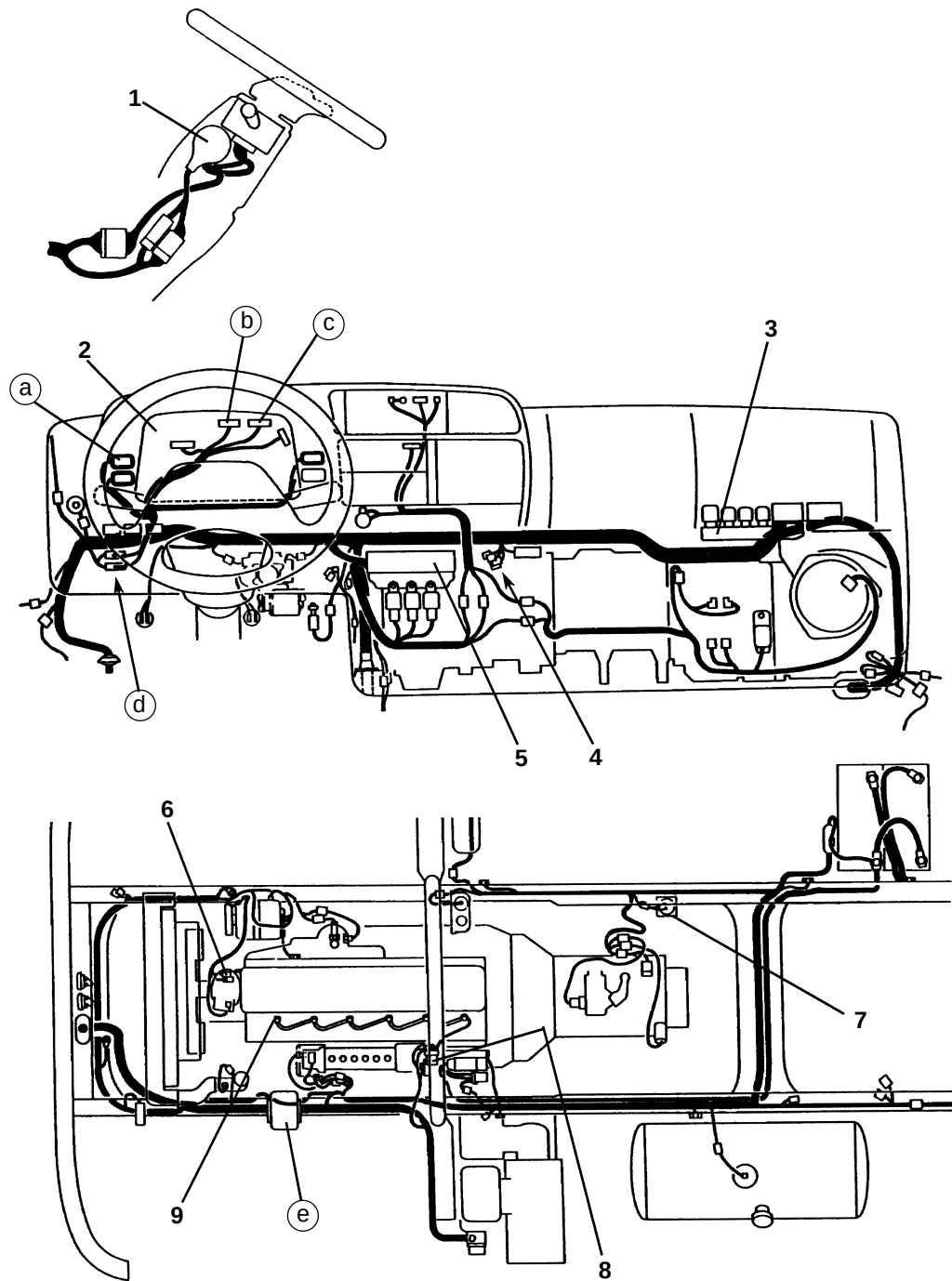
26888

- | | |
|-------------------------------------|--------------------------------|
| 1 Starter switch (210) | 6 Main high-current fuse (104) |
| 2 Diode | 7 Battery (101) |
| 3 Fuse box (104) | 8 Starter (201) |
| 4 Transmission neutral relay (604) | 9 Starter relay (210) |
| 5 Transmission neutral switch (802) | 10 High-current fuse box (104) |

: '96 Model Gr 54 (Pub. No. TWME9502-54)

220 ENGINE PREHEATING CIRCUIT < Manual Transmission >





26198

- 1 Starter switch  (210)
- 2 Meter cluster  (401)
- 3 Relay box  (604)
- 4 Diode
- 5 Fuse box  (104)

- 6 Water temperature sensor  (801)
- 7 Exhaust brake 3-way magnetic valve  (701)
- 8 Glow relay
- 9 Glow plug

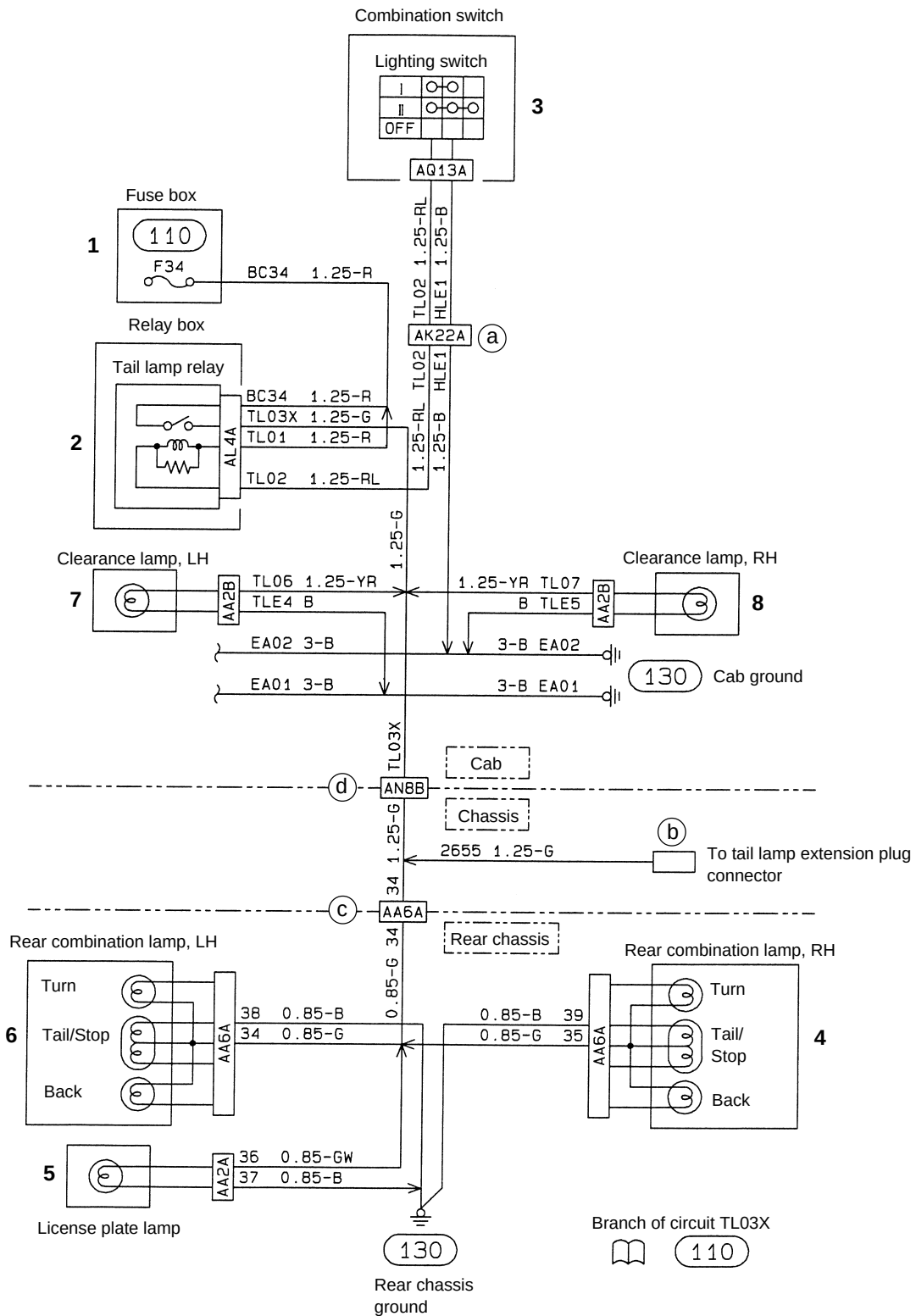
 : '96 Model Gr 54 (Pub. No. TWME9502-54)

3 LIGHTING

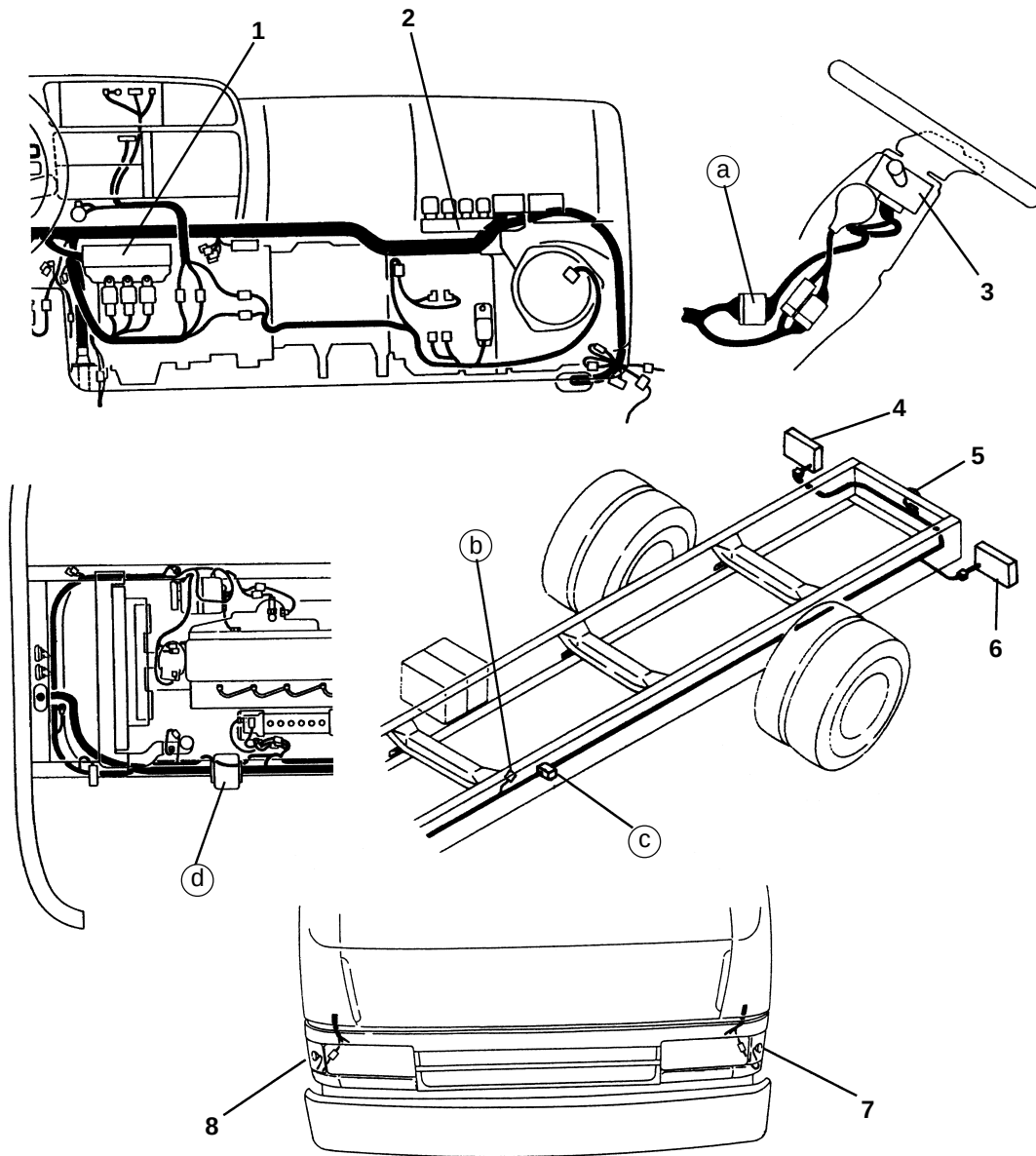
SPECIFICATIONS	
STRUCTURE AND OPERATION	
TROUBLESHOOTING	
(300) ON-VEHICLE INSPECTION AND ADJUSTMENT	
Headlamp Aiming	
(310) HEADLAMP CIRCUIT	
(320) TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS	54-3-2
(325) STOP LAMP CIRCUIT	54-3-4
(330) TURN SIGNAL LAMP AND HAZARD LAMP CIRCUITS	
(340) BACKUP LAMP CIRCUIT	
(345) CAB LAMP CIRCUIT	
(348) ILLUMINATION LAMP CIRCUIT	
(349) MARKER LAMP AND IDENTIFICATION LAMP CIRCUITS	
(352) VAN BODY DOME LIGHT CIRCUIT	54-3-6

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

320 TAIL LAMP, CLEARANCE LAMP AND LICENSE PLATE LAMP CIRCUITS



26168



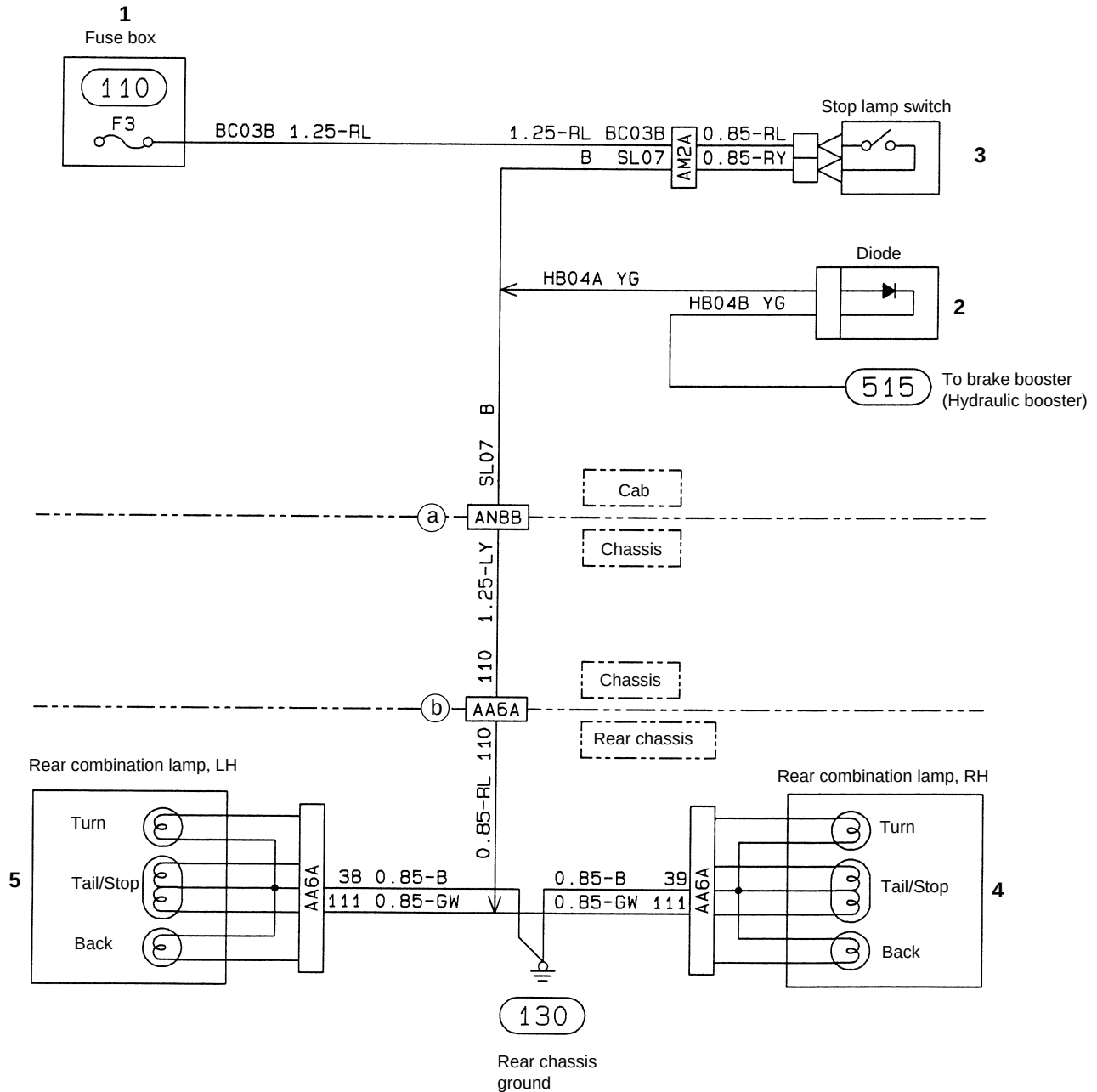
26889

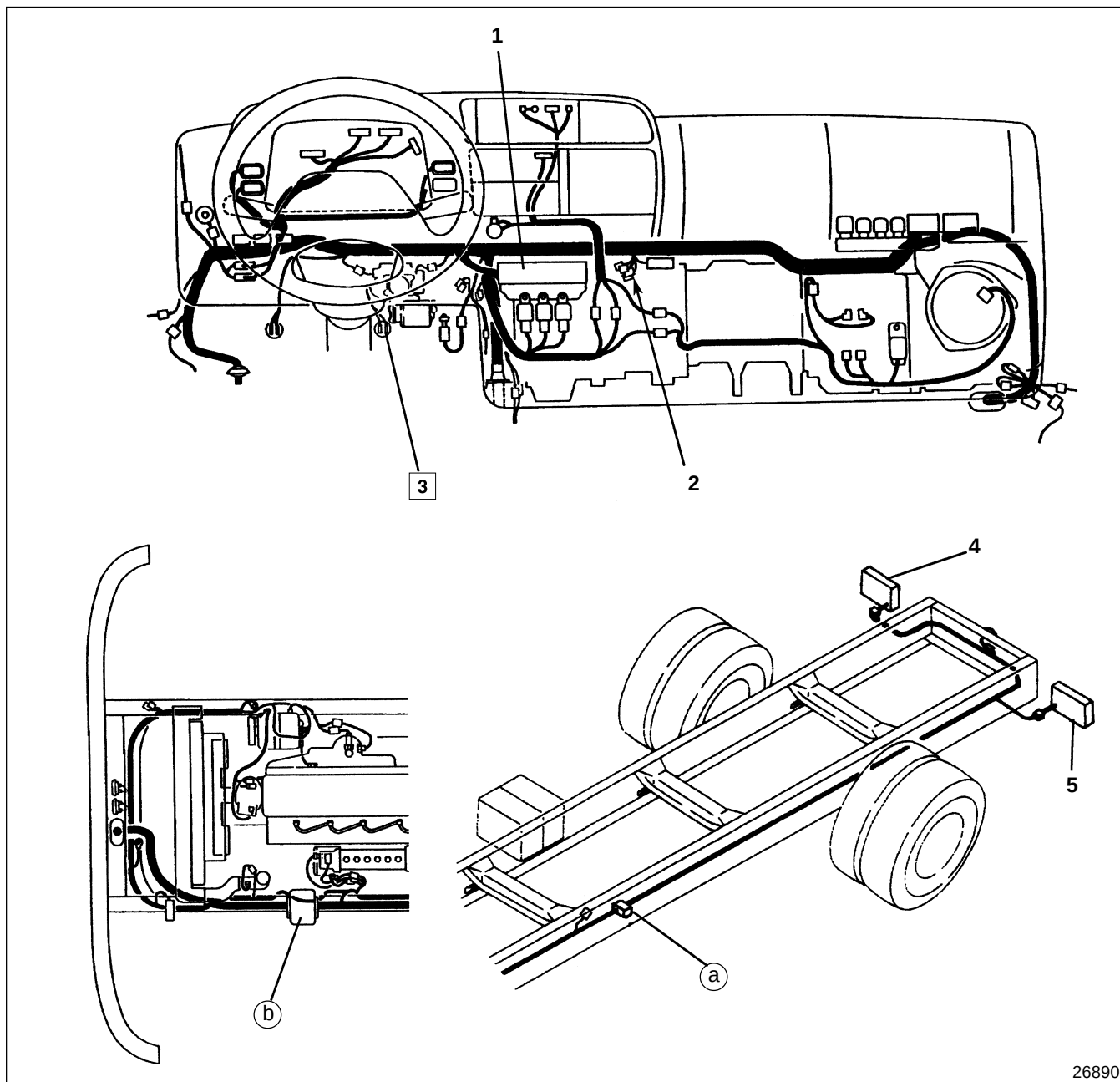
- 1 Fuse box (104)
- 2 Relay box (604)
- 3 Combination switch (601)
- 4 Rear combination lamp, RH

- 5 License plate lamp
- 6 Rear combination lamp, LH
- 7 Clearance lamp, LH
- 8 Clearance lamp, RH

: '96 Model Gr 54 (Pub. No. TWME9502-54)

325 STOP LAMP CIRCUIT





26890

- 1 Fuse box (104)
 2 Diode
 3 Stop lamp switch

- 4 Rear combination lamp, RH
 5 Rear combination lamp, LH

◆ Service procedure

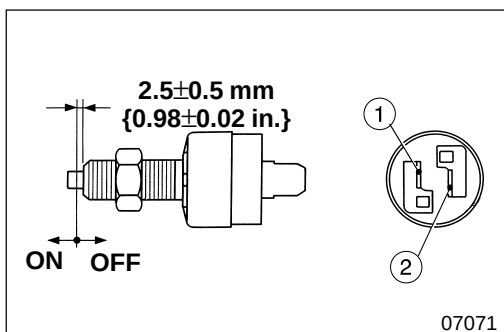
3 Inspection of stop lamp switch

- Follow the table below to inspect continuity:

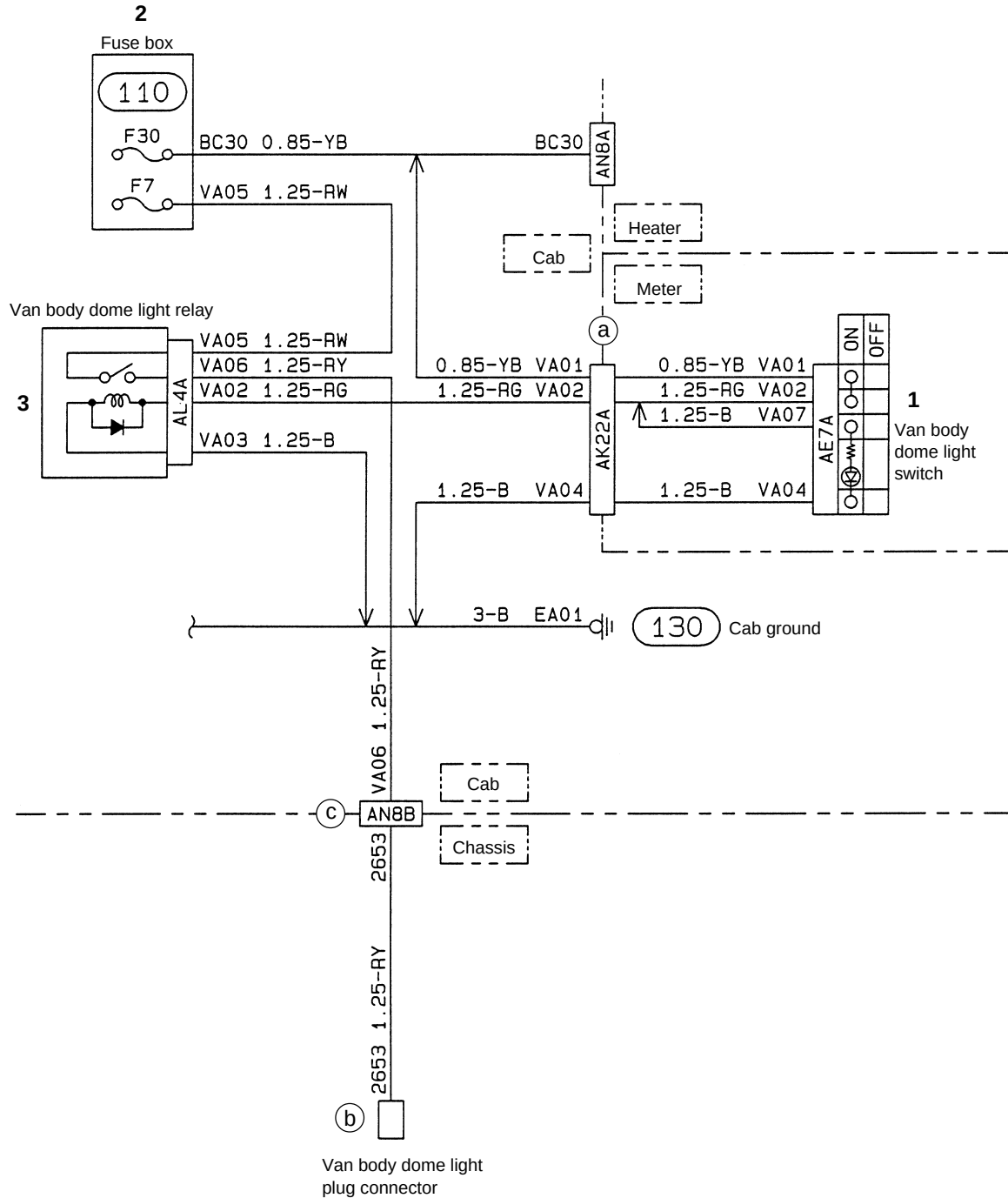
	①	②
OFF		
ON		

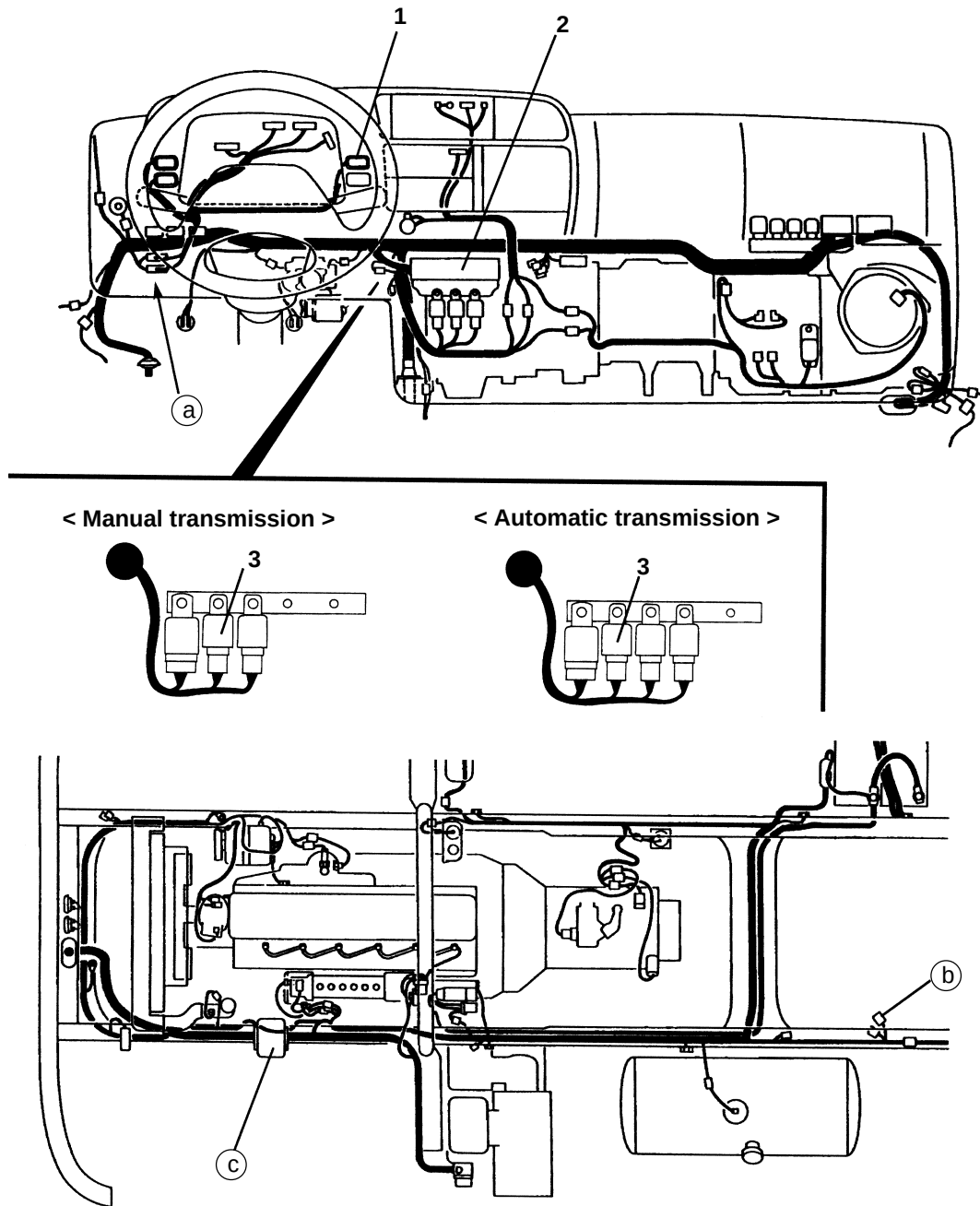
: There is continuity between terminals ① and ②.

- If any fault is found, replace stop lamp switch 3. Gr 35



352 VAN BODY DOME LIGHT CIRCUIT





26891

- 1 Van body dome light switch (601)
- 2 Fuse box (104)
- 3 Van body dome light relay (604)

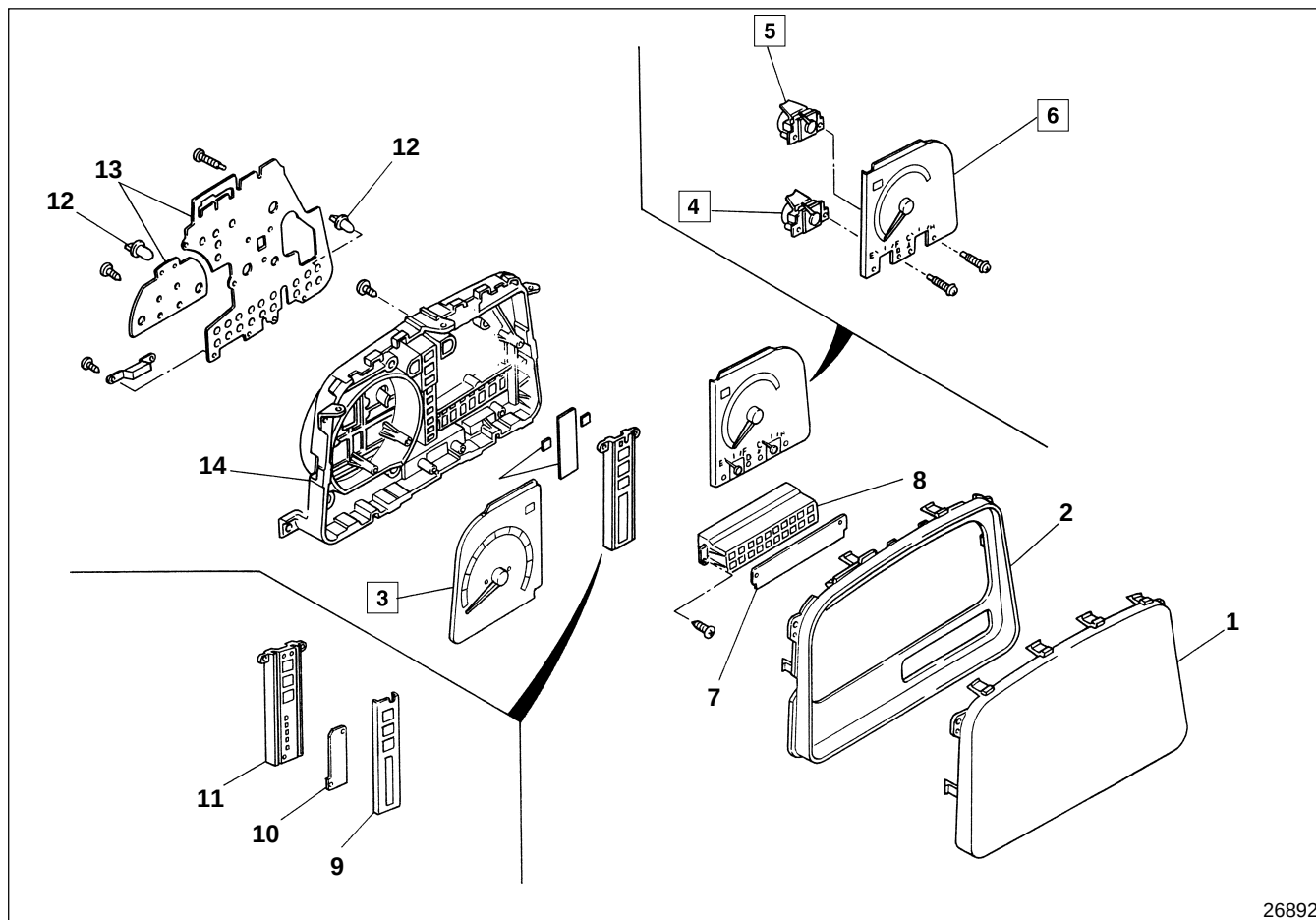
☞ : '96 Model Gr 54 (Pub. No. TWME9502-54)

4 METER

SPECIFICATIONS	
TROUBLESHOOTING	
(401) METER CLUSTER.....	54-4-2
(410) SPEEDOMETER AND TACHOMETER CIRCUITS	
(420) FUEL GAUGE CIRCUIT	
(425) WATER TEMPERATURE GAUGE CIRCUIT	

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

401 METER CLUSTER



26892

● Disassembly sequence

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

● Assembly sequence

Follow the disassembly sequence in reverse.

Removal and installation of meter cluster  Gr 42

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
3	Indication area of speedometer assembly	At 10 mph	16.1±3.2 km/h {10±2 mph}	—	Replace
		At 20 mph	32.2 $\begin{smallmatrix} +3.2 \\ -2.4 \end{smallmatrix}$ km/h {20 $\begin{smallmatrix} +2 \\ -1.5 \end{smallmatrix}$ mph}		
		At 40 mph	64.4 $\begin{smallmatrix} +4 \\ -1.6 \end{smallmatrix}$ km/h {40 $\begin{smallmatrix} +2.5 \\ -1 \end{smallmatrix}$ mph}		
		At 50 mph	80.5 $\begin{smallmatrix} +4.8 \\ 0 \end{smallmatrix}$ km/h {50 $\begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$ mph}		
		At 60 mph	96.6 $\begin{smallmatrix} +4.8 \\ 0 \end{smallmatrix}$ km/h {60 $\begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$ mph}		
4	Resistance of fuel gauge	Needle position	FULL	—	Replace
			1/2		
			EMPTY		
5	Resistance of water temperature gauge	Needle position	65°C {149°F}	—	Replace
			100°C {212°F}		
6	Indication range of tachometer 20±2°C {68±3.6°F} 13±0.2 V	At 550 rpm	550±50 rpm	—	Replace
		At 1000 rpm	1000±70 rpm		
		At 1500 rpm	1500±110 rpm		
		At 2000 rpm	2000±110 rpm		
		At 2500 rpm	2500±110 rpm		
		At 3000 rpm	3000±110 rpm		
		At 4500 rpm	4500±125 rpm		

◆ Service procedure**3 Inspection of speedometer**

- Measure the indication area of speedometer **3** at various speed ranges using a speedometer tester.
- If the measured value deviates from the standard value, carry out the following inspection. If the inspection does not indicate a fault, replace speedometer **3**.

(1) Inspection of vehicle speed sensor body (802)

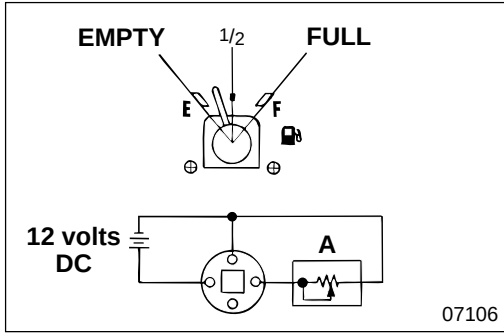
 : '96 Model Gr 54 (Pub. No. TWME9502-54)

(2) Inspection of installed condition of vehicle speed sensor

 Gr 22 < Manual transmission >

 Gr 23 < Automatic transmission >

401 METER CLUSTER



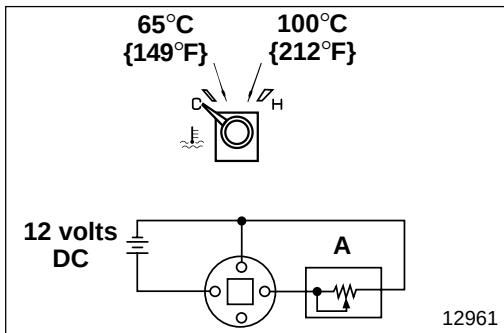
4 Inspection of fuel gauge

- Connect a variable resistor to fuel gauge 4 as illustrated.
A : Variable resistor
- Measurement order
FULL → 1/2 → EMPTY

NOTE

The movement of the gauge needle is subject to hysteresis (oscillation). Be sure to measure following the measurement order.

- Increase the value of variable resistor A gradually from 0 Ω.
- Measure the resistance respectively when the needle of fuel gauge 4 indicates FULL, 1/2 and EMPTY.
- If the measured value deviates from the standard value, replace fuel gauge 4.



5 Inspection of water temperature gauge

- Connect a variable resistor to water temperature gauge 5 as illustrated.
A : Variable resistor
- Measurement order
Low temperature → High temperature

NOTE

The movement of the gauge needle is subject to hysteresis (oscillation). Be sure to measure following the measurement order.

- Increase the value of variable resistor A gradually from 0 Ω.
- Measure the resistance respectively when the needle of water temperature gauge 5 indicates 65°C {149°F} and 100°C {212°F}.
- If the measured value deviates from the standard value, replace water temperature gauge 5.

6 Inspection of tachometer

- Measure the indication area of tachometer 6 at various revolution ranges using an engine revolution counter.
- If the measured value deviates from the standard value, carry out the following inspection. If the inspection does not indicate a fault, replace tachometer 6.

(1) Inspection of the engine revolution sensor body 801

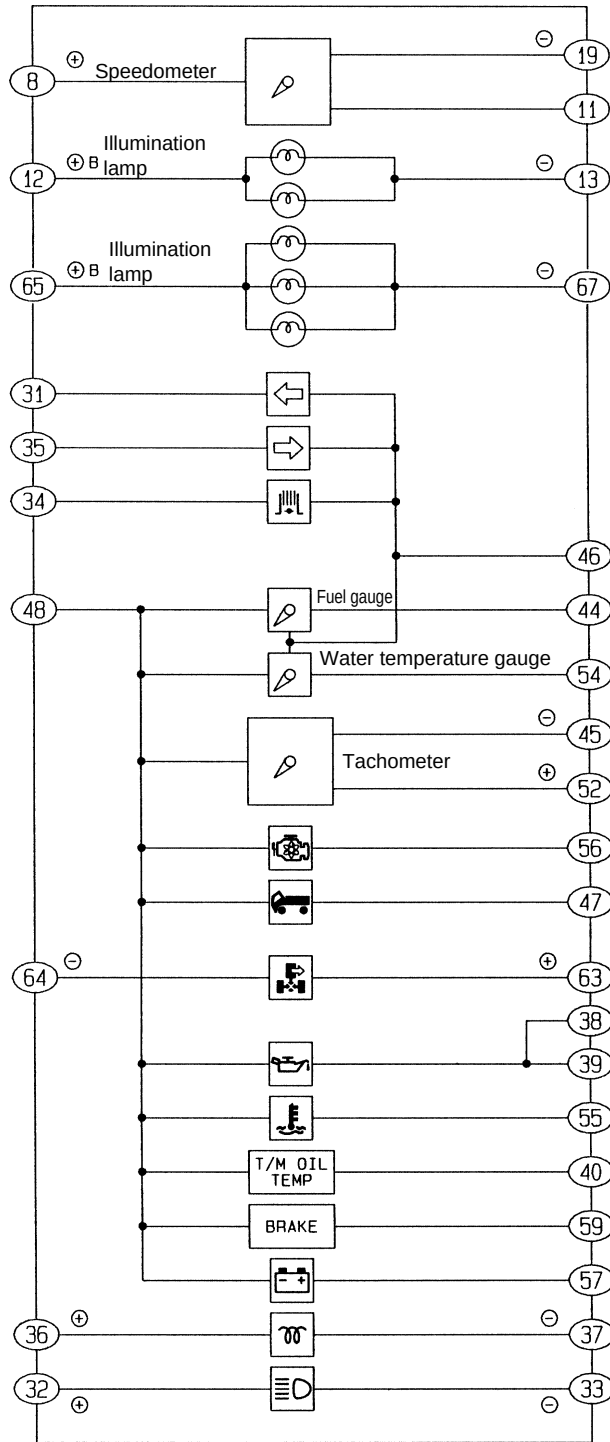
: '96 Model Gr 54 (Pub. No. TWME9502-54)

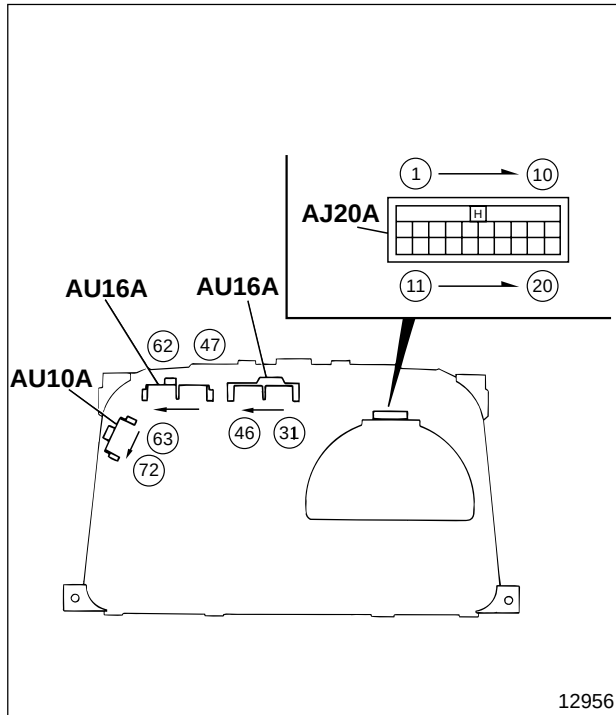
(2) Inspection of the installed condition of the engine revolution sensor Gr 13

MEMO

401 METER CLUSTER

Meter Cluster Internal Circuit





12956

Terminal No.	AJ20A
1	—
2	—
3	—
4	—
5	—
6	—
7	—
8	Speedometer (+)
9	—
10	—
11	Vehicle speed sensor (+)
12	Illumination (+) (Speedometer)
13	Illumination (−) (Speedometer)
14	—
15	—
16	—
17	—
18	—
19	Speedometer (−)
20	—

Terminal No.	AU16A
31	Turn signal (LH)
32	HIGH beam (+)
33	HIGH beam (−)
34	Exhaust brake < Manual transmission >
35	Turn signal (RH)
36	Glow (+)
37	Glow (−)
38	Engine oil filter
39	Engine oil pressure level
40	Automatic transmission fluid temperature
41	—
42	—
43	—
44	Fuel gauge
45	Tachometer (−)
46	Ground

Terminal No.	AU10A
63	Power take-off (+)
64	Power take-off (−)
65	Illumination (+)
66	—
67	Illumination (−)
68	—
69	—
70	—
71	—
72	—

Terminal No.	AU16A
47	Cab tilt
48	Power
49	—
50	—
51	—
52	Tachometer (+)
53	—
54	Water temperature gauge
55	•Engine coolant level •Engine coolant temperature
56	Pre-stroke control
57	Battery charge
58	—
59	Brake •Parking brake •Brake booster (Hydraulic booster) •Brake fluid level •Power steering fluid level
60	—
61	—
62	—

5 INDICATOR AND WARNING

TROUBLESHOOTING 54-5-2

(500) ON-VEHICLE INSPECTION AND ADJUSTMENT

- Inspection of Brake Fluid Level Switch 54-5-6
- Inspection of Power Steering Fluid Level Sensor 54-5-7

(510) PARKING BRAKE INDICATOR CIRCUIT 54-5-8

(515) BRAKE WARNING CIRCUIT 54-5-10

(530) WATER LEVEL WARNING CIRCUIT 54-5-14

(536) ENGINE OIL PRESSURE WARNING CIRCUIT 54-5-16

(537) OVERHEATING WARNING CIRCUIT 54-5-18

(547) AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT 54-5-20

(549) POWER STEERING FLUID LEVEL WARNING CIRCUIT 54-5-22

(550) CAB TILT WARNING CIRCUIT *

For details on the following indicator and warning lamps, see the relevant sections.

	*  (125)
	*  (220)
	*  (310)
	 *  (330)
	 (710)
	 Gr 13

*  : '96 Model Gr 54 (Pub. No. TWME9502-54)

TROUBLESHOOTING

Symptoms			* BRAKE					Remarks
			Lamp does not light although parking brake lever is pulled	Lamp does not go out although parking brake lever is returned	Lamp does not light although power steering fluid level is insufficient	Warning buzzer does not sound although power steering fluid level is insufficient	Lamp lights although power steering fluid level is sufficient	
Possible causes								
Connector connection faulty, harness broken, grounding faulty		☐	☐		☐	☐		
Fuse blown		☐	☐		☐			
Meter cluster	Internal circuit faulty	☐	☐	☐	☐		☐	
	Bulb burnt-out	☐	☐		☐			
Warning buzzer faulty			☐	☐		☐		
Parking brake switch faulty			☐	☐				
Parking brake relay faulty < Automatic transmission >			☐	☐				
Brake fluid level switch faulty					☐		☐	
Power steering fluid level sensor faulty								
Cab tilt lock switch	Switch body faulty							
	Installation faulty							 Gr 42
Overheating switch faulty								
Water level sensor faulty								
Multipurpose timing control unit faulty								
Engine oil pressure switch faulty								
Engine oil bypass alarm switch faulty								
Automatic transmission fluid thermostat switch faulty								

* : For information regarding hydraulic brake systems of  warning lamp, refer to Gr 35.

Symptoms										Remarks
		Lamp does not light although engine coolant level is insufficient	Lamp lights although engine coolant level is sufficient	Lamp does not light although engine coolant over-heating	Lamp lights when not overheating	Warning buzzer does not stop sounding although parking brake lever is pulled	Lamp does not light although engine oil pressure is low	Lamp lights although engine oil pressure is sufficient	Warning buzzer does not stop sounding although parking brake lever is pulled	
Possible causes										
Connector connection faulty, harness broken, grounding faulty		☐		☐		☐	☐		☐	
Fuse blown		☐		☐			☐			
Meter cluster	Internal circuit faulty	☐	☐	☐	☐		☐	☐		
	Bulb burnt-out	☐		☐			☐			
Warning buzzer faulty						☐			☐	
Parking brake switch faulty										
Parking brake relay faulty < Automatic transmission >										
Brake fluid level switch faulty						☐				 Gr 35
Power steering fluid level sensor faulty						☐				
Cab tilt lock switch	Switch body faulty									
	Installation faulty									 Gr 42
Overheating switch faulty				☐	☐					
Water level sensor faulty		☐	☐							
Multipurpose timing control unit faulty		☐	☐							
Engine oil pressure switch faulty							☐	☐		
Engine oil bypass alarm switch faulty							☐	☐		
Automatic transmission fluid thermostat switch faulty										

TROUBLESHOOTING

Symptoms		T/M OIL TEMP				Remarks	
		Lamp does not light although automatic transmission fluid temperature is high	Lamp lights although automatic transmission fluid temperature is appropriate	Warning buzzer does not stop sounding although parking brake lever is pulled	Lamp lights although cab is locked to rear cab mounting		Lamp does not light although cab is not locked to rear cab mounting
Possible causes							
Connector connection faulty, harness broken, grounding faulty		☐		☐		☐	
Fuse blown		☐				☐	
Meter cluster	Internal circuit faulty	☐	☐		☐	☐	
	Bulb burnt-out	☐				☐	
Warning buzzer faulty				☐			
Parking brake switch faulty							
Parking brake relay faulty < Automatic transmission >							
Brake fluid level switch faulty							
Power steering fluid level sensor faulty							
Cab tilt lock switch	Switch body faulty				☐	☐	
	Installation faulty				☐		 Gr 42
Overheating switch faulty							
Water level sensor faulty							
Multipurpose timing control unit faulty							
Engine oil pressure switch faulty							
Engine oil bypass alarm switch faulty							
Automatic transmission fluid thermostat switch faulty		☐	☐				

MEMO

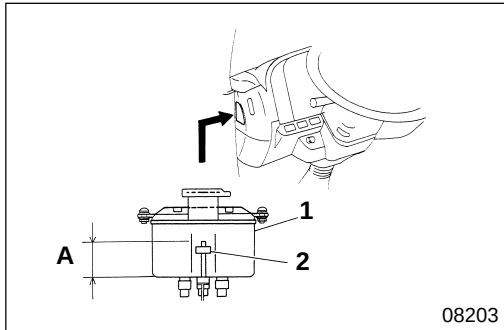
500 ON-VEHICLE INSPECTION AND ADJUSTMENT

Inspection of Brake Fluid Level Switch

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
—	Warning lamp lighting position for brake fluid level switch	41.0 ± 3 { 1.61 ± 0.12 }	—	Replace



- Start engine.
- Drain the brake fluid gradually from fluid tank assembly **1**.

CAUTION

If brake fluid is spilt on any part of the vehicle, wipe it off immediately, since the solvent in the fluid can damage the paintwork.

- Measure height **A** of brake fluid level switch **2** when  warning lamp within the meter cluster lights.
- If the measured value deviates from the standard value, remove and check fluid tank assembly **1**.

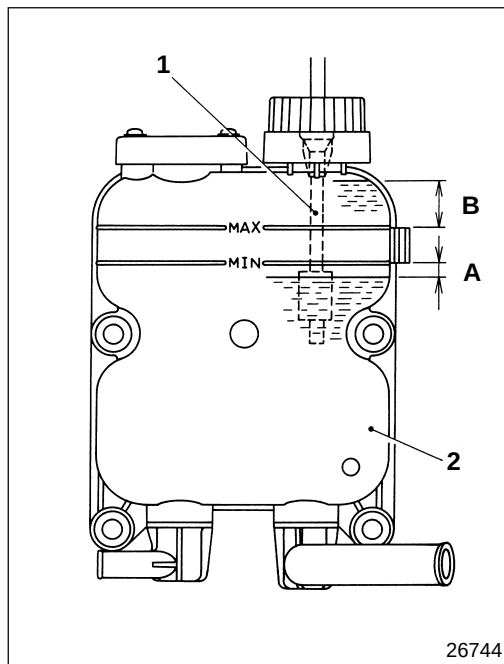
Inspection :  515

Inspection of Power Steering Fluid Level Sensor

Service standards

Unit : mm {in.}

Location	Maintenance item		Standard value	Limit	Remedy
—	Warning lamp lighting position for power steering fluid level sensor	Height from oil tank MIN level to fluid surface	15 {0.59}	—	Replace
		Height from oil tank MAX level to fluid surface	25 {0.98}	—	



Perform the following inspection and if any fault is found, remove and inspect power steering fluid level sensor **1**.

Removal and installation : Gr 37

Inspection : (549)

Perform inspection by turning the starter switch ON and determining the power steering fluid level when **BRAKE** warning lamp within the meter cluster lights (buzzer sounds at the same time).

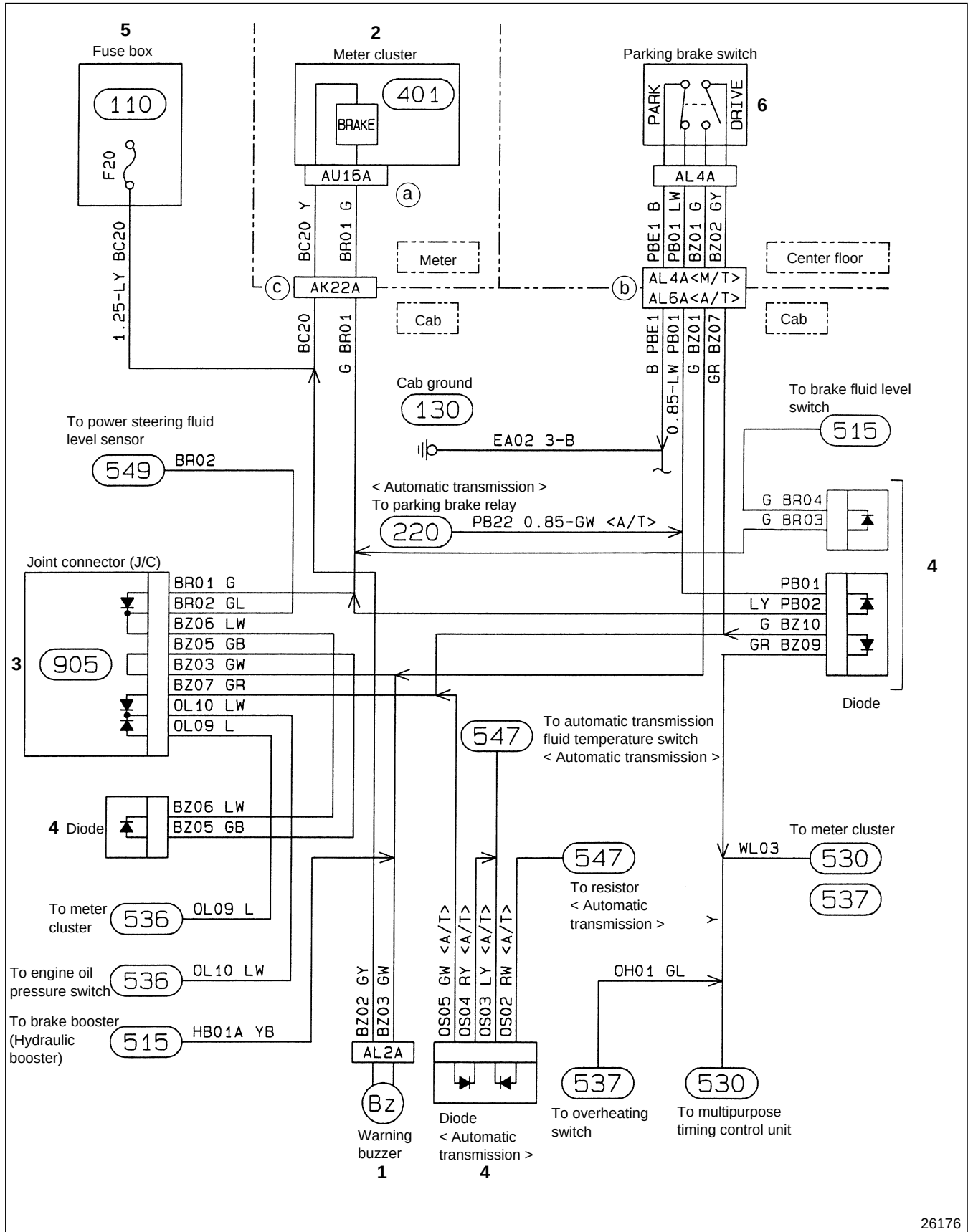
(1) Inspection procedure when the power steering fluid level is low

- Drain the power steering fluid gradually from power steering oil tank **2**.
- Inspect to make sure that, when **BRAKE** warning lamp is lit, height **A** from power steering fluid surface to the “**MIN**” level of power steering oil tank **2**, is within the standard value.

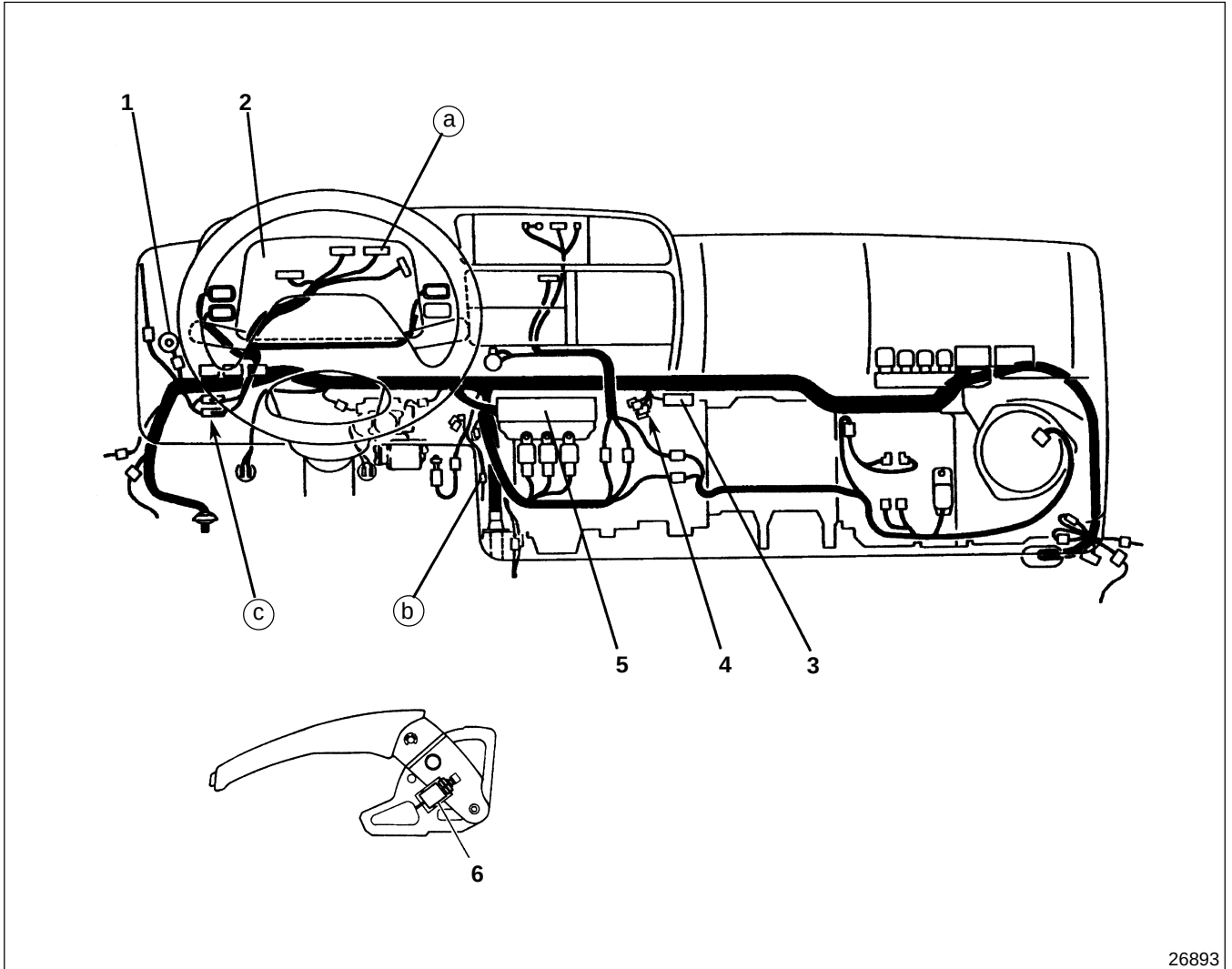
(2) When power steering fluid level is too high

- Supply power steering fluid gradually into power steering oil tank **2**.
- Inspect to make sure that, when **BRAKE** warning lamp is lit, height **B** from power steering fluid surface to the “**MAX**” level of power steering oil tank **2**, is within the standard value.

510 PARKING BRAKE INDICATOR CIRCUIT



26176



26893

1 Warning buzzer (606)

2 Meter cluster (401)

3 Joint connector (J/C) (905)

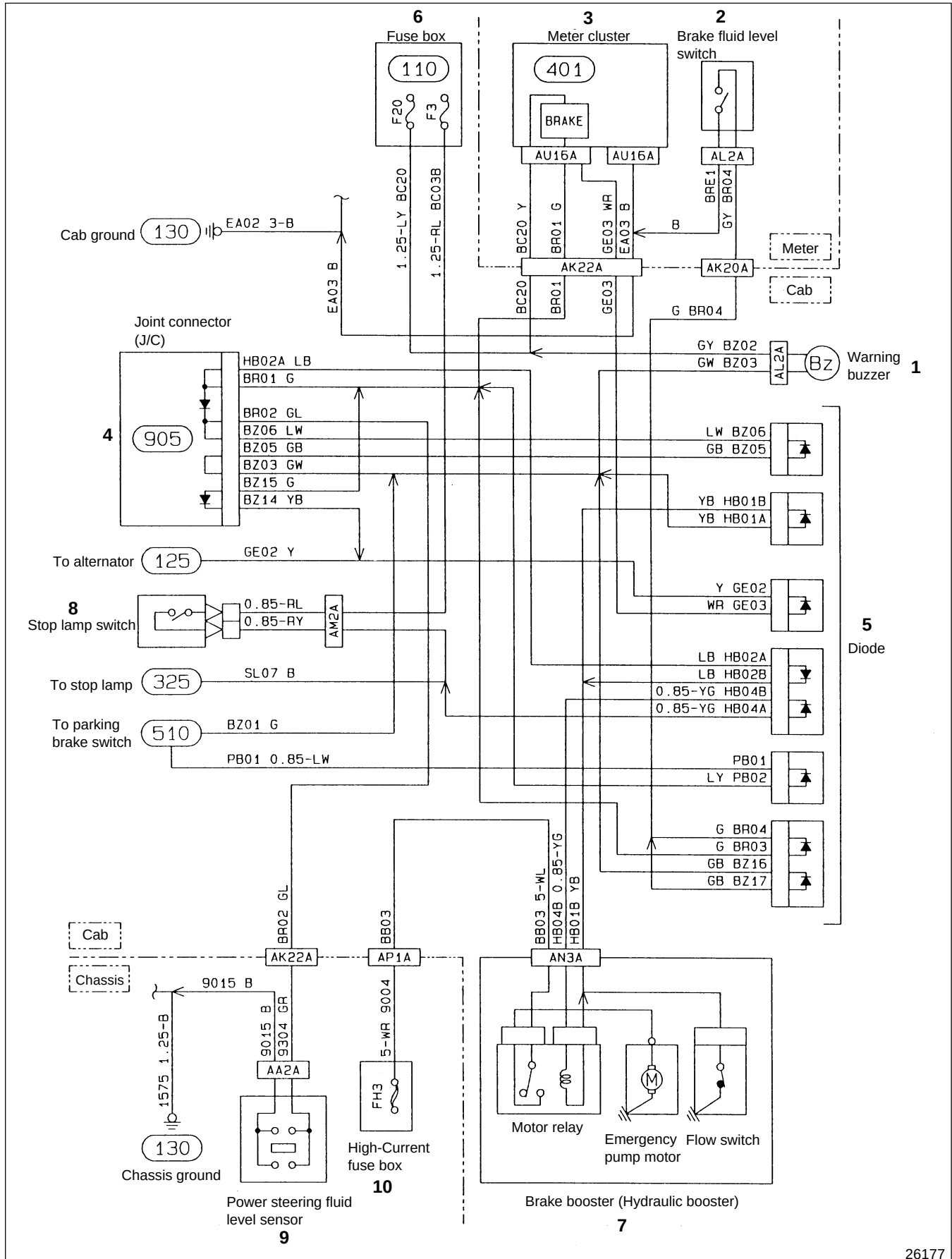
4 Diode

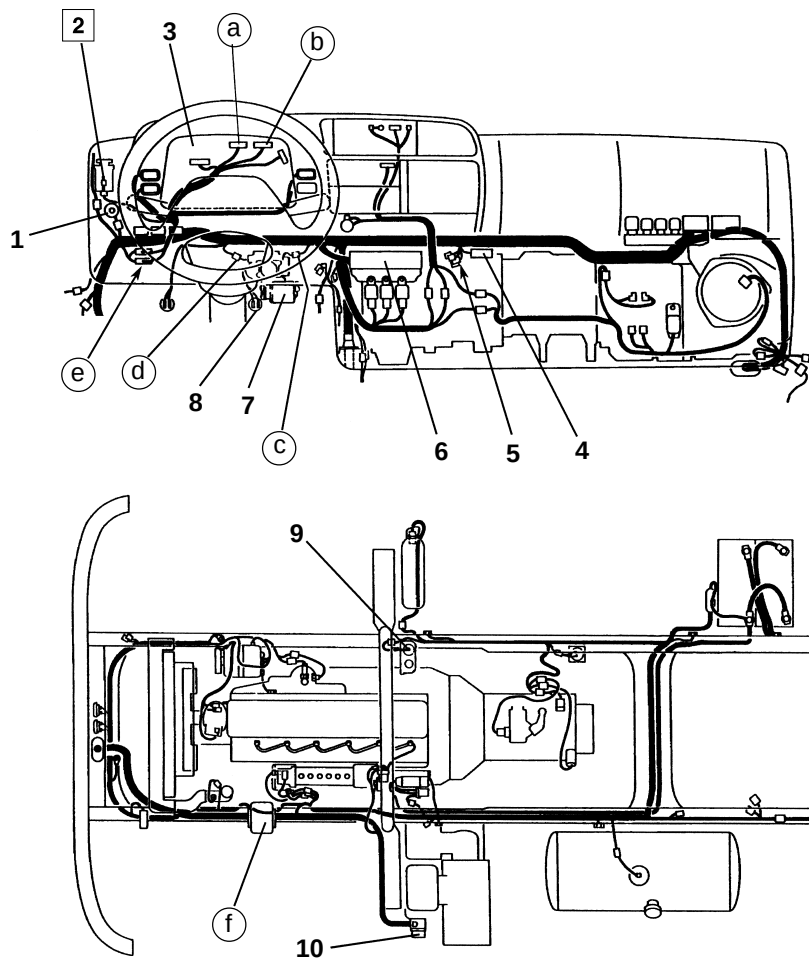
5 Fuse box (104)

6 Parking brake switch (510)

: '96 Model Gr 54 (Pub. No. TWME9502-54)

515 BRAKE WARNING CIRCUIT





26894

- | | |
|--------------------------------|--|
| 1 Warning buzzer * (606) | 6 Fuse box (104) |
| 2 Brake fluid level switch | 7 Brake booster (Hydraulic booster) Gr 35 |
| 3 Meter cluster (401) | 8 Stop lamp switch (325) |
| 4 Joint connector (J/C) (905) | 9 Power steering fluid level sensor (549) |
| 5 Diode | 10 High-current fuse box |

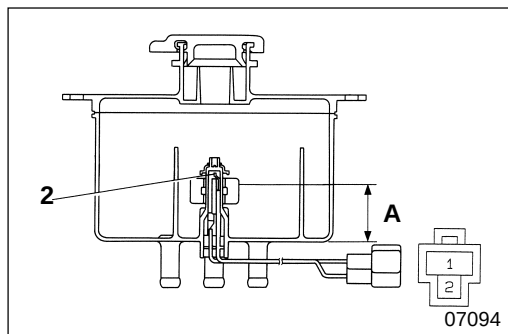
* : '96 Model Gr 54 (Pub. No. TWME9502-54)

Service standards

Unit : mm {in.}

Location	Maintenance item	Standard value	Limit	Remedy
2	Continuity position of brake fluid level switch	41.0±3 {1.61±0.12} (Equivalent to 120 cm ³ {7.32 cu.in., 120 cc})	—	Replace

515 BRAKE WARNING CIRCUIT



◆ Service procedure

2 Inspection of brake fluid level switch

- Drain the brake fluid gradually from the brake fluid tank assembly.

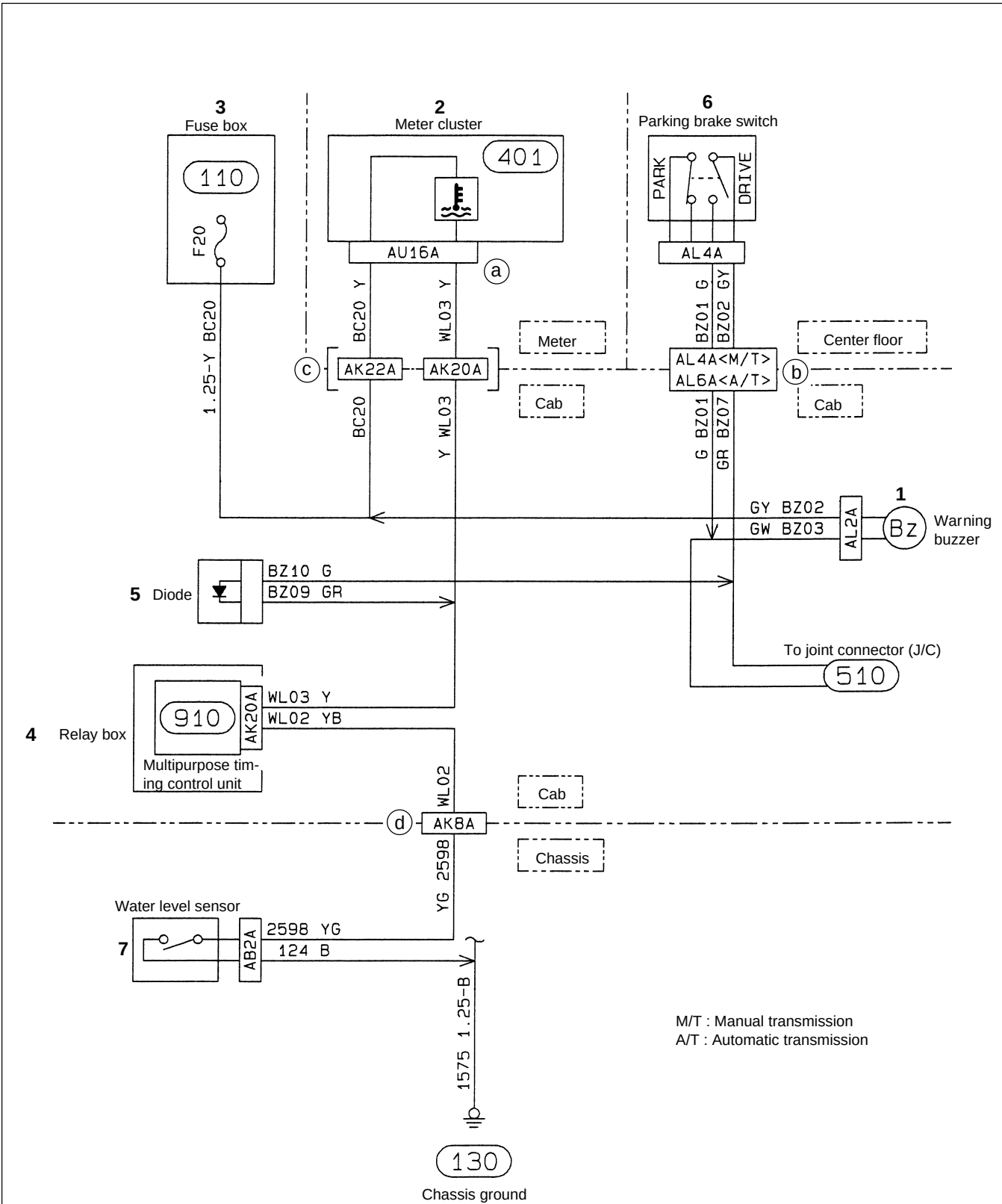
CAUTION ⚠

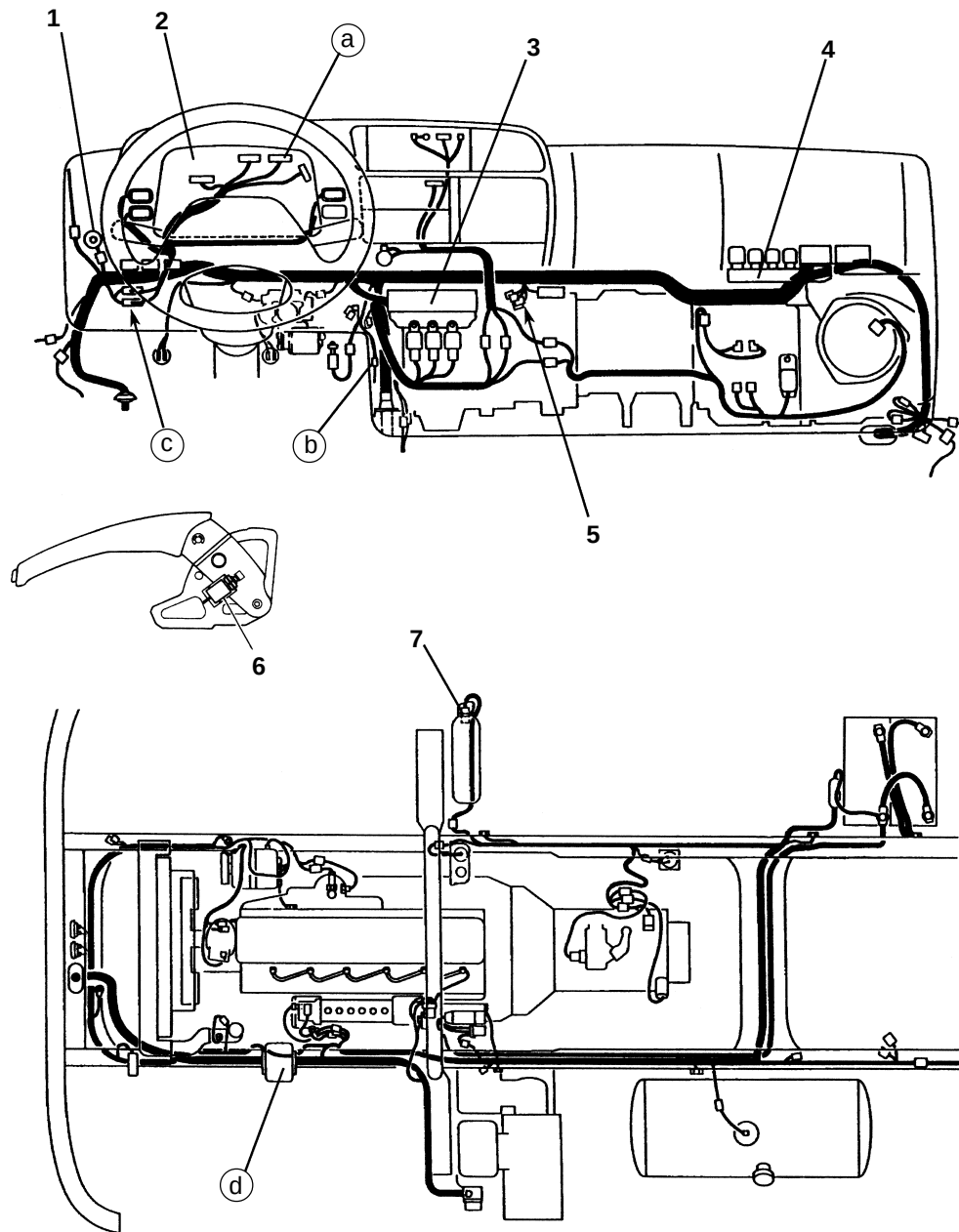
If brake fluid is spilt on any part of the vehicle, wipe it off immediately, since the solvent in the fluid can damage the paintwork.

- Measure height **A** of brake fluid level switch **2** when continuity is present between terminals ① and ②.
- If the measured value deviates from the standard value, replace the fluid tank assembly.

MEMO

530 WATER LEVEL WARNING CIRCUIT



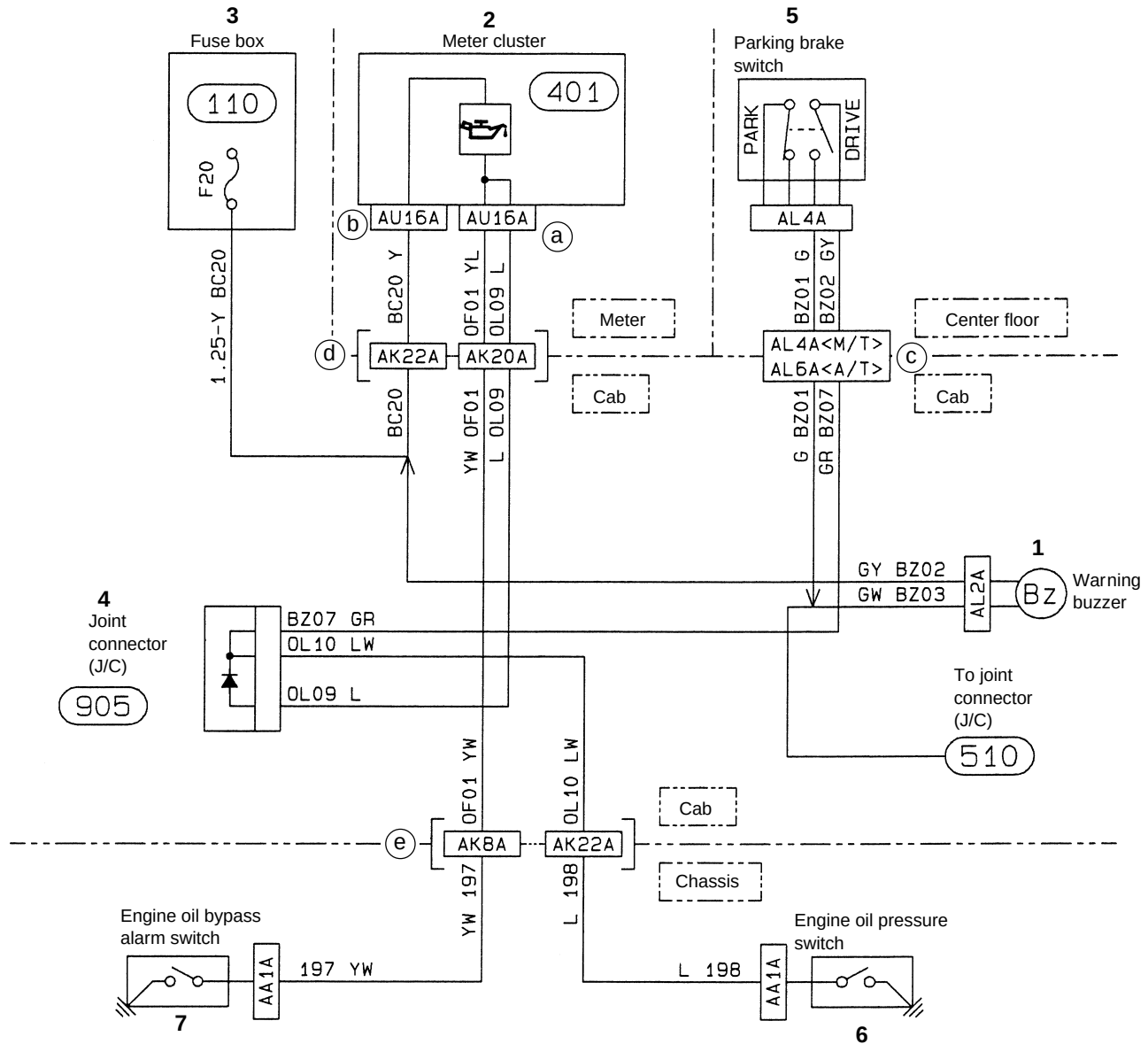


26895

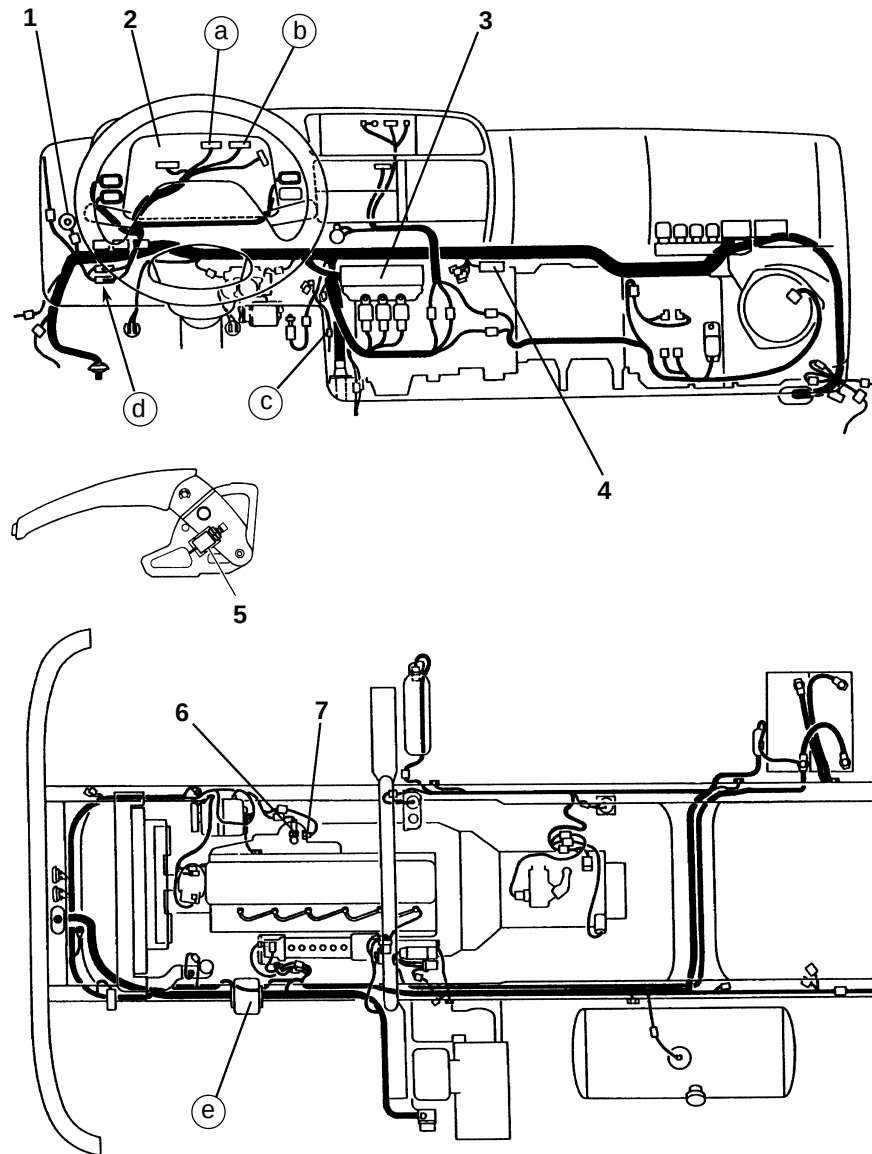
- 1 Warning buzzer  (606)
- 2 Meter cluster  (401)
- 3 Fuse box  (104)
- 4 Relay box  (604)
- 5 Diode
- 6 Parking brake switch  (510)
- 7 Water level sensor  (530)

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

536 ENGINE OIL PRESSURE WARNING CIRCUIT



M/T : Manual transmission
A/T : Automatic transmission

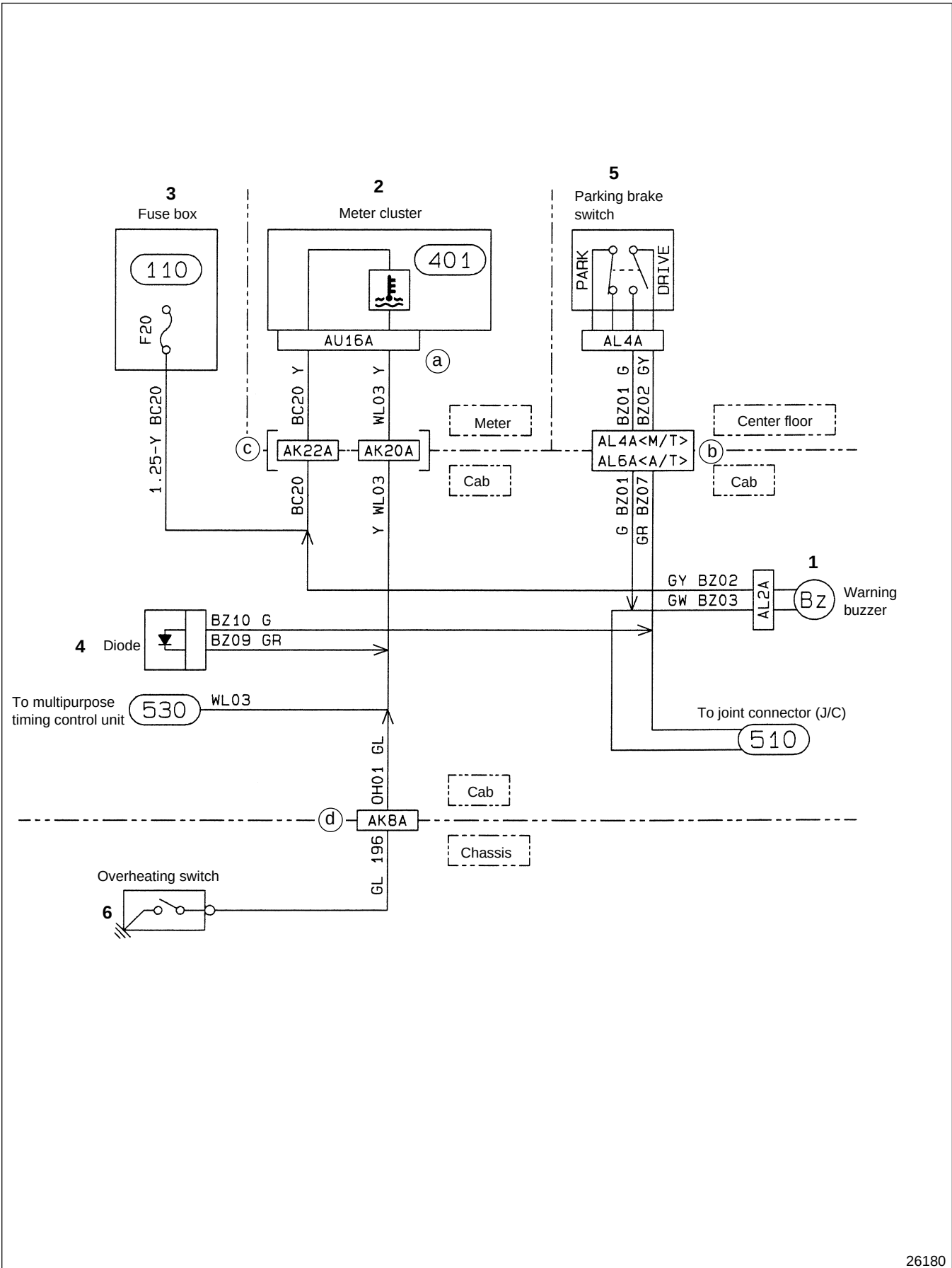


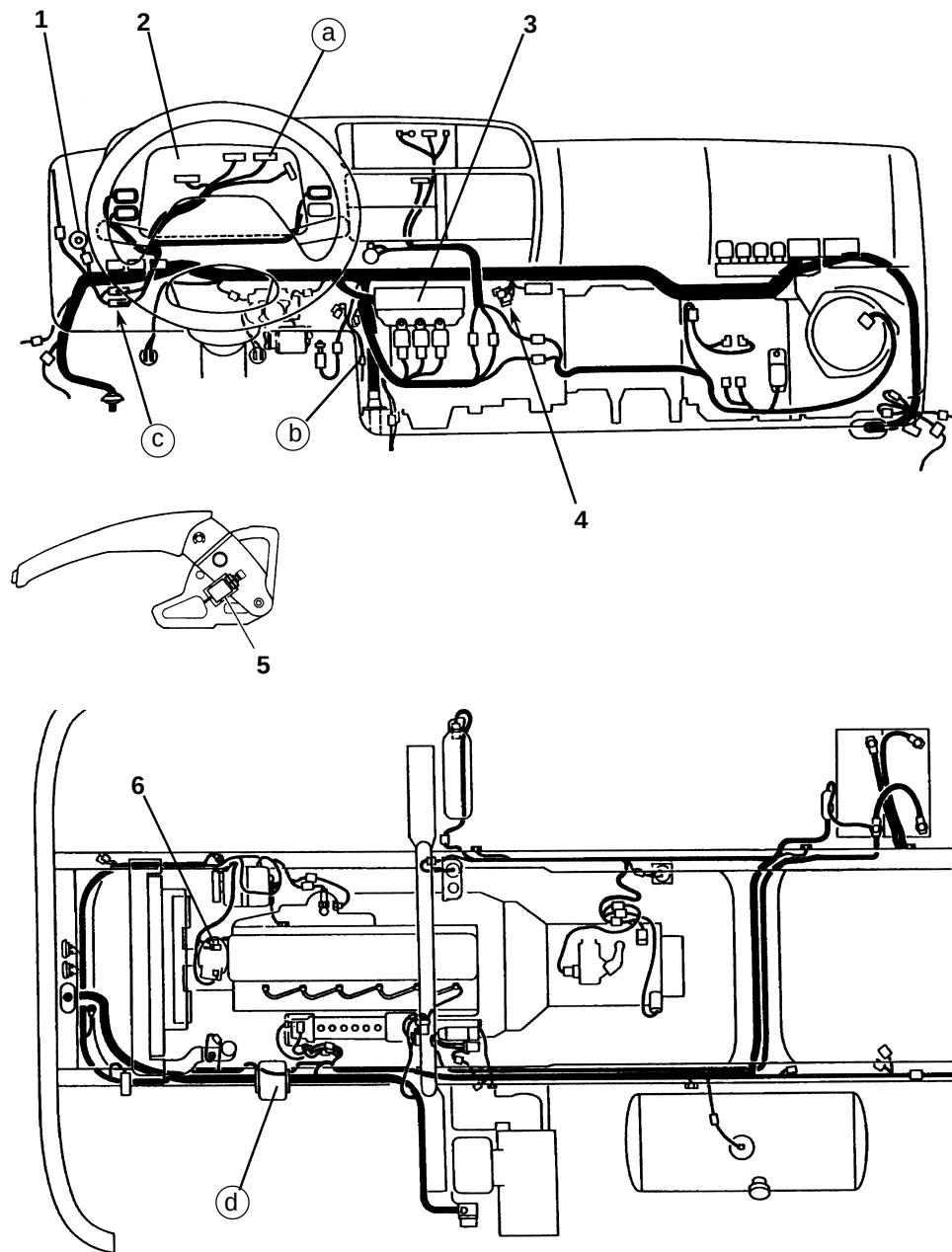
26896

- 1 Warning buzzer  (606)
- 2 Meter cluster  (401)
- 3 Fuse box  (104)
- 4 Joint connector (J/C)
- 5 Parking brake switch  (510)
- 6 Engine oil pressure switch  (810)
- 7 Engine oil bypass alarm switch  (810)

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

537 OVERHEATING WARNING CIRCUIT



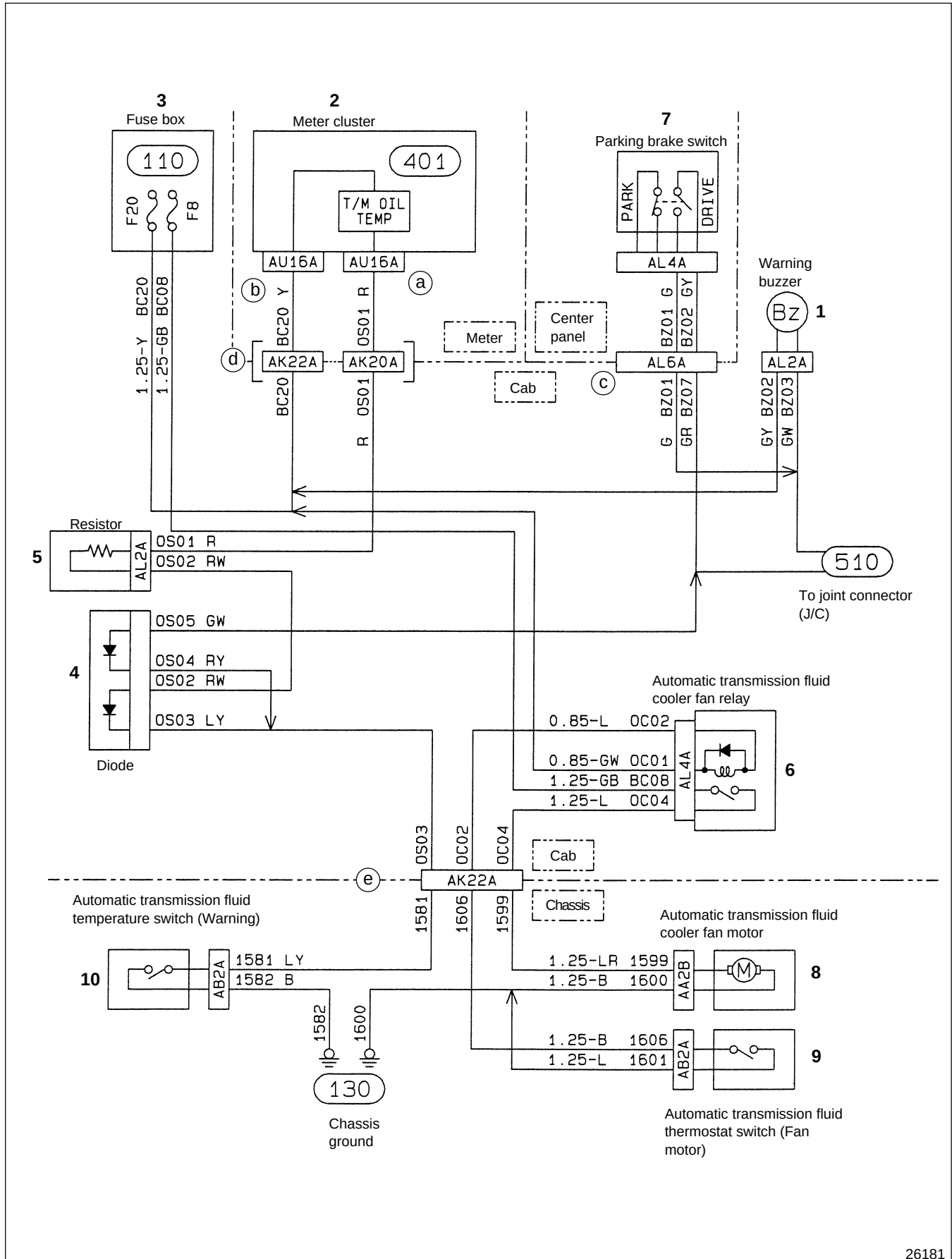


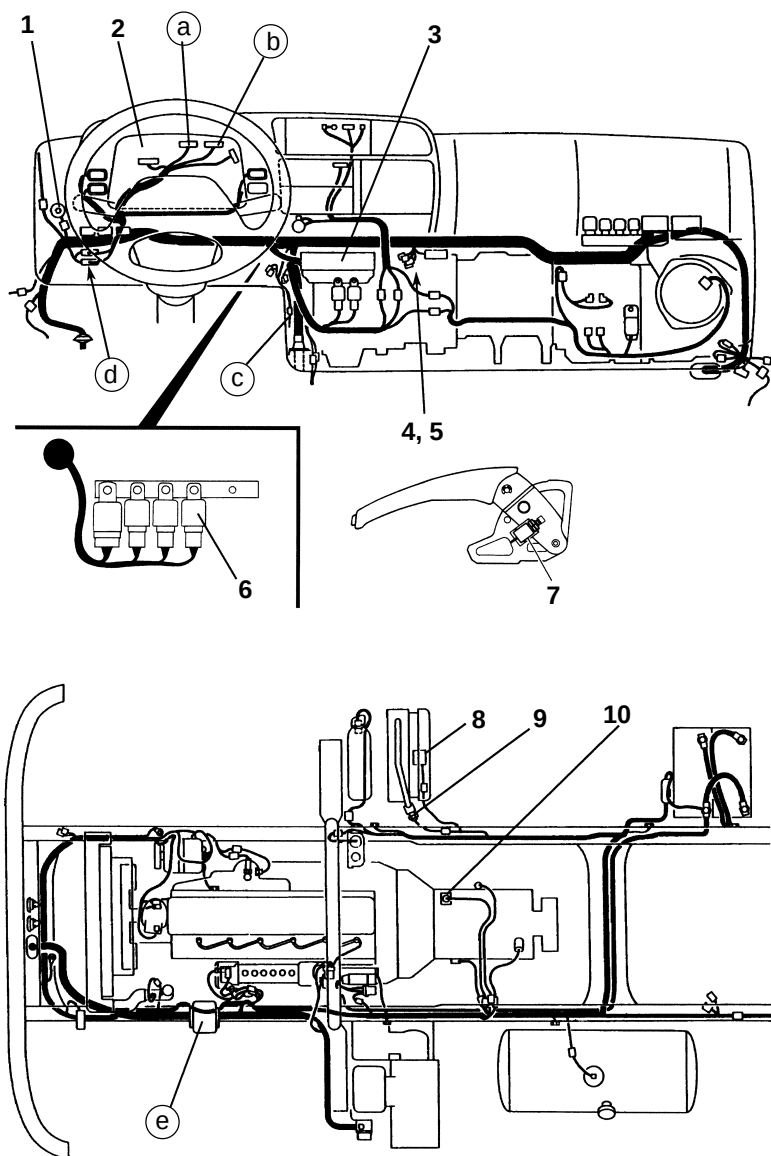
26897

- 1 Warning buzzer  (606)
- 2 Meter cluster  (401)
- 3 Fuse box  (104)
- 4 Diode
- 5 Parking brake switch  (510)
- 6 Overheating switch  (801)

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

547 AUTOMATIC TRANSMISSION FLUID TEMPERATURE WARNING CIRCUIT





26898

1 Warning buzzer (606)

2 Meter cluster (401)

3 Fuse box (104)

4 Diode

5 Resistor

6 Automatic transmission fluid cooler fan relay

7 Parking brake switch (510)

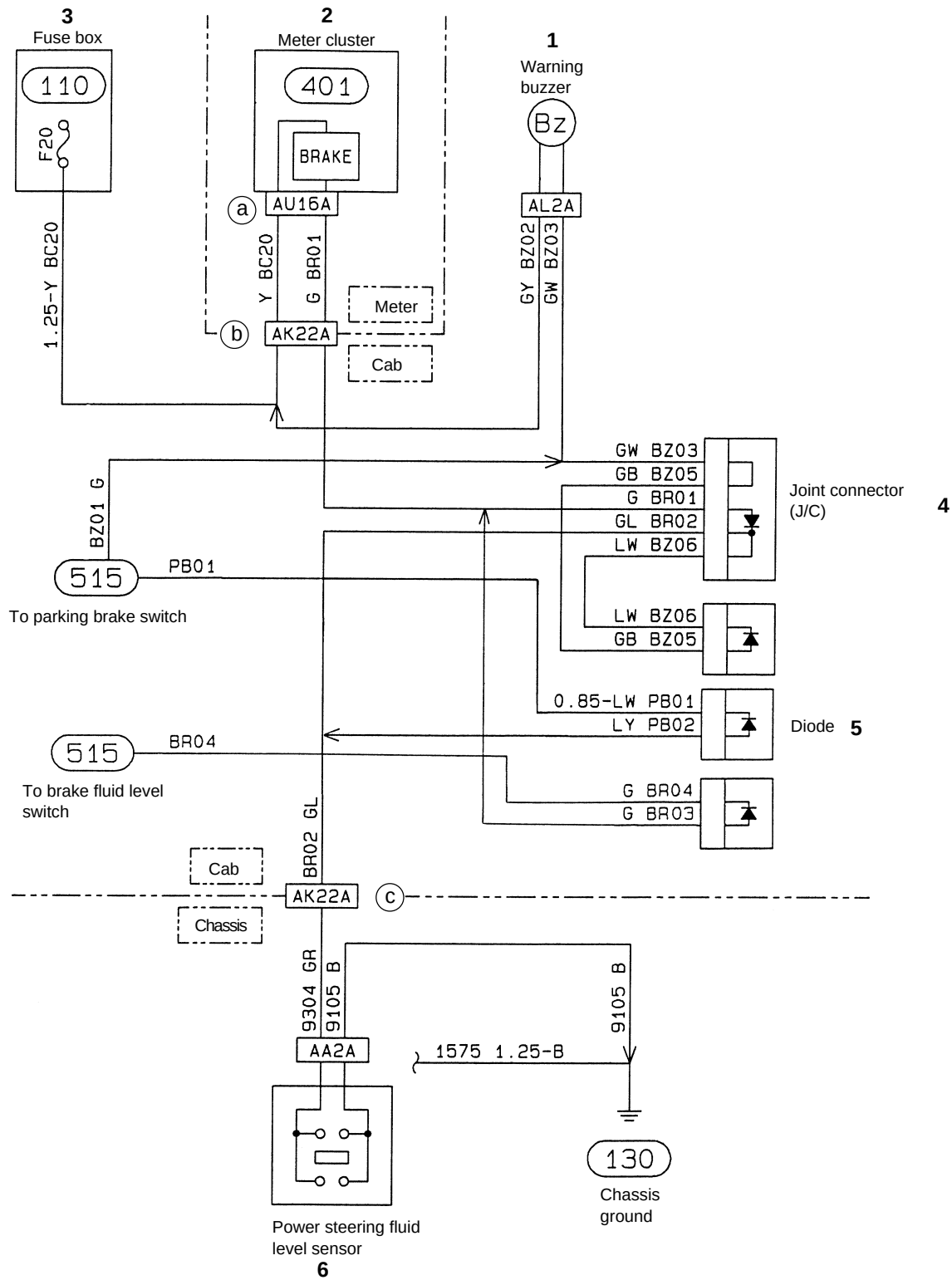
8 Automatic transmission fluid cooler fan motor

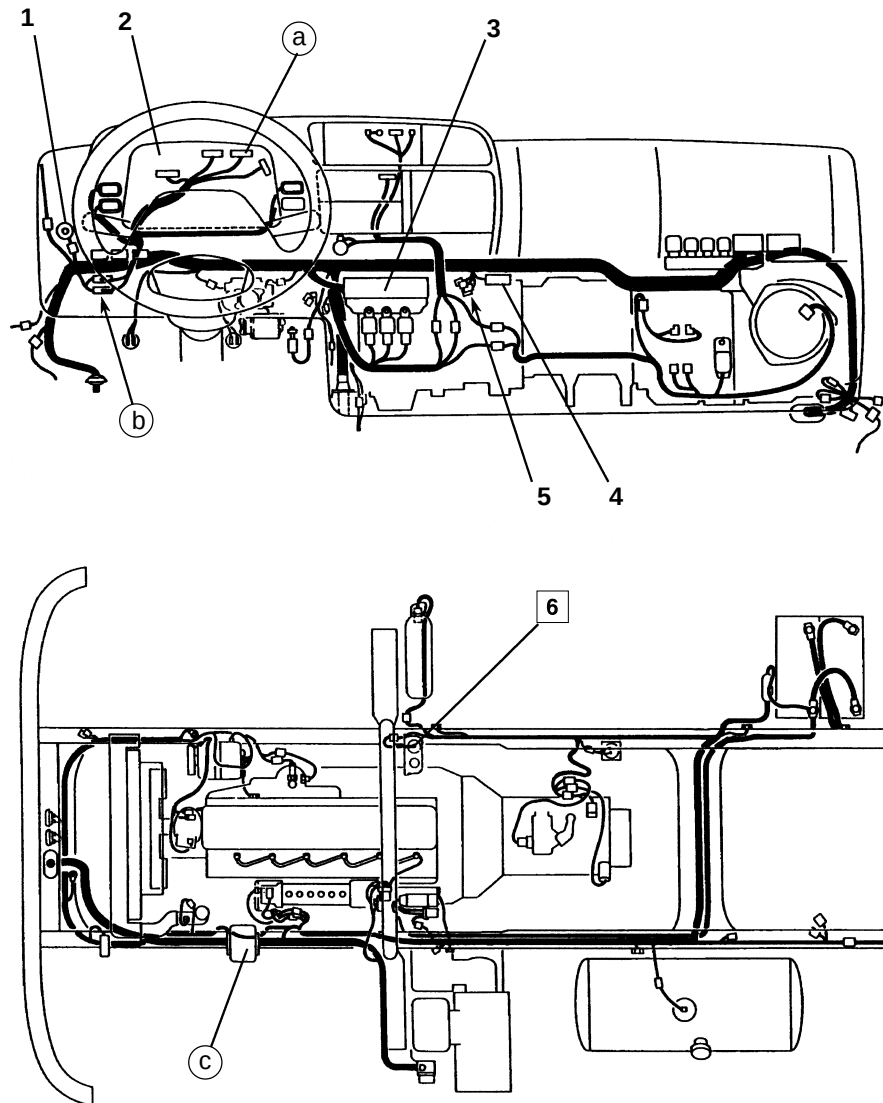
9 Automatic transmission fluid thermostat switch (547)

10 Automatic transmission fluid temperature switch (802)

: '96 Model Gr 54 (Pub. No. TWME9502-54)

549 POWER STEERING FLUID LEVEL WARNING CIRCUIT





26899

- 1 Warning buzzer (606)
- 2 Meter cluster (401)
- 3 Fuse box (104)
- 4 Joint connector (J/C) (905)
- 5 Diode
- 6 Power steering fluid level sensor

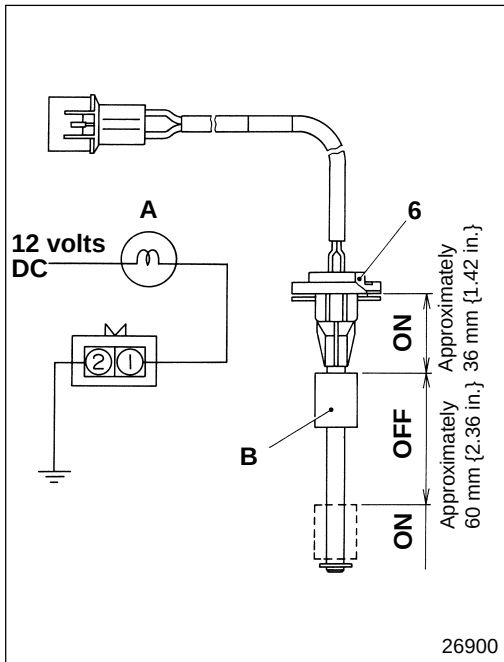
: '96 Model Gr 54 (Pub. No. TWME9502-54)

549 POWER STEERING FLUID LEVEL WARNING CIRCUIT

◆ Service procedure

6 Inspection of power steering fluid level sensor

- Wire power steering fluid level sensor **6** as illustrated.
A : Inspection lamp (12 V - 1.4 W)
- Make sure inspection lamp **A** lights when float **B** is in ON position (when float is either in the upper or lower areas).
- If any fault is found, replace power steering fluid level sensor **6**.



MEMO

6 CAB SIDE ELECTRICS

SPECIFICATIONS	54-6-2
TROUBLESHOOTING	54-6-3
601 SWITCH	
604 RELAY AND CONTROL UNIT	
606 WARNING BUZZER	
610 CIGARETTE LIGHTER CIRCUIT	
612 AUDIO CIRCUIT	
614 WIPER AND WASHER CIRCUIT	
616 HORN CIRCUIT	54-6-4
618 HEATER CIRCUIT	

This chapter contains information on the electric horn only.

 : '96 Model Gr 54 (Pub. No. TWME9502-54)

SPECIFICATIONS

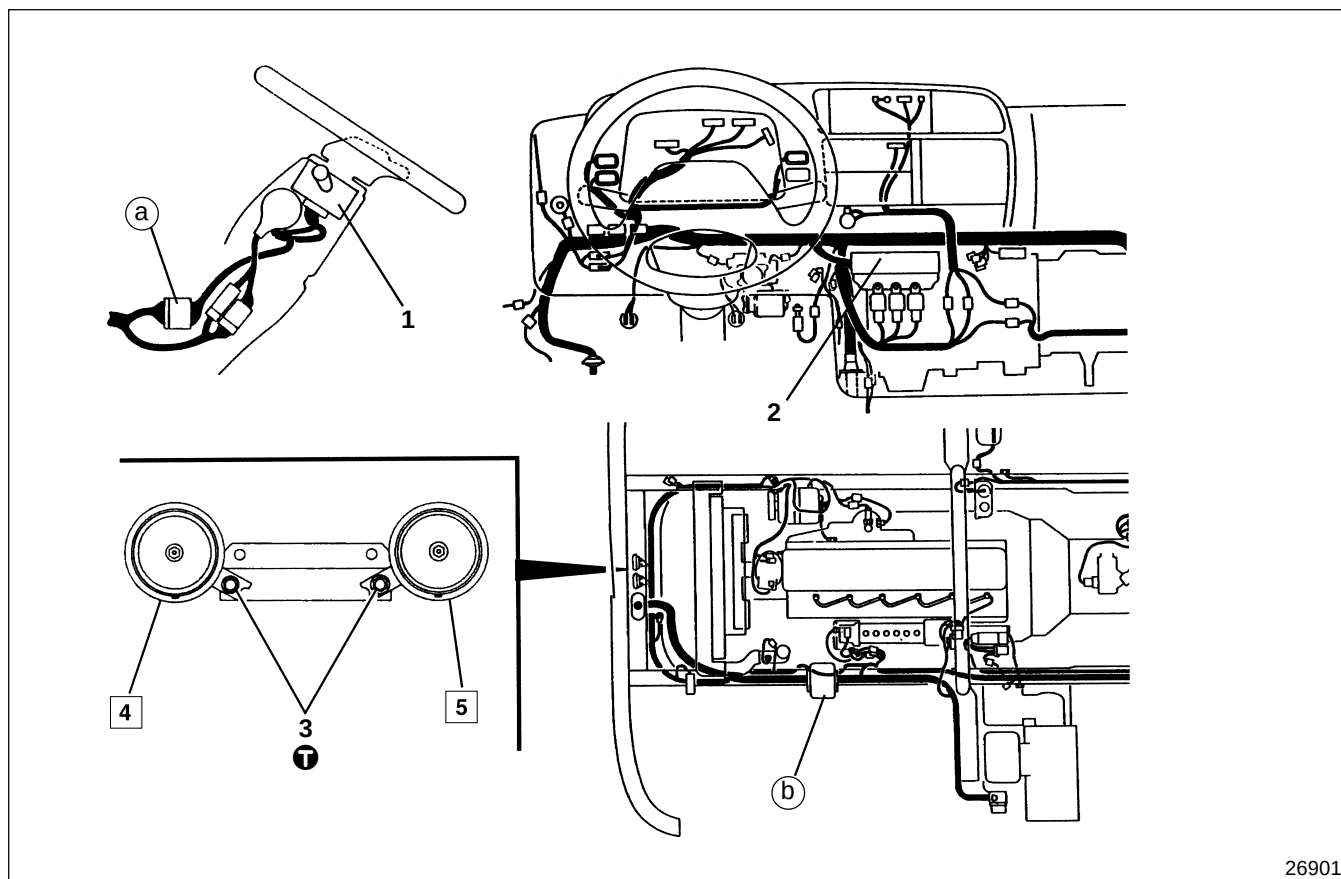
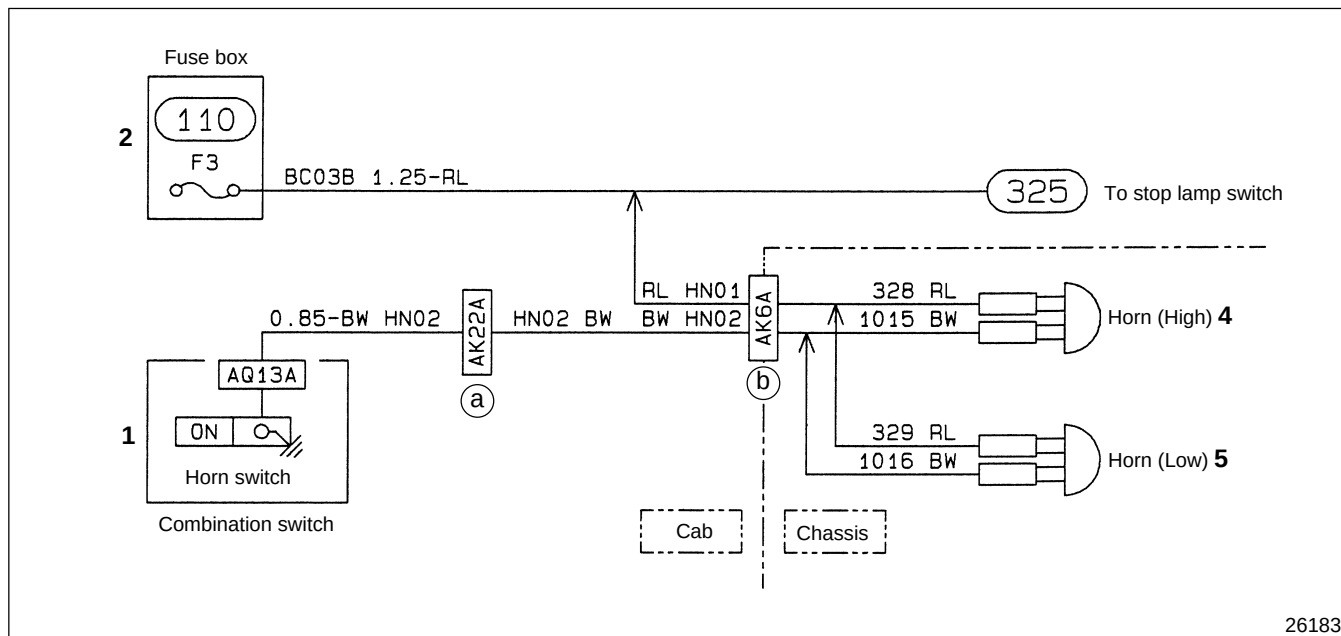
Item		Specifications
Electric horn	Rated voltage V	12
	Rated current A	3±0.5
	Sound pressure dB	110±5 (at 2 m{6.6 ft})
	Standard frequency Hz	390±20 (High/Low)

TROUBLESHOOTING

54

Symptoms	Horn				Remarks
	No Sound	Continuous sound	Small sound	Sound quality poor	
Possible causes					
Connector connection faulty, harness broken, grounding faulty	☐	☐	☐	☐	
Fuse blown	☐	☐	☐	☐	
Horn switch faulty	☐	☐	☐	☐	
Horn faulty	☐	☐	☐	☐	
Horn stay warped	☐	☐	☐	☐	
Battery voltage insufficient	☐	☐	☐	☐	

616 HORN CIRCUIT



1 Combination switch (601)

2 Fuse box (104)

3 Bolt

4 Electric horn (High)

5 Electric horn (Low)

: '96 Model Gr 54 (Pub. No. TWME9502-54)

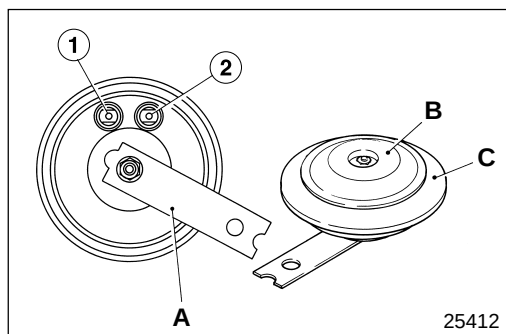
T Tightening torque

Unit : N·m {kgf·m}

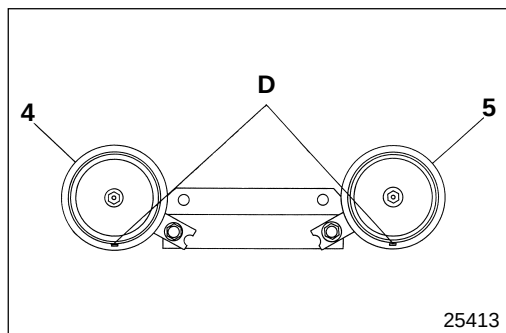
Location	Parts to be tightened	Tightening torque	Remarks
3	Bolt (Horn mounting)	11.8 to 15.6 {1.2 to 1.6}	—

◆ Service procedure**4 5 Electric horn****CAUTION** ⚠

- Bending stay **A** will result in a change in the tone quality of electric horns **4** and **5**, causing a deterioration in performance.
- Be sure not to bend or otherwise damage stay **A**.

**[Inspection]**

- Apply 12 volts DC between terminals 1 and 2 (no polarity) and make sure horns **4** and **5** sound.
- If any fault is found, replace horns **4** and **5**.
- Except when the fault is due to foreign matter sticking to resonator **B** or diaphragm **C**.

**[Installation]****D** : Drain hole

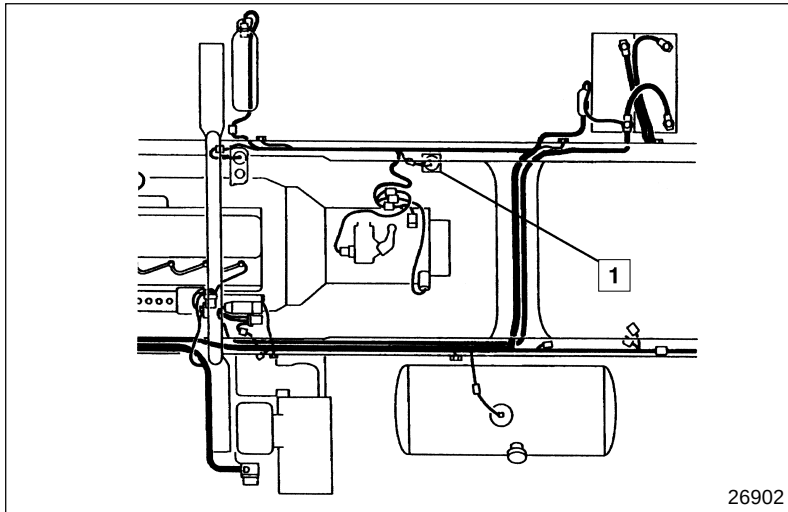
7 CHASSIS ELECTRICS

701 MAGNETIC VALVE < Manual Transmission > 54-7-2

710 EXHAUST BRAKE CIRCUIT < Manual Transmission > ... 54-7-4

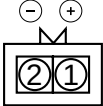
701 MAGNETIC VALVE < MANUAL TRANSMISSION >

Installing Position



- 1** 3-way magnetic valve
(For exhaust brake)

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Minimum operating voltage of 3-way magnetic valve  14318	10 V or less	—	Replace

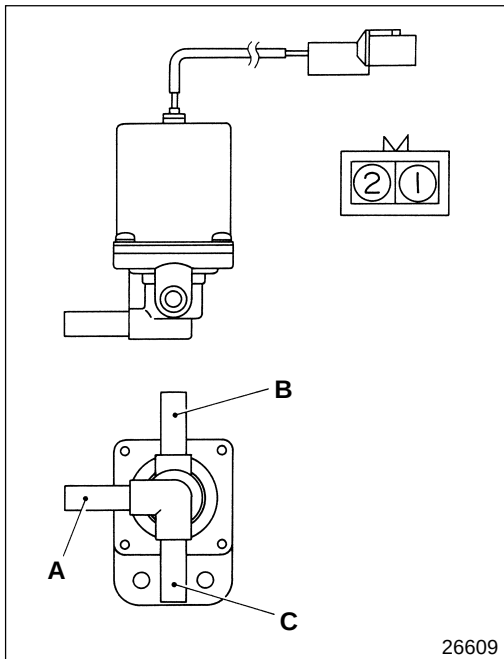
◆ Service procedure

1 Inspection of 3-way magnetic valve

Perform the following inspection and if any fault is found, replace 3-way magnetic valve **1**.

Air circuit table (There is air continuity between terminals ○ and ○.)

	Input port A (from vacuum pump)	Output port B (to exhaust brake valve)	Exhaust port C (into atmosphere)
ON	○ —	○ —	
OFF		○ —	○ —



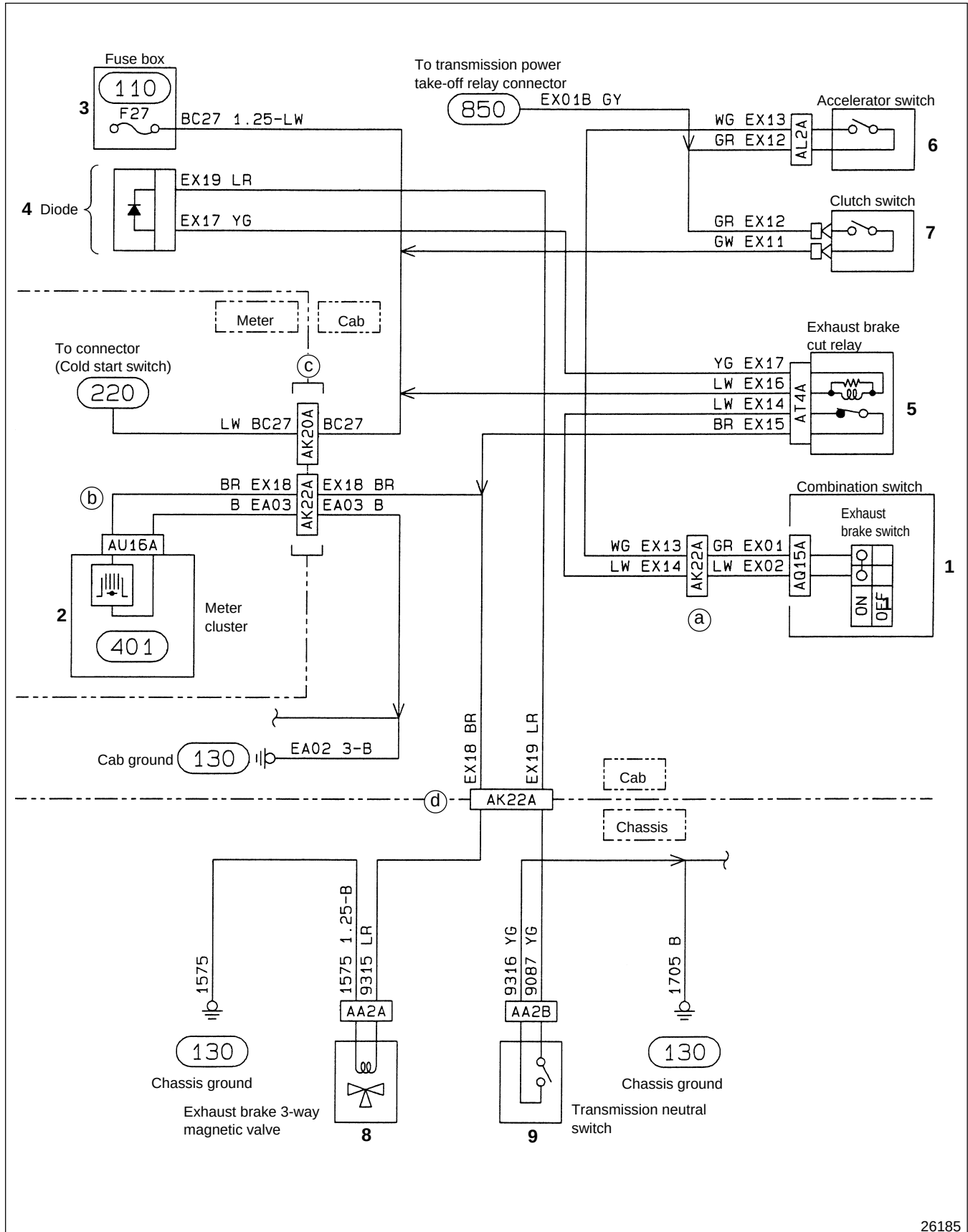
(1) Operation inspection

- While applying negative pressure of -99.99 kPa $\{-29.5 \text{ in. Hg}, -750 \text{ mm Hg}\}$ through input port **A**, apply direct-current voltage between terminals ① and ② gradually, starting at 0 volt. Measure the voltage (minimum operating voltage) when 3-way magnetic valve **15** is activated under this condition. (You can tell if the magnetic valves are ON or OFF by listening for an operating sound.)
- Seal output port **B** tightly and applying a pressure of 98.1 kPa $\{14 \text{ lbf/in}^2, 1 \text{ kgf/cm}^2\}$ through exhaust port **C**, apply voltage and perform inspection in the same way as described above.

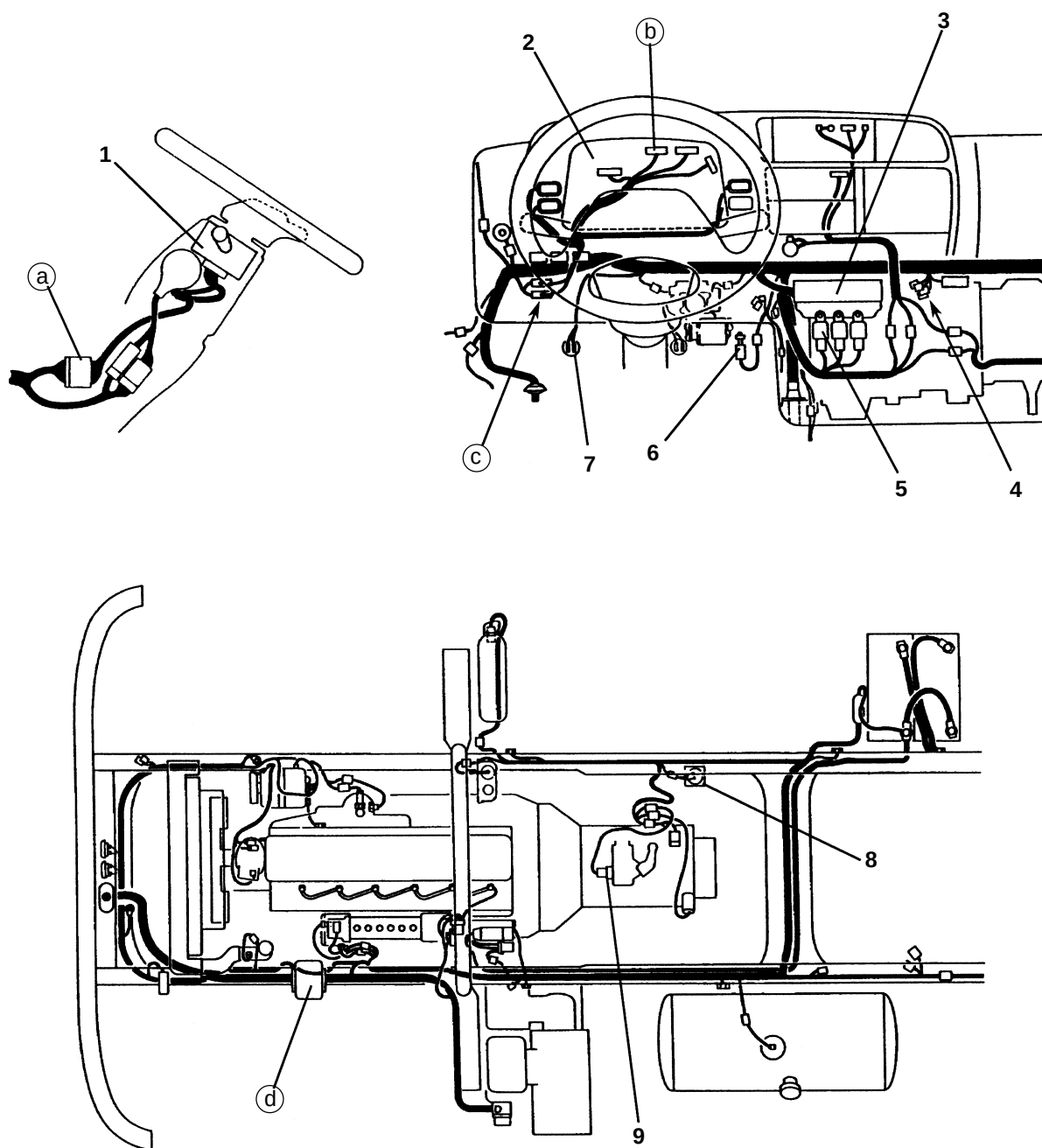
(2) Airtightness inspection

- When the 3-way magnetic valve is ON :
 - Seal output port **B** tightly.
 - While applying negative pressure of -99.99 kPa $\{-29.5 \text{ in. Hg}, -750 \text{ mmHg}\}$ through input port **A**, apply 12 volts DC between terminals ① and ②. Check to ensure air is not sucked in through exhaust port **C** at such time.
 - Next, seal output port **B** tightly, and while applying a pressure of 98.1 kPa $\{14 \text{ lbf/in}^2, 1\text{kgf/cm}^2\}$ through exhaust port **C**, apply 12 volts DC between terminals ① and ②. Check to ensure there is no air leakage from input port **A** at such time.
- When the 3-way magnetic valve is OFF :
 - Seal output port **B** tightly, apply negative pressure of -99.99 kPa $\{-29.5 \text{ in. Hg}, -750 \text{ mmHg}\}$ through input port **A** and check to ensure air is not sucked in through exhaust port **C**.
 - Next, seal output port **B** tightly, apply pressure of 1 kPa $\{14 \text{ lbf/in}^2, 1\text{kgf/cm}^2\}$ through exhaust port **C** and check to ensure there is no air leakage from input port **A**.

710 EXHAUST BRAKE CIRCUIT < MANUAL TRANSMISSION >



26185



26903

1 Combination switch (601)

2 Meter cluster (401)

3 Fuse box (104)

4 Diode

5 Exhaust brake cut relay (604)

6 Accelerator switch (710)

7 Clutch switch (710)

8 Exhaust brake 3-way magnetic valve (701)

9 Transmission neutral switch (802)

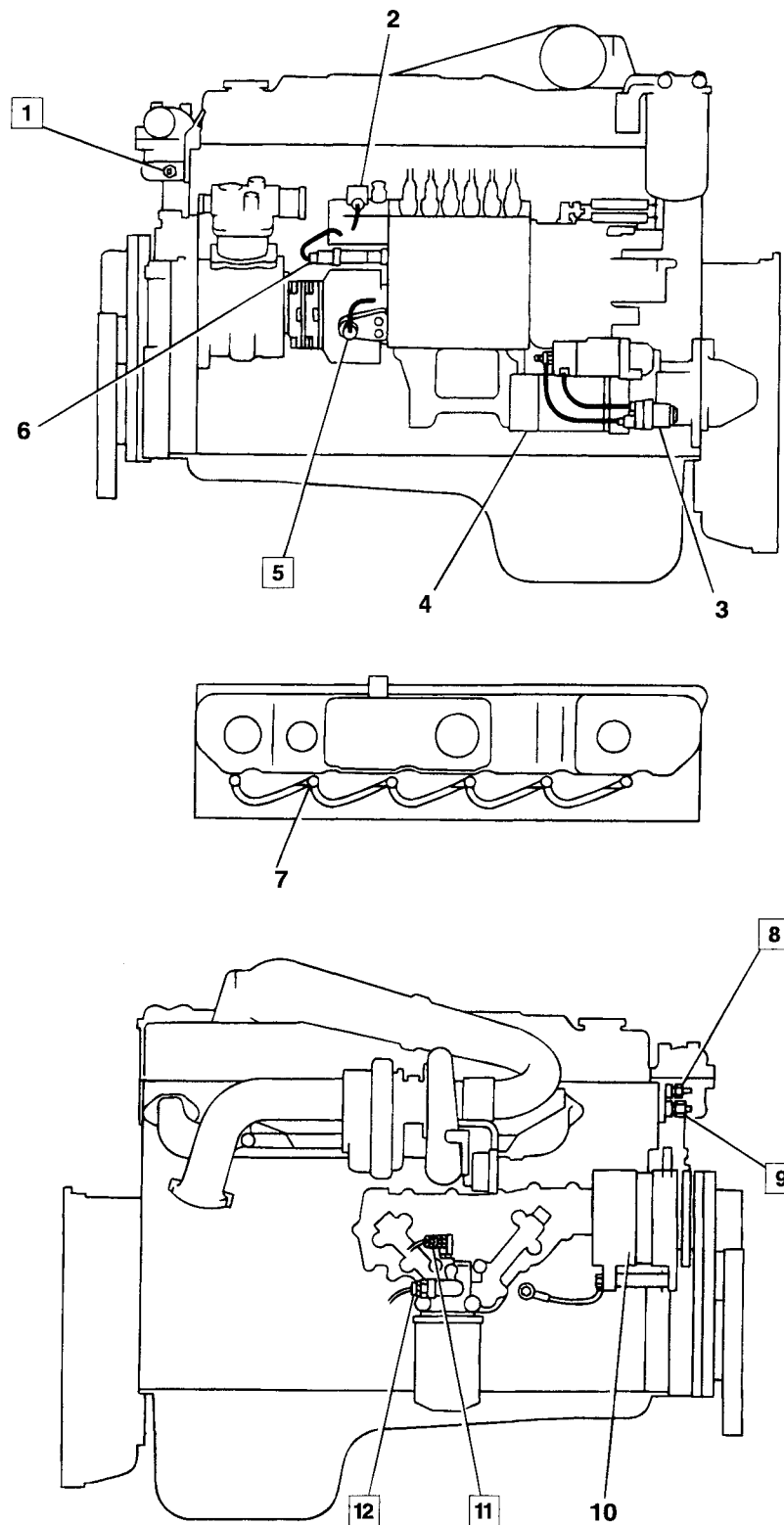
: '96 Model Gr 54 (Pub. No. TWME9502-54)

8 ENGINE AND TRANSMISSION ELECTRICS

801	ENGINE ELECTRICS.....	54-8-2
802	TRANSMISSION ELECTRICS	
	< Manual Transmission >	54-8-6
	< Automatic Transmission >	54-8-8
850	TRANSMISSION POWER TAKE-OFF CIRCUIT	
	< Option >	54-8-10

801 ENGINE ELECTRICS

Installation Position



13094

- 1 Water temperature sensor (Connects to pre-stroke control unit) Gr 13
- 2 Pre-stroke actuator Gr 13
- 3 Starter relay (210)
- 4 Starter (201)
- 5 Engine revolution sensor
- 6 Control rod position sensor Gr 13

- 7 Glow plug (220)
- 8 Water temperature sensor (Connects to water temperature gauge and multipurpose timing control unit)
- 9 Overheating switch
- 10 Alternator (106)
- 11 Engine oil pressure switch
- 12 Engine oil bypass alarm switch

Service standards

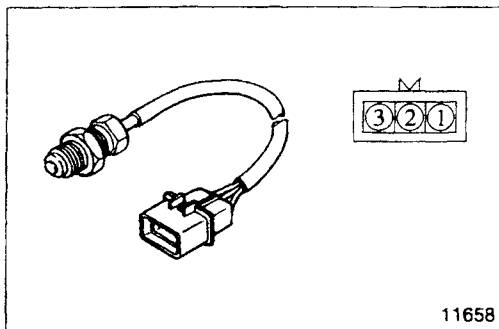
Location	Maintenance item		Standard value	Limit	Remedy
5	Resistance of engine revolution sensor (At room temperature 25°C {77°F}) 14366		①-② 2.1 to 2.5 k Ω	—	Replace
8	Resistance of water temperature sensor Body 14321	① - (Body) (Water temperature gauge side)	50°C {122°F}	(153.9 Ω)	— Replace
			80°C {176°F}	51.9 $\begin{smallmatrix} +4.9 \\ -4.4 \end{smallmatrix}$ Ω	
			100°C {212°F}	27.4 $\begin{smallmatrix} +1.9 \\ -1.2 \end{smallmatrix}$ Ω	
		② - (Body) (Multipurpose timing control unit side)	20°C {68°F}	3.25 $\pm$ 0.33 k Ω	
			60°C {140°F}	(620 Ω)	
			80°C {176°F}	(300 Ω)	
9	Operating temperature of overheating switch	When temperature increases (ON→OFF)	110 $\pm$ 2°C {230 $\pm$ 3.6°F}	—	Replace
		When temperature decreases (OFF→ON)	110 $\pm$ 4°C {230 $\pm$ 3.9°F}	—	
11	Operating pressure of engine oil pressure switch		49 $\pm$ 9.8 kpa {7.1 $\pm$ 1.4 lbf/in ² , 0.5 $\pm$ 0.1 kgf/cm ² }	—	Replace
12	Operating pressure of engine oil bypass alarm switch		140 $\pm$ 20 kPa {20 $\pm$ 2.8 lbf/in ² , 1.4 $\pm$ 0.2 kgf/cm ² }	—	Replace

The values in () are reference values.

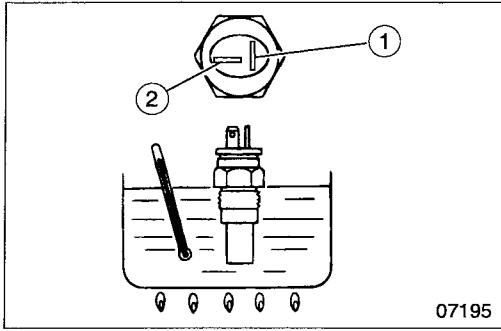
◆ Service procedures

5 Inspection of engine revolution sensor

- Measure the resistance between terminals ① and ②.
- If the measured value deviates from the standard value, replace engine revolution sensor 5. Gr 13



801 ENGINE ELECTRICS



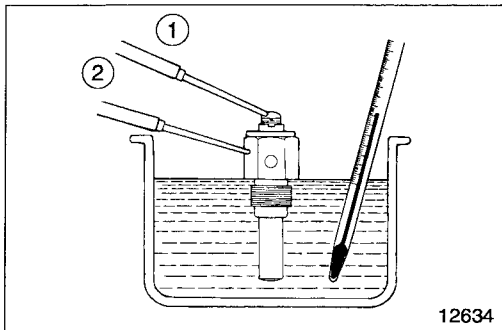
8 Inspection of water temperature sensor

- Place water temperature sensor 8 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, and terminal ② and the body.

Terminal ① : Water temperature gauge connection

Terminal ② : Multipurpose timing control unit connection

- If the measured value deviates from the standard value, replace water temperature sensor 8. Gr 14



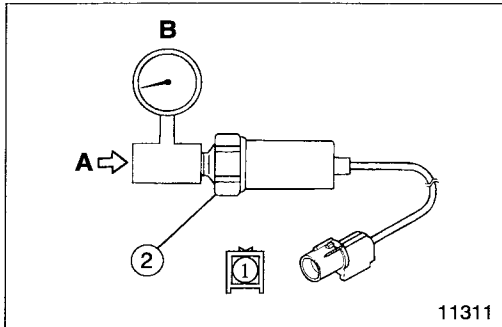
9 Inspection of overheating switch

Carry out the following inspection. If any fault is found, replace overheating switch 9. Gr 14

- Make sure that there is no continuity between terminals ① and ② (Body) at room temperature (20°C {68°F}).
- Place overheating switch 9 in a container filled with engine oil and raise the oil temperature while stirring the oil.

Measure the temperature when there is continuity between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.

- Lower the oil temperature and measure the temperature when continuity is lost between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.



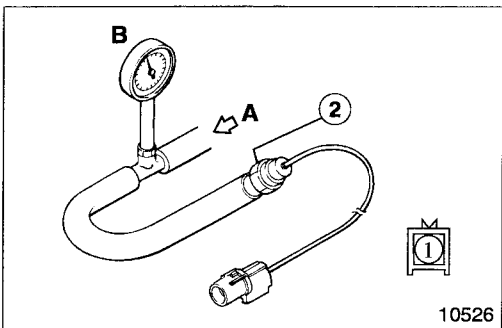
11 Inspection of engine oil pressure switch

Carry out the following inspection. If any fault is found, replace engine oil pressure switch 11. Gr 12

- Make sure that there is continuity between terminals ① and ② (Body) when air pressure A is not applied to engine oil pressure switch 11.
- Apply air pressure A to engine oil pressure switch 11 gradually starting from 0 kpa {0 lbf/in², 0 kgf/cm²}.

Measure the air pressure when continuity is lost between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.

B : Air pressure gauge



12 Inspection of engine oil bypass alarm switch

Carry out the following inspection. If any fault is found, replace engine oil bypass alarm switch 12. Gr 12

- Make sure that there is no continuity between terminals ① and ② (Body) when air pressure A is not applied to engine oil bypass alarm switch 12.
- Apply air pressure A to engine oil bypass alarm switch 12 gradually starting from 0 kpa {0 lbf/in², 0 kgf/cm²}.

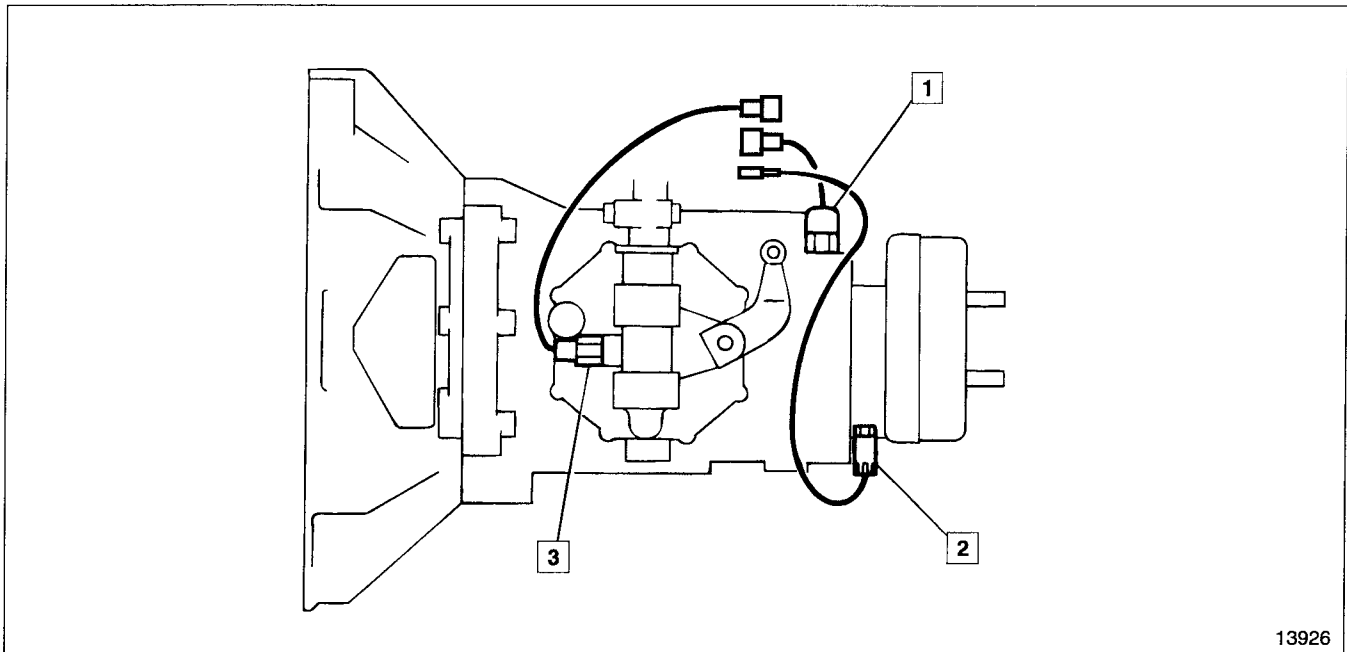
Measure the air pressure when continuity is present between terminals ① and ② (Body), and make sure that the measured value conforms to the standard value.

B : Air pressure gauge

MEMO

802 TRANSMISSION ELECTRICS < Manual Transmission >

Installation Position

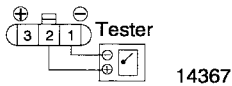


13926

- 1 Backup lamp switch
- 2 Vehicle speed sensor
- 3 Transmission neutral switch

Service standards

Location	Maintenance item		Standard value	Limit	Remedy
2	Pulse output voltage of vehicle speed sensor (8 pulses)	①-②	Low pulse	1.5 V or less	Replace
			High pulse	12 V-(0.5 V or less)	



◆ Service procedure

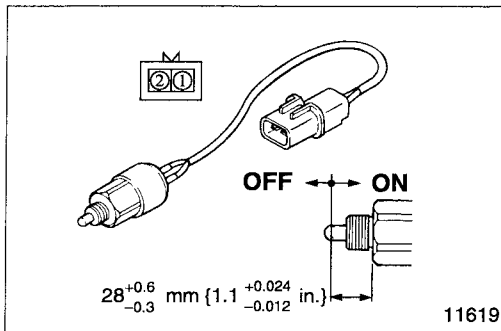
1 Inspection of Backup lamp switch

- Follow the table below to inspect continuity

	①	②
OFF		
ON	○ — ○	○ — ○

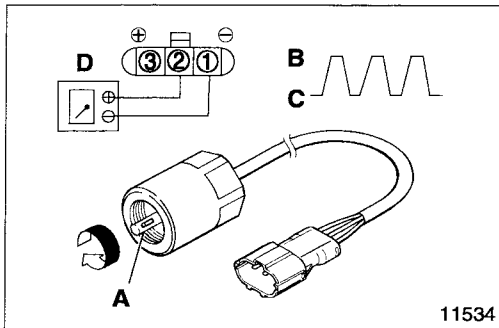
○ — ○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace backup lamp switch 1.  Gr 22



2 Inspection of vehicle speed sensor

- Apply 12 volts DC between terminals ① and ③, and rotate shaft A of vehicle speed sensor 2 slowly.
- At this state, measure the maximum voltage (High pulse voltage B) and the minimum voltage (Low pulse voltage C) generated between terminals ① and ②.
- D : Tester
- If the measured value deviates from the standard value, replace vehicle speed sensor 2.  Gr 22



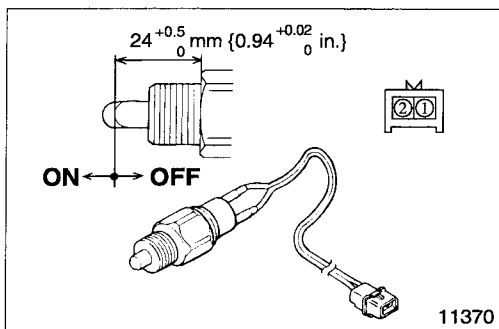
3 Inspection of transmission neutral switch

- Follow the table below to inspect continuity

	①	②
OFF		
ON	○ — ○	○ — ○

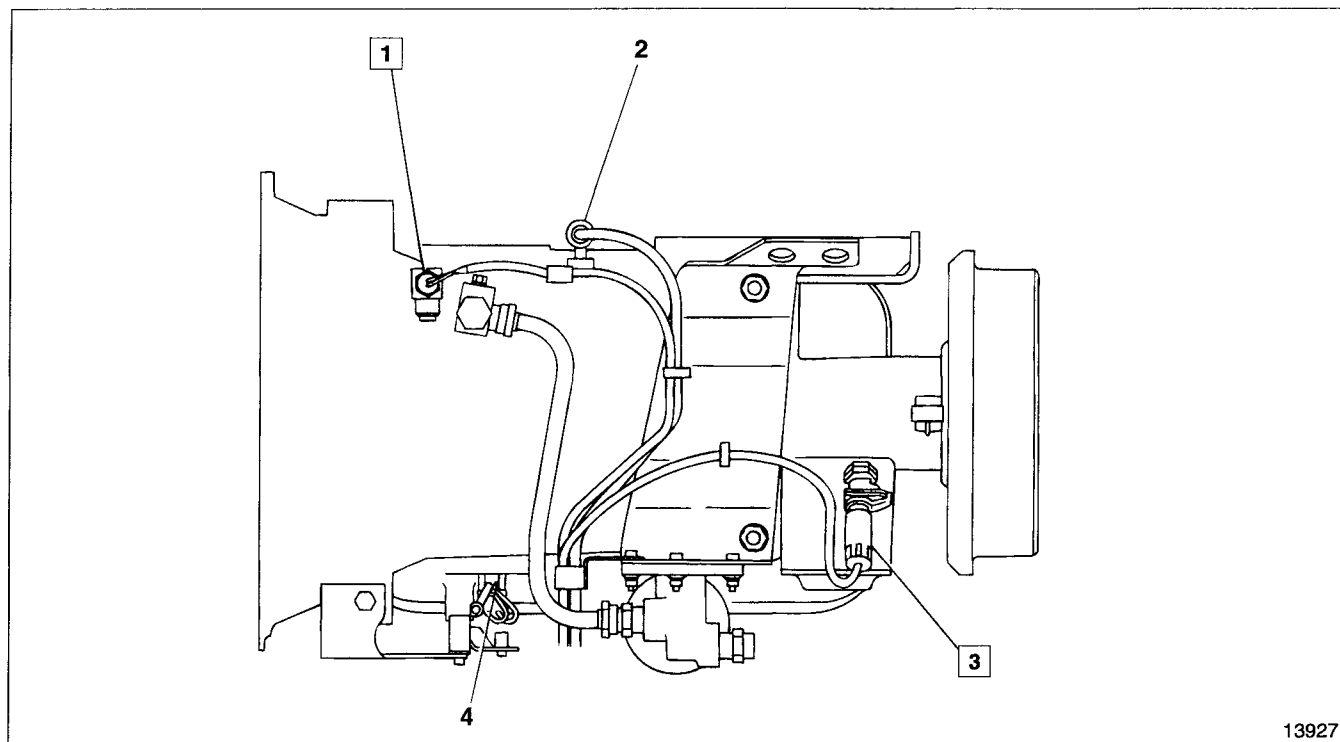
○ — ○ : There is continuity between terminals ○ and ○.

- If any fault is found, replace transmission neutral switch 3.  Gr 22



802 TRANSMISSION ELECTRICS < Automatic Transmission >

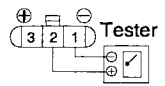
Installation Position



13927

- 1 Automatic transmission fluid temperature switch
- 2 Backup lamp switch  Gr 23
- 3 Vehicle speed sensor
- 4 Automatic transmission neutral switch  Gr 23

Service standards

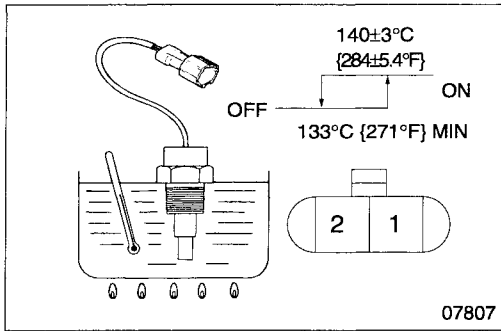
Location	Maintenance item			Standard value	Limit	Remedy
1	Operating temperature of automatic transmission fluid temperature switch	When increases (OFF→ON)		140±3°C {284±5.4°F}	—	Replace
		When decreases (ON→OFF)		133°C {271°F} MIN		
3	Output voltage of vehicle speed sensor 	①-②	Low pulse	1.5 V or less	—	Replace
			High pulse	12 V—(0.5 V or less)	—	

◆ Service procedure

1 Inspection of automatic transmission fluid temperature switch

Carry out the following inspection. If any fault is found, replace automatic transmission fluid temperature switch 1.  Gr 23

- Make sure that there is no continuity between terminals ① and ② at room temperature ($20\pm5^{\circ}\text{C}$ { $68\pm9^{\circ}\text{F}$ }).
- Place automatic transmission fluid temperature switch 1 in a container filled with engine oil and raise the oil temperature while stirring the oil. Measure the temperature when there is continuity between terminals ① and ②, and make sure that the measured value conforms to the standard value.
- Lower the oil temperature and measure the temperature when continuity is lost between terminals ① and ②, and make sure that the measured value conforms to the standard value.

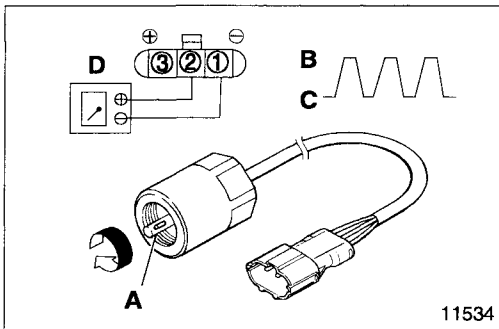


3 Inspection of vehicle speed sensor

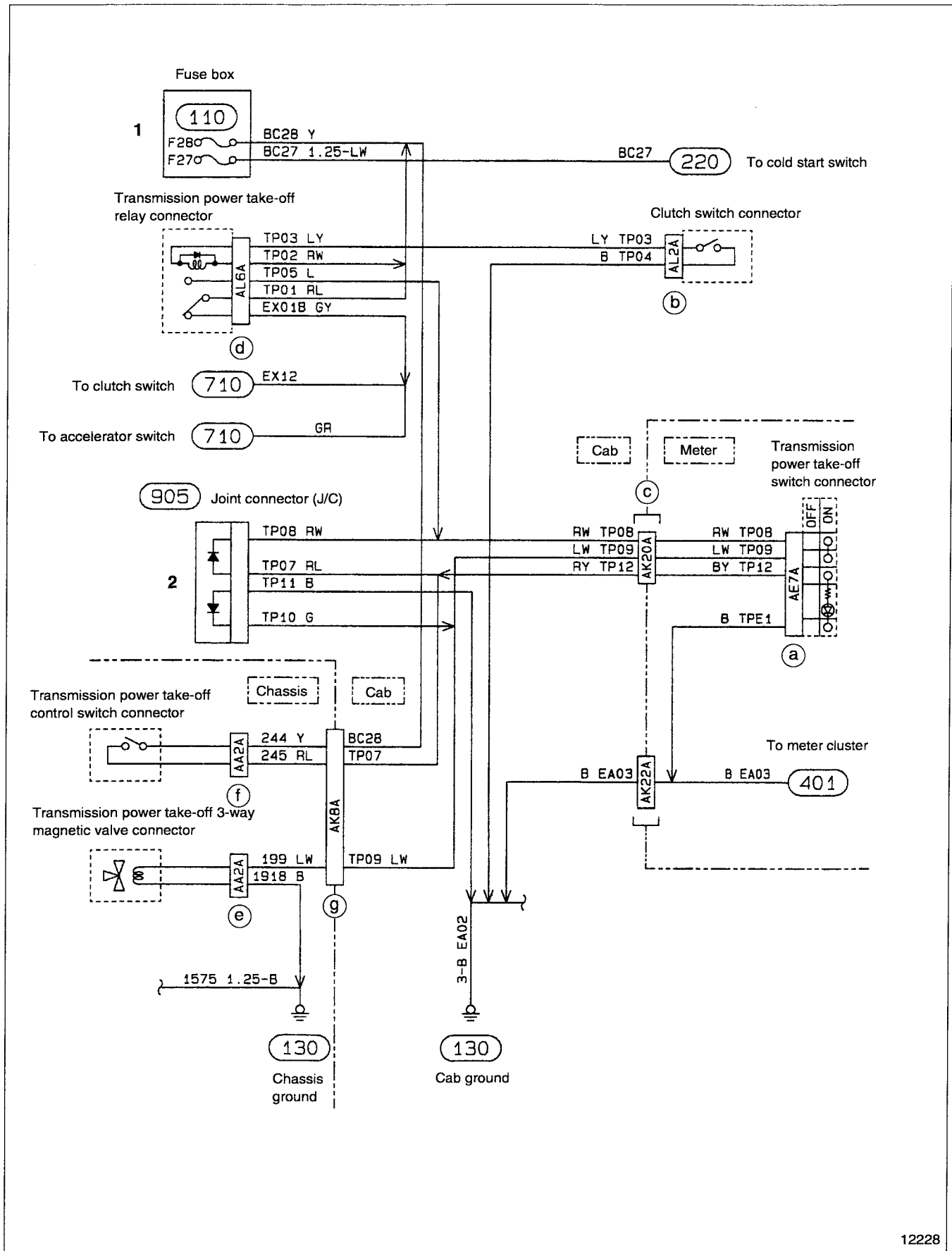
- Apply 12 volts DC between terminals ① and ③, and rotate shaft A of vehicle speed sensor 3 slowly.
- At this state, measure the maximum voltage (High pulse voltage B) and the minimum voltage (Low pulse voltage C) generated between terminals ① and ②.

D : Tester

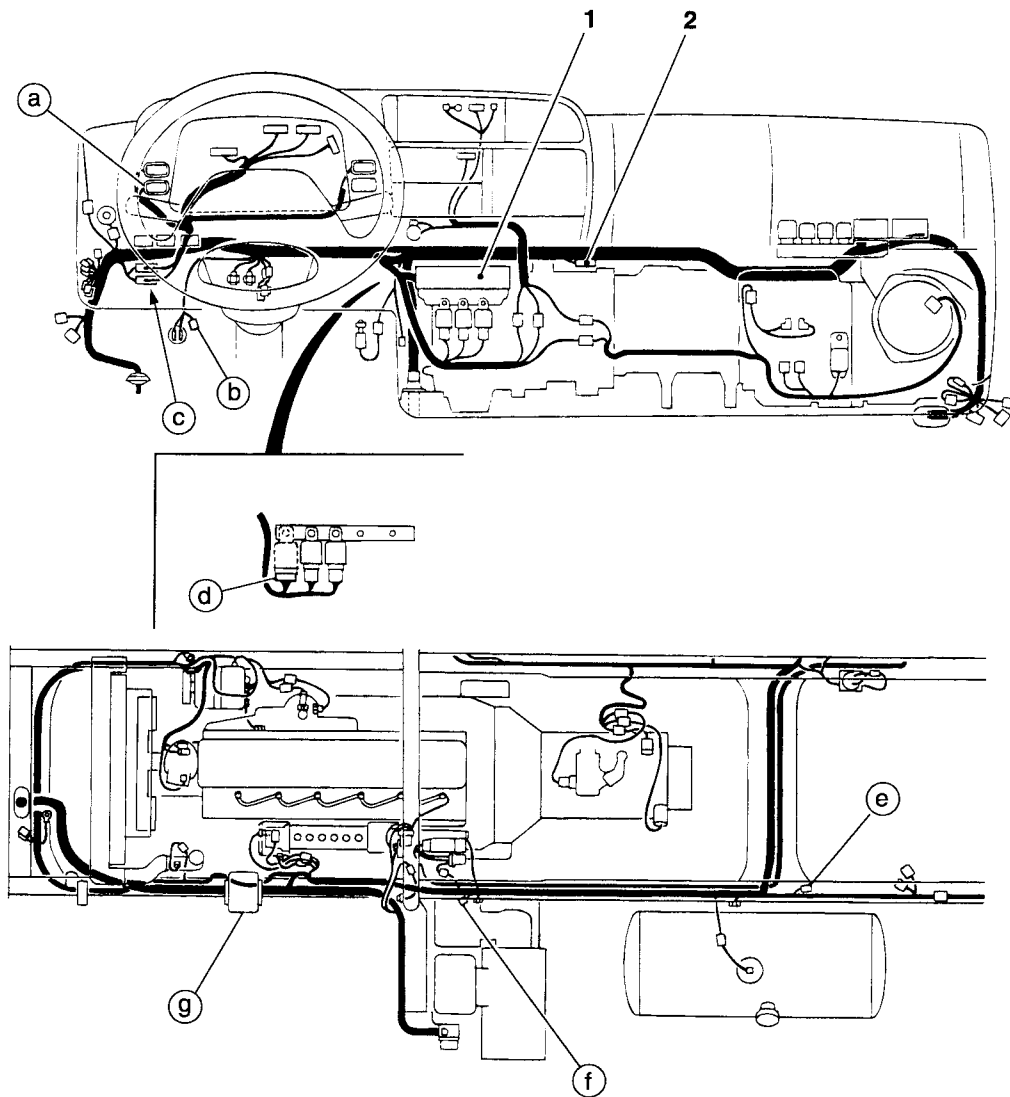
- If the measured value deviates from the standard value, replace vehicle speed sensor 3.  Gr 23



850 TRANSMISSION POWER TAKE-OFF CIRCUIT < Option >



12228



14223

- 1 Fuse box  (104)
2 Joint connector  (905)

9 OTHERS

STRUCTURE AND OPERATION 

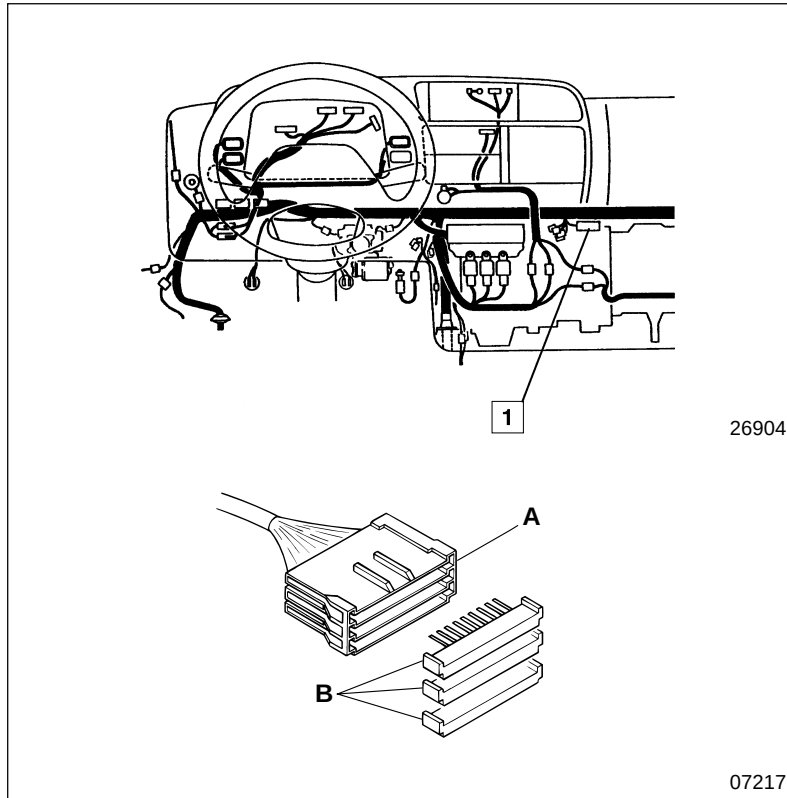
(905) JOINT CONNECTOR..... 54-9-2

(910) MULTIPURPOSE TIMING CONTROL UNIT CIRCUIT 

 : '97 Model Gr 54 (Pub. No. TWME9502-1)

905 JOINT CONNECTOR

Installation Position



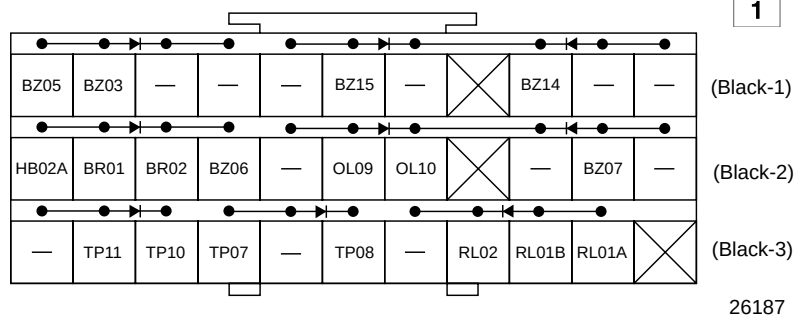
1 Joint connector

A : Housing

B : Joint

◆ Service procedure

1 Joint connector



	Circuit No.	Wire color	Destinations	Index No.	Remarks
Black-1	BZ05	GB	Diode	(515)	
	BZ03	GW	Warning buzzer	(515)	
	BZ15	G	BR01	(515)	
	BZ14	YB	GE02	(215)	
Black-2	HB02A	LB	Diode	(515)	
	BR01	G	Meter cluster (Brake)	(515)	
	BR02	GL	Power steering fluid level sensor	(515)	
	BZ06	LW	Diode	(515)	
	OL09	L	Meter cluster (Engine oil)	(536)	
	OL10	LW	Engine oil pressure switch	(536)	
	BZ07	GR	Diode	(510)	
Black-3	TP11	B	EA02	—	T/M PTO (Ground)
	TP10	G	TP09	—	T/M PTO
	TP07	RL	Transmission control switch	—	T/M PTO
	RL01A	BW	Cab lamp	(345)	
	TP08	RW	Transmission power take-off switch	—	T/M PTO
	RL02	BY	Door switch, RH	(345)	
	RL01B	BW	Door switch, LH	(345)	

T/M PTO : Transmission power take-off < Option >



FH

Service Manual

Group 55A

Air-conditioner

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

FOREWORD

This service manual describes the maintenance data consisting of constructive & functional outlines, inspection, and repair service of MITSUBISHI FUSO GENUINE TRUCK CAB AIR CONDITIONER.

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1. SPECIFICATIONS	1
2. OUTLINES OF REFRIGERATION SYSTEM	2
3. CONSTRUCTION	4
4. TROUBLE SHOOTING	11
5. REMOVAL AND INSTALLATION	18
6. TREATMENT AFTER INSTALLATION	21
7. MAINTENANCE	27
8. COOLING UNIT ASSEMBLY	28
9. COMPRESSOR & CLUTCH ASSEMBLY	30

1. SPECIFICATIONS

Item			Description
Vehicle name & model			FE
*Cooling capacity (on JIS conditions)			4,200 W (3,600 kcal/h, 14,300 B.T.U/h)
Compressor	Model		MSC90T
	Displacement		90 cc
	Maximum revolution		MAX 9,000 min ⁻¹ (9,000 rpm)
	Compressor oil		SUNPAG 56, 120cc (7.3 cu.in)
Magnetic clutch	Type		Dry single disc magnet
	Voltage & input		DC 12V, 38 W
Cooling unit assembly	Type		Laminated type
Controls	Air flow control		Rotary switch, Four step type
	Temperature control		Electric thermostat
Condenser	Type		Corrugated fin type
Receiver assembly			Cylinder type, approx 350 cc (21.4 cu.in)
Protective equipment	Frost prevention (thermostat)		OFF : 33 °F (0.5 °C) ON : 38 °F (3.5 °C)
	Relief valve		Open : 3.50 ~ 4.10 MPaG (508 ~ 594 Lb/in²G, 35.7 ~ 41.8 kgf/cm²G) Close : 2.94 MPaG (427 Lb/in²G, 30 kgf/cm²G)
	Dual pressure switch	Low pressure switch	OFF : 0.2 MPaG (28 Lb/in²G, 2 kgf/cm²G) ON : 0.225 MPaG (32 Lb/in²G, 2.25 kgf/cm²G)
		High pressure switch	OFF : 2.94 MPaG (418 Lb/in²G, 30 kgf/cm²G) ON : 2.35 MPaG (334 Lb/in²G, 24 kgf/cm²G)
	Fuse (Blower fan)		15 A
	Fuse (Magnetic clutch)		15 A
Refrigerant and quantity			HFC - 134a, 1.4 lb (650 g)

*The * marked cooling capacity is based on JIS conditions

Compressor speed : 1,800 rpm

Condensing temperature : 131 °F (55 °C)

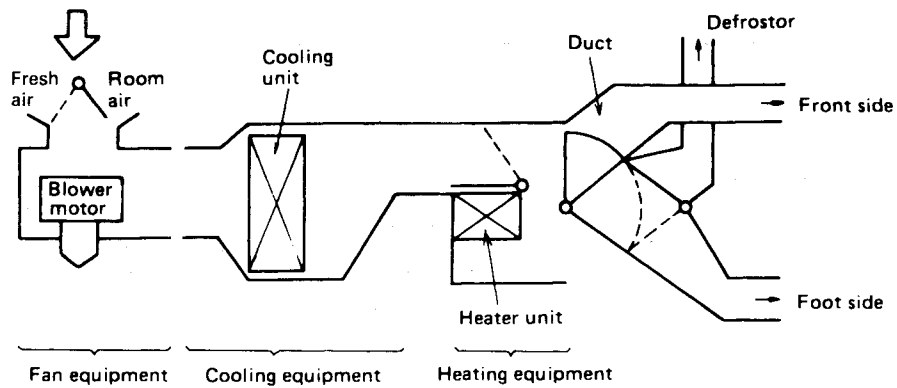
Cooling unit inlet air dry bulb temperature : 80.6 °F (27 °C)

Cooling unit inlet air wet bulb temperature : 67.1 °F (19.5 °C)

Terminal voltage : DC 12V

2. OUTLINES OF REFRIGERATION SYSTEM

2.1 Air system



Cooling operation

Fresh air is induced to the cooling unit assembly by a blower fan, where it is cooled down and dehydrated, then discharged at the front side outlet through a duct.

Dehumidifying operation

Fresh air is induced to the cooling by a blower fan, where it is cooled down and dehydrated, and succeeding to the heater unit for warming, then discharged at the front side outlet through a duct.

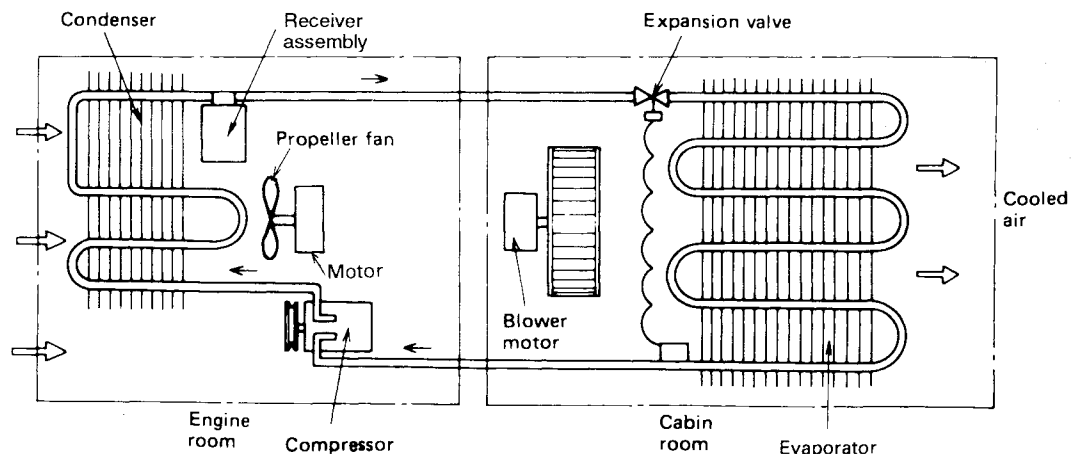
Heating operation

Fresh air is induced to the heater unit by a blower fan through the cooling unit assembly, where it is heated, then discharged at the foot side outlet through a duct.

Temperature control

Cooled air and warmed air are mixed for temperature control of the room inside.

2.2 Refrigerating cycle

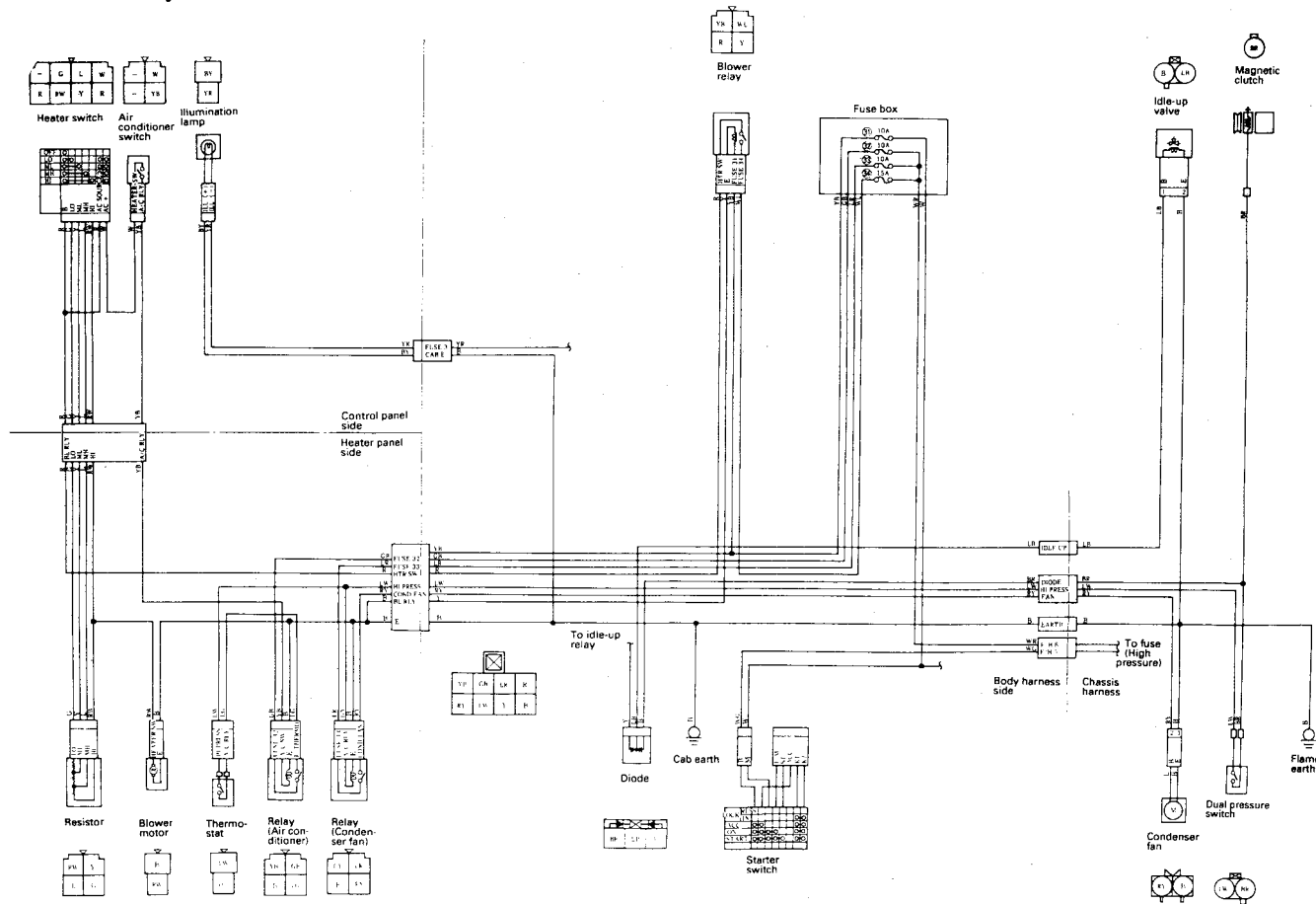


While the refrigerant, HFC-134a is cooling the air drawn into the evaporator, it evaporates and becomes a gas. This gas is compressed to high pressure and temperature in the compressor, and sent into the condenser where it is cooled and becomes liquid.

This cooling in the condenser is carried out by the open air passing through the condenser sucked by radiator fan and vehicle motion of the vehicle. The liquid refrigerant flows through the receiver assembly where water and dirt are removed, and then it enters the expansion valve. Here the liquid refrigerant is throttled and changed to a mixture of liquid and gas in low temperature and low pressure, and is sent to the evaporator.

In the evaporator, the refrigerant absorbs heat from the surroundings and becomes a gas. That is, because the evaporator itself is cooled at this time, the return air to the cooling unit is cooled, and the interior of the vehicle becomes cool. In this way the refrigerant flow makes a complete circuit.

2.3 Electrical system

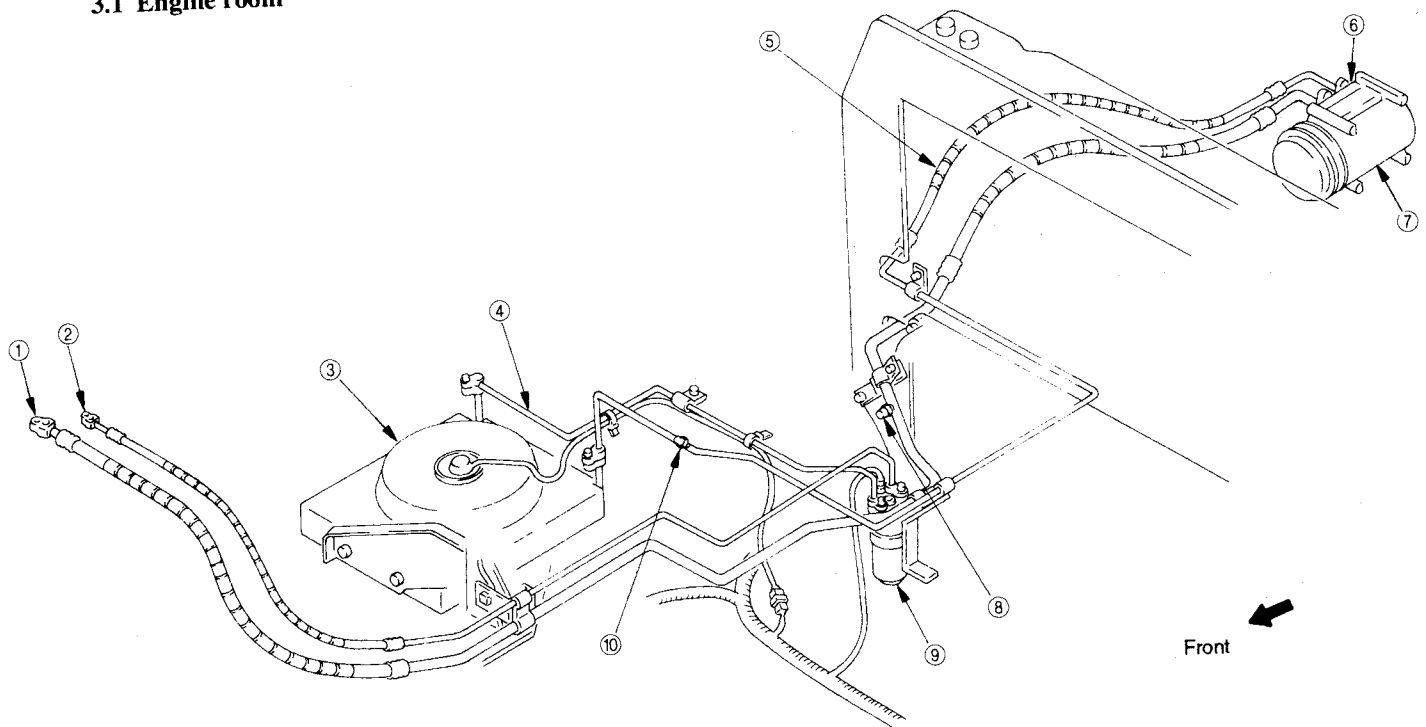


The power source is supplied from the TRUCK battery. When the blower switch is put ON, the power relay becomes ON, and electricity is connected to the magnetic clutch of the compressor. The magnetic clutch switches ON or OFF by air conditioner switch, thermostat, and low pressure switch as the controls for operation service, or safety protection.

The cabin room air temperature is set to a preset point by adjusting the temp.control lever, and the opening degree of the air mix damper.

3. CONSTRUCTION

3.1 Engine room

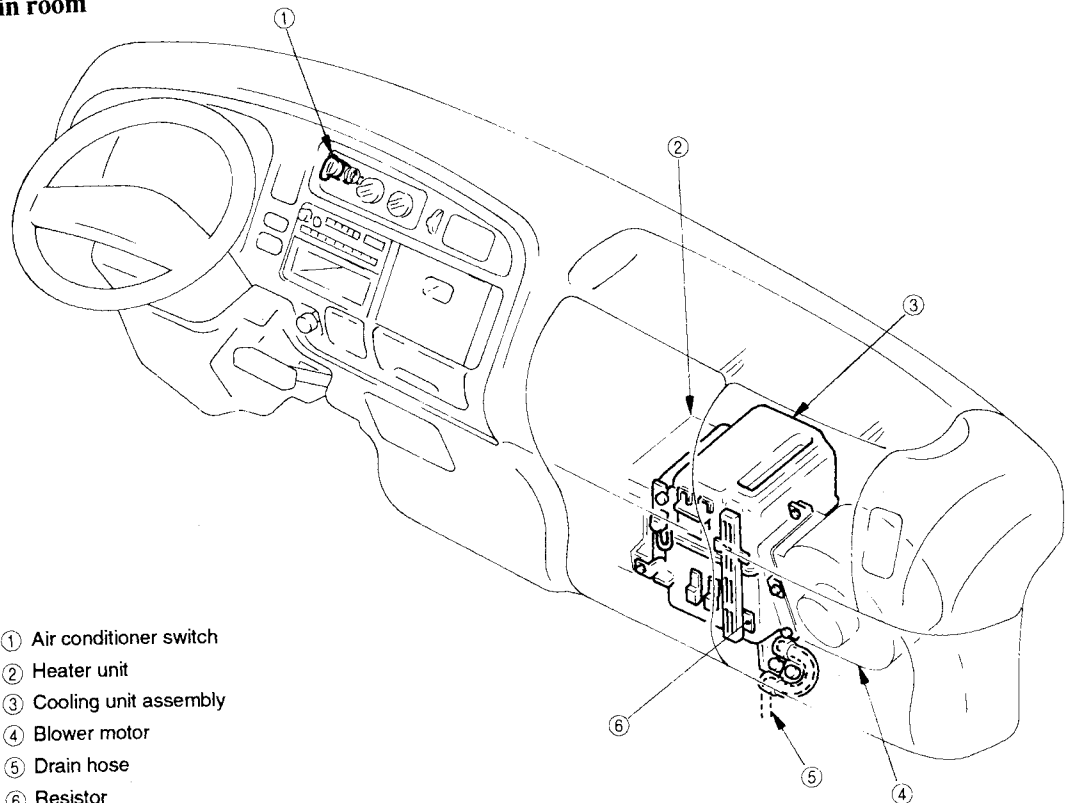


- ① Suction hose
- ② Liquid hose
- ③ Side condenser assembly
- ④ Pipe (LQ)

- ⑤ Discharge hose
- ⑥ Relief valve
- ⑦ Compressor & clutch assembly
- ⑧ Check valve (LP)

- ⑨ Receiver assembly
- ⑩ Check valve (HP)

3.2 Cabin room

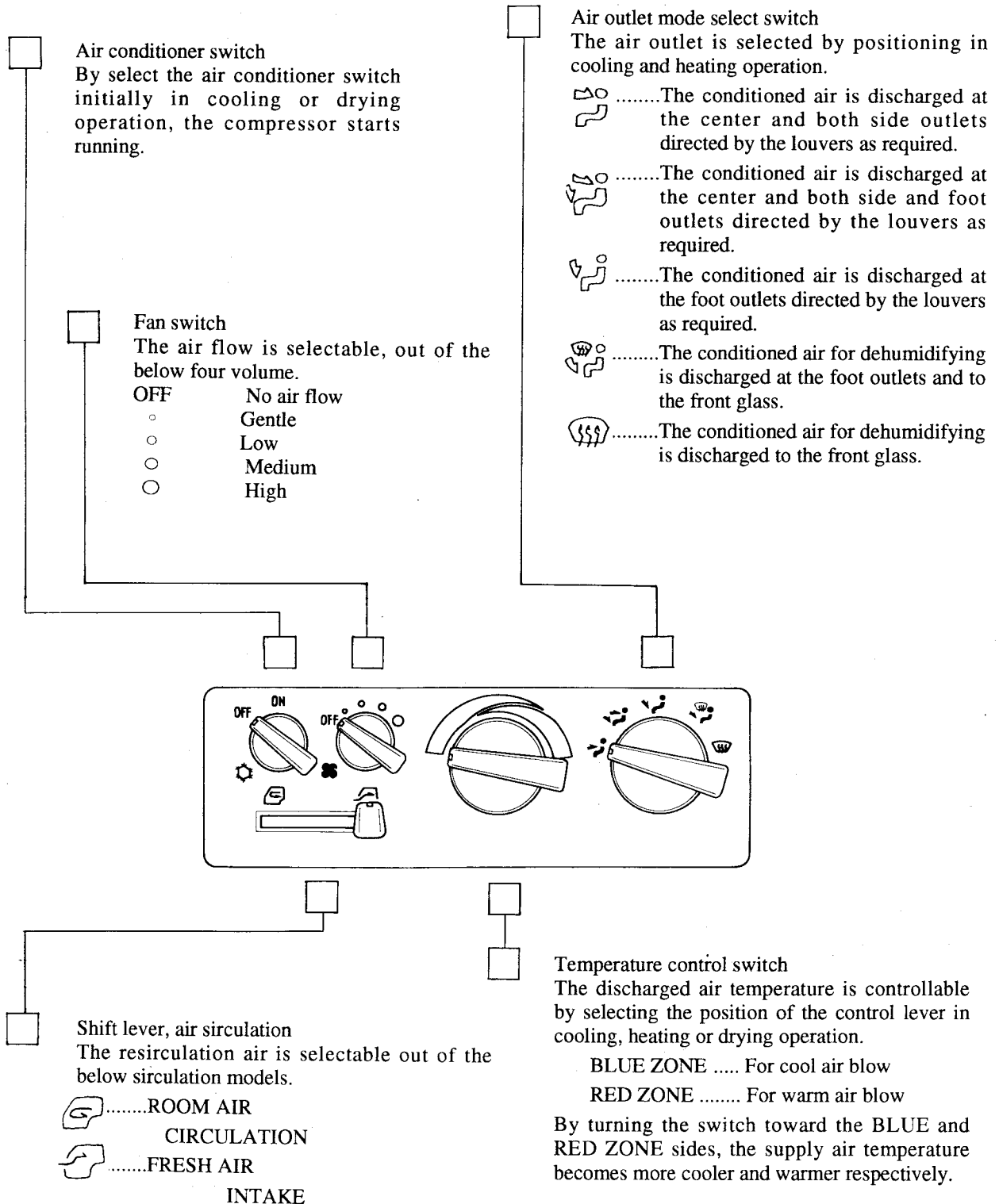


- ① Air conditioner switch
- ② Heater unit
- ③ Cooling unit assembly
- ④ Blower motor
- ⑤ Drain hose
- ⑥ Resistor

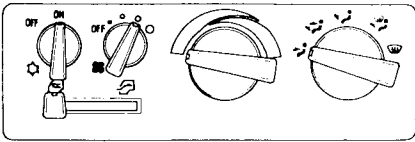
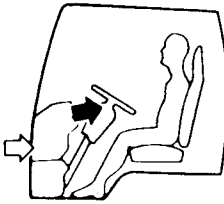
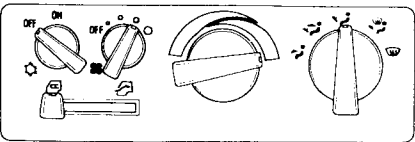
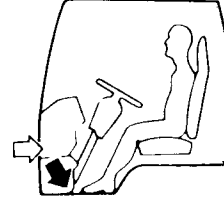
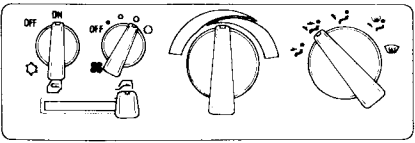
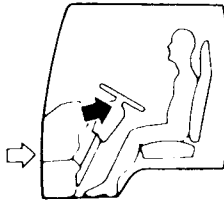
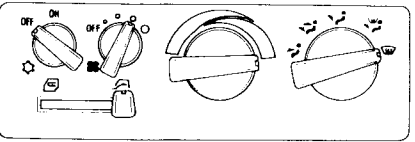
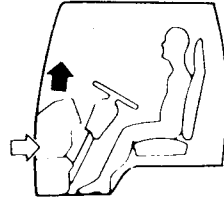
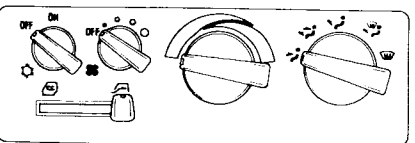
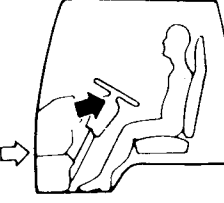
3.3 Control system

(1) Controls in panel

Do not run the air conditioner when it is child.

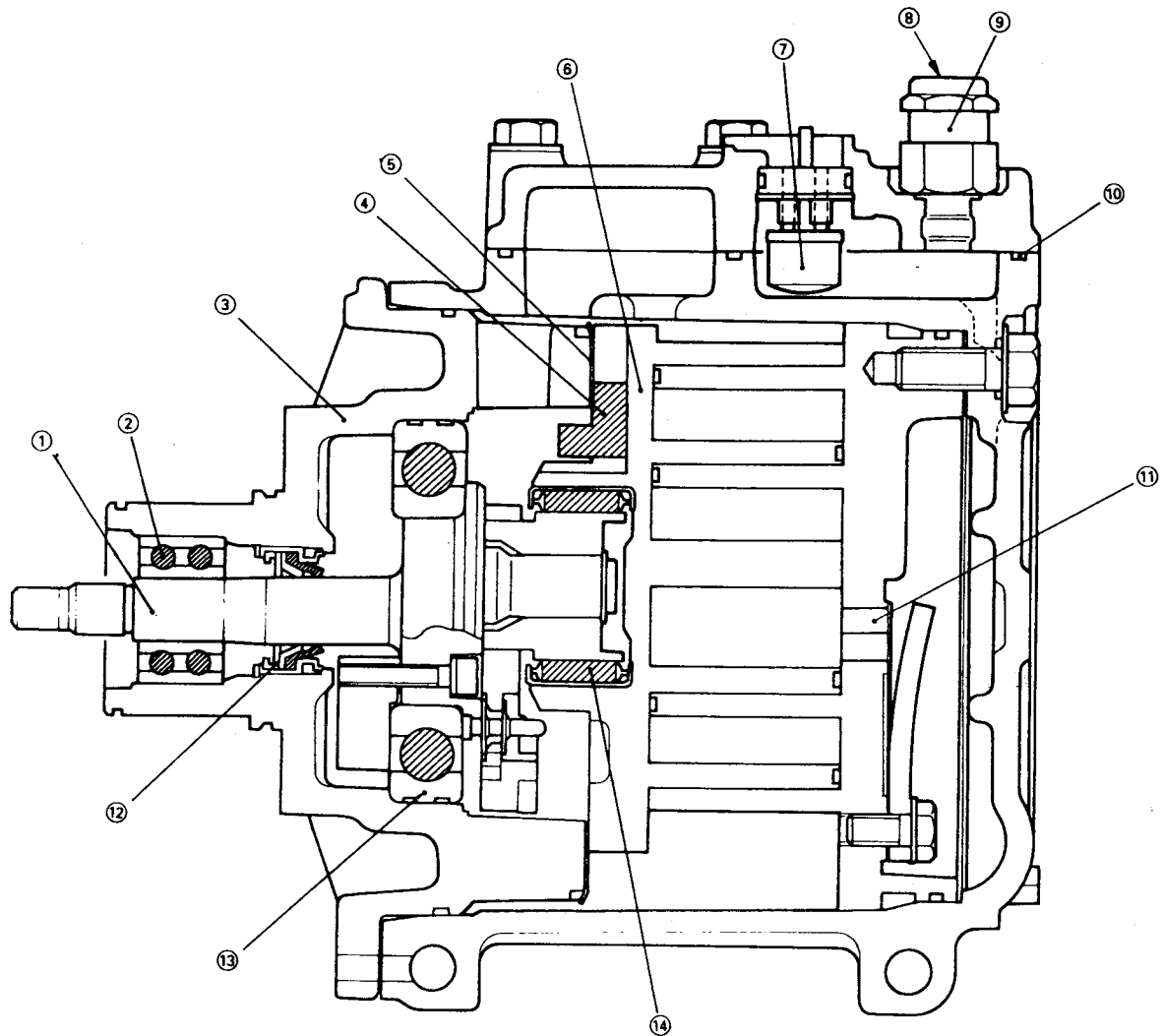


(2) Operation control

Operation mode	Setting control lever	Air delivery	Remarks
COOL			Earlier cooling service, or conditioning at dusty, polluted air prevailing places: Shift lever, air circulation 
HEAT			Earlier cooling service, or conditioning at dusty, polluted air prevailing places: Shift lever, air circulation Air outlet mode select switch 
DEHUMIDIFY			Wetty conditioning in head cooled, and foot warmed : Shift lever, air outlet Air outlet mode select switch 
DEFROST			
VENTILATION			

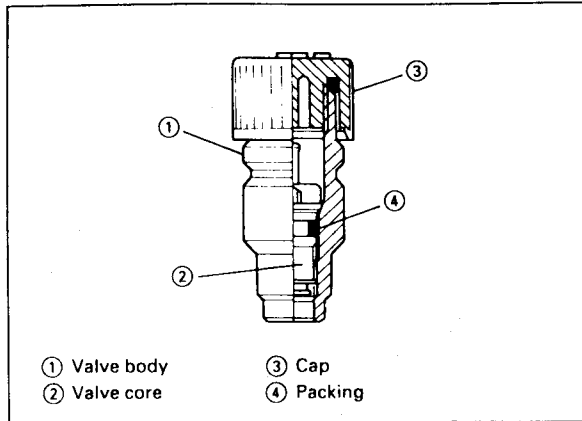
3.4 Compressor and clutch assembly

3.4.1 Compressor



- | | |
|-------------------------|--------------------|
| ① Crankshaft | ⑧ Dust seal |
| ② Bearing | ⑨ H/P relief valve |
| ③ Front case assembly | ⑩ O ring |
| ④ Housing assembly | ⑪ Port hole |
| ⑤ Thrust plate | ⑫ Shaft seal |
| ⑥ Orbit scroll assembly | ⑬ Bearing |
| ⑦ Thermostat | ⑭ Needle bearing |

3.4.2 Check valve

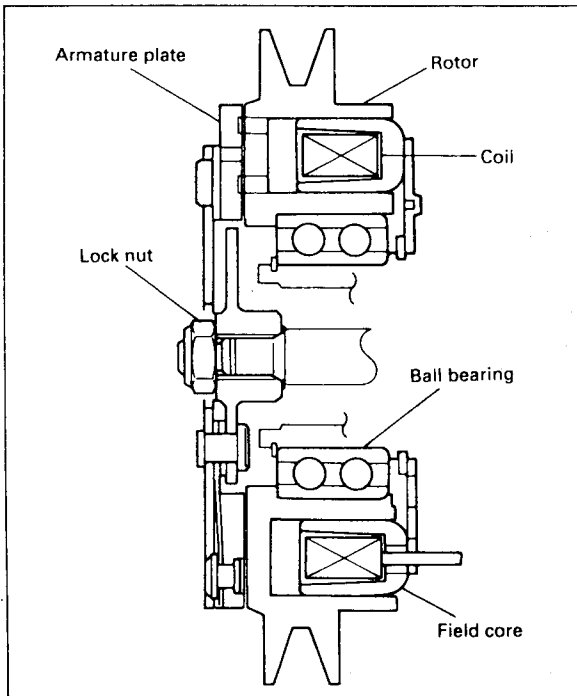


The suction hose and discharge hose are provided with check valve, and designed for gas evacuation and charging service. (shown above)

In the valves, a valve rubber tube, as in automobile tire tubes, is provided as shown in the figure.

Slackening the flare nut on the gauge manifold causes the passage to close automatically by the spring force, and tightening the flare nut causes the passage to open while pressing the compressed spring.

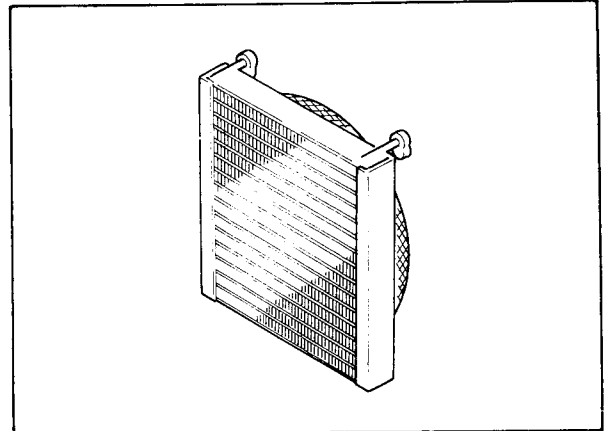
3.4.3 Magnetic clutch



The magnetic clutch is mounted on the compressor crankshaft to start and stop the compressor.

This means that the magnetic clutch is actuated to control the compressor operation electrically by the thermostat.

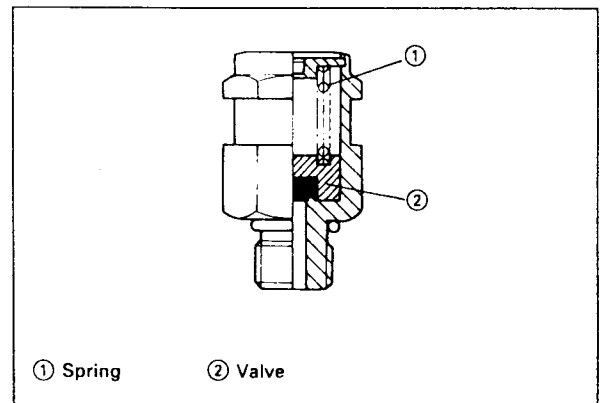
3.5 Side condenser assembly



The condenser is a means to liquefy the refrigerant gas. As the condenser is cooled by the air pulled in by the condenser fan, the refrigerant in the condenser is cooled into liquid. Therefore, when any obstacle prevents the air from flowing evenly to the condenser or the air flow is short circuited, the cooling effect is reduced, with a decrease in the performance of the condenser. When the vehicle is driven at a high speed, the air flow increases resulting in an increase of the cooling effect, and performance of the condenser.

3.6 Relief valve

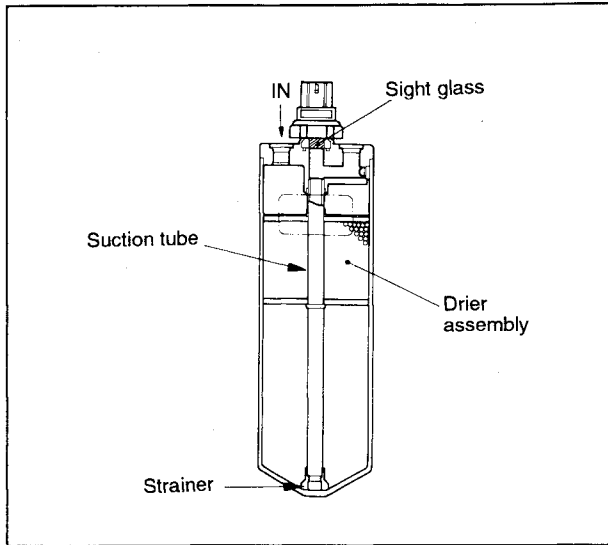
The relief valve is mounted to the compressor & clutch assembly. The relief valve is usually closed by spring. If pressure of refrigerant in air conditioner system is higher than spring pressure, refrigerant is discharged from relief valve. The pressure drop due to discharge refrigerant, and relief valve is closed again.



Preset : MPaG (Lb/in²G, kgf/cm²G)

Open	3.50~4.10 (508~594, 35.7~41.8)
Close	2.94 (427, 30)

3.7 Receiver assembly



A receiver assembly is served as a refrigerant reservoir located between the condenser and the expansion valve.

The receiver assembly consists of a filter and a sight glass. The filter is used to remove dust, the drier is used to remove moisture from the refrigerant in the circuit, and the sight glass is used to check the refrigerant charge.

Any moisture in the refrigerant may not only corrode metal surfaces in the refrigerant circuit, but also cause the throttle of the expansion valve to be frosted, resulting in the interruption of refrigerant circulation.

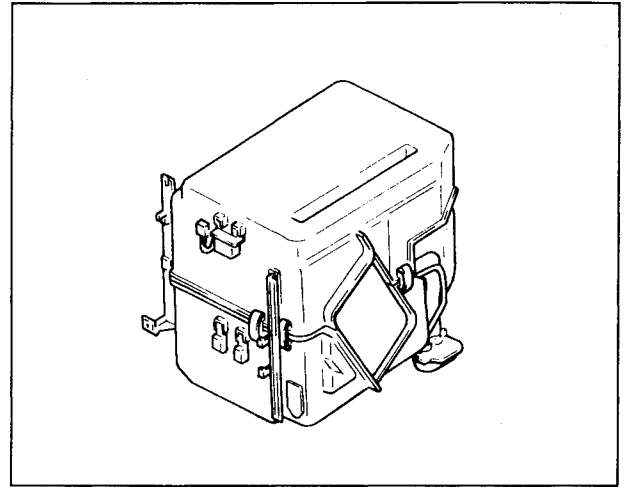
Therefore, the receiver assembly must be handled very carefully. When storing or installing it, care should be taken to protect it from the deterioration of drying performance due to exposure to the air.

The retardation of heat exchange, or any fire around the refrigerant circuit will cause excessive pressurization or heating of the refrigerant. Should such an accident occur, the refrigerant in the circuit must be expelled to the outside to prevent the above hazards.

The sight glass is a sort of peep window used to check the refrigerant flow in the refrigerant circuit.

The sight glass appears clear when the refrigerant flow is enough, and shows bubbles flowing when the refrigerant flow is short.

3.8 Cooling unit assembly



Evaporator core

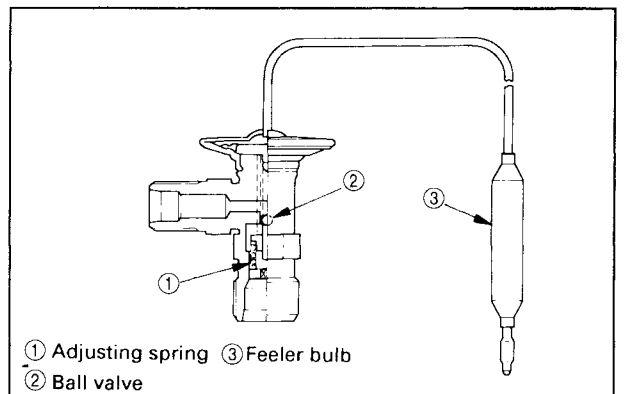
The evaporator core is a type of corrugated fin and tube.

The tube is arranged in zigzag to achieve high efficiency, and to make the core system compact.

A thicker reinforced plastic plate is used as the enclosure to increase heat and shock resistance, and to protect the core from humidity. This case is a split type, and in a simple design to facilitate installation on the floor panel and the instrument panel frame of the vehicle.

3.9 Expansion valve

The expansion valve is mounted at the inlet of the cooling unit. The liquid refrigerant from the receiver is led to it through a narrow passage (for throttle action), where-in, the liquid refrigerant is condensed with pressure dropping and at the same time the flow rate is adjusted before the refrigerant is sent to the cooling unit. The refrigeration load in the cooling unit is not constant, but usually fluctuates over a certain range. So the refrigerant flow should undergo the control in design. An automatic expansion valve performs this function automatically. The air conditioner uses a thermal type automatic expansion valve.

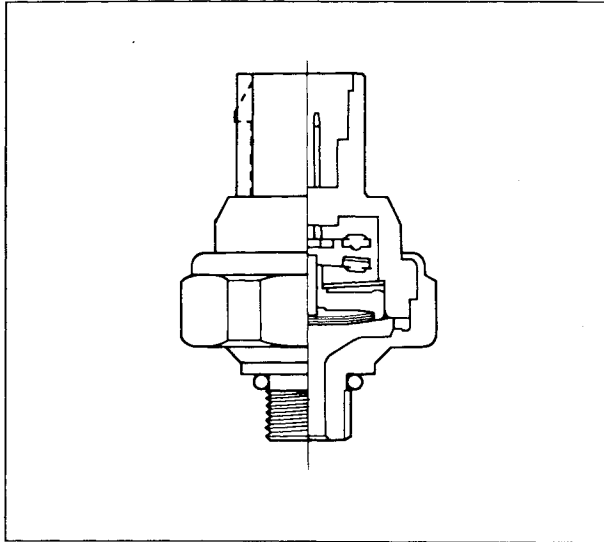


3.10 Dual pressure switch

The dual pressure switch, fixed to the receiver functions as a protector for stopping the compressor (OFF) at a preset value of pressure in the refrigerant circuit.

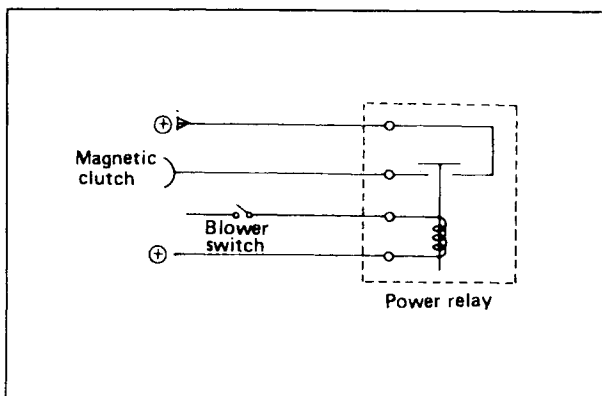
Preset : MPaG (Lb/in²G, kgf/cm²G)

	L.P.SW	H.P.SW
OFF	0.2 (28, 2)	2.94 (418, 30)
ON	0.225 (32, 2.25)	2.35 (334, 24)



3.11 Power relay

The power relay is excited at a closed position of the micro switch and enables the magnetic clutch to be ready for engaging electrically.

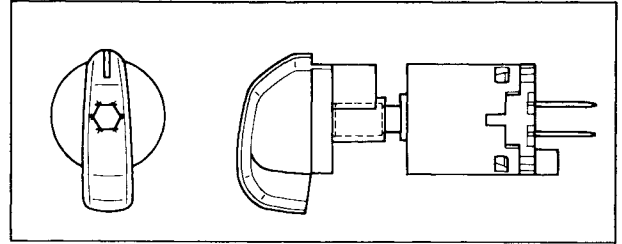


3.12 Air conditioner switch

The air conditioner switch functions as an operation controller for starting or stopping the compressor in cooling and dehumidifying

Set the it to the "ON" position, the magnetic clutch becomes engaged and the compressor starts.

Set the it to the "OFF" position, the magnetic clutch becomes disengaged and the compressor stops.



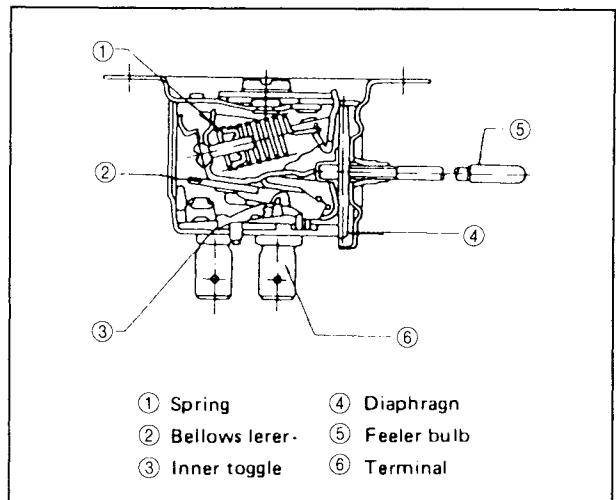
3.13 Thermostat

The thermostat is mounted on the evaporator case.

It senses the temperature of the evaporator fins, and controls the compressor operation for ON or OFF as specified below.

Preset : °F(°C)

OFF	33 (0.5)
ON	38 (3.5)

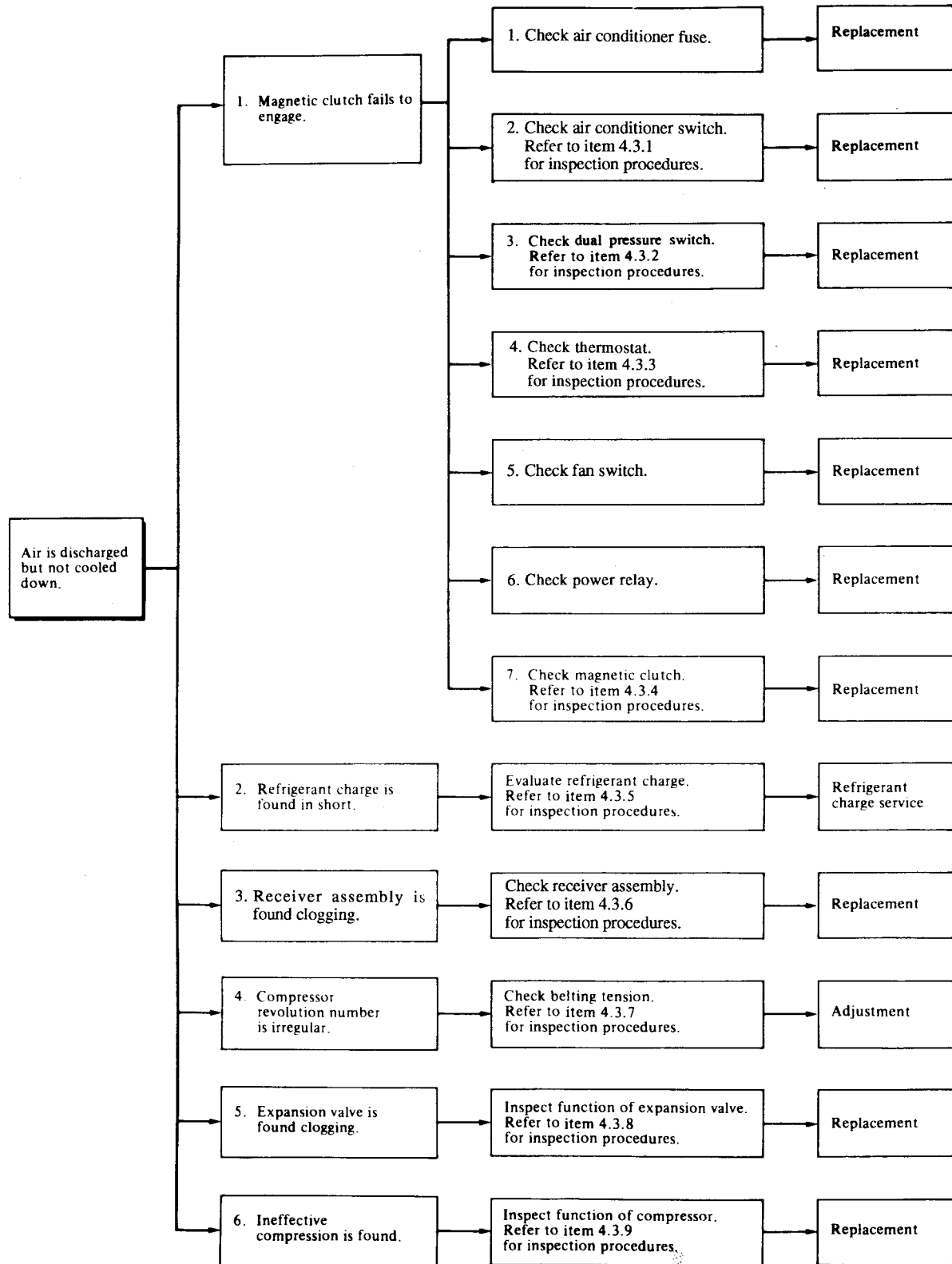


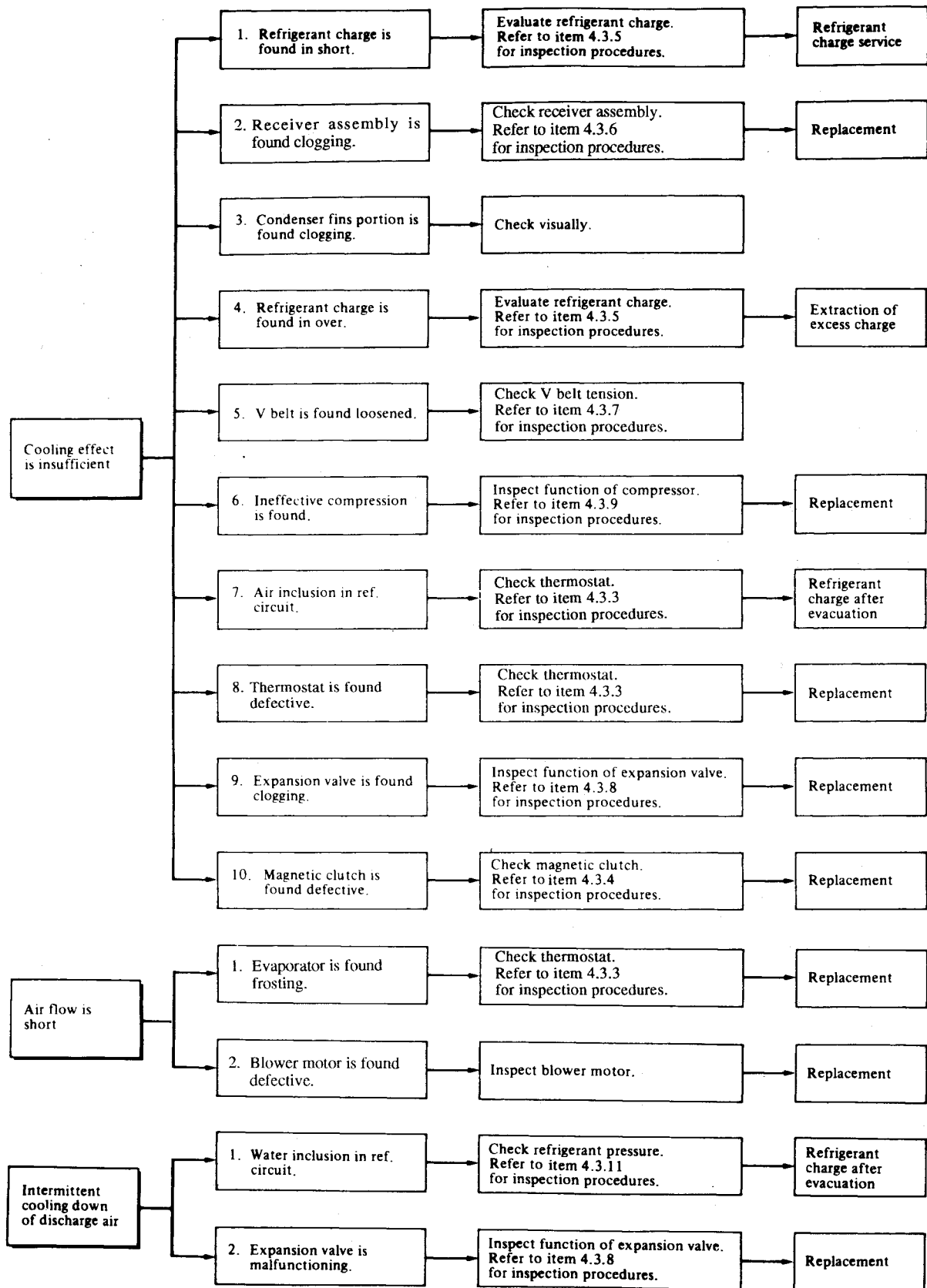
4. TROUBLE SHOOTING

4.1 General precautions

- (1) When handling refrigerant (HFC-134a), the following precautions must be observed.
 - a. Always wear eye protection and a pair of gloves while handling refrigerant.
 - b. Be careful the liquid refrigerant does not contact the skin.
 - c. Keep the refrigerant container below 100 degrees F (40 degrees C).
 - d. Do not handle the refrigerant in an enclosed area having an open flame. The refrigerant may produce a poisonous gas.
 - e. When dumping the refrigerant from the system, release it slowly so as not to expel all the compressor oil.
- (2) If liquid refrigerant strikes eye or skin.
 - a. Do not rub eye or skin.
 - b. Splash large quantities of cool water on the eye or skin.
 - c. Rush to a physician or hospital for immediate professional treatment.

4.2 Trouble cause and remedy





Action procedures

Air conditioner switch

Plug the air conditioner switch.

Check the continuity between terminals of the air conditioner switch with a tester.

Continuity

Switch position	Terminal's number	Result, in normal
OFF	①—②	No
ON	①—②	Yes

Terminal's number	1	2
OFF	○	
ON	○—○	

Dual pressure switch

The dual pressure switch is attached to the receiver assembly for controlling the operation of the air conditioner by checking the inside pressure of the receiver assembly.

MPaG (Lb/in²G, kgf/cm²G)

High side	Low side
2.94 (418, 30)	0.2 (28, 2)
2.35 (334, 24)	0.225 (32, 2.25)

Plug the connector at the receiver assembly.

Check the continuity between terminals of the connector with a tester.

When electric continuity is found, connect the connector to the high pressure switch.

Attach the high pressure gauge and low pressure gauge.

Operate the air conditioner.

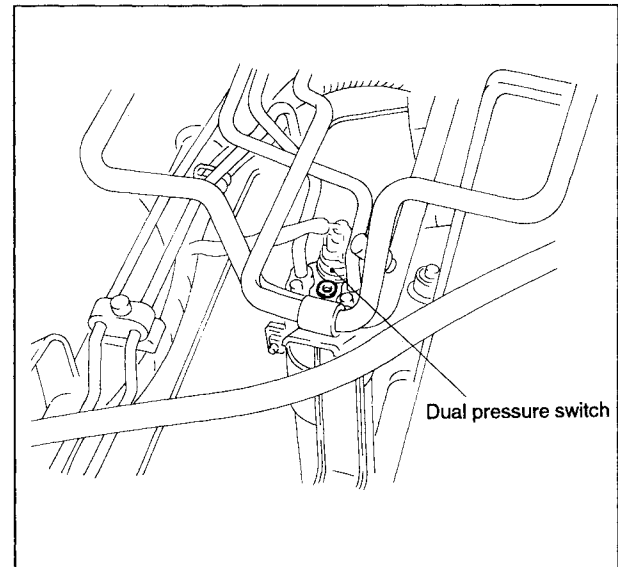
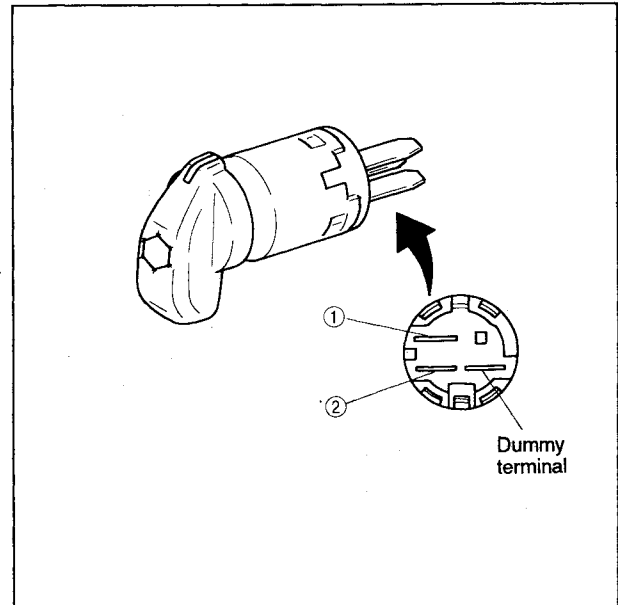
Cover the surface of the condenser by using a piece of paper.

When the high pressure exceeds 2.94 MPaG (418 Lb/in²G, 30 kgf/cm²G), if the magnetic clutch is turned off, the switch is normal.

If the magnetic clutch is not turned off, replace the pressure switch with new one.

Check the accuracy of the preset as below.

- Stop the air conditioner.
- Purge the air conditioner of refrigerant slowly starting at over 0.225 MPaG (32 Lb/in²G, 2.25kgf/cm²G).



- At reading the pressure 0.2 MPaG (28 Lb/in²G, 2 kgf/cm²G), the switch opens.
- Here, stop the purging, then turn it to charging.
- At reading the pressure 0.225 MPaG (32 Lb/in²G, 2.25 kgf/cm²G), the switch closes.

If the dual pressure switch does not meet specifications, replace the switch.

4.3.3 Thermostat

The thermostat is mounted on the evaporator case. It controls the operation of the air conditioner by sensing the temperature of the evaporator fins.

Preset : °F (°C)

OFF	33 (0.5)
ON	38 (3.5)

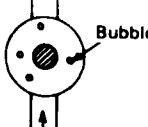
- (1) Check the accuracy of the preset as below.
 - (a) Soak the sensor of the thermostat in ice-water of below 33 °F (0.5 °C).
 - (b) Check the continuity between the switch terminals.
 - (c) Pull the sensor out of the ice-water, and check the continuity at over 38 °F (3.5 °C) of the sensor.

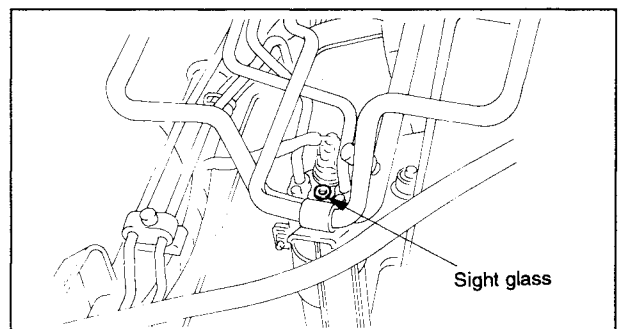
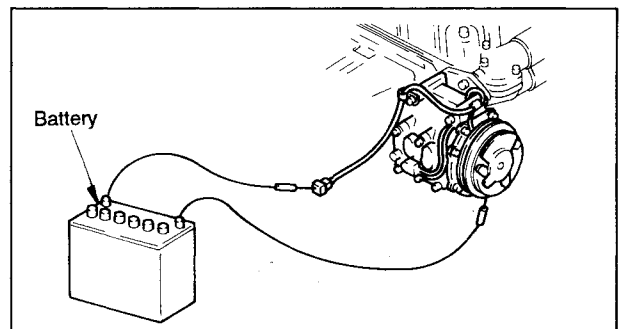
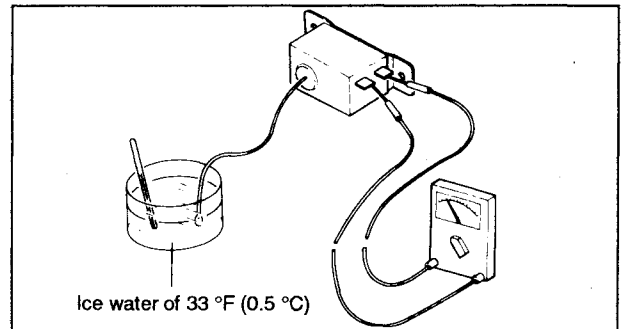
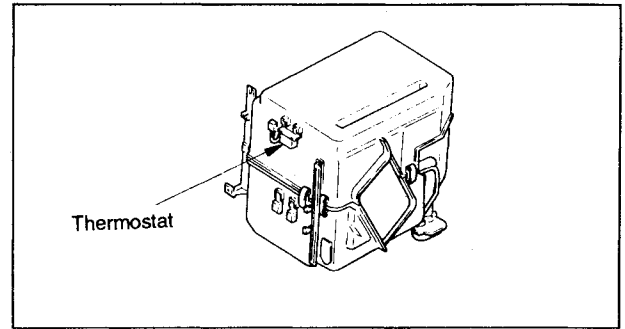
4.3.4 Magnetic clutch

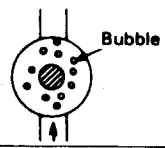
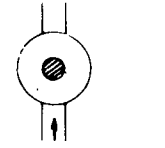
- (1) Disconnect the wiring to the magnetic clutch.
- (2) Apply a positive side power voltage to the magnetic clutch through the wiring.
- (3) In the case of regular functioning, the pulley and magnetic clutch are engaged with a clicking sound. The failing means any malfunction of the magnetic clutch.

4.3.5 Refrigerant charge

- (1) Set the temperature control lever at the cool position.
- (2) Open doors of the room.
- (3) Set the blower switch at the ON position.
- (4) Adjust the engine revolution at 1500 rpm.
- (5) Operate the air conditioner switch for comp. ON.
- (6) Watch the sight glass of the receiver assembly at the inside of the engine room.
 - (a) If judged as insufficient refrigerant charging, repair the leaks, then charge it additionally.
 - (b) If judged as over charging of refrigerant, extract an excess refrigerant.
- (7) Diagnosis by pressure reading
 - (a) Short of refrigerant :
Lower pressure for both L.P. and H.P. reading
 - (b) Express of refrigerant :
Higher pressure for L.P. and H.P. reading

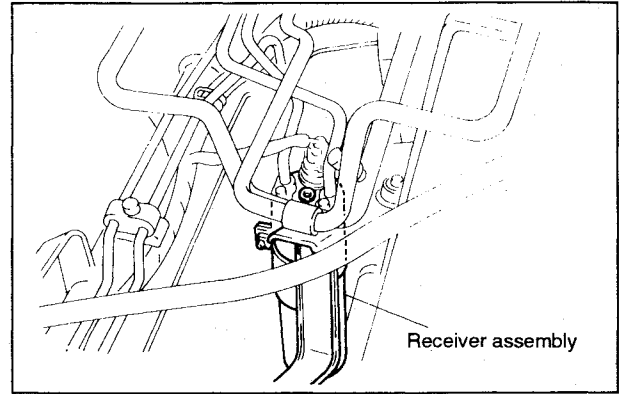
Sight glass	Remarks
	1. Bubble occasionally appears. 2. Bubble disappear if speed is a little increased.



Insufficient refrigerant		Considerable bubbles appear. If the system is extremely short of refrigerant, the sight glass appear white.
Excessive refrigerant		1. No bubbles appear. 2. Slight bubbles appear if speed is decreased.

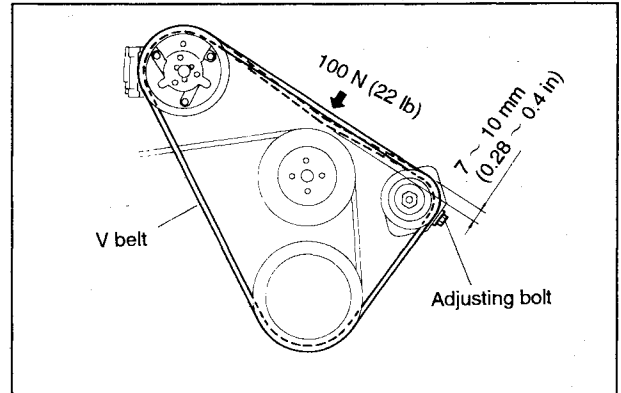
4.3.6 Receiver assembly

- (1) While operating the air conditioner, touch the refrigerant piping with a hand at the inlet and outlet portions.
 - (a) Sensed temperature difference :
It is possible that clogging is happening at the inside, liquid receiver assembly is to be replaced with a new one.



4.3.7 Belt tension

- (1) Depress the V belt with a thumb at the ◀ marked position, and adjust the stretching as below.
Stretching degree : 7 ~ 10 mm (0.28 ~ 0.40 in) (deflection)
- (2) Adjustment
 - (a) Loosen the nut of the tension pulley.
 - (b) Control the belting tension by the adjusting bolt.
 - (c) After finishing, retighten the nut as before.

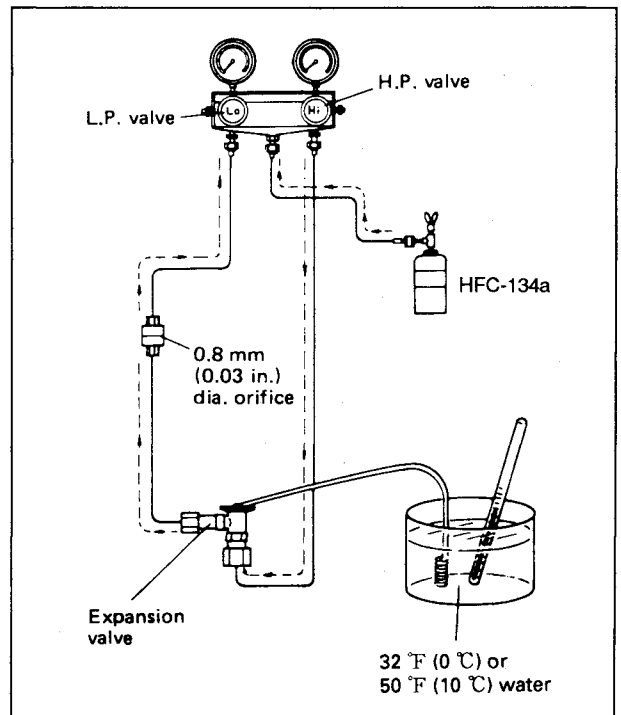


4.3.8 Expansion valve

CAUTION

The test should be applied to only the case of the other components being free from troubles, and the expansion malfunctioning singly.

- (1) Build up the test circuit with a gauge manifold.
- (2) Soak the sensor bulb in ice water of 32 °F (0 °C), and of 50 °F (10 °C) respectively.
- (3) Pressurize the H.P. side with dry nitrogen gas of 1.03MPaG (10.5 kgf/cm²G).
- (4) Check the reading of the L.P. side pressure gauge for the standard range.
At 32 °F (0 °C) --- 0.127 MPaG (18.4 Lb/in²G, 1.3 kgf/cm²G)
At 50 °F (10 °C) --- 0.23 MPaG (33.4 Lb/in²G, 2.35 kgf/cm²G)

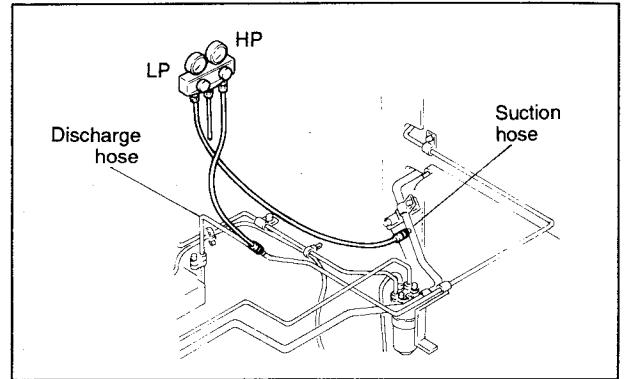


4.3.9 Pressure check

- (1) Mount a low pressure gauge hose and a high pressure gauge hose on the check valve.
- (2) Drive the air conditioner.
- (3) Showing of higher L.P. side pressure and lower H.P. side pressure evidences ineffective compression.

Standard pressure

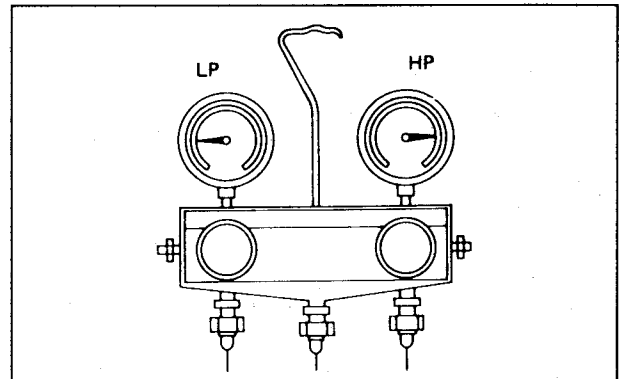
L.P. side pressure	About 0.26 MPaG (38.4 Lb/in ² G, 2.7 kgf/cm ² G)
H.P. side pressure	About 1.42 MPaG (207.6 Lb/in ² G, 14.6 kgf/cm ² G)



4.3.10 Air inclusion in ref.circuit

The abnormal reading of the refrigerant circuit evidences afraid air inclusion.

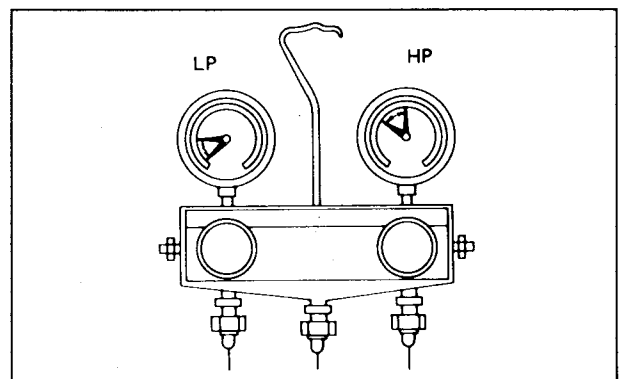
A little higher L.P. side pressure
Noticeably higher H.P. side pressure



4.3.11 Moisture inclusion in ref. circuit

- (1) During the operation, cooled air supply is interrupted periodically with a time interval. This phenomenon evidences afraid water inclusion.
- (2) Check the refrigerant pressure at a stop of the cooled air supply to make sure of the water inclusion.

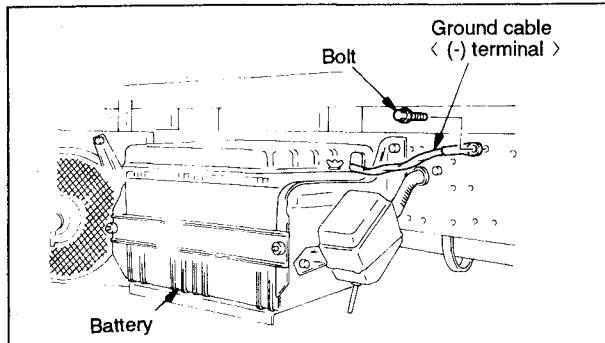
L.P. side pressure Almost vacuum
H.P. side pressure Noticeably low



5. REMOVAL AND INSTALLATION

5.1 Precaution for removal and installation.

1. Disconnect the (-) ground cable from the battery, and place a cover on the battery.

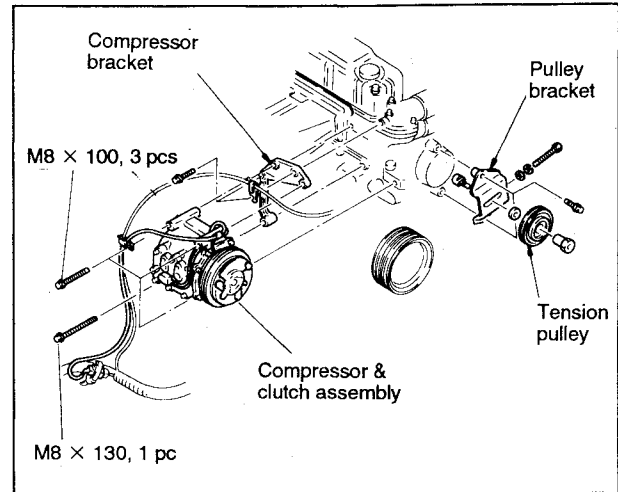


2. Make certain all the openings are covered with caps in order to prevent entry of foreign substances such as dust and dirt.
3. Never tamper with the brake and fuel systems, including the brake tubes and hoses.
4. Avoid doing the work in a dusty place or outdoors in rainy weather. If tubes or functional parts are removed, put a cap in position immediately in order to prevent entry of dust and moisture.
5. Connect the charging hose of the gauge manifold to the check valves (suction and discharge) of the suction hose and discharge hose, and recover the refrigerant by refrigerant recovery unit until its pressure is reduced to 0 kPaG (0 psiG, 0 kgf/cm²G). (Make sure that there is no internal pressure in the equipment.)
Abrupt discharging might result in the discharge of the refrigerant oil from the compressor.
6. When coupling the flared tube, coat the flared portion with the compressor oil at the inner side.
7. Make sure to use the wheel chocks.

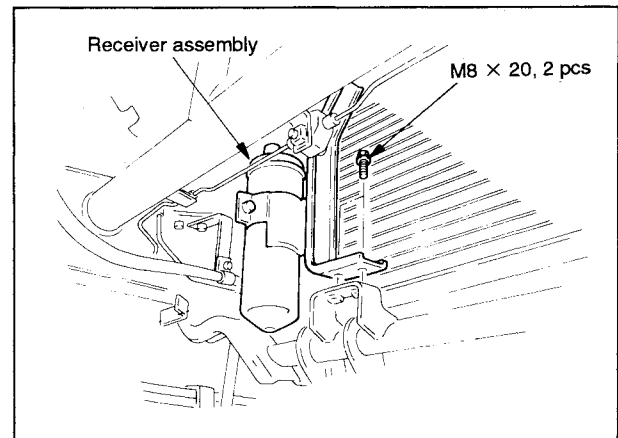
5.2 Removal

5.2.1 Inside the engine room

- (1) Compressor & clutch assembly
 - (a) Withdraw the wiring of the magnetic clutch at the connector.
 - (b) Remove the V belt by loosening fixture of the tension pulley.
 - (c) Take of the anchor bolts : M8 × 100, 3 pcs and M8 × 130, 1 pc.
 - (d) Dismount the compressor.
- (2) Receiver assembly
 - (a) Unplug the dual pressure switch at the connector.
 - (b) Separate the interconnecting refrigerant pipe of the receiver assembly.

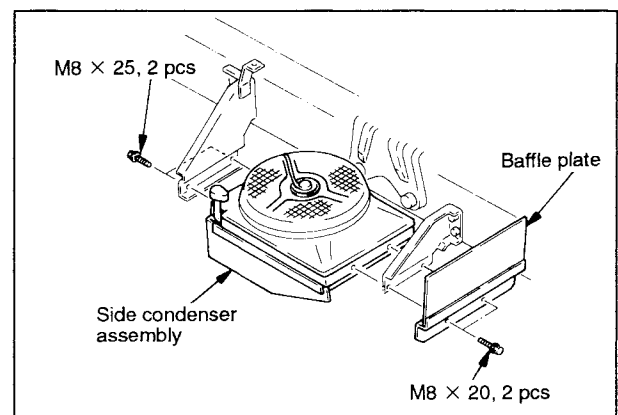


- (c) Take off the fixing bolt : M8 × 20, 2 pcs.
- (d) Dismount the receiver assembly.



(3) Side condenser assembly

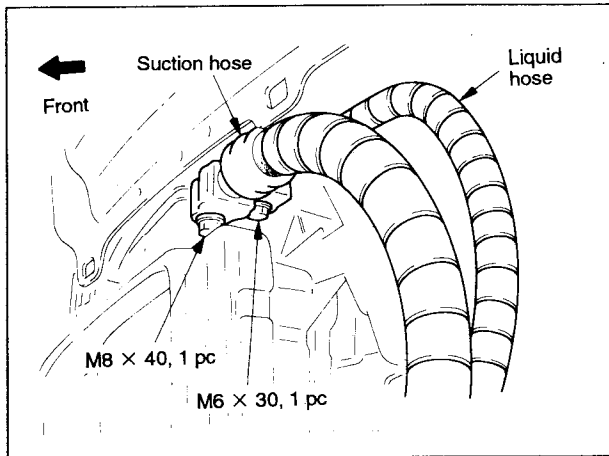
- (a) Unplug the condenser fan harness at the vehicle side harness.
- (b) Take off the fixing bolt : M8 × 20, 2 pcs and M8 × 25, 2 pcs.
- (c) Dismount the side condenser assembly (and baffle plate).



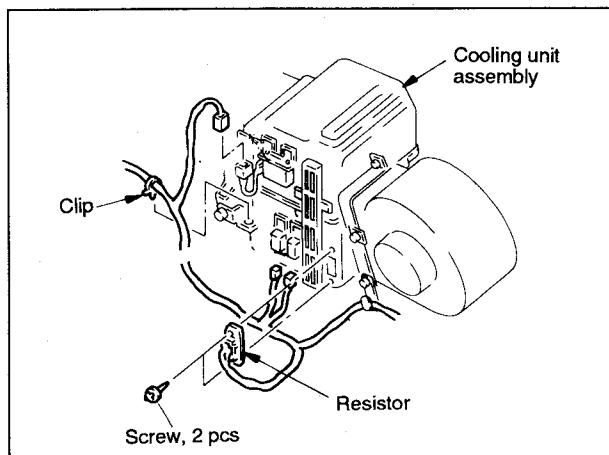
5.2.2 Cabin room

(1) Cooling unit assembly

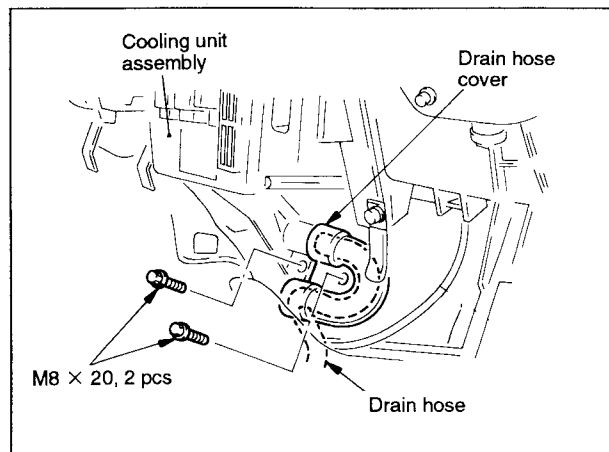
- (a) Separate the interconnecting refrigerant pipes of the cooling unit assembly.



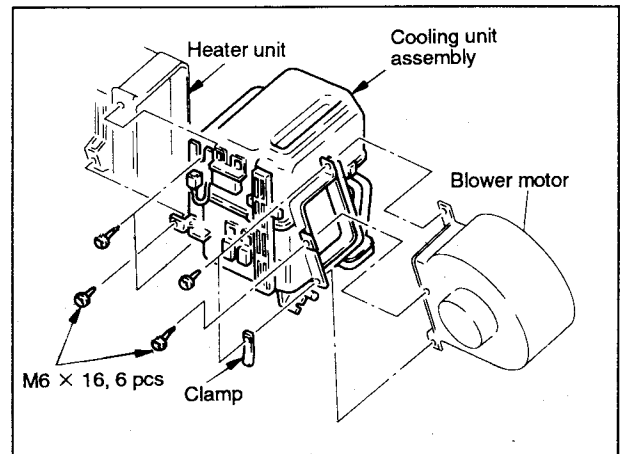
- (b) Withdraw the wiring of the cooling unit assembly at the connectors.



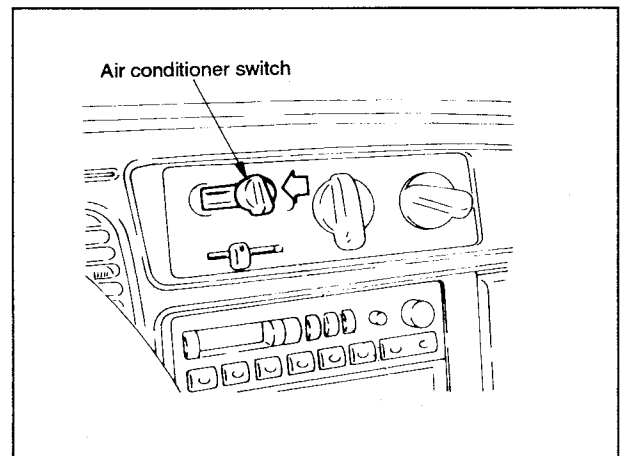
- (c) Take off the fixing bolts : M8 × 20, 2 pcs.
 (d) Dismount the drain hose cover.
 (e) Reconnect the drain hose from the cooling unit assembly.



- (f) Take off the fixing screws : M6 × 16, 6 pcs.
 (g) Dismount the cooling unit assembly.



- (2) Air conditioner switch
 Pull out the air conditioner switch.



5.3 Installation

Installation is performed in the opposite sequence of removal.

- Torques for tightening coupler of refrigerant tubing.

Nm (Lb.ft.kgm)

Compressor suction hose	29-34 (21 ~ 24, 3.0 ~ 3.5)
Compressor discharge hose	20-25 (14 ~ 18, 2.0 ~ 2.5)
Compressor inlet hose	20-25 (14 ~ 18, 2.0 ~ 2.5)
Compressor outlet hose	12-14 (8.6 ~ 10, 1.2 ~ 1.5)
Liquid receiver assembly inlet and outlet hoses	12-14 (8.6 ~ 10, 1.2 ~ 1.5)
Cooling unit inlet hose	12-14 (8.6 ~ 10, 1.2 ~ 1.5)
Cooling unit outlet hose	29-34 (21 ~ 24, 3.0 ~ 3.5)

- Torques for tightening general bolt and nut

Nm (Lb.ft. kgm)

Nominal size	Pitch	Tightening torque		
		Head mark 4	Head mark 7	Head mark 8
M 5	0.8	3-4 (2.1 ~ 2.9, 0.3 ~ 0.4)	5-6 (3.6 ~ 4.3, 0.5 ~ 0.6)	5-7 (3.6 ~ 5, 0.5 ~ 0.7)
M 6	1.0	5-6 (3.6 ~ 4.3, 0.5 ~ 0.6)	9-11 (6.4 ~ 7.9, 0.9 ~ 1.1)	8-12 (5.7 ~ 8.6, 0.8 ~ 1.2)
M 8	1.25	12-14 (8.6 ~ 10, 1.2 ~ 1.5)	19-24 (13.6 ~ 17, 2.0 ~ 2.5)	19-29 (13.6 ~ 21, 2.0 ~ 3.0)
M10	1.25	24-29 (17 ~ 21, 2.5 ~ 3.0)	38-48 (27 ~ 34, 4.0 ~ 5.0)	43-58 (30.7 ~ 41.4, 4.5 ~ 6.0)
M10	1.5	17-26 (12 ~ 18.6, 1.8 ~ 2.7)	32-48 (23 ~ 34.3, 3.3 ~ 5.0)	41-58 (29.3 ~ 41.4, 4.3 ~ 6.0)
M12	1.25	34-43 (24.3 ~ 31, 3.5 ~ 4.5)	58-77 (41 ~ 55, 6.0 ~ 8.0)	82-106 (58.6 ~ 75.7, 8.5 ~ 11.0)
M14	1.5	72-82 (51 ~ 59, 7.5 ~ 8.5)	115-134 (82 ~ 96, 12.0 ~ 14.0)	125-173 (89.3 ~ 123.6, 13.0 ~ 18.0)

NOTE

For the cases of spring washer seated, and thread or seating surface coated with oil, the value shall be reduced down to 85 percent of the data listed.

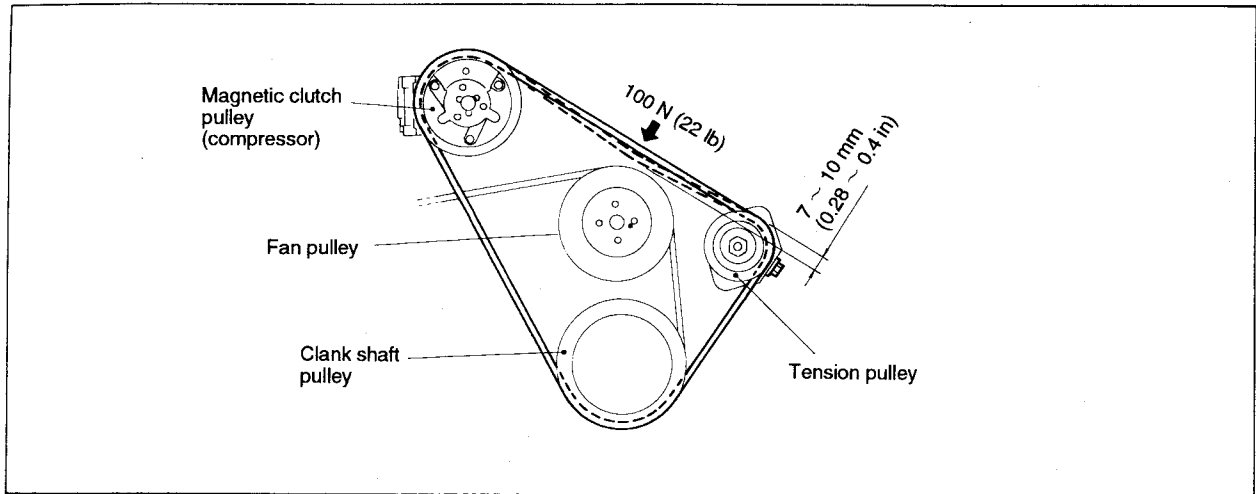
6. TREATMENT AFTER INSTALLATION

6.1 Check and adjustment

After installation, check the following points and confirm that everything is normal, then charge the gas, and do the performance and operation tests.

- (1) Check if any abnormal vehicle performance, happens or not by installing the air conditioner.

- (2) Check the operation of the magnetic clutch. (with the compressor disengaged)
- (3) Check if any parts left unmounted or any tool left in the vehicle.
- (4) Check to ensure that the temperature control lever operates properly.
- (5) Check the tension of the belt.



6.2 Leak test

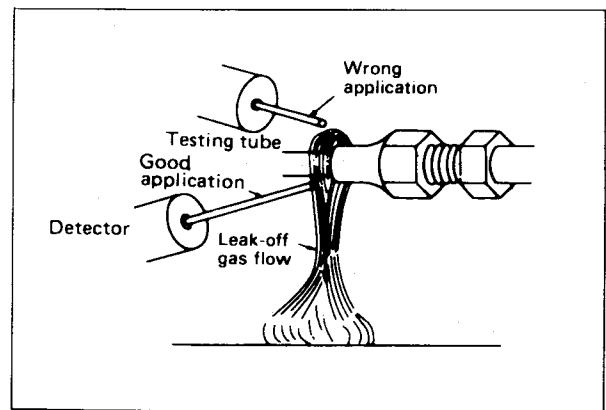
After all the piping works are completed, conduct an leak test by the following procedure to check any leaks at the flare coupling, etc. and then evacuate the system. If this leak test is omitted and evacuation is immediately started, there is no way of detecting possible leak. If there are leaks, the specified vacuum cannot be attained. In order to save the service time be sure to conduct the leak test before evacuation.

6.2.1 Test points

- (1) All pipe joint.
- (2) Shaft seal and check valve on the compressor.

6.2.2. Test procedure

- (1) For the gas leak test, the use of an electric gas leak detector is recommended. (HFC-134a SAE Approved)
- (2) Perform the test at a place as in free from air flowing.
- (3) The refrigerant is heavier than air. Leaks will concentrate at the bottom. Make certain that the testing tube is applied below the check point.



- (4) The test should be performed patiently. Make certain that testing tube is moved slowly [approx. 10 mm/sec. (0.4 in./sec.)].
- (5) The high pressure side refrigerant circuit should be tested for gas leaks during operation. Those areas which are dangerous or hard to test during operation (including areas around the compressor and condenser) should be tested direct after shutdown.

- (6) The low pressure side refrigerant circuit should be tested during shutdown after the gas pressure has balanced.
- (7) The test should be performed on the basis of the following standards:

Gas leak test standards

Test Point Instrument	Compressor shaft seal	Other parts
Electric gas leak detector	Pointer shall not swing more than 0.1 mA at the low sensitivity.	Pointer must not swing more than 0.1 mA at the high sensitivity.
Halide torch gas leak detector	Flame colour (moss green) shall not change.	

⚠ WARNING

- Smoking should be forbidden if a gas leak is detected.
- If a flame is applied to the refrigerant, toxic phosgene gas will be produced. Do not keep the detector in contact with a leaky point for a long time.

• Leak test procedure

1. Attach refrigerant supply and gauge set as shown with all valves closed. Open refrigerant supply valve on can.
2. Loosen the center charging hose fitting at the manifold gauge end to blow any air from the hose until it hisses for a few seconds, then retighten it.
3. Open both gauge valves to partially charge the system and then close both valves.
4. The system can then be checked for leaks using an electronic leak detector.
5. If leaks are found that require the system to be opened (to repair or replace hoses, fittings, etc.), release any charge in the system.
6. After checking and repairing leaks, system must be evacuated.

6.3 System Charging

GENERAL PRECAUTIONS

⚠ WARNING

When handling refrigerant (HFC-134a), the following precautions must be observed.

- Always wear eye protection and gloves while handling refrigerant.
 - Be careful that liquid refrigerant does not contact the skin.
- If liquid refrigerant strikes eye or skin:
- Do not rub on skin.
 - Splash large quantities of cool water on the eye or skin.
 - Flush eyes or skin with cool water for 5 minutes.
 - Rush to a physician or hospital for immediate professional treatment.
 - Do not attempt to treat it yourself.
- Keep the refrigerant (HFC-134a) container below 104°F (40°C).
 - Do not handle the refrigerant in an enclosed area having an open flame; the refrigerant may produce a poisonous gas.
 - Use approved recovery equipment to recover HFC-134a refrigerant before attempting service of this or any other HFC-134a system.
 - Do not attempt to leak test an HFC-134a system with high pressure air or nitrogen. Mixing HFC-134a with a concentrated quantity of air may be combustible in the presence of ignition.

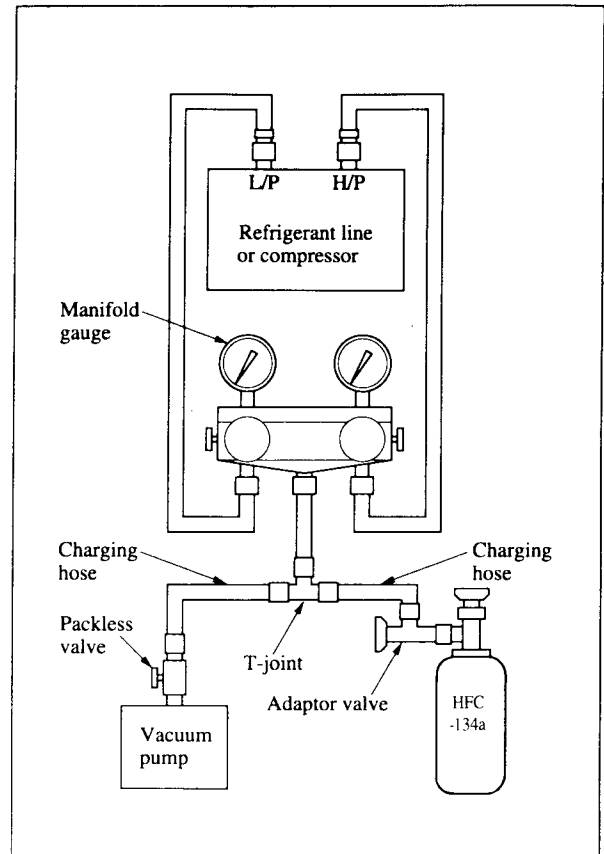
6.3.1 Evacuation

INSTALLATION OF SIMPLE HFC-134a EQUIPMENT

- (1) Connect the manifold gauge to the service valves.
- (2) Connect the packless valve to the vacuum pump.
- (3) With the charge valve handle turned back all the way, install the service can.
- (4) Connect the equipment as illustrated.

CAUTION

1. Do not connect the high and low pressure sides adversely. (Connect high pressure side to the condenser and low pressure side to the cooling unit assembly)
2. The indications "DIS" and "SUC" on the compressor indicate high and low pressure sides respectively.

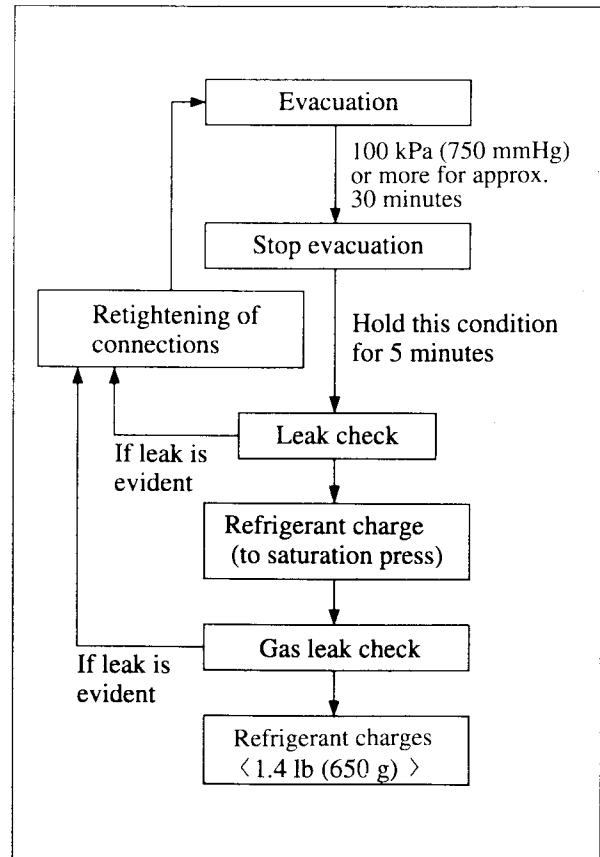


6.3.2 Evacuate the System

The refrigerant system must be evacuated before charging. Charge using HFC-134a refrigerant only. HFC-134a is available in bulk tanks. Follow the safety precautions for handling HFC-134a as listed in this section.

Follow the evacuation procedure below and at right.

This procedure assumes no HFC-134a refrigerant has been introduced into the system. If evacuating a charged system, it is necessary to recover the existing HFC-134a refrigerant before continuing with these instructions. Refer to the recovery equipment manufacturer's instructions for proper refrigerant recovery.



- (1) Start up the vacuum pump.

CAUTION

1. Do not use the compressor for evacuation.
2. Do not operate the compressor in the vacuum condition; damage may occur.

- (2) Open the manifold gauge handles and the packless valve.
- (3) Evacuate to a vacuum reading of 100 kPa (750 mmHg) or higher (approx. 30 minutes).
- (4) Turn back the packless valve all the way and close the service valve.
- (5) Stop the vacuum pump and allow to stand for 5 minutes.
- (6) Check for leak. (Good if the vacuum is held.)

CHARGING WITH BULK TANK

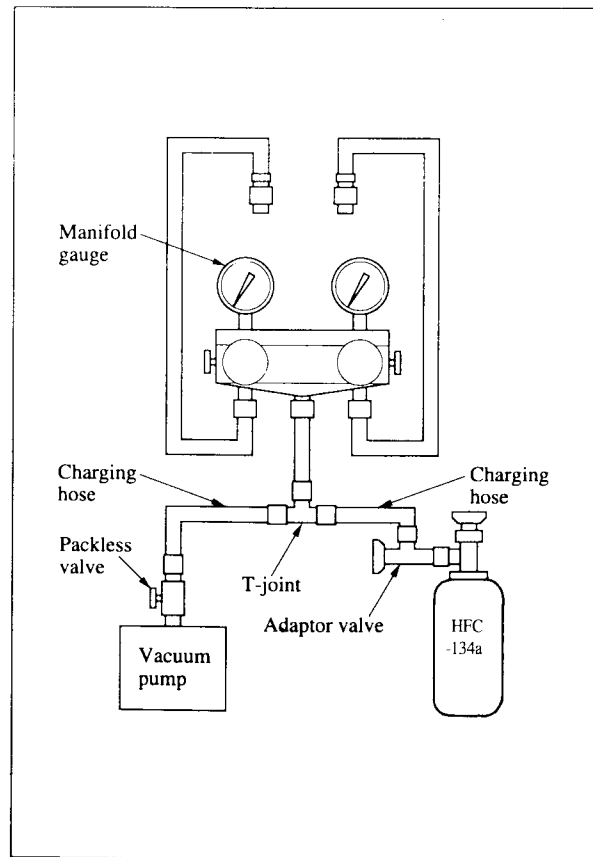
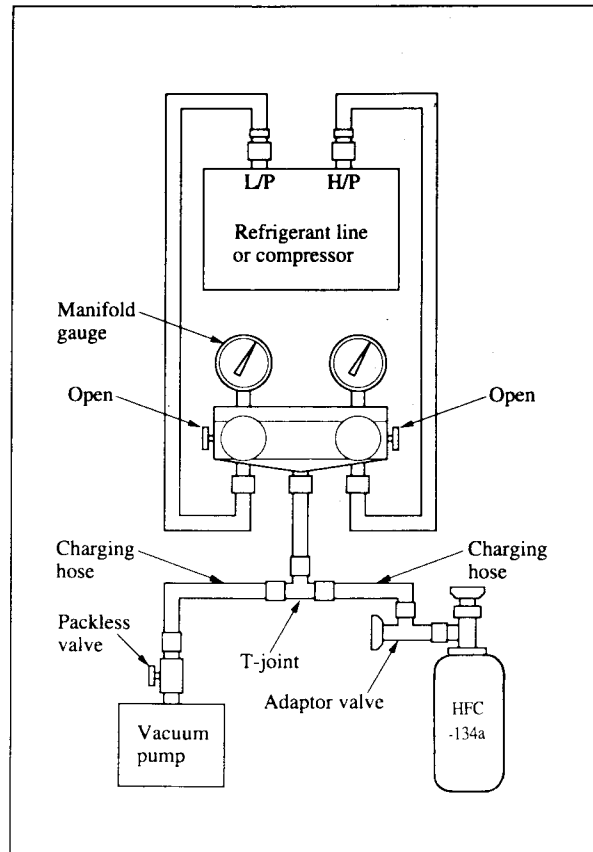
- (1) Open the charge valve to charge the system with refrigerant.
- (2) When the refrigerant is no longer drawn in, turn back the high pressure side manifold gauge handle.
- (3) Check for refrigerant leaks using a leak detector.
- (4) Start the engine.
- (5) Operate the air conditioner and set at the lowest temperature (MAX. COOL).
- (6) Fix the engine speed at 1,500 rpm.
- (7) Continue charging system until proper refrigerant quantity is introduced into the system.

CAUTION

If the bulk tank is inverted, liquid refrigerant may be drawn into the compressor damaging it by liquid compression.

Keep the bulk tank upright to ensure that refrigerant is charged in gas state.

- (8) Upon completion of charging, turn back the low pressure side manifold gauge handles.



6.3.3 Removal of Charge Equipment

- (1) Close the charge valve.
- (2) Remove the manifold gauge from each service valve.

CAUTION

Do not remove the bulk tank, T-joints and adaptor valves but keep them connected for next charge operation.

CORRECTING LOW REFRIGERANT LEVEL

Locate the source of the low refrigerant level, recover system, repair system, evacuate system, charge system, check for leaks.

CAUTION

If the bulk tank is not emptied completely, keep the charge valve connected to the can for next charging.

6.3.4 Discharging System

Use the refrigerant recovery unit which can be purchased in local market to discharge refrigerant gas from the system.

CAUTION

Refer to that Refrigerant Recovery Unit Instruction Manual for operation which is attached on the unit.

LIQUID CHARGE, through high side using charging station:

CAUTION

Do not run engine when performing liquid charge; compressor will be damaged.

- (1) After the system is evacuated, close gauge valves, connect center hose to refrigerant supply. Loosen center fitting at gauge to blow any air out of the hose and then retighten.
- (2) Following charging station manufacturer's instructions charge the system until 1.4 lb (650 g) of refrigerant is pumped into the system.
- (3) When system is fully charged, close high gauge valve and refrigerant supply valve, then quickly disconnect gauge hoses from service valves.
- (4) After charging the system, refer to Pre-Delivery Inspection.

6.4 Performance test

6.4.1 Preparation

Reinstall all vehicle parts that were removed for installation of the air conditioner at their original positions, adjust the mounting, and test the following items.

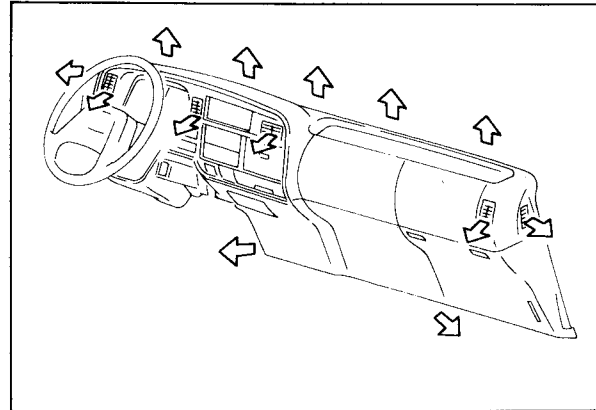
1. Installation of grommets
Install the specified grommets

6.4.2 Stationary performance test

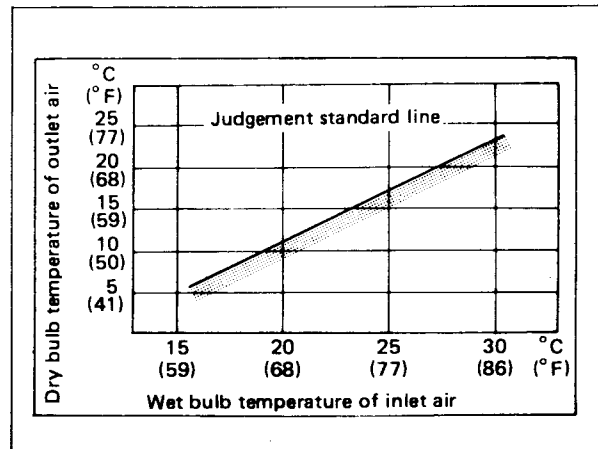
1. Operating conditions
 - a. Place the vehicle in the shade with doors open.
 - b. Keep the return air temperature between 77 to 86°F (25 to 30°C). (Adjust by changing the opening degree of the doors).
 - c. Set the fan switch to the max position.
 - d. Turn the thermostat control lever to the cool position.
 - e. Set the engine speed to approx. 1,500 rpm.
 - f. Set the high pressure at 1.17 to 1.37 MPa (170 to 200 Lb/in²G, 12 to 14 kgf/cm²G). (If the high side pressured does not rise up, place paper or the like in front of the condenser.)

2. Test procedure

Operate the air conditioner for more than 10 minutes under the above operating conditions in order to stabilize the high and low pressures. Then perform the test by the following procedure:



- a. Measure the outlet air temperature at the inside space of the outlet grille.
- b. Measure the air conditioner intake air temperature, humidity, etc., and the items shown in the Table of Measuring Items at a position free from the effects of cool outlet air.
- c. The intersecting point of the plotted line perpendicular to the point which corresponds to the air conditioner intake and outlet air temperature difference and the plotted line perpendicular to the point which corresponds to the relative humidity of intake air should be between the oblique lines in figure.



7. MAINTENANCE

No.	Check point	Service and inspection intervals				
		When used only in summer (approx. for three months)		When used in all seasons		
		At the beginning of season	At the end of season	Every 5,000 km (3,000 miles)	Every 10,000 km (6,000 miles)	Every 20,000 km (12,000 miles)
1	Check condenser and radiator fin for clogging.	○	○	○		
2	Retighten all bolts.	○			○	
3	Check for refrigerant leaks.	○			○	
4	Check refrigerant level.	○		○		
5	Check V-belt tension.	○		○		
6	Check operation of magnetic clutch.	○			○	
7	Check operation of thermostat.	○				○
8	Cooling unit assembly performance test.	○		○		
9	Compressor overhaul.		Every four years			Every 40,000 km (24,000 miles)

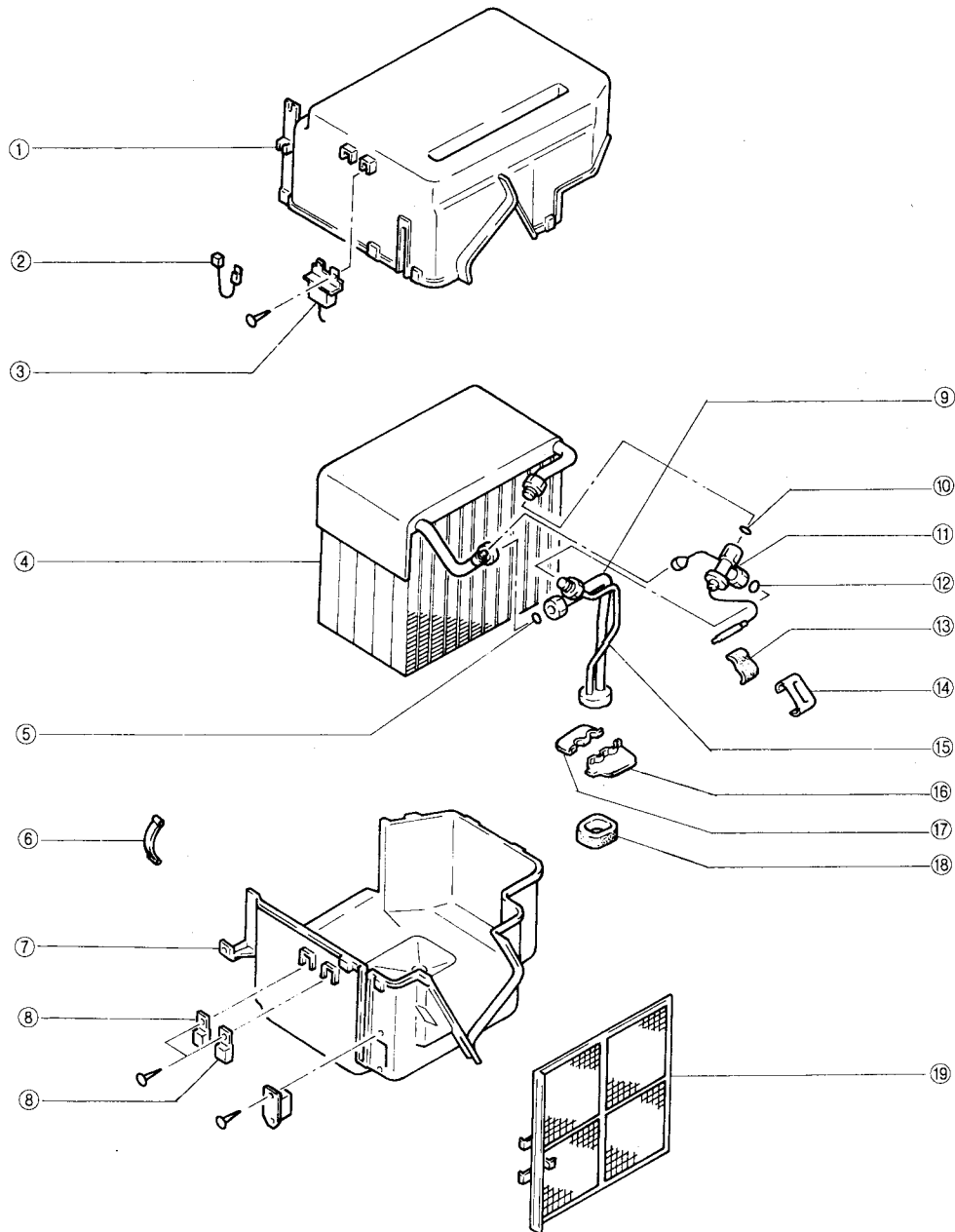
CAUTION

Even after the hot season is over, the air conditioner should be kept ready for operation all year round. Do not remove the V-belt or other parts.

This is because the air conditioner must be operated once a week for several minutes regardless of the season in order to prevent gas leaks caused by drying of the compressor shaft seal, and also to maintain the compressor itself in the best condition.

8. COOLING UNIT ASSEMBLY

8.1 Components



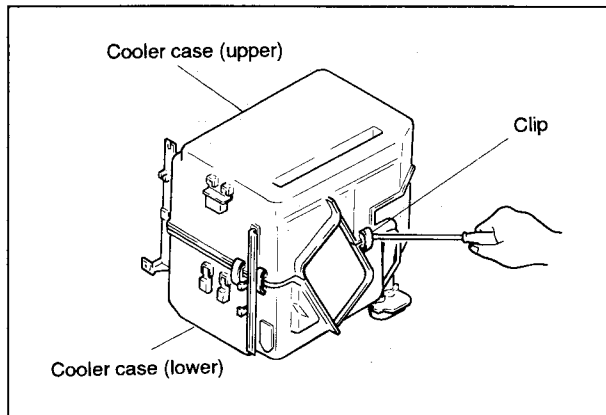
- | | |
|-----------------------|---------------------|
| ① Cooler case (upper) | ⑪ Expansion valve |
| ② Joint harness | ⑫ O-ring |
| ③ Thermostat | ⑬ Insulation rubber |
| ④ Evaporator | ⑭ Clip |
| ⑤ O-ring | ⑮ Baffle plate |
| ⑥ Clip | ⑯ Baffle plate |
| ⑦ Cooler case (lower) | ⑰ Insulation rubber |
| ⑧ Power relay | ⑱ Air filter |
| ⑨ Pipe | |
| ⑩ O-ring | |

8.2 Cautions in disassembling

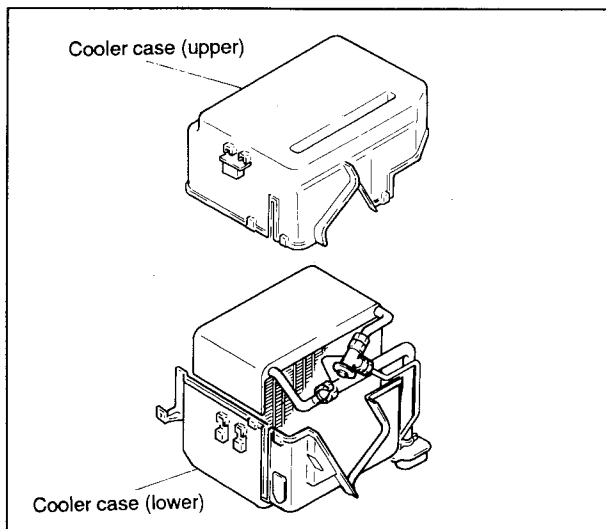
- (1) Direct after disconnecting the refrigerant piping blind the opening to prevent dust and moisture etc. from entering in it.
- (2) When disconnecting the expansion valve, surely apply two spanners to prevent unstable twisting from applying with the one for supporting and the other for torquing at the connection.
- (3) Pippings in the cooling unit assembly should be handled gently. Particularly, the ingress and egress portions should be from any bending trouble in carrying it.
- (4) If the cooling unit assembly is stored, or transported on disassembled condition, be careful not to deform the fins.
- (5) When disconnecting the wirring, avoid pulling it with the insulation cover caught, but apply force by pinching the terminals or by catching the connectors.

8.3 Disassembling

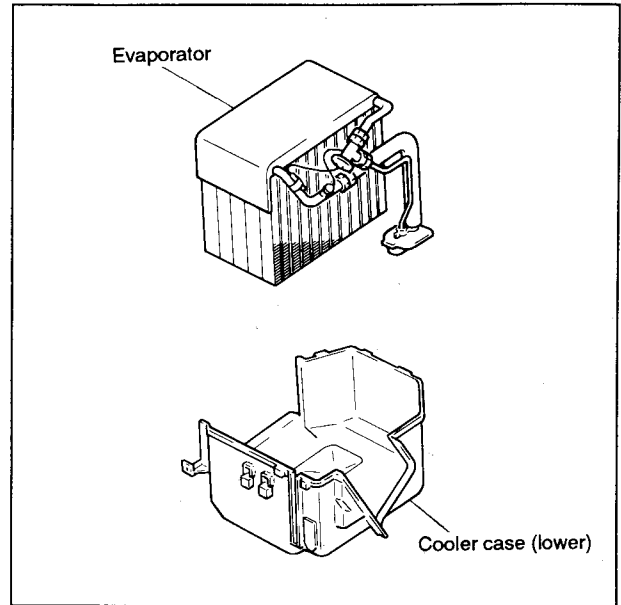
- (1) Remove the clips for jointings the upper & lower side cooler case with a flat type screwdriver.



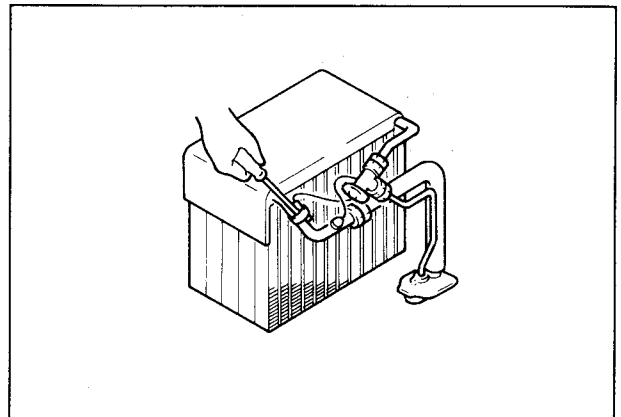
- (2) Dismount the cooler case (upper).



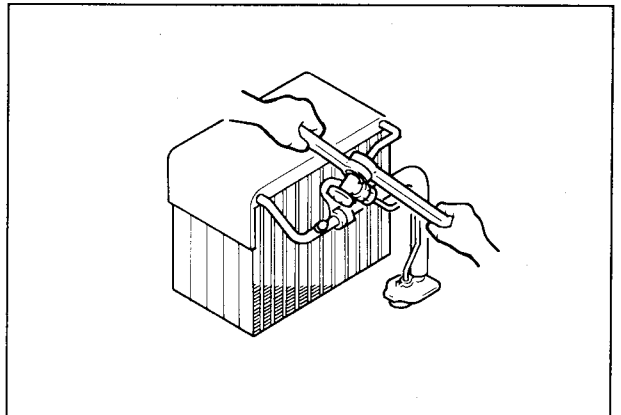
- (3) Dismount the evaporator.



- (4) Separate the expansion valve.
Dismount the feeler bulb at the suction side.

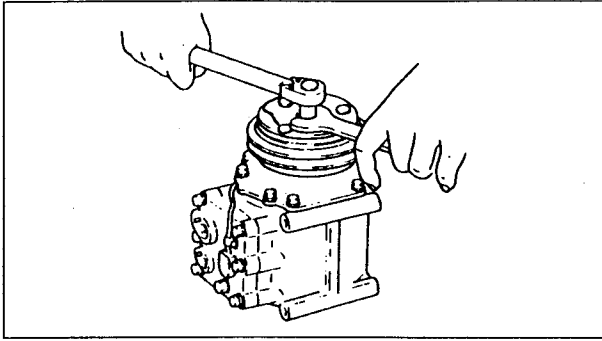


- (5) Disconnect the expansion valve from the circuit.

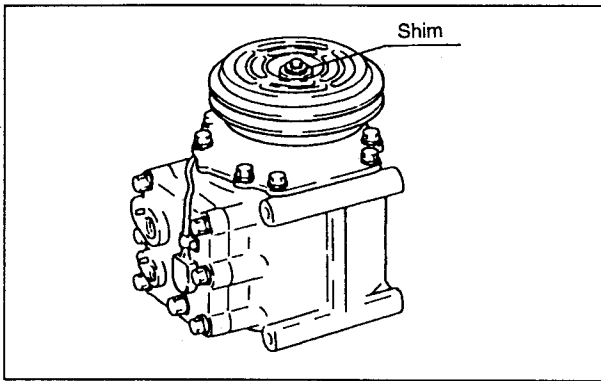


9. COMPRESSOR & CLUTCH ASSEMBLY

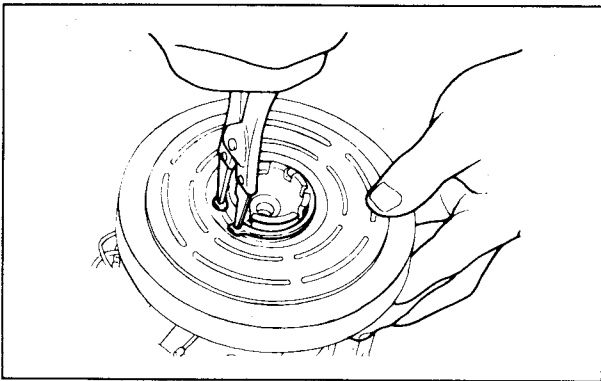
9.1 Disassembling the clutch.



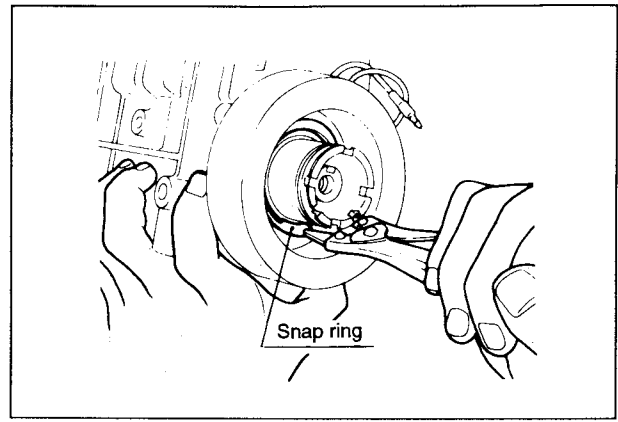
- (1) Removal of armature plate.
 - (a) Lock up the armature plate with a armature plate fixture and remove the lock nut.
 - (b) Remove the armature plate.



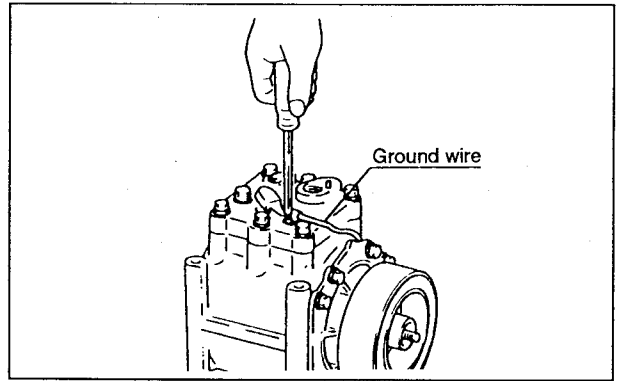
- (2) Remove the shim.



- (3) Withdrawing rotor.
 - (a) Remove the snap ring at the front case side with snap ring pliers.
 - (b) Withdraw the rotor toward you and remove it from the front case.

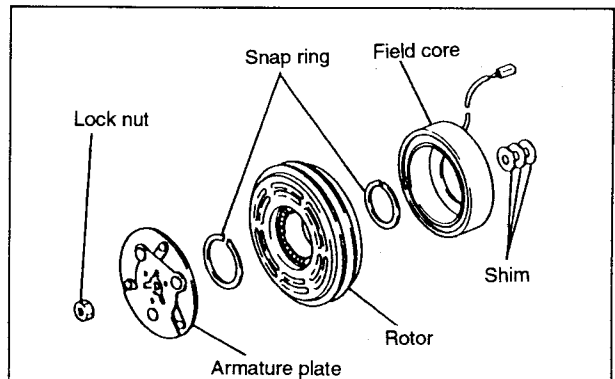


- (4) Removal of field core.
 - (a) Remove the snap ring for fixing the field core with snap ring pliers.



- (b) Remove the ground wire with a cross point screwdriver and withdraw the field core toward you to remove it from the crankcase.
- (5) Removal of key.

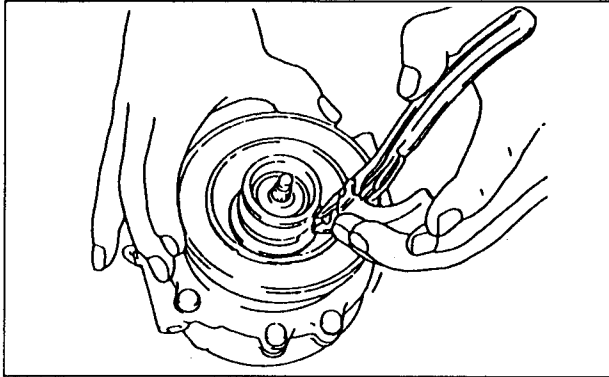
Remove the key from the shaft using the top of a flat type screwdriver.



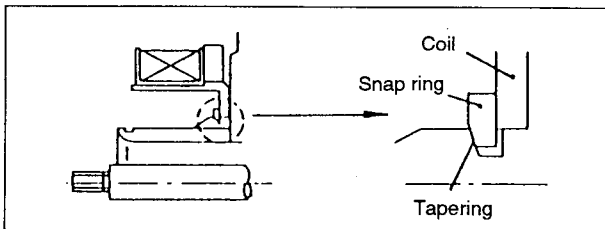
- (6) Components of magnetic clutch.

9.2 Reassembly the clutch.

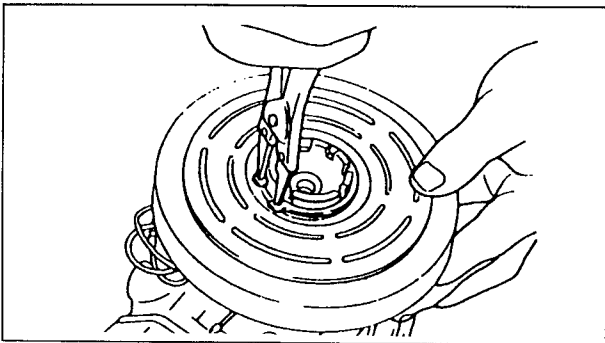
- (1) Insert the key into the crankshaft.
- (2) Insert the field core.



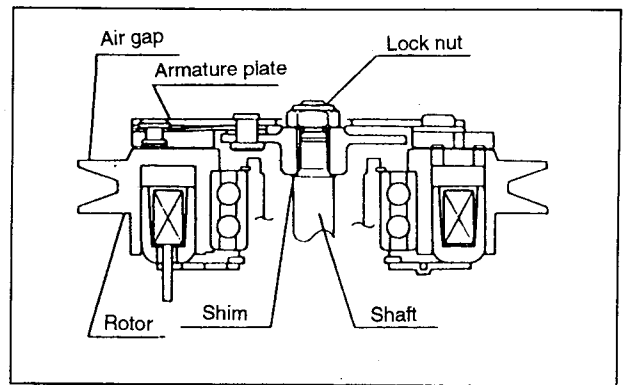
- (a) Insert the field core into the front case and position it with a knock pin.
- (b) Insert the snap ring for fixing field core into the groove and fix it with snap ring pliers as shown the below.



- (c) Connect the ground wire.
- (3) Insert the rotor into the front case.



- (4) Insert the snap ring for the front case side into the groove with snap ring pliers.

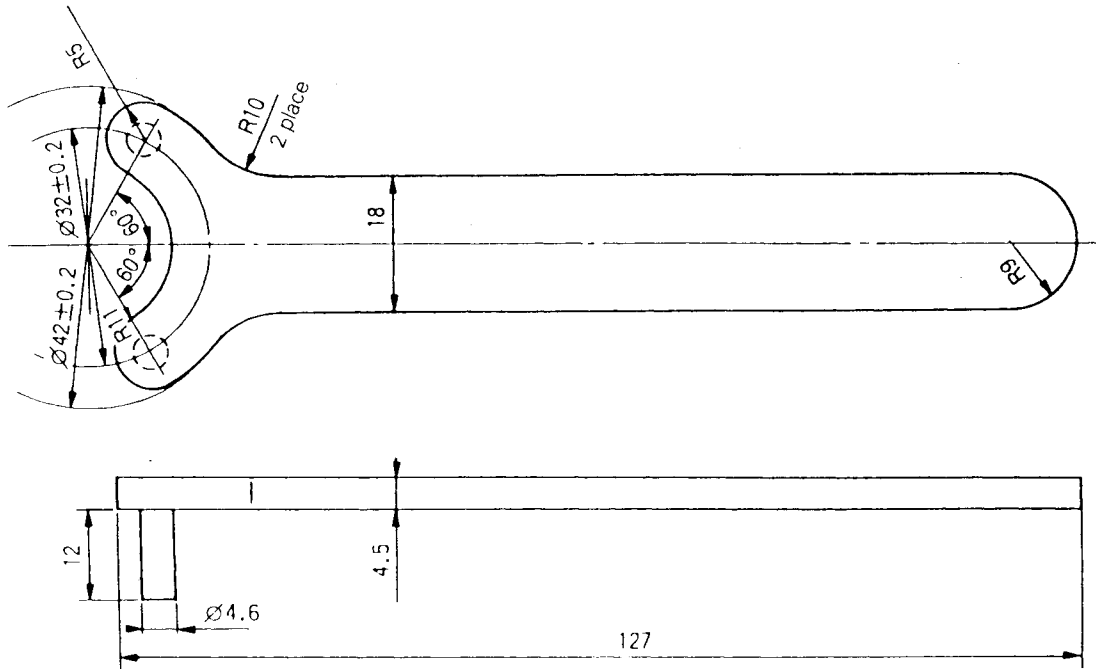


- (5) Install the armature plate.
 - (a) Place a shim on the end of the shaft and insert the armature plate, adjusting to the key.
 - (b) Tighten the center bolt to the specified torque, 15.7 N.m (160 kgf.cm), with in-between plain washer.
 - (c) Measure the air gap.
The air gap should be within 0.4 to 0.65 mm (0.016 ~ 0.026 in).
Adjust it by shim if it is not within the specifications. Adjusting shim : 0.1, 0.3, 0.5, or 0.8 mm (0.004, 0.012, 0.02, or 0.03 in).

9.3 Special tool figure

The dimensions are in millimeter

(1) Armature plate fixture





FH

Service Manual

Group 55B

Heater

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

GROUP 55B HEATER

SPECIFICATIONS	2
STRUCTURE AND OPERATION	3
TROUBLESHOOTING	9
HEATER HOSE	10
HEATER CONTROL	12
AIR DUCT	15
HEATER UNIT AND BLOWER ASSEMBLY	16

SPECIFICATIONS

Items		Specifications
System	Type	Inside/outside air combining, hot-water type heating system
	Standard voltage V	12
	Damper changeover system	Manual cable type
Blower assembly	Manufacturer	NIPPONDENSO
	Power consumption W	170
	Maximum rotation rpm	3450
Heater unit assembly	Manufacturer	NIPPONDENSO
	Temperature control system	Air mixing type
	* Heating performance kW {BTU/h, kcal/h}	*3.53 {12060, 3040}

* : Heating performance is shown under the following conditions.

Temperature difference : 65°C {119°F}

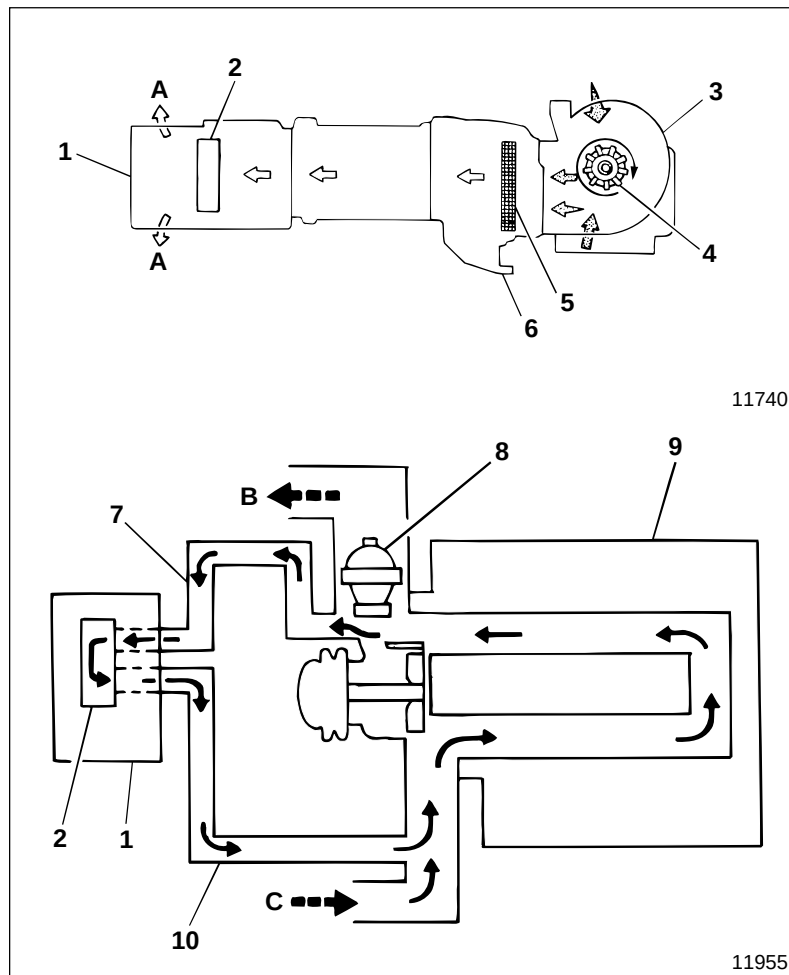
Water flow : 6 L/min {0.0035 ft³/s}

Voltage : 12 V DC

STRUCTURE AND OPERATION

55B

Heater



- 1 Heater unit
- 2 Heater core
- 3 Blower assembly
- 4 Fan
- 5 Air filter
- 6 Duct assembly
- 7 Heater hose (Heater in)
- 8 Thermostat
- 9 Engine
- 10 Heater hose (Heater out)

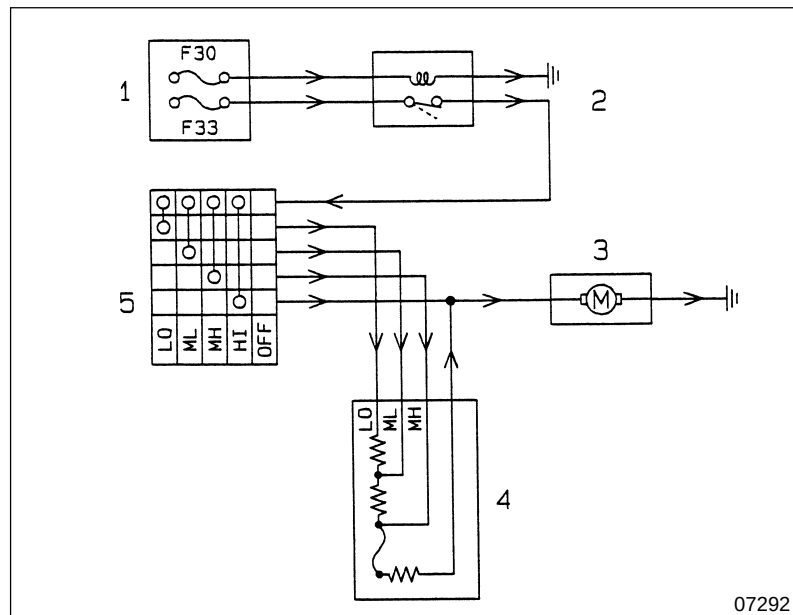
A : To duct
B : To radiator
C : From radiator

- ➡ Outside air (Intake)
- ➡ Inside air (Circulation)
- ➡ Filtered air

- Warm engine coolant that has absorbed heat from engine 9 does not flow through thermostat 8 but circulates as follows:
7→2→10→9
- Air sent to heater unit 1 from blower assembly 3 is warmed by heater core 2 (heat exchanger). Then the ducts deliver the warmed air to the cab.

STRUCTURE AND OPERATION

Heater Electric Circuit



- 1 Fuse box
- 2 Blower fan relay
- 3 Blower motor
- 4 Blower resistor
- 5 Fan switch (Heater switch)

- The resistance of blower resistor **4** controls blower motor **3**, which in turn controls the air flow, except when the air flow is set to HI (high speed). When the air flow is set to HI, the current does not flow through the blower resistor.

Fan switch 5 set to LO position

- 1 (F30)→2 (coil)→Ground
- 1 (F33)→2 (contact point)→5 (LO)→4 (LO)→3→Ground

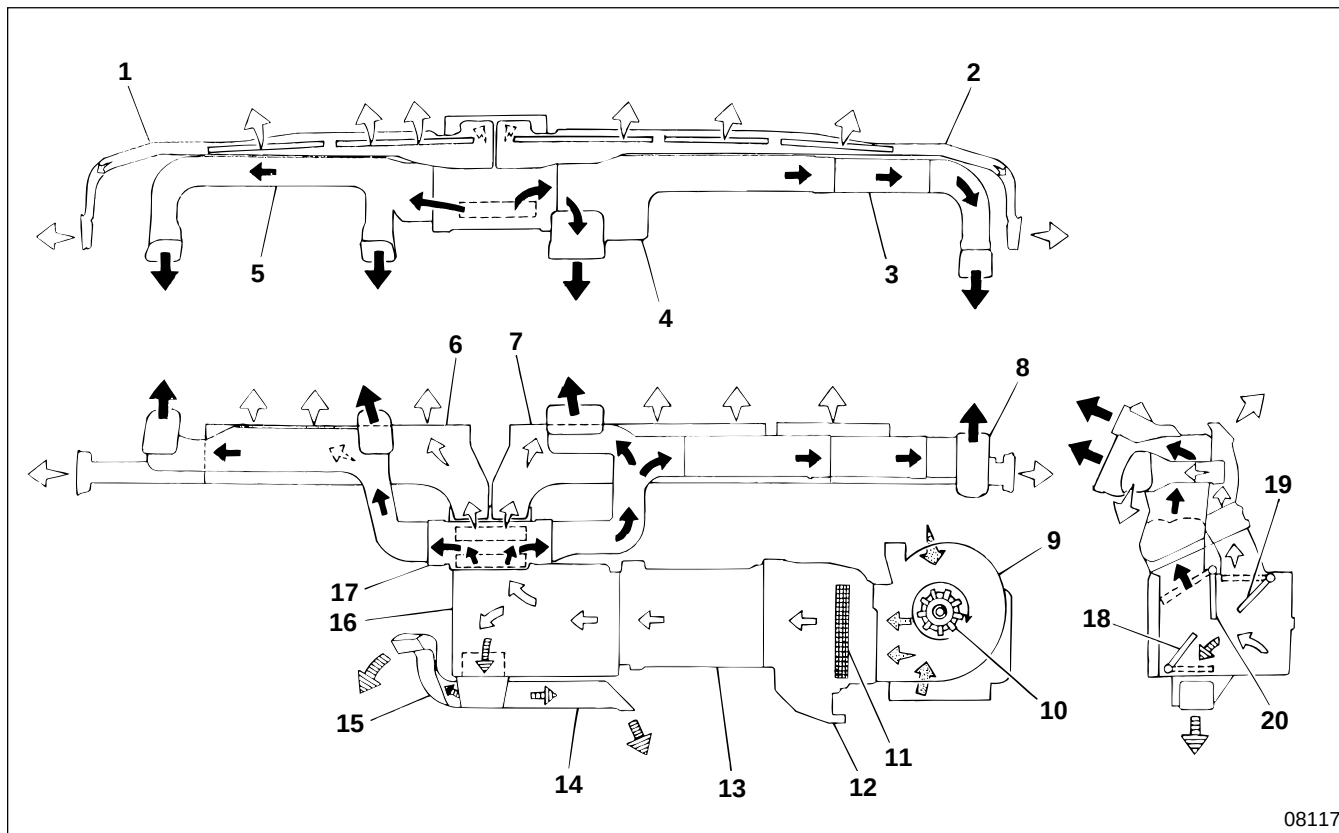
Fan switch 5 set to HI position

- 1 (F30)→2 (coil)→Ground
- 1 (F33)→2 (contact point)→5 (HI)→3→Ground

Fan switch 5 set to either ML or MH position

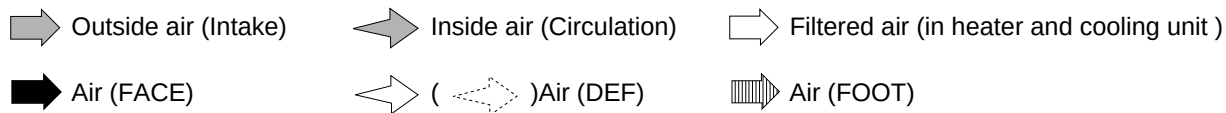
The current flows through blower resistor **4** in the same way as when set to LO position, routing ML or MH respectively instead of LO.

Air Duct



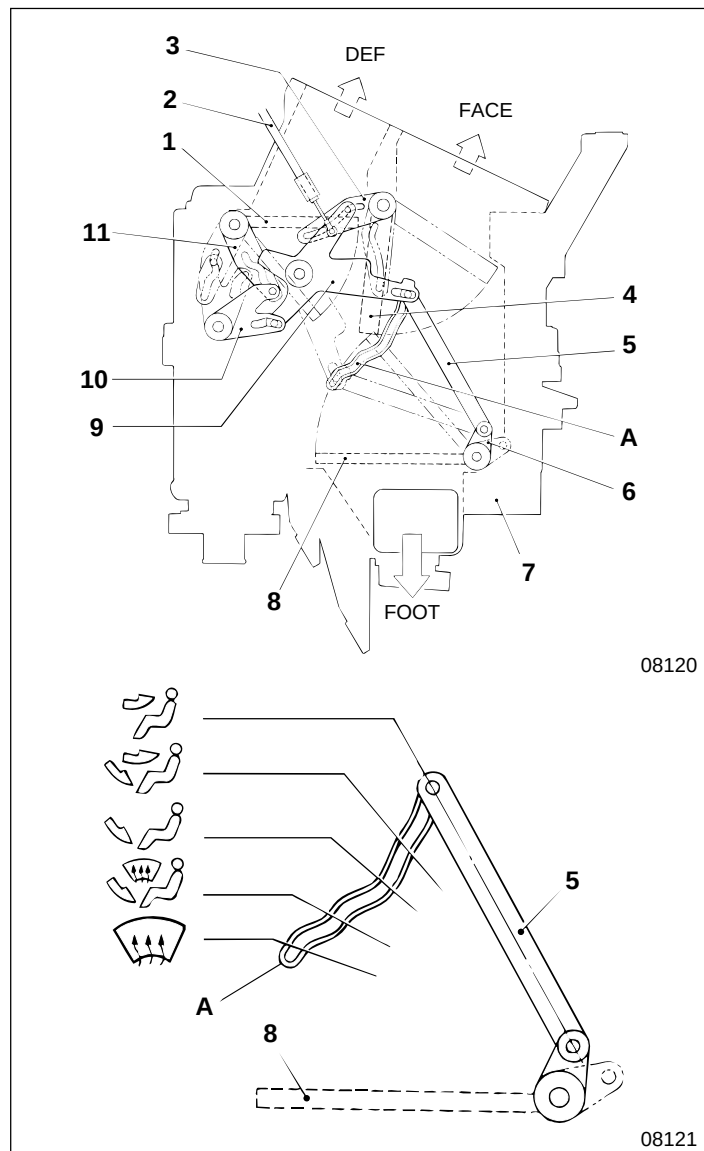
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- | | |
|---------------------------|--|
| 1 Defroster side duct, LH | 11 Air filter |
| 2 Defroster side duct, RH | 12 Duct assembly < without air-conditioner >
Cooling unit < with air-conditioner : option > |
| 3 Face duct B | 13 Joint duct |
| 4 Center face duct | 14 Foot duct, RH |
| 5 Face duct, LH | 15 Foot duct, LH |
| 6 Front defroster, LH | 16 Heater unit |
| 7 Front defroster, RH | 17 Center duct |
| 8 Face duct A | 18 Damper (FOOT) |
| 9 Blower assembly | 19 Damper (DEF) |
| 10 Fan | 20 Damper (FACE) |



Since dampers 18, 19, 20 of heater unit 16 are opened and shut by the switching operation of the heater control assembly, the outside air and inside air coming from blower assembly 9 flow as illustrated.

STRUCTURE AND OPERATION



● Mode changeover system

- 1 Damper (DEF)
- 2 Mode changeover control cable
- 3 Lever
- 4 Damper (FACE)
- 5 Lever
- 6 Lever
- 7 Heater unit
- 8 Damper (FOOT)
- 9 Lever
- 10 Lever
- 11 Lever

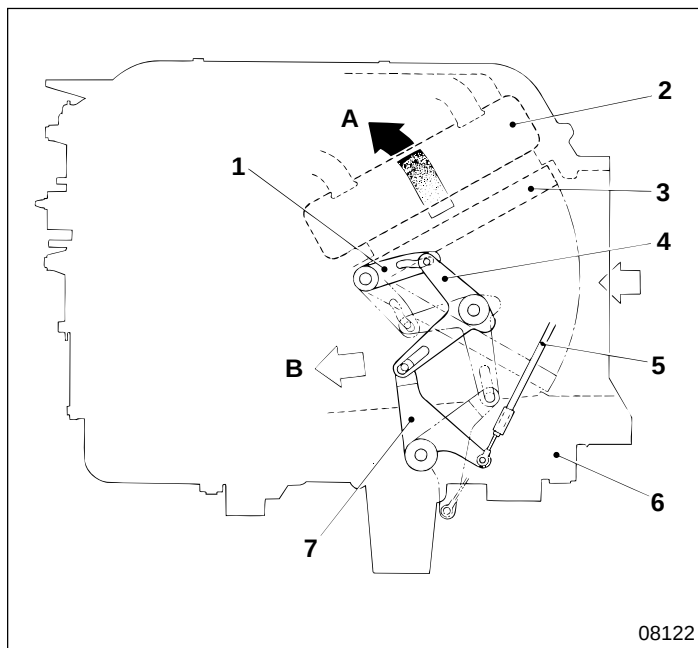
A : Rail

- The opening and closing of dampers 1, 4, 8 is mechanically controlled by the movement of mode changeover control cable 2, transmitted as follows:

2→9→3→4 (FACE)
 →5→6→8 (FOOT)
 →10→11→1 (DEF)

Levers 3, 5, 6, 10, 11 move together with lever 9. Dampers 1, 4, 8 move together with levers 3, 6, 11, the degree of opening is determined by the shape of the lever grooves.

- Lever 5 is connected to rail A. Since the lever moves along the groove of the rail, damper 8 (FOOT) can be opened and closed in combination with other modes to activate bi-level mode.

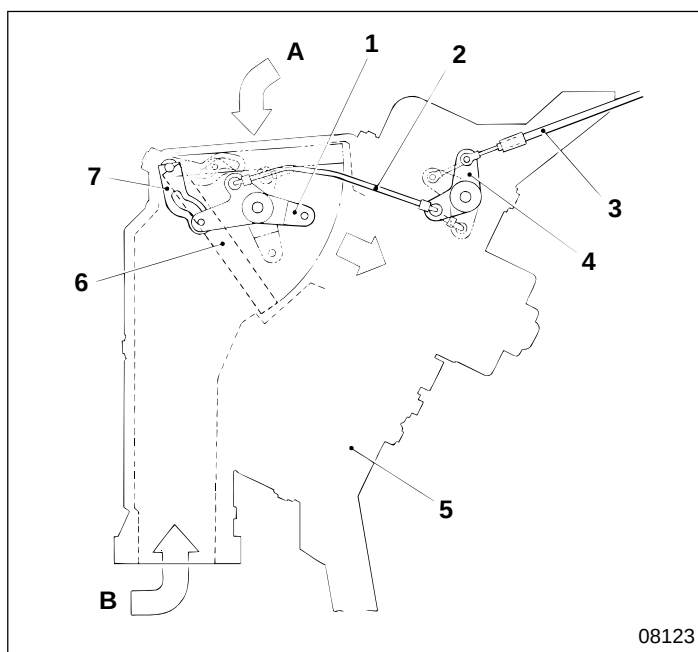


● Air mixing control

- 1 Lever
- 2 Heater core
- 3 Damper
- 4 Lever
- 5 Air mixing control cable
- 6 Heater unit
- 7 Lever

A : Warm air
B : Unwarmed air

- The degree of opening of damper **3** controls the flow of both air **A** that has passed through and been warmed by heater core **2**, and air **B** that has not been warmed.
- Damper **3** is mechanically operated by the movement of air mixing control cable **5**, transmitted as follows:
5→7→4→1→3
Lever 1 moves together with damper **3**.



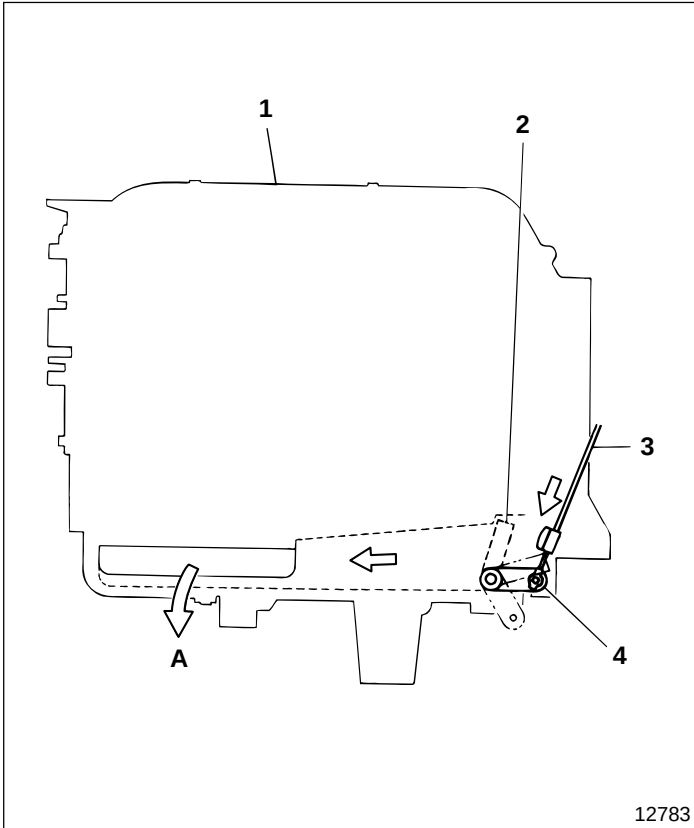
● Air intake control

- 1 Lever
- 2 Rod
- 3 Inside/outside air changeover control cable
- 4 Lever
- 5 Blower assembly
- 6 Damper
- 7 Lever

A : Inside air
B : Outside air

- Changeover of air intake from inside to outside is controlled by the opening and closing of damper **6**.
- Damper **6** is mechanically operated by the movement of inside/outside air changeover control cable **3**.
3→4→2→1→7→6
Lever 7 moves together with damper **6**.

STRUCTURE AND OPERATION



● Air flow bypass changeover

- 1 Heater unit
- 2 Damper
- 3 Air flow bypass changeover control cable
- 4 Lever

A : Air not warmed by heater core

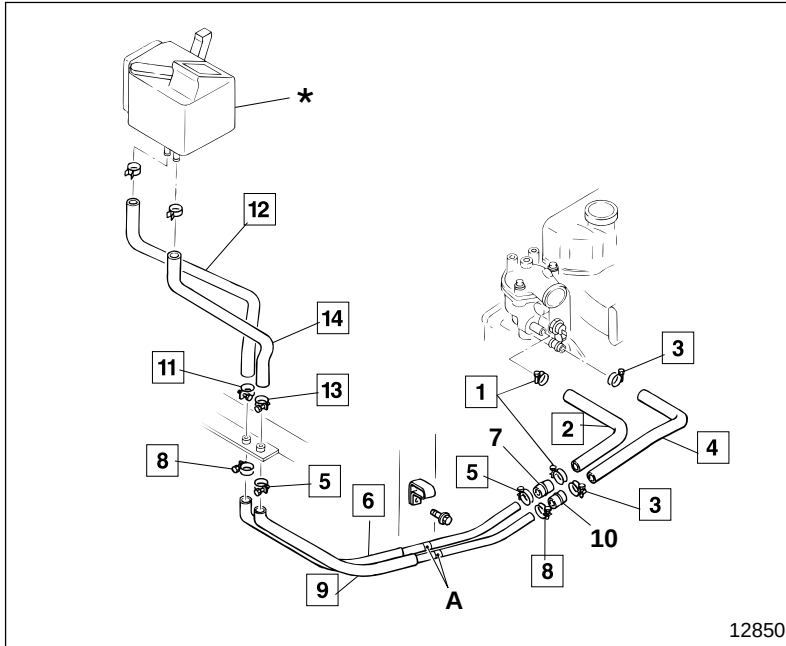
- Damper 2 is opened and closed to change the air flow from warm air to air that has not passed through and been warmed by heater core 2.
- Damper 2 is mechanically operated by the movement of air flow bypass changeover control cable 3, transmitted as follows:
3→4→2
Lever 4 moves together with damper 2.

TROUBLESHOOTING

55B

Symptoms										Remarks
	Air does not flow from vents	Heater does not work well	Airflow control setting cannot be changed	Drafts from vents	Temperature control setting cannot be adjusted	Outside/inside air control cannot be changed	Air volume from vents unstable	Control switches operation heavy	Air flow bypass cannot be changed	
Possible causes										
Blower motor coil broken or short-circuited	☐									
Blower motor relay contact point melted, coil broken or short-circuited	☐									
Blower resistor operation malfunctioning							☐			
Mode damper opening and closing faulty			☐	☐				☐		
Air mixing damper opening and closing faulty				☐	☐			☐		
Inside/outside air changeover damper opening and closing faulty				☐		☐		☐		
Heater control assembly faulty	☐	☐	☐	☐	☐	☐				
Thermostat does not close		☐								 Gr 14
Coolant amount insufficient		☐								 Gr 14
Connector connection faulty, harness broken or grounding faulty	☐		☐	☐	☐	☐				
Fuse blown	☐									
Heater pipes clogged, loose or connection faulty		☐								
Duct connection faulty			☐							
Heater unit clogged		☐								
Control cable sliding movement faulty, installation faulty			☐	☐		☐		☐		
Control cable connecting lever of units bent			☐	☐		☐		☐		
Control cable connecting lever sliding parts of units worn or lubricated insufficiently			☐	☐		☐		☐		
Air flow bypass changeover damper opening and closing faulty									☐	

HEATER HOSE



● Disassembly sequence

- 1 Hose clamp
- 2 Heater hose (Engine out)
- 3 Hose clamp
- 4 Heater hose (Engine in)
- 5 Hose clamp
- 6 Heater hose (Engine out)
- 7 Water pipe
- 8 Hose clamp
- 9 Heater hose (Engine in)
- 10 Water pipe
- 11 Hose clamp
- 12 Heater hose (Heater in)
- 13 Hose clamp
- 14 Heater hose (Heater out)

★ : Heater unit
A : White mark

NOTE

- Drain engine coolant from radiator before removing hoses. Gr 14
- Make sure that white mark A on heater hoses 6, 9 are clearly visible before removing parts. If there are no marks, make identification marks before removing parts.

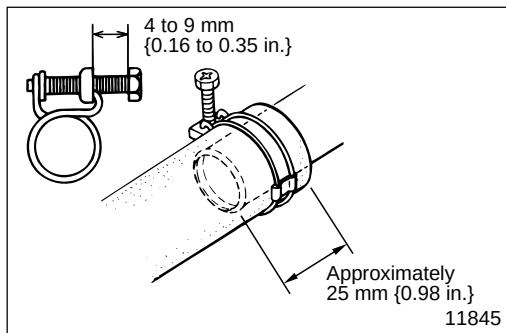
● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- Be sure that hoses are inserted securely to prevent coolant leaking.
- Make sure not to mix up heater hoses 2, 4, 6, 9, 12, 14 when connecting them because mistaken connection would damage the heater unit.

◆ Service procedure

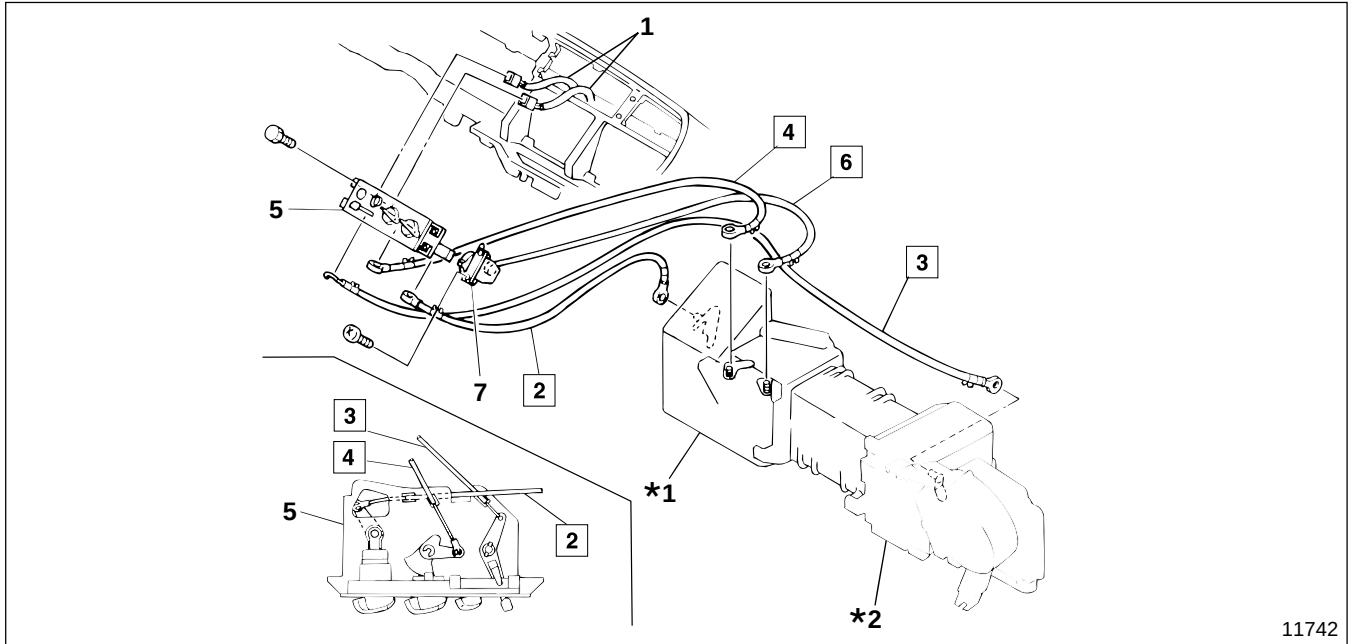


1 to 6 8 9 11 to 14 Installation of heater hose and hose clamp

- Install heater hoses 2, 4, 6, 9, 12, 14 conform to the dimension as illustrated.
- Tighten hose clamps 1, 3, 5, 8, 11, 13 to conform to the dimension as illustrated.

M E M O

HEATER CONTROL



● Disassembly sequence

- | | |
|---|---------------------------------------|
| 1 Harness | 6 Air bypass changeover control cable |
| 2 Mode changeover control cable | 7 Air bypass control lever |
| 3 Inside/outside air changeover control cable | |
| 4 Air mixing control cable | *1 : Heater unit assembly P55-16 |
| 5 Heater control assembly Gr 54 | *2 : Blower assembly P55-16 |

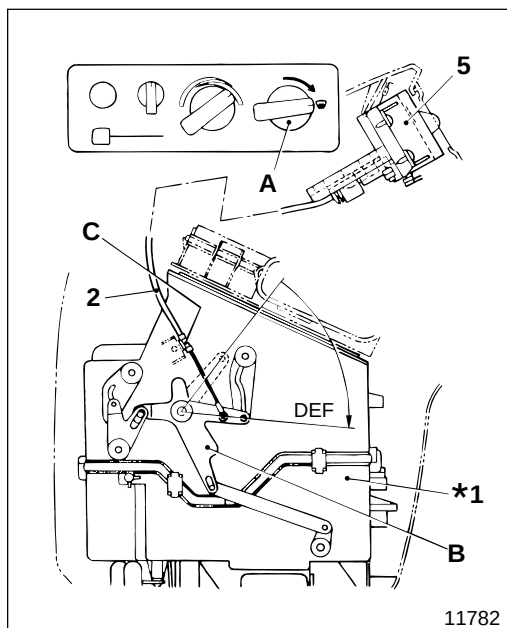
● Assembly sequence

Follow the disassembly sequence in reverse.

◆ Service procedure

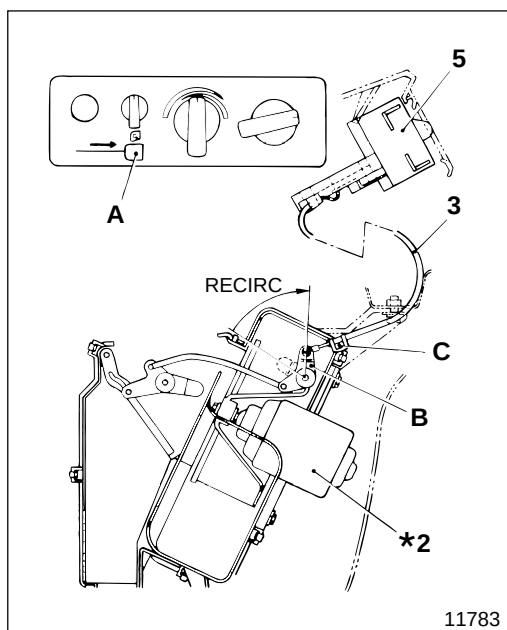
2 Installation of mode changeover control cable

- Turn mode changeover control dial **A** of heater control assembly **5** to  (DEF).
- Turn mode changeover damper lever **B** of heater unit assembly ***1** to DEF.
- Under these conditions, install mode changeover control cable **2** onto mode changeover damper lever **B** and fasten it with clip **C**.

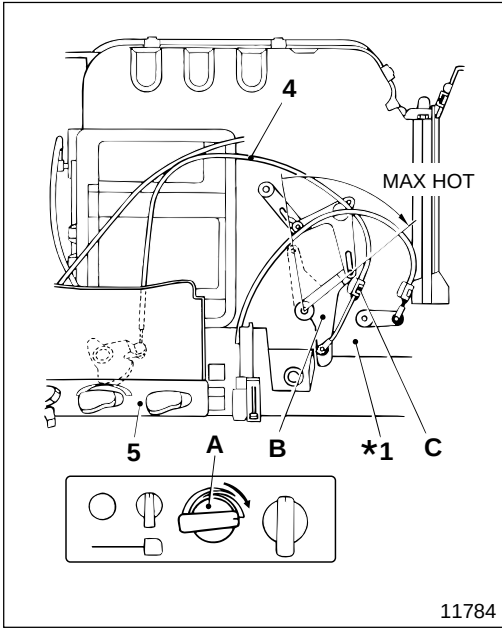


3 Installation of inside/outside air changeover control cable

- Set inside/outside changeover lever **A** of heater control assembly **5** to  (RECIRC : Inside air).
- Turn inside/outside air changeover damper lever **B** of blower assembly ***2** to RECIRC.
- Under these conditions, install inside/outside air changeover control cable **3** onto inside/outside air changeover damper lever **B** and fasten it with clip **C**.

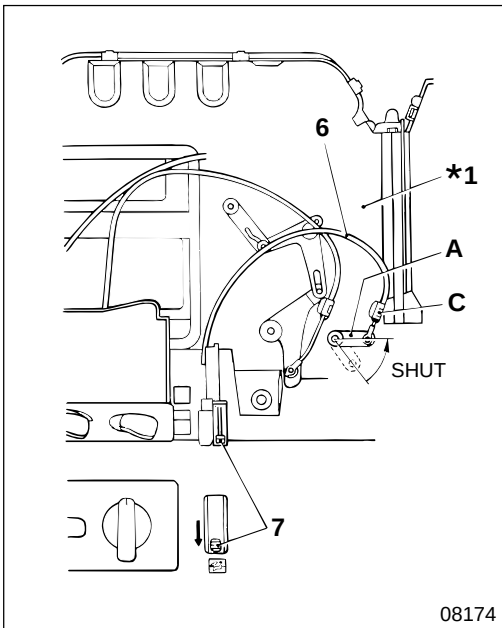


HEATER CONTROL



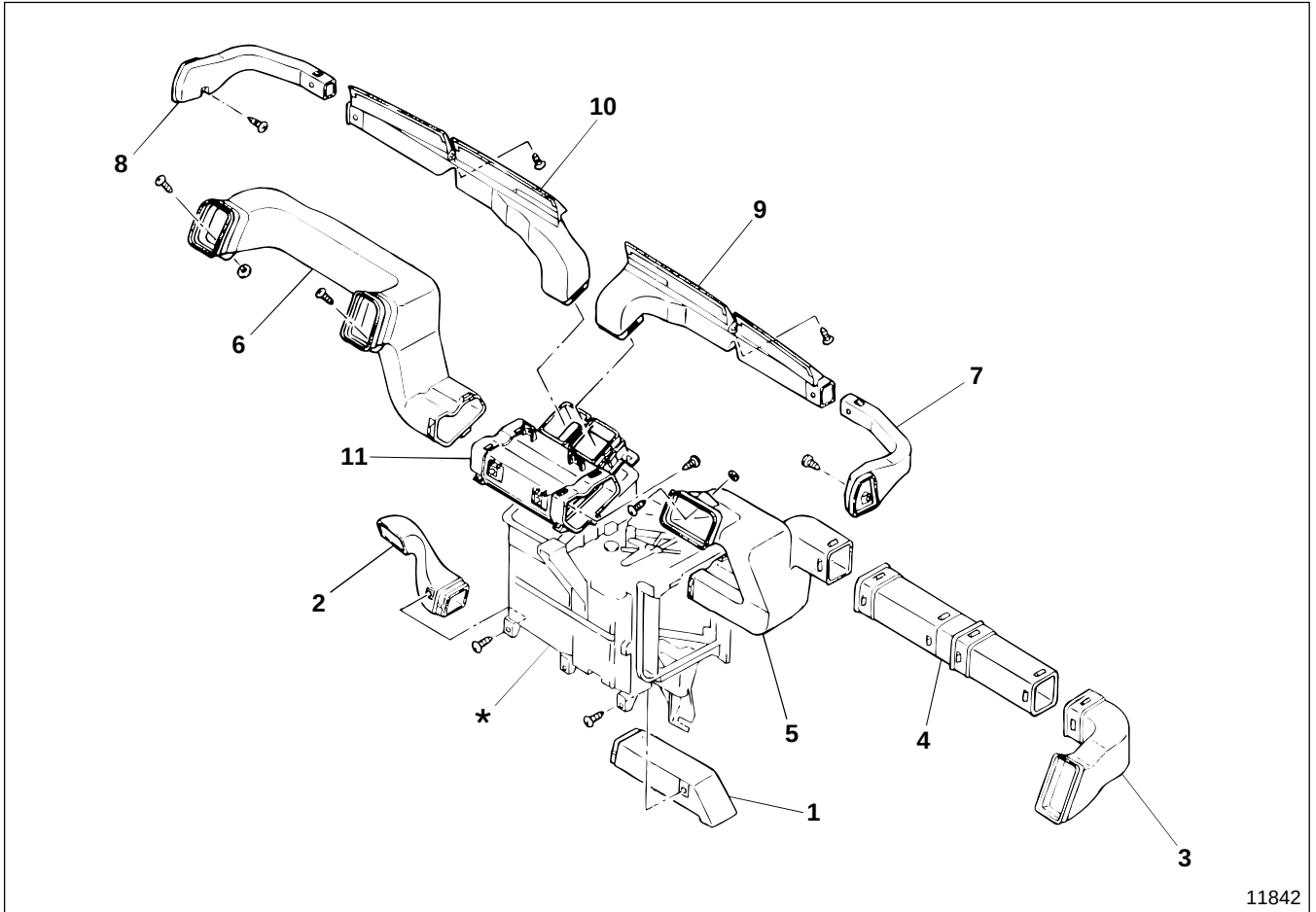
4 Installation of air mixing control cable

- Fully turn temperature control dial **A** of heater control assembly **5** clockwise to MAX HOT (maximum heating).
- Turn air mixing damper lever **B** of heater unit assembly ***1** to MAX HOT (maximum heating).
- Under these conditions, install air mixing control cable **4** onto air mixing damper lever **B** and fasten it with clip **C**.



6 Installation of air bypass changeover control cable

- Set air bypass changeover control lever **7** to SHUT.
- Set air bypass lever **A** of heater unit assembly ***1** to SHUT.
- Under these conditions, install air bypass changeover control cable **6** onto air bypass lever **7** and fasten it with clip **C**.



● Disassembly sequence

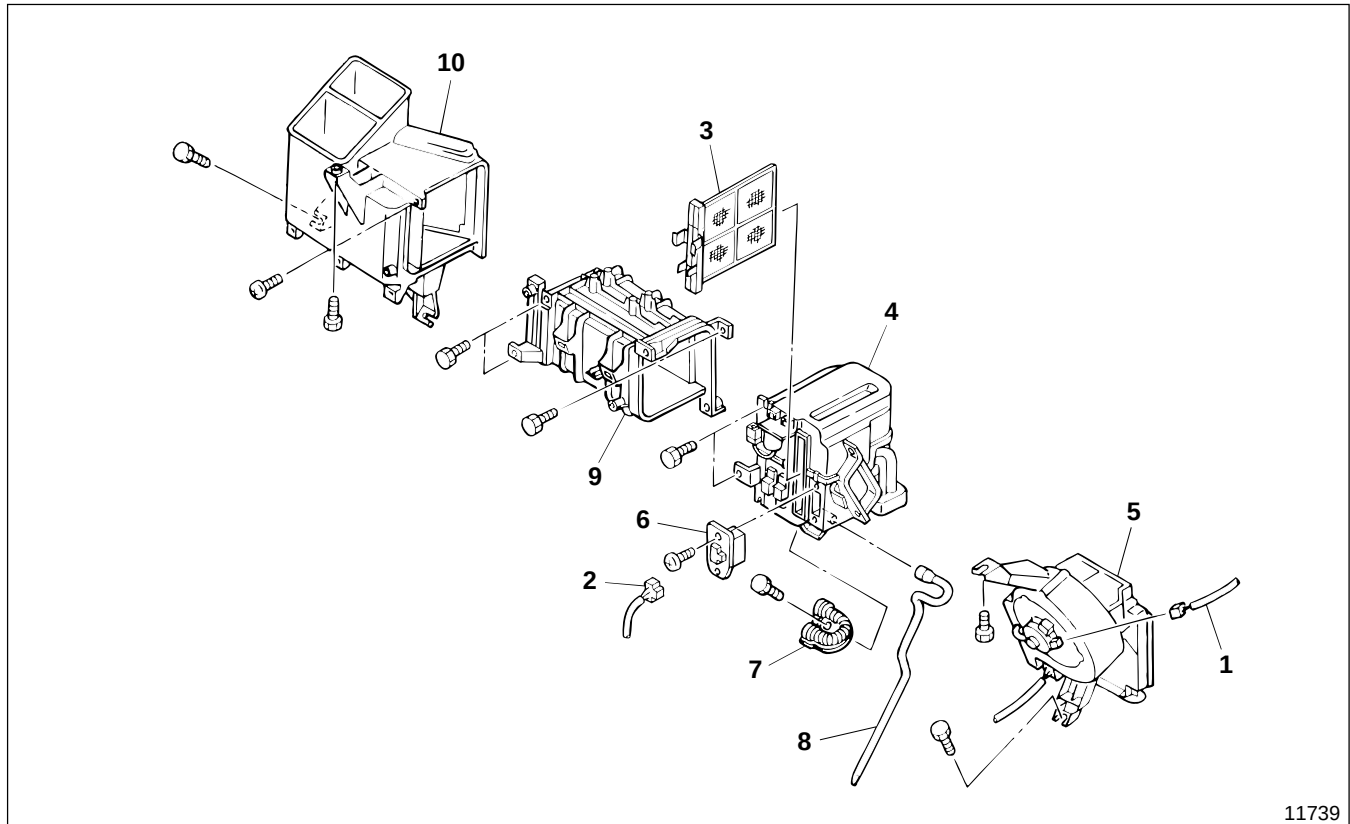
- | | |
|---------------------------|-----------------------------|
| 1 Foot duct, RH | 8 Defroster side duct, LH |
| 2 Foot duct, LH | 9 Front defroster duct, RH |
| 3 Face duct A | 10 Front defroster duct, LH |
| 4 Face duct B | 11 Center duct |
| 5 Center face duct | |
| 6 Face duct, LH | |
| 7 Defroster side duct, RH | |

* : Heater unit

● Assembly sequence

Follow the disassembly sequence in reverse.

HEATER UNIT AND BLOWER ASSEMBLY



● Disassembly sequence

- | | |
|---|-------------------------|
| 1 Harness | 7 Cover |
| 2 Harness | 8 Drain hose |
| 3 Air filter | 9 Joint duct |
| 4 Duct assembly | 10 Heater unit assembly |
| 5 Blower assembly  Gr 54 | |
| 6 Blower resistor  Gr 54 | |

● Assembly sequence

Follow the disassembly sequence in reverse.