CEBM011605

Shop Manual

WA250-5L
WA250PT-5L

WHEEL LOADER – WASTE HANDLER

SERIAL NUMBERS

WA250-5L	A73001	and UP
WA250PT-5L	A79001	

It is our policy to improve our products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to install such changes on products sold previously.

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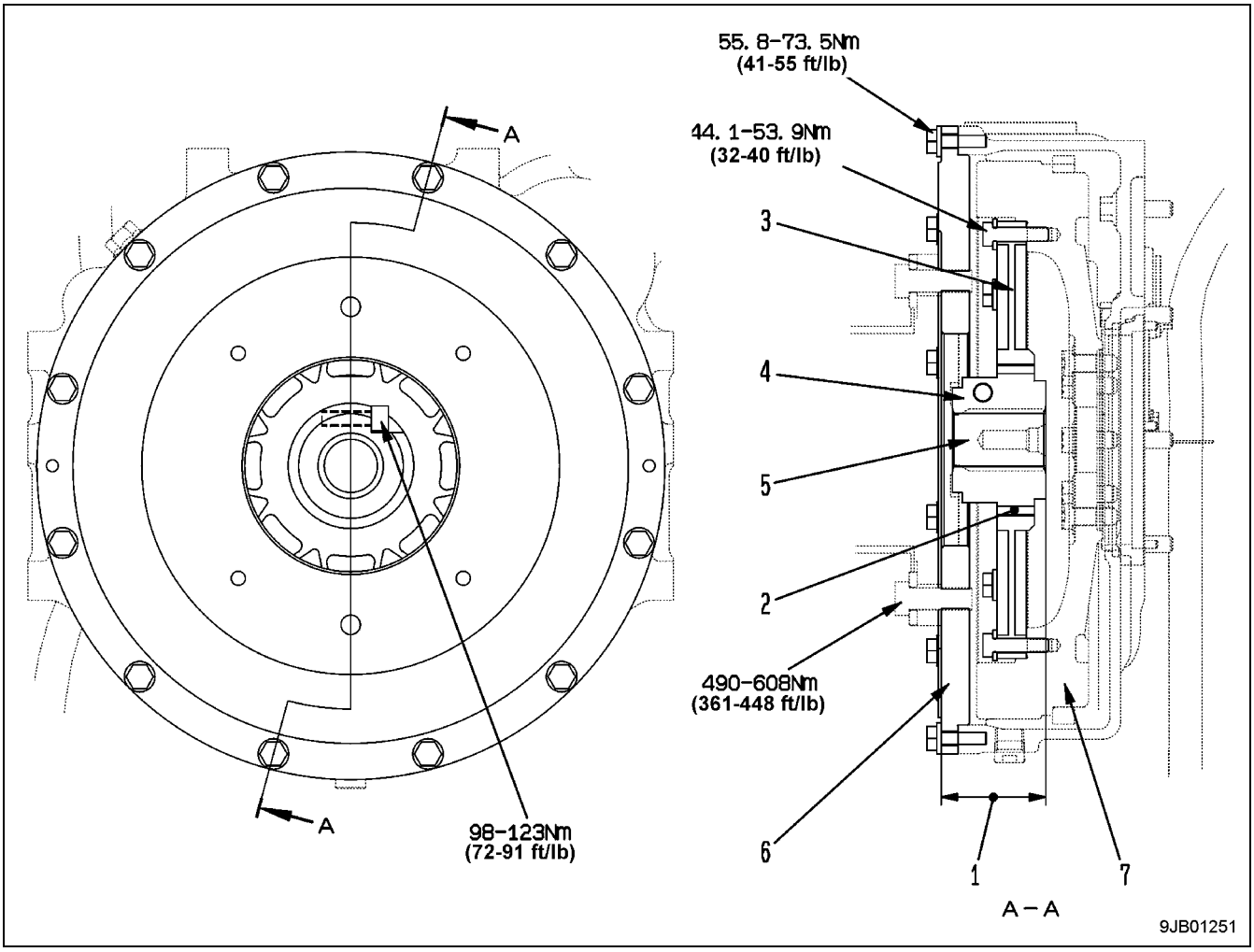
FUEL, COOLANT AND LUBRICANTS

Reservoir	Kind of fluid	Ambient Temperature: -22 -30 / -4 -20 / 14 -10 / 32 0 / 50 10 / 68 20 / 86 30 / 104 40 / 122°F 50°C
Engine oil pan	Engine oil	SAE0W-30 / SAE5W-40 / SAE10W / SAE30 / SAE10W-30 / SAE15W-40
Transfer case	Engine oil	SAE10W
Hydraulic system	Engine oil	SAE10W-30
Axle (with standard differential)		AXO80(*3)
Axle (with limited-slip differential) (*4)	Axle oil	See Next Page (*5)
Greasing system	Grease	NLGI No. 2
Fuel tank	Diesel fuel (*2)	ASTM D975 No. 2 / (*1)
Cooling system	Coolant	See Supplier Table on page 01-11

DRIVE SYSTEM DAMPER



Unit: mm (in)

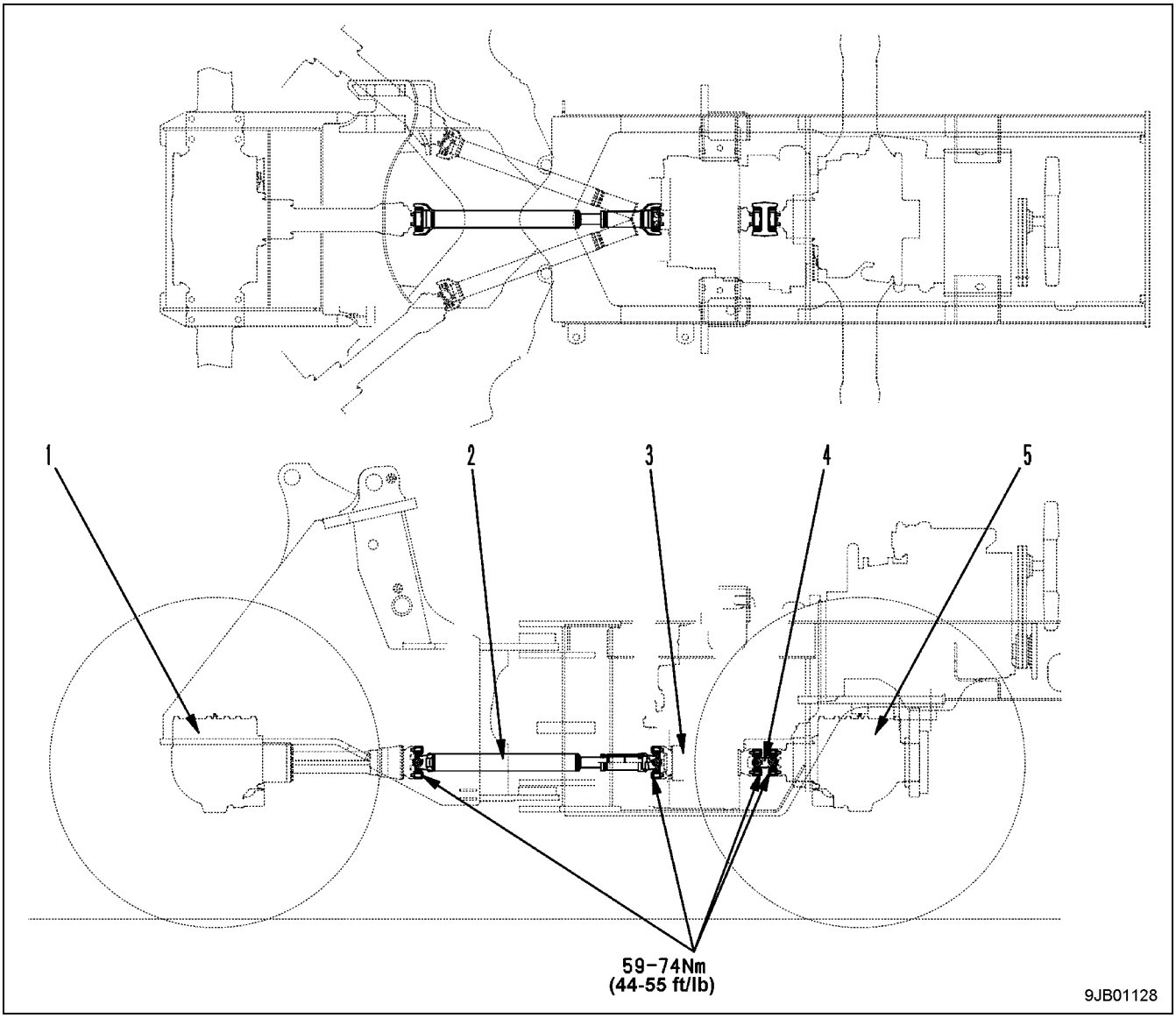
No.	Check item	Specifications		Remedy
1	Distance between HST pump mounting face and tip of boss	Standard size	Repair limit	Adjust
		75.1 (3.1)	± 0.8 (0.1)	
2	Wear of internal teeth on coupling (plastic)	Repair limit: 1.0 (0.1)		Replace

3. Coupling
4. Boss
5. HST pump input shaft
6. Cover
7. Flywheel

Outline

- The damper reduces the torsional vibration caused by fluctuation of the engine torque, it protect the drive system from the torsional vibration.
- The power from the engine is transmitted through flywheel (7) to coupling (3), which absorbs the torsional vibration, and then transmits it through boss (4) to the HST pump.

DRIVE SHAFT



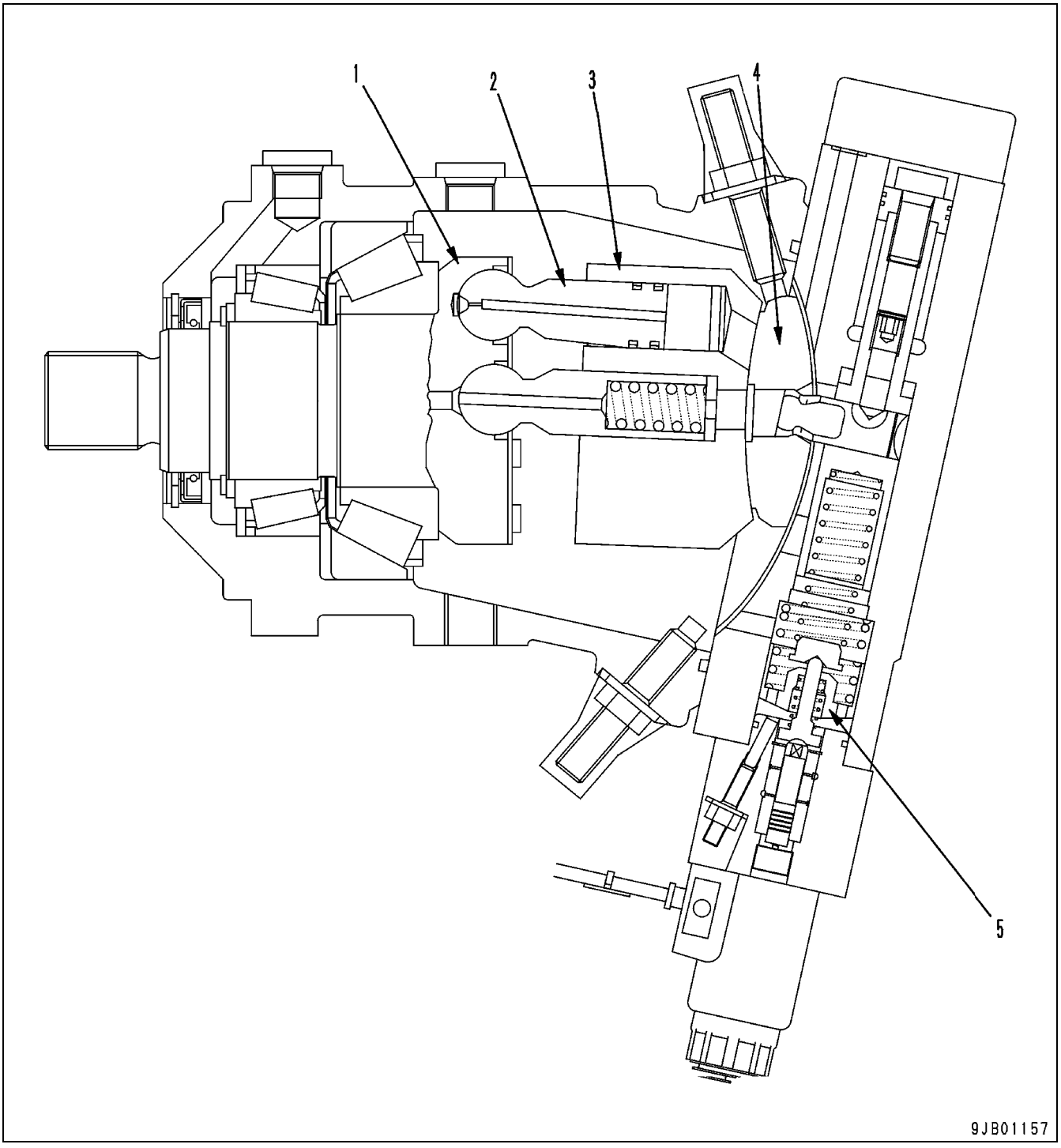
1. Front axle
2. Front drive shaft
3. Transfer
4. Rear drive shaft
5. Rear axle

Outline

- The power from the output shaft of the transfer (3) is transmitted through front drive shaft (2) and rear drive shaft (4) to front axle (1) and rear axle (5).
- When the machine is articulated or it receives an impact from the road during travel or a working impact, the positions of the transfer and front and rear axles change. The drive shafts can change their angles and lengths by means of the universal joints and sliding joints so that the power will be transmitted without damaging any part even when the positions of the components change because of the impacts.

HST MOTORS

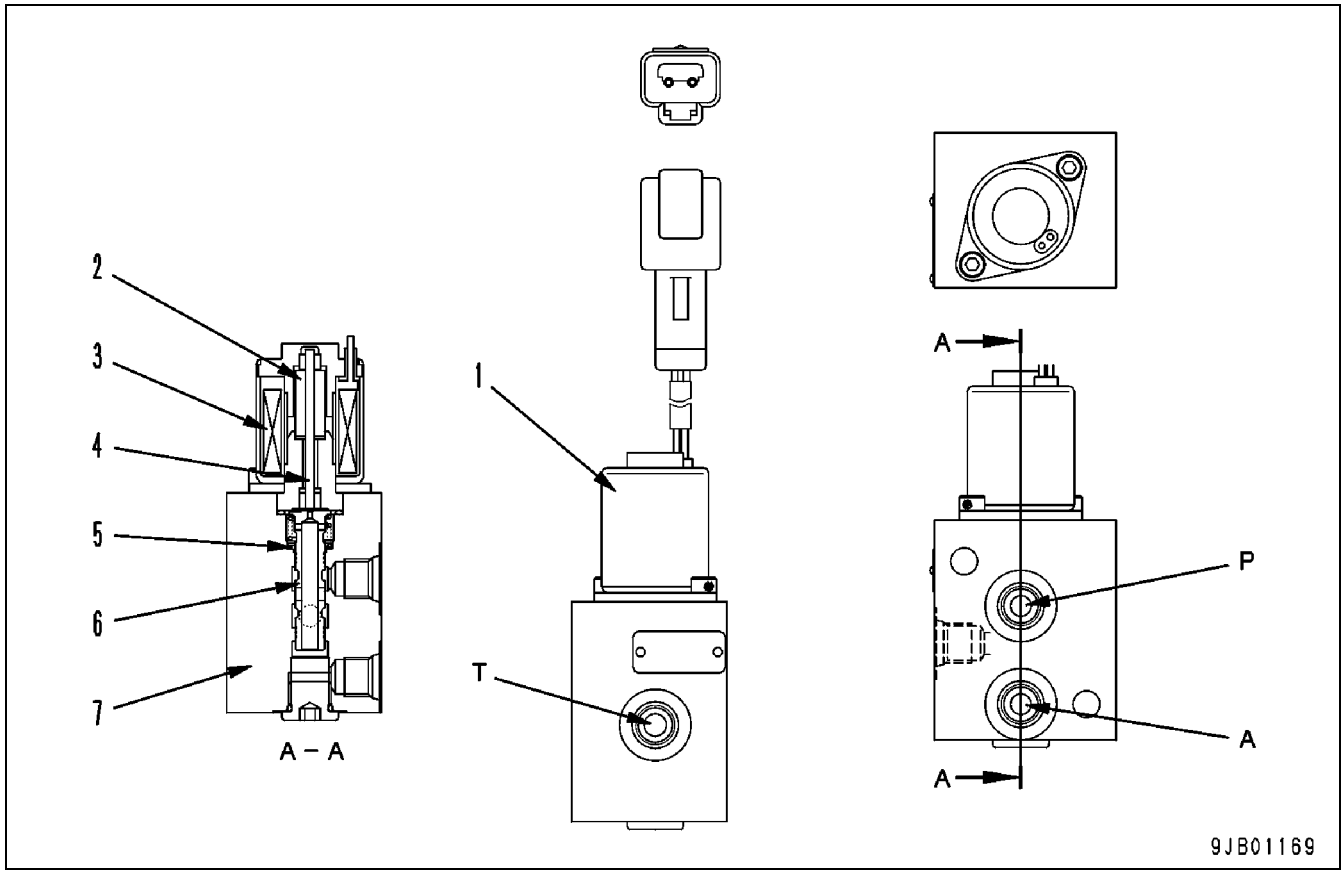
HST MOTOR 1



1. Drive shaft
2. Piston
3. Cylinder block
4. Port plate
5. EP servo valve

MEMORANDUM

CLUTCH SOLENOID VALVE



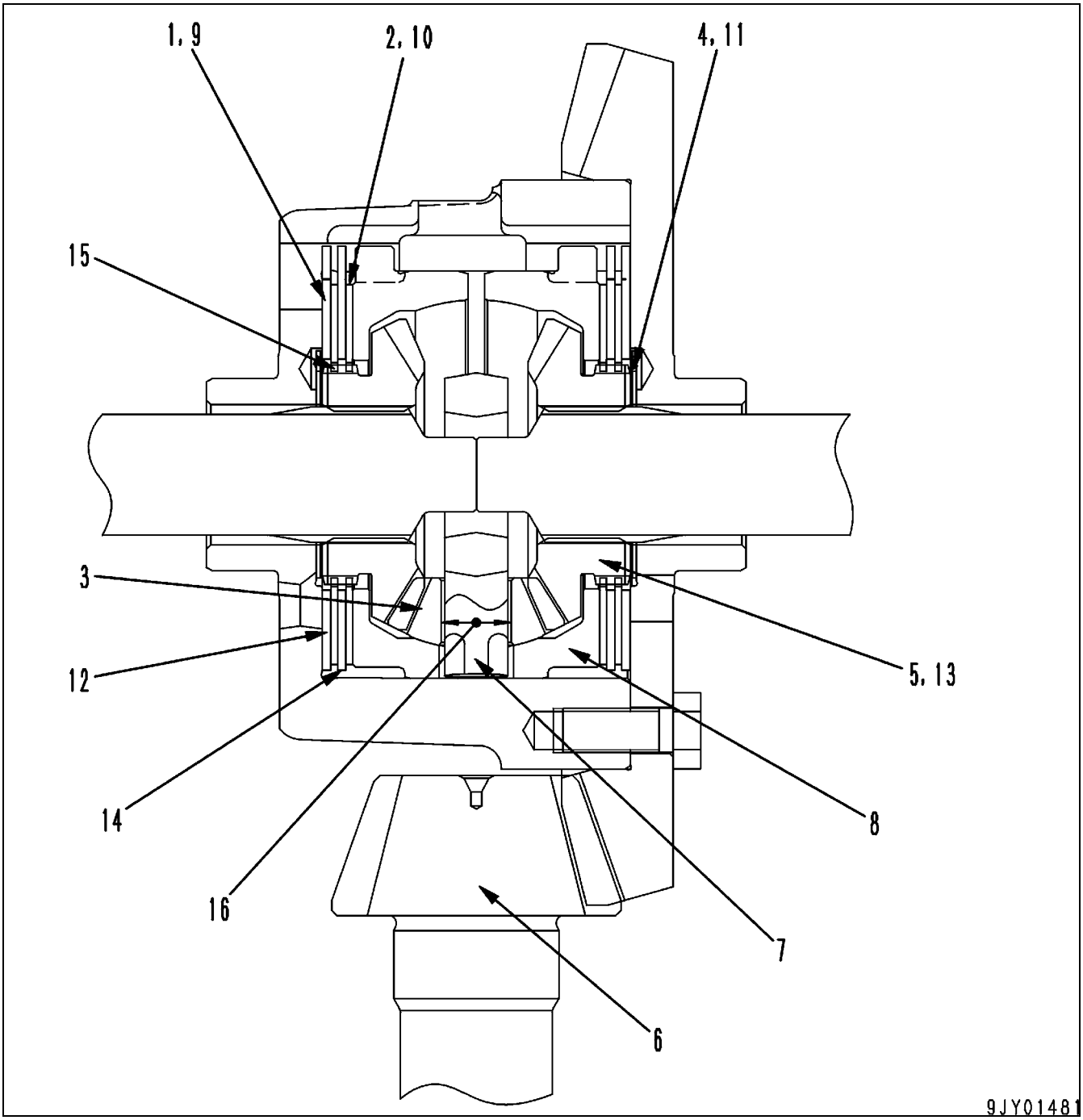
P: From HST charge pump A: To transfer clutch T: To drain port

1. Clutch solenoid valve
2. Plunger
3. Coil
4. Push pin
5. Spring
6. Spool
7. Body

Operation

- When the current of the input signal is large, the hydraulic oil of the transfer clutch is drained.
- As the current of the input signal is reduced, the hydraulic pressure of the transfer clutch is raised.
- After the current of the input signal is reduced until the hydraulic pressure of the transfer clutch reaches the hydraulic pressure sent from the HST charge pump, the hydraulic pressure of the transfer clutch is kept at the hydraulic pressure sent from the HST charge pump even if the current of the input signal is reduced further.

REAR



1. Plate
2. Disc
3. Pinion (Number of teeth:12)
4. Washer
5. Side gear (Number of teeth:24)
6. Bevel pinion
7. Shaft
8. Pressure ring

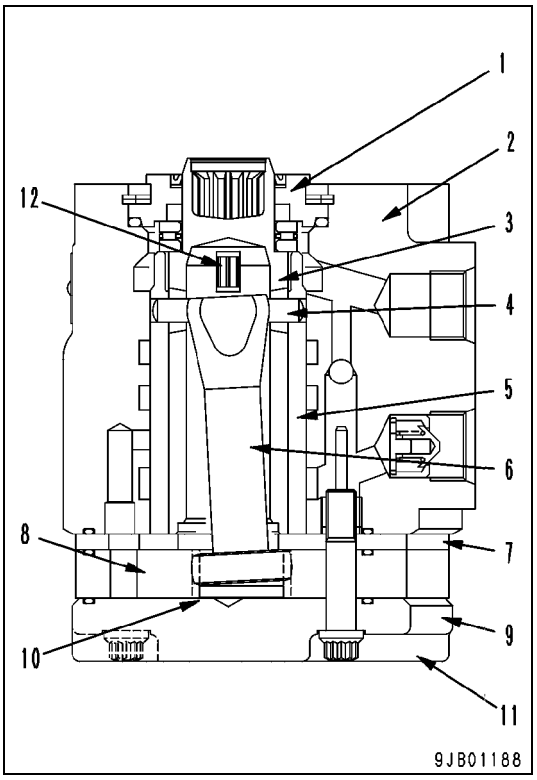
1. Front axle
2. Tension bolt
3. Front frame
4. Center hinge pin
5. Rear axle
6. Rear frame
7. Additional counterweight
8. Counterweight

Outline

- Since front axle (1) receives forces directly during work, it is fixed to front frame (3) directly with tension bolts (2).
- Rear axle (5) rocks at the center of rear frame (6) so that each tire will keep in contact with ground even when the machine travels on soft ground.
- Front frame (3) and rear frame (6) are connected by center hinge pin (4) with the bearing between them. The steering cylinders on both sides connect front frame (3) and rear frame (6) and move to adjust the bending angle, or the turning radius.

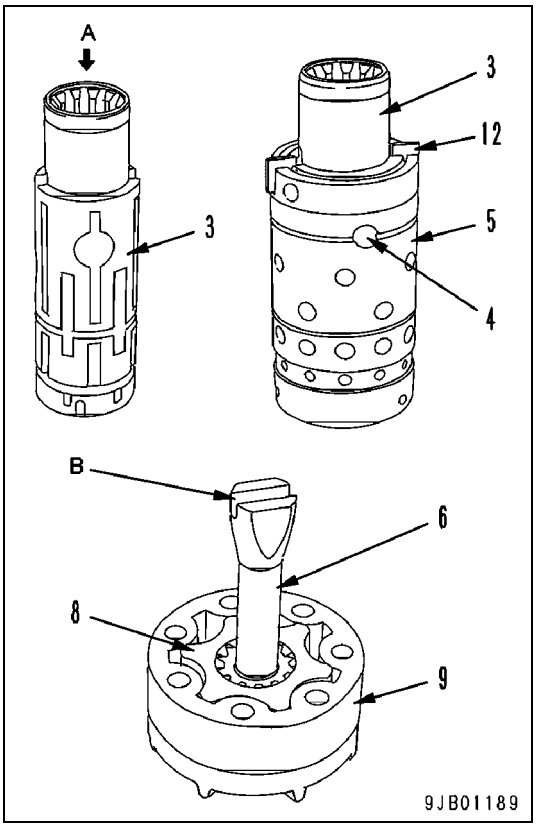
Outline

- The orbit-roll valve is connected directly to the shaft of the steering wheel. It switches the flow of oil from the steering pump to the left and right steering cylinders to determine the direction of travel of the machine.
- The orbit-roll valve, broadly speaking, consists of the following components: rotary type spool (3) and sleeve (5), which have the function of selecting the direction, and the gerotor set (a combination of rotor (8) and stator (9)), which acts as a hydraulic motor during normal steering operations, and as a hand pump (in fact, the operating force of the steering wheel is too high, so it cannot be operated) when the steering pump or engine have failed and the supply of oil has stopped.



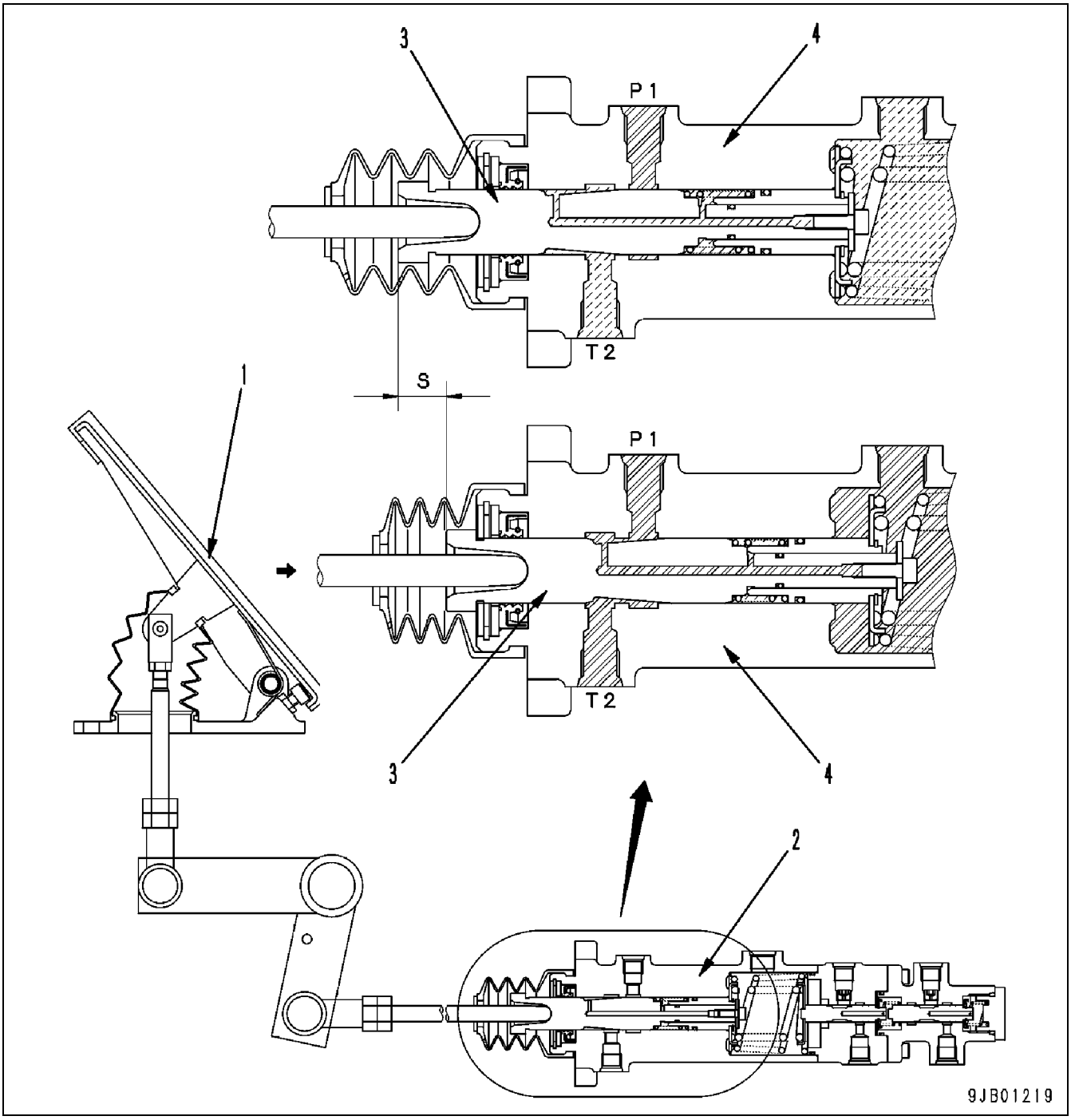
Structure

- Top (A) of spool (3) is connected to the drive shaft of the steering column and further connected to sleeve (5) through center pin (4) (which is not in contact with the spool while the steering wheel is in neutral) and centering spring (12).
- Top (B) of drive shaft (6) is engaged with center pin (4) and combined with sleeve (5) in one body, and the bottom is engaged with the spline of rotor (8) of the gerotor set.
- Valve body (2) has 5 ports, which are connected to the pump circuit, tank circuit, left steering circuit, right steering circuit, and LS circuit respectively. The ports on the pump side and tank side are connected by the check valve in the body. If the pump or engine fails, the oil can be sucked through this check valve directly from the tank side.



MEMORANDUM

INCHING VALVE



P1: From port Y of HST pump T2: To steering pump (Suction side)

1. Brake pedal 2. Brake valve 3. Spool 4. Body

Outline

- The inching valve is built in brake valve (2). It reduces the control oil pressure of the HST circuit to reduce the capacity of the HST pump according to stroke (S) of spool (3).

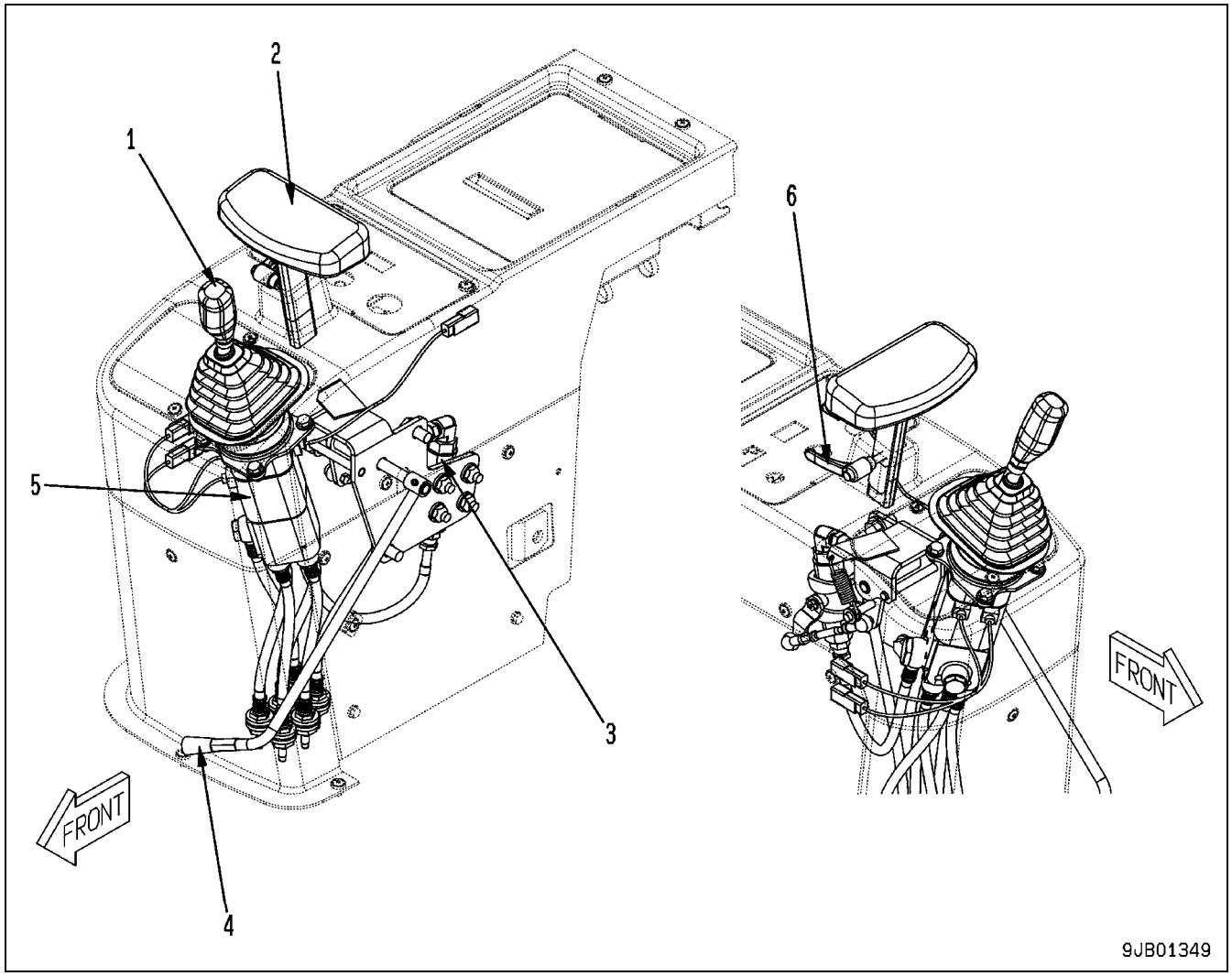
Unit: mm (in)

No.	Check item	Criteria			Remedy
10	Thickness of inner ring	Standard size	Tolerance	Repair limit	Replace
		6 (0.236)	± 0.1 (0.0039)	5.5 (0.2165)	
11	Thickness of brake disc	6.5 (0.256)	± 0.15 (0.0059)	5.7 (0.2244)	
	Depth of lining groove	0.8 (0.0314) Min.	—	0.4 (0.0157)	
	Thickness of lining	1.0 (0.0393)	0.8 (0.0314) Min.	—	
12	Wear of brake outer ring disc contact surface	Standard size	Tolerance	Wear limit	
		19.0 (0.7480)	± 0.1 (0.0039)	0.3 (0.0118)	
13	Spring load	Standard size		Repair limit	
		Installed height	Installed load	Installed load	
		6.5 (0.2559)	230 kg (570 lb)	184 kg (406lb)	

Outline

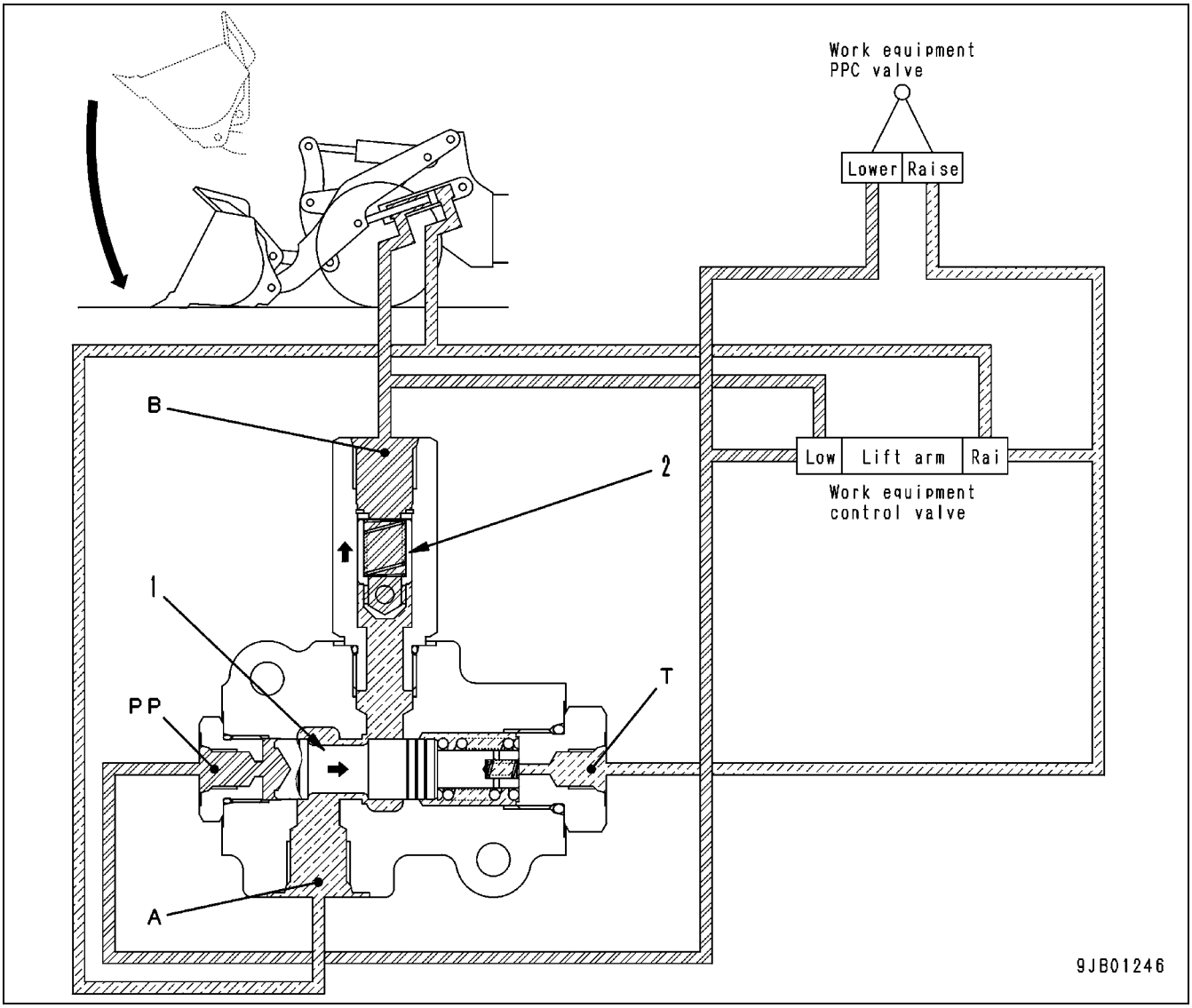
- The front brake has a wet-type multiple-disc structure, and consists of piston (3), inner ring (5), discs (9), outer ring (8), and spring (4).
- The brake cylinder consists of differential housing (1) and bearing carrier (2), and piston (3) is assembled in it.
  Inner ring (5) and outer ring (8) are joined to the spline portion of differential housing (1).
- Discs (9) have a lining stuck to both sides. They are assembled between inner ring (5) and outer ring (8), and are joined by the spline of sun gear shaft (6).

JOYSTICK TYPE (IF EQUIPPED)



1. Work equipment control lever
2. Wrist rest
3. Safety lock lever
4. Work equipment PPC valve
5. Wrist rest height adjustment lever

WHEN LIFT ARM IS "LOWERED"



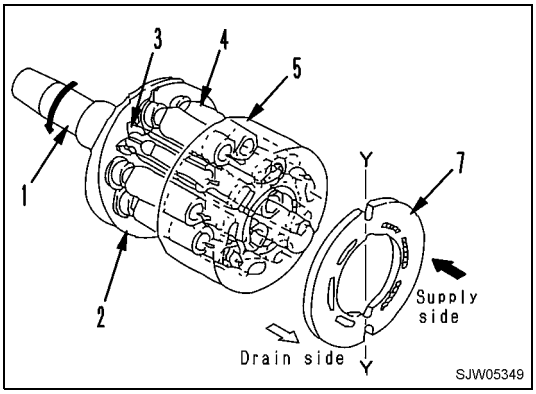
- If the lift arm is "LOWERED", the oil of the work equipment PPC valve operates the work equipment control valve and the oil from the work equipment pump flows to the lift cylinder head side.
- At this time, the oil of the work equipment PPC valve flows to port **PP** to push spool (1) to the right and opens ports **A** and **B**.
- When the lift arm is lowered, a part of the oil on the lift cylinder bottom side flows through the work equipment control valve into the hydraulic tank. A pressure higher than the pressure on the cylinder head side is generated on the cylinder bottom side by the weight of the work equipment, however.
- The hydraulic pressure generated on the lift cylinder bottom side pushes up and opens check valve plunger (2) and flows through port **B** to the cylinder head side, thus the lift arm lowers smoothly.

Specifications

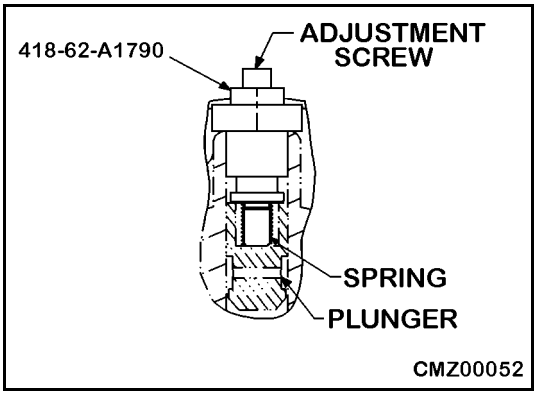
Model	MSF-12-10
Type	Fixed displacement swash plate-type piston motor
Theoretical capacity	9.9 (cc/rev)
Rated speed	1,450 rpm
Rated capacity	14.4 liters/min (4 gal/min)

Function

- This hydraulic motor is a swash plate-type axial piston motor, which converts the pressure of the hydraulic oil sent from the hydraulic pump into revolution.

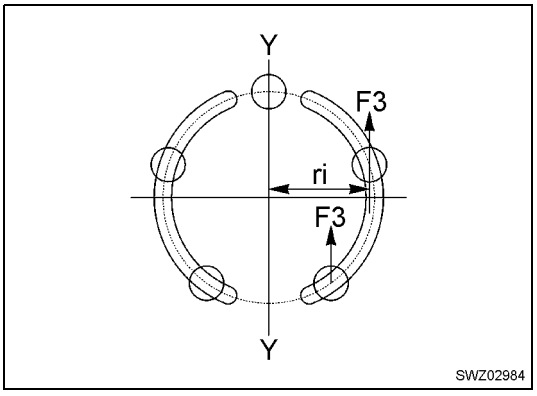


- If equipped with the Fan Reversing Option, plug 418-62-A1790 is installed to provide reverse direction capability for the hydraulic motor. Adjust the screw so the plug seats with the plunger.



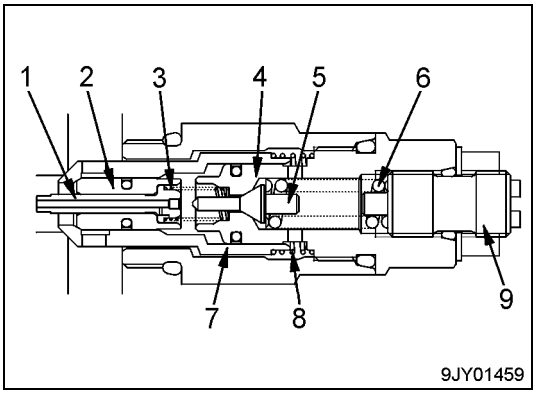
Principle of operation

- The oil sent from the hydraulic port flows through valve plate (7) into cylinder block (5).
- This oil can flow on only one side of the Y-Y line connecting the top dead center and bottom dead center of the stroke of piston (4).
- The oil sent to one side of cylinder block (5) pressed pistons (4) (2 or 3 pieces) and generates force F1 (F1 kg=P kg/cm^2 x x/4 D2 cm^2).
- This force is applied to thrust plate (2). Since thrust plate (2) is fixed to the angle of Eo degrees to the output shaft (1), the force is divided into components F2 and F3.



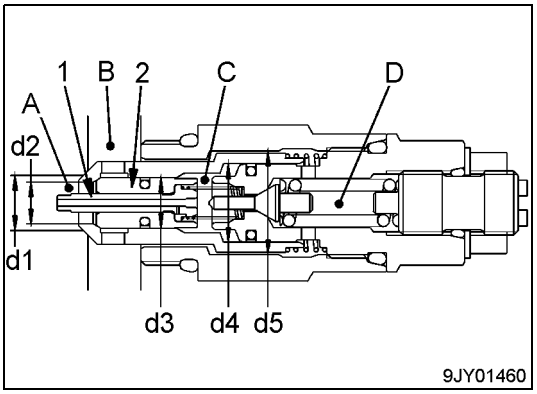
SAFETY SUCTION VALVE

1. Piston
2. Main valve
3. Piston spring
4. Valve seat
5. Poppet
6. Poppet spring
7. Suction valve
8. Suction valve spring
9. Adjustment screw



Function

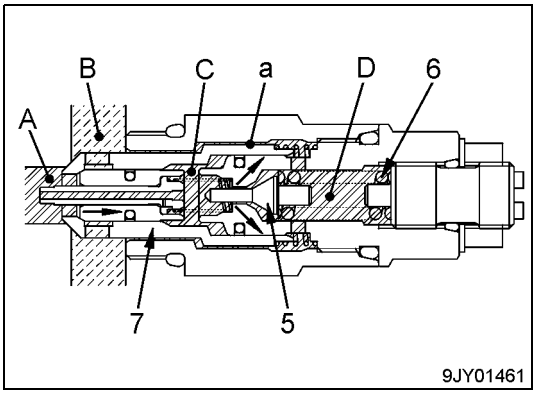
- The safety-suction valve is in the bucket cylinder circuit in the work equipment valve. When the work equipment valve is in neutral, if any impact is applied to the cylinder and abnormal pressure is generated, that pressure is released through this valve to protect the cylinder.
- If negative pressure is generated in the cylinder circuit, this valve works as a suction valve.



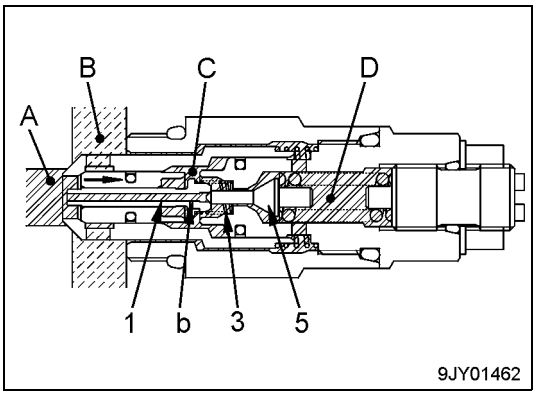
Operation

1. Operation as safety valve

- Ports **A** and **B** are connected to the cylinder circuit and drain circuit respectively.
- The hydraulic oil in port **A** flows through the hole of piston (1) to port **C**. Since **d2** < **d3**, main valve (2) is seated on the left side.
- The order of the diameters (areas) of the sections is **d5** > **d4** > **d1** > **d3** > **d2**.



- If abnormal pressure generated in port **A** reaches the set pressure of spring (6), poppet (5) opens and the hydraulic oil in port **C** is drained through port **D** and periphery **a** of suction valve (7).
- If poppet (5) opens, the pressure in port **C** lowers and piston (1) moves to the right. Piston (1) comes in contact with the tip of poppet (5) and the hydraulic oil is drained through throttle **b** and port **D**.

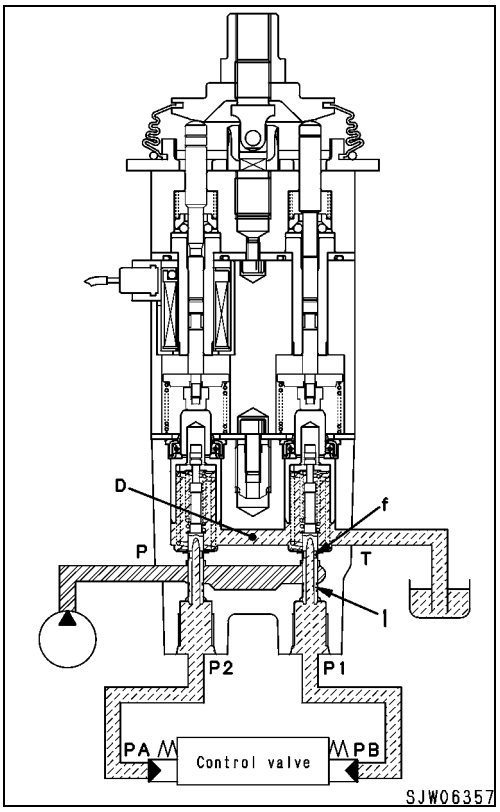


OPERATION

WHEN IN NEUTRAL

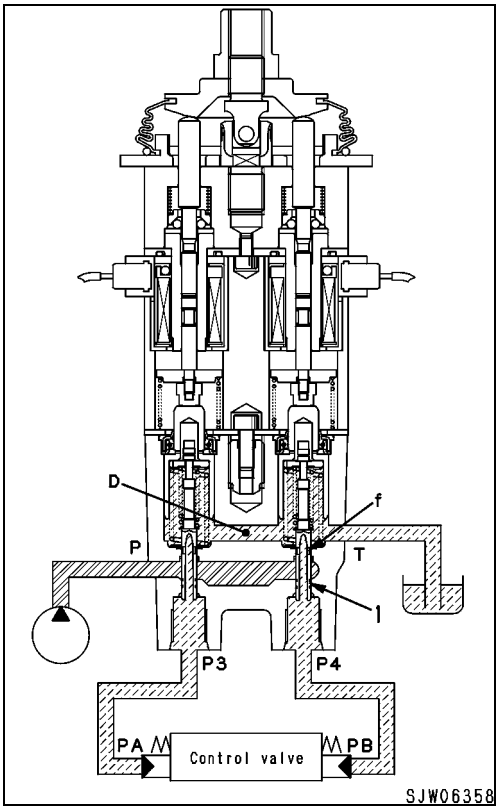
1. PPC valve for bucket

- Ports **PA** and **PB** of the bucket control valve and ports **P1** and **P2** of the PPC valve are connected through fine control hole **f** of spool (1) to the drain chamber **D**.



2. PPC valve for lift arm

- Ports **PA** and **PB** of the lift arm control valve and ports **P3** and **P4** of the PPC valve are connected through fine control hole **f** of spool (1) to the drain chamber **D**.



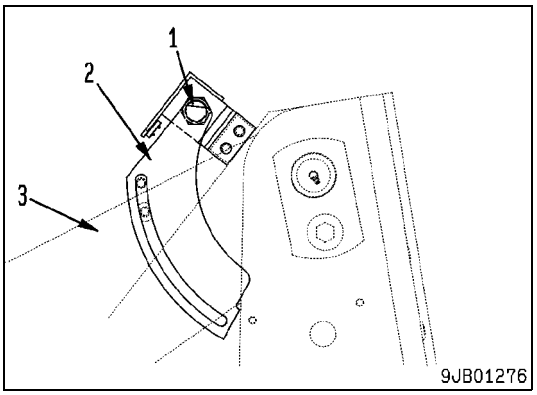
Unit: mm (in)

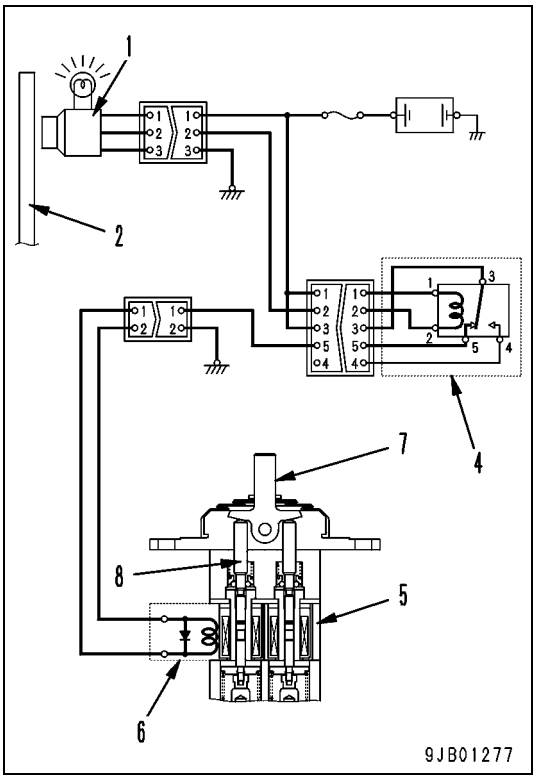
No.	Check item	Criteria					Remedy
9	Clearance between bushing and pin at each end of bucket link	Standard size	Tolerance		Standard clearance	Clearance limit	Replace (Replace if pin has scuff mark)
			Shaft	Hole			
		ø 75 (2.95)	-0.030 (0.0011) -0.076 (0.0029)	+0.174 (0.0068) +0.100 (0.0039)	0.130 – 0.250 (0.0051-0.0098)	1.0 (0.039)	
10	Clearance between bushing and pin of joint of lift arm and quick coupler	ø 75 (2.95)	-0.030 (0.0011) -0.076 (0.0029)	+0.231 (0.0090) +0.181 (0.0071)	0.211 – 0.307 (0.0083-0.0120)	1.0 (0.039)	
11	Clearance between bushing and pin of joint of lift arm and frame	ø 75 92.95)	-0.030 (0.0011) -0.076 (0.0029)	+0.231 (0.0090) +0.181 (0.0071)	0.211 – 0.307 (0.0083-0.0120)	1.0 (0.039)	
12	Clearance between bushing and pin of joint of bucket cylinder bottom and frame	ø 110 (4.33)	-0.036 (0.0014) -0.090 (0.0035)	+0.207 (0.0081) +0.120 (0.0041)	0.156 – 0.297 (0.0061-0.0116)	1.0 (0.039)	
13	Clearance between bushing and pin of joint of bucket cylinder rod and tilt lever	ø 110 (4.33)	-0.036 (0.0014) -0.090 (0.0035)	+0.207 (0.0081) +0.120 (0.0041)	0.156 – 0.297 (0.0061-0.0116)	1.0 (0.039)	
14	Clearance between bushing and pin of joint of tilt lever and lift arm	ø 65 (2.55)	-0.036 (0.0014) -0.090 (0.0035)	+0.174 (0.0068) +0.100 (0.0039)	0.130 – 0.250 (0.0051-0.0098)	1.0 (0.039)	
15	Clearance between bushing and pin of joint of lift cylinder rod and lift arm	ø 75 (2.95)	-0.030 (0.0011) -0.076 (0.0029)	+0.231 (0.0090) +0.181 (0.0071)	0.211 – 0.307 (0.0083-0.0120)	1.0 (0.039)	
16	Clearance between bushing and pin of joint of lift cylinder bottom and frame	ø 70 (2.75)	-0.030 (0.0011) -0.076 (0.0029)	+0.174 (0.0068) +0.100 (0.0039)	0.130 – 0.250 (0.0051-0.0098)	1.0 (0.039)	
17	Joint of bucket cylinder and frame	Width of boss		Width of hinge		Standard clearance	Replace (Insert shims on both sides so that clearance will be 1.5 mm (0.059) or less on each side)
		Standard size	Tolerance	Standard size	Tolerance		
		110 (4.33)	-0.5 (0.0196)	114 (4.418)	± 1.5 (0.06)	2.5 – 6.0 (0.10-0.24)	
18	Joint of lift arm and frame	108 (4.25)	—	116 (4.56)	± 1.5 (0.06)	6.5 – 9.5 (0.41-0.37)	
19	Joint of lift arm and quick coupler	86 (3.38)	—	88 (3.46)	+1.5 (0.06)	2.0 – 3.5 (0.08-0.14)	
20	Joint of bucket link and quick coupler	109 (4.29)	± 1.0 (0.0393)	112 (4.31)	± 1.5 (0.06)	0.5 – 5.5 (0.02-0.22)	
21	Joint of lift cylinder and frame	94 (3.70)	-0.5 (0.0196)	98 (3.85)	± 1.5 (0.06)	2.5 – 6.0 (0.10-0.24)	
22	Joint of tilt lever and bucket link	109 (4.29)	± 1.0 (0.0393)	112 (4.40)	± 1.5 (0.06)	0.5 – 5.5 (0.02-0.22)	Replace
23	Joint of tilt lever and lift arm	109 (4.29)	—	112 (4.40)	± 1.5 (0.06)	1.5 – 4.5 (0.06-0.01)	Adjust clearance on each side to 1.5 mm (0.059) or less
24	Joint of bucket cylinder and tilt lever	110 (4.33)	-0.5 (0.0196)	112 (4.40)	± 1.5 (0.06)	0.5 – 4.0 (0.02-0.02)	Replace
25	Joint of lift arm and lift cylinder	86 (3.38)	—	88 (3.46)	± 1.5 (0.06)	0.5 – 3.5 (0.02-0.13)	Adjust clearance on each side to 1.5 mm (0.059) or less

When lift arm is raised

- While the lift arm (3) is lower than the set position of the boom kick-out, plate (2) is over the sensing face of proximity switch (1), and its lamp lights up.

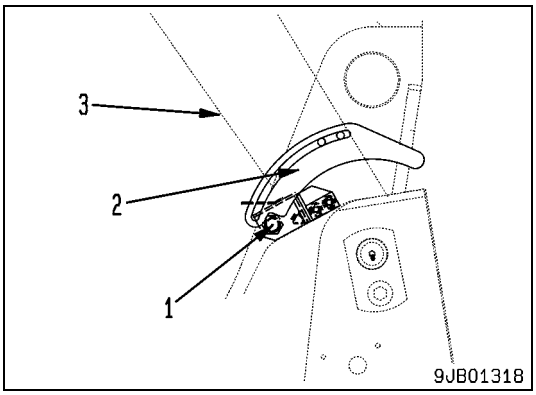
  At this time, boom kick-out relay (4) is turned on and a current flows in detent solenoid (6) of work equipment PPC valve (5) to magnetize the coil.





- If the lift arm (3) rises and parts from the set position of the kick-out, or if plate (2) parts from over the sensing face of proximity switch (1), the lamp of proximity switch (1) goes off and boom kick-out relay (4) is turned off. Accordingly, the circuit of detent solenoid (6) of work equipment PPC valve (5) is turned off to demagnetize the coil.

  Lift arm raise spool (8) held at the RAISE position receives the reaction force of spring (9) and returns work equipment (lift arm) control lever (7) to the HOLD position.



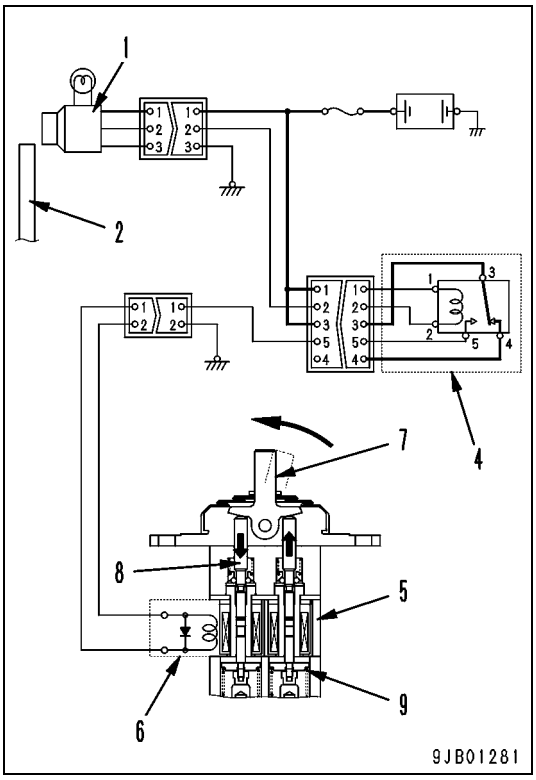
Function of Proximity Switch

When object of sensing is over sensing face of proximity switch

Lamp of proximity switch	ON
Boom kick-out relay switch circuit	Made
Work equipment PPC valve detent solenoid circuit	Made
Work equipment PPC valve detent solenoid	Magnetized

When object of sensing is apart from over sensing face of proximity switch

Lamp of proximity switch	OFF
Boom kick-out relay switch circuit	Broken
Work equipment PPC valve detent solenoid circuit	Broken
Work equipment PPC valve detent solenoid	Demagnetized



MEMORANDUM

LIST OF ITEMS DISPLAYED ON MONITOR

Condition for judging running of engine: When running judgment A or B is satisfied, it is judged that the engine is running. Input is given to alternator terminal R (24 V). Engine oil pressure is normal (Open). Signal of terminal C has been input at least once after IGN_BR, and then it has been turned OFF at least once.

Judgment of operation:

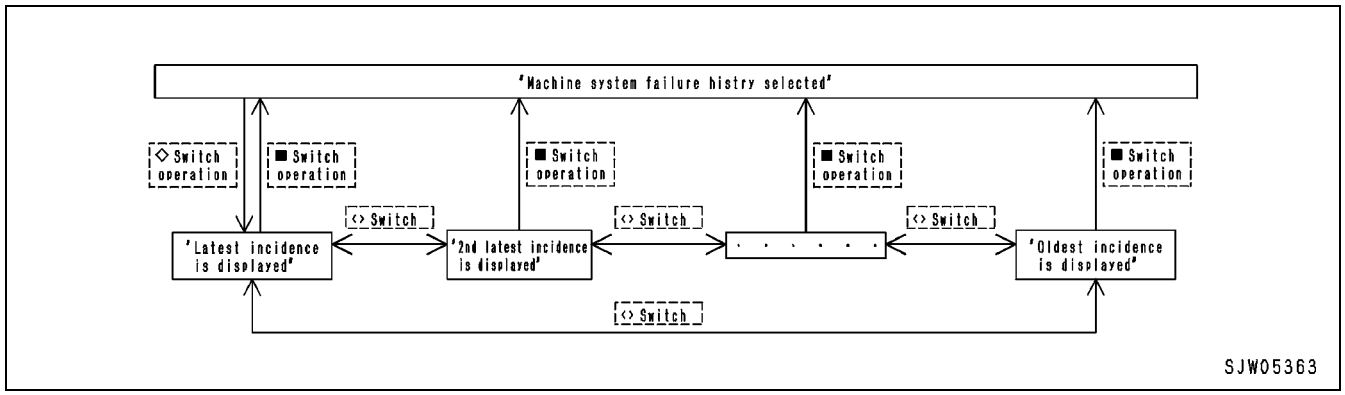
A. After 1 and 2 are established simultaneously, it is judged that the engine is running until IGN_BR is turned OFF.

B. If 1 and 3 are established simultaneously or 2 and 3 are established simultaneously, it is judged that the engine is running. If both signals of 1 and 2 are lost, however, it is judged that the engine is stopped even if IGN_BR is turned ON.

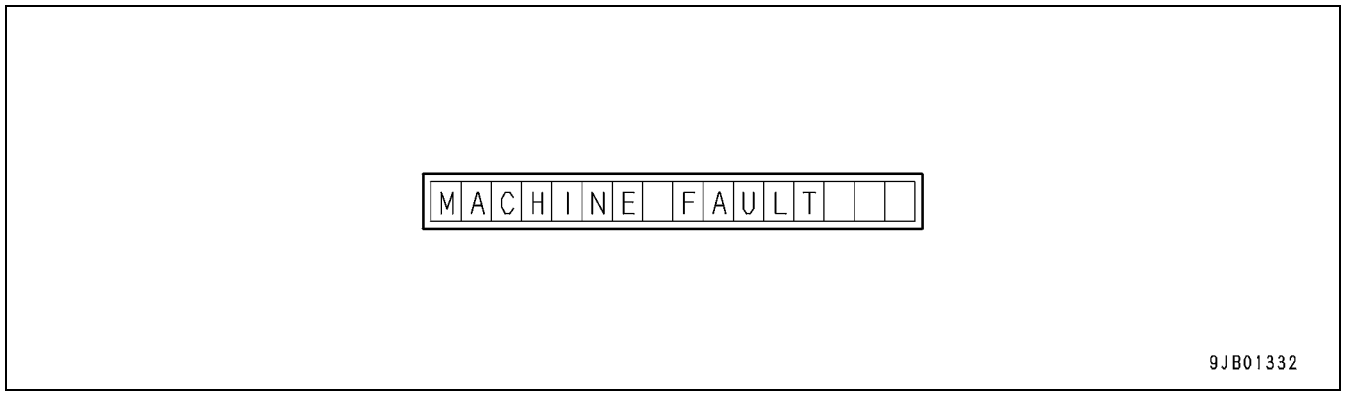
Lamp	Period of lamp	Buzzer	Condition for operation	Period of buzzer	Priority
○: ON	–	◎ : ON and OFF continuously	Warning for dangerous condition (When error indication or caution is turned on)	Period: 1,600 msec ON: 800 msec OFF: 800 msec (DUTY 50%)	1
◎ : Flash	Period: 1,600 msec ON: 800 msec OFF: 800 msec (DUTY 50%)	☆: Intermittent	Caution for wrong operation, etc. (When abnormal operation is performed)	Period: 240 msec ON 1: 80 msec OFF: 160 msec	2
☆: Intermittent	Period: 240 msec ON 1: 80 msec OFF: 160 msec	△: Cancellation sound	Cancellation of calibration, etc. (When operation is not accepted)	ON: 1,000 msec (Once)	3
△: Condition is set separately	–	▲: Completion sound	Completion of calibration, etc. (When completed normally)	ON: 1,000 msec. OFF: 160 msec. ON: 1,000 msec (Once)	4

ITEMS RELATED TO THE FAULT HISTORY OF MACHINE SYSTEM

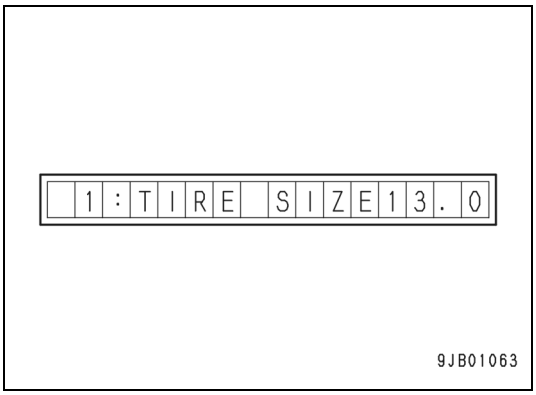
1. Display of the fault history of machine system
   A current fault is displayed prior to the restored ones. Pressing the > SW displays the next older fault. Pressing the < SW displays the next newer fault. After the oldest fault in memory was displayed, a screen is displayed allowing to select clearing the entire fault history of electric system of the relevant controller. Pressing the ■SW changes the screen to the [Select displaying abnormalities in machine system] screen on the first layer.



2. Selection of displaying the fault history of machine system (first layer)
   Pressing the > SW changes the screen to the [Select the real-time monitor functions] screen. Pressing the < SW changes the screen to the [Select displaying the fault history of machine system] screen. Pressing the ■SW changes the screen to the ordinary or alert screen. Pressing the ◇SW changes the screen to the [Display abnormalities in electric system] screen.



5. Selection of tire size (fourth layer)
   Pressing the > SW or < SW selects a tire size.
   (13.0/15.5/16.9/17.5/18.4/20.5)
   If you press the ■SW to finish selection, the operation acceptance peeps (on for 0.1 sec. ➔ off for 0.1 sec. ➔ on for 0.1 sec.) are heard and the screen changes to the [Model selection item] screen.
   ★ Since "250" was selected on the "Select model" screen, "17.5" or "20.5" can be selected. (Other tire sizes are not displayed.)



Operation

When Travel Direction Is Changed With Forward-reverse Lever

- Since forward-reverse selector switch drive switch (3) is OFF, the contacts of multi-relay 4 (7) are closed and the current to forward-reverse selector switch (2) and multi-relay 3 (6) is cut out.
- At this time, the F (Forward) signal and R (Reverse) signal of forward-reverse lever (1) flow through the diode to the forward relay or reverse relay.
- The N (Neutral) signal of forward-reverse lever (1) flows through multi-relay 2 (5), multi-relay 6 (9), and multi-relay 5 (8) to the neutral safety relay.

When Forward-reverse Selector Switch Is Selected To Be Used

- While forward-reverse lever (1) and forward-reverse selector switch (2) are in the N (Neutral) position, if forward-reverse selector switch drive switch (3) is turned ON, the contacts of multi-relay (4) (7) are open and the current flows through the ON terminal of forward-reverse selector switch drive switch (3), multi-relay 4 (7), and N terminal of forward-reverse selector switch (2) to the coil of multi-relay 3 (6), and then the contacts are closed.
- Since the current in multi-relay 4 (7) flows through multi-relay 3 (6) to the coil of multi-relay 1 (4) and the contacts are closed, the current to the coil of multi-relay 2 (5) is cut out and the contacts are opened.
- Since the current at N terminal of forward-reverse lever (1) flows through multi-relay 2 (5) to multi-relay 6 (9), the travel direction can be changed with forward-reverse selector switch (2).
- Once the current flows in the coil of multi-relay 3 (6) to close the contacts, it keeps flowing until forward-reverse selector switch drive switch (3) is turned OFF or forward-reverse lever (1) is set in the FORWARD or REVERSE position.
- While forward-reverse lever (1) is in the N (Neutral) position and forward-reverse selector switch (2) is not in the N (Neutral) position, if forward-reverse selector switch drive switch (3) is turned ON, the current does not flow in multi-relay 3 (6) and the travel direction cannot be changed with forward-reverse selector switch (2).

When Travel Direction Is Changed With Forward-reverse Selector Switch

1. When forward-reverse selector switch is in N (Neutral).
   Since the current does not flow in the coils of multi-relay 6 (9) and multi-relay 5 (8), the current at N terminal of forward-reverse lever (1) flows through multi-relay 2 (5), multi-relay 6 (9), and multi-relay 5 (8) to the neutral safety relay.

2. When forward-reverse selector switch is in F (Forward).
   Since the current flows in the coil of multi-relay 6 (9) and the contacts are closed, the current at N terminal of forward-reverse lever (1) flows through multi-relay 2 (5) and multi-relay 6 (9) to the forward relay.

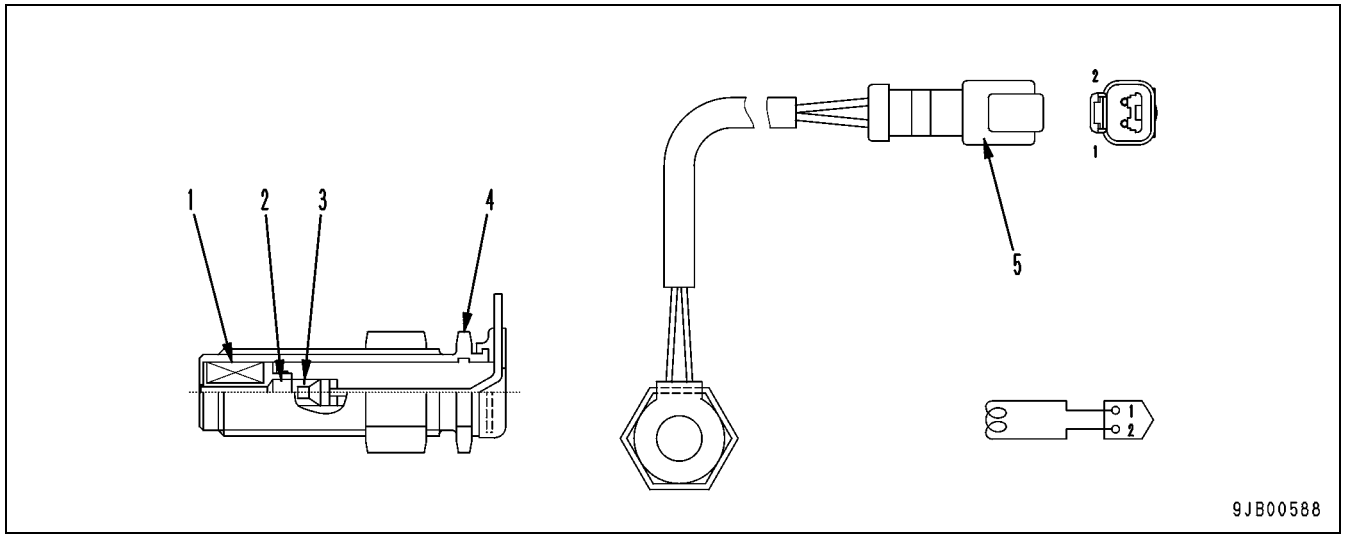
3. When forward-reverse selector switch is in R (Reverse).
   Since the current flows in the coil of multi-relay 5 (8) and the contacts are closed, the current at N terminal of forward-reverse lever (1) flows through multi-relay 2 (5), multi-relay 6 (9), and multi-relay 5 (8) to the reverse relay.

When Forward-reverse Lever Has Priority

- While forward-reverse selector switch (2) is operated, if forward-reverse lever (1) is set in the F (Forward) or R (Reverse) position, the F (Forward) or R (Reverse) signal of forward-reverse lever (1) flows through the diode into the coil of multi-relay 4 (7) and the contacts are closed. Accordingly, the current does not flow into forward-reverse selector switch (2). In this case, the travel direction does not change even if forward-reverse selector switch (2) is operated.
- The F (Forward) or R (Reverse) signal of forward-reverse lever (1) flows through the diode into the forward relay or reverse relay and the travel direction can be changed.
- When forward-reverse lever (1) is returned to the N (Neutral) position, even if forward-reverse selector switch (2) is in the F (Forward) or R (Reverse) position, the travel direction does not change since the coil of multi-relay 3 (6) is not energized. Accordingly, the machine does not start unexpectedly.
- If both forward-reverse lever (1) and forward-reverse selector switch (2) are returned to the N (Neutral) position, the travel direction can be changed again with forward-reverse selector switch (2).

SENSORS

ENGINE SPEED SENSOR

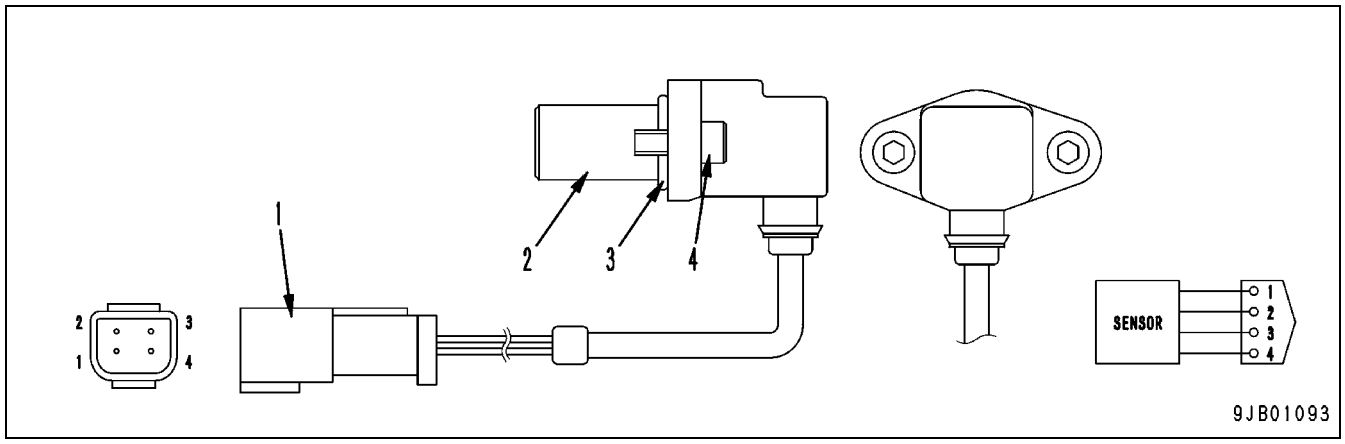


1. Wire
2. Magnet
3. Terminal
4. Housing
5. Connector

Function

- The engine speed sensor is installed to the ring gear of the flywheel housing. As the gear revolves, the engine speed sensor generates a pulse voltage.

TRAVEL SPEED SENSOR



1. Connector
2. Sensor
3. O-ring
4. Bolt

Function

- The speed sensor is installed to the transfer case. As the gear revolves, the speed sensor generates a pulse voltage and a revolving direction signal (Counterclockwise: ON).

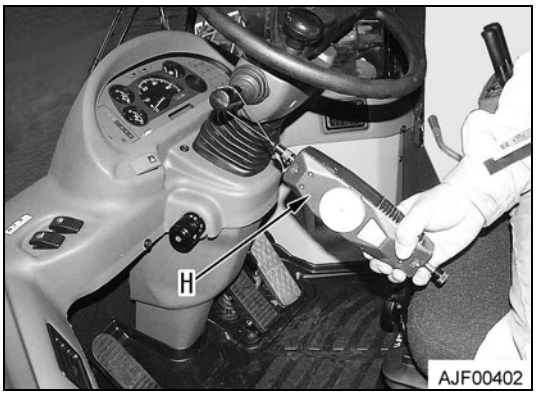
20 TESTING, ADJUSTING AND TROUBLESHOOTING

Check or measurement item	Symbol		Part number	Part Name	Qty.	Remarks
Pump PC control circuit oil pressure	L	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 MPa (25, 60, 400, 600 kg/cm^2)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.88 MPa (600 kg/cm^2)
		2	799-101-5220	Nipple	3	Size: 10 x 1.25 mm
			07002-11023	O-ring	3	
Pump LS control circuit oil pressure	M	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 MPa (25, 60, 400, 600 kg/cm^2)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.88 MPa (600 kg/cm^2)
		2	799-101-5220	Nipple	3	Size: 10 x 1.25 mm
			07002-11023	O-ring	3	
		3	799-401-1340	Differential pressure gauge	1	
Solenoid valve output oil pressure	N	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 MPa (25, 60, 400, 600 kg/cm^2)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.88 MPa (600 kg/cm^2)
		2	799-401-3100	Nipple	1	Size: 02
			02896-11008	O-ring	3	
PPC valve output oil pressure	P		799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 MPa (25, 60, 400, 600 kg/cm^2)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.88 MPa (600 kg/cm^2)
Oil leakage inside hydraulic cylinder	N		Commercially available	Cylinder	1	
Coolant temperature, oil temperature	P		799-101-1502	Digital thermometer	1	-99.9 - 1,299°C (-148 - 2370°F)
Operating effort	Q	1	79A-264-0021	Push-pull scale	1	0 - 294 N (0 - 30 kg)
		2	79A-264-0091	Push-pull scale	1	0 - 490 N (0 - 50 kg)
Stroke, hydraulic drift	R		Commercially available	Scale	1	
Work equipment speed	S		Commercially available	Stopwatch	1	
Voltage, resistance	T		Commercially available	Tester	1	

MEASURING DIRECTIONAL LEVER EFFORT

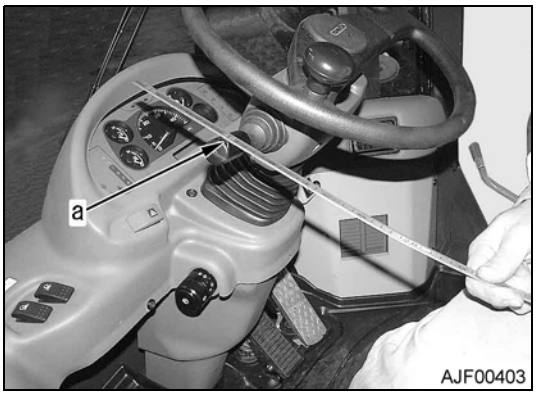
WARNING! Apply the parking brake and put blocks under the tires.

Operating effort of directional lever



1. Stop the engine.
2. Install push-pull scale **H** or a spring balance to a point 10 mm (0.033 in) from the tip of the control lever, then measure the operating effort when the lever is pulled in the direction of actuation.
   ★ Carry out the measurement in each speed range.

Travel of directional lever

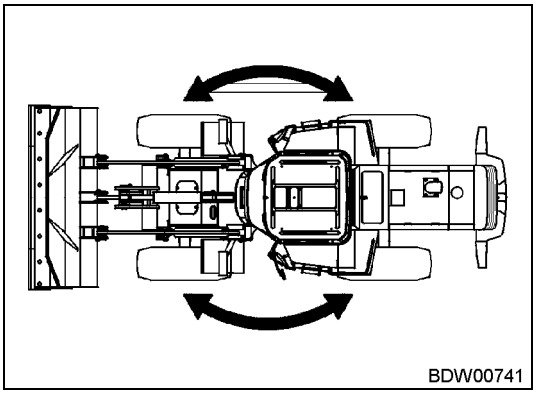


1. Stop the engine.
2. Make mark a on the center of the knob of the control lever, then measure the travel when the lever is operated in the direction of actuation.

BLEEDING AIR FROM STEERING CIRCUIT

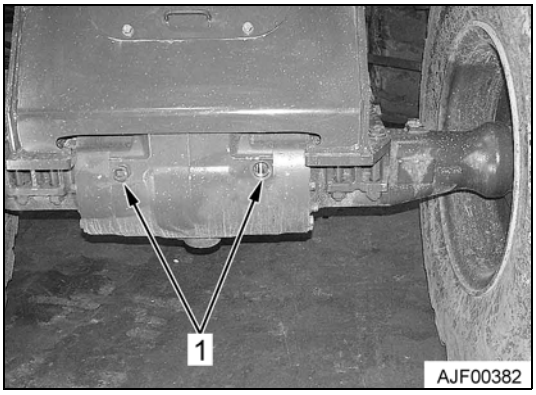
★ Bleed the air from the steering circuit as follows if the steering valve or steering cylinder have been removed and installed again.

1. Start the engine and run at idle for approximately 5 minutes.
2. Run the engine at low idle and turn 4 - 5 times to the left and right.
   ★ Operate the piston rod approximately 100 mm (4 in) before the end of its stroke. Be careful not to relieve the circuit.
3. Repeat step 2 with the engine at full throttle.
4. Run the engine at low idle and operate the piston to the end of its stroke to relieve the circuit.



MEASURING WEAR OF BRAKE DISC

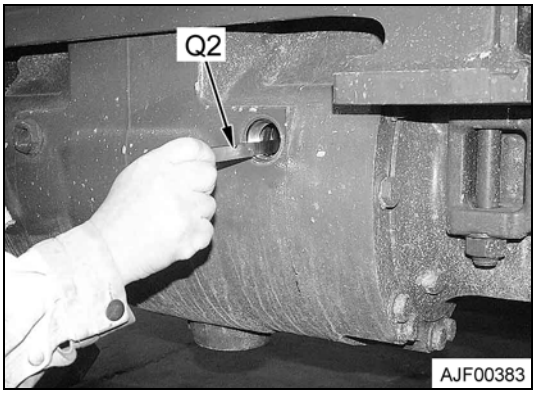
WARNING! Stop the machine on horizontal ground and put blocks under the tires.



1. Loosen drain plug and drain axle oil.

Axle oil: 1.8 liter (2 qt.)

2. Remove measuring plug (1).

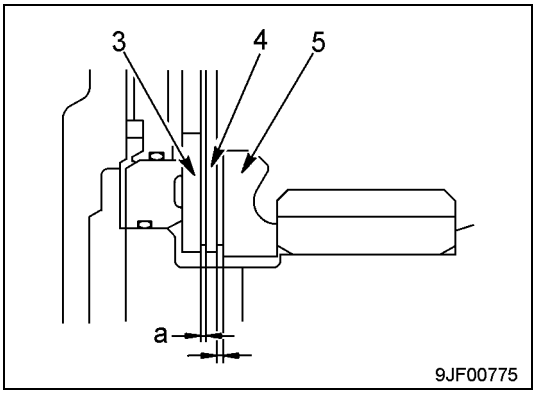


3. Depress the brake pedal lightly to the end of its travel.
   ★ Check that plate (4) and plate (5) are pressed tightly against the disc.

4. Insert tool **F2** between disc (4) and plates (3) and (5), and measure the clearance.

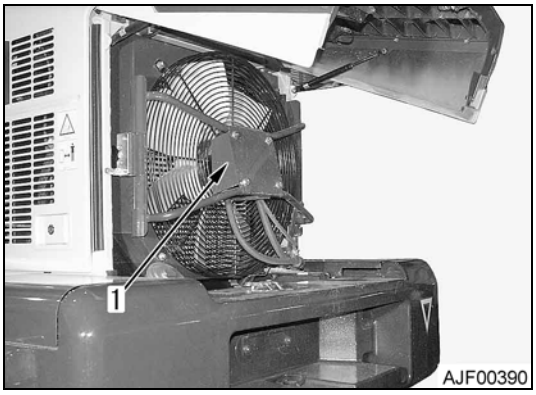
5. Tighten the drain plug and add axle oil through the oil filler to the specified level.

Axle oil: 1.8 liter (2 qt.)



BLEEDING AIR

1. Bleeding air from fan motor circuit

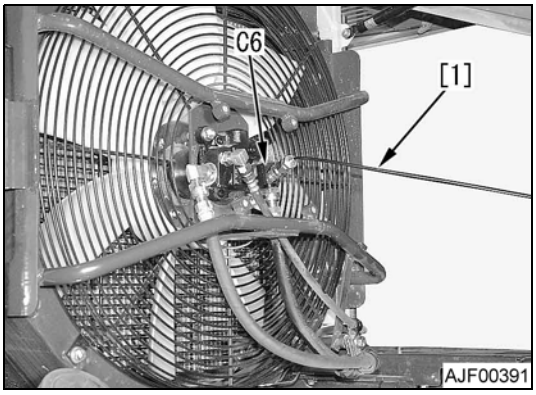


   A. Open the radiator grill, then remove cover (1).

   B. Disconnect hose (2) at the inlet port of the motor, then fit tool **C6** and connect air bleed hose [1].

   C. Start the engine, and when oil comes out from air bleed hose, stop the engine and remove the air bleed hose.

2. Bleeding air from work equipment PPC circuit



   A. Operate each work equipment lever fully and hold it in position to relieve the circuit for approx. 1 minute. Carry out this operation once for each work equipment lever stroke end.

3. Bleeding air from cylinders

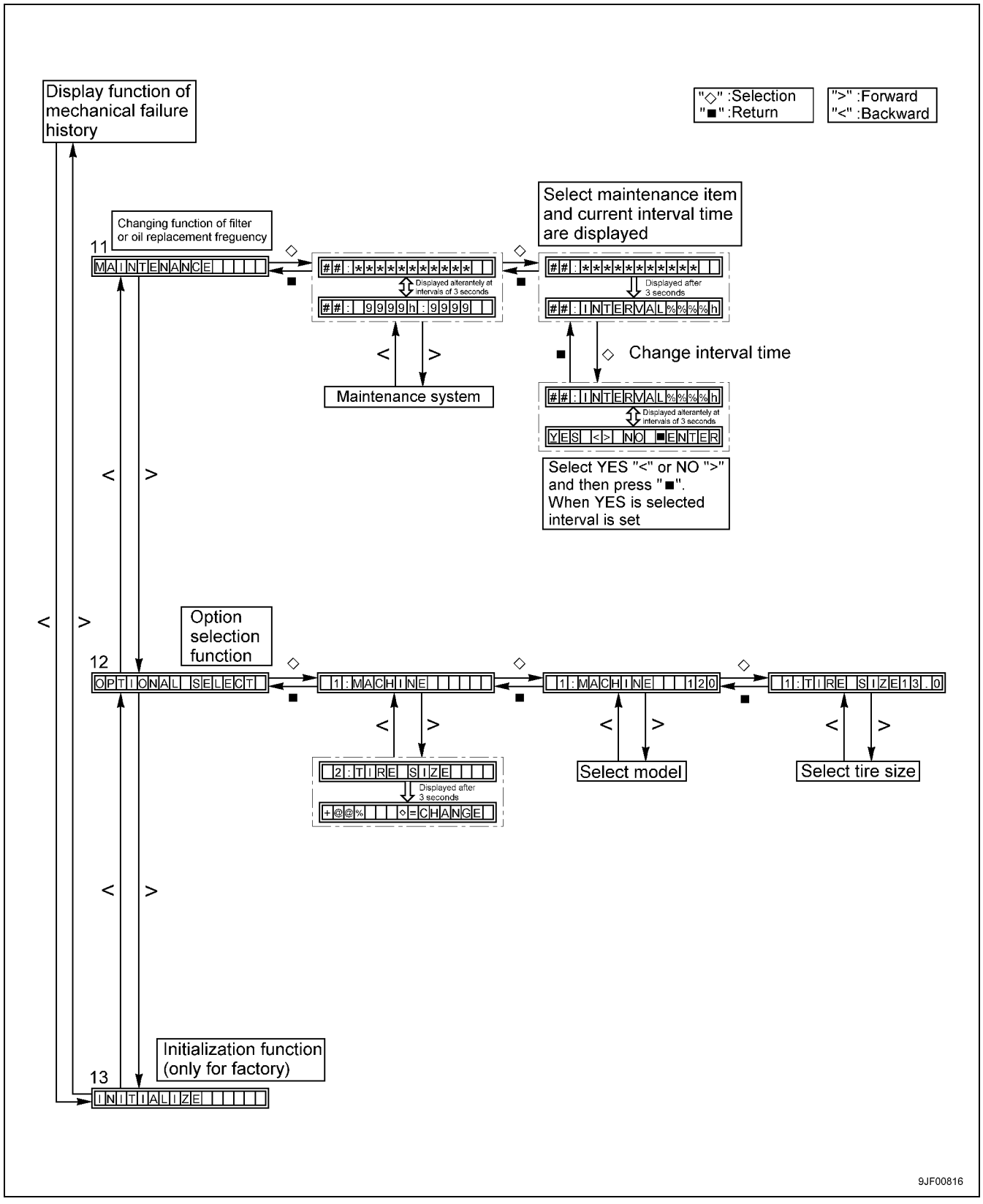
   A. Start the engine and run at idling for approx. 5 minutes.

   B. Run the engine at low idling, then raise and lower the lift arm 4 - 5 times in succession.

   C. Operate the piston rod to a point approx. 100 mm (4 in) before the end of its stroke. Do not relieve the circuit under any circumstances.

   D. Run the engine at full throttle and repeat Step 2). After that, run the engine at low idling, and operate the piston rod to the end of its stroke to relieve the circuit.

   E. Repeat Steps 2) and 3) to bleed the air from the bucket and steering cylinders.
      ★ When the cylinder has been replaced, bleed the air before connecting the piston rod.

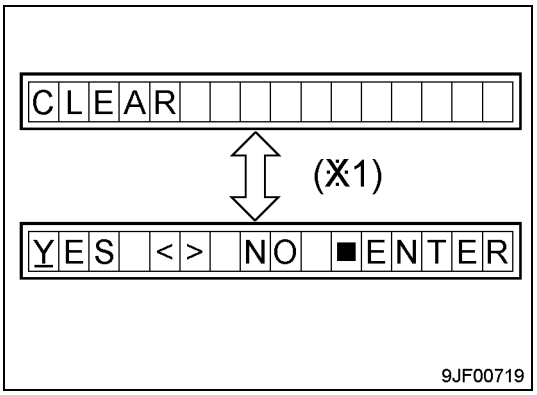

Display function of mechanical failure history
"◇" :Selection
"■" :Return
">" :Forward
"<" :Backward
Changing function of filter or oil replacement freguency
11
MAINTENANCE
Displayed alterantely at intervals of 3 seconds
Maintenance system
Select maintenance item and current interval time are displayed
Displayed after 3 seconds
Change interval time
Select YES "<" or NO ">" and then press "■". When YES is selected interval is set
Option selection function
12
OPTIONAL SELECT
1:MACHINE
Select model
Select tire size
2:TIRE SIZE
Displayed after 3 seconds
Initialization function (only for factory)
13
INITIALIZE
9JF00816

E. Deleting individual trouble data.

i. Display the trouble data to be deleted, then press the [◊] button once to display the individual item CLEAR screen (Fig. 4).
- [◊] button: Display CLEAR screen

ii. Operate the buttons according to the explanation on the screen (Fig. 4).
- [<] button: Select YES
- [>] button: Select NO
- [■] button: Run

★ The data for an existing problem (flashing display) cannot be deleted.



(*1): Displayed alternately at intervals of 3 seconds.

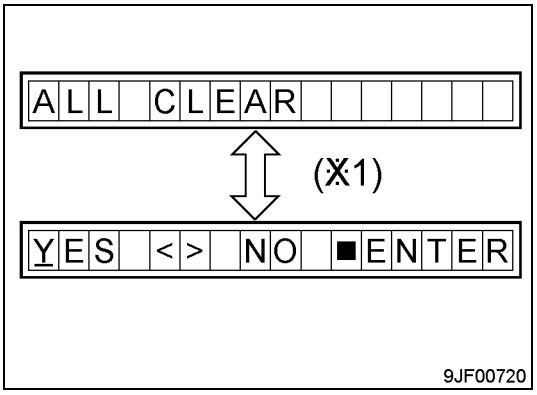
F. Deleting all trouble data

i. Display the trouble data, then press the [>] button or [<] button to display the ALL CLEAR menu (Fig. 5).

ii. Press the [◊] button once to display the ALL CLEAR screen (Fig. 6).
- [◊] button: Run ALL CLEAR menu

iii. Operate the buttons according to the explanation on the screen (Fig. 6).
- [<] button: Select YES
- [>] button: Select NO
- [■] button: Run

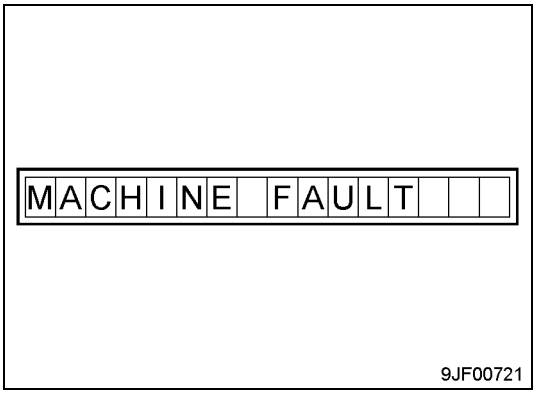
★ The data for an existing problem (flashing display) cannot be deleted.



(*1): Displayed alternately at intervals of 3 seconds.

8. Mechanical system trouble data display function (MACHINE FAULT).
The machine monitor retains the data for problems that occurred in the mechanical system in the past as failure codes. They can be displayed as follows.

A. Menu selection.
Select the display function for MACHINE FAULT trouble data on the menu screen of Service Mode 1.



3. Check before troubleshooting.

   A. Check the oil level.

   B. Check for any external leakage of oil from the piping or hydraulic equipment.

   C. Check the travel of the control levers.

   D. Check the stroke of the control valve spool.

   E. Other maintenance items can be checked externally, so check any item that is considered to be necessary.

4. Confirming the failure.

   A. Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
      ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.

5. Troubleshooting

   A. Use the results of the investigation and inspection in Steps 2 - 4 to narrow down the causes of the failure, then use the troubleshooting flowchart to locate the position of the failure exactly.

   B. The basic procedure for troubleshooting is as follows.

      i. Start from the simple points.

      ii. Start from the most likely points.

      iii. Investigate other related parts or information.

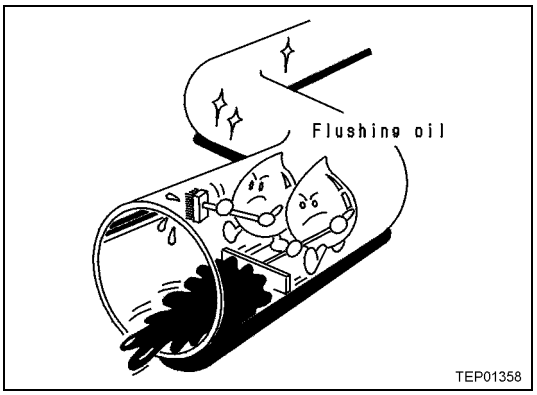
6. Measures to remove root cause of failure.

   A. Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.

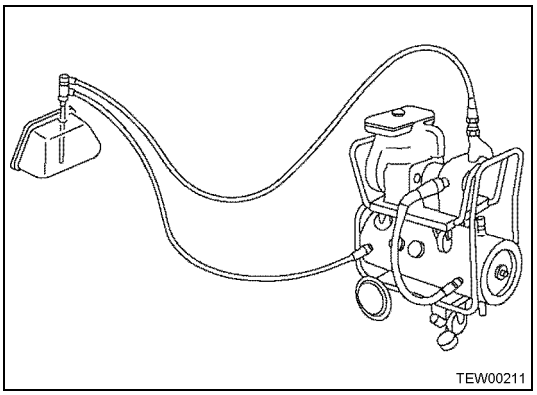
   B. To prevent this, always investigate why the problem occurred. Then, remove the root cause.

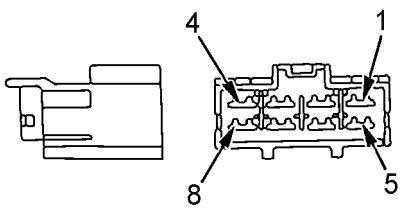
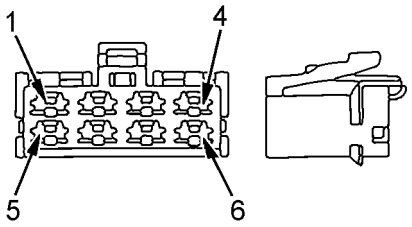
5. Change hydraulic oil when the temperature is high.
   When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Do not drain the oil from the hydraulic tank; but drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

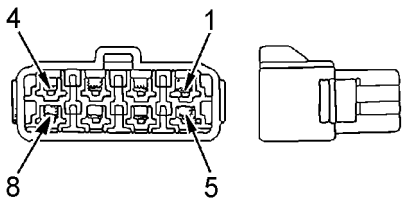
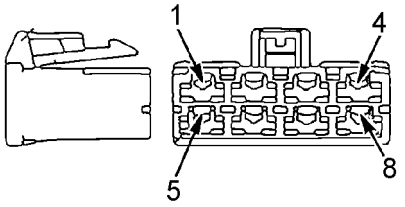
6. Flushing operations.
   After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



7. Cleaning operations.
   After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.The oil cleaning equipment is used to remove the ultra fine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



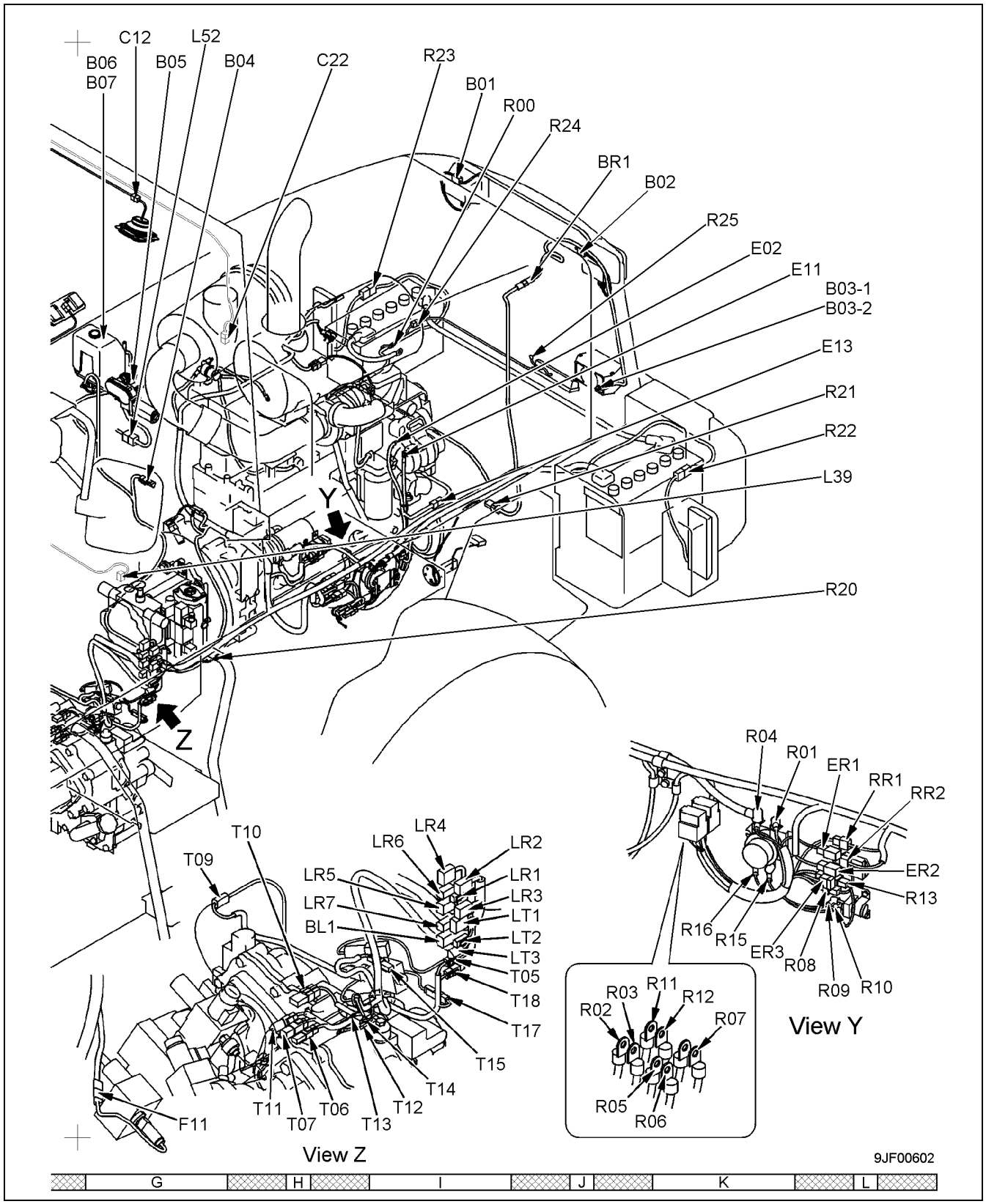
8	 BWP04725	 BWP04726	799-601-7340
	Part number: 08056-00871	Part number: 08056-00881	

Number of Pins	KES1 Automobile Type Connector		
	Male (Female housing)	Female (Male housing)	T-adapter Part Number
8	 BWP04783	 BWP04784	—
	Part number: 08027-10810 (Natural color) 08027-10820 (Black)	Part number: 08027-10860 (Natural color) 08027-10870 (Black)	

T-ADAPTER TABLE

★ The part Nos. of the T-adapter boxes and T-adapters are shown in the columns and those of the wiring harness checker assemblies are shown in the lines.

			KIT No.																	
Port No.	Connector type	Pin No.	799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	—
799-601-2600	For measuring box	Econo-21P	O		O	O						O	O		O					
799-601-3100	For measuring box	MS-37P					O													
799-601-3200	For measuring box	MS-37P					O													
799-601-3300	For measuring box	Econo-24P							O											
799-601-3360	Plate	For MS box																		
799-601-3370	Plate	For MS box																		
799-601-3380	Plate	For MS box																		
799-601-3410	BENDIX(MS)	24P							O	O										
799-601-3420	BENDIX(MS)	24P							O	O										
799-601-3430	BENDIX(MS)	17P							O	O										
799-601-3440	BENDIX(MS)	17P							O	O										
799-601-3450	BENDIX(MS)	5P						O	O											
799-601-3460	BENDIX(MS)	10P							O	O										
799-601-3510	BENDIX(MS)	5P						O	O											
799-601-3520	BENDIX(MS)	14P						O	O											
799-601-3530	BENDIX(MS)	19P							O	O										
799-601-2910	BENDIX(MS)	14P						O	O											
799-601-3470	CASE								O											
799-601-2710	MIC	5P	O	O		O							O							
799-601-2720	MIC	13P	O	O		O							O							
799-601-2730	MIC	17P	O	O	O	O						O	O		O					
799-601-2740	MIC	21P	O	O	O	O						O	O		O					
799-601-2950	MIC	9P									O	O	O		O					
799-601-2750	ECONO	2P	O	O																
799-601-2760	ECONO	3P	O	O																
799-601-2770	ECONO	4P	O	O																
799-601-2780	ECONO	8P	O	O																
799-601-2790	ECONO	12P	O	O																
799-601-2810	DLI	8P	O	O																
799-601-2820	DLI	12P	O	O																
799-601-2830	DLI	16P	O	O																
799-601-2840	Extension cable		O	O									O							
799-601-2850	CASE		O																	
799-601-7010	X	1P											O		O					
799-601-7020	X	2P									O	O	O		O					
799-601-7030	X	3P									O	O	O		O					
799-601-7040	X	4P									O	O	O		O					
799-601-7050	SWP	6P									O	O	O							
799-601-7060	SWP	8P									O	O	O							
799-601-7310	SWP	12P																		O


C12
L52
B06
B07
B05
B04
C22
R23
B01
R00
R24
BR1
B02
R25
E02
E11
B03-1
B03-2
E13
R21
R22
L39
R20
Y
Z
T10
T09
LR4
LR6
LR2
LR5
LR1
LR7
LR3
BL1
LT1
LT2
LT3
T05
T18
T17
T15
T14
T11
T06
T12
T07
T13
F11
View Z
R04
R01
ER1
RR1
RR2
ER2
R13
R16
R15
ER3
R08
R09
R10
R03
R11
R12
R02
R07
R05
R06
View Y
9JF00602
G
H
I
J
K
L

INFORMATION CONTAINED IN TESTING PROCEDURES

★ The testing table and the related circuit diagrams contain the following information. Read all information and each step carefully, if necessary, repeat each step in a test procedure to confirm the fault. The idea behind these procedures is to isolate each part of the circuit.

Contents Of Trouble	• Failure. • Failure code displayed. • Additional information.

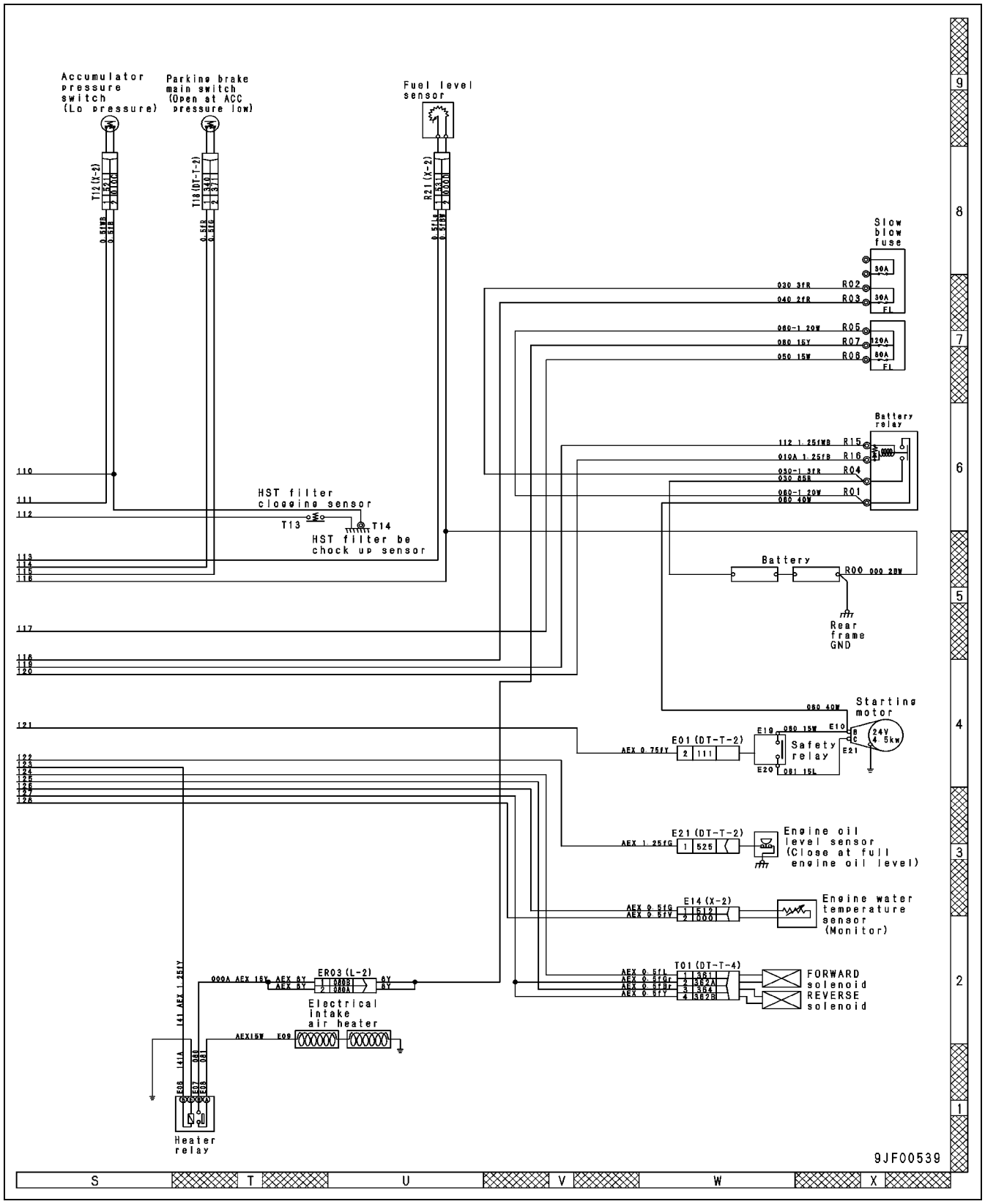
Tools and Procedures	• Digital Volt Ohm Meter. T-adapter kit. • Do not mark on original page of service manual. Remove this page from the service manual and make a copy for recording information while performing these tests. • If you are unable to copy this page, record readings on a separate paper referring to the (**No.**) numbers listed on the right of the procedure. • Follow each step throughout this procedure, do not skip steps, jump ahead or stop when a fault is found unless otherwise instructed to in the procedure. It is important to complete all steps and record information for final analyzing.

Steps	Circuit Diagnostic Procedures For Service Code		Specifications	No.	Readings
1. Sensor or Actuator • With ignition switch in the "OFF" position. (no voltage should be in the system you are testing unless called for indicated with a symbol ✷) • Disconnect components and isolate them for testing. (The importance of these tests are to isolate each component for testing separately) • Zero meter leads for proper Ω readings. (remove resistance from your meter leads before taking reading. See DVOM meter operators manual)					
A. What you are testing	Resistance Ω or Voltage	Test procedure for component only.	readings	**1**	Your information
		Test procedure for component only.	readings	**2**	Your information
2. Diode Test • With ignition switch in the "OFF" position. (The importance of these tests are to isolate each component for testing separately) • When checking a diode always isolate the circuit. Check diode continuity in both directions reversing meter leads each time to confirm electrical flow. Electrical flow should be one way only (See section 20-111 for detail).					
A. Diode test	Resistance Ω	At a diode, between point (x) and (x) reverse meter lead polarity each time to check diode.	Continuity one way only?	**3**	Yes or No
3. Wiring Harness Assembly Test • With ignition switch in the "OFF" position. (no voltage should be in the system you are testing unless called for indicated with a symbol ✷) • Disconnect components and isolate them for testing. (The importance of these tests are to isolate each component for testing separately) • Zero meter leads for proper Ω readings. (remove resistance from your meter leads before taking reading. See DVOM meter operators manual)					
A. Open or high resistance	Resistance Ω or Voltage	Test procedure for harness. (connector) to (connector)	readings	**4**	Your information
		Test procedure for harness. (connector) to (connector)	readings	**5**	Your information
B. Short to chassis ground or within harness	Resistance Ω or Voltage	Test procedure for harness. (connector) to (connector)	readings	**6**	Your information
		Test procedure for harness. (connector) to (connector)	readings	**7**	Your information
4. Additional Components To Be Tested • With ignition switch in the "OFF" position. (no voltage should be in the system you are testing unless called for indicated with a symbol ✷) • Disconnect components and isolate them for testing. (The importance of these tests are to isolate each component for testing separately) • Zero meter leads for proper Ω readings. (remove resistance from your meter leads before taking reading. See DVOM meter operators manual)					
A. What you are testing	Resistance Ω or Voltage	Test procedure for any additional components.	readings	**8**	Your information

MEMORANDUM

		At switch L03, between (1) and (3) in 4th. gear	(OL) open	**17**	
		At switch L03, between (1) and (4) in 4th. gear	(OL) open	**18**	
4. Wiring Harness Assembly Test • With ignition switch in the "OFF" position. • Disconnect (L54), (L103) and (L03) connectors from relays and switches. • Disconnect (L41) and (L42) connectors from controller and install T-adapter on (L41) and (L42) wiring harness connector only. • ✷ Turn ignition switch to the "ON" position for this test.					
A. Open or high resistance	Resistance Ω	Between connectors L03, (1) and L54, (2)	0.0 to 1.0Ω	**19**	
		Between connectors L03, (1) and L41, (1)	0.0 to 1.0Ω	**20**	
		Between connectors L03, (3) and L41, (2)	0.0 to 1.0Ω	**21**	
		Between connectors L03, (3) and L54, (3)	0.0 to 1.0Ω	**22**	
		Between connectors L03, (4) and L103, (2)	0.0 to 1.0Ω	**23**	
		Between connectors L103, (5) and L42 (12)	0.0 to 1.0Ω	**24**	
		Between connectors L54, (1) and L41 (10)	0.0 to 1.0Ω	**25**	
	Voltage	✷ At connector L103, (1) and chassis ground.	20 to 30V	**26**	
		✷ At connector L103, (3) and chassis ground.	20 to 30V	**27**	
B. Short to chassis ground or within harness	Resistance Ω	At connector L54, between (1) and chassis ground.	(OL) open	**28**	
		At connector L54, between (2) and chassis ground.	(OL) open	**29**	
		At connector L54, between (3) and chassis ground.	(OL) open	**30**	
		At connector L54, between (1) and (2)	(OL) open	**31**	
		At connector L54, between (1) and (3)	(OL) open	**32**	
		At connector L54, between (2) and (3)	(OL) open	**33**	
		At connector L03, between (1) and chassis ground.	(OL) open	**34**	
		At connector L03, between (3) and chassis ground.	(OL) open	**35**	
		At connector L03, between (4) and chassis ground.	(OL) open	**36**	
		At connector L03, between (1) and (3)	(OL) open	**37**	
		At connector L03, between (1) and (4)	(OL) open	**38**	
		At connector L03, between (3) and (4)	(OL) open	**39**	
5. HST Controller Test • With ignition switch in the "OFF" position. • Disconnect (L42) connector from HST controller and install T-adapter between (L42) wiring harness connector and controller. • Turn ignition switch to the "ON" position.					
A. Controller	Voltage	Between L42, (12) and chassis ground, in 1st. & 2nd.	20 to 30V	**40**	
		Between L42, (12) and chassis ground, in 2nd. & 3rd.	(OL) open	**41**	

MEMORANDUM

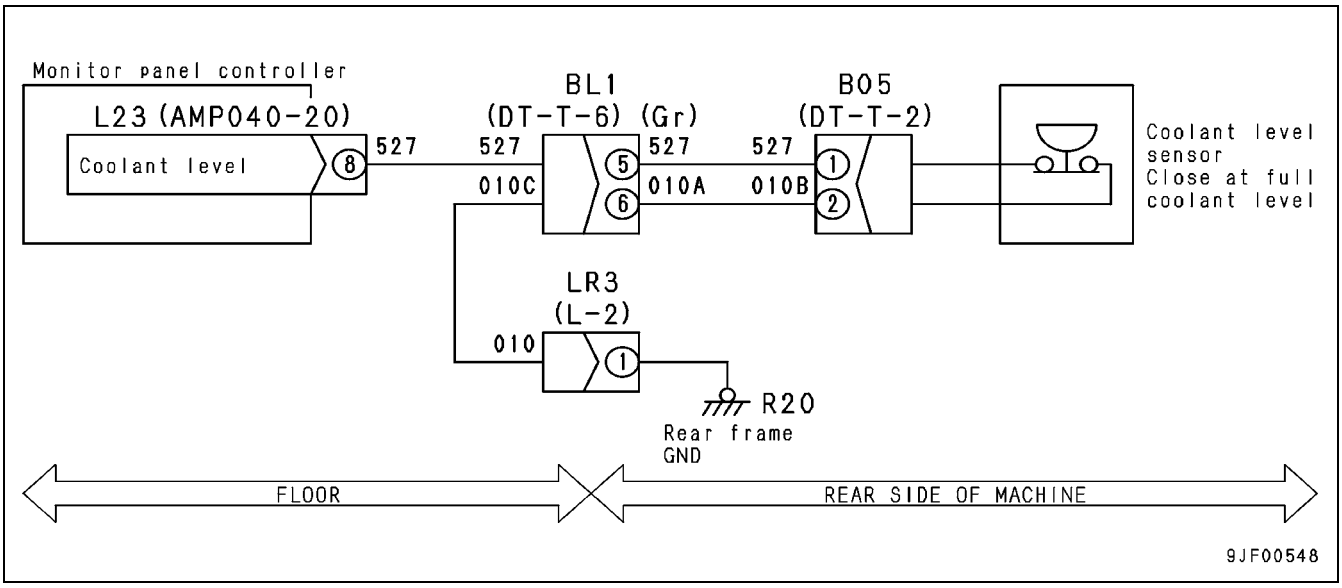

Accumulator pressure switch (Lo pressure)
Parking brake main switch (Open at ACC pressure low)
Fuel level sensor
T12 (X-2)
T18 (DT-T-2)
R21 (X-2)
Slow blow fuse
30A
30A
FL
120A
80A
FL
Battery relay
HST filter clogging sensor
T13
T14
HST filter be chock up sensor
Battery
Rear frame GND
Starting motor
24V 4.5kw
E01 (DT-T-2)
Safety relay
E21 (DT-T-2)
Engine oil level sensor (Close at full engine oil level)
E14 (X-2)
Engine water temperature sensor (Monitor)
T01 (DT-T-4)
FORWARD solenoid
REVERSE solenoid
ER03 (L-2)
Electrical intake air heater
Heater relay
9JF00539
S
T
U
V
W
X

ERROR CODE: [989FN1]

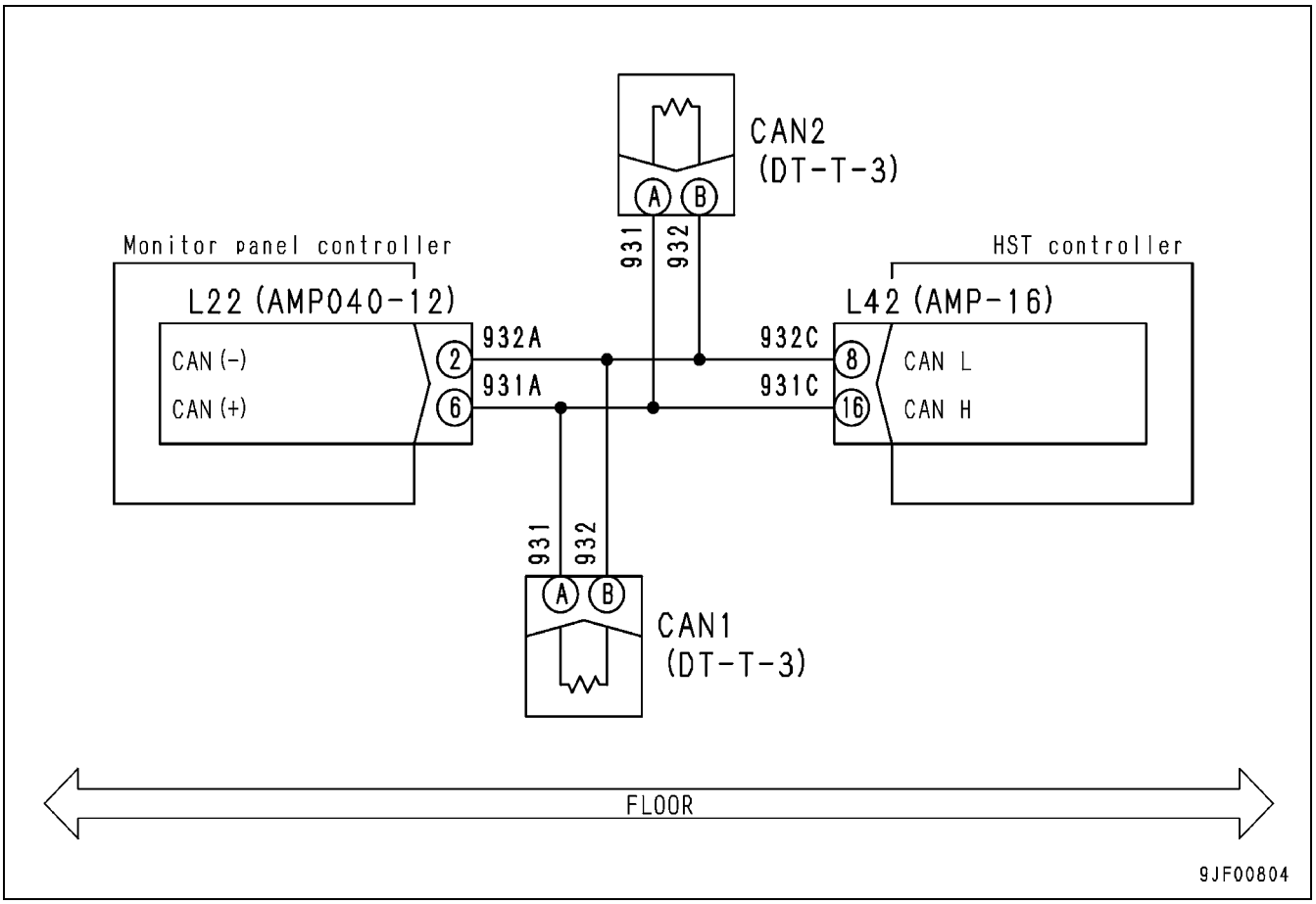
HST OVERSPEED CONDITION

<table>
<tr><td>Action Code</td><td colspan="2">Error Code</td><td>Controller Code</td><td rowspan="2">Trouble</td><td colspan="2" rowspan="2">HST overrunning (N1)</td></tr>
<tr><td>E02</td><td colspan="2">989FN1</td><td>MON</td></tr>
<tr><td>Description of Trouble</td><td colspan="6">• Travel speed exceeds 45 km/h.
• Automatic speed reduction when travel speed exceeds 40 km/h does not work.</td></tr>
<tr><td>Machine monitor or controller Reaction</td><td colspan="6">• Failure code is transmitted to HST controller, and when travel speed exceeds 40 km/h, HST controller automatically reduces speed</td></tr>
<tr><td>Effect on Machine</td><td colspan="6">• HST overrun alarm is given.
• Automatically reduces speed.</td></tr>
<tr><td>Related Information</td><td colspan="6"></td></tr>
<tr><td rowspan="6">Possible Causes and Standard Values</td><td colspan="2">Causes</td><td colspan="3">Standard Value in Normal State and Remarks on Troubleshooting</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">- - -</td><td colspan="3">1) Turn starting switch ON.
2) Operate machine monitor</td></tr>
<tr><td>Other code is displayed at same time</td><td colspan="2">Carry out troubleshooting for applicable code displayed</td></tr>
<tr><td>2</td><td>Overrunning HST</td><td>When machine was used in way that would cause HST to overrun</td><td colspan="2">Inspect and repair cause of problem and damage to HST.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective machine monitor</td><td colspan="3">1) Start engine.
2) Operate machine monitor
3) Travel on flat ground.</td></tr>
<tr><td>Travel speed goes above 40 km/h.</td><td colspan="2">Carry out troubleshooting for HST controller system failure codes DW26KZ and DX19KZ.</td></tr>
<tr><td>Travel speed does not go above 40 km/h. (Less than 40 km/h)</td><td colspan="2">Inspect and repair cause of problem and damage to HST.</td></tr>
</table>

Related circuit diagram

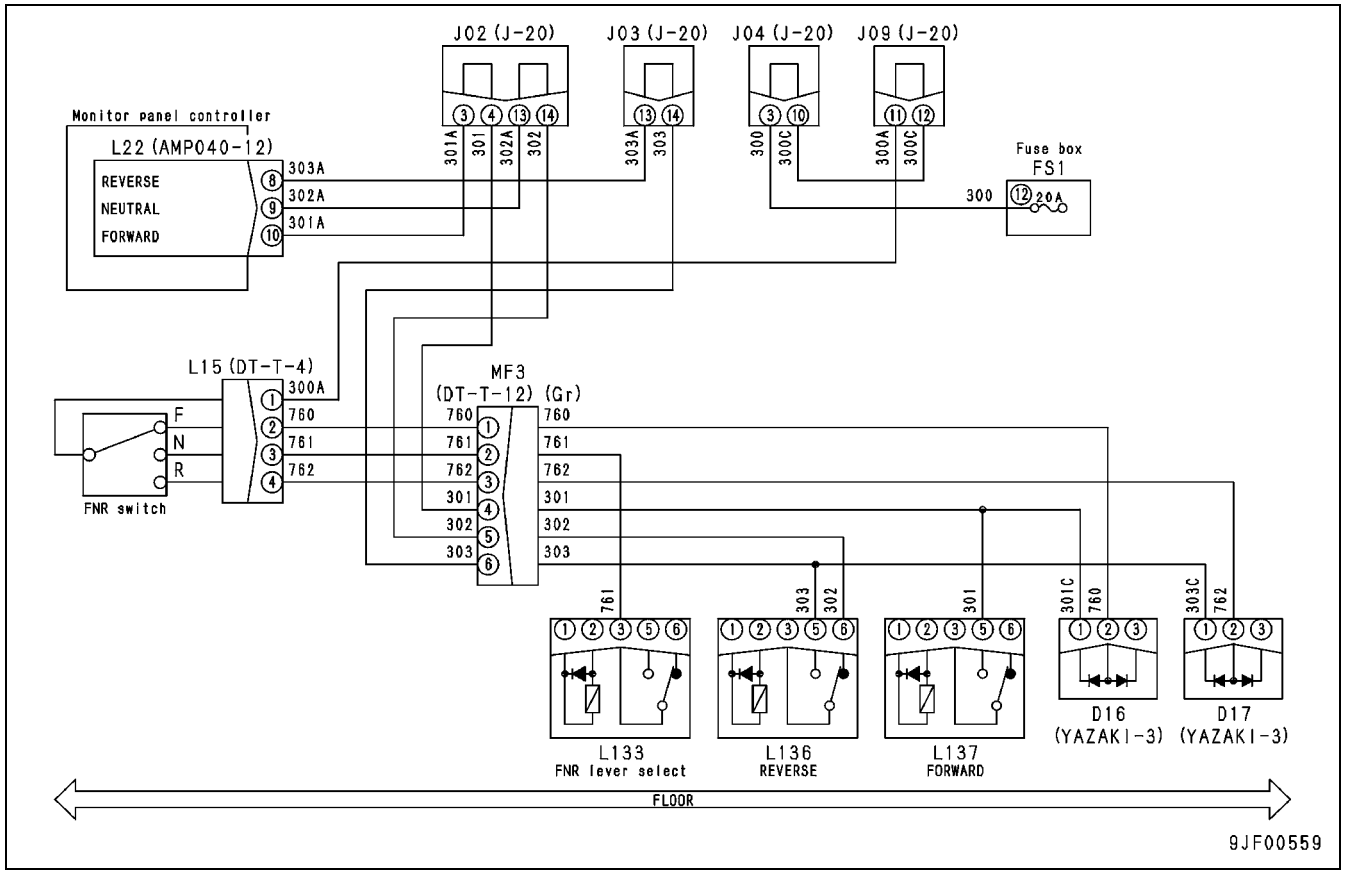


Related circuit diagram

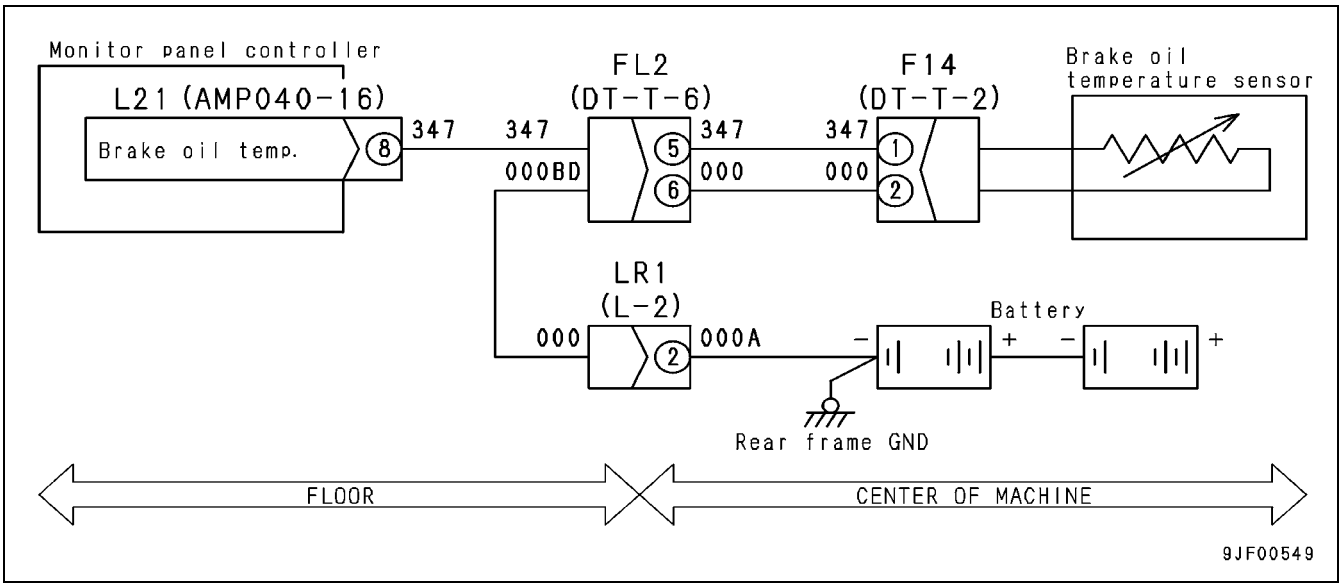


A. Diode test	Resistance Ω	At diode D16, between (1) and (2) reversing meter lead polarity each time to check.	Continuity one way only?	**15**	Yes or No
		At diode D17, between (1) and (2) reversing meter lead polarity each time to check.	Continuity one way only?	**16**	Yes or No
4. Monitor Panel Controller Unit • With ignition switch in the "OFF" position. • Disconnect (L22) connector from monitor panel and install T-adapter between (L22) connector and monitor panel. • Turn ignition switch "ON"					
A. Monitor	Voltage	At monitor L22, between (10) and chassis ground, set in "F" position.	20 to 30V	**17**	
		At monitor L22, between (10) and chassis ground, set in "R" position.	1V or lower	**18**	
		At monitor L22, between (8) and chassis ground, set in "R" position.	20 to 30V	**19**	
		At monitor L22, between (8) and chassis ground, set in "F" position.	1V or lower	**20**	
		At monitor L22, between (9) and chassis ground, set in "N" position.	20 to 30V	**21**	
		At monitor L22, between (9) and chassis ground, set in "F" position.	1V or lower	**22**	
		At monitor L22, between (9) and chassis ground, set in "R" position.	1V or lower	**23**	

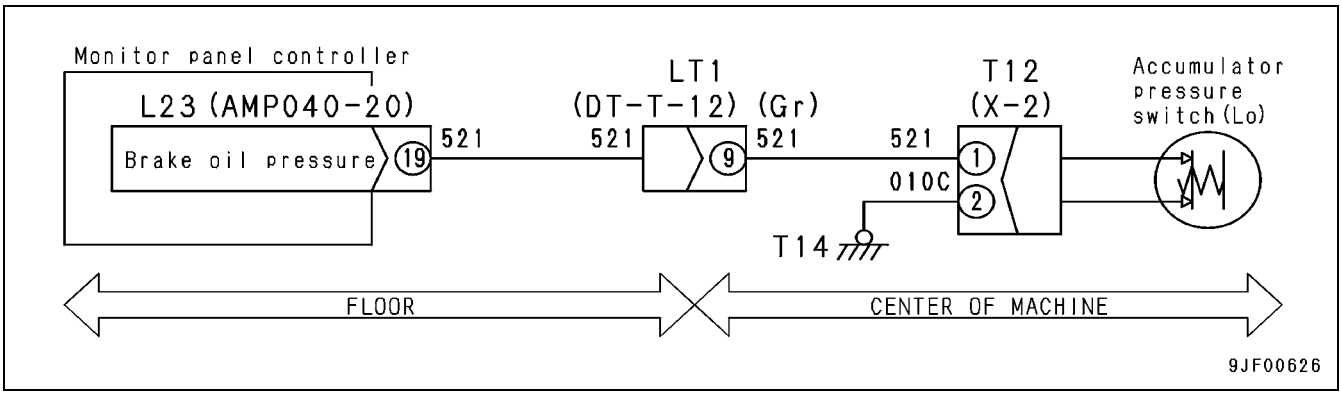
Related circuit diagram



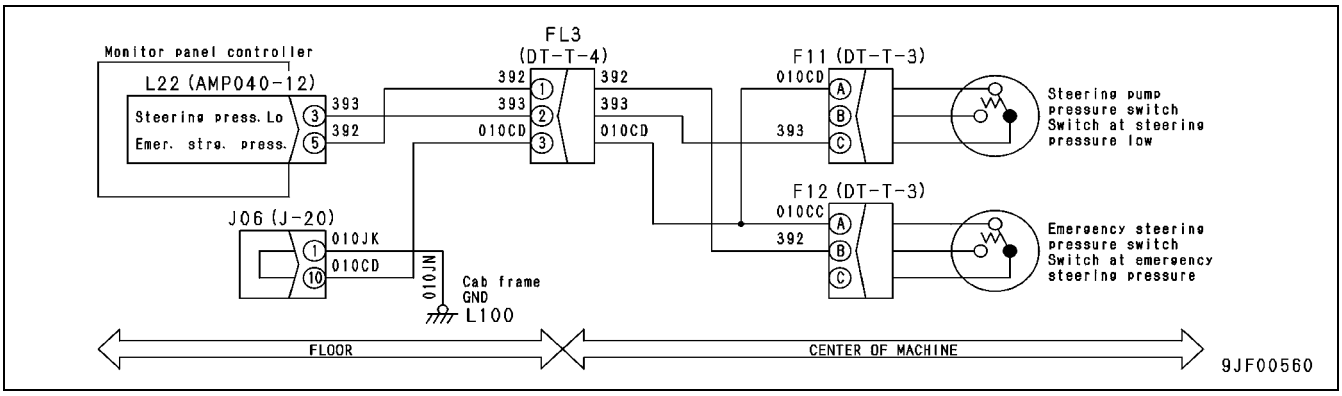
Related circuit diagram



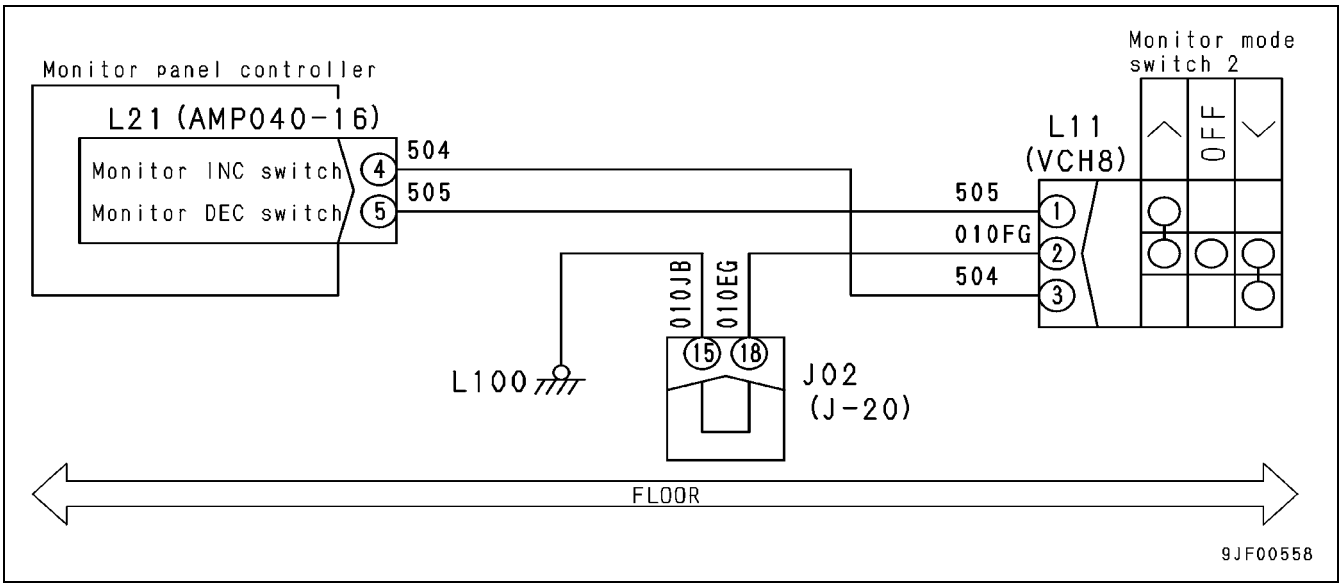
Related circuit diagram



Related circuit diagram



Related circuit diagram



TROUBLESHOOTING OF ELECTRICAL SYSTEM (E MODE)

Electrical Circuit Diagram

This is part of the electrical circuit diagram which shows the portion where the failure occurred.

- Connector No.: Indicates (Type - numbers of a pin) (color)
- Arrow: Roughly indicates the location in the machine where it is installed.

A. Open or high resistance	Voltage	✷ At connector L47, between (1) and chassis ground.	20 to 30V	**10**	
	Resistance Ω	Between connectors L101, (1) and L101, (5)	0.0 to 1.0Ω	**11**	
		Between connectors L101, (1) and L112, (1)	0.0 to 1.0Ω	**12**	
		Between connectors L101, (1) and L53, (2)	0.0 to 1.0Ω	**13**	
		Between connectors L101, (1) and L21, (13)	0.0 to 1.0Ω	**14**	
		Between connectors L101, (2) and L106, (2)	0.0 to 1.0Ω	**15**	
		Between connectors L101, (2) and L105, (2)	0.0 to 1.0Ω	**16**	
		Between connectors L101, (2) and L104, (3)	0.0 to 1.0Ω	**17**	
		Between connectors L101, (3) and L53, (1)	0.0 to 1.0Ω	**18**	
		Between connectors L101, (3) and L47, (2)	0.0 to 1.0Ω	**19**	
		Between connectors L101, (2) and L104, (3)	0.0 to 1.0Ω	**20**	
5. Wiring Harness Assembly Test • With ignition switch in the "OFF" position. • Disconnect (L19), (L112), (T03), (T17), (ER2) and both ends of (No.341, 373) connector from system. • Disconnect fuse line terminal FS1.					
A. Short to chassis ground or within harness	Resistance Ω	At connector L112, between (5) and chassis ground.	(OL) open	**21**	
		At connector ER2, between (10) and chassis ground.	(OL) open	**22**	
		At connector L47, between (1) and chassis ground.	(OL) open	**23**	
		At connector L47, between (2) and chassis ground.	(OL) open	**24**	
		At connector L53, between (1) and chassis ground.	(OL) open	**25**	
		At connector L101, between (3) and chassis ground.	(OL) open	**26**	
6. Monitor Panel Test • With ignition switch in the "OFF" position. • Disconnect (L21) connector from monitor panel and install T-adapter between (L21) wiring harness connector and monitor panel. • Turn ignition switch to the "ON" position.					
A. Monitor	Voltage	Between L21, (13) and chassis ground, lever at LOCK to MIDDLE position.	20 to 30V	**27**	
		Between L21, (13) and chassis ground, lever at MIDDLE to FREE position.	0V	**28**	

A. Open or high resistance	Voltage	✷ At connector F03, between (A) and chassis ground.	20 to 30V	**5**	
		✷ At connector L35, between (1) and chassis ground.	20 to 30V	**6**	
		✷ At connector L113, between (1), (3) and chassis ground.	20 to 30V	**7**	
		✷ At connector L114, between (1), (3) and chassis ground.	20 to 30V	**8**	
	Resistance Ω	Between connectors L113, (2) and F04, (B)	0.0 to 1.0Ω	**9**	
		Between connectors L113, (5) and L36, (1)	0.0 to 1.0Ω	**10**	
		Between connectors L114, (2) and F03, (B)	0.0 to 1.0Ω	**11**	
		Between connectors L114, (5) and L37, (1)	0.0 to 1.0Ω	**12**	
		Between connectors L113, (5) and L36, (1)	0.0 to 1.0Ω	**13**	
		At connector F03, between (C) and chassis ground.	0.0 to 1.0Ω	**14**	
		At connector F04, between (C) and chassis ground.	0.0 to 1.0Ω	**15**	
		At connector L35, between (2) and chassis ground.	0.0 to 1.0Ω	**16**	
		At connector L36, between (2) and chassis ground.	0.0 to 1.0Ω	**17**	
		At connector L37, between (2) and chassis ground.	0.0 to 1.0Ω	**18**	
B. Short to chassis ground or within harness	Resistance Ω	At connector F03, between (B) and chassis ground.	(OL) open	**19**	
		At connector F04, between (B) and chassis ground.	(OL) open	**20**	
		At connector F03, between (B) and (C)	(OL) open	**21**	
		At connector F04, between (B) and (C)	(OL) open	**22**	

CODE: (E-11)

HEADLAMPS (LO AND HIGH BEAM) DOES NOT FUNCTION

Contents Of Trouble	• The head lamps low and high beam does not work. • Action code none displayed. • No low or high beam. • See: STARTING AND LIGHTING section 10-192

Tools and Procedures	• Digital Volt Ohm Meter. T-adapter kit. • Do not mark on original page of service manual. Remove this page from the service manual and make a copy for recording information while performing these tests. • If you are unable to copy this page, record readings on a separate paper referring to the (**No.**) numbers listed on the right of the procedure. • Follow each step throughout this procedure, do not skip steps, jump ahead or stop when a fault is found unless otherwise instructed to in the procedure. It is important to complete all steps and record information for final analyzing.

Steps	Circuit Diagnostic Procedures For Code [E-11]		Specifications	No.	Readings
Fuse	—	Check condition of fuses in FS1, (8), (9) and (3)	Good Condition?	**1**	Yes or No
1. Lamps • With ignition switch in the "OFF" position. • Disconnect right and left headlight. • Turn ignition switch to the "ON" position. • Turn lamps "ON"					
A. Power supply points	Voltage	At "L" head lamp (3) to chassis ground, switch on "LO"	20 to 30V	**2**	
		At "L" head lamp (3) to chassis ground, switch on "HI"	20 to 30V	**3**	
		At "R" head lamp (3) to chassis ground, switch on "LO"	20 to 30V	**4**	
		At "R" head lamp (3) to chassis ground, switch on "HI"	20 to 30V	**5**	
2. Switches • With ignition switch in the "OFF" position. • Disconnect (L04) connector from switch and isolate switch. • Zero meter leads for proper Ω readings.					
A. Switches	Resistance Ω	At connector L04, between (2) and (3), lamps off.	(OL) open	**6**	
		At connector L04, between (2) and (3), 1st. step on switch.	(OL) open	**7**	
		At connector L04, between (2) and (3), 2nd. step on switch.	0.0 to 1.0Ω	**8**	
		At connector L04, between (4) and (3), switch on "LO".	0.0 to 1.0Ω	**9**	
		At connector L04, between (4) and (3), switch on "HI".	(OL) open	**10**	
		At connector L04, between (5) and (3), switch on "LO".	(OL) open	**11**	
		At connector L04, between (3) and (3), switch on "HI".	0.0 to 1.0Ω	**12**	

A. Open or high resistance	Resistance Ω	Between connection L04, (3) and chassis ground.	0.0 to 1.0Ω	**10**	
		Between connections L117, (5) and left lamp connection (5)	0.0 to 1.0Ω	**11**	
		Between fuse FS2, terminal (10) and L117, (1) and (3)	0.0 to 1.0Ω	**12**	
		Between connections L117, (2) and L04, (1)	0.0 to 1.0Ω	**13**	
		Between lamp left, (4) and chassis ground.	0.0 to 1.0Ω	**14**	
		Between connections L118, (5) and right lamp connection (5)	0.0 to 1.0Ω	**15**	
		Between fuse FS2, terminal (11) and L118 (1) and (3)	0.0 to 1.0Ω	**16**	
		Between connections L118, (2) and L04, (1)	0.0 to 1.0Ω	**17**	
		Between lamp right, (4) and chassis ground.	0.0 to 1.0Ω	**18**	
B. Short to chassis ground or within harness	Resistance Ω	At right lamp plug, (5) and chassis ground.	(OL) open	**19**	
		At left lamp plug, (5) and chassis ground.	(OL) open	**20**	

CODE: (E-13)

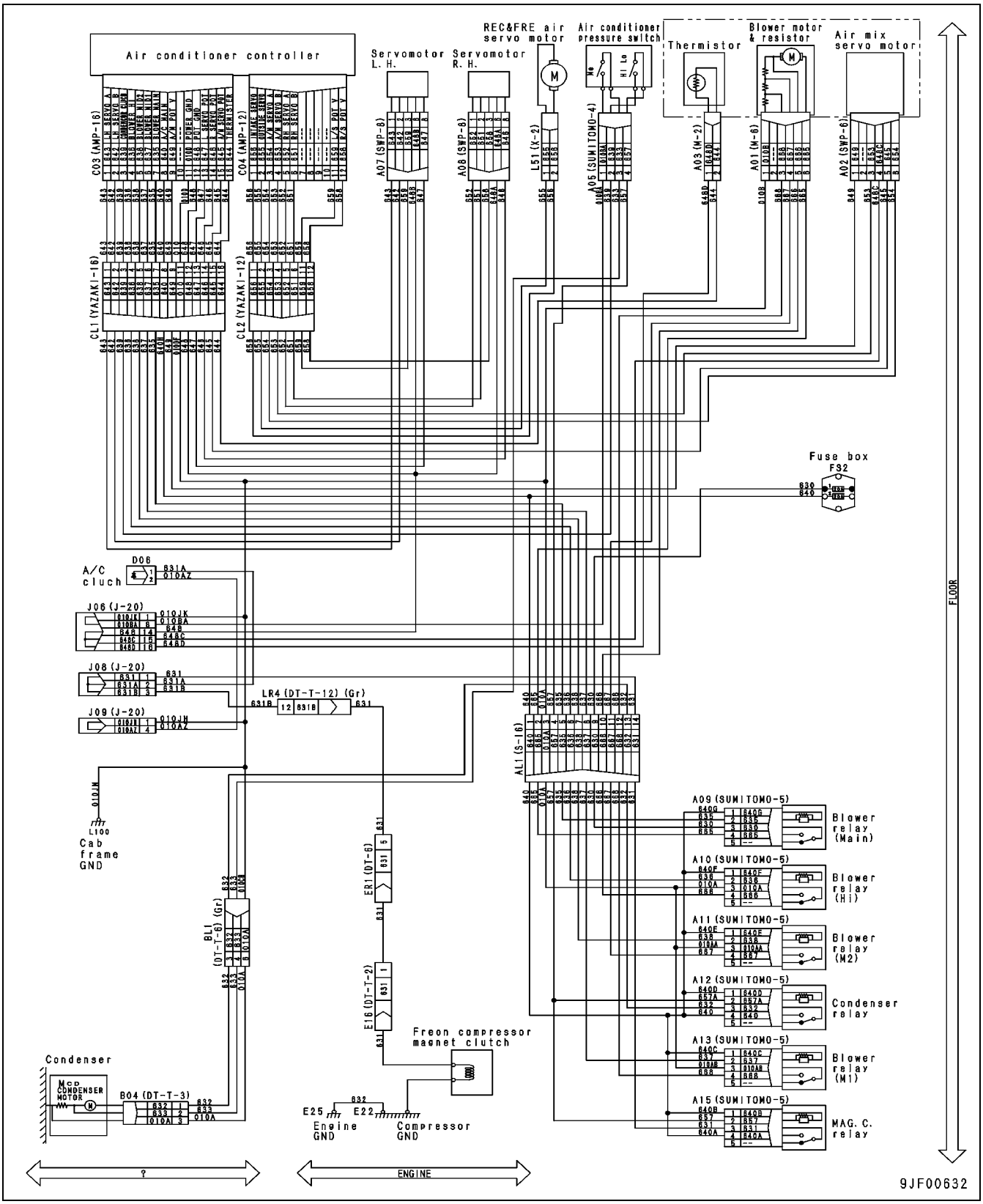
AIR CONDITIONER SYSTEM DOES NOT WORK

Contents Of Trouble	• Air conditioner system does not work. • Action code none displayed. • No air conditioning. • See: AIR CONDITIONING PIPING section 10-188

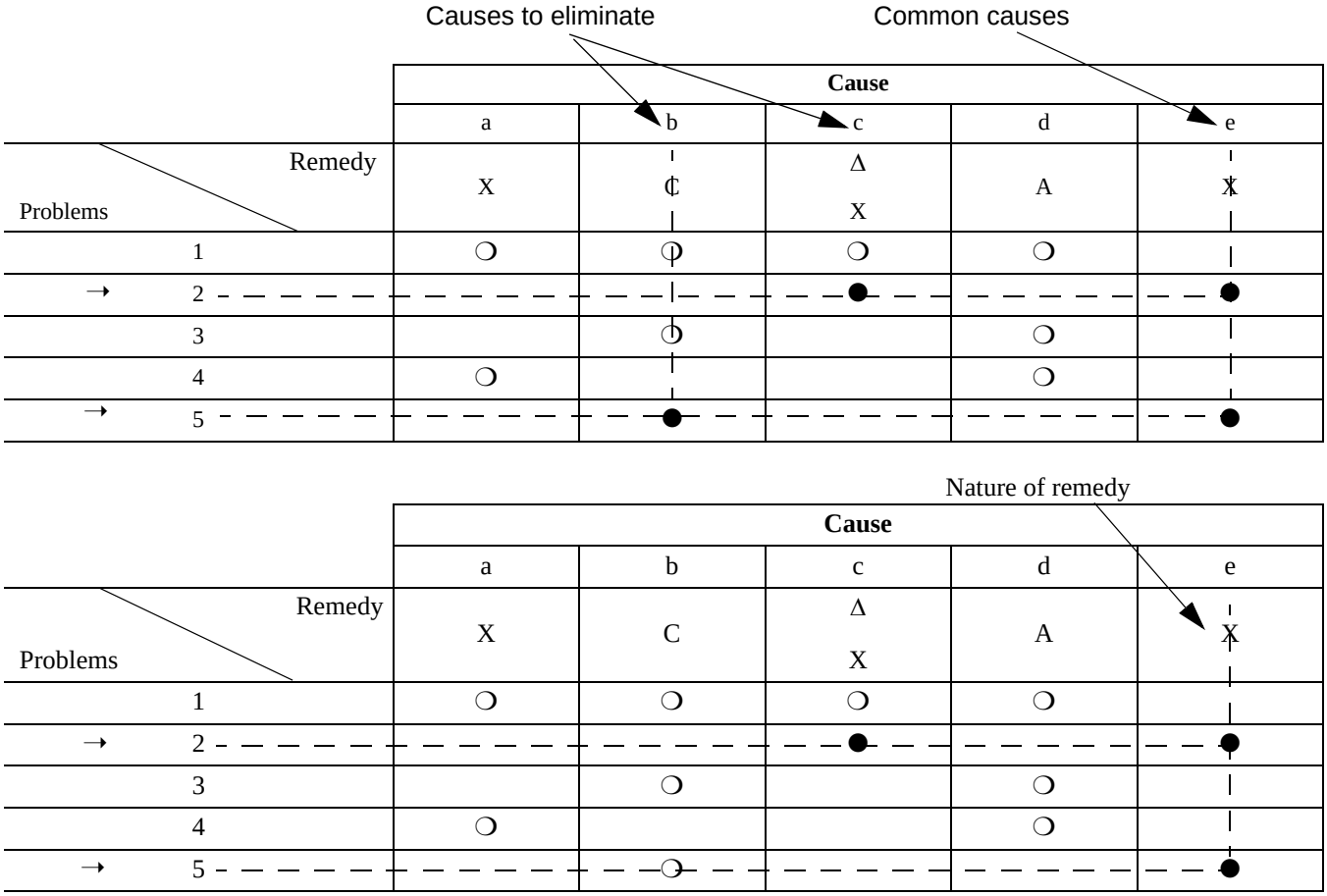
Tools and Procedures	• Digital Volt Ohm Meter. T-adapter kit. • Do not mark on original page of service manual. Remove this page from the service manual and make a copy for recording information while performing these tests. • If you are unable to copy this page, record readings on a separate paper referring to the (**No.**) numbers listed on the right of the procedure. • Follow each step throughout this procedure, do not skip steps, jump ahead or stop when a fault is found unless otherwise instructed to in the procedure. It is important to complete all steps and record information for final analyzing.

Steps	Circuit Diagnostic Procedures For Code [E-13]			Specifications	No.	Readings
Fuse check		—	Check condition of fuse at FS2, (1) and (2)	Good Condition?	**1**	Yes or No
1. Compressor Switch • Test with outside ambient air temperatures 10° C or higher (50° F or higher) • With ignition switch in the "OFF" position. • Disconnect (E16) connector from compressor. • Start the engine and allow it to idle at low RPM. • Turn air conditioning system “ON” and set temperature setting on low (cool).						
A. Compressor test		Voltage	At connector E16, between (1) and chassis ground.	20 to 30V	**2**	
2. Pressure Sensor Tests • With ignition switch in the "OFF" position. • Disconnect (A05) connector from pressure switch and isolate switch. • Zero meter leads for proper Ω readings. ★ Readings other than (0.0 to 1.0Ω) in this test may indicate system is low on refrigerant or overcharged. Do not continue with electrical testing. (See section 30 DISSAMBLY AND ASSEMBLY) for further testing procedures on system.						
A. Sensor test		Resistance Ω	★ At pressure sensor A05, between (1) and (3)	0.0 to 1.0Ω	**3**	
			★ At pressure sensor A05, between (2) and (4)	0.0 to 1.0Ω	**4**	
3. Sensor Test • With ignition switch in the "OFF" position. • Disconnect (A03) connector from sensor and isolate sensor. • Zero meter leads for proper Ω readings.						
A. Sensor test		Resistance Ω	At sensor A03, between (1) and (2) air temperatures 25° C or lower (77° F or lower)	≈37 to 50kΩ	**5**	
			At sensor A03, between (1) and (2) air temperatures 100° C or higher (212° F or higher)	≈3.5 to 4.0kΩ	**6**	
4. Diode Test • With ignition switch in the "OFF" position. • Disconnect (D06) diode connector and isolate diode.						
A. Diode test		Resistance Ω	At diode D06, between (1) and (2) reversing meter lead polarity each time to check.	Continuity one way only?	**7**	Yes or No

Circuit Diagram for (DENSO) Air Conditioner



3. Narrow down the causes. Of the causes found in Step 2) and Step 4), there are common items (❍marks on the line for each troubleshooting item and in the same Cause column as each other) that have causes common with the problem items found in the troubleshooting in Step 1) and Step 3). The items that are not common (items that do not have ❍ marks in the same cause common as each other) are probably not the cause, so they can be eliminated. The causes for Troubleshooting item 2 in the diagram on the right are (C) or (E), and the causes in Troubleshooting item (5) are (B) or (E), so Cause (E) is the common cause.



4. Repeat the operation in Steps 3), 4), and 5) until the cause is narrowed down to 1st. item (1 common item).If cause items are 2 or more, continue until number of items becomes minimum.

Remedy:
After narrowing down the common causes, taken the action given in the remedy line. **X**: Replace Δ: Repair **A**: Adjust **C**: Clean

CODE: (H-7)

STEERING WHEEL MOVEMENT IS HEAVY

Ask the operator about the following:
- Did the problem suddenly start?
  - ★ Breakage of steering related equipment
- Was there previously any symptom, such as heavy steering?
  - ★ Internal wear of steering related equipment, defective seal

Inspection before diagnosis
- Are the oil level in the hydraulic tank and the oil type appropriate?
- Is there any abnormality in steering gear box, column, linkage?
- Is steering valve control lever stopper adjusted properly?
- Is the any external oil leak found around the hydraulic piping, valve and cylinder?
- Is there any gouging of center hinge pin bearing and steering cylinder pin, bushing?
- Is the tire inflation pressure correct?

Check for abnormalities
- Measure operating effort of steering wheel and time taken to turn steering, and check standard judgment value table to see if there is any abnormality.

No.	Diagnosis \ Remedy	Cause: Hydraulic pump – The steering pump and switch pump is defective (Δ X)	Hydraulic pump – The hydraulic pump is defective (Δ X)	Valve – Internal defective steering cylinder (Defective piston seal) (Δ X)	Others – Priority valve – Spool (Δ X A)	Others – Priority valve – Relief valve (Δ X)	Others – Obit-roll	Others – Clogging of hydraulic oil return filter, defective bypass valve (Δ X C)	Others – Clogging of oil cooler (Δ X C)
		a		b	c		d	e	f
1	Steering wheel is heavy when turned in both directions (left and right)	❍	❍	❍	❍	❍	❍		
2	Steering wheel is heavy when turned in one direction (left and right)			❍			❍		
3	Steering wheel is heavy particularly when engine is running at low speed	❍	❍	❍	❍				
4	Lift arm lifting speed is slow when engine is running at full speed	❍			❍				
5	Steering wheel is heavy and there is jerking	❍					❍		
6	Hydraulic oil overheats				❍	❍			❍
7	Oil pressure of steering circuit is low or there is no pressure			❍		❍			
8	Pressure rises in return piping of steering cylinder							❍	

CODE: (H-20)

BUCKET MOVES SLOW OR THE TILTING-BACK FORCE IS INSUFFICIENT

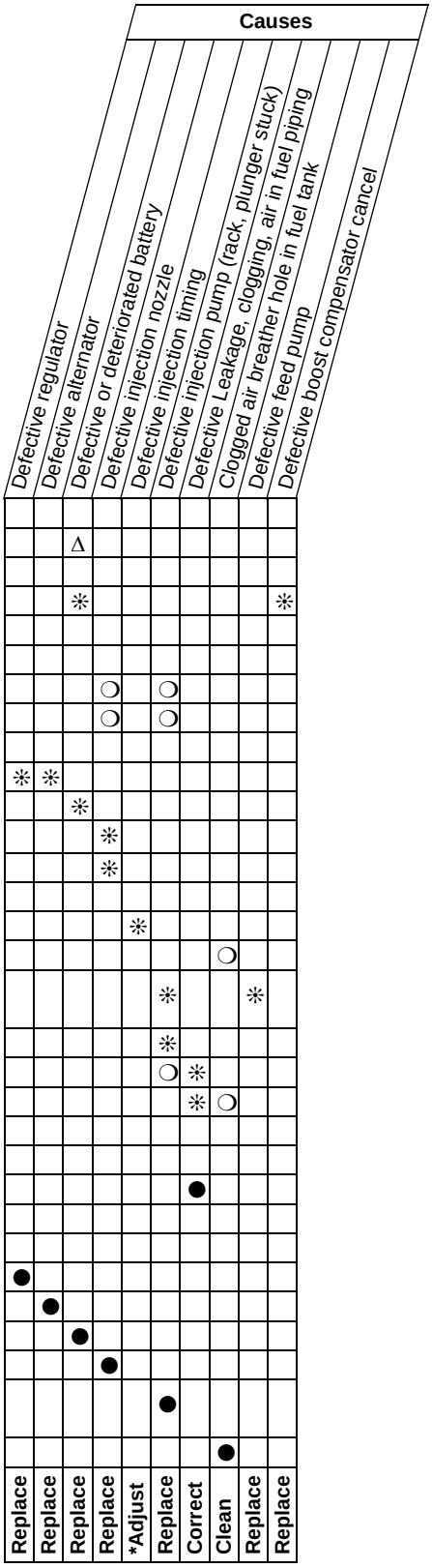
Inspection before diagnosis

- Is the stroke of the bucket control lever appropriate?
- Seizure of work equipment linkage bushing (Does any abnormal noise occur?)

Check of Abnormality

- Make sure in an actual operation that the tilting-back force is insufficient.
- Measure the operating speed of the bucket, and make sure referring to the criterion value table that the speed is abnormal

		Cause								
		Tank to Pump		Priority valve	PPC valve		Work equipment valve			Cylin-der
		a	b	c	d	e	f	g	h	i
		Clogging of pump suction port or mixing of much air in oil	The hydraulic pump and the switch pump are defective	Defective operation of spool	Defective operation of relief valve	Defective operation of spool	Defective operation or improper adjustment of main relief valve	Defective operation of safety valve (With suction valve) on bucket cylinder bottom side	Wear or breakage inside valve body (Bucket spool)	Damage of bucket cylinder piston seal
No.	Remedy / Diagnosis	**C** Δ	Δ **X**	Δ **X**	Δ **X**	Δ **X**	**A** **X**	Δ **X**	**X**	**X**
1	The lift arm rising force and speed are abnormal, and the bucket tilting force and speed are abnormal	❍	❍	❍	❍		❍			
2	The lift arm rising force and speed are normal, and the bucket tilting force and speed are abnormal					❍		❍	❍	❍
3	When the oil temperature rises in No. 1, the bucket speed becomes worse		❍						❍	
4	The hydraulic pump is causing an abnormal noise	❍	❍							
5	Large hydraulic drift of bucket cylinder							❍	❍	❍
6	The relief oil pressure from the relief valve of the work equipment valves is low		❍				❍	❍		
7	The relief oil pressure from the relief valve of the work equipment valves is too high						❍			


Causes
Defective regulator
Defective alternator
Defective or deteriorated battery
Defective injection nozzle
Defective injection timing
Defective injection pump (rack, plunger stuck)
Clogged air breather hole in fuel tank
Defective feed pump
Defective boost compensator cancel
Replace
Replace
Replace
Replace
*Adjust
Replace
Correct
Clean
Replace
Replace

(S-9) OIL BECOMES CONTAMINATED QUICKLY

General causes why oil becomes contaminated quickly

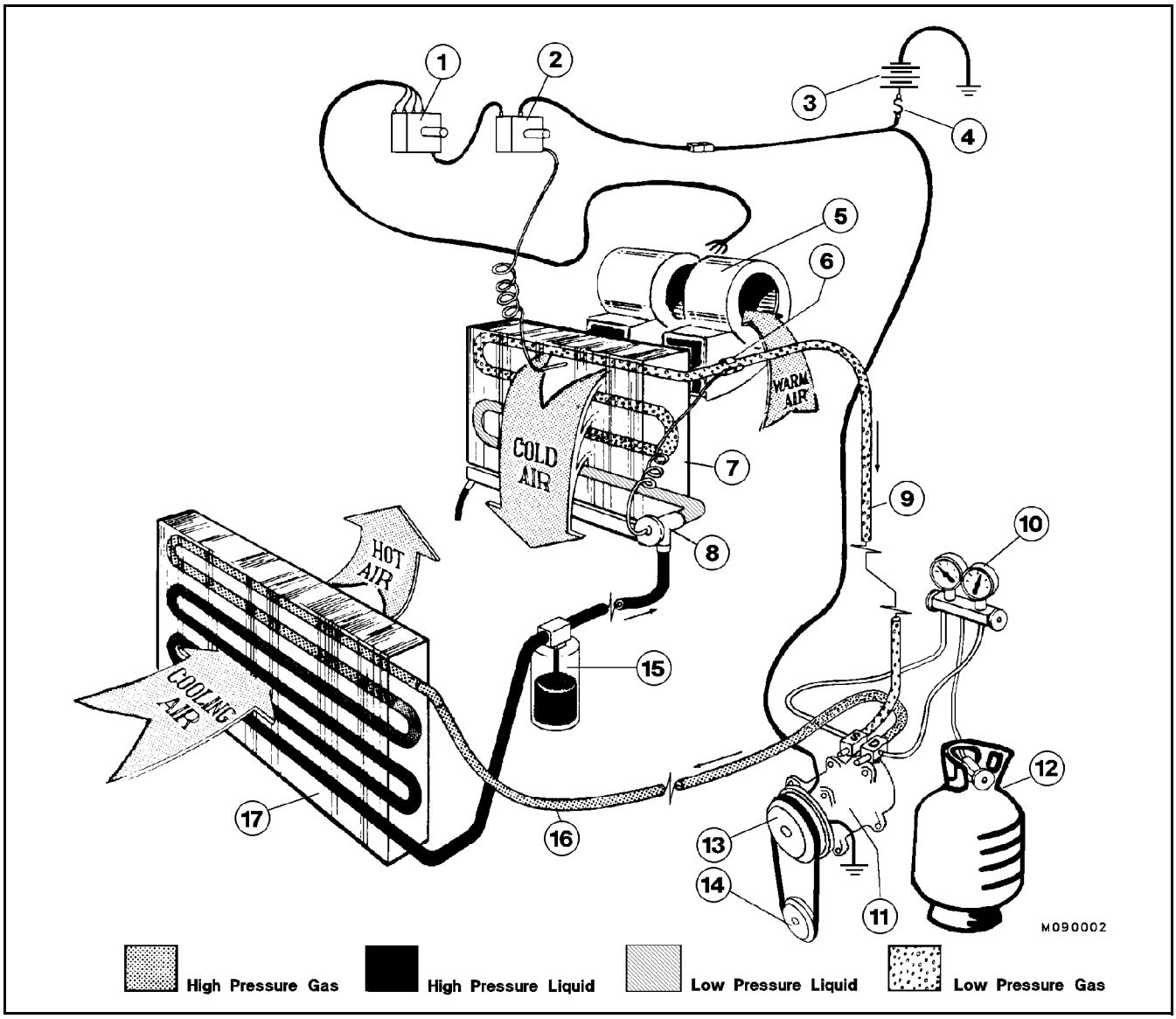
- Entry of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper fuel
- Improper oil used
- Operation under excessive load

			Causes: Worn piston ring, cylinder liner	Clogged breather, breather hose	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger oil drain tube	Defective seal at turbocharger turbine end	Exhaust smoke is black
Check items / Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period	Δ			Δ			Δ	
	Engine oil must be added more frequently		✻							
	Non-specified fuel is being used				❍					
	Color of exhaust gas	Black under light load	✻							
		Black								✻
	Amount of blow-by gas	Excessive	✻			❍		❍	❍	
		None		✻						
	When oil filter is inspected, metal particles are found		❍		✻	❍				
	When exhaust pipe is removed, inside is found to be dirty with oil					✻				
	Engine oil temperature rises quickly						✻			
Troubleshooting	When compression pressure is measured, it is found to be low		●			●				Carry out troubleshooting for "Exhaust"
	When breather element is inspected directly, hose is broken or is found to be clogged with dirty oil			●						
	When oil filter is inspected directly, it is found to be clogged				●					
	When oil cooler is inspected directly, it is found to be clogged						●			
	Turbocharger oil drain tube is clogged							●		
	Excessive play of turbocharger shaft								●	
	When safety valve is directly inspected, spring is found to be catching or broken									
		Remedy	**Replace**	**Clean**	**Replace**	**Replace**	**Clean**	**Clean**	**Replace**	-

AIR CONDITIONING SYSTEM

ENVIRONMENTAL IMPACT

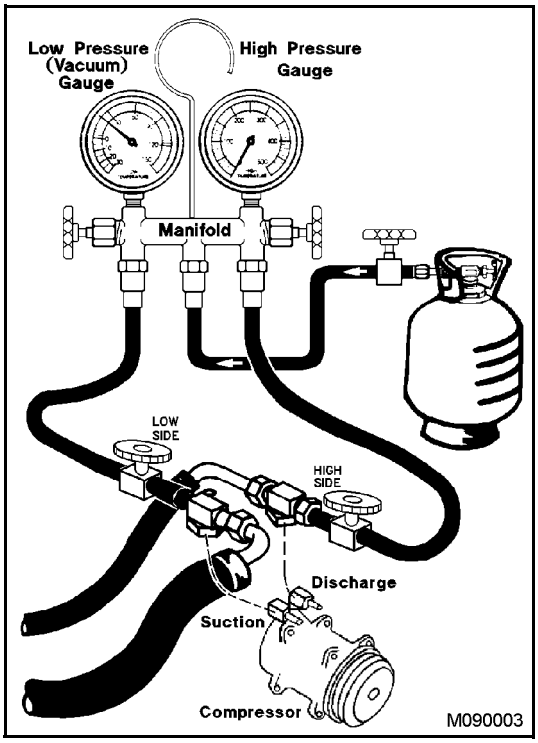
Environmental studies have indicated a weakening of the earth's protective Ozone (O_3) layer in the outer stratosphere. Chloro-flouro-carbon compounds (CFC's), such as R-12 refrigerant (Freon ®), commonly used in mobile equipment air conditioning systems, has been identified as a possible contributing factor to the Ozone depletion. Consequently, legislative bodies in more than 130 countries have mandated that the production and distribution of R-12 refrigerant be discontinued after 1995. Therefore, a more "environmentally-friendly" hydroflouro-carbon



BASIC AIR CONDITIONING SYSTEM (TYPICAL)

1. Blower Switch
2. Thermostatic Switch
3. Battery Supply
4. Circuit breaker
5. Blower
6. Temperature Sensor
7. Evaporator
8. Expansion Valve
9. Suction Line
10. Test gauges & Manifold
11. Compressor
12. Refrigerant Container
13. Magnetic Clutch
14. Compressor Drive Pulley
15. Receiver/Dryer
16. Discharge Line
17. Condenser

INSTALLING MANIFOLD GAUGE SET



WARNING! Shut off engine. DO NOT attempt to connect servicing equipment when the engine is running.

Before attempting to service the air conditioning system, a visual inspection of both the engine and system components is recommended. Particular attention should be paid to the belts, hoses, tubing and all attaching hardware plus the radiator cap, fan clutch, and thermostat. Inspect both the condenser and the radiator for any obstructions or potential contamination. Minimize all the possibilities for error or malfunction of components in the air conditioning system.

1. Be sure all valves on the manifold are closed all the way (turn them clockwise).
2. Check the hose connections on the manifold for tightness.
3. Locate the low and high side system service fittings and remove their protective caps.
4. Connect the two service hoses from the manifold to the correct service valves on the compressor. (High side to compressor discharge valve and low side to compressor suction side.) **Do not** open service valves at this time.

This gauge hook-up process will be the same, regardless of the gauge set being installed. Whether it is a recovery station or individual gauges, the connections are the same. The procedures performed next will vary depending what type of equipment is being used. If a recovery/recycling station is being used, complete servicing can be accomplished. Using only a set of gauges will limit the servicing to only adding refrigerant or observing pressures.

TROUBLESHOOTING - AIR CONDITIONING SYSTEM

PRE-DIAGNOSIS CHECKS

If the system indicates Insufficient cooling, or no cooling, the following points should be checked before proceeding with the system diagnosis procedures.

Remark

If the truck being serviced is a Model 930E, be certain the Rest Switch in the cab is ON. Place the GF Cutout Switch in the CUTOUT position.

PREPARING FOR DIAGNOSIS

Successfully servicing an air conditioning system, beyond the basic procedures outlined in the previous section, requires additional knowledge of system testing and diagnosis.

A good working knowledge of the manifold gauge set is required to correctly test and diagnose an air conditioning system. An accurate testing sequence is usually the quickest way to diagnose an internal problem. When correctly done, diagnosis becomes an accurate procedure rather than guesswork.

Compressor Belt - Must be tight, and aligned.
Compressor Clutch - The clutch must engage. If it does not, check fuses, wiring, and switches.
Oil Leaks - Inspect all connection or components for refrigeration oil leaks (especially in the area of the compressor shaft). A leak indicates a refrigerant leak.
Electrical Check - Check all wires and connections for possible open circuits or shorts. Check all system fuses.

Remark

Some systems use different safety devices in the compressor circuit to protect the compressor. Check the thermal fuse, the low pressure cutout switch, high pressure cutout switch or trinary pressure switch if equipped.

Cooling System - Check for correct cooling system operation. Inspect the radiator hoses, heater hoses, clamps, belts, water pump, thermostat and radiator for condition or proper operation.
Radiator Shutters - Inspect for correct operation and controls, if equipped.
Fan and Shroud - Check for proper operation of fan clutch. Check installation of fan and shroud.
Heater/Water Valve - Check for malfunction or leaking.
System Ducts and Doors - Check the ducts and doors for proper function.
Refrigerant Charge - Make sure system is properly charged with the correct amount of refrigerant.

PRELIMINARY STEPS

The following steps outline the correct procedures necessary to prepare the truck and the system for testing and diagnosis:

1. Correctly connect the manifold gauge set to the system. Refer to the connection and purging procedures outlined in this section.

2. Run the engine with the air conditioning system on for five to ten minutes to stabilize the system.

3. With the engine and the system at normal operating temperature, conduct a Performance Test.

SYSTEM PERFORMANCE TEST

This test is performed to establish the condition of all components in the system. Observe these conditions during testing:

1. Start engine and operate at 1200 to 1500 RPM.

2. Place fan in front of condenser to simulate normal ram air flow and allow system to stabilize.

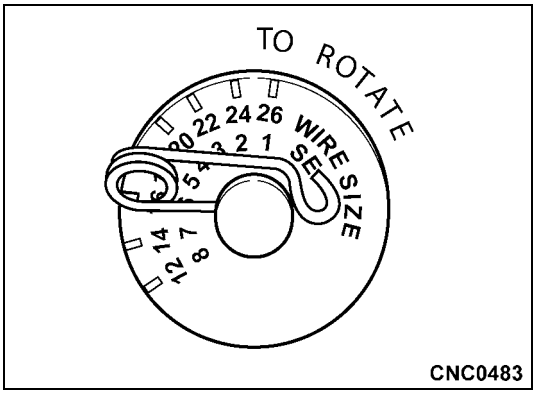
3. Place a thermometer in air conditioning vent closest to evaporator.

30 DISASSEMBLY AND ASSEMBLY

Component	Symbol		Part No.	Part Name	Necessity	Q'ty	New/remodel	Sketch	Nature of work, remarks
Differential assembly	H	5	799-301-1500	Oil leak tester	■	1			Operation check of clutch piston
		6	797-101-1211	Wrench	■	1			Removal, installation of pinion shaft nut
		7	793-615-1100	Wrench	■	1			No-load operating torque of limited-slip differential
		8	793T-422-1220	Push tool	■	1	N	❍	Press fitting of pinion shaft bearing
		9	797T-423-1320	Push tool	■	1		❍	
		10	792T-413-1130	Push tool	■	1		❍	Press fitting of oil seal of pinion shaft cage
		11	793-520-2202	Installer	●	3			Installation of brake piston Check for brake oil leakage
		12	799-101-5210	Nipple	■	1			Check for brake oil leakage
		13	790-190-1500	Pump assembly	■	1			
Hydraulic cylinder assembly	U	1	790-502-1003	Repair stand	■	1			Disassembly, assembly of hydraulic cylinder
			790-101-1102	Hydraulic pump	■	1			
		2	790-102-2303 or 790-102-3802	Wrench assembly (for lift and bucket)	■	1			Removal, installation of cylinder head
		3	790-302-1340	Socket (for lift)	■	1			Removal, installation of piston nut
		4	790-201-1702	Push tool kit		1			Press fitting of cylinder head bushing
			790-101-5021	• Grip		1			
			01010-50816	• Bolt		1			
			790-201-1811	• Push tool (Lift)		1			
			790-201-1821	• Push tool (Bucket)		1			
			790-201-1841	• Push tool (WA250PT-5L bucket)		1			
			790-201-1741	• Push tool (Steering)		1			
		5	790-201-1500	Push tool kit	■	1			Installation of dust seal
			790-101-5021	• Grip		1			
			01010-50816	• Bolt		1			
			790-210-1620	• Plate (Lift)		1			
			790-201-1630	• Plate (Bucket)		1			
			790-201-1841	• Push tool (WA250PT-5L bucket)					
			790-201-1741	• Push tool (Steering)		1			

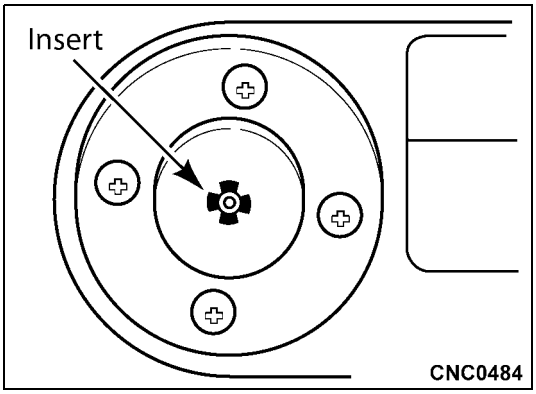
CRIMPING CONTACT TERMINAL (HD30 TYPE)

1. After insulation has been striped from the wire and contact terminal is ready for crimping, raise selector knob on Crimp Tool #HDT48-00 and rotate until arrow is aligned with wire size to be crimped.



2. Loosen locknut, turn adjusting screw in until it stops.

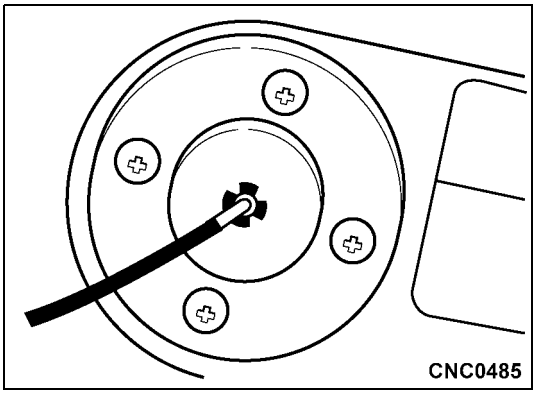
3. Insert contact terminal with barrel up. Turn adjusting screw counterclockwise until contact terminal surface is flush with indenter cover. Tighten locknut.



4. Insert wire into contact terminal. Be sure contact terminal is centered between indicators.

5. Close crimp tool handle until crimp cycle is completed.

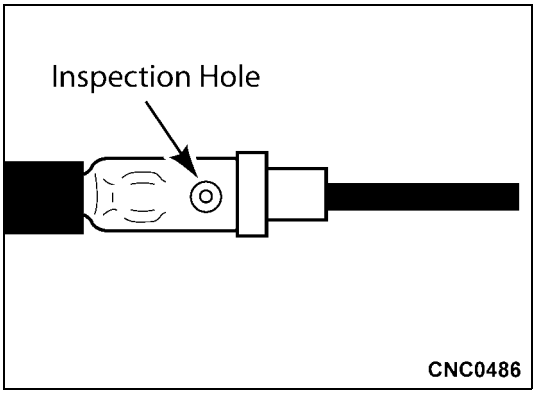
6. Release the tool handle and remove the crimped contact terminal.



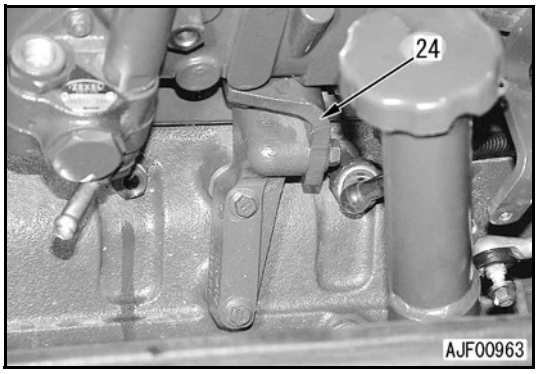
7. Using the inspection hole in the contact terminal inspect the crimped contact terminal to ensure that all strands are in the crimped barrel.

Remark

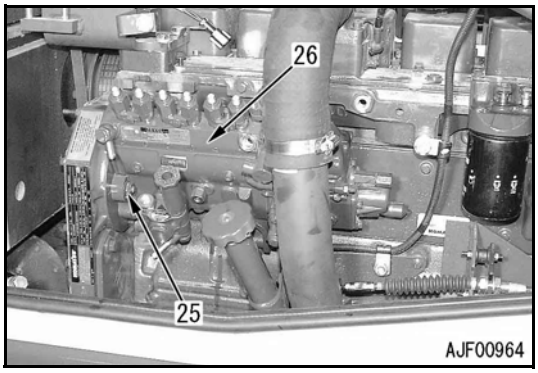
The tool must be readjusted for each type/size of contact. Use Crimp tool HDT04-08 for size 8 and 4 contacts.



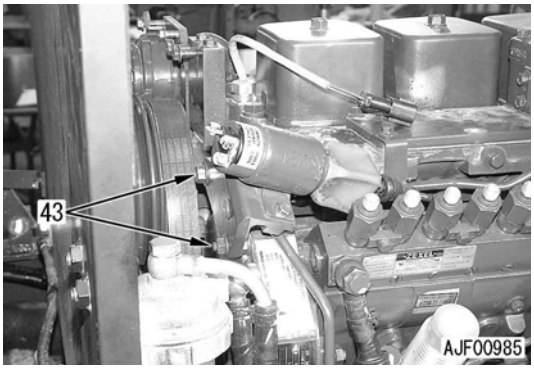
17. Remove fuel injection pump bracket (24).



18. Remove four fuel injection pump mounting nuts (25) and fuel injection pump assembly (26). ※5

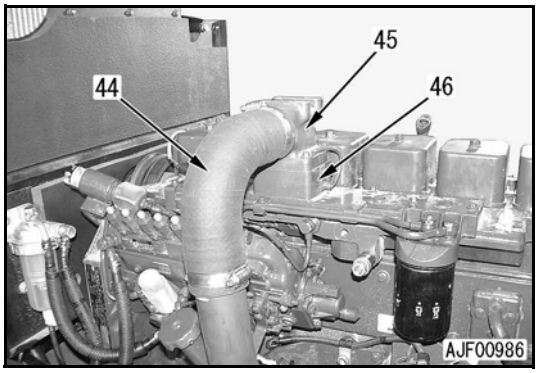


19. Remove engine stop solenoid bracket mounting bolts and nuts (43).
※9



20. Disconnect air hose (44). ※10

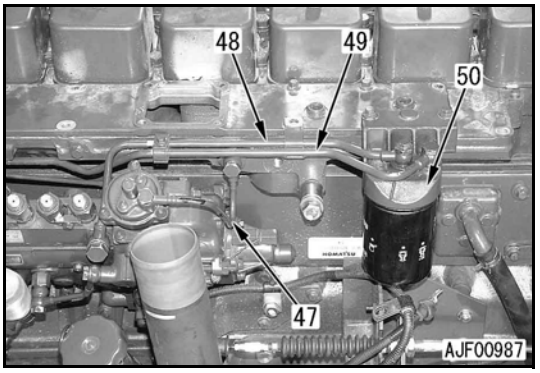
21. Remove air intake connector (45) and heater (46).



22. Remove boost compensator tube (47).

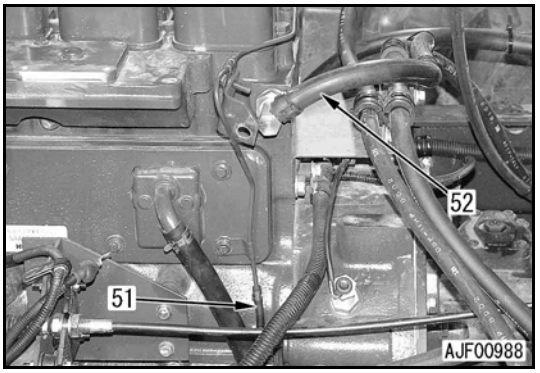
23. Remove fuel tubes (48) and (49).

24. Remove fuel filter (50).

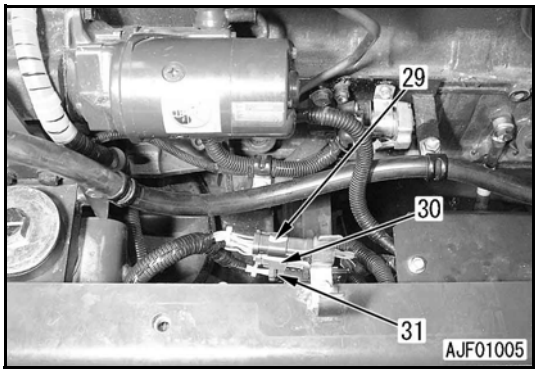


25. Disconnect spill hose (51).

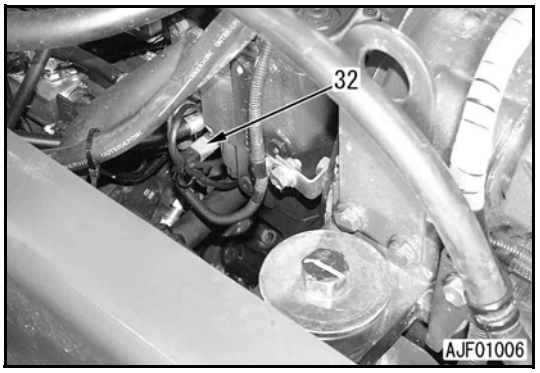
26. Disconnect heater hose (52).



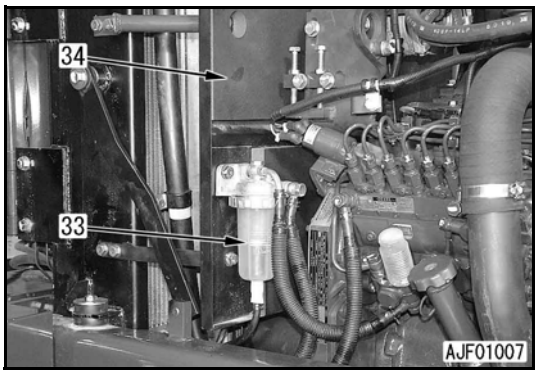
- (29): ER1
- (30): ER2
- (31): ER3



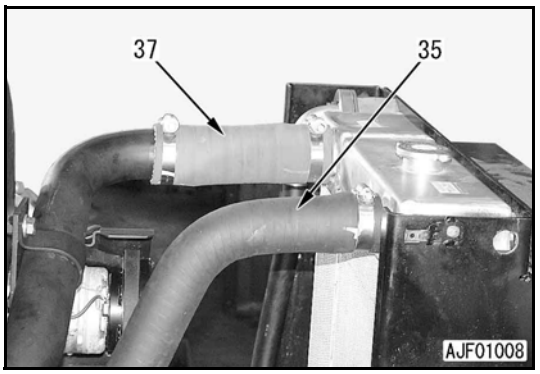
- (32): T01

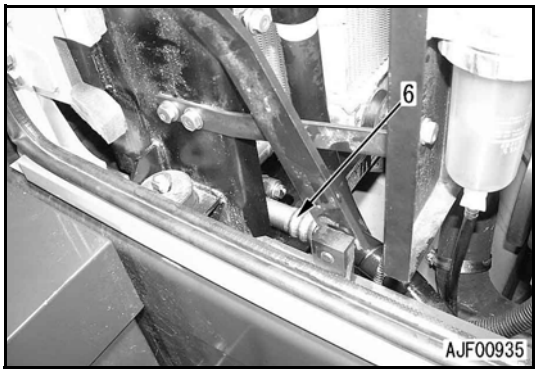


5. Remove the mounting bolts of fuel filter (33)
   ★ Bind the fuel filter to the engine with tie straps, wire, etc.
6. Remove cover (34).

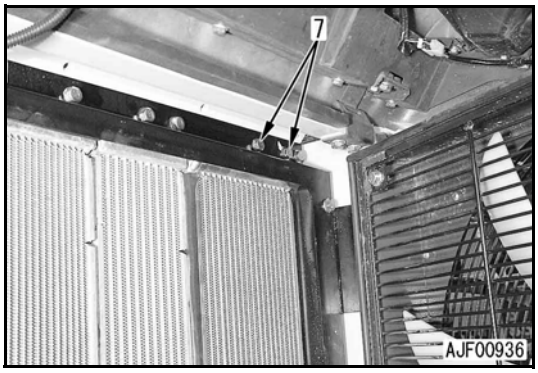


7. Disconnect radiator inlet hose (35) and radiator outlet hose (37).
   ※3

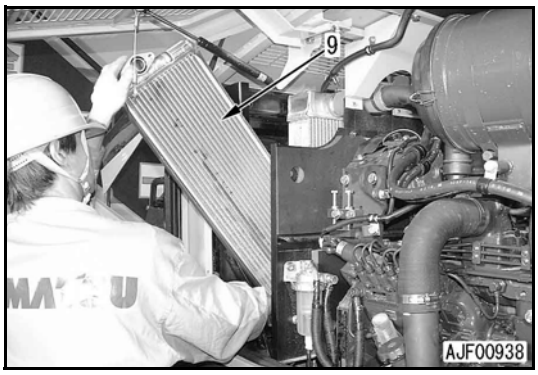




5. Remove two oil cooler upper mounting bolts (7) and two lower mounting bolts (8).



6. Pull out oil cooler (9) to the right.
   ★ Take care not to damage the core.

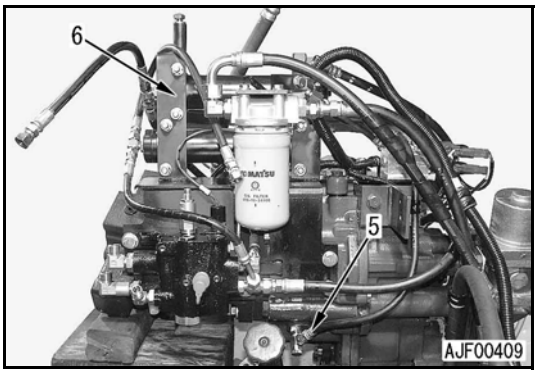


INSTALLATION

- Carry out installation in the reverse order to removal.
- **Refilling with oil (Hydraulic tank)**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, recheck the oil level.

B. Disconnect clutch port hose (5).

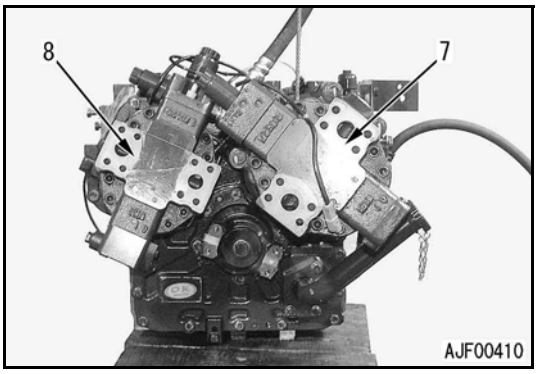
C. Remove the six mounting bolts, and then brake accumulator and transfer oil filter bracket assembly (6).



4. HST motor

A. Remove the four mounting bolts and lift off HST motor 1 (7).

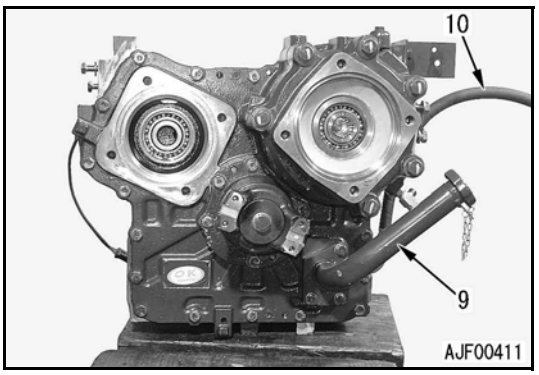
B. Remove the four mounting bolts and lift off HST motor 2 (8).



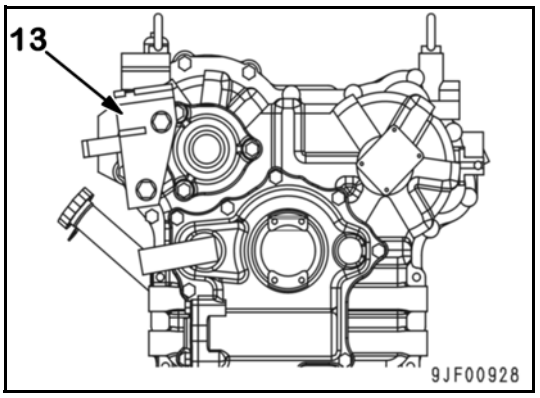
5. Oil supply pipe and hose

A. Remove oil supply pipe (9).

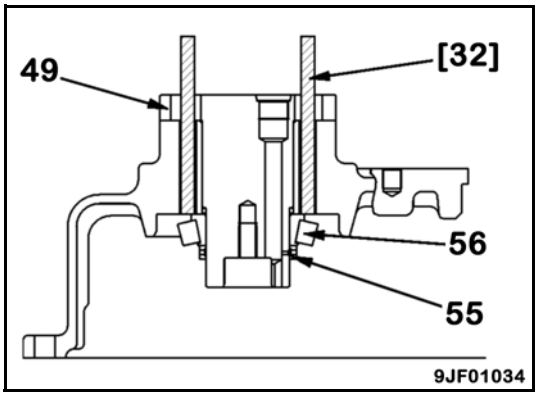
B. Remove hose (10) from the transfer case strainer.



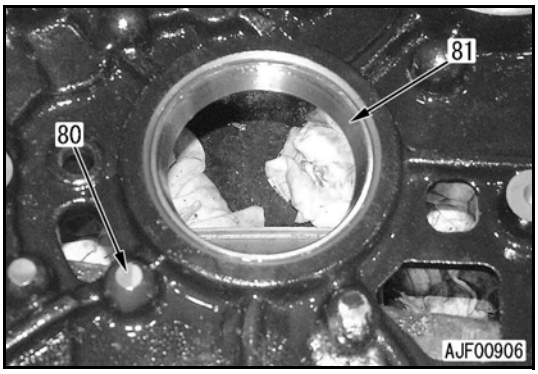
6. Remove parking brake bracket (13).



B. Insert 2 push tools [32] in the plug holes and hit them evenly to remove spacer (55) and bearing (56) from shaft (49).



C. Remove outer race (81) from rear case (80).

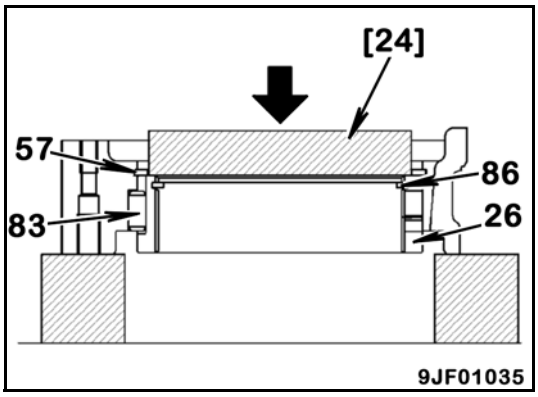


28. Clutch housing

A. Using push tool [24], remove clutch housing (26) and 3 pins (83).

B. Remove snap ring (86) from clutch housing (26).

C. Remove snap ring (57).

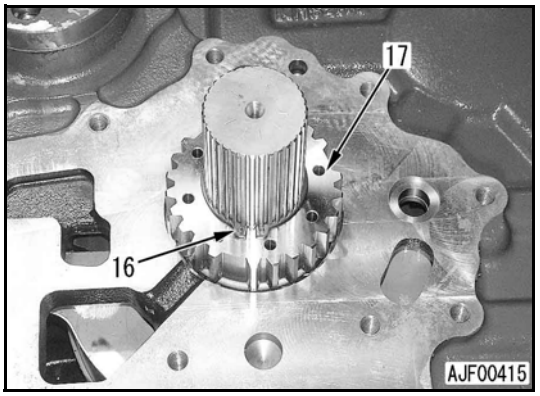


21. Hub

A. Turn over the transfer assembly, install hub (17).

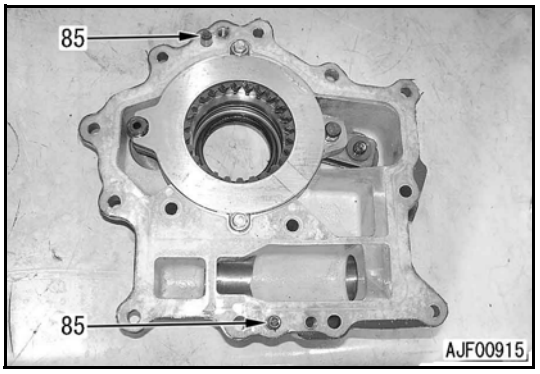
B. Install snap ring (16).

Spline of output shaft: Lubricant containing molybdenum disulfide (LM-P)



22. Parking brake assembly

A. Install 2 dowel pins (85) from the parking brake assembly.



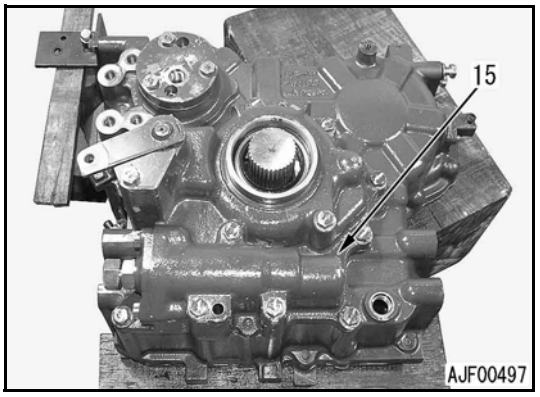
B. Install parking brake assembly (15).

★ After all internal teeth of the disc are meshed with the spline and clearance between the parking brake housing and transfer case is eliminated, tighten the mounting bolts.

★ If the mounting bolts are tightened while there is clearance between the parking brake housing and transfer case and the internal teeth of the disc are shifted from the spline, the disc will be broken. Accordingly, remove the dowel pins and check securely in advance that there is not clearance.

★ Do not reuse the basket but replace it.

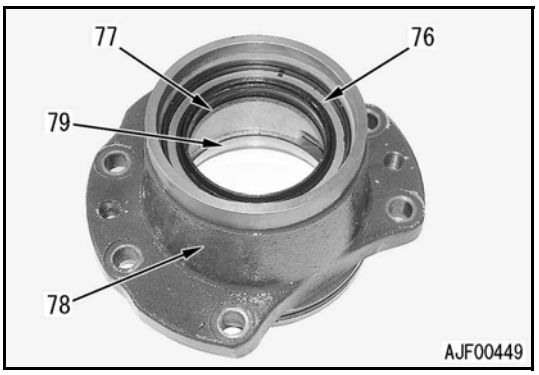
★ Install the coupling after ADJUSTING PRE-LOAD ON OUTPUT SHAFT TAPER ROLLER BEARING.



Mounting bolt: 98 - 123 Nm (72 - 91 lbf-ft)

23. Cage assembly

A. Press fit outer race (79) to cage (78).



ASSEMBLY

★ Clean the all parts and check them for dirt or damage. Coat their sliding surfaces with transfer oil (E010-CD) before installing.

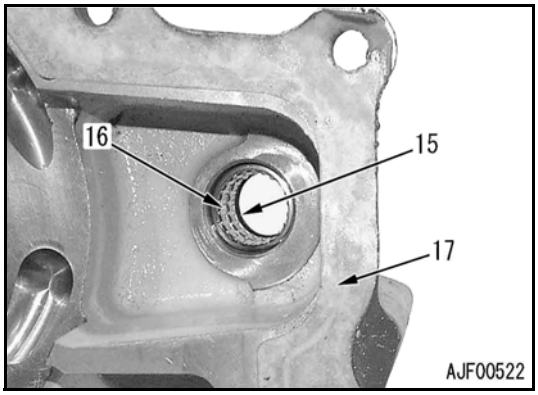
★ Do not reuse or replace the gasket but remove it completely.

1. Oil seal and bearings.

   A. Install two bearings (16) to parking brake case (17).

   B. Install oil seal (15). Although the gasket is fitted to the parking brake fitting face in the drawing, perform the work without fitting the gasket.

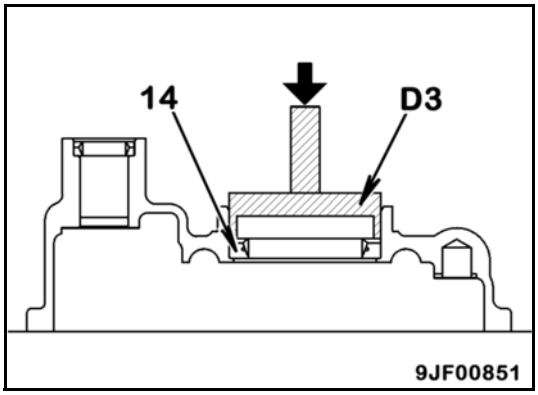
Oil seal: Grease (G2-LI)

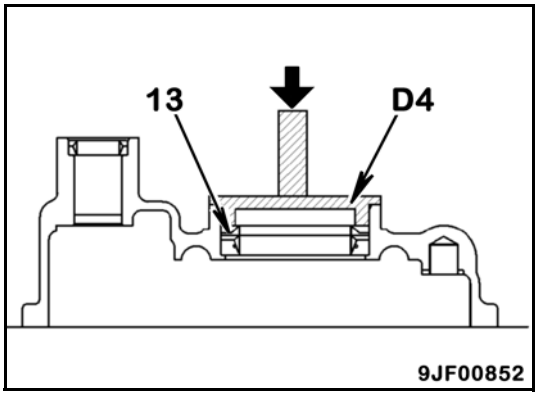


2. Oil seal and dust seal

   A. Using tools **D3** and **D4**, press fit oil seal (14) and dust seal (13).

Lips and clearances of oil seal and dust seal:
Silicone grease (ThreeBond 1855 or equivalent)





INSTALLATION

- Carry out installation in the reverse order to removal.

※1

Rear wheel mounting bolt: 785 - 980 Nm (579 - 723 lbf-ft)

※2

★ Check that the radial runout of the rear axle from the transfer in lateral direction is not larger than 3 mm. If it is larger than 3 mm, reduce it by moving the transfer mount.

★ When installing the drive shaft, check that the key way of the spider cap is fitted to the key way of the mating yoke, and then tighten the mounting bolts.

Rear drive shaft mounting bolt: 59 - 74 Nm (44 - 55 lbf-ft)

※3

Coupling mounting bolt: Adhesive (LT-2)

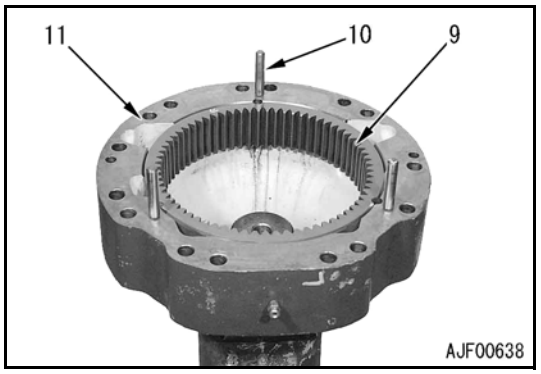
Coupling mounting bolt: 245 - 309 Nm (181 - 228 lbf-ft)

※4

Support mounting bolt: 785 - 980 Nm (579 - 723 lbf-ft)

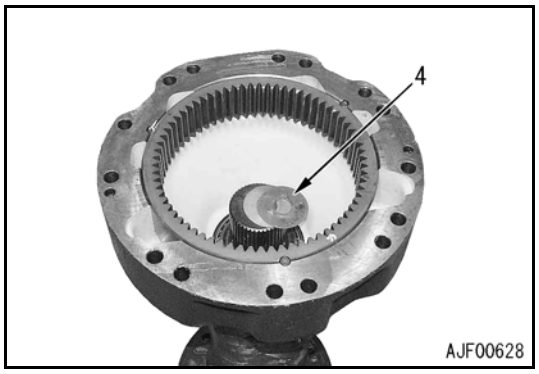
- **Bleeding air**
  Bleed air from the brake system. For details, see TESTING AND ADJUSTING, Bleeding air from brake circuit.

5. Install ring gear (9) to axle housing (11) and insert 3 pins (10).
   ★ Match the pin holes of the housing and ring gear.



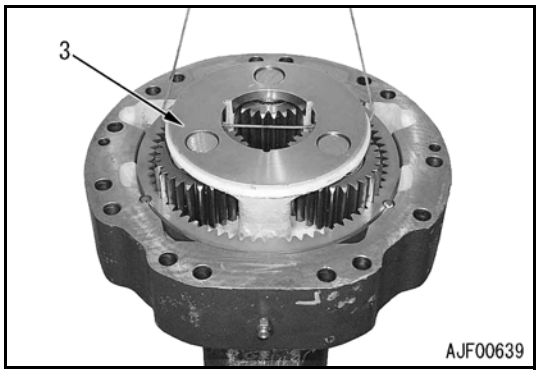
6. Planetary carrier assembly

   A. Install shim (4) selected in step 3-F) to the end of the axle shaft.



   B. Sling and install planetary carrier assembly (3).

WARNING! When installing the planetary carrier, take care not to catch your fingers in the gears.

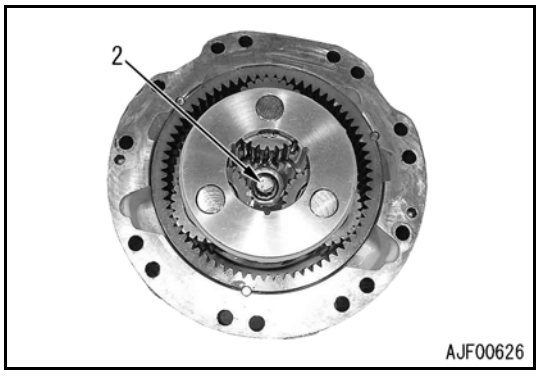


   C. Tighten mounting bolt (2).
      ★ Degrease and clean the bolt hole of the axle shaft and mounting bolt.

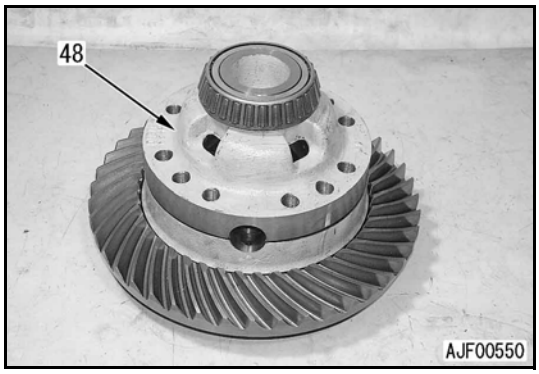
Mounting bolt: Adhesive (LT-2)

Mounting bolt: 490 - 608 Nm (361 - 448 lbf-ft)

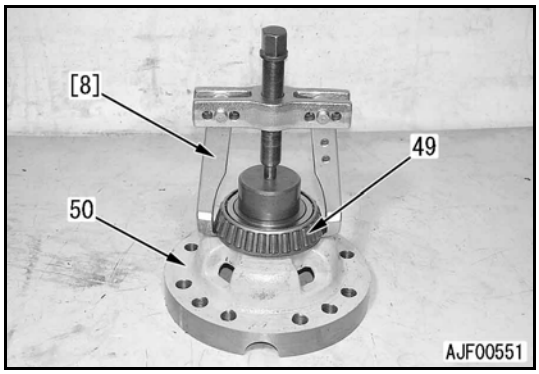
   ★ Clean the shaft end and planetary carrier spline thoroughly before installing.



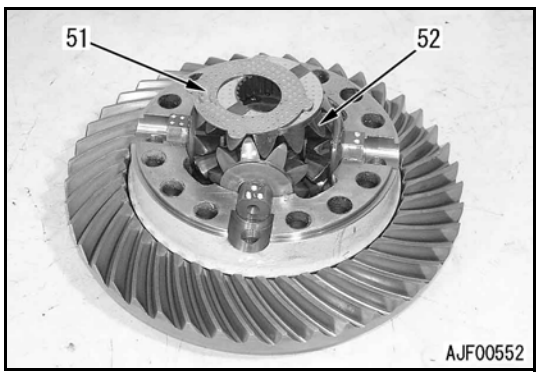
B. Remove case and bearing assembly (48).
★ Before disconnecting the case and bearing assembly, make match marks on it and the case.



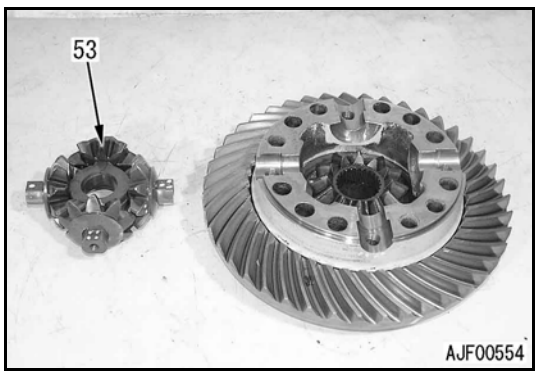
C. Using puller [8], remove bearing (49) from case (50).



D. Remove washer (51) and side gear (52).



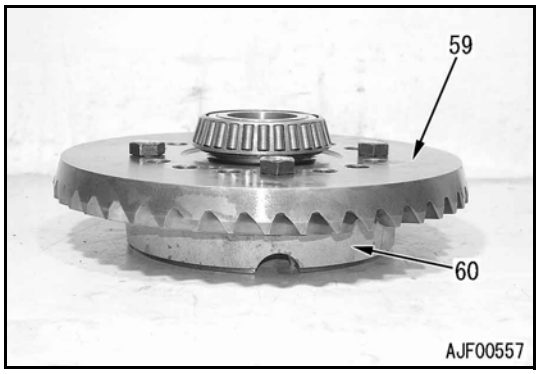
E. Remove pinion gear assembly (53).



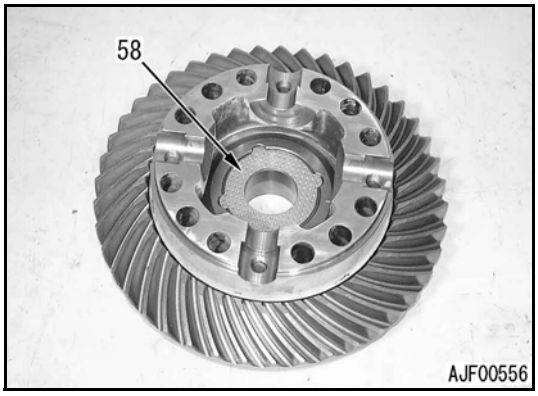
B. Install bevel gear and bearing assembly (59) to case (60) with the 4 mounting bolts.
   - ★ Match the match marks made when the assembly was removed.
   - ★ Install the mounting bolts to the 4 places of the spider shaft.

Mounting bolt: Adhesive (LT-2)

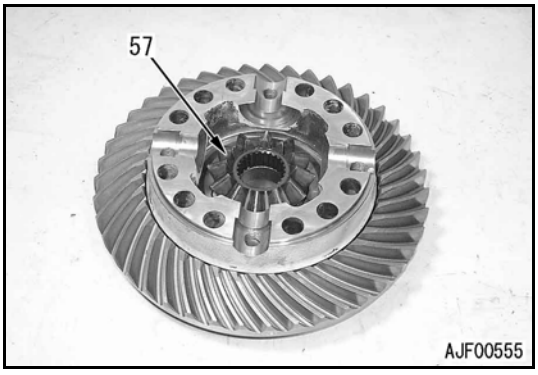
Mounting bolt: 245 - 309 Nm (181 - 228 lbf-ft)



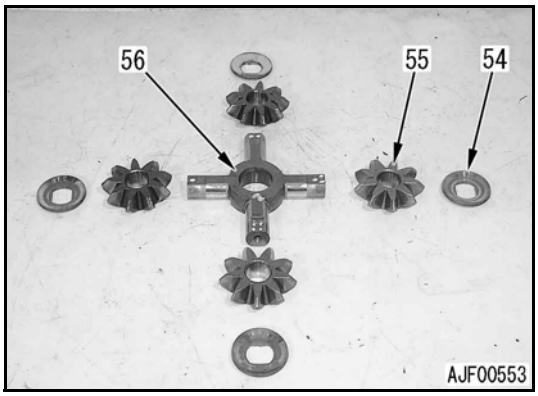
C. Install washer (58).
   - ★ Install the washer with the dimpled side up (toward the side gear).



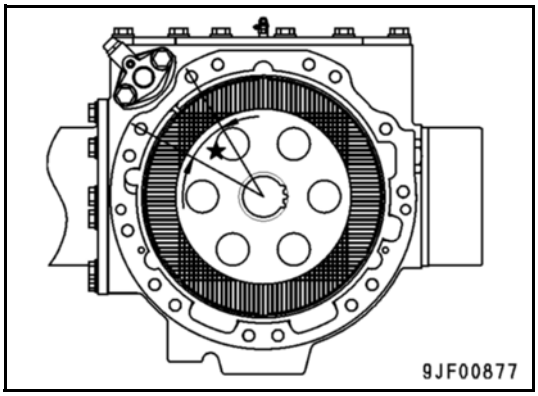
D. Install side gear (57).



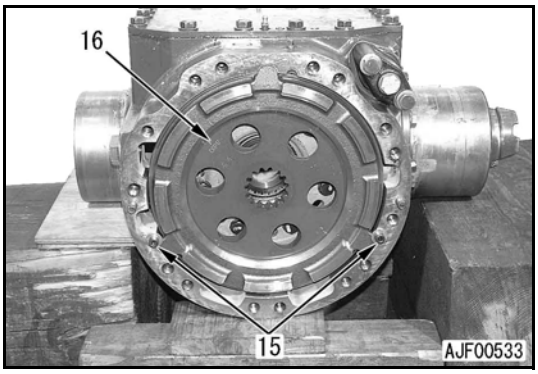
E. Install four pinion gears (55) and four spherical bushings (54) to spider shaft (56).



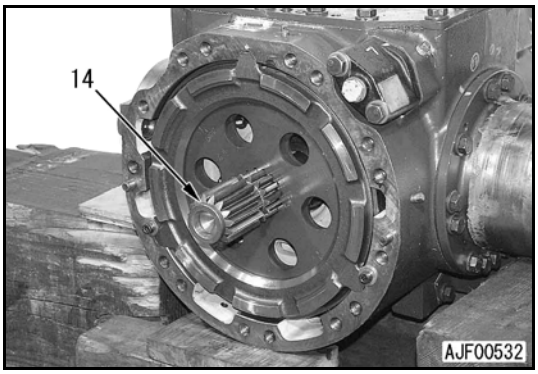
★ Pile up the 2 springs and match their cuts to each other, and then install them so that their cuts will be in the range marked with ★ in the brake oil port.



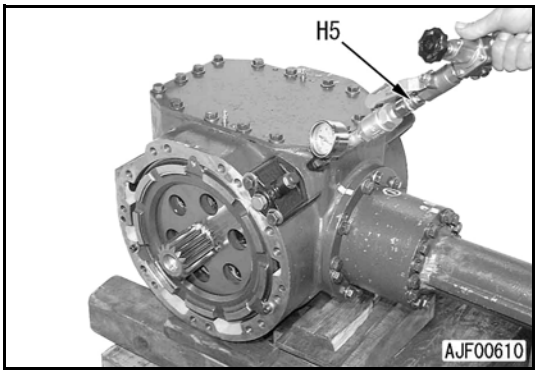
D. Install outer plate (16) and install 2 inside hexagon bolts (15).



E. Install sun gear shaft (14).

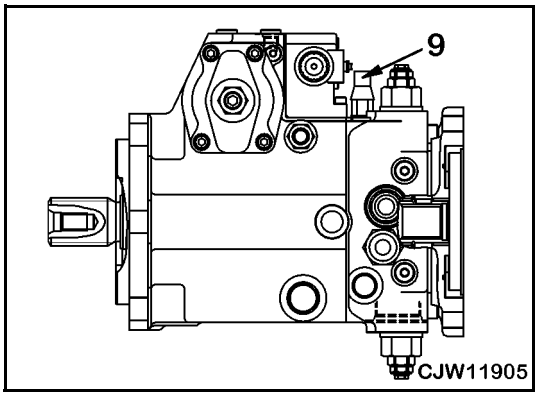


F. Using tool **H15**, supply air into the brake oil port to fit the piston.



3. High pressure cut-off valve assembly

A. Remove high pressure cut-off valve assembly (9)
★ Unscrew setting cartridge completely.
★ Control: O-ring, housing.



B. Disassemble the high pressure cut-off valve according to the following procedure, if necessary.
★ Before loosening the adjustment screw, check the adjustment dimension.

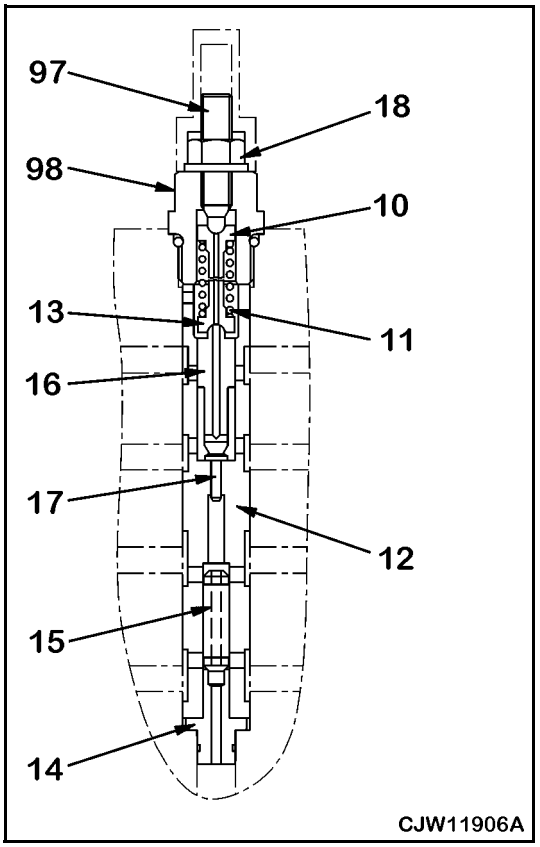
i. Remove spring seat (10) and spring (11) from the pump case.

ii. Remove barrel assembly (12) from the pump case.

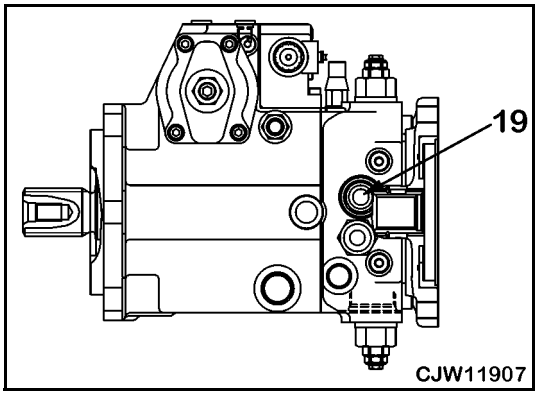
iii. Remove spring seat (13), valve seat (14), and shuttle spool (15) from barrel (12).

iv. Remove spool (16) and piston (17) from barrel (12).

v. Remove locknut (18), and then remove adjustment screw (97) from holder (98).

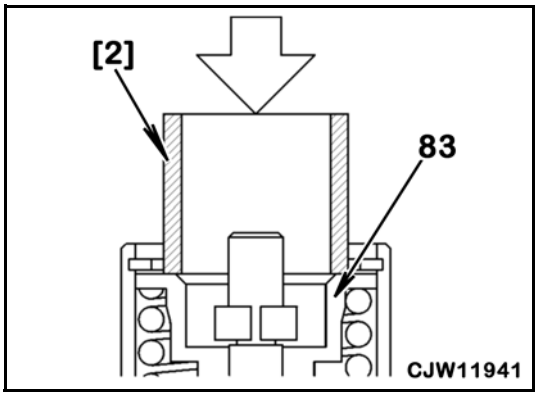


4. Remove speed-related (DA) valve assembly (19).



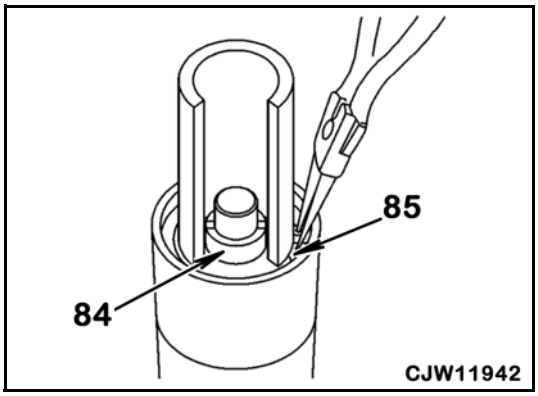
G. Disassemble the servo piston assembly according to the following procedure.

i. Using tool [2], push collar (83).



ii. Remove two rings (84).

iii. Remove snap ring (85).

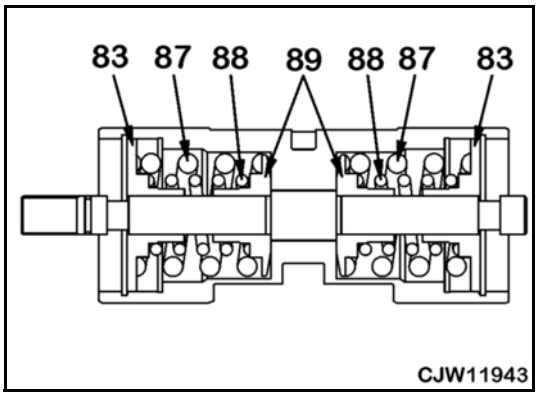


iv. Remove collars (83).

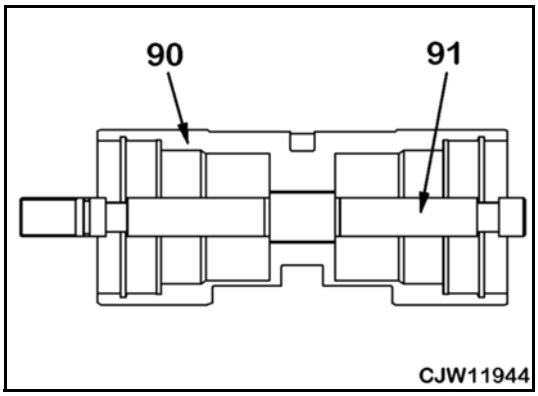
v. Remove large springs (87) and small springs (88).

vi. Remove collars (89).

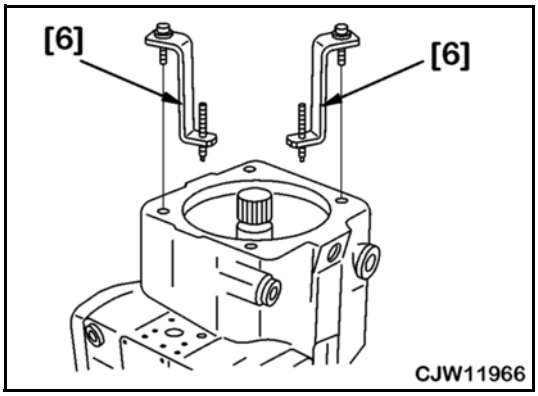
vii. Disassemble the opposite side similarly.



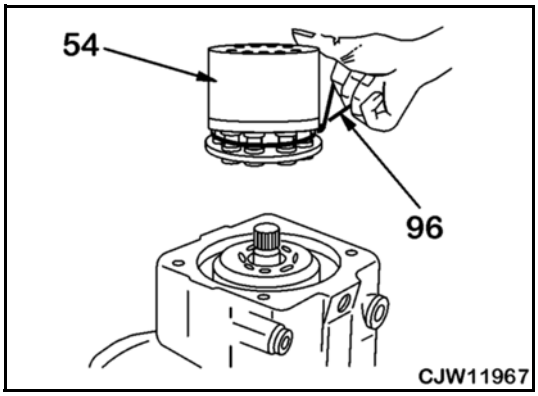
viii. Remove rod (91) from piston (90).



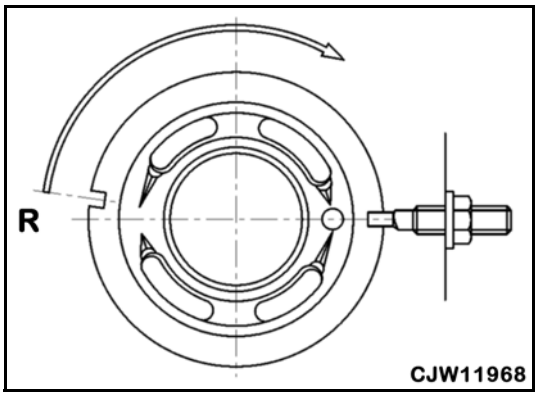
B. Remove holding device [6].
   ★ Fit cylinder complete with pistons and retaining device.



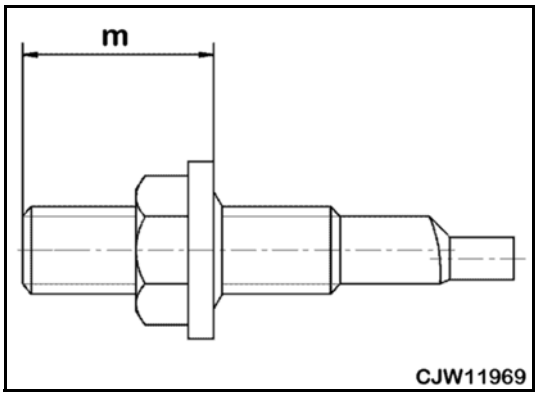
C. Hold the cylinder block and piston assembly (54) by using an O-ring (96).



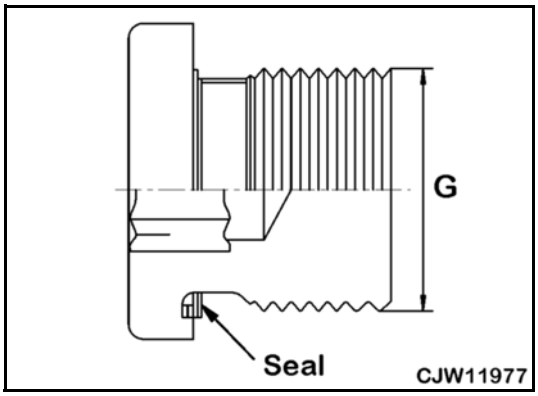
6. Control plate
   ★ Control plate clockwise rotation - indexed in the direction of rotation.
   ★ Noise grooves are machined - in based on direction of rotation.



   ★ Indexing screw basic setting - indexing screw
   Dimension m: 29 ± 0.75 mm



ii. Plugs with internal hexagon, O-ring and UNF-, UN-threads to SAE J 514



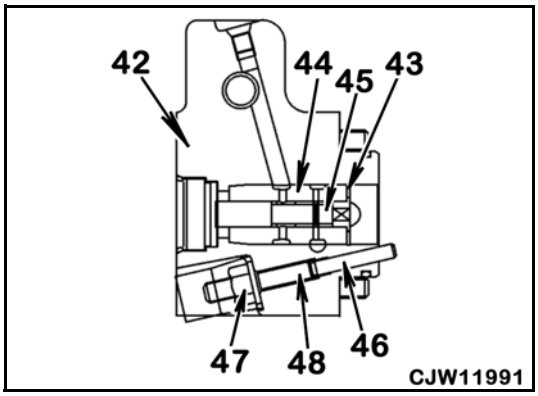
Thread	Tightening torque		Thead	Tightening torque	
7/16-20UNF	15 Nm	11 lbf-ft	M12 x 1.5	20 Nm	15 lbf-ft
1/2-20UNF	20 Nm	15 lbf-ft	M14 x 1.5	30 Nm	22 lbf-ft
9/16-18UNF	25 Nm	18 lbf-ft	M27 x 1.5	90 Nm	66 lbf-ft
3/4-16UNF	72 Nm	53 lbf-ft			
7/8-14UN	127 Nm	94 lbf-ft			
11/16-12UN	147 Nm	108 lbf-ft			
13/16-12UN	173 Nm	128 lbf-ft			
15/16-12UN	198 Nm	146 lbf-ft			
15/8-12UN	320 Nm	236 lbf-ft			
17/8-12UN	390 Nm	288 lbf-ft			

F. Disassemble the housing assembly according to the following procedure.

i. Remove snap ring (43), control bushing (44), and control piston (45) from housing (42).

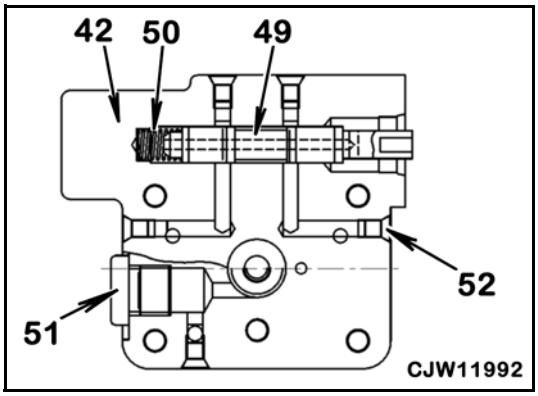
ii. Remove pin (46).

★ Do not remove nut (47) and screw (48).

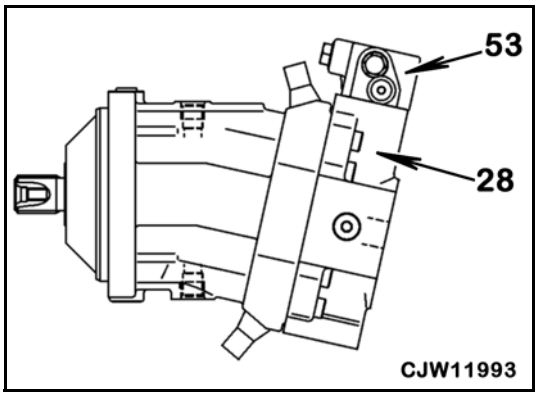


iii. Remove control piston (49) and spring (50) from housing (42).

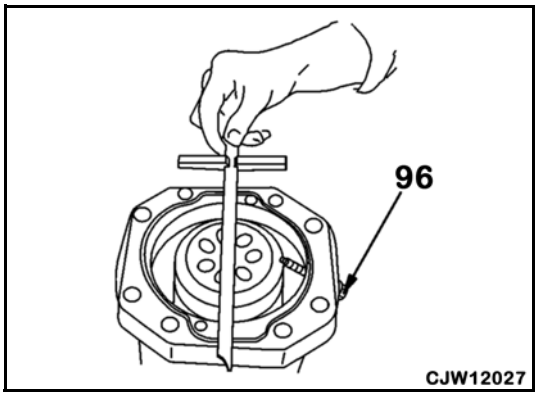
iv. Remove plug (51) and 5 plugs (52).

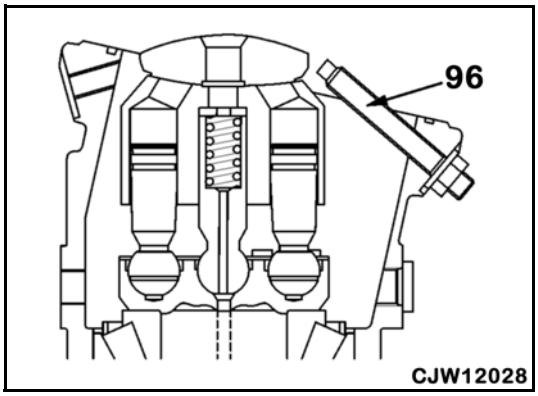


G. Remove flushing valve assembly (53) from port plate (28).



E. Determine cylinder swivel range to max, angle with Qmax-screw (96).





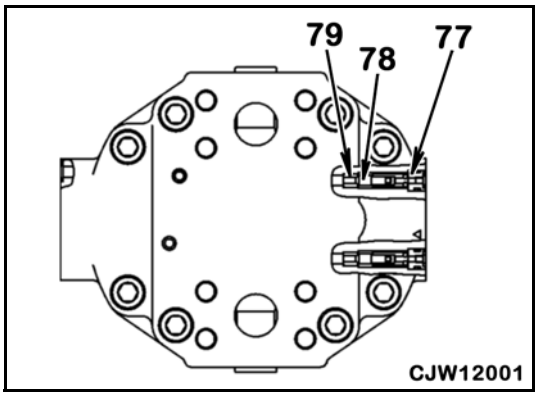
3. Port plate assembly

A. Assemble the port plate assembly according to the following procedure.

i. Install valve seat (79).

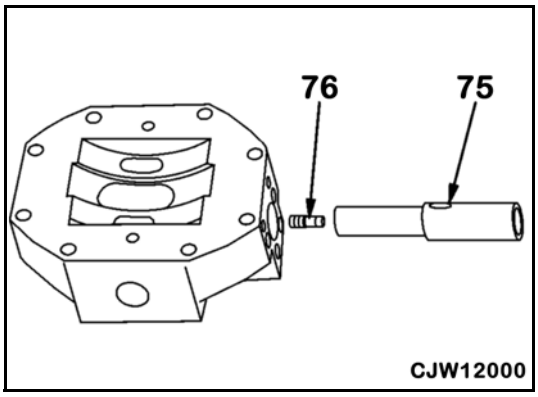
ii. Install poppet (78).

iii. Install valve guide (77).



iv. Install screw (76) to piston (75).

v. Install piston (75).



v. (8): Port A2 tube

vi. (9): Port B2 tube

vii. (10): Bucket DUMP PPC hose

viii. (11): Bucket TILT PPC hose

ix. (12): Boom LOWER PPC hose

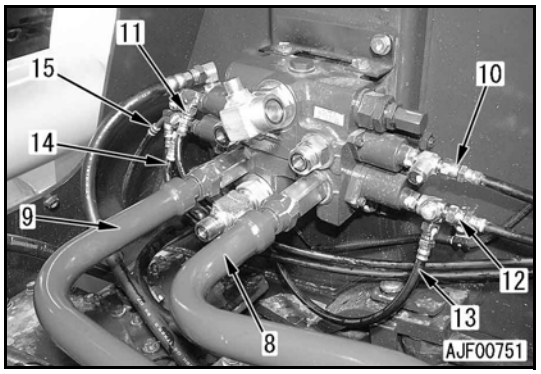
x. (13): Bypass valve port PP hose

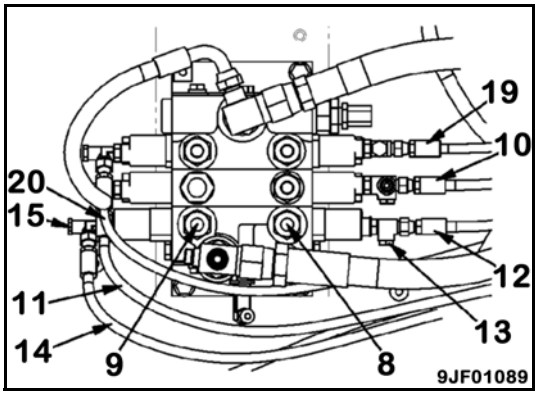
xi. (14): Boom RAISE PPC hose

xii. (15): Bypass valve port T hose

xiii. (19): PULL PPC hose (WA250PT-5L)

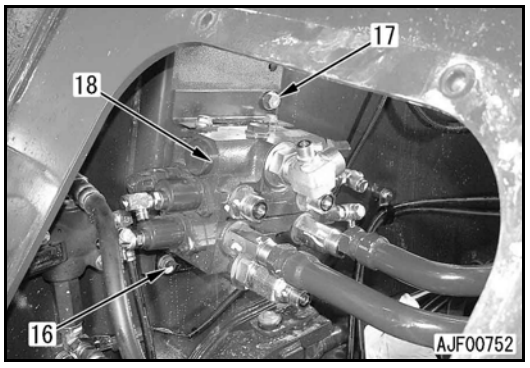
xiv. (20): PUSH PPC hose (WA250PT-5L)





4. Loosen two lower bracket mounting bolts (16) and remove one upper bracket mounting bolt (17).
   ★ Just loosen two lower bracket mounting bolts (16). Do not remove them.

5. Remove work equipment control valve assembly (18).



INSTALLATION

- Carry out installation in the reverse order to removal.

※1

★ Connect PPC hoses (10), (11), (12), (14), (19), and (20) according to their band colors shown below.

- PPC hose band colors

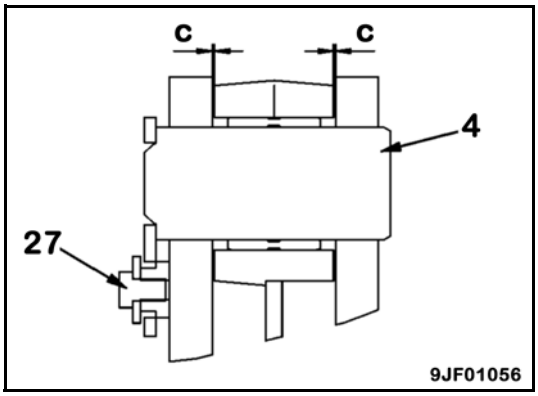
No.	Connecting point	Band color
(10)	Bucket DUMP	Orange
(11)	Bucket TILT	Red
(12)	Boom LOWER	Blue
(14)	Boom RAISE	Yellow
(19)	PULL (for WA250PT-5L)	Green
(20)	PUSH (for WA250PT-5L)	White/Red

- **Refilling with oil (Hydraulic tank)**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, recheck the oil level.

※3

BUCKET CYLINDER PIN (ON ROD SIDE)

★ It is not necessary to adjust shims for clearance (c).



1. Install mounting pin (4) and lock it with bolt (27).
   ★ Take care not to damage the pin.
   ★ Before installing the pin, apply lubricant containing molybdenum disulfide to the inside of the bushing.

   Inside of bushing: Lubricant containing molybdenum disulfide (LM-P or equivalent)

   ★ After installing the pin, supply grease containing molybdenum disulfide.

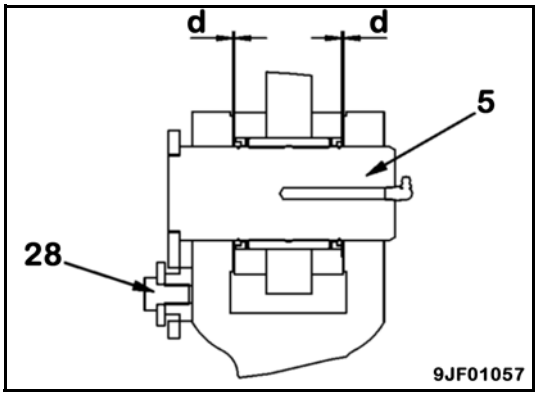
   Grease: Lubricant containing molybdenum disulfide (LM-G or Hyper White G1-T)

2. Adjust the bucket positioner. For details, see TESTING AND ADJUSTING, Testing and adjusting bucket positioner.

※4

LIFT CYLINDER PIN (ON ROD SIDE)

WARNING! When starting the engine, check that the forward-reverse lever is in neutral and the parking brake is applied.



1. Insert shims in clearance (d).
   - Clearance (d) (On each side): Max. 1.5 mm (0.059 in)
   - Varieties of shim thickness: Only 1.5 mm (0.059 in)

2. Install mounting pin (5) and lock it with bolt (28).
   ★ Take care not to damage the pin.
   ★ Before installing the pin, apply lubricant containing molybdenum disulfide to the inside of the bushing.

   Inside of bushing: Lubricant containing molybdenum disulfide (LM-P or equivalent)

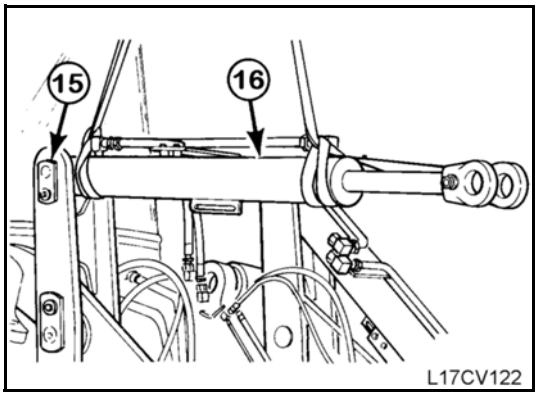
   ★ After installing the pin, supply grease containing molybdenum disulfide.

   Grease: Lubricant containing molybdenum disulfide (LM-G or Hyper White G1-T)

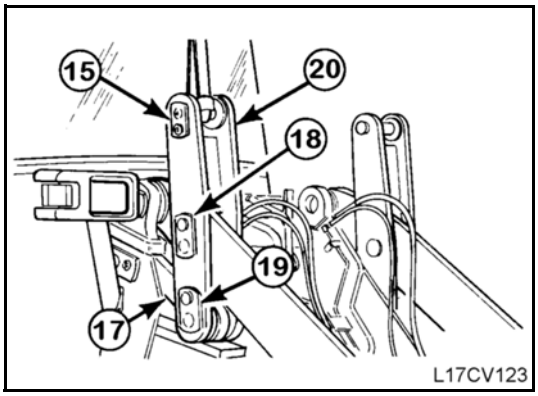
※5

★ Adjust the boom kick-out. For details, see TESTING AND ADJUSTING, Testing and adjusting of boom kick-out.

C. Attach hoist and sling to the ends of the cylinder housing, remove pin (15) and cylinder (16).
   ★ There maybe shims installed, so check the number of shims for reference when installing.

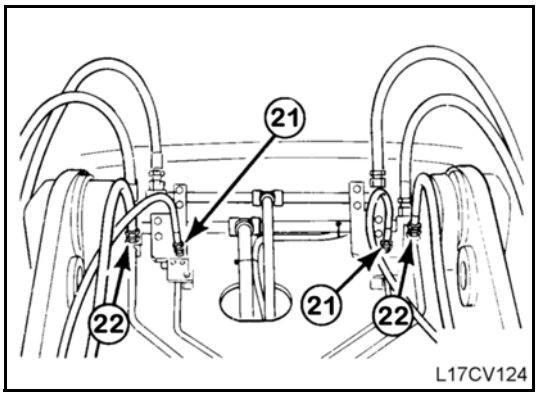


5. Install rear tilt cylinder mounting pin (15) to lever and attach hoist and sling. Place block under tilt link (17), remove pins (18) and (19), and remove rear tilt lever (20).
   ★ There maybe shims installed, so check the number of shims for reference when installing.

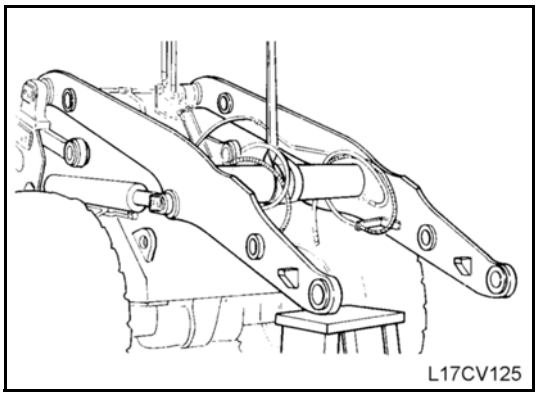


6. Boom.

   A. Disconnect cap and plug hydraulic hoses (21) and (22).



   B. Position boom control lever in float. Using hoist and sling, raise the boom and place on a stand.

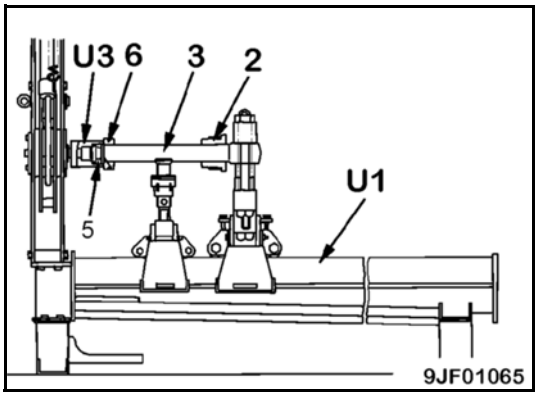


4. Piston and cylinder head (Steering cylinder and lift cylinder)

   A. Set cylinder head and piston rod assembly (3) to tool **U1**.

   B. Using tool **U3**, remove nut (5).
   - Width across flats of nut
     (Steering): 46 mm
     (Lift): 80 mm

   C. Remove piston assembly (6) and cylinder head assembly (2).

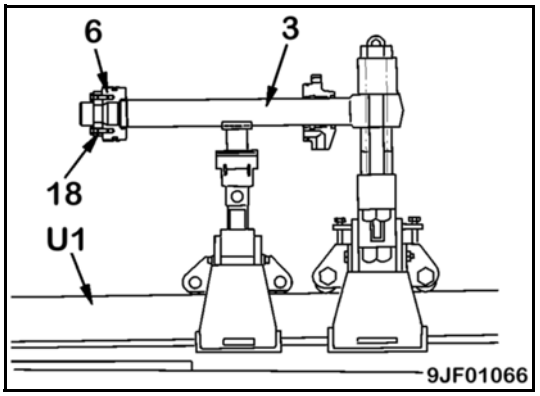


5. Piston and cylinder head (WA250-5L bucket cylinder)

   A. Set cylinder head and piston rod assembly (3) to tool **U1**.

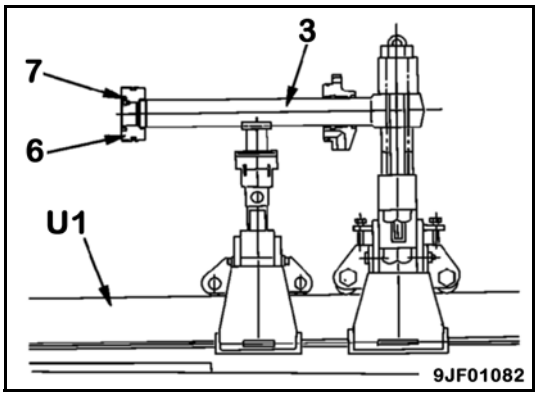
   B. Remove the mounting bolts and 2 spacers (18).

   C. Remove piston assembly (6) and cylinder head assembly (2).

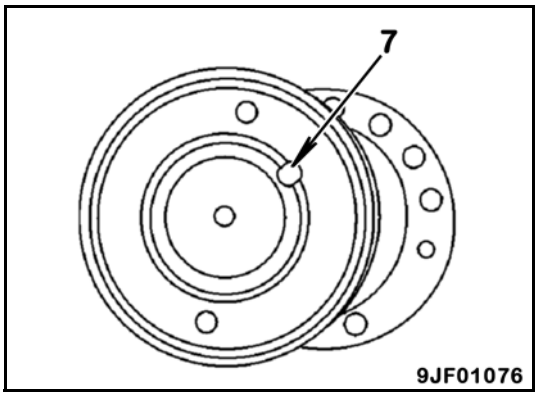


6. Piston and cylinder head (WA250PT-5L bucket cylinder)

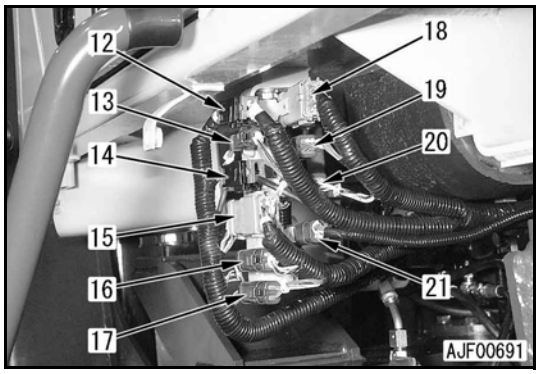
   A. Set cylinder head and piston rod assembly (3) to tool **U1**.



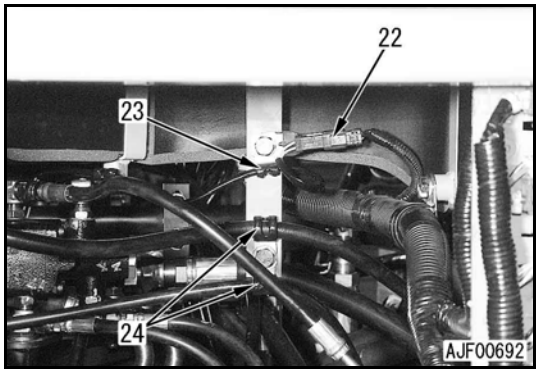
   B. Remove lock screw (7) of the piston assembly.
   - ★ Screw size: M12 x 1.75



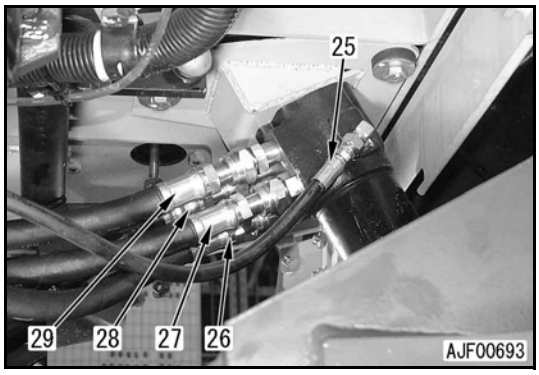
B. Left side of operator's cab
- (12): LR2
- (13): LR1
- (14): LR3
- (15): LT1
- (16): LT2
- (17): LT3
- (18): LR4
- (19): LR6
- (20): LR5
- (21): LB1
- (22): L34



8. Disconnect wire clamp (23) and brake valve hose clamps (24).

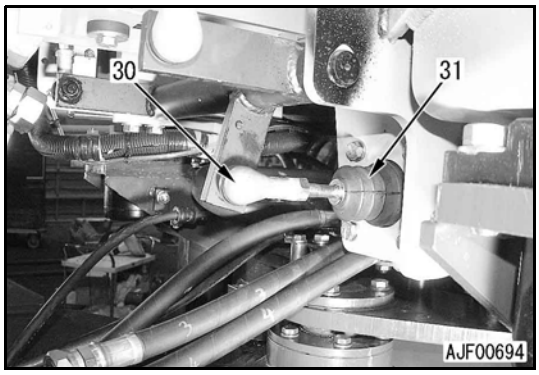


9. Disconnect hoses (25) - (29) from the orbit-roll valve.
- (25): Port LS hose (Right)
- (26): Port P hose (Left lower)
- (27): Port R hose (Right lower)
- (28): Port T hose (Left upper)
- (29): Port L hose (Right upper)



10. Remove the locknut and disconnect brake valve linkage (30). ※3.

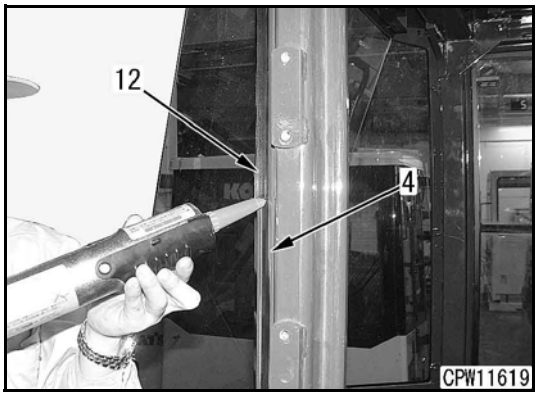
11. Remove the mounting bolt and place brake valve (31) on the frame.



D. Remove release tape (13) of the doublesided adhesive tape on the glass side.

E. Apply adhesive (12) to the outside of doublesided adhesive tape (4) of the operator's cab.

★ Before applying the adhesive, check that the primer is applied to the surface to which the adhesive will be applied.

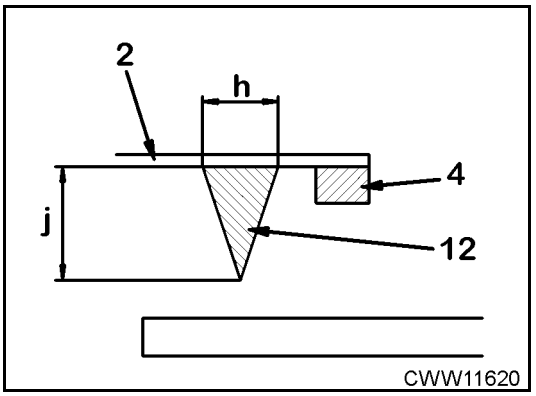


★ Apply adhesive (12) to dimensions (h) and (j) of operator's cab (2).

- Dimension (h): 10 mm (0.394 in.)
- Dimension (j): 12 mm (0.472 in.) (Approx. twice as high as adhesive tape)

★ Apply adhesive (12) higher than doublesided adhesive tape (4).

★ Apply the adhesive evenly.



8. Install window glass (3).

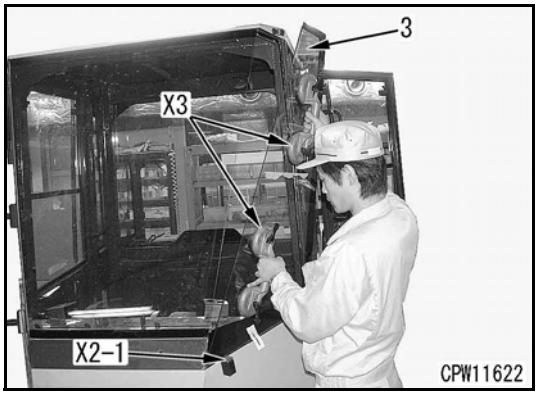
★ If the glass is positioned wrong, the adhesive must be removed and cleaned, and then the primer and adhesive must be applied again. Accordingly, position the glass carefully.

A. Using tool **X3**, raise and place window glass (3) on tool **X2-1** (5-mm spacer) and press it to the operator's cab.

★ Match the lines of the match tapes stuck in step 5-E.

★ Place the glass within 10 minutes after applying adhesive.

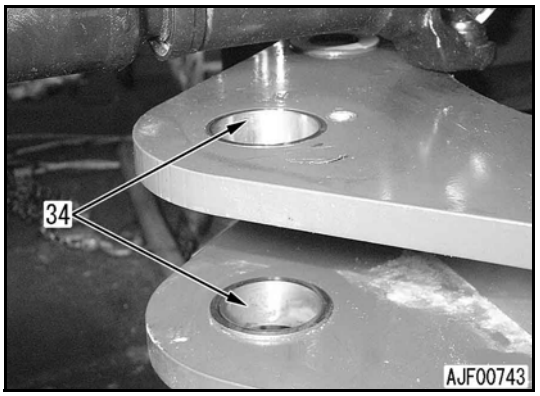
★ Before sticking the glass, check that the primer is applied to the surface properly.



※9 ※10 ※11

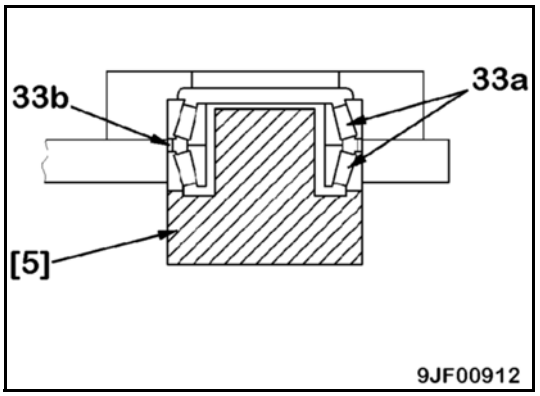
★ Assemble the upper hinge and lower hinge according to the following procedure.

1. Install 2 bushings (34) to the lower hinge of the rear frame.



2. Assemble the upper hinge of the front frame.

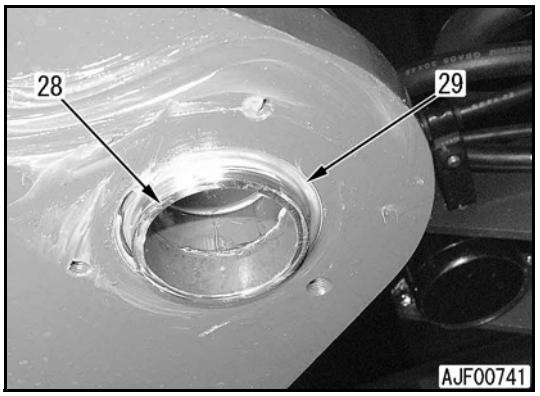
   A. Using push tool [5], press fit bearing (33a) and spacer (33b) to the front frame.
      ★ Since the clearance of bearing (33a) and spacer (33b) is adjusted properly, do not change their combination.
      ★ Since bearing (33a) and spacer (33b) are an assembly, always replace them as a set.
      ★ Press fit bearing (33a) and spacer (33b) securely so there is no clearance between the bearing and frame.



Bearing: Grease (G2-LI)

   B. Press fit dust seal (29) to the front frame.
      ★ Press fit the dust seal with the lip out.

Lip of dust seal: Grease (G2-LI)



   C. Install lower spacer (28).
      ★ Install the spacer with the chamfered part on the bearing side.

Lower spacer: Lubricant containing molybdenum disulfide (LM-P)

   D. Press fit dust seal (32) to retainer (30).
      ★ Press fit the dust seal with the lip out.

Lip of dust seal: Grease (G2-LI)

   E. Tighten the 3 mounting bolts of retainer (30) evenly.

Retainer mounting bolt: 14.7 Nm (11 lbf-ft)