CEBM013602

SHOP MANUAL

WA320PT-5L

PARALLEL TOOL CARRIER

SERIAL NUMBERS **WA320PT-5L A39001** and UP

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.

Due to this continuous program of research and development, periodic revisions may be made to this publication. It is recommended that customers contact their distributor for information on the latest revision.

September 2009
Printed in USA

DataKom Publishing Division
00-1 ②

SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended and described in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed for the purpose.

To prevent injury to workers, the symbols ⚠ and ⚠ are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the OPERATION & MAINTENANCE MANUAL carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.

2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
- Always wear safety glasses when hitting parts with a hammer.
- Always wear safety glasses when grinding parts with a grinder, etc.

3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.

4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.

5. Keep all tools in good condition and learn the correct way to use them.

6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

1. Before adding oil or making repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.

2. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.

3. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.

4. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

1. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out. Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.

2. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned. Wait for the oil and water to cool before carrying out any work on the oil or water circuits.

3. Before starting work, remove the leads from the battery. ALWAYS remove the lead from the negative (-) terminal first.

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PIPING JOINTS

★ Unless there are special instructions, tighten the O-ring boss piping joints to the torque below.

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {lbf ft})	
	mm	mm	Range	Target
02	14	Varies depending on type of connector.	35 - 63 {25.81 - 46.46}	44 {32.45}
03, 04	20		84 - 132 {61.95 - 97.35}	103 {75.96}
05, 06	24		128 - 186 {94.40 - 137.18}	157 {115.79}
10, 12	33		363 - 480 {267.73 - 354.02}	422 {311.25}
14	42		746 - 1010 {550.22 - 744.93}	883 {651.26}

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PLUGS

★ Unless there are special instructions, tighten the O-ring boss plugs to the torque below.

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {lbf lb})	
	mm	mm	Range	Target
08	08	14	5.88 - 8.82 {4.33 - 6.50}	7.35 {5.42}
10	10	17	9.8 - 12.74 {7.22 - 9.39}	11.27 {8.31}
12	12	19	14.7 - 19.6 {10.84 - 14.45}	17.64 {13.01}
14	14	22	19.6 - 24.5 {14.45 - 18.07}	22.54 {16.62}
16	16	24	24.5 - 34.3 {18.07 - 25.29}	29.4 {21.68}
18	18	27	34.3 - 44.1 {25.29 - 32.52}	39.2 {28.91}
20	20	30	44.1 - 53.9 {32.52 - 39.75}	49.0 {36.14}
24	24	32	58.8 - 78.4 {43.36 - 57.82}	68.6 {50.59}
30	30	32	93.1 - 122.5 {68.66 - 90.35}	107.8 {79.50}
33	33	_	107.8 - 147.0 {79.50 - 108.42}	124.4 {91.75}
36	36	36	127.4 - 176.4 {93.96 - 130.10}	151.9 {112.03}
42	42	_	181.3 - 240.1 {133.72 - 177.08}	210.7 {155.40}
52	52	_	274.4 - 367.5 {202.38 - 271.05}	323.4 {238.52}

TIGHTENING TORQUE TABLE FOR HOSES (TAPER SEAL TYPE AND FACE SEAL TYPE)

★ Tighten the hoses (taper seal type and face seal type) to the following torque, unless otherwise specified.

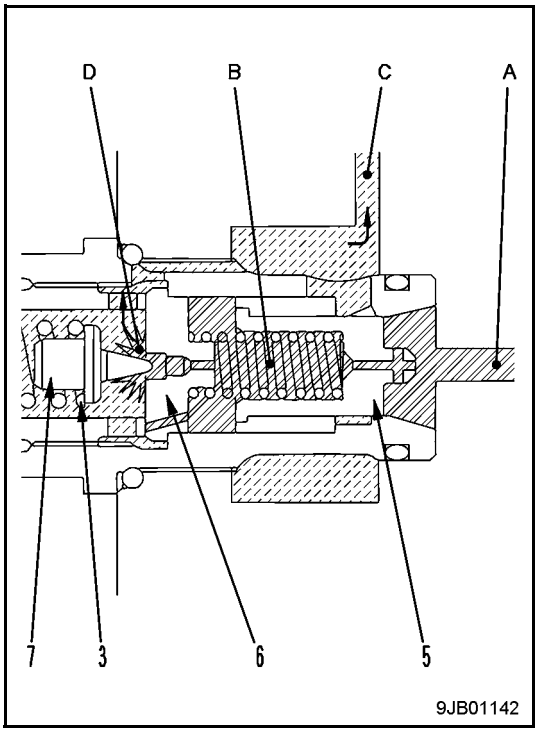
★ Apply the following torque when the threads are coated (wet) with engine oil.

Nominal size of hose	Width across flats	Tightening torque (Nm {lbf ft})		Taper seal type	Face seal type	
		Range	Target	Thread size (mm)	Nominal thread size - Threads per inch, Thread series	Root diameter (mm) (Reference)
02	19	34 - 54 {25.0 - 39.8}	44 {32.4}	-	9/16 - 18UN	14.3
		34 - 63 {25.0 - 46.4}	44 {32.4}	14	-	-
03	22	54 - 93 {39.8 - 68.5}	74 {54.5}	-	11/16 -16UN	17.5
	24	59 - 98 {43.5 - 72.2}	78 57.5}	18	-	-
04	27	84 - 132 {61.9 - 97.3}	103 {75.9}	22	13/16 - 16UN	20.6
05	32	128 - 186 {94.4 - 137.1}	157 {115.7}	24	1 - 14UNS	25.4
06	36	177 - 245 {130.5 - 180.7}	216 {159.3}	30	1 3/16 - 12UN	30.2
(10)	41	177 - 245 {130.5 - 180.7}	216 {159.3}	33	-	-
(12)	46	197 - 294 {145.3 - 216.8}	245 {180.7}	36	-	-
(14)	55	246 - 343 {181.4 - 252.9}	294 {216.8}	42	-	-

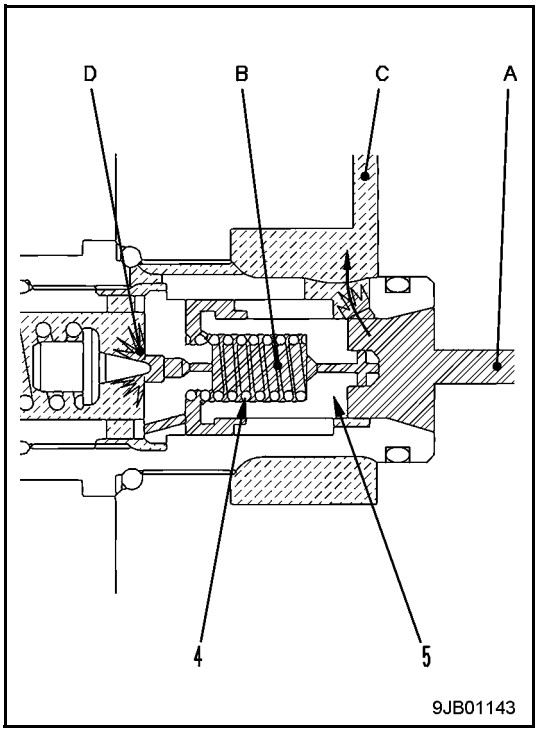
Machine model				WA320PT-5L
Serial No.				A39001 and UP
Engine	Model		—	SAA6D102E-2-A
	Type		—	4-cycle, water-cooled, in-line, 6-cylinder, direct injection with turbocharger, air-cooled after cooler
	No. of cylinders - bore x stroke		mm	6 – 102 x 120
	Piston displacement		L {cc}	5.88 {5,880}
	Flywheel horsepower		kW / rpm	124 / 2,000
			{HP / rpm}	{166 / 2,000}
	Maximum torque		N·m / rpm	647 / 1,400
			{kgf·m / rpm}	{66 / 1,400}
	Minimum fuel consumption ratio		gal/kWh {gal/HPh}	224 {167}
	High idling speed		rpm	2,225
	Low idling speed		rpm	900
	Starting motor		—	24 V 5.5 kW
	Alternator		—	24 V 60 A
	Battery		—	24 V 110 Ah x 2 pcs
Power train	HST pump		—	Variable displacement swash plate type piston pump
	HST motor 1		—	Variable displacement bent axis type piston motor
	HST motor 2		—	Variable displacement bent axis type piston motor
	Transfer		—	Multiple shaft planetary compound-type, spur gear constant mesh-type, 2 alternative power systems
	Reduction gear		—	Spiral bevel gear, splash lubrication type
	Differential		—	Straight bevel gear type, torque portioning
	Final drive		—	Planetary gear 1-stage, splash lubrication type
Axle	Drive type		—	Front and rear wheel drive
	Front axle		—	Fixed to frame, semi-floating type
	Rear axle		—	Center pin support, semi-floating type
Tire	Tire size		—	20.5–25–12PR
	Rim size		—	25 x17.00–1.7
	Inflation pressure	Front tire	kPa (psi)	324 (47)
		Rear tire	kPa (psi)	275 (40)

Valve Operation

- Port **A** is connected to the high-pressure circuit of the HST pump and ports **C** and **D** are connected to the low-pressure circuit of the HST pump. The oil fills chamber **B** through the orifice of main piston (5). Pilot poppet (7) is seated on valve seat (6).



- If the oil pressure in port **A** and chamber **B** reaches the set pressure of poppet spring (3), pilot poppet (7) opens and the oil in chamber **B** flows through chamber **D** to port **C**, and the oil pressure in chamber **B** lowers consequently. If the oil pressure in chamber **B** lowers, a pressure difference is made between port **A** and chamber **B** by the orifice of main piston (5). As a result, main piston (5) is pushed open and the oil in port **A** flows into port **C** to relieve the abnormal pressure.
- The set pressure can be adjusted by increasing or decreasing the tension of poppet spring (3). To adjust the set pressure, remove the nut and loosen the locknut. If the adjustment screw is tightened, the set pressure is heightened. If the screw is loosened, the set pressure is lowered.
- If the oil pressure in port **A** lowers below that in port **C**, check spring (4) pushes back main piston (5) and the oil in port **C** flows through chamber **D** into port **A** so that the quantity of the oil in port **A** will not become insufficient.



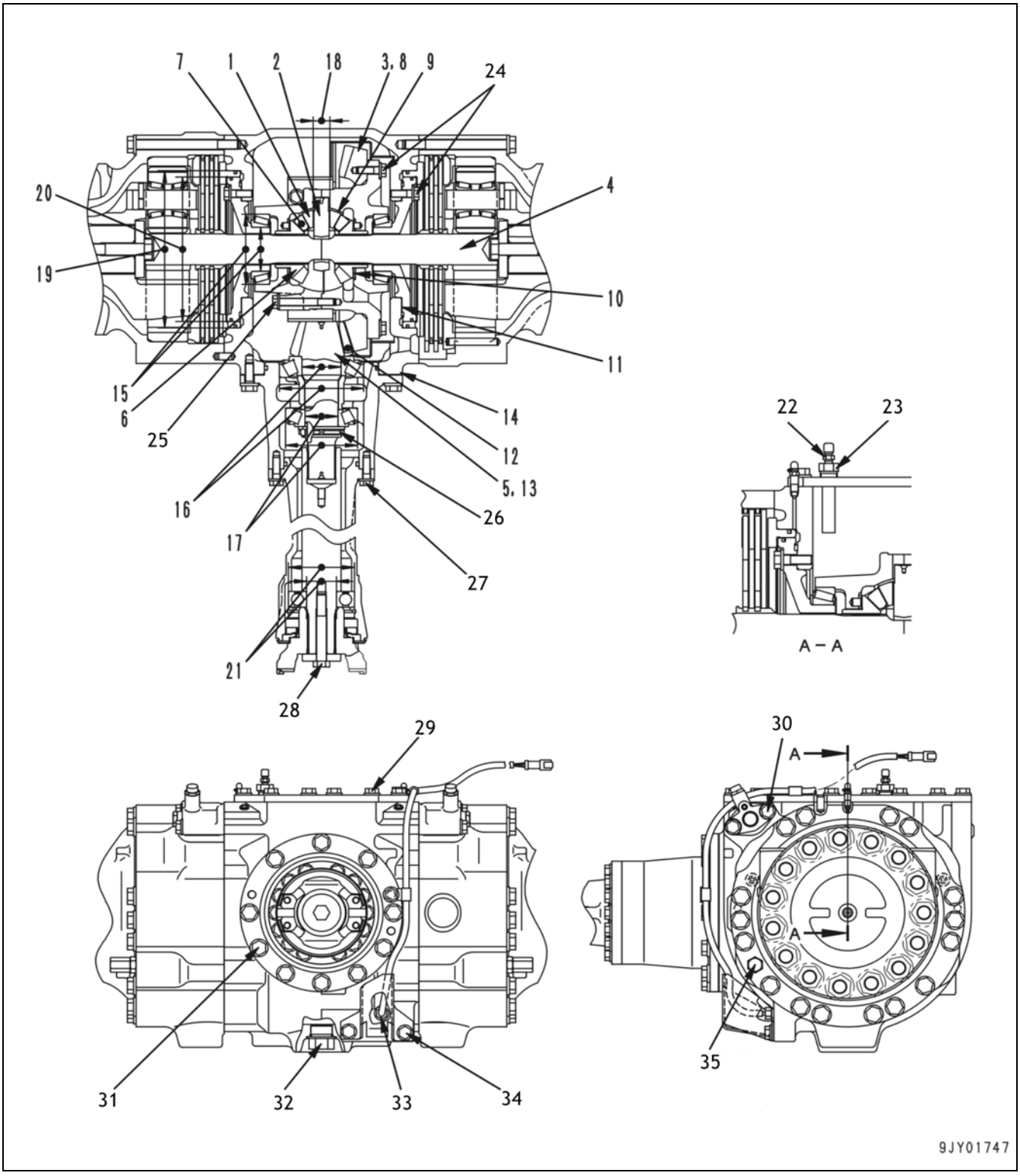
Outline

The transfer is equipped with two HST motors. The engine speed is changed to the forward 1st – 4th and rear 1st – 4th gear speeds by combining the output and revolving direction of the HST motor and the transfer clutch.

- The travel speed when tires of 20.5 – 25 size are used is shown in the table below.
- Relationship Between Transfer Clutch And Transfer Clutch Pressure At Each Gear Speed

Gear speed	Transfer clutch		Transfer clutch pressure	
1st	Engaged		OFF	
2nd	Engaged		OFF	
3rd	Travel speed 0 – 10 km/h (0 - 6 mph)	Travel speed 10 – 18 km/h (6 - 11 mph)	Travel speed 0 – 10 km/h (0 - 6 mph)	Travel speed 10 – 18 km/h (0 - 6 mph)
	Engaged	Disengaged	OFF	ON
4th	Travel speed 0 – 10 km/h (0 - 6 mph)	Travel speed 10 – 38 km/h (6 - 24 mph)	Travel speed 0 – 10 km/h (0 - 6 mph)	Travel speed 10 – 38 km/h (0 - 6 mph)
	Engaged	Disengaged	OFF	ON

Front Differential



1. Spider gear (9 teeth)
2. Shaft
3. Ring gear (42 teeth)
4. Sun gear shaft
5. Pinion gear (10 teeth)
6. Side gear (12 teeth)

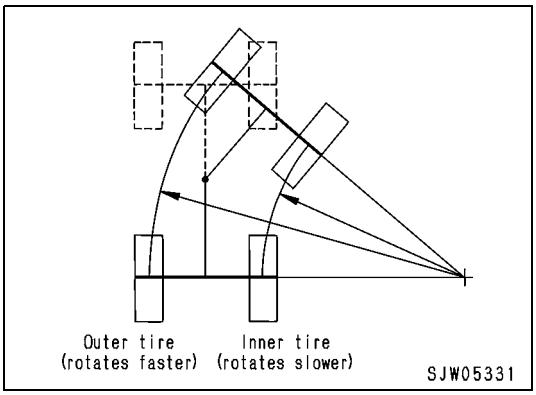
Difference In Wheel Drive Force For Each Type Of Differential When Wheel On One Side Slips

	Wheel drive force (when one wheel is slipping)		
	Slipping wheel	Locked wheel	Total (ratio)
Limited-slip differential (option)	1	2.64	3.64 (1.82)
Torque proportioning differential (standard)	1	1.38	2.38 (1)
Normal differential	1	1	2 (0.84)

On road surfaces where the wheel on one side is likely to slip, the limited-slip differential increases the drive force by 1.53 times more than the torque proportioning differential.

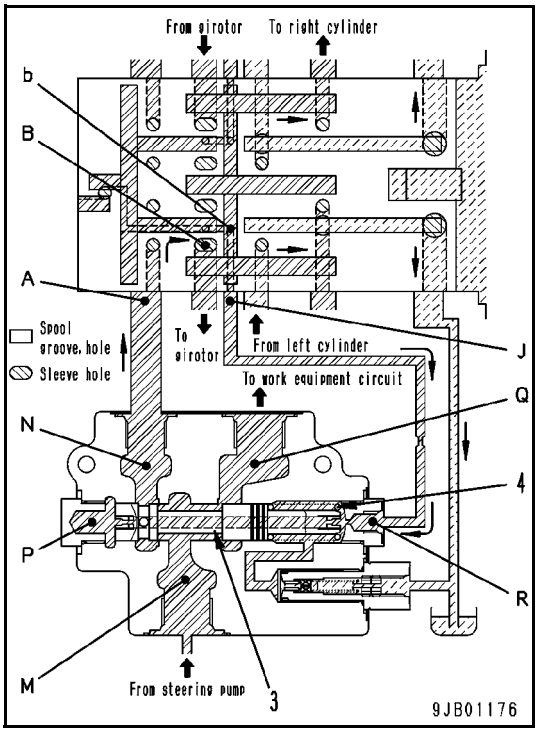
When Turning

The differential gears built into a limited-slip differential are the same as the gears used in a normal differential, so the difference in rotation between the inside and outside wheels when turning the machine can be generated smoothly.



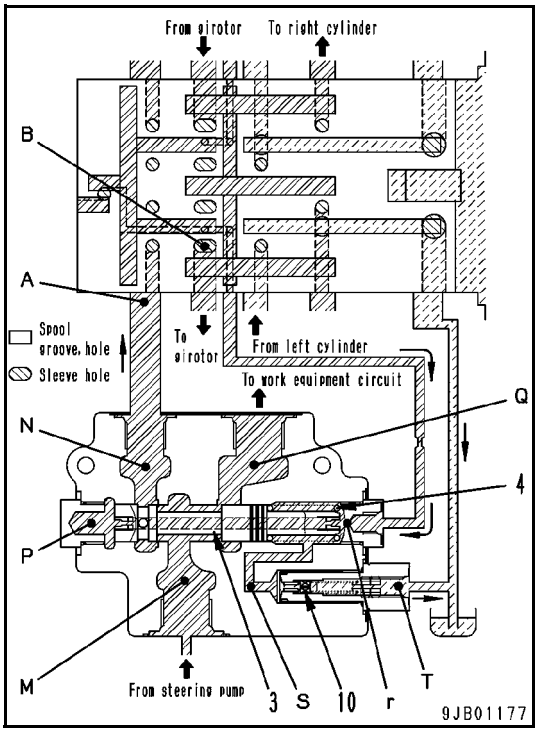
Steering Wheel Turned To Left

When the steering wheel is turned to the left, an angle variation is generated between the spool and sleeve of the orbit-roll valve, and the oil flow is switched. (For details, see ORBIT-ROLL VALVE.)
The oil from the pump flows from port **M** to port **N**, and enters port **A**. The degree of opening of the sleeve (port **A**) and spool (port **B**) creates a difference between the pressure up to port **A** and the pressure beyond port **B**. Some of the oil from port **B** flows to the gerotor, and then goes to the front right cylinder. The remaining oil passes through orifice **b**, flows to port **J**, and then enters port **R**.
When this happens, spool (3) stabilizes at a position where the differential pressure between the circuit up to port **A** and circuit beyond port **B** (pressure of port **P** - pressure of port **R**) and the load of the spring (4) are balanced. It adjusts the degree of opening from port **M** to ports **N** and **Q**, and distributes the flow to both circuits.
The ratio of this distributed flow is determined by the degree of opening of port **A** and port **B**, in other words, the angle variation between the sleeve and spool of the orbit-roll valve. The degree of opening is adjusted in steps by the amount the steering is turned.

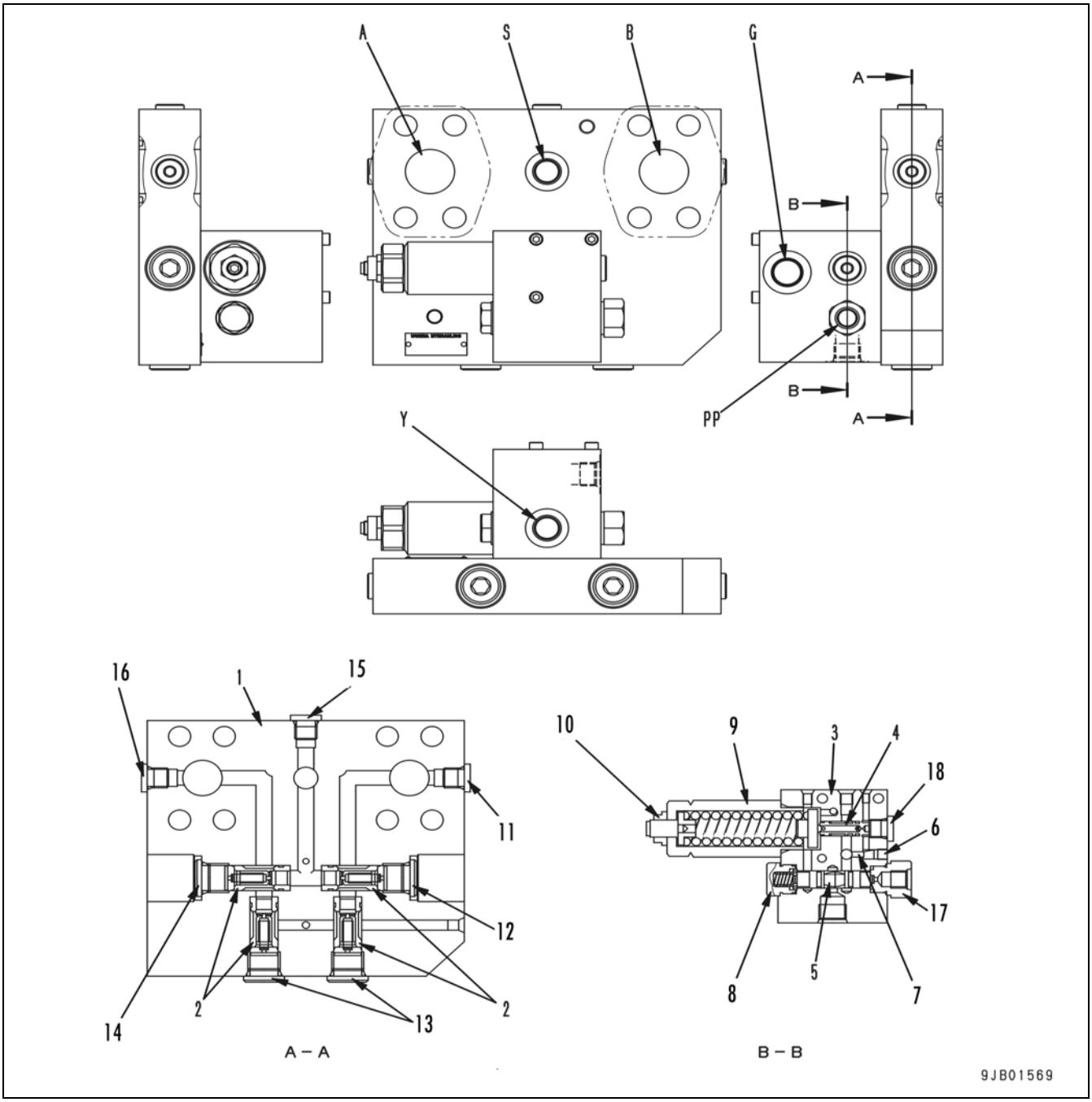


Steering Cylinder At End Of Stroke

If the operator tries to turn the steering wheel further when the steering cylinder has reached the end of its stroke, the circuit from port **M** through port **N** to port **S** is kept open and the pressure rises.
When this pressure rises above requirement pressure relief valve (10) opens and the oil is relieved to the hydraulic tank. Because of this flow of oil, a differential pressure is created on both sides of orifice **r**.
Therefore, the balance is lost between the load of spring (4) and the pressure up to port **A** and the pressure beyond port **B**. As a result, the pressure up to the port **A** becomes relatively higher.
For this reason, the pressure at port **P** moves spool (3) even further to the right from the condition in Item 2. It stabilizes the condition at a position where the circuit between ports **M** and **N** is almost fully closed, and the circuit between ports **M** and **Q** is almost fully open.



Steering Valve



PP: From steering pump
A: To port **A** of HST motor 2
B: To port **B** of HST motor 2
Y: To orbit-roll valve
S: To hydraulic tank
G: To pressure switch

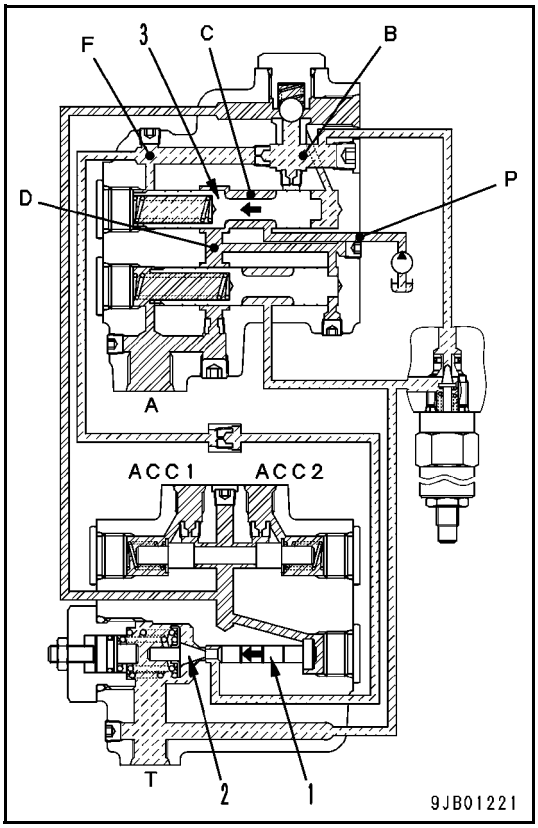
1. Check valve body
2. Check valve
3. Valve body
4. Pressure reducing valve
5. Selector valve

Operation

When Oil Is Not Supplied To Accumulator

★ **(Cut-out state)**

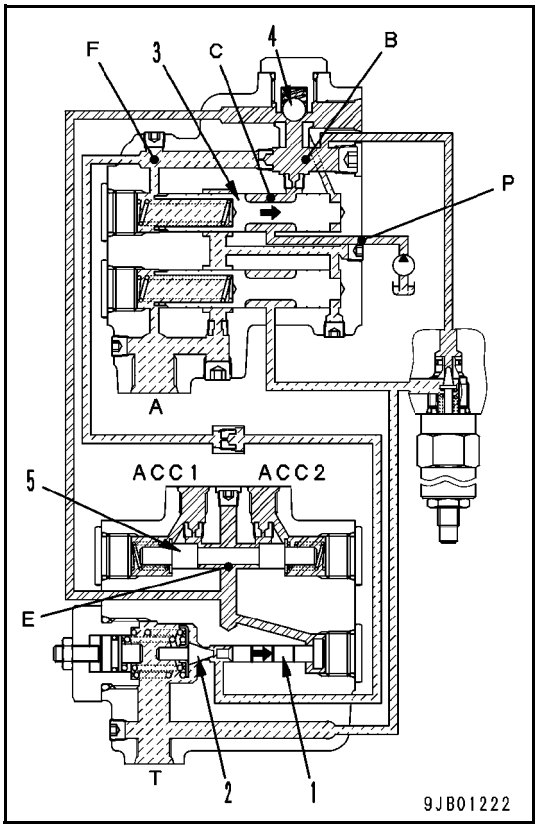
- Plunger (1) is moved by the pressure of the accumulator to the left to keep unload relief valve (2) pushed open.
- The oil in the spring chamber of unload valve (3) flows through port **F**, unload relief valve (2), and port **T** into the hydraulic tank.
- Since the oil pressure in port **F** lowers, unload valve (3) is moved by the oil pressure in chamber **B** to the left.
- Accordingly, ports **C** and **D** are connected to each other and almost all the oil from the pump flows through ports **P**, **C**, **D** and **A** to the cooling fan motor.



When Oil Is Supplied To Accumulator

★ **(Cut-in state)**

- If the accumulator pressure lowers, the pressure in port **E** lowers and plunger (1) moves to the right and unload relief valve (2) closes the drain circuit.
- Accordingly, the oil pressure in port **F** and the spring chamber of unload relief valve (3) rises and unload relief valve (3) moves to the right.
- As a result, ports **C** and **B** are connected to each other and the oil from the pump flows to port **B**.
- If the oil pressure in port **B** exceeds the set pressure of check valve (4), it pushes check valve (4) open and flows to port **E** to start increasing the pressure in the accumulator. The supply pressure for the accumulator is decided by the set pressure of check valve (4).
- A set quantity of oil is supplied to the accumulator, regardless of the engine speed, and the excessive oil flows through port **A** to the cooling fan motor.
- The oil flowing to port **E** is supplied first to the accumulator having the lowest pressure by inverse shuttle valve (5).



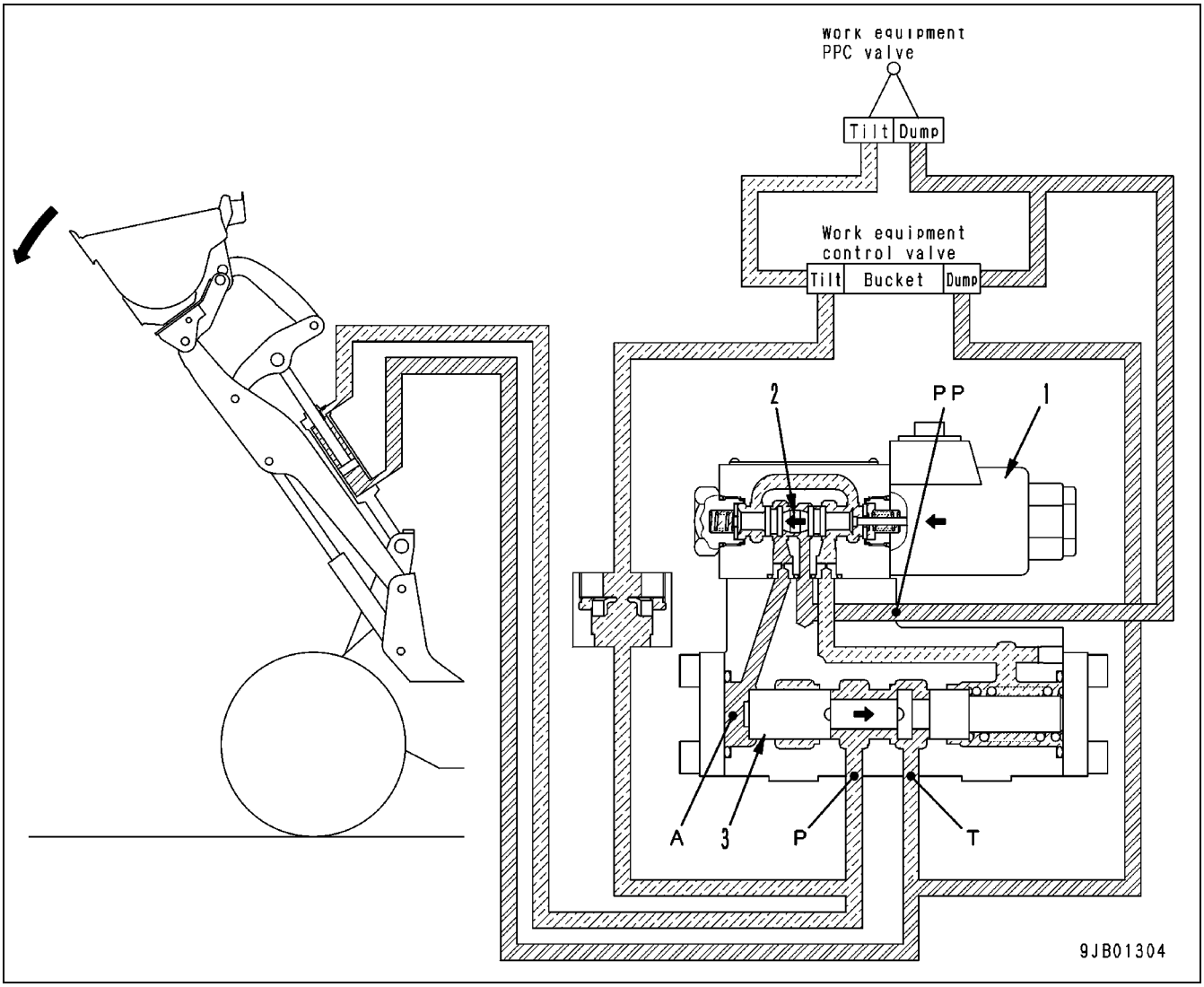
1. Work equipment control valve
2. Bucket cylinder
3. Hydraulic tank
4. Work equipment PPC valve
5. Attachment PPC valve
6. Lock valve
7. Oil cooler
8. Check valve
9. 4-gear pump unit
   - Steering pump
   - Work equipment pump
   - Brake and cooling fan pump
   - Transfer lubricating oil pump
10. Accumulator (for PPC circuit)
11. Cut-off valve
12. Accumulator (for ECSS) (if equipped)
13. ECSS valve (if equipped)
14. Bypass valve (for bucket circuit)
15. Lift cylinder
16. Coupler plunger
    (ECCS Electronically Controlled Suspension System)

Outline

- The hydraulic system consists of the HST, steering, work equipment, brake, cooling fan, and transfer lubricating circuit. Work equipment circuit controls the operation of the lift arm and bucket.
- The oil in hydraulic tank (3) is sent by the work equipment pump of 4-gear pump unit (8) to work equipment control valve (1). If both spools of the lift arm and bucket of work equipment control valve (1) are held, the oil flows through the drain circuit of work equipment control valve (1) and is filtrated by the return filter installed to hydraulic tank (3) and returns to hydraulic tank (3).
- If the work equipment control lever is operated, the spool of the lift arm or bucket of work equipment PPC valve (4) operates.
- The oil from the PPC valve hydraulically operates each spool of work equipment control valve (1) and flows to lift cylinder (13) or bucket cylinder (2) to move the lift arm or bucket.
- The maximum pressure in the hydraulic circuit is controlled by the relief valve in work equipment control valve (1). The bucket cylinder circuit has a safety valve (safety-suction valve) to protect itself.
- Accumulator (for PPC circuit) (9) is installed to the PPC pilot circuit so that the work equipment can be lowered to the ground even if the engine stops.
- Hydraulic tank (3) is pressurized, enclosed, and equipped with a breather which has a relief valve and which is also used as an oil filler cap. The breather pressurizes the tank and prevents generation of negative pressure and cavitation.

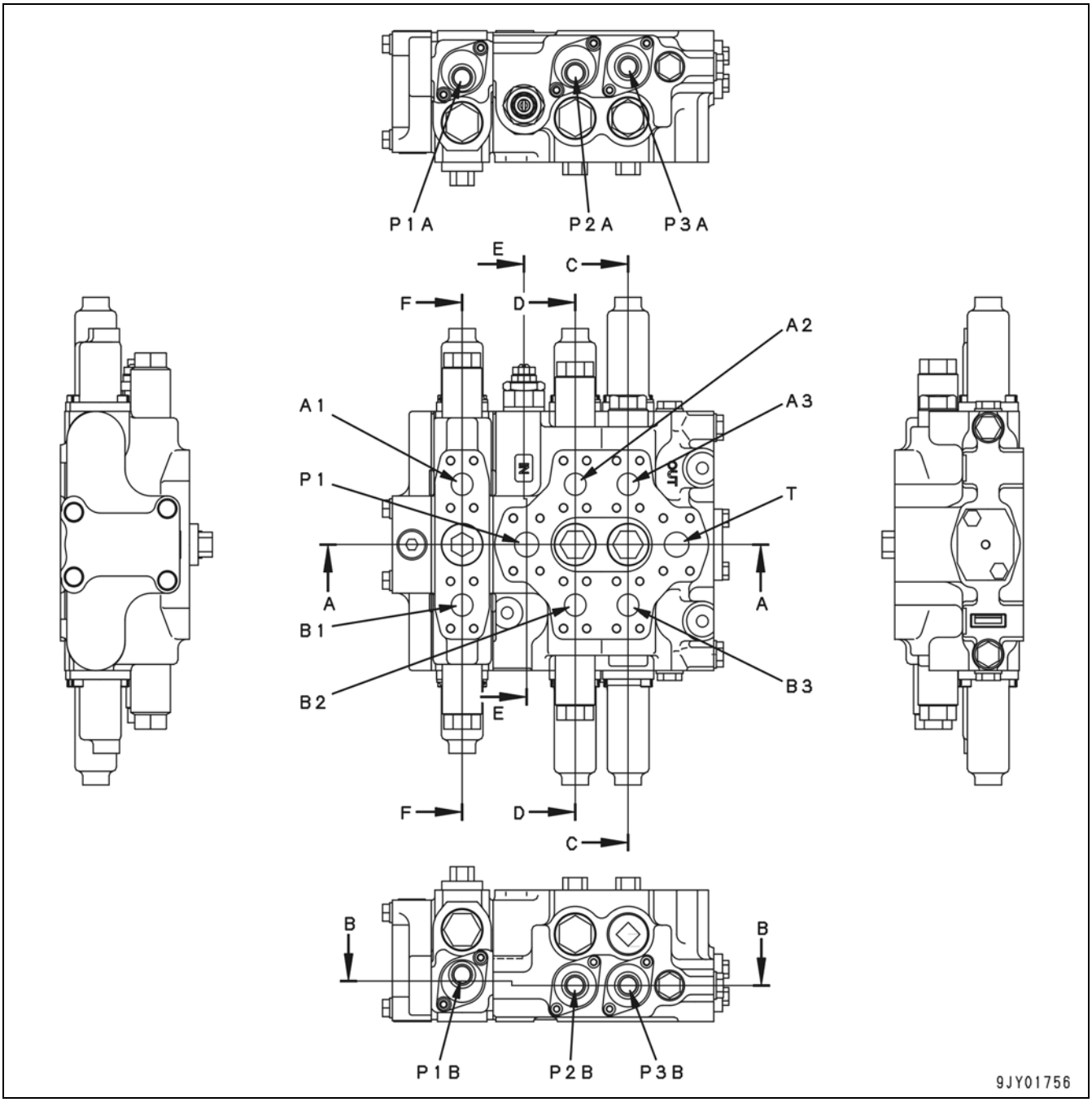
System Operation

When bucket is in "DUMP" FAST mode (from tilt-back position to just before dump end)



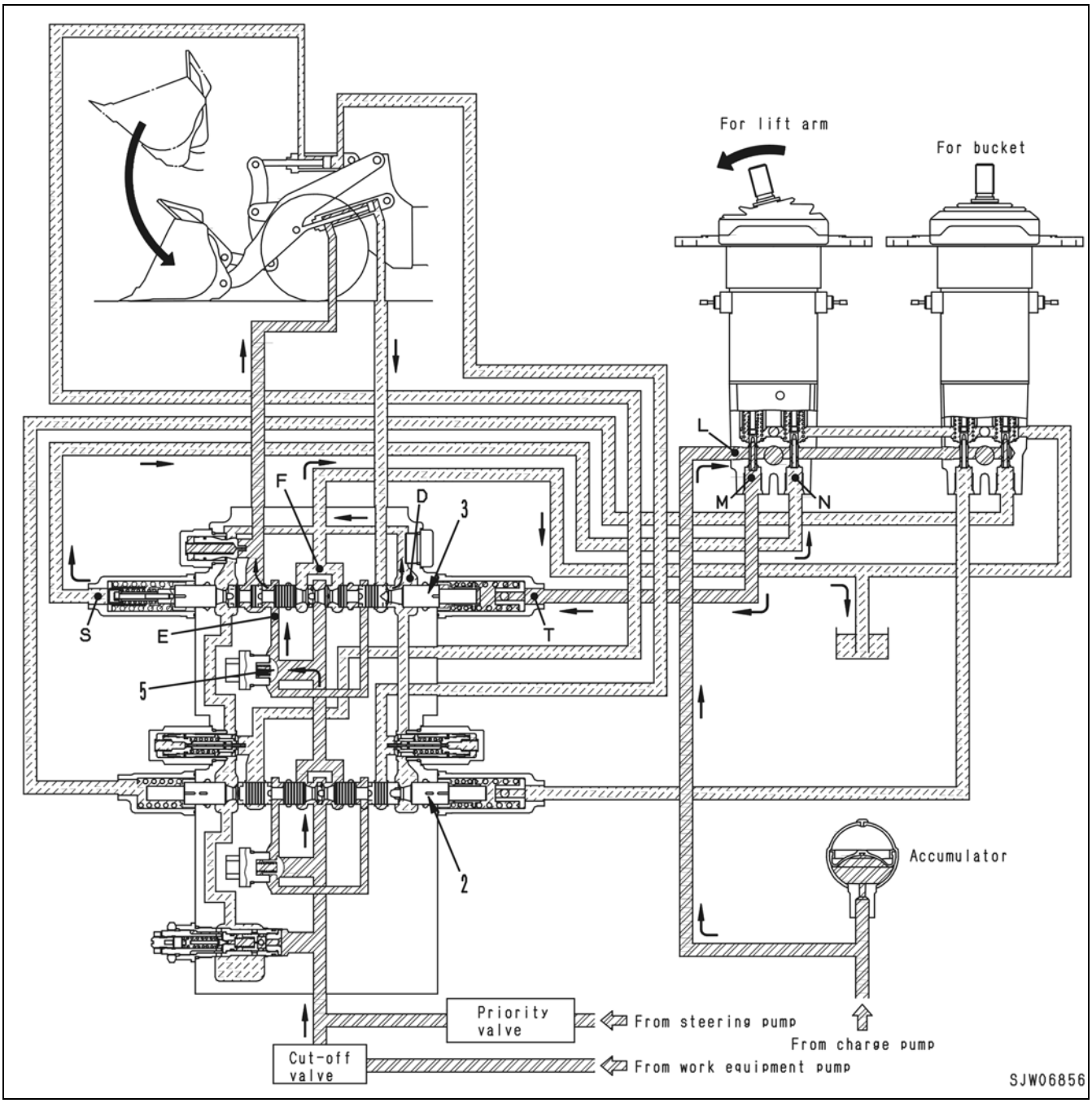
- If the bucket is "DUMP" with the dump speed switch in the FAST mode position, the oil of the work equipment PPC valve operates the work equipment control valve and the oil from the work equipment pump flows to the bucket cylinder bottom side.
- Since the tilt lever angle proximity switch does not operate, bypass solenoid valve (1) is turned ON and spool (2) moves to the left.
- At this time, the oil from the work equipment PPC valve flows through port **PP** into chamber **A** and pushes spool (3) to the right and opens ports **P** and **T**.
- A part of the oil on the bucket cylinder head side flows through the work equipment control valve into the hydraulic tank, but most of the oil flows through ports **P** and **T** to the bucket cylinder bottom side.
- The oil from the work equipment control valve and the oil from the bucket cylinder head side merge together and flow to the bucket cylinder bottom side, thus the bucket dump speed is heightened.

3-Spool Valve



P1: From steering pump
T: Drain port to tank
A1: To attachment cylinder head
A2: To bucket cylinder head
A3: To lift arm cylinder head
B1: To attachment cylinder bottom
B2: To bucket cylinder bottom
B3: To lift arm cylinder bottom
P1A: From attachment PPC valve
P1B: From attachment PPC valve
P2A: From PPC valve P1 port
P2B: From PPC valve P3 port
P3A: From PPC valve P2 port
P3B: From PPC valve P4 port

Lift Arm Spool In The Lower Position

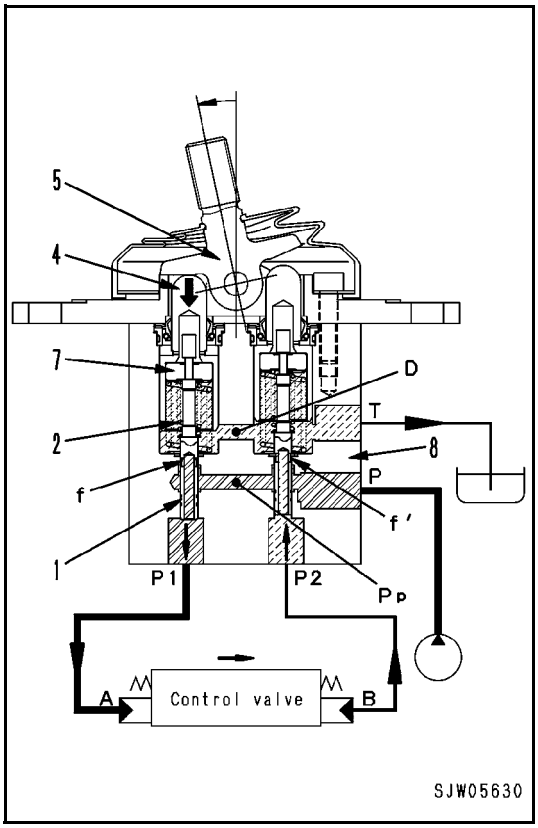


Operation

- If the lift arm control lever is pushed, the oil flows from port **L** of the PPC valve through port **N** to port **T** of work equipment control valve.
- The oil in port **S** flows to the drain circuit. The oil in port **T** pushes lift arm spool (3) to set it in the lower position.
- The oil from the pump flows through the bypass circuit of bucket spool (2) to the bypass circuit of spool (3).
- Since the bypass circuit is closed by spool (3), the oil pushes check valve (5) open.
- The oil flows through port **E** to the cylinder head.
- The oil in the cylinder bottom flows through port **D** into drain port **F** and then returns to the tank. Accordingly, the lift arm is lowered.

★ **At full stroke**

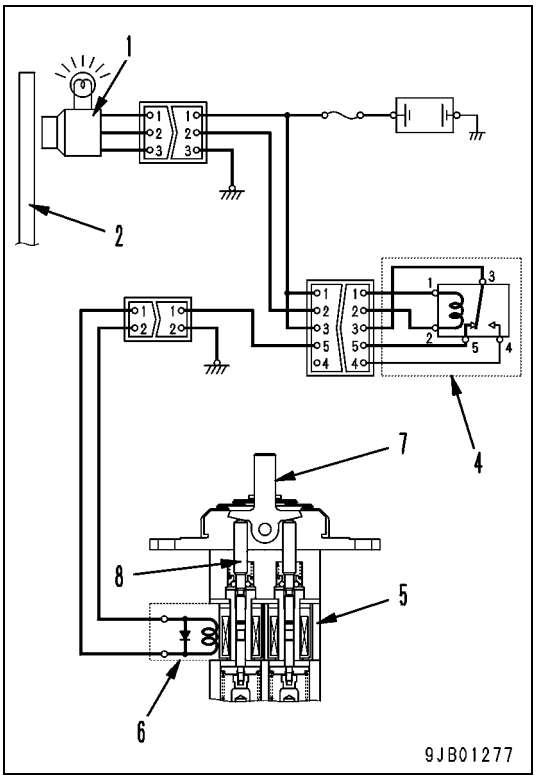
- When the lever (5) pushes down the piston (4) and when the retainer pushes down the spool (1), the fine control hole **f** is shut off from the drain chamber **D** and, then, it connects to the pressure chamber **PP** of the pump.
- Therefore, the pilot pressure oil coming from the main pump passes through the fine control hole **f** to be led to chamber **A** through port **P1** to push the control valve spool.
- The return oil from chamber **B** passes through port **P2** and the fine control hole **f'** to flow into the drain chamber **D**.



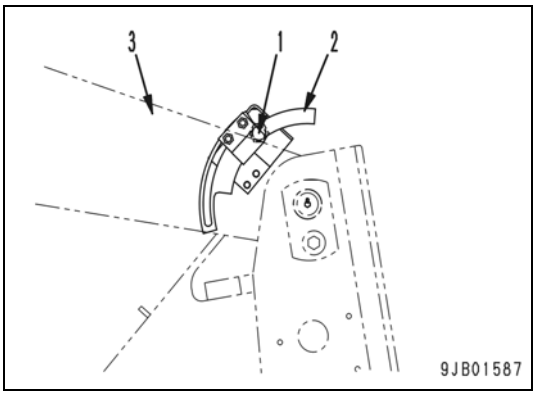
Unit: mm (in)

No.	Check item	Criteria					
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 (3.0)	-0.030 (0.001) -0.076 (0.003)	+0.174 (0.01) +0.100 (0.004)	0.130 – 0.250 (0.005 - 0.01)	1.0 (0.04)	
10	Clearance between bushing and pin of joint of lift arm and quick coupler	ø 75 (3.0)	-0.030 (0.001) -0.076 (0.003)	+0.174 (0.01) +0.100 (0.004)	0.130 – 0.250 (0.005 - 0.01)	1.0 (0.04)	
11	Clearance between bushing and pin of joint of lift arm and frame	ø 85 (3.3)	-0.036 (0.001) -0.090 (0.004)	+0.207 (0.01) +0.120 (0.005)	0.156 – 0.297 (0.006 - 0.012)	1.0 (0.04)	
12	Clearance between bushing and pin of joint of bucket cylinder bottom and frame	ø 110 (4.3)	-0.036 (0.001) -0.090 (0.004)	+0.207 (0.01) +0.120 (0.005)	0.156 – 0.297 (0.006 - 0.012)	1.0 (0.04)	
13	Clearance between bushing and pin of joint of bucket cylinder rod and tilt lever	ø 110 (4.3)	-0.036 (0.001) -0.090 (0.004)	+0.207 (0.01) +0.120 (0.005)	0.156 – 0.297 (0.006 - 0.012)	1.0 (0.04)	
14	Clearance between bushing and pin of joint of tilt lever and lift arm	ø 75 (3.0)	-0.030 (0.001) -0.076 (0.003)	+0.174 (0.01) +0.100 (0.001)	0.130 – 0.01 (0.250 - 0.012)	1.0 (0.04)	
15	Clearance between bushing and pin of joint of lift cylinder rod and lift arm	ø 85 (3.3)	-0.036 (0.001) -0.090 (0.004)	+0.207 (0.01) +0.120 (0.005)	0.156 – 0.297 (0.006 - 0.012)	1.0 (0.04)	
16	Clearance between bushing and pin of joint of lift cylinder bottom and frame	ø 85 (3.3)	-0.036 (0.001) -0.090 (0.004)	+0.207 (0.01) +0.120 (0.005)	0.156 – 0.297 (0.006 - 0.012)	1.0 (0.04)	
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 (0.1) or less on each side)
		Standard size	Tolerance	Standard size	Tolerance		
		110 (4.3)	0.5 (0.02)) 0 (0)	114 (4.5)	± 1.5 (0.06)	2.5 – 6.0 (0.1 - 0.2)	
18	Joint of lift arm and frame	105 (4.1)	—	109 (4.3)	± 1.5 (0.06)	2.5 – 5.5 (0.1 - 0.2)	
19	Joint of lift arm and quick coupler	105 (4.1)	—	108 (4.3)	+1.5 (0.06) 0 (0)	3.0 – 4.5 (0.11 - 0.2)	
20	Joint of bucket link and quick coupler	110 (4.3)	+1.0 (0.04)	112 (4.4)	+1.5 (0.06) 0 (0)	-0.5 – 4.5 (0.02 - 0.2)	
21	Joint of lift cylinder and frame	85 (3.3)	0 (0) -0.5 (0.02)	89 (3.5)	± 1.5 (0.06)	2.5 – 6.0 (0.1 - 0.2)	
22	Joint of tilt lever and bucket link	110 (4.3)	± 1.0 (0.04)	112 (4.4)	± 1.5 (0.06)	-0.5 – 4.5 (0.02 - 0.2)	
23	Joint of tilt lever and lift arm	109 (8.0)	—	112 (4.4)	± 1.5 (0.06)	1.5 – 4.5 (0.06 - 0.02)	
24	Joint of bucket cylinder and tilt lever	110 (4.3)	0 (0) -0.5 (0.02)	112 (4.4)	± 1.5 (0.06)	0.5 – 4.0 (0.02 - 0.2)	
25	Joint of lift arm and lift cylinder	84 (3.3)	—	88 (3.5)	± 1.5 (0.06)	2.5 – 5.5 (0.1 - 0.2)	

- 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 work equipment (lift arm) control lever (7) is moved to the RAISE position, lift arm lower spool (8) moves up and is held at that position by the coil magnetized by detent solenoid (6). As a result, work equipment (lift arm) control lever (7) is held at RAISE position and the lift arm rises.



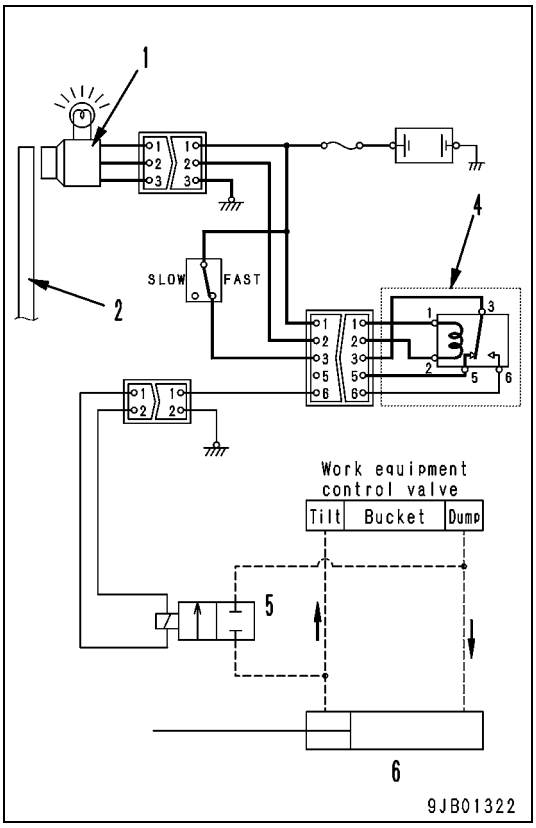
★ **Function of proximity switch**

When object of sensing is over sensing face of proximity switch

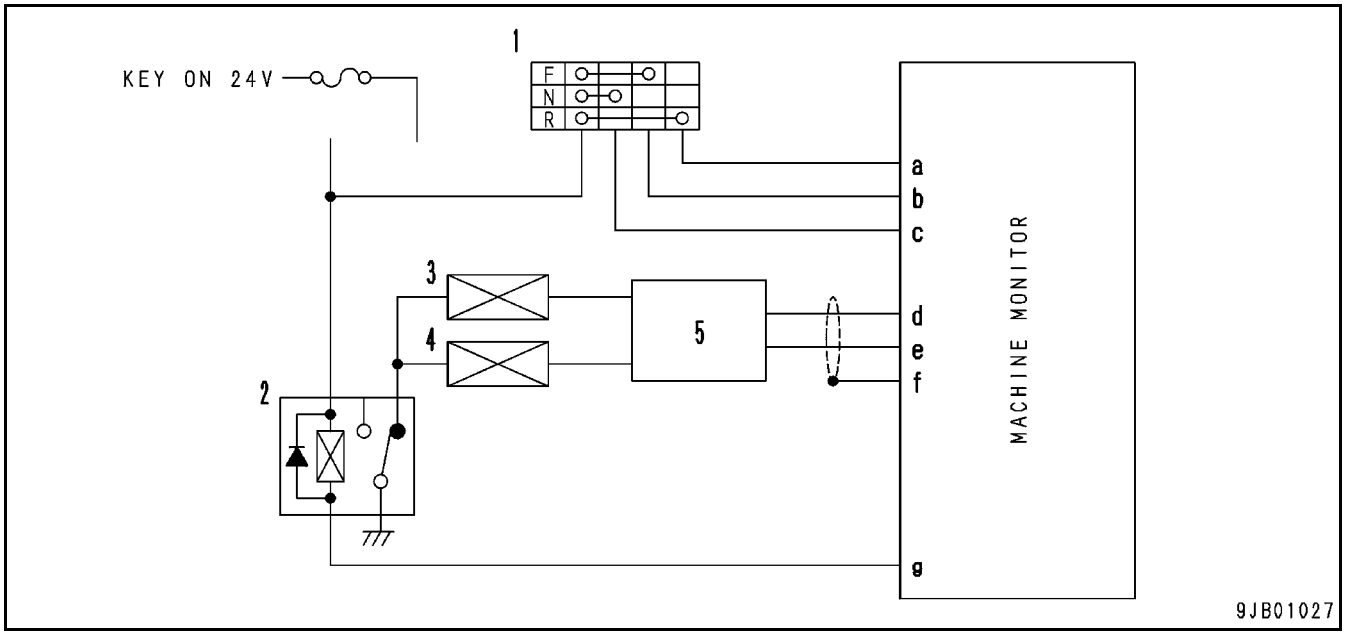
Lamp of proximity switch	ON
Dump speed relay switch circuit	Made
Bypass solenoid valve circuit	Broken
Bypass solenoid	Demagnetized

When object of sensing is not over sensing face of proximity switch

Lamp of proximity switch	ON
Dump speed relay switch circuit	Broken
Bypass solenoid valve circuit	Made
Bypass solenoid	Magnetized



HST Safety Control Power Supply



1. Forward-reverse lever
2. HST safety relay
3. Motor 1 solenoid valve
4. Clutch solenoid valve
5. HST controller

★ Connection table of connector pins of machine monitor

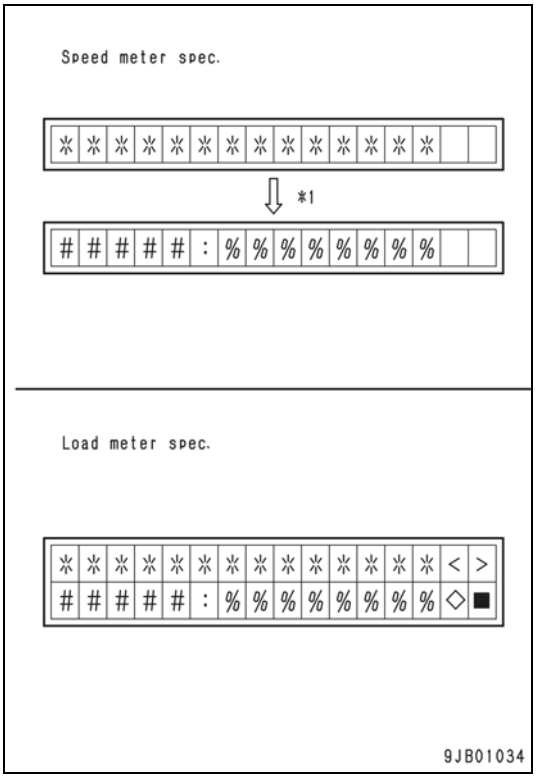
Symbol	Connector pin No.	
	Speed meter specification	Load meter specification
a	CNL22-8	CNL25-5
b	CNL22-10	CNL25-4
c	CNL22-9	CNL25-13
d	CNL22-6	CNL29-3
e	CNL22-2	CNL29-8
f	CNL21-3	CNL29-7
g	CNL23-15	CNL24-13

- Real-time Monitor

This function is used to check the input and output signals, etc. recognized by each controller on the network.
The contents of the real-time monitor displayed on the character display are as follows.

***1**: Changed after three seconds

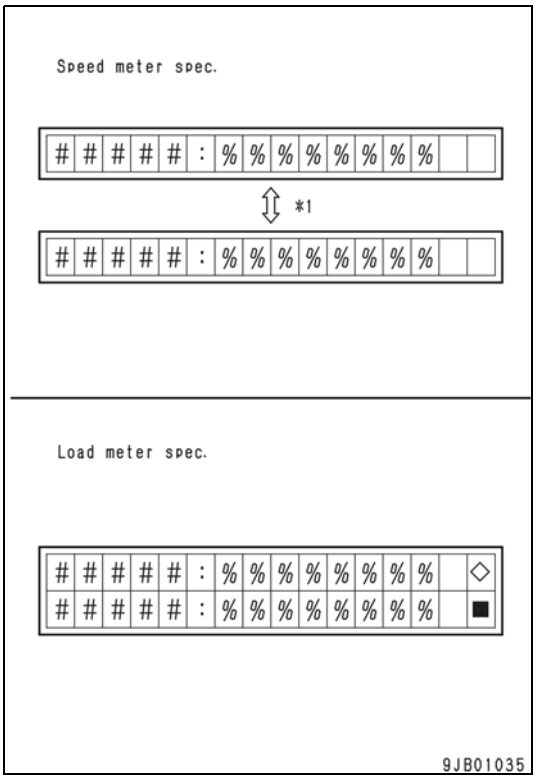
*****:** Item name
######: ID No. given to each item
%%%: Data. If a unit is used, it is displayed on the right of the data.



Any two items can be displayed simultaneously by specifying their ID Nos. In this case, they are displayed on the character display as shown below.

***1**: Displayed alternately every three seconds

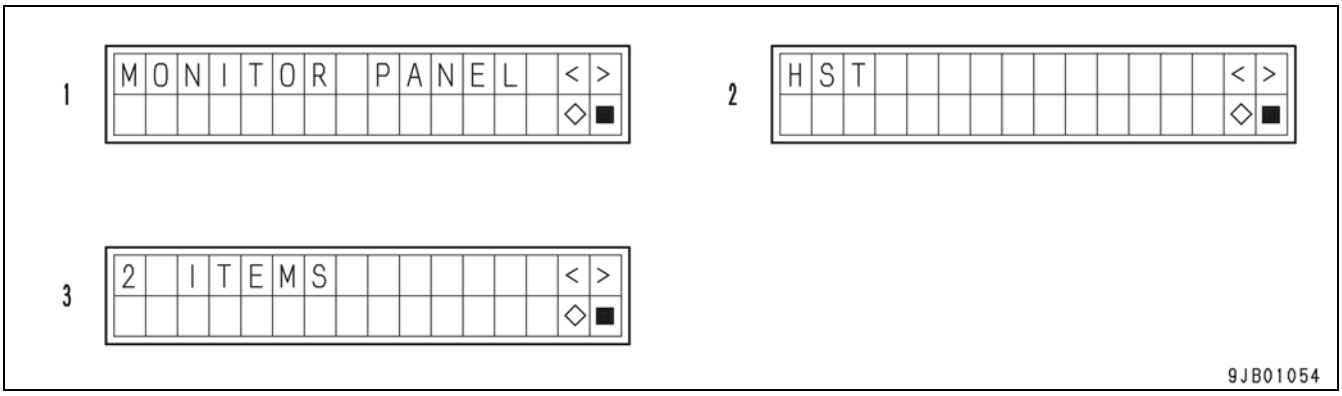
#####: Specified ID Nos.
%%%: Data. If a unit is used, it is displayed on the right of the data.



- Tuning (Only load meter specification)
  - With this function, you can initially adjust the sensors, etc. installed to the machine.
  - Use this function when a sensor or a controller is replaced or added.
- Maintenance monitor
  - This function is explained in “Operation manual, Operation, Character display, Display of replacement periods of filters and oils”. It is used to change the replacement periods of the filters and oils.
- Selection of options
  - With this function, you can display installation of an optional device and change the setting of that device. Use this function after any optional device is installed or removed.
- Setting of machine serial No. (Only load meter specification)
  - With this function, you can display and set a machine serial No.
  - Use this function for control of the machines, etc.
- Initialize
  - This function is used only in the factory. Do not use it.

3. Selection of information display of each controller and selection of display of two items (second layer)
   - Pressing the > SW changes the screen to the next [Select information display] screen.
   - Pressing the < SW returns the screen to the previous [Select information display] screen.
   - Pressing the ■ SW changes the screen to the [Select real-time monitor function] screen.

In [Select information display of each controller]: Pressing the ◇ SW changes the screen to the [Display of real-time monitor] screen. In [Select display of two items]: Pressing the ◇ SW changes the screen to the [Select two items] screen.



A. [Select information display of monitor panel] screen

B. [Select information display of HST controller] screen

C. [Select display of two items] screen

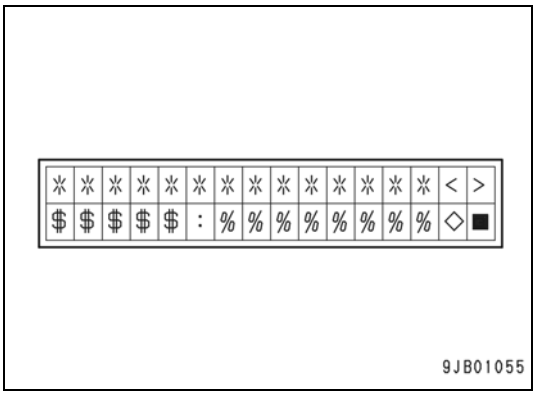
4. Display of real-time monitor (third layer)

A. Pressing the > SW changes the screen in the order of No. 1, No. 2, No. 3 ---.

B. Pressing the < SW changes the screen in the order of No. 13, No. 12, No. 11 ---.

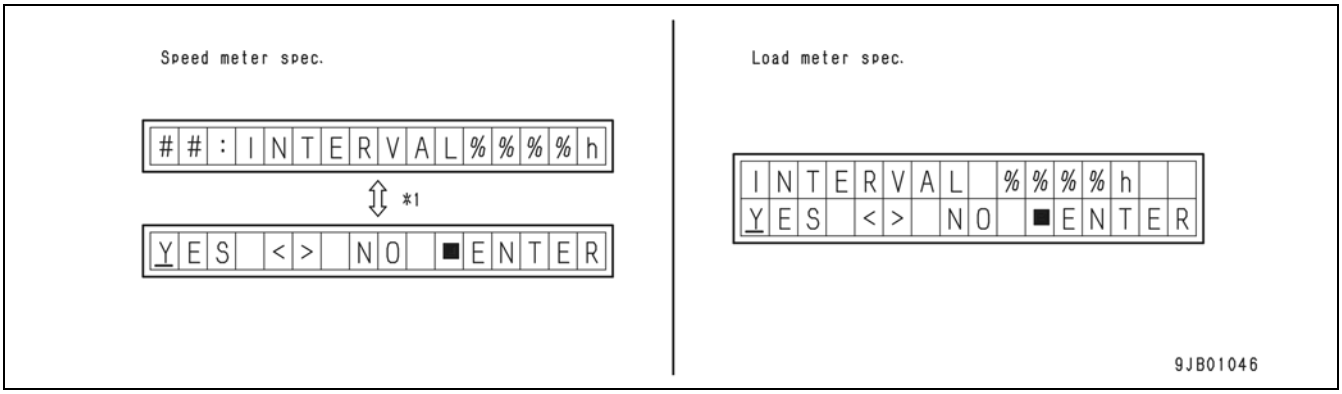
C. Pressing the ■ SW changes the screen to the [Select information display of each controller] screen.

D. Pressing the ◇SW holds the displayed data. Pressing it again returns the displayed data to the active state.



(While the displayed data are held, the mark of ◇ flashes.)
*****:** The real-time monitor item name is displayed.
$$$$$: The item ID is displayed.
%%%: The data and unit are displayed (Unit is SI unit).

5. Check of change of maintenance interval time (fourth layer) Select YES or NO with the < or > SW. The cursor (_) blinks on the selected item. Pressing the ■ SW returns the screen to the [Select maintenance item] screen with the change done if YES was selected, or not if NO was selected. By default, the cursor is on NO (the change not done) to prevent resetting by error. When the change of the set time is finished, the operation acceptance peeps (on for 0.1 sec ⇒ off for 0.1 sec. ⇒ on for 0.1 sec.) are heard.



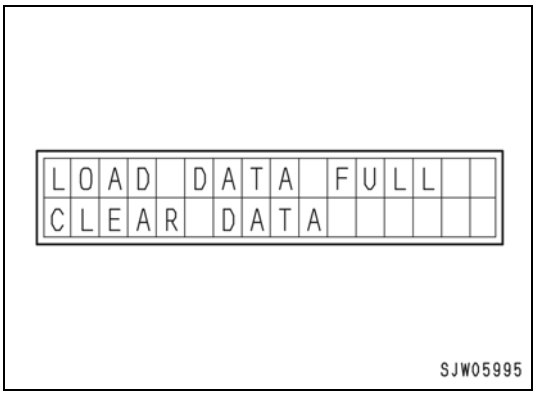
***1:** Displayed alternately every three seconds

##: ID No. of each maintenance item
%%%%: Interval time (four digits) to be changed

The maintenance interval time is set as shown in the following table, when shipped.

Item	Replacement interval time (h)	Displayed item name	ID No.
Engine oil	500	ENG OIL	01
Engine oil filter	500	ENG FILT	02
Fuel filter	500	FUEL FILT	03
Transfer oil	1,000	TRANSF OIL	25
HST oil filter	1,000	HST FILT	26
Hydraulic oil filter	2,000	HYD FILT	04
Hydraulic oil	2,000	HYD OIL	10
Axle oil	2,000	AXLE OIL	15

- Auto-subtotal function



A. When printer (optional) is connected

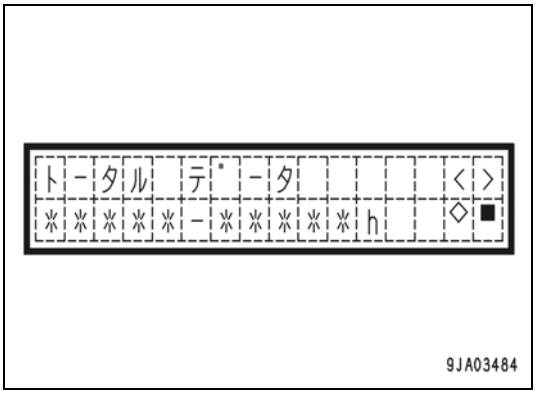
B. The weight of the 501st time is calculated. After 15 seconds, the data are saved in the RAM and the data of up to the 500th time are printed. After the data are printed, the subtotal data are cleared. After the data of the 500th time are saved, “LOAD DATA FULL” and “CLEAR DATA” are displayed on the character display. The load meter continues measurement, however.

C. When printer (optional) is not connected The weight of the 501st time is calculated. After 15 seconds, the data are saved in the RAM and the bucket load data of up to the 500th time are cleared to secure a data saving area. After the data of the 500th time are saved, “LOAD DATA FULL” and “CLEAR DATA” are displayed on the character display. The load meter continues measurement, however.

Display on character display after data of 500th time are saved

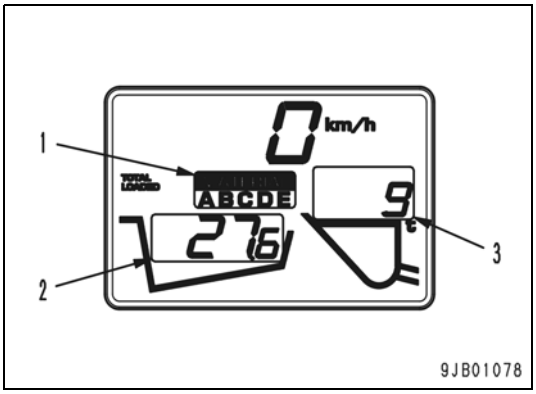
- Integrated data display function

- Display of data
  - Display the total load and the total number of loading times in the addition mode or subtraction mode.
  - Select “DISPLAY DATA” on the load meter function and display “TOTAL DATA” on the character display.



★ On the lower line (*****-*****h), the integration time based on the hour meter is displayed.

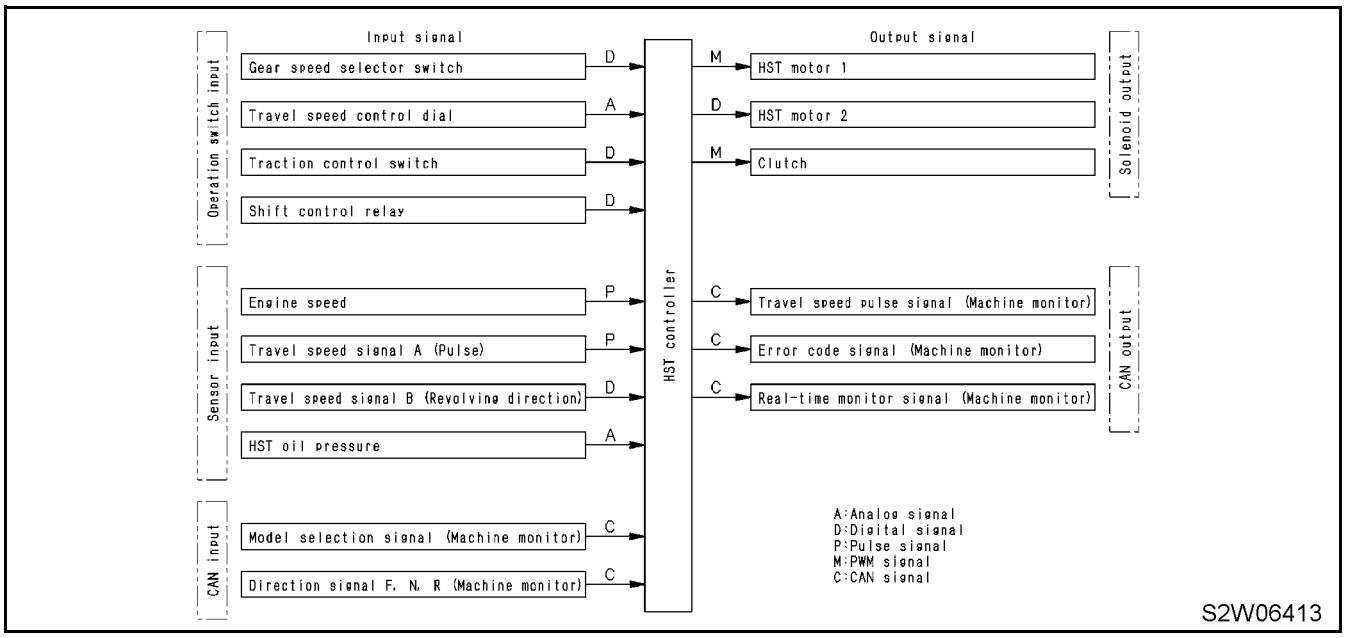
★ Example)If 12300-12450h is displayed, the data integrated during the time from 12300h to 12450h are displayed on the character display.



- Press (>) or (<) of monitor panel mode selector switch 2 and select A - E or all lighting up from objective material (1). If A - E is selected, total load (2) and number of loading times (3) of each kind are displayed. If all lighting up is selected, total load and total number of loading times of all of objective materials A - E are displayed.

HST SYSTEM ELECTRICAL CONTROLLER

System Diagram



Operation

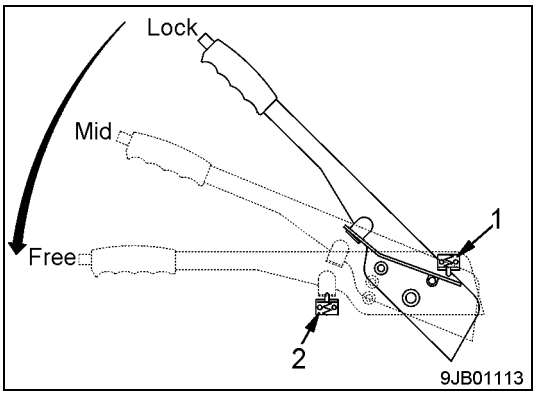
When parking brake lever is returned (ON ⇒ OFF)

Position of ignition switch	OFF			ON					
State of engine	Stopped						Running		
Position of parking brake lever	Lock	Mid-Free	Free	Lock	Mid-Free	Free	Lock	Mid-Free	Free
Intermediate switch (1)	Open	Close		Open	Close		Open	Close	
Bottom switch (2)	Open		Close	Open		Close	Open		Close
Parking brake reminder caution lamp (Alarm buzzer)	OFF (Reset)		ON (Operated)	OFF (Reset)		ON (Operated)	OFF (Reset)		
Parking brake pilot lamp	OFF			ON		OFF	ON		OFF

1. When parking brake lever is in Lock position
   - When the parking brake is applied, both intermediate switch (1) and bottom switch (2) are open.
   - The parking brake pilot lamp lights up only while the ignition switch is in the ON position and goes off regardless of the state of the parking brake reminder caution lamp.
   - The parking brake is applied.

2. When parking brake lever is moved from Lock position to Mid position
   - If the parking brake lever is returned a little, intermediate switch (1) is closed but the contacts of the parking brake relay are kept open.
   - The parking brake pilot lamp and parking brake reminder caution lamp operate as in step 1).
   - The parking brake is kept applied.

3. When parking brake is set in Free position
   - If the parking brake lever is returned to the end, bottom switch (2) is closed.
   - At this time, the coil flows in the coil of the parking brake relay to close the contacts, and then the parking brake pilot lamp relay operates.
   - Since the current flows in the coil of the parking brake drag prevention relay, the forward-reverse solenoid circuit is closed and the machine can travel forward or in reverse and the parking brake reminder caution signal is input to the machine monitor.
   - The parking brake pilot lamp goes off regardless of the state of the parking brake. Parking brake reminder caution lamp lights up and the alarm buzzer sounds only when the engine is stopped.



   - Then, the HST controller power hold relay operates and the current flows in the HST controller to hold the operation of the motor solenoid and clutch solenoid and prevent the machine from moving down on a slope, etc.
   - The parking brake is released.

MEMORANDUM

SPECIAL TOOLS

Check or measurement item	Symbol		Part number	Part Name	Qty.	Remarks
Engine speed	A	1	799-203-8001	Multi-tachometer	1	Digital indication L: 60 - 2,000 rpm H: 60 - 19,999 rpm
		2	795-790-2500	Adapter	1	For 102 engine series
Exhaust gas color	B	1	799-201-9000	Handy smoke checker	1	Discoloration 0 - 70% (With standard color) (Discoloration x 1/10 = Bosch index)
		2	Commercially available	Smoke meter	1	
Valve clearance	Q	1	795-799-1131	Gear (cranking tool)	1	For 102 engine series
		2	795-799-1900	Pin assembly	1	
		2	Commercially available	Feeler gauge	1	Intake: 0.25 mm Exhaust: 0.51 mm
Compression pressure	A	1	799-203-8001	Multi-tachometer	1	Digital indication L: 60 - 2,000 rpm H: 60 - 19,99 rpm
	D	1	795-502-1590	Gauge assembly	1	0 - 6.9 MPa (0 - 70 kgf/cm²)
		2	795-502-1700	Adapter	1	For 102 engine series
Blow-by pressure	E		799-201-1504	Blow-by kit	1	0 - 4.9 MPa (0 - 500 mm H_2O)
Fuel injection timing	Q	1	795-799-1131	Gear tool	1	For 102 engine series
		2	795-799-1900	Pin assembly	1	
		3	795-799-1950	Lock pin	1	
Engine oil pressure	C	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 MPa (25, 60, 400, 600 kgf/cm²)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.8 MPa (600 kgf/cm²)
		2	799-401-2320	Hydraulic tester	1	Pressure gauge: 0.98 MPa (10 kgf/cm²)
HST oil pressure	C	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 MPa (25, 60, 400, 600 kgf/cm²)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.88 MPa (600 kgf/cm²)
		7	799-301-1760	Joint	1	For G 3/8
			07000-12014	O-ring	1	
Clutch control pressure	C	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 58.8MPa (25, 60, 400, 600 kgf/cm²)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.88 MPa (600 kgf/cm²)
		4	799-401-31000	Adapter	1	Size: 10 x 1.25 mm
Work equipment hydraulic pressure	C	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2 58.8MPa (25, 60, 400, 600 kgf/cm²)
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.8 MPa (600 kgf/cm²)

HST OIL PRESSURE

Special Tools Required

Symbol		Part No.	Part Name
C1	1	799-101-5002	Analog type hydraulic tester
		790-261-1203	Digital type hydraulic tester
	7	709-301-1760	Joint (for G 3/8)
		07000-12014	O-ring

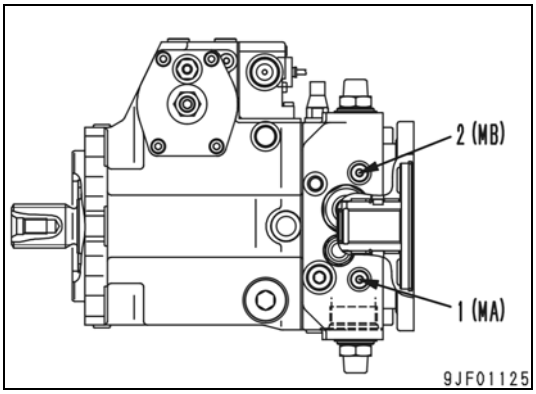
WARNING! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank, and operate the control levers 2 or 3 times to release the remaining pressure in the hydraulic piping.

Measuring

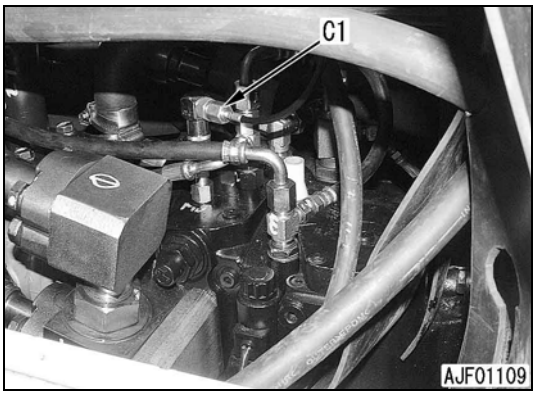
★ HST oil temperature when measuring: Within operating range.
★ The high-pressure relief pressure is the same as the safety pressure of the main circuit, so it cannot be measured. (Normally, the cut-off valve is actuated first, so it does not rise to the safety valve set pressure).

1. Measuring high-pressure cut-off oil pressure

   A. Open the engine hood side cover.



   B. Install oil pressure gauge **Cl** (58.8 MPa (600 kgf/cm²) {8534 lbf/in²}) to pressure measurement nipple (1) or (2).
      ★ Nipple (1): For FORWARD circuit (port: MA)
      ★ Nipple (2): For REVERSE circuit (port: MB)



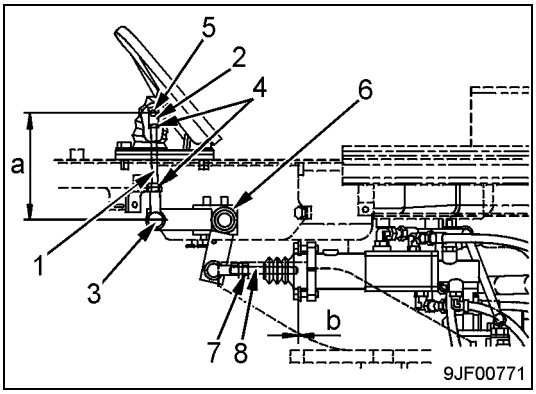
BRAKE PEDAL LINKAGE

Testing

1. Check for play in linkage mounting pin (7), pinhole of lever (6), and lever bushing.

2. Measure length of link **a** = 200 mm (7.9 in), and check to be sure it is within the standard value.
   ★ Measure the length from the center of pin (1) to the center of ball joint (3).

3. Measure the distance of movement of rod (8) and check to be sure clearance b is within the standard value.
   ★ When doing this, check to be sure the brake pedal is in contact with the stopper.



Adjusting

1. Adjusting link length (**a**)

   A. Remove pin (5) and ball joint (3), then remove rod (1).

   B. Loosen locknut (4), then turn yoke (2) and ball joint (3) to adjust the length.

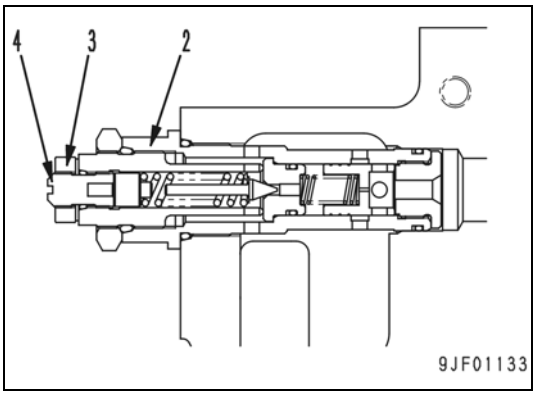
   C. After adjusting the length of link (**a**), connect it to the brake pedal.
      ★ Standard values
      a = 200 mm (7.9 in)
      b = 0 - 0.3 mm (0 - 0.012 in)

2. Adjusting rod length (b)

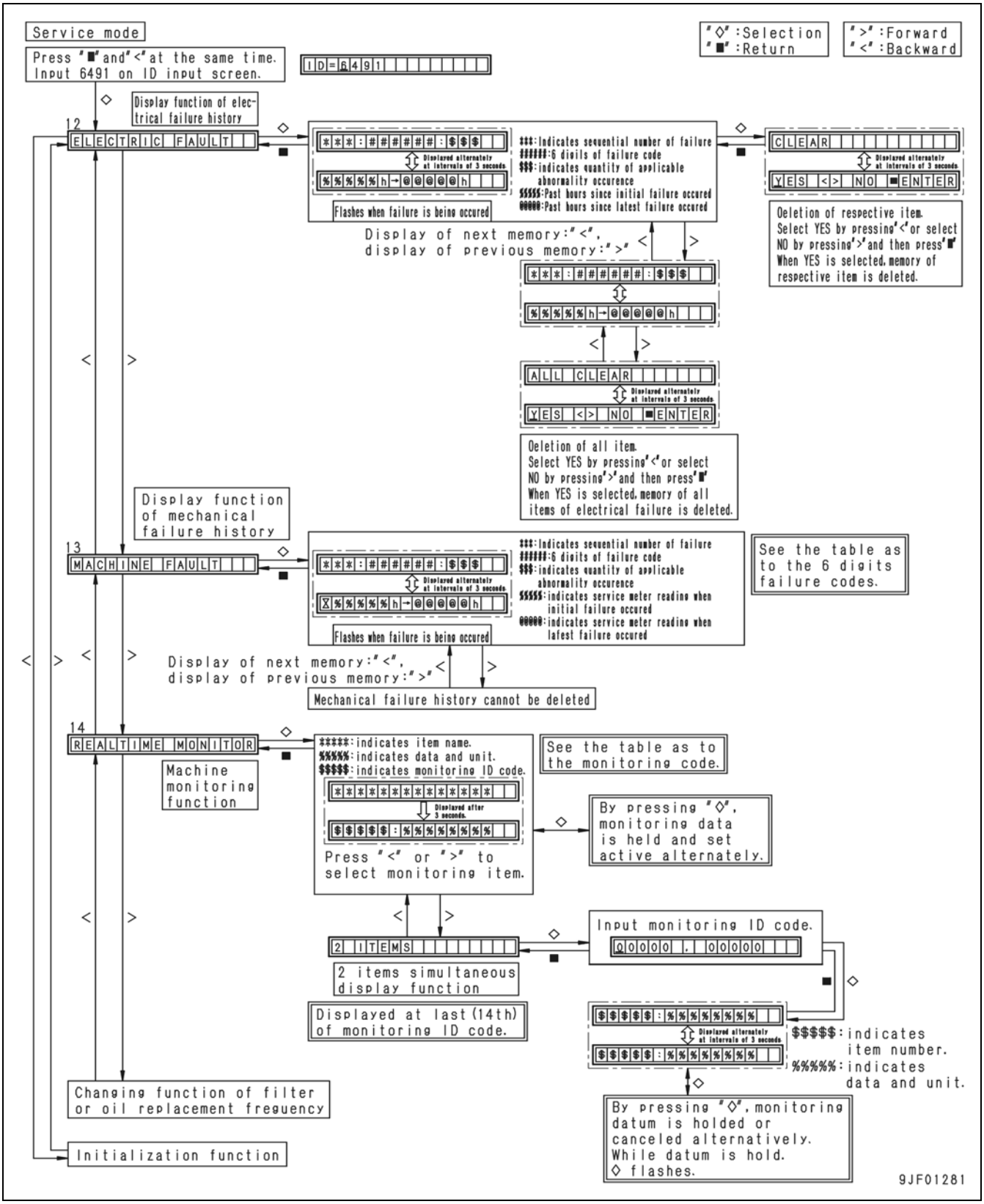
   A. Loosen locknut (7), turn rod (8) so that the tip of the rod contacts the booster cylinder piston, then turn rod (8) back 1/4 turn.
      ★ Movement for 1/2 turn of rod: 0.75 mm (0.030 in)

   B. Tighten locknut (7) to hold in position.
      ★ Standard values
      a = 200 mm (7.9 in)
      b = 0 - 0.3 mm (0 - 0.012 in)

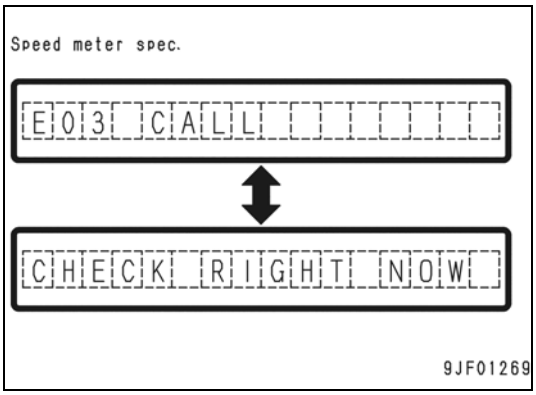
1. Loosen locknut (3) of relief valve (2), then turn adjustment screw (4) to adjust.
   - ★ Turn the adjustment screw to adjust the set pressure as follows.
     - TIGHTEN to INCREASE pressure
     - LOOSEN to DECREASE pressure
   - ★ Pressure adjustment for one turn of adjustment screw: Approximately 4.2 MPa Approximately 42.8 kgf/cm² (609 psi)
   - ★ Do not carry out any adjustment if the relief pressure cannot be measured accurately.
   - ★ Do not carry out any adjustments if the relief pressure cannot be measured.



MEMORANDUM


Service mode
Press "■" and "<" at the same time. Input 6491 on ID input screen.
ID=6491
"◇":Selection
"■":Return
">":Forward
"<":Backward
Display function of electrical failure history
12
ELECTRIC FAULT
***:######:$$$
%%%%%h→@@@@@h
Displayed alternately at intervals of 3 seconds.
Flashes when failure is being occured
***:Indicates sequential number of failure
######:6 digits of failure code
$$$:indicates quantity of applicable abnormality occurence
%%%%%:Past hours since initial failure occured
@@@@@:Past hours since latest failure occured
CLEAR
YES <> NO ■ENTER
Oeletion of respective item.
Select YES by pressing "<" or select NO by pressing ">" and then press "■"
When YES is selected, memory of respective item is deleted.
Display of next memory:"<",
display of previous memory:">"
ALL CLEAR
Oeletion of all item.
Select YES by pressing "<" or select NO by pressing ">" and then press "■"
When YES is selected, memory of all items of electrical failure is deleted.
Display function of mechanical failure history
13
MACHINE FAULT
See the table as to the 6 digits failure codes.
%%%%%h→@@@@@h
%%%%%:indicates service meter reading when initial failure occured
@@@@@:indicates service meter reading when latest failure occured
Mechanical failure history cannot be deleted
14
REALTIME MONITOR
Machine monitoring function
*****:indicates item name.
%%%%%:indicates data and unit.
$$$$$:indicates monitoring ID code.
Displayed after 3 seconds.
Press "<" or ">" to select monitoring item.
See the table as to the monitoring code.
By pressing "◇", monitoring data is held and set active alternately.
2 ITEMS
2 items simultaneous display function
Displayed at last (14th) of monitoring ID code.
Input monitoring ID code.
00000.000000
$$$$$:%%%%%%%%
$$$$$:indicates item number.
%%%%%:indicates data and unit.
By pressing "◇", monitoring datum is holded or canceled alternatively.
While datum is hold. ◇ flashes.
Changing function of filter or oil replacement frequency
Initialization function
9JF01281

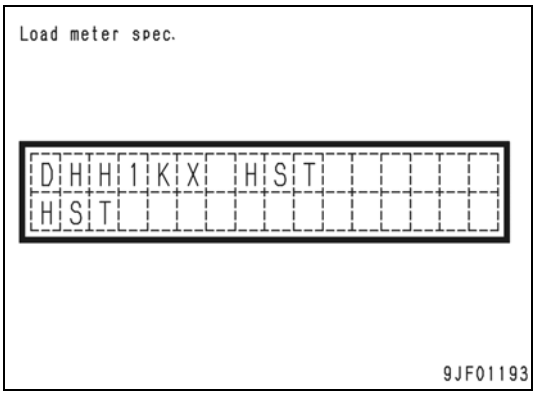
- The following figure is an example where action code “E03 CALL” and “CHECK / RIGHT / NOW” are displayed alternately for speedometer specifications.

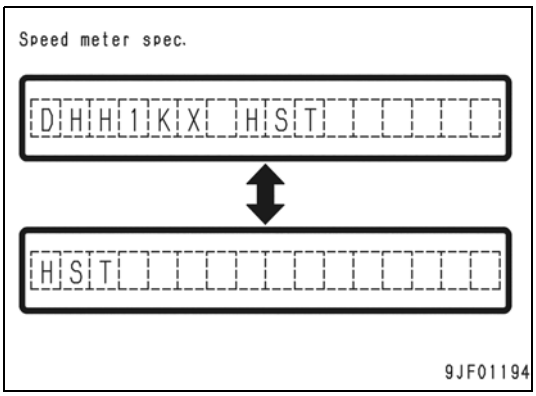


Action Codes And Remedy Recommended To Operator

Action code	CALL	Content Of Advice To Operator
E00	No	Return switches and levers for control switch to normal condition
E01	No	Carry out maintenance after completion of operation or when operators change shift
E02	No	When overrun related display is given, reduce engine speed and machine speed and continue operation
		When overheat related display is given, stop machine and run engine at a mid-range speed under no load
E03	Yes	Stop the engine and machine immediately and contact serviceman

14. Failure code display function
    If an action code is being displayed, press the [>] switch to display the failure code for the existing failure.
    - ★ The failure codes detected in the past are divided into failures of the electrical system and the mechanical system, and are recorded as trouble data. (For details, see Service mode 1)
    - ★ With the service code display function, the following information is displayed.
    - ★ [Failure code + controller detecting failure code (left side)] and [Location of failure (right side)] are displayed in turn.
    - ★ Code on right side:
    - ★ MON → Machine monitor
    - ★ HST ← HST controller
    - ★ When there are multiple failures, press the [>] switch to display the other failure codes.
    - ★ After pressing the [>] switch to display or the failure codes for existing failures, press the [>] switch to return to the service meter display screen.
    - ★ For details of of the failure code is displayed, see [Failure code list].





REAL-TIME MONITORING ITEMS

Load Meter Specifications

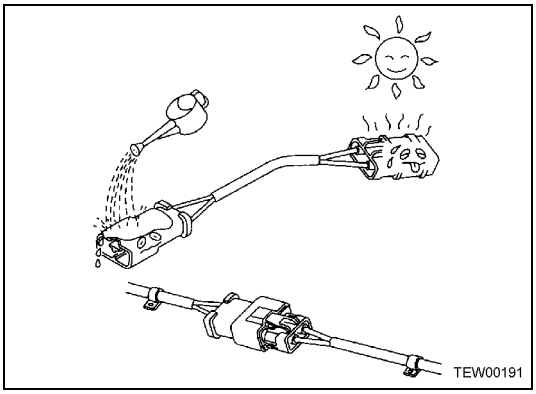
Item ID	Real-time monitoring item	Item display	Display unit	Display range	Detection compo-nent	Terminal No.	Remarks
	Items for sensors not installed depending on the model and option are all displayed	Abbreviated due to limit on number of characters	Items with units all use SI units	Values outside display range are displayed with fixed dis-play in display range			
20200	Monitor ROM part No.	MONITOR ROOM	-	-	-	-	
40000	Travel speed	SPEED	1 km/h	0 - 50	HST	L41-13	
04202	Fuel level	FUEL SENSOR	1%	0 - 100	Monitor	L28-1	
04101	Engine coolant temperature	COOLANT TEMP	1 °C	24 - 131	Monitor	L28-8	
04103	Engine water temperature (Low temperature)	COOLANT Lo	1 °C	-31 - 91	Monitor	L28-3	
30100	HST oil temperature	HST TEMP	1 °C	24 - 131	Monitor	L28-2	
30202	Axle oil temperature	BRAKE TEMP	1 °C	24 - 131	Monitor	L28-7	
06001	Lift arm angle	BOOM ANG	1 °	-41 - 46	Monitor	L28-10	Only load meter specification
40400	Lift cylinder bottom pres-sure	BTM PRESS	0.01 MPa	0.00 - 50.00	Monitor	L28-9	Only load meter specification
40500	Lift cylinder rod pressure	ROD PRESS	0.01 MPa	0.00 - 50.00	Monitor	L28-4	Only load meter specification
40600	Calibration pressure	CAL PRESS	0.01 MPa	0.00 - 50.00	Monitor	Calculated value	Only load meter specification
40700	Calibration pressure	MES PRESS	0.01 MPa	0.00 - 50.00	Monitor	Calculated value	Only load meter specification
40800	Calculated weight	MES LOAD	0.01 t	0.00 - 50.00	Monitor	Calculated value	Only load meter specification
40900	Input signal D_IN_0-7	D-IN--0------7	---	01010101	Monitor	Separate sheet	Only load meter specification
40901	Input signal D_IN_8-15	D-IN--8------15	---	01010101	Monitor	Separate sheet	Only load meter specification
40902	Input signal D_IN_16-23	D-IN--16------23	---	01010101	Monitor	Separate sheet	Only load meter specification
40903	Input signal D_IN_24-31	D-IN--24------31	---	01010101	Monitor	Separate sheet	Only load meter specification
40904	Input signal D_IN_32-39	D-IN--32------39	---	01010101	Monitor	Separate sheet	Only load meter specification
HST controller							
01005	Engine speed	ENG SPEED	1 rpm	0 - 3000	HST	L42-4	HST Controller CAN
32600	HST oil pressure	HST PRESS	0.1 MPa	0.0 - 100.0	HST	L41-3	HST Controller CAN
80000	Motor 1 solenoid feed-back current	MOTOR SOL	1 mA	0 - 1000	HST	L41-6	HST Controller CAN
80100	Clutch solenoid feed-back current	CLUTCH SOL	1 mA	0 - 1000	HST	L41-14	HST Controller CAN
50302	Potential voltage	SPEED POT	1%	0 - 100	HST	L41-1	HST Controller CAN
80200	HST traction force	TRACTION	-	STD/LIMIT	HST	L42-3	HST Controller CAN

PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

To maintain the performance of the machine over a long period, and to prevent failures or other problems before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling Electric Equipment" and "Handling Hydraulic Equipment" (particularly hydraulic oil).

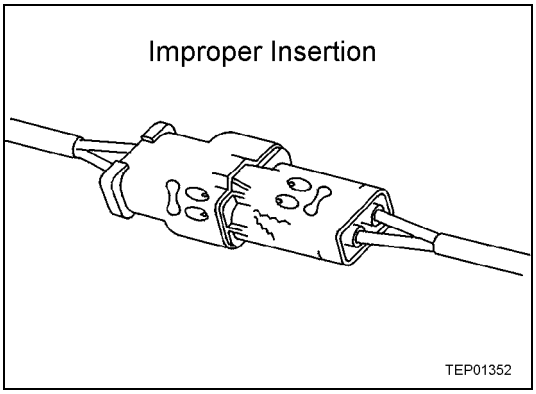
Precautions When Handling Electric Equipment

1. Handling wiring harnesses and connectors
   Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protector or tubes used for protecting the wiring. Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.

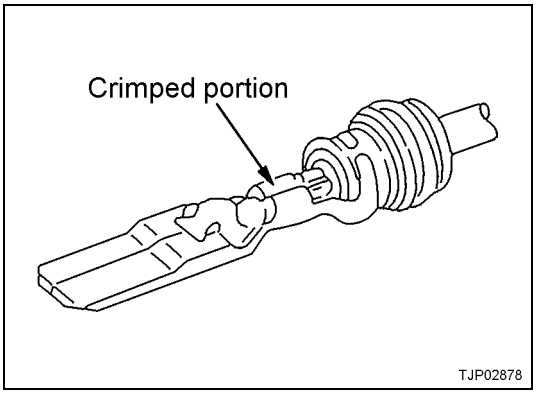


2. Main failures occurring in wiring harness

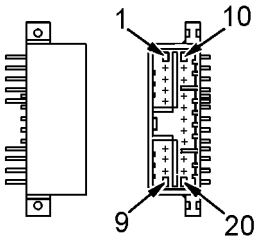
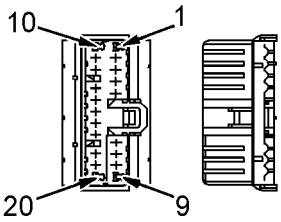
   A. Faulty contact of connectors
   (faulty contact between male and female).
   Problems with faulty contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidation of the contact surfaces.



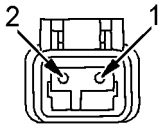
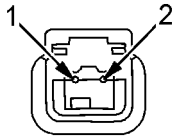
   B. Defective compression or soldering of connectors
   The pins of the male and female connectors are in contact at the compressed terminal or soldered portion, but there is excessive force on the wiring, and the plating peels to cause improper connection or breakage.



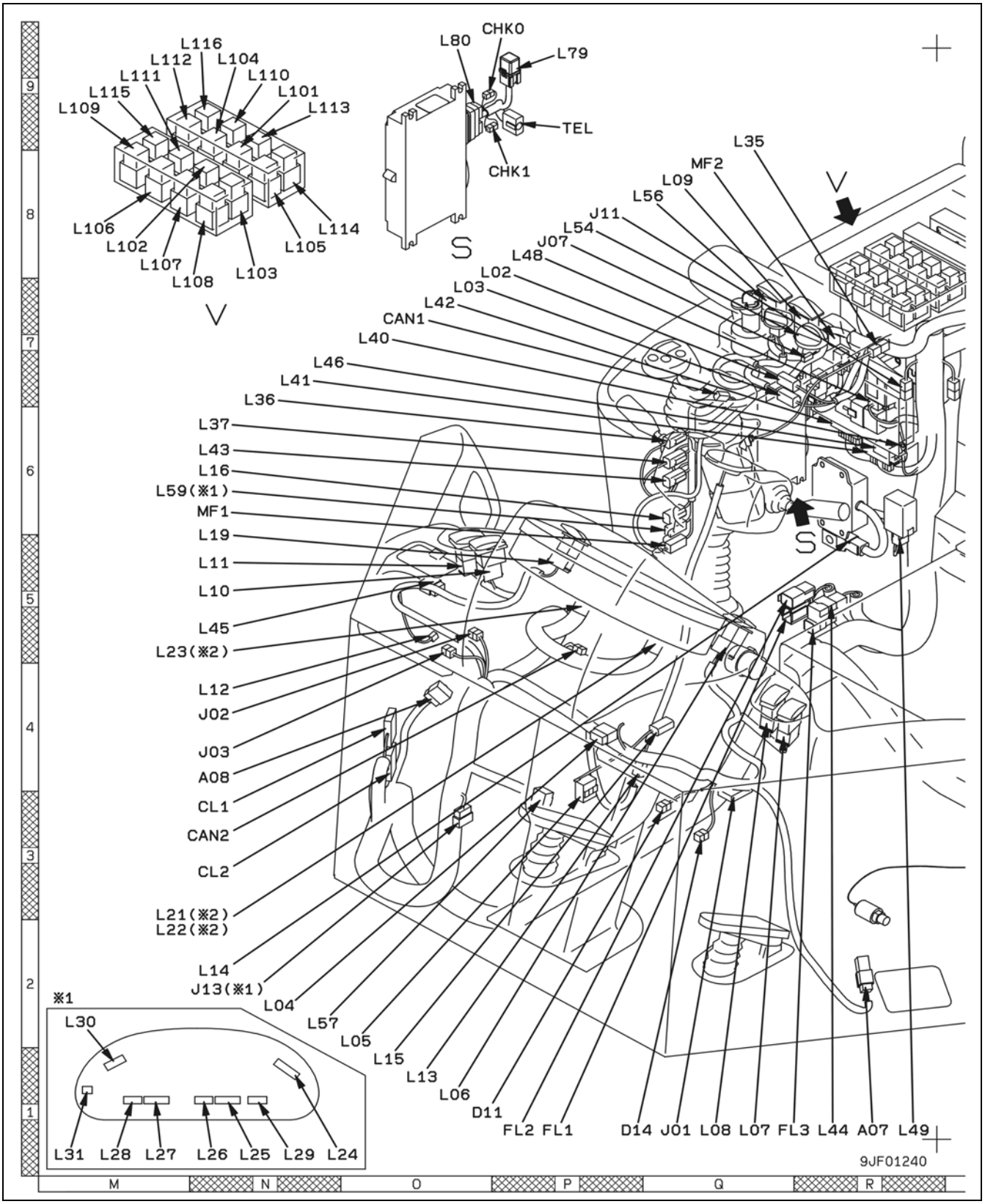
No.	Phenomena considered to be failures	Troubleshooting						
		Failure code	HST mode	ECSS mode	MON mode	E mode	H mode	S mode (Engine)
Failures related to monitor (MON mode)								
32	The steering oil pressure caution lamp does not light ON				MON-7			
33	The emergency steering oil pressure indicator lamp does not light ON				MON-8			
34	Input fault in monitor panel mode switch 1 [■] (panel switch 1)				MON-9			
35	Input fault in monitor panel mode switch 1 [◊] (panel switch 2)				MON-10			
36	Input fault in monitor panel mode switch 2 [<] (panel switch 3)				MON-11			
37	Input fault in monitor panel mode switch 2 [>] (panel switch 4)				MON-12			
38	The alarm buzzer does not sound or stop				MON-13			
39	The engine oil level caution lamp does not light ON				MON-14			
40	The air cleaner clogging indicator lamp does not light ON				MON-15			
41	Defective cancel switch				MON-16			
42	Defective subtotal switch				MON-17			
43	Defective bottom pressure sensor (Short circuit with power source)				MON-18			
44	Defective rode pressure sensor				MON-19			
45	The wiper does not function				MON-20			
46	The each lamps do not light ON				MON-21			
Failures related to electrical system (E mode)								
47	The engine does not start					E-1		
48	The engine does not stop					E-2		
49	Preheating is impossible or constant					E-3		
50	Defective parking brake system					E-4		
51	Defective lift arm kick-out function and cancellation					E-5		
52	Defective bucket leveler function and cancellation					E-6		
53	Defective lift arm FLOATING holding and cancellation					E-7		
54	Travel direction is not changed normally					E-8		
55	The wiper does not function					E-9		
56	The window washer does not function					E-10		
57	The each lamps do not light ON					E-11		
58	The horn does not sound					E-12		
59	The air conditioner does not work					E-13		
Failures related to hydraulic and mechanical system (H mode)								
60	The machine does not start						H-1	
61	The travel speed is slow						H-2	
62	The thrusting force is weak						H-3	
63	Engine stalls when traveling or engine speed drops excessively						H-4	
64	Travel speed (gear) does not shifted						H-5	
65	The steering wheel dose not turn						H-6	
66	Steering is heavy						H-7	
67	The steering wheel shakes or jerks						H-8	

20	 BWP04767	 BWP04768	799-601-7550
	—	Part number: 08195-20210	

★ The pin No. is also marked on the connector (electric wire insertion end)

Number of Pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part Number
2	 BWP05049	 BWP05050	799-601-9010
	Part number: 08192-02200	Part number: 08192-02100	

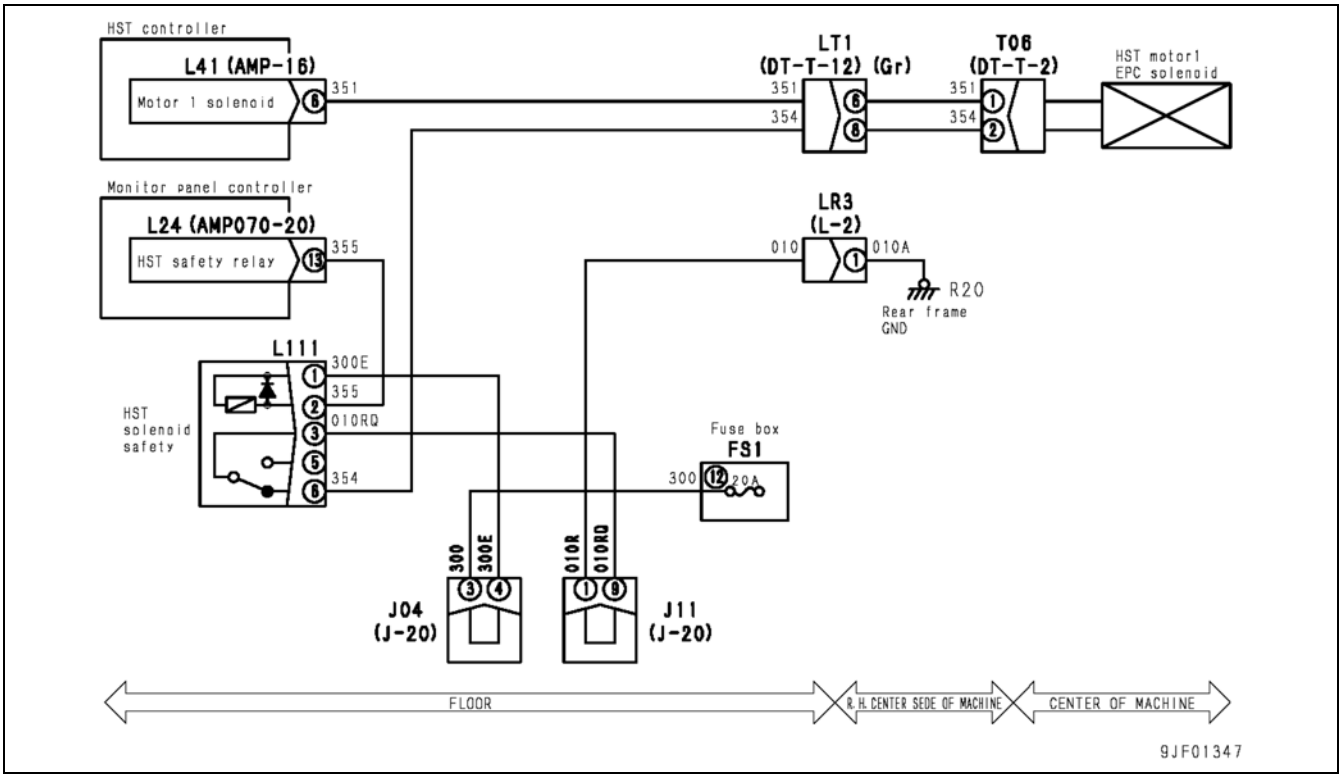
Number of Pins	DTHD Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part Number
1	 BWP05051	 BWP05052	—
	Part number: 08192-31200 (Contact size #12) 08192-41200 (Contact size #8) 08192-51200 (Contact size #4)	Part number: 08192-31100 (Contact size #12) 08192-41100 (Contact size #8) 08192-51100 (Contact size #4)	


L116
L112
L104
L111
L110
L115
L101
L109
L113
L106
L102
L107
L108
L103
L105
L114
V
L80
CHK0
L79
TEL
CHK1
S
L35
MF2
L09
L56
J11
L54
J07
L48
L02
L03
L42
CAN1
L40
L46
L41
L36
L37
L43
L16
L59(※1)
MF1
L19
L11
L10
L45
L23(※2)
L12
J02
J03
A08
CL1
CAN2
CL2
L21(※2)
L22(※2)
L14
J13(※1)
L04
L57
L05
L15
L13
L06
D11
FL2 FL1
D14 J01 L08 L07 FL3 L44 A07 L49
※1
L30
L31 L28 L27 L26 L25 L29 L24
9JF01240
M
N
O
P
Q
R

MEMORANDUM

B. Short to chassis ground or within harness	Resistance Ω	At connector T06, between (1) and chassis ground.	1MΩ and above	**11**	
		At connector T06, between (2) and chassis ground.	1MΩ and above	**12**	
		At connector T06, between (1) and (2)	1MΩ and above	**13**	
4. HST Controller Test • With ignition switch in the "OFF" position. • Disconnect (L41) connector from HST controller and install T-adapter between (L41) wiring harness connector and controller. • Turn ignition switch to the "ON" position.					
A. Controller	Voltage	Between L41, (6) and chassis ground, selector in 1st.	2 to 20V	**14**	
		Between L41, (6) and chassis ground, selector in 2nd.	2 to 20V	**15**	
		Between L41, (6) and chassis ground, selector in 3rd.	2 to 20V	**16**	
		Between L41, (6) and chassis ground, selector in 4th.	2 to 20V	**17**	

Related Circuit Diagram (Load Meter)



MEMORANDUM

TROUBLESHOOTING OF TRAVEL DAMPER SYSTEM (ECSS MODE)

POINTS TO REMEMBER WHEN TROUBLESHOOTING

Points To Remember If A Problem Returns To Normal

There is a high probability the same problem will occur again, it is desirable to follow up on the problem carefully.

1. If any abnormality returns to normal by itself.

2. If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting on the failure, and the service code is no longer displayed, or if the monitor display returns to normal.

3. After completing troubleshooting, always erase the user code from memory.

User Code Memory Retention Function

When displaying the codes in the memory and carrying out troubleshooting, record the content of the display first, then erase the display. After re-enacting the problem, carry out troubleshooting according to the failure codes that are now displayed.

There are cases where mistaken operation or abnormalities occur when a connector is disconnected. Erasing the data in this way saves any wasted work.

Load Meter Specifications (If Equipped)

Action Code	Error Code	Controller Code	Trouble	Decreased oil pressure (ZG)
E03	2G42ZG	MON		
Description of Trouble	• When engine was running (continuously for more than 30 seconds), signal from accumulator oil pressure sensor went below 4.6 MP 54 kg/cm² (768 psi)			
Machine monitor or controller Reaction	• Trigger an alarm			
Effect on Machine	• If used as is, there is a danger that the brakes will fail.			
Related 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 Error Code [2G42ZG]			Specifications	No.	Readings
A. Oil pressure check		—	Check oil pressure in system first before carrying out electrical diagnostics. See 20 TESTING ADJUSTING AND TROUBLESHOOTING. (Hydraulics)	System pressure normal?	**1**	Yes or No
1. Accumulator Pressure Sensor • With ignition switch in the “OFF” position. • Disconnect connector (T12) from sensor and isolate sensor. • Zero meter leads for proper Ω readings.						
A. Sensor check		Resistance Ω	At sensor T12, between (1) and chassis ground. (engine running at normal low idle)	0.0 to 1.0Ω	**2**	
			At sensor T12, between (1) and chassis ground. (engine off)	1MΩ and above	**3**	
2. Wiring Harness Assembly Test • With ignition switch in the “OFF” position. • Disconnect (T12) from sensor switch. • Disconnect (L26) connector from monitor panel and install T-adapter on (L26) wiring harness connector only.						
A. Open or high resistance		Resistance Ω	Between connector T12, (1) and connector L26, (1)	0.0 to 1.0Ω	**4**	
			Between connector T12, (2) and chassis ground.	0.0 to 1.0Ω	**5**	
B. Short to chassis ground or within harness		Resistance Ω	At connector T12, between (1) and chassis ground.	1MΩ and above	**6**	
			At connector T12, between (1) and (2)	1MΩ and above	**7**	
3. Monitor Panel Controller Unit • With ignition switch in the “OFF” position. • Disconnect (L26) connector from monitor panel and install T-adapter between (L26) wiring harness connector and monitor panel.						
A. Monitor panel		Voltage	Between connector L26, (1) and chassis ground. (engine running at normal low idle)	1V or lower	**8**	
			Between connector L26, (1) and chassis ground. (engine off)	20 to 30V	**9**	

[AB00MA]

Defective Battery Charging Circuit

Action Code	Error Code	Controller Code	Trouble	Defective battery charging circuit (MA) (No signal from alternator terminal R when engine stopped, Abnormal detection).
E03	AB00MA	MON		
Description of Trouble	• During engine operation, the input voltage to the alternator terminal R signal is below 5V			
Machine monitor or controller Reaction	• Activates an alarm			
Effect on Machine	• The battery is deteriorated. • The engine cannot be started. • The service meter does not work.			
Related 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 Error Code [AB00MA]			Specifications	No.	Readings
1.	**Alternator "R" Terminal Test** • With ignition switch in the "OFF" position. • Locate (E02) wire on alternator "R" terminal.					
	A. Alternator test	Voltage	Between wire location E02, (1) and chassis ground, engine running half throttle	28 to 30V	**1**	
			Between wire location E02, (1) and chassis ground, engine "OFF"	1.5V	**2**	
2.	**Wiring Harness Assembly Test** • With ignition switch in the "OFF" position. • Disconnect (E02) from alternator and (E01) from relay. • Disconnect (L23) connector from monitor panel and install T-adapter on (L23) wiring harness connector only.					
	A. Open or high resistance	Resistance Ω	Between connectors E02, (1) and L23 (12)	0.0 to 1.0Ω	**3**	
			Between connectors E02, (1) and E01, (2)	0.0 to 1.0Ω	**4**	
	B. Short to chassis ground or within harness	Resistance Ω	At connector E02, between (1) and chassis ground.	1MΩ and above	**5**	
3.	**Monitor Panel Controller Unit** • With ignition switch in the "OFF" position. • Disconnect (L23) connector from monitor panel and install T-adapter between (L23) wiring harness connector and monitor panel. • Turn ignition switch "ON".					
	A. Monitor panel	Voltage	Between L23, (12) and chassis ground, engine running, half throttle	28 to 30V	**6**	
			Between L23, (12) and chassis ground, engine "OFF"	0V	**7**	

Steps	Circuit Diagnostic Procedures For Error Code [B@BCNS]		Specifications	No.	Readings
1. Coolant Temperature Sensor Unit • With ignition switch in the “OFF” position. • Disconnect (E14) connector from temperature sensor and isolate sensor. • Zero meter leads for proper Ω readings.					
A. Open or high resistance	Resistance Ω	Between connectors E14, (1) and L21, (16)	0.0 to 1.0Ω	**4**	
		Between connectors E14, (2) and chassis ground.	0.0 to 1.0Ω	**5**	
B. Short to chassis ground or within harness	Resistance Ω	At connector E14, between (1) and chassis ground.	1MΩ and above	**6**	
		At connector E14, between (1) and (2)	1MΩ and above	**7**	
3. Monitor Panel Controller Unit • With ignition switch in the “OFF” position. • Disconnect connector (L21) and install T-adapter between (L21) connector and monitor panel.					
A. Monitor panel	Resistance Ω	At connector L21, between (16) and chassis ground temperature at 25°C (77°F)	35 to 50kΩ	**8**	
		At connector L21, between (16) and chassis ground temperature at 100°C (121°F)	3.1 to 4.5kΩ	**9**	

[B@CRNS]

HST Oil Showing Overheating Condition

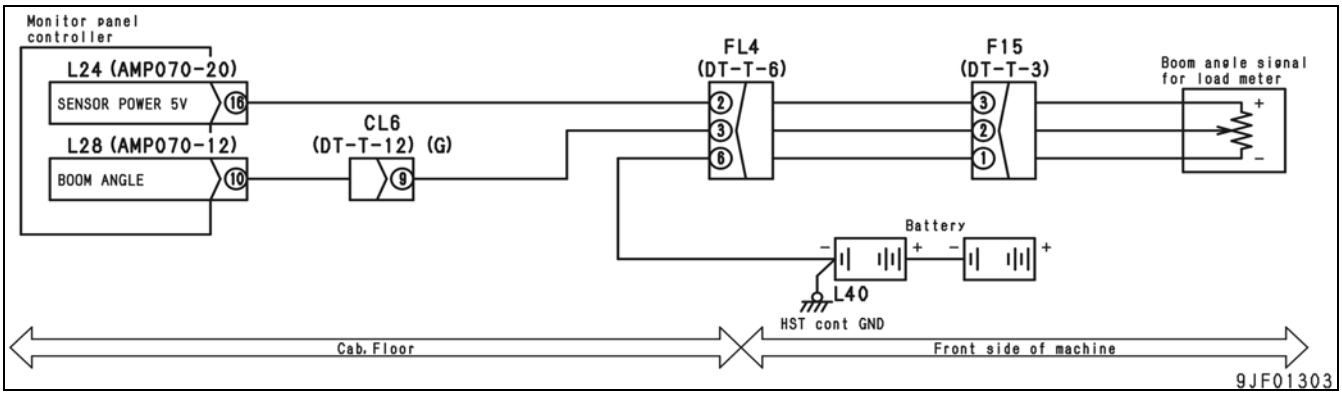
Action Code	Error Code	Controller Code	Trouble	HST oil temperature overheating (NS)
E02	B@CRNS	MON		
Description of Trouble	• The HST oil temperature is above 110°C (230°F).			
Machine monitor or controller Reaction	• Activates alarm			
Effect on Machine	• The HST may be damaged if operation continues.			
Related Information	• This failure code is displayed if the probability of a failure in the electrical system is low. • The axle oil temperature is displayed by monitoring code 30100.			

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 Error Code [B@CRNS]		Specifications	No.	Readings
1. Temperature Sensor Unit • With ignition switch in the “OFF” position. • Disconnect (T10) connector from temperature sensor and isolate sensor. • Zero meter leads for proper Ω readings.					
A. Sensor test	Resistance Ω	At sensor T10, between (1) and (2) temperature around 25°C (77°F)	35 to 50kΩ	**1**	
		At sensor T10, between (1) and (2) temperature around 100°C (212°F)	3.1 to 4.5kΩ	**2**	
		At sensor T10, between (1) or (2) and chassis ground.	1MΩ and above	**3**	
2. Wiring Harness Assembly Test • With ignition switch in the “OFF” position. • Disconnect (T10) connector from temperature sensor. • Disconnect (L21) connector from monitor panel and install T-adapter on (L21) wiring harness connector only.					
A. Open or high resistance	Resistance Ω	Between connectors T10, (1) and L21, (14)	0.0 to 1.0Ω	**4**	
		Between connectors T10, (2) and chassis ground.	0.0 to 1.0Ω	**5**	
B. Short to chassis ground or within harness	Resistance Ω	At connector T10, between (1) and chassis ground.	1MΩ and above	**6**	
		At connector T10, between (1) and (2)	1MΩ and above	**7**	
3. Monitor Panel Controller Unit • With ignition switch in the “OFF” position. • Disconnect connector (L21) and install T-adapter between (L21) connector and monitor panel. • Zero meter leads for proper Ω readings.					
A. Monitor panel	Resistance Ω	At monitor L21, between (14) and chassis ground. temperature from around 25°C (77°F)	35 to 50kΩ	**8**	
		At monitor L21, between (14) and chassis ground. temperature from around 100°C (212°F)	3.1 to 4.5kΩ	**9**	

3. Monitor Panel Controller Unit • With ignition switch in the "OFF" position. • Disconnect (L24) and (L28) connector from monitor panel and install T-adapter between (L24) and (L28) connector and monitor panel. • Turn ignition switch "ON"					
A. Monitor panel	Voltage	At monitor L24, between (16) and chassis ground.	4.75 to 5.25V	**13**	
		At monitor L28, between (10) and chassis ground. Boom fully raised.	3.5 to 4.0V	**14**	
		At monitor L28, between (10) and chassis ground. Boom fully lowered.	1.0 to 2.0V	**15**	

Related Circuit Diagram (Load Meter)



[D1B0KB]

HST Safety (Transmission Cut-off) Relay Open Or Shorted (KB)

Action Code	Error Code	Controller Code	Trouble	Short circuit of HST safety relay output (KB)
E01	D1B0KB	MON		
Description of Trouble	• When the power for the HST safety relay output circuit is turned ON, a large current flows. When the output is turned ON, any current does not flow.			
Machine monitor or controller Reaction	• The alarm is turned ON. • The output to the HST relay circuit is turned OFF.			
Effect on Machine	• HST does not function.			
Related 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. It is important to complete all steps and record information for final analyzing.

Steps	**Circuit Diagnostic Procedures For Error Code [D1B0KB]**		**Specifications**	**No.**	**Readings**
Fuse	—	Check condition of fuses FS 1 (12)	Good Condition?	**1**	Yes or No
1. Defective HST Safety Relay • With ignition switch in the "OFF" position. • Replace the relay (L111) with another one of the same type. • Turn ignition switch "ON".					
A. (L111) relay check	—	Error code [D1B0KB] is displayed.	Relay (L111) good	**2**	
	—	Error code [D1B0KB] is not displayed. System works.	Relay (L111) defective	**3**	
2. Defective Clutch Control And HST Motor 1 EPS Solenoids • With ignition switch in the “OFF” position. • Disconnect (T05) and (T06) solenoids from the system. • Zero meter leads for proper Ω readings.					
A. Clutch and HST solenoids	Resistance Ω	At connection T05 between (1) and (2).	15 to 35Ω	**5**	
		At connection T06 between (1) and (2).	15 to 35Ω	**6**	
		At connection T05, (1) or (2) and chassis ground.	1MΩ and above	**7**	
		At connection T06, (1) or (2) and chassis ground.	1MΩ and above	**8**	
3. Wiring Harness Assembly Test • With ignition switch in the "OFF" position. • Disconnect (L111) connector from relay circuit as well as (T05) and (T06) connectors from solenoids. • Disconnect (L24) and (L41) connector from monitor panel and install T-adapter on (L24) and (L41) wiring harness connector only. • ✷ For this voltage test the ignition switch must be in the “ON” position.					

[DD17LD]

Monitor Panel Mode Selector Switch Will Not Set

Action Code	Error Code	Controller Code	Trouble	Monitor panel mode selector switch 2 (<) (Panel switch 3) input error (LD)
E01	DD15LD	MON		
Description of Trouble	• The monitor panel mode selector switch 1 [<] (Panel switch 3) input circuit is always in the CLOSE state for more thirty seconds.			
Machine monitor or controller Reaction	• Activates an alarm.			
Effect on Machine	• The monitor does not work.			
Related Information	• —			

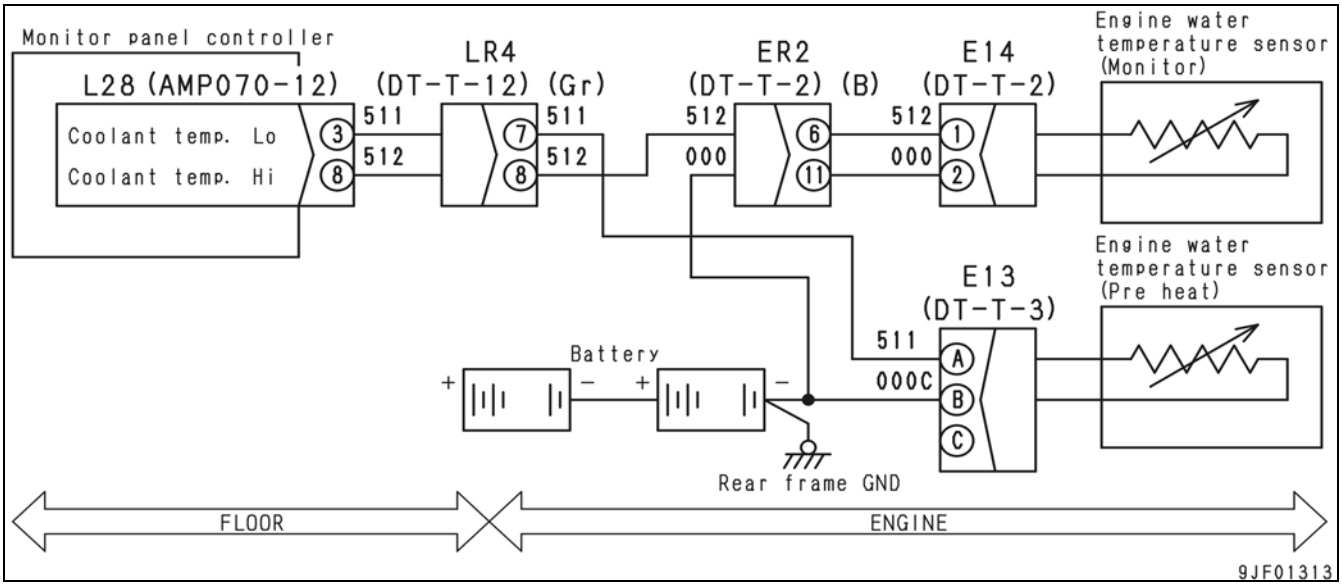
Tools and Procedures	
	• Digital Volt Ohm Meter. T-adapter kit. • Do not mark on original page of service manual. Remove this page from the service manual and make a copy for recording information while performing these tests. • If you are unable to copy this page, record readings on a separate paper 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 Error Code [DD17LD]		Specifications	No.	Readings
1.	**Monitor Mode Selector Switch** • With ignition switch in the “OFF” position. • Disconnect (L11) connector from switch and isolate switch. • Zero meter leads for proper Ω readings.				
A.	Switch test	Resistance Ω	At switch L11, between (2) and (3) switch (<) pressed.	0.0 to 1.0Ω	**1**	
			At switch L11, between (2) and (3) switch (<) released.	1MΩ and above	**2**	
2.	**Wiring Harness Assembly Test** • With ignition switch in the “OFF” position. • Disconnect (L11) connector from switch. • Disconnect (L21) connector from monitor panel and install T-adapter on (L21) wiring harness only.				
A.	Open or high resistance	Resistance Ω	Between connector L11, (1) and L21, (5)	0.0 to 1.0Ω	**3**	
			Between connector L11, (3) and L21, (4)	0.0 to 1.0Ω	**4**	
			Between connector L11, (2) and chassis ground.	0.0 to 1.0Ω	**5**	
B.	Short to chassis ground or within harness	Resistance Ω	At connector L11, between (1) and chassis ground.	1MΩ and above	**6**	
			At connector L11, between (3) and chassis ground.	1MΩ and above	**7**	
			At connector L11, between (1) and (2)	1MΩ and above	**8**	
			At connector L11, between (1) and (3)	1MΩ and above	**9**	
			At connector L11, between (2) and (3)	1MΩ and above	**10**	
3.	**Monitor Panel Controller Unit** • With ignition switch in the “OFF” position. • Disconnect (L21) connector from monitor panel and install T-adapter between (L21) connector and monitor panel. • Turn ignition switch to the “ON” position.				

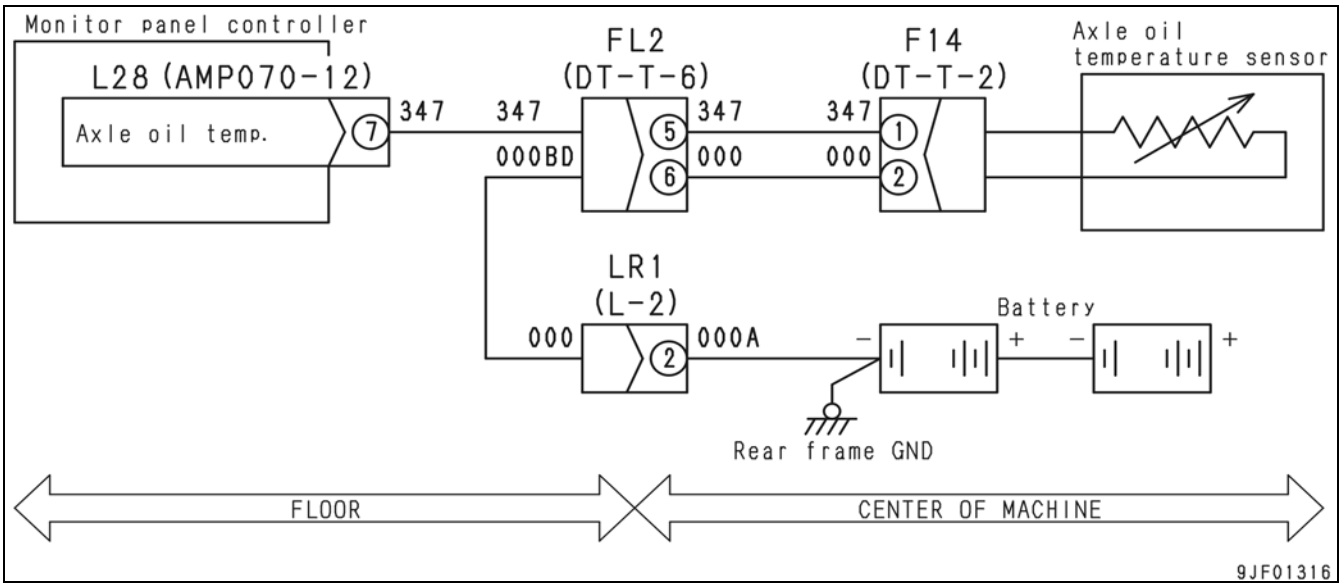
B. Short to chassis ground or within harness	Resistance Ω	At connector L15, (2) and chassis ground.	1MΩ and above	**10**	
		At connector L15, (3) and chassis ground.	1MΩ and above	**11**	
		At connector L15, (4) and chassis ground.	1MΩ and above	**12**	
		At connector L15, (2) and (3)	1MΩ and above	**13**	
		At connector L15, (2) and (4)	1MΩ and above	**14**	
		At connector L15, (3) and (4)	1MΩ and above	**15**	
3. 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 panel	Voltage	At monitor L25, between (4) and chassis ground, set in "F" position.	20 to 30V	**16**	
		At monitor L25, between (4) and chassis ground, set in "R" position.	1V or lower	**17**	
		At monitor L25, between (5) and chassis ground, set in "R" position.	20 to 30V	**18**	
		At monitor L25, between (5) and chassis ground, set in "F" position.	1V or lower	**19**	
		At monitor L25, between (13) and chassis ground, set in "N" position.	20 to 30V	**20**	
		At monitor L25, between (13) and chassis ground, set in "F" position.	1V or lower	**21**	
		At monitor L25, between (13) and chassis ground, set in "R" position.	1V or lower	**22**	

A. Monitor panel	Resistance Ω	At monitor L28, between (8) and chassis ground, temperature around 25°C (77°F)	35 to 50kΩ	**12**	
		At monitor L28, between (8) and chassis ground, temperature around 100°C (212°F).	3.1 to 4.5kΩ	**13**	

(Load Meter)



(Load Meter)


Monitor panel controller
L28 (AMP070-12)
Axle oil temp.
7
347
347
000BD
FL2
(DT-T-6)
5
6
347
000
347
000
F14
(DT-T-2)
1
2
Axle oil
temperature sensor
LR1
(L-2)
000
2
000A
Battery
Rear frame GND
FLOOR
CENTER OF MACHINE
9JF01316

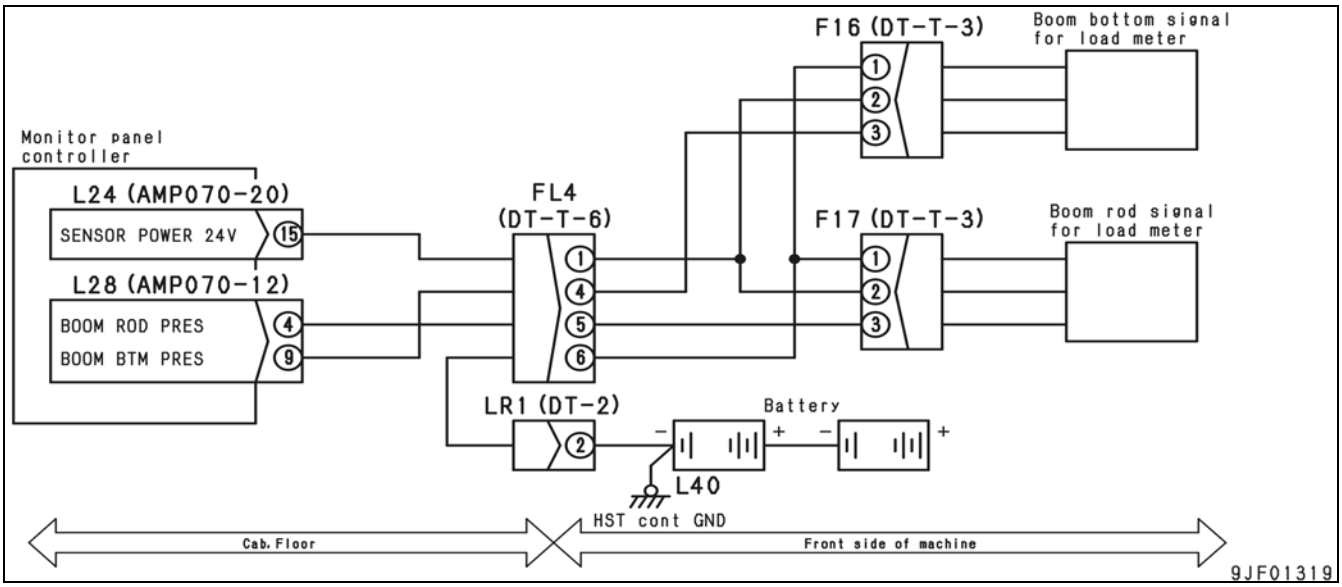
4. Monitor Panel Controller Unit (L28)

- No testing procedures for the monitor panel (L28)

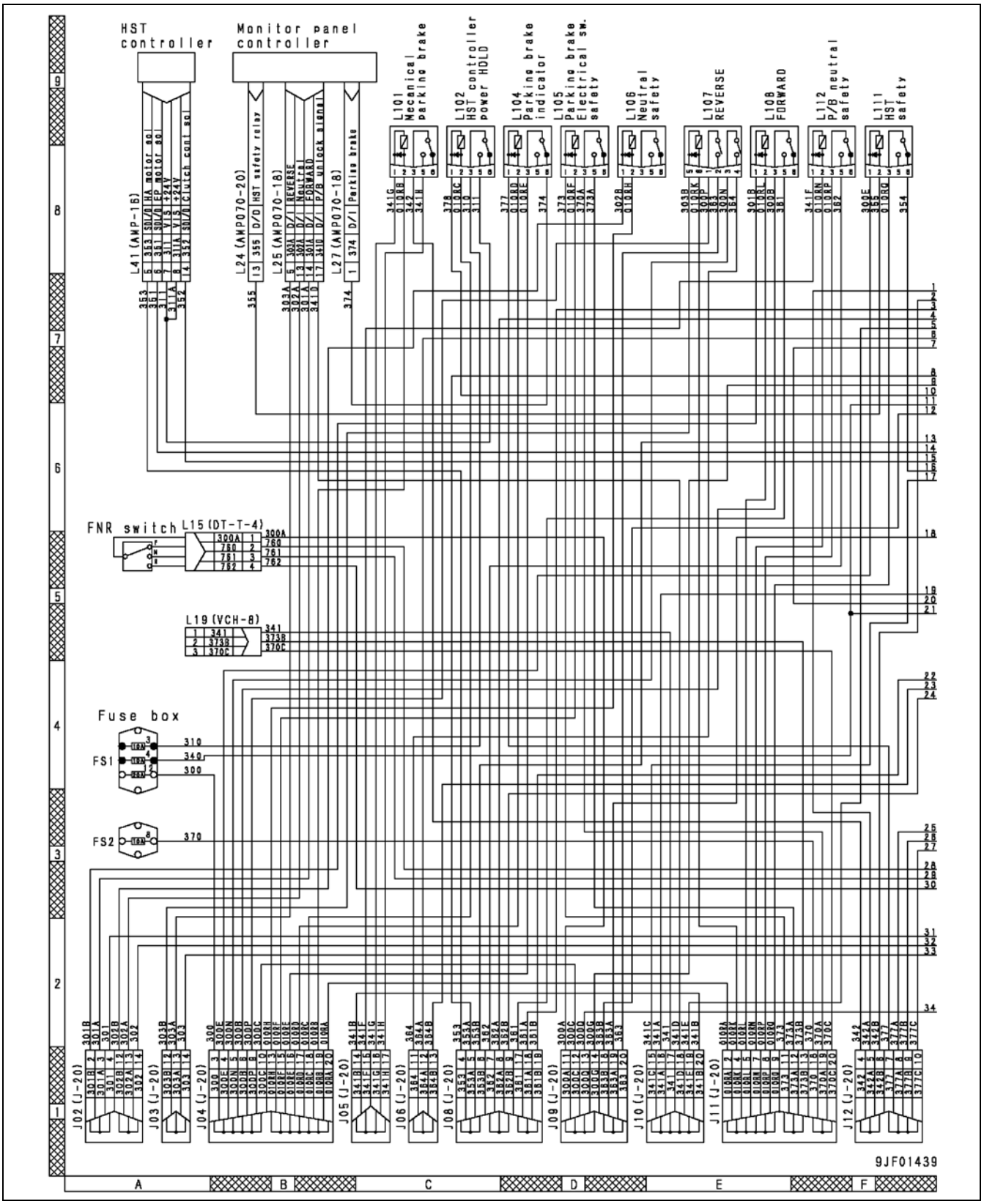
Remark

If all tests above fall within the specifications listed above replace the monitor panel unit.

Related Circuit Diagram (Load Meter)



(Load Meter)


HST controller
Monitor panel controller
L41 (AMP-16)
L24 (AMP070-20)
L25 (AMP070-18)
L27 (AMP070-18)
L101 Mecanical parking brake
L102 HST controller power HOLD
L104 Parking brake indicator
L105 Parking brake Electrical sw. safety
L106 Neutral safety
L107 REVERSE
L108 FORWARD
L112 P/B neutral safety
L111 HST safety
FNR switch
L15 (DT-T-4)
L19 (VCH-8)
Fuse box
FS1
FS2
J02 (J-20)
J03 (J-20)
J04 (J-20)
J05 (J-20)
J06 (J-20)
J08 (J-20)
J09 (J-20)
J10 (J-20)
J11 (J-20)
J12 (J-20)
9JF01439

Load Meter Specifications (If Equipped)

Action Code	Error Code	Controller Code	Trouble	The engine HST temperature caution lamp does not light ON, or after the engine starts, the engine HST temperature gauge does not rise.
—	—	—		
Description of Trouble	• The HST temperature sensor circuit is always in the OPEN state.			
Machine monitor or controller Reaction	• No reaction			
Effect on Machine	• The HST temperature caution lamp does not light ON. • After the engine starts, the HST temperature gauge does not rise.			
Related Information	• The engine HST temperature is displayed by real-time monitoring code 30100.			

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 Troubleshooting Code [MON-4]			Specifications	No.	Readings
1.	**Temperature Sensor Unit** • With ignition switch in the “OFF” position. • Disconnect (T10) connector from temperature sensor and isolate sensor. • Zero meter leads for proper Ω readings.					
A.	Sensor test	Resistance Ω	At sensor T10, between (1) and (2) temperature around 25°C (77°F)	35 to 50kΩ	**1**	
			At sensor T10, between (1) and (2) temperature around 100°C (212°F)	3.1 to 4.5kΩ	**2**	
			At sensor T10, between (1) or (2) and chassis ground.	1MΩ and above	**3**	
2.	**Wiring Harness Assembly Test** • With ignition switch in the “OFF” position. • Disconnect (T10) connector from temperature sensor. • Disconnect (L28) connector from monitor panel and install T-adapter on (L28) wiring harness connector only.					
A.	Open or high resistance	Resistance Ω	Between connectors T10, (1) and L28, (2)	0.0 to 1.0Ω	**4**	
			Between connectors T10, (2) and chassis ground.	0.0 to 1.0Ω	**5**	
B.	Short to chassis ground or within harness	Resistance Ω	At connector T10, between (1) and chassis ground.	1MΩ and above	**6**	
			At connector T10, between (1) and (2)	1MΩ and above	**7**	
3.	**Monitor Panel Controller Unit** • With ignition switch in the “OFF” position. • Disconnect connector (L28) and install T-adapter between (L28) connector and monitor panel. • Zero meter leads for proper Ω readings.					
A.	Monitor panel	Resistance Ω	At monitor L28, between (2) and chassis ground. temperature from around 25°C (77°F)	35 to 50kΩ	**8**	
			At monitor L28, between (2) and chassis ground. temperature from around 100°C (212°F)	3.1 to 4.5kΩ	**9**	

Load Meter Specifications (If Equipped)

Action Code	Error Code	Controller Code	Trouble	The steering oil pressure caution lamp does not light ON
—	—	—		
Description of Trouble	• The steering oil pressure sensor signal circuit is always in the CLOSE state during the engine is revolved.			
Machine monitor or controller Reaction	• Activates an alarm.			
Effect on Machine	• The steering may be not worked if operation continues.			
Related Information	• This warning is given when the emergency steering (option) is installed.			

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 Troubleshooting Code [MON-7]**		**Specifications**	**No.**	**Readings**
A. Live pressure test	—	Check steering oil pressure with mechanical gauge first before checking electrical system.	See Trouble-shooting in Shop Manual	**1**	—
1. Steering Pressure Switches • With ignition switch in the “OFF” position. • Disconnect (F11) and (F12) connectors from switches and isolate switches. • Zero meter leads for proper Ω readings.					
A. Switches	Resistance Ω	At switch F11, between (A) and (C), engine off.	0.0 to 1.0Ω	**2**	
		At switch F11, between (A) and (C), engine running.	1MΩ and above	**3**	
2. Wiring Harness Assembly Test • With ignition switch in the “OFF” position. • Disconnect (F11) and (F12) connectors from pressure sensors. • Disconnect (L27) connector from monitor panel and install T-adapter on (L27) wiring harness connector only.					
A. Short to chassis ground or within harness	Resistance Ω	At connector F11, (C) and chassis ground.	1MΩ and above	**4**	
		At connector F12, (B) and chassis ground.	1MΩ and above	**5**	
		At connector F11, between (A) and (C)	1MΩ and above	**6**	
		At connector F11, between (B) and (C)	1MΩ and above	**7**	
B. Open or high resistance	Resistance Ω	Between connector F11, (C) and L27, (16)	0.0 to 1.0Ω	**8**	
		Between connector F12, (B) and L27, (3)	0.0 to 1.0Ω	**9**	
		Between connector F11, (A) and chassis ground.	0.0 to 1.0Ω	**10**	
		Between connector F12, (A) and chassis ground.	0.0 to 1.0Ω	**11**	
3. Monitor Panel Controller Unit • With ignition switch in the “OFF” position. • Disconnect (L27) connector from monitor panel and install T-adapter between (L27) connector and monitor panel. • Turn ignition switch “ON”					
A. Monitor panel	Voltage	At monitor L27, between (3) and chassis ground, engine running at a low idle.	20 to 30V	**12**	
		At monitor L27, between (3) and chassis ground, engine off.	1V or lower	**13**	

Load Meter Specifications (If Equipped)

Action Code	Error Code	Controller Code	Trouble	Input failure in monitor panel mode selector switch 1 [◊] (Panel switch 1)
—	—	—		
Description of Trouble	• The monitor panel mode selector switch 1 [◊] (Panel switch 1) input circuit is always in the OPEN state.			
Machine monitor or controller Reaction	• Activates an alarm.			
Effect on Machine	• The monitor does not work.			
Related 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 Troubleshooting Code [MON-10]		Specifications	No.	Readings
1.	**Monitor Mode Selector Switch** • With ignition switch in the “OFF” position. • Disconnect (L10) connector from switch and isolate switch. • Zero meter leads for proper Ω readings.				
A. Switch test	Resistance Ω	At switch L10, between (2) and (1) switch (◊) pressed.	0.0 to 1.0Ω	**1**	
		At switch L10, between (2) and (1) switch (◊) released.	1MΩ and above	**2**	
2.	**Wiring Harness Assembly Test** • With ignition switch in the “OFF” position. • Disconnect (L10) connector from switch. • Disconnect (L25) connector from monitor panel and install T-adapter on (L25) wiring harness only. • ✷ For this voltage test the ignition switch must be in the “ON” position.				
A. Open or high resistance	Resistance Ω	Between connector L10, (1) and L25, (8)	0.0 to 1.0Ω	**3**	
		Between connector L10, (3) and L25, (6)	0.0 to 1.0Ω	**4**	
	Voltage	✷ Between connector L10, (2) and chassis ground.	20 to 30V	**5**	
B. Short to chassis ground or within harness	Resistance Ω	At connector L10, between (1) and chassis ground.	1MΩ and above	**6**	
		At connector L10, between (3) and chassis ground.	1MΩ and above	**7**	
		At connector L10, between (1) and (2)	1MΩ and above	**8**	
		At connector L10, between (1) and (3)	1MΩ and above	**9**	
		At connector L10, between (2) and (3)	1MΩ and above	**10**	
3.	**Monitor Panel Controller Unit** • With ignition switch in the “OFF” position. • Disconnect (L25) connector from monitor panel and install T-adapter between (L25) connector and monitor panel. • Turn ignition switch to the “ON” position.				

Load Meter Specifications (If Equipped)

Action Code	Error Code	Controller Code	Trouble	The alarm buzzer does not stop or remains ON
—	—	—		
Description of Trouble	• The alarm buzzer does not stop or remains ON.			
Machine monitor or controller Reaction	• No Reaction.			
Effect on Machine	• The alarm buzzer does not stop or remains ON.			
Related 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 Troubleshooting Code [MON-13]**			**Specifications**	**No.**	**Readings**
Fuse		—	Check condition of fuse FS1, (5)	Good Condition?	**1**	Yes or No
1. Buzzer • With ignition switch in the “OFF” position. • Disconnect (L46) connector from buzzer and install T-adapter between (L46) connector and buzzer. • Turn the ignition switch to the “ON” position.						
A. Buzzer test		Voltage	At buzzer L46, between (2) and chassis ground.	Buzzer sounds	**2**	
			At switch L46, between (1) and chassis ground.	20 to 30V	**3**	
2. Wiring Harness Assembly Test • With ignition switch in the “OFF” position. • Disconnect (L46) connector from buzzer. • Disconnect (L24) connector from monitor panel and install T-adapter on (L24) wiring harness connector only. • ✷ For this voltage test the ignition switch must be in the “ON” position						
A. Open or high resistance		Resistance Ω	Between connector L46, (2) and L24, (14)	0.0 to 1.0Ω	**4**	
		Voltage	✷ Between connectors L46, (1) and chassis ground.	20 to 30V	**5**	
B. Short to chassis ground or within harness		Resistance Ω	At connector L46, between (2) and chassis ground.	1MΩ and above	**6**	
			At connector L46, between (1) and (2)	1MΩ and above	**7**	
3. Monitor Panel Controller Unit • 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.nel. • Turn ignition switch to the “ON” position.						
A. Monitor panel		Voltage	At monitor L24, between (14) and chassis ground, 2 seconds after ignition switch is turned on	20 to 30V	**8**	

[MON-17]

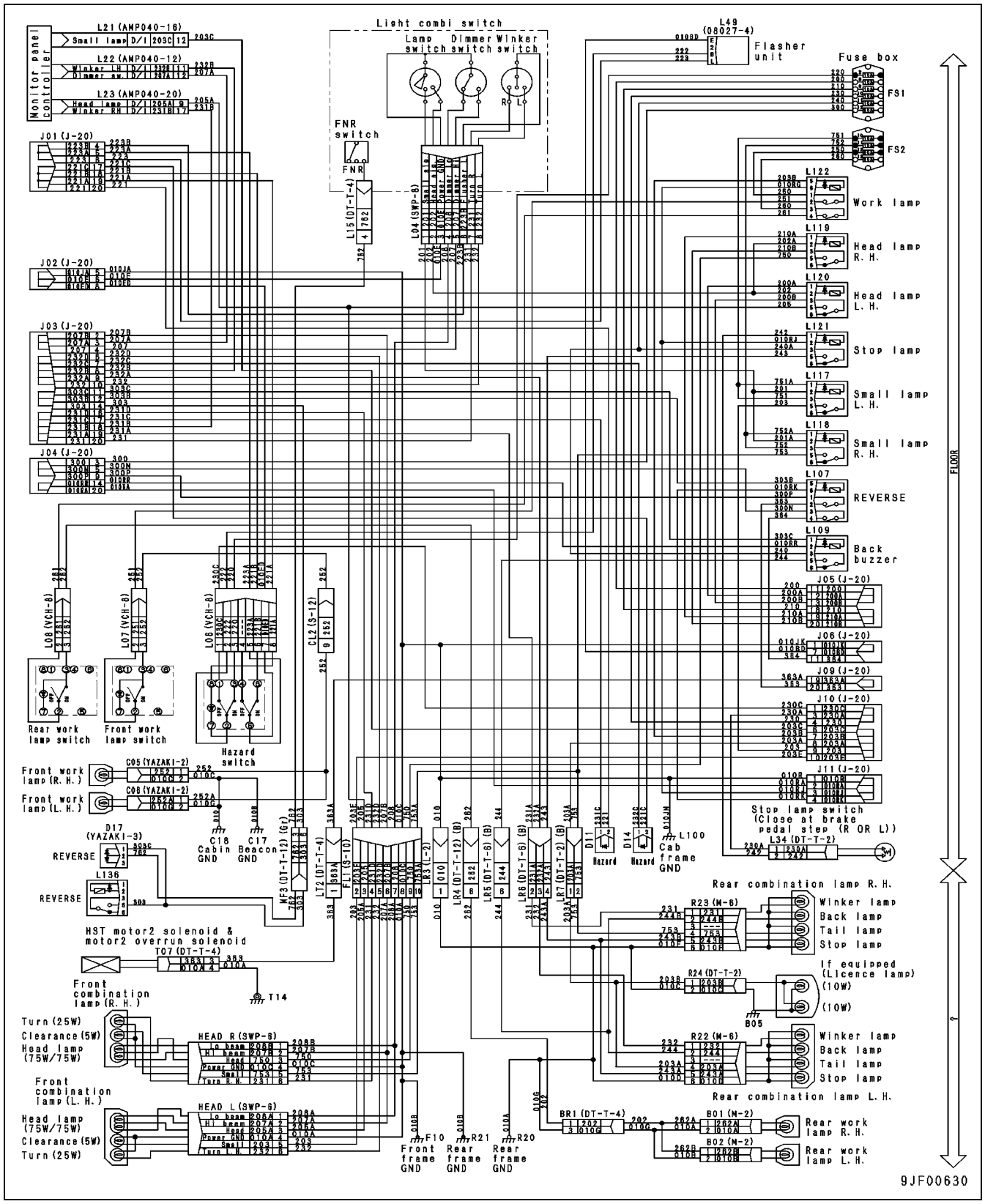
Defective Subtotal Switch

Action Code	Error Code	Controller Code	Trouble	Defective sub-total switch
—	—	—		
Description of Trouble	• The sub-total switch input circuit is open.			
Machine monitor or controller Reaction	• None in particular.			
Effect on Machine	• The sub-total of the load meter cannot be obtained.			
Related Information	• The cancel switch input signal (0/1) can be checked with the monitoring function (Code: 40904, D_IN_32).			

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 Troubleshooting Code [MON-17]		Specifications	No.	Readings
1.	**Bucket Level Switch** • With ignition switch in the “OFF” position. • Disconnect (L59) connector from switch and isolate switches. • Zero meter leads for proper Ω readings.				
A.	Switch	At switch L59, between (3) and (4), switch ON	0.0 to 1.0Ω	**1**	
	Resistance Ω	At switch L59, between (3) and (4), switch OFF	1MΩ and above	**2**	
2.	**Wiring Harness Assembly Test** • With ignition switch in the “OFF” position. • Disconnect (L59) connector from bucket level switch. • Disconnect (L27) connector from monitor panel and install T-adapter on (L27) wiring harness connector only				
A.	Short to chassis ground or within harness	At connector L59, (1) and chassis ground.	1MΩ and above	**3**	
		At connector L59, (3) and chassis ground.	1MΩ and above	**4**	
		At connector L59, between (1) and (2)	1MΩ and above	**5**	
	Resistance Ω	At connector L59, between (1) and (3)	1MΩ and above	**6**	
		At connector L59, between (1) and (4)	1MΩ and above	**7**	
		At connector L59, between (2) and (3)	1MΩ and above	**8**	
		At connector L59, between (2) and (4)	1MΩ and above	**9**	
		At connector L59, between (3) and (4)	1MΩ and above	**10**	
B.	Open or high resistance	Between connector L27, (4) and L59, (3)	0.0 to 1.0Ω	**11**	
	Resistance Ω	Between connector L59, (4) and chassis ground.	0.0 to 1.0Ω	**12**	
3.	**Monitor Panel Controller Unit** • With ignition switch in the “OFF” position. • Disconnect (L27) connector from monitor panel and install T-adapter between (L27) connector and monitor panel. • Turn ignition switch “ON”				

Related Circuit Diagram (Standard)



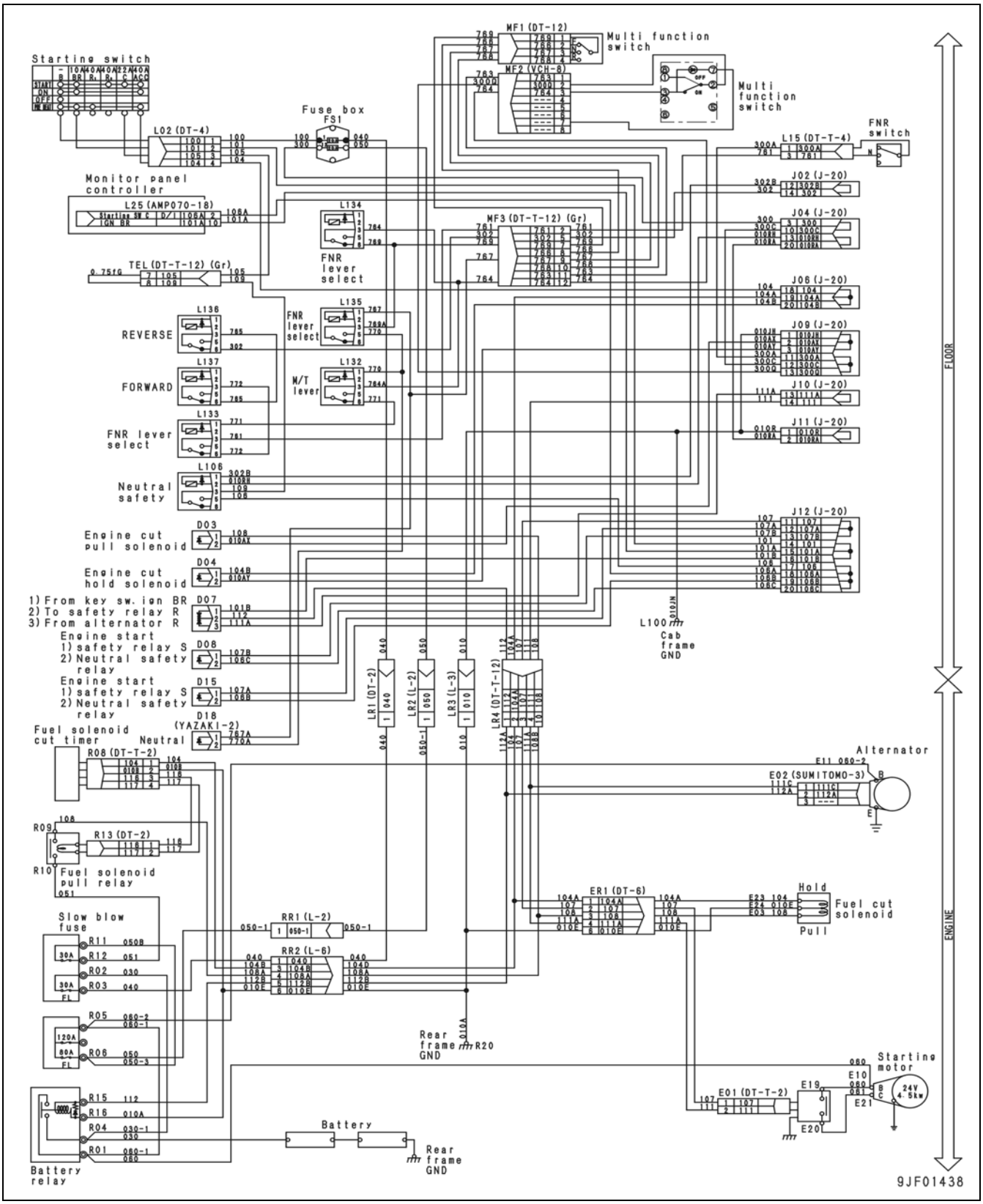
When Directional Selector Actuation Switch Is Turned ON

Action Code	Error Code	Controller Code	Trouble	The engine does not start. Defective starting motor system
—	—	—		
Description of Trouble	• The engine does not start due to defective starting motor system.			
Machine monitor or controller Reaction	• No reaction.			
Effect on Machine	• The engine does not start.			
Related Information	• If the failure code D5ZHL6 for abnormality in starting switch C input is given, carry out troubleshooting first for the applicable code. • If the fuses are blown, check the wiring harness for a short-circuit to ground. • When the directional selector actuation switch is operated, the directional lever must be in the “N” position and the directional selector switch must be in the “N” position.			

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.

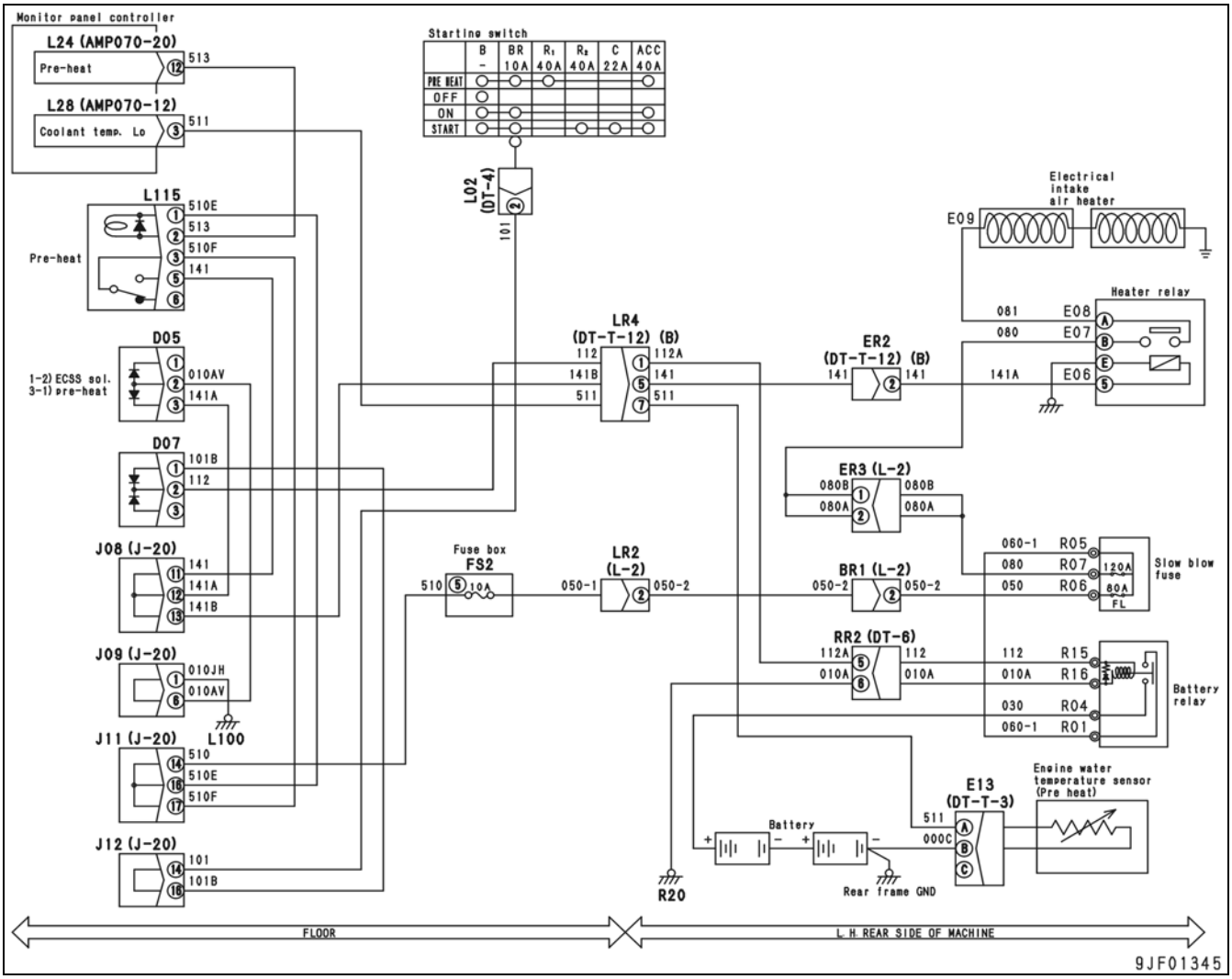
Steps	**Circuit Diagnostic Procedures For Code [E-1]**		**Specifications**	**No.**	**Readings**
Batteries	—	Check condition of batteries and connections before proceeding with these tests.	Good Condition?	**1**	Yes or No
Fuse link and fuses	—	Check condition of fuse links (R03, R06 & R 12) Check condition of fuses in FS1, (1) and (12)	Good Condition?	**2**	Yes or No
1. Defective Multifunction Relay Pack • With ignition switch in the “OFF” position. • Replace the relay (L132), (L133) and (L134) with another relay of the same type one at a time (Do not replace all relays at the same time). • Turn ignition switch to the “ON” position.					
A. Relays check	—	As each relay is replaced, problem remains?	Relays are good	**3**	
	—	As some relays are replaced, system works properly now?	One of the three relays is defective	**4**	
2. Defective Directional Selector Switch • With ignition switch in the "OFF" position. • Disconnect connector from (MF) switch and isolate (MF) switch. • Zero meter leads for proper Ω readings.					
A. Switch test	Resistance Ω	At switch MF, between (1) and (3), switch in “N”.	0.0 to 1.0Ω	**5**	
		At switch MF, between (1) and (3), switch in other mode.	1MΩ and above	**6**	
3. Diode Test • With ignition switch in the "OFF" position. • Disconnect (D18) diode connector and isolate the diode. • Zero meter leads for proper Ω readings.					
A. Diode test	Resistance Ω	At diode D18, between (1) and (2) reversing meter lead polarity each time to check.	Continuity one way only?	**7**	Yes or No

(Load Meter)


Starting switch
Fuse box
FS1
L02 (DT-4)
Monitor panel controller
L25 (AMP070-18)
TEL (DT-T-12) (Gr)
MF1 (DT-12)
MF2 (VCH-8)
MF3 (DT-T-12) (Gr)
Multi function switch
Multi function switch
FNR switch
L15 (DT-T-4)
J02 (J-20)
J04 (J-20)
J06 (J-20)
J09 (J-20)
J10 (J-20)
J11 (J-20)
J12 (J-20)
FNR lever select
L134
L135
L136
L137
L133
L106
L132
REVERSE
FORWARD
FNR lever select
Neutral safety
M/T lever
D03
Engine cut pull solenoid
D04
Engine cut hold solenoid
D07
1) From key sw. ign BR
2) To safety relay R
3) From alternator R
D08
Engine start
1) safety relay S
2) Neutral safety relay
D15
Engine start
1) safety relay S
2) Neutral safety relay
D18 (YAZAKI-2)
Fuel solenoid cut timer
Neutral
LR1 (DT-2)
LR2 (L-2)
LR3 (L-3)
LR4 (DT-T-12)
L100
Cab frame GND
Alternator
E11 080-2
E02 (SUMITOMO-3)
R08 (DT-T-2)
R09
R13 (DT-2)
R10
Fuel solenoid pull relay
Slow blow fuse
R11
R12
R02
R03
R05
R06
R15
R16
R04
R01
Battery relay
RR1 (L-2)
RR2 (L-6)
ER1 (DT-6)
Hold
Fuel cut solenoid
Pull
Rear frame GND
R20
Battery
Rear frame GND
Starting motor
E10
E19
E21
E20
E01 (DT-T-2)
24V 4.5kW
FLOOR
ENGINE
9JF01438

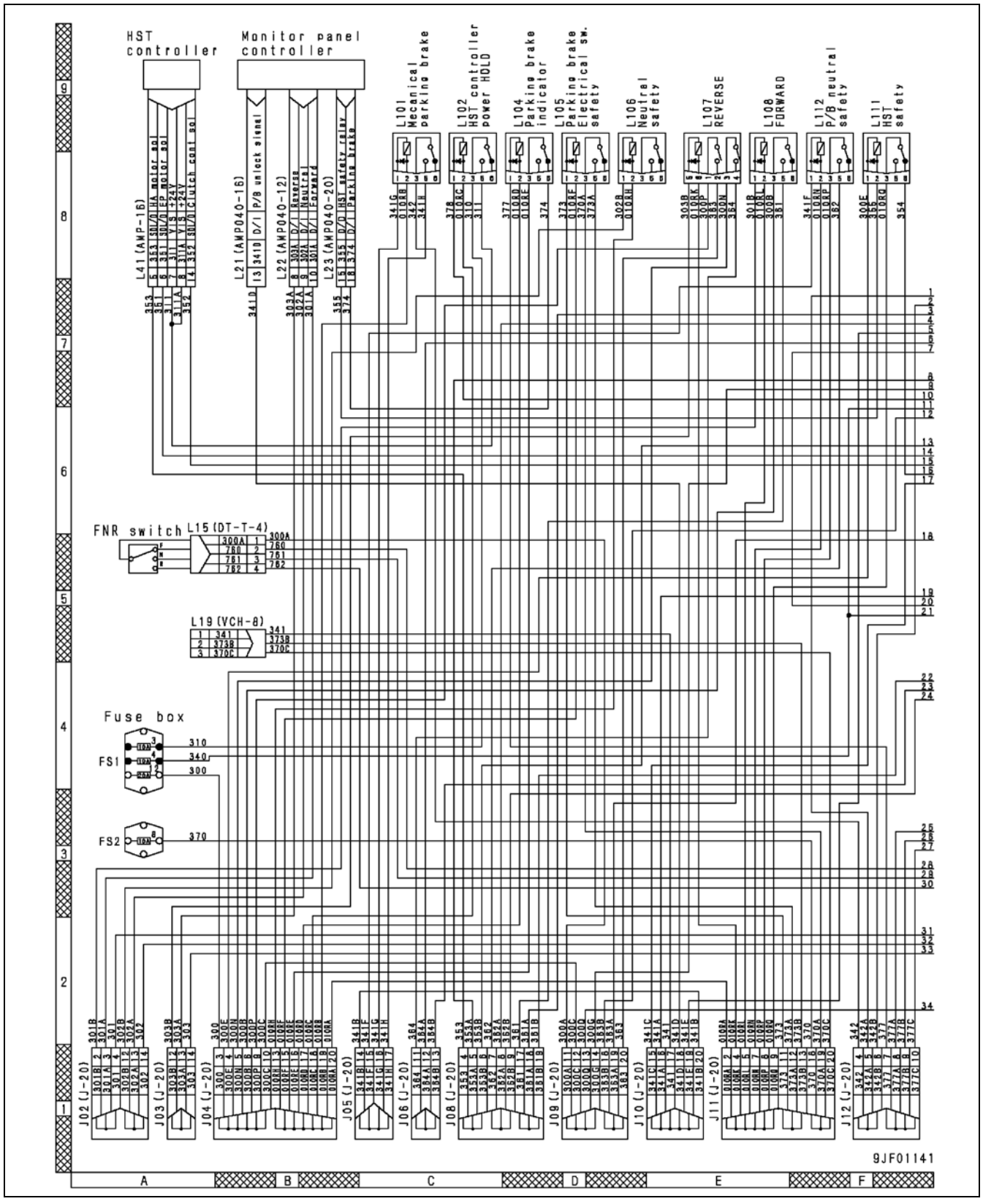
A. Open or high resistance		Between connector (E08) and chassis ground.	1V and below	**10**	
		Between connector (E06) and chassis ground.	1V and below	**11**	
B. Short to chassis ground or within harness	Resistance Ω	Between connector L115, (2) and chassis ground.	1MΩ and above	**12**	
		Between connector L24, (12) and chassis ground.	1MΩ and above	**13**	
4. Monitor Panel Controller • With ignition switch in the "OFF" position. • Disconnect (L22) connector from monitor panel and install T-adapter between (L22) wiring harness connector and monitor panel. • Turn ignition switch "ON".					
A. Monitor panel	Voltage	Between connector L22, (4) and chassis ground.	16V and above	**14**	

(Load Meter)

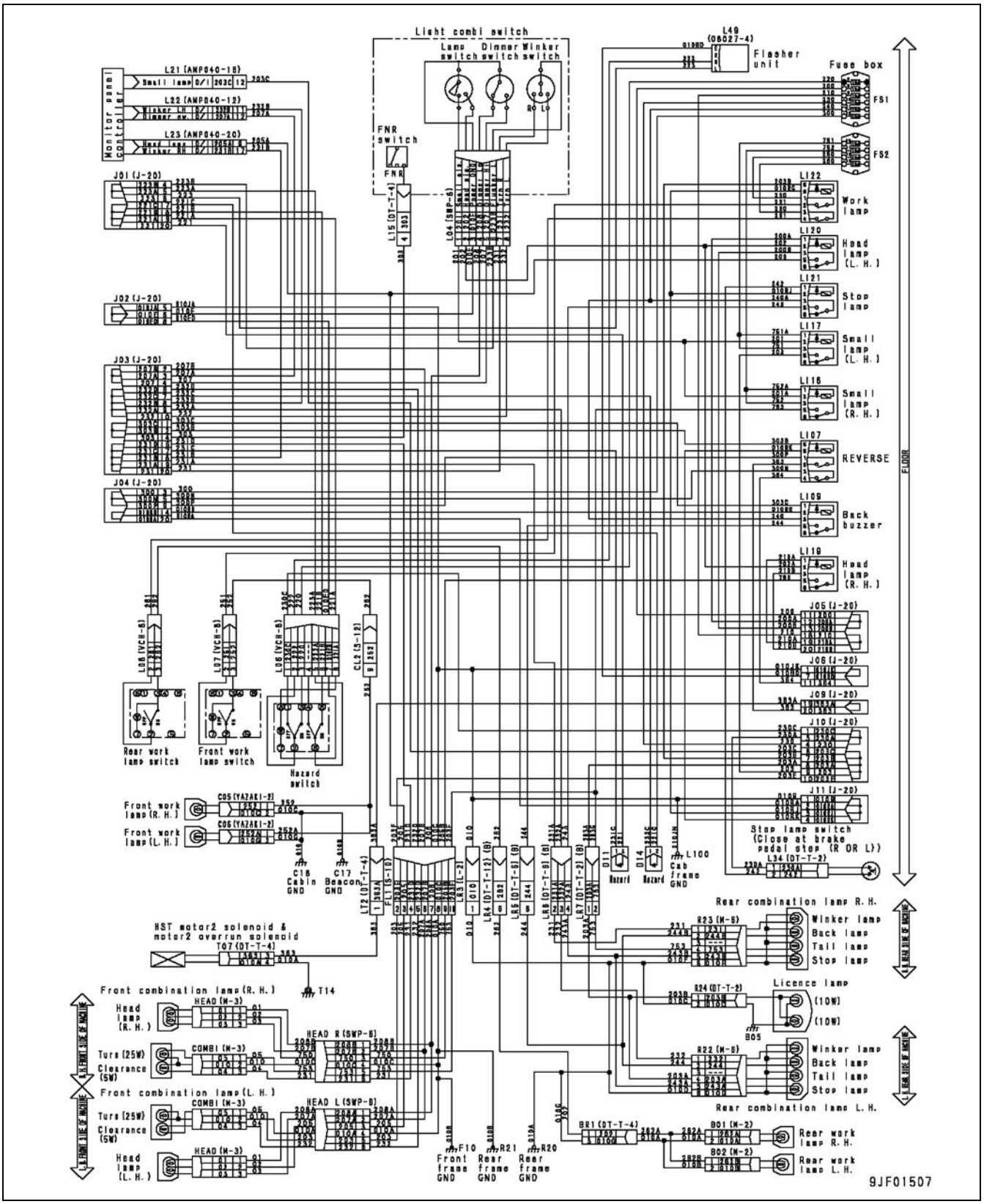


A. Open or high resistance	Voltage	✸ At connector F03, between (A) and chassis ground.	20 to 30V	**7**	
		✸ At connector L35, between (1) and chassis ground.	20 to 30V	**8**	
		✸ At connector L113, between (1), (3) and chassis ground.	20 to 30V	**9**	
		✸ At connector L114, between (1), (3) and chassis ground.	20 to 30V	**10**	
	Resistance Ω	Between connectors L113, (2) and F04, (B)	0.0 to 1.0Ω	**11**	
		Between connectors L113, (5) and L36, (1)	0.0 to 1.0Ω	**12**	
B. Open or high resistance	Resistance Ω	Between connectors L114, (2) and F03, (B)	0.0 to 1.0Ω	**13**	
		Between connectors L114, (5) and L37, (1)	0.0 to 1.0Ω	**14**	
		Between connectors L113, (5) and L36, (1)	0.0 to 1.0Ω	**15**	
		At connector F03, between (C) and chassis ground.	0.0 to 1.0Ω	**16**	
		At connector F04, between (C) and chassis ground.	0.0 to 1.0Ω	**17**	
		At connector L35, between (2) and chassis ground.	0.0 to 1.0Ω	**18**	
		At connector L36, between (2) and chassis ground.	0.0 to 1.0Ω	**19**	
		At connector L37, between (2) and chassis ground.	0.0 to 1.0Ω	**20**	
C. Short to chassis ground or within harness	Resistance Ω	At connector F03, between (B) and chassis ground.	1MΩ and above	**21**	
		At connector F04, between (B) and chassis ground.	1MΩ and above	**22**	
		At connector F03, between (B) and (C)	1MΩ and above	**23**	
		At connector F04, between (B) and (C)	1MΩ and above	**24**	

Related Circuit Diagram



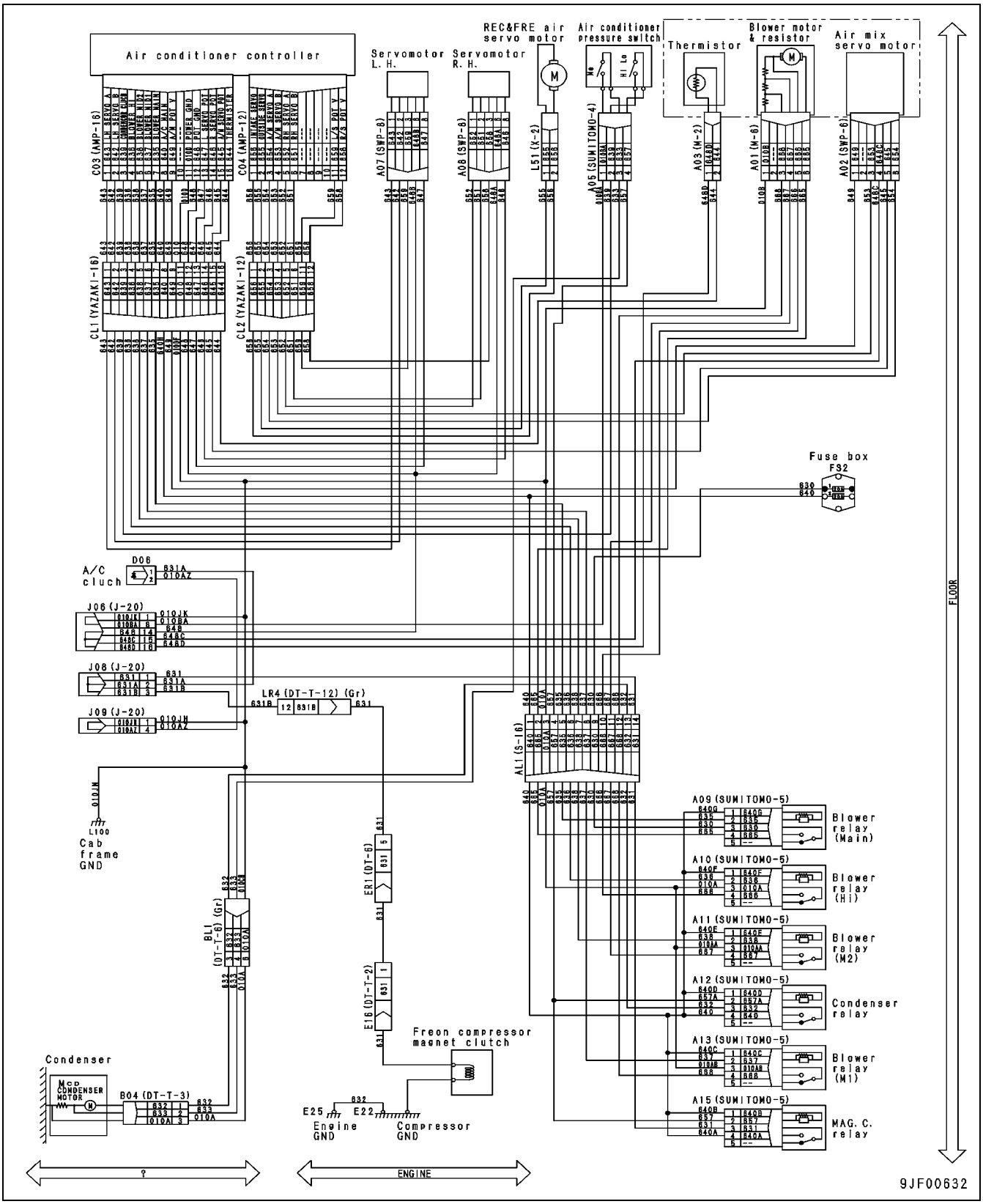
Related Circuit Diagram (Standard)



A. Relay checks	—	Lamps do not work?	Relay (L117) good	**6**	—
		Lamps work now?	Relay (L117) is faulty	**7**	—
	—	Lamps do not work?	Relay (L118) good	**8**	—
		Lamps work now?	Relay (L118) is faulty	**9**	—
4. Wiring Harness Assembly Test • With ignition switch in the "OFF" position. • Disconnect (L04), (L117), (L118) connector from circuit and right and left clearance lamps. • Zero meter leads for proper Ω readings.					
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.	1MΩ and above	**19**	
		At left lamp plug, (5) and chassis ground.	1MΩ and above	**20**	

Steps	Circuit Diagnostic Procedures For Error Code [E-11]		Specifications	No.	Readings
Fuse	—	Check condition of fuses in FS2, (9)	Good Condition?	**1**	Yes or No
1. Defective Horn Relay • With ignition switch in the "OFF" position. • Replace the relay (L116) with a relay of the same type. • Turn ignition switch to the "ON" position. • Press horn button.					
A. Horn test	Voltage	At connector F01, between (1) and (2), horn button activated	20 to 30V	**6**	
		At connector F01, between (1) and (2), horn button released.	0V	**7**	
		At connector F02, between (1) and (2), horn button activated	20 to 30V	**8**	
		At connector F02, between (1) and (2), horn button released.	0V	**9**	
4. Wiring Harness Assembly Test • With ignition switch in the "OFF" position. • Disconnect (F01), (F02), (L13) and (L116) connector from circuit and fuse FS2 (9). • Zero meter leads for proper Ω readings. • ✸ Turn ignition switch to the "ON" position for this test and reinstall fuse FS2 (9).					
A. Open or high resistance	Voltage	✸ At connection L116, (1) and chassis ground.	20 to 30V	**10**	
		✸ At connection L116, (3) and chassis ground.	20 to 30V	**11**	
	Resistance Ω	At connector L116, (2) and L13, (1)	0.0 to 1.0Ω	**12**	
		Between connector L116, (5) and F01, (1)	0.0 to 1.0Ω	**13**	
		Between connector L116, (5) and F02, (1)	0.0 to 1.0Ω	**14**	
		At connection F01, (2) and chassis ground.	0.0 to 1.0Ω	**15**	
		At connection F02, (2) and chassis ground.	0.0 to 1.0Ω	**16**	
B. Short to chassis ground or within harness	Resistance Ω	At connection F01, (1) and chassis ground.	1MΩ and above	**17**	
		At connection F02, (1) and chassis ground.	1MΩ and above	**18**	
		At connection L116, (1) and chassis ground.	1MΩ and above	**19**	
		At connection L116, (3) and chassis ground.	1MΩ and above	**20**	

Circuit Diagram for (DENSO) Air Conditioner



METHOD OF USING TROUBLESHOOTING CHART

This troubleshooting chart, like the other troubleshooting charts (YES/NO type), determines the location from the problem of occurring on the machine and categorizes the problem under one of the main components, such as the steering system or work equipment hydraulic system. Use the following procedure to carry out accurate troubleshooting swiftly.

1. Ask operator questions
   The questions to ask the operator are given under the problem. If the answer to the question matches the content given, the cause given after the arrow is the probable cause.Keeping the content of the questions in mind, read the matrix and proceed with Step (2) and Step (3) to pinpoint the correct cause.

Example: Steering wheel will not turn

Ask the operator and check the following points.

- Did the problem suddenly start?
- → Broken part in steering equipment
- Was the steering wheel heavy before?
- → Internal wear, defective seal in steering related equipment

2. Checks before troubleshooting
   Before measuring the oil pressure or starting the troubleshooting, confirm the checks before starting items, check for leakage of oil, or for loose bolts. This will prevent wasting time when troubleshooting. The items given under Checks before troubleshooting are checks that are particularly important to make about the condition of the machine before starting the actual troubleshooting.

Example: Checks before starting troubleshooting

- Is oil level and type of oil in hydraulic tank correct?
- Is there any oil leakage from steering valve or demand valve?
- Is steering linkage adjusted properly?

3. Method of reading matrix:

   A. Operate the machine when carrying out troubleshooting of the items in the Troubleshooting column. If any problems occur as the result of the troubleshooting, put a check against the item. When carrying out the troubleshooting, check the easier items first. It is not necessary to follow the number order.

   B. Find the matching cause in the Causes column. If a problem is found, the ❍ marks on the same line as the troubleshooting are the causes. (In Troubleshooting item 2 in the same diagram on the right the cause is (C) or (E) When there is one ❍ mark, carry out troubleshooting for the other items marked with m in the same Causes column to check if the problem occurs, then make repairs. When there are two ❍ marks Go to Step (3) to narrow down the cause.

Steering wheel does not turn ← Problem (example)

Ask the operator the following questions.
- Did the problem suddenly start?
  Yes = Equipment related to steering broken
- Was there previously any symptom, such as heaviness of the steering wheel?
  Yes = Wear of equipment related to steering, defective seal

Checks before troubleshooting (example)

- Is the oil level in the hydraulic tank correct? Is the type of oil correct?
- Is there any leakage of oil from the steering valve or Orbit-roll?
- Has the safety bar been removed from the frame?

(H-8)

Steering Wheel Shakes Or Has Jerky Movement

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
- Drive to a safe place and check how steering wheel shakes and under what conditions.
  - ★ If the steering wheel is heavy or there is any other problem in addition to the steering wheel shaking, see troubleshooting "H-7 Steering wheel is heavy".

No.	Diagnosis \ Remedy	Cause a: Defective inside orbital valve (Δ X)	Cause b: Defective steering cylinder (Δ X)	C: Defective cushion valve (Δ X)
1	Chassis shakes when traveling on rough road surface.	❍	❍	❍
2	During travel chassis shakes when steering is suddenly turned from one direction to the other.	❍	❍	❍
3	During travel chassis shakes when accelerating.	❍	❍	❍
4	During travel chassis shakes when engine is started.	❍		
5	Excessive shock when steering wheel is turned back.			❍

(H-27)

Travel Damper Does Not Operate And Machine Pitches And Bounces

Check the following points with the operator
- Did the machine start pitching and bouncing suddenly
  - Breakage of related devices
- Did abnormal sounds come out of machine when it starts pitching and bouncing? What part of the machine did the abnormal sounds come from.
- Did the machine start pitching and bouncing gradually?
  - Wear of related device or defective seal.

Check before troubleshooting
- Check to be sure the hydraulic tank is filled with oil of proper type and to the proper level
- Check to be sure the travel damper switch is set properly.

No.	Remedy / Diagnosis	Cause: Solenoid valve (a) Malfunction of solenoid valve	Accumulator (b) Gas leakage from accumulator or defective seal	Controller (c) Malfunction of controller	Sensor (d) Defective travel speed sensor
		C Δ	X	X	X
1	Travel speed to start operation of travel damper 6km/h (3.7 mph) is changing.			❍	❍
2	Travel damper does not work when machine is loaded.		❍	❍	
3	Travel damper does not work while machine is empty		❍	❍	
4	Boom lowers more than 30 cm (6 in) at maximum when travel damper operates when machine is loaded.			❍	
5	Travel damper does not work at all.	❍	❍	❍	❍

(S-3) ENGINE DOES NOT RUN SMOOTHLY

General causes why engine does not run smoothly

- Insufficient intake air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used

			Causes: Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn piston ring, cylinder liner	Seized turbocharger, interface	Improper valve clearance	Clogged air breather hole in fuel tank cap	Clogged, leaking fuel piping	Defective contact of valve and valve seat
Questions / Check items	Confirm recent repair history												
	Degree of use of machine	Operated for long period	Δ	Δ	Δ			Δ					Δ
	Replacement of filters has not been carried out according to Operation Manual		✳	✳	✳								
	Non-specified fuel is being used			✳	✳	✳	✳						
	Engine oil must be added more frequently							✳					
	Engine pick-up suddenly became poor					❍			✳		❍	❍	
	Rust and water are found when oil is drained			✳	✳								
	Dust indicator lamp is red		✳										
	Noise of interference is heard from around turbocharger								✳				
	Color of exhaust gas	Blue under light load				❍		✳					
		Black	✳			✳			✳				❍
	Clanging sound is heard from around cylinder head									✳			
	Mud is stuck to fuel tank cap										✳		
	There is leakage from fuel piping											✳	
	High idling speed under no load is normal, but speed suddenly drops when load is applied			✳	✳						❍		
	There is hunting from engine (rotation is irregular)			❍	✳	❍					❍		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					✳	❍						
	Blow-by gas excessive							✳					
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●										
	When fuel filter, strainer are inspected directly, they are found to be clogged			●									
	When feed pump strainer is inspected directly, it is found to be clogged				●								
	Speed does not change when operation of certain cylinders is stopped					●							
	When control rack is pushed, it is found to be heavy, or does not return						●						
	When compression pressure is measured, it is found to be low							●					●
	When turbocharger is rotated by hand, it is found to be heavy								●				
	When valve clearance is checked directly, it is found to be outside standard value									●			
	When fuel tank cap is inspected directly, it is found to be clogged										●		
	When feed pump is operated, operation is too light or too heavy											●	
		Remedy	**Clean**	**Clean**	**Clean**	**Correct**	**Replace**	**Replace**	**Replace**	**Adjust**	**Clean**	**Correct**	**Replace**

(S-15) ABNORMAL NOISE IS HEARD WHEN ENGINE IS RUNNUNG

★ Judging if the noise is an internal noise or an external noise.

General causes why abnormal noise is made

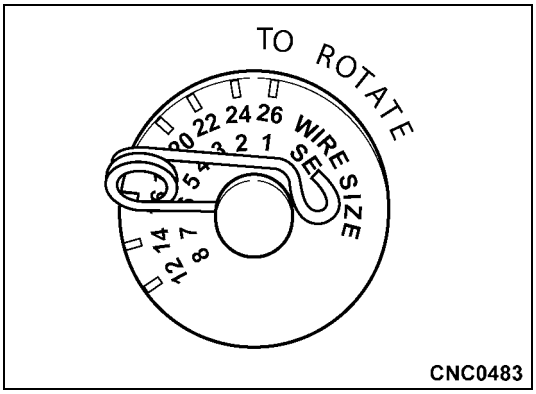
- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system

			Causes: Excessive wear of piston ring, cylinder (liner less engine)	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump	Defective injection pump (rack, plunger seized)	Deformed fan, fan belt interference	Defective adjustment of valve clearance	Broken dynamic valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and cylinder head	Defect inside muffler (dividing board out of position)
Questions / Check items	Confirm recent repair history													
	Degree of use of machine	Operated for long period	Δ											
	Condition of abnormal noise	Gradually occurred	❍					❍						
		Suddenly occurred		❍	❍					❍				
	Non-specified fuel is being used					❍	❍							
	Engine oil must be added more frequently		✲											
	Color of exhaust gas	Black under light load	✲											
		Black		✲					❍			❍		
	Metal particles found in oil filter		✲		✲									
	Blow-by gas excessive		✲											
	Noise of interference is heard from around turbocharger			✲										
	Engine pickup is poor and combustion is abnormal					✲								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					✲	❍							
	Seal on injection pump has come off							✲						
	Abnormal noise is loud when accelerating engine					❍	❍	❍	❍	❍		❍		
	Clanging sound is heard from around cylinder head								✲	✲				
	Leakage of air between turbocharger and cylinder head, loose clamp												✲	
	Vibrating noise is heard from around muffler													✲
Troubleshooting	When compression pressure is measured, it is found to be low		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	Remove gear cover and inspect directly				●							●		
	Speed does not change when operation of certain cylinders is stopped					●								
	When control rack is pushed, it is found to be heavy, or does not return						●							
	Injection pump test shows that injection amount is incorrect							●						
	Fan is deformed, belt is loose								●					
	When valve clearance is checked, it is found to be outside standard value									●				
	Remove cylinder head cover and inspect directly										●			
	When muffler is removed, abnormal noise disappears													●
		remedy	**replace**	**replace**	**replace**	**replace**	**correct**	**replace**	**correct**	**replace**	**correct**	**replace**	**replace**	**replace**

Component	Symbol		Part No.	Part Name	Necessity	Qty	New/remodel	Sketch	Nature Of Work, Remarks
Installation of operator's cab glass	X	1	799-703-1200	Service tool kit	■	2			Collection and supply of air conditioner refrigerant
			799-703-1100	Vacuum pump (100 V)	■	1			
			799-703-1110	Vacuum pump (220 V)	■	1			
			799-703-1120	Vacuum pump (240 V)	■	1			
			799-703-1400	Gas leak tester	■	1			
		2-1	793-498-1120	Clear plate	■	2			Adjustment of clearance of window glass
		2-2	793-498-1130	Plate	■	2			
		2-3	793-498-1110	Magnet	■	2			
		3	793-498-1210	Lifter (Suction cup)	■	2			Removal, installation of window glass

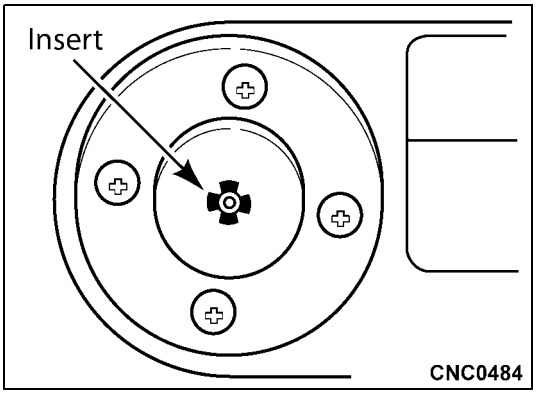
Crimping Contact Terminal (DT Type)

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.

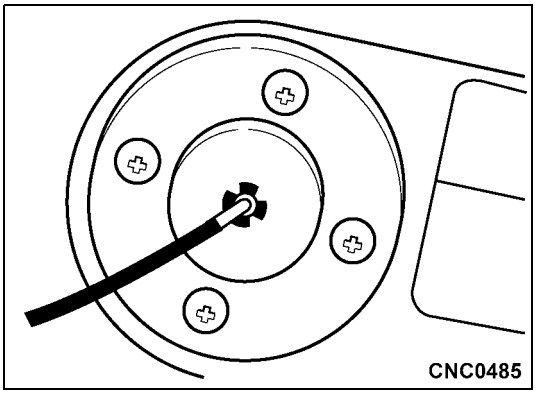
3. Insert contact terminal with barrel up. Turn adjusting screw counterclockwise until contact terminal surface is flush with indenter cover. Tighten locknut.



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

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

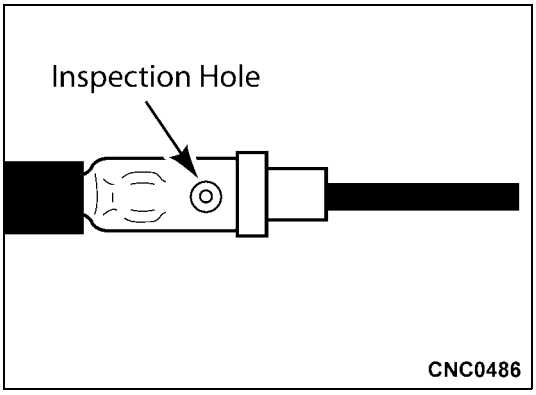
6. Release the tool handle and remove the crimped contact terminal.



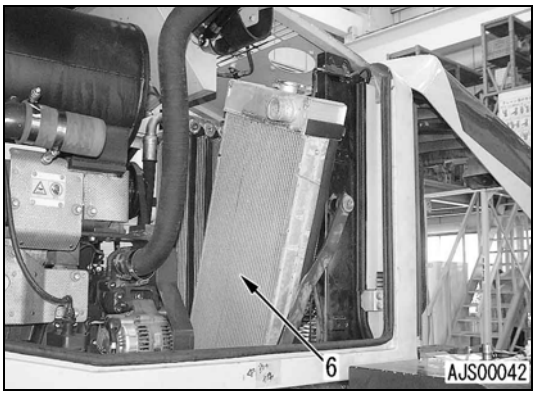
7. Using the inspection hole in the contact terminal inspect the crimped contact terminal to ensure that all strands are in the crimped barrel.

Remark

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



7. Raise radiator assembly (6) and pull it out to the left to remove.
   - Be careful not to damage the core.



Radiator Installation Procedures

- Carry out installation in the reverse order to removal.

※1 ※2

Radiator hose clamp: 8.8 N·m (78 lbf·in)

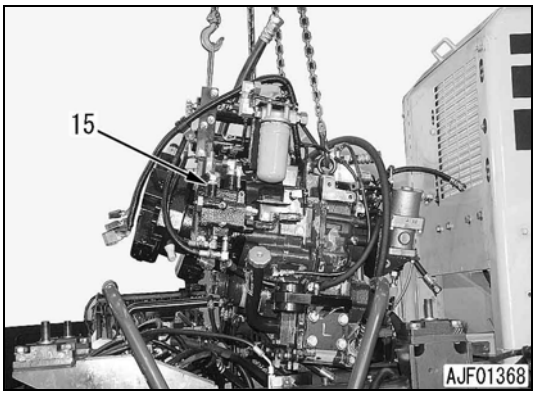
Mating face of hose: Gasket sealant (Three Bond 1208E or equivalent)

Refilling With Coolant

- Add coolant through the coolant filler to the specified level. Run the engine to warm the coolant. Recheck the coolant level.

13. Lift off transfer assembly (15).
    ★ Check that all the wires and pipes are disconnected, and then lift the assembly slowly.

kg Transfer and HST motor assembly: 420 kg (926lb)



Installation Procedures

- Carry out installation in the reverse order to removal.

※1 ※2

Drive shaft mounting bolt: 59 - 74 N·m (44 - 55 lbf·ft)

- When installing the drive shaft, check that the key way of the spider cap is fitted in the key way of the mating yoke, and then tighten the mounting bolts.
- When installing the rear drive shaft, check that the lateral run out of the rear axle and transfer from each other is less than 3 mm (0.118 in). If the run out is 3 mm (0.118 in) or larger, shift the transfer cushion and transfer mount to reduce the run out.

※3

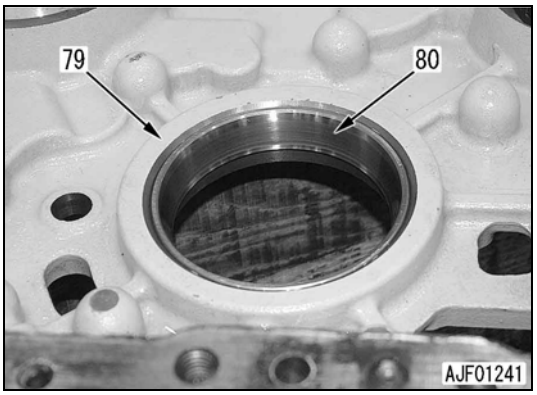
Transfer mount mounting bolt: 662 - 828 N·m (488 - 611 lbf·ft)

Assembly Procedures

★ Clean the all parts and check them for dirt or damage. Coat their sliding surfaces with oil (TO10, EO10-CD) before installing.
★ Before icing a bearing in dry ice for expansion install, drop about 6 cc of EO10-CD or EO-30CD onto it and rotate it 10 turns.

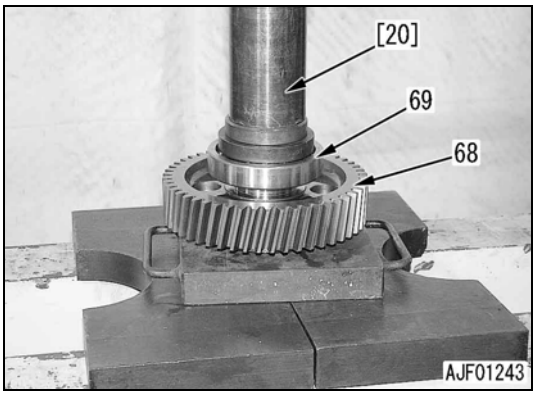
1. Rear case.

   A. Press fit outer race (80) of the output shaft to rear case (79).



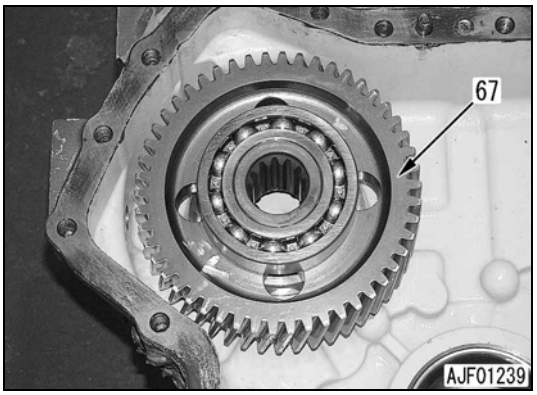
2. Assembly of HST motor 2 gear and bearing assembly

   A. Using tool [20], press fit two bearings (69) to HST motor 2 gear (68).
      ★ After press fitting the bearings, apply transfer oil to them and rotate them.



3. Installation of HST motor 2 gear and bearing assembly.

   A. Install HST motor 2 gear and bearing assembly (67).



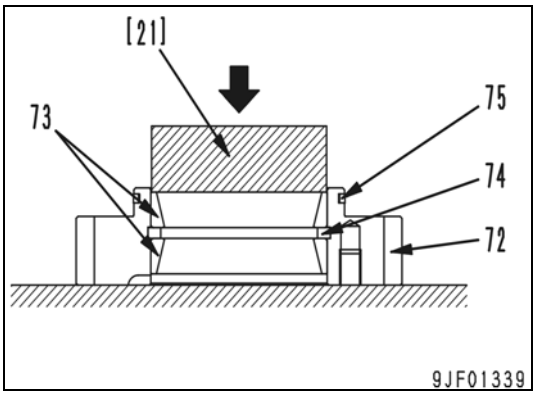
4. Assembly of HST motor 1 gear and outer races.

   A. Install spacer (74) to HST motor 1 gear (72).

   B. Using tool [21], press fit two outer races (73) to HST motor 1 gear (72).

   C. Install seal ring (75) to HST motor 1 gear (72).

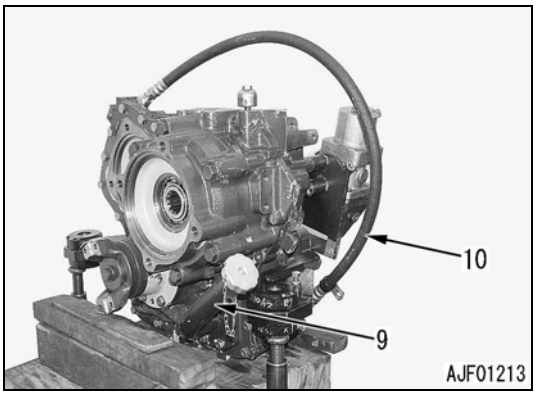
Seal ring: Grease (G2-LI)



27. Oil supply pipe and hose.

A. Connect hose (10) to the transfer case strainer.

B. Install oil supply pipe (9).



28. HST motor.

A. Sling and install HST motor 2 (8).

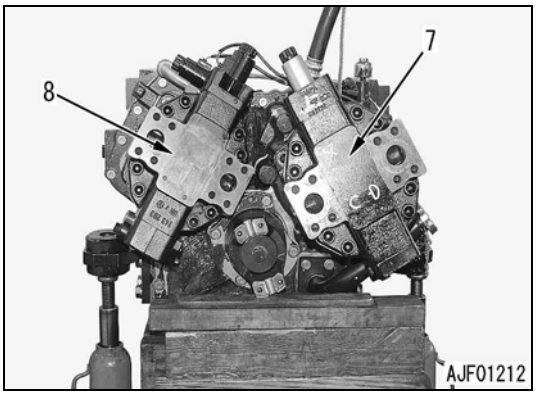
Mounting bolt: 245 - 309 N·m (181 - 228 lbf·ft)

Spline of HST motor 2: Lubricant containing molybdenum disulfide (LM-G)

B. Sling and install HST motor 1 (7).

★ Do not apply LM-G to the spline of HST motor 1.

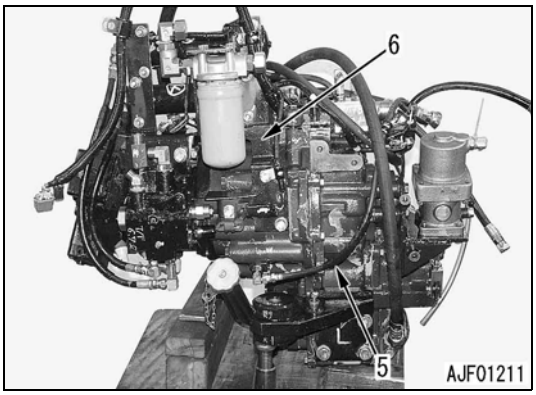
Mounting bolt: 245 - 309 N·m (181 - 228 lbf·ft)



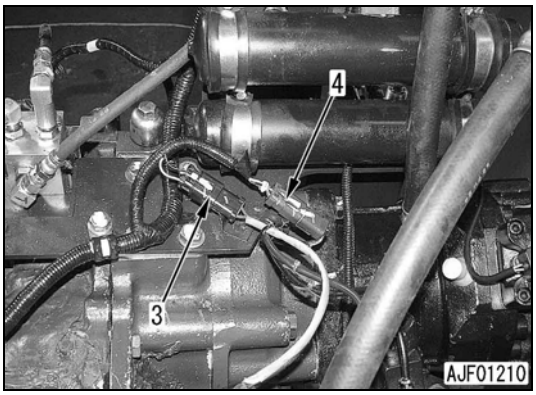
29. Brake accumulator

A. Install brake accumulator and transfer oil filter bracket assembly (6) with the six mounting bolts.

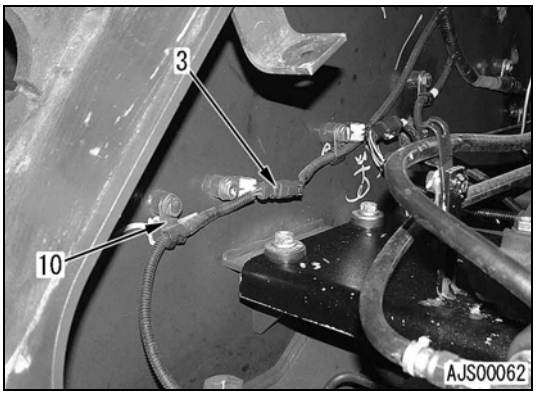
B. Connect clutch port hose (5).



C. Connect wiring connectors **T10** (3) and **T07** (4).



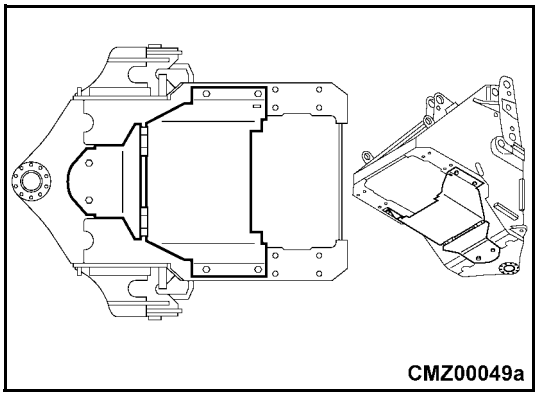
4. Disconnect wiring connector **F14** (3) and clamp (10).



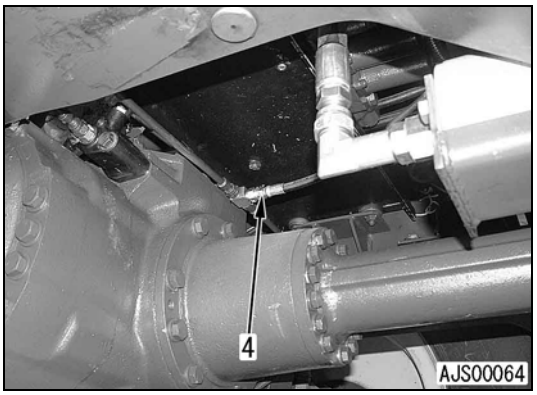
★ Temporarily support the Front Underguard Assembly (if equipped) with slings or a jack before removing the mounting bolts.

kg Front Underguard: 62 kg (137 lbs)

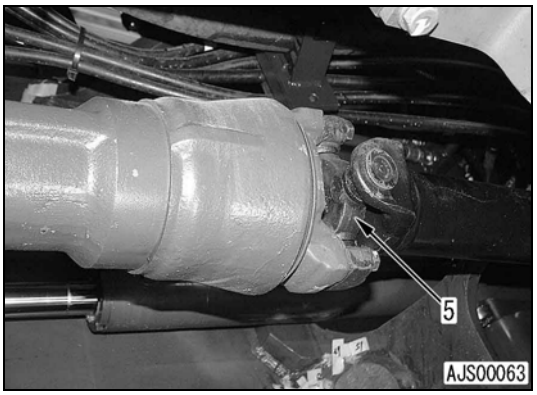
5. Remove the access plate from the under guard assembly (if equipped).
★ Remove the four mounting bolts on the guard assembly.



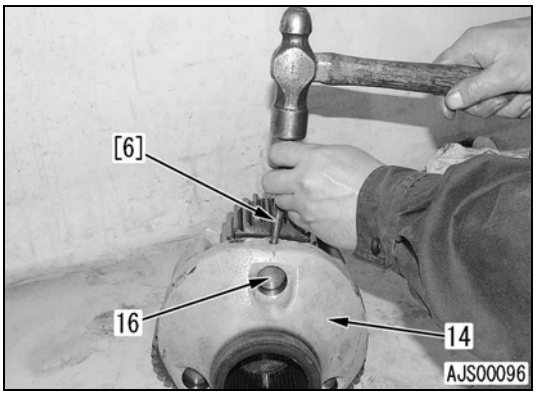
6. Disconnect brake hose (4).



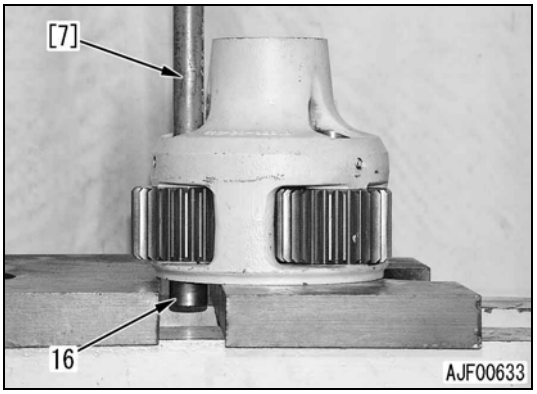
7. Disconnect front drive shaft (5). ※2



A. Using tool [6], drive in roll pin (15) of planetary carrier (14) until it is in the range of shaft (16).
   ★ Be careful not to drive in the roll pin too deep.



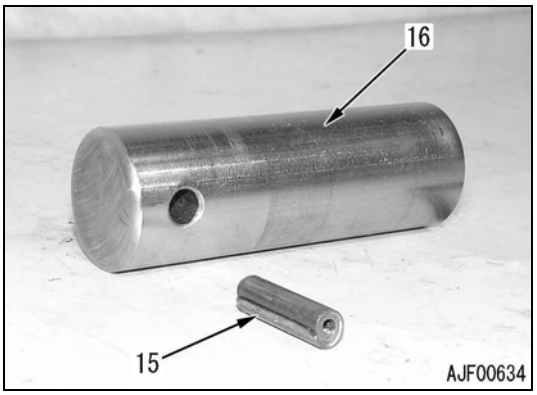
B. Using tool [7], push out shaft (16) with a press.



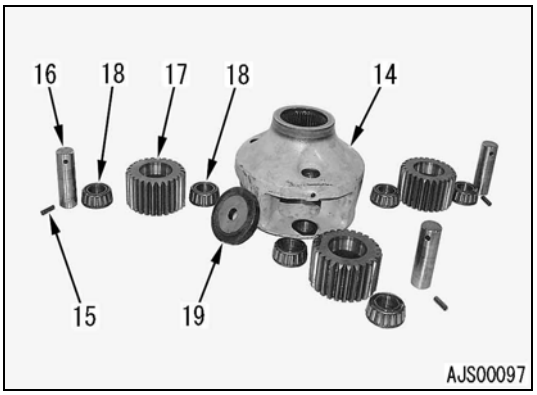
C. Remove roll pin (15) out of removed shaft (16).

D. Remove pinion gear (17) and 2 bearings (18) from planetary carrier (14).

E. Similarly, remove the 2nd and 3rd pinion gears (17) and two sets of shaft (16), roll pin (15), and bearing (18) from planetary carrier (14).



F. Remove spacer (19) from planetary carrier (14).



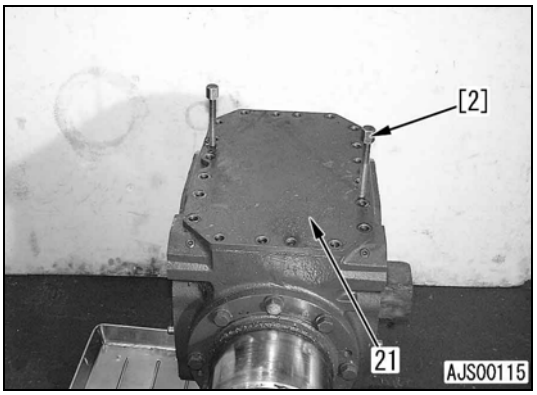
E. Remove piston (20).

F. Remove coupling (18).

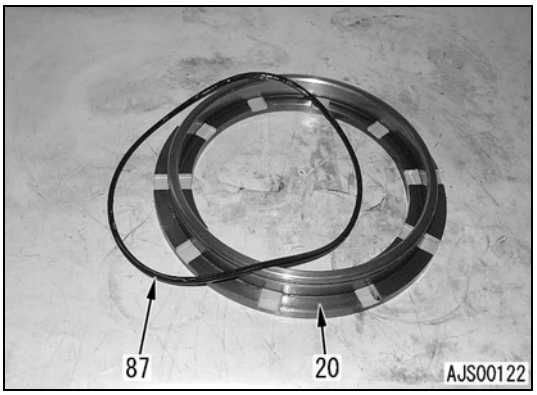
G. Perform this step for only rear differential.

H. Remove the mounting bolts of top cover (21).

I. Using forcing screws [2], remove top cover (21).

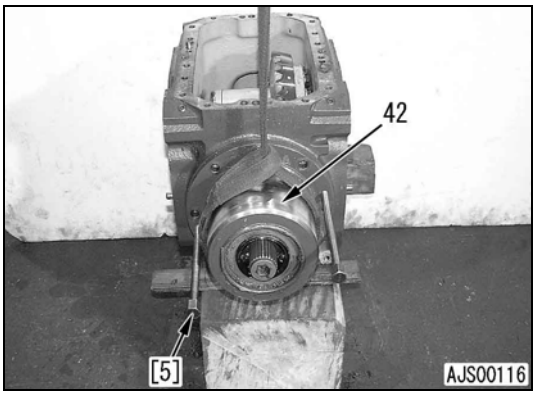


J. Remove seal (87) from piston (20).



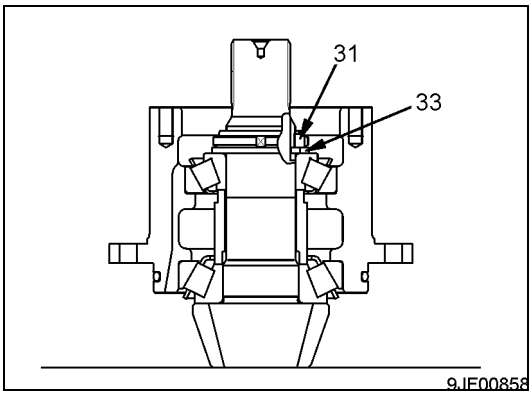
7. Removal of pinion housing assembly (For rear differential)

A. Remove the mounting bolts. Using forcing screw [5], remove pinion housing assembly (42).
★ Check the thickness and quantity of the shims.

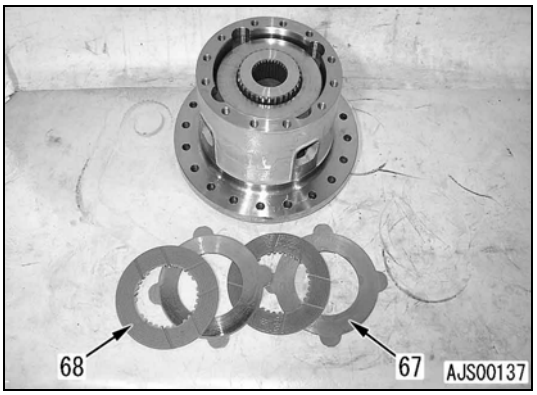


8. Disassembly of axle housing assembly (For front differential)

A. Remove nut (31) and holder (33).



J. Install two discs (68), two plates (67), two discs (68), and two plates (67) in order from the bottom.



Remark

Before installing the discs and plates, soak them in axle oil (AX080, see Operation Manual, Komatsu genuine parts list).

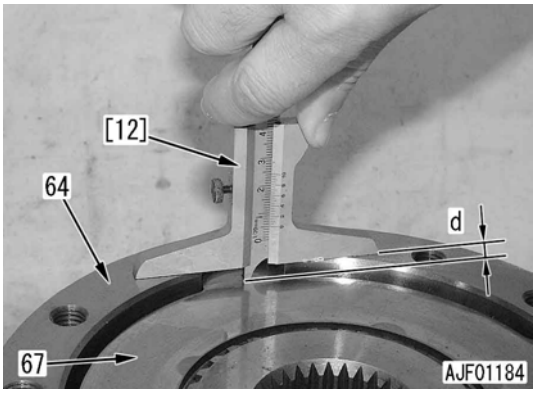
K. Selection of thickness of plate

★ Using depth gauge [12], measure distance (d) between the end of case (64) and plate (67).

★ Distance dd [(d) – 4.8 mm (0.189 in)] is the clearance between the case and plate.

★ Select the thickness of the plate so that distance dd [(d) – 4.8 mm (0.189 in)] will be 0.2 - 0.6mm. (0.008 - 0.024 in)

- Replace the plates on both sides so that their thickness (total of 2 pieces) will be the same and assemble them according to the procedure in and after J) shown above.
- Varieties of plate thickness: 3.0 mm, 3.1 mm (0.118 in, 0.122 in)

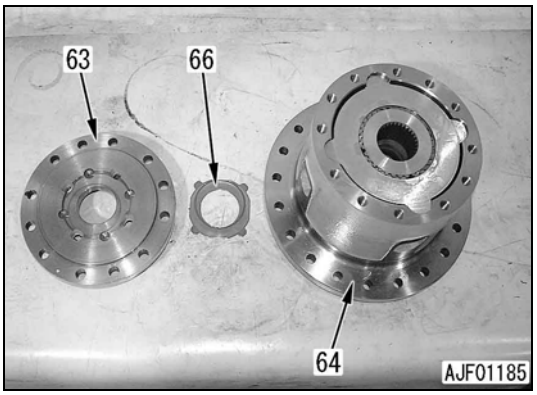


L. Install washer (66) to cover (63), and then install cover (63) temporarily.

★ There are grooves on both sides of the washer.

★ Apply axle oil or grease thinly to the washer so that it will stick to the cover.

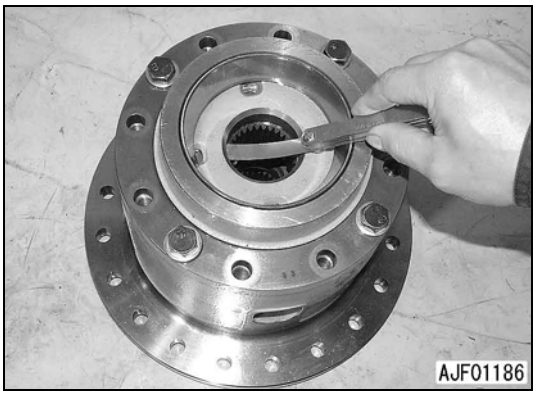
★ When installing the cover, match the match marks made when it was removed.



M. Adjust the clearance of the side gear in the axial direction.

★ Measure clearance (e) between the side gear and washer through the shaft holes on both sides of the anti-slip differential.

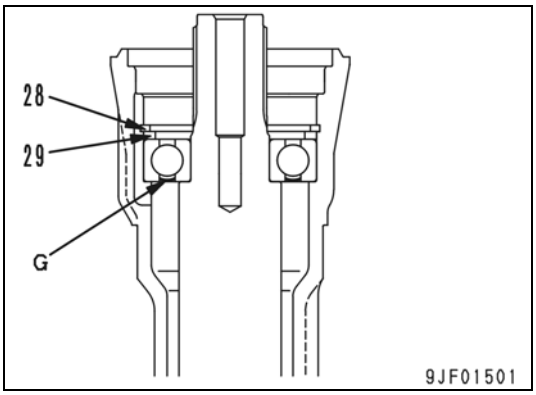
- Clearance (e): 0.15 - 0.35 mm (0.006 - 0.014 in) (on each side)



D. Using tool **H10**, press fit oil seal (25).

Oil seal: Grease (G2-LI)

★ Install top (h) of the oil seal rim flush with end face (i) of the carrier.



17. Installation of axle housing assembly (For only front differential)

A. Sling and install axle housing assembly (24).

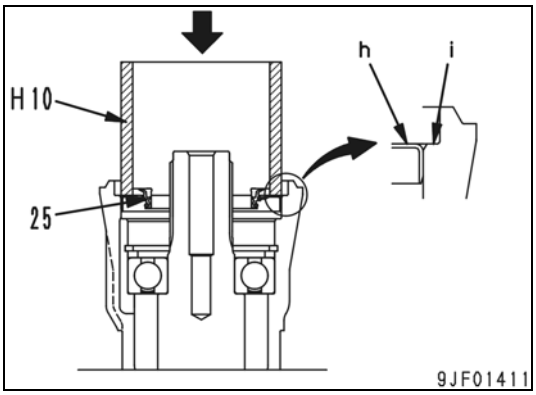
Mounting bolt: 98 - 123 N·m (72 - 91 lbf·ft)

B. Install coupling (23).

Mounting bolt: 245 - 309 N·m (181 - 228 lbf·ft)

Contact surfaces of coupling and bearing: Lubricant containing molybdenum disulfide (LM-G) or (LM-P)

Mounting bolt: Adhesive (LT-2)



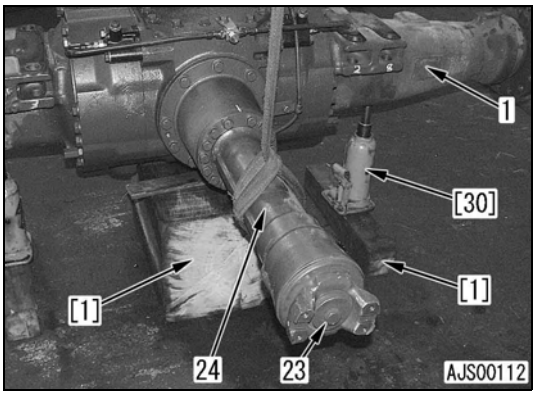
Refilling With Oil (Axle Housing)

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

Axle (Each of front and rear):27 liters (7.1 gal)

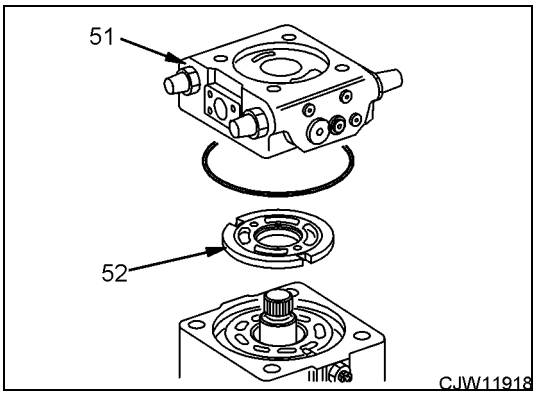
Drain plug: 127.4 - 176.4 N·m (94 - 130 lbf·ft)

Oil filler plug: 93.1 - 122.5 N·m (69 - 90 lbf·ft)



MEMORANDUM

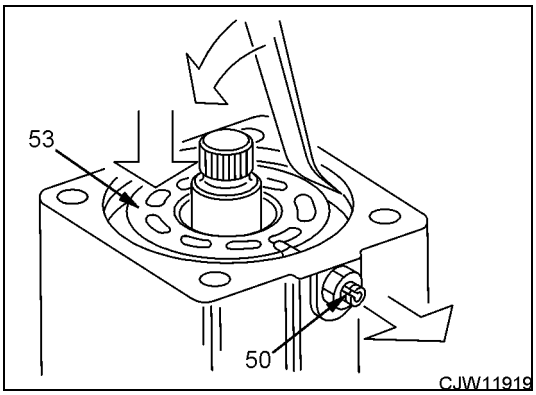
F. Lift off port plate Assembly (51) and control plate (52).



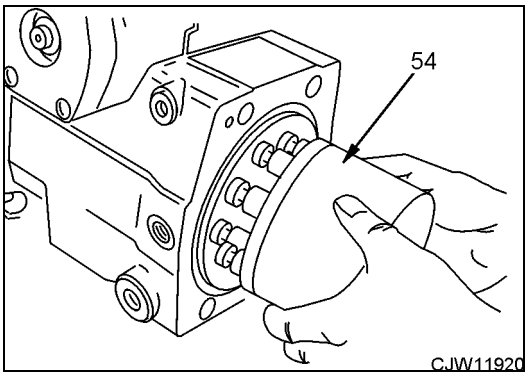
8. Cylinder block, Piston assembly (54)

A. Press the cylinder (53) to the bottom.

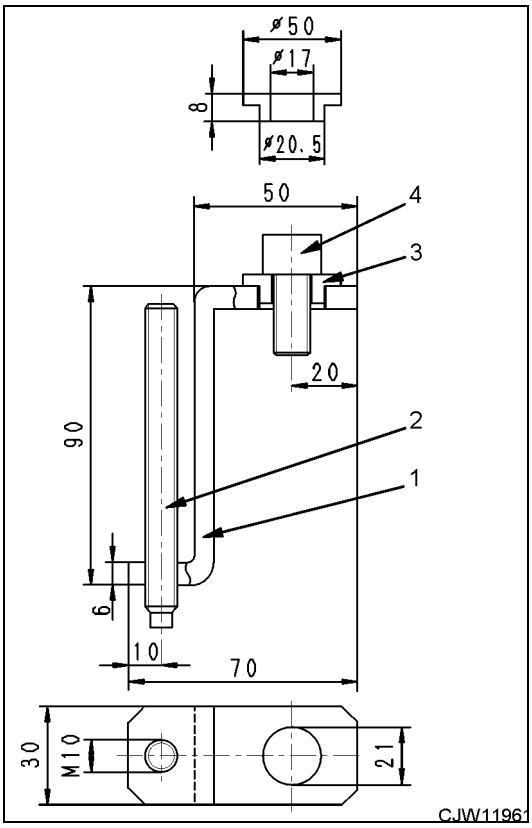
B. Remove fixing indexing screw (50).



C. Remove cylinder block and piston assembly (54).

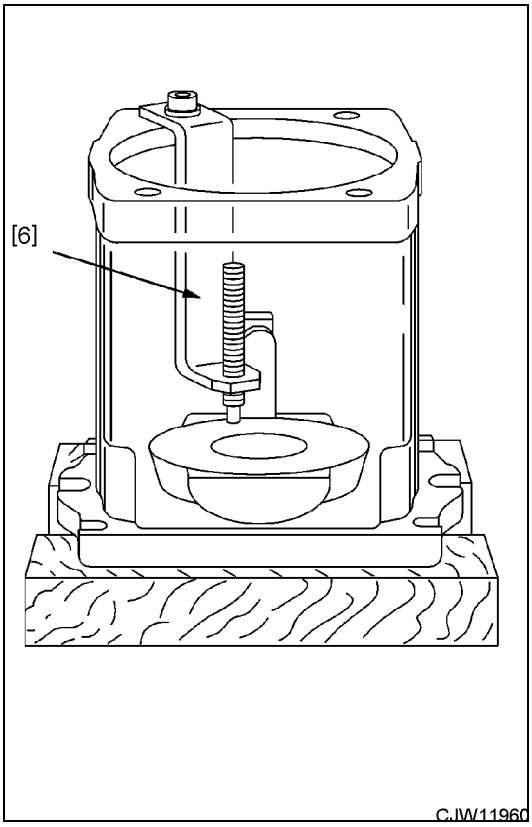


G. Make holding devices [6] (two pieces).
★ Holding device [6] “swivel cradle”

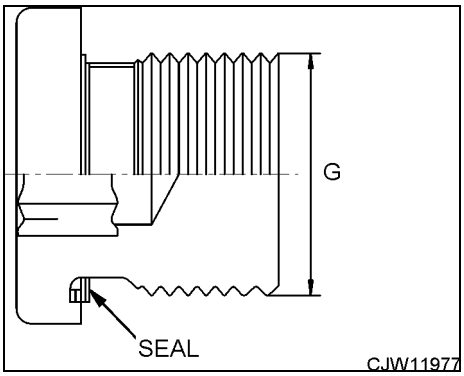


H. Hold swash plate in position unscrew the seat screw.
★ Do not use force.

I. Install second holding device [6] diagonally and install the swash plate.

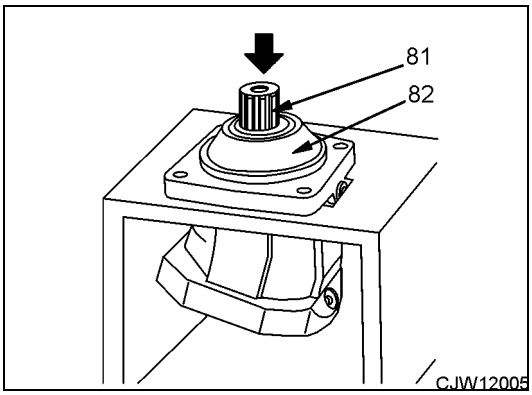


★ Plugs with internal hexagon, O-ring and UNF-, UN- threads to SAE J 514



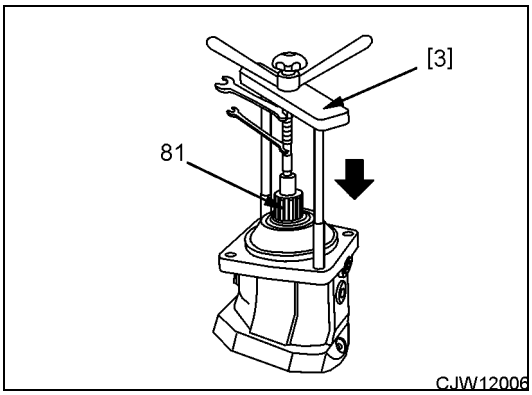
Thread	Tightening torque		Thread	Tightening torque	
7/16-20UNF	15 N·m	11 lbf·ft	M12 x 1.5	20 N·m	15 lbf·ft
1/2-20UNF	20 N·m	15 lbf·ft	M14 x 1.5	30 N·m	22 lbf·ft
9/16-18UNF	25 N·m	18 lbf·ft	M27 x 1.5	90 N·m	66 lbf·ft
3/4-16UNF	72 N·m	53 lbf·ft			
7/8-14UN	127 N·m	94 lbf·ft			
11/16-12UN	147 N·m	108 lbf·ft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

D. Push the shaft end with a press to remove shaft and rotary group assembly (81) from housing (82).

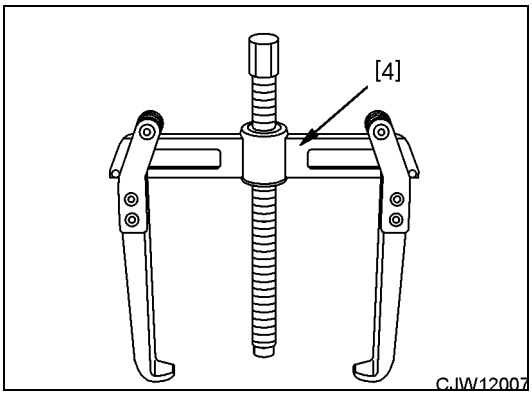


Remark

If the bearings are used again do not strike the drive shaft.

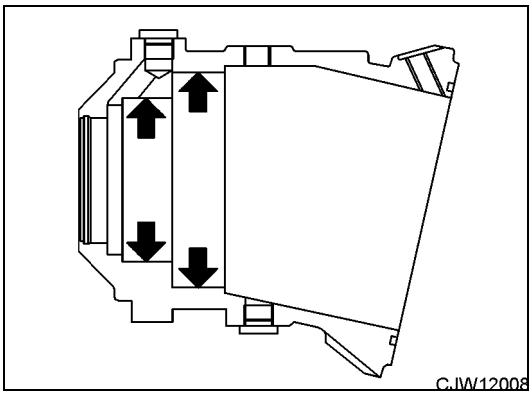


★ If a press is not available, push the shaft end with tool [3] or [4] to remove rotary group assembly (81).



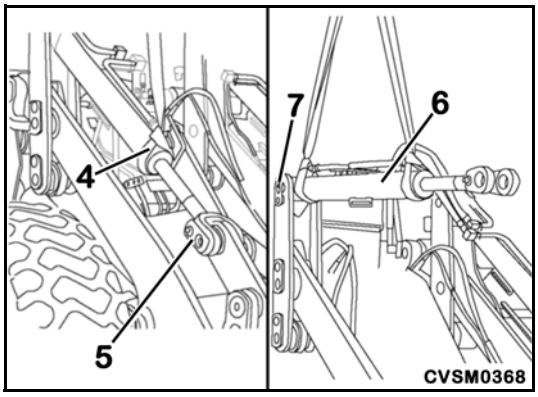
★ Check of housing

- Sliding surface and slide guides free of scoring and no wear.
- Since shaft and bearing are used as an assembly, do not remove the bearing.



5. Remove lock bolt and remove pin on rod eye end (5) of tilt cylinder.
   ★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.

6. Tilt the cylinder horizontal (6) and remove the pin on the piston end of the tilt cylinder (7).
   ★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.
   ★ Sling and cylinder may sway upon pin removal.
   ★ Be careful not to damage the cylinder rod portion.



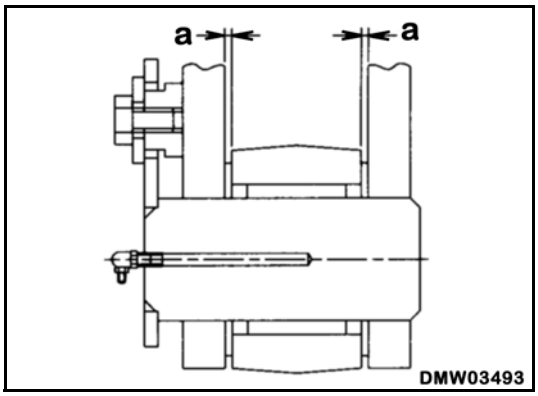
kg Tilt cylinder: 67.5 kg (149 lb)

Installation

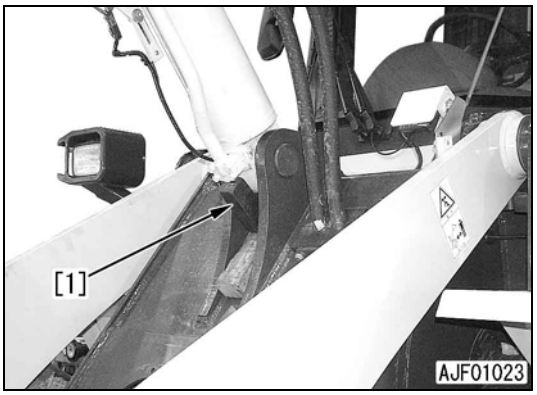
- Carry out installation in the reverse order of removal.
- Bucket positioner
  For details of adjusting the bucket positioner, see "TESTING AND ADJUSTING".
- Rod pin

WARNING! When aligning the position of the pin hole, use a bar. Never insert your fingers into the pin hole.

- Hydraulic piping
  - Fit the O-ring securely in the groove.
  - Install the hoses without twisting, over bending, or interference.
- Bucket cylinder
  ★ Align the pin hole at the bottom end and assemble shims so that the total for clearance **a** between the cylinder and frame is within the standard value.
  ★ Clearance: Max. 1.5 mm (0.059 in.)



★ Install block [1] between the cylinder bottom and frame.
★ Check the thickness and quantity of the shims.

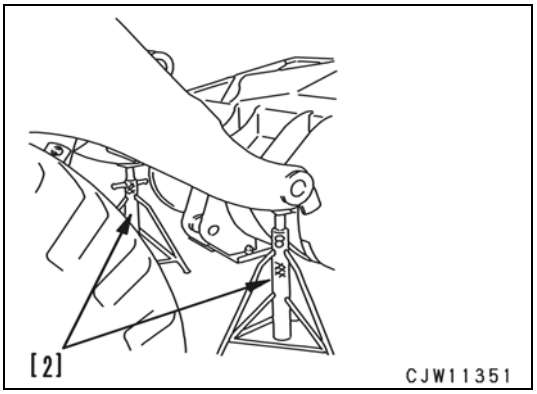


WARNING! Never insert your fingers in the pin holes.

kg Bucket link: 45 kg (99 lb)

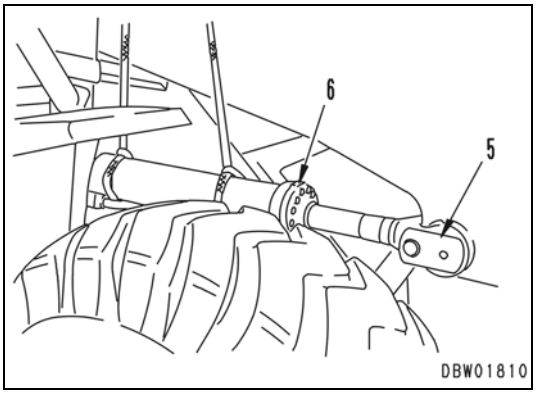
kg Bucket cylinder assembly: 130 kg (287 lb)

5. Set supports [2] under the end of the lift arm and release residual pressure in the hydraulic piping.



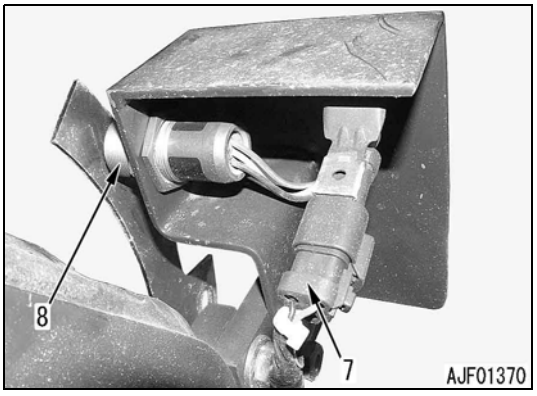
6. Sling lift cylinder assembly (6) temporarily and remove mounting pin (5).
   ★ Check the thickness and quantity of the shims. ※4
   ★ When lowering the lift cylinder assembly, put a block on the axle.

kg Lift cylinder assembly (two pieces): 110 kg (244 lb)



7. Disconnect boom positioner proximity switch connector F04 (7).

8. Remove boom kick-out switch (8). ※5

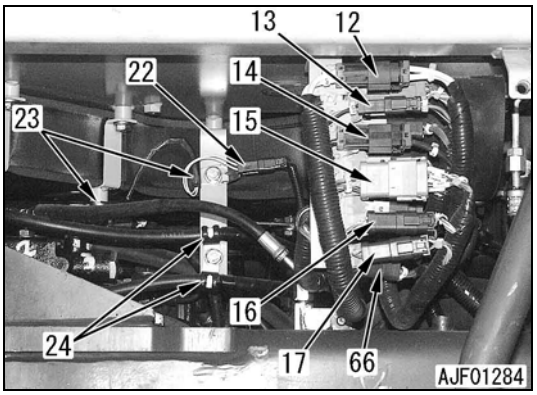


12. Disconnect wire clamp (23) and brake valve hose clamp (24).

13. Disconnect two air conditioner hoses (38).

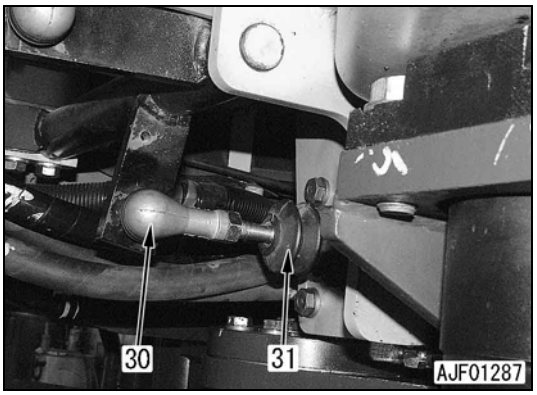
14. Disconnect two heater hoses (39).
    ★ Before disconnecting the hoses, place tags to them and check their mounting positions.

15. Disconnect wire clamp (67).



16. Remove the locknut and disconnect brake valve linkage (30). ※2

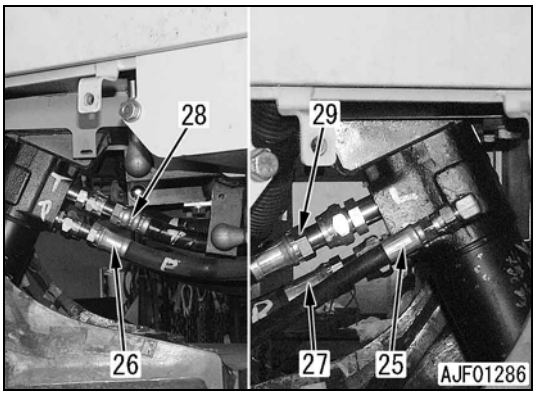
17. Remove the mounting bolt and place brake valve (31) on the frame.



18. 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)

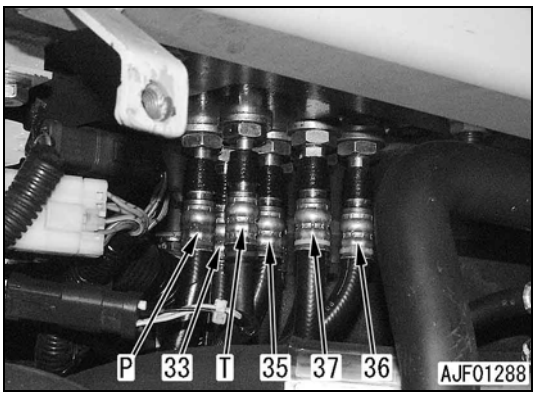
    ※3

    ★ Before disconnecting the hoses, place tags to them and check their mounting positions.
    ★ Since oil will flow out of the disconnected hoses and tubes, prepare an oil drain pan.

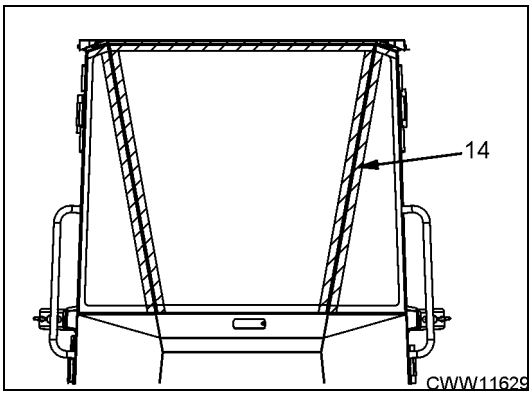


19. Disconnect eight PPC hoses (32) - (37), **P**, and **T**.
    ★ Since oil will flow out of the disconnected hoses and tubes, prepare an oil drain pan.
    ★ Layout of hose Nos. (Seen from right below)

●37 ●36
●T => Front of chassis
●35 ●34
●P
●33 ●32

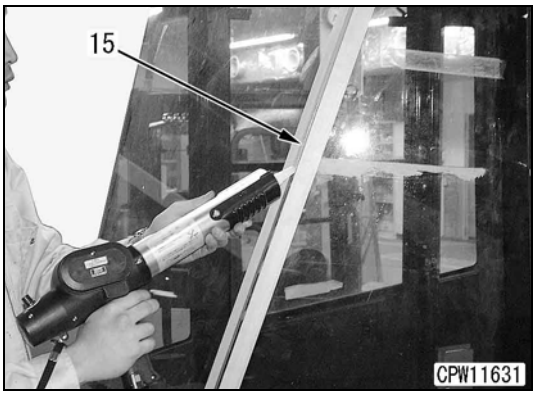


A. Stick masking tapes (14) along the parts to be sealed shown in the figure.
   ★ Stick the masking tapes to both inside and outside of the operator's cab.



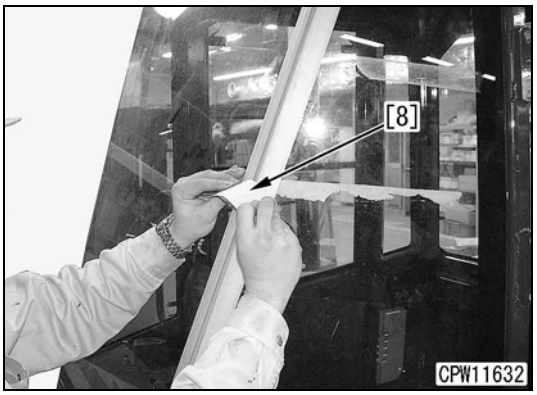
B. Fill the joint of the glasses with caulking material (15).
   ★ The usable period of the following caulking material is four months after the date of manufacture. Do not use the caulking material after its usable period.

Caulking material: SUNSTAR PENGUINE SEAL NO. 2505



C. Remove the caulking material projected from the joint with cardboard [8], etc.

D. Remove the masking tapes from the window glass.



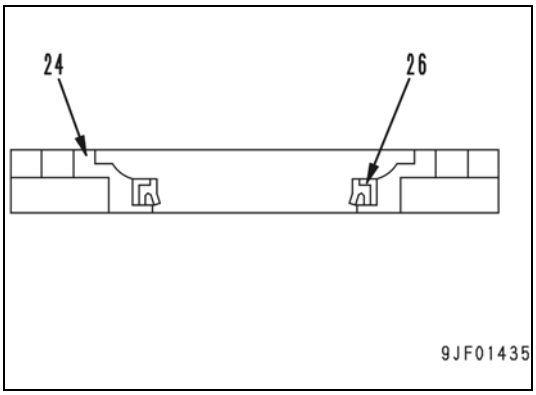
10. Remove the primer and adhesive from the operator's cab and window glass.
   ★ Using paint thinner, wipe off the adhesive before it is dried up.
   ★ When cleaning the glass, do not apply too much pressure.

C. Press fit dust seal (26) to retainer (24).
★ Press fit the dust seal with the lip out.

Lip of dust seal: Grease (G2-LI)

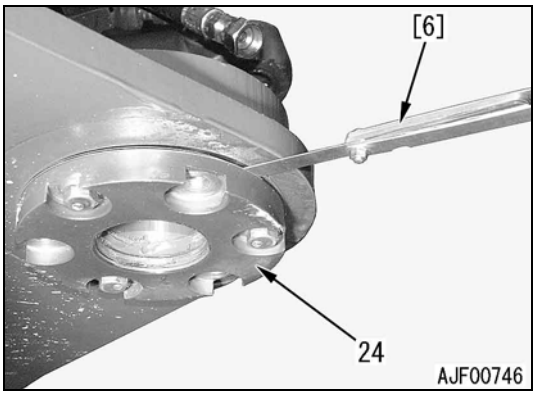
D. Tighten the 3 mounting bolts of retainer (24) evenly.

Retainer mounting bolt: 30 N·m (22 lbf·ft)



E. Measure the clearance between retainer (24) and front frame with feeler gauge [6], then select shims so that the maximum clearance will be less than 0.1 mm (0.0039 in) when the shims are inserted.
- Standard shim thickness: 1 mm (0.039 in)
- Varieties of shim thickness: 0.1 mm, 0.5 mm, (0.0039 in, 0.0197 in)

★ WA270-5 is shown in the photo. WA320PT-5 is disassembled and assembled similarly. (The umber of the bolts used for WA320PT-5 is ten.)

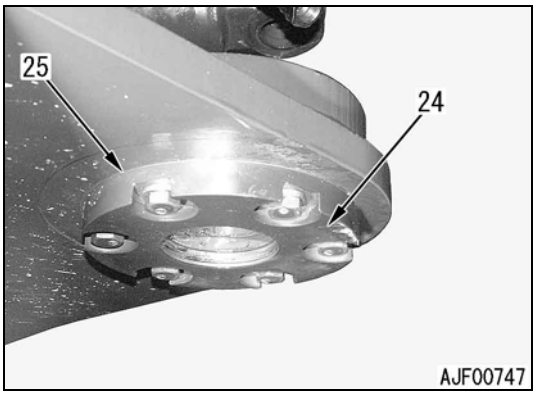


F. Insert selected shim (25) and tighten the ten mounting bolts.

Mounting bolt: 98 - 123 N·m (72 - 91 lbf·ft)

Mounting bolt: Adhesive (LOCTITE #2701)

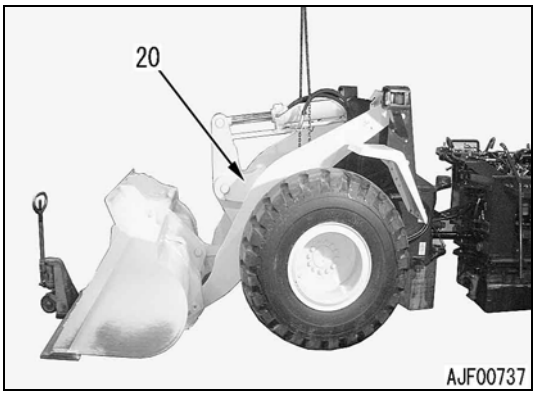
★ WA270-5 is shown in the photo. WA320PT-5 is disassembled and assembled similarly. (The umber of the bolts used for WA320PT-5 is ten.)



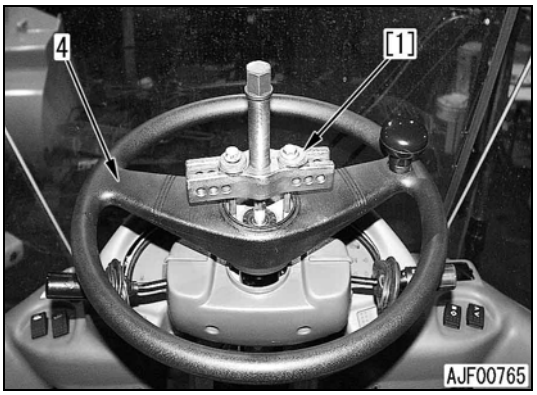
※8 ※9 ※10 ※11

- Install the upper hinge pin and lower hinge pin according to the following procedure.

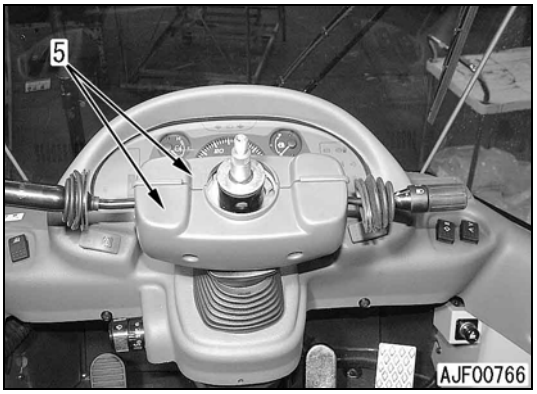
3. Place hand lift truck [4] under the bucket and turn the tires to move the front frame assembly toward the rear frame.



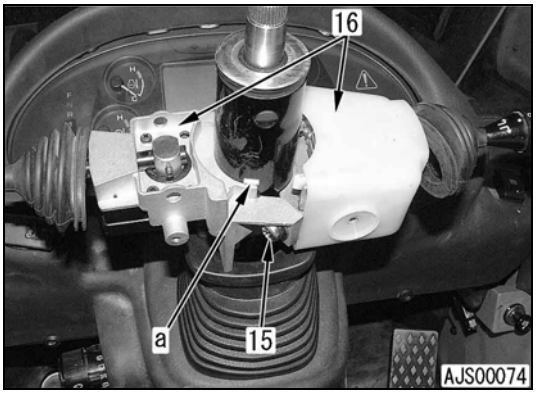
4. Using puller [1], remove steering wheel (4) from the steering column.



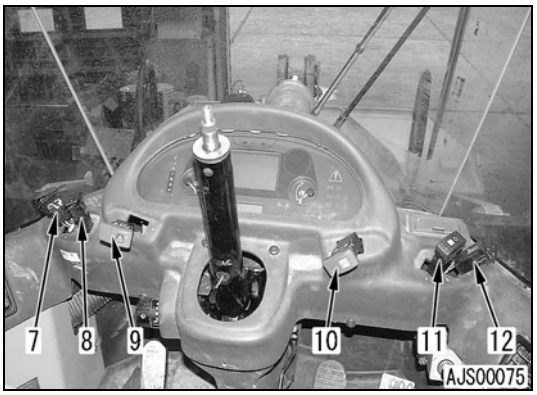
5. Remove cover (5). ※2

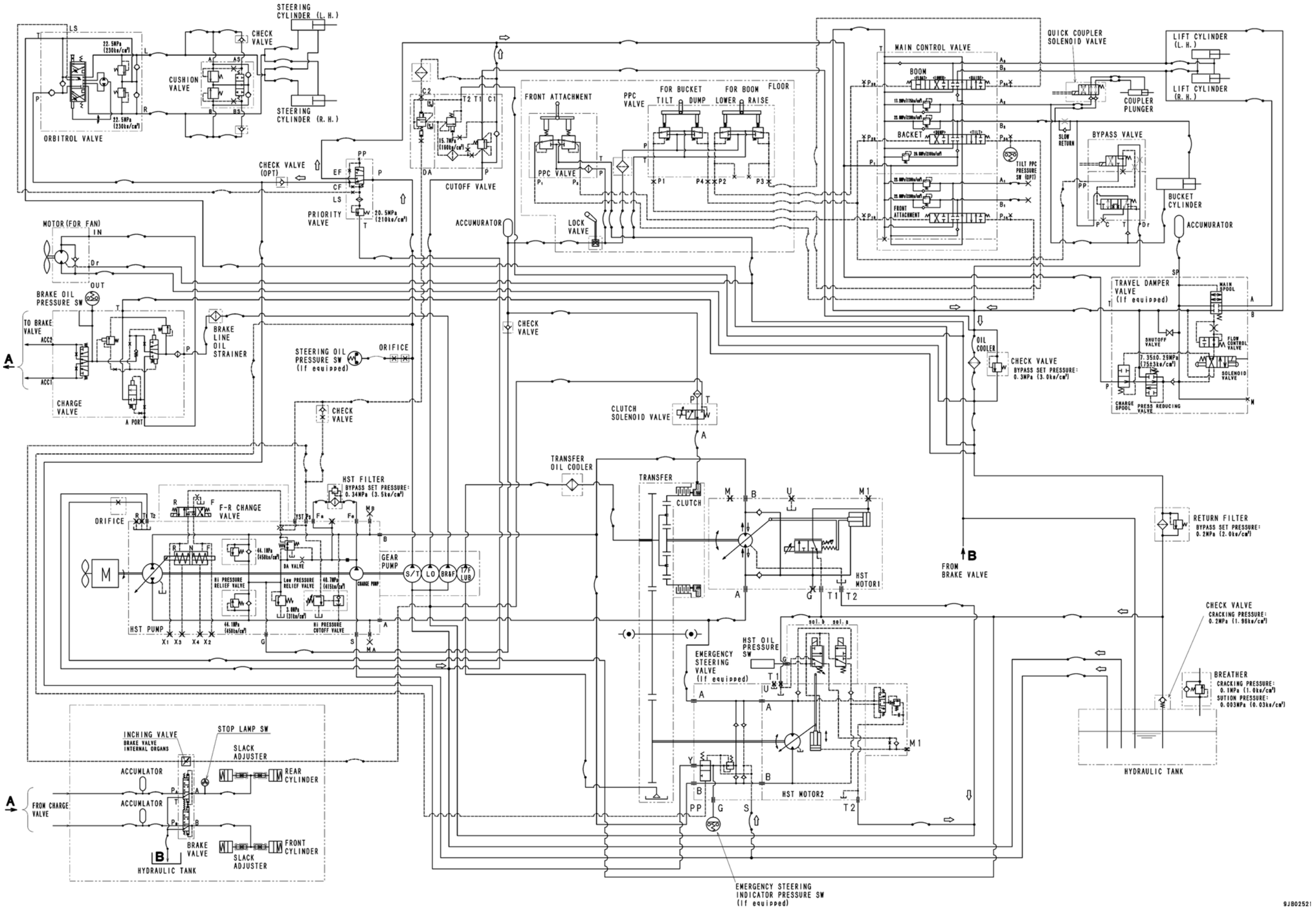


6. Make a mark of the installed height (a) of light and FNR switch assembly (16) in advance, then loosen crossed screw (15) and remove light and (FNR) switch assembly (16). ※3



7. Remove the following wiring connectors.
   - ★ Before disconnecting switch connectors (7) - (12) above the front panel cover, remove the switch upward.
     - (7): **L07**
     - (8): **L08**
     - (9): **L06**
     - (10): **L19**
     - (11): **L10**
     - (12): **L11**
     - (13): **L04**
     - (14): **L15**




STEERING CYLINDER (L.H.)
CHECK VALVE
CUSHION VALVE
STEERING CYLINDER (R.H.)
ORBITROL VALVE
CHECK VALVE (OPT)
PRIORITY VALVE
CUTOFF VALVE
ACCUMULATOR
FRONT ATTACHMENT
PPC VALVE
FOR BUCKET TILT DUMP
FOR BOOM LOWER RAISE
FLOOR
LOCK VALVE
MAIN CONTROL VALVE
BOOM
BACKET
FRONT ATTACHMENT
QUICK COUPLER SOLENOID VALVE
COUPLER PLUNGER
SLOW RETURN
TILT PPC PRESSURE SW (OPT)
LIFT CYLINDER (L.H.)
LIFT CYLINDER (R.H.)
BYPASS VALVE
BUCKET CYLINDER
ACCUMULATOR
TRAVEL DAMPER VALVE (If equipped)
MAIN SPOOL
SHUTOFF VALVE
FLOW CONTROL VALVE
SOLENOID VALVE
CHARGE SPOOL
PRESS REDUCING VALVE
OIL COOLER
CHECK VALVE
BYPASS SET PRESSURE: 0.3MPa (3.0kg/cm²)
MOTOR(FOR FAN)
BRAKE OIL PRESSURE SW
TO BRAKE VALVE
CHARGE VALVE
BRAKE LINE OIL STRAINER
STEERING OIL PRESSURE SW (If equipped)
ORIFICE
CHECK VALVE
CLUTCH SOLENOID VALVE
TRANSFER OIL COOLER
TRANSFER
CLUTCH
HST FILTER
BYPASS SET PRESSURE: 0.34MPa (3.5kg/cm²)
F-R CHANGE VALVE
GEAR PUMP
HST PUMP
HST MOTOR1
HST MOTOR2
FROM BRAKE VALVE
RETURN FILTER
BYPASS SET PRESSURE: 0.2MPa (2.0kg/cm²)
CHECK VALVE
CRACKING PRESSURE: 0.2MPa (1.98kg/cm²)
BREATHER
CRACKING PRESSURE: 0.1MPa (1.0kg/cm²)
SUTION PRESSURE: 0.003MPa (0.03kg/cm²)
HYDRAULIC TANK
EMERGENCY STEERING VALVE (If equipped)
HST OIL PRESSURE SW
EMERGENCY STEERING INDICATOR PRESSURE SW (If equipped)
INCHING VALVE
BRAKE VALVE INTERNAL ORGANS
STOP LAMP SW
SLACK ADJUSTER
REAR CYLINDER
FRONT CYLINDER
ACCUMULATOR
FROM CHARGE VALVE
BRAKE VALVE
HYDRAULIC TANK
9JB02521