SHOP MANUAL

KOMATSU

WA700-3

(KA SPEC.)

MACHINE MODEL	SERIAL NO.
WA700-3	**51005 and up**

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require.
  Materials and specifications are subject to change without notice.
- WA700-3 mount the SAA6D170E-3 engine.
  For details of the engine, see the 170-3 Series Engine Shop Manual.

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HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model
Engine volume: Issued for each engine series
Electrical volume:
Attachments volume: } Each issued as one volume to cover all models

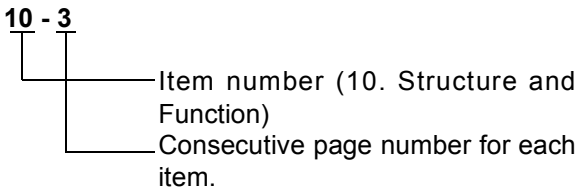
These various volumes are designed to avoid duplicating the same information. Therefore, to deal with all repairs for any model , it is necessary that chassis, engine, electrical and attachment volumes be available.

DISTRIBUTION AND UPDATING

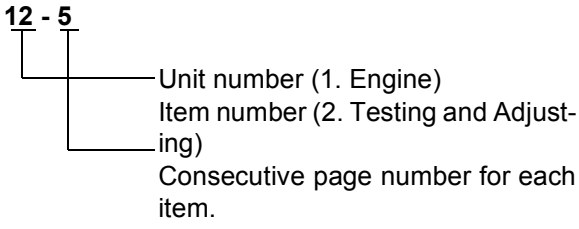
Any additions, amendments or other changes will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
   Example 1 (Chassis volume):



   Example 2 (Engine volume):



3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:

REVISED EDITION MARK

When a manual is revised, an edition mark ((1)(2)(3)....) is recorded on the bottom of the pages.

REVISIONS

Revised pages are shown in the LIST OF REVISED PAGES next to the CONTENTS page.

SYMBOLS

So that the shop manual can be of ample practical use, important safety and quality portions are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts of systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants, etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

CONVERSION TABLE

METHOD OF USING THE CONVERSION TABLE

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

EXAMPLE

- Method of using the Conversion Table to convert from millimeters to inches

1. Convert 55 mm into inches.
   (1) Locate the number 50 in the vertical column at the left side, take this as (A), then draw a horizontal line from (A).
   (2) Locate the number 5 in the row across the top, take this as (B), then draw a perpendicular line down from (B).
   (3) Take the point where the two lines cross as (C). This point (C) gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.
2. Convert 550 mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to inches

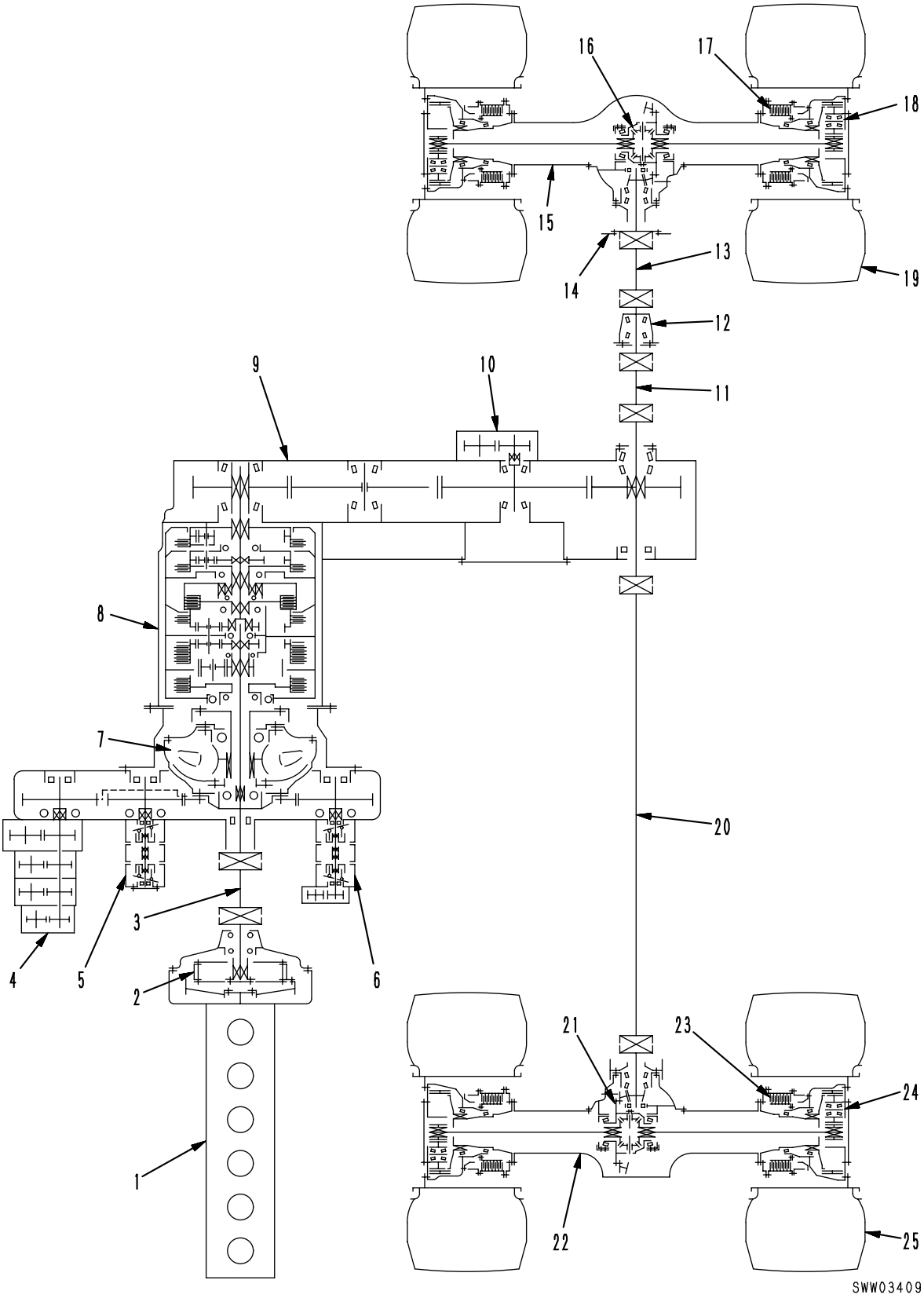
(B)

1 mm = 0.03937 in

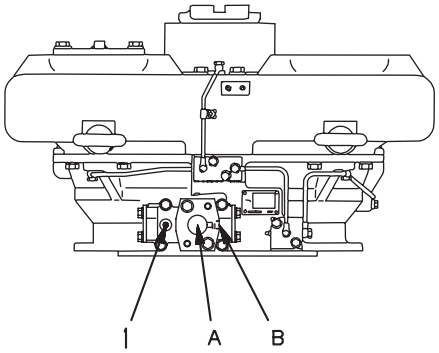
	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
(A) 50	1.969	2.008	2.047	2.087	2.126	(C) 2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

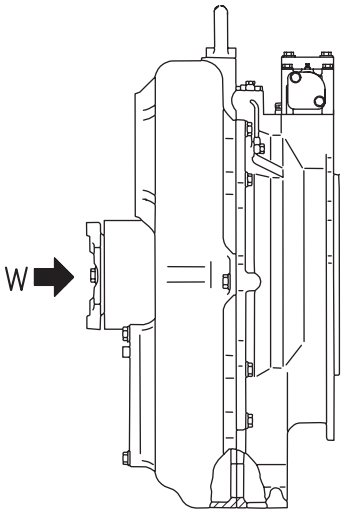
Machine model				WA700-3
Serial No.				51005 and up
Engine		Model		SAA6D170E-3
		Type		4-cycle, water-cooled, in-line, 6-cylinder, direct injection, with turbocharger, after-cooler
		No. of cylinders – bore × stroke	mm	6 – 170 × 170
		Piston displacement	ℓ {cc}	23.15 {23,150}
	Performance	Flywheel horsepower	kW/rpm {HP/rpm}	502/2,000 {672/2,000}
		Maximum torque	Nm/rpm {kgm/rpm}	2,884/1,400 {294/1,400}
		Fuel consumption ratio (at rated output)	g/kW·h {g/HP·h}	214 {160}
		High idling speed	rpm	2,240
		Low idling speed	rpm	725
		Starting motor		24 V 7.5 kW × 2
		Alternator		24 V 75 A
		Battery		12 V 200 Ah × 2
Power train		Torque converter		3-element, 1-stage, single-phase
		Transmission		Planetary gear, constant-mesh multiple-disc, hydraulically actuated, pressure rised lubrication, modulation type
		Reduction gear		Spiral bevel gear, splash lubrication
		Differential		Straight bevel gear
		Final drive		Planetary gear single stage, splash lubrication
Axle, wheel		Drive type		Front/rear-wheel drive
		Front axle		Fixed-frame, full-floating
		Rear axle		Center pin support type, full-floating
		Tire		40/65-39-36PR(L-5)
		Wheel rim		32.00 × 39-4WTB
		Inflation pressure Front tire	kPa {kg/cm^2}	441 {4.5}
		Rear tire	kPa {kg/cm^2}	441 {4.5}
Brakes		Main brake		Front/rear wheel braking, separate front/rear wheel, wet disc, hydraulically actuated
		Parking brake		Drive shaft, dry caliper type disc brake, hydraulically released spring type

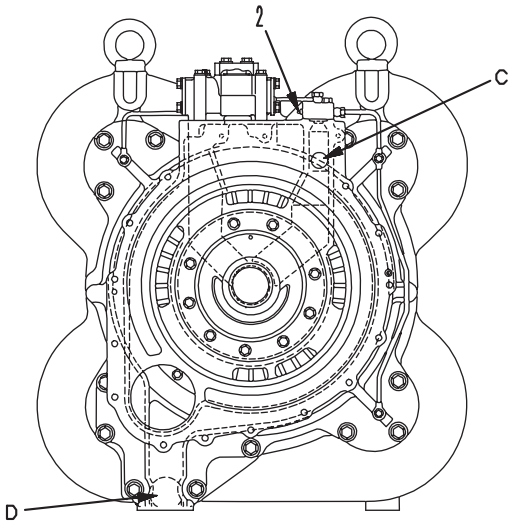
POWER TRAIN SYSTEM

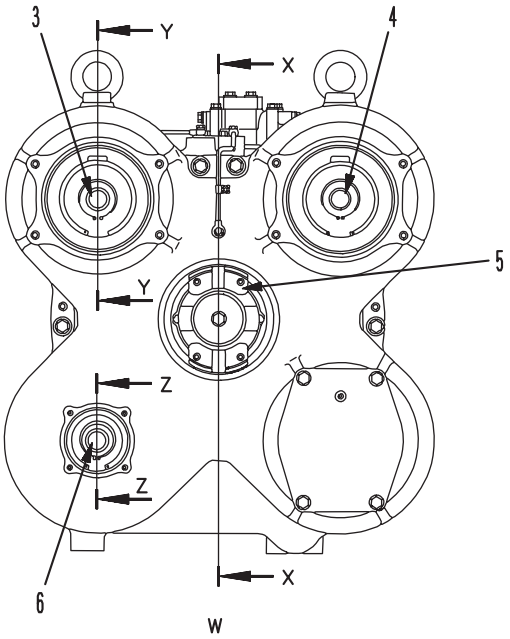


TORQUE CONVERTER AND PTO









SPECIFICATIONS
Type: 3-element, single stage, single phase
Stall torque ratio: 2.84

1. Torque converter outlet oil pressure pick-up
2. Torque converter inlet oil pressure pick-up
3. Steering and switch pump mounting
4. Main pump mounting
5. Coupling
6. Torque converter charging, cooling, PPC and brake pump mounting

A. Torque converter outlet port
B. Torque converter oil temperature sensor mounting port
C. Torque converter inlet port
D. Drain port (to transmission)

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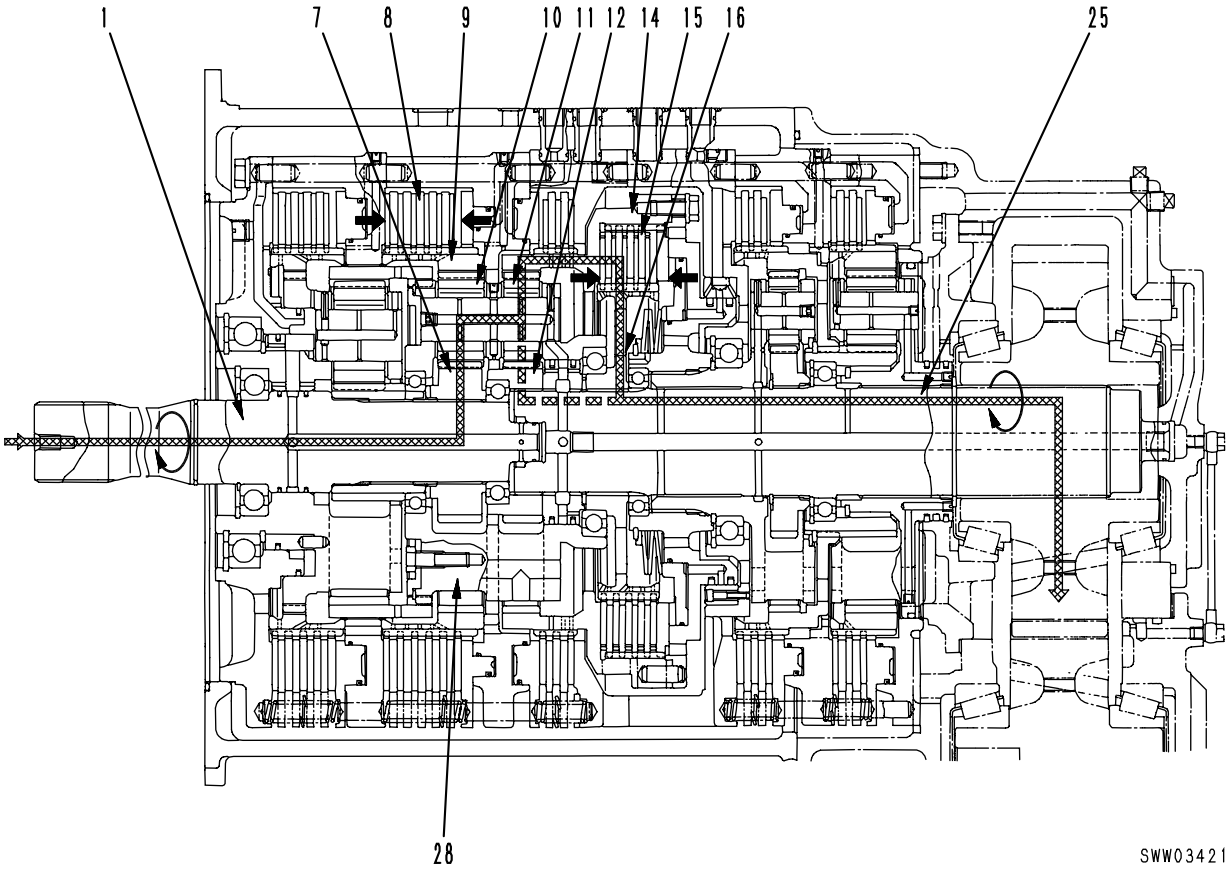
FORWARD 2ND



- In the case of FORWARD 2nd, FORWARD clutch (8) and 2nd clutch (15) are engaged. The power transmitted from the torque converter to input shaft (1) is transmitted to output shaft (25).
- FORWARD clutch (8) is actuated by the oil pressure applied by the clutch piston, and holds ring gear (9) in position. 2nd clutch (15) is actuated by the oil pressure applied by the clutch piston, and engages ring gear (14) and hub (16).
- The power from the torque converter is transmitted to input shaft (1). The rotation of input shaft (1) is transmitted through sun gear (7) to planet gear (10). Ring gear (9) is held in position by FORWARD clutch (8), so the rotation of planet gear (10) rotates carrier (28) inside ring gear (9).
- The rotation of carrier (28) is transmitted along two paths. One path goes through planet gear (11) and rotates ring gear (14). The other goes through planet gear (11) and sun gear (12) and is transmitted to output shaft (25).
- Ring gear (14) and hub (16) are formed into one unit by 2nd clutch (15), and the rotation of hub (16) is transmitted to output shaft (25).
- The rotation of output shaft (25) is output in combination with the power transmitted from sun gear (12) and hub (16).

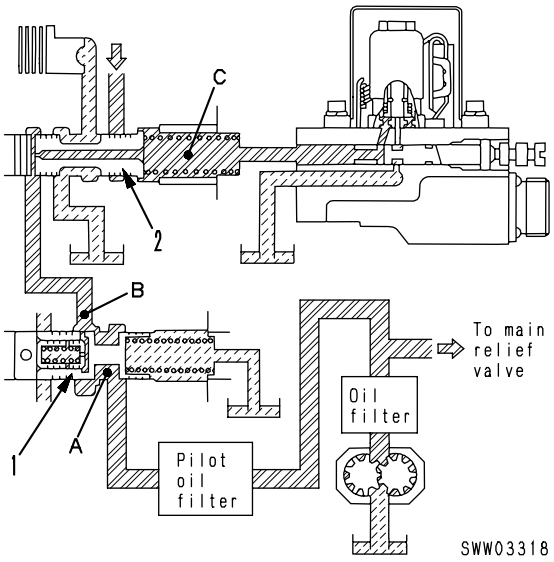
PILOT REDUCING VALVE

FUNCTION

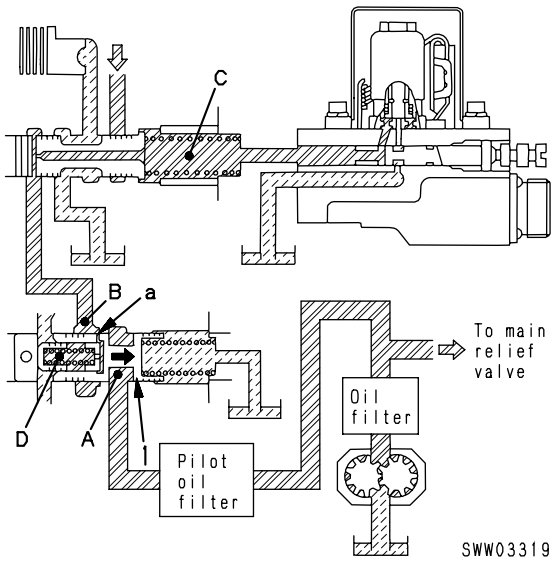
- The pilot reducing valve acts to control the pressure needed to actuate the transmission spools.

OPERATION

- The oil from the pump passes through the pilot filter and enters port **A** of pilot reducing valve (1). The oil passes through port **B** and enters through the orifice of transmission spool (2) to fill the inside of port **C**.



- When the pressure inside port **C** rises, pressurized oil flows from orifice "**a**" of pilot reducing valve (1) and goes to port **D**.
  As a result, pilot reducing valve (1) moves to the right, and ports **A** and **B** are shut off, so the pressurized oil at port **C** is maintained at the same pressure.



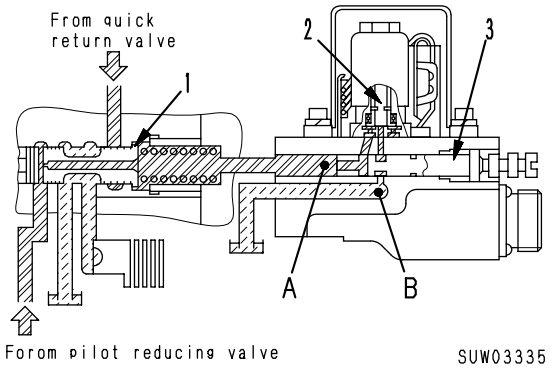
EMERGENCY MANUAL SPOOL

FUNCTION

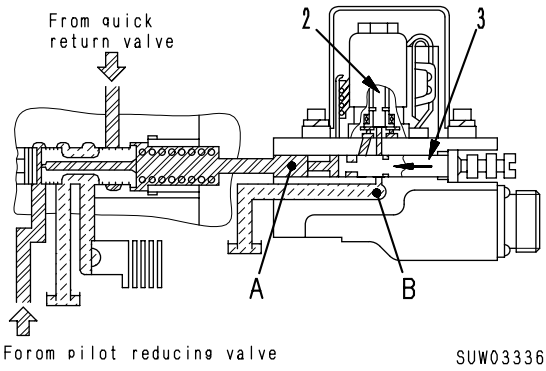
- A directional spool and the speed spools are installed to make it possible to actuate the transmission valve mechanically if there should be a failure in the electrical system of the transmission controller system and the solenoid valve cannot be actuated.
  (This spool is used to move the machine under its own power to a place where it can be serviced.)
  ★ When using this spool, pay particularly careful attention to safety.

OPERATION

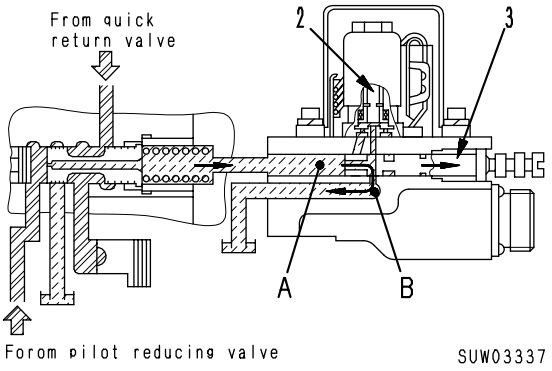
- **Normal position**
  When the solenoid valve is working normally, spool (3) is held in the position shown in the diagram.
  The oil from the directional spool and speed spool (1) enters port **A**, but it is shut off by solenoid valve (2).



- **Clutch at OFF position**
  When emergency manual spool (3) is pushed in to the left (screwed in 10 mm), the oil at port **A** is shut off regardless of the operation of solenoid valve (2). It cannot flow to port **B**, so the clutch is not actuated.

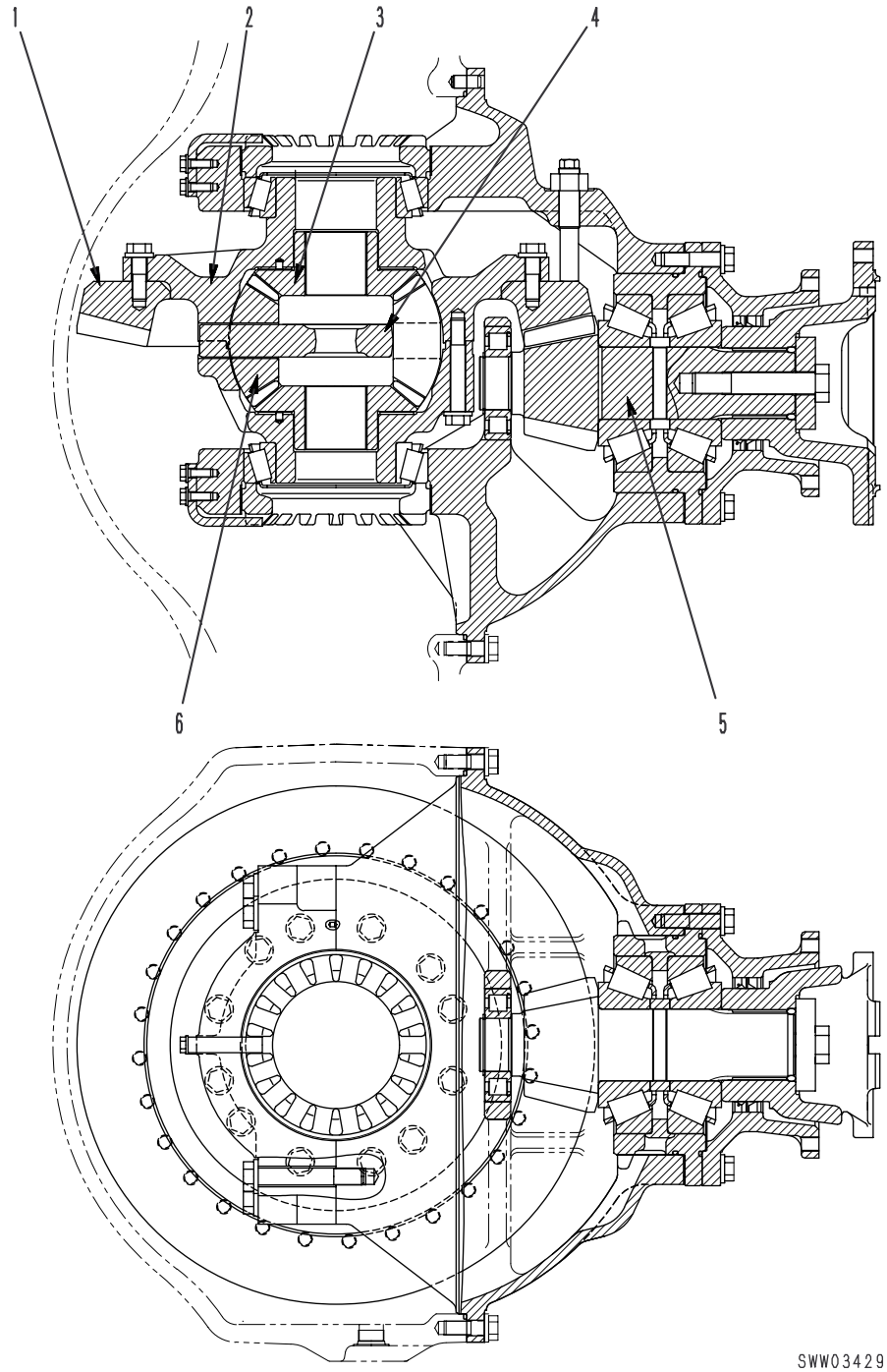


- **Clutch at ON position**
  When emergency manual spool (3) is pulled out to the right (loosened 10 mm), the oil at port **A** is drained to port **B** regardless of the operation of solenoid valve (2). Therefore, the clutch is actuated.



DIFFERENTIAL

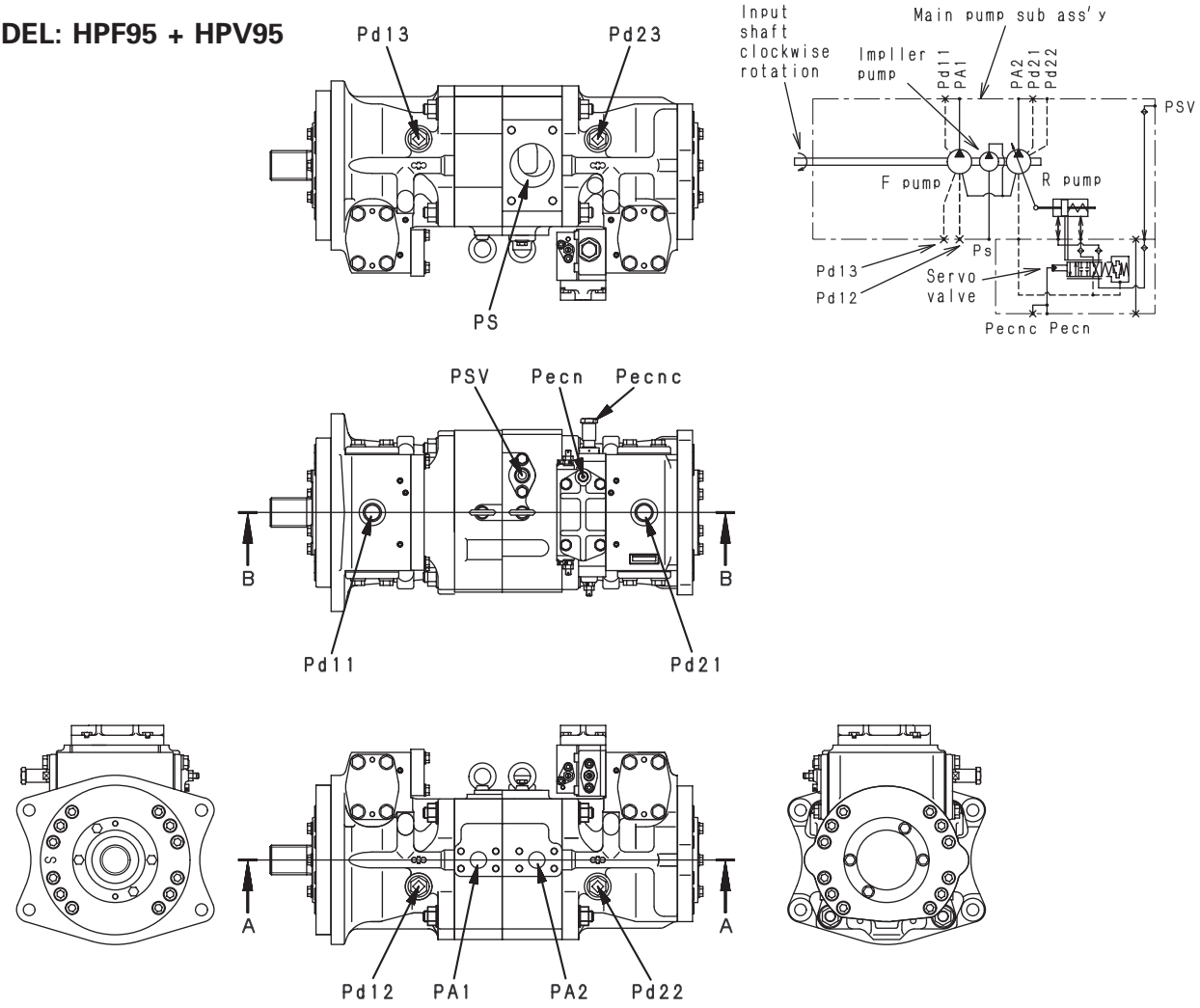
FRONT DIFFERENTIAL



1. Bevel gear (Teeth 43)
2. Differential case
3. Side gear (Teeth 24)
4. Shaft
5. Bevel pinion (Teeth 9)
6. Pinion gear (Teeth 17)

STEERING AND SWITCH PUMP

MODEL: HPF95 + HPV95



1. Shaft (front)
2. Cradle (front)
3. Case (front)
4. Swash plate
5. Shoe
6. Piston
7. Cylinder block
8. Valve plate
9. Impeller
10. Cradle (rear)
11. Shaft (rear)
12. Case (rear)
13. End cap (rear)
14. End cap (front)
15. Servo piston
16. Collar

SWW06458

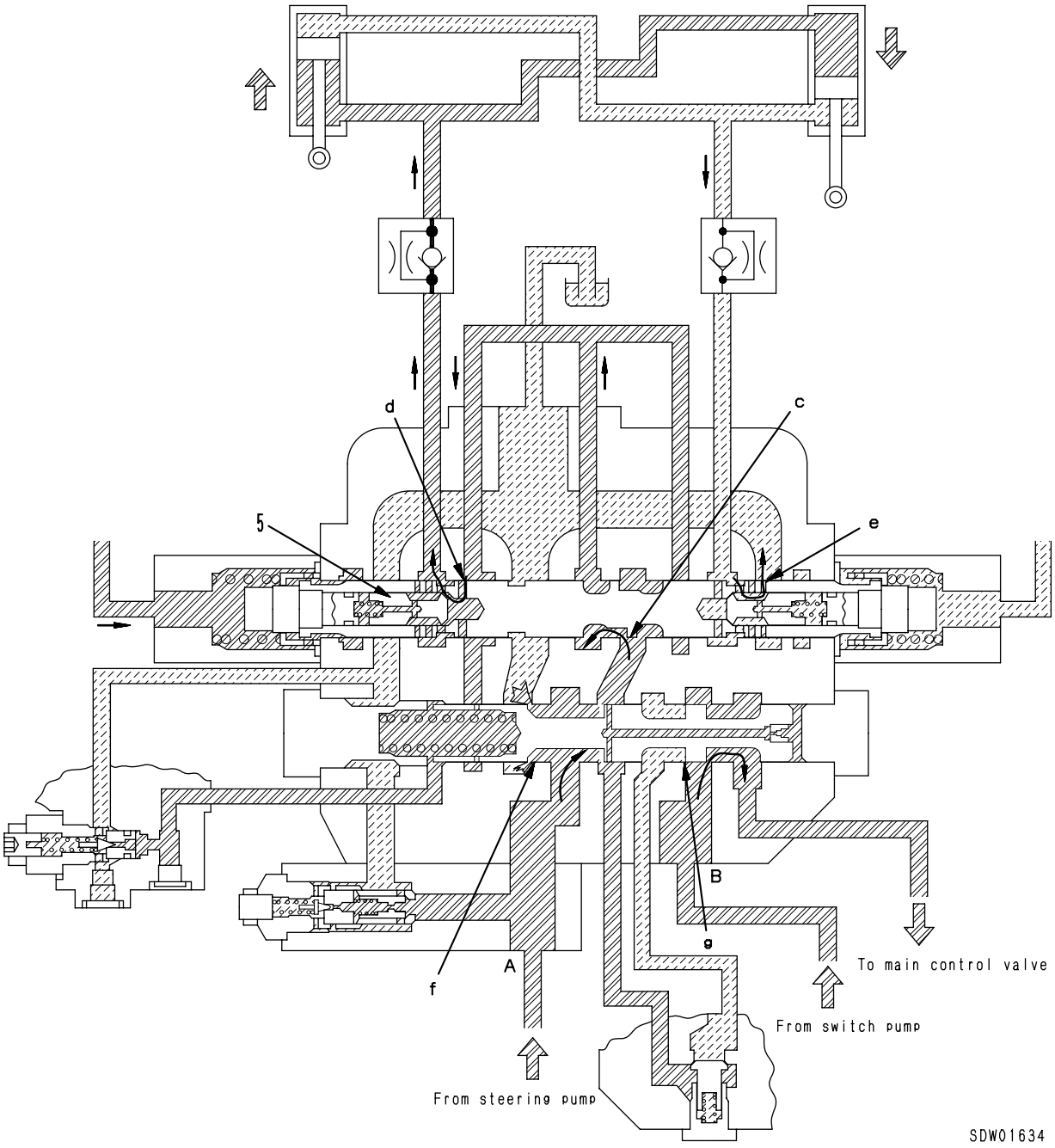
Specification

	Steering and switch pump
Model	HPF95 + HPV95
Rated delivery pressure	31.4 MPa {320 kg/cm^2}
Rated rpm	2,120 rpm
Theoretical delivery (front)	97.4 cc/rev
Theoretical delivery (rear)	10 – 97.4 cc/rev
Max. delivery	206.5 + 206.5 ℓ/min

OUTLINE

- This pump consists of 1 fixed-displacement swash plate-type piston pump on the front side, 1 variable-displacement swash plate-type piston pump on the rear side, and 1 impeller pump between them.
- The front pump is originally of the variable displacement type, but its displacement is fixed since inserted collar (16) disables servo piston (15) and fixes swash plate (4).
- For explanation of the operation, see the section of the work equipment pump. The work equipment pump is of the variable displacement type, however, since its rocker cam can move.

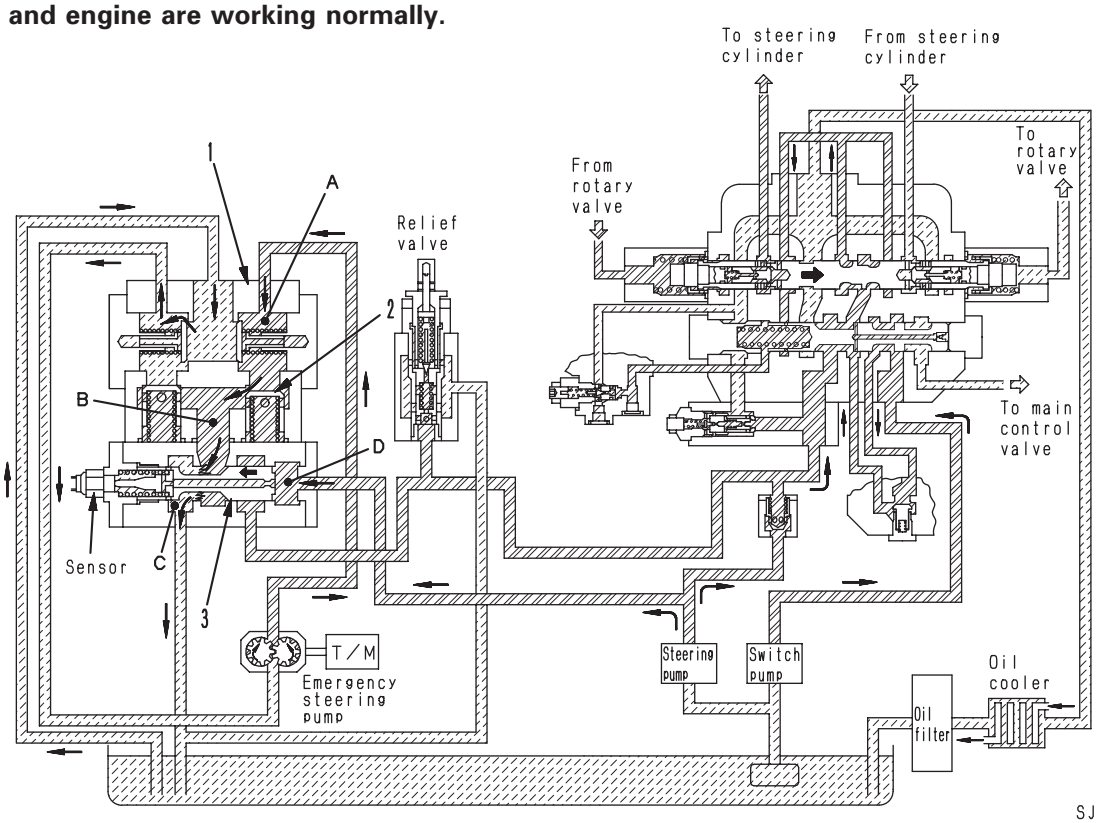
Engine running at high speed



- There is no need for supply of extra oil from the switch pump, so the steering pump pressure rises until notch **g** closes and shuts off the merge passage from port **B**.
- The pressure difference on both sides of notch **c** is controlled only by notch **f**, and the excess oil from the steering pump is drained from notch **f** to the drain circuit. (At this point, notch **g** is completely closed.)
- The oil from the steering pump passes through notches **c** and **d**, pushes load check valve (5), and flows to the cylinder. The return oil from the cylinder passes through notch **e** and flows to the drain circuit.
- Notch **g** is closed, so the oil from the switch pump all flows from port **B** and is sent to the main control valve.

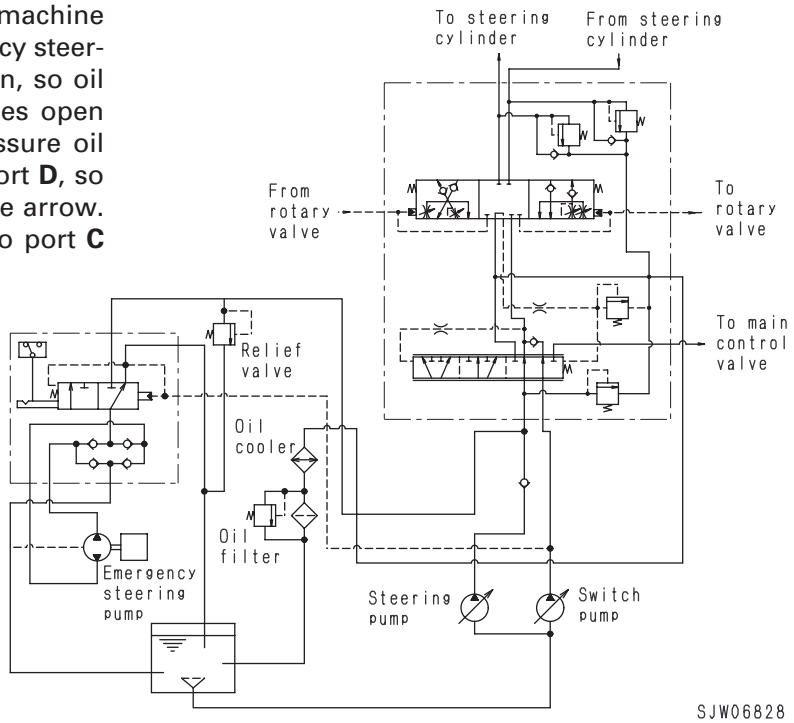
OPERATION

- **Pump and engine are working normally.**



SJW06827

When the steering pump and engine are working normally, the steering pump, and switch pump are rotated by the engine. Therefore, oil is sent to the steering valve, and the machine can be steered. In addition, the emergency steering pump is rotated by the transmission, so oil from port **A** of the diverter valve pushes open check valve (2) and enters port **B**. Pressure oil from the steering pump is flowing to port **D**, so it pushes spool (3) in the direction of the arrow. As a result, the oil from port **B** flows to port **C** and is drained to the hydraulic tank.



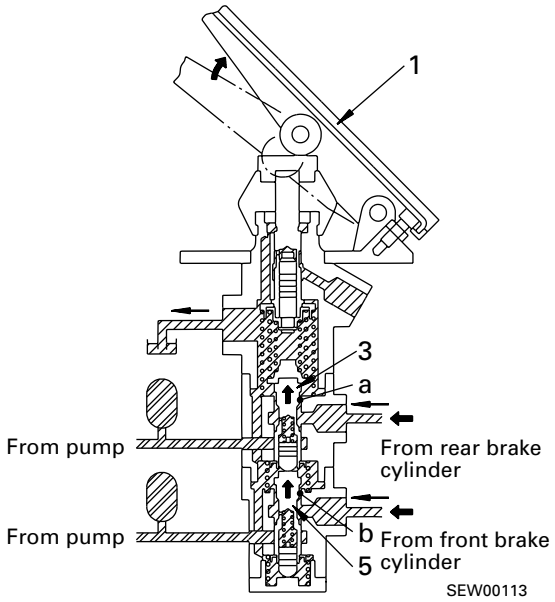
SJW06828

Brake released (right brake valve)
Upper portion

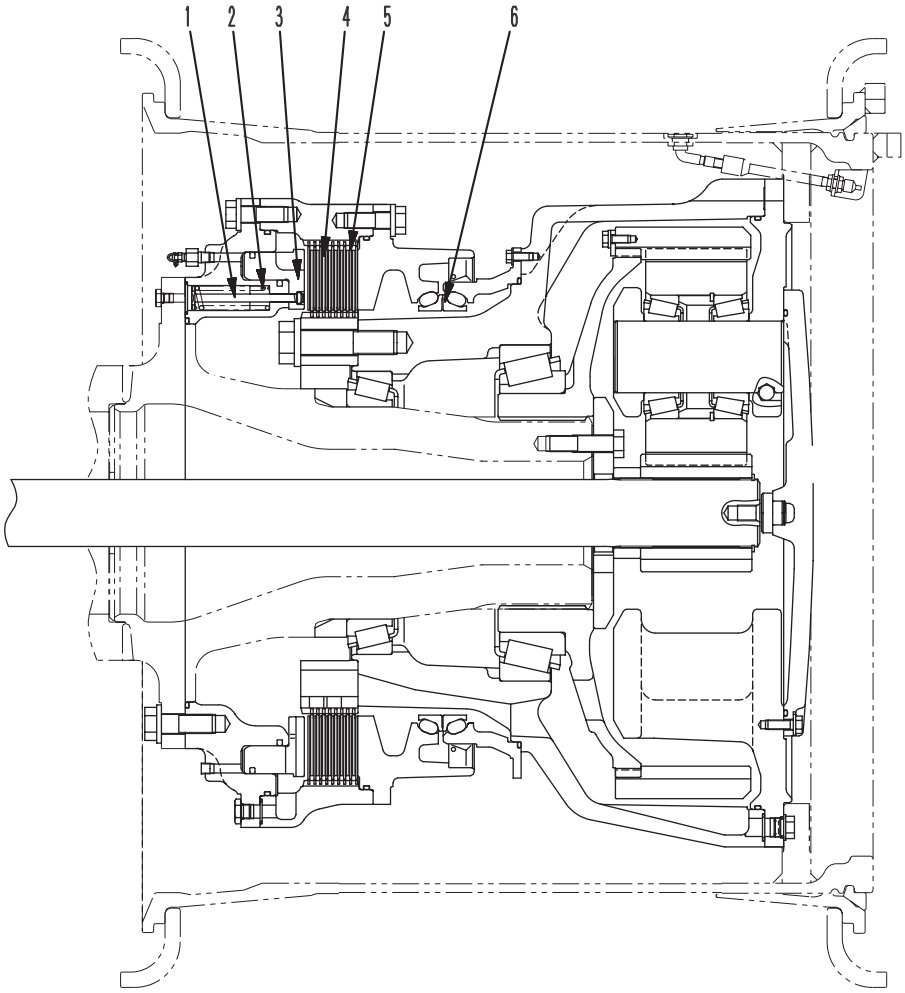
- When pedal (1) is released and the operating force is removed from the top of the spool, the back pressure from the brake cylinder and the force of the spool return spring move spool (3) up. Drain port **a** is opened and the oil from the brake cylinder flows to the hydraulic tank return circuit to release the rear brake.

Lower portion

- When the pedal is released, spool (3) in the upper portion moves up. At the same time, the back pressure from the brake cylinder and the force of the spool return spring move spool (5) up. Drain port **b** is opened and the oil from the brake cylinder flows to the hydraulic tank return circuit to release the front brake.



BRAKE

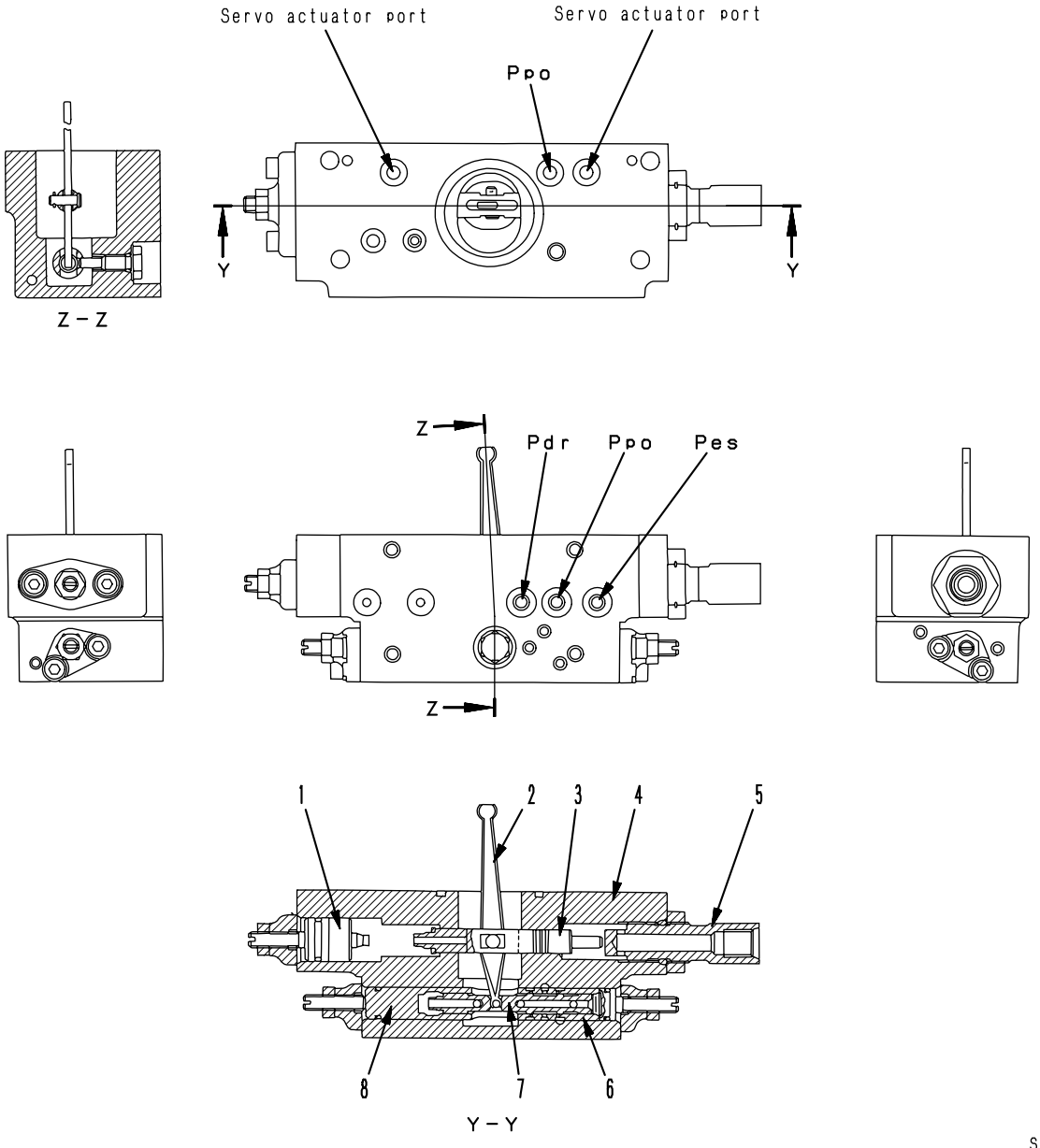


SJW06587

1. Guide pin
2. Return spring
3. Brake piston
4. Disc
5. Plate
6. Floating seal

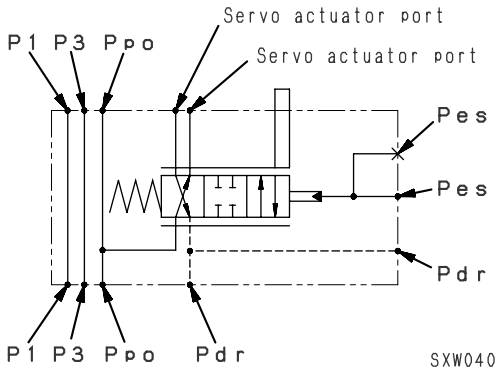
1. Hydraulic tank
2. Breather
3. Oil filter
4. Torque converter & transmission, cooling, PPC, and brake pumps
5. Differential pressure valve
6. Work equipment pump (main piston pump)
7. CO valve
8. ES valve
9. Servo valve
10. Control pump
11. Steering and switch pumps
12. Servo valve
13. Solenoid valve
14. Emergency steering pump
15. Diverter valve
16. Alarm lamp switch
17. Emergency relief valve (20.6 MPa {210 kg/cm^2})
18. Hydraulic oil cooler
19. Cold relief valve
20. PPC relief valve
21. Check valve
22. Accumulator
23. PPC valve
24. Work equipment valve
25. Bucket spool
26. Boom spool
27. Relief valve (31.4 MPa {320 kg/cm^2})
28. Safety-suction valve (36.8 MPa {375 kg/cm^2})
29. Unload valve
30. Float selector valve (2.6 MPa {26 kg/cm^2})
31. Rotary valve
32. Oil pressure switch
33. Lock valve
34. EPC valve
35. Steering demand valve
36. Demand spool
37. Steering spool
38. Relief valve (31.4 MPa {320 kg/cm^2})
39. Surge cut relief valve (33.3 MPa {340 kg/cm^2})
40. Overload relief valve (33.3 MPa {340 kg/cm^2})
41. Slow-return valve (2-way restrictor valve)
42. Steering cylinder
43. Boom cylinder
44. Bucket cylinder

SERVO VALVE



SXW04029

1. Plug
2. Arm
3. Spool
4. Body
5. Sleeve
6. Sleeve
7. Spool
8. Plug



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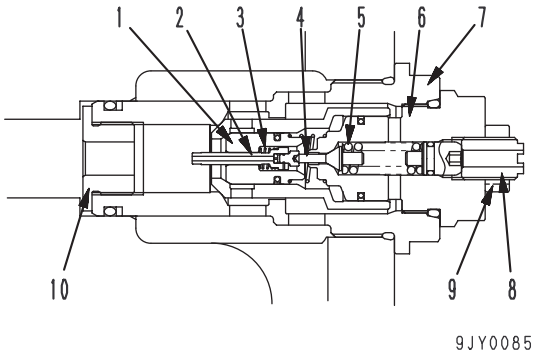
RELIEF VALVE



9JY00851

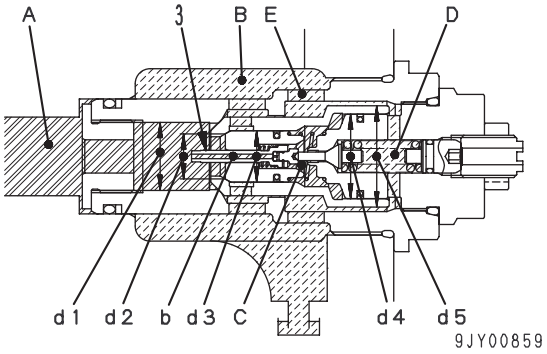
1. Main valve
2. Piston
3. Piston spring
4. Poppet
5. Poppet spring
6. Plug with valve seat
7. Sleeve
8. Adjustment screw
9. Lock nut
10. Orifice

FUNCTION

- The relief valve is installed at the inlet of the work equipment valve. When the oil pressure rises above the specified level, this valve drains the oil into the hydraulic tank to limit the maximum pressure of the work equipment circuit and protect the circuit.

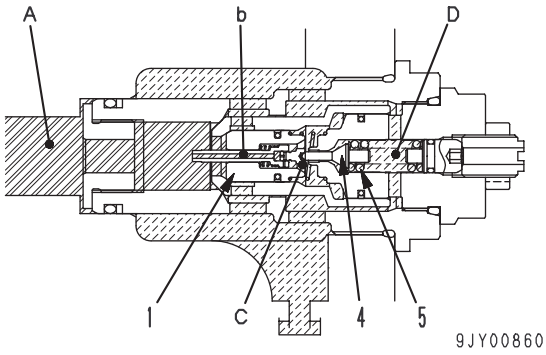
OPERATION

- Ports **A** and **B** are connected to the pump circuit and drain circuit respectively. The oil pressure in port **A** is applied through the hole of piston (3) to port **C**.
- When the oil pressure is below the set relief pressure, poppet (4) is in contact with the seat of plug (6) and the oil does not flow from chamber **C** into the drain circuit. Accordingly, the oil pressure in port **A** is equal to that in chamber **C**.
- Since **d2** < **d3**, main valve (2) is in contact with the left side. The sectional areas are set in the following order; **d5** > **d4** > **d1** > **d3** > **d2**.



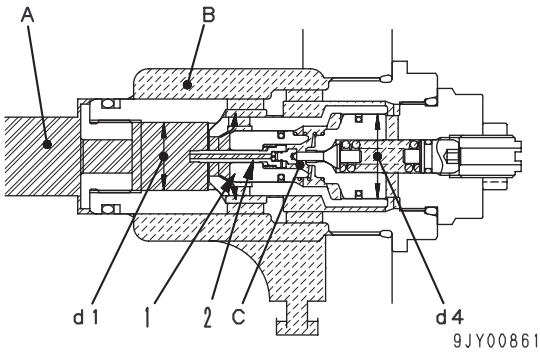
9JY00859

- If the pump pressure is raised by spring (5) to the relief pressure poppet (4) opens and the oil in chamber **C** is drained through chamber **D**.
- If poppet (4) opens, the oil flows from **A** through **C** to **D**.



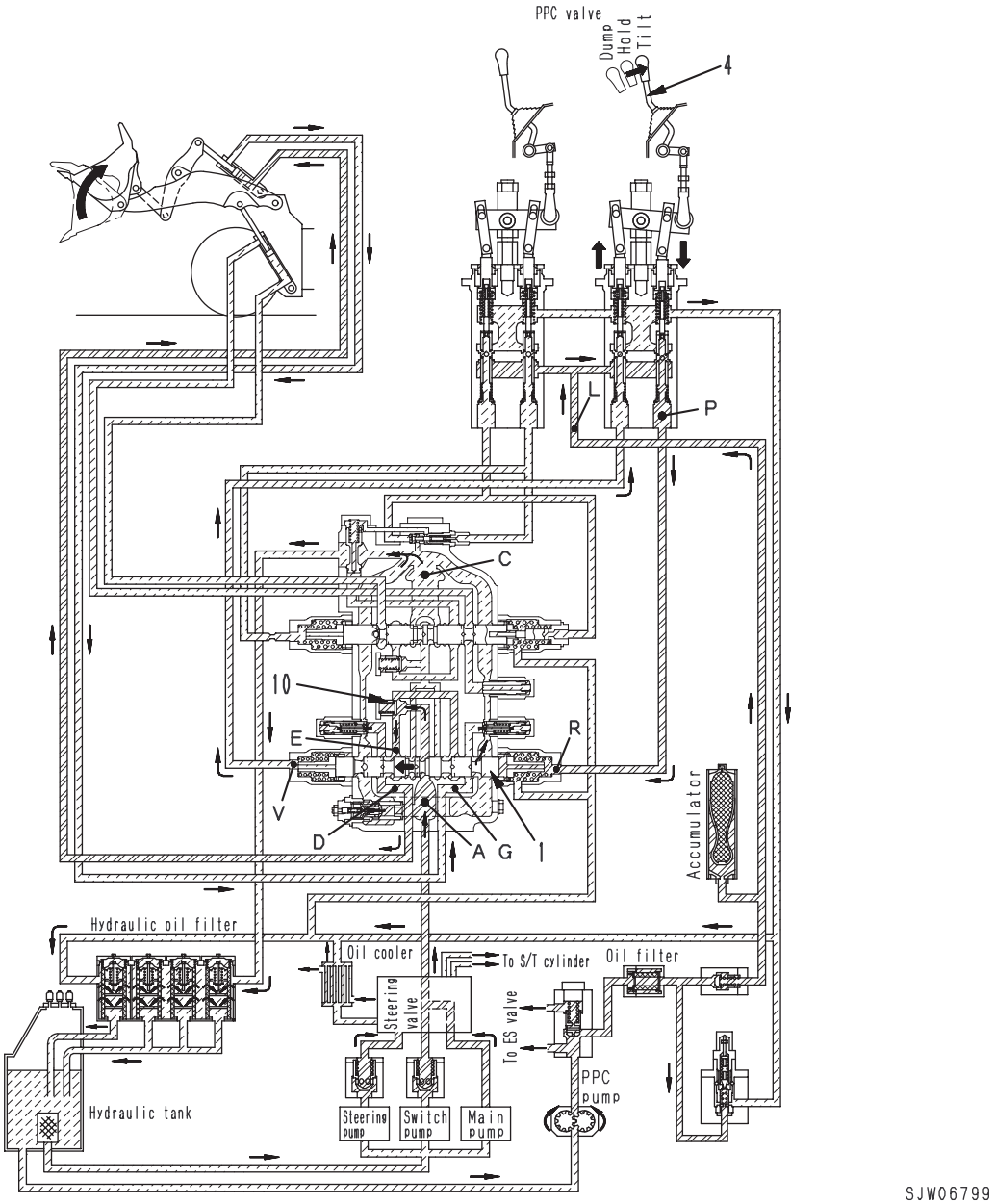
9JY00860

- As the oil flows from **A** → **C** [hole through piston (2)]. its pressure lowers. As a result, the pressure in chamber **C** is lower than that in port **A**, thus main valve (1) moves to the right.
- Then, the oil flows from port **A** to port **B** and limits the maximum pressure to protect the circuit.



9JY00861

BUCKET SPOOL IN "TILT BACK"

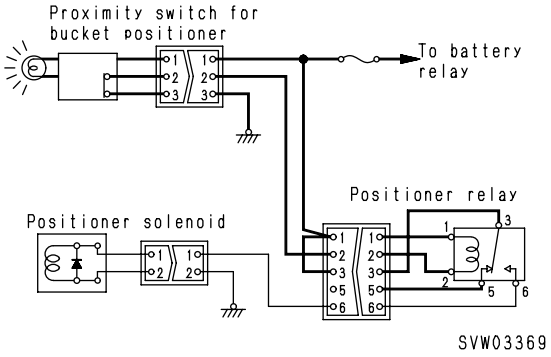


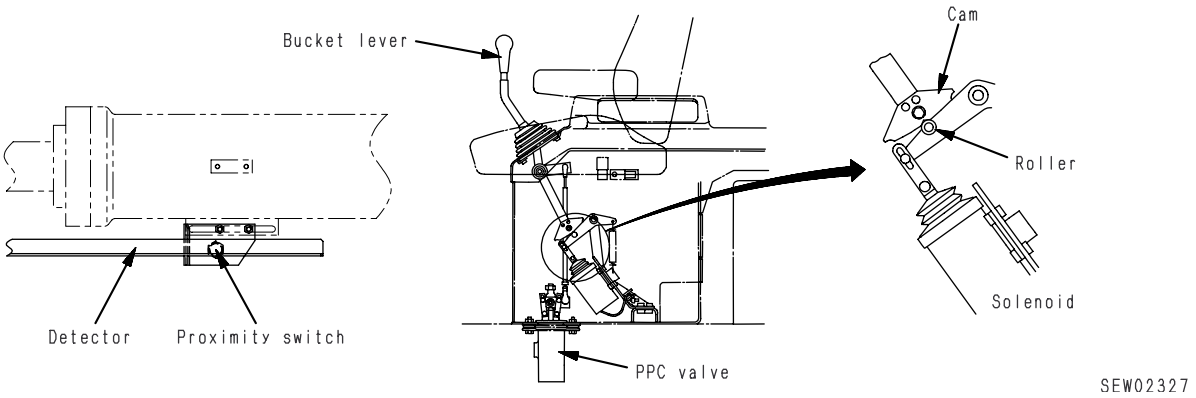
OPERATION

- When bucket lever (4) is pulled, the pressure oil at port **L** of the PPC valve flows from port **P** to port **R**. In addition, the oil at port **V** flows to the drain circuit. The pressure oil at port **R** moves bucket spool (1) to the TILT position.
- The bypass circuit is closed by bucket spool (1), so the oil from port **A** pushes open check valve (10). The oil from check valve (10) flows from port **E** to port **D**, and then flows to the cylinder bottom.
- At the same time, the oil at the cylinder rod end flows from port **G** to drain port **C**, and returns to the tank, so the bucket is tilted.

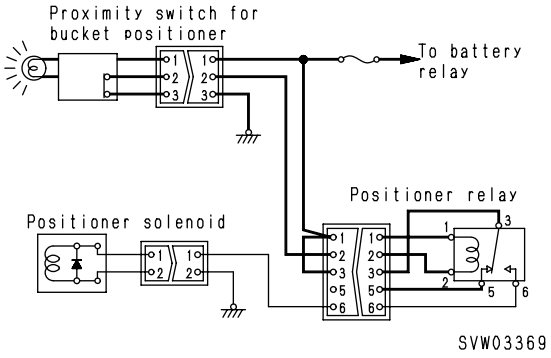
BUCKET TILT

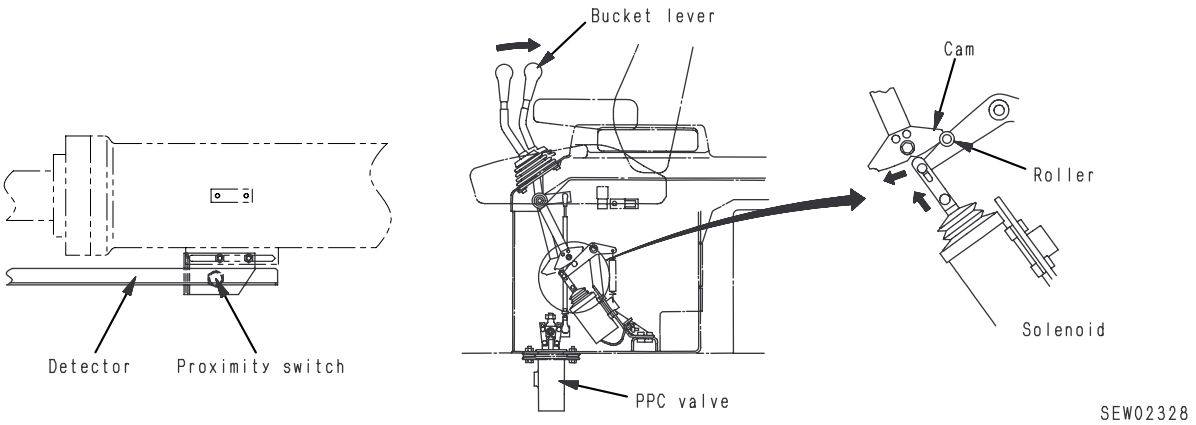
- When the bucket is dumped beyond the set position for the auto-leveler, the sensor (steel plate) is above the detection surface of the bucket proximity switch, so electric current flows in the proximity switch load circuit. The positioner relay is turned ON and the current for the solenoid is shut off.



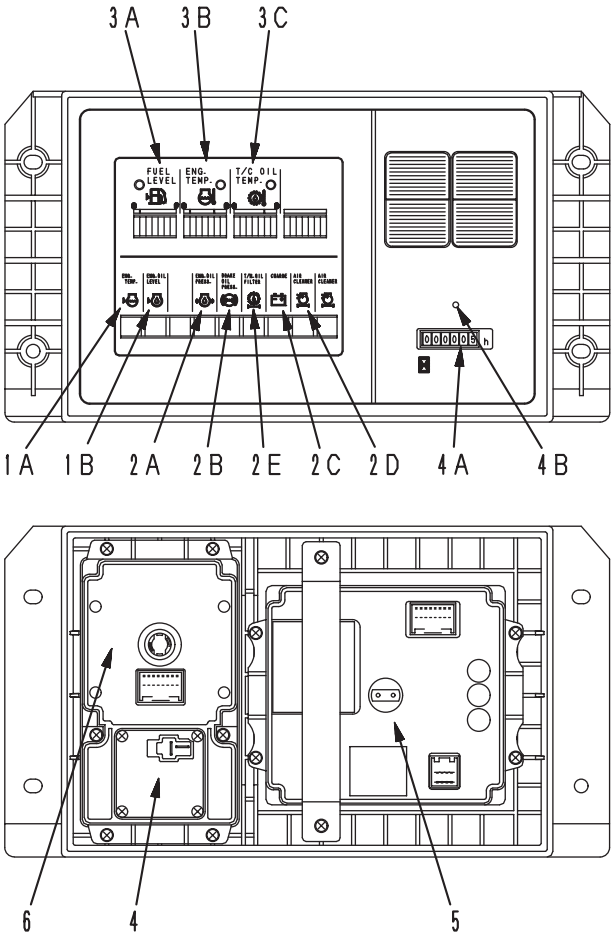


- When the bucket lever is moved to the TILT position, the bucket spool is held at the TILT position by the cam follower and cam on the lever, and the bucket tilts.





MAINTENANCE MONITOR



SJW06832

1. Check items (Checks before starting)
   1A. Engine water level
   1B. Engine oil level
2. Caution items (warning items)
   2A. Engine oil pressure
   2B. Brake oil pressure
   2C. Battery charge
   2D. Air cleaner
   2E. Transmission oil filter
3. Gauge items
   3A. Fuel level
   3B. Engine water temperature
   3C. Torque converter oil temperature
4. Service meter
   4A. Service meter numeric display
   4B. Service meter RUN pilot lamp
5. Monitor module
6. Switch module

OUTLINE

- The maintenance monitor has a display function for the caution items and gauges.
- The maintenance monitor consists of the monitor module, switch module, service meter, case, and other mechanisms.
- The monitor module has a built-in CPU (Central Processing Unit). It processes the signal from the sensors, and carries out the display and output.
- A liquid crystal display and LEDs are used for the display portions. The switches are embossed sheet switches.

11. Function selection signal

This signal is a GND/OPEN digital signal. When the engine is started, the function is judged from this signal.

1) Model selection

Table 4 Machine model selection signal table

Machine model	CN3B-2	CN3B-10	CN3B-3
WA600-3	OPEN	OPEN	GND
WA700-3	GND	OPEN	OPEN

2) Engine selection

Table 5 Engine selection table

Engine / Signal and data	Komatsu	Cummins
Engine selection (CN3A-10)	OPEN	GND

3) Option function selection

Table 6 Option (function) selection table

Input signal	Signal condition			
Auto-shift transmission (opt) (CN3A-20)	OPEN	GND	OPEN	GND
Joystick steering (opt) (CN3B-1)	OPEN	OPEN	GND	GND
Applicable model	Function			
WA600-3 WA700-3	Not set (*1)	Transmission auto/manual	Not set (*1)	Transmission auto/manual & joystick auto/manual

*1: When Not set condition is detected, all controller outputs are turned OFF and it is impossible to travel.

★ After displaying the program part number, the LED display shows [0∘0∘].

12. Engine speed sensor signal

This signal is a pulse signal. It converts the pulses from the electromagnetic pickup sensor to rotation speed for control.
When the engine speed is 1450 rpm or above, it is called the engine speed ON mode, and when the speed is less than 1450 rpm, it is called the engine speed OFF mode.

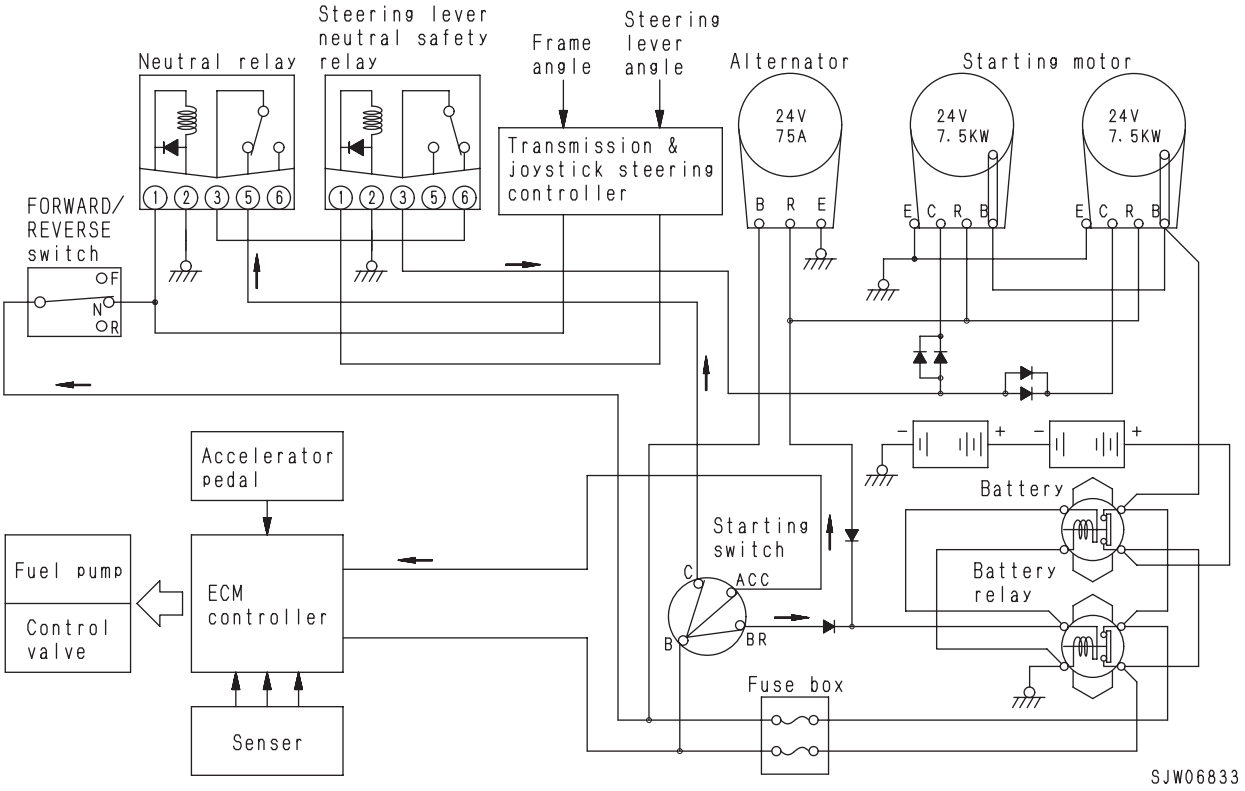
13. Travel speed sensor signal

This signal is a pulse signal. It converts the pulses from the electromagnetic pickup sensor to rotation speed for control.

14. Communications signal (S-NET)

This transmits the troubleshooting code to the main monitor.

ENGINE STARTING CIRCUIT



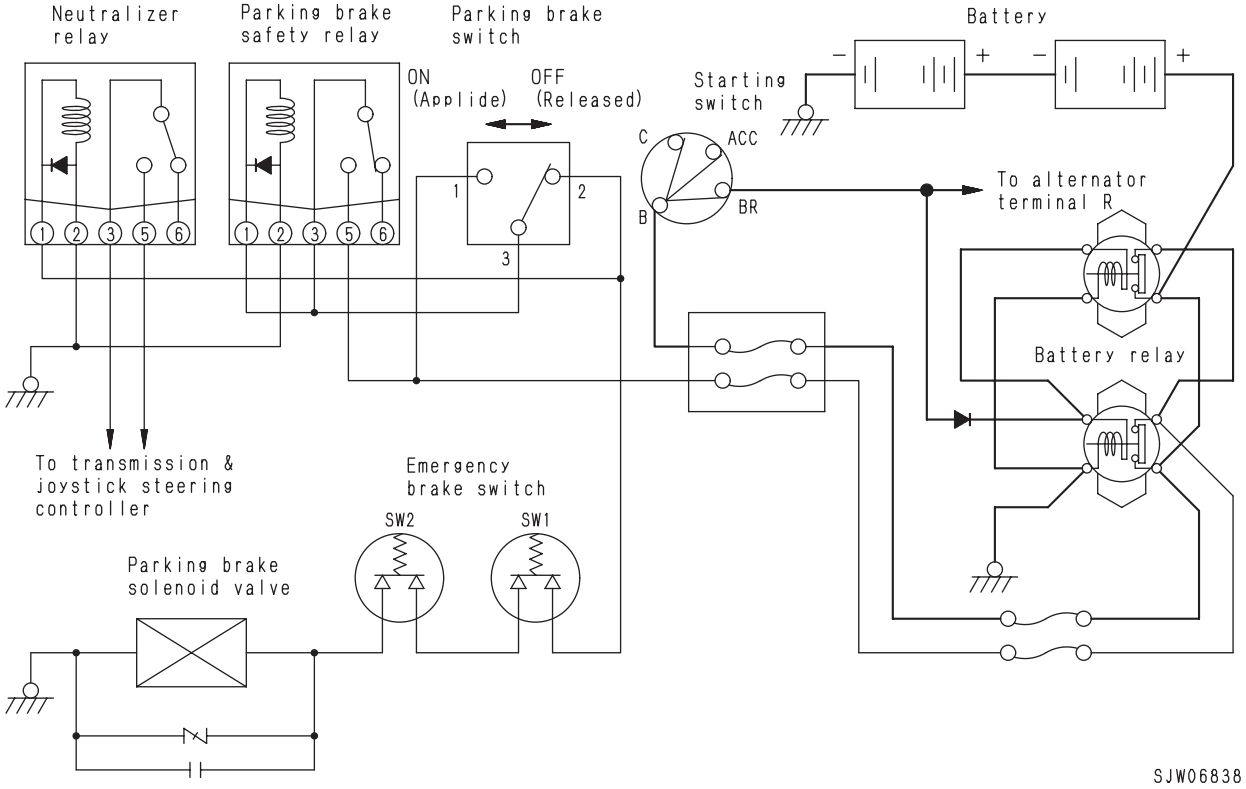
Function

- The neutral safety circuit is employed to secure safety when the engine is started. This circuit allows the engine to start only when the forward-reverse lever and the joystick steering lever are in the **N** (Neutral) position.
- If the starting switch is turned to the **OFF** position, supply of the fuel is stopped to stop the engine.

Operation

- If the forward-reverse lever is set in the **N** (Neutral) position, the neutral contacts of the forward-reverse lever are "**closed**". If the starting switch is turned to the ON position, the neutral relay operates to "**close**" terminals 3 – 5. Then, the current flows from starting switch terminal **BR** through the battery relay coil to the ground to "**close**" the battery relay.
  While the joystick steering lever is in the **N** (Neutral) position, the current does not flow from the transmission and joystick steering controller to the steering lever neutral safety relay coil and relay contacts 3 – 6 are "**closed**"
  If the starting switch is turned to the START position, the current flows from the positive (+) terminal of battery through starting switch terminals **B** and **C**, neutral relay terminals ⑤ and ③, steering lever neutral safety relay terminals ⑥ and ③, and starting motor terminals **C** and **E** to the ground.
- The ECM controller controls the fuel injection rate and injection timing according to various signals.
- The circuit from the battery through battery relay to starting motor terminal **B** is formed to start the engine.
- If the forward-reverse switch is not in the **N** (Neutral) position, the neutral relay does not operate, thus the starting circuit is not formed and the engine does not start.
  If the joystick steering lever is not in the **N** (Neutral) position, the steering lever neutral safety relay operates to break the starting circuit, thus the engine does not start.

2-2 When parking brake switch is OFF (actuated) before starting switch is turned ON



- Electric current flows in circuit ① from the battery → starting switch → battery relay coil → ground, so the battery relay is closed. However, in this case, the parking brake switch is OFF (released), so the parking safety relay is not actuated. For this reason, the electric current does not flow to the parking brake solenoid valve, so after the automatic parking brake is applied, the parking brake is not released automatically even when the starting switch is turned ON.
- In addition, the electric current does not flow to the transmission & joystick steering controller, so the machine does not move.

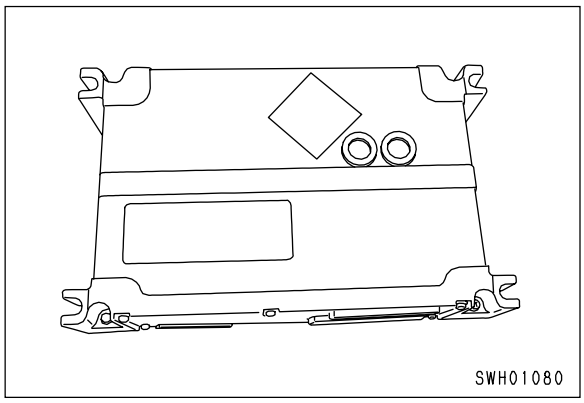
VHMS CONTROLLER

VHMS: Vehicle Health Monitoring System

★ For details of the basic precautions, outlines, method of sending and receiving data, and the procedure for the initial setup, see TESTING AND ADJUSTING.

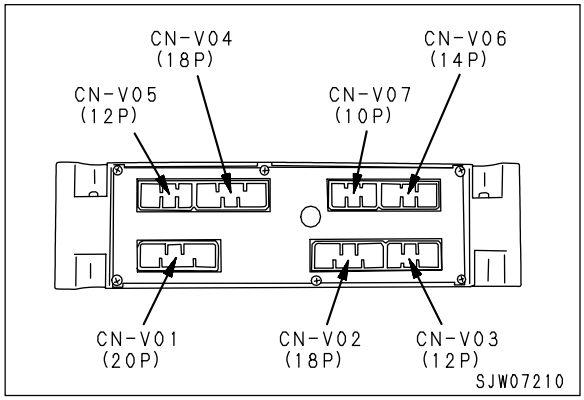
Specifications

1. Voltage of power supply : DC20V - DC30V
2. Size : W272 x D169 x H72 (mm)



Function

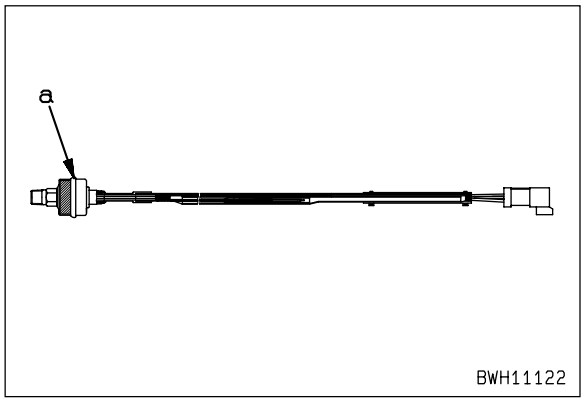
The VHMS controller collects and stores signals from each sensor and signals from the machine controller. It also gives commands for transmitting the accumulated data through the communications satellite.



BLOW-BY PRESSURE SENSOR

Specifications

1. Voltage of power supply: DC5V
2. Output voltage : Min. 0.5V (at engine stopped)
3. Size: Mount (portion **a**) : R 1/4
   : Outside diameter of seat receiving pressure : 37 mm
   : Length of cable: 1,110 mm



Function

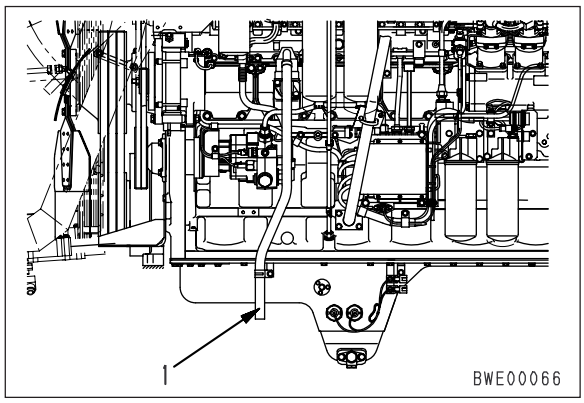
The blow-by sensor converts the pressure inside the engine crankcase into a voltage and inputs this into the VHMS controller as the blow-by pressure.

STANDARD VALUE TABLE FOR CHASSIS

Machine model						WA700-3	
Category	Item			Measurement conditions	Unit	Standard value for new machine	Service limit value
Directional lever	Operating effort		N–FORWARD, REVERSE	• Engine stopped • Measure at center of lever knob	N{kg}	5.88 $^{+4.9}_{-2.94}$ {0.6 $^{+0.5}_{-0.3}$}	Max. 16.7 {1.7}
	Travel		N–FORWARD, REVERSE		mm	35 ± 10	35 ± 10
Speed control lever	Operating effort		1st – 2nd	• Engine stopped • Measure at center of lever knob	N{kg}	5.88 $^{+4.9}_{-2.94}$ {0.6 $^{+0.5}_{-0.3}$}	Max. 16.7 {1.7}
			2nd – 3rd			5.88 $^{+4.9}_{-2.94}$ {0.6 $^{+0.5}_{-0.3}$}	Max. 16.7 {1.7}
			3rd – 4th			5.88 $^{+4.9}_{-2.94}$ {0.6 $^{+0.5}_{-0.3}$}	Max. 16.7 {1.7}
	Travel		1st – 2nd		mm	35 ± 10	35 ± 20
			2nd – 3rd			35 ± 10	35 ± 20
			3rd – 4th			35 ± 10	35 ± 20
Work equipment control lever	Operating effort	Boom	HOLD→RAISE	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C	N {kg}	Max. 23.5 {2.4}	Max. 35.3 {3.6}
			RAISE→HOLD			Max. 15.7 {1.6}	Max. 23.5 {2.4}
			HOLD→LOWER			Max. 24.5 {2.5}	Max. 37.3 {3.8}
			LOWER→HOLD			—	—
			LOWER→FLOAT			Max. 34.3 {3.5}	Max. 52.0 {5.3}
			FLOAT→HOLD			Max. 14.7 {1.5}	Max. 22.6 {2.3}
		Bucket	HOLD→DUMP			Max. 23.5 {2.4}	Max. 35.3 {3.6}
			HOLD→TILT			Max. 23.5 {2.4}	Max. 35.3 {3.6}
			TILT→HOLD			Max. 14.7 {1.5}	Max. 22.6 {2.3}
	Travel	Boom	HOLD→RAISE	• Engine speed Low idling • Hydraulic oil temperature: 45 – 55°C	mm	67 ± 15	67 ± 30
			HOLD→LOWER			53 ± 15	53 ± 30
			HOLD→FLOAT			67 ± 15	67 ± 30
		Bucket	HOLD→DUMP			60 ± 15	60 ± 30
			HOLD→TILT			60 ± 15	60 ± 30
Steering wheel	Play			• Engine stopped • Machine facing straight to front	mm	Max. 20	Max. 20
	Operating effort			• Flat, horizontal, straight, dry paved road surface	N {kg}	10.0 ± 3.0 {1.0 ± 0.3}	Max. 19.6 {2.0}
	Turns			• Engine speed: High idling • Leftt lock - righ lock	Turns	4.0 ± 0.7	Max. 4.5
	Operating time		Low idling	• Engine running • Hydraulic oil temperature: 45 – 55°C • Leftt lock - righ lock	sec.	Max. 5.5	Max. 6.5
			High idling			Max. 4.7	Max. 5.0

<table>
<tr><th>System</th><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="6">Others</td><td>Emergency brake switch</td><td>C07, C08 (male)</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal.<table><tr><td>Accumulator pressure: Min. 3.92 ± 0.49 MPa {40 ± 5 kg/cm²}</td><td rowspan="2">Between C07, C08 (1) – (2)</td><td>Max. 1 Ω</td></tr><tr><td>Depress brake and lower accumulator pressure to below 3.63 ± 0.49 MPa {37 ± 5 kg/cm²}</td><td>Min. 1 MΩ</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connectors.
3) Connect T-adapter.</td></tr>
<tr><td>Emergency brake switch</td><td>BC01</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal.<table><tr><td>Accumulator pressure: Min. 3.92 ± 0.49 MPa {40 ± 5 kg/cm²}</td><td rowspan="2">Between (4) – (5)</td><td>20 – 30 V</td></tr><tr><td>Depress brake and lower accumulator pressure to below 3.63 ± 0.49 MPa {37 ± 5 kg/cm²}</td><td>Max. 1 V</td></tr></table></td><td>1) Turn starting switch OFF.
2) Insert T-adapter.
3) Turn starting switch ON.</td></tr>
<tr><td>Bucket positioner proximity switch</td><td>F05</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal.<table><tr><td></td><td>When screwdriver is brough close</td><td>When screwdriver is not brough close</td></tr><tr><td>Between (1) – (2)</td><td>20 – 30 V</td><td>Max. 3 V</td></tr><tr><td>Between (1) – (3)</td><td>20 – 30 V</td><td>20 – 30 V</td></tr><tr><td>Between (2) – (3)</td><td>Max. 3 V</td><td>20 – 30 V</td></tr></table></td><td>1) Turn starting switch OFF.
2) Insert T-adapter.
3) Turn starting switch ON.</td></tr>
<tr><td>Boom kick-out proximity switch</td><td>F06</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal.<table><tr><td></td><td>When screwdriver is brough close</td><td>When screwdriver is not brough close</td></tr><tr><td>Between (1) – (2)</td><td>20 – 30 V</td><td>Max. 3 V</td></tr><tr><td>Between (1) – (3)</td><td>20 – 30 V</td><td>20 – 30 V</td></tr><tr><td>Between (2) – (3)</td><td>Max. 3 V</td><td>20 – 30 V</td></tr></table></td><td>1) Turn starting switch OFF.
2) Insert T-adapter.
3) Turn starting switch ON.</td></tr>
<tr><td>Boom kick-out solenoid</td><td>L16</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal.<table><tr><td>Between (1) – (2)</td><td>19 – 23 Ω</td></tr><tr><td>Between (1), (2) – chassis</td><td>Min. 1 MΩ</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connectors.
3) Connect T-adapter.</td></tr>
<tr><td>Bucket positioner solenoid</td><td>L17</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal.<table><tr><td>Between (1) – (2)</td><td>19 – 23 Ω</td></tr><tr><td>Between (1), (2) – chassis</td><td>Min. 1 MΩ</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connectors.
3) Connect T-adapter.</td></tr>
</table>

MEASURING BLOW-BY PRESSURE



1. Install the nozzle of pressure test kit **E** to blow-by hose (1), then connect to the pressure test kit.

2. Run the engine at near rated output, and measure the blow-by pressure.

   ⚠ When measuring, be careful not to touch any hot parts or rotating parts.

   Note:
   ★ Blow-by varies greatly according to the condition of the engine. Therefore, if the blow-by value is considered abnormal, check for problems connected with defective blow-by, such as excessive oil consumption, defective exhaust gas color, and prematurely dirty or deteriorated oil.

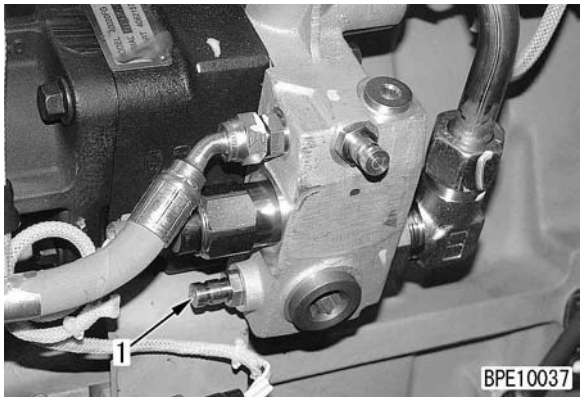
MEASURING FUEL CIRCUIT PRESSURE

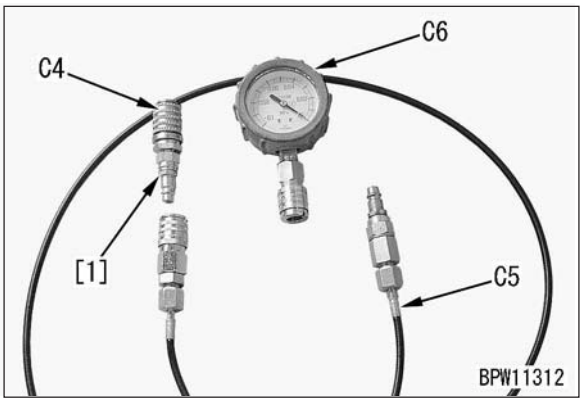
1. Measuring fuel pump inlet pressure

1) Connect adapter **C4**, hose **C5**, and oil pressure gauge **C6** to inlet pressure pickup coupler (1).
   ★ Connect nipple [1] of hydraulic tester **C1** to adapter **C4**.

2) Run the engine at high idling and measure the fuel pump inlet pressure.
   ★ Check that the fuel pump inlet pressure is in the following range.
   ★ Fuel pump inlet pressure (negative pressure):

Engine speed	Fuel pump inlet pressure (kPa {mmHg})	Condition
High idling	Max. –13.6 {Max. –102}	When new filter is used
	Max. –27.1 {Max. –203}	Normal





2. Adjusting

Adjusting output voltage of potentiometer

1) Check that punch mark (2) made on intermediate connector (1) between the case and potentiometer is on the side where it can be seen.
   Insert the protruding part of the potentiometer into the groove in the intermediate connector, then temporarily tighten the mounting screw.
   Potentiometer mounting surface: **Cemedyne POS seal**
   Potentiometer mounting screw: **LT-2**
2) Set the pedal to the low idling position, impress a voltage of DC5V on the potentiometer, and turn the potentiometer to the left and right to set it within the range for the low idling output voltage.

• Output voltage at low idling: $4.1^{+0.2}_{-0.1}$ V

Operate the pedal 2 or 3 times and check that the voltage is within the specified output voltage range at the low idling position. If the voltage is not within the specified range, carry out the adjustment again.

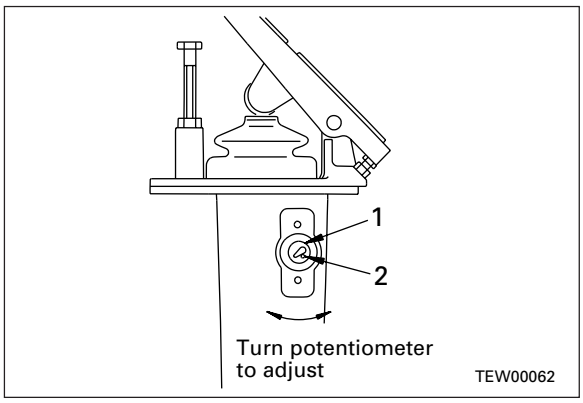
★ When adjusting the low idling output voltage, first operate the pedal 2 or 3 times at the lowest output voltage position, then turn the potentiometer to increase the voltage until it is within the specified voltage range. This will keep the play on one side and make it easier to adjust.

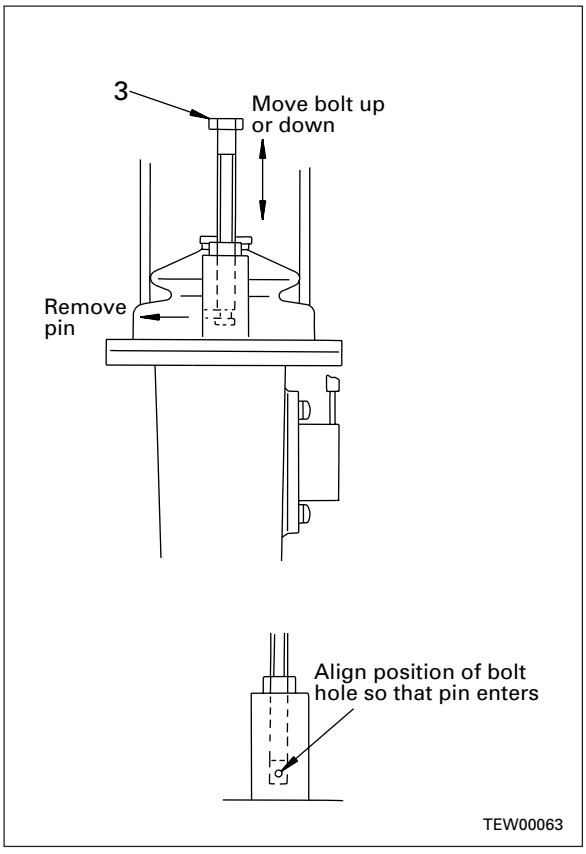
3) Next, operate the pedal to the high idling position and check that the voltage is within the high idling output voltage range.

• Output voltage at high idling: 0.7 ± 0.2 V

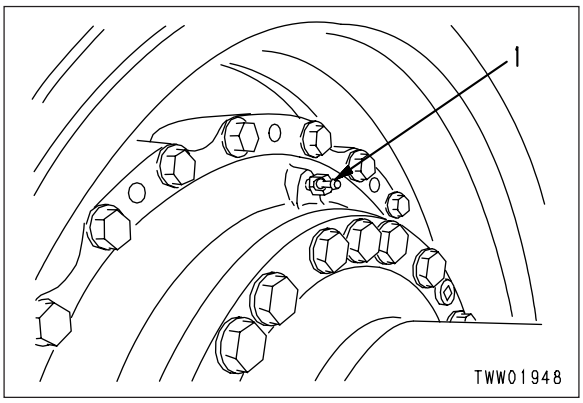
If the voltage is not within the specified range, adjust the low idling voltage again within the specified range and adjust so that both the low idling and high idling voltages are the specified voltage.

4) If the high idling voltage does not enter the voltage range with the procedure up to Step 3), remove the pin from the bottom of stopper bolt (3), loosen the stopper bolt, and move it up or down to adjust so that the high idling voltage is within the voltage range.
   ★ Adjust the position of the hole so that the pin can enter the hole at the bottom of the bolt.
   ★ The stopper bolt is already properly adjusted, so do not adjust it unless there is some special reason.
5) Tighten the potentiometer mounting screw.



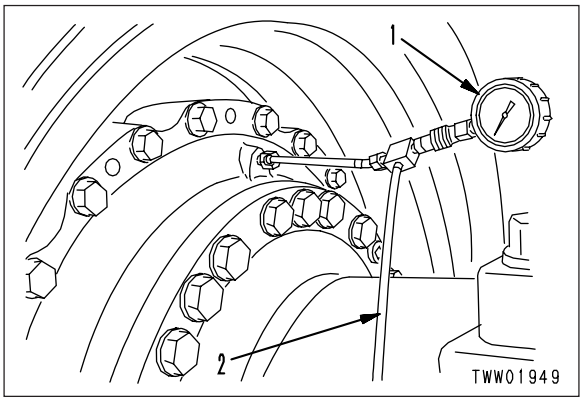


TESTING BRAKE OIL PRESSURE



1. Inspecting brake oil pressure

1) Remove bleeder screw (1), then install oil pressure gauge tool **I** (19.6 MPa {200 kg/cm^2}), the elbow, joint, bleeder screw, and nipple,
2) Connect hose (2) to the bleeder screw and bleed the air from the brake circuit. For details, see BLEEDING AIR.
3) Depress the left brake and measure the brake oil pressure.



2. Measuring drop in brake piston pressure

1) Remove bleeder screw (1), then install oil pressure gauge tool **I** (19.6 MPa {200 kg/cm^2}), the elbow, joint, bleeder screw, and nipple.
2) Connect hose (2) to the bleeder screw and bleed the air from the brake circuit. For details, see BLEEDING AIR.
3) Stop the engine, depress the left brake pedal, leave for 5 minutes with the oil pressure at 4.9 MPa {50 kg/cm^2}, and measure the drop in pressure.

★ Be careful not to move the brake pedal for 5 minutes.
★ After completing the operation, bleed the air from the brake circuit again.

BLEEDING AIR FROM PISTON PUMP

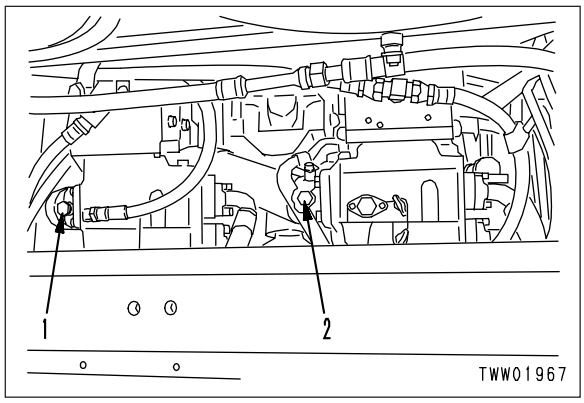
★ If the oil in the hydraulic tank has been changed, or the piston pump has been removed, or the piston pump piping has been removed, bleed the air as follows to prevent seizure of the pump.

1. Check that the oil in the hydraulic tank is at the upper level.
   ★ The cap of the hydraulic tank remains removing, until the air bleeding of the piston pump finishes.

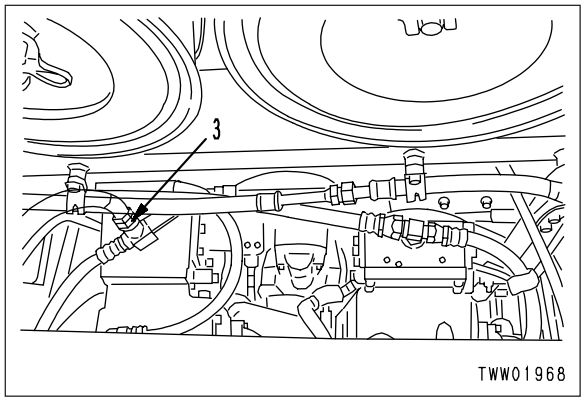
2. Loosen plugs (1) and (2) of the tube at the suction side of the piston pump.

3. Let oil flow out in turn from plugs (1) and (2), and when the air is completely bled from the piston pump, tighten the plugs. After that, in order to fill the inside of the pump with the hydraulic oil, leave it for 10 minutes.

★ The oil level in the hydraulic tank is higher than the positions of parts (1) and (2), so it is possible to bleed the air easily.



4. Loosen the mouthpiece of the case drain hose (3), starting an engine at the condition of low idling. Tighten the mouthpiece, confirming that hydraulic oil flows from the mouthpiece.



Pm CLINIC INSPECTION TABLE WA700-3

	-hour inspection

Machine serial No.	#
Engine serial No.	SAA6D170E-3

Work instruction No.	Date of execution	Service meter	Inspector
	Year: Month: Day:	hours	

Interview with operator and walk-around check

Is there abnormality before starting inspection?	Outside temperature Max.: °C
	Min.: °C
	Height: m

What is maximum level of coolant temperature? (During work)							What is maximum level of torque converter and transmission oil temperature? (During work)						
White 1	Green 2	Green 3	Green 4	Green 5	Red 6	Red 7	Green 1	Green 2	Green 3	Green 4	Green 5	Red 6	Red 7

★ After starting engine

	Item	Condition		Unit	Standard value for new machine	Service limit value	Measurement result	Good	Bad
ENGINE	Engine speed	Low idling		rpm	700 – 750	—			
		High idling			2240 – 2300	—			
		Torque converter stall			2125 – 2225	1975 – 2275			
		Hydraulic stall			2100 – 2200	1950 – 2250			
		Full stall			1520 – 1720	1320 – 1920			
	Blow-by pressure	Torque converter stall		kPa {mmAq}	Max. 3.92 {Max. 400}	Max. 7.9 {Max. 800}			
	Engine lubricating oil pressure	SAE30 or SAE15W-40	Engine: Full throttle	MPa {kg/cm²}	0.39 – 0.54 {4.0 – 5.5}	Min. 0.21 {Min. 2.1}			
			Engine: Low idling		Min. 0.12 Min. 1.2	Min. 0.07 {Min. 0.7}			
		SAE10W	Engine: Full throttle		0.34 – 0.49 {3.5 – 5.0}	Min. 0.18 {Min. 1.8}			
			Engine: Low idling		Min. 0.10 Min. 1.0	Min. 0.05 {Min. 0.5}			
	Boost pressure	Torque converter stall		kPa {mmHg}	Min. 120 {Min. 900}	Min. 107 {Min. 800}			
	Exhaust temperature	Outside temperature		°C	—	—			
		Torque converter stall			Max. 650	Max. 700			

T/C	Inlet pressure 1	Engine: Full throttle Torque converter oil temperature: 60 – 80°C Transmission: Neutral	MPa {kg/cm²}	0.65 – 0.85 {6.6 – 8.6}	0.65 – 0.85 {6.6 – 8.6}			
	Outlet pressure 2			0.54 – 0.64 {5.5 – 6.5}	0.54 – 0.64 {5.5 – 6.5}			

★ When the transmission is in the speed range, apply the brake fully.

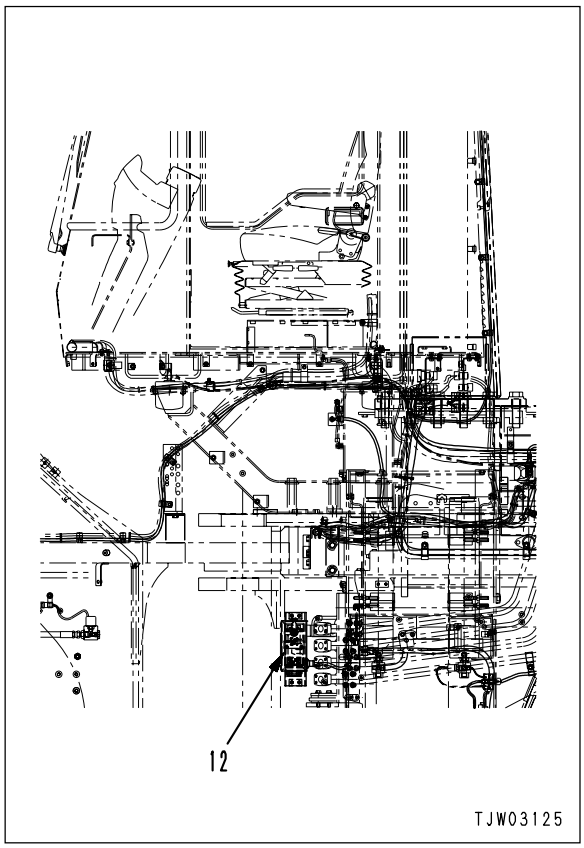
TRANSMISSION	Main relief pressure P6	Transmission: Neutral	Engine: Full throttle Oil temperature: (SAE30) 70 – 90°C	MPa {kg/cm²}	2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			
	Modulating pressure in N & 1st P1	Forward-reverse lever: Neutral Gearshift lever: 2nd → 1st			2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			
	Modulating pressure in N & 2nd P1	Forward-reverse lever: Neutral Gearshift lever: 1st → 2nd			2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			
	Reducing pressure P3				2.2 – 2.4 {22.5 – 24.5}	2.2 – 2.4 {22.5 – 24.5}			
	Modulating pressure in N & 3rd P1	Forward-reverse lever: Neutral Gearshift lever: 2nd → 3rd			2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			
	Modulating pressure in N & 4th P1	Forward-reverse lever: Neutral Gearshift lever: 3rd → 4th			2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			
	Modulating pressure in F & 4th P1	Forward-reverse lever: Neutral → F Gearshift lever: 4th			2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			
	Modulating pressure in R & 4th P1	Forward-reverse lever: Neutral → R Gearshift lever: 4th			2.94 – 3.24 {30.0 – 33.0}	2.94 – 3.24 {30.0 – 33.0}			

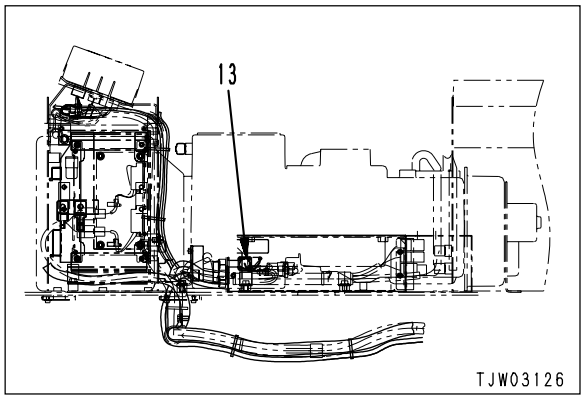
3) External communication function

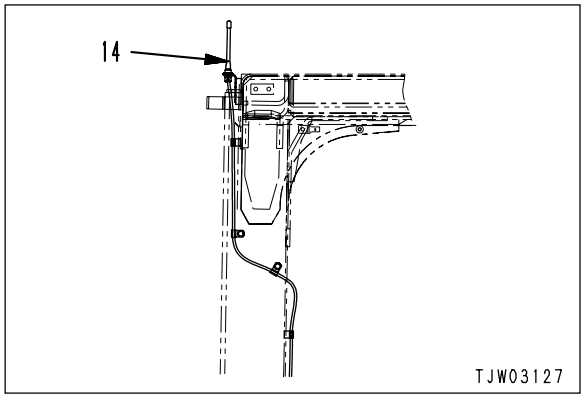
- Connect the PC (personal computer) to the VHMS controller, download the data, and transmit the data through the Internet.
- Send the data automatically from remote areas through the communications satellite (ORB).

(12): Ground level download connector
(13): Download connector inside cab
(14): Communications antenna/pole

Antenna mount:
Thread tightener (LT-2)







POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.

⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.

⚠ If the radiator cap is removed when the engine is hot, hot water may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.

⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.

⚠ When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.

⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

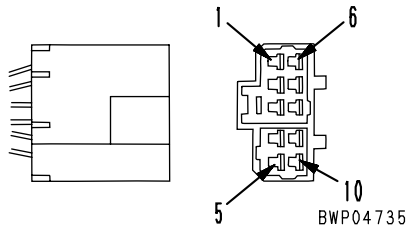
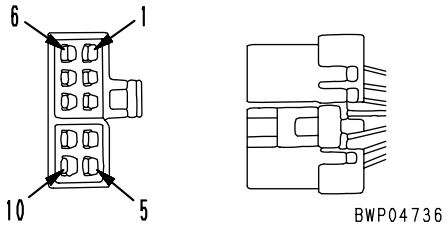
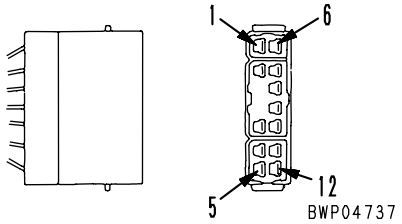
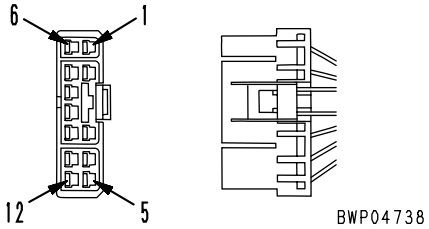
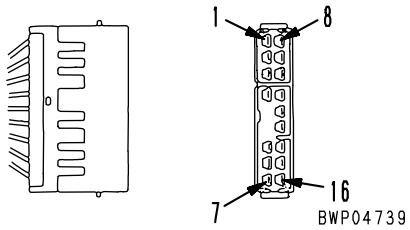
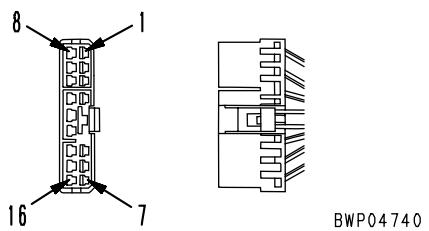
The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.
When carrying out troubleshooting, and important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

1. **When carrying out troubleshooting, do not hurry to disassemble the components.**
   If components are disassembled immediately any failure occurs:
   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

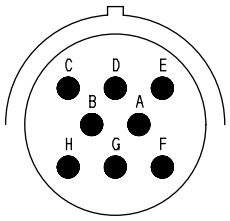
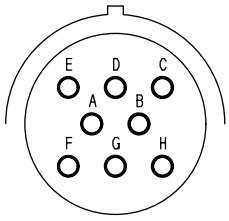
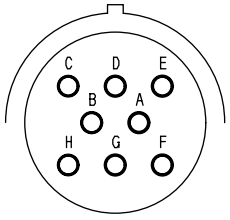
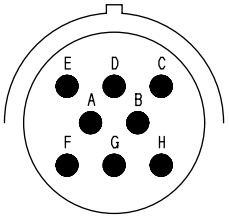
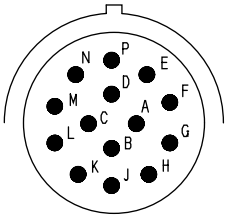
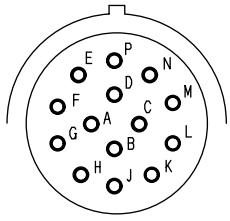
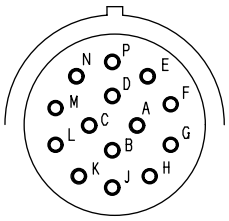
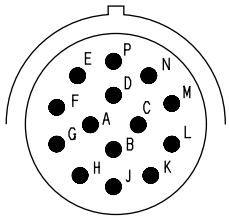
   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. **Points to ask user or operator**
   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure?
      When were these repairs carried out?
   6) Has the same kind of failure occurred before?
3. **Check before troubleshooting**
   1) Check the oil level
   2) Check for any external leakage of oil from the piping or hydraulic equipment.
   3) Check the travel of the control levers.
   4) Check the stroke of the control valve spool.
   5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.
4. **Confirming failure**
   Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
   ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. **Troubleshooting**
   Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.
   ★ The basic procedure for troubleshooting is as follows.
      1) Start from the simple points.
      2) Start from the most likely points.
      3) Investigate other related parts or information.
6. **Measures to remove root cause of failure**
   Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
   To prevent this, always investigate why the problem occurred. Then, remove the root cause.

CHECKS BEFORE TROUBLESHOOTING

	Item	Judgement standard	Remedy
Lubricating oil, cooling water	1. Check fuel level, type of fuel	—	Add fuel
	2. Check for impurities in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check hydraulic filter (Torque converte, Transmission hydraulic oil)	—	Clean, drain
	5. Check brake oil level	—	Add oil
	6. Check engine oil level	—	Add oil
	7. Check coolant level	—	Add water
	8. Check dust indicator for clogging	—	Clean or replace
Electrical equipment	9. Check for looseness, corrosion of battery terminal, wiring	—	Tighten or replace
	10. Check for looseness, corrosion of alternator terminal, wiring	—	Tighten or replace
	11. Check for looseness, corrosion of starting motor terminal, wiring	—	Tighten or replace
	12. Check operation of instruments	—	Repair or replace
Hydraulic, mechanical equipment	13. Check for abnormal noise, smell	—	Repair
	14. Check for oil leakage	—	Repair
	15. Carry out air bleeding	—	Bleed air
	16. Check effect of parking brake, wheel brake	—	Repair or replace
Electrics, electrical equipment	17. Check battery voltage (engine stopped)	24 – 26 V	Replace
	18. Check battery electrolyte level	—	Add or replace
	19. Check for discolored, burnt, exposed wiring	—	Replace
	20. Check for missing wiring clamps, hanging wiring	—	Repair
	21. Check for water leaking on wiring (be particularly careful attention to water leaking on connectors or terminals)	—	Disconnect connector and dry
	22. Check for blown, corroded fuses	—	Replace
	23. Check alternator voltage (engine running at 1/2 throttle or above) (If the battery charge is low, the voltage may be approx. 25V immediately after starting.)	28.5 – 29.5 V	Replace
	24. Sound of actuation of battery relay (when starting switch is turned ON, OFF)	—	—

No. of pins	S-type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10 (Blue)			—
	—	—	
12 (Blue)			799-601-7160
	Part No.: 08056-11272	Part No.: 08056-11282	
16 (Blue)			799-601-7170
	Part No.: 08056-11672	Part No.: 08056-11682	

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

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
18-8 (1)	Pin (male terminal)	Pin (female termial)	799-601-9210
	 BWP05001	 BWP05002	
	Part No.: 08191-11201, 08191-11202, 08191-11205, 08191-11206	Part No.: 08191-14101, 08191-14102, 08191-14105, 08191-14106	
	Pin (female terminal)	Pin (male termial)	799-601-9210
	 BWP05003	 BWP05004	
	Part No.: 08191-12201, 08191-12202, 08191-12205, 08191-12206	Part No.: 08191-13101, 08191-13102, 08191-13105, 08191-13106	
18-14 (2)	Pin (male terminal)	Pin (female termial)	799-601-9220
	 BWP05005	 BWP05006	
	Part No.: 08191-21201, 08191-12202, 08191-21205, 08191-12206	Part No.: 08191-24101, 08191-24102, 08191-24105, 08191-24106	
	Pin (female terminal)	Pin (male termial)	799-601-9230
	 BWP05007	 BWP05008	
	Part No.: 08191-22201, 08191-22202, 08191-22205, 08191-22206	Part No.: 08191-23101, 08191-23102, 08191-23105, 08191-23106	

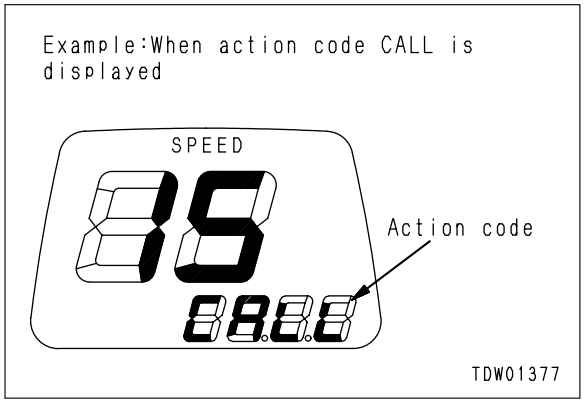
METHOD OF DISPLAYING ACTION CODE AND FAILURE CODE

1. Outline

The speedometer display on the main monitor is used to display the troubleshooting for each control system. The nature of the troubleshooting is displayed as the failure action code, failure code, and the time elapsed since failure.
The signals between the main monitor and each controller are transmitted in serial through the network circuit. (Only the engine controller uses a special parallel signal.)

2. Display of failure action code

This code informs the operator directly of the abnormality, and takes action, such as stopping the machine immediately.
There are three types of action code: E00, E01 + CALL (E01 and CALL are displayed alternately), and CALL. If a failure occurs suddenly, one of these codes is shown on the speedometer display.



3. Failure code and time elapsed since failure

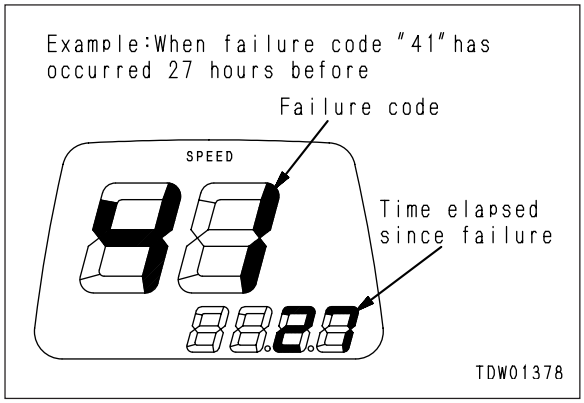
The failures detected by each controller are changed to a code and displayed. It is possible to tell from this code which system in which controller has failed, so carry out troubleshooting for the applicable controller.

4. Saving failure code

The transmission controller writes the failure codes to memory.

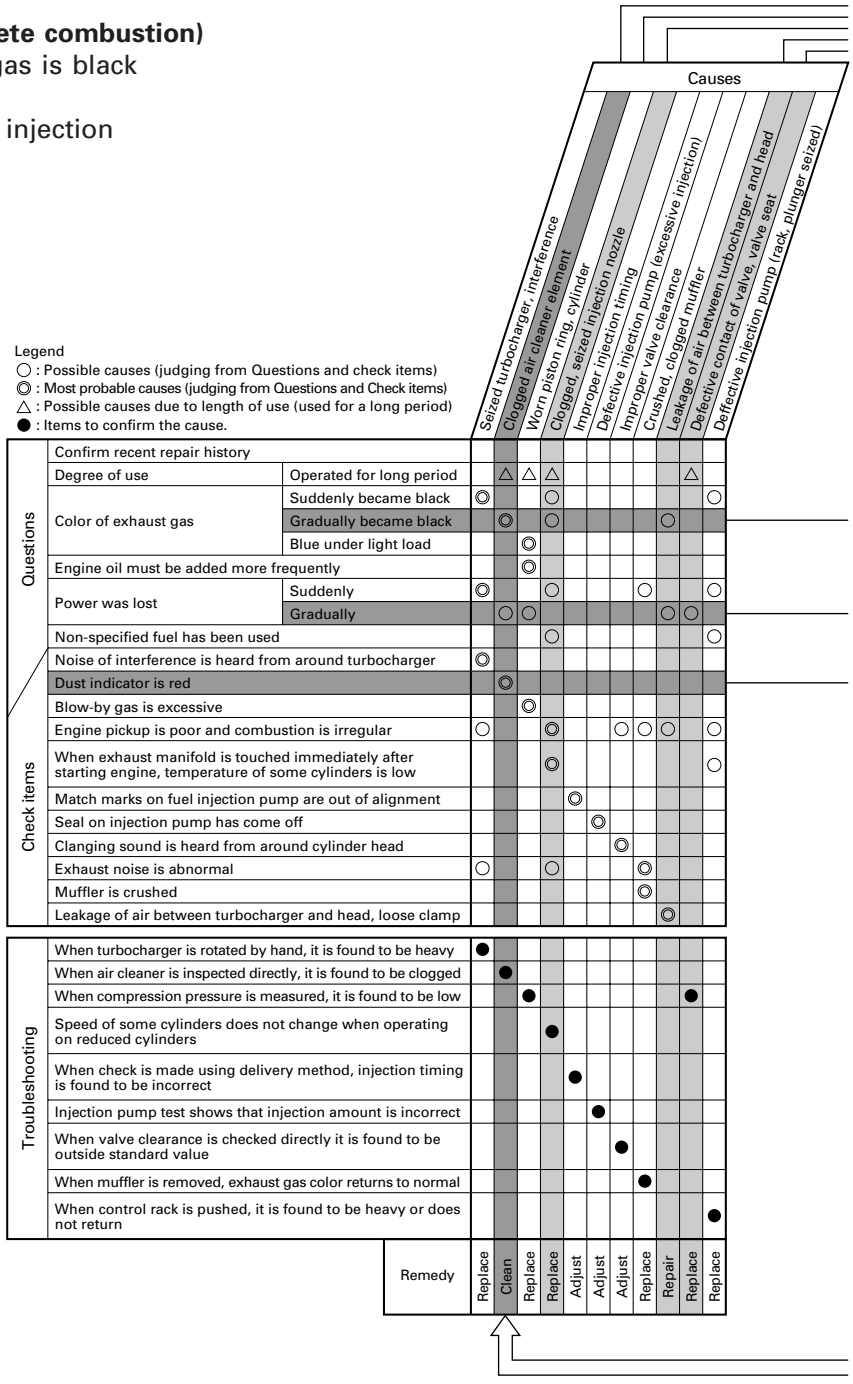
1) A total of 9 failure codes can be saved in memory.
2) The data that is saved to memory is as follows: (1) Failure code
   (2) Time elapsed since failure (up to 1000 hours)
3) The failures are saved in the order that they occur. If a failure code already exists in the memory, the repeat failure code is not saved.
4) If there are already 9 items in memory, and a 10th failure occurs, the oldest item is deleted and the new item is saved.

★ It is possible to display the failure code and time elapsed since failure for items saved in memory by operating the main monitor set switch.



- **Example of troubleshooting when exhaust gas is black**
  Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [Dust indicator is red].
  If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

S-7 Exhaust gas is black (incomplete combustion)
General causes why exhaust gas is black
- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel



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S-3 Engine does not pick up smoothly (follow-up is poor)

General causes why engine does not pick up smoothly
- Insufficient intake of air
- Insufficient supply of fuel
- Defective condirion of fuel spray
- Improper fuel used
- Abnormality in fuel control sysytem
- Defective HPI sensor
- Defective HPI actuator
- Normal output is not applied
  → See Troubleshooting S-6

			Causes										
			Clogged air cleaner element	Seized turbocharger	Defective contact of valve and valve seal	Improper valve clearance	Worn piston ring, cylinder liner	Clogged fuel tank cap	Loose piping, fuel filter, entry of air	Clogged fuel filter, strainer	Defective fuel pump	Defective injector	Failure boost pressure sensor
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period	△							△			
	Engine pick-up suddenly became worse			◎	○			○	◎			○	
	Non-specified fuel is being used									◎	◎	◎	
	Replacement of filters has not been carried out according to Operation Manual		◎							◎		○	
	Engine oil must be added more frequently						◎						
Check items	Dust indicator is red		◎										
	Air breather hole in fuel tank cap is clogged							◎					
	Rust and water are found when fuel tank is drained									◎	◎		
	There is leakage from fuel piping								◎				
	When engine is cranked with starting motor, and	Fuel pump outlet port coupler is pushed, almost no fuel comes out								◎	◎		
		Fuel pump outlet port coupler is pushed, air comes out together with fuel						◎	◎				
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎	
	Color of exhaust gas	Blue under light load					◎						
		Black	◎	◎	○							◎	◎
	Clanging sound is heard from around cylinder head					◎							
	Noise of interference is heard from around turbocharger			◎									
	High idling speed under no load is normal, but speed suddenly drops when load is applied									◎	◎		◎
	There is hunting from engine (rotation is irregular)									○	◎	○	
	Blow-by gas is excessive						◎						
Troubleshooting	Inspect air cleaner element directly		●										
	When turbocharger is rotated by hand, it is found to be heavy			●									
	When compression pressure is measured, it is found to be low				●		●						
	Inspect valve clearance directly					●							
	When pressure at outlet port of fuel pump is measured, it is found to vary							●	●				
	Inspect fuel filter, strainer directly									●			
	When negative pressure at inlet port of fuel pump is measured, it is found to be high									●			
	When pressure at outlet port of fuel pump is measured, it is found to be low										●		
	When temperature of injector of each cylinder is measured, there are some cylinders that are low											●	
	When intake air pressure (boost pressure) is measured, it is found to be normal												●
	Inspect actuator directly (Resistance and filter for clogging)												
	Inspect sensor directly (Output voltage and resistance)												
	Inspect for air leakage												
	Remedy		Clean	Correct	Replace	Correct	Replace	Correct	Clean	Clean	Replace	Replace	Replace

S-8 Oil consumption is excessive (or exhaust smoke is blue)

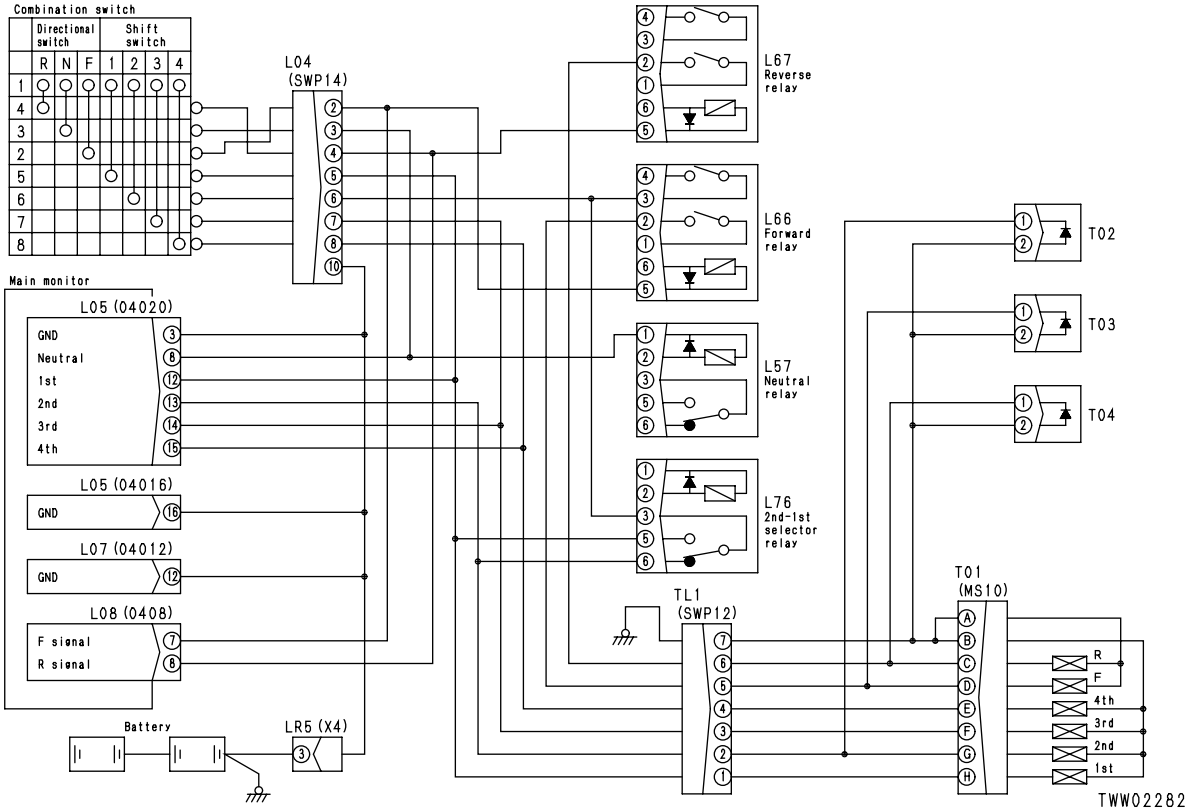
★ To prevent the oil from leaking up or down in the turbocharger, do not run the engine at idling for more than 20 minutes continuously (both low and high idling).

General causes why oil consumption is excessive
- Abnormal combustion of oil
- External leakage of oil
- Wear of parts in lubrication system

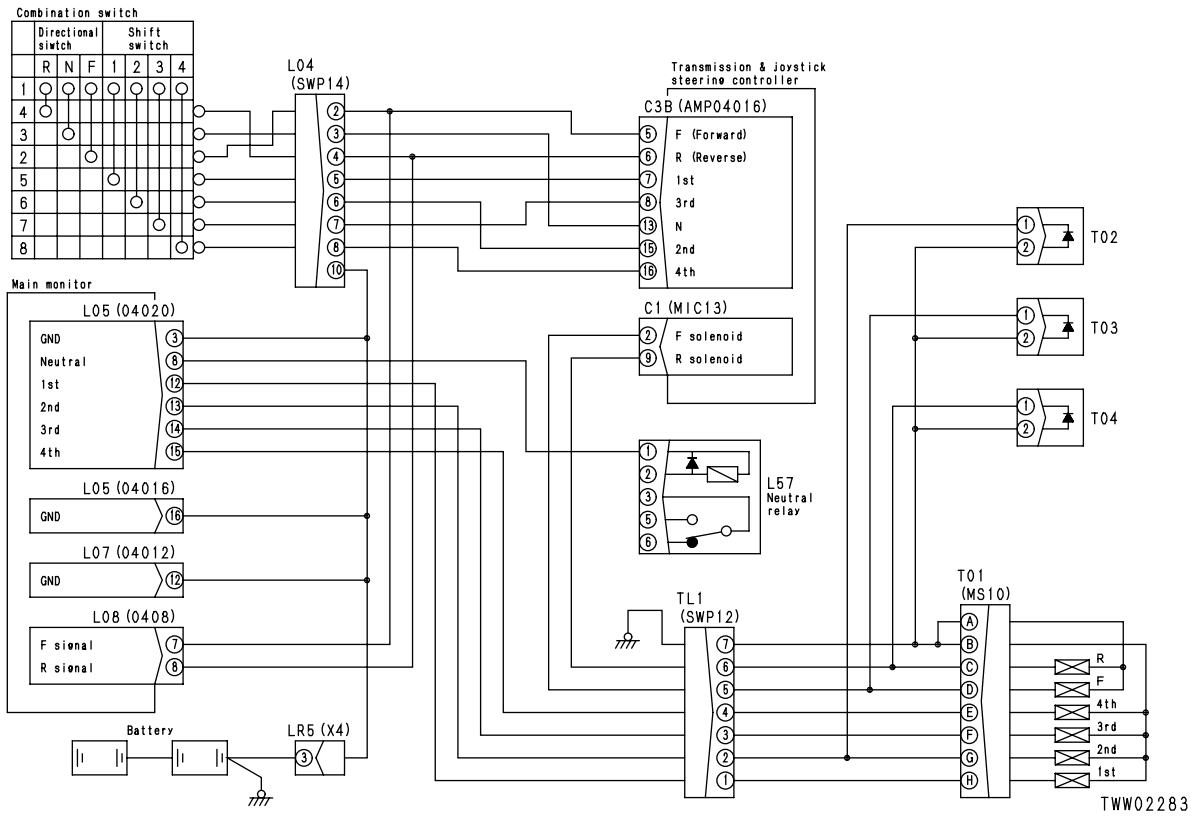
			Causes															
			Dust sucked in from intake system	Turbocharger	Worn seal at turbine end	Worn seal at blower end	Worn, damaged valve (stem, guide, seal)	Worn piston ring, cylinder liner	Broken piston ring	Clogged breather or breather hose	Worn, broken rear oil seal	Too much engine oil added	Leakage from oil drain plug	Broken oil cooler	Leakage from oil filter or oil cooler	Leakage from oil piping	Leakage from oil pan or cylinder head
Questions / Check items	Confirm recent repair history																	
	Degree of use of machine	Operated for long period		△		△	△	△										
	Oil consumption suddenly increased								◎			◎		○				
	Engine oil must be added more frequently							◎						○				
	Engine oil becomes contaminated quickly							◎	○	○								
	Oil level is above H level on gauge											◎						
	Outside of engine is dirty with oil												◎		◎	◎	◎	
	There are loose piping clamps in intake system		◎															
	Inside of turbocharger intake pipe is dirty with oil					◎	○											
	Inside of exhaust pipe is dirty with oil				◎													
	There is oil in engine cooling water													◎				
	Oil level in clutch chamber or damper chamber rises										◎							
	Exhaust smoke is blue under light load							◎	◎									
	Amount of blow-by gas	Excessive				○	○	◎	◎									
		None								◎								
Troubleshooting	When intake manifold is removed, dust is found inside		●															
	Excessive play of turbocharger shaft			●		●												
	When intake manifold is removed, inside is found to be dirty with oil						●											
	When compression pressure is measured, it is found to be low							●	●									
	Inspect breather element directly									●								
	Inspect rear oil seal directly										●							
	There is external leakage of oil from engine												●		●	●	●	
	Pressure-tightness test of oil cooler shows there is leakage													●				
	Remedy		Correct	Replace		Replace	Correct	Replace	Replace	Clean	Correct	Correct	Correct	Replace	Correct	Correct	Correct	

M-4 Related electrical circuit diagram

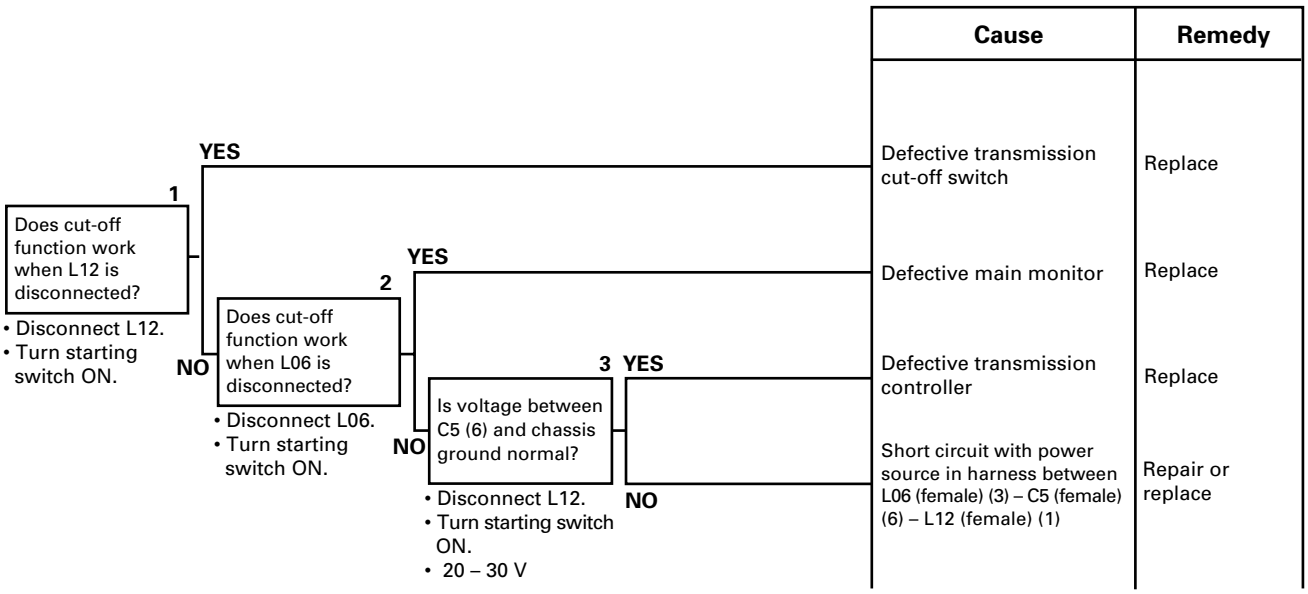
Standard specification



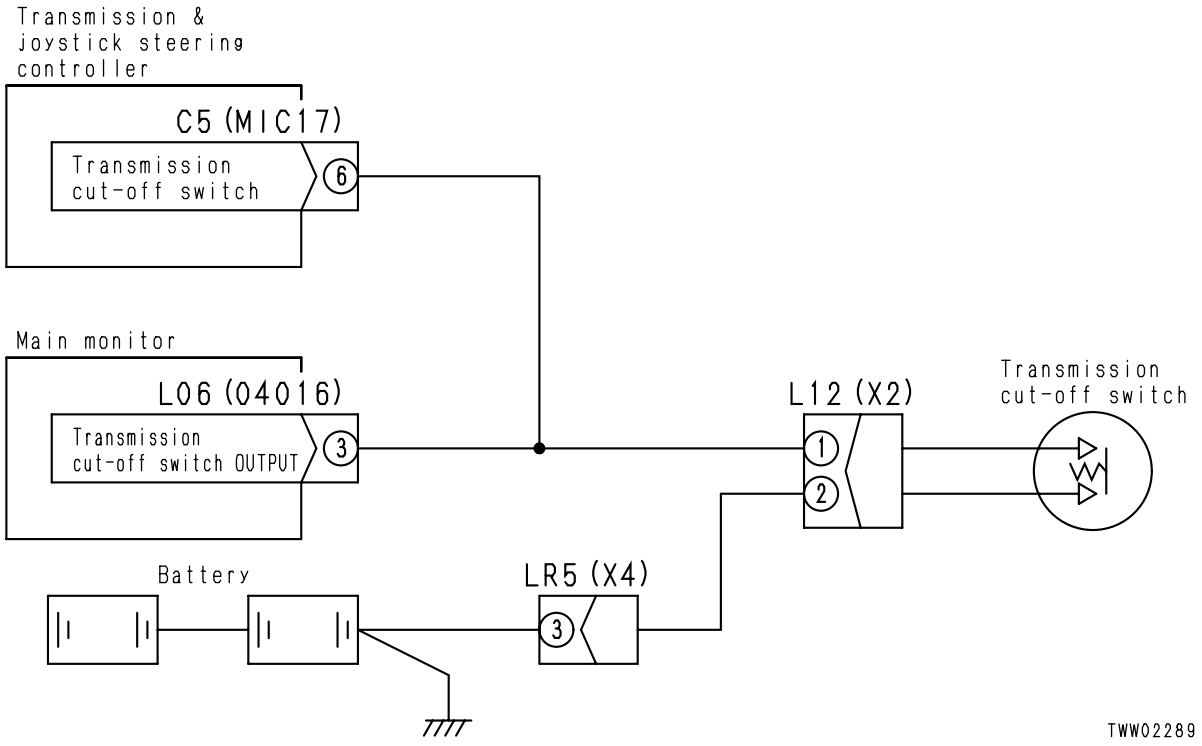
Auto-shift specification



e) Monitor display lights up (transmission cut-off switch turned ON), but cut-off function is not actuated



M-10 Related electrical circuit diagram



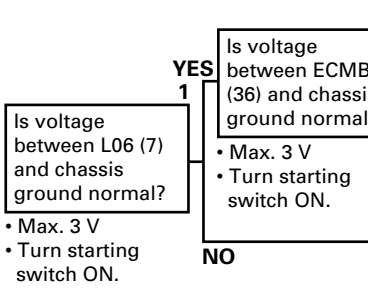
M-18 Abnormality in low idling select system

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) Display does not change when switch is pressed

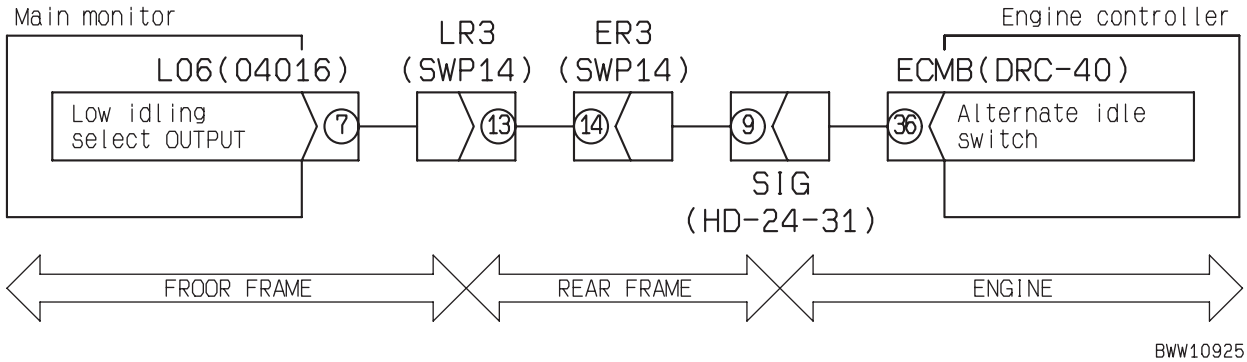
Cause	Remedy
Defective main monitor	Replace

b) Monitor display lights up but low idling select function does not work

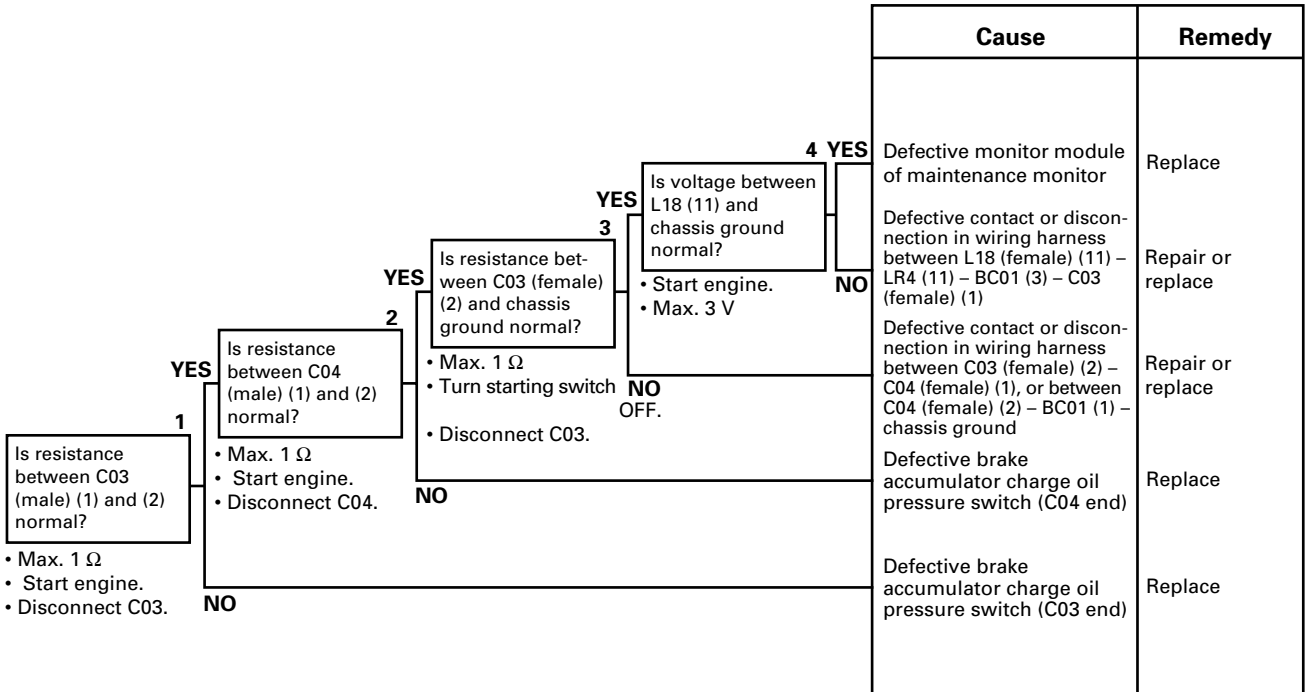


Cause	Remedy
See Troubleshooting (EA mode) of engine controller	—
Defective contact or disconnection in wiring harness between L06 (female) (7) and ECMB (female) (36)	Repair or replace
Defective main monitor	Replace

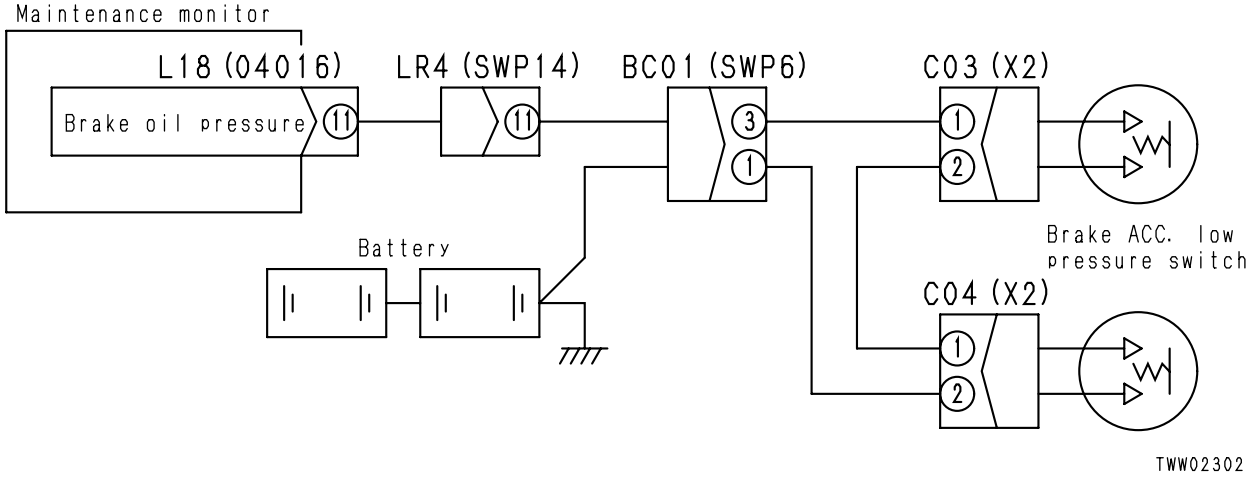
M-18 Related electrical circuit diagram



c) Brake oil pressure display flashes
(Check that the brake oil pressure is correct.)



K-5 c) Related electrical circuit diagram



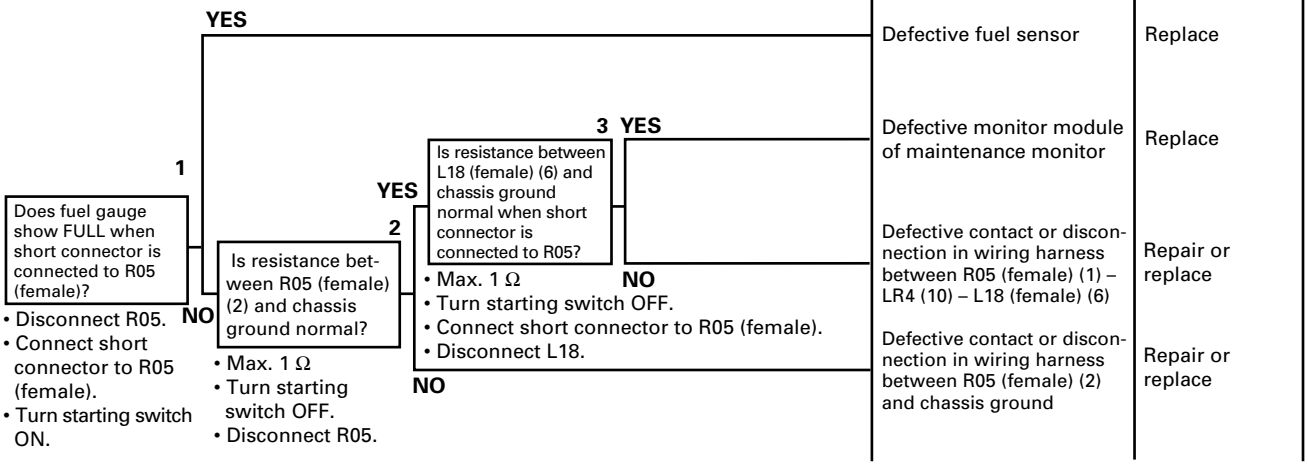
K-14 Abnormality in gauge items

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

a) Abnormality in fuel gauge

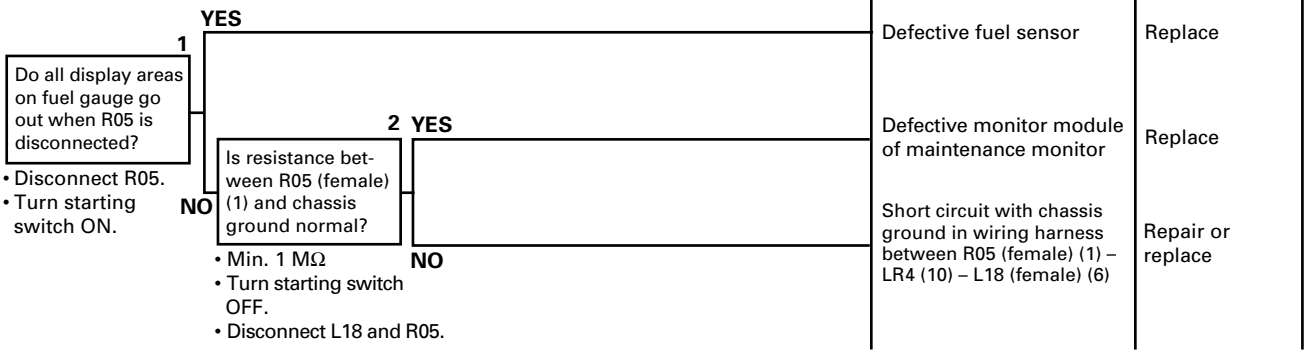
★ Before carrying out troubleshooting, check the fuel level again.
(Check that the fuel level is correct.)

(1) Little or nothing is displayed in display area



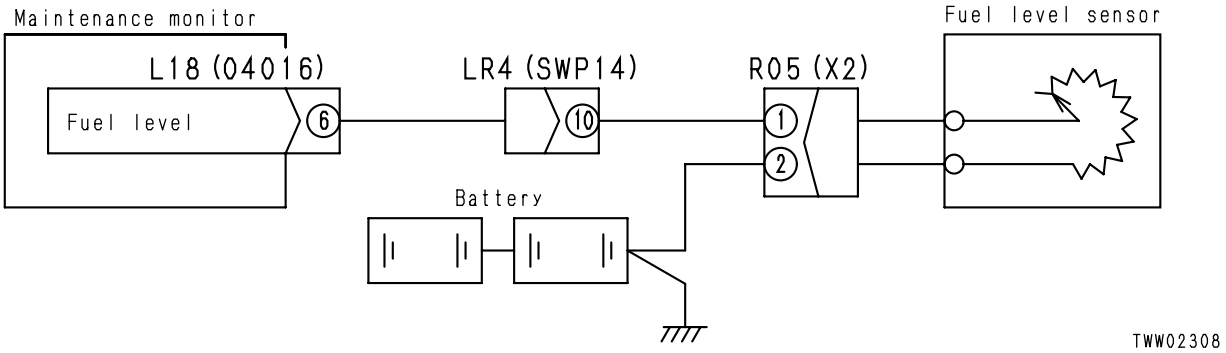
Cause	Remedy
Defective fuel sensor	Replace
Defective monitor module of maintenance monitor	Replace
Defective contact or disconnection in wiring harness between R05 (female) (1) – LR4 (10) – L18 (female) (6)	Repair or replace
Defective contact or disconnection in wiring harness between R05 (female) (2) and chassis ground	Repair or replace

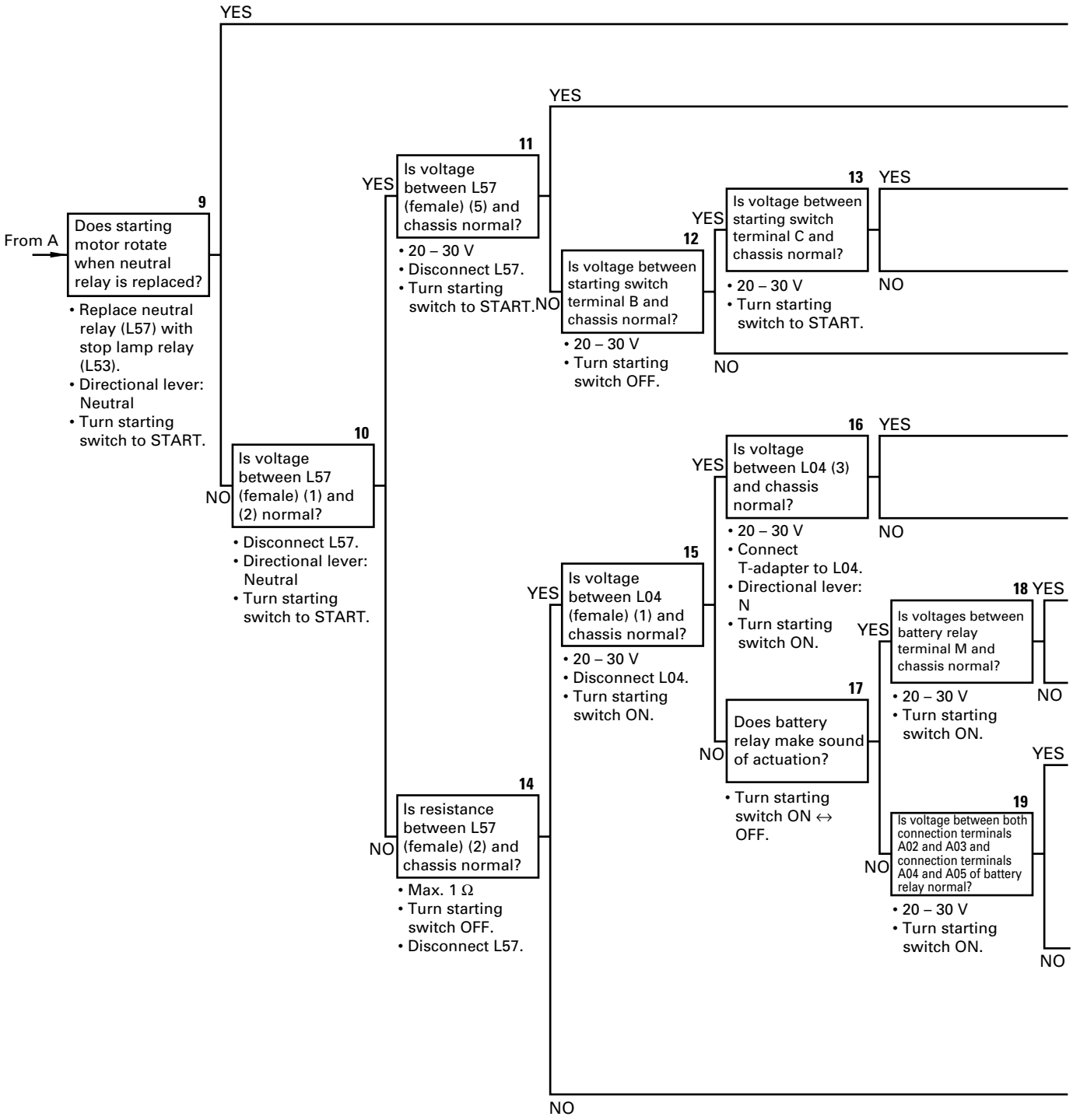
(2) Display always shows FULL and does not move



Cause	Remedy
Defective fuel sensor	Replace
Defective monitor module of maintenance monitor	Replace
Short circuit with chassis ground in wiring harness between R05 (female) (1) – LR4 (10) – L18 (female) (6)	Repair or replace

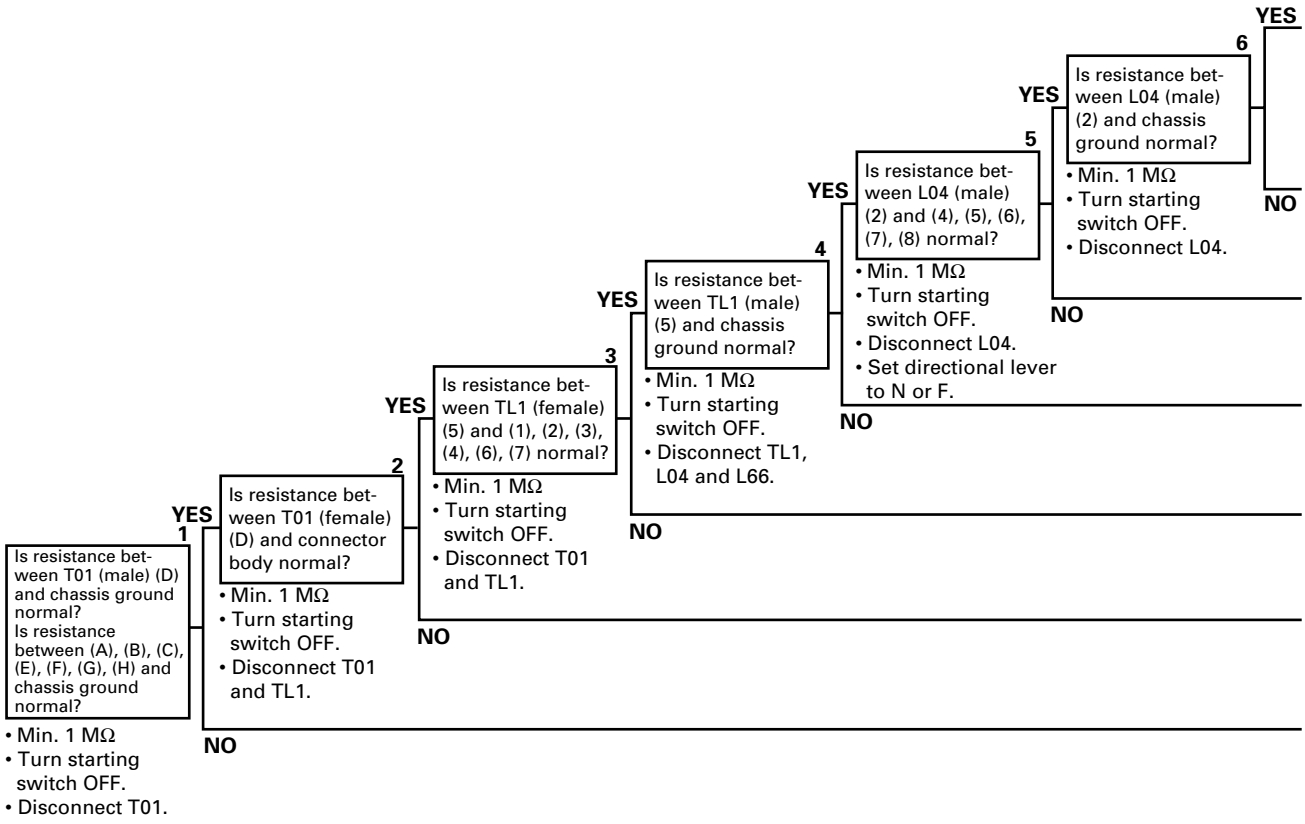
K-14 a) Related electrical circuit diagram



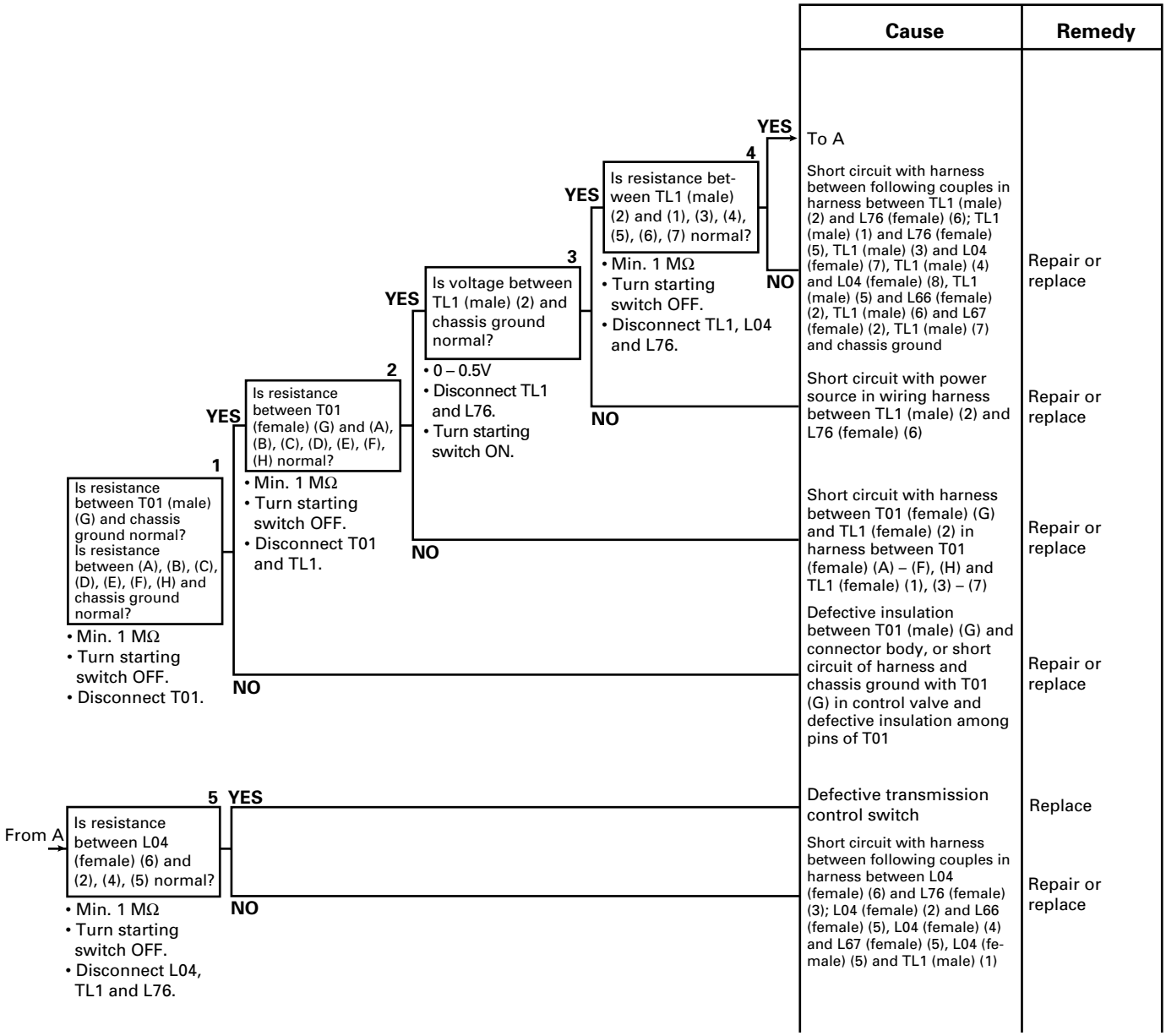

From A
9
Does starting motor rotate when neutral relay is replaced?
• Replace neutral relay (L57) with stop lamp relay (L53).
• Directional lever: Neutral
• Turn starting switch to START.
YES
NO
10
Is voltage between L57 (female) (1) and (2) normal?
• Disconnect L57.
• Directional lever: Neutral
• Turn starting switch to START.
YES
11
Is voltage between L57 (female) (5) and chassis normal?
• 20 – 30 V
• Disconnect L57.
• Turn starting switch to START.
NO
14
Is resistance between L57 (female) (2) and chassis normal?
• Max. 1 Ω
• Turn starting switch OFF.
• Disconnect L57.
YES
NO
12
Is voltage between starting switch terminal B and chassis normal?
• 20 – 30 V
• Turn starting switch OFF.
YES
NO
13
Is voltage between starting switch terminal C and chassis normal?
• 20 – 30 V
• Turn starting switch to START.
YES
NO
15
Is voltage between L04 (female) (1) and chassis normal?
• 20 – 30 V
• Disconnect L04.
• Turn starting switch ON.
YES
NO
16
Is voltage between L04 (3) and chassis normal?
• 20 – 30 V
• Connect T-adapter to L04.
• Directional lever: N
• Turn starting switch ON.
YES
NO
17
Does battery relay make sound of actuation?
• Turn starting switch ON ↔ OFF.
YES
NO
18
Is voltages between battery relay terminal M and chassis normal?
• 20 – 30 V
• Turn starting switch ON.
YES
NO
19
Is voltage between both connection terminals A02 and A03 and connection terminals A04 and A05 of battery relay normal?
• 20 – 30 V
• Turn starting switch ON.
YES
NO

d) Short circuit to chassis ground in directional solenoid circuit

1) Short circuit to chassis ground in travel FORWARD circuit

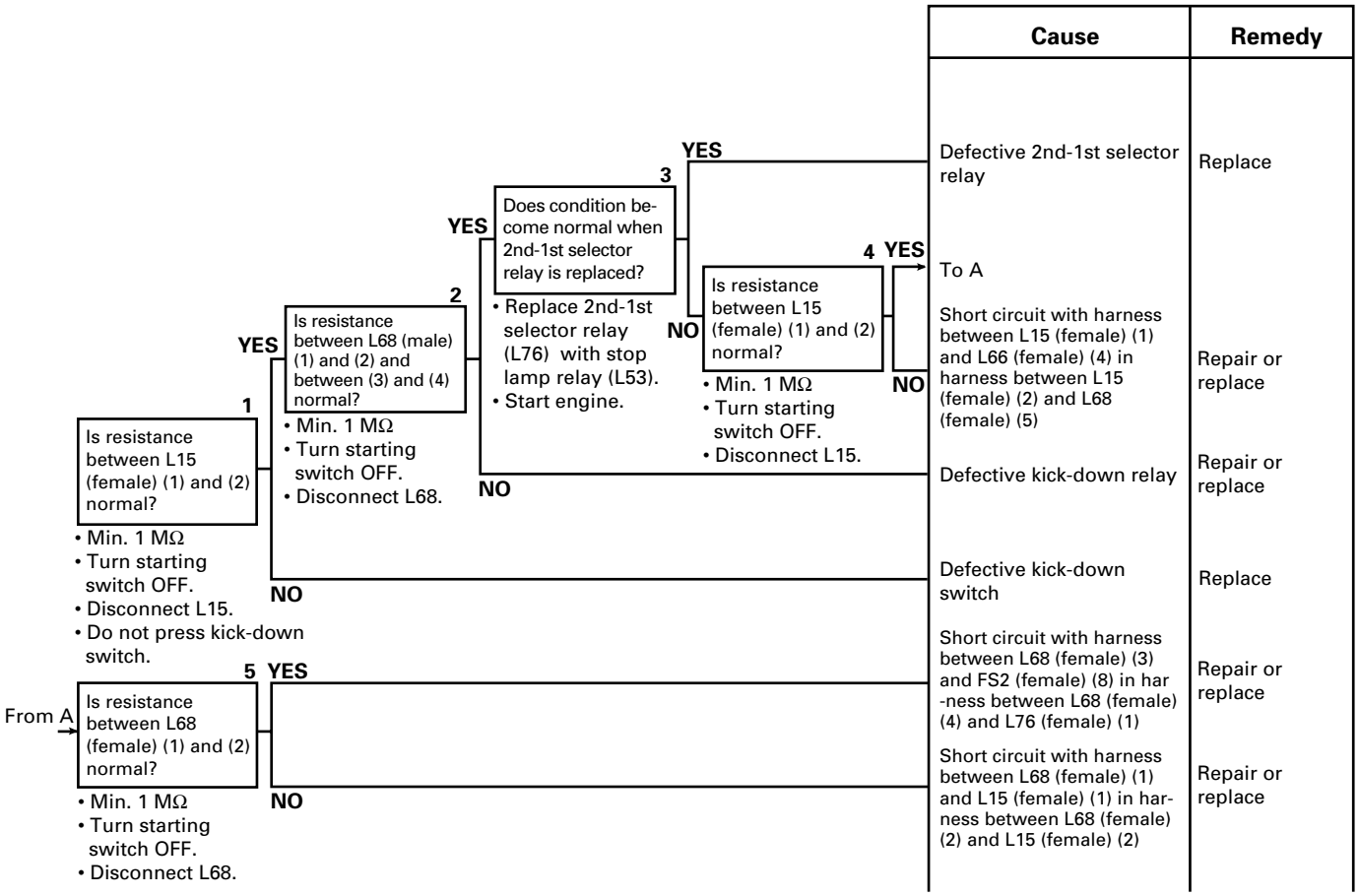


2) Short circuit to chassis ground in 2nd solenoid circuit



E-11 Kick-down swich works even when traveling FORWARD in 2nd

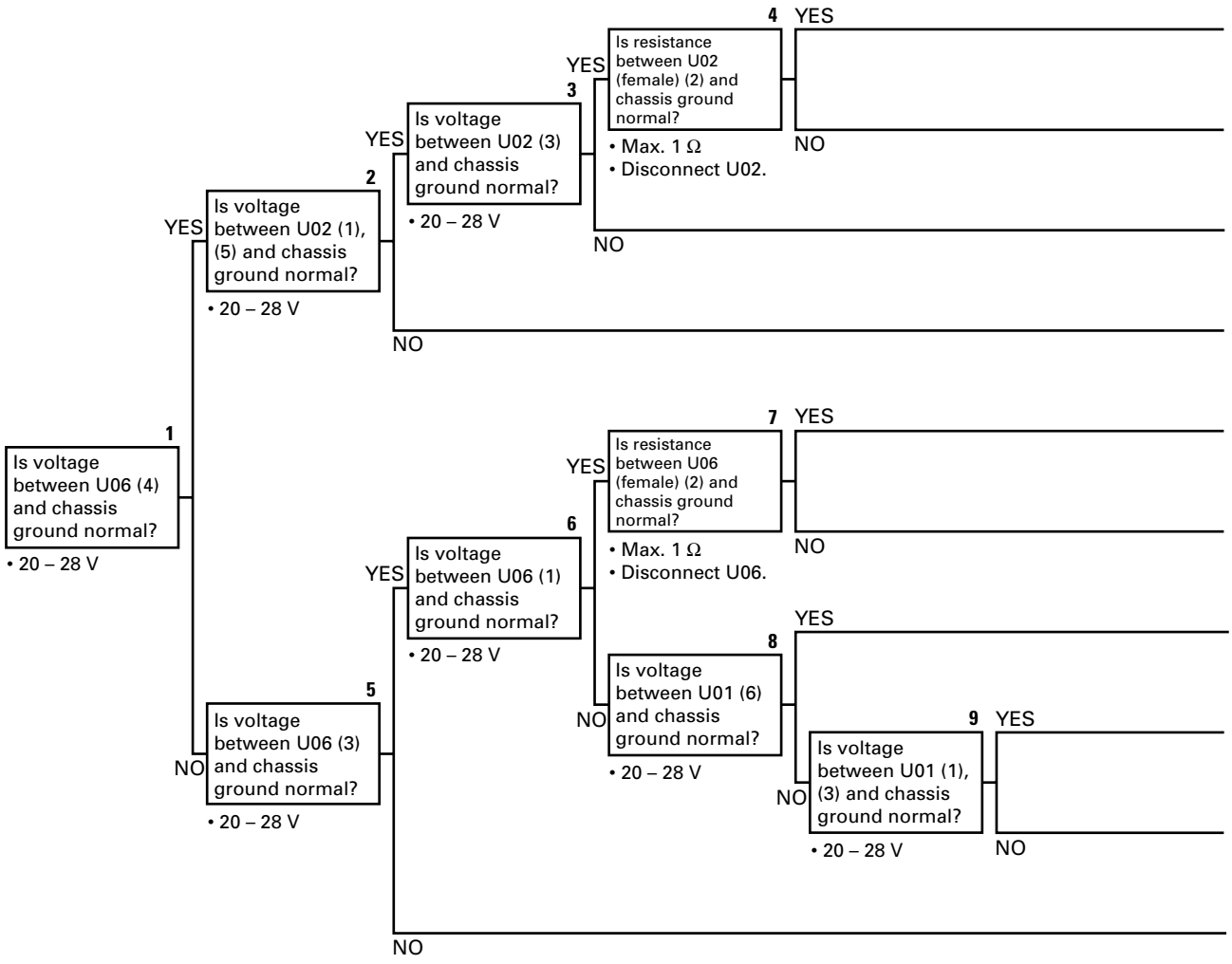
★ Before disconnecting or connecting connectors, surely turn starting switch OFF.
★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



E-15 Defective operation of solenoid for power maximizing function

a) Inspection of timer 1 and no-load relay system

★ Lower the work equipment to the ground in the digging position and set the transmission in the forward 1st gear speed for inspection. (Do not perform digging operation.)



H-7 Turning, response of steering is poor

Ask the operator the following questions.

- Did the problem suddenly start?
  Yes → Related equipment broken
  Was there any abnormal noise when this happened? Where did the noise come from?
- Was there any symptom of difficulty in steering?
  Yes → Wear of related equipment, defective seal

Checks before troubleshooting

- Is the oil level in the hydraulic tank correct? Is the type of oil correct?

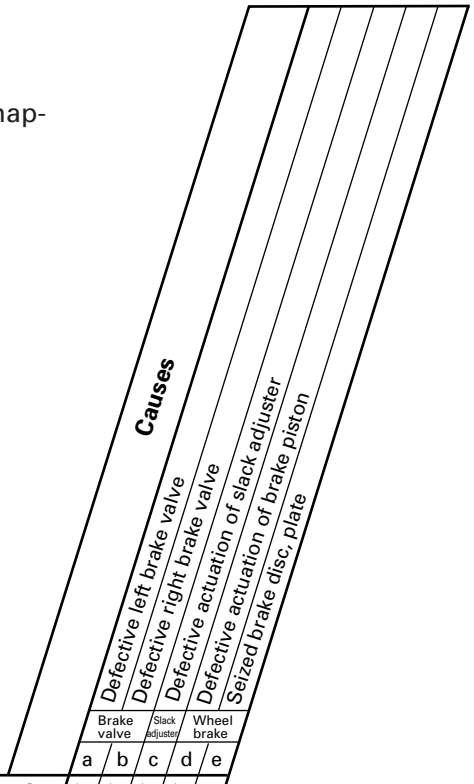
No.	Problems \ Causes / Remedy		Hydraulic pump					PPC relief valve	Orbit-roll	Stop valve	Steering valve				Cylinder
			a	b	c	d	e	f	g	h	i	j	k	l	m
			Defective PTO	Air sucked in at suction end of pump	Defective PPC pump	Defective steering pump	Defective switch pump	Defective PPC reliefe valve	Defective orbit-roll	Defective actuation of stop valve	Defective actuation of demand spool	Defective main relief valve	Defective actuation of steering spool	Defective safety-suction valve	Defective piston seal
			△ ×	△	×	×	×	△ ×	△ ×	△ ×	△ ×	△ ×	△ ×	×	△ ×
1	Turning, response of steering is poor in both directions(left and right)		○	○	○	○	○	○	○		○	○	○		○
2	Turning, response of steering is poor in one direction (left or right)				○					○				○	
3	Steering wheel is heavy in both directions (left and right)							○					○		
4	Steering wheel is heavy in one direction (left or right)								○						
5	Work equipment moves normally							○	○	○		○	○	○	○
6	Work equipment speed is low		○	○	○		○	○							
7	Abnormal noise comes from around PTO		○												
8	Abnormal noise comes from around steering pump or hydraulic tank			○		○									
9	Abnormal noise comes from around switch pump or hydraulic tank				○	○									
10	When steering relief pressure is measured	Oil pressure is low or zero in both directions (left and right)	○	○	○	○	○	○	○		○	○			○
11		Oil pressure is low or zero in one direction (left or right)								○				○	
12	Measured Orbit-roll output pressure is low				○			○	○						
13	Measured PPC valve (Orbit-roll) basic pressure is low				○			○							

★ There is close connection between the steering circuit and the work equipment circuit, so if any abnormality is felt in the steering, check the operation of the work equipment, also.

H-14 Wheel brakes are not released or brakes drag

Ask the operator the following questions.
- Did the problem suddenly start?
  → Related equipment broken
  Was there any abnormal noise when this happened? Where did the noise come from?

Checks before troubleshooting
- Does the brake pedal come back fully?
- Is the parking brake still applied?



No.	Problems \ Remedy	△ ×	△ ×	△ ×	△ ×	×
1	Machine cannot travel at all	○	○			
2	Machine can travel a small amount			○	○	○
3	When remaining pressure is released from brake accumulator circuit with left brake pedal only, break is released		○			
4	When remaining pressure is released from brake accumulator circuit with right brake pedal only, break is released	○				
5	When air bleed plug in wheel portion is loosened, oil flows out and brake is released			○		
6	When air bleed plug is loosened, a large amount of oil flows out	○	○			
7	When wear of brake disc is measured and brake pedal is released, piston returns					○
8	When wear of brake disc is measured and brake pedal is released, piston does not return			○	○	

H-25 Bucket is slow or lacks power

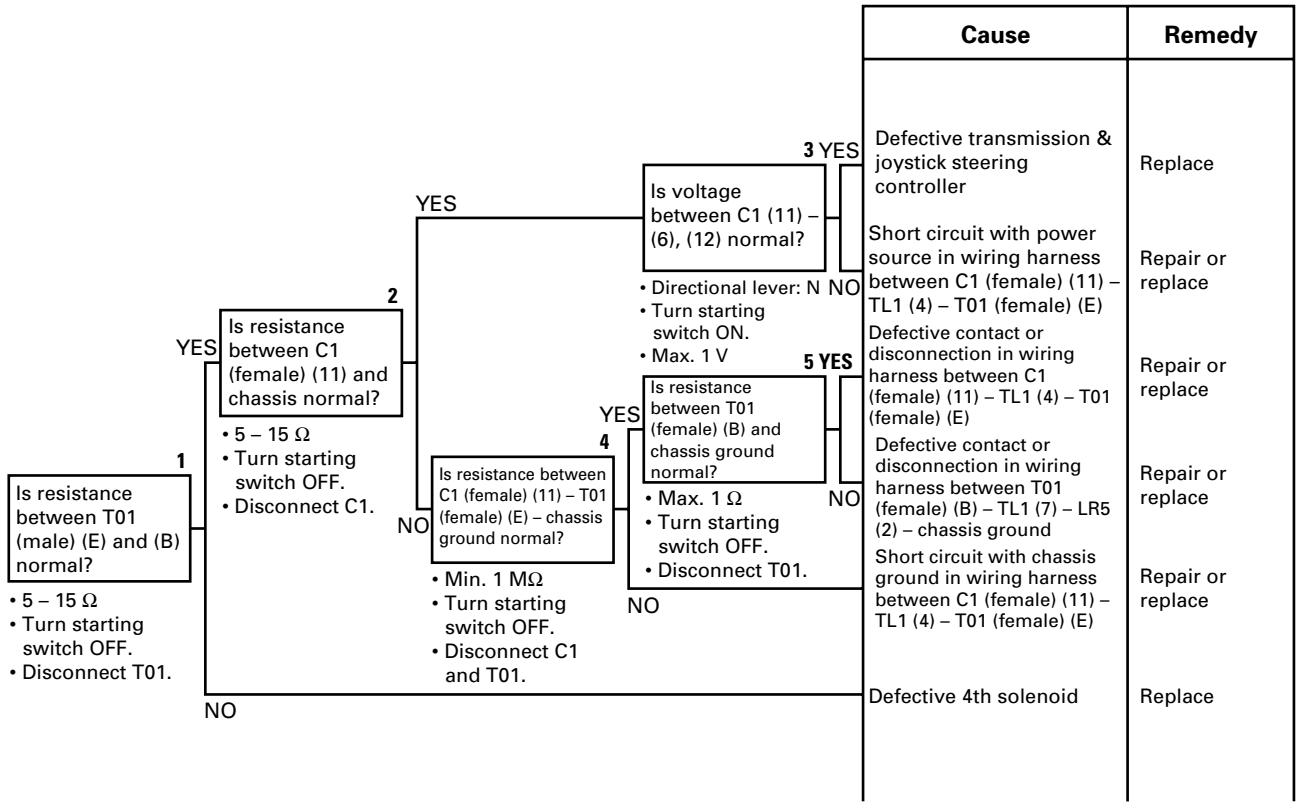
Ask the operator the following questions.
- Did the problem suddenly start?
  Yes = Related equipment broken
- Was there any abnormal noise when this happened? Where did the noise come from?
- Did the problem gradually appear?
  Yes = Wear of related parts, defective seal

No.	Problems		Remedy / Causes: Defective PPC valve (PPC valve a)	Defective actuation of bucket spool (Control valve b)	Defective actuation of load check valve (Control valve c)	Defective safety-suction valve (Control valve d)	Defective cylinder seal (Cylinder e)	Defective control lever linkage (Others f)
			△ ×	△ ×	△ ×	×	△ ×	A
1	Does not move in both directions (TILT and DUMP)			○	○		○	○
2	Does not move in one direction (TILT or DUMP)		○			○		
3	When bucket relief pressure is measured	Oil pressure is low in both directions (TILT and DUMP)		○	○		○	○
4		Oil pressure is low in one direction (TILT or DUMP)	○			○		
5	When PPC valve output pressure is measured, oil pressure is found to be low		○					○
6	When hydraulic drift of bucket is measured, it is found to be excessive						○	
7	When operating effort of bucket control lever is measured, lever is found to be heavy		○					○
8	When travel of bucket control lever is measured, it is found to be short							○

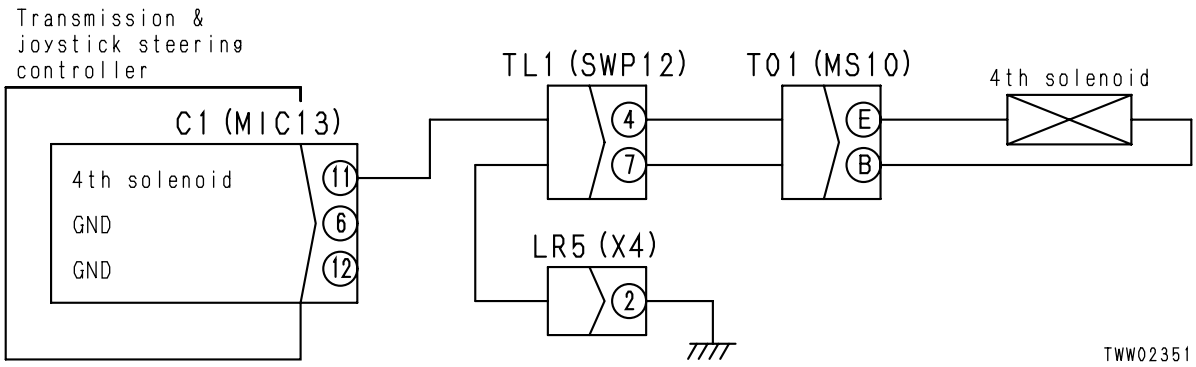
Failure code	Abnormal system	Nature of abnormality
23	Abnormality in engine speed sensor system	1) Defective engine speed sensor 2) Defective adjustment of engine speed sensor mount 3) Short circuit with ground, defective contact, disconnection in wiring harness between transmission controller C4 (female) (2) and EC3A (5) 4) Defective contact or disconnection in wiring harness between transmission controller C4 (female) (9) – LR5 (3) – chassis ground 5) Defective transmission controller

T-7 Failure code [17] (Short circuit, disconnection, short circuit with power source in 4th solenoid) is displayed

★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the error code is no longer displayed on the monitor display, the problem has been removed.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

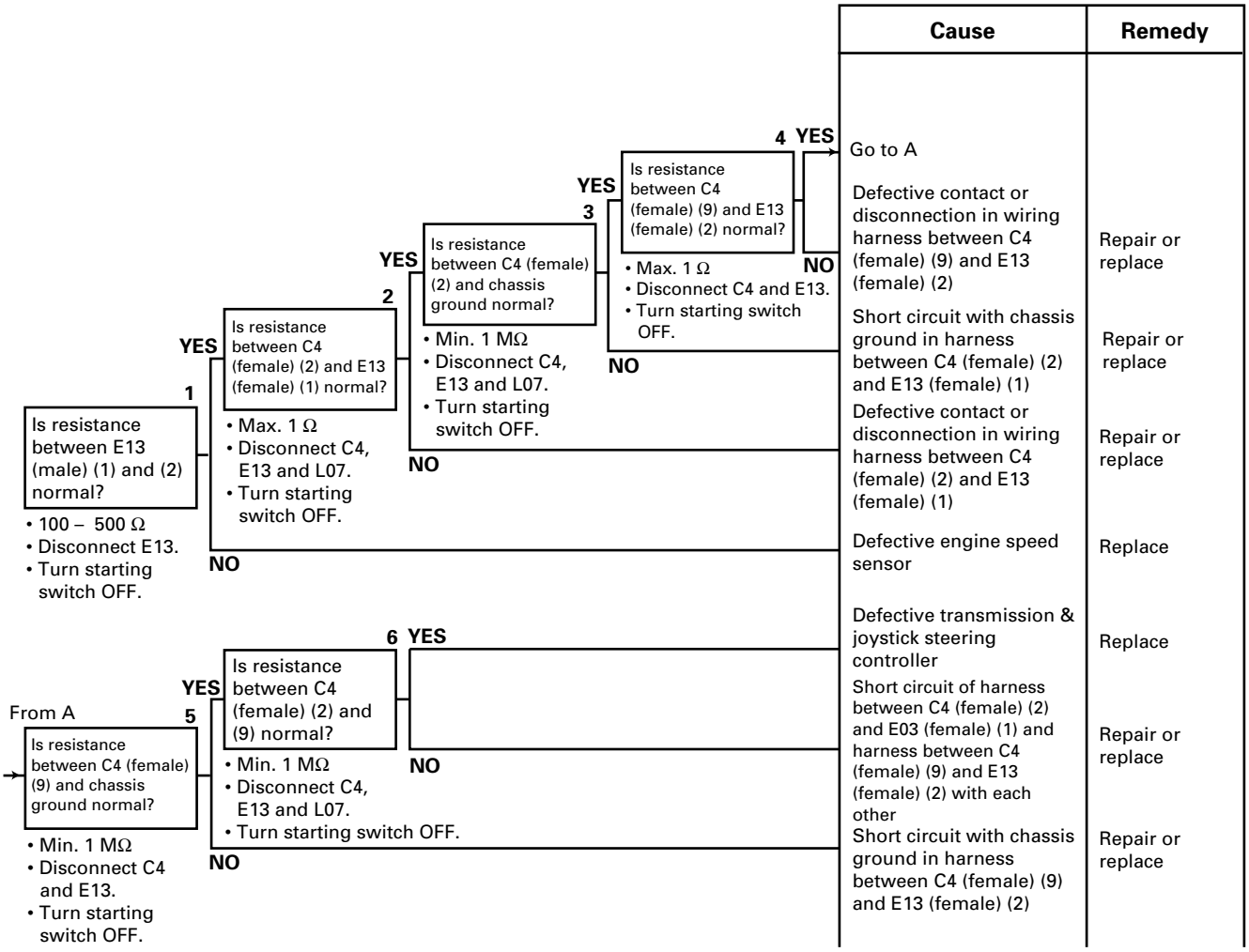


T-7 Related electrical circuit diagram

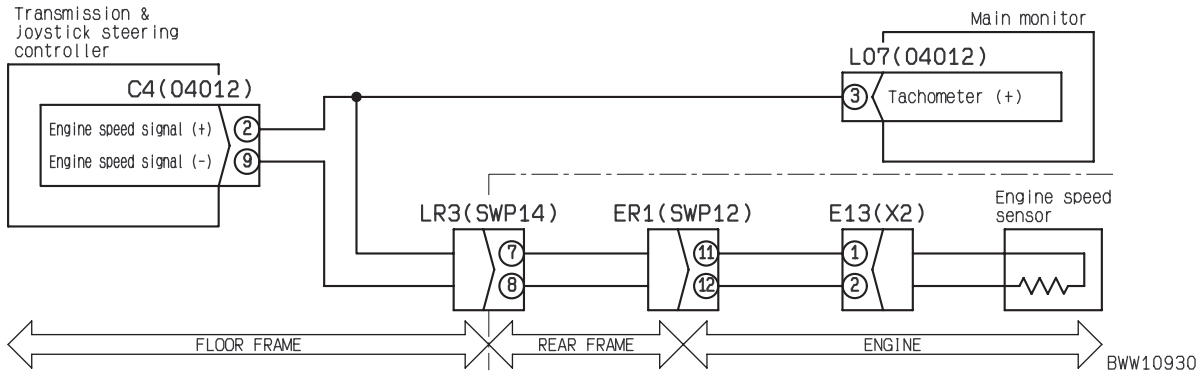


T-12 Failure code [23] (Short circuit, disconnection in engine speed sensor system) is displayed

★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the failure code is no longer displayed on the monitor display, the problem has been removed.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



T-12 Related electrical circuit diagram



JUDGEMENT TABLE FOR AJSS (ADVANCED JOYSTICK STEERING SYSTEM) CONTROL SYSTEM

	Location of failure / Failure code / Failure mode	Self-diagnosis display (Display of abnormality)							
		Disconnection or short circuit with chassis ground in caution buzzer relay system	Disconnection or short circuit with chassis ground in steering lever angle sensor system	Deviation of steering lever angle sensor and frame angle sensor signals	Disconnection or short circuit with chassis ground in frame angle sensor system	Disconnection or short circuit with chassis ground in steering lever lock pressure switch system	Disconnection or short circuit with chassis ground in steering neutral interlock relay system	Disconnection, short circuit with chassis ground, or short circuit with power source in steering main pressure control EPC solenoid system	Diagnosis code when failure code is not displayed
		56	57	58	59	60	62	63	
1	Engine does not start						○		E-1
2	Steering speed is heightened							○	—
3	Steering speed is lowered							○	H-8, H-11
4	Response of steering system is heightened							○	—
5	Response of steering system is lowered							○	H-8, H-11
6	Steering speeds in both directions are different		○	○	○				—
7	Machine is steered suddenly after engine is started						○		—
8	Engine can be started while machine is steered						○		—
9	Caution buzzer does not sound or keeps sounding	○							M-13
	Diagnosis code when failure code is displayed	J-1	J-2	J-3	J-4	J-5	J-6	J-7	

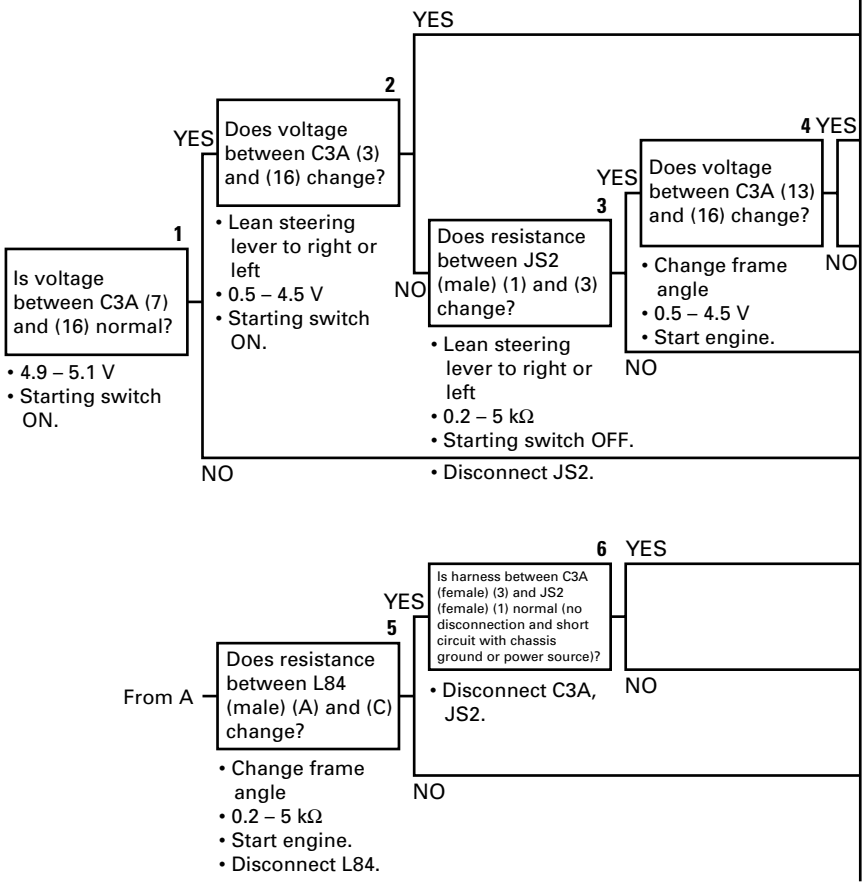
J-3 Error code [58] (Deviation of steering lever angle sensor and frame angle sensor signals) is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the error code is no longer displayed on the monitor display, the problem has been removed.**

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

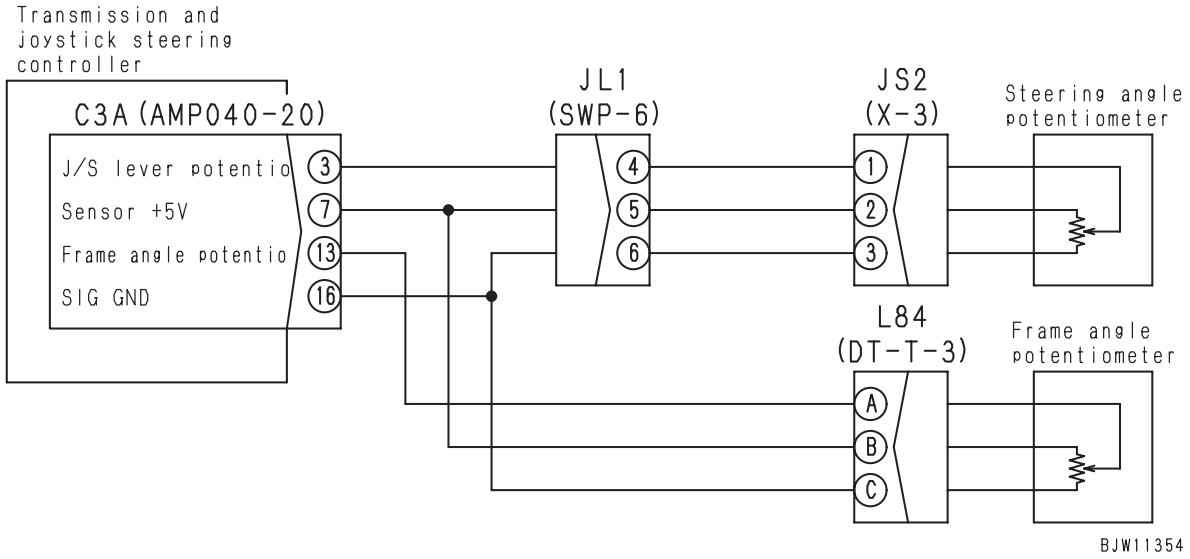
★ When the joystick steering lever is not being used, leave it at the neutral position.

★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Improper installation of steering lever angle sensor (Deviation of neutral position)	Replace or adjust neutral position
Improper installation of frame angle sensor (Deviation of neutral position)	Replace or adjust neutral position
Go to A.	
Defective steerintg lever angle sensor	Replace
Defective T/M and J/S controller	Replace
Disconnection, defective contact, short circuit with chassis ground, or short circuit with power source in wiring harness between C3A (female) (13) – L84 (female) (A)	Repair or replace
Disconnection, defective contact, short circuit with chassis ground, or short circuit with power source in wiring harness between C3A (female) (3) – JS2 (female) (1)	Repair or replace
Defective frame angle sensor	Replace

J-3 Related electrical circuit diagram



★ This section gives an outline of the troubleshooting procedures for the electrical systems related to the engine proper and the engine controller (for construction equipment).
When carrying out troubleshooting of the electrical system with the engine mounted on the machine, use this section and the shop manual for the machine.

User code	System with abnormality	Nature of abnormality	Condition when normal
432	Idling validation process error	• Throttle sensor signal and idling validation ON signal, OFF signal do not match ECMB (12): Idling OFF signal ECMB (13): Idling ON signal	• Resistance of idling switch Between L14(1) – (2): Max. 125 Ω (pedal released) Between L14(1) – (3): Max. 125 Ω (pedal depressed)
441	Abnormality in battery voltage low level	• Abnormality has occurred in controller power source circuit ECMB (3)(4)(5): 12 V or less detected	• Voltage of controller power source Between ECMB (3)(4)(5) – ECMA (7)(8): 17.3 – 34.7 V (When starting switch is OFF)
442	Abnormality in battery voltage high level	• Abnormality has occurred in controller power source circuit ECMB (3)(4)(5): 38 V or less detected	• Voltage of controller power source Between ECMB (3)(4)(5) – ECMA (7)(8): 17.3 – 34.7 V (When starting switch is OFF)
451	Abnormality in fuel rail pressure sensor system high level	• Abnormality has occurred in fuel rail pressure sensor circuit ECMA (31): 4.78 V or more detected	• Voltage of fuel rail pressure sensor Between ECMA (5) – (18) (power source): 4.75 – 5.25 V Between ECMA (31) – (18) (signal): 0.42 – 0.58 V (engine stopped)
452	Abnormality in fuel rail pressure sensor system low level	• Abnormality has occurred in fuel rail pressure sensor circuit ECMA (31): 0.15 V or less detected	• Voltage of fuel rail pressure sensor Between ECMA (5) – (18) (power source): 4.75 – 5.25 V Between ECMA (31) – (18) (signal): 0.42 – 0.58 V (engine stopped)
455	Abnormality in fuel rail actuator system current	• Abnormality has occurred in fuel rail actuator circuit Between ECMA (1) – (20) (reference value): 0.40 ± 0.35 A (engine stopped)	• Resistance of fuel rail actuator Between RAIL (A) – (C): 7 – 9 Ω
467	Abnormality in timing rail actuator control	• Excessive difference between timing rail command fuel value and actual timing fuel, does not reach target value	—
468	Abnormality in fuel rail actuator control	• Excessive difference between fuel rail command injection amount value and actual injection amount, does not reach target value	—
514	Abnormality in fuel rail actuator	• Excessive difference between fuel rail command injection amount value and actual injection amount Fuel rail judgment value (reference): Difference ±600 mm^3/st or more for ±50 msec or difference ±250 mm^3/st or more for ± 200 msec	—
527	Abnormality in dual output solenoid A system	• Abnormality has occurred in dual output solenoid A circuit ECMB (1): Circuit open or short circuit detected	• Resistance of dual output solenoid A Between R17(female)(A) – chassis: 28 – 32 Ω
529	Abnormality in dual output solenoid B system	• Abnormality has occurred in dual output solenoid B circuit ECMB (9): Circuit open or short circuit detected	• Resistance of dual output solenoid B Between solenoid pins: 28 – 32 Ω
551	Abnormality 2 in idling validation switch system	• Simultaneous detection of no voltage from both ON signal and OFF signal of idling validation switch ECMB (12): Idling OFF signal ECMB (13): Idling ON signal	• Resistance of idling switch Between IVS (A) – (B): Max. 125 Ω (pedal released) Between IVS (A) – (C): Max. 125 Ω (pedal depressed)
554	Abnormality in fuel rail pressure sensor in range	• Fuel rail pressure sensor detected abnormal pressure Judgment value (reference): When starting switch is ON: 0.17 MPa {1.76 kg/cm^2} or more	—

EA-7 Error code [118] (Abnormality [high level] in fuel pump pressure sensor system)

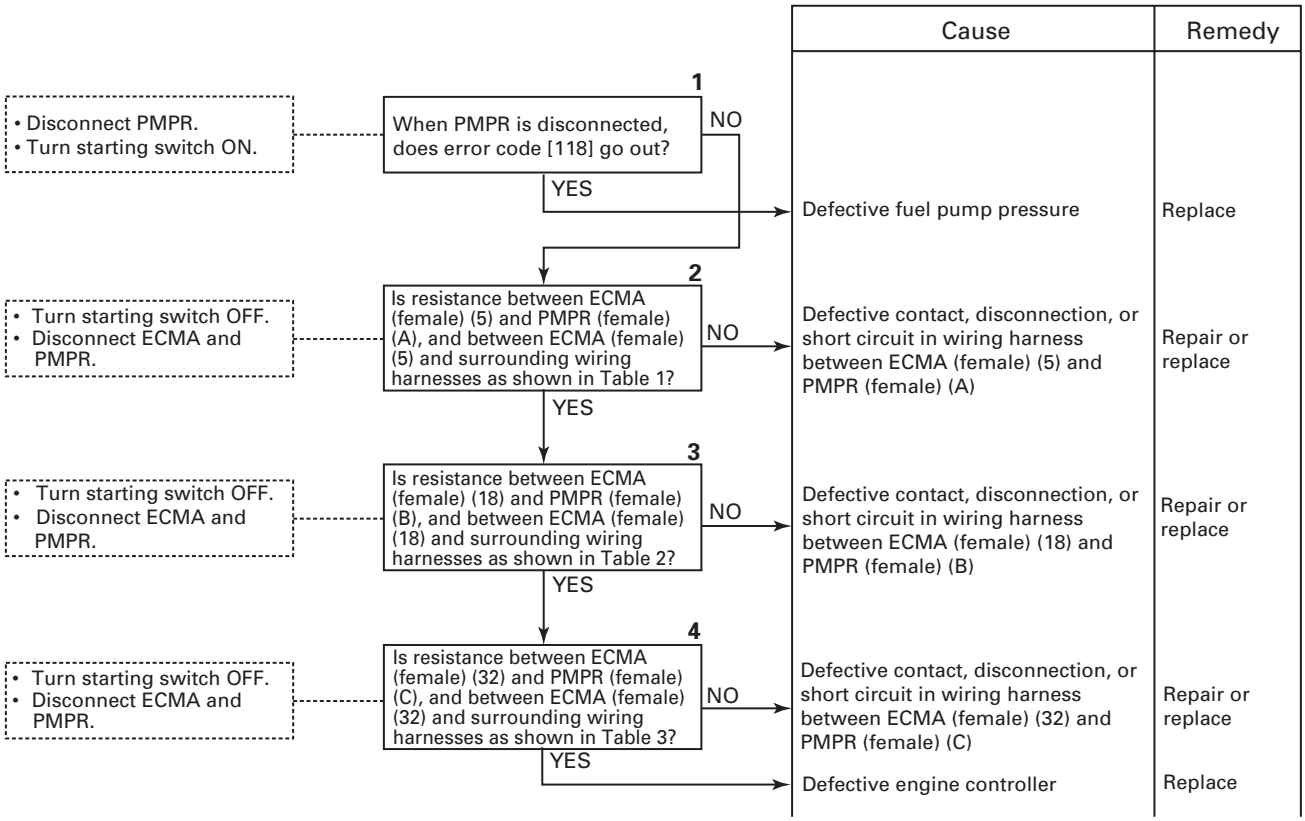


Table 1

ECMA (female), PMPR (female)	Resistance value
Between ECMA (5) and PMPR (A)	Max. 10 Ω
Between ECMA (5) and surrounding wiring harnesses	Min. 1 MΩ

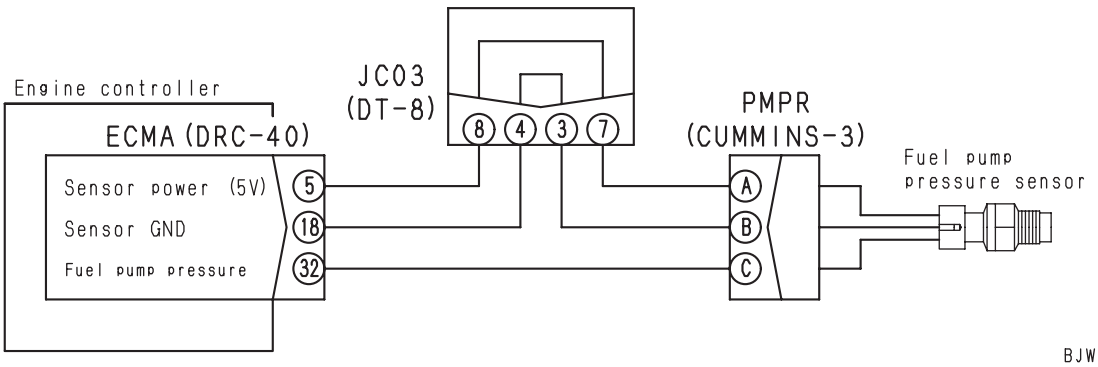
Table 2

ECMA (female), PMPR (female)	Resistance value
Between ECMA (18) and PMPR (B)	Max. 10 Ω
Between ECMA (18) and surrounding wiring harnesses	Min. 1 MΩ

Table 3

ECMA (female), PMPR (female)	Resistance value
Between ECMA (32) and PMPR (C)	Max. 10 Ω
Between ECMA (32) and surrounding wiring harnesses	Min. 1 MΩ

EA-7 Related electrical circuit diagram



EA-17 Error code [144] (Abnormality [high level] in water temperature sensor system)

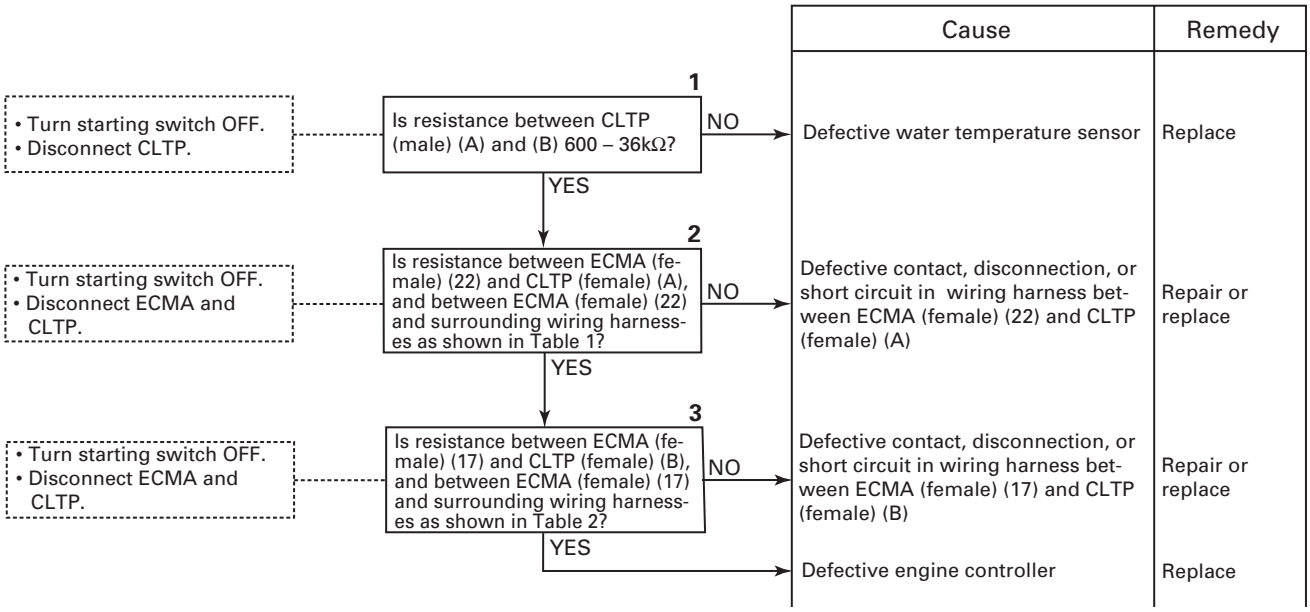


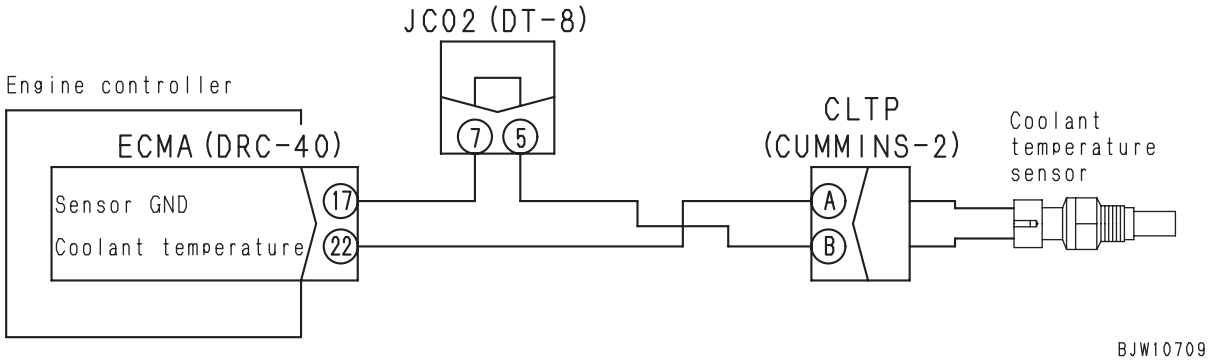
Table 1

ECMA (female), CLTP (female)	Resistance value
Between ECMA (22) and CLTP (A)	Max. 10 Ω
Between ECMA (22) and surrounding wiring harnesses	Min. 1 MΩ

Table 2

ECMA (female), CLTP (female)	Resistance value
Between ECMA (17) and CLTP (B)	Max. 10 Ω
Between ECMA (17) and surrounding wiring harnesses	Min. 1 MΩ

EA-17 Related electrical circuit diagram



EA-30 Error code [316] (Abnormality in fuel pump actuator system current)

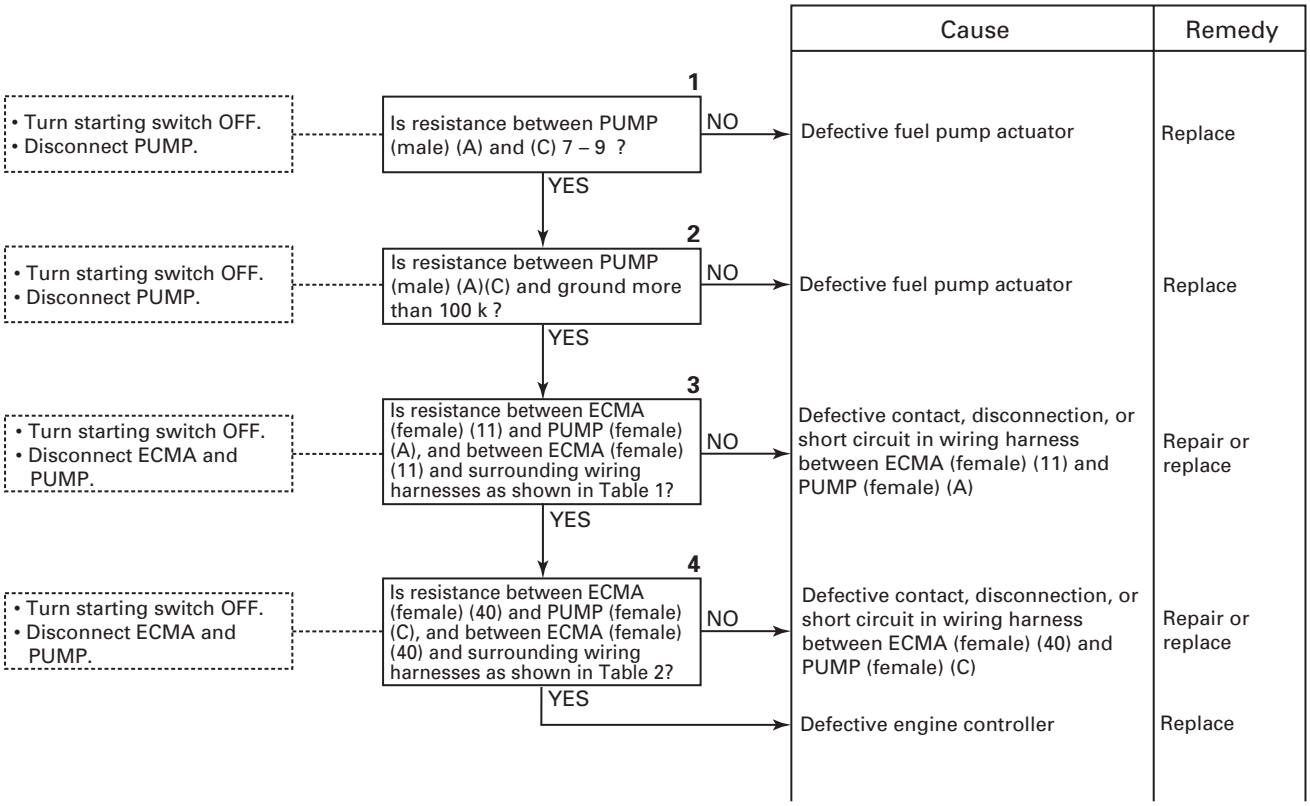


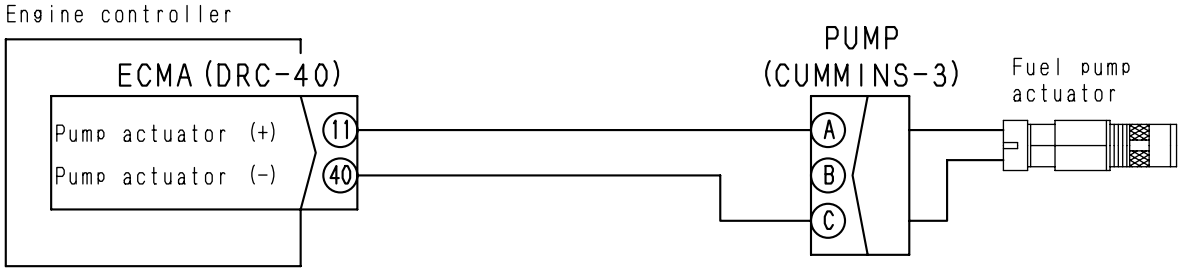
Table 1

ECMA (female), PUMP (female)	Resistance value
Between ECMA (11) and PUMP (A)	Max. 10
Between ECMA (11) and surrounding wiring harnesses	Min. 1 M

Table 2

ECMA (female), PUMP (female)	Resistance value
Between ECMA (40) and PUMP (C)	Max. 10
Between ECMA (40) and surrounding wiring harnesses	Min. 1 M

EA-30 Related electrical circuit diagram



BXE00024

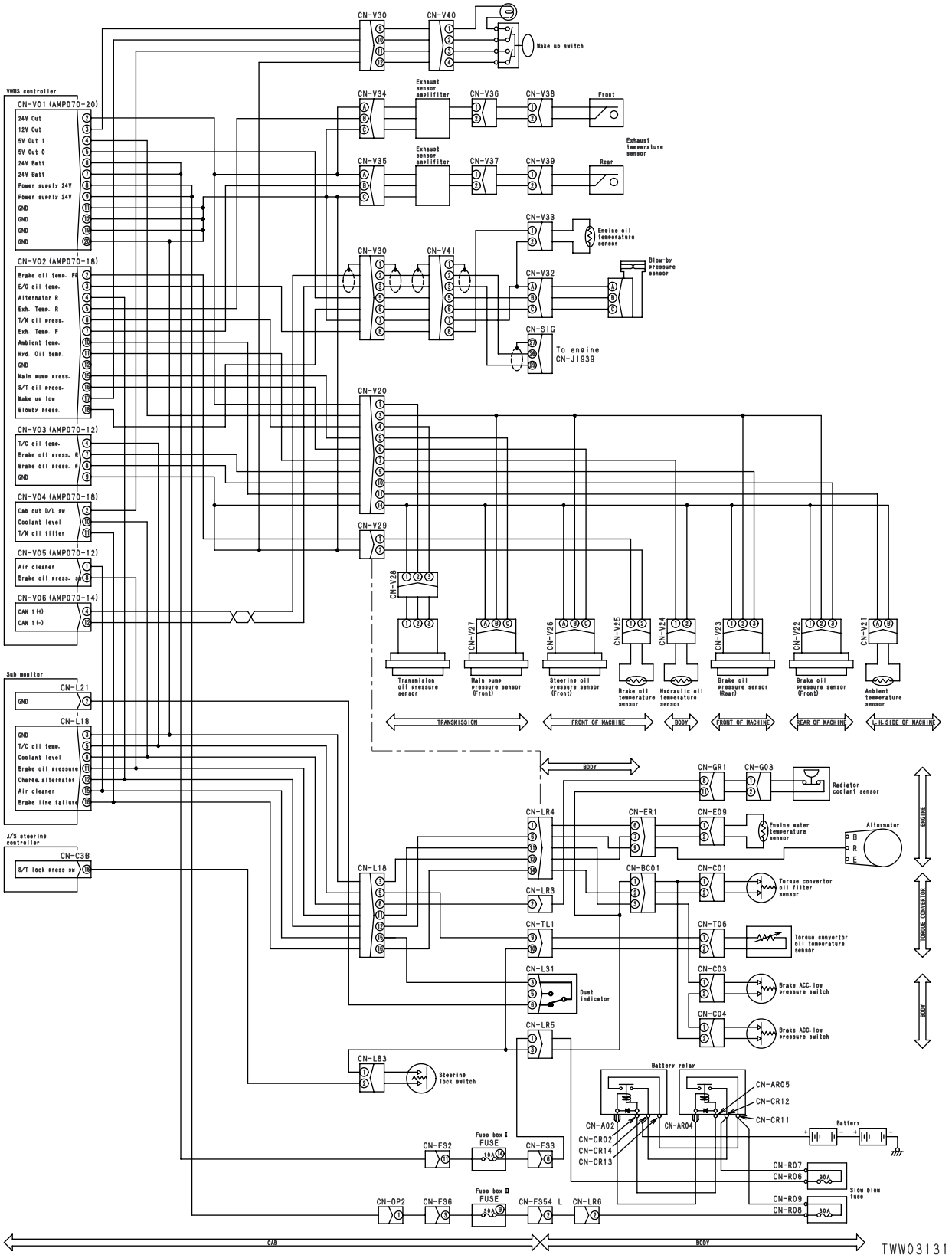
EA-39 Error code [441] (Abnormality [low level] in battery voltage)

★ Carry out troubleshooting for error code [346].

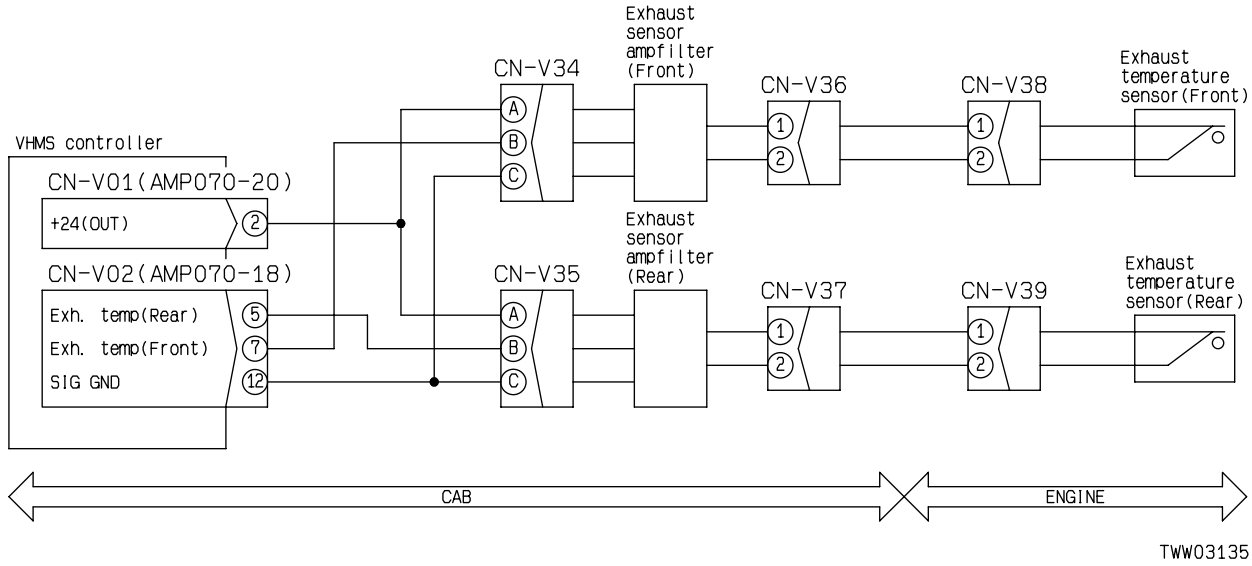
EA-40 Error code [442] (Abnormality [high level] in battery voltage)

★ Carry out troubleshooting for error code [346].

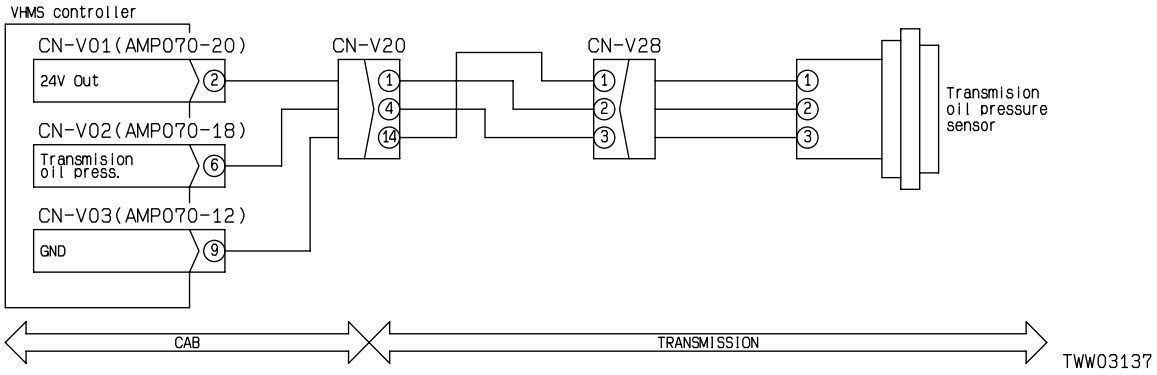
Related electrical circuit diagram



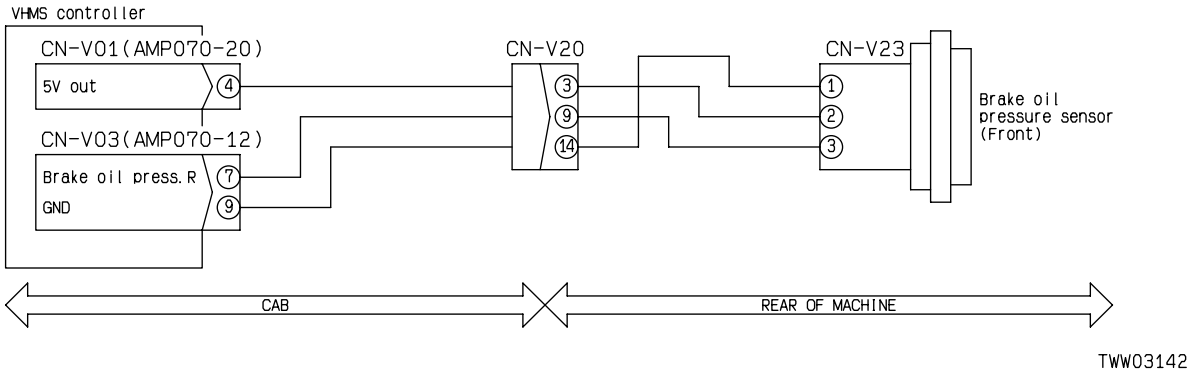
Related electrical circuit diagram



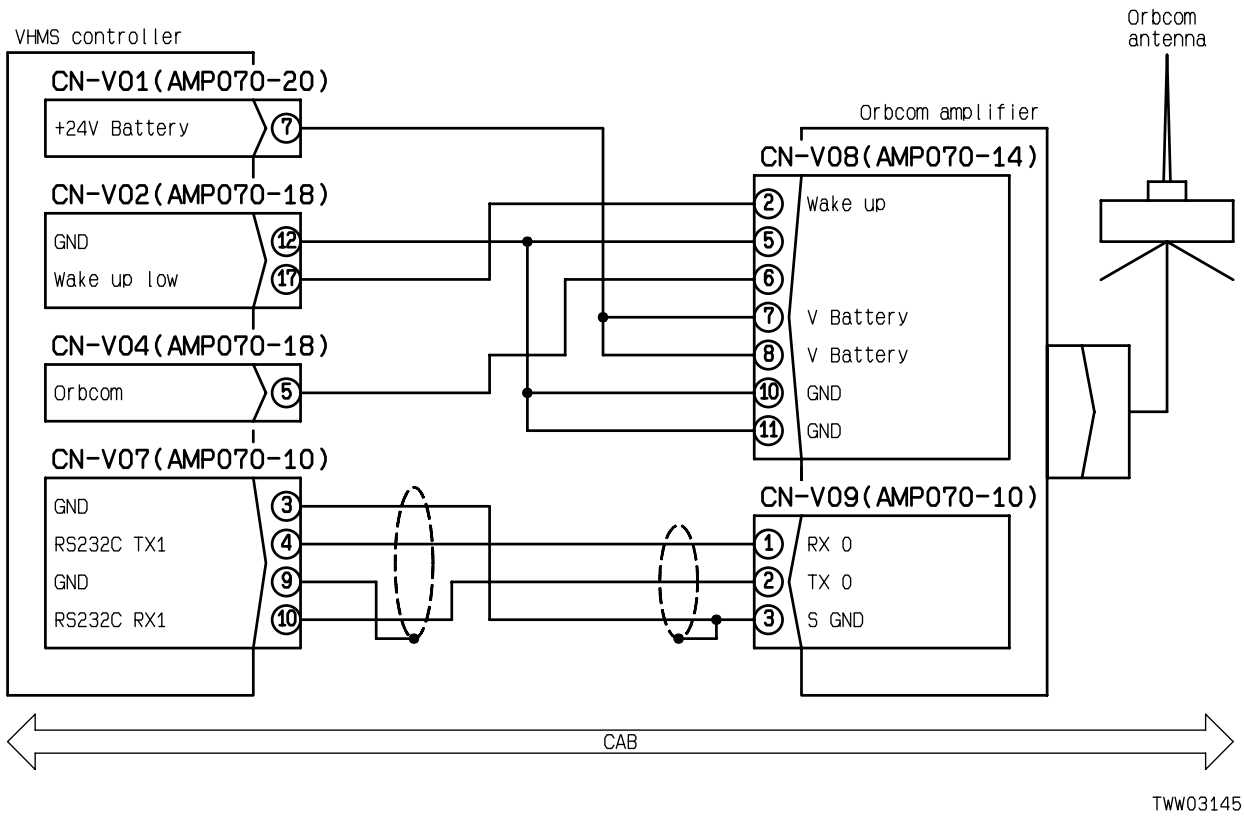
Related electrical circuit diagram



Related electrical circuit diagram



Related electrical circuit diagram



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between bearing and shaft	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		85	+0.015 +0.003	0 –0.020	–0.035 – –0.003	0.025	
2	Clearance between bearing and housing	150	0 –0.018	–0.008 –0.033	–0.033 – 0.010	0.018	
3	Clearance between inner body and shaft	85	–0.012 –0.034	+0.110 +0.030	0.042 – 0.144	0.25	
4	Wear of surface in shaft and oil seal	Standard size		Tolerance		Repair limit	
		100		0 –0.087		–0.133	
5	Wear of surface in sleeve and oil seal	120		0 –0.087		–0.138	
6	Backlash of spline	0.068 – 0.262					

Unit: mm

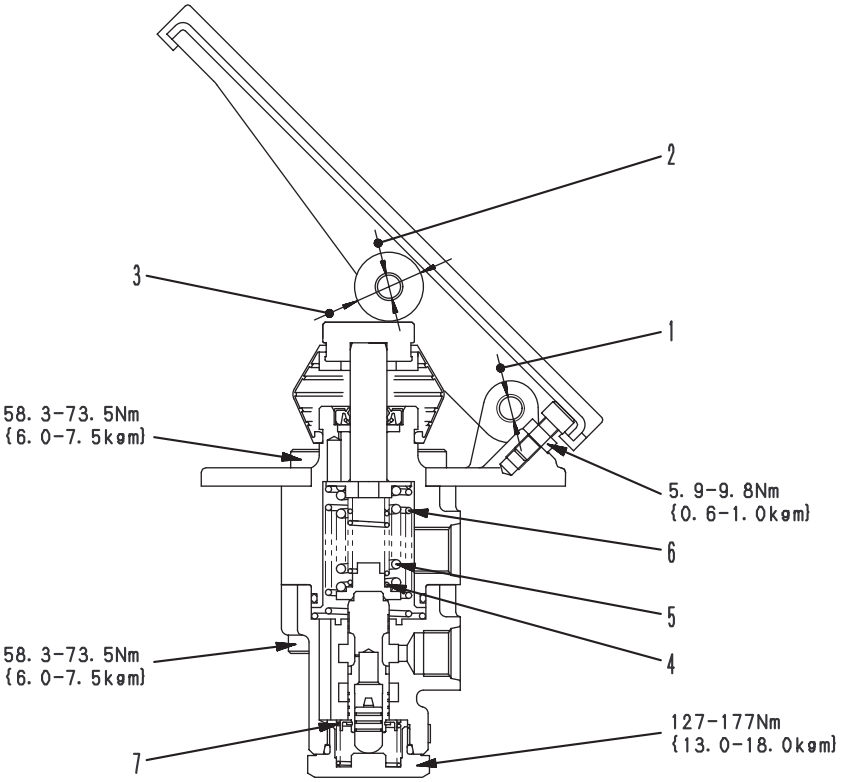
No.	Check item	Criteria					Remedy
1	Clearance between FORWARD-REVERSE spool and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
2	Clearance between 1st speed spool and body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
3	Clearance between 2nd speed spool and body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
4	Clearance between 3rd speed spool and body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
5	Clearance between 4th speed spool and body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
6	Clearance between pilot reducing valve spool and body	25	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
7	Clearance between lubrication valve plunger and body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
8	FORWARD-REVERSE, No. 1, No. 2 No. 3, and No. 4 speed spring	Standard size			Repair limit		
		Free length	Installation length	Installation load	Free length	Installation load	
		78	47	107 N {10.9 kg}	75	102 N {10.4 kg}	
9	Pilot reducing valve spring	62	43.7	164 N {16.7 kg}	60.1	156 N {15.9 kg}	
10	Lubrication valve spring	39.4	37	60.8 N {6.2 kg}	38.2	57.9 N {5.9 kg}	
11	Thickness of shim for pilot reducing valve	3 mm (pressure per 1 piece: 0.026 MPa {0.26 kg/cm^2})					Adjust

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between planetary shaft and bearing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		90	+0.018 0	0 –0.020	0 – –0.038	–	
2	Clearance between planet gear and bearing	155	0 –0.025	–0.035 –0.075	–0.010 – –0.075	–	
3	Clearance between ring gear hub and bearing	300.038	+0.066 +0.034	+0.025 0	–0.009 – –0.066	–	
4	Clearance between wheel hub and bearing	422.275	+0.051 0	–0.017 –0.080	–0.017 – –0.131	–	
5	Clearance between case and bearing	266.7	–0.017 –0.049	+0.025 0	0.074 – 0.017	–	
6	Clearance between wheel hub and bearing	355.6	+0.051 0	–0.016 –0.073	–0.016 – –0.124	–	
7	Thickness of retainer at ring gear hub mount	Standard size		Tolerance		Repair limit	
		25		±0.1		24.6	
8	Backlash between planetary gear and sun gear	Standard clearance			Clearance limit		
		0.22 – 0.53			–		
9	Backlash between planetary gear and ring gear	0.26 – 0.72			–		
10	Thickness of standard shim for wheel hub	2.1					

BRAKE VALVE

(LEFT)



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Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pedal mount hole and bracket hole	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		10	–0.025 –0.075	+0.1 0	0.175 – 0.025	0.25	
2	Clearance between roller and pin	10	–0.025 –0.075	+0.1 0	0.175 – 0.025	0.25	
3	Outside diameter of roller	Standard size		Tolerance		Repair limit	
		30		0 –0.5		29.2	
4	Control spring	Standard size			Repair limit		
		Free length	Installation length	Installation load	Free length	Installation load	
		28	28	0 N {0 kg}	27	–	
5	Control spring	47.2	46	37.2 N {3.8 kg}	46.2	–	
6	Return spring	86.2	58	60.8 N {6.2 kg}	78	–	
7	Return spring	31.5	19.5	16.7 N {1.7 kg}	28	–	

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length	Installation length	Installation load	Free length	Installation load	
		69.9	63.0	431.5 N {44.0 kg}	–	345.2 N {35.2 kg}	
2	Spool return spring	77.0	77.0	0 N {0 kg}	–	–	
3	Spool return spring	79.7	78.5	61.6 N {6.28 kg}	–	49.0 N {5.0 kg}	
4	Main valve spring of relief valve (Large)	15.0	12.1	5.6 N {0.57 kg}	–	4.5 N {0.46 kg}	
5	Check valve spring	78.2	52.0	18.8 N {1.92 kg}	–	14.7 N {1.5 kg}	Replace
6	Suction valve spring of safety valve	27.9	18.0	6.9 N {0.70 kg}	–	5.9 N {0.6 kg}	
7	Suction valve spring	64.9	5.6	6.4 N {0.65 kg}		5.1 N {0.52 kg}	
8	Float selector valve spring	53.0	42.1	137.3 N {14.0 kg}		109.8 N {11.2 kg}	
9	Unloader valve spring	82.7	47.0	49.0 N {5.0 kg}		39.2 N {4.0 kg}	
10	Pilot poppet spring of relief valve	27.7	25.4	319.7 N {32.6 kg}		256.0 N {26.1 kg}	
11	Main valve spring of relief valve (Small)	10.45	6.3	2.3 N {0.236 kg}		1.9 N {0.19 kg}	

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